X-550-67-186

# STANDARD FORMAT

# for

# ON-STATION DIGITAL RECORDING

# of

# C-BAND METRIC TRACKING DATA

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# 1. INTRODUCTION

High-speed C-band radar metric tracking data is recorded on digital magnetic tape at seven radar tracking stations which support manned spaceflight missions. These stations are BDA, CRO, CYI, HAW, EGL, WHS, and WLP. Present plans are to record data at the CAL FPS-16 station also. No two remote station formats are the same; consequently, a standard GSFC Format was created and the IBM 7094 programs required to perform the necessary conversions have been written. An analysis is also performed on the data as it is being reformatted to separately indicate Range, Azimuth, and Elevation (RAE) system noise and gross range, azimuth, elevation, and time data discontinuities.

Preparations are presently under way to perform the same type of analysis for USB metric tracking data.

Changes in the hardware at remote stations frequently result in changes in the recording format. Such changes are not and will not be reflected in the GSFC standardized format. The reasoning is that the user is not as much concerned with keeping abreast of recording format changes as he is in obtaining recorded tracking data in a consistent and usable form and in receiving an estimate of its quality.

# 2. FORMAT IDIOSYNCRASIES

## 2.1 DATA RATES

All high-speed, C-band metric tracking data is recorded at 10 complete data samples per second, except at White Sands where 20 samples per second are used. Any variation in this procedure for special tests will be clearly visible in the time word.

## 2.2 TIME TAG

RAE are time-tagged with an accuracy of ±500 microseconds with respect to the local station time standard. Interrange time synchronization is ±7 milliseconds with respect to WWV.

## 2.3 DOUBLE STATION

By interleaving radar tracking data with the information on the remote station format, BDA can record tracking data from the FPS-16 and the FPQ-6 simultaneously. The GSFC standardized format program for BDA will separate and strip-out the data of each radar and place it on a separate file or tape. A standard analysis will be generated for each radar. In addition, a second analysis will be prepared to compare the two sets of data obtained from tracking the same vehicles.

## 2.4 RAE DATA SMOOTHING

None.

## 2.5 ACCURACY OF CONVERSION

All conversions are accurate to within the least significant bit of the data format. This, of course, does not mean that FPS-16 or MPS-26 radars have azimuth or elevation resolution to .006 mil.

## 2.6 DATA RECORDED

All data on the original station tape is transcribed onto the GSFC standardized tape except for those records having parity errors. Therefore a single parity error will cause a loss of one complete set of range, elevation, azimuth, and time data and a .1 second gap in the data recorded on the standard tape. When particular information (such as digitized AGC and status words) is not available to the on-station recording hardware, it will not appear on the standard tape. (Operator logs can be used to obtain this information.) Word 2, the identification word, will be complete for every standard tape.

## 2.7 DATA DIVISION

Each file recorded on magnetic tape in the standardized format represents the data of one radar for one pass over one station.

# 3. STANDARDIZED FORMAT

## 3.1 GENERAL

The output digital recording is in standard IBM 7094 binary format, i.e., 6 bits plus one parity bit per column, 6 columns per word. This tape is recorded at 75 inches per second, 556 characters per inch. The first word of each record is a Fortran word and should be ignored.

A group of 13 word blocks recorded consecutively on tape is called a record. When more than one record is placed on a tape, a 3/4-inch section of blank tape, called the record gap, is placed between them. An arbitrary number of records grouped together form a file. Each file is separated by 3-3/4 inches of blank tape, called an end of file gap, and a single special character (or tape mark). Two or more tape marks appear at the end of the last file.

As each word is recorded on tape, the sum of the logical "1" (odd or even) in each six-bit data column is sensed and a parity bit will be recorded in the seventh channel. In addition to the lateral parity check of each character, a longitudinal count of logical "1" in each channel is maintained during recording. The sum (odd or even) is decoded and a separate character called the "longitudinal redundancy check character" (LRCC) is recorded at the end of every record and every file. The LRCC for a record yields a parity check for that record and the LRCC for a file yields a parity check for that end of file word only.

Tape recordings thusly generated produce tapes which are compatible with the IBM 729 II binary tape format, and as a result, they are suitable for reading directly into an IBM 7094 computer.

## 3.2 DESCRIPTION OF GSFC STANDARDIZED FORMAT

A word-for-word description of the GSFC standardized format follows.

### 3.2.1 WORD 1

This word is automatically placed on any Fortran compatible tape indicating the total number of words in a record. For this application the decimal number 12 will appear as follows: $(00001400001)_8$.

### 3.2.2 WORD 2, IDENTIFICATION

| Bit | Function | Bit Value |
|---|---|---|
| 0 | *Station Number | 32 |
| 1 | " " | 16 |
| 2 | " " | 8 |
| 3 | " " | 4 |
| 4 | " " | 2 |
| 5 | " " | 1 |
| 6 | **NCG Number | 2048 |
| 7 | " " | 1024 |
| 8 | " " | 512 |
| 9 | " " | 256 |
| 10 | " " | 128 |
| 11 | " " | 64 |
| 12 | " " | 32 |
| 13 | " " | 16 |
| 14 | " " | 8 |
| 15 | " " | 4 |
| 16 | " " | 2 |
| 17 | " " | 1 |
| 18 | ***Day of the Year | 256 |
| 19 | " " | 128 |
| 20 | " " | 64 |
| 21 | " " | 32 |
| 22 | " " | 16 |
| 23 | " " | 8 |
| 24 | " " | 4 |
| 25 | " " | 2 |
| 26 | " " | 1 |
| 27 | ****Vehicle Number | 256 |
| 28 | " " | 128 |
| 29 | " " | 64 |
| 30 | " " | 32 |
| 31 | " " | 16 |
| 32 | " " | 8 |
| 33 | " " | 4 |
| 34 | " " | 2 |
| 35 | " " | 1 |

*Station numbers:

1 = BDA (FPS-16/FPQ-6)
2 = CYI (MPS-26)
3 = EGL (FPS-16)
4 = HAW (FPS-16)
5 = WHS (FPS-16)
6 = WLP (FPQ-6)
7 = Not Assigned
8 = CRO (FPQ-6)
9-61 = Not Assigned

**To determine the NCG number for various missions, call MSFNOC/NST Controller (301-982-6154).

***Data recorded during a changing of the day will be tagged with the day of the acquisition of the signal (AOS).

****
1 = Spacecraft (S/C)
2 = Gemini Adapter (ADP)
3 = Agena Target Vehicle (ATV)
4 = Gemini Launch Vehicle (GLV)
5 = S-IVB Apollo
6 = SCM Apollo
7 = LEM Apollo
8-511 = Not Assigned

### 3.2.3 WORD 3, TIME

| Bit | Bit Value (Milliseconds) |
|---|---|
| 0 | 34 359 738 368 |
| 1 | 17 179 869 184 |
| 2 | 8 589 934 592 |
| 3 | 4 294 967 296 |
| 4 | 2 147 483 648 |
| 5 | 1 073 741 824 |
| 6 | 536 870 912 |
| 7 | 268 435 456 |
| 8 | 134 217 728 |
| 9 | 67 108 864 |
| 10 | 33 554 432 |
| 11 | 16 777 216 |
| 12 | 8 388 608 |
| 13 | 4 194 304 |
| 14 | 2 097 152 |
| 15 | 1 048 576 |
| 16 | 524 288 |
| 17 | 262 144 |
| 18 | 131 072 |
| 19 | 65 536 |
| 20 | 32 768 |
| 21 | 16 384 |
| 22 | 8 192 |
| 23 | 4 096 |
| 24 | 2 048 |
| 25 | 1 024 |
| 26 | 512 |
| 27 | 256 |
| 28 | 128 |
| 29 | 64 |
| 30 | 32 |
| 31 | 16 |
| 32 | 8 |
| 33 | 4 |
| 34 | 2 |
| 35 | 1 |

### 3.2.4 WORD 4, RANGE

| Bit | Bit Value (Yards) |
|---|---|
| 0 | 17 179 869 184 |
| 1 | 8 589 934 592 |
| 2 | 4 294 967 296 |
| 3 | 2 147 483 648 |
| 4 | 1 073 741 824 |
| 5 | 536 870 912 |
| 6 | 268 435 456 |
| 7 | 134 217 728 |
| 8 | 67 108 864 |
| 9 | 33 554 432 |
| 10 | 16 777 216 |
| 11 | 8 388 608 |
| 12 | 4 194 304 |
| 13 | 2 097 152 |
| 14 | 1 048 576 |
| 15 | 524 288 |
| 16 | 262 144 |
| 17 | 131 072 |
| 18 | 65 536 |
| 19 | 32 768 |
| 20 | 16 384 |
| 21 | 8 192 |
| 22 | 4 096 |
| 23 | 2 048 |
| 24 | 1 024 |
| 25 | 512 |
| 26 | 256 |
| 27 | 128 |
| 28 | 64 |
| 29 | 32 |
| 30 | 16 |
| 31 | 8 |
| 32 | 4 |
| 33 | 2 |
| 34 | 1 |
| 35 | 0.5 |

### 3.2.5 WORD 5, RANGE RATE

Bit 0 to 35: Not used.

### 3.2.6 WORD 6, AZIMUTH

| Bit | Bit 0-19 Value (Mils)* |
|---|---|
| 0 | 3200 |
| 1 | 1600 |
| 2 | 800 |
| 3 | 400 |
| 4 | 200 |
| 5 | 100 |
| 6 | 50 |
| 7 | 25 |
| 8 | 12.5 |
| 9 | 6.25 |
| 10 | 3.125 |
| 11 | 1.5625 |
| 12 | 0.78125 |
| 13 | 0.390625 |
| 14 | 0.1953125 |
| 15 | 0.09765625 |
| 16 | 0.048828125 |
| 17 | 0.0244140625 |
| 18 | 0.01220703125 |
| 19 | 0.006103515625 |
| 20 | Zero |
| 21 | |
| 22 | |
| 23 | |
| 24 | |
| 25 | |
| 26 | |
| 27 | |
| 28 | |
| 29 | |
| 30 | |
| 31 | |
| 32 | |
| 33 | |
| 34 | |
| 35 | Zero |

*1 mil = 1/6400 X 360° (not a milliradian)

### 3.2.7 WORD 7, *AZIMUTH RATE

| Bit | Bit 1-24 Value (Mils/Second)** |
|---|---|
| 0 | Sign Bit (0 = Positive Rate, 1 = Negative Rate) |
| 1 | 400 |
| 2 | 200 |
| 3 | 100 |
| 4 | 50 |
| 5 | 25 |
| 6 | 12.5 |
| 7 | 6.25 |
| 8 | 3.125 |
| 9 | 1.5625 |
| 10 | 0.78125 |
| 11 | 0.390625 |
| 12 | 0.1953125 |
| 13 | 0.09765625 |
| 14 | 0.048828125 |
| 15 | 0.0244140625 |
| 16 | 0.01220703125 |
| 17 | 0.006103515625 |
| 18 | 0.0030517578125 |
| 19 | 0.00152587890625 |
| 20 | 0.000762939453125 |
| 21 | 0.0003814697265625 |
| 22 | 0.00019073486328125 |
| 23 | 0.000095367431640625 |
| 24 | 0.0000476837158203125 |
| 25-35 | Always Zero |

*Angle rate data obtained from rate gyros is available from only BDA

**1 Mil = 1/6400 X $360^{o}$ (not a milliradian).

### 3.2.8 WORD 8, ELEVATION

| Bit | Bit 0-19 Value (Mils)* |
|---|---|
| 0 | 3200 |
| 1 | 1600 |
| 2 | 800 |
| 3 | 400 |
| 4 | 200 |
| 5 | 100 |
| 6 | 50 |
| 7 | 25 |
| 8 | 12.5 |
| 9 | 6.25 |
| 10 | 3.125 |
| 11 | 1.5625 |
| 12 | 0.78125 |
| 13 | 0.390625 |
| 14 | 0.1953125 |
| 15 | 0.09765625 |
| 16 | 0.048828125 |
| 17 | 0.0244140625 |
| 18 | 0.01220703125 |
| 19 | 0.006103515625 |
| 20 | ZERO |
| 21 | |
| 22 | |
| 23 | |
| 24 | |
| 25 | |
| 26 | |
| 27 | |
| 28 | |
| 29 | |
| 30 | |
| 31 | |
| 32 | |
| 33 | |
| 34 | |
| 35 | ZERO |

*1 mil = 1/6400 X $360^{o}$ (not a milliradian)

### 3.2.9 WORD 9, *ELEVATION RATE

| Bit | Bit 1-24 Value (Mils/Second)** |
|---|---|
| 0 | Sign Bit (0 = Positive Rate, 1 = Negative Rate) |
| 1 | 400 |
| 2 | 200 |
| 3 | 100 |
| 4 | 50 |
| 5 | 25 |
| 6 | 12.5 |
| 7 | 6.25 |
| 8 | 3.125 |
| 9 | 1.5625 |
| 10 | 0.78125 |
| 11 | 0.390625 |
| 12 | 0.1953125 |
| 13 | 0.09765625 |
| 14 | 0.048828125 |
| 15 | 0.0244140625 |
| 16 | 0.01220703125 |
| 17 | 0.006103515625 |
| 18 | 0.0030517578125 |
| 19 | 0.00152587890625 |
| 20 | 0.000762939453125 |
| 21 | 0.0003814697265625 |
| 22 | 0.00019073486328125 |
| 23 | 0.000095367431640625 |
| 24 | 0.0000476837158203125 |
| 25 - 35 | Always Zero |

*Angle rate data obtained from rate gyros is available from only BDA.

**1 Mil = 1/6400 X $360^{o}$ (not a milliradian).

### 3.2.10 WORD 10, AUTOMATIC GAIN CONTROL

| Bit | Bit 1-7 Value (Volts) |
|---|---|
| 0 | Sign Bit (0 = Positive Voltage, 1 = Negative Voltage) |
| 1 | 3.90625 |
| 2 | 1.953125 |
| 3 | 0.9765625 |
| 4 | 0.48828125 |
| 5 | 0.244140625 |
| 6 | 0.1220703125 |
| 7 | 0.06103515625 |
| 8 | Zero |
| 9 | |
| 10 | |
| 11 | |
| 12 | |
| 13 | |
| 14 | |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |
| 21 | |
| 22 | |
| 23 | |
| 24 | |
| 25 | |
| 26 | |
| 27 | |
| 28 | |
| 29 | |
| 30 | |
| 31 | |
| 32 | |
| 33 | |
| 34 | |
| 35 | Zero |

NOTE: If sign bit is a logical "1" (Negative) data will be in "ones" complement form.

### 3.2.11 WORD 11, STATION STATUS IDENTIFICATION

| Bit | | |
|---|---|---|
| 0 | 1 = Record Data | 0 = Not in Record Mode |
| 1 | 1 = Track Mode | 0 = Non-track |
| 2 | 1 = Acquisition Mode | 0 = Non-acquisition |
| 3 | 1 = Designation Mode | 0 = Non-designation |
| 4 | 1 = Range Designate Source 1 | 0 = Non-designation Source 1 |
| 5, 6 | 1, 0 = 160 PRF | 0, 1 = 640 PRF; 0, 0 = Other PRF |
| 7, 8 | 1, 1 = 0.6-Mc BW | 0, 1 = 1.6-Mc BW; 1, 0 = 2.4-Mc BW; 0, 0 = 4.8-Mc BW |
| 9, 10 | 1, 1 = 0.25 PKW | 0, 1 = 0.5 PKW; 1, 0 = 1.0 PKW; 0, 0 = 2.4 PKW |
| 11 | 1 = AGC | 0 = Not in AGC |
| 12 | 1 = Angle Coast | 0 = Not in Coast |
| 13 | 1 = Operate Status | 0 = Test Status |
| 14 | 1 = Circle Scan | 0 = Not Circle Scan |
| 15 | 1 = Sprial Scan | 0 = Not Spiral Scan |
| 16 | 1 = Rectangular Scan | 0 = Not Rectangular Scan |
| 17 | 1 = Raster Scan | 0 = Not Raster Scan |
| 18 | 1 = Azimuth Major Axis Scan | 0 = Not Azimuth Major Axis Scan |
| 19 | 1 = Elevation Major Axis Scan | 0 = Not Elevation Major Axis Scan |
| 20 | 1 = Azimuth 2-kc Bandwidth Scan | 0 = Not Azimuth 2-kc Bandwidth Scan |
| 21 | 1 = Elevation 2-kc Bandwidth | 0 = Not Elevation 2-kc Bandwidth |
| 22 | 1 = Azimuth data lag corrected | 0 = Azimuth data lag not corrected |
| 23 | 1 = Elevation data lag corrected | 0 = Elevation data lag not corrected |
| 24 | 1 = Console Range Display in Yards | 0 = Console Range Display in 100's Yards |
| 25 | 1 = Skin Track | 0 = Beacon Track |
| 26 | 1 = Range Designate Source 2 | 0 = Not Designate Source 2 |
| 27 | 1 = Range Designate Source 3 | 0 = Not Designate Source 3 |
| 28 | 1 = Range Designate Source 4 | 0 = Not Designate Source 4 |
| 29 | 1 = Computer Designating (for program testing) | 0 = Not Computer Designating |

3.2.11 WORD 11, STATION STATUS IDENTIFICATION (contd)

| Bit | | | |
|---|---|---|---|
| 30 | 0 = FPS-16 | 5 = FPS-16 Modified | (32) |
| 31 | 1 = MPS-26 | 6 = SPANDAR | (16) |
| 32 | 2 = Verlort | 7 = FPS-26 | (8) |
| 33 | 3 = FPQ-6 | 8-61 = Unassigned | (4) |
| 34 | 4 = FPQ-18 | | (2) |
| 35 | | | (1) |

NOTES

CYI, EGL, HAW, ignore all bits except 1, 25, and 30 thru 35.
WHS and WLP ignore all bits except 1 and 30 thru 35.

3.2.12 WORD 12 and 13

Bit 0 to 35: All zeros.

## 4. ANALYSIS CONSIDERATIONS

Figure 1 shows a typical analysis produced in conjunction with a standard tape. A separate analysis of this type and a separate magnetic tape file is generated for each pass over a station. The significance of the information contained on the analysis sheet (figure 1) is indicated in subparagraphs a. thru k.

a. Total On-Track Time. Only on-track data is used to generate information for the analysis sheet. Under this heading the amount of on-track time is tabulated for later use in weighting averages and comparison's of one radar system against another. Periods of time when LOS occurs during a pass are not included in this tabulation. At CRO and BDA the FPQ-6 radar on-track is automatically obtained from the radar on-track bus which can be manually or automatically controlled. At all other stations the on-track is obtained by a manual operation.

b. Average RMS Range (or Azimuth, Elevation) Error: The words "Azimuth, Elevation" enclosed in parentheses is intended to indicate to the reader that the text of this subparagraph would be equally applicable if either "Azimuth" or "elevation" were substituted for "range". One hundred time-consecutive range (Azimuth, Elevation) data points are used to obtain an estimate of the RMS range system noise. The estimate is made using the variant difference techniques; dynamic orbital constraints are not used to obtain this RMS value. Each group of 100 data points is considered one arc. The average of all such arcs for one pass over a station is the value called average RMS range (Azimuth, Elevation) error.

c. Number of AOS Times. This represents the total number of times a vehicle being tracked was acquired during one pass over a station. The Zulu time for up to 5 of these AOS events are recorded in milliseconds at the lower-middle portion of the analysis sheets. Corresponding LOS times are also printed except that the fifth LOS time is the last LOS regardless of the total number of LOS's for that pass.

d. Number of Time Discrepancies. Whenever the interval between data sets is greater than .1 second without LOS, a "Time Discrepancy" is said to have occurred. The number of such discrepancies is tabulated and printed on the analysis sheet. Furthermore, the Zulu time just before the anomalies for up to five occurrences is also printed out in the lower middle of the analysis sheet.

e. Number of Skin and/or Beacon Tracks. The number of on-track data points for skin and/or beacon tracks are tabulated under this heading. Since data rates are 10 per second, "total on track time" should equal the sum of skin data points and beacon data points divided by 10 (20 for WHS data).

f. Average (Maximum, Minimum) S/N for Beacon and/or Skin Tracking. This provides a gross estimate of the signal-to-noise characteristics of a pass over a station. The figures are referenced to an arbitrary 0-signal level as determined in the Network Operations Directive for NASA Manned Space Flight Operations and are expressed in decibels.

g. Maximum Elevation. Self explanatory. A Mil is $\frac{1}{6400}$ of a circle and not a milliradian.

h. Maximum Elevation. Self explanatory. The Zulu time of occurrence is also printed out next to the minimum range.

i. Number of Bad Ranges (Azimuths or Elevations). The words "Azimuth, Elevation" enclosed in parentheses is intended to indicate to the reader that the text of this subparagraph would be equally applicable if either "Azimuth" or "Elevation" were substituted for "Range". If the first difference in range (Azimuth or Elevation) exceeds 1000 yards (8.888 mils Az or 8.888 mils El) it is called out as a bad data point. These points are tabulated and the total number is printed out. The Zulu time of day of day of up to five bad ranges (Azimuth, Elevation) are also printed out in the lower middle of the analysis sheet.

j. Number of 100-Point Arcs Used. One hundred consecutive points are required for one arc. Therefore, if there are no time discrepancies, the number of 100-point arcs will be equal to the number of skin tracks plus the number of beacon tracks, all divided by 100.

k. Number of Parity Errors. Parity errors indicate a recording malfunction usually associated with the magnetic tape itself. The total number of these unusable data records or sets is listed on the analysis sheet.

RADAR DATA MAGNETIC TAPE QUALITY STATEMENT

BILLINGTON/GUZIK - ADVANCED TECHNIQUES GROUP

TAPE IDENTIFICATION STATION BDA MISSION 0 VEHICLE NO. 3 DAY NO. 0 REV NO. 75

| | |
|---|---|
| TOTAL ON TRACK TIME = 0.55010000E 03SECONDS | MAXIMUM ELEVATION = 0.62478027E 03MILS |
| AVERAGE RMS RANGE ERROR = 0.20258471E 01YDS | MINIMUM RANGE = 0.53940625E 06YDS 0.69351900E 08 |
| AVERAGE RMS AZTH ERROR = 0.72591817E-01MILS | MAXIMUM S/N (BEAC) = 0.52339844E 02 |
| AVERAGE RMS ELEV ERROR = 0.13381188E-01MILS | MINIMUM S/N (BEAC) = 0.39453125E-00 |
| AVERAGE S/N (BEAC) = 0.39856686E 02 | MAXIMUM S/N (SKIN) = 0. |
| AVERAGE S/N (SKIN) = 0. | MINIMUM S/N (SKIN) = 0. |
| NUMBER OF AOS TIMES = 2 | NUMBER OF BAD RANGES = 1 |
| NO. OF TIME DISCREPANCIES = 1 | NUMBER OF BAD AZIMUTHS = 0 |
| NUMBER OF SKIN TRACKS = 0 | NUMBER OF BAD ELEVATIONS = 0 |
| NUMBER OF BEACON TRACKS = 5507 | NO. OF 100 PT. ARCS USED = 54 |
| NUMBER OF PARITY ERRORS = 0 | |

TIMES BELOW ARE IN MILLISEC TAPE LOS TIME NO. 5 IS END OF TAPE TIME

| TAPE AOS TIMES | TAPE LOS TIMES | TIME DISCREPANCIES | BAD RANGE TIMES | BAD AZ TIMES | BAD EL TIMES |
|---|---|---|---|---|---|
| 0.69103600E 08 | 0.69189100E 08 | 0.69187100E 08 | 0.69187200E 08 | 0. | 0. |
| 0.69195600E 08 | 0.69661300E 08 | 0. | 0. | 0. | 0. |
| 0. | 0. | 0. | 0. | 0. | 0. |
| 0. | 0. | 0. | 0. | 0. | 0. |
| 0. | 0.69664100E 08 | 0. | 0. | 0. | 0. |

STANDARDIZED DATA TAPE FORMAT-

BINARY HIGH DENSITY 13 WORD RECORDS 36 BIT WORDS CAPABLE OF BEING READ WITH FORTRAN
NOTE- FIRST WORD OF EACH STD TAPE RECORD IS FORTRAN COMPATIBILITY WORD- NOT RADAR DATA

| WORD | FUNCTION | UNITS | WORD | FUNCTION | UNITS |
|---|---|---|---|---|---|
| 1 | FORTRAN WORD | | | | |
| 2 | ID WORD | | 8 | ELEVATION | MILS |
| 3 | TIME | MILLISEC | 9 | ELEV RATE | |
| 4 | RANGE | YDS | 10 | AGC | VOLTS |
| 5 | RANGE RATE | | 11 | STATION STATUS WORD | |
| 6 | AZIMUTH | MILS | 12 | OPEN | |
| 7 | AZTH RATE | | 13 | OPEN | |

Figure 1. Typical Standard Tape Analysis