GOES 8-12

GOES I, J, K, L & M

XRS, EPS and HEPAD

XRS PDR DATA PACKAGE

Submitted

May 7, 1986

to

Ford Aerospace and Communications Corporation
Western Development Laboratories Division
3939 Fabian Way
Palo Alto, California 94303

by

PANAMETRICS, INC.
221 Crescent Street
Waltham, Massachusetts 02254

GOES I-M XRS

PRELIMINARY DESIGN REVIEW

GOES I - M XRS

OVERVIEW OF SYSTEM REQUIREMENTS

- GENERAL FUNCTIONAL REQUIREMENTS
- GENERAL PERFORMANCE REQUIREMENTS
- SYSTEM BLOCK DIAGRAM
- MAJOR DESIGN CONSTRAINTS

GOES I - M XRS

GENERAL FUNCTIONAL REQUIREMENTS

* MEASURE SOLAR X-RAYS IN THE SPECTRAL RANGE .5-3 AND 1-8 ANGSTROM.
* DETECTION OF X-RAYS WITH DUAL ION CHAMBER, ONE CHAMBER FOR EACH SPECTRAL RANGE.
* MINIMIZE NOISE SIGNALS INDUCED IN THE ION CHAMBERS BY ELECTRONS, BREMSSTRAHLUNG AND SOLAR UV BY FOLLOWING MEANS:

  COLLIMATING TELESCOPE
  PERMANENT MAGNETIC FIELD IN THE APERTURE
  SUITABLE RADIATION SHIELD FOR ION CHAMBER
  UV SHIELD FOIL

* SIGNAL PROCESSING BY TWO SEPARATE ELECTRONIC CHANNELS.
* PROVIDE SEPARATE AUTOMATIC RANGE CHANGING MEANS FOR EACH SIGNAL PROCESSING CHANNEL.
* PROVIDE COMMAND ACTIVATED SELF-CALIBRATION OF BOTH CHANNELS AND INDICATE MODE COMMANDED.

GOES I - M XRS

GENERAL FUNCTIONAL REQUIREMENTS (CONT'D)

* CALIBRATE ION CHAMBERS TO AN ACCURACY OF $\pm$ 10%.
* CALIBRATE BOTH ELECTRONIC CHANNELS OVER TOTAL DYNAMIC RANGES WITH DC CURRENTS APPLIED TO THE INPUTS. OBTAIN CALIBRATION OVER TEMPERATURE RANGE.
* DEMONSTRATE ACCURACY OF COMPOSITE CALIBRATION TO BE $\leq \pm$ 16%
* VERIFY COMPOSITE CALIBRATION WITH FE 55 SOURCE TEST.

GOES I - M XRS

GENERAL PERFORMANCE REQUIREMENTS

*	X-RAY SPECTRAL BANDS	- .5-3 ANGSTROM, SHORT SUN CHANNEL - 1-8 ANGSTROM, LONG SUN CHANNEL
*	X-RAY DETECTION	- DUAL ION CHAMBER TO BE USED. - DETECTOR AND ELECTRONICS OPERATING DESIGN LIFE TO BE 7 YEARS AND GROUND STORAGE LIFE TO BE 5 YEARS.
*	X-RAY DYNAMIC RANGE	- SHORT SUN: 10^{-6} TO 10^{-1} ERG/CM^2/SEC. - LONG SUN: 10^{-5} TO 1 ERG/CM^2/SEC. - 5 DECADE DYNAMIC RANGE IN EACH CHANNEL TO BE DIVIDED INTO 4 DATA RANGES.
*	SENSOR THRESHOLD SENSITIVITY	- DEFINITION: X-RAY FLUX = STANDARD DEVIATION OF DATA OUTPUT. - SHORT SUN: 10^{-16} ERG/CM^2/SEC, DESIGN GOAL. DEGRADING TO 10^{-15} ERG/CM^2/SEC AT MAXIMUM ELECTRON FLUX. - LONG SUN: 10^{-15} ERG/CM^2/SEC

GOES I - M XRS

GENERAL PERFORMANCE REQUIREMENTS (CONT'D)

* DATA PROCESSING
  - TWO SEPÁRATE ELECTRONICS CHANNELS, ONE FOR EACH SPECTRAL BAND.
  - RESOLUTION OF DATA TO BE $\leq$ 2% AT X-RAY FLUX > 2ØX THRESHOLD FLUX.
  - DATA SAMPLING RATE = 1/.512 SEC.
  - S/C DIGITIZES TO 8 BITS.
  - Ø-9Ø% RESPONSE TO STEP INPUT $\cong$ 2 SEC.
* AUTOMATIC RANGING
  - SENSE DATA RANGE LIMITS.
  - AUTOMATICALLY INITIATE RANGE CHANGE COMMANDS WHEN LIMITS ARE EXCEEDED.
  - DIVIDE TOTAL DYNAMIC RANGE INTO 4 RANGES.
  - PROVIDE SUFFICIENT HYSTERISIS TO PREVENT HUNTING.
  - SEPARATE AUTO-RANGE ELECTRONICS FOR EACH CHANNEL.

GOES I - M XRS

GENERAL PERFORMANCE REQUIREMENTS (CONT'D)

*	SELF CALIBRATION	-	CAPABLE OF DETERMINING ELECTRONICS GAIN WITH ACCURACY OF ± 2%, WHEN GAIN CORRECTED FOR TEMPERATURE VARIATIONS.
		-	CALIBRATION SIGNALS TO SPAN TOTAL DYNAMIC RANGE OF EACH CHANNEL.
		-	PROVIDE 2 CALIBRATION POINTS, 1/2 SCALE AND O-SCALE, FOR EACH RANGE.
		-	INSTRUMENT DERIVED CLOCK CONTROLS CALIBRATION SEQUENCE AND DURATION.
*	OPERATING TEMPERATURE	-	+35OC TO -2ØOC
*	NON-OPERATING TEMPERATURE		+5ØOC TO -2ØOC
*	POWER DISSIPATION	-	2.5 W OVER BUS VOLTAGE RANGE 29.5V TO 42.5V
*	MASS PROPERTIES	-	1Ø.6 LBS
*	COMMANDS	-	SEE TABLE
*	TELEMETRY	-	SEE TABLE

GOES I - M XRS

GENERAL PERFORMANCE REQUIREMENTS (CONT'D)

CALIBRATION SEQUENCE

STEP	RANGE	STIMULATION
1	4	5Ø ± 1Ø% FS
2	4	NO SIGNAL
3	3	5Ø ± 1Ø% FS
4	3	NO SIGNAL
5	1	5Ø ± 1Ø% FS
6	2	5Ø ± 1Ø% FS
7	2	NO SIGNAL
8	1	NO SIGNAL

ANALOG DATA

TM OUTPUTS

SHORT SUN X-RAY
LONG SUN X-RAY

COMMANDS

XRS ON
XRS OFF
CAL ON
CAL OFF

BI-LEVEL DATA

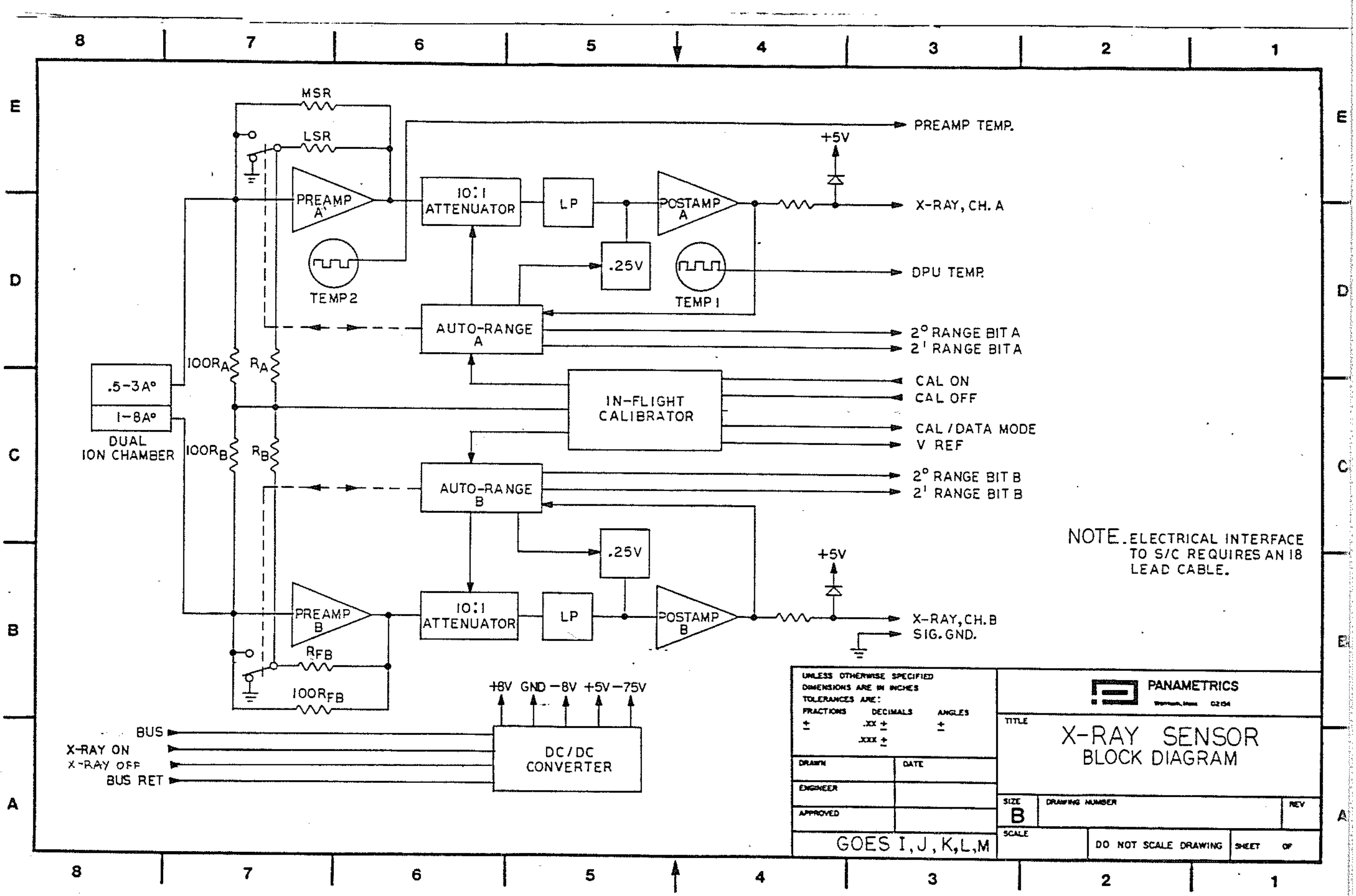
TM OUTPUTS

CAL DATA MODE
SHORT SUN RANGE BIT 2^0
SHORT SUN RANGE BIT 2^1
LONG SUN RANGE BIT 2^0
LONG SUN RANGE BIT 2^1

ANALOG MONITORS

TM OUTPUTS

CAL REFERENCE VOLTAGE
PREAMP TEMPERATURE
DPU TEMPERATURE


MSR
LSR
PREAMP A
PREAMP B
TEMP 2
TEMP 1
10:1 ATTENUATOR
LP
.25V
POSTAMP A
POSTAMP B
AUTO-RANGE A
AUTO-RANGE B
IN-FLIGHT CALIBRATOR
+5V
PREAMP TEMP.
X-RAY, CH. A
DPU TEMP.
2° RANGE BIT A
2¹ RANGE BIT A
CAL ON
CAL OFF
CAL / DATA MODE
V REF
2° RANGE BIT B
2¹ RANGE BIT B
X-RAY, CH. B
SIG. GND.
100R_A
R_A
100R_B
R_B
R_FB
100R_FB
.5-3A°
1-8A°
DUAL ION CHAMBER
+8V GND -8V +5V -75V
DC/DC CONVERTER
BUS
X-RAY ON
X-RAY OFF
BUS RET
NOTE. ELECTRICAL INTERFACE TO S/C REQUIRES AN 18 LEAD CABLE.
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:
FRACTIONS ±
DECIMALS .XX ± .XXX ±
ANGLES ±
DRAWN
DATE
ENGINEER
APPROVED
GOES I, J, K, L, M
PANAMETRICS
TITLE
X-RAY SENSOR
BLOCK DIAGRAM
SIZE B
DRAWING NUMBER
REV
SCALE
DO NOT SCALE DRAWING
SHEET OF

XRS 1.3

GOES I - M XRS

MAJOR DESIGN CONSTRAINTS

* DUAL ION CHAMBER - IS A SPEC. REQUIREMENT.
* FIELD OF VIEW - MINIMIZING RESPONSE TO DIRECT ENTRY ELECTRONS AND MAXIMIZING X-RAY RESPONSE DEFINES OPTIMUM FOV.
* CENTER OF GRAVITY - ACCURATE LOCATION OF XRS CG REQUIRED FOR FACC SUPPLIED POSITIONER AXIS DETERMINATION.

GOES I - M XRS

OVERVIEW OF SYSTEM DESIGN

- DESIGN CONSIDERATIONS
- XRS ASSEMBLY
- COLLIMATOR AND MAGNET SUBASSEMBLY
- PREAMP SUBASSEMBLY
- DPU SUBASSEMBLY
    - POST AMPLIFIER
    - AUTO-RANGE
    - IN-FLIGHT CALIBRATOR
    - DC/DC CONVERTER

GOES I - M

DESIGN CONSIDERATIONS

* ION CHAMBER - USE OF DUAL ION CHAMBER IS A REQUIREMENT. ONLY DUAL ION CHAMBER WITH COMBINED FLIGHT HISTORY OF 13 YEARS ON GOES D-F IS MANUFACTURED BY REUTER STOKES. ALSO SUCCESSFUL ACCEPTANCE TESTING AND INTEGRATION TESTING ON GOES G & H. USE OF IDENTICAL PART ON CURRENT PROGRAM IS A DESIGN CONSTRAINT.

* PREAMPLIFIER - SUCCESSFUL FLIGHT PERFORMANCE ON GOES D-F AND PASSED ACCEPTANCE AND S/C INTEGRATION TESTS ON GOES G & H. USE IDENTICAL CIRCUITS ON CURRENT PROGRAM WITH MODIFICATIONS TO IN-FLIGHT AND GROUND CALIBRATION SCHEMES AS WELL AS FREQUENCY RESPONSE AND INPUT STAGE BIAS CONSIDERATIONS.

* AUTO-RANGE - SUCCESSFUL FLIGHT PERFORMANCE ON GOES D-F AND PASSED ACCEPTANCE AND S/C INTEGRATION TESTS ON GOES G & H. USE IDENTICAL CIRCUIT WITH MINOR MODIFICATIONS TO INTERFACE CIRCUITS FOR RANGE BIT STATUS OUTPUTS TO TM.

* MAGNET YOKE - SUCCESSFUL FLIGHT PERFORMANCE ON GOES D-F AND PASSED ACCEPTANCE AND S/C INTEGRATION TESTS ON GOES G & H. MAKES MOST EFFECTIVE USE OF PERMANENT MAGNETS WITH MINIMUM STRAY MAGNETIC FIELDS. USE IDENTICAL DESIGN BUT WITH SMALLER FIELD GAP ON CURRENT PROGRAM.

GOES I - M XRS

XRS ASSEMBLY

- Functional Characteristics
- Performance Characteristics
- Block Diagram
- Mechanical Interface Control Drawing

XRS ASSEMBLY, FUNCTIONAL CHARACTERISTICS

* REAL TIME MEASUREMENT OF SOLAR X-RAYS.
* DUAL ION CHAMBER SENSES X-RAYS IN TWO SPECTRAL BANDS, .5-3 AND 1-8 ANGSTROM.
* COLLIMATOR DEFINES $\pm$ 2° FIELD OF VIEW AND REDUCES RESPONSE TO UNWANTED BACKGROUND FROM ELECTRONS AND BREMSSTRAHLUNG.
* USE OF A STRONG MAGNETIC FIELD SWEEPS OUT ELECTRONS BELOW ABOUT 4 MEV.
* PREAMPLIFIERS CONVERT THE DC CURRENTS FROM THE DUAL ION CHAMBER INTO DC VOLTAGES. ONE PREAMP FOR EACH SPECTRAL BAND.
* RADIATION SHIELDING OF ION CHAMBER AND PREAMP HOUSING FURTHER REDUCES EFFECTS OF BREMSSTRAHLUNG.
* DPU PROCESSES PREAMPLIFIER OUTPUTS BY TWO SEPARATE ELECTRONIC CHANNELS.
* EACH CHANNEL PROVIDES FILTERING, POST AMPLIFICATION AND AUTOMATIC RANGE CHANGING.
* IN-FLIGHT CALIBRATION AND POWER SUPPLY IS COMMON TO BOTH CHANNELS.

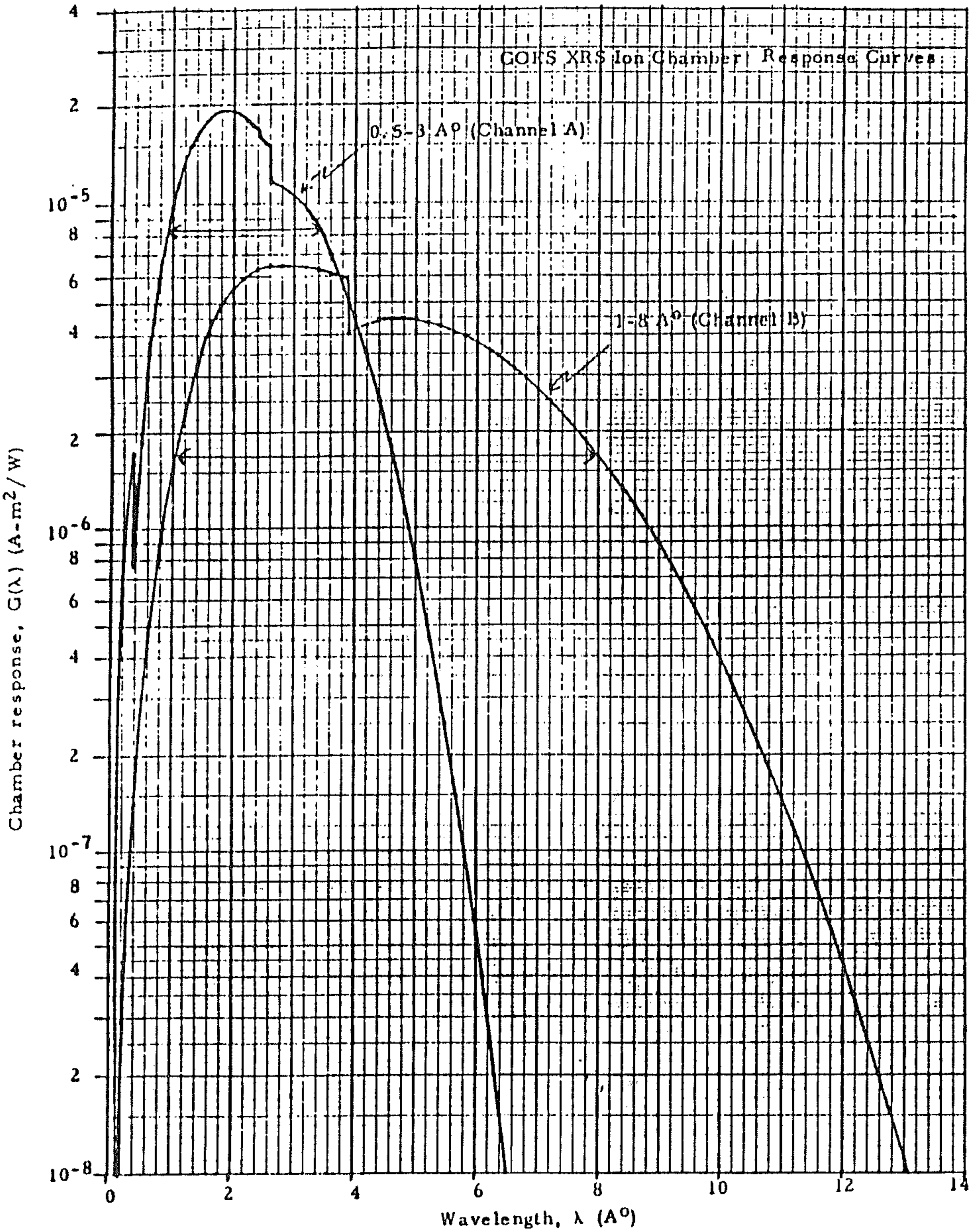
XRS ASSEMBLY, PERFORMANCE CHARACTERISTICS

PARAMETER	NOMINAL VALUES: SHORT SUN (.5-3Å)	NOMINAL VALUES: LONG SUN (1-8Å)
X-RAY FLUX (W/M2)	10^{-9} TO 10^{-4}	10^{-8} TO 10^{-3}
ION CHAMBER RESPONSIVITY (A/W/M2)	1.7×10^{-5}	4.6×10^{-6}
PREAMP CONVERSION GAIN - MSR (V/A)	2.5×10^{11}	$.93 \times 10^{11}$
PREAMP BW IN MSR (HZ)	~1	~1
THRESHOLD FLUX - DESIGN GOAL W/M2	10^{-9}	10^{-8}
- DEGRADED, MAX	10^{-8}	NO DEGRADATION
PREAMP OUT AT DESIGN GOAL THRESH. (MV)	4.3	4.3
PREAMP NOISE OUTPUT, RMS		
- SPURIOUS ION CH 1) (MV)	.5	.2
- ELECTRONICS (BW=1HZ) 2) (MV)	.8	.8
- BACKGROUND RADIATION (MV) (MAX ELECTRON FLUX)	.3	.08
- TOTAL, RMS (MV)	1.0	.83
POST AMPLIFIER GAIN	10	10
AUTO-RANGING	4 DECADE RANGES	4 DECADE RANGES
	STIMULATION TO 50± 10% AND 0 IN EACH RANGE.	
IN-FLIGHT CALIBRATION	REQUIRES TELESCOPE OFF-SUN AND LOW BACKGROUND ENVIRONMENT.	

1) 5×10^{-4} A_{PP} R/S TEST LIMIT WITH KEITHLEY ELECTROMETER, ~100HZ BW. AT 1HZ BW ~$.5 \times 10^{-14}$ P_{PP} OR $.2 \times 10^{-14}$ ARMS.
2) SCREENING TEST DATA: MAX .4 μV AT 10HZ BW. EXTRAPOLATED TO MAX 4 μV AT 1HZ, 1HZ BW.

XRS ASSEMBLY, PERFORMANCE CHARACTERISTICS (CONT'D)

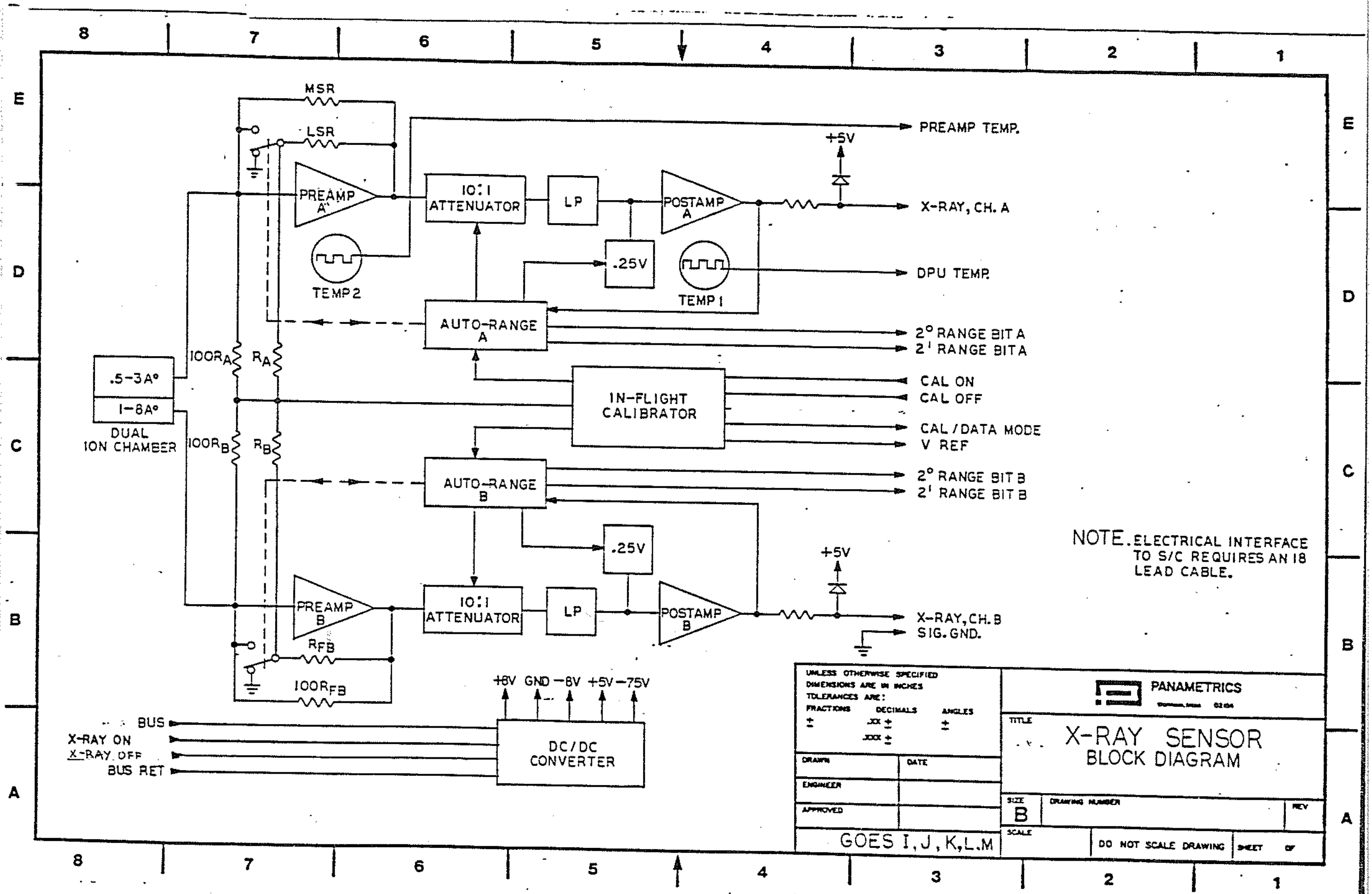
POWER DISSIPATION	2.5W
WEIGHT	10.6 LB
MATERIAL - COLLIMATOR	ALUMINUM EXCEPT ENTRANCE COLLIMATOR IS COPPER.
- PREAMP	ALUMINUM COVERED WITH 1/16" BERYLLIUM SHEET STOCK.
- MAGNET YOKE	SOFT IRON POLE PIECES, RARE EARTH COBALT MAGNETS.
- DPU	ALUMINUM
FINISH	ALUMINUM IS CHROMATE CONVERSION COATED COPPER IS ELECTROLESS NICKEL PLATED SOFT IRON IS ELECTROLESS NICKEL PLATED NO FINISH ON BERYLLIUM OR MAGNETS
THERMAL FINISH	FACC TO DETERMINE



ION CHAMBER NOMINAL RESPONSE VS. WAVELENGTH

Ion Chamber Properties

Characteristic	Chamber A Value	Chamber B Value
Nominal x-ray range (Å)	0.5 - 3	1 - 8
Window thickness - Be (mils) (nominal)	20	2
Gas fill (Component/%)	Xe/99.6, He/0.3	Ar/99.6, He/0.4
Fill pressure (mm Hg at 25°C)	180	800
Window width, w (in/cm)	0.75/1.91	0.25/0.64
Window area, a(cm^2)	5.80	1.90
Chamber depth (cm)	3.99	3.99
Effective gas density for x-ray absorption (mg/cm^3(type))	1.266 (Xe)	1.712 (Ar)
Total gas thickness, t_g(mg/cm^2)	5.051 (Xe)	6.831 (Ar)
1/e depth for Fe-55 x-rays, $1/\mu$ (cm)	1.17	2.21
Energy to produce an electron-ion pair, W(eV/pair)	22.0 (Xe)	26.2 (Ar)


MSR
LSR
PREAMP A'
TEMP 2
10:1 ATTENUATOR
LP
POSTAMP A
.25V
TEMP 1
+5V
PREAMP TEMP.
X-RAY, CH. A
DPU TEMP.
AUTO-RANGE A
2° RANGE BIT A
2' RANGE BIT A
.5-3A°
1-8A°
DUAL ION CHAMBER
100R_A
R_A
100R_B
R_B
IN-FLIGHT CALIBRATOR
CAL ON
CAL OFF
CAL/DATA MODE
V REF
AUTO-RANGE B
2° RANGE BIT B
2' RANGE BIT B
NOTE. ELECTRICAL INTERFACE TO S/C REQUIRES AN 18 LEAD CABLE.
PREAMP B
R_FB
100R_FB
10:1 ATTENUATOR
LP
.25V
POSTAMP B
+5V
X-RAY, CH. B
SIG. GND.
+8V GND -8V +5V -75V
DC/DC CONVERTER
BUS
X-RAY ON
X-RAY OFF
BUS RET
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:
FRACTIONS ±
DECIMALS .XX ± .XXX ±
ANGLES ±
DRAWN
DATE
ENGINEER
APPROVED
GOES I, J, K, L, M
PANAMETRICS
TITLE
X-RAY SENSOR BLOCK DIAGRAM
SIZE B
DRAWING NUMBER
REV
SCALE
DO NOT SCALE DRAWING
SHEET OF

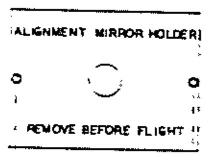
XRS 2.2.3

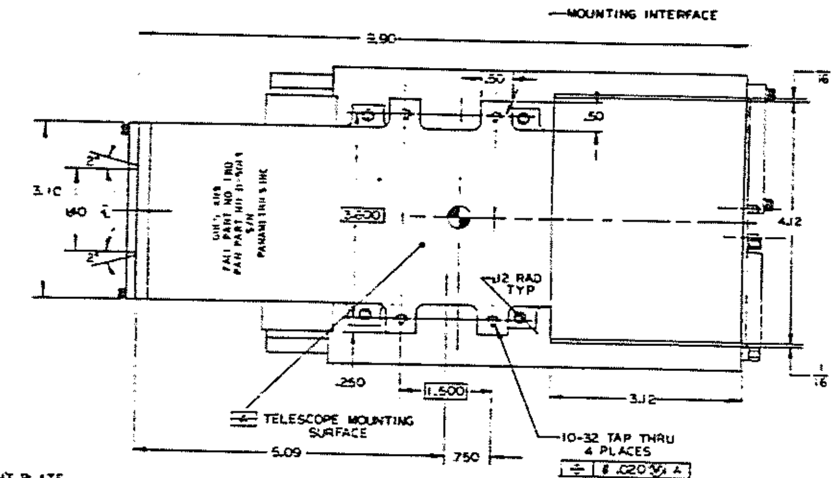
NOTES

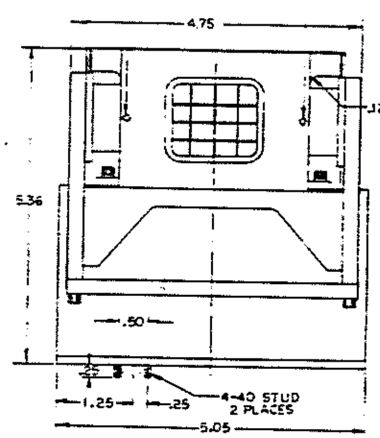
1. ⊕ = COMBINED CG'S OF TELESCOPE, MAGNET, PREAMPLIFIER, AND DPU.
2. NOMINAL WEIGHTS: 1. TELESCOPE & PREAMP. — 6.1 LB
   2. MAGNET ASS'Y. — 1.7 LB
   3. DPU — 2.8 LB
   XRS TOTAL 10.6 LB

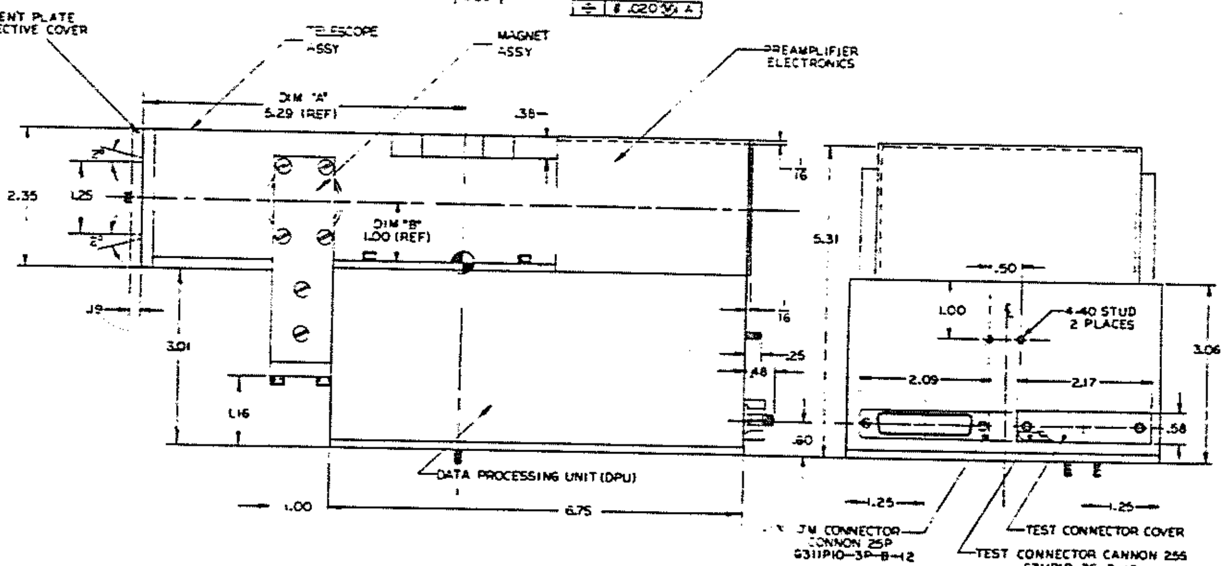
X-RAY SENSOR, ACTUAL			
SERIAL NO.	WEIGHT	DIM A	DIM B

3. MOUNTING INTERFACE:
   — FLATNESS .010" TIR
   — MOUNTING HOLE LOCATION AS SHOWN.
   — MOUNTING HARDWARE TO BE FURNISHED BY FACC.
   — FINISH: BARE ALUMINUM. MUST BE CLEANED BEFORE MOUNTING TO FACC POSITIONER TO ACHIEVE TBD OHMS CONTACT RESISTANCE.
4. EXTERIOR FINISH: TELESCOPE & DPU, CHROMATE CONVERSION PER MIL-C-5541. PREAMPLIFIER & MAGNET ASS'Y., ELECTROLESS NICKEL PER MIL-C-26074 CLASS 1, GRADE B (MAX. THK. .001")
5. POWER DISSIPATION: PREAMPLIFIER .1 WATT
   DPU — 2.4 WATTS
6. F.O.V.: AS SHOWN
7. QUALIFICATION TEMPERATURE LIMITS: OPERATING −20 TO +35°C
   NON OPERATING −20 TO +50°C
   TURN ON −20 TO +35°C
8. MARKING: AS SHOWN PER. TBD









REVISIONS				
A	142-7	SEE ECO		

PANAMETRICS

INTERFACE CONTROL DRAWING
X-RAY SENSOR

D 4983 A

XRS 2.2.4

GOES I - M XRS

COLLIMATOR AND MAGNET

- Functional Characteristics
- Performance Characteristics
- Cross Section of Collimator and Magnet Yoke, Conceptual Design
- GOES D, E, F Magnet Yoke Assembly
- Calculation of Shielding Effectiveness and Bremsstrahlung Response

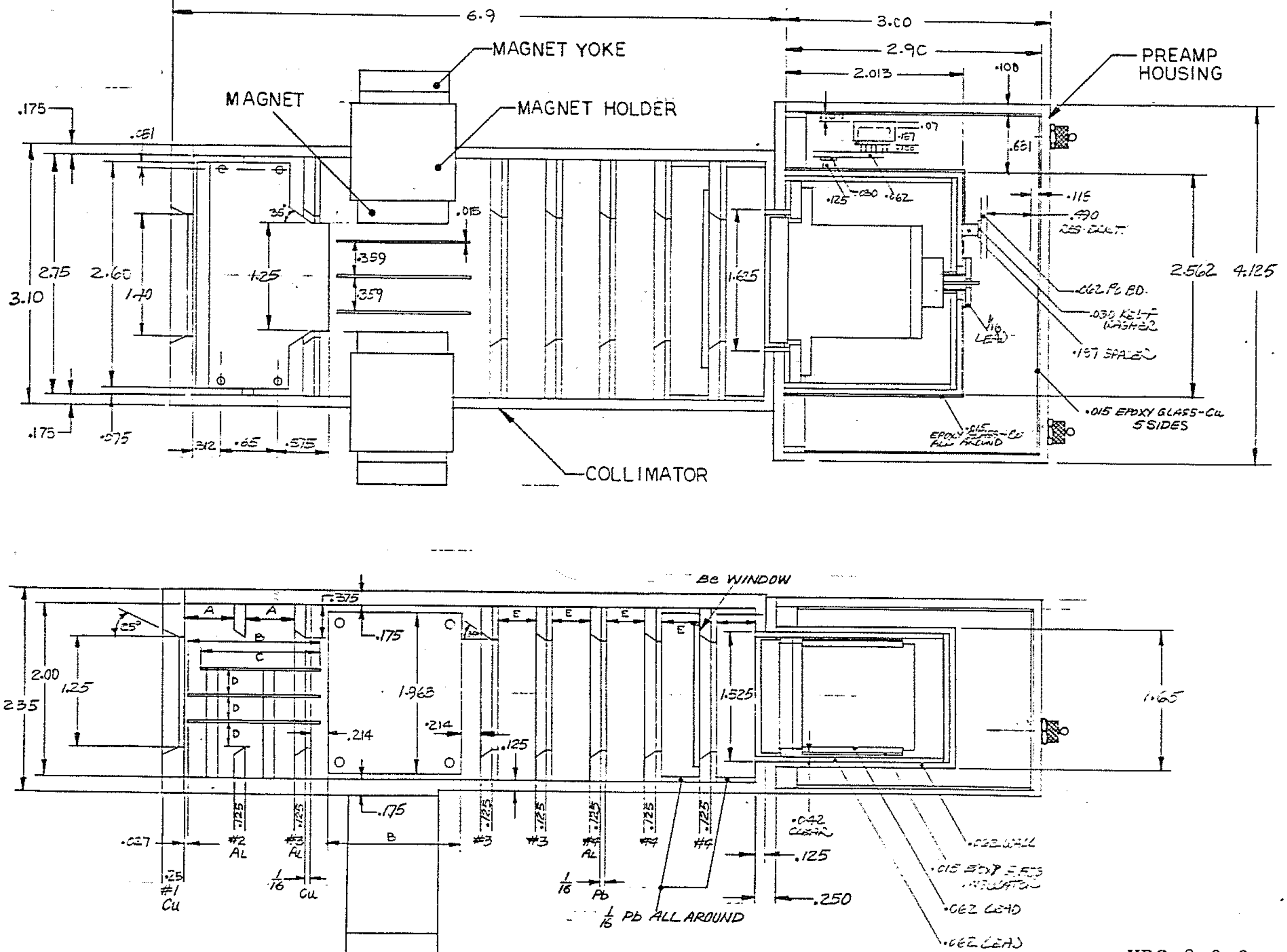
COLLIMATOR AND MAGNET SUBASSEMBLY, FUNCTIONAL CHARACTERISTICS

* REDUCES CHARGE CURRENTS INDUCED IN THE ION CHAMBER BY ELECTRONS AND BREMSSTRAHLUNG BY FOLLOWING MEANS:
  * NARROW FIELD OF VIEW ($\pm 2°$) REDUCES BACKGROUND FROM DIRECT ELECTRON FLUXES.
  * OUT OF APERTURE ELECTRONS ARE STOPPED BY AL COLLIMATOR HOUSING AND COPPER ENTRANCE COLLIMATOR. LO Z ALUMINUM MINIMIZES BREMSSTRAHLUNG PRODUCTION.
  * IN-APERTURE ELECTRONS TO ABOVE 4 MEV ARE SWEPT OUT OF FOV OF ION CHAMBER BY PERMANENT MAGNETIC FIELD CREATED BY MAGNET AND YOKE.
  * INTERNAL AL COLLIMATORS MINIMIZE BREMSSTRAHLUNG PRODUCTION. THEY ARE COPPER BACKED TOWARDS THE FRONT AND LEAD BACKED TOWARDS THE REAR.
  * HORIZONTAL AND VERTICAL SS BAFFLES COLLIMATE ELECTRONS INTO THE MAGNET GAP.
  * COLLIMATOR HOUSING HAS INTERNAL LEAD CLADDING NEAR ION CHAMBER TO SHIELD IT FROM EXTERNAL BREMSSTRAHLUNG.
* BE-WINDOW DOES NOT PERMIT UV AND HEAT RADIATION FROM SUN TO REACH ION CHAMBER WINDOWS.

COLLIMATOR AND MAGNET SUBASSEMBLY PERFORMANCE CHARACTERISTICS

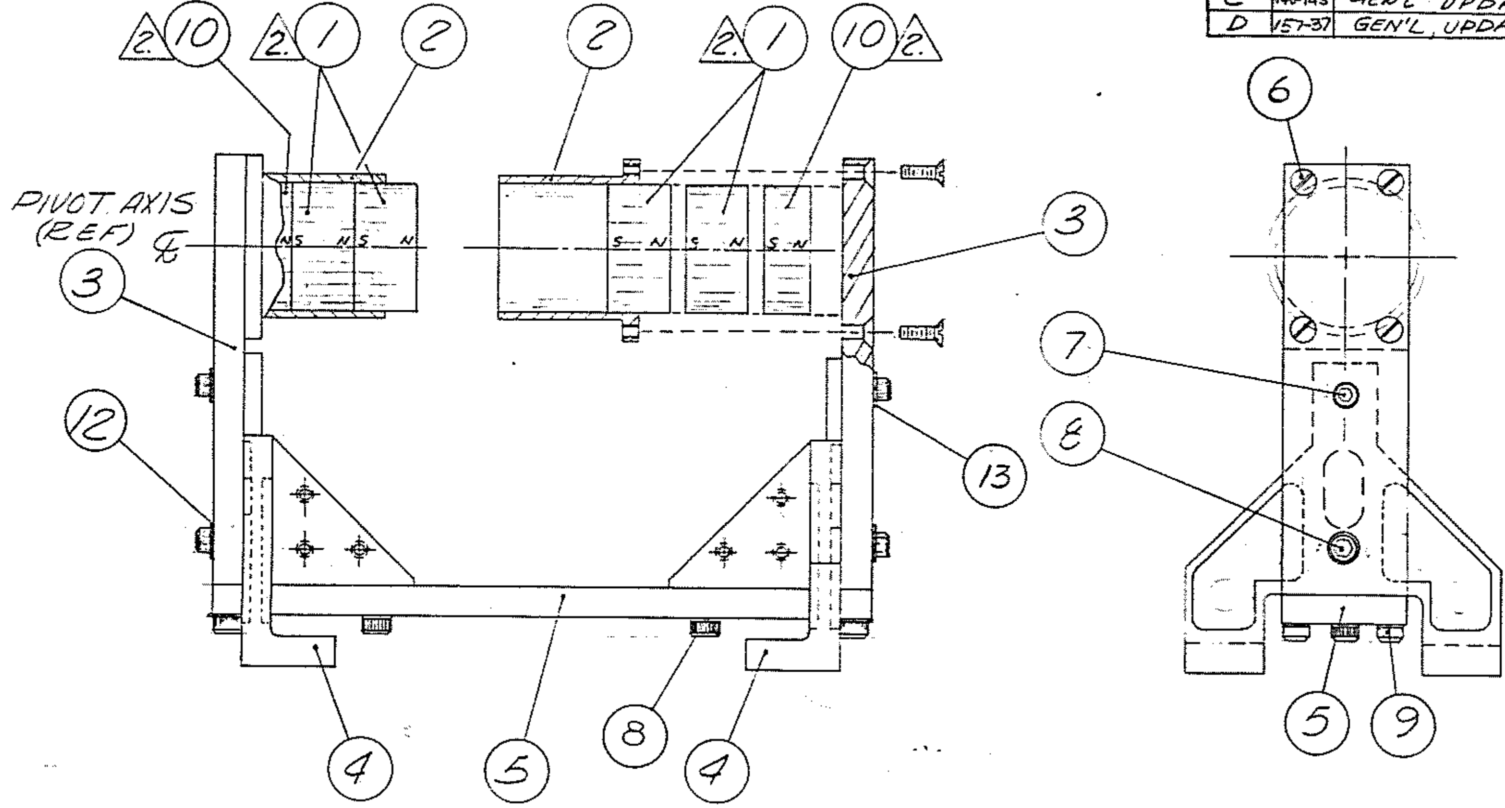
* FIELD OF VIEW OF ± 2°
* IN-APERTURE ELECTRONS TO ABOVE 4 MEV ARE SWEPT OUT OF FOV. (ELECTRON FLUX ABOVE ~ 4 MEV OF THE ORDER OF 10^2 CM^{-2} SEC^{-1})
* DESIGN GOAL FOR REDUCTION OF BREMSSTRAHLUNG EMANATING FROM EXTERNAL HOUSING BY TWO ORDERS OF MAGNITUDE WITH ION CHAMBER HEAVILY SHIELDED WITH LEAD.
* WHEN MOUNTED TO FACC SUPPLIED POSITIONER SUN TRACKING IS BETTER THAN 1/2° OF ARC N-S AND E-W.

COLLIMATOR, MAGNET & PREAMP SUBASSEMBLIES, CONCEPTUAL DESIGN



XRS 2.3.3

REV	ECO	DESCRIPTION	DWN	APPLS	DATE
A	140-36	GEN'L UPDATE, 2 MAGNETS ADDED	EL	[illegible]	28 NOV 78
B	140-59	SHOW LIGHTNING MILLING	[illegible]	[illegible]	2-21-79
C	140-145	GEN'L UPDATE	EL	[illegible]	9-27-79
D	157-37	GEN'L UPDATE	RGM	[illegible]	1-17-83



2. NOTE POLARITY WHEN INSTALLING MAGNETS
1. FOR PARTS LIST SEE PL-4418

NOTES

SEES DEEF X-RAY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:

FRACTIONS	DECIMALS	ANGLES
±	.XX ± / .XXX ±	±

DRAWN R. LUNG	DATE 8.4.78
ENGINEER 8/4/78	5/11/78
APPROVED 8.5.1.78	3/14/78

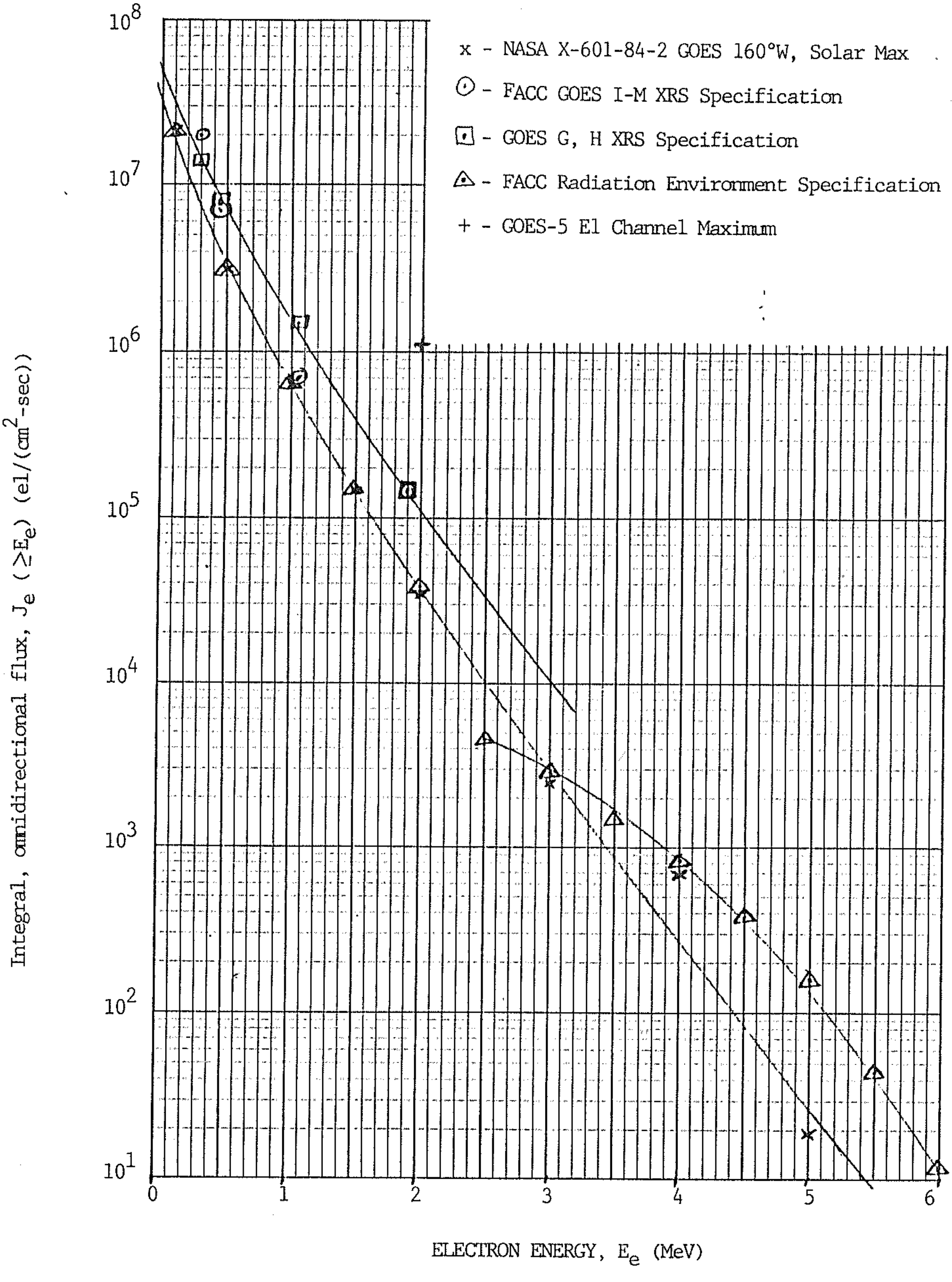
PANAMETRICS
Waltham, Mass 02154

TITLE
MAGNET YOKE ASSEMBLY

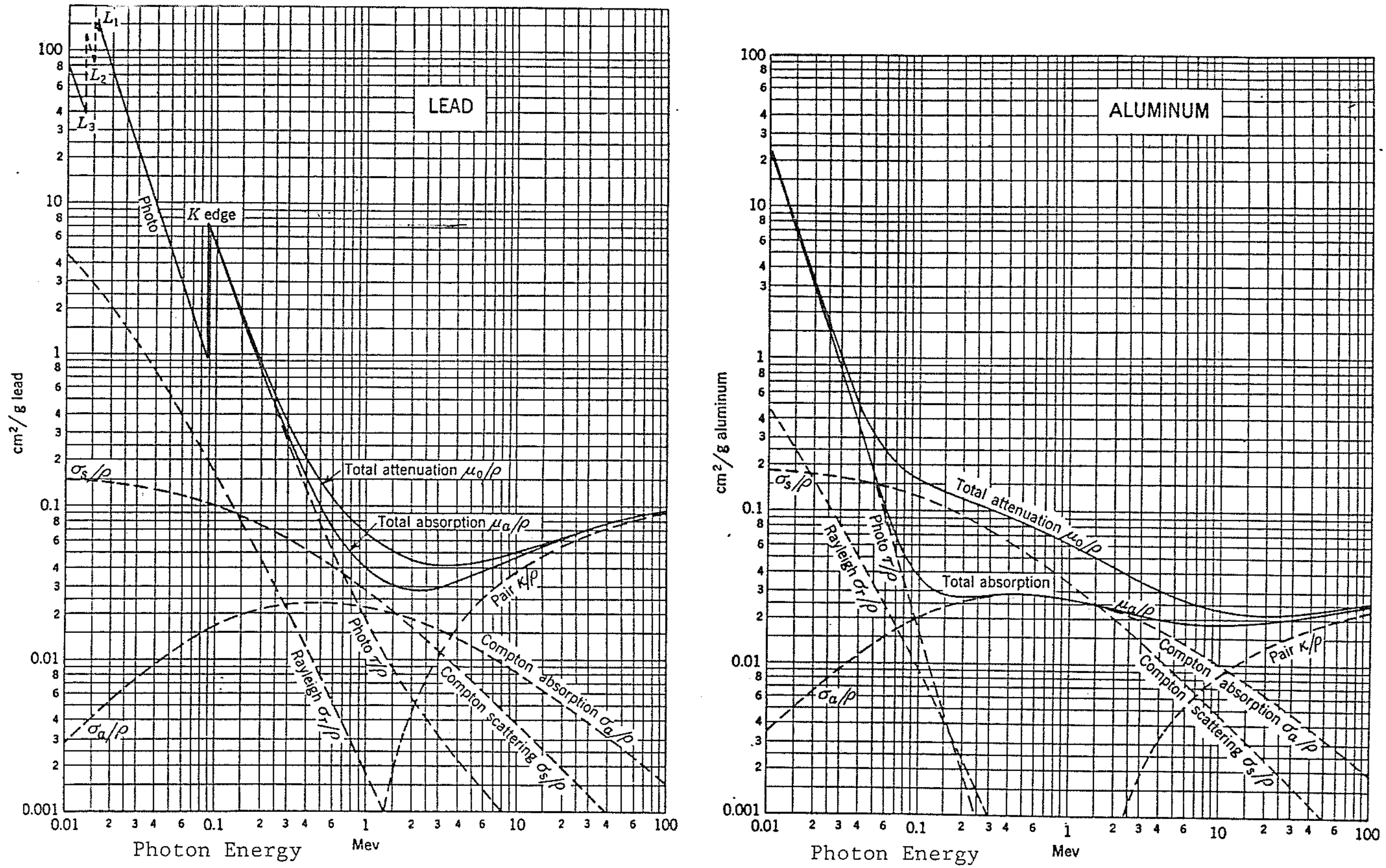
SIZE	DRAWING NUMBER	REV
B	4418	D

SCALE FULL | DO NOT SCALE DRAWING | SHEET 1 OF 1

XRS 2.3.4

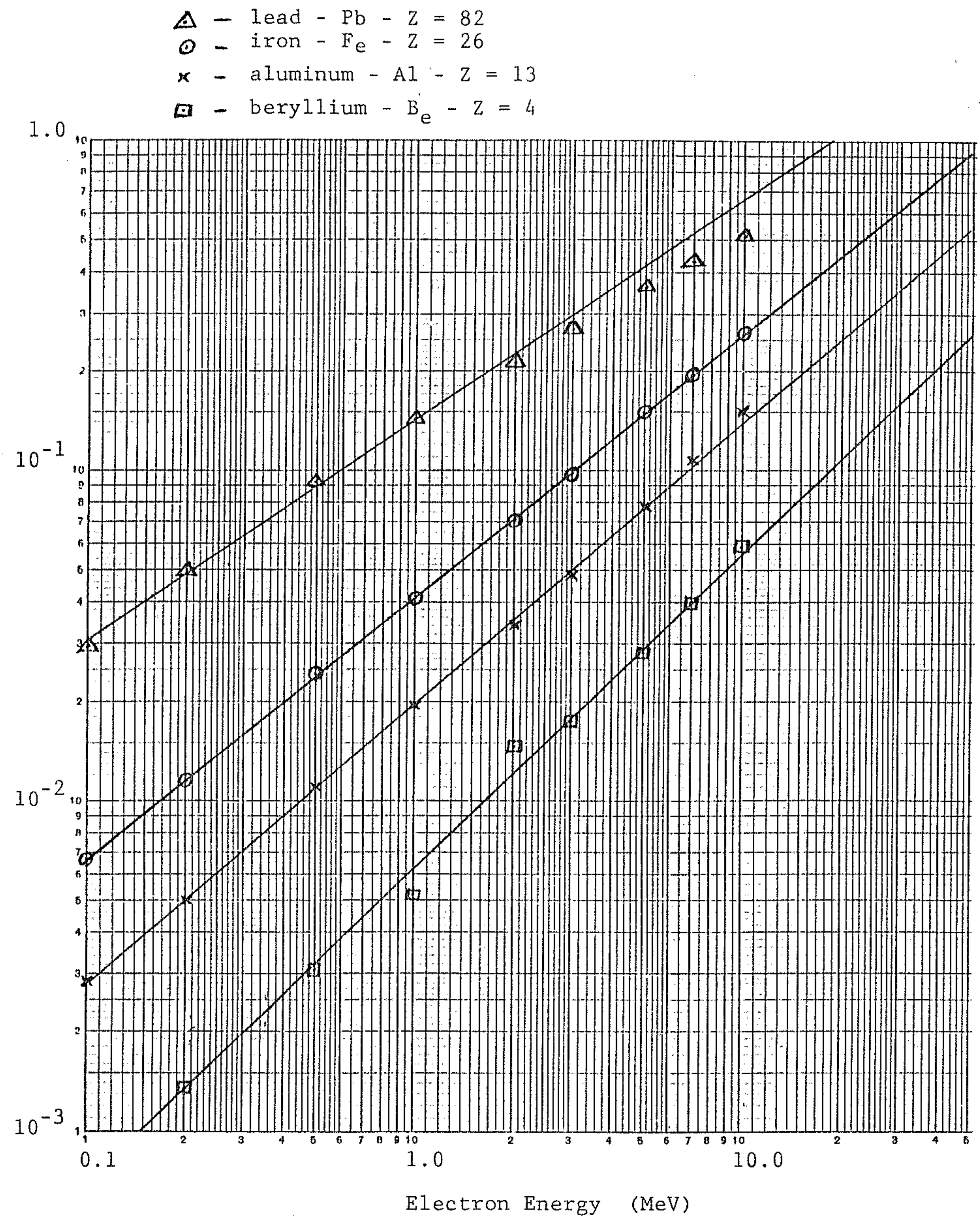

x - NASA X-601-84-2 GOES 160°W, Solar Max
⊙ - FACC GOES I-M XRS Specification
⊡ - GOES G, H XRS Specification
⚠ - FACC Radiation Environment Specification
+ - GOES-5 El Channel Maximum
Integral, omnidirectional flux, J_e ($\geq E_e$) (el/(cm^2-sec))
ELECTRON ENERGY, E_e (MeV)
10^8
10^7
10^6
10^5
10^4
10^3
10^2
10^1
0
1
2
3
4
5
6

XRS 2.3.5-1



PHOTON ABSORPTION COEFFICIENTS FOR LEAD AND ALUMINUM

(From R.D. Evans, "The Atomic Nucleus", McGraw-Hill, 1955).



FRACTIONAL STOPPING POWER FOR BREMSSTRAHLUNG (RADIATION)

BREMSSTRAHLUNG FLUX FROM THE GOES 16ØØW, SOLAR MAX
ELECTRON SPECTRUM - STOPPING IN ALUMINUM
ELECTRON AND BREMSSTRAHLUNG FLUXES ISOTROPIC

Bremsstrahlung Energy (MeV)		Bremsstrahlung Spectrum PH/(CM^2-SEC-MeV))	Fraction of Bremsstrahlung from Electrons of Energy Range (MeV)			
$\bar{E}$	ΔE_γ	dJ_γ/dE_γ	< Ø.3	Ø.3-1	1-2	>2
Ø.Ø625	Ø.Ø25	2.51 x 1Ø6	Ø.358	Ø.524	Ø.1Ø7	Ø.Ø11
Ø.Ø875	Ø.Ø25	1.56 x 1Ø6	Ø.3Ø5	Ø.562	Ø.12Ø	Ø.Ø12
Ø.125	Ø.Ø5Ø	9.14 x 1Ø5	Ø.244	Ø.6Ø4	Ø.137	Ø.Ø15
Ø.175	Ø.Ø5Ø	5.Ø9 x 1Ø5	Ø.151	Ø.663	Ø.168	Ø.Ø18
Ø.25Ø	Ø.1ØØ	2.69 x 1Ø5	Ø.1Ø2	Ø.67Ø	Ø.2Ø5	Ø.Ø23
Ø.4Ø	Ø.2ØØ	1.Ø7 x 1Ø5	-	Ø.696	Ø.271	Ø.Ø33
Ø.75	Ø.5ØØ	2.77 x 1Ø4	-	Ø.6Ø4	Ø.34Ø	Ø.Ø56
1.25	Ø.5Ø	3.36 x 1Ø3	-	-	Ø.8Ø3	Ø.197
1.75	Ø.5Ø	5.82 x 1Ø2	-	-	Ø.5Ø5	Ø.495
2.5Ø	1.Ø	1.29 x 1Ø2	-	-	-	Ø.495
3.5	1.Ø	7.3Ø x 1ØO	-	-	-	1.ØØØ
4.5	1.Ø	1.23 x 1ØO	-	-	-	1.ØØØ
5.5	1.Ø	2.6Ø x 1Ø-2	-	-	-	1.ØØØ

ION CHAMBER RESPONSE TO BREMSSTRAHLUNG
GOES 1600W, SOLAR MAX, ELECTRON SPECTRUM INTO ALUMINUM
ATTENUATED BY 1.00 G/CM^2 AL + 1.10 G/CM^2 FE + 1.80 G/CM^2 PB

BREMSSTRAHLUNG ENERGY KEV	ATTENUATED FLUX $\Delta E_\gamma DJ_\gamma / dE_\gamma$ TR (AL, FD, PG) (PHOTONS/(CM^2-SEC))	ION CHAMBER CURRENT, ΔI (A): CHAMBER A (Xe)	ION CHAMBER CURRENT, ΔI (A): CHAMBER B (Ar)
62.5	3.09×10^{0}	5.08×10^{-17}	1.56×10^{-18}
87.5	1.53×10^{2}	8.41×10^{-16}	4.29×10^{-17}
125	4.89×10^{1}	1.09×10^{-16}	1.59×10^{-17}
175	1.23×10^{3}	1.10×10^{-15}	3.50×10^{-16}
250	5.86×10^{3}	2.37×10^{-15}	9.85×10^{-16}
400	1.18×10^{4}	1.78×10^{-15}	9.97×10^{-16}
750	1.01×10^{4}	7.16×10^{-16}	4.54×10^{-16}
1250	1.35×10^{3}	6.26×10^{-17}	4.03×10^{-17}
1750	2.42×10^{2}	9.69×10^{-18}	6.02×10^{-18}
2500	1.10×10^{2}	3.56×10^{-18}	2.26×10^{-18}
3500	6.31×10^{0}	1.64×10^{-19}	1.04×10^{-19}
4500	1.07×10^{0}	2.35×10^{-20}	1.50×10^{-20}
5500	2.26×10^{-2}	9.62×10^{-23}	2.77×10^{-22}
BREMSSTRAHLUNG BACKGROUND: =		7.04×10^{-15} A	2.90×10^{-15} A
X-RAY THRESHOLD FLUX CURRENT (DESIGN GOAL) =		1.8×10^{-14} A	4.7×10^{-14} A
BACKGROUND/THRESHOLD =		0.391	0.062

ELECTRON ENERGY RANGE (MEV)	CHAMBER A CURRENT(A)	CHAMBER A FRACTION	CHAMBER B CURRENT(A)	CHAMBER B FRACTION
$\leq$ 0.3	7.09×10^{-16}	0.101	1.71×10^{-16}	0.059
0.3-1	4.55×10^{-15}	0.646	1.89×10^{-15}	0.654
1 - 2	1.57×10^{-15}	0.223	7.28×10^{-16}	0.252
$\geq$ 2	2.06×10^{-16}	0.029	1.01×10^{-16}	0.035

SUMMARY OF ELECTRON PRODUCED XRS BACKGROUND
BREMSSTRAHLUNG-PRODUCED BACKGROUND

ELECTRON SPECTRUM (ISOTROPIC) SOURCE	$\geq$ Ee(MEV)	J (EL/CM^2-SEC)	~ J($\geq$2MEV) (EL/(CM^2-SEC))	~ BKGND/X-RAY CHANNEL A	THRESHOLD CHANNEL B
GOES 16ØO SOLAR MAX	2	$3.4 \times 1Ø^4$	$3.4 \times 1Ø^4$	= Ø.39	= Ø.Ø62
FACC I-M XRS SPEC.	1.9	$1.5 \times 1Ø^5$	$1.2 \times 1Ø^5$	1.4	Ø.22
GOES G,H XRS SPEC.	1.9	$1.5 \times 1Ø^5$	$1.2 \times 1Ø^5$	1.4	Ø.22
FACC REQ. ENV. SPEC.	2	$3.8 \times 1Ø^4$	$3.8 \times 1Ø^4$	Ø.44	Ø.Ø69
GOES-5 E1 MAX.	2	$1.1 \times 1Ø^6$	$1.1 \times 1Ø^6$	13.	2.Ø

ION CHAMBER BACKGROUND CURRENTS OVERESTIMATED BECAUSE:

1) HAVE NEGLECTED 1/16 INCH (1.8Ø G/CM^2) LEAD SHIELDING OF SIDES, TOP AND BOTTOM OF ION CHAMBER.

2) BREMSSTRAHLUNG ATTENUATION IS CALCULATED FOR THE SHORTEST ABSORBER PATH IN AL, FE AND PB SHIELDING.

3) BERYLLIUM SHIELDING IS USED ON SOME EXTERNAL PARTS OF HOUSING.

NEGLECTED BACKGROUND CURRENTS ARE:

1) DIRECT APERTURE ENTRY ELECTRONS - ASSUME MAGNETIC SHIELDING OF ION CHAMBER WINDOWS IS FOR 4-6 MEV ELECTRONS.

2) IN-APERTURE ELECTRON BREMSSTRAHLUNG BACKGROUND - SHOULD BE SMALL BUT WILL BE CHECKED WITH THE ENGINEERING MODEL TELESCOPE.

ELECTRON AND BREMSSTRAHLUNG RESPONSE OF XRS

SUMMARY OF CALCULATION AND DATA FOR GOES-5 XRS

CALCULATED RESPONSE:

SOURCE OF BACKGROUND	METHOD OF CALCULATION	RESPONSES -A/(E1 COUNT) CHANNEL A (SHORT)	RESPONSES -A/(E1 COUNT) CHANNEL B (LONG)
DIRECT ELECTRON RESPONSE (ELECTRONS > 2 MEV)	GOES D,E,F MAGNET DESIGN REPORT - X-RAY SENSOR	1.02 x 10-16	7.4 x 10-17
BREMSSTRAHLUNG RESPONSE (MOSTLY ELECTRONS < 1 MEV)	GOES 1600W SPECTRAL SHAPE AVERAGE OF LEAD/NO LEAD SHIELDING CALCULATIONS	8.6 x 10-16	6.5 x 10-17
TOTAL RESPONSE		9.6 x 10-16	1.39 x 10-16

MEASURED RESPONSES FROM GOES-5

DATES OF DATA USED XRS & EPS)	SOLAR X-RAY AND E1 FLUX CONDITIONS	CHANNEL A (SHORT) MEASURED	CHANNEL A (SHORT) MEAS/CAL	CHANNEL B(LONG) MEASURED	CHANNEL B(LONG) MEAS/CAL
		MEASURED RESPONSES - A/(E1 COUNT)			
FEB. & AUG. 1985 DATA	LOW X-RAY; MODERATE E1 (100 TO 600/READOUT)	7.8X10-16	0.81*	<2.6X10-16	<1.87*
8 OCT. 1985 DATA	LOW X-RAY; VERY HIGH E1 (~ 15000/READOUT)	1.02X10-16	1.00+	6.4X10-16 10-17	0.86+

* NORMALIZED TO THE TOTAL RESPONSE

\+ NORMALIZED ONLY TO THE DIRECT ELECTRON RESPONSE

GOES I - M XRS

ION CHAMBER AND PREAMPLIFIER SUBASSEMBLY

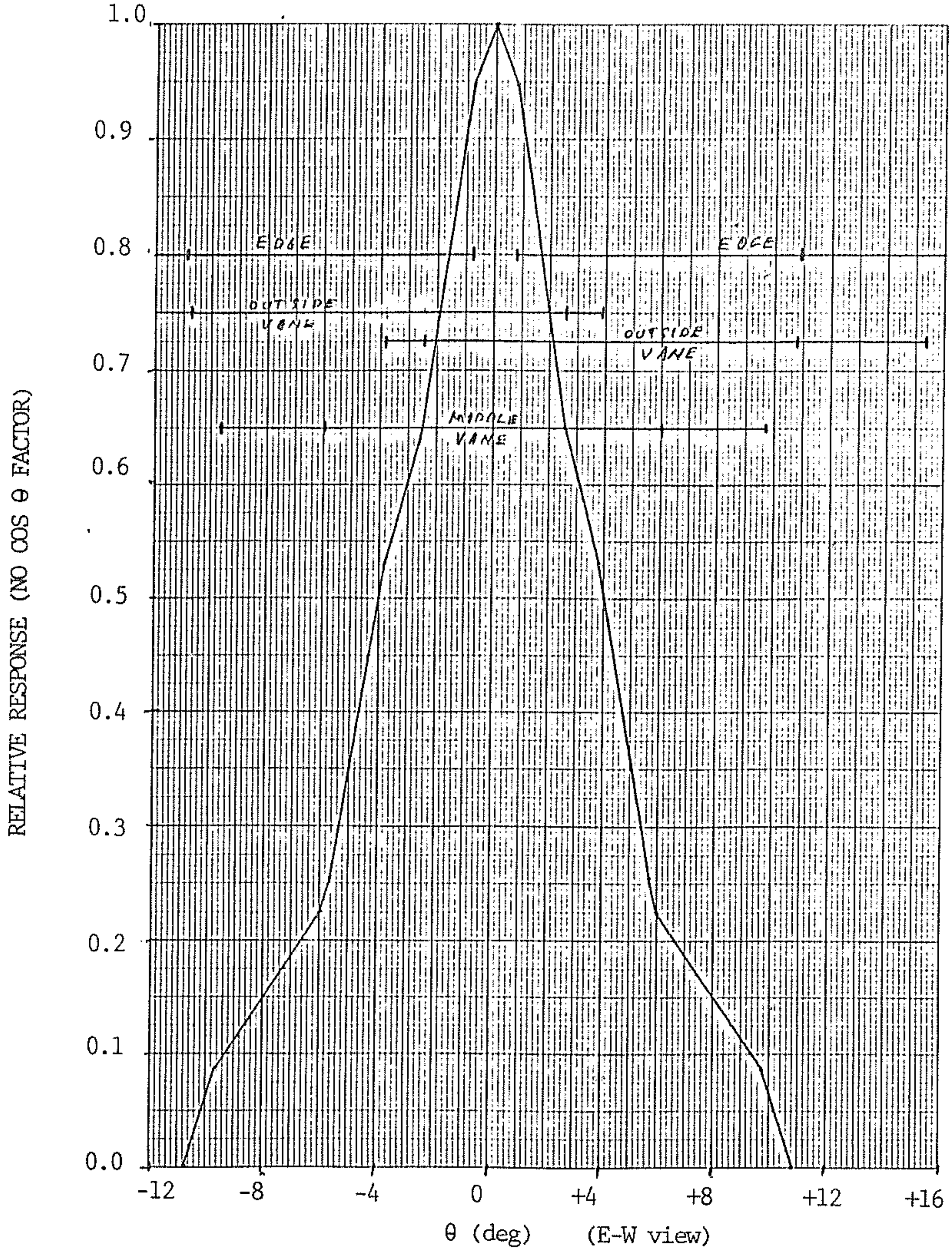
- Functional Characteristics
- Performance Characteristics
- Block Diagram
- Cross Section of Ion Chamber Preamp Subassembly
- Modifications from GOES D-H.

ION CHAMBER AND PREAMPLIFIER SUBASSEMBLY, FUNCTIONAL CHARACTERISTICS

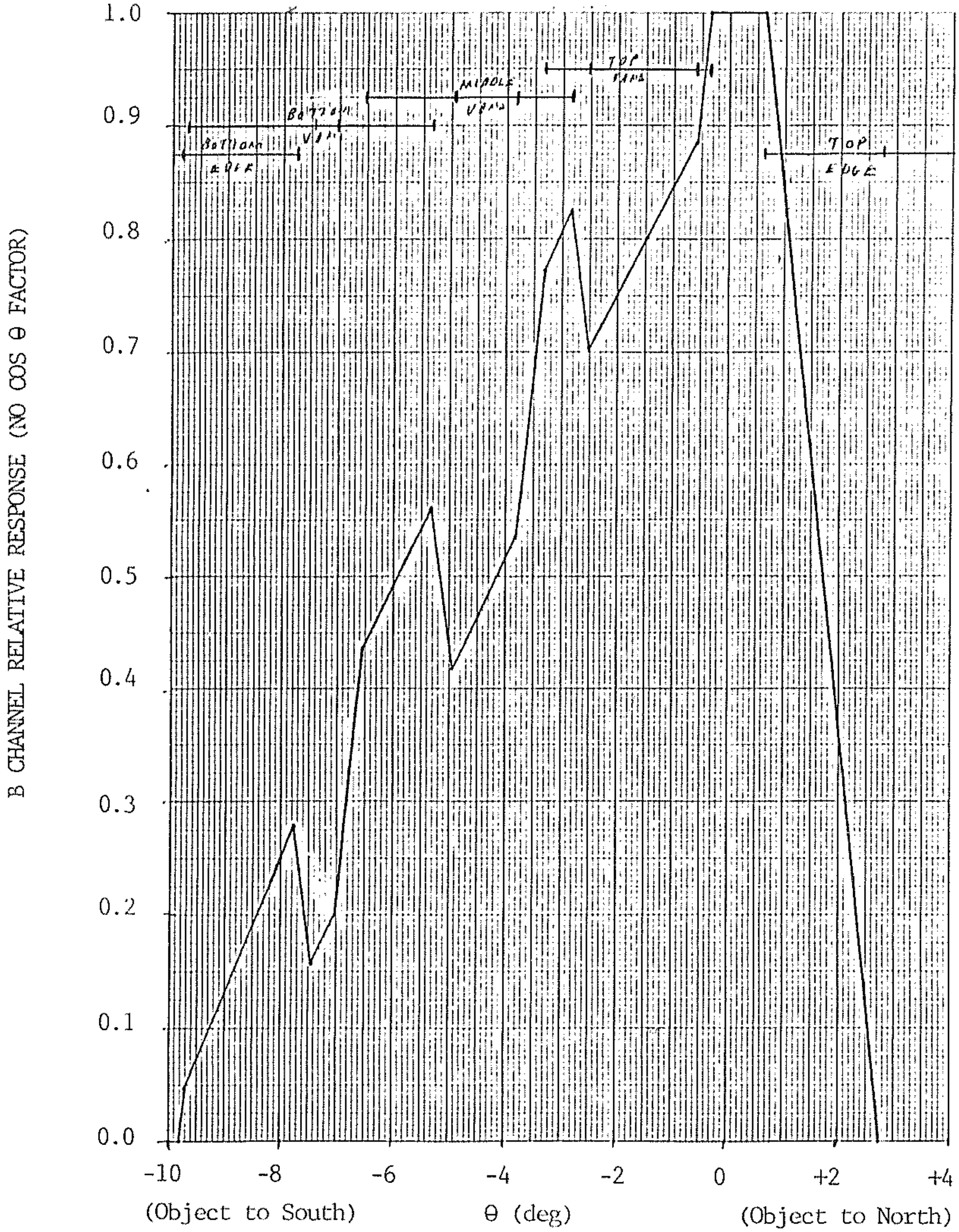
* DUAL ION CHAMBER DETECTS SOLAR X-RAYS IN THE .5-3 AND 1-8 ANGSTROM SPECTRAL BAND. TWO CHARGE CURRENT OUTPUTS, ONE FOR EACH BAND.
* LEAD SHIELDING SURROUNDING ION CHAMBERS REDUCE BACKGROUND CURRENTS FROM BREMSSTRAHLUNG.
* PREAMPLIFIERS CONVERT CONTINUOUS CHARGE CURRENTS TO DC VOLTAGES. ONE PREAMP PER BAND.
* DUAL MOS FET INPUT STAGES HAVE EXTREMELY LOW LEAKAGE CURRENTS.
* TWO RANGES OF SENSITIVITY (MSR AND LSR) PER PREAMP ARE SELECTED BY COMMAND FROM AUTO-RANGE ELECTRONICS.
* RANGE STATUS IS FED BACK TO AUTO-RANGE ELECTRONICS.
* PREAMP ENCLOSED IN ELECTRICAL SHIELD CONNECTED TO SIGNAL GROUND.
* TEST CONNECTORS ALLOW GROUND CALIBRATION.

ION CHAMBER AND PREAMPLIFIER SUBASSEMBLY PERFORMANCE CHARACTERISTICS

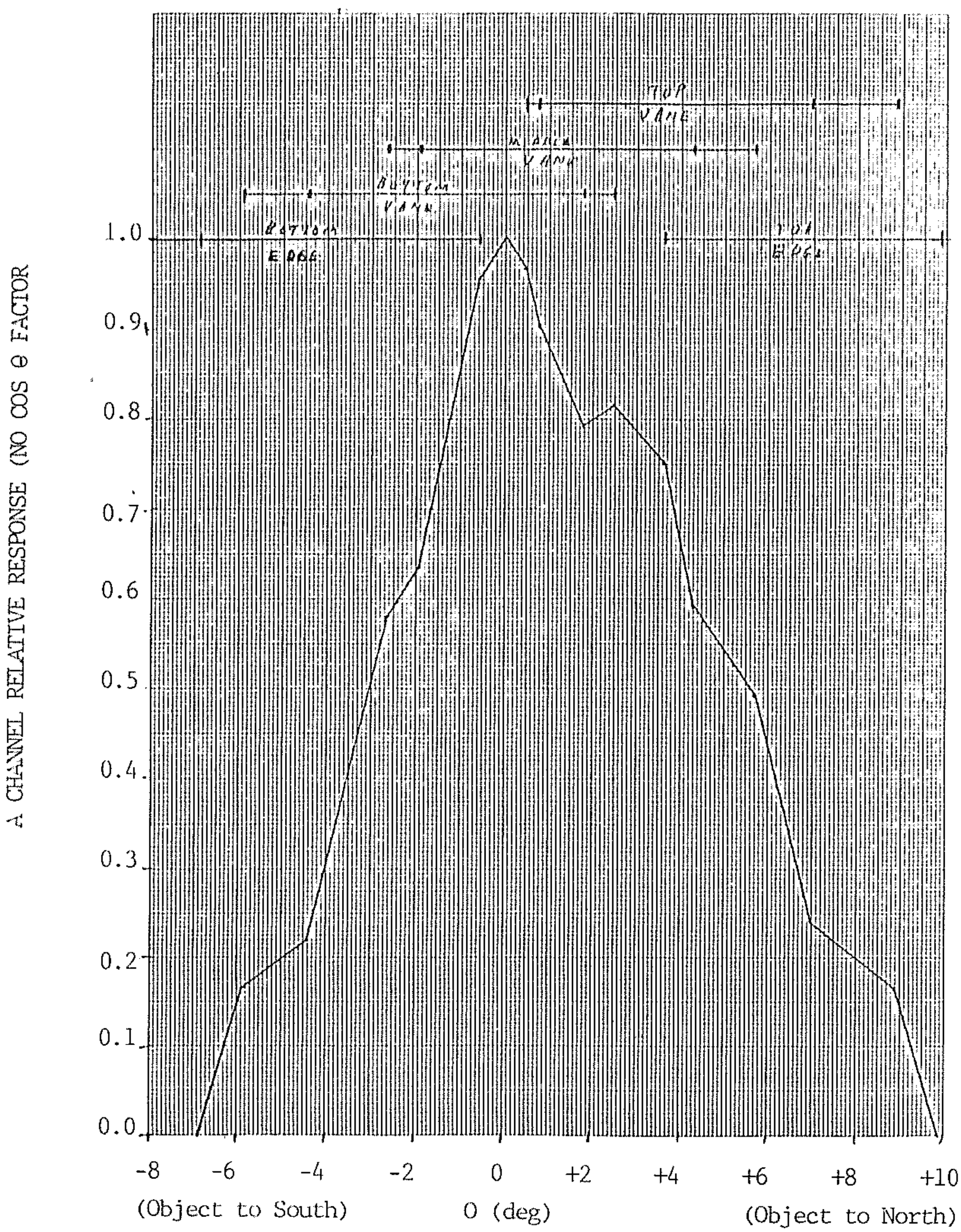
* SEE PERFORMANCE CHARACTERISTICS OF XRS ASSEMBLY.
* NOMINAL DYNAMIC RANGE: SHORT SUN 1.7×10^{-14} A TO 1.7×10^{-9} A
LONG SUN 4.6×10^{-14} A TO 4.6×10^{-9} A
* ANGULAR RESPONSE - SEE FOLLOWING GRAPHS.
* 5 DECADE DYNAMIC RANGE DIVIDED INTO 2 SENSITIVITY RANGES (MSR AND LSR). FACTOR OF 100 SENSITIVITY CHANGE.
* BANDWIDTH OF MORE SENSITIVE RANGE $\leq$ 1HZ TO KEEP ELECTRONIC NOISE TO A MINIMUM AT LOW SIGNAL LEVELS.
* VOLTAGE OUTPUT RANGE, BOTH SENSITIVITY RANGES: 0-5V, DC COUPLED TO PROCESSING ELECTRONICS IN DPU.
* MONITORS PREAMP TEMPERATURE.



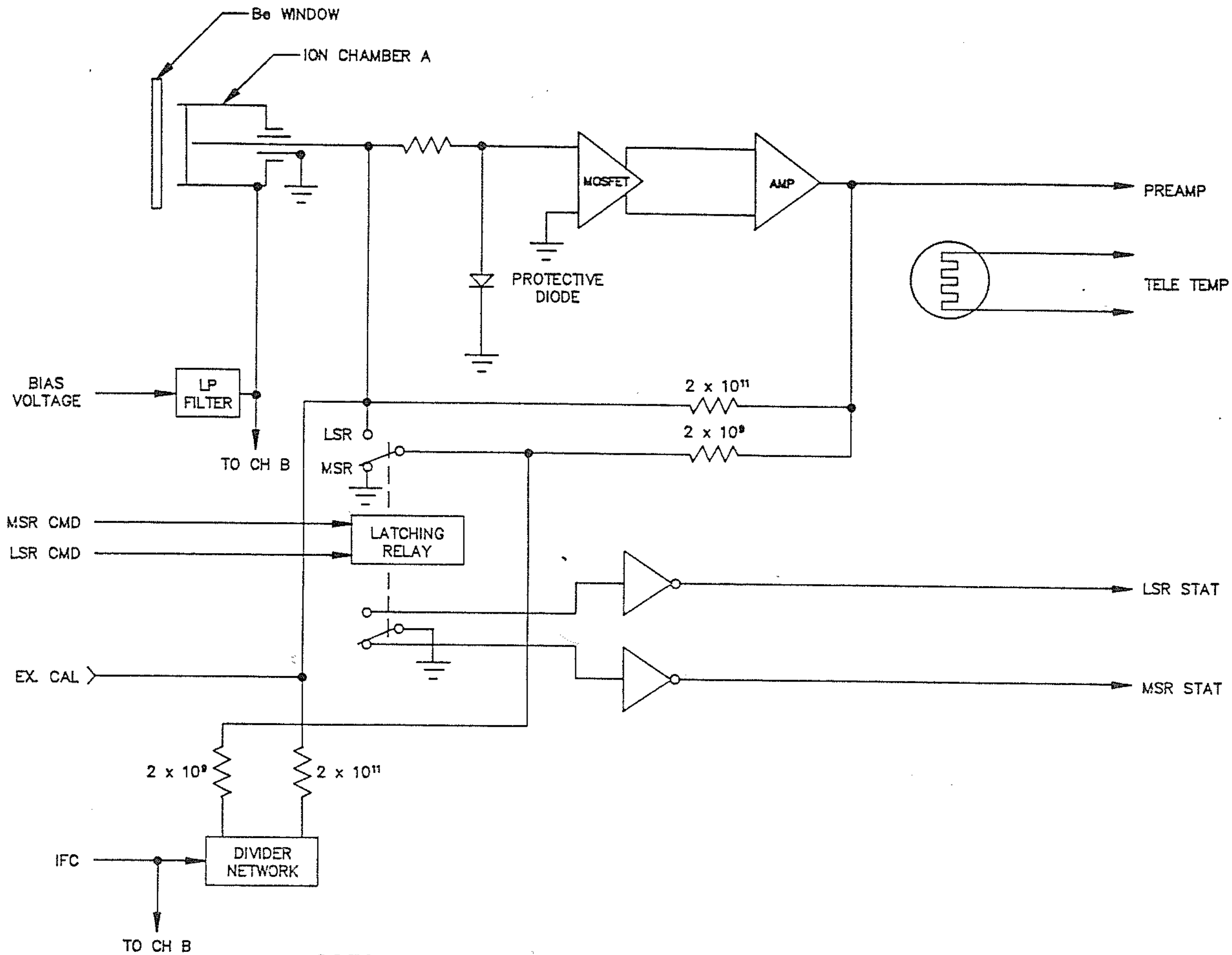
A & B CHANNELS, E-W ANGULAR RESPONSE



B CHANNEL, N-S ANGULAR RESPONSE

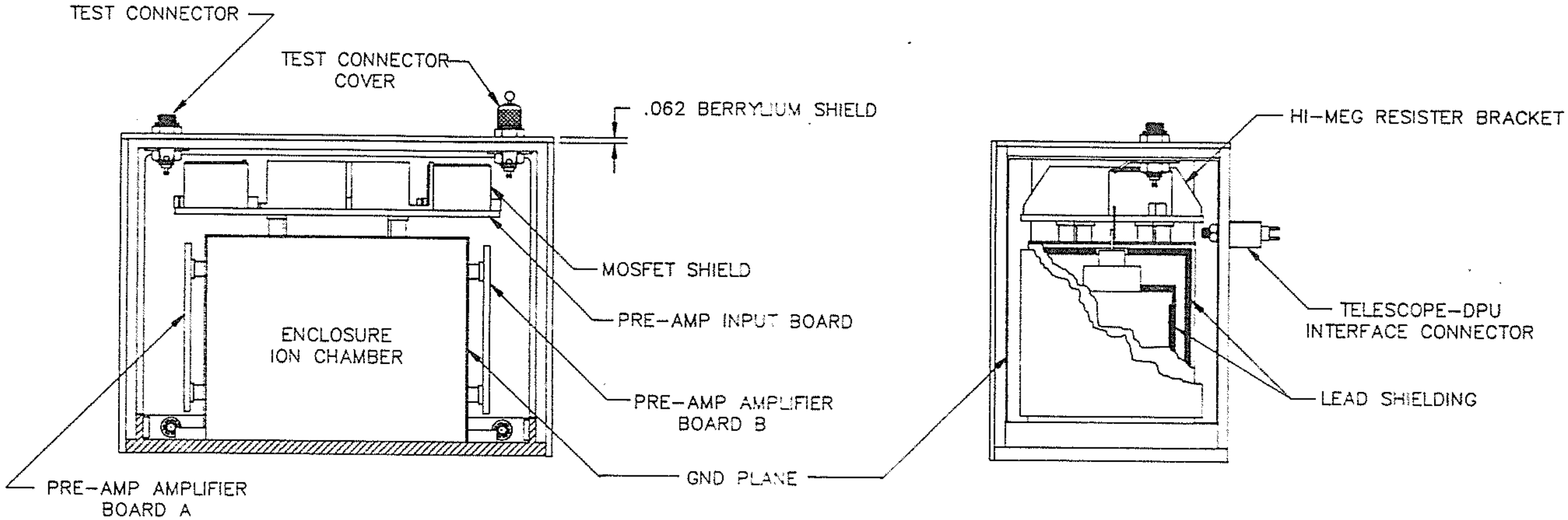


A CHANNEL, N-S ANGULAR RESPONSE



GOES NEXT XRS PREAMPLIFIER BLOCK DIAGRAM
ONE CHANNEL SHOWN

XRS 2.4.3



XRS ION CHAMBER AND PRE-AMP ASSEMBLY

ION CHAMBER AND PREAMPLIFIER SUBASSEMBLY, MODIFICATIONS FROM GOES D-H

* CHANGE A.C. COUPLING OF IFC SIGNALS TO PREAMP INPUT TO D.C. COUPLING THROUGH HI-MEG RESISTORS.
* CHANGE A.C. RESPONSE (BP = 2HZ - 1ØHZ) OF PREAMP TO D.C. RESPONSE WITH BW ≤ 1HZ.
* INCREASE BIAS OF MOSFETS TO AT LEAST 1ØØ MICROAMPS (WAS 8Ø) TO REDUCE ELECTRONIC NOISE.

GOES I - M XRS

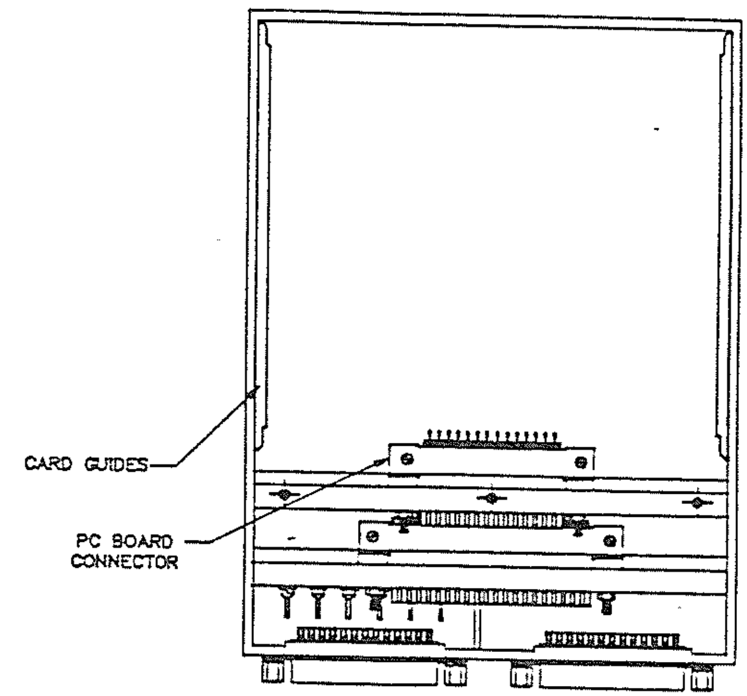
DPU SUBASSEMBLY

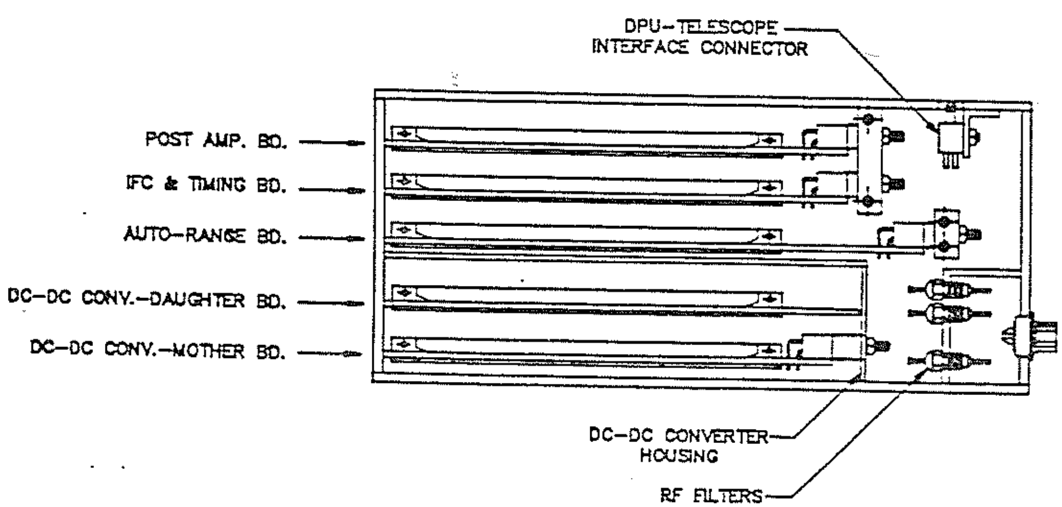
- FUNCTIONAL CHARACTERISTICS
- MECHANICAL ASSEMBLY DRAWING
- POST AMPLIFIER
- AUTO-RANGE
- IN-FLIGHT CALIBRATOR
- DC/DC CONVERTER
- PENDING MODIFICATIONS

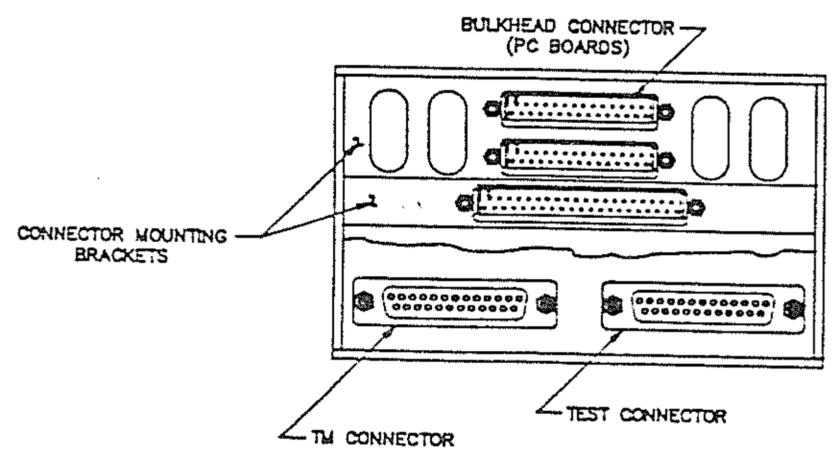
DPU SUBASSEMBLY, FUNCTIONAL CHARACTERISTICS

* SIGNAL CONDITIONING AND POST AMPLIFICATION OF PREAMP OUTPUT. ONE ELECTRONIC CHANNEL FOR EACH WAVELENGTH BAND.
* AUTOMATIC RANGE CHANGING KEEPS DATA OUTPUT WITHIN VOLTAGE LIMITS.
* PROVIDES FOUR DECADE RANGES PER CHANNEL.
* INDICATES RANGE SELECTED BY TWO BI-LEVEL STATUS BITS PER CHANNEL.
* GENERATES THE NECESSARY IN-FLIGHT CALIBRATION SIGNALS FOR BOTH PREAMPLIFIERS.
* INITIATES AND TERMINATES A CALIBRATION SEQUENCE BY GROUND COMMAND.
* ONE BI-LEVEL SIGNAL INDICATES THE CALIBRATION AND DATA MODE.
* PROVIDES AN ANALOG MONITOR OF THE CALIBRATION REFERENCE VOLTAGE.
* MONITORS THE SUBASSEMBLY TEMPERATURE.
* DC/DC CONVERTER ACCEPTS SPACECRAFT BUS POWER AND SUPPLIES ALL ELECTRONICS WITH NECESSARY D.C. VOLTAGES.
* CONVERTER IS TURNED ON AND OFF BY GROUND COMMAND.

DPU MECHANICAL ASSEMBLY DRAWING







XRS 2.5.2

DPU SUBASSEMBLY, PENDING MODIFICATIONS

* PROVIDE ONE BI-LEVEL, POWER ON/OFF STATUS MONITOR.
* PROVIDE DESIRABLE HOUSEKEEPING MONITORS.
* MODIFY IFC CIRCUITS TIMING AND CONTROL DESIGN.
* MODIFY DC/DC CONVERTERS COMMAND INTERFACE.

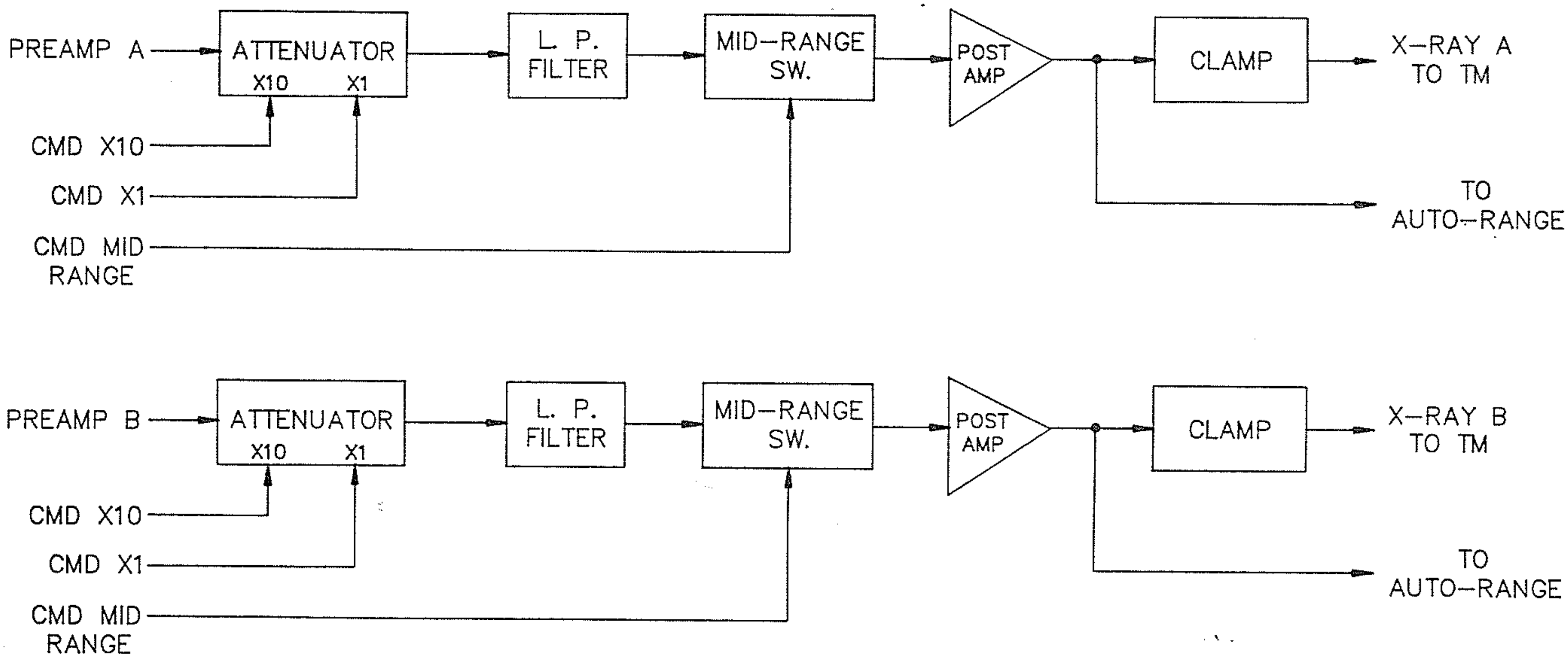
DPU SUBASSEMBLY POSTAMPLIFIER

- PERFORMANCE CHARACTERISTICS
- BLOCK DIAGRAM
- ENGINEERING SCHEMATIC (NOT RELEASED).

POST AMPLIFIER, PERFORMANCE CHARACTERISTICS

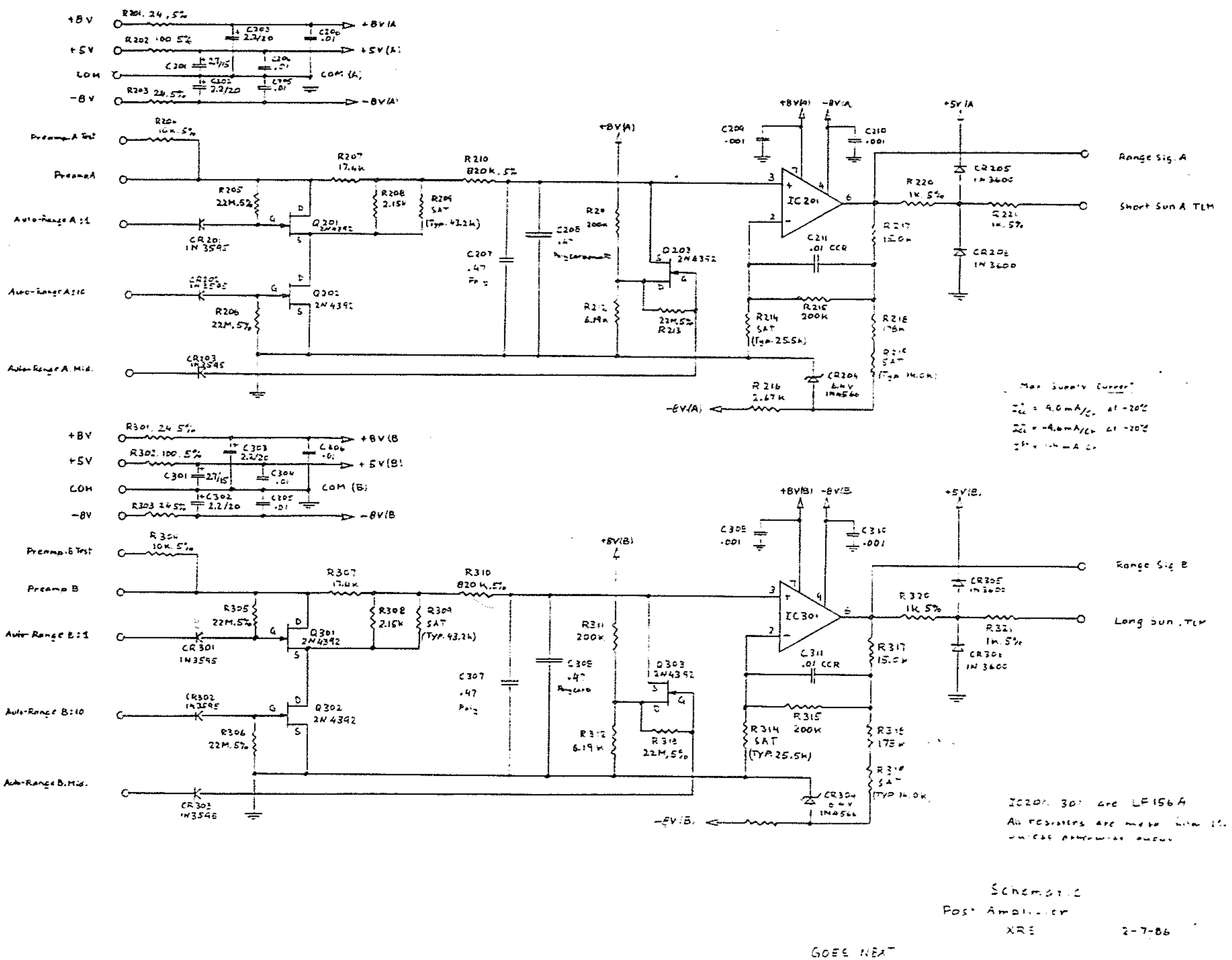
(EACH CHANNEL)

* ATTENUATES PREAMPLIFIER SIGNAL X1Ø OR X1 ON COMMAND FROM AUTO-RANGE.
* FINAL LOW PASS FILTER WITH ABOUT 8ØØ MS TIME CONSTANT.
* POST AMPLIFICATION OF ATTENUATED AND FILTERED D.C. SIGNAL. CLOSED LOOP GAIN OF 1Ø.
* ANALOG OUTPUT HAS 4 RANGES OF SENSITIVITY TO ACCOMMODATE THE 5 DECADE RANGE OF X-RAY INPUT.
* OUTPUT IS REFERENCED TO INCIDENT X-RAY FLUX VIA ELECTRONICS CALIBRATION AND ION CHAMBER CALIBRATION.
* OUTPUT HAS .5V OFFSET AT ZERO X-RAY FLUX.



GOES XRS BLOCK DIAGRAM,POST AMPLIFIER

XRS 2.5.4.2



+8V
+5V
COM
-8V
R201 24, 5%
R202 100 5%
R203 24.5%
C203 2.2/20
C200 .01
C201 27/15
C202 2.2/20
C205 .01
+8V(A)
+5V(A)
COM (A)
-8V(A)
Preamp A Test
Preamp A
Auto-Range A 1:1
Auto-Range A 1:10
Auto-Range A Mid.
R204 10K 5%
R205 22M, 5%
R206 22M, 5%
R207 17.4K
R208 2.15K
R209 SAT (Typ. 43.2K)
R210 820K, 5%
Q201 2N4392
Q202 2N4392
Q203 2N4392
CR201 1N3595
CR202 1N3595
CR203 1N3595
C207 .47
C208 .47
R212 6.19K
R213 22M, 5%
IC201
C209 .001
C210 .001
C211 .01 CCR
R214 SAT (Typ. 25.5K)
R215 200K
R216 2.67K
R217 15.0K
R218 178K
CR204 6.4V 1N4566
-8V(A)
R220 1K, 5%
R221 1K, 5%
CR205 1N3600
CR206 1N3600
+5V(A)
Range Sig. A
Short Sun A TLM
Max Supply Current
+8V(B)
+5V(B)
COM (B)
-8V(B)
R301 24 5%
R302 100 5%
R303 24 5%
C301 27/15
C302 2.2/20
C303 2.2/20
C304 .01
C305 .01
C306 .01
Preamp B Test
Preamp B
Auto-Range B 1:1
Auto-Range B 1:10
Auto-Range B Mid.
R304 10K 5%
R305 22M, 5%
R306 22M, 5%
R307 17.4K
R308 2.15K
R309 SAT (Typ. 43.2K)
R310 820K, 5%
Q301 2N4392
Q302 2N4392
Q303 2N4392
CR301 1N3595
CR302 1N3595
CR303 1N3595
C307 .47
C308 .47
R311 200K
R312 6.19K
R313 22M, 5%
IC301
C309 .001
C310 .001
C311 .01 CCR
R314 SAT (TYP. 25.5K)
R315 200K
R317 15.0K
R318 178K
CR304 6.4V 1N4566
-8V(B)
R320 1K, 5%
R321 1K, 5%
CR305 1N3600
CR306 1N3600
+5V(B)
Range Sig B
Long Sun TLM
IC201, 301 are LF156A
Schematic
Post Amplifier
XRS
2-7-86
GOES NEXT

XRS 2.5.4.3

DPU SUBASSEMBLY, AUTO-RANGE

- PERFORMANCE CHARACTERISTICS
- BLOCK AND TIMING DIAGRAM
- MODIFICATIONS FROM GOES D-H

AUTO-RANGE, PERFORMANCE CHARACTERISTICS

(EACH CHANNEL)

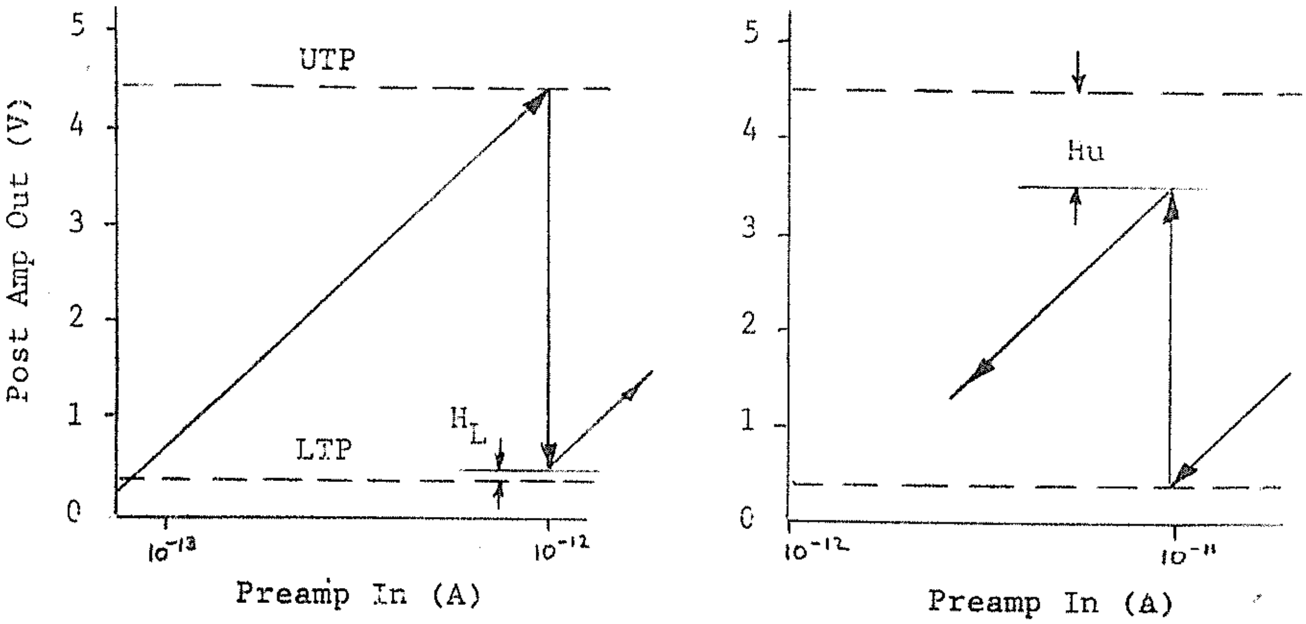
- CHANGES X-RAY ELECTRONICS SENSITIVITY AUTOMATICALLY WHEN POST AMP OUTPUT REACHES ITS RANGE LIMITS.
- PROVIDES 4 INCREMENTAL RANGES EACH COVERING APPROXIMATELY ONE DECADE OF TOTAL DYNAMIC RANGE.
- PROVIDES RANGE STATUS INDICATION WITH TWO BI-LEVEL OUTPUTS, WHERE

  RANGE 1 = "ØØ"
  RANGE 2 = "Ø1"
  RANGE 3 = "1Ø"
  RANGE 4 = "11"

- DRIVES POST AMP TO MID-RANGE FOR APPROXIMATELY 3 MS WHEN RANGE CHANGE OCCURS.
- HYSTERISIS PREVENTS HUNTING.
- RANGES ARE FORCED OR INHIBITED, AS NECESSARY, IN CALIBRATION MODE.

AUTO-RANGE, PERFORMANCE CHARACTERISTICS (CONT)

HYSTERISIS



$\frac{UTP}{10} = LTP + H_L$

$10\ LTP = UTP - Hu$

$Hu = 10\ H_L$

Min H_L = 1.4 e_n where e_n = rms noise = V_{thr}

Min H_L = 0.6V V_{thr} = .04V

Choose H_L = .09V H_u = .9V

Required UTP = 4.3V

Then LTP = .43 - .09 = .34V

With Post Amp offset = .5V

UTP = 4.8V = 96% F.S.

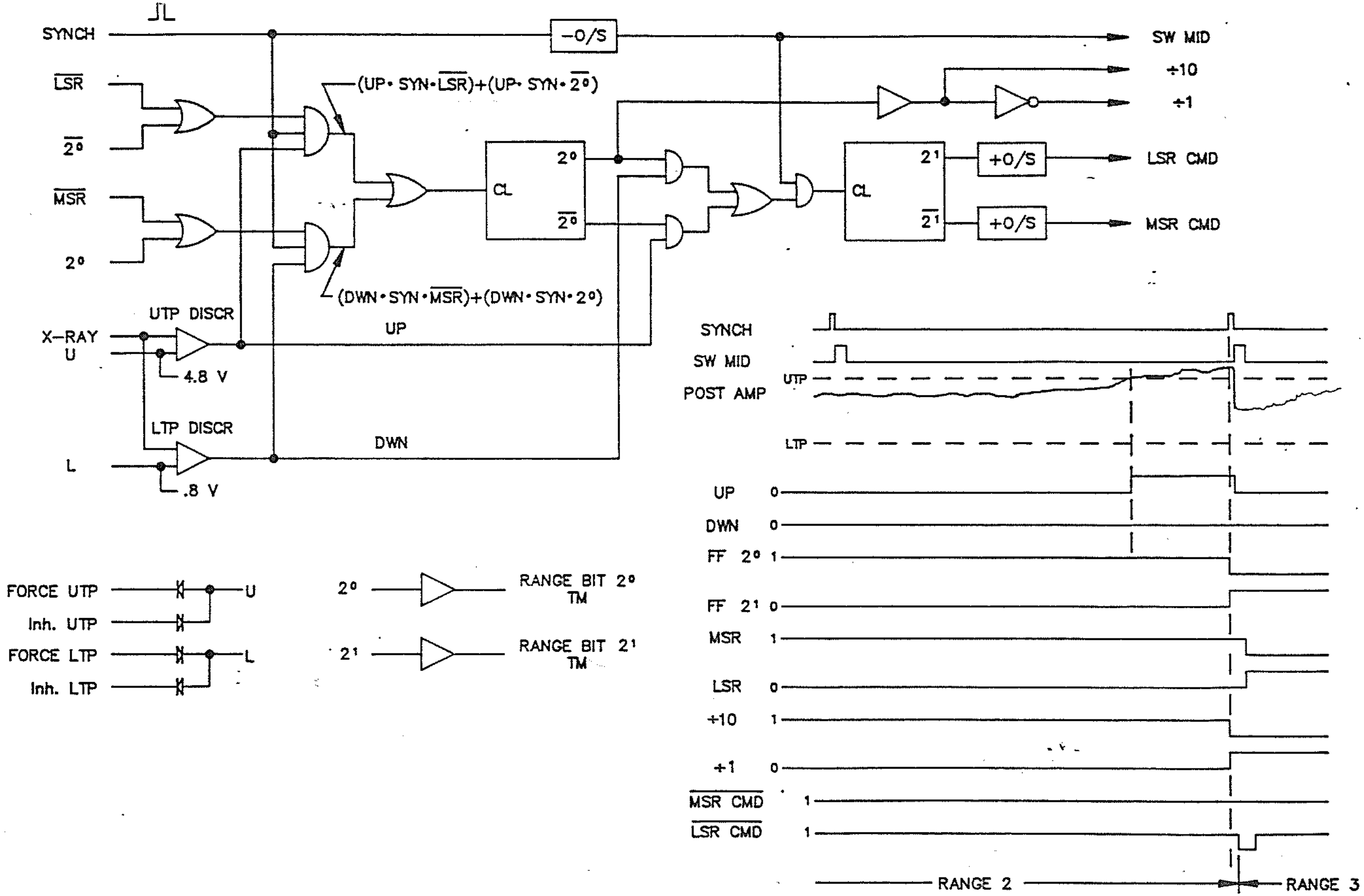
LTP = .84V = 17% F.S.

Hysterisis unchanged.

AUTO-RANGE, PERFORMANCE CHARACTERISTICS (CONT'D)

TRUTH TABLE AND NORMALIZED GAIN

RANGE	PREAMP. GAIN STATUS		ATTENUATOR STATUS		RANGE STATUS		NORMALIZED GAIN
	MSR	LSR	X1Ø	X1	2^1	2^0	
1	1	Ø	Ø	1	Ø	Ø	1ØØØ
2	1	Ø	1	Ø	Ø	1	1ØØ
3	Ø	1	Ø	1	1	Ø	1Ø
4	Ø	1	1	Ø	1	1	1



GOES XRS BLOCK AND TIMING DIAGRAM, AUTO-RANGE

XRS 2.5.5.2

AUTO-RANGE, MODIFICATIONS FROM GOES D-H

* CHANGE "1" AND "Ø" LEVEL OF STATUS BITS TO 5V AND ØV RESPECTIVELY.

DPU SUBASSEMBLY, IN-FLIGHT CALIBRATOR

- PERFORMANCE CHARACTERISTICS
- BLOCK DIAGRAM
- ENGINEERING SCHEMATIC
- PENDING MODIFICATIONS

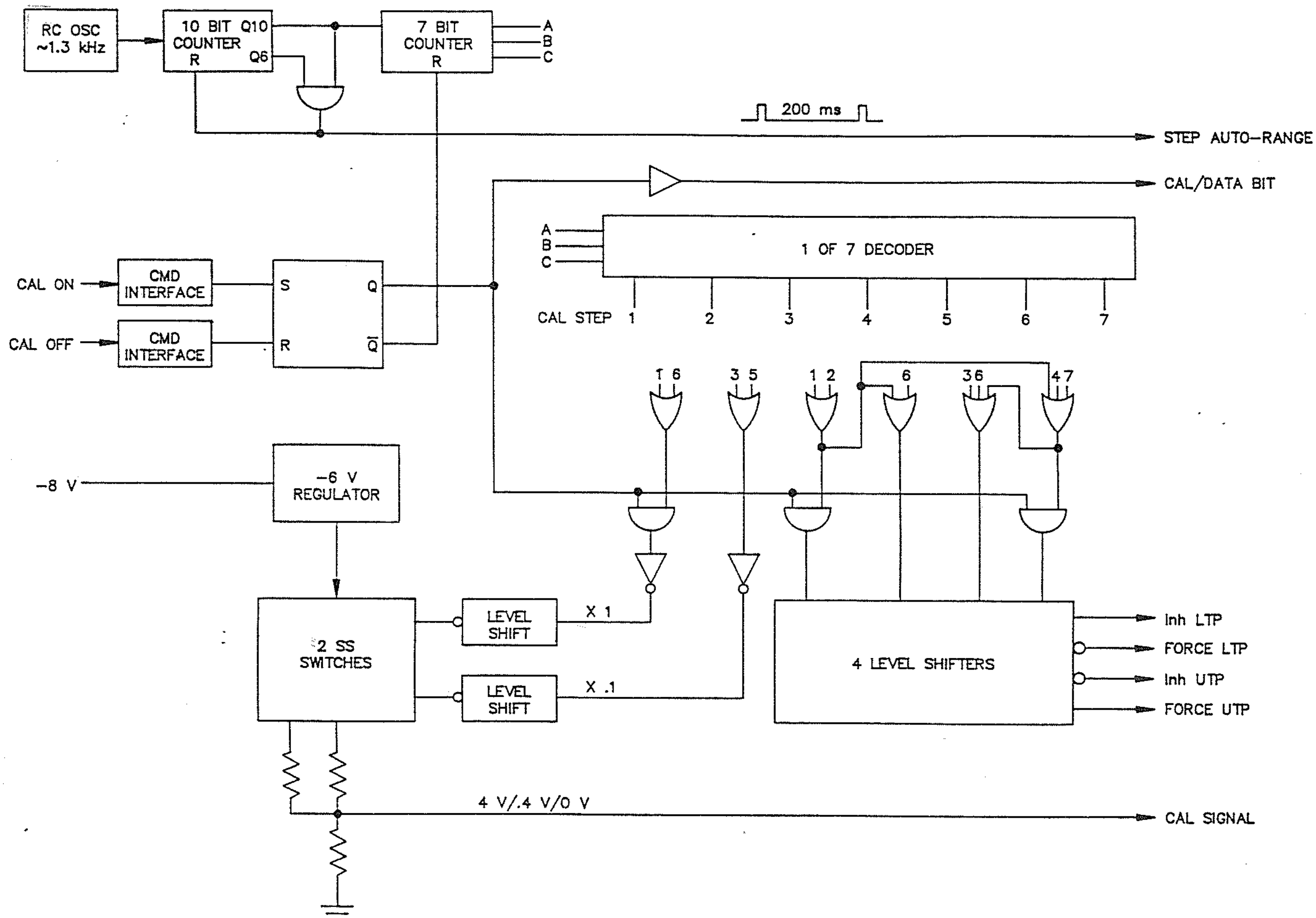
IN-FLIGHT CALIBRATOR, PERFORMANCE CHARACTERISTICS

CAL MODE - LOGIC AND SIGNAL OUTPUTS

REQUIREMENT			PERFORMANCE					
STEP	RANGE	X-RAY OUT	CAL SIGNAL	PREAMP INPUT CURRENT	UTP FORCE	UTP INH	LTP FORCE	LTP INH
1	4	5Ø ± 1Ø% FS	VCAL	ICAL	1	Ø	Ø	1
2	4	Ø	Ø	Ø	1	Ø	Ø	Ø
3	3	5Ø ± 1Ø% FS	VCAL/1Ø	ICAL/1Ø	Ø	1	Ø	Ø
4	3	Ø	Ø	Ø	Ø	1	Ø	1
5	1	5Ø ± 1Ø% FS	VCAL/1Ø	ICAL/1ØØØ	Ø	1	1	Ø
6	2	5Ø ± 1Ø% FS	VCAL	ICAL/1ØØ	Ø	Ø	Ø	Ø
7	2	Ø	Ø	Ø	Ø	1	Ø	1
8	1	Ø	Ø	Ø	Ø	1	1	Ø

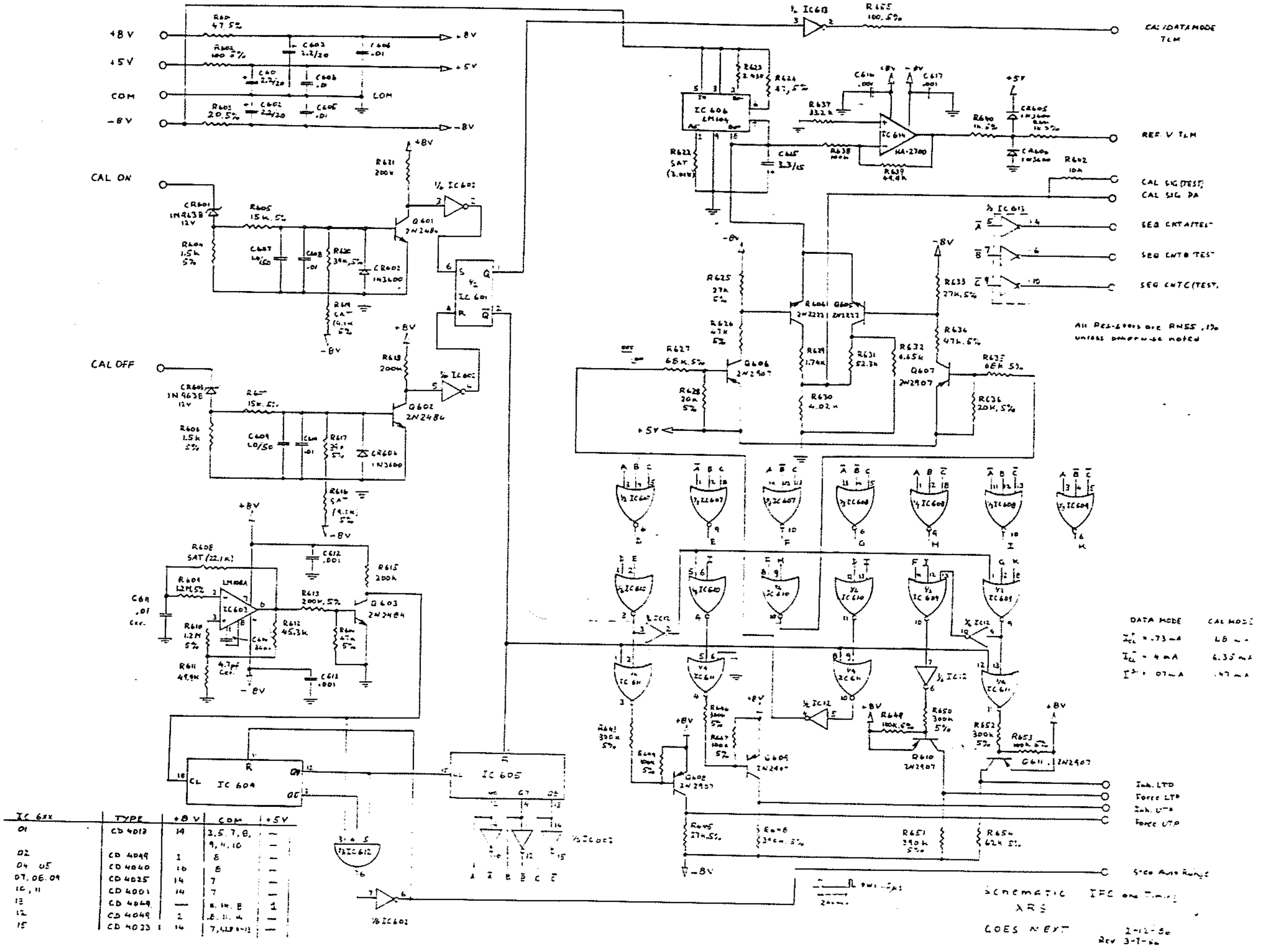
IN-FLIGHT CALIBRATOR, PERFORMANCE CHARACTERISTICS (CONT'D)

* CALIBRATION SEQUENCE AND DURATION CONTROLLED BY ON-BOARD OSCILLATOR.
* DURATION PER CAL STEP = 12 SEC.
* CAL SEQUENCE DURATION = 46 SEC.
* CAL SEQUENCE IS INITIATED AND TERMINATED BY GROUND COMMAND. NOT SELF TERMINATING.
* CAL VOLTAGES DERIVED FROM STABLE REFERENCE VOLTAGE.
* ANALOG OF REFERENCE VOLTAGE IS CONTINUOUSLY AVAILABLE TO TM.
* BI-LEVEL OUTPUT MONITORS CAL/DATA MODE.



XRS IN-FLIGHT CALIBRATOR,BLOCK DIAGRAM

XRS 2.5.6.2



IC 6XX	TYPE	+8 V	COM	+5V
01	CD 4013	14	3, 5, 7, 8, 9, 11, 10	—
02	CD 4049	1	8	—
04 05	CD 4040	16	8	—
07, 08, 09	CD 4025	14	7	—
10, 11	CD 4001	14	7	—
13	CD 4049	—	[illegible]	1
12	CD 4049	1	[illegible]	—
15	CD 4023	14	[illegible]	—

XRS 2.5.6.3

IN-FLIGHT CALIBRATOR, PENDING MODIFICATIONS

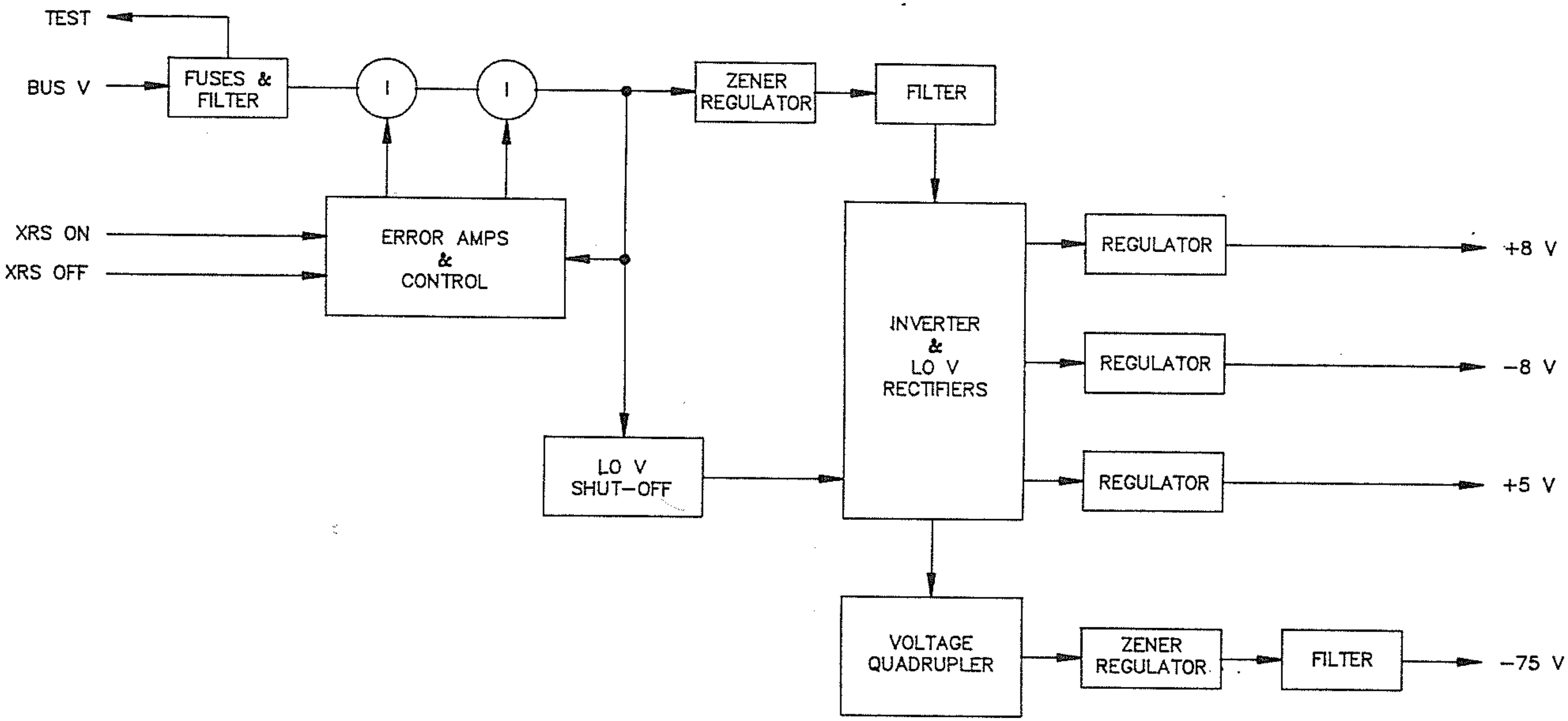
* USE SPACECRAFT DERIVED TIMING SIGNAL INSTEAD OF INSTRUMENT TIMING OSCILLATOR TO SYNCHRONIZE THE CALIBRATION STEP OUTPUT AND CAL FLAG WITH TM READ RATE.
* CONFIGURE THE COMMAND INTERFACE CIRCUIT TO ACCEPT SUCCESSIVE PULSE COMMANDS ON SINGLE LINE TO INITIATE AND TERMINATE CAL SEQUENCE. WAS TWO COMMAND LINES.

DPU SUBASSEMBLY, DC/DC CONVERTER

- PERFORMANCE CHARACTERISTICS
- BLOCK DIAGRAM
- MODIFICATIONS FROM GOES D-H

DC/DC CONVERTER PERFORMANCE CHARACTERISTICS

* ACCEPTS SPACECRAFT PROVIDED BUS AND CONVERTS IT TO MULTIPLE DC OUTPUT VOLTAGES, REQUIRED BY INSTRUMENT.
* OUTPUT VOLTAGES ARE: +8V, -8V, +5V FOR ELECTRONICS
-75V FOR ION CHAMBER BIAS
* CONVERTER IS ENABLED AND DISABLED BY GROUND COMMAND.
* COMMAND INTERFACE ACCEPTS TWO PULSE COMMANDS, ONE FOR XRS ON AND ONE FOR XRS OFF.



XRS DC/DC CONVERTER BLOCK DIAGRAM

DC/DC CONVERTER PENDING MODIFICATIONS

* CHANGE FROM TWO LINE PULSE COMMAND TO SINGLE LINE LATCHING RELAY COMMAND.

GOES I-M XRS

SUMMARY OF PERTINENT GOES D-H DATA AND ANALYSIS

GOES I-M XRS

D-H ION CHAMBER CALIBRATION DATA

PANA-GOESX-CR1

XRS 3.1.1-1

GOES D, E, F CALIBRATION REPORT
X-RAY SENSOR

Calibration Report for the Engineering Model and Flight Unit X-Ray Ion Chambers

P.O. No. 779412-LY5

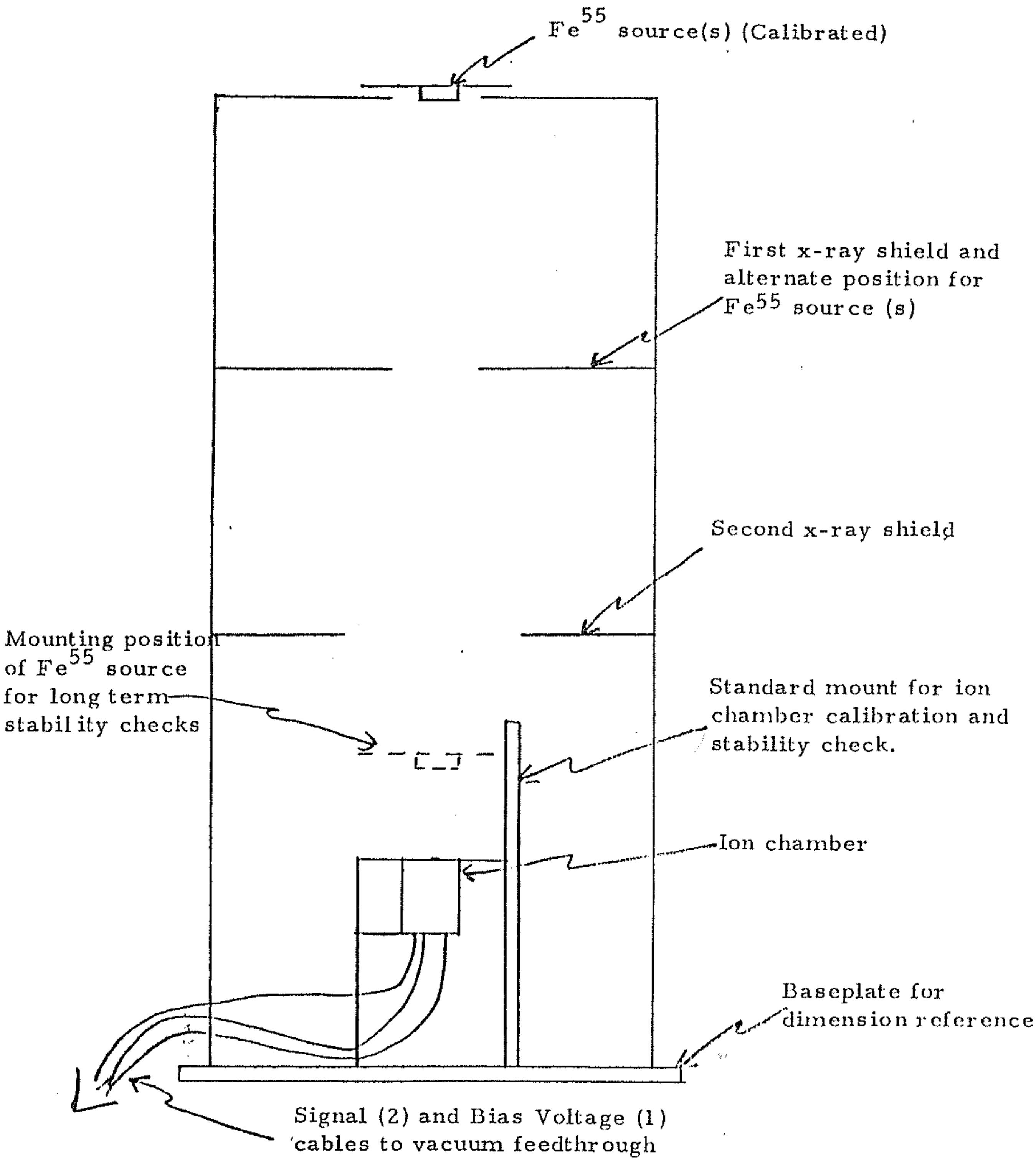
October 30, 1978

Prepared for

Hughes Aircraft Company
P.O. Box 92919
Los Angeles, CA 90009

by

PANAMETRICS, INC.
221 Crescent Street
Waltham, MA 02154



Outline of Geometry for Ion Chamber Calibration
GOES XRS

Table 3.6

Fe-55 Calibration Results for A Chambers

Item	Value for A Chamber of Ion Chamber #						Aver-age for 9/78 Cal	Average for top & middle Cal
	W2336*	W2336	W2337	W2338	W2339	W2340		
Average Fe-55 Calibration ($A\text{-}m^2/W$)/# in average	$1.892 \times 10^{-5}/5$	$1.919 \times 10^{-5}/7$	$1.942 \times 10^{-5}/6$	$1.998 \times 10^{-5}/7$	$1.971 \times 10^{-5}/6$	$1.973 \times 10^{-5}/6$		
Relative responses for Fe-55 source								
#331-top	1.000	1.009	1.009	1.002	1.027	0.988	1.007	1.001
#547-top	-	0.997	1.002	0.989	1.003	1.002	0.999	
4S-top	0.993	0.992	0.993	0.997	0.998	1.004	0.997	
#331-middle	1.011	0.997	0.995	1.013	0.989	1.026	1.004	0.997
#547-middle	0.994	1.001	1.014	0.994	0.982	0.990	0.996	
4S-middle	-	0.987	0.987	0.989	1.002	0.991	0.991	
- - - - - - -								
#331-top	1.002	-	-	-	-	-		
#331-middle	-	1.016	-	-	-	-		
4S-top	-	-	-	1.016	-	-		
Standard deviation, σ, in relative response, for a single measurement	0.007	0.010	0.010	0.011	0.015	0.014	0.012	

*Data from 6/78 Calibration for the Engineering Model ion chamber.

Table 3.7

Fe-55 Calibration Results for B Chambers

Item	Value for B Chamber of Ion Chamber #						Aver-age for 9/78Cal	Average for top & middle Cal
	W2336*	W2336	W2337	W2338	W2339	W2340		
Average Fe-55 Calibration ($A\text{-}m^2/W$)/# in average	$5.69 \times 10^{-6}/5$	$5.93 \times 10^{-6}/7$	$5.97 \times 10^{-6}/6$	$6.06 \times 10^{-6}/7$	$5.79 \times 10^{-6}/6$	$6.26 \times 10^{-6}/6$		
Relative responses for Fe-55 source								
#331-top	0.986	0.987	0.979	1.004	0.889	1.046	0.981	
#547-top	-	0.994	1.022	1.008	1.018	0.974	1.003	0.982
4S-top	0.971	0.943	0.943	0.976	0.966	0.987	0.963	
#331-middle	1.069	1.028	1.034	0.968	1.067	1.051	1.030	
#548-middle	-	1.044	1.055	1.040	1.072	0.976	1.037	1.016
4S-middle	0.971	0.965	0.967	1.028	0.987	0.965	0.982	
- - - - - - -								
#331-top	1.003	-	-	-	-	-		
#331-middle	-	1.038	-	-	-	-		
4S-top	-	-	-	0.976	-	-		
Standard deviation, σ, in relative response, for a single measurement	0.029	0.038	0.043	0.028	0.069	0.038	0.043	

*Data from 6/78 Calibration for the Engineering Model ion chamber.

Table 3.8

Summary of Ion Chamber Calibration Results

Ion Chamber #	Chamber A (0.5-3Å) Normalization Factor, B_m	Chamber A (0.5-3Å) Corrected Response to flat spectrum, $\overline{G}_{cal}(0.5-3)(A-m^2/W)$	Chamber B (1-8Å) Normalization Factor, B_m	Chamber B (1-8Å) Corrected Response to flat spectrum, $\overline{G}_{cal}(1-8)(A-m^2/W)$
W2336*	1.030	1.821×10^{-5}	1.035	4.86×10^{-6}
W2337	1.044	1.843×10^{-5}	1.043	4.93×10^{-6}
W2338	1.068	1.903×10^{-5}	1.056	5.16×10^{-6}
W2339	1.059	1.868×10^{-5}	1.008	4.96×10^{-6}
W2340	1.056	1.879×10^{-5}	1.091	5.42×10^{-6}
	Average=1.051		Average=1.047	

*W2336 is the Engineering Model ion chamber. Results listed are for the 9/78 calibration.

Table 3.9

Estimated Uncertainties in Ion Chamber Calibrations

All uncertainties in %; 3σ uncertainties listed

Uncertainty Source	Chamber A		Chamber B
NBS Calibration		1.8	
Fe-55 half life effect		1.4	
Transfer of Fe-55 calibration		6.3	
Fe-55 source contribution	6.7	6.7	6.7
Shadow correction uncertainty	0.5		2.9
$1/\mu$ correction uncertainty	3.0		5.4
Measurement $3\sigma\,(1/\sqrt{6})$	1.5		5.3
Electrometer calibration	4.0		4.0
Total 3σ uncertainty	8.5%		11.2%
Total 1σ uncertainty	2.8%		3.7%

Table 4.1

Results of Initial Leak Tests on Ion Chambers

Date (mo/day/yr)	Normalized Response for Chambers A/B* W2336†	W2337	W2338	W2339	W2340
Eng. Model Chamber 6/28-30/78	0.99/0.96				
2 weeks vacuum, 7/12/78	0.99/0.97				
1 week vacuum, 7/20/78	1.00/0.98				
EM tests, 9/19/78	1.05/1.08				
Flight unit chambers 8/25-28/78		1.07/1.02	1.06/1.10	1.02/1.05	1.04/0.99
3 weeks vacuum, 9/19-21/78		1.07/1.05	1.07/1.10	1.06/1.03	1.05/1.02

*A chamber normalization = 4.0×10^{-12} A/mCi, B chamber normalization = 8.0×10^{-13} A/mCi.

†Engineering Model ion chamber.

Table 4.1

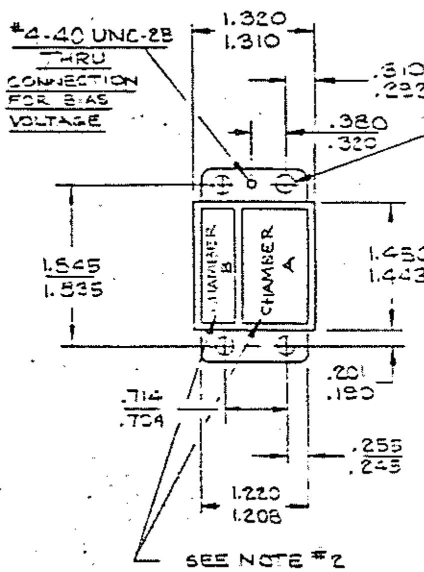
Results of Initial Leak Tests on Ion Chambers

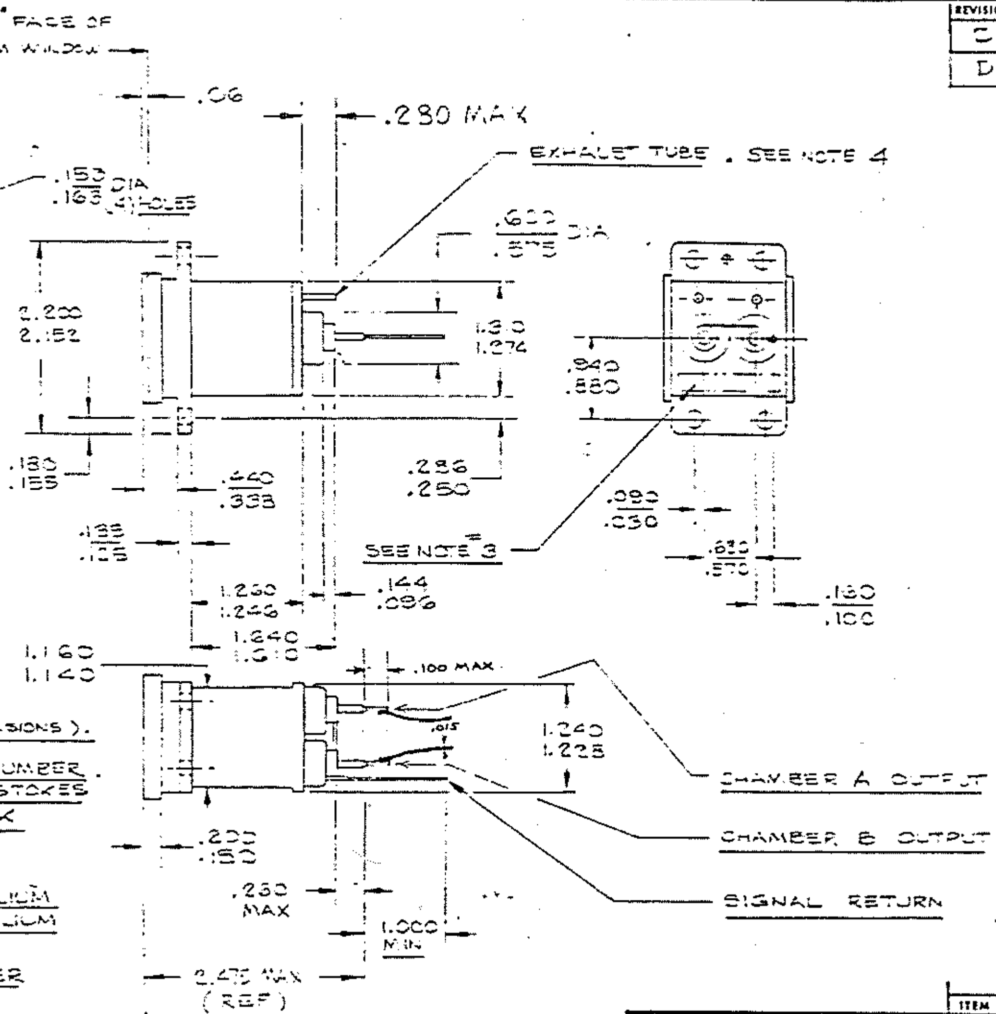
Date mo/day/year)	Response ratio to 1/16/84 date for Fe-55 sources #751, #547, and #578, averages for chambers A/B W2336*	B-1652	B-1653	B-1654	B-1655
2/6-13/84	1.00/1.01	1.01/0.99	1.00/0.99	1.00/1.00	1.01/1.01
9/19/78	0.96/1.01				
7/20/78	0.92/0.95				
7/12/78	0.91/0.94				
6/30/78	0.91/0.93				

*Engineering model ion chamber. Most of the pre-1984 data are for Fe-55 source #331.

DWG. NO. RS-C4-1102-201 REV. D

REVISION	REVISED BY	DATE	DESCRIPTION	APPV'D
C	W. PULLEY	[illegible]	SEE ECN 002760	[illegible]
D	W. PULLEY	[illegible]	SEE ECN 005794	WF





4 - EXHAUST TUBE MAY BE BENT OVER, PROVIDED IT DOES NOT PROTRUDE OUTSIDE THE BODY OF THE CHAMBER (1.310 X 1.240 DIMENSIONS).

3 - MARK WITH CUSTOMER'S PART NUMBER, SERIAL NUMBER AND REUTER-STOKES MFG NUMBER USING EPOXY INK

2-c - FILL GAS
CHAMBER A: XENON & HELIUM
CHAMBER B: ARGON & HELIUM

2-b - ANODE SPACING TO CHAMBER
CHAMBER A: .375
CHAMBER B: .125

2-a - WINDOW
CHAMBER A: 1.216 X .750 X .020 Beryllium
CHAMBER B: 1.216 x .250 x .002 Beryllium

1 - REMOVE BURRS, BREAK EDGES WHEN APPLICABLE.

NOTES:

ITEM	PART/ASS'Y NO.	DESCRIPTION	QTY

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES AND DIMENSIONAL LIMITS AS FOLLOWS:

SURFACE FINISH 63	.XX DECIMAL ±.01
FRACTIONAL ±1/64	.XXX ±.002
ANGULAR ±0° 30'	.XXXX ±.0005

REUTER-STOKES CLEVELAND, OHIO 44128

TITLE: ION CHAMBER X-RAY, DUAL

MAT'L.: TYPE 304 STAINLESS STEEL

DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE	SCALE	DWG. NO.	REV.
WEP	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	~	RS-C4-1102-201	D

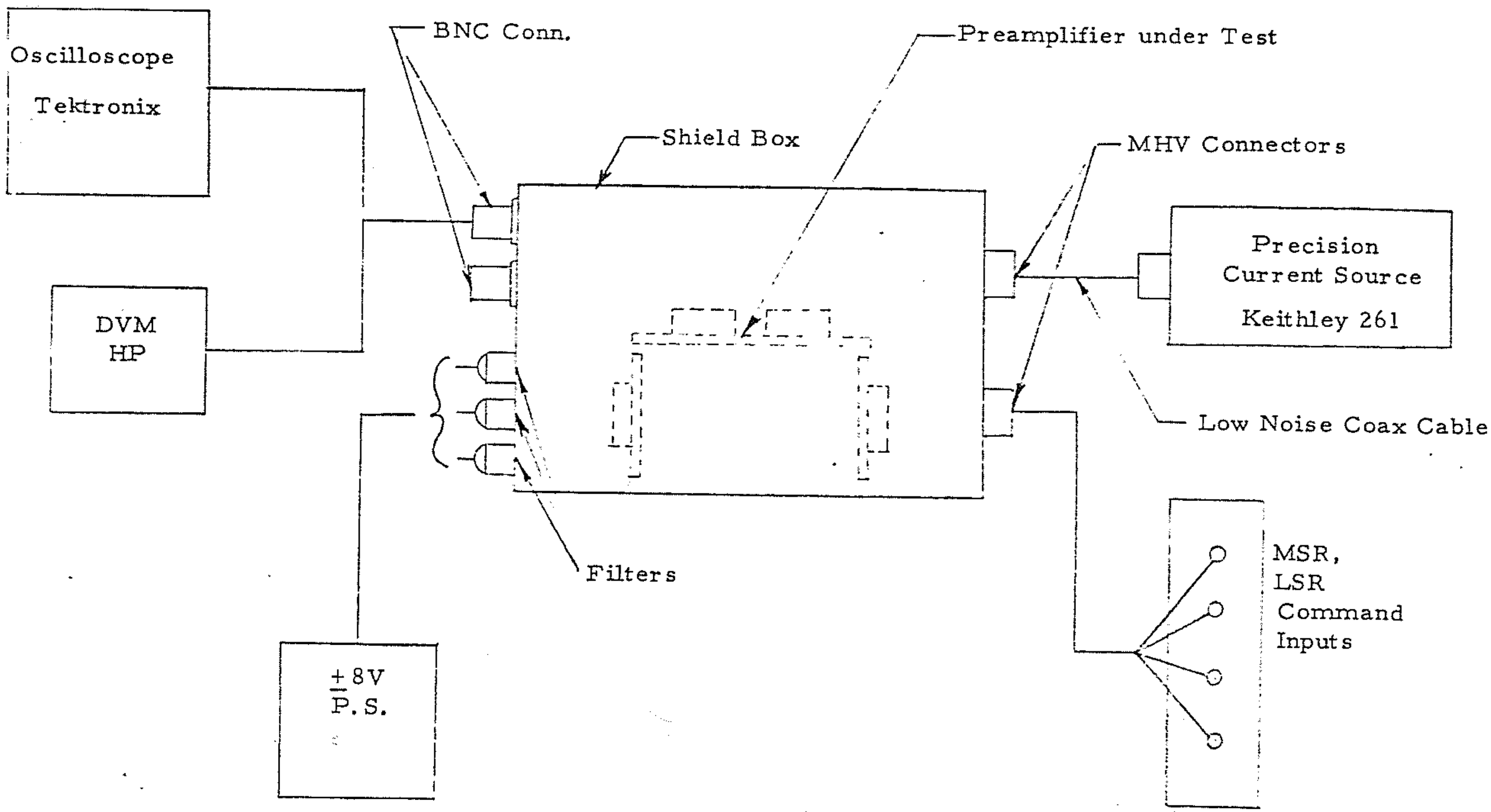
BRUNING 40 21

XRS 3.1.3

GOES I-M XRS

D-H, ELECTRONICS CALIBRATION TESTS

*	Preamplifier Calibration	XRS 3.2.1
*	Auto-Range Breadboard Tests	XRS 3.2.2



Note: Input and Output connections inside shield box are coax cables.

GOES-XRS Test Set-up for Preamplifier D. C. CAL

XRS 3.2.1-1

GOES I-M XRS

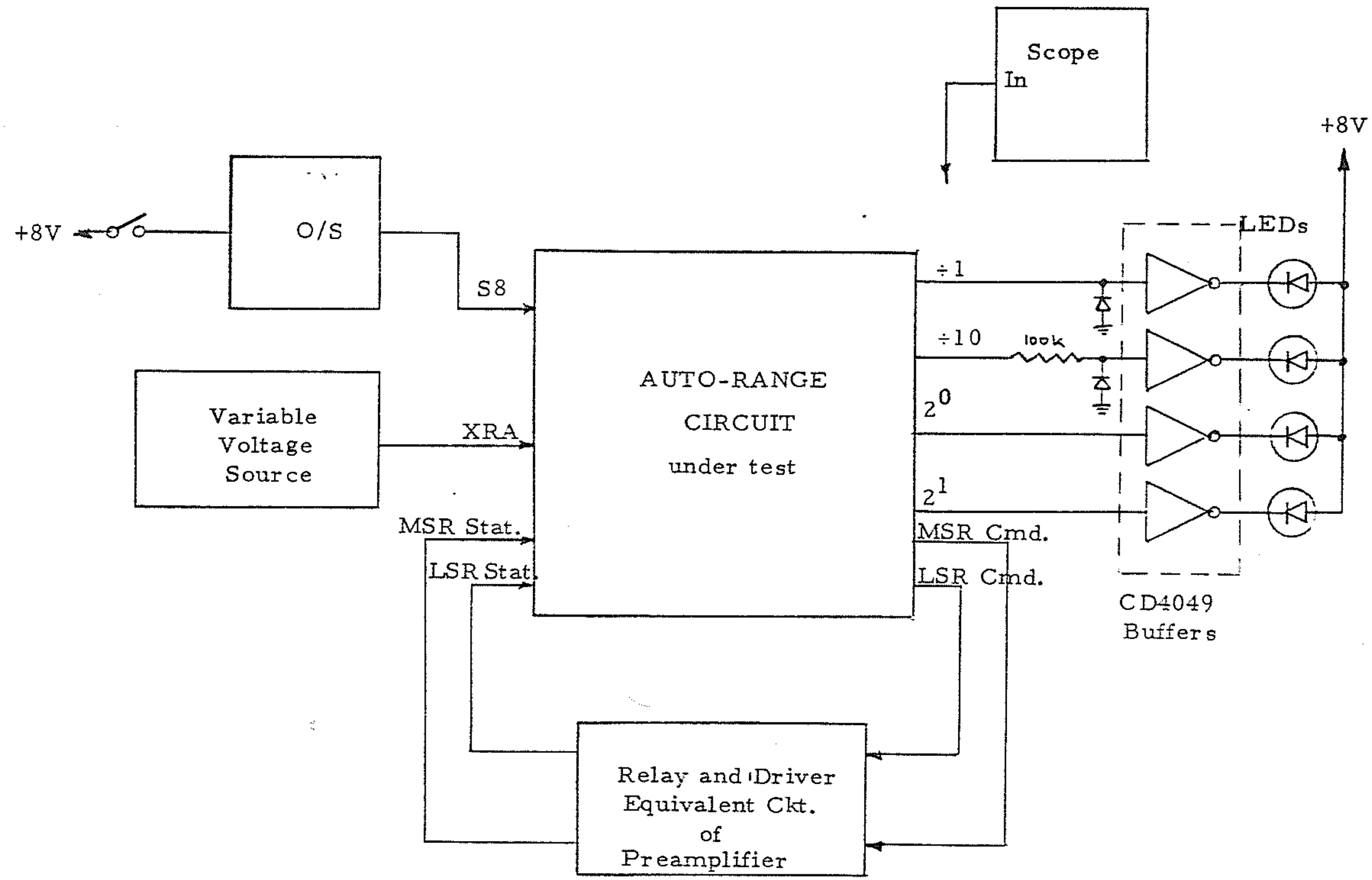
SUMMARY OF D-H PREAMP DC CALIBRATION

* MEASUREMENTS MADE AT +25, +4Ø, +55, Ø AND -25°C
* AVERAGE DELTA OF OUTPUT OFFSET FROM +25 TO +4Ø°C = 2.5 MV
FROM +25 TO -25°C = 2.7 MV
* AVERAGE TEMPCO FROM +25 TO +55°C: CH A -.24%/°C CH B -.18%/°C
* AVERAGE TEMPCO FROM +25 TO -25°C: CH A -.15%/°C CH B -.13%/°C

GOES I–M XRS

D–H PREAMP DC CALIBRATION

GOES	PREAMP IN (A)	CH A OUTPUT, RANGE MSR (V) +25C	+40C	+55C	0	−25C	PREAMP IN (A)	CH B OUTPUT, RANGE MSR (V) +25C	+40C	+55C	0	−25C
D	0	.000	-.002	-.009	+.003	+.003	0	.003	-.001	-.032	.002	.000
	$2x10^{-12}$	.445	.430	.404	.466	.484	$5x10^{-12}$	.396	.376	.328	.412	.426
	$5x10^{-12}$	1.102	1.066	1.014	1.154	1.193	$1.x10^{-11}$	.777	.746	.685	.819	.850
	$1x10^{-11}$	2.140	2.085	1.995	2.257	2.332	$3x10^{-11}$	2.300	2.220	2.104	2.428	2.522
	$2x10^{-11}$	4.120	4.020	3.860	4.332	4.468	$5x10^{-11}$	3.786	3.663	3.502	3.999	4.145
E	0	-.001	-.002	-.004	+.003	+.004	0	-.001	.000	+.003	-.002	-.002
	$2x10^{-12}$	+.485	+.466	+.433	+.506	+.530	$5x10^{-12}$	+.388	+.376	+.365	+.405	+.426
	$5x10^{-12}$	1.194	1.153	1.085	1.242	1.296	$1x10^{-11}$	.773	.749	.722	.808	.846
	$1x10^{-11}$	2.310	2.238	2.129	2.405	2.502	$3x10^{-11}$	2.292	2.220	2.143	2.393	2.504
	$2x10^{-11}$	4.400	4.268	4.100	4.573	4.737	$5x10^{-11}$	3.770	3.646	3.520	3.922	4.102
F	0	+.001	+.001	-.004	0.000	0.000	0	+.001	+.001	-.002	0.000	+.002
	$2x10^{-12}$	.525	.505	.496	.553	.562	$5x10^{-12}$	.389	.379	.359	.409	.416
	$5x10^{-12}$	1.285	1.238	1.160	1.351	1.369	$1x10^{-11}$	.773	.753	.717	.810	.825
	$1x10^{-11}$	2.439	2.358	2.228	2.563	2.593	$3x10^{-11}$	2.295	2.236	2.146	2.400	2.442
	$2x10^{-11}$	4.506	4.370	4.170	4.700	4.762	$5x10^{-11}$	3.776	3.680	3.543	3.942	4.010
G	0	+.0015	+.010	+.040	+.001	-.003	0	+.0012	+.005	+.026	-.003	-.011
	$2x10^{-12}$	+.518	+.512	+.520	+.542	+.558	$5x10^{-12}$	+.457	+.453	+.450	+.457	+.462
	$5x10^{-12}$	+1.295	1.277	1.220	1.340	1.381	$1x10^{-11}$	+.884	+.878	+.868	+.904	+.917
	$1x10^{-11}$	2.478	2.423	2.336	2.598	2.675	$3x10^{-11}$	2.545	2.522	+2.463	2.603	2.646
	$2x10^{-11}$	4.723	4.620	4.446	4.952	5.089	$5x10^{-11}$	4.093	4.048	3.960	4.173	4.245
H	0	+.001	.000	+.002	.000	+.001	0	+.001	+.001	+.006	0.000	+.002
	$2x10^{-12}$	.504	+.490	+.472	+.528	+.540	$5x10^{-12}$	+.443	+.435	+.430	+.453	+.464
	$5x10^{-12}$	1.256	1.219	1.175	1.322	1.342	$1x10^{-11}$	+.879	+.865	+.850	+.900	+.922
	$1x10^{-11}$	2.454	2.383	2.305	2.558	2.623	$3x10^{-11}$	2.542	2.502	2.456	2.600	2.653
	$2x10^{-11}$	4.702	4.575	4.426	4.885	5.015	$5x10^{-11}$	4.076	4.013	3.948	4.215	4.214



TEST SET-UP FOR AUTO-RANGE CIRCUIT TESTS

GOES I-M

SUMMARY OF D, E & F AUTO-RANGE BB TEST DATA

* CIRCUIT PERFORMANCE MEASURED -5Ø, -25, Ø, +5Ø, +75 AND +1ØØOC.
* STABILITY OF THE UPPER TRIP POINT IS ± .Ø5% AND THE HYSTERISIS IS STABLE TO ± .5%.
* STABILITY OF THE LOWER TRIP POINT IS ± .3% AND THE HYSTERISIS IS STABLE TO ± 1%.
* IN DATA MODE, VERIFIED PROPER RANGING SEQUENCE FOR RANGE SIGNAL INPUTS OF 5.1V AND .8V, RESPECTIVELY.
* IN CAL MODE THE RANGE SIGNAL REQUIRED TO TRIP THE UPPER AND LOWER THRESHOLD DETECTORS IS STABLE WITHIN ± 8% FOR THE FORCED AS WELL AS THE INHIBITED CONDITION.
* VERIFIED PROPER RANGE BIT STATUS (2 BITS) WITH RESPECT TO ACTUAL RANGE COMMANDS.
* VERIFIED PULSE WIDTH OF MSR AND LSR COMMANDS TO BE APPROXIMATELY 6 MS.

D,E,F AUTO-RANGE BB TEMPERATURE TEST

DISCRIMINATOR TRIP VOLTAGES AND HYSTERISIS

TEMP. OC	+25	0	-25	-50	+50	+75	+100	MIN	MAX	Δ
UTP = 1	4.925	4.930	4.928	4.926	4.929	4.930	4.925	4.925	4.930	.005
UTP = 0	4.697	4.701	4.700	4.698	4.700	4.700	4.700	4.697	4.701	.004
HYSTERISIS	.228	.229	.228	.228	.229	.230	.225	.225	.230	.005
LTP = 1	.904	.905	.902	.903	.905	.906	.908	.902	.908	.006
LTP = 0	1.018	1.020	1.018	1.018	1.021	1.022	1.023	1.018	1.023	.005
HYSTERISIS	.114	.115	.116	.115	.116	.116	.115	.114	.116	.002
UTP, FORCE	-.848	-.815	-.804	-.773	-.877	-.905	-.930	-.773	-.930	.157
UTP, INH.	+6.313	+6.299	+6.250	+6.213	+6.348	+6.368	+6.378	+6.213	+6.378.	165
LTP, FORCE	+1.452	+1.444	+1.435	+1.423	+1.452	+1.446	+1.436	+1.423	+1.452	.029
LTP, INH.	-.969	-.950	-.945	-.930	-.979	-.989	-1.002	-.930	+1.002	.072

GOES I-M

SUMMARY OF D, E, F EM MAGNET TEST AND ANALYSIS

* MAGNETIC FIELD PROPERTIES MEASURED ALONG TELESCOPE AXIS 3.78 KG-CM (SEE TABLE 2.1, XRS 3.3-1)
* CALCULATED DISPLACEMENT AND BENDING ANGLES FOR ELECTRONS OF .5 TO 10 MEV (SEE TABLE 3.1, XRS 3.3-4)
* MEASURED ION CHAMBER RESPONSES TO BETA SOURCES (SEE TABLE 3.7, XRS 3.3-4)
* ELECTRON SHIELDING EFFECTIVENESS (SEE TABLE 3.8, XRS 3.3-5)

PANA-GOESX-CR2

XRS 3.3-1

GOES D, E, F MAGNET DESIGN REPORT
X-RAY SENSOR

The Design and Electron Shielding Effectiveness Measurement for the Engineering Model X-Ray Telescope and Magnet Assembly

P.O. #08-779412-LY5

November 6, 1978

Prepared for

Hughes Aircraft Company
P.O. Box 92919
Los Angeles, CA 90009

by

PANAMETRICS, INC.
221 Crescent Street
Waltham, MA 02154

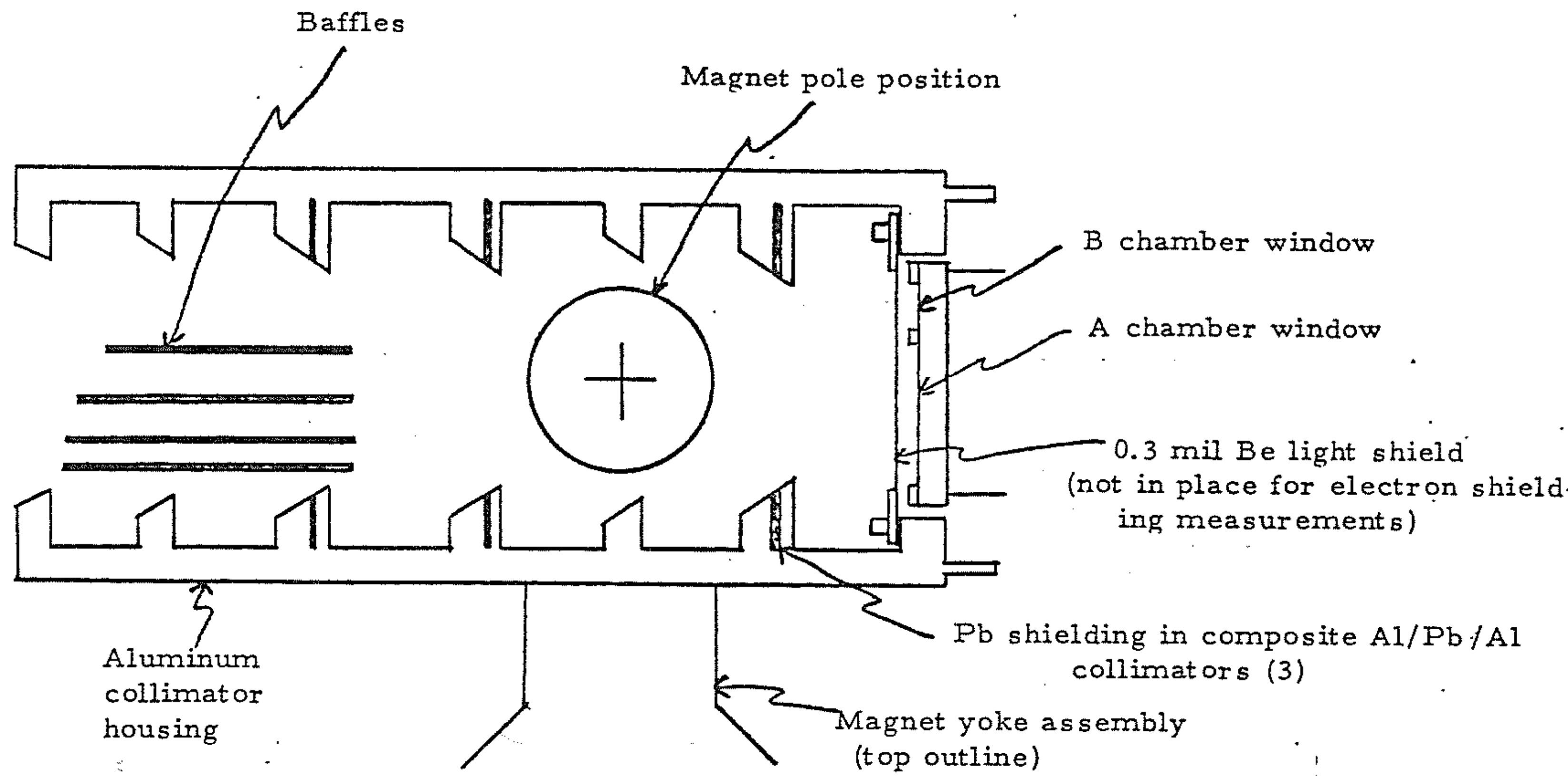


Fig. 3.2. Design of Aluminum Collimator Housing Used for Tests of Electron Shielding Effectiveness of Final Magnet Design.

Table 2.1

Magnetic Field Properties of the Panametrics and Keithley Engineering Model Magnet Assemblies

Distance along telescope axis from magnet pole axis (in/cm)	Panametrics EM Magnet Assembly (fields in G)		Keithley EM Magnet Assembly (fields in G)	
	Centerline Value	Average over ± 1/4 inch*	Centerline Value	Average over ± 1/4 inch*
-3.0/-7.62	12	8	68	60
-2.5/-6.35	26	17	101	88
-2.0/-5.08	58	37	152	133
-1.5/-3.81	135	84	232	208
-1.0/-2.54	312	310	346	346
-0.5/-1.27	628	656	475	480
0.0/0.00	826	888	539	551
+0.5/+1.27	628	656	475	480
+1.0/+2.54	312	310	346	346
+1.5/+3.81	135	84	232	208
Shielding effectiveness for -1.75 to +1.75 inches (kG-cm)	3.78	3.79	3.36	3.33

*Average is over ± 1 inch for ±1.5, -2.0, -2.5, and -3.0 inches.

Table 3.1
Calculated Displacements and Bending Angles for Electrons in the Engineering Model Magnet Assemblies

Electron Energy (MeV)	Panametrics EM: In baffles	Panametrics EM: From baffles to ion chamber	Keithley EM: In baffles	Keithley EM: From baffles to ion chamber
0.5	0.05/2.4	____*	0.22/8.1	____*
1.0	0.03/1.5	4.80/53	0.14/4.9	3.80/45
1.5	0.02/1.1	2.95/36	0.10/3.6	2.51/31
2.0	0.02/0.9	2.21/28	0.08/2.9	1.92/24
2.5	0.02/0.7	1.79/23	0.07/2.4	1.56/20
3.0	0.01/0.6	1.51/19	0.06/2.0	1.32/17
4.0	0.01/0.5	1.15/15	0.04/1.6	1.02/13
5.0	0.01/0.4	0.93/12	0.04/1.3	-.83/11
10.0	0.00/0.2	0.48/6	0.02/0.7	0.43/6

Listed are displacement (cm)/bending angle (deg) for Panametrics EM and Keithley EM.

*For this energy the electrons bend 90° before reaching the ion chamber.

Table 3.7
Measured Ion Chamber Responses to Sr-Y-90 and Ru-Rh-106 Beta Sources

Condition		Chamber A: Measured Current (A)	Chamber A: (Measured/Calculated)	Chamber B: Measured Current (A)	Chamber B: (Measured/Calculated)
No magnets					
Panametrics EM	Sr-Y-90	7.03×10^{-10}	0.62	3.17×10^{-10}	1.03
	Ru-Rh-106	1.99×10^{-10}	0.46	8.07×10^{-11}	0.69
Keithley EM	Sr-Y-90	7.51×10^{-10}	0.66	3.46×10^{-10}	1.12
	Ru-Rh-106	2.14×10^{-10}	0.50	8.68×10^{-11}	0.74
Magnets					
Panametrics EM	Sr-Y-90	7.27×10^{-11}	12.2	4.05×10^{-11}	0.70
	Ru-Rh-106	2.96×10^{-11}	0.89	1.67×10^{-11}	0.20
Keithley EM	Sr-Y-90	6.97×10^{-11}	3.92	5.20×10^{-11}	0.44
	Ru-Rh-106	3.02×10^{-11}	0.54	2.31×10^{-11}	0.21

Table 3.8

Comparison of Panametrics EM and Keithley EM Electron Shielding Effectiveness

Condition	Panametrics EM Response Ratio (Mags/no mags)	Keithley EM Response Ratio (Mags/no mags)	(Panametrics Ratio / Keithley Ratio)
Chamber A			
Sr-Y-90	0.013	0.093	1.11
Ru-Rh-106	0.149	0.141	1.06
Chamber B			
Sr-Y-90	0.128	0.150	0.85
Ru-Rh-106	0.207	0.266	0.78
		Average =	0.95

GOES I-M XRS

GOES D-H ANALYSIS

XRS 3.4.1-1

GOES XRS

PARTS APPLICATION DERATING AND STRESS ANALYSIS

Prepared for

HUGHES AIRCRAFT COMPANY
P.O. Box 92919
Los Angeles, California 90009

In accordance with P.O. No. 08-871102-LBP

SCDRL Line Item No. 27

by

PANAMETRICS, INC.
221 Crescent Street
Waltham, MA 02254

Prepared by J.L. Hunerwadel Date 4-29-83

Approved by B S [illegible] Date 4-29-83

John [illegible] Date 5/3/83

Date

Table 2.1

GOES XRS SUBSYSTEM - ITEMS

Item Number	Description
1	Preamplifier Input Board
2	Preamplifier Sideboard "A"
3	Preamplifier Sideboard "B"
4	Post, Null and WB Amplifiers
5	Auot Range Logic
6	Timing Logic
7	In-Flight Calibrator (IFC)
8	DC/DC Converter, Mother Board
9	DC/DC Converter, Daughter Board
10	XRS Telescope Assembly
11	DPU Assembly

Table 2.2

Assumptions - General

1) The case temperature of all components is equal to the maximum specified ambient operating temperature (+35°C).

2) The power or current rating of components is derated for +35°C ambient, where applicable (some components are rated up to 70°C ambient). For integrated circuits, transistors and diodes the specified θ_{J-A} was used.

3) Actual junction temperatures are calculated for +35°C ambient using worst case device power dissipation and θ_{J-A}.

4) Command and control signal pulses from the spacecraft or from subsystem circuits are treated as d.c. levels of the max "1" or "0" state of that signal pulse, whichever results in a worst case analysis of a particular parameter.

5) For Set At Test (SAT) components the typical value according to schematic is used, except if the range of possible SAT values may require parts of different ratings (capacitors, for example).

Table 2.3

Additional Assumptions - Preamplifier Input Board (Item 1)

1) Quiescent operating conditions - derated parameters not appreciably affected by signal levels due to low duty cycle (≈ 10%) and low output loading.

2) Relays (RY201, 301) are energized once per minute - actual duty cycle is much less.

Table 2.4

Additional Assumptions - Preamplifier Sideboards "A" & "B" (Item 2 and 3)

1) Quiescent operating conditions - derated parameters not appreciably affected by signal levels due to low duty cycle (≈10%) and low output loading.

Table 2.5

Additional Assumptions - Post, Null and WB Amplifiers (Item 4)

1) Maximum input and output signal range conditions for Post and Null amplifiers and associated components.

2) Quiescent operating conditions for WB amplifier - derated parameters not appreciably affected by signal levels due to low duty cycle (≈10%) and low output loading.

3) FET switches considered ON or OFF in accordance with internally generated timing signals.

Table 2.6

Additional Assumptions - Auto Range Logic (Item 5)

1) Analog inputs of threshold discriminators are considered at max high or low d.c. level, whichever results in worst case analysis.

2) Quiescent operating conditions for all C-MOS IC's - max. input frequency is < 2 HZ and therefore does not contribute to power consumption.

Table 2.7

Additional Assumptions - Timing Logic (Item 6)

1) Quiescent operating conditions for all IC's (C-MOS) except as noted in 2) below - maximum input frequency is < 2 Hz and therefore does not contribute to power consumption.

2) 3.4 kHz input frequency for IC 1, IC 2 and IC 10 - this is specified clock frequency from spacecraft.

3) Input t_r and t_f < 100 ns at f = 1 kHz for IC 3, 9 and 11 - dynamic power depends on t_r, t_f and f. Actual f = 1.7 kHz for 1/6 of IC 3 and < 1 kHz for remaining IC's.

Table 2.8

Additional Assumptions - In-Flight Calibrator (Item 7)

1) Worst case, continuous "On" conditions for all IC's, transistors and diodes - actual conditions are max 13% duty cycle pulses or ramp signals.

Table 2.9

Additional Assumptions - DC/DC Converter, Mother Board (Item 8)

1) Worst case steady state buss voltage is 30 V including ripple.

2) The 0 to 40 V buss transient is used to calculate the voltage stress ratio of all components directly or indirectly affected by that transient. The actual power stress is not affected by the 100 us transient, since thermal time constants of components are much larger. The X-Ray ON/OFF relay circuit is not affected by the transient since the relay supply voltage is derived from LP filter.

3) The pass transistors (Q1101, 1106) in the constant current regulator and zener diode (D1114) are heat sunk to the DPU chassis. The junction temperatures of the transistors are calculated using θ_{J-C}, assuming a case temperature of +35°C. The junction temperature of the zener is calculated using θ_{J-A} (no data for θ_{J-C} available) resulting in an overestimate of junction temperature.

Table 2.10

Additional Assumptions - DC/DC Converter, Daughter Board (Item 9)

1) Supply and input voltages, as well as output currents, are within limits per test procedure PANA-RTP-13.

2) No transients are present - voltage and current preregulated on mother board.

Table 3.1

Deviations From HAC Derating Policy For Subcontractors No. 303

Item Number	Reference Designation	Deviation
2	C203, C208	Voltage stress ratio < .25
3	C303, C308	Voltage stress ratio < .25
4	C614, C615, C616 C714, C715, C716	Votlage stress ratio < .25 and Series Resistance < 3 ohms/V
4	C406, C506 C601, C701	Voltage stress raito < .25
5	C812, C814	Voltage stress ratio < .25 and Series Resistance < 3 ohms/V
6	C1, C2	Voltage stress ratio < .25
7	C1008, C1010	Voltage stress ratio < .25 and Series Resistance < 3 ohms/V
7	C1009	Voltage stress ratio < .25
8	C1102	Voltage stress ratio < .25
8	C1109	Voltage stress ratio < .25 and Series Resistance < 3 ohms/V
8	C1110, C1111	Series Resistance < 3 ohms/V
8	Q1108, Q1109	Voltage stress raio > .71
9	C1114, C115, C117	Voltage stress ratio < .25 and Series Resistance < 3 ohms/V

PARTS STRESS ANALYSIS

Item Preamplifier Input Bd.
Schematic D-4337 Rev. C, D-4510 Rev -
Parts List PL- 4485 Rev C
Assembly C-4485C Rev A

Program GOES G+H XRS
Date 3/23/83
Sheet 1 of 2

Part or Drawing Number	Reference Designation	Check Applicable Block V	I	Pwr	Other	Rated	Actual	Stress Ratio	Temperature (°c) Rated Min	Max	Act. op.
JANTX 2N930	Q201, Q301	VEEO				6.0V	10mV	.002	-55	+150	+35
Note: Emitter + Base of 2N930 used only			I_b			—	$1\times10^{-14}A$	—			
PANA RSP-9	Q202, Sidelor 2	V				35V	8	.228	-50	+100	+35
			V			50mA	.140 ma	.003	"	"	"
				V		100mW	1.12mW	.011	"	"	"
					Tj	125°C	36°C	—	"	"	"
PANA RSP-9	Q302 Sidelor 2	V				35 V	8 V	.228	-50	+100	+35
			V			50 mA	.140 mA	.003	"	"	"
				V		100mW	1.12 mW	.011	"	"	"
					Tj	125°C	36°C	—	"	"	"
M39016/28-016P	RY201, 301		V			500mA	.103 mA	0	-65	+125	+35
					Temp.	+125°C	35°C	—	"	"	"
					# of operat.	10×10^6	3.676×10^6 w.c.	.368	"	"	"
M39003/02-0209	C209, 309	V				35V	16V	.457	-55	+125	+35
M23269/01-7091	C201, 301	V				100V	5V peak	.05	-55	+125	+35
M23269/01-7029	C302	V				100V	0.5V peak	.005	-55	+125	+35
M23269/01-7010	C202	V				100V	1.2V peak	.012	-55	+125	+35
M39014/02-1350	C205, C305	V				100V	8V	.080	-55	+125	+35
RNC55H5902FS	R206, 207, 306, 307			V		100mW	.285 mW	.003	-55	+125	+35
RNC55H9531FS	R208, R308			V		100 mW	.051 mW	0	-55	+125	+35
RNC55H1002FS	R218, R318			V		100mW	.049 mW	0	-55	+125	+35

PARTS STRESS ANALYSIS

Item: Preamplifier Input Bd.
Schematic: D-4337 Rev C
Parts List: PL-4485 Rev C
Assembly: C-4485 Rev A

Program: GOES G+H XRS
Date: 3/23/83
Sheet 2 of 2

Part or Drawing Number	Reference Designation	Critical Stress Parameter: Check Applicable Block V	I	Pwr	Other	Rated	Actual	Stress Ratio	Temperature (°c) Rated Min	Rated Max	Act. op.
RNC55HxxxxFS	R217, R317			V		100 mW	.012 mW	0	-55	+125	+35
RNC55HxxxxFS	R210, R310			V		100 mW	0 mW	0	-55	+125	+35
RCR05G104JS	R205, R305			V		125 mW	0 mW	0	-55	+130	+35
RCR05G243JS	R211, R311			V		125 mW	.454 mW	.004	-55	+130	+35
RCR05G753JS	R225, R325			V		125 mW	3.413 mW	.027	-55	+130	+35
RCR05GxxxJS	R234, R334			V		125 mW	0	0	-55	+130	+35
PANA RSP II	R202, R213	V				60 V	7V max	.117	-200	+150	+35
"	"				$P=\frac{E^2}{R}$	1.8×10^{-8} W	2.5×10^{-10} W	.014	"	"	"
PANA RSP II	R302, R313	V				60 V	7V max	.117	-200	+150	+35
"	"				$P=\frac{E^2}{R}$	5.1×10^{-3} W	7×10^{-10} W	.014	"	"	"
PANA RSP II	R214	V				60 V	7V max	.117	-200	+150	+35
"	"				$P=\frac{E^2}{R}$	1.8×10^{-6} W	2.5×10^{-5} W	.014	"	"	"
PANA RSP II	R314	V				60 V	7V max	.117	-200	+150	+35
					$P=\frac{E^2}{R}$	5.1×10^{-6} W	7×10^{-8} W	.014	"	"	"

PARTS STRESS ANALYSIS

Item: Preamp. Sideboard "A"
Schematic: D-4337 Rev. C, D-4510 Rev -
Parts List: PL-4524 Rev C
Assembly: C-4524 Rev A

Program: GOES G+H XRS
Date: 3/30/83
Sheet: 1 of 2

Part or Drawing Number	Reference Designation	Critical Stress Parameter							Temperature (°c)		
		Check Applicable Block				Rated	Actual	Stress Ratio	Rated		Act. op.
		V	I	Pwr	Other				Min	Max	
908961-4	IC 201	V+				+5V to +20V	+8V	—	-55	+125	+35
		V-				-5V to -20V	-8V	—			
		VI				± 8V	< -4V	—			
		Vdi				± 1V	< ±.14V	—			
				V		500 mW	10 mW max	.036			
					Tj	150°C	38°C	—			
JANTXV 2N2907A	Q204, Q205	V				60V	8V	.133	-55	+150	+35
			V			600mA	.017mA	0			
				V		377 mW	.003mW	0			
					Tj	200°C	35°C	—			
JANTXV 2N2907A	Q206, Q207	V				60V	16V	.266	-55	+150	+35
			V			600 mA	32mA	.053			
				V		377 mW	6.4mW	.017			
					Tj	200°C	38°C	—			
M39003/02-0209	C203; C208	V				35V	8V	.23	-55	+125	+35
M83421/01-4173S	C212	V				200V	75V	.375	-65	+100	+35
M39014/02-1339	C206, C207	V				200V	8V	.040	-55	+125	+35
M39014/02-1339	C210	V				200V	5V pk	.025	-55	+125	+35
M39014/02-1339	C211	V				200V	7V max	.035	-55	+125	+35
M39014/02-1350	C211	V				100V	7V max	.070	-55	+125	+35
M39014/01-1340	C204	V				200V	8V max	.04	-55	+125	+35
RNC55H7501FS	R204			V		100mW	.012mW	0	-55	+125	+35

PARTS STRESS ANALYSIS

Item Preamp. Sideboard "A"
Schematic D-4337 Rev C
Parts List PL-4524 Rev C
Assembly C-4524 Rev. A

Program GOES G+H XRS
Date 3/30/29
Sheet 2 of 2

Part or Drawing Number	Reference Designation	Critical Stress Parameter: Check Applicable Block							Temperature (°c): Rated		
		V	I	Pwr	Other	Rated	Actual	Stress Ratio	Min	Max	Act. op.
RNC55H 2492FS	R203			V		100 mW	.040 mW	0	-55	+125	+35
RNC55H 8872FS	R201			V		100mW	.154 mW	.001	"	"	"
RCR05G 104JS	R222, R224			V		125mW	.005 mW	0	-55	+130	+35
RCR05G 104JS	R228, R230			V		"	.005mW	0	"	"	"
RCR05G 104JS	R233			V		"	0	0	"	"	"
RCR05G 102JS	R220, R212			V		"	.02 mW	0	"	"	"
RCR05G 911JS	R221			V		"	.14 mW	.001	"	"	"
RCR05G 124JS	R227, R231			V		"	.53 mW	.004	"	"	"
RCR05G 472JS	R223, R226			V		"	.77mW	.006	"	"	"
RCR05G 755JS	R215			V		"	.001mW	0	"	"	"
RCR05G 303JS	R216			V		"	.01 mW	0	"	"	"
RCR05G 273JS	R232			V		"	.001 mW	0	"	"	"
RCR05G 334JS	R229			V		"	.12 mW	.001	"	"	"
RCR05G 304JS	R209			V		"	.13 mW	.001	"	"	"
RCR05G 106JS	R219			V		"	0	0	"	"	"

PARTS STRESS ANALYSIS

Item: Preamp. Sideboard "B"
Schematic: D-4337 Rev. C, D-4510 Rev -
Parts List: PL-4525 Rev B
Assembly: C-4525 Rev -

Program: GOES G+H XRS
Date: 3/29/83
Sheet 1 of 2

Part or Drawing Number	Reference Designation	Critical Stress Parameter: Check Applicable Block				Rated	Actual	Stress Ratio	Temperature (°c): Rated		Act. op.
		V	I	Pwr	Other				Min	Max	
908961-4	IC 301	V^+				+5V to +20V	+8V	—	-55	+125	+35
"		V^-				-5V to -20V	-8V	—			
"		V_I				± 8V	< -4V	—			
"		V_{di}				± 1V	< ± .14V	—			
"				V		500 mW	10 mW max	.036			
					Tj	150°C	38°C	—			
JANTXV2N2907A	Q304, Q305	V				60 V	8 V	.133	-55	+150	+35
			V			600 mA	.017 mA	0			
				V		377 mW	.003 mW	0			
					Tj	200°C	35°C	—			
JANTXV2N2907A	Q306, Q307	V				60V	16 V	.266	-55	+150	+35
			V			600 mA	32 mA	.053			
				V		377 mW	6.4 mW	.017			
					Tj	200°C	38°C	—			
M39003/02-0209	C303, C308	V				35V	8V	.23	-55	+125	+35
M39014/02-1339	C306, C307	V				200V	8V	.04	-55	+125	+35
M39014/02-1350	C310	V				100V	5V pk	.05	-55	+125	+35
M39014/02-1339	C311	V				200V	7V max	.04	-55	+125	+35
M39014/02-1350	C311	V				100V	7V max	.07	-55	+125	+35
M39014/02-1418	C311	V				50V	7V max	.14	-55	+125	+35
M39014/01-1340	C304	V				200V	8V max	.04	-55	+125	+35
RNC55H1002FS	R301, R304			V		100 mW	.025 mW	0	-55	+125	+35

XRS 3.4.2-1

Goes G & H XRS

RELIABILITY REPORT

Prepared for

HUGHES AIRCRAFT COMPANY
P.O. Box 92919
Los Angeles, California 90009

In accordance with P.O. No. 08-871102-LBP

SCDRL Item 26 - Reliability Analysis
SCDRL Item 28 - Failure Mode Effects and Criticality Analysis
SCDRL Item 29 - Single Point Failure Analysis

by

PANAMETRICS, INC.
221 Crescent Street
Waltham, MA 02254

Prepared by [signature] Date 5/5/83

Approved by [signature] Date 5/5/83

J.L. [signature] 5/5/83

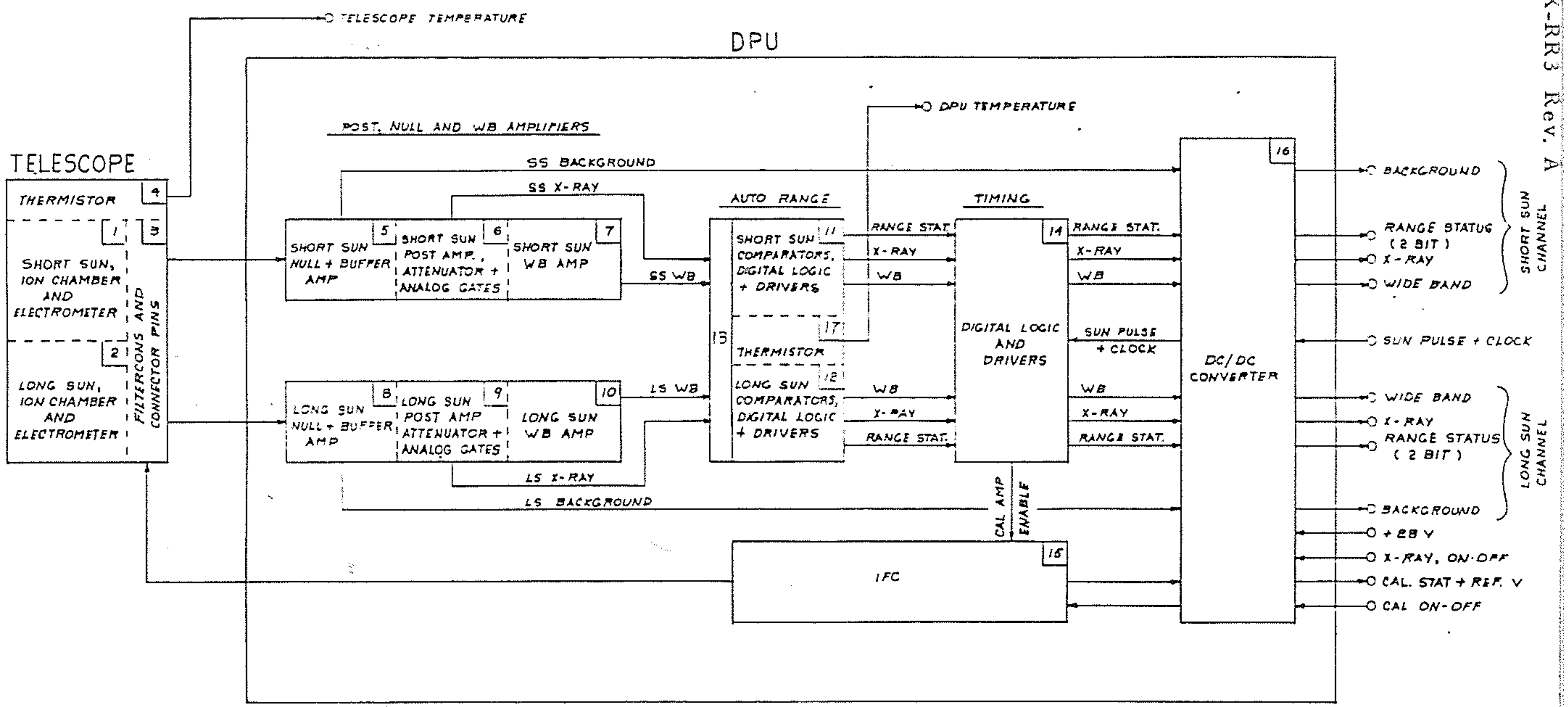


FIG. 2.1
GOES XRS
RELIABILITY BLOCK DIAGRAM

XRS 3.4.2-2

PREAMP-B SIDE BOARD
XRS 2 LONG SUN
INPUT DATA

Line	Part	for Formula= 1	A	B	C	D
5	M39014/02-1339 CKR06		.00074	1.000	.0300	1.1290
6	M39014/01-1340 CKR05		.00074	1.000	.0300	.6800
7	RNC55H <=100K		.00075	1.000	1.0000	.0300
8	RCR05 <=100K		.00026	1.000	1.0000	.0300
9	RCR05 1M TO 10M		.00026	1.000	1.6000	.0300
14	M23269/01-7091 100PF		.00003	1.000	.0300	1.9100
15	M23269/01-7029 OR 7016		.00003	1.000	.0300	.8600
16	M39014/02-1350 CKR06(.1MF)		.00074	1.000	.0300	1.4500
17	RNC55H <=100K		.00075	1.000	1.0000	.0300
18	RCR05 <=100K		.00026	1.000	1.0000	.0300
19	PANA RSP-11 HI-MEG RES		.00076	1.000	2.5000	.0300

Line	Part	for Formula= 2	A	B	C	D	E	F	G
2	JANTXV2N2907A		.0080	1.0000	1.5000	.1200	1.0000	.3130	1.0000
3	JANTXV2N2907A		.0100	1.0000	1.5000	.1200	1.0000	.3130	1.0000
10	JANTX2N930(AS A DIODE)		.0012	1.0000	.3000	1.0000	1.0000	.7000	1.0000

Line	Part	for Formula= 4	A	B	C	D	E
4	M39003/02-0209 CSR		.0059	1.0000	.0700	.0300	1.1300
11	MOSFET PANA RSP-9 (DUAL)		.0178	1.0000	1.5000	.2400	1.2000
13	M39003/02-0209 CAP		.0100	1.0000	.0700	.0300	1.1270

Line	Part	for Formula= 5	A	B	C	D	E
1	LM108A (908961-4)		1.0000	1.0000	.5600	.2000	29.0000

Line	Part	for Formula= 8	A	B	C	D	E	F	G	H	I	J	K
12	RELAY M39016/29-016P		.1000	3.0000	.1000	5.0000	.0054	35.000	377.000	10.400	.000	.800	2.000

Figure 2.2 Data Input Printout

PREAMP-B SIDE BOARD

XRS 2 LONG SUN

ANALYSIS REPORT

Line	Part	Qty	Formula	Panametrics Results	Panametrics Extension	Hughes Results	Hughes Extension	Factor
1	LM108A (908961-4)	1	5	.007375	.007375	.014750	.014750	2.00
2	JANTXV2N2907A	2	2	.000451	.000902	.000901	.001802	2.00
3	JANTXV2N2907A	2	2	.000563	.001126	.001127	.002254	2.00
4	M39003/02-0209 CSR	2	4	.000014	.000028	.000047	.000094	3.33
5	M39014/02-1339 CKR06	4	1	.000025	.000100	.000083	.000332	3.33
6	M39014/01-1340 CKR05	1	1	.000015	.000015	.000050	.000050	3.33
7	RNC55H <=100K	3	1	.000023	.000069	.000075	.000225	3.33
8	RCR05 <=100K	15	1	.000008	.000120	.000026	.000390	3.33
9	RCR05 1M TO 10M	2	1	.000012	.000024	.000042	.000084	3.33
10	JANTX2N930(AS A DIODE)	1	2	.000241	.000241	.000483	.000483	2.00
11	MOSFET PANA RSP-9 (DUAL)	1	4	.007690	.007690	.015379	.015379	2.00
12	RELAY M39016/29-016P	1	8	.000915	.000915	.002746	.002746	3.00
13	M39003/02-0209 CAP	1	4	.000024	.000024	.000078	.000078	3.33
14	M23269/01-7091 100PF	1	1	.000001	.000001	.000005	.000005	3.33
15	M23269/01-7029 OR 7016	1	1	.000001	.000001	.000002	.000002	3.33
16	M39014/02-1350 CKR06(.1MF)	1	1	.000032	.000032	.000107	.000107	3.33
17	RNC55H <=100K	6	1	.000023	.000138	.000075	.000450	3.33
18	RCR05 <=100K	4	1	.000008	.000032	.000026	.000104	3.33
19	PANA RSP-11 HI-MEG RES	2	1	.000057	.000114	.000190	.000380	3.33

	Panametrics	Hughes
Sub Unit Failure Rate	.018947	.039715 $/10^6$ Hours
Sub Unit Failure Rate	.001162	.002435 /7 Years
Sub Unit Reliability Factor	P= .998839	P= .997568

Figure 2.3 Reliability Analysis Printout

XRS 3.4.2-5

Table 2.1

Failure Rate Formulae

FORMULA NUMBER	EXPRESSION
1	$\lambda_p = \lambda_b (\pi_E \times \pi_R \times \pi_Q)$
2	$\lambda_p = \lambda_b (\pi_E \times \pi_A \times \pi_Q \times \pi_R \times \pi_{S2} \times \pi_C)$ where λ_b is a table look-up.
3	$\lambda_p = \lambda_b (\pi_E \times \pi_A \times \pi_Q \times \pi_R \times \pi_{S2} \times \pi_C)$ where $\lambda_b = Ae^{xy}$ $x = \left(\frac{NT}{273 + T + (\Delta T)S}\right)$ $y = \left(\frac{273 + T + (\Delta T)S}{T_\mu}\right)^P$
4	$\lambda_p = \lambda_b (\pi_E \times \pi_{SR} \times \pi_Q \times \pi_{CV})$
5	$\lambda_p = \pi_L \times \pi_Q (C_1 \pi_{T2} + C_2 \pi_E)$ where $C_1 = .00056T^{.763}$ $C_2 = .0026T^{.547}$ T = Number of Transistors
6	$\lambda_p = \pi_L \times \pi_Q (C_1 \pi_T + C_2 \pi_E) \pi_P$ where $C_1 = .00129G^{.677}$ $C_2 = .0038G^{.359}$ G = Number of Gates
8	$\lambda_p = \lambda_b (\pi_E \times \pi_C \times \pi_{CYC} \times \pi_F \times \pi_Q)$ where $\lambda_b = \lambda_T \times \pi_L$ $\lambda_T = Ae^{\left(\frac{T + 273}{NT}\right)^G}$ $\pi_L = e^{\left(\frac{S}{NS}\right)^H}$
10	$\lambda_p = \lambda_b (\pi_E \times \pi_Q)$ where $\lambda_b = Ae^x$ $x = \left(\frac{T_{HS} + 273}{N_T}\right)^G$

Note: Formulae 7 and 9 were not used.

Table 2.2

Computer Input Parameter Assignments

Formula	A	B	C	D	E	F	G	H	I	J	K	L	M
1	λ_b	π_E	π_R	π_Q									
2	λ_b	π_E	π_A	π_Q	π_R	π_{S2}	π_C						
3	π_E	π_A	π_Q	π_R	π_{S2}	π_C	A	N_T	T	ΔT	S	T_M	P
4	λ_b	π_E	π_{SR}	π_Q	π_{CV}								
5	π_L	π_Q	π_{T2}	π_E	T								
6	π_L	π_Q	π_T	π_E	π_P	G							
8	π_L	π_C	π_{CYC}	π_F	A	T	N_T	G	S	N_S	H	π_E	
10	π_E	π_Q	A	T_{HS}	N_T	G							

XRS 3.4.2-6

Table 2.3

Summary of XRS Subsystem Sub Unit Failure Rates and Reliabilities

Sub Unit[3]	Description	Failure Rate[1] PAN	Failure Rate[1] HAC	Reliabilities[2] PAN	Reliabilities[2] HAC
XRS-1	SS Ion Chamber and Electrometer	.018950	.039776	.998839	.997564
XRS-2	LS Ion Chamber and Electrometer	.018947	.039715	.998839	.997568
XRS-3	Filters and Connector Pins (common)	.014143	.014143	.999133	.999133
XRS-5	SS Null and Buffer Amplifier	.040837	.062965	.997499	.996146
XRS-6	SS Post Amp., Atten. + Analog Gates	.012457	.024891	.999236	.998475
XRS-7	SS WB Amplifier	.008056	.016054	.999506	.999016
XRS-8	LS Null and Buffer Amplifier	.040837	.062965	.997499	.996146
XRS-9	LS Post Amp., Atten. + Analog Gates	.012457	.024891	.999236	.998475
XRS-10	LS WB Amplifier	.008056	.016054	.999506	.999016
XRS-11	SS Auto Range Comp., Dig. Logic + Dr.	.051571	.098942	.996843	.993951
XRS-12	LS Auto Range Comp., Dig. Logic + Dr.	.051571	.098942	.996843	.993951
XRS-13	Auto Range Connector Pins (common)	.014018	.026518	.999141	.998375
XRS-14	Timing, Digital Logic + Drivers	.069023	.136179	.995777	.991684
XRS-15	In-Flight Calibrator (IFC)	.089291	.175254	.994540	.989311
XRS-16	DC/DC Converter	.281671	.370272	.982876	.977551

Notes: 1) Sum of individual part failure rates (failures per 10^6 Hours)
2) Probability of Sub Unit success for 7 year mission
3) Sub Unit XRS-4 is the telescope thermistor for which no reliability is calculated.

Table 2.4

Summary of XRS Subsystem Success Path Reliabilities

Operating Mode	Success Path	Sub Units[1] 1	2	3	5	6	7	8	9	10	11	12	13	14	15	16	Reliability[2] PAN	HAC
DATA	SS X-Ray	x		x	x	x					x		x	x		x	.969647	.953665
DATA	SS WB	x		x	x	x	x				x		x	x		x	.969168	.952726
DATA	SS Background	x		x	x											x	.978431	.970569
DATA	SS Range Stat										x		x	x		x	.974797	.961992
DATA	LS X-Ray		x	x				x	x			x	x	x		x	.969647	.953668
DATA	LS WB		x	x				x	x	x		x	x	x		x	.969168	.952730
DATA	LS Background		x	x				x								x	.978431	.970573
DATA	LS Range Stat											x	x	x		x	.974797	.961992
DATA	All Paths	x	x	x	x	x	x	x	x	x	x	x	x	x		x	.961363	.938660
CAL	SS X-Ray	x		x	x	x					x		x	x	x	x	.964353	.943471
CAL	SS Range Stat										x		x	x	x	x	.969475	.951709
CAL	LS X-Ray		x	x				x	x			x	x	x	x	x	.964353	.943475
CAL	LS Range Stat											x	x	x	x	x	.969475	.951709
CAL	All Circuits	x	x	x	x	x		x	x		x	x	x	x	x	x	.957059	.930457
ALL	All Data + Cal	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	.956114	.928627

Notes: 1) X denotes the Sub Unit (XRS-1 through -16) in a particular success path

2) Probability of path success for 7 year mission

Table 3.1

XRS Sub Unit Catastrophic Failure Effects

Sub Unit Identification		Primary Elements	Failure Effects
Telescope	-1	Short Sun Ion Chamber and Electrometer	Loss of Short Sun X-Ray, WB and Background Data
	-2	Long Sun Ion Chamber and Electrometer	Loss of Long Sun X-Ray, WB and Background Data
	-3	Telescope RF Filters and Connector Pins common to both Channels	Loss of Short and Long Sun X-Ray, WB and Background Data
	-4	Telescope Thermistor	Loss of Telescope Temperature Monitor
DPU	-5	Short Sun Null and Buffer Amplifiers	Loss of Short Sun Background, X-Ray and WB Data
	-6	Short Sun Post Amp., Attenuator and Analog Gates	Loss of Short Sun X-Ray and WB Data
	-7	Short Sun WB Amp	Loss of Long Sun WB Data
	-8	Long Sun Null and Buffer Amplifiers	Loss of Long Sun Background, X-Ray and WB Data
	-9	Long Sun Post Amp., Attenuator and Analog Gates	Loss of Long Sun X-Ray and WB Data
	-10	Long Sun WB Amp	Loss of Long Sun WB Data
	-11	Short Sun Auto Range Comparators, Digital Logic and Drivers	Loss of Short Sun X-Ray and WB Data. Loss of Short Sun Range status monitor
	-12	Long Sun Auto Range Comparators, Digital Logic and Drivers	Loss of Long Sun X-Ray and WB Data. Loss of Long Sun Range status monitor

Table 3.1 (continued)

XRS Sub Unit Catastrophic Failure Effects

Sub Unit Identification	Primary Elements	Failure Effects
-13	Auto Range, Common Connector Pins	Loss of Short and Long Sun X-Ray and WB Data. Loss of Short and Long Sun Range status monitor
-14	Timing Digital Logic and Drivers	Loss of Short and Long Sun X-Ray and Range Status Monitors. Loss of In-Flight Calibration Capability of both channels (Short and Long Sun). CAL Status and Ref. Voltage not affected
-15	In-Flight Calibration	Loss of In-Flight Calibration Capability of both channels (Short and Long Sun), Ref. Voltage and CAL status monitors. Short and Long Sun X-Ray, WB and Background Data not affected in Data Mode.
-16	DC/DC Converter	Loss of all data and Monitor Outputs
-17	DPU Thermistor	Loss of DPU Temperature Monitor

XRS 3.4.3-1

RADIATION REPORT

FOR

GOES D, E & F XRS SUBSYSTEM

P. O. No. 08-779412-LBG

July, 1980

Prepared for

Hughes Aircraft Company
P.O. Box 92919
Los Angeles, CA 90009

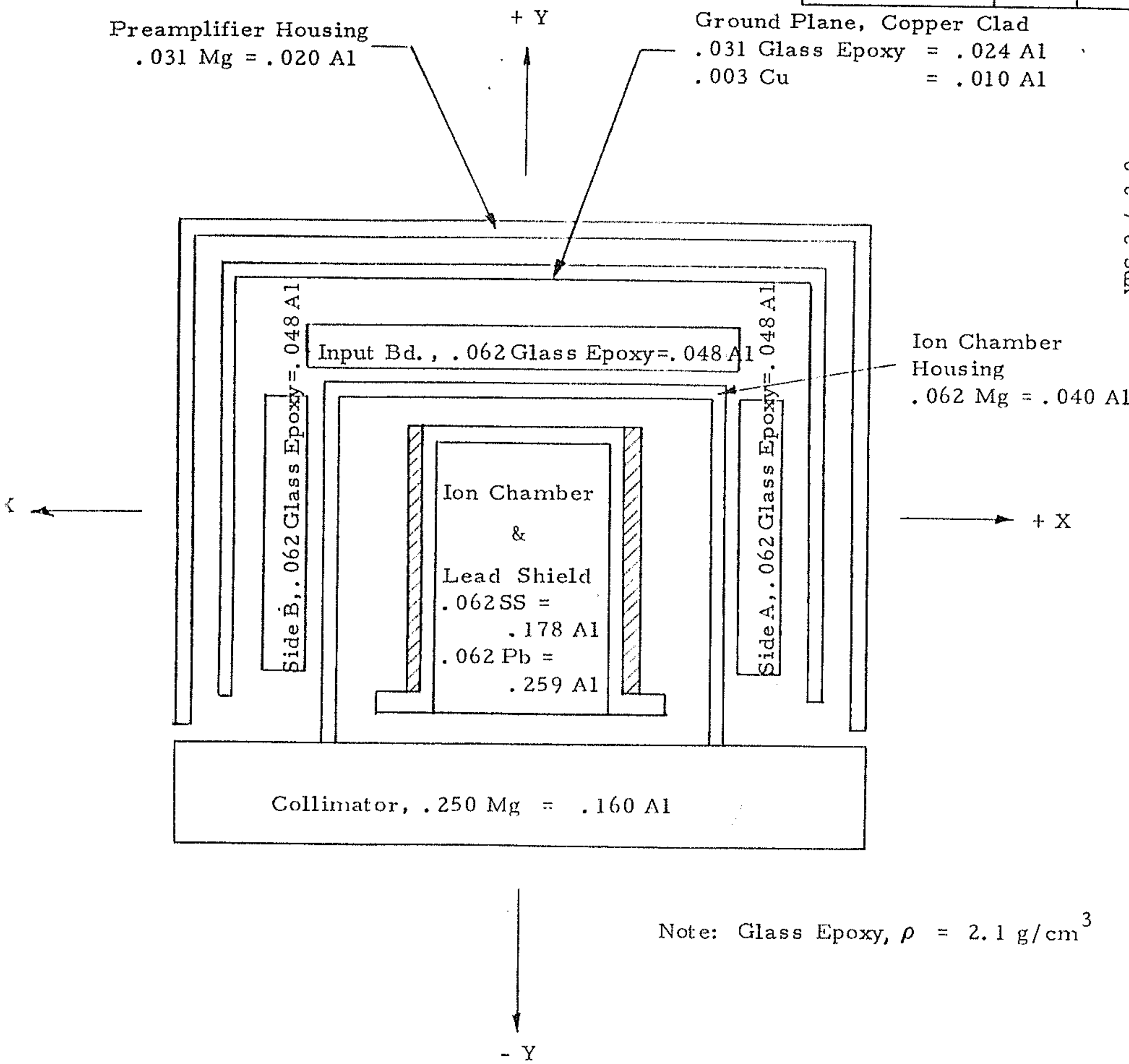
This report has been reviewed and found to meet the requirements of HAC Purchase Order No. 08-871102-LBP, SCDRL Line Item No. 19, "Radiatinn Assessment."

Reviewed by JM Date 3/23/83

R&QA 3/29/83

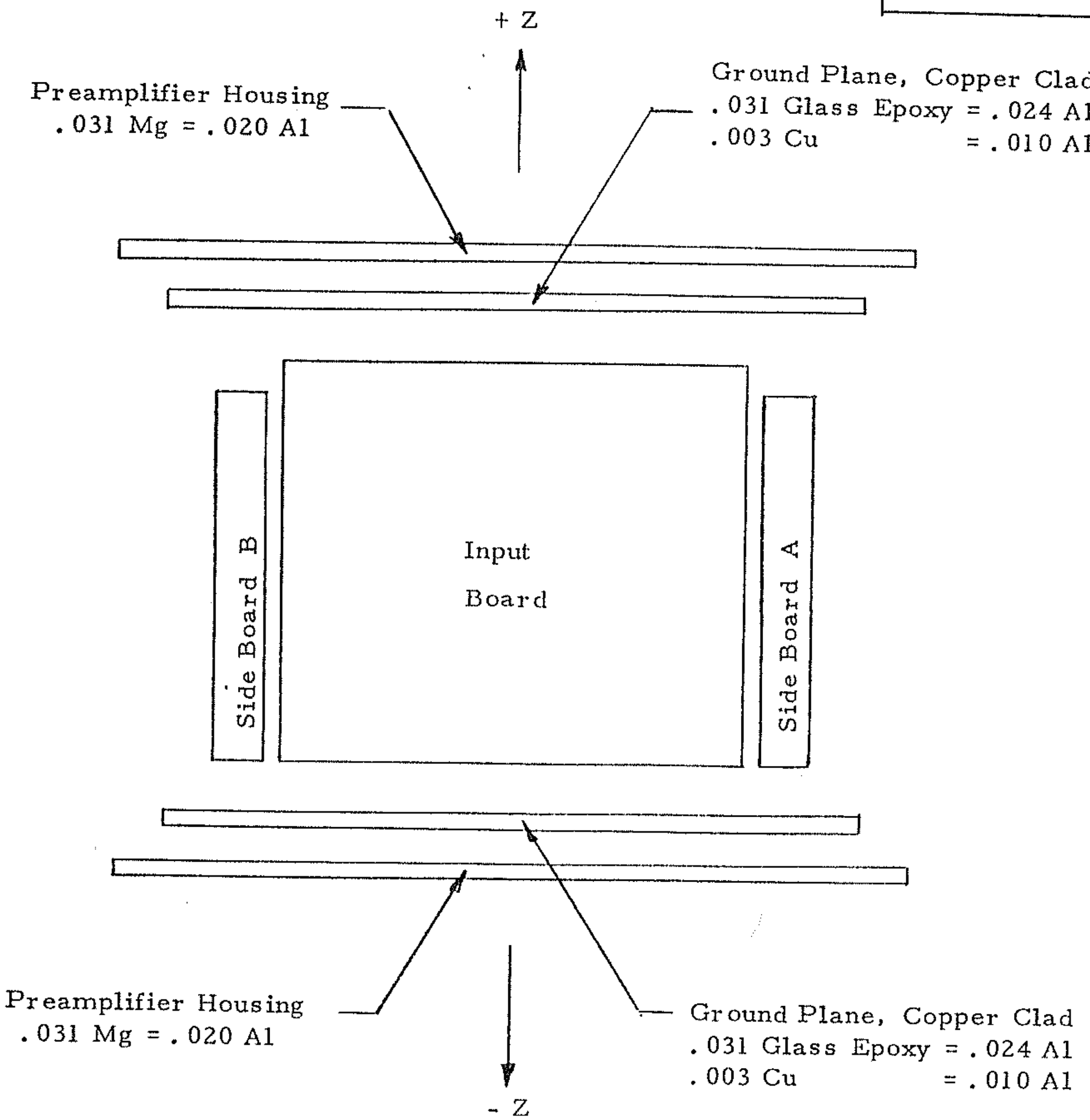
3/29/83

XRS 3.4.3-2



Note: Glass Epoxy, ρ = 2.1 g/cm^3

Figure 2.1 Diagram of Telescope P. C. Board Shielding in X and Y Axis by Box Walls and other Structural Materials



Note: Glass Epoxy, ρ = 2.1 g/cm^3

Figure 2. 2 Diagram of Telescope P. C. Board Shielding in Z Axis by Box Walls and Ground Plane

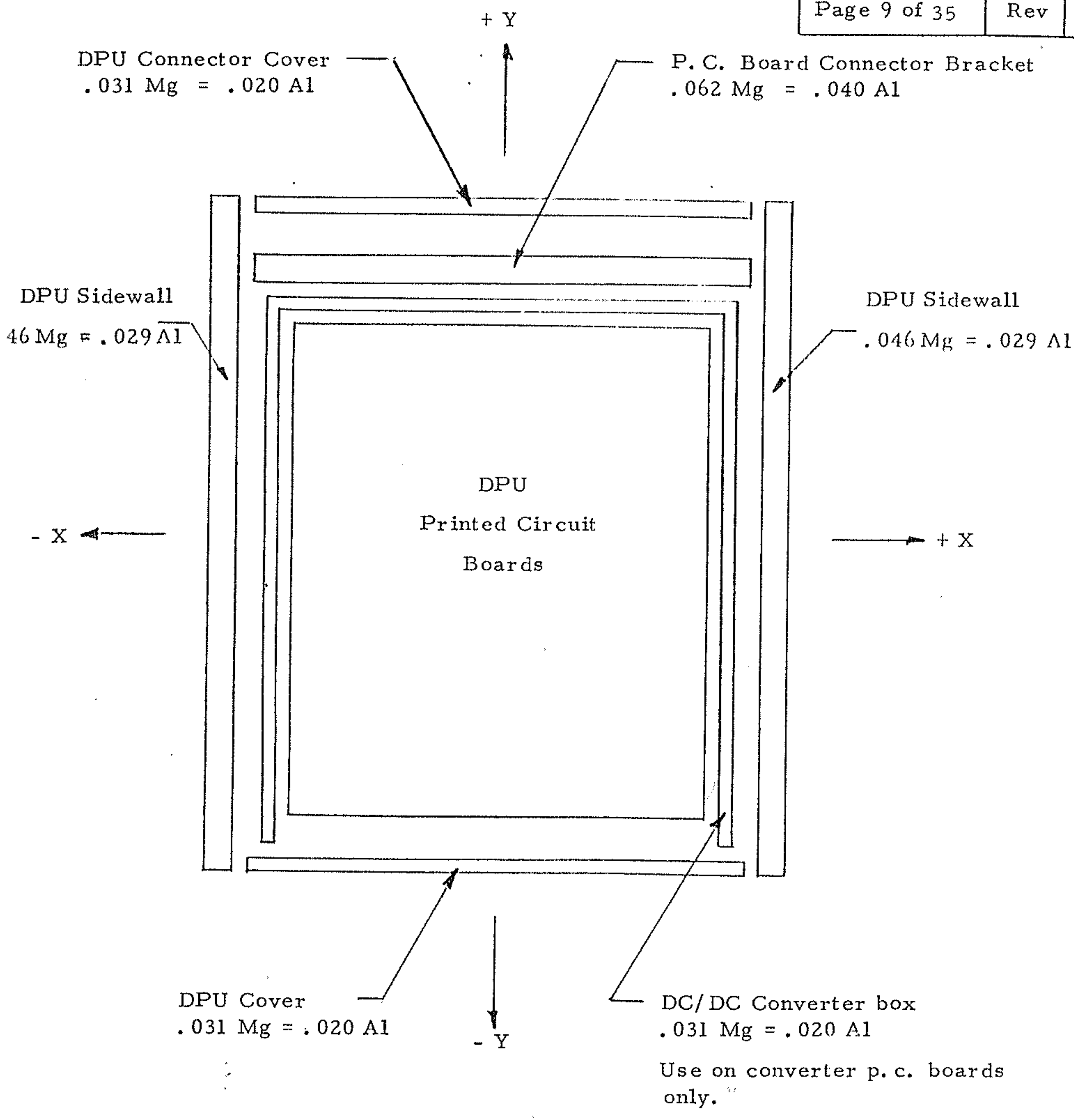
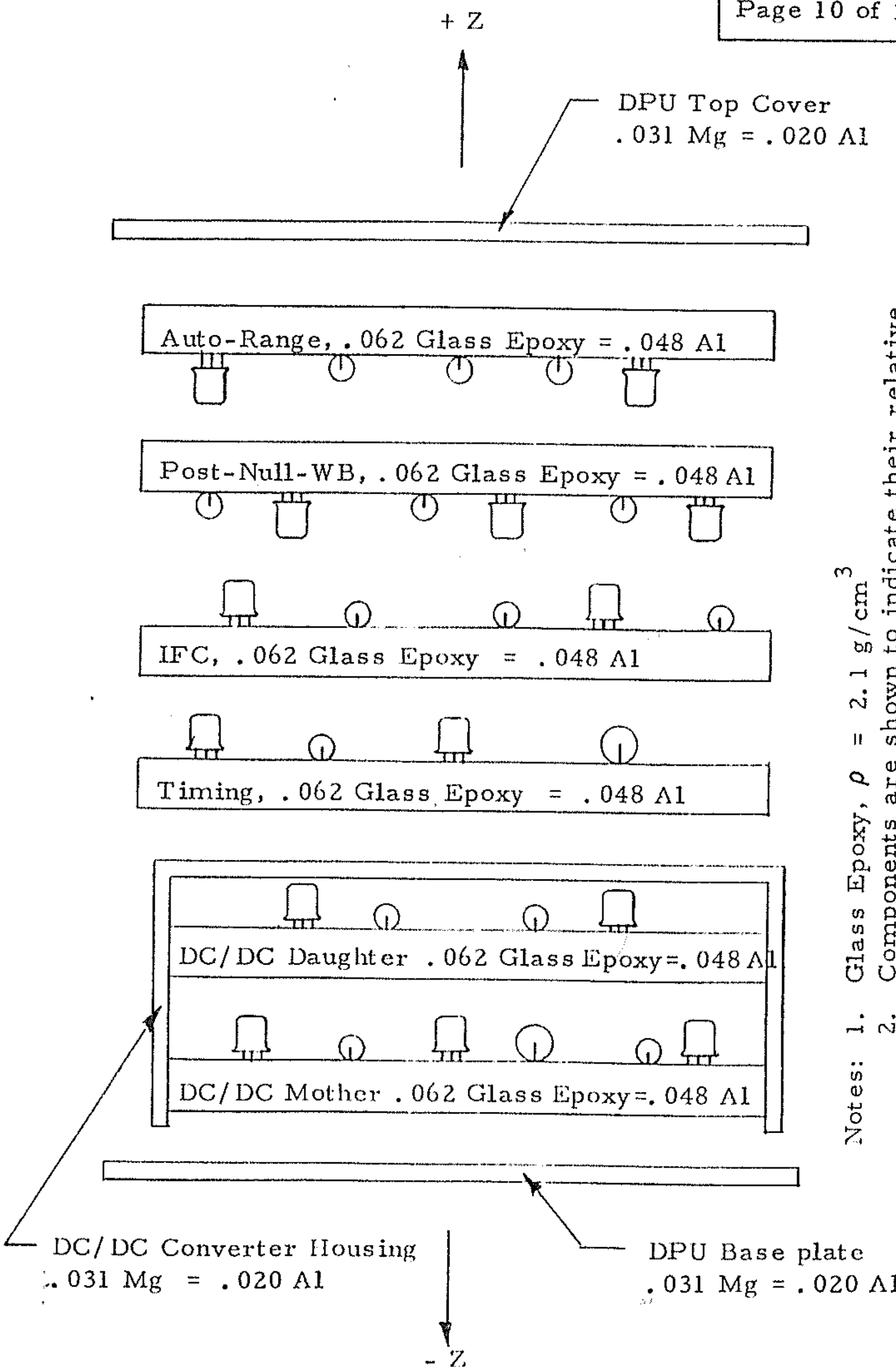


Figure 2.3 Diagram of DPU P. C. Board Shielding in X and Y Axis by Box Walls and Structural Material



Notes: 1. Glass Epoxy, $\rho = 2.1\ g/cm^3$
2. Components are shown to indicate their relative orientation to $\pm Z$ axis. They are <u>not</u> included in shielding thickness determination.

XRS 3.4.3-5

Figure 2.4 Diagram of DPU P. C. Board Shielding in Z Axis by Box Walls and Structural Material

TABLE 2.1

Telescope & DPU P. C. Board Shielding and Radiation Dose for +X Direction

Printed Circuit Board	Min. Shielding (1) (mil Al)	Avg. Shielding (2) (mil Al)	Total Shielding (3) (mil Al)	Internal Dose (4) (RAD's x 10^4)
Telescope -				
Preamp Input	54	76	119	2.0
Preamp Side A	531	750	793	negligible
Preamp Side B	531	750	793	negligible
DPU -				
Auto-Range	29	78	121	1.8
Post-Null-WB	29	78	121	1.8
IFC	29	78	121	1.8
Timing	29	78	121	1.8
DC/DC Conv. Daughter	49	105	148	.7
DC/DC Conv. Mother	49	105	148	.7

Notes: (1) From Figure 2.1 for Telescope, Figure 2.3 for DPU

(2) $\sqrt{2}$ x min. Shielding for Telescope p.c. boards
$\sqrt{2}$ x min. Shielding + 37 mil Al for DPU p.c. boards in X and Y axis (see Appendix for detailed calculation of added shielding).

(3) Sum of avg. Shielding + external shielding + typical part can shielding

(4) 1/6 of reading from GOES Dose Depth Curve of Metsat-0422.

TABLE 2.2

Telescope & DPU P. C. Board Shielding and Radiation Dose for - X Direction

Printed Circuit Board	Min. Shielding (1) (mil Al)	Avg. Shielding (2) (mil Al)	Total Shielding (3) (mil Al)	Internal Dose (4) (RAD's x 10^4)
Telescope -				
Preamp Input	54	76	119	2.0
Preamp Side A	531	750	793	negligible
Preamp Side B	531	750	793	negligible
DPU -				
Auto-Range	29	78	121	1.8
Post-Null-WB	29	78	121	1.8
IFC	29	78	121	1.8
Timing	29	78	121	1.8
DC/DC Conv. Daughter	49	105	148	.7
DC/DC Conv. Mother	49	105	148	.7

Notes: (1) From Figure 2.1 for Telescope, Figure 2.3 for DPU

(2) $\sqrt{2}$ x min. Shielding for Telescope p. c. boards
$\sqrt{2}$ x min. Shielding + 37 mil Al for DPU p. c. boards in X and Y axis (see Appendix for detailed calculation of added shielding).

(3) Sum of avg. Shielding + external shielding + typical part can shielding

(4) 1/6 of reading from GOES Dose Depth Curve of Metsat-0422.

TABLE 2.3

Telescope & DPU P. C. Board Shielding and Radiation Dose for + Y Direction

Printed Circuit Board	Min. Shielding (1) (mil Al)	Avg. Shielding (2) (mil Al)	Total Shielding (3) (mil Al)	Internal Dose (4) (RAD's x 10^4)
Telescope -				
Preamp Input	248	350	393	negligible
Preamp Side A	160	226	269	.04
Preamp Side B	160	226	269	.04
DPU -				
Auto-Range	20	65	108	3.2
Post-Null-WB	20	65	108	3.2
IFC	20	65	108	3.2
Timing	20	65	108	3.2
DC/DC Conv. Daughter	20	65	108	3.2
DC/DC Conv. Mother	20	65	108	3.2

Notes: (1) From Figure 2.1 for Telescope, Figure 2.3 for DPU

(2) $\sqrt{2}$ x min. Shielding for Telescope p. c. boards
$\sqrt{2}$ x min. Shielding + 37 mil Al for DPU p. c. boards in X and Y axis (see Appendix for detailed calculation of added shielding).

(3) Sum of avg. Shielding + external shielding + typical part can shielding

(4) 1/6 of reading from GOES Dose Depth Curve of Metsat-0422.

TABLE 2.4

Telescope & DPU P. C. Board Shielding and Radiation Dose for - Y Direction

Printed Circuit Board	Min. Shielding[1] (mil Al)	Avg. Shielding[2] (mil Al)	Total Shielding[3] (mil Al)	Internal Dose[4] (RAD's x 10^4)
Telescope -				
Preamp Input	54	76	119	2.0
Preamp Side A	54	76	119	2.0
Preamp Side B	54	76	119	2.0
DPU -				
Auto-Range	60	122	165	.38
Post-Null-WB	60	122	165	.38
IFC	60	122	165	.38
Timing	60	122	165	.38
DC/DC Conv. Daughter	80	150	193	.16
DC/DC Conv. Mother	80	150	193	.16

Notes:
(1) From Figure 2.1 for Telescope, Figure 2.3 for DPU

(2) $\sqrt{2}$ x min. Shielding for Telescope p. c. boards
$\sqrt{2}$ x min. Shielding + 37 mil Al for DPU p. c. boards in X and Y axis (see Appendix for detailed calculation of added shielding).

(3) Sum of avg. Shielding + external shielding + typical part can shielding

(4) 1/6 of reading from GOES Dose Depth Curve of Metsat-0422.

TABLE 2.5

Telescope & DPU P. C. Board Shielding and Radiation Dose for +Z Direction

Printed Circuit Board	Min. Shielding (1) (mil Al)	Avg. Shielding (2) (mil Al)	Total Shielding (3) (mil Al)	Internal Dose (4) (RAD's x 10^4)
Telescope -				
Preamp Input	54	76	119	2.0
Preamp Side A	54	76	119	2.0
Preamp Side B	54	76	119	2.0
DPU -				
Auto-Range	280	395	438	negligible
Post-Null-WB	232	328	371	negligible
IFC	232	328	371	negligible
Timing	184	260	303	.03
DC/DC Conv. Daughter	116	164	207	.12
DC/DC Conv. Mother	68	96	139	.9

Notes: (1) From Figure 2.2 for Telescope, Figure 2.4 for DPU

(2) $\sqrt{2}$ x min. Shielding for Telescope p.c. boards
$\sqrt{2}$ x min. Shielding + 37 mil Al for DPU p.c. boards in X and Y axis (see Appendix for detailed calculation of added shielding).

(3) Sum of avg. Shielding + external shielding + typical part can shielding

(4) 1/6 of reading from GOES Dose Depth Curve of Metsat-0422.

TABLE 2.6

Telescope & DPU P.C. Board Shielding and Radiation Dose for - Z Direction

Printed Circuit Board	Min. Shielding (1) (mil Al)	Avg. Shielding (2) (mil Al)	Total Shielding (3) (mil Al)	Internal Dose (4) (RAD's x 10^4)
Telescope -				
Preamp Input	54	76	119	2.0
Preamp Side A	54	76	119	2.0
Preamp Side B	54	76	119	2.0
DPU -				
Auto-Range	68	96	139	.9
Post-Null-WB	116	164	207	.12
IFC	116	164	207	.12
Timing	164	232	275	.04
DC/DC Conv. Daughter	232	328	371	negligible
DC/DC Conv. Mother	280	395	438	negligible

Notes: (1) From Figure 2.2 for Telescope, Figure 2.4 for DPU

(2) $\sqrt{2}$ x min. Shielding for Telescope p.c. boards
$\sqrt{2}$ x min. Shielding + 37 mil Al for DPU p.c. boards in X and Y axis (see Appendix for detailed calculation of added shielding).

(3) Sum of avg. Shielding + external shielding + typical part can shielding

(4) 1/6 of reading from GOES Dose Depth Curve of Metsat-0422.

TABLE 2.7

Telescope & DPU P.C. Board, Summary of Dose Levels for each Direction and Total Dose

Printed Circuit Board	Dose for each Direction - RAD's x 10^4						Total Dose (1) RAD's x 10^5
	+ X	- X	+ Y	- Y	+ Z	- Z	
Telescope -							
Preamp Input	2.0	2.0	.0	2.0	2.0	2.0	1.0
Preamp Side A	0	0	.04	2.0	2.0	2.0	.64
Preamp Side B	0	0	.04	2.0	2.0	2.0	.64
DPU -							
Auto-Range	1.8	1.8	3.2	.38	0	.9	.72
Post-Null-WB	1.8	1.8	3.2	.38	0	.12	.73
IFC	1.8	1.8	3.2	.38	0	.12	.73
Timing	1.8	1.8	3.2	.38	.03	.04	.73
DC/DC Conv. Daughter	.7	.7	3.2	.16	.12	0	.49
DC/DC Conv. Mother	.7	.7	3.2	.16	.9	0	.48

Note: (1) Sum of dose for each direction

UNIT Preamplifier, Input PC BD

DOSE see Remarks Column

Module	Ref. Des.	908XXX	(Xsistors only) I_C	Parameter	Starting Value	Radiated Value	Required Value	Problem	Remarks
	Q202,302	MEM 955-012	MOS FET'S	$\Delta V_{GS(Th)}$ (V)	0	0	.1	No	at
			I_D = 100 µa	ΔI_{GSS} (pA)	.0	0	.01	No	1×10^3 RAD
				Y_{FS} (µmho)	700	700	200	No	Table 2.8
	Q201,301	2N930	Used as diode base to emitter	ΔI_{EBO} (A)	0	$.35\times10^{-14}$	1×10^{-14}	No	at 5×10^4 RAD
									Table 2.8
Telescope									

UNIT Preamplifier Sideboard A + B

DOSE 1×10^5 RAD except as noted

Module	Ref. Des.	908XXX	(Xsistors only) I_C	Parameter	Starting Value	Radiated Value	Required Value	Problem	Remarks
	IC 201,301	961-4	LM 108 A	ΔV_{IO} (mV)	0	.1	$\leq .5$	No	at
				I_{IO} (nA)	.2	.26	≤ 20	No	2×10^4 RAD
				I_{IN} (nA)	2	3.1	≤ 10	No	Table 2.8
				A_V (V/mV)	50	45(*)	≥ 20	No	
	Q206, 207	2N2907A	.04 ma	h_{FE}	40	35	≥ 1	No	
	306, 307								
	Q204, 205	2N2907A	15 ma	h_{FE}	99	75	≥ 40	No	
	304, 305								

(*) Latch-up at $\geq 4 \times 10^4$ RAD

GOES I-M XRS

GOES D,E & F FLIGHT HISTORY

S/C	LAUNCH DATE	TURN ON DATE	OPERATIONAL STATUS AS OF APRIL, '86
GOES D/4	8 SEPT. 1980	15 SEPT. 1980	VAS FAILED 26 NOV. 1982. XRS DATA AVAILABLE TIL MAY '83. PRESENT STATUS UNKNOWN. PAN REQUESTED DATA TO DETERMINE XRS STATUS. IN-ORBIT LIFE ~ 5.6 YRS. XRS DATA FOR ~ 3 YEARS.
GOES E/5	22 MAY, 1981	4 JUNE, 1981	VAS FAILED 30 JULY, 1984. USED FOR SEM DATA. XRS OPERATIONAL FOR ~ 4.8 YRS.
GOES F/6	MAY, 1983	13 MAY. 1983	S/C OPERATIONAL. XRS OPERATIONAL FOR ~ 2.8 YRS.

GOES E/5 XRS IN-FLIGHT CALIBRATION DATA HISTORY

RATIOS OF (HIGH CAL-LOW CAL)/BASE RANGE, AND (LOW CAL)/BASE

BASE = +25 C VALUES FROM THERMAL VACUUM TESTS
= VALUES IN CALIBRATION REPORT

		(HIGH CAL-LOW CAL)/BASE RANGE FOR						(LOW CAL)/BASE FOR					
X-RAY CHANNEL	RANGE	4JUN81	5JUN81	5SEP81	16OCT82	20AUG85	8OCT85	4JUN81	5JUN81	5SEP81	16OCT82	20AUG85	8OCT85
A (SHORT)	3	1.ØØ7	1.Ø15	1.Ø11	1.ØØ6	1.ØØ7	1.ØØ4	Ø.987	Ø.967	Ø.984	Ø.974	Ø.972	Ø.964
A (SHORT)	2	1.ØØ7	1.Ø11	1.Ø11	1.ØØ5	1.ØØ6	1.ØØ3	Ø.986	Ø.966	Ø.986	Ø.976	Ø.972	Ø.966
A (SHORT)	1	Ø.987	Ø.994	1.Ø11	Ø.995	Ø.99Ø	Ø.985	Ø.986	Ø.982	(1.Ø12)	Ø.972	Ø.986	Ø.984
A (SHORT)	Ø	Ø.978	Ø.99Ø	1.ØØ7	Ø.99Ø	1.Ø18	Ø.988	1.Ø1Ø	1.ØØ4	(1.211)	Ø.984	Ø.984	(1.Ø14)
B (LONG)	3	1.ØØ6	1.Ø1Ø	1.ØØ8	1.ØØ4	1.ØØ4	1.ØØØ	Ø.986	Ø.971	Ø.982	Ø.968	Ø.968	Ø.996
B (LONG)	2	1.ØØ5	1.ØØ7	1.ØØ7	1.ØØ1	1.ØØ1	Ø.996	Ø.968	Ø.968	Ø.988	Ø.974	Ø.968	Ø.971
B (LONG)	1	Ø.951	Ø.955	1.Ø15	1.ØØØ	Ø.997	Ø.989	Ø.974	Ø.994	(1.25Ø)	Ø.998	Ø.968	Ø.968
B (LONG)	Ø	Ø.931	Ø.938	1.Ø18	Ø.998	Ø.997	Ø.99Ø	Ø.994	(1.159)	(3.683)	(1.23Ø)	1.ØØ4	Ø.984

NOTE: (LOW CAL)/BASE NUMBERS IN PARENTHESIS ARE AFFECTED BY THE SOLAR X-RAY PULSE TAIL IN THE TWO LOWEST RANGES.

AFTER 4 YEARS, 4 MONTHS OF ORBITAL OPERATION THE GAINS ARE ALL WITHIN 1.5% OF THE BASE VALUE. THE OFFSET (LOW CAL) VALUES ARE ALL WITHIN 3.6% OF THE BASE VALUES.

GOES F/6 XRS IN-FLIGHT CALIBRATION DATA HISTORY

RATIOS OF (HIGH CAL-LOW CAL)/ BASE RANGE, AND (LOW CAL)/BASE

BASE = +25 C VALUES FROM THERMAL VACUUM TESTS
= VALUES IN CALIBRATION REPORT (PERFORMANCE TEST DATA)

X-RAY CHANNEL	RANGE	(HIGH CAL-LOW CAL)/BASE RANGE FOR		(LOW CAL)/BASE FOR	
		18MAY83	19AUG85	18MAY83	19AUG85
A (SHORT)	3	1.Ø15	1.ØØ9	Ø.988	Ø.978
A (SHORT)	2	1.Ø14	1.ØØ7	Ø.988	Ø.974
A (SHORT)	1	1.Ø18	Ø.988	Ø.994	Ø.969
A (SHORT)	Ø	1.Ø37	Ø.985	(Ø.937)	Ø.98Ø
B (LONG)	3	1.Ø13	1.ØØ9	Ø.996	Ø.979
B (LONG)	2	1.Ø14	1.ØØ7	Ø.996	Ø.976
B (LONG)	1	1.Ø29	1.Ø15	(1.Ø41)	Ø.979
B (LONG)	Ø	1.Ø36	1.ØØ9	(1.387)	Ø.978

NOTE: (LOW CAL)/BASE NUMBERS IN PARENTHESIS ARE AFFECTED BY THE SOLAR X-RAY PULSE TAIL IN THE TWO LOWEST RANGES.

AFTER 2 YEARS, 3 MONTHS OF ORBITAL OPERATION THE GAINS ARE ALL WITHIN 1.5% OF THE BASE VALUES. THE OFFSET (LOW CAL) VALUES ARE ALL WITHIN 3.1% OF THE BASE VALUES.

GOES XRS Range Data Summary - as of May 1986

A Channel (1/2 - 3 A°, Short) - Flux Ratios

Range	$\left(\frac{G-4}{G-2}\right)$	$\left(\frac{G-5}{G-4}\right)$	$\left(\frac{G-6}{G-5}\right)$	$\left(\frac{G-3}{G-2}\right)$	$\left(\frac{G-5}{G-2}\right)$
R4	0.85		0.87	1.13	0.94
R3	0.88	1.14	0.85		0.98
R2	~1.00	1.04	0.88		
R1	~0.98	1.04	0.88		

B Channel (1-8 A°, Long) - Flux Ratios

Range	$\left(\frac{G-4}{G-2}\right)$	$\left(\frac{G-5}{G-4}\right)$	$\left(\frac{G-6}{G-5}\right)$	$\left(\frac{G-3}{G-2}\right)$	$\left(\frac{G-5}{G-2}\right)$
R4	1.07		1.16	1.10	1.01
R3	1.07	1.00	1.15		1.02
R2	1.12	1.02	1.16		
R1	1.09		1.16		

Flux ratios at range switches - A channel

Range Ratio	SMS-1	SMS-2	G-2	G-3	G-4	G-5	G-6
R4/R3	1.06	0.90	0.99	0.87	0.99	1.03	1.04
R3/R2	(~1)	1.0	0.95	0.86	0.95	1.09	1.06
R2/R1	(~1)	0.89	1.00	0.80	1.00	0.95	0.96

Flux ratios at range switches - B channel

Range Ratio	SMS-1	SMS-2	G-2	G-3	G-4	G-5	G-6
R4/R3	1.08	0.95	0.99	1.07	1.01	1.03	1.04
R3/R3	0.90	0.93	0.98	1.21	0.92	0.95	0.94
R2/R1	(~1)	0.94	0.97		1.02	1.01	1.01

GOES I-M XRS

PACKAGE DESIGN

GOES I-M XRS

MECHANICAL DESIGN AND ANALYSIS

MECHANICAL DESIGN AND ANALYSIS IS ADDRESSED IN THE FOLLOWING SECTIONS:

XRS ASSEMBLY	XRS 2.2.4
COLLIMATOR & MAGNET SUBASSEMBLY	XRS 2.3.3
AND	XRS 2.3.4
PREAMP SUBASSEMBLY	XRS 2.4.4
DPU SUBASSEMBLY	XRS 2.5.2

GOES I-M XRS

THERMAL DESIGN AND ANALYSIS

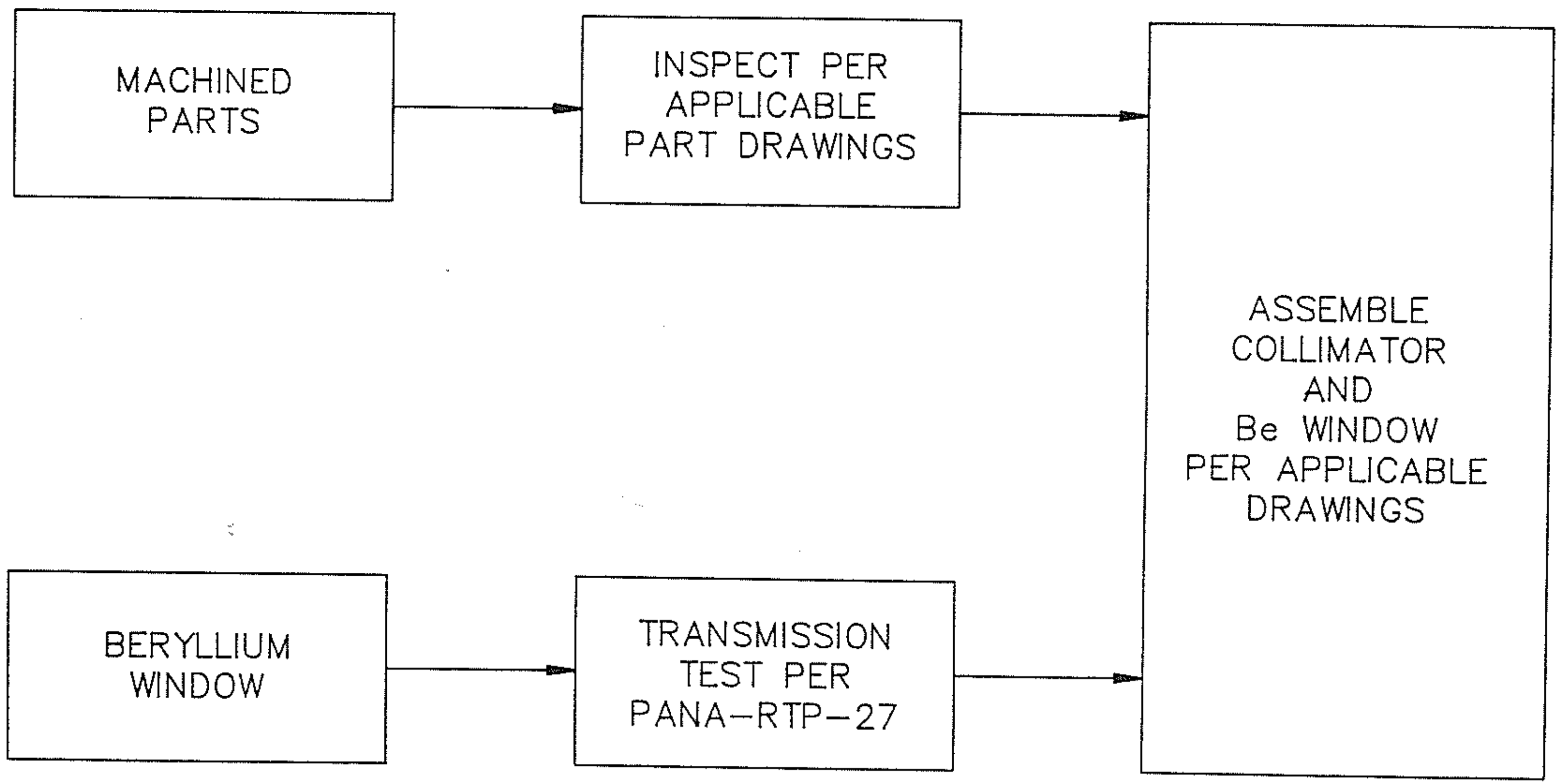
- EXTERNAL THERMAL CONTROL
  - HEATING BLANKET CONTROLS XRS TEMPERATURE. FACC SUPPLIED.
  - UNIT EXTERNAL THERMAL COATING TBS BY FACC DURING SPACECRAFT THERMAL ANALYSIS.
- INTERNAL THERMAL ANALYSIS
  - MAXIMUM COMPONENT TEMPERATURE NEEDED FOR DERATING AND RELIABILITY ANALYSES.
  - POWER DISSIPATING COMPONENTS HAVE HEAT ENERGY CONDUCTED AWAY BY COPPER PC BOARD TRACES.
  - LOW THERMAL CONDUCTIVITY OF FIBER GLASS/EPOXY PC BOARDS (FR4) RESULTS IN MOST HEAT LOSS BY THERMAL (BLACKBODY) RADIATION.
  - CALCULATE WORST CASE COMPONENT TEMPERATURE RISE FROM PC TRACE TEMPERATURE DROPS AND FROM PC BOARD RADIATIVE TEMPERATURE RISES.
  - CENTER PC BOARDS WILL HAVE THE HIGHEST COMPONENT TEMPERATURES.
  - PRELIMINARY ESTIMATES SHOW COMPONENT TEMPERATURES WILL GENERALLY BE WITHIN 5 DEG C OF UNIT BASE TEMPERATURE.

GOES I-M XRS

DEVELOPMENT AND QUALIFICATION/ACCEPTANCE TEST PLANS

* COLLIMATOR SUBASSEMBLY INTEGRATION TEST SEQUENCE
* MAGNET YOKE SUBASSEMBLY INTEGRATION TEST SEQUENCE
* PREAMPLIFIER SUBASSEMBLY INTEGRATION TEST SEQUENCE
* EM TELESCOPE SUBASSEMBLY INTEGRATION TEST SEQUENCE
* P/F MODEL TELESCOPE SUBASSEMBLY INTEGRATION TEST SEQUENCE
* DPU SUBASSEMBLY INTEGRATION TEST SEQUENCE
* XRS ASSEMBLY INTEGRATION TEST SEQUENCE
* EM ACCEPTANCE TEST SEQUENCE
* PROTOFLIGHT/FLIGHT MODEL QUALIFICATION/ACCEPTANCE TEST SEQUENCE

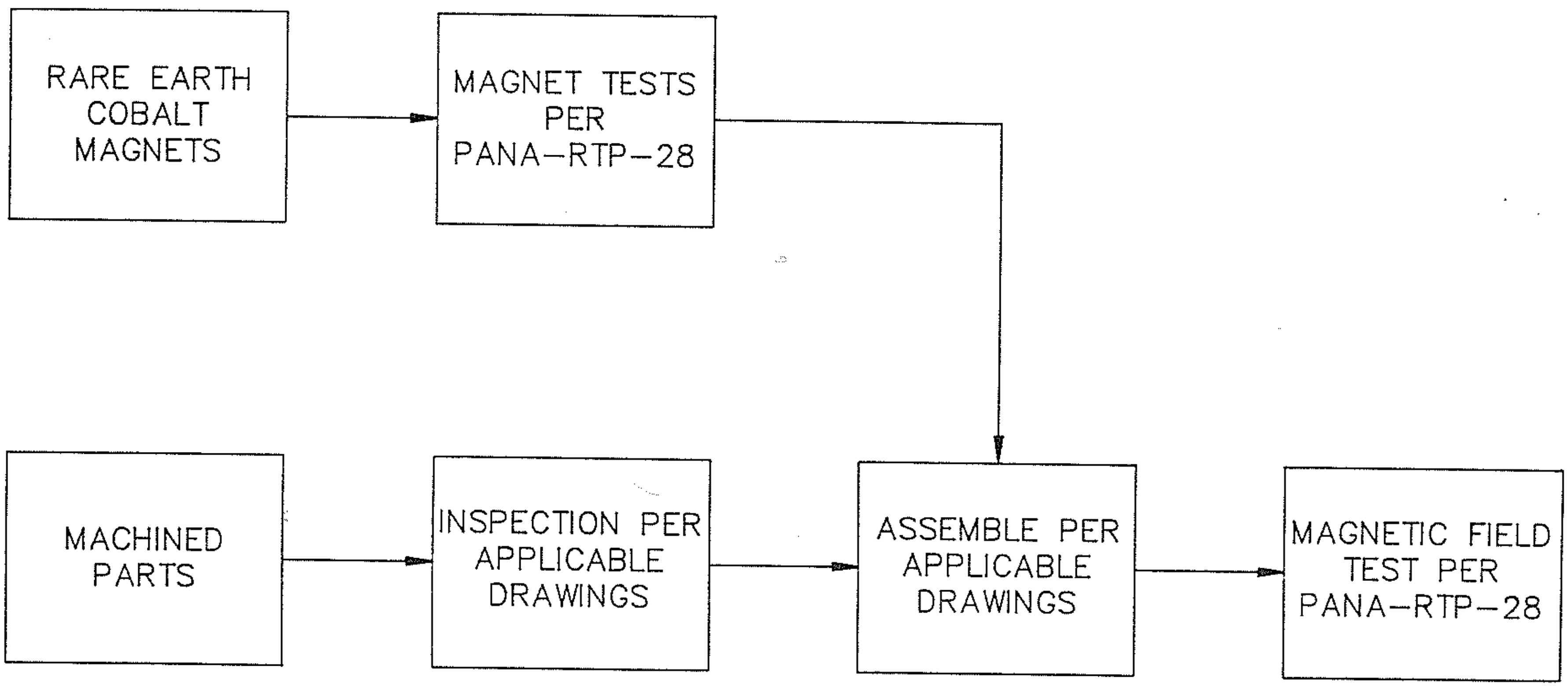
GOES I-M XRS



COLLIMATOR SUBASSEMBLY INTEGRATION TEST SEQUENCE

XRS 6-1

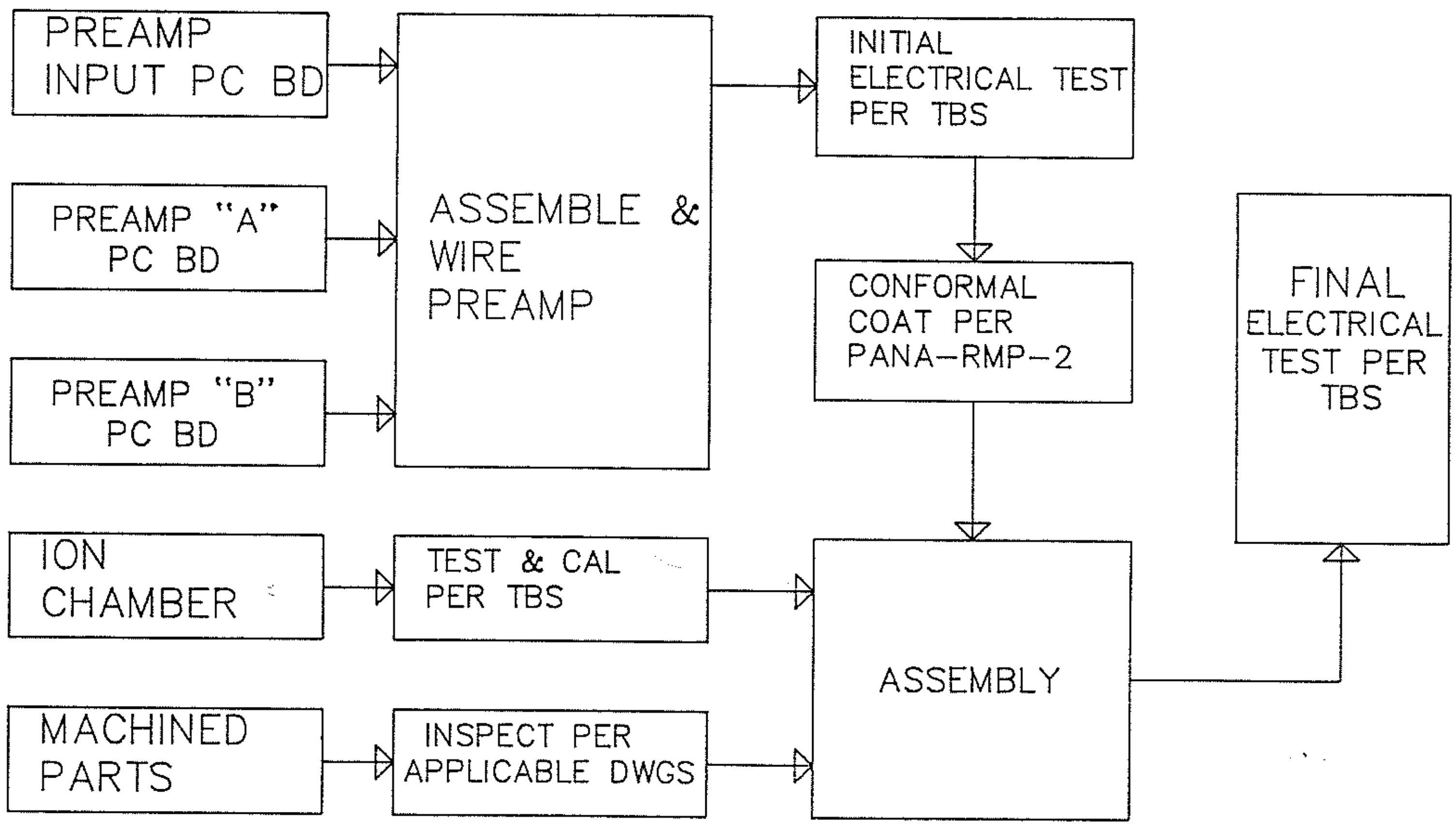
GOES I–M XRS



MAGNET YOKE SUBASSEMBLY INTEGRATION TEST SEQUENCE

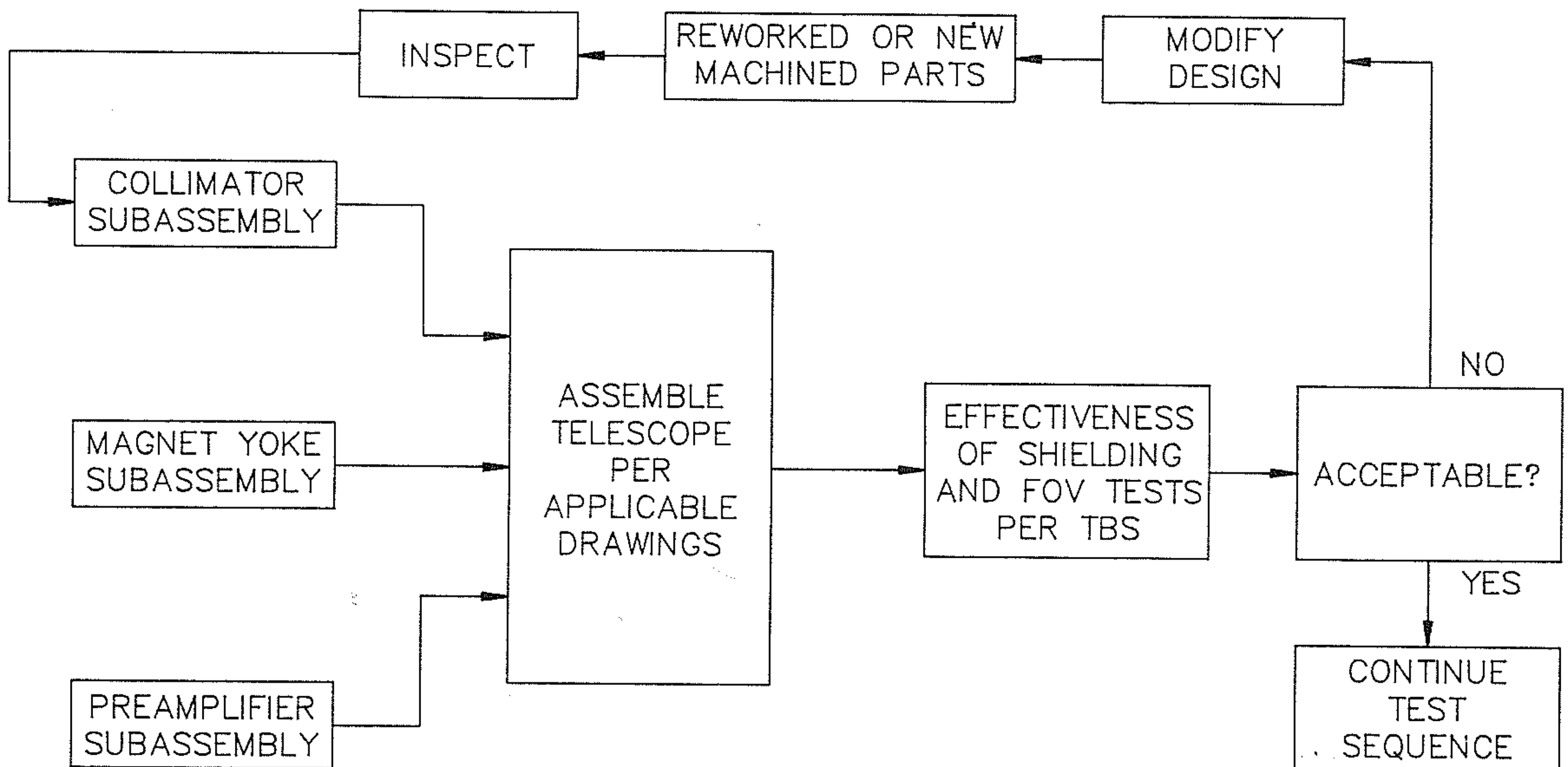
XRS 6–2

GOES I-M XRS



PREAMPLIFIER SUBASSEMBLY INTRGRATION TEST SEQUENCE

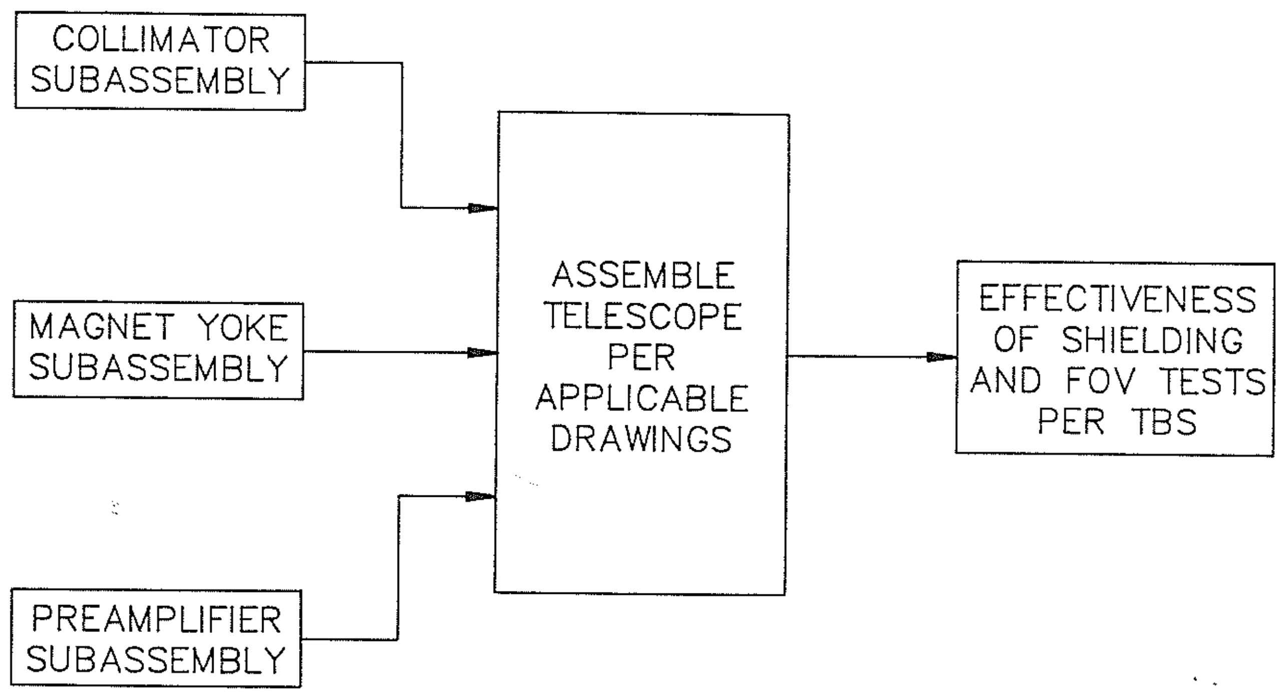
GOES I–M XRS



ENGINEERING MODEL

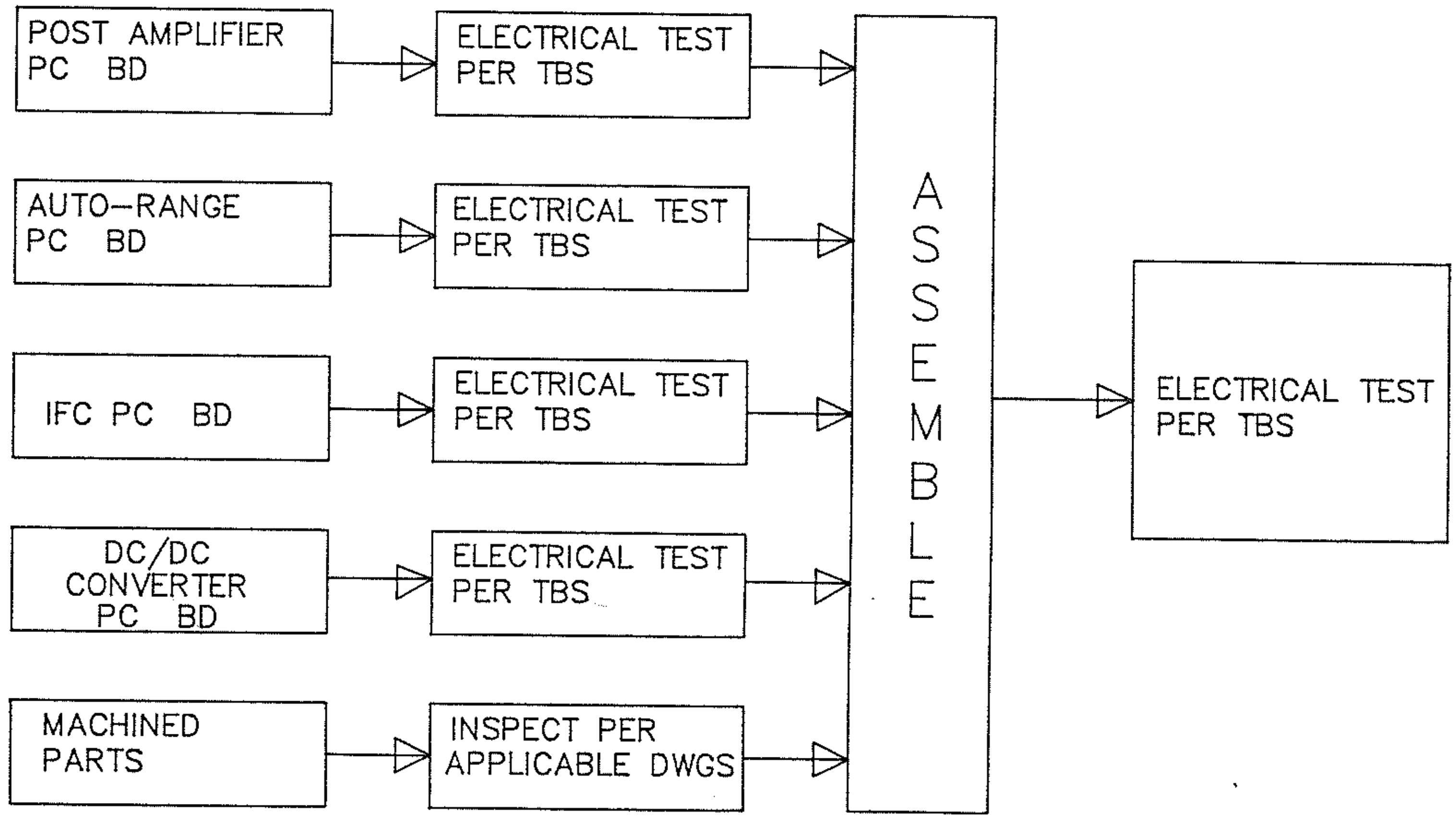
TELESCOPE SUBASSEMBLY INTEGRATION SEQUENCE

GOES I–M XRS



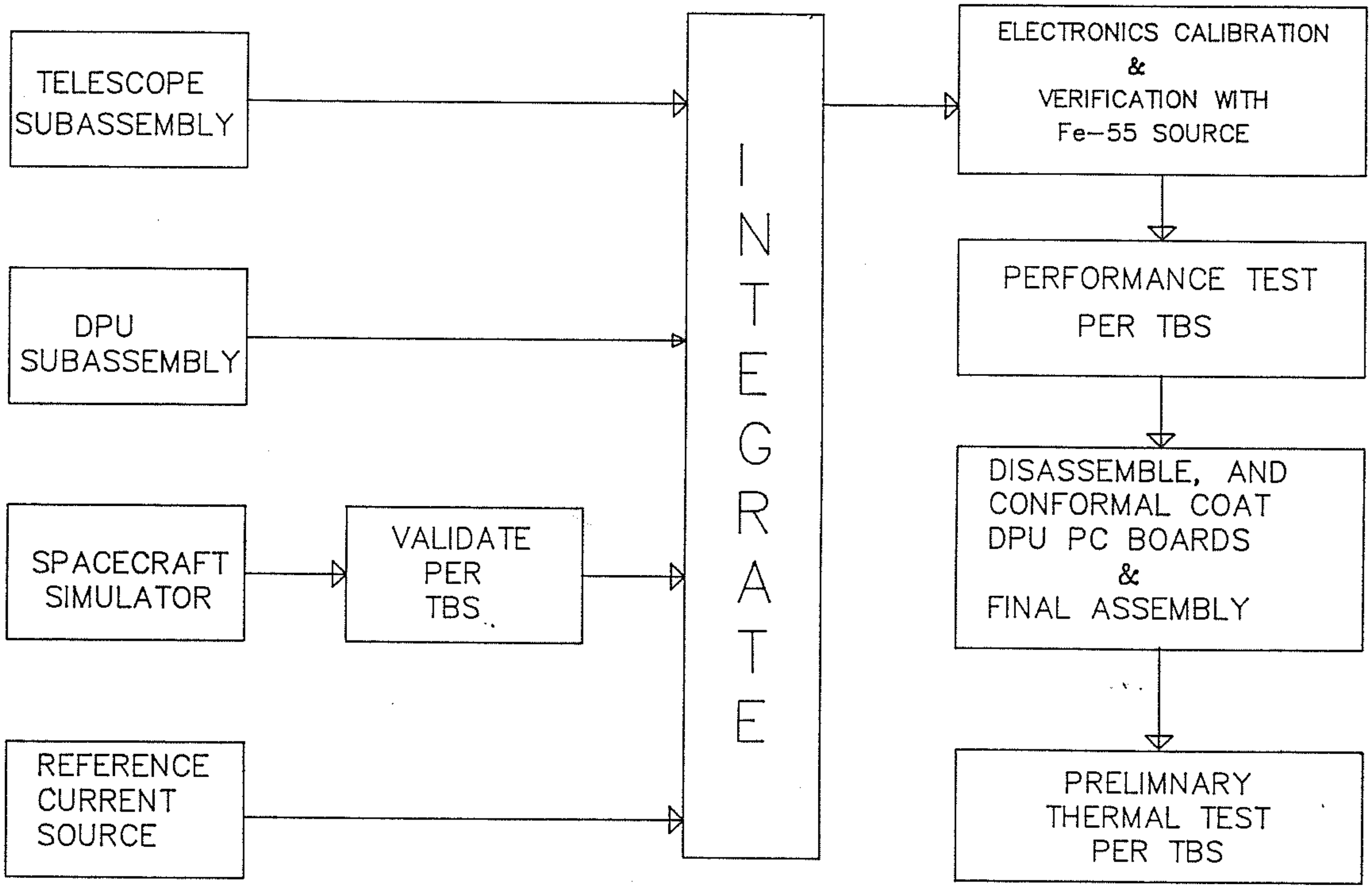
PROTOFLIGHT/FLIGHT MODEL
TELESCOPE SUBASSEMBLY INTEGRATION SEQUENCE

GOES I–M XRS



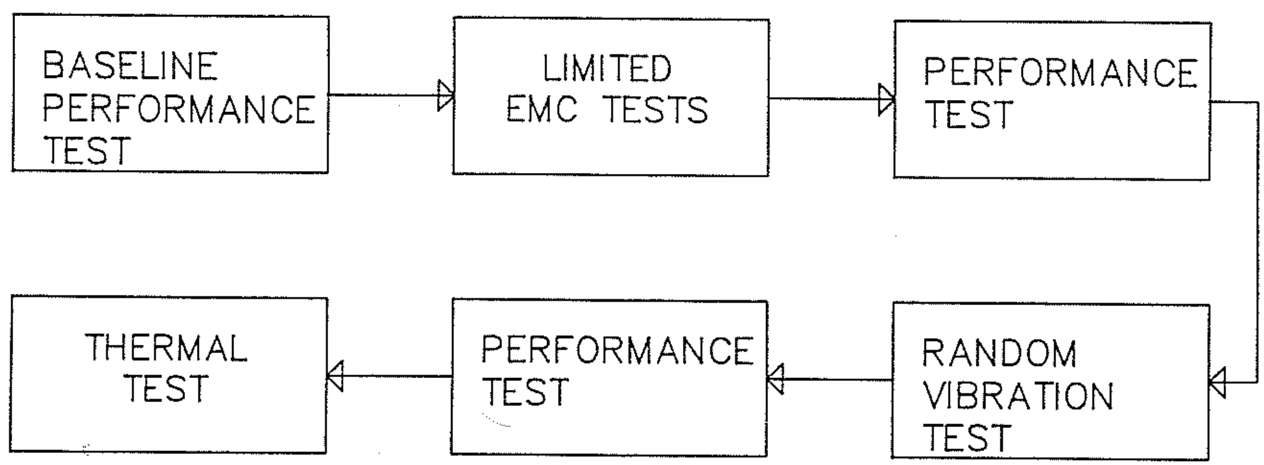
DPU SUBASSEMBLY INTEGRATION TEST SEQUENCE

GOES I–M XRS



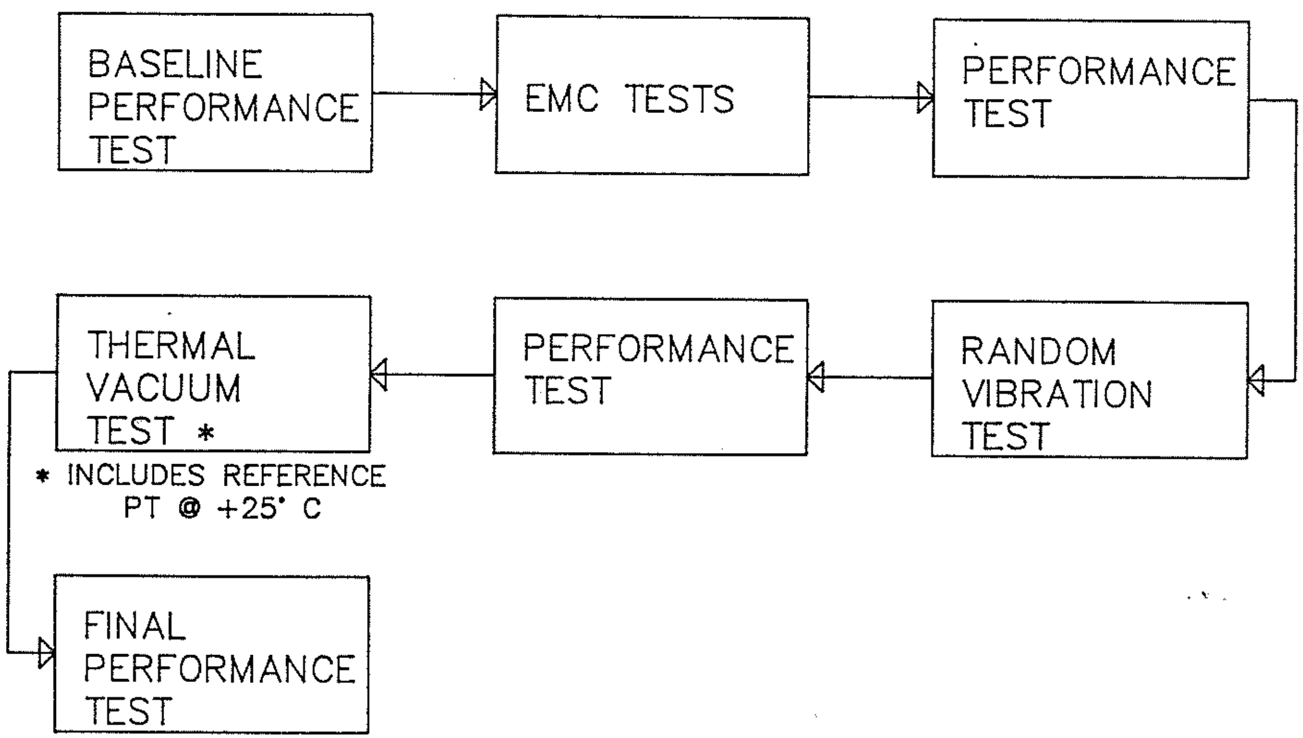
XRS ASSEMBLY INTEGRATION TEST SEQUENCE

<u>GOES I–M XRS</u>



ENGINEERING MODEL ACCEPTANCE TEST SEQUENCE

GOES I–M XRS



PROTOFLIGHT/FLIGHT MODEL QUALIFICATION/ACCEPTANCE TEST SEQUENCE

<u>GOES I, J, K, L & M XRS</u>

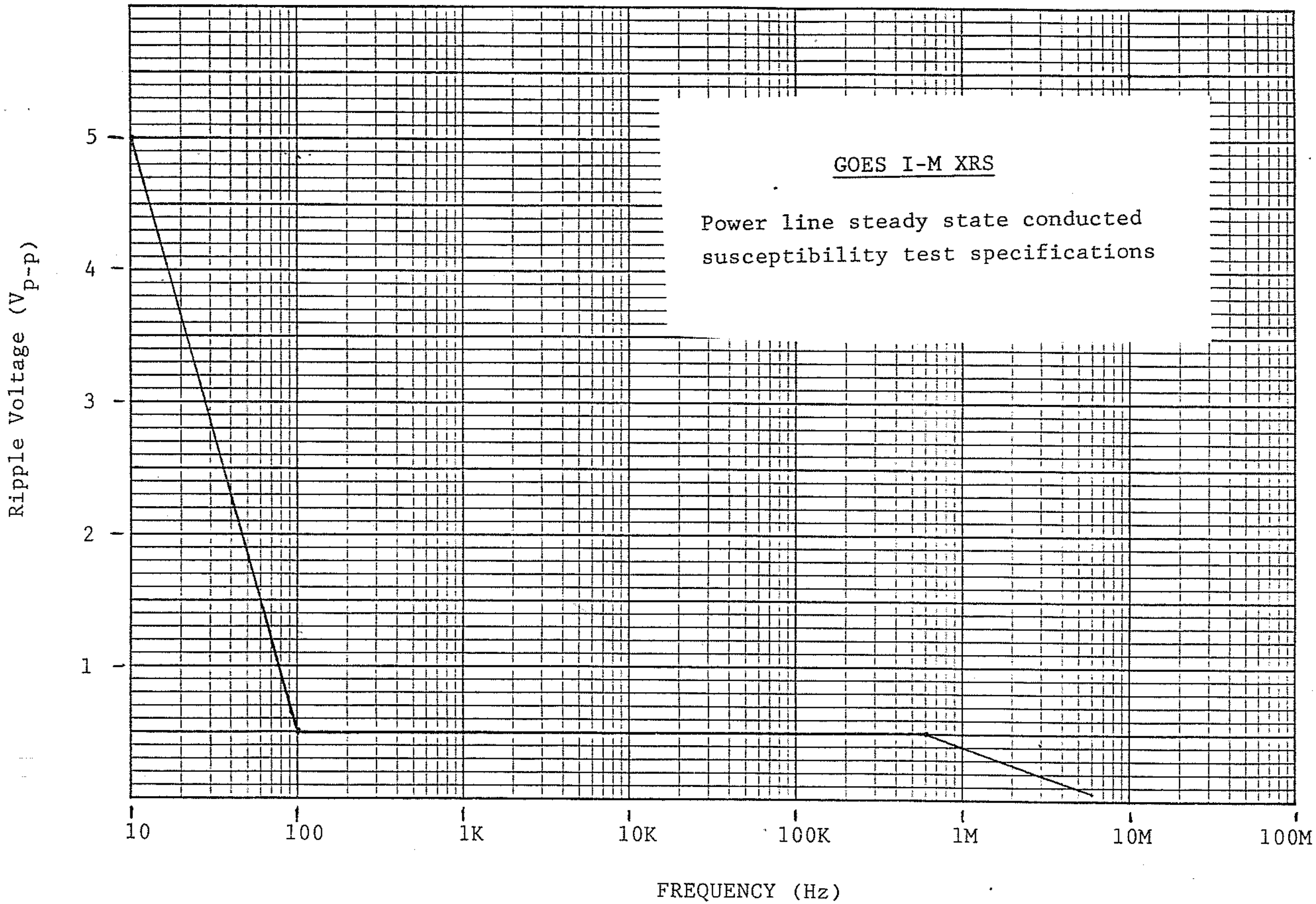
<u>EMI - CONDUCTED EMISSION TEST SPECIFICATIONS</u>

	GOES I, J, K, L & M
POWER LINES	≤ 3% P-P, OF DC STEADY-STATE INPUT I 1 HZ TO 100 MHZ (≤ 2.5 MA P-P)
COMMAND LINES	≤ 8.3 MA, P-P 1 HZ TO 150 KHZ ≤ 0.15 MA, P-P 150 KHZ TO 100 MHZ
DIGITAL TELEMETRY LINES	≤ 20 MV, P-P 1 HZ TO 150 KHZ ≤ 10 MV, P-P 150 KHZ TO 100 MHZ
ANALOG TELEMETRY LINES	≤ 10 MV, P-P 1 HZ TO 150 KHZ ≤ 5 MV, P-P 150 KHZ TO 100 MHZ

GOES I, J, K, L & M XRS

EMI - CONDUCTED SUSCEPTIBILITY TEST SPECIFICATIONS

	GOES I, J, K, L & M
POWER LINES	SEE GRAPHS
COMMAND LINES	≤ Ø.5 V, P-P 1 HZ TO 15Ø KHZ ≤ Ø.25 V, P-P 15Ø KHZ TO 1ØØ MHZ
DIGITAL TELEMETRY LINES	≤ 16Ø UA, P-P 1 HZ TO 15Ø KHZ ≤ 8Ø UA, P-P 15Ø KHZ TO 1ØØ MHZ
ANALOG TELEMETRY LINES	≤ 5 UA, P-P 1 HZ TO 15Ø KHZ ≤ 2.5 UA, P-P 15Ø KHZ TO 1ØØ MHZ



GOES I-M XRS
Power line steady state conducted
susceptibility test specifications
Ripple Voltage (V_{p-p})
5
4
3
2
1
10
100
1K
10K
100K
1M
10M
100M
FREQUENCY (Hz)

GOES I, J, K, L & M XRS

ELECTROSTATIC SENSITIVITY (ARC DISCHARGE) SPECIFICATIONS

	GOES I, J, K, L & M
RADIATED (SUSCEPTIBILITY)	1Ø KV, 1 PPS* 3Ø SECONDS MINIMUM 3Ø CM FROM EACH EXPOSED FACE
CONDUCTED (SURVIVABILITY)	1Ø KV, 1 PPS* 3Ø SECONDS MINIMUM DIRECT DISCHARGE TO SHORT PROJECTING LUG ATTACHED TO FACE OR CORNER

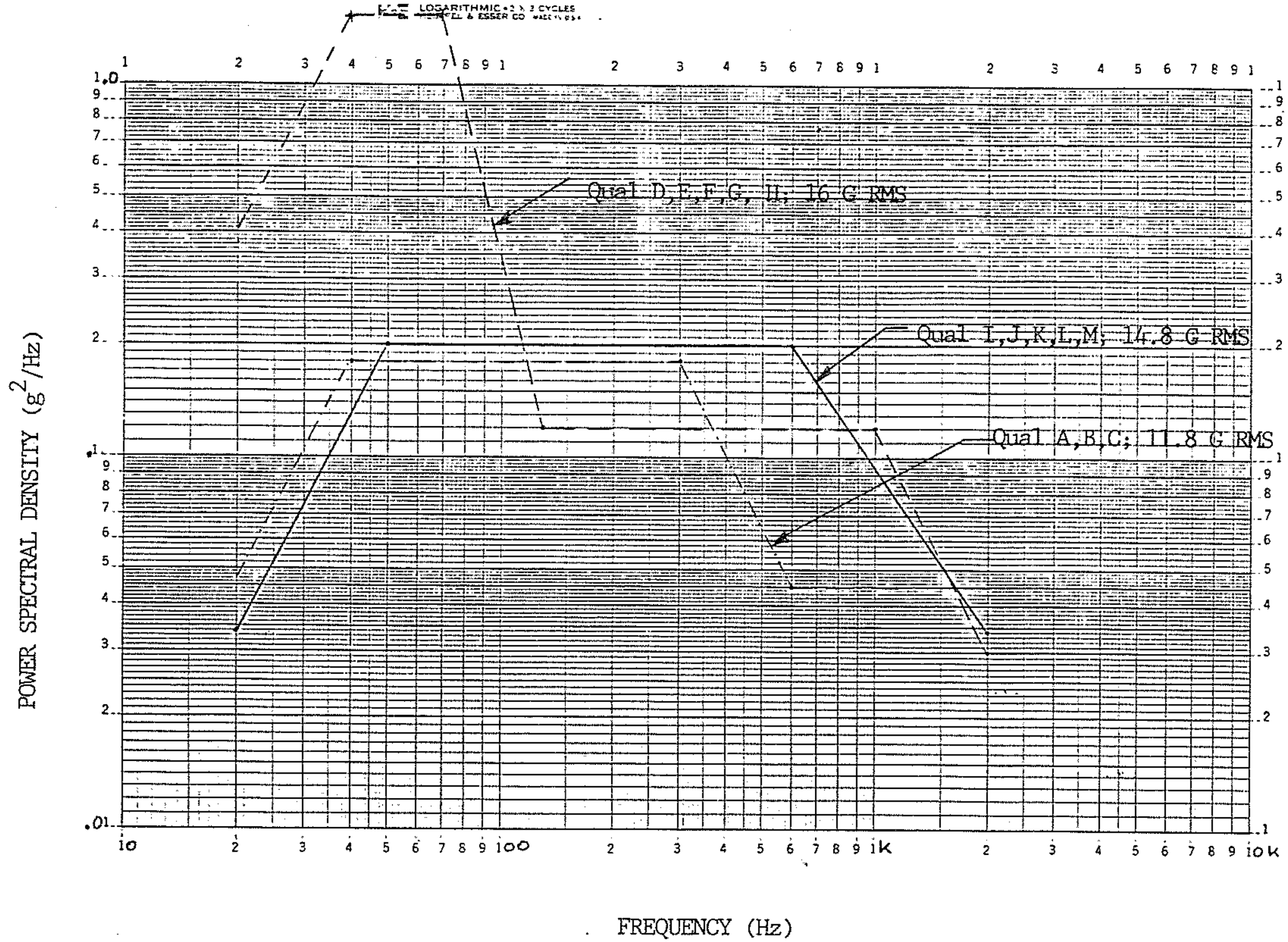
GOES I, J, K, L & M XRS

VIBRATION TEST SPECIFICATIONS

	GOES I, J, K, L & M
RANDOM PROTOFLIGHT LEVELS PERPENDICULAR TO MOUNTING PLANE	14.8 G'S RMS 6Ø SEC (SEE GRAPH)
PARALLEL TO MOUNTING PLANE	1Ø.5 G'S RMS 6Ø SEC PER AXIS (SEE GRAPH)
RANDOM ACCEPTANCE LEVELS POWER SPECTRAL DENSITY	Ø.5Ø X PROTOFLIGHT LEVELS
OVERALL G'S RMS	Ø.7Ø7 X PROTOFLIGHT LEVELS
DURATION	SAME AS PROTOFLIGHT
NOTE	UNIT OPERATING INPUT CURRENT TO BE MONTIORED

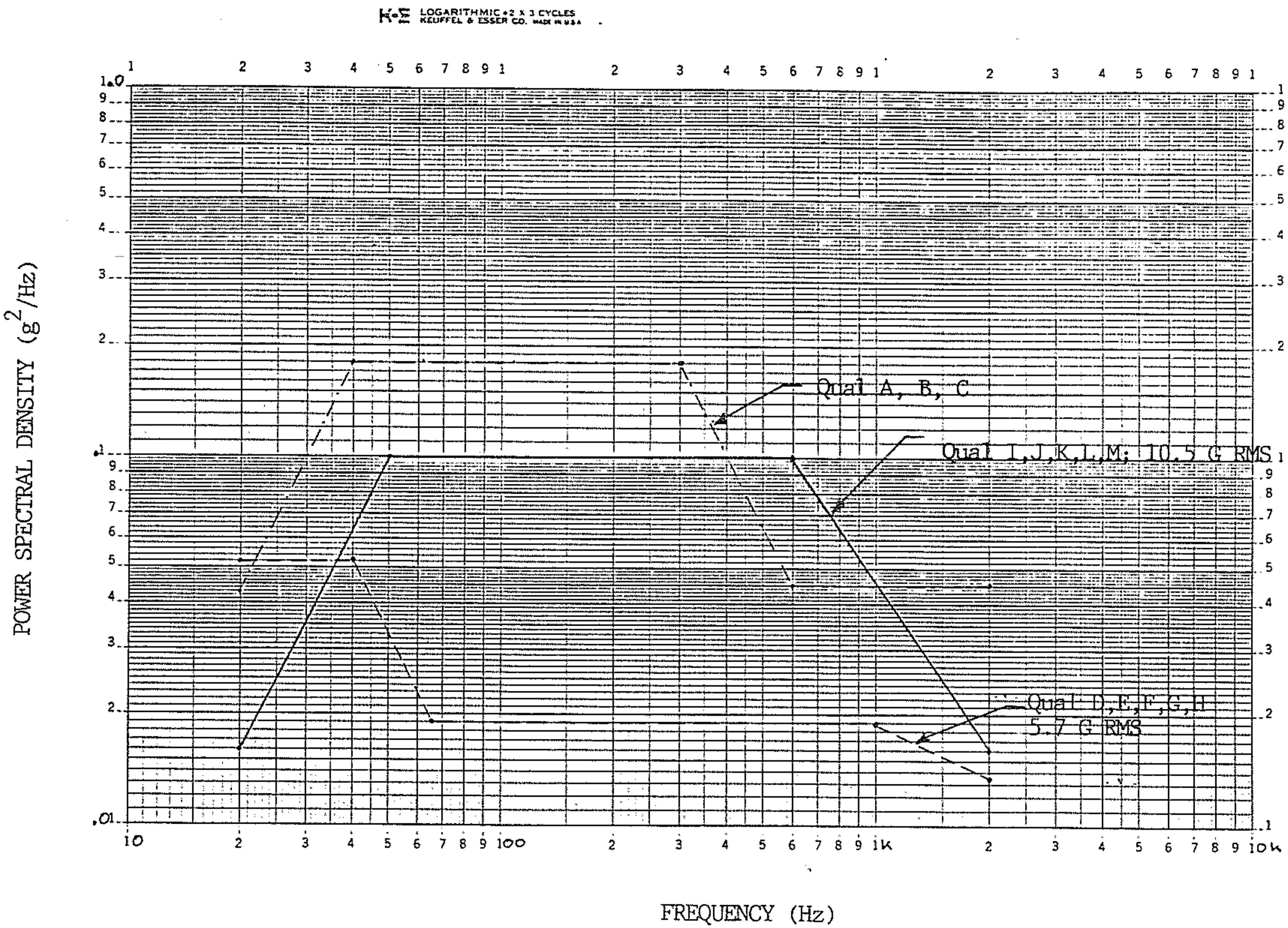
RANDOM VIBRATION TEST SPECIFICATIONS FOR PREVIOUS AND CURRENT GOES

(Perpendicular to mounting plane)

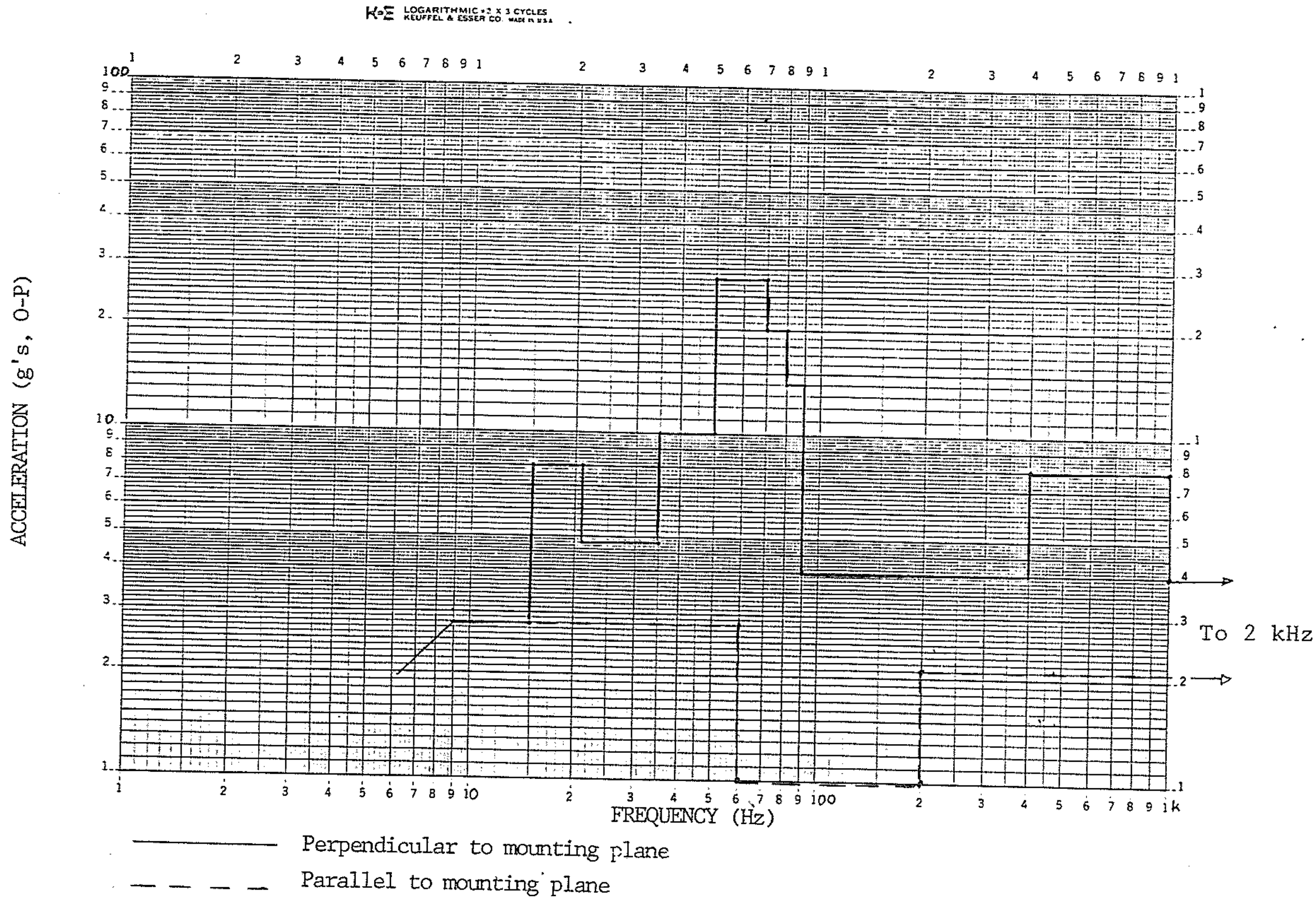


RANDOM VIBRATION TEST SPECIFICATION FOR PREVIOUS AND CURRENT GOES

(Parallel to mounting plane)



GOES D-H SINUSOIDAL VIBRATION TEST SPECIFICATIONS



GOES I-M XRS

THERMAL VACUUM TEST SPECIFICATIONS 1)

PT AT AMBIENT TEMPERATURE
COOL, NON-OPERATING, TO -20°C
TURN ON AT -20°C, PT AT -20°C, TURN OFF AT -20°C
HEAT, NON-OPERATING, TO +50°C
COOL, NON-OPERATING, TO +35°C (+25°C)
TURN ON AT +35°C (+25°C), PT AT 35°C (+25°C)
COOL, OPERATING, TO -20°C
PT AT -20°C (PROTOFLIGHT ONLY)
HEAT, OPERATING, TO +35°C (+25°C)
PT AT +35°C (+25°C) (PROTOFLIGHT ONLY)
COOL, OPERATING, TO -20°C
PT AT -20°C (PROTOFLIGHT ONLY)
HEAT, OPERATING, TO +35°C (+25°C)
PT AT +35°C (+25°C) (PROTOFLIGHT ONLY)
COOL, OPERATING, TO -20°C
PT AT -20°C
HEAT, OPERATING, TO +35°C (+25°C)
PT AT +35°C (+25°C)
COOL, OPERATING, TO AMBIENT TEMPERATURE
PT AT AMBIENT TEMPERATURE, TURN OFF

NOTE 1) NUMBERS IN PARENTHESIS ARE ACCEPTANCE TEMPERATURE LEVELS. WHERE NO NUMBERS IN PARENTHESIS ARE SHOWN THE QUALIFICATION AND ACCEPTANCE TEMPERATURE LEVELS ARE THE SAME.

GOES I-M XRS

SUMMARY OF INTEGRATION TESTS, EM PROTOFLIGHT AND FLIGHT MODEL

* ALL PC BDS AND SUBASSEMBLIES ARE TESTED IN ACCORDANCE WITH THEIR RESPECTIVE TEST PROCEDURES. PROCEDURES ARE UNDER CONFIGURATION CONTROL.

* ION CHAMBER IS TESTED AND CALIBRATED. TEST INCLUDES LONG TERM LEAK TEST.

* UV FOIL SHIELD (BE) THICKNESS IS MEASURED.

* MAGNET FIELD STRENGTH IS MEASURED AND MAGNET YOKE SUBASSEMBLY FIELD IS MAPPED.

* PREAMPLIFIER CONVERSION GAIN, OFFSET AND BW ARE SET AND NOISE MEASURED. TESTED OVER RANGE -25^{O}C TO 55^{O}C.

* TELESCOPE SUBASSEMBLY, EFFECTIVENESS OF SHIELDING AND FOV:
  - EM SERVES TO DETERMINE BY ANALYSIS AND TEST THE FINAL SHIELDING MATERIAL, THICKNESS AND LOCATION ON TELESCOPE.
  - VERIFIED ON PROTOFLIGHT AND FLIGHT MODELS.

* IN-FLIGHT CALIBRATION LEVELS ARE SET.

* INTERFACE LINES ARE TESTED UNDER WORST CASE DRIVE AND LOAD CONDITIONS.

* PERFORMANCE TEST AT AMBIENT CONDITIONS IS CONDUCTED.

* PRELIMINARY THERMAL TEST IS CONDUCTED OVER QUALIFICATION TEMPERATURE RANGE (-2Ø TO +35^{O}C) WITH PERFORMANCE TESTS AT AMBIENT AND TEMPERATURE EXTREMES.

SUMMARY OF INTEGRATION TESTS, EM PROTOFLIGHT AND FLIGHT MODEL (CONT'D)

* ELECTRONICS CALIBRATION IS PERFORMED OVER DYNAMIC RANGE.
* FE-55 SOURCES ARE USED TO VERIFY END TO END CALIBRATION, THRESHOLD SENSITIVITY, RESOLUTION AND RESPONSE TIME.

GOES I-M XRS

SUMMARY OF PERFORMANCE TEST

* PROPER OPERATION AT LOW, NOMINAL AND HIGH BUS VOLTAGE IS VERIFIED.
* BUS VOLTAGE AND CURRENT LEVELS ARE MEASURED.
* PROPER OPERATION OF ALL COMMAND LINES IS VERIFIED.
* ELECTRONIC CALIBRATION IS VERIFIED.
* ANALOG TELEMETRY OUTPUT LEVEL OF REFERENCE VOLTAGE IS VERIFIED.
* TEMPERATURE MONITOR OUTPUT LEVELS ARE MEASURED.
* PROPER OPERATION OF AUTOMATIC RANGING AND BI-LEVEL STATUS OUTPUT LEVELS OVER DYNAMIC RANGE ARE VERIFIED.
* PROPER OPERATION OF IN-FLIGHT LOGIC AND OUTPUT LEVELS ARE VERIFIED.
* DATA OUTPUT NOISE LEVELS ARE MEASURED.
* ALIVENESS AND PROPER RESPONSE OF ION CHAMBERS IS VERIFIED WITH FE-55 SOURCES.