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PREPRINT

THE GODDARD GENERAL ORBIT DETERMINATION SYSTEM

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GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

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Mission and Trajectory Analysis Division
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ABSTRACT

The General Orbit Determination System currently being used for Orbit Determination at the Goddard Space Flight Center has evolved over a period of approximately a decade.

It was contemplated, when the system was designed, that it would come to be used to determine orbits of satellites of various kinds, tracked by different types of tracking systems, and moving in many sorts of orbits which would be perturbed in a variety of ways by an atmosphere having variable characteristics and by a gravitational field whose higher harmonics would come into play, as well as by the moon, the sun, and radiation pressure. As the needs arose and the occasions demanded, additional orbit determination capabilities to meet the new circumstances were incorporated into the system in accordance with the basic plans. During this time the program was extended to accept new data types and, at various times, additional sets of unknowns were incorporated into it. The program was also equipped to use several general perturbation and special perturbation orbit theories and has been adapted to operate on various computers.

The purpose of this report is to set forth the formulations used in the system. In addition, flowcharts and program listings are also included.

THE GODDARD GENERAL ORBIT DETERMINATION SYSTEM

I. INTRODUCTION

The Goddard General Orbit Determination System accepts as input a set of orbital parameters at a specified epoch, some of which are to be corrected, and a set of observations of a satellite. The output of the system includes a set of corrected parameters obtained by means of a weighted least squares procedure, associated statistical information, and a satellite ephemeris. The differential correction portion of the system, which is the principal subject of this report, consists of nine basic section. These are:

1. Conversion of Elements, (CE)
2. Position of Space Vehicle, (P)
3. Local Station Predictions, (LSP)
4. Position in Ellipse, (PE)
5. Position Partial Derivatives, (PP)
6. Observation Partial Derivatives, (OP)
7. Equations of Condition, (EQC)
8. Least Squares Solution, (LSQ)
9. Conversion of Corrections, (CC)

In the next several sections of this report a description of each of these nine sections of the Differential Correction System, together with the mathematical formulations, will be given.

This report contains a description and documentation of one version of the Goddard General Orbit Determination System. It records the theoretical formulations most of which, aside from the indicated material obtained from references 1 and 3, were derived at the end of the last decade by J. W. Siry, who also wrote the accompanying discussion of Section 9 of Chapter III for this report. The original formulations had been prepared in a form which included condensed, general notation and minimal discussion needed to serve as the basis for programming. J. P. Murphy wrote expanded versions of formulas for certain specific cases of interest, added discussions, and carried through preparations for publication. In addition, flow charts and program listings of the version in current use were compiled for this publication by I. J. Cole.

The original flow diagram of this system is given in Figure 1.

II. NOTATION

The principal symbols employed in this report and their meanings are given in the following list:

a, semi-major axis of the satellite orbit
b, semi-minor axis of the satellite orbit

E, eccentric anomaly

e, eccentricity of the satellite orbit

f, dynamical flattening of earth

f, true anomaly

G, universal gravitational constant

$\underline{g}_1$ or $\underline{\ell}$, the local topocentric east vector

$\underline{g}_2$ or $\underline{m}$, the local topocentric north vector

$\underline{g}_3$ or $\underline{n}$, the local topocentric vertical vector

$\underline{g}_4$ or $\underline{h}$, $\underline{\ell} \times \underline{k}$

$\{\underline{g}_5, \underline{g}_6, \underline{g}_7\}, \{\underline{i}, \underline{j}, \underline{k}\}$

$\{\underline{g}_8, \ldots, \underline{g}_{14}\}, \{\dot{\underline{g}}_1, \ldots, \dot{\underline{g}}_7\}$

g, acceleration of gravity

$\breve{g}$, argument of perigee

$\hbar$, local hour angle

h, right ascension of the ascending node

I, inclincation of orbit plane to earth's equator

$\underline{i}$, (1,0,0)

J, $\frac{3}{2}J_2$

J_n, coefficient of the n^{th} zonal harmonic

$\underline{j}$, (0, 1, 0)

$\underline{k}$, (0, 0, 1)

ℓ, m, direction cosines relative to the local topocentric east-west and north-south directions, respectively

ℓ, mean anomaly

$\underline{\ell}$, local topocentric east vector

M, mean anomaly

M_e, mass of the earth

$\underline{m}$, local topocentric north vector

n, mean motion

$n_{p,q}$, coefficients multiplying the p^{th} power term in the time polynominal for the value of the mean anomaly associated with the q^{th} segment of the observational arc.

$\underline{n}$, local topocentric vertical vector

P, period of the satellite orbit

P_n, Legendre polynomial of degree n

p, semi-latus rectum, $a(1-e^2)$.

$\underline{p}$, vector directed to perigee

q, perigee distance

$\underline{q}$, $\underline{\alpha} \times \underline{p}$

R_e, mean equatorial radius of the earth

$\underline{R}_i$, station position vector of the i^{th} station

r, magnitude of radius vector of the satellite

$\underline{r}$, radius vector of the satellite

r_{zi}, radial distance from axis of rotation of earth to i^{th} station

r_{zsi}, radial distance from axis of rotation of earth to surface point (on reference ellipsoid) directly below or above the i^{th} station

t, time

U, potential function of the earth

v, magnitude of velocity vector of the satellite

$\underline{v}$, the velocity vector of the satellite

x_j, ~~corrections to~~ the unknowns

y_R, the observable quantities

z_{si}, distance from surface point associated with the i^{th} station to the earth's equatorial plane

α, right ascension

$\underline{\alpha}$, unit vector in direction of angular momentum

β, latitude

$\underline{\beta}$, unit vector in a specific direction in the orbit plane

$\underline{\gamma}$, $(\underline{\alpha} \times \underline{\beta})$

δ, declination

δ_1, angle which the unit vector $\underline{\beta}$ makes with the nodal ray

θ, topocentric azimuth angle measured from the north

θ_ℓ, local hour angle

θ_1, antenna x-angle

θ_2, antenna y-angle

λ_G, right ascension of Greenwich

λ_{Gi}, East longitude of i^{th} station in system referred to Greenwich.

λ_i, inertial longitude of the i^{th} station or local sidereal time.

μ, $\sqrt{GM_e}$

ν, true anomaly

ρ, range

ϕ, argument of latitude

ϕ_i, topocentric elevation angle

ϕ_{di}, geodetic latitude of the i^{th} station

Ω, longitude of the ascending node

$\underline{\Omega}$, unit vector directed toward the ascending node

ω, argument of perigee

ω_e, speed of rotation of the earth

Generally the indices and special symbols have the following meanings

c, index to denote computed value

e, index to denote earth

i, index to denote i^{th} tracking station

j, index to denote j^{th} unknown

k, index to denote k^{th} observation type

n, index to denote n^{th} observation time

o, index to denote "observed" value

0, index to denote initial value

', indicates long-period parameters in the Brouwer Theory

", indicates parameters in the Brouwer Theory which include short-period terms

., indicates total differentiation with respect to time

*, indicates unit vector (e.g. $\underline{a}^* = \underline{a}/|\underline{a}|$)

In certain cases, a symbol is associated with more than one definition. In each case in which such a symbol is used, the meaning will be clear from the context.

Several of the symbols in the above list are illustrated in Figure 2.

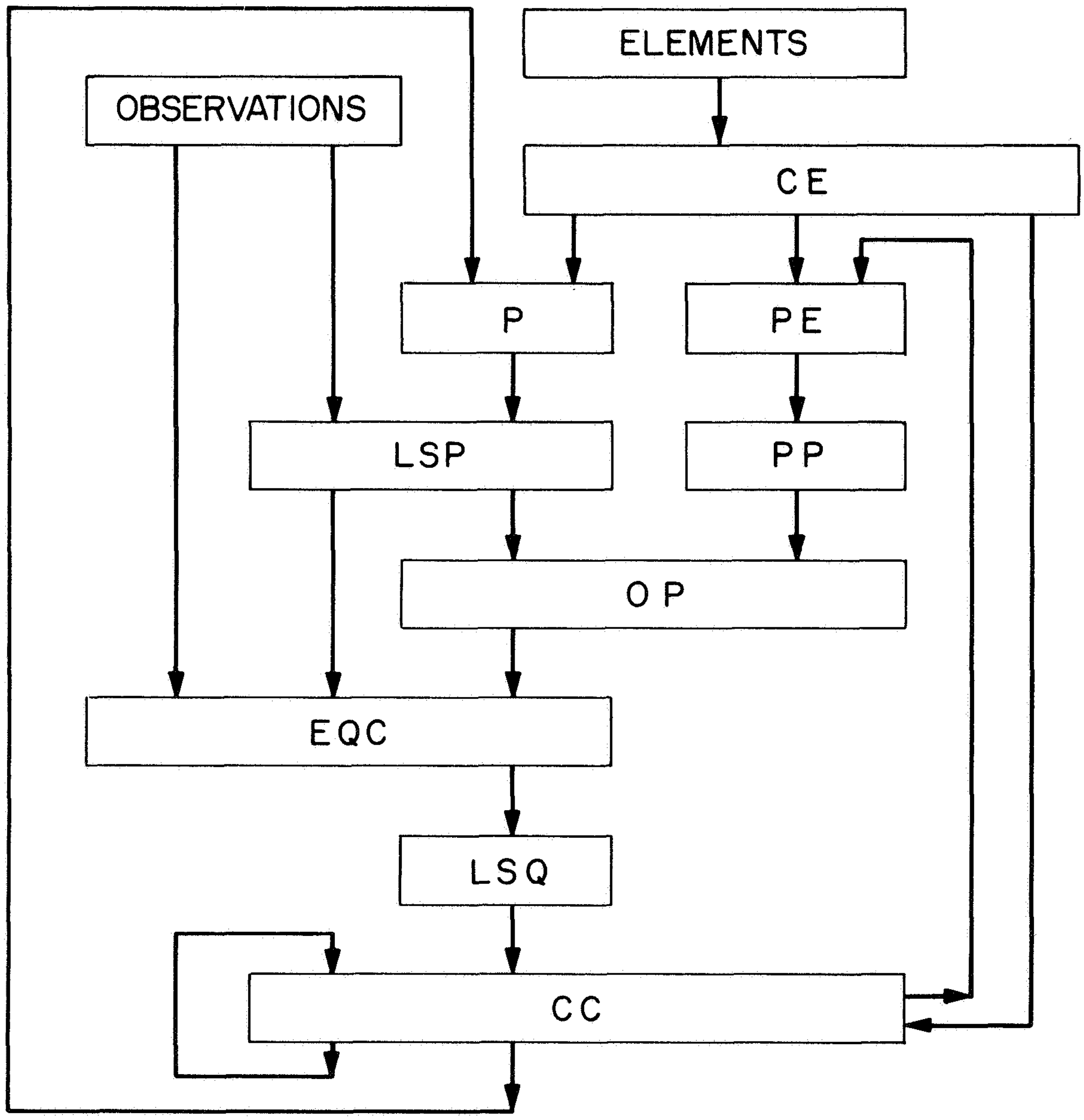

Figure 1–Differential Correction Program Flow Diagram

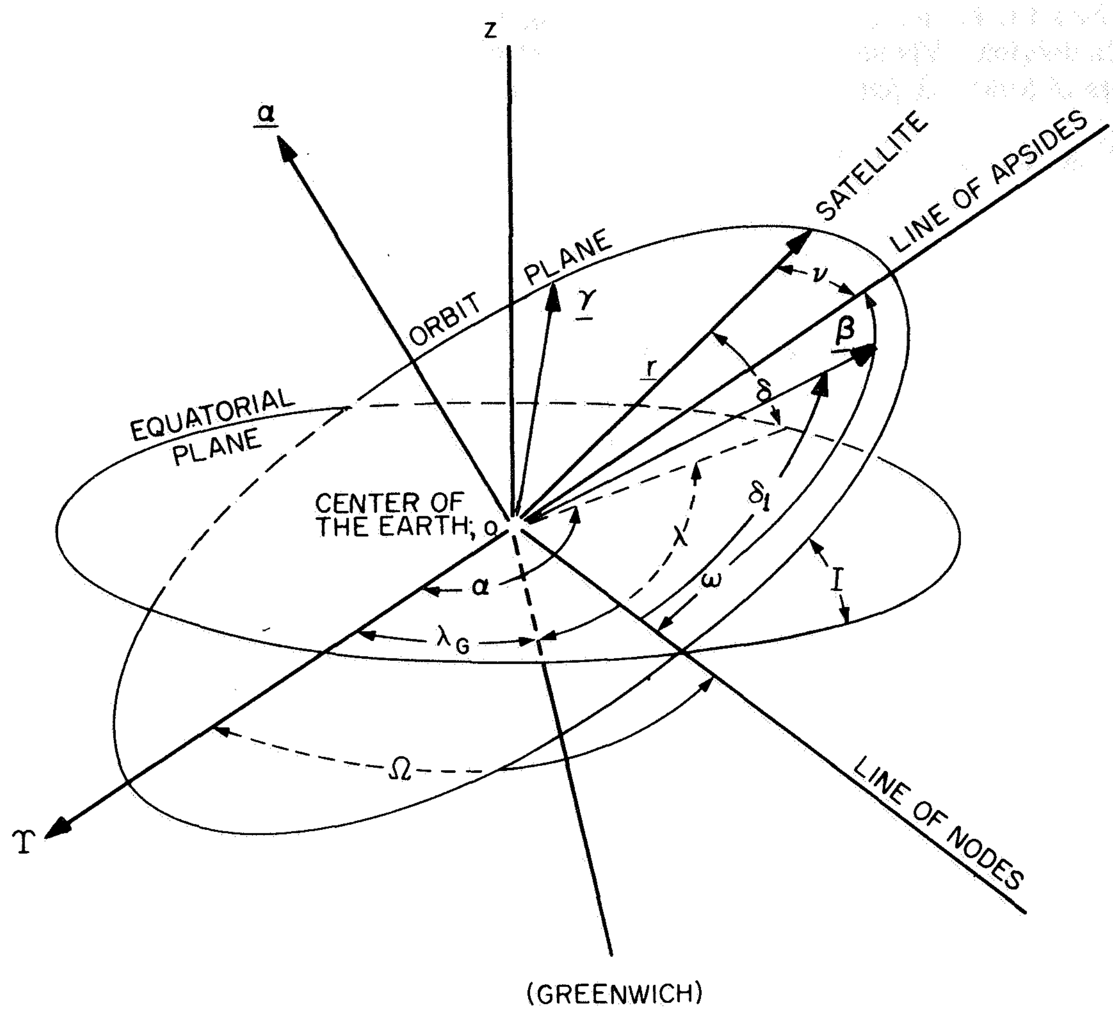

Figure 2–The Geometry of an Orbit

III. PRINCIPAL SECTIONS OF THE SYSTEM

1. Conversion of Elements

In this portion of the system a certain set of orbital elements or equivalent parameters at a particular epoch are provided as input, and two new sets of similar constants are computed. Specifically, one of the sets

$$\left\{x(t_0),\ y(t_0),\ z(t_0),\ \dot{x}(t_0)\ \dot{y}(t_0)\ \dot{z}(t_0)\right\},$$

$$\left\{a, e, i, \Omega, \phi(t_0), \nu(t_0)\right\} \text{ or } \left\{a, e, i, \Omega, \omega, M(t_0)\right\}$$

serves as input and the other two sets are computed in this section.

Values for the additional parameters, p, q, b, n, and P, are also computed in this section. These calculations are performed through the use of the following sets of formulas and others found on page 16 of this report.

A. Given $\underline{r}(t_0)$, $\underline{v}(t_0)$

$$r_0 = |\underline{r}(t_0)|$$

$$v_0 = |\underline{v}(t_0)|$$

$$\theta_0 = - \arc \sin \left[\underline{r}^*(t_0) \cdot \underline{v}^*(t_0)\right]$$

$$\underline{\alpha}(t_0) = \left[\underline{r}(t_0) \times \underline{v}(t_0)\right]^* \tag{1}$$

$$\underline{\Omega}(t_0) = \left[\underline{k} \times \underline{\alpha}(t_0)\right]^*$$

$$i = \arc \cos \left[\underline{\alpha}(t_0) \cdot \underline{k}\right]$$

$$\Omega(t_0) = \arc \cos \left[\underline{\Omega}(t_0) \cdot \underline{i}\right]$$

$$\phi(t_0) = \arc \cos \left[\underline{r}^*(t_0) \cdot \underline{\Omega}(t_0)\right]$$

$$\omega(t_0) = \phi(t_0) - \nu(t_0)$$

B. Given r_0, v_0, θ_0

$$a = \frac{\mu^2 r_0}{2\mu^2 - r_0 v_0^2}$$

$$e = \sqrt{1 - \frac{(r_0 v_0 \cos \theta_0)^2}{a\mu^2}} \tag{2}$$

$$\nu_0 = \arc \cos \left[\frac{a(1-e^2) - r_0}{e r_0}\right]$$

C. Given a, e, ν_0

$$r_0 = \frac{a(1-e^2)}{1+e\cos\nu_0}$$

$$v_0 = \mu\sqrt{\frac{2}{r_0} - \frac{1}{a}}$$

$$\theta_0 = \text{arc cos}\,\frac{\mu\sqrt{a(1-e^2)}}{r_0 v_0}$$

$$E(t) = \text{arc cos}\left[\frac{\cos\nu(t)+e}{1-e\cos\nu(t)}\right] = \text{arc sin}\left[\frac{\sqrt{1-e^2}\,\sin\nu(t)}{1+e\cos\nu(t)}\right] \tag{3}$$

$$\nu(t) = \text{arc cos}\left[\frac{\cos E(t)-e}{1-e\cos E(t)}\right] = \text{arc sin}\left[\frac{\sqrt{1-e^2}\,\sin E(t)}{1-e\cos E(t)}\right]$$

$$M(t) = E(t) - e\sin E(t) = M(t_0) + n(t-t_0)$$

D. Additional Parameters

$$p = a(1-e^2)$$

$$q = a(1-e)$$

$$b = a\sqrt{1-e^2} \tag{4}$$

$$n = \frac{\mu}{a^{3/2}}$$

$$P = \frac{2\pi}{n}$$

2. Position of Space Vehicle

In this portion of the system the position of a space vehicle is computed by means of a special perturbation method, such as a Cowell integration method, or by means of a general perturbation method, such as the one associated with the Brouwer theory. As an illustration of the function of this portion of the system we shall consider the case of an ephemeris of a satellite generated by means of the Brouwer theory (see References 1 and 2). The potential function* for this theory is

$$U = \frac{\mu^2}{r}\left[1 - \sum_{n=2}^{5} \frac{J_n R_e^n}{r^n} P_n(\sin\beta)\right]. \tag{5}$$

The position and velocity of a spacecraft at any time, t, are found by substituting the time into Equations (6) through (10). The fundamental plane is the equator with the x-axis directed toward the vernal equinox. In this theory an initial set of elements a'', e'', I'', ℓ_0'', g_0'', and h_0'' at an epoch time, t_0, are estimated or obtained from the previous iteration of the differential correction process. These parameters are the constants of integration of the theory and are related to the osculating Keplerian elements $\{a, e, I, \ell, g, h\}$ through the following formulas found in References 1 and 2. The secular terms are

$$\begin{aligned}
\ell'' &= \ell_0'' + n_0 t \left\{1 - \frac{3}{4}\frac{J_2 R_e^2}{a''^2\eta^3}(1-3\theta^2) + \frac{3}{128}\frac{J_2^2 R_e^4}{a''^4\eta^7} \cdot \right. \\
&\quad \cdot [-15 + 16\eta + 25\eta^2 + (30 - 96\eta - 90\eta^2)\theta^2 + (105 + 144\eta + 25\eta^2)\theta^4] \\
&\quad \left. - \frac{45}{128}\frac{J_4 R_e^4}{a''^4\eta^7} e''^2 [3 - 30\theta^2 + 35\theta^4]\right\} \\
g'' &= g''_0 + n_0 t \left\{-\frac{3}{4}\frac{J_2 R_e^2}{a''^2\eta^4}(1-5\theta^2) + \frac{3}{128}\frac{J_2^2 R_e^4}{a''^4\eta^8} \cdot \right. \\
&\quad \cdot [-35 + 24\eta + 25\eta^2 + (90 - 192\eta - 126\eta^2)\theta^2 + (385 + 360\eta + 45\eta^2)\theta^4] \\
&\quad \left. - \frac{15}{128}\frac{J_4 R_e^4}{a''^4\eta^8} [21 - 9\eta^2 + (-270 + 126\eta^2)\theta^2 + (385 - 189\eta^2)\theta^4]\right\}
\end{aligned} \tag{6}$$

---

*Note that in Brouwer's original paper, the convention $\mu = GM_e$ was employed.

$$h'' = h''_0 + n_0 t \left\{ -\frac{3}{2} \frac{J_2 R_e^2 \theta}{a''^2 \eta^4} + \frac{3}{32} \frac{J_2^2 R_e^4}{a''^4 \eta^8} [(-5 + 12\eta + 9\eta^2)\theta \right.$$

$$\left. + (-35 - 36\eta - 5\eta^2)\theta^3] - \frac{15}{32} \frac{J_4 R_e^4}{a''^4 \eta^8} (5 - 3\eta^2)\theta (3 - 7\theta^2) \right\},$$

where, $\theta = \cos I''$, $\eta = \sqrt{1 - e''^2}$, and $n_0 = \mu / \sqrt{a''^3}$.

In cases in which the drag perturbation is not too large, it is convenient to represent its principal effect by means of quadratic and cubic terms in the mean anomaly. The coefficients n_{pq}, where p = 2 or 3, refer to terms of the quadratic and cubic type respectively. Since a single pair of constants might not be accurate enough over the entire observational arc, up to twenty parameters may be employed corresponding to the epochs, t_q, where q = 0, 1, $\cdots$, 19, at which the intervals of interest begin. If the arc is not subdivided, the subscript q = 0 is understood but not always written.

The long-period terms for e and I are

$$\delta_1 e = \left\{ \frac{1}{16} \frac{J_2 R_e^2 e''}{a''^2 \eta^2} [1 - 11\theta^2 - 40\theta^4 (1 - 5\theta^2)^{-1}] + \right.$$

$$\left. + \frac{5}{16} \frac{J_4 R_e^2 e''}{J_2 a''^2 \eta^2} [1 - 3\theta^2 - 8\theta^4 (1 - 5\theta^2)^{-2}] \right\} \cos 2g''$$

$$+ \left\{ \frac{-J_3 R_e}{2 J_2 a''} \sin I'' - \frac{5}{32} \frac{J_5 R_e^3}{J_2 a''^3 \eta^4} \sin I'' (4 + 3e''^2) \cdot \right.$$

$$\left. \cdot [1 - 9\theta^2 - 24\theta^4 (1 - 5\theta^2)^{-1}] \right\} \sin g'' + \frac{35}{192} \frac{J_5 R_e^3 e''^2}{J_2 a''^3 \eta^4} \sin I \cdot$$

$$\cdot [1 - 5\theta^2 - 16\theta^4 (1 - 5\theta^2)^{-1}] \sin 3g''$$

$$\delta_1 I = - \frac{e'' \delta_1 e}{\eta^2 \tan I''}$$

The secular and long-period terms for ℓ, g, and h, are, respectively,

$$\ell' = \ell'' + \left\{ \frac{J_2 R_e^2}{16 a''^2 \eta} \left[1 - 11\theta^2 - 40\theta^4 (1-5\theta^2)^{-1}\right] + \frac{5 J_4 R_e^2}{16 J_2 a''^4 \eta} \cdot \right.$$

$$\cdot \left[1 - 3\theta^2 - 8\theta^4 (1-5\theta^2)^{-1}\right]$$

$$+ \left\{ \frac{J_3 R_e \eta}{2 J_2 a e''} \sin I'' + \frac{5 J_5 R_e^3}{32 J_2 a^3 \eta^3 e''} \sin I'' (4 + 9e''^2) \cdot \right.$$

$$\cdot \left[1 - 9\theta^2 - 24\theta^4 (1-5\theta^2)^{-1}\right] \Bigg\} \cos g'' - \frac{35}{192} \frac{J_5 R_e^3 e''}{J_2 a''^3 \eta^3} \sin I'' \cdot$$

$$\cdot \left[1 - 5\theta^2 - 16\theta^4 (1-5\theta^2)^{-1}\right] \cos 3g''$$

$$g' = g'' + \left\{ \frac{-J_2 R_e^2}{32 a''^2 \eta^4} \left[(2 + e''^2) - 11(2 + 3e''^2)\theta^2 - 40(2 + 5e''^2) \cdot \right. \right.$$

$$\left. \cdot \theta^4 (1-5\theta^2)^{-1} - 400 e''^2 \theta^6 (1-5\theta^2)^{-2}\right]$$

$$- \frac{5 J_4 R_e^2}{32 J_2 a''^2 \eta^4} \left[2 + e''^2 - 3(2 + 3e''^2)\theta^2 - 8(2 + 5e''^2) \cdot \right.$$

$$\left. \cdot \theta^4 (1-5\theta^2)^{-1} - 80 e''^2 \theta^6 (1-5\theta^2)^{-2}\right] \Bigg\} \sin 2g''$$

$$+ \left\{ \frac{J_3 R_e}{2 J_2 a'' \eta^3} \left(\frac{\sin I''}{e''} - \frac{e'' \theta^2}{\sin I''} \right) - \frac{5 J_5 R_e^3}{32 J_2 a''^3 \eta^6} \cdot \right.$$

$$\cdot \left[\left(\frac{\eta^2 \sin I''}{e''} - \frac{e'' \theta^2}{\sin I''} \right) (4 + 3e''^2) + e'' \sin I'' (26 + 9e''^2) \right] \cdot$$

$$\cdot\,[1-5\theta^2-16\theta^4(1-5\theta^2)^{-1}]+\frac{15J_5R_e^3\theta^3e''}{16J_2a''^3\eta^6}\sin I''(4+3e''^2)\,\cdot$$

$$\left.\cdot[3+16\theta^2(1-5\theta^2)^{-1}+40\theta^4(1-5\theta^2)^{-2}]\right\}\cos g''$$

$$+\left\{\frac{35J_5R_e^3}{576J_2a''^3\eta^6}\left[e''\sin I''(3+2e''^2)-\frac{e''^3\theta^2}{\sin I''}\right][1-5\theta^2-16\theta^4(1-5\theta^2)^{-1}]\right.$$

$$-\frac{35J_5e^3\theta^2R_e^3}{288J_2a''^3\eta^6}\sin I''\,[5+32\theta^2(1-5\theta^2)^{-1}+80\theta^4(1-5\theta^2)^{-2}]\cos 3g''$$

$$h'=h''+\left\{-\frac{J_2R_e^2e''^2\theta}{16a''^2\eta^4}[11+80\theta^2(1-5\theta^2)^{-1}+200\theta^4(1-5\theta^2)^{-2}]\right.$$

$$-\frac{5J_4e''^2\theta R_e^2}{16J_2a''^2\eta^4}\;[3+16\theta^2(1-5\theta^2)^{-1}$$

$$\left.+40\theta^4(1-5\theta^2)^{-2}]\right\}\sin 2g''+\left\{-\frac{J_3e''\theta R_e}{2J_2a''\eta^2\sin I''}\right.$$

$$-\frac{5J_5e''\theta R_e^3}{32J_2a''^3\eta^6\sin I''}(4+3e''^2)\;[1-9\theta^2-24\theta^4(1-5\theta^2)^{-1}]$$

$$\left.-\frac{15J_5e''\theta R_e^3}{16J_2a''^3\eta^6}\sin I''(4+3e''^2)[3+16\theta^2(1-5\theta^2)^{-1}+40\theta^4(1+5\theta^2)^{-2}]\right\}\cos g''$$

$$+\left\{\frac{35}{576}\;\frac{J_5e''^3\theta R_e^3}{J_2a''^3\eta^6\sin I''}\;[1-5\theta^2-16\theta^4(1-5\theta^2)^{-1}]\right.$$

$$\left.+\frac{35}{288}\;\frac{J_5e^3\theta R_e^3}{J_2a''^3\eta^6}\sin I''\;[5+32\theta^2(1-5\theta^2)^{-1}\;+80\theta^4(1-5\theta^2)^{-2}]\right\}\cos 3g''\,\cdot$$

After adding the short-period terms, the osculating elements are obtained from

$$
\begin{aligned}
a &= a''\left\{1+\frac{J_2R_e^2}{2a''^2}\left[-(1-3\theta^2)\left(\frac{a''^3}{r'^3}-\eta^{-3}\right)\right.\right.\\
&\quad\left.\left.+3(1-\theta^2)\frac{a''^3}{r'^3}\cos(2g'+2f')\right]\right\}\\
e &= e''+\delta_1 e+\frac{\eta^2}{2e''}\left\{\frac{J_2R_e^2}{2a''^2}\left[-(1-3\theta^2)\left(\frac{a''^3}{r'^3}-\eta^{-3}\right)\right.\right.\\
&\quad\left.+3(1-\theta^2)\left(\frac{a''^3}{r'^3}-\eta^{-4}\right)\cos(2g'+2f')\right]\\
&\quad-\frac{J_2R_e^2}{2a''^2\eta^4}(1-\theta^2)\,[3e''\cos(2g'+f')\\
&\quad\left.+e''\cos(2g'+3f')]\right\}\\
I &= I''+\delta_1 I+\frac{J_2\theta R_e^2}{4a''^2\eta^4}\sqrt{1-\theta^2}\,[3\cos(2g'+2f')\\
&\quad+3e''^2\cos(2g'+f')+e''\cos(2g'+3f')]\\
\ell &= \ell'-\frac{J_2R_e^2}{8e''a''^2\eta}\left\{-2(1-3\theta^2)\left(\frac{a''^2}{r'^2}\eta^2+\frac{a''}{r'}+1\right)\sin f'\right.\\
&\quad+3(1-\theta^2)\left[-\left(\frac{a''^2}{r'^2}\eta^2+\frac{a''}{r'}-1\right)\sin(2g'+f')\right.\\
&\quad\left.\left.+\left(\frac{a''^2}{r'^2}\eta^2+\frac{a''}{r'}+\frac{1}{3}\right)\sin(2g'+3f')\right]\right\}
\end{aligned}
\tag{7}
$$

$$g = g' + \frac{J_2 R_e^2}{8 e'' a''^2 \eta^2} \left\{ -2(1-3\theta^2) \left(\frac{a''^2}{r'^2} \eta^2 + \frac{a''}{r'} + 1 \right) \sin f' \right.$$

$$+ 3(1-\theta^2) \left[- \left(\frac{a''^2}{r'^2} \eta^2 + \frac{a''}{r'} - 1 \right) \sin(2g' + f') \right.$$

$$\left.\left. + \left(\frac{a''^2}{r'^2} \eta^2 + \frac{a''}{r'} + \frac{1}{3} \right) \sin(2g' + 3f') \right] \right\}$$

$$+ \frac{J_2 R_e^2}{8 a''^2 \eta^4} \left\{ -6(1-5\theta^2)(f' + \ell' - e'' \sin f') \right.$$

$$+ (3-5\theta^2) [3 \sin(2g' + 2f')$$

$$\left. + 3e'' \sin(2g' + f') + e'' \sin(2g' + 3f')] \right\}$$

$$h = h' - \frac{J_2 \theta R_e^2}{4 a''^2 \eta^4} [6(f' - \ell' + e'' \sin f')$$

$$- 3 \sin(2g' + 2f') - 3e'' \sin(2g' + f') - e'' \sin(2g' + 3f')]$$

where f' and r' are computed from

$$E' - e'' \sin E' = \ell'$$

$$\tan \frac{1}{2} f' = \sqrt{\frac{1 + e''}{1 - e''}} \tan \frac{1}{2} E' \tag{8}$$

$$\frac{a''}{r'} = (1 + e'' \cos f')/(1 - e''^2)$$

The position and velocity vectors in rectangular coordinates may then be obtained from

$$\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} A_x & B_x & 0 \\ A_y & B_y & 0 \\ A_z & B_z & 0 \end{pmatrix} \begin{pmatrix} \cos E - e \\ \sin E \\ 0 \end{pmatrix} = \underline{r}_c\,(t)$$

and (9)

$$\begin{pmatrix} \dot{x} \\ \dot{y} \\ \dot{z} \end{pmatrix} = \frac{a}{r} n \begin{pmatrix} A_x & B_x & 0 \\ A_y & B_y & 0 \\ A_z & B_z & 0 \end{pmatrix} \begin{pmatrix} -\sin E \\ \cos E \\ 0 \end{pmatrix} = \dot{\underline{r}}_c\,(t)$$

where

$$E - e \sin E = \ell$$

and where

$$\begin{aligned}
A_x &= a\,(\cos g \cos h - \sin g \sin h \cos I) \\
A_y &= a\,(\sin g \cos h \cos I + \cos g \sin h) \\
A_z &= a \sin I \sin g \\
B_x &= -a\sqrt{1-e^2}\,(\sin g \cos h + \cos g \sin h \cos I) \\
B_y &= a\sqrt{1-e^2}\,(\cos g \cos h \cos I - \sin g \sin h) \\
B_z &= a\sqrt{1-e^2}\,\sin I \cos g
\end{aligned} \tag{10}$$

In the differential correction of the orbit, the constants of integration a'', e'', I'', ℓ_0'', g_0'', and h_0'' are determined. One or more drag parameters are also solved for if this is appropriate.

3. Local Station Predictions

In this portion of the system computed values for the various observations at the times of observation are obtained. An actual observable at time, t_n, taken at the i^{th} station and of the k^{th} type, is denoted by the symbol $y_{0,k,i}(t_n)$, while the computed value of this observable is denoted by $y_{c,k,i}(t_n)$. In Table 1 there appears a list of the various observation types, the symbols used to designate them, and the value of the designator k for each type.

Table 1
Observation Types $- y_k$

k	Symbol	Name
1	ρ	range
2	ℓ	east-west direction cosine
3	m	north-south direction cosine
4	θ	azimuth
5	ϕ	elevation
6	α	right ascension
7	δ	declination
8	h	local hour angle
9	$\dot{\rho}$	range rate
10	$\dot{\ell}$	east-west direction cosine rate
11	$\dot{m}$	north-south direction cosine rate
12	$\dot{\theta}$	azimuth rate
13	$\dot{\phi}$	elevation rate
14	$\dot{\alpha}$	right ascension rate
15	$\dot{\delta}$	declination rate
16	$\dot{h}$	local hour angle rate
17	θ_1	antenna x-angle
18	θ_2	antenna y-angle

Formulas for obtaining computed values of the quantities appearing in Table 1 will now be developed. Before these formulas are obtained, it is convenient to give expressions for the following quantities.

$\underline{R}_i$ the station position vector

$\underline{\ell}_i$ the local topocentric east vector

$\underline{m}_i$ the local topocentric north vector

$\underline{n}_i$ the local topocentric vertical vector

$\underline{h}_i$ $\underline{\ell}_i \times \underline{k}$

and their rates of change as functions of the coordinates of the i^{th} tracking station. The inertial longitude or local sidereal time, $\lambda_i(t)$, of the i^{th} station at time t is given by

$$\lambda_i(t) = \lambda_{Gi} + \lambda_G(t_0) + \omega_e(t - t_0) \tag{11}$$

where λ_{Gi}, $\lambda_G(t_0)$, and ω_e denote, respectively, the east longitude of the i^{th} station in the system referred to Greenwich, the right ascension of the Greenwich meridian at t_0, and the earth's angular velocity. Then,

$$\begin{aligned}
\underline{\ell}_i(t) &= -\sin\lambda_i(t)\,\underline{i} + \cos\lambda_i(t)\,\underline{j} \\
\underline{m}_i(t) &= -\sin\phi_{di}\cos\lambda_i(t)\,\underline{i} - \sin\phi_{di}\sin\lambda_i(t)\,\underline{j} + \cos\phi_{di}\,\underline{k} \\
\underline{n}_i(t) &= \cos\phi_{di}\cos\lambda_i(t)\,\underline{i} + \cos\phi_{di}\sin\lambda_i(t)\,\underline{j} + \sin\phi_{di}\,\underline{k} \\
\underline{h}_i(t) &= \cos\lambda_i(t)\,\underline{i} + \sin\lambda_i(t)\,\underline{j} \\
\dot{\underline{\ell}}_i(t) &= -\omega_e\,\underline{h}_i(t) \\
\dot{\underline{m}}_i(t) &= -\omega_e\sin\phi_{di}\,\underline{\ell}_i(t) \\
\dot{\underline{n}}_i(t) &= \omega_e\cos\phi_{di}\,\underline{\ell}_i(t) \\
\dot{\underline{h}}_i(t) &= \omega_e\,\underline{\ell}_i(t)
\end{aligned} \tag{12}$$

where ϕ_{di} denotes the geodetic latitude of the i^{th} station. Define p_{ei} and ϕ_{ci} to be

$$\begin{aligned}
p_{ei} &= (1-f)^2\tan\phi_{di} \\
\phi_{ci} &= \arctan p_{ei}
\end{aligned} \tag{13}$$

where f is the flattening. The radial distance r_{zsi} from the axis of rotation of the earth to the surface point on the reference ellipsoid below or above the i^{th} station is given by

$$r_{zsi} = \frac{R_e (1-f)}{\sqrt{p_{ei}^2 + (1-f)^2}} \tag{14}$$

where R_e is the mean equatorial radius of the earth. The radial distance r_{zi} from the axis of rotation of the earth to the i^{th} station is given by

$$r_{zi} = r_{zsi} + H_i \cos \phi_{di} \tag{15}$$

where H_i is the height of the i^{th} station above the reference ellipsoid. The distance z_{si} from the i^{th} station surface point on the reference ellipsoid below or above the station to the earth's equatorial plane is given by

$$z_{si} = p_{ei} \, r_{zsi} \, . \tag{16}$$

The rectangular coordinates x_i (t), y_i (t), z_i of the i^{th} station and their rates of change are given by

$$\begin{aligned}
x_i (t) &= r_{zi} \cos \lambda_i (t) \\
y_i (t) &= r_{zi} \sin \lambda_i (t) \\
z_i &= z_{si} + H_i \sin \phi_{di} \\
\dot{x}_i (t) &= -\omega \, r_{zi} \sin \lambda_i (t) \\
\dot{y}_i (t) &= \omega \, r_{zi} \cos \lambda_i (t) \\
\dot{z}_i &= 0
\end{aligned} \tag{17}$$

Then, $\underline{R}_i$ (t) and $\dot{\underline{R}}_i$ (t) are given by

$$\begin{aligned}
\underline{R}_i (t) &= x_i (t) \, \underline{i} + y_i (t) \, \underline{j} + z_i \, \underline{k} \\
\dot{\underline{R}}_i (t) &= \dot{x}_i (t) \, \underline{i} + \dot{y}_i (t) \, \underline{j}
\end{aligned} \tag{18}$$

The vector from the i^{th} station to the space vehicle, and the rate of change, are given, respectively, by

$$\underline{\rho}_i(t) = \underline{r}_c(t) - \underline{R}_i(t)$$

$$\dot{\underline{\rho}}_i(t) = \dot{\underline{r}}_c(t) - \dot{\underline{R}}_i(t) \ . \qquad (19)$$

It is now possible to write explicit formulas for computed values of the eighteen types of observations listed in Table 1. The output of this portion of the system contains computed values of the observed quantities at each time, t_n.

Formulas involving inverse tangent functions are quadrant-oriented, i.e., information needed to determine quadrants is contained within them.

$$y_{c,1,i} = \rho_i(t) = |\underline{\rho}_i(t)|$$

$$y_{c,2,i} = \ell_i(t) = \underline{\ell}_i(t) \cdot \underline{\rho}_i^*(t)$$

$$y_{c,3,i} = m_i(t) = \underline{m}_i(t) \cdot \underline{\rho}_i^*(t)$$

$$y_{c,4,i} = \theta_i(t) = \text{arc tan}\ \{[\underline{\rho}_i^*(t) \cdot \underline{\ell}_i(t)/\underline{\rho}_i^*(t) \cdot \underline{m}_i(t)]\}$$

$$y_{c,5,i} = \phi_i(t) = \text{arc sin}\ [\underline{n}_i(t) \cdot \underline{\rho}_i^*(t)]$$

$$y_{c,6,i} = \alpha_i(t) = \text{arc tan}\ \{[\underline{\rho}_i^*(t) \cdot \underline{j}/\underline{\rho}_i^*(t) \cdot \underline{i}]\}$$

$$y_{c,7,i} = \delta_i(t) = \text{arc sin}\ [\underline{k} \cdot \underline{\rho}_i^*(t)]$$

$$y_{c,8,i} = h_i(t) = \text{arc tan}\ \{[\underline{\rho}_i^*(t) \cdot \underline{\ell}_i/\underline{\rho}_i^*(t) \cdot \underline{h}_i(t)]\}$$

$$y_{c,9,i} = \dot{\rho}_i(t) = \underline{\rho}_i^*(t) \cdot \dot{\underline{\rho}}_i(t)$$

$$y_{c,10,i} = \dot{\ell}_i(t) = \dot{\underline{\ell}}_i(t) \cdot \underline{\rho}_i^*(t) + \underline{\ell}_i(t) \cdot \frac{d}{dt} \underline{\rho}_i^*(t)$$

$$y_{c,11,i} = \dot{m}_i(t) = \dot{\underline{m}}_i(t) \cdot \underline{\rho}_i^*(t) + \underline{m}_i(t) \cdot \frac{d}{dt} \underline{\rho}_i^*(t)$$

$$y_{c,12,i} = \dot{\theta}_i(t) =$$

$$\frac{\left\{[\underline{\rho}_i^*(t) \cdot \dot{\underline{\ell}}_i(t)] + \left[\frac{d}{dt} \underline{\rho}_i^*(t) \cdot \underline{\ell}_i(t)\right]\right\} [\underline{\rho}_i^*(t) \cdot \underline{m}_i(t)] - \left\{[\underline{\rho}_i^*(t) \cdot \dot{\underline{m}}_i(t)] + \left[\frac{d}{dt} \underline{\rho}_i^*(t) \cdot \underline{m}_i(t)\right]\right\} [\underline{\rho}_i^*(t) \cdot \underline{m}_i(t)]}{[\underline{\rho}_i^*(t) \cdot \underline{\ell}_i(t)]^2 + [\underline{\rho}_i^*(t) \cdot \underline{m}_i(t)]^2}$$

$$y_{c,13,i} = \dot{\phi}_i(t) = \left\{\left[\frac{d}{dt} \underline{\rho}_i^*(t) \cdot \underline{n}_i(t)\right] + [\underline{\rho}_i^*(t) \cdot \underline{n}_i(t)]\right\} \Big/ \sqrt{1 - [\underline{\rho}_i^*(t) \cdot \underline{n}_i(t)]^2}$$

$$y_{c,14,i} = \dot{\alpha}_i(t) =$$

$$\left\{\left[\frac{d}{dt} \underline{\rho}_i^*(t) \cdot \underline{j}\right] [\underline{\rho}_i^*(t) \cdot \underline{i}] - \left[\frac{d}{dt} \underline{\rho}_i^*(t) \cdot \underline{i}\right] [\underline{\rho}_i^*(t) \cdot \underline{j}]\right\} \Big/ \left\{[\underline{\rho}_i^*(t) \cdot \underline{i}]^2 + [\underline{\rho}_i^*(t) \cdot \underline{j}]^2\right\}$$

$$y_{c,15,i} = \dot{\delta}_i(t) = \left\{\left[\frac{d}{dt} \underline{\rho}_i^*(t) \cdot \underline{k}\right] \Big/ \sqrt{1 - [\underline{\rho}_i^*(t) \cdot \underline{k}]}\right.$$

$$y_{c,16,i} = \dot{h}_i(t) =$$

$$\frac{\left\{[\underline{\rho}_i^*(t) \cdot \dot{\underline{\ell}}_i(t)] + \left[\frac{d}{dt} \underline{\rho}_i^*(t) \cdot \underline{\ell}_i(t)\right]\right\} [\underline{\rho}_i^*(t) \cdot \underline{h}_i(t)] - \left\{[\underline{\rho}_i^*(t) \cdot \dot{\underline{h}}_i(t)] + \left[\frac{d}{dt} \underline{\rho}_i^*(t) \cdot \underline{h}_i(t)\right]\right\} [\underline{\rho}_i^*(t) \cdot \underline{\ell}_i(t)]}{[\underline{\rho}_i^*(t) \cdot \underline{\ell}_i(t)]^2 + [\underline{\rho}_i^*(t) \cdot \underline{h}_i(t)]^2}$$

$$y_{c,17,i} = \theta_{1,i}(t) = \arctan \left\{[\underline{\rho}_i^* \cdot \underline{\ell}_i(t)] / [\underline{\rho}_i^*(t) \cdot \underline{n}_i(t)]\right\}$$

$$y_{c,18,i} = \theta_{2,i}(t) = \arcsin [\underline{\rho}_i^*(t) \cdot \underline{m}_i(t)] \tag{20}$$

where

$$\frac{d}{dt} \underline{\rho}_i^* = \frac{1}{\rho_i(t)} \dot{\underline{\rho}}_i(t) - \frac{1}{\rho_i(t)} [\underline{\rho}_i^*(t) \cdot \dot{\underline{\rho}}_i(t)] \underline{\rho}_i^*(t)$$

The expressions, $y_{c,k,i}(t)$, then are used to calculate the computed value of an observation of the k^{th} type, relative to the i^{th} station, at the time t.

In addition, the times at which

$$y_{c,2,i} = 0$$

$$y_{c,3,i} = 0$$

$$y_{c,5,i} = 0$$

$$y_{c,9,i} = 0$$

$$y_{c,13,i} = 0$$

$$y_{c,7,i} = \frac{\pi}{2}$$

$$y'_{c,7,i} = -\phi_i$$

$$y_{c,8,i} = \pm\frac{\pi}{2}$$

are provided in the output.

4. Position in Ellipse

The input to this portion of the system is the set of parameters $\{a,\ e,\ i, \Omega,\ \omega,\ M\ (t_0)\}$ obtained from either the Conversion of Elements Section or the Conversion of Corrections Section. The output contains the vector quantities $\underline{\alpha}(t), \underline{\beta}(t), \underline{\gamma}(t), \underline{p}(t), \underline{q}(t), \underline{r}(t), \dot{\underline{r}}(t)$ obtained from the formulas listed below. Approximate values of Ω and ω can be obtained from

$$\begin{aligned} \Omega(t) &= \Omega(t_0) + \dot{\Omega}(t - t_0) \\ \omega(t) &= \omega(t_0) + \dot{\omega}(t - t_0) \end{aligned} \tag{21}$$

where

$$\dot{\Omega} = -\frac{2\pi \cos I}{Pp^2} R_e^2 J$$

$$\dot{\omega} = \frac{4\pi\left(1 - \frac{5}{4}\sin^2 I\right)}{Pp^2} R_e^2 J,$$

then

$$
\begin{aligned}
&\underline{\Omega}(t) = \underline{i}\cos\Omega(t) + \underline{j}\sin\Omega(t) \\
&\underline{\alpha}(t) = \underline{k}\cos I + [\underline{\Omega}(t)\times\underline{k}]\sin I \\
&\underline{\beta}(t) = \underline{\Omega}(t)\cos\delta_1 + [\underline{\alpha}(t)\times\underline{\Omega}(t)]\sin\delta_1 \\
&\underline{\gamma}(t) = \underline{\alpha}(t)\times\underline{\beta}(t) \\
&\underline{p}(t) = \underline{\beta}(t)\cos[\omega(t)-\delta_1] + \underline{\gamma}(t)\sin[\omega(t)-\delta_1] \\
&\underline{q}(t) = \underline{\beta}(t)\sin[\omega(t)-\delta_1] + \underline{\gamma}(t)\cos[\omega(t)-\delta_1] \\
&\underline{r}(t) = a\underline{p}(t)[\cos E(t) - e] + b\underline{q}(t)\sin E(t) \\
&\dot{\underline{r}}(t) = n\,\frac{b\cos E(t)\,\underline{q}(t) - a\sin E(t)\,\underline{p}(t)}{1 - e\cos E(t)}
\end{aligned}
\tag{22}
$$

where E(t) is obtained through Kepler's equation, and δ_1 here is the angle which the unit vector $\underline{\beta}$ makes with the nodal ray. This angle can be set equal to ω_0, $\omega_0 + \nu_0$, $\omega + \nu$, or some other specified angle.

5. Position Partial Derivatives

This portion of the system is used to evaluate partial derivatives of the form

$$\frac{\partial \underline{r}(t)}{\partial x_j},$$

and

$$\frac{\partial \dot{\underline{r}}(t)}{\partial x_j},$$

for $j = 1, 2, \ldots, n$, where quantities, x_j, $j = 1, 2, \ldots, n$, are the unknowns.

A discussion of the position partial derivatives, the unknowns, and the formulas which give corrections to the elements in terms of the unknowns is contained in the section entitled Conversion of Corrections. (Cf. reference 3 in connection with relations such as (24-1) and (24-3) and related portions of this section and the Conversion of Corrections Section.)

Let

$$\begin{aligned} r(t) &= a\,[1 - e \cos E(t)], \\ C(t) &= (1 - e^2) \cos E(t), \\ S(t) &= -\sqrt{1 - e^2} \sin E(t), \end{aligned} \tag{23}$$

and

$$K = 2 \cos E(t_0) + e \sin^2 E(t_0).$$

Then

$$\frac{\partial \underline{r}(t)}{\partial x_1} = \underline{r}(t) - \frac{3}{2}(t - t_0)\,\dot{\underline{r}}(t), \tag{24-1}$$

$$\frac{\partial \dot{\underline{r}}(t)}{\partial x_1} = -\frac{\dot{\underline{r}}(t)}{2} + \left[\frac{3\mu^2}{2r^3(t)}\,(t - t_0)\right]\underline{r}(t) \tag{24-2}$$

$$\frac{\partial \underline{r}(t)}{\partial x_2} = -\frac{\cos E(t) + e}{1 - e^2}\,\underline{r}(t) + \left[\frac{2}{1 - e^2} - e\,\frac{\cos E(t) + e}{1 - e^2}\right]\frac{\sin E(t)}{n}\,\dot{\underline{r}}(t) \tag{24-3}$$

$$\frac{\partial \dot{\underline{r}}(t)}{\partial x_2} = \frac{\cos a^2}{r^2(t)(1 - e^2)}\left\{\frac{a}{r(t)}\,S(t)\,\underline{r}(t) + \cos E(t)\,[\underline{\alpha}(t) \times \underline{r}(t)]\right\} \tag{24-4}$$

$$\begin{aligned} \frac{\partial \underline{r}(t)}{\partial x_3} = \frac{a^2}{r(t)}\Bigg[&\frac{\sin E(t)}{\sqrt{1 - e^2}}\,\{K - 2e - C(t)\}\,\underline{p}(t) \\ &+ \{1 - [K - \cos E(t)] \cos E(t)\}\,\underline{q}(t)\Bigg] \end{aligned} \tag{24-5}$$

$$\frac{\partial \dot{\underline{r}}(t)}{\partial x_3} = \frac{na^4}{r^3(t)\sqrt{1-e^2}}\Big[[\{1 + 2\cos E(t)\ [\cos E(t_0) - \cos E(t)]$$

$$- e\ \{\cos E(t)\ [\sin^2 E(t) + \cos^2 E(t_0)] + 2\cos E(t_0)\}$$

$$+ e^2\ [2\cos^2 E(t) + \cos^2 E(t_0)] - e^3 \cos^3 E(t)\}\ \underline{p}(t)$$

$$+ S(t)\Big\{[\cos E(t_0) - \cos E(t)]\Big[e[\cos E(t) + \cos E(t_0)] - 2\Big]\Big\}\ \underline{q}(t)\Big] \quad (24\text{-}6)$$

$$\frac{\partial \underline{r}(t)}{\partial x_4} = \underline{\alpha}(t) \times \underline{r}(t) \quad (24\text{-}7)$$

$$\frac{\partial \dot{\underline{r}}(t)}{\partial x_4} = \underline{\alpha}(t) \times \dot{\underline{r}}(t) \quad (24\text{-}8)$$

$$\frac{\partial \underline{r}(t)}{\partial x_5} = \underline{\beta}(t) \times \underline{r}(t) \quad (24\text{-}9)$$

$$\frac{\partial \dot{\underline{r}}(t)}{\partial x_5} = \underline{\beta}(t) \times \dot{\underline{r}}(t) \quad (24\text{-}10)$$

$$\frac{\partial \underline{r}(t)}{\partial x_6} = \underline{\gamma}(t) \times \underline{r}(t) \quad (24\text{-}11)$$

$$\frac{\partial \dot{\underline{r}}(t)}{\partial x_6} = \underline{\gamma}(t) \times \dot{\underline{r}}(t) \quad (24\text{-}12)$$

$$\frac{\partial \underline{r}(t)}{\partial x_7} = 2\,\frac{\partial \underline{r}(t)}{\partial x_1} + C(t_0)\,\frac{\partial \underline{r}(t)}{\partial x_2} + S(t_0)\,\frac{\partial \underline{r}(t)}{\partial x_3} \quad (24\text{-}13)$$

$$\frac{\partial \dot{\underline{r}}(t)}{\partial x_7} = 2\,\frac{\partial \dot{\underline{r}}(t)}{\partial x_1} + C(t_0)\,\frac{\partial \dot{\underline{r}}(t)}{\partial x_2} + S(t_0)\,\frac{\partial \dot{\underline{r}}(t)}{\partial x_3} \quad (24\text{-}14)$$

$$\frac{\partial \underline{r}(t)}{\partial x_8} = [1 + e \cos E(t_0)] \frac{\partial \underline{r}(t)}{\partial x_1} + C(t_0) \frac{\partial \underline{r}(t)}{\partial x_2} + S(t_0) \frac{\partial \underline{r}(t)}{\partial x_3} \tag{24-15}$$

$$\frac{\partial \dot{\underline{r}}(t)}{\partial x_8} = [1 + e \cos E(t_0)] \frac{\partial \dot{\underline{r}}(t)}{\partial x_1} + C(t_0) \frac{\partial \dot{\underline{r}}(t)}{\partial x_2} + S(t_0) \frac{\partial \dot{\underline{r}}(t)}{\partial x_3} \tag{24-16}$$

$$\frac{\partial \underline{r}(t)}{\partial x_9} = S(t_0) \frac{\partial \underline{r}(t)}{\partial x_2} - [e + \cos E(t_0)] \frac{\partial \underline{r}(t)}{\partial x_3} \tag{24-17}$$

$$\frac{\partial \dot{\underline{r}}(t)}{\partial x_9} = S(t_0) \frac{\partial \dot{\underline{r}}(t)}{\partial x_2} - [e + \cos E(t_0)] \frac{\partial \dot{\underline{r}}(t)}{\partial x_3} \tag{24-18}$$

$$\frac{\partial \underline{r}(t)}{\partial x_{10}} = n \dot{\underline{r}}(t) (t - t_0)^2 \tag{24-19}$$

$$\frac{\partial \dot{\underline{r}}(t)}{\partial x_{10}} = - \frac{(t - t_0)^2}{\sqrt{a}\, r^3} [(\cos E - e) \underline{p} + \sqrt{1 - e^2} \sin E \underline{q}] \tag{24-20}$$

$$\frac{\partial \underline{r}(t)}{\partial x_{11}} = n (t - t_0) \frac{\partial \underline{r}(t)}{\partial x_{10}} \tag{24-21}$$

$$\frac{\partial \dot{\underline{r}}(t)}{\partial x_{11}} = n (t - t_0) \frac{\partial \dot{\underline{r}}(t)}{\partial x_{10}} \tag{24-22}$$

$$\frac{\partial \underline{r}(t)}{\partial x_{19}} = \frac{a (1 - \cos E_0)^2}{(1 - e^2)(1 - e \cos E)} [S(t) \underline{p} + C(t) \underline{q}] \tag{24-23}$$

$$\frac{\partial \dot{\underline{r}}(t)}{\partial x_{19}} = \frac{a^4 n (1 - e \cos E_0)^2}{r^3 \sqrt{1 - e^2}} [(e - \cos E) \underline{p} + S(t) \underline{q}] . \tag{24-24}$$

The partial derivatives of $\underline{r}(t)$ and $\dot{\underline{r}}(t)$ with respect to the unknowns x_{20+q} and x_{40+q} are the same as the partial derivatives with respect to x_{10} and x_{11}, respectively, when $q = 0$. For other values of the index, in the range $q = 1, 2, \ldots, 19$, the partial derivatives of $\underline{r}(t)$ and $\dot{\underline{r}}(t)$ with respect to

x_{20+q} and x_{40+q} are the same, respectively, as the partial derivatives with respect to x_{20} and x_{40} with the exception that the former partials are referred to the epoch t_q, while the latter partials are referred to the epoch t_0.

This portion of the program uses, as input, the specification of the set of unknown parameters, x_j, and the times t_n, $n = 1, 2, \ldots$, at which the appropriate position partial derivatives are to be calculated. This portion of the program also uses as input either the output of the Position in Ellipse Section of the program or corresponding information from the portion of the program which is used to calculate the satellite position.

6. Observation Partial Derivatives

The inputs to this portion of the system are the outputs of the Local Station Predictions Section and the Position Partial Derivatives Section. The output contains the values of the partial derivatives of the observation of type k from the i^{th} tracking station at time t_n with respect to the unknowns, x_j, for various values of the indices. It will be understood that the quantities such as $\underline{m}_i(t)$, $\theta_i(t)$, $\underline{\rho}_i^*(t)$, etc. are functions of the time, t, and the i^{th} tracking station, and therefore, for convenience, we shall, at times, write $\underline{m}$, θ, $\underline{\rho}^*$, etc. The partial derivatives are now given.

$$\frac{\partial \rho}{\partial x_j} = \underline{\rho}^* \cdot \frac{\partial \underline{r}}{\partial x_j}$$

$$\frac{\partial \ell}{\partial x_j} = \underline{c}^j \cdot \underline{\ell}$$

$$\frac{\partial m}{\partial x_j} = \underline{c}^j . \underline{m}$$

$$\frac{\partial \theta}{\partial x_j} = \frac{(\underline{\rho}^* \cdot \underline{m}) \left(\frac{\partial \ell}{\partial x_j}\right) - (\underline{\rho}^* \cdot \underline{\ell}) \left(\frac{\partial m}{\partial x_j}\right)}{(\underline{\rho}^* \cdot \underline{m})^2 + (\underline{\rho}^* \cdot \underline{\ell})^2}$$

$$\frac{\partial \phi}{\partial x_j} = \frac{(\underline{c}^j \cdot \underline{n})}{\sqrt{1 - (\underline{\rho}^* \cdot \underline{n})^2}}$$

$$\frac{\partial \alpha}{\partial x_j} = \frac{(\underline{\rho}^* \cdot \underline{i})\,(\underline{c}^j \cdot \underline{j}) - (\underline{\rho}^* \cdot \underline{j})\,(\underline{c}^j \cdot \underline{i})}{(\underline{\rho}^* \cdot \underline{i})^2 + (\underline{\rho}^* \cdot \underline{j})^2}$$

$$\frac{\partial \delta}{\partial x_j} = \frac{(\underline{c}^j \cdot \underline{k})}{\sqrt{1 - (\underline{\rho}^* \cdot \underline{k})^2}}$$

$$\frac{\partial h}{\partial x_j} = -\frac{\partial \alpha}{\partial x_j}$$

$$\frac{\partial \theta_1}{\partial x_j} = \frac{(\underline{\rho}^* \cdot \underline{n})\,(\underline{c}^j \cdot \underline{\ell}) - (\underline{\rho}^* \cdot \underline{\ell})\,(\underline{c}^j \cdot \underline{n})}{(\underline{\rho}^* \cdot \underline{n})^2 + (\underline{\rho}^* \cdot \underline{\ell})^2}$$

$$\frac{\partial \theta_2}{\partial x_j} = \frac{(\underline{c}^j \cdot \underline{m})}{\sqrt{1 - (\underline{\rho}^* \cdot \underline{m})^2}}$$

$$\frac{\partial \dot{\rho}}{\partial x_j} = \left(\frac{\partial \dot{\underline{r}}}{\partial x_j} \cdot \underline{\rho}^*\right) + \left(\frac{\partial \underline{r}}{\partial x_j} \cdot \underline{d}\right)$$

$$\frac{\partial \dot{\ell}}{\partial x_j} = (\underline{c}^j \cdot \dot{\underline{\ell}}) + (\dot{\underline{c}}^j \cdot \underline{\ell})$$

$$\frac{\partial \dot{m}}{\partial x_j} = (\underline{c}^j \cdot \dot{\underline{m}}) + (\dot{\underline{c}}^j \cdot \underline{m}) \tag{25}$$

$$\frac{\partial \dot{\theta}}{\partial x_j} = \frac{\left(\frac{\partial \ell}{\partial x_j}\right)\,[(\underline{\rho}^* \cdot \dot{\underline{m}}) + (\underline{d} \cdot \underline{m})] - \left(\frac{\partial m}{\partial x_j}\right)\,[(\underline{\rho}^* \cdot \dot{\underline{\ell}}) + (\underline{d} \cdot \underline{\ell})]}{(\underline{\rho}^* \cdot \underline{m})^2 + (\underline{\rho}^* \cdot \underline{\ell})^2}$$

$$+ \frac{\left(\frac{\partial \dot{\ell}}{\partial x_j}\right)\,(\underline{\rho}^* \cdot \underline{m}) - \left(\frac{\partial \dot{m}}{\partial x_j}\right)\,(\underline{\rho}^* \cdot \underline{\ell})}{(\underline{\rho}^* \cdot \underline{m})^2 + (\underline{\rho}^* \cdot \underline{\ell})^2}$$

$$- 2\left(\frac{\partial \theta}{\partial x_j}\right)\left\{\frac{\underline{\rho}^* \cdot \underline{m})\,[(\underline{\rho}^* \cdot \dot{\underline{m}}) + (\underline{d} \cdot \underline{m})] + (\underline{\rho}^* \cdot \underline{\ell})[(\underline{\rho}^* \cdot \dot{\underline{\ell}}) + (\underline{d} \cdot \underline{\ell})]}{(\underline{\rho}^* \cdot \underline{m})^2 + (\underline{\rho}^* \cdot \underline{\ell})^2}\right\}$$

$$\frac{\partial \dot{\phi}}{\partial x_j} = \frac{(\dot{\underline{c}}^j \cdot \underline{n}) + (\underline{c}^j \cdot \dot{\underline{n}})}{\sqrt{1-(\underline{\rho}^* \cdot \underline{n})^2}}$$

$$+ \frac{(\underline{c}^j \cdot \underline{n})\ (\underline{\rho}^* \cdot \underline{n})\ [(\underline{d} \cdot \underline{n}) + (\underline{\rho}^* \cdot \dot{\underline{n}})]}{[1-(\underline{\rho}^* \cdot \underline{n})^2]^{3/2}}$$

$$\frac{\partial \dot{\alpha}}{\partial x_j} = \frac{\left(\frac{\partial \ell}{\partial x_j}\right)(\underline{d} \cdot \underline{i}) - \left(\frac{\partial m}{\partial x_j}\right)(\underline{d} \cdot \underline{j})}{(\underline{\rho}^* \cdot \underline{i})^2 + (\underline{\rho}^* \cdot \underline{j})^2}$$

$$+ \frac{\left(\frac{\partial \dot{\ell}}{\partial x_j}\right)(\underline{\rho}^* \cdot \underline{i}) - \left(\frac{\partial \dot{m}}{\partial x_j}\right)(\underline{\rho}^* \cdot \underline{j})}{(\underline{\rho}^* \cdot \underline{i})^2 + (\underline{\rho}^* \cdot \underline{j})^2}$$

$$- 2\left(\frac{\partial \alpha}{\partial x_j}\right)\left[\frac{(\underline{\rho}^* \cdot \underline{i})\ (\underline{d} \cdot \underline{i}) + (\underline{\rho}^* \cdot \underline{j})\ (\underline{d} \cdot \underline{j})}{(\underline{\rho}^* \cdot \underline{i})^2 + (\underline{\rho}^* \cdot \underline{j})^2}\right]$$

$$\frac{\partial \dot{\delta}}{\partial x_j} = \frac{(\dot{\underline{c}}^j \cdot \underline{k})}{\sqrt{1-(\underline{\rho}^* \cdot \underline{k})^2}} + \frac{(\underline{c}^j \cdot \underline{k})\ (\underline{\rho}^* \cdot \underline{k})\ (\underline{d} \cdot \underline{k})}{[1-(\underline{\rho}^* \cdot \underline{k})^2]^{3/2}}$$

$$\frac{\partial \dot{h}}{\partial x_j} = -\frac{\partial \dot{\alpha}}{\partial x_j}$$

where

$$\underline{c}^j = \frac{\partial \underline{\rho}^*}{\partial x_j} = \frac{1}{\rho}\left(\frac{\partial \underline{r}}{\partial x_j} - \underline{\rho}^* \frac{\partial \rho}{\partial x_j}\right); \ \underline{d} = \frac{d\underline{\rho}^*}{dt} = \frac{1}{\rho}(\dot{\underline{\rho}} - \underline{\rho}^* \dot{\rho})$$

and

$$\dot{\underline{c}}^j = \frac{1}{\rho}\left(\frac{\partial \dot{\underline{r}}}{\partial x_j} - \underline{\rho}^* \frac{\partial \dot{\rho}}{\partial x_j} - \underline{d}\,\frac{\partial \rho}{\partial x_j} - \underline{c}^j \dot{\rho}\right)$$

7. Equations of Condition

The input to this portion of the system includes the values of the various $y_{0,k,i}$ (t_n), values for weights $w_{k,i}$ (t_n), and the outputs of the Observation Partial Derivatives Section and the Local Station Predictions Section. The output of this portion of the system contains the equations of condition and the normal equations.

The equations of condition are

$$\sum \frac{\partial y_{k,i}(t_n)}{\partial x_j} x_j = y_{0,k,i}(t_n) - y_{c,k,i}(t_n) \cdot \tag{26}$$

The normal equations are

$$\sum_i \left[\sum_j w_{k,i} \frac{\partial y_i}{\partial x_j} \frac{\partial y_i}{\partial x_\lambda} x_j - w_{k,i} \frac{\partial y_i}{\partial x_\lambda} (y_{0,k,i} - y_{c,k,i}) \right] = 0 \quad (\lambda = 1, 2, \cdots) \tag{27}$$

where the weights, $w_{k,i}$, are functions of the observation type, estimated or observed uncertainties, and factors associated with the geometry of a particular pass at a particular station. Weights, including null weights, can be assigned to subsets of observations selected in terms of time, station, type, or residual characteristics.

8. Least Squares Solution

The input to this portion of the system is the output of the Equations of Condition Section. The output contains values for the various quantities, x_j, and statistical information associated with the fit to the observations.

9. Conversion of Corrections

The input to this portion of the system consists of the output of the Least Squares Solution Section, the Conversion of Elements Section and the Conversion of Corrections Section associated with the current iteration. The output includes the original value, the previous value, the new value of each of the parameters, and the standard deviation of fit, and its increment.

Corrections to the previous values or the original values of the elements and associated parameters are obtained in the manner indicated in the following discussion.

The partial derivatives and the corresponding expressions for the differential changes in the elements as functions of the unknowns are employed in sets. For example, when the partial derivatives

$$\frac{\partial \underline{r}}{\partial x j}, \tag{28}$$

j = 1, 2, . . . , 6, i.e., the expressions (24-1), (24-3), (24-5), (24-7), (24-9), and (24-11), are employed, the use of formulas for obtaining differential changes in the elements as functions of the unknowns can be indicated in the following way.

The expression

$$\delta a = a x_1 , \tag{29}$$

gives the differential change, δa, in the semi-major axis, a , as a function of the unknown, x_1.

Similarly, the expression

$$\delta e = x_2 , \tag{30}$$

gives the differential change, δe, in the eccentricity, e , as a function of the unknown, x_2.

The differential change, δi, in the inclination, i , is given by the relation

$$\delta i = \delta \beta \cos \delta_1 - \delta \gamma \sin \delta_1 , \tag{31}$$

where the quantities $\delta \beta$ and $\delta \gamma$ are obtained from the relations

$$\delta \beta = x_5 , \tag{32}$$

and

$$\delta \gamma = x_6 . \tag{33}$$

Hence, the expression for δi directly in terms of the unknowns is

$$\delta i = x_5 \cos \delta_1 - x_6 \sin \delta_1 . \tag{34}$$

In similar fashion, the expression obtained for the differential change, $\delta \Omega$, in the right ascension of the ascending node, Ω, directly in terms of the unknowns is

$$\delta \Omega = \csc i \, (x_5 \sin \delta_1 + x_6 \cos \delta_1), \tag{35}$$

the expression obtained for the differential change, δM_0, in the mean anomaly at the epoch, M_0, directly in terms of the unknown is

$$\delta M_0 = \frac{(1 - e \cos E_0)^2}{\sqrt{1 - e^2}} \frac{1}{e} x_3 , \tag{36}$$

and the expression obtained for the differential change, $\delta \omega$, in the argument of perigee, ω, directly in terms of the unknowns is

$$\delta \omega = x_4 - \frac{x_3}{e} - \operatorname{ctn} i \, (x_5 \sin \delta_1 + x_6 \cos \delta_1). \tag{37}$$

The relationships between these two sets of formulas for computation, i.e., those for the partial derivatives, and those for the corresponding differential changes in the elements as functions of the unknowns, can be indicated in the following way.

In view of the relation (29) we can write

$$\frac{\partial \underline{r}}{\partial x_1} = a \frac{\partial \underline{r}}{\partial a}, \tag{38}$$

from which expression (24-1) can be derived. (Cf. reference 3 in connection with this relation and portions of the following discussion.) In view of the relation (30) we can write

$$\frac{\partial \underline{r}}{\partial x_2} = \frac{\partial \underline{r}}{\partial e} , \tag{39}$$

from which expression (24-3) follows.

The quantities $\delta\beta$ and $\delta\gamma$ denote, respectively, differential rotations of the orbit plane about the $\underline{\beta}$ and $\underline{\gamma}$ axes, as can be seen, respectively, from the pairs of expressions (24-9) and (32), and (24-11) and (33). We can also write the expression (37) in the following form:

$$\delta\omega = \delta\omega_\alpha - \text{ctn i } (\delta\beta \sin\delta_1 + \delta\gamma\cos\delta_1), \tag{40}$$

where the terms involving $\delta\beta$ and $\delta\gamma$ correspond to the differential changes in ω due to differential rotations of the orbit plane about the $\underline{\beta}$ and $\underline{\gamma}$ axes, respectively, and the term $\delta\omega_\alpha$ corresponds to differential changes in ω due to differential changes within the orbit plane, i.e., to differential rotations about the $\underline{\alpha}$ axis, i.e.,

$$\frac{\partial \underline{r}}{\partial \beta} = \underline{\beta} \times \underline{r}, \tag{41}$$

$$\frac{\partial \underline{r}}{\partial \gamma} = \underline{\gamma} \times \underline{r}, \tag{42}$$

and

$$\frac{\partial \underline{r}}{\partial \omega_\alpha} = \underline{\alpha} \times \underline{r}, \tag{43}$$

and, from (37) and (40),

$$\delta\omega_\alpha = x_4 - \frac{1}{e} x_3 . \tag{44}$$

In view of (36) and (44), we have

$$\frac{\partial \underline{r}}{\partial x_3} = \frac{\partial \underline{r}}{\partial M_0} \left[\frac{(1 - e\cos E_0)^2}{\left(\sqrt{1-e^2}\right)e}\right] + \frac{\partial \underline{r}}{\partial \omega_\alpha}\left[-\frac{1}{e}\right], \tag{45}$$

and

$$\frac{\partial \underline{r}}{\partial x_4} = \frac{\partial \underline{r}}{\partial \omega_a}, \tag{46}$$

from which expressions (24-5) and (24-7), respectively, can be derived.

The partial derivatives

$$\frac{\partial \underline{r}}{\partial x_j}, \tag{47}$$

$$j = 1,\ 2,\ 3,\ 5,\ 6,\ 19,$$

i.e., the expressions (24-1), (24-3), (24-5), (24-9), (24-11), and (24-23), are frequently employed. The use of formulas for obtaining differential changes in the elements as functions of the unknowns in this case can be indicated in the following way.

The expressions (29), (30), (34), and (35) occur as in the case discussed previously. The differential changes in the mean anomaly at the epoch and the argument of perigee obtained in this case will be denoted, respectively, by the symbols

$$\delta M_{01}, \text{ and } \delta \omega_1,$$

in order to distinguish them from the corresponding quantities which were discussed above.

The expression obtained for δM_{01}, directly in terms of the unknowns is, in this case,

$$\delta M_{01} = \frac{(1 - e \cos E_0)^2}{\sqrt{1 - e^2}} \left[\frac{1}{e} x_3 + x_{19}\right] \tag{48}$$

The expression obtained for $\delta\omega_1$, directly in terms of the unknowns is, in this case,

$$\delta\omega_1 = -\frac{x_3}{e} - \text{ctn } i \ (x_5 \sin \delta_1 + x_6 \cos \delta_1). \tag{49}$$

We can also write the expression (49) in the following form:

$$\delta\omega_1 = \delta\omega_{1\alpha} - \text{ctn } i \ (\delta\beta \sin \delta_1 + \delta\gamma \cos \delta_1), \tag{50}$$

where, here, the terms involving $\delta\beta$ and $\delta\gamma$ correspond to the differential changes in the argument of perigee due to differential rotations of the orbit plane about the $\underline{\beta}$ and $\underline{\gamma}$ axes, respectively, and the term $\delta\omega_{1\alpha}$ corresponds to differential changes in the argument of perigee due to differential changes within the orbit plane, i.e., to differential rotations about the $\underline{\alpha}$ axis, i.e., we have the relations (41) and (42) and

$$\frac{\partial \underline{r}}{\partial \omega_{1\alpha}} = \underline{\alpha} \times \underline{r}, \tag{51}$$

and, from (49) and (50),

$$\delta\omega_{1\alpha} = -\frac{x_3}{e}. \tag{52}$$

In view of (48) and (52) we have

$$\frac{\partial \underline{r}}{\partial x_3} = \frac{\partial \underline{r}}{\partial M_{01}} \left[\frac{(1 - e \cos E_0)^2}{\left(\sqrt{1 - e^2}\right) e} \right] + \frac{\partial \underline{r}}{\partial \omega_{1\alpha}} \left[-\frac{1}{e} \right], \tag{53}$$

and

$$\frac{\partial \underline{r}}{\partial x_{19}} = \frac{\partial \underline{r}}{\partial M_{01}} \left[\frac{(1 - e \cos E_0)^2}{\sqrt{1 - e^2}} \right] , \tag{54}$$

from which expressions (24-5) and (24-23), respectively, can be derived.

Corrections to previous or original values of other parameters of interest are obtained with the aid of formulas (55) through (67).

$$\delta r_0 = \frac{r_0^2}{a} x_7 , \tag{55}$$

$$\delta v_0 = \frac{na}{2} \sqrt{1 - e^2 \cos^2 E_0} \; x_8 , \tag{56}$$

$$\delta \theta_0 = x_9 , \tag{57}$$

$$\delta n_2 = n^2 x_{10} , \tag{58}$$

$$\delta n_3 = n^3 x_{11} , \tag{59}$$

The corrections $\delta n_{2,0}$ and $\delta n_{3,0}$ bear the same relationship to the unknowns x_{20} and x_{40} , respectively, as do the corrections δn_2 and δn_3 to the unknowns x_{10} and x_{11} , respectively.

The ratio of $\delta n_{2,q}$ to x_{20+q} is the same as the ratio of δn_2 to x_{10}, for $q = 0, 1, 2, \cdots, 19$, and similarly, the ratio of $\delta n_{3,q}$ to X_{40+q} is the same as the ratio of δn_3 to x_{11}, for $q = 0, 1, 2, \cdots, 19$.

$$\delta \underline{r} = \sum_{i=1}^{n} \frac{\partial \underline{r}}{\partial x_i} x_i , \tag{60}$$

$$\delta \dot{\underline{r}} = \sum_{i=1}^{n} \frac{\partial \dot{\underline{r}}}{\partial x_i} x_i , \tag{61}$$

$$\delta x = \delta \underline{r} \cdot \underline{i} , \tag{62}$$

$$\delta y = \delta \underline{r} \cdot \underline{j} , \tag{63}$$

$$\delta z = \delta r \cdot \underline{k} , \tag{64}$$

$$\delta \dot{x} = \delta \dot{\underline{r}} \cdot \underline{i} , \tag{65}$$

$$\delta \dot{y} = \delta \dot{\underline{r}} \cdot \underline{j} , \tag{66}$$

and

$$\delta \dot{z} = \delta \dot{\underline{r}} \cdot \underline{k} . \tag{67}$$

These latter relations are used, for example, when the spacecraft position is specified by means of a special perturbation numerical integration method referred to Cartesian coordinates.

This completes the outline of the contents of the nine basic portions of the Goddard General Orbit Determination System.

IV. SUMMARY

In the previous pages of this report the mathematical description of the Goddard General Orbit Determination System is presented. Appendix A contains the schematic flowchart for the differential correction portion of the system. In Appendices B and C, respectively, the program flowchart and program listing are to be found. It is hoped that the formulation together with the program information will be of assistance to the many users of the Goddard General Orbit Determination System as well as to the recipients of the orbital information which it is used to generate.

V. ACKNOWLEDGMENT

The Goddard General Orbit Determination System was programmed by a team of Goddard staff members under the direction of Thomas P. Gorman, who served for a number of years as Head of the Data Systems Division's Advanced Orbital Programming Branch, and Melba Mouton, who succeeded him in that position and is currently serving as Head of the Mission and Trajectory Analysis Division's Program Systems Branch. The authors also wish to express their thanks to Dr. Hans G. Hertz for his careful reading of the manuscript.

VI. REFERENCES

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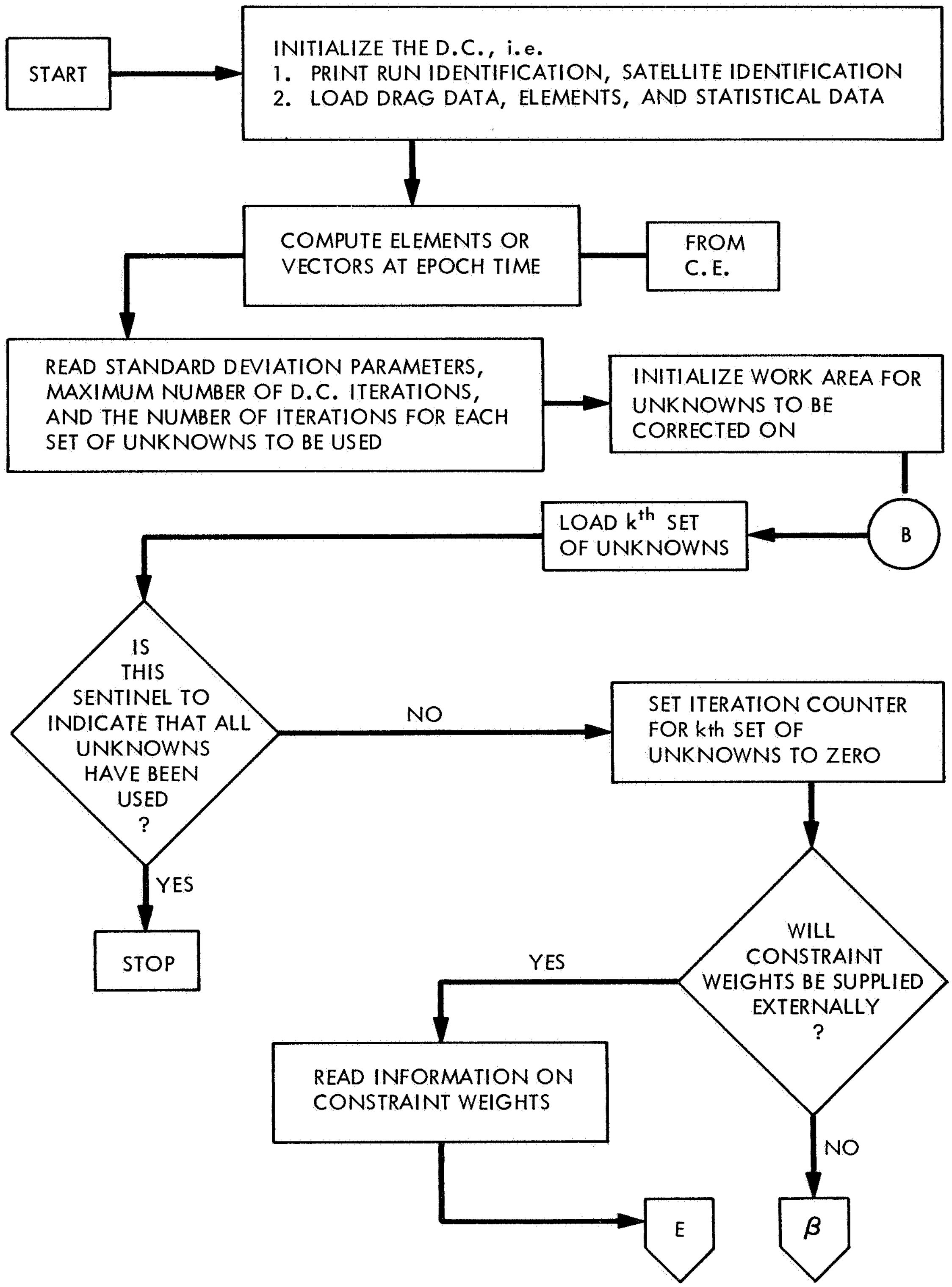
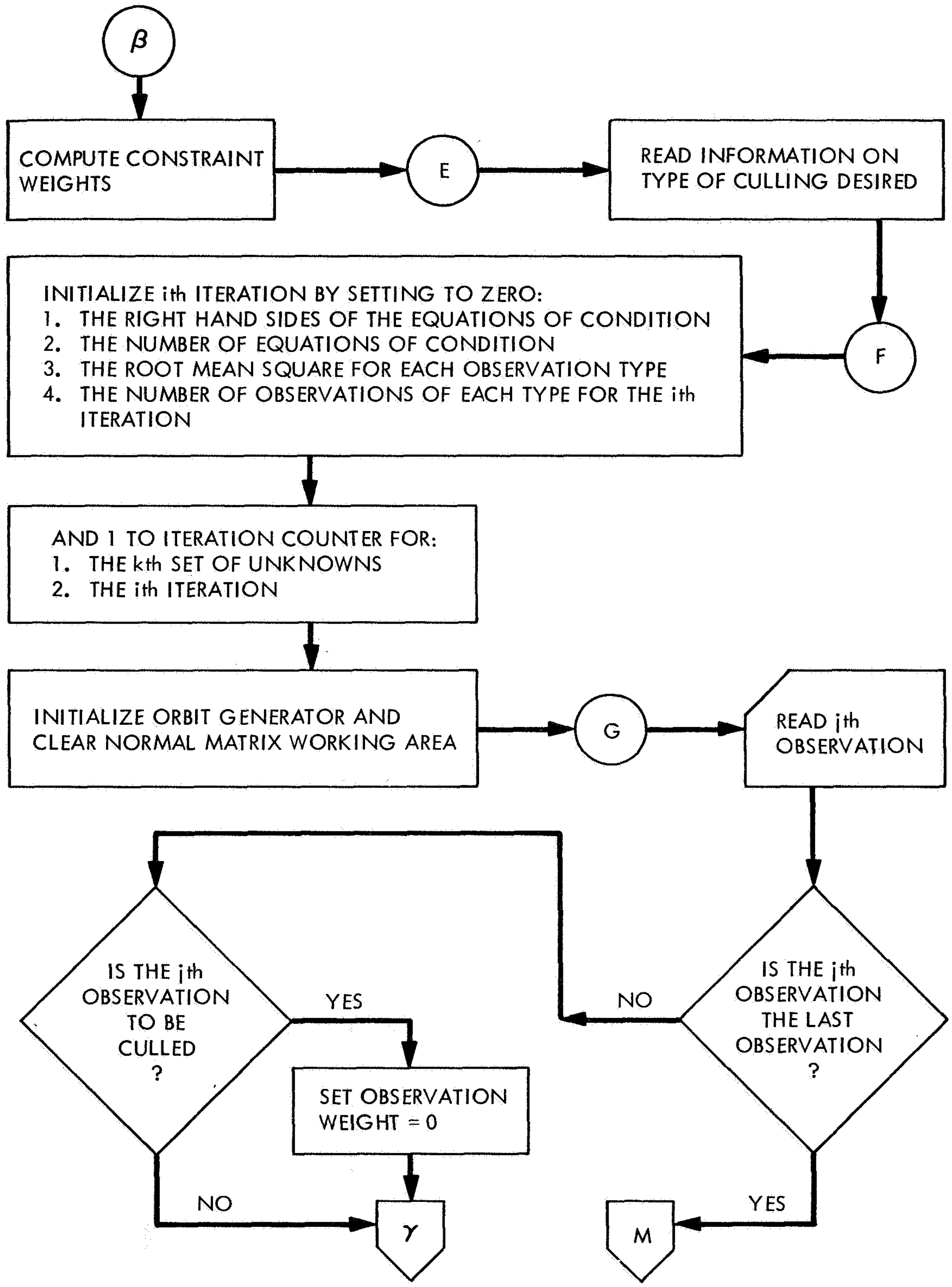
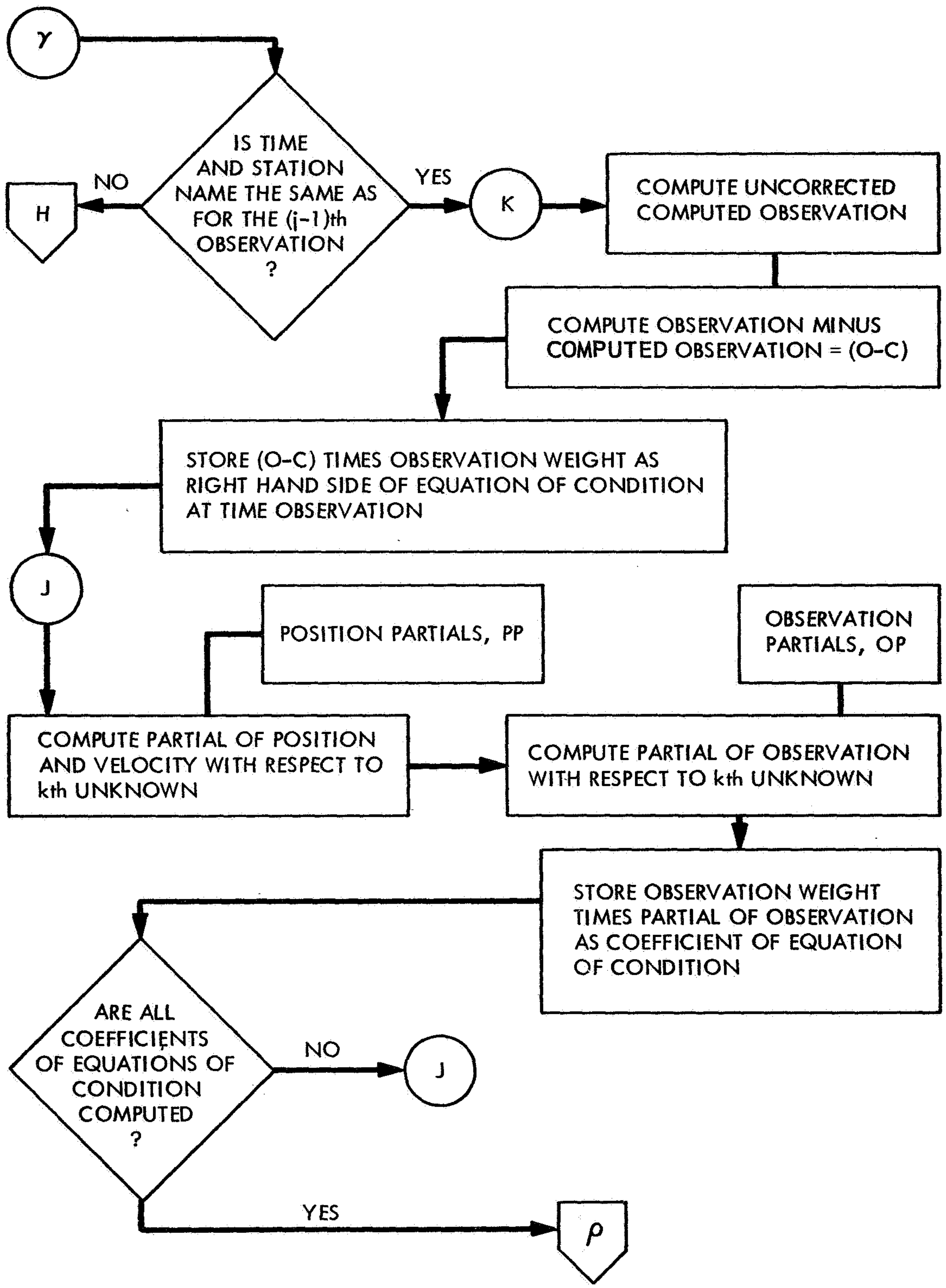
2. Brouwer, D. and Clemence, G. M., Methods of Celestial Mechanics, Academic Press, New York, 1961.

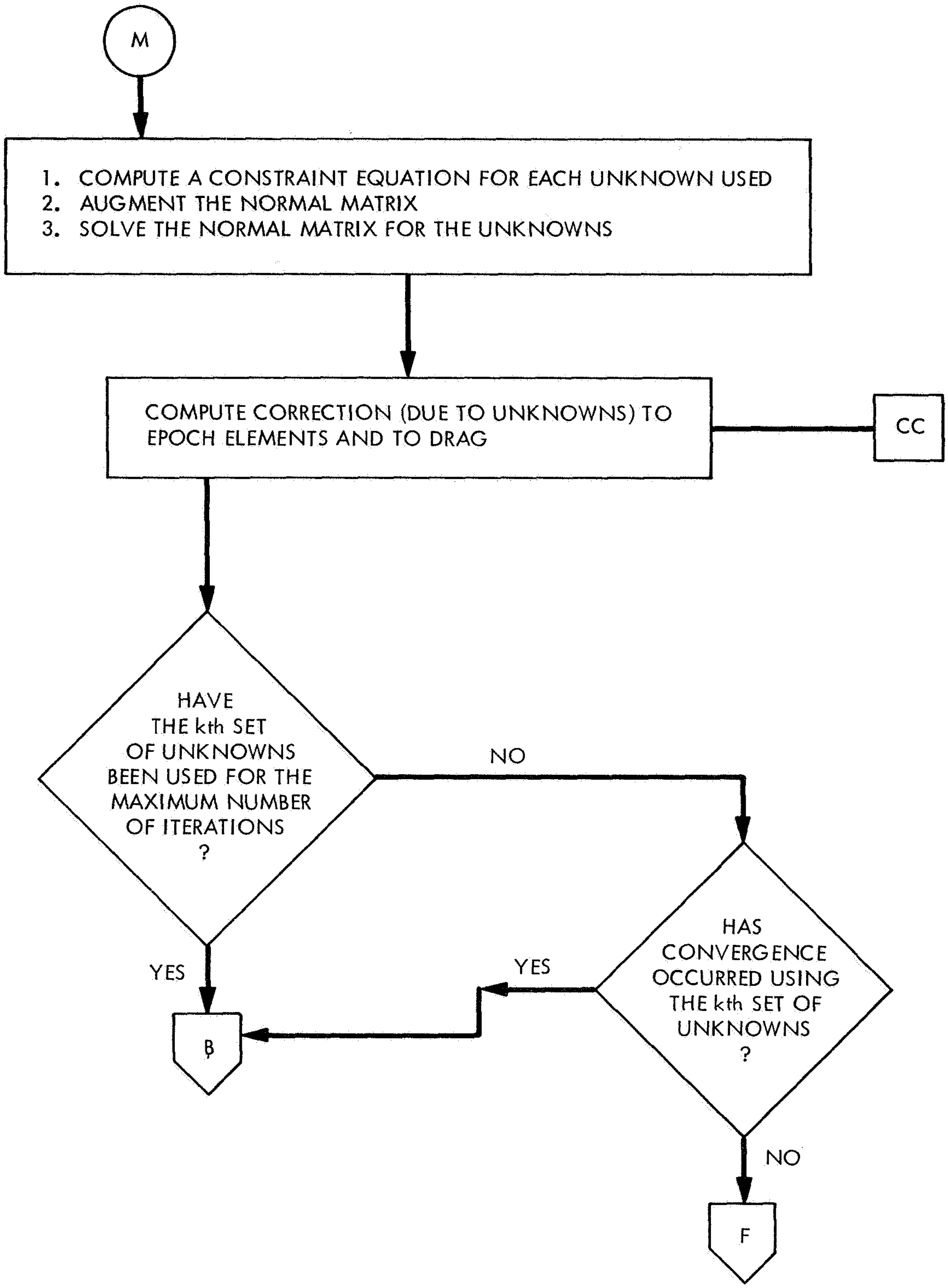
3. Eckert, W. J. and Brouwer D., 1937, A. J., (46).

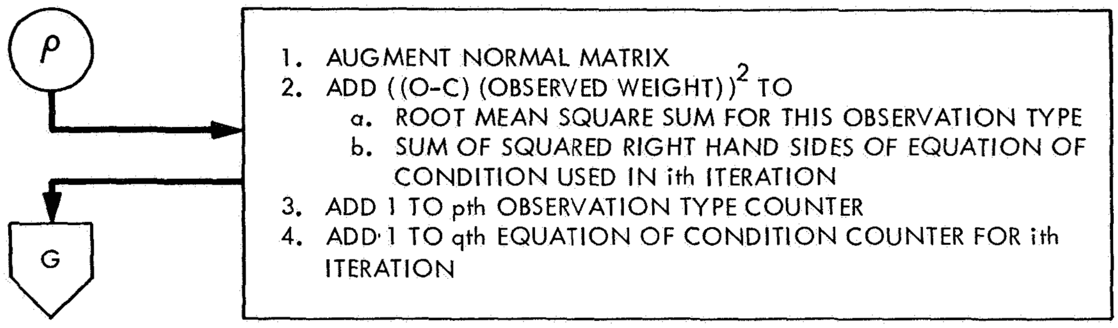
APPENDIX A
SCHEMATIC FLOW CHART OF THE DIFFERENTIAL CORRECTION SYSTEM

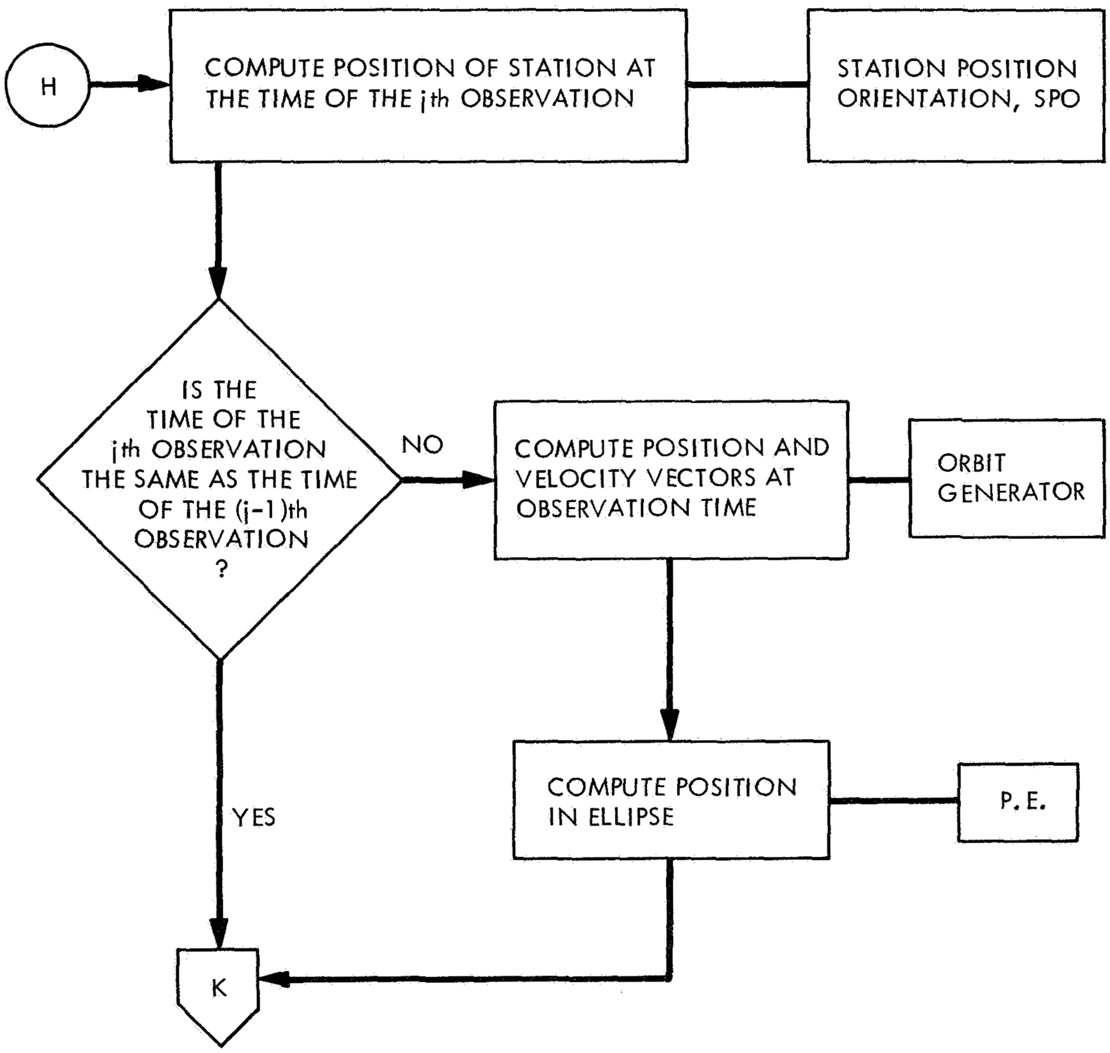



β
COMPUTE CONSTRAINT WEIGHTS
E
READ INFORMATION ON TYPE OF CULLING DESIRED
F
INITIALIZE ith ITERATION BY SETTING TO ZERO:
1. THE RIGHT HAND SIDES OF THE EQUATIONS OF CONDITION
2. THE NUMBER OF EQUATIONS OF CONDITION
3. THE ROOT MEAN SQUARE FOR EACH OBSERVATION TYPE
4. THE NUMBER OF OBSERVATIONS OF EACH TYPE FOR THE ith ITERATION
AND 1 TO ITERATION COUNTER FOR:
1. THE kth SET OF UNKNOWNS
2. THE ith ITERATION
INITIALIZE ORBIT GENERATOR AND CLEAR NORMAL MATRIX WORKING AREA
G
READ jth OBSERVATION
IS THE jth OBSERVATION TO BE CULLED ?
YES
SET OBSERVATION WEIGHT = 0
NO
γ
IS THE jth OBSERVATION THE LAST OBSERVATION ?
NO
YES
M


γ
IS TIME AND STATION NAME THE SAME AS FOR THE (j-1)th OBSERVATION ?
NO
H
YES
K
COMPUTE UNCORRECTED COMPUTED OBSERVATION
COMPUTE OBSERVATION MINUS COMPUTED OBSERVATION = (O-C)
STORE (O-C) TIMES OBSERVATION WEIGHT AS RIGHT HAND SIDE OF EQUATION OF CONDITION AT TIME OBSERVATION
J
POSITION PARTIALS, PP
OBSERVATION PARTIALS, OP
COMPUTE PARTIAL OF POSITION AND VELOCITY WITH RESPECT TO kth UNKNOWN
COMPUTE PARTIAL OF OBSERVATION WITH RESPECT TO kth UNKNOWN
STORE OBSERVATION WEIGHT TIMES PARTIAL OF OBSERVATION AS COEFFICIENT OF EQUATION OF CONDITION
ARE ALL COEFFICIENTS OF EQUATIONS OF CONDITION COMPUTED ?
NO
J
YES
ρ


M
1. COMPUTE A CONSTRAINT EQUATION FOR EACH UNKNOWN USED
2. AUGMENT THE NORMAL MATRIX
3. SOLVE THE NORMAL MATRIX FOR THE UNKNOWNS
COMPUTE CORRECTION (DUE TO UNKNOWNS) TO EPOCH ELEMENTS AND TO DRAG
CC
HAVE THE kth SET OF UNKNOWNS BEEN USED FOR THE MAXIMUM NUMBER OF ITERATIONS ?
NO
YES
HAS CONVERGENCE OCCURRED USING THE kth SET OF UNKNOWNS ?
YES
NO
B
F


P
1. AUGMENT NORMAL MATRIX
2. ADD ((O-C) (OBSERVED WEIGHT))^2 TO
a. ROOT MEAN SQUARE SUM FOR THIS OBSERVATION TYPE
b. SUM OF SQUARED RIGHT HAND SIDES OF EQUATION OF CONDITION USED IN ith ITERATION
3. ADD 1 TO pth OBSERVATION TYPE COUNTER
4. ADD 1 TO qth EQUATION OF CONDITION COUNTER FOR ith ITERATION
G

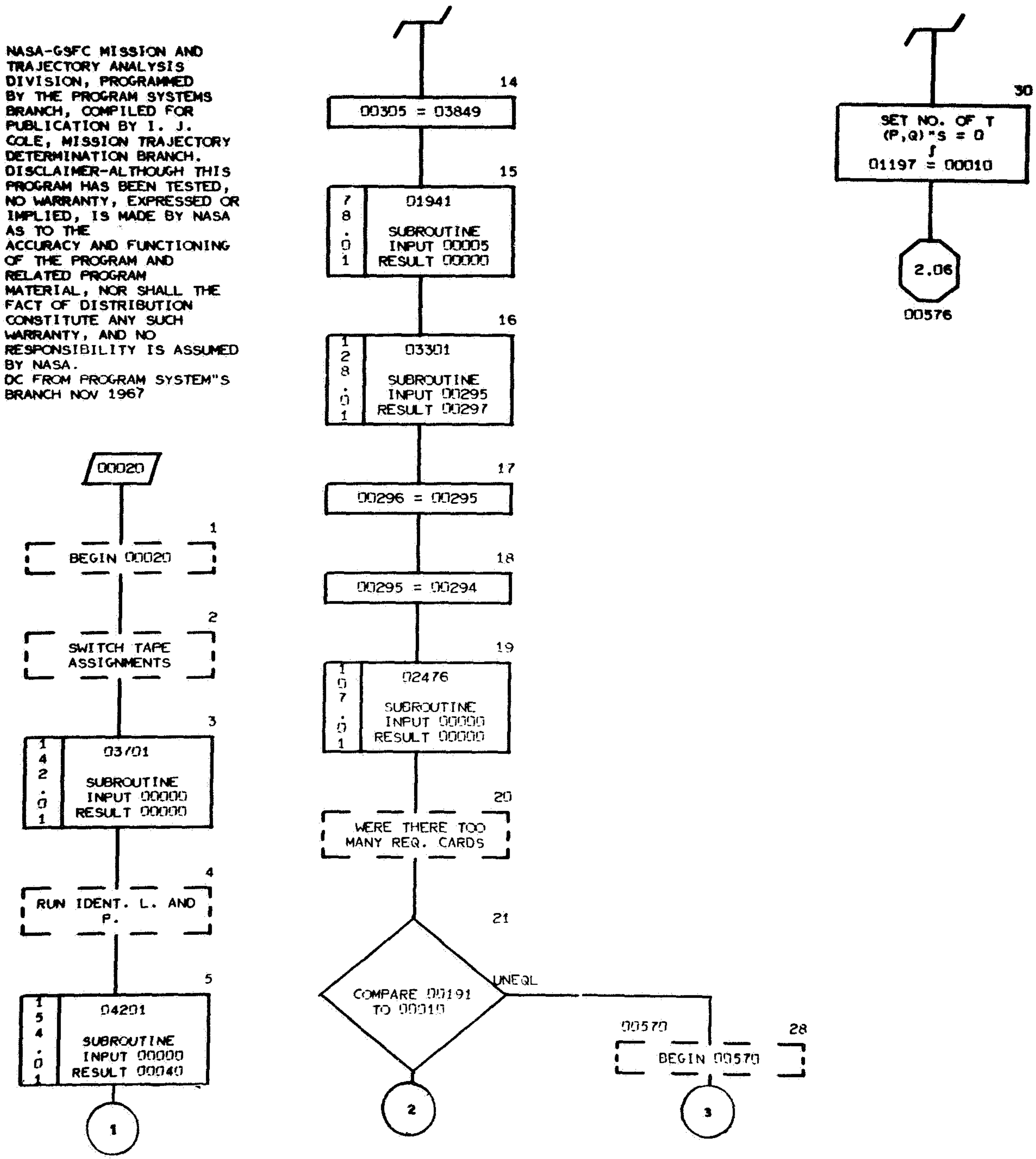

H
COMPUTE POSITION OF STATION AT THE TIME OF THE jth OBSERVATION
STATION POSITION ORIENTATION, SPO
IS THE TIME OF THE jth OBSERVATION THE SAME AS THE TIME OF THE (j-1)th OBSERVATION ?
NO
COMPUTE POSITION AND VELOCITY VECTORS AT OBSERVATION TIME
ORBIT GENERATOR
COMPUTE POSITION IN ELLIPSE
P.E.
YES
K

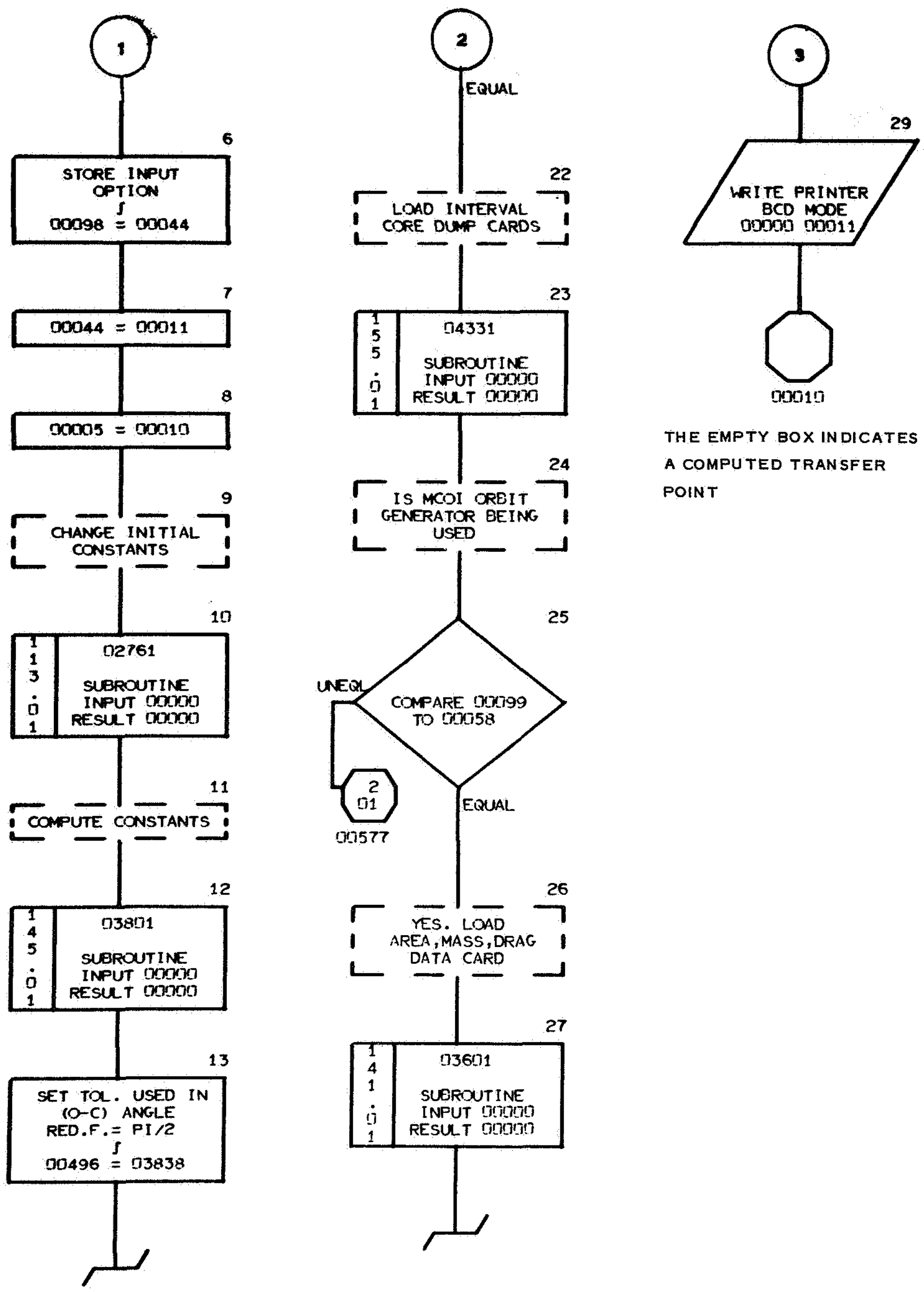
APPENDIX B

Differential Correction System Flowchart

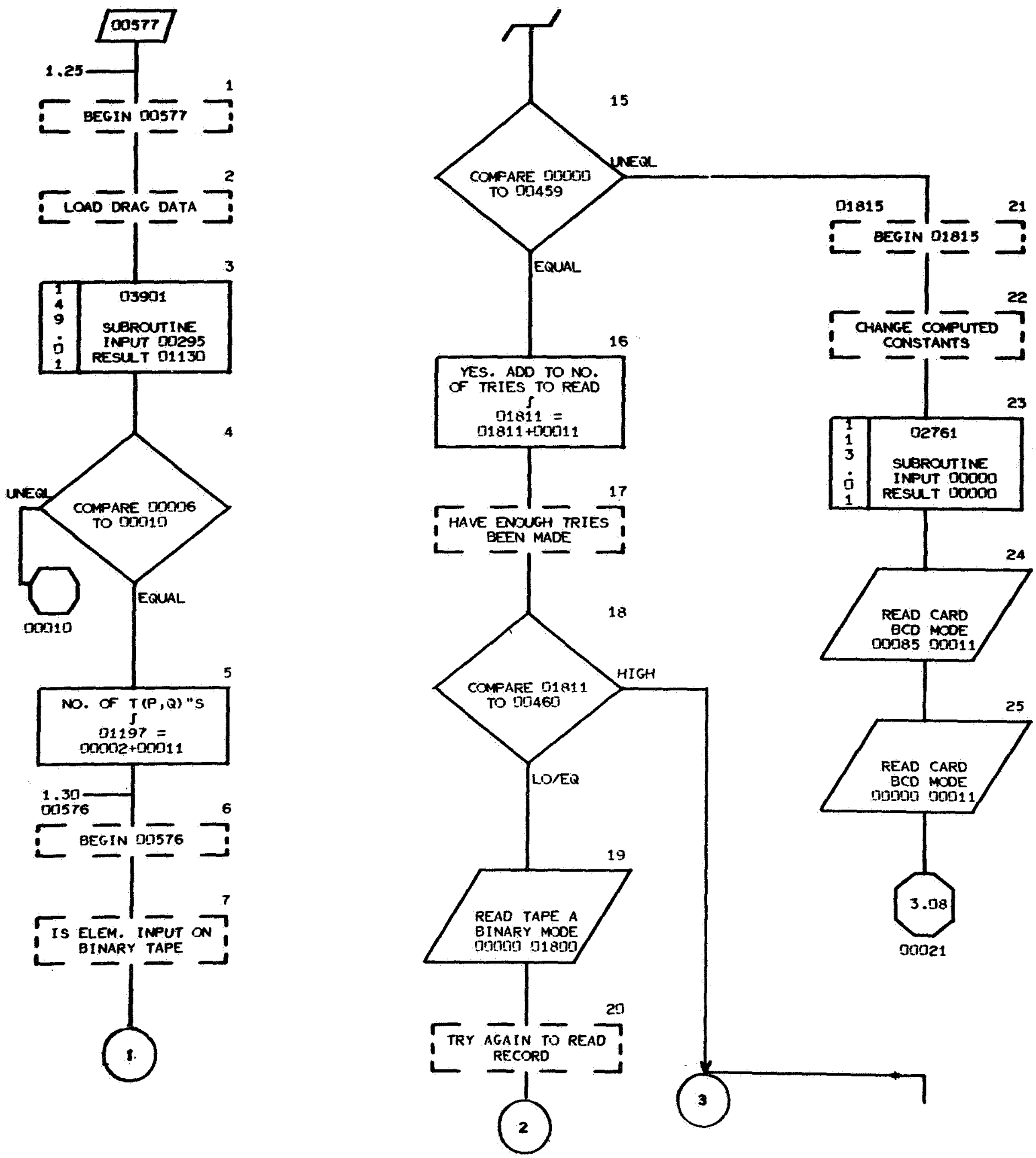
The Differential Correction program is designed so that the basic computations are performed by several subroutines. This portion of this paper presents the logic of these subroutines and describes their relationships to each other and to the main or executive program. It is intended to be an aid in relating the actual computations to the formulae given earlier and to show the logical flow of these computations.

The location statements (Q statements) and constant statements (V statements) for each subroutine are presented along with a Table of Contents and Cross-Reference Listing for the subroutine. The Cross-Reference Listings show for each label in the subroutine the page and symbol number for the label itself and for all points in the flow charts at which transfers to it are found. These latter points are referred to as references in the Cross Reference Listings. These page numbers refer to the flow charts and are at the right uppermost corner of each flow chart page. They are not to be confused with the page numbers of this paper itself. An asterisk, *, indicates that there are transfers to a label other than the one shown.

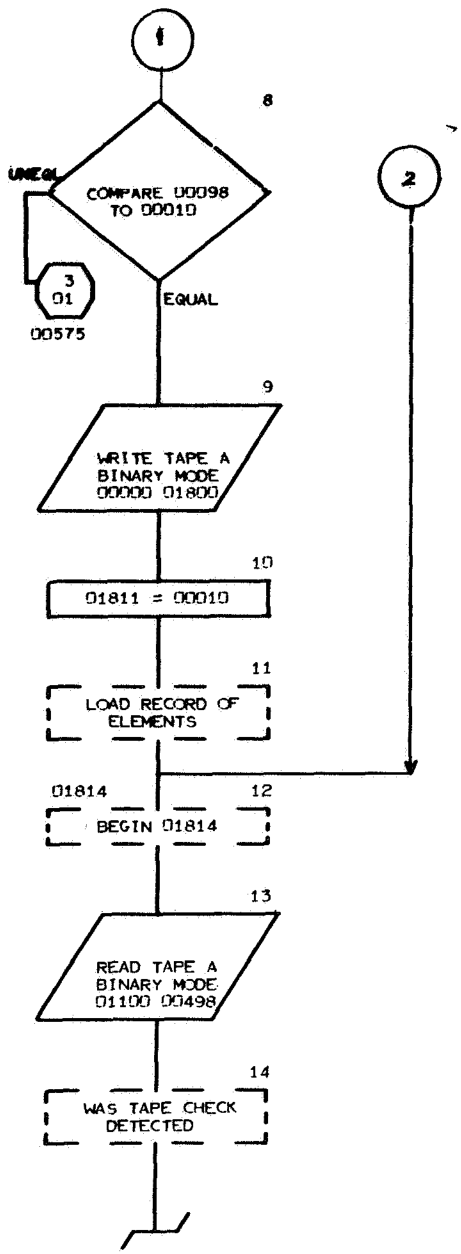

00020
1
BEGIN 00020
2
SWITCH TAPE ASSIGNMENTS
3
142.01
03701
SUBROUTINE
INPUT 00000
RESULT 00000
4
RUN IDENT. L. AND P.
5
154.01
04201
SUBROUTINE
INPUT 00000
RESULT 00040
1
14
00305 = 03849
15
78.01
01941
SUBROUTINE
INPUT 00005
RESULT 00000
16
128.01
03301
SUBROUTINE
INPUT 00295
RESULT 00297
17
00296 = 00295
18
00295 = 00294
19
107.01
02476
SUBROUTINE
INPUT 00000
RESULT 00000
20
WERE THERE TOO MANY REQ. CARDS
21
COMPARE 00191 TO 00010
UNEQL
2
00570
28
BEGIN 00570
3
30
SET NO. OF T (P,Q)"S = 0
01197 = 00010
2.06
00576



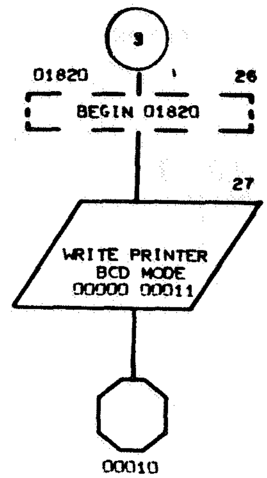
THE EMPTY BOX INDICATES A COMPUTED TRANSFER POINT

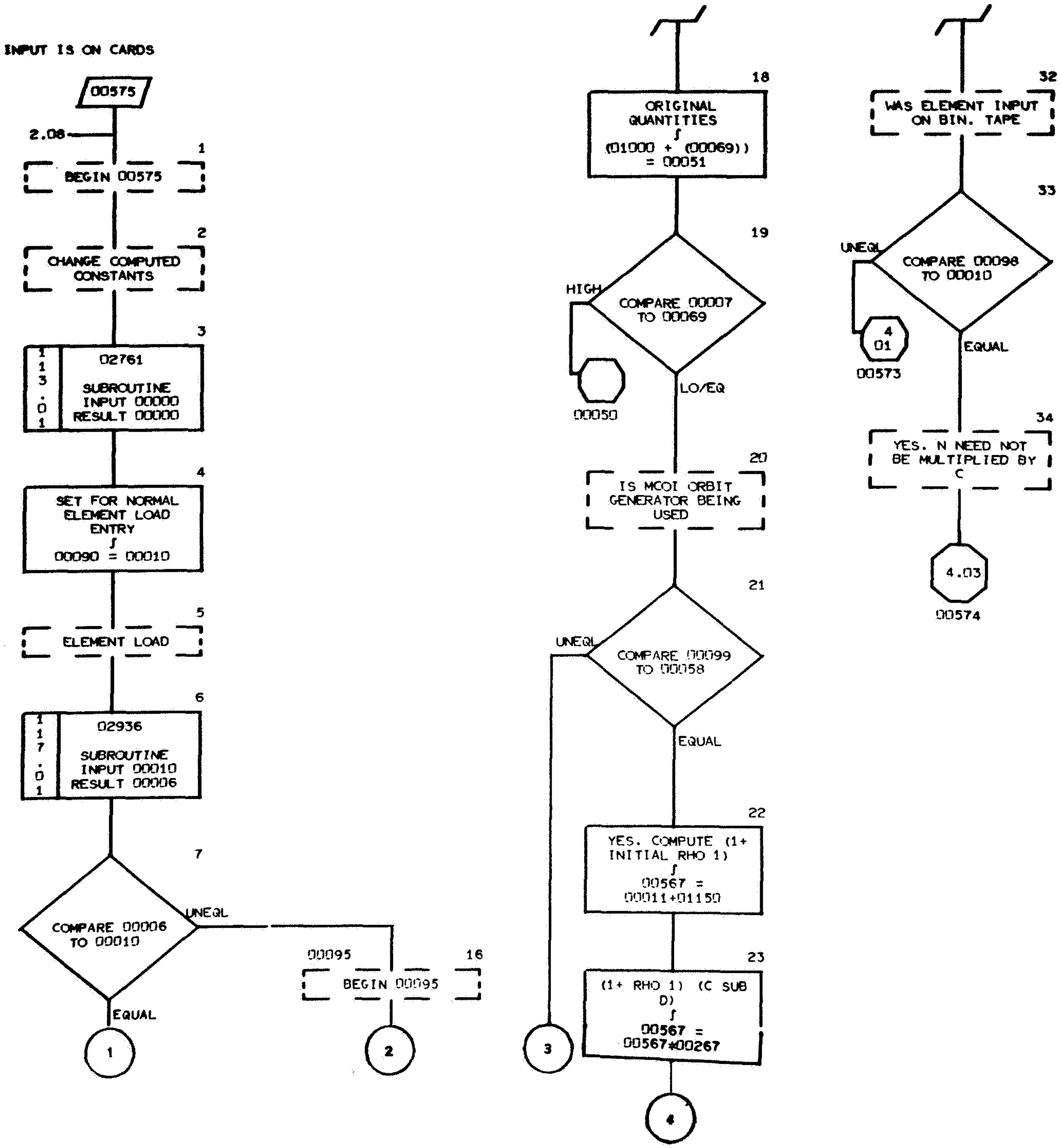


00577
1.25
1
BEGIN 00577
2
LOAD DRAG DATA
3
1 4 9 . 0 1
03901
SUBROUTINE
INPUT 00295
RESULT 01130
4
COMPARE 00006 TO 00010
UNEQL
EQUAL
00010
5
NO. OF T(P,Q)"S
01197 = 00002+00011
1.30
00576
6
BEGIN 00576
7
IS ELEM. INPUT ON BINARY TAPE
1
15
COMPARE 00000 TO 00459
UNEQL
EQUAL
16
YES. ADD TO NO. OF TRIES TO READ
01811 = 01811+00011
17
HAVE ENOUGH TRIES BEEN MADE
18
COMPARE 01811 TO 00460
HIGH
LO/EQ
19
READ TAPE A BINARY MODE 00000 01800
20
TRY AGAIN TO READ RECORD
2
3
01815
21
BEGIN 01815
22
CHANGE COMPUTED CONSTANTS
23
1 1 3 . 0 1
02761
SUBROUTINE
INPUT 00000
RESULT 00000
24
READ CARD BCD MODE 00085 00011
25
READ CARD BCD MODE 00000 00011
3.08
00021

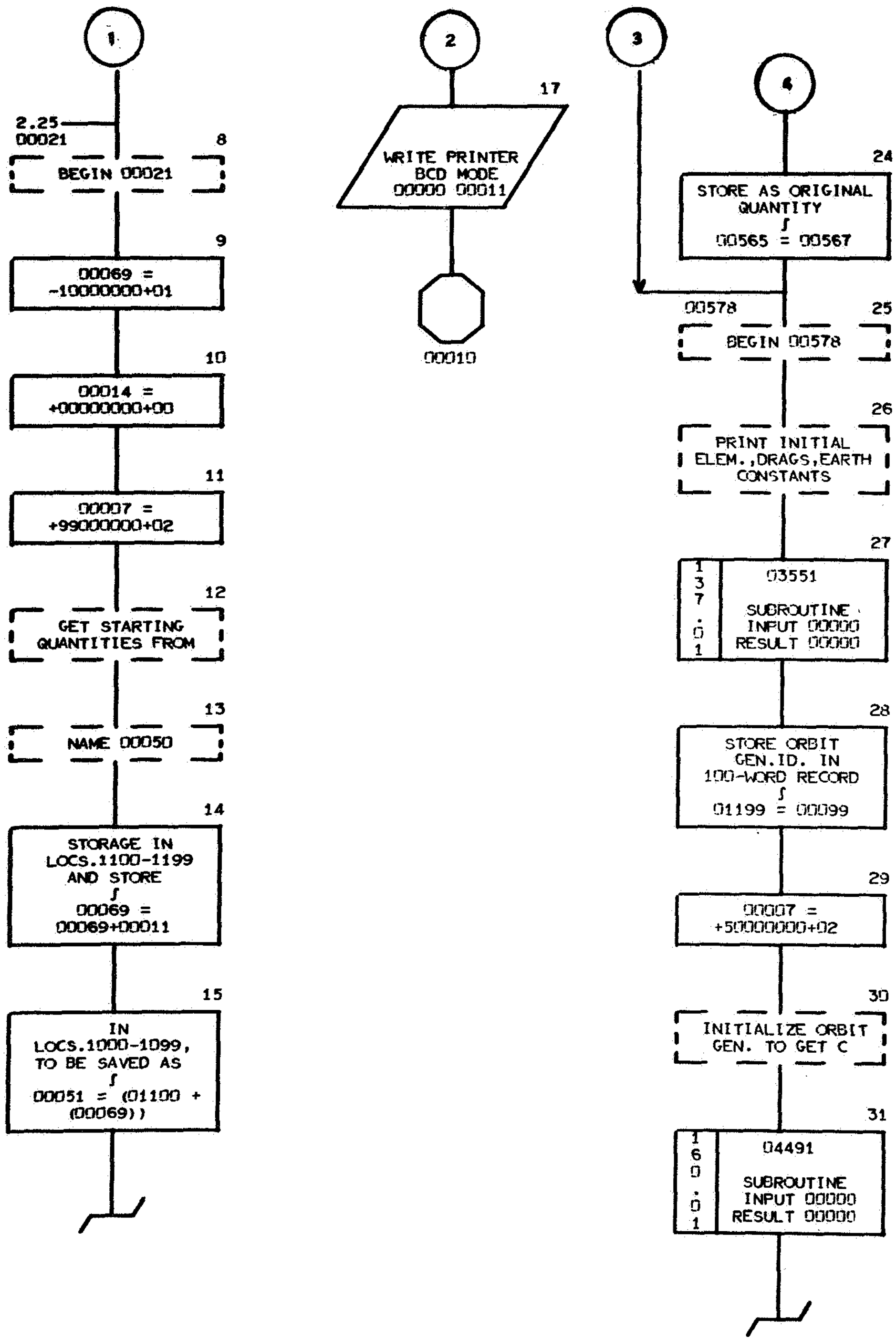


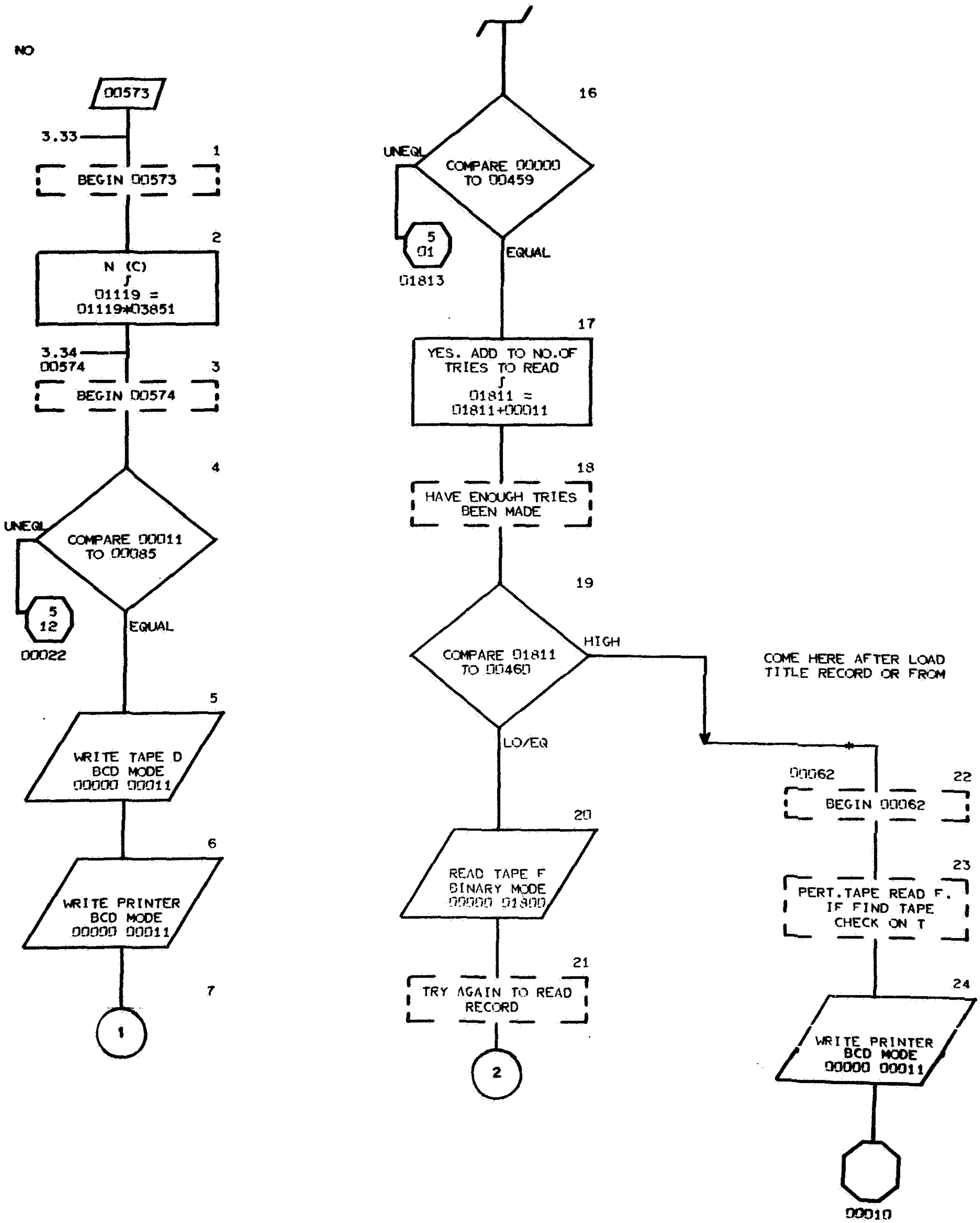
PAGE 2 CONTINUED



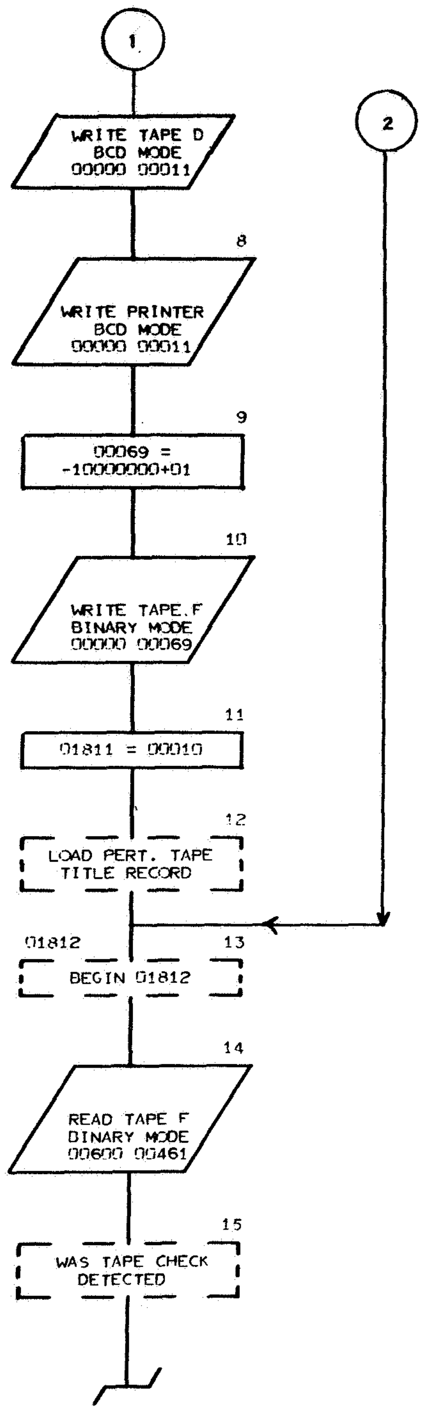

INPUT IS ON CARDS
00575
2.08
1
BEGIN 00575
2
CHANGE COMPUTED CONSTANTS
3
02761
SUBROUTINE
INPUT 00000
RESULT 00000
4
SET FOR NORMAL ELEMENT LOAD ENTRY
00090 = 00010
5
ELEMENT LOAD
6
02936
SUBROUTINE
INPUT 00010
RESULT 00006
7
COMPARE 00006 TO 00010
UNEQL
EQUAL
1
00095
16
BEGIN 00095
2
18
ORIGINAL QUANTITIES
(01000 + (00069)) = 00051
19
COMPARE 00007 TO 00069
HIGH
00050
LO/EQ
20
IS MCOI ORBIT GENERATOR BEING USED
21
COMPARE 00099 TO 00058
UNEQL
EQUAL
22
YES. COMPUTE (1+ INITIAL RHO 1)
00567 = 00011+01150
23
(1+ RHO 1) (C SUB D)
00567 = 00567*00267
3
4
32
WAS ELEMENT INPUT ON BIN. TAPE
33
COMPARE 00098 TO 00010
UNEQL
4
01
00573
EQUAL
34
YES. N NEED NOT BE MULTIPLIED BY C
4.03
00574

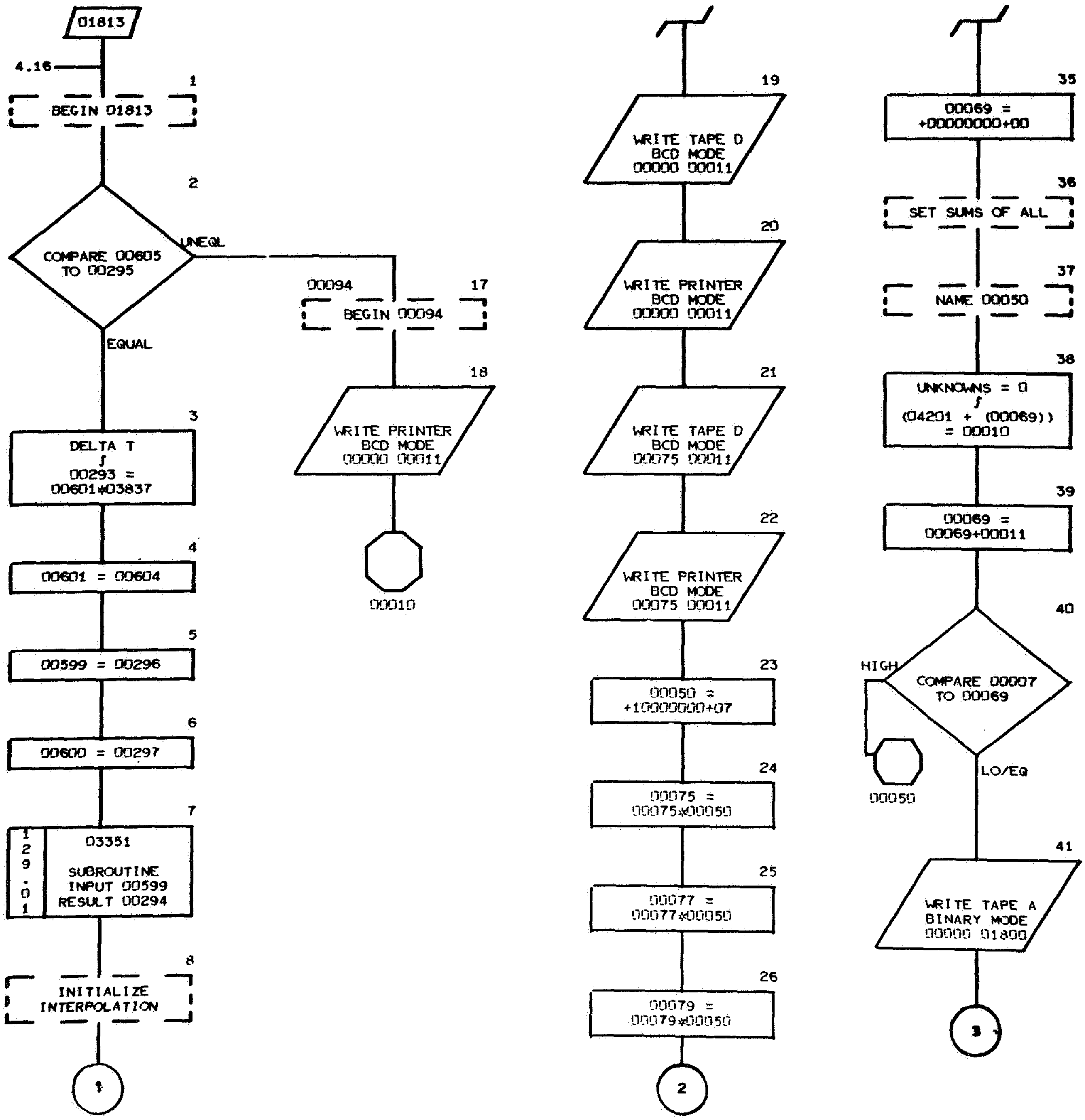
PAGE 3 CONTINUED

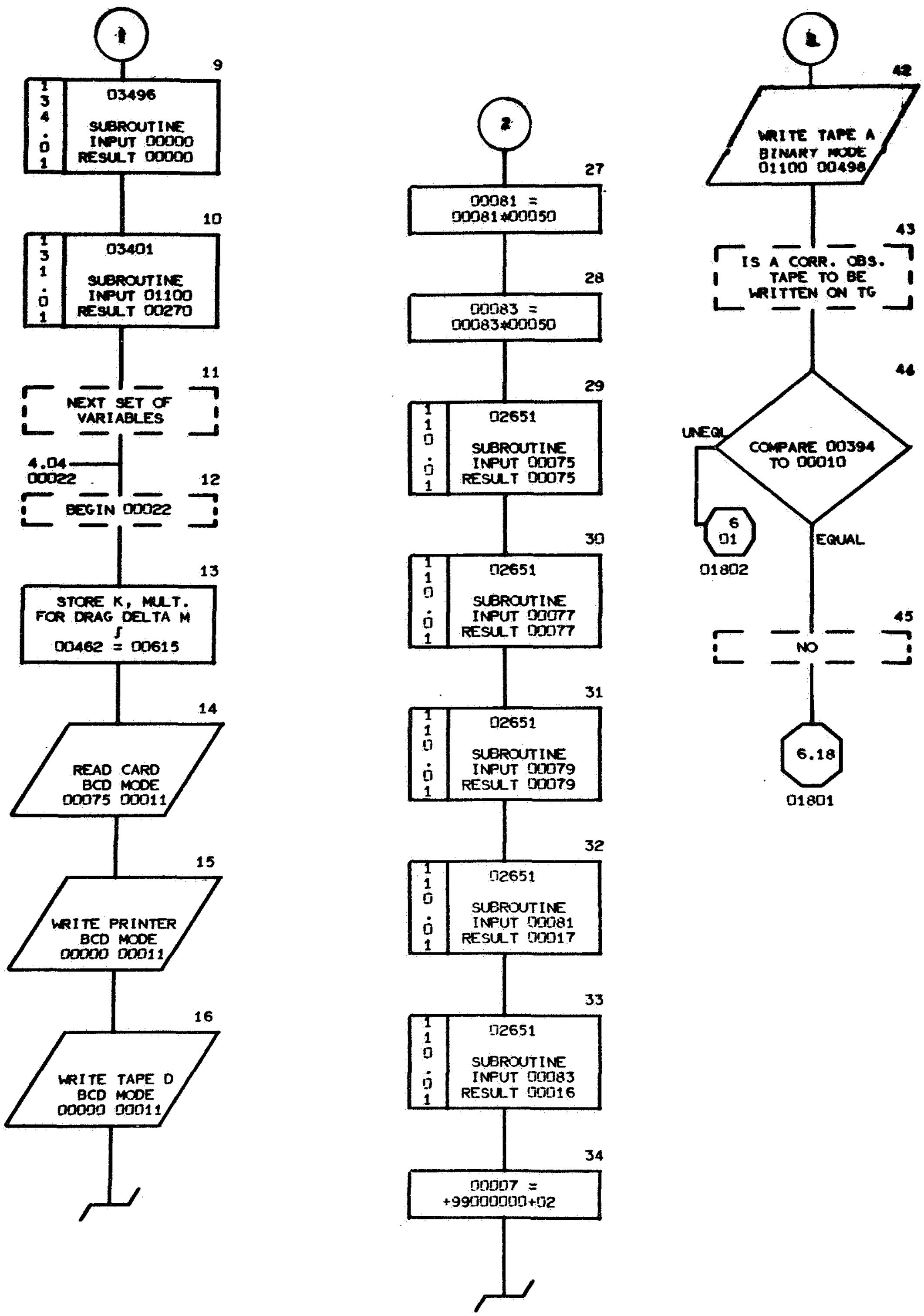


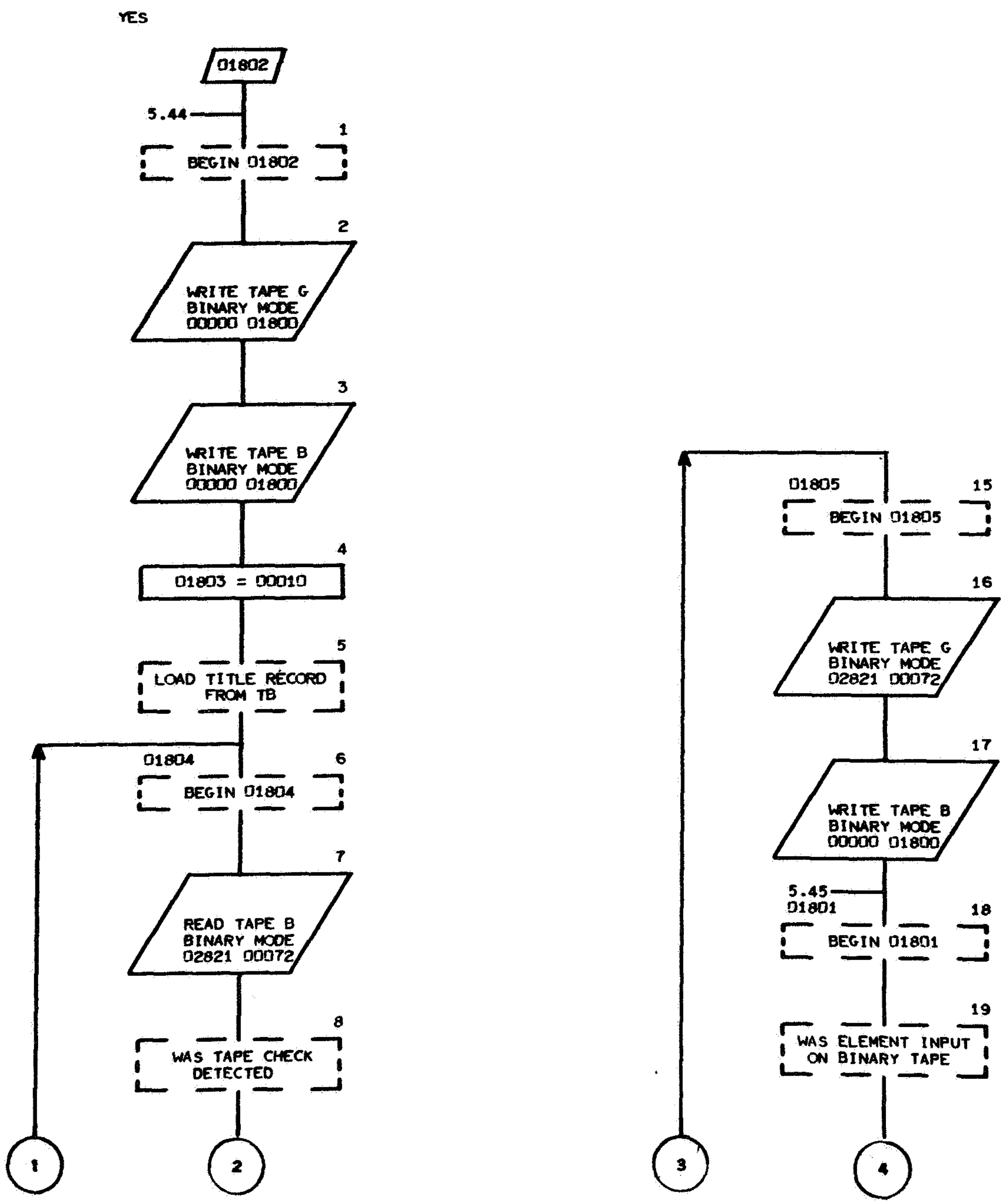

NO
00573
3.33
1
BEGIN 00573
2
N (C)
01119 =
01119+03851
3.34
00574
3
BEGIN 00574
4
UNEQL
COMPARE 00011
TO 00085
5
12
00022
EQUAL
5
WRITE TAPE D
BCD MODE
00000 00011
6
WRITE PRINTER
BCD MODE
00000 00011
7
1
16
UNEQL
COMPARE 00000
TO 00459
5
01
01813
EQUAL
17
YES. ADD TO NO.OF
TRIES TO READ
01811 =
01811+00011
18
HAVE ENOUGH TRIES
BEEN MADE
19
COMPARE 01811
TO 00460
HIGH
LO/EQ
20
READ TAPE F
BINARY MODE
00000 01800
21
TRY AGAIN TO READ
RECORD
2
COME HERE AFTER LOAD
TITLE RECORD OR FROM
00062
22
BEGIN 00062
23
PERT.TAPE READ F.
IF FIND TAPE
CHECK ON T
24
WRITE PRINTER
BCD MODE
00000 00011
00010

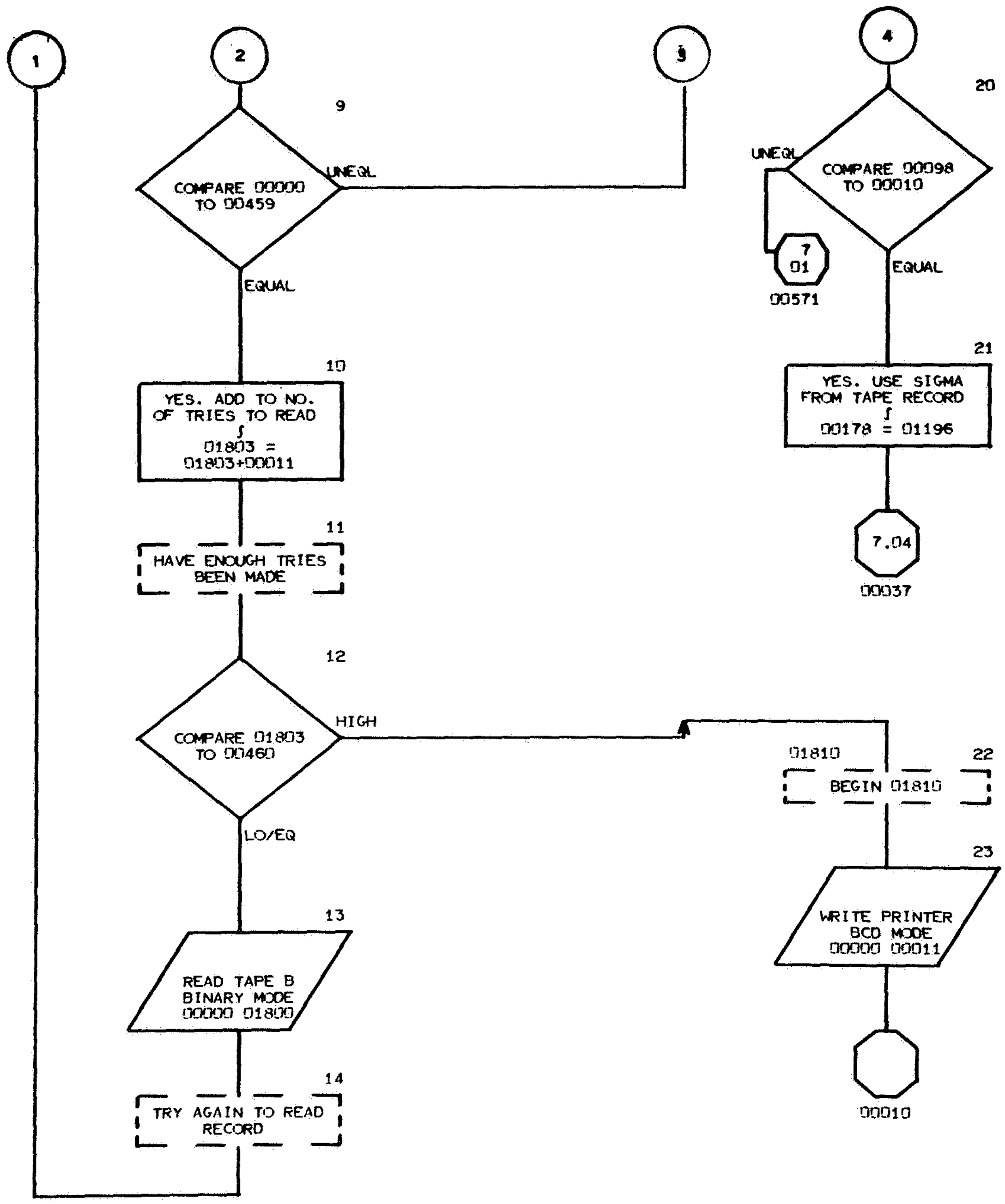
PAGE 4 CONTINUED

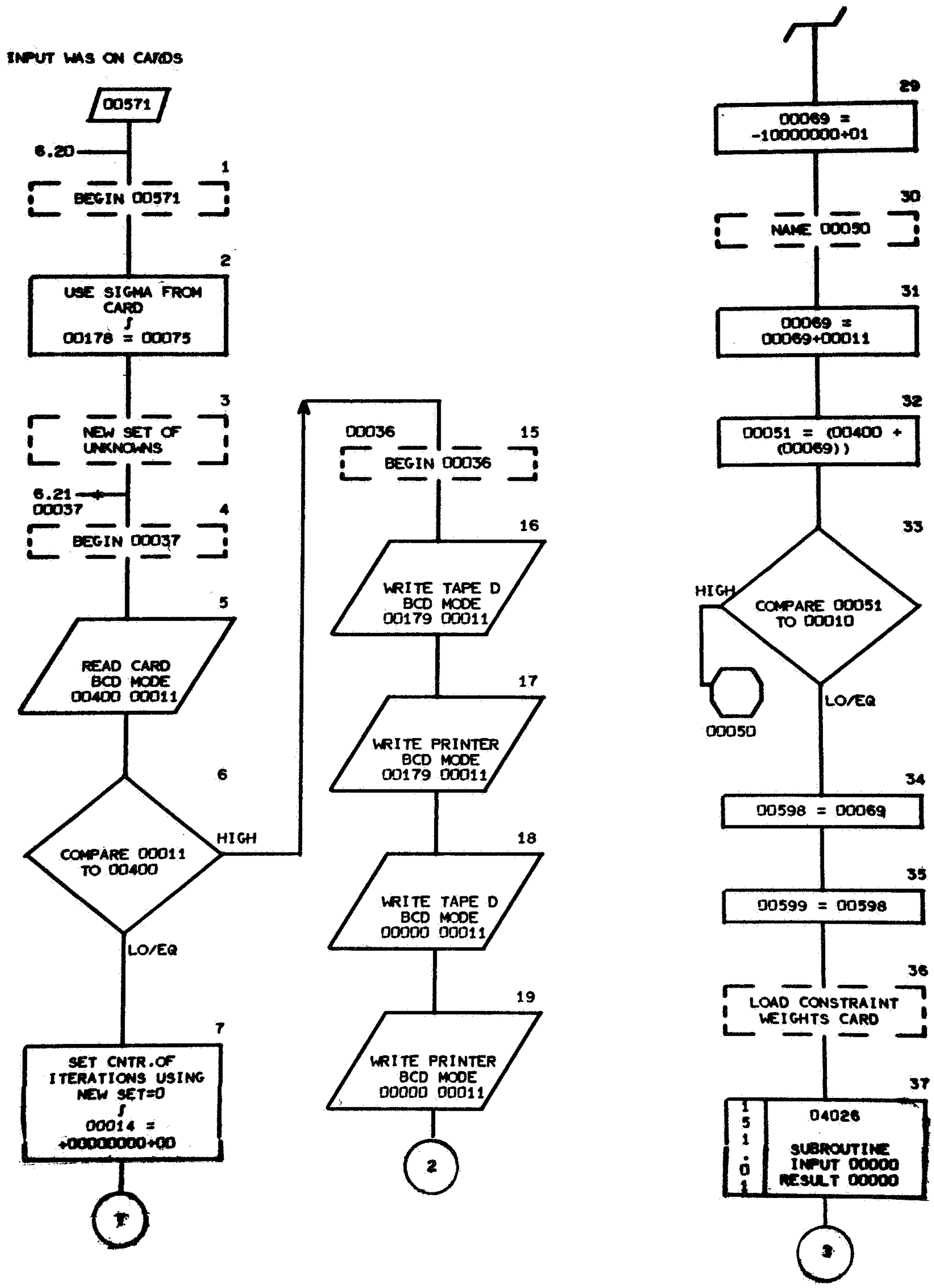



01813
4.16
1
BEGIN 01813
2
COMPARE 00605 TO 00295
UNEQL
EQUAL
3
DELTA T
∫
00293 = 00601*03837
4
00601 = 00604
5
00599 = 00296
6
00600 = 00297
7
1 2 9 . 0 1
03351
SUBROUTINE
INPUT 00599
RESULT 00294
8
INITIALIZE INTERPOLATION
1
00094
17
BEGIN 00094
18
WRITE PRINTER BCD MODE 00000 00011
00010
19
WRITE TAPE D BCD MODE 00000 00011
20
WRITE PRINTER BCD MODE 00000 00011
21
WRITE TAPE D BCD MODE 00075 00011
22
WRITE PRINTER BCD MODE 00075 00011
23
00050 = +10000000+07
24
00075 = 00075*00050
25
00077 = 00077*00050
26
00079 = 00079*00050
2
35
00069 = +00000000+00
36
SET SUMS OF ALL
37
NAME 00050
38
UNKNOWNS = 0
∫
(04201 + (00069)) = 00010
39
00069 = 00069+00011
40
COMPARE 00007 TO 00069
HIGH
00050
LO/EQ
41
WRITE TAPE A BINARY MODE 00000 01800
3

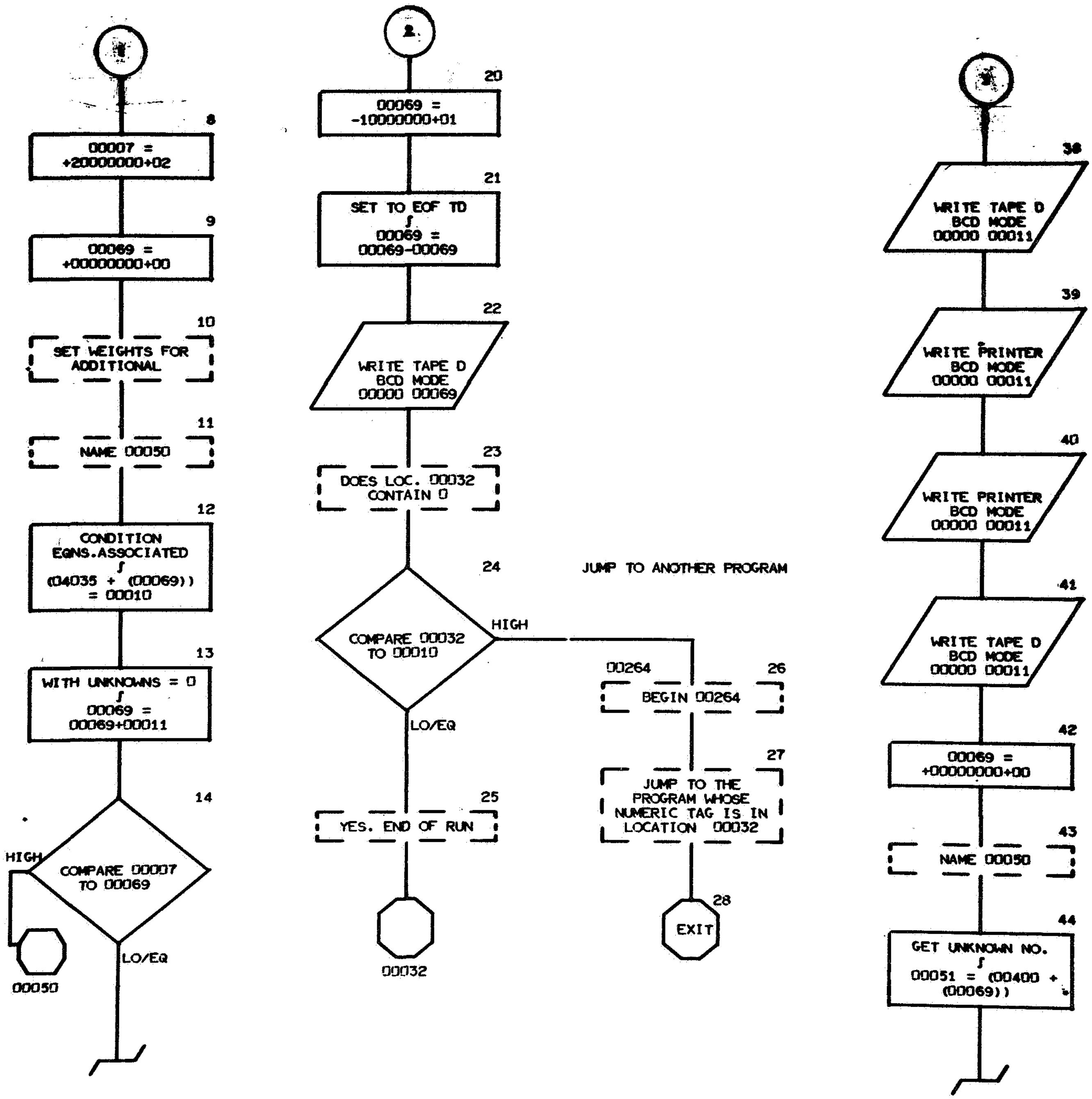

9
1 3 4 . 0 1
03496
SUBROUTINE
INPUT 00000
RESULT 00000
10
1 3 1 . 0 1
03401
SUBROUTINE
INPUT 01100
RESULT 00270
11
NEXT SET OF VARIABLES
4.04
00022
12
BEGIN 00022
13
STORE K, MULT. FOR DRAG DELTA M
00462 = 00615
14
READ CARD
BCD MODE
00075 00011
15
WRITE PRINTER
BCD MODE
00000 00011
16
WRITE TAPE D
BCD MODE
00000 00011
27
00081 =
00081*00050
28
00083 =
00083*00050
29
1 1 0 . 0 1
02651
SUBROUTINE
INPUT 00075
RESULT 00075
30
1 1 0 . 0 1
02651
SUBROUTINE
INPUT 00077
RESULT 00077
31
1 1 0 . 0 1
02651
SUBROUTINE
INPUT 00079
RESULT 00079
32
1 1 0 . 0 1
02651
SUBROUTINE
INPUT 00081
RESULT 00017
33
1 1 0 . 0 1
02651
SUBROUTINE
INPUT 00083
RESULT 00016
34
00007 =
+99000000+02
42
WRITE TAPE A
BINARY MODE
01100 00498
43
IS A CORR. OBS. TAPE TO BE WRITTEN ON TG
44
COMPARE 00394 TO 00010
UNEQL
6
01
01802
EQUAL
45
NO
6.18
01801

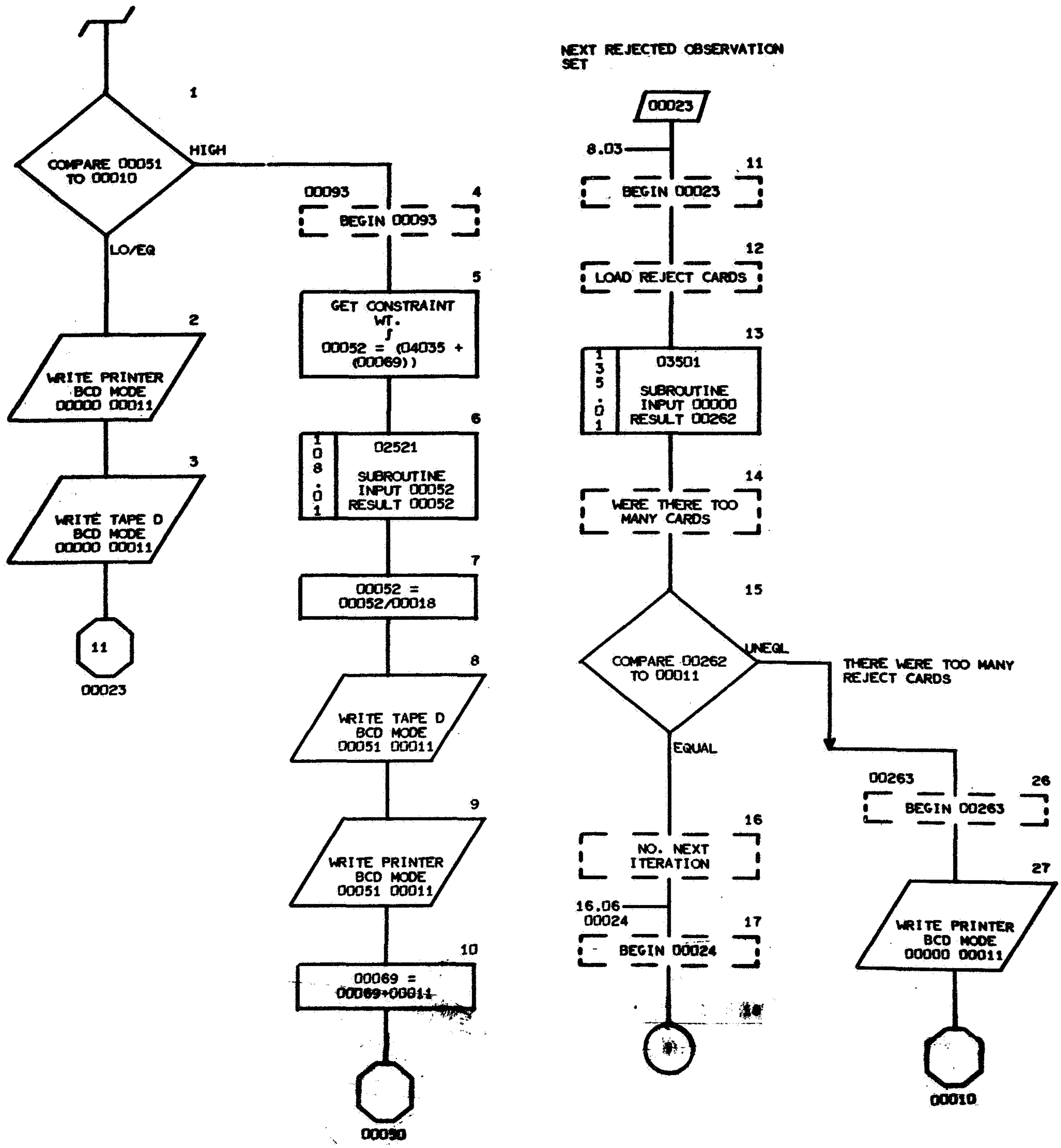

YES
01802
5.44
1
BEGIN 01802
2
WRITE TAPE G
BINARY MODE
00000 01800
3
WRITE TAPE B
BINARY MODE
00000 01800
4
01803 = 00010
5
LOAD TITLE RECORD
FROM TB
01804
6
BEGIN 01804
7
READ TAPE B
BINARY MODE
02821 00072
8
WAS TAPE CHECK
DETECTED
1
2
01805
15
BEGIN 01805
16
WRITE TAPE G
BINARY MODE
02821 00072
17
WRITE TAPE B
BINARY MODE
00000 01800
5.45
01801
18
BEGIN 01801
19
WAS ELEMENT INPUT
ON BINARY TAPE
3
4

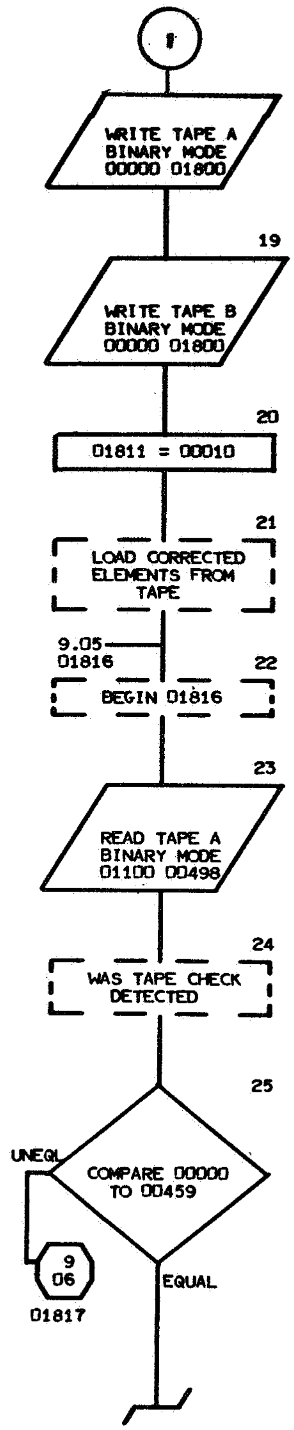

1
2
3
4
9
COMPARE 00000 TO 00459
UNEQL
EQUAL
10
YES. ADD TO NO. OF TRIES TO READ
01803 = 01803+00011
11
HAVE ENOUGH TRIES BEEN MADE
12
COMPARE 01803 TO 00460
HIGH
LO/EQ
13
READ TAPE B BINARY MODE 00000 01800
14
TRY AGAIN TO READ RECORD
20
COMPARE 00098 TO 00010
UNEQL
EQUAL
7 01
00571
21
YES. USE SIGMA FROM TAPE RECORD
00178 = 01196
7.04
00037
01810
22
BEGIN 01810
23
WRITE PRINTER BCD MODE 00000 00011
00010


INPUT WAS ON CARDS
00571
6.20
1
BEGIN 00571
2
USE SIGMA FROM CARD
00178 = 00075
3
NEW SET OF UNKNOWNS
6.21
00037
4
BEGIN 00037
5
READ CARD BCD MODE 00400 00011
6
COMPARE 00011 TO 00400
HIGH
LO/EQ
7
SET CNTR.OF ITERATIONS USING NEW SET=0
00014 = +00000000+00
1
00036
15
BEGIN 00036
16
WRITE TAPE D BCD MODE 00179 00011
17
WRITE PRINTER BCD MODE 00179 00011
18
WRITE TAPE D BCD MODE 00000 00011
19
WRITE PRINTER BCD MODE 00000 00011
2
29
00069 = -10000000+01
30
NAME 00050
31
00069 = 00069+00011
32
00051 = (00400 + (00069))
33
COMPARE 00051 TO 00010
HIGH
00050
LO/EQ
34
00598 = 00069
35
00599 = 00598
36
LOAD CONSTRAINT WEIGHTS CARD
37
1 5 1 . 0 1
04026
SUBROUTINE INPUT 00000 RESULT 00000
3

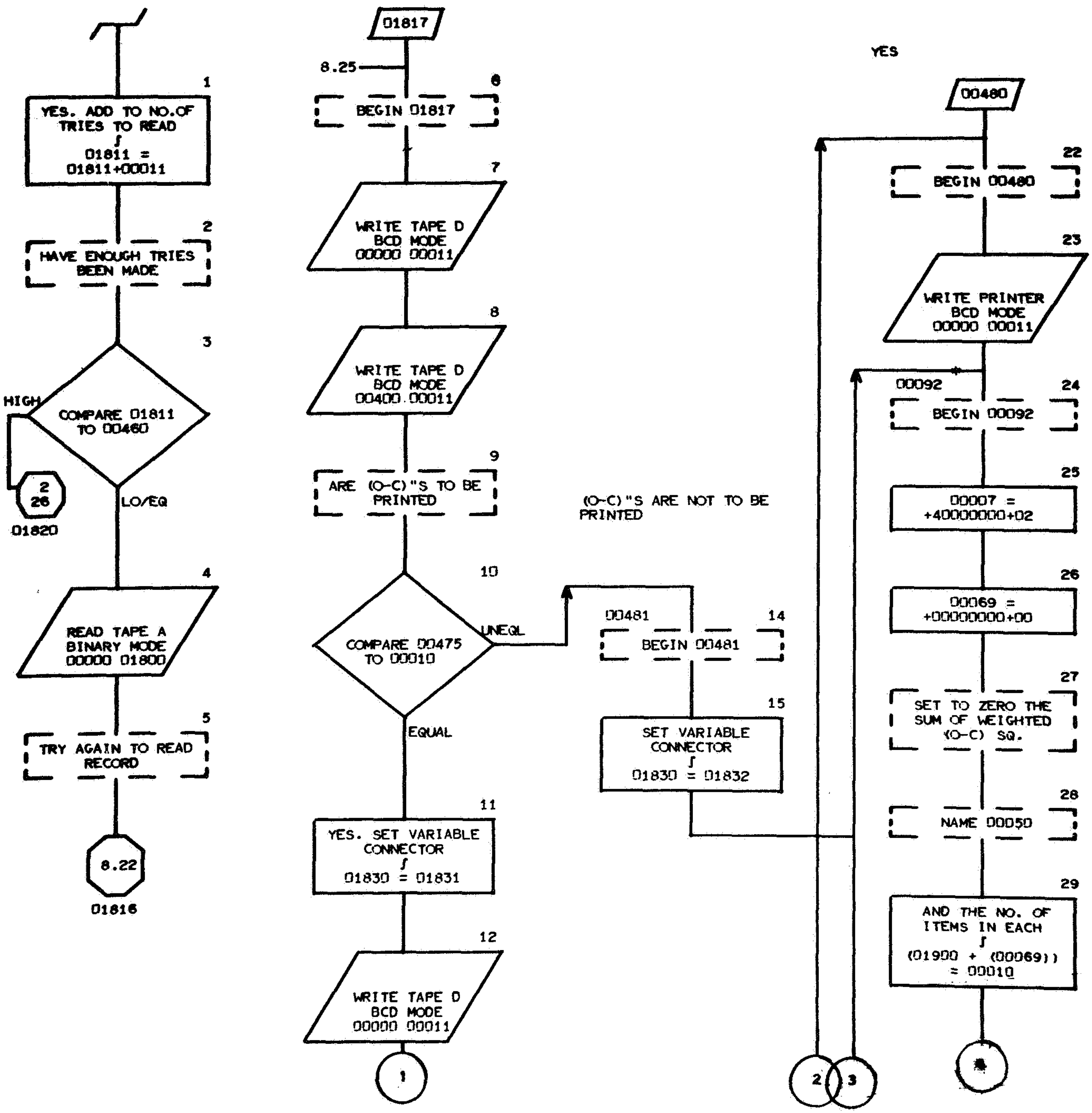
PAGE 7 CONTINUED

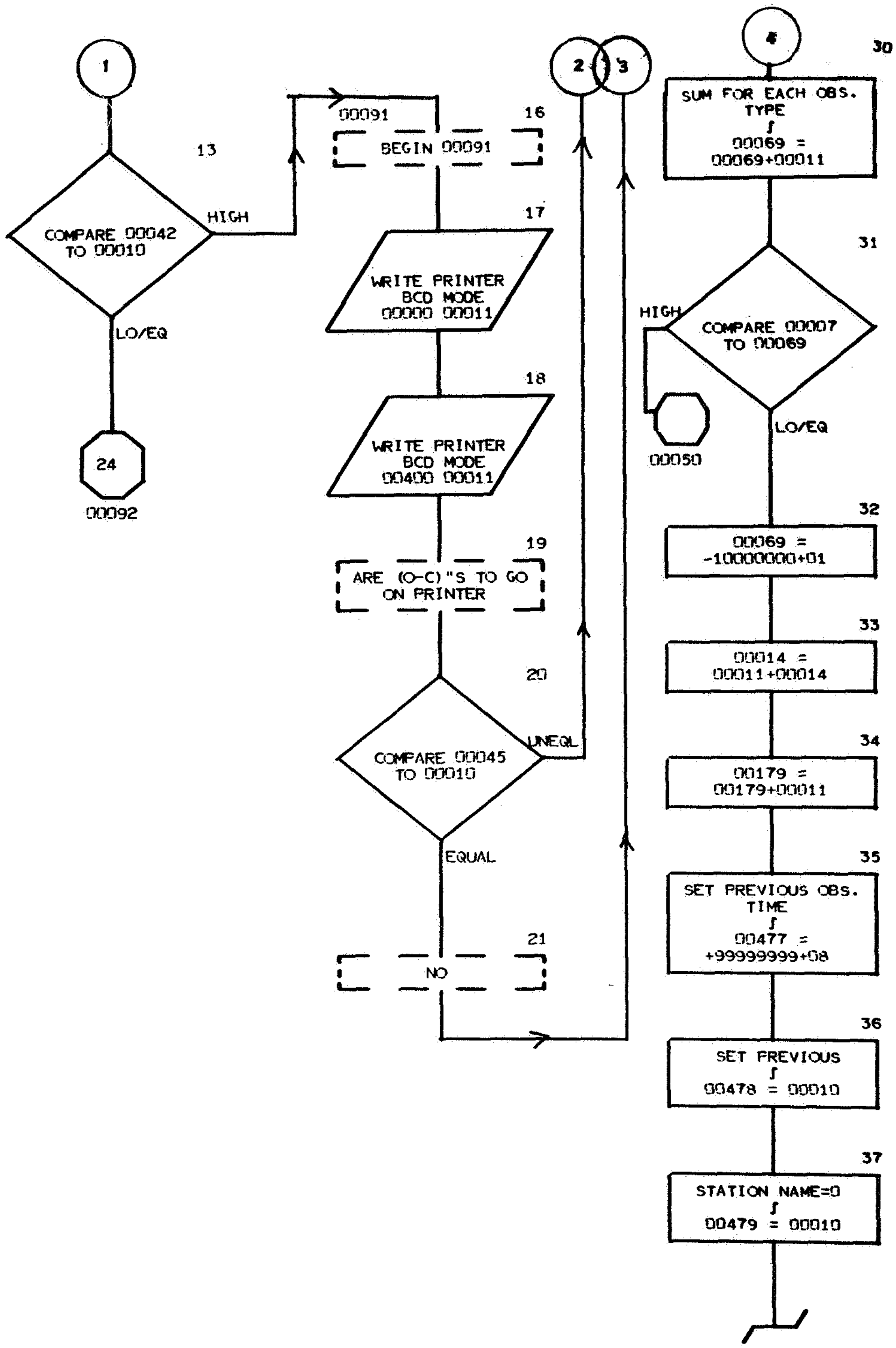


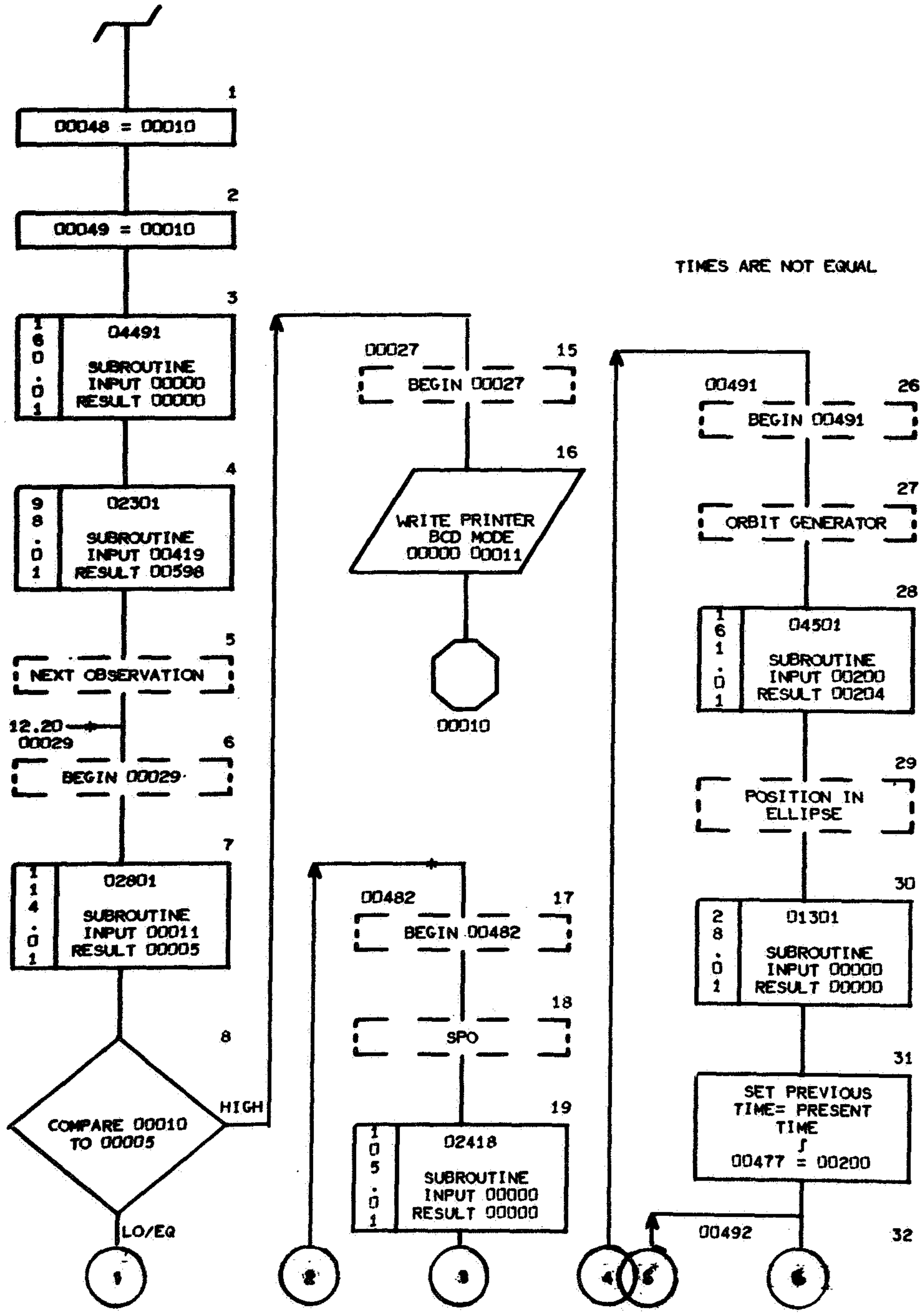

1
COMPARE 00051 TO 00010
HIGH
LO/EQ
2
WRITE PRINTER BCD MODE 00000 00011
3
WRITE TAPE D BCD MODE 00000 00011
11
00023
00093
4
BEGIN 00093
5
GET CONSTRAINT WT.
00052 = (04035 + (00069))
6
108.01
02521
SUBROUTINE INPUT 00052 RESULT 00052
7
00052 = 00052/00018
8
WRITE TAPE D BCD MODE 00051 00011
9
WRITE PRINTER BCD MODE 00051 00011
10
00069 = 00069+00011
00090
NEXT REJECTED OBSERVATION SET
00023
8.03
11
BEGIN 00023
12
LOAD REJECT CARDS
13
135.01
03501
SUBROUTINE INPUT 00000 RESULT 00262
14
WERE THERE TOO MANY CARDS
15
COMPARE 00262 TO 00011
UNEQL
THERE WERE TOO MANY REJECT CARDS
EQUAL
16
NO. NEXT ITERATION
16.06
00024
17
BEGIN 00024
00263
26
BEGIN 00263
27
WRITE PRINTER BCD MODE 00000 00011
00010

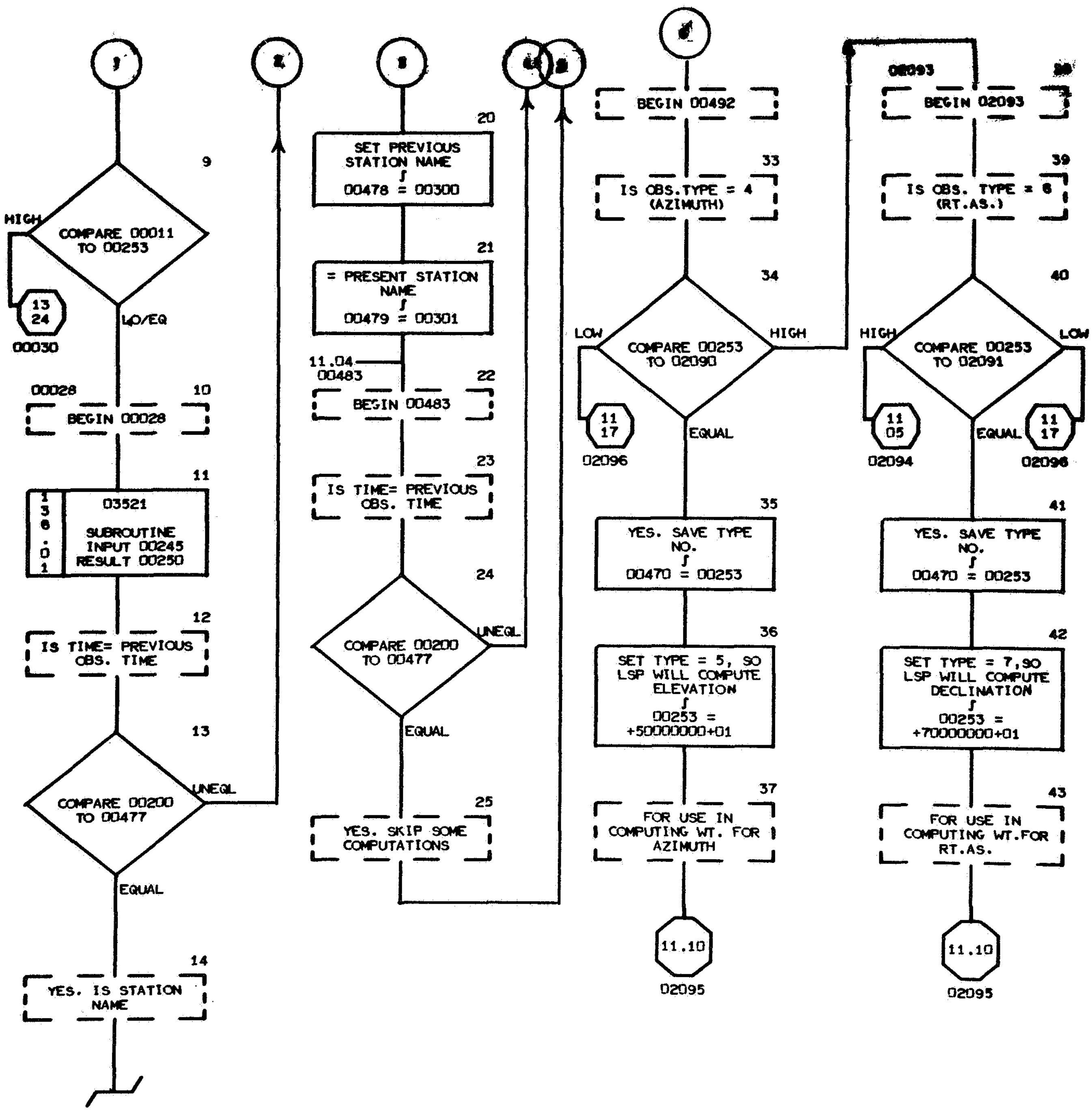


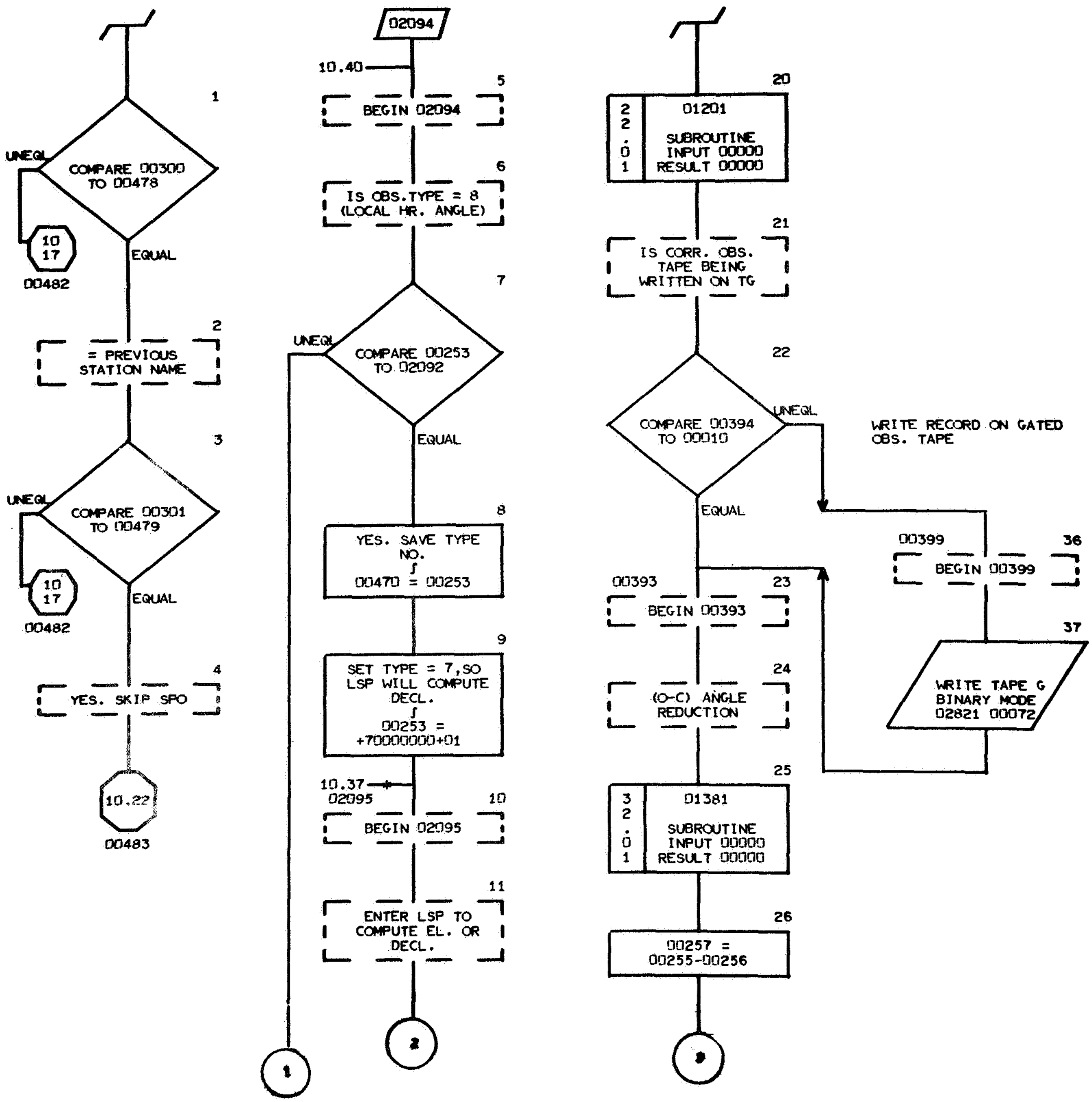
WRITE TAPE A
BINARY MODE
00000 01800
19
WRITE TAPE B
BINARY MODE
00000 01800
20
01811 = 00010
21
LOAD CORRECTED ELEMENTS FROM TAPE
9.05
01816
22
BEGIN 01816
23
READ TAPE A
BINARY MODE
01100 00498
24
WAS TAPE CHECK DETECTED
25
COMPARE 00000 TO 00459
UNEQL
9
06
01817
EQUAL

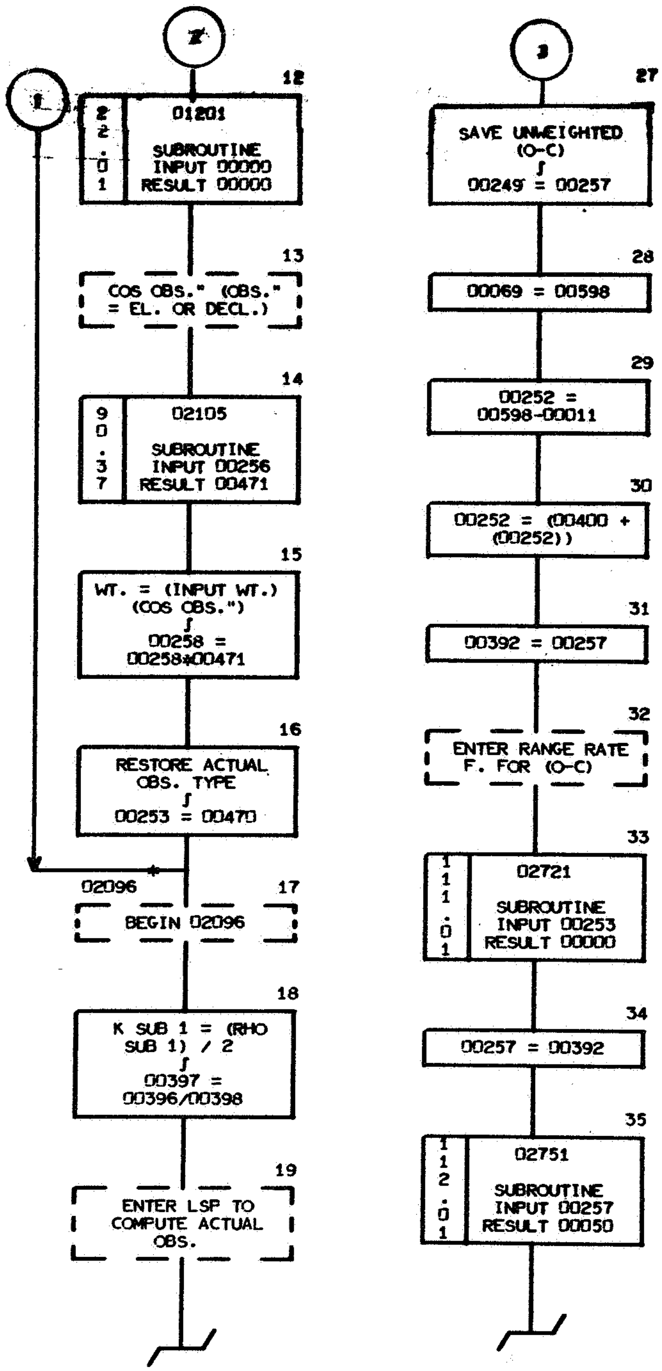

1
YES. ADD TO NO.OF TRIES TO READ
01811 = 01811+00011
2
HAVE ENOUGH TRIES BEEN MADE
3
HIGH
COMPARE 01811 TO 00460
2
26
01820
LO/EQ
4
READ TAPE A BINARY MODE 00000 01800
5
TRY AGAIN TO READ RECORD
8.22
01816
01817
8.25
6
BEGIN 01817
7
WRITE TAPE D BCD MODE 00000 00011
8
WRITE TAPE D BCD MODE 00400 00011
9
ARE (O-C)"S TO BE PRINTED
10
COMPARE 00475 TO 00010
UNEQL
EQUAL
11
YES. SET VARIABLE CONNECTOR
01830 = 01831
12
WRITE TAPE D BCD MODE 00000 00011
1
(O-C)"S ARE NOT TO BE PRINTED
00481
14
BEGIN 00481
15
SET VARIABLE CONNECTOR
01830 = 01832
YES
00480
22
BEGIN 00480
23
WRITE PRINTER BCD MODE 00000 00011
00092
24
BEGIN 00092
25
00007 = +40000000+02
26
00069 = +00000000+00
27
SET TO ZERO THE SUM OF WEIGHTED (O-C) SQ.
28
NAME 00050
29
AND THE NO. OF ITEMS IN EACH
(01900 + (00069)) = 00010
2
3

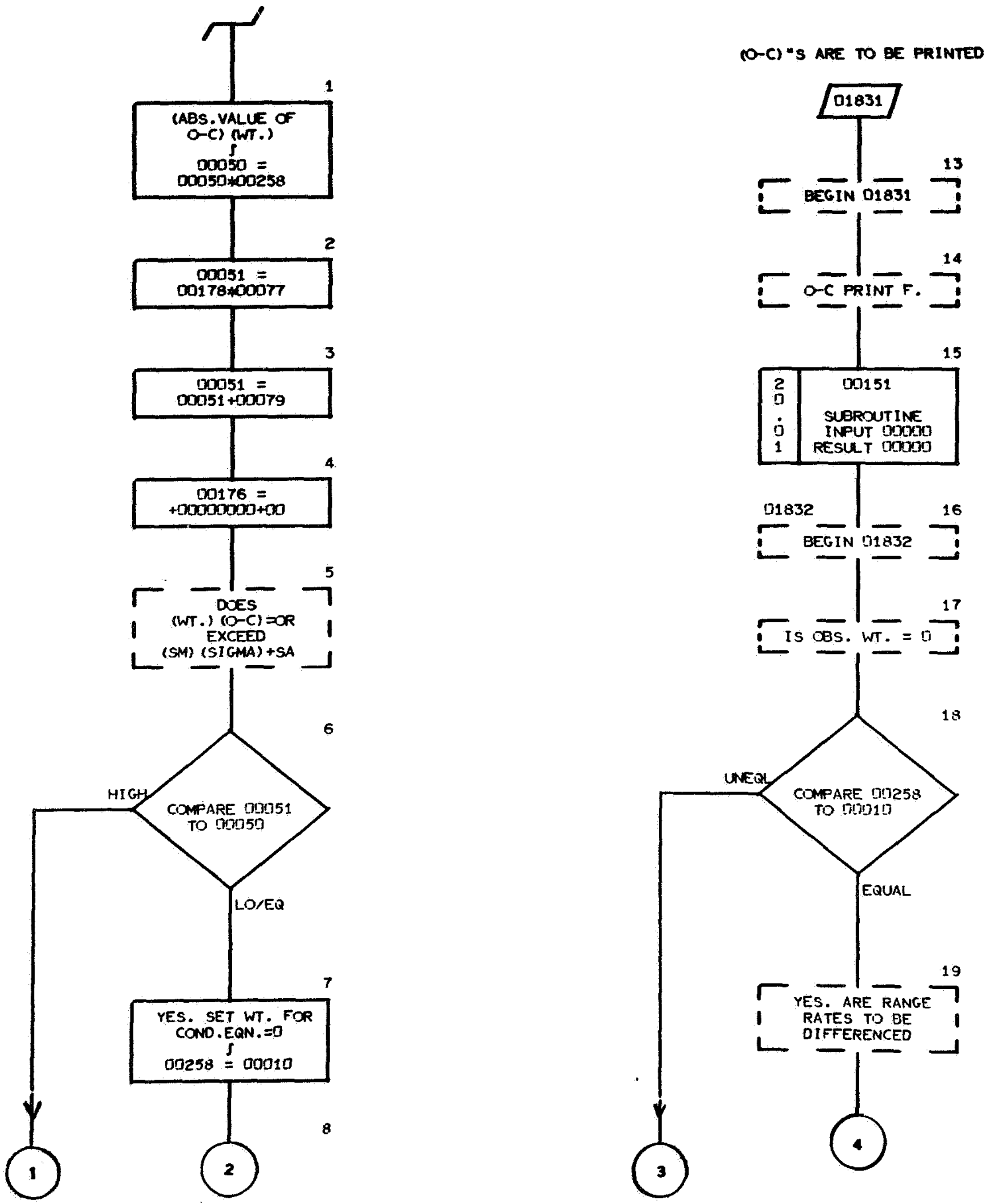

1
13
COMPARE 00042 TO 00010
HIGH
LO/EQ
24
00092
00091
16
BEGIN 00091
17
WRITE PRINTER BCD MODE 00000 00011
18
WRITE PRINTER BCD MODE 00400 00011
19
ARE (O-C)"S TO GO ON PRINTER
20
COMPARE 00045 TO 00010
UNEQL
EQUAL
21
NO
2
3
4
30
SUM FOR EACH OBS. TYPE
00069 = 00069+00011
31
COMPARE 00007 TO 00069
HIGH
00050
LO/EQ
32
00069 = -10000000+01
33
00014 = 00011+00014
34
00179 = 00179+00011
35
SET PREVIOUS OBS. TIME
00477 = +99999999+08
36
SET PREVIOUS
00478 = 00010
37
STATION NAME=0
00479 = 00010

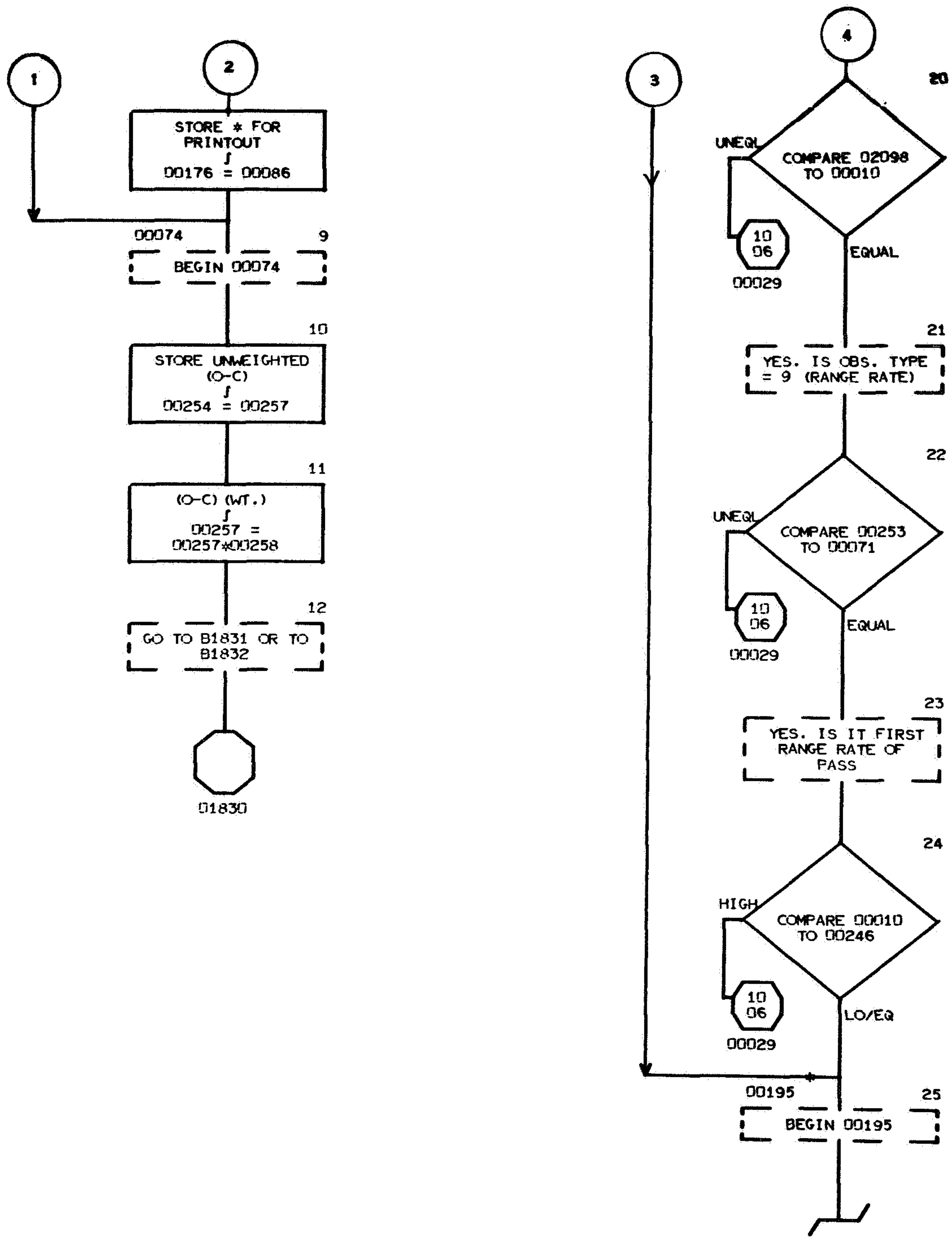

1
00048 = 00010
2
00049 = 00010
3
04491
SUBROUTINE
INPUT 00000
RESULT 00000
4
02301
SUBROUTINE
INPUT 00419
RESULT 00598
5
NEXT OBSERVATION
12.20
00029
6
BEGIN 00029
7
02801
SUBROUTINE
INPUT 00011
RESULT 00005
8
COMPARE 00010
TO 00005
HIGH
LO/EQ
00027
15
BEGIN 00027
16
WRITE PRINTER
BCD MODE
00000 00011
00010
00482
17
BEGIN 00482
18
SPO
19
02418
SUBROUTINE
INPUT 00000
RESULT 00000
TIMES ARE NOT EQUAL
00491
26
BEGIN 00491
27
ORBIT GENERATOR
28
04501
SUBROUTINE
INPUT 00200
RESULT 00204
29
POSITION IN
ELLIPSE
30
01301
SUBROUTINE
INPUT 00000
RESULT 00000
31
SET PREVIOUS
TIME= PRESENT
TIME
00477 = 00200
00492
32


9
COMPARE 00011 TO 00253
HIGH
13 24
00030
LO/EQ
00028
10
BEGIN 00028
11
03521
SUBROUTINE
INPUT 00245
RESULT 00250
12
IS TIME= PREVIOUS OBS. TIME
13
COMPARE 00200 TO 00477
UNEQL
EQUAL
14
YES. IS STATION NAME
20
SET PREVIOUS STATION NAME
00478 = 00300
21
= PRESENT STATION NAME
00479 = 00301
11.04
00483
22
BEGIN 00483
23
IS TIME= PREVIOUS OBS. TIME
24
COMPARE 00200 TO 00477
UNEQL
EQUAL
25
YES. SKIP SOME COMPUTATIONS
BEGIN 00492
33
IS OBS.TYPE = 4 (AZIMUTH)
34
COMPARE 00253 TO 02090
LOW
HIGH
11 17
02096
EQUAL
35
YES. SAVE TYPE NO.
00470 = 00253
36
SET TYPE = 5, SO LSP WILL COMPUTE ELEVATION
00253 = +50000000+01
37
FOR USE IN COMPUTING WT. FOR AZIMUTH
11.10
02095
02093
BEGIN 02093
39
IS OBS. TYPE = 6 (RT.AS.)
40
COMPARE 00253 TO 02091
HIGH
LOW
11 05
02094
EQUAL
11 17
02096
41
YES. SAVE TYPE NO.
00470 = 00253
42
SET TYPE = 7, SO LSP WILL COMPUTE DECLINATION
00253 = +70000000+01
43
FOR USE IN COMPUTING WT. FOR RT.AS.
11.10
02095

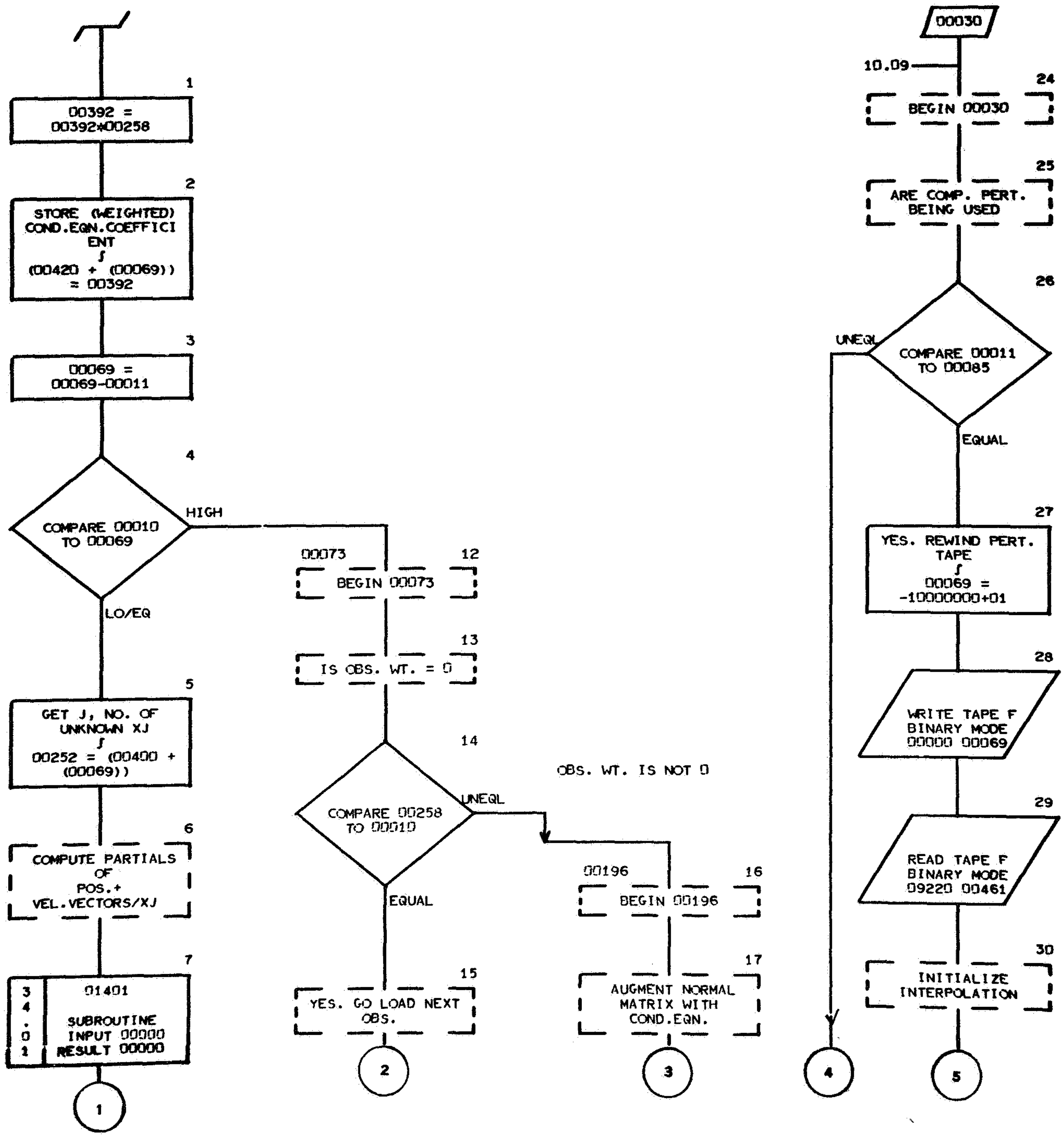

1
COMPARE 00300 TO 00478
UNEQL
EQUAL
10 17
00482
2
= PREVIOUS STATION NAME
3
COMPARE 00301 TO 00479
UNEQL
EQUAL
10 17
00482
4
YES. SKIP SFO
10.22
00483
02094
10.40
5
BEGIN 02094
6
IS OBS.TYPE = 8 (LOCAL HR. ANGLE)
7
COMPARE 00253 TO 02092
UNEQL
EQUAL
8
YES. SAVE TYPE NO.
00470 = 00253
9
SET TYPE = 7,SO LSP WILL COMPUTE DECL.
00253 = +70000000+01
10.37
02095
10
BEGIN 02095
11
ENTER LSP TO COMPUTE EL. OR DECL.
1
2
20
22.01
01201
SUBROUTINE
INPUT 00000
RESULT 00000
21
IS CORR. OBS. TAPE BEING WRITTEN ON TG
22
COMPARE 00394 TO 00010
UNEQL
EQUAL
WRITE RECORD ON GATED OBS. TAPE
00399
36
BEGIN 00399
37
WRITE TAPE G BINARY MODE 02821 00072
00393
23
BEGIN 00393
24
(O-C) ANGLE REDUCTION
25
32.01
01381
SUBROUTINE
INPUT 00000
RESULT 00000
26
00257 = 00255-00256
3

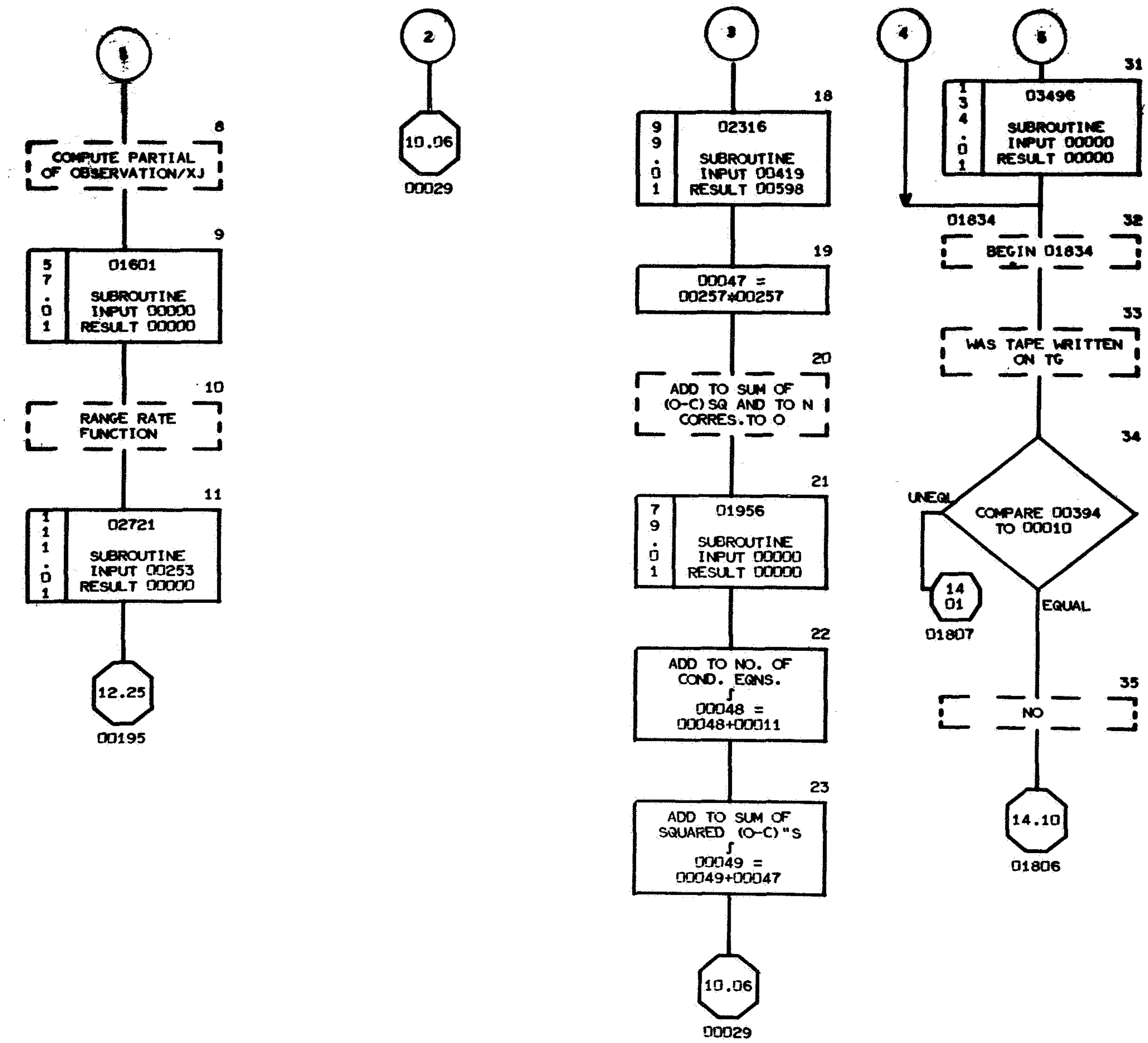

12
2 2 . 0 1
01201
SUBROUTINE
INPUT 00000
RESULT 00000
13
COS OBS." (OBS."
= EL. OR DECL.)
14
9 0 . 3 7
02105
SUBROUTINE
INPUT 00256
RESULT 00471
15
WT. = (INPUT WT.)
(COS OBS.")
00258 =
00258*00471
16
RESTORE ACTUAL
OBS. TYPE
00253 = 00470
02096
17
BEGIN 02096
18
K SUB 1 = (RHO
SUB 1) / 2
00397 =
00396/00398
19
ENTER LSP TO
COMPUTE ACTUAL
OBS.
27
SAVE UNWEIGHTED
(O-C)
00249 = 00257
28
00069 = 00598
29
00252 =
00598-00011
30
00252 = (00400 +
(00252))
31
00392 = 00257
32
ENTER RANGE RATE
F. FOR (O-C)
33
1 1 1 . 0 1
02721
SUBROUTINE
INPUT 00253
RESULT 00000
34
00257 = 00392
35
1 1 2 . 0 1
02751
SUBROUTINE
INPUT 00257
RESULT 00050

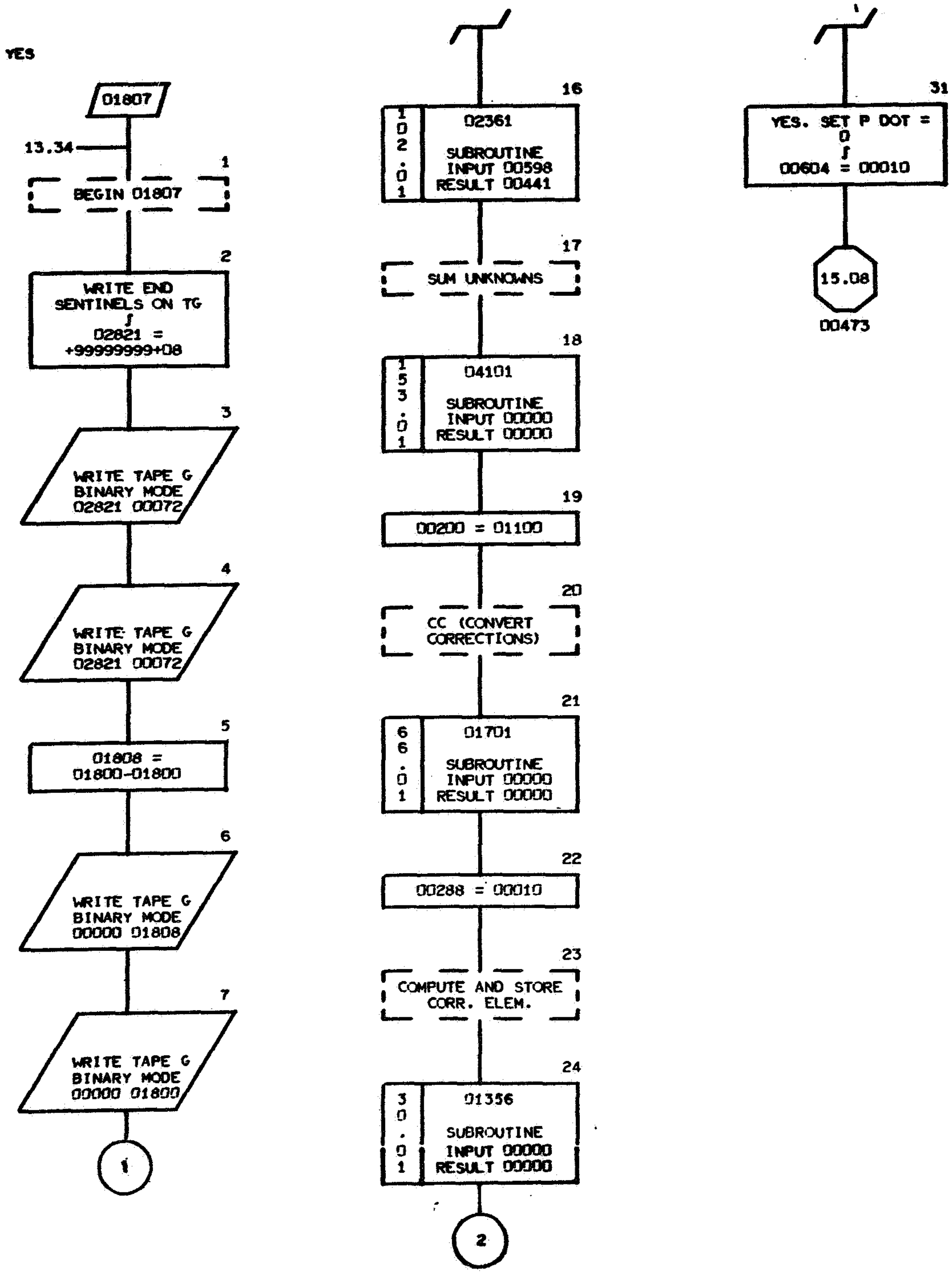

1
(ABS.VALUE OF O-C) (WT.)
00050 = 00050*00258
2
00051 = 00178*00077
3
00051 = 00051+00079
4
00176 = +00000000+00
5
DOES (WT.) (O-C) =OR EXCEED (SM) (SIGMA)+SA
6
COMPARE 00051 TO 00050
HIGH
LO/EQ
7
YES. SET WT. FOR COND.EQN.=0
00258 = 00010
8
1
2
(O-C)'S ARE TO BE PRINTED
01831
13
BEGIN 01831
14
O-C PRINT F.
15
20.01
00151
SUBROUTINE
INPUT 00000
RESULT 00000
01832
16
BEGIN 01832
17
IS OBS. WT. = 0
18
COMPARE 00258 TO 00010
UNEQL
EQUAL
19
YES. ARE RANGE RATES TO BE DIFFERENCED
3
4

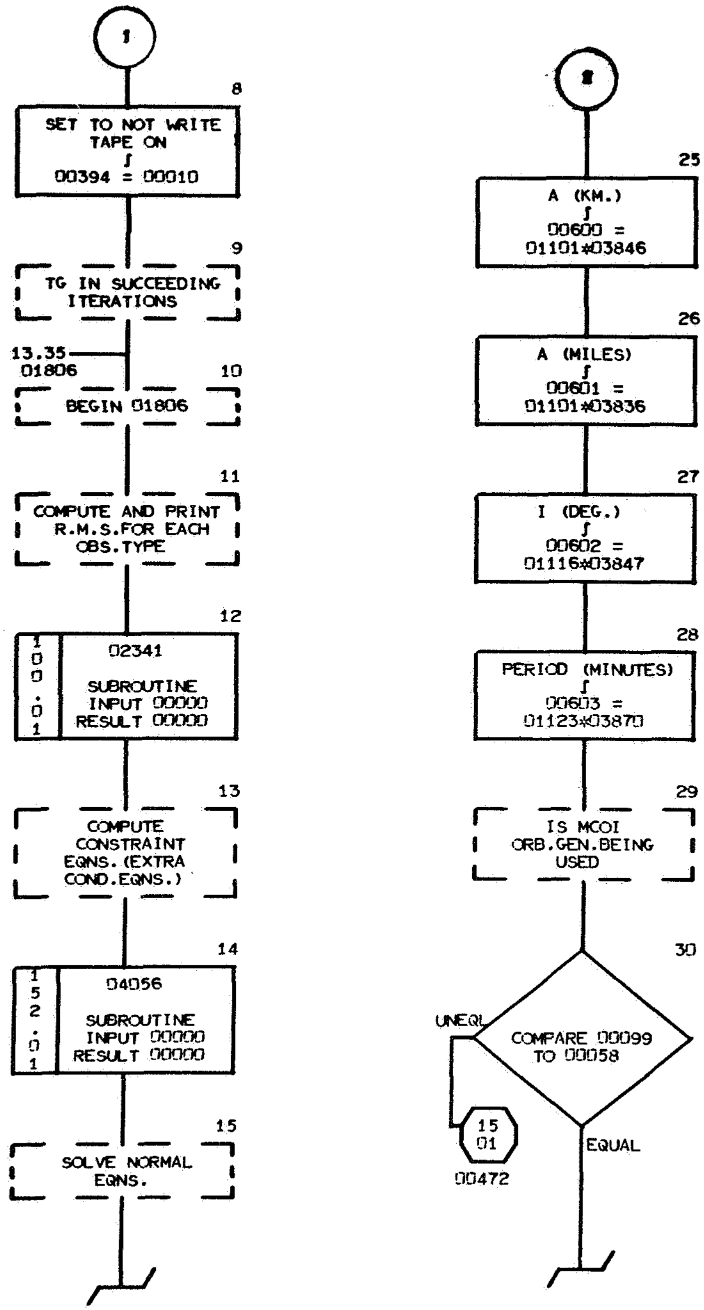


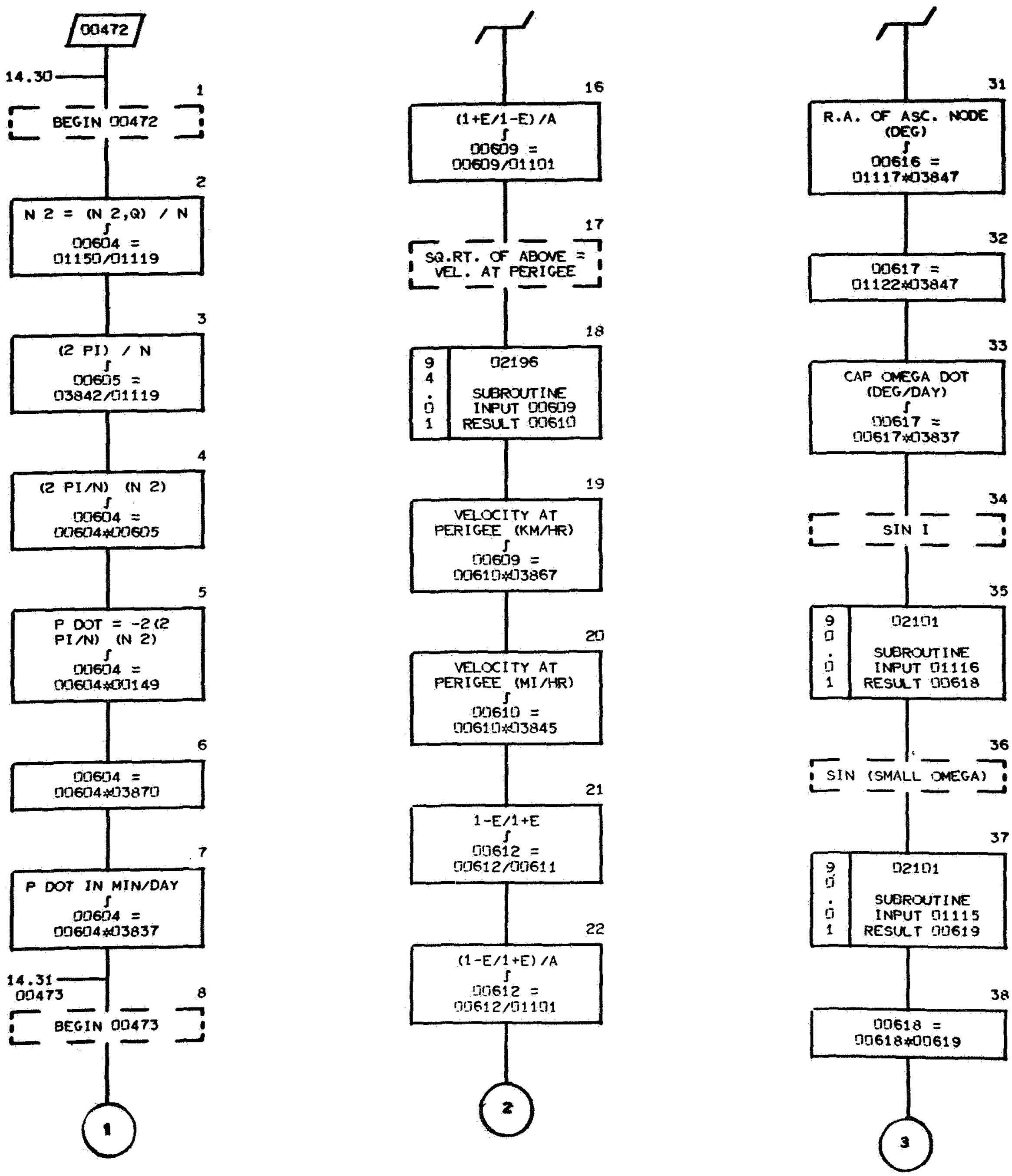
1
2
STORE * FOR PRINTOUT
00176 = 00086
00074
9
BEGIN 00074
10
STORE UNWEIGHTED (O-C)
00254 = 00257
11
(O-C) (WT.)
00257 = 00257*00258
12
GO TO B1831 OR TO B1832
01830
3
4
20
UNEQL
COMPARE 02098 TO 00010
10 06
00029
EQUAL
21
YES. IS OBS. TYPE = 9 (RANGE RATE)
22
UNEQL
COMPARE 00253 TO 00071
10 06
00029
EQUAL
23
YES. IS IT FIRST RANGE RATE OF PASS
24
HIGH
COMPARE 00010 TO 00246
10 06
00029
LO/EQ
00195
25
BEGIN 00195

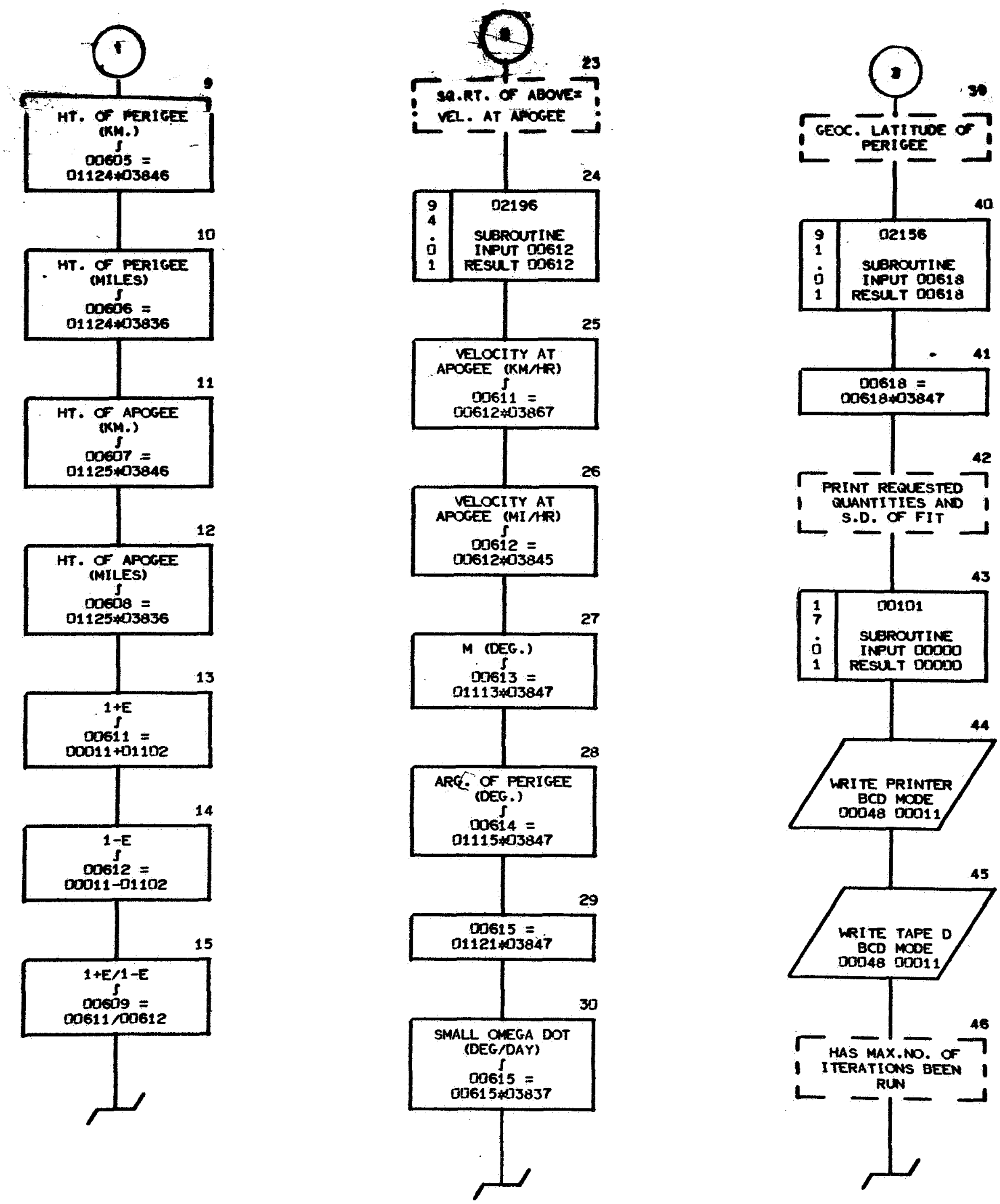

00030
10.09
24
BEGIN 00030
25
ARE COMP. PERT. BEING USED
26
COMPARE 00011 TO 00085
UNEQL
EQUAL
27
YES. REWIND PERT. TAPE
00069 = -10000000+01
28
WRITE TAPE F BINARY MODE 00000 00069
29
READ TAPE F BINARY MODE 09220 00461
30
INITIALIZE INTERPOLATION
1
00392 = 00392*00258
2
STORE (WEIGHTED) COND.EQN.COEFFICI ENT
(00420 + (00069)) = 00392
3
00069 = 00069-00011
4
COMPARE 00010 TO 00069
HIGH
LO/EQ
5
GET J, NO. OF UNKNOWN XJ
00252 = (00400 + (00069))
6
COMPUTE PARTIALS OF POS.+ VEL.VECTORS/XJ
7
3 4 . 0 1
01401
SUBROUTINE INPUT 00000 RESULT 00000
00073
12
BEGIN 00073
13
IS OBS. WT. = 0
14
COMPARE 00258 TO 00010
UNEQL
EQUAL
OBS. WT. IS NOT 0
15
YES. GO LOAD NEXT OBS.
00196
16
BEGIN 00196
17
AUGMENT NORMAL MATRIX WITH COND.EQN.
1
2
3
4
5

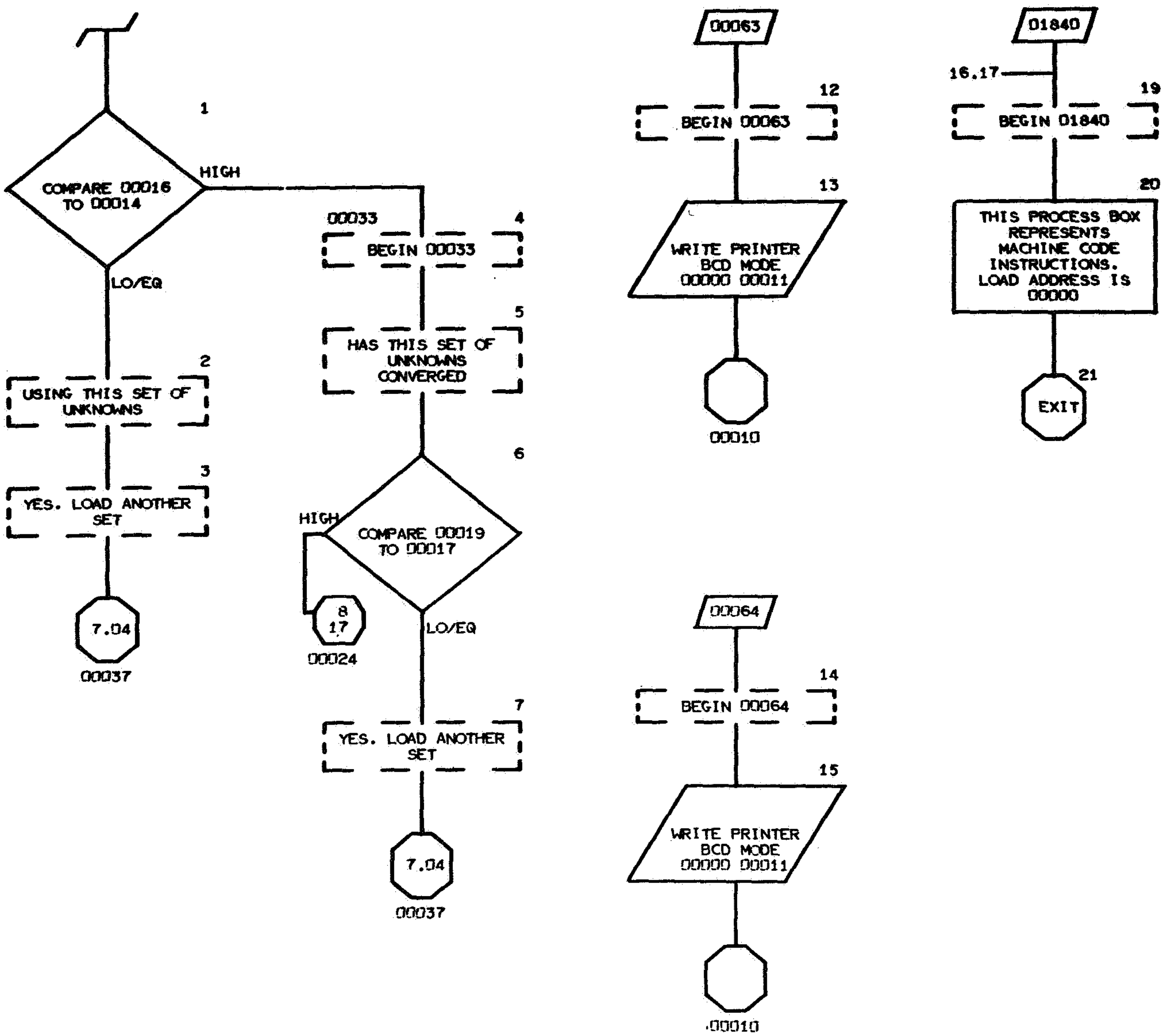

1
8
COMPUTE PARTIAL OF OBSERVATION/XJ
9
57.01
01601
SUBROUTINE
INPUT 00000
RESULT 00000
10
RANGE RATE FUNCTION
11
111.01
02721
SUBROUTINE
INPUT 00253
RESULT 00000
12.25
00195
2
10.06
00029
3
18
99.01
02316
SUBROUTINE
INPUT 00419
RESULT 00598
19
00047 =
00257*00257
20
ADD TO SUM OF (O-C) SQ AND TO N CORRES. TO O
21
79.01
01956
SUBROUTINE
INPUT 00000
RESULT 00000
22
ADD TO NO. OF COND. EQNS.
00048 =
00048+00011
23
ADD TO SUM OF SQUARED (O-C)"S
00049 =
00049+00047
10.06
00029
4
5
31
134.01
03496
SUBROUTINE
INPUT 00000
RESULT 00000
01834
32
BEGIN 01834
33
WAS TAPE WRITTEN ON TG
34
COMPARE 00394 TO 00010
UNEQL
14 01
01807
EQUAL
35
NO
14.10
01806

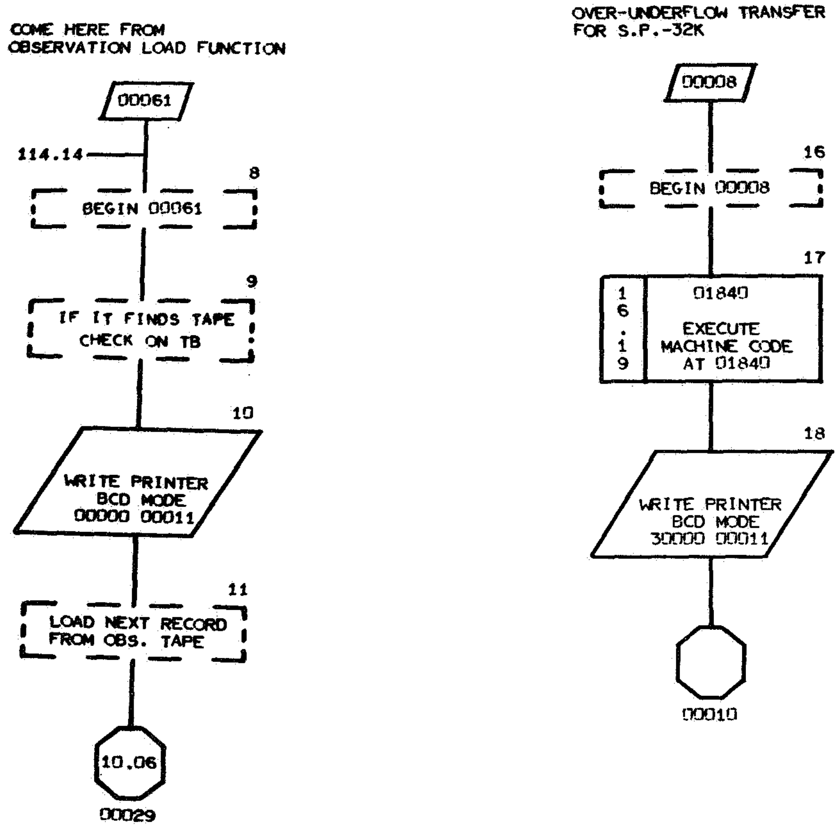

YES
01807
13.34
1
BEGIN 01807
2
WRITE END SENTINELS ON TG
02821 =
+99999999+08
3
WRITE TAPE G BINARY MODE 02821 00072
4
WRITE TAPE G BINARY MODE 02821 00072
5
01808 =
01800-01800
6
WRITE TAPE G BINARY MODE 00000 01808
7
WRITE TAPE G BINARY MODE 00000 01800
1
16
102.01
02361
SUBROUTINE
INPUT 00598
RESULT 00441
17
SUM UNKNOWNS
18
153.01
04101
SUBROUTINE
INPUT 00000
RESULT 00000
19
00200 = 01100
20
CC (CONVERT CORRECTIONS)
21
66.01
01701
SUBROUTINE
INPUT 00000
RESULT 00000
22
00288 = 00010
23
COMPUTE AND STORE CORR. ELEM.
24
30.01
01356
SUBROUTINE
INPUT 00000
RESULT 00000
2
31
YES. SET P DOT =
0
00604 = 00010
15.08
00473


1
8
SET TO NOT WRITE TAPE ON
00394 = 00010
9
TG IN SUCCEEDING ITERATIONS
13.35
01806
10
BEGIN 01806
11
COMPUTE AND PRINT R.M.S.FOR EACH OBS.TYPE
12
100.01
02341
SUBROUTINE
INPUT 00000
RESULT 00000
13
COMPUTE CONSTRAINT EQNS. (EXTRA COND.EQNS.)
14
152.01
04056
SUBROUTINE
INPUT 00000
RESULT 00000
15
SOLVE NORMAL EQNS.
2
25
A (KM.)
00600 =
01101*03846
26
A (MILES)
00601 =
01101*03836
27
I (DEG.)
00602 =
01116*03847
28
PERIOD (MINUTES)
00603 =
01123*03870
29
IS MCOI ORB.GEN.BEING USED
30
COMPARE 00099 TO 00058
UNEQL
15
01
00472
EQUAL


00472
14.30
1 BEGIN 00472
2 N 2 = (N 2,Q) / N
00604 =
01150/01119
3 (2 PI) / N
00605 =
03842/01119
4 (2 PI/N) (N 2)
00604 =
00604*00605
5 P DOT = -2(2 PI/N) (N 2)
00604 =
00604*00149
6 00604 =
00604*03870
7 P DOT IN MIN/DAY
00604 =
00604*03837
14.31
00473
8 BEGIN 00473
1
16 (1+E/1-E)/A
00609 =
00609/01101
17 SQ.RT. OF ABOVE = VEL. AT PERIGEE
18 94.01
02196
SUBROUTINE
INPUT 00609
RESULT 00610
19 VELOCITY AT PERIGEE (KM/HR)
00609 =
00610*03867
20 VELOCITY AT PERIGEE (MI/HR)
00610 =
00610*03845
21 1-E/1+E
00612 =
00612/00611
22 (1-E/1+E)/A
00612 =
00612/01101
2
31 R.A. OF ASC. NODE (DEG)
00616 =
01117*03847
32 00617 =
01122*03847
33 CAP OMEGA DOT (DEG/DAY)
00617 =
00617*03837
34 SIN I
35 90.01
02101
SUBROUTINE
INPUT 01116
RESULT 00618
36 SIN (SMALL OMEGA)
37 90.01
02101
SUBROUTINE
INPUT 01115
RESULT 00619
38 00618 =
00618*00619
3


9
HT. OF PERIGEE (KM.)
ʃ
00605 = 01124*03846
10
HT. OF PERIGEE (MILES)
ʃ
00606 = 01124*03836
11
HT. OF APOGEE (KM.)
ʃ
00607 = 01125*03846
12
HT. OF APOGEE (MILES)
ʃ
00608 = 01125*03836
13
1+E
ʃ
00611 = 00011+01102
14
1-E
ʃ
00612 = 00011-01102
15
1+E/1-E
ʃ
00609 = 00611/00612
23
SQ.RT. OF ABOVE= VEL. AT APOGEE
24
9 4 . 0 1
02196
SUBROUTINE
INPUT 00612
RESULT 00612
25
VELOCITY AT APOGEE (KM/HR)
ʃ
00611 = 00612*03867
26
VELOCITY AT APOGEE (MI/HR)
ʃ
00612 = 00612*03845
27
M (DEG.)
ʃ
00613 = 01113*03847
28
ARG. OF PERIGEE (DEG.)
ʃ
00614 = 01115*03847
29
00615 = 01121*03847
30
SMALL OMEGA DOT (DEG/DAY)
ʃ
00615 = 00615*03837
39
GEOC. LATITUDE OF PERIGEE
40
9 1 . 0 1
02156
SUBROUTINE
INPUT 00618
RESULT 00618
41
00618 = 00618*03847
42
PRINT REQUESTED QUANTITIES AND S.D. OF FIT
43
1 7 . 0 1
00101
SUBROUTINE
INPUT 00000
RESULT 00000
44
WRITE PRINTER BCD MODE 00048 00011
45
WRITE TAPE D BCD MODE 00048 00011
46
HAS MAX.NO. OF ITERATIONS BEEN RUN


1
COMPARE 00016 TO 00014
HIGH
LO/EQ
2
USING THIS SET OF UNKNOWNS
3
YES. LOAD ANOTHER SET
7.04
00037
00033
4
BEGIN 00033
5
HAS THIS SET OF UNKNOWNS CONVERGED
6
COMPARE 00019 TO 00017
HIGH
LO/EQ
8 17
00024
7
YES. LOAD ANOTHER SET
7.04
00037
00063
12
BEGIN 00063
13
WRITE PRINTER BCD MODE 00000 00011
00010
00064
14
BEGIN 00064
15
WRITE PRINTER BCD MODE 00000 00011
00010
01840
16,17
19
BEGIN 01840
20
THIS PROCESS BOX REPRESENTS MACHINE CODE INSTRUCTIONS. LOAD ADDRESS IS 00000
21
EXIT


COME HERE FROM
OBSERVATION LOAD FUNCTION
00061
114.14
8
BEGIN 00061
9
IF IT FINDS TAPE
CHECK ON TB
10
WRITE PRINTER
BCD MODE
00000 00011
11
LOAD NEXT RECORD
FROM OBS. TAPE
10.06
00029
OVER-UNDERFLOW TRANSFER
FOR S.P.-32K
00008
16
BEGIN 00008
17
1
6
.
1
9
01840
EXECUTE
MACHINE CODE
AT 01840
18
WRITE PRINTER
BCD MODE
30000 00011
00010

CROSS-REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES		
1.01	00020			
1.28	00570	1.21		
2.01	00577	1.25		
2.08	00576	1.30		
2.12	01814	2.20		
2.21	01815	2.15		
2.26	01820	2.18	9.03	
3.01	00575	2.08		
3.08	00021	2.25		
3.16	00095	3.07		
3.25	00578	3.21		
4.01	00573	3.33		
4.03	00574	3.34		
4.13	01812	4.21		
4.22	00062	4.19	132.36	133.33
5.01	01813	4.16		
5.12	00022	4.04		
5.17	00094	5.02		
6.01	01802	5.44		
6.06	01804	6.14		
6.15	01805	6.09		
6.18	01801	5.45		
6.22	01810	6.12		
7.01	00571	6.20		
7.04	00037	6.21	16.03	16.07
7.15	00036	7.06		
7.26	00264	7.24		
8.04	00093	8.01		
8.11	00023	8.03		
8.17	00024	16.06		
8.22	01816	9.05		
8.26	00263	8.15		
9.06	01817	8.25		
9.14	00481	9.10		
9.16	00091	9.13		
9.22	00480	9.20		

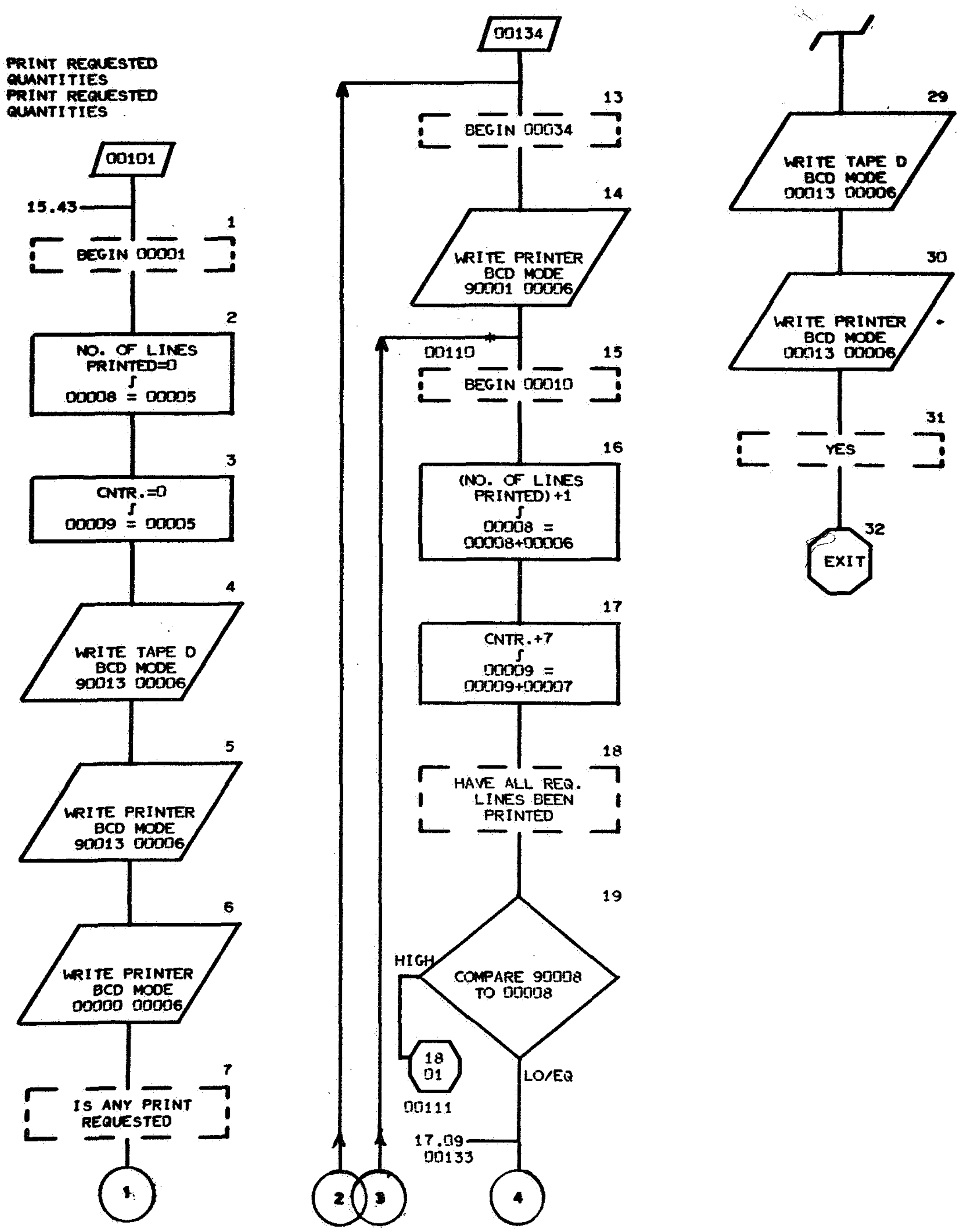
9.24	00092	9.13	9.15	9.21			
10.06	00029	12.20	12.22	12.24	13.15	13.23	16.11
10.10	00028						
10.15	00027	10.08					
10.17	00482	10.13	11.01	11.03			
10.22	00483	11.04					
10.26	00491	10.24					
10.32	00492	10.25					
10.38	02093	10.34					
11.05	02094	10.40					
11.10	02095	10.37	10.43				
11.17	02096	10.34	10.40	11.07			
11.23	00393	11.37					
11.36	00399	11.22					
12.09	00074	12.06					
12.13	01831						
12.16	01832						
12.25	00195	12.18	13.11				
13.12	00073	13.04					
13.16	00196	13.14					
13.24	00030	10.09					
13.32	01834	13.26					
14.01	01807	13.34					
14.10	01806	13.35					
15.01	00472	14.30					
15.08	00473	14.31					
16.04	00033	16.01					
16.08	00061	114.14					
16.12	00063						
16.14	00064						
16.16	00008						
16.19	01840	16.17*					

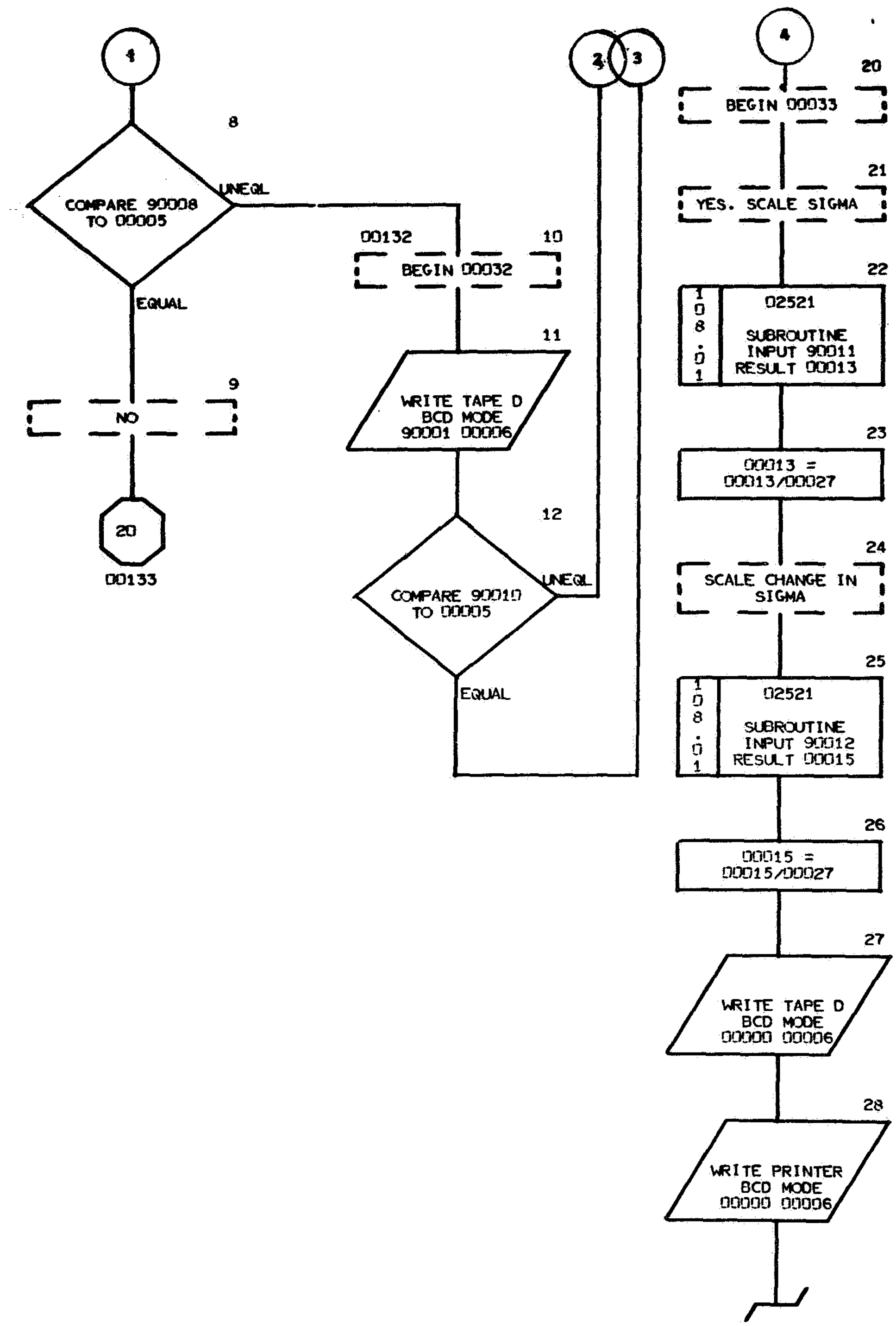
Q9003703701	SWITCH TAPE ASSIGNMENTS
Q9004002105	COSINE
Q9004103551	PRINT INITIAL ELEM.,DRAGS, EARTH CON
Q9004303601	LOAD AREA,MASS,DRAG DATA CARD FOR MC
Q9004503801	COMPUTE CONSTANTS FUNCTION
Q9004602341	COMPUTE AND PRINT R.M.S. FOR EACH OB
Q9006604401	COMPUTE EFFECTIVE DRAG
Q9004701956	ADD TO SUM OF (O-C) SQ. AND TO N COR
Q9004904056	COMPUTE CONSTRAINT EQNS.(ADDIT.EQC)
Q9005001381	(O-C) ANGLE REDUCTION F.
Q9005803496	INITIALIZE INTERPOLATION
Q9005901356	COMPUTE AND STORE CORR. ELEM.
Q9006002476	LOAD AND STORE PRINT REQUEST CARDS
Q9006100101	PRINT CORR. ELEM. AND S.D. OF FIT
Q9006204101	SUM UNKNOWNS
Q9006300151	O-C PRINT FUNCTION
Q9006402751	ABSOLUTE VALUE
Q9006502721	RANGE RATE FUNCTION
Q9006704026	LOAD CONSTRAINT WEIGHTS
Q9006803401	DELTA TAPE READ AND INTERP.
Q9006902761	ONE-WORD LOAD
Q9007002651	INPUT CONVERTER
Q9007102521	OUTPUT SCALE
Q9007203901	LOAD DRAG DATA
Q9007304201	RUN IDENT. LOAD + PRINT
Q9007401941	SATELLITE IDENTIFICATION
Q9007503301	DAY COUNT
Q9007603351	OBSERVED DATE TO J.D.
Q9007704491	ORBIT GENERATOR INITIALIZE
Q9007902936	ELEMENT LOAD
Q9008102301	MATRIX CLEAR
Q9008202801	OBSERVATION LOAD
Q9008302418	SPO
Q9008404501	ORBIT GENERATOR
Q9008501201	LOCAL STATION PREDICTION
Q9008601301	POSITION IN ELLIPSE

Q9008701401	POSITION PARTIALS
Q9008801601	OBSERVATION PARTIALS
Q9008902316	AUGMENT MATRIX
Q9009002361	SOLVE EQUATIONS
Q9009101701	CONVERT CORRECTIONS
Q9009303501	LOAD REJECT CARDS
Q9009403521	SEARCH AND REJECT FUNCTION
Q9009602196	SQUARE ROOT
Q9009702101	SIN
Q9009802156	ARC SIN
Q9009904331	LOAD INTERVAL CORE DUMP CARDS
V00032+00000000+00	NORMAL SETTING,FOR NO JUMP AT END OF
V00461+16000000+02	NO. WORDS IN PERT. TAPE TITLE RECORD
V00615+10000000+01	K, MULTIPLIER FOR DRAG DELTA M
V00459-10000000+01	NO.STORED IN LOC.00000 IF TAPE CHECK
V00460+10000000+02	NO. OF TIMES TO TRY TO READ TAPE REC
V00465+10000000+02	MAXIMUM NO. OF INTERVAL CORE DUMPS
V00466+10000000+01	SETTING FOR INTERVAL CORE DUMPS ON T
V00475+00000000+00	NORMAL SETTING,FOR (O-C)"S PRINTED
V00498+10000000+03	
V00495+28000000+02	MAX.NO. PRINT REQ. CARDS(INCL. HEADI
V02098+10000000+01	SET FOR RANGE RATE (O-C),S NOT DIFF.
V00002+30000000+01	
V00003+50000000+01	
V00007+50000000+02	
V00009+10000000+02	
V00010+00000000+00	ZERO
V00011+10000000+01	
V00012+19000000+02	NO. OF ELEMENTS
V00013+18000000+02	MAX. NO. OF VARIABLES
V00015+50000000+01	NO. OF WORDS/ELEMENT NAME
V00016+10000000+02	
V00017+10000000-02	
V00018+10000000+06	
V00058+20000000+01	

```
V00071+90000000+01
W00086    *
V00179+00000000+00
V00149-20000000+01
V00419+10000000+01
V02090+40000000+01
V02091+60000000+01
V02092+80000000+01
V00072+48000000+02          WORDS/RECORD ON TG OUTPUT TAPE
V00394+00000000+00          NORMAL SETTING,FOR NO CORRECTED
V00398+20000000+01          X, WHERE K 1 = (RHO 1) / X
V01800-10000000+01
V00089+00000000+00          SET FOR SINGLE PRECISION
```

K VALUE = 00100

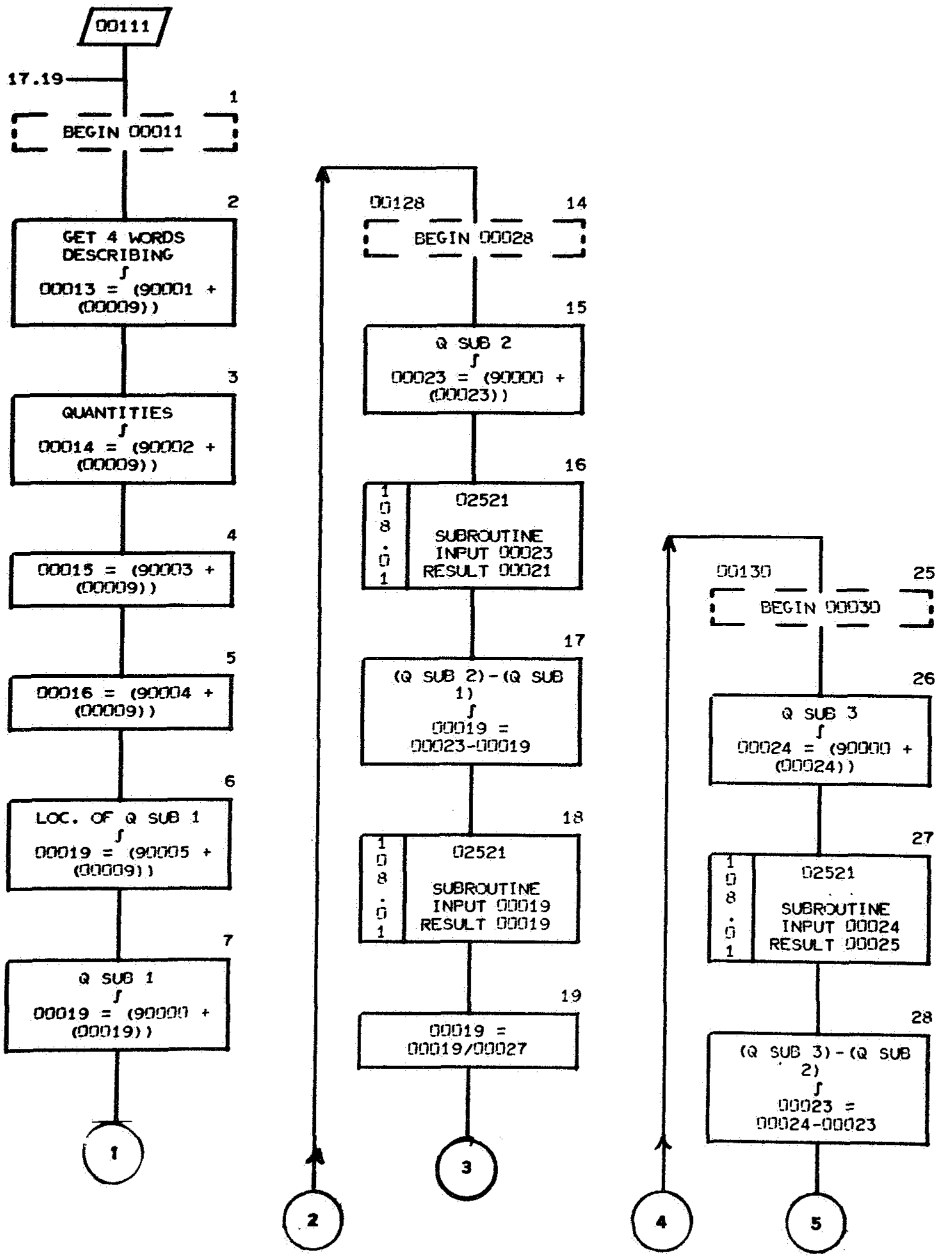


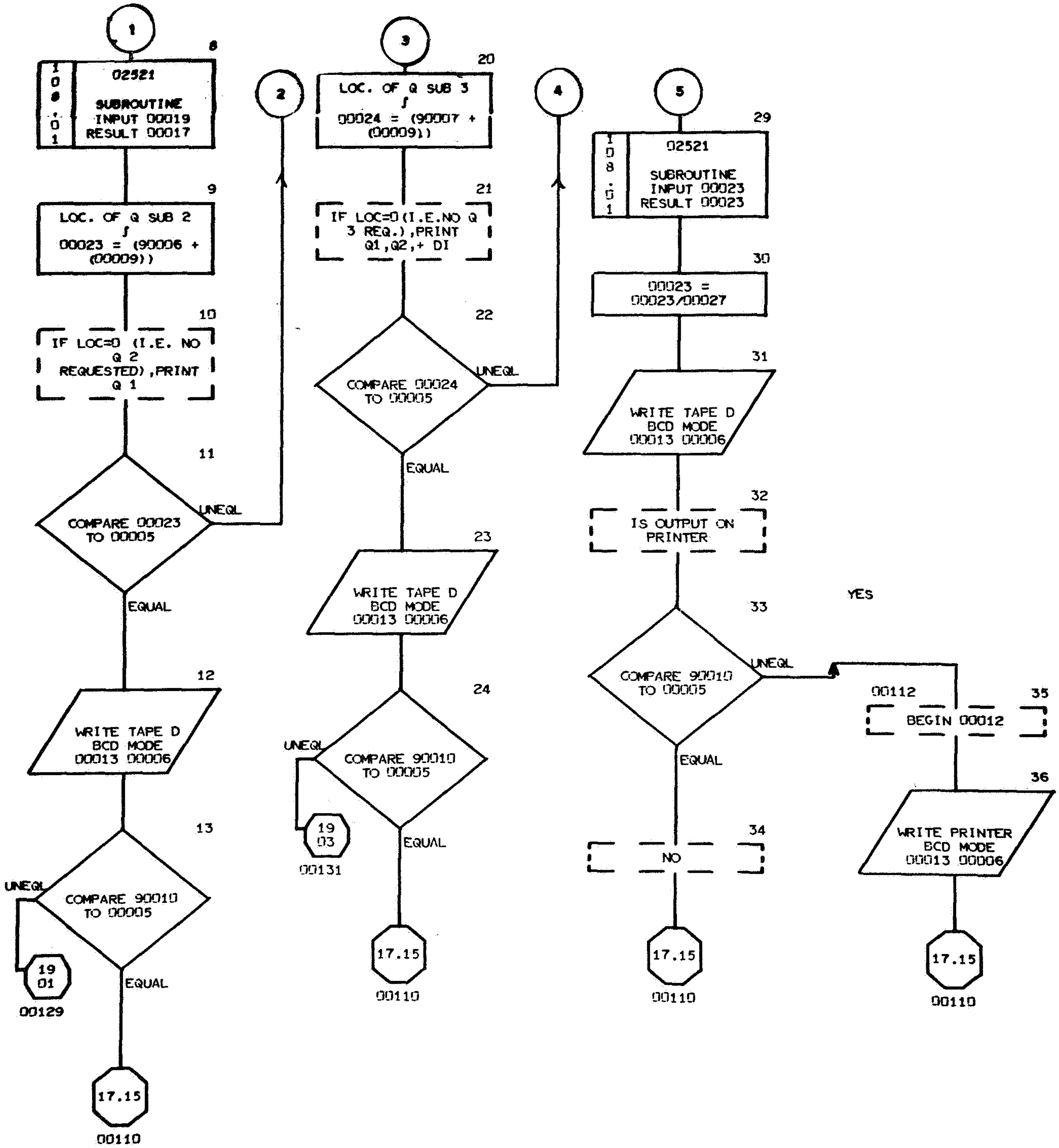


4
8
COMPARE 90008 TO 00005
UNEQL
EQUAL
9
NO
20
00133
00132
10
BEGIN 00032
11
WRITE TAPE D BCD MODE 90001 00006
12
COMPARE 90010 TO 00005
UNEQL
EQUAL
2
3
4
20
BEGIN 00033
21
YES. SCALE SIGMA
22
108.01
02521
SUBROUTINE INPUT 90011 RESULT 00013
23
00013 = 00013/00027
24
SCALE CHANGE IN SIGMA
25
108.01
02521
SUBROUTINE INPUT 90012 RESULT 00015
26
00015 = 00015/00027
27
WRITE TAPE D BCD MODE 00000 00006
28
WRITE PRINTER BCD MODE 00000 00006

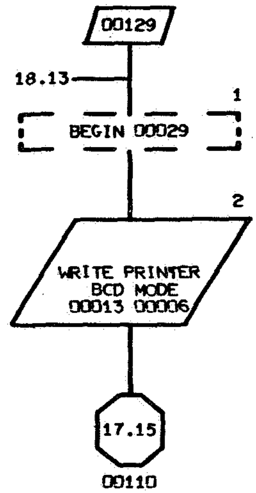
K VALUE = 00100

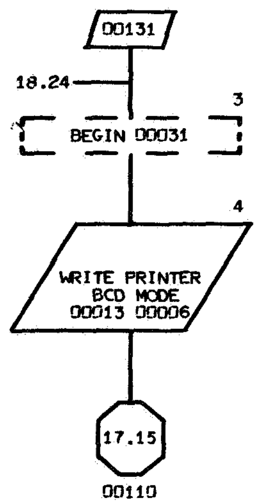
NO




1
8
1 0 8 . 0 1
02521
SUBROUTINE
INPUT 00019
RESULT 00017
9
LOC. OF Q SUB 2
00023 = (90006 + (00009))
10
IF LOC=0 (I.E. NO Q 2 REQUESTED), PRINT Q 1
11
COMPARE 00023 TO 00005
UNEQL
EQUAL
12
WRITE TAPE D BCD MODE 00013 00006
13
COMPARE 90010 TO 00005
UNEQL
EQUAL
19 01
00129
17.15
00110
2
3
20
LOC. OF Q SUB 3
00024 = (90007 + (00009))
21
IF LOC=0 (I.E.NO Q 3 REQ.), PRINT Q1,Q2,+ DI
22
COMPARE 00024 TO 00005
UNEQL
EQUAL
23
WRITE TAPE D BCD MODE 00013 00006
24
COMPARE 90010 TO 00005
UNEQL
EQUAL
19 03
00131
17.15
00110
4
5
29
1 0 8 . 0 1
02521
SUBROUTINE
INPUT 00023
RESULT 00023
30
00023 = 00023/00027
31
WRITE TAPE D BCD MODE 00013 00006
32
IS OUTPUT ON PRINTER
33
COMPARE 90010 TO 00005
YES
UNEQL
EQUAL
34
NO
17.15
00110
00112
35
BEGIN 00012
36
WRITE PRINTER BCD MODE 00013 00006
17.15
00110

K VALUE = 00100





NASA-GSFC MISSION AND TRAJECTORY ANALYSIS DIVI

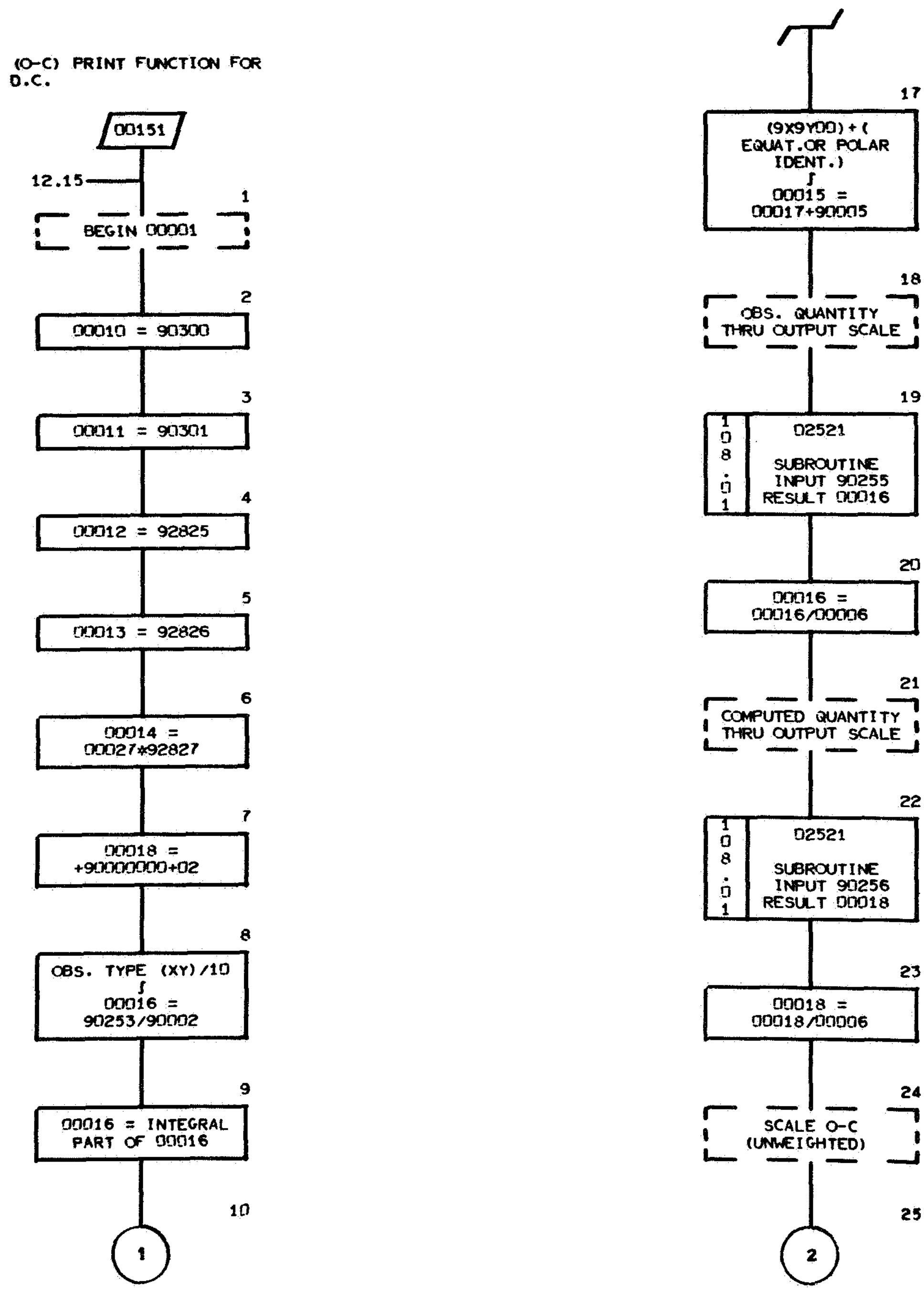
K VALUE = 00100

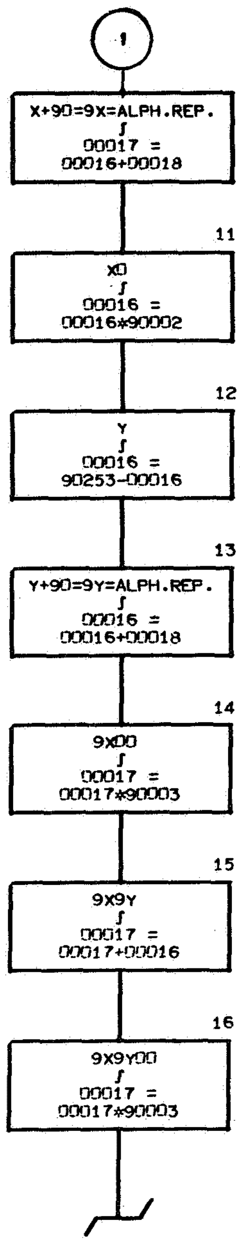
```
Q9000000000
Q9000103100        1 ST LOC. OF DATA STORAGE
Q9000203101        2 ND STG. LOC.
Q9000303102        3 RD STG. LOC.
Q9000403103        4 TH STG. LOC.
Q9000503104        5 TH STG. LOC.
Q9000603105        6 TH STG. LOC.
Q9000703106        7 TH STG. LOC.
Q9000800060        NO. OF LINES TO PRINT
Q9000902521        OUTPUT SCALE
Q9001000042        PRINTER OUTPUT OPTION
Q9001100178        SIGMA
Q9001200065        CHANGE IN SIGMA
Q9001300179        ITERATION NO.
V00005+00000000+00
V00006+10000000+01
V00007+70000000+01
V00027+10000000+06
```

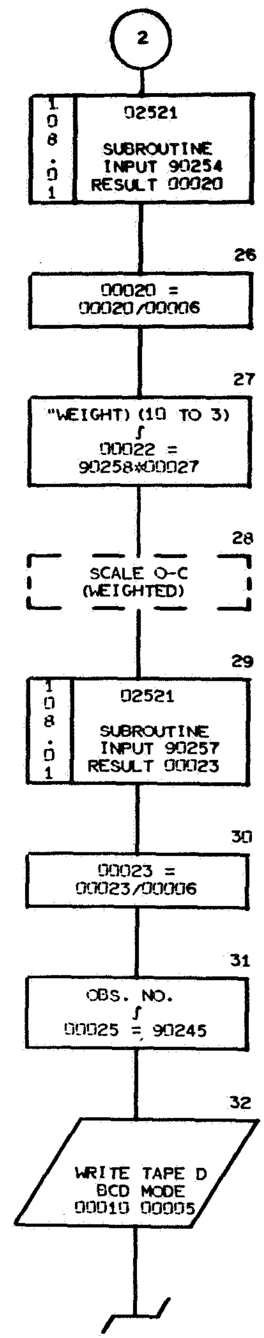
CROSS-REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES					
17.01	00101	15.43*					
17.10	00132	17.08					
17.13	00134	17.12					
17.15	00110	17.12	18.13	18.24	18.34	18.36	19.02	19.04
17.20	00133	17.09					
18.01	00111	17.19					
18.14	00128	18.11					
18.25	00130	18.22					
18.35	00112	18.33					
19.01	00129	18.13					
19.03	00131	18.24					

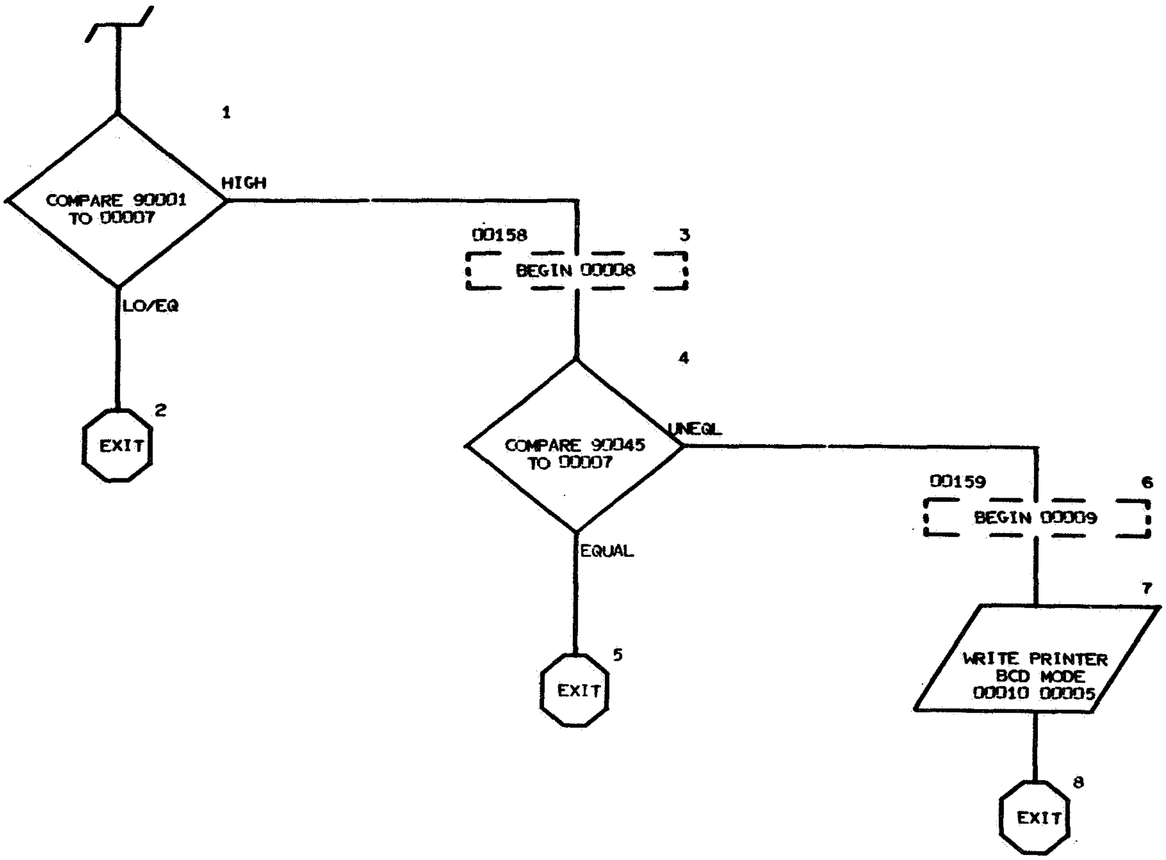
K VALUE = 00150




1
X+90=9X=ALPH.REP.
00017 =
00016+00018
11
X0
00016 =
00016*90002
12
Y
00016 =
90253-00016
13
Y+90=9Y=ALPH.REP.
00016 =
00016+00018
14
9X00
00017 =
00017*90003
15
9X9Y
00017 =
00017+00016
16
9X9Y00
00017 =
00017*90003


2
108.01
02521
SUBROUTINE
INPUT 90254
RESULT 00020
26
00020 =
00020/00006
27
"WEIGHT) (10 TO 3)
00022 =
90258*00027
28
SCALE O-C
(WEIGHTED)
29
108.01
02521
SUBROUTINE
INPUT 90257
RESULT 00023
30
00023 =
00023/00006
31
OBS. NO.
00025 = 90245
32
WRITE TAPE D
BCD MODE
00010 00005

K VALUE = 00150



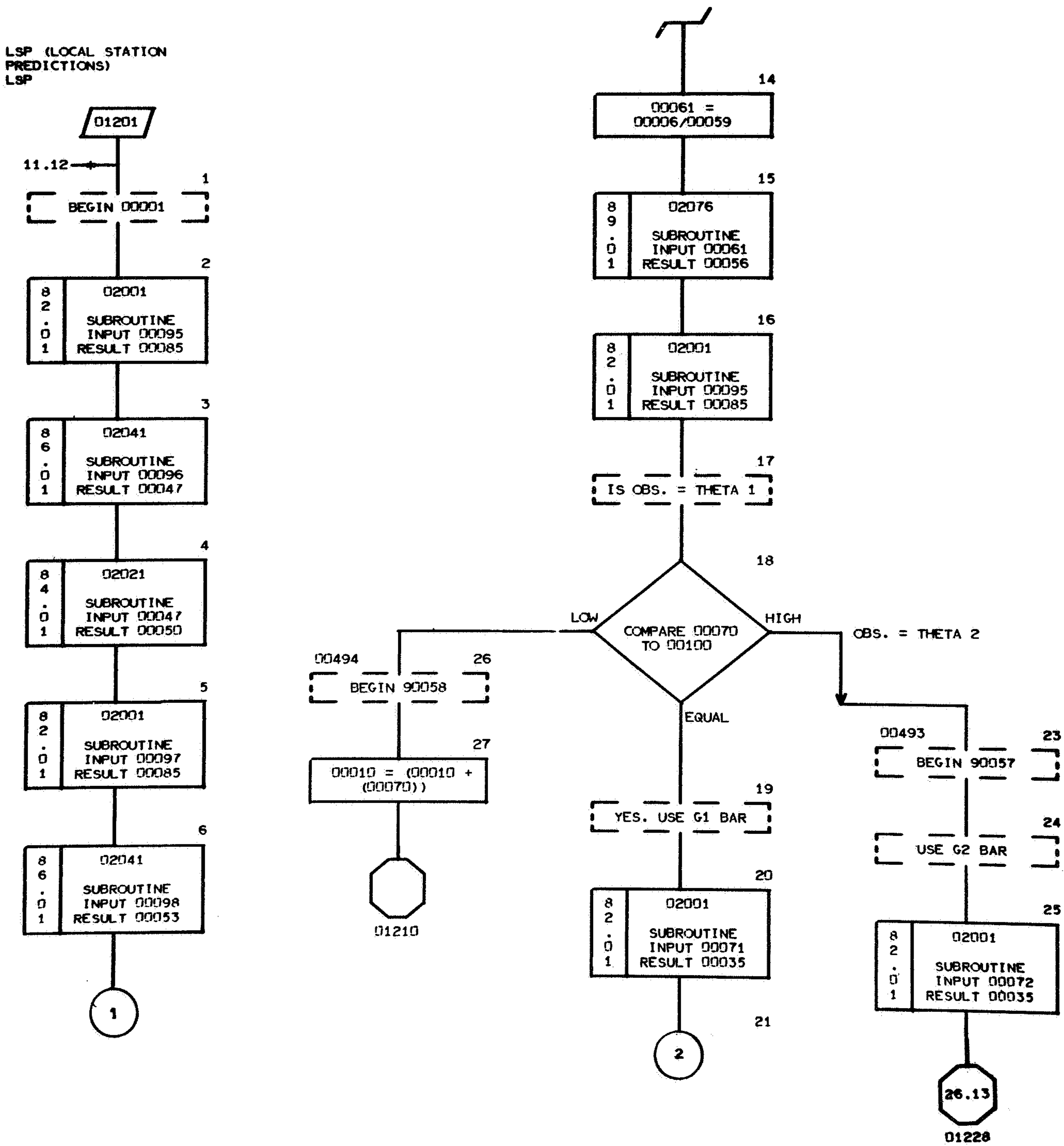
CROSS-REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES
20.01	00151	12.15*
21.03	00158	21.01
21.06	00159	21.04

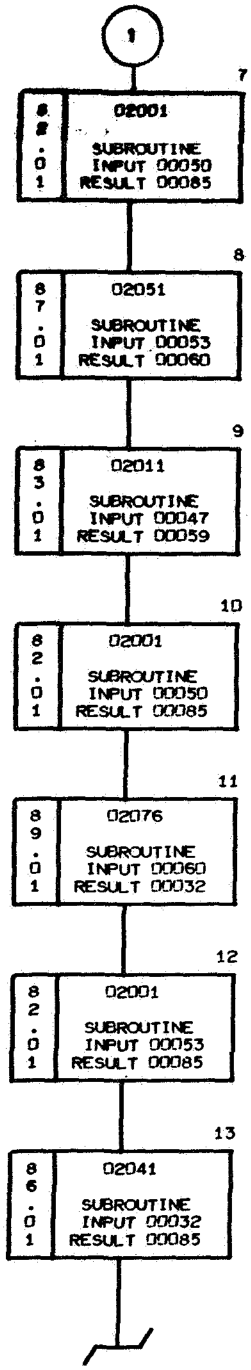
K VALUE = 00150

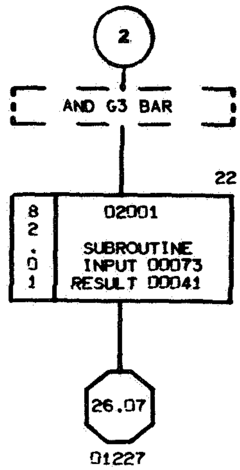
Q9000100042	
Q9000200009	TEN
Q9000300498	100
Q9000500497	EQUATORIAL OR POLAR IDENT.
Q9004500045	
Q9030000300	STATION LABEL
Q9030100301	
Q9282502825	YR MO DY
Q9282602826	HR MI
Q9282702827	SE. SEC
Q9025300253	OBS TYPE
Q9025500255	OBSERVED QUANTITY
Q9025600256	COMPUTED QUANTITY
Q9025400254	O-C (UNWEIGHTED)
Q9025700257	O-C (WEIGHTED)
Q9025800258	OBSERVATION WEIGHT
Q9024500245	OBS. NO.
Q9252102521	OUTPUT SCALE
V00005+10000000+01	
V00006+10000000+06	
V00007+00000000+00	
V00027+10000000+04	10 TO 3

K VALUE = 01200

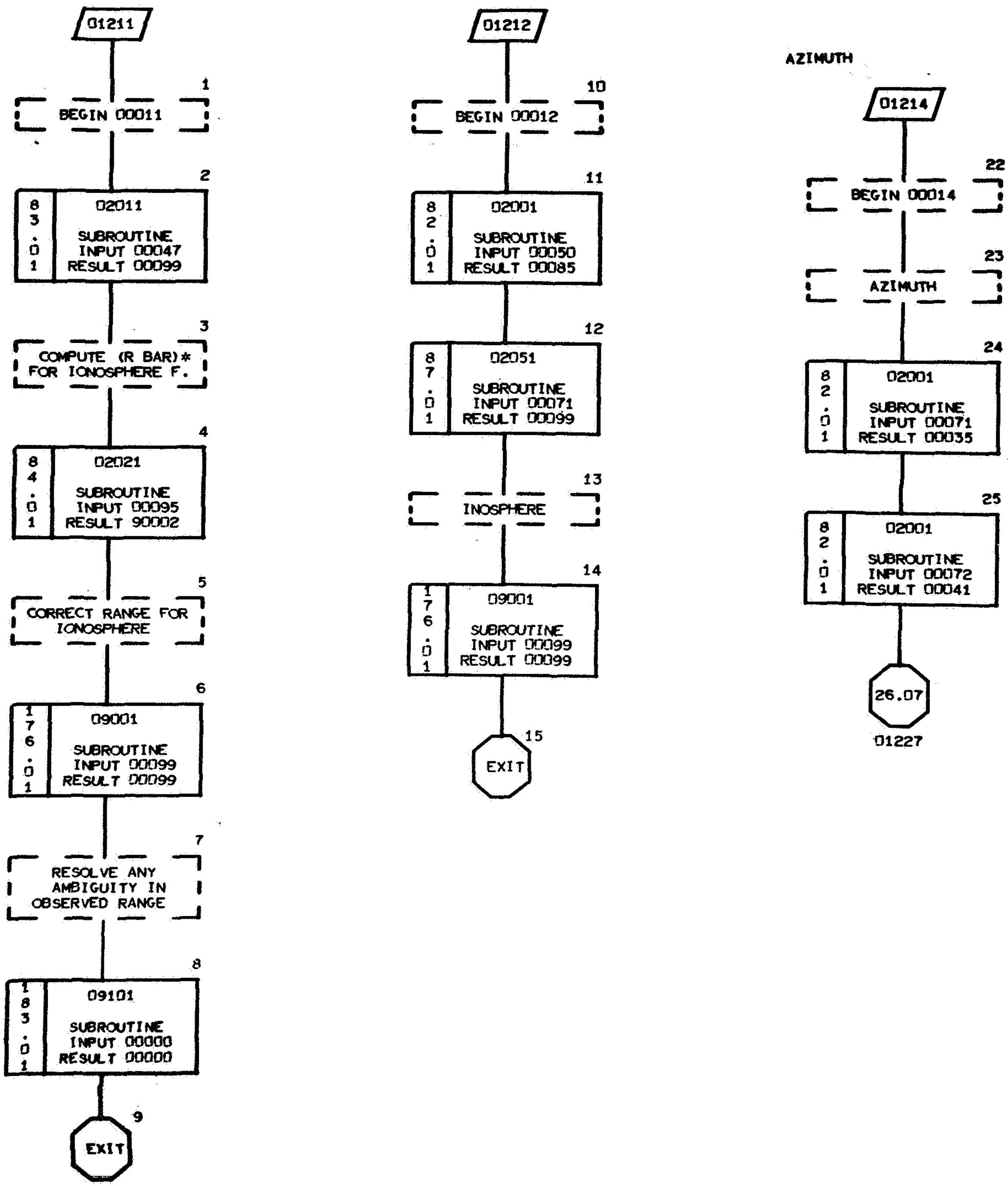


PAGE 22 CONTINUED

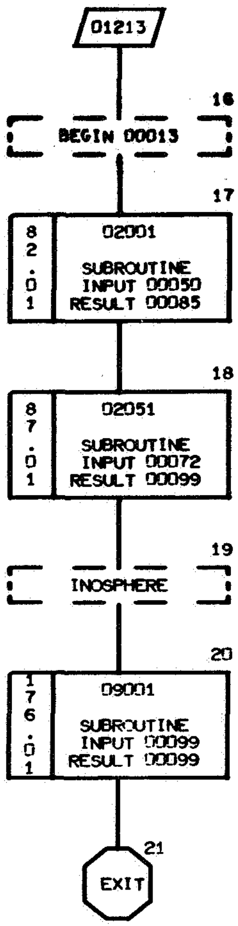




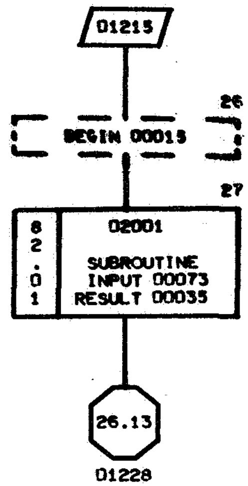
K VALUE = 01200



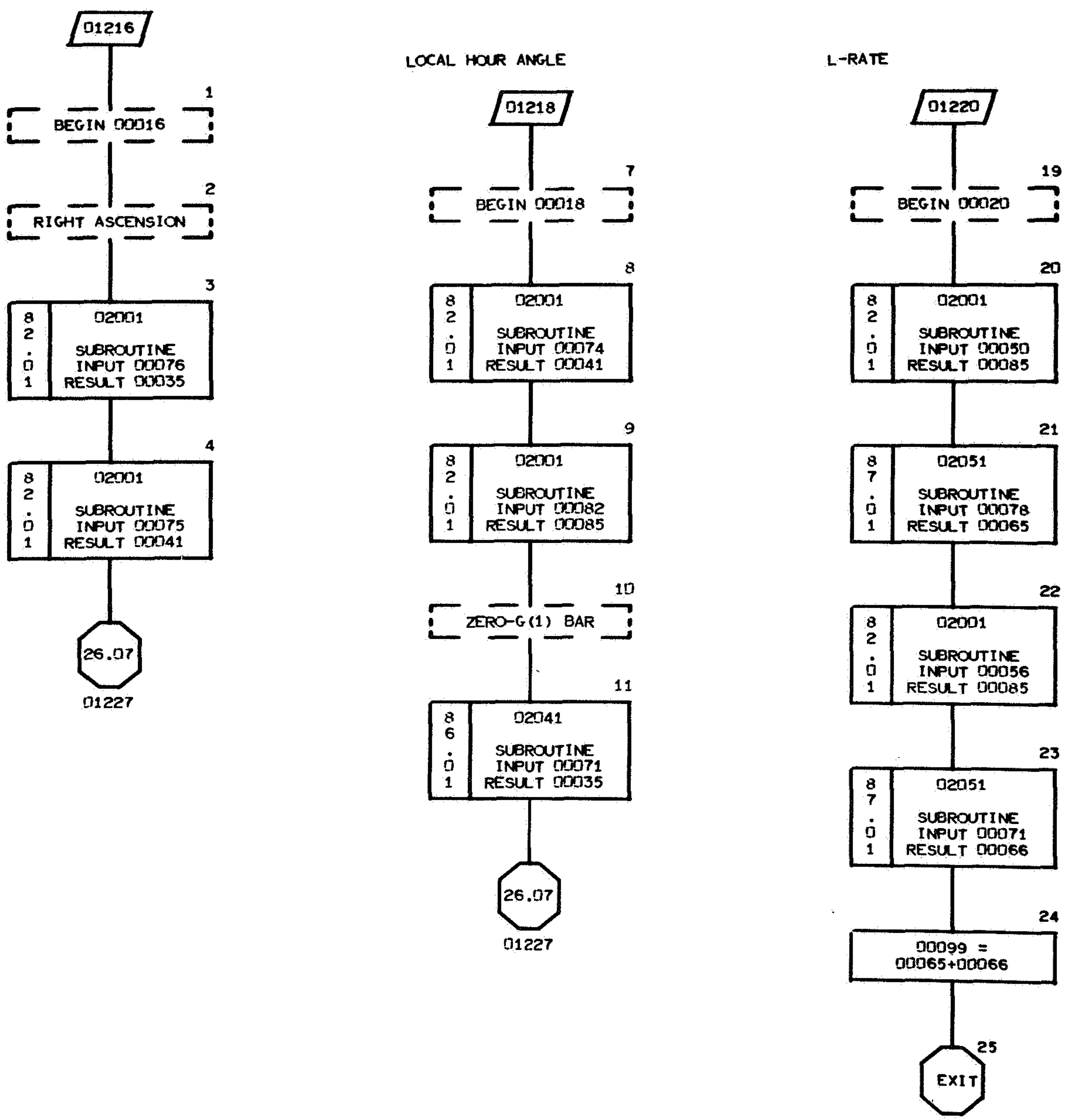
PAGE 23 CONTINUED

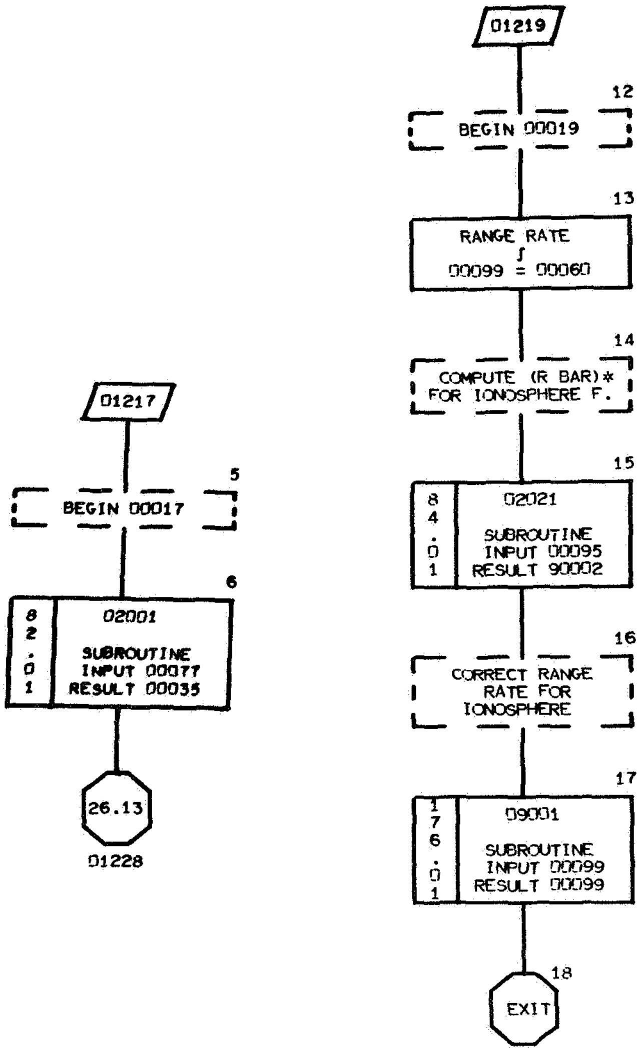


ELEVATION

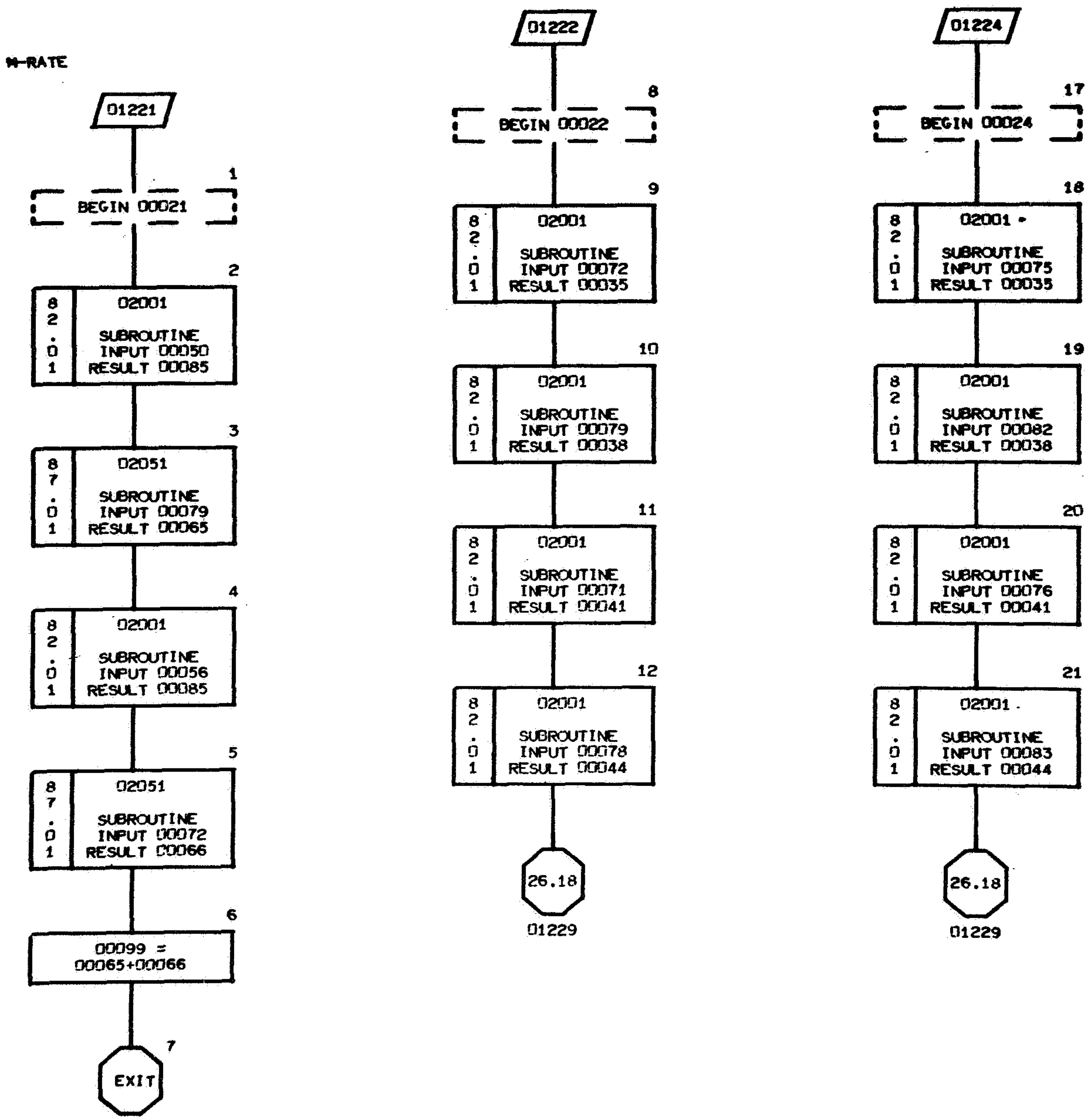


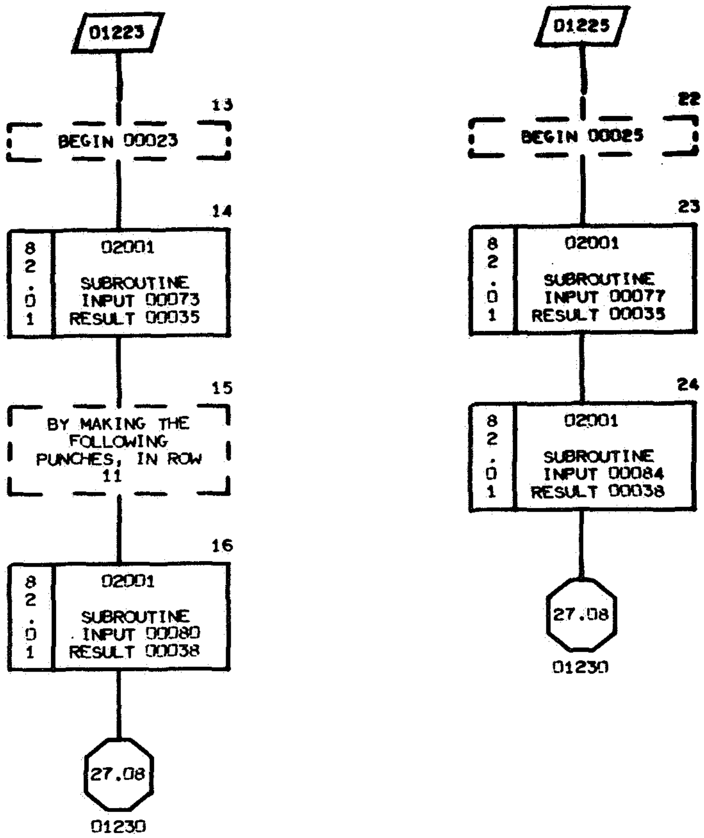
K VALUE = 01200



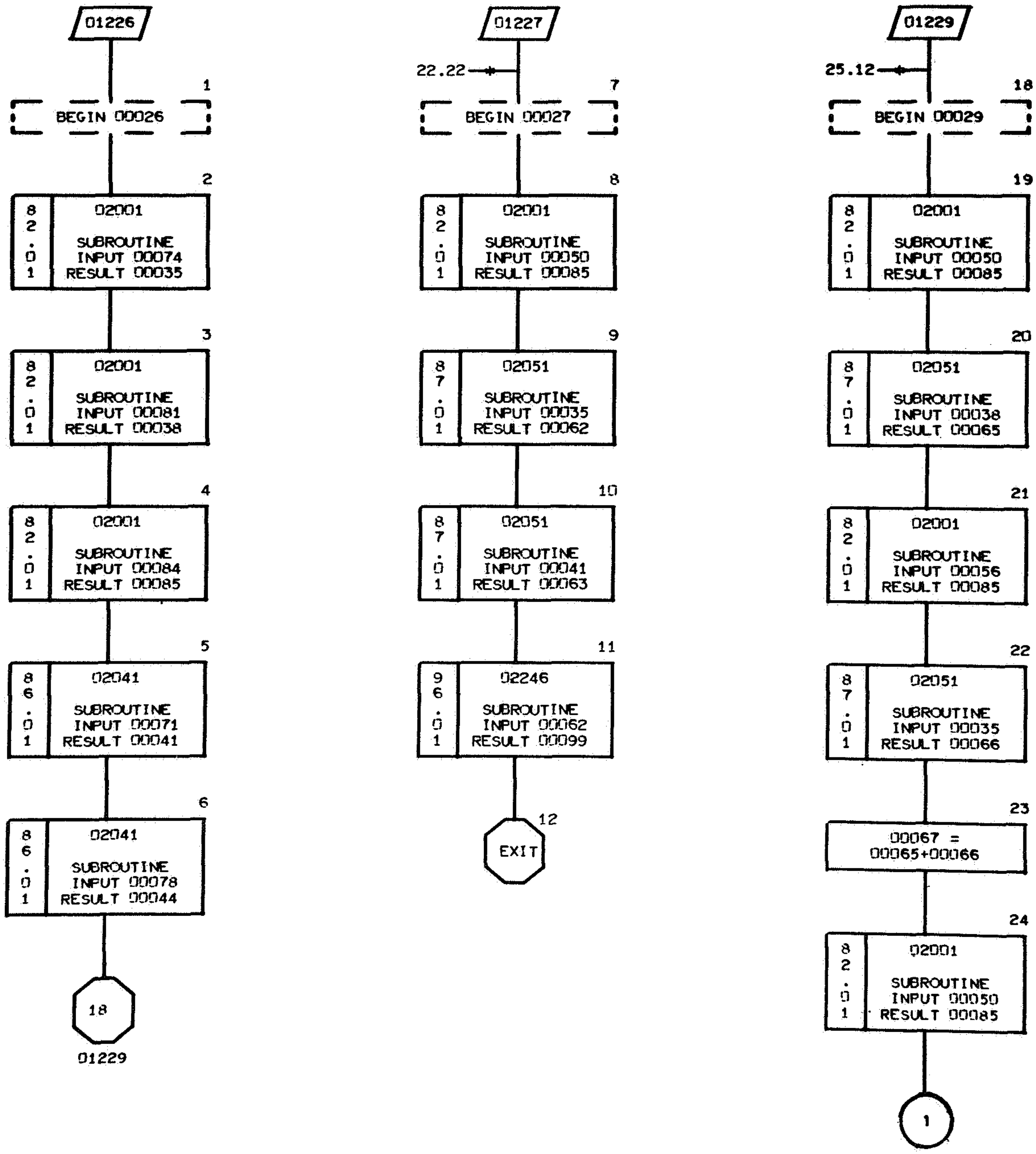

01217
BEGIN 00017
5
6
8
2
.
0
1
02001
SUBROUTINE
INPUT 00077
RESULT 00035
26.13
01228
01219
12
BEGIN 00019
13
RANGE RATE
00099 = 00060
14
COMPUTE (R BAR)*
FOR IONOSPHERE F.
15
8
4
.
0
1
02021
SUBROUTINE
INPUT 00095
RESULT 90002
16
CORRECT RANGE
RATE FOR
IONOSPHERE
17
1
7
6
.
0
1
09001
SUBROUTINE
INPUT 00099
RESULT 00099
18
EXIT

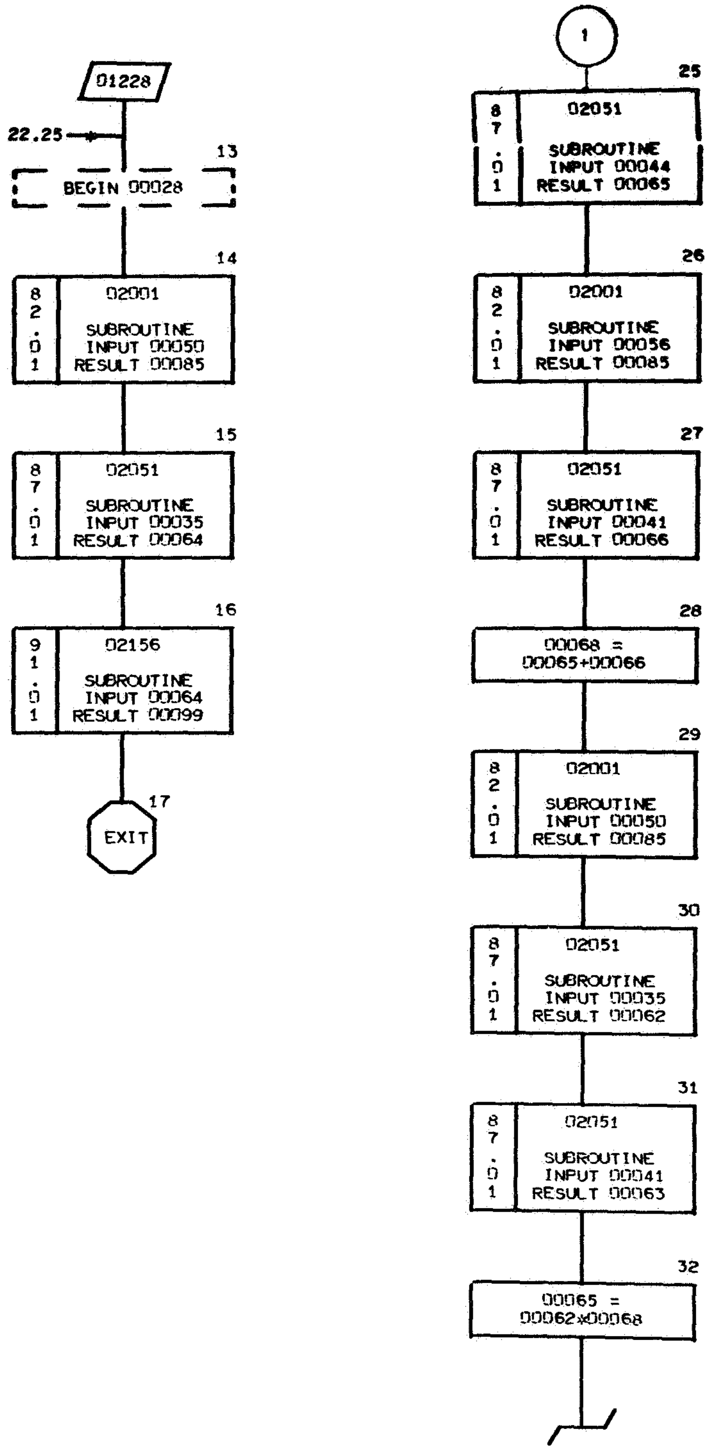
K VALUE = 01200



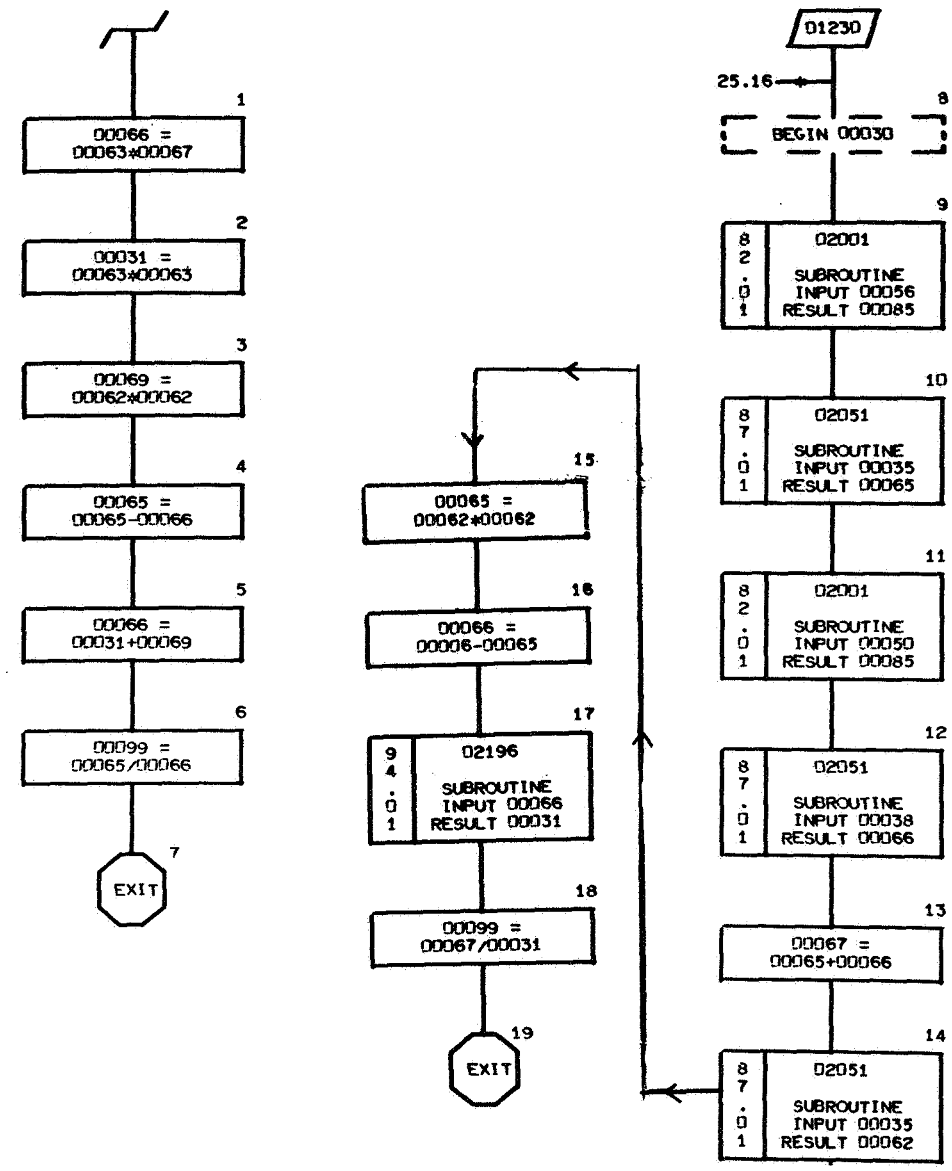

01223
13
BEGIN 00023
14
8 2 . 0 1
02001
SUBROUTINE
INPUT 00073
RESULT 00035
15
BY MAKING THE FOLLOWING PUNCHES, IN ROW 11
16
8 2 . 0 1
02001
SUBROUTINE
INPUT 00080
RESULT 00038
27.08
01230
01225
22
BEGIN 00025
23
8 2 . 0 1
02001
SUBROUTINE
INPUT 00077
RESULT 00035
24
8 2 . 0 1
02001
SUBROUTINE
INPUT 00084
RESULT 00038
27.08
01230

K VALUE = 01200




01228
22.25
13
BEGIN 00028
14
82.01
02001
SUBROUTINE
INPUT 00050
RESULT 00085
15
87.01
02051
SUBROUTINE
INPUT 00035
RESULT 00064
16
91.01
02156
SUBROUTINE
INPUT 00064
RESULT 00099
17
EXIT
1
25
87.01
02051
SUBROUTINE
INPUT 00044
RESULT 00065
26
82.01
02001
SUBROUTINE
INPUT 00056
RESULT 00085
27
87.01
02051
SUBROUTINE
INPUT 00041
RESULT 00066
28
00068 =
00065+00066
29
82.01
02001
SUBROUTINE
INPUT 00050
RESULT 00085
30
87.01
02051
SUBROUTINE
INPUT 00035
RESULT 00062
31
87.01
02051
SUBROUTINE
INPUT 00041
RESULT 00063
32
00065 =
00062*00068

K VALUE = 01200



K VALUE = 01200

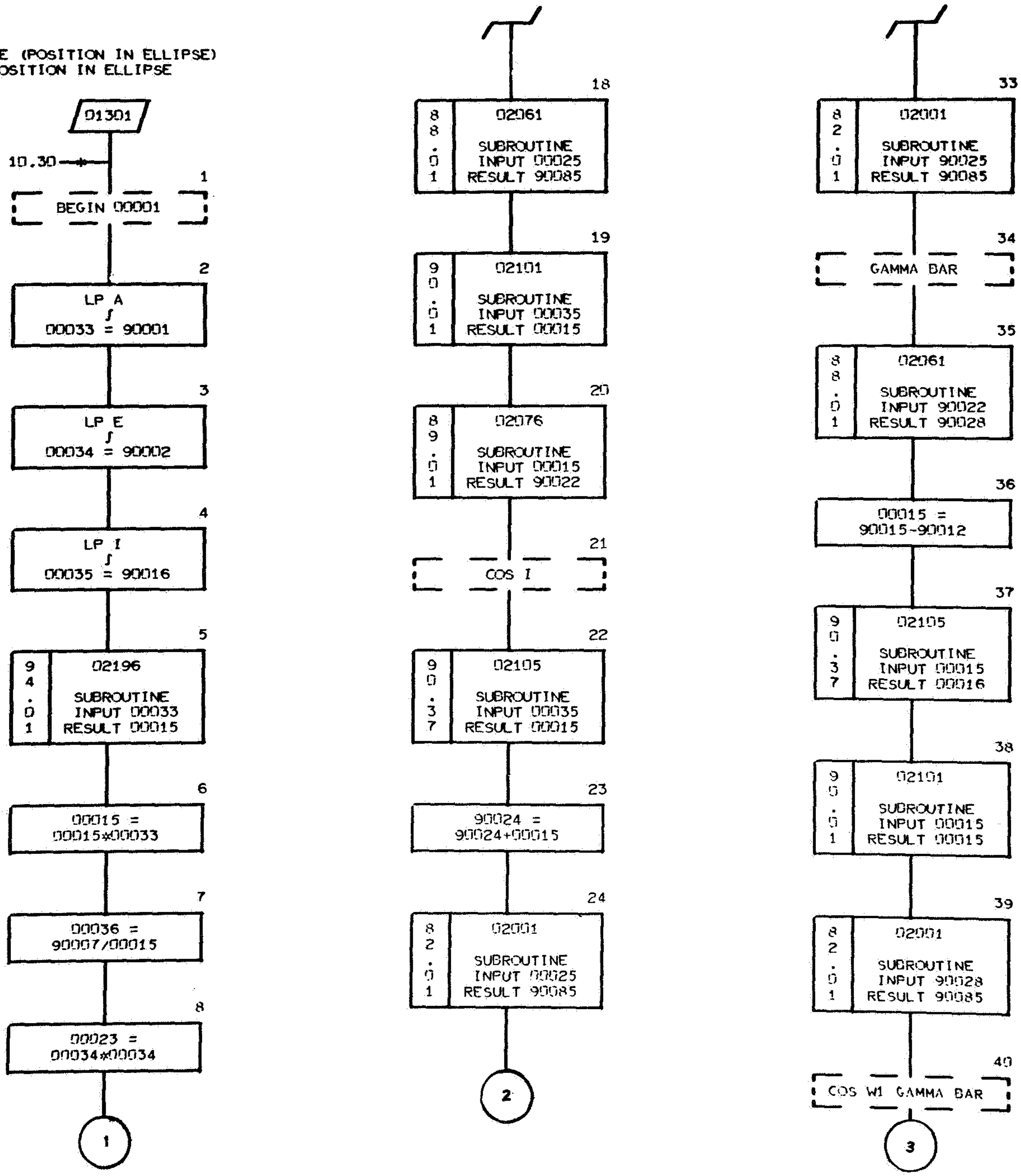
Q9005700493	WORKING STG. (BEGIN COMMAND)
Q9005800494	WORKING STG. (BEGIN COMMAND)
Q0004700358	RHO BAR
Q0005000361	(RHO BAR)*
Q0005300365	RHO DOT BAR
Q0005600368	(RHO DOT BAR)*
Q0005900364	RHO
Q0006000371	RHO DOT
Q0007000253	OBSERVATION TYPE
Q0007100316	G 1 BAR
Q0007200319	G 2 BAR
Q0007300322	G 3 BAR
Q0007400325	G 4 BAR
Q0007500328	G 5 BAR
Q0007600331	G 6 BAR
Q0007700334	G 7 BAR
Q0007800337	G 1 DOT BAR
Q0007900340	G 2 DOT BAR
Q0008000343	G 3 DOT BAR
Q0008100346	G 4 DOT BAR
Q0008200349	G 5 DOT BAR
Q0008300352	G 6 DOT BAR
Q0008400355	G 7 DOT BAR
Q0008502085	VQ
Q0008602001	VECTOR MOVE
Q0008702051	DOT PRODUCT
Q0008802011	VECTOR MAGNITUDE
Q0008902041	VECTOR SUBTRACT
Q0009002021	VECTOR DIRECTION
Q0009102076	SCALAR-VECTOR MULTIPLY
Q0009202246	ARC TAN (Y/X)
Q0009302156	ARC SIN
Q0009402196	SQUARE ROOT
Q0009500204	R BAR,SATELLITE POSITION VECTOR
Q0009600310	CAP R BAR,STATION POSITION VECTOR
Q0009700207	R DOT BAR,SATELLITE VELOCITY VECTOR
Q0009800313	CAP R DOT BAR,STATION VELOCITY VECTO
Q0009900256	COMPUTED OBSERVATION
Q9000109001	IONOSPHERE CORR. FUNCTION
Q9000200375	(R BAR)*
Q9000309101	RANGE AMBIGUITY RESOLUTION F.
V00100+17000000+02	
V00005+00000000+00	
V00006+10000000+01	

CROSS-REFERENCE LISTING

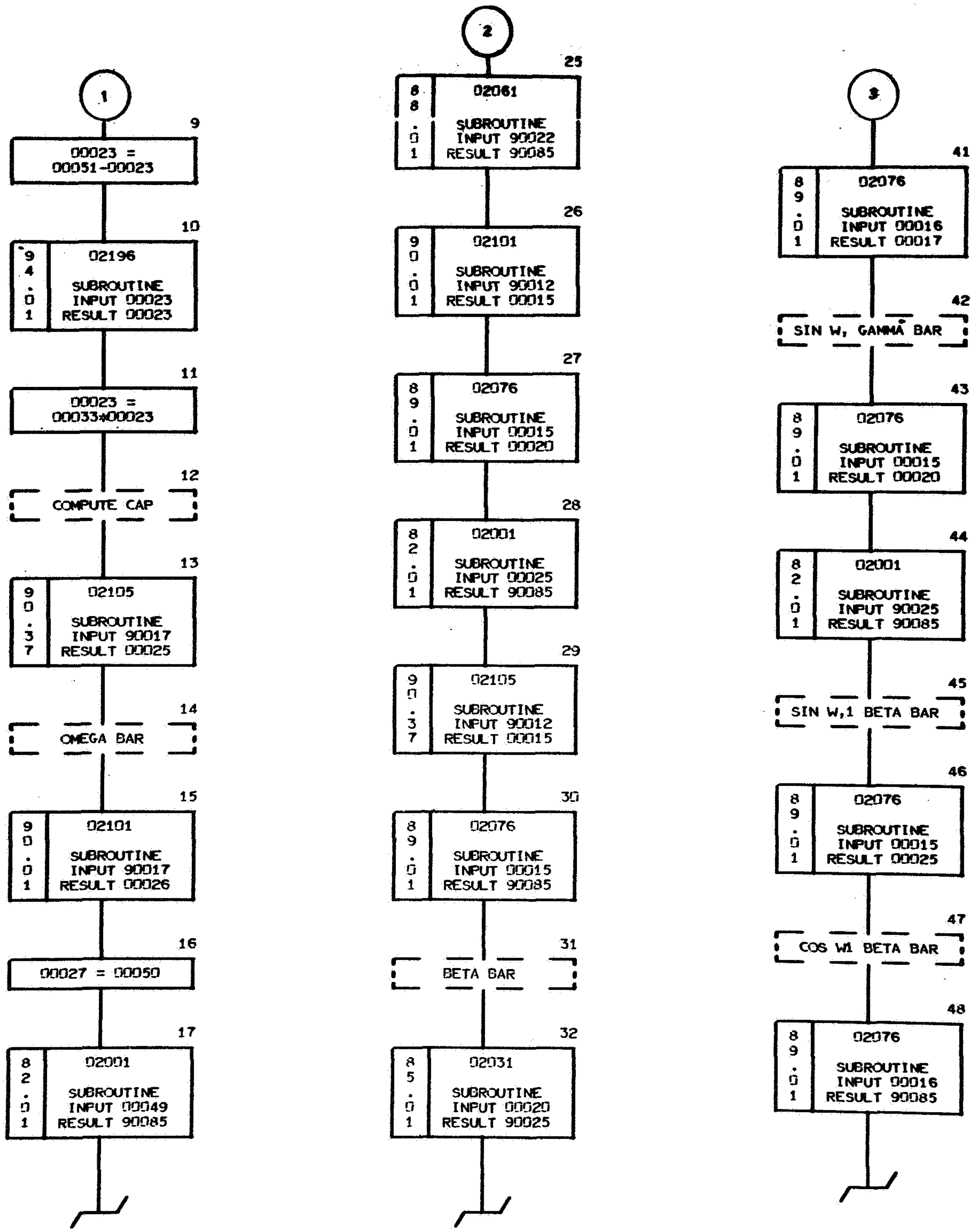
PAGE BOX	LABEL	REFERENCES				
22.01	01201	11.12*	11.20*	176.20*	179.05*	179.18*
22.23	00493	22.18				
22.26	00494	22.18				
23.01	01211					
23.10	01212					
23.16	01213					
23.22	01214					
23.26	01215					
24.01	01216					
24.05	01217					
24.07	01218					
24.12	01219					
24.19	01220					
25.01	01221					
25.08	01222					
25.13	01223					
25.17	01224					
25.22	01225					
26.01	01226					
26.07	01227	22.22	23.25	24.04	24.11	
26.13	01228	22.25	23.27	24.06		
26.18	01229	25.12	25.21	26.06		
27.08	01230	25.16	25.24			

K VALUE = 01300

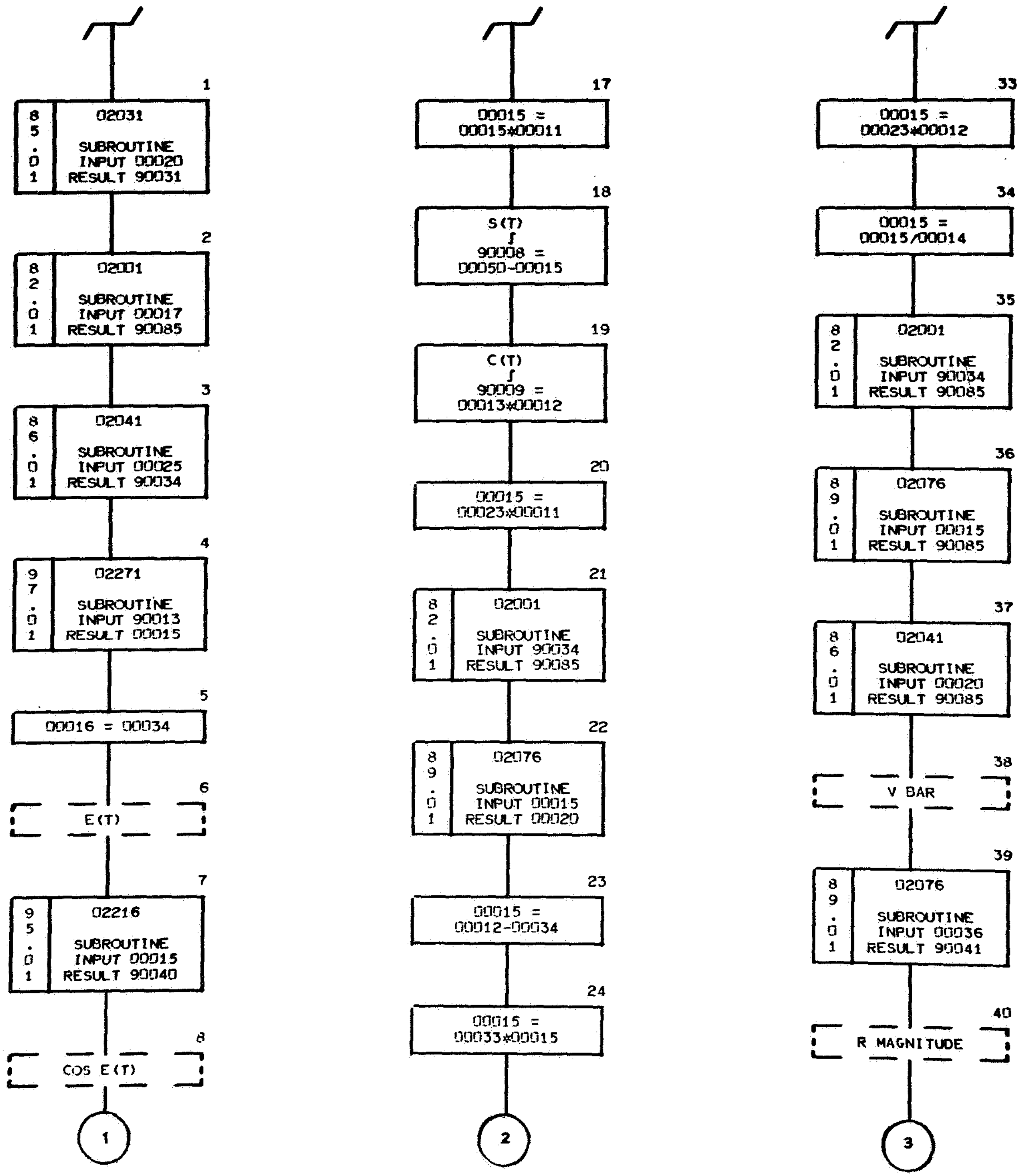
PE (POSITION IN ELLIPSE)
POSITION IN ELLIPSE

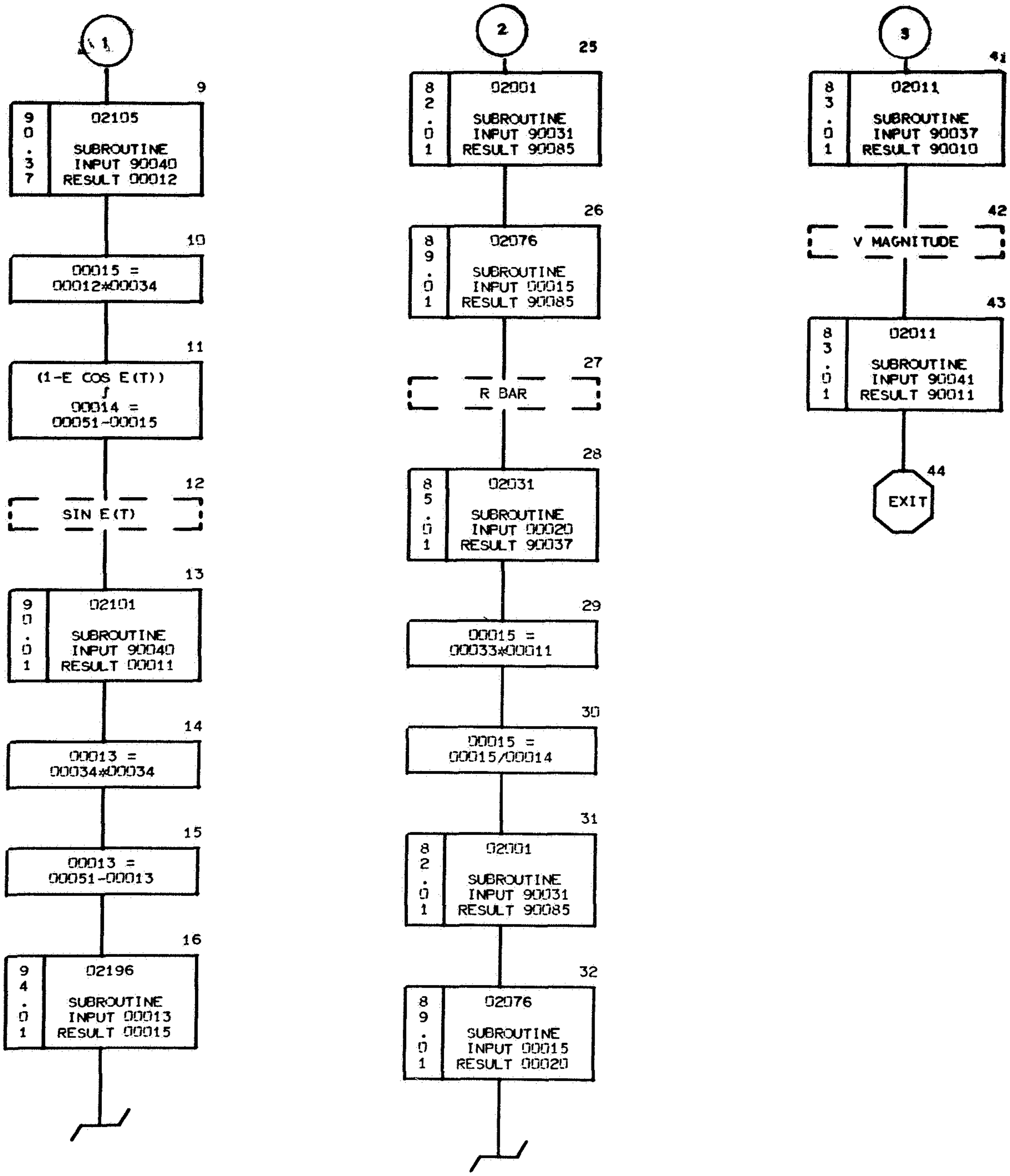


PAGE 28 CONTINUED



K VALUE = 01300




1
9
90.37
02105
SUBROUTINE
INPUT 90040
RESULT 00012
10
00015 =
00012*00034
11
(1-E COS E(T))
f
00014 =
00051-00015
12
SIN E(T)
13
90.01
02101
SUBROUTINE
INPUT 90040
RESULT 00011
14
00013 =
00034*00034
15
00013 =
00051-00013
16
94.01
02196
SUBROUTINE
INPUT 00013
RESULT 00015
2
25
82.01
02001
SUBROUTINE
INPUT 90031
RESULT 90085
26
89.01
02076
SUBROUTINE
INPUT 00015
RESULT 90085
27
R BAR
28
85.01
02031
SUBROUTINE
INPUT 00020
RESULT 90037
29
00015 =
00033*00011
30
00015 =
00015/00014
31
82.01
02001
SUBROUTINE
INPUT 90031
RESULT 90085
32
89.01
02076
SUBROUTINE
INPUT 00015
RESULT 00020
3
41
83.01
02011
SUBROUTINE
INPUT 90037
RESULT 90010
42
V MAGNITUDE
43
83.01
02011
SUBROUTINE
INPUT 90041
RESULT 90011
44
EXIT

K VALUE = 01300

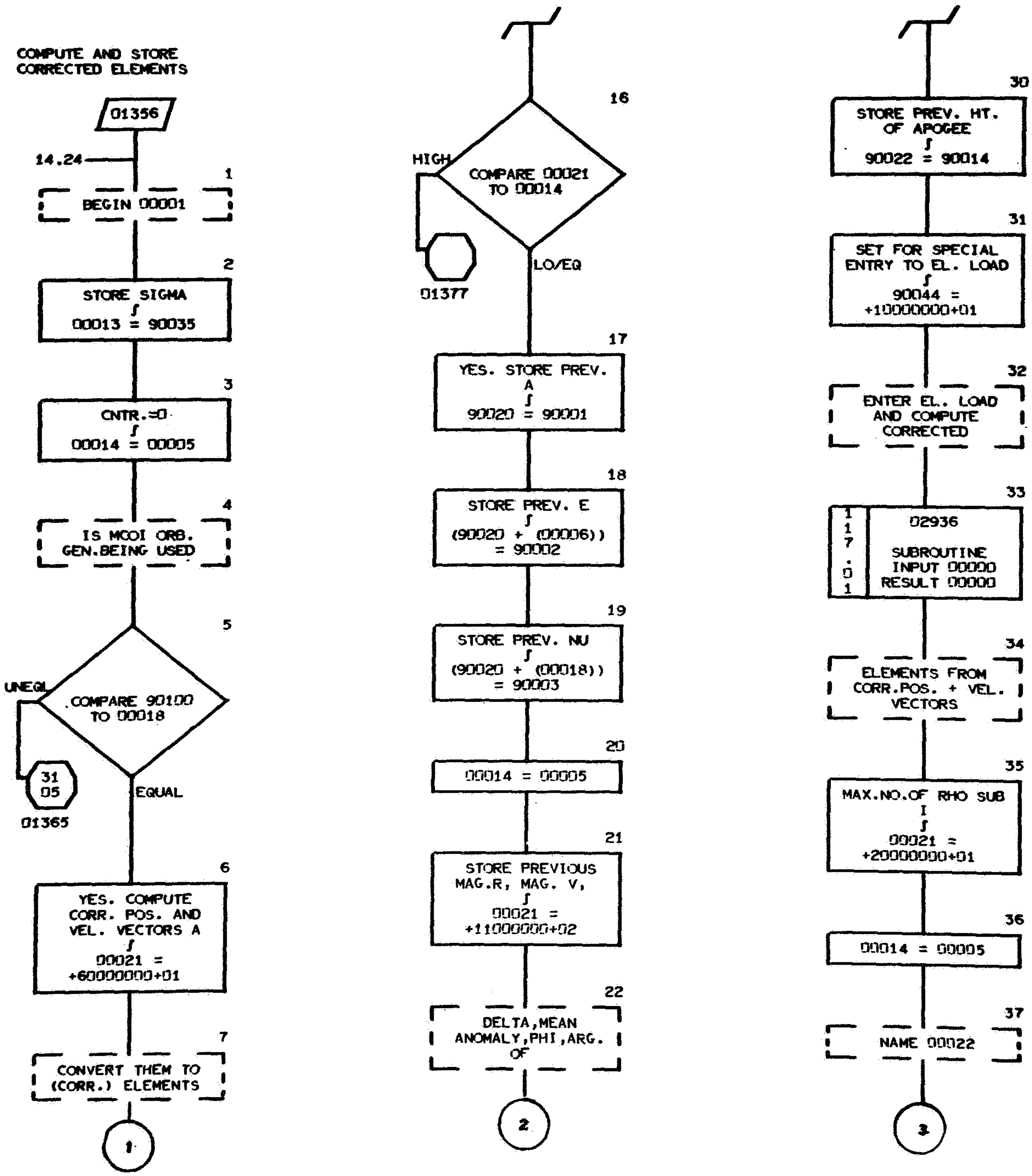
Q9000001100	T(0), EPOCH TIME IN C.U.T.
Q9000100218	SEMI MAJOR AXIS AT T, TIME OF OBS.
Q9000200219	ECCENTRICITY AT T
Q9000301113	MEAN ANOMALY AT T(0)
Q9000401115	ARG. OF PERIGEE AT T(0)
Q9000501117	LONG. OF ASC. NODE AT T(0)
Q9000603864	J
Q9000703852	MU
Q9000800201	S(T)
Q9000900202	C(T)
Q9001000210	R (MAGNITUDE OF R BAR)
Q9001100211	V (MAGNITUDE OF V BAR)
Q9001201112	DELTA AT T(0)
Q9001300213	MEAN ANOMALY AT T
Q9001500215	ARG. OF PERIGEE AT T
Q9001600220	INCLINATION AT T
Q9001700217	LONG. OF ASC. NODE AT T
Q9001901119	MEAN MOTION AT T(0)
Q9002200222	ALPHA BAR
Q9002400224	ALPHA SUB K
Q9002500225	BETA BAR
Q9002800228	GAMMA BAR
Q9003100231	P BAR
Q9003400234	Q BAR
Q9003700237	R BAR (POSITION VECTOR)
Q9004000240	E(T) (ECCENTRIC ANOMALY)
Q9004100241	V BAR (VELOCITY VECTOR)
Q9005000200	T, TIME OF OBS. IN C.U.T.
Q9008502085	VQ
Q9008602001	VECTOR MOVE
Q9008702061	CROSS PRODUCT
Q9008802011	VECTOR MAGNITUDE
Q9008902196	SQUARE ROOT
Q9009002271	PRINCIPAL VALUE

Q9009102101	SIN
Q9009202105	COS
Q9009302216	KEPLER
Q9009402031	VECTOR ADD
Q9009502041	VECTOR SUBTRACT
Q9009602076	SCALAR MULTIPLY
V00007+50000000+01	
V00008+40000000+01	
V00049+00000000+00	ZERO
V00050+00000000+00	ZERO
V00051+10000000+01	ONE

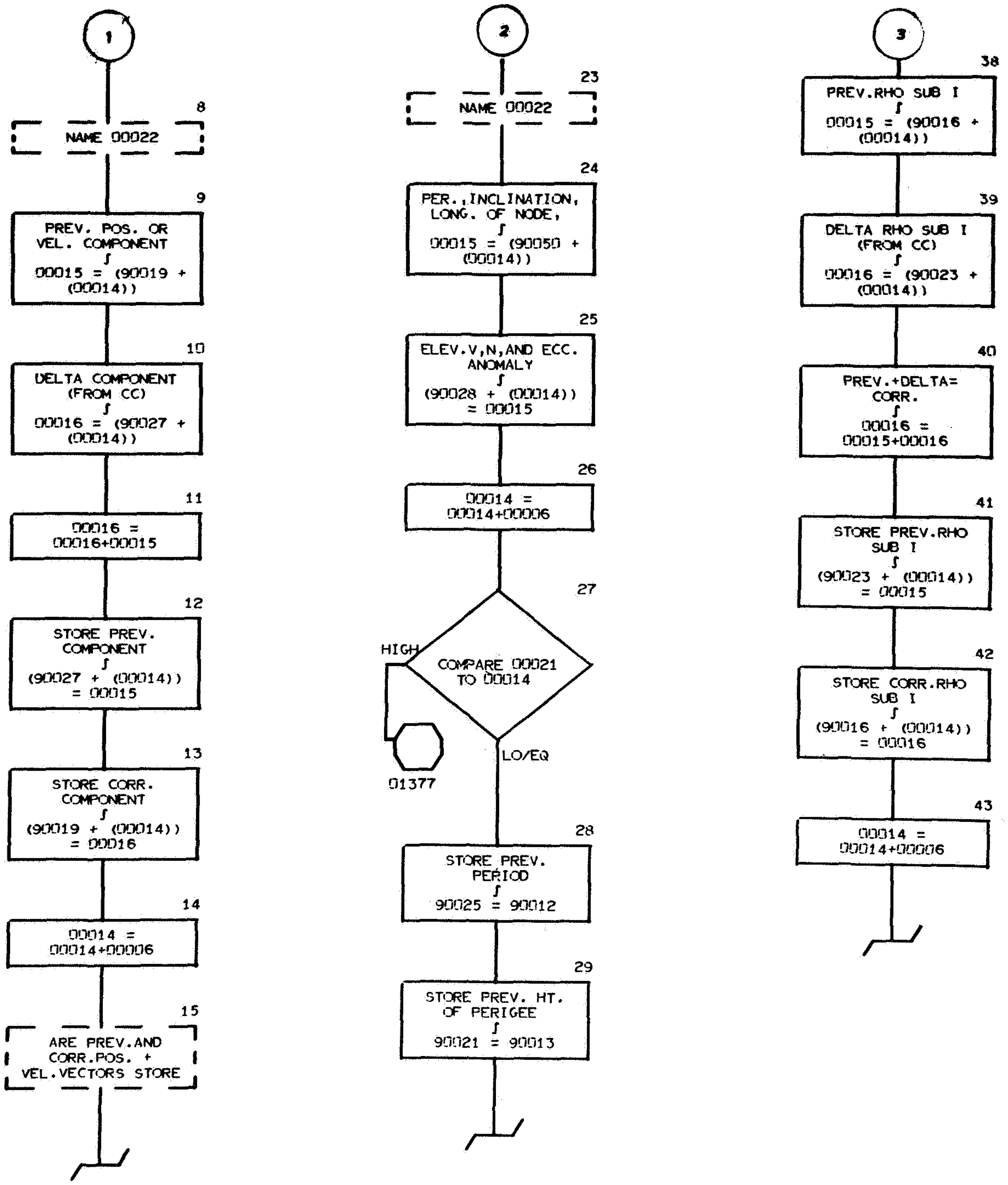
CROSS-REFERENCE LISTING

PAGE BOX	LABEL	REFERENCE	
28.01	01301	10.30*	08.27*

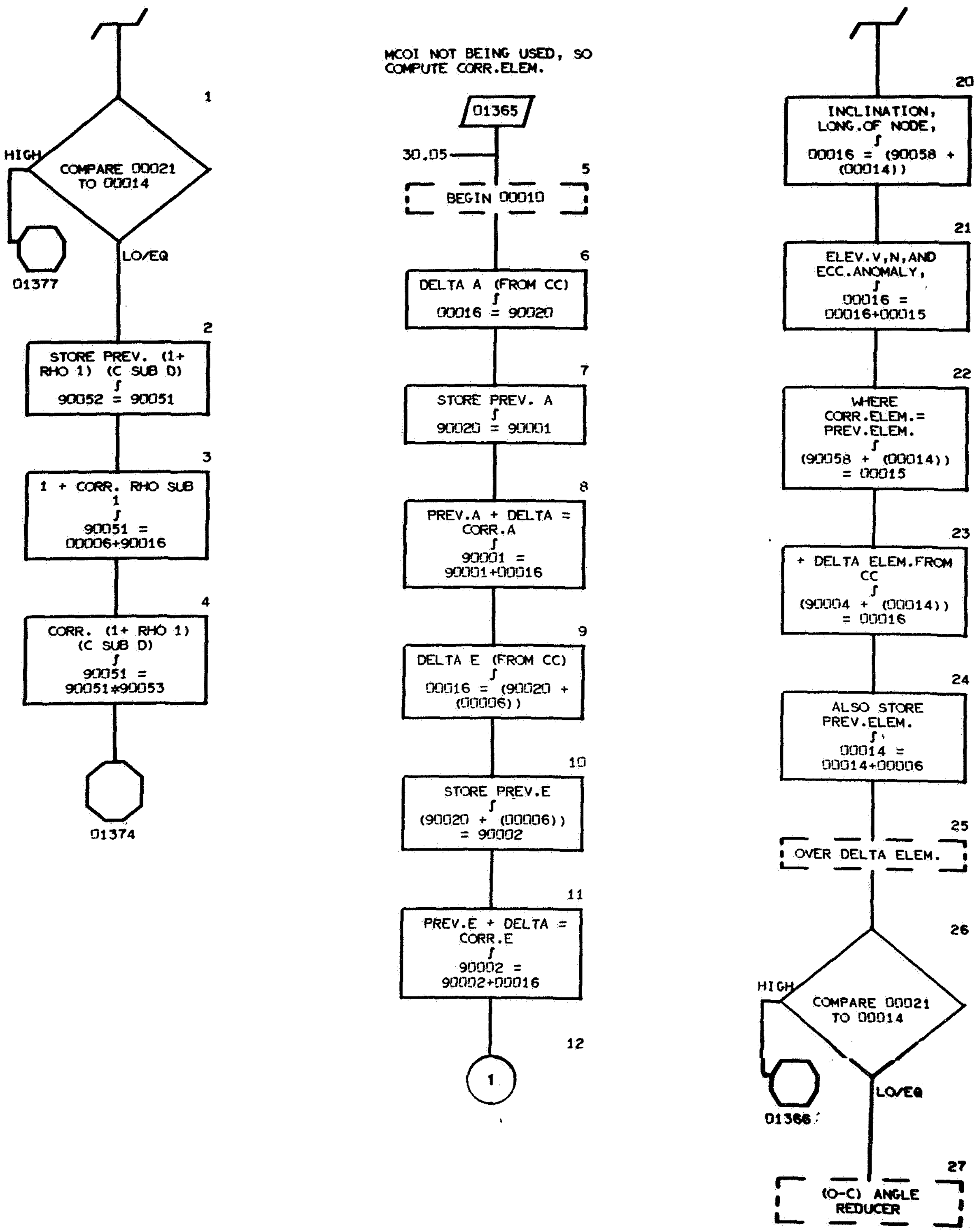
K VALUE = 01355



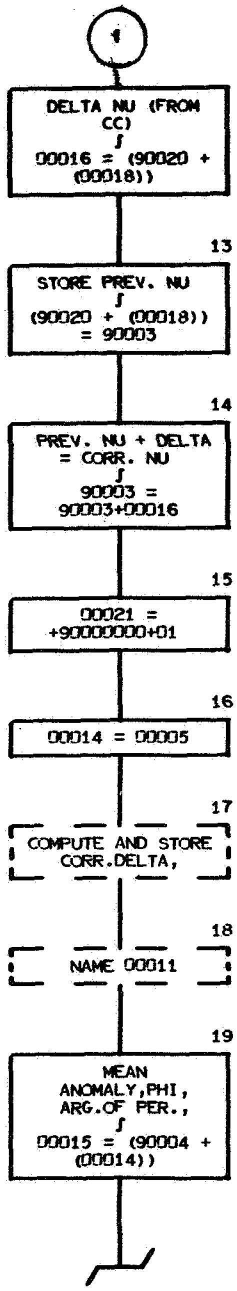
PAGE 30 CONTINUED



K VALUE = 01355



PAGE 31 CONTINUED



MISCELLANEOUS STATEMENTS

K VALUE = 01355

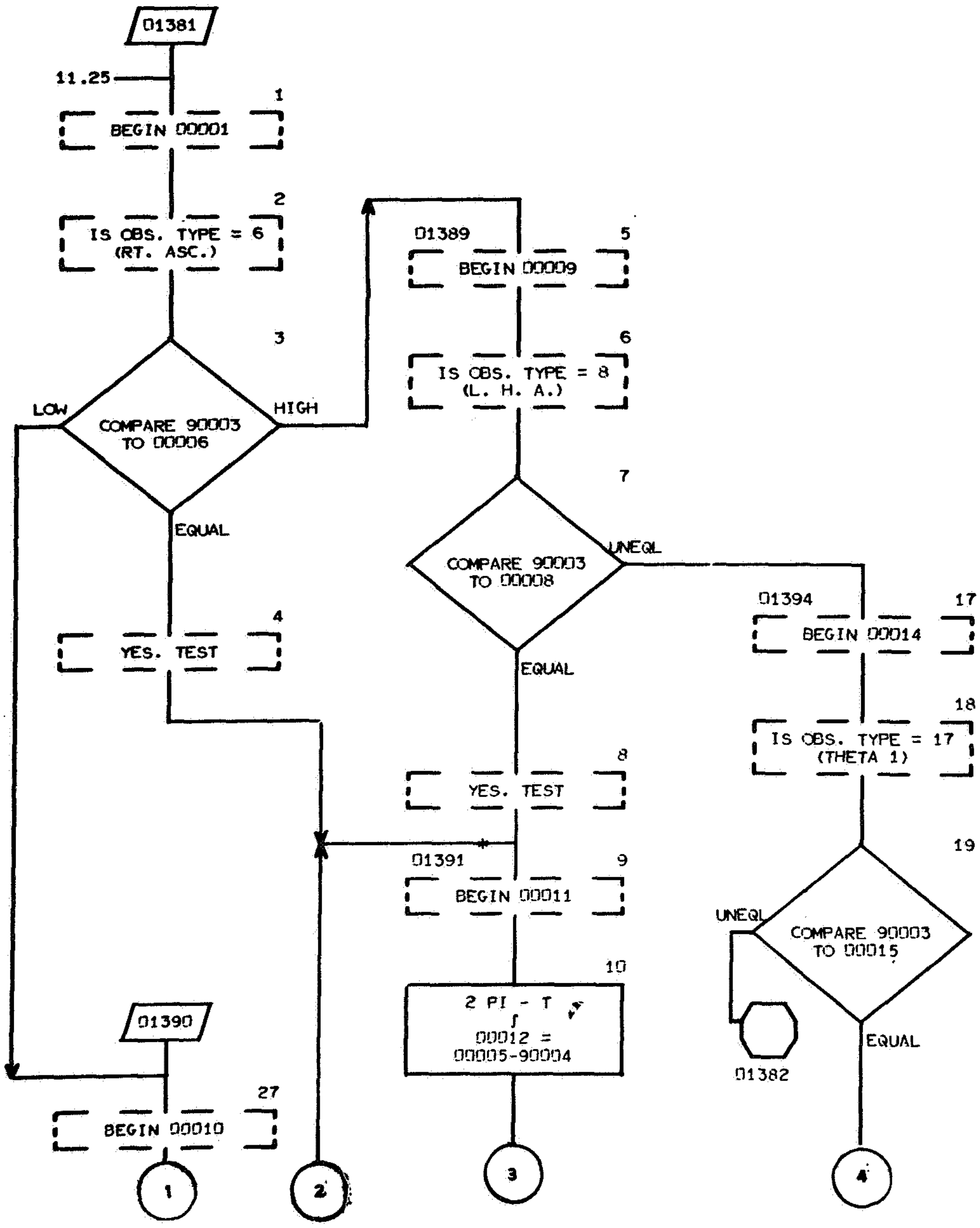
Q9000001100	1ST OF 100 LOCS.FROM WHICH BIN. RECO
Q9000101101	A (PREVIOUS ELEMENTS, WHICH
Q9000201102	E REPLACED BY CORRECTED ELE
Q9000301103	NU THE FUNCTION)
Q9000401112	ANGLE DELTA
Q9000501113	M
Q9000601114	ANGLE PHI
Q9000701115	ARG. OF PERIGEE
Q9000801116	I
Q9000901117	LONG. OF NODE
Q9001001119	N
Q9001101120	ECC. ANOMALY
Q9001201123	PERIOD
Q9001301124	HT. OF PERIGEE
Q9001401125	HT. OF APOGEE
Q9001601150	N(2,Q) OR RHO SUB I
Q9001701170	N3,Q
Q9001801196	SIGMA
Q9001901104	FIRST LOC. OF POS. + VEL. VECTORS
Q9002000500	DELTA A (REPL.BY PREV.A IN F.)
Q9002100523	PREV. HT. OF PERIGEE
Q9002200524	PREV. HT. OF APOGEE
Q9002300525	DELTA N(2,Q) OR DELTA RHO SUB I
Q9002400545	DELTA N3,Q (REPLACED BY PREV.N3,Q IN
Q9002500522	PREVIOUS PERIOD
Q9002700503	DELTA R BAR,V BAR (REPL.BY PREV.VECT
Q9002800509	FIRST OF 11 LOC. OF PREV. ELEM.
Q9003003851	C
Q9003103852	MU
Q9003200599	M (NO. OF UNKNOWNS)
Q9003300048	N
Q9003400049	SUM OF (O-C) SQ.
Q9003500178	SIGMA
Q9003600065	CHANGE IN SIGMA
Q9003700082	ABS. VALUE OF DELTA SIGMA
Q9003800019	(DELTA SIGMA)/SIGMA
Q9004002196	SQ.RT.

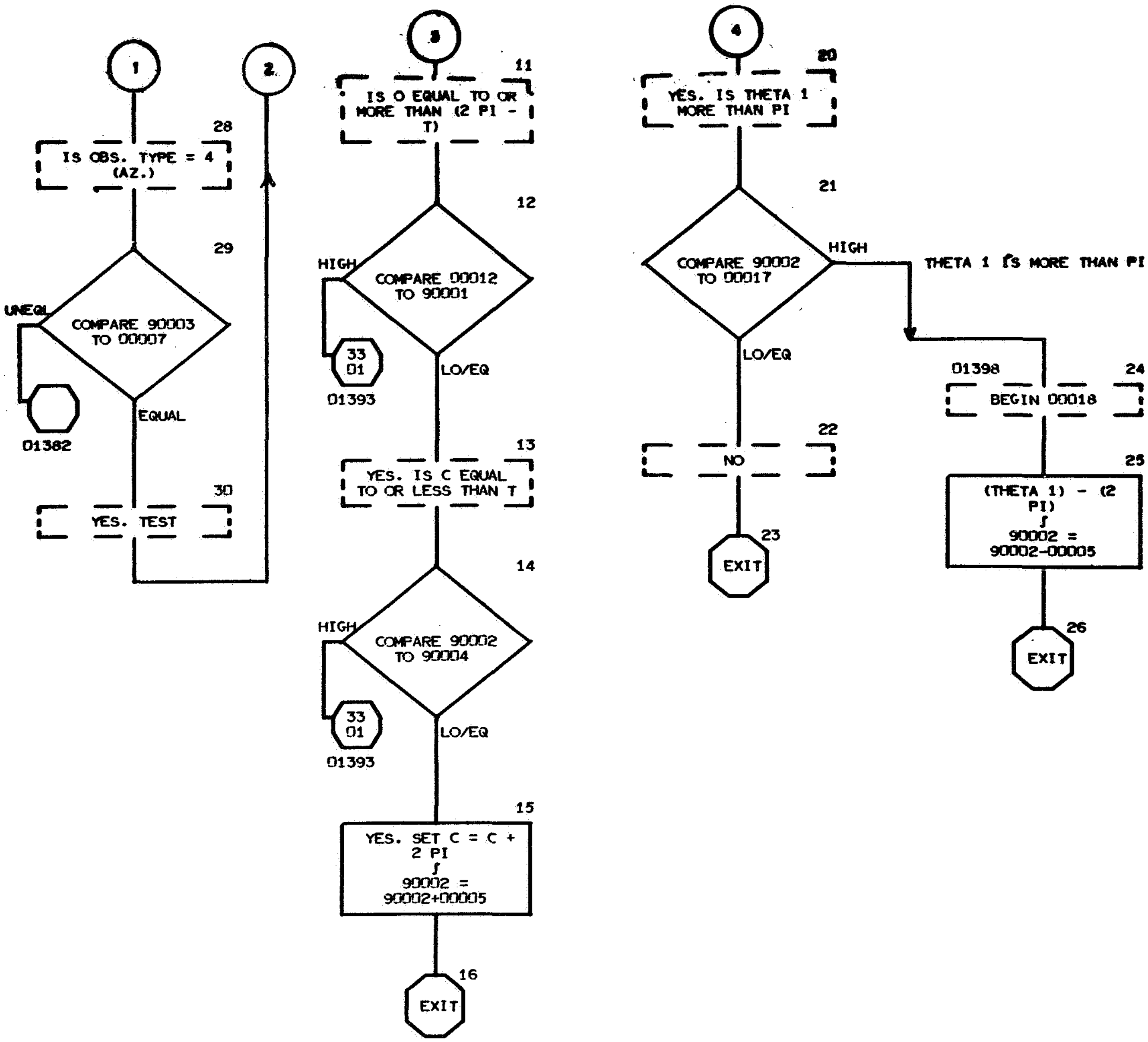
Q9004102271	ANGLE RED.
Q9004202751	ABSOLUTE VALUE
Q9004302936	ELEMENT LOAD (CONVERSION OF ELEM.)
Q9004400090	IND. OF NORMAL OR SPECIAL ENTRY TO E
Q9005001110	FIRST OF 11 LOC. OF PREV. ELEM.
Q9005100567	CORR. VALUE OF (1+ RHO 1) (C SUB D)
Q9005200566	PREV. VALUE OF (1+ RHO 1) (C SUB D)
Q9005300267	C SUB D
Q9005402011	VECTOR MAGNITUDE F.
Q9005501107	PREV.VEL.VECTOR (REPL.BY CORR. IN F.
Q9005601111	PREV.MAG.VEL. (REPL.BY CORR. IN F.)
Q9005700510	DELTA MAG.VEL. (REPL.BY PREV. IN F.)
Q9005800511	1ST LOC.OF 9 DELTAS (REPL.BY PREV.EL
Q9006904491	ORBIT GENERATOR INITIALIZE
Q9007004501	ORBIT GENERATOR
Q9007100200	OBS. TIME IN C.U.T.
Q9010000099	ORBIT GENERATOR IDENT.
Q0000803842	2 PI
V00005+00000000+00	
V00006+10000000+01	
V00007+20000000+02	
V00009-10000000+01	
V00012+10000000+03	
V00018+20000000+01	

CROSS-REFERENCE LISTING

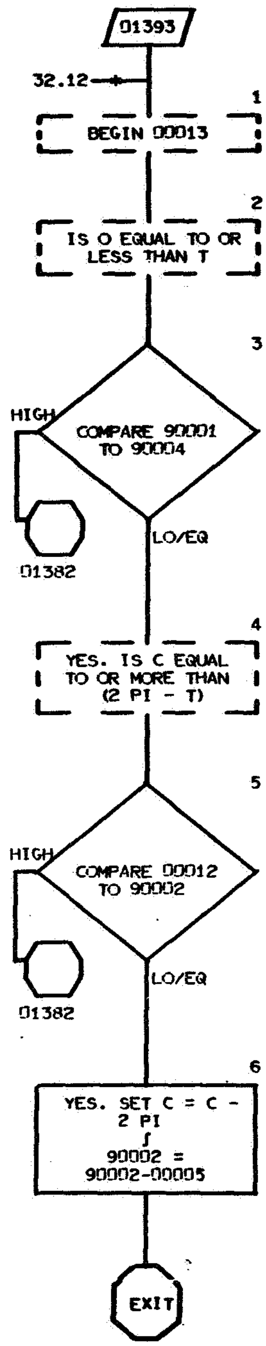
PAGE BOX	LABEL	REFERENCES
30.01	01356	14.24*
31.05	01365	30.05

ANGLE REDUCER FOR
ABS.VALUE OF (O-C)




1
2
28
IS OBS. TYPE = 4 (AZ.)
29
COMPARE 90003 TO 00007
UNEQL
01382
EQUAL
30
YES. TEST
3
11
IS O EQUAL TO OR MORE THAN (2 PI - T)
12
COMPARE 00012 TO 90001
HIGH
33 01
01393
LO/EQ
13
YES. IS C EQUAL TO OR LESS THAN T
14
COMPARE 90002 TO 90004
HIGH
33 01
01393
LO/EQ
15
YES. SET C = C + 2 PI
90002 = 90002+00005
16
EXIT
4
20
YES. IS THETA 1 MORE THAN PI
21
COMPARE 90002 TO 00017
HIGH
THETA 1 IS MORE THAN PI
LO/EQ
22
NO
23
EXIT
01398
24
BEGIN 00018
25
(THETA 1) - (2 PI)
90002 = 90002-00005
26
EXIT

K VALUE = 01380



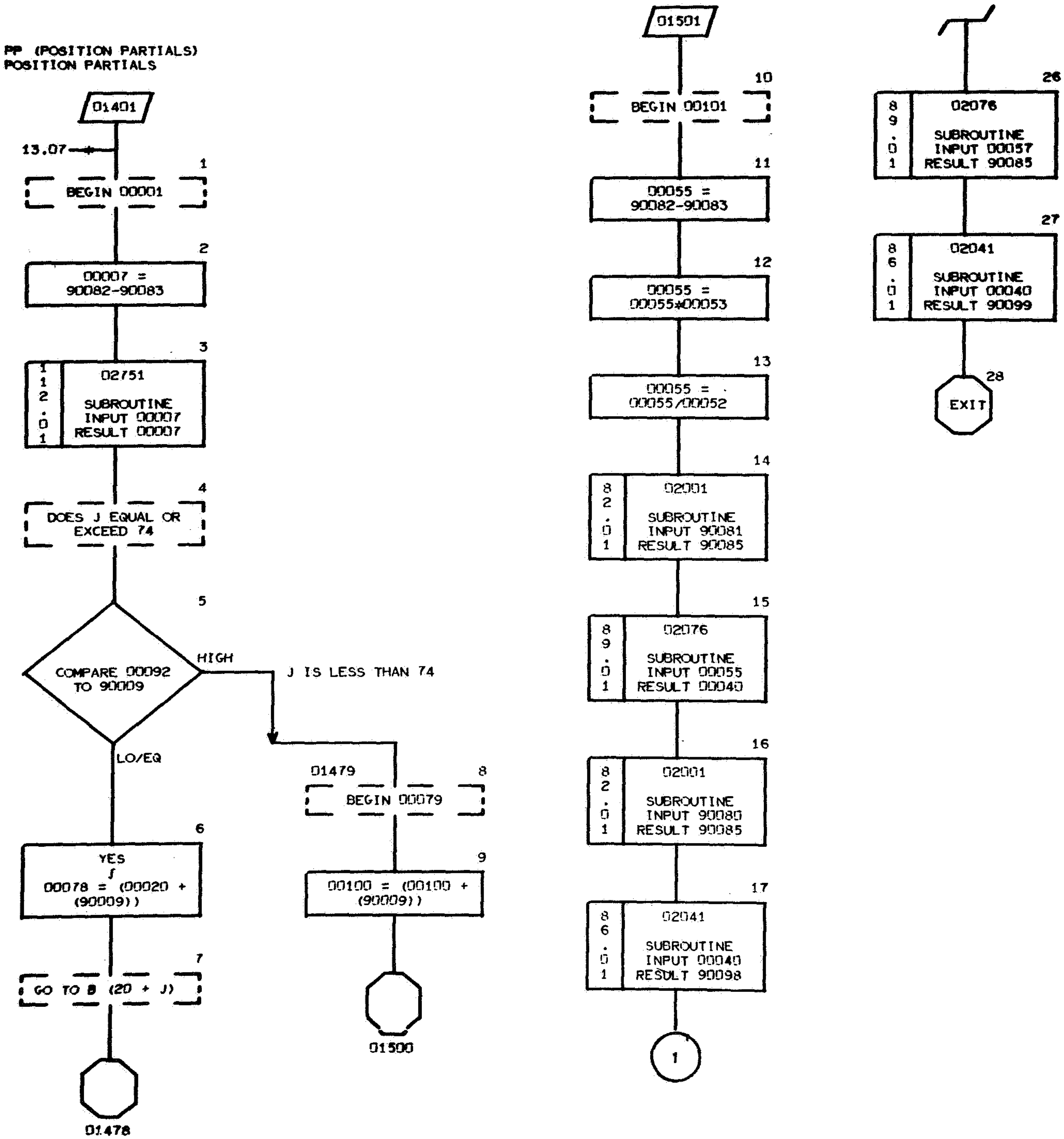
CROSS-REFERENCE LISTING

PAGE BOX	TABLE	REFERENCES	
K VALUE = 01380			
32.01	01381	11.25*	
32.05	01389	32.03	
32.09	01391	32.04	32.30
32.17	01394	32.07	
32.24	01398	32.21	
32.27	01390	32.03	
33.01	01393	32.12	32.14

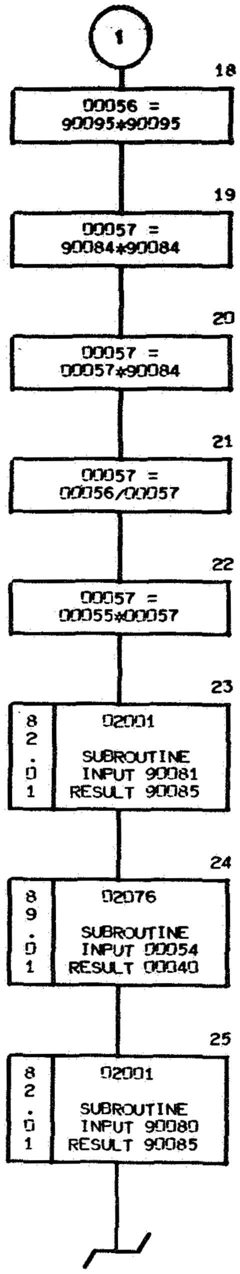
K VALUE = 01380

Q9000100255	O (OBS. QUANTITY IN RAD.)
Q9000200256	C (COMPUTED QUANTITY IN RAD.)
Q9000300253	OBSERVATION TYPE
Q9000400496	T (TOLERANCE IN RAD.)
Q0000503842	2 PI
Q0001703839	PI
V00006+60000000+01	(PURPOSE IS TO REDUCE COMPUTED ANGL
V00007+40000000+01	WHEN (O-C) IS LARGE DUE TO DIFF.
V00008+80000000+01	AROUND 2 PI. ALL INPUT AND OUTPUT I
V00015+17000000+02	USES 18 LOCS.)

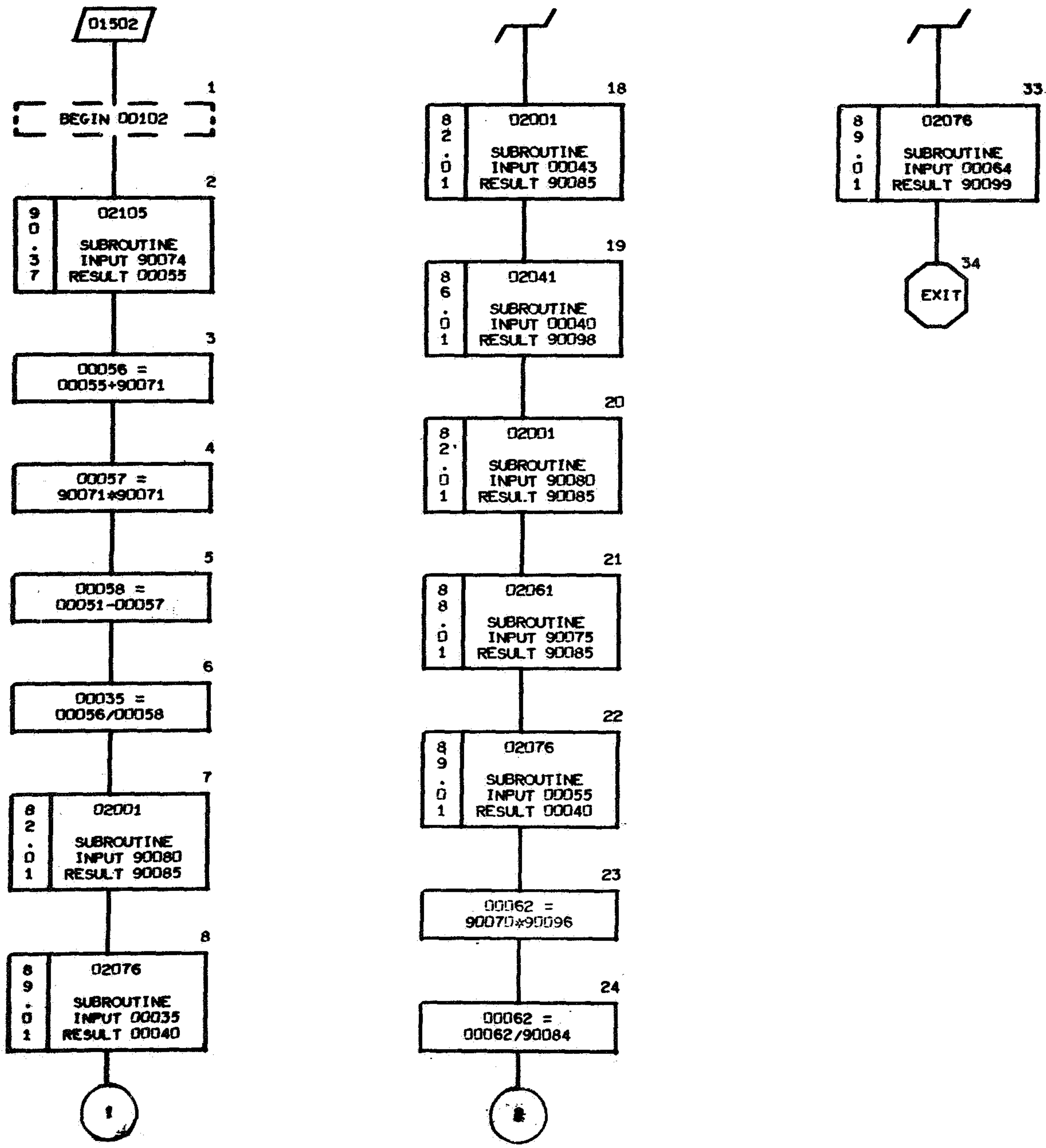
K VALUE = 01400



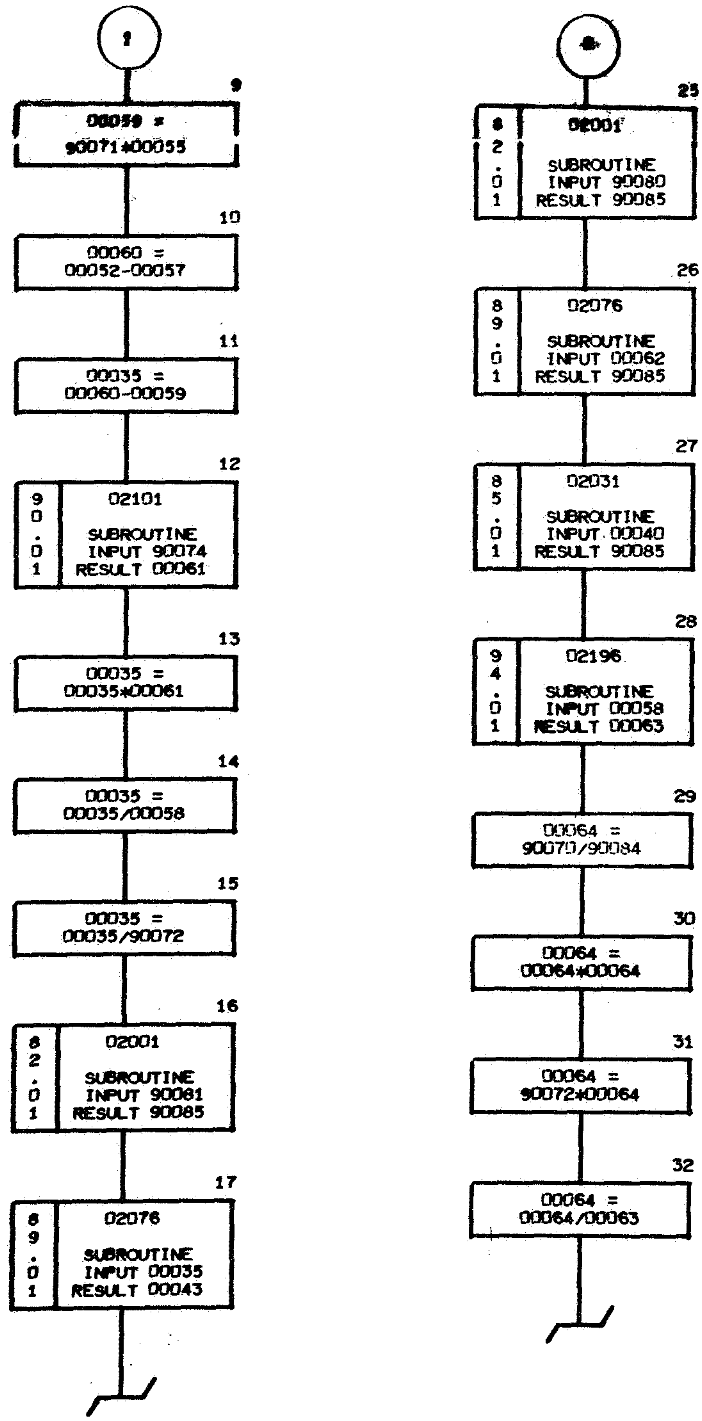
PAGE 34 CONTINUED



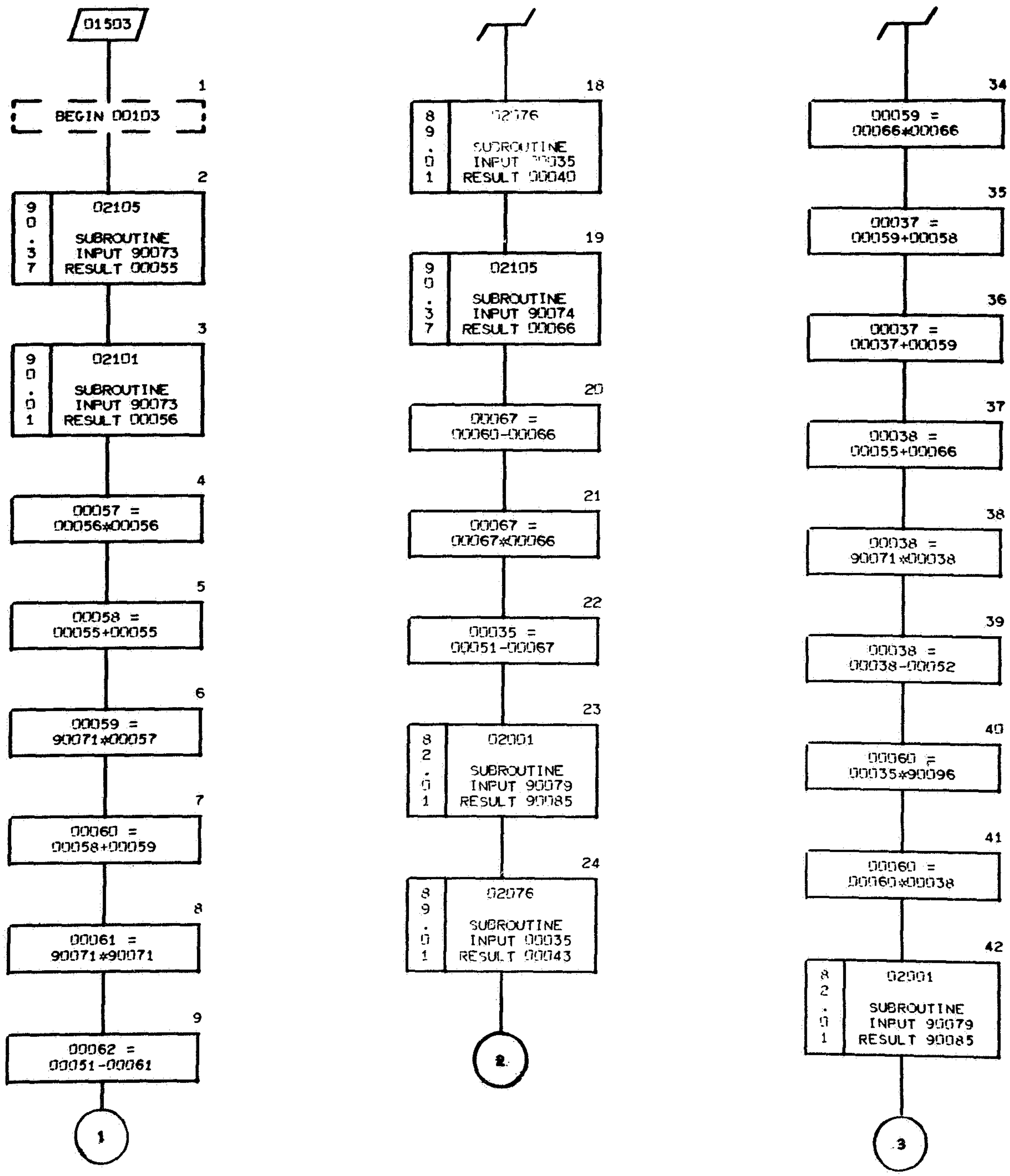
K VALUE = 01400

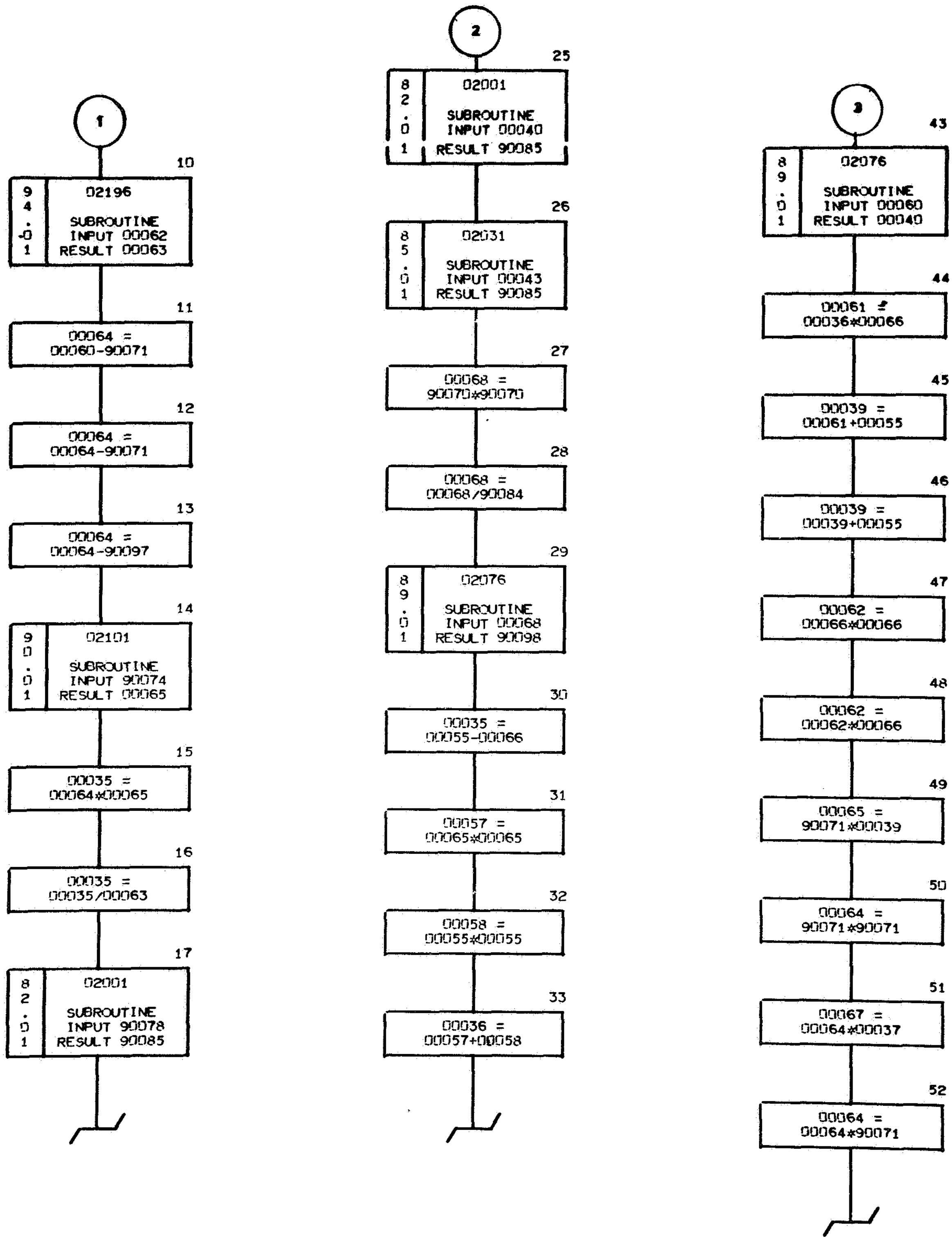


PAGE 35 CONTINUED

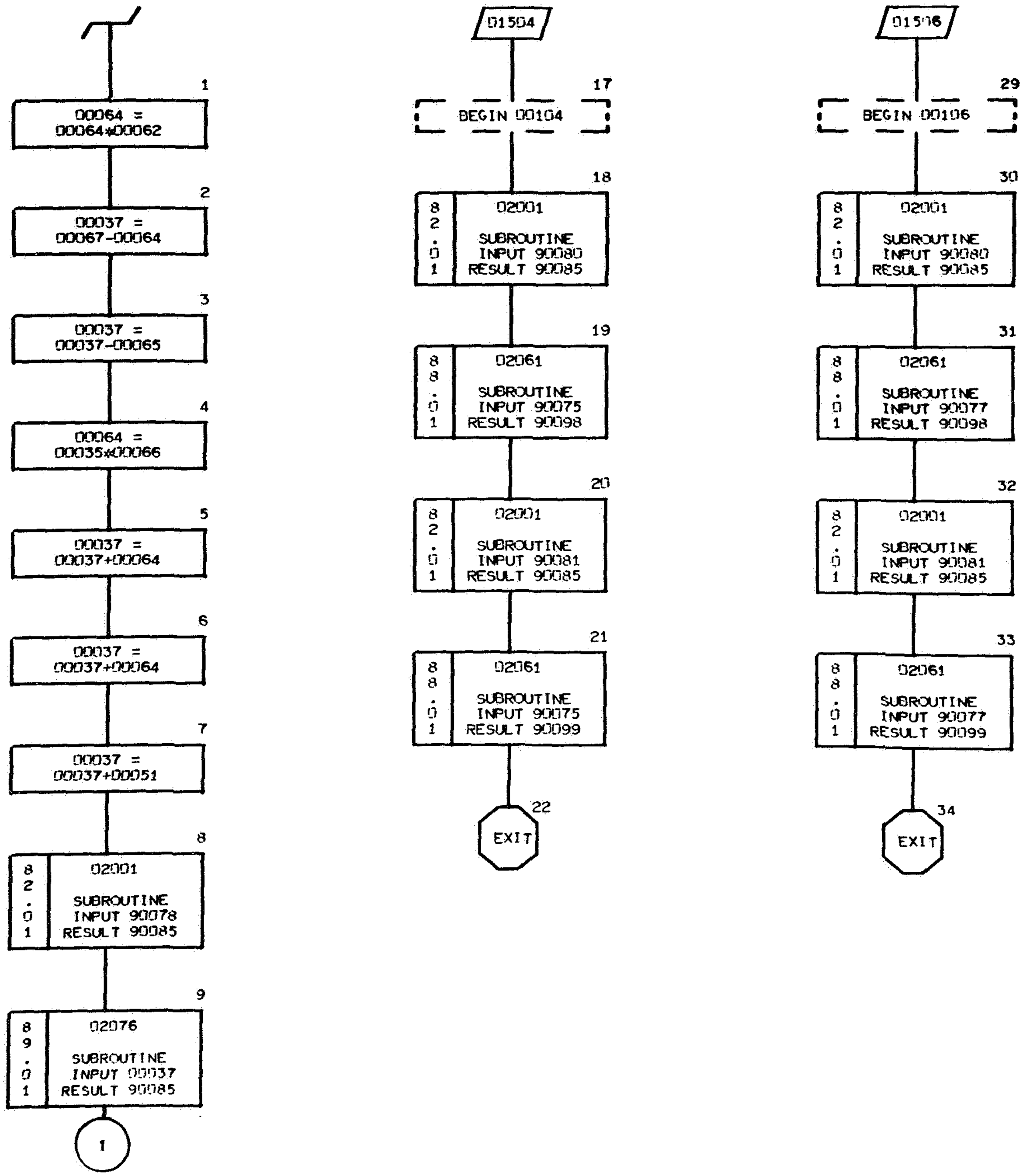


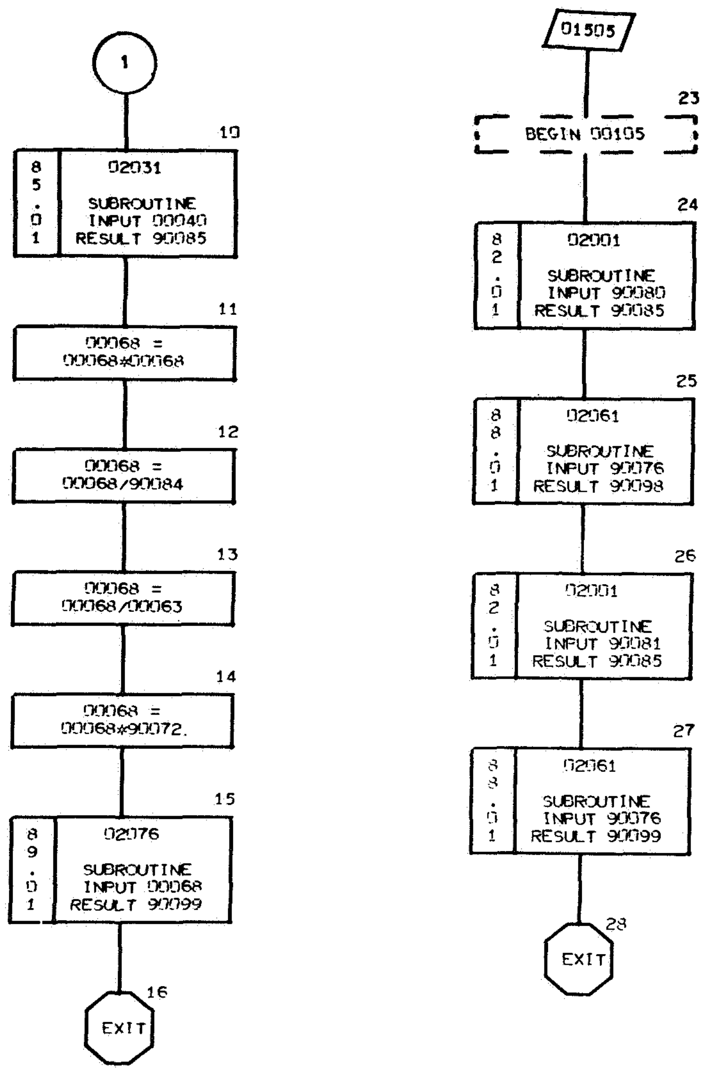
K VALUE = 01400



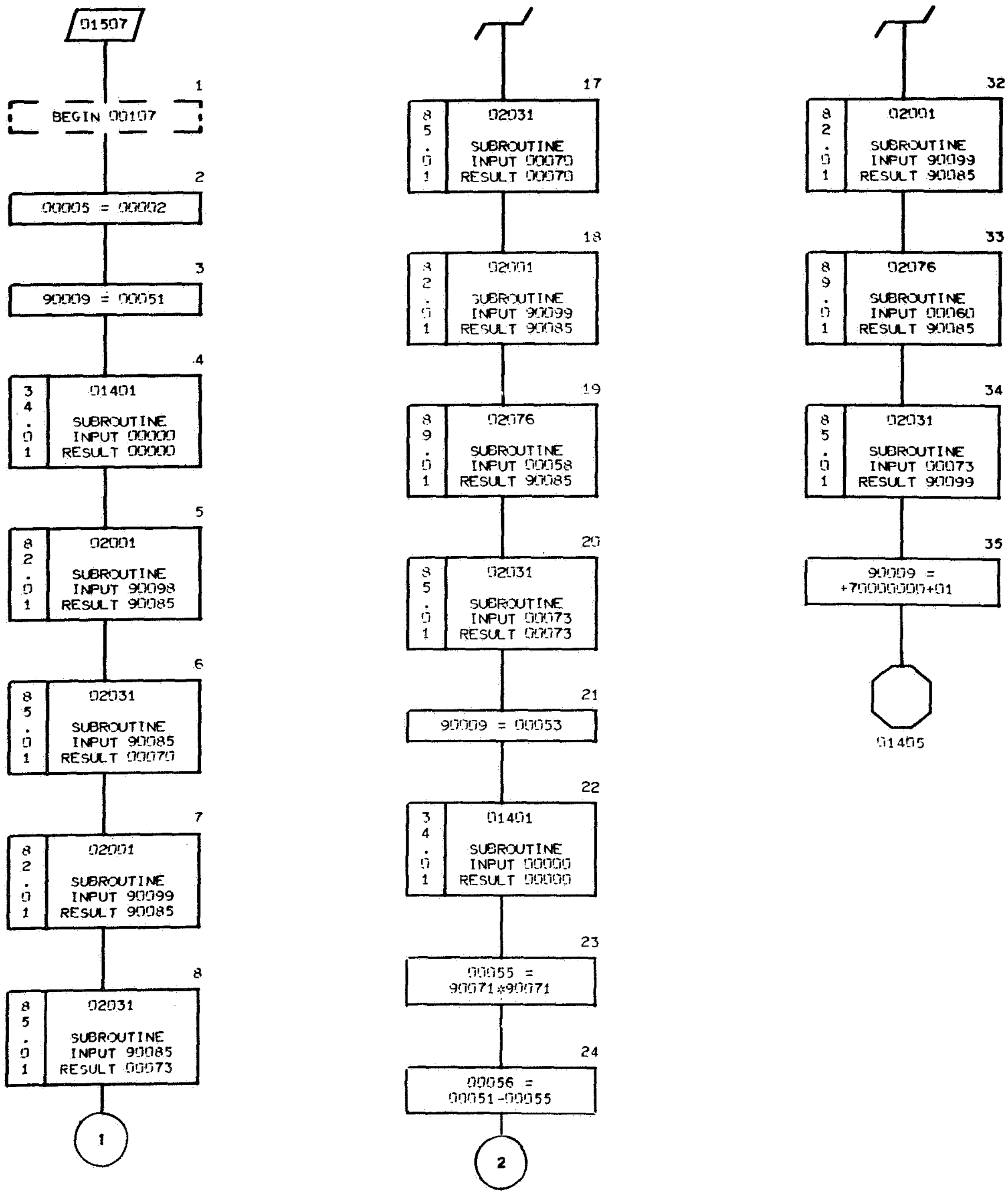

1
10
94.01
02196
SUBROUTINE
INPUT 00062
RESULT 00063
11
00064 = 00060-90071
12
00064 = 00064-90071
13
00064 = 00064-90097
14
90.01
02101
SUBROUTINE
INPUT 90074
RESULT 00065
15
00035 = 00064*00065
16
00035 = 00035/00063
17
82.01
02001
SUBROUTINE
INPUT 90078
RESULT 90085
2
25
82.01
02001
SUBROUTINE
INPUT 00040
RESULT 90085
26
85.01
02031
SUBROUTINE
INPUT 00043
RESULT 90085
27
00068 = 90070*90070
28
00068 = 00068/90084
29
89.01
02076
SUBROUTINE
INPUT 00068
RESULT 90098
30
00035 = 00055-00066
31
00057 = 00065*00065
32
00058 = 00055*00055
33
00036 = 00057+00058
3
43
89.01
02076
SUBROUTINE
INPUT 00060
RESULT 00040
44
00061 = 00036*00066
45
00039 = 00061+00055
46
00039 = 00039+00055
47
00062 = 00066*00066
48
00062 = 00062*00066
49
00065 = 90071*00039
50
00064 = 90071*90071
51
00067 = 00064*00037
52
00064 = 00064*90071

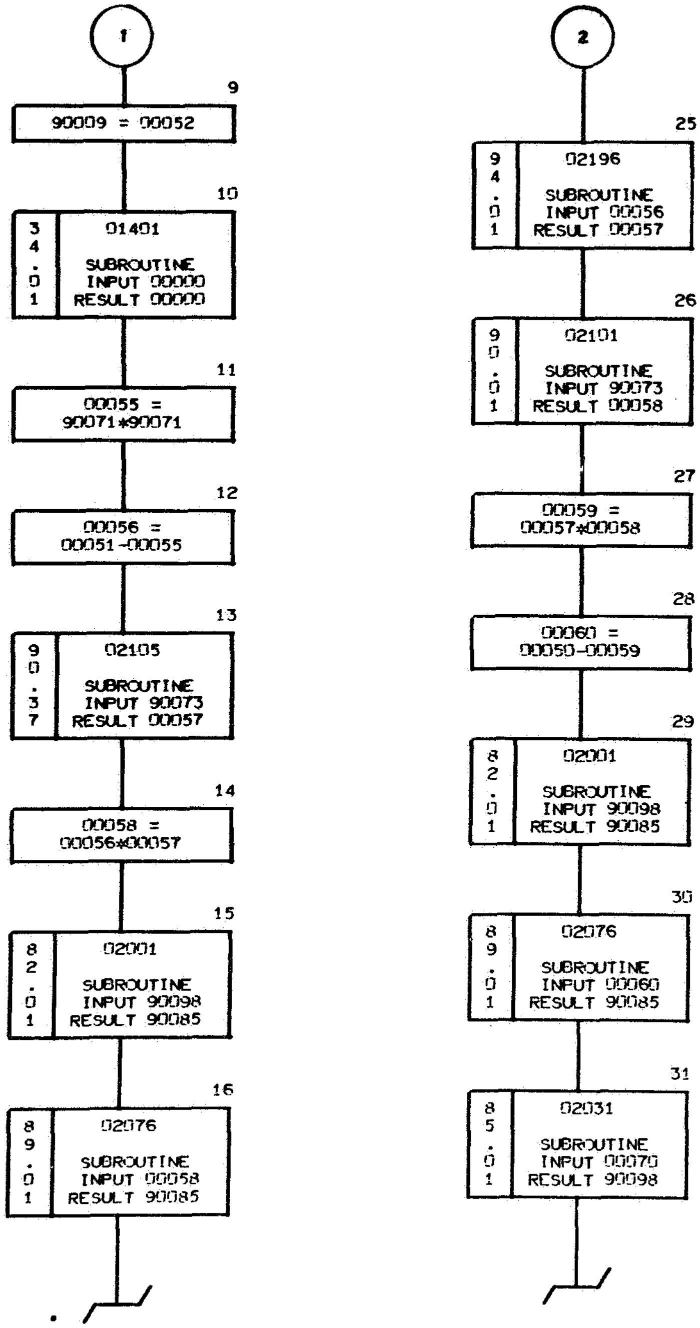
K VALUE = 01400



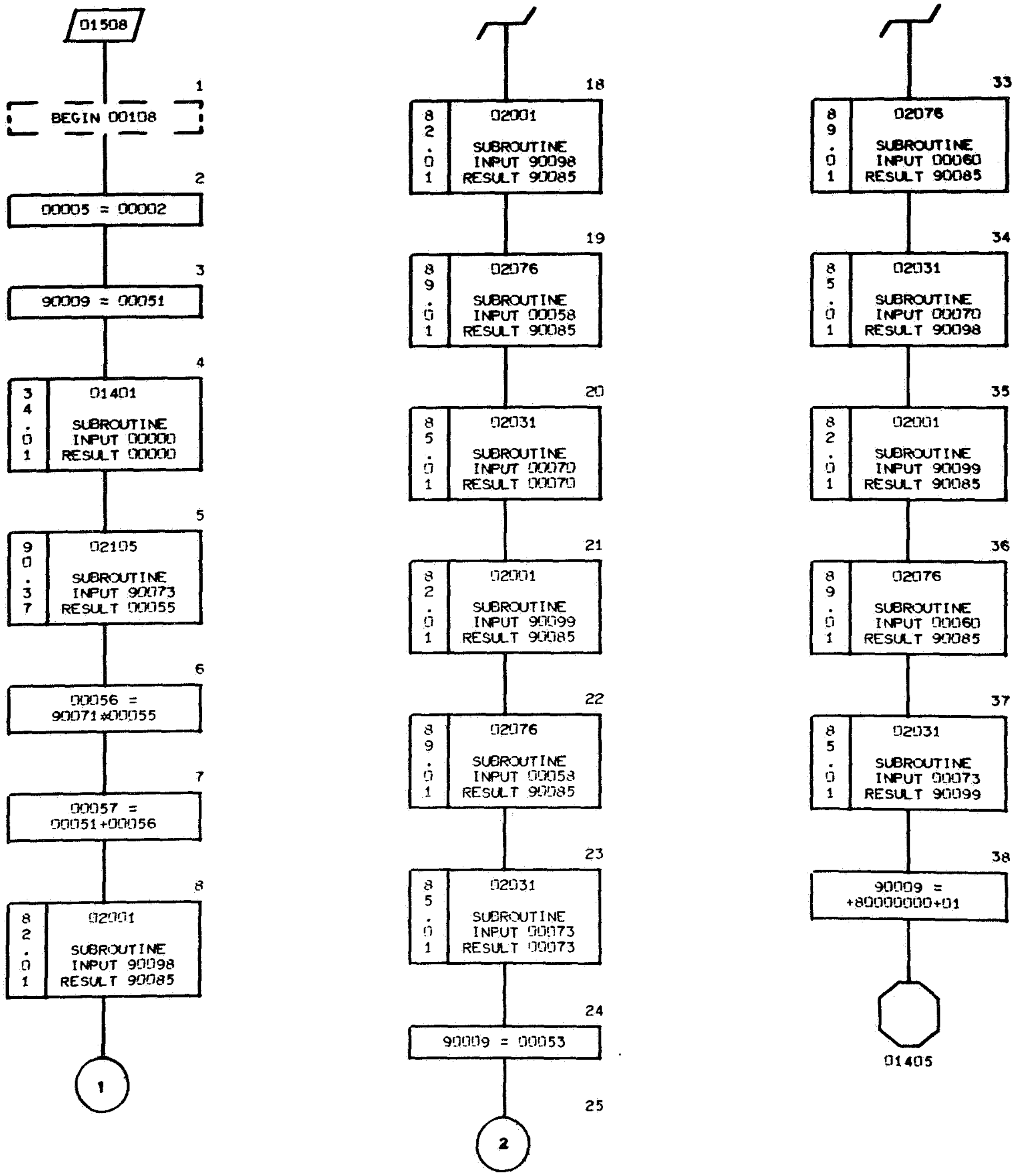

1
10
85.01
02031
SUBROUTINE
INPUT 00040
RESULT 90085
11
00068 =
00068*00068
12
00068 =
00068/90084
13
00068 =
00068/00063
14
00068 =
00068*90072.
15
89.01
02076
SUBROUTINE
INPUT 00068
RESULT 90099
16
EXIT
01505
23
BEGIN 00105
24
82.01
02001
SUBROUTINE
INPUT 90080
RESULT 90085
25
88.01
02061
SUBROUTINE
INPUT 90076
RESULT 90098
26
82.01
02001
SUBROUTINE
INPUT 90081
RESULT 90085
27
88.01
02061
SUBROUTINE
INPUT 90076
RESULT 90099
28
EXIT

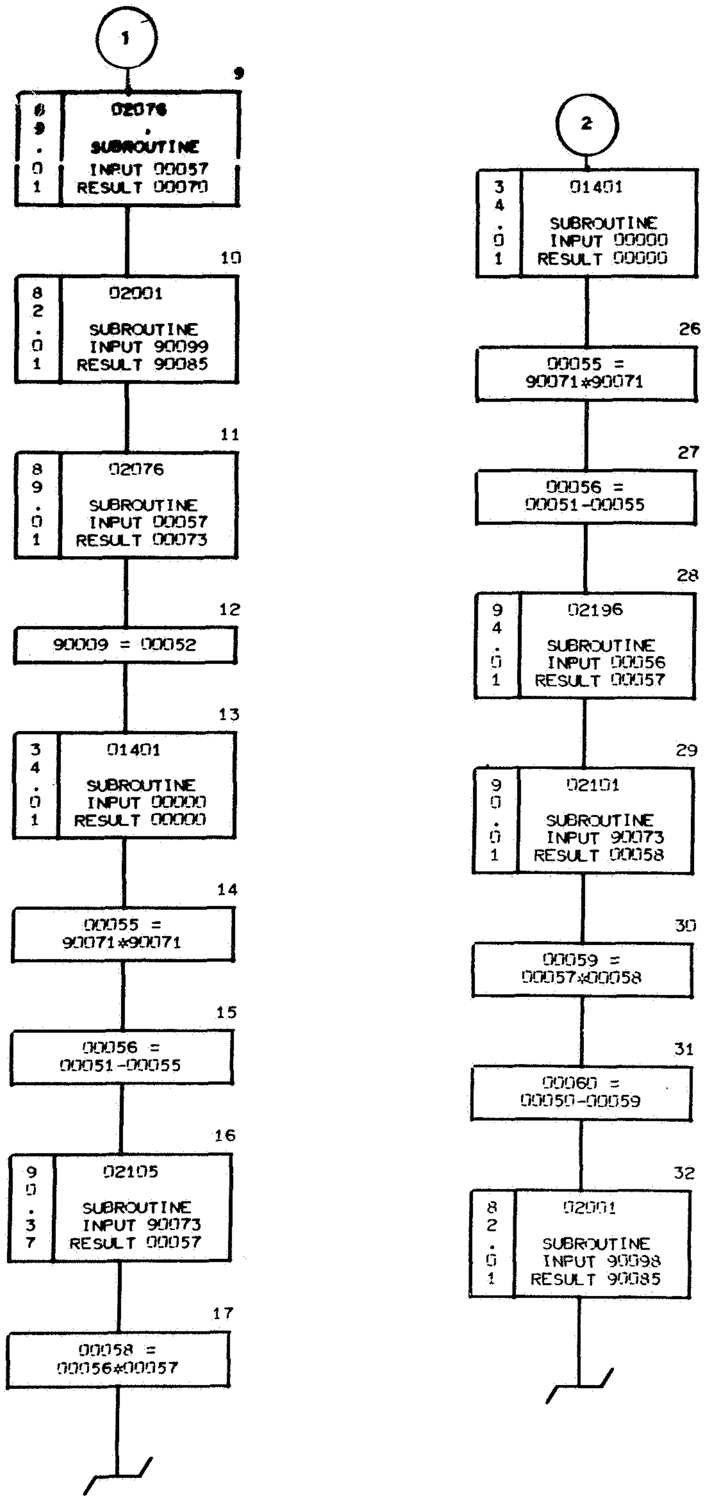
K VALUE = 01400



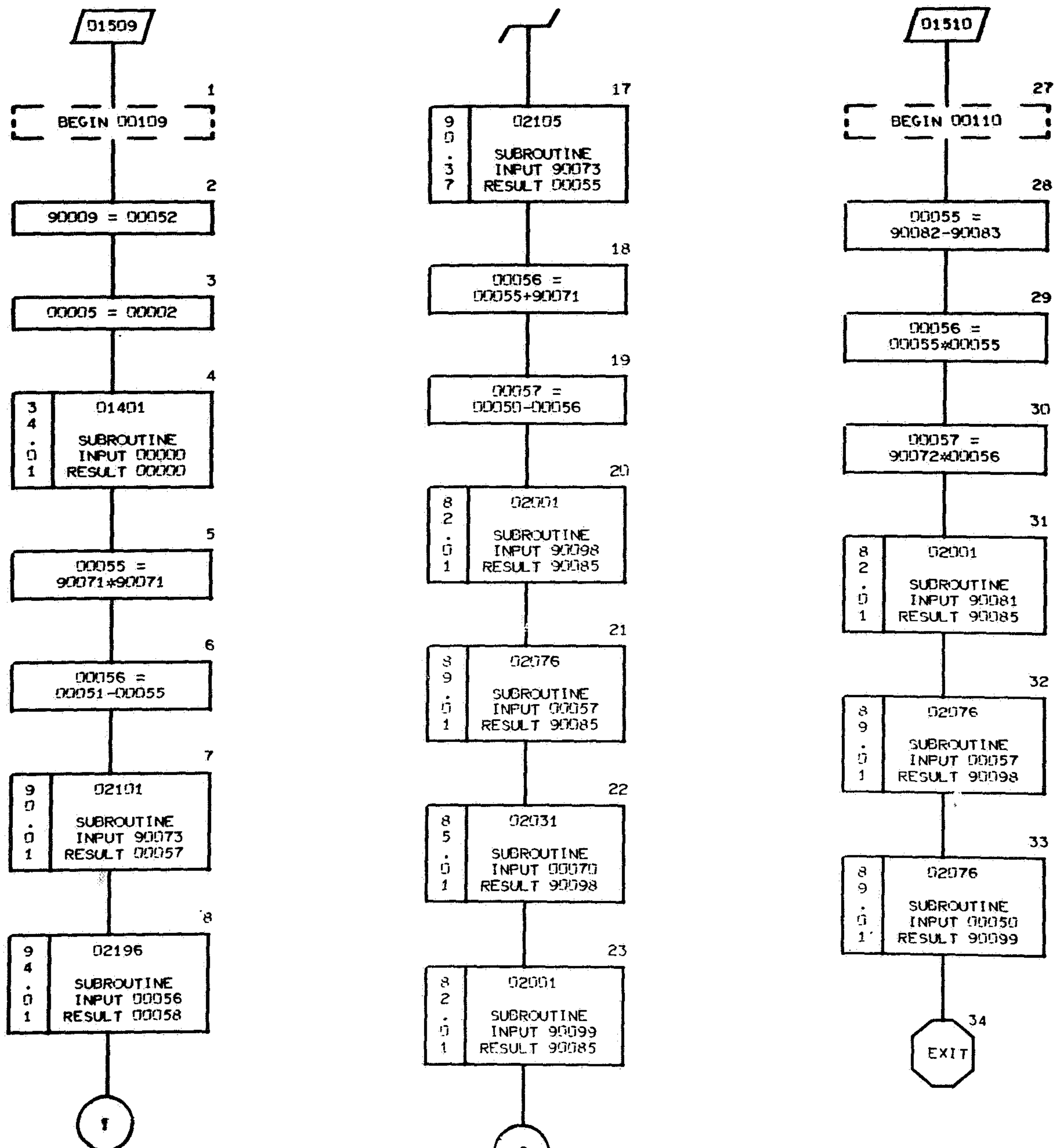

1
9
90009 = 00052
10
34.01
01401
SUBROUTINE
INPUT 00000
RESULT 00000
11
00055 =
90071*90071
12
00056 =
00051-00055
13
90.37
02105
SUBROUTINE
INPUT 90073
RESULT 00057
14
00058 =
00056*00057
15
82.01
02001
SUBROUTINE
INPUT 90098
RESULT 90085
16
89.01
02076
SUBROUTINE
INPUT 00058
RESULT 90085
2
25
94.01
02196
SUBROUTINE
INPUT 00056
RESULT 00057
26
90.01
02101
SUBROUTINE
INPUT 90073
RESULT 00058
27
00059 =
00057*00058
28
00060 =
00050-00059
29
82.01
02001
SUBROUTINE
INPUT 90098
RESULT 90085
30
89.01
02076
SUBROUTINE
INPUT 00060
RESULT 90085
31
85.01
02031
SUBROUTINE
INPUT 00070
RESULT 90098

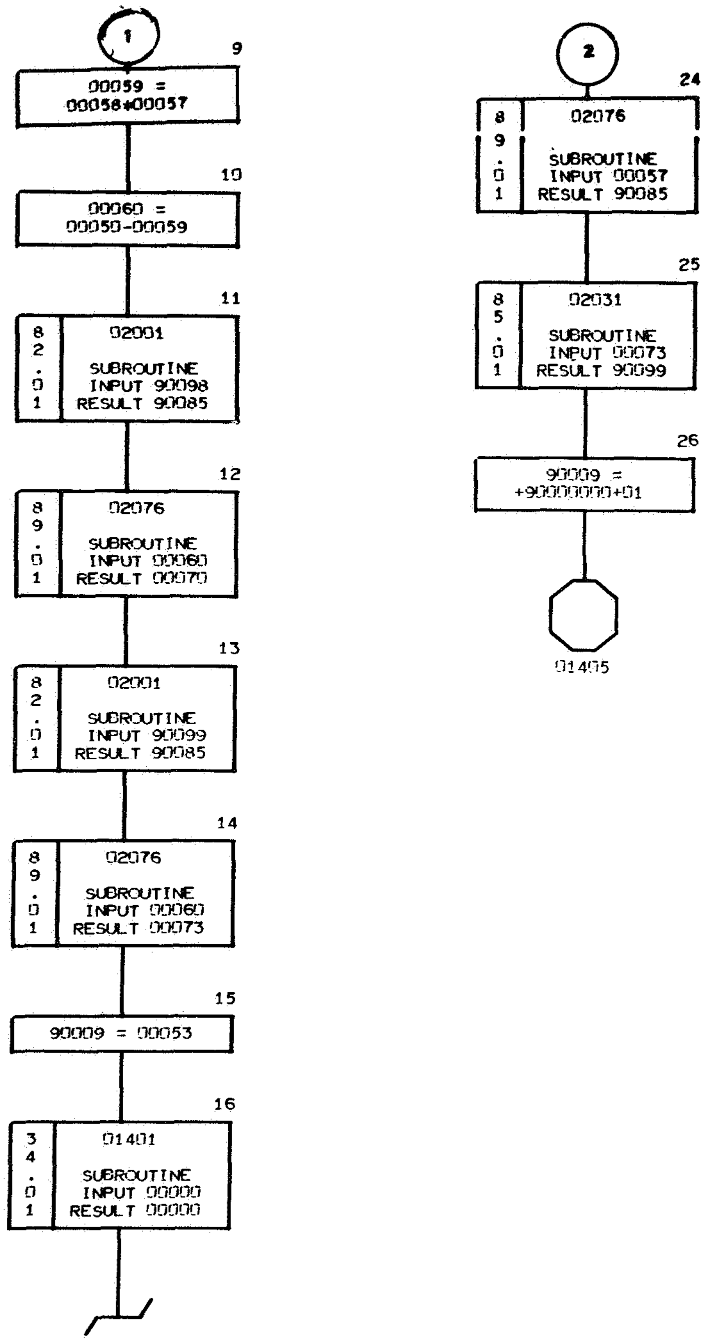
K VALUE = 01400



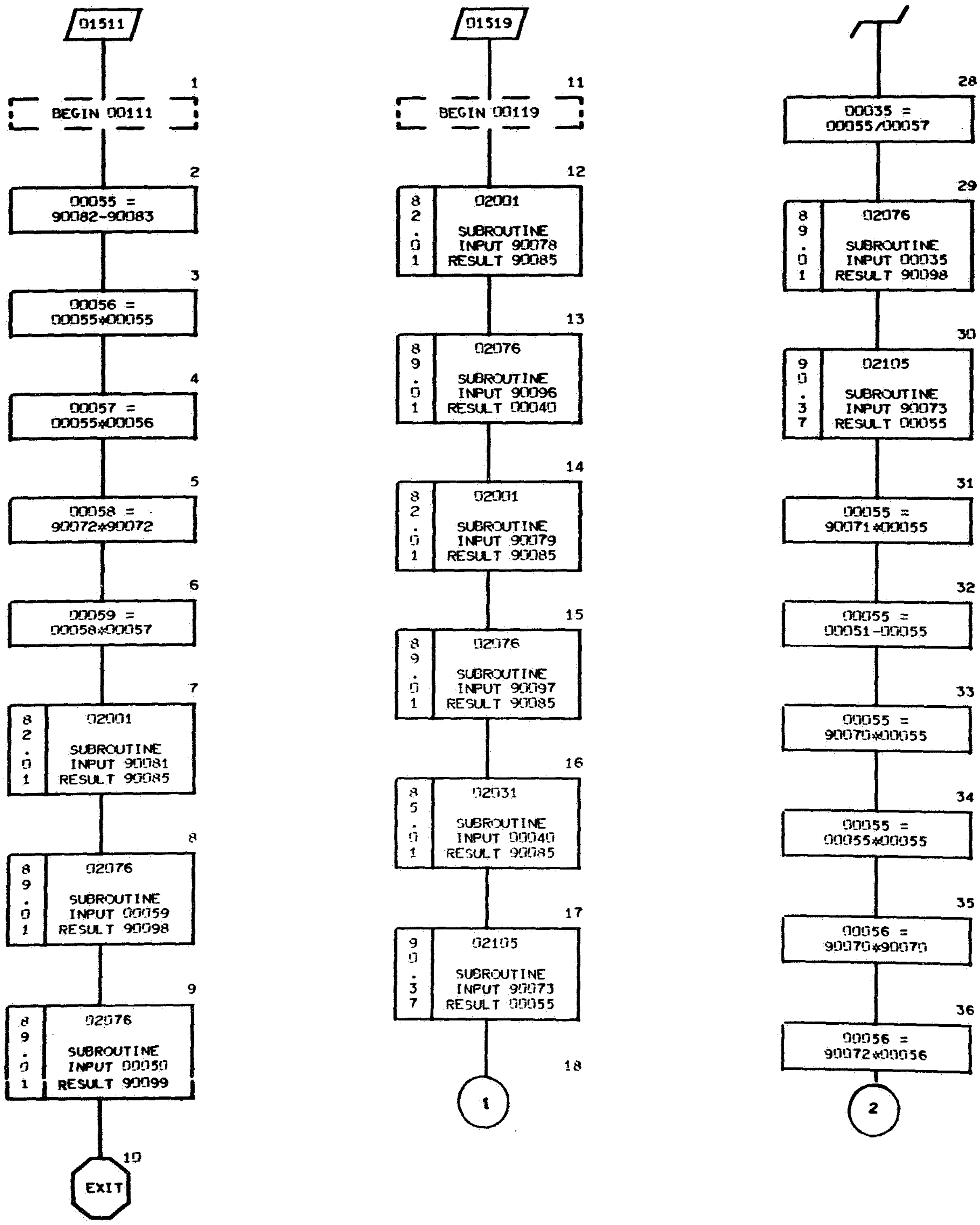

1
9
89.01
02076
SUBROUTINE
INPUT 00057
RESULT 00070
10
82.01
02001
SUBROUTINE
INPUT 90099
RESULT 90085
11
89.01
02076
SUBROUTINE
INPUT 00057
RESULT 00073
12
90009 = 00052
13
34.01
01401
SUBROUTINE
INPUT 00000
RESULT 00000
14
00055 =
90071*90071
15
00056 =
00051-00055
16
90.37
02105
SUBROUTINE
INPUT 90073
RESULT 00057
17
00058 =
00056*00057
2
34.01
01401
SUBROUTINE
INPUT 00000
RESULT 00000
26
00055 =
90071*90071
27
00056 =
00051-00055
28
94.01
02196
SUBROUTINE
INPUT 00056
RESULT 00057
29
90.01
02101
SUBROUTINE
INPUT 90073
RESULT 00058
30
00059 =
00057*00058
31
00060 =
00050-00059
32
82.01
02001
SUBROUTINE
INPUT 90098
RESULT 90085

K VALUE = 01400

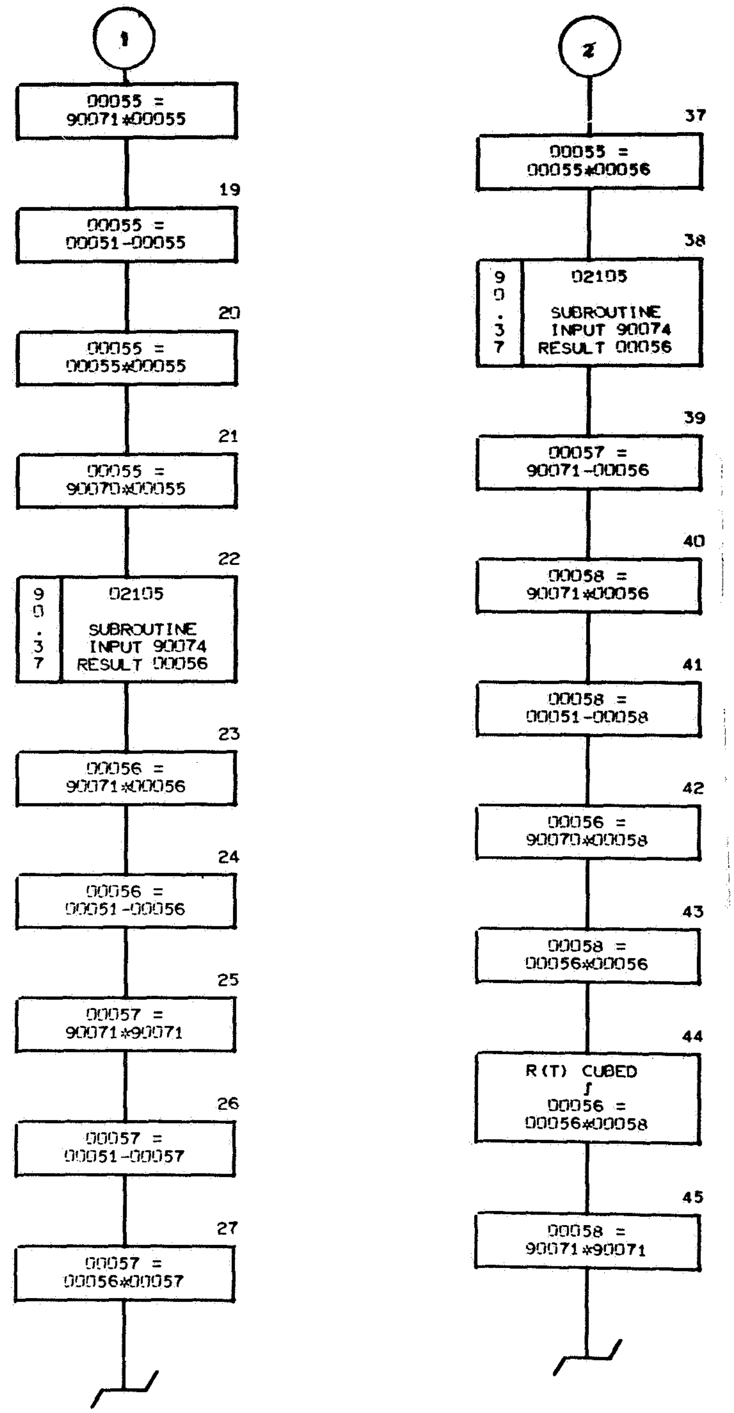



1
9
00059 =
00058+00057
10
00060 =
00050-00059
11
8 2 . 0 1
02001
SUBROUTINE
INPUT 90098
RESULT 90085
12
8 9 . 0 1
02076
SUBROUTINE
INPUT 00060
RESULT 00070
13
8 2 . 0 1
02001
SUBROUTINE
INPUT 90099
RESULT 90085
14
8 9 . 0 1
02076
SUBROUTINE
INPUT 00060
RESULT 00073
15
90009 = 00053
16
3 4 . 0 1
01401
SUBROUTINE
INPUT 00000
RESULT 00000
2
24
8 9 . 0 1
02076
SUBROUTINE
INPUT 00057
RESULT 90085
25
8 5 . 0 1
02031
SUBROUTINE
INPUT 00073
RESULT 90099
26
90009 =
+90000000+01
01405

K VALUE = 01400



PAGE 41 CONTINUED



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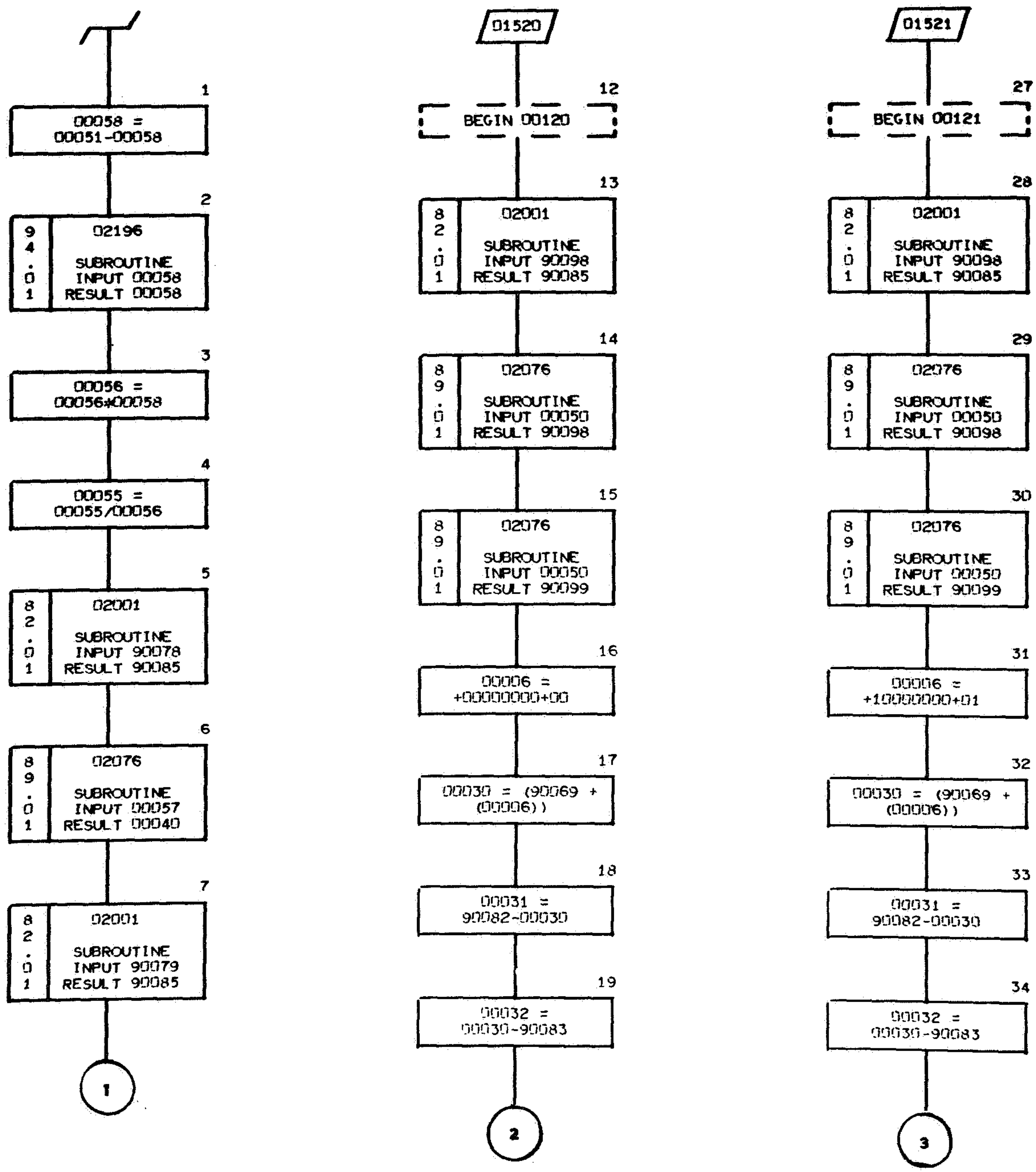
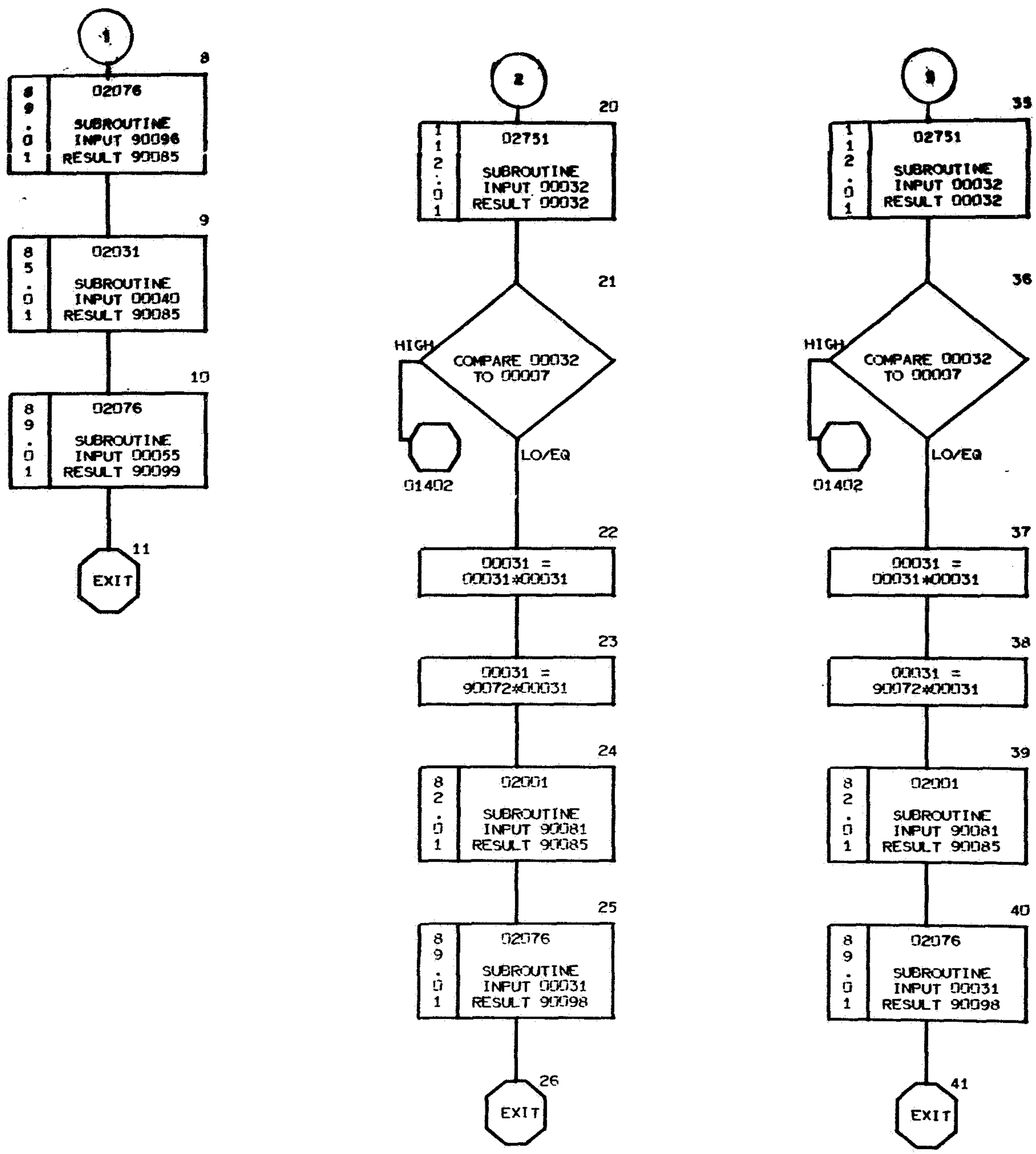


PAGE 42 CONTINUED



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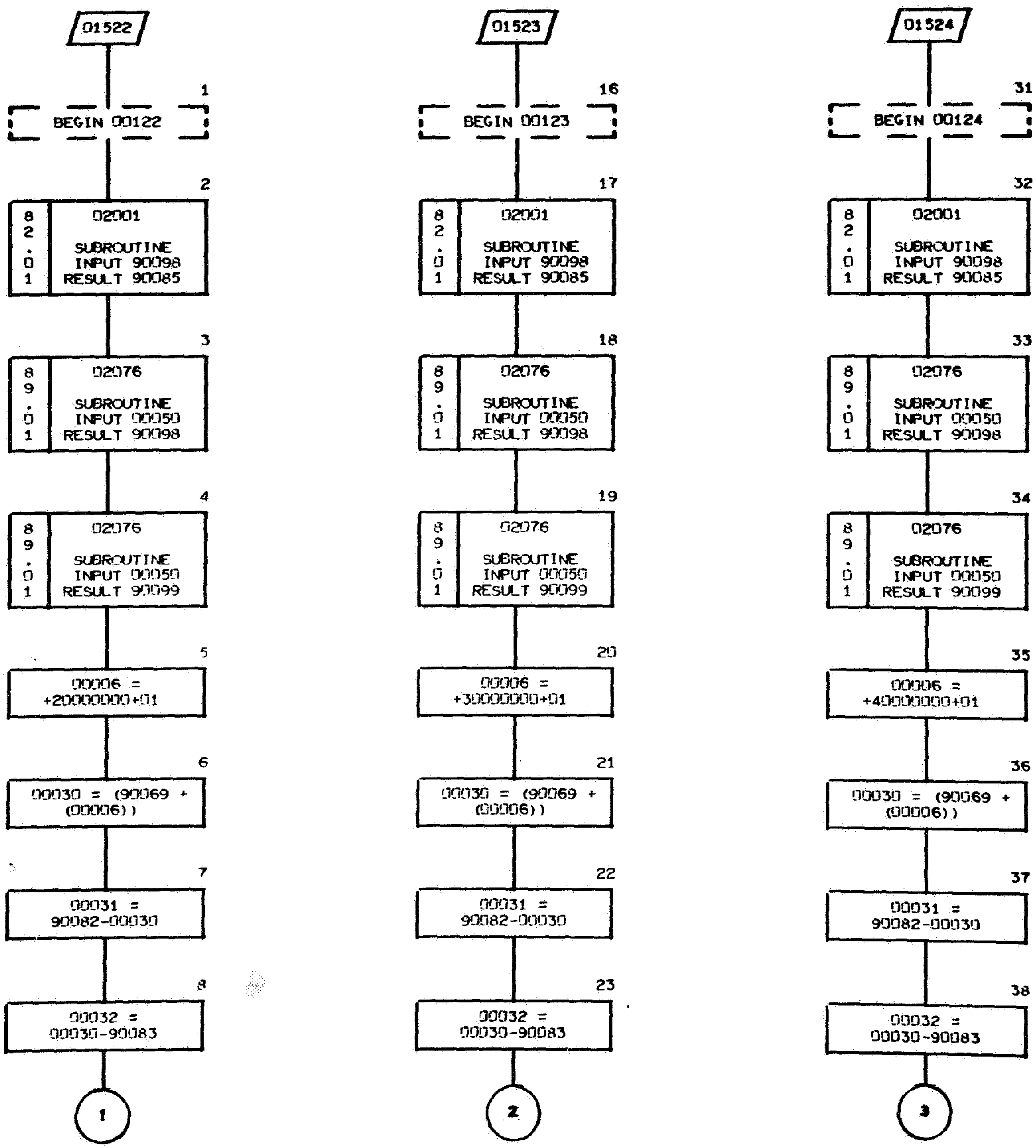

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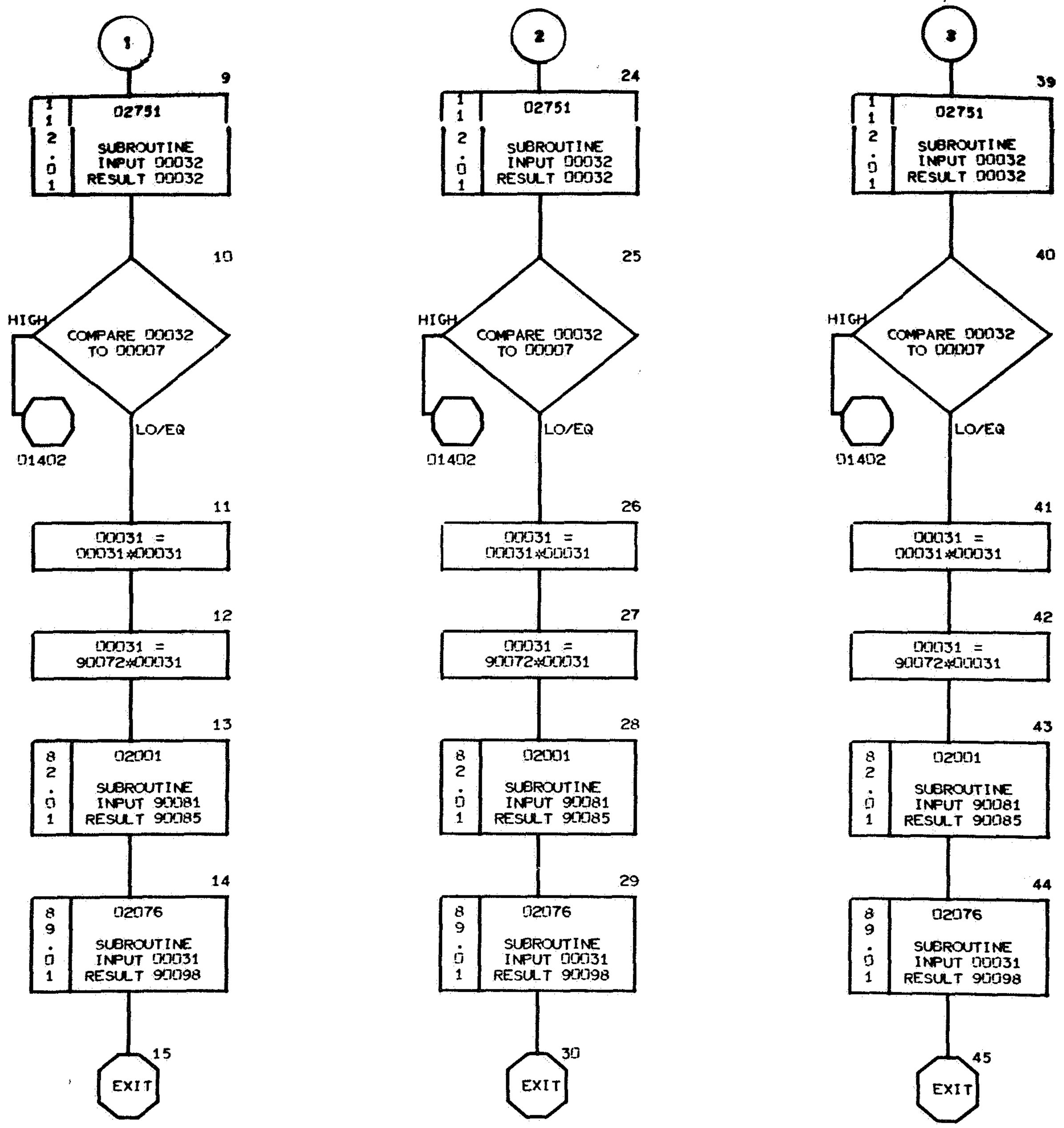

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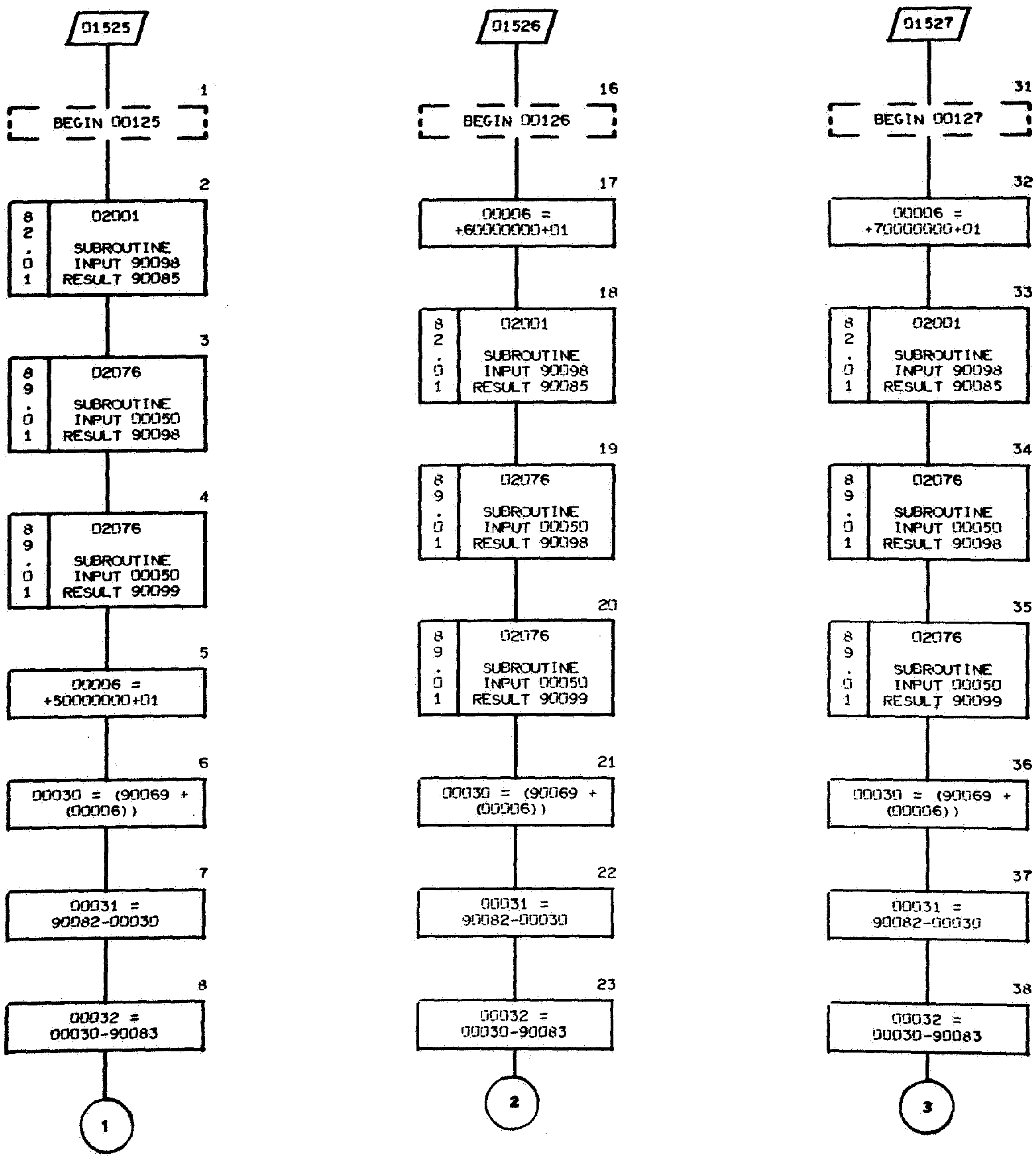

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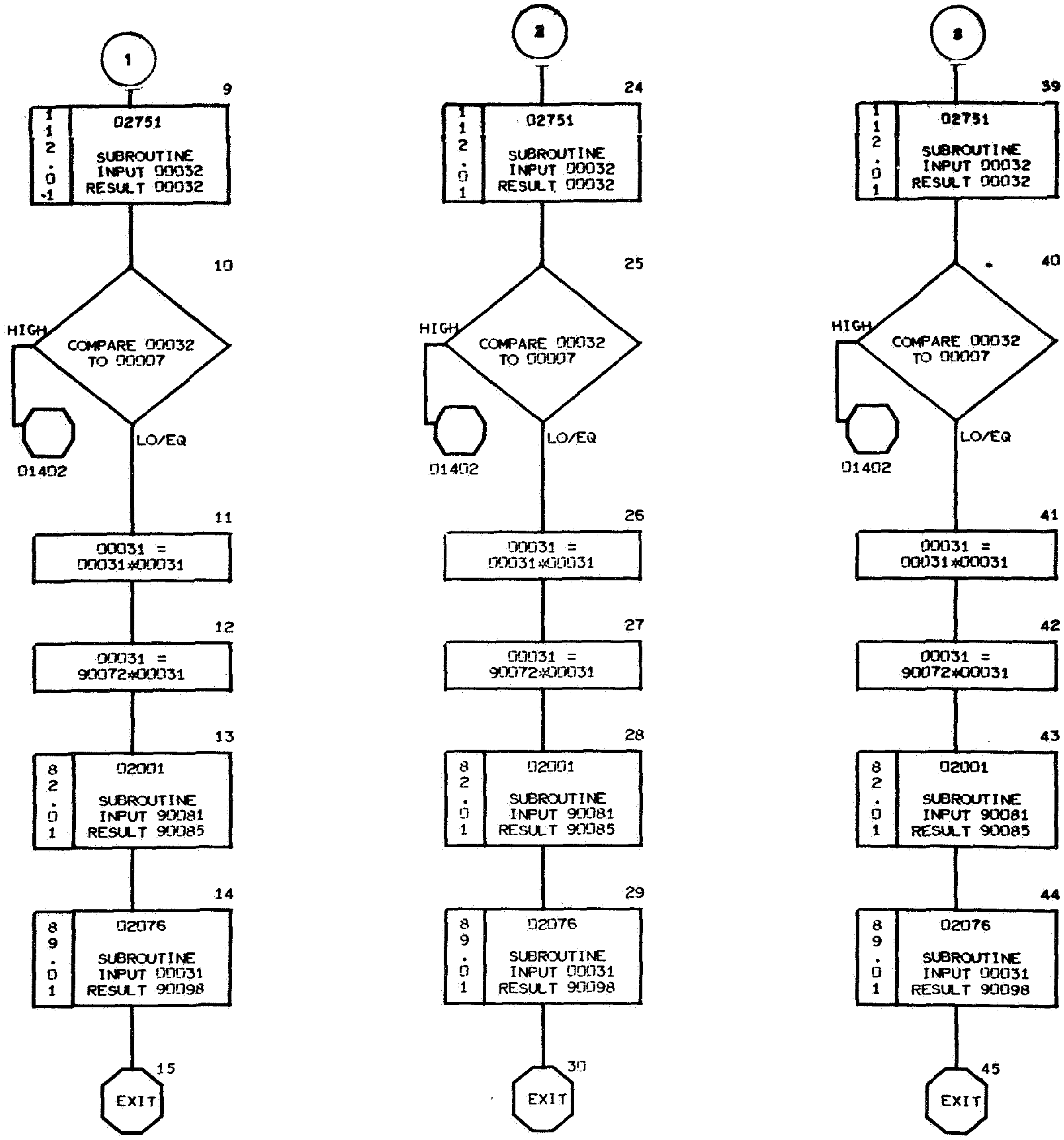

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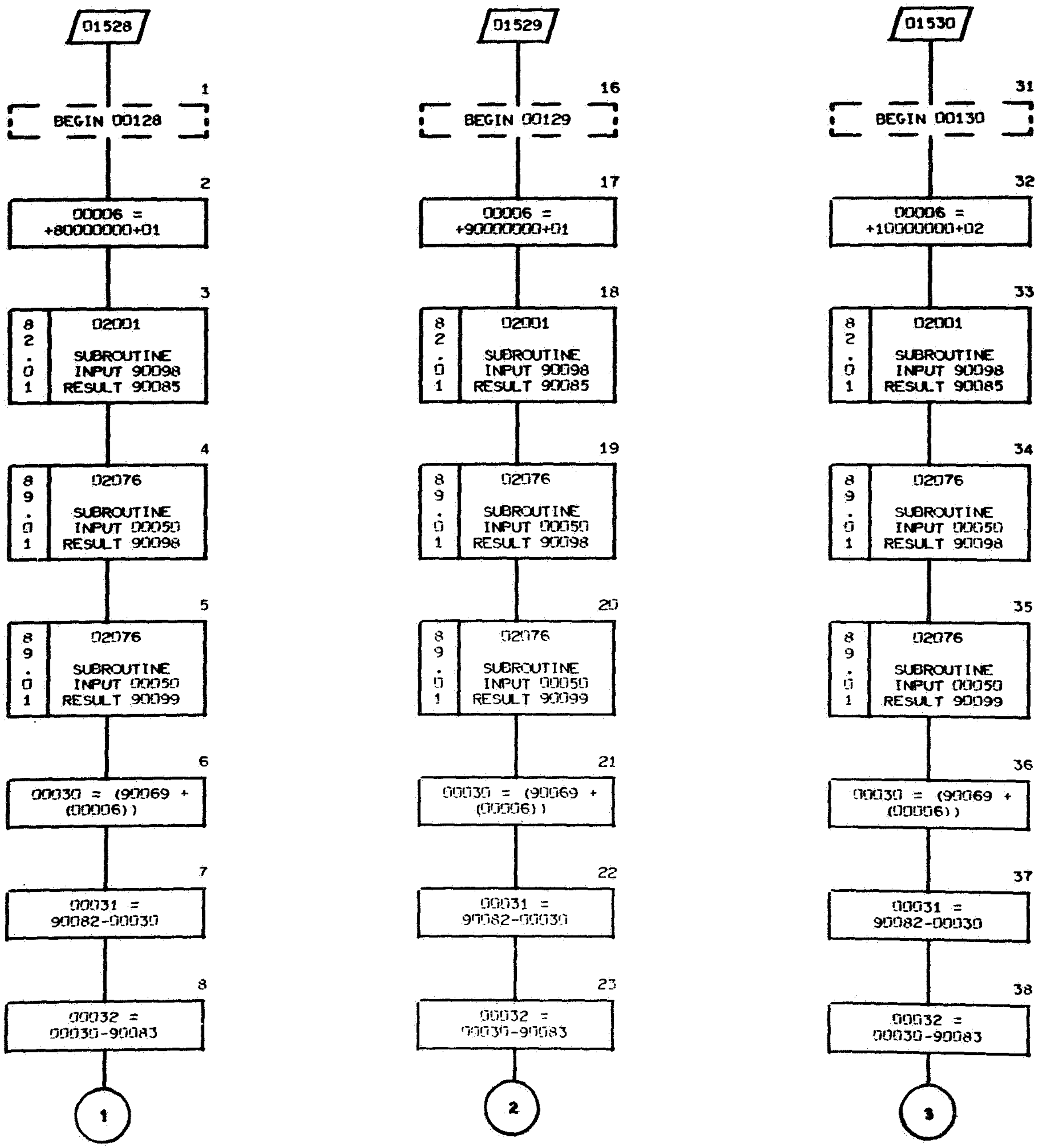

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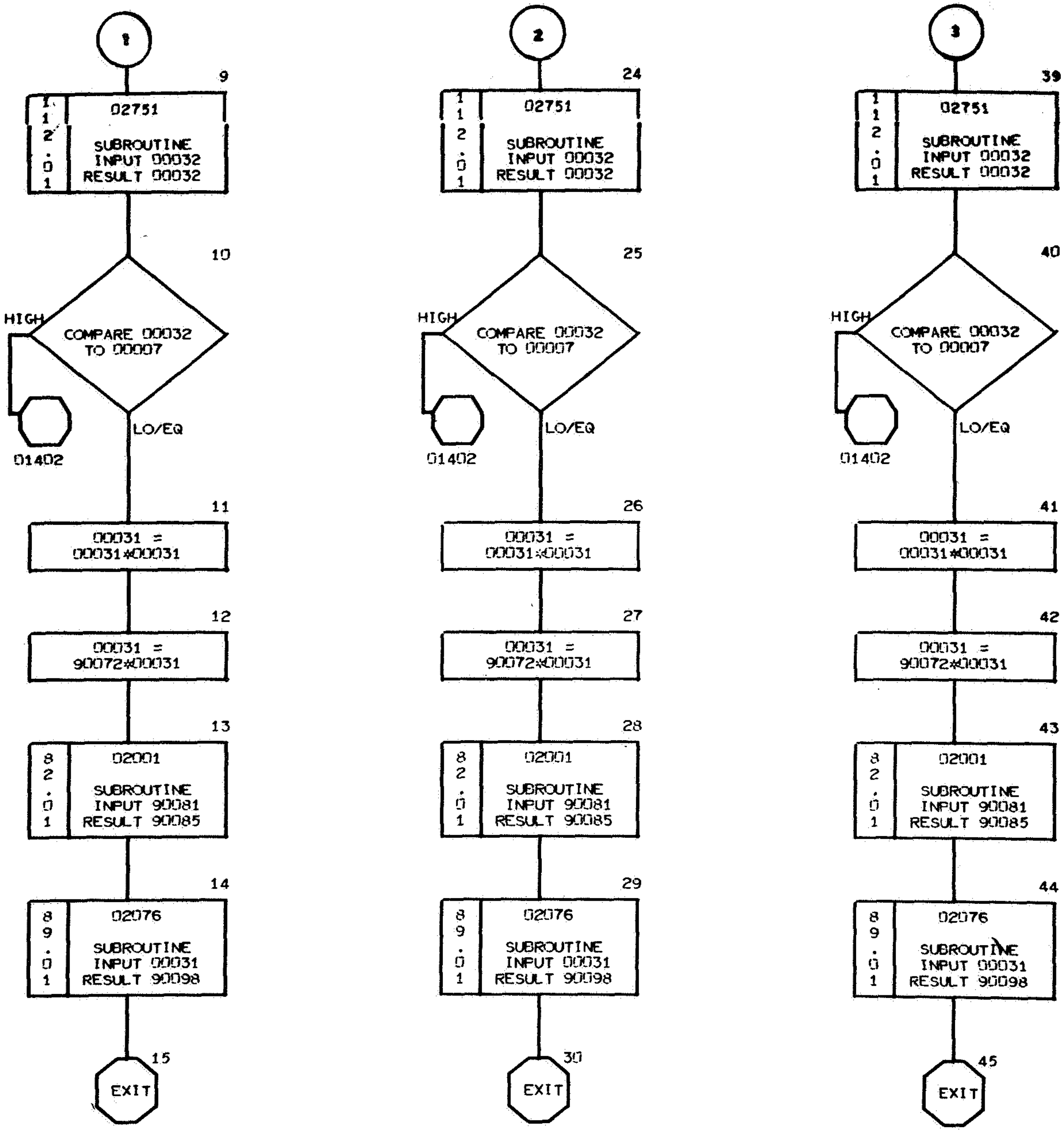

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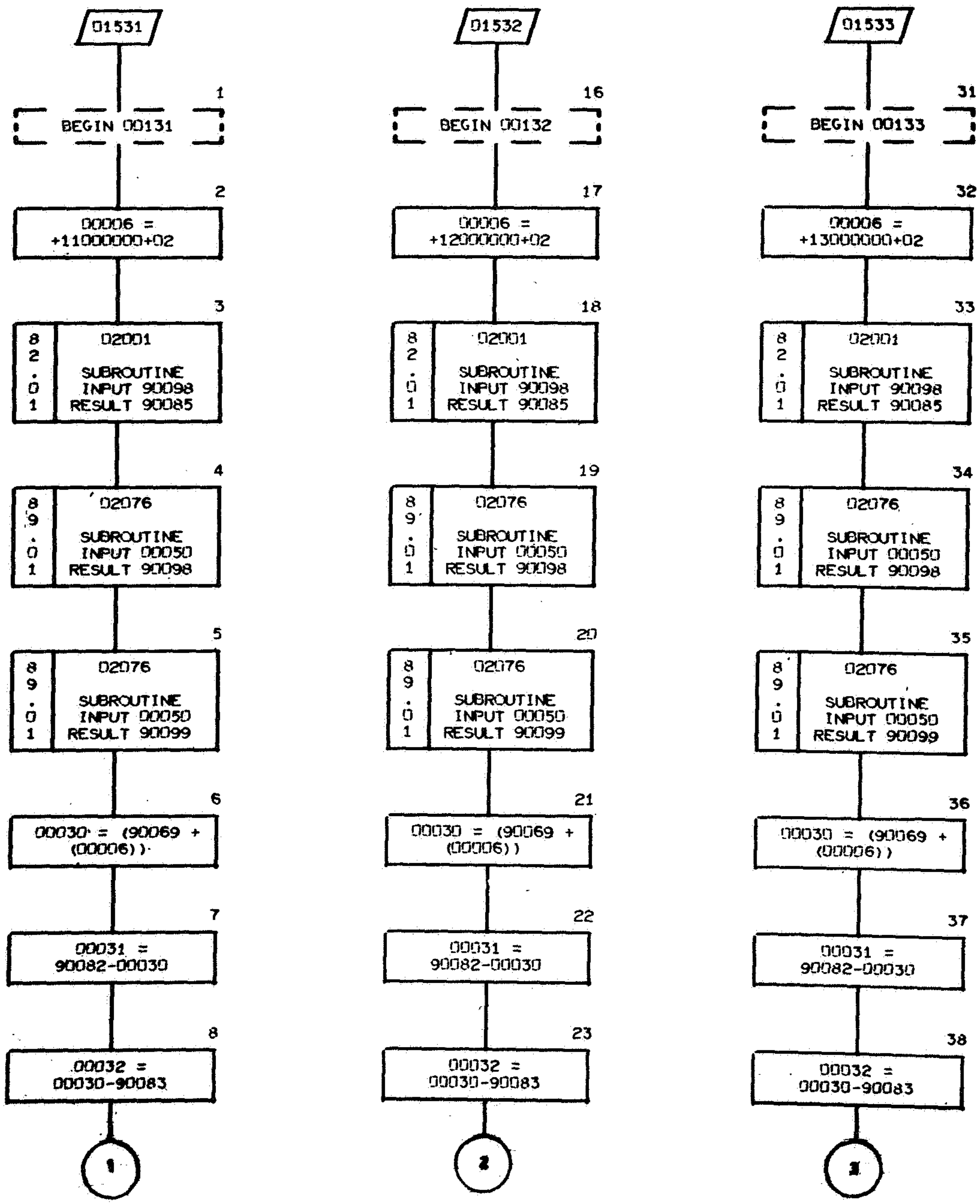

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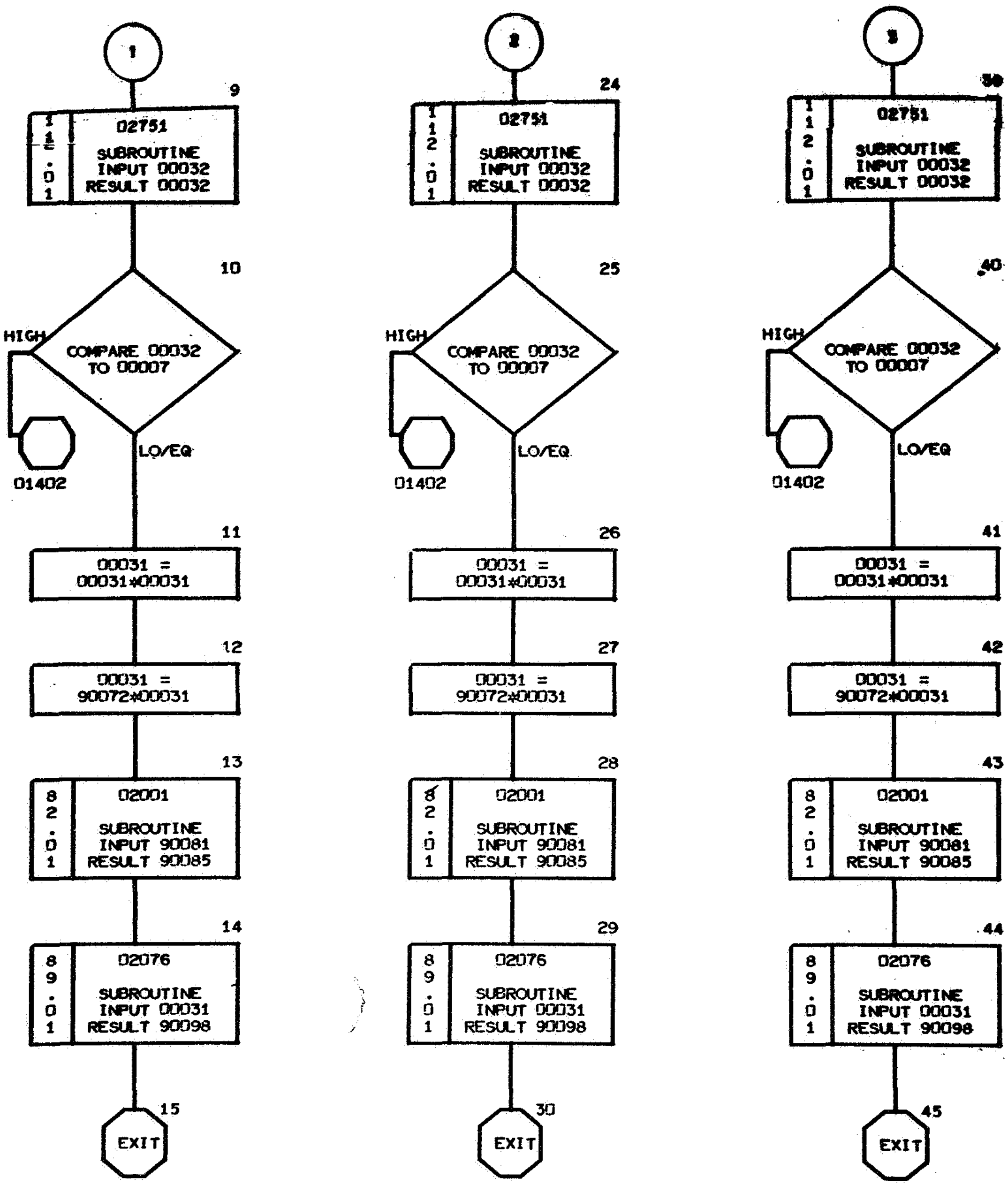

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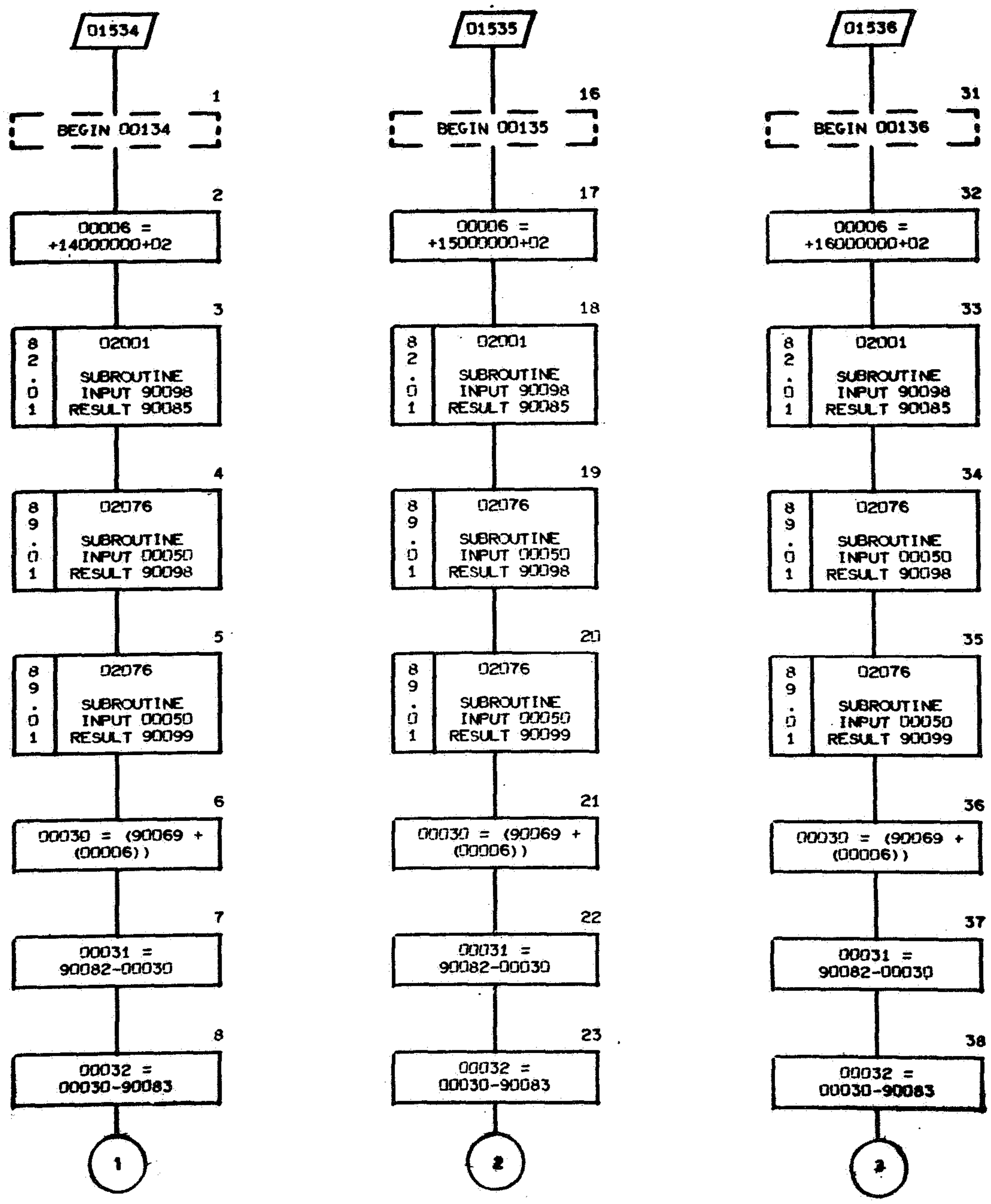

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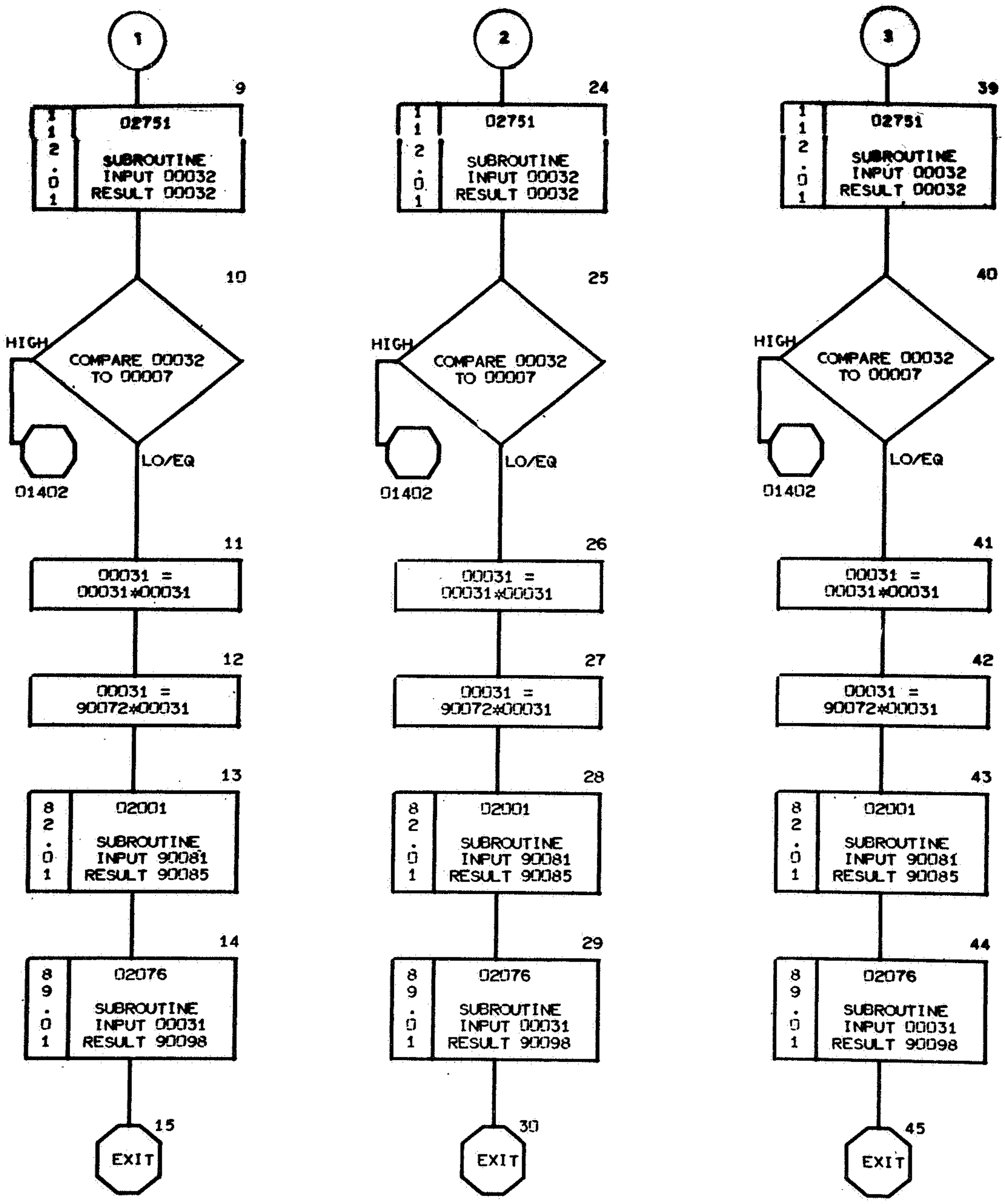

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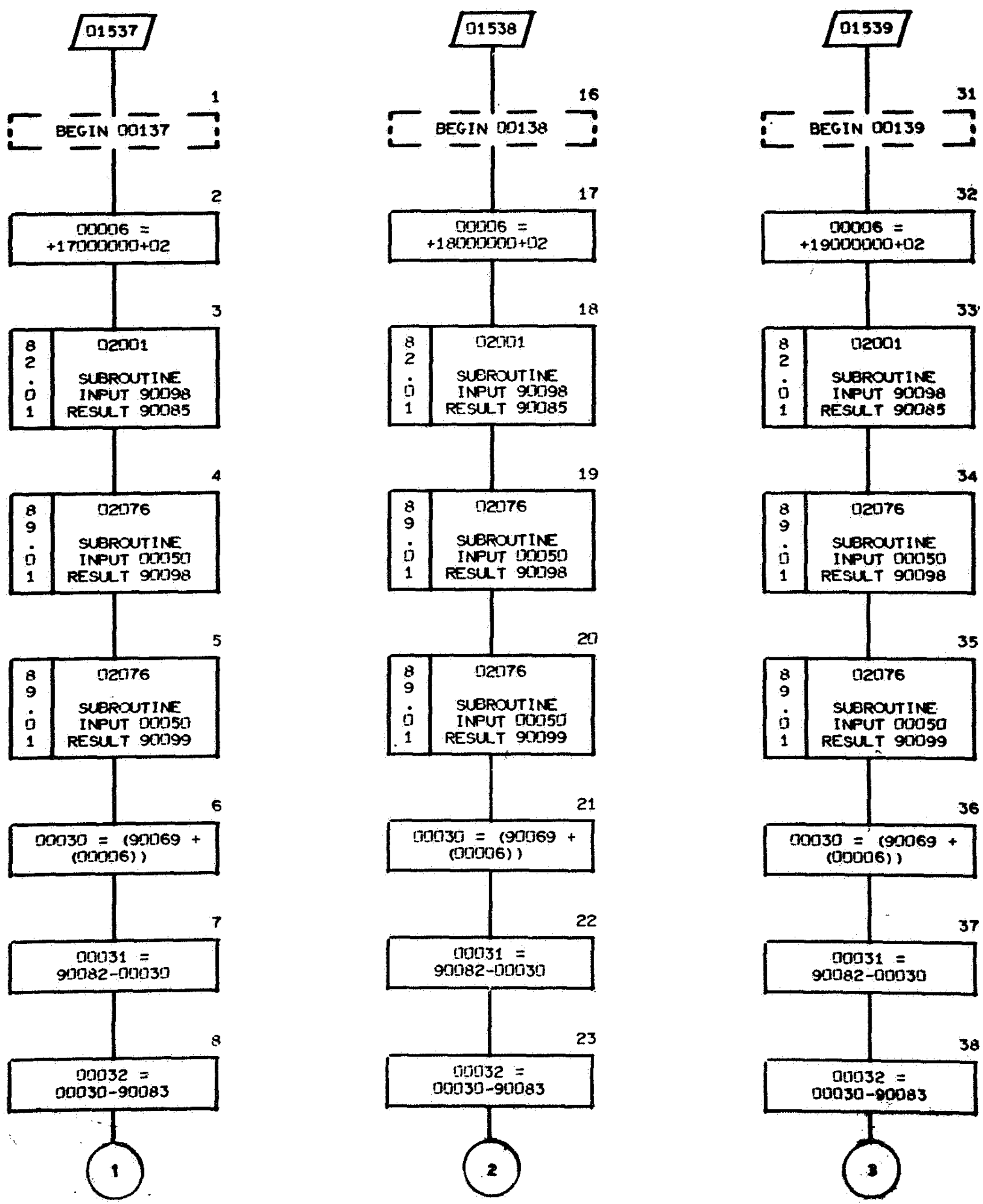

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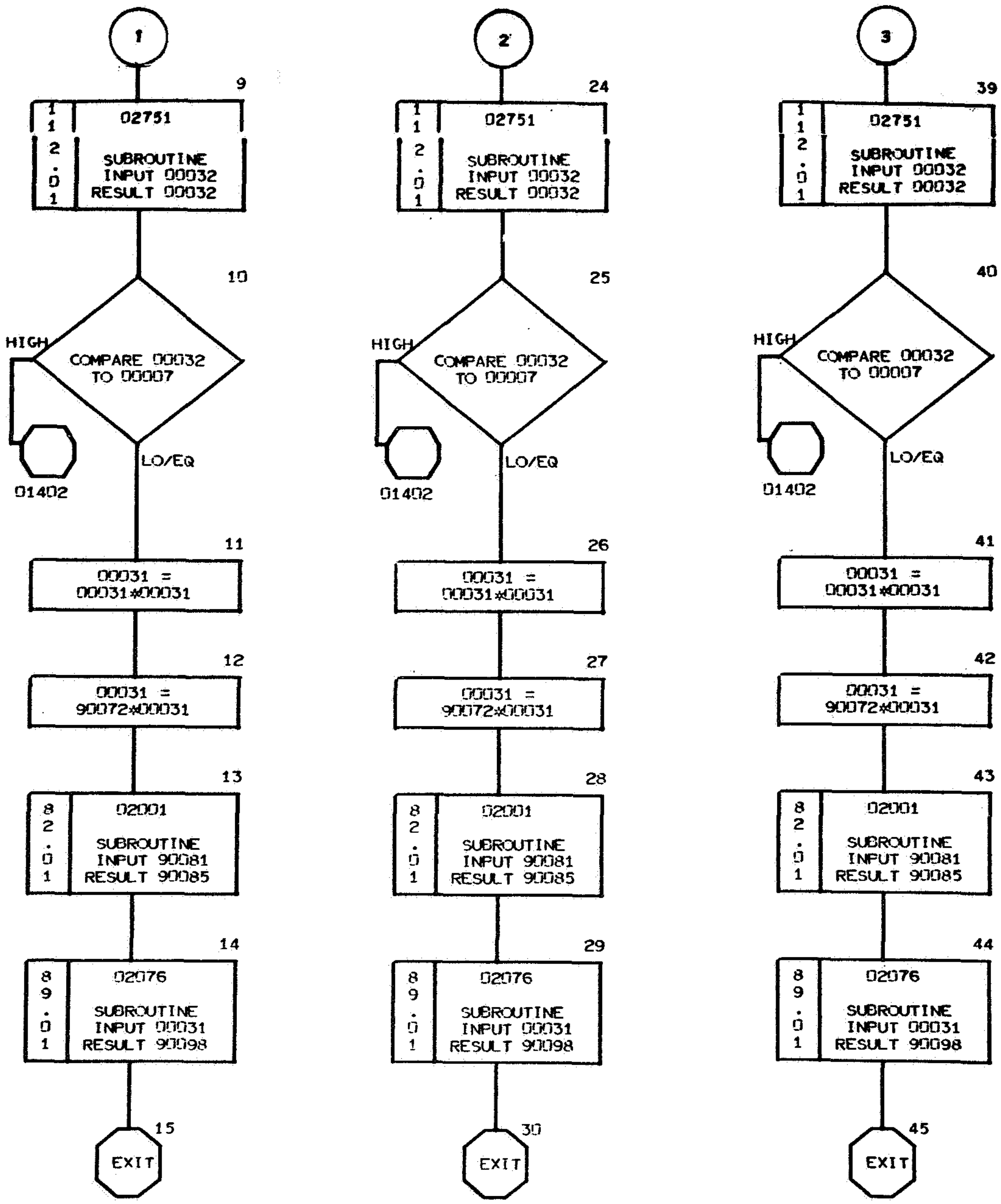

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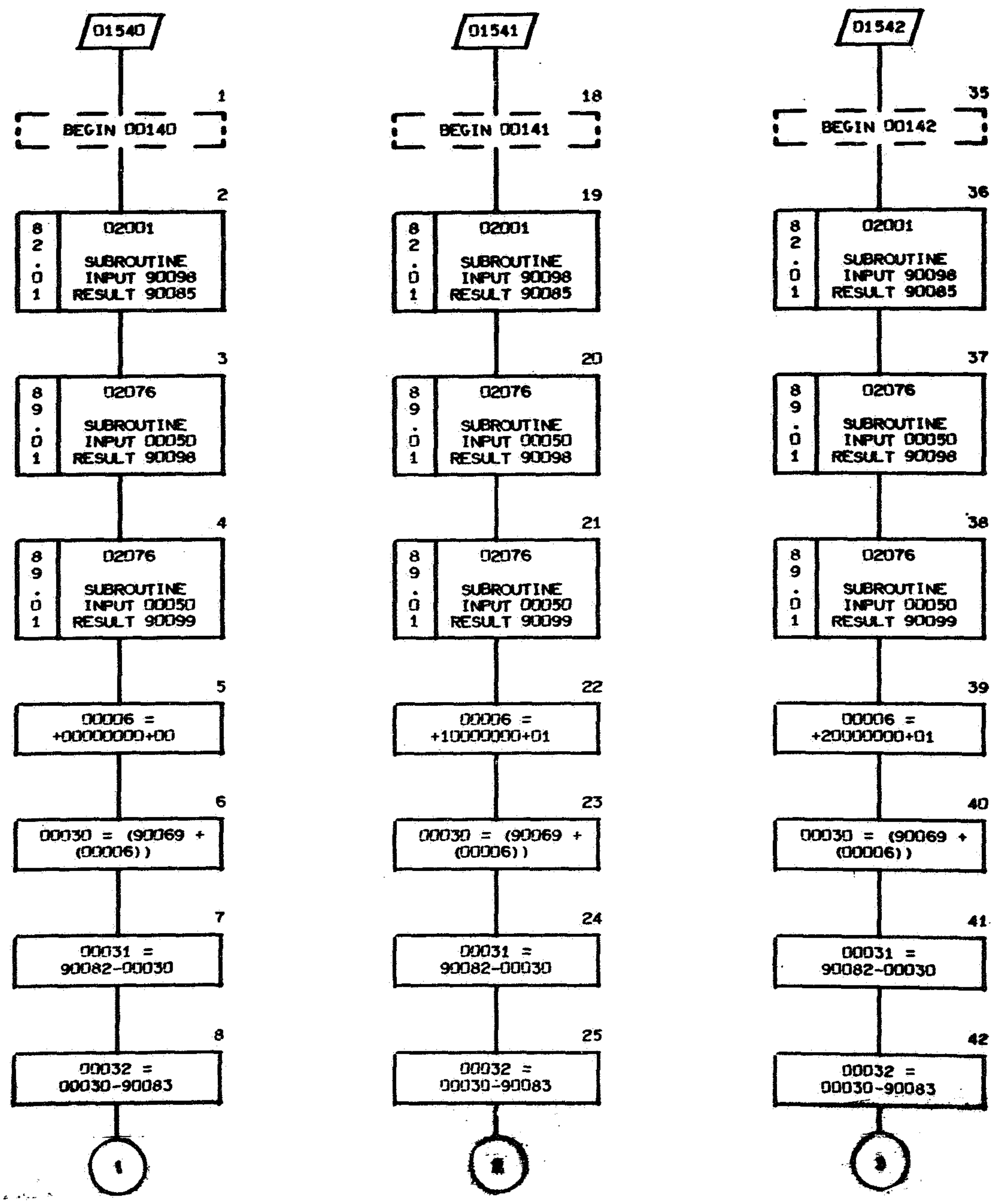
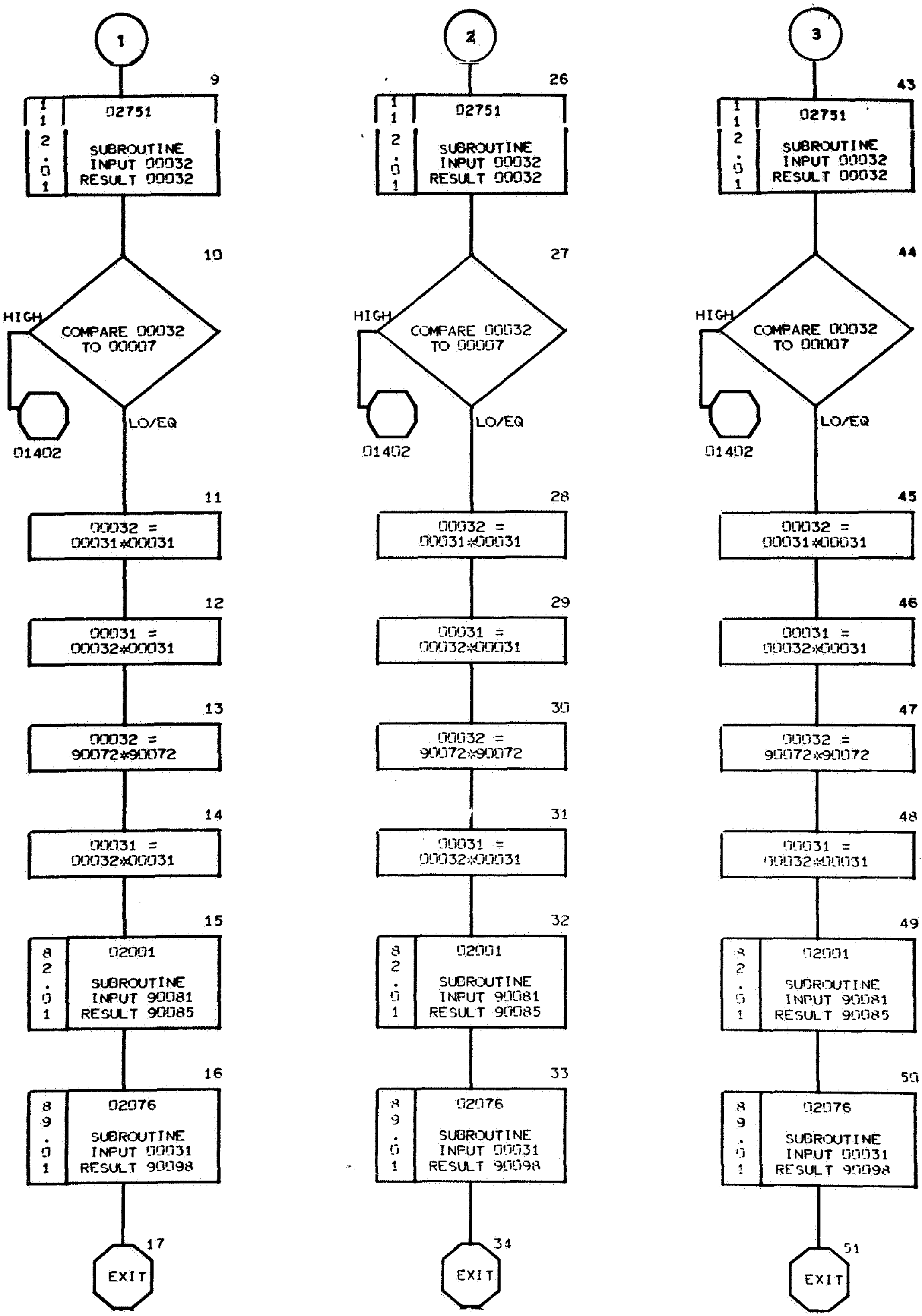
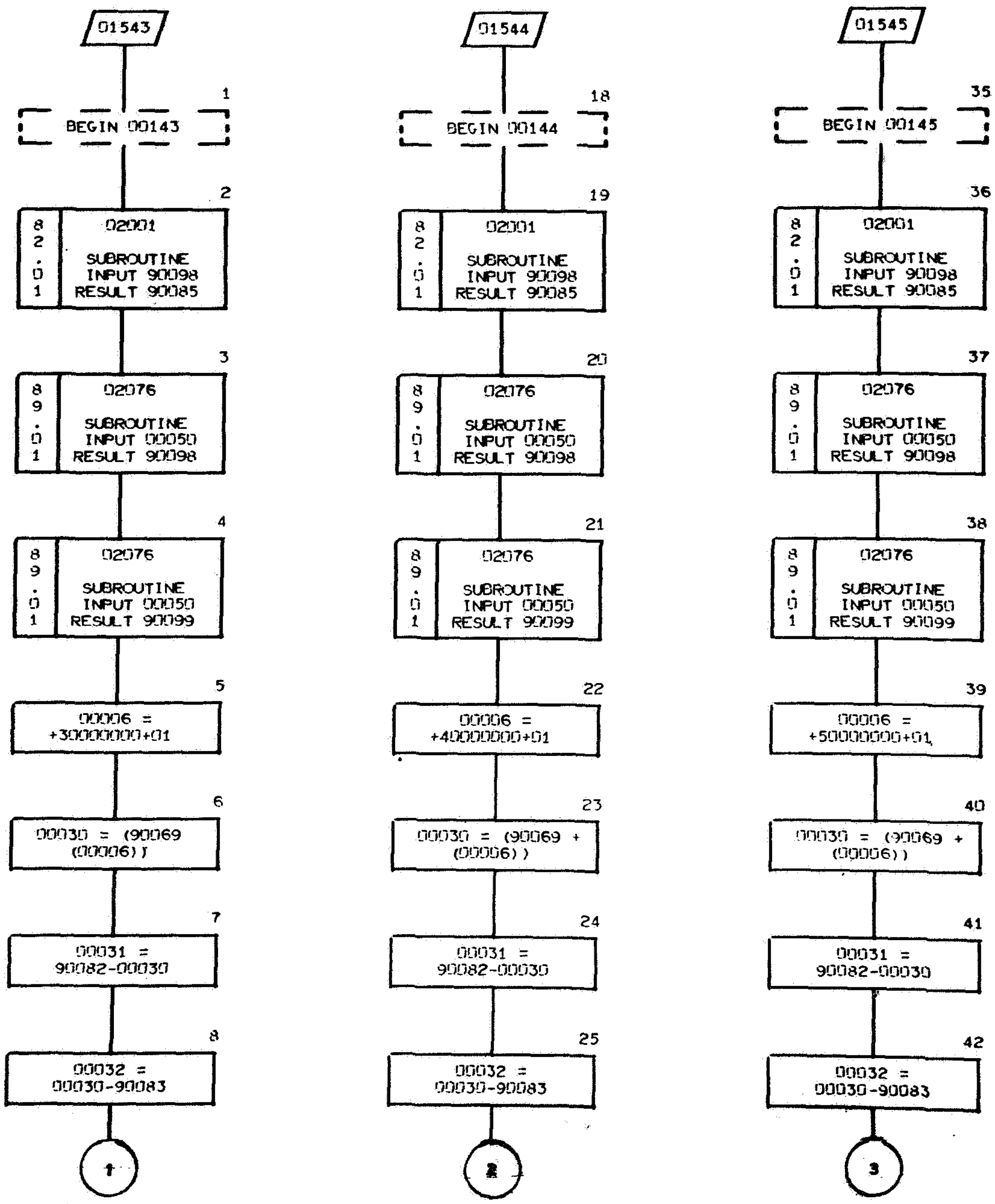



1
9
11 2.01
02751
SUBROUTINE
INPUT 00032
RESULT 00032
10
HIGH
COMPARE 00032
TO 00007
01402
LO/EQ
11
00032 =
00031*00031
12
00031 =
00032*00031
13
00032 =
90072*90072
14
00031 =
00032*00031
15
82.01
02001
SUBROUTINE
INPUT 90081
RESULT 90085
16
89.01
02076
SUBROUTINE
INPUT 00031
RESULT 90098
17
EXIT
2
26
11 2.01
02751
SUBROUTINE
INPUT 00032
RESULT 00032
27
HIGH
COMPARE 00032
TO 00007
01402
LO/EQ
28
00032 =
00031*00031
29
00031 =
00032*00031
30
00032 =
90072*90072
31
00031 =
00032*00031
32
82.01
02001
SUBROUTINE
INPUT 90081
RESULT 90085
33
89.01
02076
SUBROUTINE
INPUT 00031
RESULT 90098
34
EXIT
3
43
11 2.01
02751
SUBROUTINE
INPUT 00032
RESULT 00032
44
HIGH
COMPARE 00032
TO 00007
01402
LO/EQ
45
00032 =
00031*00031
46
00031 =
00032*00031
47
00032 =
90072*90072
48
00031 =
00032*00031
49
82.01
02001
SUBROUTINE
INPUT 90081
RESULT 90085
50
89.01
02076
SUBROUTINE
INPUT 00031
RESULT 90098
51
EXIT

K VALUE = 01400



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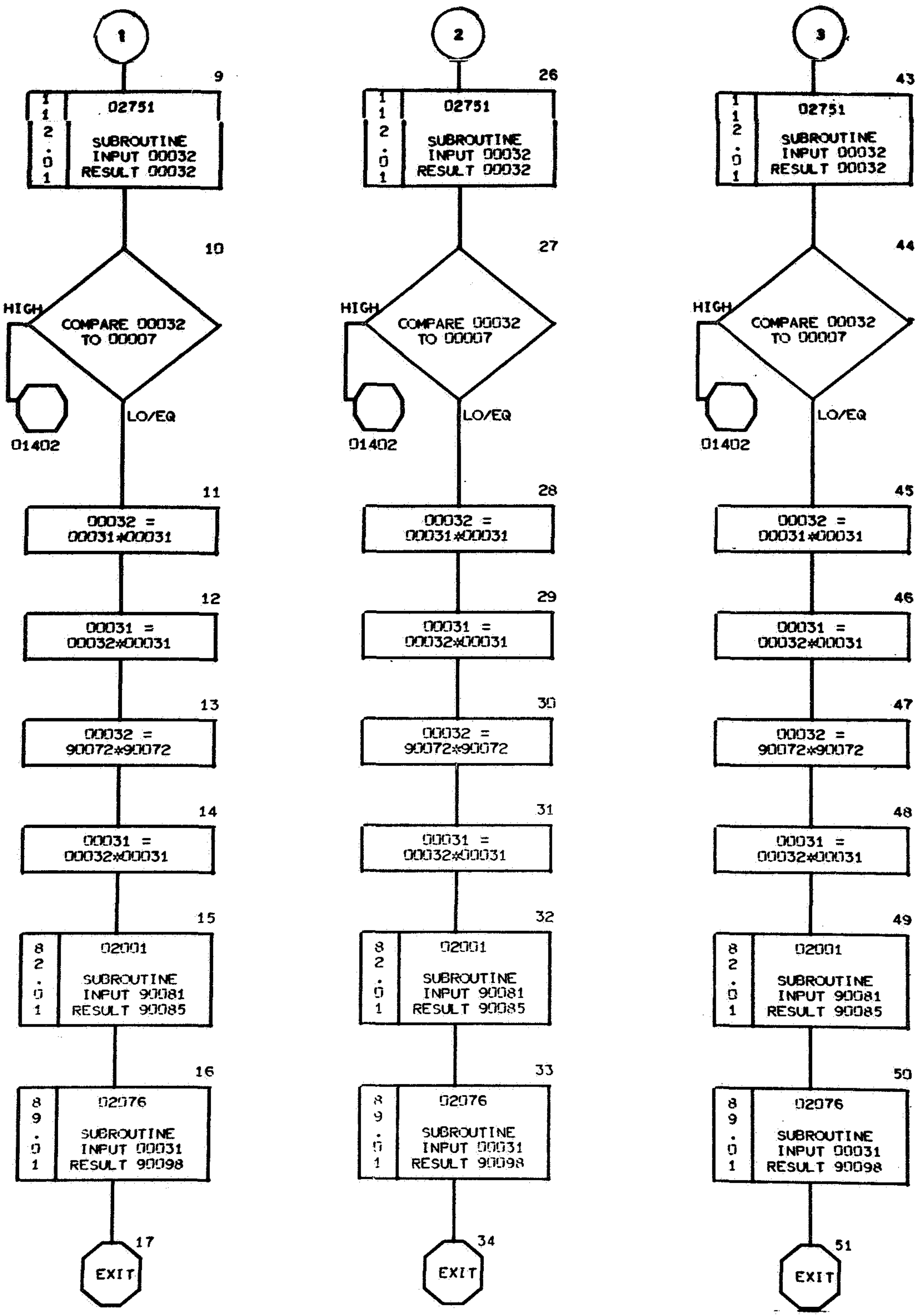

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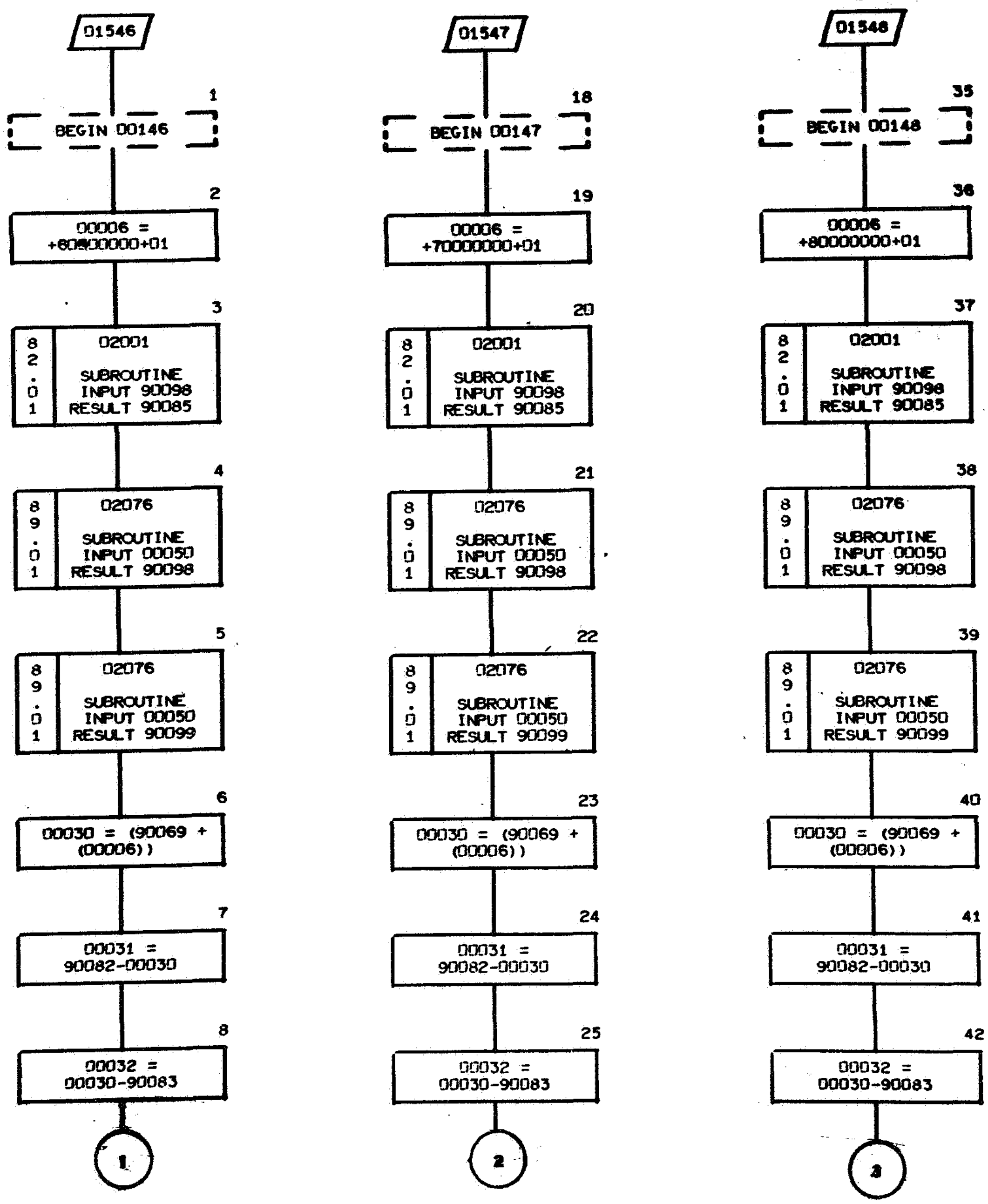

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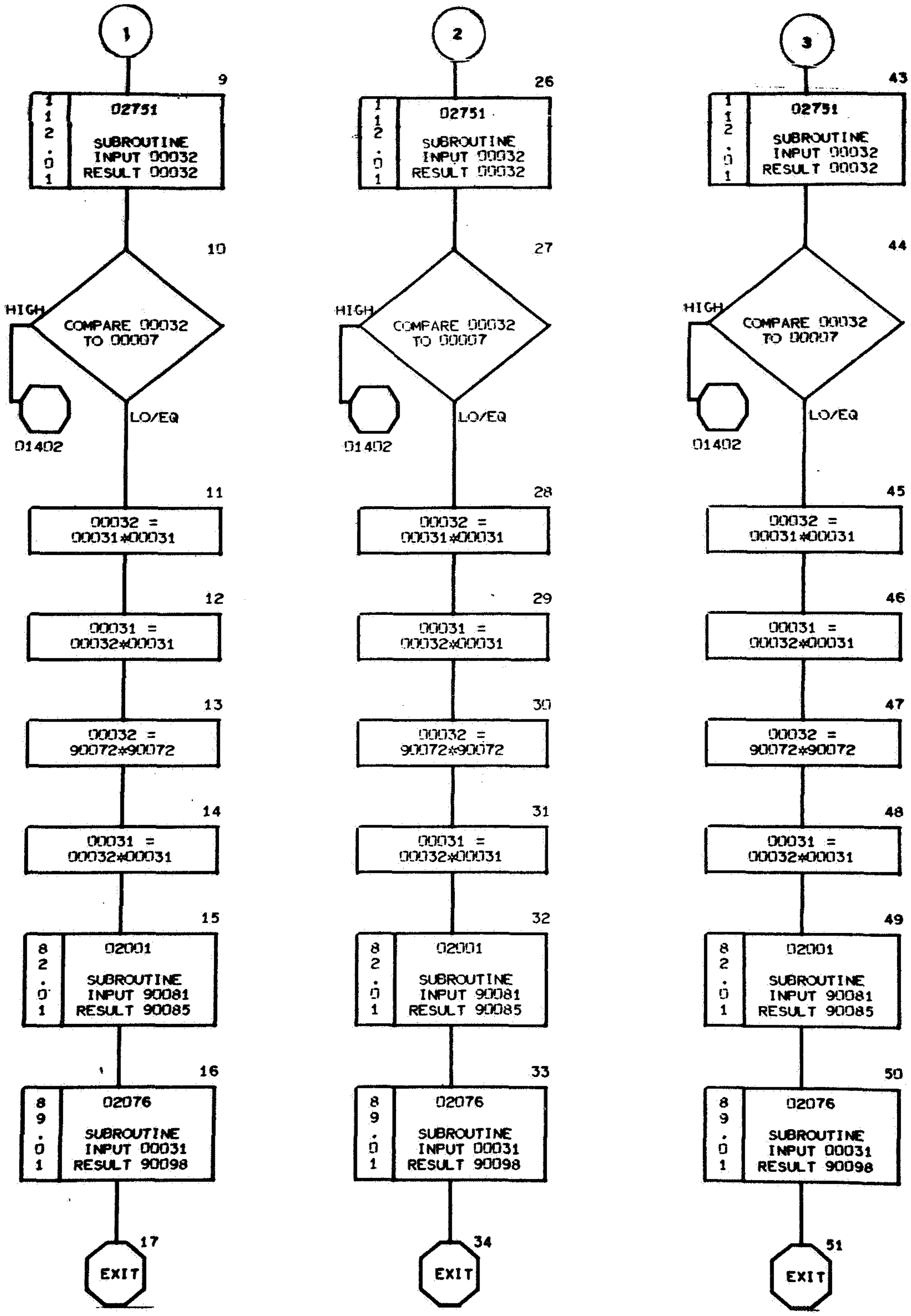

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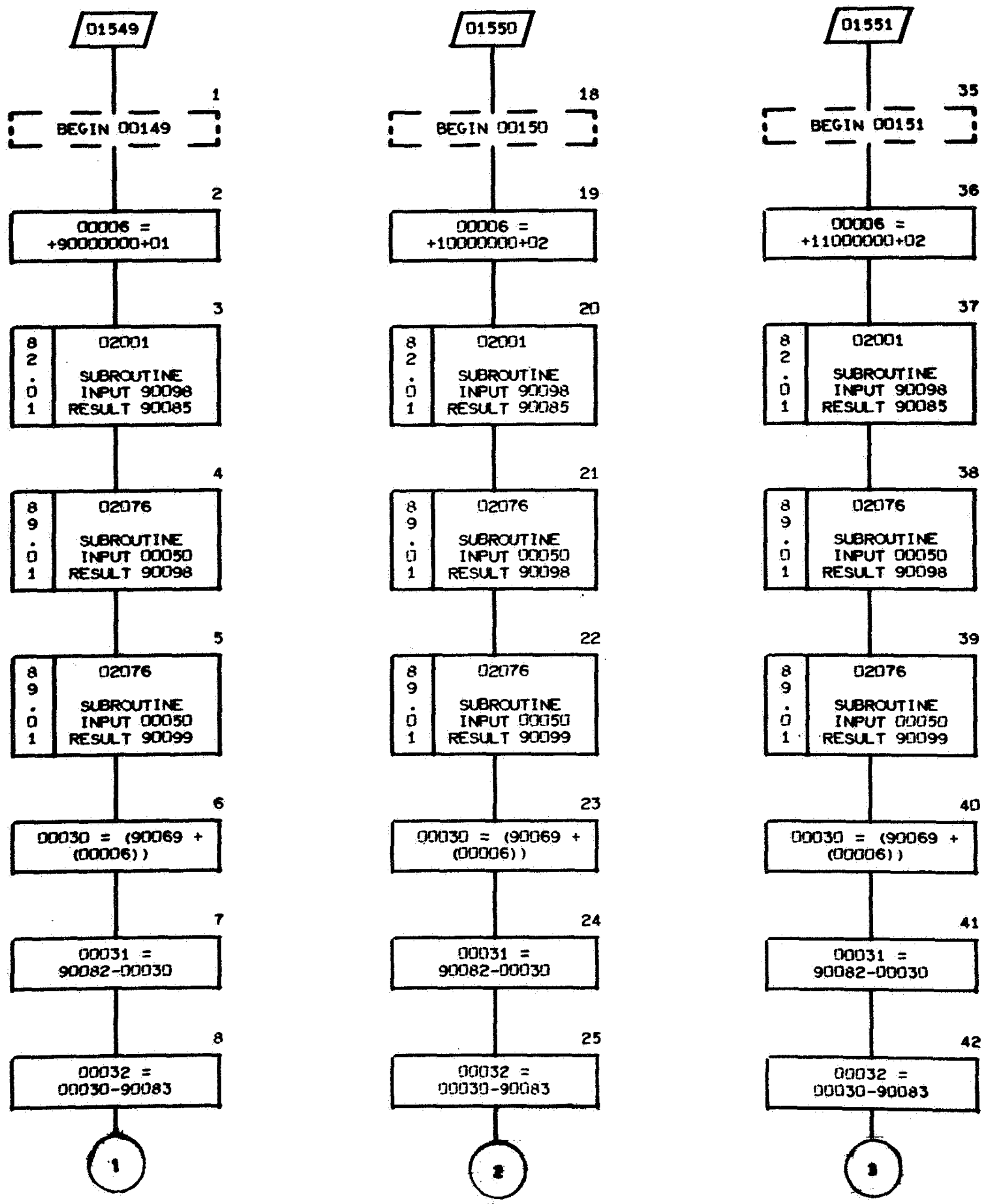

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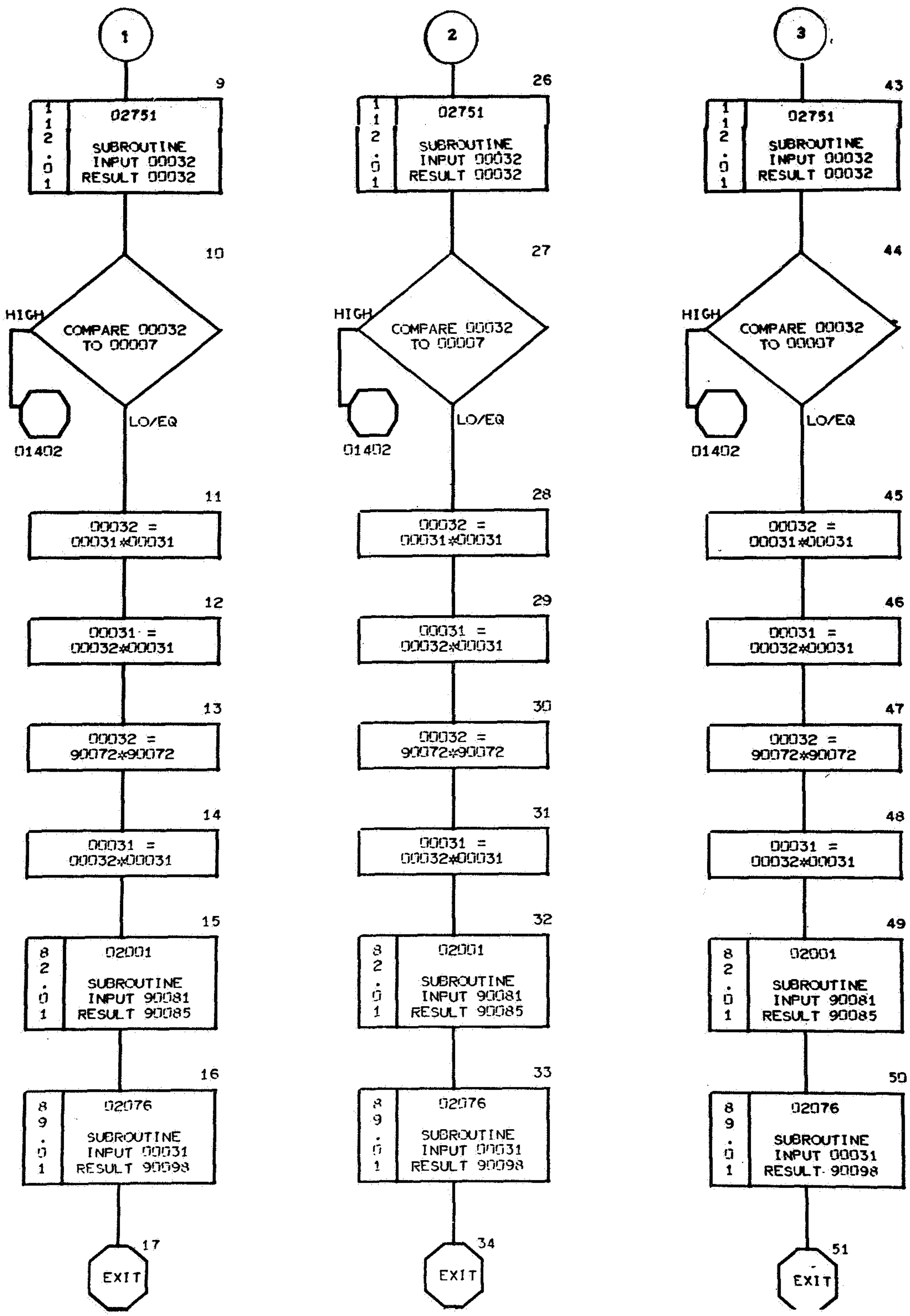

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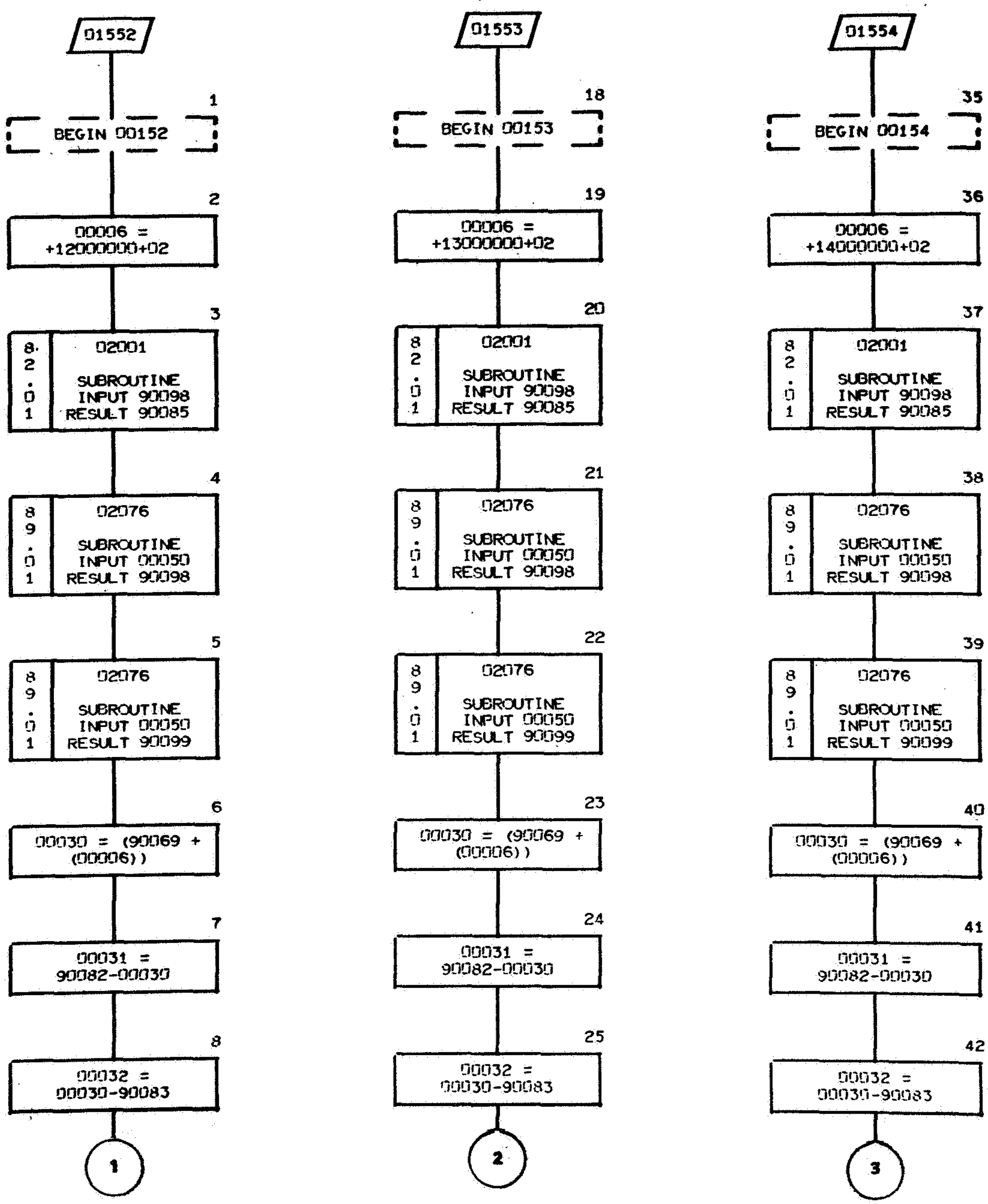

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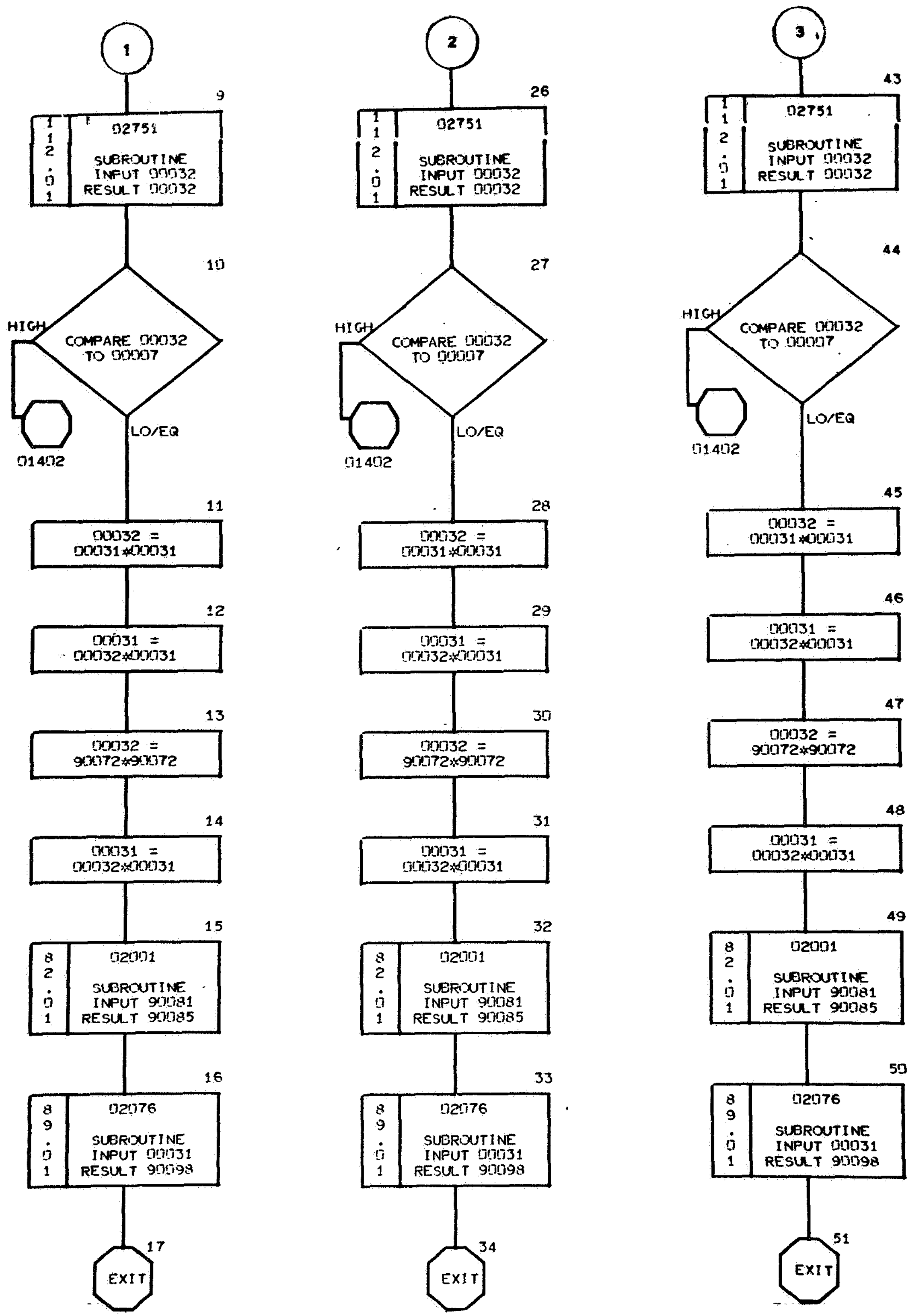

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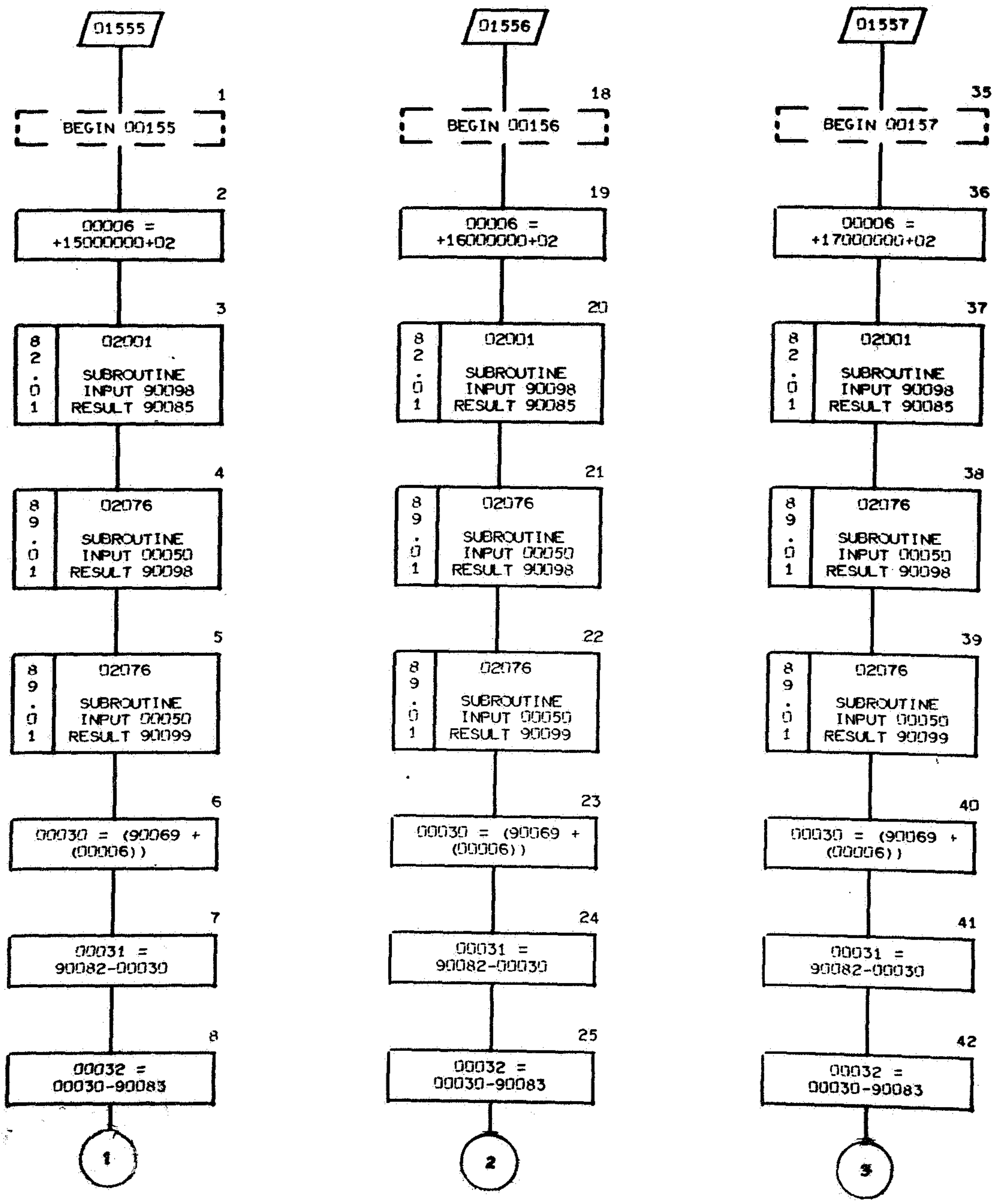
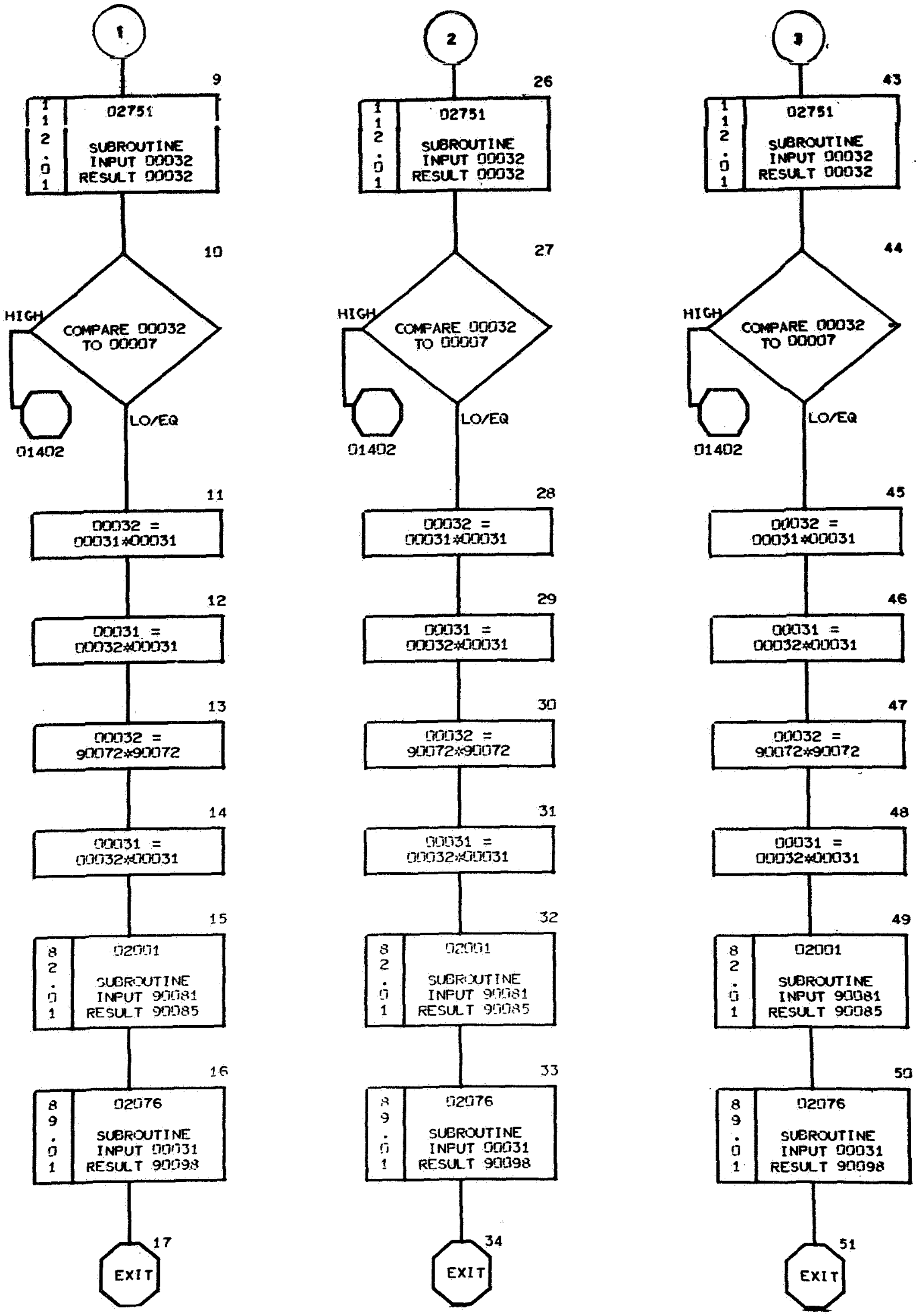
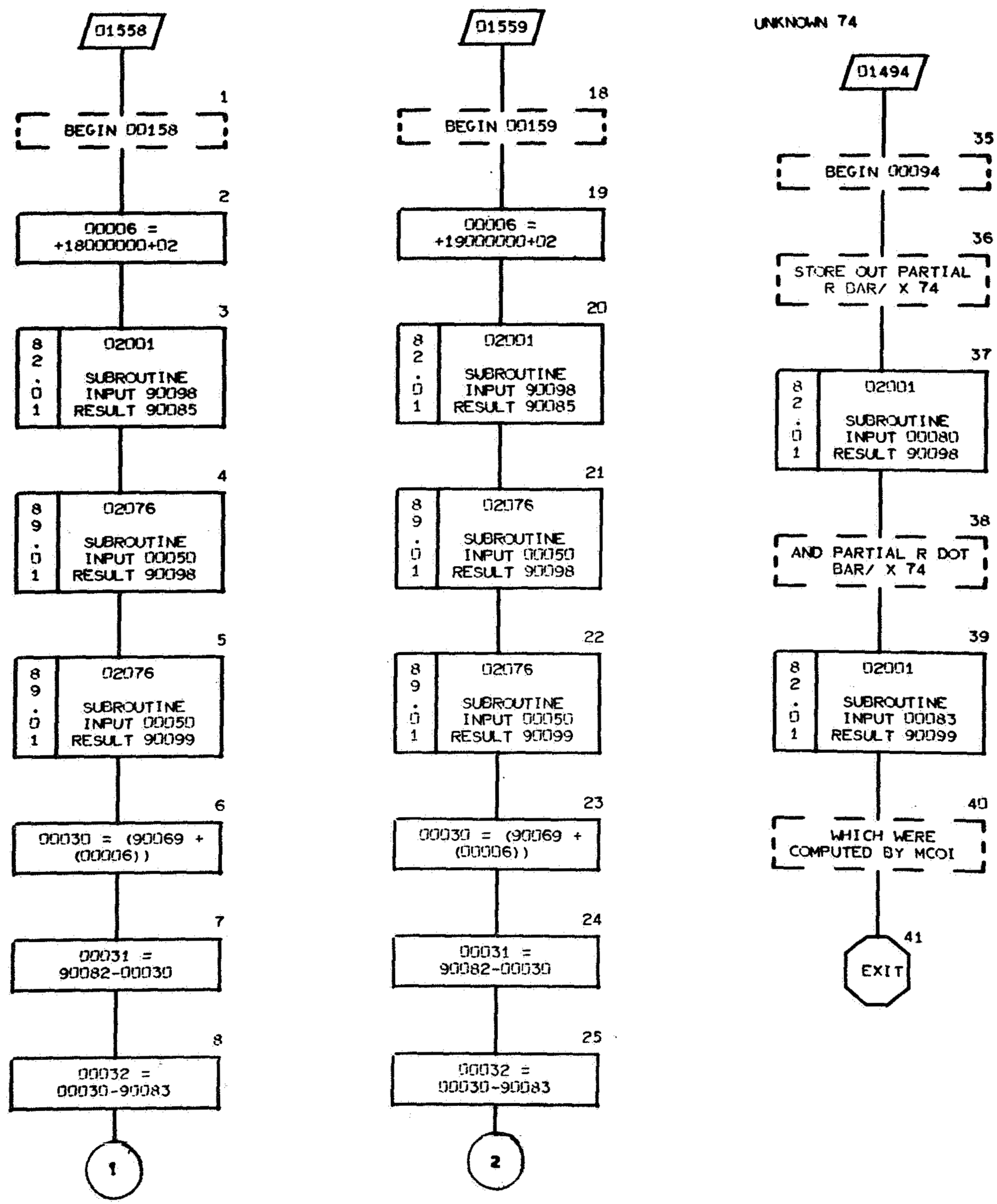
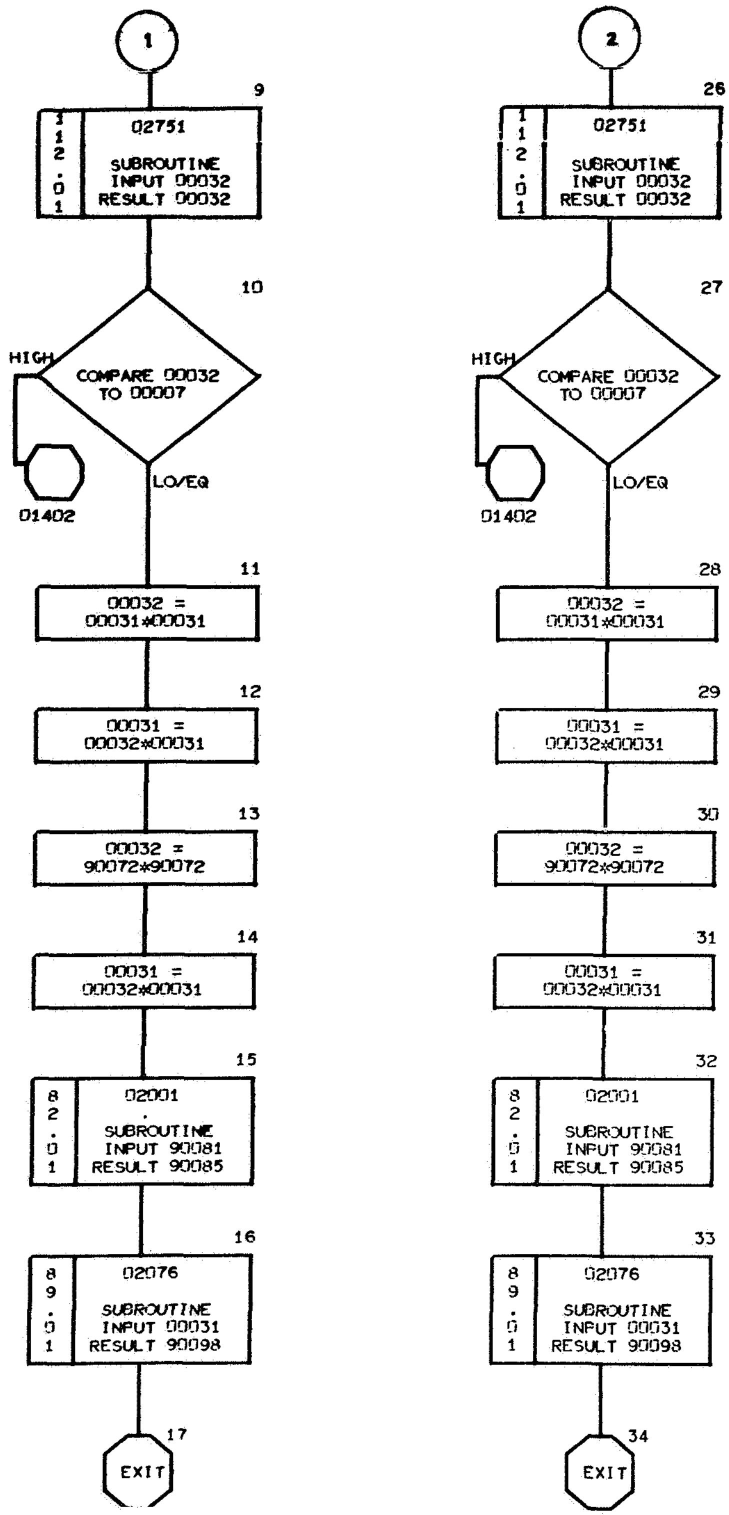




1
9
1 1 2 . 0 1
02751
SUBROUTINE
INPUT 00032
RESULT 00032
10
HIGH
COMPARE 00032 TO 00007
LO/EQ
01402
11
00032 = 00031*00031
12
00031 = 00032*00031
13
00032 = 90072*90072
14
00031 = 00032*00031
15
8 2 . 0 1
02001
SUBROUTINE
INPUT 90081
RESULT 90085
16
8 9 . 0 1
02076
SUBROUTINE
INPUT 00031
RESULT 90098
17
EXIT
2
26
1 1 2 . 0 1
02751
SUBROUTINE
INPUT 00032
RESULT 00032
27
HIGH
COMPARE 00032 TO 00007
LO/EQ
01402
28
00032 = 00031*00031
29
00031 = 00032*00031
30
00032 = 90072*90072
31
00031 = 00032*00031
32
8 2 . 0 1
02001
SUBROUTINE
INPUT 90081
RESULT 90085
33
8 9 . 0 1
02076
SUBROUTINE
INPUT 00031
RESULT 90098
34
EXIT
3
43
1 1 2 . 0 1
02751
SUBROUTINE
INPUT 00032
RESULT 00032
44
HIGH
COMPARE 00032 TO 00007
LO/EQ
01402
45
00032 = 00031*00031
46
00031 = 00032*00031
47
00032 = 90072*90072
48
00031 = 00032*00031
49
8 2 . 0 1
02001
SUBROUTINE
INPUT 90081
RESULT 90085
50
8 9 . 0 1
02076
SUBROUTINE
INPUT 00031
RESULT 90098
51
EXIT

K VALUE = 01400

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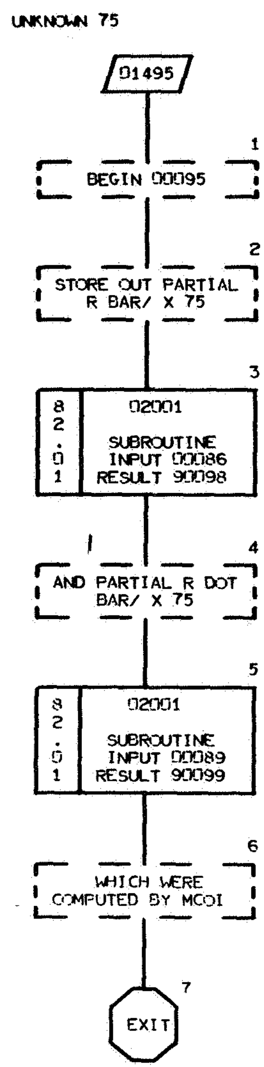
9
112.01
02751
SUBROUTINE
INPUT 00032
RESULT 00032
10
HIGH
COMPARE 00032
TO 00007
01402
LO/EQ
11
00032 =
00031*00031
12
00031 =
00032*00031
13
00032 =
90072*90072
14
00031 =
00032*00031
15
82.01
02001
SUBROUTINE
INPUT 90081
RESULT 90085
16
89.01
02076
SUBROUTINE
INPUT 00031
RESULT 90098
17
EXIT
2
26
112.01
02751
SUBROUTINE
INPUT 00032
RESULT 00032
27
HIGH
COMPARE 00032
TO 00007
01402
LO/EQ
28
00032 =
00031*00031
29
00031 =
00032*00031
30
00032 =
90072*90072
31
00031 =
00032*00031
32
82.01
02001
SUBROUTINE
INPUT 90081
RESULT 90085
33
89.01
02076
SUBROUTINE
INPUT 00031
RESULT 90098
34
EXIT

K VALUE = 01400



MISCELLANEOUS STATEMENTS

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Q9000900252	J, NO. OF UNKNOWN
Q9006802751	ABSOLUTE VALUE FUNCTION
Q9006901130	FIRST LOC. OF T(P,Q)"S, TIMES OF DRA
Q9007001101	A, SEMI-MAJOR AXIS AT T(0)
Q9007101102	ECCENTRICITY AT T(0)
Q9007201119	N, MEAN MOTION AT T(0)
Q9007301120	ECCENTRIC ANOMALY AT T(0)
Q9007400240	ECCENTRIC ANOMALY AT T
Q9007500222	ALPHA BAR
Q9007600225	BETA BAR
Q9007700228	GAMMA BAR
Q9007800231	P BAR
Q9007900234	Q BAR
Q9008000237	R BAR (COMPUTED BY POS. IN ELLIPSE)
Q9008100241	R DOT BAR (COMPUTED BY POS.IN ELLIPS
Q9008200200	T, OBSERVATION TIME IN C.U.T.
Q9008301100	T(0), EPOCH TIME IN C.U.T.
Q9008400210	MAG.OF R BAR (COMPUTED BY POS.IN E.)
Q9008502085	VQ
Q9008602001	VECTOR MOVE
Q9008702076	SCALAR MULTIPLY
Q9008802041	VECTOR SUBTRACT
Q9008902031	VECTOR ADD
Q9009002061	CROSS PRODUCT
Q9009102271	PRINCIPAL VALUE
Q9009202196	SQUARE ROOT
Q9009302101	SINE
Q9009402105	COSINE
Q9009503852	MU
Q9009600201	S (T)
Q9009700202	C (T)
Q9009800380	PARTIAL R BAR / X J
Q9009900383	PARTIAL R DOT BAR / X J
V00092+74000000+02	
V00050+00000000+00	
V00051+10000000+01	
V00052+20000000+01	
V00053+30000000+01	
V00054+50000000+00	

PAGE BOX	LABEL	REFERENCE						
34.01	01401	13.07*	38.04*	38.10*	38.22*	39.04*	39.13*	39.25*
		40.04*	40.16*	67.05*				
34.08	01479	34.05						
34.10	01501							
35.01	01502							
36.01	01503							
37.17	01504							
37.23	01505							
37.29	01506							
38.01	01507							
39.01	01508							
40.01	01509							
40.27	01510							
41.01	01511							
41.11	01519							
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43.16	01523							
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45.01	01528							
45.16	01529							
45.31	01530							
46.01	01531							
46.16	01532							
46.31	01533							
47.01	01534							
47.16	01535							
47.31	01536							
48.01	01537							
48.16	01538							
48.31	01539							
49.01	01540							
49.18	01541							
49.35	01542							

CROSS-REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES
50.01	01543	
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50.35	01545	
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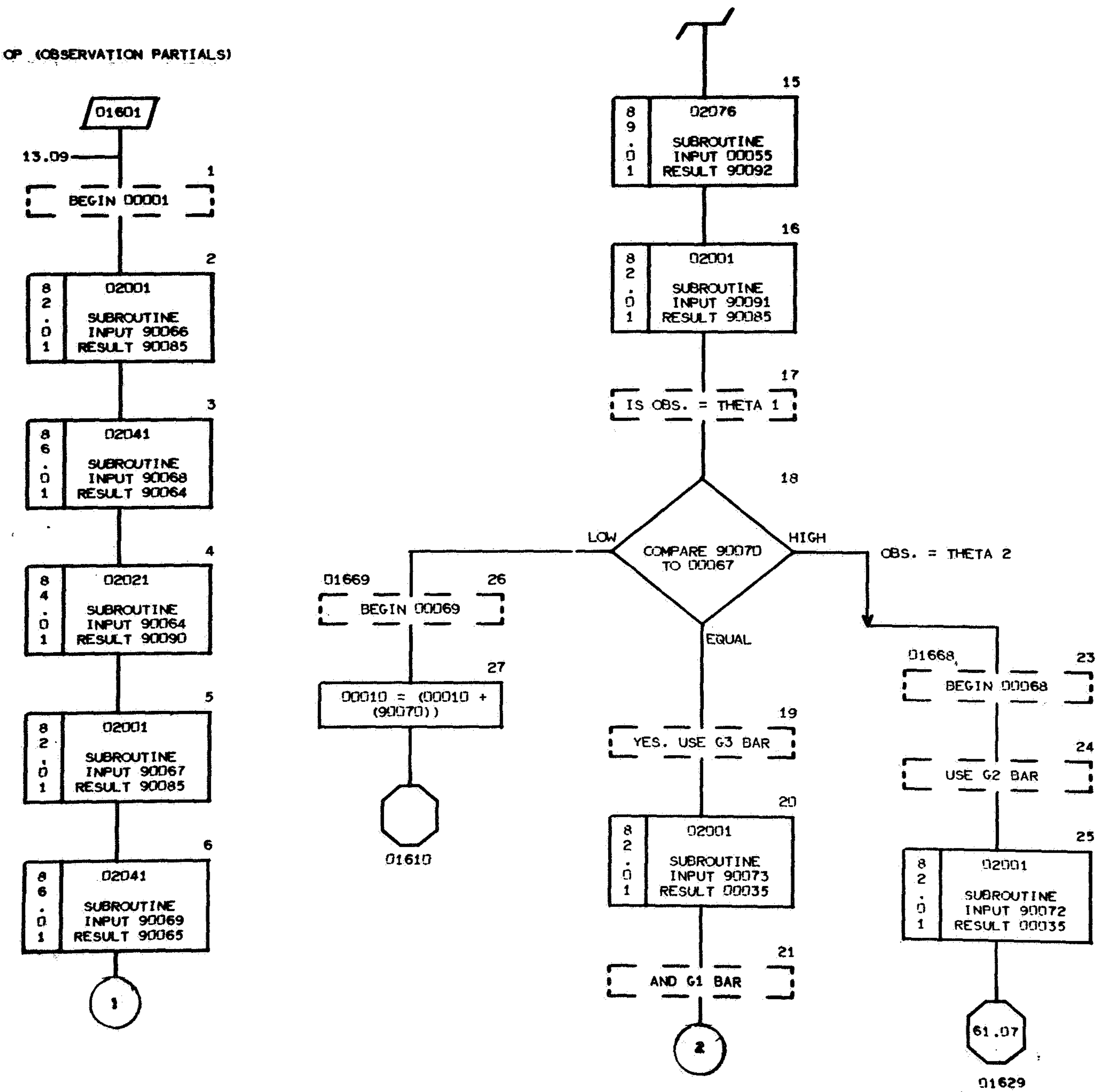
52.01	01549	
52.18	01550	
52.35	01551	
53.01	01552	
53.18	01553	
53.35	01554	
54.01	01555	
54.18	01556	
54.35	01557	
55.01	01558	
55.18	01559	
55.35	01494	
56.01	01495	

K VALUE = 01600

OP (OBSERVATION PARTIALS)



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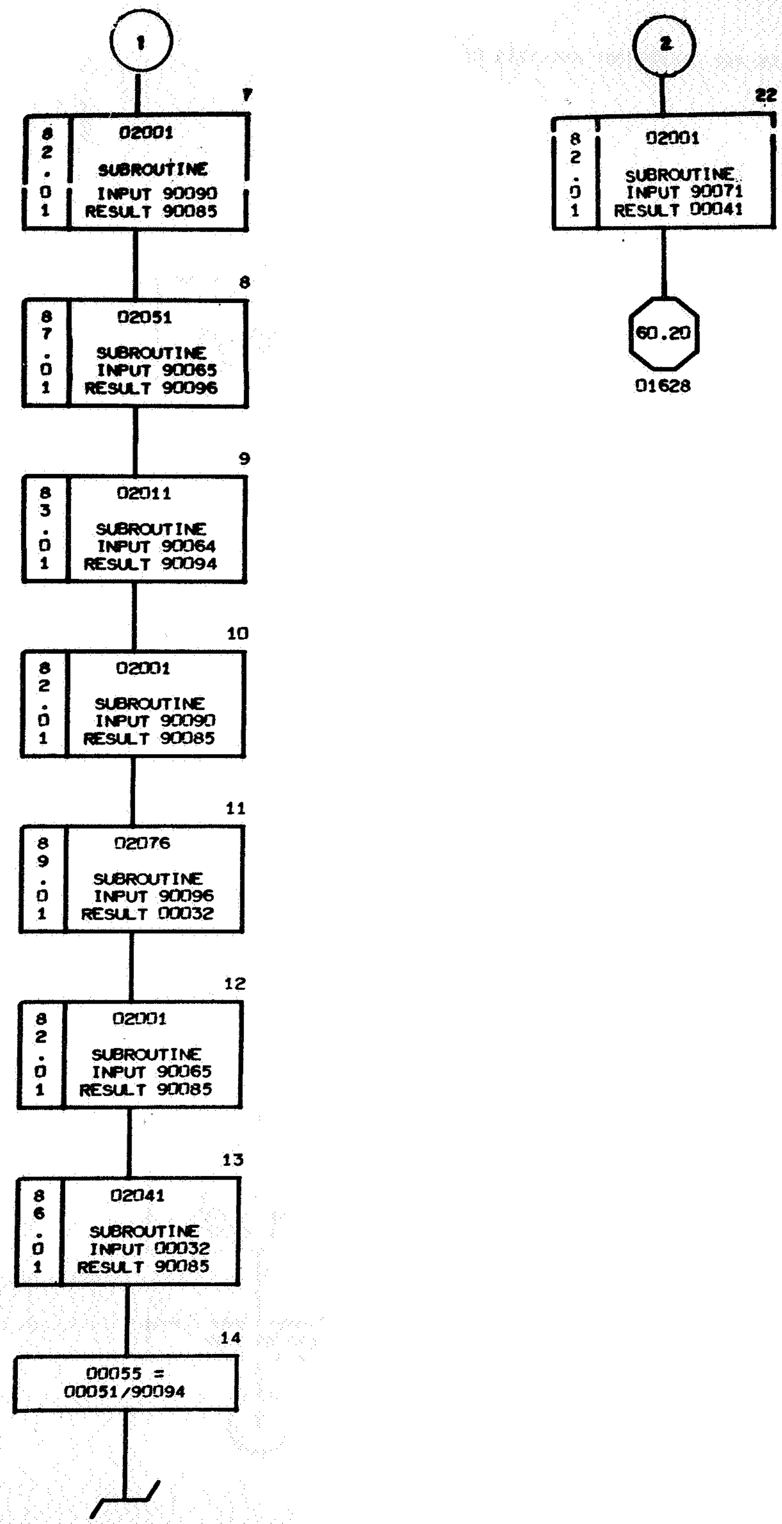
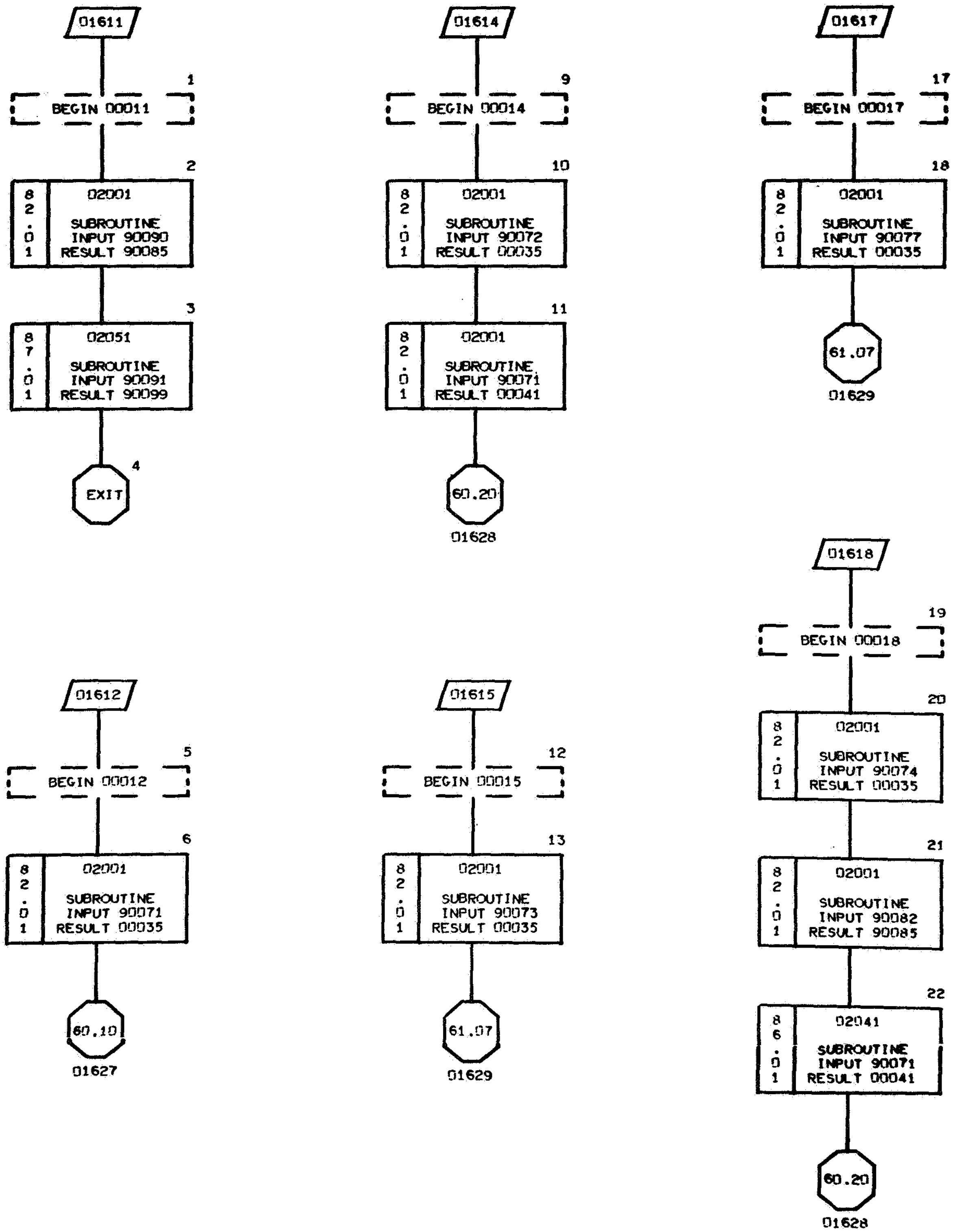


K VALUE = 01600



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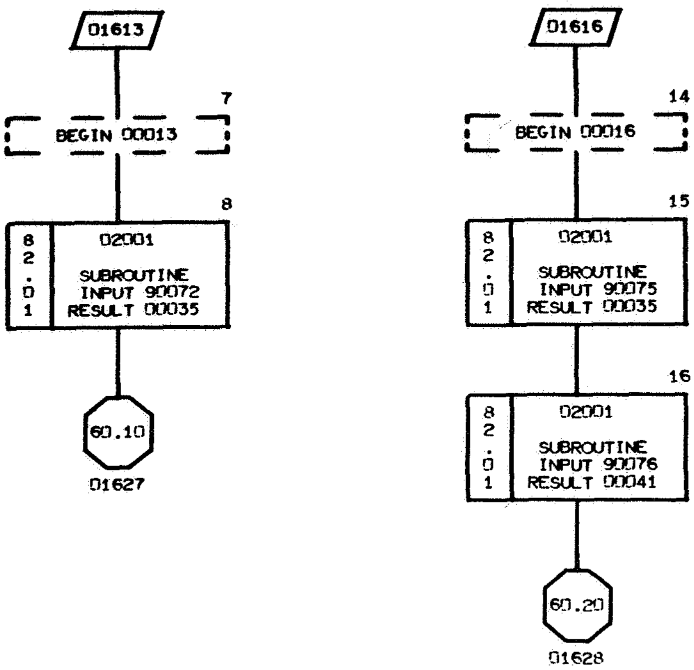

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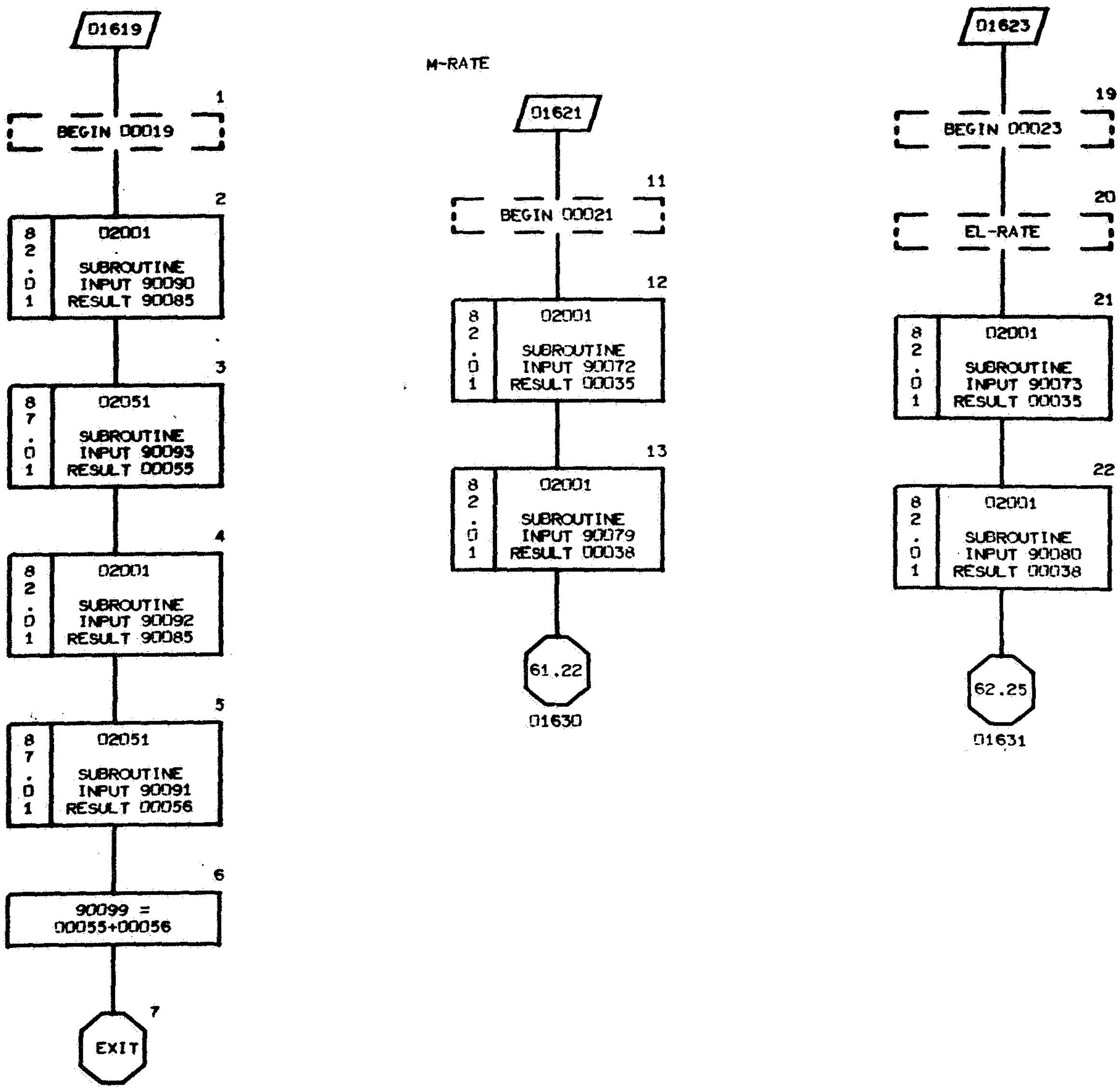
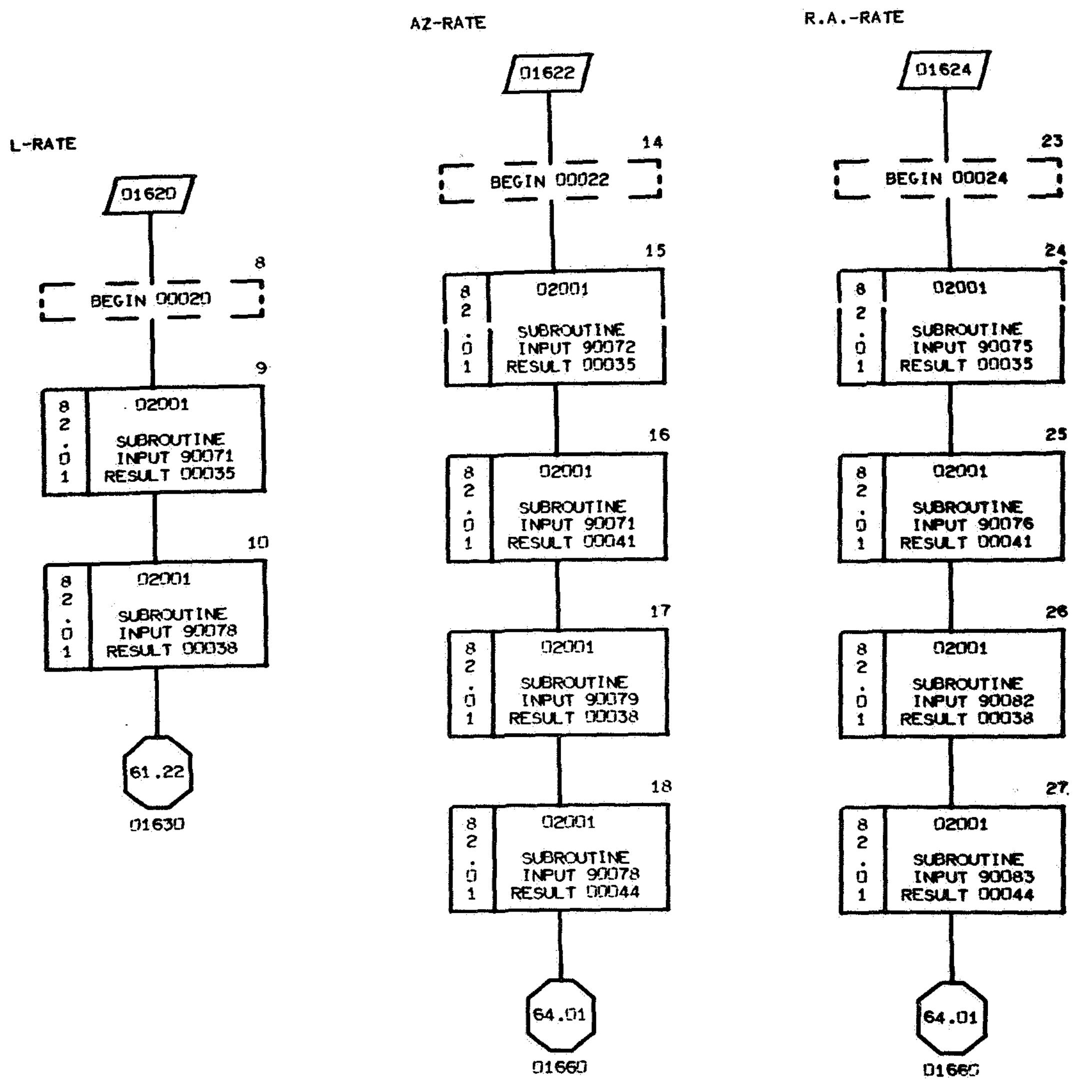
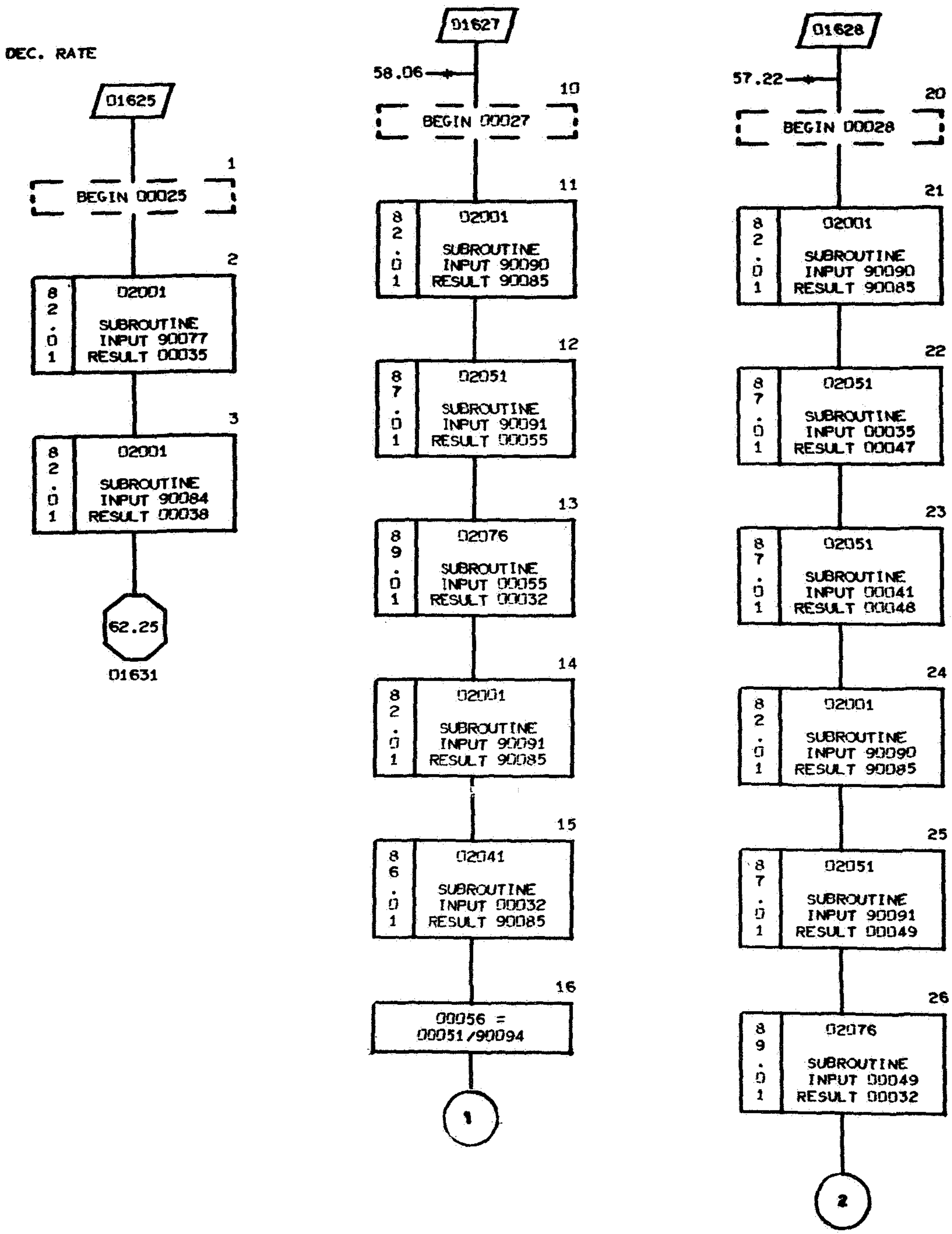
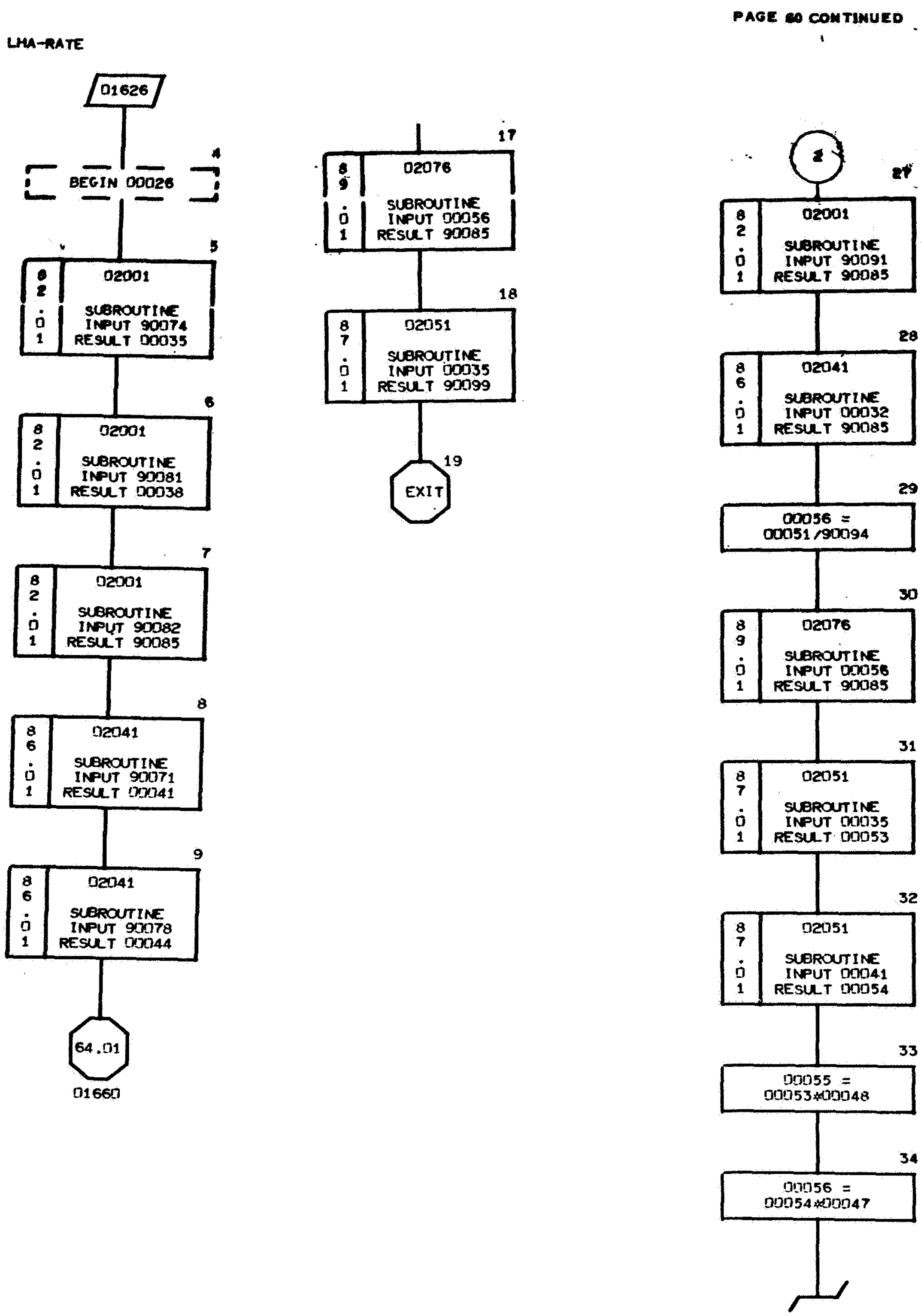


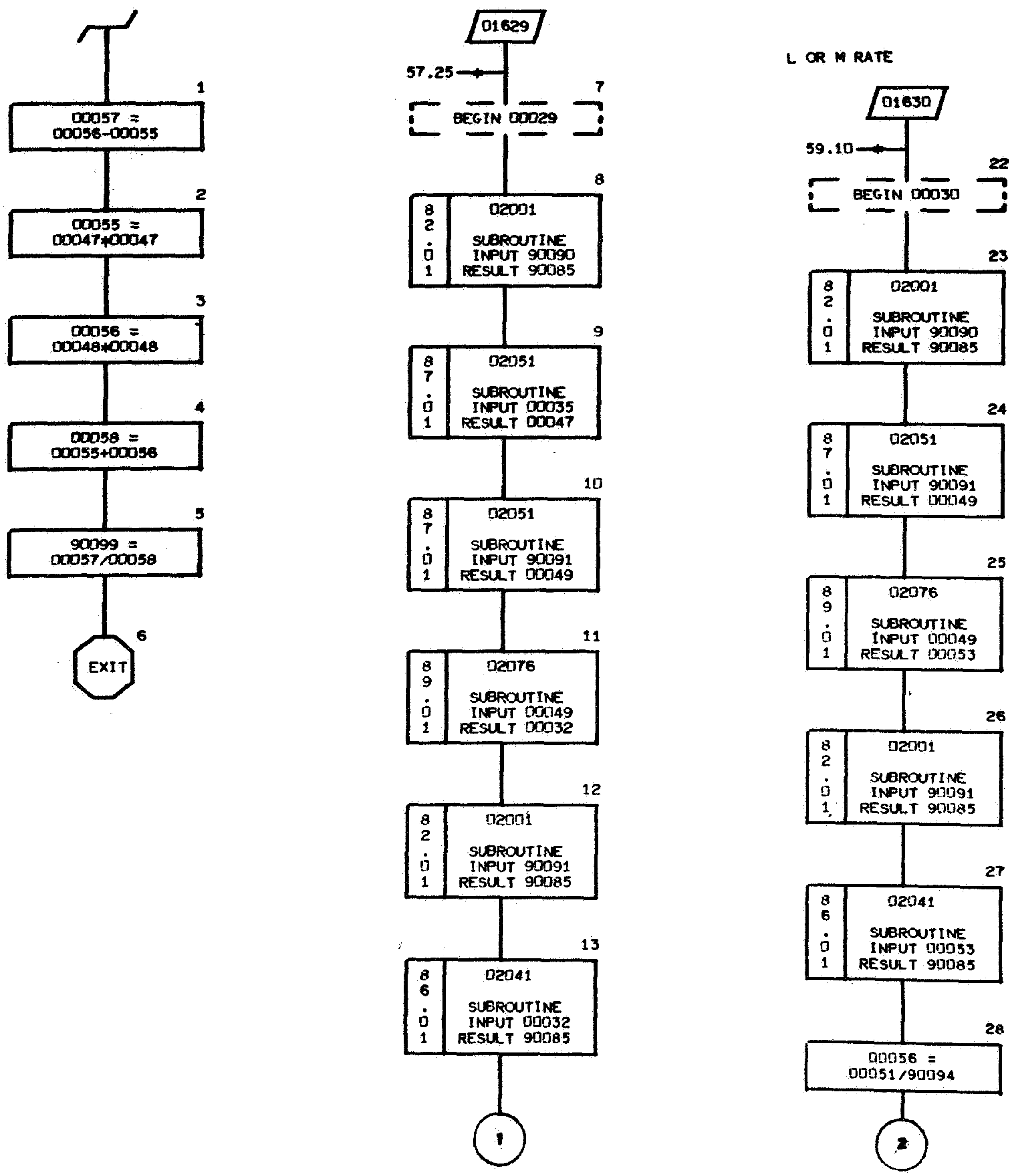

L-RATE
01620
8
BEGIN 00020
9
8 2 . 0 1
02001
SUBROUTINE
INPUT 90071
RESULT 00035
10
8 2 . 0 1
02001
SUBROUTINE
INPUT 90078
RESULT 00038
61.22
01630
AZ-RATE
01622
14
BEGIN 00022
15
8 2 . 0 1
02001
SUBROUTINE
INPUT 90072
RESULT 00035
16
8 2 . 0 1
02001
SUBROUTINE
INPUT 90071
RESULT 00041
17
8 2 . 0 1
02001
SUBROUTINE
INPUT 90079
RESULT 00038
18
8 2 . 0 1
02001
SUBROUTINE
INPUT 90078
RESULT 00044
64.01
01660
R.A.-RATE
01624
23
BEGIN 00024
24
8 2 . 0 1
02001
SUBROUTINE
INPUT 90075
RESULT 00035
25
8 2 . 0 1
02001
SUBROUTINE
INPUT 90076
RESULT 00041
26
8 2 . 0 1
02001
SUBROUTINE
INPUT 90082
RESULT 00038
27
8 2 . 0 1
02001
SUBROUTINE
INPUT 90083
RESULT 00044
64.01
01660

K VALUE = 01600

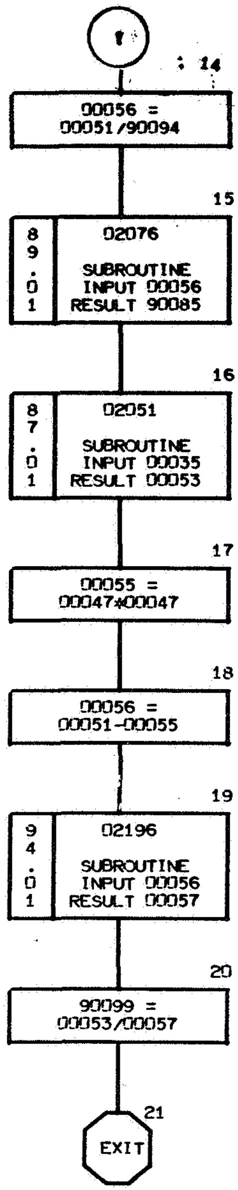


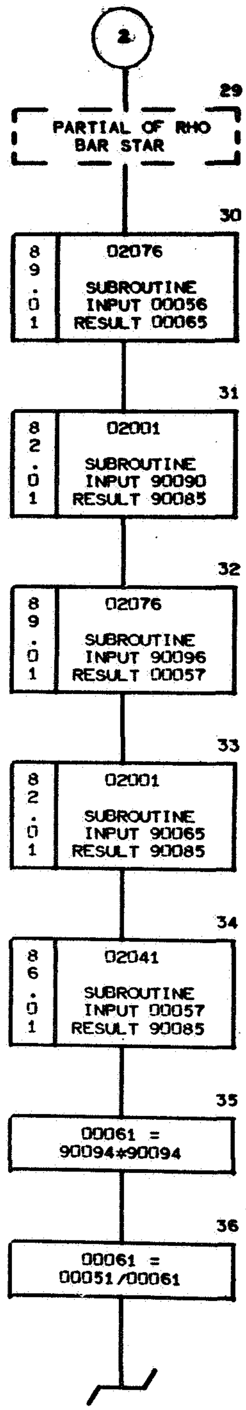

LMA-RATE
PAGE 60 CONTINUED
01626
BEGIN 00026
4
5
02001
SUBROUTINE
INPUT 90074
RESULT 00035
8 2 . 0 1
6
02001
SUBROUTINE
INPUT 90081
RESULT 00038
8 2 . 0 1
7
02001
SUBROUTINE
INPUT 90082
RESULT 90085
8 2 . 0 1
8
02041
SUBROUTINE
INPUT 90071
RESULT 00041
8 6 . 0 1
9
02041
SUBROUTINE
INPUT 90078
RESULT 00044
8 6 . 0 1
64.01
01660
17
02076
SUBROUTINE
INPUT 00056
RESULT 90085
8 9 . 0 1
18
02051
SUBROUTINE
INPUT 00035
RESULT 90099
8 7 . 0 1
19
EXIT
2
27
02001
SUBROUTINE
INPUT 90091
RESULT 90085
8 2 . 0 1
28
02041
SUBROUTINE
INPUT 00032
RESULT 90085
8 6 . 0 1
29
00056 =
00051/90094
30
02076
SUBROUTINE
INPUT 00056
RESULT 90085
8 9 . 0 1
31
02051
SUBROUTINE
INPUT 00035
RESULT 00053
8 7 . 0 1
32
02051
SUBROUTINE
INPUT 00041
RESULT 00054
8 7 . 0 1
33
00055 =
00053*00048
34
00056 =
00054*00047

K VALUE = 01600

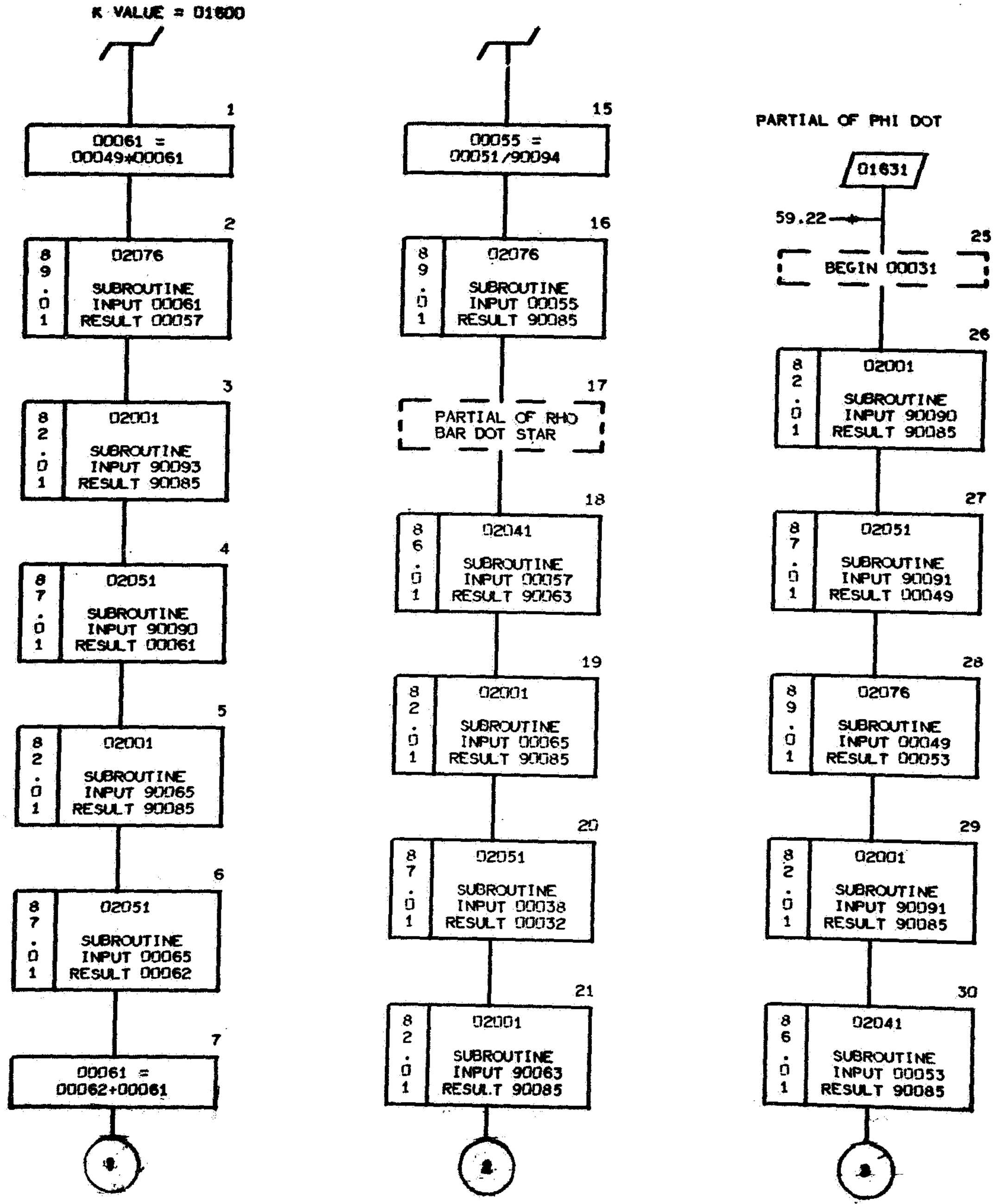


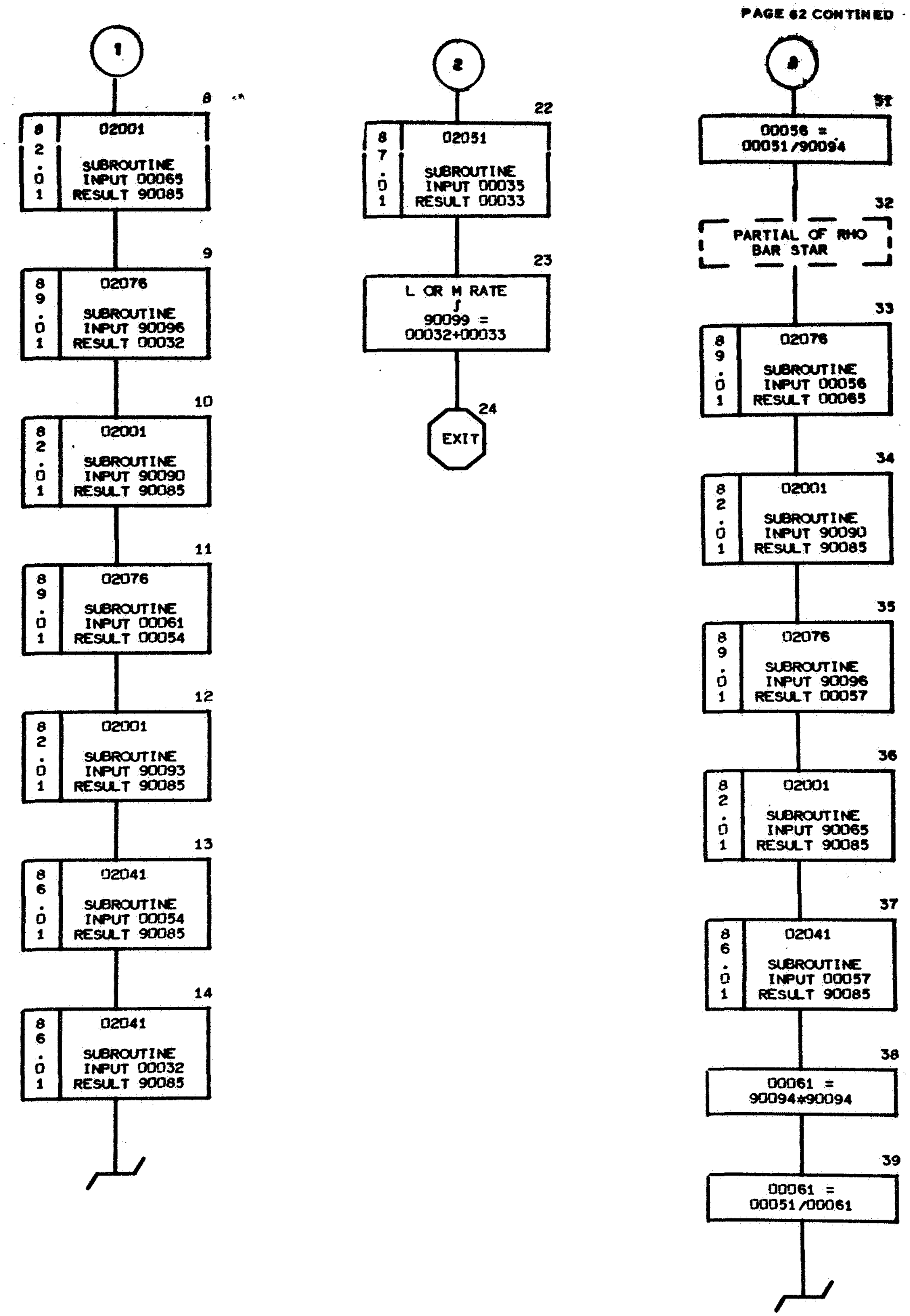
PAGE 61 CONTINUED





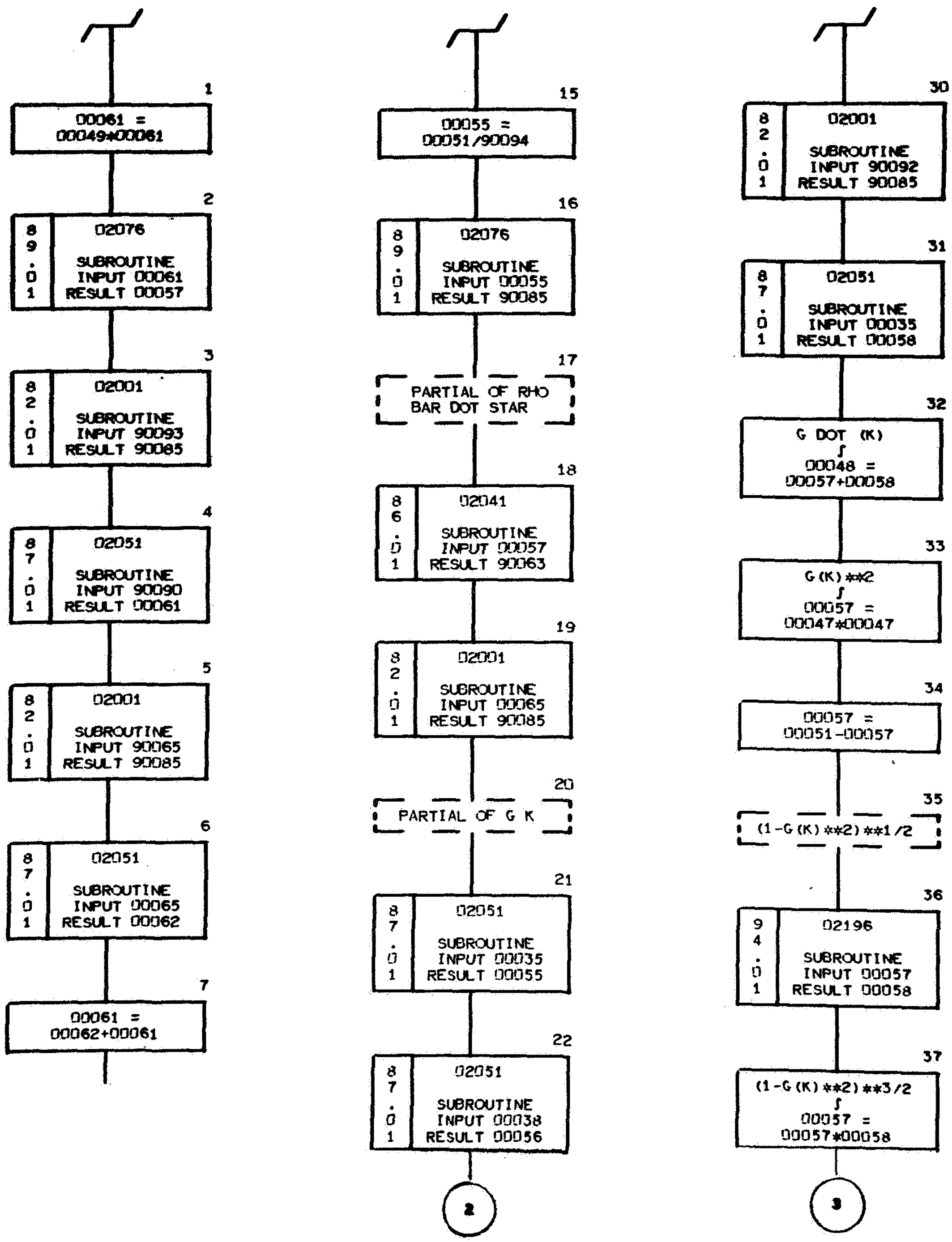
K VALUE = 01600





PAGE 62 CONTINUED
1
8
8 2 . 0 1
02001
SUBROUTINE
INPUT 00065
RESULT 90085
9
8 9 . 0 1
02076
SUBROUTINE
INPUT 90096
RESULT 00032
10
8 2 . 0 1
02001
SUBROUTINE
INPUT 90090
RESULT 90085
11
8 9 . 0 1
02076
SUBROUTINE
INPUT 00061
RESULT 00054
12
8 2 . 0 1
02001
SUBROUTINE
INPUT 90093
RESULT 90085
13
8 6 . 0 1
02041
SUBROUTINE
INPUT 00054
RESULT 90085
14
8 6 . 0 1
02041
SUBROUTINE
INPUT 00032
RESULT 90085
2
22
8 7 . 0 1
02051
SUBROUTINE
INPUT 00035
RESULT 00033
23
L OR M RATE
∫
90099 =
00032+00033
24
EXIT
31
00056 =
00051/90094
32
PARTIAL OF RHO
BAR STAR
33
8 9 . 0 1
02076
SUBROUTINE
INPUT 00056
RESULT 00065
34
8 2 . 0 1
02001
SUBROUTINE
INPUT 90090
RESULT 90085
35
8 9 . 0 1
02076
SUBROUTINE
INPUT 90096
RESULT 00057
36
8 2 . 0 1
02001
SUBROUTINE
INPUT 90065
RESULT 90085
37
8 6 . 0 1
02041
SUBROUTINE
INPUT 00057
RESULT 90085
38
00061 =
90094*90094
39
00061 =
00051/00061

K VALUE = 01600



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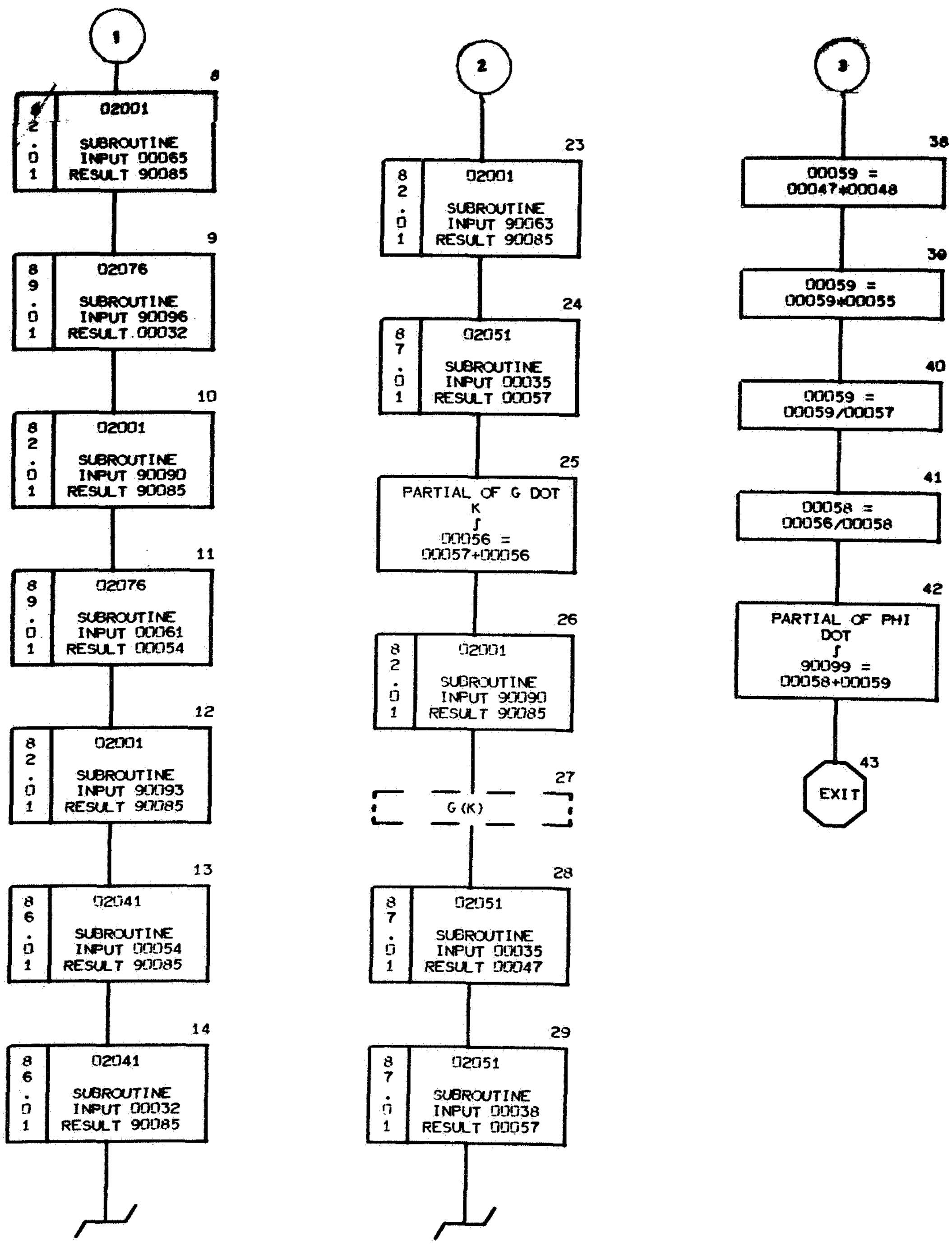
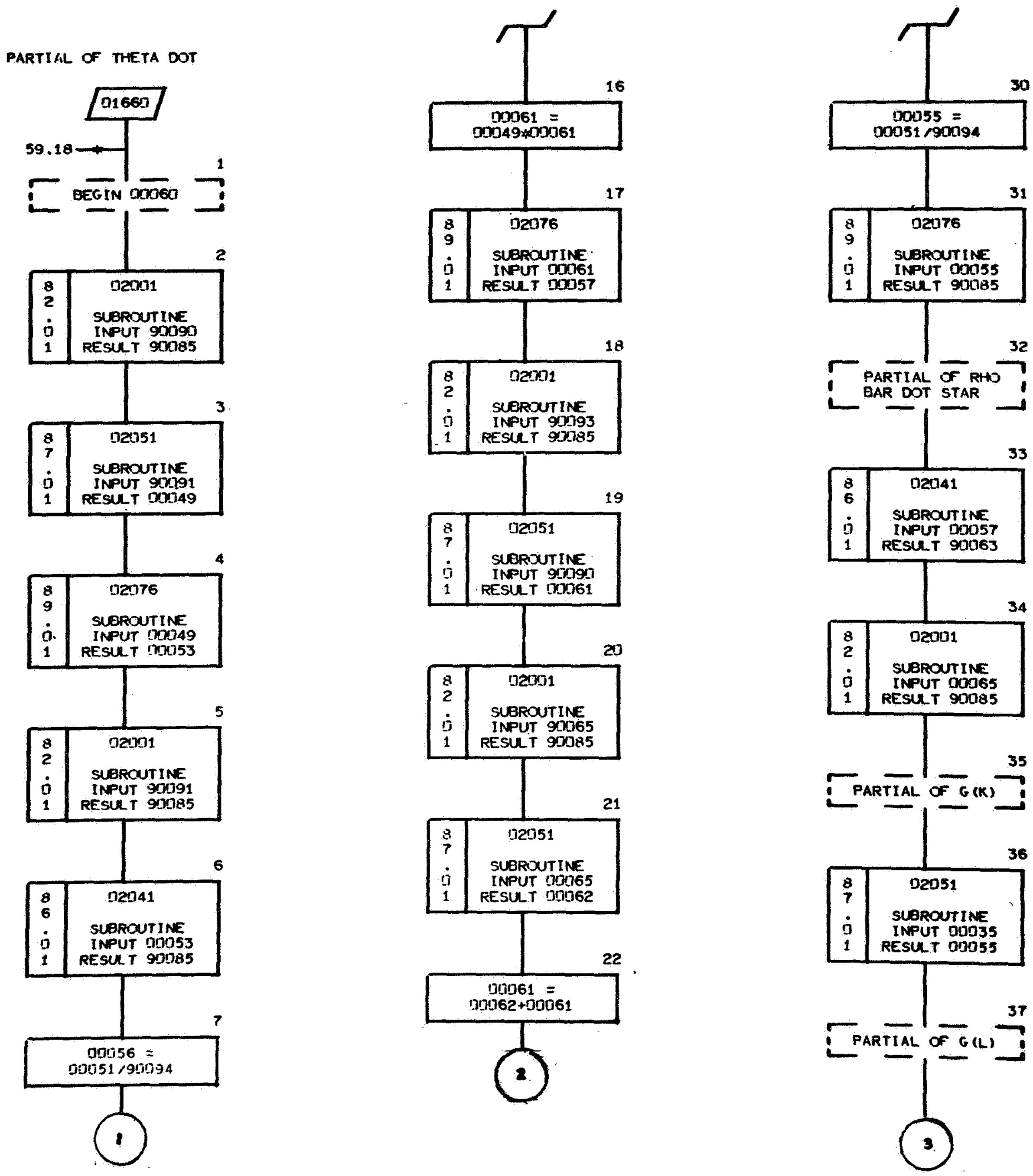


K VALUE = 01600



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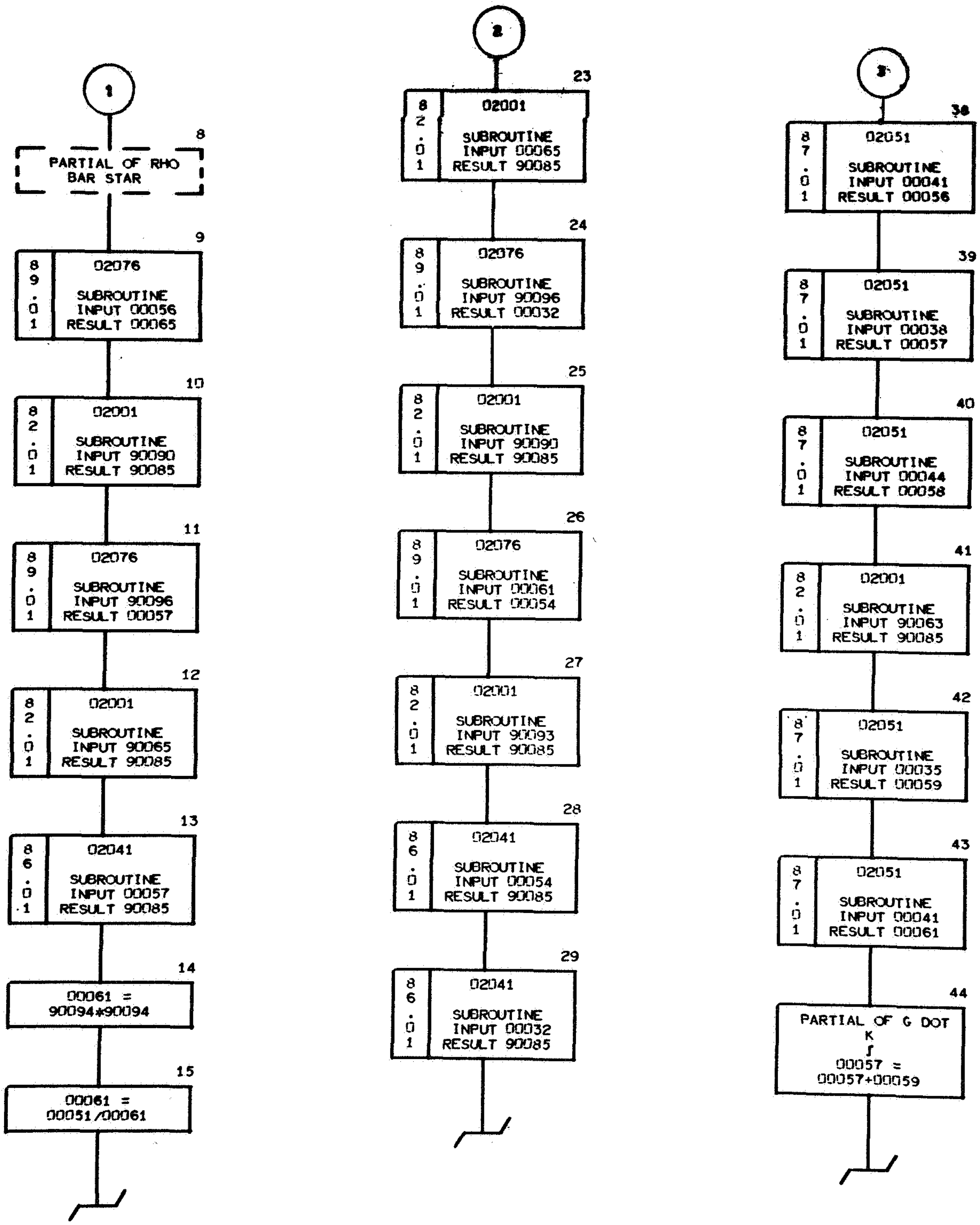
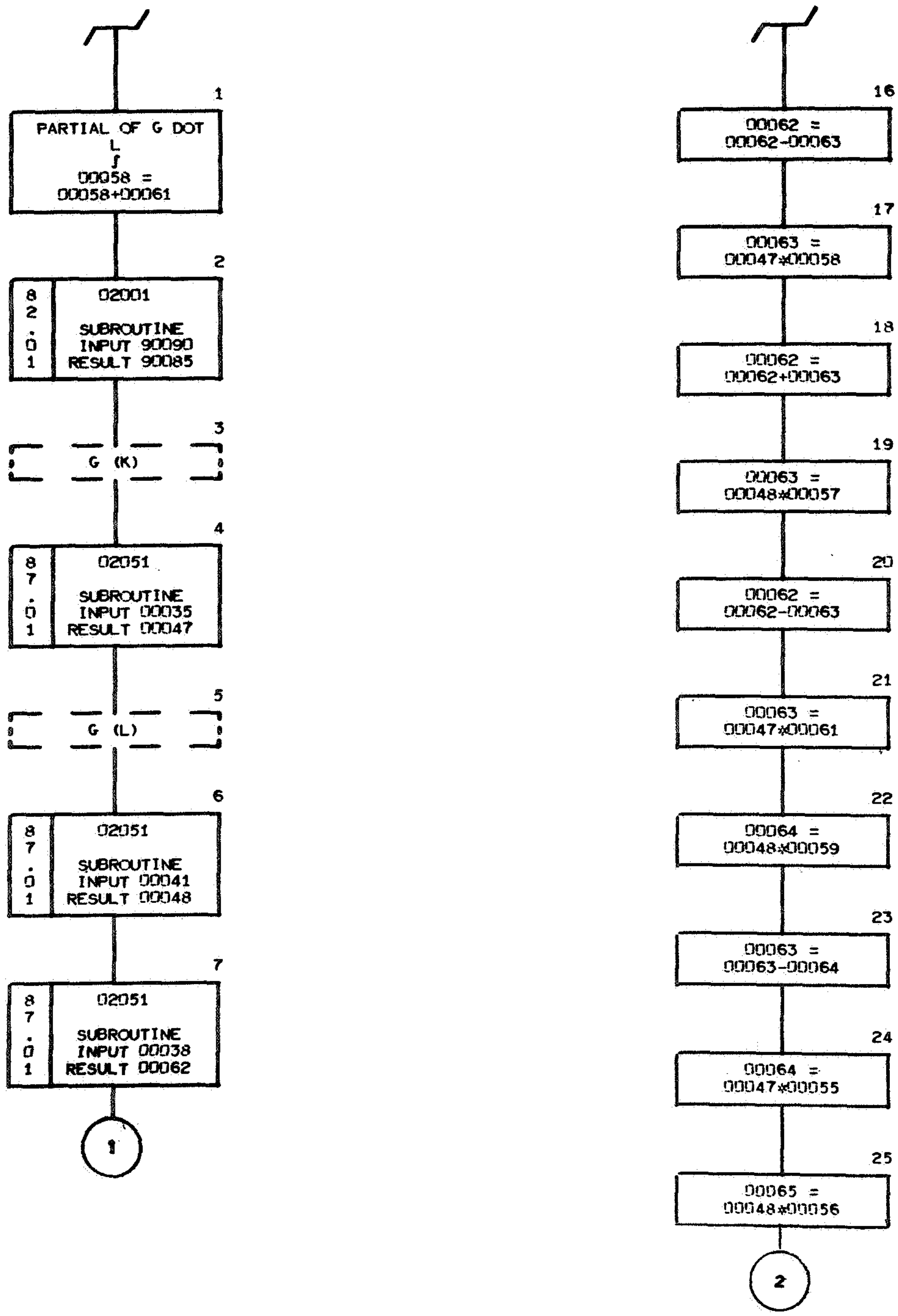
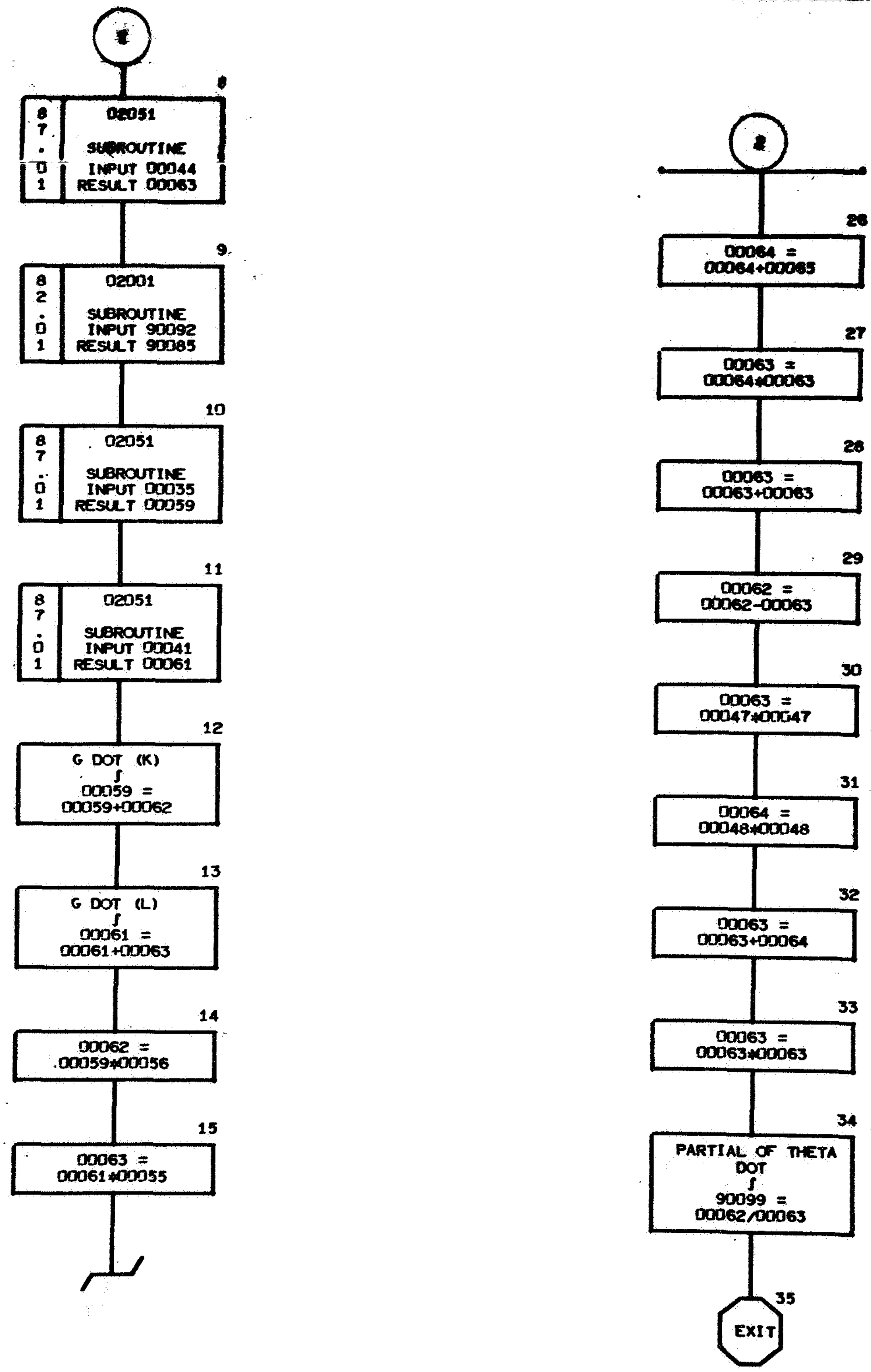


K VALUE = 01600




8
87.01
02051
SUBROUTINE
INPUT 00044
RESULT 00063
9
82.01
02001
SUBROUTINE
INPUT 90092
RESULT 90085
10
87.01
02051
SUBROUTINE
INPUT 00035
RESULT 00059
11
87.01
02051
SUBROUTINE
INPUT 00041
RESULT 00061
12
G DOT (K)
∫
00059 =
00059+00062
13
G DOT (L)
∫
00061 =
00061+00063
14
00062 =
00059*00056
15
00063 =
00061*00055
2
26
00064 =
00064+00065
27
00063 =
00064*00063
28
00063 =
00063+00063
29
00062 =
00062-00063
30
00063 =
00047*00047
31
00064 =
00048*00048
32
00063 =
00063+00064
33
00063 =
00063*00063
34
PARTIAL OF THETA
DOT
∫
90099 =
00062/00063
35
EXIT

K VALUE = 01600

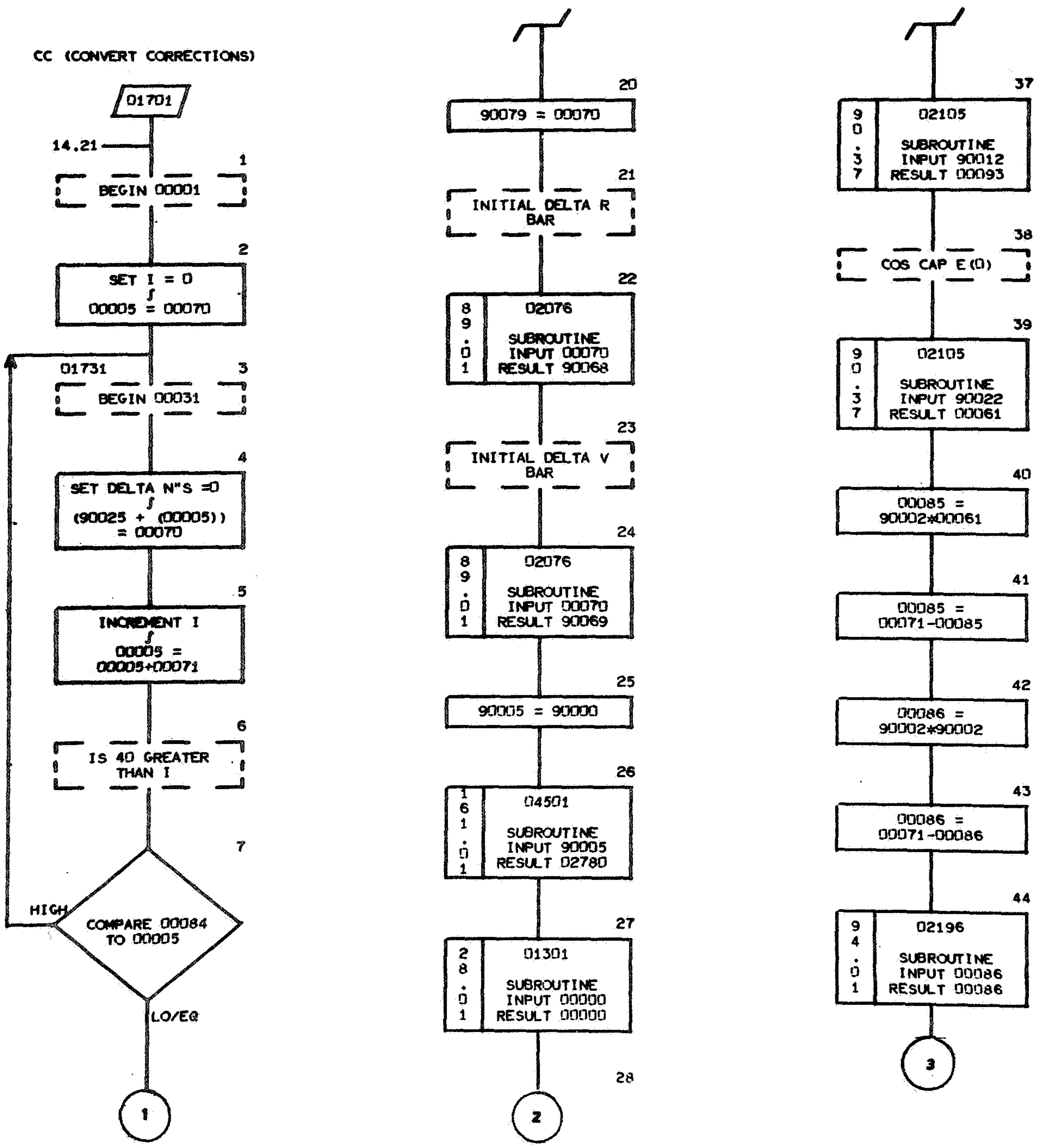
Q9006300389	PARTIAL OF (RHO DOT BAR)*/XJ
Q9006400358	RHO BAR
Q9006500365	RHO DOT BAR
Q9006600237	R BAR,SAT.POS.VECTOR (FROM PE)
Q9006700241	R DOT BAR,SAT.VEL.VECTOR(FROM PE)
Q9006800310	CAP R BAR,STATION POSITION VECTOR
Q9006900313	CAP R DOT BAR,STATION VELOCITY VECTO
Q9007000253	OBSERVATION TYPE
Q9007100316	G 1 BAR
Q9007200319	G 2 BAR
Q9007300322	G 3 BAR
Q9007400325	G 4 BAR
Q9007500328	G 5 BAR
Q9007600331	G 6 BAR
Q9007700334	G 7 BAR
Q9007800337	G 1 DOT BAR
Q9007900340	G 2 DOT BAR
Q9008000343	G 3 DOT BAR
Q9008100346	G 4 DOT BAR
Q9008200349	G 5 DOT BAR
Q9008300352	G 6 DOT BAR
Q9008400355	G 7 DOT BAR
Q9008502085	VQ
Q9008602001	VECTOR MOVE
Q9008702051	DOT PRODUCT
Q9008802076	SCALAR-VECTOR MULTIPLY
Q9008902041	VECTOR SUBTRACT
Q9009000361	(RHO BAR)*
Q9009100380	PARTIAL OF R BAR / XJ
Q9009200368	(RHO DOT BAR)*
Q9009300383	PARTIAL OF R DOT BAR / XJ
Q9009400364	RHO
Q9009502196	SQUARE ROOT
Q9009600371	RHO DOT
Q9009702021	VECTOR DIRECTION
Q9009802011	VECTOR MAGNITUDE
Q9009900392	PARTIAL OF OBS. / XJ
V00067+17000000+02	
V00050+00000000+00	
V00051+10000000+01	
V00052+20000000+01	

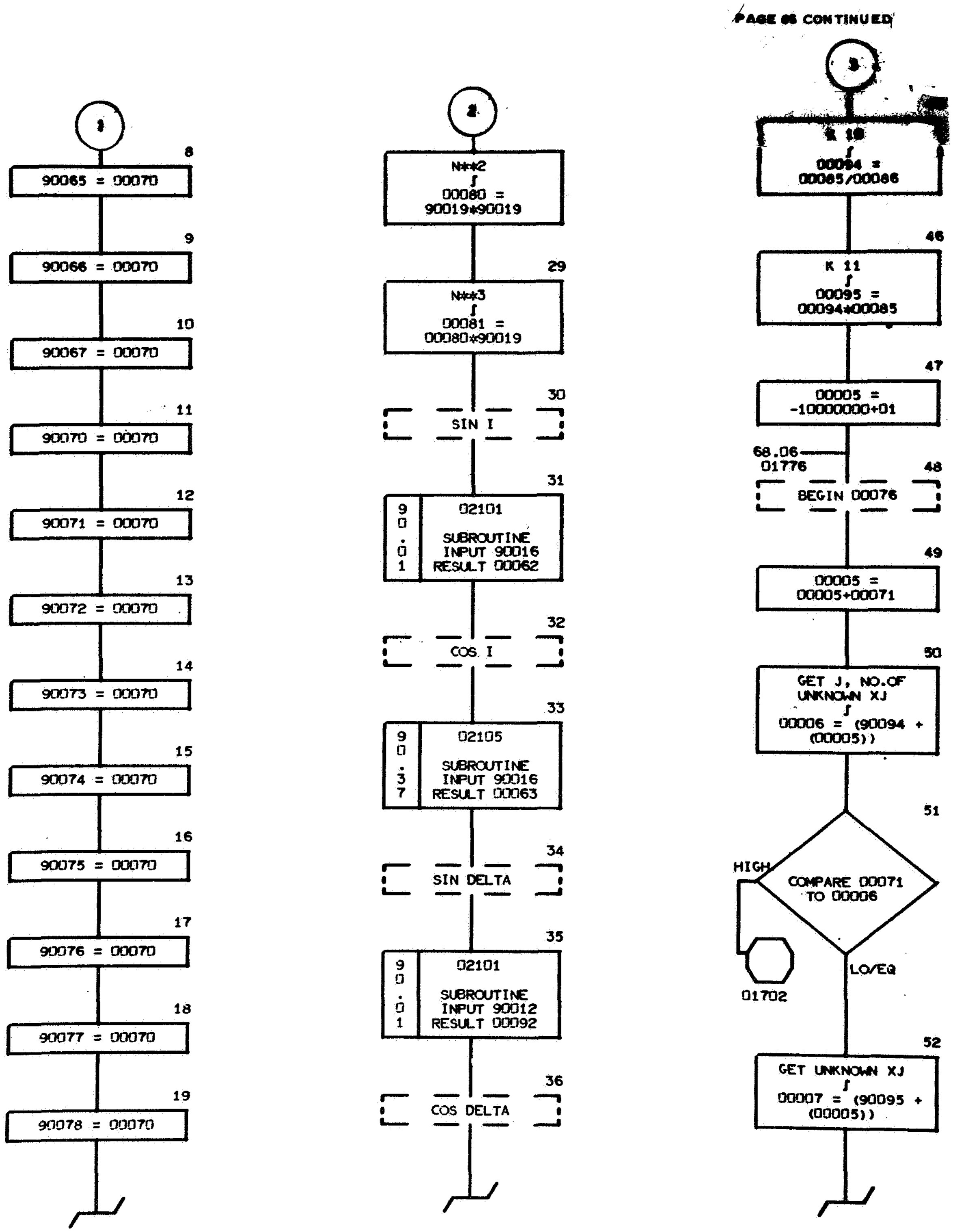
CROSS-REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES			
57.01	01601	13.09*			
57.23	01668	57.18			
57.26	01669	57.18			
58.01	01611				
58.05	01612				
58.07	01613				
58.09	01614				
58.12	01615				
58.14	01616				
58.17	01617				
58.19	01618				
59.01	01619				
59.08	01620				
59.11	01621				
59.14	01622				
59.19	01623				
59.23	01624				
60.01	01625				
60.04	01626				
60.10	01627	58.06	58.08		
60.20	01628	57.22	58.11	58.16	58.22
61.07	01629	57.25	58.13	58.18	
61.22	01630	59.10	59.13		
62.25	01631	59.22	60.03		
64.01	01660	59.18	59.27	60.09	

K VALUE = 01700

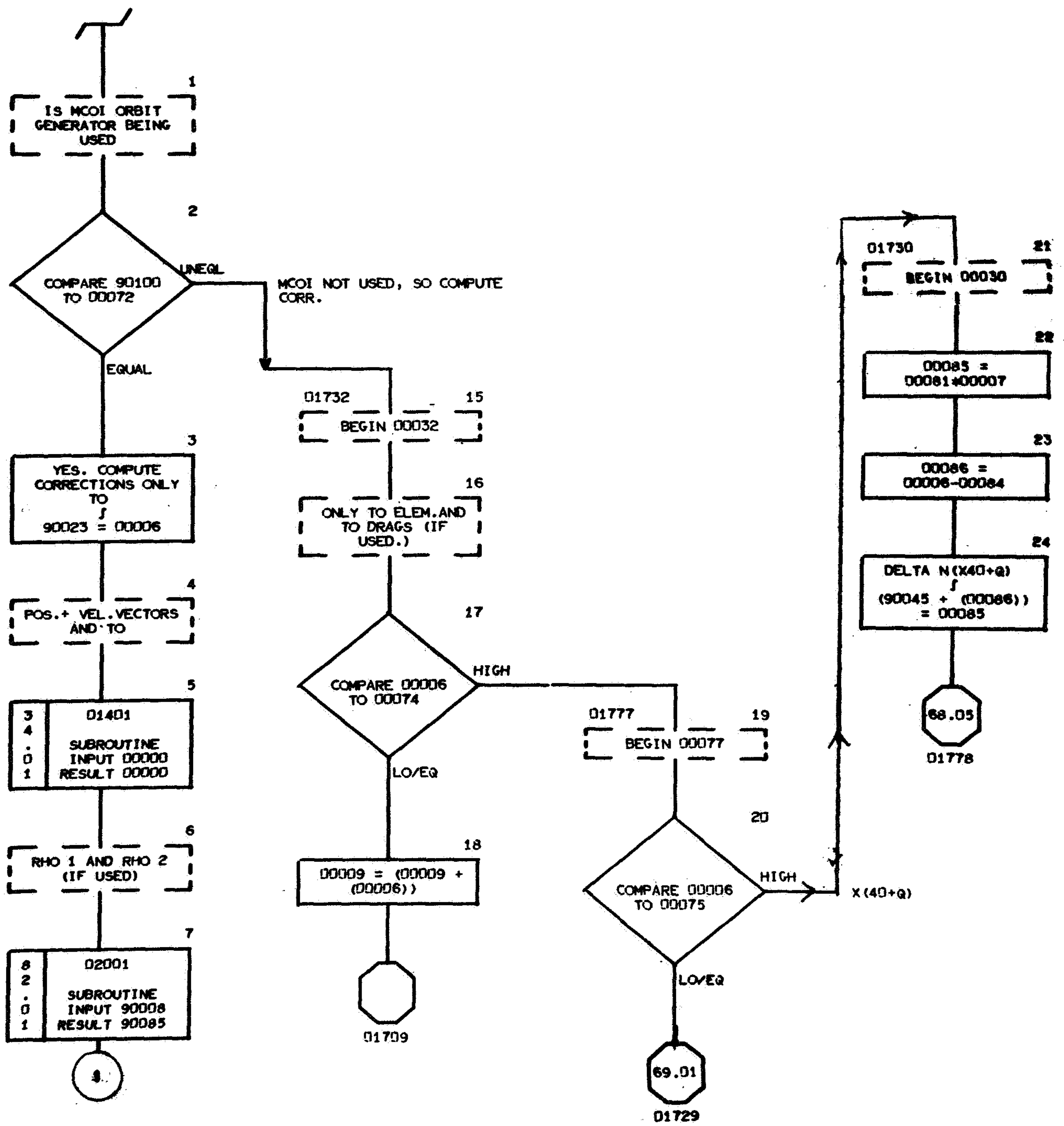
CC (CONVERT CORRECTIONS)



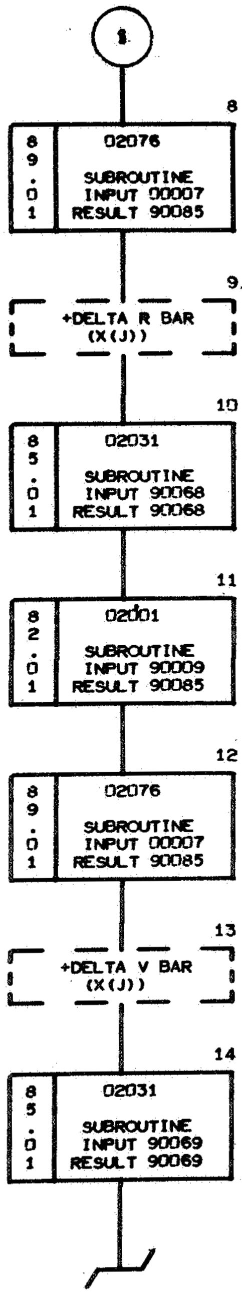


1
8
90065 = 00070
9
90066 = 00070
10
90067 = 00070
11
90070 = 00070
12
90071 = 00070
13
90072 = 00070
14
90073 = 00070
15
90074 = 00070
16
90075 = 00070
17
90076 = 00070
18
90077 = 00070
19
90078 = 00070
2
N**2
00080 =
90019*90019
29
N**3
00081 =
00080*90019
30
SIN I
31
90.01
02101
SUBROUTINE
INPUT 90016
RESULT 00062
32
COS I
33
90.37
02105
SUBROUTINE
INPUT 90016
RESULT 00063
34
SIN DELTA
35
90.01
02101
SUBROUTINE
INPUT 90012
RESULT 00092
36
COS DELTA
CONTINUED
00085/00086
46
K 11
00095 =
00094*00085
47
00005 =
-10000000+01
68.06
01776
48
BEGIN 00076
49
00005 =
00005+00071
50
GET J, NO.OF
UNKNOWN XJ
00006 = (90094 +
(00005))
51
COMPARE 00071
TO 00006
HIGH
01702
LO/EQ
52
GET UNKNOWN XJ
00007 = (90095 +
(00005))

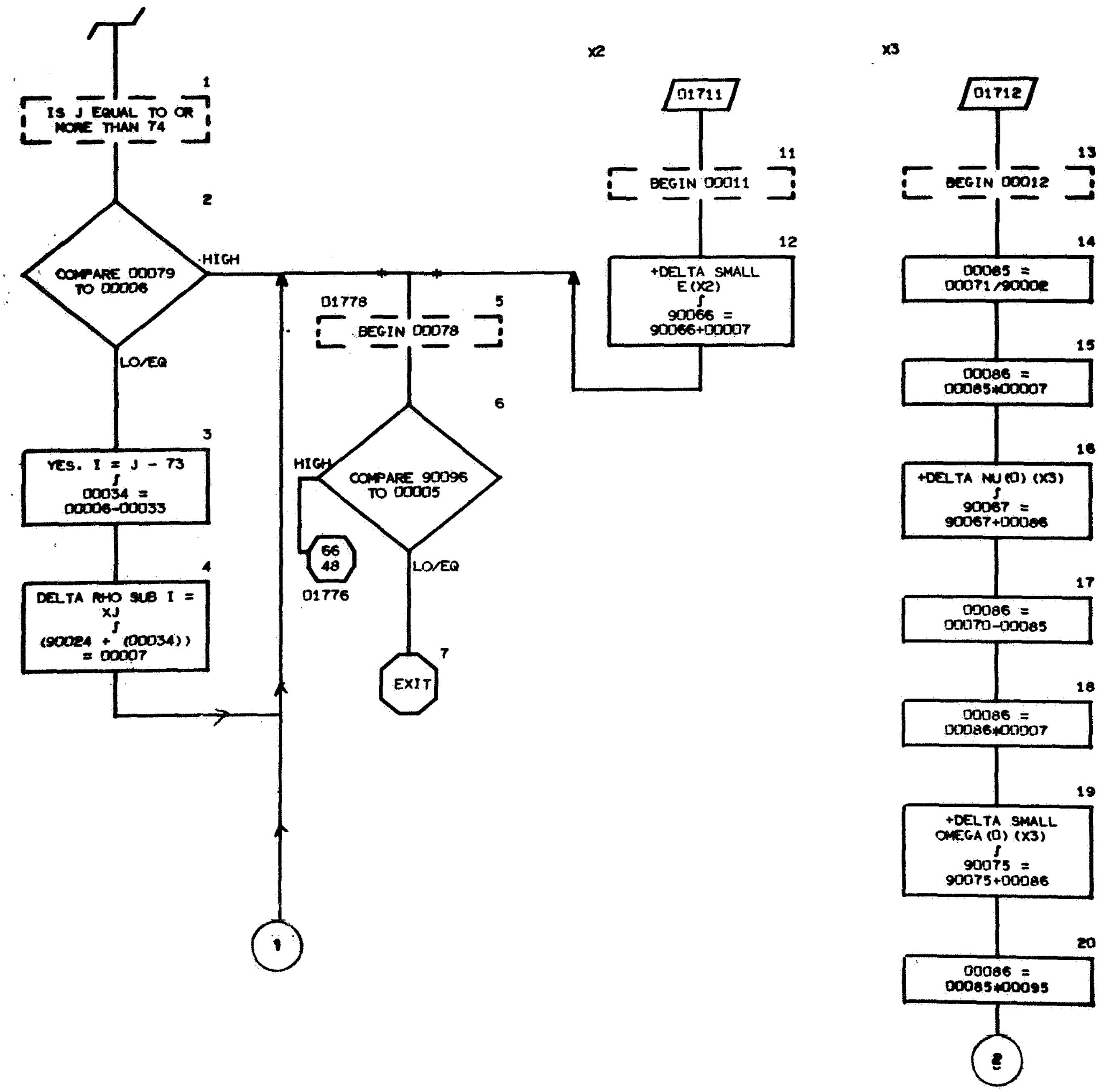
K VALUE = 01700

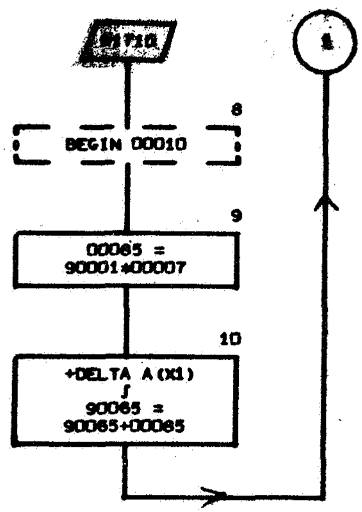


PAGE 67 CONTINUED

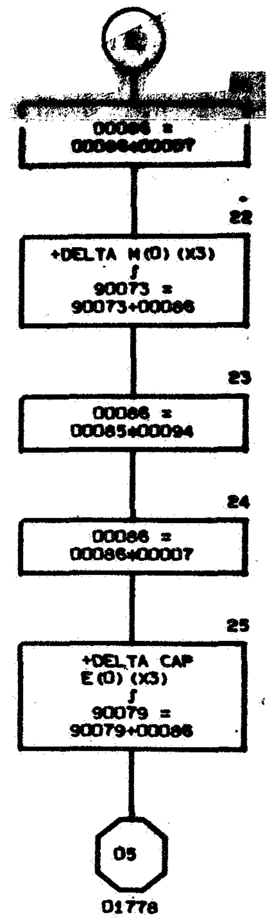


K VALUE = 01700

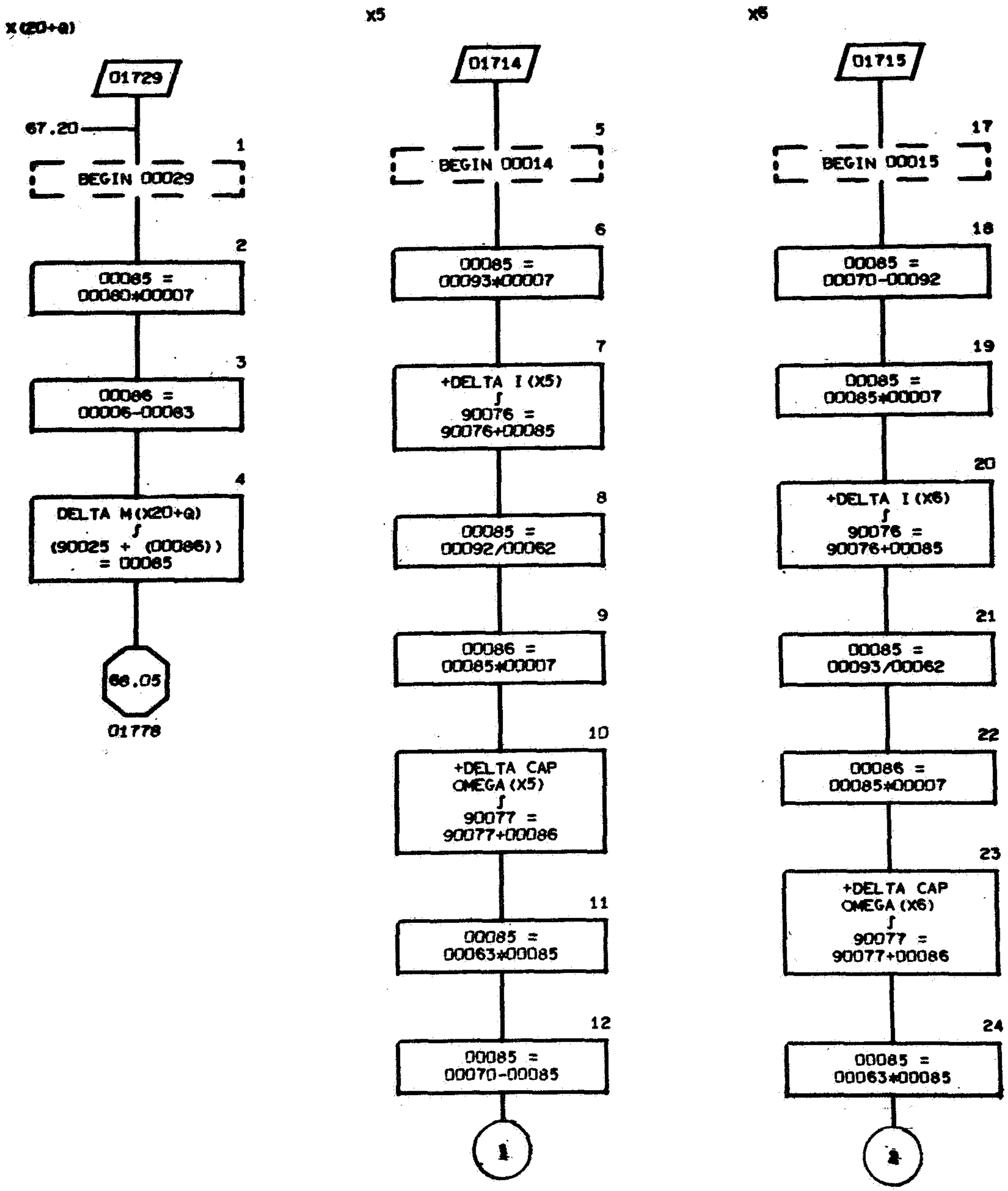




PAGE 68 CONTINUED



K VALUE = 01700



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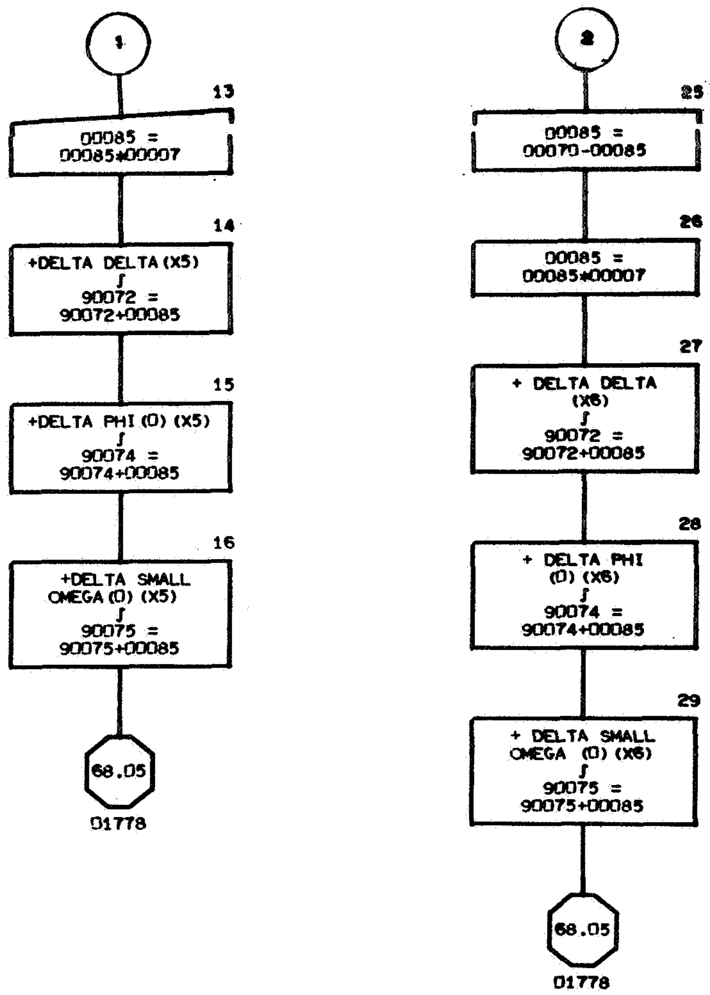
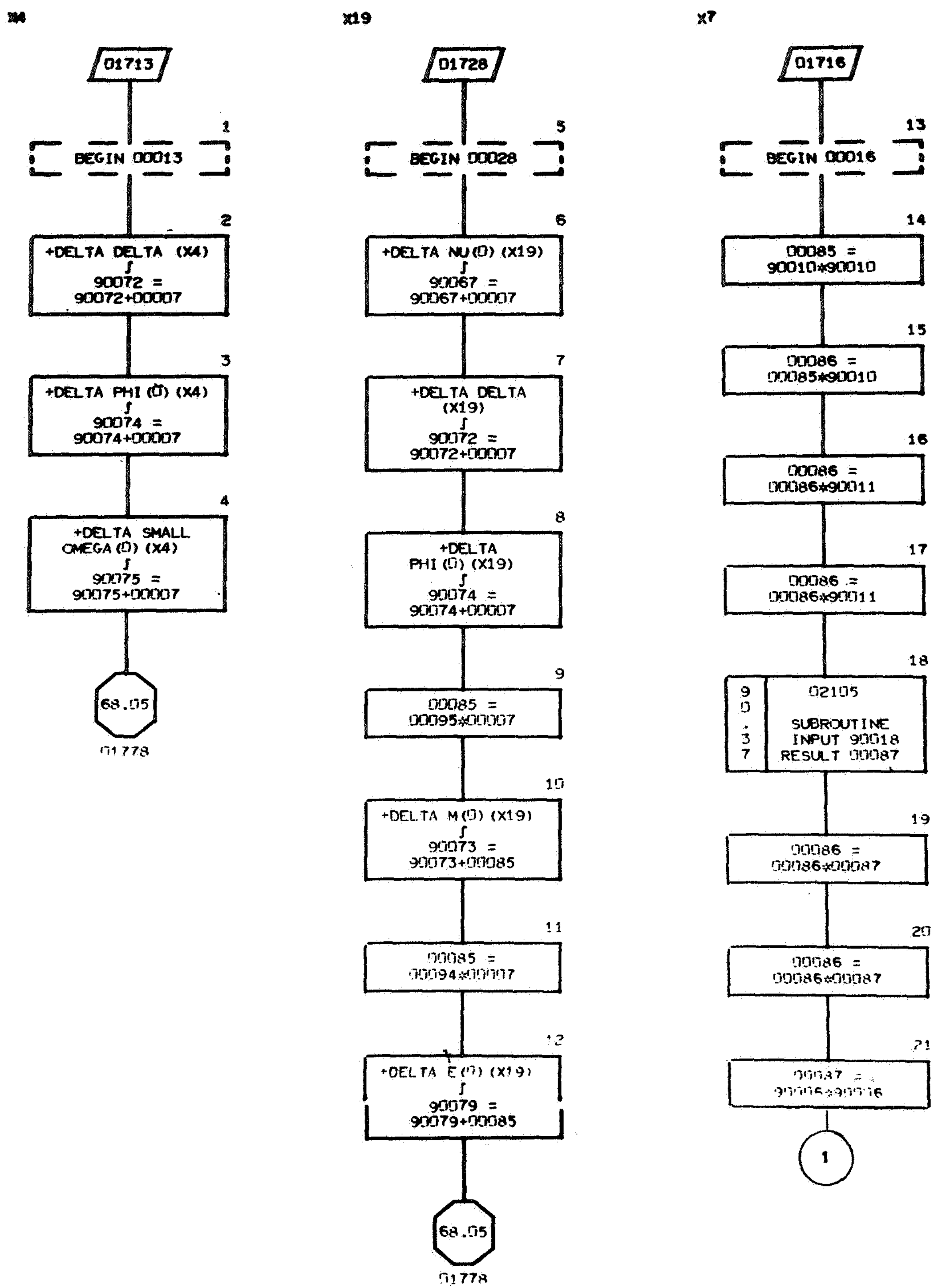
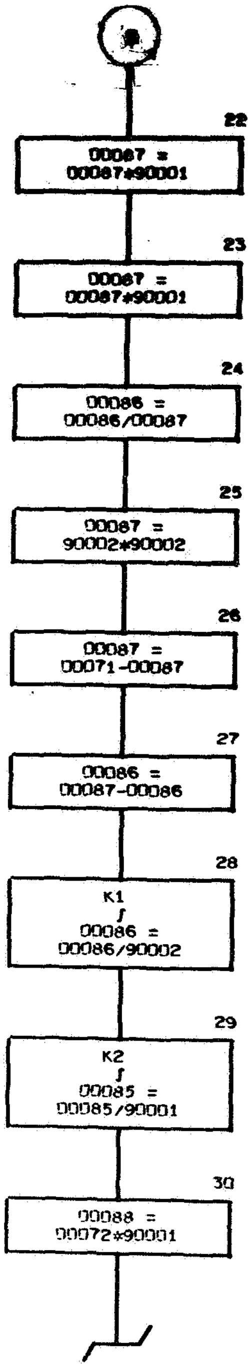


X VALUE = 01700



PAGE 70 CONTINUED



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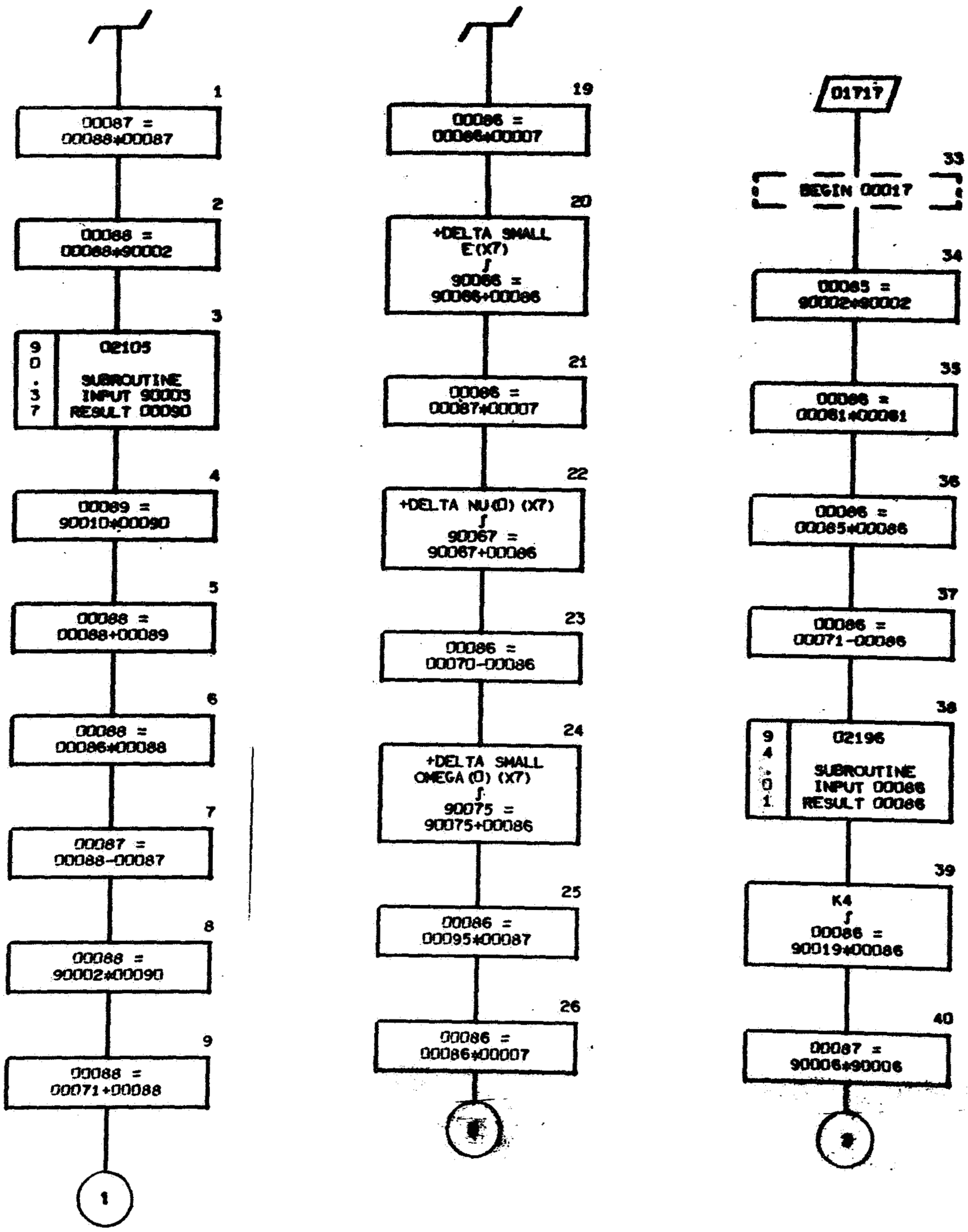

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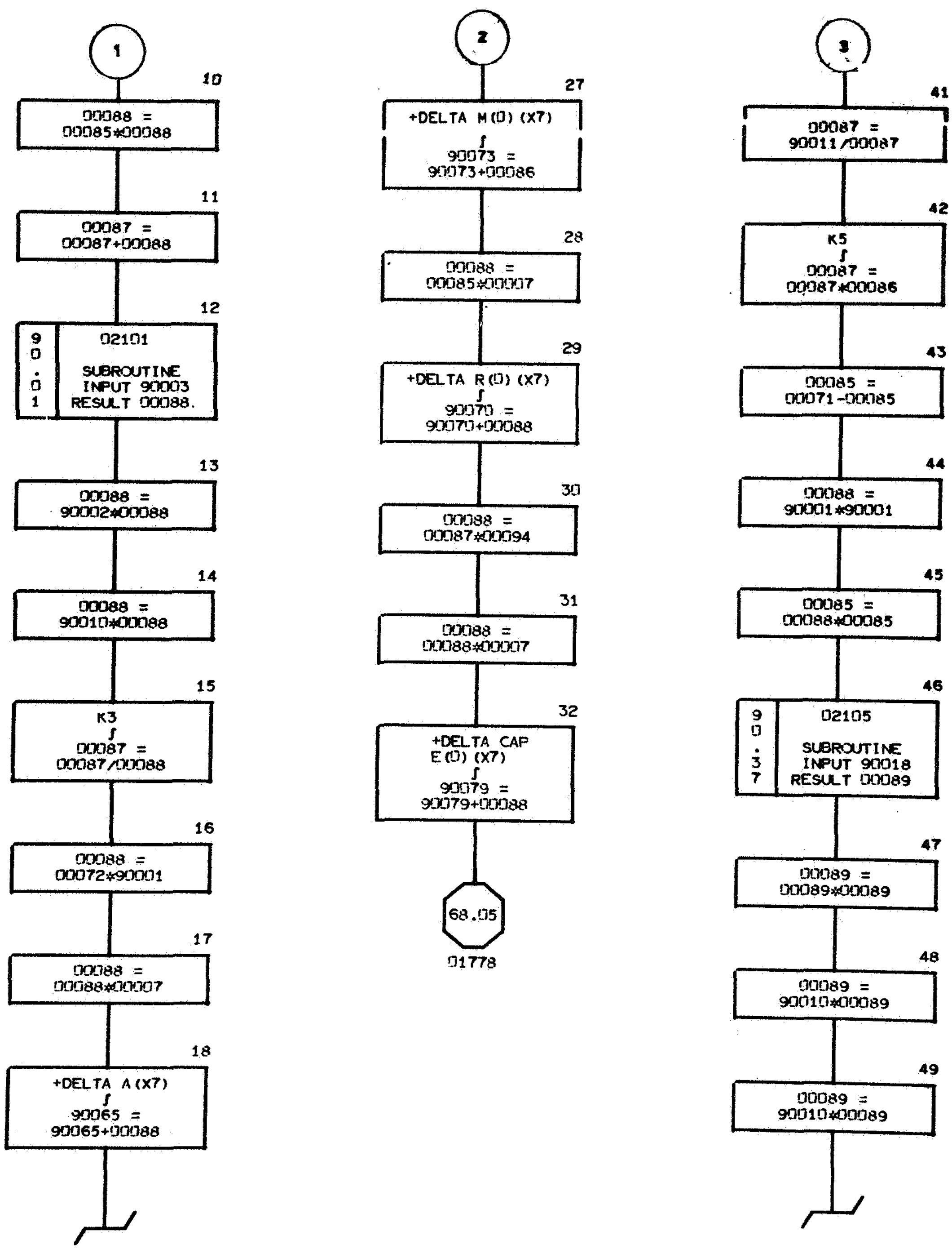
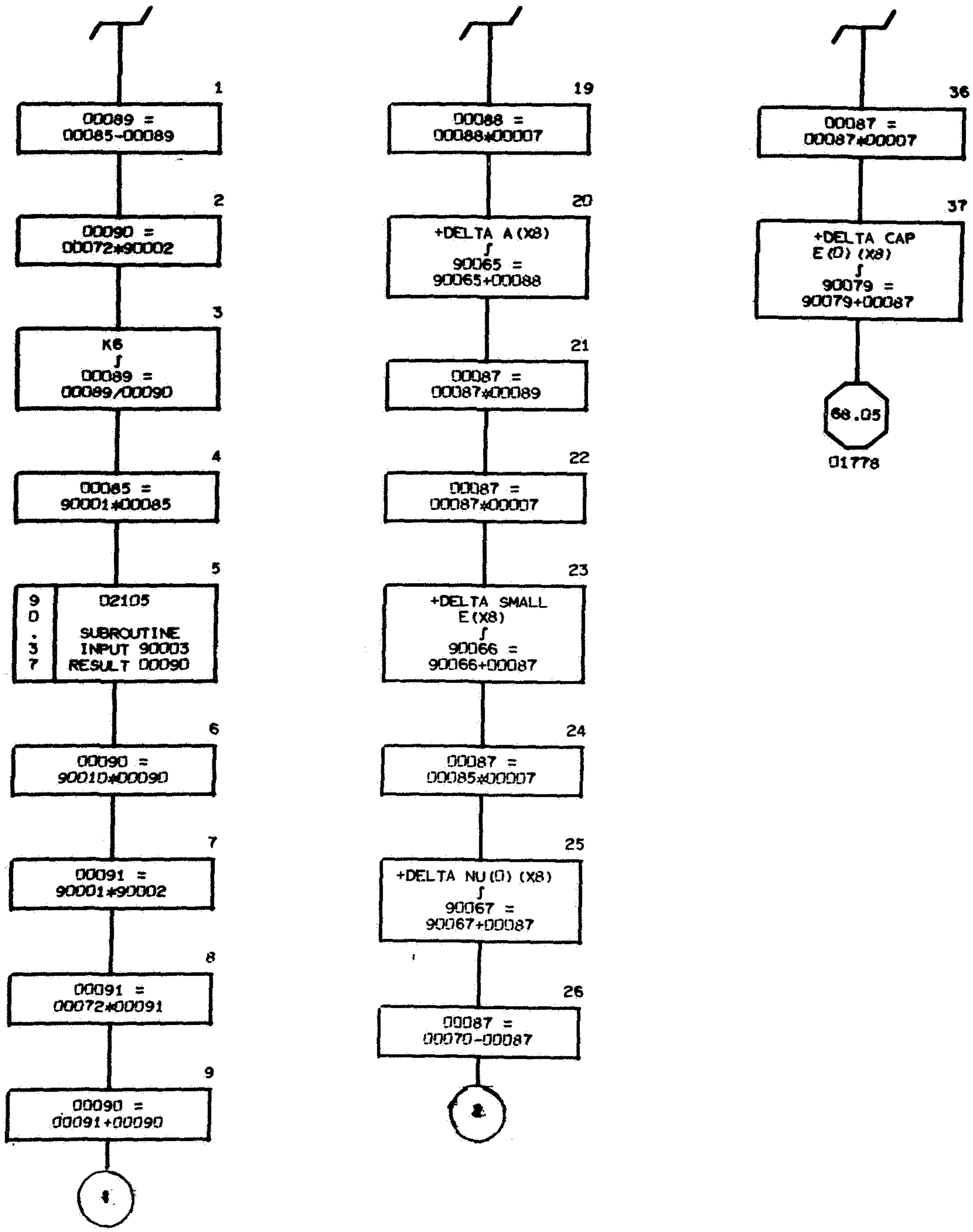
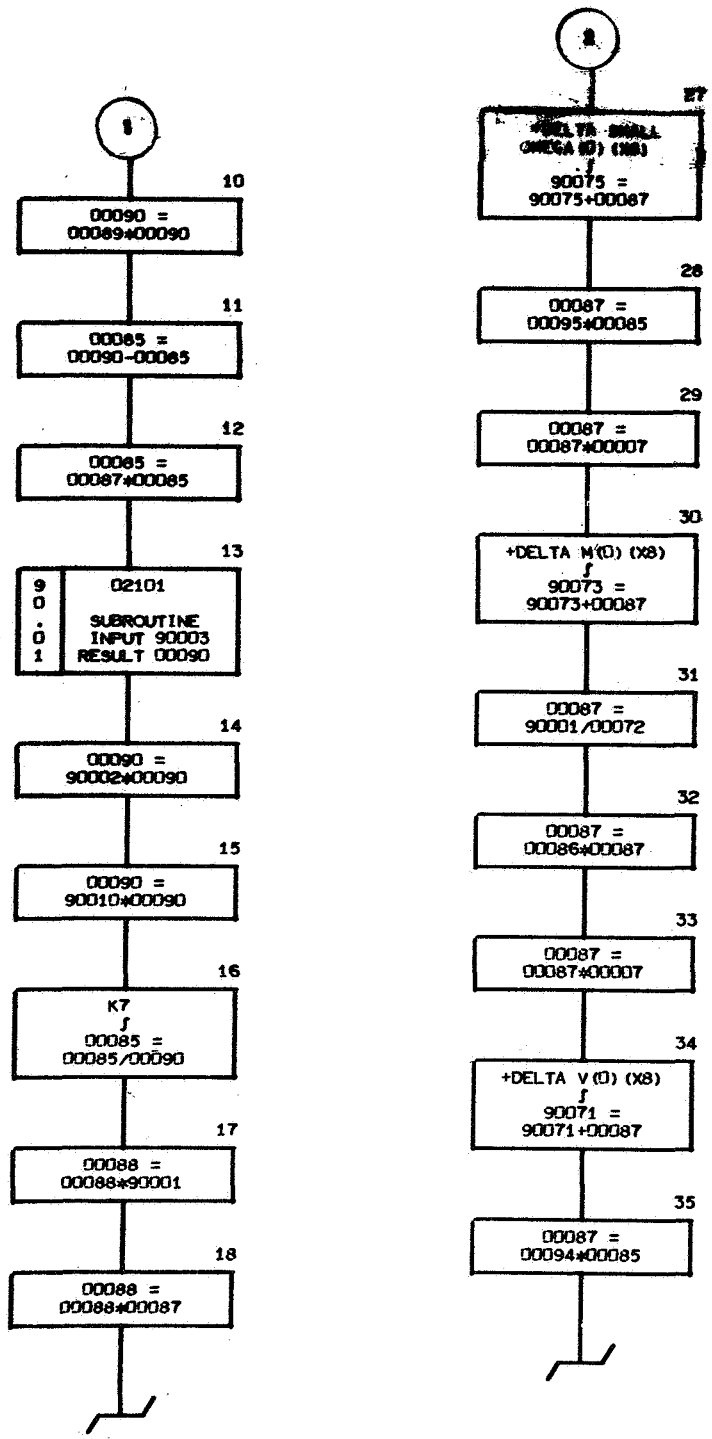


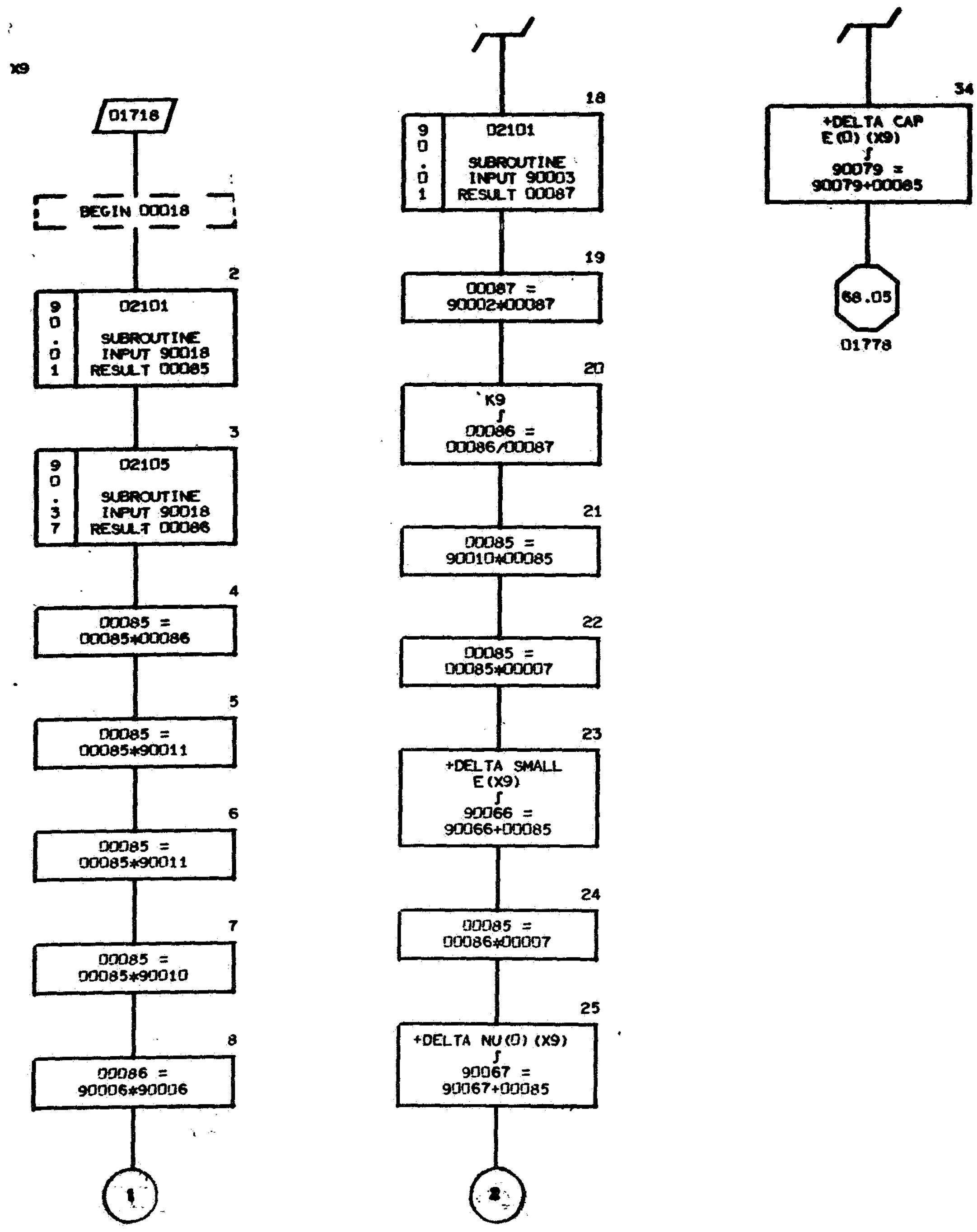
K VALUE = 01700



PAGE 72 CONTINUED



K VALUE = 01700



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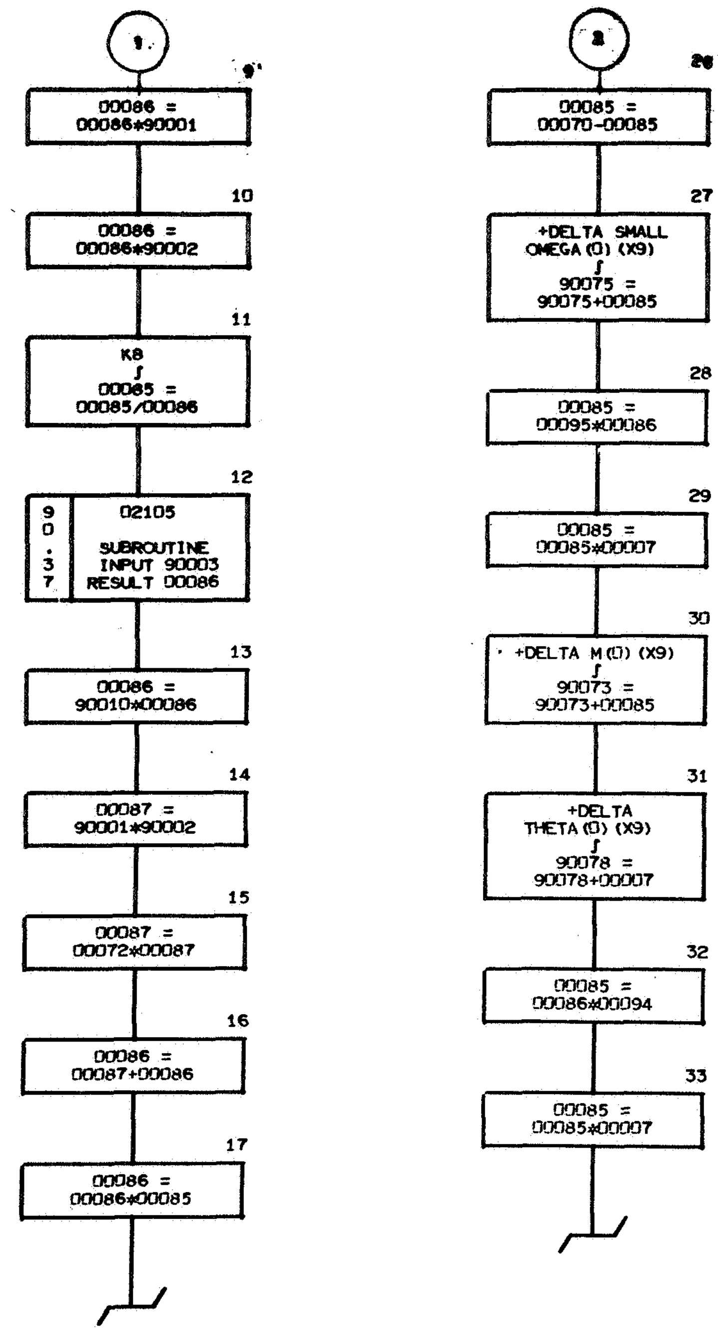

K VALUE = 01700

Q9000001100	T(0)
Q9000101101	A
Q9000201102	SMALL E
Q9000301103	NU(0)
Q9000401104	R BAR
Q9000500200	T(N)
Q9000603852	MU
Q9000701107	V BAR
Q9000800380	PARTIAL R BAR (X(J))
Q9000900383	PARTIAL V BAR (X(J))
Q9001001110	R(0)
Q9001101111	V(0)
Q9001201112	DELTA
Q9001301113	M(0)
Q9001401114	PHI(0)
Q9001501115	SMALL OMEGA (0)
Q9001601116	I
Q9001701117	CAP OMEGA
Q9001801118	THETA(0)
Q9001901119	N
Q9002201120	CAP E(0)
Q9002300252	J,UNKNOWN NO.
Q9002400524	LOC.PRECEDING DELTA N(2,Q) OR DELTA
Q9002500525	DELTA N(2,Q) OR DELTA RHO SUB I
Q9004500545	DELTA N(3,Q)
Q9006500500	DELTA A
Q9006600501	DELTA SMALL E
Q9006700502	DELTA NU(0)

Q9006800505	DELTA R BAR
Q9006900506	DELTA V BAR
Q9007000509	DELTA R(0)
Q9007100510	DELTA V(0)
Q9007200511	DELTA DELTA
Q9007300512	DELTA M(0)
Q9007400513	DELTA PHI(0)
Q9007500514	DELTA SMALL OMEGA(0)
Q9007600515	DELTA I
Q9007700516	DELTA CAP OMEGA
Q9007800517	DELTA THETA(0)
Q9007900519	DELTA CAP E(0)
Q9008502085	VQ
Q9008602001	VMV
Q9008702076	SM
Q9008802031	VECTOR ADD
Q9008901301	PE
Q9009001401	PP
Q9009102101	SIN
Q9009202105	COS
Q9009302196	SQ RT
Q9009400400	J (UNKNOWNS)
Q9009500441	X(J)
Q9009600013	LIMIT OF UNKNOWNS
Q9009700002	M(LIMIT OF Q"S)
Q9009804501	ORBIT GENERATOR
Q9010000099	ORBIT GENERATOR IDENT.
V00070+00000000+00	
V00071+10000000+01	
V00072+20000000+01	
V00073+30000000+01	
V00074+19000000+02	
V00075+39000000+02	
V00079+74000000+02	
V00033+73000000+02	

V00063+20000000+02

V00064+40000000+02

CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES						
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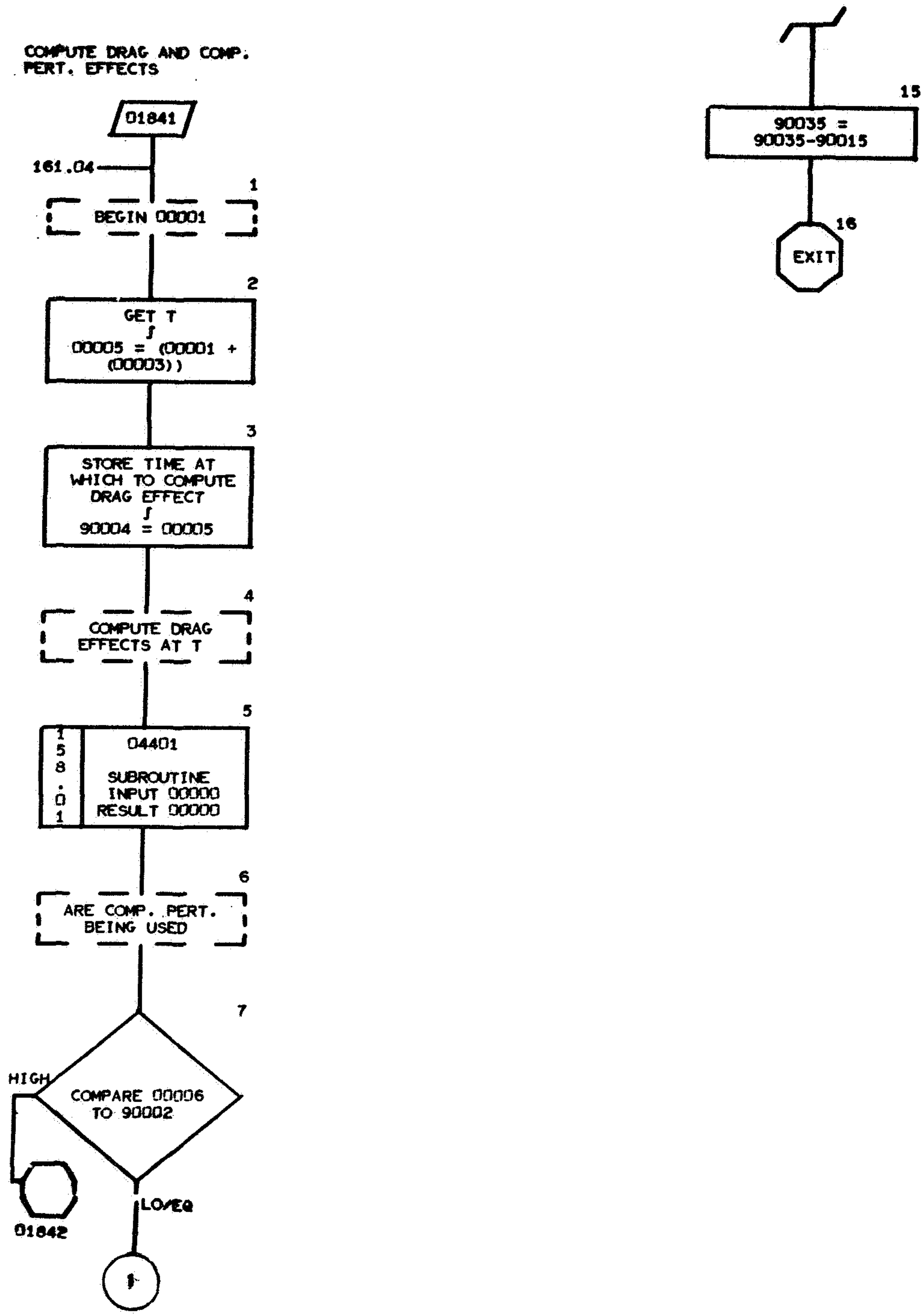
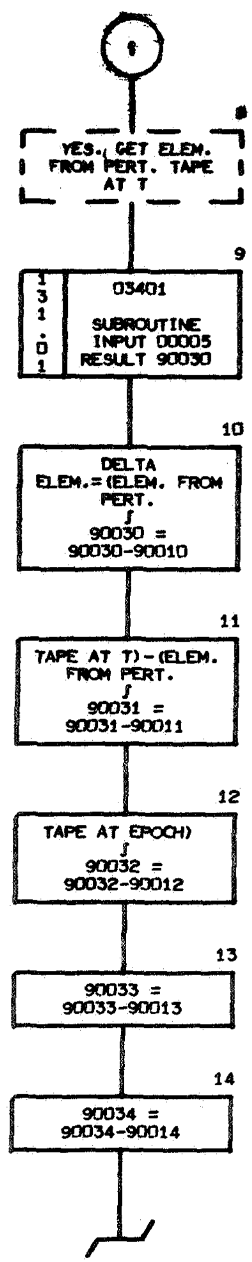
66.05	01731	66.07						
66.48	01776	66.06						
67.15	01732	67.02						
67.19	01777	67.17						
67.21	01730	67.20						
68.05	01778	67.24	68.02	68.04	68.10	68.12	68.25	[illegible]
		69.16	69.29	70.04	70.12	71.32	72.37	[illegible]
68.08	01710							
68.11	01711							
68.13	01712							
69.01	01729	67.20						
69.05	01714							
69.17	01715							
70.01	01713							
70.05	01728							
70.13	01716							
71.33	01717							
73.01	01718							

K VALUE = 01840



PAGE 74 CONTINUED.



K VALUE = 01840

Q9000104401	DRAG (DELTA M) F.
Q9000200005	COMP. PERT. OPTION
Q9000303401	COMP. PERT. TAPE READ F.
Q9000400200	TIME OF DRAG EFFECTS
Q9001000270	A ELEM. FROM PERT. TAPE
Q9001100271	E AT EPOCH
Q9001200272	I
Q9001300273	M
Q9001400274	SMALL OMEGA
Q9001500275	CAP OMEGA
Q9003000276	DELTA A
Q9003100277	DELTA E
Q9003200278	DELTA I
Q9003300279	DELTA M
Q9003400280	DELTA SMALL OMEGA
Q9003500281	DELTA CAP OMEGA

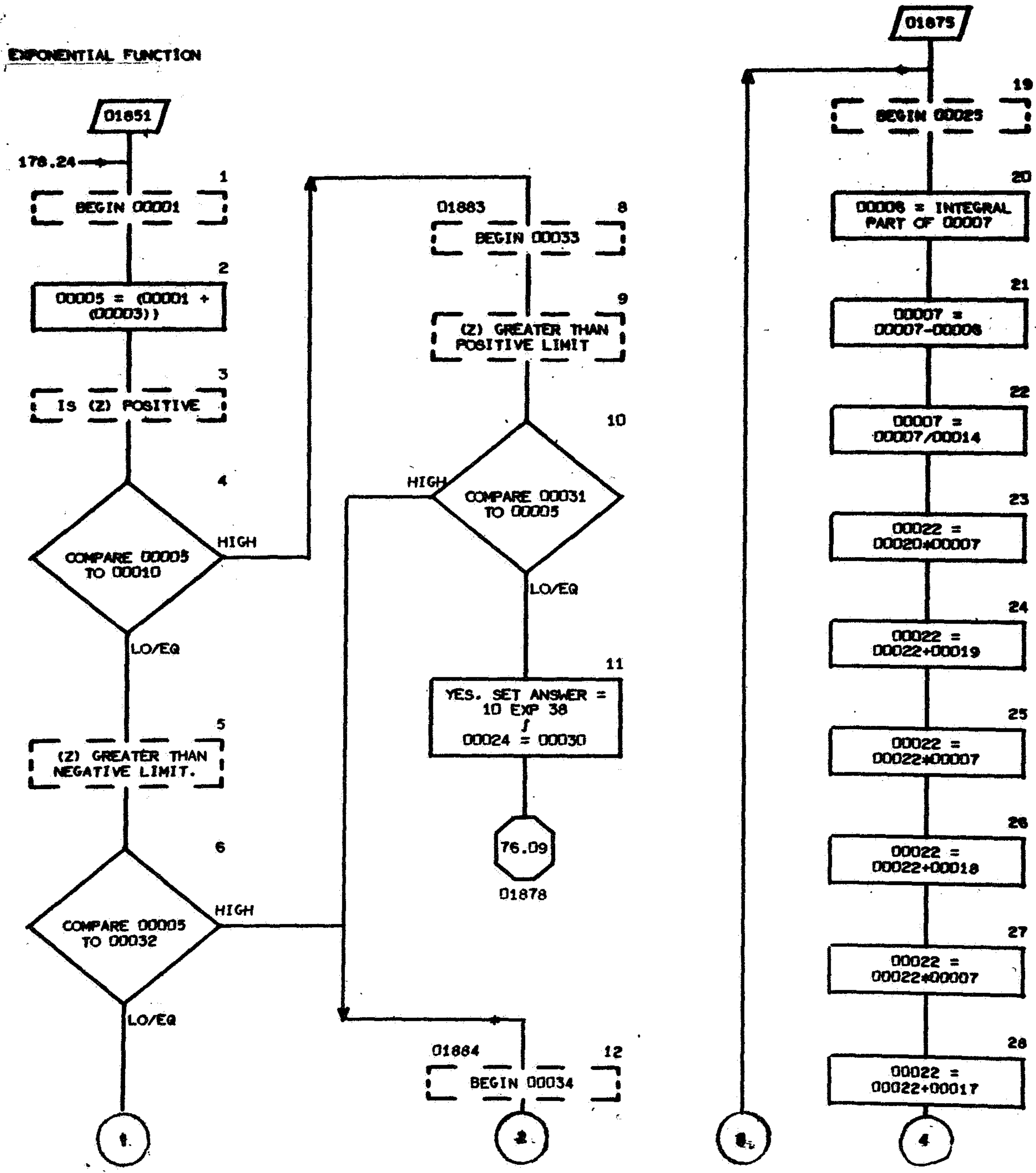
V00006+10000000+01

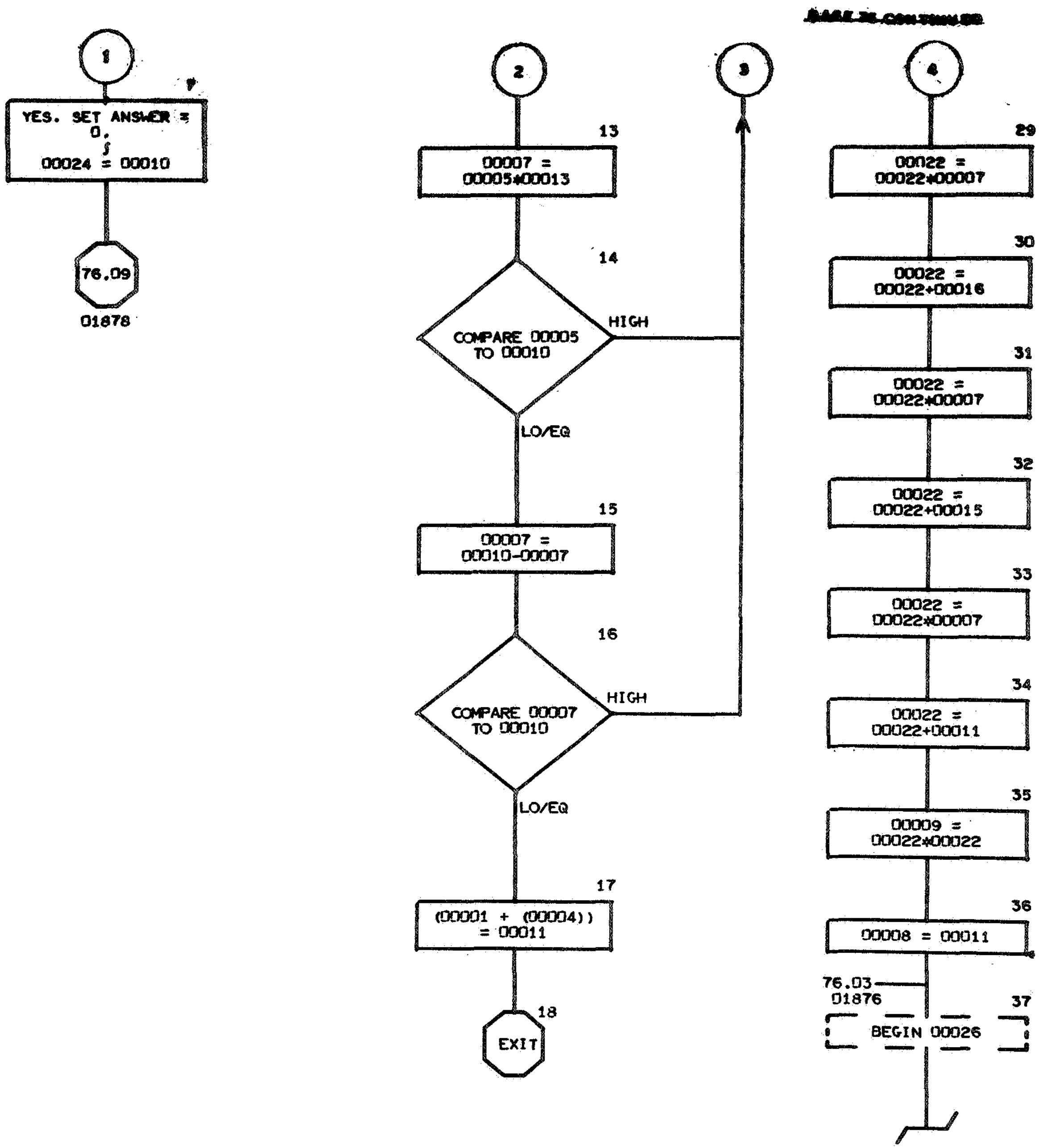
CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES
K VALUE = 01840		
14.01	01841	161.04*

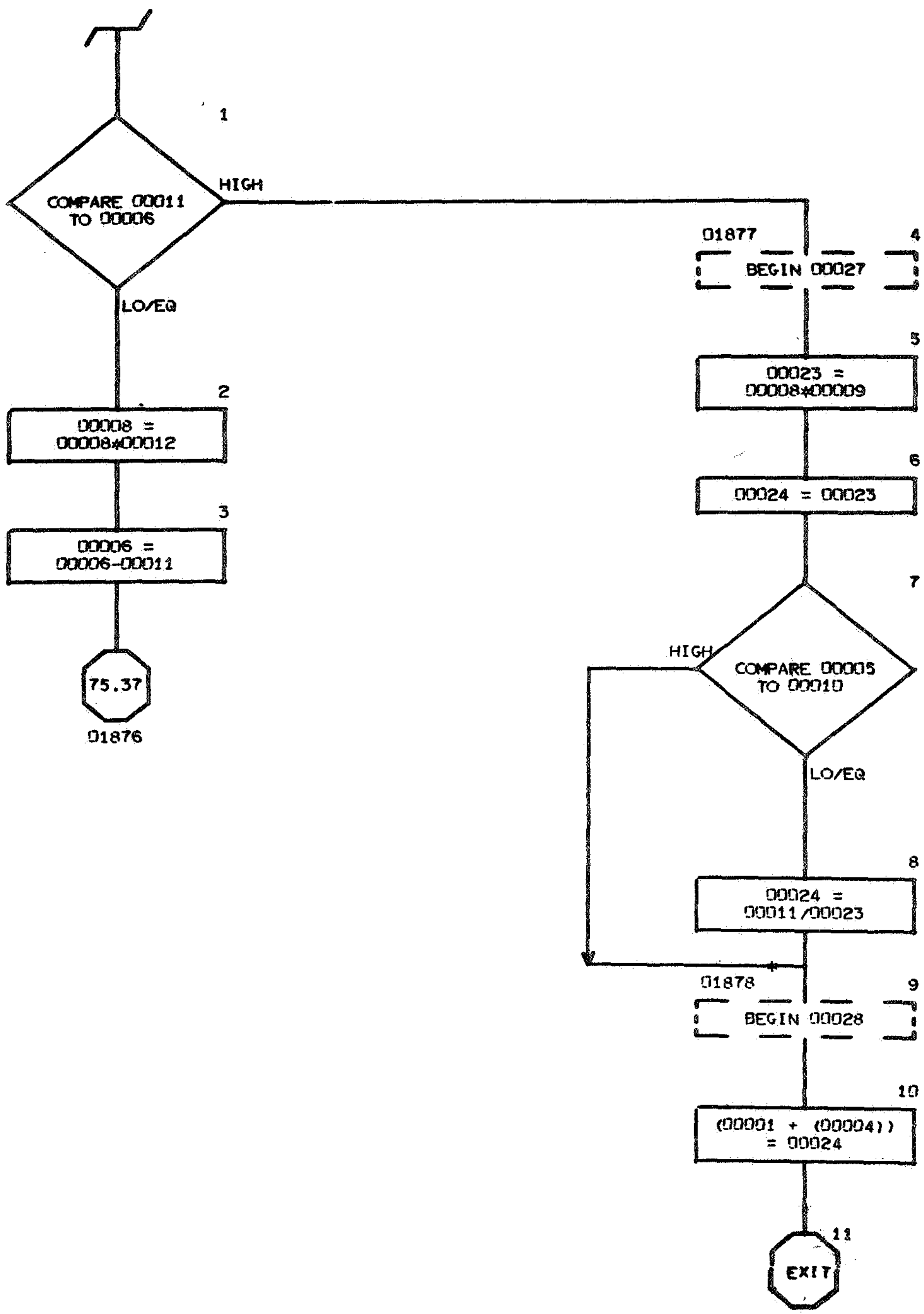
K VALUE = 01850

EXPONENTIAL FUNCTION




1
YES. SET ANSWER = 0.
00024 = 00010
76.09
01878
2
13
00007 = 00005*00013
14
COMPARE 00005 TO 00010
HIGH
LO/EQ
15
00007 = 00010-00007
16
COMPARE 00007 TO 00010
HIGH
LO/EQ
17
(00001 + (00004)) = 00011
18
EXIT
3
4
29
00022 = 00022*00007
30
00022 = 00022+00016
31
00022 = 00022*00007
32
00022 = 00022+00015
33
00022 = 00022*00007
34
00022 = 00022+00011
35
00009 = 00022*00022
36
00008 = 00011
76.03
01876
37
BEGIN 00026

K VALUE = 01850



CROSS REFERENCE LISTING

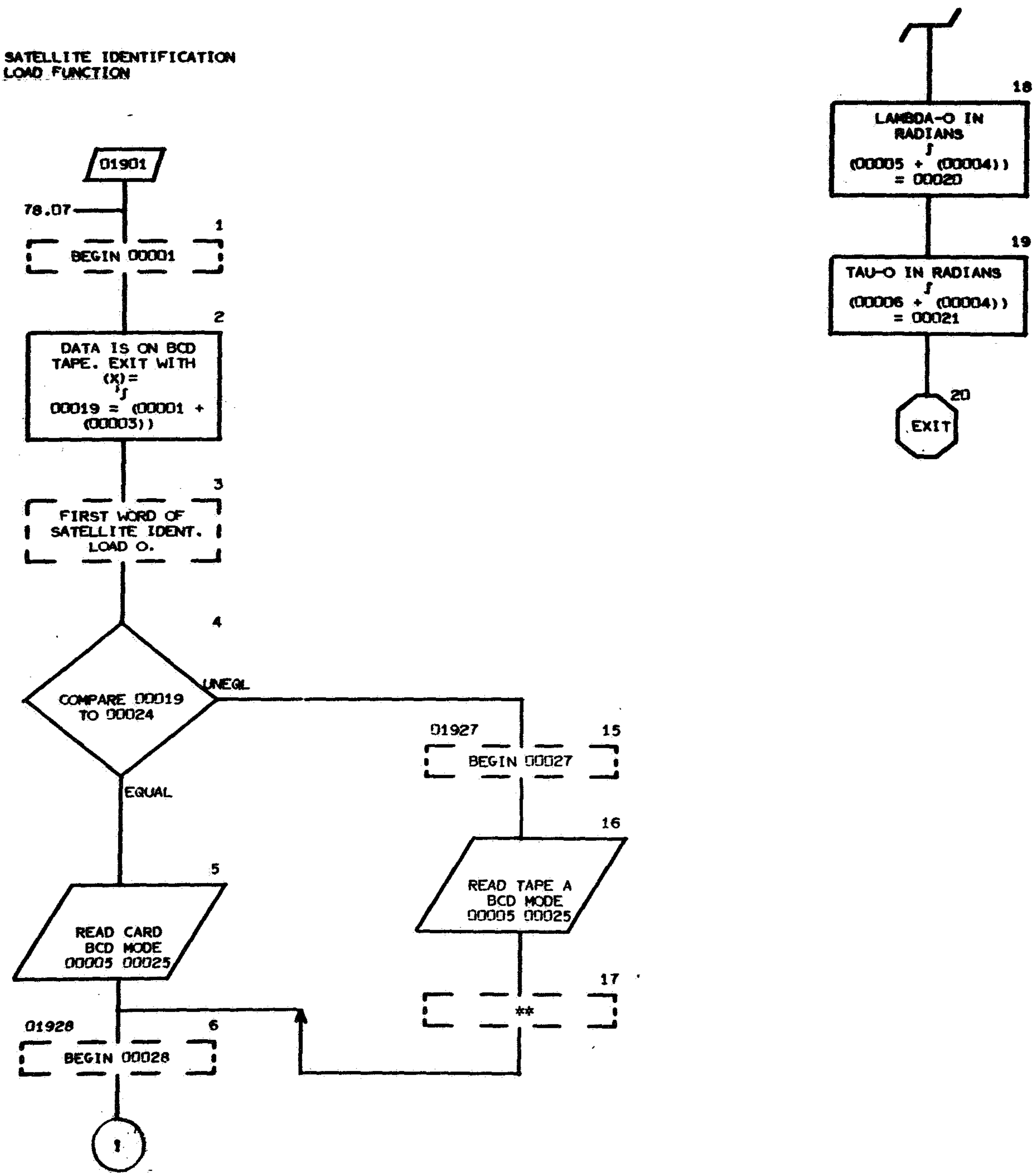
PAGE BOX	LABEL	REFERENCES		
K VALUE = 01850				
75.01	01851	178.24*	178.27*	
75.08	01883	75.04		
75.12	01884	75.06	75.10	
75.19	01875	75.14	75.16	
75.37	01876	76.03		
76.04	01877	76.01		
76.09	01878	75.07	75.11	76.07

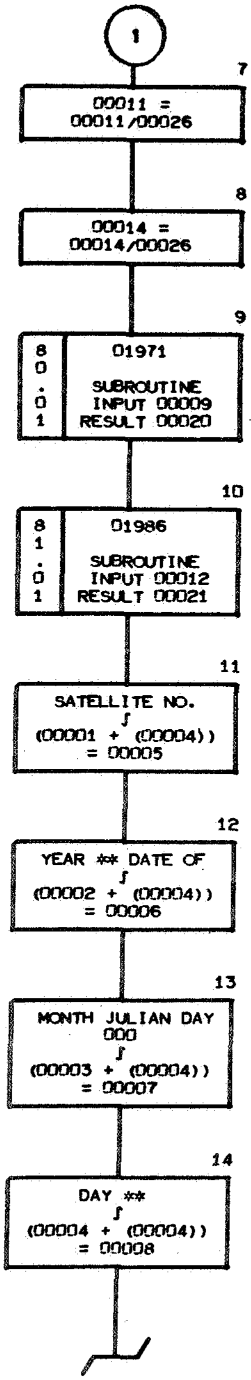
K VALUE = 01850

```
V00010+00000000+00
V00011+10000000+01
V00012+10000000+02
V00013+43429448+00
V00014+31622787+01
V00015+36406910+01
V00016+66284315+01
V00017+80196410+01
V00018+75467547+01
V00019+42440739+01
V00020+56549020+01
V00030+10000000+38
V00031+85000000+02
V00032-85000000+02
```

K VALUE = 01900

SATELLITE IDENTIFICATION
LOAD FUNCTION




1
7
00011 =
00011/00026
8
00014 =
00014/00026
9
80.01
01971
SUBROUTINE
INPUT 00009
RESULT 00020
10
81.01
01986
SUBROUTINE
INPUT 00012
RESULT 00021
11
SATELLITE NO.
(00001 + (00004))
= 00005
12
YEAR ** DATE OF
(00002 + (00004))
= 00006
13
MONTH JULIAN DAY
000
(00003 + (00004))
= 00007
14
DAY **
(00004 + (00004))
= 00008

CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES
K VALUE = 01900		
77.01	01901	78.07*
77.06	01928	77.17
77.15	01927	77.04

K VALUE = 01900

Q0002201971 H-M-S TO RAD) FUNCTION

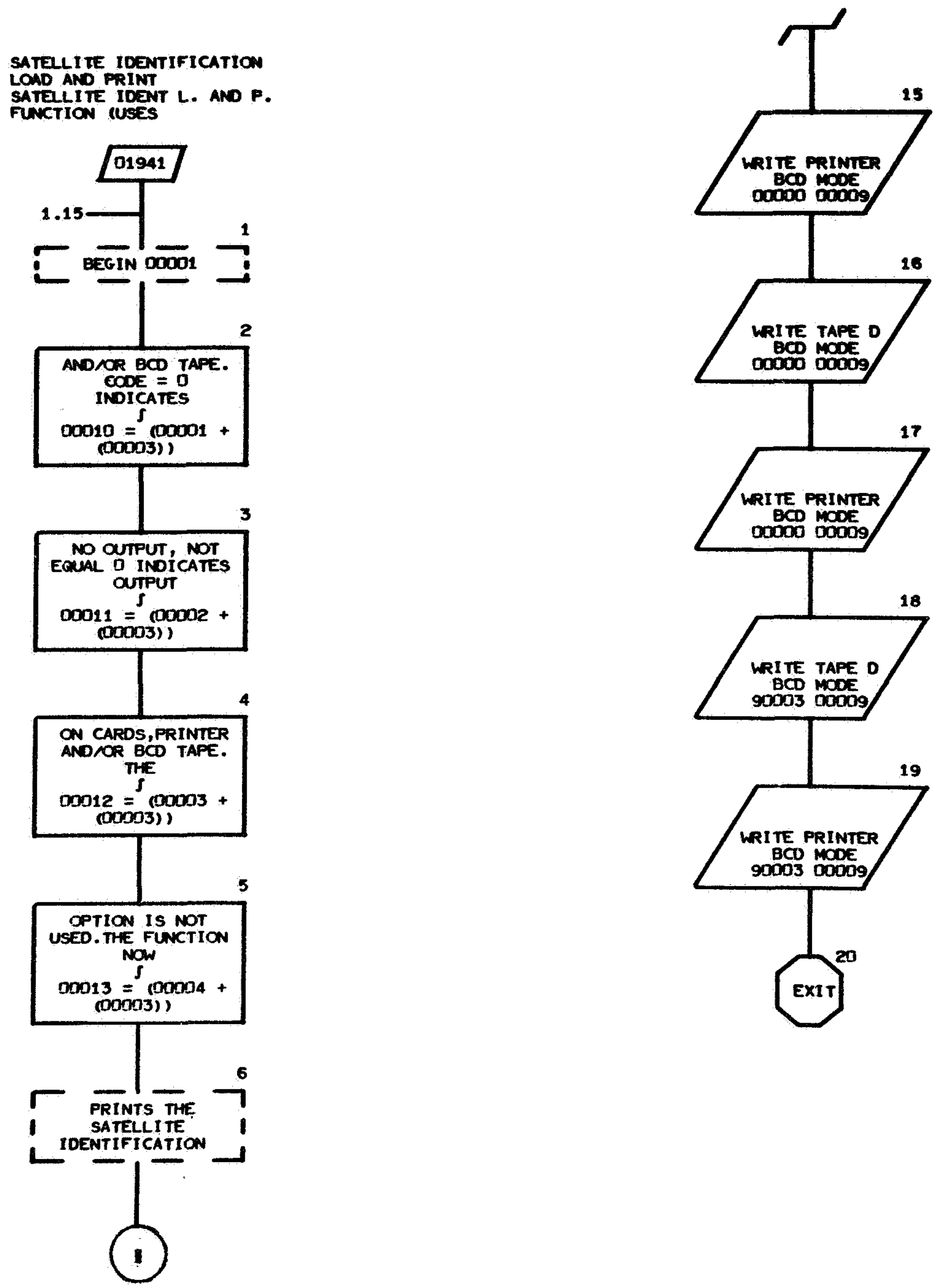
Q0002301986 D-M-S TO RAD. FUNCTION

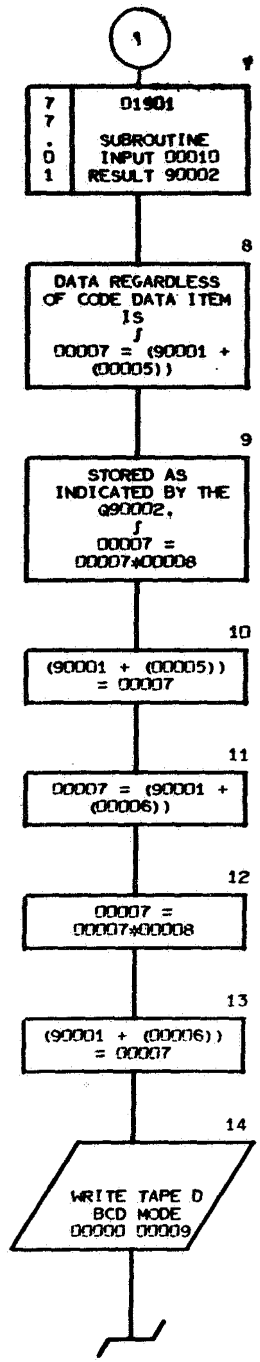
V00024+00000000+00 (USES LOCATIONS 1 TO 34)

V00025+10000000+01 ENTER WITH (Z)=0 IF SAT. DATA IS

V00026+10000000+04 CARDS OR (Z) NOT EQUAL TO ZERO IF

K VALUE = 01940




1
7
7
7.01
01901
SUBROUTINE
INPUT 00010
RESULT 90002
8
DATA REGARDLESS OF CODE DATA ITEM IS
∫
00007 = (90001 + (00005))
9
STORED AS INDICATED BY THE Q90002,
∫
00007 = 00007*00008
10
(90001 + (00005)) = 00007
11
00007 = (90001 + (00006))
12
00007 = 00007*00008
13
(90001 + (00006)) = 00007
14
WRITE TAPE D
BCD MODE
00000 00009

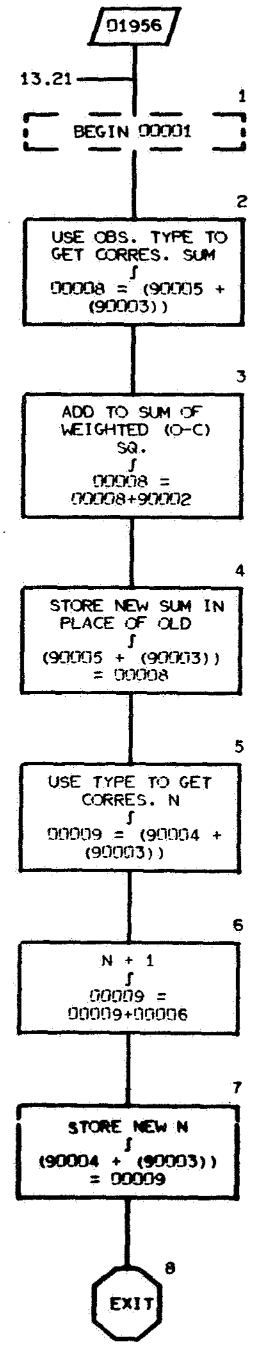
```
      K VALUE = 01940
Q9000101901               LOCAT OF SAT. IDENT. PACKAGE
Q9000200294               LOCAT OF SAT DATA ITEM
Q9000301905               LOCAT OF SAT. IDENT.LD +4
V00005+10000000+02        LOCATIONS 1 TO 24)
V00006+13000000+02           ENTER WITH (Z)=0 IF INPUT DATA IS
V00008+10000000+04           CARDS OR NOT EQUAL 0 IF INPUT IS
V00009+10000000+01           TAPE, (Z+1),(Z+2),AND (Z+3) = TO
V00014+00000000+00           OUTPUT OPTION CODES FOR CARDS,PRI
```

CROSS REFERENCE LISTING

```
PAGE BOX     LABEL        REFERENCES
      K VALUE = 01940
 T8.01        01941      1.15*
```

K VALUE = 01955

ADD TO CORRES. SUM OF (O-C) SQ. AND TO N FOR ONE OBS.



```
     K VALUE = 01955
Q9000100258              WEIGHT FOR OBS.
Q9000200047              WEIGHTED (O-C) SQUARED
Q9000300253              OBS. TYPE
Q9000401899              LOC.PRECEDING 20 LOCS. OF N"S
Q9000501919              LOC.PRECEDING 20 LOCS.OF SUMS OF (O-C
V00005+00000000+00        OBS.TYPE.ALSO ADDED 1 TO N,THE NO.OF
V00006+10000000+01        INCLUDED IN SUM FOR THAT TYPE. USES
```

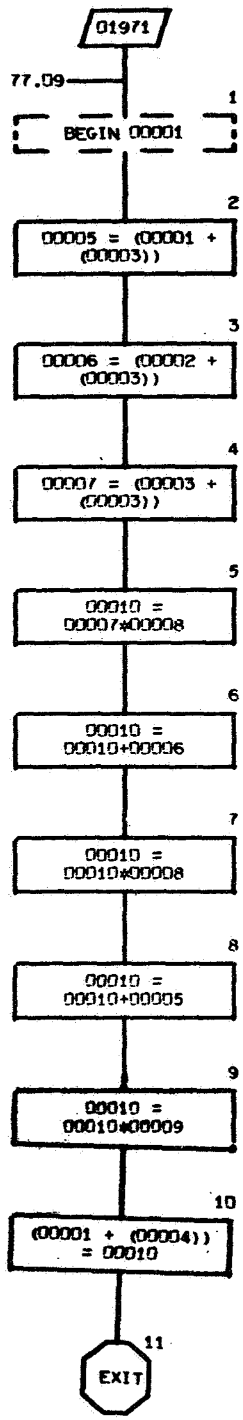
CROSS REFERENCE LISTING

```
PAGE BOX      LABEL      REFERENCES

     K VALUE = 01955
  79.01       01956      13.[illegible]
```

K VALUE = 01970

HOURS-MINUTES-SECONDS TO RADIANS



K VALUE = 01970

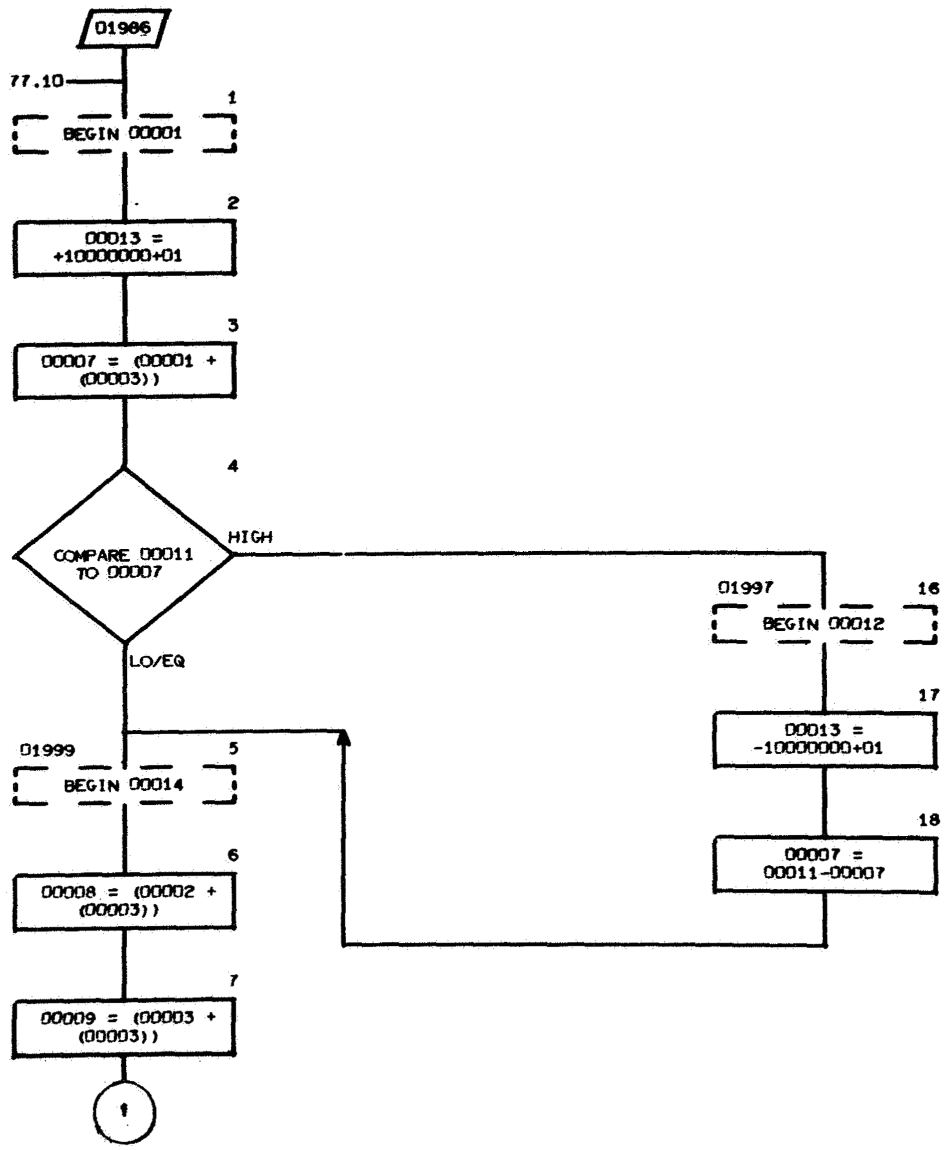
@0000603875	1/60
@0000903874	RADIANS/HOUR

CROSS REFERENCE LISTING

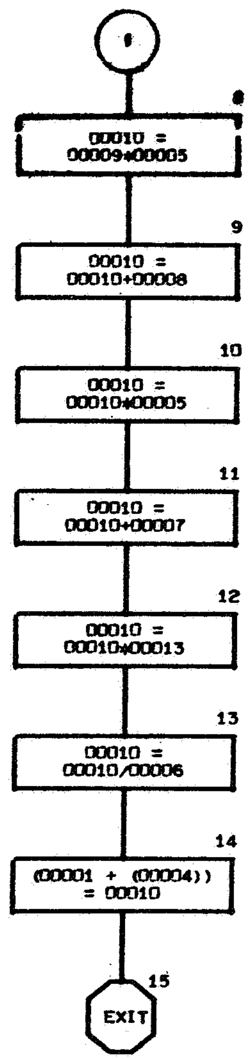
PAGE BOX	LABEL	REFERENCES
	K VALUE = 01970	
88.01	01971	77.09*

K VALUE = 01985

DEGREES-MINUTES-SECONDS
TO RADIANS



PAGE 81 CONTINUED



K VALUE = 01985

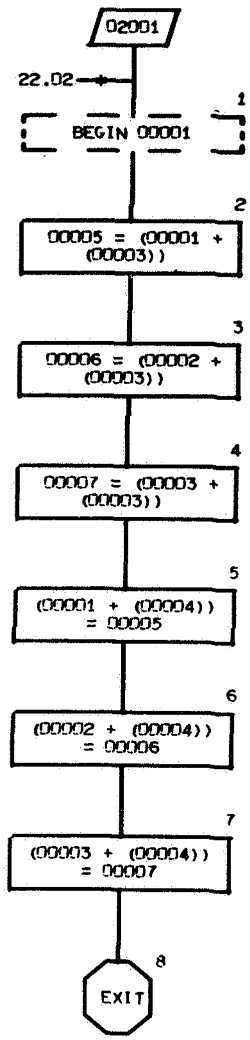
```
Q0000503875                1/60
Q0000603847                DEGREES/RADIAN
V00011+00000000+00
```

CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES
K VALUE = 01985		
81.01	01986	77.10*
81.05	01999	81.18
81.16	01997	81.04

K VALUE = 02000

VECTOR PACKAGE
VECTOR MOVE 7



CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES						
K VALUE = 02000								
82.01	02001	22.02*	22.05*	22.07*	22.10*	22.12*	22.16*	22.20*
		22.22*	22.25*	23.11*	23.17*	23.24*	23.25*	23.27*
		24.03*	24.04*	24.06*	24.08*	24.09*	24.20*	24.22*
		25.02*	25.04*	25.09*	25.10*	25.11*	25.12*	25.14*
		25.16*	25.18*	25.19*	25.20*	25.21*	25.23*	25.24*
		26.02*	26.03*	26.04*	26.08*	26.14*	26.19*	26.21*
		26.24*	26.26*	26.29*	27.09*	27.11*	28.17*	28.24*
		28.28*	28.33*	28.39*	28.44*	29.02*	29.21*	29.25*
		29.31*	29.35*	34.14*	34.16*	34.23*	34.25*	35.07*
		35.16*	35.18*	35.20*	35.25*	36.17*	36.23*	36.25*
		36.42*	37.08*	37.18*	37.20*	37.24*	37.26*	37.30*
		37.32*	38.05*	38.07*	38.15*	38.18*	38.29*	38.32*
		39.08*	39.10*	39.18*	39.21*	39.32*	39.35*	40.11*
		40.13*	40.20*	40.23*	40.31*	41.07*	41.12*	41.14*
		42.05*	42.07*	42.13*	42.24*	42.28*	42.39*	43.02*
		43.13*	43.17*	43.28*	43.32*	43.43*	44.02*	44.13*
		44.18*	44.28*	44.33*	44.43*	45.03*	45.13*	45.18*
		45.28*	45.33*	45.43*	46.03*	46.13*	46.18*	46.28*
		46.33*	46.43*	47.03*	47.13*	47.18*	47.28*	47.33*
		47.43*	48.03*	48.13*	48.18*	48.28*	48.33*	48.43*
		49.02*	49.15*	49.19*	49.32*	49.36*	49.49*	50.02*
		50.15*	50.19*	50.32*	50.36*	50.49*	51.03*	51.15*
		51.20*	51.32*	51.37*	51.49*	52.03*	52.15*	52.20*
		52.32*	52.37*	52.49*	53.03*	53.15*	53.20*	53.32*
		53.37*	53.49*	54.03*	54.15*	54.20*	54.32*	54.37*
		54.49*	55.03*	55.15*	55.20*	55.32*	55.37*	55.39*
		56.03*	56.05*	57.02*	57.05*	57.07*	57.10*	57.12*
		57.16*	57.20*	57.22*	57.25*	58.02*	58.06*	58.08*
		58.10*	58.11*	58.13*	58.15*	58.16*	58.18*	58.20*
		58.21*	59.02*	59.04*	59.09*	59.10*	59.12*	59.13*
		59.15*	59.16*	59.17*	59.18*	59.21*	59.22*	59.24*
		59.25*	59.26*	59.27*	60.02*	60.03*	60.05*	60.06*
		60.07*	60.11*	60.14*	60.21*	60.24*	60.27*	61.08*
		61.12*	61.23*	61.26*	61.31*	61.33*	62.03*	62.05*

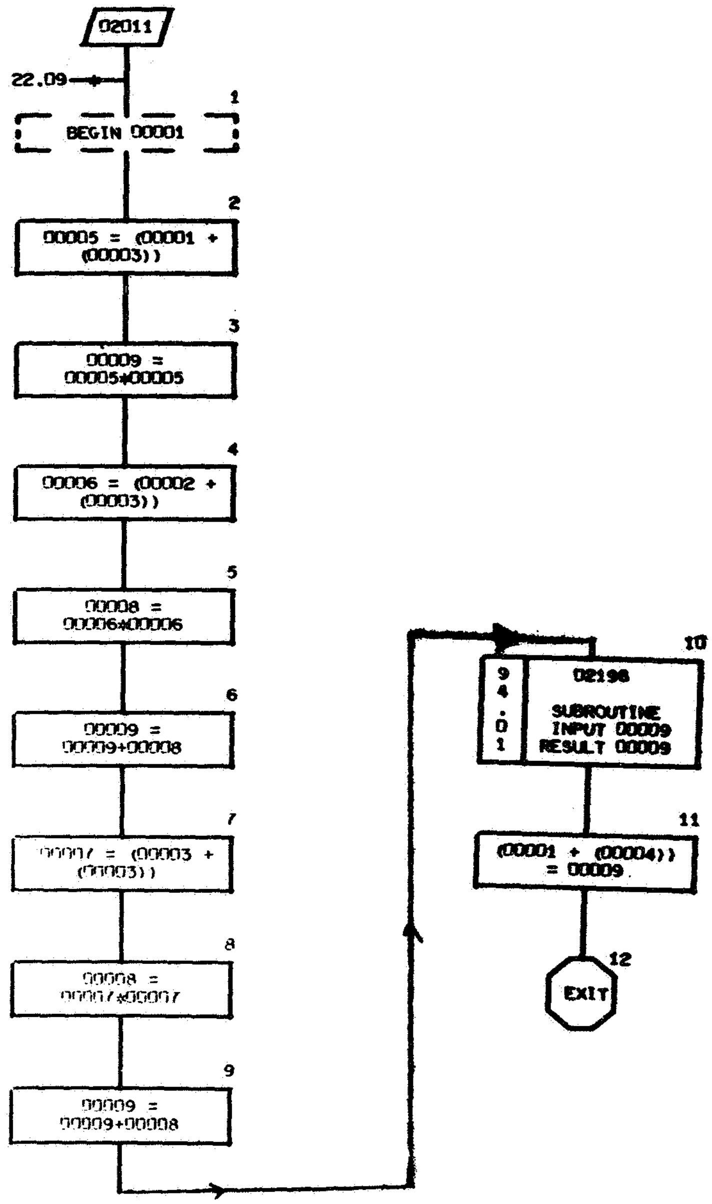
NASA-GSFC MISSION AND TRAJECTORY ANALYSIS DIVI PAGE [illegible]

CROSS-REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES						
		62.08*	62.10*	62.12*	62.19*	62.21*	62.2[illegible]*	62.2[illegible]*
		62.34*	62.36*	63.03*	63.05*	63.08*	63.10*	63.12*
		63.19*	63.23*	63.26*	63.30*	64.02*	64.05*	64.10*
		64.12*	64.18*	64.20*	64.23*	64.25*	64.27*	64.34*
		64.41*	65.02*	65.09*	67.07*	67.11*	119.27*	119.31*
		119.35*	119.39*	119.41*	119.46*	120.02*	120.16*	123.11*
		123.16*	123.17*	123.20*	123.24*	124.02*	124.04*	124.07*
		124.09*	124.20*	124.23*	124.31*	124.33*	180.15*	181.[illegible]

K VALUE = 02010

VECTOR MAGNITUDE 9



CROSS REFERENCE LISTING

PAGE BOX   LABEL   REFERENCES

K VALUE = 02010

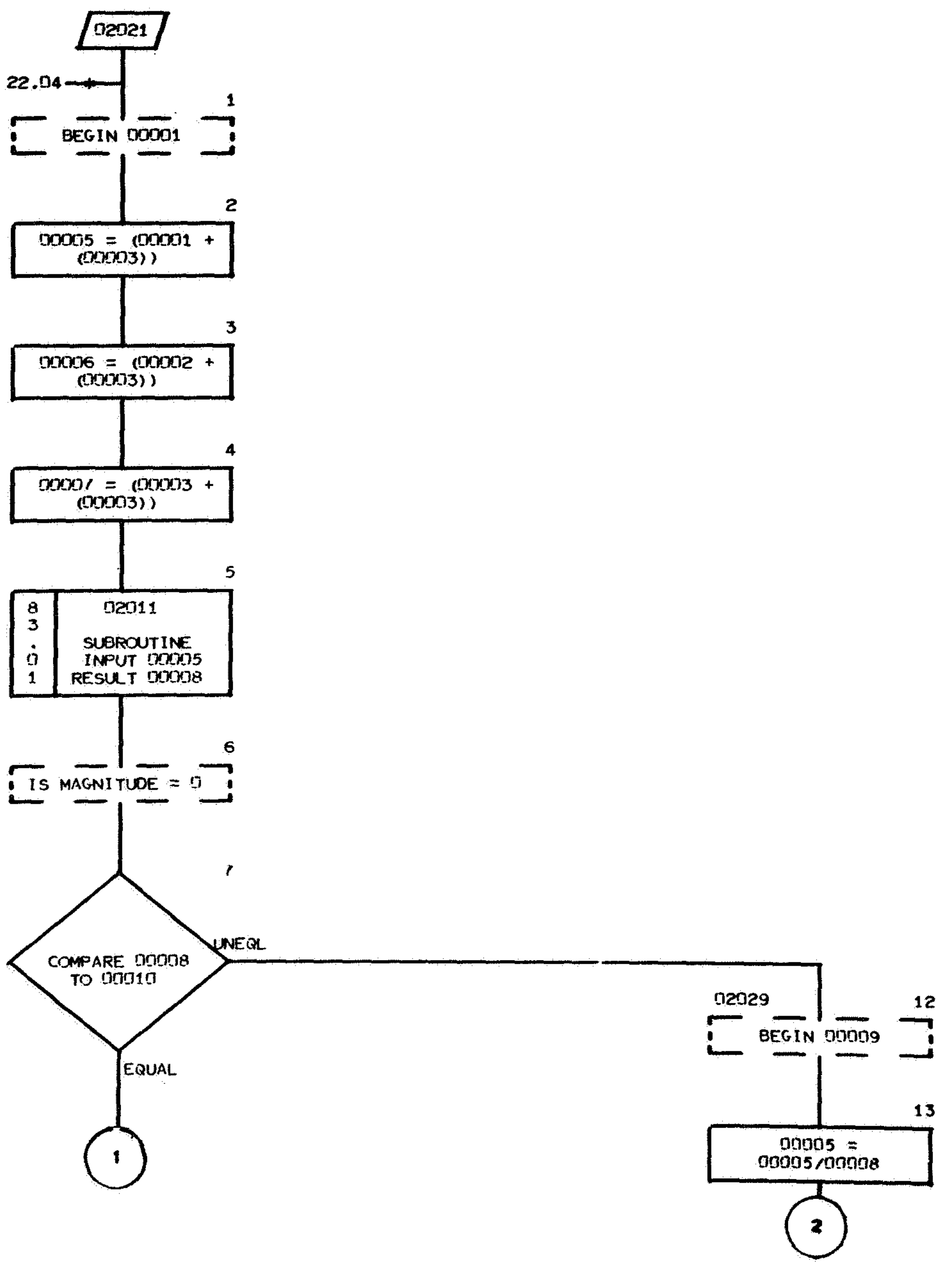
85.01	02011	22.09* 23.02* 29.41* 29.43* 57.09* 84.05* [illegible]
		119.19* 124.43* 125.01* 177.14*

K VALUE = 02010

Q0002502196   SQUARE ROOT

K VALUE = 02020

VECTOR DIRECTION 8



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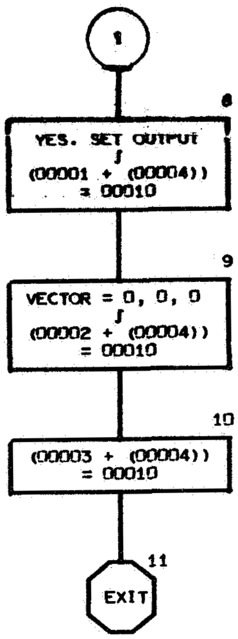
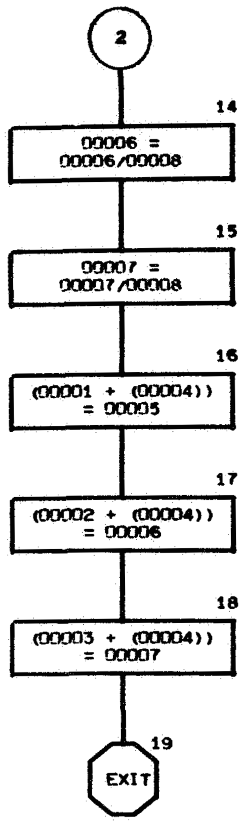




CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES
K VALUE = 02020		
84.01	02021	22.04* 23.04* 24.15* 57.04* 119.21* 119.23* 119.30* 119.34* 124.38* 124.39*
84.12	02029	84.07

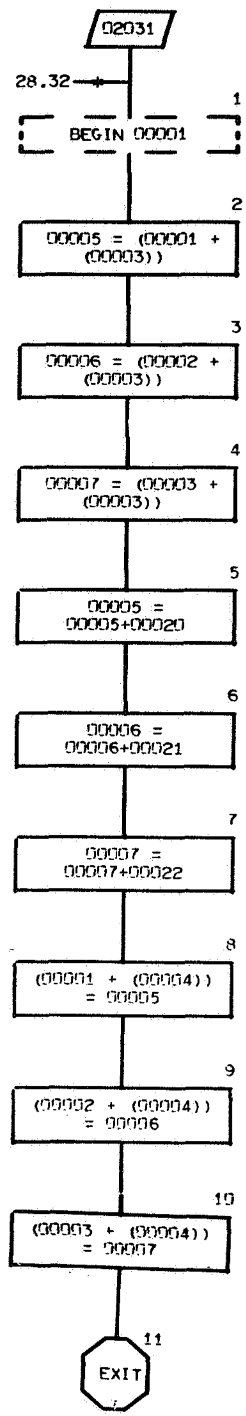
K VALUE = 02020

Q0001102011

V00010+00000000+00

K VALUE = 02030

VECTOR ADD 7



K VALUE = 02030

@0002002085

@0002102086

@0002202087

CROSS REFERENCE LISTING

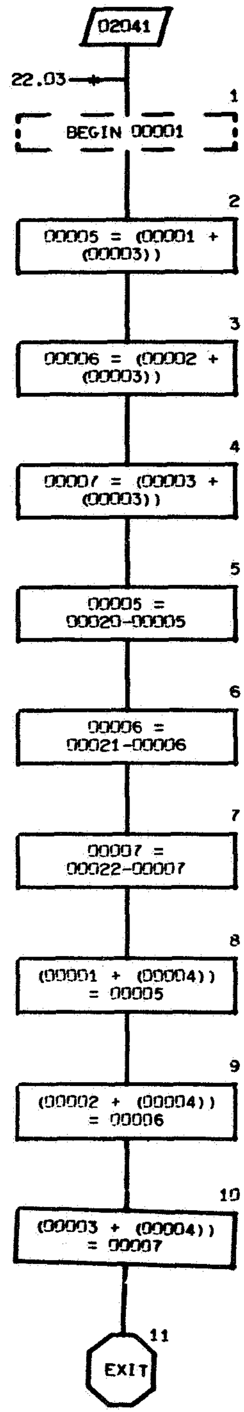
PAGE BOX LABEL REFERENCES

K VALUE = 02030

PAGE BOX	LABEL	REFERENCES						
85.01	02031	28.32*	29.01*	29.28*	35.27*	36.26*	37.10*	38.06*
		38.08*	38.17*	38.20*	38.31*	38.34*	39.20*	39.23*
		39.34*	39.37*	40.22*	40.25*	41.16*	42.09*	67.10*
		67.14*	123.23*	124.06*	124.26*			

K VALUE = 02040

VECTOR SUBTRACT 7



CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES						
K VALUE = 02040								
86.01	02041	22.03*	22.06*	22.13*	24.11*	26.05*	26.06*	29.03*
		29.37*	34.17*	34.27*	35.19*	57.03*	57.06*	57.13*
		58.22*	60.08*	60.09*	60.15*	60.28*	61.13*	61.27*
		61.34*	62.13*	62.14*	62.18*	62.30*	62.37*	63.13*
		63.14*	63.18*	64.06*	64.13*	64.28*	64.29*	64.33*
		124.14*	124.35*					

K VALUE = 02040

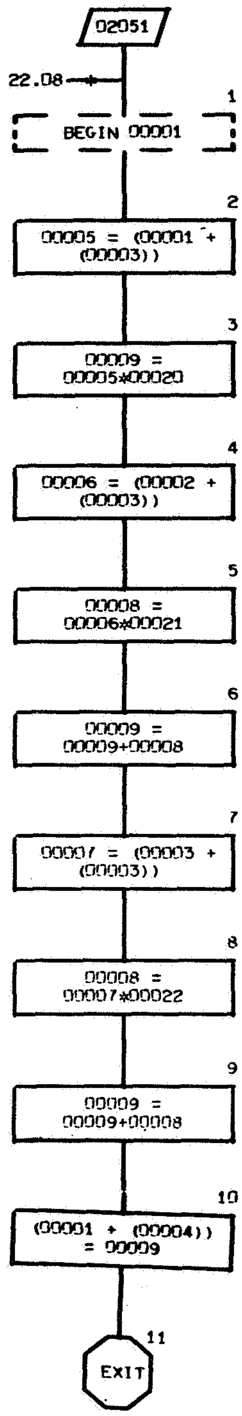
@0002002085

@0002102086

@0002202087

K VALUE = 02050

DOT PRODUCT 9



PAGE BOX	LABEL	REFERENCES						
K VALUE = 02050								
87.01	02051	22.08*	23.12*	23.18*	24.21*	24.23*	25.03*	25.05*
		26.09*	26.10*	26.15*	26.20*	26.22*	26.25*	26.27*
		26.30*	26.31*	27.10*	27.12*	27.14*	57.08*	58.03*
		59.03*	59.05*	60.12*	60.18*	60.22*	60.23*	60.25*
		60.31*	60.32*	61.09*	61.10*	61.16*	61.24*	62.04*
		62.06*	62.20*	62.22*	62.27*	63.04*	63.06*	63.21*
		63.22*	63.24*	63.28*	63.29*	63.31*	64.03*	64.19*
		64.21*	64.36*	64.38*	64.39*	64.40*	64.42*	64.43*
		65.04*	65.06*	65.07*	65.08*	65.10*	65.11*	119.24*
		119.36*	119.40*	119.43*	120.01*	120.04*	120.18*	124.40*
		180.16*	181.33*					

K VALUE = 02050

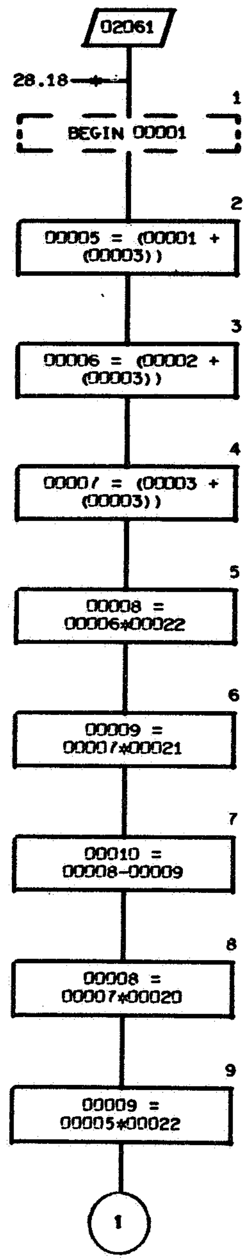
Q0002002085

Q0002102086

Q0002202087

K VALUE = 02060

CROSS PRODUCT 12



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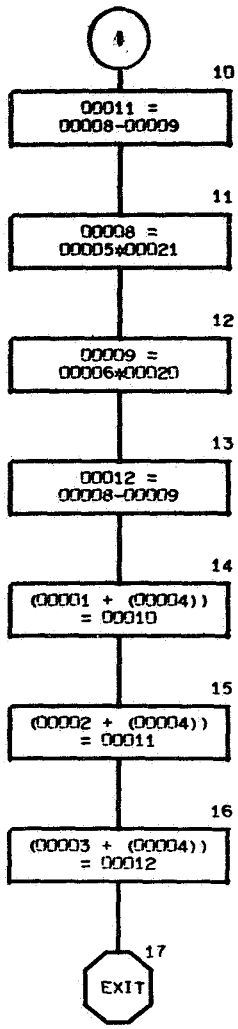
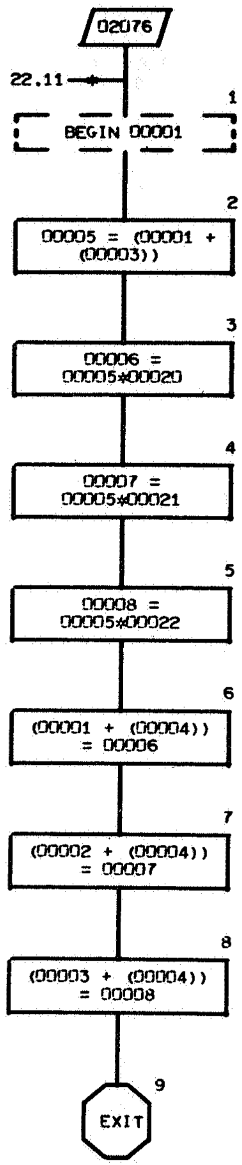


K VALUE = 02075

SCALAR BY VECTOR PRODUCT



PAGE BOX	LABEL	REFERENCES						
K VALUE = 02060								
88.01	02061	28.18*	28.25*	28.35*	35.21*	37.19*	37.21*	37.25*
		37.27*	37.31*	37.33*	119.28*	119.32*	119.42*	120.03*
		123.12*	123.18*	123.26*				

K VALUE = 02060

Q0002002085

Q0002102086

Q0002202087

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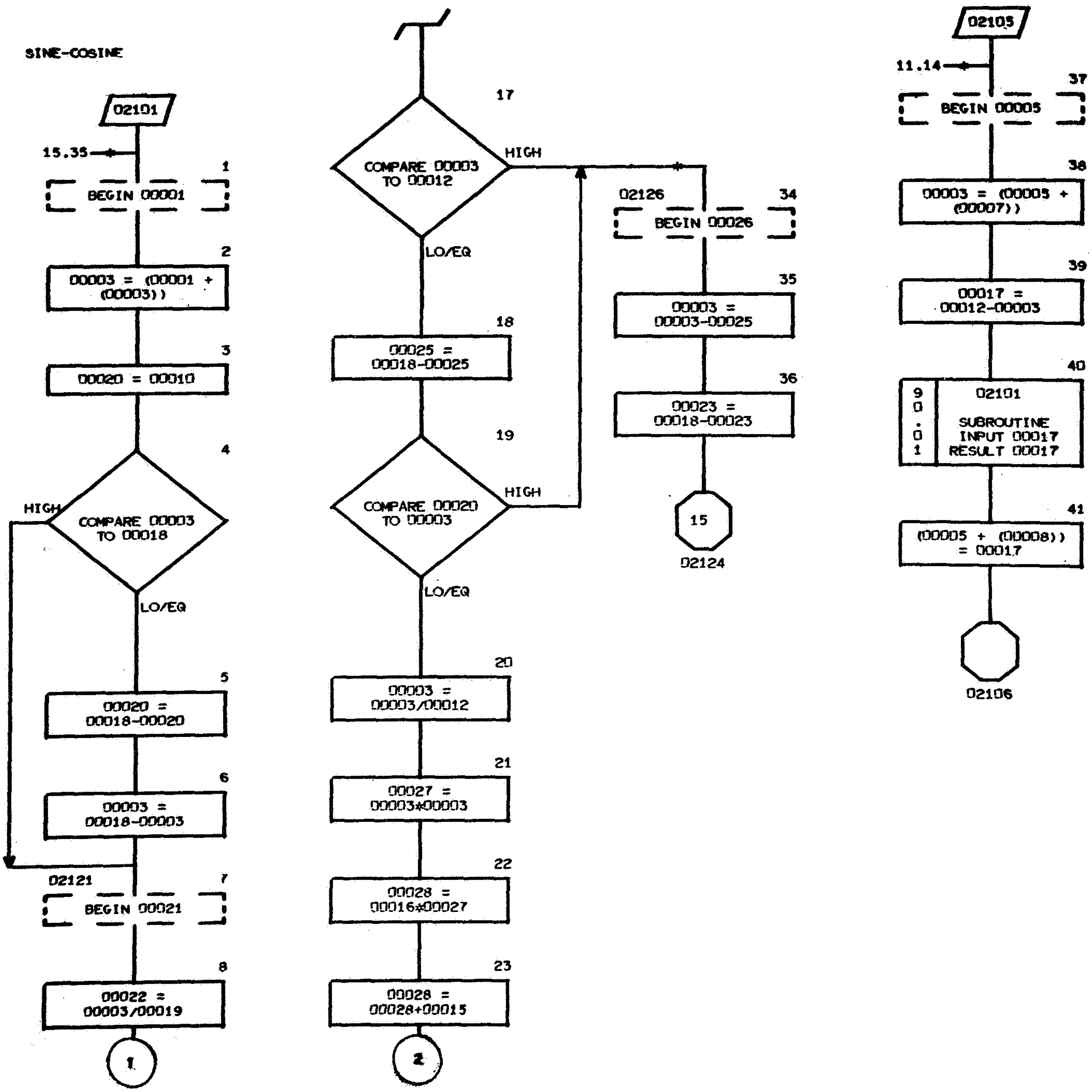
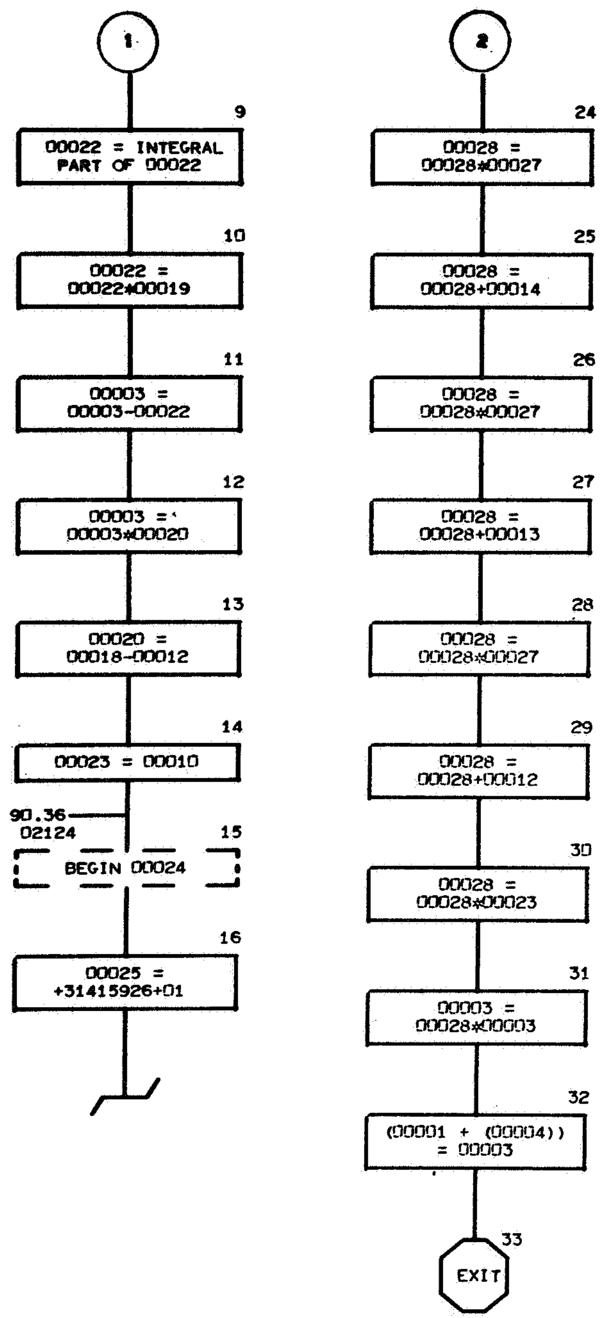
CROSS-REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES						
K VALUE = 02075								
89.01	02076	22.11*	22.15*	28.20*	28.27*	28.30*	28.41*	28.43*
		28.46*	28.48*	29.22*	29.26*	29.32*	29.36*	29.39*
		34.15*	34.24*	34.26*	35.08*	35.17*	35.22*	35.26*
		35.33*	36.18*	36.24*	36.29*	36.43*	37.09*	37.15*
		38.16*	38.19*	38.30*	38.33*	39.09*	39.11*	39.19*
		39.22*	39.33*	39.36*	40.12*	40.14*	40.21*	40.24*
		40.32*	40.33*	41.08*	41.09*	41.13*	41.15*	41.29*
		42.06*	42.08*	42.10*	42.14*	42.15*	42.25*	42.29*
		42.30*	42.40*	43.03*	43.04*	43.14*	43.18*	43.19*
		43.29*	43.33*	43.34*	43.44*	44.03*	44.04*	44.14*
		44.19*	44.20*	44.29*	44.34*	44.35*	44.44*	45.04*
		45.05*	45.14*	45.19*	45.20*	45.29*	45.34*	45.35*
		45.44*	46.04*	46.05*	46.14*	46.19*	46.20*	46.29*
		46.34*	46.35*	46.44*	47.04*	47.05*	47.14*	47.19*
		47.20*	47.29*	47.34*	47.35*	47.44*	48.04*	48.05*
		48.14*	48.19*	48.20*	48.29*	48.34*	48.35*	48.44*
		49.03*	49.04*	49.16*	49.20*	49.21*	49.33*	49.37*
		49.38*	49.50*	50.03*	50.04*	50.16*	50.20*	50.21*
		50.33*	50.37*	50.38*	50.50*	51.04*	51.05*	51.16*
		51.21*	51.22*	51.33*	51.38*	51.39*	51.50*	52.04*
		52.05*	52.16*	52.21*	52.22*	52.33*	52.38*	52.39*
		52.50*	53.04*	53.05*	53.16*	53.21*	53.22*	53.33*
		53.38*	53.39*	53.50*	54.04*	54.05*	54.16*	54.21*
		54.22*	54.33*	54.38*	54.39*	54.50*	55.04*	55.05*
		55.16*	55.21*	55.22*	55.33*	57.11*	57.15*	60.13*
		60.17*	60.26*	60.30*	61.11*	61.15*	61.25*	61.30*
		61.32*	62.02*	62.09*	62.11*	62.16*	62.28*	62.33*
		62.35*	63.02*	63.09*	63.11*	63.16*	64.04*	64.09*
		64.11*	64.17*	64.24*	64.26*	64.31*	66.22*	66.24*
		67.08*	67.12*	123.13*	123.19*	123.21*	124.03*	124.05*
		124.08*	124.10*	124.21*	124.24*	124.32*	124.34*	124.37*
K VALUE = 02075								
Q0002002085								
Q0002102086								
Q0002202087								

K VALUE = 02100

SINE-COSINE




1
9
00022 = INTEGRAL PART OF 00022
10
00022 = 00022*00019
11
00003 = 00003-00022
12
00003 = 00003*00020
13
00020 = 00018-00012
14
00023 = 00010
90.36
02124
15
BEGIN 00024
16
00025 = +31415926+01
2
24
00028 = 00028*00027
25
00028 = 00028+00014
26
00028 = 00028*00027
27
00028 = 00028+00013
28
00028 = 00028*00027
29
00028 = 00028+00012
30
00028 = 00028*00023
31
00003 = 00028*00003
32
(00001 + (00004)) = 00003
33
EXIT

CROSS REFERENCE LISTING

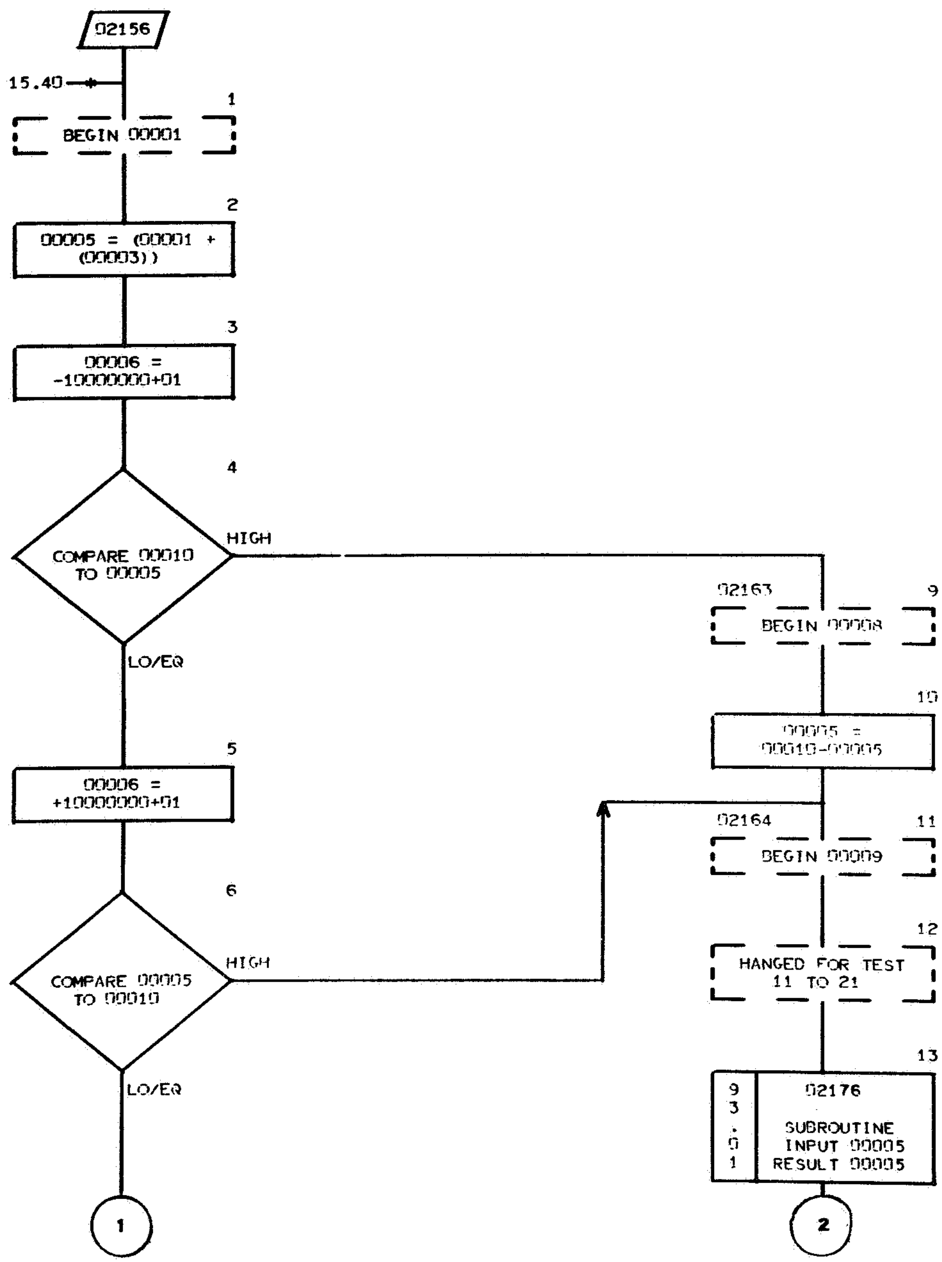
PAGE BOX	LABEL	REFERENCES						
K VALUE = 02100								
90.01	02101	15.35*	15.37*	28.15*	28.19*	28.26*	28.38*	29.13*
		35.12*	36.03*	36.14*	38.26*	39.29*	40.07*	66.31*
		66.35*	71.12*	72.13*	73.02*	73.18*	90.40*	95.15*
		105.08*	105.10*	121.18*	122.25*	123.01*	123.06*	123.10*
		123.37*	124.01*	124.15*	125.06*	145.13*	163.29*	169.03*
		169.32*	169.36*	169.46*	170.12*	170.14*	170.47*	171.36*
		172.03*	172.07*	172.11*	180.04*	181.22*		
90.07	02121	90.04						
90.15	02124	90.36						
90.34	02126	90.17	90.19					
90.37	02105	11.14*	28.13*	28.22*	28.29*	28.37*	29.09*	35.02*
		36.02*	36.19*	38.13*	39.05*	39.16*	40.17*	41.17*
		41.22*	41.30*	41.38*	66.33*	66.37*	66.39*	70.18*
		71.03*	71.46*	72.05*	73.03*	73.12*	95.14*	105.09*
		105.11*	105.17*	122.23*	122.49*	123.04*	123.08*	123.30*
		123.43*	124.13*	125.04*	145.11*	162.09*	166.47*	169.05*
		169.07*	169.30*	169.48*	170.16*	170.20*	170.22*	171.38*
		172.05*	172.09*	172.13*	180.10*	181.03*		

K VALUE = 02100

```
V00010+10000000+01
V00012 15707963 01
V00013-64596371 00
V00014 79689679-01
V00015-46737660-02
V00016 15148400-03
V00018+00000000+00
V00019+62831853+01
```

K VALUE = 02155

ARC SINE



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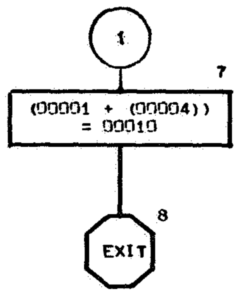
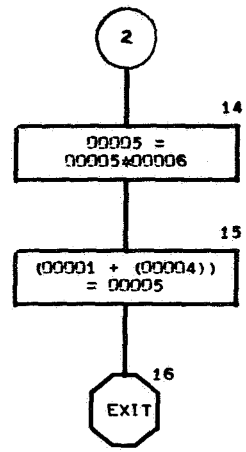


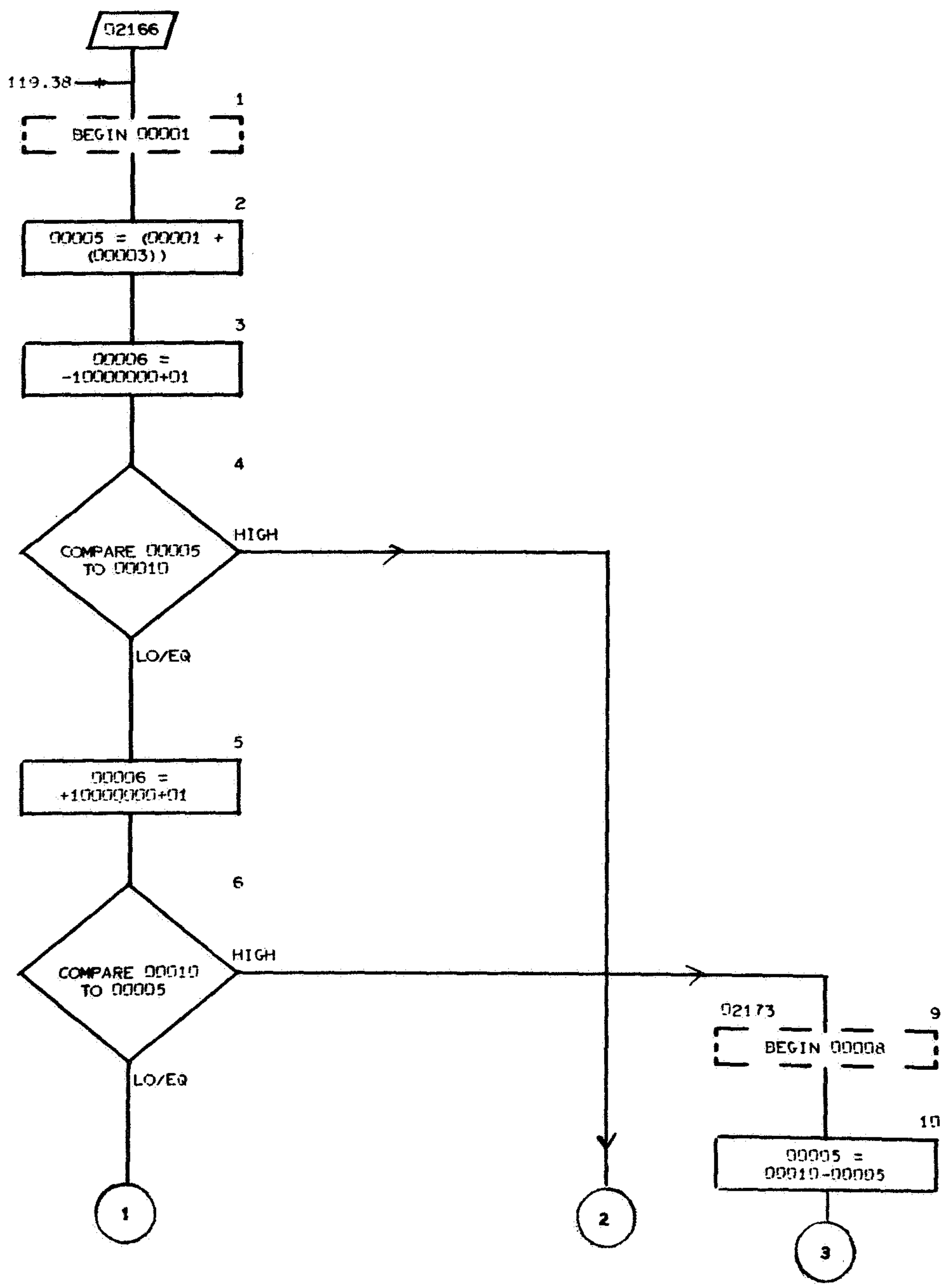


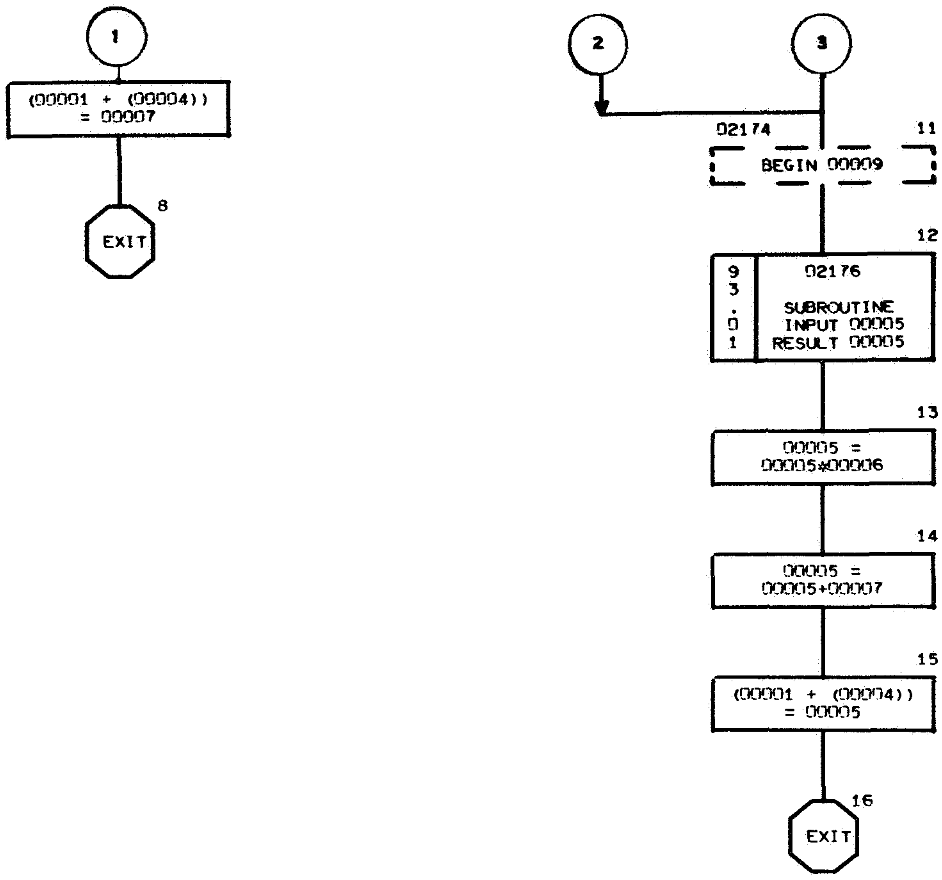
CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES				
K VALUE = 02155						
91.01	02156	15.40*	26.16*	119.25*	124.41*	174.10*
91.09	02163	91.04				
91.11	02164	91.06				

K VALUE = 02165

ARC COSINE




1
(00001 + (00004))
= 00007
8
EXIT
2
3
02174
11
BEGIN 00009
12
9
3
.
0
1
02176
SUBROUTINE
INPUT 00005
RESULT 00005
13
00005 =
00005*00006
14
00005 =
00005+00007
15
(00001 + (00004))
= 00005
16
EXIT

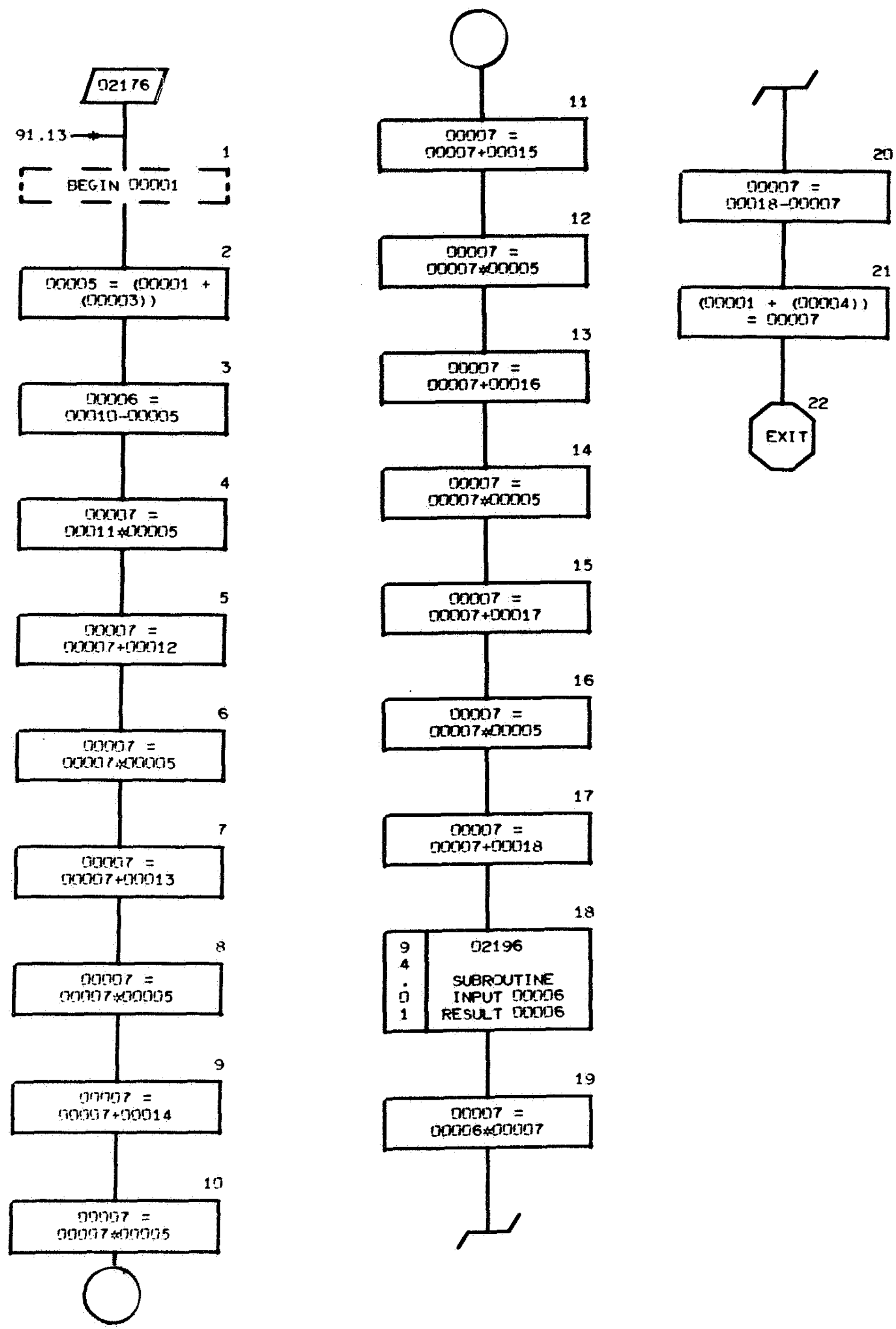
CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES			
K VALUE = 02165					
92.01	02166	119.38*	120.41*	123.36*	174.18*
92.09	02173	92.06			
92.11	02174	92.04			

K VALUE = 02165

V00007+15707963+01

K VALUE = 02175



K VALUE = 02175

```
V00010+10000000+01
V00011-12624911-02
V00012+66700901-02
V00013-17088125-01
V00014+30891881-01
V00015-50174304-01
V00016+88978987-01
```

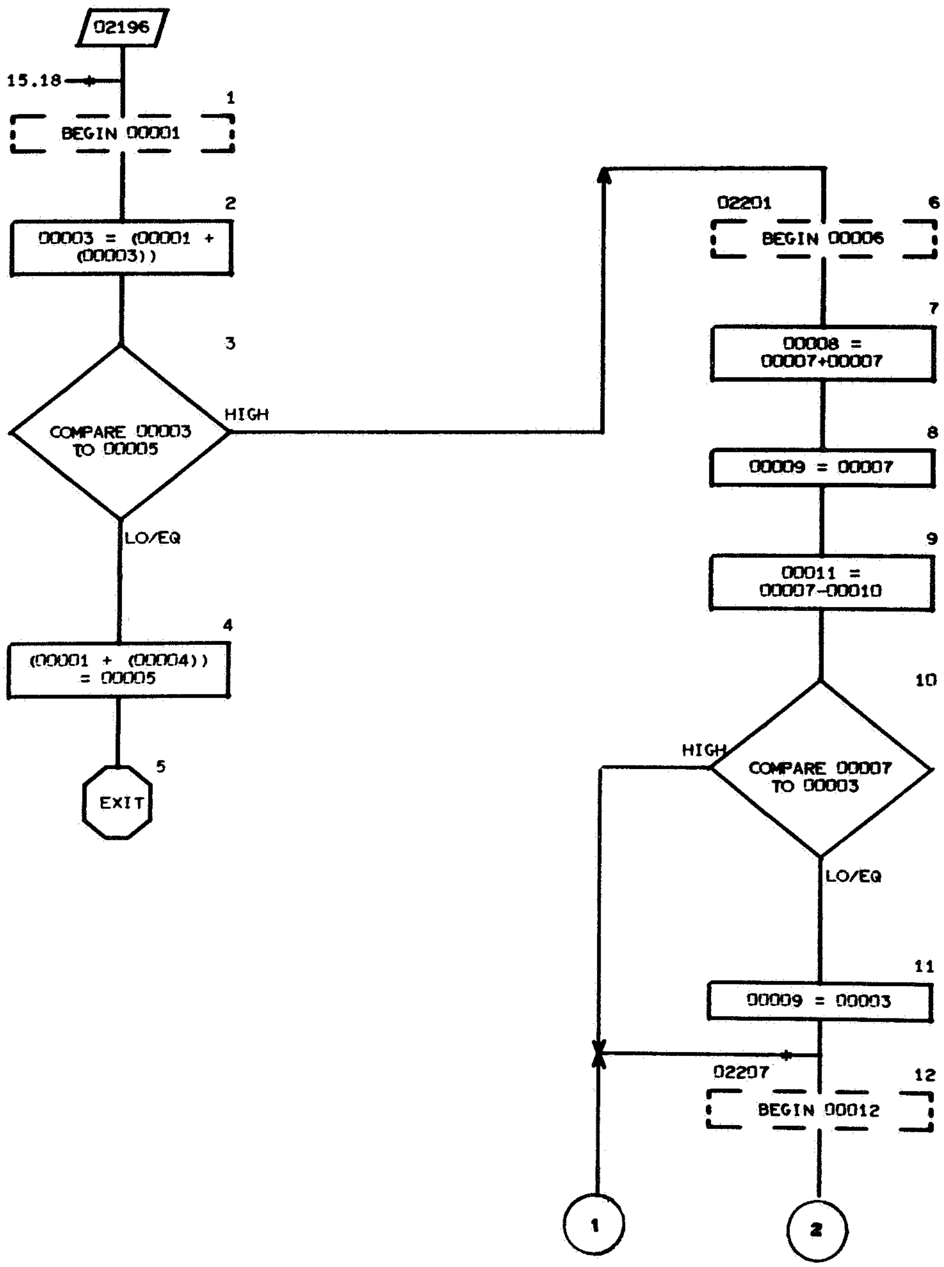
```
V00017-21459880+00
V00018+15707963+01
```

CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES	
	K VALUE = 02175		
93.01	02176	91.13*	92.12*

K VALUE = 02195

SQUARE ROOT FUNCTION



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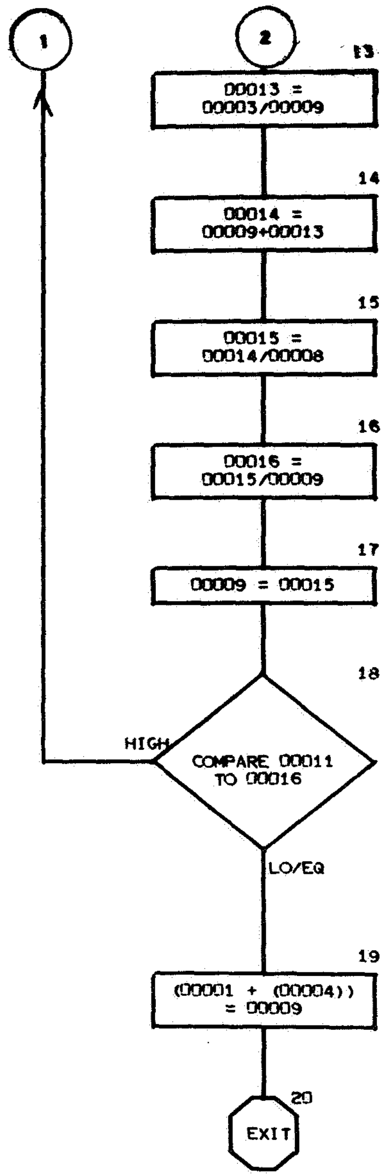
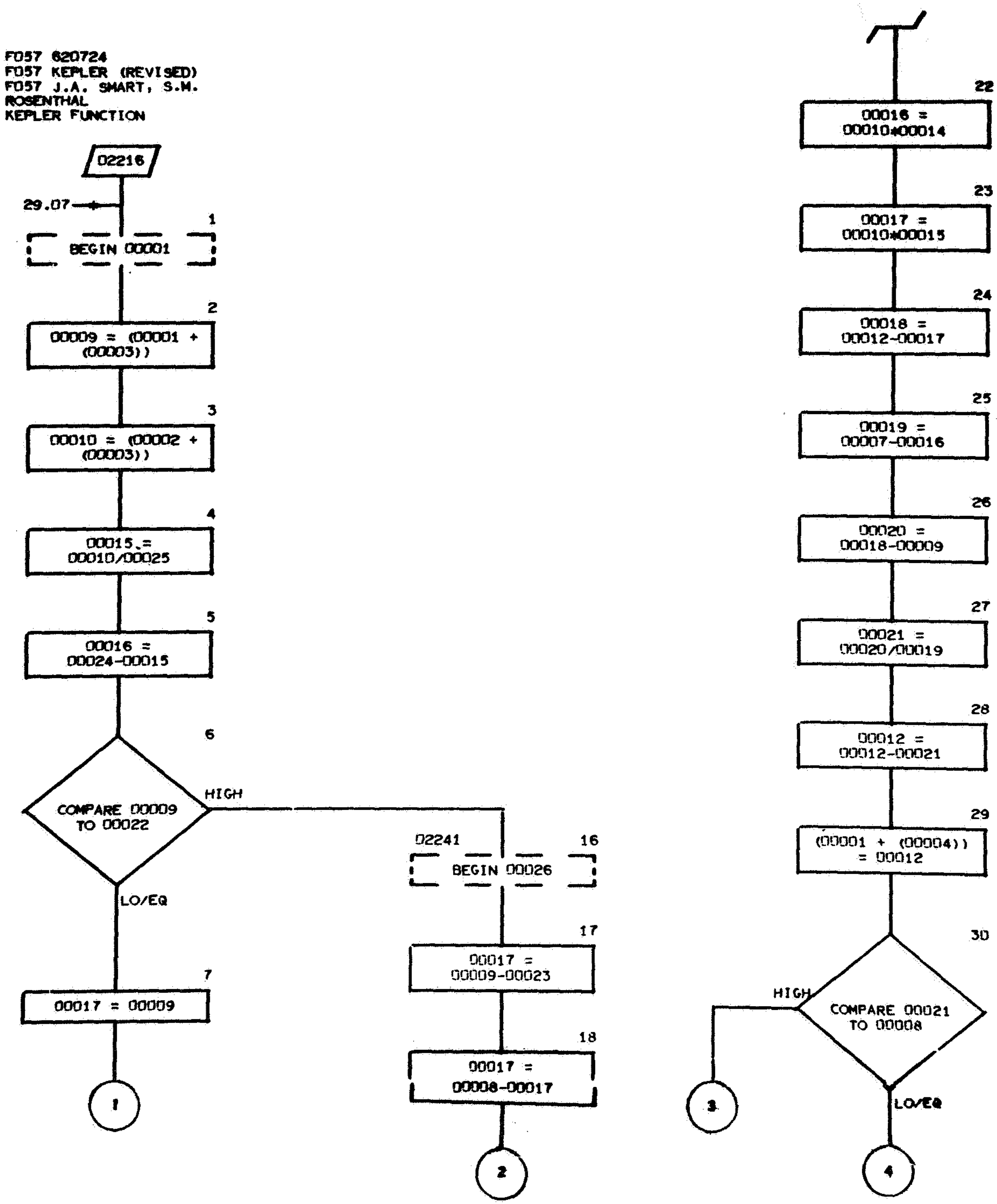


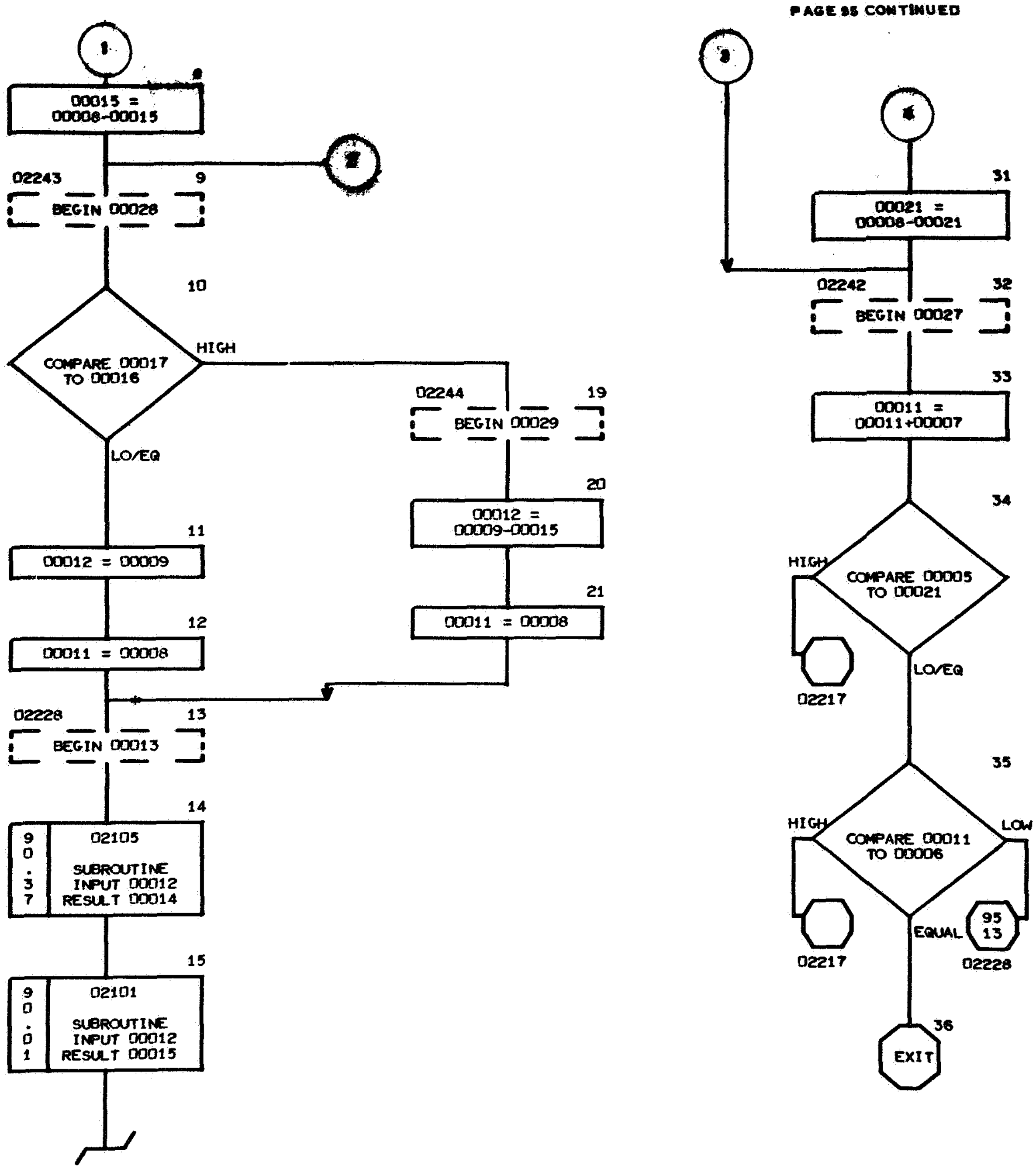
CROSS REFERENCE LISTING

```
PAGE BOX      LABEL            REFERENCES
       K VALUE = 02195
  94.01       02196       15.18*  15.24*  27.17*  28.05*  28.10*  29.16*  35.26*
                          36.10*  38.25*  39.28*  40.08*  42.02*  61.19*  63.36*
                          66.44*  71.38*  83.10*  93.18* 100.26* 105.46* 120.23*
                         120.38* 120.49* 120.54* 121.16* 121.28* 122.32* 122.42*
                         122.47* 145.15* 161.22* 161.46* 163.17* 163.43* 166.28*
                         167.05* 171.46* 172.19* 181.12* 181.14*
  94.06       02201       94.03
  94.12       02207       94.10   94.18

        K VALUE = 02195
V00007 10000000 01
V00010 20000000-07
```

K VALUE = 02215



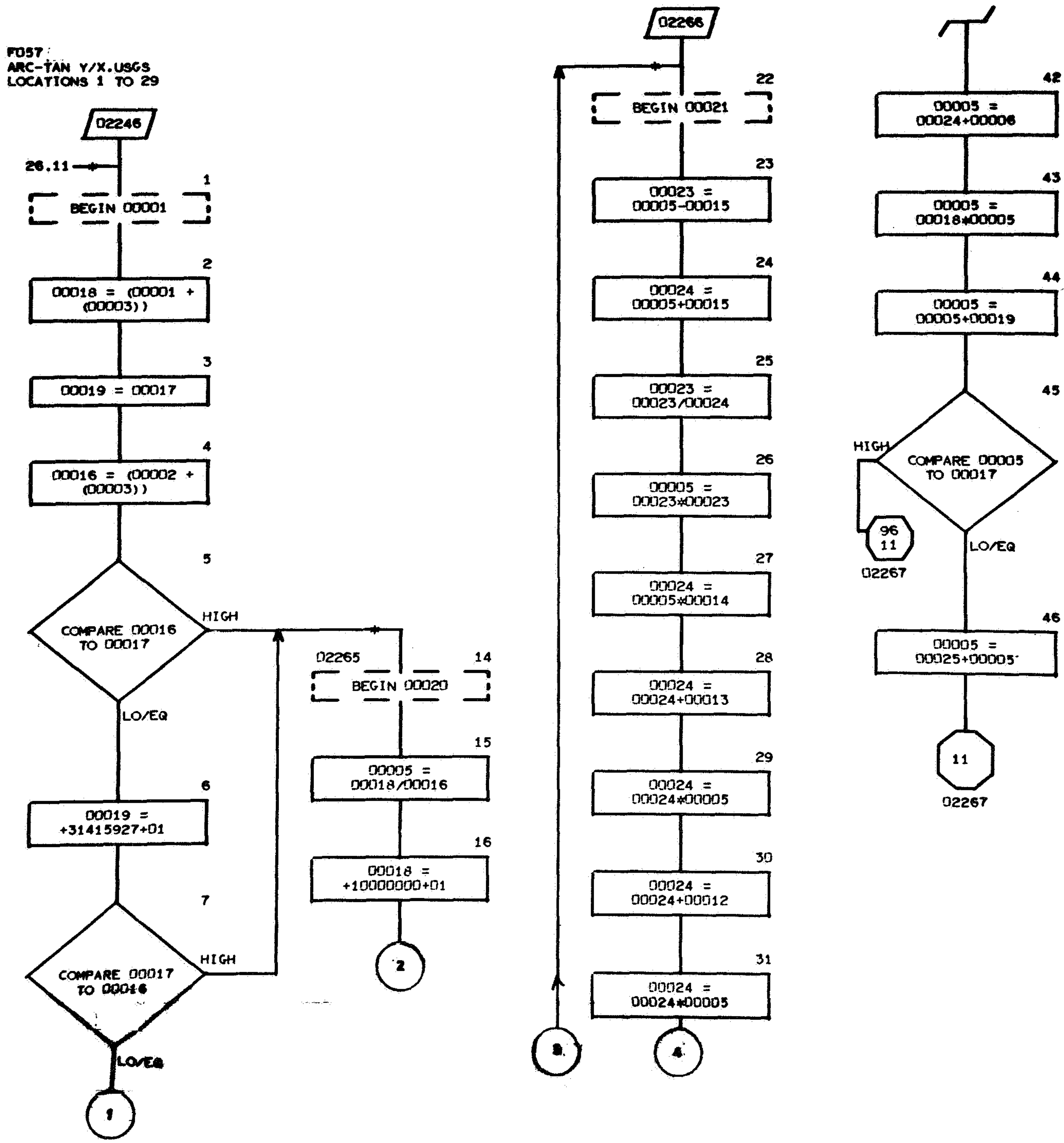
PAGE 95 CONTINUED

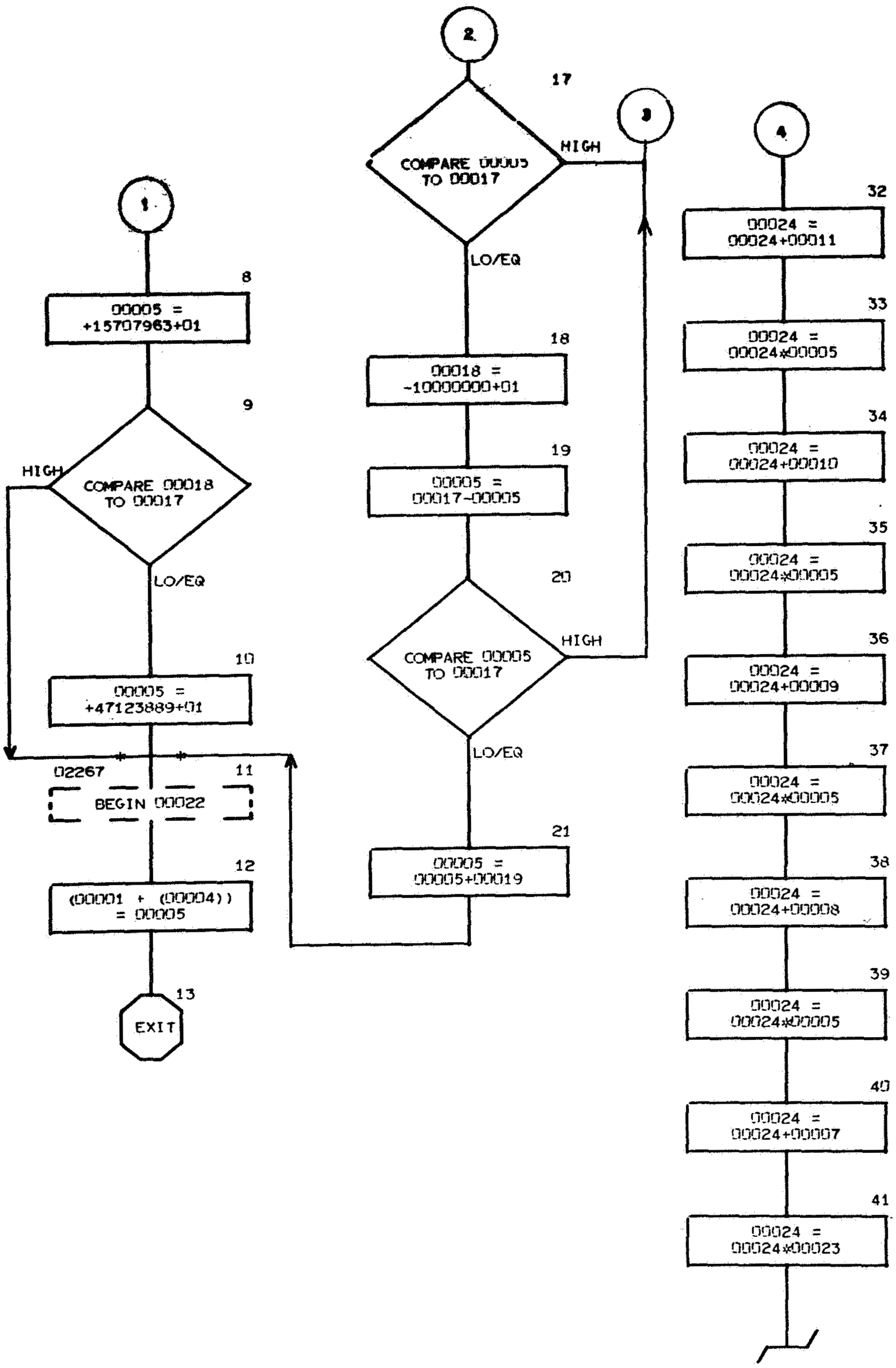


```
        K VALUE = 02215
Q00002203839                    PI
Q00002303842                    2 PI
Q00002403857                    PI / 6
Q00612020105                    COSINE
Q00614020101                    SINE
V00005+50000000-08              S.P. CONVERGENCE CRITERIUM
V00006 10000000 02
V00007 10000000 01
V00008 00000000 00
V00025+20000000+01
```

CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES			
K VALUE = 02215					
95.01	02216	29.07*	122.21*	169.44*	171.33*.
95.09	02243	95.18			
95.13	02228	95.21	95.35		
95.16	02241	95.06			
95.19	02244	95.10			
95.32	02242	95.30			


F057
ARC-TAN Y/X.USGS
LOCATIONS 1 TO 29
02246
26.11
1
BEGIN 00001
2
00018 = (00001 + (00003))
3
00019 = 00017
4
00016 = (00002 + (00003))
5
COMPARE 00016 TO 00017
HIGH
LO/EQ
6
00019 = +31415927+01
7
COMPARE 00017 TO 00016
HIGH
LO/EQ
1
02265
14
BEGIN 00020
15
00005 = 00018/00016
16
00018 = +10000000+01
2
02266
22
BEGIN 00021
23
00023 = 00005-00015
24
00024 = 00005+00015
25
00023 = 00023/00024
26
00005 = 00023*00023
27
00024 = 00005*00014
28
00024 = 00024+00013
29
00024 = 00024*00005
30
00024 = 00024+00012
31
00024 = 00024*00005
3
4
42
00005 = 00024+00006
43
00005 = 00018*00005
44
00005 = 00005+00019
45
COMPARE 00005 TO 00017
HIGH
96
11
02267
LO/EQ
46
00005 = 00025+00005
11
02267



2
17
COMPARE 00005 TO 00017
HIGH
LO/EQ
3
4
1
8
00005 = +15707963+01
9
COMPARE 00018 TO 00017
HIGH
LO/EQ
10
00005 = +47123889+01
02267
11
BEGIN 00022
12
(00001 + (00004)) = 00005
13
EXIT
18
00018 = -10000000+01
19
00005 = 00017-00005
20
COMPARE 00005 TO 00017
HIGH
LO/EQ
21
00005 = 00005+00019
32
00024 = 00024+00011
33
00024 = 00024*00005
34
00024 = 00024+00010
35
00024 = 00024*00005
36
00024 = 00024+00009
37
00024 = 00024*00005
38
00024 = 00024+00008
39
00024 = 00024*00005
40
00024 = 00024+00007
41
00024 = 00024*00023

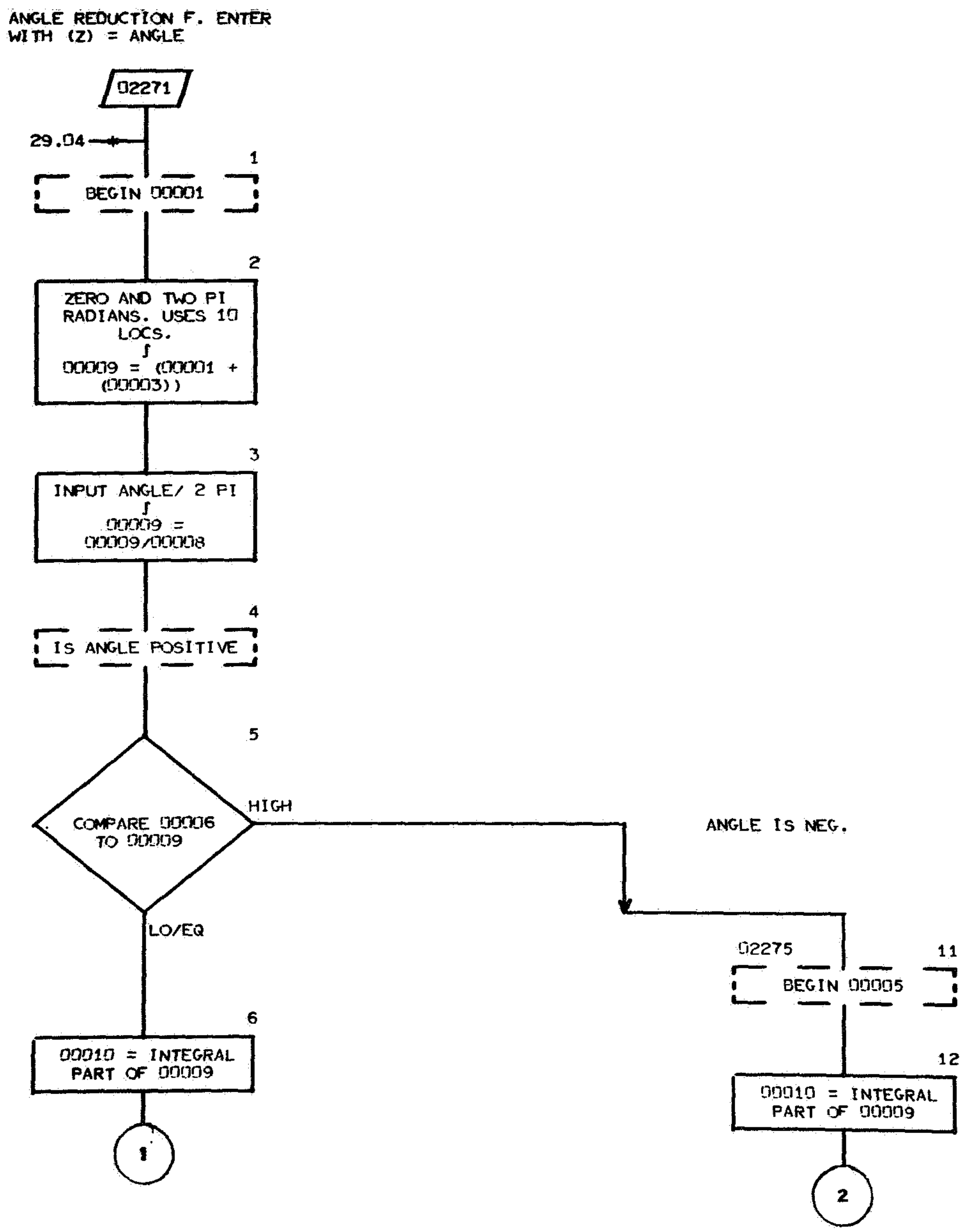
CROSS REFERENCE LISTING

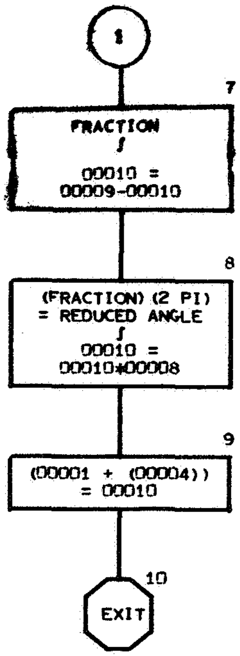
PAGE BOX	LABEL	REFERENCES				
K VALUE = 02245						
96.01	02246	26.11*	119.45*	120.05*	121.22*	122.36*
96.11	02267	96.09	96.21	96.45	96.46	
96.14	02265	96.05	96.07			
96.22	02266	96.17	96.20			

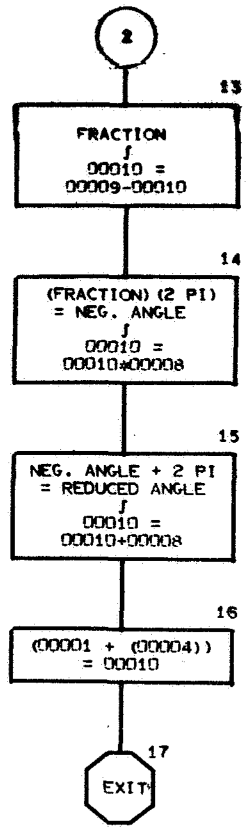
K VALUE = 02245

```
V00006+78539816+00
V00007+99999933+00
V00008-33329856+00
V00009+19946536+00
V00010-13908533+00
V00011+96420044-01
V00012-55909886-01
V00013+21861229-01
V00014-40540580-02
V00015+10000000+01
V00017+00000000+00
V00025+62831853+01
V00015+10000000+01
```

K VALUE = 02270



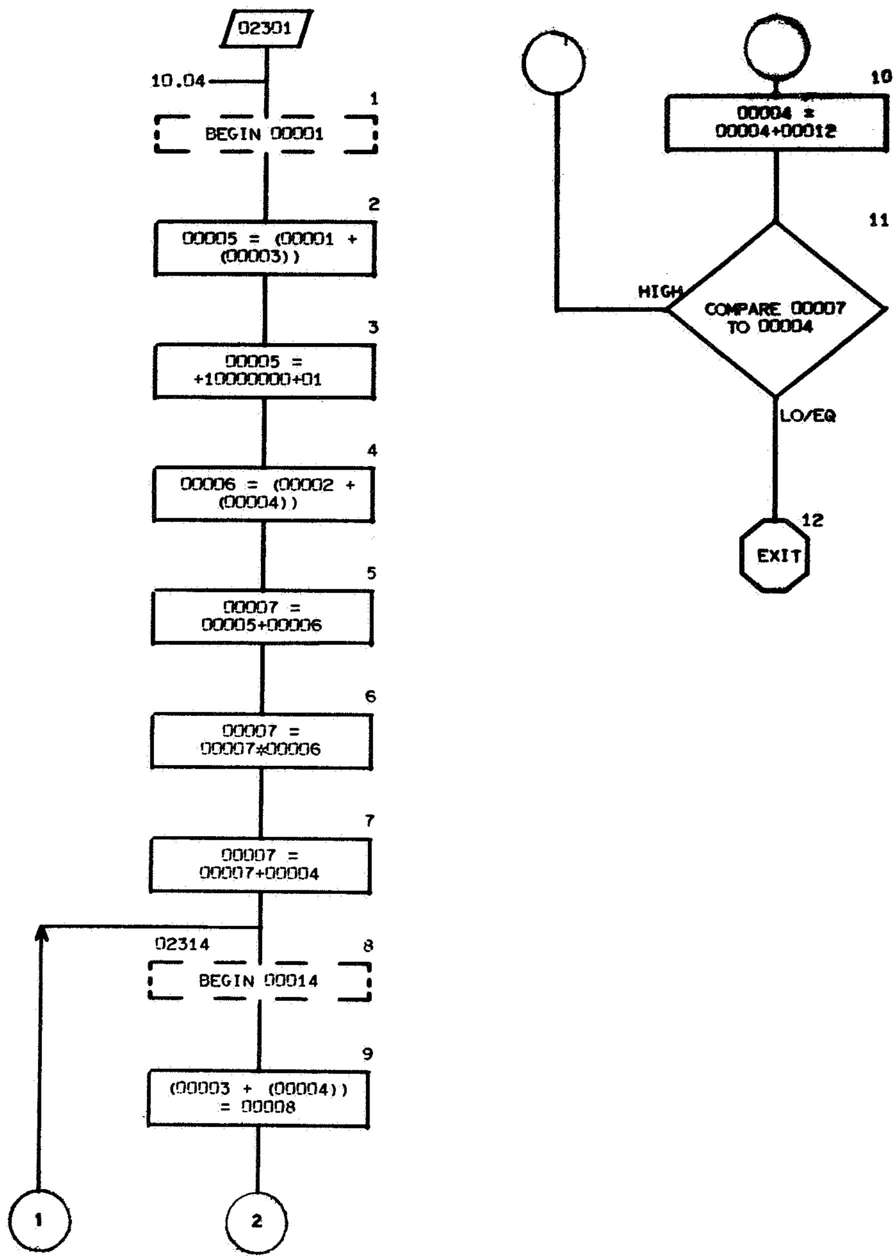

1
7
FRACTION
∫
00010 =
00009-00010
8
(FRACTION) (2 PI)
= REDUCED ANGLE
∫
00010 =
00010*00008
9
(00001 + (00004))
= 00010
10
EXIT


2
13
FRACTION
∫
00010 =
00009-00010
14
(FRACTION) (2 PI)
= NEG. ANGLE
∫
00010 =
00010*00008
15
NEG. ANGLE + 2 PI
= REDUCED ANGLE
∫
00010 =
00010+00008
16
(00001 + (00004))
= 00010
17
EXIT

```
                              CROSS REFERENCE LISTING

PAGE BOX      LABEL               REFERENCES

       K VALUE = 02270

  97.01        02271      29.04*  105.03*  105.05*  105.07*  120.06*  121.26*  122.30*
                         158.06*  158.20*  158.25*  168.10*  168.12*  168.19*  168.2[illegible]*
                         168.26*  168.27*  168.31*  168.32*  168.33*  169.26*  169.27*
                         169.28*  171.27*  171.28*  171.29*  171.34*

  97.11        02275      97.05


       K VALUE = 02270

Q0000803842                 2 PI

V00006+00000000+00            IN RADIANS. EXIT WITH (X) = ANGLE B
```

K VALUE = 02300

MATRIX CLEAR FUNCTION



NASA-GSFC MISSION AND TRAJECTORY ANALYSIS DIVI

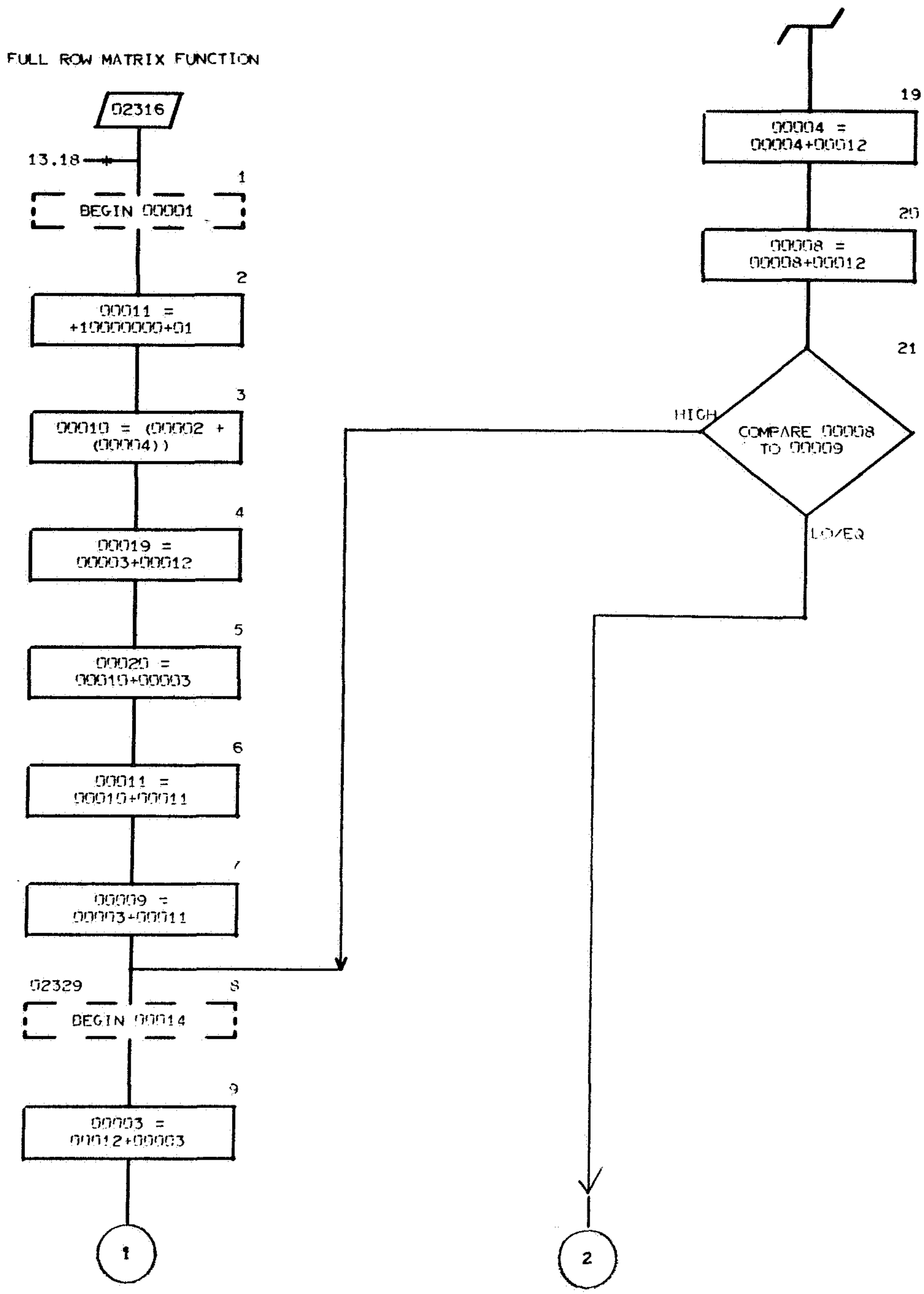
PAGE BOX	LABEL	REFERENCES
K VALUE = 02300		
98.01	02301	10.04*
98.08	02314	98.11

K VALUE = 02300

V00008+00000000+00

V00012+10000000+01

K VALUE = 02315



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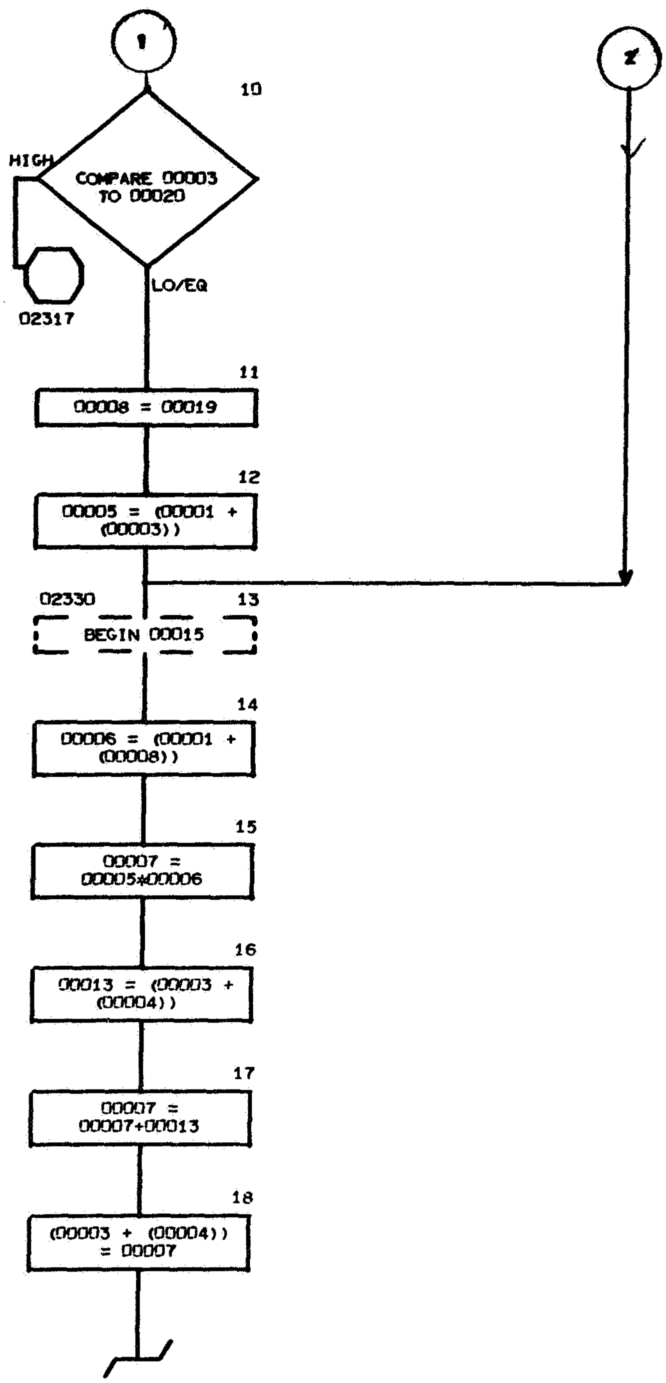


CROSS REFERENCE LISTING

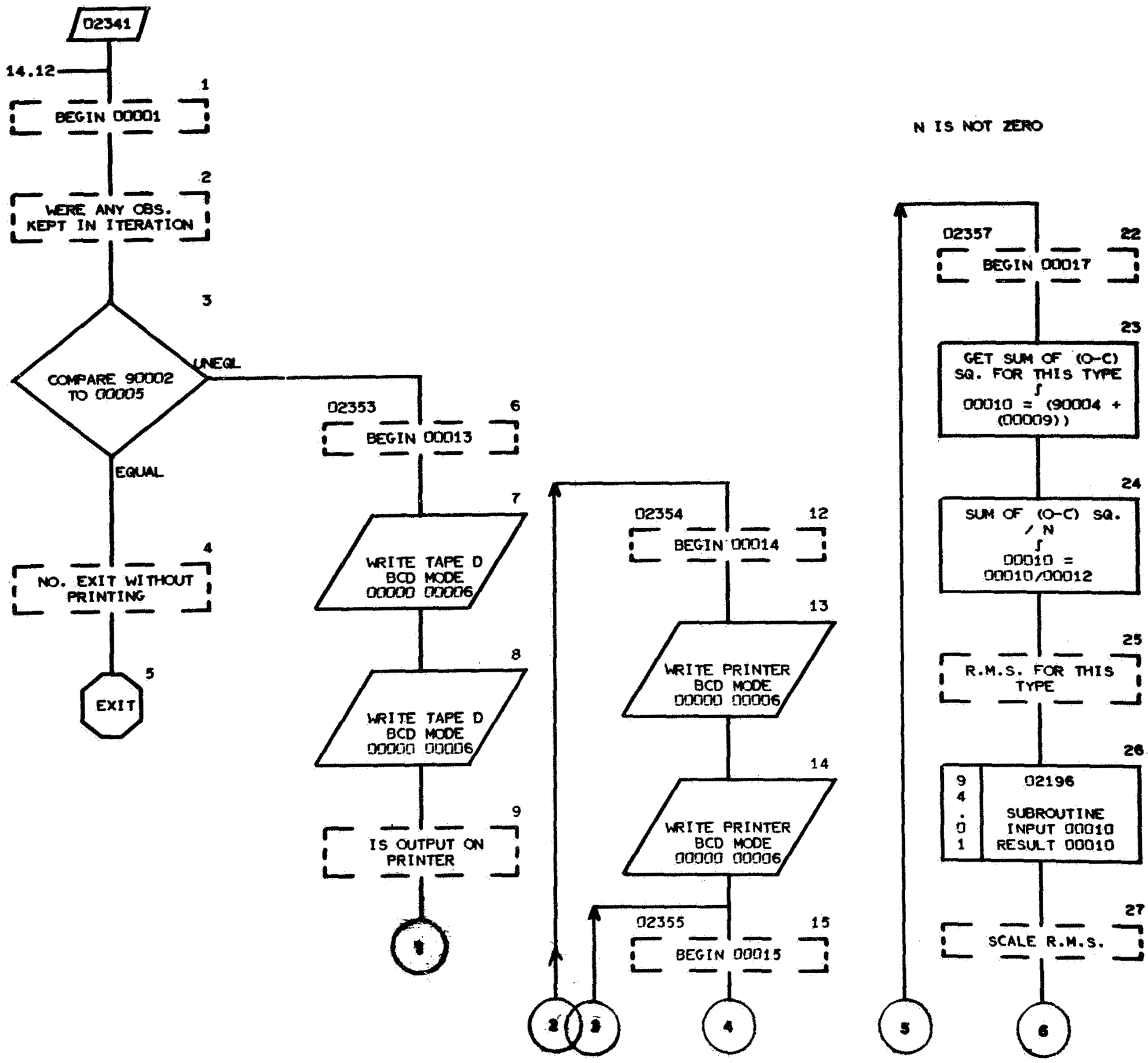
PAGE BOX	LABEL	REFERENCES
K VALUE = 02315		
99.01	02316	13.18* 152.18*
99.08	02329	99.21
99.13	02330	99.21

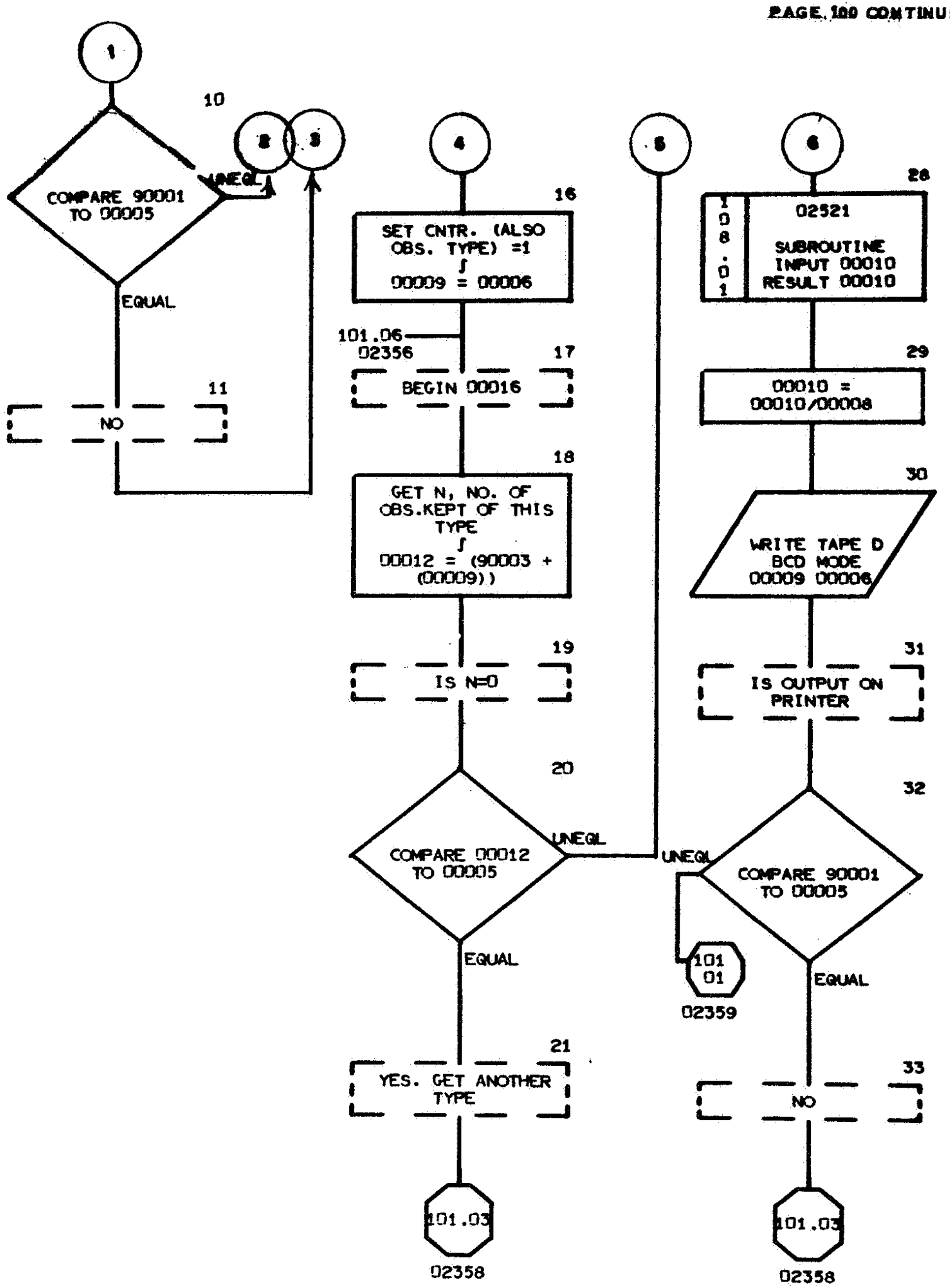
K VALUE = 02315

V00012+10000000+01

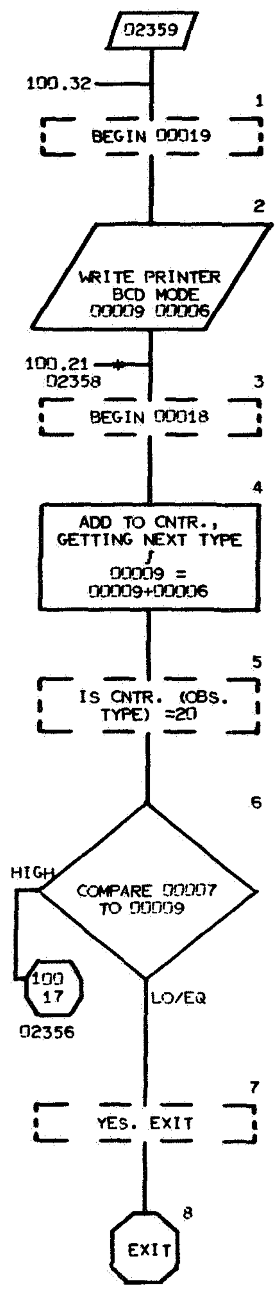
K VALUE = 02340

COMPUTE AND PRINT R.M.S.
FOR EACH OBSERVATION TYPE




1
10
COMPARE 90001 TO 00005
UNEQL
EQUAL
2
3
11
NO
4
16
SET CNTR. (ALSO OBS. TYPE) =1
00009 = 00006
101.06
02356
17
BEGIN 00016
18
GET N, NO. OF OBS.KEPT OF THIS TYPE
00012 = (90003 + (00009))
19
IS N=0
20
COMPARE 00012 TO 00005
UNEQL
EQUAL
21
YES. GET ANOTHER TYPE
101.03
02358
5
6
28
108.01
02521
SUBROUTINE
INPUT 00010
RESULT 00010
29
00010 = 00010/00008
30
WRITE TAPE D
BCD MODE
00009 00006
31
IS OUTPUT ON PRINTER
32
COMPARE 90001 TO 00005
UNEQL
101
01
02359
EQUAL
33
NO
101.03
02358

K VALUE = 02340



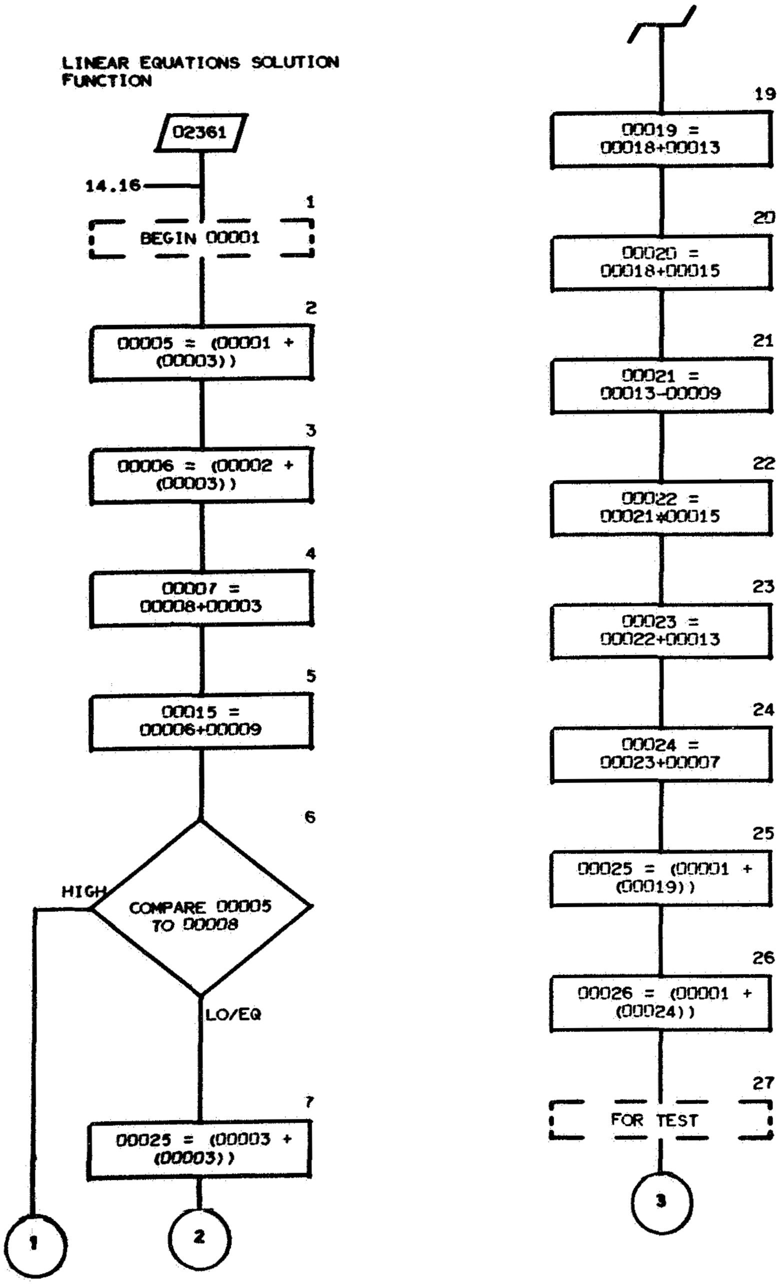
CROSS-REFERENCE LISTING

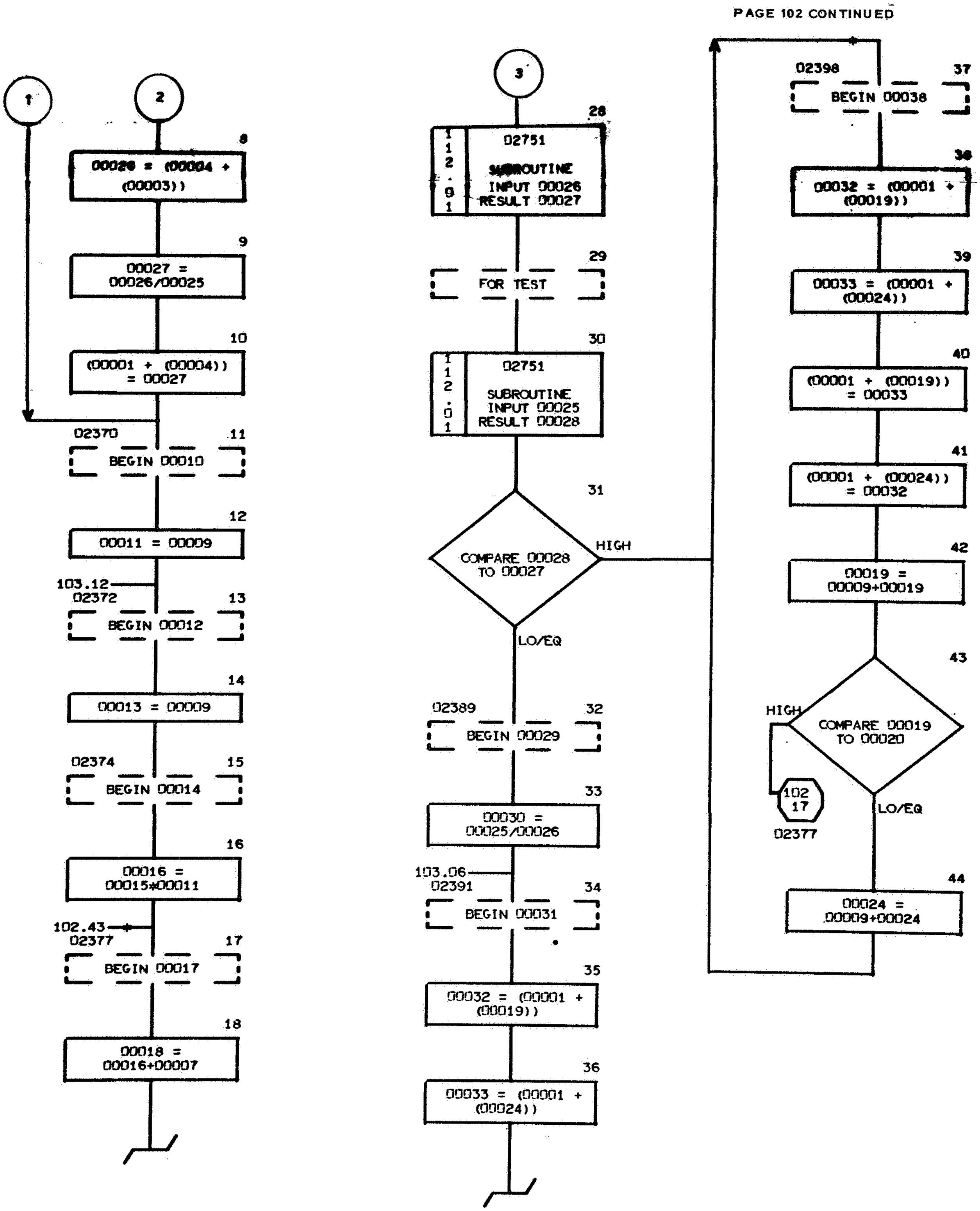
PAGE BOX	LABEL	REFERENCES	
100.15	02355	100.11	
100.17	02356	101.06	
100.22	02357	100.20	
101.01	02359	100.32	
101.03	02358	100.21	100.33
100.01	02341	14.12*	
100.06	02353	100.03	
100.12	02354	100.10	

K VALUE = 02340

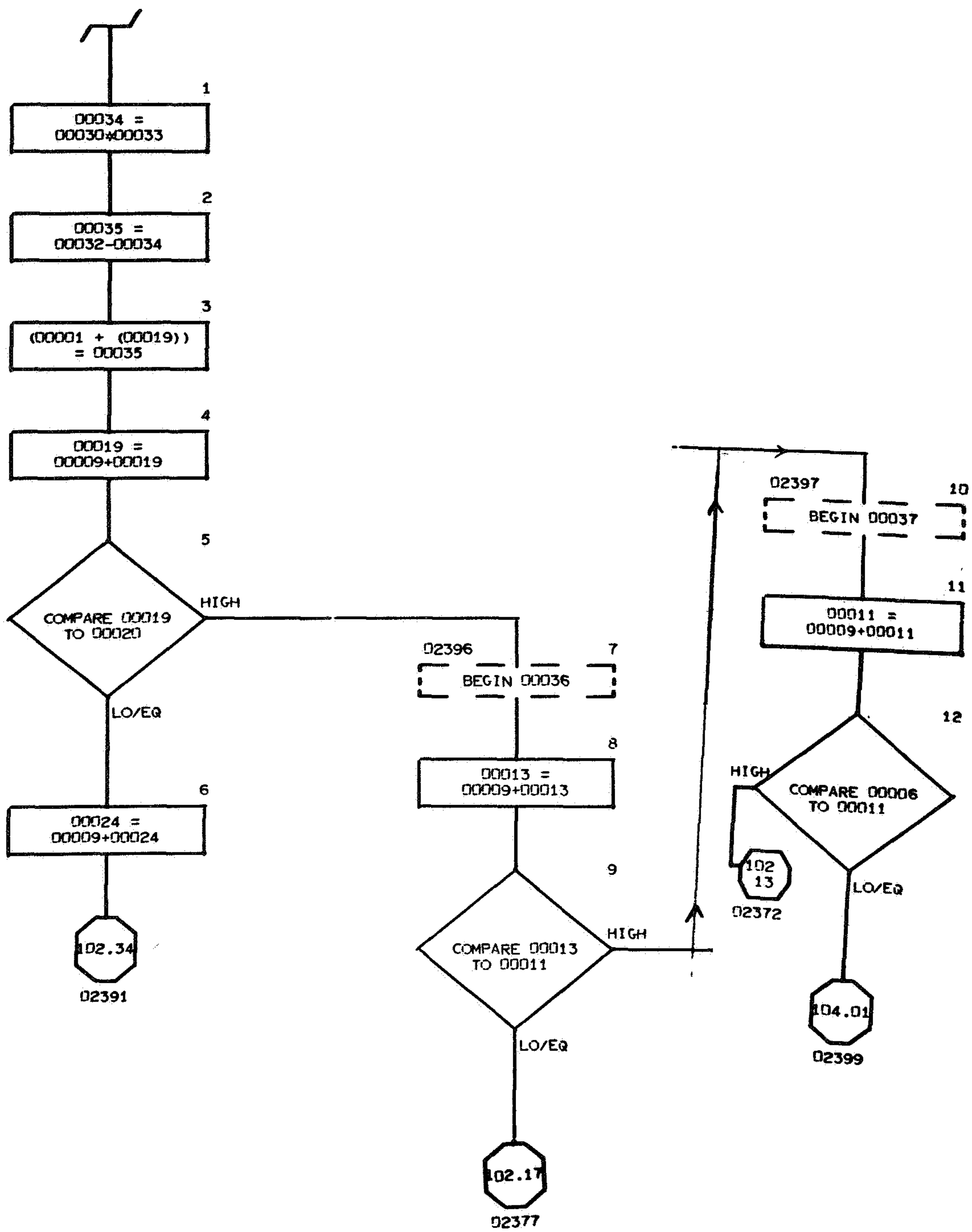
```
Q9000100042             PRINTER OUTPUT OPTION
Q9000200048             N, TOTAL NO. OF OBS. KEPT
Q9000301899             LOC.PRECEDING 20 LOCS. OF N"S
Q9000401919             LOC.PRECEDING 20 LOC.OF SUMS OF (O-C
Q9000502196             SQUARE ROOT
Q9000602521             OUTPUT SCALE
V00005+00000000+00      (GETS AND TESTS N FOR EACH OBS.TYPE
V00006+10000000+01      N IS NO.OF (O-C)SQ.INCLUDED IN SUM
V00007+20000000+02      TYPE.IF N IS NOT 0,GETS CORRES.SUM
V00008+10000000+06      COMPUTES R.M.S.FOR TYPE.PRINTS TYPE
```

K VALUE = 02360

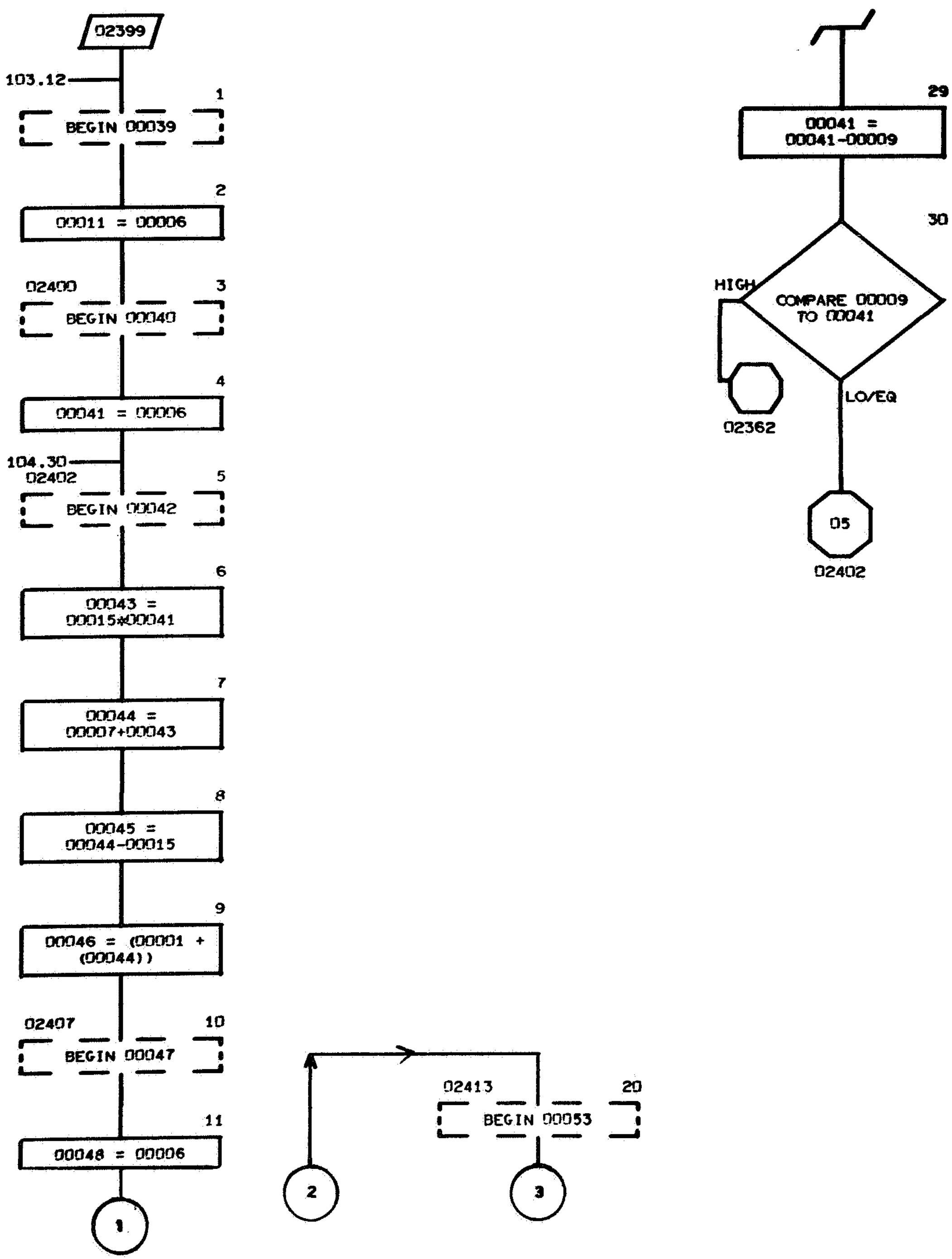


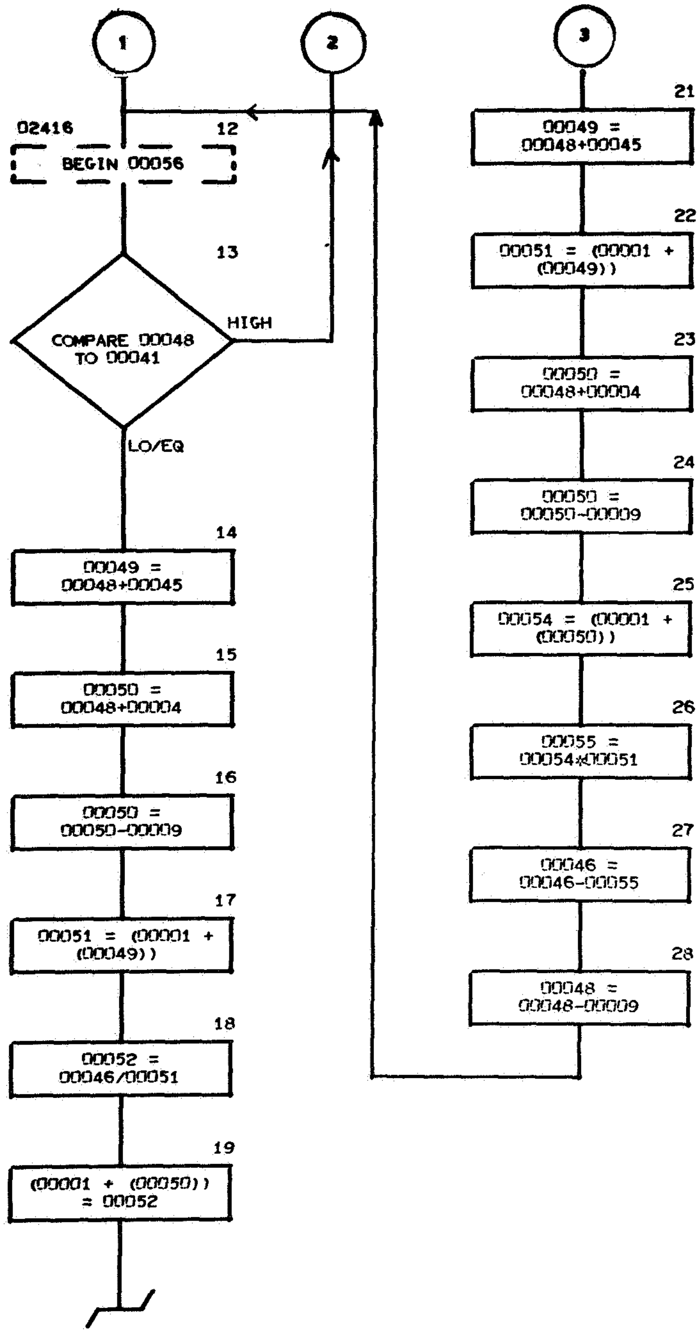

PAGE 102 CONTINUED
1
2
8
00026 = (00004 + (00003))
9
00027 = 00026/00025
10
(00001 + (00004)) = 00027
02370
11
BEGIN 00010
12
00011 = 00009
103.12
02372
13
BEGIN 00012
14
00013 = 00009
02374
15
BEGIN 00014
16
00016 = 00015*00011
102.43
02377
17
BEGIN 00017
18
00018 = 00016+00007
3
28
112.01
02751
SUBROUTINE
INPUT 00026
RESULT 00027
29
FOR TEST
30
112.01
02751
SUBROUTINE
INPUT 00025
RESULT 00028
31
COMPARE 00028 TO 00027
HIGH
LO/EQ
02389
32
BEGIN 00029
33
00030 = 00025/00026
103.06
02391
34
BEGIN 00031
35
00032 = (00001 + (00019))
36
00033 = (00001 + (00024))
02398
37
BEGIN 00038
38
00032 = (00001 + (00019))
39
00033 = (00001 + (00024))
40
(00001 + (00019)) = 00033
41
(00001 + (00024)) = 00032
42
00019 = 00009+00019
43
COMPARE 00019 TO 00020
HIGH
LO/EQ
102
17
02377
44
00024 = 00009+00024

K VALUE = 02360



K VALUE = 02360




1
2
3
02416
12
BEGIN 00056
13
COMPARE 00048 TO 00041
HIGH
LO/EQ
14
00049 = 00048+00045
15
00050 = 00048+00004
16
00050 = 00050-00009
17
00051 = (00001 + (00049))
18
00052 = 00046/00051
19
(00001 + (00050)) = 00052
21
00049 = 00048+00045
22
00051 = (00001 + (00049))
23
00050 = 00048+00004
24
00050 = 00050-00009
25
00054 = (00001 + (00050))
26
00055 = 00054*00051
27
00046 = 00046-00055
28
00048 = 00048-00009

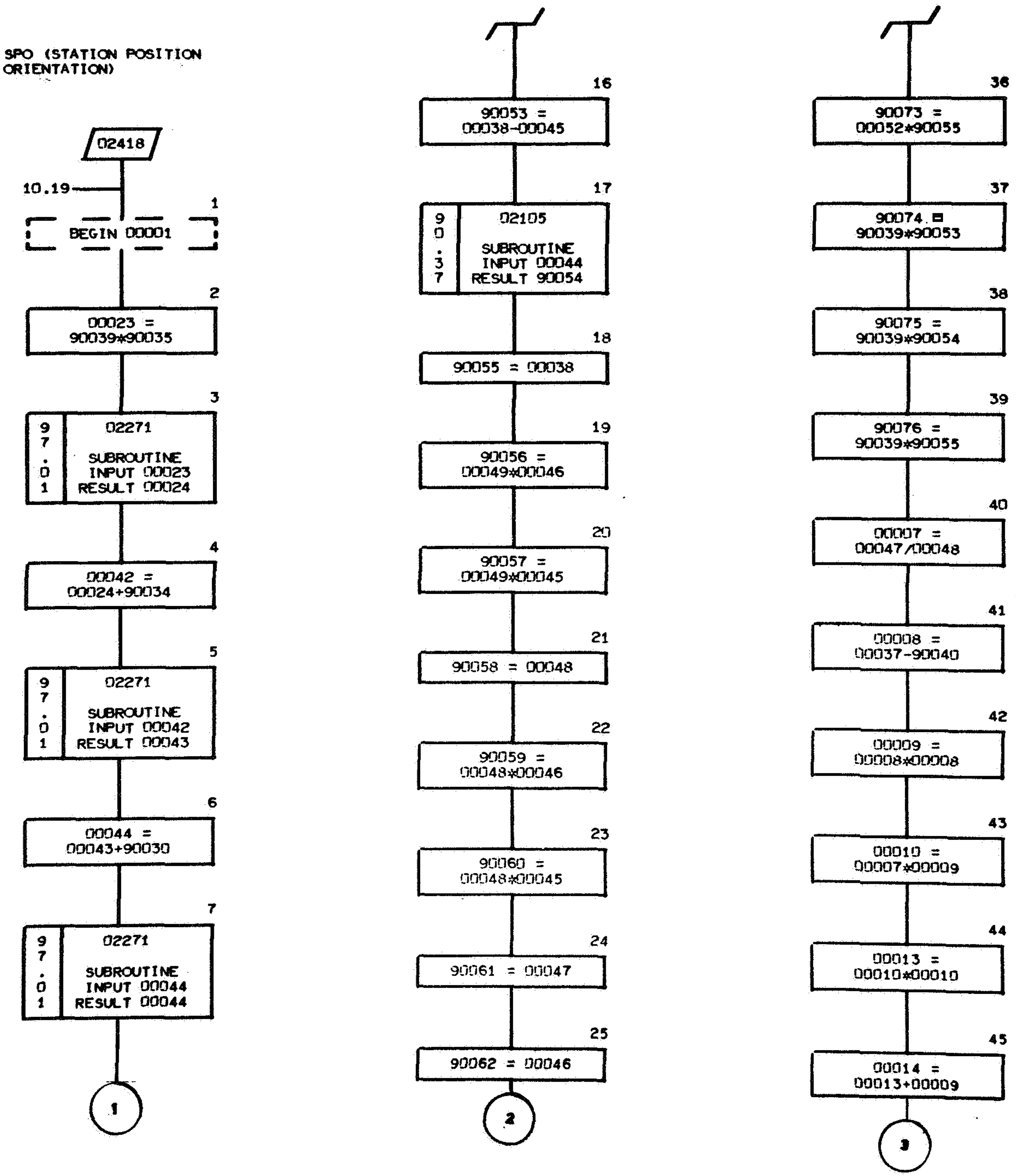
CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES	
K VALUE = 02360			
102.01	02361	14.16*	
102.11	02370	102.06	
102.13	02372	103.12	
102.15	02374		
102.17	02377	102.43	103.09
102.32	02389		
102.34	02391	103.06	
102.37	02398	102.31	102.44
103.07	02396	103.05	
103.10	02397	103.09	
104.01	02399	103.12	
104.03	02400		
104.05	02402	104.30	
104.10	02407		
104.12	02416	104.28	
104.20	02413	104.13	

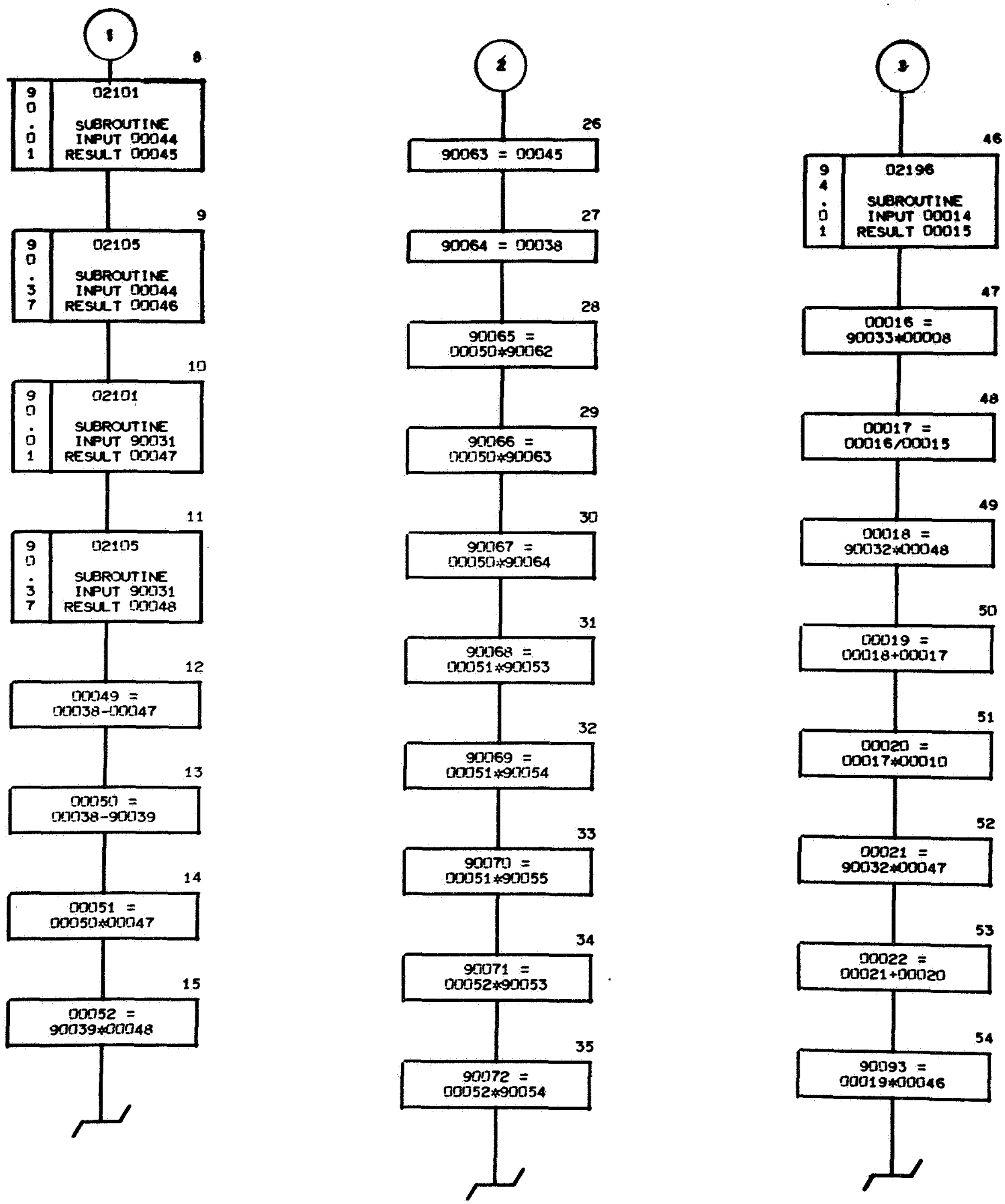
```
        K VALUE = 02360
Q90000102751                    ABSOLUTE VALUE FUNCTION
V00008+10000000+01
V00009+10000000+01
```

K VALUE = 02417

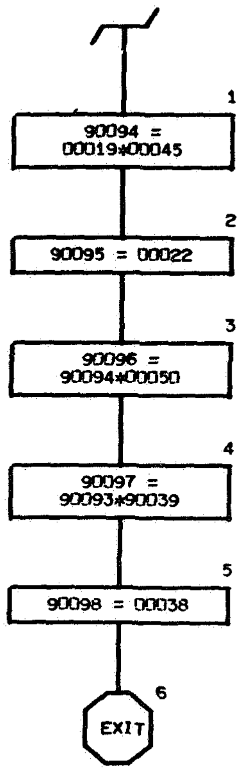
SPO (STATION POSITION ORIENTATION)



PAGE 105 CONTINUED



K VALUE = 02417



K VALUE = 02417

Q9003000302	STATION LONGITUDE (RADIANS)
Q9003100303	STATION LATITUDE (RADIANS)
Q9003200304	STATION HEIGHT (C.U.L.)
Q9003300305	DIST.FROM EARTH CENTER TO STATION (C
Q9003400298	LAMBDA SUB ZERO (RADIANS)
Q9003500200	T, OBSERVATION TIME IN C.U.T.
Q9003903835	ROTATION OF EARTH (RAD/C.U.T.)
Q9004003834	FLATNESS OF EARTH
Q9005300316	G 1 BAR
Q9005400317	
Q9005500318	
Q9005600319	G 2 BAR
Q9005700320	
Q9005800321	
Q9005900322	G 3 BAR
Q9006000323	
Q9006100324	
Q9006200325	G 4 BAR
Q9006300326	

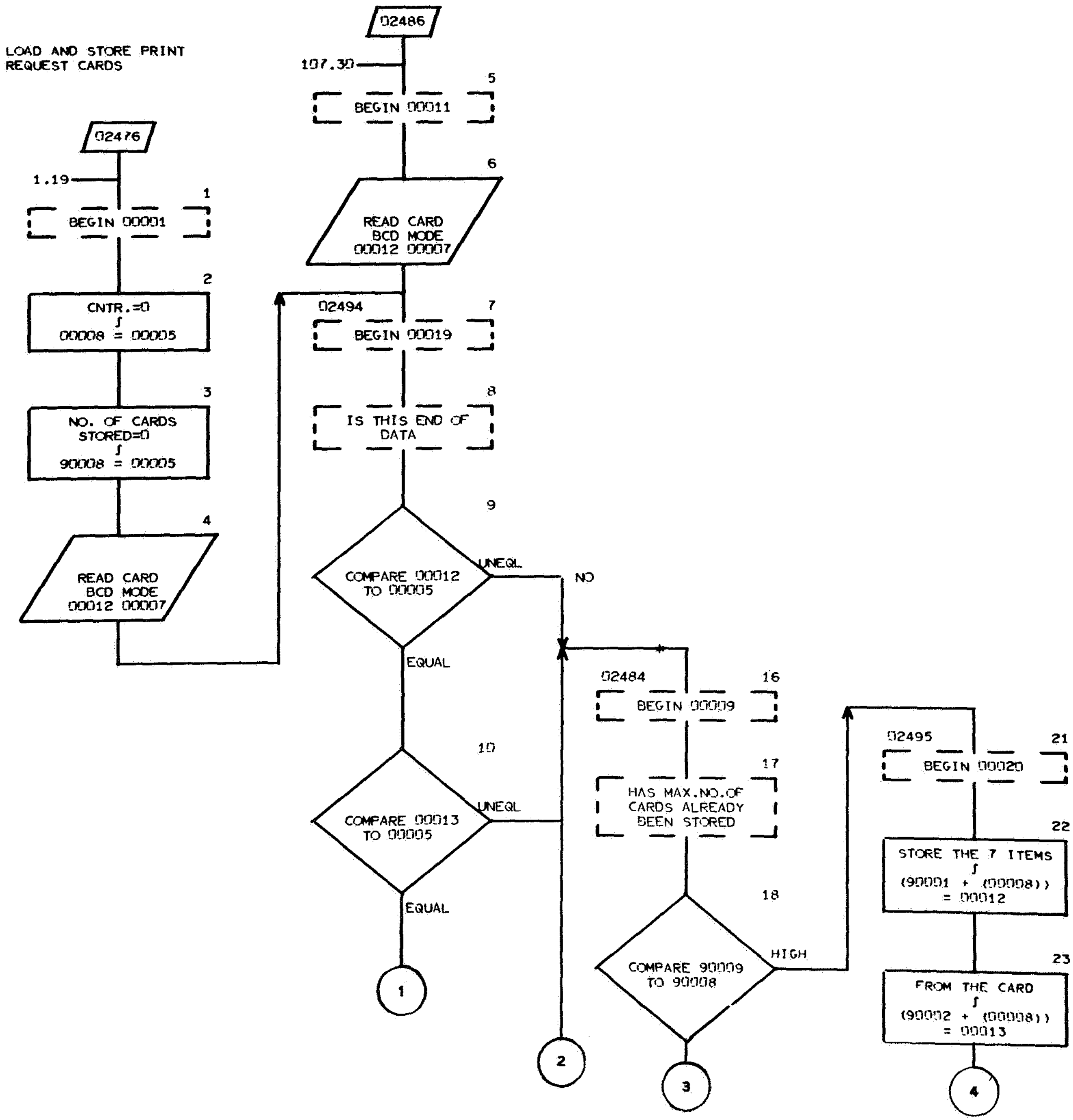
```
Q9006400327
Q9006500337                     G 1 DOT BAR
Q9006600338
Q9006700339
Q9006800340                     G 2 DOT BAR
Q9006900341
Q9007000342
Q9007100343                     G 3 DOT BAR
Q9007200344
Q9007300345
Q9007400346                     G 4 DOT BAR
Q9007500347
Q9007600348
Q9007700328                     G 5 BAR
Q9007800329
Q9007900330
Q9008000331                     G 6 BAR
Q9008100332
Q9008200333
Q9008300334                     G 7 BAR
Q9008400335
Q9008500336
Q9002000349                     G 5 DOT BAR
Q9002100350
Q9002200351
Q9002300352                     G 6 DOT BAR
Q9002400353
Q9002500354
Q9002600355                     G 7 DOT BAR
Q9002700356
Q9002800357
Q9009300310                     CAP R BAR, STATION POSITION VECTOR
Q9009400311
Q9009500312
Q9009600313                     CAP R DOT BAR, STATION VELOCITY VECT
```

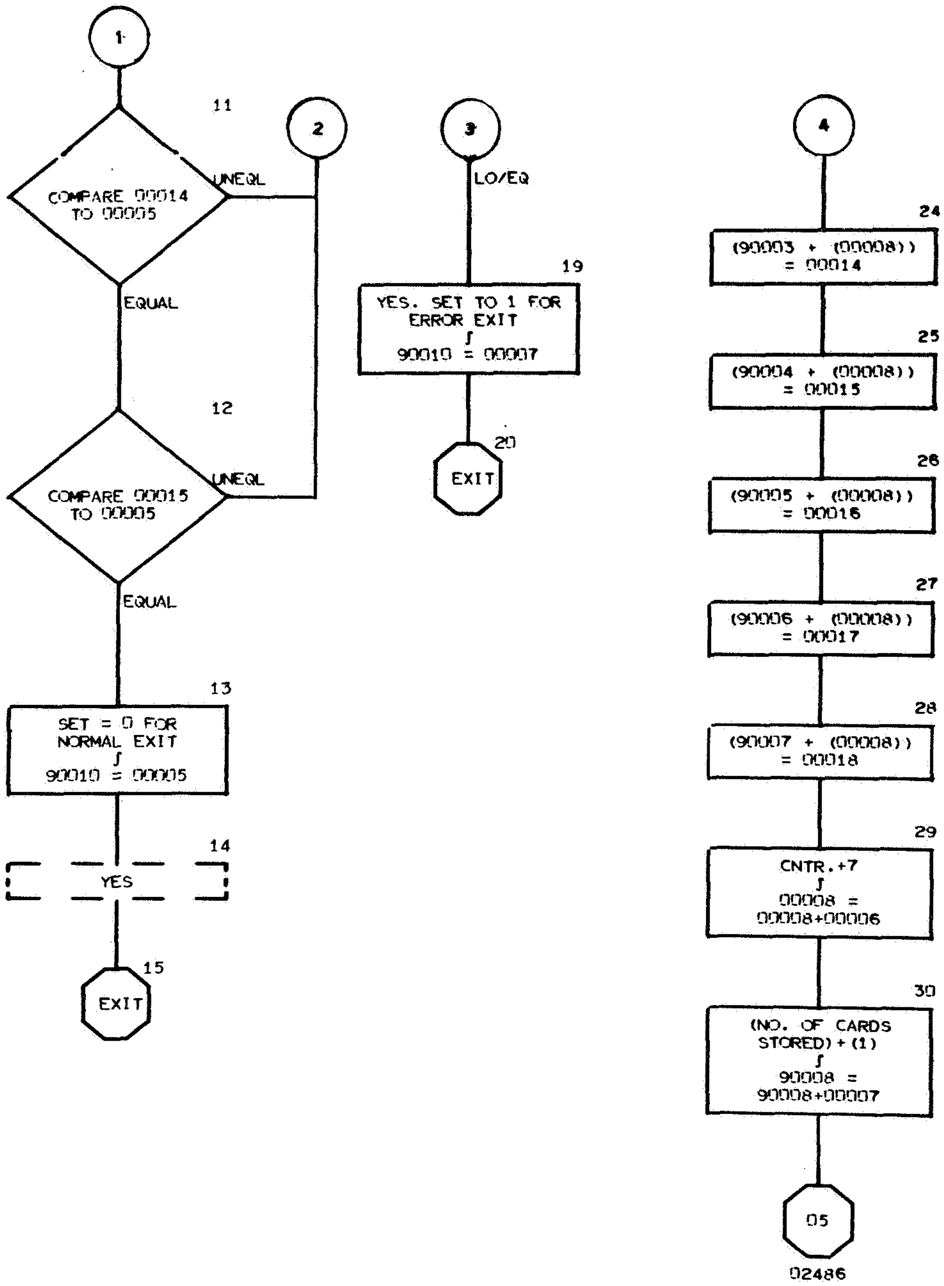
```
Q9009700314
Q9009800315
Q9008602271                    ANGLE REDUCER
Q9061202105                    COSINE
Q9061402101                    SINE
Q9062202196                    SQUARE ROOT
Q0000503842                    2 PI
V90077+10000000+01
V90078+00000000+00
V90079+00000000+00
V90080+00000000+00
V90081+10000000+01
V90082+00000000+00
V90083+00000000+00
V90084+00000000+00
V90085+10000000+01
V90020+00000000+00             G 5 DOT BAR
V90021+00000000+00
V90022+00000000+00
V90023+00000000+00             G 6 DOT BAR
V90024+00000000+00
V90025+00000000+00
V90026+00000000+00             G 7 DOT BAR
V90027+00000000+00
V90028+00000000+00
V00037+10000000+01
V00038+00000000+00
V00049+00000000+00
```

CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES
	K VALUE = 02417	
105.01	02418	10.19*

K VALUE = 02475



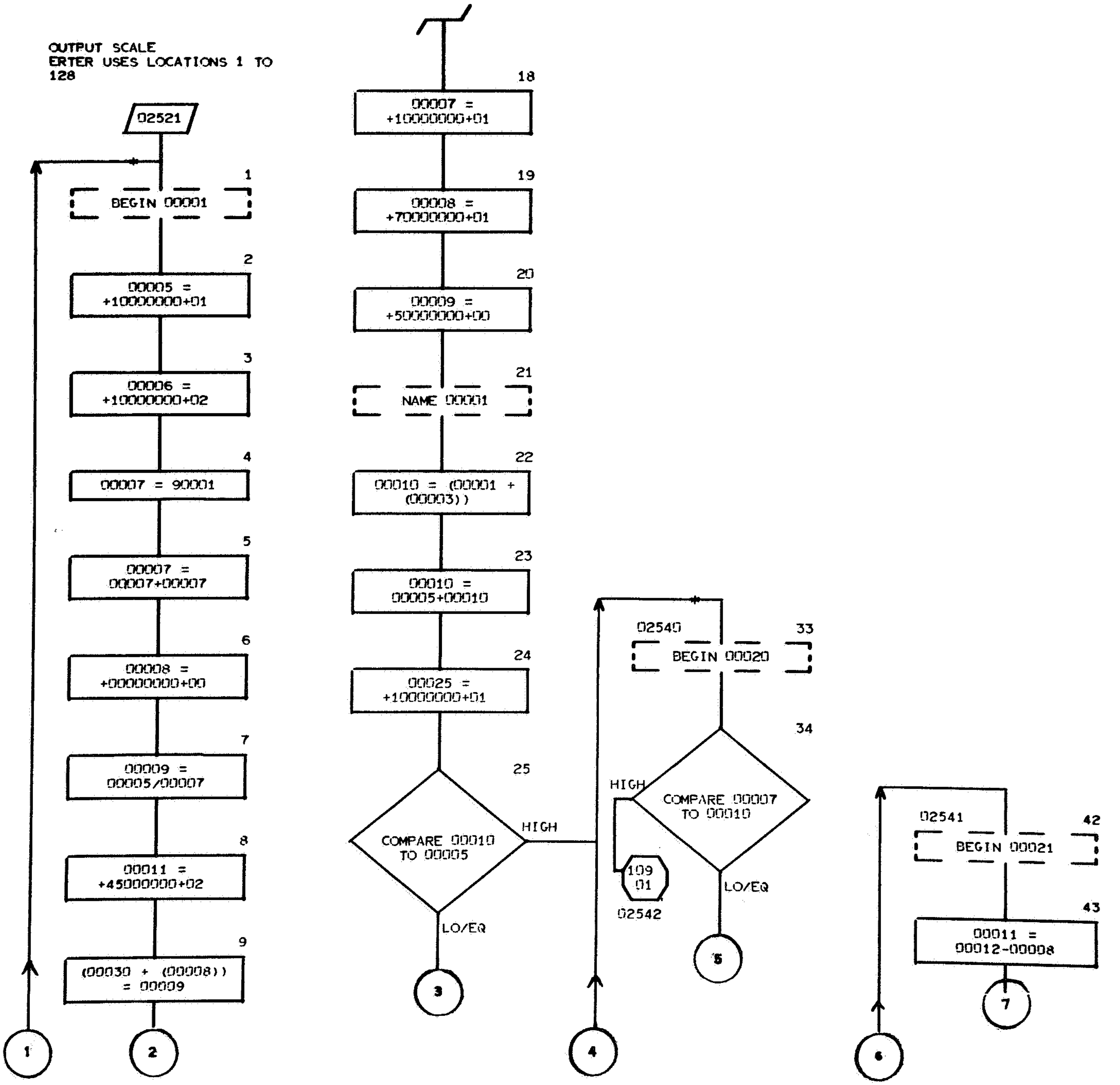

1
11
COMPARE 00014 TO 00005
UNEQL
EQUAL
2
12
COMPARE 00015 TO 00005
UNEQL
EQUAL
13
SET = 0 FOR NORMAL EXIT
90010 = 00005
14
YES
15
EXIT
3
LO/EQ
19
YES. SET TO 1 FOR ERROR EXIT
90010 = 00007
20
EXIT
4
24
(90003 + (00008)) = 00014
25
(90004 + (00008)) = 00015
26
(90005 + (00008)) = 00016
27
(90006 + (00008)) = 00017
28
(90007 + (00008)) = 00018
29
CNTR.+7
00008 = 00008+00006
30
(NO. OF CARDS STORED) + (1)
90008 = 90008+00007
05
02486

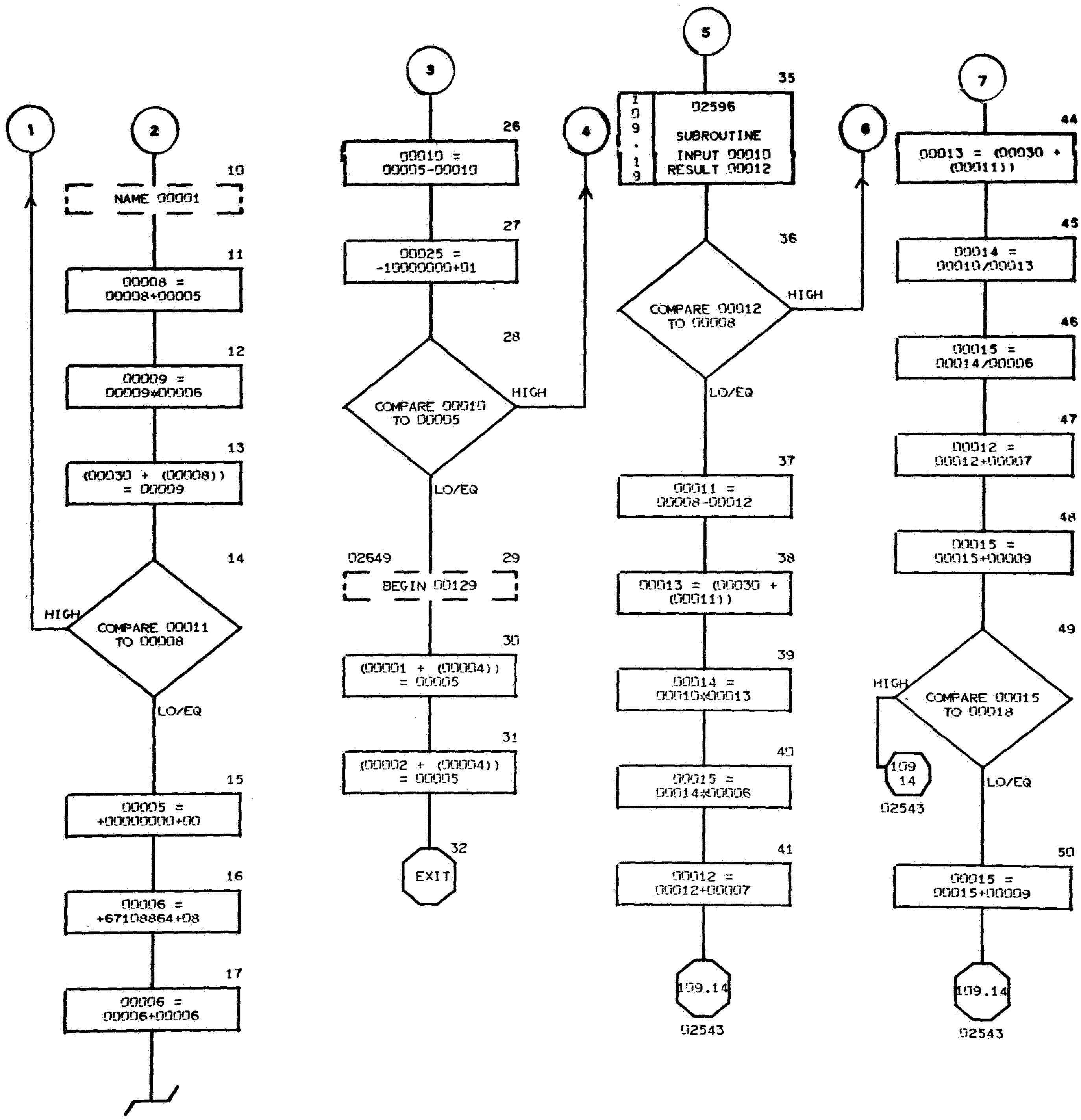
```
        K VALUE = 02475
Q9000103100                1 ST LOC. OF STORAGE FOR CARDS
Q9000203101                2 ND STG. LOC.
Q9000303102                3 RD STG. LOC.
Q9000403103                4 TH STG. LOC.
Q9000503104                5 TH STG. LOC.
Q9000603105                6 TH STG. LOC.
Q9000703106                7 TH STG. LOC.
Q9000800060                NO. OF CARDS STORED
Q9000900495                MAX.NO. OF CARDS ALLOWED
Q9001000191                ERROR EXIT
V00005+00000000+00          (LOADS IN CARDS AND STORES
V00006+70000000+01           CONTENTS IN TABLE.)
V00007+10000000+01
```

CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES			
K VALUE = 02475					
107.01	02476	1.19*			
107.05	02486	107.30			
107.07	02494	107.04			
107.16	02484	107.09	107.10	107.11	107.12
107.21	02495	107.18			

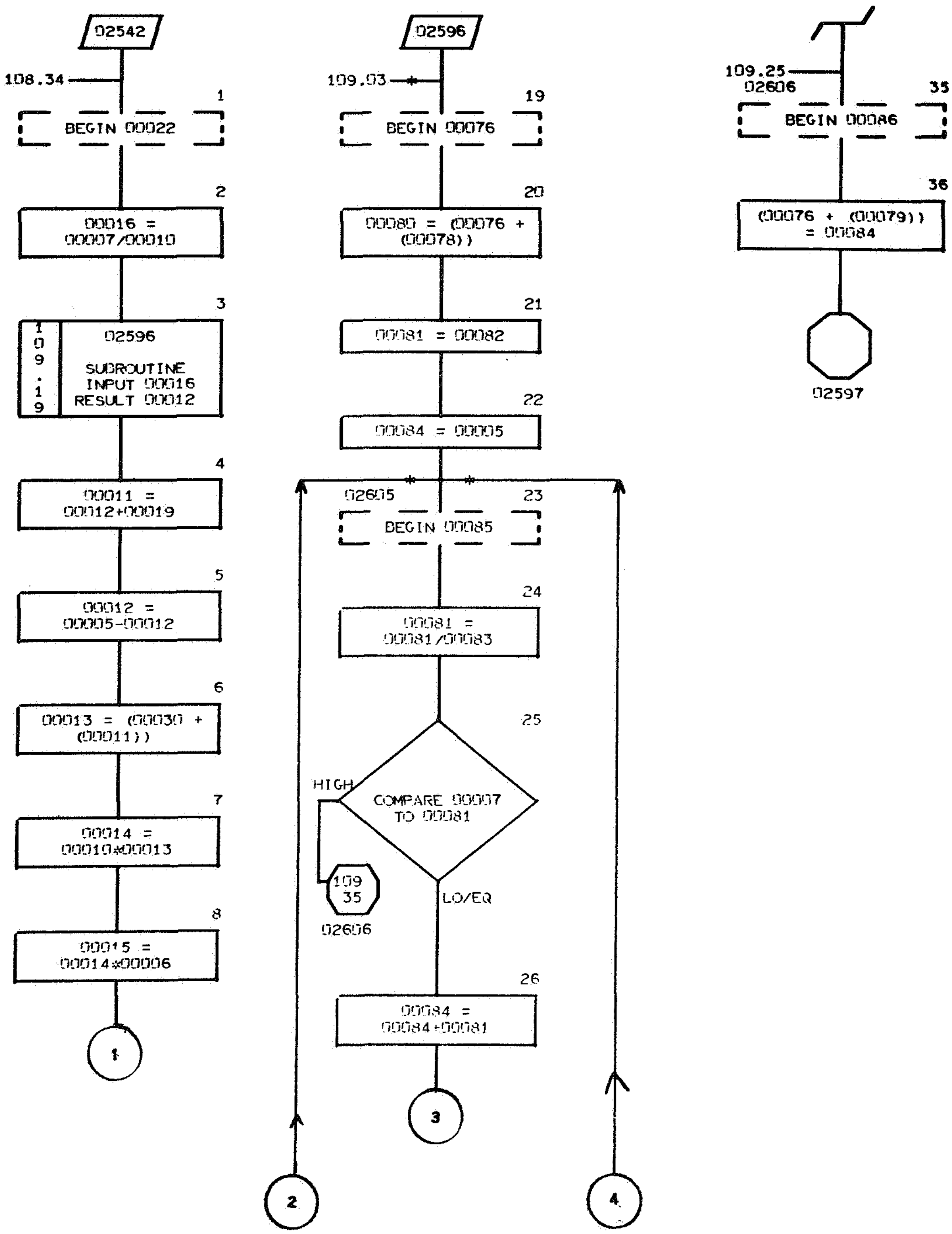
K VALUE = 02520

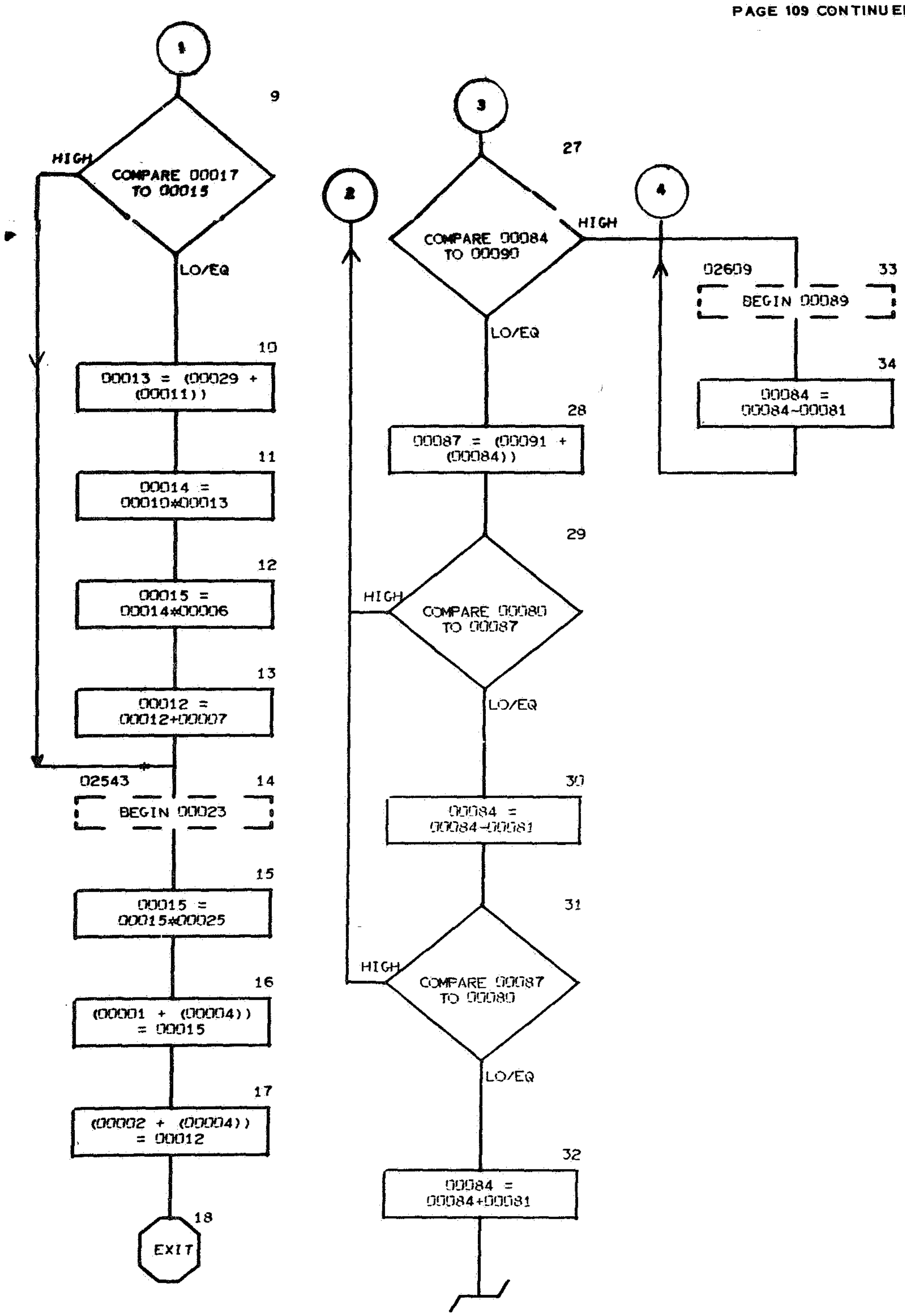




1
2
10
NAME 00001
11
00008 = 00008+00005
12
00009 = 00009*00006
13
(00030 + (00008)) = 00009
14
COMPARE 00011 TO 00008
HIGH
LO/EQ
15
00005 = +00000000+00
16
00006 = +67108864+08
17
00006 = 00006+00006
3
26
00010 = 00005-00010
27
00025 = -10000000+01
28
COMPARE 00010 TO 00005
HIGH
4
LO/EQ
02649
29
BEGIN 00129
30
(00001 + (00004)) = 00005
31
(00002 + (00004)) = 00005
32
EXIT
5
35
109.19
02596
SUBROUTINE
INPUT 00010
RESULT 00012
36
COMPARE 00012 TO 00008
HIGH
6
LO/EQ
37
00011 = 00008-00012
38
00013 = (00030 + (00011))
39
00014 = 00010*00013
40
00015 = 00014*00006
41
00012 = 00012+00007
109.14
02543
7
44
00013 = (00030 + (00011))
45
00014 = 00010/00013
46
00015 = 00014/00006
47
00012 = 00012+00007
48
00015 = 00015+00009
49
COMPARE 00015 TO 00018
HIGH
109 14
02543
LO/EQ
50
00015 = 00015+00009
109.14
02543

K VALUE = 02520




1
9
HIGH
COMPARE 00017 TO 00015
LO/EQ
10
00013 = (00029 + (00011))
11
00014 = 00010*00013
12
00015 = 00014*00006
13
00012 = 00012+00007
02543
14
BEGIN 00023
15
00015 = 00015*00025
16
(00001 + (00004)) = 00015
17
(00002 + (00004)) = 00012
18
EXIT
2
3
27
COMPARE 00084 TO 00090
HIGH
LO/EQ
28
00087 = (00091 + (00084))
29
HIGH
COMPARE 00080 TO 00087
LO/EQ
30
00084 = 00084-00081
31
HIGH
COMPARE 00087 TO 00080
LO/EQ
32
00084 = 00084+00081
4
02609
33
BEGIN 00089
34
00084 = 00084-00081

MISCELLANEOUS STATEMENTS

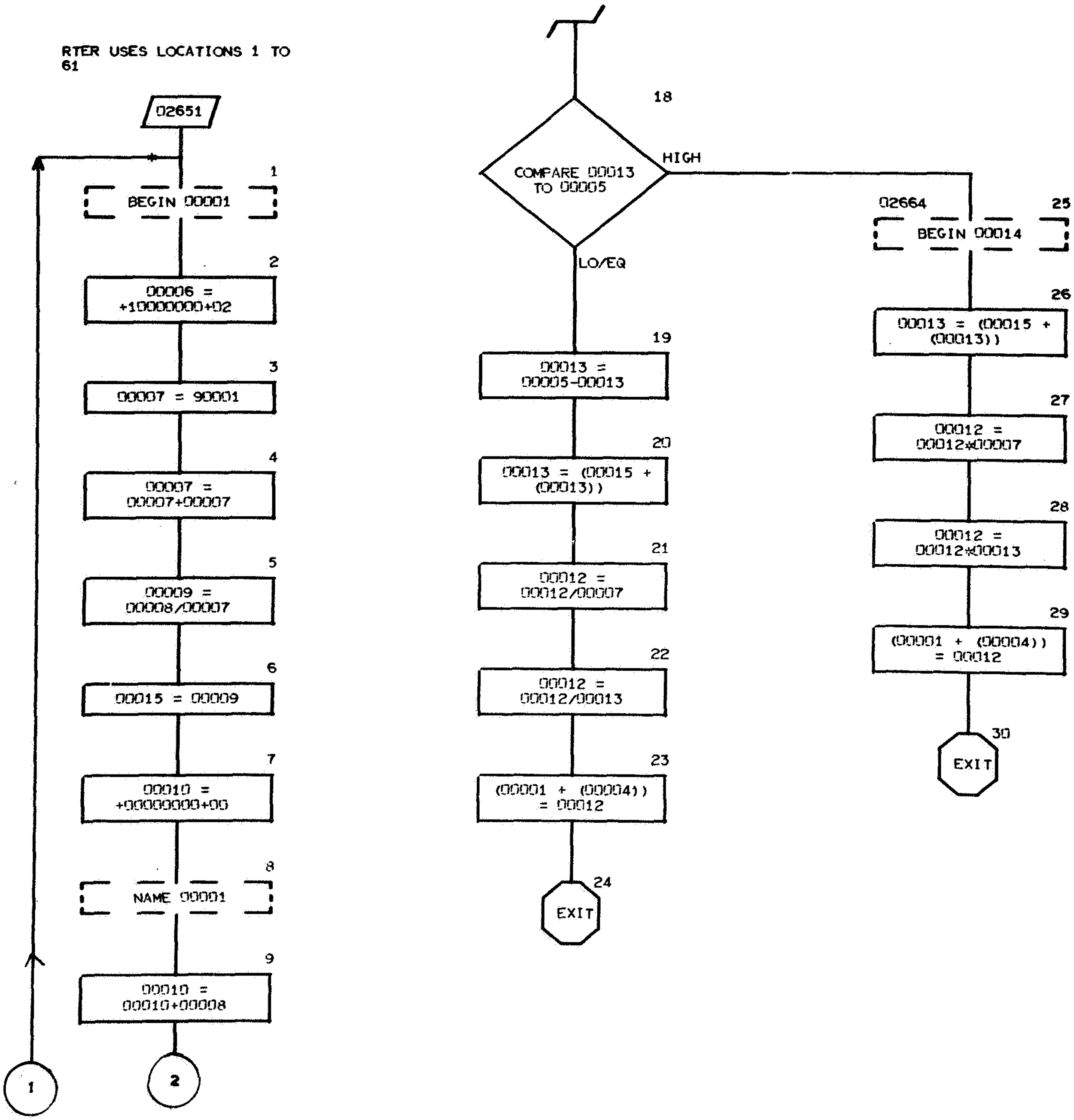
```
V00113+10000000+23
V00114+10000000+24
V00115+10000000+25
V00116+10000000+26
V00117+10000000+27
V00118+10000000+28
V00119+10000000+29
V00120+10000000+30
V00121+10000000+31
V00122+10000000+32
V00123+10000000+33
V00124+10000000+34
V00125+10000000+35
V00126+10000000+36
V00127+10000000+37
V00128+10000000+38
```

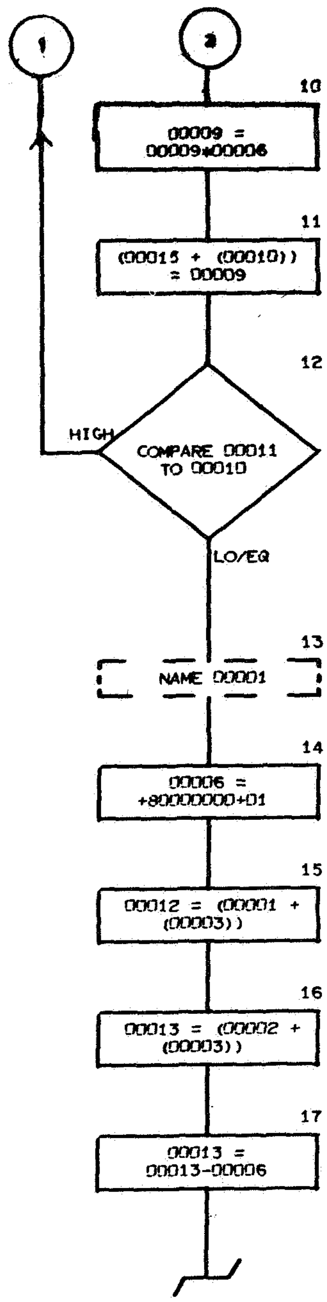
CROSS REFERENCE LISTING

```
PAGE BOX     LABEL          REFERENCES

     K VALUE = 02520

108.01       02521      8.06*   17.22*   17.25*   18.08*   18.16*   18.18*   18.27*
                       18.29*   20.19*   20.22*   20.25*   20.29*  100.28*  108.14
                      137.15*  137.17*  137.19*  137.21*  137.23*  137.25*  138.10*
                      138.12*  138.14*  138.16*  138.18*  138.20*  138.27*  138.29*
                      138.31*  138.33*  138.35*  138.37*  139.08*  139.10*  139.30*
                      139.32*  140.03*  140.05*  140.07*  140.09*  160.08*  160.10*
                      160.12*  160.14*  160.24*  160.26*  160.28*  160.30*
108.29       02649
108.33       02540    108.25   108.28
108.42       02541    108.36
109.01       02542    108.34
109.14       02543    108.41   108.49   108.50   109.09
109.19       02596    108.35*  109.03*
109.23       02605    109.29   109.31   109.34
109.33       02609    109.27
109.35       02606    109.25
```

```
        K VALUE = 02520
Q9000103841                    2**26
V00017+10000000+09
V00018+99999999+07
V00019+80000000+01
V00028+10000000+08
V00082+64000000+02
V00083+20000000+01
V00090+37000000+02
V00091+10000000+01
V00092+10000000+02
V00093+10000000+03
V00094+10000000+04
V00095+10000000+05
V00096+10000000+06
V00097+10000000+07
V00098+10000000+08
V00099+10000000+09
V00100+10000000+10
V00101+10000000+11
V00102+10000000+12
V00103+10000000+13
V00104+10000000+14
V00105+10000000+15
V00106+10000000+16
V00107+10000000+17
V00108+10000000+18
V00109+10000000+19
V00110+10000000+20
V00111+10000000+21
V00112+10000000+22
```

K VALUE = 02650





1
2
10
00009 =
00009*00006
11
(00015 + (00010))
= 00009
12
HIGH
COMPARE 00011
TO 00010
LO/EQ
13
NAME 00001
14
00006 =
+80000000+01
15
00012 = (00001 +
(00003))
16
00013 = (00002 +
(00003))
17
00013 =
00013-00006

CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES						
K VALUE = 02650								
110.01	02651	5.29*	5.30*	5.31*	5.32*	5.33*	110.12	113.13*
		119.07*	119.08*	119.09*	119.11*	119.12*	119.13*	122.07*
		122.09*	122.11*	122.13*	122.15*	122.17*	125.37*	125.39*
		125.41*	125.43*	125.45*	126.02*	141.04*	141.06*	141.08*
		141.10*	141.12*	141.14*	149.33*	149.34*	151.05*	151.07*
		151.09*	151.11*	151.13*	151.15*	151.17*	151.19*	151.21*
110.25	02664	110.18						

K VALUE = 02650

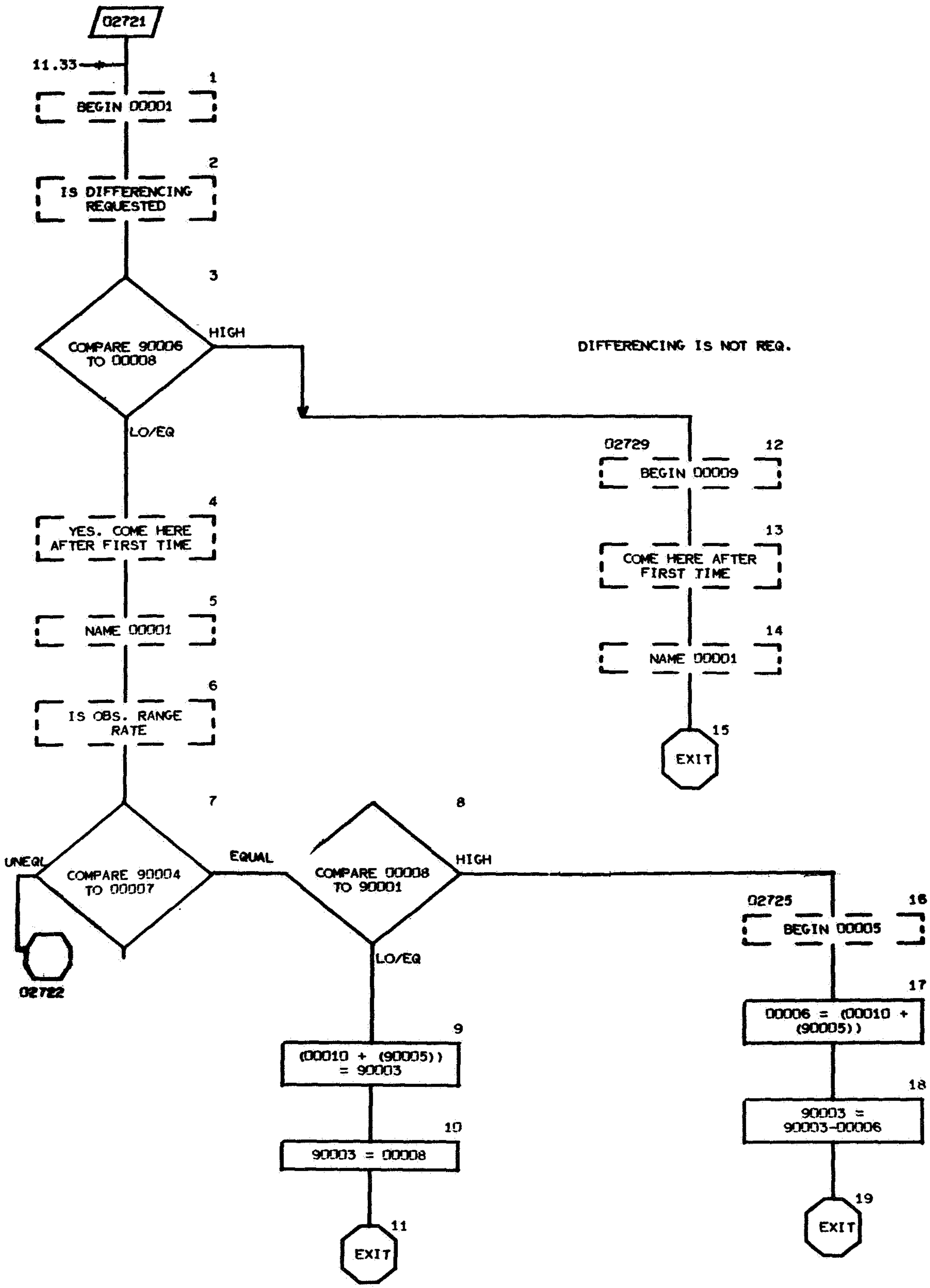
Q9000103841 2**26

V00005+00000000+00

V00008+10000000+01

V00011+46000000+02

RANGE RATE FUNCTION



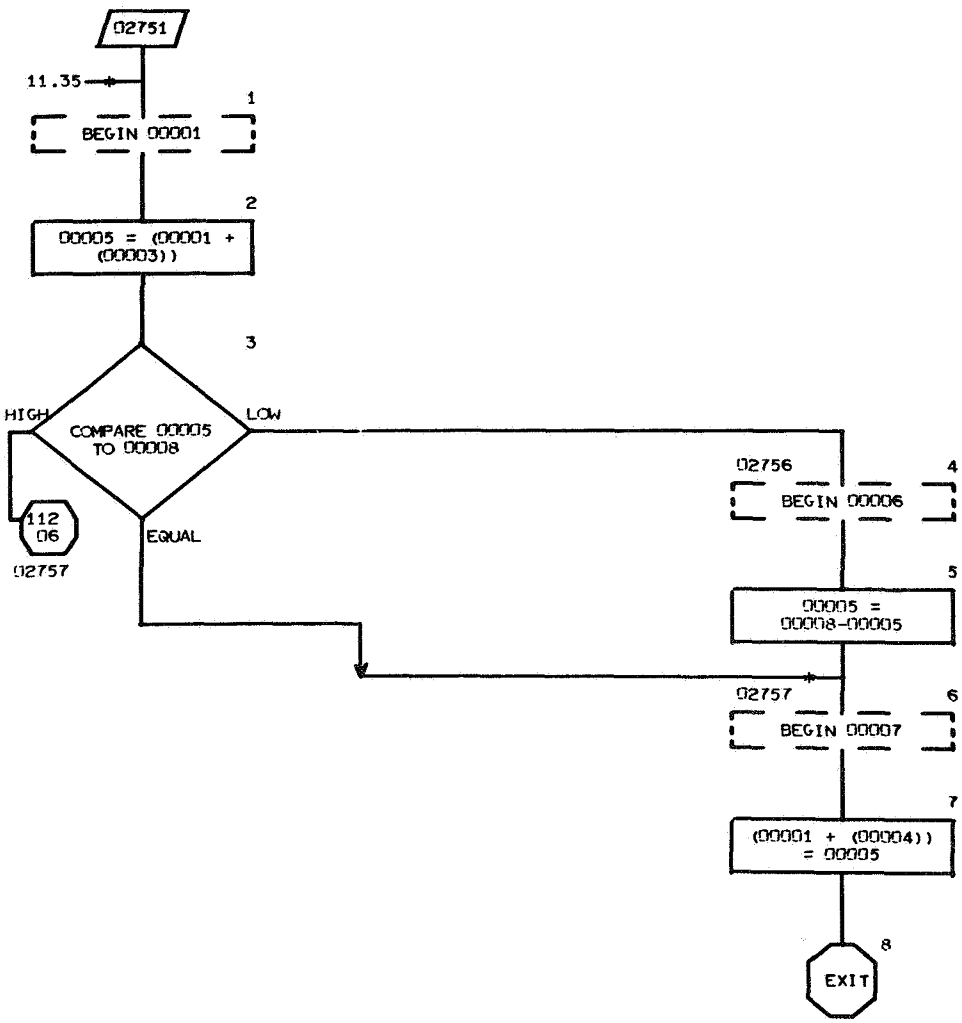
```
        K VALUE = 02720
Q9000100246
Q9000200258
Q9000300392
Q9000400253
Q9000500069
Q9000602098                  DIFF. IND. (DIFF. IF IND.=0)
V00007+90000000+01
V00008+00000000+00
```

CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES	
K VALUE = 02720			
111.01	02721	11.33*	13.11*
111.12	02729	111.03	
111.16	02725	111.08	

K VALUE = 02750

ABSOLUTE VALUE FUNCTION



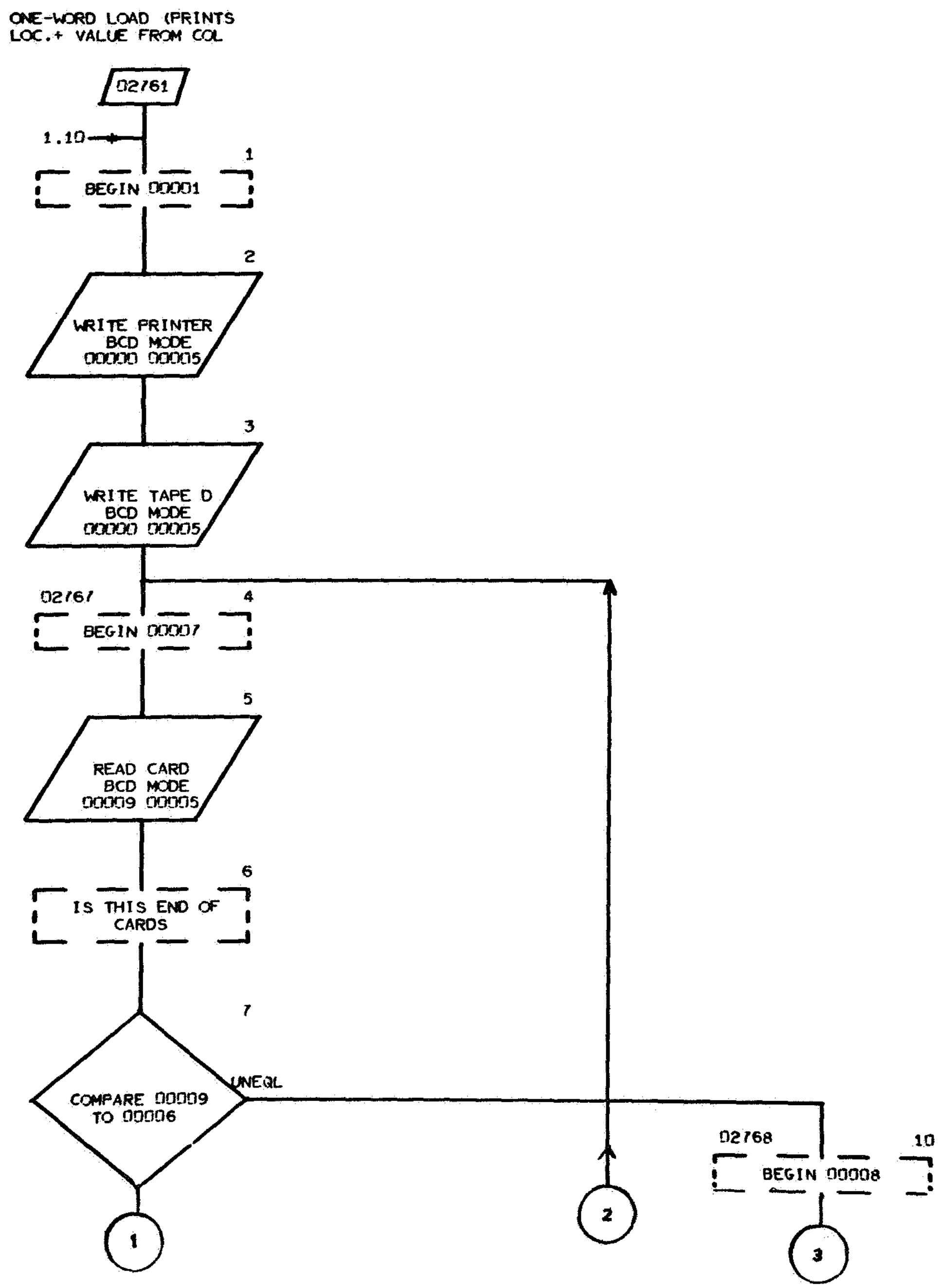
K VALUE = 02750

V00008+00000000+00

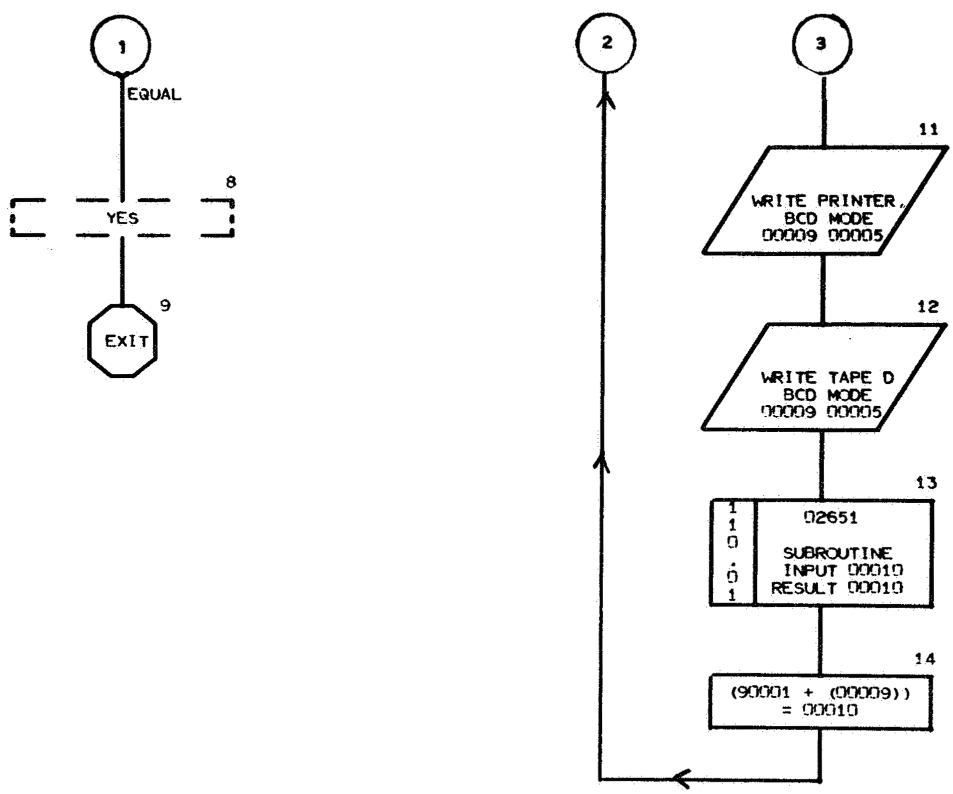
CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES						
k VALUE = 02750								
112.01	02751	11.35*	34.03*	42.20*	42.35*	43.09*	43.24*	43.39*
		44.09*	44.24*	44.39*	45.09*	45.24*	45.39*	46.09*
		46.24*	46.39*	47.09*	47.24*	47.39*	48.09*	48.24*
		48.39*	49.09*	49.26*	49.43*	50.09*	50.26*	50.43*
		51.09*	51.26*	51.43*	52.09*	52.26*	52.43*	53.09*
		53.26*	53.43*	54.09*	54.26*	54.43*	55.09*	55.26*
		102.28*	102.30*	120.51*	121.01*	158.13*	158.15*	179.13*
		179.22*	183.14*					
112.04	02756	112.03						
112.06	02757	112.03	112.03					

K VALUE = 02760



PAGE 113 CONTINUED



CROSS-REFERENCE LISTING

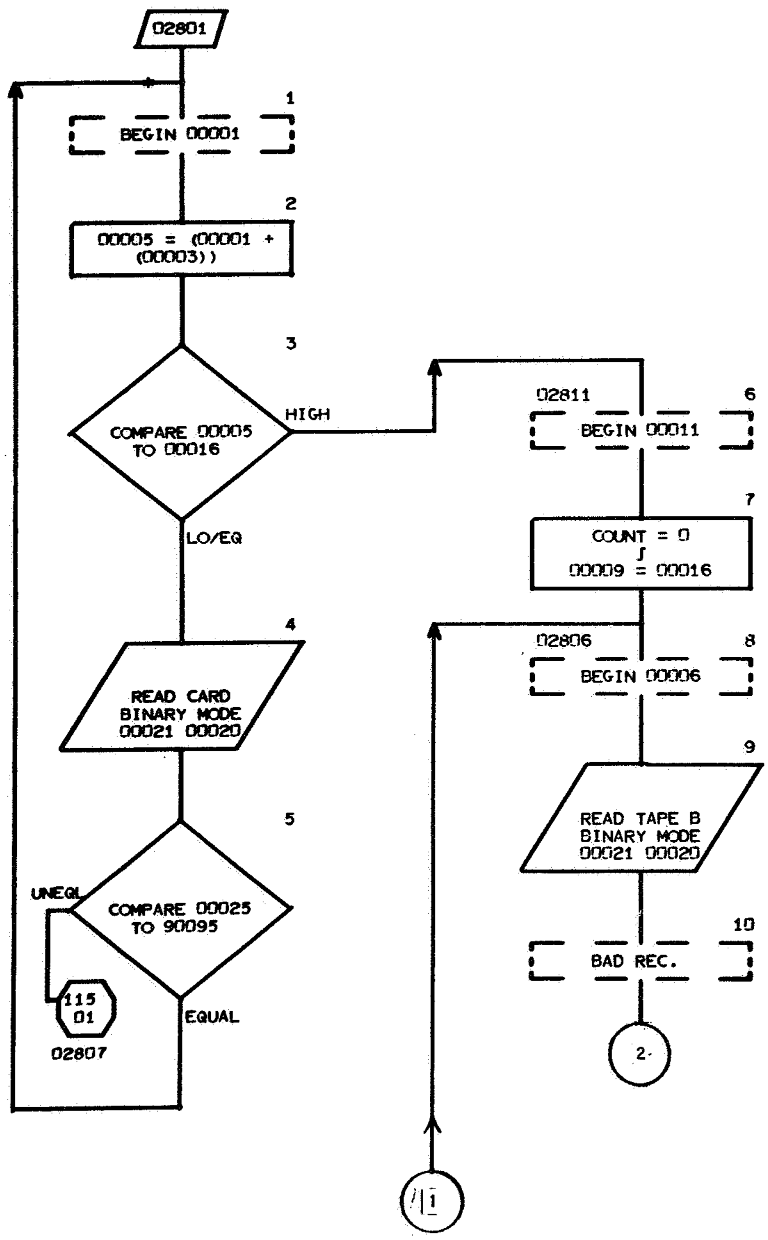
PAGE BOX	LABEL	REFERENCES		
113.01	02761	1.10*	2.23*	3.03*
113.04	02767	113.14		
113.10	02768	113.07		

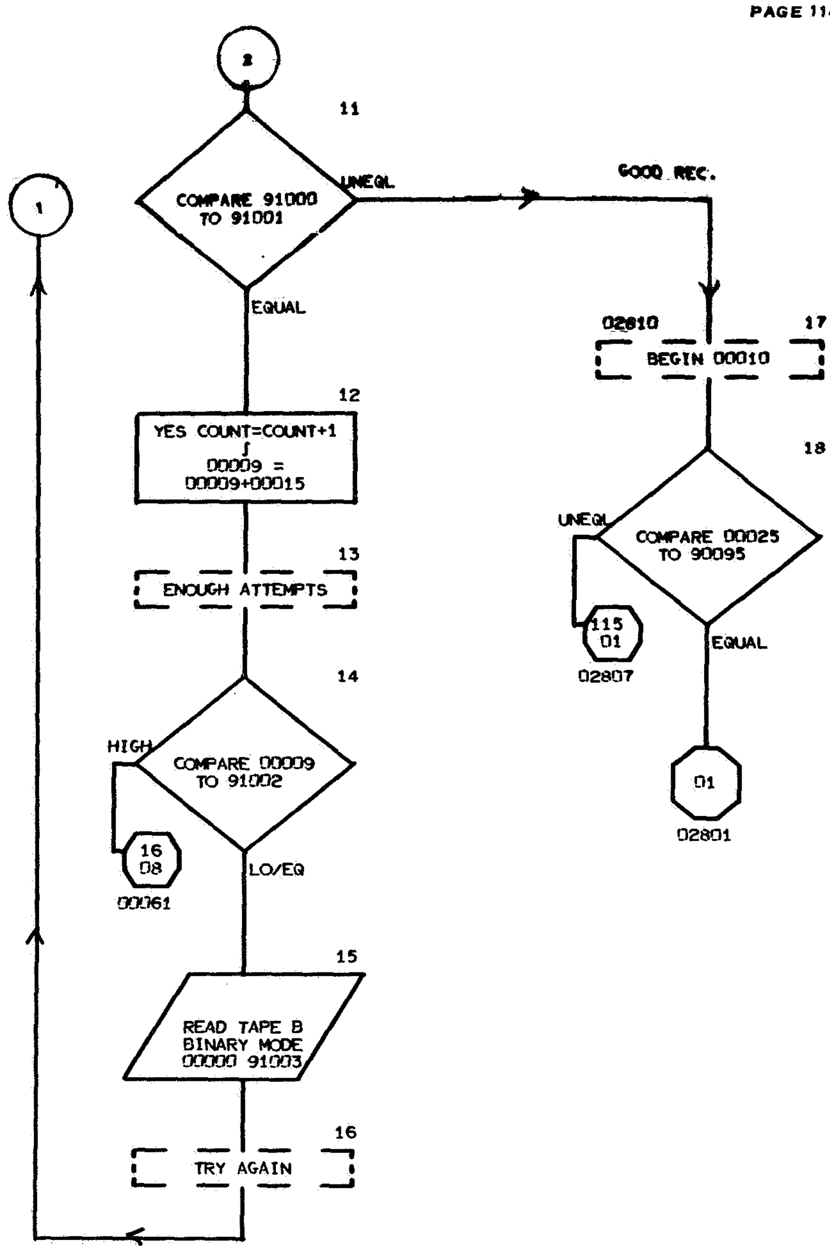
K VALUE = 02760

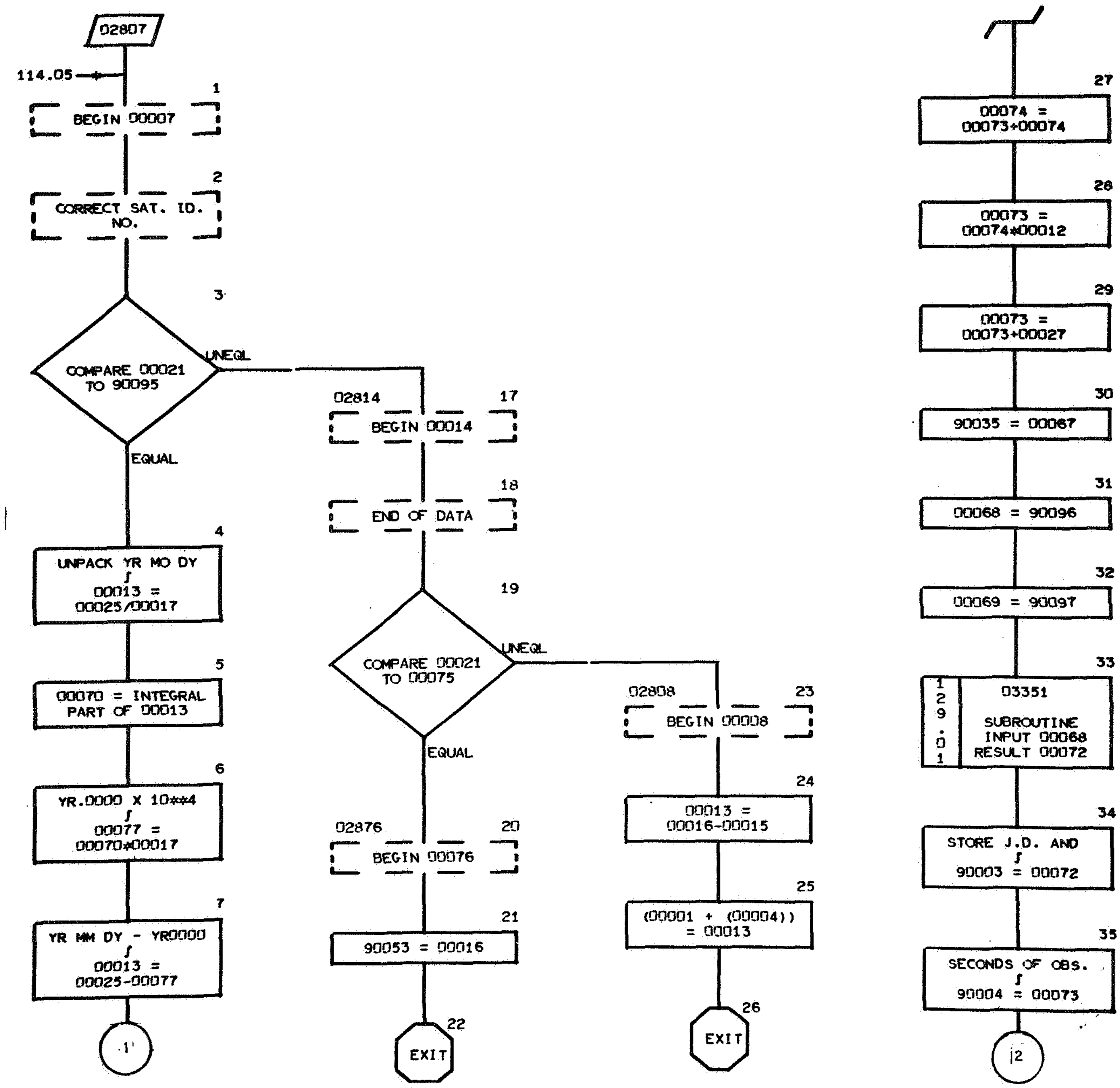
```
Q9000100000
Q9000202651                  INPUT CONVERTER
V00005+10000000+01           1-17 + ALPHABETIC IDENT.FROM COLS.3
V00006+00000000+00           OF EACH CARD LOADED. USES 19 LOCS.)
```

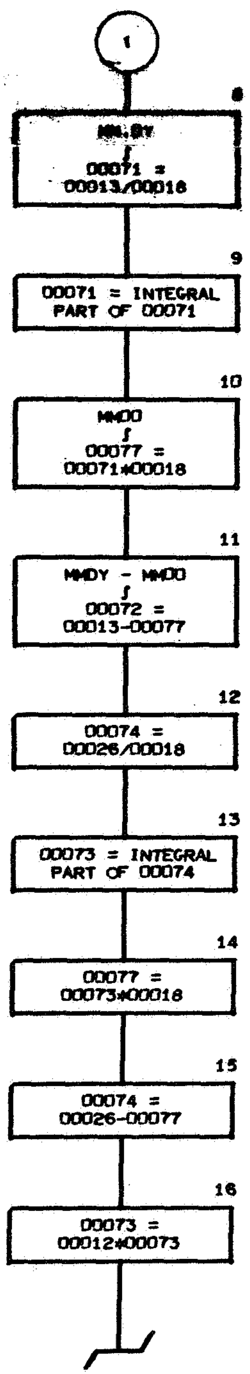
K VALUE = 02800

OBSERVATION LOAD FUNCTION




2
1
11
COMPARE 91000
TO 91001
UNEQL
GOOD REC.
EQUAL
02810
17
BEGIN 00010
12
YES COUNT=COUNT+1
00009 =
00009+00015
18
UNEQL
COMPARE 00025
TO 90095
13
ENOUGH ATTEMPTS
115
01
02807
EQUAL
14
HIGH
COMPARE 00009
TO 91002
01
02801
16
08
00061
LO/EQ
15
READ TAPE B
BINARY MODE
00000 91003
16
TRY AGAIN


02807
114.05
1
BEGIN 00007
2
CORRECT SAT. ID. NO.
3
COMPARE 00021 TO 90095
UNEQL
EQUAL
4
UNPACK YR MO DY
00013 = 00025/00017
5
00070 = INTEGRAL PART OF 00013
6
YR.0000 X 10**4
00077 = 00070*00017
7
YR MM DY - YR0000
00013 = 00025-00077
1
02814
17
BEGIN 00014
18
END OF DATA
19
COMPARE 00021 TO 00075
UNEQL
EQUAL
02876
20
BEGIN 00076
21
90053 = 00016
22
EXIT
02808
23
BEGIN 00008
24
00013 = 00016-00015
25
(00001 + (00004)) = 00013
26
EXIT
27
00074 = 00073+00074
28
00073 = 00074*00012
29
00073 = 00073+00027
30
90035 = 00067
31
00068 = 90096
32
00069 = 90097
33
129.01
03351
SUBROUTINE INPUT 00068 RESULT 00072
34
STORE J.D. AND
90003 = 00072
35
SECONDS OF OBS.
90004 = 00073
2



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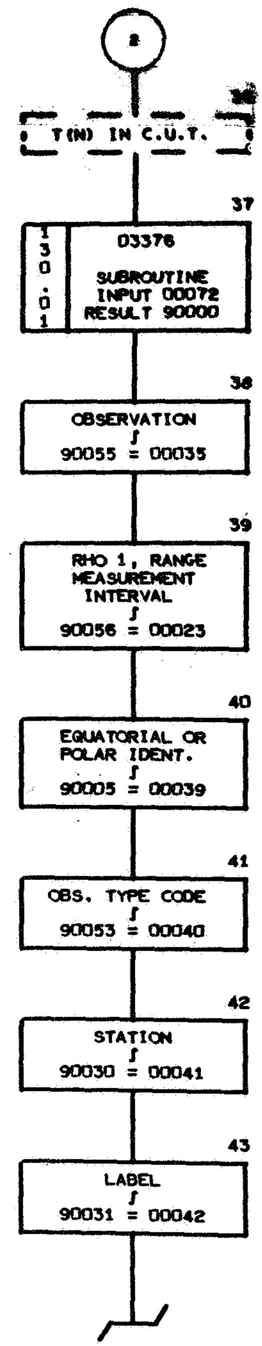
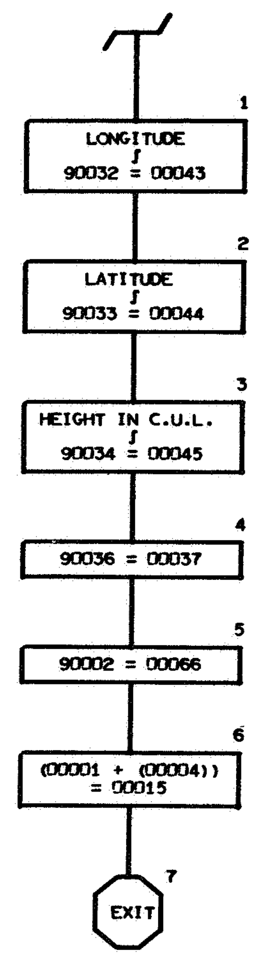


K VALUE = 02800



CROSS REFERENCE LISTING

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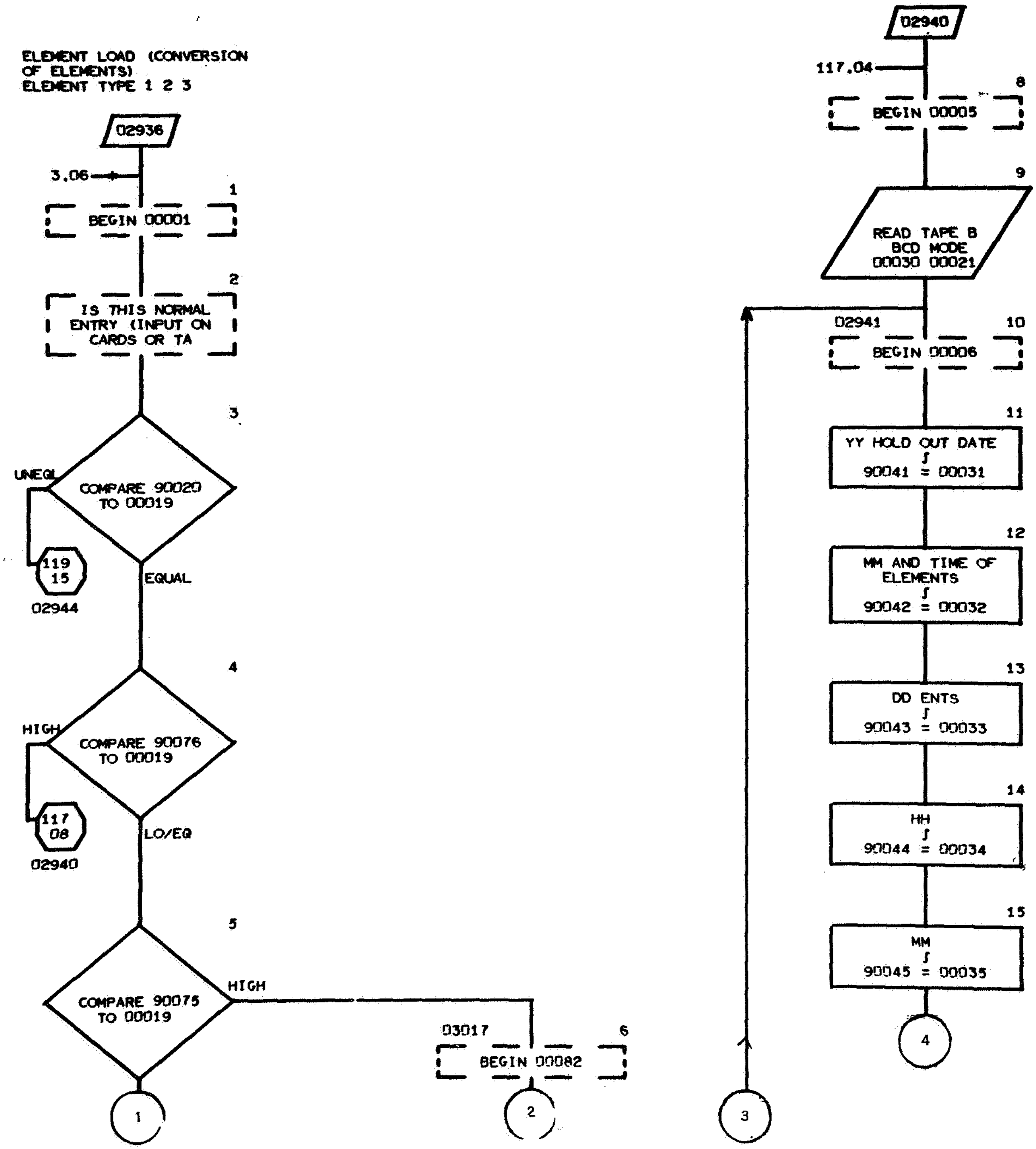
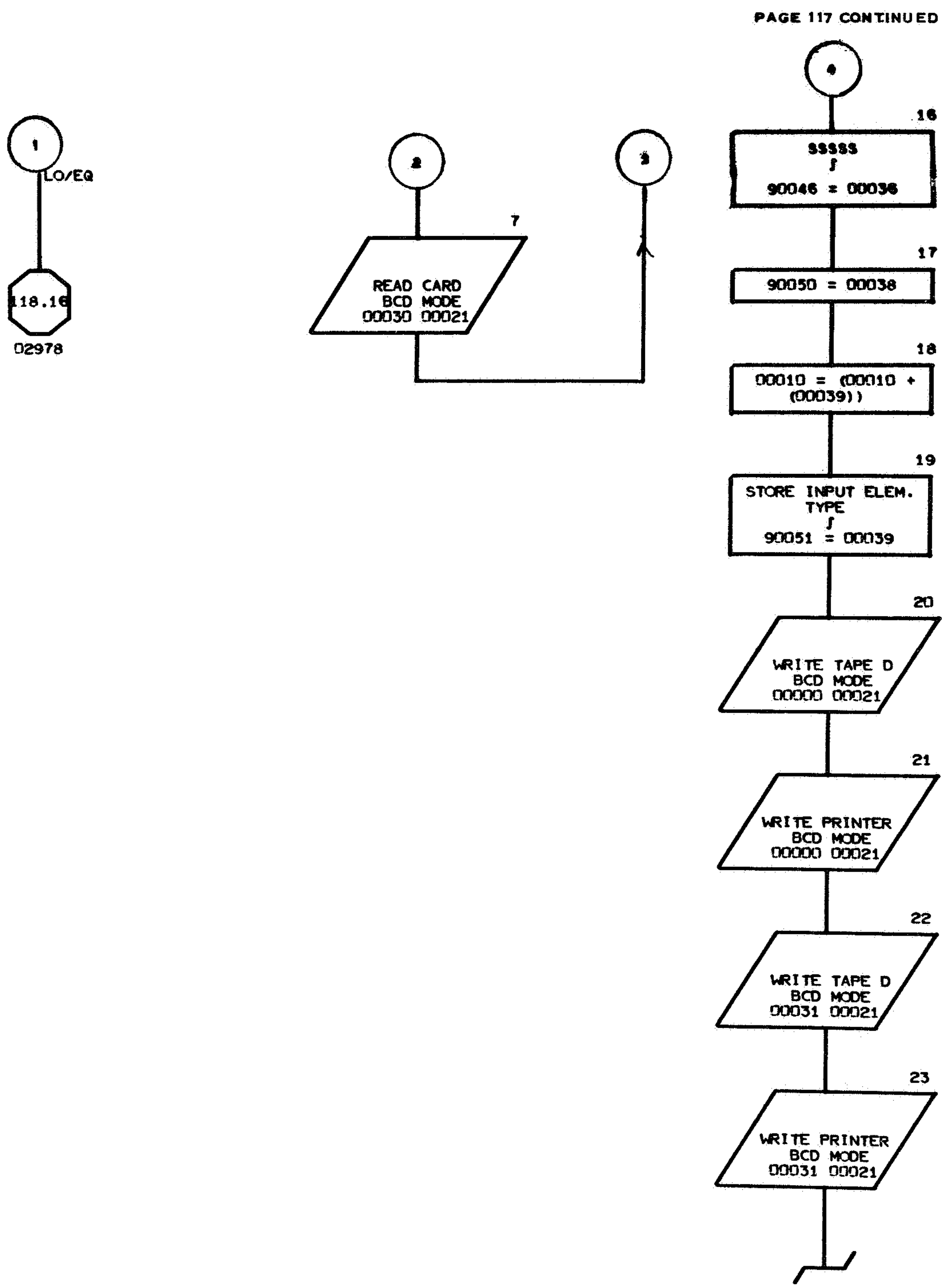
114.06	02811	114.03		
114.08	02806	114.16		
114.17	02810	114.11		
115.01	02807	114.05	114.18	
115.17	02814	115.03		
115.20	02876			
115.23	02808	115.19		

K VALUE = 02800

Q9000000200	T(N)
Q9000200245	OBSERVATION COUNTER
Q9000300378	J.D. TIME OF
Q9000400379	SECONDS OBS.
Q9000700007	
Q9003000300	STATION LABEL
Q9003100301	
Q9003200302	LONGITUDE
Q9003300303	LATITUDE
Q9003400304	HEIGHT
Q9003500246	RANGE RATE CODE
Q9003600258	
Q9000500497	EQUATORIAL OR POLAR IDENT.
Q9005300253	OBS. TYPE CODE
Q9005500255	OBSERVATION
Q9005600396	RHO 1,RANGE MEASUREMENT INTERVAL IN
Q9009500295	SAT. ID.
Q9009600296	YREF
Q9009700297	DREF
Q9009803351	OBS. DATE TO DAY COUNT
Q9009903376	JULIAN DAYS-SECONDS TO C.U.T.
Q9100000000	LOC. ZERO
Q9100100459	BAD RECORD IND.
Q9100200460	NO.OF READ ATTEMPTS
Q9100303812	MINUS ONE (TO BACKSPACE ONE RECORD)
Q9001000061	TRANSFER POINT FOR BAD TAPE ON TB
V00012+60000000+02	
V00015+10000000+01	ONE
V00016+00000000+00	ZERO
V00017+10000000+05	10**04
V00018+10000000+03	10**02
V00020+48000000+02	NO. OF INPUT WORDS
V00075+99999999+08	END SENTINEL

K VALUE = 02935




PAGE 117 CONTINUED
1
LO/EQ
118.16
02978
2
7
READ CARD
BCD MODE
00030 00021
3
4
16
SSSSS
90046 = 00036
17
90050 = 00038
18
00010 = (00010 +
(00039))
19
STORE INPUT ELEM.
TYPE
90051 = 00039
20
WRITE TAPE D
BCD MODE
00000 00021
21
WRITE PRINTER
BCD MODE
00000 00021
22
WRITE TAPE D
BCD MODE
00031 00021
23
WRITE PRINTER
BCD MODE
00031 00021

K VALUE = 02935

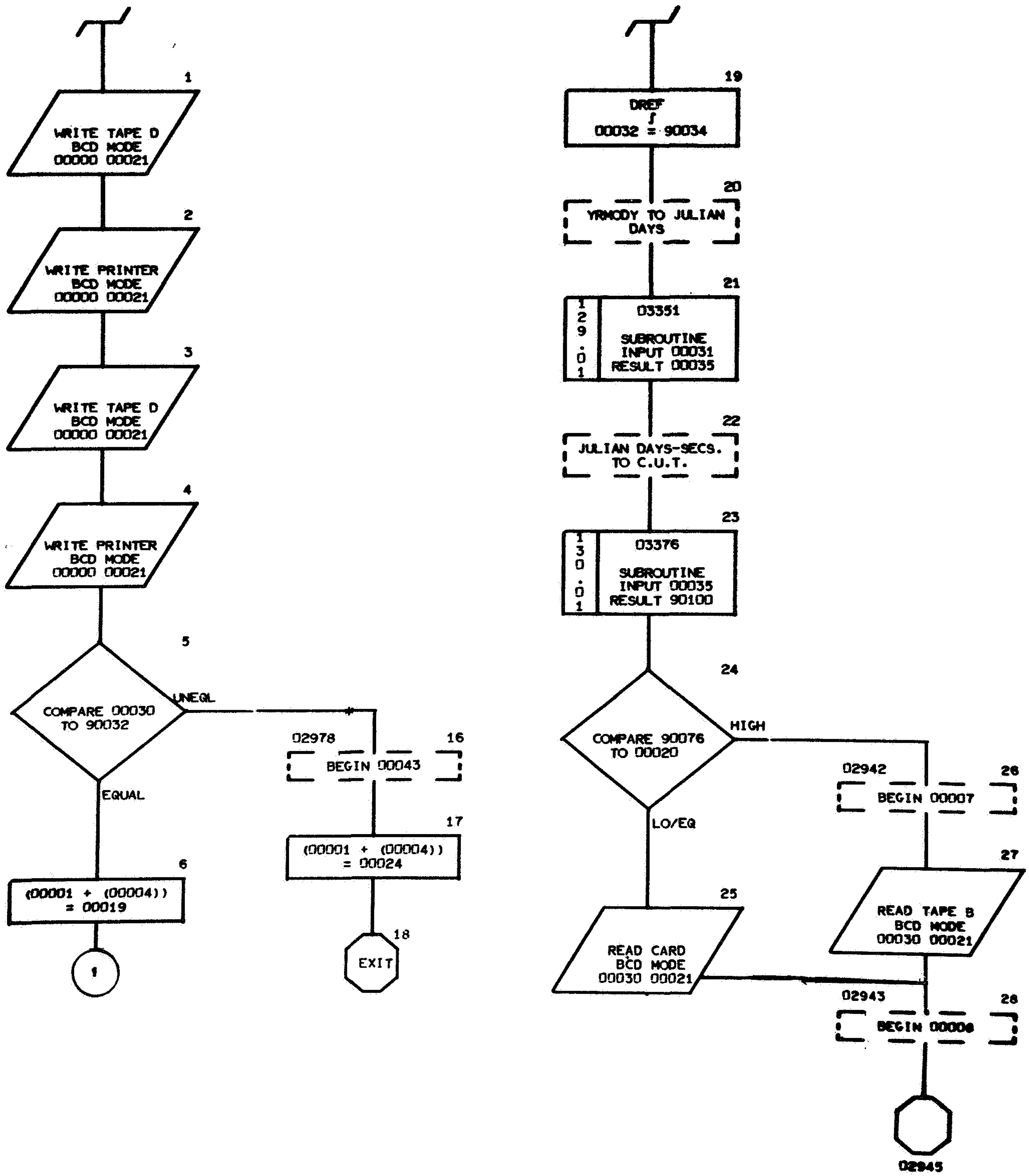
117.01	02936	3.06*	30.33*	
117.06	03017	117.05		
117.08	02940	117.04		
117.10	02941	117.07		
118.16	02978	117.05	118.05	
118.26	02942	118.24		
118.28	02943	118.25		
119.01	02946			
119.15	02944	117.03		
120.32	03020	120.25		
121.04	03016	121.02		
121.06	02964	120.42		
121.09	02949	120.42	121.03	121.05
122.01	02947			
122.41	02952	126.03		
123.28	02953	123.27		
123.40	02979	123.27		
125.02	03005	120.40	121.30	
125.30	02948			
125.35	03026			

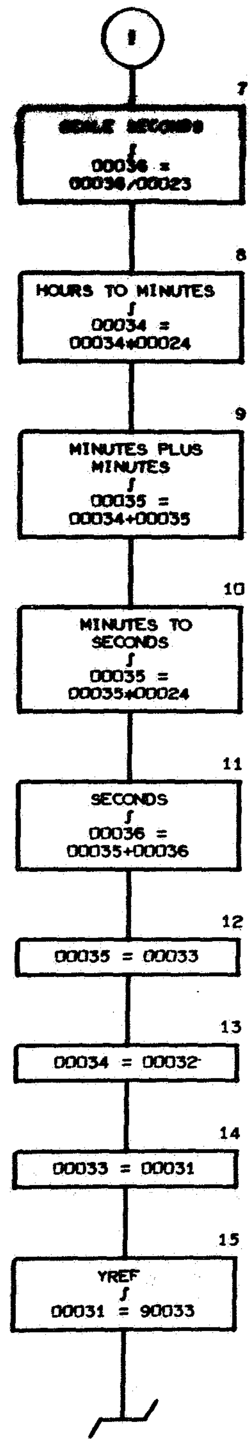
K VALUE = 02935

Q9000101101	A, SEMI-MAJOR AXIS IN C.U.L.	O
Q9000201102	E, ECCENTRICITY	O
Q9000301103	NU, TRUE ANOMALY IN RADIANS	O
Q9000401104	R SUB I SATELLITE POSITION	I
Q9000501105	R SUB J VECTOR IN C.U.L.	I
Q9000601106	R SUB K	I
Q9000701107	V SUB I SATELLITE VELOCITY	I
Q9000801108	V SUB J VECTOR IN CUL/CUT	I
Q9000901109	V SUB K	I
Q9001001110	R 0, MAG. OF R BAR	O
Q9001101111	V 0, MAG. OF V BAR	O
Q9001201112	ANGLE DELTA IN RADIANS	O
Q9001301113	M, MEAN ANOMALY IN RADIANS	O
Q9001401114	PHI, ORBITAL AZIMUTH IN RADIANS	O
Q9001501115	SMALL OMEGA,ARG.OF PERIGEE IN RAD	O
Q9001601116	I, INCLINATION IN RADIANS	O
Q9001701117	CAP OMEGA,LONG.OF ASC.NODE IN RAD	O
Q9001801118	THETA (ELEVATION V) IN RADIANS	O
Q9001901119	N, MEAN MOTION IN RAD/C.U.T.	O
Q9002000090	NORMAL OR SPECIAL ENTRY IND.	I
Q9002203852	MU	I
Q9002702651	INPUT CONVERTER	F
Q9002903864	J	I
Q9003003351	OBSERVED DATE TO J.D.	F
Q9003103376	JULIAN DAYS, SECONDS TO C.U.T.	F
Q9003200295	SATELLITE ID. NO.	I
Q9003300296	YEAR OF REFERENCE (LAST 2 DIGITS)	I
Q9003400297	DAYS JAN.1 - DAY OF REFERENCE	I
Q9003501123	PERIOD IN C.U.T.	O
Q9003601125	HEIGHT OF APOGEE IN C.U.L.	O
Q9003701122	CAP OMEGA DOT IN RADIANS / CUT	O
Q9003801121	SMALL OMEGA DOT IN RADIANS/CUT	O
Q9003901124	HEIGHT OF PERIGEE IN C.U.L.	O
Q9004001120	CAP E, ECCENTRIC ANOMALY IN RAD	O
Q9004101190	YEAR DATE AND TIME	O
Q9004201191	MONTH OF ELEMENTS	O
Q9004301192	DAY	O
Q9004401193	HOUR	O
Q9004501194	MINUTE	O

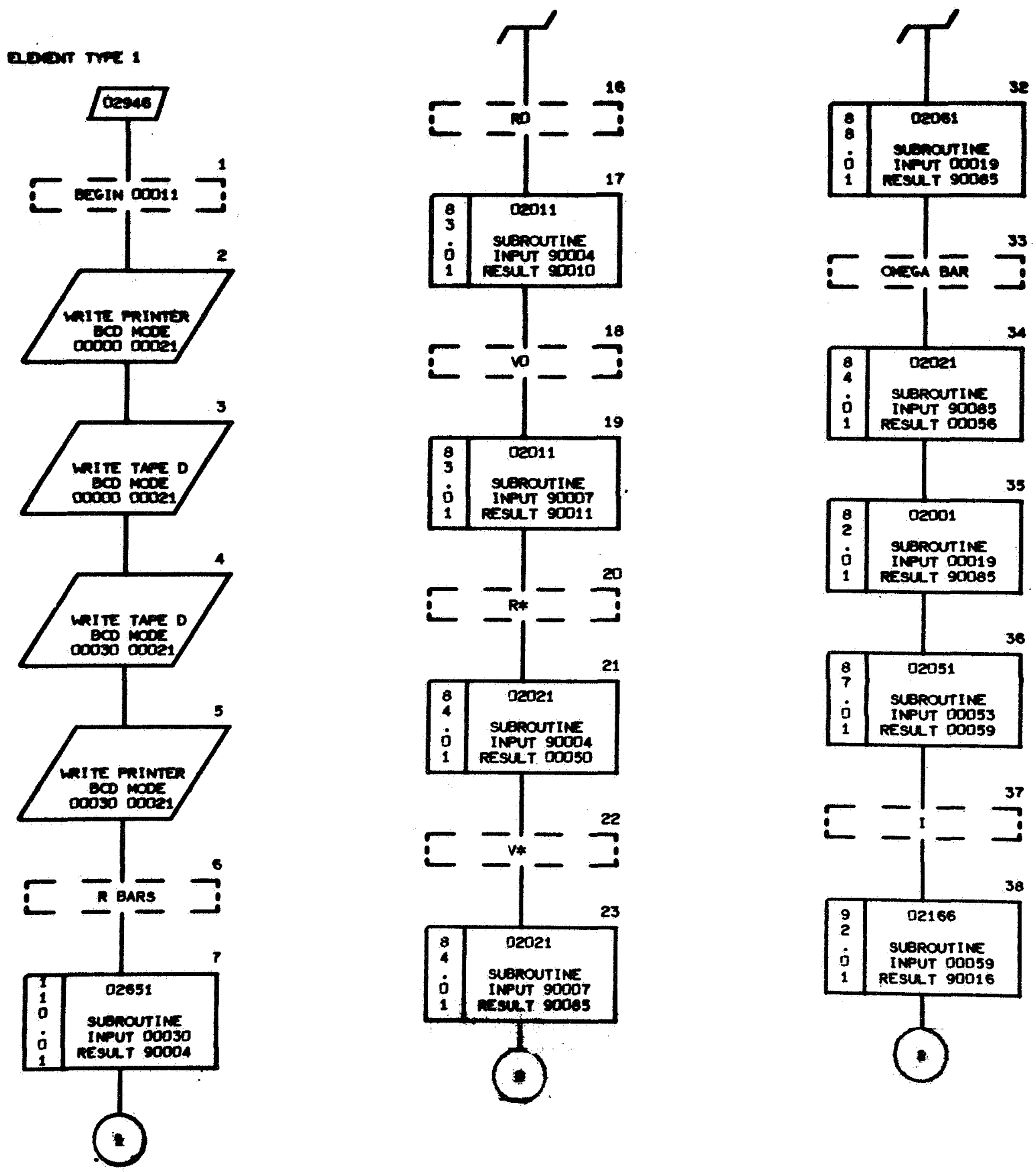
Q9004601195	(SECONDS) (1000)	O
Q9005000085	COL.69 OF TIME CARD (PERT.OPTION)	O
Q9005100096	TYPE OF INPUT ELEMENTS	O
Q9007500044	CARD INPUT OPTION IND.	I
Q9007600040	TAPE INPUT OPTION IND.	I
Q9007800042	ON-LINE PRINTOUT OPTION IND.	I
Q9007902731	ABSOLUTE VALUE	F
Q9008002271	ANGLE REDUCER (0 TO 2 PI)	F
Q9008102011	VECTOR MAGNITUDE	F
Q9008202021	VECTOR DIRECTION	F
Q9008302051	DOT PRODUCT	F
Q9008402087	VQ + 2	O
Q9008502085	VQ	O
Q9008602001	VECTOR MOVE	F
Q9008702076	SCALAR-VECTOR MULTIPLY	F
Q9008802061	CROSS PRODUCT	F
Q9008902031	VECTOR ADD	F
Q9009002041	VECTOR SUBTRACT	F
Q9009102101	SIN	F
Q9009202105	COS	F
Q9009302196	SQUARE ROOT	F
Q9009402216	KEPLER	F
Q9009502246	ARC TAN (Y/X)	F
Q9009602166	ARC COS	F
Q9009702156	ARC SIN	F
Q9010001100	T (0), TIME OF ELEMENTS IN CUT	O
Q0002203842	2 PI	I
Q0007303839	PI	I
V00019+00000000+00		
V00020+00000000+00		
V00021+10000000+01		
V00023+10000000+04		
V00024+60000000+02		
V00026+10000000+01		
V00027+00000000+00		
V00028+00000000+00		
V00083+50000000-08	S. P. TOLERANCE FOR ZERO E	
V00071+40000000+01		
V00072+50000000+01		

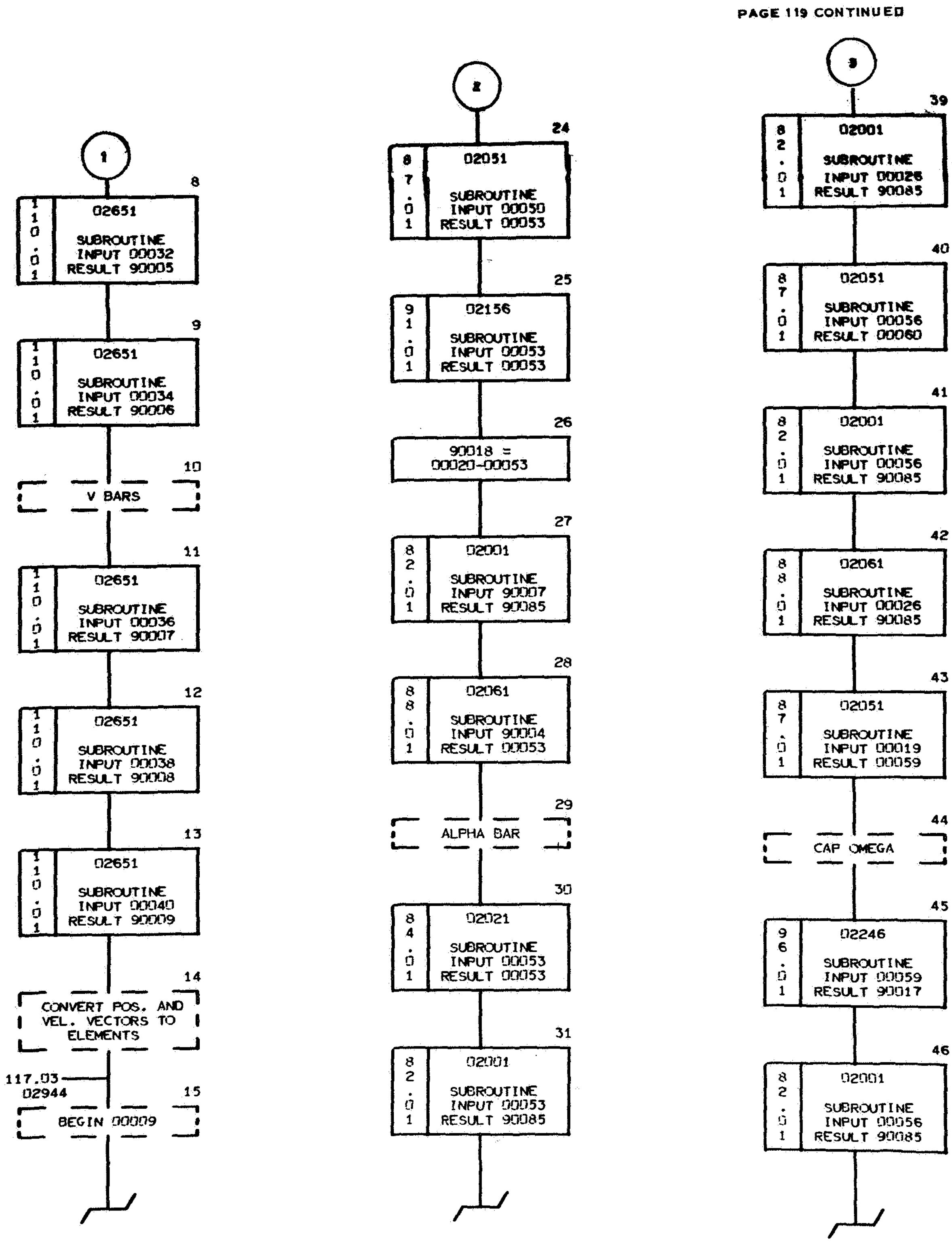
K VALUE = 02935




7
8
HOURS TO MINUTES
00034 =
00034*00024
9
MINUTES PLUS MINUTES
00035 =
00034+00035
10
MINUTES TO SECONDS
00035 =
00035*00024
11
SECONDS
00036 =
00035+00036
12
00035 = 00033
13
00034 = 00032
14
00033 = 00031
15
YREF
00031 = 90033

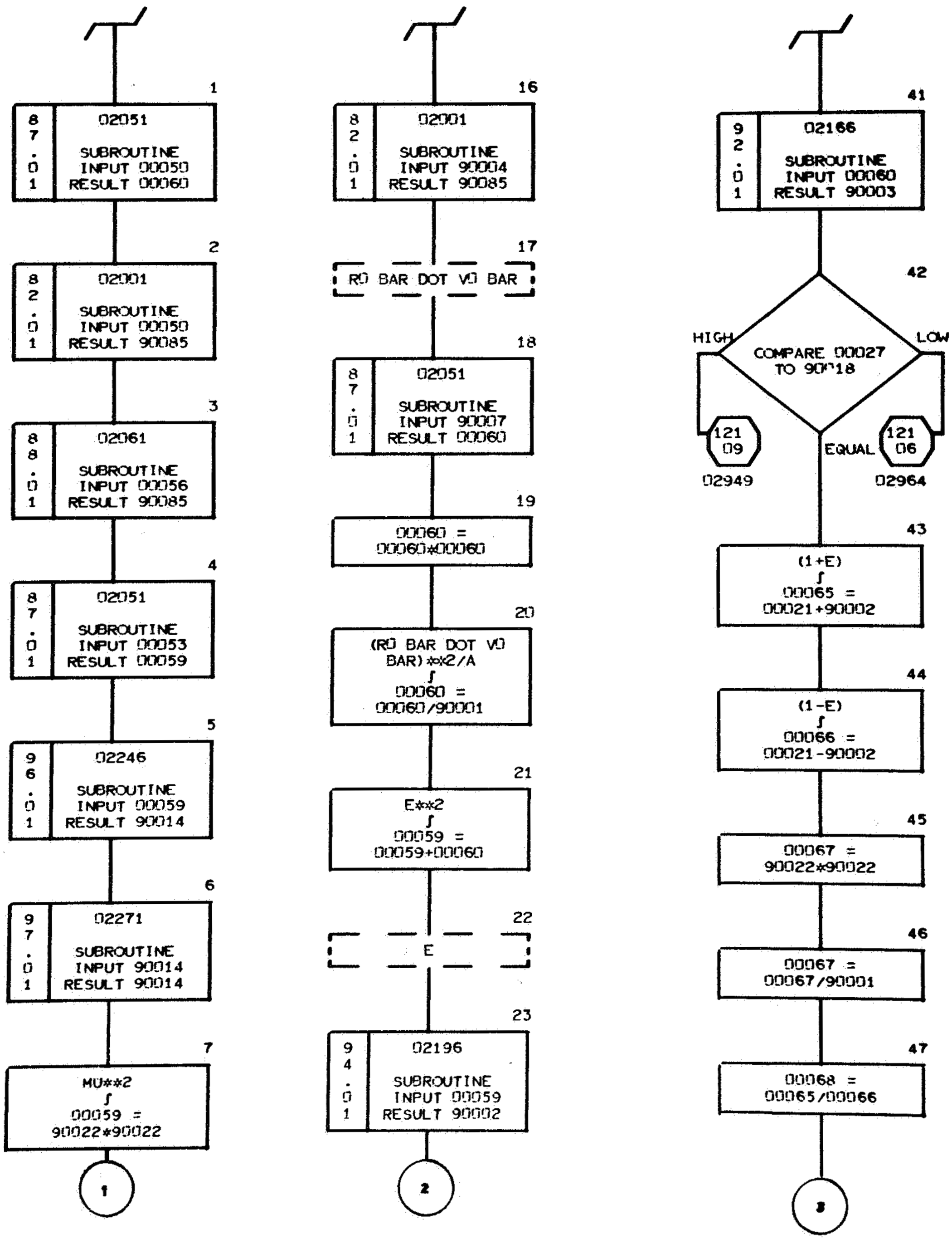
K VALUE = 02935

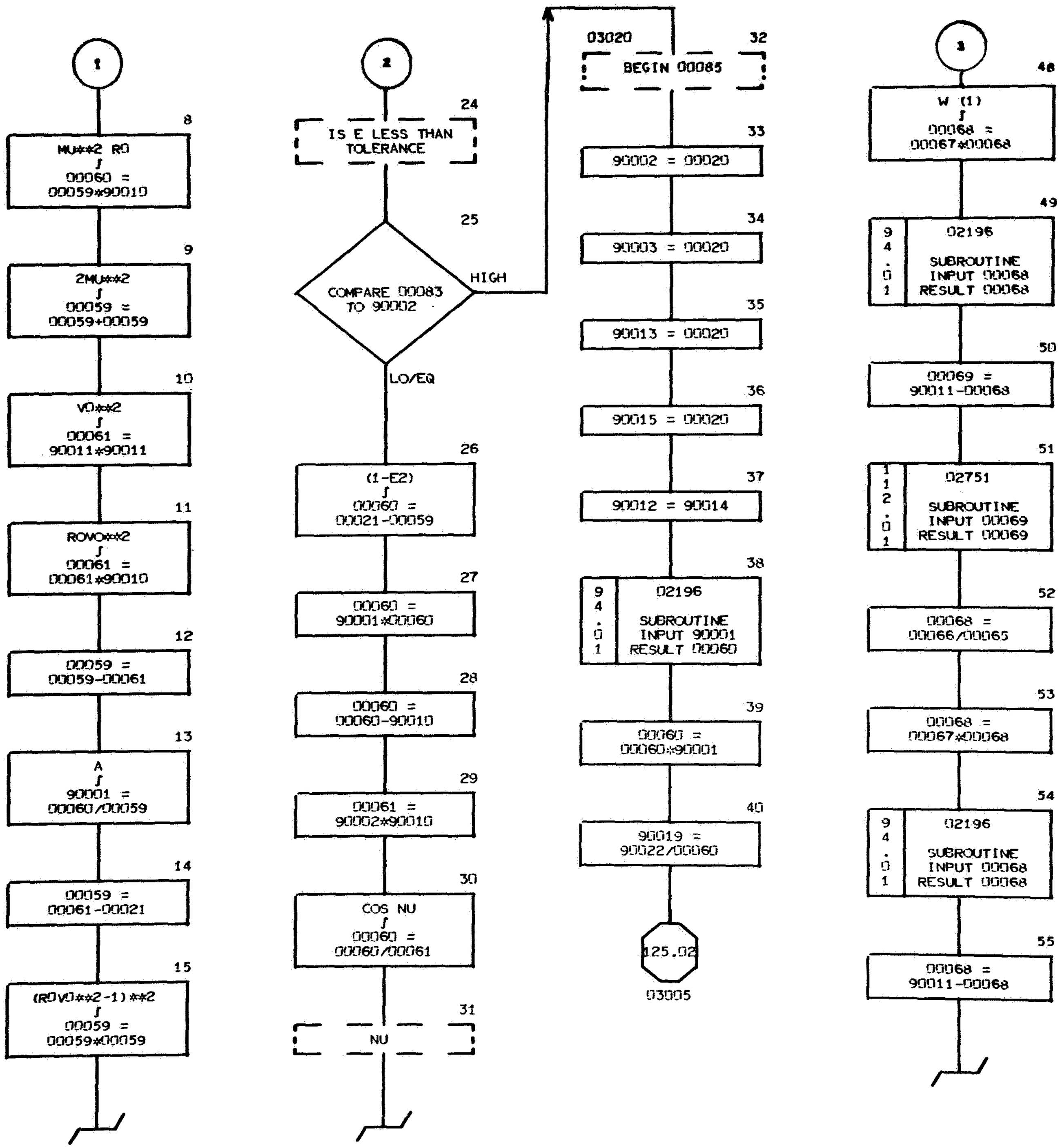




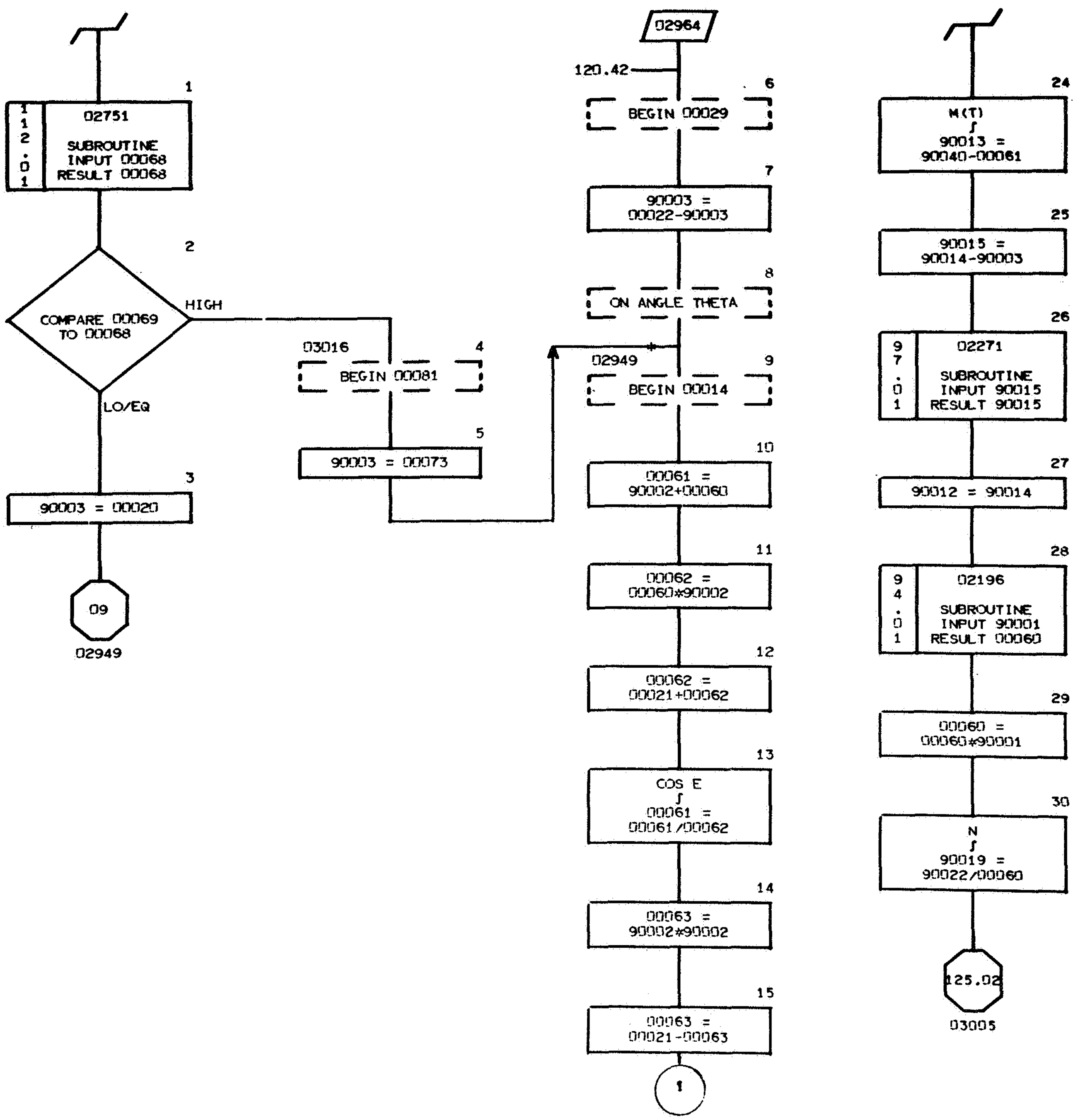
PAGE 119 CONTINUED
1
8
110.01
02651
SUBROUTINE
INPUT 00032
RESULT 90005
9
110.01
02651
SUBROUTINE
INPUT 00034
RESULT 90006
10
V BARS
11
110.01
02651
SUBROUTINE
INPUT 00036
RESULT 90007
12
110.01
02651
SUBROUTINE
INPUT 00038
RESULT 90008
13
110.01
02651
SUBROUTINE
INPUT 00040
RESULT 90009
14
CONVERT POS. AND VEL. VECTORS TO ELEMENTS
117.03
02944
15
BEGIN 00009
2
24
87.01
02051
SUBROUTINE
INPUT 00050
RESULT 00053
25
91.01
02156
SUBROUTINE
INPUT 00053
RESULT 00053
26
90018 =
00020-00053
27
82.01
02001
SUBROUTINE
INPUT 90007
RESULT 90085
28
88.01
02061
SUBROUTINE
INPUT 90004
RESULT 00053
29
ALPHA BAR
30
84.01
02021
SUBROUTINE
INPUT 00053
RESULT 00053
31
82.01
02001
SUBROUTINE
INPUT 00053
RESULT 90085
3
39
82.01
02001
SUBROUTINE
INPUT 00026
RESULT 90085
40
87.01
02051
SUBROUTINE
INPUT 00056
RESULT 00060
41
82.01
02001
SUBROUTINE
INPUT 00056
RESULT 90085
42
88.01
02061
SUBROUTINE
INPUT 00026
RESULT 90085
43
87.01
02051
SUBROUTINE
INPUT 00019
RESULT 00059
44
CAP OMEGA
45
96.01
02246
SUBROUTINE
INPUT 00059
RESULT 90017
46
82.01
02001
SUBROUTINE
INPUT 00056
RESULT 90085

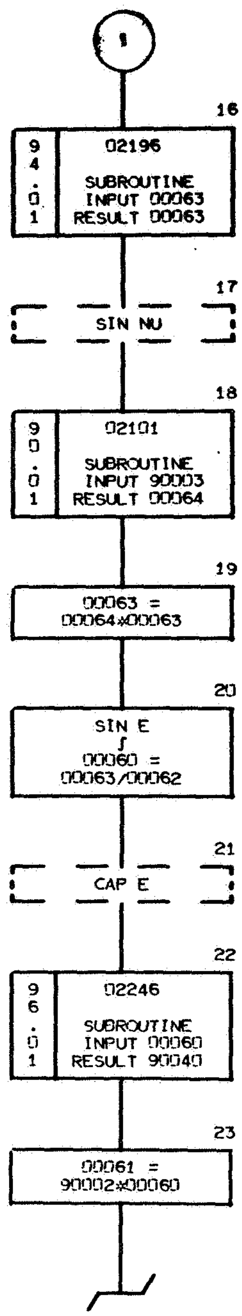
K VALUE = 02935



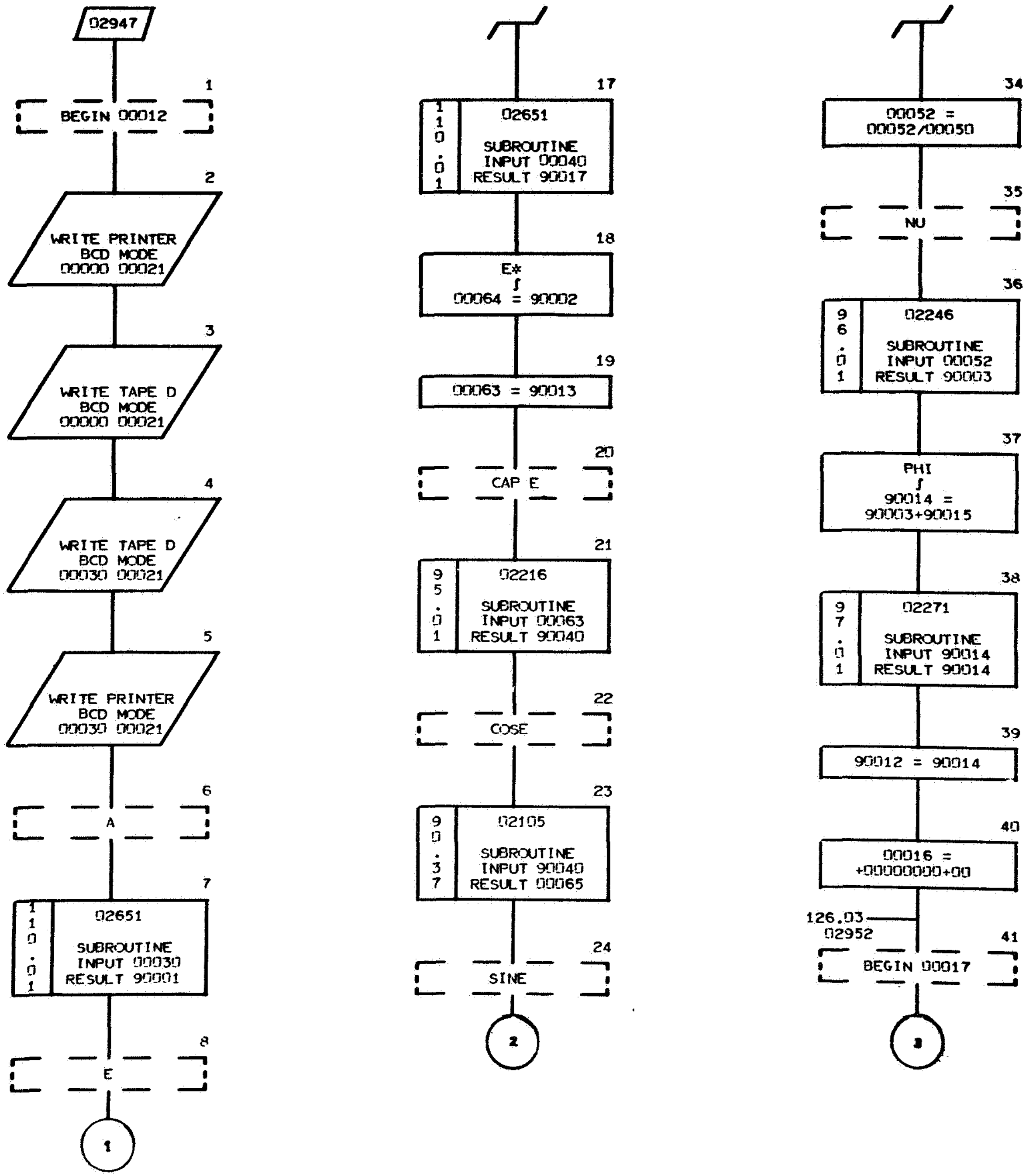

1
8
MU**2 RO
ʃ
00060 =
00059*90010
9
2MU**2
ʃ
00059 =
00059+00059
10
VO**2
ʃ
00061 =
90011*90011
11
ROVO**2
ʃ
00061 =
00061*90010
12
00059 =
00059-00061
13
A
ʃ
90001 =
00060/00059
14
00059 =
00061-00021
15
(ROVO**2-1)**2
ʃ
00059 =
00059*00059
2
24
IS E LESS THAN
TOLERANCE
25
COMPARE 00083
TO 90002
HIGH
LO/EQ
26
(1-E2)
ʃ
00060 =
00021-00059
27
00060 =
90001*00060
28
00060 =
00060-90010
29
00061 =
90002*90010
30
COS NU
ʃ
00060 =
00060/00061
31
NU
03020
32
BEGIN 00085
33
90002 = 00020
34
90003 = 00020
35
90013 = 00020
36
90015 = 00020
37
90012 = 90014
38
9
4
.
0
1
02196
SUBROUTINE
INPUT 90001
RESULT 00060
39
00060 =
00060*90001
40
90019 =
90022/00060
125.02
03005
3
48
W (1)
ʃ
00068 =
00067*00068
49
9
4
.
0
1
02196
SUBROUTINE
INPUT 00068
RESULT 00068
50
00069 =
90011-00068
51
1
1
2
.
0
1
02751
SUBROUTINE
INPUT 00069
RESULT 00069
52
00068 =
00066/00065
53
00068 =
00067*00068
54
9
4
.
0
1
02196
SUBROUTINE
INPUT 00068
RESULT 00068
55
00068 =
90011-00068

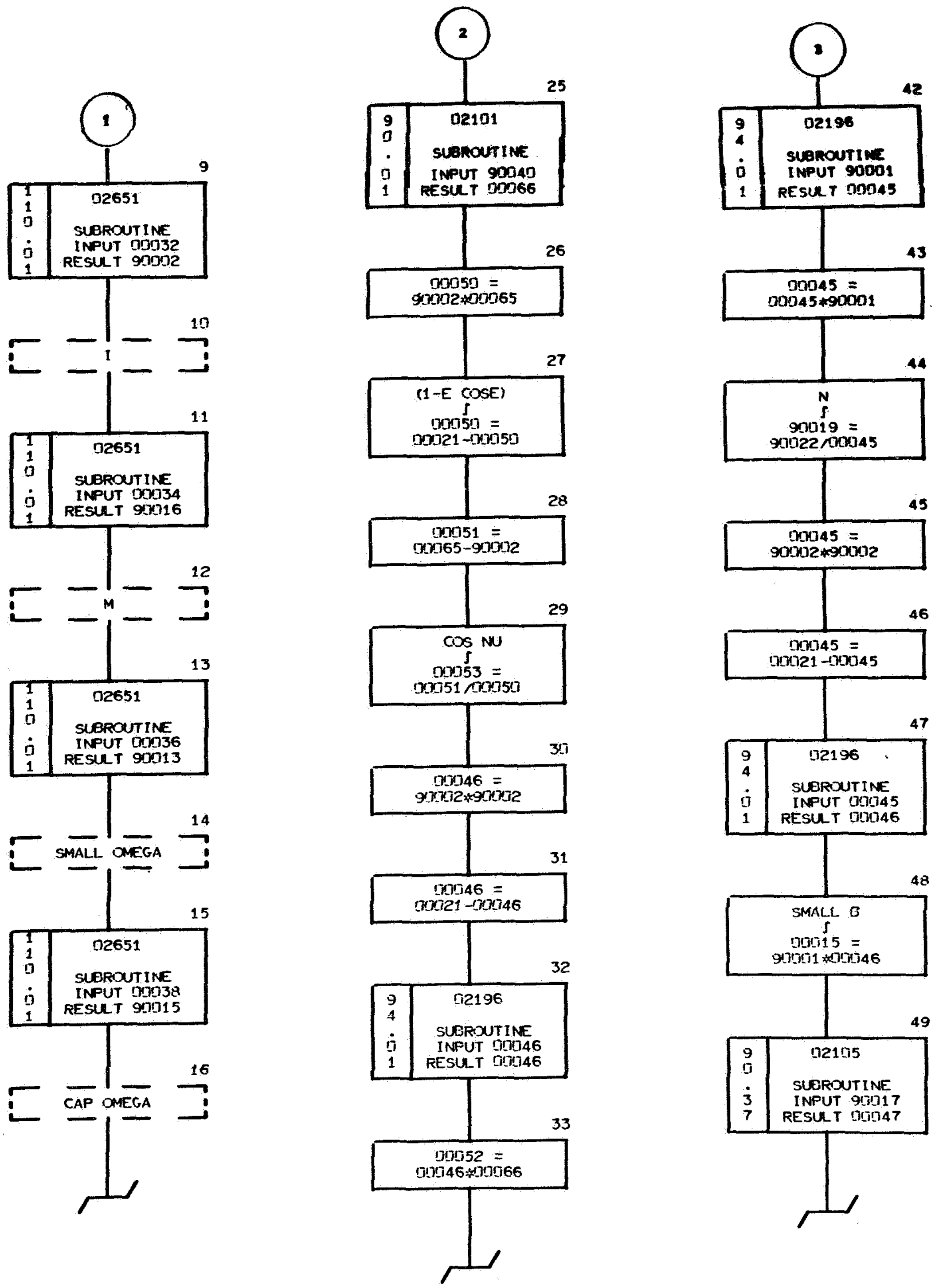
K VALUE = 02935



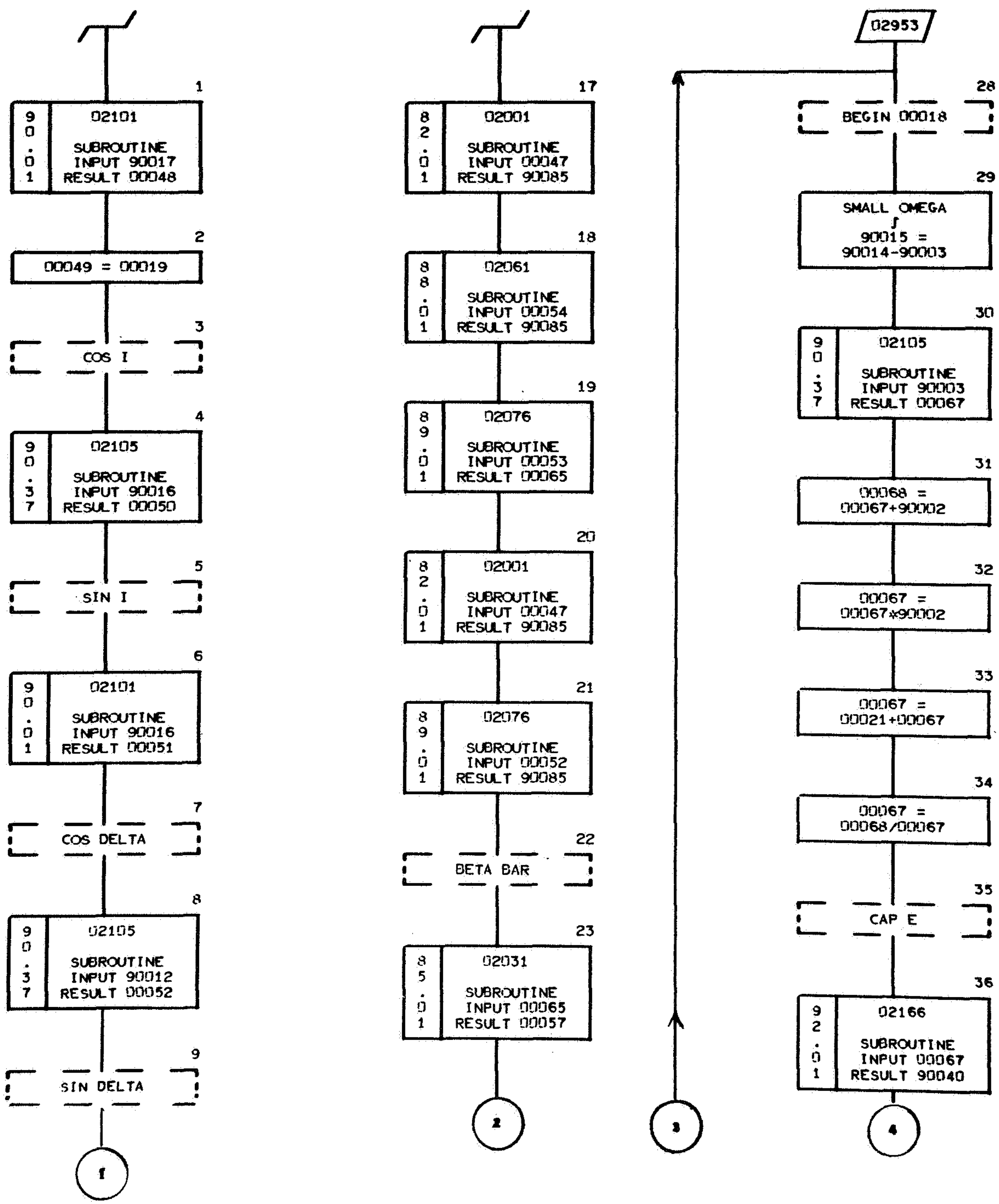

1
16
9
4
.
0
1
02196
SUBROUTINE
INPUT 00063
RESULT 00063
17
SIN NU
18
9
0
.
0
1
02101
SUBROUTINE
INPUT 90003
RESULT 00064
19
00063 =
00064*00063
20
SIN E
∫
00060 =
00063/00062
21
CAP E
22
9
6
.
0
1
02246
SUBROUTINE
INPUT 00060
RESULT 90040
23
00061 =
90002*00060

K VALUE = 02935




1
9
1 1 0 . 0 1
02651
SUBROUTINE
INPUT 00032
RESULT 90002
10
I
11
1 1 0 . 0 1
02651
SUBROUTINE
INPUT 00034
RESULT 90016
12
M
13
1 1 0 . 0 1
02651
SUBROUTINE
INPUT 00036
RESULT 90013
14
SMALL OMEGA
15
1 1 0 . 0 1
02651
SUBROUTINE
INPUT 00038
RESULT 90015
16
CAP OMEGA
2
25
9 0 . 0 1
02101
SUBROUTINE
INPUT 90040
RESULT 00066
26
00050 =
90002*00065
27
(1-E COSE)
00050 =
00021-00050
28
00051 =
00065-90002
29
COS NU
00053 =
00051/00050
30
00046 =
90002*90002
31
00046 =
00021-00046
32
9 4 . 0 1
02196
SUBROUTINE
INPUT 00046
RESULT 00046
33
00052 =
00046*00066
3
42
9 4 . 0 1
02196
SUBROUTINE
INPUT 90001
RESULT 00045
43
00045 =
00045*90001
44
N
90019 =
90022/00045
45
00045 =
90002*90002
46
00045 =
00021-00045
47
9 4 . 0 1
02196
SUBROUTINE
INPUT 00045
RESULT 00046
48
SMALL B
00015 =
90001*00046
49
9 0 . 3 7
02105
SUBROUTINE
INPUT 90017
RESULT 00047

K VALUE = 02935



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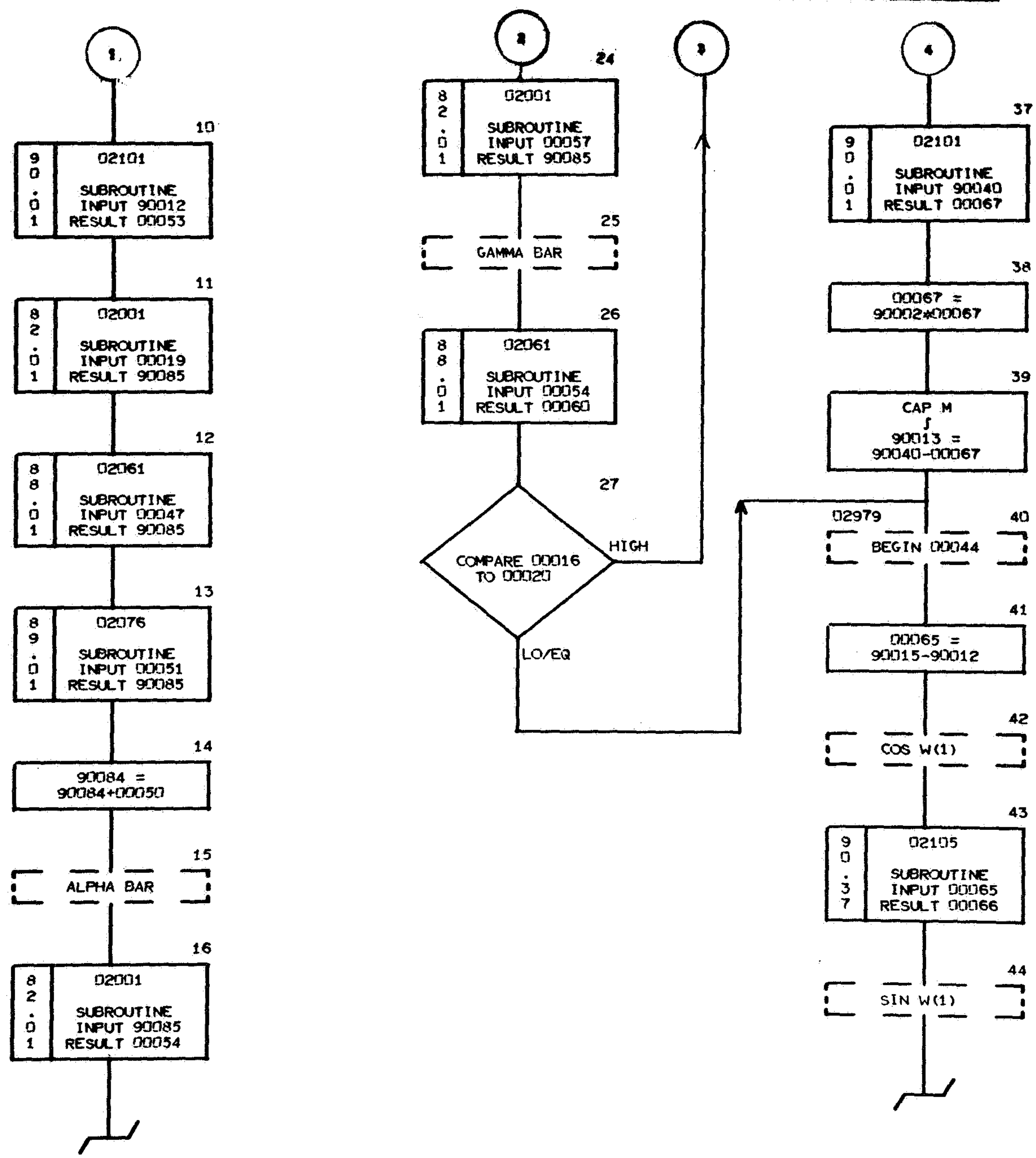
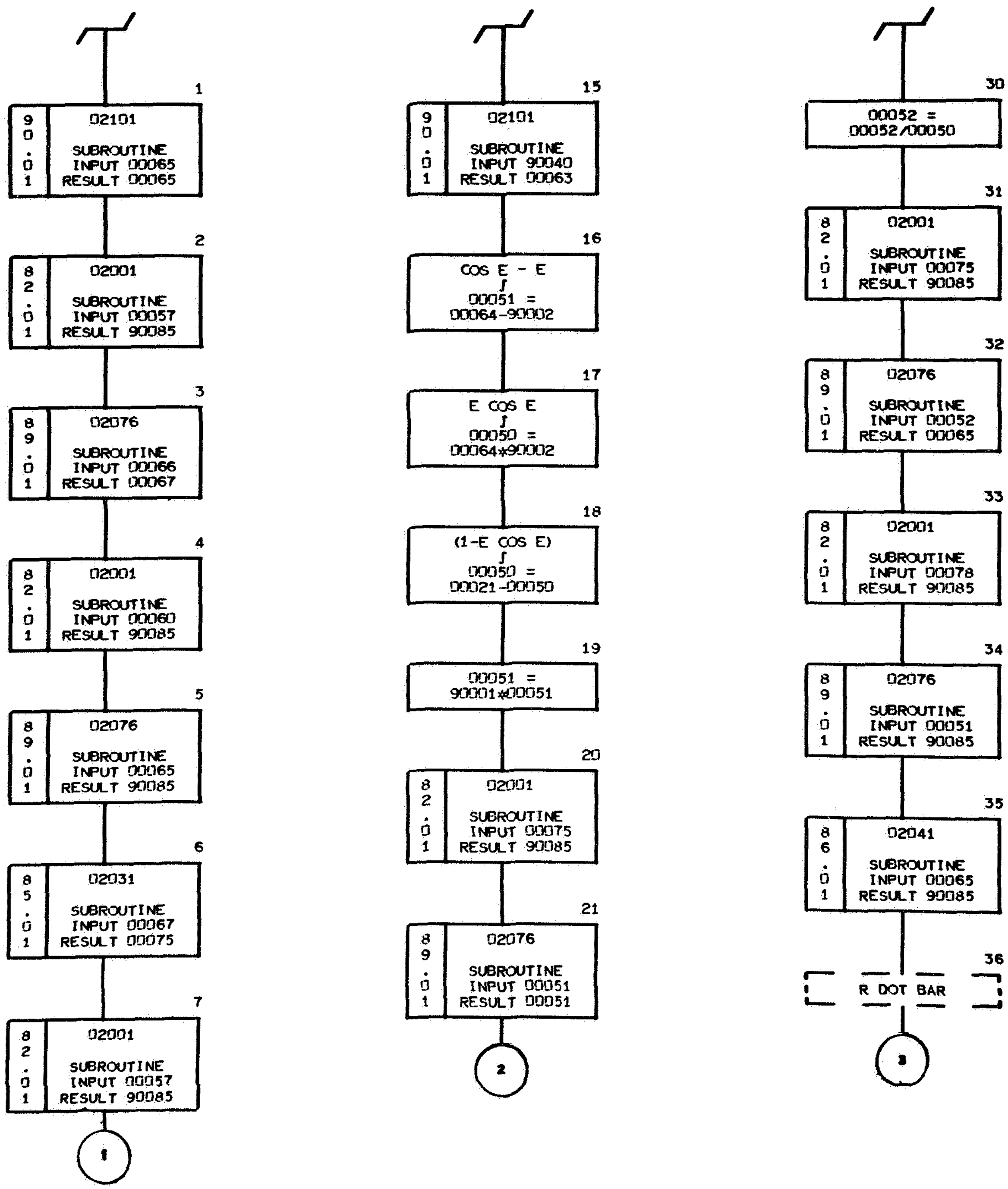
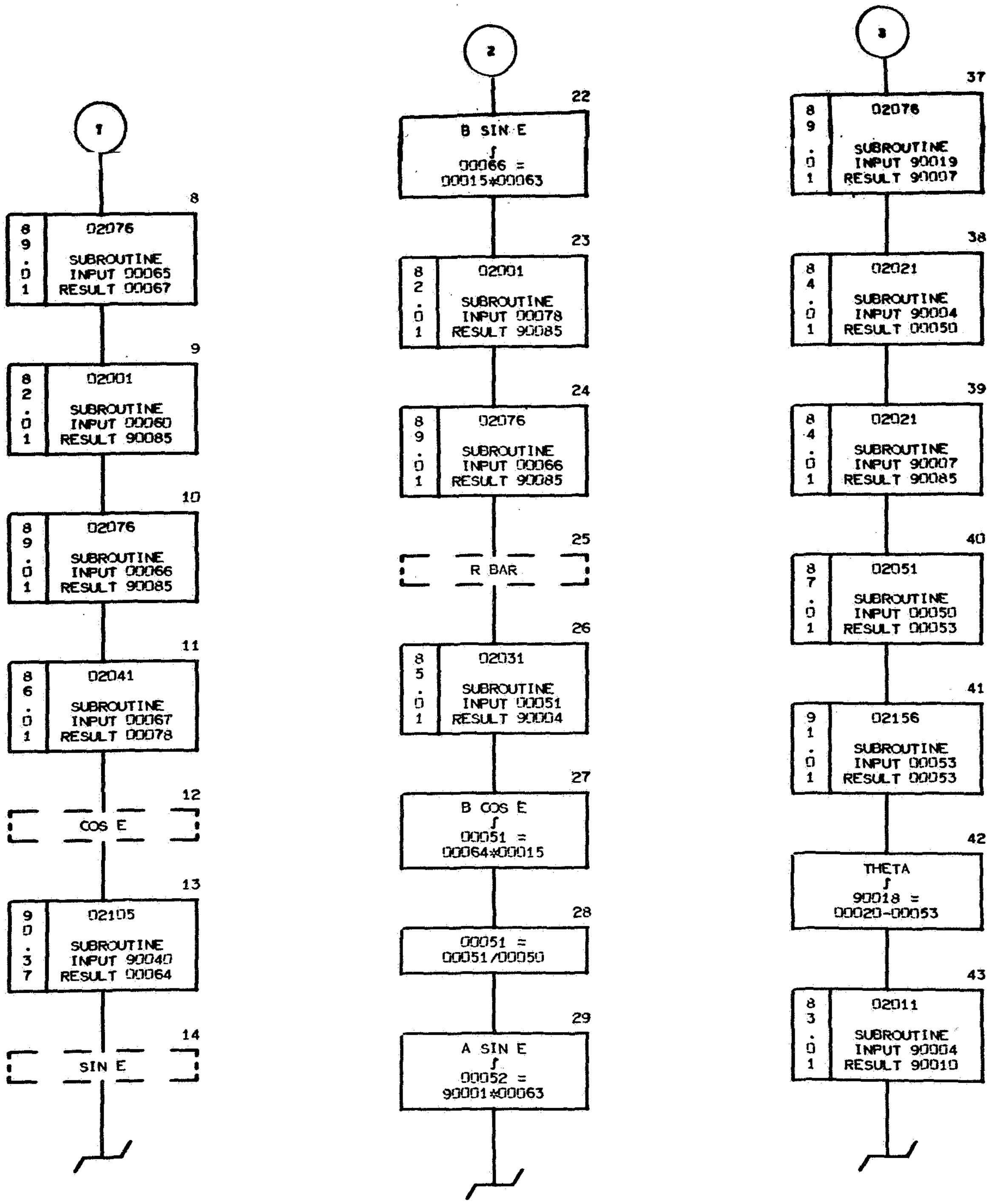


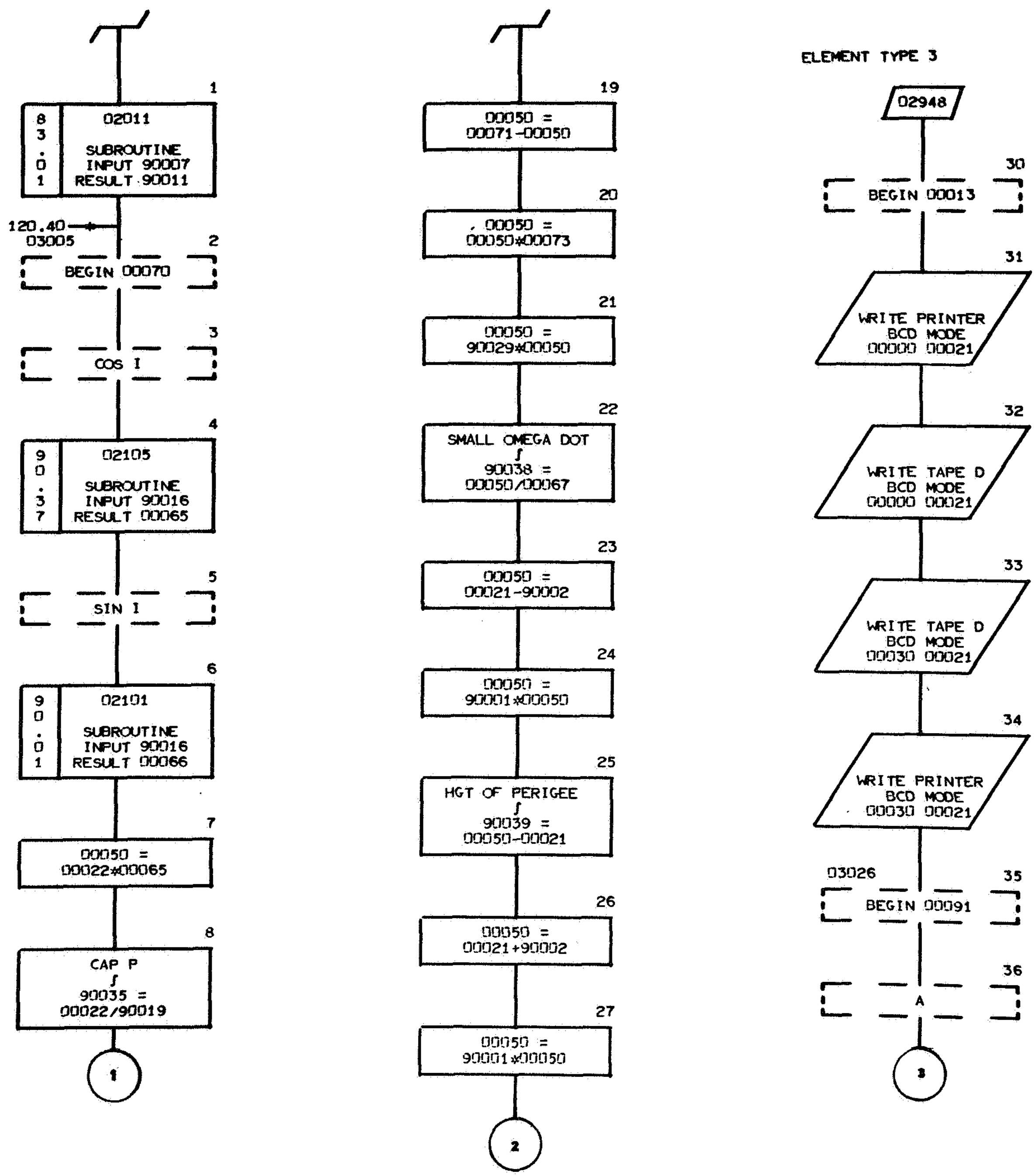
K VALUE = 02935




1
8
89.01
02076
SUBROUTINE
INPUT 00065
RESULT 00067
9
82.01
02001
SUBROUTINE
INPUT 00060
RESULT 90085
10
89.01
02076
SUBROUTINE
INPUT 00066
RESULT 90085
11
86.01
02041
SUBROUTINE
INPUT 00067
RESULT 00078
12
COS E
13
90.37
02105
SUBROUTINE
INPUT 90040
RESULT 00064
14
SIN E
2
22
B SIN E
00066 =
00015*00063
23
82.01
02001
SUBROUTINE
INPUT 00078
RESULT 90085
24
89.01
02076
SUBROUTINE
INPUT 00066
RESULT 90085
25
R BAR
26
85.01
02031
SUBROUTINE
INPUT 00051
RESULT 90004
27
B COS E
00051 =
00064*00015
28
00051 =
00051/00050
29
A SIN E
00052 =
90001*00063
3
37
89.01
02076
SUBROUTINE
INPUT 90019
RESULT 90007
38
84.01
02021
SUBROUTINE
INPUT 90004
RESULT 00050
39
84.01
02021
SUBROUTINE
INPUT 90007
RESULT 90085
40
87.01
02051
SUBROUTINE
INPUT 00050
RESULT 00053
41
91.01
02156
SUBROUTINE
INPUT 00053
RESULT 00053
42
THETA
90018 =
00020-00053
43
83.01
02011
SUBROUTINE
INPUT 90004
RESULT 90010

K VALUE = 02935

ELEMENT TYPE 3



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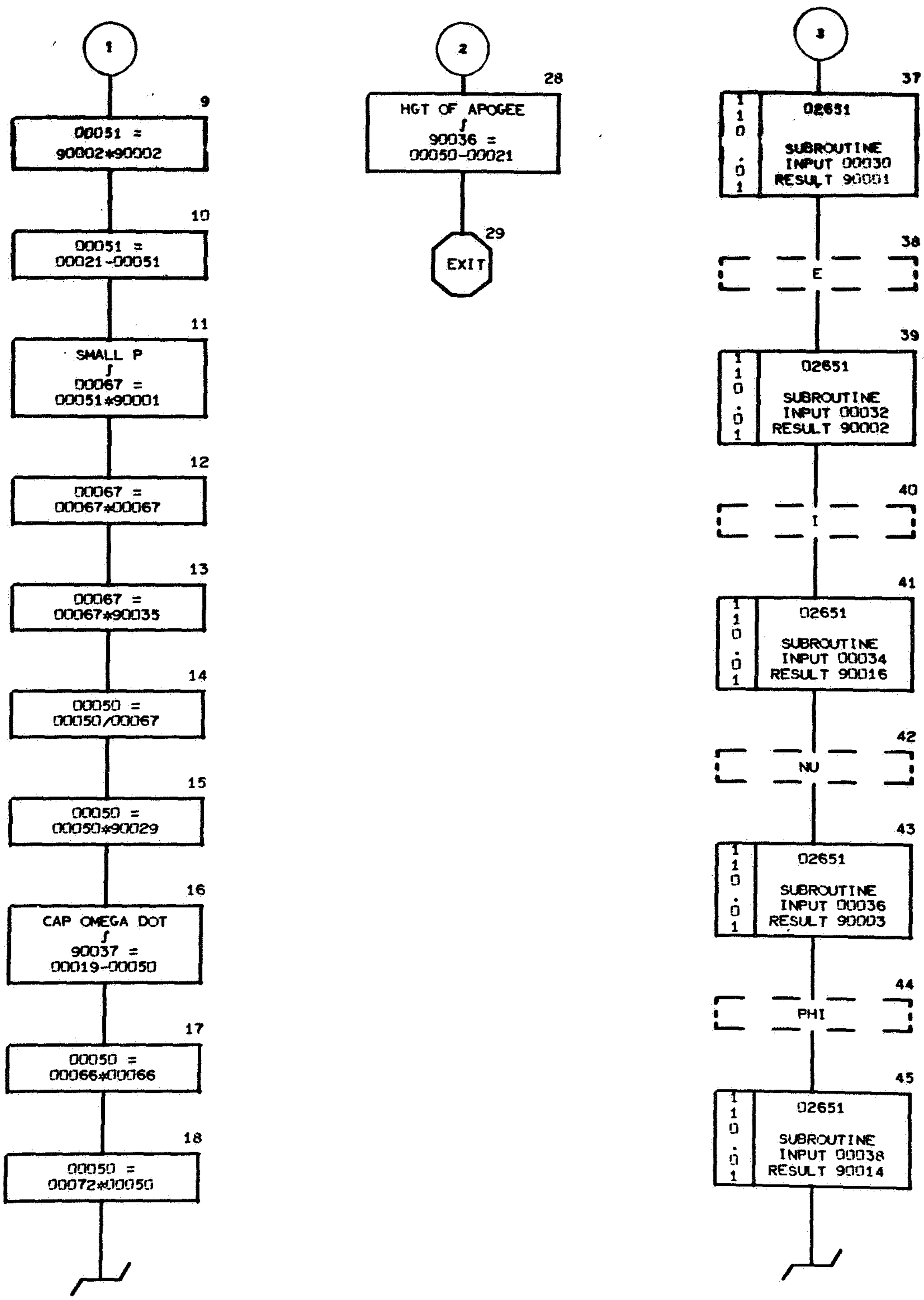
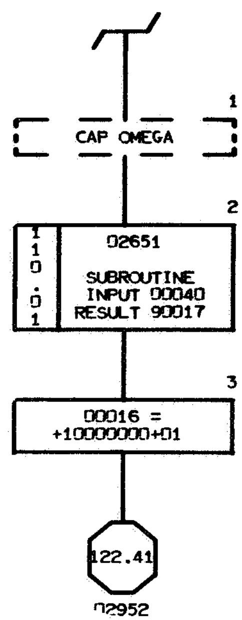


K VALUE = 02935



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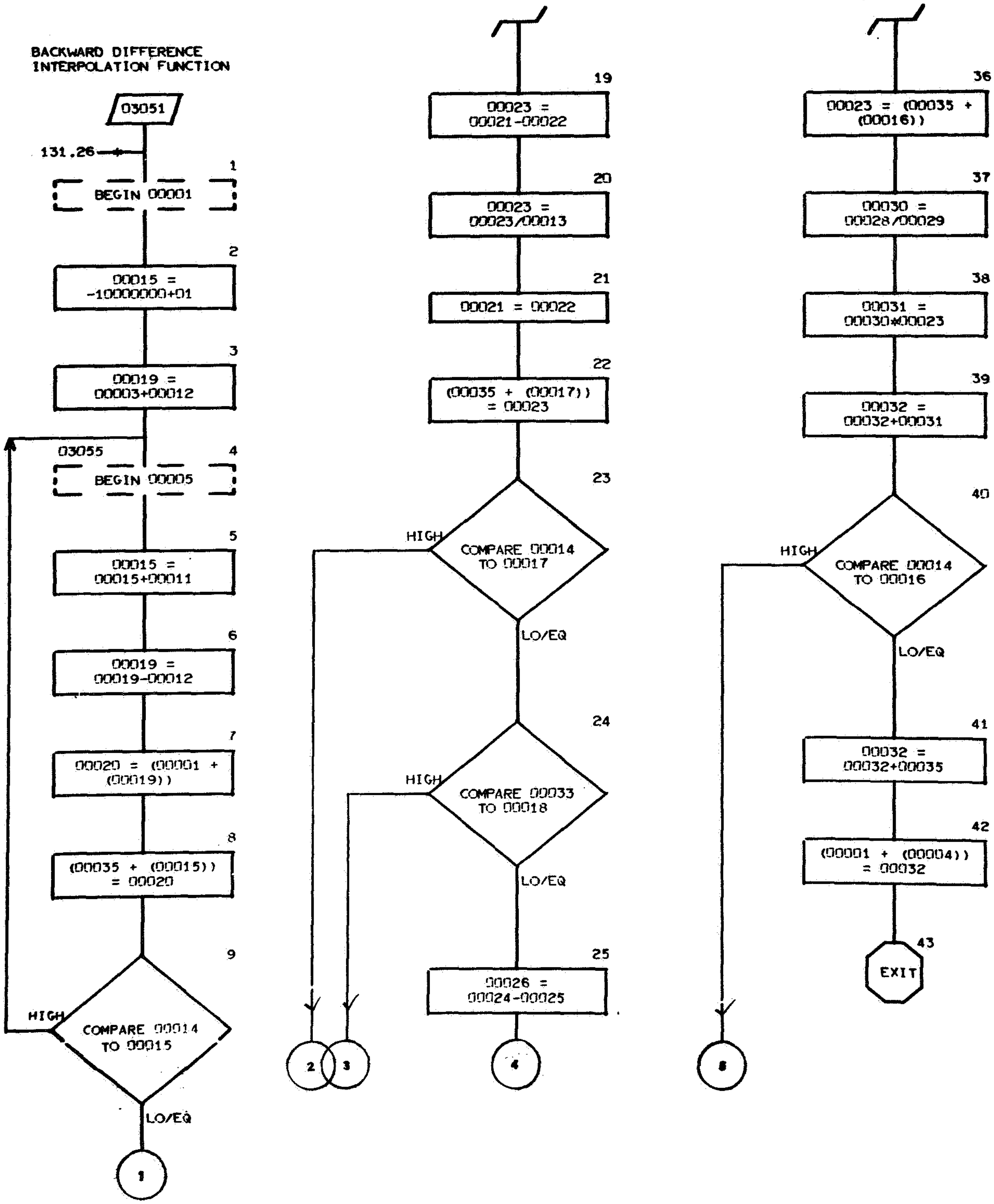
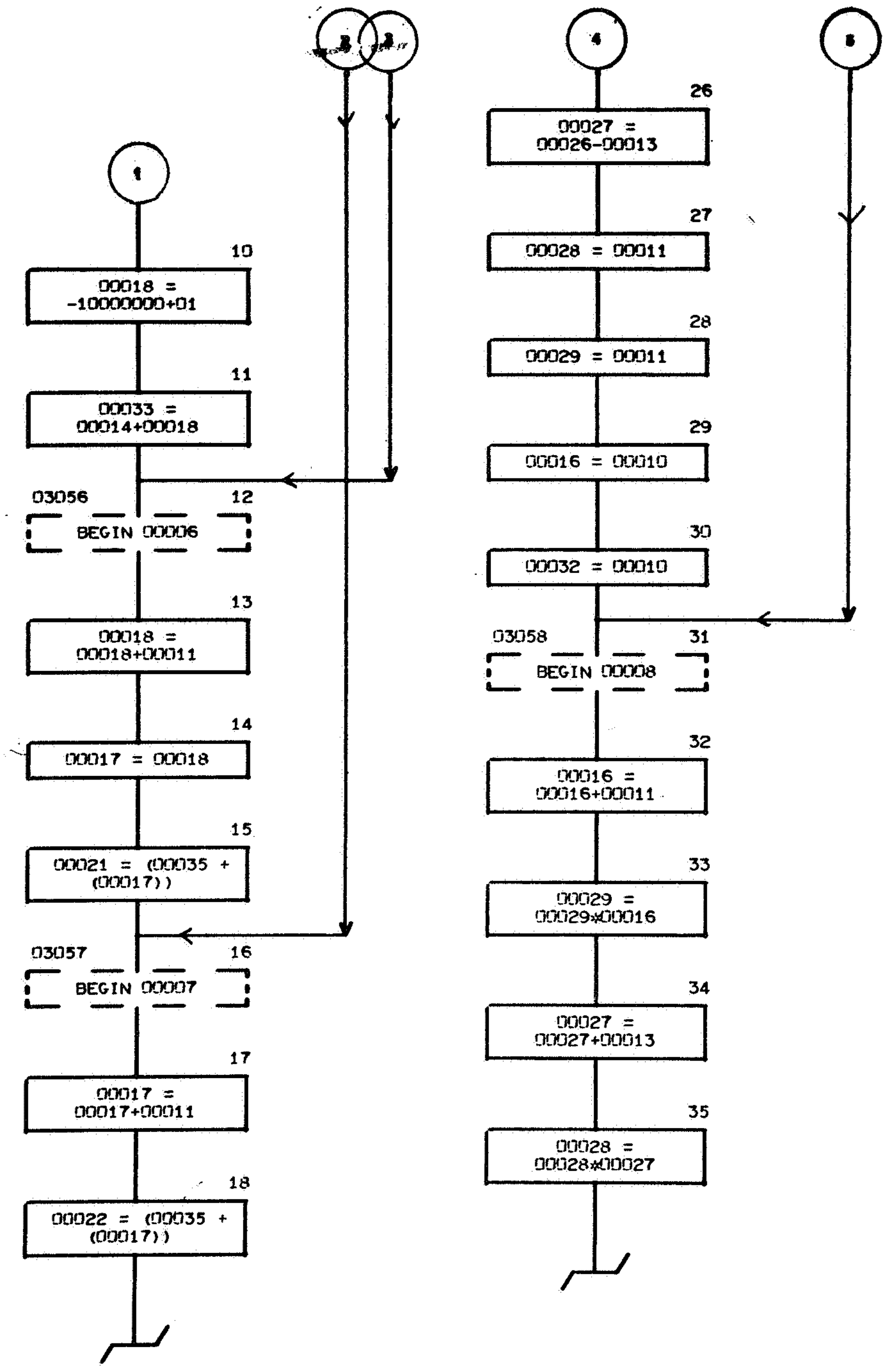


PAGE 12 (CONTINUED)



CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES					
K VALUE = 03050							
127.01	03051	131.26*	131.28*	131.30*	131.32*	131.34*	131.36*
127.04	03055	127.09					
127.12	03056	127.24					
127.16	03057	127.23					
127.31	03058	127.40					

K VALUE = 03050

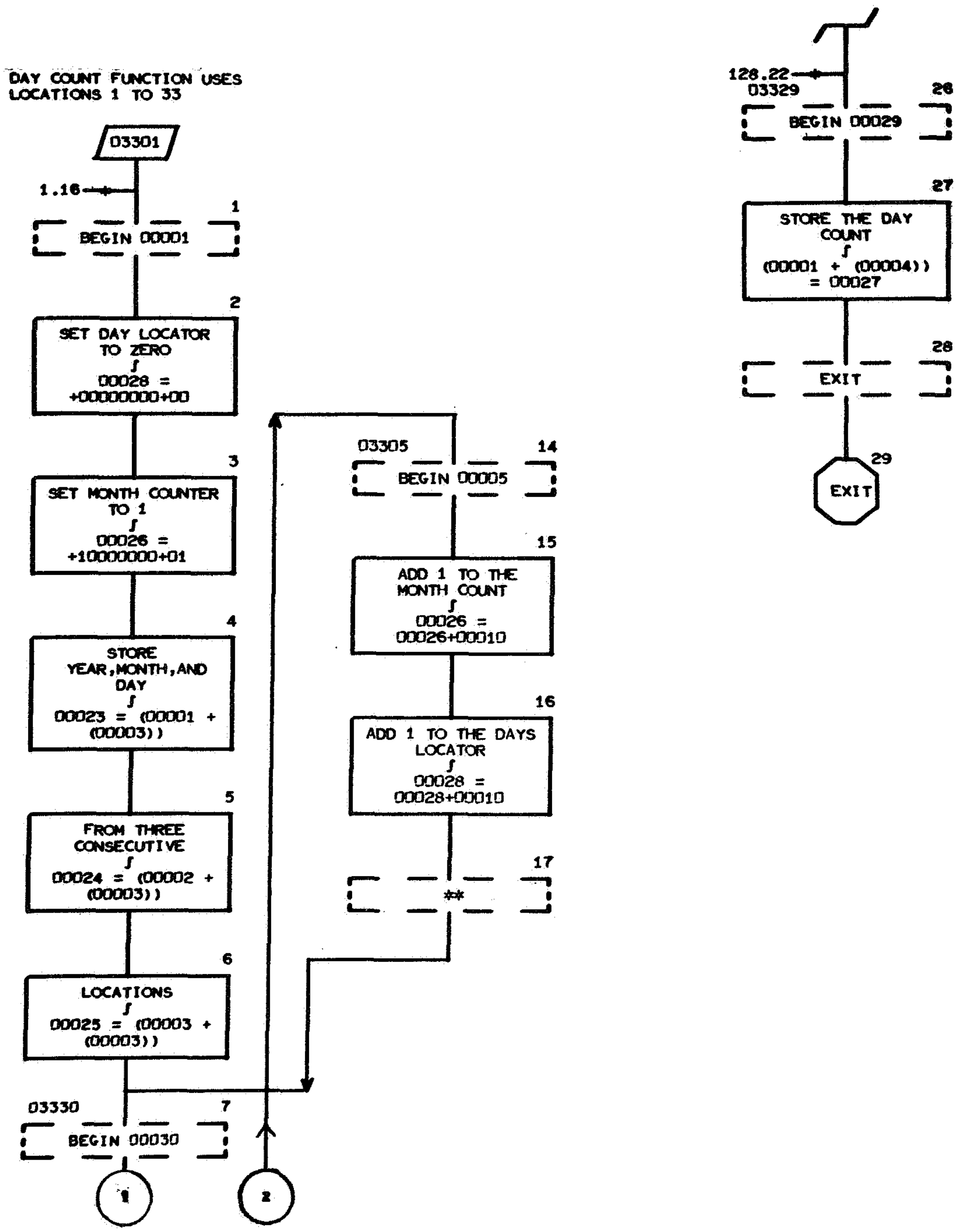
V00010+00000000+00

V00011+10000000+01

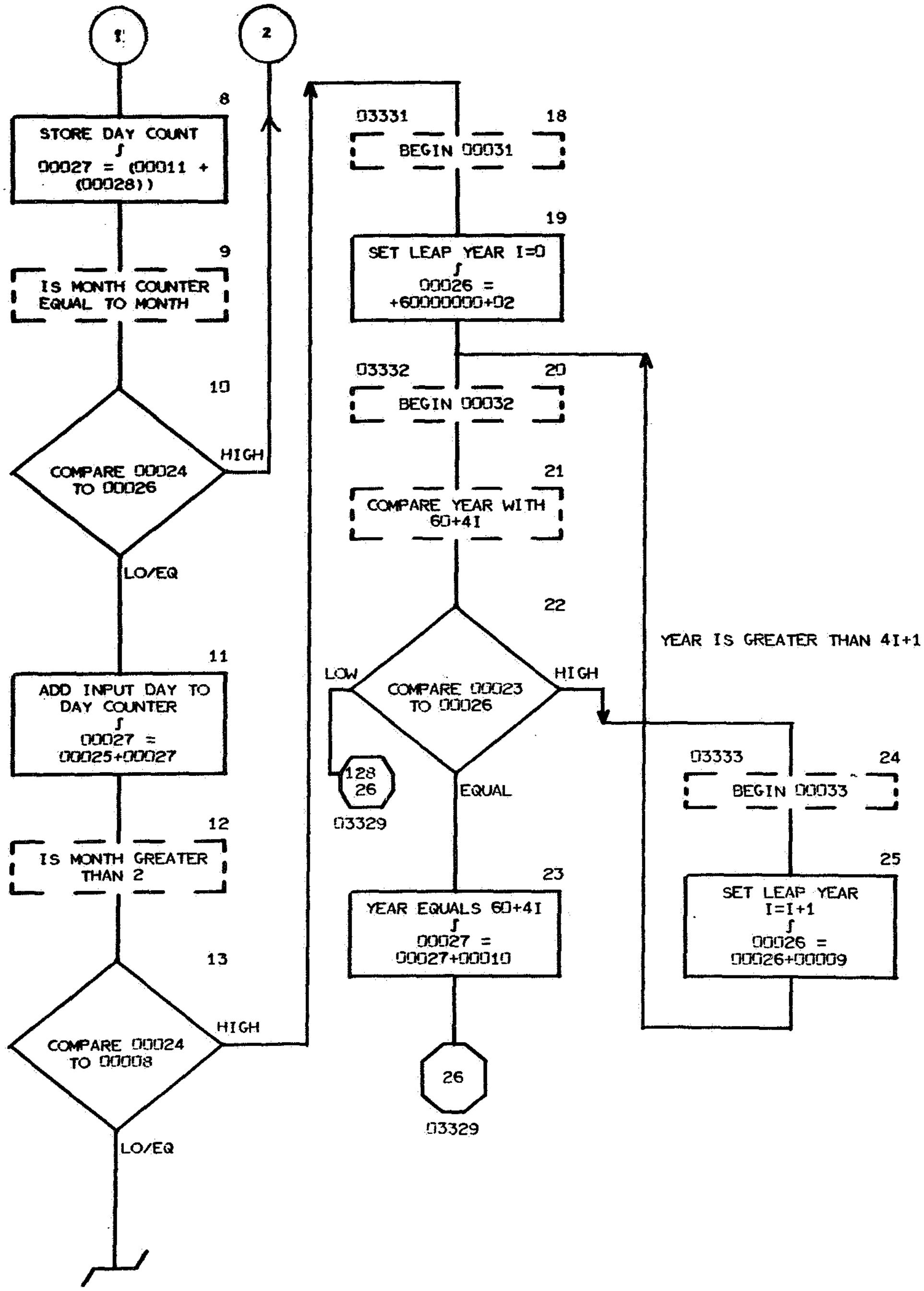
V00012+10000000+02

V00014+50000000+01

K VALUE = 03300



PAGE 128 CONTINUED

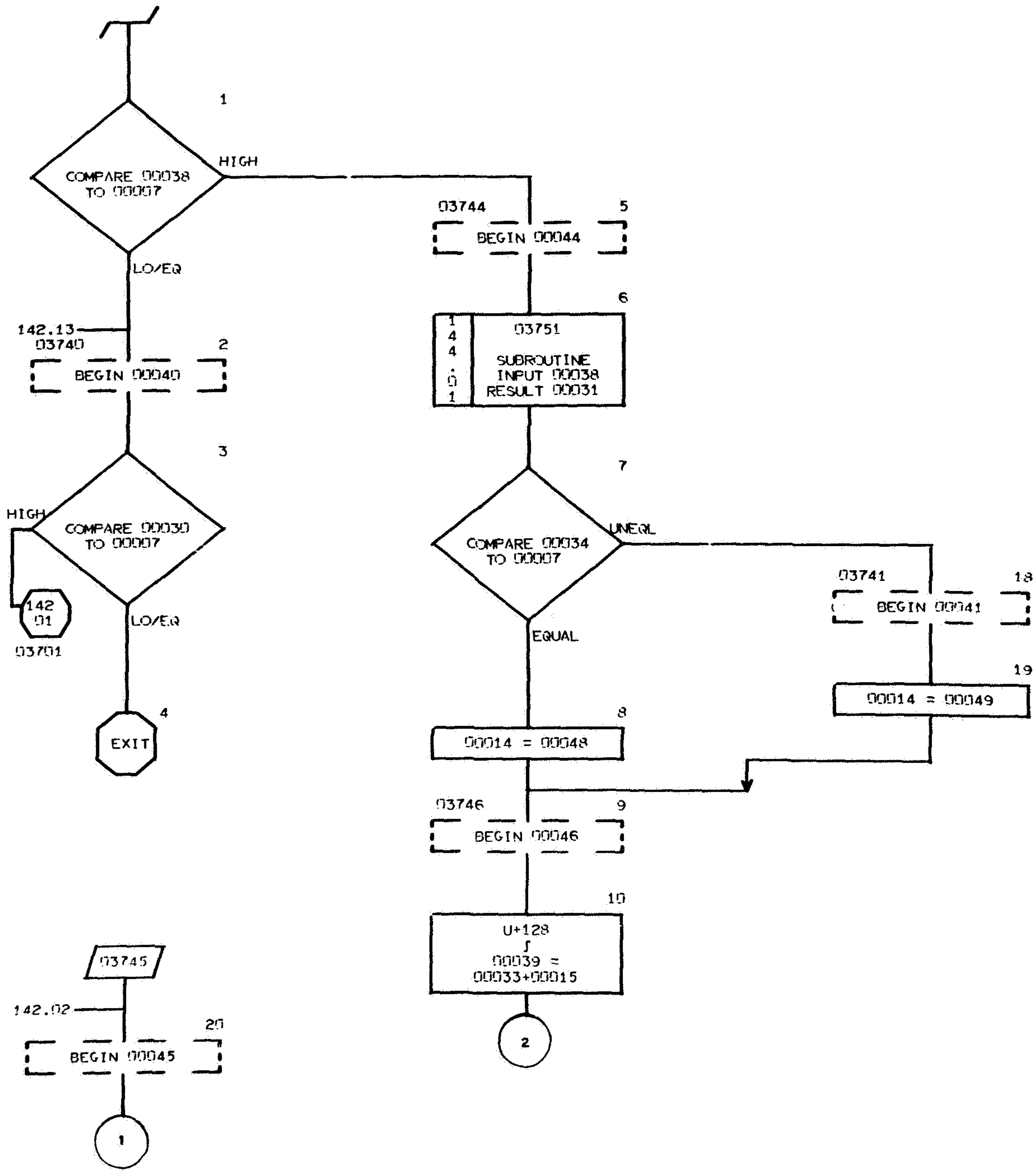


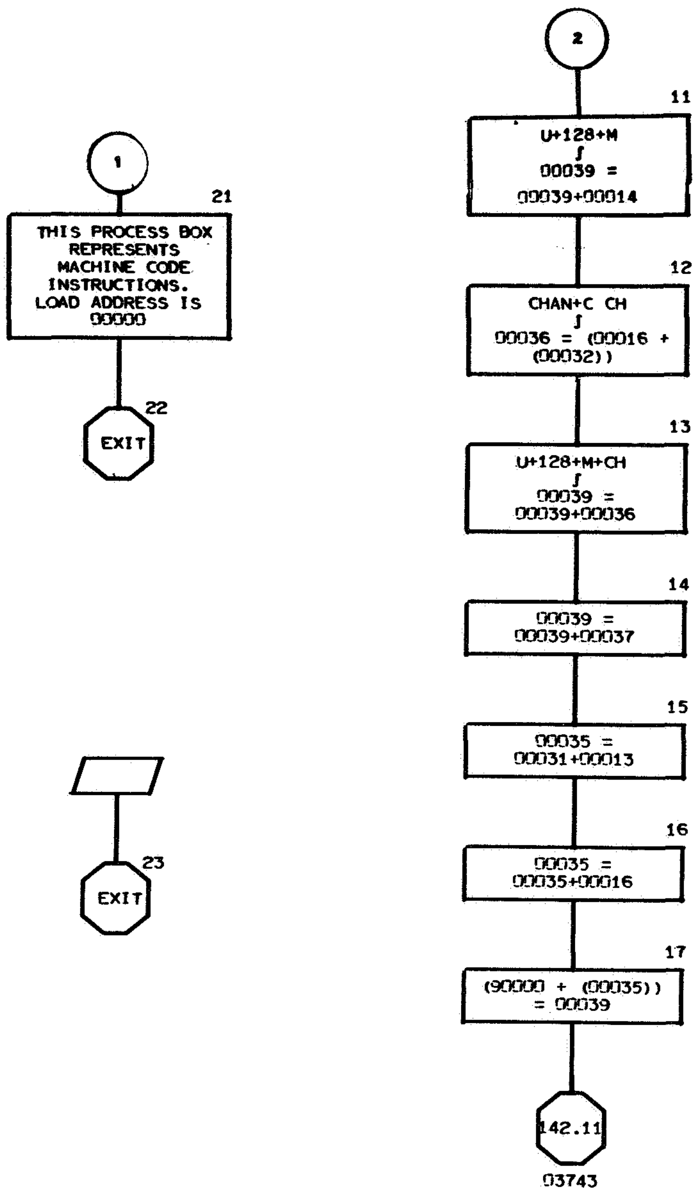
```
        K VALUE = 03300
V00008+20000000+01              ENTER WITH (Z)=YEAR,(Z+1)=MONTH,(
V00009+40000000+01              DAY. EXIT WITH (X)=NUMBER OF DAYS
V00010+10000000+01              JAN.1 OF THE GIVEN YEAR THROUGH T
V00011+00000000+00              GIVEN DATE.
V00012+31000000+02            NO. OF DAYS UP TO FEB. 1
V00013+59000000+02            NO. OF DAYS UP TO MAR. 1
V00014+90000000+02            NO. OF DAYS UP TO APR. 1
V00015+12000000+03            NO. OF DAYS UP TO MAY 1
V00016+15100000+03            NO. OF DAYS UP TO JUNE 1
V00017+18100000+03            NO. OF DAYS UP TO JULY 1
V00018+21200000+03            NO. OF DAYS UP AUG. 1
V00019+24300000+03            NO. OF DAYS UP TO SEPT. 1
V00020+27300000+03            NO. OF DAYS UP TO OCT. 1
V00021+30400000+03            NO. OF DAYS UP TO NOV. 1
V00022+33400000+03            NO. OF DAYS UP TO DEC. 1
```

CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES	
K VALUE = 03300			
128.01	03301	1.16*	129.12*
128.07	03330	128.17	
128.14	03305	128.10	
128.18	03331	128.13	
128.20	03332	128.25	
128.24	03333	128.22	
128.26	03329	128.22	128.23

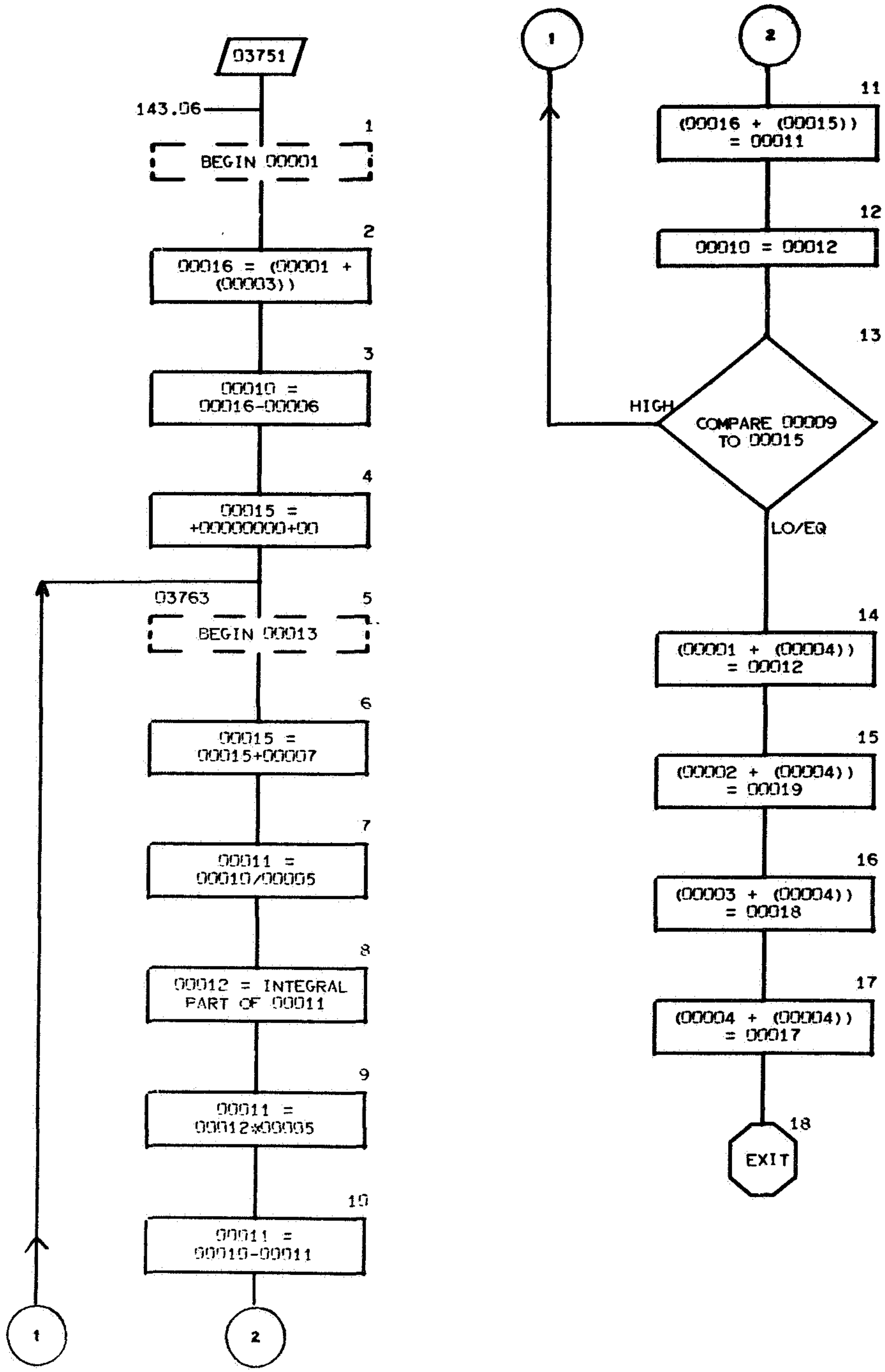
K VALUE = 03700




1
21
THIS PROCESS BOX REPRESENTS MACHINE CODE INSTRUCTIONS. LOAD ADDRESS IS 00000
22
EXIT
23
EXIT
2
11
U+128+M
∫
00039 = 00039+00014
12
CHAN+C CH
∫
00036 = (00016 + (00032))
13
U+128+M+CH
∫
00039 = 00039+00036
14
00039 = 00039+00037
15
00035 = 00031+00013
16
00035 = 00035+00016
17
(90000 + (00035)) = 00039
142.11
03743

```
        K VALUE = 03700
Q9000000000
Q9000103751
Q0003703841                          2**26
V00005+10000000+01
V00006+20000000+01
V00007+00000000+00
V00008+60000000+02
V00009+90000000+01
V00010+16000000+02
V00015+12800000+03
V00016+30054000+05
V00017+51200000+03
V00018+10240000+04
V00019+15360000+04
```

K VALUE = 03750

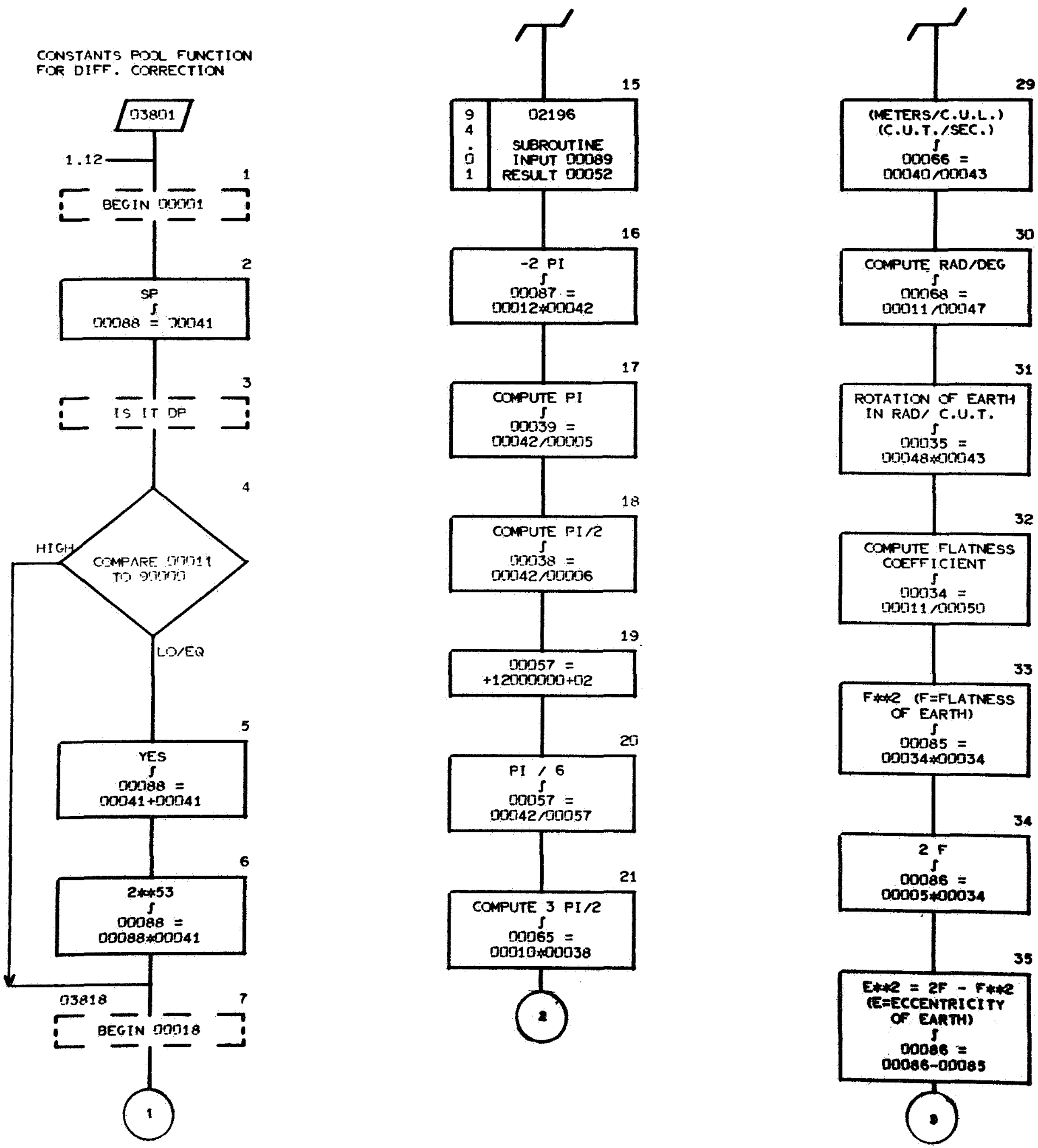


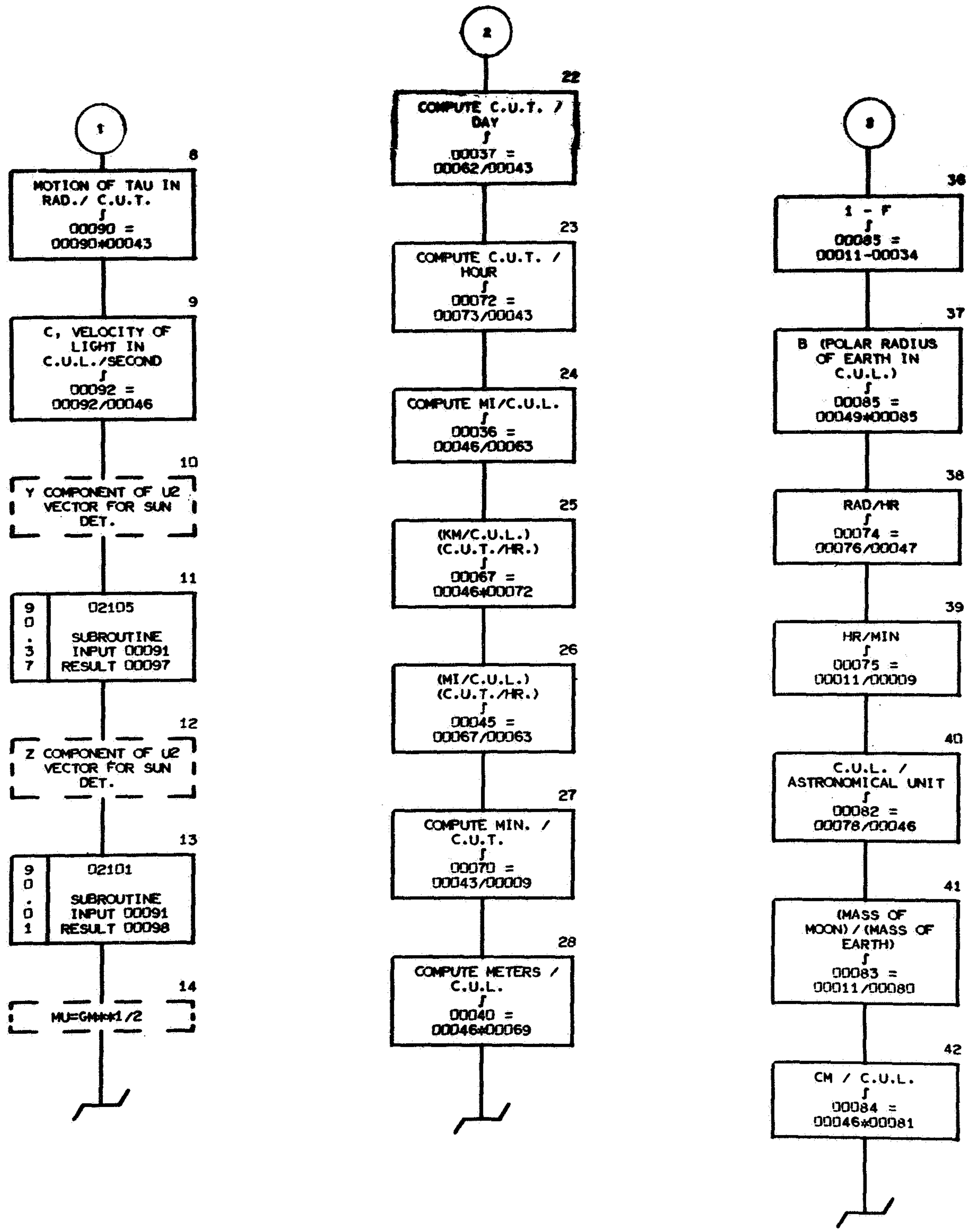
```
        K VALUE = 03750
V00005+10000000+03
V00006+60609000+08
V00007+10000000+01
V00009+30000000+01
```

CROSS REFERENCE LISTING

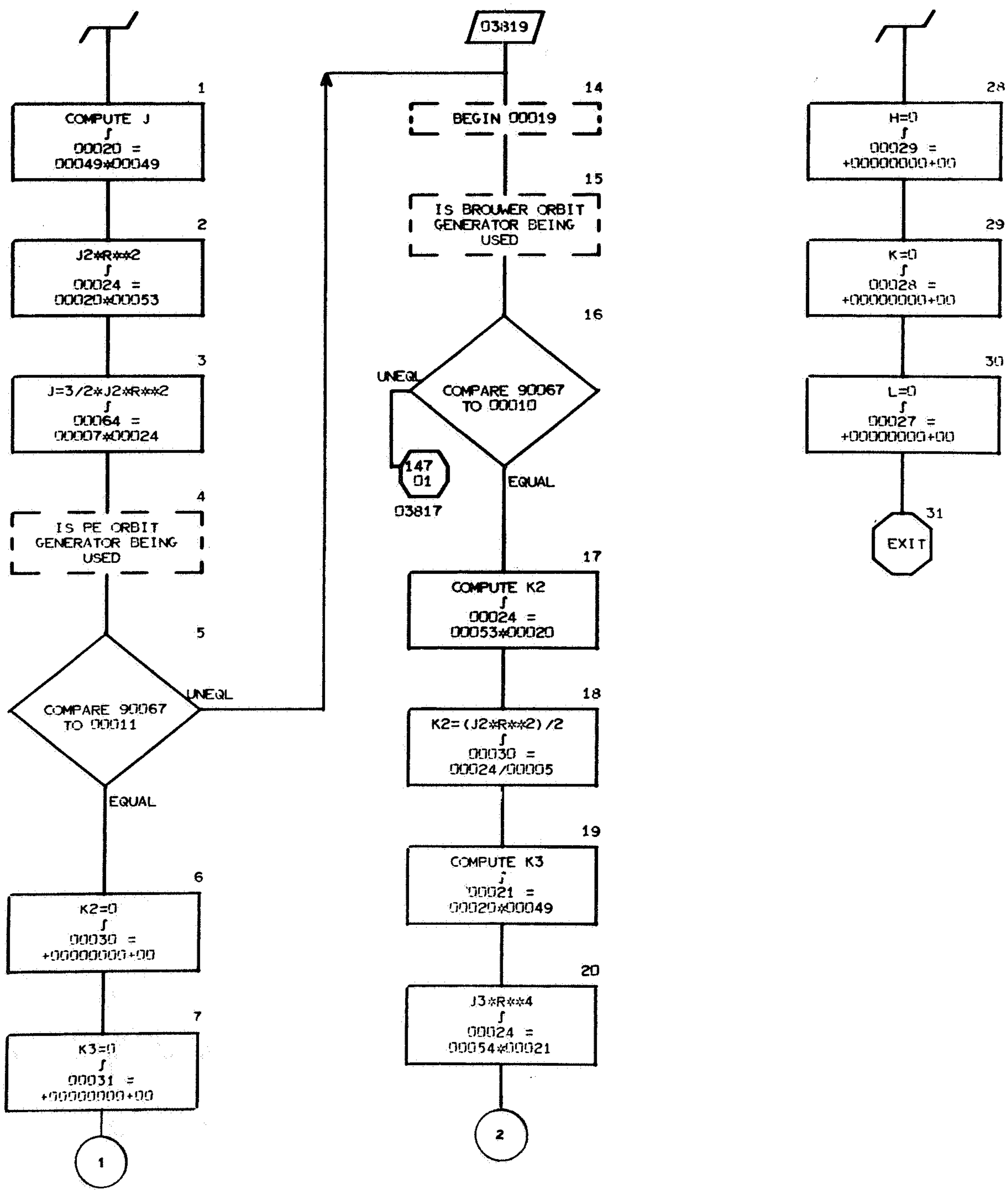
PAGE BOX	LABEL	REFERENCES
	K VALUE = 03750	
144.01	03751	143.06*
144.05	03763	144.13

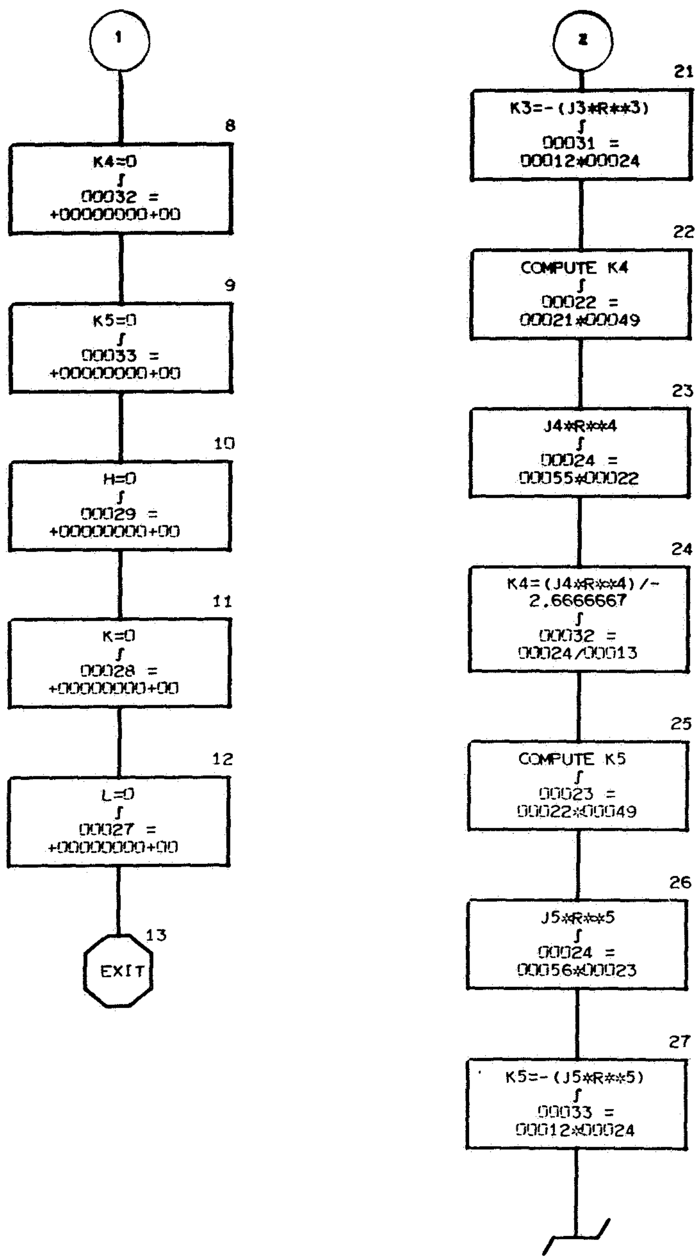
K VALUE = 03800



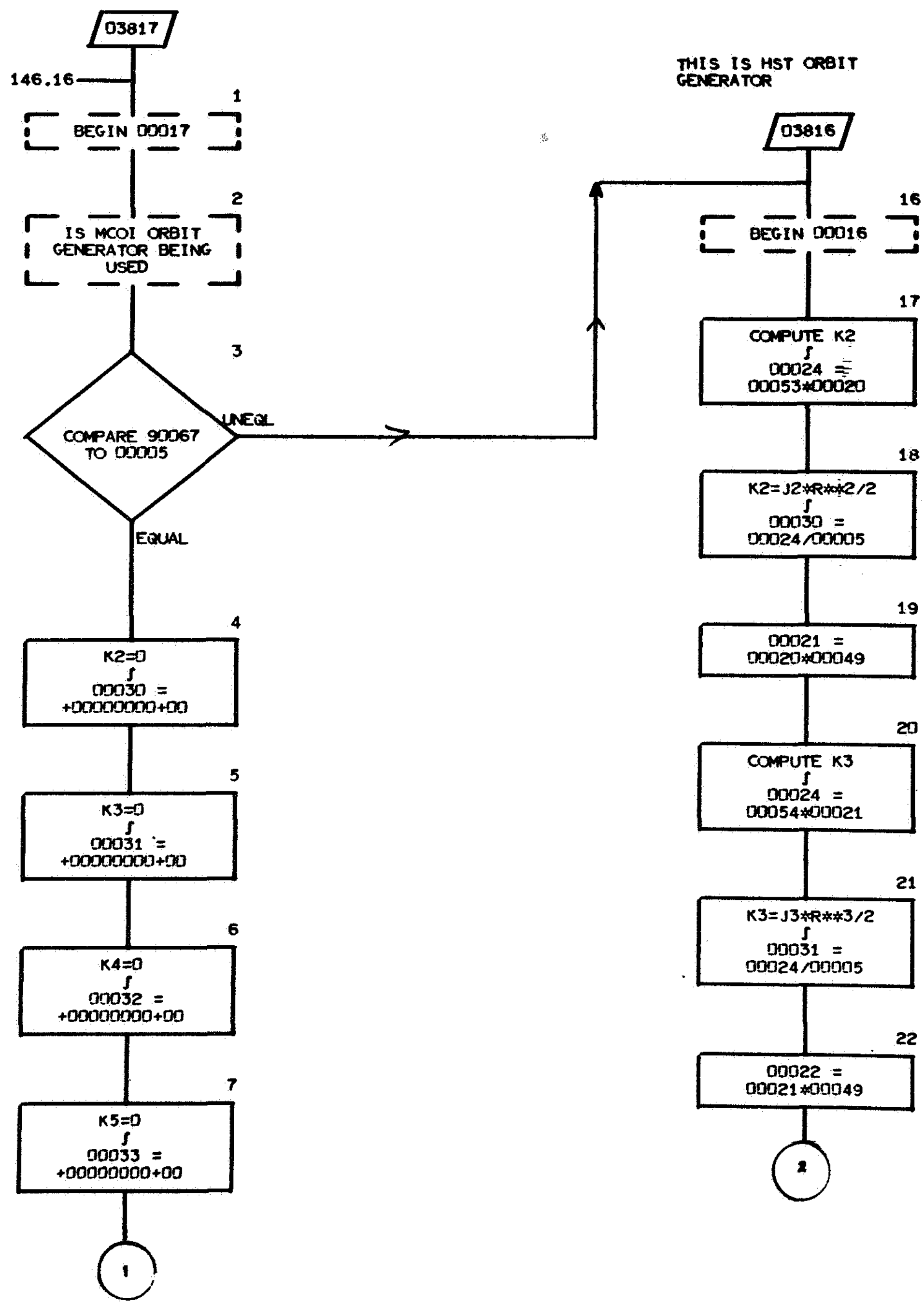

1
8
MOTION OF TAU IN RAD./ C.U.T.
00090 = 00090*00043
9
C, VELOCITY OF LIGHT IN C.U.L./SECOND
00092 = 00092/00046
10
Y COMPONENT OF U2 VECTOR FOR SUN DET.
11
9 0 . 3 7
02105
SUBROUTINE INPUT 00091 RESULT 00097
12
Z COMPONENT OF U2 VECTOR FOR SUN DET.
13
9 0 . 0 1
02101
SUBROUTINE INPUT 00091 RESULT 00098
14
MU=GM**1/2
2
22
COMPUTE C.U.T. / DAY
00037 = 00062/00043
23
COMPUTE C.U.T. / HOUR
00072 = 00073/00043
24
COMPUTE MI/C.U.L.
00036 = 00046/00063
25
(KM/C.U.L.) (C.U.T./HR.)
00067 = 00046*00072
26
(MI/C.U.L.) (C.U.T./HR.)
00045 = 00067/00063
27
COMPUTE MIN. / C.U.T.
00070 = 00043/00009
28
COMPUTE METERS / C.U.L.
00040 = 00046*00069
3
36
1 - F
00085 = 00011-00034
37
B (POLAR RADIUS OF EARTH IN C.U.L.)
00085 = 00049*00085
38
RAD/HR
00074 = 00076/00047
39
HR/MIN
00075 = 00011/00009
40
C.U.L. / ASTRONOMICAL UNIT
00082 = 00078/00046
41
(MASS OF MOON) / (MASS OF EARTH)
00083 = 00011/00080
42
CM / C.U.L.
00084 = 00046*00081

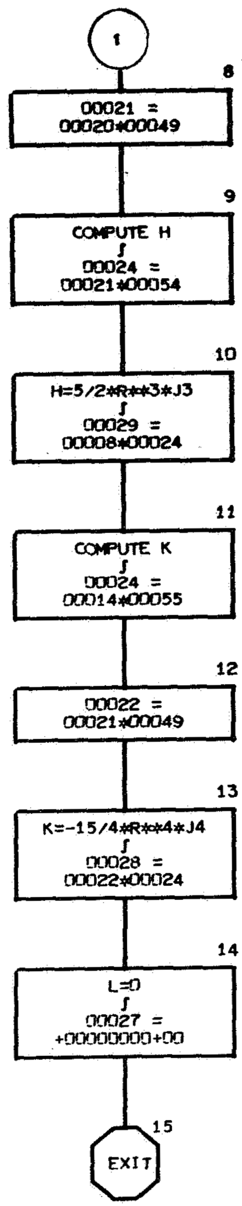
K VALUE = 03800



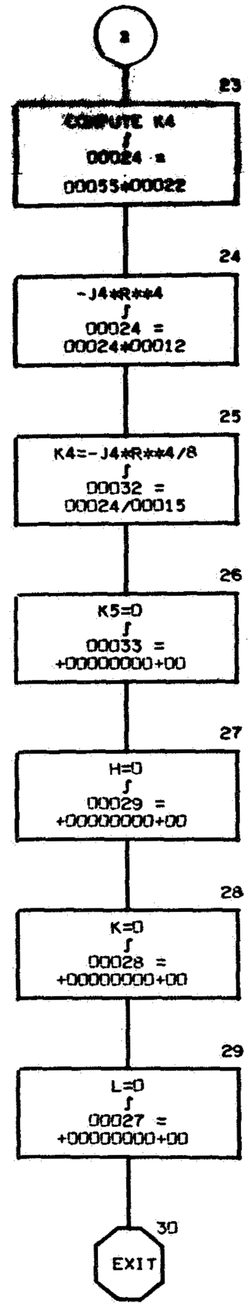

1
8
K4=0
00032 =
+00000000+00
9
K5=0
00033 =
+00000000+00
10
H=0
00029 =
+00000000+00
11
K=0
00028 =
+00000000+00
12
L=0
00027 =
+00000000+00
13
EXIT
2
21
K3=-(J3*R**3)
00031 =
00012*00024
22
COMPUTE K4
00022 =
00021*00049
23
J4*R**4
00024 =
00055*00022
24
K4=(J4*R**4)/-
2.6666667
00032 =
00024/00013
25
COMPUTE K5
00023 =
00022*00049
26
J5*R**5
00024 =
00056*00023
27
K5=-(J5*R**5)
00033 =
00012*00024

K VALUE = 03800





PAGE 147 CONTINUED



K VALUE = 03800

Q90006700099	ORBIT GENERATOR INDICATOR
Q90000000089	0=SP (88)=2**26, 1=DP (88)=2**53
Q90002202196	SQUARE ROOT
Q90003302101	SIN
Q90004402105	COS
V00005+20000000+01	
V00006+40000000+01	
V00007+15000000+01	3/2
V00008+25000000+01	5/2
V00009-60000000+02	MIN/HR
V00010+30000000+01	
V00011+10000000+01	
V00012-10000000+01	
V00013-26666667+01	-8/3
V00014-37500000+01	-15/4
V00015+80000000+01	

CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES
K VALUE = 03800		
145.01	03801	1.12*
145.07	03818	145.04
146.14	03819	146.05
147.01	03817	146.16
147.16	03816	147.03

THESE CONTENTS ARE STORED IN THIS AREA FOR USE BY OTHER PORTIONS OF THE PROGRAM.

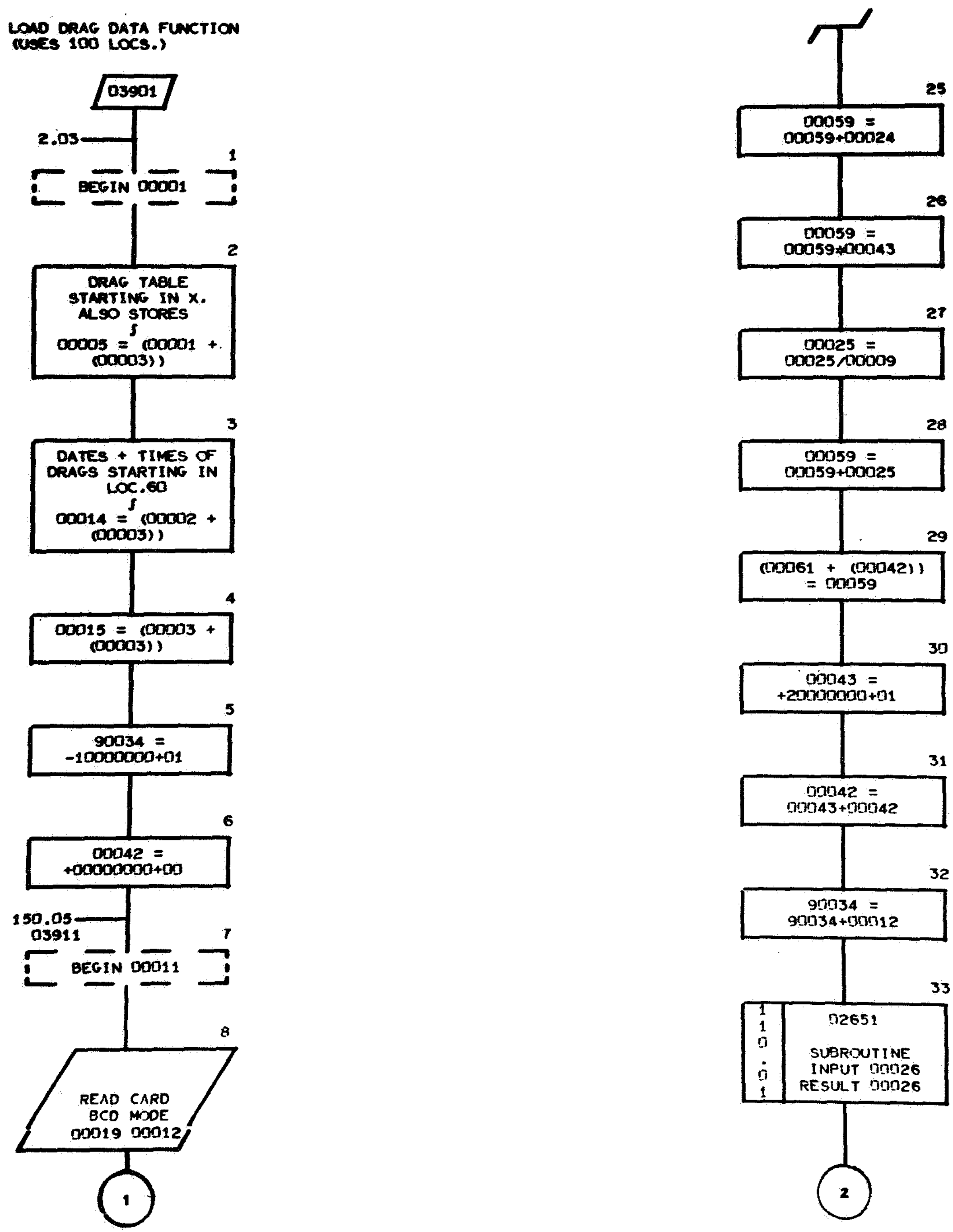
K VALUE = 03825

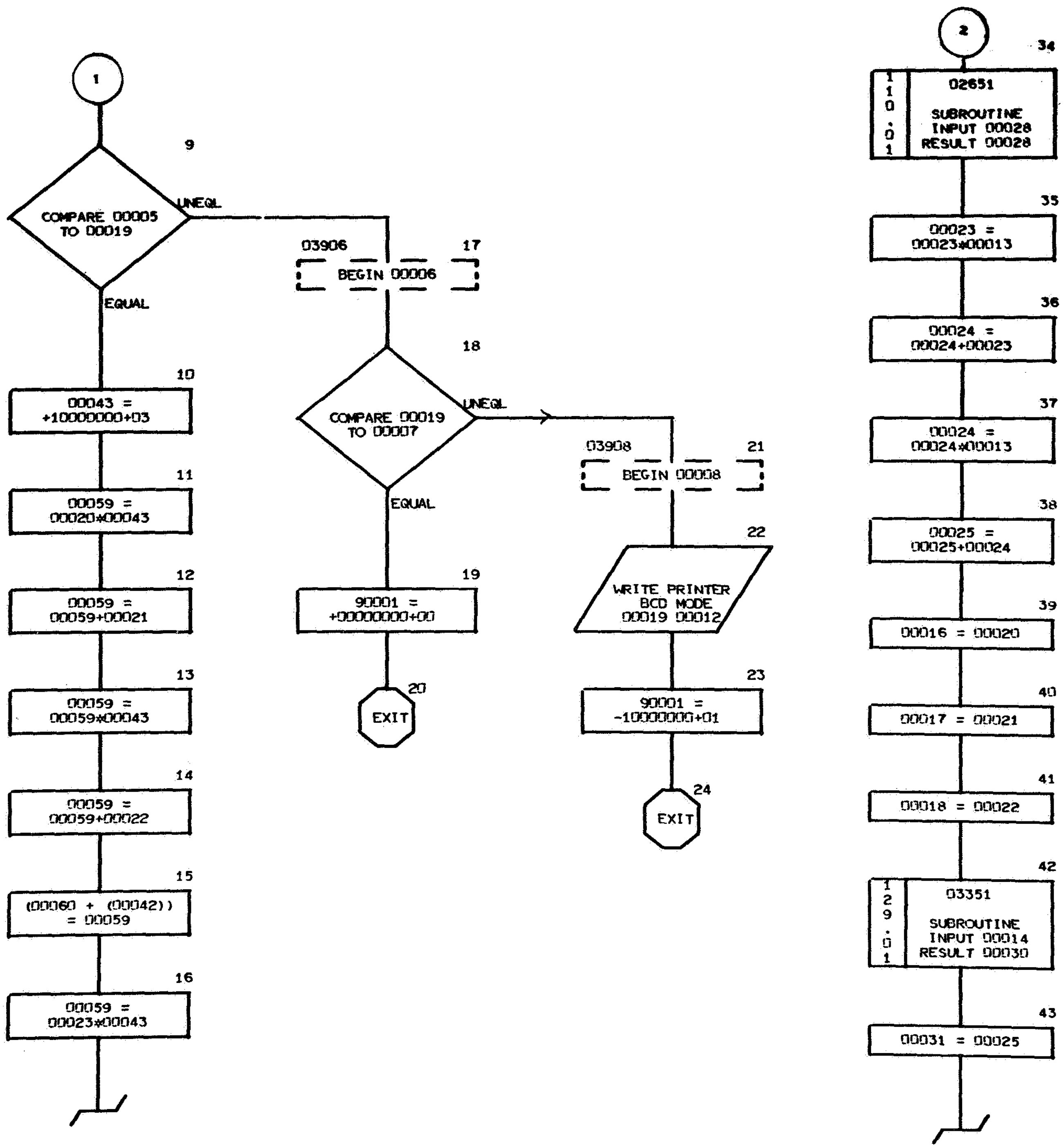
V00000+00000000+00	T1, TOL. FOR MAG.OF (R X U) IN SUN D
V00001+00000000+00	TOL. FOR (UNIT R) DOT (U) IN SUN DET
V00016+67108864+08	2**26
V00017+62831853+01	2 PI
V00018 80683200+03	SECONDS / C.U.T. (C.U.T. =
V00019+10000000-01	CRITICAL INCL. FOR BROUWER
V00021+63783880+04	KILOMETERS/C.U.L. (C.U.L. =
V00022+57295780+02	DEGREES/RADIAN
V00023+72921159-04	ROTATION OF EARTH IN RAD/SEC
V00024+10000000+01	RADIUS OF EARTH IN C.U.L.
V00025+29700000+03	
V00026+10000000+01	C
V00064+10000000+01	MU**2=GM
V00028+10821900-02	J2
V00029-22850000-05	J3
V00030-21230000-05	J4
V00031-23200000-06	J5
V00033+36000000+01	
V00034+31355885-01	SMALL H SUB 0
V00035+26666667+00	(4/3) (BETA)
V00036+62711769-02	(4/3)(H SUB 0)
V00037+86400000+05	SEC/DAY
V00038+16093472+01	KM/MI
V00044+10000000+04	M/KM
V00046+10000000+01	1+N SUB 0
V00048+36000000+04	SEC/HR
V00051+15000000+02	DEG/HR
V00052+45000000-04	SUNLIGHT PRESSURE IN DYNES / CM**2
V00053+14947300+09	KM/ASTRONOMICAL UNIT
V00054+33343200+06	(MASS OF SUN)/(MASS OF EARTH)
V00055+81450000+02	(MASS OF EARTH)/(MASS OF MOON)
V00056+10000000+06	CM/KM
V00065+19910638-06	MOTION OF TAU IN RAD./ SECOND
V00066+40915752+00	23 DEG. 26 MIN. 34.795 SEC.
V00067+29979250+06	C, VELOCITY OF LIGHT IN KM. / SECOND
V00068+10000000+01	X COMPONENT OF U1 VECTOR FOR SUN DET
V00069+00000000+00	Y COMPONENT OF U1 VECTOR FOR SUN DET
V00070+00000000+00	Z COMPONENT OF U1 VECTOR FOR SUN DET
V00071+00000000+00	X COMPONENT OF U2 VECTOR FOR SUN DET

CROSS REFERENCE LISTING

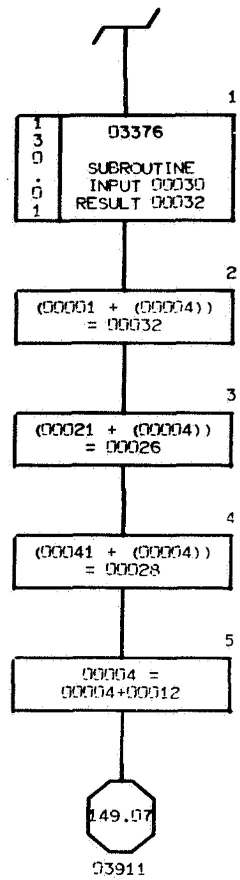
PAGE BOX	LABEL	REFERENCES
K VALUE = 03825		
149.01	03901	2.03*
149.07	03911	150.05
149.17	03906	149.09
149.21	03908	149.18

K VALUE = 03900




1
9
COMPARE 00005 TO 00019
UNEQL
EQUAL
10
00043 = +10000000+03
11
00059 = 00020*00043
12
00059 = 00059+00021
13
00059 = 00059*00043
14
00059 = 00059+00022
15
(00060 + (00042)) = 00059
16
00059 = 00023*00043
03906
17
BEGIN 00006
18
COMPARE 00019 TO 00007
UNEQL
EQUAL
19
90001 = +00000000+00
20
EXIT
03908
21
BEGIN 00008
22
WRITE PRINTER BCD MODE 00019 00012
23
90001 = -10000000+01
24
EXIT
2
34
110.01
02651
SUBROUTINE INPUT 00028 RESULT 00028
35
00023 = 00023*00013
36
00024 = 00024+00023
37
00024 = 00024*00013
38
00025 = 00025+00024
39
00016 = 00020
40
00017 = 00021
41
00018 = 00022
42
129.01
03351
SUBROUTINE INPUT 00014 RESULT 00030
43
00031 = 00025

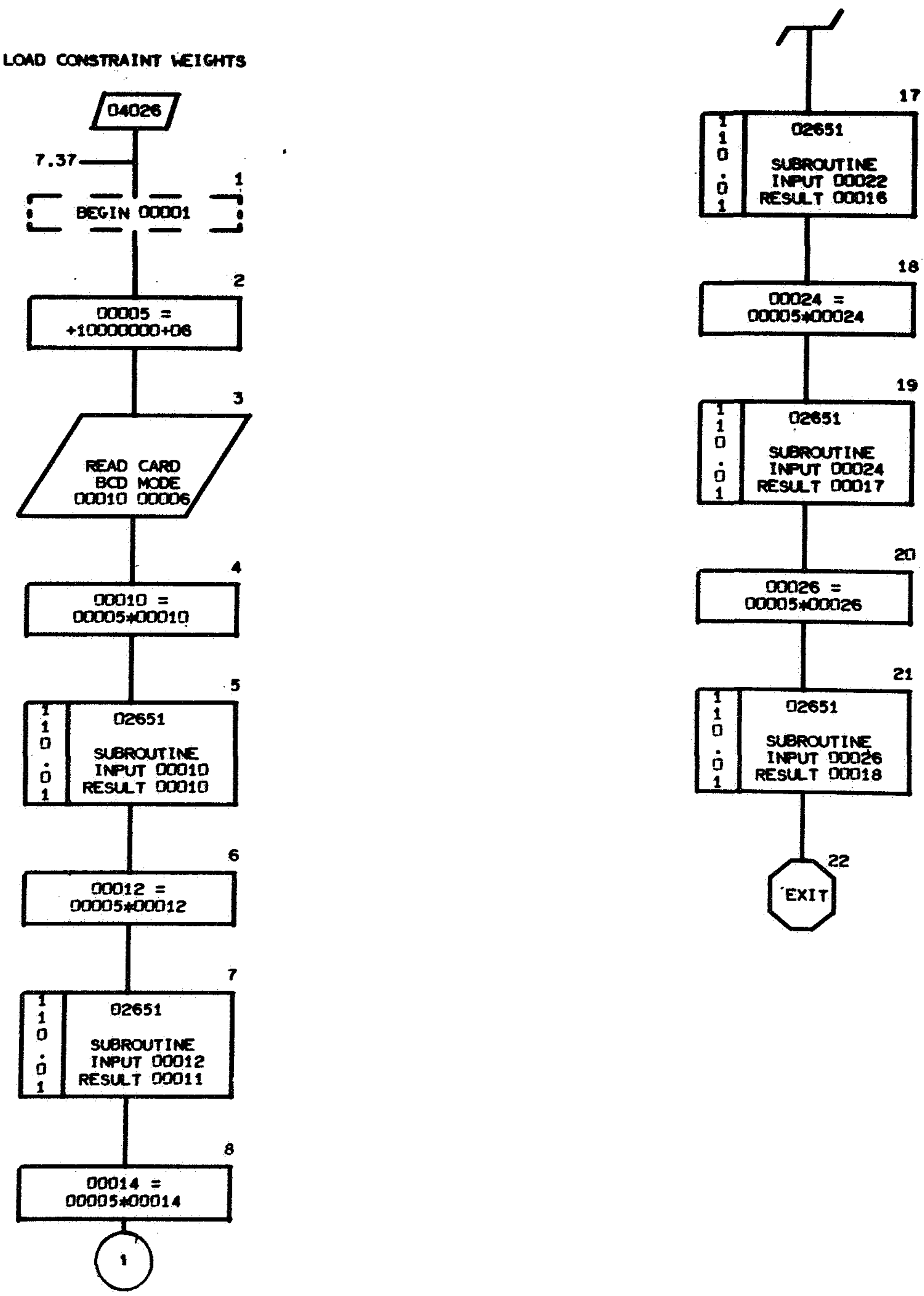
K VALUE = 03900



```
        K VALUE = 03900
Q9000100006              ERROR INDICATOR
Q9000202651              INPUT CONVERTER F.
Q9000303351              OBS. DATE TO J.D. F.
Q9000403376              JULIAN DAYS-SECONDS TO C.U.T.
Q9003400002              NO. OF T(P,Q)"S - 1
V00007+00000000+00        ENTER WITH (Z)= SAT. ID. NO., (Z+1)
V00009+10000000+04        OF REF., (Z+2)= DAYS JAN.1- DAY OF
V00012+10000000+01        EXIT WITH (X)=T(P,Q) IN CUT,...(X+2
V00013+60000000+02        N(2,Q),...(X+40)= N(3,Q)... I.E., W
```

K VALUE = 04025

LOAD CONSTRAINT WEIGHTS



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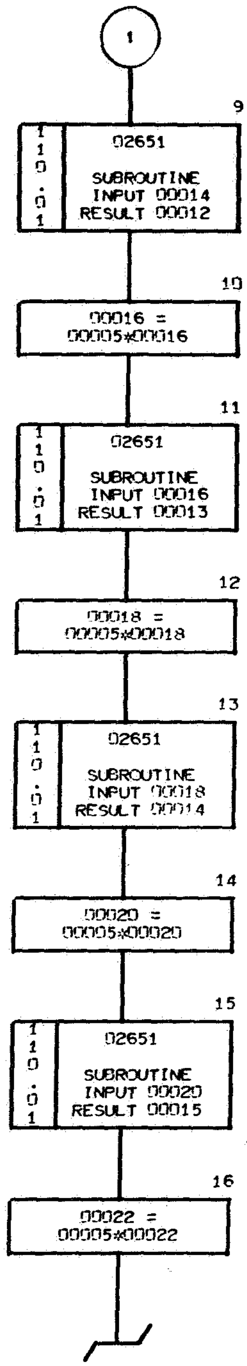


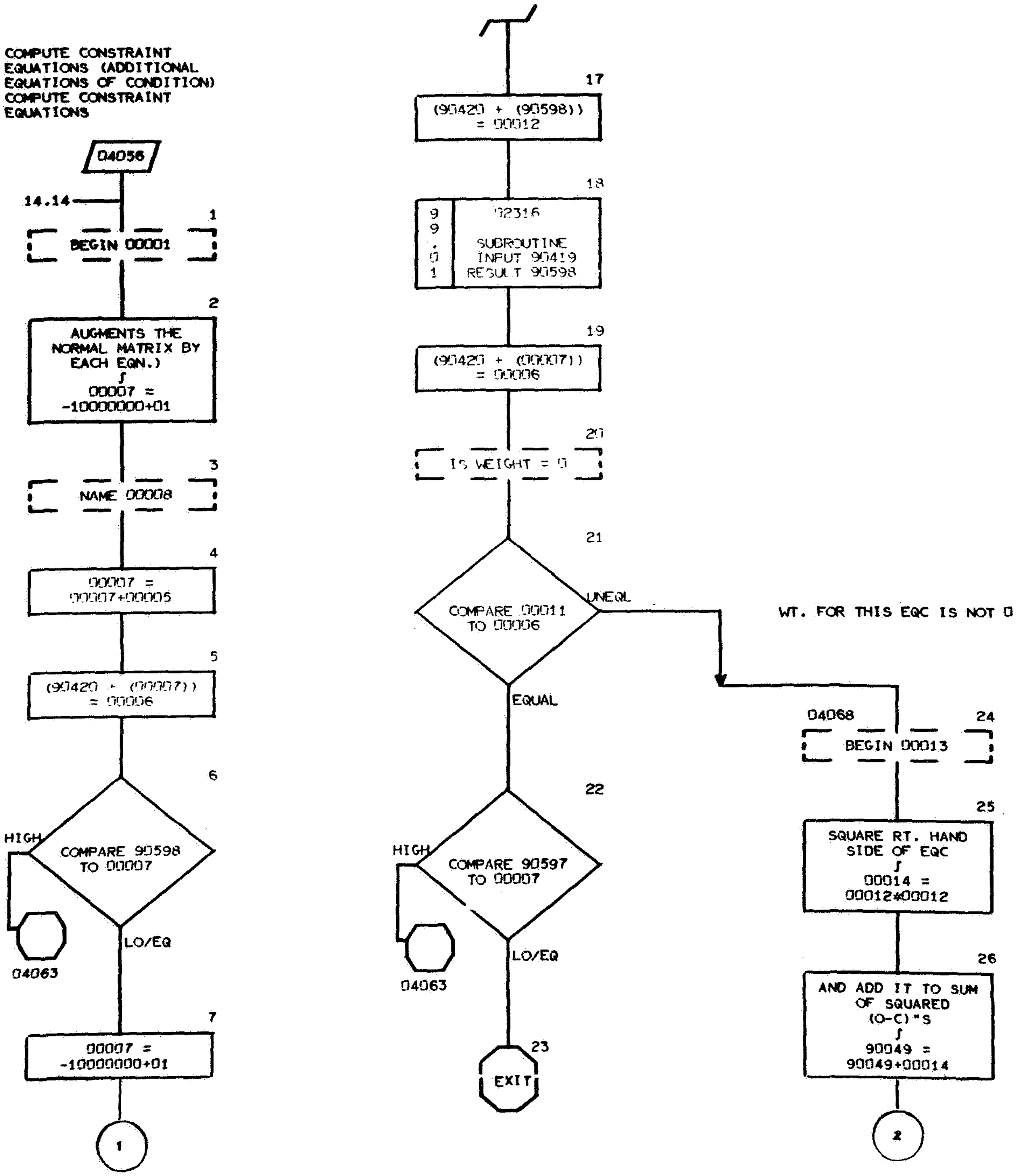
CROSS REFERENCE LISTING

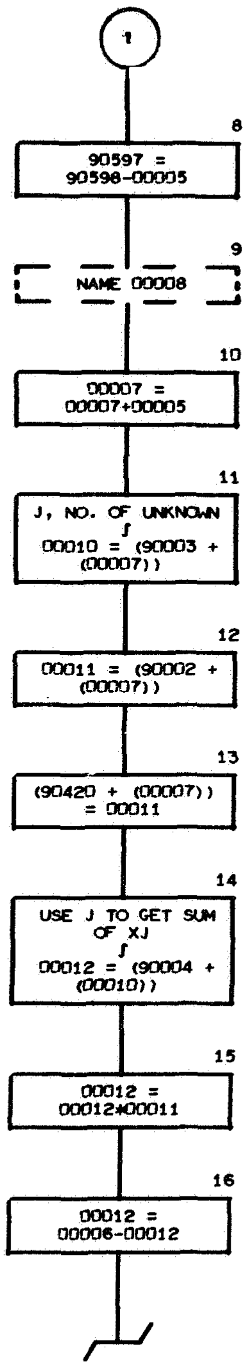
PAGE BOX	LABEL	REFERENCES
	K VALUE = 04025	
151.01	04026	7.37*

K VALUE = 04025

Q9000102651	INPUT CONVERTER
V00006+10000000+01	ONE

K VALUE = 04055





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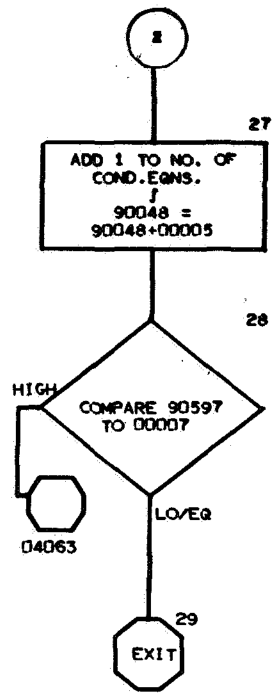
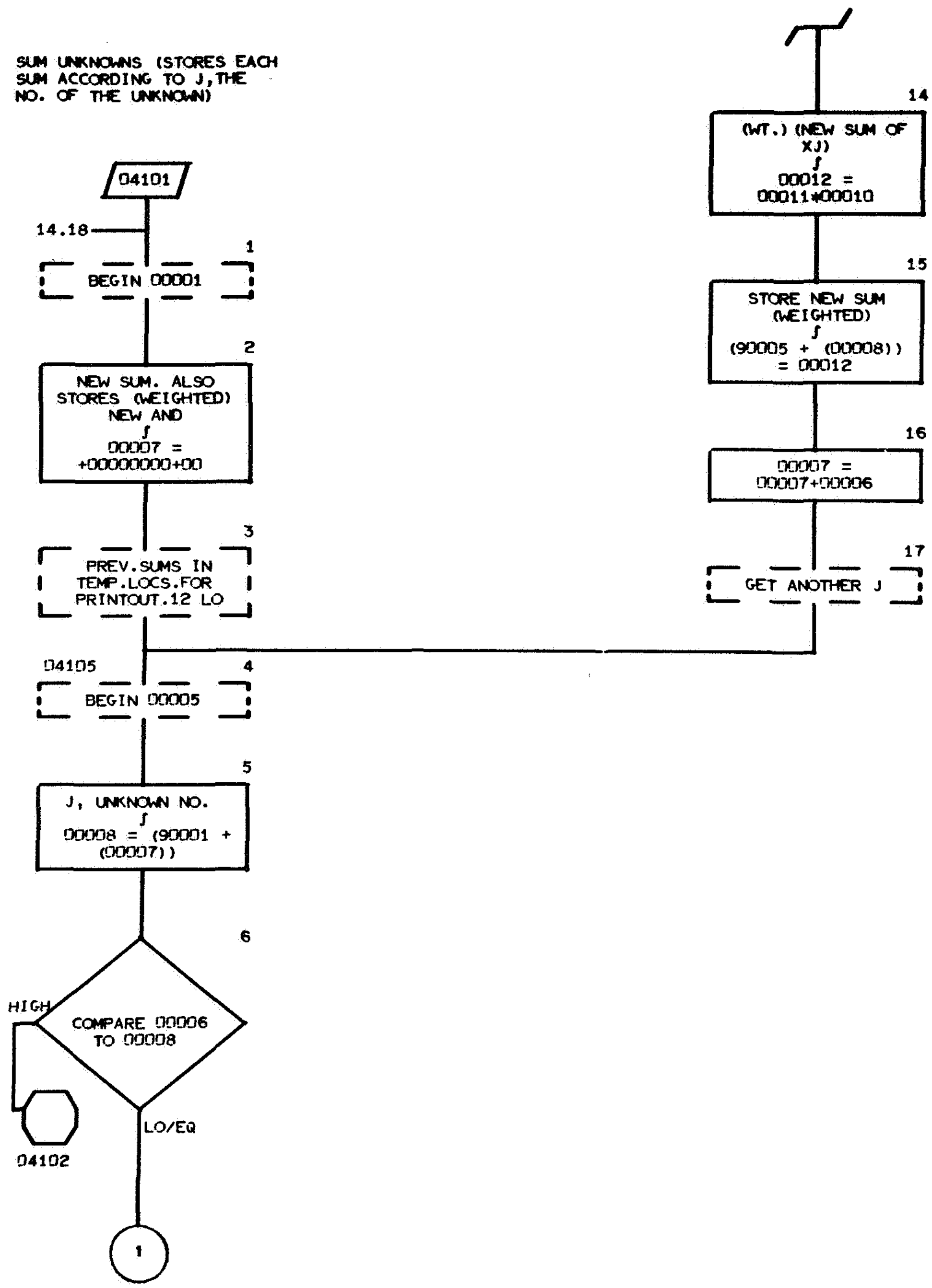


```
        K VALUE = 04055
Q9059800598                  M
Q9059700580                  M-1
Q9042000420
Q9000102316                  AUGMENT MATRIX
Q9000204035                  WEIGHTS
Q9000300400                  FIRST LOC. OF UNKNOWN NO"S
Q9000404200                  LOC.PRECEDING FIRST OF SUMS OF XJ
Q9041900419
Q9004800048                  N, NO.OF CONDITION EQNS.
Q9004900049                  SUM OF SQUARED (O-C)"S
V00005+10000000+01            (COMPUTES AN EQUATION OF CONDITION
V00006+00000000+00            EACH UNKNOWN BEING SOLVED FOR, AND
```

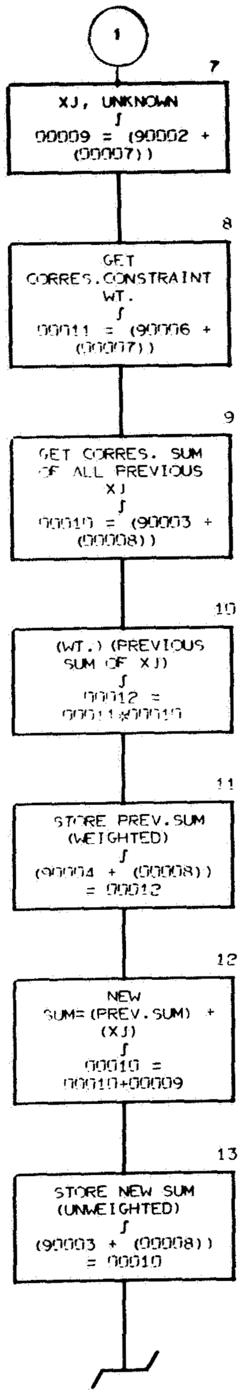
CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES
K VALUE = 04055		
152.01	04056	14.14*
152.24	04068	152.21

K VALUE = 04100



PAGE 153 CONTINUED



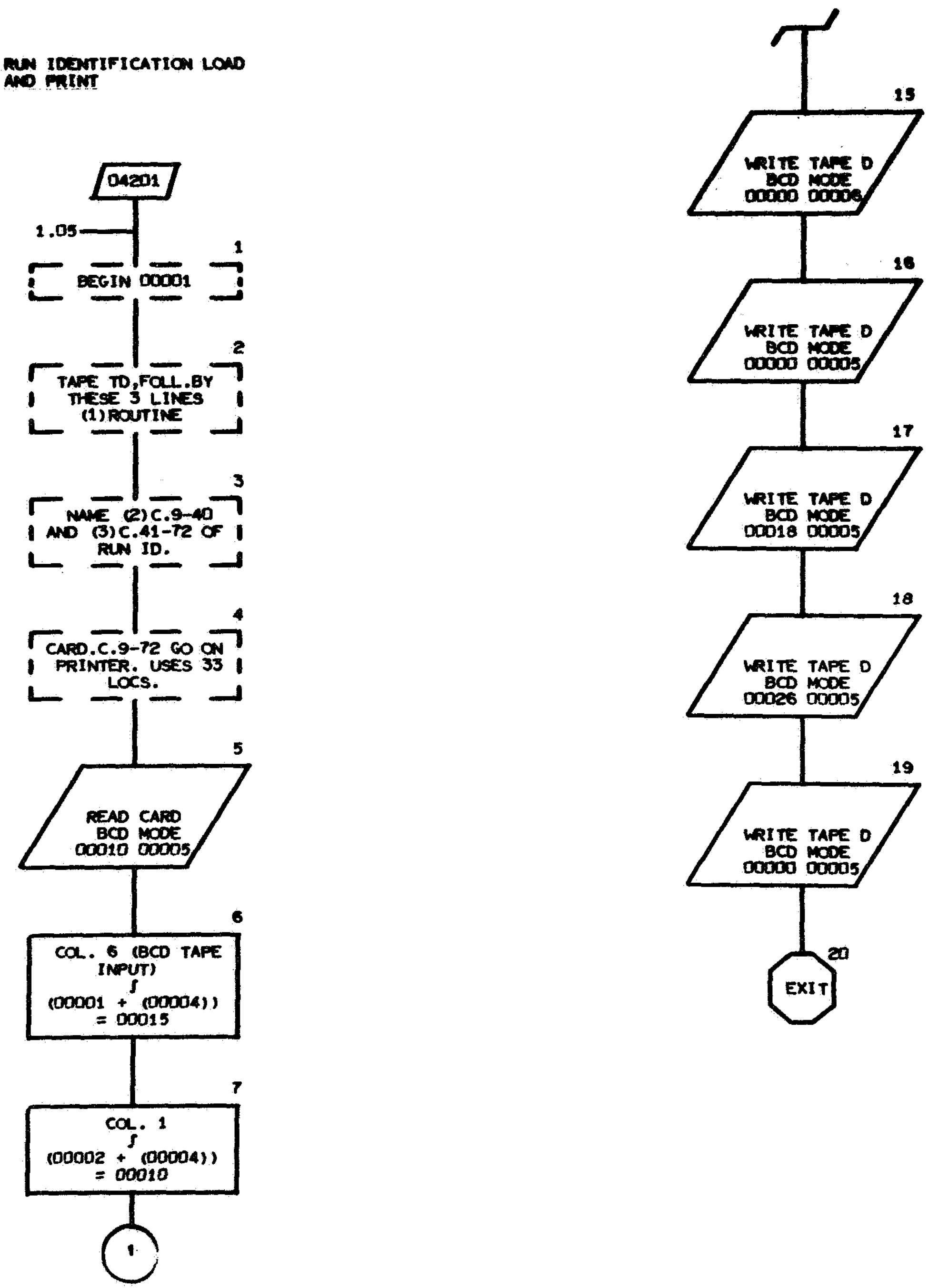
```
        K VALUE = 04100
Q9000100400                 FIRST LOC. OF UNKNOWN NO'S,J
Q9000200441                 FIRST LOC. OF UNKNOWNS, XJ
Q9000304200                 LOC.PRECEDING(UNWEIGHTED)SUMS OF XJ
Q9000400700                 LOC.PRECEDING (WEIGHTED) PREV.SUMS O
Q9000500800                 LOC.PRECEDING (WEIGHTED) SUMS OF XJ
Q9000604035                 FIRST LOC.OF CONSTRAINT WEIGHTS
V00006+10000000+01           GET SUM OF PREV.XJ, ADDS XJ TO IT +
```

CROSS REFERENCE LISTING

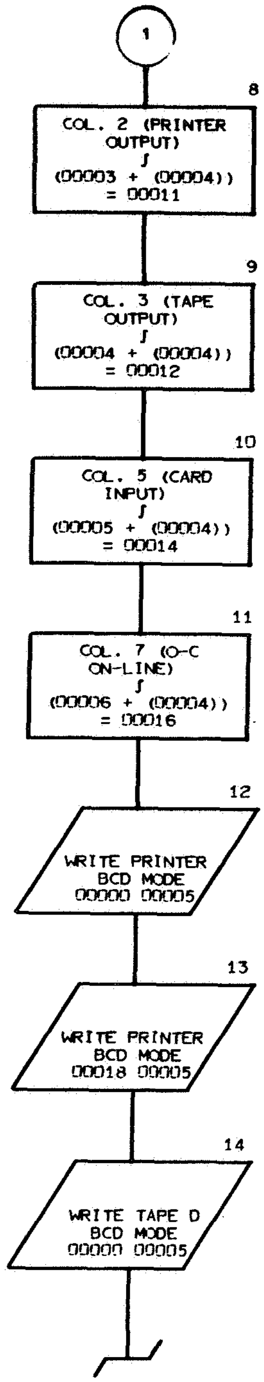
PAGE BOX	LABEL	REFERENCES
	K VALUE = 04100	
153.01	04101	14.18*
153.04	04105	153.17

K VALUE = 04200

RUN IDENTIFICATION LOAD AND PRINT



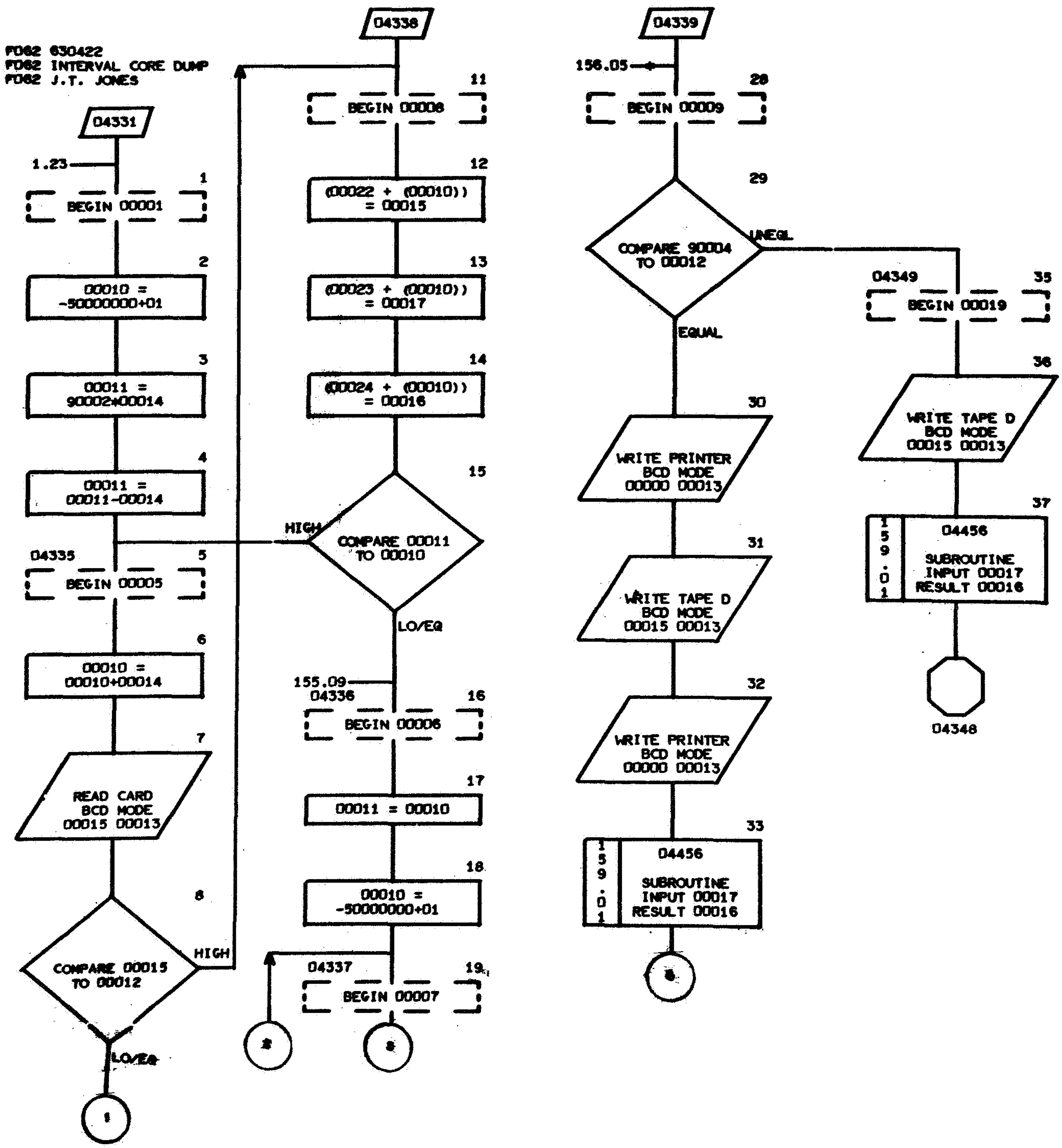
PAGE 154 CONTINUED



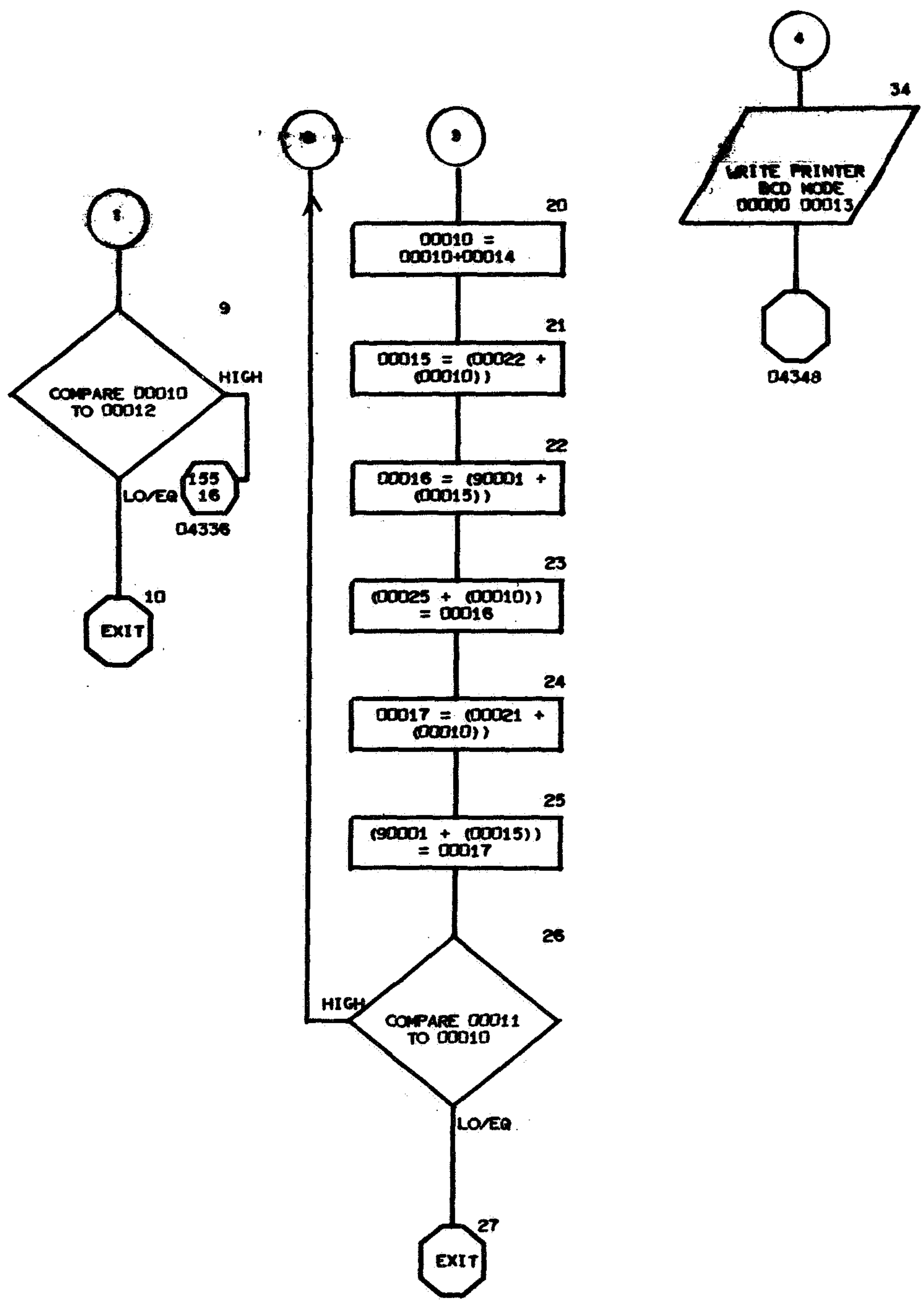
```
      K VALUE = 04200
Q9000100099                   ORBIT GENERATOR IDENTIFICATION
V00005+10000000+01             1,2,3,4,5,7    (ALPHABETIC) IN X...X
V00006+60000000+01             LINES OF PRINT CONTROL CHAR.ARE WRI

        CROSS REFERENCE LISTING
  PAGE BOX       LABEL       REFERENCES
        K VALUE = 04200
   154.01        04201        1.05*
```

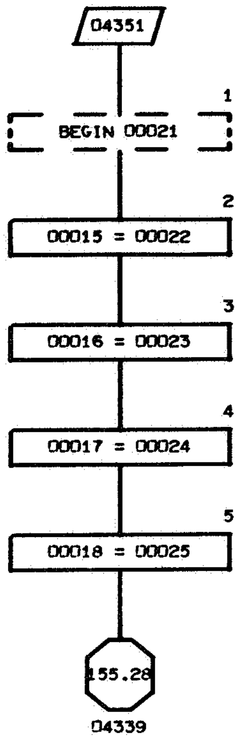
K VALUE = 04330

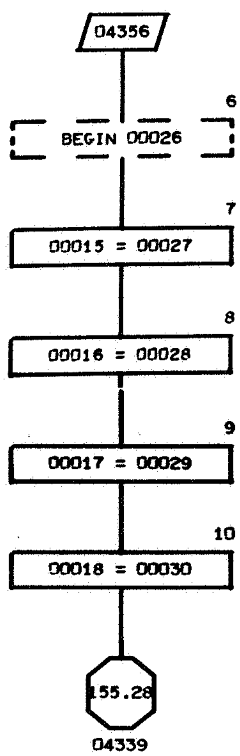


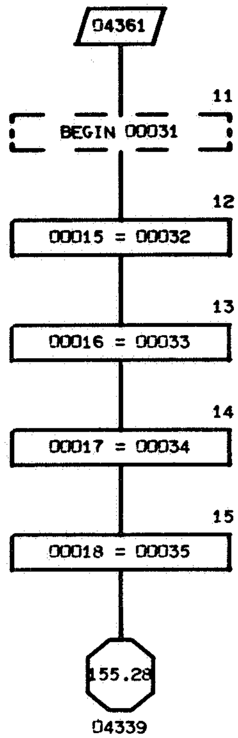
PAGE 155 CONTINUED

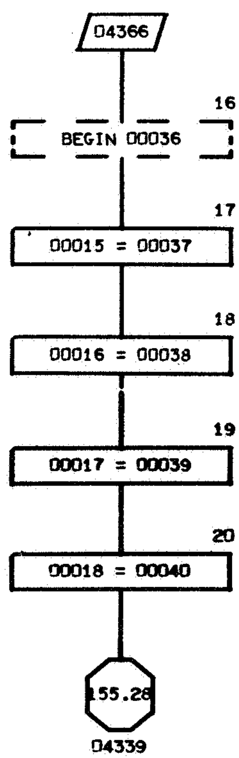


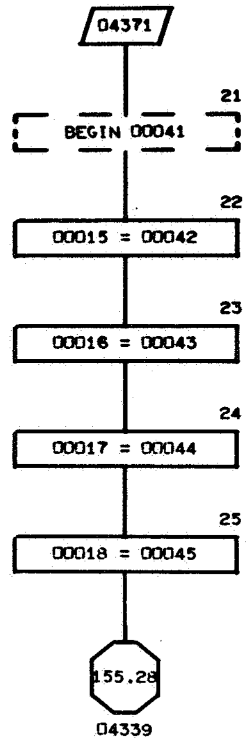
K VALUE = 04330

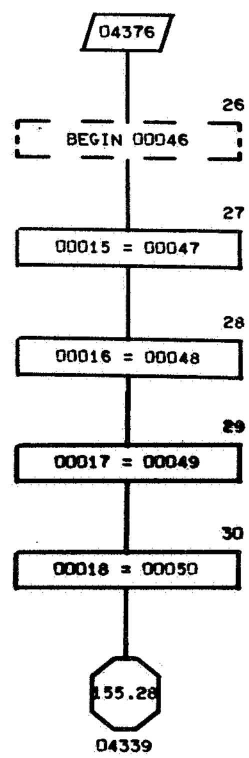




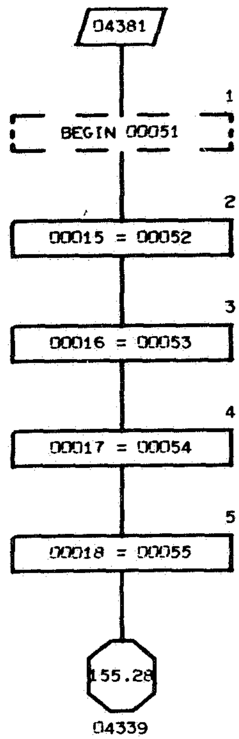


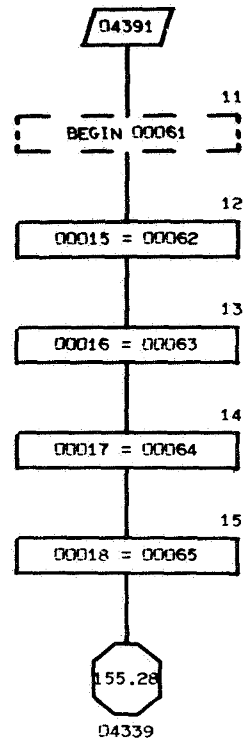


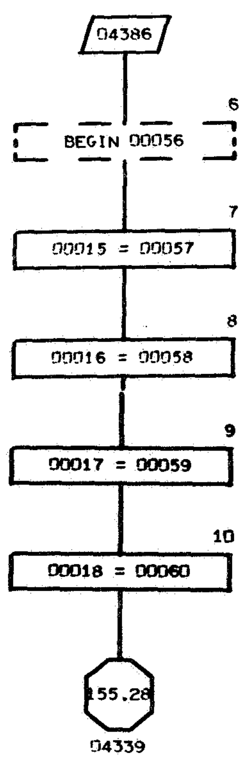


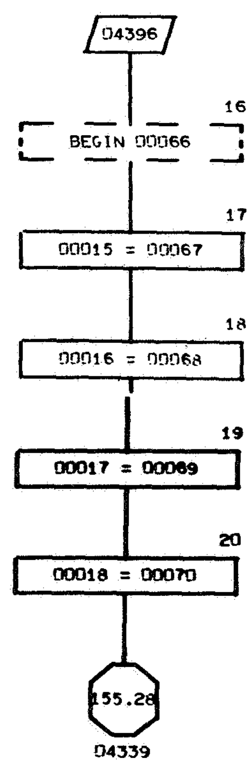


K VALUE = 04330









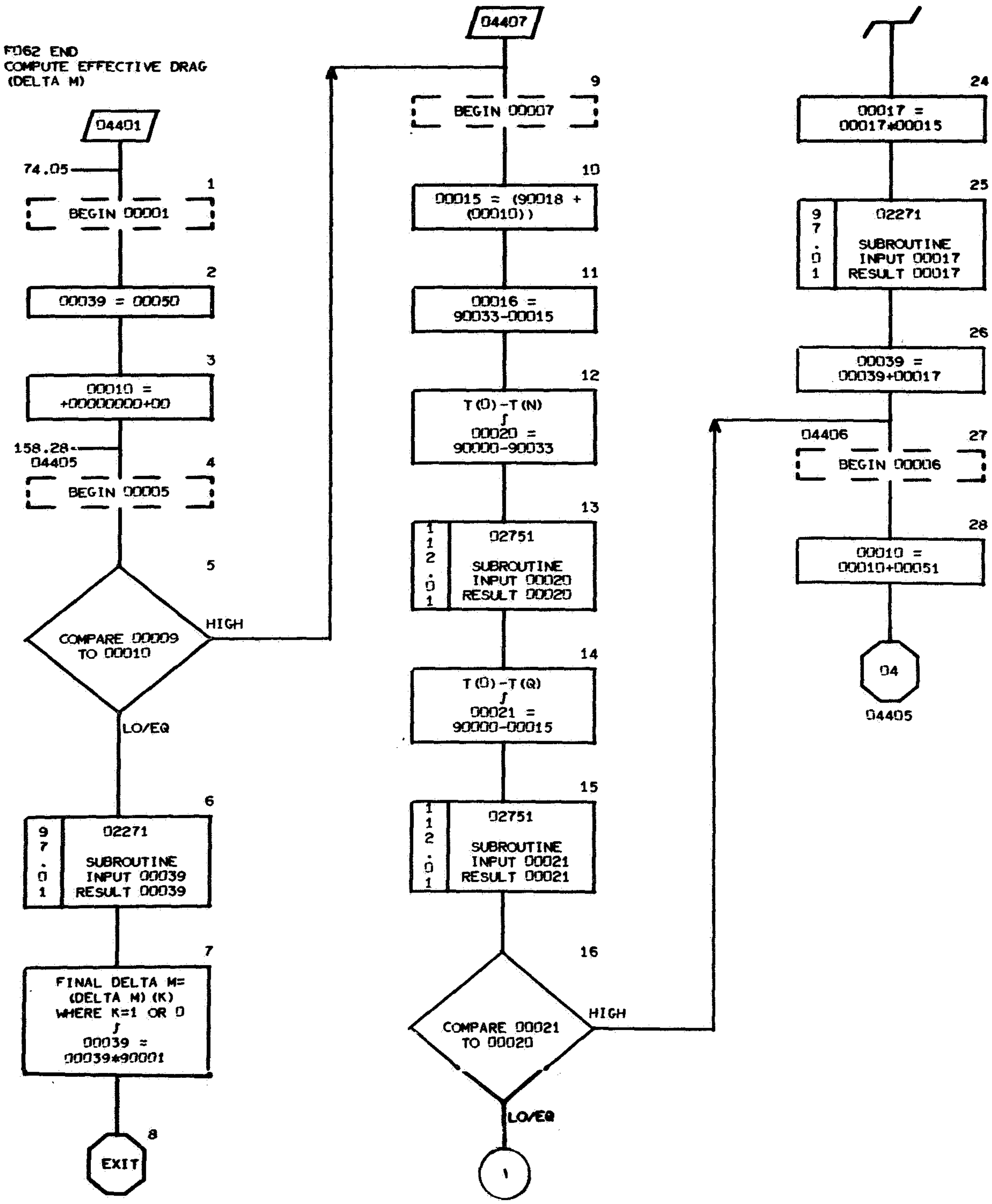
CROSS-REFERENCE LISTING

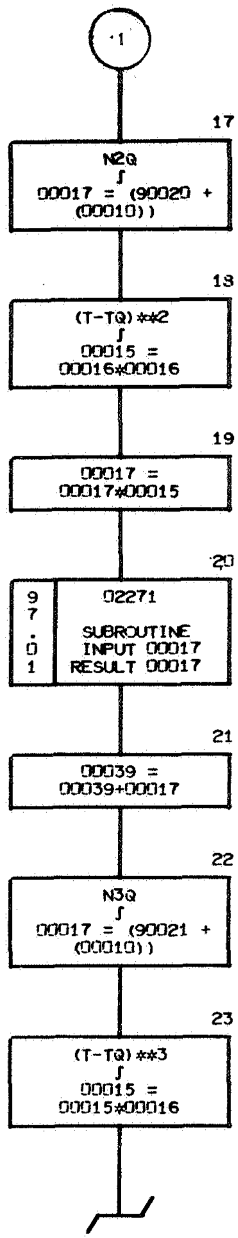
PAGE BOX	LABEL	REFERENCES						
	K VALUE = 04330							
155.01	04331	1.23*						
155.05	04335	155.15						
155.11	04338	155.08						
155.16	04336	155.09						
155.19	04337	155.26						
155.28	04339	156.05	156.10	156.15	156.20	156.25	156.30	157.05
		157.10	157.15	157.20				
155.35	04349	155.29						
156.01	04351							
156.06	04356							
156.11	04361							
156.16	04366							
156.21	04371							
156.26	04376							
157.01	04381							
157.06	04386							
157.11	04391							
157.16	04396							

K VALUE = 04330

```
Q9000100000
Q9000200465          N=MAX. OF IP DUMP REQUESTS
Q9000304456
Q9000400466          OUTPUT OPTION
V00012+00000000+00
V00013+10000000+01
V00014+50000000+01
```

K VALUE = 04400




1
17
N2Q
00017 = (90020 +
(00010))
18
(T-TQ)**2
00015 =
00016*00016
19
00017 =
00017*00015
20
97.01
02271
SUBROUTINE
INPUT 00017
RESULT 00017
21
00039 =
00039+00017
22
N3Q
00017 = (90021 +
(00010))
23
(T-TQ)**3
00015 =
00015*00016

CROSS REFERENCE LISTING

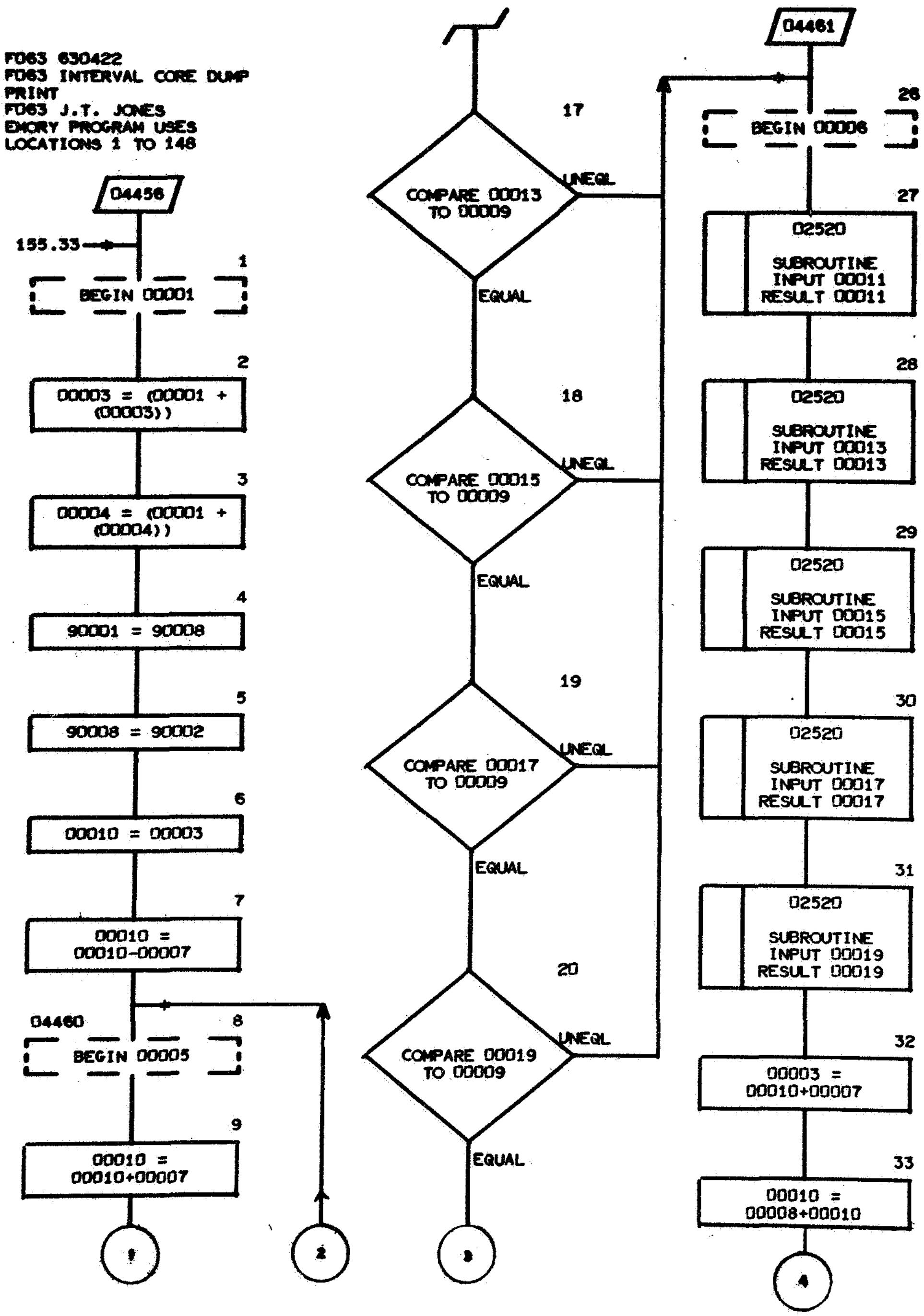
PAGE BOX	LABEL	REFERENCES
	K VALUE = 04400	
158.01	04401	74.05*
158.04	04405	158.28
158.09	04407	158.05
158.27	04406	158.16

K VALUE = 04400

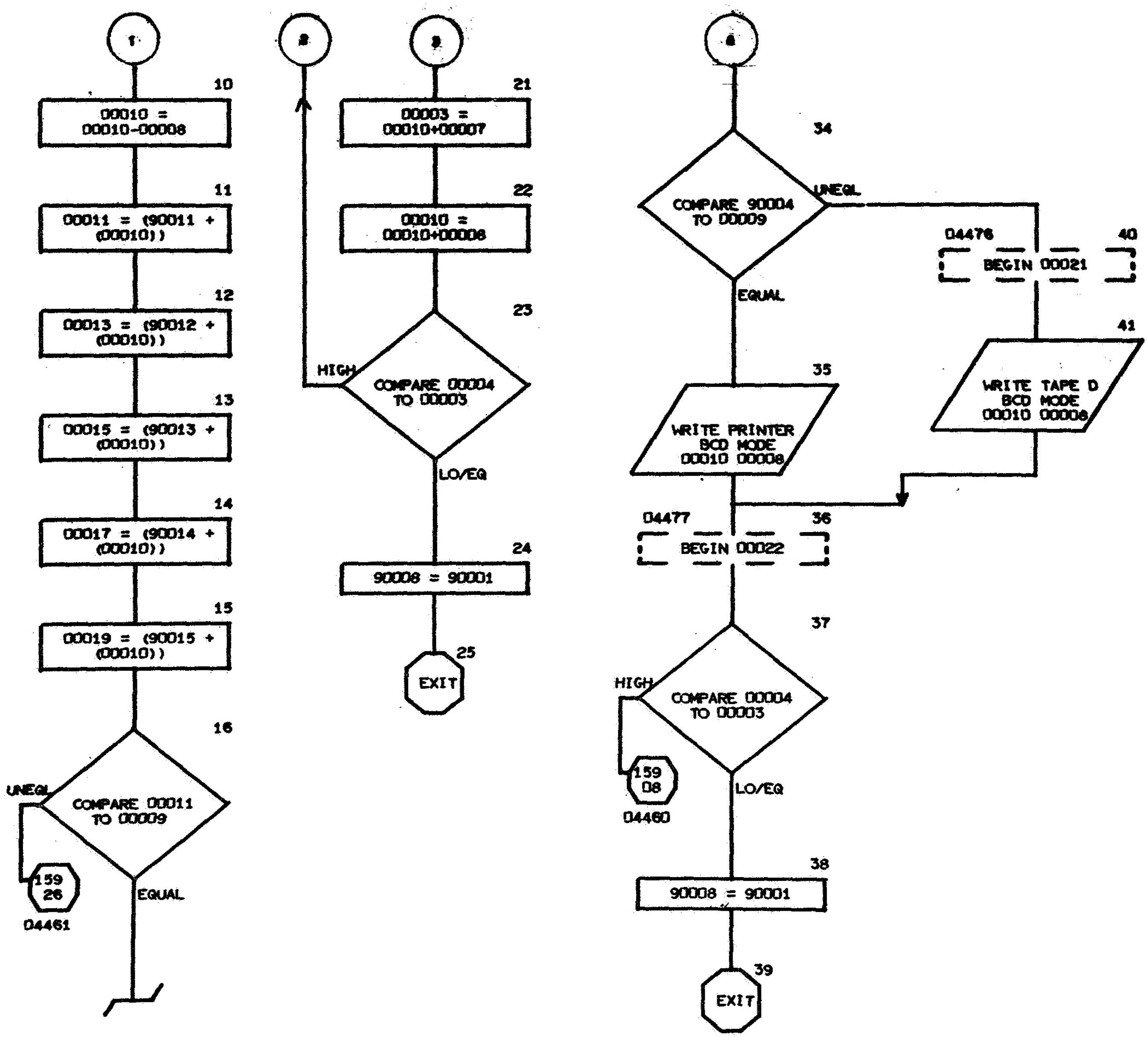
Q0000901197	NO. OF T(P,Q)"S
Q9000001100	T(0), EPOCH TIME IN C.U.T.
Q9000100462	K, MULTIPLIER FOR DELTA M (K= 1 OR
Q9001801130	T(P,Q)"S TIMES OF DRAGS IN C.U.T.
Q9002001150	N(2,Q)"S
Q9002101170	N(3,Q)"S
Q9003300200	OBS. TIME IN C.U.T.
Q9009002271	PRINCIPAL VALUE
Q9009102751	ABSOLUTE VALUE
V00050+00000000+00	
V00051+10000000+01	

K VALUE = 04455

FD63 630422
FD63 INTERVAL CORE DUMP PRINT
FD63 J.T. JONES
EMORY PROGRAM USES
LOCATIONS 1 TO 148



PAGE 159 CONTINUED

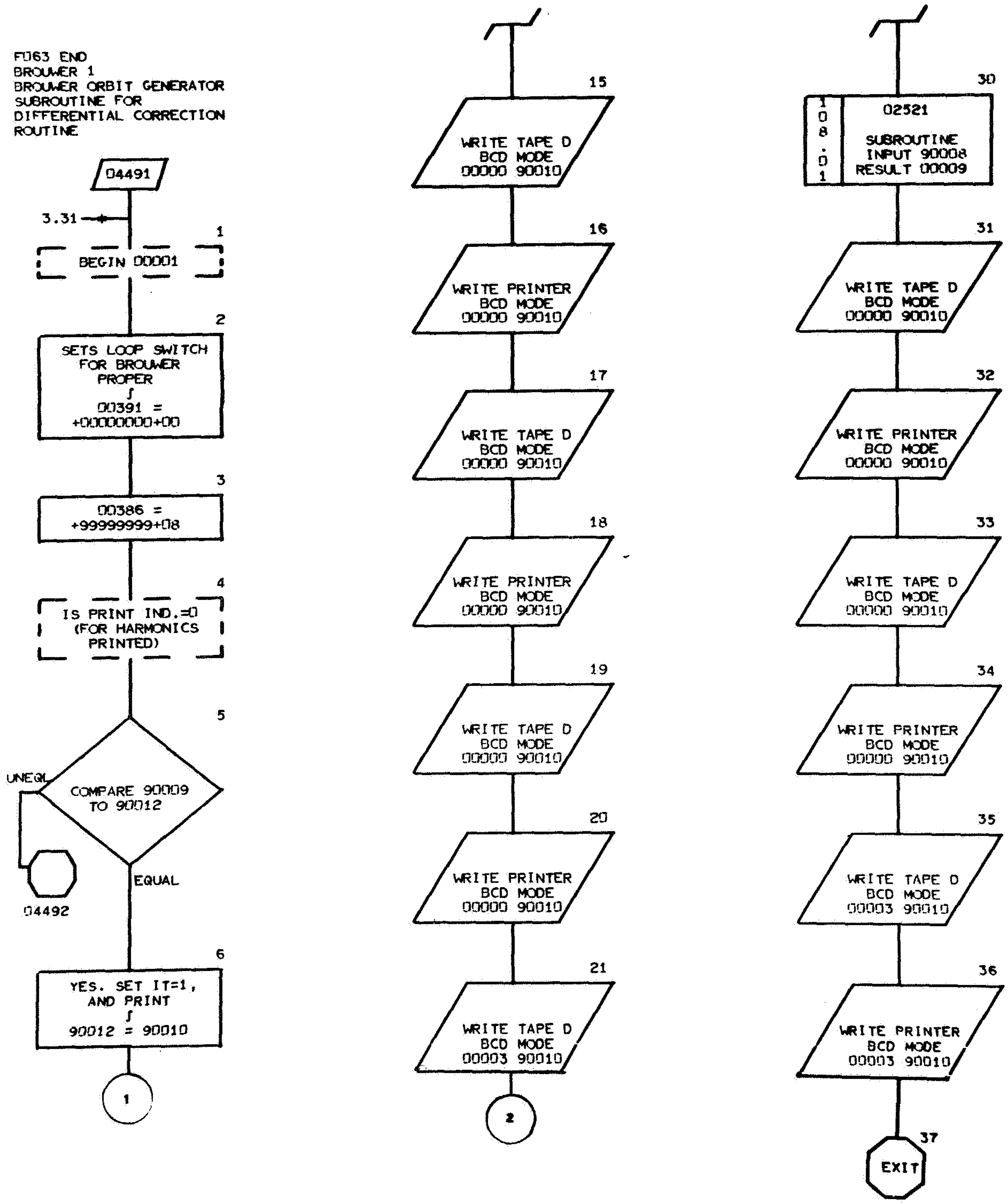


```
K VALUE = 04455
Q9000102650                 K OF OPS F. + 130 ,INPUT CONVERTER
Q9000202649                 K OF OPS F. + 129 '
Q9000302520                 OUTPUT SCALE F.
Q9000400042                 OUTPUT OPTION
Q9000600069                 SINGLE PRECISION
Q9001100001
Q9001200002
Q9001300003
Q9001400004
Q9001500005
V00007+50000000+01
V00008+10000000+01
V00009+00000000+00
```

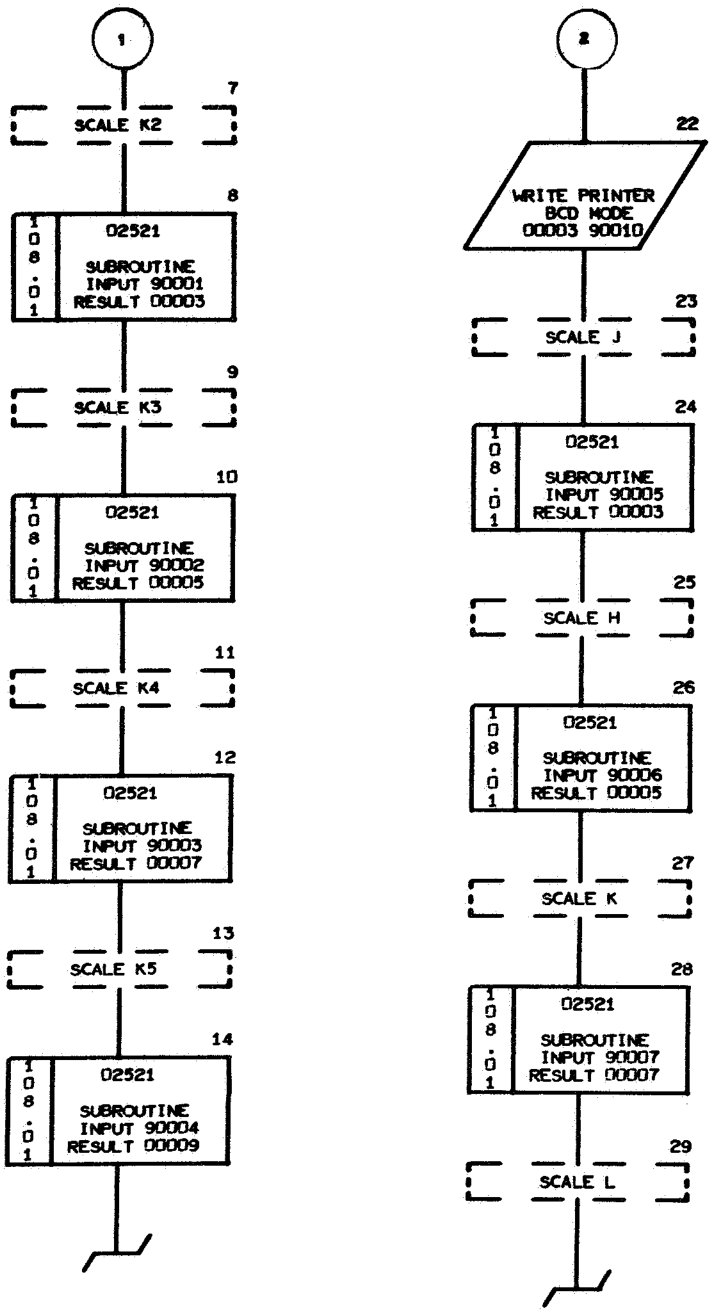
CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES				
K VALUE = 04455						
159.01	04456	155.33*	155.37*			
159.08	04460	159.23	159.37			
159.26	04461	159.16	159.17	159.18	159.19	159.20
159.36	04477	159.41				
159.40	04476	159.34				

K VALUE = 04490



PAGE 160 CONTINUED



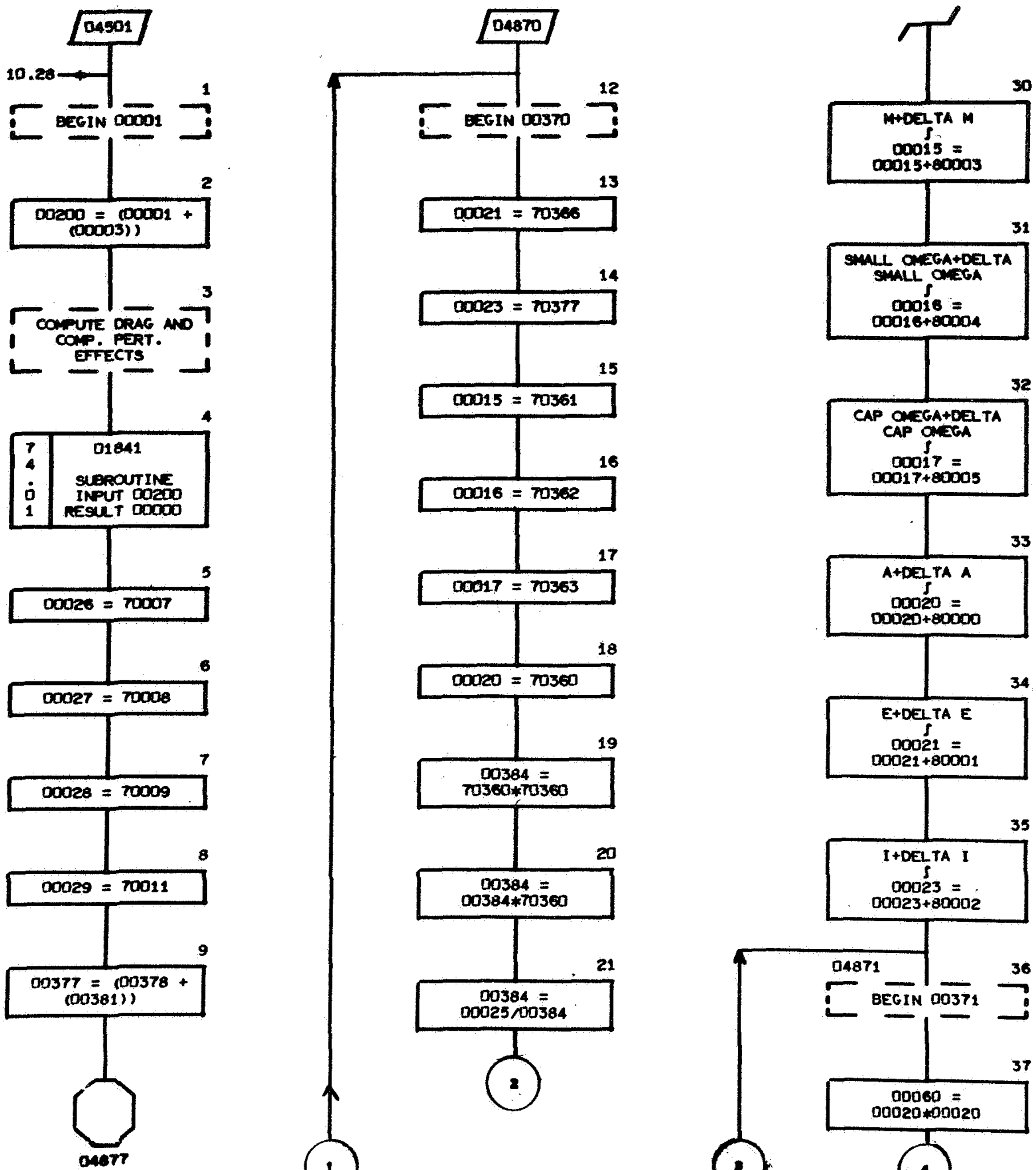
K VALUE = 04490

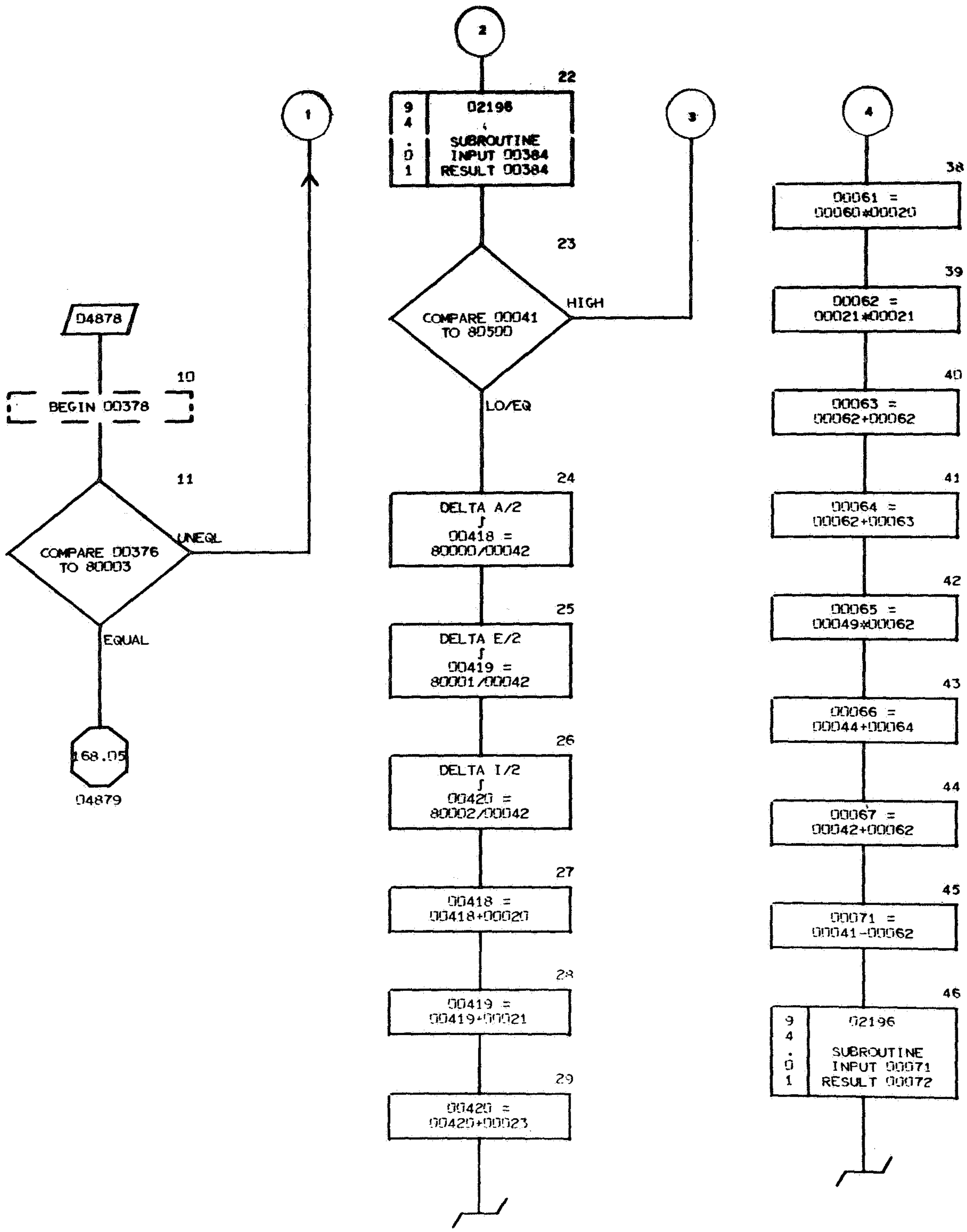
Q9000103830	K 2
Q9000203831	K 3
Q9000303832	K 4
Q9000403833	K 5
Q9000503864	J
Q9000603829	H
Q9000703828	K
Q9000803827	L
Q9000900010	ZERO
Q9001000011	ONE
Q9001102521	OUTPUT SCALE
Q9001202290	PRINT IND.
V90012+00000000+00	SET PRINT IND.

CROSS REFERENCE LISTING

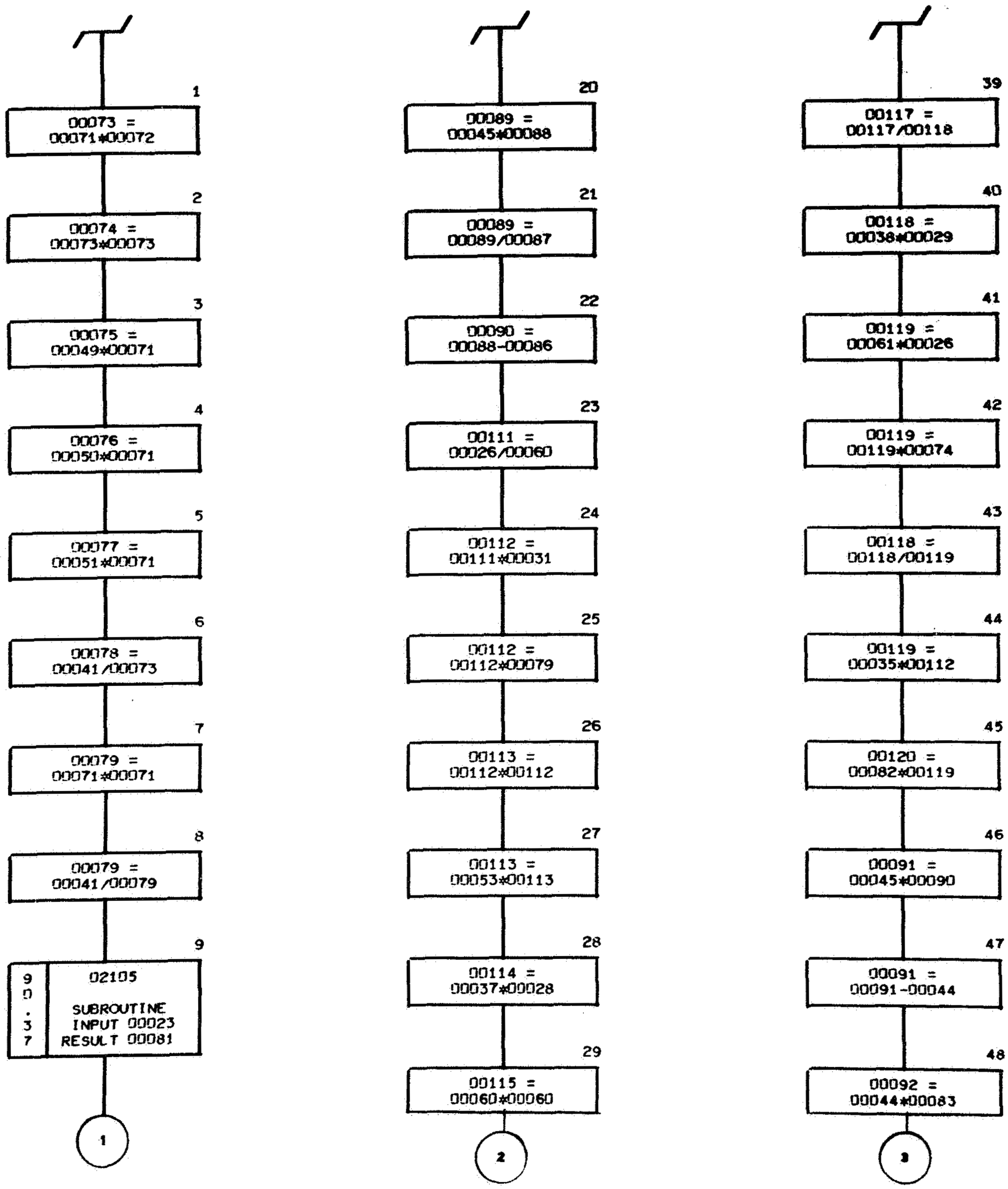
PAGE BOX	LABEL	REFERENCES	
K VALUE = 04490			
160.01	04491	3.31*	10.03*

K VALUE = 04500

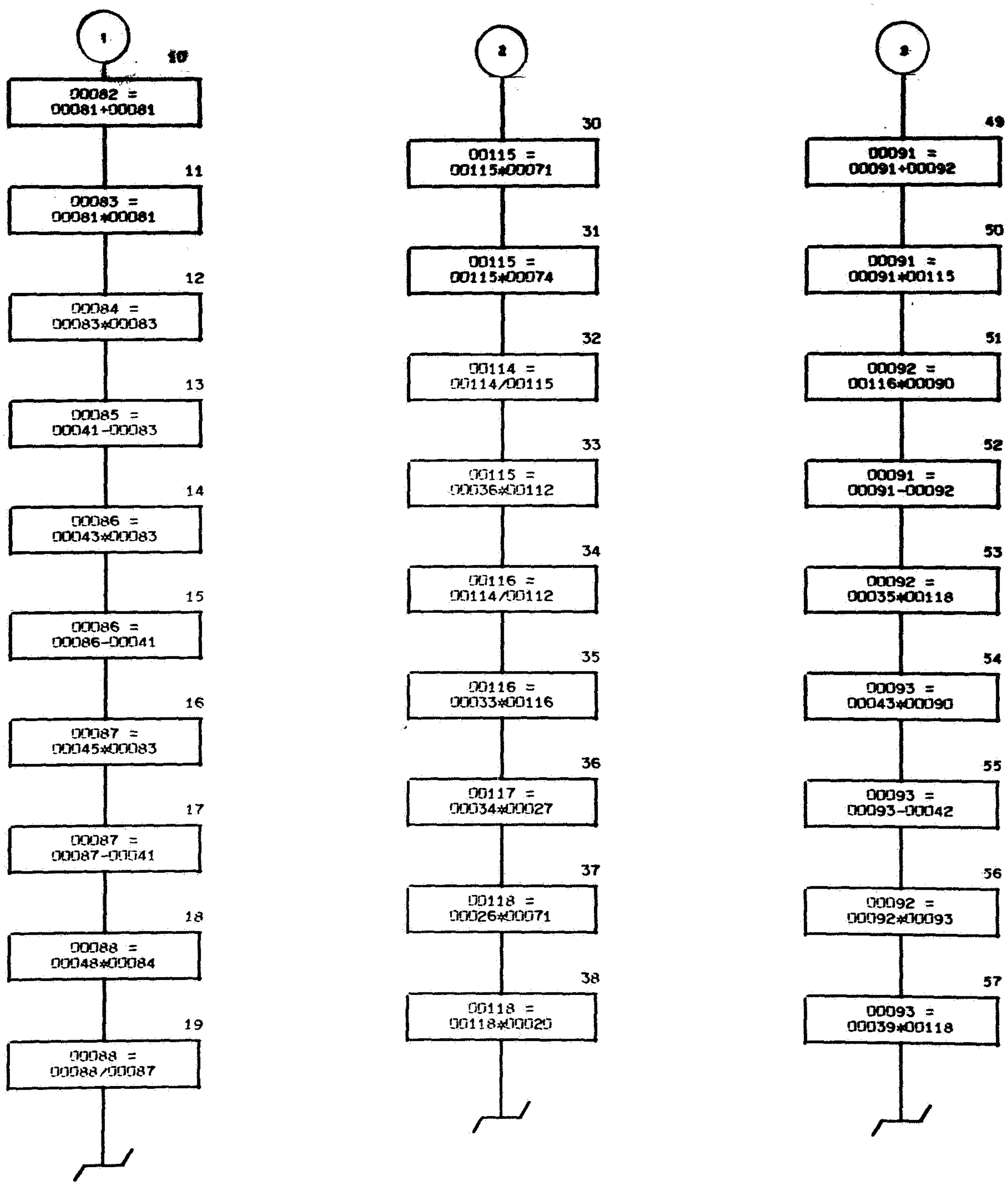



2
22
9
4
.
0
1
02198
SUBROUTINE
INPUT 00384
RESULT 00384
23
COMPARE 00041
TO 80500
HIGH
LO/EQ
3
24
DELTA A/2
00418 =
80000/00042
25
DELTA E/2
00419 =
80001/00042
26
DELTA I/2
00420 =
80002/00042
27
00418 =
00418+00020
28
00419 =
00419+00021
29
00420 =
00420+00023
1
04878
10
BEGIN 00378
11
COMPARE 00376
TO 80003
UNEQL
EQUAL
168.05
04879
4
38
00061 =
00060*00020
39
00062 =
00021*00021
40
00063 =
00062+00062
41
00064 =
00062+00063
42
00065 =
00049*00062
43
00066 =
00044+00064
44
00067 =
00042+00062
45
00071 =
00041-00062
46
9
4
.
0
1
02196
SUBROUTINE
INPUT 00071
RESULT 00072

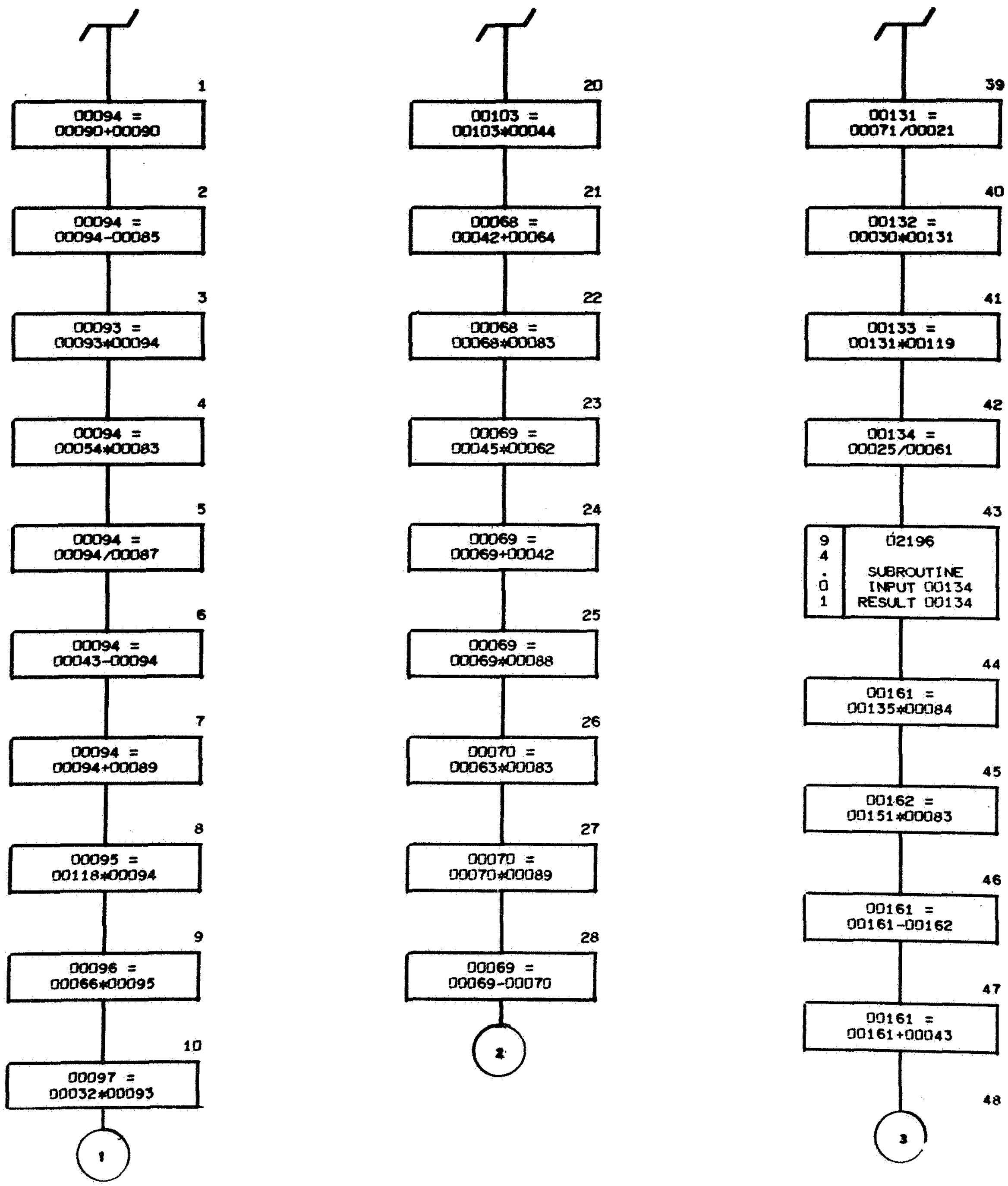
K VALUE = 04500



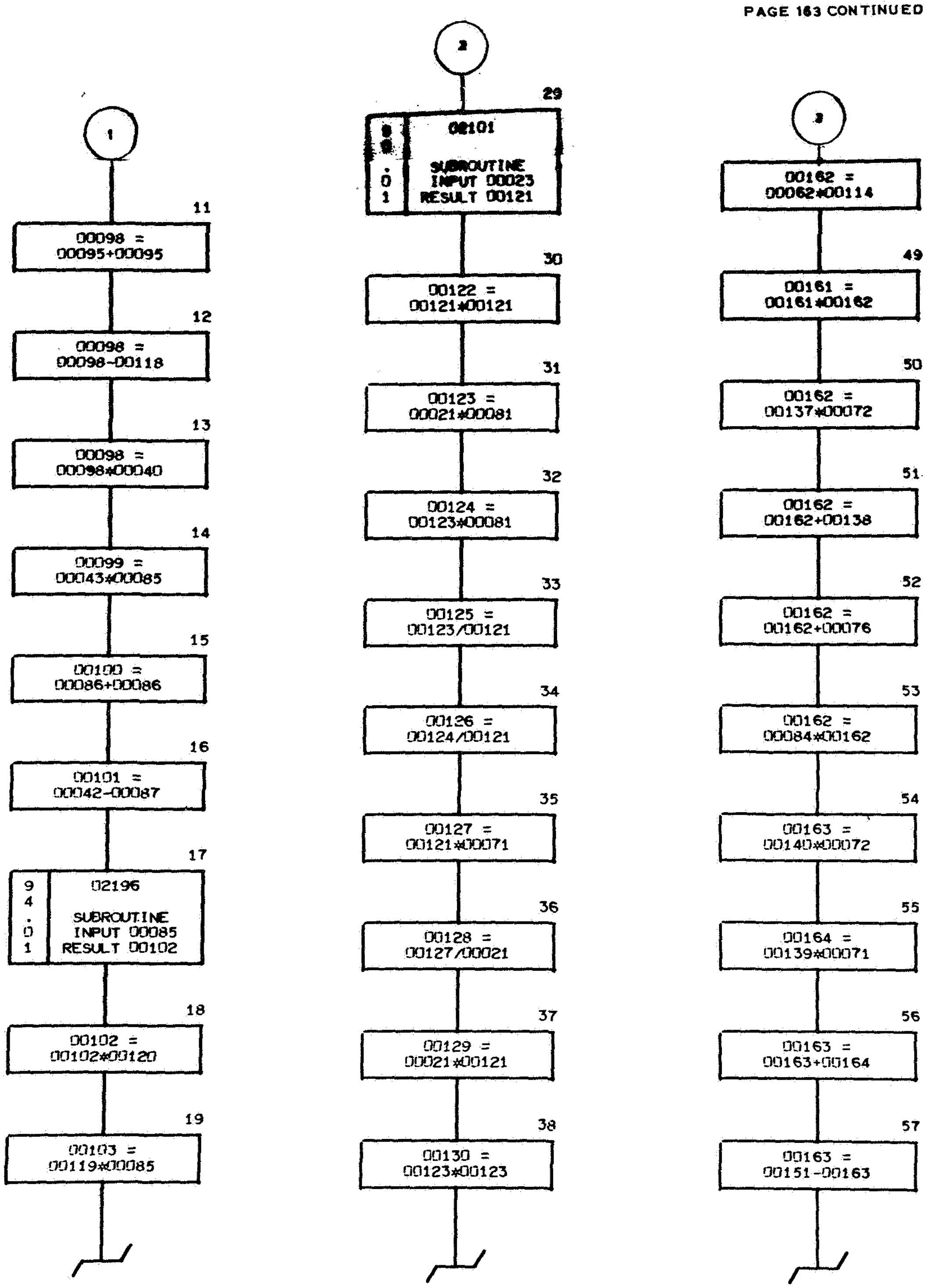
PAGE 162 CONTINUED



K VALUE = 04500



PAGE 163 CONTINUED



K VALUE = 04500

1 00163 = 00083*00163

2 00164 = 00054*00072

3 00164 = 00164-00141

4 00164 = 00164+00076

5 00164 = 00164+00163

6 00164 = 00164+00162

7 00164 = 00164*00113

8 00164 = 00164+00161

9 00163 = 00112*00086

10 00164 = 00164+00163

(1)

20 00162 = 00162-00075

21 00162 = 00162*00114

22 00162 = 00162*00032

23 00163 = 00071*00146

24 00164 = 00072*00145

25 00163 = 00163+00164

26 00163 = 00163+00144

27 00163 = 00084*00163

28 00164 = 00143*00072

29 00164 = 00139-00164

(2)

39 00163 = 00112*00087

40 00162 = 00162+00163

41 S-2 ʃ 00162 = 00162*00134

42 00163 = 00045*00071

43 00164 = 00136*00072

44 00163 = 00163+00164

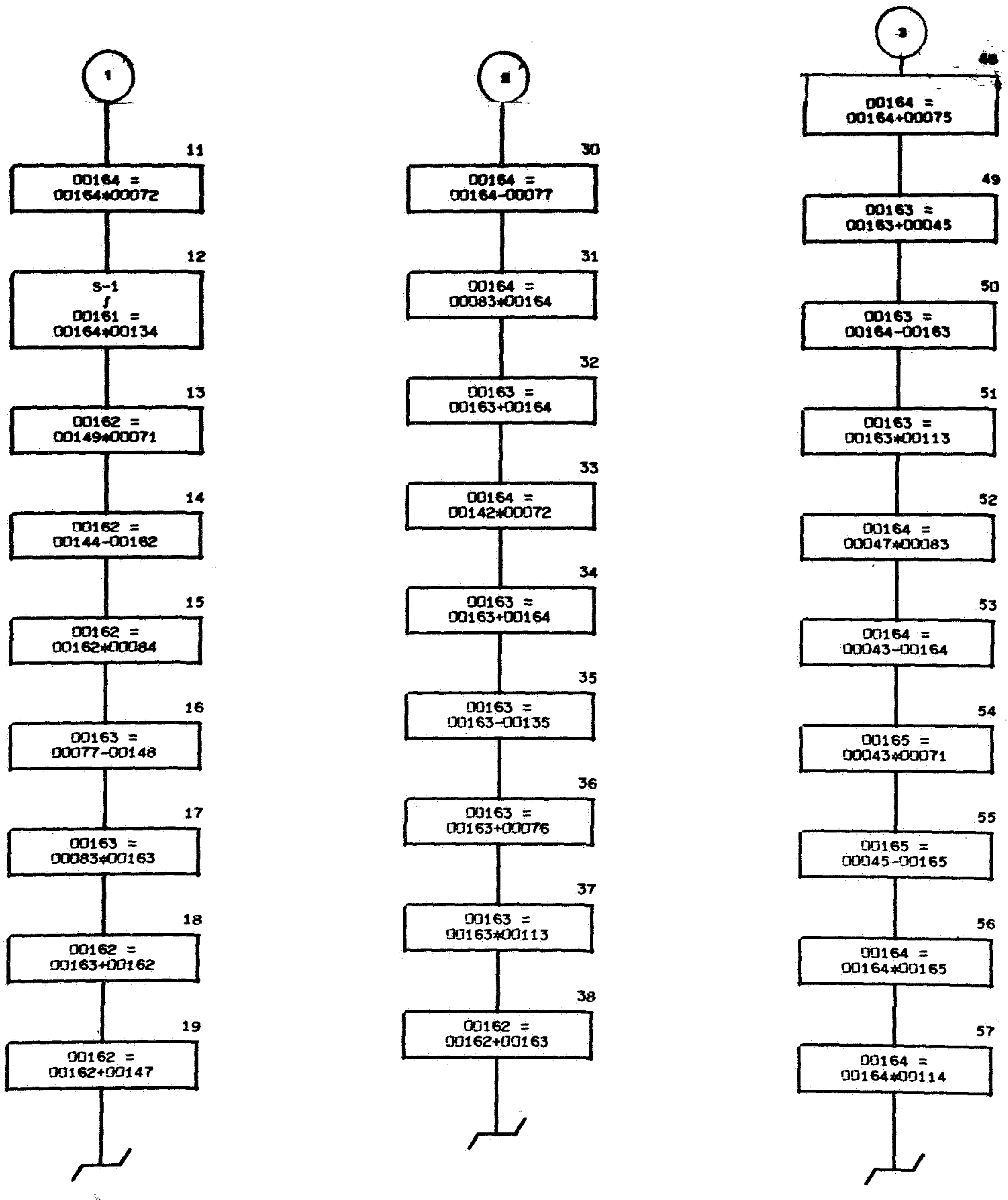
45 00163 = 00163+00135

46 00163 = 00163*00083

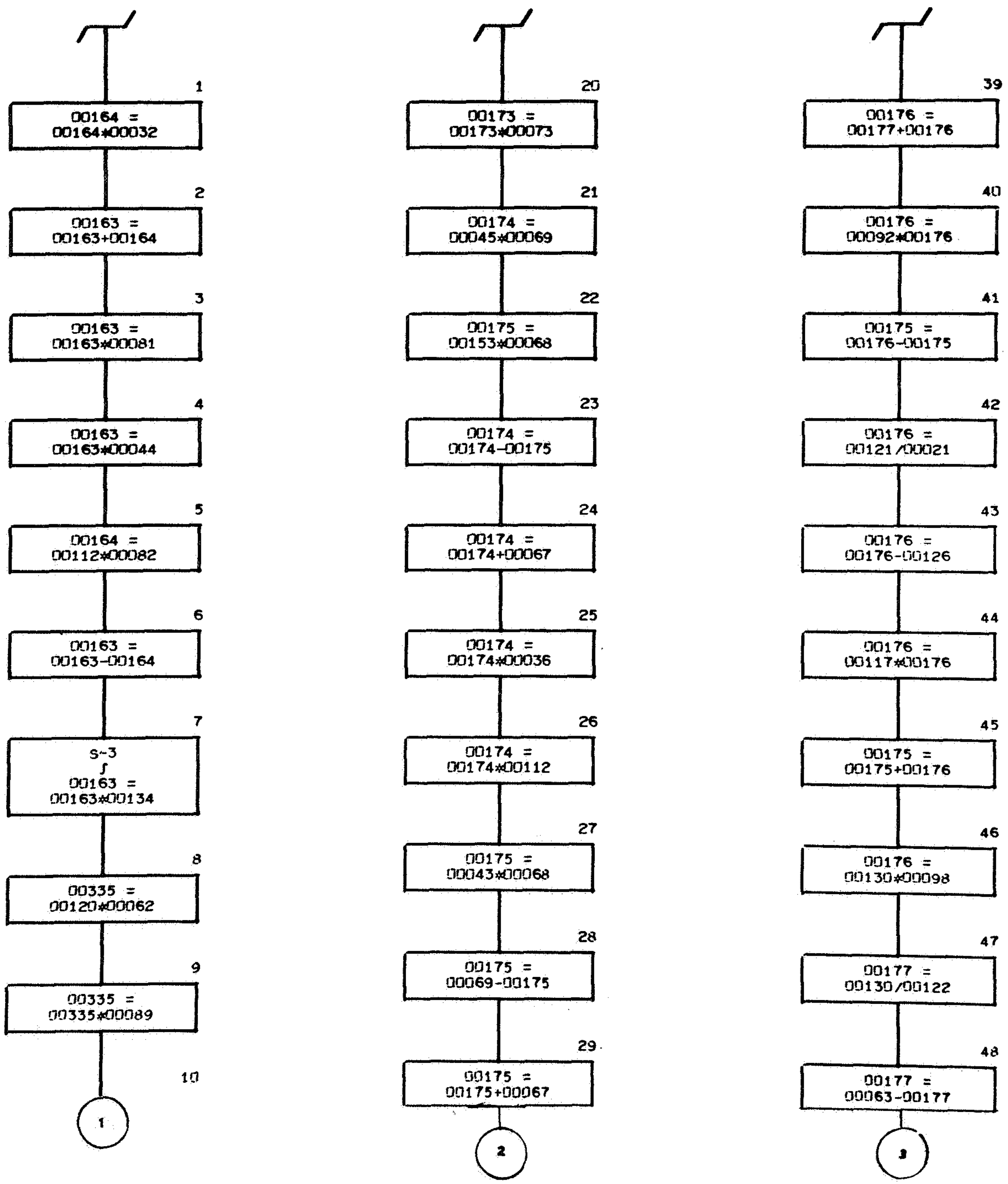
47 00164 = 00150*00072

(3)

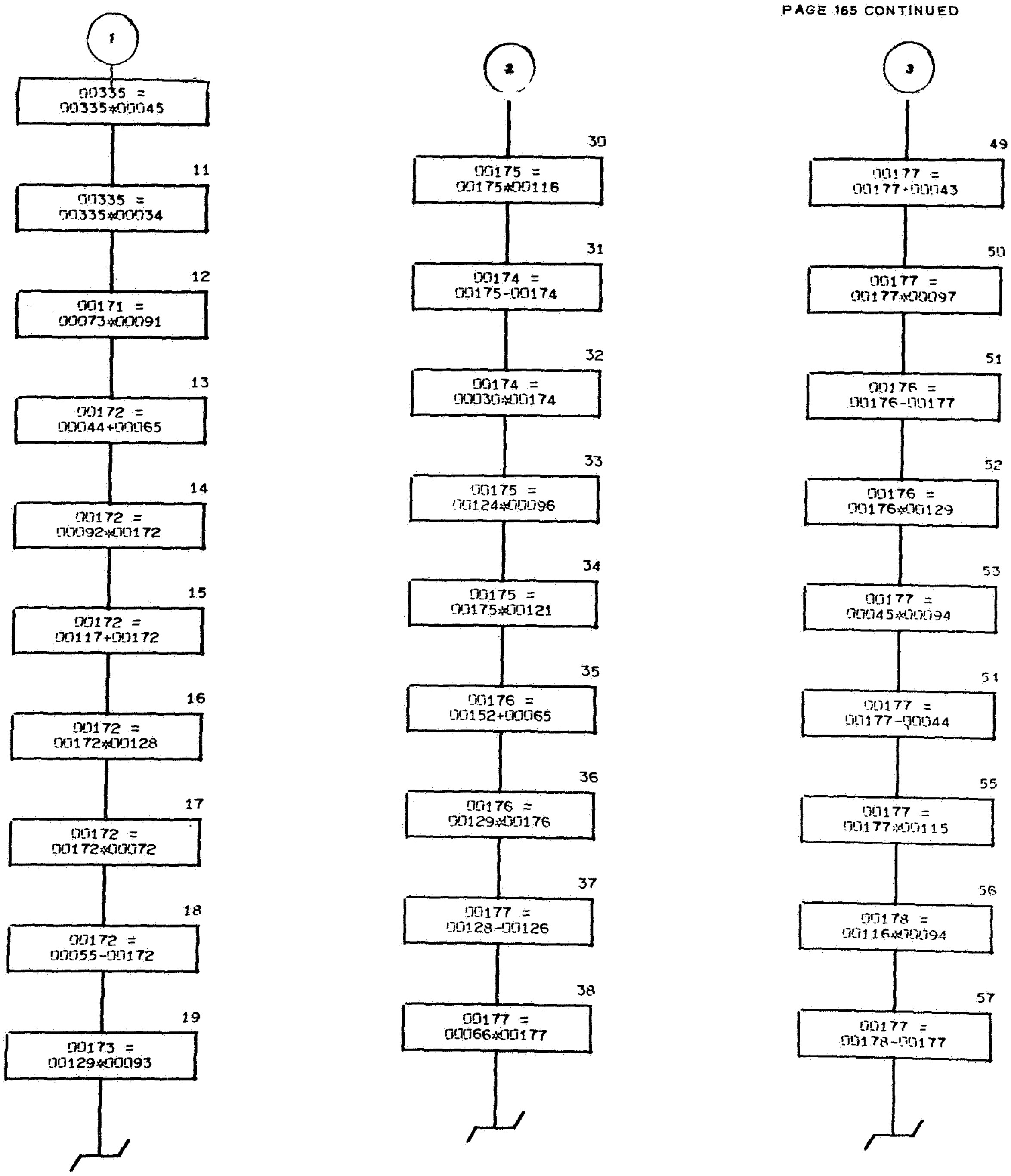
PAGE 164 CONTINUED



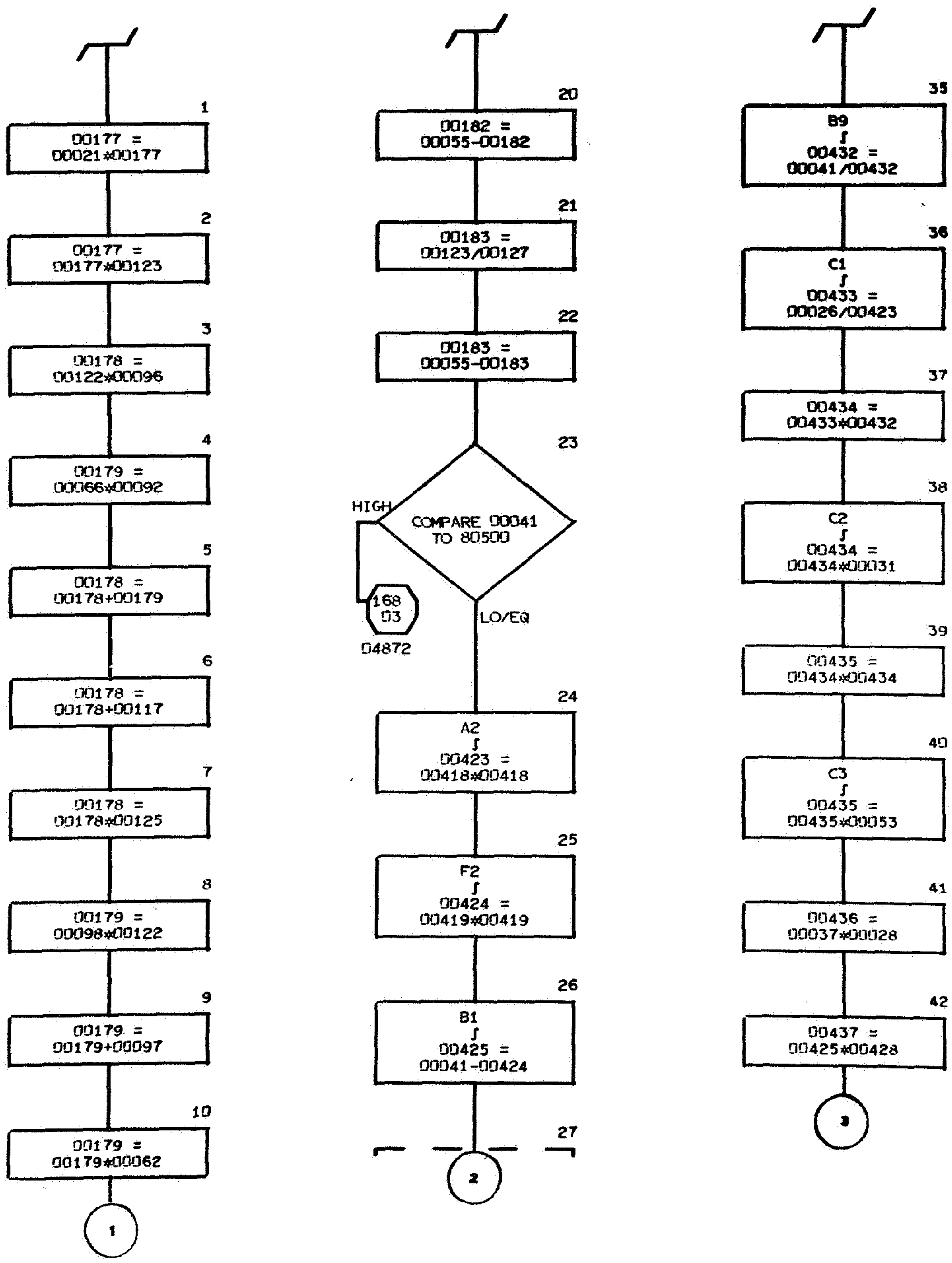
K VALUE = 04500

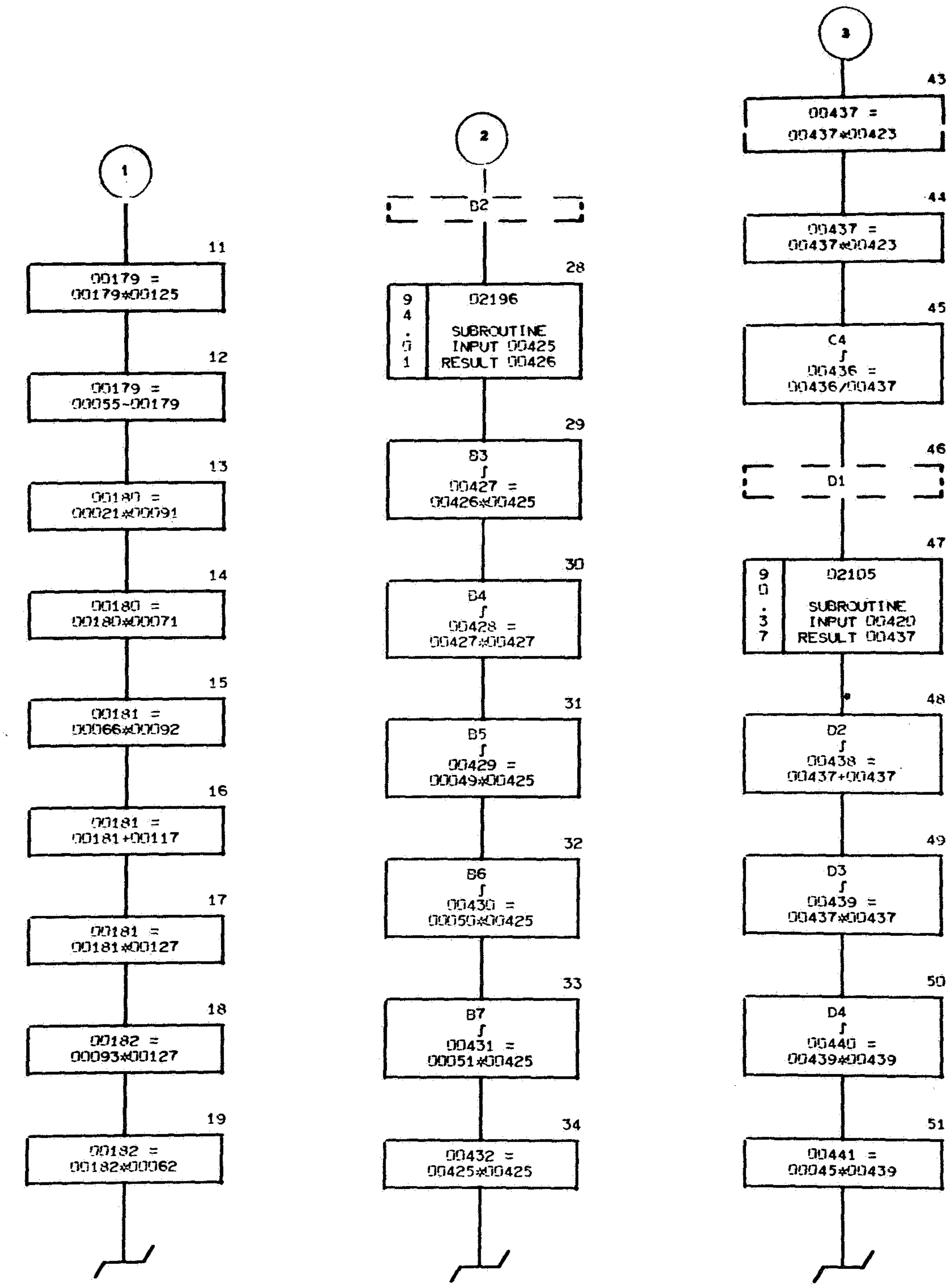


PAGE 165 CONTINUED



K VALUE = 04500




1
11
00179 =
00179*00125
12
00179 =
00055-00179
13
00180 =
00021*00091
14
00180 =
00180*00071
15
00181 =
00066*00092
16
00181 =
00181+00117
17
00181 =
00181*00127
18
00182 =
00093*00127
19
00182 =
00182*00062
2
D2
28
9
4
.
0
1
02196
SUBROUTINE
INPUT 00425
RESULT 00426
29
B3
∫
00427 =
00426*00425
30
B4
∫
00428 =
00427*00427
31
B5
∫
00429 =
00049*00425
32
B6
∫
00430 =
00050*00425
33
B7
∫
00431 =
00051*00425
34
00432 =
00425*00425
3
43
00437 =
00437*00423
44
00437 =
00437*00423
45
C4
∫
00436 =
00436/00437
46
D1
47
9
0
.
3
7
02105
SUBROUTINE
INPUT 00420
RESULT 00437
48
D2
∫
00438 =
00437+00437
49
D3
∫
00439 =
00437*00437
50
D4
∫
00440 =
00439*00439
51
00441 =
00045*00439

CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES	
K VALUE = 04500			
161.01	04501	10.28*	66.26*
161.10	04878		
161.12	04870	161.11	
161.36	04871	161.23	
168.03	04872	166.23	
168.05	04879	161.11	168.02
168.14	04713	168.23	
168.20	04853		
168.36	04836	168.34	
169.40	04837	168.41	
173.09	04656	173.01	
173.17	04657	173.01	

K VALUE = 04500

Q7000001100	T(0) , EPOCH TIME IN C.U.T.
Q7000104947	ANGLE-QUAD. DET.
Q7000202196	SQUARE ROOT
Q7000302101	SINE
Q7000402105	COSINE
Q7000502216	KEPLER
Q7000602166	ARC COSINE
Q7000703830	K 2
Q7000803831	K 3
Q7000903832	K 4
Q7001103833	K 5
Q7001002271	PRINCIPAL VALUE
Q7036001101	A, SEMI-MAJOR AXIS AT T(0)
Q7036101113	M, MEAN ANOMALY AT T(0)
Q7036201115	ARG. OF PERIGEE AT T(0)
Q7036301117	RT. ASC. OF NODE AT T(0)
Q7036601102	ECCENTRICITY AT T(0)
Q7037701116	I, INCLINATION AT T(0)
Q7040003844	K SUB C (CRITICAL INCLINATION)
Q8000000276	DELTA A (COMP. PERT.)
Q8000100277	DELTA E (COMP. PERT.)
Q8000200278	DELTA I (COMP. PERT.)
Q8000300279	DELTA M (COMP. PERT.)
Q8000400280	DELTA ARG. OF PERIGEE (COMP.PERT.)
Q8000500281	DELTA RT. AS. OF NODE (COMP.PERT.)
Q8050000085	COMPLEMENTARY PERTURBATIONS IND.
Q8050104439	DELTA M (DRAG)
Q9000100218	A, SEMI-MAJOR AXIS AT REQUEST TIME
Q9000200219	E, ECCENTRICITY AT REQUEST TIME
Q9000300220	I, INCLINATION AT REQUEST TIME
Q9000400213	M, MEAN ANOMALY AT REQUEST TIME
Q9000500215	ARG. OF PERIGEE AT REQUEST TIME
Q9000600217	RT. AS. OF NODE AT REQUEST TIME
Q9000701841	COMPUTE DRAG AND COMP. PERT. EFFECTS
Q0001803840	METERS/C.U.L.
Q0001903866	(METERS/C.U.L.) (C.U.T./SEC.)
Q0002403843	SECONDS/C.U.T.
Q0002503889	MU**2=GM
Q0005203868	RAD/DEG
Q0020503842	2 PI
Q0020603843	SECONDS/C.U.T.

V00030+50000000+00
V00031+15000000+01
V00032+33333333+00
V00033+66666667+00
V00034+25000000+00
V00035+16666667+00
V00036+83333333-01
V00037+93750000+00
V00038+46875000+00

```
V00152+26000000+02
V00153+11000000+02
V00039+19444444+00
V00040+12962963+00
V00041+10000000+01
V00042+20000000+01
V00043+30000000+01
V00044+40000000+01
V00045+50000000+01
V00046+60000000+01
V00047+70000000+01
V00048+80000000+01
V00049+90000000+01
V00050+25000000+02
V00051+12600000+03
V00053+41666667-01
V00054+16000000+02
V00055+00000000+00
V00155+00000000+00
V00339+10000000+00
V00135+35000000+02
V00136+36000000+02
V00137+14400000+03
V00138+10500000+03
V00139+90000000+02
V00140+96000000+02
V00141+15000000+02
V00142+24000000+02
V00143+19200000+03
V00144+38500000+03
V00145+36000000+03
V00146+45000000+02
V00147+21000000+02
V00148+27000000+03
V00149+18900000+03
V00150+12000000+02
V00151+30000000+02
```

CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES					
K VALUE = 09000							
176.01	09001	23.06*	23.14*	23.20*	24.17*		
176.10	09034						
176.12	09029	176.11					
176.14	09070	176.13					
176.16	09073	176.15	179.03				
177.01	09045	176.11					
177.03	09067	177.02	178.39	180.08	180.20	180.22	182.05
177.12	09007	176.13	176.15	179.15	179.24		
177.38	09005	177.30	177.32	177.34	177.36		
178.35	09006	178.23	178.34				
179.01	09071	176.13	176.15				
179.09	09012	179.08					
179.11	09081	179.08	179.10				
179.16	09082	176.22	180.25				
180.01	09053						
180.07	09063	180.06	181.19				
180.09	09054						
180.21	09059	179.15	179.24				
180.23	09078	176.22					
181.01	09079						
181.20	09080						

K VALUE = 09000

Q8002503834	F, FLATTENING COEFFICIENT
Q8002603837	K SUB 2 = C.U.T./DAY
Q8002803858	3.6
Q8003003871	1+N SUB O
Q8003103859	SMALL H SUB O
Q8003203861	H SUB O
Q8003303860	BETA
Q9000000204	SMALL R VECTOR,X COMPONENT
Q9000100206	SMALL R VECTOR,Z COMPONENT
Q9000202011	VECTOR MAGNITUDE FUNCTION
Q9000402846	A SUB S FOR L,M C1 SUB S FOR R, R DO
Q9000502847	B SUB S FOR L,M CQ/F2 FOR R,R DOT
Q9000602848	WORK AREA FOR T SUB 0 NO. 1 OF 6 LO
Q9000702849	T SUB 1
Q9000802850	T SUB 2
Q9000902851	T SUB 3
Q9001002852	T SUB 4
Q9001102853	WORK AREA FOR T SUB 5
Q9001202854	WORK AREA FOR N AUB 0 NO. 1 OF 6 LO
Q9001302855	N SUB 1
Q9001602858	N SUB 4
Q9001702859	WORK AREA FOR N SUB 5
Q9001802860	WORK AREA FOR H SUB 0 NO. 1 OF 6 LO
Q9001902861	H SUB 1
Q9002202864	H SUB 4
Q9002302865	WORK AREA FOR H SUB 5

K VALUE = 04946

Q9000102156	ARC SIN
Q9000202166	ARC COS
Q0000503838	PI/2
Q0000603839	PI
Q0000703865	3 PI/2
Q0001003842	2 PI
V00008+60000000+00	.6
V00009+00000000+00	ZERO

K VALUE = 04946

174.01	04947	170.06*	171.51*
174.06	04961	174.15	
174.14	04962	174.04	
174.16	04963	174.08	
174.26	04967	174.20	
174.31	04968	174.22	
174.34	04969	174.27	
175.05	04965	175.01	
175.09	04964	174.12	
175.14	04966	175.10	

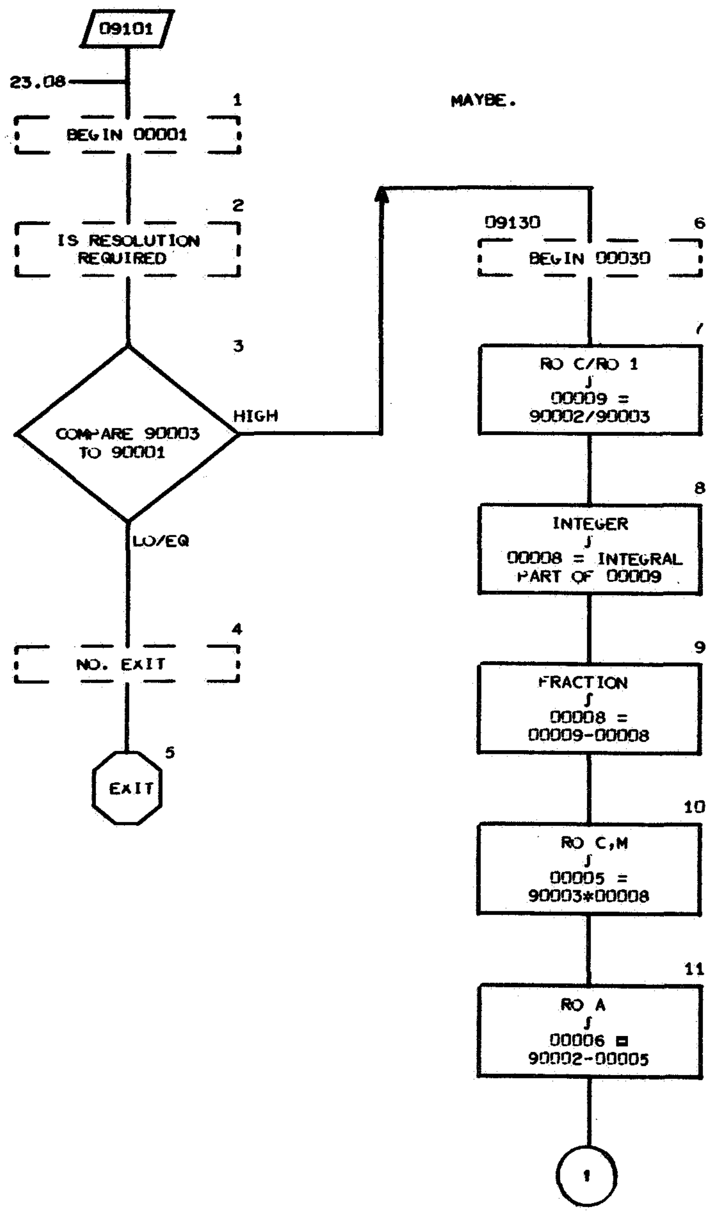
FOR THE ANGLE-QUADRANT DETERMINATION SUBROUTINE K=04946 SEE PAGE 202 OF THE PROGRAM LISTING

Q9002402099	UNCORRECTED L, M, RHO OR RHO DOT
Q9002500200	TIME IN C.U.T.
Q9002602751	ENTRY TO ABSOLUTE VALUE SUBROUTINE
Q9002700256	COMPUTED OBSERVATIONS
Q9002800207	R, BAR DOT
Q9002900375	R, BAR STAR
Q9003000253	TYPE CODE
Q9003202051	DOT PRODUCT ENTRY
Q9003302001	VECTOR MOVE ENTRY
Q9003402101	SIN ENTRY
Q9003502105	COS ENTRY
Q9003602085	VECTOR Q 1 NO. 1 OF 3 LOCATIONS
Q9003901201	LSP ENTRY
Q9004001851	ENTRY TO EXPONENTIAL FUNCTION
Q9004101202	LSP EXIT
Q9004202196	ENTRY TO SQ. ROOT
Q9004303849	EARTH RADIUS IN CUL
V00010+00000000+00	ZERO
V00011+10000000+01	ONE, CODE FOR RANGE
V00047+20000000+01	TWO, CODE FOR L
V00048+30000000+01	THREE, CODE FOR M
V00049+50000000+01	FIVE, CODE FOR EL
V00050+90000000+01	NINE, CODE FOR RANGE RATE
V00051+13000000+02	THIRTEEN, CODE FOR EL DOT
V00058+10000000-12	TOLERANCE FOR ZERO EL
V00076+10000000+10	PSUEDO PARAMETER IF EL APPROACHES Z
V00052+99922944+00	COS PHI SUB IM
V00028+17453293+00	TEN DEGREES, B1

THE INFORMATION ON THIS PAGE IS FOR THE L, M, R, RR CORRECTOR FOR IONOSPHERIC REFRACTION SUBROUTINE K=09000. SEE PAGE 204 OF THE PROGRAM LISTING.

K VALUE = 09100

RANGE AMBIGUITY
RESOLUTION FUNCTION
RANGE AMBIGUITY
RESOLUTION F.



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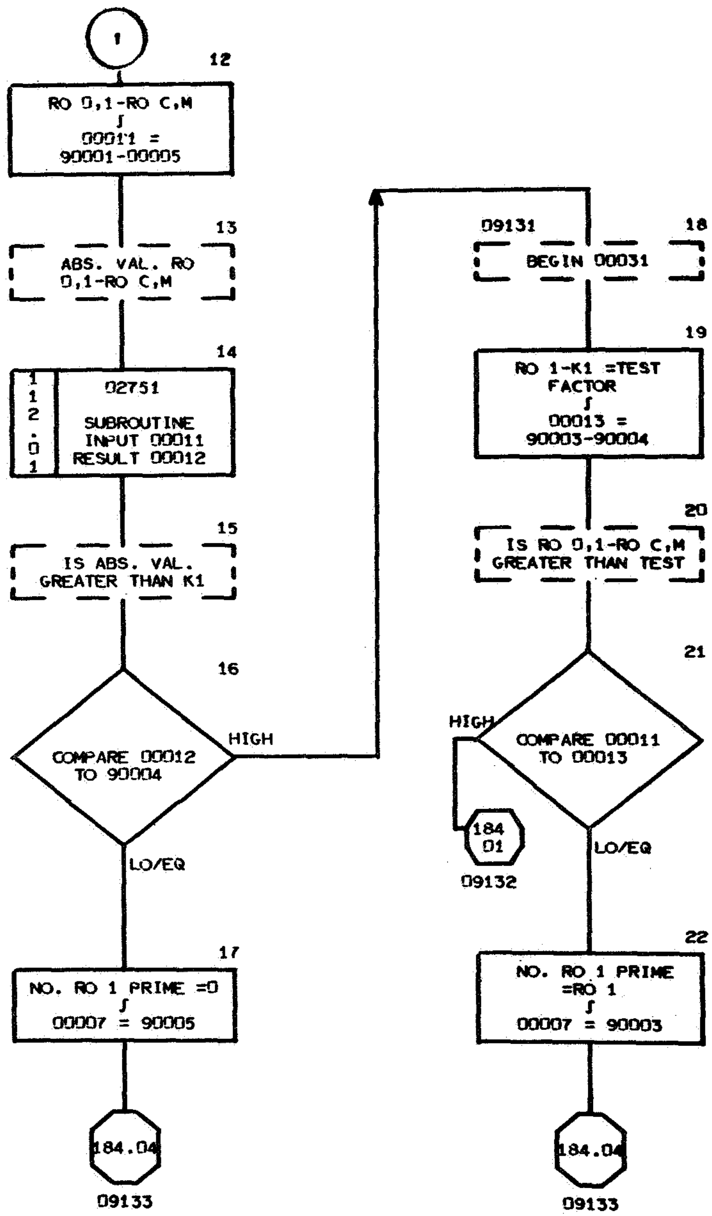
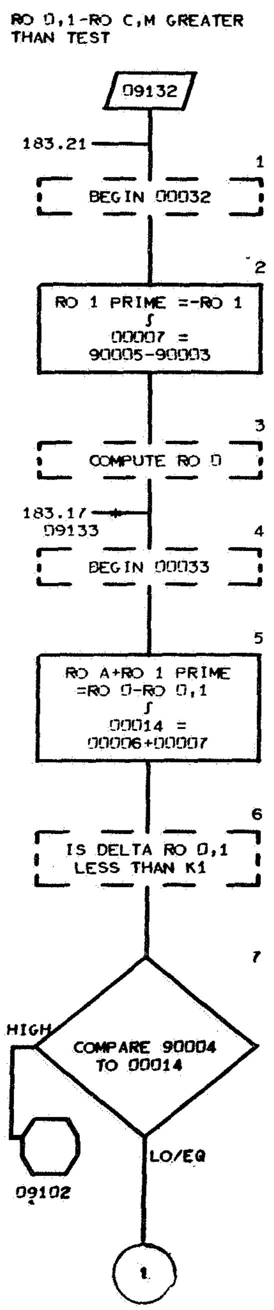
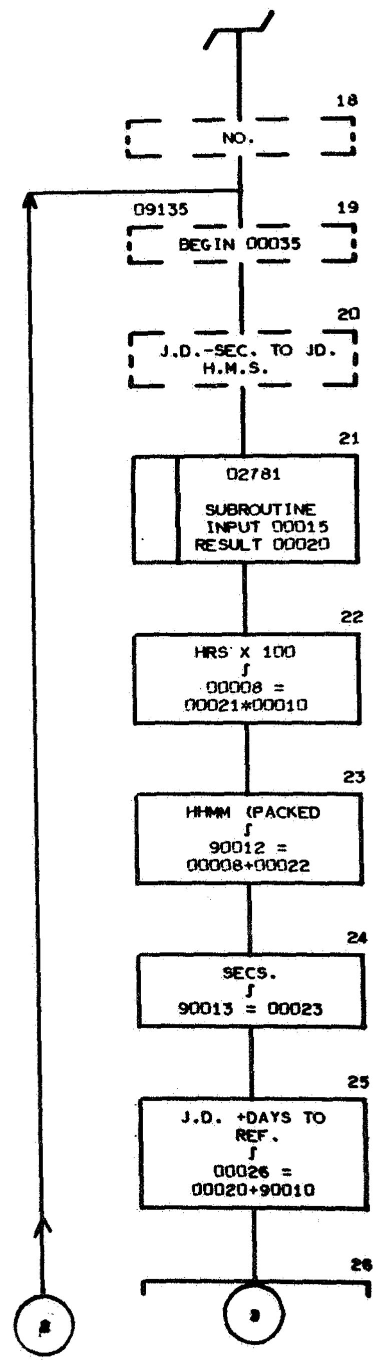
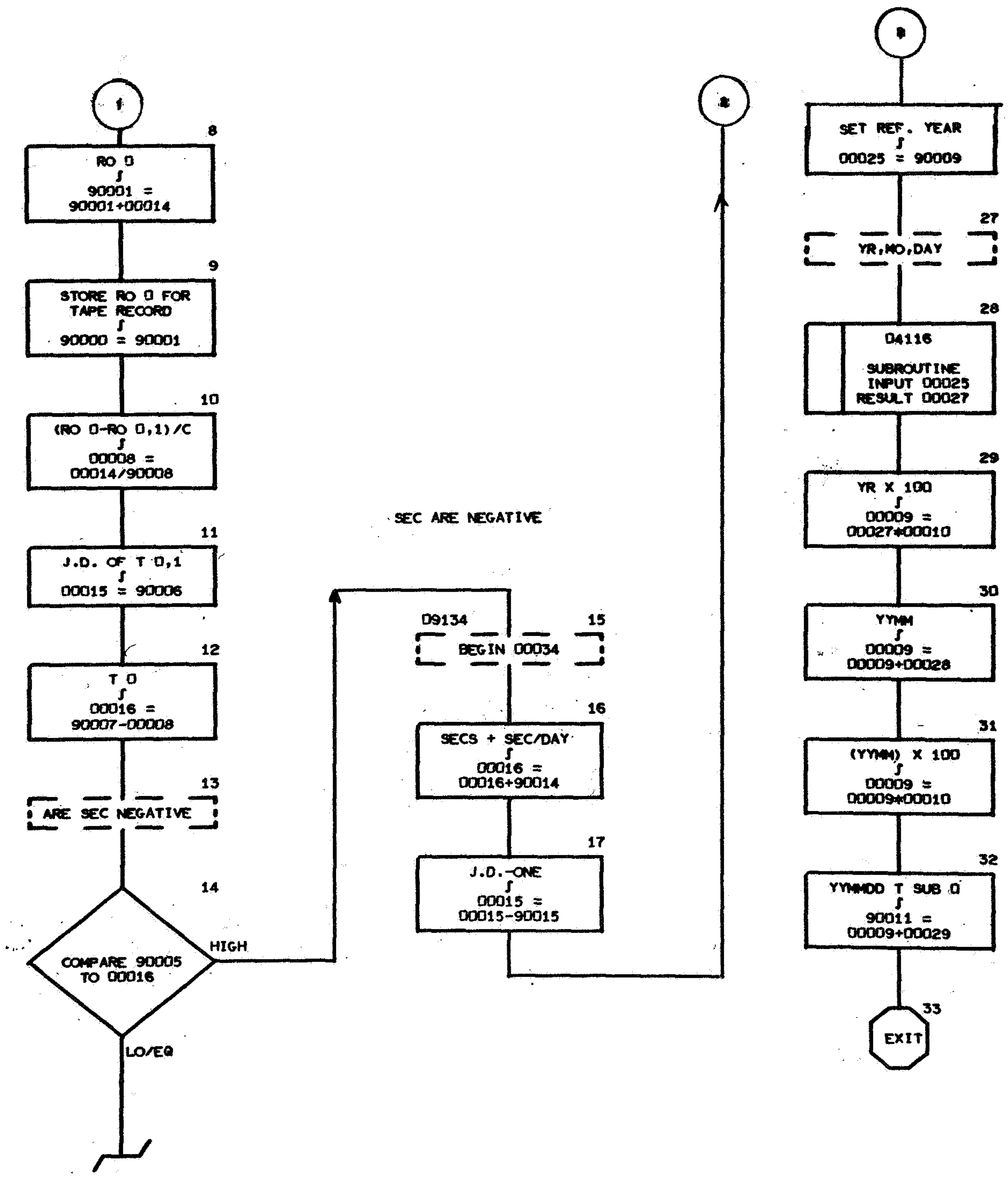


K VALUE = 09100





PAGE 184 CONTINUED



K VALUE = 09100

Q9000002835	CORRECTED RO SUB 0
Q9000100255	RO SUB 0,1 (INPUT). ROSUB0 (OUTPUT)
Q9000200256	RO SUB C
Q9000300396	RO SUB 1
Q9000400397	K SUB 1
Q9000500010	ZERO
Q9000600378	J.D. OF T SUB 0,1
Q9000700379	SEC. OF T SUB 0,1
Q9000803892	C,VEL. OF LIGHT IN CUL/SEC
Q9000900296	YEAR OF REFERENCE
Q9001000297	DAYS JAN 1- REF DAY
Q9001102825	YYMMDD T SUB 0
Q9001202826	HH MM T SUB 0
Q9001302827	SECONDS T SUB 0
Q9001403862	SEC/DAY
Q9001503811	ONE
Q9100102751	ABSOLUTE VALUE F.
Q9100202781	JD.- SEC TO J.D. HMS
Q9100304116	DATE FUNCTION
V00017+00000000+00	ROUNDING FACTOR
V00010+10000000+03	100

NASA-GSFC MISSION AND TRAJECTORY ANALYSIS DIVI

CROSS-REFERENCE LISTING

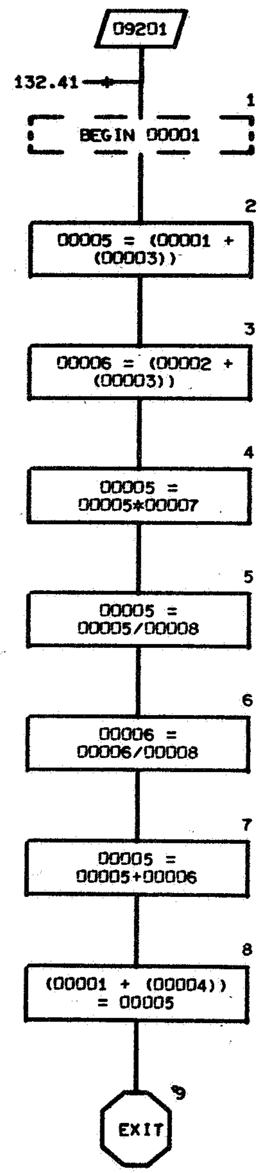
PAGE BOX	LABEL	REFERENCES	
183.18	09131	183.16	
184.01	09132	183.21	
184.04	09133	183.17	183.22
184.15	09134	184.14	
184.19	09135	184.17	

K VALUE = 09100

183.01	09101	23.08*
183.06	09130	183.03

K VALUE = 09200

JULIAN DAYS- SECONDS TO C.U.T.



CROSS REFERENCE LISTING

PAGE BOX	LABEL	REFERENCES
	K VALUE = 09200	
185.01	09201	132.41* 133.38*

K VALUE = 09200

Q0000703862	SECONDS/DAY
Q0000803843	SECONDS/C.U.T.

THE FOLLOWING 6 PAGES CONTAIN A LISTING OF ALL OF THE BEGIN COMMANDS OF THE D.C. PROGRAM. THE LOCATION INDICATED BY A BEGIN COMMAND IS THE EQUIVALENT OF A FORTRAN STATEMENT NUMBER OR A MAP/FAP LABEL. THEY ARE USEFUL FOR REFERENCING PURPOSES IN THE EVENT OF THE NEED FOR INTERMEDIATE OUTPUT NOT NORMALLY PRINTED BY THE PROGRAM (SEE PAGE 180 OF THE PROGRAM LISTING).

LABEL	PAGE BOX	LABEL	PAGE BOX	LABEL	PAGE BOX
00008	16.16	01218	24.07	01551	52.35
00020	1.01	01219	24.12	01552	53.01
00021	3.08	01220	24.19	01553	53.18
00022	5.12	01221	25.01	01554	53.35
00023	8.11	01222	25.08	01555	54.01
00024	8.17	01223	25.13	01556	54.18
00027	10.15	01224	25.17	01557	54.35
00028	10.10	01225	25.22	01558	55.01
00029	10.06	01226	26.01	01559	55.18
00030	13.24	01227	26.07	01601	57.01
00033	16.04	01228	26.13	01611	58.01
00036	7.15	01229	26.18	01612	58.05
00037	7.04	01230	27.08	01613	58.07
00061	16.08	01301	28.01	01614	58.09
00062	4.22	01356	30.01	01615	58.12
00063	16.12	01365	31.05	01616	58.14
00064	16.14	01381	32.01	01617	58.17
00073	13.12	01389	32.05	01618	58.19
00074	12.09	01390	32.27	01619	59.01
00091	9.16	01391	32.09	01620	59.08
00092	9.24	01393	33.01	01621	59.11
00093	8.04	01394	32.17	01622	59.14
00094	5.17	01398	32.24	01623	59.19
00095	3.16	01401	34.01	01624	59.23
00101	17.01	01479	34.08	01625	60.01
00110	17.15	01494	55.35	01626	60.04
00111	18.01	01495	56.01	01627	60.10
00112	18.35	01501	34.10	01628	60.20
00128	18.14	01502	35.01	01629	61.07
00129	19.01	01503	36.01	01630	61.22
00130	18.25	01504	37.17	01631	62.25
00131	19.03	01505	37.23	01660	64.01
00132	17.10	01506	37.29	01668	57.23
00133	17.20	01507	38.01	01669	57.26

TABLE OF BEGIN COMMANDS

LABEL	PAGE BOX	LABEL	PAGE BOX	LABEL	PAGE BOX
00134	17.13	01508	39.01	01701	66.01
00151	20.01	01509	40.01	01710	68.08
00158	21.03	01510	40.27	01711	68.11
00159	21.06	01511	41.01	01712	68.13
00195	12.25	01519	41.11	01713	70.01
00196	13.16	01520	42.12	01714	69.05
00263	8.26	01521	42.27	01715	69.17
00264	7.26	01522	43.01	01716	70.13
00393	11.23	01523	43.16	01717	71.33
00399	11.36	01524	43.31	01718	73.01
00472	15.01	01525	44.01	01728	70.05
00473	15.08	01526	44.16	01729	69.01
00480	9.22	01527	44.31	01730	67.21
00481	9.14	01528	45.01	01731	66.03
00482	10.17	01529	45.16	01732	67.15
00483	10.22	01530	45.31	01776	66.48
00491	10.26	01531	46.01	01777	67.19
00492	10.32	01532	46.16	01778	68.05
00493	22.23	01533	46.31	01801	6.18
00494	22.26	01534	47.01	01802	6.01
00570	1.28	01535	47.16	01804	6.06
00571	7.01	01536	47.31	01805	6.15
00573	4.01	01537	48.01	01806	14.10
00574	4.03	01538	48.16	01807	14.01
00575	3.01	01539	48.31	01810	6.22
00576	2.06	01540	49.01	01812	4.13
00577	2.01	01541	49.18	01813	5.01
00578	3.25	01542	49.35	01814	2.12
01201	22.01	01543	50.01	01815	2.21
01211	23.01	01544	50.18	01816	8.22
01212	23.10	01545	50.35	01817	9.06
01213	23.16	01546	51.01	01820	2.26
01214	23.22	01547	51.18	01831	12.13
01215	23.26	01548	51.35	01832	12.16
01216	24.01	01549	52.01	01834	13.32
01217	24.05	01550	52.18	01840	16.19

TABLE OF BEGIN COMMANDS

LABEL	PAGE BOX	LABEL	PAGE BOX	LABEL	PAGE BOX
01841	74.01	02361	102.01	03026	125.35
01851	75.01	02370	102.11	03051	127.01
01875	75.19	02372	102.13	03055	127.04
01876	75.37	02374	102.15	03056	127.12
01877	76.04	02377	102.17	03057	127.16
01878	76.09	02389	102.32	03058	127.31
01883	75.08	02391	102.34	03301	128.01
01884	75.12	02396	103.07	03305	128.14
01901	77.01	02397	103.10	03329	128.26
01927	77.15	02398	102.37	03330	128.07
01928	77.06	02399	104.01	03331	128.18
01941	78.01	02400	104.03	03332	128.20
01956	79.01	02402	104.05	03333	128.24
01971	80.01	02407	104.10	03351	129.01
01986	81.01	02413	104.20	03365	129.11
01997	81.16	02416	104.12	03366	129.14
01999	81.05	02418	105.01	03369	129.17
02001	82.01	02476	107.01	03370	129.09
02011	83.01	02484	107.16	03371	129.20
02021	84.01	02486	107.05	03376	130.01
02029	84.12	02494	107.07	03380	130.16
02031	85.01	02495	107.21	03388	130.11
02041	86.01	02521	108.01	03389	130.20
02051	87.01	02540	108.33	03390	130.08
02061	88.01	02541	108.42	03401	131.01
02076	89.01	02542	109.01	03405	131.03
02093	10.38	02543	109.14	03406	132.01
02094	11.05	02596	109.19	03407	133.01
02095	11.10	02605	109.23	03416	131.12
02096	11.17	02606	109.35	03417	131.21
02101	90.01	02609	109.33	03418	132.19
02105	90.37	02649	108.29	03488	133.19
02121	90.07	02651	110.01	03491	132.30
02124	90.15	02664	110.25	03492	132.39

TABLE OF BEGIN COMMANDS

LABEL	PAGE BOX	LABEL	PAGE BOX	LABEL	PAGE BOX
02126	90.34	02721	111.01	03494	133.27
02156	91.01	02725	111.16	03495	133.36
02163	91.09	02729	111.12	03496	134.01
02164	91.11	02751	112.01	03501	135.01
02166	92.01	02756	112.04	03506	135.08
02173	92.09	02757	112.06	03510	135.11
02174	92.11	02761	113.01	03513	135.18
02176	93.01	02767	113.04	03514	135.25
02196	94.01	02768	113.10	03521	136.01
02201	94.06	02801	114.01	03530	136.04
02207	94.12	02806	114.08	03532	136.10
02216	95.01	02807	115.01	03535	136.17
02228	95.13	02808	115.23	03539	136.13
02241	95.16	02810	114.17	03551	137.01
02242	95.32	02811	114.06	03573	138.01
02243	95.09	02814	115.17	03574	138.08
02244	95.19	02876	115.20	03575	138.25
02246	96.01	02936	117.01	03576	139.15
02265	96.14	02940	117.08	03577	140.01
02266	96.22	02941	117.10	03578	140.16
02267	96.11	02942	118.26	03579	139.24
02271	97.01	02943	118.28	03580	139.02
02275	97.11	02944	119.15	03601	141.01
02301	98.01	02946	119.01	03701	142.01
02314	98.08	02947	122.01	03740	143.02
02316	99.01	02948	125.30	03741	143.18
02329	99.08	02949	121.09	03742	142.15
02330	99.13	02952	122.41	03743	142.11
02341	100.01	02953	123.28	03744	143.05
02353	100.06	02964	121.06	03745	143.20
02354	100.12	02978	118.16	03746	143.09
02355	100.15	02979	123.40	03751	144.01
02356	100.17	03005	125.02	03763	144.05
02357	100.22	03016	121.04	03801	145.01
02358	101.03	03017	117.06	03816	147.16
02359	101.01	03020	120.32	03817	147.01

TABLE OF BEGIN COMMANDS

LABEL	PAGE BOX
03818	145.07
03819	146.14
03901	149.01
03906	149.17
03908	149.21
03911	149.07
04026	151.01
04056	152.01
04068	152.24
04101	153.01
04105	153.04
04201	154.01
04331	155.01
04335	155.05
04336	155.16
04337	155.19
04338	155.11
04339	155.28
04349	155.35
04351	156.01
04356	156.06
04361	156.11
04366	156.16
04371	156.21
04376	156.26
04381	157.01
04386	157.06
04391	157.11
04396	157.16
04401	158.01
04405	158.04
04406	158.27
04407	158.09
04456	159.01

LABEL	PAGE BOX
09054	180.09
09059	180.21
09063	180.07
09067	177.03
09070	176.14
09071	179.01
09073	176.16
09078	180.23
09079	181.01
09080	181.20
09081	179.11
09082	179.16
09101	183.01
09130	183.06
09131	183.18
09132	184.01
09133	184.04
09134	184.15
09135	184.19
09201	185.01

TABLE OF BEGIN COMMANDS

LABEL	PAGE BOX
04460	159.08
04461	159.26
04476	159.40
04477	159.36
04491	160.01
04501	161.01
04656	173.09
04657	173.17
04713	168.14
04836	168.36
04837	169.40
04853	168.20
04870	161.12
04871	161.36
04872	168.03
04878	161.10
04879	168.05
04947	174.01
04961	174.06
04962	174.14
04963	174.16
04964	175.09
04965	175.05
04966	175.14
04967	174.26
04968	174.31
04969	174.34
09001	176.01
09005	177.38
09006	178.35
09007	177.12
09012	179.09
09029	176.12
09034	176.10
09045	177.01
09053	180.01

Reference

B1. IBM 7090/7094 Autoflow System User's and Operator's Manual, Prepared under Contract No. NAS5-10021 by Applied Data Research, Inc., Washington, D. C.

APPENDIX C

Differential Correction System Program Listing

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        NASA-GSFC MISSION AND TRAJECTORY ANALYSIS DIVISION, PROGRAMMED
        BY THE PROGRAM SYSTEMS BRANCH, COMPILED FOR PUBLICATION BY I. J.
        COLE, MISSION TRAJECTORY DETERMINATION BRANCH.



  DC FROM PROGRAM SYSTEMS  BRANCH NOV 1967
 O 00000



 K 00000
 K 00000
 Q 90037 03701             SWITCH TAPE ASSIGNMENTS
 Q 90040 02105             COSINE
 Q 90041 03551             PRINT INITIAL ELEM.,DRAGS, EARTH CONSTANTS
 Q 90043 03601             LOAD AREA,MASS,DRAG DATA CARD FOR MCOI
 Q 90045 03801             COMPUTE CONSTANTS FUNCTION
 Q 90046 02341             COMPUTE AND PRINT R.M.S. FOR EACH OBS. TYPE
 Q 90066 04401             COMPUTE EFFECTIVE DRAG
 Q 90047 01956             ADD TO SUM OF (O-C) SQ. AND TO N CORRES.TO
 Q 90049 04056             COMPUTE CONSTRAINT EQNS.(ADDIT.EQC)
 Q 90050 01381             (O-C) ANGLE REDUCTION F.
 Q 90053 03496             INITIALIZE INTERPOLATION
 Q 90059 01356             COMPUTE AND STORE CORR. ELEM.
 Q 90060 02476             LOAD AND STORE PRINT REQUEST CARDS
 Q 90061 00101             PRINT CORR. ELEM. AND S.D. OF FIT
 Q 90062 04101             SUM UNKNOWNS
 Q 90063 00151             O-C PRINT FUNCTION
 Q 90064 02751             ABSOLUTE VALUE
 Q 90065 02721             RANGE RATE FUNCTION
 Q 90067 04026             LOAD CONSTRAINT WEIGHTS
 Q 90068 03401             DELTA TAPE READ AND INTERP.
 Q 90069 02761             ONE-WORD LOAD
 Q 90070 02651             INPUT CONVERTER
 Q 90071 02521             OUTPUT SCALE
 Q 90072 03901             LOAD DRAG DATA
```

Q	90073 04201	RUN IDENT. LOAD + PRINT	00041
Q	90074 01941	SATELLITE IDENTIFICATION	00042
Q	90075 03301	DAY COUNT	00043
Q	90076 03351	OBSERVED DATE TO J.D.	00044
Q	90077 04491	ORBIT GENERATOR INITIALIZE	00045
Q	90079 02936	ELEMENT LOAD	00046
Q	90081 02301	MATRIX CLEAR	00047
Q	90082 02801	OBSERVATION LOAD	00048
Q	90083 02418	SPO	00049
Q	90084 04501	ORBIT GENERATOR	00050
Q	90085 01201	LOCAL STATION PREDICTION	00051
Q	90086 01301	POSITION IN ELLIPSE	00052
Q	90087 01401	POSITION PARTIALS	00053
Q	90088 01601	OBSERVATION PARTIALS	00054
Q	90089 02316	AUGMENT MATRIX	00055
Q	90090 02361	SOLVE EQUATIONS	00056
Q	90091 01701	CONVERT CORRECTIONS	00057
Q	90093 03501	LOAD REJECT CARDS	00058
Q	90094 03521	SEARCH AND REJECT FUNCTION	00059
Q	90096 02196	SQUARE ROOT	00060
Q	90097 02101	SIN	00061
Q	90098 02156	ARC SIN	00062
Q	90099 04331	LOAD INTERVAL CORE DUMP CARDS	00063
V	00032 +00000000+00	NORMAL SETTING,FOR NO JUMP AT END OF RUN	00064
V	00461 +16000000+02	NO. WORDS IN PERT. TAPE TITLE RECORD	00065
V	00615 +10000000+01	K, MULTIPLIER FOR DRAG DELTA M	00066
V	00459 -10000000+01	NO.STORED IN LOC.00000 IF TAPE CHECK FOUND	00067
V	00460 +10000000+02	NO. OF TIMES TO TRY TO READ TAPE RECORD	00068
V	00465 +10000000+02	MAXIMUM NO. OF INTERVAL CORE DUMPS	00069
V	00466 +10000000+01	SETTING FOR INTERVAL CORE DUMPS ON TAPE	00070
V	00475 +00000000+00	NORMAL SETTING,FOR (O-C)'S PRINTED	00071
V	00498 +10000000+03		00072
V	00495 +28000000+02	MAX.NO. PRINT REQ. CARDS(INCL. HEADING CARD	00073
V	02098 +10000000+01	SET FOR RANGE RATE (O-C),S NOT DIFF.	00074
V	00002 +30000000+01		00075
V	00003 +50000000+01		00076
V	00007 +50000000+02		00077
V	00009 +10000000+02		00078
V	00010 +00000000+00	ZERO	00079
V	00011 +10000000+01		00080

```
V 00012 +19000000+02              NO. OF ELEMENTS                                     00081
V 00013 +18000000+02              MAX. NO. OF VARIABLES                               00082
V 00015 +50000000+01              NO. OF WORDS/ELEMENT NAME                           00083
V 00016 +10000000+02                                                                  00084
V 00017 +10000000-02                                                                  00085
V 00018 +10000000+06                                                                  00086
V 00058 +20000000+01                                                                  00087
V 00071 +90000000+01                                                                  00088
W 00086     *                                                                         00089
V 00179 +00000000+00                                                                  00090
V 00149 -20000000+01                                                                  00091
V 00419 +10000000+01                                                                  00092
V 02090 +40000000+01                                                                  00093
V 02091 +60000000+01                                                                  00094
V 02092 +80000000+01                                                                  00095
V 00072 +48000000+02              WORDS/RECORD ON TG OUTPUT TAPE                      00096
V 00394 +00000000+00              NORMAL SETTING,FOR NO CORRECTED                     00097
                                   OBS. TAPE WRITTEN ON TG                            00098
V 00398 +20000000+01              X, WHERE K 1 = (RHO 1) / X                          00099
V 01800 -10000000+01                                                                  00100
* B 00020                         NEW SATELLITE                          B 00020      00101
F 00000 90037 00000               SWITCH TAPE ASSIGNMENTS                             00102
F 00040 90073 00000               RUN IDENT. L. AND P.                                00103
R 00098 00044                     STORE INPUT OPTION                                  00104
R 00044 00011                                                                         00105
R 00005 00010                                                                         00106
F 00000 90069 00000               CHANGE INITIAL CONSTANTS                            00107
F 00000 90045 00000               COMPUTE CONSTANTS                                   00108
R 00496 03838                     SET TOL. USED IN (O-C) ANGLE RED.F.= PI/2           00109
R 00305 03849                                                                         00110
F 00000 90074 00005                                                                   00111
F 00297 90075 00295                                                                   00112
R 00296 00295                                                                         00113
R 00295 00294                                                                         00114
F 00000 90060 00000                                                                   00115
C 00191 00010 00570 00570         WERE THERE TOO MANY REQ. CARDS                      00116
F 00000 90099 00000               LOAD INTERVAL CORE DUMP CARDS                       00117
C 00099 00058 00577 00577         IS MCOI ORBIT GENERATOR BEING USED                  00118
F 00000 90043 00000               YES. LOAD AREA,MASS,DRAG DATA CARD                  00119
R 01197 00010                     SET NO. OF T (P,Q)'S = 0                            00120
```

```
     E 00576                                                                  00121
   * B 00577                                                       B 00577    00122
     F 01130 90072 00295          LOAD DRAG DATA                              00123
     C 00006 00010 00010 00010                                                00124
     A 01197 00002 00011          NO. OF T(P,Q)'S                             00125
   * B 00576                                                       B 00576    00126
     C 00098 00010 00575 00575    IS ELEM. INPUT ON BINARY TAPE               00127
     P 00000 01800 TAB            YES. REWIND TA                              00128
     R 01811 00010                                                            00129
   * B 01814                      LOAD RECORD OF ELEMENTS          B 01814    00130
     L 01100 00498 TAB                                                        00131
     C 00000 00459 01815 01815    WAS TAPE CHECK DETECTED                     00132
     A 01811 01811 00011          YES. ADD TO NO. OF TRIES TO READ            00133
     C 01811 00460 01820          HAVE ENOUGH TRIES BEEN MADE                 00134
     L 00000 01800 TAB            NO. BACKSPACE AND                           00135
     E 01814                       TRY AGAIN TO READ RECORD                   00136
   * B 01815                                                       B 01815    00137
     F 00000 90069 00000          CHANGE COMPUTED CONSTANTS                   00138
     L 00085 00011 CA    151515150801           SSSSSN                        00139
     L 00000 00011 CA                                                         00140
     E 00021                                                                  00141
   * B 00575                      INPUT IS ON CARDS                B 00575    00142
     F 00000 90069 00000          CHANGE COMPUTED CONSTANTS                   00143
     R 00090 00010                SET FOR NORMAL ELEMENT LOAD ENTRY           00144
     F 00006 90079 00010          ELEMENT LOAD                                00145
     C 00006 00010 00095 00095                                                00146
   * B 00021                                                       B 00021    00147
     I 00069 -10000000+01                                                     00148
     I 00014 +00000000+00                                                     00149
     I 00007 +99000000+02                                                     00150
   * N 00050                      GET STARTING QUANTITIES FROM     N 00050    00151
     A 00069 00069 00011           STORAGE IN LOCS.1100-1199 AND STORE        00152
     G 00051 01100 00069           IN LOCS.1000-1099, TO BE SAVED AS          00153
     H 01000 00069 00051           ORIGINAL QUANTITIES                        00154
     C 00007 00069 00050                                                      00155
     C 00099 00058 00578 00578    IS MCOI ORBIT GENERATOR BEING USED          00156
     A 00567 00011 01150          YES. COMPUTE (1+ INITIAL RHO 1)             00157
     M 00567 00567 00267          (1+ RHO 1) (C SUB D)                        00158
     R 00565 00567                STORE AS ORIGINAL QUANTITY                  00159
   * B 00578                                                       B 00578    00160
```

```
   F 00000 90041 00000           PRINT INITIAL ELEM.,DRAGS,EARTH CONSTANTS                00161
   R 01199 00099                 STORE ORBIT GEN.ID. IN 100-WORD RECORD                   00162
   I 00007 +50000000+02                                                                   00163
   F 00000 90077 00000           INITIALIZE ORBIT GEN. TO GET C                           00164
   C 00098 00010 00573 00573     WAS ELEMENT INPUT ON BIN. TAPE                           00165
   E 00574                       YES. N NEED NOT BE MULTIPLIED BY C                       00166
 * B 00573                       NO                                      B 00573          00167
   M 01119 01119 03851           N (C)                                                    00168
 * B 00574                                                               B 00574          00169
   C 00011 00085 00022 00022                                                              00170
      T                                                                                   00171
   P 00000 00011 TD                                                                       00172
   P 00000 00011 PA                                                                       00173
      T COMPLEMENTARY PERTURBATIONS                                                       00174
   P 00000 00011 TD                                                                       00175
   P 00000 00011 PA                                                                       00176
      T                                                                                   00177
   I 00069 -10000000+01                                                                   00178
   P 00000 00069 TFB                                                                      00179
   R 01811 00010                                                                          00180
 * B 01812                       LOAD PERT. TAPE TITLE RECORD            B 01812          00181
   L 00600 00461 TFB                                                                      00182
   C 00000 00459 01813 01813     WAS TAPE CHECK DETECTED                                  00183
   A 01811 01811 00011           YES. ADD TO NO.OF TRIES TO READ                          00184
   C 01811 00460 00062           HAVE ENOUGH TRIES BEEN MADE                              00185
   L 00000 01800 TFB             NO. BACKSPACE AND                                        00186
   E 01812                        TRY AGAIN TO READ RECORD                                00187
 * B 01813                                                               B 01813          00188
   C 00605 00295 00094 00094                                                              00189
   M 00293 00601 03837           DELTA T                                                  00190
   R 00601 00604                                                                          00191
   R 00599 00296                                                                          00192
   R 00600 00297                                                                          00193
   F 00294 90076 00599                                                                    00194
   F 00000 90058 00000           INITIALIZE INTERPOLATION                                 00195
   F 00270 90068 01100                                                                    00196
 * B 00022                       NEXT SET OF VARIABLES                   B 00022          00197
   R 00462 00615                 STORE K, MULT. FOR DRAG DELTA M                          00198
   L 00075 00011 CA     03020302030203020302030215151502       NNNNNNNNNNSSSS             00199
      T                                                                                   00200
```

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```
  P 00000 00011 PA
  P 00000 00011 TD
    T STANDARD DEVIATION PARAMETERS  SIGMA  SM   SA   CT   NI
  P 00000 00011 TD
  P 00000 00011 PA
    T
  P 00075 00011 TD    151502030203020302030203020302       SSSNNNNNNNNNN
  P 00075 00011 PA    151502030203020302030203020302       SSSNNNNNNNNNN
  I 00050 +10000000+07
  M 00075 00075 00050
  M 00077 00077 00050
  M 00079 00079 00050
  M 00081 00081 00050
  M 00083 00083 00050
  F 00075 90070 00075
  F 00077 90070 00077
  F 00079 90070 00079
  F 00017 90070 00081
  F 00016 90070 00083
  I 00007 +99000000+02
  I 00069 +00000000+00
* N 00050                      SET SUMS OF ALL                          N 00050
  H 04201 00069 00010           UNKNOWNS = 0
  A 00069 00069 00011
  C 00007 00069 00050
  P 00000 01800 TAB
  P 01100 00498 TAB
  C 00394 00010 01802 01802    IS A CORR. OBS. TAPE TO BE WRITTEN ON TG
  E 01801                      NO
* B 01802                      YES                                      B 01802
  P 00000 01800 TGB
  P 00000 01800 TBB
  R 01803 00010
* B 01804                      LOAD TITLE RECORD FROM TB                B 01804
  L 02821 00072 TBB
  C 00000 00459 01805 01805    WAS TAPE CHECK DETECTED
  A 01803 01803 00011          YES. ADD TO NO. OF TRIES TO READ
  C 01803 00460 01810          HAVE ENOUGH TRIES BEEN MADE
  L 00000 01800 TBB            NO. BACKSPACE AND
  E 01804                       TRY AGAIN TO READ RECORD
```

```
 * B 01805                                                                        B 01805   00241
   P 02821 00072 TGB             WRITE TITLE RECORD ON TG                                   00242
   P 00000 01800 TBB                                                                        00243
 * B 01801                                                                        B 01801   00244
   C 00098 00010 00571 00571     WAS ELEMENT INPUT ON BINARY TAPE                           00245
   R 00178 01196                 YES. USE SIGMA FROM TAPE RECORD                            00246
   E 00037                                                                                  00247
 * B 00571                       INPUT WAS ON CARDS                               B 00571   00248
   R 00178 00075                 USE SIGMA FROM CARD                                        00249
 * B 00037                       NEW SET OF UNKNOWNS                              B 00037   00250
   L 00400 00011 CA      0303030303030303030303030303030303NNNNNNNNNNNNNNNN                 00251
   C 00011 00400 00036                                                                      00252
   I 00014 +0000000+00           SET CNTR.OF ITERATIONS USING NEW SET=0                     00253
   I 00007 +2000000+02                                                                      00254
   I 00069 +0000000+00                                                                      00255
 * N 00050                       SET WEIGHTS FOR ADDITIONAL                       N 00050   00256
   H 04035 00069 00010            CONDITION EQNS.ASSOCIATED                                 00257
   A 00069 00069 00011            WITH UNKNOWNS = 0                                         00258
   C 00007 00069 00050                                                                      00259
   I 00069 -1000000+01                                                                      00260
 * N 00050                                                                        N 00050   00261
   A 00069 00069 00011                                                                      00262
   G 00051 00400 00069                                                                      00263
   C 00051 00010 00050                                                                      00264
   R 00598 00069                                                                            00265
   R 00599 00598                                                                            00266
   F 00000 90067 00000           LOAD CONSTRAINT WEIGHTS CARD                               00267
     T                                                                                      00268
   P 00000 00011 TD                                                                         00269
   P 00000 00011 PA                                                                         00270
     T UNKNOWN NO.  CONSTRAINT WT.                                                          00271
   P 00000 00011 PA                                                                         00272
   P 00000 00011 TD                                                                         00273
   I 00069 +0000000+00                                                                      00274
 * N 00050                                                                        N 00050   00275
   G 00051 00400 00069           GET UNKNOWN NO.                                            00276
   C 00051 00010 00093                                                                      00277
     T                                                                                      00278
   P 00000 00011 PA                                                                         00279
   P 00000 00011 TD                                                                         00280
```

```
     E 00023
   * B 00093                                                                  B 00093
     G 00052 04035 00069               GET CONSTRAINT WT.
     F 00052 90071 00052
     D 00052 00052 00018
       T
     P 00051 00011 TD     0403100403                    SNSNN
     P 00051 00011 PA     0403100403                    SNSNN
     A 00069 00069 00011
     E 00050
   * B 00023                           NEXT REJECTED OBSERVATION SET          B 00023
     F 00262 90093 00000               LOAD REJECT CARDS
     C 00262 00011 00263 00263         WERE THERE TOO MANY CARDS
   * B 00024                           NO. NEXT ITERATION                     B 00024
     P 00000 01800 TAB
     P 00000 01800 TBB
     R 01811 00010
   * B 01816                           LOAD CORRECTED ELEMENTS FROM TAPE      B 01816
     L 01100 00498 TAB
     C 00000 00459 01817 01817         WAS TAPE CHECK DETECTED
     A 01811 01811 00011               YES. ADD TO NO.OF TRIES TO READ
     C 01811 00460 01820               HAVE ENOUGH TRIES BEEN MADE
     L 00000 01800 TAB                 NO. BACKSPACE AND
     E 01816                            TRY AGAIN TO READ RECORD
   * B 01817                                                                  B 01817
       T UNKNOWNS
     P 00000 00011 TD
       T
     P 00400 00011 TD     0303030303030303030303030303030303NNNNNNNNNNNNNNNNN
     C 00475 00010 00481 00481         ARE (O-C)'S TO BE PRINTED
     R 01830 01831                     YES. SET VARIABLE CONNECTOR
       T STAT.  YYMMDD HHMM SS    T      O       C      O-C   1000RW (O-C)RW NO.
     P 00000 00011 TD
     C 00042 00010 00091
     E 00092
   * B 00481                           (O-C)'S ARE NOT TO BE PRINTED          B 00481
     R 01830 01832                     SET VARIABLE CONNECTOR
     E 00092
   * B 00091                                                                  B 00091
       T UNKNOWNS
```

```
   P 00000 00011 PA
       T
   P 00400 00011 PA     0303030303030303030303030303030303NNNNNNNNNNNNNNNNNN
   C 00045 00010 00480 00480          ARE (O-C)'S TO GO ON PRINTER
   E 00092                            NO
 * B 00480                            YES                                  B 00480
       T STAT.  YYMMDD HHMM SS    T      O       C       O-C   1000RW (O-C)RW NO.
   P 00000 00011 PA
 * B 00092                                                                 B 00092
   I 00007 +40000000+02
   I 00069 +00000000+00
 * N 00050                            SET TO ZERO THE SUM OF WEIGHTED (O-C) SQ.   N 00050
   H 01900 00069 00010                 AND THE NO. OF ITEMS IN EACH
   A 00069 00069 00011                 SUM FOR EACH OBS. TYPE
   C 00007 00069 00050
   I 00069 -10000000+01
   A 00014 00011 00014
   A 00179 00179 00011
   I 00477 +99999999+08               SET PREVIOUS OBS. TIME
   R 00478 00010                      SET PREVIOUS
   R 00479 00010                       STATION NAME=0
   R 00048 00010
   R 00049 00010
   F 00000 90077 00000
   F 00598 90081 00419
 * B 00029                            NEXT OBSERVATION                     B 00029
   F 00005 90082 00011
   C 00010 00005 00027
   C 00011 00253 00030
 * B 00028                                                                 B 00028
   F 00250 90094 00245
   C 00200 00477 00482 00482          IS TIME= PREVIOUS OBS. TIME
   C 00300 00478 00482 00482          YES. IS STATION NAME
   C 00301 00479 00482 00482           = PREVIOUS STATION NAME
   E 00483                            YES. SKIP SPO
 * B 00482                                                                 B 00482
   F 00000 90083 00000                SPO
   R 00478 00300                      SET PREVIOUS STATION NAME
   R 00479 00301                       = PRESENT STATION NAME
 * B 00483                                                                 B 00483
```

```
  C 00200 00477 00491 00491   IS TIME= PREVIOUS OBS. TIME                          00361
  E 00492                     YES. SKIP SOME COMPUTATIONS                          00362
* B 00491                     TIMES ARE NOT EQUAL                        B 00491   00363
  F 00204 90084 00200         ORBIT GENERATOR                                      00364
  F 00000 90086 00000         POSITION IN ELLIPSE                                  00365
  R 00477 00200               SET PREVIOUS TIME= PRESENT TIME                      00366
* B 00492                                                                B 00492   00367
  C 00253 02090 02093 02096   IS OBS.TYPE = 4 (AZIMUTH)                            00368
  R 00470 00253               YES. SAVE TYPE NO.                                   00369
  I 00253 +50000000+01        SET TYPE = 5, SO LSP WILL COMPUTE ELEVATION          00370
  E 02095                      FOR USE IN COMPUTING WT. FOR AZIMUTH                00371
* B 02093                                                                B 02093   00372
  C 00253 02091 02094 02096   IS OBS. TYPE = 6  (RT.AS.)                           00373
  R 00470 00253               YES. SAVE TYPE NO.                                   00374
  I 00253 +70000000+01        SET TYPE = 7,SO LSP WILL COMPUTE DECLINATIO          00375
  E 02095                      FOR USE IN COMPUTING WT.FOR RT.AS.                  00376
* B 02094                                                                B 02094   00377
  C 00253 02092 02096 02096   IS OBS.TYPE = 8 (LOCAL HR. ANGLE)                    00378
  R 00470 00253               YES. SAVE TYPE NO.                                   00379
  I 00253 +70000000+01        SET TYPE = 7,SO LSP WILL COMPUTE DECL.               00380
* B 02095                                                                B 02095   00381
  F 00000 90085 00000         ENTER LSP TO COMPUTE EL. OR DECL.                    00382
  F 00471 90040 00256         COS OBS.'  (OBS.' = EL. OR DECL.)                    00383
  M 00258 00258 00471         WT. = (INPUT WT.) (COS OBS.')                        00384
  R 00253 00470               RESTORE ACTUAL OBS. TYPE                             00385
* B 02096                                                                B 02096   00386
  D 00397 00396 00398         K SUB 1 = (RHO SUB 1) / 2                            00387
  F 00000 90085 00000         ENTER LSP TO COMPUTE ACTUAL OBS.                     00388
  C 00394 00010 00399 00399    IS CORR. OBS. TAPE BEING WRITTEN ON TG              00389
* B 00393                                                                B 00393   00390
  F 00000 90050 00000         (O-C) ANGLE REDUCTION                                00391
  S 00257 00255 00256                                                              00392
  R 00249 00257               SAVE UNWEIGHTED (O-C)                                00393
  R 00069 00598                                                                    00394
  S 00252 00598 00011                                                              00395
  G 00252 00400 00252                                                              00396
  R 00392 00257                                                                    00397
  F 00000 90065 00253         ENTER RANGE RATE F. FOR (O-C)                        00398
  R 00257 00392                                                                    00399
  F 00050 90064 00257                                                              00400
```

```
  M 00050 00050 00258         (ABS.VALUE OF O-C)(WT.)                                 00401
  M 00051 00178 00077                                                                 00402
  A 00051 00051 00079                                                                 00403
  I 00176 +00000000+00                                                                00404
  C 00051 00050 00074         DOES (WT.)(O-C)=OR EXCEED (SM)(SIGMA)+SA                00405
  R 00258 00010               YES. SET WT. FOR COND.EQN.=0                            00406
  R 00176 00086               STORE * FOR PRINTOUT                                    00407
* B 00074                                                               B 00074       00408
  R 00254 00257               STORE UNWEIGHTED (O-C)                                  00409
  M 00257 00257 00258         (O-C)(WT.)                                              00410
  E 01830                     GO TO B1831 OR TO B1832                                 00411
* B 01831                     (O-C)'S ARE TO BE PRINTED                 B 01831       00412
  F 00000 90063 00000         O-C PRINT F.                                            00413
* B 01832                                                               B 01832       00414
  C 00258 00010 00195 00195   IS OBS. WT. = 0                                         00415
  C 02098 00010 00029 00029   YES. ARE RANGE RATES TO BE DIFFERENCED                  00416
  C 00253 00071 00029 00029   YES. IS OBS. TYPE = 9 (RANGE RATE)                      00417
  C 00010 00246 00029         YES. IS IT FIRST RANGE RATE OF PASS                     00418
* B 00195                                                               B 00195       00419
  M 00392 00392 00258                                                                 00420
  H 00420 00069 00392         STORE (WEIGHTED) COND.EQN.COEFFICIENT                   00421
  S 00069 00069 00011                                                                 00422
  C 00010 00069 00073                                                                 00423
  G 00252 00400 00069         GET J, NO. OF UNKNOWN XJ                                00424
  F 00000 90087 00000         COMPUTE PARTIALS OF POS.+VEL.VECTORS/XJ                 00425
  F 00000 90088 00000         COMPUTE PARTIAL OF OBSERVATION/XJ                       00426
  F 00000 90065 00253         RANGE RATE FUNCTION                                     00427
  E 00195                                                                             00428
* B 00073                                                               B 00073       00429
  C 00258 00010 00196 00196   IS OBS. WT. = 0                                         00430
  E 00029                     YES. GO LOAD NEXT OBS.                                  00431
* B 00196                     OBS. WT. IS NOT 0                         B 00196       00432
  F 00598 90089 00419         AUGMENT NORMAL MATRIX WITH COND.EQN.                    00433
  M 00047 00257 00257                                                                 00434
  F 00000 90047 00000         ADD TO SUM OF (O-C)SQ AND TO N CORRES.TO OB             00435
  A 00043 00048 00011         ADD TO NO. OF COND. EQNS.                               00436
  A 00049 00049 00047         ADD TO SUM OF SQUARED (O-C)'S                           00437
  E 00029                                                                             00438
* B 00399                     WRITE RECORD ON GATED OBS. TAPE           B 00399       00439
  P 02821 00072 TGB                                                                   00440
```

```
  E 00393
* B 00030                                                        B 00030
  C 00011 00085 01834 01834     ARE COMP. PERT. BEING USED
  I 00069 -10000000+01          YES. REWIND PERT. TAPE
  P 00000 00069 TFB
  L 09220 00461 TFB
  F 00000 90058 00000           INITIALIZE INTERPOLATION
* B 01834                                                        B 01834
  C 00394 00010 01807 01807     WAS TAPE WRITTEN ON TG
  E 01806                       NO
* B 01807                       YES                              B 01807
  I 02821 +99999999+08           WRITE END SENTINELS ON TG
  P 02821 00072 TGB
  P 02821 00072 TGB
  S 01808 01800 01800
  P 00000 01808 TGB             EOF TG
  P 00000 01800 TGB             REWIND TG
  R 00394 00010                  SET TO NOT WRITE TAPE ON
                                 TG IN SUCCEEDING ITERATIONS
* B 01806                                                        B 01806
  F 00000 90046 00000           COMPUTE AND PRINT R.M.S.FOR EACH OBS.TYPE
  F 00000 90049 00000           COMPUTE CONSTRAINT EQNS.(EXTRA COND.EQNS.)
  F 00441 90090 00598           SOLVE NCRMAL EQNS.
  F 00000 90062 00000           SUM UNKNOWNS
  R 00200 01100
  F 00000 90091 00000           CC (CONVERT CORRECTIONS)
  R 00288 00010
  F 00000 90059 00000           COMPUTE AND STORE CORR. ELEM.
  M 00600 01101 03846           A         (KM.)
  M 00601 01101 03836           A         (MILES)
  M 00602 01116 03847           I         (DEG.)
  M 00603 01123 03870           PERIOD    (MINUTES)
  C 00099 00058 00472 00472     IS MCCI ORB.GEN.BEING USED
  R 00604 00010                 YES. SET P DOT = 0
  E 00473
* B 00472                                                        B 00472
  D 00604 01150 01119           N 2 = (N 2,Q) / N
  D 00605 03842 01119           (2 PI) / N
  M 00604 00604 00605           (2 PI/N) (N 2)
  M 00604 00604 00149           P DOT = -2(2 PI/N) (N 2)
```

```
   M 00604 00604 03870                                                            00481
   M 00604 00604 03837           P DOT IN MIN/DAY                                 00482
 * B 00473                                                              B 00473   00483
   M 00605 01124 03846           HT. OF PERIGEE (KM.)                             00484
   M 00606 01124 03836           HT. OF PERIGEE (MILES)                           00485
   M 00607 01125 03846           HT. OF APOGEE (KM.)                              00486
   M 00608 01125 03836           HT. OF APOGEE (MILES)                            00487
   A 00611 00011 01102           1+E                                              00488
   S 00612 00011 01102           1-E                                              00489
   D 00609 00611 00612           1+E/1-E                                          00490
   D 00609 00609 01101           (1+E/1-E)/A                                      00491
   F 00610 90096 00609           SQ.RT. OF ABOVE = VEL. AT PERIGEE                00492
   M 00609 00610 03867           VELOCITY AT PERIGEE (KM/HR)                      00493
   M 00610 00610 03845           VELOCITY AT PERIGEE (MI/HR)                      00494
   D 00612 00612 00611           1-E/1+E                                          00495
   D 00612 00612 01101           (1-E/1+E)/A                                      00496
   F 00612 90096 00612           SQ.RT. OF ABOVE= VEL. AT APOGEE                  00497
   M 00611 00612 03867           VELOCITY AT APOGEE (KM/HR)                       00498
   M 00612 00612 03845           VELOCITY AT APOGEE (MI/HR)                       00499
   M 00613 01113 03847           M (DEG.)                                         00500
   M 00614 01115 03847           ARG. OF PERIGEE (DEG.)                           00501
   M 00615 01121 03847                                                            00502
   M 00615 00615 03837           SMALL OMEGA DOT (DEG/DAY)                        00503
   M 00616 01117 03847           R.A. OF ASC. NODE (DEG)                          00504
   M 00617 01122 03847                                                            00505
   M 00617 00617 03837           CAP OMEGA DOT (DEG/DAY)                          00506
   F 00618 90097 01116           SIN I                                            00507
   F 00619 90097 01115           SIN (SMALL OMEGA)                                00508
   M 00618 00618 00619                                                            00509
   F 00618 90098 00618           GEOC. LATITUDE OF PERIGEE                        00510
   M 00618 00618 03847                                                            00511
   F 00000 90061 00000           PRINT REQUESTED QUANTITIES AND S.D. OF FIT       00512
     T N EQUALS                                                                   00513
   P 00048 00011 PA    1205                   SN                                  00514
   P 00048 00011 TD    1205                   SN                                  00515
   C 00016 00014 00033           HAS MAX.NO. OF ITERATIONS BEEN RUN               00516
                                  USING THIS SET OF UNKNOWNS                      00517
   E 00037                       YES. LOAD ANOTHER SET                            00518
 * B 00033                                                              B 00033   00519
   C 00019 00017 00024           HAS THIS SET OF UNKNOWNS CONVERGED               00520
```

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   E 00037                        YES. LOAD ANOTHER SET                                 00521
 * B 00036                                                                   B 00036    00522
      T RUN TERMINATED AFTER     ITERATIONS                                             00523
   P 00179 00011 TD     150603                   SSN                                    00524
   P 00179 00011 PA     150603                   SSN                                    00525
      T THE END                                                                         00526
   P 00000 00011 TD                                                                     00527
   P 00000 00011 PA                                                                     00528
   I 00069 -10000000+01                                                                 00529
   S 00069 00069 00069            SET TO EOF TD                                         00530
   P 00000 00069 TD                                                                     00531
   C 00032 00010 00264            DOES LOC. 00032 CONTAIN 0                             00532
   E 00032                        YES. END OF RUN                                       00533
 * B 00264                        JUMP TO ANOTHER PROGRAM                    B 00264    00534
   J 00032                                                                              00535
                                                                                        00536
 * B 01810                                                                   B 01810    00537
      T TAPE CHECK IN TITLE RECORD OF BINARY OBSERVATION TAPE ON TB                     00538
   P 00000 00011 PA                                                                     00539
   E 00010                                                                              00540
 * B 01820                                                                   B 01820    00541
      T TAPE CHECK ON BINARY ELEMENT TAPE ON TA                                         00542
   P 00000 00011 PA                                                                     00543
   E 00010                                                                              00544
 * B 00061                        COME HERE FROM OBSERVATION LOAD FUNCTION   B 00061    00545
                                   IF IT FINDS TAPE CHECK ON TB                         00546
      T TAPE CHECK ON BINARY OBSERVATION TAPE ON TB                                     00547
   P 00000 00011 PA                                                                     00548
   E 00029                        LOAD NEXT RECORD FROM OBS. TAPE                       00549
 * B 00062                        COME HERE AFTER LOAD TITLE RECORD OR FROM  B 00062    00550
                                   PERT.TAPE READ F. IF FIND TAPE CHECK ON TF           00551
      T TAPE CHECK ON COMPLEMENTARY PERTURBATIONS TAPE ON TF                            00552
   P 00000 00011 PA                                                                     00553
   E 00010                                                                              00554
 * B 00063                                                                   B 00063    00555
      T TAPE CHECK ON LUNAR PERT. TAPE ON TE                                            00556
   P 00000 00011 PA                                                                     00557
   E 00010                                                                              00558
 * B 00064                                                                   B 00064    00559
      T TAPE CHECK ON SOLAR PERT. TAPE ON TF                                            00560
```

```
     P 00000 00011 PA
     E 00010
   * B 00027                                                           B 00027
         T WRONG SATELLITE ID. NO. ON OBSERVATION TAPE TB (NORMALLY C-1)
     P 00000 00011 PA
     E 00010
   * B 00094                                                           B 00094
         T WRONG SAT. ID. NO. ON COMP. PERTURBATIONS TAPE TF (NORMALLY B-4)
     P 00000 00011 PA
     E 00010
   * B 00095                                                           B 00095
         TWRONG SAT. ID ON ELEMENT CARD
     P 00000 00011 PA
     E 00010
   * B 00570                                                           B 00570
         T REDUCE THE NO.OF PRINT REQUEST CARDS AND START AGAIN (THE MAX.IS 28)
     P 00000 00011 PA
     E 00010
   * B 00263                        THERE WERE TOO MANY REJECT CARDS   B 00263
         T REDUCE THE NO. OF CULL CARDS AND START AGAIN (THE MAX. IS 124)
     P 00000 00011 PA
     E 00010
     V 00089 +00000000+00           SET FOR SINGLE PRECISION
   * B 00008                        OVER-UNDERFLOW TRANSFER FOR S.P.-32K B 00008
     X 01840
         TTHIS STOP CAUSED BY OVERFLOW.LAST TRANSFER ATTEMPTED WAS TO LOC.
     P 30000 00011 PA     151515150406                     SSSSSN
     E 00010
   * B 01840                                                           B 01840
     . 00000

                            THE PRECEDING CARD IS A BINARY CARD FORMED
                            BY MAKING THE FOLLOWING PUNCHES, IN ROW 11
                            COLUMNS 34,36,67-73, IN ROW 10 COLUMNS
                            70-72, IN ROW 0 COLUMNS 77-80, IN ROW 1
                            COLUMN 8, IN ROW 2 COLUMNS 4-7,9,10,40,42-
                            44,68,73, IN ROW 3 COLUMNS 4-8,12,44,55,72,
                            IN ROW 4 COLUMNS 1,5,6,8,32,35,36,41-43,68,
                            71, IN ROW 5 COLUMNS 4,5,11,33-36,40-45,48,
                            68,71, IN ROW 6 COLUMNS 1,4,6,40,41,44,48,
```

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69,70, IN ROW 7 COLUMNS 4,5,11,33,34,36,37,
40,41,69-71, IN ROW 8 COLUMNS 2,5,10,13,18,
21,30,33, IN ROW 9 COLUMNS 2,14,16,41-43,
45-50,52,54,55,57,64,68,70.
9                                        B
```

```
        PRINT REQUESTED QUANTITIES
  K 00000
  K 00100
  Q 90000 00000
  Q 90001 03100                      1 ST LOC. OF DATA STORAGE
  Q 90002 03101                      2 ND STG. LOC.
  Q 90003 03102                      3 RD STG. LOC.
  Q 90004 03103                      4 TH STG. LOC.
  Q 90005 03104                      5 TH STG. LOC.
  Q 90006 03105                      6 TH STG. LOC.
  Q 90007 03106                      7 TH STG. LOC.
  Q 90008 00060                      NO. OF LINES TO PRINT
  Q 90009 02521                      OUTPUT SCALE
  Q 90010 00042                      PRINTER OUTPUT OPTION
  Q 90011 00178                      SIGMA
  Q 90012 00065                      CHANGE IN SIGMA
  Q 90013 00179                      ITERATICN NO.
* B 00001                            PRINT REQUESTED QUANTITIES                 B 00001
  V 00005 +00000000+00
  V 00006 +10000000+01
  V 00007 +70000000+01
  V 00027 +10000000+06
  R 00008 00005                      NO. OF LINES PRINTED=0
  R 00009 00005                      CNTR.=0
      T1ITERATION NO.
  P 90013 00006 TD     1404                          SN
      T ITERATION NO.
  P 90013 00006 PA     1404                          SN
      T
  P 00000 00006 PA
  C 90008 00005 00032 00032          IS ANY PRINT REQUESTED
  E 00033                            NO
* B 00032                                                                       B 00032
      TO
  P 90001 00006 TD     01041404041104041104O4        SASAASAASAA
      T
  C 90010 00005 00034 00034
  E 00010
* B 00034                                                                       B 00034
  P 90001 00006 PA     010414040411040411O404        SASAASAASAA
```

```
   * B 00010                                                           B 00010
     A 00008 00008 00006               (NO. OF LINES PRINTED)+1
     A 00009 00009 00007               CNTR.+7
     C 90008 00008 00011               HAVE ALL REQ. LINES BEEN PRINTED
   * B 00033                                                           B 00033
     F 00013 90009 90011               YES. SCALE SIGMA
     D 00013 00013 00027
     F 00015 90009 90012               SCALE CHANGE IN SIGMA
     D 00015 00015 00027
        T
     P 00000 00006 TD
     P 00000 00006 PA
        T STANDARD DEVIATION
     P 00013 00006 TD    1515060403050403             SSSNNSNN
     P 00013 00006 PA    1515060403050403             SSSNNSNN
     E 00002                           YES
   * B 00011                           NO                              B 00011
     G 00013 90001 00009               GET 4 WORDS DESCRIBING
     G 00014 90002 00009                QUANTITIES
     G 00015 90003 00009
     G 00016 90004 00009
     G 00019 90005 00009               LOC. OF Q SUB 1
     G 00019 90000 00019               Q SUB 1
     F 00017 90009 00019
     G 00023 90006 00009               LOC. OF Q SUB 2
     C 00023 00005 00028 00028         IF LOC=0 (I.E. NO Q 2 REQUESTED),PRINT Q 1
     P 00013 00006 TD    01040404041515080903         SAAAASSSNN
     C 90010 00005 00029 00029
     E 00010
   * B 00029                                                           B 00029
     P 00013 00006 PA    01040404041515080903         SAAAASSSNN
     E 00010
   * B 00028                                                           B 00028
     G 00023 90000 00023               Q SUB 2
     F 00021 90009 00023
     S 00019 00023 00019               (Q SUB 2)-(Q SUB 1)
     F 00019 90009 00019
     D 00019 00019 00027
     G 00024 90007 00009               LOC. OF Q SUB 3
     C 00024 00005 00030 00030         IF LOC=0(I.E.NO Q 3 REQ.),PRINT Q1,Q2,+ DIF
```

```
  P 00013 00006 TD    010404040415040903040309O3        SAAAASSNNNNNN
  C 90010 00005 00031 00031
  E 00010
* B 00031                                                            B 00031
  P 00013 00006 PA    01040404041504090304030903        SAAAASSNNNNNN
  E 00010
* B 00030                                                            B 00030
  G 00024 90000 00024             Q SUB 3
  F 00025 90009 00024
  S 00023 00024 00023             (Q SUB 3)-(Q SUB 2)
  F 00023 90009 00023
  D 00023 00023 00027
  P 00013 00006 TD    0104040404090304030903040309O3    SAAAANNNNNNNNNN
  C 90010 00005 00012 00012       IS OUTPUT ON PRINTER
  E 00010                         NO
* B 00012                         YES                                B 00012
  P 00013 00006 PA    010404040409030403090304030903    SAAAANNNNNNNNNN
  E 00010
```

```
          (O-C) PRINT FUNCTION FOR D.C.
   K 00000
   K 00150
   Q 90001 00042
   Q 90002 00009              TEN
   Q 90003 00498              100
   Q 90005 00497              EQUATORIAL CR POLAR IDENT.
   Q 90045 00045
   Q 90300 00300              STATION LABEL
   Q 90301 00301
   Q 92825 02825              YR MO DY
   Q 92826 02826              HR MI
   Q 92827 02827              SE. SEC
   Q 90253 00253              OBS TYPE
   Q 90255 00255              OBSERVED QUANTITY
   Q 90256 00256              COMPUTED QUANTITY
   Q 90254 00254              O-C  (UNWEIGHTED)
   Q 90257 00257              O-C  (WEIGHTED)
   Q 90258 00258              OBSERVATION WEIGHT
   Q 90245 00245              OBS. NO.
   Q 92521 02521              OUTPUT SCALE
 * B 00001                                                B 00001
   V 00005 +10000000+01
   V 00006 +10000000+06
   V 00007 +00000000+00
   V 00027 +10000000+04       10 TO 3
   R 00010 90300
   R 00011 90301
   R 00012 92825
   R 00013 92826
   M 00014 00027 92827
   I 00018 +90000000+02
   D 00016 90253 90002        OBS. TYPE (XY)/10
   U 00016 00016
   A 00017 00016 00018        X+90=9X=ALPH.REP.
   M 00016 00016 90002        X0
   S 00016 90253 00016        Y
   A 00016 00016 00018        Y+90=9Y=ALPH.REP.
   M 00017 00017 90003        9X00
   A 00017 00017 00016        9X9Y
```

```
  M 00017 00017 90003              9X9Y00
  A 00015 00017 90005              (9X9Y00)+(EQUAT.OR POLAR IDENT.)
  F 00015 92521 90255              OBS. QUANTITY THRU OUTPUT SCALE
  D 00016 00016 00006
  F 00018 92521 90256              COMPUTED QUANTITY THRU OUTPUT SCALE
  D 00018 00018 00006
  F 00020 92521 90254              SCALE O-C  (UNWEIGHTED)
  D 00020 00020 00006
  M 00022 90258 00027              *WEIGHT)(10 TO 3)
  F 00023 92521 90257              SCALE O-C (WEIGHTED)
  D 00023 00023 00006
  R 00025 90245                    OBS. NO.
    T
  P 00010 00005 TD     0104020705060404030403040307040305O3SAANNNANNNNNNNNNA
  C 90001 00007 00008
  E 00002
* B 00008                                                          B 00008
  C 90045 00007 00009 00009
  E 00002
* B 00009                                                          B 00009
  P 00010 00005 PA     0104020705060404030403040307040305O3SAANNNANNNNNNNNNA
  E 00002
```

```
        LSP (LOCAL STATION PREDICTIONS)
K 00000
K 01200
Q 90057 00493           WORKING STG. (BEGIN COMMAND)               O
Q 90058 00494           WORKING STG. (BEGIN COMMAND)               O
Q 00047 00358           RHO BAR                                    O
Q 00050 00361           (RHO BAR)*                                 O
Q 00053 00365           RHO DOT BAR                                O
Q 00056 00368           (RHO DOT BAR)*                             O
Q 00059 00364           RHO                                        O
Q 00060 00371           RHO DOT                                    O
Q 00070 00253           OBSERVATION TYPE                           I
Q 00071 00316           G 1 BAR                                    I
Q 00072 00319           G 2 BAR                                    I
Q 00073 00322           G 3 BAR                                    I
Q 00074 00325           G 4 BAR                                    I
Q 00075 00328           G 5 BAR                                    I
Q 00076 00331           G 6 BAR                                    I
Q 00077 00334           G 7 BAR                                    I
Q 00078 00337           G 1 DOT BAR                                I
Q 00079 00340           G 2 DOT BAR                                I
Q 00080 00343           G 3 DOT BAR                                I
Q 00081 00346           G 4 DOT BAR                                I
Q 00082 00349           G 5 DOT BAR                                I
Q 00083 00352           G 6 DOT BAR                                I
Q 00084 00355           G 7 DOT BAR                                I
Q 00085 02085           VQ                                         O
Q 00086 02001           VECTOR MOVE                                F
Q 00087 02051           DOT PRODUCT                                F
Q 00088 02011           VECTOR MAGNITUDE                           F
Q 00089 02041           VECTOR SUBTRACT                            F
Q 00090 02021           VECTOR DIRECTION                           F
Q 00091 02076           SCALAR-VECTOR MULTIPLY                     F
Q 00092 02246           ARC TAN (Y/X)                              F
Q 00093 02156           ARC SIN                                    F
Q 00094 02196           SQUARE ROOT                                F
Q 00095 00204           R BAR,SATELLITE POSITION VECTOR            I
Q 00096 00310           CAP R BAR,STATION POSITION VECTOR          I
Q 00097 00207           R DOT BAR,SATELLITE VELOCITY VECTOR        I
Q 00098 00313           CAP R DOT BAR,STATION VELOCITY VECTOR      I
```

```
  Q 00099 00256                 COMPUTED OBSERVATION                 D              00881
  Q 90001 09001                 IONOSPHERE CORR. FUNCTION            F              00882
  Q 90002 00375                 (R BAR)*                             D              00883
  Q 90003 09101                 RANGE AMBIGUITY RESOLUTION F.        F              00884
* B 00001                       LSP.                                     B 00001    00885
  V 00100 +17000000+02                                                              00886
  F 00085 00086 00095                                                               00887
  F 00047 00089 00096                                                               00888
  F 00050 00090 00047                                                               00889
  F 00085 00086 00097                                                               00890
  F 00053 00089 00098                                                               00891
  F 00085 00086 00050                                                               00892
  F 00060 00087 00053                                                               00893
  F 00059 00088 00047                                                               00894
  F 00085 00086 00050                                                               00895
  F 00032 00091 00060                                                               00896
  F 00085 00086 00053                                                               00897
  F 00085 00089 00032                                                               00898
  D 00061 00006 00059                                                               00899
  F 00056 00091 00061                                                               00900
  F 00085 00086 00095                                                               00901
  C 00070 00100 90057 90058      IS OBS. = THETA 1                                  00902
  F 00035 00086 00071           YES. USE G1 BAR                                     00903
  F 00041 00086 00073            AND G3 BAR                                         00904
  E 00027                                                                           00905
* B 90057                       OBS. = THETA 2                           B 90057    00906
  F 00035 00086 00072           USE G2 BAR                                          00907
  E 00028                                                                           00908
* B 90058                                                                B 90058    00909
  G 00010 00010 00070                                                               00910
  E 00010                                                                           00911
* B 00011                                                                B 00011    00912
  F 00099 00088 00047                                                               00913
  F 90002 00090 00095           COMPUTE (R BAR)* FOR IONOSPHERE F.                  00914
  F 00099 90001 00099           CORRECT RANGE FOR IONOSPHERE                        00915
  F 00000 90003 00000           RESOLVE ANY AMBIGUITY IN OBSERVED RANGE             00916
  E 00002                                                                           00917
* B 00012                                                                B 00012    00918
  F 00085 00086 00050                                                               00919
  F 00099 00087 00071                                                               00920
```

```
   F 00099 90001 00099      INOSPHERE                        00921
   E 00002                                                   00922
 * B 00013                                        B 00013    00923
   F 00085 00086 00050                                       00924
   F 00099 00087 00072                                       00925
   F 00099 90001 00099      INOSPHERE                        00926
   E 00002                                                   00927
 * B 00014                  AZIMUTH               B 00014    00928
   F 00035 00086 00071      AZIMUTH                          00929
   F 00041 00036 00072                                       00930
   E 00027                                                   00931
 * B 00015                  ELEVATION             B 00015    00932
   F 00035 00086 00073                                       00933
   E 00028                                                   00934
 * B 00016                                        B 00016    00935
   F 00035 00086 00076      RIGHT ASCENSION                  00936
   F 00041 00086 00075                                       00937
   E 00027                                                   00938
 * B 00017                                        B 00017    00939
   F 00035 00086 00077                                       00940
   E 00028                                                   00941
 * B 00018                  LOCAL FOUR ANGLE      B 00018    00942
   F 00041 00086 00074                                       00943
   F 00085 00086 00082                                       00944
   F 00035 00089 00071      ZERO-G(1) BAR                    00945
   E 00027                                                   00946
 * B 00019                                        B 00019    00947
   R 00099 00060            RANGE RATE                       00948
   F 90002 00090 00095      CEMPUTE (R BAR)* FOR IONOSPHERE F.  00949
   F 00099 90001 00099      CORRECT RANGE RATE FOR IONOSPHERE   00950
   E 00002                                                   00951
 * B 00020                  L-RATE                B 00020    00952
   F 00085 00086 00050                                       00953
   F 00065 00087 00078                                       00954
   F 00085 00086 00056                                       00955
   F 00066 00087 00071                                       00956
   A 00099 00065 00066                                       00957
   E 00002                                                   00958
 * B 00021                  M-RATE                B 00021    00959
   F 00085 00086 00050                                       00960
```

	F	00065	00087	00079		00961
	F	00085	00086	00056		00962
	F	00066	00087	00072		00963
	A	00099	00065	00066		00964
	E	00002				00965
*	B	00022			B 00022	00966
	F	00035	00086	00072		00967
	F	00038	00086	00079		00968
	F	00041	00086	00071		00969
	F	00044	00086	00078		00970
	E	00029				00971
*	B	00023			B 00023	00972
	F	00035	00086	00073		00973
	F	00038	00086	00080		00975
	E	00030				00976
*	B	00024			B 00024	00977
	F	00035	00086	00C75		00978
	F	00033	00086	00082		00979
	F	00041	00086	00076		00980
	F	00044	00086	00083		00981
	E	00029				00982
*	B	00025			B 00025	00983
	F	00035	00086	00077		00984
	F	00038	00086	00084		00985
	E	00030				00986
*	B	00026			B 00026	00987
	F	00035	00086	00074		00988
	F	00033	00086	00081		00989
	F	00085	00086	00084		00990
	F	00041	00089	00071		00991
	F	00044	00089	00078		00992
	E	00029				00993
*	B	00027			B 00027	00994
	F	00085	00086	00050		00995
	F	00062	00087	00035		00996
	F	00063	00087	00041		00997
	F	00099	00092	00062		00998
	E	00002				00999
*	B	00028			B 00028	01000

```
  F 00085 00086 00050                 01001
  F 00064 00087 00035                 01002
  F 00099 00093 00064                 01003
  E 00002                             01004
* B 00029                    B 00029  01005
  F 00085 00086 00050                 01006
  F 00065 00087 00038                 01007
  F 00085 00086 00056                 01008
  F 00066 00087 00035                 01009
  A 00067 00065 00066                 01010
  F 00085 00086 00050                 01011
  F 00065 00087 00044                 01012
  F 00085 00086 00056                 01013
  F 00066 00087 00041                 01014
  A 00068 00065 00066                 01015
  F 00085 00086 00050                 01016
  F 00062 00087 00035                 01017
  F 00063 00087 00041                 01018
  M 00065 00062 00068                 01019
  M 00066 00063 00067                 01020
  M 00031 00063 00063                 01021
  M 00069 00062 00062                 01022
  S 00065 00065 00066                 01023
  A 00066 00031 00069                 01024
  D 00099 00065 00066                 01025
  E 00002                             01026
* B 00030                    B 00030  01027
  F 00085 00086 00056                 01028
  F 00065 00087 00035                 01029
  F 00085 00086 00050                 01030
  F 00066 00087 00038                 01031
  A 00067 00065 00066                 01032
  F 00062 00087 00035                 01033
  M 00065 00062 00062                 01034
  S 00066 00006 00065                 01035
  F 00031 00094 00066                 01036
  D 00099 00067 00031                 01037
  E 00002                             01038
  V 00005 +0000000+00                 01039
  V 00006 +1000000+01                 01040
```

```
          PE (POSITION IN ELLIPSE)
K 00000
K 01300                        POSITION IN ELLIPSE
Q 90000 01100                  T(0), EPOCH TIME IN C.U.T.                I
Q 90001 00218                   SEMI MAJOR AXIS AT T, TIME OF OBS.       I
Q 90002 00219                  ECCENTRICITY AT T                         I
Q 90003 01113                  MEAN ANOMALY AT T(0)                      I
Q 90004 01115                  ARG. OF PERIGEE AT T(0)                   I
Q 90005 01117                  LONG. OF ASC. NODE AT T(0)                I
Q 90006 03864                  J                                         I
Q 90007 03852                  MU                                        I
Q 90008 00201                  S(T)                                      O
Q 90009 00202                  C(T)                                      O
Q 90010 00210                  R (MAGNITUDE OF R BAR)                    O
Q 90011 00211                  V (MAGNITUDE OF V BAR)                    O
Q 90012 01112                  DELTA AT T(0)                             I
Q 90013 00213                  MEAN ANOMALY AT T                         I
Q 90015 00215                  ARG. OF PERIGEE AT T                      I
Q 90016 00220                  INCLINATION AT T                          I
Q 90017 00217                  LONG. OF ASC. NODE AT T                   I
Q 90019 01119                  MEAN MOTION AT T(0)                       I
Q 90022 00222                  ALPHA BAR                                 O
Q 90024 00224                  ALPHA SUB K                               O
Q 90025 00225                  BETA BAR                                  O
Q 90028 00228                  GAMMA BAR                                 O
Q 90031 00231                  P BAR                                     O
Q 90034 00234                  Q BAR                                     O
Q 90037 00237                  R BAR (POSITION VECTOR)                   O
Q 90040 00240                  E(T) (ECCENTRIC ANOMALY)                  O
Q 90041 00241                  V BAR (VELOCITY VECTOR)                   O
Q 90050 00200                  T, TIME OF OBS. IN C.U.T.                 I
Q 90085 02085                  VQ                                        O
Q 90086 02001                  VECTOR MOVE                               F
Q 90087 02061                  CROSS PRODUCT                             F
Q 90088 02011                  VECTOR MAGNITUDE                          F
Q 90039 02196                  SQUARE ROOT                               F
Q 90090 02271                  PRINCIPAL VALUE                           F
Q 90091 02101                  SIN                                       F
Q 90092 02105                  COS                                       F
```

```
  Q 90093 02216         KEPLER                F             01081
  Q 90094 02031         VECTOR ADD            F             01082
  Q 90095 02041         VECTOR SUBTRACT       F             01083
  Q 90096 02076         SCALAR MULTIPLY       F             01084
* B 00001                                         B` 00001  01085
  V 00007 +50000000+01                                      01086
  V 00008 +40000000+01                                      01087
  V 00049 +00000000+00  ZERO                                01088
  V 00050 +00000000+00  ZERO                                01089
  V 00051 +10000000+01  ONE                                 01090
  R 00033 90001         LP A                                01091
  R 00034 90002         LP E                                01092
  R 00035 90016         LP I                                01093
  F 00015 90089 00033                                       01094
  M 00015 00015 00033                                       01095
  D 00036 90007 00015                                       01096
  M 00023 00034 00034                                       01097
  S 00023 00051 00023                                       01098
  F 00023 90089 00023                                       01099
  M 00023 00033 00023                                       01100
  F 00025 90092 90017   COMPUTE CAP                         01101
  F 00026 90091 90017   OMEGA BAR                           01102
  R 00027 00050                                             01103
  F 90085 90086 00049                                       01104
  F 90085 90087 00025                                       01105
  F 00015 90091 00035                                       01106
  F 90022 90096 00015                                       01107
  F 00015 90092 00035   CCS I                               01108
  A 90024 90024 00015                                       01109
  F 90085 90086 00025                                       01110
  F 90085 90087 90022                                       01111
  F 00015 90091 90012                                       01112
  F 00020 90096 00015                                       01113
  F 90085 90086 00025                                       01114
  F 00015 90092 90012                                       01115
  F 90085 90096 00015                                       01116
  F 90025 90094 00020   BETA BAR                            01117
  F 90085 90086 90025                                       01118
  F 90028 90087 90022   GAMMA BAR                           01119
  S 00015 90015 90012                                       01120
```

F	00016	90092	00015		01121
F	00015	90091	00015		01122
F	90085	90086	90028		01123
F	00017	90096	00016	CCS W1 GAMMA BAR	01124
F	00020	90096	00015	SIN W, GAMMA BAR	01125
F	90085	90086	90025		01126
F	00025	90096	00015	SIN W,1 BETA BAR	01127
F	90085	90096	00016	CCS W1 BETA BAR	01128
F	90031	90094	00020		01129
F	90085	90086	00017		01130
F	90034	90095	00025		01131
F	00015	90090	90013		01132
R	00016	00034			01133
F	90040	90093	00015	E(T)	01134
F	00012	90092	90040	CCS E(T)	01135
M	00015	00012	00034		01136
S	00014	00051	00015	(1-E CCS E(T))	01137
F	00011	90091	90040	SIN E(T)	01138
M	00013	00034	00034		01139
S	00013	00051	00013		01140
F	00015	90089	00013		01141
M	00015	00015	00011		01142
S	90008	00050	00015	S(T)	01143
M	90009	00013	00012	C(T)	01144
M	00015	00023	00011		01145
F	90085	90086	90034		01146
F	00020	90096	00015		01147
S	00015	00012	00034		01148
M	00015	00033	00015		01149
F	90085	90086	90031		01150
F	90085	90096	00015		01151
F	90037	90094	00020	R BAR	01152
M	00015	00033	00011		01153
D	00015	00015	00014		01154
F	90085	90086	90031		01155
F	00020	90096	00015		01156
M	00015	00023	00012		01157
D	00015	00015	00014		01158
F	90085	90086	90034		01159
F	90085	90096	00015		01160

```
F 90085 90095 00020
F 90041 90096 00036          V BAR
F 90010 90088 90037          R MAGNITUCE
F 90011 90088 90041          V MAGNITUDE
E 00002
```

```
      COMPUTE AND STORE CORRECTED ELEMENTS                                    01201
 K 00000                                                                      01202
 K 01355                                                                      01203
 Q 90000 01100          1ST OF 100 LOCS.FROM WHICH BIN. RECORD WRIT           01204
 Q 90001 01101          A          (PREVIOUS ELEMENTS, WHICH WILL BE          01205
 Q 90002 01102          E           REPLACED BY CORRECTED ELEMENTS I          01206
 Q 90003 01103          NU          THE FUNCTION)                             01207
 Q 90004 01112          ANGLE DELTA                                           01208
 Q 90005 01113          M                                                     01209
 Q 90006 01114          ANGLE PHI                                             01210
 Q 90007 01115          ARG. OF PERIGEE                                       01211
 Q 90008 01116          I                                                     01212
 Q 90009 01117          LONG. OF NODE                                         01213
 Q 90010 01119          N                                                     01214
 Q 90011 01120          ECC. ANOMALY                                          01215
 Q 90012 01123          PERIOD                                                01216
 Q 90013 01124          HT. OF PERIGEE                                        01217
 Q 90014 01125          HT. OF APOGEE                                         01218
 Q 90016 01150          N(2,Q) OR RHO SUB I                                   01219
 Q 90017 01170          N3,Q                                                  01220
 Q 90018 01196          SIGMA                                                 01221
 Q 90019 01104          FIRST LOC. OF POS. + VEL. VECTORS                     01222
 Q 90020 00500          DELTA A (REPL.BY PREV.A IN F.)                        01223
 Q 90021 00523          PREV. HT. OF PERIGEE                                  01224
 Q 90022 00524          PREV. HT. OF APOGEE                                   01225
 Q 90023 00525          DELTA N(2,Q) OR DELTA RHO SUB I                       01226
 Q 90024 00545          DELTA N3,Q (REPLACED BY PREV.N3,Q IN FUNCTI           01227
 Q 90025 00522          PREVIOUS PERIOD                                       01228
 Q 90027 00503          DELTA R BAR,V BAR (REPL.BY PREV.VECTORS IN            01229
 Q 90028 00509          FIRST OF 11 LOC. OF PREV. ELEM.         O             01230
 Q 90030 03851          C                                       I             01231
 Q 90031 03852          MU                                      I             01232
 Q 90032 00599          M (NO. OF UNKNOWNS)                                   01233
 Q 90033 00048          N                                                     01234
 Q 90034 00049          SUM OF (O-C) SQ.                                      01235
 Q 90035 00178          SIGMA                                                 01236
 Q 90036 00065          CHANGE IN SIGMA                                       01237
 Q 90037 00082          ABS. VALUE OF DELTA SIGMA                             01238
 Q 90038 00019          (DELTA SIGMA)/SIGMA                                   01239
 Q 90040 02196          SQ.RT.                                                01240
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  Q 90041 02271               ANGLE RED.                                              01241
  Q 90042 02751               ABSOLUTE VALUE                                          01242
  Q 90043 02936               ELEMENT LOAD (CONVERSION OF ELEM.)                      01243
  Q 90044 00090               IND. OF NORMAL OR SPECIAL ENTRY TO ELEM.LOA             01244
  Q 90050 01110               FIRST OF 11 LOC. OF PREV. ELEM.          I              01245
  Q 90051 00567               CORR. VALUE OF (1+ RHO 1) (C SUB D)                     01246
  Q 90052 00566               PREV. VALUE OF (1+ RHO 1) (C SUB D)                     01247
  Q 90053 00267               C SUB D                                  I              01248
  Q 90054 02011               VECTOR MAGNITUDE F.                                     01249
  Q 90055 01107               PREV.VEL.VECTOR (REPL.BY CORR. IN F.)                   01250
  Q 90056 01111               PREV.MAG.VEL. (REPL.BY CORR. IN F.)                     01251
  Q 90057 00510               DELTA MAG.VEL. (REPL.BY PREV. IN F.)                    01252
  Q 90058 00511               1ST LOC.OF 9 DELTAS (REPL.BY PREV.EL.IN F.)             01253
  Q 90069 04491               ORBIT GENERATOR INITIALIZE               F              01254
  Q 90070 04501               ORBIT GENERATOR                          F              01255
  Q 90071 00200               OBS. TIME IN C.U.T.                                     01256
  Q 90100 00099               ORBIT GENERATOR IDENT.                   I              01257
  Q 00008 03842               2 PI                                     I              01258
* B 00001                                                                    B 00001  01259
  V 00005 +00000000+00                                                                01260
  V 00006 +10000000+01                                                                01261
  V 00007 +20000000+02                                                                01262
  V 00009 -10000000+01                                                                01263
  V 00012 +10000000+03                                                                01264
  V 00018 +20000000+01                                                                01265
  R 00013 90035               STORE SIGMA                                             01266
  R 00014 00005               CNTR.=0                                                 01267
  C 90100 00018 00010 00010   IS MCOI ORB. GEN.BEING USED                             01268
  I 00021 +60000000+01        YES. COMPUTE CORR. POS. AND VEL. VECTORS AN             01269
* N 00022                      CONVERT THEM TO (CORR.) ELEMENTS              N 00022  01270
  G 00015 90019 00014         PREV. POS. OR VEL. COMPONENT                            01271
  G 00016 90027 00014         DELTA COMPONENT (FROM CC)                               01272
  A 00016 00016 00015                                                                 01273
  H 90027 00014 00015         STORE PREV. COMPONENT                                   01274
  H 90019 00014 00016         STORE CORR. COMPONENT                                   01275
  A 00014 00014 00006                                                                 01276
  C 00021 00014 00022         ARE PREV.AND CORR.POS. + VEL.VECTORS STORED             01277
  R 90020 90001               YES. STORE PREV. A                                      01278
  H 90020 00006 90002         STORE PREV. E                                           01279
  H 90020 00018 90003         STORE PREV. NU                                          01280
```

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  R 00014 00005                                                           01281
  I 00021 +11000000+02      STORE PREVICUS MAG.R, MAG. V,                 01282
* N 00022                    DELTA,MEAN ANOMALY,PHI,ARG. OF      N 00022  01283
  G 00015 90050 00014        PER.,INCLINATICN,LONG. OF NODE,              01284
  H 90028 00014 00015       ELEV.V,N,AND ECC. ANOMALY                     01285
  A 00014 00014 00006                                                     01286
  C 00021 00014 00022                                                     01287
  R 90025 90012             STORE PREV. PERIOD                            01288
  R 90021 90013             STORE PREV. HT. CF PERIGEE                    01289
  R 90022 90014             STORE PREV. HT. CF APOGEE                     01290
  I 90044 +10000000+01      SET FCR SPECIAL ENTRY TO FL. LOAD             01291
  F 00000 90043 00000       ENTER EL. LOAD AND COMPUTE CORRECTED          01292
                             ELEMENTS FROM CORR.POS. + VEL. VECTORS       01293
  I 00021 +20000000+01      MAX.NO.CF RHO SUB I                           01294
  R 00014 00005                                                           01295
* N 00022                                                        N 00022  01296
  G 00015 90016 00014       PREV.RHC SUB I                                01297
  G 00016 90023 00014       DELTA RHC SUB I (FROM CC)                     01298
  A 00016 00015 00016       PREV.+DELTA= CORR.                            01299
  H 90023 00014 00015       STORE PREV.RHO SUB I                          01300
  H 90016 00014 00016       STORE CORR.RHO SUB I                          01301
  A 00014 00014 00006                                                     01302
  C 00021 00014 00022                                                     01303
  R 90052 90051             STORE PREV. (1+ RHO 1) (C SUB D)              01304
  A 90051 00006 90016       1 + CORR. RHO SUB 1                           01305
  M 90051 90051 90053       CORR. (1+ RHO 1) (C SUB D)                    01306
  E 00019                                                                 01307
* B 00010                   MCOI NOT BEING USED, SO COMPUTE CORR.ELEM.  B 00010  01308
  R 00016 90020             DELTA A (FROM CC)                             01309
  R 90020 90001             STORE PREV. A                                 01310
  A 90001 90001 00016       PREV.A + DELTA = CORR.A                       01311
  G 00016 90020 00006       DELTA E (FROM CC)                             01312
  H 90020 00006 90002       STORE PREV.E                                  01313
  A 90002 90002 00016       PREV.E + DELTA = CORR.E                       01314
  G 00016 90020 00018       DELTA NU (FROM CC)                            01315
  H 90020 00018 90003       STORE PREV. NU                                01316
  A 90003 90003 00016       PREV. NU + DELTA = CORR. NU                   01317
  I 00021 +90000000+01                                                    01318
  R 00014 00005                                                           01319
* N 00011                   COMPUTE AND STORE CORR.DELTA,        N 00011  01320
```

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G 00015 90004 00014     MEAN ANOMALY,PHI,ARG.OF PER.,      01321
G 00016 90058 00014     INCLINATION,LONG.OF NODE,          01322
A 00016 00016 00015     ELEV.V,N,AND ECC.ANOMALY,          01323
H 90053 00014 00015     WHERE CORR.ELEM.=PREV.ELEM.        01324
H 90004 00014 00016     + DELTA ELEM.FROM CC               01325
A 00014 00014 00006     ALSO STORE PREV.ELEM.              01326
C 00021 00014 00011     OVER DELTA ELEM.                   01327
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```
              (O-C) ANGLE REDUCER
     K 00000
     K 01380
     Q 90001 00255                  O   (OBS. QUANTITY IN RAD.)            I
     Q 90002 00256                  C   (COMPUTED QUANTITY IN RAD.)        IO
     Q 90003 00253                  OBSERVATION TYPE                       I
     Q 90004 00496                  T   (TOLERANCE IN RAD.)                I
     Q 00005 03842                  2 PI                                   I
     Q 00017 03839                  PI                                     I
   * B 00001                        ANGLE REDUCER FOR ABS.VALUE OF (O-C)         B 00001
     V 00006 +60000000+01            (PURPOSE IS TO REDUCE COMPUTED ANGLE
     V 00007 +40000000+01            WHEN (O-C) IS LARGE DUE TO DIFF.
     V 00008 +80000000+01            AROUND 2 PI. ALL INPUT AND OUTPUT IS Q'D.
     V 00015 +17000000+02            USES 18 LOCS.)
     C 90003 00006 00009 00010      IS OBS. TYPE = 6     (RT. ASC.)
     E 00011                        YES. TEST
   * B 00010                                                                     B 00010
     C 90003 00007 00002 00002      IS OBS. TYPE = 4     (AZ.)
     E 00011                        YES. TEST
   * B 00009                                                                     B 00009
     C 90003 00003 00014 00014       IS OBS. TYPE = 8    (L. H. A.)
   * B 00011                        YES. TEST                                    B 00011
     S 00012 00005 90004            2 PI - T
     C 00012 90001 00013            IS O EQUAL TO OR MORE THAN (2 PI - T)
     C 90002 90004 00013            YES. IS C EQUAL TO OR LESS THAN T
     A 90002 90002 00005            YES. SET C = C + 2 PI
     E 00002
   * B 00013                                                                     B 00013
     C 90001 90004 00002            IS O EQUAL TO OR LESS THAN T
     C 00012 90002 00002            YES. IS C EQUAL TO OR MORE THAN (2 PI - T)
     S 90002 90002 00005            YES. SET C = C - 2 PI
     E 00002
   * B 00014                                                                     B 00014
     C 90003 00015 00002 00002      IS OBS. TYPE = 17    (THETA 1)
     C 90002 00017 00018            YES. IS THETA 1 MORE THAN PI
     E 00002                        NO
   * B 00018                        THETA 1 IS MORE THAN PI                      B 00018
     S 90002 90002 00005            (THETA 1) - (2 PI)
     E 00002
```

```
     PP (POSITION PARTIALS)                                                       01401
  K 00000                                                                         01402
  K 01400                                                                         01403
  Q 90009 00252          J, NO. OF UNKNOWN                         I              01404
  Q 90063 02751          ABSOLUTE VALUE FUNCTION                   F              01405
  Q 90069 01130          FIRST LOC. OF T(P,Q)'S, TIMES OF DRAGS    I              01406
  Q 90070 01101          A, SEMI-MAJOR AXIS AT T(0)                I              01407
  Q 90071 01102          ECCENTRICITY AT T(0)                      I              01408
  Q 90072 01119          N, MEAN MOTION AT T(0)                    I              01409
  Q 90073 01120          ECCENTRIC ANOMALY AT T(0)                 I              01410
  Q 90074 00240          ECCENTRIC ANOMALY AT T                    I              01411
  Q 90075 00222          ALPHA BAR                                 I              01412
  Q 90076 00225          BETA BAR                                  I              01413
  Q 90077 00228          GAMMA BAR                                 I              01414
  Q 90078 00231          P BAR                                     I              01415
  Q 90079 00234          Q BAR                                     I              01416
  Q 90080 00237          R BAR  (COMPUTED BY POS. IN ELLIPSE)      I              01417
  Q 90081 00241          R DOT BAR (COMPUTED BY POS.IN ELLIPSE)    I              01418
  Q 90082 00200          T, OBSERVATION TIME IN C.U.T.             I              01419
  Q 90083 01100          T(0), EPOCH TIME IN C.U.T.                I              01420
  Q 90084 00210          MAG.OF R BAR (COMPUTED BY POS.IN E.)      I              01421
  Q 90085 02085          VQ                                        O              01422
  Q 90086 02001          VECTOR MOVE                               F              01423
  Q 90087 02076          SCALAR MULTIPLY                           F              01424
  Q 90088 02041          VECTOR SUBTRACT                           F              01425
  Q 90089 02031          VECTOR ADD                                F              01426
  Q 90090 02061          CROSS PRODUCT                             F              01427
  Q 90091 02271          PRINCIPAL VALUE                           F              01428
  Q 90092 02196          SQUARE ROOT                               F              01429
  Q 90093 02101          SINE                                      F              01430
  Q 90094 02105          COSINE                                    F              01431
  Q 90095 03852          MU                                        I              01432
  Q 90096 00201          S (T)                                     I              01433
  Q 90097 00202          C (T)                                     I              01434
  Q 90098 00380          PARTIAL R BAR / X J                       O              01435
  Q 90099 00383          PARTIAL R DOT BAR / X J                   O              01436
* B 00001                POSITION PARTIALS                             B 00001    01437
  S 00007 90082 90083                                                             01438
  F 00007 90068 00007                                                             01439
  C 00092 90009 00079    DOES J EQUAL OR EXCEED 74                                01440
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  G 00078 00020 90009        YES                                  01441
  E 00078                    GO TO B (20 + J)                     01442
* B 00079                    J IS LESS THAN 74          B 00079   01443
  G 00100 00100 90009                                             01444
  E 00100                                                         01445
* B 00101                                               B 00101   01446
  S 00055 90082 90083                                             01447
  M 00055 00055 00053                                             01448
  D 00055 00055 00052                                             01449
  F 90085 90086 90081                                             01450
  F 00040 90087 00055                                             01451
  F 90085 90086 90080                                             01452
  F 90098 90088 00040                                             01453
  M 00056 90095 90095                                             01454
  M 00057 90084 90084                                             01455
  M 00057 00057 90084                                             01456
  D 00057 00056 00057                                             01457
  M 00057 00055 00057                                             01458
  F 90085 90086 90081                                             01459
  F 00040 90087 00054                                             01460
  F 90085 90086 90080                                             01461
  F 90085 90087 00057                                             01462
  F 90099 90088 00040                                             01463
  E 00002                                                         01464
* B 00102                                               B 00102   01465
  F 00055 90094 90074                                             01466
  A 00056 00055 90071                                             01467
  M 00057 90071 90071                                             01468
  S 00058 00051 00057                                             01469
  D 00035 00056 00058                                             01470
  F 90085 90086 90080                                             01471
  F 00040 90087 00035                                             01472
  M 00059 90071 00055                                             01473
  S 00060 00052 00057                                             01474
  S 00035 00060 00059                                             01475
  F 00061 90093 90074                                             01476
  M 00035 00035 00061                                             01477
  D 00035 00035 00058                                             01478
  D 00035 00035 90072                                             01479
  F 90085 90086 90081                                             01480
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	F	00043	90087	00035		01481
	F	90085	90086	00043		01482
	F	90098	90088	00040		01483
	F	90085	90086	90080		01484
	F	90085	90090	90075		01485
	F	00040	90087	00055		01486
	M	00062	90070	90096		01487
	D	00062	00062	90084		01488
	F	90085	90086	90080		01489
	F	90085	90087	00062		01490
	F	90085	90089	00040		01491
	F	00063	90092	00058		01492
	D	00064	90070	90084		01493
	M	00064	00064	00064		01494
	M	00064	90072	00064		01495
	D	00064	00064	00063		01496
	F	90099	90087	00064		01497
	E	00002				01498
*	B	00103			B 00103	01499
	F	00055	90094	90073		01500
	F	00056	90093	90073		01501
	M	00057	00056	00056		01502
	A	00058	00055	00055		01503
	M	00059	90071	00057		01504
	A	00060	00058	00059		01505
	M	00061	90071	90071		01506
	S	00062	00051	00061		01507
	F	00063	90092	00062		01508
	S	00064	00060	90071		01509
	S	00064	00064	90071		01510
	S	00064	00064	90097		01511
	F	00065	90093	90074		01512
	M	00035	00064	00065		01513
	D	00035	00035	00063		01514
	F	90085	90086	90078		01515
	F	00040	90087	00035		01516
	F	00066	90094	90074		01517
	S	00067	00060	00066		01518
	M	00067	00067	00066		01519
	S	00035	00051	00067		01520

F	90085	90086	90079	01521
F	00043	90087	00035	01522
F	90085	90086	00040	01523
F	90085	90089	00043	01524
M	00068	90070	90070	01525
D	00068	00068	90084	01526
F	90098	90087	00068	01527
S	00035	00055	00066	01528
M	00057	00065	00065	01529
M	00058	00055	00055	01530
A	00036	00057	00058	01531
M	00059	00066	00066	01532
A	00037	00059	00058	01533
A	00037	00037	00059	01534
A	00038	00055	00066	01535
M	00038	90071	00038	01536
S	00038	00038	00052	01537
M	00060	00035	90096	01538
M	00060	00060	00038	01539
F	90085	90086	90079	01540
F	00040	90087	00060	01541
M	00061	00036	00066	01542
A	00039	00061	00055	01543
A	00039	00039	00055	01544
M	00062	00066	00066	01545
M	00062	00062	00066	01546
M	00065	90071	00039	01547
M	00064	90071	90071	01548
M	00067	00064	00037	01549
M	00064	00064	90071	01550
M	00064	00064	00062	01551
S	00037	00067	00064	01552
S	00037	00037	00065	01553
M	00064	00035	00066	01554
A	00037	00037	00064	01555
A	00037	00037	00064	01556
A	00037	00037	00051	01557
F	90085	90086	90078	01558
F	90085	90087	00037	01559
F	90085	90089	00040	01560

	M	00068	00068	00068		01561
	D	00068	00068	90084		01562
	D	00068	00068	00063		01563
	M	00068	00068	90072		01564
	F	90099	90087	00068		01565
	E	00002				01566
*	B	00104			B 00104	01567
	F	90085	90086	90080		01568
	F	90098	90090	90075		01569
	F	90085	90086	90081		01570
	F	90099	90090	90075		01571
	E	00002				01572
*	B	00105			B 00105	01573
	F	90085	90086	90080		01574
	F	90098	90090	90076		01575
	F	90085	90086	90081		01576
	F	90099	90090	90076		01577
	E	00002				01578
*	B	00106			B 00106	01579
	F	90085	90086	90080		01580
	F	90098	90090	90077		01581
	F	90085	90086	90081		01582
	F	90099	90090	90077		01583
	E	00002				01584
*	B	00107			B 00107	01585
	R	00005	00002			01586
	R	90009	00051			01587
	F	00000	00001	00000		01588
	F	90085	90086	90098		01589
	F	00070	90089	90085		01590
	F	90085	90086	90099		01591
	F	00073	90089	90085		01592
	R	90009	00052			01593
	F	00000	00001	00000		01594
	M	00055	90071	90071		01595
	S	00056	00051	00055		01596
	F	00057	90094	90073		01597
	M	00058	00056	00057		01598
	F	90085	90086	90098		01599
	F	90085	90087	00058		01600

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  F 00070 90089 00070                      01601
  F 90085 90086 90099                      01602
  F 90085 90087 00058                      01603
  F 00073 90089 00073                      01604
  R 90009 00053                            01605
  F 00000 00001 00000                      01606
  M 00055 90071 90071                      01607
  S 00056 00051 00055                      01608
  F 00057 90092 00056                      01609
  F 00058 90093 90073                      01610
  M 00059 00057 00058                      01611
  S 00060 00050 00059                      01612
  F 90085 90086 90098                      01613
  F 90085 90087 00060                      01614
  F 90098 90089 00070                      01615
  F 90085 90086 90099                      01616
  F 90085 90087 00060                      01617
  F 90099 90089 00073                      01618
  I 90009 +70000000+01                     01619
  E 00005                                  01620
* B 00103                        B 00108   01621
  R 00005 00002                            01622
  R 90009 00051                            01623
  F 00000 00001 00000                      01624
  F 00055 90094 90073                      01625
  M 00056 90071 00055                      01626
  A 00057 00051 00056                      01627
  F 90085 90086 90098                      01628
  F 00070 90087 00057                      01629
  F 90085 90086 90099                      01630
  F 00073 90087 00057                      01631
  R 90009 00052                            01632
  F 00000 00001 00000                      01633
  M 00055 90071 90071                      01634
  S 00056 00051 00055                      01635
  F 00057 90094 90073                      01636
  M 00058 00056 00057                      01637
  F 90085 90086 90098                      01638
  F 90085 90087 00058                      01639
  F 00070 90089 00070                      01640
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	F	90085	90086	90099		01641
	F	90085	90087	00058		01642
	F	00073	90089	00073		01643
	R	90009	00053			01644
	F	00000	00001	00000		01645
	M	00055	90071	90071		01646
	S	00056	00051	00055		01647
	F	00057	90092	00056		01648
	F	00058	90093	90073		01649
	M	00059	00057	00058		01650
	S	00060	00050	00059		01651
	F	90085	90086	90098		01652
	F	90085	90087	00060		01653
	F	90098	90089	00070		01654
	F	90085	90086	90099		01655
	F	90085	90087	00060		01656
	F	90099	90089	00073		01657
	I	90009	+80000000+01			01658
	E	00005				01659
*	B	00109			B 00109	01660
	R	90009	00052			01661
	R	00005	00002			01662
	F	00000	00001	00000		01663
	M	00055	90071	90071		01664
	S	00056	00051	00055		01665
	F	00057	90093	90073		01666
	F	00058	90092	00056		01667
	M	00059	00058	00057		01668
	S	00060	00050	00059		01669
	F	90085	90086	90098		01670
	F	00070	90087	00060		01671
	F	90085	90086	90099		01672
	F	00073	90087	00060		01673
	R	90009	00053			01674
	F	00000	00001	00000		01675
	F	00055	90094	90073		01676
	A	00056	00055	90071		01677
	S	00057	00050	00056		01678
	F	90085	90086	90098		01679
	F	90085	90087	00057		01680

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  F 90098 90089 00070              01681
  F 90085 90086 90099              01682
  F 90085 90087 00057              01683
  F 90099 90089 00073              01684
  I 90009 +90000000+01             01685
  E 00005                          01686
* B 00110                B 00110   01687
  S 00055 90082 90083              01688
  M 00056 00055 00055              01689
  M 00057 90072 00056              01690
  F 90085 90086 90081              01691
  F 90098 90087 00057              01692
  F 90099 90087 00050              01693
  E 00002                          01694
* B 00111                B 00111   01695
  S 00055 90082 90083              01696
  M 00056 00055 00055              01697
  M 00057 00055 00056              01698
  M 00058 90072 90072              01699
  M 00059 00058 00057              01700
  F 90085 90086 90081              01701
  F 90098 90087 00059              01702
  F 90099 90087 00050              01703
  E 00002                          01704
* B 00119                B 00119   01705
  F 90085 90086 90078              01706
  F 00040 90087 90096              01707
  F 90085 90086 90079              01708
  F 90085 90087 90097              01709
  F 90085 90089 00040              01710
  F 00055 90094 90073              01711
  M 00055 90071 00055              01712
  S 00055 00051 00055              01713
  M 00055 00055 00055              01714
  M 00055 90070 00055              01715
  F 00056 90094 90074              01716
  M 00056 90071 00056              01717
  S 00056 00051 00056              01718
  M 00057 90071 90071              01719
  S 00057 00051 00057              01720
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  M 00057 00056 00057                                  01721
  D 00035 00055 00057                                  01722
  F 90098 90087 00035                                  01723
  F 00055 90094 90073                                  01724
  M 00055 90071 00055                                  01725
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	M	00031	00031	00031		01836
	M	00031	90072	00031		01837
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  F 90099 90087 00050                                01845
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	F	90098	90087	00031		01884
	E	00002				01885
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	F	90099	90087	00050		01890
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	S	00032	00030	90083		01893
	F	00032	90068	00032		01894
	C	00032	00007	00002		01895
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	M	00031	90072	00031		01897
	F	90085	90086	90081		01898
	F	90098	90087	00031		01899
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	F	90098	90087	00050		01904
	F	90099	90087	00050		01905
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	S	00031	90082	00030		01907
	S	00032	00030	90083		01908
	F	00032	90068	00032		01909
	C	00032	00007	00002		01910
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	M	00031	90072	00031		01912
	F	90085	90086	90081		01913
	F	90098	90087	00031		01914
	E	00002				01915
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	F	90098	90087	00050		01919
	F	90099	90087	00050		01920

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  F 00032 90068 00032                     01939
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  F 90098 90087 00031                     01944
  E 00002                                 01945
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  F 90098 90087 00050                     01949
  F 90099 90087 00050                     01950
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  S 00032 00030 90083                     01953
  F 00032 90068 00032                     01954
  C 00032 00007 00002                     01955
  M 00031 00031 00031                     01956
  M 00031 90072 00031                     01957
  F 90085 90086 90081                     01958
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  F 90098 90087 00031                                01989
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  F 90099 90087 00050                                01995
  G 00030 90069 00006                                01996
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  S 00032 00030 90083                          02028
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507

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  M 00031 00032 00031              02098
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  F 90099 90087 00050                                        02157
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	F	90099	90087	00050		02174
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	F	90098	90087	00050		02190
	F	90099	90087	00050		02191
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	S	00032	00030	90083			02245
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	M	00031	00032	00031			02249
	M	00032	90072	90072			02250
	M	00031	00032	00031			02251
	F	90085	90086	90081			02252
	F	90098	90087	00031			02253
	E	00002					02254
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	F	90098	90087	00050			02258
	F	90099	90087	00050			02259
	G	00030	90069	00006			02260
	S	00031	90082	00030			02261
	S	00032	00030	90083			02262
	F	00032	90068	00032			02263
	C	00032	00007	00002			02264
	M	00032	00031	00031			02265
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	M	00032	90072	90072			02267
	M	00031	00032	00031			02268
	F	90085	90086	90081			02269
	F	90098	90087	00031			02270
	E	00002					02271
*	B	00153				B 00153	02272
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	F	90085	90086	90098			02274
	F	90098	90087	00050			02275
	F	90099	90087	00050			02276
	G	00030	90069	00006			02277
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	S	00032	00030	90083			02279
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    F 90085 90086 90081                    02286
    F 90098 90087 00031                    02287
    E 00002                                02288
  * B 00154                     B 00154    02289
    I 00006 +14000000+02                   02290
    F 90085 90086 90098                    02291
    F 90098 90087 00050                    02292
    F 90099 90087 00050                    02293
    G 00030 90069 00006                    02294
    S 00031 90082 00030                    02295
    S 00032 00030 90083                    02296
    F 00032 90068 00032                    02297
    C 00032 00007 00002                    02298
    M 00032 00031 00031                    02299
    M 00031 00032 00031                    02300
    M 00032 90072 90072                    02301
    M 00031 00032 00031                    02302
    F 90085 90086 90081                    02303
    F 90098 90087 00031                    02304
    E 00002                                02305
  * B 00155                     B 00155    02306
    I 00006 +15000000+02                   02307
    F 90085 90086 90098                    02308
    F 90098 90087 00050                    02309
    F 90099 90087 00050                    02310
    G 00030 90069 00006                    02311
    S 00031 90082 00030                    02312
    S 00032 00030 90083                    02313
    F 00032 90068 00032                    02314
    C 00032 00007 00002                    02315
    M 00032 00031 00031                    02316
    M 00031 00032 00031                    02317
    M 00032 90072 90072                    02318
    M 00031 00032 00031                    02319
    F 90085 90086 90081                    02320
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   F 90098 90087 00031                02321
   E 00002                            02322
 * B 00156                    B 00156 02323
   I 00006 +16000000+02               02324
   F 90085 90086 90098                02325
   F 90098 90087 00050                02326
   F 90099 90087 00050                02327
   G 00030 90069 00006                02328
   S 00031 90082 00030                02329
   S 00032 00030 90083                02330
   F 00032 90068 00032                02331
   C 00032 00007 00002                02332
   M 00032 00031 00031                02333
   M 00031 00032 00031                02334
   M 00032 90072 90072                02335
   M 00031 00032 00031                02336
   F 90085 90086 90081                02337
   F 90098 90087 00031                02338
   E 00002                            02339
 * B 00157                    B 00157 02340
   I 00006 +17000000+02               02341
   F 90085 90086 90098                02342
   F 90098 90087 00050                02343
   F 90099 90087 00050                02344
   G 00030 90069 00006                02345
   S 00031 90082 00030                02346
   S 00032 00030 90083                02347
   F 00032 90068 00032                02348
   C 00032 00007 00002                02349
   M 00032 00031 00031                02350
   M 00031 00032 00031                02351
   M 00032 90072 90072                02352
   M 00031 00032 00031                02353
   F 90085 90086 90081                02354
   F 90098 90087 00031                02355
   E 00002                            02356
 * B 00158                    B 00158 02357
   I 00006 +18000000+02               02358
   F 90085 90086 90098                02359
   F 90098 90087 00050                02360
```

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     F 90099 90087 00050                                                         02361
     G 00030 90069 00006                                                         02362
     S 00031 90082 00030                                                         02363
     S 00032 00030 90083                                                         02364
     F 00032 90068 00032                                                         02365
     C 00032 00007 00002                                                         02366
     M 00032 00031 00031                                                         02367
     M 00031 00032 00031                                                         02368
     M 00032 90072 90072                                                         02369
     M 00031 00032 00031                                                         02370
     F 90085 90086 90081                                                         02371
     F 90098 90087 00031                                                         02372
     E 00002                                                                     02373
   * B 00159                                                          B 00159    02374
     I 00006 +19000000+02                                                        02375
     F 90085 90086 90098                                                         02376
     F 90098 90087 00050                                                         02377
     F 90099 90087 00050                                                         02378
     G 00030 90069 00006                                                         02379
     S 00031 90082 00030                                                         02380
     S 00032 00030 90083                                                         02381
     F 00032 90068 00032                                                         02382
     C 00032 00007 00002                                                         02383
     M 00032 00031 00031                                                         02384
     M 00031 00032 00031                                                         02385
     M 00032 90072 90072                                                         02386
     M 00031 00032 00031                                                         02387
     F 90085 90086 90081                                                         02388
     F 90098 90087 00031                                                         02389
     E 00002                                                                     02390
   * B 00094                  UNKNOWN 74                              B 00094    02391
     F 90098 90086 00080      STORE OUT PARTIAL R BAR/ X 74                      02392
     F 90099 90086 00083       AND PARTIAL R DOT BAR/ X 74                       02393
     E 00002                   WHICH WERE COMPUTED BY MCOI                       02394
   * B 00095                  UNKNOWN 75                              B 00095    02395
     F 90098 90086 00086      STORE OUT PARTIAL R BAR/ X 75                      02396
     F 90099 90086 00089       AND PARTIAL R DOT BAR/ X 75                       02397
     E 00002                   WHICH WERE COMPUTED BY MCOI                       02398
     V 00092 +74000000+02                                                        02399
     V 00050 +00000000+00                                                        02400
```

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V 00051 +10000000+01
V 00052 +20000000+01
V 00053 +30000000+01
V 00054 +50000000+00
```

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          OP (OBSERVATION PARTIALS)                                                    02441
K 00000                                                                                02442
K 01600                                                                                02443
Q 90063 00389            PARTIAL OF (RHO DOT BAR)*/XJ                  Q               02444
Q 90064 00358            RHO BAR                                       O               02445
Q 90065 00365            RHO DOT BAR                                   O               02446
Q 90066 00237            R BAR,SAT.POS.VECTOR (FROM PE)                I               02447
Q 90067 00241            R DOT BAR,SAT.VEL.VECTOR(FROM PE)             I               02448
Q 90068 00310            CAP R BAR,STATION POSITION VECTOR             I               02449
Q 90069 00313            CAP R DOT BAR,STATION VELOCITY VECTOR         I               02450
Q 90070 00253            OBSERVATION TYPE                              I               02451
Q 90071 00316            G 1 BAR                                       I               02452
Q 90072 00319            G 2 BAR                                       I               02453
Q 90073 00322            G 3 BAR                                       I               02454
Q 90074 00325            G 4 BAR                                       I               02455
Q 90075 00328            G 5 BAR                                       I               02456
Q 90076 00331            G 6 BAR                                       I               02457
Q 90077 00334            G 7 BAR                                       I               02458
Q 90078 00337            G 1 DOT BAR                                   I               02459
Q 90079 00340            G 2 DOT BAR                                   I               02460
Q 90080 00343            G 3 DOT BAR                                   I               02461
Q 90081 00346            G 4 DOT BAR                                   I               02462
Q 90082 00349            G 5 DOT BAR                                   I               02463
Q 90083 00352            G 6 DOT BAR                                   I               02464
Q 90084 00355            G 7 DOT BAR                                   I               02465
Q 90085 02085            VQ                                            O               02466
Q 90086 02001            VECTOR MOVE                                   F               02467
Q 90087 02051            DOT PRODUCT                                   F               02468
Q 90088 02076            SCALAR-VECTOR MULTIPLY                        F               02469
Q 90089 02041            VECTOR SUBTRACT                               F               02470
Q 90090 00361            (RHO BAR)*                                    O               02471
Q 90091 00380            PARTIAL OF R BAR / XJ                         I               02472
Q 90092 00368            (RHO DOT BAR)*                                O               02473
Q 90093 00383            PARTIAL OF R DOT BAR / XJ                     I               02474
Q 90094 00364            RHO                                           O               02475
Q 90095 02196            SQUARE ROOT                                   F               02476
Q 90096 00371            RHO DOT                                       O               02477
Q 90097 02021            VECTOR DIRECTION                              F               02478
Q 90098 02011            VECTOR MAGNITUDE                              F               02479
Q 90099 00392            PARTIAL OF OBS. / XJ                          O               02480
```

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* B 00001                           OP (OBSERVATION PARTIALS)        B 00001   02481
  V 00067 +17000000+02                                                         02482
  F 90085 90086 90066                                                          02483
  F 90064 90089 90068                                                          02484
  F 90090 90097 90064                                                          02485
  F 90085 90086 90067                                                          02486
  F 90065 90089 90069                                                          02487
  F 90085 90086 90090                                                          02488
  F 90096 90087 90065                                                          02489
  F 90094 90098 90064                                                          02490
  F 90085 90086 90090                                                          02491
  F 00032 90088 90096                                                          02492
  F 90085 90086 90065                                                          02493
  F 90085 90089 00032                                                          02494
  D 00055 00051 90094                                                          02495
  F 90092 90088 00055                                                          02496
  F 90085 90086 90091                                                          02497
  C 90070 00067 00068 00069         IS OBS. = THETA 1                          02498
  F 00035 90086 90073               YES. USE G3 BAR                            02499
  F 00041 90086 90071                AND G1 BAR                                02500
  E 00028                                                                      02501
* B 00068                           OBS. = THETA 2                   B 00068   02502
  F 00035 90086 90072               USE G2 BAR                                 02503
  E 00029                                                                      02504
* B 00069                                                            B 00069   02505
  G 00010 00010 90070                                                          02506
  E 00010                                                                      02507
* B 00011                                                            B 00011   02508
  F 90085 90086 90090                                                          02509
  F 90099 90087 90091                                                          02510
  E 00002                                                                      02511
* B 00012                                                            B 00012   02512
  F 00035 90086 90071                                                          02513
  E 00027                                                                      02514
* B 00013                                                            B 00013   02515
  F 00035 90086 90072                                                          02516
  E 00027                                                                      02517
* B 00014                                                            B 00014   02518
  F 00035 90086 90072                                                          02519
  F 00041 90086 90071                                                          02520
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  E 00028                                                  02521
* B 00015                                        B 00015   02522
  F 00035 90086 90073                                      02523
  E 00029                                                  02524
* B 00016                                        B 00016   02525
  F 00035 90086 90075                                      02526
  F 00041 90086 90076                                      02527
  E 00028                                                  02528
* B 00017                                        B 00017   02529
  F 00035 90086 90077                                      02530
  E 00029                                                  02531
* B 00018                                        B 00018   02532
  F 00035 90086 90074                                      02533
  F 90085 90086 90082                                      02534
  F 00041 90089 90071                                      02535
  E 00028                                                  02536
* B 00019                                        B 00019   02537
  F 90085 90086 90090                                      02538
  F 00055 90087 90093                                      02539
  F 90085 90086 90092                                      02540
  F 00056 90087 90091                                      02541
  A 90099 00055 00056                                      02542
  E 00002                                                  02543
* B 00020               L-RATE                   B 00020   02544
  F 00035 90086 90071                                      02545
  F 00038 90086 90078                                      02546
  E 00030                                                  02547
* B 00021               M-RATE                   B 00021   02548
  F 00035 90086 90072                                      02549
  F 00038 90086 90079                                      02550
  E 00030                                                  02551
* B 00022               AZ-RATE                  B 00022   02552
  F 00035 90086 90072                                      02553
  F 00041 90086 90071                                      02554
  F 00038 90086 90079                                      02555
  F 00044 90086 90078                                      02556
  E 00060                                                  02557
* B 00023                                        B 00023   02558
  F 00035 90086 90073   EL-RATE                            02559
  F 00038 90086 90080                                      02560
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  E 00031                                                 02561
* B 00024                  R.A.-RATE              B 00024 02562
  F 00035 90086 90075                                     02563
  F 00041 90086 90076                                     02564
  F 00038 90086 90082                                     02565
  F 00044 90086 90083                                     02566
  E 00060                                                 02567
* B 00025                  DEC. RATE              B 00025 02568
  F 00035 90086 90077                                     02569
  F 00038 90086 90084                                     02570
  E 00031                                                 02571
* B 00026                  LHA-RATE               B 00026 02572
  F 00035 90086 90074                                     02573
  F 00038 90086 90081                                     02574
  F 90085 90086 90082                                     02575
  F 00041 90089 90071                                     02576
  F 00044 90089 90078                                     02577
  E 00060                                                 02578
* B 00027                                         B 00027 02579
  F 90085 90086 90090                                     02580
  F 00055 90087 90091                                     02581
  F 00032 90088 00055                                     02582
  F 90085 90086 90091                                     02583
  F 90085 90089 00032                                     02584
  D 00056 00051 90094                                     02585
  F 90085 90088 00056                                     02586
  F 90099 90087 00035                                     02587
  E 00002                                                 02588
* B 00028                                         B 00028 02589
  F 90085 90086 90090                                     02590
  F 00047 90087 00035                                     02591
  F 00048 90087 00041                                     02592
  F 90085 90086 90090                                     02593
  F 00049 90087 90091                                     02594
  F 00032 90088 00049                                     02595
  F 90085 90086 90091                                     02596
  F 90085 90089 00032                                     02597
  D 00056 00051 90094                                     02598
  F 90085 90088 00056                                     02599
  F 00053 90087 00035                                     02600
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  F 00054 90087 00041                                          02601
  M 00055 00053 00048                                          02602
  M 00056 00054 00047                                          02603
  S 00057 00056 00055                                          02604
  M 00055 00047 00047                                          02605
  M 00056 00048 00048                                          02606
  A 00058 00055 00056                                          02607
  D 90099 00057 00058                                          02608
  E 00002                                                      02609
* B 00029                                              B 00029 02610
  F 90085 90086 90090                                          02611
  F 00047 90087 00035                                          02612
  F 00049 90087 90091                                          02613
  F 00032 90088 00049                                          02614
  F 90085 90086 90091                                          02615
  F 90085 90089 00032                                          02616
  D 00056 00051 90094                                          02617
  F 90085 90083 00056                                          02618
  F 00053 90087 00035                                          02619
  M 00055 00047 00047                                          02620
  S 00056 00051 00055                                          02621
  F 00057 90095 00056                                          02622
  D 90099 00053 00057                                          02623
  E 00002                                                      02624
* B 00030              L OR M RATE                     B 00030 02625
  F 90085 90086 90090                                          02626
  F 00049 90087 90091                                          02627
  F 00053 90088 00049                                          02628
  F 90085 90086 90091                                          02629
  F 90085 90089 00053                                          02630
  D 00056 00051 90094                                          02631
  F 00065 90088 00056  PARTIAL OF RHO EAR STAR                 02632
  F 90085 90086 90090                                          02633
  F 00057 90088 90096                                          02634
  F 90085 90086 90065                                          02635
  F 90085 90089 00057                                          02636
  M 00061 90094 90094                                          02637
  D 00061 00051 00061                                          02638
  M 00061 00049 00061                                          02639
  F 00057 90088 00061                                          02640
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	F	90085	90086	90093			02641
	F	00061	90087	90090			02642
	F	90085	90086	90065			02643
	F	00062	90087	00065			02644
	A	00061	00062	00061			02645
	F	90085	90086	00065			02646
	F	00032	90088	90096			02647
	F	90085	90086	90090			02648
	F	00054	90088	00061			02649
	F	90085	90086	90093			02650
	F	90085	90089	00054			02651
	F	90085	90089	00032			02652
	D	00055	00051	90094			02653
	F	90085	90088	00055			02654
	F	90063	90089	00057	PARTIAL OF RHO BAR DOT STAR		02655
	F	90085	90086	00065			02656
	F	00032	90087	00038			02657
	F	90085	90086	90063			02658
	F	00033	90087	00035			02659
	A	90099	00032	00033	L OR M RATE		02660
	E	00002					02661
*	B	00031			PARTIAL OF PHI DOT	B 00031	02662
	F	90085	90086	90090			02663
	F	00049	90087	90091			02664
	F	00053	90088	00049			02665
	F	90085	90086	90091			02666
	F	90085	90089	00053			02667
	D	00056	00051	90094			02668
	F	00065	90088	00056	PARTIAL OF RHO BAR STAR		02669
	F	90085	90086	90090			02670
	F	00057	90088	90096			02671
	F	90085	90086	90065			02672
	F	90085	90089	00057			02673
	M	00061	90094	90094			02674
	D	00061	00051	00061			02675
	M	00061	00049	00061			02676
	F	00057	90088	00061			02677
	F	90085	90086	90093			02678
	F	00061	90087	90090			02679
	F	90085	90086	90065			02680

	F	00062	90087	00065			02681
	A	00061	00062	00061			02682
	F	90085	90086	00065			02683
	F	00032	90088	90096			02684
	F	90085	90086	90090			02685
	F	00054	90088	00061			02686
	F	90085	90086	90093			02687
	F	90085	90089	00054			02688
	F	90085	90089	00032			02689
	D	00055	00051	90094			02690
	F	90085	90088	00055			02691
	F	90063	90089	00057	PARTIAL OF RHO BAR DOT STAR		02692
	F	90085	90086	00065			02693
	F	00055	90087	00035	PARTIAL OF G K		02694
	F	00056	90087	00038			02695
	F	90085	90086	90063			02696
	F	00057	90087	00035			02697
	A	00056	00057	00056	PARTIAL OF G DOT K		02698
	F	90085	90086	90090			02699
	F	00047	90087	00035	G(K)		02700
	F	00057	90087	00038			02701
	F	90085	90086	90092			02702
	F	00058	90087	00035			02703
	A	00048	00057	00058	G DOT (K)		02704
	M	00057	00047	00047	G(K)**2		02705
	S	00057	00051	00057			02706
	F	00058	90095	00057	(1-G(K)**2)**1/2		02707
	M	00057	00057	00058	(1-G(K)**2)**3/2		02708
	M	00059	00047	00048			02709
	M	00059	00059	00055			02710
	D	00059	00059	00057			02711
	D	00058	00056	00058			02712
	A	90099	00058	00059	PARTIAL OF PHI DOT		02713
	E	00002					02714
*	B	00060			PARTIAL OF THETA DOT	B 00060	02715
	F	90085	90086	90090			02716
	F	00049	90087	90091			02717
	F	00053	90088	00049			02718
	F	90085	90086	90091			02719
	F	90085	90089	00053			02720

D	00056	00051	90094		02721
F	00065	90088	00056	PARTIAL OF RHO EAR STAR	02722
F	90085	90086	90090		02723
F	00057	90088	90096		02724
F	90085	90086	90065		02725
F	90085	90089	00057		02726
M	00061	90094	90094		02727
D	00061	00051	00061		02728
M	00061	00049	00061		02729
F	00057	90088	00061		02730
F	90085	90086	90093		02731
F	00061	90087	90090		02732
F	90085	90086	90065		02733
F	00062	90087	00065		02734
A	00061	00062	00061		02735
F	90085	90086	00065		02736
F	00032	90088	90096		02737
F	90085	90086	90090		02738
F	00054	90088	00061		02739
F	90085	90086	90093		02740
F	90085	90089	00054		02741
F	90085	90089	00032		02742
D	00055	00051	90094		02743
F	90085	90088	00055		02744
F	90063	90089	00057	PARTIAL OF RHO EAR DOT STAR	02745
F	90085	90086	00065		02746
F	00055	90087	00035	PARTIAL OF G(K)	02747
F	00056	90087	00041	PARTIAL OF G(L)	02748
F	00057	90087	00038		02749
F	00058	90087	00044		02750
F	90085	90086	90063		02751
F	00059	90087	00035		02752
F	00061	90087	00041		02753
A	00057	00057	00059	PARTIAL OF G DOT K	02754
A	00058	00058	00061	PARTIAL OF G DOT L	02755
F	90085	90086	90090		02756
F	00047	90087	00035	G (K)	02757
F	00048	90087	00041	G (L)	02758
F	00062	90087	00038		02759
F	00063	90087	00044		02760

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F 90085 90086 90092
F 00059 90087 00035
F 00061 90087 00041
A 00059 00059 00062          G DOT (K)
A 00061 00061 00063          G DOT (L)
M 00062 00059 00056
M 00063 00061 00055
S 00062 00062 00063
M 00063 00047 00058
A 00062 00062 00063
M 00063 00048 00057
S 00062 00062 00063
M 00063 00047 00061
M 00064 00048 00059
S 00063 00063 00064
M 00064 00047 00055
M 00065 00048 00056
A 00064 00064 00065
M 00063 00064 00063
A 00063 00063 00063
S 00062 00062 00063
M 00063 00047 00047
M 00064 00048 00048
A 00063 00063 00064
M 00063 00063 00063
D 90099 00062 00063          PARTIAL OF THETA DOT
E 00002
V 00050 +00000000+00
V 00051 +10000000+01
V 00052 +20000000+01
```

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          CC (CONVERT CORRECTIONS)                                                  02801
 K 00000                                                                            02802
 K 01700                                                                            02803
 Q 90000 01100            T(0)                                                      02804
 Q 90001 01101            A                                                         02805
 Q 90002 01102            SMALL E                                                   02806
 Q 90003 01103            NU(0)                                                     02807
 Q 90004 01104            R BAR                                                     02808
 Q 90005 00200            T(N)                                                      02809
 Q 90006 03852            MU                                        I               02810
 Q 90007 01107            V BAR                                                     02811
 Q 90008 00380            PARTIAL R BAR (X(J))                                      02812
 Q 90009 00383            PARTIAL V BAR (X(J))                                      02813
 Q 90010 01110            R(0)                                                      02814
 Q 90011 01111            V(0)                                                      02815
 Q 90012 01112            DELTA                                                     02816
 Q 90013 01113            M(0)                                                      02817
 Q 90014 01114            PHI(0)                                                    02818
 Q 90015 01115            SMALL OMEGA (0)                                           02819
 Q 90016 01116            I                                                         02820
 Q 90017 01117            CAP OMEGA                                                 02821
 Q 90018 01118            THETA(0)                                                  02822
 Q 90019 01119            N                                                         02823
 Q 90022 01120            CAP E(0)                                                  02824
 Q 90023 00252            J,UNKNOWN NO.                                             02825
 Q 90024 00524            LOC.PRECEDING DELTA N(2,Q) OR DELTA RHO I                 02826
 Q 90025 00525            DELTA N(2,Q) OR DELTA RHO SUB I                           02827
 Q 90045 00545            DELTA N(3,Q)                                              02828
 Q 90065 00500            DELTA A                                                   02829
 Q 90066 00501            DELTA SMALL E                                             02830
 Q 90067 00502            DELTA NU(0)                                               02831
 Q 90068 00503            DELTA R BAR                                               02832
 Q 90069 00506            DELTA V BAR                                               02833
 Q 90070 00509            DELTA R(0)                                                02834
 Q 90071 00510            DELTA V(0)                                                02835
 Q 90072 00511            DELTA DELTA                                               02836
 Q 90073 00512            DELTA M(0)                                                02837
 Q 90074 00513            DELTA PHI(0)                                              02838
 Q 90075 00514            DELTA SMALL OMEGA(0)                                      02839
 Q 90076 00515            DELTA I                                                   02840
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     Q 90077 00516               DELTA CAP OMEGA
     Q 90078 00517               DELTA THETA(0)
     Q 90079 00519               DELTA CAP E(0)
     Q 90085 02085               VQ
     Q 90086 02001               VMV
     Q 90087 02076               SM
     Q 90088 02031               VECTOR ADD
     Q 90089 01301               PE
     Q 90090 01401               PP
     Q 90091 02101               SIN
     Q 90092 02105               COS
     Q 90093 02196               SQ RT
     Q 90094 00400               J (UNKNOWNS)
     Q 90095 00441               X(J)
     Q 90096 00013               LIMIT OF UNKNOWNS
     Q 90097 00002               M(LIMIT OF Q'S)
     Q 90098 04501               ORBIT GENERATOR
     Q 90100 00099               ORBIT GENERATOR IDENT.            I
   * B 00001                                                             B 00001
     V 00070 +00000000+00
     V 00071 +10000000+01
     V 00072 +20000000+01
     V 00073 +30000000+01
     V 00074 +19000000+02
     V 00075 +39000000+02
     V 00079 +74000000+02
     V 00033 +73000000+02
     V 00083 +20000000+02
     V 00084 +40000000+02
     R 00005 00070               SET I = 0
   * B 00031                                                             B 00031
     H 90025 00005 00070         SET DELTA N'S =0
     A 00005 00005 00071         INCREMENT I
     C 00084 00005 00031         IS 40 GREATER THAN I
     R 90065 00070
     R 90066 00070
     R 90067 00070
     R 90070 00070
     R 90071 00070
     R 90072 00070
```

```
  R 90073 00070
  R 90074 00070
  R 90075 00070
  R 90076 00070
  R 90077 00070
  R 90078 00070
  R 90079 00070
  F 90068 90087 00070             INITIAL DELTA R BAR
  F 90069 90087 00070             INITIAL DELTA V BAR
  R 90005 90000
  F 02780 90098 90005
  F 00000 90089 00000
  M 00080 90019 90019             N**2
  M 00081 00080 90019             N**3
  F 00062 90091 90016             SIN I
  F 00063 90092 90016             CCS I
  F 00092 90091 90012             SIN DELTA
  F 00093 90092 90012             CCS DELTA
  F 00061 90092 90022             CCS CAP E(0)
  M 00085 90002 00061
  S 00085 00071 00085
  M 00086 90002 90002
  S 00086 00071 00086
  F 00086 90093 00086
  D 00094 00085 00086             K 10
  M 00095 00094 00085             K 11
  I 00005 -10000000+01
* B 00076                                                       B 00076
  A 00005 00005 00071
  G 00006 90094 00005             GET J, NC.OF UNKNOWN XJ
  C 00071 00006 00002
  G 00007 90095 00005             GET UNKNCWN XJ
  C 90100 00072 00032 00032       IS MCOI ORBIT GENERATOR BEING USED
  R 90023 00006                   YES. COMPUTE CORRECTIONS ONLY TO
  F 00000 90090 00000              PCS.+ VEL.VECTORS AND TO
  F 90085 90086 90008              RHO 1 AND RHO 2 (IF USED)
  F 90085 90087 00007
  F 90068 90088 90068             +DELTA R BAR (X(J))
  F 90085 90086 90009
  F 90085 90087 00007
```

```
  F 90069 90088 90069       +DELTA V BAR (X(J))                              02921
  C 00079 00006 00078       IS J EQUAL TO OR MORE THAN 74                    02922
  S 00034 00006 00033       YES. I = J - 73                                  02923
  H 90024 00034 00007       DELTA RHO SUB I = XJ                             02924
  E 00078                                                                    02925
* B 00032                   MCOI NOT USED, SO COMPUTE CORR.        B 00032   02926
  C 00006 00074 00077        ONLY TO ELEM.AND TO DRAGS (IF USED.)            02927
  G 00009 00009 00006                                                        02928
  E 00009                                                                    02929
* B 00077                                                          B 00077   02930
  C 00006 00075 00030                                                        02931
  E 00029                                                                    02932
* B 00078                                                          B 00078   02933
  C 90096 00005 00076                                                        02934
  E 00002                                                                    02935
* B 00010                   X1                                     B 00010   02936
  M 00085 90001 00007                                                        02937
  A 90065 90065 00085       +DELTA A(X1)                                     02938
  E 00078                                                                    02939
* B 00011                   X2                                     B 00011   02940
  A 90066 90066 00007       +DELTA SMALL E(X2)                               02941
  E 00078                                                                    02942
* B 00012                   X3                                     B 00012   02943
  D 00085 00071 90002                                                        02944
  M 00086 00085 00007                                                        02945
  A 90067 90067 00086       +DELTA NU(0)(X3)                                 02946
  S 00086 00070 00085                                                        02947
  M 00086 00086 00007                                                        02948
  A 90075 90075 00086       +DELTA SMALL OMEGA(0)(X3)                        02949
  M 00086 00085 00095                                                        02950
  M 00086 00086 00007                                                        02951
  A 90073 90073 00086       +DELTA M(0)(X3)                                  02952
  M 00086 00085 00094                                                        02953
  M 00086 00086 00007                                                        02954
  A 90079 90079 00086       +DELTA CAP E(0)(X3)                              02955
  E 00078                                                                    02956
* B 00029                   X(20+Q)                                B 00029   02957
  M 00085 00080 00007                                                        02958
  S 00086 00006 00083                                                        02959
  H 90025 00086 00085       DELTA M(X20+Q)                                   02960
```

	E	00078					02961
*	B	00030			X(40+Q)	B 00030	02962
	M	00085	00081	00007			02963
	S	00086	00006	00084			02964
	H	90045	00086	00085	DELTA N(X40+Q)		02965
	E	00078					02966
*	B	00014			X5	B 00014	02967
	M	00085	00093	00007			02968
	A	90076	90076	00085	+DELTA I(X5)		02969
	D	00085	00092	00062			02970
	M	00086	00085	00007			02971
	A	90077	90077	00086	+DELTA CAP OMEGA(X5)		02972
	M	00085	00063	00085			02973
	S	00085	00070	00085			02974
	M	00085	00085	00007			02975
	A	90072	90072	00085	+DELTA DELTA(X5)		02976
	A	90074	90074	00085	+DELTA PHI(0)(X5)		02977
	A	90075	90075	00085	+DELTA SMALL CMEGA(0)(X5)		02978
	E	00078					02979
*	B	00015			X6	B 00015	02980
	S	00085	00070	00092			02981
	M	00085	00085	00007			02982
	A	90076	90076	00085	+DELTA I(X6)		02983
	D	00085	00093	00062			02984
	M	00086	00085	00007			02985
	A	90077	90077	00086	+DELTA CAP OMEGA(X6)		02986
	M	00085	00063	00085			02987
	S	00085	00070	00085			02988
	M	00085	00085	00007			02989
	A	90072	90072	00085	+ DELTA DELTA (X6)		02990
	A	90074	90074	00085	+ DELTA PHI (0)(X6)		02991
	A	90075	90075	00085	+ DELTA SMALL OMEGA (0)(X6)		02992
	E	00078					02993
*	B	00013			X4	B 00013	02994
	A	90072	90072	00007	+DELTA DELTA (X4)		02995
	A	90074	90074	00007	+DELTA PHI(0)(X4)		02996
	A	90075	90075	00007	+DELTA SMALL OMEGA(0)(X4)		02997
	E	00078					02998
*	B	00028			X19	B 00028	02999
	A	90067	90067	00007	+DELTA NU(0)(X19)		03000

	A	90072	90072	00007	+DELTA DELTA (X19)		03001
	A	90074	90074	00007	+DELTA PHI(0)(X19)		03002
	M	00085	00095	00007			03003
	A	90073	90073	00085	+DELTA M(0)(X19)		03004
	M	00085	00094	00007			03005
	A	90079	90079	00085	+DELTA E(0)(X19)		03006
	E	00078					03007
*	B	00016			X7	B 00016	03008
	M	00085	90010	90010			03009
	M	00086	00085	90010			03010
	M	00086	00086	90011			03011
	M	00086	00086	90011			03012
	F	00087	90092	90018			03013
	M	00086	00086	00087			03014
	M	00086	00086	00087			03015
	M	00087	90006	90006			03016
	M	00087	00087	90001			03017
	M	00087	00087	90001			03018
	D	00086	00086	00087			03019
	M	00087	90002	90002			03020
	S	00087	00071	00087			03021
	S	00086	00087	00086			03022
	D	00086	00086	90002	K1		03023
	D	00085	00085	90001	K2		03024
	M	00088	00072	90001			03025
	M	00087	00088	00087			03026
	M	00088	00088	90002			03027
	F	00090	90092	90003			03028
	M	00089	90010	00090			03029
	A	00088	00088	00089			03030
	M	00088	00086	00088			03031
	S	00087	00088	00087			03032
	M	00088	90002	00090			03033
	A	00088	00071	00088			03034
	M	00088	00085	00088			03035
	A	00087	00087	00088			03036
	F	00088	90091	90003			03037
	M	00088	90002	00088			03038
	M	00088	90010	00088			03039
	D	00087	00087	00088	K3		03040

```
  M 00088 00072 90001                                              03041
  M 00088 00088 00007                                              03042
  A 90065 90065 00088      +DELTA A(X7)                            03043
  M 00086 00086 00007                                              03044
  A 90066 90066 00086      +DELTA SMALL E(X7)                      03045
  M 00086 00087 00007                                              03046
  A 90067 90067 00086      +DELTA NU(0)(X7)                        03047
  S 00086 00070 00086                                              03048
  A 90075 90075 00086      +DELTA SMALL OMEGA(0)(X7)               03049
  M 00086 00095 00087                                              03050
  M 00086 00086 00007                                              03051
  A 90073 90073 00086      +DELTA M(0)(X7)                         03052
  M 00088 00085 00007                                              03053
  A 90070 90070 00088      +DELTA R(0)(X7)                         03054
  M 00088 00087 00094                                              03055
  M 00088 00088 00007                                              03056
  A 90079 90079 00088      +DELTA CAP E(0)(X7)                     03057
  E 00078                                                          03058
* B 00017                  X8                             B 00017  03059
  M 00085 90002 90002                                              03060
  M 00086 00061 00061                                              03061
  M 00086 00085 00086                                              03062
  S 00086 00071 00086                                              03063
  F 00086 90093 00086                                              03064
  M 00086 90019 00086      K4                                      03065
  M 00087 90006 90006                                              03066
  D 00087 90011 00087                                              03067
  M 00087 00087 00086      K5                                      03068
  S 00085 00071 00085                                              03069
  M 00088 90001 90001                                              03070
  M 00085 00088 00085                                              03071
  F 00089 90092 90018                                              03072
  M 00089 00089 00089                                              03073
  M 00089 90010 00089                                              03074
  M 00089 90010 00089                                              03075
  S 00089 00085 00089                                              03076
  M 00090 00072 90002                                              03077
  D 00089 00089 00090      K6                                      03078
  M 00085 90001 00085                                              03079
  F 00090 90092 90003                                              03080
```

```
  M 00090 90010 00090                                         03081
  M 00091 90001 90002                                         03082
  M 00091 00072 00091                                         03083
  A 00090 00091 00090                                         03084
  M 00090 00089 00090                                         03085
  S 00085 00090 00085                                         03086
  M 00085 00087 00085                                         03087
  F 00090 90091 90003                                         03088
  M 00090 90002 00090                                         03089
  M 00090 90010 00090                                         03090
  D 00085 00085 00090      K7                                 03091
  M 00088 00088 90001                                         03092
  M 00088 00088 00087                                         03093
  M 00088 00088 00007                                         03094
  A 90065 90065 00088      +DELTA A(X8)                       03095
  M 00087 00087 00089                                         03096
  M 00087 00087 00007                                         03097
  A 90066 90066 00087      +DELTA SMALL E(X8)                 03098
  M 00087 00085 00007                                         03099
  A 90067 90067 00087      +DELTA NU(0)(X8)                   03100
  S 00087 00070 00087                                         03101
  A 90075 90075 00087      +DELTA SMALL OMEGA(0)(X8)          03102
  M 00087 00095 00085                                         03103
  M 00087 00087 00007                                         03104
  A 90073 90073 00087      +DELTA M(0)(X8)                    03105
  D 00087 90001 00072                                         03106
  M 00087 00086 00087                                         03107
  M 00087 00087 00007                                         03108
  A 90071 90071 00087      +DELTA V(0)(X8)                    03109
  M 00087 00094 00085                                         03110
  M 00087 00087 00007                                         03111
  A 90079 90079 00087      +DELTA CAP E(0)(X8)                03112
  E 00078                                                     03113
* B 00018                  X9                       B 00018   03114
  F 00085 90091 90018                                         03115
  F 00086 90092 90018                                         03116
  M 00085 00085 00086                                         03117
  M 00085 00085 90011                                         03118
  M 00085 00085 90011                                         03119
  M 00085 00085 90010                                         03120
```

```
M 00086 90006 90006
M 00086 00086 90001
M 00086 00086 90002
D 00085 00085 00086          K8
F 00086 90092 90003
M 00086 90010 00086
M 00087 90001 90002
M 00087 00072 00087
A 00086 00087 00086
M 00086 00086 00085
F 00087 90091 90003
M 00087 90002 00087
D 00086 00086 00087          K9
M 00085 90010 00085
M 00085 00085 00007
A 90066 90066 00085          +DELTA SMALL E(X9)
M 00085 00086 00007
A 90067 90067 00085          +DELTA NU(0)(X9)
S 00085 00070 00085
A 90075 90075 00085          +DELTA SMALL OMEGA(0)(X9)
M 00085 00095 00086
M 00085 00085 00007
A 90073 90073 00085          +DELTA M(0)(X9)
A 90078 90078 00007          +DELTA THETA(0)(X9)
M 00085 00086 00094
M 00085 00085 00007
A 90079 90079 00085          +DELTA CAP E(0)(X9)
E 00078
```

```
        COMPUTE DRAG AND COMP. PERT. EFFECTS
  K 00000
  K 01840
  Q 90001 04401           DRAG (DELTA M) F.                         F
  Q 90002 00085           COMP. PERT. OPTION                        I
  Q 90003 03401           COMP. PERT. TAPE READ F.                  F
  Q 90004 00200           TIME OF DRAG EFFECTS                      O
  Q 90010 00270           A         ELEM. FROM PERT. TAPE           I
  Q 90011 00271           E          AT EPOCH                       I
  Q 90012 00272           I                                         I
  Q 90013 00273           M                                         I
  Q 90014 00274           SMALL OMEGA                               I
  Q 90015 00275           CAP OMEGA                                 I
  Q 90030 00276           DELTA A                                   O
  Q 90031 00277           DELTA E                                   O
  Q 90032 00278           DELTA I                                   O
  Q 90033 00279           DELTA M                                   O
  Q 90034 00280           DELTA SMALL OMEGA                         O
  Q 90035 00281           DELTA CAP OMEGA                           O
* B 00001                                                               B 00001
  V 00006 +10000000+01
  G 00005 00001 00003     GET T
  R 90004 00005           STORE TIME AT WHICH TO COMPUTE DRAG EFFECTS
  F 00000 90001 00000     COMPUTE DRAG EFFECTS AT T
  C 00006 90002 00002     ARE COMP. PERT. BEING USED
  F 90030 90003 00005     YES. GET ELEM. FROM PERT. TAPE AT T
  S 90030 90030 90010     DELTA ELEM.=(ELEM. FROM PERT.
  S 90031 90031 90011      TAPE AT T)-(ELEM. FROM PERT.
  S 90032 90032 90012      TAPE AT EPOCH)
  S 90033 90033 90013
  S 90034 90034 90014
  S 90035 90035 90015
  E 00002
```

```
        EXPONENTIAL FUNCTION                                                     03201
    K 00000                                                                      03202
    K 01850                                                                      03203
  * B 00001                     EXPONENTIAL 28                          B 00001  03204
    V 00010 +00000000+00                                                         03205
    V 00011 +10000000+01                                                         03206
    V 00012 +10000000+02                                                         03207
    V 00013 +43429448+00                                                         03208
    V 00014 +31622787+01                                                         03209
    V 00015 +36406910+01                                                         03210
    V 00016 +66284315+01                                                         03211
    V 00017 +80196410+01                                                         03212
    V 00018 +75467547+01                                                         03213
    V 00019 +42440739+01                                                         03214
    V 00020 +56549020+01                                                         03215
    V 00030 +10000000+38                                                         03216
    V 00031 +85000000+02                                                         03217
    V 00032 -85000000+02                                                         03218
    G 00005 00001 00003                                                          03219
    C 00005 00010 00033         IS (Z) POSITIVE                                  03220
    C 00005 00032 00034         (Z) GREATER THAN NEGATIVE LIMIT.                 03221
    R 00024 00010               YES. SET ANSWER = 0.                             03222
    E 00028                                                                      03223
  * B 00033                                                             B 00033  03224
    C 00031 00005 00034         (Z) GREATER THAN POSITIVE LIMIT                  03225
    R 00024 00030               YES. SET ANSWER = 10 EXP 38                      03226
    E 00028                                                                      03227
  * B 00034                                                             B 00034  03228
    M 00007 00005 00013                                                          03229
    C 00005 00010 00025                                                          03230
    S 00007 00010 00007                                                          03231
    C 00007 00010 00025                                                          03232
    H 00001 00004 00011                                                          03233
    E 00002                                                                      03234
  * B 00025                                                             B 00025  03235
    U 00006 00007                                                                03236
    S 00007 00007 00006                                                          03237
    D 00007 00007 00014                                                          03238
    M 00022 00020 00007                                                          03239
    A 00022 00022 00019                                                          03240
```

```
  M 00022 00022 00007
  A 00022 00022 00018
  M 00022 00022 00007
  A 00022 00022 00017
  M 00022 00022 00007
  A 00022 00022 00016
  M 00022 00022 00007
  A 00022 00022 00015
  M 00022 00022 00007
  A 00022 00022 00011
  M 00009 00022 00022
  R 00008 00011
* B 00026                                        B 00026
  C 00011 00006 00027
  M 00008 00008 00012
  S 00006 00006 00011
  E 00026
* B 00027                                        B 00027
  M 00023 00008 00009
  R 00024 00023
  C 00005 00010 00028
  D 00024 00011 00023
* B 00028                                        B 00028
  H 00001 00004 00024
  E 00002
```

```
          SATELLITE IDENTIFICATION LOAD FUNCTION
   K 00000
   K 01900                                    SATELLITE IDENT PACKAGE
 * B 00001                                    SATELLITE IDENTIFICATION LOAD FUNCTION          B 00001
   Q 00022 01971                              H-M-S TO RAD) FUNCTION
   Q 00023 01986                              D-M-S TO RAD. FUNCTION
   V 00024 +00000000+00                       (USES LOCATIONS 1 TO 34)
   V 00025 +10000000+01                          ENTER WITH (Z)=0 IF SAT. DATA IS ON
   V 00026 +10000000+04                          CARDS OR (Z) NOT EQUAL TO ZERO IF SAT.
   G 00019 00001 00003                           DATA IS ON BCD TAPE. EXIT WITH (X)=
   C 00019 00024 00027 00027                     FIRST WORD OF SATELLITE IDENT. LOAD 0.
   L 00005 00025 CA     050202020202050302051414040404      NNNNNNNNNNSSAAA
 * B 00028                                                                                    B 00028
   D 00011 00011 00026
   D 00014 00014 00026
   F 00020 00022 00009
   F 00021 00023 00012
   H 00001 00004 00005                        SATELLITE NO.
   H 00002 00004 00006                        YEAR ** DATE OF
   H 00003 00004 00007                        MONTH    JULIAN DAY 000
   H 00004 00004 00008                        DAY    **
   H 00005 00004 00020                        LAMBDA-O IN RADIANS
   H 00006 00004 00021                        TAU-O IN RADIANS
   E 00002
 * B 00027                                                                                    B 00027
   L 00005 00025 TA     050202020202050302051414040404      NNNNNNNNNNSSAAA
                                                                                 **
   E 00028
```

```
          SATELLITE IDENTIFICATION LOAD AND PRINT
   K 00000
   K 01940
   Q 90001 01901             LOCAT OF SAT. IDENT. PACKAGE
   Q 90002 00294             LOCAT OF SAT DATA ITEM
   Q 90003 01905             LOCAT OF SAT. IDENT.LD +4
 * B 00001                   SATELLITE IDENT L. AND P. FUNCTION (USES      B 00001
   V 00005 +10000000+02      LOCATIONS 1 TO 24)
   V 00006 +13000000+02        ENTER WITH (Z)=0 IF INPUT DATA IS ON
   V 00008 +10000000+04        CARDS OR NOT EQUAL 0 IF INPUT IS ON
   V 00009 +10000000+01        TAPE, (Z+1),(Z+2),AND (Z+3) = TO THE
   V 00014 +00000000+00        OUTPUT OPTION CODES FOR CARDS,PRINTER,
   G 00010 00001 00003         AND/OR BCD TAPE. CODE = 0 INDICATES
   G 00011 00002 00003         NO OUTPUT, NOT EQUAL 0 INDICATES OUTPUT
   G 00012 00003 00003         ON CARDS,PRINTER AND/OR BCD TAPE. THE
   G 00013 00004 00003         OPTION IS NOT USED.THE FUNCTION NOW
   F 90002 90001 00010         PRINTS THE SATELLITE IDENTIFICATION
   G 00007 90001 00005         DATA REGARDLESS OF CODE DATA ITEM IS
   M 00007 00007 00008         STORED AS INDICATED BY THE Q90002.
   H 90001 00005 00007
   G 00007 90001 00006
   M 00007 00007 00008
   H 90001 00006 00007
     T
   P 00000 00009 TD
   P 00000 00009 PA
     T  ID.NO. REF.DATE LAMBDA  HMS TAU    DMS  SATELLITE
   P 00000 00009 TD    16                           S
   P 00000 00009 PA    16                           S
     T
   P 90003 00009 TD    0106010303030306040306020404C4   SNSNNNNNNNNSAAA
   P 90003 00009 PA    0106010303030306040306020404O4   SNSNNNNNNNNSAAA
   E 00002
```

```
        ADD TO CORRES. SUM OF (O-C)SQ. AND TO N FOR ONE OBS.
   K 00000
   K 01955
   Q 90001 00258              WEIGHT FOR OBS.                         I
   Q 90002 00047              WEIGHTED (O-C) SQUARED                  I
   Q 90003 00253              OBS. TYPE                               I
   Q 90004 01899              LOC.PRECEDING 20 LOCS. OF N'S           IO
   Q 90005 01919              LOC.PRECEDING 20 LOC.OF SUMS OF (O-C)SQ.IO
 * B 00001                    ADDS INPUT (O-C)SQ.TO SUM OF (O-C)SQ.FOR TH      B 00001
   V 00005 +00000000+00        OBS.TYPE.ALSO ADDS 1 TO N,THE NO.OF (O-C)S
   V 00006 +10000000+01        INCLUDED IN SUM FOR THAT TYPE. USES 9 LOC.
   G 00008 90005 90003        USE OBS. TYPE TO GET CORRES. SUM
   A 00008 00008 90002        ADD TO SUM OF WEIGHTED (O-C) SQ.
   H 90005 90003 00008        STORE NEW SUM IN PLACE OF OLD
   G 00009 90004 90003        USE TYPE TO GET CORRES. N
   A 00009 00009 00006        N + 1
   H 90004 90003 00009        STORE NEW N
   E 00002
```

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```
        HOURS-MINUTES-SECONDS TO RADIANS
   K 00000
   K 01970
   Q 00008 03875                  1/60                                   I
   Q 00009 03874                  RADIANS/HCUR                           I
 * B 00001                        HCUR-MINUTE-SECOND TO RADIANS                B 00001
   G 00005 00001 00003
   G 00006 00002 00003
   G 00007 00003 00003
   M 00010 00007 00008
   A 00010 00010 00006
   M 00010 00010 00008
   A 00010 00010 00005
   M 00010 00010 00009
   H 00001 00004 00010
   E 00002
```

```
        DEGREES-MINUTES-SECONDS TO RADIANS
   K 00000
   K 01985
   Q 00005 03875          1/60                                I
   Q 00006 03847          DEGREES/RADIAN                      I
 * B 00001                DEGREES-MINUTES-SECONDS TO RADIANS        B 00001
   V 00011 +00000000+00
   I 00013 +10000000+01
   G 00007 00001 00003
   C 00011 00007 00012
 * B 00014                                                          B 00014
   G 00008 00002 00003
   G 00009 00003 00003
   M 00010 00009 00005
   A 00010 00010 00008
   M 00010 00010 00005
   A 00010 00010 00007
   M 00010 00010 00013
   D 00010 00010 00006
   H 00001 00004 00010
   E 00002
 * B 00012                                                          B 00012
   I 00013 -10000000+01
   S 00007 00011 00007
   E 00014
```

```
        VECTOR PACKAGE
  K 00000
  K 02000                                                B 00001
* B 00001                       VECTOR MOVE 7
  G 00005 00001 00003
  G 00006 00002 00003
  G 00007 00003 00003
  H 00001 00004 00005
  H 00002 00004 00006
  H 00003 00004 00007
  E 00002
```

```
   K 00000
   K 02010
   Q 00025 02196            SQUARE ROOT
 * B 00001                  VECTOR MAGNITUDE 9             B 00001
   G 00005 00001 00003
   M 00009 00005 00005
   G 00006 00002 00003
   M 00008 00006 00006
   A 00009 00009 00008
   G 00007 00003 00003
   M 00008 00007 00007
   A 00009 00009 00008
   F 00009 00025 00009
   H 00001 00004 00009
   E 00002
```

```
  K 00000
  K 02020
  Q 00011 02011
* B 00001                        VECTOR DIRECTION 8         B 00001
  V 00010 +00000000+00
  G 00005 00001 00003
  G 00006 00002 00003
  G 00007 00003 00003
  F 00008 00011 00005
  C 00008 00010 00009 00009      IS MAGNITUDE = 0
  H 00001 00004 00010            YES. SET OUTPUT
  H 00002 00004 00010            VECTOR = 0, 0, 0
  H 00003 00004 00010
  E 00002
* B 00009                                                   B 00009
  D 00005 00005 00008
  D 00006 00006 00008
  D 00007 00007 00008
  H 00001 00004 00005
  H 00002 00004 00006
  H 00003 00004 00007
  E 00002
```

```
  K 00000                                          03601
  K 02030                                          03602
  Q 00020 02085                                    03603
  Q 00021 02086                                    03604
  Q 00022 02087                                    03605
* B 00001          VECTOR ADD 7           B 00001  03606
  G 00005 00001 00003                              03607
  G 00006 00002 00003                              03608
  G 00007 00003 00003                              03609
  A 00005 00005 00020                              03610
  A 00006 00006 00021                              03611
  A 00007 00007 00022                              03612
  H 00001 00004 00005                              03613
  H 00002 00004 00006                              03614
  H 00003 00004 00007                              03615
  E 00002                                          03616
                                                   03617
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                                                   03637
                                                   03638
                                                   03639
                                                   03640
```

```
   K 00000
   K 02040
   Q 00020 02085
   Q 00021 02086
   Q 00022 02087
 * B 00001                     VECTOR SUBTRACT 7                     B 00001
   G 00005 00001 00003
   G 00006 00002 00003
   G 00007 00003 00003
   S 00005 00020 00005
   S 00006 00021 00006
   S 00007 00022 00007
   H 00001 00004 00005
   H 00002 00004 00006
   H 00003 00004 00007
   E 00002
```

```
   K 00000
   K 02050
   Q 00020 02085
   Q 00021 02086
   Q 00022 02087
 * B 00001                    DCT PRODUCT 9                    B 00001
   G 00005 00001 00003
   M 00009 00005 00020
   G 00006 00002 00003
   M 00008 00006 00021
   A 00009 00009 00008
   G 00007 00003 00003
   M 00008 00007 00022
   A 00009 00009 00008
   H 00001 00004 00009
   E 00002
```

	K 00000					03721
	K 02060					03722
	Q 00020	02085				03723
	Q 00021	02086				03724
	Q 00022	02087				03725
*	B 00001			CROSS PRODUCT 12	B 00001	03726
	G 00005	00001	00003			03727
	G 00006	00002	00003			03728
	G 00007	00003	00003			03729
	M 00008	00006	00022			03730
	M 00009	00007	00021			03731
	S 00010	00008	00009			03732
	M 00008	00007	00020			03733
	M 00009	00005	00022			03734
	S 00011	00008	00009			03735
	M 00008	00005	00021			03736
	M 00009	00006	00020			03737
	S 00012	00008	00009			03738
	H 00001	00004	00010			03739
	H 00002	00004	00011			03740
	H 00003	00004	00012			03741
	E 00002					03742
						03743
						03744
						03745
						03746
						03747
						03748
						03749
						03750
						03751
						03752
						03753
						03754
						03755
						03756
						03757
						03758
						03759
						03760

```
  K 00000
  K 02075
  Q 00020 02085
  Q 00021 02086
  Q 00022 02087
* B 00001                 SCALAR BY VECTOR PRODUCT          B 00001
  G 00005 00001 00003
  M 00006 00005 00020
  M 00007 00005 00021
  M 00008 00005 00022
  H 00001 00004 00006
  H 00002 00004 00007
  H 00003 00004 00008
  E 00002
```

```
          SINE-COSINE
    K 00000
    K 02100
  * B 00001                          SINE-COSINE FUNCTION              B 00001
    V 00010 +10000000+01
    V 00012  15707963 01
    V 00013 -64596371 00
    V 00014  79689679-01
    V 00015 -46737660-02
    V 00016  15148400-03
    V 00018 +00000000+00
    V 00019 +62831853+01
    G 00003 00001 00003
    R 00020 00010
    C 00003 00018 00021
    S 00020 00018 00020
    S 00003 00018 00003
  * B 00021                                                            B 00021
    D 00022 00003 00019
    U 00022 00022
    M 00022 00022 00019
    S 00003 00003 00022
    M 00003 00003 00020
    S 00020 00018 00012
    R 00023 00010
  * B 00024                                                            B 00024
    I 00025 +31415926+01
    C 00003 00012 00026
    S 00025 00018 00025
    C 00020 00003 00026
    D 00003 00003 00012
    M 00027 00003 00003
    M 00028 00016 00027
    A 00028 00028 00015
    M 00028 00028 00027
    A 00028 00028 00014
    M 00028 00028 00027
    A 00028 00028 00013
    M 00028 00028 00027
    A 00028 00028 00012
```

	M	00028	00028	00023		03841
	M	00003	00028	00003		03842
	H	00001	00004	00003		03843
	E	00002				03844
*	B	00026			B 00026	03845
	S	00003	00003	00025		03846
	S	00023	00018	00023		03847
	E	00024				03848
*	B	00005			B 00005	03849
	G	00003	00005	00007		03850
	S	00017	00012	00003		03851
	F	00017	00001	00017		03852
	H	00005	00008	00017		03853
	E	00006				03854
						03855
						03856
						03857
						03858
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						03877
						03878
						03879
						03880

```
  K 00000
  K 02155
* B 00001                      ARC SINE                              B 00001
  G 00005 00001 00003
  I 00006 -10000000+01
  C 00010 00005 00008
  I 00006 +10000000+01
  C 00005 00010 00009
  H 00001 00004 00010
  E 00002
* B 00008                                                            B 00008
  S 00005 00010 00005
* B 00009                                                            B 00009
  F 00005 00021 00005         CHANGED FOR TEST   11 TO 21
  M 00005 00005 00006
  H 00001 00004 00005
  E 00002
```

```
  K 00000
  K 02165
* B 00001                  ARC COSINE                    B 00001
  G 00005 00001 00003
  I 00006 -10000000+01
  C 00005 00010 00009
  I 00006 +10000000+01
  C 00010 00005 00008
  V 00007 +15707963+01
  H 00001 00004 00007
  E 00002
* B 00008                                                B 00008
  S 00005 00010 00005
* B 00009                                                B 00009
  F 00005 00011 00005
  M 00005 00005 00006
  A 00005 00005 00007
  H 00001 00004 00005
  E 00002
```

```
  K 00000
  K 02175                      TANGENT
* B 00001                                        B 00001
  G 00005 00001 00003
  S 00006 00010 00005
  M 00007 00011 00005
  A 00007 00007 00012
  M 00007 00007 00005
  A 00007 00007 00013
  M 00007 00007 00005
  A 00007 00007 00014
  M 00007 00007 00005
  A 00007 00007 00015
  M 00007 00007 00005
  A 00007 00007 00016
  M 00007 00007 00005
  A 00007 00007 00017
  M 00007 00007 00005
  A 00007 00007 00018
  F 00006 00021 00006
  M 00007 00006 00007
  S 00007 00018 00007
  H 00001 00004 00007
  E 00002
  V 00010 +10000000+01
  V 00011 -12624911-02
  V 00012 +66700901-02
  V 00013 -17088125-01
  V 00014 +30891881-01
  V 00015 -50174304-01
  V 00016 +88978987-01
  V 00017 -21459880+00
  V 00018 +15707963+01
```

```
  K 00000                                                             04001
  K 02195                                                             04002
* B 00001                        SQUARE ROOT FUNCTION   F   B 00001   04003
  V 00007  10000000 01                                  F             04004
  V 00010  20000000-07                                  F             04005
  G 00003 00001 00003                                   F             04006
  C 00003 00005 00006                                   F             04007
  H 00001 00004 00005                                   F             04008
  E 00002                                               F             04009
* B 00006                                               F   B 00006   04010
  A 00008 00007 00007                                   F             04011
  R 00009 00007                                         F             04012
  S 00011 00007 00010                                   F             04013
  C 00007 00003 00012                                   F             04014
  R 00009 00003                                         F             04015
* B 00012                                               F   B 00012   04016
  D 00013 00003 00009                                   F             04017
  A 00014 00009 00013                                   F             04018
  D 00015 00014 00008                                   F             04019
  D 00016 00015 00009                                   F             04020
  R 00009 00015                                         F             04021
  C 00011 00016 00012                                   F             04022
  H 00001 00004 00009                                   F             04023
  E 00002                                               F             04024
                                                                      04025
                                                                      04026
                                                                      04027
                                                                      04028
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                                                                      04040
```

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```
     F057  620724                                                       04041
     F057  KEPLER (REVISED)                                             04042
     F057  J.A. SMART, S.M. ROSENTHAL                                   04043
                                                                        04044
   K 00000                                                              04045
   K 02215                                                              04046
   Q 00022 03839            PI                      I                   04047
   Q 00023 03842            2 PI                    I                   04048
   Q 00024 03857            PI / 6                  I                   04049
   Q 00612 02105            COSINE                  F                   04050
   Q 00614 02101            SINE                    F                   04051
 * B 00001                  KEPLER FUNCTION               B 00001       04052
   V 00005 +50000000-08     S.P. CONVERGENCE CRITERIUM                  04053
   V 00006  10000000 02                                                 04054
   V 00007  10000000 01                                                 04055
   V 00008  00000000 00                                                 04056
   V 00025 +20000000+01                                                 04057
   G 00009 00001 00003                                                  04058
   G 00010 00002 00003                                                  04059
   D 00015 00010 00025                                                  04060
   S 00016 00024 00015                                                  04061
   C 00009 00022 00026                                                  04062
   R 00017 00009                                                        04063
   S 00015 00008 00015                                                  04064
 * B 00028                                                B 00028       04065
   C 00017 00016 00029                                                  04066
   R 00012 00009                                                        04067
   R 00011 00008                                                        04068
 * B 00013                                                B 00013       04069
   F 00014 00612 00012                                                  04070
   F 00015 00614 00012                                                  04071
   M 00016 00010 00014                                                  04072
   M 00017 00010 00015                                                  04073
   S 00018 00012 00017                                                  04074
   S 00019 00007 00016                                                  04075
   S 00020 00018 00009                                                  04076
   D 00021 00020 00019                                                  04077
   S 00012 00012 00021                                                  04078
   H 00001 00004 00012                                                  04079
   C 00021 00008 00027                                                  04080
```

```
   S 00021 00008 00021
 * B 00027                                        B 00027
   A 00011 00011 00007
   C 00005 00021 00002
   C 00011 00006 00002 00013
   E 00002
 * B 00026                                        B 00026
   S 00017 00009 00023
   S 00017 00008 00017
   E 00028
 * B 00029                                        B 00029
   S 00012 00009 00015
   R 00011 00008
   E 00013
     F057  END
```

```
  K 00000                                                         04121
  K 02245                                                         04122
* B 00001                 ARC-TAN Y/X.USGS LOCATIONS 1 TO 29  F  B 00001  04123
  V 00006 +78539816+00                                        F           04124
  V 00007 +99999933+00                                        F           04125
  V 00008 -33329856+00                                        F           04126
  V 00009 +19946536+00                                        F           04127
  V 00010 -13908533+00                                        F           04128
  V 00011 +96420044-01                                        F           04129
  V 00012 -55909886-01                                        F           04130
  V 00013 +21861229-01                                        F           04131
  V 00014 -40540580-02                                        F           04132
  V 00015 +10000000+01                                        F           04133
  V 00017 +00000000+00                                        F           04134
  V 00025 +62831853+01                                        F           04135
  G 00018 00001 00003                                         F           04136
  R 00019 00017                                               F           04137
  G 00016 00002 00003                                         F           04138
  C 00016 00017 00020                                         F           04139
  I 00019 +31415927+01                                        F           04140
  C 00017 00016 00020                                         F           04141
  I 00005 +15707963+01                                        F           04142
  C 00018 00017 00022                                                     04143
  I 00005 +47123889+01                                        F           04144
* B 00022                                                        B 00022  04145
  H 00001 00004 00005                                         F           04146
  E 00002                                                     F           04147
* B 00020                                                     F  B 00020  04148
  D 00005 00018 00016                                         F           04149
  I 00018 +10000000+01                                        F           04150
  C 00005 00017 00021                                         F           04151
  I 00018 -10000000+01                                        F           04152
  S 00005 00017 00005                                         F           04153
  C 00005 00017 00021                                         F           04154
  A 00005 00005 00019                                         F           04155
  E 00022                                                                 04156
* B 00021                                                     F  B 00021  04157
  S 00023 00005 00015                                         F           04158
  V 00015 +10000000+01                                        F           04159
  A 00024 00005 00015                                         F           04160
```

D	00023	00023	00024	F	04161
M	00005	00023	00023	F	04162
M	00024	00005	00014	F	04163
A	00024	00024	00013	F	04164
M	00024	00024	00005	F	04165
A	00024	00024	00012	F	04166
M	00024	00024	00005	F	04167
A	00024	00024	00011	F	04168
M	00024	00024	00005	F	04169
A	00024	00024	00010	F	04170
M	00024	00024	00005	F	04171
A	00024	00024	00009	F	04172
M	00024	00024	00005	F	04173
A	00024	00024	00008	F	04174
M	00024	00024	00005	F	04175
A	00024	00024	00007	F	04176
M	00024	00024	00023	F	04177
A	00005	00024	00006	F	04178
M	00005	00018	00005	F	04179
A	00005	00005	00019	F	04180
C	00005	00017	00022		04181
A	00005	00025	00005	F	04182
E	00022				04183
					04184
					04185
					04186
					04187
					04188
					04189
					04190
					04191
					04192
					04193
					04194
					04195
					04196
					04197
					04198
					04199
					04200

```
                ANGLE REDUCTION FUNCTION
     K 00000
     K 02270
     Q 00008 03842                   2 PI                                  I
   * B 00001                         ANGLE REDUCTION F. ENTER WITH (Z) = ANGLE      B 00001
     V 00006 +00000000+00             IN RADIANS. EXIT WITH (X) = ANGLE BETWEEN
     G 00009 00001 00003              ZERO AND TWO PI RADIANS. USES 10 LOCS.
     D 00009 00009 00008             INPUT ANGLE/ 2 PI
     C 00006 00009 00005             IS ANGLE POSITIVE
     U 00010 00009
     S 00010 00009 00010             FRACTION
     M 00010 00010 00008             (FRACTION)(2 PI) = REDUCED ANGLE
     H 00001 00004 00010
     E 00002
   * B 00005                         ANGLE IS NEG.                                  B 00005
     U 00010 00009
     S 00010 00009 00010             FRACTION
     M 00010 00010 00008             (FRACTION)(2 PI) = NEG. ANGLE
     A 00010 00010 00008             NEG. ANCLE + 2 PI = REDUCED ANGLE
     H 00001 00004 00010
     E 00002
```

```
      MATRIX CLEAR FUNCTION
  K 00000
  K 02300
* B 00001                                    B 00001
  V 00008 +00000000+00
  V 00012 +10000000+01
  G 00005 00001 00003
  I 00005 +10000000+01
  G 00006 00002 00004
  A 00007 00005 00006
  M 00007 00007 00006
  A 00007 00007 00004
* B 00014                                    B 00014
  H 00003 00004 00008
  A 00004 00004 00012
  C 00007 00004 00014
  E 00002
```

```
  K 00000
  K 02315
* B 00001                         FULL ROW MATRIX FUNCTION             B 00001
  V 00012 +10000000+01
  I 00011 +10000000+01
  G 00010 00002 00004
  A 00019 00003 00012
  A 00020 00010 00003
  A 00011 00010 00011
  A 00009 00003 00011
* B 00014                                                              B 00014
  A 00003 00012 00003
  C 00003 00020 00002
  R 00008 00019
  G 00005 00001 00003
* B 00015                                                              B 00015
  G 00006 00001 00008
  M 00007 00005 00006
  G 00013 00003 00004
  A 00007 00007 00013
  H 00003 00004 00007
  A 00004 00004 00012
  A 00008 00008 00012
  C 00008 00009 00014
  E 00015
```

```
          COMPUTE AND PRINT R.M.S. FOR EACH OBSERVATION TYPE
    K 00000
    K 02340
    Q 90001 00042                  PRINTER OUTPUT OPTION                      I
    Q 90002 00048                  N, TOTAL NO. OF OBS. KEPT                  I
    Q 90003 01899                  LOC.PRECEDING 20 LOCS. OF N'S              I
    Q 90004 01919                  LOC.PRECEDING 20 LOC.OF SUMS OF (O-C)SQ    I
    Q 90005 02196                  SQUARE ROOT                                F
    Q 90006 02521                  OUTPUT SCALE                               F
  * B 00001                        COMPUTE AND PRINT R.M.S.FOR EACH OBS.TYPE      B 00001
    V 00005 +00000000+00            (GETS AND TESTS N FOR EACH OBS.TYPE,WHERE
    V 00006 +10000000+01             N IS NO.OF (O-C)SQ.INCLUDED IN SUM FOR THA
    V 00007 +20000000+02             TYPE.IF N IS NOT 0,GETS CORRES.SUM AND
    V 00008 +10000000+06             COMPUTES R.M.S.FOR TYPE.PRINTS TYPE,RMS,N)
    C 90002 00005 00013 00013      WERE ANY OBS. KEPT IN ITERATION
    E 00002                        NO. EXIT WITHOUT PRINTING
  * B 00013                                                                   B 00013
      TO
    P 00000 00006 TD
      TOTYPE    R.M.S.      N
    P 00000 00006 TD
    C 90001 00005 00014 00014      IS OUTPUT ON PRINTER
    E 00015                        NO
  * B 00014                                                                   B 00014
      T
    P 00000 00006 PA
      T TYPE    R.M.S.      N
    P 00000 00006 PA
  * B 00015                                                                   B 00015
    R 00009 00006                  SET CNTR. (ALSO OBS. TYPE) =1
  * B 00016                                                                   B 00016
    G 00012 90003 00009            GET N, NO. OF OBS.KEPT OF THIS TYPE
    C 00012 00005 00017 00017      IS N=0
    E 00018                        YES. GET ANOTHER TYPE
  * B 00017                        N IS NOT ZERO                                  B 00017
    G 00010 90004 00009            GET SUM OF (O-C) SQ. FOR THIS TYPE
    D 00010 00010 00012            SUM OF (O-C) SQ. / N
    F 00010 90005 00010            R.M.S. FOR THIS TYPE
    F 00010 90006 00010            SCALE R.M.S.
    D 00010 00010 00008
```

```
     T
   P 00009 00006 TD    01030304030305                        SNSNNSN
   C 90001 00005 00019 00019          IS OUTPUT ON PRINTER
   E 00018                            NO
 * B 00019                                                                      B 00019
   P 00009 00006 PA    01030304030305                        SNSNNSN
 * B 00018                                                                      B 00018
   A 00009 00009 00006                ADD TO CNTR., GETTING NEXT TYPE
   C 00007 00009 00016                IS CNTR. (OBS. TYPE) =20
   E 00002                            YES. EXIT
```

```
           LINEAR EQUATIONS SOLUTION FUNCTION                                   04401
  K 00000                                                                       04402
  K 02360                                                                       04403
  Q 90001 02751                ABSOLUTE VALUE FUNCTION                          04404
* B 00001                                                             B 00001   04405
  G 00005 00001 00003                                                           04406
  G 00006 00002 00003                                                           04407
  A 00007 00008 00003                                                           04408
  V 00008 +1000000+01                                                           04409
  V 00009 +1000000+01                                                           04410
  A 00015 00006 00009                                                           04411
  C 00005 00008 00010                                                           04412
  G 00025 00003 00003                                                           04413
  G 00026 00004 00003                                                           04414
  D 00027 00026 00025                                                           04415
  H 00001 00004 00027                                                           04416
* B 00010                                                             B 00010   04417
  R 00011 00009                                                                 04418
* B 00012                                                             B 00012   04419
  R 00013 00009                                                                 04420
* B 00014                                                             B 00014   04421
  M 00016 00015 00011                                                           04422
* B 00017                                                             B 00017   04423
  A 00018 00016 00007                                                           04424
  A 00019 00018 00013                                                           04425
  A 00020 00018 00015                                                           04426
  S 00021 00013 00009                                                           04427
  M 00022 00021 00015                                                           04428
  A 00023 00022 00013                                                           04429
  A 00024 00023 00007                                                           04430
  G 00025 00001 00019                                                           04431
  G 00026 00001 00024                                                           04432
  F 00027 90001 00026          FOR TEST                                         04433
  F 00028 90001 00025          FOR TEST                                         04434
  C 00028 00027 00038                                                           04435
* B 00029                                                             B 00029   04436
  D 00030 00025 00026                                                           04437
* B 00031                                                             B 00031   04438
  G 00032 00001 00019                                                           04439
  G 00033 00001 00024                                                           04440
```

	M	00034	00030	00033		04441
	S	00035	00032	00034		04442
	H	00001	00019	00035		04443
	A	00019	00009	00019		04444
	C	00019	00020	00036		04445
	A	00024	00009	00024		04446
	E	00031				04447
*	B	00036			B 00036	04448
	A	00013	00009	00013		04449
	C	00013	00011	00037		04450
	E	00017				04451
*	B	00037			B 00037	04452
	A	00011	00009	00011		04453
	C	00006	00011	00012		04454
	E	00039				04455
*	B	00038			B 00038	04456
	G	00032	00001	00019		04457
	G	00033	00001	00024		04458
	H	00001	00019	00033		04459
	H	00001	00024	00032		04460
	A	00019	00009	00019		04461
	C	00019	00020	00017		04462
	A	00024	00009	00024		04463
	E	00038				04464
*	B	00039			B 00039	04465
	R	00011	00006			04466
*	B	00040			B 00040	04467
	R	00041	00006			04468
*	B	00042			B 00042	04469
	M	00043	00015	00041		04470
	A	00044	00007	00043		04471
	S	00045	00044	00015		04472
	G	00046	00001	00044		04473
*	B	00047			B 00047	04474
	R	00048	00006			04475
*	B	00056			B 00056	04476
	C	00048	00041	00053		04477
	A	00049	00048	00045		04478
	A	00050	00048	00004		04479
	S	00050	00050	00009		04480

```
  G 00051 00001 00049
  D 00052 00046 00051
  H 00001 00050 00052
  S 00041 00041 00009
  C 00009 00041 00002
  E 00042
* B 00053                                   B 00053
  A 00049 00048 00045
  G 00051 00001 00049
  A 00050 00048 00004
  S 00050 00050 00009
  G 00054 00001 00050
  M 00055 00054 00051
  S 00046 00046 00055
  S 00048 00048 00009
  E 00056
```

```
            SPD (STATION POSITION ORIENTATION)                                                    04521
    K 00000                                                                                       04522
    K 02417                          S P O                                                        04523
    Q 90030 00302                    STATION LONGITUDE   (RADIANS)                 I              04524
    Q 90031 00303                    STATION LATITUDE    (RADIANS)                 I              04525
    Q 90032 00304                    STATION HEIGHT      (C.U.L.)                  I              04526
    Q 90033 00305                    DIST.FROM EARTH CENTER TO STATION (CUL)       I              04527
    Q 90034 00298                    LAMBDA SUB ZERO     (RADIANS)                 I              04528
    Q 90035 00200                    T, OBSERVATION TIME IN C.U.T.                 I              04529
    Q 90039 03835                    ROTATION OF EARTH   (RAD/C.U.T.)              I              04530
    Q 90040 03834                    FLATNESS OF EARTH                             I              04531
    Q 90053 00316                    G 1 BAR                                       O              04532
    Q 90054 00317                                                                                 04533
    Q 90055 00318                                                                                 04534
    Q 90056 00319                    G 2 BAR                                       O              04535
    Q 90057 00320                                                                                 04536
    Q 90058 00321                                                                                 04537
    Q 90059 00322                    G 3 BAR                                       O              04538
    Q 90060 00323                                                                                 04539
    Q 90061 00324                                                                                 04540
    Q 90062 00325                    G 4 BAR                                       O              04541
    Q 90063 00326                                                                                 04542
    Q 90064 00327                                                                                 04543
    Q 90065 00337                    G 1 DOT BAR                                   O              04544
    Q 90066 00338                                                                                 04545
    Q 90067 00339                                                                                 04546
    Q 90068 00340                    G 2 DOT BAR                                   O              04547
    Q 90069 00341                                                                                 04548
    Q 90070 00342                                                                                 04549
    Q 90071 00343                    G 3 DOT BAR                                   O              04550
    Q 90072 00344                                                                                 04551
    Q 90073 00345                                                                                 04552
    Q 90074 00346                    G 4 DOT BAR                                   O              04553
    Q 90075 00347                                                                                 04554
    Q 90076 00348                                                                                 04555
    Q 90077 00328                    G 5 BAR                                       O              04556
    Q 90078 00329                                                                                 04557
    Q 90079 00330                                                                                 04558
    Q 90080 00331                    G 6 BAR                                       O              04559
    Q 90081 00332                                                                                 04560
```

	Q	90082 00333				04561
	Q	90083 00334	G 7 BAR	O		04562
	Q	90084 00335				04563
	Q	90085 00336				04564
	Q	90020 00349	G 5 DOT BAR	O		04565
	Q	90021 00350				04566
	Q	90022 00351				04567
	Q	90023 00352	G 6 DOT BAR	O		04568
	Q	90024 00353				04569
	Q	90025 00354				04570
	Q	90026 00355	G 7 DOT BAR	O		04571
	Q	90027 00356				04572
	Q	90028 00357				04573
	Q	90093 00310	CAP R BAR, STATION POSITION VECTOR	O		04574
	Q	90094 00311				04575
	Q	90095 00312				04576
	Q	90096 00313	CAP R DOT BAR, STATION VELOCITY VECTOR	O		04577
	Q	90097 00314				04578
	Q	90098 00315				04579
	Q	90086 02271	ANGLE REDUCER	F		04580
	Q	90612 02105	COSINE	F		04581
	Q	90614 02101	SINE	F		04582
	Q	90622 02196	SQUARE ROOT	F		04583
	Q	00005 03842	2 PI	I		04584
*	B	00001	SPO		B 00001	04585
	V	90077 +10000000+01				04586
	V	90078 +00000000+00				04587
	V	90079 +00000000+00				04588
	V	90080 +00000000+00				04589
	V	90081 +10000000+01				04590
	V	90082 +00000000+00				04591
	V	90083 +00000000+00				04592
	V	90084 +00000000+00				04593
	V	90085 +10000000+01				04594
	V	90020 +00000000+00	G 5 DOT BAR			04595
	V	90021 +00000000+00				04596
	V	90022 +00000000+00				04597
	V	90023 +00000000+00	G 6 DOT BAR			04598
	V	90024 +00000000+00				04599
	V	90025 +00000000+00				04600

```
V 90026 +00000000+00        G 7 DOT BAR        04601
V 90027 +00000000+00                           04602
V 90028 +00000000+00                           04603
V 00037 +10000000+01                           04604
V 00038 +00000000+00                           04605
V 00049 +00000000+00                           04606
M 00023 90039 90035                            04607
F 00024 90086 00023                            04608
A 00042 00024 90034                            04609
F 00043 90086 00042                            04610
A 00044 00043 90030                            04611
F 00044 90086 00044                            04612
F 00045 90614 00044                            04613
F 00046 90612 00044                            04614
F 00047 90614 90031                            04615
F 00048 90612 90031                            04616
S 00049 00038 00047                            04617
S 00050 00038 90039                            04618
M 00051 00050 00047                            04619
M 00052 90039 00048                            04620
S 90053 00038 00045                            04621
F 90054 90612 00044                            04622
R 90055 00038                                  04623
M 90056 00049 00046                            04624
M 90057 00049 00045                            04625
R 90058 00048                                  04626
M 90059 00048 00046                            04627
M 90060 00048 00045                            04628
R 90061 00047                                  04629
R 90062 00046                                  04630
R 90063 00045                                  04631
R 90064 00038                                  04632
M 90065 00050 90062                            04633
M 90066 00050 90063                            04634
M 90067 00050 90064                            04635
M 90068 00051 90053                            04636
M 90069 00051 90054                            04637
M 90070 00051 90055                            04638
M 90071 00052 90053                            04639
M 90072 00052 90054                            04640
```

```
M 90073 00052 90055
M 90074 90039 90053
M 90075 90039 90054
M 90076 90039 90055
D 00007 00047 00048
S 00008 00037 90040
M 00009 00008 00008
M 00010 00007 00009
M 00013 00010 00010
A 00014 00013 00009
F 00015 90622 00014
M 00016 90033 00008
D 00017 00016 00015
M 00018 90032 00048
A 00019 00018 00017
M 00020 00017 00010
M 00021 90032 00047
A 00022 00021 00020
M 90093 00019 00046
M 90094 00019 00045
R 90095 00022
M 90096 90094 00050
M 90097 90093 90039
R 90098 00038
E 00002
```

```
          LOAD AND STORE PRINT REQUEST CARDS                                             04681
   K 00000                                                                               04682
   K 02475                                                                               04683
   Q 90001 03100                   1 ST LOC. OF STORAGE FOR CARDS                        04684
   Q 90002 03101                   2 ND STG. LOC.                                        04685
   Q 90003 03102                   3 RD STG. LOC.                                        04686
   Q 90004 03103                   4 TH STG. LOC.                                        04687
   Q 90005 03104                   5 TH STG. LOC.                                        04688
   Q 90006 03105                   6 TH STG. LOC.                                        04689
   Q 90007 03106                   7 TH STG. LOC.                                        04690
   Q 90008 00060                   NO. OF CARDS STORED                                   04691
   Q 90009 00495                   MAX.NO. OF CARDS ALLOWED                              04692
   Q 90010 00191                   ERROR EXIT                                            04693
 * B 00001                         LOAD AND STORE PRINT REQUEST CARDS          B 00001   04694
   V 00005 +00000000+00             (LOADS IN CARDS AND STORES                           04695
   V 00006 +70000000+01             CONTENTS IN TABLE.)                                  04696
   V 00007 +10000000+01                                                                  04697
   R 00008 00005                   CNTR.=0                                               04698
   R 90008 00005                   NO. OF CARDS STORED=0                                 04699
   L 00012 00007 CA     04040404040404                AAAAAAA                            04700
   E 00019                                                                               04701
 * B 00011                                                                     B 00011   04702
   L 00012 00007 CA     04040404060606                AAAANNN                            04703
 * B 00019                                                                     B 00019   04704
   C 00012 00005 00009 00009       IS THIS END OF DATA                                   04705
   C 00013 00005 00009 00009                                                             04706
   C 00014 00005 00009 00009                                                             04707
   C 00015 00005 00009 00009                                                             04708
   R 90010 00005                   SET = 0 FOR NORMAL EXIT                               04709
   E 00002                         YES                                                   04710
 * B 00009                         NO                                          B 00009   04711
   C 90009 90008 00020             HAS MAX.NO.OF CARDS ALREADY BEEN STORED               04712
   R 90010 00007                   YES. SET TO 1 FOR ERROR EXIT                          04713
   E 00002                                                                               04714
 * B 00020                                                                     B 00020   04715
   H 90001 00008 00012             STORE THE 7 ITEMS                                     04716
   H 90002 00008 00013              FROM THE CARD                                        04717
   H 90003 00008 00014                                                                   04718
   H 90004 00008 00015                                                                   04719
   H 90005 00008 00016                                                                   04720
```

```
H 90006 00008 00017
H 90007 00008 00018
A 00008 00008 00006          CNTR.+7
A 90008 90008 00007          (NO. OF CARDS STORED)+(1)
E 00011
```

```
          OUTPUT SCALE                                                              04761
   K 00000                                                                          04762
   K 02520                                                                          04763
   Q 90001 03841           2**26                          I                         04764
 * B 00001            OUTPUT CONVERTER USES LOCATIONS 1 TO 128             B 00001  04765
   I 00005 +10000000+01                                                             04766
   I 00006 +10000000+02                                                             04767
   R 00007 90001                                                                    04768
   A 00007 00007 00007                                                              04769
   I 00008 +00000000+00                                                             04770
   D 00009 00005 00007                                                              04771
   I 00011 +45000000+02                                                             04772
   H 00030 00008 00009                                                              04773
 * N 00001                                                                 N 00001  04774
   A 00008 00008 00005                                                              04775
   M 00009 00009 00006                                                              04776
   H 00030 00008 00009                                                              04777
   C 00011 00008 00001                                                              04778
   I 00005 +00000000+00                                                             04779
   I 00006 +67108864+08                                                             04780
   A 00006 00006 00006                                                              04781
   I 00007 +10000000+01                                                             04782
   I 00008 +70000000+01                                                             04783
   I 00009 +50000000+00                                                             04784
 * N 00001                                                                 N 00001  04785
   G 00010 00001 00003                                                              04786
   A 00010 00005 00010                                                              04787
   I 00025 +10000000+01                                                             04788
   C 00010 00005 00020                                                              04789
   S 00010 00005 00010                                                              04790
   I 00025 -10000000+01                                                             04791
   C 00010 00005 00020                                                              04792
 * B 00129                                                                 B 00129  04793
   H 00001 00004 00005                                                              04794
   H 00002 00004 00005                                                              04795
   E 00002                                                                          04796
 * B 00020                                                                 B 00020  04797
   C 00007 00010 00022                                                              04798
   F 00012 00076 00010                                                              04799
   C 00012 00008 00021                                                              04800
```

```
  S 00011 00008 00012              04801
  G 00013 00030 00011              04802
  M 00014 00010 00013              04803
  M 00015 00014 00006              04804
  A 00012 00012 00007              04805
  E 00023                          04806
* B 00021                 B 00021  04807
  S 00011 00012 00008              04808
  G 00013 00030 00011              04809
  D 00014 00010 00013              04810
  D 00015 00014 00006              04811
  A 00012 00012 00007              04812
  A 00015 00015 00009              04813
  C 00015 00018 00023              04814
  A 00015 00015 00009              04815
  E 00023                          04816
* B 00022                 B 00022  04817
  D 00016 00007 00010              04818
  F 00012 00076 00016              04819
  A 00011 00012 00019              04820
  S 00012 00005 00012              04821
  G 00013 00030 00011              04822
  M 00014 00010 00013              04823
  M 00015 00014 00006              04824
  C 00017 00015 00023              04825
  G 00013 00029 00011              04826
  M 00014 00010 00013              04827
  M 00015 00014 00006              04828
  A 00012 00012 00007              04829
* B 00023                 B 00023  04830
  M 00015 00015 00025              04831
  H 00001 00004 00015              04832
  H 00002 00004 00012              04833
  E 00002                          04834
* B 00076                 B 00076  04835
  G 00080 00076 00078              04836
  R 00081 00082                    04837
  R 00084 00005                    04838
* B 00085                 B 00085  04839
  D 00081 00081 00083              04840
```

```
    C 00007 00081 00086                          04841
    A 00084 00084 00081                          04842
    C 00084 00090 00089                          04843
    G 00087 00091 00084                          04844
    C 00080 00087 00085                          04845
    S 00084 00084 00081                          04846
    C 00087 00080 00085                          04847
    A 00084 00084 00081                          04848
  * B 00086                             B 00086  04849
    H 00076 00079 00084                          04850
    E 00077                                      04851
  * B 00089                             B 00089  04852
    S 00084 00084 00081                          04853
    E 00085                                      04854
    V 00017 +10000000+09                         04855
    V 00018 +99999999+07                         04856
    V 00019 +80000000+01                         04857
    V 00028 +10000000+08                         04858
    V 00082 +64000000+02                         04859
    V 00083 +20000000+01                         04860
    V 00090 +37000000+02                         04861
    V 00091 +10000000+01                         04862
    V 00092 +10000000+02                         04863
    V 00093 +10000000+03                         04864
    V 00094 +10000000+04                         04865
    V 00095 +10000000+05                         04866
    V 00096 +10000000+06                         04867
    V 00097 +10000000+07                         04868
    V 00098 +10000000+08                         04869
    V 00099 +10000000+09                         04870
    V 00100 +10000000+10                         04871
    V 00101 +10000000+11                         04872
    V 00102 +10000000+12                         04873
    V 00103 +10000000+13                         04874
    V 00104 +10000000+14                         04875
    V 00105 +10000000+15                         04876
    V 00106 +10000000+16                         04877
    V 00107 +10000000+17                         04878
    V 00108 +10000000+18                         04879
    V 00109 +10000000+19                         04880
```

```
V 00110 +10000000+20
V 00111 +10000000+21
V 00112 +10000000+22
V 00113 +10000000+23
V 00114 +10000000+24
V 00115 +10000000+25
V 00116 +10000000+26
V 00117 +10000000+27
V 00118 +10000000+28
V 00119 +10000000+29
V 00120 +10000000+30
V 00121 +10000000+31
V 00122 +10000000+32
V 00123 +10000000+33
V 00124 +10000000+34
V 00125 +10000000+35
V 00126 +10000000+36
V 00127 +10000000+37
V 00128 +10000000+38
```

```
    K 00000
    K 02650
    Q 90001 03841                  2**26                          I
  * B 00001          INPUT CONVERTER USES LOCATIONS 1 TO 61           B 00001
    V 00005 +00000000+00
    V 00008 +10000000+01
    V 00011 +46000000+02
    I 00006 +10000000+02
    R 00007 90001
    A 00007 00007 00007
    D 00009 00008 00007
    R 00015 00009
    I 00010 +00000000+00
  * N 00001                                                           N 00001
    A 00010 00010 00008
    M 00009 00009 00006
    H 00015 00010 00009
    C 00011 00010 00001
  * N 00001                                                           N 00001
    I 00006 +80000000+01
    G 00012 00001 00003
    G 00013 00002 00003
    S 00013 00013 00006
    C 00013 00005 00014
    S 00013 00005 00013
    G 00013 00015 00013
    D 00012 00012 00007
    D 00012 00012 00013
    H 00001 00004 00012
    E 00002
  * B 00014                                                           B 00014
    G 00013 00015 00013
    M 00012 00012 00007
    M 00012 00012 00013
    H 00001 00004 00012
    E 00002
```

```
              RANGE RATE FUNCTION
    K 00000
    K 02720
  * B 00001                                                               B 00001
    Q 90001 00246
    Q 90002 00258
    Q 90003 00392
    Q 90004 00253
    Q 90005 00069
    Q 90006 02098                  DIFF. IND. (DIFF. IF IND.=0)
    C 90006 00008 00009            IS DIFFERENCING REQUESTED
  * N 00001                        YES. COME HERE AFTER FIRST TIME        N 00001
    C 90004 00007 00002 00002      IS OBS. RANGE RATE
    C 00008 90001 00005
    H 00010 90005 90003
    R 90003 00008
    E 00002
  * B 00005                                                               B 00005
    G 00006 00010 90005
    S 90003 90003 00006
    E 00002
  * B 00009                        DIFFERENCING IS NOT REQ.               B 00009
  * N 00001                        COME HERE AFTER FIRST TIME             N 00001
    E 00002
    V 00007 +90000000+01
    V 00008 +00000000+00
```

```
  K 00000
  K 02750
  V 00008 +0000000+00
* B 00001                                   ABSOLUTE VALUE FUNCTION          B 00001
  G 00005 00001 00003
  C 00005 00008 00007 00006
  E 00007
* B 00006                                                                    B 00006
  S 00005 00008 00005
* B 00007                                                                    B 00007
  H 00001 00004 00005
  E 00002
```

582

```
          ONE-WORD LOAD
  K 00000
  K 02760
  Q 90001 00000
  Q 90002 02651                   INPUT CONVERTER
* B 00001                         ONE-WORD LOAD (PRINTS LOC.+ VALUE FROM COLS    B 00001
  V 00005 +10000000+01             1-17 + ALPHABETIC IDENT.FROM COLS.30-61
  V 00006 +00000000+00             OF EACH CARD LOADED. USES 19 LOCS.)
     T
  P 00000 00005 PA
  P 00000 00005 TD
* B 00007                                                                      B 00007
  L 00009 00005 CA     0509031204040404040404          NNNSAAAAAAAA
  C 00009 00006 00008 00008       IS THIS END OF CARDS
  E 00002                         YES
* B 00008                                                                      B 00008
     T LOC.      CONTAINS
  P 00009 00005 PA     04061009030704040404040404      SNSNNSAAAAAAAA
  P 00009 00005 TD     04061009030704040404040404      SNSNNSAAAAAAAA
  F 00010 90002 00010
  H 90001 00009 00010
  E 00007
```

```
           OBSERVATION LOAD FUNCTION                                                        05081
   K 00000                                                                                  05082
   K 02800                            OBSERVATION LOAD FUNCTION                             05083
   Q 90000 00200                      T(N)                                                  05084
   Q 90002 00245                      OBSERVATION COUNTER                                   05085
   Q 90003 00378                      J.D.            TIME OF          O                    05086
   Q 90004 00379                      SECONDS         OBS.             O                    05087
   Q 90007 00007                                                                            05088
   Q 90030 00300                      STATION LABEL                                         05089
   Q 90031 00301                                                                            05090
   Q 90032 00302                      LONGITUDE                                             05091
   Q 90033 00303                      LATITUDE                                              05092
   Q 90034 00304                      HEIGHT                                                05093
   Q 90035 00246                      RANGE RATE CODE                                       05094
   Q 90036 00258                                                                            05095
   Q 90005 00497                      EQUATORIAL OR POLAR IDENT.                            05096
   Q 90053 00253                      OBS. TYPE CODE                                        05097
   Q 90055 00255                      OBSERVATION                                           05098
   Q 90056 00396                      RHO 1,RANGE MEASUREMENT INTERVAL IN CUL O             05099
   Q 90095 00295                      SAT. ID.                                              05100
   Q 90096 00296                      YREF                                                  05101
   Q 90097 00297                      DREF                                                  05102
   Q 90098 03351                      OBS. DATE TO DAY COUNT                                05103
   Q 90099 03376                      JULIAN DAYS-SECONDS TO C.U.T.                         05104
   Q 91000 00000                      LOC. ZERO                        I                    05105
   Q 91001 00459                      BAD RECORD IND.                  I                    05106
   Q 91002 00460                      NO.OF READ ATTEMPTS              I                    05107
   Q 91003 03812                      MINUS ONE (TO BACKSPACE ONE RECORD) I                 05108
   Q 90010 00061                      TRANSFER POINT FOR BAD TAPE ON TB I                   05109
 * B 00001                                                                 B 00001          05110
   G 00005 00001 00003                                                                      05111
   C 00005 00016 00011                                                                      05112
   L 00021 00020 CAB                                                                        05113
   C 00025 90095 00007 00007                                                                05114
   E 00001                                                                                  05115
 * B 00011                                                                 B 00011          05116
   R 00009 00016                      COUNT = 0                                             05117
 * B 00006                                                                 B 00006          05118
   L 00021 00020 TBB                                                                        05119
   C 91000 91001 00010 00010          BAD REC.                                              05120
```

```
  A 00009 00009 00015         YES COUNT=COUNT+1                          05121
  C 00009 91002 90010         ENOUGH ATTEMPTS                            05122
  L 00000 91003 TBB           NO.BACKSPACE ONE RECORD                    05123
  E 00006                     TRY AGAIN                                  05124
* B 00010                     GOOD REC.                         B 00010  05125
  C 00025 90095 00007 00007                                              05126
  E 00001                                                                05127
* B 00007                                                       B 00007  05128
  C 00021 90095 00014 00014   CORRECT SAT. ID. NO.                       05129
  D 00013 00025 00017         UNPACK YR MO DY                            05130
  U 00070 00013                                                          05131
  M 00077 00070 00017         YR.0000 X 10**4                            05132
  S 00013 00025 00077         YR MM DY - YR0000                          05133
  D 00071 00013 00018         MM.DY                                      05134
  U 00071 00071                                                          05135
  M 00077 00071 00018         MM00                                       05136
  S 00072 00013 00077         MMDY - MM00                                05137
  D 00074 00026 00018                                                    05138
  U 00073 00074                                                          05139
  M 00077 00073 00018                                                    05140
  S 00074 00026 00077                                                    05141
  M 00073 00012 00073                                                    05142
  A 00074 00073 00074                                                    05143
  M 00073 00074 00012                                                    05144
  A 00073 00073 00027                                                    05145
  R 90035 00067                                                          05146
  R 00068 90096                                                          05147
  R 00069 90097                                                          05148
  F 00072 90098 00068                                                    05149
  R 90003 00072               STORE J.D. AND                             05150
  R 90004 00073                SECONDS OF OBS.                           05151
  F 90000 90099 00072         T(N) IN C.U.T.                             05152
  R 90055 00035               OBSERVATION                                05153
  R 90056 00023               RHO 1, RANGE MEASUREMENT INTERVAL          05154
  R 90005 00039               EQUATORIAL OR POLAR IDENT.                 05155
  R 90053 00040               OBS. TYPE CODE                             05156
  R 90030 00041               STATION                                    05157
  R 90031 00042               LABEL                                      05158
  R 90032 00043               LONGITUDE                                  05159
  R 90033 00044               LATITUDE                                   05160
```

```
    R 90034 00045                 HEIGHT IN C.U.L.
    R 90036 00037
    R 90002 00066
    H 00001 00004 00015
    E 00002
  * B 00014                                                    B 00014
    C 00021 00075 00008 00008     END OF CATA
  * B 00076                                                    B 00076
    R 90053 00016
    E 00002
  * B 00008                                                    B 00008
    S 00013 00016 00015
    H 00001 00004 00013
    E 00002
    V 00012 +60000000+02
    V 00015 +10000000+01          ONE
    V 00016 +00000000+00          ZERO
    V 00017 +10000000+05          10**04
    V 00018 +10000000+03          10**02
    V 00020 +48000000+02          NO. OF INPUT WORDS
    V 00075 +99999999+08          END SENTINEL
```

```
          ELEMENT LOAD (CONVERSION OF ELEMENTS)                                                05201
K 00000                                                                                        05202
K 02935                                                 ELEMENT TYPE 1  2  3                   05203
Q 90001 01101                 A, SEMI-MAJOR AXIS IN C.U.L.           0  I  I                   05204
Q 90002 01102                 E, ECCENTRICITY                        0  I  I                   05205
Q 90003 01103                 NU, TRUE ANOMALY IN RADIANS            0  0  I                   05206
Q 90004 01104                 R SUB I    SATELLITE POSITION          I  0  0                   05207
Q 90005 01105                 R SUB J      VECTOR IN C.U.L.          I  0  0                   05208
Q 90006 01106                 R SUB K                                I  0  0                   05209
Q 90007 01107                 V SUB I    SATELLITE VELOCITY          I  0  0                   05210
Q 90008 01108                 V SUB J      VECTOR IN CUL/CUT         I  0  0                   05211
Q 90009 01109                 V SUB K                                I  0  0                   05212
Q 90010 01110                 R 0, MAG. OF R BAR                     0  0  0                   05213
Q 90011 01111                 V 0, MAG. OF V BAR                     0  0  0                   05214
Q 90012 01112                 ANGLE DELTA IN RADIANS                 0  0  0                   05215
Q 90013 01113                 M, MEAN ANOMALY IN RADIANS             0  I  0                   05216
Q 90014 01114                 PHI, ORBITAL AZIMUTH IN RADIANS        0  0  I                   05217
Q 90015 01115                 SMALL OMEGA,ARG.OF PERIGEE IN RAD      0  I  0                   05218
Q 90016 01116                 I, INCLINATION IN RADIANS              0  I  I                   05219
Q 90017 01117                 CAP OMEGA,LONG.OF ASC.NODE IN RAD      0  I  I                   05220
Q 90018 01118                 THETA (ELEVATION V) IN RADIANS         0  0  0                   05221
Q 90019 01119                 N, MEAN MOTION IN RAD/C.U.T.           0  0  0                   05222
Q 90020 00090                 NORMAL OR SPECIAL ENTRY IND.           I  I  I                   05223
Q 90022 03852                 MU                                     I  I  I                   05224
Q 90027 02651                 INPUT CONVERTER                        F  F  F                   05225
Q 90029 03864                 J                                      I  I  I                   05226
Q 90030 03351                 OBSERVED DATE TO J.D.                  F  F  F                   05227
Q 90031 03376                 JULIAN DAYS, SECONDS TO C.U.T.         F  F  F                   05228
Q 90032 00295                 SATELLITE ID. NO.                      I  I  I                   05229
Q 90033 00296                 YEAR OF REFERENCE (LAST 2 DIGITS)      I  I  I                   05230
Q 90034 00297                 DAYS JAN.1 - DAY OF REFERENCE          I  I  I                   05231
Q 90035 01123                 PERIOD IN C.U.T.                       0  0  0                   05232
Q 90036 01125                 HEIGHT OF APOGEE IN C.U.L.             0  0  0                   05233
Q 90037 01122                 CAP OMEGA DOT IN RADIANS / CUT         0  0  0                   05234
Q 90038 01121                 SMALL OMEGA DOT IN RADIANS/CUT         0  0  0                   05235
Q 90039 01124                 HEIGHT OF PERIGEE IN C.U.L.            0  0  0                   05236
Q 90040 01120                 CAP E, ECCENTRIC ANOMALY IN RAD        0  0  0                   05237
Q 90041 01190                 YEAR         DATE AND TIME             0  0  0                   05238
Q 90042 01191                 MONTH          OF ELEMENTS             0  0  0                   05239
Q 90043 01192                 DAY                                    0  0  0                   05240
```

Q 90044 01193	HOUR	0	0	0		05241
Q 90045 01194	MINUTE	0	0	0		05242
Q 90046 01195	(SECONDS)(1000)	0	0	0		05243
Q 90050 00085	COL.69 OF TIME CARD (PERT.OPTION)	0	0	0		05244
Q 90051 00096	TYPE OF INPUT ELEMENTS	0	0	0		05245
Q 90075 00044	CARD INPUT OPTION IND.	I	I	I		05246
Q 90076 00040	TAPE INPUT OPTICN IND.	I	I	I		05247
Q 90078 00042	ON-LINE PRINTOUT OPTION IND.	I	I	I		05248
Q 90079 02751	ABSOLUTE VALUE	F	F	F		05249
Q 90080 02271	ANGLE REDUCER (0 TO 2 PI)	F	F	F		05250
Q 90081 02011	VECTOR MAGNITUDE	F	F	F		05251
Q 90082 02021	VECTOR CIRECTION	F	F	F		05252
Q 90083 02051	DOT PRODUCT	F	F	F		05253
Q 90084 02087	VQ + 2	0	0	0		05254
Q 90085 02085	VQ	0	0	0		05255
Q 90086 02001	VECTOR MOVE	F	F	F		05256
Q 90087 02076	SCALAR-VECTOR MULTIPLY	F	F	F		05257
Q 90088 02061	CROSS PRODUCT	F	F	F		05258
Q 90089 02031	VECTOR ADD	F	F	F		05259
Q 90090 02041	VECTOR SUBTRACT	F	F	F		05260
Q 90091 02101	SIN	F	F	F		05261
Q 90092 02105	COS	F	F	F		05262
Q 90093 02196	SQUARE ROOT	F	F	F		05263
Q 90094 02216	KEPLER	F	F	F		05264
Q 90095 02246	ARC TAN (Y/X)	F	F	F		05265
Q 90096 02166	ARC COS	F	F	F		05266
Q 90097 02156	ARC SIN	F	F	F		05267
Q 90100 01100	T (0), TIME OF ELEMENTS IN CUT	0	0	0		05268
Q 00022 03842	2 PI	I	I	I		05269
Q 00073 03839	PI	I	I	I		05270
* B 00001					B 00001	05271
V 00019 +00000000+00						05272
V 00020 +00000000+00						05273
V 00021 +10000000+01						05274
V 00023 +10000000+04						05275
V 00024 +60000000+02						05276
V 00026 +10000000+01						05277
V 00027 +00000000+00						05278
V 00028 +00000000+00						05279
V 00083 +50000000-08	S. P. TOLERANCE FOR ZERO E					05280

```
  C 90020 00019 00009 00009      IS THIS NORMAL ENTRY (INPUT ON CARDS OR TAP                05281
  C 90076 00019 00005                                                                       05282
  C 90075 00019 00082                                                                       05283
  E 00043                                                                                   05284
* B 00082                                                                          B 00082  05285
  L 00030 00021 CA    06030202030206151508050101020l        NNNNNNNSSSNSNSN                 05286
  E 00006                                                                                   05287
* B 00005                                                                          B 00005  05288
  L 00030 00021 TB    06030202030206151508050101020l        NNNNNNNSSSNSNSN                 05289
* B 00006                                                                          B 00006  05290
  R 90041 00031                  YY        HOLD OUT DATE                                    05291
  R 90042 00032                  MM         AND TIME OF ELEMENTS                            05292
  R 90043 00033                  DD                       ENTS                              05293
  R 90044 00034                  HH                                                         05294
  R 90045 00035                  MM                                                         05295
  R 90046 00036                  SSSSS                                                      05296
  R 90050 00038                                                                             05297
  G 00010 00010 00039                                                                       05298
  R 90051 00039                  STORE INPUT ELEM. TYPE                                     05299
     T                                                                                      05300
  P 00000 00021 TD                                                                          05301
  P 00000 00021 PA                                                                          05302
     T EPOCH                                                                                05303
  P 00031 00021 TD    08030303030306                 SNNNNNN                                05304
  P 00031 00021 PA    08030303030306                 SNNNNNN                                05305
     T                                                                                      05306
  P 00000 00021 TD                                                                          05307
  P 00000 00021 PA                                                                          05308
     T INPUT QUANTITIES FROM CARD                                                           05309
  P 00000 00021 TD                                                                          05310
  P 00000 00021 PA                                                                          05311
  C 00030 90032 00043 00043                                                                 05312
  H 00001 00004 00019                                                                       05313
  D 00036 00036 00023            SCALE SECONDS                                              05314
  M 00034 00034 00024            HOURS TO MINUTES                                           05315
  A 00035 00034 00035            MINUTES PLUS MINUTES                                       05316
  M 00035 00035 00024            MINUTES TO SECONDS                                         05317
  A 00036 00035 00036            SECONDS                                                    05318
  R 00035 00033                                                                             05319
  R 00034 00032                                                                             05320
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  R 00033 00031                                                                           05321
  R 00031 90033                   YREF                                                    05322
  R 00032 90034                   DREF                                                    05323
  F 00035 90030 00031             YRMODY TO JULIAN CAYS                                   05324
  F 90100 90031 00035             JULIAN CAYS-SECS. TO C.U.T.                             05325
  C 90076 00020 00007                                                                     05326
  L 00030 00021 CA   09030903090309030903090303        NNNNNNNNNNN                         05327
  E 00008                                                                                 05328
* B 00007                                                                       B 00007   05329
  L 00030 00021 TB   090309030903090309030903          NNNNNNNNNNN                         05330
* B 00008                                                                       B 00008   05331
  E 00010                                                                                 05332
* B 00011                         ELEMENT TYPE 1                                B 00011   05333
      T      X           Y           Z          X DOT       Y DOT       Z DOT             05334
  P 00000 00021 PA                                                                        05335
  P 00000 00021 TD                                                                        05336
      T                                                                                   05337
  P 00030 00021 TD   01090309030903090309030903        SNNNNNNNNNNN                        05338
  P 00030 00021 PA   090309030903090309030903          NNNNNNNNNNN                         05339
  F 90004 90027 00030             R BARS                                                  05340
  F 90005 90027 00032                                                                     05341
  F 90006 90027 00034                                                                     05342
  F 90007 90027 00036             V BARS                                                  05343
  F 90008 90027 00038                                                                     05344
  F 90009 90027 00040                                                                     05345
* B 00009                         CONVERT POS. AND VEL. VECTORS TO ELEMENTS     B 00009   05346
  F 90010 90081 90004             RO                                                      05347
  F 90011 90081 90007             VO                                                      05348
  F 00050 90082 90004             R*                                                      05349
  F 90085 90082 90007             V*                                                      05350
  F 00053 90083 00050                                                                     05351
  F 00053 90097 00053                                                                     05352
  S 90018 00020 00053                                                                     05353
  F 90085 90086 90007                                                                     05354
  F 00053 90088 90004                                                                     05355
  F 00053 90082 00053             ALPHA BAR                                               05356
  F 90085 90086 00053                                                                     05357
  F 90085 90088 00019                                                                     05358
  F 00056 90082 90085             CMEGA BAR                                               05359
  F 90085 90086 00019                                                                     05360
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F 00059 90083 00053                                         05361
F 90016 90096 00059       I                                 05362
F 90085 90086 00026                                         05363
F 00060 90083 00056                                         05364
F 90085 90086 00056                                         05365
F 90085 90088 00026                                         05366
F 00059 90083 00019                                         05367
F 90017 90095 00059       CAP OMEGA                         05368
F 90085 90086 00056                                         05369
F 00060 90083 00050                                         05370
F 90085 90086 00050                                         05371
F 90085 90088 00056                                         05372
F 00059 90083 00053                                         05373
F 90014 90095 00059                                         05374
F 90014 90080 90014                                         05375
M 00059 90022 90022       MU**2                             05376
M 00060 00059 90010       MU**2 RO                          05377
A 00059 00059 00059       2MU**2                            05378
M 00061 90011 90011       VO**2                             05379
M 00061 00061 90010       ROVO**2                           05380
S 00059 00059 00061                                         05381
D 90001 00060 00059       A                                 05382
S 00059 00061 00021                                         05383
M 00059 00059 00059       (ROVO**2-1)**2                    05384
F 90085 90086 90004                                         05385
F 00060 90083 90007       RO BAR DOT VO BAR                 05386
M 00060 00060 00060                                         05387
D 00060 00060 90001       (RO BAR DOT VO BAR)**2/A          05388
A 00059 00059 00060       E**2                              05389
F 90002 90093 00059       E                                 05390
C 00083 90002 00085       IS E LESS THAN TOLERANCE          05391
S 00060 00021 00059       (1-E2)                            05392
M 00060 90001 00060                                         05393
S 00060 00060 90010                                         05394
M 00061 90002 90010                                         05395
D 00060 00060 00061       COS NU                            05396
F 90003 90096 00060       NU                                05397
C 00027 90018 00014 00029                                   05398
A 00065 00021 90002       (1+E)                             05399
S 00066 00021 90002       (1-E)                             05400
```

	M	00067	90022	90022			05401
	D	00067	00067	90001			05402
	D	00068	00065	00066			05403
	M	00068	00067	00068	W (1)		05404
	F	00068	90093	00068			05405
	S	00069	90011	00068			05406
	F	00069	90079	00069			05407
	D	00068	00066	00065			05408
	M	00068	00067	00068			05409
	F	00068	90093	00068			05410
	S	00068	90011	00068			05411
	F	00068	90079	00068			05412
	C	00069	00068	00081			05413
	R	90003	00020				05414
	E	00014					05415
*	B	00081				B 00081	05416
	R	90003	00073				05417
	E	00014					05418
*	B	00029				B 00029	05419
	S	90003	00022	90003			05420
*	B	00014			ON ANGLE THETA	B 00014	05421
	A	00061	90002	00060			05422
	M	00062	00060	90002			05423
	A	00062	00021	00062			05424
	D	00061	00061	00062	COS E		05425
	M	00063	90002	90002			05426
	S	00063	00021	00063			05427
	F	00063	90093	00063			05428
	F	00064	90091	90003	SIN NU		05429
	M	00063	00064	00063			05430
	D	00060	00063	00062	SIN E		05431
	F	90040	90095	00060	CAP E		05432
	M	00061	90002	00060			05433
	S	90013	90040	00061	M(T)		05434
	S	90015	90014	90003			05435
	F	90015	90080	90015			05436
	R	90012	90014				05437
	F	00060	90093	90001			05438
	M	00060	00060	90001			05439
	D	90019	90022	00060	N		05440

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   E 00070                                                                                        05441
 * B 00085                                                                           B 00085      05442
   R 90002 00020                                                                                  05443
   R 90003 00020                                                                                  05444
   9004000020                                                                                     05445
   R 90013 00020                                                                                  05446
   R 90015 00020                                                                                  05447
   R 90012 90014                                                                                  05448
   F 00060 90093 90001                                                                            05449
   M 00060 00060 90001                                                                            05450
   D 90019 90022 00060                                                                            05451
   E 00070                                                                                        05452
 * B 00012                                                                           B 00012      05453
       T     A           E              I            M         OMEGA      THETA                   05454
   P 00000 00021 PA                                                                               05455
   P 00000 00021 TD                                                                               05456
       T                                                                                          05457
   P 00030 00021 TD  01090309030903090309030903        SNNNNNNNNNNN                               05458
   P 00030 00021 PA  0903090309030903090309030903      NNNNNNNNNNNN                               05459
   F 90001 90027 00030            A                                                               05460
   F 90002 90027 00032            E                                                               05461
   F 90016 90027 00034            I                                                               05462
   F 90013 90027 00036            M                                                               05463
   F 90015 90027 00038            SMALL OMEGA                                                     05464
   F 90017 90027 00040            CAP OMEGA                                                       05465
   R 00064 90002                  E*                                                              05466
   R 00063 90013                                                                                  05467
   F 90040 90094 00063            CAP E                                                           05468
   F 00065 90092 90040            COSE                                                            05469
   F 00066 90091 90040            SINE                                                            05470
   M 00050 90002 00065                                                                            05471
   S 00050 00021 00050            (1-E COSE)                                                      05472
   S 00051 00065 90002                                                                            05473
   D 00053 00051 00050            COS NU                                                          05474
   M 00046 90002 90002                                                                            05475
   S 00046 00021 00046                                                                            05476
   F 00046 90093 00046                                                                            05477
   M 00052 00046 00066                                                                            05478
   D 00052 00052 00050                                                                            05479
   F 90003 90095 00052            NU                                                              05480
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	A	90014	90003	90015	PHI		05481
	F	90014	90080	90014			05482
	R	90012	90014				05483
	I	00016	+00000000+00				05484
*	B	00017				B 00017	05485
	F	00045	90093	90001			05486
	M	00045	00045	90001			05487
	D	90019	90022	00045	N		05488
	M	00045	90002	90002			05489
	S	00045	00021	00045			05490
	F	00046	90093	00045			05491
	M	00015	90001	00046	SMALL B		05492
	F	00047	90092	90017			05493
	F	00048	90091	90017			05494
	R	00049	00019				05495
	F	00050	90092	90016	COS I		05496
	F	00051	90091	90016	SIN I		05497
	F	00052	90092	90012	COS DELTA		05498
	F	00053	90091	90012	SIN DELTA		05499
	F	90085	90086	00019			05500
	F	90085	90088	00047			05501
	F	90085	90087	00051			05502
	A	90084	90084	00050			05503
	F	00054	90086	90085	ALPHA BAR		05504
	F	90085	90086	00047			05505
	F	90085	90088	00054			05506
	F	00065	90087	00053			05507
	F	90085	90086	00047			05508
	F	90085	90087	00052			05509
	F	00057	90089	00065	BETA BAR		05510
	F	90085	90086	00057			05511
	F	00060	90088	00054	GAMMA BAR		05512
	C	00016	00020	00018			05513
	E	00044					05514
*	B	00018				B 00018	05515
	S	90015	90014	90003	SMALL OMEGA		05516
	F	00067	90092	90003			05517
	A	00068	00067	90002			05518
	M	00067	00067	90002			05519
	A	00067	00021	00067			05520

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   D 00067 00068 00067                                          05521
   F 90040 90096 00067     CAP E                                05522
   F 00067 90091 90040                                          05523
   M 00067 90002 00067                                          05524
   S 90013 90040 00067     CAP M                                05525
 * B 00044                                           B 00044    05526
   S 00065 90015 90012                                          05527
   F 00066 90092 00065     COS W(1)                             05528
   F 00065 90091 00065     SIN W(1)                             05529
   F 90085 90086 00057                                          05530
   F 00067 90087 00066                                          05531
   F 90085 90086 00060                                          05532
   F 90085 90087 00065                                          05533
   F 00075 90089 00067                                          05534
   F 90085 90086 00057                                          05535
   F 00067 90087 00065                                          05536
   F 90085 90086 00060                                          05537
   F 90085 90087 00066                                          05538
   F 00078 90090 00067                                          05539
   F 00064 90092 90040     COS E                                05540
   F 00063 90091 90040     SIN E                                05541
   S 00051 00064 90002     COS E - E                            05542
   M 00050 00064 90002     E COS E                              05543
   S 00050 00021 00050     (1-E COS E)                          05544
   M 00051 90001 00051                                          05545
   F 90085 90086 00075                                          05546
   F 00051 90087 00051                                          05547
   M 00066 00015 00063     B SIN E                              05548
   F 90085 90086 00078                                          05549
   F 90085 90087 00066                                          05550
   F 90004 90089 00051     R BAR                                05551
   M 00051 00064 00015     B COS E                              05552
   D 00051 00051 00050                                          05553
   M 00052 90001 00063     A SIN E                              05554
   D 00052 00052 00050                                          05555
   F 90085 90086 00075                                          05556
   F 00065 90087 00052                                          05557
   F 90085 90086 00078                                          05558
   F 90085 90087 00051                                          05559
   F 90085 90090 00065                                          05560
```

```
  F 90007 90087 90019          R DOT BAR                               05561
  F 00050 90082 90004                                                  05562
  F 90085 90082 90007                                                  05563
  F 00053 90083 00050                                                  05564
  F 00053 90097 00053                                                  05565
  S 90018 00020 00053          THETA                                   05566
  F 90010 90081 90004                                                  05567
  F 90011 90081 90007                                                  05568
* B 00070                                                     B 00070  05569
  F 00065 90092 90016          COS I                                   05570
  F 00066 90091 90016          SIN I                                   05571
  M 00050 00022 00065                                                  05572
  D 90035 00022 90019          CAP P                                   05573
  M 00051 90002 90002                                                  05574
  S 00051 00021 00051                                                  05575
  M 00067 00051 90001          SMALL P                                 05576
  M 00067 00067 00067                                                  05577
  M 00067 00067 90035                                                  05578
  D 00050 00050 00067                                                  05579
  M 00050 00050 90029                                                  05580
  S 90037 00019 00050          CAP OMEGA DOT                           05581
  M 00050 00066 00066                                                  05582
  M 00050 00072 00050                                                  05583
  S 00050 00071 00050                                                  05584
  M 00050 00050 00073                                                  05585
  M 00050 90029 00050                                                  05586
  D 90038 00050 00067          SMALL OMEGA DOT                         05587
  S 00050 00021 90002                                                  05588
  M 00050 90001 00050                                                  05589
  S 90039 00050 00021          HGT OF PERIGEE                          05590
  A 00050 00021 90002                                                  05591
  M 00050 90001 00050                                                  05592
  S 90036 00050 00021          HGT OF APOGEE                           05593
  E 00002                                                              05594
  V 00071 +40000000+01                                                 05595
  V 00072 +50000000+01                                                 05596
* B 00013                      ELEMENT TYPE 3                 B 00013  05597
     T     A         E         I       NU       PHI     THETA          05598
  P 00000 00021 PA                                                     05599
  P 00000 00021 TD                                                     05600
```

```
    T
  P 00030 00021 TD    01090309030903090309030903        SNNNNNNNNNNNN
  P 00030 00021 PA    0903090309030903090309030903      NNNNNNNNNNNN
* B 00091                                                               B 00091
  F 90001 90027 00030           A
  F 90002 90027 00032           E
  F 90016 90027 00034           I
  F 90003 90027 00036           NU
  F 90014 90027 00038           PHI
  F 90017 90027 00040           CAP OMEGA
  I 00016 +10000000+01
  E 00017
* B 00043                                                               B 00043
  H 00001 00004 00024
  E 00002
```

```
          BACKWARD DIFFERENCE INTERPOLATION FUNCTION                05641
    K 00000                                                         05642
    K 03050                                                         05643
  * B 00001                                               B 00001   05644
    I 00015 -10000000+01                                            05645
    A 00019 00003 00012                                             05646
  * B 00005                                               B 00005   05647
    A 00015 00015 00011                                             05648
    S 00019 00019 00012                                             05649
    G 00020 00001 00019                                             05650
    H 00035 00015 00020                                             05651
    C 00014 00015 00005                                             05652
    I 00018 -10000000+01                                            05653
    A 00033 00014 00018                                             05654
  * B 00006                                               B 00006   05655
    A 00018 00018 00011                                             05656
    R 00017 00018                                                   05657
    G 00021 00035 00017                                             05658
  * B 00007                                               B 00007   05659
    A 00017 00017 00011                                             05660
    G 00022 00035 00017                                             05661
    S 00023 00021 00022                                             05662
    D 00023 00023 00013                                             05663
    R 00021 00022                                                   05664
    H 00035 00017 00023                                             05665
    C 00014 00017 00007                                             05666
    C 00033 00018 00006                                             05667
    S 00026 00024 00025                                             05668
    S 00027 00026 00013                                             05669
    R 00028 00011                                                   05670
    R 00029 00011                                                   05671
    R 00016 00010                                                   05672
    R 00032 00010                                                   05673
  * B 00008                                               B 00008   05674
    A 00016 00016 00011                                             05675
    M 00029 00029 00016                                             05676
    A 00027 00027 00013                                             05677
    M 00028 00028 00027                                             05678
    G 00023 00035 00016                                             05679
    D 00030 00028 00029                                             05680
```

```
M 00031 00030 00023
A 00032 00032 00031
C 00014 00016 00008
A 00032 00032 00035
H 00001 00004 00032
E 00002
V 00010 +00000000+00
V 00011 +10000000+01
V 00012 +10000000+02
V 00014 +50000000+01                                        **
```

```
          DAY COUNT FUNCTION
   K 00000
   K 03300
 * B 00001                              DAY COUNT FUNCTION USES LOCATIONS 1 TO 33     B 00001
   V 00008 +20000000+01                   ENTER WITH (Z)=YEAR,(Z+1)=MONTH,(Z+2)=
   V 00009 +40000000+01                   DAY. EXIT WITH (X)=NUMBER OF DAYS FROM
   V 00010 +10000000+01                   JAN.1 OF THE GIVEN YEAR THROUGH THE
   V 00011 +00000000+00                   GIVEN DATE.
   V 00012 +31000000+02                 NO. OF DAYS UP TO FEB. 1
   V 00013 +59000000+02                 NO. OF DAYS UP TO MAR. 1
   V 00014 +90000000+02                 NO. OF DAYS UP TO APR. 1
   V 00015 +12000000+03                 NO. OF DAYS UP TO MAY 1
   V 00016 +15100000+03                 NO. OF DAYS UP TO JUNE 1
   V 00017 +18100000+03                 NO. OF DAYS UP TO JULY 1
   V 00018 +21200000+03                 NO. OF DAYS UP AUG. 1
   V 00019 +24300000+03                 NO. OF DAYS UP TO SEPT. 1
   V 00020 +27300000+03                 NO. OF DAYS UP TO OCT. 1
   V 00021 +30400000+03                 NO. OF DAYS UP TO NOV. 1
   V 00022 +33400000+03                 NO. OF DAYS UP TO DEC. 1
   I 00028 +00000000+00                 SET DAY LOCATOR TO ZERO
   I 00026 +10000000+01                 SET MONTH COUNTER TO  1
   G 00023 00001 00003                  STORE YEAR,MONTH,AND DAY
   G 00024 00002 00003                  FROM THREE CONSECUTIVE
   G 00025 00003 00003                  LOCATIONS
 * B 00030                                                                            B 00030
   G 00027 00011 00028                  STORE DAY COUNT
   C 00024 00026 00005                  IS MONTH COUNTER EQUAL TO MONTH
   A 00027 00025 00027                  ADD INPUT DAY TO DAY COUNTER
   C 00024 00008 00031                  IS MONTH GREATER THAN 2
 * B 00029                                                                            B 00029
   H 00001 00004 00027                  STORE THE DAY COUNT
   E 00002                              EXIT
 * B 00031                                                                            B 00031
   I 00026 +60000000+02                 SET LEAP YEAR I=0
 * B 00032                                                                            B 00032
   C 00023 00026 00033 00029            COMPARE YEAR WITH 60+4I
   A 00027 00027 00010                  YEAR EQUALS 60+4I
   E 00029
 * B 00033                              YEAR IS GREATER THAN 4I+1                     B 00033
   A 00026 00026 00009                  SET LEAP YEAR I=I+1
```

```
  E 00032
* B 00005                                                              B 00005
  A 00026 00026 00010        ADD 1 TO THE MONTH COUNT
  A 00028 00028 00010        ADD 1 TO THE DAYS LOCATOR
  E 00030                                                     **
```

```
            OBSERVED DATE TO JULIAN DAYS FUNCTION
    K 00000
    K 03350
    Q 00011 03301                  DAY COUNT FUNCTION
  * B 00001                        OBSERV. DATE TO DAY COUNT FROM DREF(DAY OF      B 00001
    V 00012 +36500000+03           REFERENCE) F. (USES LOCATIONS 1 TO 24)
    V 00013 +10000000+01             ENTER WITH (Z)=YEAR OF THE REFERENCE
    V 00018 +40000000+01             DATE,(Z+1)=NO. OF DAYS FROM JAN.1 OF
    G 00005 00001 00003              THE YEAR THROUGH THE DAY OF REFERENCE,
    G 00006 00002 00003              (Z+2),(Z+3),(Z+4)= YEAR,MONTH,DAY FOR
    G 00007 00003 00003              THE OBSERVATION DATE.
    G 00008 00004 00003              EXIT WITH THE NUMBER OF DAYS FROM THE
    G 00009 00005 00003              REFERENCE DATE THROUGH THE OBSERVATION
    I 00010 +00000000+00             DATE,(TOE. THE JULIAN DAY COUNT FROM
    I 00017 +60000000+02             REFERENCE DAY.)
  * B 00020                                                                        B 00020
    C 00007 00005 00016
  * B 00015                                                                        B 00015
    F 00022 00011 00007
    A 00010 00010 00022
    S 00010 00010 00006
    H 00001 00004 00010
    E 00002
  * B 00016                                                                        B 00016
    C 00005 00017 00021 00019
    A 00010 00010 00013
  * B 00019                                                                        B 00019
    A 00010 00010 00012
    A 00005 00005 00013
    E 00020
  * B 00021                                                                        B 00021
    A 00017 00017 00018
    E 00016                                                               **
```

```
        REDUCED JULIAN DAYS- SECONDS TO C. U. T.
  K 00000
  K 03375
  Q 00006 03843             SEC/CUT                                I
  Q 00007 03862             SEC/DAY                                I
* B 00001                   REDUCED J.D., SEC. TO C.U.T. F.                 B 00001
  V 00008 +10000000+01      ENTER WITH (Z) = J.D., (Z+1) = SECONDS
  V 00012 +00000000+00       EXIT WITH (Z) = J.D., (Z+1) = SECONDS
  G 00009 00001 00003        LESS THAN 86,400, (X) = CUT . 15 LOCS.
  G 00010 00002 00003       SECONDS
  C 00007 00010 00005       DO SEC. EQUAL OR EXCEED ONE DAY
  S 00010 00010 00007       YES. (SEC)-(SEC. IN DAY)
  A 00009 00009 00008       J.D.+1
* B 00015                                                                   B 00015
  H 00001 00003 00009       J.D. AND
  H 00002 00003 00010        REDUCED SEC.
* B 00013                                                                   B 00013
  M 00009 00009 00007       J.D. TO SEC.
  D 00009 00009 00006
  D 00011 00010 00006
  A 00011 00011 00009
  H 00001 00004 00011
  E 00002
* B 00005                                                                   B 00005
  C 00012 00010 00014       ARE SEC. ZERO OR POSITIVE
  E 00013                   YES
* B 00014                   SEC. ARE NEG.                                   B 00014
  A 00010 00010 00007       SEC. + SEC. IN DAY (TO MAKE SEC. POS.)
  S 00009 00009 00008       J. D. - 1
  E 00015
```

```
            PROGRAM P FOR COMPLEMENTARY PERTURBATIONS TAPE                          05881
             (READS BINARY COMP. PERT. TAPE ON TF)                                  05882
    K 00000                                                                         05883
    K 03400                                                                         05884
    Q 90091 03051              BACKWARD DIFFERENCE INTERPOLATION F.    F            05885
    Q 90001 03074              LOC.24 OF INTERPOLATION F. (T SUB N)    O            05886
    Q 90002 03075              LOC.25 OF INTERPOLATION F. (T SUB O)    O            05887
    Q 90003 03063              LOC.13 OF INTERPOLATION F. (DELTA T)    O            05888
    Q 90004 09201              J.D. - SEC. TO C.U.T.                   F            05889
    Q 90005 00294              J.D.CORRES.TO START DATE OF PERT.TAPE   I            05890
    Q 90006 00293              DELTA T ON PERT. TAPE (C.U.T.)          I            05891
    Q 00089 03843              SECONDS / C.U.T.                                     05892
    Q 91000 00000              LOC. ZERO                               I            05893
    Q 91001 00459              BAD RECORD IND.                         I            05894
    Q 91002 00460              NO.OF READ ATTEMPTS                     I            05895
    Q 91003 03812              MINUS ONE (TO BACKSPACE ONE RECORD)     I            05896
    Q 90010 00062              TRANSFER POINT FOR BAD RECORD ON TF     I            05897
  * B 00001                                                      B 00001            05898
    G 00013 00001 00003                                                             05899
  * B 00005                                                      B 00005            05900
    C 00040 00013 00007 00016                                                       05901
    H 00001 00004 00041                                                             05902
    H 00002 00004 00042                                                             05903
    H 00003 00004 00043                                                             05904
    H 00004 00004 00044                                                             05905
    H 00005 00004 00045                                                             05906
    H 00006 00004 00046                                                             05907
    E 00002                                                                         05908
  * B 00016                                                      B 00016            05909
    C 00013 00050 00006 00017                                                       05910
    H 00001 00004 00051                                                             05911
    H 00002 00004 00052                                                             05912
    H 00003 00004 00053                                                             05913
    H 00004 00004 00054                                                             05914
    H 00005 00004 00055                                                             05915
    H 00006 00004 00056                                                             05916
    E 00002                                                                         05917
  * B 00017                                                      B 00017            05918
    R 00080 00013                                                                   05919
    R 90001 00080                                                                   05920
```

```
  R 90002 00070                                                      05921
  R 90003 90006              STORE DELTA T                           05922
  F 00081 90091 00071                                                05923
  H 00001 00004 00081                                                05924
  F 00082 90091 00072                                                05925
  H 00002 00004 00082                                                05926
  F 00083 90091 00073                                                05927
  H 00003 00004 00083                                                05928
  F 00084 90091 00074                                                05929
  H 00004 00004 00084                                                05930
  F 00085 90091 00075                                                05931
  H 00005 00004 00085                                                05932
  F 00086 90091 00076                                                05933
  H 00006 00004 00086                                                05934
  E 00002                                                            05935
* B 00006                                                   B 00006  05936
  I 00014 -50000000+02                                               05937
  C 00090 00009 00018                                                05938
* N 00008                                                   N 00008  05939
  A 00014 00014 00012                                                05940
  G 00080 00070 00014                                                05941
  H 00060 00014 00080                                                05942
  G 00081 00071 00014                                                05943
  H 00061 00014 00081                                                05944
  G 00082 00072 00014                                                05945
  H 00062 00014 00082                                                05946
  G 00083 00073 00014                                                05947
  H 00063 00014 00083                                                05948
  G 00084 00074 00014                                                05949
  H 00064 00014 00084                                                05950
  G 00085 00075 00014                                                05951
  H 00065 00014 00085                                                05952
  G 00086 00076 00014                                                05953
  H 00066 00014 00086                                                05954
  C 00009 00014 00008                                                05955
  R 00093 00009              BAD COUNT=0                             05956
* B 00091                                                   B 00091  05957
  L 00069 00011 TFB          LOAD ONE RECORD                         05958
  C 91000 91001 00092 00092  CHECK FOR BAD RECORD                    05959
  A 00093 00093 00010        BAD COUNT=BAD COUNT+1                   05960
```

```
  C 00093 91002 90010      HAVE ENOUGH TRIES BEEN MADE                05961
  L 00000 91003 TFB        NO BACKSPACE ONE RECORD                    05962
  E 00091                  TRY AGAIN                                  05963
* B 00092                  GCOD RECORD                     B 00092    05964
  R 00069 90005                                                       05965
  F 00070 90004 00069                                                 05966
  E 00005                                                             05967
* B 00013                                                  B 00018    05968
  I 00090 +00000000+00                                                05969
  I 00014 +50000000+01                                                05970
* N 00008                                                  N 00008    05971
  L 00019 00011 TFB                                                   05972
  A 00090 00090 00010                                                 05973
  C 00014 00090 00008                                                 05974
  R 00090 00009                                                       05975
  E 00006                                                             05976
* B 00007                                                  B 00007    05977
  I 00014 +50000000+02                                                05978
  C 00010 00090 00088                                                 05979
* N 00008                                                  N 00008    05980
  S 00014 00014 00012                                                 05981
  G 00080 00020 00014                                                 05982
  H 00030 00014 00080                                                 05983
  G 00081 00021 00014                                                 05984
  H 00031 00014 00081                                                 05985
  G 00082 00022 00014                                                 05986
  H 00032 00014 00082                                                 05987
  G 00083 00023 00014                                                 05988
  H 00033 00014 00083                                                 05989
  G 00084 00024 00014                                                 05990
  H 00034 00014 00084                                                 05991
  G 00085 00025 00014                                                 05992
  H 00035 00014 00085                                                 05993
  G 00086 00026 00014                                                 05994
  H 00036 00014 00086                                                 05995
  C 00014 00009 00008                                                 05996
  L 00019 00015 TFB                                                   05997
  R 00093 00009            BAD COUNT=0                                05998
* B 00094                                                  B 00094    05999
  L 00019 00011 TFB        LCAD RECORD                                06000
```

```
  C 91000 91001 00095 00095   CHECK FOR BAD RECORD
  A 00093 00093 00010         BAD COUNT=BAD COUNT+1
  C 00093 91002 90010         HAVE ENOUGH TRIES BEEN MADE
  L 00000 91003 TFB           NO.BACKSPACE
  E 00094                     TRY AGAIN
* B 00095                     GOOD RECORD                    B 00095
  R 00019 90005
  F 00020 90004 00019
  E 00005
* B 00088                                                    B 00088
  I 00014 -50000000+01
  L 00019 00014 TFB
  R 00090 00010
  E 00007
  V 00009 +00000000+00
  V 00010 +10000000+01
  V 00011 +80000000+01
  V 00012 +10000000+02
  V 00015 -20000000+01
```

```
     INITIALIZE PROGRAM P FOR COMP. PERT. TAPE                   06041
                                                                 06042
  K 00000                                                        06043
  K 03495                                                        06044
  Q 90001 03420                                                  06045
  Q 90002 03430                                                  06046
  Q 90003 03440                                                  06047
  Q 90004 03450                                                  06048
  Q 90005 03460                                                  06049
  Q 90006 03470                                        B 00001   06050
* B 00001               INITIALIZE INTERPOLATION                 06051
  I 90001 -99999999+08                                           06052
  R 90002 90001                                                  06053
  R 90003 90001                                                  06054
  R 90004 90001                                                  06055
  R 90005 90001                                                  06056
  R 90006 90001                                                  06057
  E 00002                                                        06058
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                                                                 06077
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                                                                 06079
                                                                 06080
```

```
          LOAD REJECT CARDS
   K 00000
   K 03500
 * B 00001                                                            B 00001
   V 00005 +00000000+00
   V 00007 +10000000+01
   V 00008 +99999999+08
   I 00009 +00000000+00
   I 00015 +20000000+01
   V 00019 +63847373+03               CULL
   V 00020 +72656577+03               KEEP
   V 00016 +24800000+03
   V 00017 +10000000+04
   L 00011 00007 CA     04                            A
   C 00011 00019 00006 00006
   R 00018 00007
   S 00038 00007 00018
   E 00010                                                            B 00006
 * B 00006
   C 00011 00020 00005 00005
   R 00038 00007                                                      B 00010
 * B 00010
   L 00011 00007 CA     0508                          NN
   C 00011 00005 00013 00013
   H 00001 00004 00007
   H 00050 00009 00008
   H 00051 00009 00008
   E 00002                                                            B 00013
 * B 00013
   C 00016 00009 00014                HAS MAX.NO.OF CARDS (124) BEEN LOADED
   I 00015 -10000000+01               YES
   H 00001 00004 00015
   E 00002                            ERROR EXIT                      B 00014
 * B 00014
   D 00012 00012 00017
   H 00050 00009 00011                OBS TO TABLE
   H 00051 00009 00012
   A 00009 00009 00015
   E 00010
```

```
        OBSERVATION SEARCH AND REJECT FUNCTION
  K 00000
  K 03520
  Q 90001 00258                 OBS. WEIGHT                    IO
* B 00001                                                              B 00001
  V 00005 +99999999+08
  V 00006 +10000000+01
  I 00007 +00000000+00
  V 00008 -10000000+01
  V 00014 +20000000+01
  G 00009 00001 00003
* B 00010                                                              B 00010
  G 00011 00030 00007
  G 00013 00031 00007
  C 00011 00009 00012
  C 00009 00013 00012
  M 90001 90001 00018
  E 00015
* B 00012                                                              B 00012
  A 00007 00007 00014
  C 00005 00011 00010
* B 00019                                                              B 00019
  C 00018 00006 00015 00015
  I 00007 +00000000+00
  M 90001 90001 00007
* B 00015                                                              B 00015
  H 00001 00004 00006
  E 00002
```

```
     PRINT INITIAL ELEMENTS,DRAGS,AND EARTH CONSTANTS                                         06161
   K 00000                                                                                    06162
   K 03550                                                                                    06163
   Q 90001 00098            IND.OF INPUT ON CARDS OR BINARY TAPE   I                          06164
   Q 90002 00042            PRINTER OUTPUT OPTION                  I                          06165
   Q 90003 00096            TYPE OF INPUT ELEM.(IF ON CARD)        I                          06166
   Q 90004 00099            ORBIT GENERATOR IDENT.                 I                          06167
   Q 90005 01004            X                     INITIAL          I                          06168
   Q 90006 01005            Y                      TYPE 1 ELEMENTS I                          06169
   Q 90007 01006            Z                                      I                          06170
   Q 90008 01007            X DOT                                  I                          06171
   Q 90009 01008            Y DOT                                  I                          06172
   Q 90010 01009            Z DOT                                  I                          06173
   Q 90011 01001            A                     INITIAL          I                          06174
   Q 90012 01002            E                      TYPE 2 ELEMENTS I                          06175
   Q 90013 01016            I                                      I                          06176
   Q 90014 01013            M                                      I                          06177
   Q 90015 01015            SMALL OMEGA                            I                          06178
   Q 90016 01017            CAP OMEGA                              I                          06179
   Q 90017 01090            DATE AND TIME OF ELEM.                 I                          06180
   Q 90018 03852            MU                                     I                          06181
   Q 90019 03835            ROTATION OF EARTH (RAD/CUT)            I                          06182
   Q 90020 03849            RADIUS OF EARTH (CUL)                  I                          06183
   Q 90021 03834            FLATNESS OF EARTH                      I                          06184
   Q 90022 03960            FIRST LOC. OF DRAG YYMMDD              I                          06185
   Q 90023 03961            FIRST LOC. OF DRAG HHMMSS              I                          06186
   Q 90024 01050            FIRST LOC. OF N(2,Q)'S OR RHO SUB I'S  I                          06187
   Q 90025 01051            RHO SUB 2                              I                          06188
   Q 90028 01070            FIRST LOC. OF N(3,Q)'S                 I                          06189
   Q 90029 01097            NO. OF T(P,Q)'S                        I                          06190
   Q 90030 02521            OUTPUT SCALE                           F                          06191
 * B 00001                  PRINT ELEMENTS,DRAGS,EARTH CONSTANTS              B 00001         06192
   V 00005 +00000000+00                                                                       06193
   V 00006 +10000000+01                                                                       06194
   V 00007 +20000000+01                                                                       06195
   C 90001 00005 00023 00023   WAS INPUT ON BINARY TAPE                                       06196
       T                                                                                      06197
   P 00000 00006 TD                                                                           06198
   P 00000 00006 PA                                                                           06199
     T INPUT QUANTITIES FROM BINARY TAPE                                                      06200
```

```
   P 00000 00006 TD                                                                         06201
   P 00000 00006 PA                                                                         06202
     T                                                                                      06203
   P 00000 00006 TD                                                                         06204
   P 00000 00006 PA                                                                         06205
     T EPOCH                                                                                06206
   P 90017 00006 TD     08030303030306                     SNNNNNN                          06207
   P 90017 00006 PA     08030303030306                     SNNNNNN                          06208
     T                                                                                      06209
   P 00000 00006 TD                                                                         06210
   P 00000 00006 PA                                                                         06211
   F 00010 90030 90005              X                    SCALE TYPE 1                       06212
   F 00012 90030 90006              Y                     INPUT ELEMENTS                    06213
   F 00014 90030 90007              Z                                                       06214
   F 00016 90030 90008              X DOT                                                   06215
   F 00018 90030 90009              Y DOT                                                   06216
   F 00020 90030 90010              Z DOT                                                   06217
     T    X          Y              Z         X DOT       Y DOT       Z DOT                 06218
   P 00000 00006 TD                                                                         06219
   P 00000 00006 PA                                                                         06220
     T                                                                                      06221
   P 00010 00006 TD     01090309030903090309030903         SNNNNNNNNNNN                     06222
   P 00010 00006 PA     0903090309030903090309030903       NNNNNNNNNNN                      06223
     T                                                                                      06224
   P 00000 00006 TD                                                                         06225
   P 00000 00006 PA                                                                         06226
   E 00024                                                                                  06227
 * B 00023                          INPUT WAS ON CARDS                         B 00023      06228
     T                                                                                      06229
   P 00000 00006 TD                                                                         06230
   P 00000 00006 PA                                                                         06231
     T CONVERTED QUANTITIES                                                                 06232
   P 00000 00006 TD                                                                         06233
   P 00000 00006 PA                                                                         06234
   C 90003 00006 00025 00025        WERE INPUT ELEMENTS TYPE 1                              06235
 * B 00024                                                                     B 00024      06236
   F 00010 90030 90011              A                    SCALE TYPE 2                       06237
   F 00012 90030 90012              E                     INPUT ELEMENTS                    06238
   F 00014 90030 90013              I                                                       06239
   F 00016 90030 90014              M                                                       06240
```

```
  F 00018 90030 90015            OMEGA                                                         06241
  F 00020 90030 90016            THETA                                                         06242
      T      A           E        I           M          OMEGA        THETA                    06243
  P 00000 00006 TD                                                                             06244
  P 00000 00006 PA                                                                             06245
      T                                                                                        06246
  P 00010 00006 TD      010903090309030903090309030903               SNNNNNNNNNNN              06247
  P 00010 00006 PA      0903090309030903090309030903                 NNNNNNNNNNNN              06248
  E 00030                                                                                      06249
* B 00025                        INPUT ELEMENTS WERE NOT TYPE 1                     B 00025    06250
  F 00010 90030 90005            X                     SCALE TYPE 1                            06251
  F 00012 90030 90006            Y                      INPUT ELEMENTS                         06252
  F 00014 90030 90007            Z                                                             06253
  F 00016 90030 90008            X DOT                                                         06254
  F 00018 90030 90009            Y DOT                                                         06255
  F 00020 90030 90010            Z DOT                                                         06256
      T      X           Y        Z        X DOT        Y DOT        Z DOT                     06257
  P 00000 00006 TD                                                                             06258
  P 00000 00006 PA                                                                             06259
      T                                                                                        06260
  P 00010 00006 TD      010903090309030903090309030903               SNNNNNNNNNNN              06261
  P 00010 00006 PA      0903090309030903090309030903                 NNNNNNNNNNNN              06262
                                                                                    B 00030    06263
* B 00030                                                                                      06264
      T                                                                                        06265
  P 00000 00006 TD                                                                             06266
  P 00000 00006 PA                                                                             06267
  C 90004 00007 00026 00026      IS MCOI ORB.GEN.BEING USED                                    06268
  F 00010 90030 90024            YES. SCALE RHO 1                                              06269
  F 00012 90030 90025            SCALE RHO 2                                                   06270
      T    RHO 1       RHO 2                                                                   06271
  P 00000 00006 TD                                                                             06272
  P 00000 00006 PA                                                                             06273
      T                                                                                        06274
  P 00010 00006 TD      010903010903                                 SNNSNN                    06275
  P 00010 00006 PA      010903010903                                 SNNSNN                    06276
  E 00027                                                                                      06277
* B 00026                        ORBIT GEN. IS NOT MCOI                             B 00026    06278
      T DRAG EFFECTS     T (P,Q)    N (2,Q)      N (3,Q)                                       06279
  P 00000 00006 TD                                                                             06280
  P 00000 00006 PA
```

```
  I 00008 +00000000+00                                                          06281
  I 00009 +00000000+00                                                          06282
* N 00022                                                              N 00022  06283
  C 90029 00008 00029          HAVE ALL DRAGS BEEN PRINTED                      06284
  E 00027                      YES                                              06285
* B 00029                                                              B 00029  06286
  G 00010 90022 00009          YYMMDD OF DRAG                                   06287
  G 00011 90023 00009          HH MMSS OF DRAG                                  06288
  G 00012 90024 00008          N(2,Q)                                           06289
  G 00014 90028 00008          N(3,Q)                                           06290
  F 00012 90030 00012          SCALE N(2,Q)                                     06291
  F 00014 90030 00014          SCALE N(3,Q)                                     06292
      T                                                                         06293
  P 00010 00006 TD    140707020903010903               SNNSNNSNN                06294
  P 00010 00006 PA    140707020903010903               SNNSNNSNN                06295
  A 00008 00008 00006                                                           06296
  A 00009 00009 00007                                                           06297
  E 00022                                                                       06298
* B 00027                                                              B 00027  06299
  F 00010 90030 90018          MU                    SCALE                      06300
  F 00012 90030 90019          ROTATION               EARTH CONSTANTS           06301
  F 00014 90030 90020          RADIUS                                           06302
  F 00016 90030 90021          FLATNESS                                         06303
      T                                                                         06304
  P 00000 00006 TD                                                              06305
  P 00000 00006 PA                                                              06306
      T EARTH CONSTANTS      MU        ROTATION     RADIUS       FLATNESS       06307
  P 00000 00006 TD                                                              06308
      T                                                                         06309
  P 00010 00006 TD    15020903010903010903010903       SSNNSNNSNNSNN            06310
  C 90002 00005 00028 00028    OUTPUT ON PRINTER                                06311
  E 00002                      NO                                               06312
* B 00028                      YES                                     B 00028  06313
      T EARTH CONSTANTS      MU        ROTATION     RADIUS       FLATNESS       06314
  P 00000 00006 PA                                                              06315
      T                                                                         06316
  P 00010 00006 PA    15020903010903010903010903       SSNNSNNSNNSNN            06317
  E 00002                                                                       06318
                                                                                06319
                                                                                06320
```

```
          LOAD AREA, MASS, DRAG DATA CARD FOR MCOI
      K 00000
      K 03600
      Q 90001 00282                 AREA                              O
      Q 90002 00283                 MASS                              O
      Q 90003 00267                 C SUB D                           O
      Q 90004 01150                 RHO 1                             O
      Q 90005 01151                 RHO 2                             O
      Q 90006 00284                 K, SATELLITE SHAPE PARAMETER      O
      Q 90007 02651                 INPUT CONVERTER                   F
    * B 00001                       LOAD AREA,MASS,DRAG DATA CARD              B 00001
      V 00005 +10000000+01
      L 00010 00005 CA    0903090309030903090309030903      NNNNNNNNNNNN
      F 90001 90007 00010           SCALE AREA
      F 90002 90007 00012           SCALE MASS
      F 90003 90007 00014           SCALE C SUB D
      F 90004 90007 00016           SCALE RHO 1
      F 90005 90007 00018           SCALE RHO 2
      F 90006 90007 00020           SCALE K
      E 00002
```

```
         F094  621231                                                              06361
         F094  CTMU ASSIGNMENT FUNCTION                                            06362
         F094  J.T. JONES                                                          06363
                                                                                   06364
      K 00000                                                                      06365
      K 03700                                                                      06366
      Q 90000 00000                                                                06367
      Q 90001 03751                                                                06368
      Q 00037 03841              2**26                                             06369
      V 00005 +10000000+01                                                         06370
      V 00006 +20000000+01                                                         06371
      V 00007 +00000000+00                                                         06372
      V 00008 +60000000+02                                                         06373
      V 00009 +90000000+01                                                         06374
      V 00010 +16000000+02                                                         06375
      V 00015 +12800000+03                                                         06376
      V 00016 +30054000+05                                                         06377
      V 00017 +51200000+03                                                         06378
      V 00018 +10240000+04                                                         06379
      V 00019 +15360000+04                                                         06380
    * B 00001                                                         B 00001      06381
      X 00045                                                                      06382
    * N 00001                                                         N 00001      06383
      L 00020 00005 CA    0101040404040404040415150301    ASAAAAAAAAASSSA          06384
      R 00012 00007                                                                06385
      S 00020 00020 00008                                                          06386
      C 00020 00006 00042                                                          06387
      R 00013 00009                                                                06388
      R 00048 00010                                                                06389
      R 00049 00007                                                                06390
    * B 00043                                                         B 00043      06391
      A 00012 00012 00005                                                          06392
      C 00012 00009 00040                                                          06393
      G 00038 00020 00012                                                          06394
      C 00038 00007 00044                                                          06395
    * B 00040                                                         B 00040      06396
      C 00030 00007 00001                                                          06397
      E 00002                                                                      06398
    * B 00044                                                         B 00044      06399
      F 00031 90001 00038                                                          06400
```

```
    C 00034 00007 00041 00041                                          06401
    R 00014 00048                                                      06402
  * B 00046                                                  B 00046  06403
    A 00039 00033 00015        U+128                                   06404
    A 00039 00039 00014        U+128+M                                 06405
    G 00036 00016 00032        CHAN+C CH                               06406
    A 00039 00039 00036        U+128+M+CH                              06407
    A 00039 00039 00037                                                06408
    A 00035 00031 00013                                                06409
    A 00035 00035 00016                                                06410
    H 90000 00035 00039                                                06411
    E 00043                                                            06412
  * B 00042                                                  B 00042  06413
    R 00013 00007                                                      06414
    R 00048 00007                                                      06415
    R 00049 00010                                                      06416
    E 00043                                                            06417
  * B 00041                                                  B 00041  06418
    R 00014 00049                                                      06419
    E 00046                                                            06420
  * B 00045                                                  B 00045  06421
    , 90000                                                            06422
     2  7773        996     777 776       7               77           06423
                            THE PRECEDING CARD IS BINARY AND IS FORMED 06424
                            BY MAKING THE FOLLOWING PUNCHES, IN ROW 6  06425
                            COLUMNS 8,19,36, IN ROW 7 COLUMNS 4-8,30-  06426
                            32,34,35,44,71,72, IN ROW 8 COLUMN 4, IN   06427
                               ROW 9 COLUMNS 2,17,18.                  06428
     9                                                                 06429
                                                                       06430
    E 00002                                                            06431
                                                                       06432
                                                                       06433
                                                                       06434
                                                                       06435
                                                                       06436
                                                                       06437
                                                                       06438
                                                                       06439
                                                                       06440
```

```
  K 00000                                                    06441
  K 03750                   CTMU COMPLEMENT                  06442
  V 00005 +10000000+03                                       06443
  V 00006 +60609000+08                                       06444
  V 00007 +10000000+01                                       06445
  V 00009 +30000000+01                                       06446
* B 00001                                          B 00001   06447
  G 00016 00001 00003                                        06448
  S 00010 00016 00006                                        06449
  I 00015 +00000000+00                                       06450
* B 00013                                          B 00013   06451
  A 00015 00015 00007                                        06452
  D 00011 00010 00005                                        06453
  U 00012 00011                                              06454
  M 00011 00012 00005                                        06455
  S 00011 00010 00011                                        06456
  H 00016 00015 00011                                        06457
  R 00010 00012                                              06458
  C 00009 00015 00013                                        06459
  H 00001 00004 00012                                        06460
  H 00002 00004 00019                                        06461
  H 00003 00004 00018                                        06462
  H 00004 00004 00017                                        06463
  E 00002                                                    06464
                                                             06465
                                                             06466
                                                             06467
                                                             06468
                                                             06469
                                                             06470
                                                             06471
                                                             06472
                                                             06473
                                                             06474
                                                             06475
                                                             06476
                                                             06477
                                                             06478
                                                             06479
                                                             06480
```

```
          CONSTANTS POOL FUNCTION FOR DIFF. CORRECTION                                        06481
    K 00000                                                                                   06482
    K 03800                                                                                   06483
    Q 90067 00099                ORBIT GENERATOR INDICATOR                   I                06484
    Q 90000 00089                0=SP (88)=2**26, 1=DP (88)=2**53                             06485
    Q 90002 02196                SQUARE ROOT                                 F                06486
    Q 90003 02101                SIN                                         F                06487
    Q 90004 02105                COS                                         F                06488
  * B 00001                                                                      B 00001      06489
    V 00005 +20000000+01                                                                      06490
    V 00006 +40000000+01                                                                      06491
    V 00007 +15000000+01         3/2                                                          06492
    V 00008 +25000000+01         5/2                                                          06493
    V 00009 +60000000+02         MIN/HR                                                       06494
    V 00010 +30000000+01                                                                      06495
    V 00011 +10000000+01                                                                      06496
    V 00012 -10000000+01                                                                      06497
    V 00013 -26666667+01         -8/3                                                         06498
    V 00014 -37500000+01         -15/4                                                        06499
    V 00015 +80000000+01                                                                      06500
    R 00088 00041                SP                                                           06501
    C 00011 90000 00018          IS IT DP                                                     06502
    A 00088 00041 00041          YES                                                          06503
    M 00088 00088 00041          2**53                                                        06504
  * B 00018                                                                      B 00018      06505
    M 00090 00090 00043          MOTION OF TAU IN RAD./ C.U.T.                                06506
    D 00092 00092 00046          C, VELOCITY OF LIGHT IN C.U.L./SECOND                        06507
    F 00097 90004 00091          Y COMPONENT OF U2 VECTOR FOR SUN DET.                        06508
    F 00098 90003 00091          Z COMPONENT OF U2 VECTOR FOR SUN DET.                        06509
    F 00052 90002 00089          MU=GM**1/2                                                   06510
    M 00087 00012 00042          -2 PI                                                        06511
    D 00039 00042 00005          COMPUTE PI                                                   06512
    D 00038 00042 00006          COMPUTE PI/2                                                 06513
    I 00057 +12000000+02                                                                      06514
    D 00057 00042 00057           PI / 6                                                      06515
    M 00065 00010 00038          COMPUTE 3 PI/2                                               06516
    D 00037 00062 00043          COMPUTE C.U.T. / DAY                                         06517
    D 00072 00073 00043          COMPUTE C.U.T. / HOUR                                        06518
    D 00036 00046 00063          COMPUTE MI/C.U.L.                                            06519
    M 00067 00046 00072          (KM/C.U.L.) (C.U.T./HR.)                                     06520
```

```
  D 00045 00067 00063        (MI/C.U.L.) (C.U.T./HR.)
  D 00070 00043 00009        COMPUTE MIN. / C.U.T.
  M 00040 00046 00069        COMPUTE METERS / C.U.L.
  D 00066 00040 00043        (METERS/C.U.L.) (C.U.T./SEC.)
  D 00068 00011 00047        COMPUTE RAD/DEG
  M 00035 00048 00043        ROTATION OF EARTH IN RAD/ C.U.T.
  D 00034 00011 00050        COMPUTE FLATNESS COEFFICIENT
  M 00085 00034 00034        F**2           (F=FLATNESS OF EARTH)
  M 00086 00005 00034        2 F
  S 00086 00086 00085        E**2 = 2F - F**2 (E=ECCENTRICITY OF EARTH)
  S 00085 00011 00034        1 - F
  M 00085 00049 00085        B (POLAR RADIUS OF EARTH IN C.U.L.)
  D 00074 00076 00047        RAD/HR
  D 00075 00011 00009        HR/MIN
  D 00082 00078 00046        C.U.L. / ASTRONOMICAL UNIT
  D 00083 00011 00080        (MASS OF MOON)/(MASS OF EARTH)
  M 00084 00046 00081        CM / C.U.L.
  M 00020 00049 00049        COMPUTE J
  M 00024 00020 00053        J2*R**2
  M 00064 00007 00024        J=3/2*J2*R**2
  C 90067 00011 00019 00019  IS PE ORBIT GENERATOR BEING USED
  I 00030 +00000000+00       K2=0
  I 00031 +00000000+00       K3=0
  I 00032 +00000000+00       K4=0
  I 00033 +00000000+00       K5=0
  I 00029 +00000000+00       H=0
  I 00028 +00000000+00       K=0
  I 00027 +00000000+00       L=0
  E 00002
* B 00019                                                  B 00019
  C 90067 00010 00017 00017  IS BROUWER ORBIT GENERATOR BEING USED
  M 00024 00053 00020        COMPUTE K2
  D 00030 00024 00005        K2=(J2*R**2)/2
  M 00021 00020 00049        COMPUTE K3
  M 00024 00054 00021        J3*R**4
  M 00031 00012 00024        K3=-(J3*R**3)
  M 00022 00021 00049        COMPUTE K4
  M 00024 00055 00022        J4*R**4
  D 00032 00024 00013        K4=(J4*R**4)/-2.6666667
  M 00023 00022 00049        COMPUTE K5
```

```
  M 00024 00056 00023          J5*R**5
  M 00033 00012 00024          K5=-(J5*R**5)
  I 00029 +0000000+00          H=0
  I 00028 +0000000+00          K=0
  I 00027 +0000000+00          L=0
  E 00002
* B 00017                                                       B 00017
  C 90067 00005 00016 00016    IS MCOI ORBIT GENERATOR BEING USED
  I 00030 +0000000+00          K2=0
  I 00031 +0000000+00          K3=0
  I 00032 +0000000+00          K4=0
  I 00033 +0000000+00          K5=0
  M 00021 00020 00049
  M 00024 00021 00054          COMPUTE H
  M 00029 00008 00024          H=5/2*R**3*J3
  M 00024 00014 00055          COMPUTE K
  M 00022 00021 00049
  M 00028 00022 00024          K=-15/4*R**4*J4
  I 00027 +0000000+00          L=0
  E 00002
* B 00016                      THIS IS HST ORBIT GENERATOR      B 00016
  M 00024 00053 00020          COMPUTE K2
  D 00030 00024 00005          K2=J2*R**2/2
  M 00021 00020 00049
  M 00024 00054 00021          COMPUTE K3
  D 00031 00024 00005          K3=J3*R**3/2
  M 00022 00021 00049
  M 00024 00055 00022          COMPUTE K4
  M 00024 00024 00012          -J4*R**4
  D 00032 00024 00015          K4=-J4*R**4/8
  I 00033 +0000000+00          K5=0
  I 00029 +0000000+00          H=0
  I 00028 +0000000+00          K=0
  I 00027 +0000000+00          L=0
  E 00002
```

```
K 00000                                                              06601
K 03825                  SHADOW DETERMINATION CONSTANTS              06602
V 00000 +00000000+00     T1, TOL. FOR MAG.OF (R X U) IN SUN DET.     06603
V 00001 +00000000+00     TOL. FOR (UNIT R) DOT (U) IN SUN DET.       06604
V 00016 +67108864+08     2**26                                       06605
V 00017 +62831853+01     2 PI                                        06606
V 00018 +80683200+03     SECONDS / C.U.T.   (C.U.T. =                06607
                           CANONICAL UNIT OF TIME)                   06608
V 00019 +10000000-01     CRITICAL INCL. FOR BROUWER                  06609
V 00021 +63783880+04     KILOMETERS/C.U.L.  (C.U.L. =                06610
                           CANONICAL UNIT OF LENGTH)                 06611
V 00022 +57295780+02     DEGREES/RADIAN                              06612
V 00023 +72921159-04     ROTATION OF EARTH IN RAD/SEC                06613
V 00024 +10000000+01     RADIUS OF EARTH IN C.U.L.                   06614
V 00025 +29700000+03                                                 06615
V 00026 +10000000+01     C                                           06616
V 00064 +10000000+01     MU**2=GM                                    06617
V 00028 +10821900-02     J2                                          06618
V 00029 -22850000-05     J3                                          06619
V 00030 -21230000-05     J4                                          06620
V 00031 -23200000-06     J5                                          06621
V 00033 +36000000+01                                                 06622
V 00034 +31355885-01     SMALL H SUB 0                               06623
V 00035 +26666667+00      (4/3) (BETA)                               06624
V 00036 +62711769-02      (4/3)(H SUB 0)                             06625
V 00037 +86400000+05     SEC/DAY                                     06626
V 00038 +16093472+01     KM/MI                                       06627
V 00044 +10000000+04     M/KM                                        06628
V 00046 +10000000+01     1+N SUB 0                                   06629
V 00048 +36000000+04     SEC/HR                                      06630
V 00051 +15000000+02     DEG/HR                                      06631
V 00052 +45000000-04     SUNLIGHT PRESSURE IN DYNES / CM**2          06632
V 00053 +14947300+09     KM/ASTRONOMICAL UNIT                        06633
V 00054 +33343200+06     (MASS OF SUN)/(MASS OF EARTH)               06634
V 00055 +81450000+02     (MASS OF EARTH)/(MASS OF MOON)              06635
V 00056 +10000000+06     CM/KM                                       06636
V 00065 +19910638-06     MOTION OF TAU IN RAD./ SECOND               06637
V 00066 +40915752+00     23 DEG. 26 MIN. 34.795 SEC.                 06638
V 00067 +29979250+06     C, VELOCITY OF LIGHT IN KM. / SECOND        06639
V 00068 +10000000+01     X COMPONENT OF U1 VECTOR FOR SUN DET.       06640
```

```
V 00069 +00000000+00          Y COMPONENT OF U1 VECTOR FOR SUN DET.
V 00070 +00000000+00          Z COMPONENT OF U1 VECTOR FOR SUN DET.
V 00071 +00000000+00          X COMPONENT OF U2 VECTOR FOR SUN DET.
```

```
          LOAD DRAG DATA                                                              06681
  K 00000                                                                             06682
  K 03900                                                                             06683
  Q 90001 00006                  ERROR INDICATOR                      O               06684
  Q 90002 02651                  INPUT CONVERTER F.                   F               06685
  Q 90003 03351                  OBS. DATE TO J.D. F.                 F               06686
  Q 90004 03376                  JULIAN DAYS-SECONDS TO C.U.T.        F               06687
  Q 90034 00002                  NO. OF T(P,Q)'S - 1                  O               06688
* B 00001                        LOAD DRAG DATA FUNCTION (USES 100 LOCS.)    B 00001  06689
  V 00007 +00000000+00            ENTER WITH (Z)= SAT. ID. NO., (Z+1)= YEAR           06690
  V 00009 +10000000+04            OF REF., (Z+2)= DAYS JAN.1- DAY OF REF.             06691
  V 00012 +10000000+01            EXIT WITH (X)=T(P,Q) IN CUT,...(X+20)=              06692
  V 00013 +60000000+02            N(2,Q),...(X+40)= N(3,Q)... I.E., WITH              06693
  G 00005 00001 00003             DRAG TABLE STARTING IN X. ALSO STORES               06694
  G 00014 00002 00003             DATES + TIMES OF DRAGS STARTING IN LOC.60           06695
  G 00015 00003 00003                                                                 06696
  I 90034 -10000000+01                                                                06697
  I 00042 +00000000+00                                                                06698
* B 00011                                                                    B 00011  06699
  L 00019 00012 CA     01050102020201020201050109030903    SNSNNNSNNSNSNNNN           06700
  C 00005 00019 00006 00006                                                           06701
  I 00043 +10000000+03                                                                06702
  M 00059 00020 00043                                                                 06703
  A 00059 00059 00021                                                                 06704
  M 00059 00059 00043                                                                 06705
  A 00059 00059 00022                                                                 06706
  H 00060 00042 00059                                                                 06707
  M 00059 00023 00043                                                                 06708
  A 00059 00059 00024                                                                 06709
  M 00059 00059 00043                                                                 06710
  D 00025 00025 00009                                                                 06711
  A 00059 00059 00025                                                                 06712
  H 00061 00042 00059                                                                 06713
  I 00043 +20000000+01                                                                06714
  A 00042 00043 00042                                                                 06715
  A 90034 90034 00012                                                                 06716
  F 00026 90002 00026                                                                 06717
  F 00028 90002 00028                                                                 06718
  M 00023 00023 00013                                                                 06719
  A 00024 00024 00023                                                                 06720
```

```
  M 00024 00024 00013                                          06721
  A 00025 00025 00024                                          06722
  R 00016 00020                                                06723
  R 00017 00021                                                06724
  R 00018 00022                                                06725
  F 00030 90003 00014                                          06726
  R 00031 00025                                                06727
  F 00032 90004 00030                                          06728
  H 00001 00004 00032                                          06729
  H 00021 00004 00026                                          06730
  H 00041 00004 00028                                          06731
  A 00004 00004 00012                                          06732
  E 00011                                                      06733
* B 00006                                            B 00006   06734
  C 00019 00007 00008 00008                                    06735
  I 90001 +00000000+00                                         06736
  E 00002                                                      06737
* B 00008                                            B 00008   06738
    TWRONG SAT. ID NO. ON DRAG CARD                            06739
  P 00019 00012 PA    151306              SSN                  06740
  I 90001 -10000000+01                                         06741
  E 00002                                                      06742
                                                               06743
                                                               06744
                                                               06745
                                                               06746
                                                               06747
                                                               06748
                                                               06749
                                                               06750
                                                               06751
                                                               06752
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                                                               06754
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                                                               06758
                                                               06759
                                                               06760
```

```
          LOAD CONSTRAINT WEIGHTS
    K 00000
    K 04025
    Q 90001 02651                  INPUT CONVERTER
  * B 00001                                                              B 00001
    I 00005 +10000000+06
    L 00010 00006 CA     04030403040304030403040304030403NNNNNNNNNNNNNNNNN
    M 00010 00005 00010
    F 00010 90001 00010
    M 00012 00005 00012
    F 00011 90001 00012
    M 00014 00005 00014
    F 00012 90001 00014
    M 00016 00005 00016
    F 00013 90001 00016
    M 00018 00005 00018
    F 00014 90001 00018
    M 00020 00005 00020
    F 00015 90001 00020
    M 00022 00005 00022
    F 00016 90001 00022
    M 00024 00005 00024
    F 00017 90001 00024
    M 00026 00005 00026
    F 00018 90001 00026
    V 00006 +10000000+01          ONE
    E 00002
```

```
            COMPUTE CONSTRAINT EQUATIONS (ADDITIONAL EQUATIONS OF CONDITION)                   06801
  K 00000                                                                                      06802
  K 04055                                                                                      06803
  Q 90598 00598                    M                                    I                      06804
  Q 90597 00580                    M-1                                  O                      06805
  Q 90420 00420                                                                                06806
  Q 90001 02316                    AUGMENT MATRIX                                              06807
  Q 90002 04035                    WEIGHTS                                                     06808
  Q 90003 00400                    FIRST LOC. OF UNKNOWN NO'S           I                      06809
  Q 90004 04200                    LOC.PRECEDING FIRST OF SUMS OF XJ    I                      06810
  Q 90419 00419                                                                                06811
  Q 90048 00048                    N, NO.OF CONDITION EQNS.             IO                     06812
  Q 90049 00049                    SUM OF SQUARED (O-C)'S               IO                     06813
* B 00001                          COMPUTE CONSTRAINT EQUATIONS                   B 00001      06814
  V 00005 +10000000+01              (COMPUTES AN EQUATION OF CONDITION FOR                     06815
  V 00006 +00000000+00              EACH UNKNOWN BEING SOLVED FOR, AND                         06816
  I 00007 -10000000+01              AUGMENTS THE NORMAL MATRIX BY EACH EQN.)                   06817
* N 00008                                                                         N 00008      06818
  A 00007 00007 00005                                                                          06819
  H 90420 00007 00006                                                                          06820
  C 90598 00007 00008                                                                          06821
  I 00007 -10000000+01                                                                         06822
  S 90597 90598 00005                                                                          06823
* N 00008                                                                         N 00008      06824
  A 00007 00007 00005                                                                          06825
  G 00010 90003 00007              J, NO. OF UNKNOWN                                           06826
  G 00011 90002 00007                                                                          06827
  H 90420 00007 00011                                                                          06828
  G 00012 90004 00010              USE J TO GET SUM OF XJ                                      06829
  M 00012 00012 00011                                                                          06830
  S 00012 00006 00012                                                                          06831
  H 90420 90598 00012                                                                          06832
  F 90598 90001 90419                                                                          06833
  H 90420 00007 00006                                                                          06834
  C 00011 00006 00013 00013        IS WEIGHT = 0                                               06835
  C 90597 00007 00008                                                                          06836
  E 00002                                                                                      06837
* B 00013                          WT. FOR THIS EQC IS NOT 0                      B 00013      06838
  M 00014 00012 00012              SQUARE RT. HAND SIDE OF EQC                                 06839
  A 90049 90049 00014               AND ADD IT TO SUM OF SQUARED (O-C)'S                       06840
```

```
A 90048 90048 00005          ADD 1 TO NO. OF COND.EQNS.
C 90597 00007 00008
E 00002
```

K = 04055 LINE 06880 PAGE 172

```
       SUM UNKNOWNS (STORES EACH SUM ACCORDING TO J,THE NO. OF THE UNKNOWN)
    K 00000
    K 04100
    Q 90001 00400                 FIRST LOC. OF UNKNOWN NO'S,J              I
    Q 90002 00441                 FIRST LOC. OF UNKNOWNS, XJ                I
    Q 90003 04200                 LOC.PRECEDING(UNWEIGHTED)SUMS OF XJ      IO
    Q 90004 00700                 LOC.PRECEDING (WEIGHTED) PREV.SUMS OF XJ  O
    Q 90005 00800                 LOC.PRECEDING (WEIGHTED) SUMS OF XJ       O
    Q 90006 04035                 FIRST LOC.OF CONSTRAINT WEIGHTS           I
  * B 00001                       SUM UNKNOWNS. USES J (NO.OF UNKNOWN XJ) TO       B 00001
    V 00006 +10000000+01           GET SUM OF PREV.XJ, ADDS XJ TO IT + STORES
    I 00007 +00000000+00           NEW SUM. ALSO STORES (WEIGHTED) NEW AND
  * B 00005                        PREV.SUMS IN TEMP.LOCS.FOR PRINTOUT.12 LOC      B 00005
    G 00008 90001 00007           J, UNKNOWN NO.
    C 00006 00008 00002
    G 00009 90002 00007           XJ, UNKNOWN
    G 00011 90006 00007           GET CORRES.CONSTRAINT WT.
    G 00010 90003 00008           GET CORRES. SUM OF ALL PREVIOUS XJ
    M 00012 00011 00010           (WT.)(PREVIOUS SUM OF XJ)
    H 90004 00008 00012           STORE PREV.SUM (WEIGHTED)
    A 00010 00010 00009           NEW SUM=(PREV.SUM) + (XJ)
    H 90003 00008 00010           STORE NEW SUM (UNWEIGHTED)
    M 00012 00011 00010           (WT.)(NEW SUM OF XJ)
    H 90005 00008 00012           STORE NEW SUM (WEIGHTED)
    A 00007 00007 00006
    E 00005                       GET ANOTHER J
```

```
            RUN IDENTIFICATION LOAD AND PRINT
     K 00000
     K 04200

     Q 90001 00099                  ORBIT GENERATOR IDENTIFICATION       0
   * B 00001                        RUN IDENT.LCAD+ PRINT.LOADS CARD,STORES C.6    B 00001
     V 00005 +10000000+01            1,2,3,4,5,7   (ALPHABETIC) IN X...X+5. 7
     V 00006 +60000000+01            LINES CF PRINT CCNTROL CHAR.ARE WRITTEN ON
                                     TAPE TD,FOLL.BY THESE 3 LINES (1)ROUTINE
                                     NAME (2)C.9-40 AND (3)C.41-72 OF RUN ID.
                                     CARD.C.9-72 GO CN PRINTER. USES 33 LOCS.
         T  DIFFERENTIAL CORRECTION PROGRAM                              ***
     L 00010 00005 CA 01 01010101010101010404040404040404040404AAAAAAAAAAAAAAAAA
         CONTINUED       040404040404                  AAAAAA
     H 00001 00004 00015            CCL. 6 (BCD TAPE INPUT)
     H 00002 00004 00010            COL. 1
     H 00003 00004 00011            COL. 2 (PRINTER CUTPUT)
     H 00004 00004 00012            COL. 3 (TAPE OUTPUT)
     H 00005 00004 00014            COL. 5 (CARD INPLT)
     H 00006 00004 00016            COL. 7 (D-C ON-LINE)
         T  USER SUPPLIED INFORMATION                                    ***
     P 00000 00005 PA
         T
     P 00018 00005 PA     0804040404040404040404040404040404  SAAAAAAAAAAAAAAAA
         T1
     P 00000 00005 TD
         T0
     P 00000 00006 TD
         T  USER SUPPLIED INFORMATION                                    ***
     P 00000 00005 TD
         T0
     P 00018 00005 TD     150504040404040404                  SSAAAAAAAA
     P 00026 00005 TD     150504040404040404                  SSAAAAAAAA
         T  USER SUPPLIED INFORMATION                                    ***
     P 00000 00005 TD
     E 00002
```

```
      F062  630422
      F062  INTERVAL CORE DUMP
      F062  J.T. JONES

    K 00000
    K 04330
    Q 90001 00000
    Q 90002 00465                    N=MAX. OF IP DUMP REQUESTS
    Q 90003 04456
    Q 90004 00466                    OUTPUT OPTION
    V 00012 +00000000+00
    V 00013 +10000000+01
    V 00014 +50000000+01
  * B 00001                                                          B 00001
    I 00010 -50000000+01
    M 00011 90002 00014
    S 00011 00011 00014
  * B 00005                                                          B 00005
    A 00010 00010 00014
    L 00015 00013 CA      050505                  NNN
    C 00015 00012 00008
    C 00010 00012 00006
    E 00002
  * B 00008                                                          B 00008
    H 00022 00010 00015
    H 00023 00010 00017
    H 00024 00010 00016
    C 00011 00010 00005
  * B 00006                                                          B 00006
    R 00011 00010
    I 00010 -50000000+01
  * B 00007                                                          B 00007
    A 00010 00010 00014
    G 00015 00022 00010
    G 00016 90001 00015
    H 00025 00010 00016
    G 00017 00021 00010
    H 90001 00015 00017
    C 00011 00010 00007
    E 00002
```

```
* B 00009                                                        B 00009   07001
  C 90004 00012 00019 00019                                                07002
      T                                                                    07003
  P 00000 00013 PA                                                         07004
      T MEMORY IMMEDIATELY BEFORE EXECUTION OF B                           07005
  P 00015 00013 TD     13151506                   SSSN                     07006
      T                                                                    07007
  P 00000 00013 PA                                                         07008
  F 00016 90003 00017                                                      07009
      T                                                                    07010
  P 00000 00013 PA                                                         07011
  E 00018                                                                  07012
* B 00019                                                        B 00019   07013
      T MEMORY IMMEDIATELY BEFORE EXECUTION OF B                           07014
  P 00015 00013 TD     13151506                   SSSN                     07015
      T                                                                    07016
  F 00016 90003 00017                                                      07017
      T                                                                    07018
  E 00018                                                                  07019
* B 00021                                                        B 00021   07020
  R 00015 00022                                                            07021
  R 00016 00023                                                            07022
  R 00017 00024                                                            07023
  R 00018 00025                                                            07024
  E 00009                                                                  07025
* B 00026                                                        B 00026   07026
  R 00015 00027                                                            07027
  R 00016 00028                                                            07028
  R 00017 00029                                                            07029
  R 00018 00030                                                            07030
  E 00009                                                                  07031
* B 00031                                                        B 00031   07032
  R 00015 00032                                                            07033
  R 00016 00033                                                            07034
  R 00017 00034                                                            07035
  R 00018 00035                                                            07036
  E 00009                                                                  07037
* B 00036                                                        B 00036   07038
  R 00015 00037                                                            07039
  R 00016 00038                                                            07040
```

```
  R 00017 00039                    07041
  R 00018 00040                    07042
  E 00009                          07043
* B 00041                 B 00041  07044
  R 00015 00042                    07045
  R 00016 00043                    07046
  R 00017 00044                    07047
  R 00018 00045                    07048
  E 00009                          07049
* B 00046                 B 00046  07050
  R 00015 00047                    07051
  R 00016 00048                    07052
  R 00017 00049                    07053
  R 00018 00050                    07054
  E 00009                          07055
* B 00051                 B 00051  07056
  R 00015 00052                    07057
  R 00016 00053                    07058
  R 00017 00054                    07059
  R 00018 00055                    07060
  E 00009                          07061
* B 00056                 B 00056  07062
  R 00015 00057                    07063
  R 00016 00058                    07064
  R 00017 00059                    07065
  R 00018 00060                    07066
  E 00009                          07067
* B 00061                 B 00061  07068
  R 00015 00062                    07069
  R 00016 00063                    07070
  R 00017 00064                    07071
  R 00018 00065                    07072
  E 00009                          07073
* B 00066                 B 00066  07074
  R 00015 00067                    07075
  R 00016 00068                    07076
  R 00017 00069                    07077
  R 00018 00070                    07078
  E 00009                          07079
    F062  END                      07080
```

```
                                                                                07081
          COMPUTE EFFECTIVE DRAG (DELTA M)                                      07082
   K 00000                                                                      07083
   K 04400                                                                      07084
   Q 00009 01197           NO. OF T(P,Q)'S                      I               07085
   Q 90000 01100           T(0), EPOCH TIME IN C.U.T.           I               07086
   Q 90001 00462           K, MULTIPLIER FOR DELTA M  (K= 1 OR 0) I             07087
   Q 90018 01130           T(P,Q)'S TIMES OF DRAGS IN C.U.T.    I               07088
   Q 90020 01150           N(2,Q)'S                             I               07089
   Q 90021 01170           N(3,Q)'S                             I               07090
   Q 90033 00200           OBS. TIME IN C.U.T.                  I               07091
   Q 90090 02271           PRINCIPAL VALUE                      F               07092
   Q 90091 02751           ABSOLUTE VALUE                       F               07093
 * B 00001                                                        B 00001       07094
   V 00050 +00000000+00                                                         07095
   V 00051 +10000000+01                                                         07096
   R 00039 00050                                                                07097
   I 00010 +00000000+00                                                         07098
 * B 00005                                                        B 00005       07099
   C 00009 00010 00007                                                          07100
   F 00039 90090 00039                                                          07101
   M 00039 00039 90001     FINAL DELTA M= (DELTA M)(K) WHERE K=1 OR 0           07102
   E 00002                                                                      07103
 * B 00007                                                        B 00007       07104
   G 00015 90018 00010                                                          07105
   S 00016 90033 00015                                                          07106
   S 00020 90000 90033     T(0)-T(N)                                            07107
   F 00020 90091 00020                                                          07108
   S 00021 90000 00015     T(0)-T(Q)                                            07109
   F 00021 90091 00021                                                          07110
   C 00021 00020 00006                                                          07111
   G 00017 90020 00010     N2Q                                                  07112
   M 00015 00016 00016     (T-TQ)**2                                            07113
   M 00017 00017 00015                                                          07114
   F 00017 90090 00017                                                          07115
   A 00039 00039 00017                                                          07116
   G 00017 90021 00010     N3Q                                                  07117
   M 00015 00015 00016     (T-TQ)**3                                            07118
   M 00017 00017 00015                                                          07119
   F 00017 90090 00017                                                          07120
```

```
 A 00039 00039 00017                                   B 00006
*B 00006
 A 00010 00010 00051
 E 00005
```

```
     F063  630422
     F063  INTERVAL CORE DUMP PRINT
     F063  J.T. JONES

   K 00000
   K 04455
   Q 90001 02650             K OF OPS F. + 130 ,INPUT CONVERTER
   Q 90002 02649             K OF OPS F. + 129
   Q 90003 02520             OUTPUT SCALE F.
   Q 90004 00042             OUTPUT OPTION
   Q 90008 00089             SINGLE PRECISION
   Q 90011 00001
   Q 90012 00002
   Q 90013 00003
   Q 90014 00004
   Q 90015 00005
   V 00007 +50000000+01
   V 00008 +10000000+01
   V 00009 +00000000+00
 * B 00001           PRINT OUT MEMORY PROGRAM USES LOCATIONS 1 TO 148      B 00001
   G 00003 00001 00003
   G 00004 00001 00004
   R 90001 90008
   R 90008 90002
   R 00010 00003
   S 00010 00010 00007
 * B 00005                                                                 B 00005
   A 00010 00010 00007
   S 00010 00010 00008
   G 00011 90011 00010
   G 00013 90012 00010
   G 00015 90013 00010
   G 00017 90014 00010
   G 00019 90015 00010
   C 00011 00009 00006 00006
   C 00013 00009 00006 00006
   C 00015 00009 00006 00006
   C 00017 00009 00006 00006
   C 00019 00009 00006 00006
   A 00003 00010 00007
```

```
  A 00010 00010 00008
  C 00004 00003 00005
  R 90008 90001
  E 00002
* B 00006                                                                              B 00006
  F 00011 90003 00011
  F 00013 90003 00013
  F 00015 90003 00015
  F 00017 90003 00017
  F 00019 90003 00019
  A 00003 00010 00007
  A 00010 00008 00010
  C 90004 00009 00021 00021
  P 00010 00008 PA    060209030109030109030109030109 03      NSNNSNNSNNSNNSNN
* B 00022                                                                              B 00022
  C 00004 00003 00005
  R 90008 90001
  E 00002
* B 00021                                                                              B 00021
  P 00010 00008 TD    0602090301090301090301090301090 3      NSNNSNNSNNSNNSNN
  E 00022
    F063  END
```

```
           BROUWER 1
          BROUWER ORBIT GENERATOR SUBROUTINE FOR
          DIFFERENTIAL CORRECTION ROUTINE

K 00000
K 04490
Q 90001 03830                 K 2                                   I
Q 90002 03831                 K 3                                   I
Q 90003 03832                 K 4                                   I
Q 90004 03833                 K 5                                   I
Q 90005 03864                 J                                     I
Q 90006 03829                 H                                     I
Q 90007 03828                 K                                     I
Q 90008 03827                 L                                     I
Q 90009 00010                 ZERO                                  I
Q 90010 00011                 ONE                                   I
Q 90011 02521                 OUTPUT SCALE                          F
Q 90012 02290                 PRINT IND.                            O
B 00001                                                                 B 00001
V 90012 +00000000+00          SET PRINT IND.
I 00391 +00000000+00          SETS LOOP SWITCH FOR BROUWER PROPER
I 00386 +99999999+08
C 90009 90012 00002 00002     IS PRINT IND.=0 (FOR HARMONICS PRINTED)
R 90012 90010                 YES. SET IT=1, AND PRINT
F 00003 90011 90001           SCALE K2
F 00005 90011 90002           SCALE K3
F 00007 90011 90003           SCALE K4
F 00009 90011 90004           SCALE K5
   T
P 00000 90010 TD
P 00000 90010 PA
   T HARMONICS
P 00000 90010 TD
P 00000 90010 PA
   T     K2           K3           K4           K5
P 00000 90010 TD
P 00000 90010 PA
   T
P 00003 90010 TD   010903010903010903010903        SNNSNNSNNSNN
P 00003 90010 PA   010903010903010903010903        SNNSNNSNNSNN
```

```
F 00003 90011 90005                 SCALE J
F 00005 90011 90006                 SCALE H
F 00007 90011 90007                 SCALE K
F 00009 90011 90008                 SCALE L
    T
P 00000 90010 TD
P 00000 90010 PA
    T    J          H           K           L
P 00000 90010 TD
P 00000 90010 PA
    T
P 00003 90010 TD    0109030109030109030109O3         SNNSNNSNNSNN
P 00003 90010 PA    010903010903010903010903         SNNSNNSNNSNN
E 00002
```

K 00000			07321
K 04500			07322
Q 70000 01100	T(0) , EPOCH TIME IN C.U.T.	I	07323
Q 70001 04947	ANGLE-QUAD. DET.	F	07324
Q 70002 02196	SQUARE ROOT	F	07325
Q 70003 02101	SINE	F	07326
Q 70004 02105	COSINE	F	07327
Q 70005 02216	KEPLER	F	07328
Q 70006 02166	ARC COSINE	F	07329
Q 70007 03830	K 2	I	07330
Q 70008 03831	K 3	I	07331
Q 70009 03832	K 4	I	07332
Q 70011 03833	K 5	I	07333
Q 70010 02271	PRINCIPAL VALUE	F	07334
Q 70360 01101	A, SEMI-MAJOR AXIS AT T(0)	I	07335
Q 70361 01113	M, MEAN ANOMALY AT T(0)	I	07336
Q 70362 01115	ARG. OF PERIGEE AT T(0)	I	07337
Q 70363 01117	RT. ASC. OF NODE AT T(0)	I	07338
Q 70366 01102	ECCENTRICITY AT T(0)	I	07339
Q 70377 01116	I, INCLINATION AT T(0)	I	07340
Q 70400 03844	K SUB C (CRITICAL INCLINATION)	I	07341
Q 80000 00276	DELTA A (COMP. PERT.)	I	07342
Q 80001 00277	DELTA E (COMP. PERT.)	I	07343
Q 80002 00278	DELTA I (COMP. PERT.)	I	07344
Q 80003 00279	DELTA M (COMP. PERT.)	I	07345
Q 80004 00280	DELTA ARG. OF PERIGEE (COMP.PERT.)	I	07346
Q 80005 00281	DELTA RT. AS. OF NODE (COMP.PERT.)	I	07347
Q 80500 00085	COMPLEMENTARY PERTURBATIONS IND.	I	07348
Q 80501 04439	DELTA M (DRAG)	I	07349
Q 90001 00218	A, SEMI-MAJOR AXIS AT REQUEST TIME	O	07350
Q 90002 00219	E, ECCENTRICITY AT REQUEST TIME	O	07351
Q 90003 00220	I, INCLINATION AT REQUEST TIME	O	07352
Q 90004 00213	M, MEAN ANOMALY AT REQUEST TIME	O	07353
Q 90005 00215	ARG. OF PERIGEE AT REQUEST TIME	O	07354
Q 90006 00217	RT. AS. OF NODE AT REQUEST TIME	O	07355
Q 90007 01841	COMPUTE DRAG AND COMP. PERT. EFFECTS	F	07356
Q 00018 03840	METERS/C.U.L.	I	07357
Q 00019 03866	(METERS/C.U.L.)(C.U.T./SEC.)	I	07358
Q 00024 03843	SECONDS/C.U.T.	I	07359
Q 00025 03889	MU**2=GM	I	07360

```
  Q 00052 03868           RAD/DEG                              I                 07361
  Q 00205 03842           2 PI                                 I                 07362
  Q 00206 03843           SECONDS/C.U.T.                       I                 07363
* B 00001                                                             B 00001    07364
  G 00200 00001 00003                                                            07365
  F 00000 90007 00200     COMPUTE DRAG AND COMP. PERT. EFFECTS                   07366
  R 00026 70007                                                                  07367
  R 00027 70008                                                                  07368
  R 00028 70009                                                                  07369
  R 00029 70011                                                                  07370
  V 00030 +50000000+00                                                           07371
  V 00031 +15000000+01                                                           07372
  V 00032 +33333333+00                                                           07373
  V 00033 +66666667+00                                                           07374
  V 00034 +25000000+00                                                           07375
  V 00035 +16666667+00                                                           07376
  V 00036 +83333333-01                                                           07377
  V 00037 +93750000+00                                                           07378
  V 00038 +46875000+00                                                           07379
  V 00039 +19444444+00                                                           07380
  V 00040 +12962963+00                                                           07381
  V 00041 +10000000+01                                                           07382
  V 00042 +20000000+01                                                           07383
  V 00043 +30000000+01                                                           07384
  V 00044 +40000000+01                                                           07385
  V 00045 +50000000+01                                                           07386
  V 00046 +60000000+01                                                           07387
  V 00047 +70000000+01                                                           07388
  V 00048 +80000000+01                                                           07389
  V 00049 +90000000+01                                                           07390
  V 00050 +25000000+02                                                           07391
  V 00051 +12600000+03                                                           07392
  V 00053 +41666667-01                                                           07393
  V 00054 +16000000+02                                                           07394
  V 00055 +00000000+00                                                           07395
  V 00155 +00000000+00                                                           07396
  V 00339 +10000000+00                                                           07397
  G 00377 00378 00381                                                            07398
  E 00377                                                                        07399
* B 00378                                                             B 00378    07400
```

```
  C 00376 80003 00370 00370                                            07401
  E 00379                                                              07402
* B 00370                                                    B 00370   07403
  R 00021 70366                                                        07404
  R 00023 70377                                                        07405
  R 00015 70361                                                        07406
  R 00016 70362                                                        07407
  R 00017 70363                                                        07408
  R 00020 70360                                                        07409
  M 00384 70360 70360                                                  07410
  M 00384 00384 70360                                                  07411
  D 00384 00025 00384                                                  07412
  F 00384 70002 00384                                                  07413
  C 00041 80500 00371                                                  07414
  D 00418 80000 00042       DELTA A/2                                  07415
  D 00419 80001 00042       DELTA E/2                                  07416
  D 00420 80002 00042       DELTA I/2                                  07417
  A 00418 00418 00020                                                  07418
  A 00419 00419 00021                                                  07419
  A 00420 00420 00023                                                  07420
  A 00015 00015 80003       M+DELTA M                                  07421
  A 00016 00016 80004       SMALL OMEGA+DELTA SMALL OMEGA              07422
  A 00017 00017 80005       CAP OMEGA+DELTA CAP OMEGA                  07423
  A 00020 00020 80000       A+DELTA A                                  07424
  A 00021 00021 80001       E+DELTA E                                  07425
  A 00023 00023 80002       I+DELTA I                                  07426
* B 00371                                                    B 00371   07427
  M 00060 00020 00020                                                  07428
  M 00061 00060 00020                                                  07429
  M 00062 00021 00021                                                  07430
  A 00063 00062 00062                                                  07431
  A 00064 00062 00063                                                  07432
  M 00065 00049 00062                                                  07433
  A 00066 00044 00064                                                  07434
  A 00067 00042 00062                                                  07435
  S 00071 00041 00062                                                  07436
  F 00072 70002 00071                                                  07437
  M 00073 00071 00072                                                  07438
  M 00074 00073 00073                                                  07439
  M 00075 00049 00071                                                  07440
```

M	00076	00050	00071	07441
M	00077	00051	00071	07442
D	00078	00041	00073	07443
M	00079	00071	00071	07444
D	00079	00041	00079	07445
F	00081	70004	00023	07446
A	00082	00081	00081	07447
M	00083	00081	00081	07448
M	00084	00083	00083	07449
S	00085	00041	00083	07450
M	00086	00043	00083	07451
S	00086	00086	00041	07452
M	00087	00045	00083	07453
S	00087	00087	00041	07454
M	00088	00048	00084	07455
D	00088	00088	00087	07456
M	00089	00045	00088	07457
D	00089	00089	00087	07458
S	00090	00088	00086	07459
D	00111	00026	00060	07460
M	00112	00111	00031	07461
M	00112	00112	00079	07462
M	00113	00112	00112	07463
M	00113	00053	00113	07464
M	00114	00037	00028	07465
M	00115	00060	00060	07466
M	00115	00115	00071	07467
M	00115	00115	00074	07468
D	00114	00114	00115	07469
M	00115	00036	00112	07470
D	00116	00114	00112	07471
M	00116	00033	00116	07472
M	00117	00034	00027	07473
M	00118	00026	00071	07474
M	00118	00118	00020	07475
D	00117	00117	00118	07476
M	00118	00038	00029	07477
M	00119	00061	00026	07478
M	00119	00119	00074	07479
D	00118	00118	00119	07480

M	00119	00035	00112	07481
M	00120	00082	00119	07482
M	00091	00045	00090	07483
S	00091	00091	00044	07484
M	00092	00044	00083	07485
A	00091	00091	00092	07486
M	00091	00091	00115	07487
M	00092	00116	00090	07488
S	00091	00091	00092	07489
M	00092	00035	00118	07490
M	00093	00043	00090	07491
S	00093	00093	00042	07492
M	00092	00092	00093	07493
M	00093	00039	00118	07494
A	00094	00090	00090	07495
S	00094	00094	00085	07496
M	00093	00093	00094	07497
M	00094	00054	00083	07498
D	00094	00094	00087	07499
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A	00094	00094	00089	07501
M	00095	00118	00094	07502
M	00096	00066	00095	07503
M	00097	00032	00093	07504
A	00098	00095	00095	07505
S	00098	00098	00118	07506
M	00098	00098	00040	07507
M	00099	00043	00085	07508
A	00100	00086	00086	07509
S	00101	00042	00087	07510
F	00102	70002	00085	07511
M	00102	00102	00120	07512
M	00103	00119	00085	07513
M	00103	00103	00044	07514
A	00068	00042	00064	07515
M	00068	00068	00083	07516
M	00069	00045	00062	07517
A	00069	00069	00042	07518
M	00069	00069	00088	07519
M	00070	00063	00083	07520

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S 00069 00069 00070            07522
F 00121 70003 00023            07523
M 00122 00121 00121            07524
M 00123 00021 00081            07525
M 00124 00123 00081            07526
D 00125 00123 00121            07527
D 00126 00124 00121            07528
M 00127 00121 00071            07529
D 00128 00127 00021            07530
M 00129 00021 00121            07531
M 00130 00123 00123            07532
D 00131 00071 00021            07533
M 00132 00030 00131            07534
M 00133 00131 00119            07535
D 00134 00025 00061            07536
F 00134 70002 00134            07537
V 00135 +35000000+02           07538
V 00136 +36000000+02           07539
V 00137 +14400000+03           07540
V 00138 +10500000+03           07541
V 00139 +90000000+02           07542
V 00140 +96000000+02           07543
V 00141 +15000000+02           07544
V 00142 +24000000+02           07545
V 00143 +19200000+03           07546
V 00144 +38500000+03           07547
V 00145 +36000000+03           07548
V 00146 +45000000+02           07549
V 00147 +21000000+02           07550
V 00148 +27000000+03           07551
V 00149 +18900000+03           07552
V 00150 +12000000+02           07553
V 00151 +30000000+02           07554
V 00152 +26000000+02           07555
V 00153 +11000000+02           07556
M 00161 00135 00084            07557
M 00162 00151 00083            07558
S 00161 00161 00162            07559
A 00161 00161 00043            07560
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M	00162	00084	00162		07566
M	00163	00140	00072		07567
M	00164	00139	00071		07568
A	00163	00163	00164		07569
S	00163	00151	00163		07570
M	00163	00083	00163		07571
M	00164	00054	00072		07572
S	00164	00164	00141		07573
A	00164	00164	00076		07574
A	00164	00164	00163		07575
A	00164	00164	00162		07576
M	00164	00164	00113		07577
A	00164	00164	00161		07578
M	00163	00112	00086		07579
A	00164	00164	00163		07580
M	00164	00164	00072		07581
M	00161	00164	00134	S-1	07582
M	00162	00149	00071		07583
S	00162	00144	00162		07584
M	00162	00162	00034		07585
S	00163	00077	00148		07586
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A	00162	00162	00147		07589
S	00162	00162	00075		07590
M	00162	00162	00114		07591
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M	00164	00072	00145		07594
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A	00163	00163	00144		07596
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M	00164	00143	00072		07598
S	00164	00139	00164		07599
S	00164	00164	00077		07600

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A	00163	00163	00164		07602
M	00164	00142	00072		07603
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S	00163	00163	00135		07605
A	00163	00163	00076		07606
M	00163	00163	00113		07607
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M	00163	00045	00071		07612
M	00164	00136	00072		07613
A	00163	00163	00164		07614
A	00163	00163	00135		07615
M	00163	00163	00083		07616
M	00164	00150	00072		07617
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S	00163	00164	00163		07620
M	00163	00163	00113		07621
M	00164	00047	00083		07622
S	00164	00043	00164		07623
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S	00165	00045	00165		07625
M	00164	00164	00165		07626
M	00164	00164	00114		07627
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A	00163	00163	00164		07629
M	00163	00163	00081		07630
M	00163	00163	00044		07631
M	00164	00112	00082		07632
S	00163	00163	00164		07633
M	00163	00163	00134	S-3	07634
M	00335	00120	00062		07635
M	00335	00335	00089		07636
M	00335	00335	00045		07637
M	00335	00335	00034		07638
M	00171	00073	00091		07639
A	00172	00044	00065		07640

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A	00172	00117	00172	07642
M	00172	00172	00128	07643
M	00172	00172	00072	07644
S	00172	00055	00172	07645
M	00173	00129	00093	07646
M	00173	00173	00073	07647
M	00174	00045	00069	07648
M	00175	00153	00068	07649
S	00174	00174	00175	07650
A	00174	00174	00067	07651
M	00174	00174	00036	07652
M	00174	00174	00112	07653
M	00175	00043	00068	07654
S	00175	00069	00175	07655
A	00175	00175	00067	07656
M	00175	00175	00116	07657
S	00174	00175	00174	07658
M	00174	00030	00174	07659
M	00175	00124	00096	07660
M	00175	00175	00121	07661
A	00176	00152	00065	07662
M	00176	00129	00176	07663
S	00177	00128	00126	07664
M	00177	00066	00177	07665
A	00176	00177	00176	07666
M	00176	00092	00176	07667
S	00175	00176	00175	07668
D	00176	00121	00021	07669
S	00176	00176	00126	07670
M	00176	00117	00176	07671
A	00175	00175	00176	07672
M	00176	00130	00098	07673
D	00177	00130	00122	07674
S	00177	00063	00177	07675
A	00177	00177	00043	07676
M	00177	00177	00097	07677
S	00176	00176	00177	07678
M	00176	00176	00129	07679
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S	00177	00178	00177		07684
M	00177	00021	00177		07685
M	00177	00177	00123		07686
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M	00179	00066	00092		07688
A	00178	00178	00179		07689
A	00178	00178	00117		07690
M	00178	00178	00125		07691
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A	00179	00179	00097		07693
M	00179	00179	00062		07694
M	00179	00179	00125		07695
S	00179	00055	00179		07696
M	00180	00021	00091		07697
M	00180	00180	00071		07698
M	00181	00066	00092		07699
A	00181	00181	00117		07700
M	00181	00181	00127		07701
M	00182	00093	00127		07702
M	00182	00182	00062		07703
S	00182	00055	00182		07704
D	00183	00123	00127		07705
S	00183	00055	00183		07706
C	00041	80500	00372		07707
M	00423	00418	00418	A2	07708
M	00424	00419	00419	F2	07709
S	00425	00041	00424	B1	07710
F	00426	70002	00425	B2	07711
M	00427	00426	00425	B3	07712
M	00428	00427	00427	B4	07713
M	00429	00049	00425	B5	07714
M	00430	00050	00425	B6	07715
M	00431	00051	00425	B7	07716
M	00432	00425	00425		07717
D	00432	00041	00432	B9	07718
D	00433	00026	00423	C1	07719
M	00434	00433	00432		07720

M	00434	00434	00031	C2	07721
M	00435	00434	00434		07722
M	00435	00435	00053	C3	07723
M	00436	00037	00028		07724
M	00437	00425	00428		07725
M	00437	00437	00423		07726
M	00437	00437	00423		07727
D	00436	00436	00437	C4	07728
F	00437	70004	00420	D1	07729
A	00438	00437	00437	D2	07730
M	00439	00437	00437	D3	07731
M	00440	00439	00439	D4	07732
M	00441	00045	00439		07733
S	00441	00441	00041	D7	07734
D	00442	00025	00423		07735
D	00442	00442	00418		07736
F	00442	70002	00442	G14	07737
M	00443	00149	00425		07738
S	00443	00144	00443		07739
M	00443	00443	00440	D4(385-189B1)	07740
S	00444	00431	00148		07741
M	00444	00439	00444	D3(B7-270)	07742
A	00443	00444	00443		07743
A	00443	00443	00147		07744
S	00443	00443	00429		07745
M	00443	00443	00436		07746
M	00443	00443	00032	1/3C4(21-B5+D3(B7-270)+D4(385-189B1))	07747
M	00444	00146	00425		07748
M	00445	00145	00426		07749
A	00444	00444	00445		07750
A	00444	00444	00144		07751
M	00444	00444	00440	D4(45B1+360B2+385)	07752
S	00445	00139	00431		07753
M	00446	00143	00426		07754
S	00445	00445	00446		07755
M	00445	00445	00439	D3(90-192B2-B7)	07756
A	00444	00444	00445		07757
A	00444	00444	00430		07758
S	00444	00444	00135		07759
M	00445	00142	00426		07760

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  A 00444 00444 00445                                                 07761
  M 00444 00444 00435     C3(B6+24B2-35+C3(90-192B2-B7)+D46))         07762
  M 00445 00434 00441     C207                                        07763
  A 00443 00443 00444                                                 07764
  A 00443 00443 00445                                                 07765
  M 00162 00443 00442     S2                                          07766
  M 00444 00045 00425                                                 07767
  M 00445 00136 00426                                                 07768
  A 00444 00444 00445                                                 07769
  A 00444 00444 00135                                                 07770
  M 00444 00444 00439                                                 07771
  A 00444 00444 00045                                                 07772
  S 00444 00429 00444                                                 07773
  M 00445 00150 00426                                                 07774
  A 00444 00444 00445                                                 07775
  M 00444 00444 00435     C3(12B2+B5-(5+D3(5B1+36B2+35)))             07776
  M 00445 00047 00439                                                 07777
  S 00445 00043 00445                                                 07778
  M 00446 00043 00425                                                 07779
  S 00446 00045 00446                                                 07780
  M 00445 00445 00446                                                 07781
  M 00445 00445 00436                                                 07782
  M 00445 00445 00032                                                 07783
  A 00444 00445 00444                                                 07784
  M 00444 00444 00437                                                 07785
  M 00444 00444 00044                                                 07786
  M 00445 00438 00434                                                 07787
  S 00444 00444 00445                                                 07788
  M 00163 00444 00442     S3                                          07789
  E 00379                                                             07790
* B 00372                                                  B 00372    07791
  I 00381 +10000000+01                                                07792
* B 00379                                                  B 00379    07793
  R 00376 80003                                                       07794
  S 00200 00200 70000                                                 07795
  R 00209 00200                                                       07796
  M 00382 00384 00209                                                 07797
  F 00382 70010 00382                                                 07798
  A 00366 80501 00015     M+DELTA M                                   07799
  F 00366 70010 00366                                                 07800
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   I 00211 +00000000+00                                  07801
 * B 00213                                      B 00213  07802
   I 00210 +10000000+01                                  07803
   A 00211 00211 00041                                   07804
   G 00214 00160 00211                                   07805
   M 00215 00214 00209                                   07806
   F 00348 70010 00215                                   07807
 * B 00353                                      B 00353  07808
   M 00348 00348 00210                                   07809
   H 00227 00211 00348                                   07810
   C 00043 00211 00213                                   07811
   A 00228 00228 00382                                   07812
   F 00228 70010 00228                                   07813
   F 00229 70010 00229                                   07814
   F 00230 70010 00230                                   07815
   A 00231 00228 00366                                   07816
   A 00232 00229 00016                                   07817
   A 00233 00230 00017                                   07818
   F 00231 70010 00231                                   07819
   F 00232 70010 00232                                   07820
   F 00233 70010 00233                                   07821
   C 00335 70400 00336                                   07822
   A 00241 00232 00232        2G                         07823
   A 00242 00241 00232        3G                         07824
   F 00243 70003 00241        SIN 2 G                    07825
   F 00244 70004 00232        COS G                      07826
   F 00245 70004 00242        COS 3 G                    07827
   M 00235 00171 00243                                   07828
   M 00236 00172 00244                                   07829
   A 00235 00235 00236                                   07830
   M 00236 00173 00245                                   07831
   A 00235 00235 00236                                   07832
   A 00235 00235 00231        L-PRIME                    07833
   M 00236 00174 00243                                   07834
   M 00237 00175 00244                                   07835
   A 00236 00236 00237                                   07836
   M 00237 00176 00245                                   07837
   A 00236 00236 00237                                   07838
   A 00236 00236 00232        G-PRIME                    07839
   M 00237 00177 00243                                   07840
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  M 00238 00178 00244                                          07841
  A 00237 00237 00238                                          07842
  M 00233 00179 00245                                          07843
  A 00237 00237 00238                                          07844
  A 00237 00237 00233         H-PRIME                          07845
  F 00235 70010 00235                                          07846
  F 00236 70010 00236                                          07847
  F 00237 70010 00237                                          07848
  F 00234 70004 00241         CCS 2G                           07849
  M 00238 00180 00234                                          07850
  F 00234 70003 00232                                          07851
  M 00239 00181 00234                                          07852
  A 00238 00238 00239                                          07853
  F 00234 70003 00242         SIN 3G                           07854
  M 00239 00182 00234                                          07855
  A 00238 00238 00239         DELTA E                          07856
  M 00239 00238 00183         DELTA I                          07857
* B 00337                                            B 00337   07858
  R 00220 00235               L                                07859
  R 00221 00021               EC                               07860
  F 00222 70005 00220         E                                07861
  F 00246 70003 00222         SIN E                            07862
  F 00247 70004 00222         CCS E                            07863
  M 00248 00021 00247                                          07864
  S 00248 00041 00248         (1-EC CCS(E))=R/A                07865
  D 00249 00041 00248         A/R                              07866
  M 00250 00249 00249         (A/R)**2                         07867
  M 00251 00250 00249         (A/R)**3                         07868
  M 00252 00249 00246                                          07869
  M 00252 00252 00072         SIN F                            07870
  S 00253 00247 00021                                          07871
  M 00253 00249 00253         CCS F                            07872
  F 00253 70001 00252                                          07873
  A 00254 00236 00236         2G-PRIME                         07874
  A 00255 00254 00253         2G+F                             07875
  A 00256 00255 00253         2G+2F                            07876
  A 00257 00256 00253         2G+3F                            07877
  F 00258 70003 00255         SIN(2G+F)                        07878
  F 00259 70003 00257         SIN(2G+3F)                       07879
  F 00260 70004 00256         CCS(2G+2F)                       07880
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S	00261	00251	00078	(-1+3TH**2)(A/R**3-GA**-3)	07881
M	00261	00261	00086		07882
M	00262	00099	00260	3(1-TH**2)COS(2G+2F)	07883
F	00263	70004	00257		07884
M	00263	00263	00021		07885
F	00264	70004	00255		07886
M	00264	00264	00021		07887
M	00264	00264	00043		07888
A	00263	00263	00264		07889
M	00264	00250	00071		07890
A	00264	00264	00249		07891
A	00265	00264	00032		07892
M	00265	00265	00259		07893
S	00266	00041	00264		07894
M	00266	00266	00258		07895
A	00265	00265	00266		07896
M	00265	00265	00099		07897
A	00266	00041	00264		07898
M	00266	00266	00252		07899
M	00256	00266	00100		07900
A	00265	00265	00266		07901
M	00265	00265	00133		07902
M	00266	00021	00252		07903
A	00266	00266	00253		07904
S	00266	00266	00235		07905
M	00266	00266	00046	6(F-L+ECSINF)	07906
M	00267	00021	00259		07907
M	00268	00021	00258		07908
M	00268	00268	00043		07909
A	00267	00267	00268		07910
F	00268	70003	00256		07911
M	00268	00268	00043		07912
A	00267	00267	00268		07913
M	00280	00251	00262		07914
A	00280	00280	00261		07915
M	00280	00111	00280		07916
A	00280	00280	00041		07917
M	00280	00280	00020	A	07918
M	00281	00103	00263		07919
S	00282	00251	00079		07920

M	00282	00282	00262		07921
A	00282	00282	00261		07922
M	00282	00282	00111		07923
S	00281	00282	00281		07924
M	00281	00281	00132		07925
A	00281	00281	00238		07926
A	00281	00281	00021		07927
M	00282	00260	00043		07928
A	00282	00282	00263		07929
M	00282	00282	00102		07930
A	00282	00282	00239		07931
A	00282	00282	00023		07932
M	00283	00072	00265		07933
S	00283	00235	00283		07934
M	00284	00101	00267		07935
M	00285	00087	00266		07936
A	00284	00284	00285		07937
M	00284	00284	00119		07938
A	00284	00284	00265		07939
A	00284	00284	00236	G	07940
S	00285	00266	00267		07941
M	00285	00285	00120		07942
S	00285	00237	00285	H	07943
F	00283	70010	00283		07944
F	00284	70010	00284		07945
F	00285	70010	00285		07946
R	00286	00283		L	07947
R	00287	00281		EC	07948
F	00288	70005	00286	E	07949
F	00288	70010	00288		07950
F	00268	70003	00288	SIN E	07951
F	00269	70004	00288	COS E	07952
M	00270	00287	00269		07953
S	00270	00041	00270	(1-ECCOSE)=R/A	07954
D	00271	00041	00270	A/R	07955
M	00272	00280	00270	R	07956
M	00273	00281	00281	EC**2	07957
S	00273	00041	00273		07958
F	00273	70002	00273	(1-EC**2)**1/2	07959
M	00275	00273	00268		07960

M	00275	00275	00271	SIN F	07961
S	00276	00269	00281		07962
M	00276	00276	00271	COS F	07963
F	00274	70001	00275		07964
A	00291	00284	00274	G+F	07965
F	00292	70003	00291	SIN(G+F)	07966
F	00293	70004	00291	COS(G+F)	07967
F	00294	70003	00282	SIN I	07968
F	00295	70004	00282	COS I	07969
F	00296	70003	00285	SIN H	07970
F	00297	70004	00285	COS H	07971
M	00298	00293	00297		07972
M	00299	00293	00296		07973
M	00300	00292	00297		07974
M	00301	00292	00296		07975
M	00302	00280	00025		07976
F	00302	70002	00302		07977
D	00302	00302	00272		07978
M	00303	00302	00268	V(R)	07979
M	00303	00303	00281		07980
M	00304	00302	00273	V(TH)	07981
M	00305	00301	00295		07982
S	00305	00298	00305		07983
M	00306	00300	00295		07984
A	00306	00306	00299		07985
M	00307	00292	00294		07986
M	00308	00272	00305		07987
M	00309	00272	00306		07988
M	00310	00272	00307	Z	07989
M	00313	00299	00295		07990
A	00313	00300	00313		07991
M	00313	00313	00304		07992
M	00314	00303	00305		07993
S	00313	00314	00313	X DOT	07994
M	00314	00298	00295		07995
S	00314	00301	00314		07996
M	00314	00314	00304		07997
M	00315	00303	00306		07998
S	00314	00315	00314	Y DOT	07999
M	00315	00293	00294		08000

```
  M 00315 00315 00304
  M 00316 00303 00307
  A 00315 00315 00316       Z DOT
  H 00001 00004 00308
  H 00002 00004 00309
  H 00003 00004 00310
  H 00004 00004 00313
  H 00005 00004 00314
  H 00006 00004 00315
  C 00155 00055 00156 00157 TEST FOR KIND CF OUTPUT ELEM.
  R 90001 00020             STCRE OLT SINGLE PRIME ELEMENTS
  A 90002 00021 00238
  A 90003 00023 00239
  R 90004 00235
  R 90005 00236
  R 90006 00237
  E 00002
* B 00156                   STORE OUT UNPRIMED (CSCULATING)ELEM.         B 00156
  R 90001 00280             A
  R 90002 00281             E
  R 90003 00282             I
  R 90004 00283             M
  R 90005 00284             OMEGA
  R 90006 00285             THETA (CAP CMEGA)
  E 00002
* B 00157                   STORE OLT DOUBLE PRIME ELEM.                 B 00157
  R 90001 00020             A-DOUBLE PRIME
  R 90002 00021             E-DOUBLE PRIME
  R 90003 00023             I-DOUBLE PRIME
  R 90004 00231             L-DOUBLE PRIME=M-DOUBLE PRIME
  R 90005 00232             G-DOUBLE PRIME=SMALL OMEGA-DOUBLE PRIME
  R 90006 00233             H-DOUBLE PRIME=CAP OMEGA-DOUBLE PRIME
  E 00002
* B 00336                                                                B 00336
  R 00238 00055
  R 00239 00055
  R 00235 00231
  R 00236 00232
  R 00237 00233
  E 00337
```

```
               ANGLE-QUADRANT DETERMINATION
            ENTER WITH Z=SIN A, Z+1=COS A     EXIT WITH X=A, X BETWEEN 0 -360 DEG

        K 00000
        K 04946
        Q 90001 02156               ARC SIN                         F
        Q 90002 02166               ARC COS                         F
        Q 00005 03838               PI/2                            I
        Q 00006 03839               PI                              I
        Q 00007 03865               3 PI/2                          I
        Q 00010 03842               2 PI                            I
      * B 00001                                                         B 00001
        V 00008 +60000000+00        .6
        V 00009 +00000000+00        ZERO
        G 00011 00001 00003         SIN A
        G 00012 00002 00003         COS A
        C 00009 00011 00016
        R 00013 00011
      * B 00015                                                         B 00015
        C 00013 00008 00017         SIN A GREATER THAN .6
        F 00014 90001 00011         NO, A=ARC SIN (I OR IV)
        C 00014 00009 00018         IS A IN I OR IV
        C 00012 00009 00019         A=IV, COS A=+ OR -
        S 00014 00006 00014
        H 00001 00004 00014
        E 00002
      * B 00019                     COS A=+, A IN IV                    B 00019
        A 00014 00014 00010
        H 00001 00004 00014
        E 00002
      * B 00018                     A IN I OR II                        B 00018
        C 00012 00009 00020
        S 00014 00006 00014
        H 00001 00004 00014
        E 00002
      * B 00020                     A IN I                              B 00020
        H 00001 00004 00014
        E 00002
      * B 00017                     SIN A GREATER THAN .6               B 00017
```

```
  F 00014 90002 00012        A=ARC COS (I OR II)                08081
  C 00014 00005 00021        A IN II                            08082
  C 00011 00009 00022        NC, A=I OR IV                      08083
  S 00014 00010 00014                                           08084
  H 00001 00004 00014                                           08085
  E 00002                                                       08086
* B 00016                                             B 00016   08087
  S 00013 00009 00011                                           08088
  E 00015                                                       08089
* B 00022                    A IN I                   B 00022   08090
  H 00001 00004 00014                                           08091
  E 00002                                                       08092
* B 00021                    A IN II OR III           B 00021   08093
  C 00011 00009 00023                                           08094
  S 00014 00010 00014                                           08095
  H 00001 00004 00014                                           08096
  E 00002                                                       08097
* B 00023                    A IN II                  B 00023   08098
  H 00001 00004 00014                                           08099
  E 00002                                                       08100
                                                                08101
                                                                08102
                                                                08103
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                                                                08118
                                                                08119
                                                                08120
```

```
     F116   640131
     F116   L,M,R,RR, CORRECTOR FOR IONOSPHERIC REFRACTION
     F116   I.J. COLE



K 00000
K 09000
Q 80025 03834               F, FLATTENING COEFFICIENT                      I
Q 80026 03837                K SUB 2 = C.U.T./DAY                          I
Q 80028 03858                3.6                                           I
Q 80030 03871                1+N SUB 0                                     I
Q 80031 03859                SMALL H SUB 0                                 I
Q 80032 03861                H SUB 0                                       I
Q 80033 03860                BETA                                          I
Q 90000 00204               SMALL R VECTOR,X COMPONENT                     I
Q 90001 00206               SMALL R VECTOR,Z COMPONENT                     I
Q 90002 02011               VECTOR MAGNITUDE FUNCTION                      F
Q 90004 02846               A SUB S FOR L,M C1 SUB S FOR R, R DOT          I
Q 90005 02847               B SUB S FOR L,M CQ/F2 FOR R,R DOT              I
Q 90006 02848                WORK AREA FOR T SUB 0 NO. 1 OF 6 LOC.         O
Q 90007 02849               T SUB 1                                        I
Q 90008 02850               T SUB 2                                        I
Q 90009 02851               T SUB 3                                        I
Q 90010 02852               T SUB 4                                        I
Q 90011 02853                WORK AREA FOR T SUB 5                         O
Q 90012 02854                WORK AREA FOR N AUB 0 NO. 1 OF 6 LOC.         O
Q 90013 02855               N SUB 1                                        I
Q 90016 02858               N SUB 4                                        I
Q 90017 02859                WORK AREA FOR N SUB 5                         O
Q 90018 02860                WORK AREA FOR H SUB 0 NO. 1 OF 6 LOC.         O
Q 90019 02861               H SUB 1                                        I
Q 90022 02864               H SUB 4                                        I
Q 90023 02865                WORK AREA FOR H SUB 5                         O
Q 90024 02099                UNCORRECTED L, M, RHO OR RHO DOT              O
Q 90025 00200               TIME IN C.U.T.                                 I
Q 90026 02751                ENTRY TO ABSOLUTE VALUE SUBROUTINE            F
Q 90027 00256                COMPUTED OBSERVATIONS                         O
Q 90028 00207                R, BAR DOT                                    I
Q 90029 00375                R, BAR STAR                                   I
```

```
  Q 90030 00253           TYPE CODE                                     I
  Q 90032 02051           DOT PRODUCT ENTRY                             F
  Q 90033 02001           VECTOR MOVE ENTRY                             F
  Q 90034 02101           SIN ENTRY                                     F
  Q 90035 02105           COS ENTRY                                     F
  Q 90036 02085           VECTOR Q 1 NO. 1 OF 3 LOCATIONS               O
  Q 90039 01201           LSP ENTRY                                     F
  Q 90040 01851           ENTRY TO EXPONENTIAL FUNCTION                 F
  Q 90041 01202           LSP EXIT                                      I
  Q 90042 02196           ENTRY TO SQ. ROOT                             F
  Q 90043 03849           EARTH RADIUS IN CUL                           I
  V 00010 +00000000+00   ZERO
  V 00011 +10000000+01    ONE, CODE FOR RANGE
  V 00047 +20000000+01    TWO, CODE FOR L
  V 00048 +30000000+01    THREE, CODE FOR M
  V 00049 +50000000+01    FIVE, CODE FOR EL
  V 00050 +90000000+01    NINE, CODE FOR RANGE RATE
  V 00051 +13000000+02    THIRTEEN, CODE FOR EL DOT
  V 00053 +10000000-12    TOLERANCE FOR ZERO EL
  V 00076 +10000000+10    PSUEDO PARAMETER IF EL APPROACHES ZERO
  V 00052 +99922944+00    COS PHI SUB IM
  V 00023 +17453293+00    TEN DEGREES, B1
* B 00001                                                                  B 00001
  R 00077 90041
  G 00002 00001 00003
  R 90024 00008          UNCORRECTED L,M, OR RANGE RATE
  R 00035 90030           STORE TYPE CODE
  R 00072 00006           STORE EXIT 1
  R 00074 00063           STORE EXIT 3
  R 00085 00053
  R 00084 00054
* B 00034                                                                  B 00034
  C 90005 00010 00029 00029
  E 00045
* B 00045                 EXIT 2                                           B 00045
  R 00009 0000[illegible] CORRECTED PARAMETER IS ORIGINAL PARAMETER
  E 00067
* B 00067                                                                  B 00067
  R 90041 00077
  H 00001 00004 00009
```

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```
  R 00006 00072           RESTORE EXIT 1                        08201
  R 90030 00035           RESTORE TYPE CODE                     08202
  R 00063 00074           RESTORE EXIT 3                        08203
  R 00053 00083                                                 08204
  R 00054 00084                                                 08205
  F 00002                                                       08206
* B 00007                                              B 00007  08207
  F 00015 90002 90000     COMPUTE MAGNITUDE OF R                08208
  D 00016 90001 00015     COMPUTE H                             08209
  M 00016 00016 00016                                           08210
  M 00016 80025 00016                                           08211
  A 00016 00015 00016                                           08212
  S 00016 00016 00011                                           08213
  D 00013 90025 80026                                           08214
  U 00014 00013                                                 08215
  S 00013 00013 00014                                           08216
  S 90006 90010 00011     T SUB 0=T SUB 4-1                     08217
  R 90012 90016           N SUB 0=N SUB 4                       08218
  R 90018 90022           H SUB 0=H SUB 4                       08219
  A 90011 90007 00011     T SUB 5=1+T SUB 1                     08220
  R 90017 90013           N SUB 5=N SUB 1                       08221
  R 90023 90019           H SUB 5=H SUB 1                       08222
  I 00024 +40000000+01                                          08223
  C 00013 90010 00005                                           08224
  I 00024 +30000000+01                                          08225
  C 00013 90009 00005                                           08226
  I 00024 +20000000+01                                          08227
  C 00013 90008 00005                                           08228
  I 00024 +10000000+01                                          08229
  C 00013 90007 00005                                           08230
  I 00024 +00000000+00                                          08231
* B 00005                                              B 00005  08232
  G 00039 90006 00024     T SUB I                               08233
  G 00040 90012 00024     N SUB I                               08234
  G 00041 90018 00024     H SUB I                               08235
  G 00042 90007 00024     T SUB I+1                             08236
  G 00043 90013 00024     N SUB I+1                             08237
  G 00044 90019 00024     H SUB I+1                             08238
  S 00038 00042 00013     COMPUTE CAP N                         08239
  S 00037 00042 00039                                           08240
```

```
  S 00014 00013 00039                                                      08241
  M 00040 00038 00040                                                      08242
  M 00043 00014 00043                                                      08243
  A 00017 00040 00043                                                      08244
  D 00017 00017 00037                                                      08245
  M 00041 00038 00041                                                      08246
  M 00044 00014 00044                                                      08247
  A 00018 00041 00044                                                      08248
  D 00018 00018 00037                                                      08249
  S 00044 00018 80031         COMPUTE CAP H                                08250
  M 00019 80033 00044                                                      08251
  A 00019 80032 00019                                                      08252
  M 00019 90005 00019                                                      08253
  S 00020 00018 00016        CCMPUTE U                                     08254
  D 00020 00020 00019                                                      08255
  I 00036 +0000000+00                                                      08256
  I 00055 +0000000+00         LET N, DN/DT BE ZERO IF U IS GREATER         08257
  I 00069 +0000000+00         THAN 3.6                                     08258
  C 00020 80028 00006                                                      08259
  F 00021 90040 00020                                                      08260
  R 00069 00021                                                            08261
  S 00021 00011 00021                                                      08262
  F 00043 90040 00021                                                      08263
  M 00022 00017 00019                                                      08264
  M 00055 00022 00043                                                      08265
  M 00069 00055 00069                                                      08266
  D 00069 00069 00019                                                      08267
  D 00022 00022 00016                                                      08268
  M 00036 00022 00043                                                      08269
  E 00006                     EXIT 1                                       08270
* B 00006                                                        B 00006   08271
  S 00022 90004 00036                                                      08272
  A 00023 00011 00022        CCMPUTE Q                                     08273
  D 00023 80030 00023                                                      08274
  D 00009 00008 00023                                                      08275
  E 00067                                                                  08276
* B 00029                                                        B 00029   08277
  C 00035 00047 00070 00071                                                08278
  E 00007                                                                  08279
* B 00070                                                        B 00070   08280
```

```
   C 00035 00048 00073 00071                                                         08281
   E 00007                                                                           08282
 * B 00071                                                                B 00071    08283
   C 00035 00011 00073 00002      *                                                  08284
   R 90030 00049                                                                     08285
   F 00000 90039 00000                                                               08286
   R 00056 90027                                                                     08287
   C 00028 00056 00012            IS EL GREATER THAN TEN DEGREES                     08288
   E 00081                                                                           08289
 * B 00081                                                                B 00081    08290
   R 00006 00053                  CHANGE EXIT 1 TC EXIT 2A                           08291
   F 00075 90026 00056                                                               08292
   C 00075 00058 00007            DOES EL APPROACH ZERO                              08293
   E 00059                                                                           08294
 * B 00073                                                                B 00073    08295
   C 00035 00050 00002 00002      *                                                  08296
   R 90030 00049                                                                     08297
   F 00000 90039 00000                                                               08298
   R 00056 90027                                                                     08299
   C 00028 00056 00078                                                               08300
   E 00082                                                                           08301
 * B 00082                                                                B 00082    08302
   R 90030 00051                                                                     08303
   F 00000 90039 00000                                                               08304
   R 00057 90027                                                                     08305
   R 00006 00053                  CHANGE EXIT 1 TC EXIT 2A                           08306
   R 00063 00054                  CHANGE EXIT 3 TO EXIT 3A                           08307
   F 00075 90026 00056                                                               08308
   C 00075 00058 00007            DCES EL APPROACH ZERO                              08309
   E 00059                                                                           08310
 * B 00053                        EXIT 2A                                 B 00053    08311
   M 00060 90005 00055                                                               08312
   A 00060 90004 00060                                                               08313
   F 00061 90034 00056                                                               08314
   D 00062 00011 00061                                                               08315
   M 00060 00060 00062                                                               08316
   E 00063                                                                           08317
 * B 00063                        EXIT 3                                  B 00063    08318
   S 00009 00008 00060                                                               08319
   E 00067                                                                           08320
```

```
* B 00054                      EXIT 3A                       B 00054   08321
  F 00064 90035 00056                                                  08322
  M 00065 03062 00064                                                  08323
  M 00065 00065 00057                                                  08324
  M 00065 00065 00060                                                  08325
  M 00066 90005 00069                                                  08326
  F 90036 90033 90028                                                  08327
  F 00068 90032 90029                                                  08328
  M 00068 00068 00066                                                  08329
  M 00068 00068 00062                                                  08330
  S 00068 00068 00065                                                  08331
  S 00009 00008 00068                                                  08332
  E 00057                                                              08333
* B 00059                                                    B 00059   08334
  R 00009 00076                                                        08335
  E 00067                                                              08336
* B 00012                                                    B 00012   08337
  R 00053 00079                                                        08338
  E 00081                                                              08339
* B 00078                                                    B 00078   08340
  R 00053 00079                                                        08341
  R 00054 00080                                                        08342
  E 00082                                                              08343
* B 00079                                                    B 00079   08344
  F 00061 90035 00056          COS EL                                  08345
  M 00062 00061 00052          COS PHI SUB 1                           08346
  A 00046 00018 90043                                                  08347
  D 00046 90043 00046                                                  08348
  M 00026 00061 00046          COS PHI SUB 2                           08349
  M 00025 00062 00062                                                  08350
  M 00030 00026 00026                                                  08351
  S 00025 00011 00025                                                  08352
  S 00030 00011 00030                                                  08353
  F 00025 90042 00025                                                  08354
  D 00025 00011 00025          CSC PHI SUB 1                           08355
  F 00030 90042 00030                                                  08356
  D 00030 00011 00030          CSC PHI SUB 2                           08357
  M 00031 90005 00055                                                  08358
  M 00031 00031 00030          2ND TERM OF DELTA RHO                   08359
  M 00033 90004 00025          1ST TERM OF DELTA RHO                   08360
```

```
  A 00060 00031 00033                                            08361
  E 00063                                                        08362
* B 00080                                               B 00080  08363
  F 00064 90034 00056        SIN EL                              08364
  M 00065 00064 00057        SIN EL.EL DOT                       08365
  M 00032 00033 00025                                            08366
  M 00033 00031 00030                                            08367
  M 00031 00032 00065                                            08368
  M 00033 00033 00065                                            08369
  M 00031 00031 00052                                            08370
  M 00025 00025 00062        CTN PHI-1                           08371
  M 00031 00031 00025        2ND TERM OF DELTA RHO DOT           08372
  M 00066 90005 00069                                            08373
  F 90036 90033 90028                                            08374
  F 00068 90032 90029                                            08375
  M 00068 00068 00066                                            08376
  M 00068 00068 00030        1ST TERM OF DELTA RHO DOT           08377
  M 00033 00033 00046                                            08378
  M 00025 00025 00026        CTN PHI-2                           08379
  M 00033 00033 00025       3RD TERM OF DELTA RHO DOT            08380
  S 00068 00068 00031                                            08381
  S 00068 00068 00033                                            08382
  S 00009 00008 00068                                            08383
  E 00067                                                        08384
                                                                 08385
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                                                                 08400
```

```
        RANGE AMBIGUITY RESOLUTION FUNCTION                                                   08401
  K 00000                                                                                     08402
  K 09100                               RANGE AMBIGUITY RESOLUTION F.                         08403
  Q 90000 02835                         CORRECTED RO SUB 0                     O              08404
  Q 90001 00255                         RO SUB 0,1 (INPUT). ROSUBO (OUTPUT)  I O              08405
  Q 90002 00256                         RO SUB C                               I              08406
  Q 90003 00396                         RO SUB 1                               I              08407
  Q 90004 00397                         K SUB 1                                I              08408
  Q 90005 00010                         ZERO                                   I              08409
  Q 90006 00378                         J.D. OF T SUB 0,1                      I              08410
  Q 90007 00379                         SEC. OF T SUB 0,1                      I              08411
  Q 90008 03892                         C,VEL. OF LIGHT IN CUL/SEC             I              08412
  Q 90009 00296                         YEAR OF REFERENCE                      I              08413
  Q 90010 00297                         DAYS JAN 1- REF DAY                    I              08414
  Q 90011 02825                         YYMMDD T SUB 0                         O              08415
  Q 90012 02826                         HH MM T SUB 0                          O              08416
  Q 90013 02827                         SECONDS T SUB 0                        O              08417
  Q 90014 03862                         SEC/DAY                                I              08418
  Q 90015 03811                         ONE                                    I              08419
  Q 91001 02751                         ABSOLUTE VALUE F.                      F              08420
  Q 91002 02781                         JD.- SEC TO J.D. HMS                   F              08421
  Q 91003 04116                         DATE FUNCTION                          F              08422
  V 00017 +00000000+00                  ROUNDING FACTOR                                       08423
  V 00010 +10000000+03                  100                                                   08424
* B 00001                                                                      B 00001        08425
  C 90003 90001 00030                   IS RESOLUTION REQUIRED                                08426
  E 00002                               NO. EXIT                                              08427
* B 00030                               MAYBE.                                 B 00030        08428
  D 00009 90002 90003                   RO C/RO 1                                             08429
  U 00008 00009                         INTEGER                                               08430
  S 00008 00009 00008                   FRACTION                                              08431
  M 00005 90003 00008                   RO C,M                                                08432
  S 00006 90002 00005                   RO A                                                  08433
  S 00011 90001 00005                   RO 0,1-RO C,M                                         08434
  F 00012 91001 00011                   ABS. VAL. RO 0,1-RO C,M                               08435
  C 00012 90004 00031                   IS ABS. VAL. GREATER THAN K1                          08436
  R 00007 90005                         NO. RO 1 PRIME =0                                     08437
  E 00033                                                                                     08438
* B 00031                                                                      B 00031        08439
  S 00013 90003 90004                   RO 1-K1 =TEST FACTOR                                  08440
```

```
  C 00011 00013 00032    IS RO 0,1-RO C,M GREATER THAN TEST
  R 00007 90003          NO. RO 1 PRIME =RO 1
  E 00033
* B 00032                RO 0,1-RO C,M GREATER THAN TEST      B 00032
  S 00007 90005 90003    RO 1 PRIME =-RO 1
* B 00033                COMPUTE RO 0                         B 00033
  A 00014 00006 00007    RO A+RO 1 PRIME =RO 0-RO 0,1
  C 90004 00014 00002    IS DELTA RO 0,1 LESS THAN K1
  A 90001 90001 00014    RO 0
  R 90000 90001          STORE RO 0 FOR TAPE RECORD
  D 00008 00014 90008    (RO 0-RO 0,1)/C
  R 00015 90006          J.D. OF T 0,1
  S 00016 90007 00008    T 0
  C 90005 00016 00034    ARE SEC NEGATIVE
* B 00035                NO.                                  B 00035
  F 00020 91002 00015    J.D.-SEC. TO JD. H.M.S.
  M 00008 00021 00010    HRS X 100
  A 90012 00008 00022    HHMM (PACKED
  R 90013 00023          SECS.
  A 00026 00020 90010    J.D. +DAYS TO REF.
  R 00025 90009          SET REF. YEAR
  F 00027 91003 00025    YR,MO,DAY
  M 00009 00027 00010    YR X 100
  A 00009 00009 00028    YYMM
  M 00009 00009 00010    (YYMM) X 100
  A 90011 00009 00029    YYMMDD T SUB 0
  E 00002
* B 00034                SEC ARE NEGATIVE                     B 00034
  A 00016 00016 90014    SECS + SEC/DAY
  S 00015 00015 90015    J.D.-ONE
  E 00035
```

```
        JULIAN DAYS- SECONDS TO C.U.T.
K 00000
K 09200
Q 00007 03862                 SECONDS/DAY                     I
Q 00008 03843                 SECONDS/C.U.T.                  I
                                                                   B 00001
* B 00001
G 00005 00001 00003
G 00006 00002 00003
M 00005 00005 00007
D 00005 00005 00008
D 00006 00006 00008
A 00005 00005 00006
H 00001 00004 00005
E 00002

30 00020
```

K = 09200 LINE 08501 PAGE 213

K =	PAGE	LINE	NAME
00100	017	00643	PRINT REQUESTED QUANTITIES
00150	020	00763	(O-C) PRINT FUNCTION FOR D.C.
01200	022	00843	LSP (LOCAL STATION PREDICTIONS)
01300	027	01044	PE (POSITION IN ELLIPSE)
01355	031	01203	COMPUTE AND STORE CORRECTED ELEMENTS
01380	035	01363	(O-C) ANGLE REDUCER
01400	036	01403	PP (POSITION PARTIALS)
01600	062	02443	OP (OBSERVATION PARTIALS)
01700	071	02803	CC (CONVERT CORRECTIONS)
01840	080	03163	COMPUTE DRAG AND COMP. PERT. EFFECTS
01850	081	03203	EXPONENTIAL FUNCTION
01900	083	03283	SATELLITE IDENTIFICATION LOAD FUNCTION
01940	084	03323	SATELLITE IDENTIFICATION LOAD AND PRINT
01955	085	03363	ADD TO CORRES. SUM OF (O-C) SQ AND TO N FOR ONE OBS.
01970	086	03403	HOURS–MINUTES–SECONDS TO RADIANS
01985	087	03443	DEGREES–MINUTES–SECONDS TO RADIANS
02000	088	03483	VECTOR PACKAGE (VECTOR MOVE)
02010	089	03522	VECTOR PACKAGE (VECTOR MAGNITUDE)
02020	090	03562	VECTOR PACKAGE (VECTOR DIRECTION)
02030	091	03602	VECTOR PACKAGE (VECTOR ADD)
02040	092	03642	VECTOR PACKAGE (VECTOR SUBTRACT)
02050	093	03682	VECTOR PACKAGE (DOT PRODUCT)
02060	094	03722	VECTOR PACKAGE (CROSS PRODUCT)
02075	095	03762	VECTOR PACKAGE (SCALAR BY VECTOR PRODUCT)
02100	096	03803	SINE–COSINE FUNCTION
02155	098	03882	ARC SINE
02165	099	03922	ARC COSINE
02175	100	03962	TANGENT
02195	101	04002	SQUARE ROOT FUNCTION
02215	102	04046	KEPLER
02245	104	04122	ARC TAN
02270	106	04203	ANGLE REDUCTION FUNCTION
02300	107	04243	MATRIX CLEAR
02315	108	04282	FULL ROW MATRIX FUNCTION
02340	109	04323	COMPUTE AND PRINT R.M.S. FOR EACH OBSERVATION TYPE
02360	111	04403	LINEAR EQUATIONS SOLUTION FUNCTION
02417	114	04523	SPO (STATION POSITION ORIENTATION)
02475	118	04683	LOAD AND STORE PRINT REQUEST CARDS
02520	120	04763	OUTPUT SCALE
02650	124	04922	INPUT CONVERTER

K =	PAGE	LINE	NAME
02720	125	04963	RANGE RATE FUNCTION
02750	126	05002	ABSOLUTE VALUE FUNCTION
02760	127	05043	ONE WORD LOAD
02800	128	05083	OBSERVATION LOAD FUNCTION
02935	131	05203	ELEMENT LOAD (CONVERSION OF ELEMENTS)
03050	142	05643	BACKWARD DIFFERENCE INTERPOLATION FUNCTION
03300	144	05723	DAY COUNT FUNCTION
03350	146	05083	OBSERVED DATE TO JULIAN DAYS FUNCTION
03375	147	05843	REDUCTED JULIAN DAYS–SECONDS TO CUT
03400	148	05884	PROGRAM P FOR COMPLEMENTARY PERTURBATIONS
03495	152	06043	INITIALISE PROGRAM P FOR COMP. PERT. TAPE
03500	153	06083	LOAD REJECT CARDS
03520	154	06123	OBSERVATION SEARCH AND REJECT FUNCTION
03550	155	06163	PRINT INITIAL ELEMENTS, DRAGS, AND EARTH CONSTANTS
03600	159	06323	LOAD AREA, MASS, DRAG DATA CARD FOR MCOI
03700	160	06366	CTMU ASSIGNMENT FUNCTION
03750	162	06442	CTMU COMPLEMENT
03800	163	06483	CONSTANTS POOL FUNCTION FOR DIFF. CORRECTION
03825	166	06602	SHADOW DETERMINATION CONSTANTS
03900	168	06683	LOAD DRAG DATA
04025	170	06763	LOAD CONSTRAIN WEIGHTS
04055	171	06803	COMPUTE CONSTRAINT EQUATIONS
04100	173	06883	SUM UNKNOWNS
04200	174	06923	RUN IDENTIFICATION LOAD AND PRINT
04330	175	06966	INTERVAL CORE DUMP
04400	178	07084	COMPUTE EFFECTIVE DRAG (DELTA M)
04455	180	07166	INTERVAL CORE DUMP DUMP
04490	182	07246	INITIALISE BROUWER ORBIT GENERATOR
04500	184	07322	BROUWER ORBIT GENERATOR
04946	202	08046	ANGLE-QUADRANT DETERMINATION
09000	204	08128	CORRECTOR FOR IONOSPHERIC REFRACTION
09100	211	08403	RANGE AMBIGUITY RESOLUTION FUNCTION
09200	213	08483	JULIAN DAYS–SECONDS TO C.U.T.

References

C1. Gorman, T. P., CAMEO System Description, GSFC Report X-542-64-148.

C2. Maury, J. L., Programming in MYSTIC: A Primer on the use of CAMEO, GSFC Report X-542-64-393.