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NASA CR-

130206

(NASA-CR-130206) THE RADIATION MONITOR
COSMIC X-RAY EXPERIMENT OSO-1 Final
Project Report (Iowa Univ.) ~~139~~ 140 p HC
$9.00 CSCL 03B

N73-22747

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THE UNIVERSITY OF IOWA FOUNDED 1847

Department of Physics and Astronomy

THE UNIVERSITY OF IOWA

Iowa City, Iowa

FINAL PROJECT REPORT
FOR THE
RADIATION MONITOR
COSMIC X-RAY EXPERIMENT
OSO-I

Prepared by
Roger F. Randall

1 March 1973

Department of Physics and Astronomy
University of Iowa
Iowa City, Iowa
52242

Contract NAS5-23112

FINAL PROJECT REPORT FOR THE RADIATION MONITOR,
COSMIC X-RAY EXPERIMENT, OSO-I

SUBMITTED BY:

Roger F. Randall

ROGER F. RANDALL
PROJECT MANAGER

1 March 1973
DATE

APPROVED BY:

JA Van Allen

J. A. VAN ALLEN, HEAD
DEPT. OF PHYSICS AND ASTRONOMY

1 March 1973
DATE

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TABLE OF CONTENTS

TABLE OF CONTENTS

(Continued)

## LIST OF DRAWINGS AND FIGURES

LIST OF DRAWINGS AND FIGURES

(Continued)

# 1.0 SUMMARY

## 1.1 OBJECT OF REPORT

The object of this report is to provide a comprehensive technical description of the Radiation Monitor which is part of the GSFC cosmic x-ray experiment to be flown on the OSO-I satellite. Design and fabrication of this instrument was contracted under UI/GSFC Contract NAS5-23112.

## 1.2 UI PROJECT PERSONNEL

University of Iowa personnel directly involved in the project management, conception, planning, design, fabrication, testing or delivery of the Radiation Monitor are as follows:

| | |
|---|---|
| Dr. J. A. Van Allen<br>Head, Dept. of Physics and Astronomy | General director of the project and responsible for the scientific design criteria of the GM detector. |
| Dr. D. C. Enemark<br>Senior Electrical Engineer | Served as electronic design consultant and responsible for final electrical design approval. |
| R. F. Randall<br>Engineer IV/Project Manager | Responsible for execution of project and design of all electronics. |
| K. Henry<br>Engineer III | Responsible for mechanical design, electronic packaging, and production of finished drawings. |
| H. Owens<br>Research Physicist | Responsible for the procurement, selection, qualification testing, assembly and physical calibration of the GM detector. |

| | |
|---|---|
| E. Kruse<br>Engineer III | Responsible for Quality Assurance aspects of project. Performed in-process and final inspection of flight hardware. |
| T. Robertson<br>Contracts Administrator | Responsible for negotiation of contract and financial analysis. |
| E. Williams<br>Design Draftsman | Executed mechanical design layouts and electronic packaging layouts. |
| D. Cramer<br>Electronic Technician | Responsible for part procurements, final assembly, testing, and delivery of instrument. |
| R. Wenman<br>Lab. Technician | Responsible for assembly of all electronic modules and harnessing of instrument. |
| E. A. Freund<br>Machine Shop Foreman | Responsible for all fabrication of mechanical parts. |
| Dr. B. A. Randall<br>Research Associate | Performed electron and proton calibration on Radiation Monitor SN29-2. |
| D. Baker<br>Graduate Research Assistant | Assisted in electron and proton calibrations on Radiation Monitor SN29-2. |
| P. Johnson<br>Lab. Technician | Provided assistance during thermal vacuum testing. |
| J. Birkbeck<br>Inker | Preparation of final graphs, charts, etc. |
| L. Williams<br>Secretary | Typist for all correspondence, technical reports, etc. |

## 1.3 COGNIZANT GOVERNMENT AGENCY PERSONNEL

Office of Naval Research personnel directly involved in the project Quality Assurance aspects are as follows:

| | |
|---|---|
| D. Byal<br>Quality Assurance<br>Engineer | Administered Quality Assurance aspects of contract as delegated by GSFC. |
| R. Alabaugh<br>Quality Control<br>Specialist | Performed in-process and final inspection of flight hardware. |

## 1.4 SCOPE OF WORK

### 1.4.1 FLIGHT INSTRUMENTS

As required by subject contract the University of Iowa furnished all non-special type materials, all personnel, facilities and equipment necessary to furnish the items below in accordance with GSFC specification for Radiation Monitor (Cosmic X-Ray Experiment, OSO-I) dated January 1972.

1.4.1.1 Design, fabricate, test and deliver two (2) flight unit Radiation Monitors.

1.4.1.2 Design, fabricate, test and deliver two (2) removable radiation source fixtures.

1.4.1.3 Demonstrate successful operation of each flight unit at GSFC.

1.4.1.4 Prepare and deliver a reproducible design manual.

### 1.4.2 DOCUMENTATION

The University of Iowa prepared and submitted, in accordance with subject contract, with following reports.

1.4.2.1 Monthly Progress Report submitted by the fifteenth (15) day of each month. This report included the following: Work Completed During Reporting Period; Projected Activity for Next Reporting Period; Signficant Problem Areas; Affirmation of Delivery; Expenditures to Date and Cost to Complete.

1.4.2.2 Final Project Report. As set forth in this document, this report includes performance specifications, design details, and test data.

## 1.5 GENERAL DESCRIPTION OF THE RADIATION MONITOR

The Radiation Monitor is designed to detect, within the Van Allen Belts and the South Atlantic Anomaly, electron flux with energies $\geq$ 80 keV. A pulse rate proportional to the density of the electrons is provided as an output from the monitor to the GSFC rate meter. The Radiation Monitor consists of a single EON 6213 GM detector, a signal conditioning circuit, and a power converter. The Monitor electronics is contained within a rectangular aluminum structure which has the peripheral dimensions of 7.000 x 3.125 x 1.340 inches. The average power consumption and weight of the Radiation Monitor is 72 mw and 0.85 lbs.

# 2.0 THEORY OF OPERATION

## 2.1 GENERAL

The Radiation Monitor consists of seven components as illustrated by the functional block diagram in drawing 76 C 3002. Following in Section 2.2 is a detailed description of each of these components.

## 2.2 DETAILED

### 2.2.1 COMMAND INTERFACE CIRCUIT

The command interface circuit chosen for this instrument is a standard input buffer IC (supplied by Hughes Aircraft Co.) which is designed to be compatible with the S/C command subsystem (see drawing 76 C 3000). This buffer is used to drive two darlington amplifiers ($Q_6$, $Q_7$ and $Q_8$, $Q_9$) which control the set and reset coils on a Teledyne 422 (basic) relay. Supply voltage for the relay amplifiers is supplied from the +12.0 volt bus via a 10K resistor ($R_2$). The purpose of $R_2$ is to provide short circuit protection to the bus from the relay/amplifier combination. Due to current limiting of $R_2$, capacitor $C_{14}$ (15µf) is required to supply latching current during the presence of an input command to the buffer. Since a finite time is required to recharge $C_{14}$, after a command has been executed, the maximum ON/OFF command rate will be limited by the time constant of $R_2C_{14}$. Diodes $D_{13}$ and $D_{14}$ provide transient protection to the transistor collectors during turn-off of the transistors. Presence of a discrete pulse command on pins 6 and 7 of the input buffer will cause the relay to latch in a position to supply the +12.0 volt bus to the input filter.

2.2.2 POWER SWITCHING RELAY/INPUT FILTER

Bus voltage to the input filter ($L_1$, $C_1$, $D_1$) is supplied through contacts 2 and 4 of a Teledyne 422 magnetic latching relay (see drawing 76 C 3000). At $t = 0$, when contacts 2 and 4 make, the input filter sees a voltage step with a magnitude of +12.0 volts. The initial surge current due to the voltage step, as seen on the +12.0 volt line, will have a peak amplitude of approximately 125 ma. In the absence of diode $D_1$ the surge current waveform would be a damped sinusoid with a natural frequency of approximately $1/2\pi\sqrt{LC}$ $H_Z$ and a duration dependent upon the inherent resistance of the bus and inductor. However the presence of $D_1$ limits the transient duration to a period of approximately $\pi\sqrt{LC}/2$ sec. At $t = 0$ the line current begins to increase in a sinusoidal fashion until ~ $\pi\sqrt{LC}/2$ sec. at which time $D_1$ becomes forward biased and the surge current drops to the operating quiescent level of the instrument. The transient current duration will be approximately .0125 amp-milliseconds. During the period of time when contacts 3 and 4 initially make, diode $D_1$ suppresses possible contact arcing due to $L_1$'s collapsing field.

The primary function of the input filter is to reduce the noise current fed back onto the bus due to the switching action of the saturable-core multivibrator. The noise current fed back onto the bus will be approximately 2 ma peak to peak at a fundamental frequency of 2 kHz.

2.2.3 SATURABLE-CORE MULTIVIBRATOR

A single transformer saturable-core multivibrator operating at 2 kHz from the +12 volt bus is used to generate the required low and high voltages (see drawing 76 C 3000). The transformer was specially designed at the UI for this application and was fabricated by Rayco Electronics in Los Angeles, California. The transformer core was manufactured by Magnetics Inc. and consists of a tape wound square permalloy 80 material. The tape material is .001 inches thick and the effective core cross sectional area is .151 $cm^2$. The saturation flux density of the core is approximately 7000 gauss. The primary collector drive winding and the base feedback windings are wound with 30 AWG wire. The secondary low and high voltage windings are wound with 36 AWG wire. The number of turns required for the drive winding were computed from the following relationship:

$$N = \frac{V}{(4.44\ BmAcf)10^{-8}}$$

where Bm = 7000 gauss

Ac = .151 $Cm^2$

f = 2 kHz

v = 12 volts

8

Based on core parameters and operating frequency a core loss of approximately 41 mw would be realized with this design.

Bias for initial turn on of the multivibrator is supplied by the resistive network of $R_3$ and $R_4$. Initial unbalance for starting requirements is enhanced by capacitor $C_2$ which is connected between the collectors of $Q_1$ and $Q_2$. Diodes $D_2$ and $D_3$ suppress negative transients which may occur on the collectors of $Q_1$ and $Q_2$ due to the switching action of the transformer.

With no secondary load on the transformer approximately 45 mw of power is required to operate the multivibrator. 41 mw can be accounted for due to core loss, 3 mw can be attributed to bias network dissipation. Under a normal secondary load of 26 mw the input power requirement is 73 mw. Based on these figures the system efficiency is approximately 36%.

2.2.4 LOW VOLTAGE POWER SUPPLY

The capacitive filtered fullwave rectifier made up of $D_4$, $D_5$ and $C_3$ make up the low voltage power supply which feeds +6.8 volts to the GM Signal Amplifier and the Command Verification network (see drawing 76 C 3000). The AC voltage developed on the secondary winding which feeds the fullwave rectifier is 7.4 volts peak in amplitude.

The output of the Command Verification network made up of $R_5$ and $R_6$ is +3.4 volts. This dc level, when present, signifies the ON state of the Radiation Monitor.

2.2.5 HIGH VOLTAGE POWER SUPPLY

Diodes $D_7$ through $D_{12}$ and capacitors $C_7$ through $C_{12}$ make up the high voltage multiplier which yields +890 volts (see drawing 76 C 3000). The AC voltage developed on the secondary high voltage winding is approximately 150 volts peak in amplitude. Capacitors $C_8$ through $C_{12}$ will charge to twice the peak amplitude of the AC driving voltage, while $C_7$ charges to only the peak amplitude. Consequently, the output of the multiplier will be the sum of the voltages developed across capacitors $C_{10}$ through $C_{12}$. The AC ripple at the node of $C_{12}$, $D_{12}$ is approximately 10 volts peak to peak as measured with a 10 M ohm input impedance scope. However, under normal operating conditions with only $R_{20}$ and $VR_1$ loading the multiplier, a peak to peak ripple of approximately 3 volts is expected. A first order approximation of the expected peak to peak ripple at the output of the multiplier can be expressed as follows:

$$Vrp = (V_H - V_R)(1 - e^{\frac{-t}{T}}) \qquad \text{where}$$

$$T = \left(\frac{C_{12}}{3}\right) R_{20}$$

$t = .25$ m sec.

$V_H$ = High Voltage out

$V_R$ = $VR_1$ Voltage

Voltage regulator tube $VR_1$ is selected to match the operating level of the 6213 GM tube. Resistor $R_{20}$ is selected to provide 30μa of current to $VR_1$ ($R_{20} = (V_H - V_R)/30\mu a$). Capacitor $C_{13}$ serves to supply the current pulses required during the firing of the GM tube. Thus the voltage level across $VR_1$ is maintained relatively constant with only a slight drop in voltage. The voltage change normally seen across $VR_1$ in this case is approximately 0.5 volts. Without $C_{13}$ a voltage excursion of approximately 20 volts would occur.

2.2.6 GM SIGNAL AMPLIFIER

The output from the cathode of the GM tube is a pulse of approximately 30 volts in amplitude. This pulse is applied to the three stage amplifier, depicted in drawing 76 C 3000, made up of transistors $Q_3$, $Q_4$, and $Q_5$. The first two stages of the amplifier make up a standard GM pre-amp which has been flown on numerous other UI instruments. The input sensitivity of the first stage is increased by the use of the forward biased diode $D_6$. This diode compensates for base to emitter drift over temperature to maintain a relatively constant discrimination point. The third stage, transistor $Q_5$, has been added to satisfy the interface requirements imposed by the subject contract. The characteristics of the output pulse as seen at the collector of $Q_5$ are as follows:

Reference during input pulse absence: +4.75 v.

Pulse transition: +4.75 V, negative going to ~0.2 V.

Leading edge transition time: ~ 0.02μsec. when loaded with 47pf.

Trailing edge transition time: ~ 0.8μsec. when loaded with 47 pf. and ~ 0.3μsec. when unloaded.

Nominal pulse width: ~ 6.0μsec.

Current sinking: ~ 0.60 ma assuming worst case β of 10 on $Q_5$.

2.2.7 DETECTOR ASSEMBLY

The Detector Assembly consists of an EON 6213 GM tube and its associated quenching resistor $R_{21}$ (see drawing 76 C 3000). The 6213 is a mica end-window (1.3 mg/cm$^2$) tube having a cylindrical volume of detecting gas 0.6 cm in length and 0.24 cm in diameter (see figure 1.0). The effective area of the tube is ~ 0.05 cm$^2$. The inert gas contained in tube is approximately 98% Neon and 2% Argon with a trace of chlorine. The overall dimensions of the tube are 1.360" in length and .345" in diameter. The tube housing is constructed of stainless steel and ceramic.

The gas-filled chamber has two electrodes, consisting of the outer stainless steel cylinder (cathode) and the thin wire (.011" diameter) along the cylinder axis (anode). The wire is maintained at a high positive voltage (~ 600 to 700 volts) with respects to the cylinder. Entry of charged particles into the chamber ionizes some of the gas molecules which in turn causes a current to flow between the anode and cathode. In the configuration shown (see drawing 76 C 3000) a pulse of $\sim$ 30 volts is developed across resistor $R_8$.

The GM tube and quenching resistor $R_{21}$ are potted in Eccofoam FP. Drawing 76 B 1002 depicts the potted configuration. For assembly location of the encapsulated GM tube and quenching resistor refer to drawing 76 C 1003.

# 3.0 FABRICATION AND ASSEMBLY

## 3.1 HOUSING

Drawing 76 D 0001 depicts the detailed configuration of the Radiation Monitor housing. A three dimensional view can be seen in drawing 76 C 1000. The housing is milled out of a 6061-T6 aluminum block with finished overall outside dimensions of 7.000" in length, 3.125" in width, and 1.340" in height. The housing consists of four compartments, each isolated from each other by a wall in order to minimize EMI. Three of the compartments house the UI subassemblies and the fourth will contain the GSFC rate meter electronics. Drawing 76 B 1001 shows the area allotted for the rate meter electronics. Access to the electronics after integration is gained by removing a .032" thick aluminum cover plate (see drawing 76 C 0002). All aluminum parts are finished with gold iridite.

## 3.2 CORDWOOD MODULES

Wherever feasible the cordwood module concept of packaging was used in order to increase packaging density. Drawings 76 C 4000, 76 C 4001 and 76 D 4002 show the module layout and PC configuration for the Teledyne Relay Drives electronics, the Saturable-Core Multivibrator/Low Voltage Rectifier electronics, and the GM Signal Amplifier. For respective module locations on motherboards, see drawings 76 C 4003 and 76 D 4004.

## 3.3 MOTHERBOARD ASSEMBLIES

The standard input buffer IC and all discrete components, with the exception of those fabricated in the cordwood modules, are located in a planar fashion on the motherboard assemblies depicted in drawings 76 C 4003 and 76 D 4004. For respective assembly locations in the housing compartments see drawing 76 C 1003.

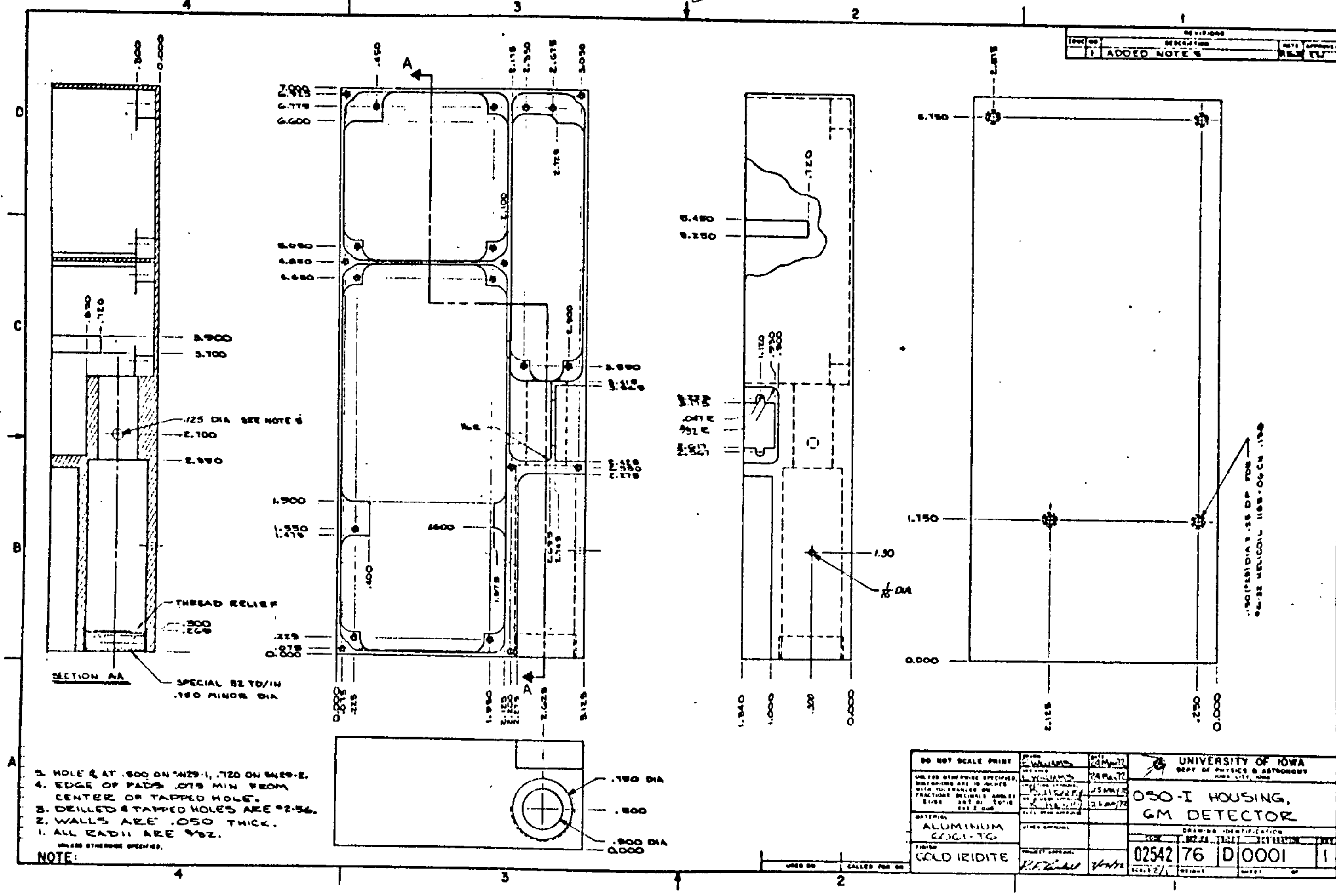
The wiring interface between the 18 pin Continental connector and the different subassemblies is shown in drawing 76 C 3001.

## 4.0 CONE ANGLE DETERMINATION

Figure 2.0 shows in detail the mechanical configuration which determines the 90° cone angle of the Radiation Monitor detector.

## 5.0 REQUIRED PRESSURE CONDITIONS FOR INSTRUMENT TURN-ON

Due to high voltage developed in the instrument, do not operate instrument during a pressure transition from sea level to $10^{-5}$ mm of mercury. Operate instrument only at sea level pressure or a pressure less than or equal to $10^{-5}$ mm of mercury. Operation during the aforementioned pressure transition will cause corona discharge and damage to electronic components may occur.


ADDED NOTE 5
SECTION AA
SPECIAL 32 TD/IN
.750 MINOR DIA
THREAD RELIEF
.125 DIA SEE NOTE 5
5. HOLE ℄ AT .500 ON SN29-1, .720 ON SN29-2.
4. EDGE OF PADS .075 MIN FROM CENTER OF TAPPED HOLE.
3. DRILLED & TAPPED HOLES ARE #2-56.
2. WALLS ARE .050 THICK.
1. ALL RADII ARE 1/32.
UNLESS OTHERWISE SPECIFIED.
NOTE:
.750 DIA
.500
.900 DIA
0.000
DO NOT SCALE PRINT
MATERIAL
ALUMINUM
6061-T6
FINISH
GOLD IRIDITE
UNIVERSITY OF IOWA
DEPT OF PHYSICS & ASTRONOMY
050-I HOUSING,
GM DETECTOR
DRAWING IDENTIFICATION
02542
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D
0001
1
SCALE 2/1

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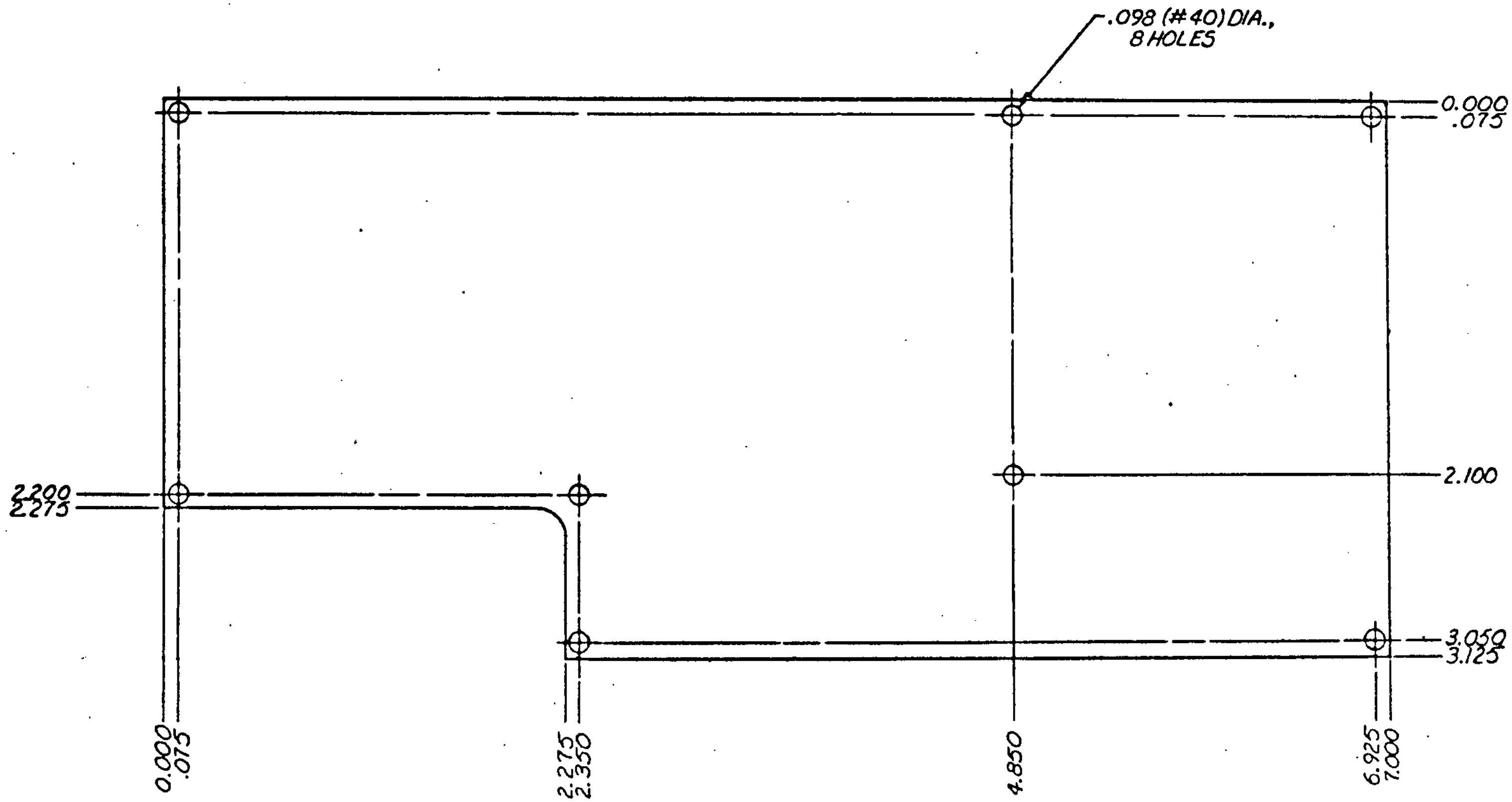


REVISIONS

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NOTE:
UNLESS OTHERWISE SPECIFIED,

| USED ON | CALLED FOR ON |
|---|---|

DO NOT SCALE PRINT

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES WITH TOLERANCES ON FRACTIONS ±1/64, DECIMALS .XX ± .01, .XXX ± .005, ANGLES ± 0°15'

MATERIAL: .032 ALUMINUM 6061-T6

FINISH: GOLD IRIDITE

| | | |
|---|---|---|
| DRAWN | SALA KNIPFER | 26 May 1972 |
| DESIGNED | E. WILLIAMS | 26 MAY 72 |
| DRAFTING APPROVAL | E. Williams | 30 May 72 |
| MECH DSGN APPROVAL | K. HENRY | 14 JULY 72 |
| ELEC DSGN APPROVAL | | |
| OTHER APPROVAL | | |
| PROJECT APPROVAL | R. F. Randall | 7/19/72 |

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DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA

COVER, GM DETECTOR HOUSING, OSO-I

DRAWING IDENTIFICATION

| CODE | SERIES | SIZE | DESIGNATION | REV |
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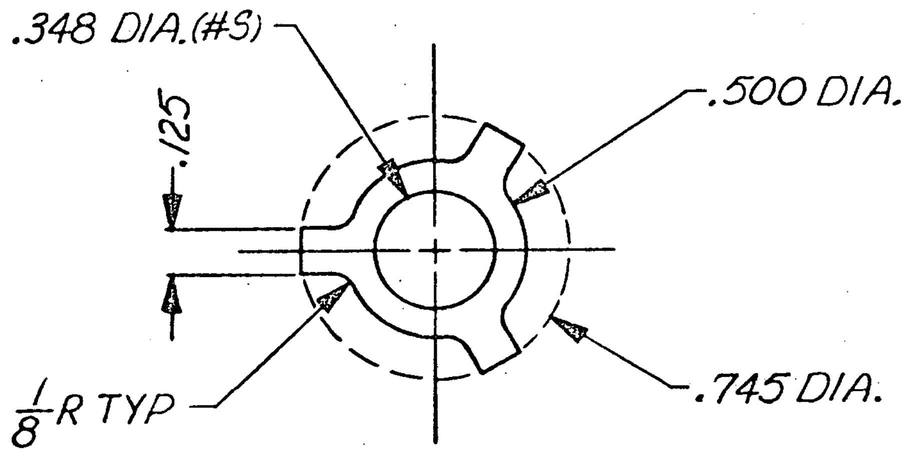


MATERIAL: 1/16 FIBERGLASS

| | |
|---|---|
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| DESIGNED: E. Williams | 29 May 72 |
| DRAFTING APPROVAL: E. WILLIAMS | 31 MAY 72 |
| MECH DSGN APPROVAL: K. HENRY | 14 July 72 |
| ELEC DSGN APPROVAL: | |
| OTHER APPROVAL: | |
| PROJECT APPROVAL: R.F. Randall | 7/19/72 |

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DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA

SPACER, GM TUBE,
RADIATION MONITOR, OSO-I

DRAWING IDENTIFICATION

| CODE | SERIES | SIZE | DESIGNATION | REV |
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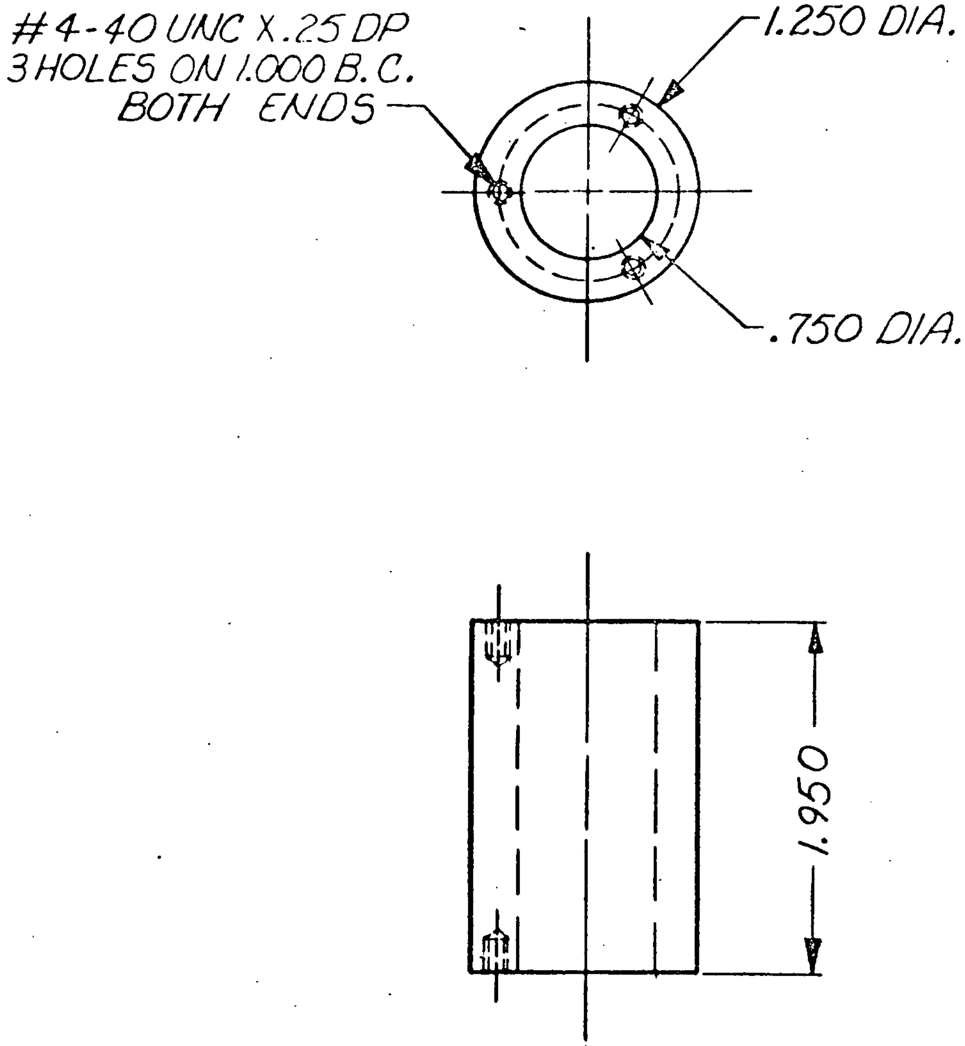


MATERIAL: TEFLON

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| DESIGNED E. Williams | 29 May 72 |
| DRAFTING APPROVAL E. WILLIAMS | 31 May 72 |
| MECH. DSGN APPROVAL K. HENRY | 14 July 72 |
| ELEC DSGN APPROVAL | |
| OTHER APPROVAL | |
| PROJECT APPROVAL R. F. Randall | 7/14/72 |

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DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA

POTTING MOULD, GM TUBE
RADIATION MONITOR, OSO-I

DRAWING IDENTIFICATION

| CODE | SERIES | SIZE | DESIGNATION | REV |
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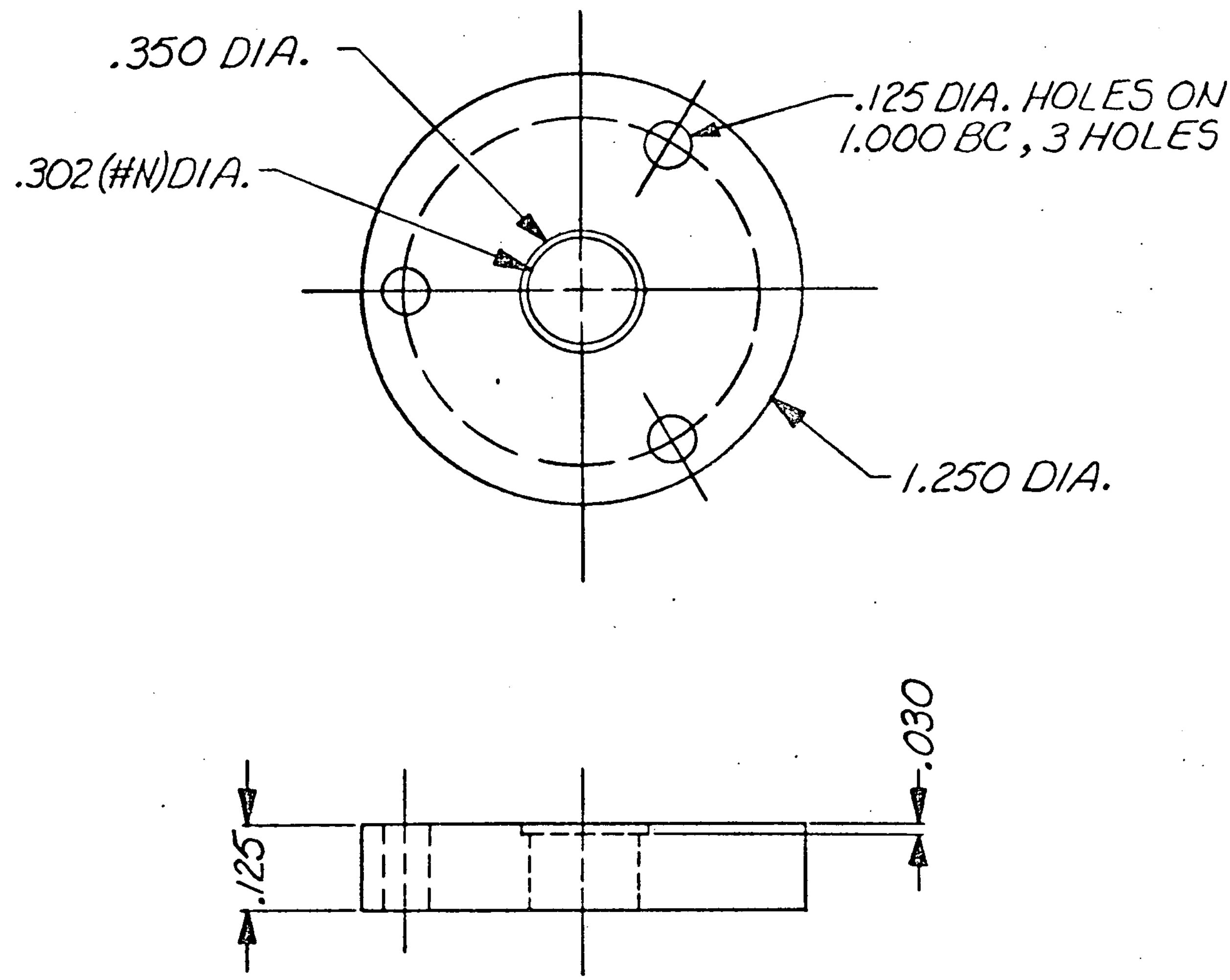


MATERIAL: TEFLON

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|---|---|
| DRAWN SALA KNIPFER | DATE 30 MAY 72 |
| DESIGNED E. Williams | 29 MAY 72 |
| DRAFTING APPROVAL E. WILLIAMS | 31 MAY 72 |
| MECH DSGN APPROVAL K. HENRY | 14 July 72 |
| ELEC DSGN APPROVAL | |
| OTHER APPROVAL | |
| PROJECT APPROVAL R. F. Randall | 7/14/72 |

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IOWA CITY, IOWA

FRONT, POTTING MOULD
RADIATION MONITOR, OSO-I

DRAWING IDENTIFICATION

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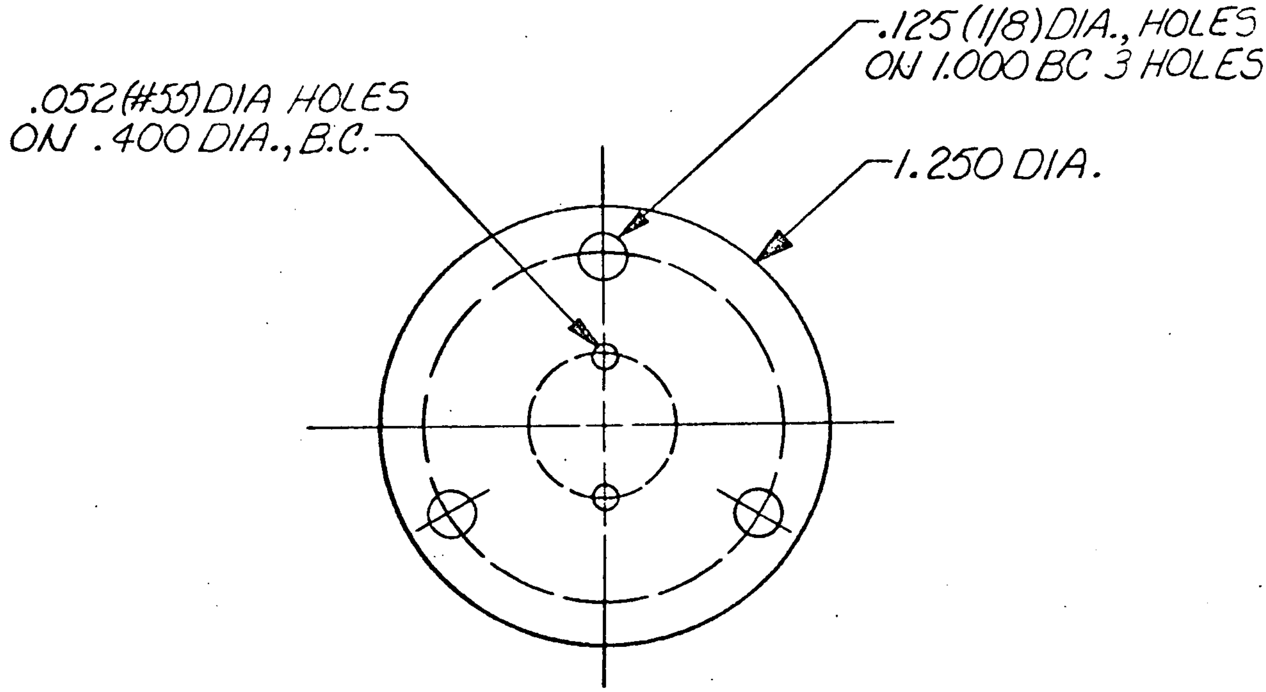


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| DESIGNED E. Williams | 31 May 72 |
| DRAFTING APPROVAL E. WILLIAMS | 31 MAY 72 |
| MECH DSGN APPROVAL K. HENRY | 14 JULY 72 |
| ELEC DSGN APPROVAL | |
| OTHER APPROVAL | |
| PROJECT APPROVAL R.F. Randall | 7/14/72 |

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IOWA CITY, IOWA

BACK, POTTING MOULD
RADIATION MONITOR, OSO I

DRAWING IDENTIFICATION

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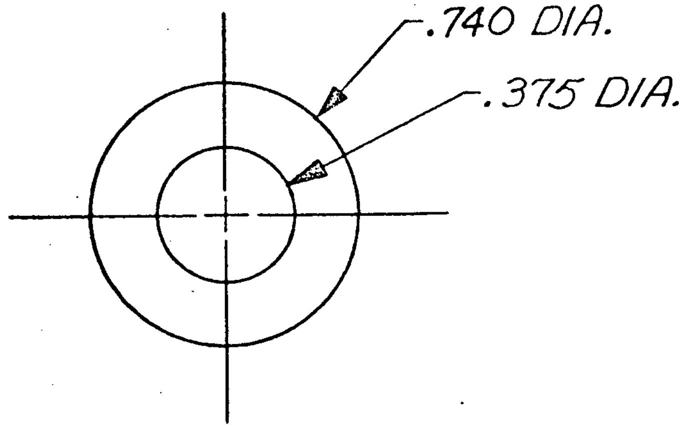


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| DESIGNED E. Williams | 29 May 72 |
| DRAFTING APPROVAL E. WILLIAMS | 31 MAY 72 |
| MECH DSGN APPROVAL K. HENRY | 14 July 72 |
| ELEC DSGN APPROVAL | |
| OTHER APPROVAL | |
| PROJECT APPROVAL R.F. Randall | 7/19/72 |

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IOWA CITY, IOWA

# FRONT SPACER

DRAWING IDENTIFICATION

| CODE | SERIES | SIZE | DESIGNATION | REV |
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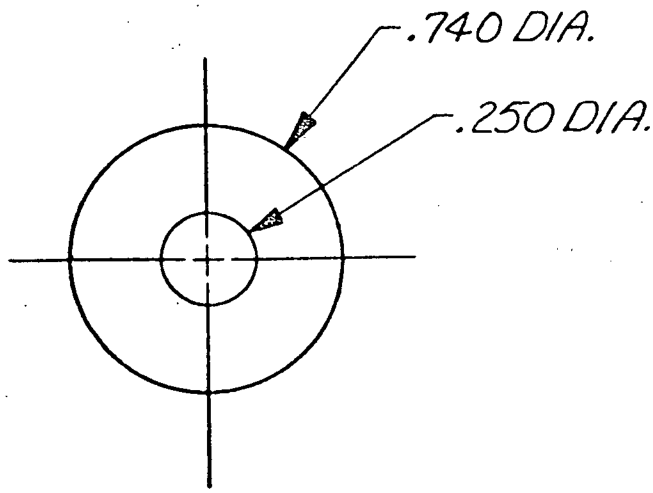


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| DESIGNED E. Williams | 29 May 72 | FRONT PRESSURE PLATE |
| DRAFTING APPROVAL E. WILLIAMS | 31 MAY 72 | |
| MECH. DSGN APPROVAL K. HENRY | 14 July 72 | |
| ELEC DSGN APPROVAL | | |
| OTHER APPROVAL | | DRAWING IDENTIFICATION |
| PROJECT APPROVAL R.F. Randall | 7/19/72 | |

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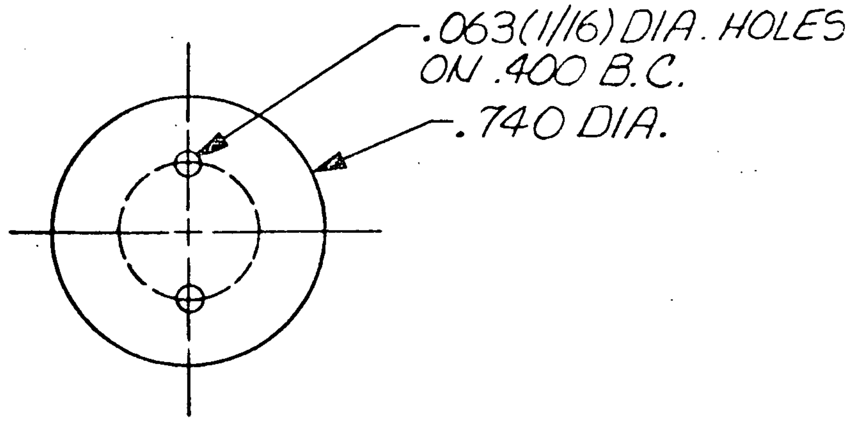
| SYM | DESCRIPTION | DATE | APPROVED |
| 1 | THICKNESS WAS 1/32 | 7/13/72 | EW |




MATERIAL: .085 THK FIBERGLASS

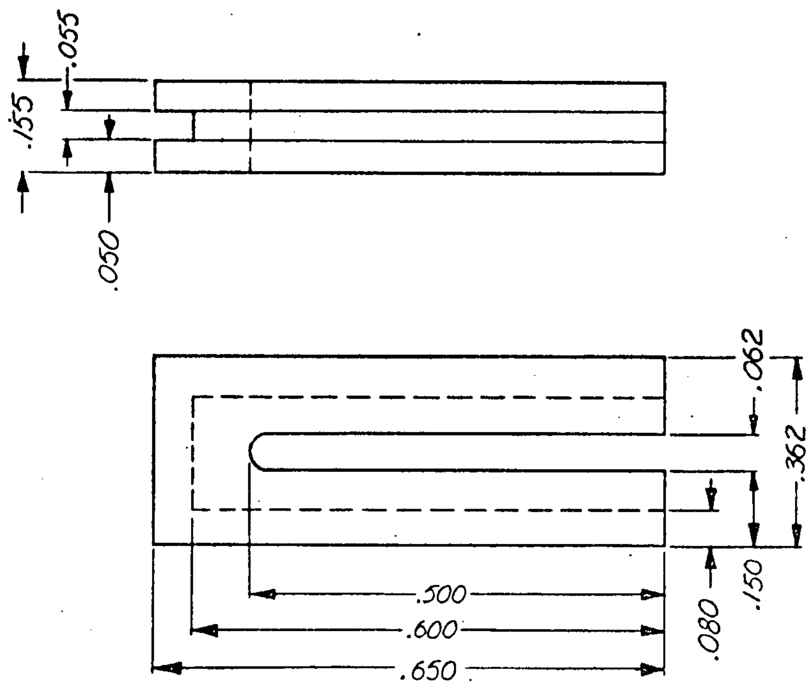
| | DATE |
|---|---|
| DRAWN SALA KNIPFER | 31 MAY 72 |
| DESIGNED E. Williams | 29 May 72 |
| DRAFTING APPROVAL E. WILLIAMS | 31 MAY 72 |
| MECH DSGN APPROVAL K. HENRY | 14 JULY 72 |
| ELEC DSGN APPROVAL | |
| OTHER APPROVAL | |
| PROJECT APPROVAL R. F. Randall | 7/19/72 |

UNIVERSITY OF IOWA
DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA

# REAR PRESSURE PLATE

| DRAWING IDENTIFICATION | | | | |
|---|---|---|---|---|
| CODE | SERIES | SIZE | DESIGNATION | REV |
| 02542 | 76 | A | 0009 | 1 |
| SCALE 2/1 | WEIGHT | | SHEET OF | |

| REVISIONS | | | | |
|---|---|---|---|---|
| ZONE | NO. | DESCRIPTION | DATE | APPROVED |
| | 1 | GENERAL REVISION | 21 JUN 72 | SK |




UNLESS OTHERWISE SPECIFIED,

NOTE:

| | | |
|---|---|---|
| DO NOT SCALE PRINT | DRAWN SALA KNIPFER | DATE 2 JUNE 72 |
| UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES WITH TOLERANCES ON FRACTIONS ±1/64, DECIMALS .XX ±.01 .XXX ±.005, ANGLES ±0°15' | DESIGNED E. Williams | 2 June 72 |
| | DRAFTING APPROVAL E. Williams | June 72 |
| | MECH DSGN APPROVAL K. HENRY | 14 July 72 |
| | ELEC DSGN APPROVAL | |
| MATERIAL TEFLON | OTHER APPROVAL | |
| FINISH | PROJECT APPROVAL R.F. Candall | 7/14/72 |

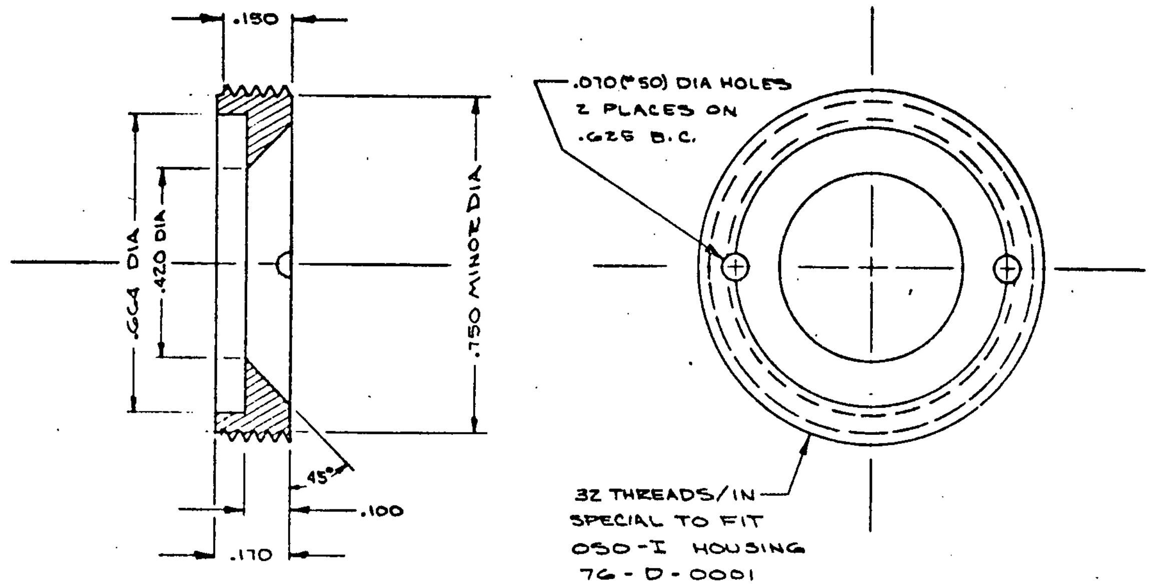
| USED ON | CALLED FOR ON |
|---|---|
| | |

UNIVERSITY OF IOWA
DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA

FEED THROUGH INSULATOR, RADIATION MONITOR, OSO-I

| DRAWING IDENTIFICATION | | | | |
|---|---|---|---|---|
| CODE | SERIES | SIZE | DESIGNATION | REV |
| 02542 | 76 | B | 0010 | 1 |
| SCALE 5/1 | WEIGHT | | SHEET OF | |

| ZONE | NO. | REVISIONS DESCRIPTION | DATE | APPROVED |
|---|---|---|---|---|
| | | | | |




UNLESS OTHERWISE SPECIFIED,
NOTE:

| USED ON | CALLED FOR ON |
|---|---|
| | |

DO NOT SCALE PRINT

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES WITH TOLERANCES ON FRACTIONS ±1/64, DECIMALS .XX ±.01 .XXX ±.005, ANGLES ±0°15'

MATERIAL: ALUMINUM 6061-T6

FINISH: GOLD IRIDITE

| | | DATE |
|---|---|---|
| DRAWN | E. WILLIAMS | 7 JUNE 72 |
| DESIGNED | E. WILLIAMS | 7 JUNE 72 |
| DRAFTING APPROVAL | K. Henry | 14 July 72 |
| MECH DSGN APPROVAL | K. Henry | 14 July 72 |
| ELEC DSGN APPROVAL | | |
| OTHER APPROVAL | | |
| PROJECT APPROVAL | R.F. Randall | 7/14/72 |

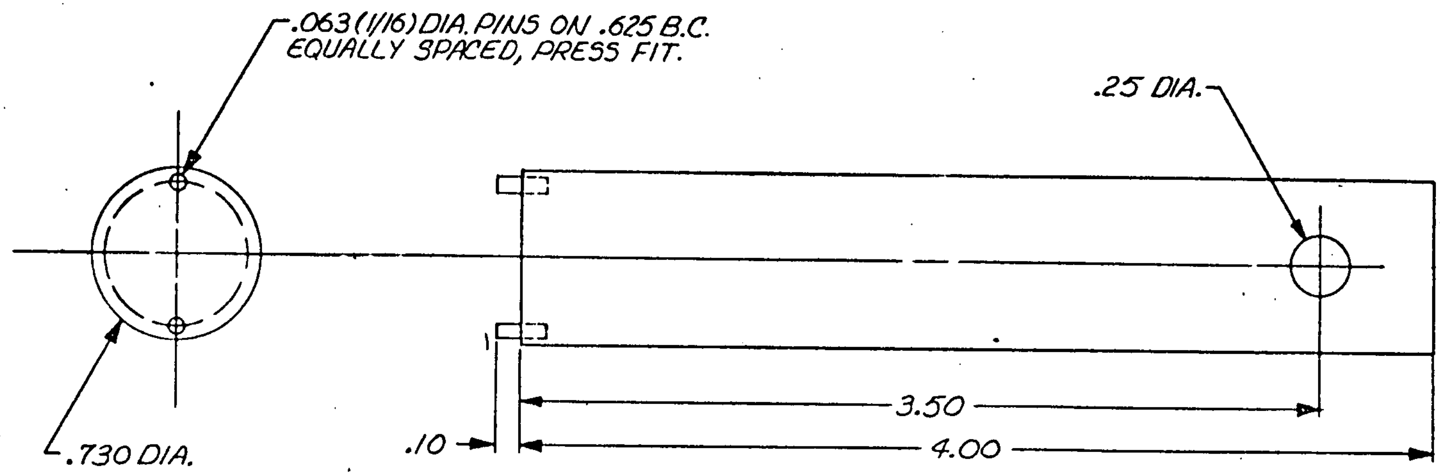
**UNIVERSITY OF IOWA**
DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA

RETAINING RING,
GM DETECTOR

DRAWING IDENTIFICATION

| CODE | PROJECT | SIZE | DESIGNATION | REV |
|---|---|---|---|---|
| 02542 | 76 | C | 0011 | 0 |

SCALE 5/1 WEIGHT SHEET OF




UNLESS OTHERWISE SPECIFIED,

NOTE:

| | |
|---|---|
| DO NOT SCALE PRINT | |
| UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES WITH TOLERANCES ON FRACTIONS ±1/64, DECIMALS .XX ±.01, .XXX ±.005, ANGLES ±0°15' | |
| MATERIAL | AL |
| FINISH | |

| | | |
|---|---|---|
| DRAWN | SALA KNIPFER | 9 JUNE 72 |
| DESIGNED | E. WILLIAMS | 7 JUNE 72 |
| DRAFTING APPROVAL | Williams | 7 June 72 |
| MECH DSGN APPROVAL | K. Henry | 14 JULY 72 |
| ELEC DSGN APPROVAL | | |
| OTHER APPROVAL | | |
| PROJECT APPROVAL | R. F. Randall | 7/14/72 |

UNIVERSITY OF IOWA
DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA

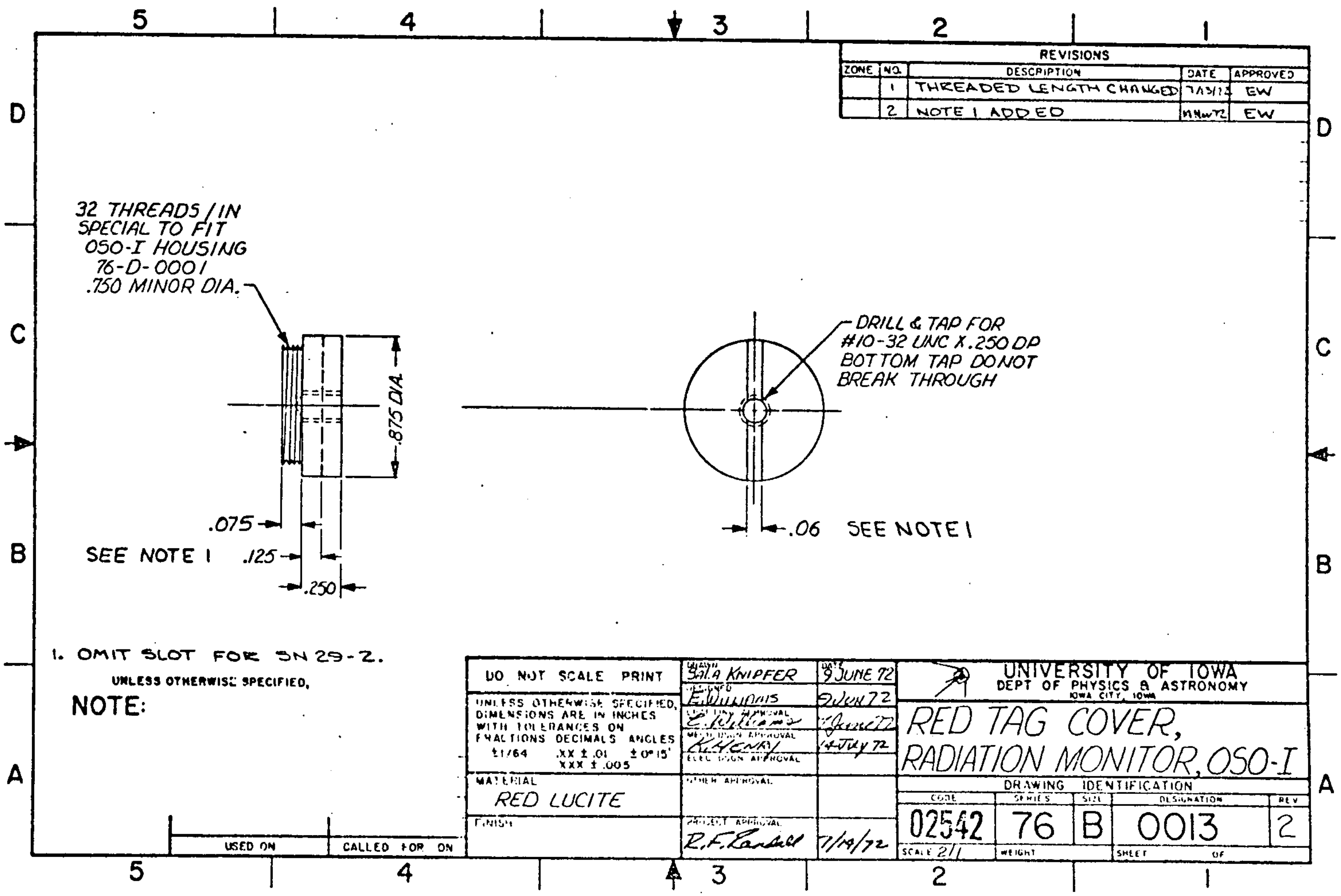
WRENCH, RETAINING RING
GM DETECTOR

DRAWING IDENTIFICATION

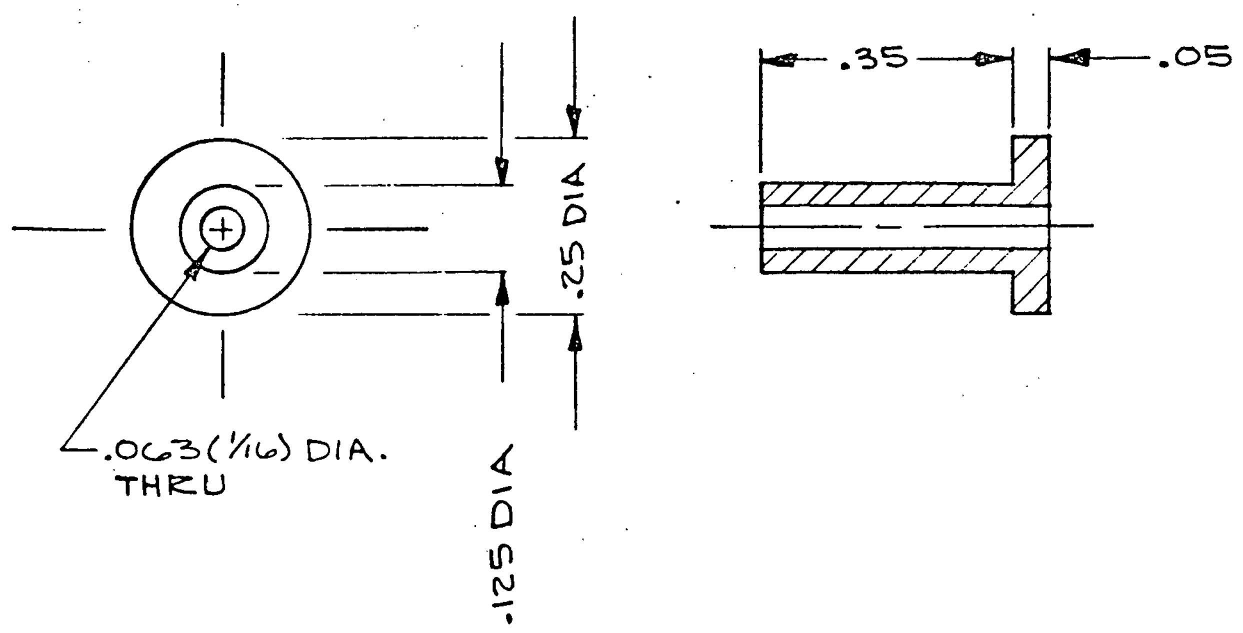
| CODE | SERIES | SIZE | DESIGNATION | REV |
|---|---|---|---|---|
| 02542 | 76 | B | 0012 | 0 |
| SCALE 2/1 | WEIGHT | | SHEET OF | |

| USED ON | CALLED FOR ON |
|---|---|
| | |

| ZONE | NO. | REVISIONS DESCRIPTION | DATE | APPROVED |
|---|---|---|---|---|
| | | | | |


REVISIONS
ZONE | NO. | DESCRIPTION | DATE | APPROVED
1 THREADED LENGTH CHANGED 7/13/72 EW
2 NOTE 1 ADDED 11Nov72 EW
32 THREADS / IN
SPECIAL TO FIT
OSO-I HOUSING
76-D-0001
.750 MINOR DIA.
.875 DIA.
.075
SEE NOTE 1
.125
.250
DRILL & TAP FOR
#10-32 UNC X .250 DP
BOTTOM TAP DO NOT
BREAK THROUGH
.06 SEE NOTE 1
1. OMIT SLOT FOR SN 29-2.
UNLESS OTHERWISE SPECIFIED,
NOTE:
DO NOT SCALE PRINT
UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES WITH TOLERANCES ON FRACTIONS DECIMALS ANGLES ±1/64 .XX ± .01 ±0°15' .XXX ± .005
MATERIAL
RED LUCITE
FINISH
USED ON
CALLED FOR ON
DRAWN S.L.A. KNIPFER 9 JUNE 72
DESIGNED E. Williams 9 Jun 72
ELECT. ENG. APPROVAL
MECH. DSGN. APPROVAL K. Henry 14 July 72
ELEC. DSGN. APPROVAL
OTHER APPROVAL
PROJECT APPROVAL R. F. Randall 7/14/72
UNIVERSITY OF IOWA
DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA
RED TAG COVER,
RADIATION MONITOR, OSO-I
DRAWING IDENTIFICATION
CODE 02542
SERIES 76
SIZE B
DESIGNATION 0013
REV 2
SCALE 2/1
WEIGHT
SHEET OF

| USED ON | CF ON | REVISIONS | | | |
|---|---|---|---|---|---|
| | | SYM | DESCRIPTION | DATE | APPROVED |

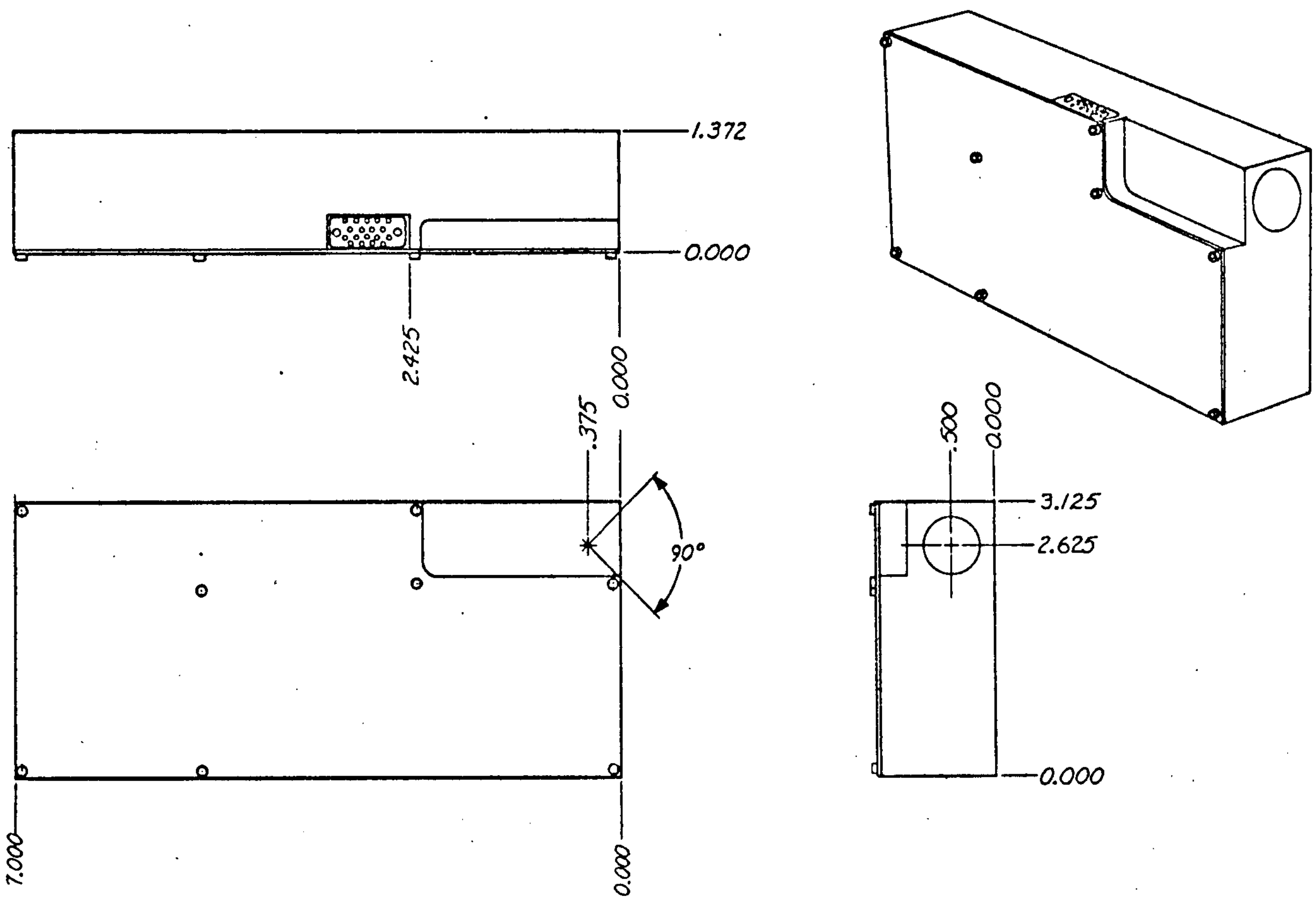



MAT'L - TEFLON

| | | |
|---|---|---|
| DRAWN E. WILLIAMS | DATE 18 AUG 72 | UNIVERSITY OF IOWA<br>DEPT OF PHYSICS & ASTRONOMY<br>IOWA CITY, IOWA |
| DESIGNED E. Williams | 17 Aug 72 | FEEDTHROUGH<br>RADIATION MONITOR, OSO I |
| DRAFTING APPROVAL [signature] | 21 Aug 72 | |
| MECH DSGN APPROVAL [signature] | 21 Aug 72 | |
| ELEC DSGN APPROVAL | | |
| OTHER APPROVAL | | DRAWING IDENTIFICATION |
| PROJECT APPROVAL C.F. Kandall | 8/21/72 | |

| CODE | SERIES | SIZE | DESIGNATION | REV |
|---|---|---|---|---|
| 02542 | 76 | A | 0017 | 0 |
| SCALE 4:1 | WEIGHT | | SHEET OF | |

| REVISIONS | | | | |
|---|---|---|---|---|
| ZONE | NO. | DESCRIPTION | DATE | APPROVED |
| | 1 | GENERAL UPDATE | 13JUL72 | SK |



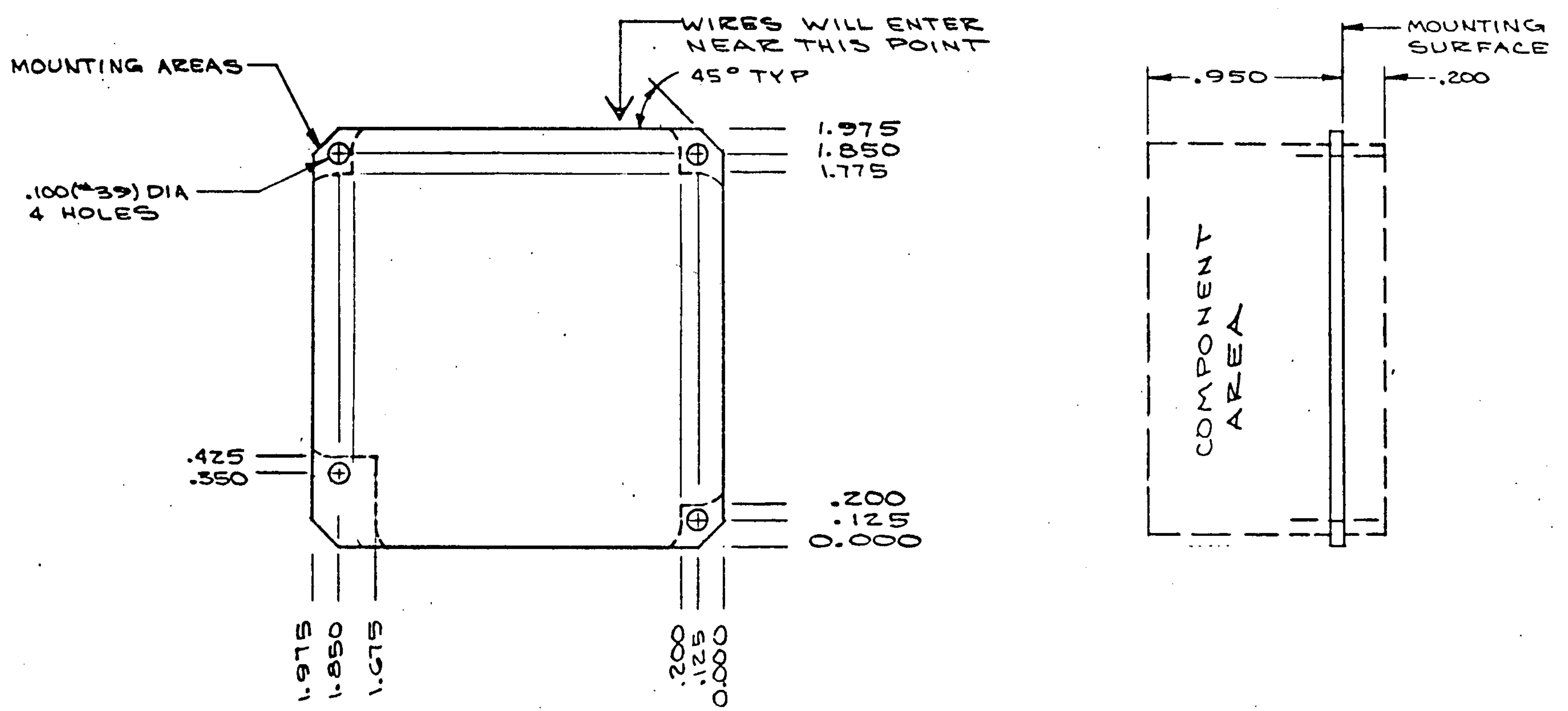

| | | | |
|---|---|---|---|
| DO NOT SCALE PRINT | DRAWN Bala Knipfer | DATE 13 JULY 72 | UNIVERSITY OF IOWA DEPT OF PHYSICS & ASTRONOMY IOWA CITY, IOWA |
| UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES WITH TOLERANCES ON FRACTIONS ±1/64 DECIMALS .XX ± .01 .XXX ± .005 ANGLES ± 0°15' | DESIGNED | 13 Jul 72 | RADIATION MONITOR PACKAGE |
| | DRAFTING APPROVAL K. Henry | 14 July 72 | |
| | MECH DSGN APPROVAL | | |
| MATERIAL | ELEC DSGN APPROVAL | | DRAWING IDENTIFICATION |
| | OTHER APPROVAL | | CODE 02542 · 76 · SIZE C · DESIGNATION 1000 · REV 1 |
| FINISH | PROJECT APPROVAL R. F. Randall | 7/19/72 | SCALE 1/1 · WEIGHT · SHEET · OF |

UNLESS OTHERWISE SPECIFIED,
NOTE:

USED ON | CALLED FOR ON

31

| REVISIONS | | | | |
|---|---|---|---|---|
| ZONE | NO. | DESCRIPTION | DATE | APPROVED |
| | 1 | MOUNTING LUG CHANGED | 6-6-72 | EW |




UNLESS OTHERWISE SPECIFIED,

NOTE:

| USED ON | CALLED FOR ON |
|---|---|

DO NOT SCALE PRINT

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES WITH TOLERANCES ON:
FRACTIONS ±1/64 DECIMALS .XX ± .01 .XXX ± .005 ANGLES ± 0° 15'

MATERIAL N.A.

FINISH N.A.

| | | |
|---|---|---|
| DRAWN | E. WILLIAMS | DATE 25 MAY 72 |
| DESIGNED | E. Williams | 25 May 72 |
| DRAFTING APPROVAL | B. Henry | 14 JULY 72 |
| MECH DSGN APPROVAL | | |
| ELEC DSGN APPROVAL | | |
| OTHER APPROVAL | | |
| PROJECT APPROVAL | R. F. Randall | 7/10/72 |

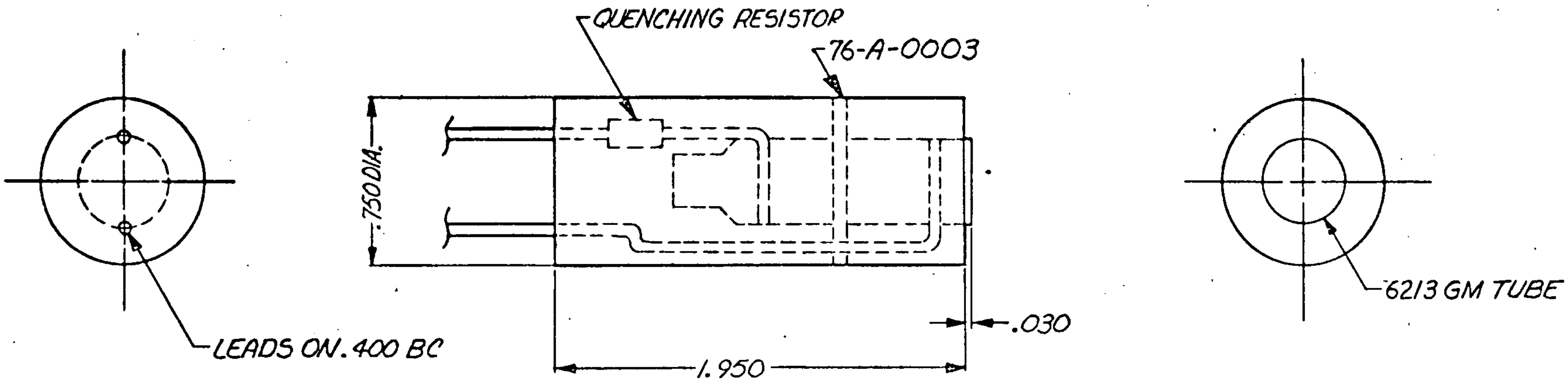
UNIVERSITY OF IOWA
DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA

# RATE METER BOARD, RADIATION MONITOR, OSO-I

DRAWING IDENTIFICATION

| CODE | SERIES | SIZE | DESIGNATION | REV |
|---|---|---|---|---|
| 02542 | 76 | B | 1001 | 1 |

SCALE 2/1 WEIGHT SHEET OF




POTTING MOULD 76-A-0004
76-A-0005
76-A-0006

| REVISIONS | | | | |
|---|---|---|---|---|
| ZONE | NO. | DESCRIPTION | DATE | APPROVED |

UNLESS OTHERWISE SPECIFIED,

NOTE:

DO NOT SCALE PRINT

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES WITH TOLERANCES ON FRACTIONS ±1/64, DECIMALS .XX ± .01, .XXX ± .005, ANGLES ± 0° 15'

MATERIAL

FINISH

USED ON | CALLED FOR ON

| | | |
|---|---|---|
| DRAWN | SALA KNIPFER | 8 JUN 72 |
| DESIGNED | [illegible] Williams | 9 June 72 |
| DRAFTING APPROVAL | [illegible] Williams | 9 June 72 |
| MECH DSGN APPROVAL | R. HENRY | 14 July 72 |
| ELEC DSGN APPROVAL | | |
| OTHER APPROVAL | | |
| PROJECT APPROVAL | R.F. Randall | 7/19/72 |

UNIVERSITY OF IOWA
DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA

GM TUBE, FOAMED
RADIATION MONITOR OSO-I

DRAWING IDENTIFICATION

| CODE | SERIES | SIZE | DESIGNATION | REV |
|---|---|---|---|---|
| 02542 | 76 | B | 1002 | 0 |

SCALE | WEIGHT | SHEET | OF

V.34

# UNIVERSITY OF IOWA
## DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA

CODE NO. 02542

SIZE A

REV NO

TITLE: GM TUBE, FOAMED, RADIATION MONITOR OSO-I

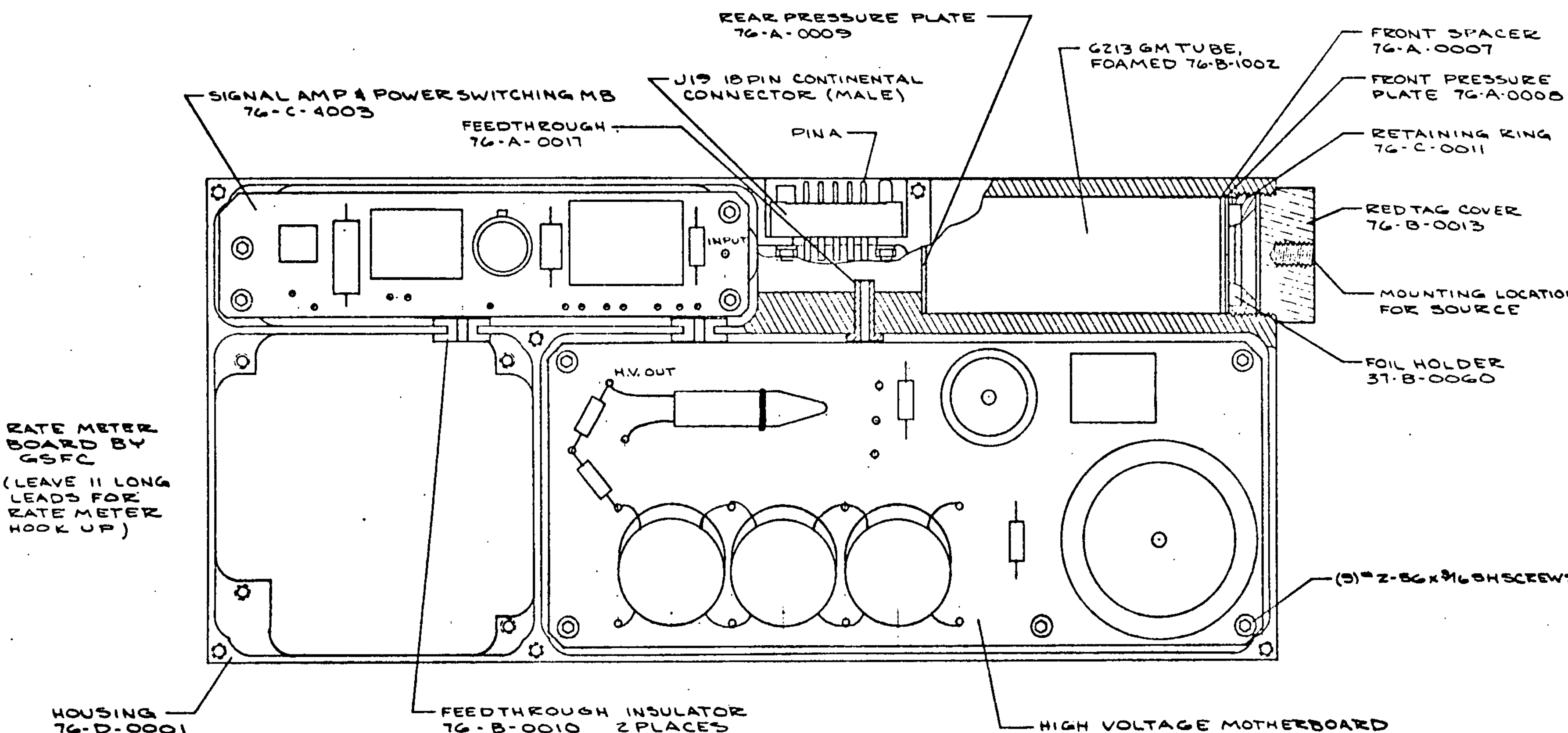
USED ON OSO-I

CF ON 76-C-1003

| GR. NO. & QTY. | | | | PART NO. | NAME | COMP NO. | DRAWING NO., DESCRIPTION | MFR. |
|---|---|---|---|---|---|---|---|---|
| | | | 1 | | GM Tube | | 6213 | EON |
| | | | 1 | | Spacer | | 76-A-0003 | UofI |
| | | | 1 | | Resistor | R21 | 10 M, 1/4 W, RCR07G106JS | AB |
| | | | | | | | | |
| | | | | | Foam | | | |

| DRAWN | DATE | ELEC DSGN APPROVAL | DATE | PARTS LIST FOR |
|---|---|---|---|---|
| E. Williams | 7/13/72 | | | 76-B-1002 |
| DESIGNED | | OTHER APPROVAL | | |
| DRAFTING APPROVAL | | PROJECT APPROVAL | | |
| MECH DSGN APPROVAL | | | | CONT ON SHEET / SH NO. |

| REVISIONS | | | | |
|---|---|---|---|---|
| ZONE | NO. | DESCRIPTION | DATE | APPROVED |
| | 1 | FEEDTHROUGH ADDED | 10AUG72 | EW |




NOT SHOWN

COVER 76-D-0002
(8) #2-56 x 1/8 SH SCREWS
(4) 1185-06 CN .138 HELICOIL INSERTS

UNLESS OTHERWISE SPECIFIED,
NOTE:

| USED ON | CALLED FOR ON |
|---|---|
| | |

DO NOT SCALE PRINT

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES WITH TOLERANCES ON FRACTIONS DECIMALS ANGLES ±1/64 .XX ± .01 ±0°15' .XXX ± .005

MATERIAL

FINISH

| | | |
|---|---|---|
| DRAWN | E. WILLIAMS | DATE 12 JULY 72 |
| DESIGNED | E. Williams | 7/14/72 |
| DRAFTING APPROVAL | K. Hovey | 14 July 72 |
| MECH DSGN APPROVAL | | |
| ELEC DSGN APPROVAL | | |
| OTHER APPROVAL | | |
| PROJECT APPROVAL | R. F. Randall | 7/19/72 |

UNIVERSITY OF IOWA
DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA

MECHANICAL ASSEMBLY, RADIATION MONITOR, OSO-I

DRAWING IDENTIFICATION

| CODE | SERIES | SIZE | DESIGNATION | REV |
|---|---|---|---|---|
| 02542 | 76 | C | 1003 | 1 |

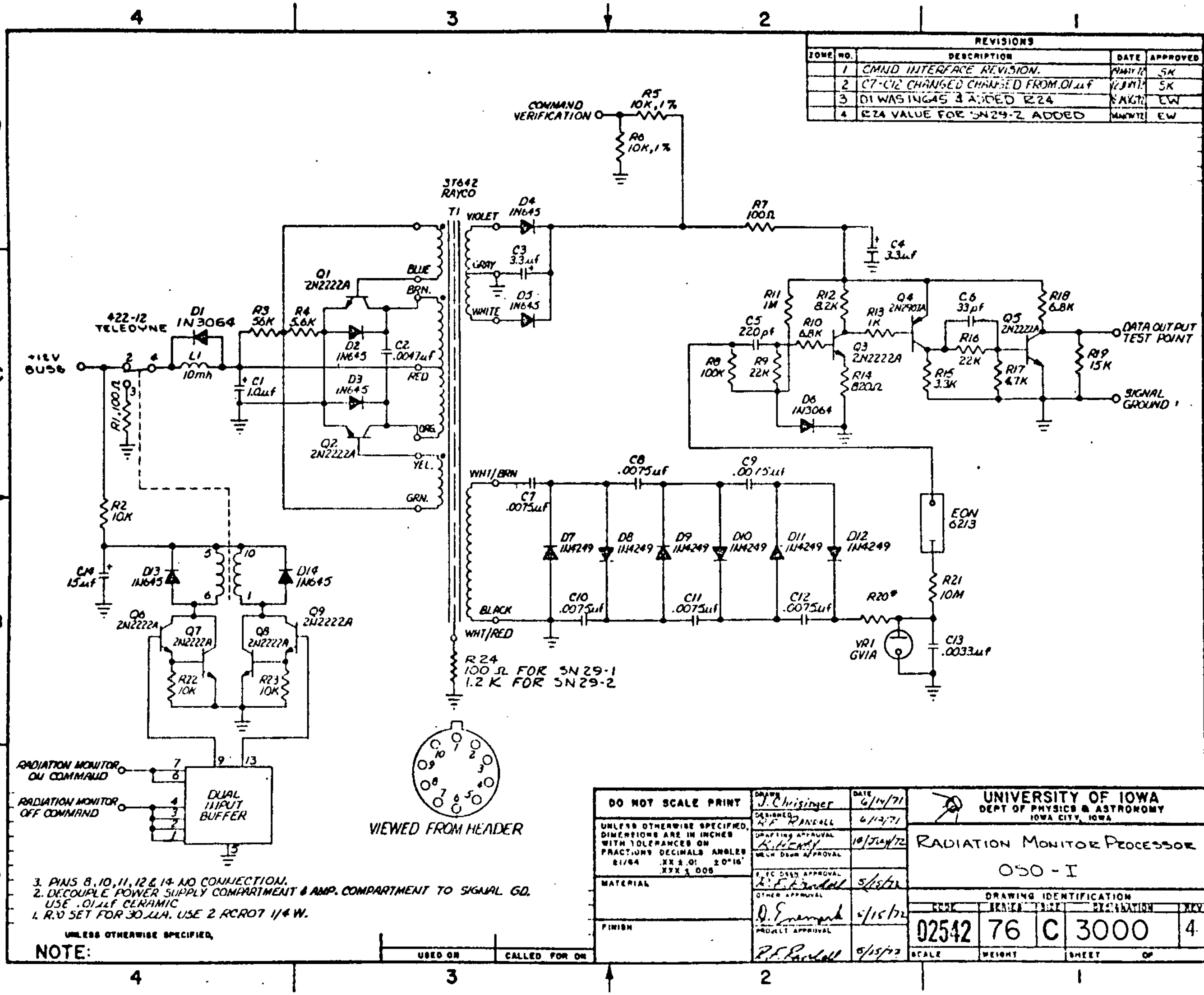
SCALE 2/1 WEIGHT SHEET OF

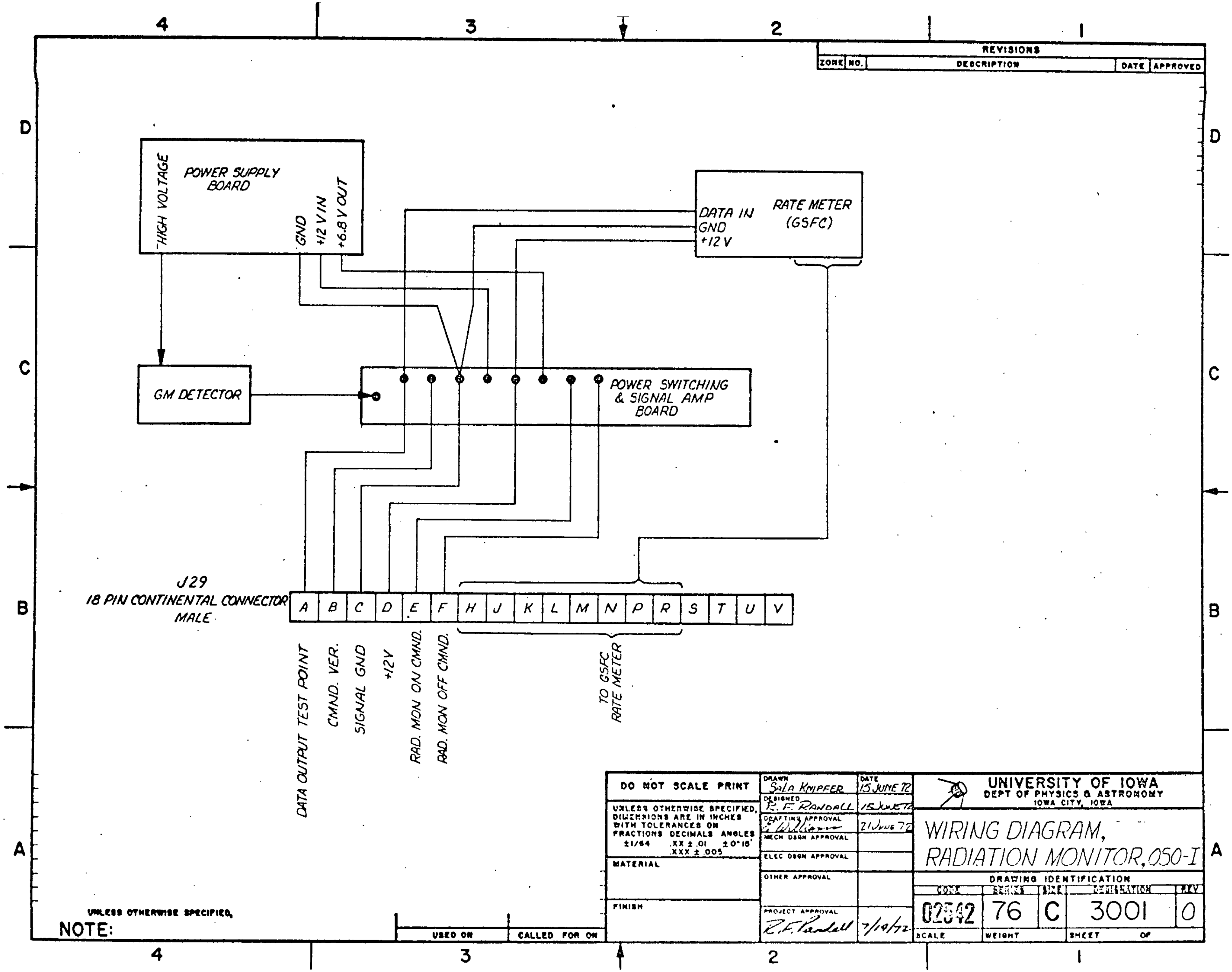
# UNIVERSITY OF IOWA
## DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA

| CODE NO. | REV NO. | TITLE |
|---|---|---|
| 02542 | | MECHANICAL ASSEMBLY, RADIATION MONITOR |
| SIZE A | | USED ON OSO-I CF ON |

| GR. NO. & QTY. | | | | PART NO. | NAME | COMP NO. | DRAWING NO., DESCRIPTION | MFR. |
|---|---|---|---|---|---|---|---|---|
| | | | 1 | | Housing | | 76-D-0001 | UofI |
| | | | 4 | | Helicoil | | 1185-06CN .138 Helicoil Inserts | Helicoil |
| | | | | | | | | |
| | | | 1 | | Rear Plate | | 76-A-0009 | UofI |
| | | | 1 | | GM Tube | | 76-B-1002 | UofI |
| | | | 1 | | Front Spacer | | 76-A-0007 | UofI |
| | | | 1 | | Front Plate | | 76-A-0008 | UofI |
| | | | 1 | | Foil Holder | | 37-B-0060 | UofI |
| | | | 1 | | Retaining Ring | | 76-C-0011 | UofI |
| | | | 1 | | Red Tag Cover | | 76-B-0013 | UofI |
| | | | 1 | | Feed Through | | 76-A-0017 | UofI |
| | | | 2 | | Feed Through | | 76-B-0010 | UofI |
| | | | | | | | | |
| | | | 1 | | Signal Amp MB | | 76-C-4003 | UofI |
| | | | 4 | | Screws | | #2-56 x 3/16 SH Screws | |
| | | | | | | | | |
| | | | 1 | | H.V. Motherboard | | 76-D-4004 | UofI |
| | | | 5 | | Screws | | #2-56 x 3/16 SH Screws | |
| | | | | | | | | |
| | | | 1 | | Connector | | MM18-22 | Continental |
| | | | | | | | | |
| | | | 1 | | Cover | | 76-D-0002 | UofI |
| | | | 8 | | Screws | | #2-56 x 1/8 SH Screws | |
| | | | | | | | | |
| | | | | | Wire | | | |
| | | | | | | | | |
| | | | | | | | | |

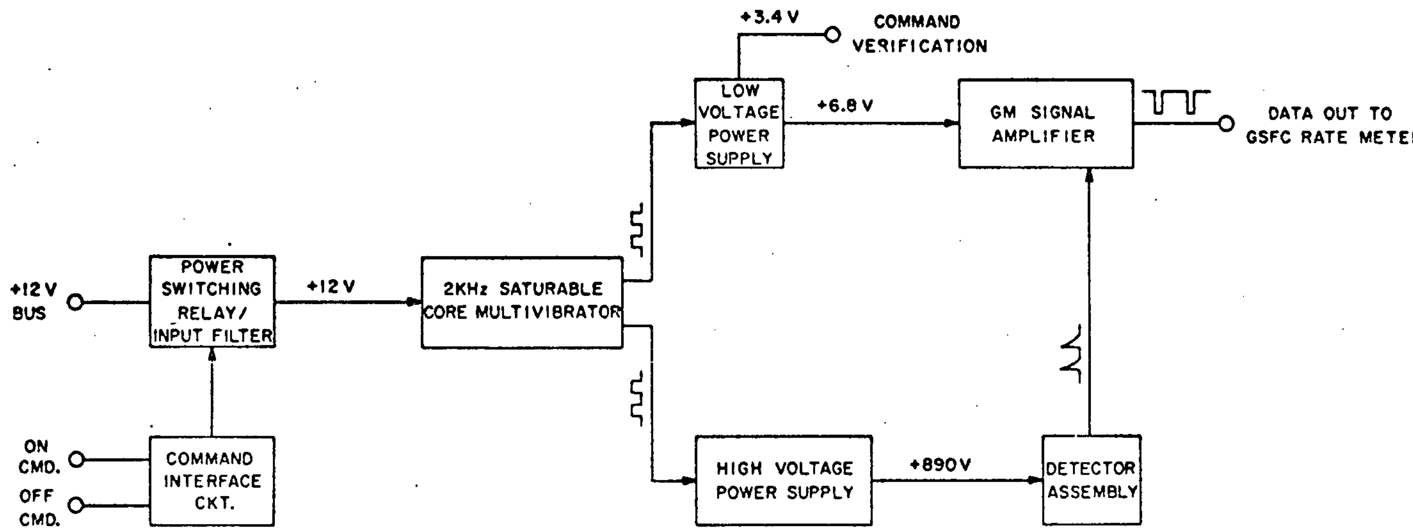
| DRAWN E. Williams | DATE 7/13/72 | ELEC DSGN APPROVAL | DATE | PARTS LIST FOR |
|---|---|---|---|---|
| DESIGNED | | OTHER APPROVAL | | 76-C-1003 |
| DRAFTING APPROVAL | | PROJECT APPROVAL | | |
| MECH DSGN APPROVAL | | | | CONT ON SHEET SH NO. |


REVISIONS
ZONE | NO. | DESCRIPTION | DATE | APPROVED
1 | CMND INTERFACE REVISION. | SK
2 | C7-C12 CHANGED CHANGED FROM .01µf | SK
3 | D1 WAS IN645 & ADDED R24 | EW
4 | R24 VALUE FOR SN29-2 ADDED | EW
COMMAND VERIFICATION
R5 10K, 1%
R6 10K, 1%
3T642 RAYCO
T1
VIOLET
GRAY
WHITE
BLUE
BRN.
RED
ORG.
YEL.
GRN.
D4 1N645
C3 3.3µf
D5 1N645
R7 100Ω
C4 3.3µf
Q1 2N2222A
Q2 2N2222A
D2 1N645
D3 1N645
C2 .0047µf
422-12 TELEDYNE
D1 1N3064
L1 10mh
R3 56K
R4 5.6K
C1 1.0µf
+12V BUSS
R1 100Ω
R2 10K
C14 15µf
D13 1N645
D14 1N645
Q6 2N2222A
Q7 2N2222A
Q8 2N2222A
Q9 2N2222A
R22 10K
R23 10K
RADIATION MONITOR ON COMMAND
RADIATION MONITOR OFF COMMAND
DUAL INPUT BUFFER
R11 1M
R12 8.2K
C5 220pf
R10 6.8K
R8 100K
R9 22K
Q3 2N2222A
R14 820Ω
D6 1N3064
R13 1K
Q4 2N2907A
C6 33pf
R16 22K
R15 3.3K
Q5 2N2222A
R17 4.7K
R18 6.8K
R19 15K
DATA OUTPUT TEST POINT
SIGNAL GROUND
WHT/BRN
C7 .0075µf
C8 .0075µf
C9 .0075µf
D7 1N4249
D8 1N4249
D9 1N4249
D10 1N4249
D11 1N4249
D12 1N4249
C10 .0075µf
C11 .0075µf
C12 .0075µf
BLACK
WHT/RED
EON 6213
R21 10M
R20*
VR1 GV1A
C13 .0033µf
R24 100 Ω FOR SN29-1 1.2 K FOR SN29-2
VIEWED FROM HEADER
3. PINS 8, 10, 11, 12 & 14 NO CONNECTION.
2. DECOUPLE POWER SUPPLY COMPARTMENT & AMP. COMPARTMENT TO SIGNAL GD. USE .01µf CERAMIC
1. R20 SET FOR 30 µA. USE 2 RCR07 1/4 W.
UNLESS OTHERWISE SPECIFIED,
NOTE:
DO NOT SCALE PRINT
UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES WITH TOLERANCES ON FRACTIONS DECIMALS ANGLES ±1/64 .XX ±.01 ±0°15' .XXX ±.005
MATERIAL
FINISH
USED ON
CALLED FOR ON
DRAWN J. Chrisinger 6/14/71
DESIGNED R.F. Randall 6/14/71
DRAFTING APPROVAL K. Hardy 10 JAN 72
PROJECT APPROVAL R.F. Randall 5/15/72
UNIVERSITY OF IOWA
DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA
RADIATION MONITOR PROCESSOR
OSO - I
DRAWING IDENTIFICATION
02542 | 76 | C | 3000 | 4
SCALE
WEIGHT
SHEET OF


REVISIONS
ZONE NO. DESCRIPTION DATE APPROVED
POWER SUPPLY BOARD
HIGH VOLTAGE
GND
+12 V IN
+6.8 V OUT
RATE METER (GSFC)
DATA IN
GND
+12 V
GM DETECTOR
POWER SWITCHING & SIGNAL AMP BOARD
J29
18 PIN CONTINENTAL CONNECTOR MALE
A B C D E F H J K L M N P R S T U V
DATA OUTPUT TEST POINT
CMND. VER.
SIGNAL GND
+12V
RAD. MON ON CMND.
RAD. MON OFF CMND.
TO GSFC RATE METER
DO NOT SCALE PRINT
UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES WITH TOLERANCES ON FRACTIONS DECIMALS ANGLES ±1/64 .XX ± .01 ± 0°15' .XXX ± .005
MATERIAL
FINISH
DRAWN Sala Knipfer
DATE 15 JUNE 72
DESIGNED R. F. RANDALL 15 JUNE 72
DRAFTING APPROVAL E. Williams 21 June 72
MECH DSGN APPROVAL
ELEC DSGN APPROVAL
OTHER APPROVAL
PROJECT APPROVAL R. F. Randall 7/19/72
UNIVERSITY OF IOWA
DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA
WIRING DIAGRAM,
RADIATION MONITOR, OSO-I
DRAWING IDENTIFICATION
CODE SERIES SIZE DESIGNATION REV
02542 76 C 3001 0
SCALE WEIGHT SHEET OF
UNLESS OTHERWISE SPECIFIED,
NOTE:
USED ON
CALLED FOR ON

REVISIONS

| ZONE | NO. | DESCRIPTION | DATE | APPROVED |
|---|---|---|---|---|




UNLESS OTHERWISE SPECIFIED,
NOTE:

| USED ON | CALLED FOR ON |
|---|---|

DO NOT SCALE PRINT

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES WITH TOLERANCES ON FRACTIONS ±1/64, DECIMALS .XX ± .01, .XXX ± .005, ANGLES ± 0°15'

MATERIAL

FINISH

| | | DATE |
|---|---|---|
| DRAWN | J. CHRISINGER | 12 JUL 72 |
| DESIGNED | R.F. RANDALL | 22 JUN 72 |
| DRAFTING APPROVAL | K Henry | 14 July 72 |
| MECH DSGN APPROVAL | | |
| ELEC DSGN APPROVAL | | |
| OTHER APPROVAL | | |
| PROJECT APPROVAL | R.F. Randall | 7/14/72 |

UNIVERSITY OF IOWA
DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA

BLOCK DIAGRAM
RADIATION MONITOR, OSO-I

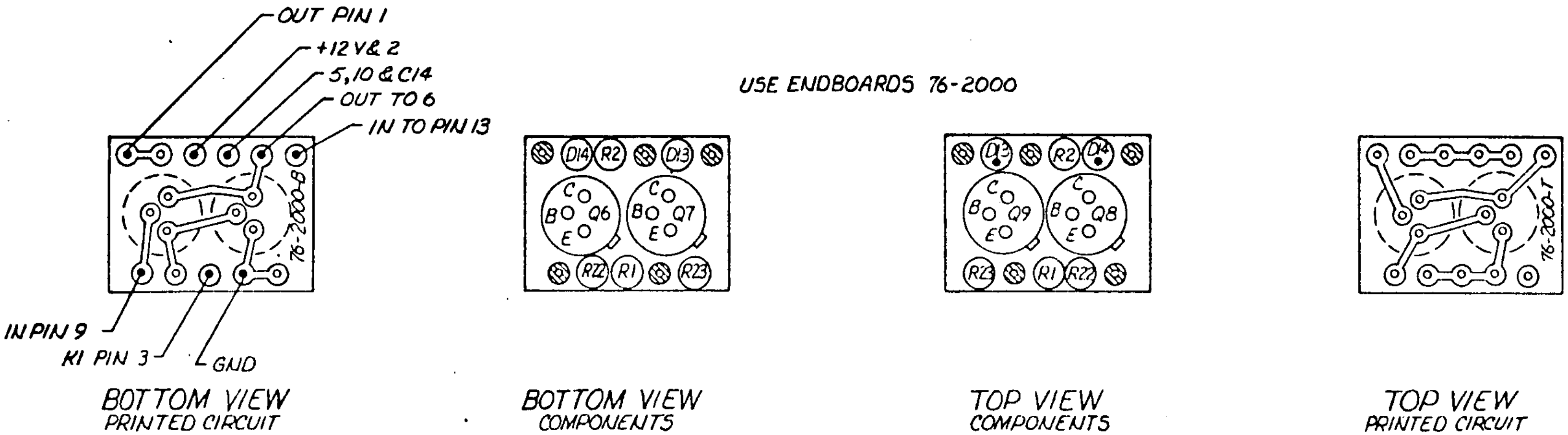
DRAWING IDENTIFICATION

| CODE | SERIES | SIZE | DESIGNATION | REV |
|---|---|---|---|---|
| 02342 | 76 | C | 3002 | 0 |

SCALE | WEIGHT | SHEET | OF

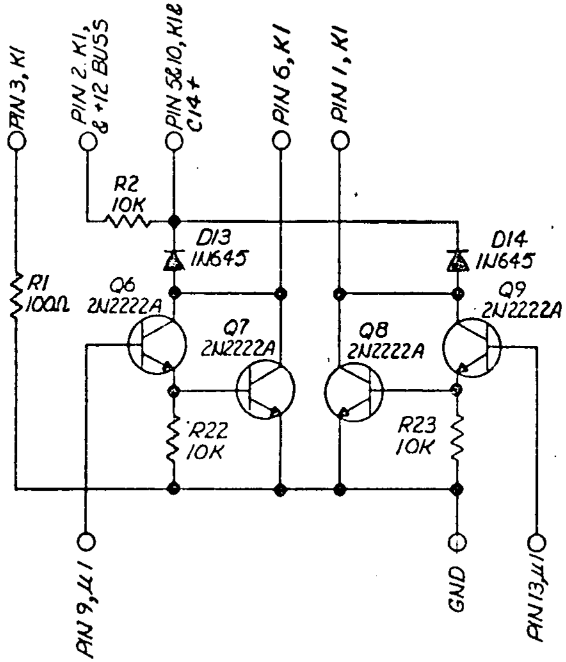
| REVISIONS | | | | |
|---|---|---|---|---|
| ZONE | NO. | DESCRIPTION | DATE | APPROVED |

USE ENDBOARDS 76-2000




PARTS LIST

| | |
|---|---|
| R1 | 100Ω |
| R2 | 10K |
| R22 | 10K |
| R23 | 10K |
| D13 | 1N645 |
| D14 | 1N645 |
| Q6 | 2N2222A |
| Q7 | 2N2222A |
| Q8 | 2N2222A |
| Q9 | 2N2222A |




NOTE: UNLESS OTHERWISE SPECIFIED,

1. LEAVE 8 LEADS MARKED ◎ 1-INCH LONG.
2. RISERS TO BE #24 WIRE.
3. SLEEVING TO BE #24 TEFLON.
4. ● INDICATES BANDED END OF DIODE.
5. CONFORMAL COAT MODULE WITH SOLITHANE 113 (CURE AGENT C-113-300)

| USED ON | CALLED FOR ON |
|---|---|
| | |

DO NOT SCALE PRINT

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES WITH TOLERANCES ON FRACTIONS ±1/64, DECIMALS .XX ± .01, .XXX ± .005, ANGLES ± 0° 15'

MATERIAL

FINISH

| | | |
|---|---|---|
| DRAWN | SALA KNIPFER | 6 JUNE 72 |
| DESIGNED | [illegible] | [illegible] 72 |
| DRAFTING APPROVAL | [illegible] | [illegible] 72 |
| MECH DSGN APPROVAL | | |
| ELEC DSGN APPROVAL | | |
| OTHER APPROVAL | | |
| PROJECT APPROVAL | R. F. Randall | 7/14/72 |

UNIVERSITY OF IOWA
DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA

# RELAY DRIVER, RADIATION MONITOR 050-I

DRAWING IDENTIFICATION

| CODE | [illegible] | SIZE | [illegible] | REV |
|---|---|---|---|---|
| 02542 | 76 | C | 4000 | 0 |

SCALE | WEIGHT | SHEET OF

40

UNIVERSITY OF IOWA
DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA

CODE NO. 02542

SIZE A

REV NO

TITLE

# RELAY DRIVER

USED ON OSO-I

CF ON 76-C-4003

| GR. NO. & QTY. | PART NO. | NAME | COMP NO. | DRAWING NO., DESCRIPTION | MFR. |
|---|---|---|---|---|---|
| 1 | | End Board | | 76-2000 T | |
| 1 | | End Board | | 76-2000 B | |
| 1 | | Resistor | R1 | 100Ω, RCR07G101JS | AB |
| 3 | | Resistor | R2, R22, R23 | 10K, RCR07G103JS | AB |
| 2 | | Diodes | D13, D14 | 1N645JANTX | ITT |
| 4 | | Transistors | Q6, Q7, Q8, Q9 | 2N2222A JANTX | Fairchild |
| 4 | | Transistor Pads | | 7717-16N | Thermalloy |

DRAWN E. Williams

DATE 7/13/72

ELEC DSGN APPROVAL

DATE

DESIGNED

OTHER APPROVAL

DRAFTING APPROVAL

PROJECT APPROVAL

MECH DSGN APPROVAL

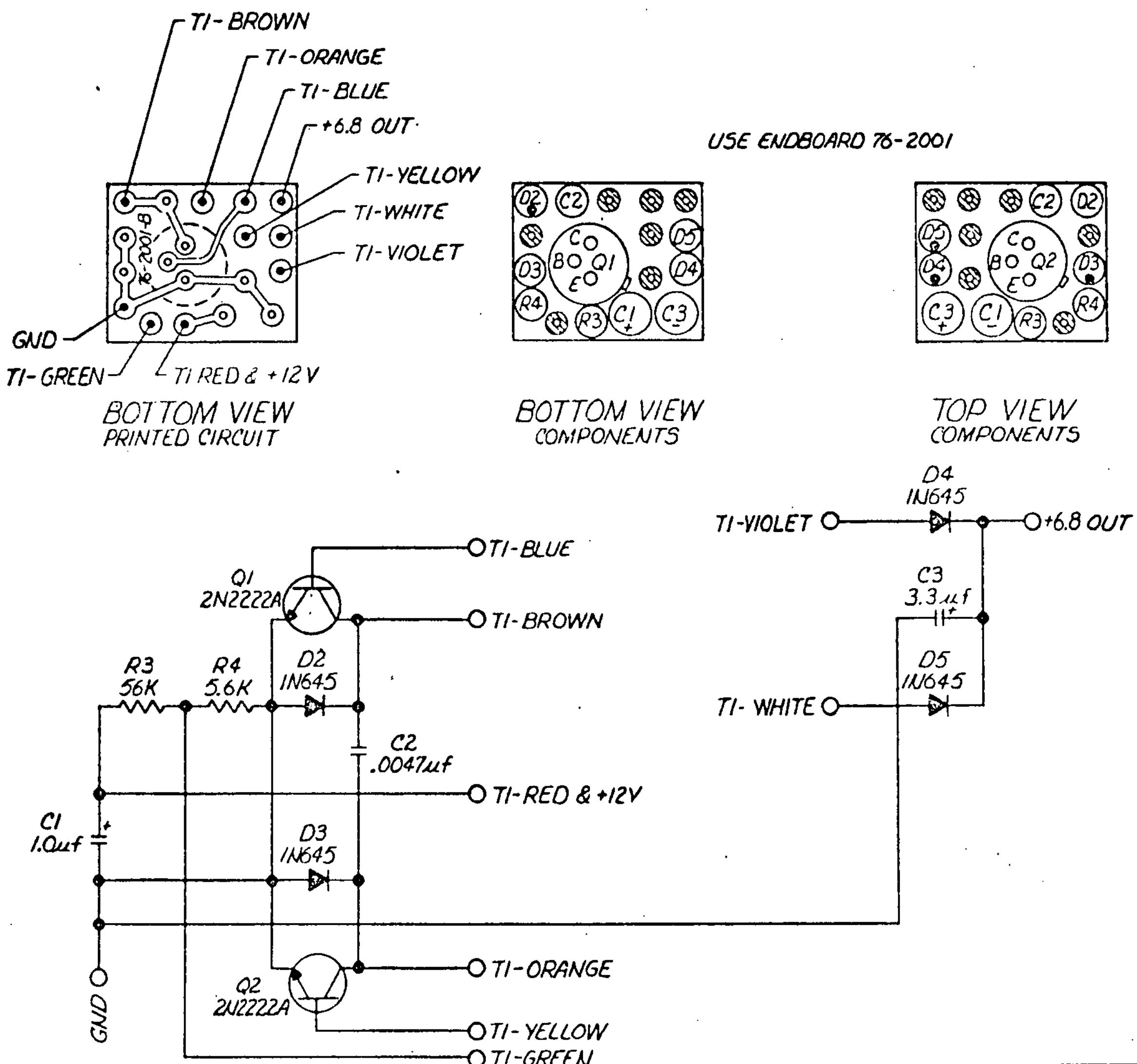
PARTS LIST FOR

76-C-4000

CONT ON SHEET

SH NO.

| REVISIONS | | | | |
|---|---|---|---|---|
| ZONE | NO. | DESCRIPTION | DATE | APPROVED |




PARTS LIST

| | |
|---|---|
| C1 | 1.0 µf |
| C2 | .0047µf |
| C3 | 3.3 µf |
| D2 | 1N645 |
| D3 | 1N645 |
| D4 | 1N645 |
| D5 | 1N645 |
| Q1 | 2N2222A |
| Q2 | 2N2222A |
| R3 | 56 K |
| R4 | 5.6 K |

NOTE:

5. CONFORMAL COAT MODULE WITH SOLITHANE 113 (CURE AGENT C-113-300).
4. ● INDICATES BANDED END OF DIODE.
3. RISERS TO BE #24 WIRE.
2. SLEEVING TO BE #24 TEFLON.
1. LEAVE 10 LEADS MARKED ⊙ 1-INCH LONG.
UNLESS OTHERWISE SPECIFIED.

USED ON | CALLED FOR ON

DO NOT SCALE PRINT

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES WITH TOLERANCES ON FRACTIONS ±1/64, DECIMALS .XX ±.01 .XXX ±.005, ANGLES ±0°15'

MATERIAL

FINISH

DRAWN: SALA KNIPFER — DATE: 7 JUNE 72
DESIGNED BY: [signature] — 9 Jun 72
DRAFTING APPROVAL: [signature] — 9 Jun 72
MECH DSGN APPROVAL
ELEC DSGN APPROVAL
OTHER APPROVAL
PROJECT APPROVAL: [signature] — 7/19/72

UNIVERSITY OF IOWA
DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA

# CHOPPER, RADIATION MONITOR, OSO-I

DRAWING IDENTIFICATION

| CODE | SERIES | SIZE | DESIGNATION | REV |
|---|---|---|---|---|
| 02542 | 76 | C | 4001 | 0 |

SCALE | WEIGHT | SHEET OF

UNIVERSITY OF IOWA
DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA

CODE NO. 02542

SIZE A

REV NO

TITLE

CHOPPER MODULE

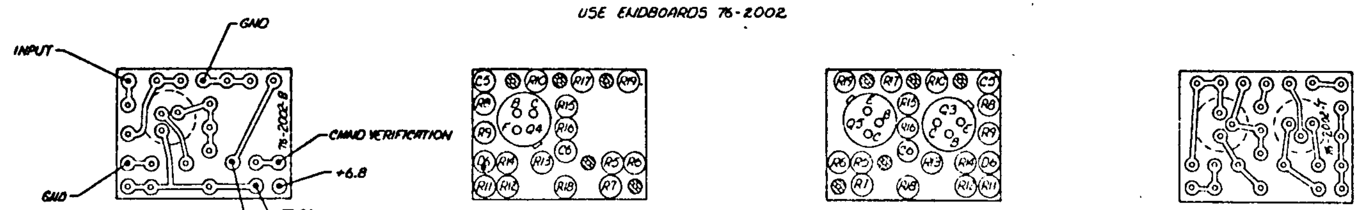
USED ON OSO-I

CF ON 76-C-4004

| GR. NO. & QTY. | | | | PART NO. | NAME | COMP NO. | DRAWING NO., DESCRIPTION | MFR. |
|---|---|---|---|---|---|---|---|---|
| | | | 1 | | Endboard | | 76-2001T | |
| | | | 1 | | Endboard | | 76-2001B | |
| | | | | | | | | |
| | | | 1 | | Resistor | R3 | 56K, RCR07G563JS | AB |
| | | | 1 | | Resistor | R4 | 5.6K, RCR07G562JS | AB |
| | | | | | | | | |
| | | | 4 | | Diodes | D4, D5 D2, D3, | 1N645 JANTX | |
| | | | | | | | | |
| | | | 1 | | Capacitor | C1 | 1.0µf, CSR13G105KP | Kemet |
| | | | 1 | | Capacitor | C2 | .0047µf, CKR12BX472KP | Kemet |
| | | | 1 | | Capacitor | C3 | 3.3µf, CSR13D335KP | Kemet |
| | | | | | | | | |
| | | | 2 | | Transistors | Q1, Q2 | 2N2222A JANTX | Fairchild |
| | | | 2 | | Transistor Pads | | 7717-16N | Thermalloy |

| | | | | |
|---|---|---|---|---|
| DRAWN E. Williams | DATE 7/13/72 | ELEC DSGN APPROVAL | DATE | PARTS LIST FOR 76-C-4001 |
| DESIGNED | | OTHER APPROVAL | | |
| DRAFTING APPROVAL | | PROJECT APPROVAL | | |
| MECH DSGN APPROVAL | | | | CONT ON SHEET / SH NO. |

USE ENDBOARDS 76-2002

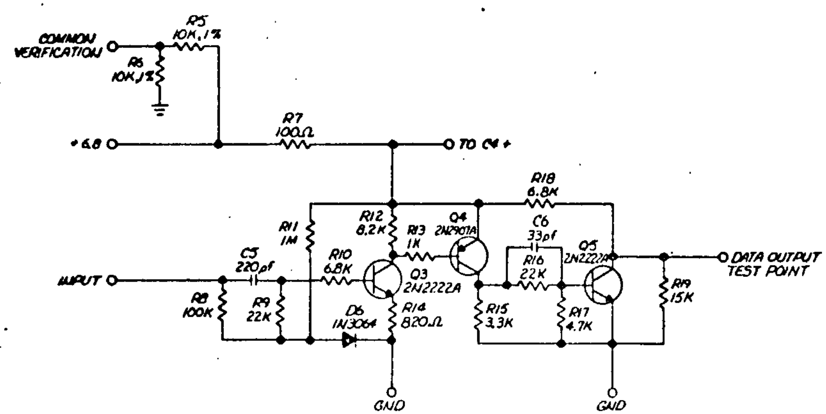



BOTTOM VIEW
PRINTED CIRCUIT

BOTTOM VIEW
COMPONENTS

TOP VIEW
COMPONENTS

TOP VIEW
PRINTED CIRCUIT




PARTS LIST

| | |
|---|---|
| C5 | 220pf |
| C6 | 33pf |
| D6 | 1N3064 |
| R5 | 10K,1% |
| R6 | 10K,1% |
| R7 | 100Ω |
| R8 | 100K |
| R9 | 22K |
| R10 | 6.8K |
| R11 | 1M |
| R12 | 8.2K |
| R13 | 1K |
| R14 | 820Ω |
| R15 | 3.3K |
| R16 | 22K |
| R17 | 4.7K |
| R18 | 6.8K |
| R19 | 15K |
| Q3 | 2N2222A |
| Q4 | 2N2907A |
| Q5 | 2N2222A |

5. CONFORMAL COAT MODULE WITH SOLITHANE 113 (CURE AGENT C-113-300).
4. ● INDICATES BANDED END OF DIODE.
3. SLEEVING TO BE #24 TEFLON.
2. RISER TO BE #24 WIRE.
1. LEAVE 7 LEADS MARKED ⊙ 1-INCH LONG.

UNLESS OTHERWISE SPECIFIED.
NOTE:

REVISIONS

| ZONE | NO. | DESCRIPTION | DATE | APPROVED |
|---|---|---|---|---|

DO NOT SCALE PRINT

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES WITH TOLERANCES ON FRACTIONS DECIMALS ANGLES ±1/64 .XX ±.01 ±0°15' .XXX ±.005

MATERIAL

FINISH

USED ON | CALLED FOR ON

DRAWN A. KUIPER 6 JUNE 72

PROJECT APPROVAL R F [signature] 1/19/72

UNIVERSITY OF IOWA
DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA

SIGNAL AMP, RADIATION MONITOR, OSO-I

DRAWING IDENTIFICATION

| CODE | | SIZE | NUMBER | REV |
|---|---|---|---|---|
| 02542 | 76 | D | 4002 | 0 |

SCALE | WEIGHT | SHEET OF

345

# UNIVERSITY OF IOWA
## DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA

CODE NO. 02542

SIZE A

REV NO

TITLE SIGNAL AMP

USED ON OSO-I

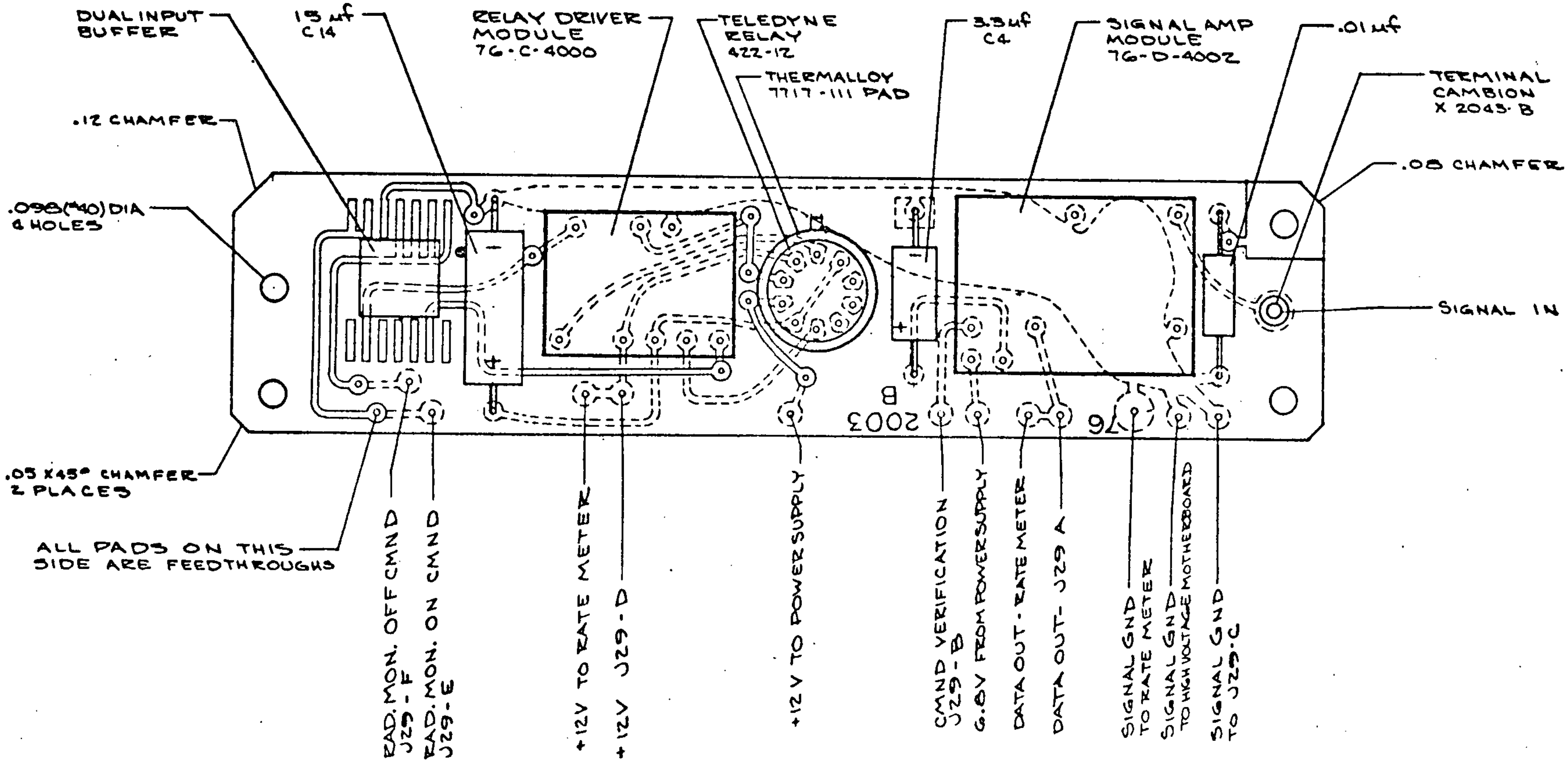
CF ON 76-C-4003

| GR. NO. & QTY. | PART NO. | NAME | COMP NO. | DRAWING NO., DESCRIPTION | MFR. |
|---|---|---|---|---|---|
| 1 | | Endboard | | 76-2002T | |
| 1 | | Endboard | | 76-2002B | |
| | | | | | |
| 2 | | Resistor | R5, R6 | 10K, 1%, RNC55H1002FR | Mepco |
| 1 | | Resistor | R7 | 100Ω, RCR07G101JS | AB |
| 1 | | Resistor | R14 | 820Ω, RCR07G821JS | AB |
| 1 | | Resistor | R13 | 1K, RCR07G102JS | AB |
| 1 | | Resistor | R15 | 3.3K, RCR07G332JS | AB |
| 1 | | Resistor | R17 | 4.7 K, RCR07G472JS | AB |
| 2 | | Resistor | R10, R18 | 6.8K, RCR07G682JS | AB |
| 1 | | Resistor | R12 | 8.2K, RCR07G82JS | AB |
| 1 | | Resistor | R19 | 15K, RCR07G153JS | AB |
| 2 | | Resistor | R16 | 22K, RCR07G223JS | AB |
| 1 | | Resistor | R8 | 100K, RCR07G104JS | AB |
| 1 | | Resistor | R11 | 1M, RCR07G105JS | AB |
| | | | | | |
| 1 | | Diode | D6 | 1N3064 JANTX | Fairchild |
| | | | | | |
| 1 | | Capacitor | C5 | 220 pf, CKR12BX221KP | Kemet |
| 1 | | Capacitor | C6 | 33 pf, CKR12BX330KP | Kemet |
| | | | | | |
| 2 | | Transistor | Q3, Q5 | 2N2222A JANTX | Fairchild |
| 1 | | Transistor | Q4 | 2N2907A JANTX | Fairchild |
| | | | | | |
| 3 | | Transistor Pad | | 7717-16N | Thermalloy |

| | | | | |
|---|---|---|---|---|
| DRAWN E. Williams | DATE 7/13/72 | ELEC DSGN APPROVAL | DATE | PARTS LIST FOR |
| DESIGNED | | OTHER APPROVAL | | 76-D-4002 |
| DRAFTING APPROVAL | | PROJECT APPROVAL | | |
| MECH DSGN APPROVAL | | | | CONT ON SHEET  SH NO. |

| REVISIONS | | | | |
|---|---|---|---|---|
| ZONE | NO. | DESCRIPTION | DATE | APPROVED |

USE BOARD 76-2003




NOTE: UNLESS OTHERWISE SPECIFIED,

1. CONFORMAL COAT ASSEMBLY WITH SOLITHANE 113 (CURE AGENT C-113-300).

| USED ON | CALLED FOR ON |
|---|---|
| | |

DO NOT SCALE PRINT

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES WITH TOLERANCES ON FRACTIONS ±1/64, DECIMALS .XX ±.01, .XXX ±.005, ANGLES ±0°15'

MATERIAL

FINISH

| | | |
|---|---|---|
| DRAWN | E. WILLIAMS | DATE 7 July 72 |
| DESIGNED | E. Williams | 7 July 72 |
| DRAFTING APPROVAL | K. HENRY | 14 July 72 |
| MECH DSGN APPROVAL | | |
| ELEC DSGN APPROVAL | | |
| OTHER APPROVAL | | |
| PROJECT APPROVAL | C. F. Kendall | 7/14/72 |

UNIVERSITY OF IOWA
DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA

SIGNAL AMP & POWER SWITCHING MOTHERBOARD ASSEMBLY, RADIATION MONITOR, OSO I

DRAWING IDENTIFICATION

| CODE | SERIES | SIZE | DESIGNATION | REV |
|---|---|---|---|---|
| 02542 | 76 | C | 4003 | 0 |

SCALE 4/1 | WEIGHT | SHEET OF

47

UNIVERSITY OF IOWA
DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA



CODE NO. 02542

SIZE A

REV NO

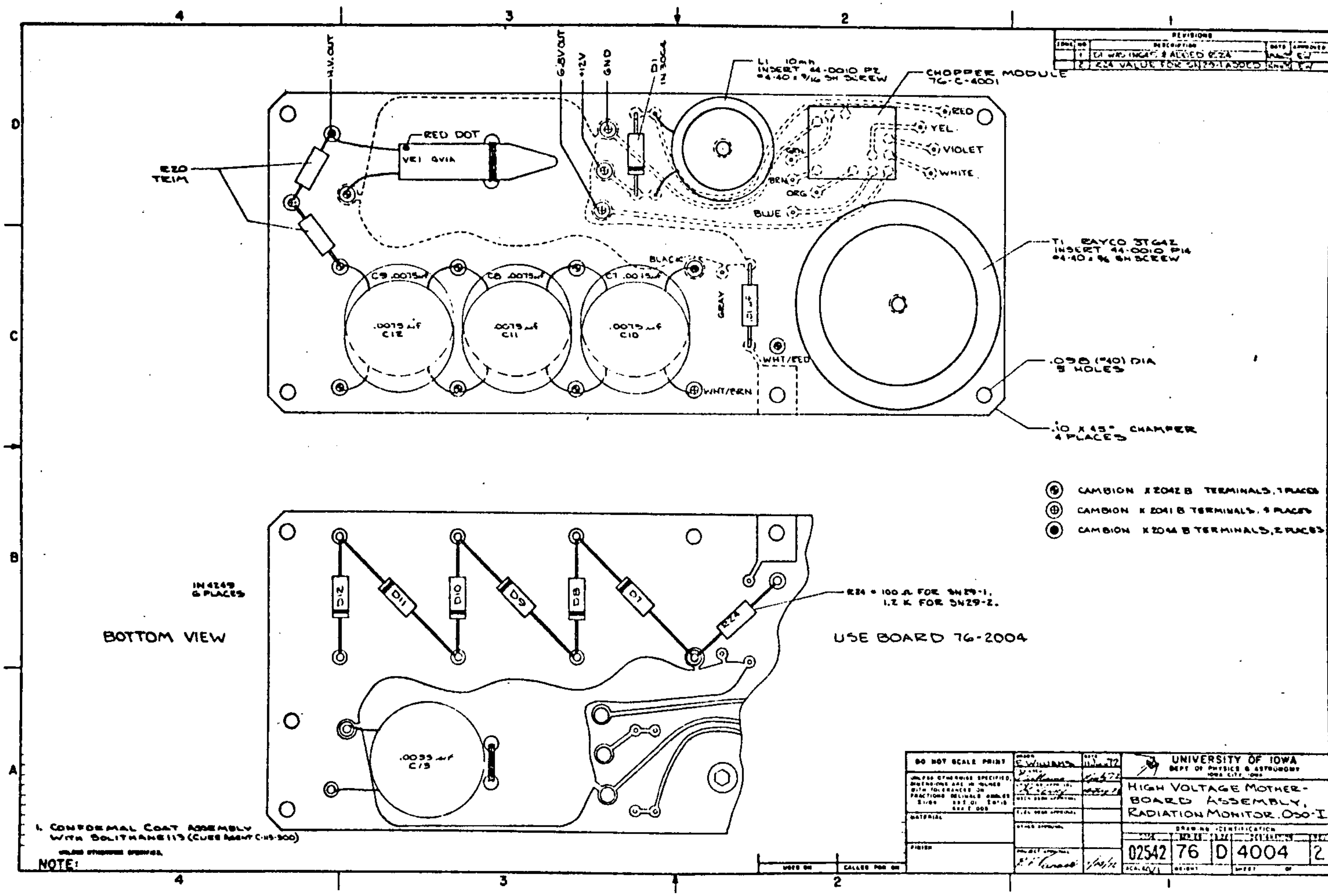
TITLE

SIGNAL AMP & POWER SWITCHING MOTERBOARD ASSEMBLY

USED ON OSO-I CF ON 76-C-1003

| GR. NO. & QTY. | | | | PART NO. | NAME | COMP NO. | DRAWING NO., DESCRIPTION | MFR. |
|---|---|---|---|---|---|---|---|---|
| | | | 1 | | Motherboard | | 76-2003 T&B | |
| | | | 1 | | Signal Amp Mod | | 76-D-4002 | UofI |
| | | | 1 | | Relay Driver Mod | | 76-C-4000 | UofI |
| | | | 1 | | IC | | Dual Input Buffer | Hughes |
| | | | 1 | | Relay | | 422-12 | Teledyne |
| | | | 1 | | Relay Pad | | 7717-111 | Thermalloy |
| | | | 1 | | Capacitor | C14 | 15 $\mu$f, CSR13E156KP | Kemet |
| | | | 1 | | Capacitor | C4 | 3.3 $\mu$f, CSR13D335KP | Kemet |
| | | | 1 | | Capacitor | | .01 $\mu$f, CKR12BX103KP | Kemet |
| | | | 1 | | Terminal | | X2043-B Cambion | |

| | | | | |
|---|---|---|---|---|
| DRAWN E. Williams | DATE 7/13/77 | ELEC DSGN APPROVAL | DATE | PARTS LIST FOR 76-C-4003 |
| DESIGNED | | OTHER APPROVAL | | |
| DRAFTING APPROVAL | | | | |
| MECH DSGN APPROVAL | | PROJECT APPROVAL | | CONT ON SHEET SH NO. |


H.V. OUT
6.8V OUT
+12V
GND
D1 1N3064
L1 10mh
INSERT 44-0010 P2
#4-40 x 5/16 SH SCREW
CHOPPER MODULE
76-C-4001
RED DOT
VE1 GVIA
R20 TRIM
RED
YEL
VIOLET
WHITE
BRN
ORG
BLUE
BLACK
GRAY
WHT/RED
WHT/BRN
T1 RAYCO 3TG42
INSERT 44-0010 P14
#4-40 x 5/16 SH SCREW
.098 (#40) DIA
5 HOLES
.10 X 45° CHAMFER
4 PLACES
CAMBION X2042 B TERMINALS, 7 PLACES
CAMBION X2041 B TERMINALS, 5 PLACES
CAMBION X2044 B TERMINALS, 2 PLACES
1N4249
6 PLACES
R24 = 100 Ω FOR SN29-1,
1.2 K FOR SN29-2.
BOTTOM VIEW
USE BOARD 76-2004
.0055 µf
C13
1. CONFORMAL COAT ASSEMBLY
WITH SOLITHANE 113 (CURE AGENT C-113-300)
NOTE:
DO NOT SCALE PRINT
UNIVERSITY OF IOWA
DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA
HIGH VOLTAGE MOTHER-
BOARD ASSEMBLY,
RADIATION MONITOR, OSO-I
02542 76 D 4004 2

# UNIVERSITY OF IOWA
## DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA



CODE NO. 02542

SIZE A

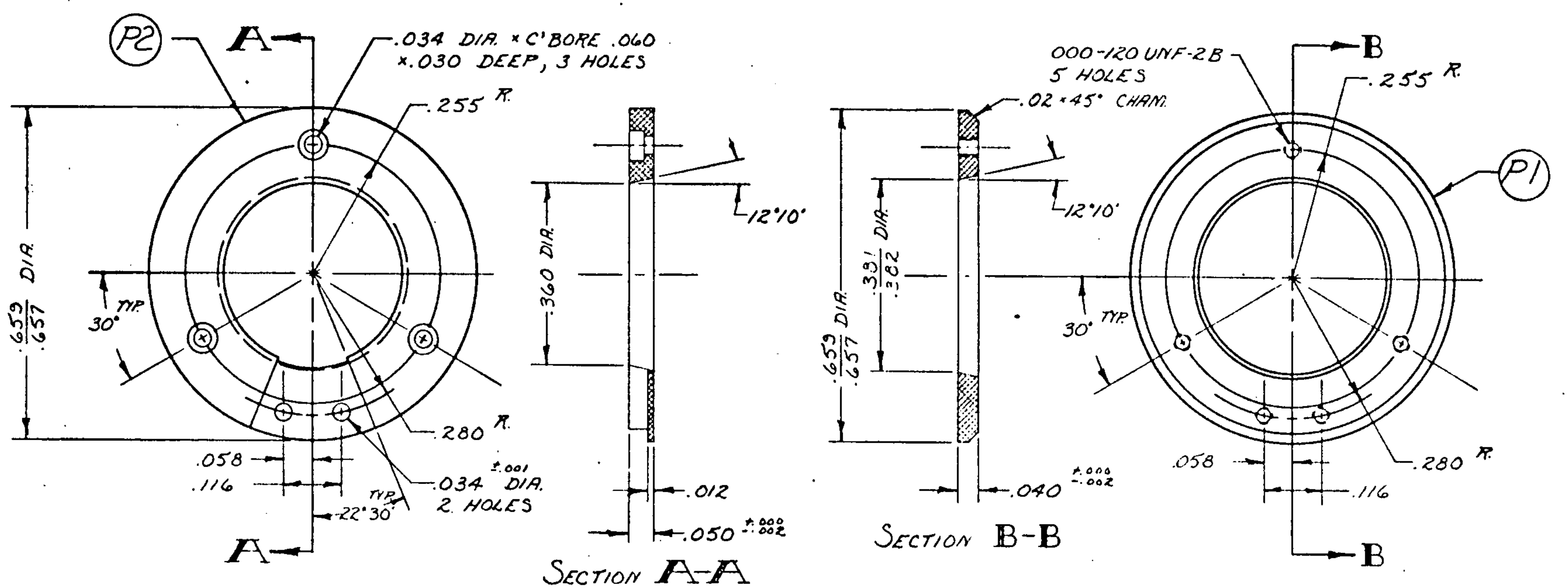
REV NO

TITLE: HIGH VOLTAGE MOTHERBOARD ASSEMBLY

USED ON OSO-I CF ON 76-C-1003

| GR. NO. & QTY. | PART NO. | NAME | COMP NO. | DRAWING NO., DESCRIPTION | MFR. |
|---|---|---|---|---|---|
| 1 | | Motherboard | | 76-2004 | |
| 1 | | Chopper Module | | 76-C-4001 | UofI |
| 1 | | Transformer | T1 | 3T642 | Rayco |
| 1 | | Insert | | 44-0010 P 14 | UofI |
| 1 | | Screw | | #4-40 x 3/4 SH Screw | |
| 1 | | Inductor | L1 | 10mh, V50-5-W | Torotel |
| 1 | | Insert | | 44-0010P2 | UofI |
| 1 | | Screw | | #4-40 x 9/16 SH Screw | |
| 1 | | Diode | D1 | IN3064 JANTX | ITT |
| 6 | | Diode | D10, D11, D12 D7, D8, D9, | 1N4249 JANTX | Semtech |
| 1 | | Capacitor | | .01 μf, | Kemet |
| 6 | | Capacitor | C7, C8, C9, C10, C11, C12 | .0075 μf at 1000VDC DD-7521X5U | Centralab |
| 1 | | Capacitor | C13 | .0033 μf, CK64AW332M | Aerovox |
| 1 | | Voltage Regulator Tube | VR1 | GV1A | Victoreen |
| 1 | | Resistor | RZ4 | 100Ω, RCR07G101JS | AB |
| 2 | | Resistor | R20 | Trim RCR07G---JS | AB |
| 8 | | Terminal | | X 2042 B | Cambion |
| 5 | | Terminal | | X 2041 B | Cambion |
| 2 | | Terminal | | X 2044 B | Cambion |

| | | | | |
|---|---|---|---|---|
| DRAWN E. Williams | DATE 7/13/72 | ELEC DSGN APPROVAL | DATE | PARTS LIST FOR |
| DESIGNED | | OTHER APPROVAL | | **76-D-4004** |
| DRAFTING APPROVAL | | PROJECT APPROVAL | | |
| MECH DSGN APPROVAL | | | | CONT ON SHEET   SH NO. 4 |




1. REMOVE ALL BURRS & SHARP EDGES
UNLESS OTHERWISE SPECIFIED,

**NOTE:**

| REVISIONS | | | | |
|---|---|---|---|---|
| ZONE | NO. | DESCRIPTION | DATE | APPROVED |

DO NOT SCALE PRINT

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES WITH TOLERANCES ON
FRACTIONS ±1/64 DECIMALS .XX ±.01 .XXX ±.005 ANGLES ±0°15'

MATERIAL: NICKEL SILVER

FINISH: 32√

| USED ON | CALLED FOR ON |
|---|---|
| OGO-D | PL 37-C1005 |

| | |
|---|---|
| DRAWN Donald F. Dudley | DATE 12-14-65 |
| DESIGNED Theodore A. Fritz | 24 June 1966 |
| DRAFTING APPROVAL S. L. Bussey | 28 June 1966 |
| CHECKING APPROVAL S. L. Bussey | 28 June 1966 |
| ELEC DSGN APPROVAL | |
| OTHER APPROVAL | |
| PROJECT APPROVAL Theodore A. Fritz | 24 June 1966 |

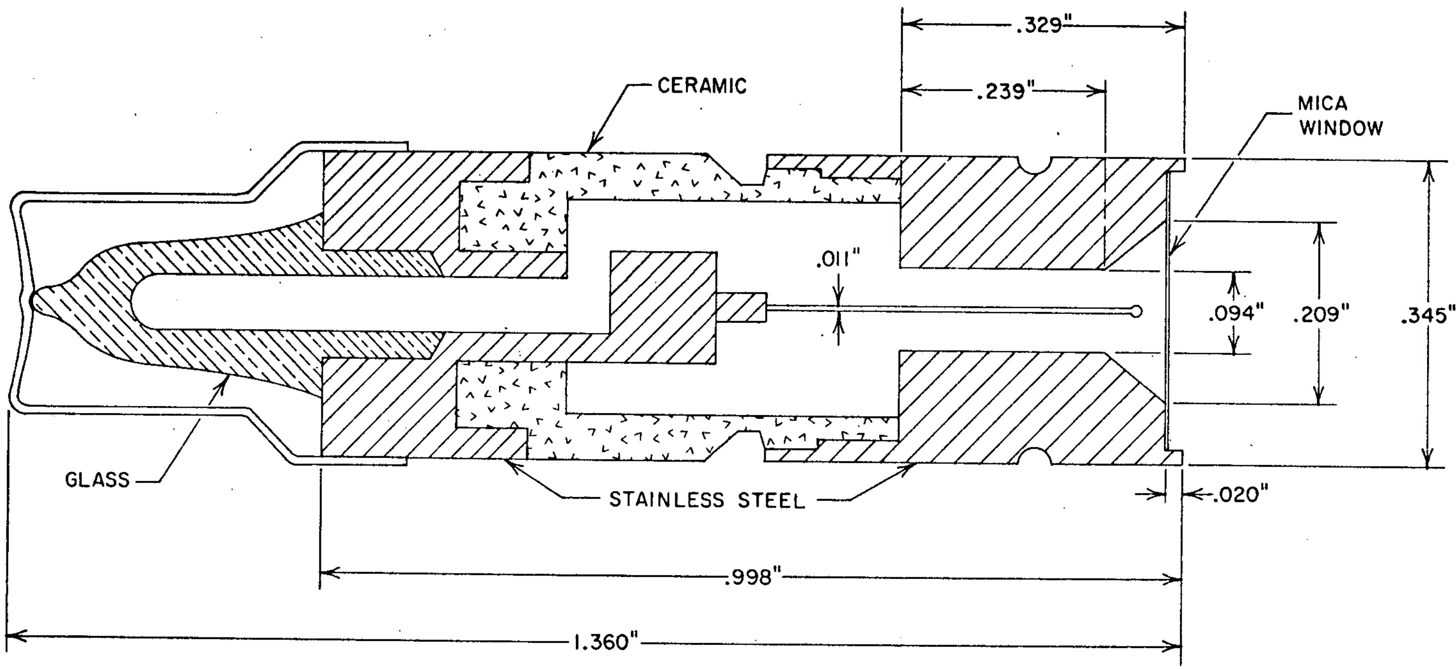
UNIVERSITY OF IOWA
DEPT OF PHYSICS & ASTRONOMY
IOWA CITY, IOWA

FOIL HOLDER & SPACER
APERTURE TYPE 5

| DRAWING IDENTIFICATION | | | | |
|---|---|---|---|---|
| CODE | SERIES | SIZE | DESIGNATION | REV |
| 02542 | 37 | B | 0060 | 0 |

SCALE 5/1 WEIGHT CONT ON SH SH NO

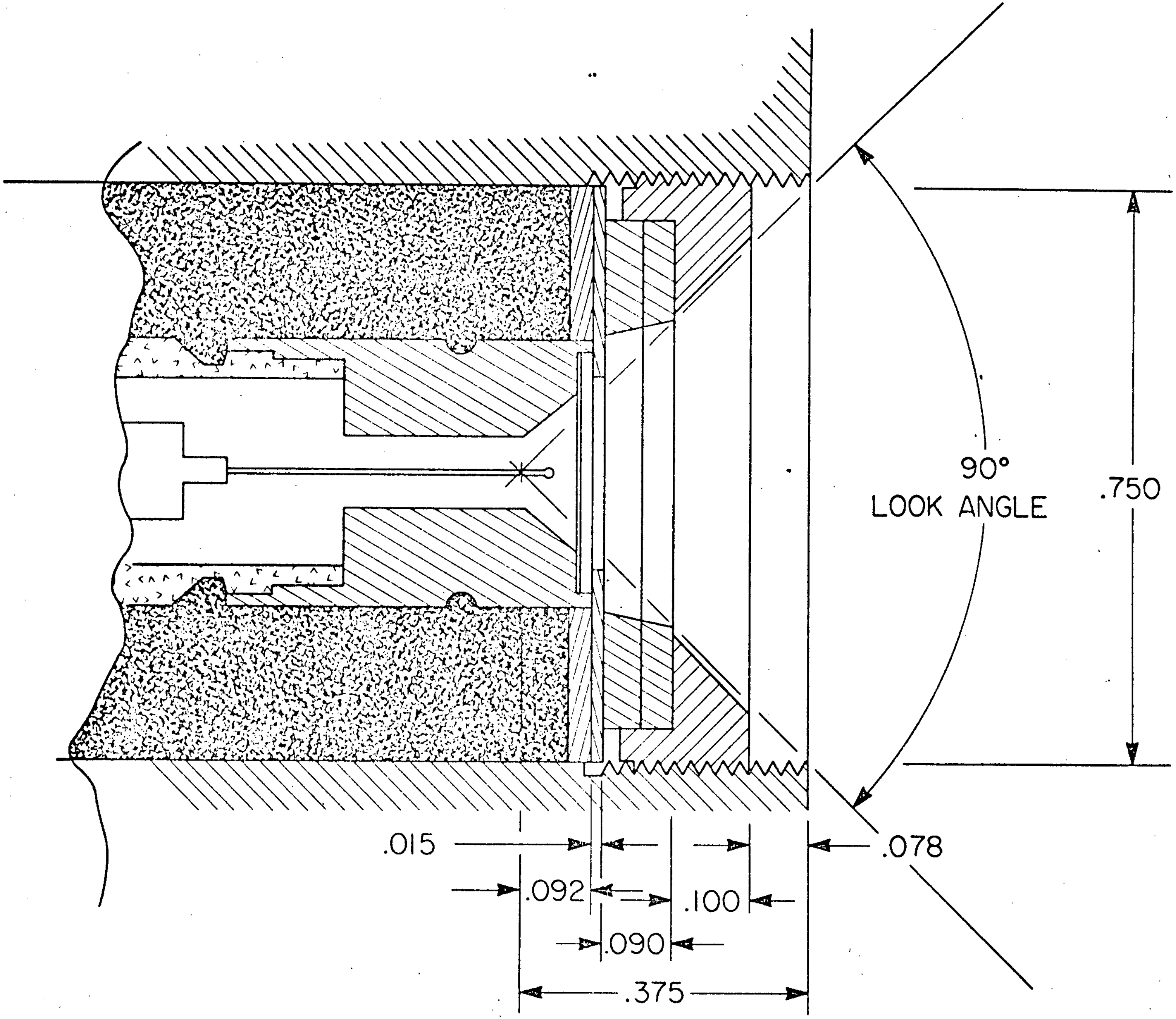
C-G70-418




EON 6213

FIGURE 1

C-G72-356




CONE ANGLE DETERMINATION
DIAGRAM

FIGURE 2

# APPENDIX A

## RADIATION MONITOR (SN29-1)

## ENVIRONMENTAL/CALIBRATION DATA

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES

(Continued)

# 1.0 ENVIRONMENTAL TEST DATA (SN29-1)

With the exception of test deviations noted, all tests were performed in accordance with the document titled UNIT-LEVEL TEST PROGRAM, RADIATION MONITOR, COSMIC X-RAY EXPERIMENT, OSO-I, dated 30 June 1972. (See Appendix C - Unit Level Test Program)

## 1.1 FUNCTIONAL TEST

### 1.1.1 INPUT POWER

| BUS VOLTAGE | BUS CURRENT | AVE. POWER |
|---|---|---|
| 12.0 Volts | 6.0 ma | 72.0 mw |
| 12.2 Volts | 6.2 ma | 75.64 mw |
| 11.8 Volts | 5.8 ma | 68.44 mw |

### 1.1.2 OPERATING FREQUENCY

| BUS VOLTAGE | MULTIVIBRATOR FREQUENCY |
|---|---|
| 12.0 Volts | 1.884 kHz |
| 12.2 Volts | 1.913 kHz |
| 11.8 Volts | 1.852 kHz |

### 1.1.3 SECONDARY RECTIFIED VOLTAGES

| BUS VOLT. | LOW VOLT. | UNREG. HIGH* | REG. HIGH |
|---|---|---|---|
| 12.0 Volts | 6.87 Volts | 848 Volts | 646.2 Volts |
| 12.2 Volts | 7.00 Volts | 863 Volts | 646.4 Volts |
| 11.8 Volts | 6.74 Volts | 836 Volts | 645.9 Volts |

Low Voltage Ripple: 30 mv peak to peak at osc. freq.

*High Voltage Ripple: 10 volts peak to peak at osc. freq. (measurements made with X10 Tektronix probe).

### 1.1.4 COMMAND VERIFICATION OUTPUT

| BUS VOLTAGE | CMD. VER. VOLTAGE |
|---|---|
| 12.0 Volts | 3.44 Volts |
| 12.2 Volts | 3.51 Volts |
| 11.8 Volts | 3.38 Volts |

Command Verification Ripple: 20 mv peak to peak at osc. freq.

1.1.5 TURN-ON CURRENT TRANSIENT

| | |
|---|---|
| Peak Current: | 125 ma (bus 12.0 v) |
| Transient Current Duration: | ~ .0125 amp-msec. |
| Current Envelope Waveform: | Quarter Sine Wave |

1.1.6 BUS CURRENT NOISE

2.6 ma peak to peak at osc. freq. Current envelope half sine wave in nature.

1.1.7 GM OUTPUT PULSE

28 volts peak measured at the input to signal amplifier.

1.1.8 AMPLIFIER OUTPUT CHARACTERISTICS (BUS 12.0 VOLTS)

| | |
|---|---|
| Reference During Input Pulse Absence: | 4.68 volts |
| Pulse Transition: | 4.68 volts negative going to ~ 0.2 Volts |
| Leading Edge Transition Time: | ~ 0.02 μsec when loaded with 47 pf |
| Trailing Edge Transition Time: | 1.1 μsec when loaded with 47 pf and 0.6 μsec when unloaded |

1.1.9 SIGNAL GROUND (DC ISOLATION TO CHASSIS)

Resistance from pin C of J29 to chassis in excess of 2000 MΩ.

1.2 PHYSICAL PROPERITIES

1.2.1 WEIGHT: 387.8 grams (0.856 lbs.)

1.2.2 EXTERNAL DIMENSIONS: SEE FIGURE A1.

1.2.3 MOUNTING SURFACE FLATNESS: SEE FIGURE A2.

1.3 PRE-VIBRATION O.O.E.

1.3.1 100 μCURIE $Co^{60}$ STIMULUS (SOURCE SN1059-1)

| TOTAL COUNTS | ACCUMULATION TIME | AVE. C/S | DEV. |
|---|---|---|---|
| 2104290 | 3610 sec. | 582.91 | .402 |

1.3.2 BACKGROUND

| TOTAL COUNTS | ACCUMULATION TIME | AVE. C/S | DEV. |
|---|---|---|---|
| 28 | 3600 sec. | .0078 | .0015 |

1.4 VIBRATION TEST

The Qualification Level Vibration Test was performed satisfactory with no instrument anomalies noted. The thrust axis sinusoidal specifications and random specifications were modified as follows in order to accommodate the maximum DA displacement of the vibration table. Table trip-out occurred at 0.8 inches DA.

THRUST AXIS (Z) - SINUSOIDAL

| FREQ. (HZ) | ACCELERATION (O-PK) G | DISPLACEMENT INCHES DA |
|---|---|---|
| 5 - 23 | - | 0.6 |
| 23 - 35 | 22.0 | - |
| 35 - 100 | 5.0 | - |
| 100 - 200 | 18.0 | - |
| 200 - 2000 | 5.0 | - |

RANDOM VIBRATION

| FREQ. (HZ) | ACCELERATION PSD $g^2$/Hz | ACCELERATION PSD db/OCT | OVERALL GRMS |
|---|---|---|---|
| 20 - 40 | 0.176 | 6 | 18.43 |
| 40 - 200 | 0.70 | - | |
| 200 - 560 | - | -6 | |
| 560 - 2000 | 0.09 | - | |

1.5 POST VIBRATION O.O.E.

1.5.1 100 μCURIE $Co^{60}$ STIMULUS (SOURCE SN1059-1)

| TOTAL COUNTS | ACCUMULATION TIME | AVE. C/S | DEV. |
|---|---|---|---|
| 2094115 | 3590 sec. | 583.32 | .403 |

1.5.2 BACKGROUND

| TOTAL COUNTS | ACCUMULATION TIME | AVE. C/S | DEV. |
|---|---|---|---|
| 21 | 3450 sec. | .0061 | .0013 |

1.6 TEMPERATURE TEST

1.6.1 COMMAND VERIFICATION/BUS CURRENT VS. TEMPERATURE (BUS 12.0 VOLTS)

| TEMPERATURE | CMD. VER. | BUS CURRENT |
|---|---|---|
| 25 °C | 3.43 Volts | 6.0 ma |
| -20 °C | 3.38 Volts | 5.7 ma |
| +40 °C | 3.44 Volts | 6.0 ma |

1.6.2 -20 °C SOURCE AND BACKGROUND DATA (SOURCE SN1059-1)

| TOTAL COUNTS | ACCUMULATION TIME | AVE. C/S | DEV. |
|---|---|---|---|
| ($Co^{60}$) 2005546 | 3440 sec. | 583.01 | .412 |
| (BKG) 18 | 3600 sec. | .005 | .0012 |

1.6.3 +40 °C SOURCE AND BACKGROUND DATA (SOURCE SN1059-1)

| TOTAL COUNTS | ACCUMULATION TIME | AVE. C/S | DEV. |
|---|---|---|---|
| ($Co^{60}$)2077359 | 3600 sec. | 577.04 | .400 |
| (BKG) 21 | 3580 sec. | .0059 | .0013 |

1.6.4 +25 °C SOURCE AND BACKGROUND DATA (SOURCE SN1059-1)

| TOTAL COUNTS | ACCUMULATION TIME | AVE. C/S | DEV. |
|---|---|---|---|
| ($Co^{60}$)2092397 | 3590 sec. | 582.84 | .403 |
| (BKG) 20 | 3570 sec. | .0056 | .0013 |

(See Figure A3 for a plot of temperature test data.)

1.7 THERMAL VACUUM TEST

The qualification thermal vacuum test consisted of 84 hours of low temperature soak (-20 °C) and 84 hours of high temperature soak (+40 °C) while maintaining the chamber pressure between $5 \times 10^{-8}$ mm of mercury and $6 \times 10^{-6}$ mm of mercury. The instrument was commanded ON for 16 consecutive hours out of every 24 hours and the detector was excited during the entire test with a 100 μcurie $Co^{60}$ source (SN1059-1). Thermal control of the instrument was maintained by placing the instrument inside of a shroud which was heated and cooled with a temperature controlled glycol solution. The instrument was mounted on a plate which was suspended from the ceiling of the chamber.

Temperature observation of the instrument was performed by monitoring, with a recorder, two sets of thermocouples. One of the thermocouples was attached to the top center of the instrument box and the other to the bottom of the plate. Once each hour during the thermal vacuum test temperature, pressure, and instrument parameters were noted and logged. The following outlines the daily statistics of the data taken:

| TEMPERATURE | DATE | TOTAL COUNTS ACCUMULATED | ACCUMULATION TIME (SEC) | AVE. C/S | DEV. |
|---|---|---|---|---|---|
| -20 °C | 9/07/72 | 31,968,945 | 53,520 | 597.33 | .106 |
| -20 °C | 9/08/72 | 33,739,794 | 56,490 | 597.27 | .103 |
| -20 °C | 9/09/72 | 33,578,099 | 56,240 | 597.05 | .103 |
| -20 °C | 9/10/72 | 25,143,114 | 42,129 | 596.81 | .119 |
| +40 °C | 9/11/72 | 33,238,621 | 56,230 | 591.12 | .103 |
| +40 °C | 9/12/72 | 32,054,770 | 54,240 | 590.98 | .104 |
| +40 °C | 9/13/72 | 33,254,379 | 56,280 | 590.87 | .102 |
| +40 °C | 9/14/72 | 6,187,889 | 10,470 | 591.01 | .238 |

(See Figure A4 for a plot of daily averaged test data.)

1.8 POST THERMAL VACUUM O.O.E

1.8.1 100 μCURIE $Co^{60}$ STIMULUS (SOURCE SN1059-1)

| TOTAL COUNTS | ACCUMULATION TIME | AVE. C/S | DEV. |
|---|---|---|---|
| 2069914 | 3560 sec. | 581.44 | .404 |

1.8.2 BACKGROUND

| TOTAL COUNTS | ACCUMULATION TIME | AVE. C/S | DEV. |
|---|---|---|---|
| 25 | 3870 sec. | .0065 | .0013 |

## 2.0 SCREEN/TEST DATA EON 6213 (SNA3270)

Figures A5 through A11 depict the before screening and after screening plateau characteristics of the EON 6213 GM tube (SNA3270). Figures A12 and A13 show the tube background characteristics taken during a 24 hour life test and during a 3000 sec quiet run. Figure A14 depicts the tubes counting rate temperature dependence prior to integration with the remaining instrument.

F

## 3.0 CALIBRATION DATA

(RADIATION MONITOR SN29-1, GM TUBE A3270)

The following data was prepared by Dr. J. A. Van Allen, Head, Department of Physics and Astronomy, University of Iowa.

### 3.1 APPROXIMATE PHYSICAL CHARACTERISTICS AS A PARTICLE DETECTOR

#### 3.1.1 INTRODUCTION

In order to use this detector for precision observations of absolute intensities and angular distributions of electrons it will be necessary to:

(a) Determine experimentally a full set of angular response curves, and

(b) Determine experimentally the transmission curve vs particle energy of the composite absorber comprised of the gold foil and the mica window of the tube.

These experimental determinations have not been made. The following data are synthesized from various reference material and previous experimental experience with similar detectors. The data are considered adequate for the monitoring function on OSO-I.

#### 3.1.2 UNIDIRECTIONAL GEOMETRIC FACTOR

(a) Half-angle of Maximum Look-Angle Cone = 45°.

(b) Half-angle of Effective Look-Angle Cone = 28°.

(c) Effective Solid Angle, $\Omega = 0.74$ steradian.

(d) Effective Detection Area, $A = 0.045\ cm^2$.

(e) Unidirectional Geometric Factor,

$$g' = A \cdot \Omega = 3.3 \times 10^{-2} \text{ cm}^2 \text{ steradian.}$$

(f) Typical Electron Efficiency, $\epsilon = 0.83$.

(g) Effective Unidirectional Geometric Factor, $g = \epsilon g'$

$$= 2.8 \times 10^{-2} \text{ cm}^2 \text{ steradian.}$$

Thus, the absolute particle intensity,

$$j \text{ (cm}^2 \text{ sec sterad)}^{-1} = R/g$$

where R $(\text{sec})^{-1}$ is the true counting rate of the detector caused by particles entering through the collimator. The factor $1/g \doteq 36$ $(\text{cm}^2 \text{ sterad})^{-1}$ with an overall uncertainty of about $\pm$ 30%.

3.1.3 EFFECTIVE ENERGY THRESHOLD FOR ELECTRONS

(a) The transmission of the mica window of the GM tube was measured experimentally with the proton beam from the U. of I. Van de Graaff accelerator and found to be 50% at 611 keV. This corresponds to a window thickness of 1.67 mg $\text{cm}^{-2}$ of mica.

(b) The gold foil was weighed and found to have an areal density of 7.2 mg $\text{cm}^{-2}$.

(c) The transmission of the composite absorber (gold foil plus mica window) is estimated to be zero for 50 keV electrons and 50% for 120 keV electrons.

Thus, the estimated effective energy threshold for <u>electrons</u> is 120 keV.

3.1.4 EFFECTIVE ENERGY THRESHOLD FOR PROTONS

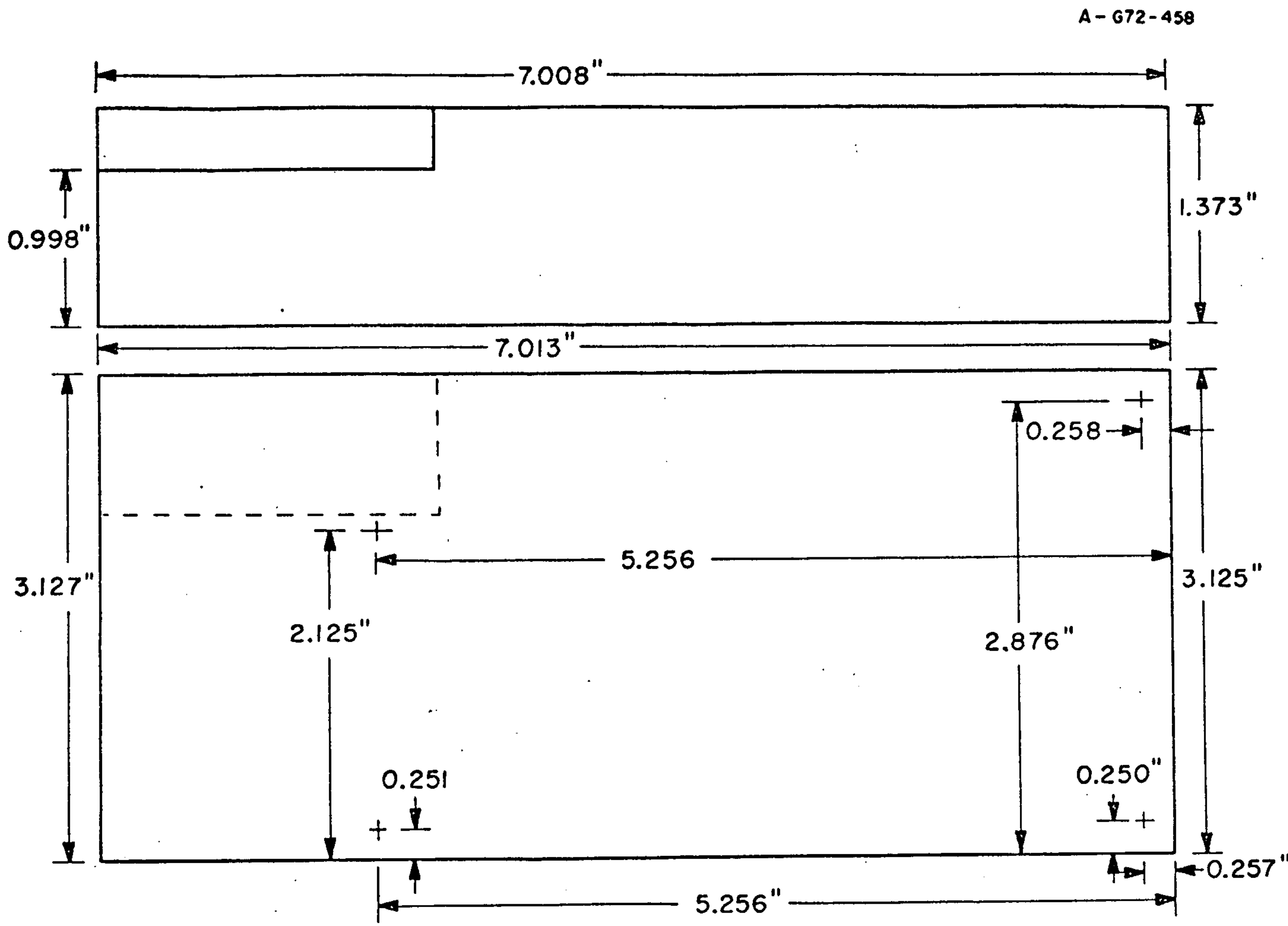
The estimated effective energy threshold for protons is 1.1 MeV.

3.1.5 X-RAY SENSITIVITY AT NORMAL INCIDENCE

| $\lambda$ | Calculated Transmission of Gold Foil | Estimated erg $cm^{-2}$ per GM Count |
|---|---|---|
| 9.87 A° | $2.3 \times 10^{-6}$ % | 87 |
| 5.39 | $7 \times 10^{-4}$ | 0.2 |
| 4.15 | $9 \times 10^{-3}$ | $1.7 \times 10^{-2}$ |
| 3.03 | $1.2 \times 10^{-1}$ | $2 \times 10^{-3}$ |
| 1.93 | 6.3 | $1.6 \times 10^{-4}$ |
| 1.0 | 29. | $3.8 \times 10^{-4}$ |
| $\lambda \leq 0.5$ | > 70 | $> 1.4 \times 10^{-2}$ |

3.2 r VS R CURVES

Figures A15, A16 and A17 show the relationship between the "Apparent Counting Rate" (r) and the "True Counting Rate" (R) for GM tube A3270 and its associated circuitry. The calibration runs were made using the UI/Westinghouse 240 KV D.C. X-ray machine. The family of curves shown represent the r vs R characteristics at -20 °C, +25 °C and +40 °C.




PHYSICAL PROPERTIES MEASUREMENTS
EXTERNAL DIMENSIONS/MOUNTING HOLE LOCATION (SN29-1)

FIGURE A1

A-G72-459

PHYSICAL PROPERTIES MEASUREMENTS

MOUNTING SURFACE FLATNESS (SN29-1)

⊕ – REFERENCE POINT

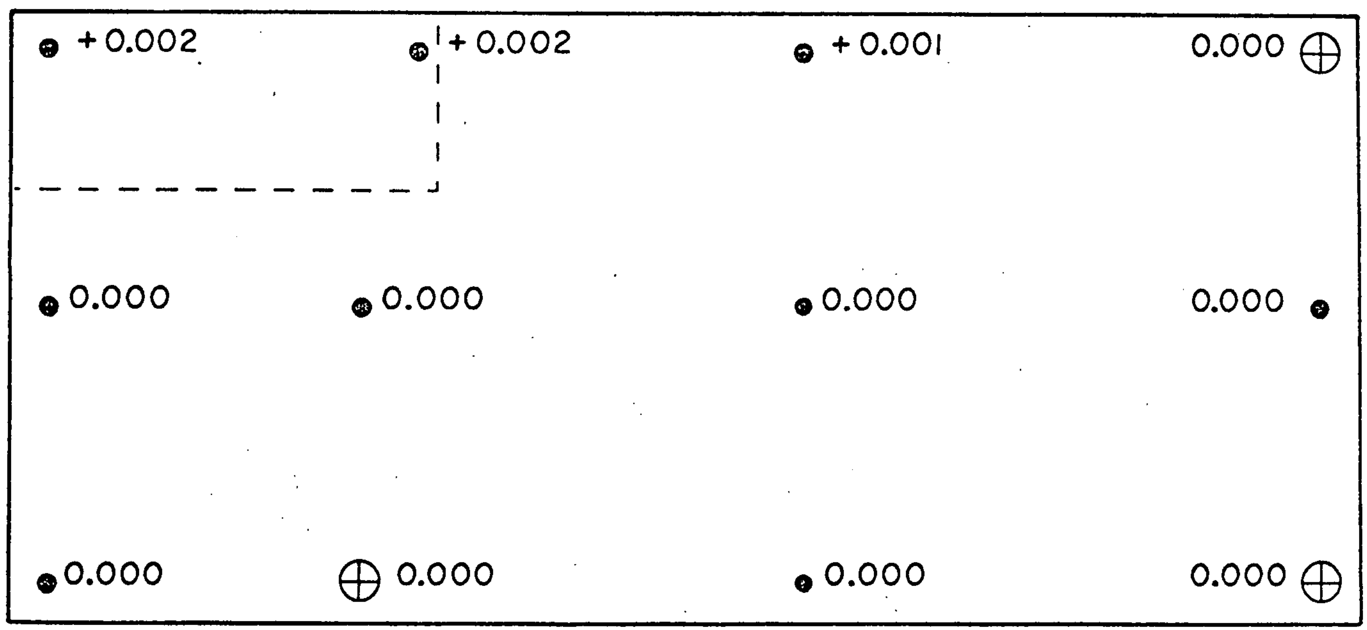



FIGURE A2

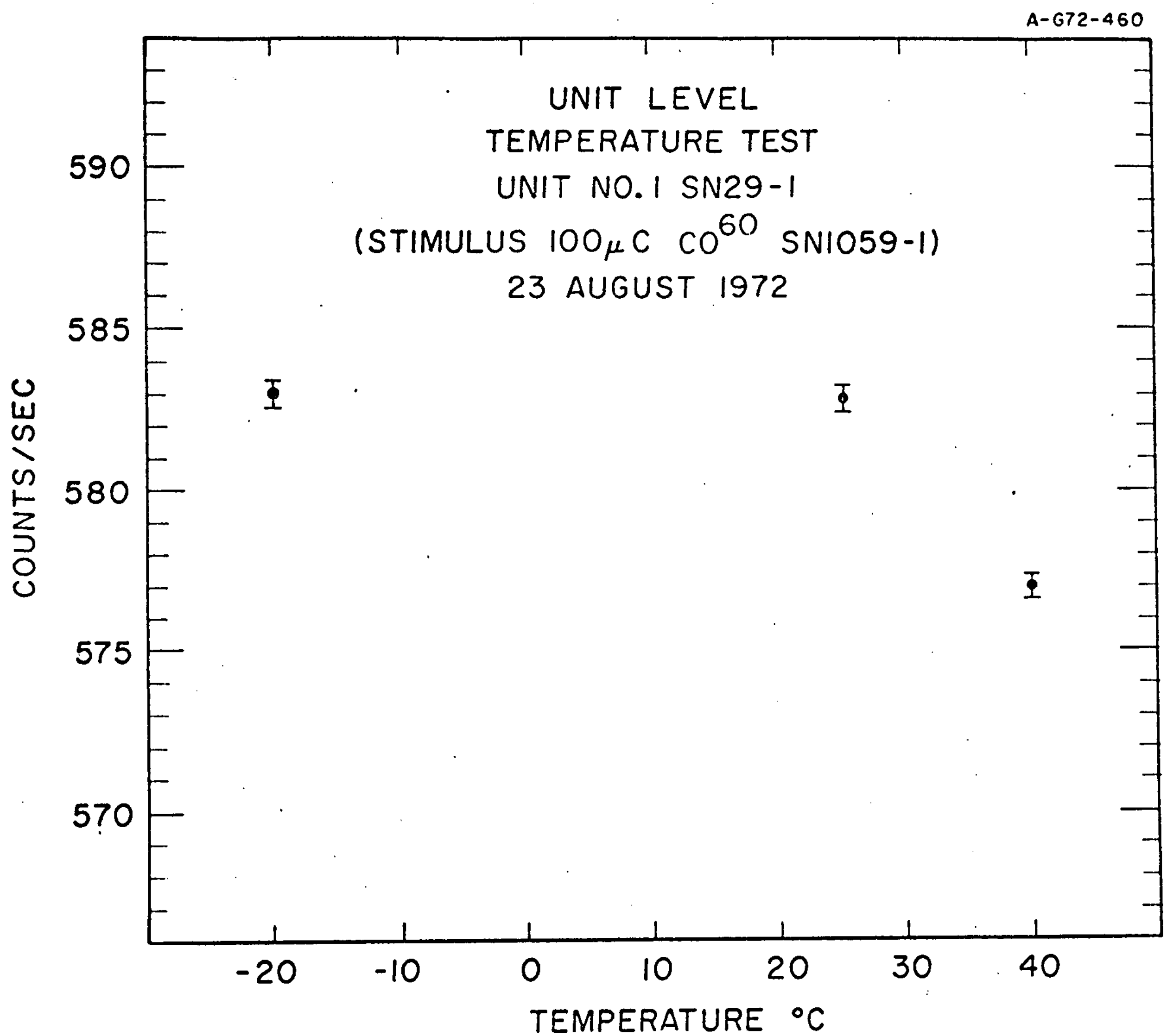

A-G72-460
UNIT LEVEL
TEMPERATURE TEST
UNIT NO. I SN29-I
(STIMULUS 100μC CO60 SN1059-I)
23 AUGUST 1972
COUNTS/SEC
590
585
580
575
570
-20
-10
0
10
20
30
40
TEMPERATURE °C

FIGURE A3

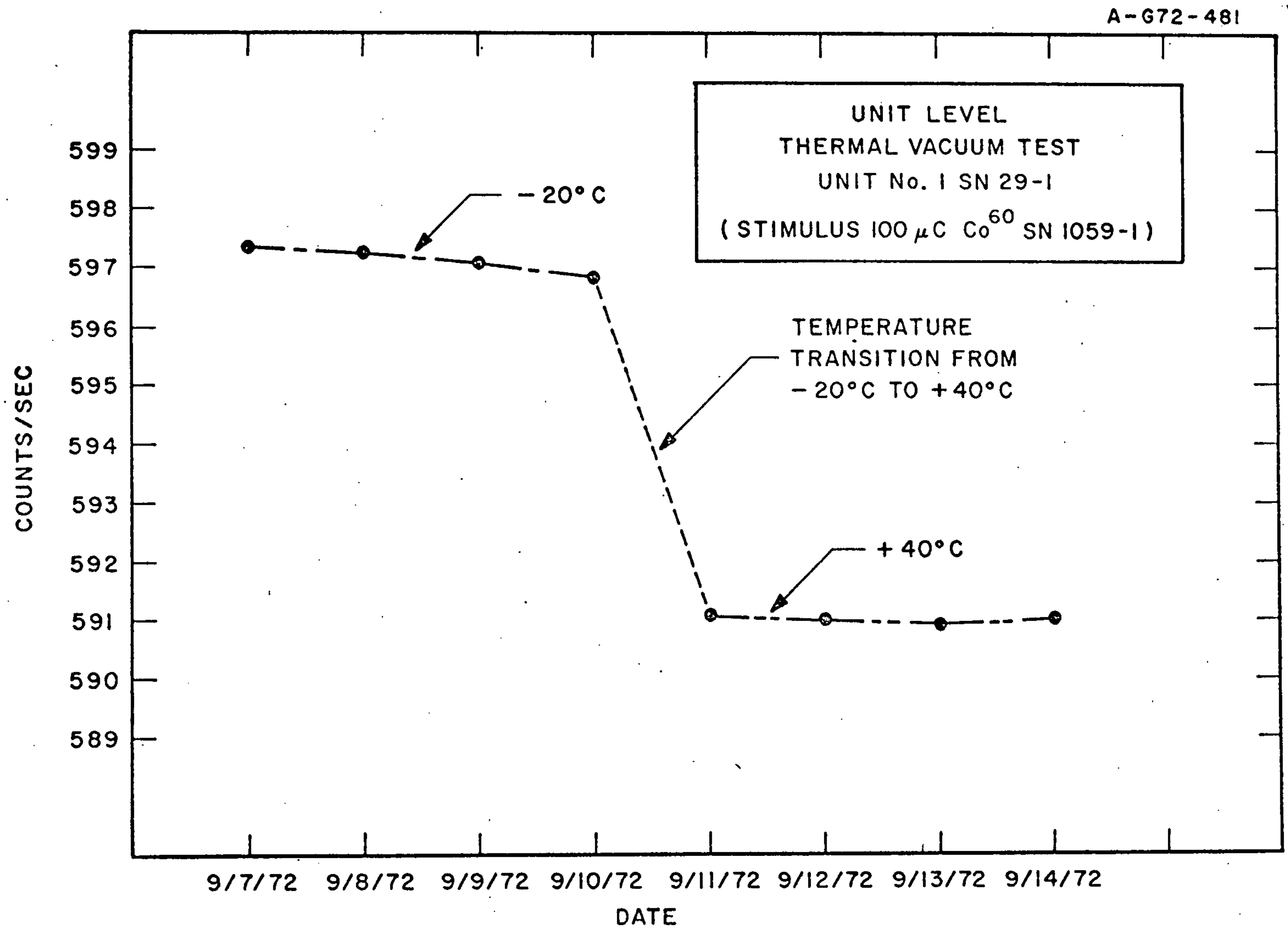

A-G72-481
UNIT LEVEL
THERMAL VACUUM TEST
UNIT No. 1 SN 29-1
( STIMULUS 100 $\mu$C $Co^{60}$ SN 1059-1 )
-20° C
TEMPERATURE
TRANSITION FROM
-20°C TO +40°C
+40°C
599
598
597
596
595
594
593
592
591
590
589
COUNTS/SEC
9/7/72
9/8/72
9/9/72
9/10/72
9/11/72
9/12/72
9/13/72
9/14/72
DATE

FIGURE A4

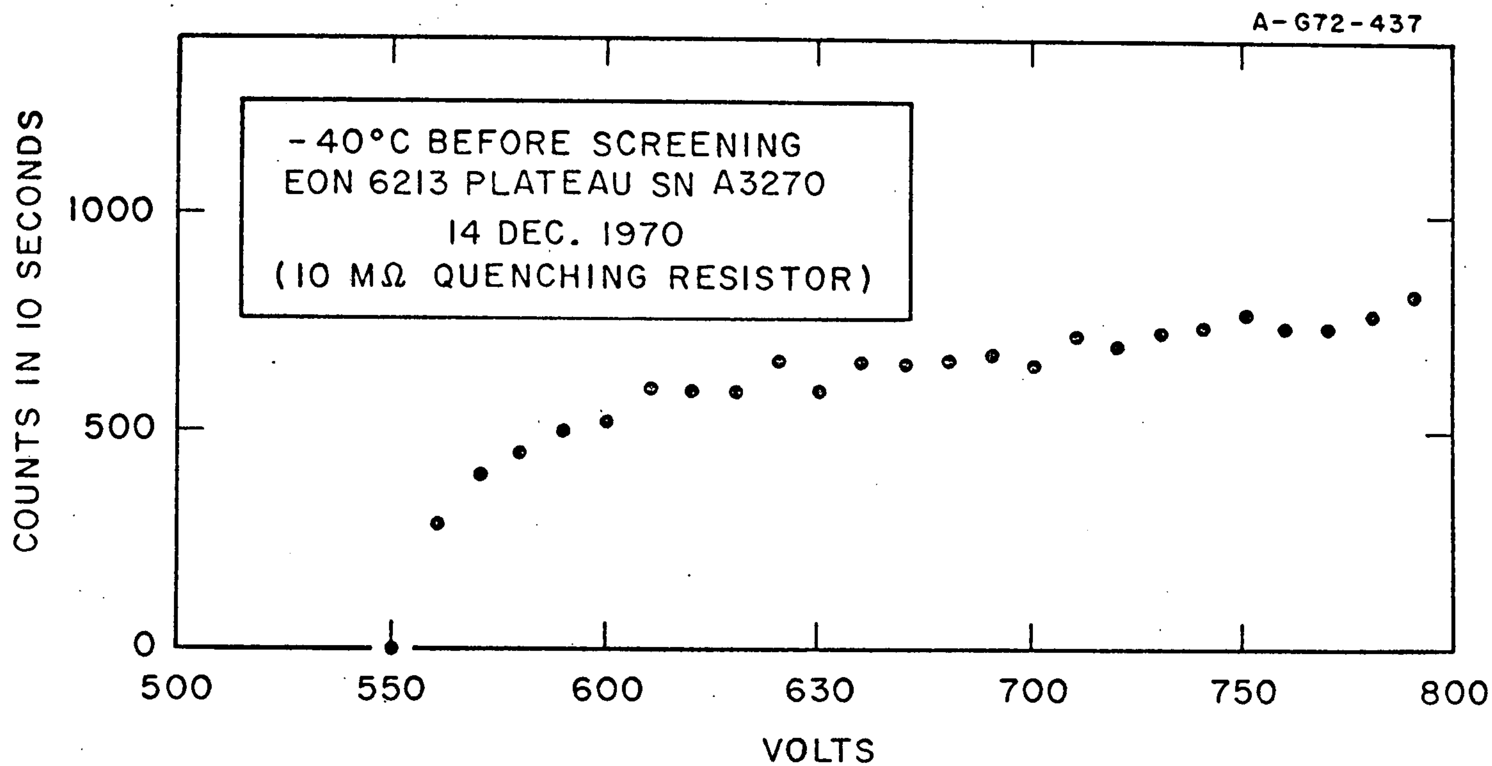
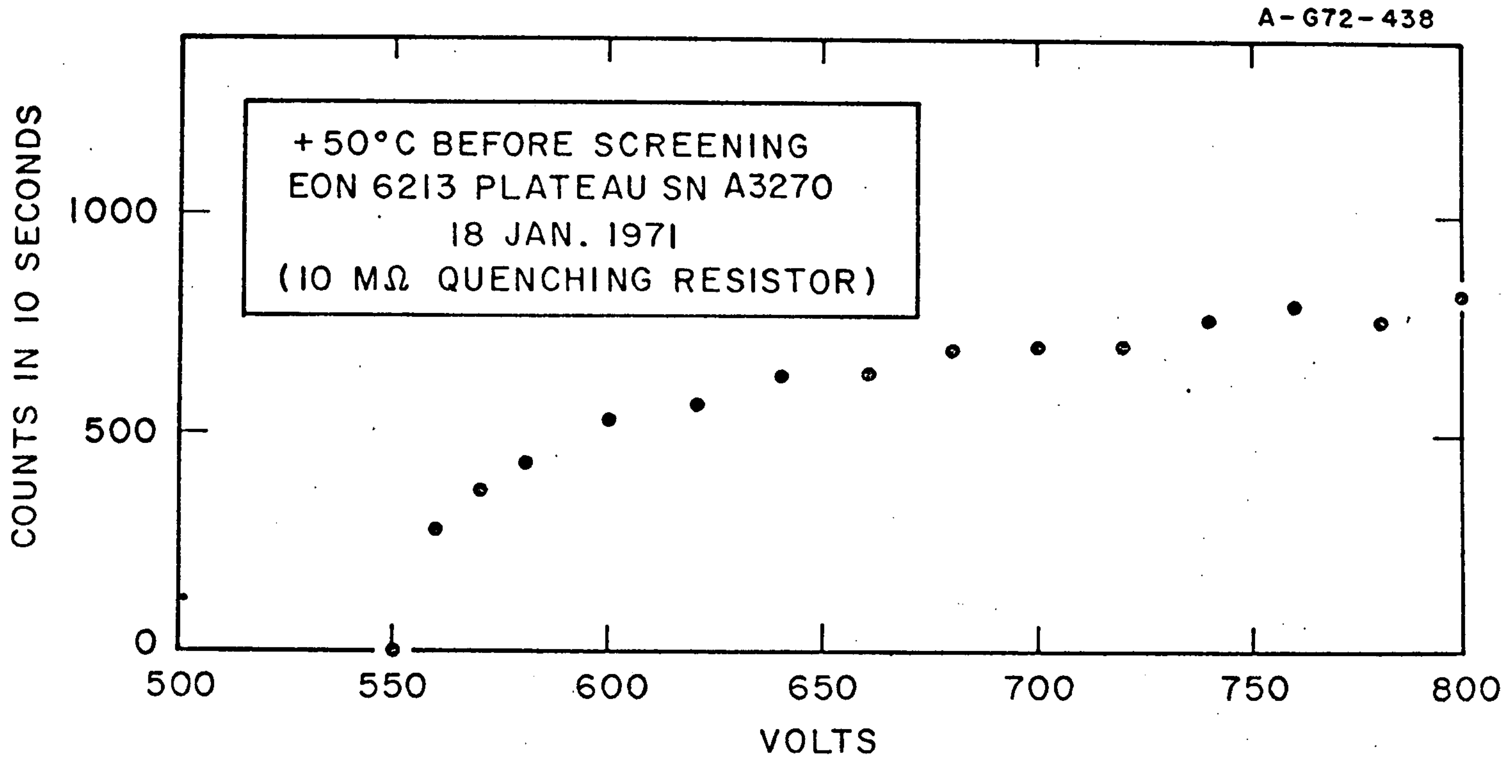

A-G72-437
-40°C BEFORE SCREENING
EON 6213 PLATEAU SN A3270
14 DEC. 1970
(10 MΩ QUENCHING RESISTOR)
COUNTS IN 10 SECONDS
1000
500
0
500
550
600
630
700
750
800
VOLTS

FIGURE A5




A16

FIGURE A6

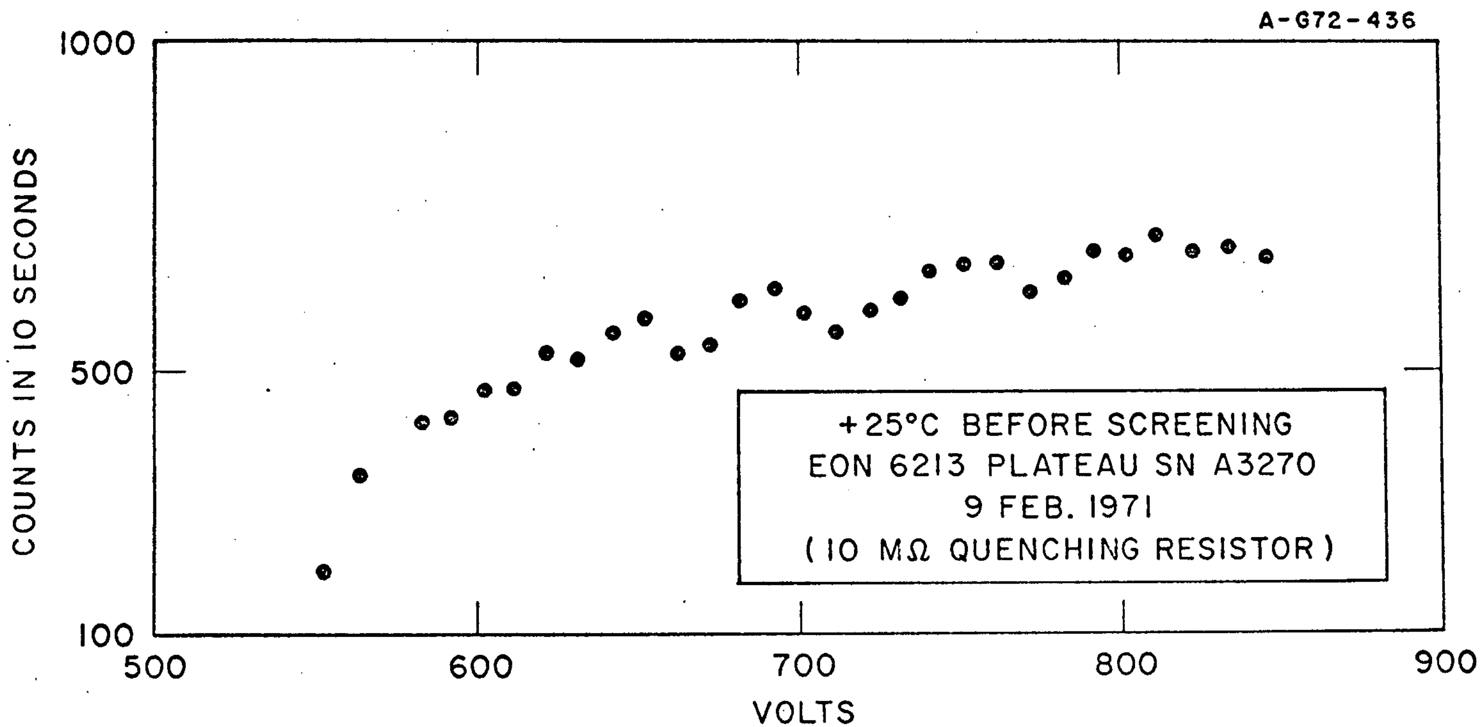

A-G72-436
1000
500
100
500
600
700
800
900
COUNTS IN 10 SECONDS
VOLTS
+25°C BEFORE SCREENING
EON 6213 PLATEAU SN A3270
9 FEB. 1971
( 10 MΩ QUENCHING RESISTOR )

FIGURE A7

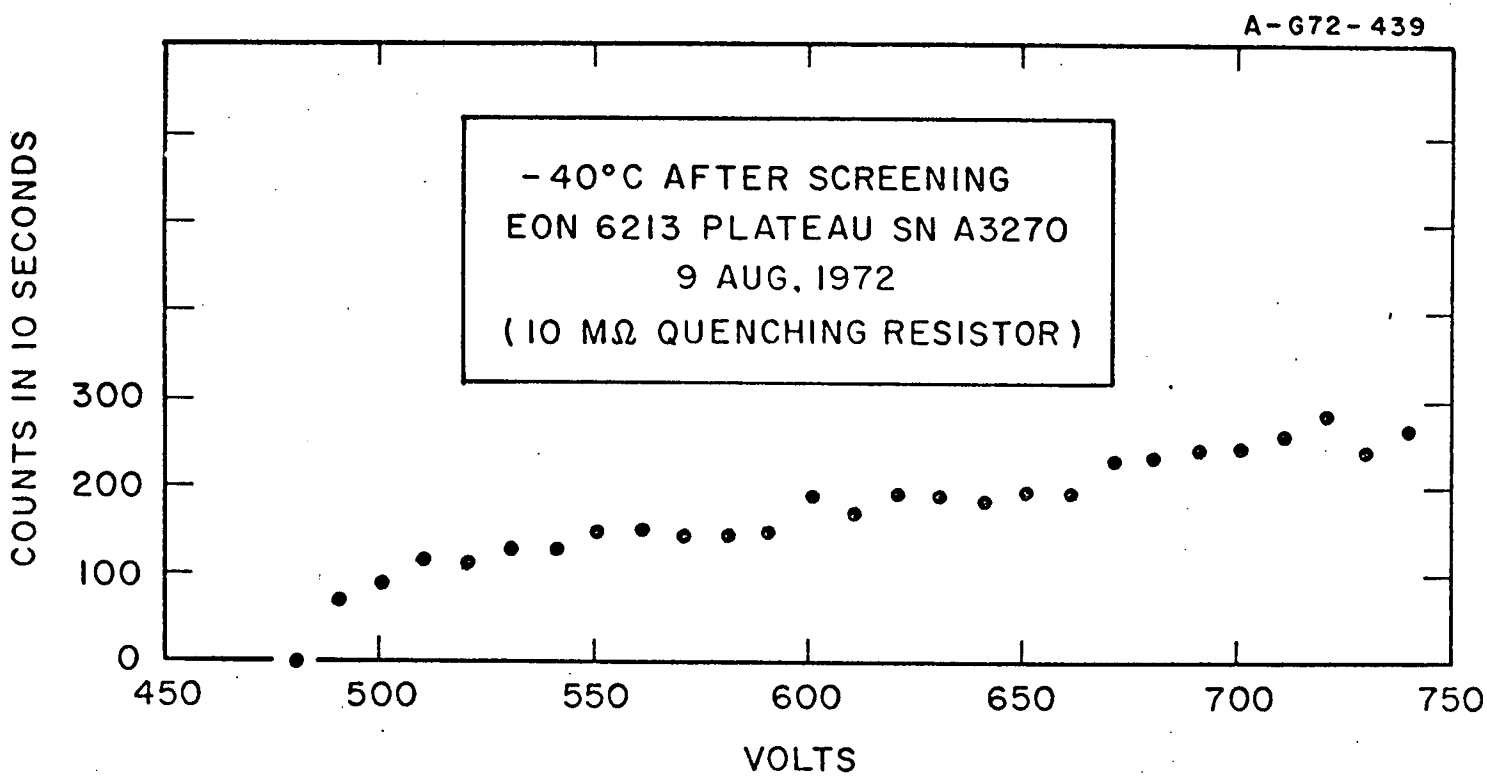

A-G72-439
-40°C AFTER SCREENING
EON 6213 PLATEAU SN A3270
9 AUG. 1972
(10 MΩ QUENCHING RESISTOR)
COUNTS IN 10 SECONDS
300
200
100
0
450
500
550
600
650
700
750
VOLTS

FIGURE A8

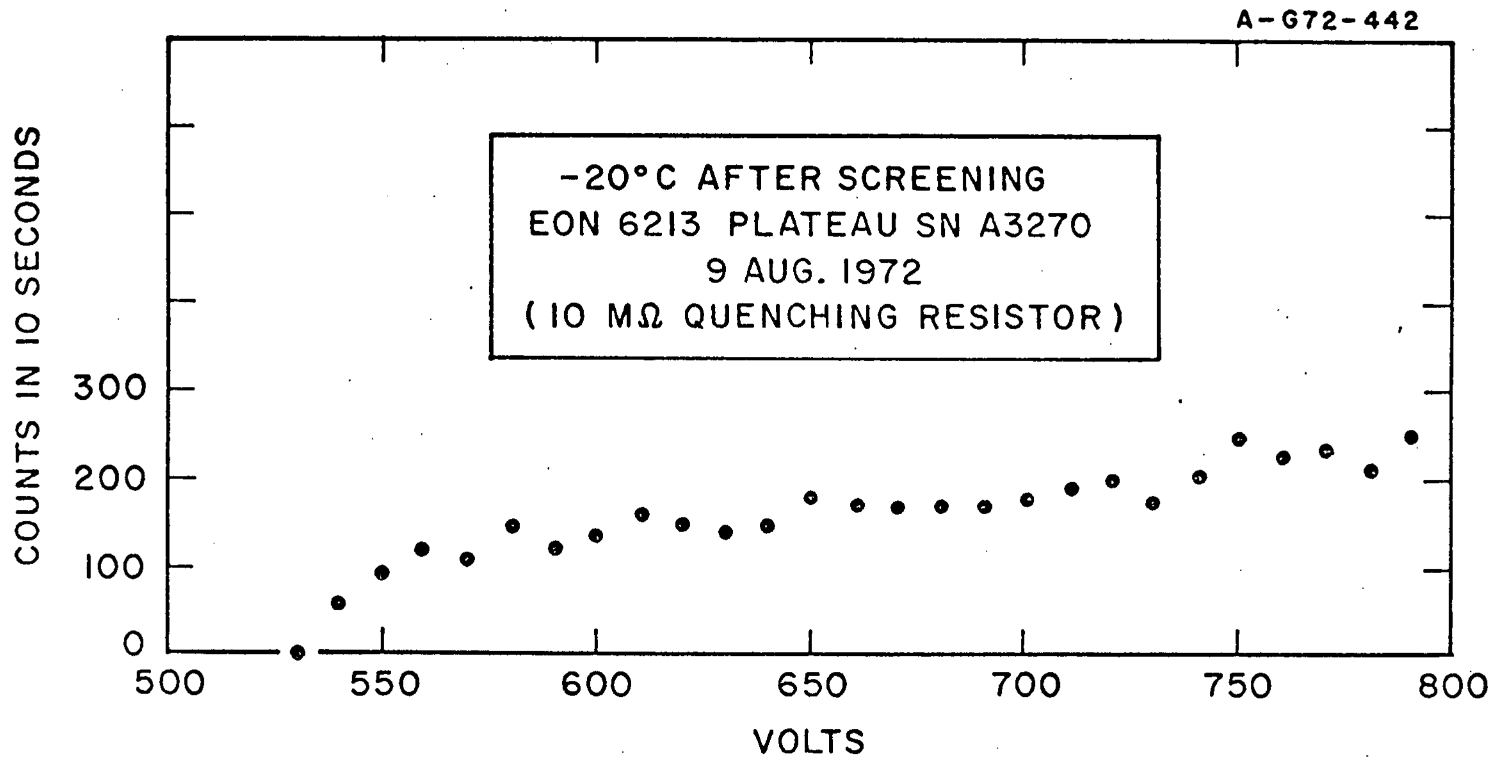

A-G72-442
-20°C AFTER SCREENING
EON 6213 PLATEAU SN A3270
9 AUG. 1972
( 10 MΩ QUENCHING RESISTOR )
COUNTS IN 10 SECONDS
0
100
200
300
500
550
600
650
700
750
800
VOLTS

FIGURE A9

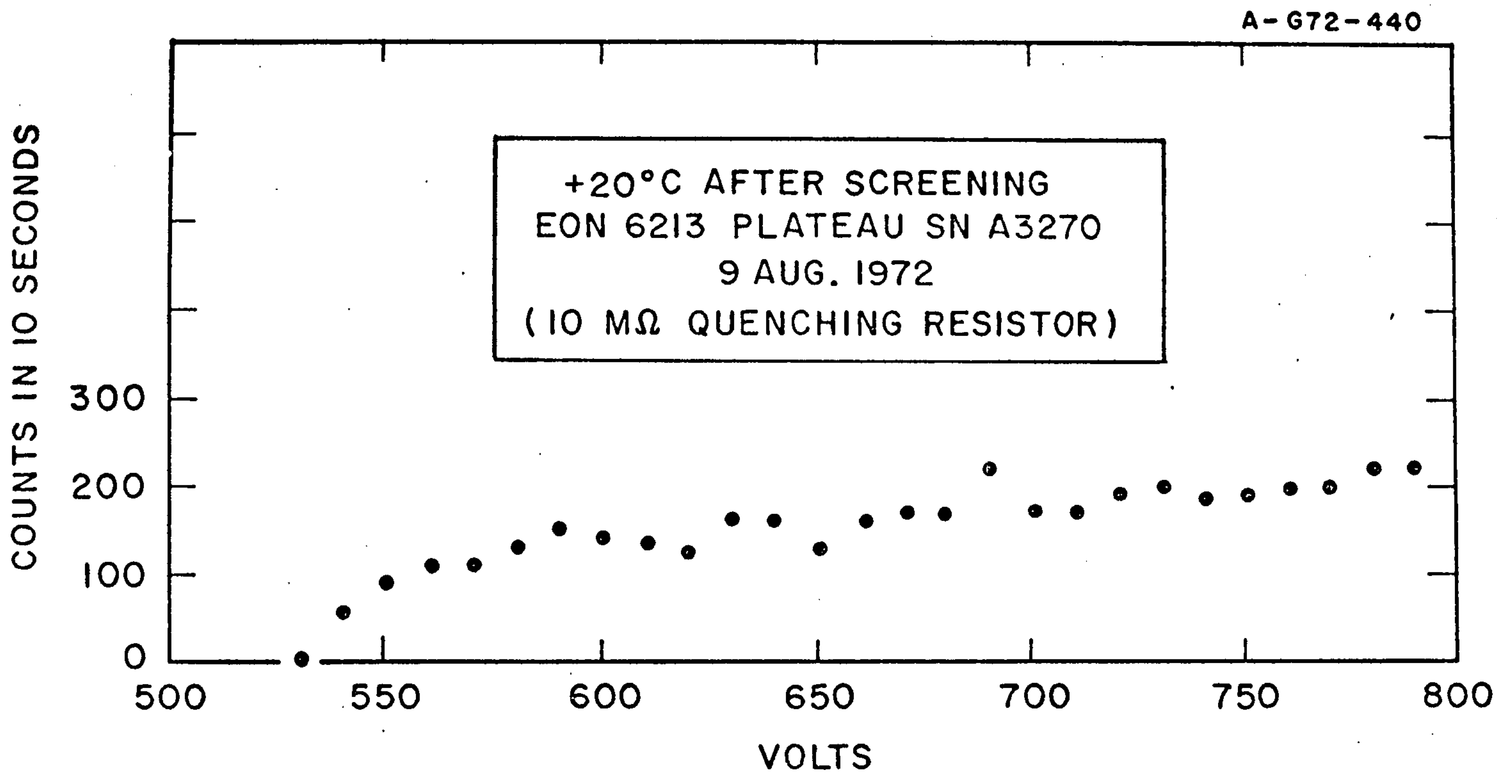
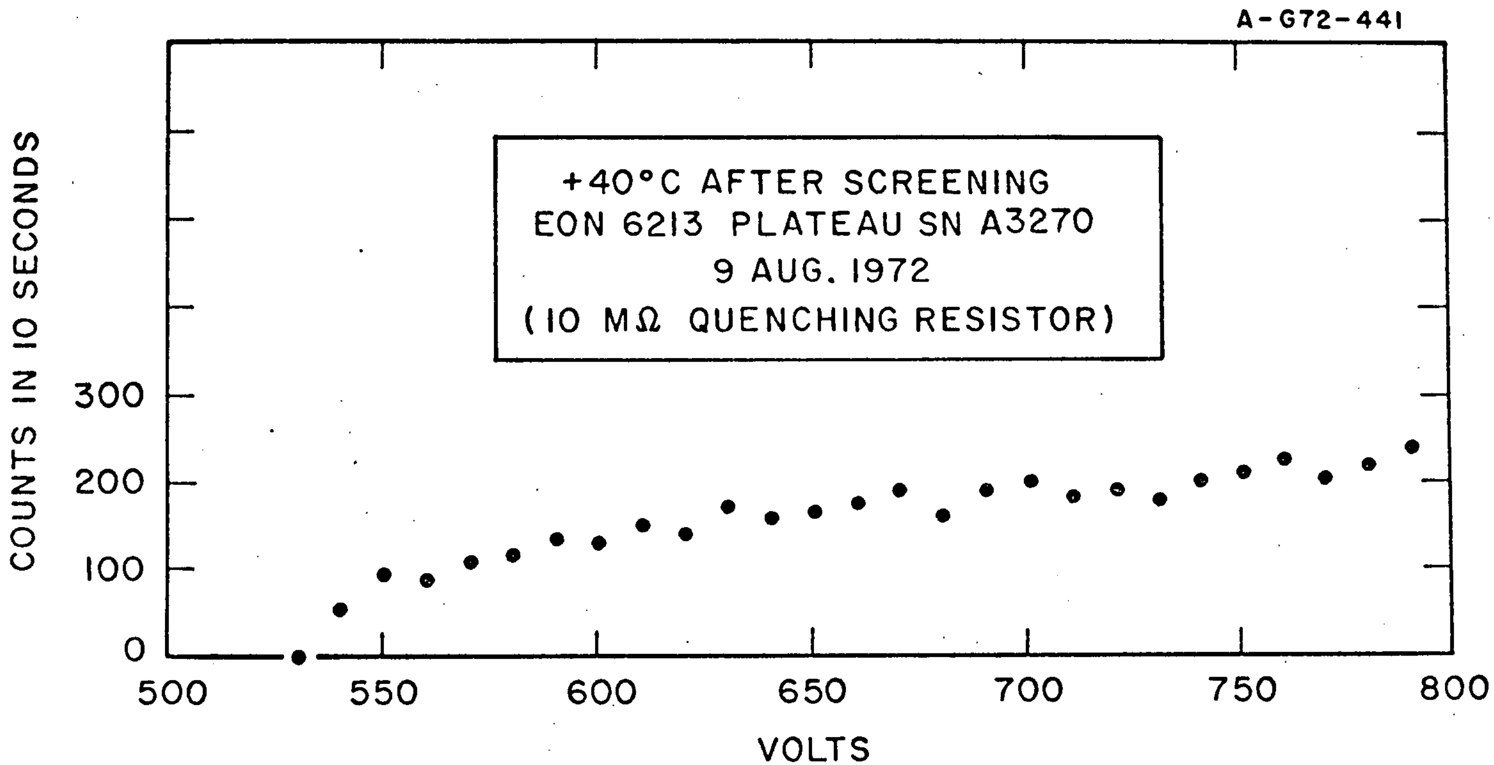

A-G72-440
+20°C AFTER SCREENING
EON 6213 PLATEAU SN A3270
9 AUG. 1972
(10 MΩ QUENCHING RESISTOR)
COUNTS IN 10 SECONDS
0
100
200
300
500
550
600
650
700
750
800
VOLTS

FIGURE A10



A-G72-441
+40°C AFTER SCREENING
EON 6213 PLATEAU SN A3270
9 AUG. 1972
(10 MΩ QUENCHING RESISTOR)
COUNTS IN 10 SECONDS
0
100
200
300
500
550
600
650
700
750
800
VOLTS


FIGURE A11

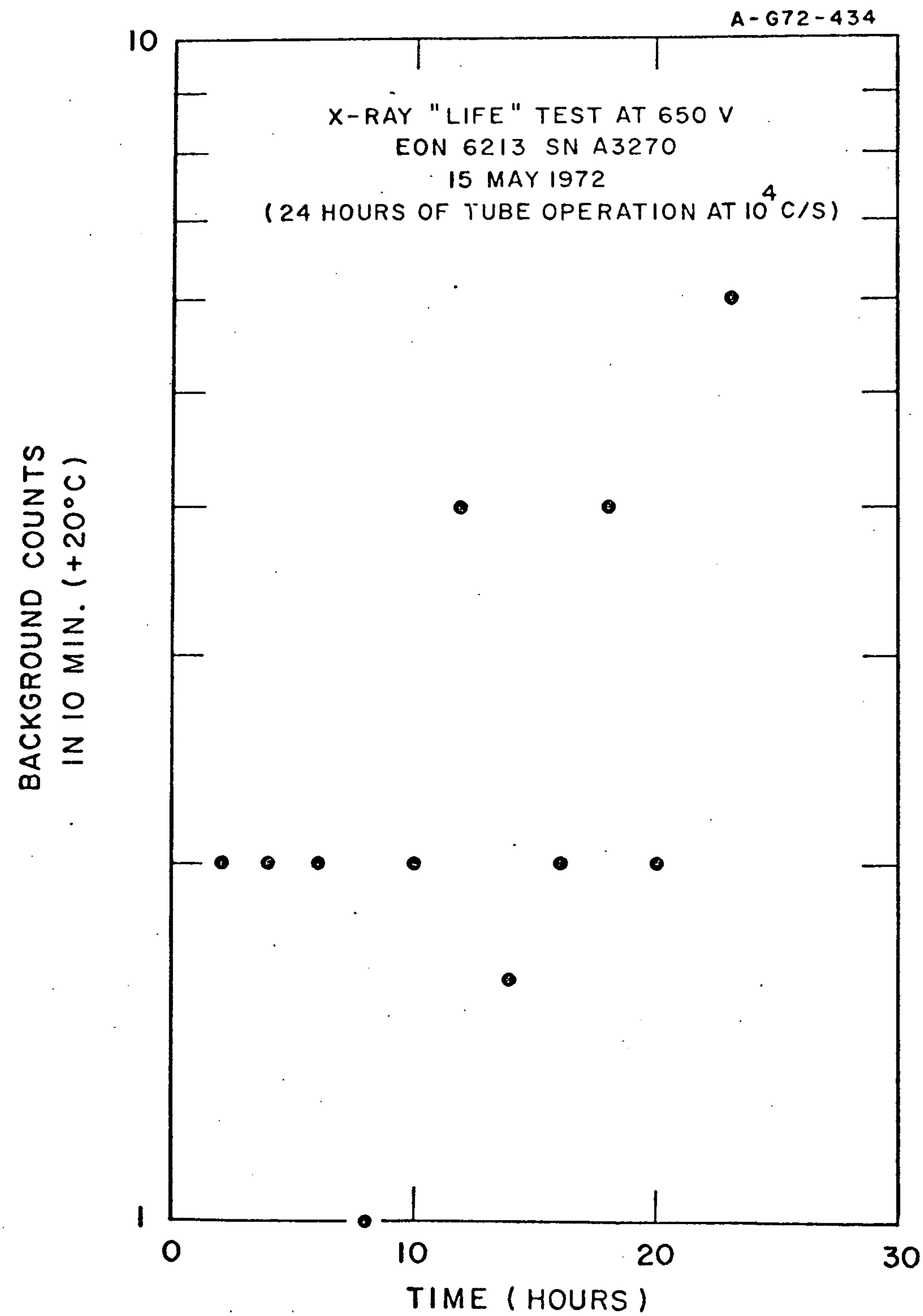

A-G72-434
X-RAY "LIFE" TEST AT 650 V
EON 6213 SN A3270
15 MAY 1972
(24 HOURS OF TUBE OPERATION AT $10^4$ C/S)
BACKGROUND COUNTS
IN 10 MIN. (+20°C)
10
1
0
10
20
30
TIME (HOURS)

FIGURE A12

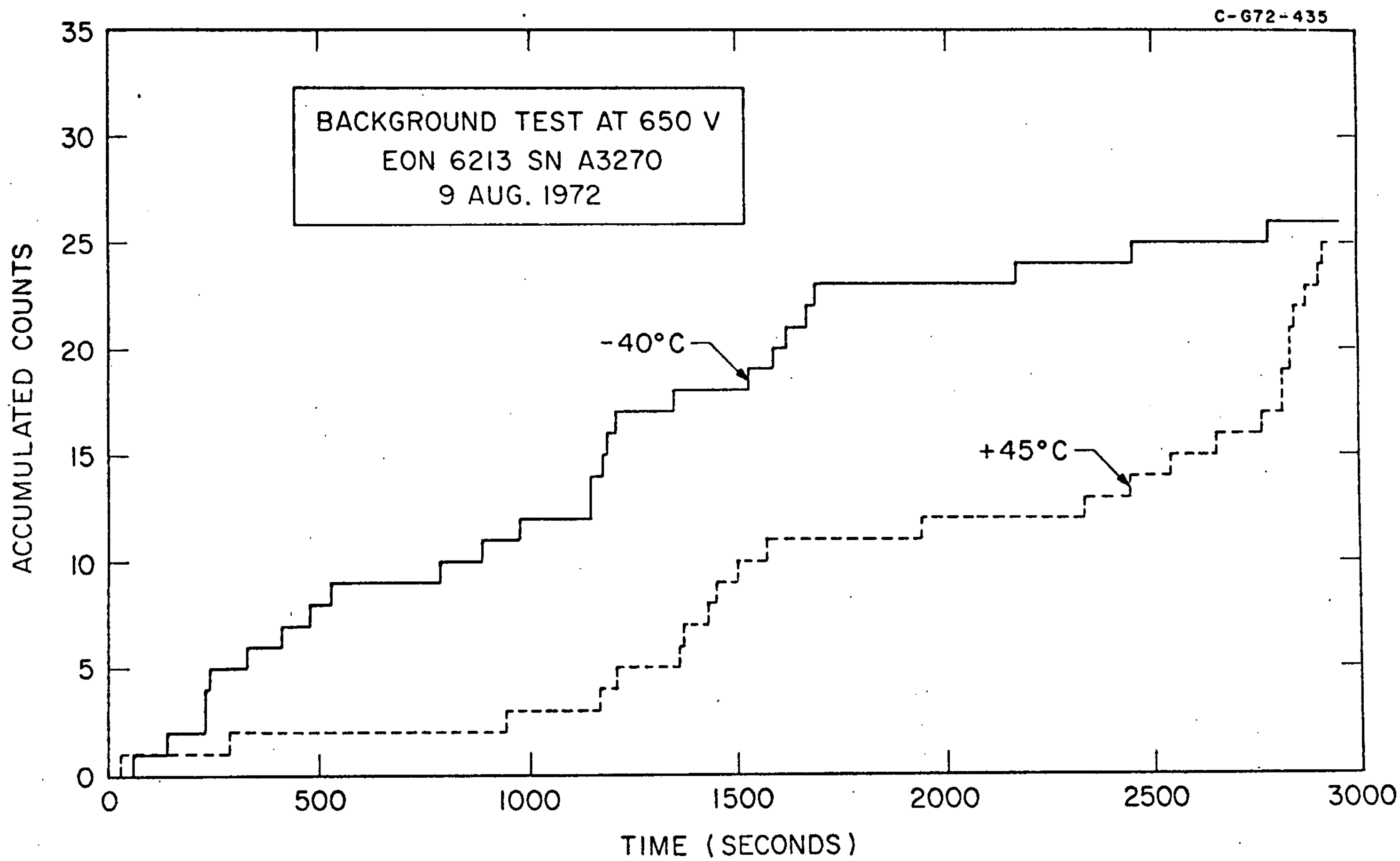

C-G72-435
BACKGROUND TEST AT 650 V
EON 6213 SN A3270
9 AUG. 1972
-40°C
+45°C
ACCUMULATED COUNTS
TIME (SECONDS)
0
5
10
15
20
25
30
35
0
500
1000
1500
2000
2500
3000

FIGURE A13

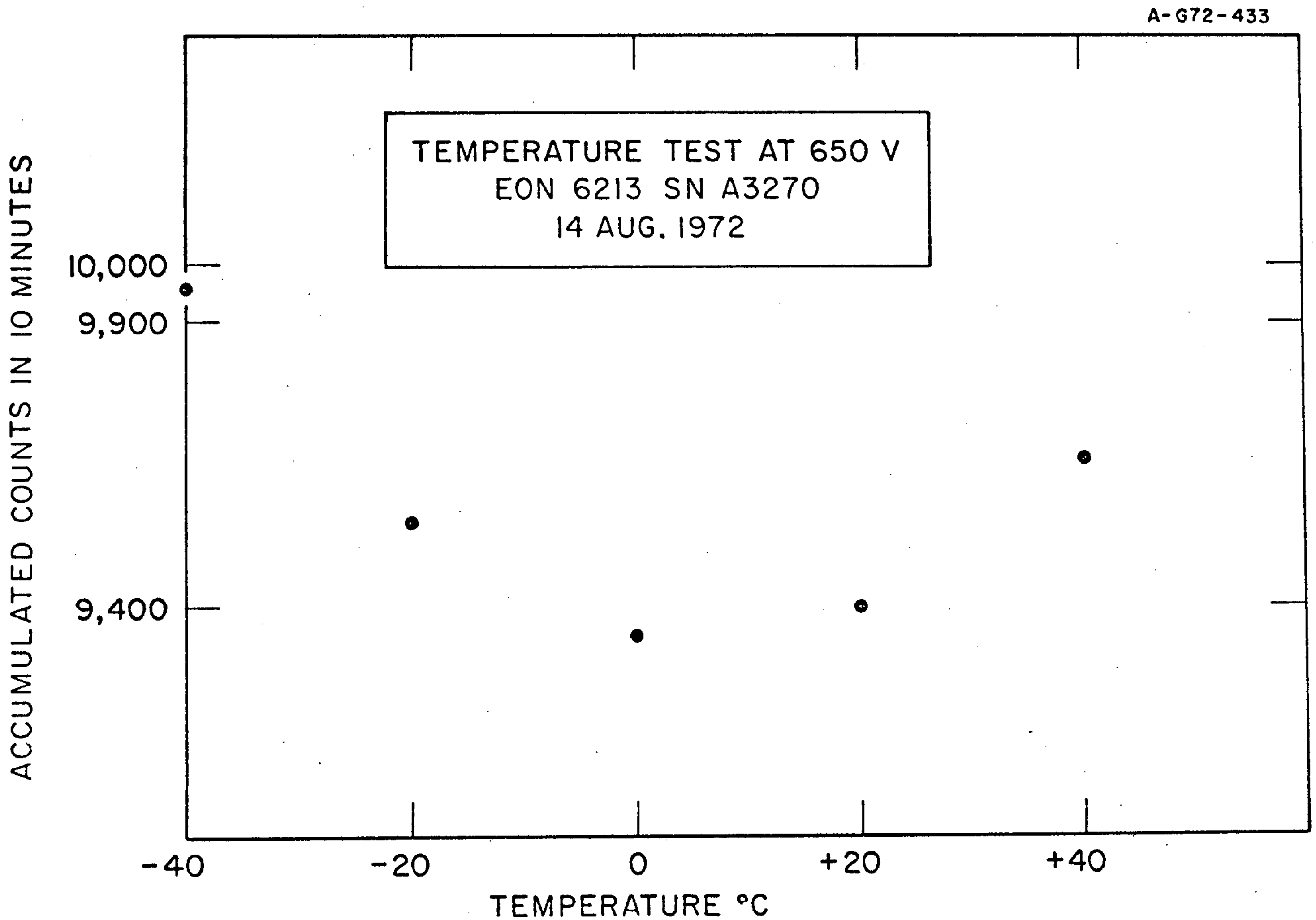

A-G72-433
TEMPERATURE TEST AT 650 V
EON 6213 SN A3270
14 AUG. 1972
ACCUMULATED COUNTS IN 10 MINUTES
10,000
9,900
9,400
-40
-20
0
+20
+40
TEMPERATURE °C

FIGURE A14

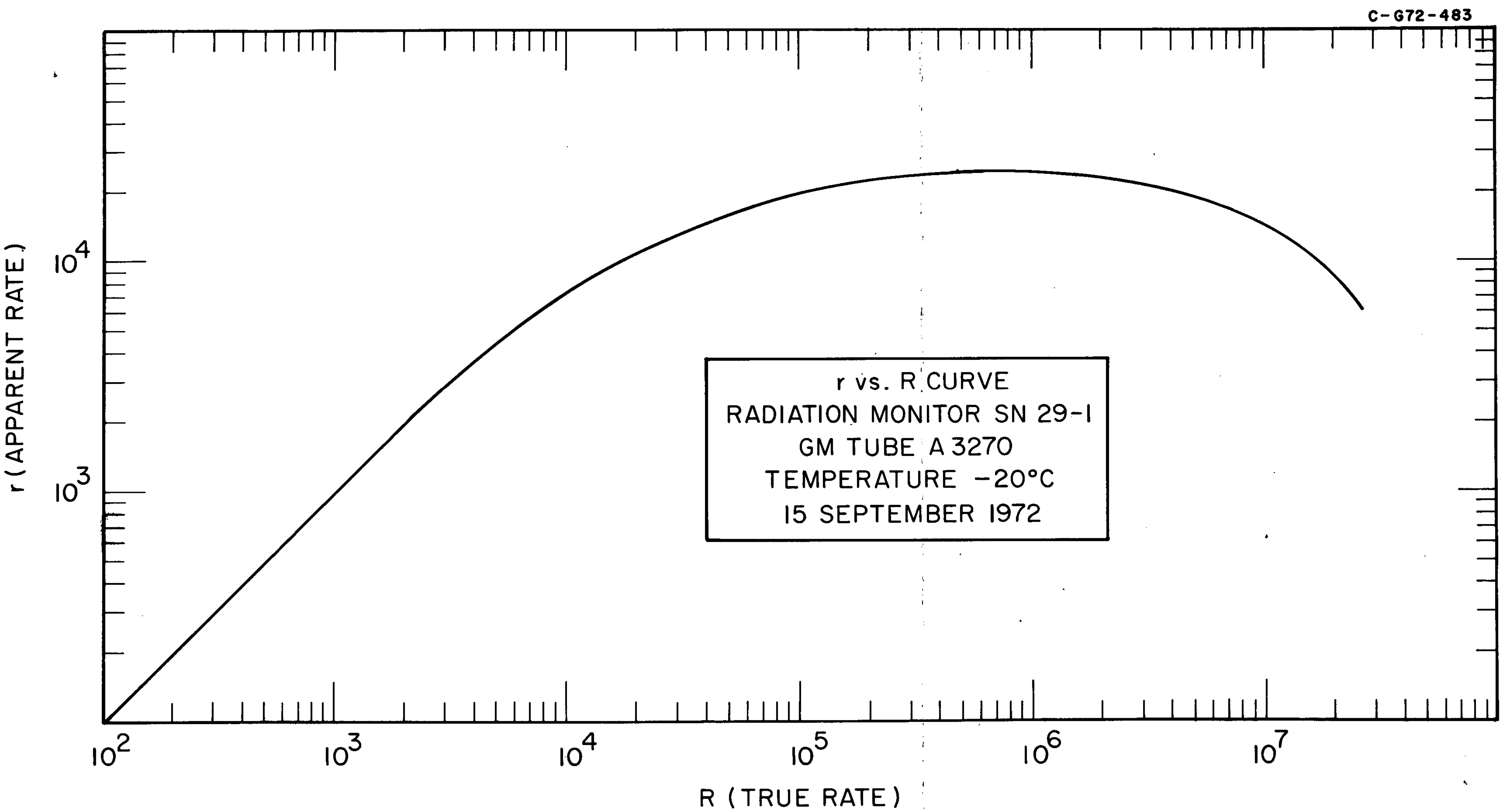



FIGURE A15

FOLDOUT FRAME 1

FOLDOUT FRAME 2

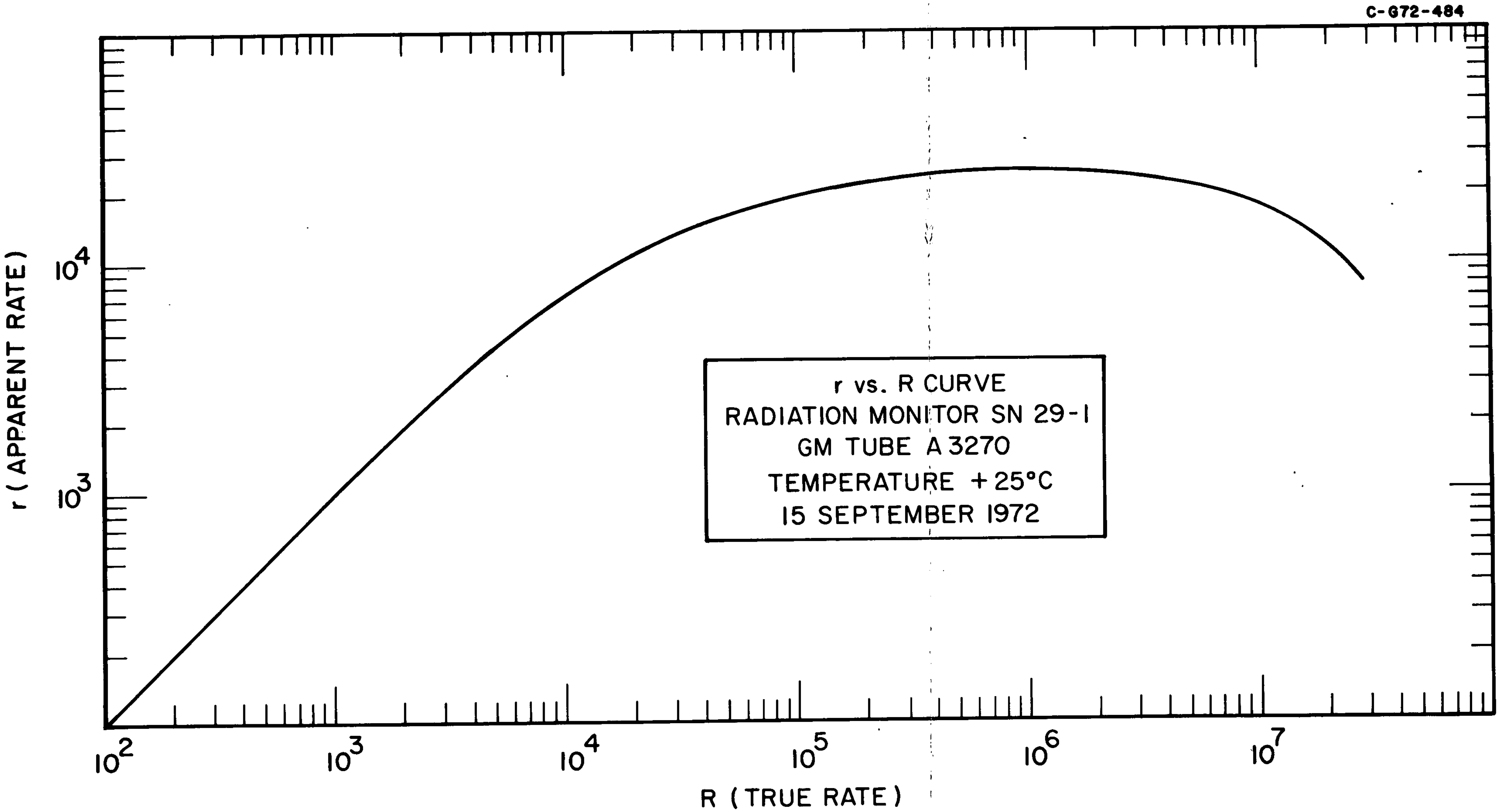

C-G72-484
r ( APPARENT RATE )
$10^4$
$10^3$
r vs. R CURVE
RADIATION MONITOR SN 29-1
GM TUBE A 3270
TEMPERATURE +25°C
15 SEPTEMBER 1972
$10^2$
$10^3$
$10^4$
$10^5$
$10^6$
$10^7$
R ( TRUE RATE )

FIGURE A16

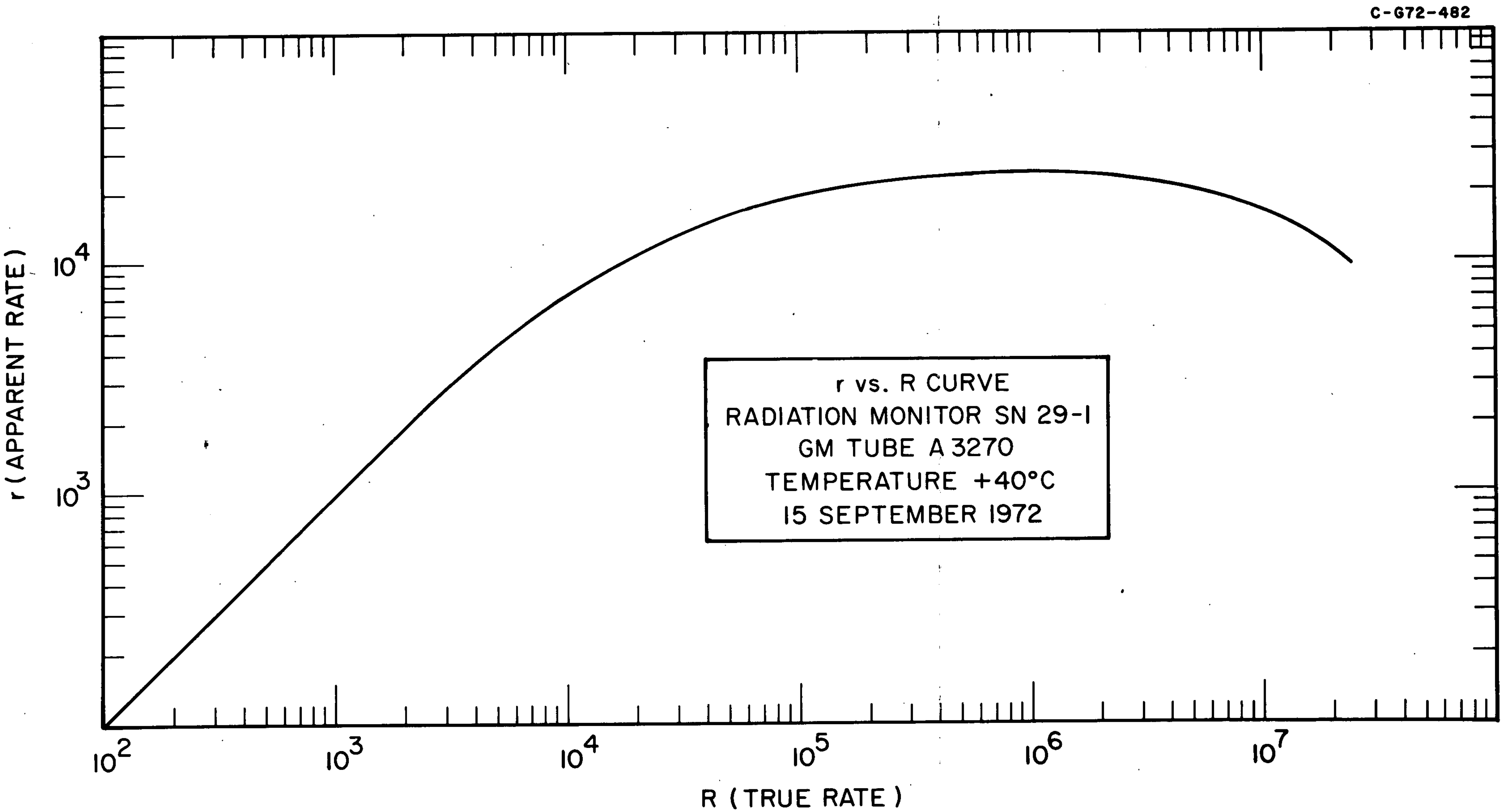

C-G72-482
r (APPARENT RATE)
$10^4$
$10^3$
r vs. R CURVE
RADIATION MONITOR SN 29-1
GM TUBE A 3270
TEMPERATURE +40°C
15 SEPTEMBER 1972
$10^2$
$10^3$
$10^4$
$10^5$
$10^6$
$10^7$
R (TRUE RATE)

FIGURE A17

APPENDIX B

RADIATION MONITOR (SN29-2)

ENVIRONMENTAL/CALIBRATION DATA

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES

(Continued)

## 1.0 ENVIRONMENTAL TEST DATA (SN29-2)

All tests were performed in accordance with the document titled UNIT-LEVEL TEST PROGRAM, RADIATION MONITOR, COSMIC X-RAY EXPERIMENT, OSO-I, dated 30 June 1972. (See Appendix C - Unit Level Test Program)

### 1.1 Functional Test

#### 1.1.1 Input Power

| Bus Voltage | Bus Current | Ave. Power |
|---|---|---|
| 12.0 volts | 5.7 ma | 68.40 mw |
| 12.2 volts | 5.9 ma | 71.98 mw |
| 11.8 volts | 5.5 ma | 64.90 mw |

#### 1.1.2 Operating Frequency

| Bus Voltage | Multivibrator Frequency |
|---|---|
| 12.0 volts | 1.884 kHz |
| 12.2 volts | 1.915 kHz |
| 11.8 volts | 1.853 kHz |

#### 1.1.3 Secondary Rectified Voltages

| Bus Voltage | Low Voltage | Unreg. High | Reg. High |
|---|---|---|---|
| 12.0 volts | 6.88 volts | 887 volts | 664.2 volts |
| 12.2 volts | 7.01 volts | 904 volts | 664.3 volts |
| 11.8 volts | 6.75 volts | 870 volts | 663.8 volts |

Low Voltage Ripple: 30 mv peak to peak at osc. freq.

#### 1.1.4 Command Verification Output

| Bus Voltage | Cmd. Ver. Voltage |
|---|---|
| 12.0 volts | 3.43 volts |
| 12.2 volts | 3.50 volts |
| 11.8 volts | 3.37 volts |

Command Verification Ripple: 20 mv peak to peak at osc. freq.

$C^2$

1.1.5 Turn-On Current Transient

Peak Current: 135 ma (Bus 12.0 volts)

Transient Current Duration: ~ .0135 amp-msec

Current Envelope Waveform: Quarter Sine Wave

1.1.6 Bus Current Noise

Peak to Peak Current: 2.7 ma

Current Envelope: Half Sine Wave

1.1.7 GM Output Pulse

30 volts peak measured at the input to signal amplifier.

1.1.8 Amplifier Output Characteristics (Bus 12.0 Volts)

Reference During Input Pulse

Absence: 4.75 volts

Pulse Transition: 4.75 volts negative going to ~ 0.2 volts.

Leading Edge Transition Time: ~ 0.02 μsec when loaded with 47 pf.

Trailing Edge Transition Time: 0.9 μsec when loaded with 47 pf and 0.6 μsec when unloaded.

1.1.9 Signal Ground (DC Isolation to Chassis)

Resistance from Pin C of J29 to chassis in excess of

200 MΩ.

1.2 Physical Properties

1.2.1 Weight: 404.8 gr. (.892 lbs)

1.2.2 External Dimensions: (See Figure B1)

1.2.3 Mounting Surface Flatness: (See Figure B2)

## 1.3 Pre-Vibration O.O.E

### 1.3.1 Source and Background Data
(Source: 100 μc $Co^{60}$ SN1059-2)

| | Total Counts | Accumulation Time | Ave c/s | Dev. |
|---|---|---|---|---|
| ($Co^{60}$) | 1164995 | 3600 sec | 323.61 | .300 |
| (BKG) | 59 | 3600 sec | .016 | .0021 |

## 1.4 Vibration Test

No instrument anomalies were noted during the performance of the acceptance level vibration test. A post axis electrical checkout of the instrument was performed after each axis of vibration.

## 1.5 Post Vibration O.O.E

### 1.5.1 Source and Background Data
(Source: 100 μc $Co^{60}$ SN1059-2)

| | Total Counts | Accumulation Time | Ave c/s | Dev. |
|---|---|---|---|---|
| ($Co^{60}$) | 1182583 | 3650 sec | 324.00 | .298 |
| (BKG) | 74 | 3700 sec | .0200 | .0023 |

## 1.6 Temperature Test

### 1.6.1 Command Verification/Bus Current Vs. Temperature

| Temperature | Cmd. Ver. | Bus Current |
|---|---|---|
| +20 °C | 3.428 volts | 5.6 ma |
| -20 °C | 3.391 volts | 5.35 ma |
| +40 °C | 3.453 volts | 5.75 ma |

1.6.2 -20 °C Source and Background Data
(Source SN1059-2)

| | Total Counts | Accumulation Time | Ave c/s | Dev. |
|---|---|---|---|---|
| ($Co^{60}$) | 1152573 | 3600 sec | 320.16 | .298 |
| (BKG) | 71 | 3600 sec | .0197 | .0023 |

1.6.3 +40 °C Source and Background Data
(Source 1059-2)

| | Total Counts | Accumulation Time | Ave c/s | Dev. |
|---|---|---|---|---|
| ($Co^{60}$) | 1152955 | 3610 sec | 319.38 | .297 |
| (BKG) | 80 | 3600 sec | .0222 | .0025 |

1.6.4 +20 °C Source and Background Data
(Source 1059-2)

| | Total Counts | Accumulation Time | Ave c/s | Dev. |
|---|---|---|---|---|
| ($Co^{60}$) | 1166240 | 3600 sec | 323.96 | .300 |
| (BKG) | 82 | 3600 sec | .0228 | .0025 |

(See Figure B3 for a plot of temperature test data.)

1.7 Thermal Vacuum Test

The acceptance thermal vacuum test consisted of 84 hours of low temperature soak (-20 °C) and 84 hours of high temperature soak (+40 °C) while maintaining the chamber pressure between $1 \times 10^{-9}$ mm of mercury and $2 \times 10^{-6}$ mm of mercury. The instrument was commanded on for 16 consecutive hours out of every 24 hours and the detector was excited during the entire test with a 100 μcurie $Co^{60}$ source (SN1059-2). Thermal control of the instrument was maintained by placing the instrument inside of a shroud which was heated and cooled with a temperature controlled glycol solution. The instrument was mounted on a plate which was suspended from the ceiling of the chamber.

Temperature observation of the instrument was performed by monitoring, with a recorder, two sets of thermocouples. One of the thermocouples was attached to the top center of the instrument box and the other to the bottom of the support plate. Once each hour during the thermal vacuum test temperature, pressure and instrument parameters were noted and logged. The following outlines the daily statistics of the data taken:

| Temperature | Date | Total Counts Accumulated | Accumulation Time (sec) | Ave. c/s | Dev. |
|---|---|---|---|---|---|
| -20 °C | 1/26/73 | 17,468,833 | 54720 | 319.24 | .076 |
| -20 °C | 1/27/73 | 17,687,949 | 55660 | 317.79 | .076 |
| -20 °C | 1/28/73 | 16,941,842 | 53450 | 316.97 | .077 |
| -20 °C | 1/29/73 | 13,323,901 | 42090 | 316.56 | .087 |
| +40 °C | 1/30/73 | 17,892,360 | 54910 | 325.85 | .077 |
| +40 °C | 1/31/73 | 18,395,488 | 55400 | 332.05 | .077 |
| +40 °C | 2/01/73 | 18,831,952 | 56680 | 332.25 | .077 |
| +40 °C | 2/02/73 | 4,596,016 | 13900 | 330.65 | .154 |

(See Figure B4 for a plot of daily averaged test data.)

1.8 Post Thermal Vacuum O.O.E

1.8.1 Source and Background Data
(Source: 100 μc $Co^{60}$ SN1059-2)

| | Total Counts | Accumulation Time | Ave c/s | Dev. |
|---|---|---|---|---|
| ($Co^{60}$) | 1169355 | 3600 sec | 324.82 | .300 |
| (BKG) | 71 | 3600 sec | .0197 | .0023 |

## 2.0 SCREEN/TEST DATA EON6213 (SNA3514)

Figure B5 through B10 depict the before and after screening plateau characteristics of the EON 6213 GM tube (SNA3514). Figures B11 and B12 show the tube background characteristics taken during a 24 hour life test and during a 3000 sec quiet run. Figure B13 depicts the tubes counting rate temperature dependence prior to integration with the remaining instrument.

# 3.0 CALIBRATION DATA

(Radiation Monitor SN 29-2, G.M. Tube SNA3514)

The following material was prepared by Dr. J. A. Van Allen with the help of Dr. B. A. Randall and D. N. Baker.

## 3.1 Physical Characteristics as a Particle Detector

### 3.1.1 Introduction

Radiation Monitor SN 29-2 has been subjected to a rather full set of particle calibrations. The data are believed to be equally applicable to SN 29-1 because of the essential identity of the two instruments. Hence section 7 of the "Design Manual" of 20 September 1972 should be replaced by the current material.

### 3.1.2 Transmission Curve for Electrons

The absolute electron transmission of the complete window system of the assembled detector was measured at normal incidence with monoenergetic electrons from the new University of Iowa 300 keV electron accelerator. The result is shown in Figure 17. The transmission tends to level at a value of about 31% as the electron energy is increased from 200 to 300 keV. The fact that it is not nearly 100% is believed to be due to a combination of backscattering and the angular diffuseness of the electron beam as it emerges from the inner side of the gold foil, which has a significant stand-off distance from the active volume of the G.M. tube. The transmission curve presumably continues to rise gradually with increasing energy. The extrapolated threshold is 100 keV. A transmission of 15% occurs at 170 keV.

3.1.3 Angular Response

The angular response of the assembled detector was measured with $Sr^{90}$ $\beta$ rays (546 keV upper limit) (Figure B18). The full width at half height is 82°.

3.1.4 Unidirectional Geometric Factor

(a) Half angle of Maximum Look-Angle cone = 45°.

(b) Half angle of Effective Look-Angle cone = 41°.

(c) Effective Solid Angle, $\Omega$ = 1.54 steradian.

(d) Effective Detector Area, A = 0.045 $cm^2$.

(e) Unidirectional Geometric Factor, $g' = A \cdot \Omega$

$$= 6.93 \times 10^{-2} \text{ cm}^2 \text{ steradian.}$$

3.1.5 Effective Unidirectional Geometric Factor for Electrons

The effective unidirectional geometric factor g for electrons is the product of the transmission as read from Figure B17 and g' as given in 3.1.4.

For 300 keV monoenergetic electrons, for example,

$g = (0.31)(6.93 \times 10^{-2}) = 2.2 \times 10^{-2}$ $cm^2$ steradian

and the absolute particle intensity,

$$j \text{ (cm}^2 \text{ sec sterad)}^{-1} = R/g = 47\,R$$

where R $(\sec)^{-1}$ is the true counting rate of the G.M. tube caused by particles entering through the collimator. For any known or assumed electron spectrum the corresponding relationship between j and R can be worked out using the experimental transmission curve and the data of 3.1.4.

3.1.6 Energy Threshold for Protons

The energy threshold of the assembled detector was measured for protons using the University of Iowa 2 MeV Van de Graaff. It was found to be 1.1 $\pm$ 0.05 MeV.

3.1.7 Effective Unidirectional Geometric Factor for Protons

For protons

$$g = g' = 6.93 \times 10^{-2} \quad \text{for } E_p > 1.1 \text{ MeV}$$

and $$g = 0 \quad \text{for } E_p < 1.1 \text{ MeV}.$$

Hence

$$j = 14.4\ R \quad \text{for } E_p > 1.1 \text{ MeV}$$

and $j$ is unknown for $E_p < 1.1$ MeV.

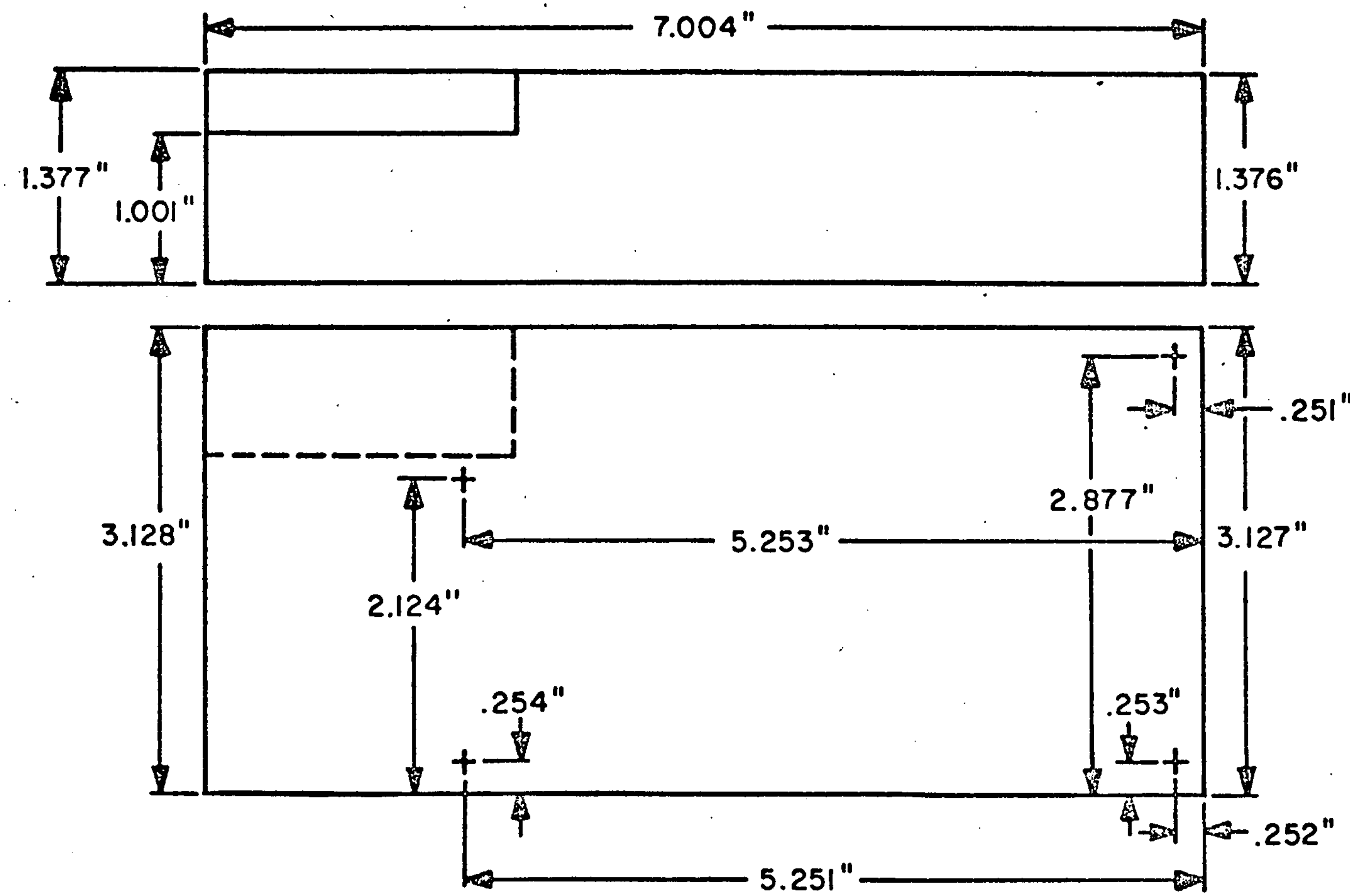
3.1.8 X-Ray Sensitivity at Normal Incidence

| $\lambda$ | Calculated Transmission of Gold Foil | Estimated erg $cm^{-2}$ per GM Count |
|---|---|---|
| 9.87 A° | $2.3 \times 10^{-6}$ % | 87 |
| 5.39 | $7 \times 10^{-4}$ | 0.2 |
| 4.15 | $9 \times 10^{-3}$ | $1.7 \times 10^{-2}$ |
| 3.03 | $1.2 \times 10^{-1}$ | $2 \times 10^{-3}$ |
| 1.93 | 6.3 | $1.6 \times 10^{-4}$ |
| 1.0 | 29. | $3.8 \times 10^{-4}$ |
| $\lambda \leq 0.5$ | > 70 | $> 1.4 \times 10^{-2}$ |

3.2 r Vs R Curves

Figures B14, B15 and B16 show the relationship between the "Apparent Counting Rate" (r) and the "True Counting Rate" (R) for GM tube SNA3514 and its associated circuitry. The calibration runs were made using the UI/Westinghouse 240 KV D.C. X-ray machine. The family of curves shown represent the r vs R characteristics at -20 °C, +24 °C and +40 °C.

A-G73-52




PHYSICAL PROPERTIES MEASUREMENTS
EXTERNAL DIMENSIONS / MOUNTING HOLE LOCATION (SN29-2)

FIGURE B1

A-G73-51

PHYSICAL PROPERTIES MEASUREMENTS
MOUNTING SURFACE FLATNESS (SN29-2)

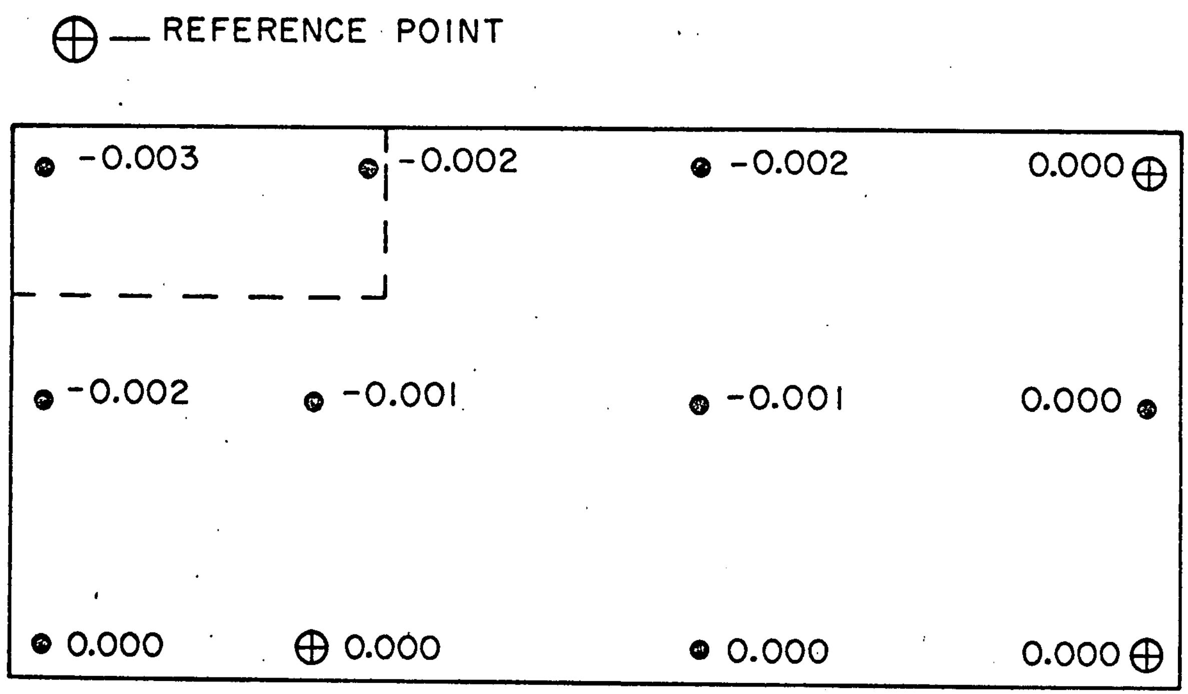



FIGURE B2

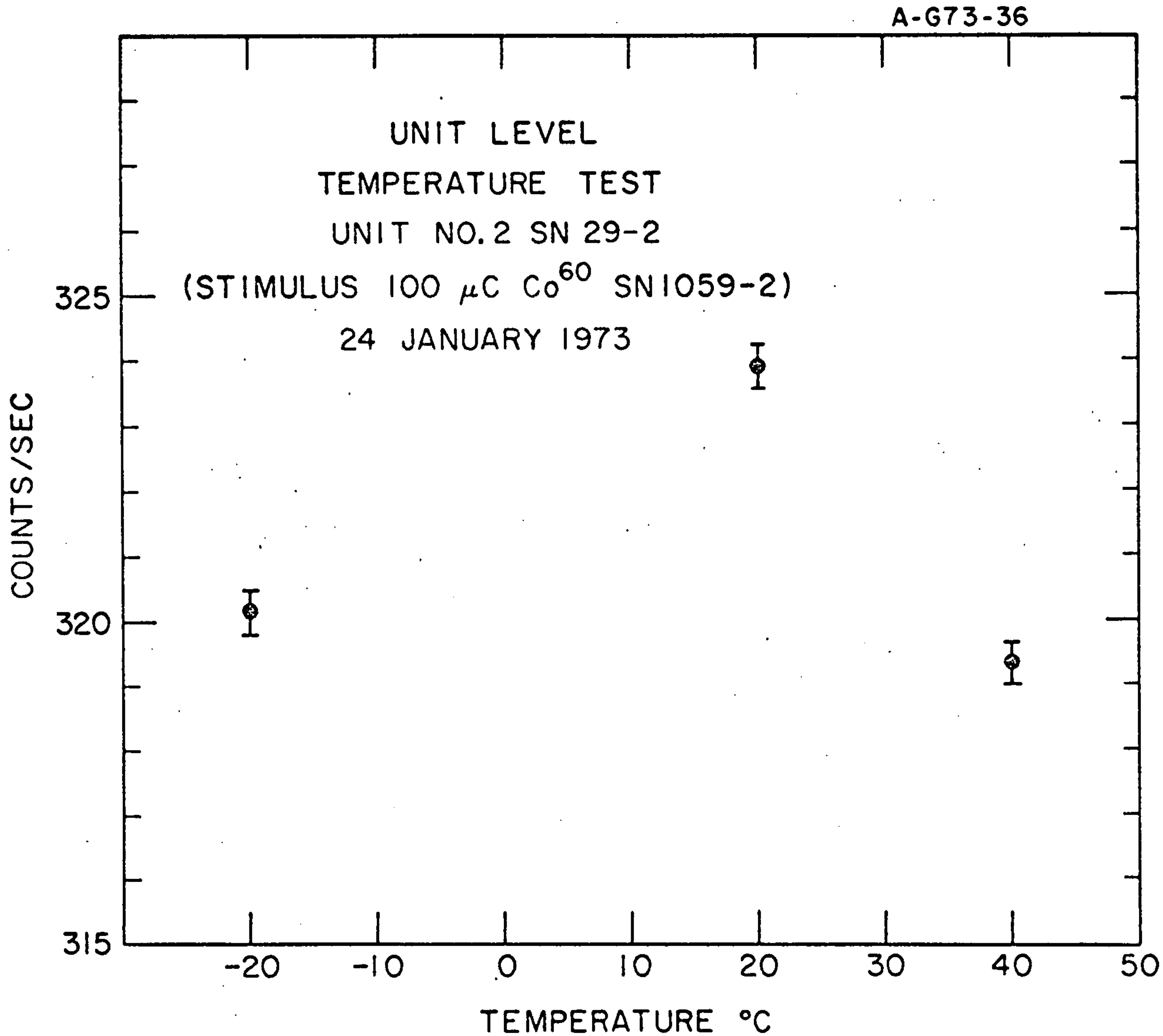

A-G73-36
UNIT LEVEL
TEMPERATURE TEST
UNIT NO. 2 SN 29-2
(STIMULUS 100 μC Co60 SN1059-2)
24 JANUARY 1973
COUNTS/SEC
325
320
315
-20
-10
0
10
20
30
40
50
TEMPERATURE °C

FIGURE B3

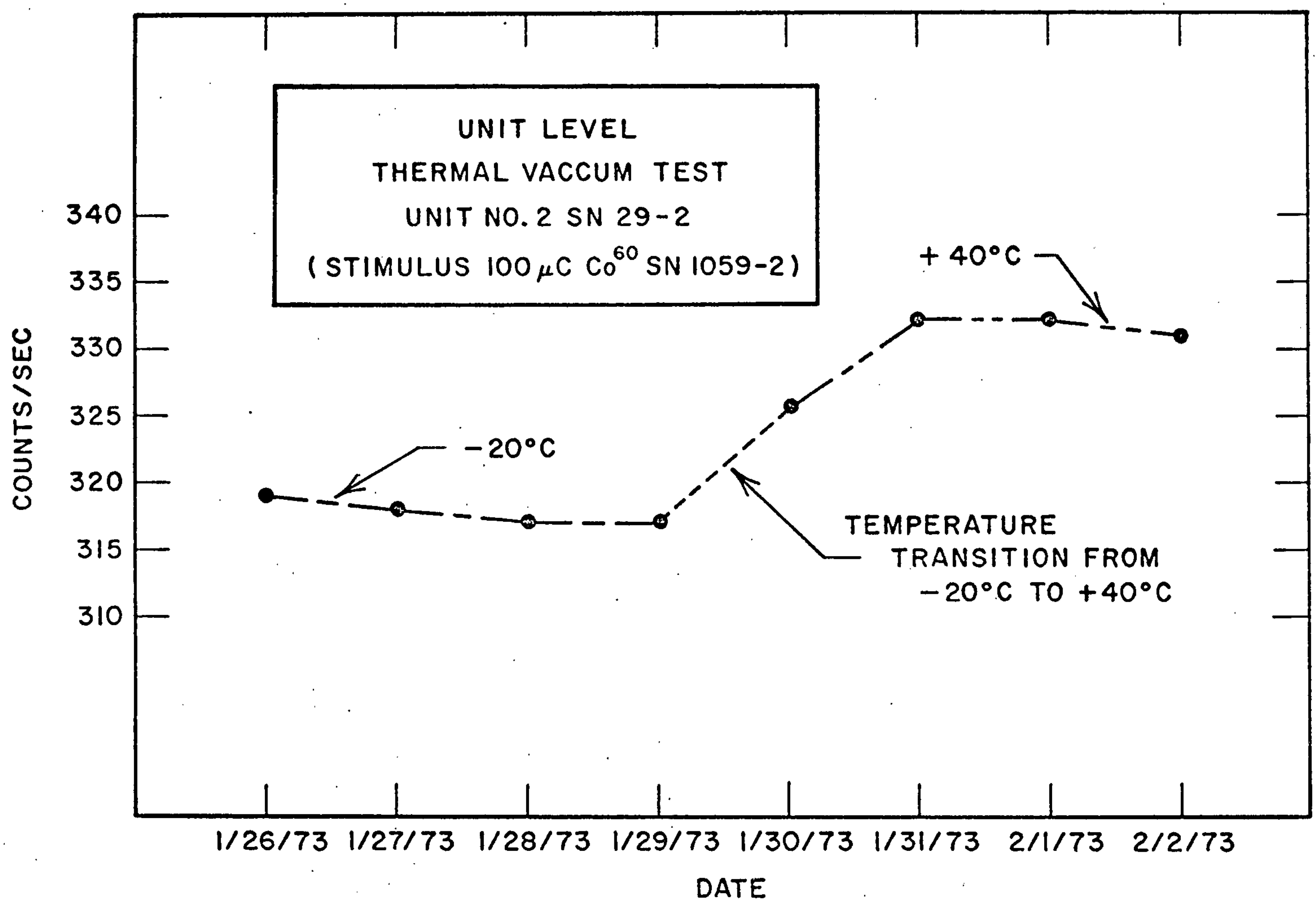

UNIT LEVEL
THERMAL VACCUM TEST
UNIT NO. 2 SN 29-2
( STIMULUS 100 $\mu$C $Co^{60}$ SN 1059-2 )
+ 40°C
−20°C
TEMPERATURE TRANSITION FROM −20°C TO +40°C
COUNTS/SEC
340
335
330
325
320
315
310
1/26/73
1/27/73
1/28/73
1/29/73
1/30/73
1/31/73
2/1/73
2/2/73
DATE

FIGURE B4

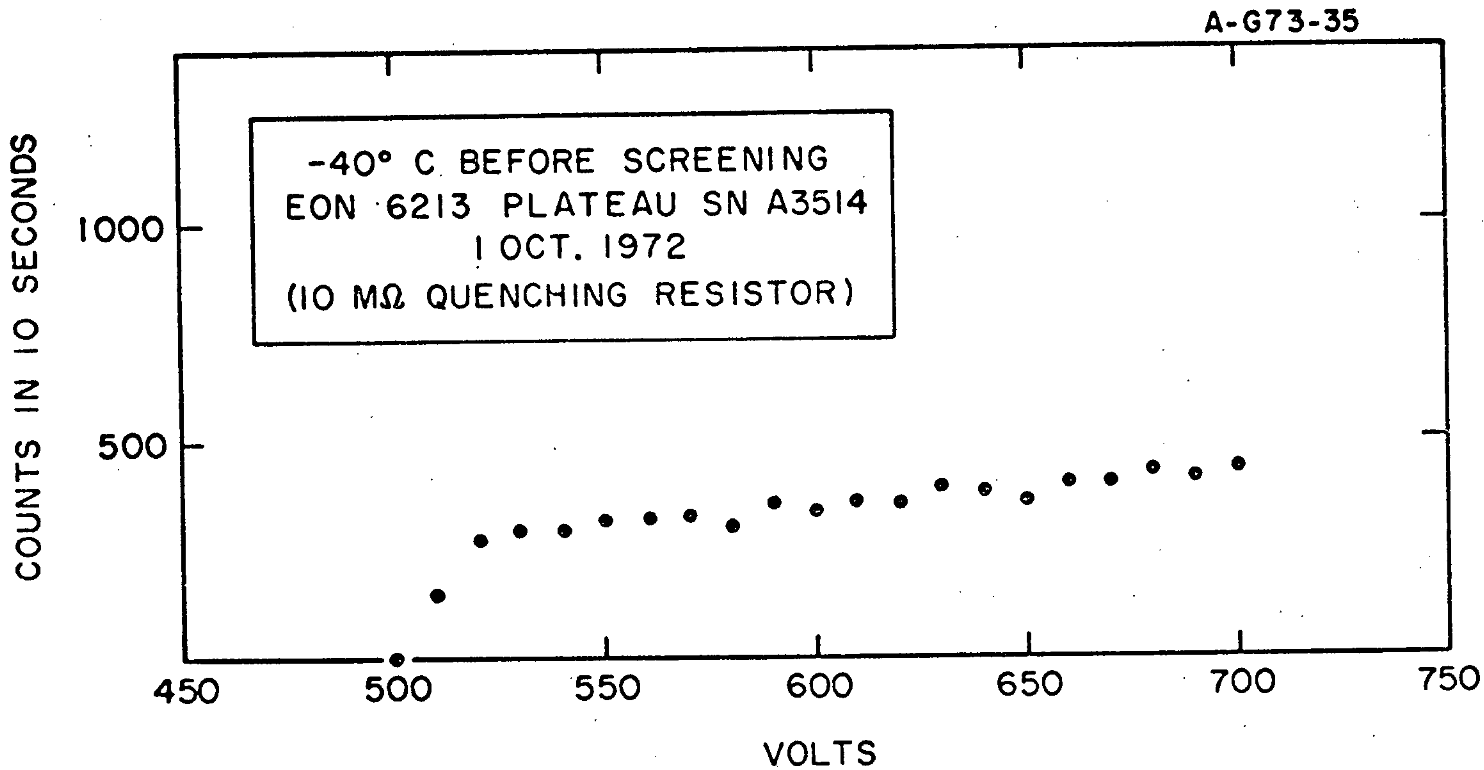

A-G73-35
-40° C BEFORE SCREENING
EON 6213 PLATEAU SN A3514
1 OCT. 1972
(10 MΩ QUENCHING RESISTOR)
COUNTS IN 10 SECONDS
1000
500
450
500
550
600
650
700
750
VOLTS

FIGURE B5

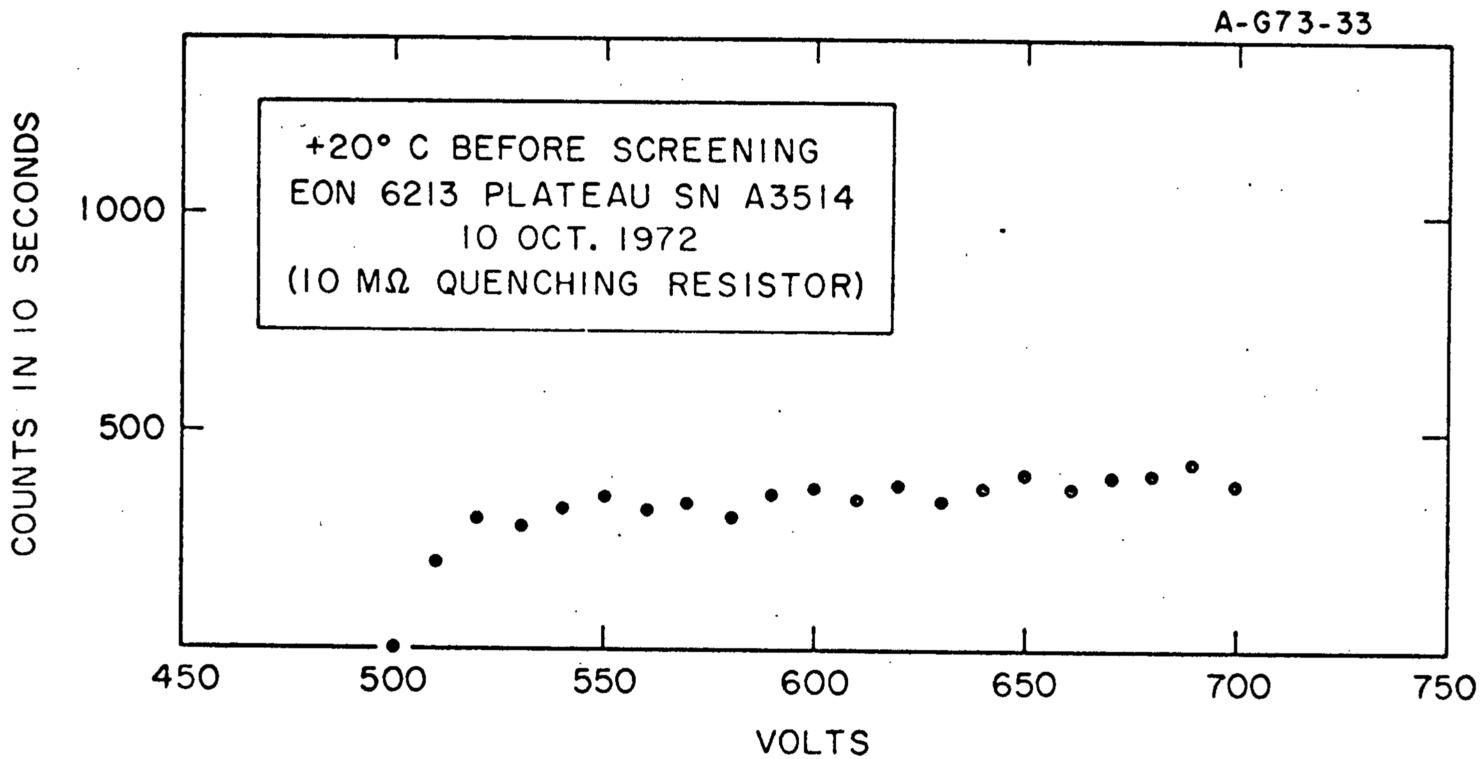

A-G73-33
+20° C BEFORE SCREENING
EON 6213 PLATEAU SN A3514
10 OCT. 1972
(10 MΩ QUENCHING RESISTOR)
COUNTS IN 10 SECONDS
1000
500
450
500
550
600
650
700
750
VOLTS

FIGURE B6

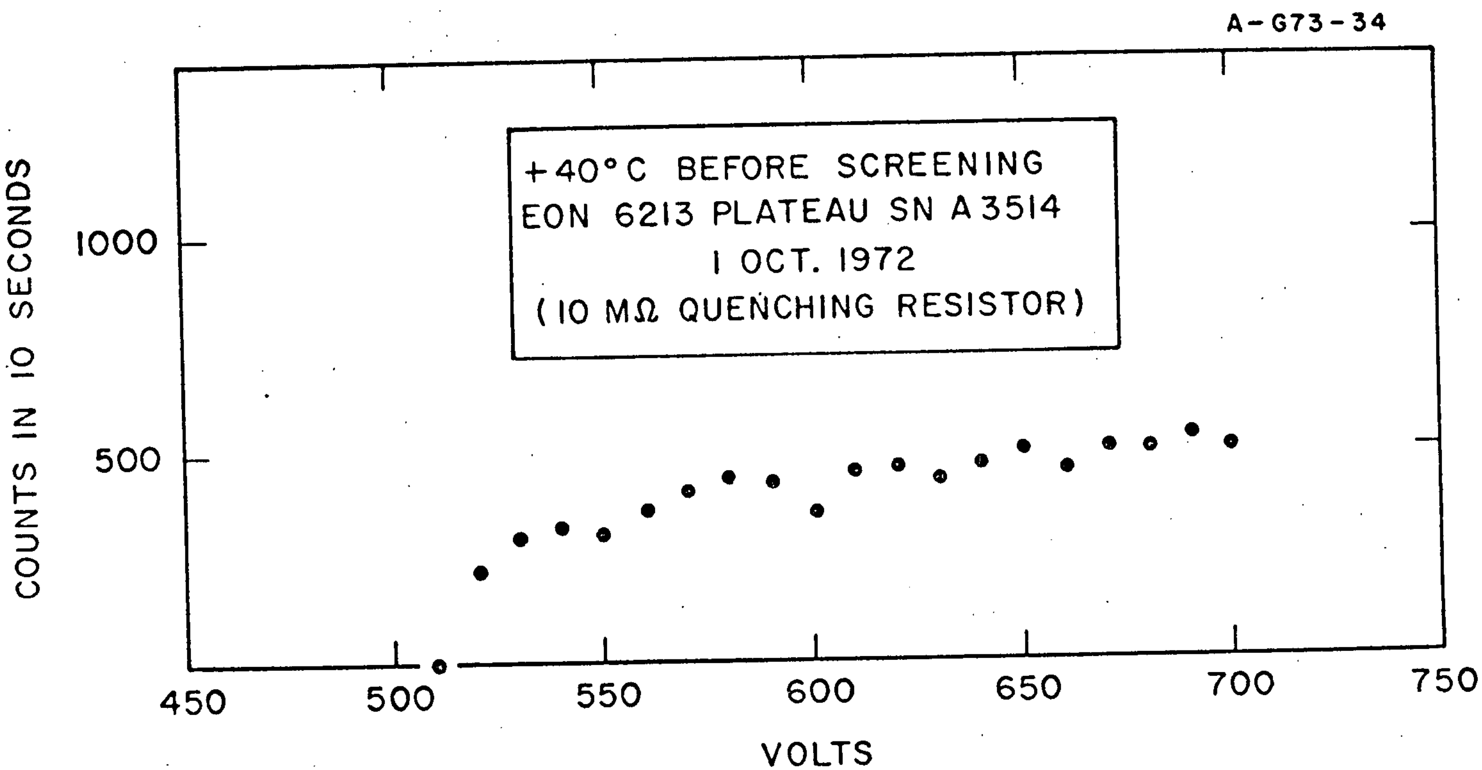

A-G73-34
+40°C BEFORE SCREENING
EON 6213 PLATEAU SN A3514
1 OCT. 1972
(10 MΩ QUENCHING RESISTOR)
COUNTS IN 10 SECONDS
1000
500
450
500
550
600
650
700
750
VOLTS

FIGURE B7

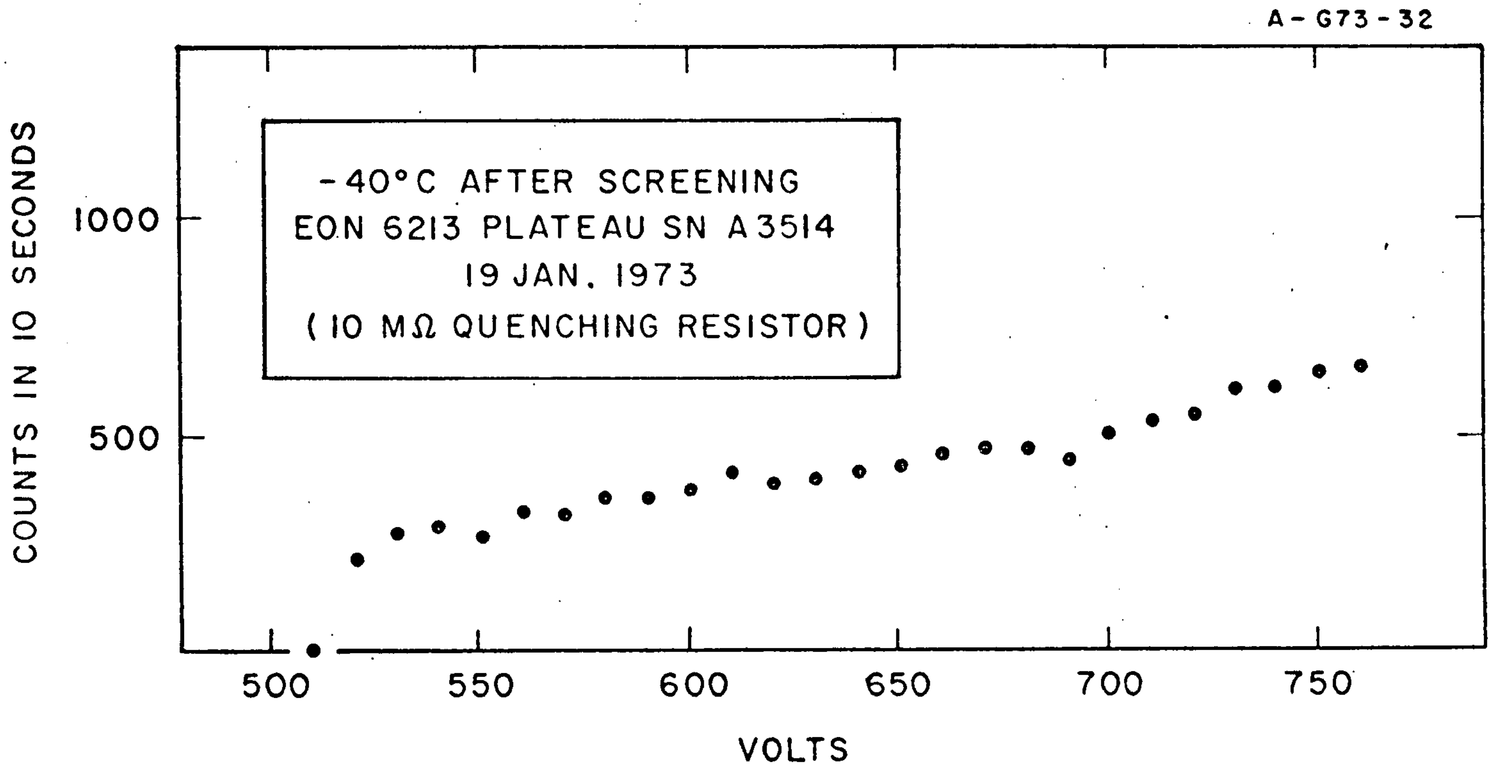

A-G73-32
-40°C AFTER SCREENING
EON 6213 PLATEAU SN A3514
19 JAN. 1973
(10 MΩ QUENCHING RESISTOR)
COUNTS IN 10 SECONDS
1000
500
500
550
600
650
700
750
VOLTS

FIGURE B8

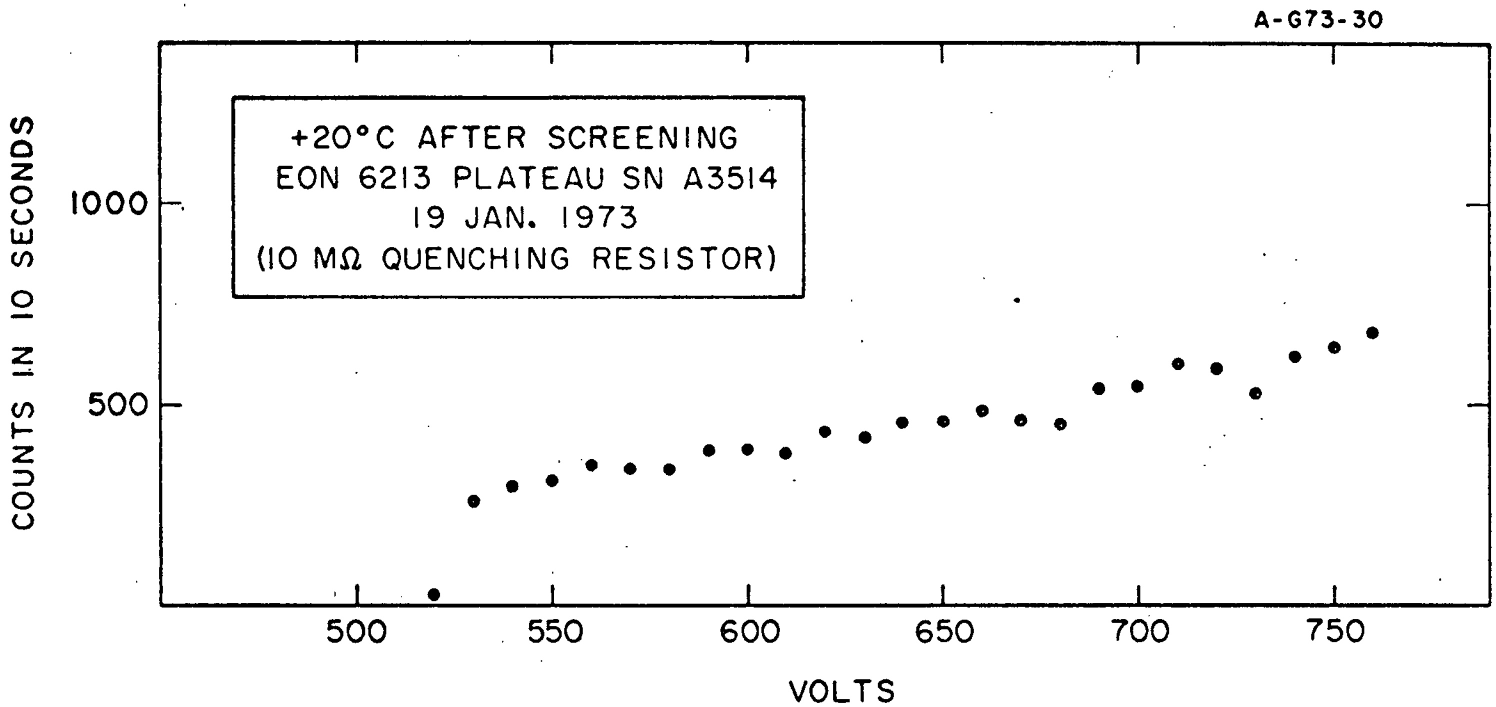

A-G73-30
+20°C AFTER SCREENING
EON 6213 PLATEAU SN A3514
19 JAN. 1973
(10 MΩ QUENCHING RESISTOR)
COUNTS IN 10 SECONDS
1000
500
500
550
600
650
700
750
VOLTS

FIGURE B9

A-G73-31

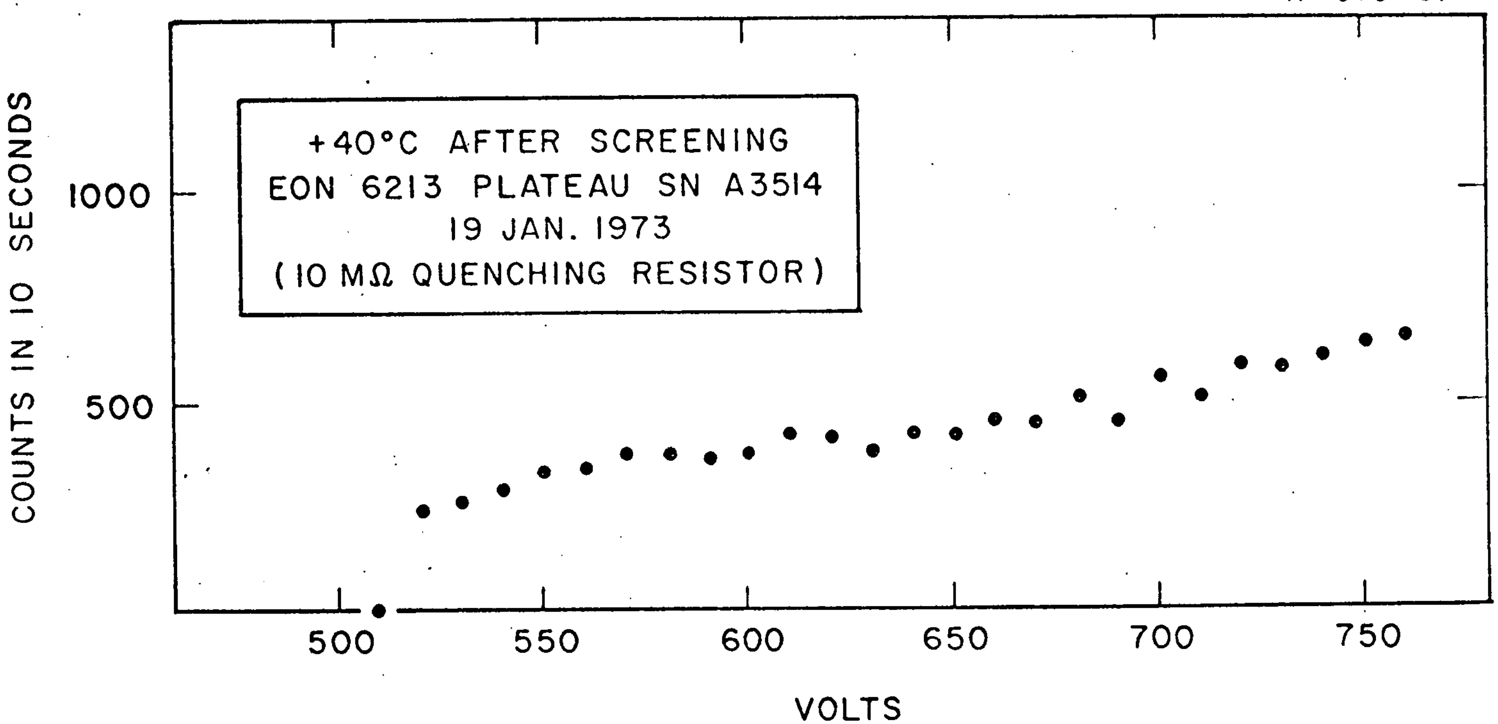



FIGURE B10

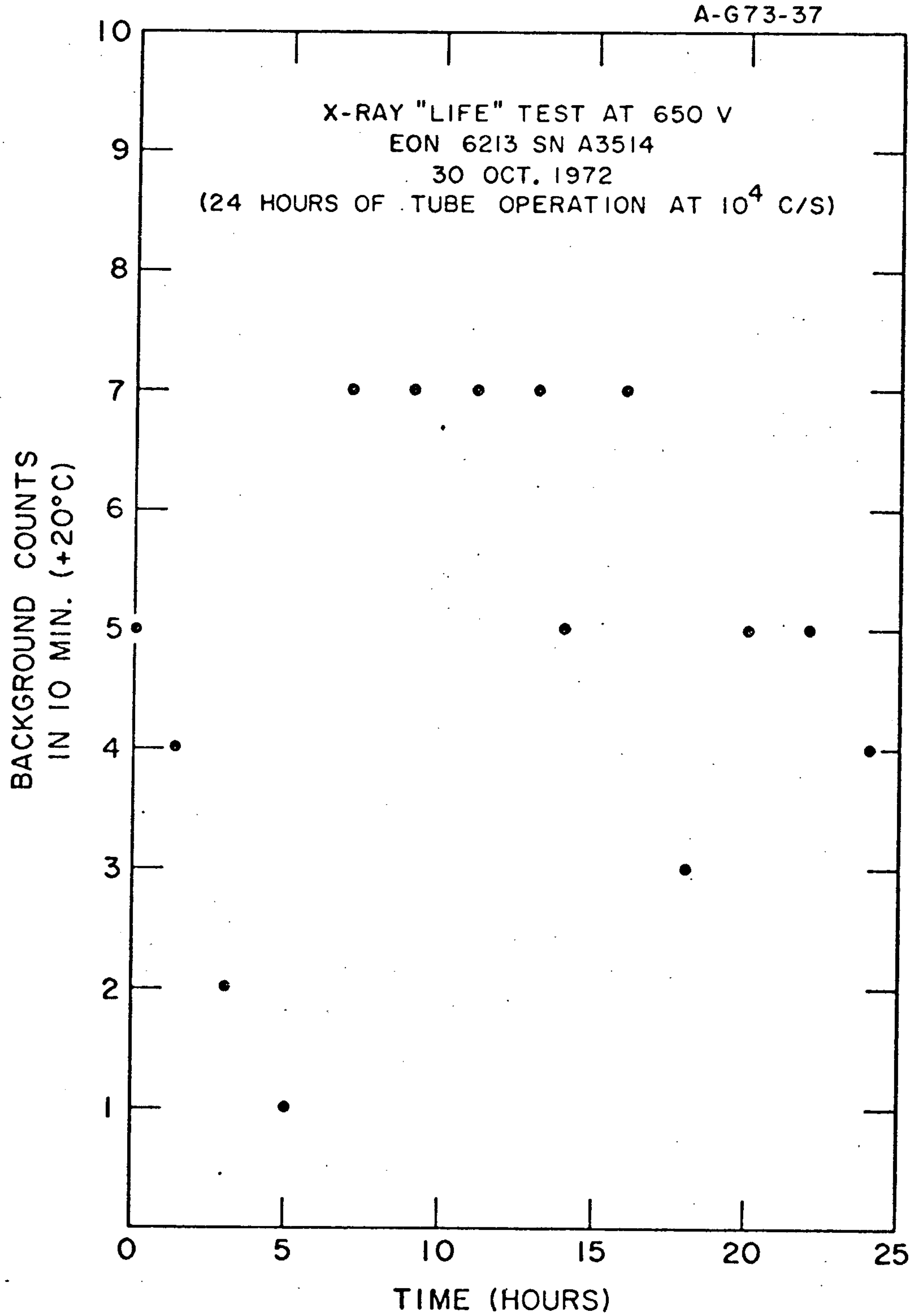

A-G73-37
X-RAY "LIFE" TEST AT 650 V
EON 6213 SN A3514
30 OCT. 1972
(24 HOURS OF TUBE OPERATION AT 10^4 C/S)
BACKGROUND COUNTS
IN 10 MIN. (+20°C)
0
1
2
3
4
5
6
7
8
9
10
0
5
10
15
20
25
TIME (HOURS)

FIGURE B11

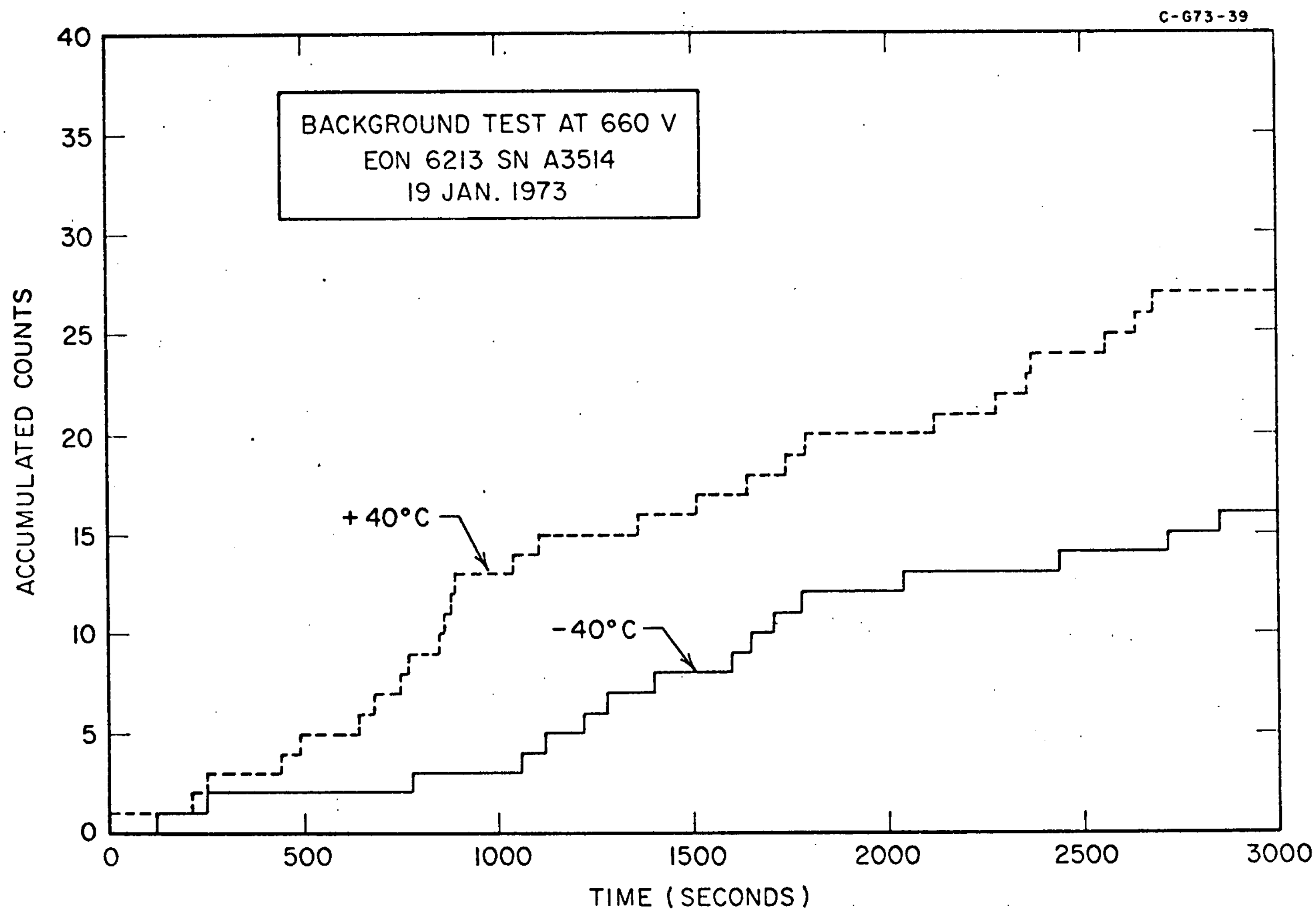

C-G73-39
BACKGROUND TEST AT 660 V
EON 6213 SN A3514
19 JAN. 1973
ACCUMULATED COUNTS
+40°C
-40°C
TIME (SECONDS)
0
5
10
15
20
25
30
35
40
0
500
1000
1500
2000
2500
3000

FIGURE B12

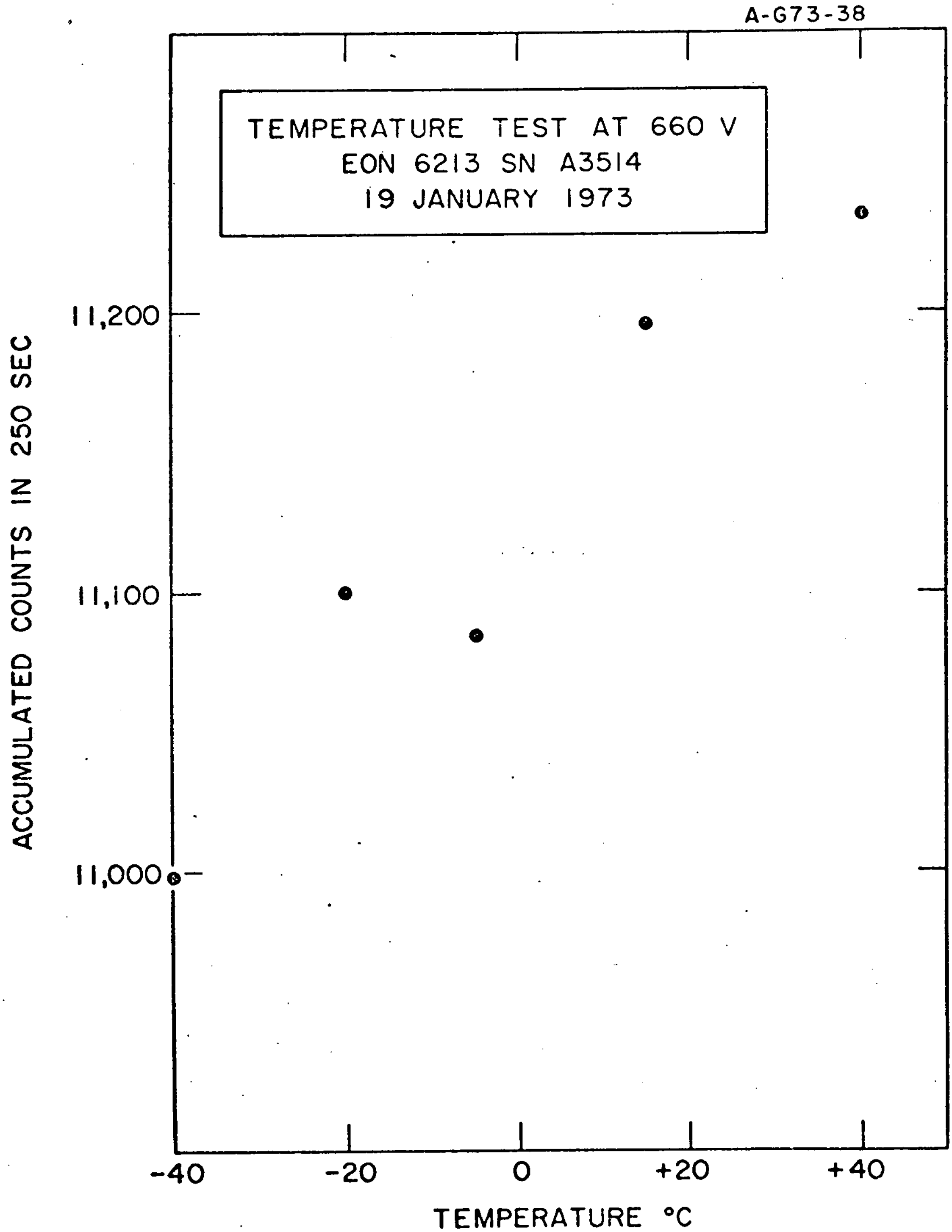

A-G73-38
TEMPERATURE TEST AT 660 V
EON 6213 SN A3514
19 JANUARY 1973
ACCUMULATED COUNTS IN 250 SEC
11,200
11,100
11,000
-40
-20
0
+20
+40
TEMPERATURE °C

FIGURE B13

B24

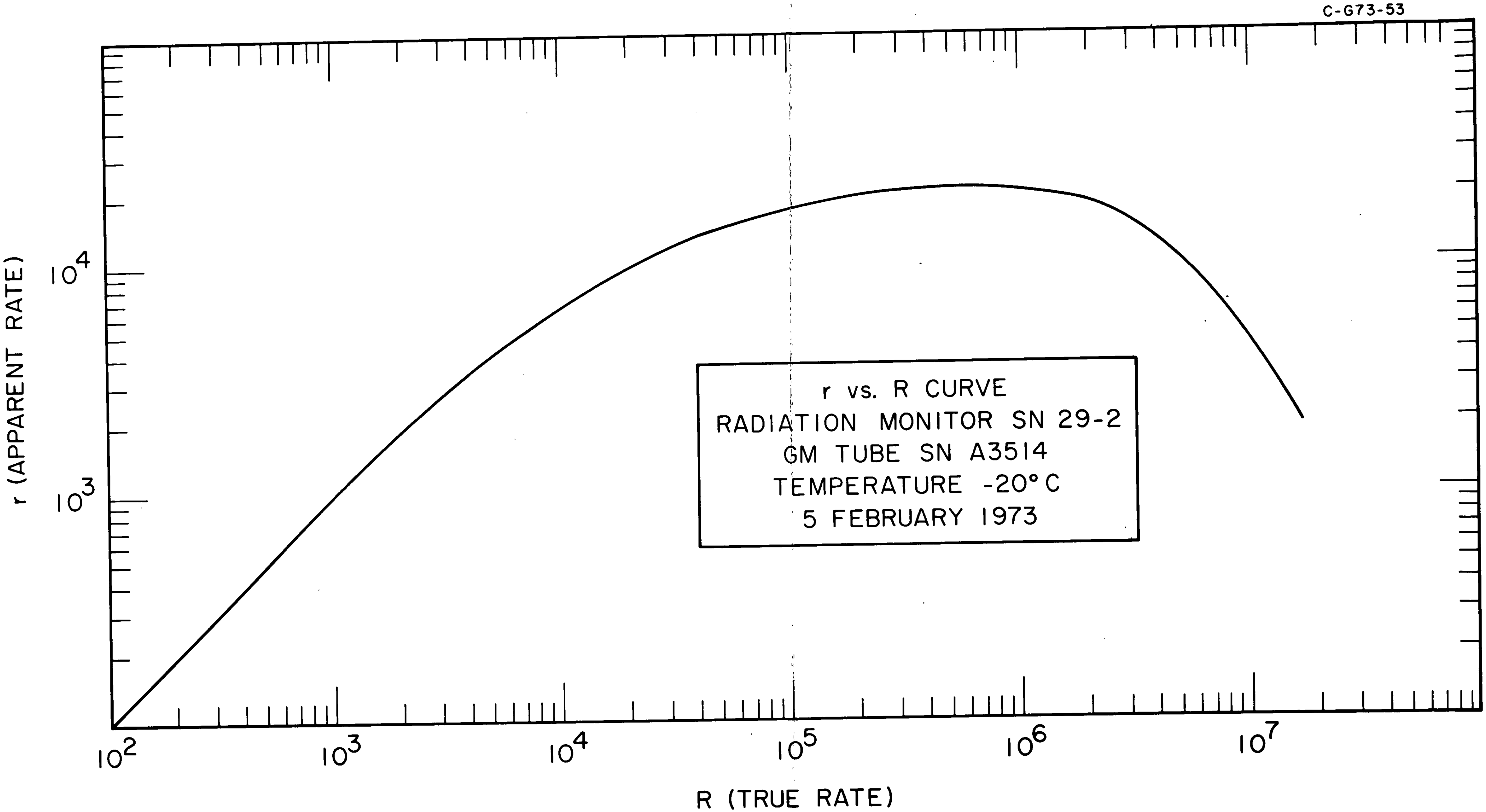



FIGURE B14

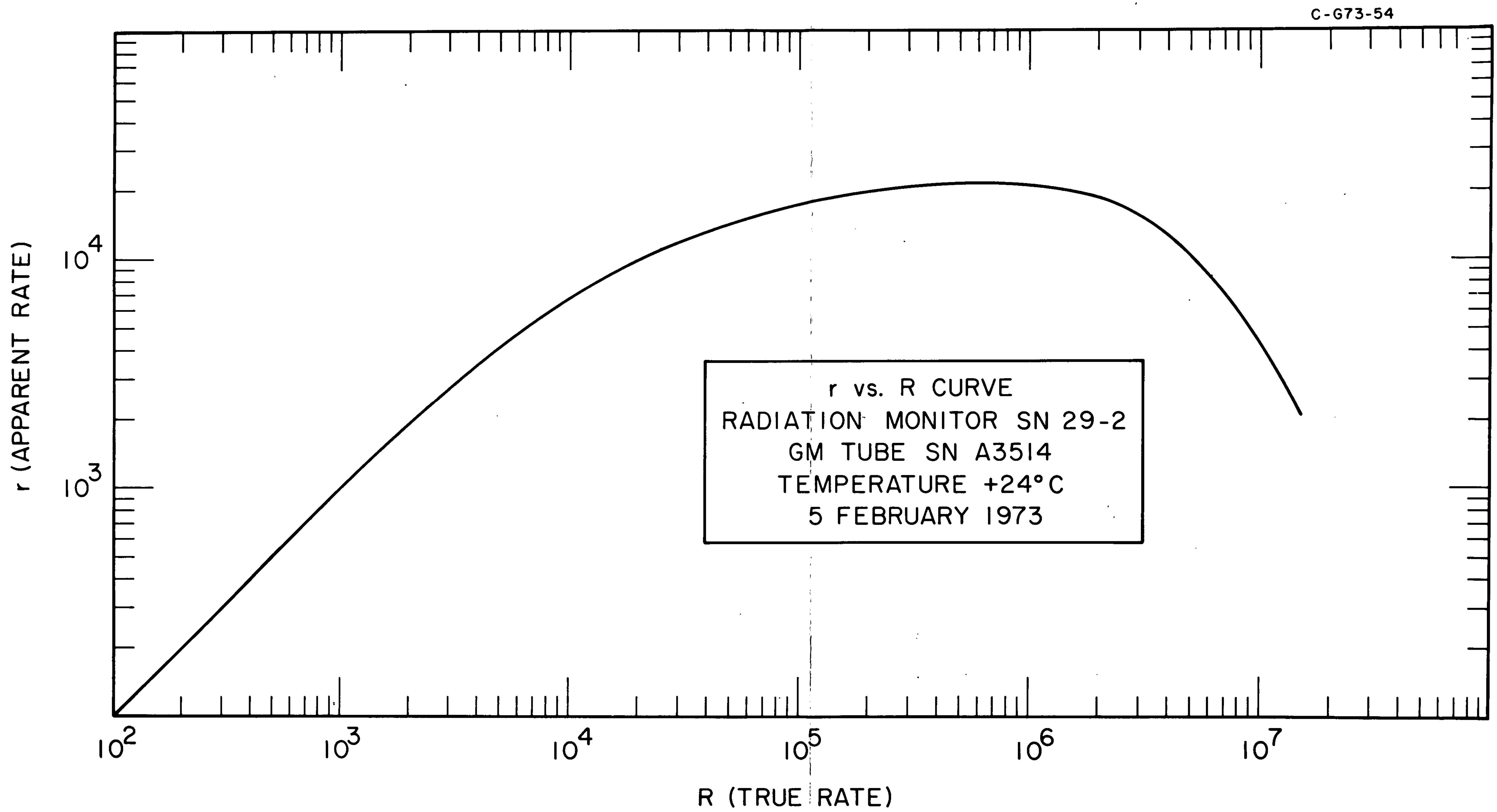



FIGURE B15

FOLDOUT FRAME 1

FOLDOUT FRAME 2

C-G73-55

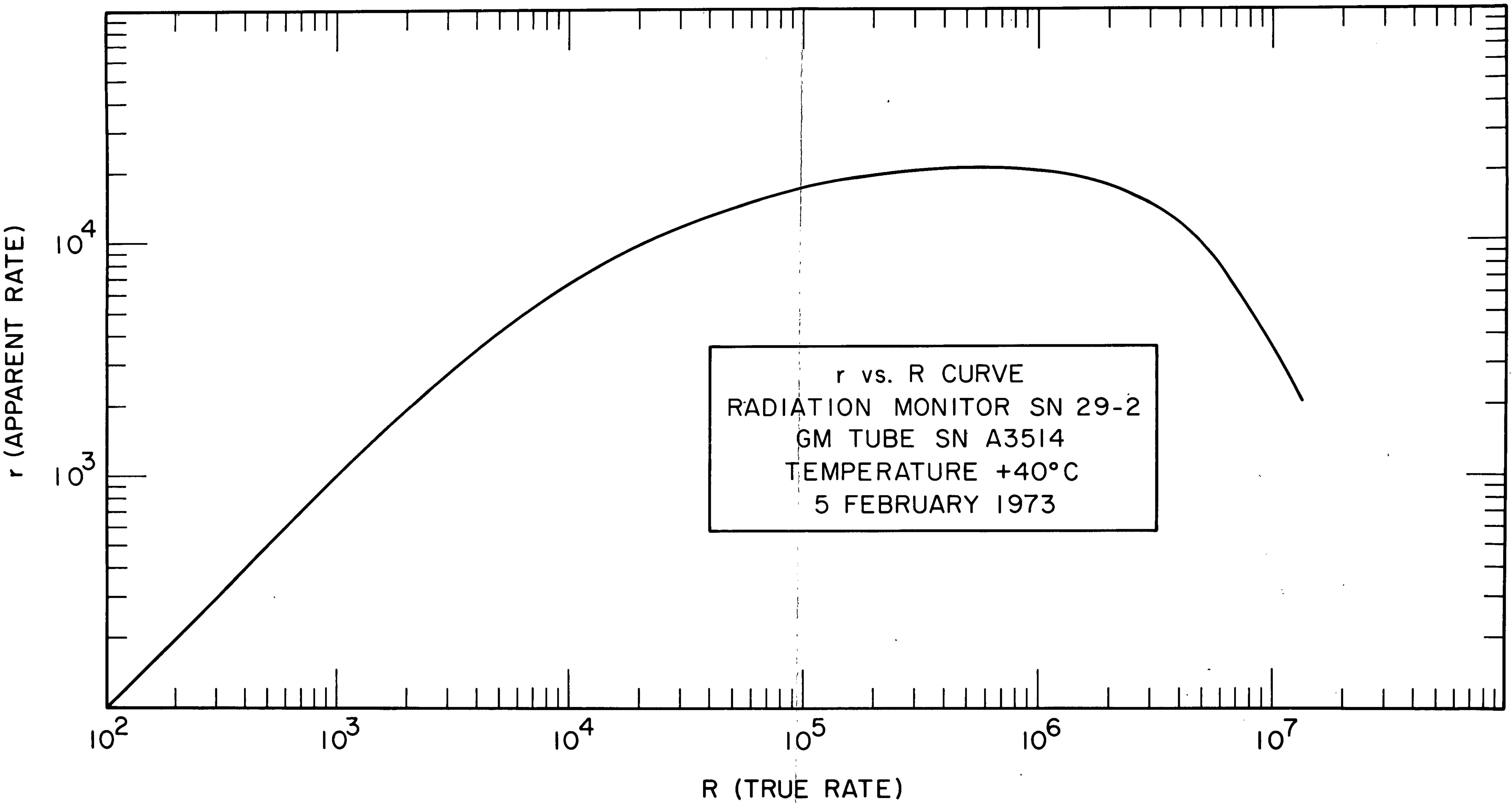



FIGURE B16

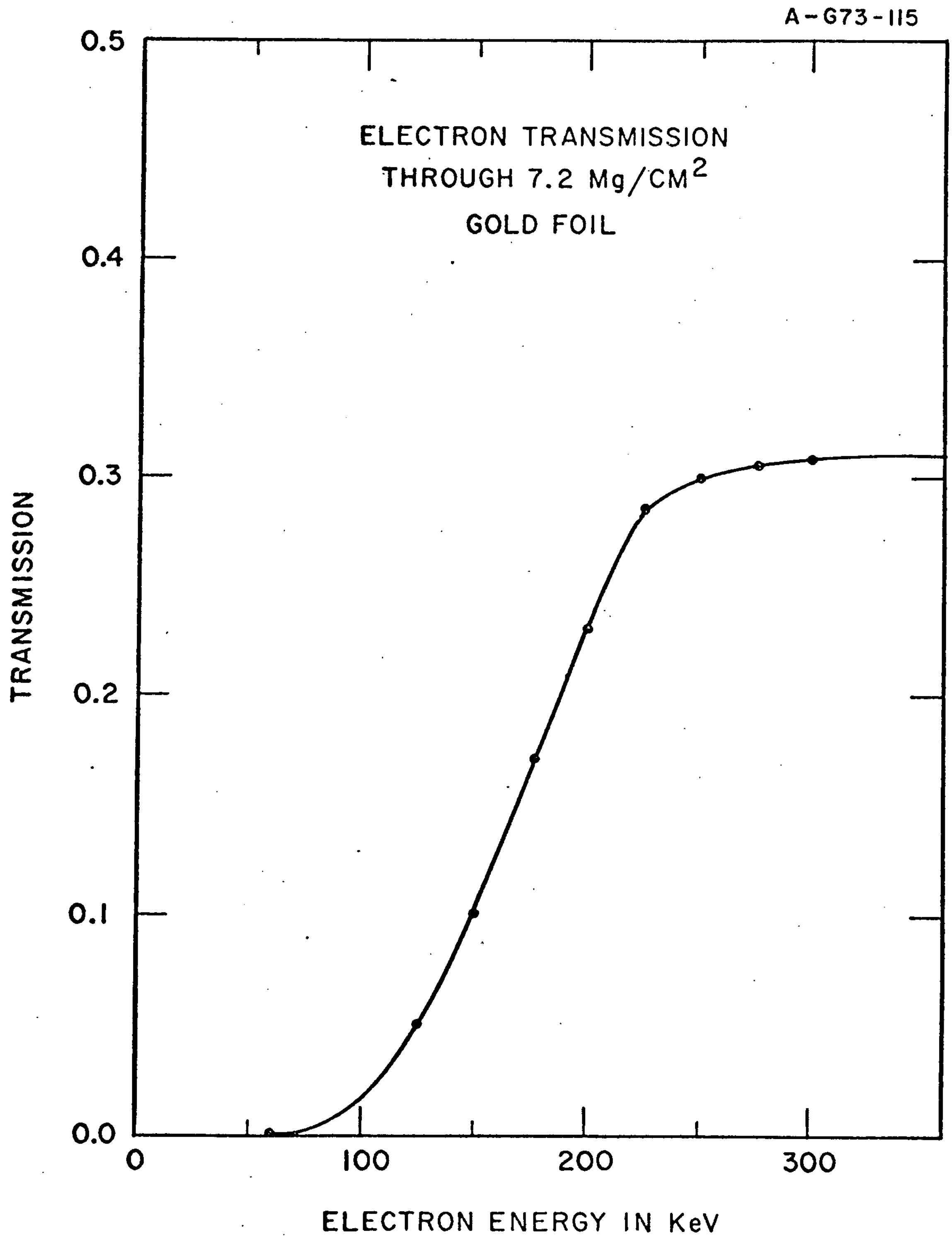

A-G73-115
ELECTRON TRANSMISSION
THROUGH 7.2 Mg/CM2
GOLD FOIL
TRANSMISSION
0.5
0.4
0.3
0.2
0.1
0.0
0
100
200
300
ELECTRON ENERGY IN KeV

FIGURE B17

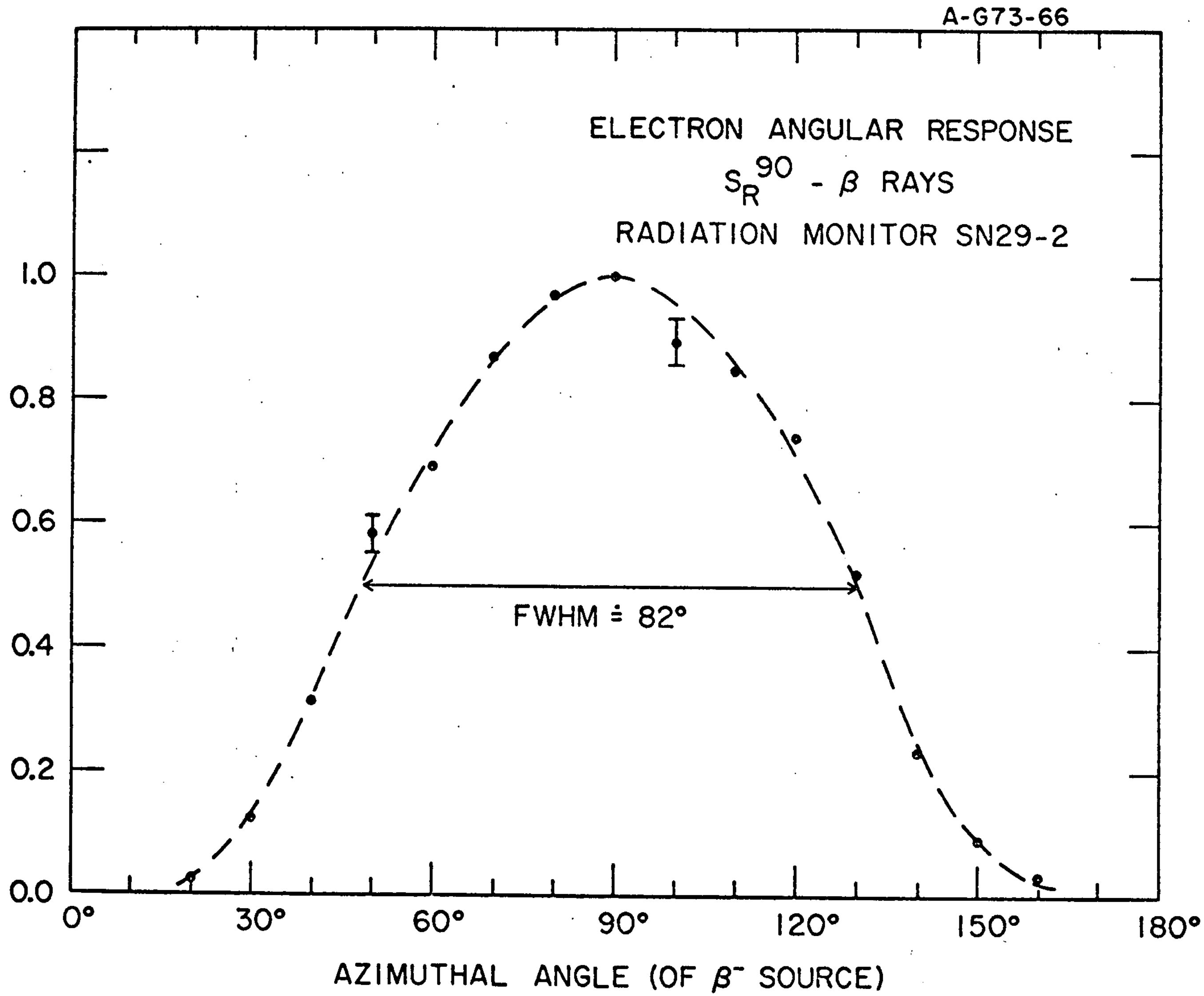

A-G73-66
ELECTRON ANGULAR RESPONSE
$S_R^{90}$ - $\beta$ RAYS
RADIATION MONITOR SN29-2
FWHM ≐ 82°
1.0
0.8
0.6
0.4
0.2
0.0
0°
30°
60°
90°
120°
150°
180°
AZIMUTHAL ANGLE (OF $\beta^-$ SOURCE)

FIGURE B18

# APPENDIX C

# UNIT-LEVEL TEST PROGRAM

TABLE OF CONTENTS

## 1.0 SCOPE

1.1 This document outlines the Unit-Level Tests to be performed by the University of Iowa on the OSO-I Cosmic X-Ray Experiment Radiation Monitors.

1.2 The Unit-Level Tests shall consist of the following:

- 1.2.1 Functional Checkout
- 1.2.2 Physical Properties Measurements
- 1.2.3 Environmental Tests
  - 1.2.3.1 Overall Operational Evaluation
  - 1.2.3.2 Vibration
  - 1.2.3.3 Temperature
  - 1.2.3.4 Thermal Vacuum

## 2.0 DOCUMENTATION/NOTIFICATION REQUIREMENTS

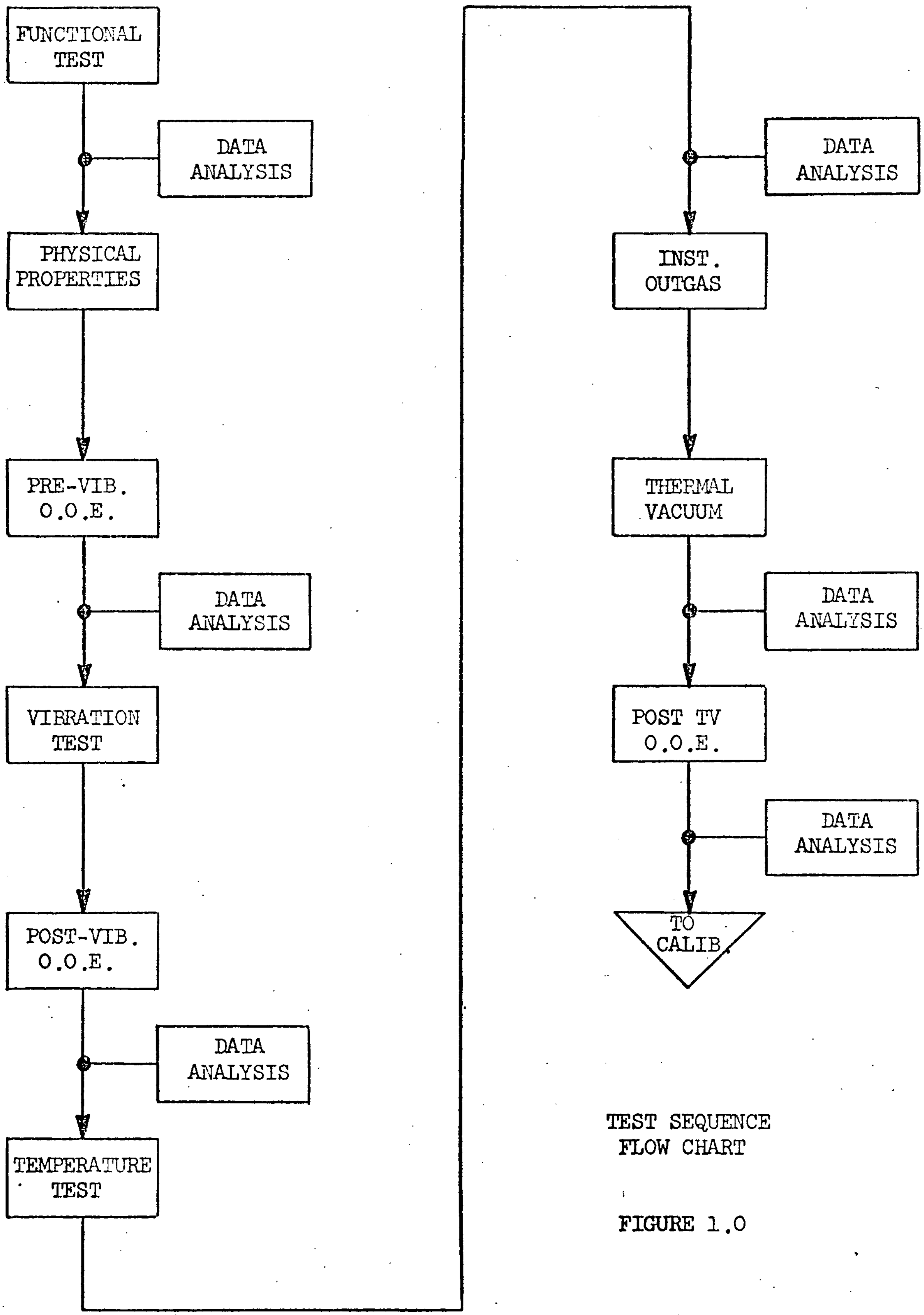
2.1 A detailed test log shall be kept in a Coop Computation Book in a neat precise legible form. All data entries shall be logged according to date, time, type of test, and person making entry. Tests being performed shall also be logged in the Instrument Logbook.

2.2 At least twenty-four (24) hours prior to commencement of any given test phase notification of test start time shall be given to the UI and ONR QA representatives.

2.3 After completion of each phase the Instrument Logbook shall be submitted to the UI and ONR QA representatives for proper certification of data and test sequence.

## 3.0 UNIT LEVEL TEST SEQUENCE

3.1 Figure 1.0 depicts the test sequence which shall be implemented during unit-level testing. Deviations from this sequence can be granted by the Project Manager providing sufficient cause for deviation is presented.




TEST SEQUENCE FLOW CHART

FIGURE 1.0

## 4.0 FUNCTIONAL CHECKOUT

### 4.1 Input Power Measurements

4.1.1 Measure instrument power at the following bus voltages:

(a) 12.0 VDC

(b) 12.2 VDC

(c) 11.8 VDC

### 4.2 Operating Frequency

4.2.1 Measure the operating frequency of the saturable-core multivibrator at the following bus voltages:

(a) 12.0 VDC

(b) 12.2 VDC

(c) 11.8 VDC

4.2.2 Verify proper waveform characteristics on the primary and secondary windings of the transformer at a bus voltage of 12.0 VDC.

### 4.3 Secondary Rectified Voltages

4.3.1 Measure the dc level and ripple content of the low and high rectified voltages at the following bus voltages:

(a) 12.0 VDC

(b) 12.2 VDC

(c) 11.8 VDC

4.4 Command Verification Output

4.4.1 Measure the Command Verification dc level and ripple content at the following bus voltages:

(a) 12.0 VDC

(b) 12.2 VDC

(c) 11.8 VDC

4.5 Turn-ON Current Transient

4.5.1 Measure the following current transient characteristics at a bus voltage of 12.0 VDC:

(a) peak current

(b) transient current duration

(c) current envelope waveform

4.6 Bus Current Noise

4.6.1 With the instrument operating at a bus voltage of 12.0 VDC measure the bus current noise.

4.7 GM Output Pulse Characteristics

4.7.1 With the GM tube excited with a 100 $\mu$curie $Co^{60}$ source measure the output characteristics of the GM tube pulse at the input to the signal amplifier. (Bus Voltage 12.0 VDC)

4.8 Amplifier Output Characteristics

4.8.1 With the GM tube excited with a 100 $\mu$curie $Co^{60}$ source measure the following amplifier output pulse characteristics (Bus Voltage 12.0 VDC):

(a) Reference during input pulse absence;

(b) Pulse transition;

(c) Leading edge transition time;

(d) Trailing edge transition time;

(e) Nominal pulse width.

4.8.2 Repeat Section 4.8.1 with an output capacitive load of 47 pf.

4.9 ON/OFF Command Checkout

4.9.1 Cycle instrument through several ON/OFF commands with a one second duration between commands (Bus Voltage 12.0 VDC).

4.9.2 With instrument left in the ON state, command instrument ON and OFF by removing and applying the +12.0 VDC bus.

4.10 Signal Ground Checkout

4.10.1 Verify an infinite dc resistance between pin C of J29 and chassis.

## 5.0 PHYSICAL PROPERTIES MEASUREMENTS

5.1 The following mechanical properties of each unit comprising the Radiation Monitor, in flight configuration, shall be measured:

5.1.1 Weight: To within 0.01 pounds or 4.5 grams.

5.1.2 External Dimensions: To within 0.010 inches.

5.1.3 Mounting Surface Flatness: To within 0.001 inches.

6.0 ENVIRONMENTAL TESTS

6.1 Overall Operational Evaluation (O.O.E.)

6.1.1 This test shall be performed at ambient temperature and atmospheric pressure. All output pulse data will be monitored with a counter and printer. Ten (10) second accumulation periods will be used when recording data. Bus voltage will be +12.0 VDC.

6.1.2 Perform the following tasks:

(a) Section 4.9 ON/OFF Command Checkout.

(b) Measure Command Verification Output voltage.

(c) With 100 $\mu$curie $Co^{60}$ excitation verify proper output pulse waveform.

(d) Record sixty (60) minutes of background data.

(e) Record sixty (60) minutes of 100 $\mu$curie $Co^{60}$ stimulus data.

6.2 Vibration Test

6.2.1 Mount instrument and control accelerometer to the Radiation Monitor shake fixture. During test the maximum allowable tolerance for vibration amplitude shall be ± 10 percent and for frequency shall be ± 2 percent. During test do not operate instrument.

After each axis of vibration perform Section 6.1.2 (a), (b), and (c) to verify satisfactory operation of instrument. Radiation Monitor SN29-1 shall be subjected to Qualification Levels. Radiation Monitor SN29-2 shall be subjected to Acceptance Levels.

6.2.2 Sinusoidal

The instrument will be exposed in three mutually perpendicular axes to the level indicated in the schedule shown. See Figure 2 for instrument axis identification.

QUALIFICATION LEVEL

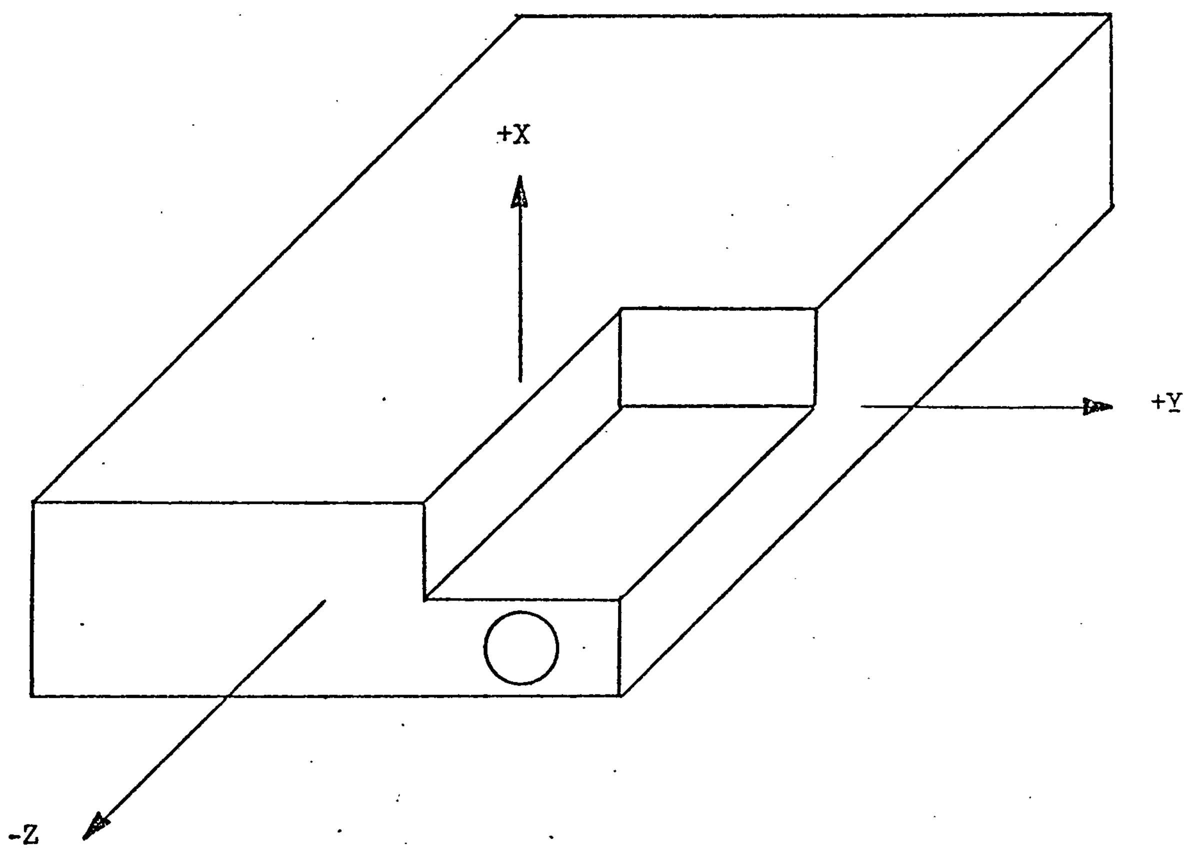
LATERAL AXES (X AND Y) - SINUSOIDAL

| FREQ. (HZ) | ACCELERATION (O-PEAK) G | DISPLACEMENT INCHES DA |
|---|---|---|
| 5-20 | - | 0.5 |
| 20-30 | 10.0 | - |
| 30-90 | 4.0 | - |
| 90-150 | 13.0 | - |
| 150-2000 | 5.0 | - |

THRUST AXIS (Z) - SINUSOIDAL

| FREQ. (HZ) | ACCELERATION (O-PEAK) G | DISPLACEMENT INCHES DA |
|---|---|---|
| 5-23 | - | 0.8 |
| 23-35 | 22.0 | - |
| 35-100 | 5.0 | - |
| 100-200 | 18.0 | - |
| 200-2000 | 5.0 | - |

NOTE: Sweep Rate = 2 octaves/minute




INSTRUMENT AXIS IDENTIFICATION

FIGURE 2.0

## ACCEPTANCE LEVEL

### LATERAL AXES (X AND Y) - SINUSOIDAL

| FREQ. (HZ) | ACCELERATION (O-PEAK) G | DISPLACEMENT INCHES DA |
|---|---|---|
| 5-20 | - | .33 |
| 20-30 | 6.67 | - |
| 30-90 | 2.67 | - |
| 90-150 | 8.67 | - |
| 150-2000 | 3.33 | - |

### THRUST AXIS (Z) - SINUSOIDAL

| FREQ. (HZ) | ACCELERATION (O-PEAK) G | DISPLACEMENT INCHES DA |
|---|---|---|
| 5-23 | - | .53 |
| 23-35 | 14.67 | - |
| 35-100 | 3.33 | - |
| 100-200 | 12.0 | - |
| 200-2000 | 3.33 | - |

NOTE: Sweep Rate = 4 octaves/minute

6.2.3 Random

The instrument will be exposed in three mutually perpendicular axes to the random level indicated in the schedule shown.

## QUALIFICATION LEVEL

### RANDOM VIBRATION

| FREQ. (HZ) | ACCELERATION $g^2$/HZ | PSD db/oct. | OVERALL grms |
|---|---|---|---|
| 20 to 200 | 0.7 | - | |
| 200 to 560 | - | -6 | 18.6 |
| 560 to 2000 | 0.09 | - | |

NOTE: Dwell time per axis = 4 minutes.

ACCEPTANCE LEVEL

RANDOM VIBRATION

| FREQ. (HZ) | ACCELERATION $g^2$/HZ | PSD db/oct. | OVERALL grms |
|---|---|---|---|
| 20 to 200 | 0.31 | - | |
| 200 to 560 | - | -6 | 12.4 |
| 560 to 2000 | 0.04 | - | |

NOTE: Dwell time per axis = 2 minutes.

6.3 Temperature Test

6.3.1 The instrument will be subjected, while operating, to the following thermal routine, with performance monitored throughout the test. All output pulse data will be monitored with a counter and printer. Ten (10) second accumulation periods will be used when recording data. Bus voltage will be +12.0 VDC.

6.3.1.1 From room ambient, decrease temperature to -20 °C in no less than one hour at a uniform rate to prevent excessive thermal shock. During transition time stimulate instrument with a 100 μcurie $Co^{60}$ source and record data. Log the Command Verification output level and bus current every 10 °C change in temperature. Periodically monitor pulse output waveform on scope. Verify satisfactory operation.

6.3.1.2 Stabilize at -20 °C for a minimum of 30 minutes. During stabilization period perform Section 4.9, ON/OFF Command Checkout. After stabilization take sixty (60) minutes of $Co^{60}$ stimulus data and sixty (60) minutes of background data. Check output pulse waveform on scope, and log command verification output and bus current. Verify satisfactory operation.

6.3.1.3 Increase temperature from -20 °C to +40 °C in no less than one hour at a uniform rate. During transition <u>do not</u> allow moisture to condense on instrument surface. Repeat Section 6.3.1.1 for instrument checkout.

6.3.1.4 Stabilize at +40 °C for a minimum of 30 minutes. Repeat Section 6.3.1.2 for instrument checkout.

6.3.1.5 Decrease temperature from +40 °C to +25 °C in no less than 30 minutes. Repeat Section 6.3.1.1 for instrument checkout.

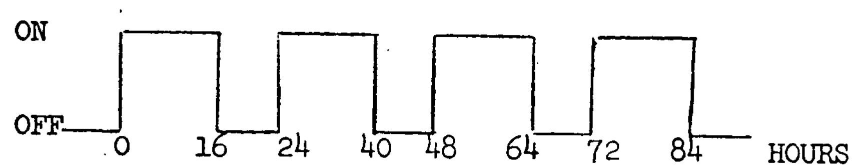
6.3.1.6 Stabilize at +25 °C for a minimum of 30 minutes. Repeat Section 6.3.1.2 for instrument checkout.

6.4 Thermal Vacuum

6.4.1 Mount instrument in thermal vacuum chamber and subject instrument, while operating, to the following thermal routine. Attach 100 $\mu$curie $Co^{60}$ source to red tag cover. All output pulse data will be monitored with a counter and printer. Ten (10) second accumulation periods will be used when recording data. Bus voltage will be +12.0 VDC.

6.4.1.1 Low Temperature Soak

Decrease temperature from ambient to -20 °C in no less than one hour at a uniform rate to prevent excessive thermal shock and draw a vacuum to $10^{-5}$ mm of mercury. After stabilization of environment, turn on instrument and operate at the following duty cycle for 84 hours:



During on period, break up data printouts into one hour segments. Once every hour log bus current, bus voltage, chamber pressure, chamber temperature, and command verification output. Periodically monitor pulse output waveform on scope and verify correct. At the end of each 16 hour on period perform Section 4.9, ON/OFF Command Checkout.

6.4.1.2 While holding chamber pressure at $10^{-5}$ mm of mercury increase temperature to +40 °C in no less than one hour. Repeat operating duty cycle and instrument checkout as delineated in Section 6.4.1.1.

## 7.0 INSTRUMENT OUTGAS

7.1 Prior to Thermal Vacuum Test instrument shall be outgassed for a minimum of 48 hours at a vacuum of no greater than $10^{-5}$ mm of mercury.