THE UNIVERSITY OF MICHIGAN

COLLEGE OF ENGINEERING
Department of Atmospheric, Oceanic and Space Sciences
Space Physics Research Laboratory

Solar Extreme Ultraviolet Sensor and Advanced Langmuir Probe

PROGRESS REPORT
December 14, 1992

Prepared on behalf of the project by:

N. R. Voronka
B. P. Block
G. R. Carignan

Under Contract with:
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Progress Report
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George R. Carignan

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Ann Arbor, Michigan 48109-2143

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1.0 Introduction

For more that two decades, the staff of the Space Physics Research Laboratory (SPRL) has collaborated with the Goddard Space Flight Center (GSFC) in the design and implementation of Langmuir probes (LP). This program of probe development under the direction of Larry Brace of GSFC has evolved methodically with innovations to: improve measurement precision, increase the speed of measurement, and reduce the weight, size, power consumption and data rate of the instrument. Under contract NAG5-419 these improvements were implemented and are what characterize the Advanced Langmuir Probe (ALP).

Using data from the Langmuir Probe on the Pioneer Venus Orbiter, Brace and Walter Hoegy of GSFC demonstrated a novel method of monitoring the solar extreme ultraviolet (EUV) flux. This led to the idea of developing a sensor similar to a Langmuir probe specifically designed to measure solar EUV (SEUV) that uses a similar electronics package. Under this contract, a combined instrument package of the ALP and SEUV sensor was to be designed, constructed, and laboratory tested . Finally the instrument was to be flight tested as part of a sounding rocket experiment to acquire the necessary data to validate this method for possible use in future earth and planetary aeronomy missions.

2.0 Summary of Project Activities

The primary purpose of this contract was to develop the electronics hardware and software for this instrument, since the actual sensors were supplied by GSFC. Due to budget constraints, only a flight model was constructed. These electronics were tested and calibrated in the laboratory, and then the instrument was integrated into the rocket payload at Wallops Flight Facility where it underwent environmental testing. After instrument recalibration at SPRL, the payload was reintegrated and launched from the Poker Flat Research Range near Fairbanks Alaska. The payload was successfully recovered and after refurbishment underwent further testing and development to improve its performance for future use.

2.1 Project Hardware

The SEUV/ALP hardware was designed for the sounding rocket mission but also with the intention of allowing it to be easily upgradable to a flight qualified instrument with minimal effort. The entire instrument consisted of a Flight Computer with Telemetry Interface, a Grid Voltage Generator Board and two VA Generator/Electrometer Boards. In addition, ground support equipment was designed that would allow the instrument to

operate in a laboratory setting as well as support the instrument once it was integrated into the rocket payload.

2.1.1 Flight Computer

The processor chosen for the flight computer was Intel's 80C916 12MHz microcontroller which was specifically designed to be used in embedded systems such as this one. The advantages of using this processor were that it has two timers, an eight channel A/D converter, and a serial port. The additional functionality of this processor provided for a smaller and more power efficient flight computer.

The flight computer has an address space of 64K: 8K was used for the boot ROM, 32K was used for the program EEPROM (electrically-erasable PROM), 8K was used for battery-backed RAM, and 4K was used for memory mapped I/O. A watchdog timer was also integrated into the flight computer, which would reset the flight computer should the flight program crash. The flight computer also had some signal conditioning hardware to allow the eight A/D channels to be used for housekeeping purposes.

The programming of the flight computer was done via the serial port. Once the flight program was compiled, it was uploaded to the flight computers EEPROM using the ground support computer communicating over a RS-422 link.

2.1.2 Grid Voltage Generator

The solar EUV sensor has three grids which must be biased with varying potentials ranging from approximately -50V to +50V. The Grid Voltage Generator Board has a quadruple 12-bit digital to analog converter (DAC) which produces voltages in the -10V to +10V range. Three high voltage amplifiers were used to amplify these signals to the required levels. The fourth DAC was not used for the rocket mission, but its output signal is available externally should it be required in the future. The Grid Voltage Generator Board also has a programmable timer which generates two shift clocks (one each for the SEUV and the ALP) for the optocoupled electrometers in the VA Generator/Electrometer Boards. In addition, there are buffers which were used to condition the grid voltage signals so that the rocket's telemetry system could monitor these signals during the flight.

2.1.3 VA Generator/Electrometer

The VA Generator/Electrometer Board is a result of extensive work done at SPRL to improve the accuracy and speed of the Langmuir Probe instrument. The VA Generator is constructed similarly to the Grid Voltage Generators except that a single 16-bit DAC is used to allow the VA to have a -65V to +65V ranges with 2mV resolution. The

electrometer makes its measurements while floating on the applied potential. Data signals are optically coupled from the flight computer to the electrometer gain registers and the 12-bit A/D converter. There is also a relay circuit which is used to apply +125V to the sensor to clean the sensor by electron bombardment using ionospheric electrons.

2.1.4 Ground Support Equipment

The ground support equipment for this instrument is contained in a single suitcase with the addition of a notebook sized IBM PC compatible computer. The suitcase contains a power supply and RS-422 to RS-232 interface hardware. The ground support computer is used to develop, compile, and upload object code to the flight computer. In addition, there exists software that allows one to operate the instrument in a laboratory environment where one sends commands to the instrument and receives data back from the instrument via the RS-422 link. This software has the capability of displaying the resulting I-V curves in real-time as well as saving them to disk for later analysis.

2.2 Project Software

The following paragraphs describe the real-time flight control software of the SEUV/ALP instrument . This software was designed to operate the instrument at the highest sampling rate possible without sacrificing instrument reliability, accuracy, and the portability of the flight code. The instrument can operate either in flight mode or test/laboratory mode without reprogramming the flight computer. In flight mode, the instrument steps through a sequence of pre-programmed measurement modes and telemeters the acquired data. In test/laboratory mode, the instrument requires a ground support computer to control the instrument and record measured data.

2.2.1 Overview

The majority of the software was written in a high level language, ANSI C, and was compiled with the Archimedes 80C196 cross-compiler. A high level language was used to reduce software development time. ANSI C was chosen because it is a high level language that is well suited for real-time embedded systems programming. Some assembly language programming was necessary and the Archimedes 80C196 cross-assembler was used to produce object code.

In early development phases of the software, it was decided that the use of a real-time kernel and operating system was not necessary, because it would produce overhead that would reduce the temporal resolution of the instrument. Instead, the instrument was to perform its tasks within a predefined measurement interval. In that interval, current was to

be measured, voltages were to be adjusted, telemetry was to be sent and housekeeping information gathered. This concept allowed the instrument to have temporal resolution that was dictated by the analog hardware and not by the speed of the flight computer.

The flight software was designed in modules or processes (see drawing in Appendix A). Each process or module is a collection of functionally similar tasks or routines, and these processes are described below.

2.2.2 Module Descriptions

MAIN -- This is the highest level control process of the flight software system. This process is initiated upon reset of the system -- either powerup, manual or watchdog timer reset. This process can operate in two modes: flight or bench mode.

After performing all necessary initialization, this process goes into bench mode. In this mode the process awaits for commands from the serial port continuously until a launch signal is detected. The commands are processed and executed by the COMPROC process and can be used to configure or test the instrument during pre-launch operations or to operate the instrument in a laboratory setting for measurements or testing. After the launch signal is detected, this process is in flight mode and measurement sequencing is initiated and controlled by the MODES process. To insure that measurements are made at regular time intervals in flight mode, after the necessary tasks are done, the CPU is placed into a power-conserving sleep mode and wakes up by an interrupt generated by the TIMER process.

COMPROC -- This process parses, limit checks and executes all commands received from the serial port from the SERIAL process. The commands are executed by referencing a function pointer in a lookup table allowing a very flexible and expandable command processor. Currently, there are commands for testing, calibration, hardware debugging, mode debugging, and laboratory measurement programmed in the command processor. The results from these commands are either sent via the SERIAL process to the ground support computer or via the TM process to the telemetry interface.

MODES -- The MODES process executes a pre-programmed sequence of modes . There are two tables (one for the SEUV and one for the ALP) of ordered mode names which are used to control this sequence. These tables can be either compiled in, or programmed by commands in the COMPROC process. This process contols measurement sequencing by communicating to the MODES2 process which step of which mode is to be executed. The current measurement mode and step are stored in zero-powered RAM to allow the instrument to continue operation where it left off after a power failure or a watchdog timer reset.

The mode names are stored in a table also, along with function pointers and other information, to facilitate the addition of new modes.

MODES2 -- This module is not a single process but a collection of processes that control the activities necessary to perform scientific measurements (adjusting gains, setting applied voltages, measuring currents) by executing I/O routines. Each measurement mode process is controlled by a mode step number that is received from the MODES process. The modes that are programmed in this module are specified by the *Modes of Operation* document (see Appendix B).

TM -- The process generates and transmits telemetry either over the dedicated telemetry channel or via the serial port. The SEUV/ALP instrument uses packet telemetry conforming to the Consultative Committee's on Space Data Systems (CCSDS) packet telemetry standard as specified in the CCSDS 102.0-B-2 Blue Book. This telemetry system uses packet error control as specified in the CCSDS 100.0-G-1 Green book. This process assembles data into packets and when completed, copies the assembled packets into the telemetry system interface hardware.

SERIAL -- This is an Interrupt Service Routine(ISR) module whose task is to receive data from the serial command port and transmit it to the COMPROC process, and to send data back to the ground support equipment during testing and laboratory measurement setups. To maximize the throughput and efficiency, this process was programmed in 80C916 assembly language.

TIMER -- This ISR module initializes the CPU's timers and acknowledges interrupts from the CPU. The timers are used to provide an instrument clock which ensures that current measurements are made at regular time intervals, and to provide a start time for all measurement modes which simplifies the data analysis process. This module was programmed in assembly language also.

I/O -- This module is a collection of routines that communicate directly with the instrument hardware (VA generators, A/D converters, registers, timers, etc.). The purpose of this module was to keep all device dependent programming together to reduce the effort necessary to modify the flight code for various hardware configurations. Any calibration information used in the instrument is also contained in this module.

2.3 Flight Experiment Details

The combined SEUV/ALP instrument was part of Dr. William Sharp's sounding rocket mission 27.133 UE. The instrument was piggybacked onto Dr. Sharp's payload and was launched by a Nike-Black Brant VC from Poker Flat Research Range (65°07'N 147°28'W) at 206:13:36:00 UT 1992. The payload achieved an apogee of 233.36 km,

and was successfully recovered with the SEUV/ALP instrument not sustaining any damage.

The instrument was partially successful in achieving its objectives which were twofold: to acquire SEUV data to verify the measurement model, and to perform an engineering test of the combined SEUV/ALP electronics. A satisfactory number of SEUV measurements were made, and are currently being processed. Due to a component failure, the ALP channel failed and no measurements were made. However this does not constitute a failure to meet the second objective since an identical unit which was used to measure SEUV currents did not fail.

APPENDIX A

System Specifications and Block Diagrams

Langmuir Probe/Solar EUV Electronics Data Sheet

- **Applied Voltage Generators:** 2 Generators with 16 bits of resolution
  Range: -65.536V to 65.534V in 2mV increments

- **Grid Voltage Generators:** 3 Generators with 12 bits of resolution
  Range: -51.200V to 51.175V in 25mV increments

- **Electrometers:** 2 Electrometers sampled with 12 bits resolution
  Range 1: -66μA to +66μA
  Range 2: -4μA to +4μA
  Range 3: -200nA to +200nA
  Range 4: -15nA to +15nA

- **Flight Computer:** Custom Computer based on Intel 80C196 12MHz processor w/watchdog timer
  32K of EEPROM Program Memory
  8K of Boot/Loader ROM
  8K of Battery Backed RAM

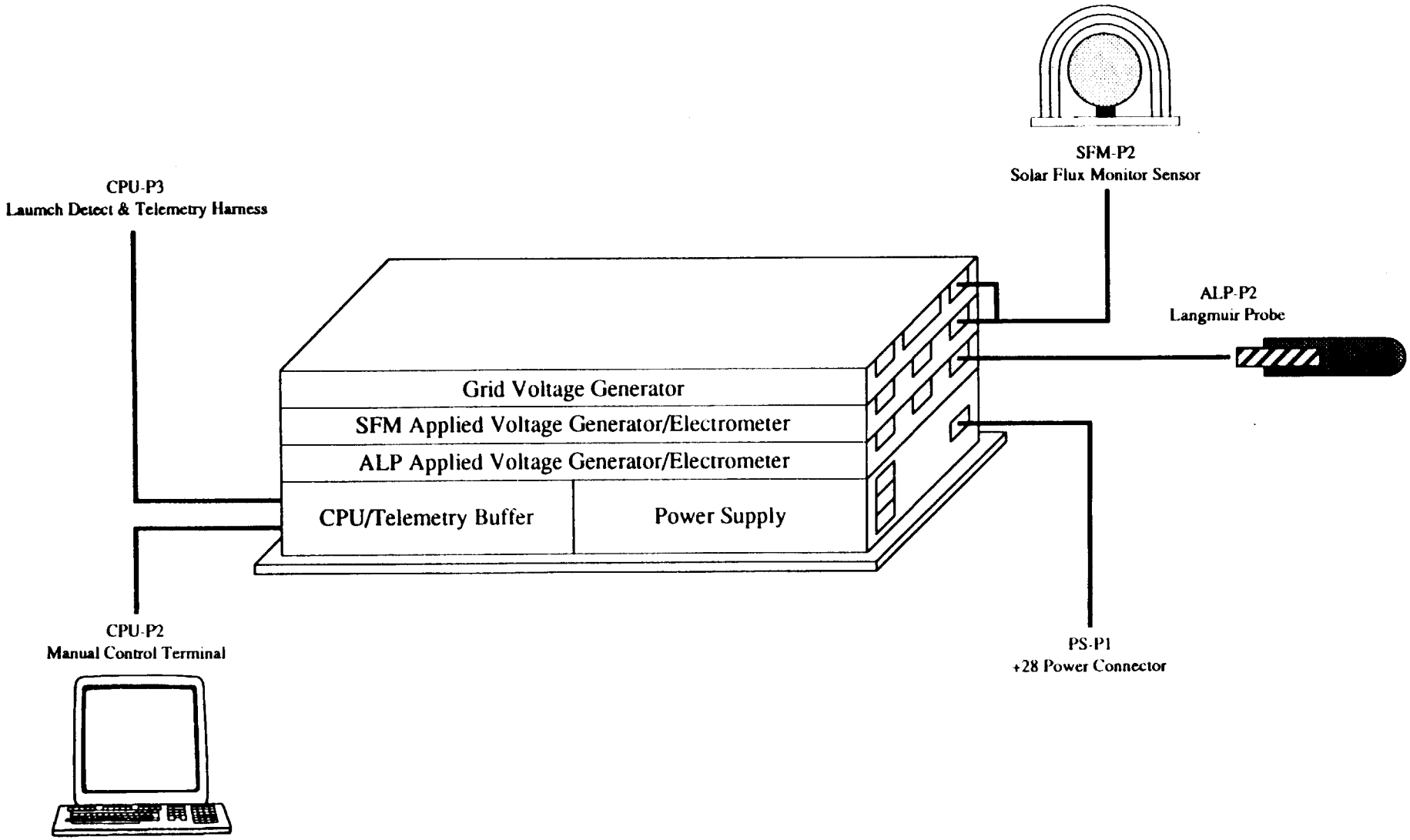
- **Telemetry/Command Interface:** Serial TM Interface to PCM stack at 1250 bytes/sec
  (Packet TM conforming to CCSDS 102.0-B-2 standard)
  Serial RS-422 Command/TM Interface at 9600 baud

- **Size of Electronics:** 10.180" (L) x 5.930"(W) x 5.610"(H)

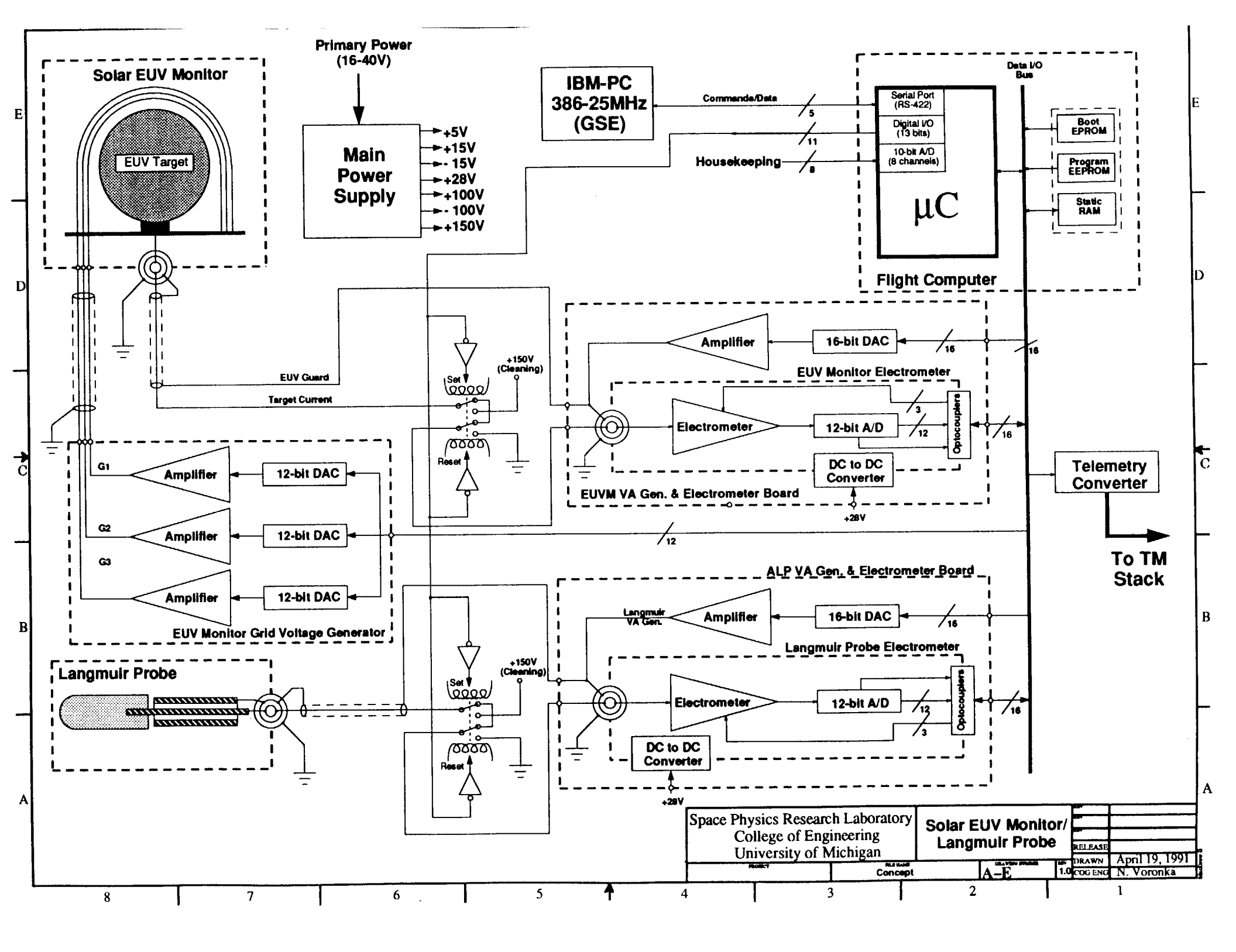
- **Mass of Electronics:** 3.75 kg

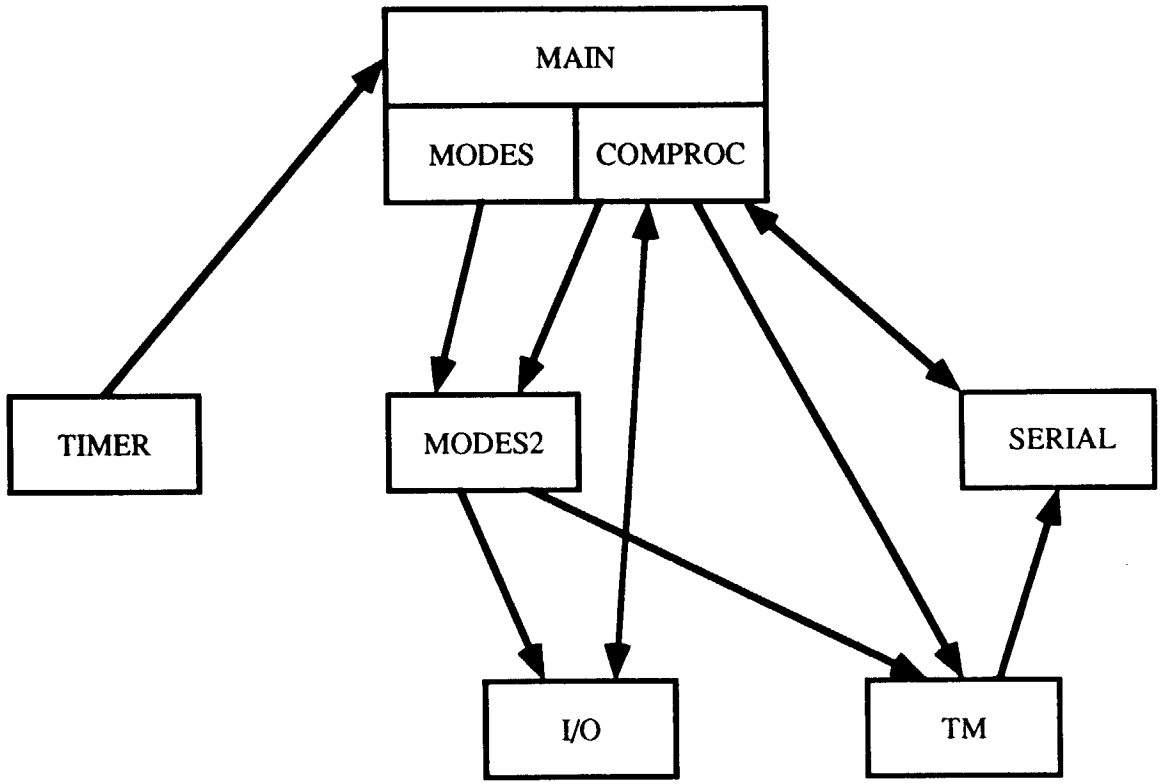
- **Power Consumption:**

(2) V_a Generator/Electrometers	2.10 W
Grid Voltage Generators	2.94 W
CPU/Telemetry	2.23 W



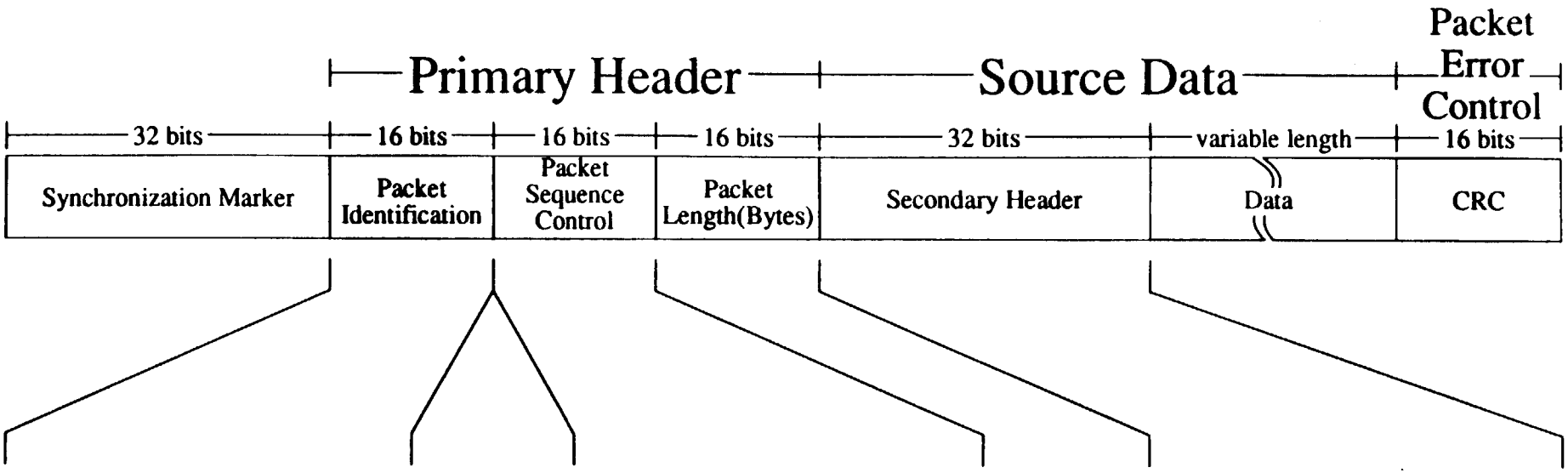
Space Physics Research Laboratory College of Engineering University of Michigan		SFM/ALP Instrument Interface	
SFM/ALP		A-E	DRAWN ENG N. VORONKA


Solar EUV Monitor
EUV Target
Primary Power
(16-40V)
Main
Power
Supply
+5V
+15V
- 15V
+28V
+100V
- 100V
+150V
IBM-PC
386-25MHz
(GSE)
Commands/Data
5
11
Housekeeping
8
Serial Port
(RS-422)
Digital I/O
(13 bits)
10-bit A/D
(8 channels)
µC
Flight Computer
Data I/O
Bus
Boot
EPROM
Program
EEPROM
Static
RAM
EUV Guard
Target Current
Set
+150V
(Cleaning)
Reset
Amplifier
16-bit DAC
16
EUV Monitor Electrometer
Electrometer
12-bit A/D
3
12
Optocouplers
DC to DC
Converter
EUVM VA Gen. & Electrometer Board
+28V
Telemetry
Converter
To TM
Stack
G1
G2
G3
12-bit DAC
EUV Monitor Grid Voltage Generator
ALP VA Gen. & Electrometer Board
Langmuir
VA Gen.
Langmuir Probe Electrometer
Langmuir Probe
Space Physics Research Laboratory
College of Engineering
University of Michigan
Solar EUV Monitor/
Langmuir Probe
RELEASE
DRAWN
April 19, 1991
COG ENG
N. Voronka
Concept
A-E
1.0



Process Name	Description
MAIN	High Level Control
COMPROC	Terminal Command Processing
MODES	Mode Sequencer
MODE S2	Measurement Mode Execution
TM	Telemetry Processing
SERIAL	Serial Port ISRs
TIMER	Timer ISRs
I/O	Hardware Interface Library

Space Physics Research Laboratory College of Engineering University of Michigan	SFM/ALP Flight Software Overview		
		RELEASE	
		DRAWN	December 3, 1992
SFM/ALP	A-E	COG ENG	N. VORONKA



Packet Identification			
Version #	Packet Type	Secondary Header Flag	Application Process ID
3	1	1	11
000	0	1	00111110000 -- SFM 01000001111 -- ALP 11111111111 -- Idle 10010010101 -- Housekeeping

Packet Sequence Control	
Segmentation Flags	Source Sequence Count
2	14
00-- Continuation Segment 01-- First Segment 10-- Last Segment 11-- Unsegmented Packet	

Secondary Header (User Defined)			
Version	Header Length	Mode #	Time Stamp
2	6	8	16
00	000011	x23 -- SFM_STD x2B -- SFM_HR x26 -- SFM_GT x29 -- SFM_GS x27 -- SFM_RPA x2E -- SFM_CLN x40 -- ALP_5PT x41 -- ALP_STD x42 -- ALP_HR x44 -- ALP_MR x48 -- ALP_CLN	

Notes:

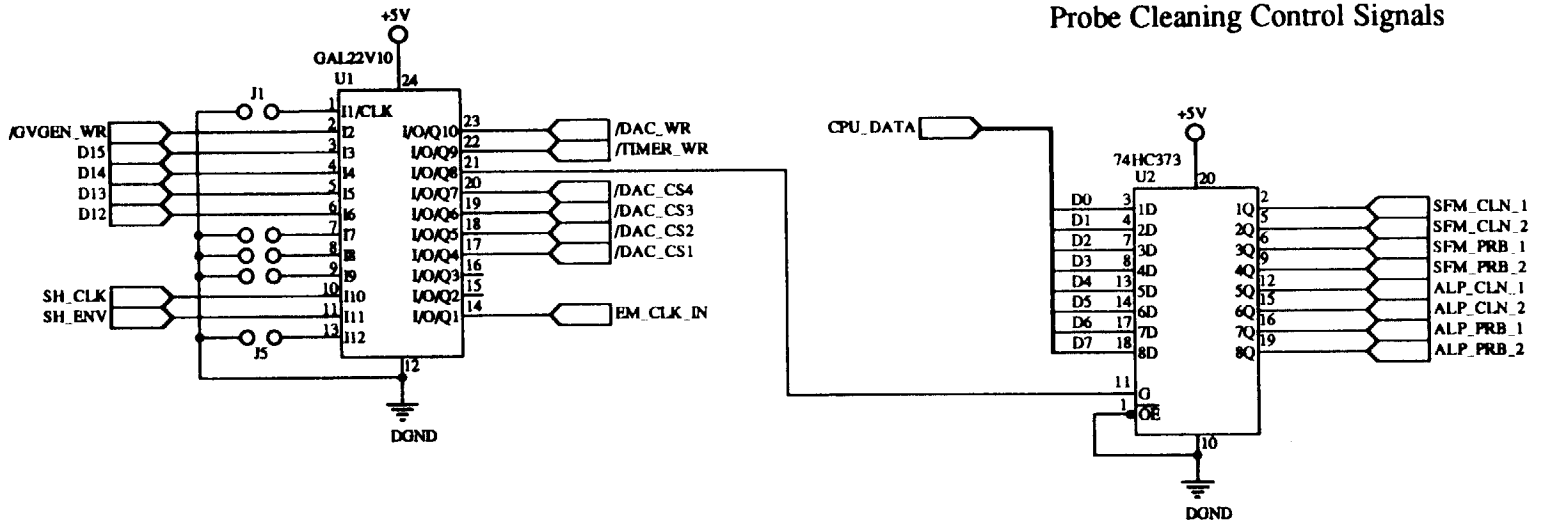
1. The above format conforms to the CCSDS Packet Telemetry format as specified in the CCSDS 102.0-B-2 Blue Book (January 1987).
2. The Frame Synchronization Marker when NOT using Reed-Solomon Encoding is 0x1ACFFC1D.
3. The error control word is a cyclic redundancy code generated using the genenerator polynomial specified in the CCSDS Telemetry 100.0-G-1 Green Book (December 1987.)

Space Physics Research Laboratory College of Engineering University of Michigan	SFM/ALP Packet Telemetry Data Format	RELEASE
SFM/ALP	A-E	DRAWN COG ENG N. VORONKA

APPENDIX B

SEUV/ALP Electrical Drawings

Probe Cleaning Control Signals

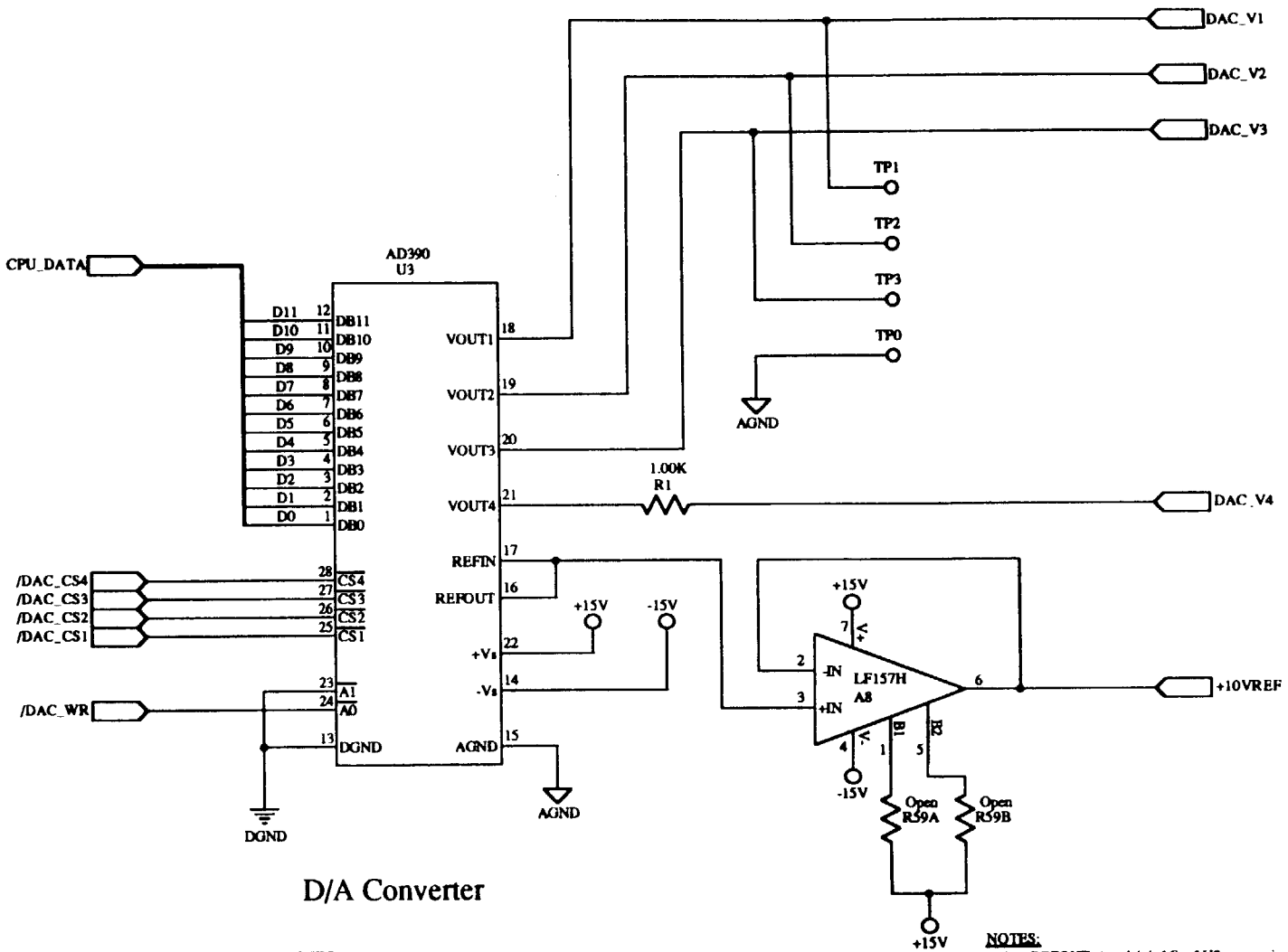


To write to:	Data must be of the form
Programmable Timer	00XXXXAADDDDDDDD
Quadruple DAC	01AADDDDDDDDDDDD
Octal Latch	10XXXXXXDDDDDDDD

NOTES:
1. Unless otherwise specified, all resistors are type RNC55 and all capacitors are type CKR05.

Space Physics Research Laboratory College of Engineering University of Michigan	Decoding PAL & Latch Grid Voltage Generator Solar Flux Monitor	REV	
		REV	
		CONTROL	
		RELEASE	
		DRAWN	Dec. 31,1991
PROJECT NAME: SFM/ALP	FILE NAME:	DRAWING NUMBER:	ENGINEER: N. Voronka

1.1

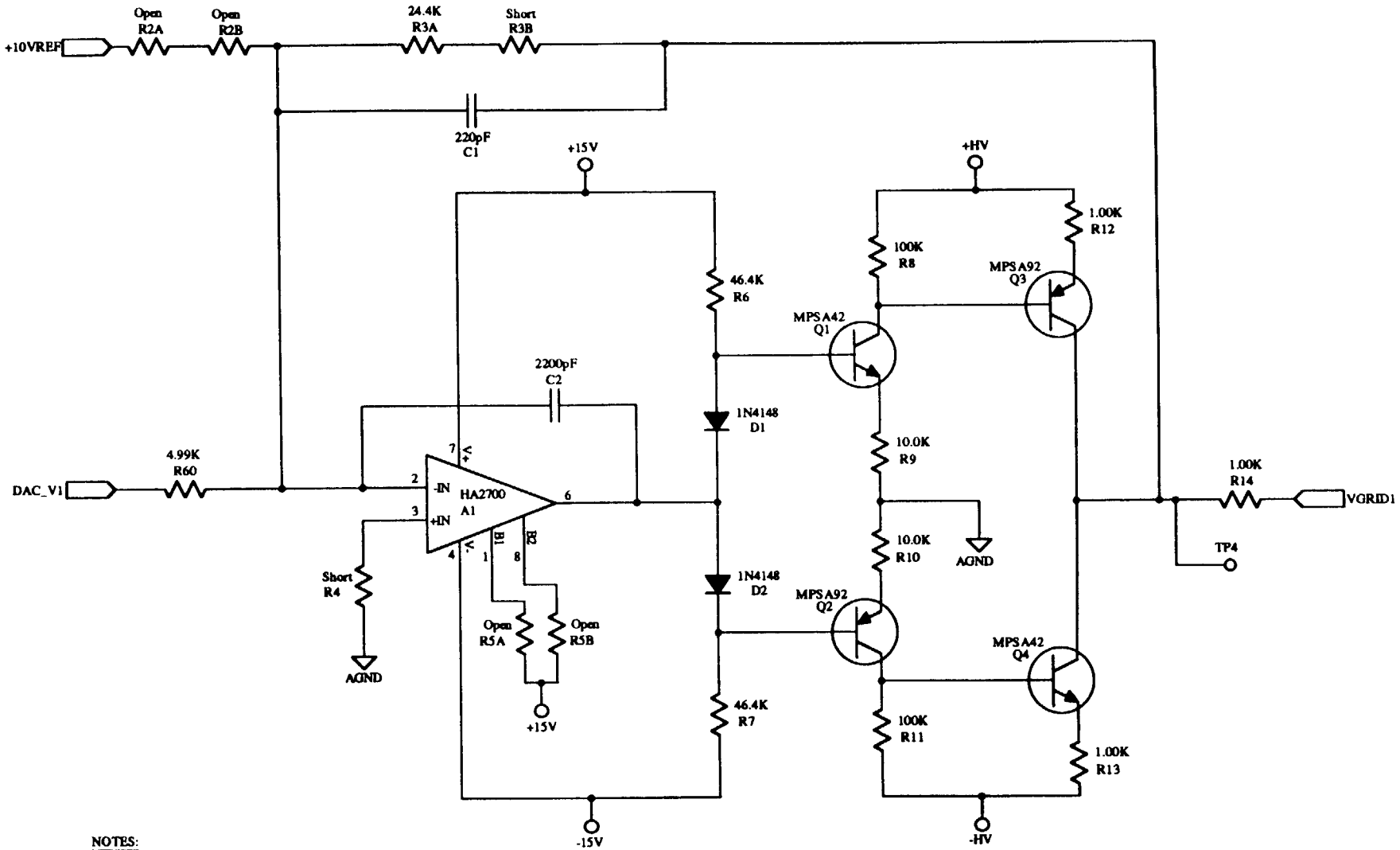


D/A Converter

To write to:	Data must be of the form
Programmable Timer	00XXXXAADDDDDDDD
Quadruple DAC	01AADDDDDDDDDDDD
Octal Latch	10XXXXXXDDDDDDDD

NOTES:
1. The REFOUT signal (pin16) of U3 can typically tolerate 3.5mA for external use.

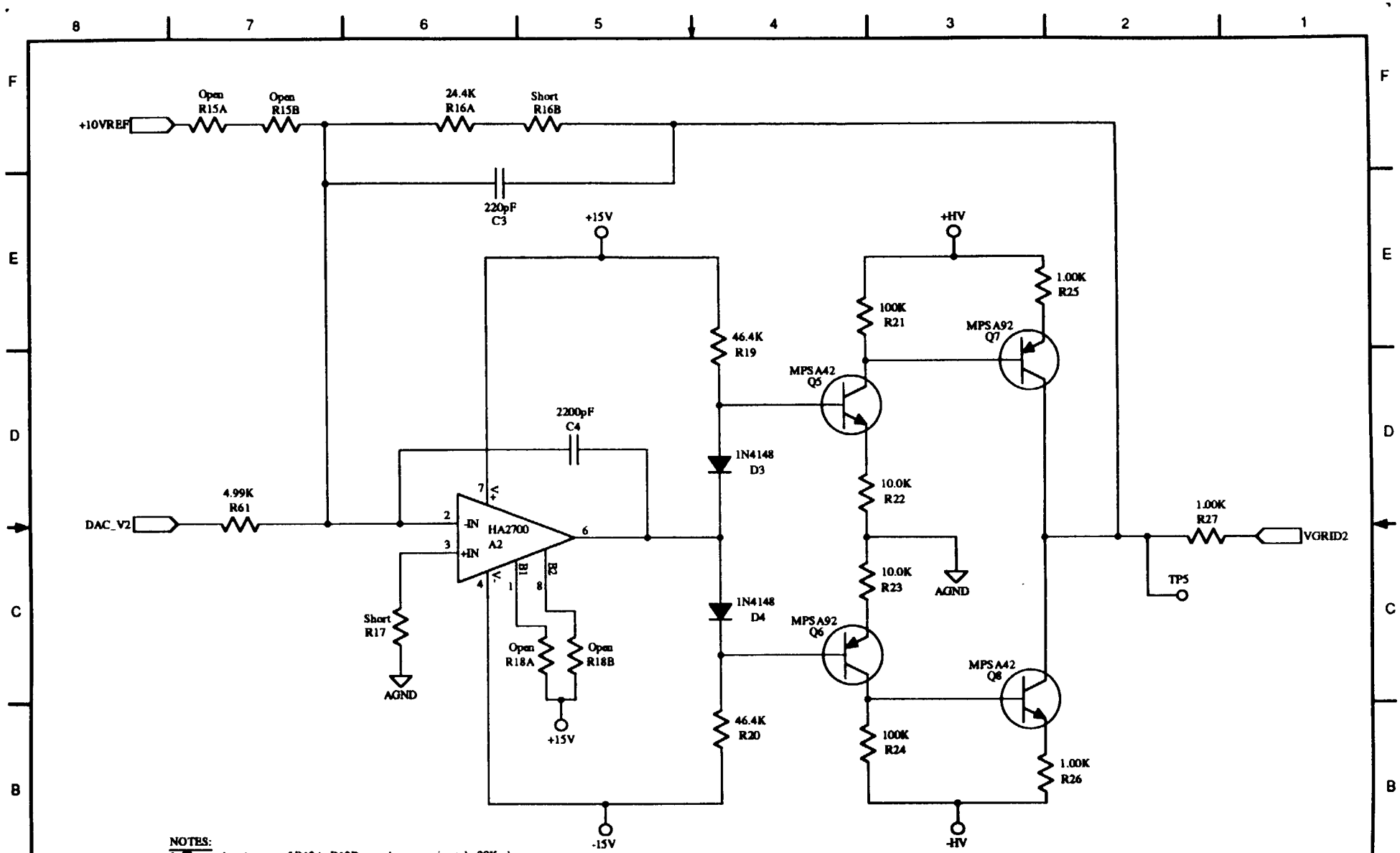
Space Physics Research Laboratory College of Engineering University of Michigan	D/A Converter Grid Voltage Generator Solar Flux Monitor	REV Nov 14, 1992 REV CONTROL RELEASE DRAWN Sept 15, 1991 ENGINEER N. Voronka
PROJECT NUMBER SFM/ALP	PART NUMBER	DRAWING NUMBER 1.2



NOTES:
1. The total resistance of R5A+R5B must be approximately 20K ohms.

Space Physics Research Laboratory College of Engineering University of Michigan	Grid 1 Bipolar Amplifier Grid Voltage Generator Solar Flux Monitor	REV	Nov 14, 1992
		REV	
		CONTROL	
		RELEASE	
PROJECT NUMBER: SFM/ALP	FILE NUMBER	DRAWING NUMBER	DRAWN: Sept 15,1991
			ENGINEER: Block/Voronka

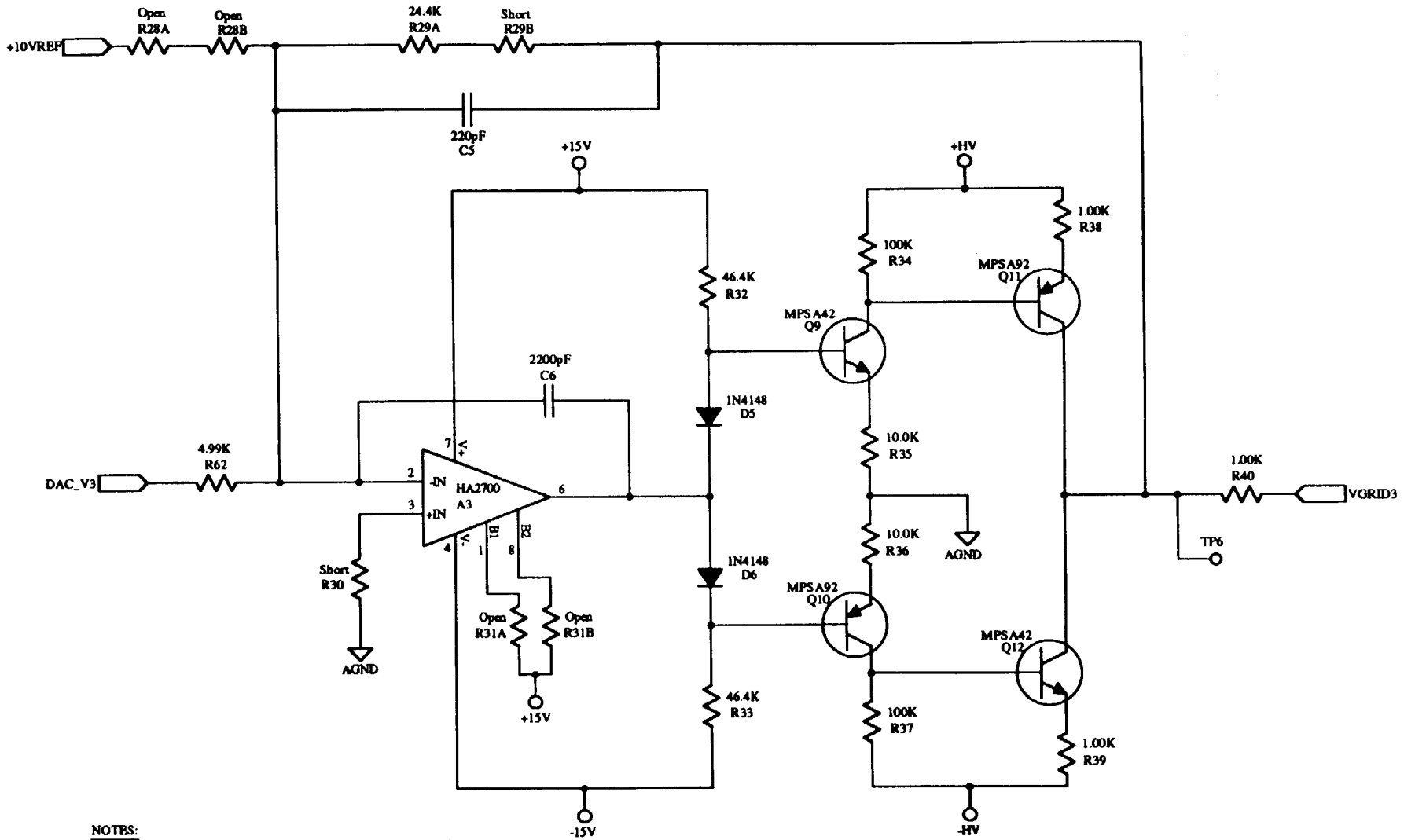
1.3

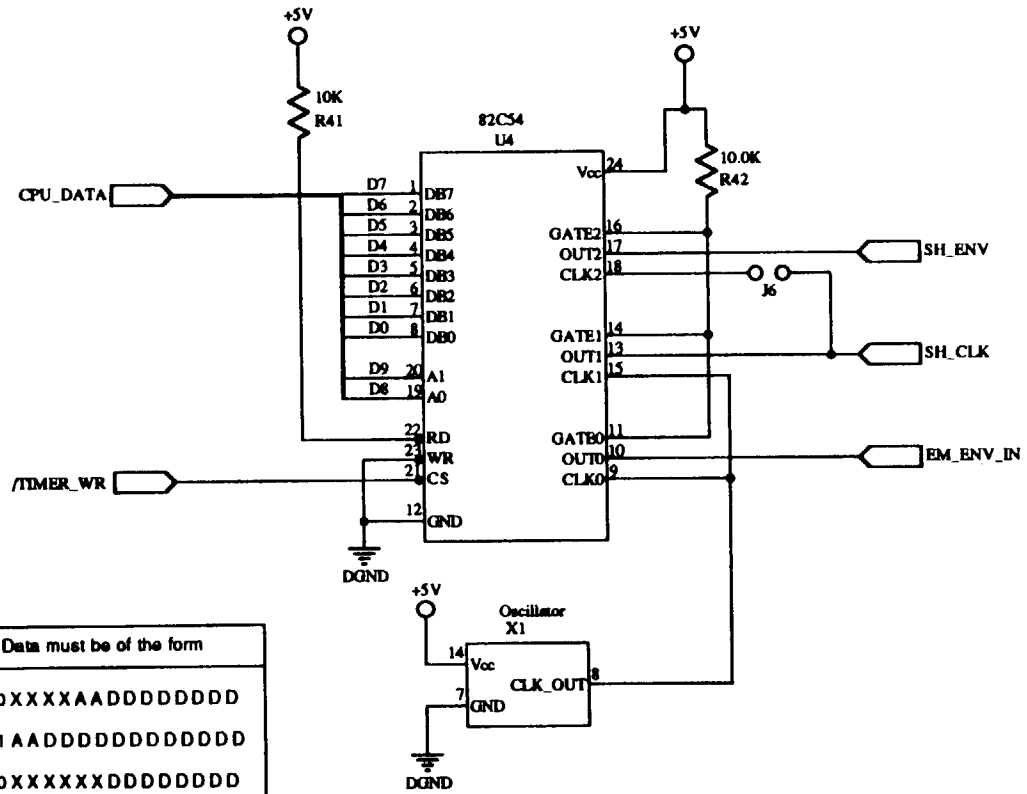


NOTES:
1. The total resistance of R18A+R18B must be approximately 20K ohms.

Space Physics Research Laboratory College of Engineering University of Michigan	Grid 2 Bipolar Amplifier Grid Voltage Generator Solar Flux Monitor	REV	Nov 14, 1992
		REV	
		CONTR'LD	
		RELEASE	
		DRAWN	Sept 15,1991
SPM/ALP		ENGINEER	Block/Voronka

1.4


+10VREF
Open
R28A
Open
R28B
24.4K
R29A
Short
R29B
220pF
C5
+15V
+HV
46.4K
R32
100K
R34
1.00K
R38
MPSA92
Q11
MPSA42
Q9
2200pF
C6
1N4148
D5
10.0K
R35
4.99K
R62
DAC_V3
HA2700
A3
1.00K
R40
VGRID3
TP6
10.0K
R36
AGND
Short
R30
1N4148
D6
MPSA92
Q10
MPSA42
Q12
Open
R31A
Open
R31B
46.4K
R33
100K
R37
1.00K
R39
-15V
-HV
NOTES:
1. The total resistance of R31A+R31B must be approximately 20K ohms.
Space Physics Research Laboratory
College of Engineering
University of Michigan
Grid 3 Bipolar Amplifier
Grid Voltage Generator
Solar Flux Monitor
SFM/ALP
Nov 14, 1992
Sept 15,1991
Block/Voronka
1.5

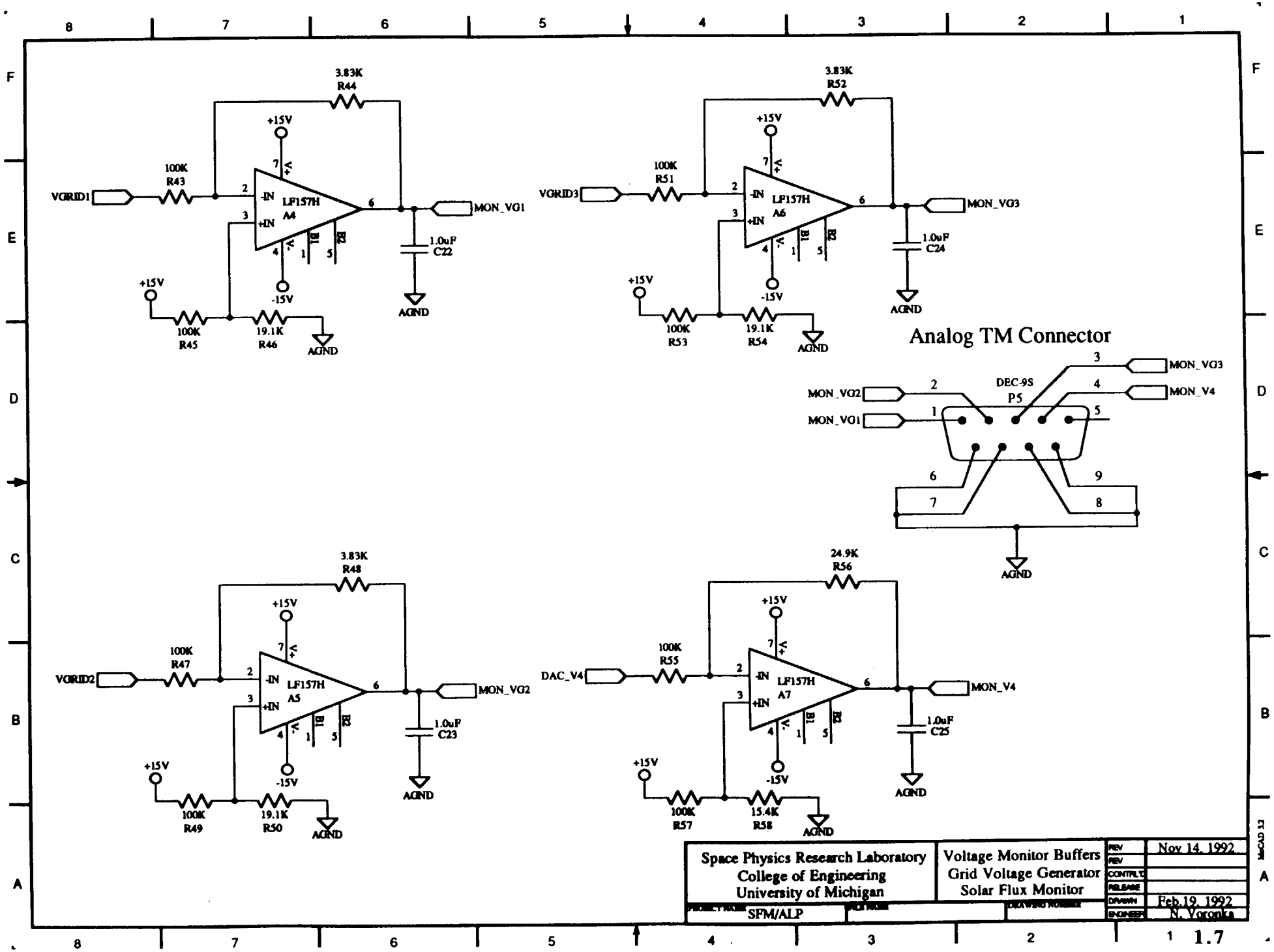


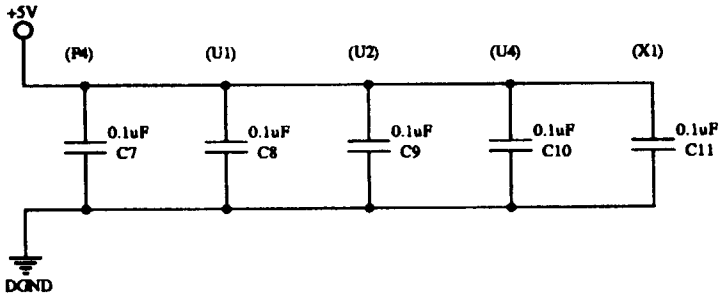
To write to:	Data must be of the form
Programmable Timer	00XXXXAADDDDDDDD
Quadruple DAC	01AADDDDDDDDDDDD
Octal Latch	10XXXXXXDDDDDDDD

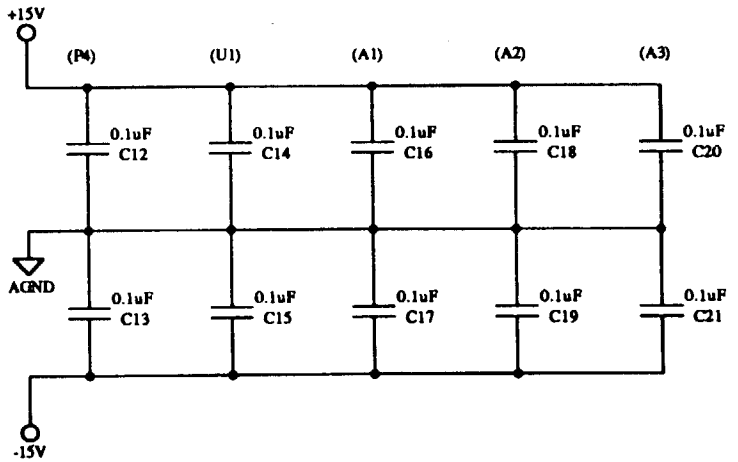
Space Physics Research Laboratory College of Engineering University of Michigan	Programmable Clock Grid Voltage Generator Solar Flux Monitor	REV	
		REV	
		CONTR'D	
		RELEASE	
PROJECT NAME: SFM/ALP	FILE NAME	DRAWING NUMBER	DRAWN: Oct. 12, 1991 ENGINEER: N. Voronka

MicCAD 3.2

1.6


3.83K
R44
+15V
100K
R43
VGRID1
LF157H
A4
MON_VG1
1.0uF
C22
AGND
-15V
100K
R45
19.1K
R46
3.83K
R52
VGRID3
LF157H
A6
MON_VG3
1.0uF
C24
100K
R53
19.1K
R54
Analog TM Connector
DEC-9S
P5
MON_VG3
MON_VG2
MON_V4
MON_VG1
3.83K
R48
VGRID2
LF157H
A5
MON_VG2
1.0uF
C23
100K
R49
19.1K
R50
24.9K
R56
DAC_V4
LF157H
A7
MON_V4
1.0uF
C25
100K
R57
15.4K
R58
Space Physics Research Laboratory
College of Engineering
University of Michigan
Voltage Monitor Buffers
Grid Voltage Generator
Solar Flux Monitor
SFM/ALP
Nov 14, 1992
Feb 19, 1992
N. Voronka
1.7

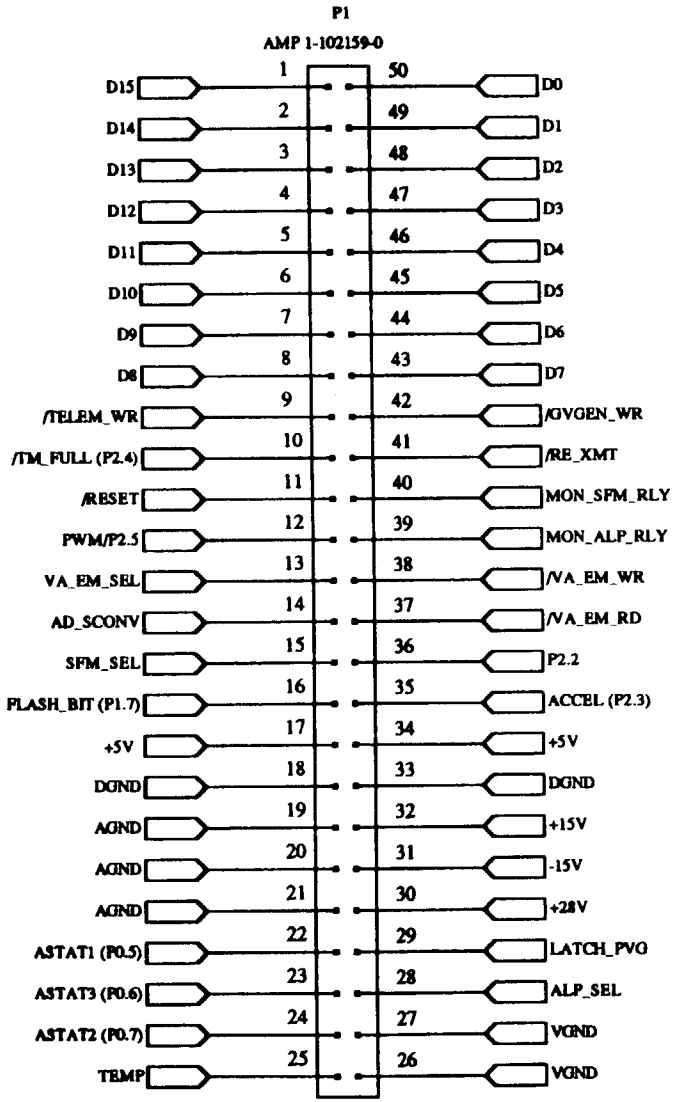




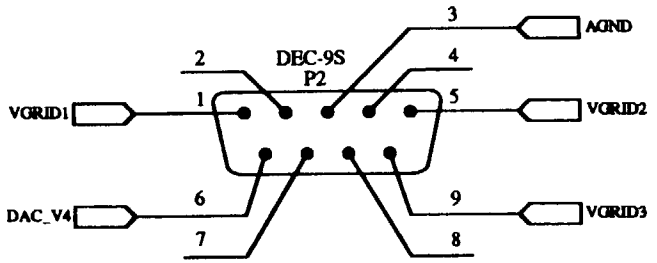
Space Physics Research Laboratory College of Engineering University of Michigan	Power Supply Filters Grid Voltage Generator Solar Flux Monitor
PROJECT NAME: SFM/ALP	PLOT NAME:
DRAWING NUMBER:	REV / REV / CONTR'D / RELEASE / DRAWN: Feb 20,1991 / ENGINEER: N. Voronka

1.8

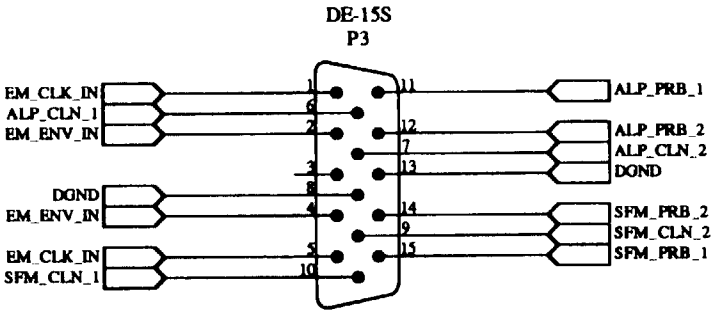
CPU Bus Connector



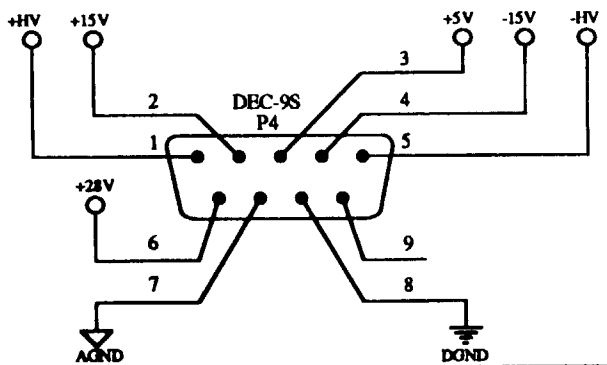
Grid Voltage Connector



Relay Control & Shift Clock Connector

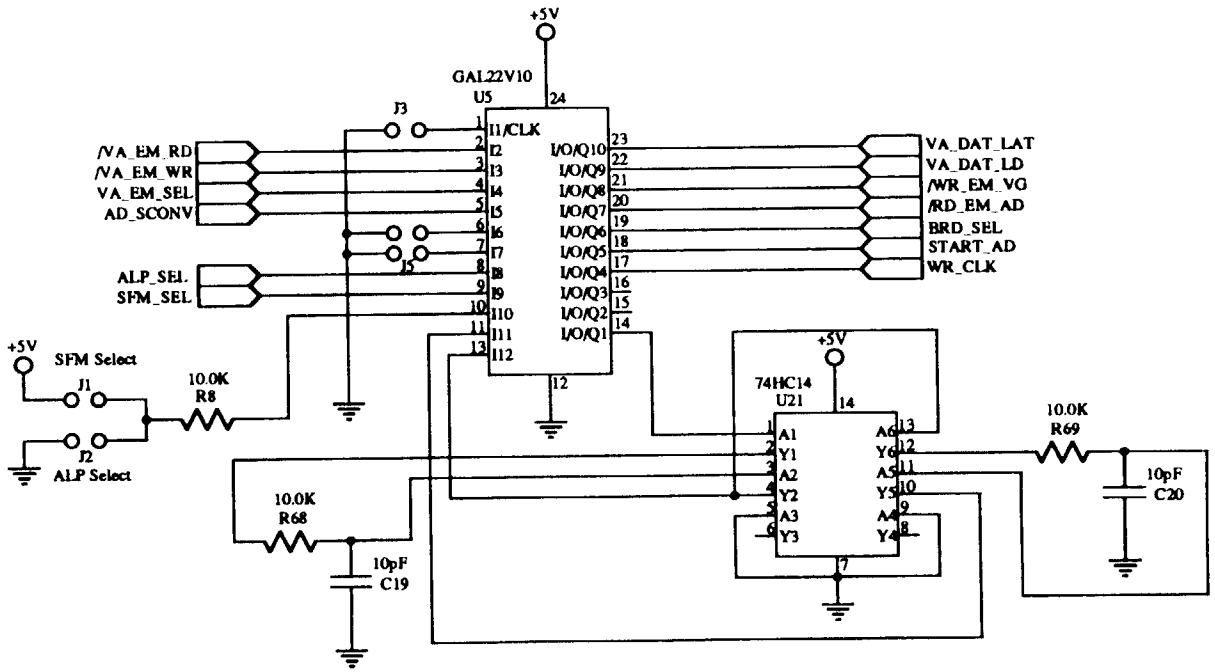


Power Supply Connector



Space Physics Research Laboratory College of Engineering University of Michigan	Connectors Grid Voltage Generator Solar Flux Monitor	REV	Nov 14, 1992
		REV	
		CONTR'D	
		RELEASE	
		DRAWN	Sept 14,1991
PROJECT NAME: SFM/ALP	FILE NAME	DRAWING NUMBER	ENGINEER: N. Voronka

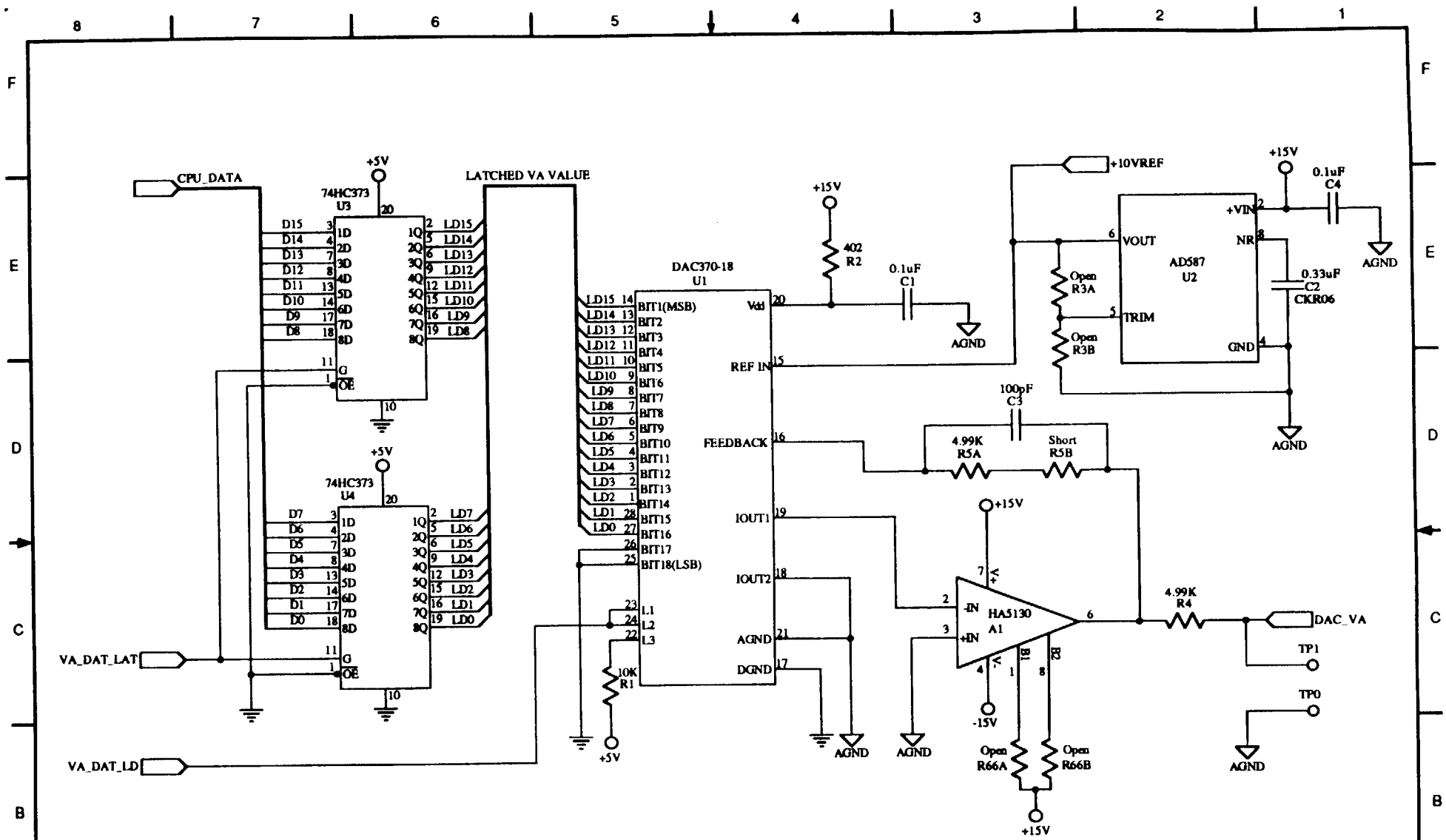
1.9

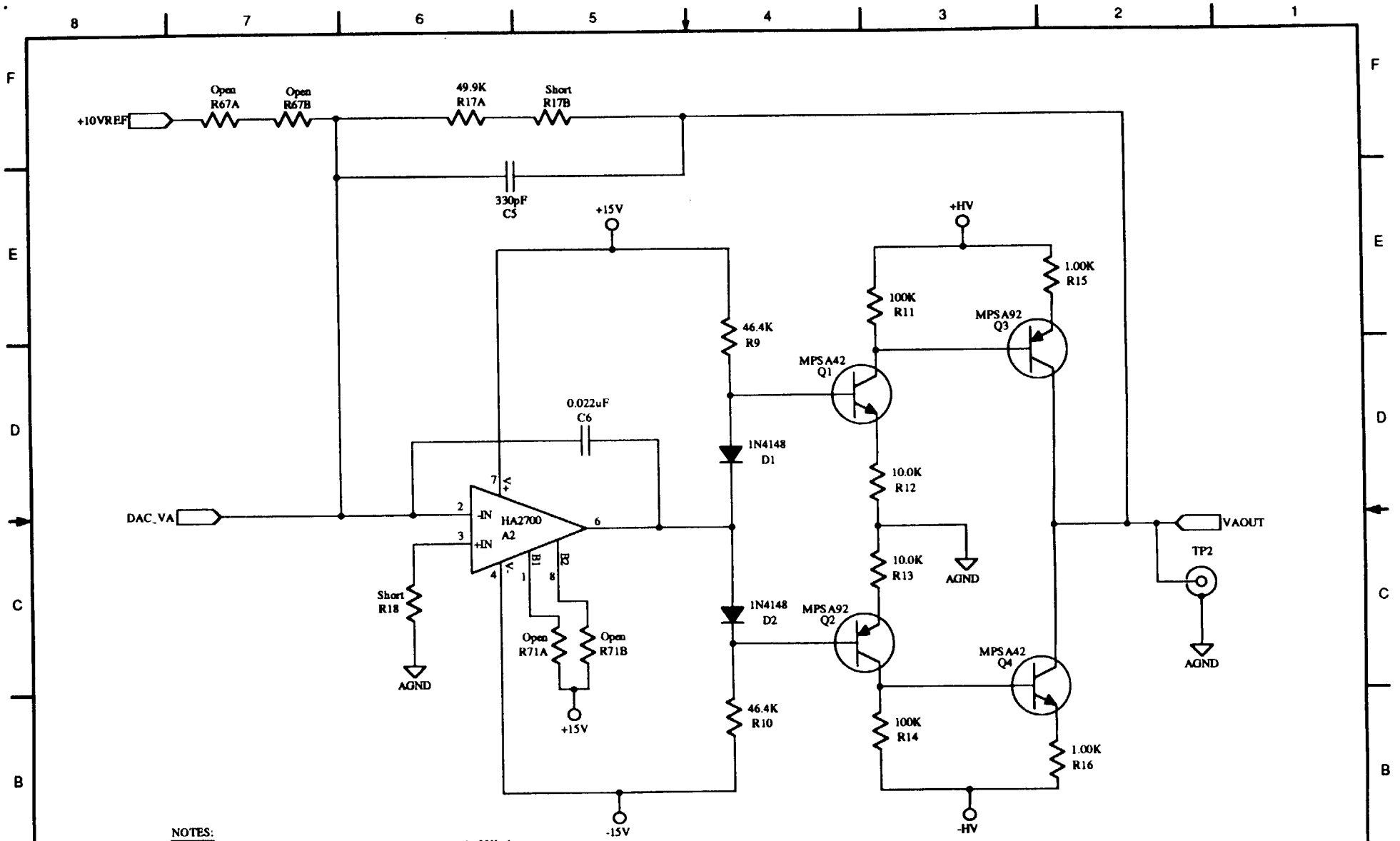


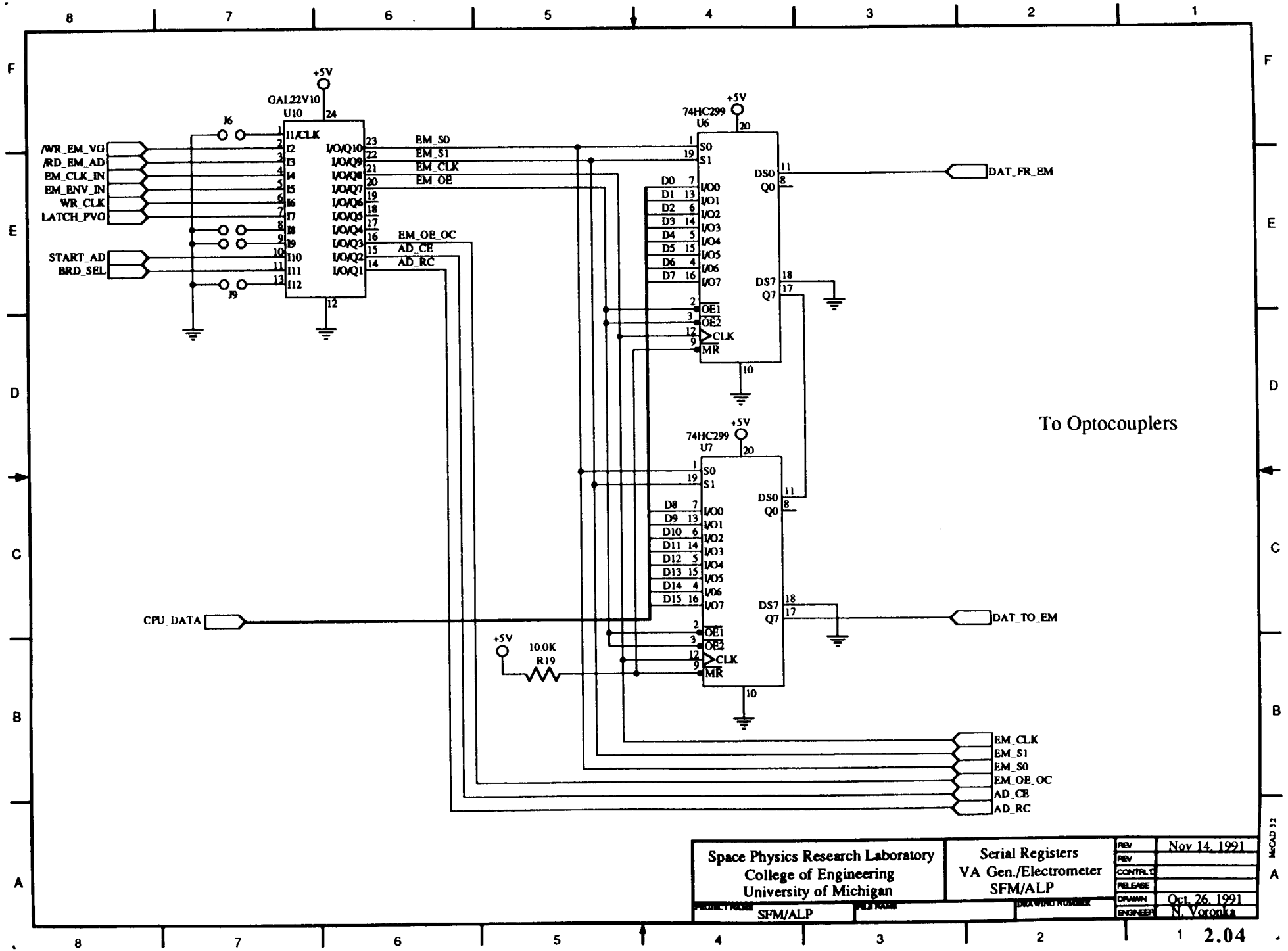
NOTES:
1. Unless otherwise specified, all resistors are type RNC55 and all capacitors are type CKR05.

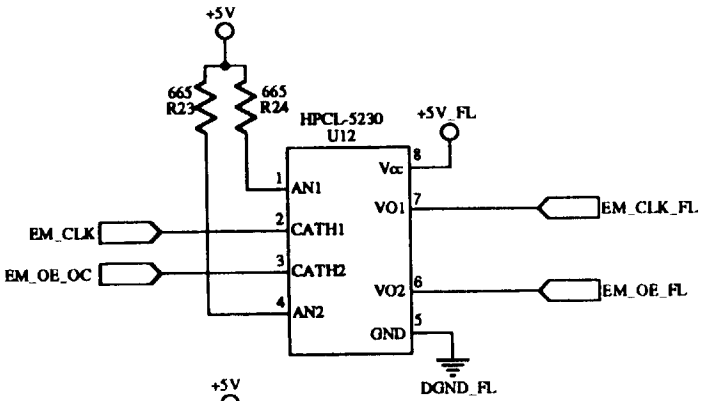
Space Physics Research Laboratory College of Engineering University of Michigan	Control Logic VA Gen./Electrometer SFM/ALP	REV	Nov 14, 1991
		REV	
		CONTR'D	
		RELEASE	
		DRAWN	Sept 19, 1991
PROJECT NUMBER: SFM/ALP	PART NUMBER	DRAWING NUMBER	ENGINEER: N. Voronka

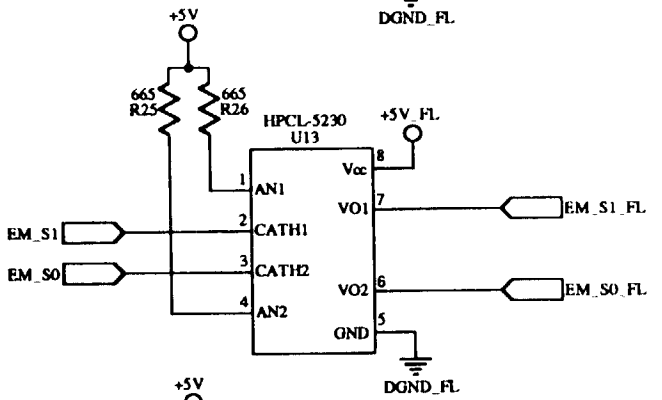
2.01

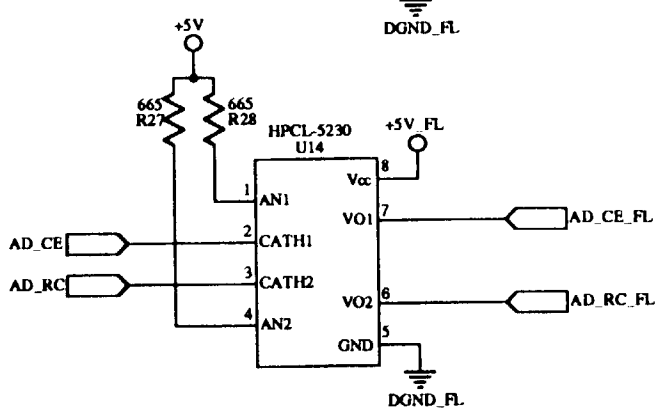

CPU_DATA
74HC373
U3
+5V
LATCHED VA VALUE
74HC373
U4
VA_DAT_LAT
VA_DAT_LD
DAC370-18
U1
BIT1(MSB)
REF IN
FEEDBACK
IOUT1
IOUT2
AGND
DGND
Vdd
402
R2
0.1uF
C1
10K
R1
+10VREF
AD587
U2
+VIN
VOUT
TRIM
NR
GND
Open
R3A
Open
R3B
0.1uF
C4
0.33uF
C2
CKR06
100pF
C3
4.99K
R5A
Short
R5B
HA5130
A1
-IN
+IN
4.99K
R4
DAC_VA
TP1
TP0
Open
R66A
Open
R66B
-15V
NOTES:
1. The total resistance of R3A+R3B must be approximately 10K ohms.
2. The total resistance of R66A+R66B must be approximately 20K ohms.
Space Physics Research Laboratory
College of Engineering
University of Michigan
VA Generator DAC
VA Gen./Electrometer
SFM/ALP
SFM/ALP
Nov 14, 1991
Sept 19, 1991
Block Veronika
2.02


+10VREF
Open
R67A
Open
R67B
49.9K
R17A
Short
R17B
330pF
C5
+15V
+HV
1.00K
R15
100K
R11
MPSA92
Q3
46.4K
R9
MPSA42
Q1
0.022uF
C6
1N4148
D1
10.0K
R12
DAC_VA
HA2700
A2
-IN
+IN
V+
V-
B1
B2
VAOUT
TP2
10.0K
R13
AGND
Short
R18
1N4148
D2
MPSA92
Q2
MPSA42
Q4
Open
R71A
Open
R71B
46.4K
R10
100K
R14
1.00K
R16
-15V
-HV
NOTES:
1. The total resistance of R71A+R71B must be approximately 20K ohms.
Space Physics Research Laboratory
College of Engineering
University of Michigan
VA Bipolar Amplifier
VA Gen./Electrometer
SFM/ALP
REV
Nov 14, 1991
CONTR'LD
RELEASE
DRAWN
Sept 17, 1991
ENGINEER
Block/Veronika
SFM/ALP
2.03

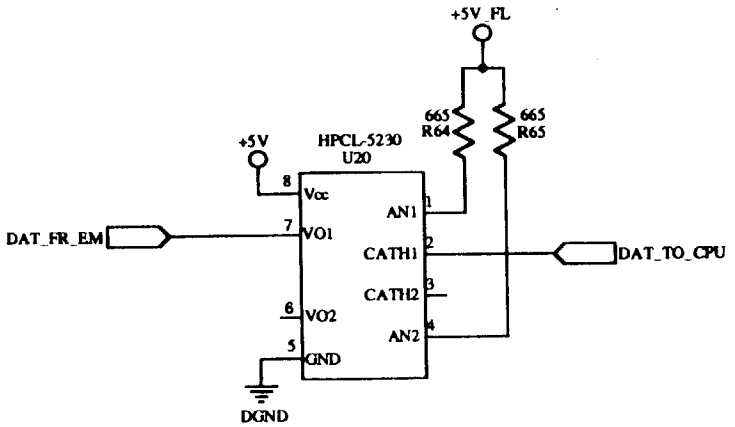

+5V
GAL22V10
U10
J6
/WR_EM_VG
/RD_EM_AD
EM_CLK_IN
EM_ENV_IN
WR_CLK
LATCH_PVG
START_AD
BRD_SEL
J9
I1/CLK
I2
I3
I4
I5
I6
I7
I8
I9
I10
I11
I12
I/O/Q10
I/O/Q9
I/O/Q8
I/O/Q7
I/O/Q6
I/O/Q5
I/O/Q4
I/O/Q3
I/O/Q2
I/O/Q1
EM_S0
EM_S1
EM_CLK
EM_OE
EM_OE_OC
AD_CE
AD_RC
74HC299
U6
74HC299
U7
S0
S1
D0
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
D13
D14
D15
I/O0
I/O1
I/O2
I/O3
I/O4
I/O5
I/O6
I/O7
DS0
Q0
DS7
Q7
OE1
OE2
CLK
MR
DAT_FR_EM
DAT_TO_EM
CPU_DATA
10.0K
R19
To Optocouplers
EM_CLK
EM_S1
EM_S0
EM_OE_OC
AD_CE
AD_RC
Space Physics Research Laboratory
College of Engineering
University of Michigan
Serial Registers
VA Gen./Electrometer
SFM/ALP
REV
Nov 14, 1991
CONTR'D
RELEASE
DRAWN
Oct 26, 1991
ENGINEER
N. Voronka
PROJECT NUMBER
SFM/ALP
DRAWING NUMBER
2.04

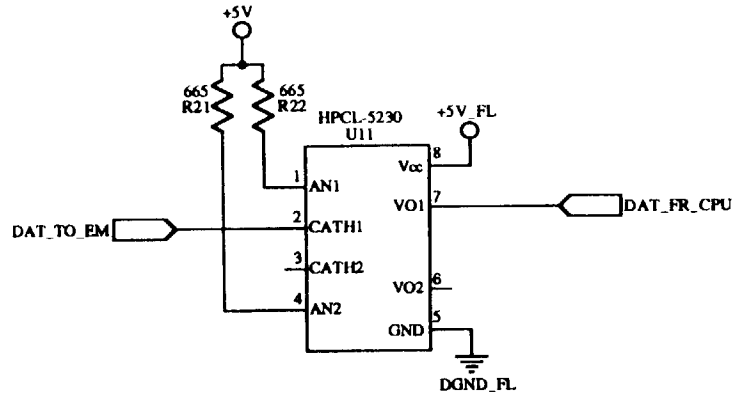






Control Signals

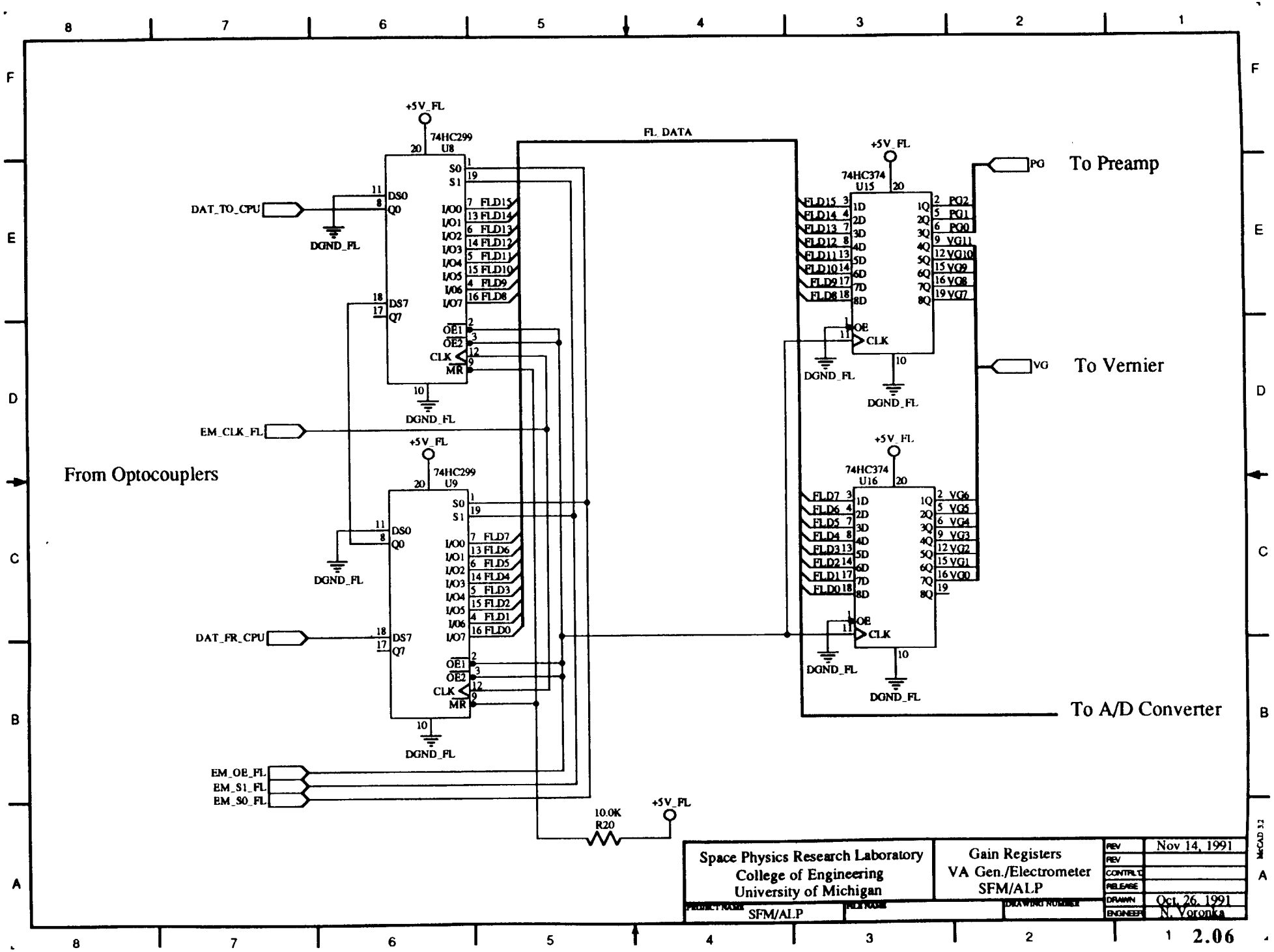


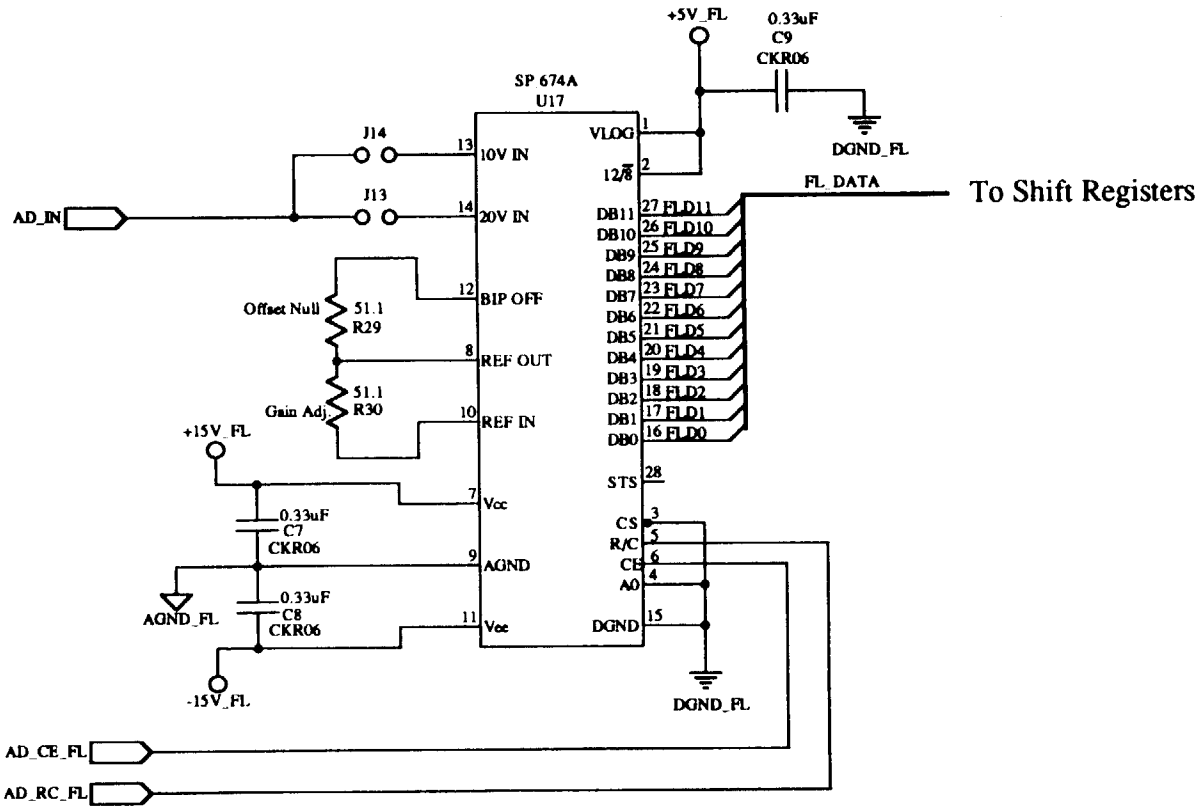


Data Signals

Space Physics Research Laboratory College of Engineering University of Michigan	Optocoupler Interface VA Gen./Electrometer SFM/ALP	REV REV CONTRLG RELEASE DRAWN Oct. 26, 1991 ENGINEER N. Voronka
PROJECT NAME SFM/ALP	PART NAME	DRAWING NUMBER 2.05

McCAD 3.1


From Optocouplers
DAT_TO_CPU
EM_CLK_FL
DAT_FR_CPU
EM_OE_FL
EM_S1_FL
EM_S0_FL
74HC299
U8
U9
+5V_FL
DGND_FL
DS0
DS7
Q0
Q7
S0
S1
I/O0
I/O1
I/O2
I/O3
I/O4
I/O5
I/O6
I/O7
OE1
OE2
CLK
MR
FLD15
FLD14
FLD13
FLD12
FLD11
FLD10
FLD9
FLD8
FLD7
FLD6
FLD5
FLD4
FLD3
FLD2
FLD1
FLD0
FL_DATA
74HC374
U15
U16
1D
2D
3D
4D
5D
6D
7D
8D
1Q
2Q
3Q
4Q
5Q
6Q
7Q
8Q
OE
CLK
PG
VG
PG2
PG1
PG0
VG11
VG10
VG9
VG8
VG7
VG6
VG5
VG4
VG3
VG2
VG1
VG0
To Preamp
To Vernier
To A/D Converter
10.0K
R20
Space Physics Research Laboratory
College of Engineering
University of Michigan
Gain Registers
VA Gen./Electrometer
SFM/ALP
REV
Nov 14, 1991
CONTROL
RELEASE
DRAWN
Oct. 26, 1991
ENGINEER
N. Voronka
PROJECT NAME
SFM/ALP
DRAWING NUMBER
2.06
McCAD 3.2



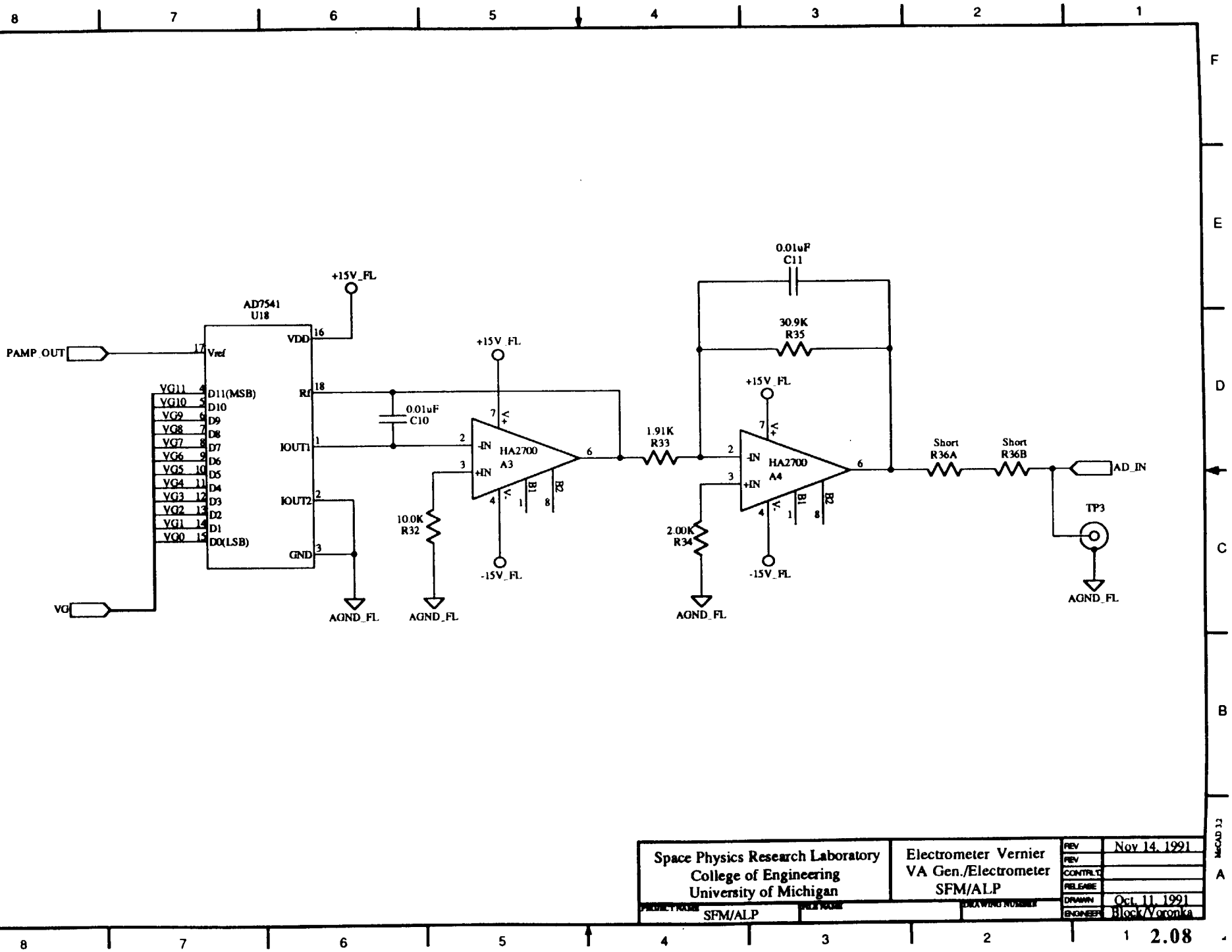
A/D Converter

NOTES:
1. The values of resistors R29 and R30 must not exceed 100 ohms.

Space Physics Research Laboratory College of Engineering University of Michigan	Electrometer A/D VA Gen./Electrometer SFM/ALP	REV	Nov 14, 1991
		REV	
		CONTR'CT	
		RELEASE	
PROJECT NUMBER: SFM/ALP	FILE NAME	DRAWING NUMBER	DRAWN: Oct. 11, 1991
			ENGINEER: N. Voronka

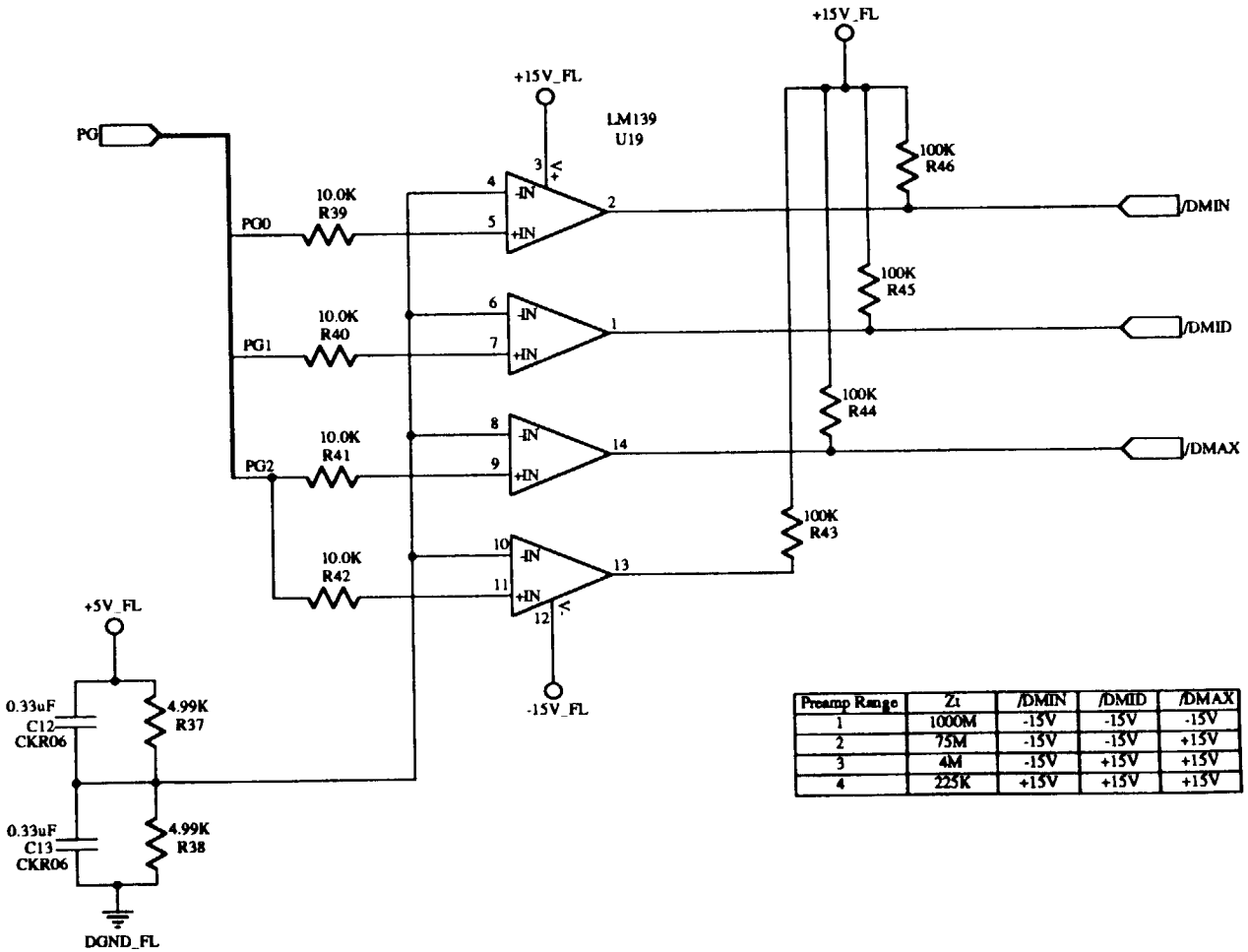
McCAD 3.2

2.07



Space Physics Research Laboratory College of Engineering University of Michigan	Electrometer Vernier VA Gen./Electrometer SFM/ALP	REV	Nov 14, 1991
		REV	
		CONTROL	
		RELEASE	
		DRAWN	Oct. 11, 1991
PROJECT NAME: SFM/ALP	PART NAME	DRAWING NUMBER	ENGINEER: Block/Voronka

2.08



Preamp Range	Zt	/DMIN	/DMID	/DMAX
1	1000M	-15V	-15V	-15V
2	75M	-15V	-15V	+15V
3	4M	-15V	+15V	+15V
4	225K	+15V	+15V	+15V

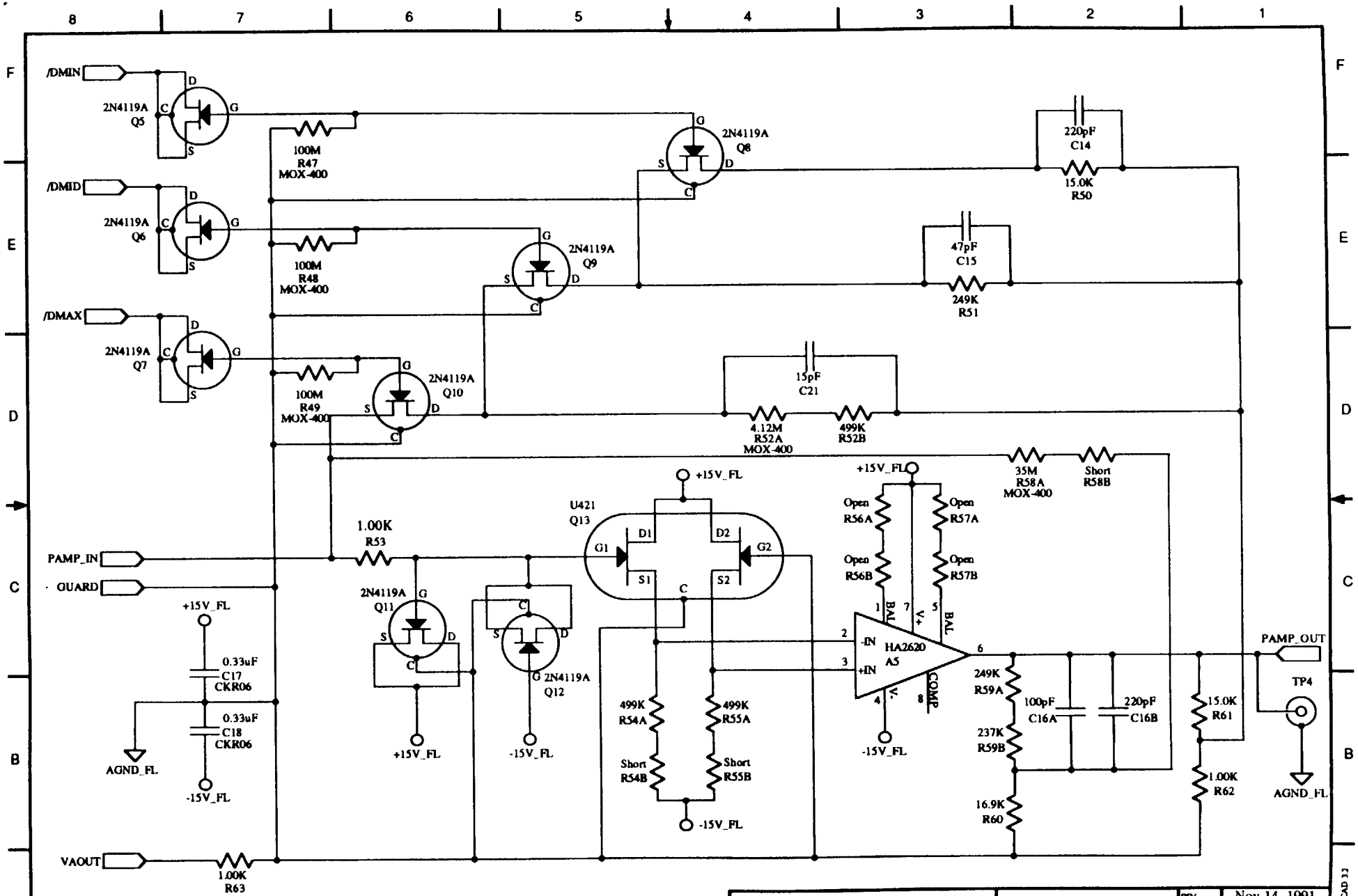
Space Physics Research Laboratory
College of Engineering
University of Michigan

Gain Level Shifters
VA Gen./Electrometer
SFM/ALP

SFM/ALP

REV
REV
CONTR'D
RELEASE
DRAWN Oct. 11, 1991
ENGINEER Block/Voronka

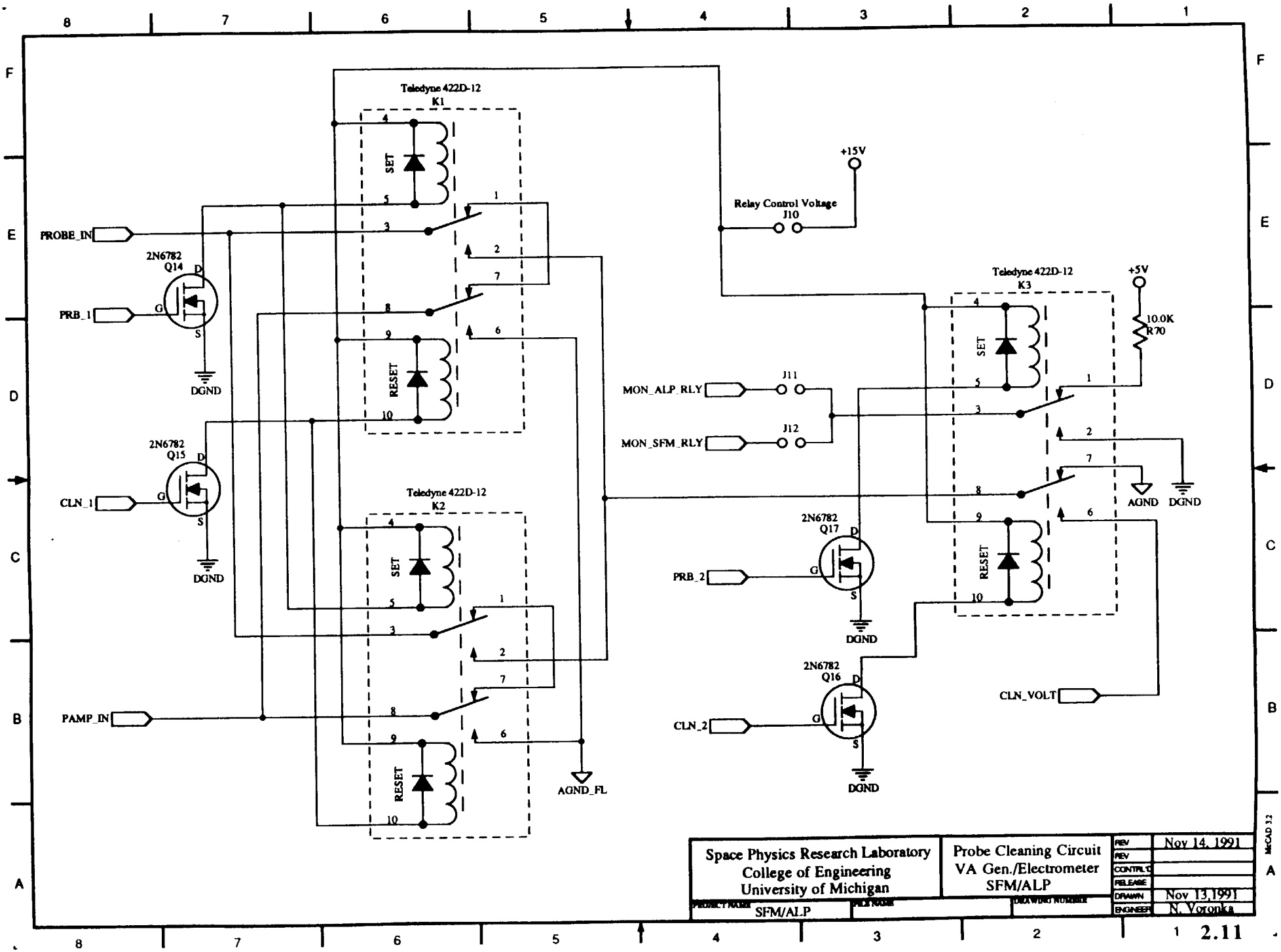
2.09

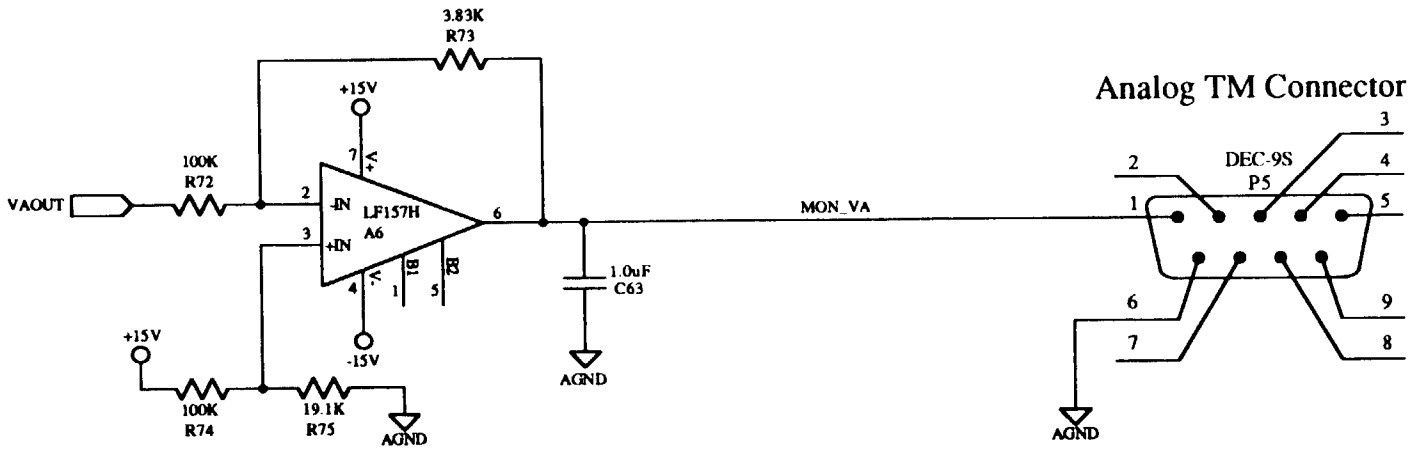


Space Physics Research Laboratory College of Engineering University of Michigan	Electrometer Preamplifier VA Gen./Electrometer SFM/ALP
PROJECT NUMBER: SFM/ALP	FILE NUMBER / DRAWING NUMBER: 2.10

REV	Nov 14, 1991
REV	
CONTROL	
RELEASE	
DRAWN	Sept 14,1991
ENGINEER	B. Block

McCAD 3.2

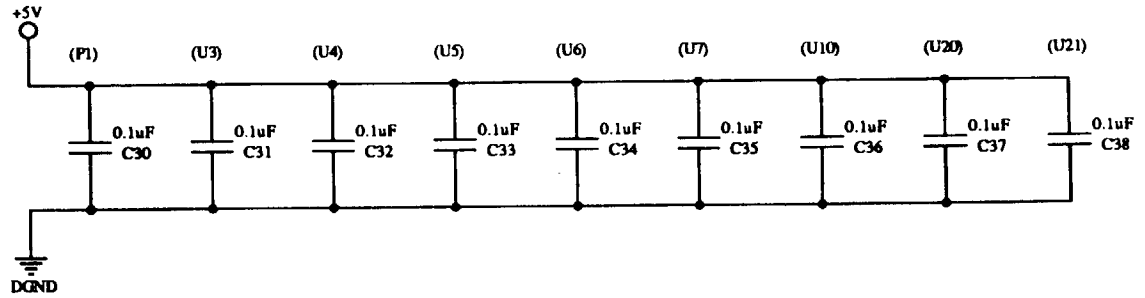

Teledyne 422D-12
K1
SET
RESET
Teledyne 422D-12
K2
SET
RESET
Teledyne 422D-12
K3
SET
RESET
+15V
Relay Control Voltage
J10
PROBE_IN
2N6782
Q14
PRB_1
DGND
2N6782
Q15
CLN_1
DGND
PAMP_IN
MON_ALP_RLY
J11
MON_SFM_RLY
J12
+5V
10.0K
R70
AGND
DGND
2N6782
Q17
PRB_2
DGND
2N6782
Q16
CLN_2
DGND
CLN_VOLT
AGND_FL
Space Physics Research Laboratory
College of Engineering
University of Michigan
Probe Cleaning Circuit
VA Gen./Electrometer
SFM/ALP
REV
Nov 14, 1991
REV
CONTR'D
RELEASE
DRAWN
Nov 13,1991
ENGINEER
N. Voronka
PROJECT NAME
SFM/ALP
DRAWING NUMBER
2.11
McCAD 3.2

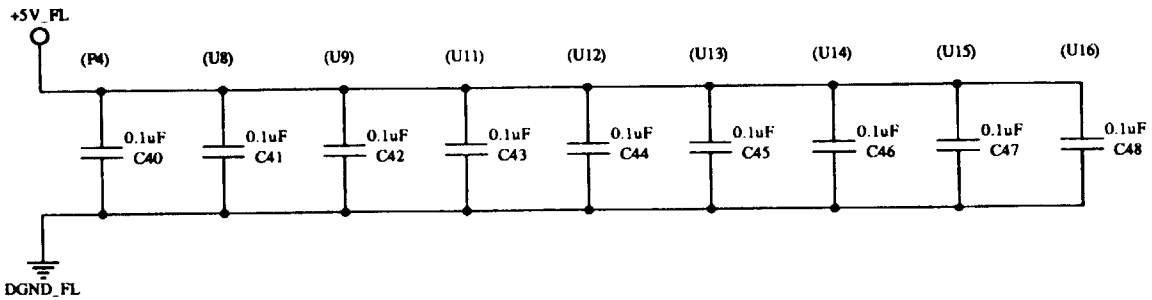


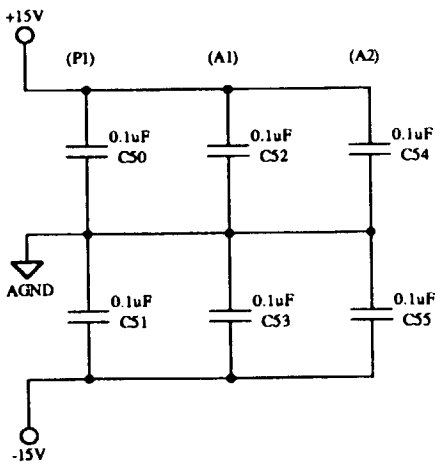
Space Physics Research Laboratory College of Engineering University of Michigan	Voltage Monitor Buffers VA Gen./Electrometer Solar Flux Monitor	REV	Nov 14, 1991
		REV	
		CONTR'T	
		RELEASE	
		DRAWN	Feb 19, 1992
PROJECT NUMBER: SFM/ALP	FILE NUMBER	DRAWING NUMBER	ENGINEER: N. Voronka

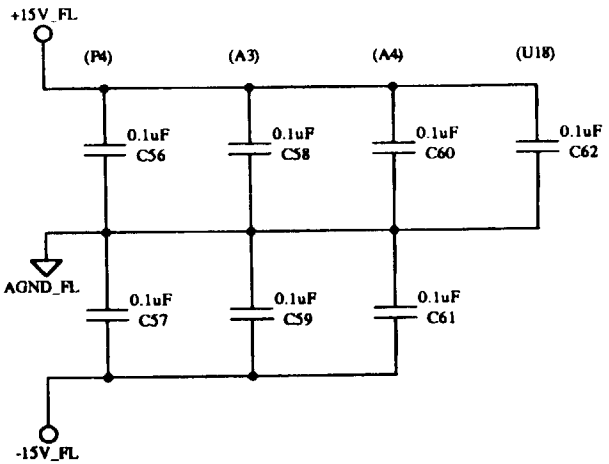
MICAD 3.2

12.12







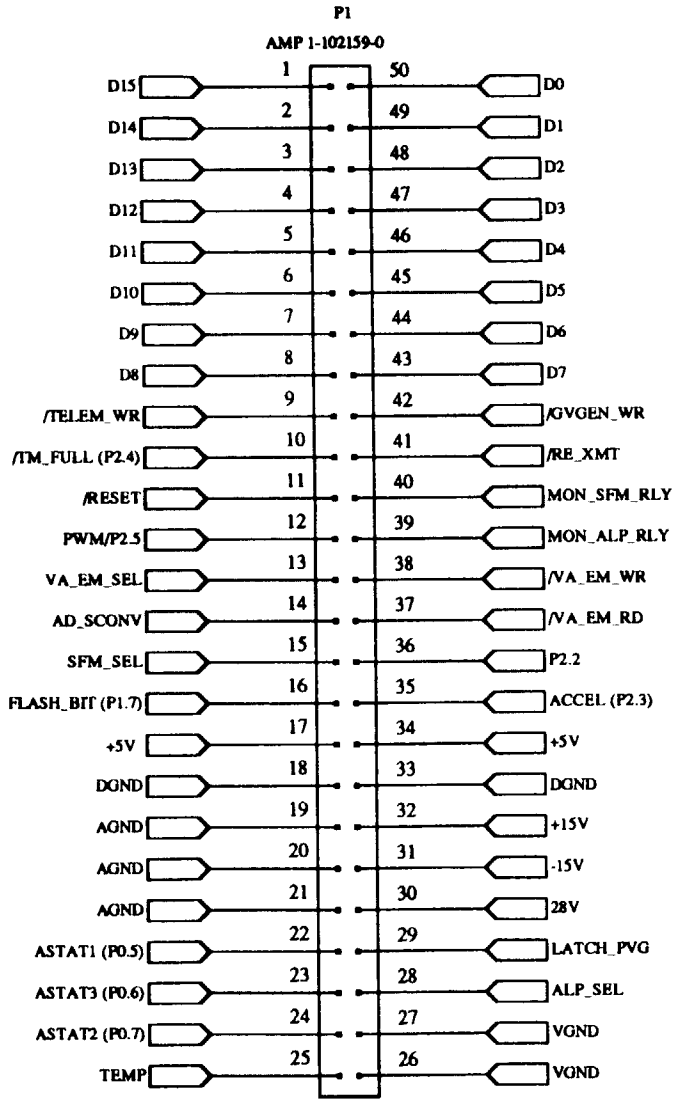


Space Physics Research Laboratory College of Engineering University of Michigan	Power Supply Filters VA Gen./Electrometer Solar Flux Monitor	REV	
		REV	
		CONTRLD	
		RELEASE	
PROJECT NAME: SFM/ALP	SHEET NAME:	DRAWING NUMBER:	DRAWN: Feb 20,1991
			ENGINEER: N. Voronka

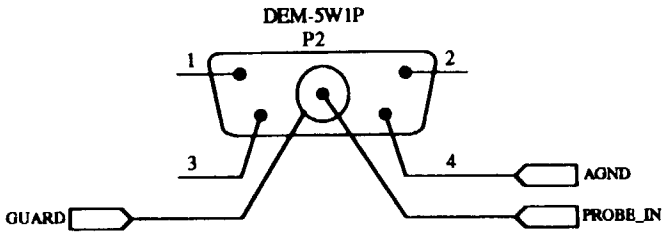
McCAD 3.2

2.13

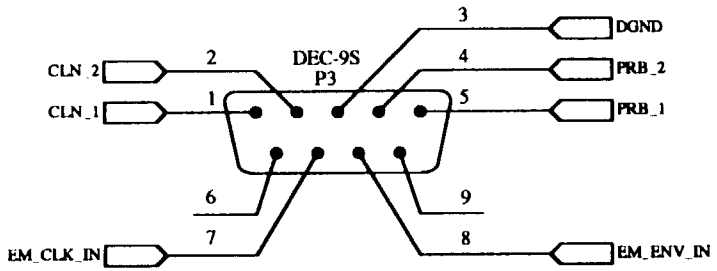
System Connector



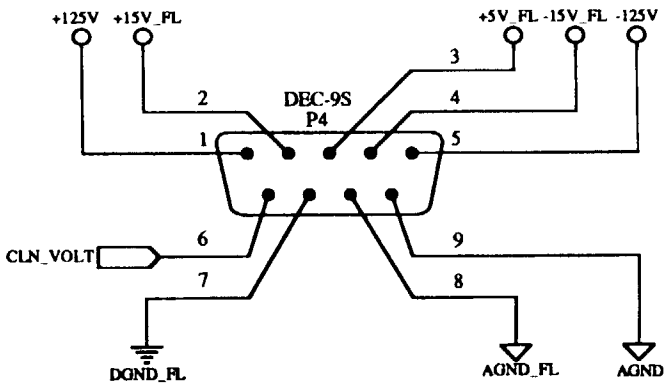
Sensor Connector



Relay Control & Shift Clock Connector



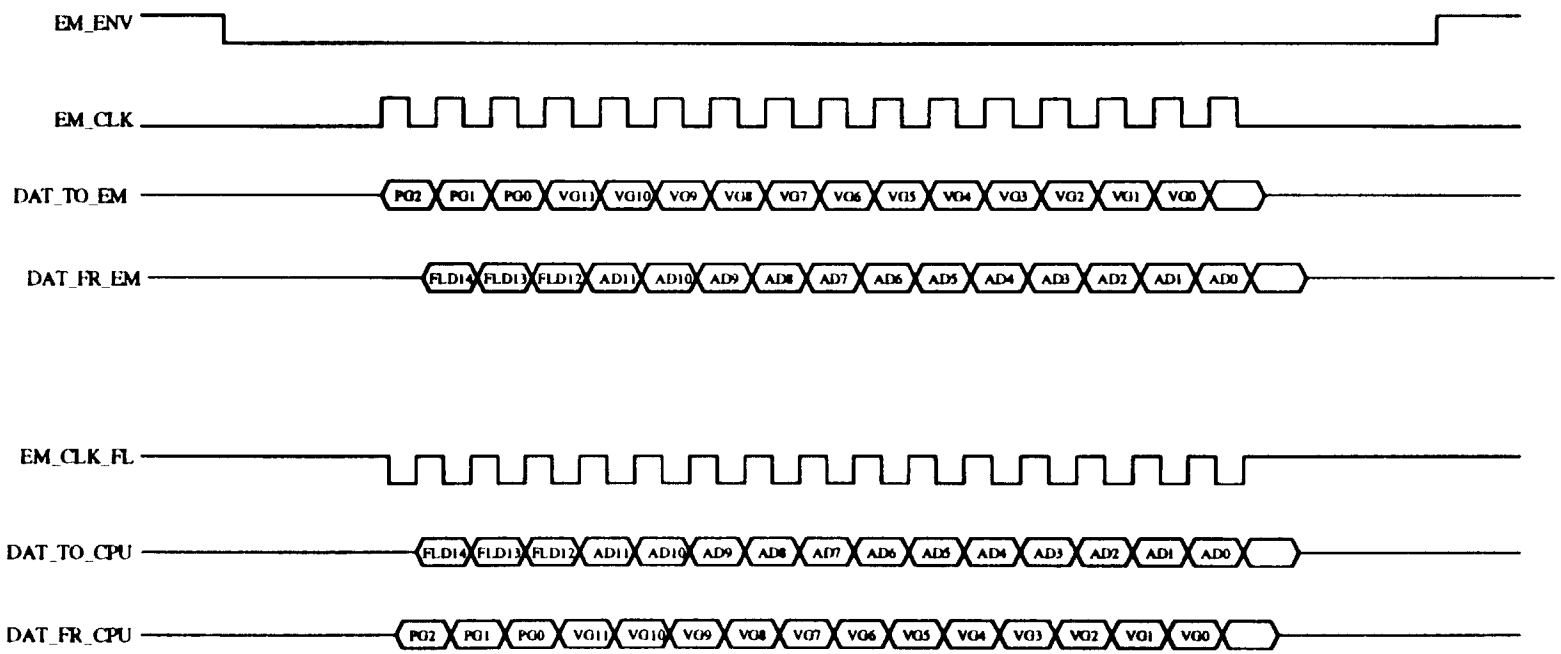
Power Supply Connector



NOTES:
1. A jumper must be installed between pin 3 of P2 (GUARD) and pin 8 of P4 (AGND_FL).

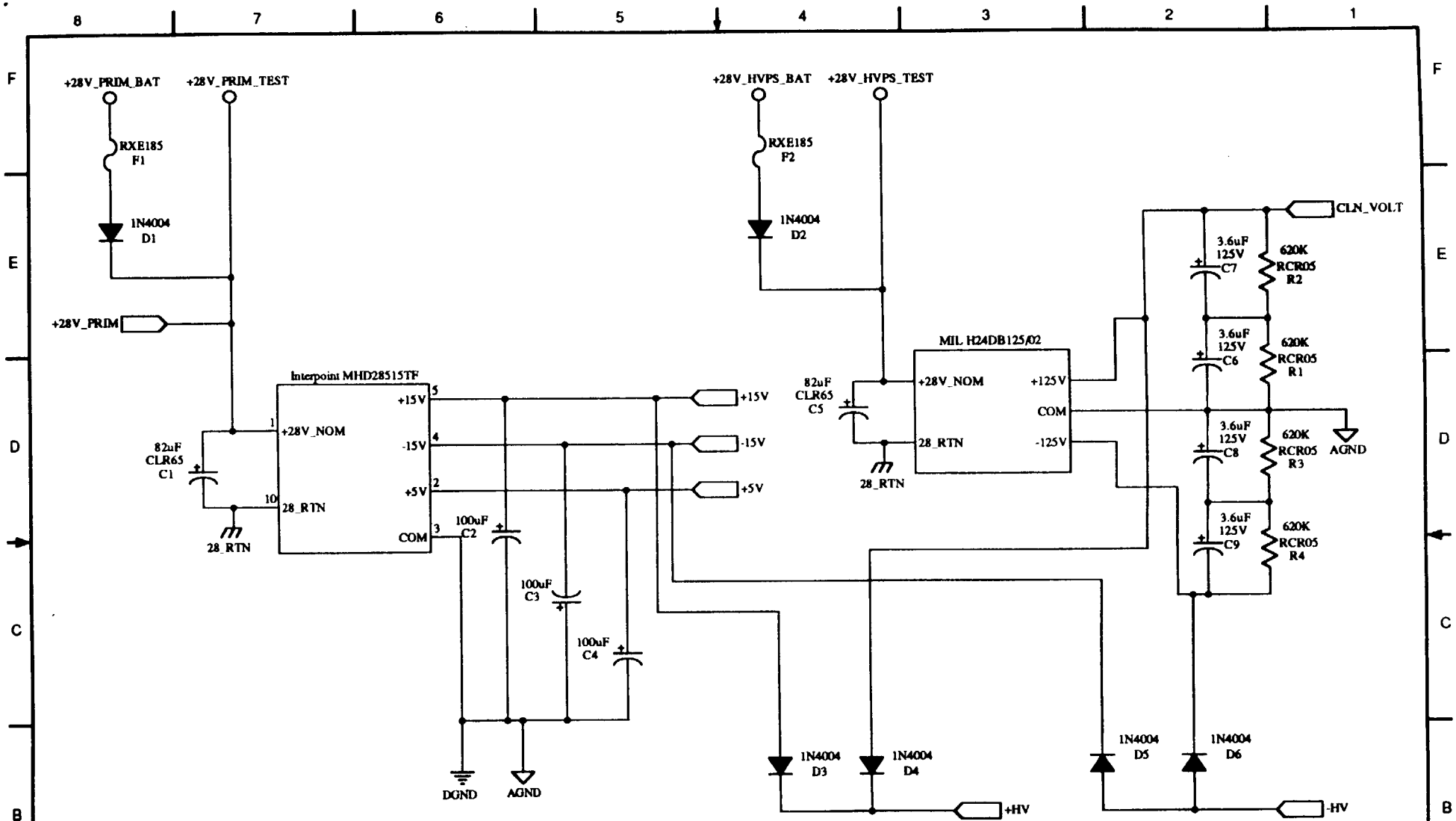
Space Physics Research Laboratory College of Engineering University of Michigan	Connectors VA Gen./Electrometer SFM/ALP	REV	
		REV	
		CONTR'D	
		RELEASE	
		DRAWN	Sept 14,1991
PROJECT NUMBER: SFM/ALP	SHEET NUMBER:	DRAWING NUMBER:	ENGINEER: N. Voronka

McCAD 3.2



Space Physics Research Laboratory College of Engineering University of Michigan	Serial Interface Timing Solar Flux Monitor /Adv. Langmuir Probe	REV	
		REV	
		CONTROL	
		RELEASE	
PROJECT NAME: SFM/ALP	FILE NAME	DRAWING NUMBER	ORIGIN: Jan 26,1992 ENGINEER: N. Voronka

2.15

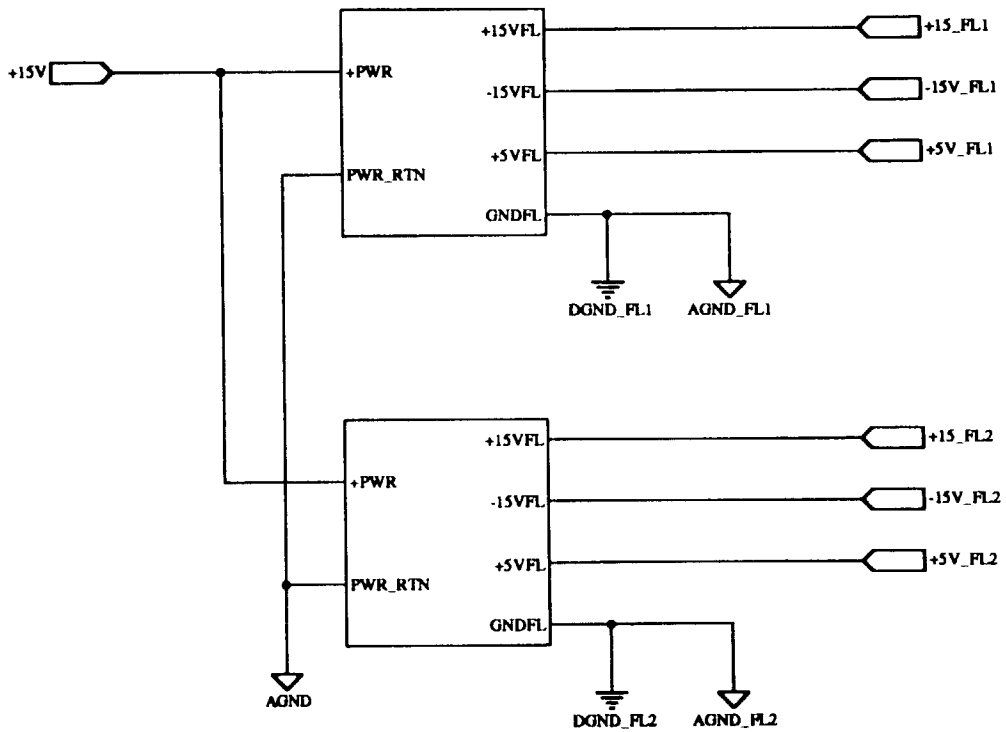


NOTES:

1. Devices F1 and F2 are PolySwitch current limiting devices. They were required by NASA/WFF for the 27.133 rocket flight experiment. They will sustain a maximum of 1.85 amperes without tripping.

Space Physics Research Laboratory College of Engineering University of Michigan	Primary&HV Converters Solar Flux Monitor /Adv. Langmuir Probe	REV	Nov 14, 1991
		REV	
		CONTR'D	
		RELEASE	
PROJECT NAME: SFM/ALP	PROJECT NUMBER:	DRAWING NUMBER:	DRAWN: Mar 5,1992
			ENGINEER: N. Voronka

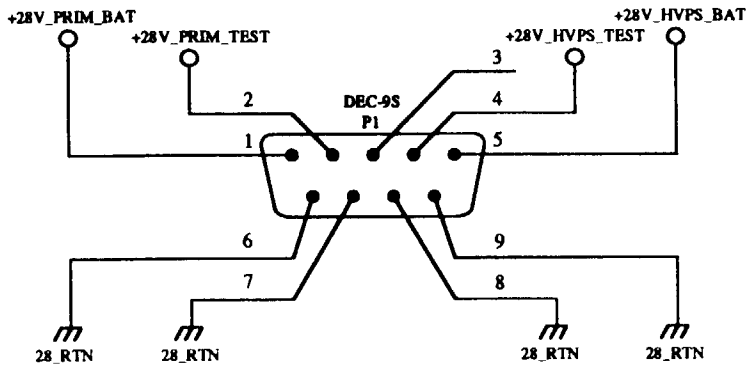
McCAD 32



Space Physics Research Laboratory College of Engineering University of Michigan	Floating PS Converters Solar Flux Monitor /Adv. Langmuir Probe	REV	
		REV	
		CONTR'D	
		RELEASE	
		DRAWN	Mar 7,1992
PROJECT NAME: SFM/ALP	FILE NAME	DRAWING NUMBER	ENGINEER: N. Voronka

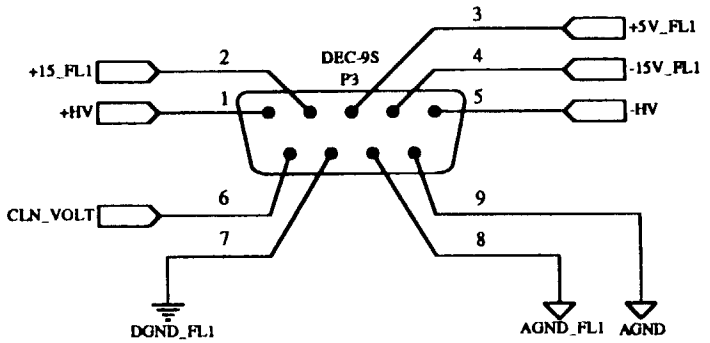
3.2

Primary Power Connector (to SC)



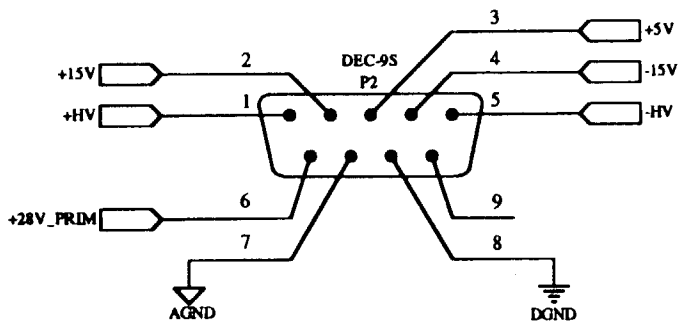
Power Supply Connector

ALP VA Gen./Electrometer



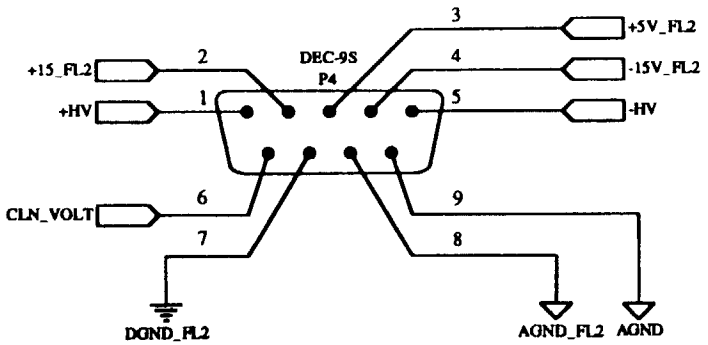
Power Supply Connector

Grid Voltage Generator



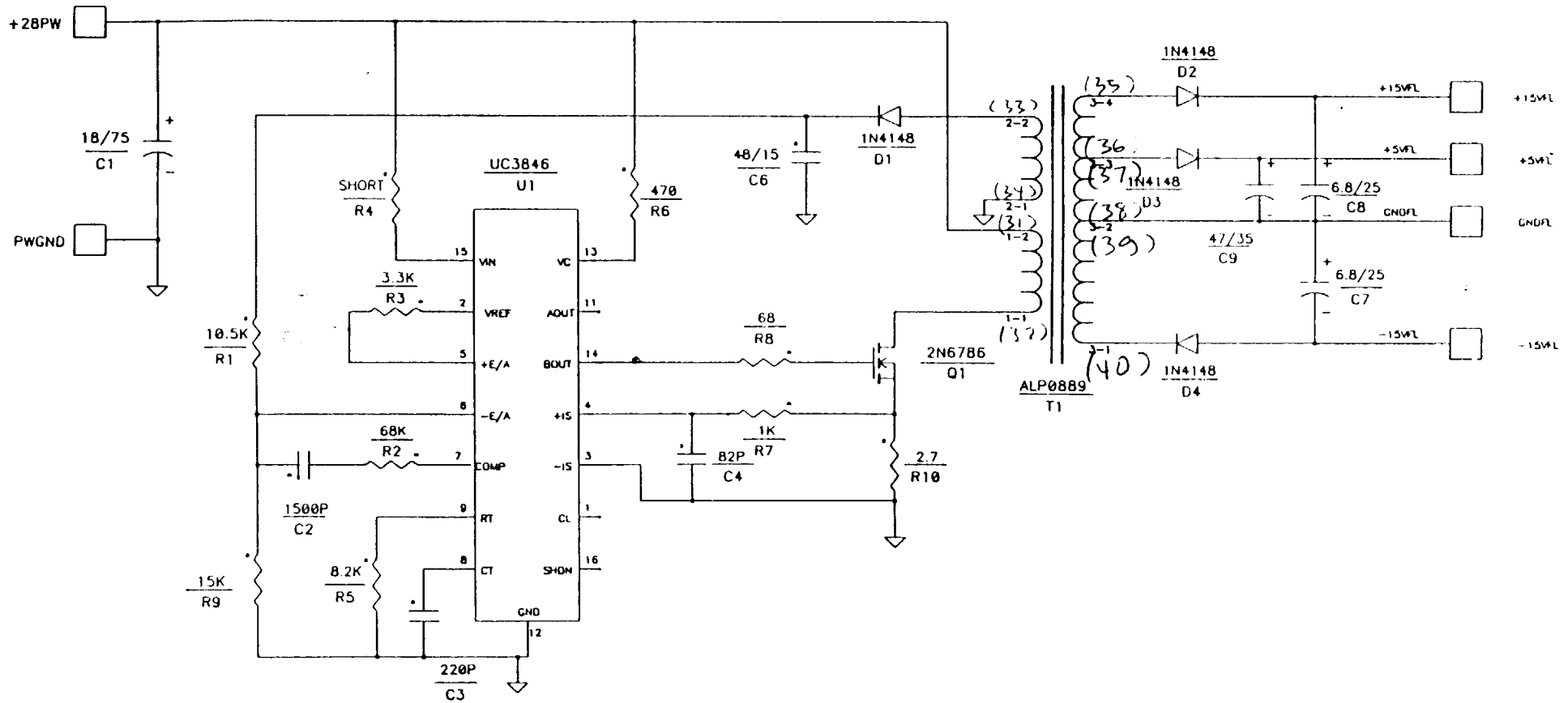
Power Supply Connector

SFM VA Gen./Electrometer



Space Physics Research Laboratory College of Engineering University of Michigan	Powe Supply Connectors Solar Flux Monitor /Adv. Langmuir Probe	REV	
		REV	
		CONTR LT	
		RELEASE	
		DRAWN	Jan 9,1992
PROJECT NAME: SFM/ALP	PROJ NAME	DRAWING NUMBER	ENGINEER: N. Voronka

3.3



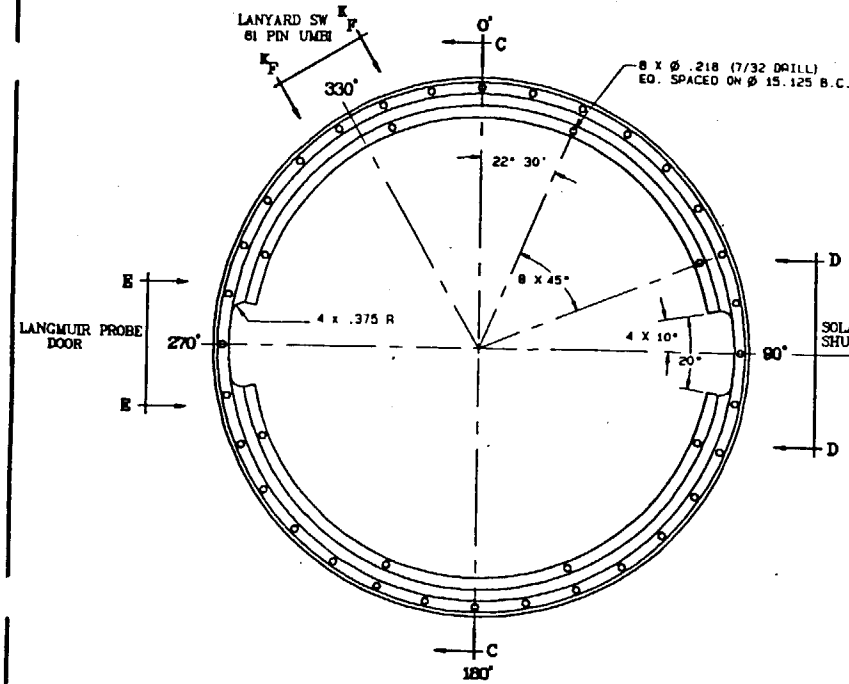
ENGINEER BLOCK	DRAFTSMAN 8/26/89
SPACE PHYSICS RESEARCH LABORATORY COLLEGE OF ENGINEERING UNIVERSITY OF MICHIGAN ANN ARBOR, MICHIGAN	+/-15, +5 POWER SUPPLY CURRENT-MODE TECHNOLOGY CRAF-NGIMS/ALP
	B-E8574

LAST USED R . . C . D . I

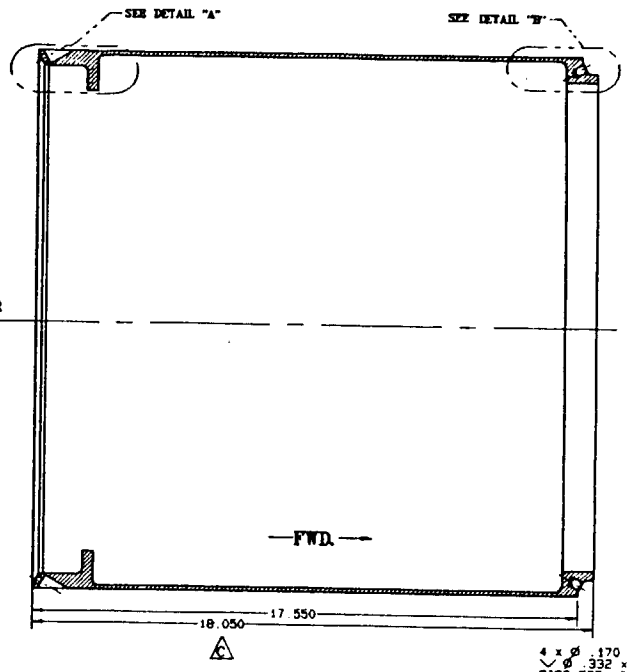
APPENDIX C

SEUV/ALP Mechanical Drawings

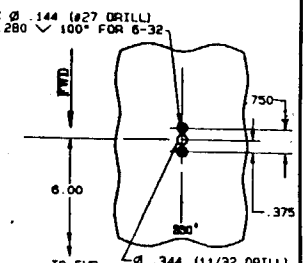
DATE	LET	REVISION	BY
4/93	A	ADDED 61 PIN UMBI	RAY
4/93	B	ADDED LANYARD SWITCH	RAY
4/93	C	ADDED OVERALL DIMENSION 18.050	RAY



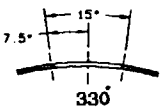
LOOKING FORWARD



SECTION "C-C"

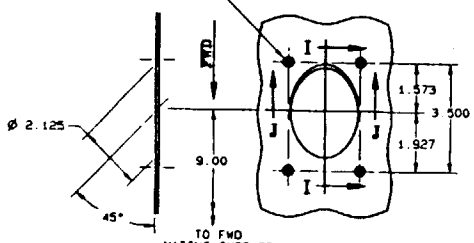


VIEW "K-K"
LANYARD SWITCH (B)



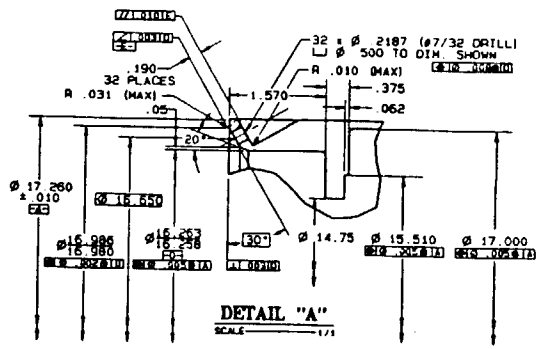
SECTION "J-J"

4 x Ø .170 (Ø18 DRILL)
⌵ Ø .332 x 100° NEAR
SIDE FOR #8-32 SCREWS.
INSTALL 61 PIN UMBILICAL
BRKT. D-GEN-14029.

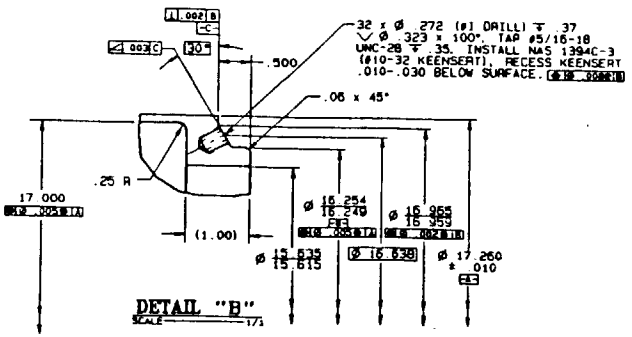


SECTION "I-I"

VIEW "F-F" (A)



DETAIL "A"



DETAIL "B"

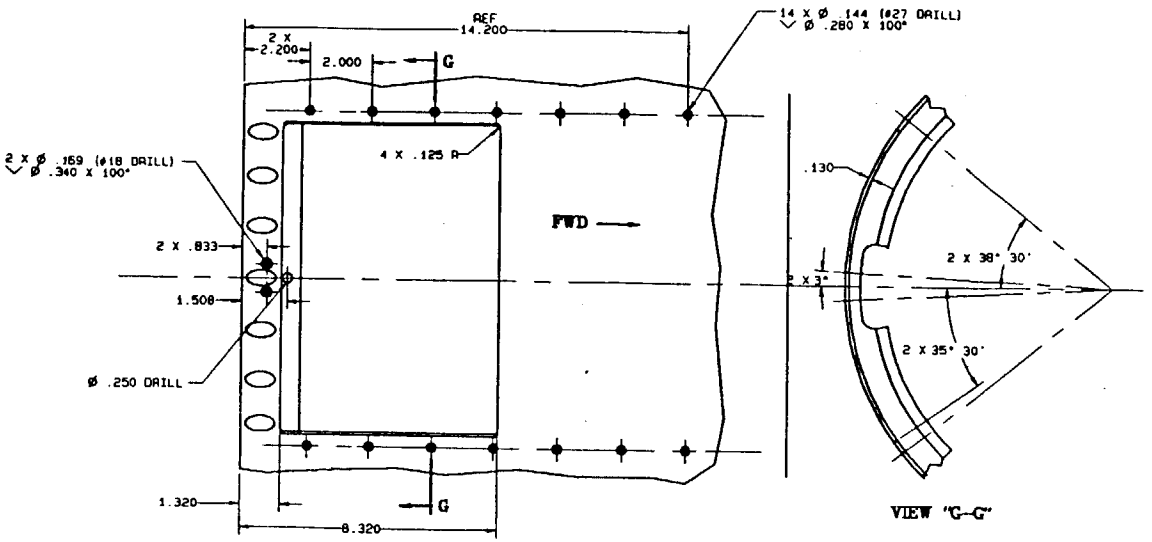
ITEM	QTY.	DESCRIPTION	MATERIAL

MARCH 11, 1992

NEXT ASSEMBLY	UNIT OR PROJECT	SCALE	MATERIAL	HEAT TREAT	DR	BOB RAY
	27 133	1/2	6061-T6 ALUMINUM		DES	BOB RAY
TOLERANCE ON DIMENSIONS UNLESS SHOWN OTHERWISE: ANGULAR ± ; 2 PL ± .010; 3 PL ± .005; 4 PL ± .0025			NATIONAL AERONAUTICS AND SPACE ADMINISTRATION GODDARD SPACE FLIGHT CENTER WALLOPS FLIGHT FACILITY WALLOPS ISLAND, VIRGINIA 23337		CHK	
SURFACE FINISH IN MICROINCHES UNLESS SHOWN OTHERWISE: 125					EL	
					AP	
			AFT EXPERIMENT SKIN			D-27-18898
			SHARP/CONT OF MICHIGAN			SHEET 1 OF 4

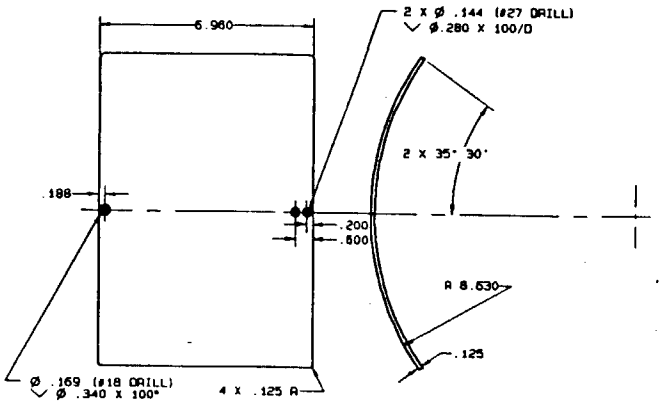
D-27-18898

DATE	LET	REVISION	BY



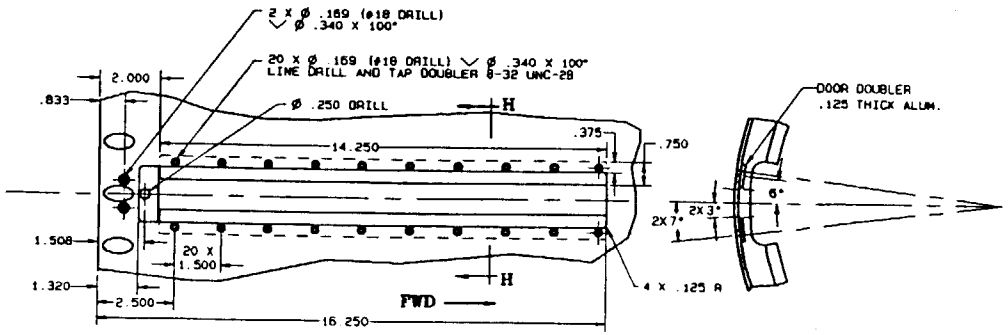
VIEW "D-D"
SOLAR FLUX MONITOR DOOR CUTOUT

VIEW "G-G"



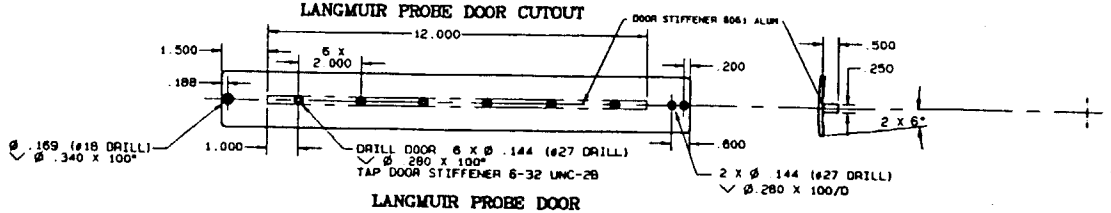
NOTE: MACHINE TO FIT DOOR CUTOUT
SHOWN IN VIEW "D-D" WITH .020 CLEARANCE

① SOLAR FLUX MONITOR EJECTABLE DOOR
6061-T6 ALUMINUM, 1 REQ.

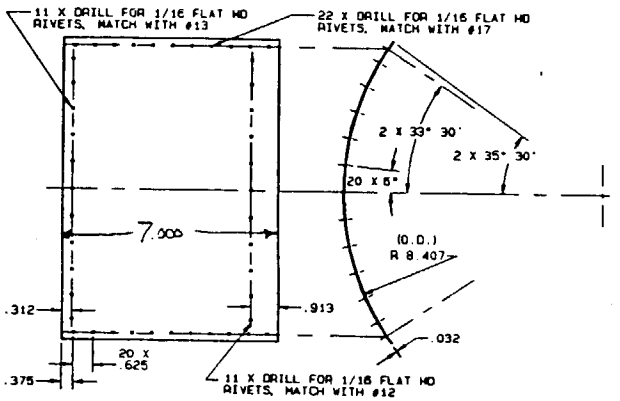


VIEW "E-E"
LANGMUIR PROBE DOOR CUTOUT

VIEW "H-H"



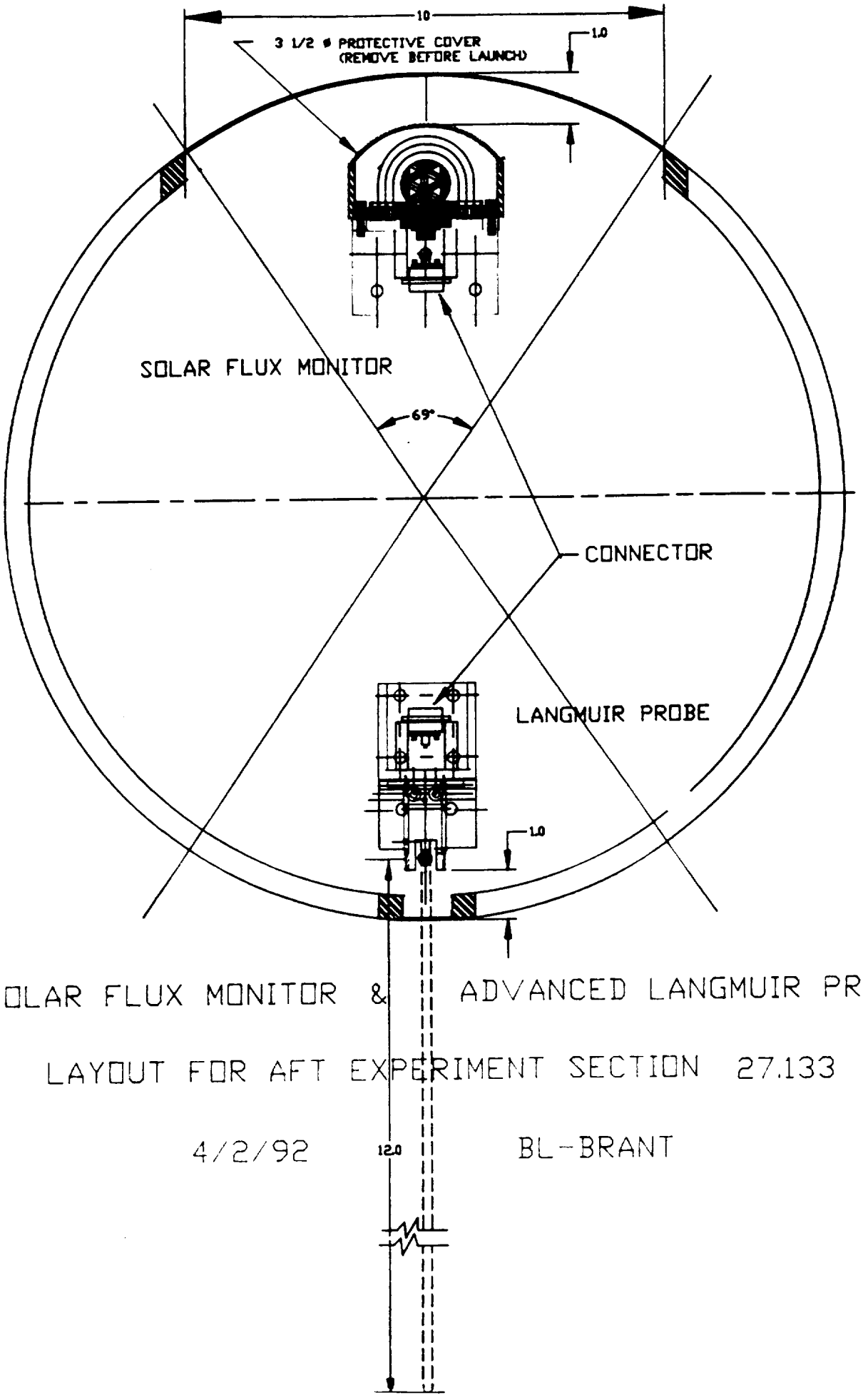
LANGMUIR PROBE DOOR
6061-T6 ALUMINUM, 1 REQ



① SOLAR FLUX MONITOR SLIDING DOOR
STAINLESS STEEL, 1 REQ.

D-27-18998

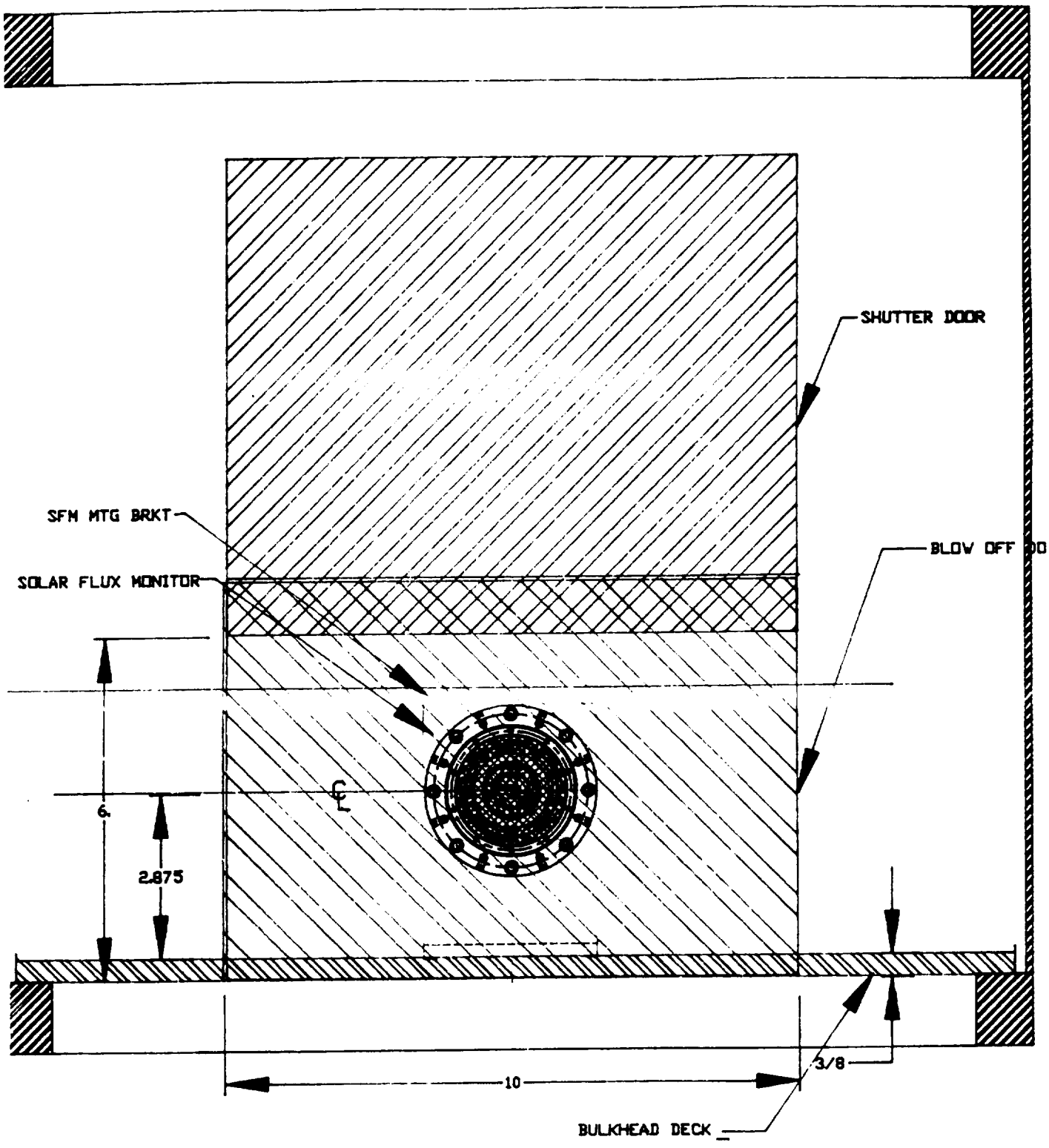
	UNIT OR PROJECT	SCALE	MATERIAL	HEAT TREAT	DR	BOB RAY
MDFT ASSEMBLY	27 133	21	NOTED		DES.	BOB RAY
TOLERANCE ON DIMENSIONS UNLESS SHOWN OTHERWISE: ANGULAR ±			NATIONAL AERONAUTICS AND SPACE ADMINISTRATION GODDARD SPACE FLIGHT CENTER WALLOPS FLIGHT FACILITY WALLOPS ISLAND, VIRGINIA 23337		CHK	
SURFACE FINISH IN MICRO INCHES RMS UNLESS SHOWN OTHERWISE: 125			AFT EXPERIMENT DOOR DETAILS SHARP/UNIV OF MICHIGAN PP98		DWG.	D-27-18998 SHEET 2 OF 4



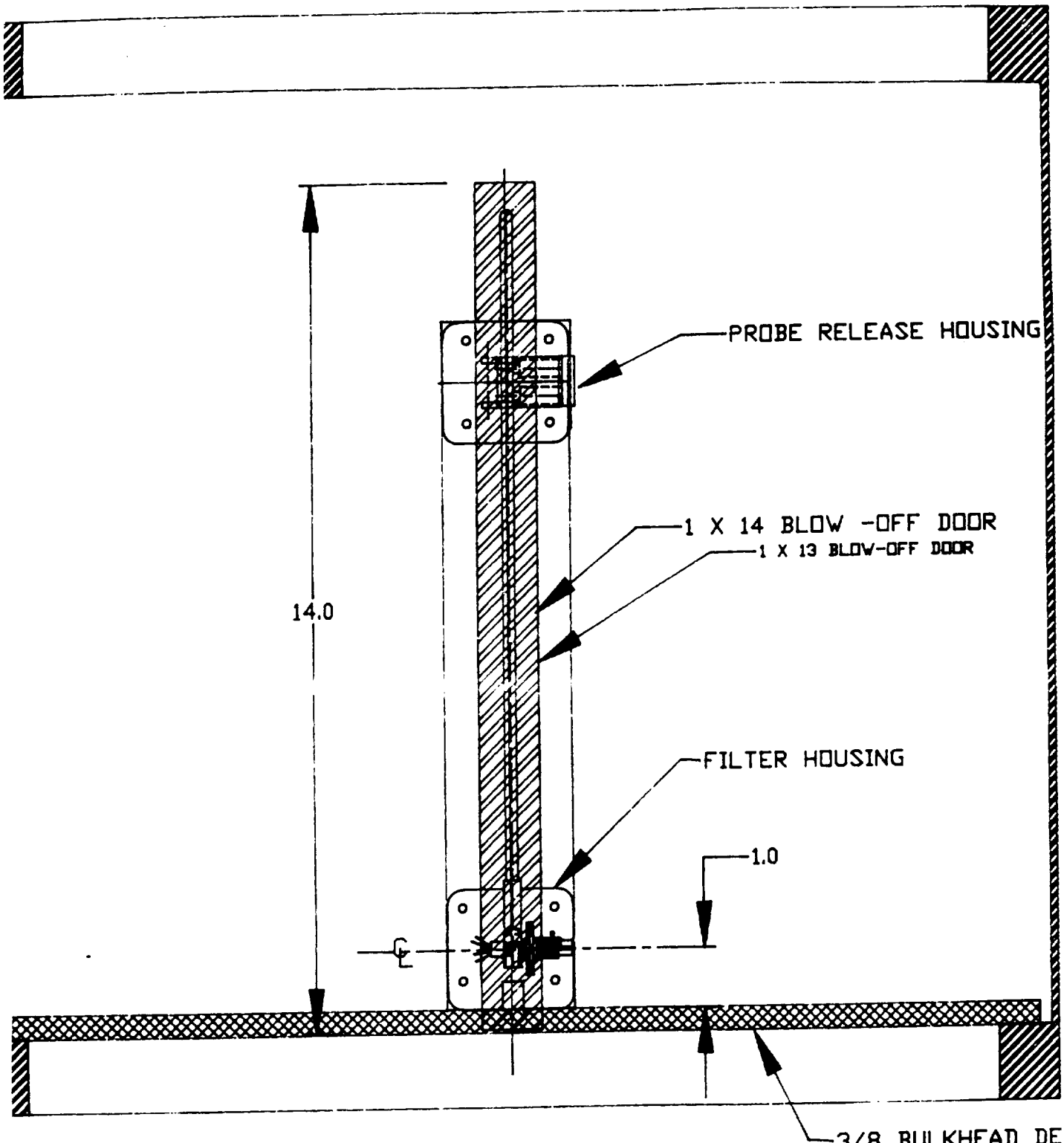
SOLAR FLUX MONITOR & ADVANCED LANGMUIR PROBE

LAYOUT FOR AFT EXPERIMENT SECTION 27.133

4/2/92 BL-BRANT

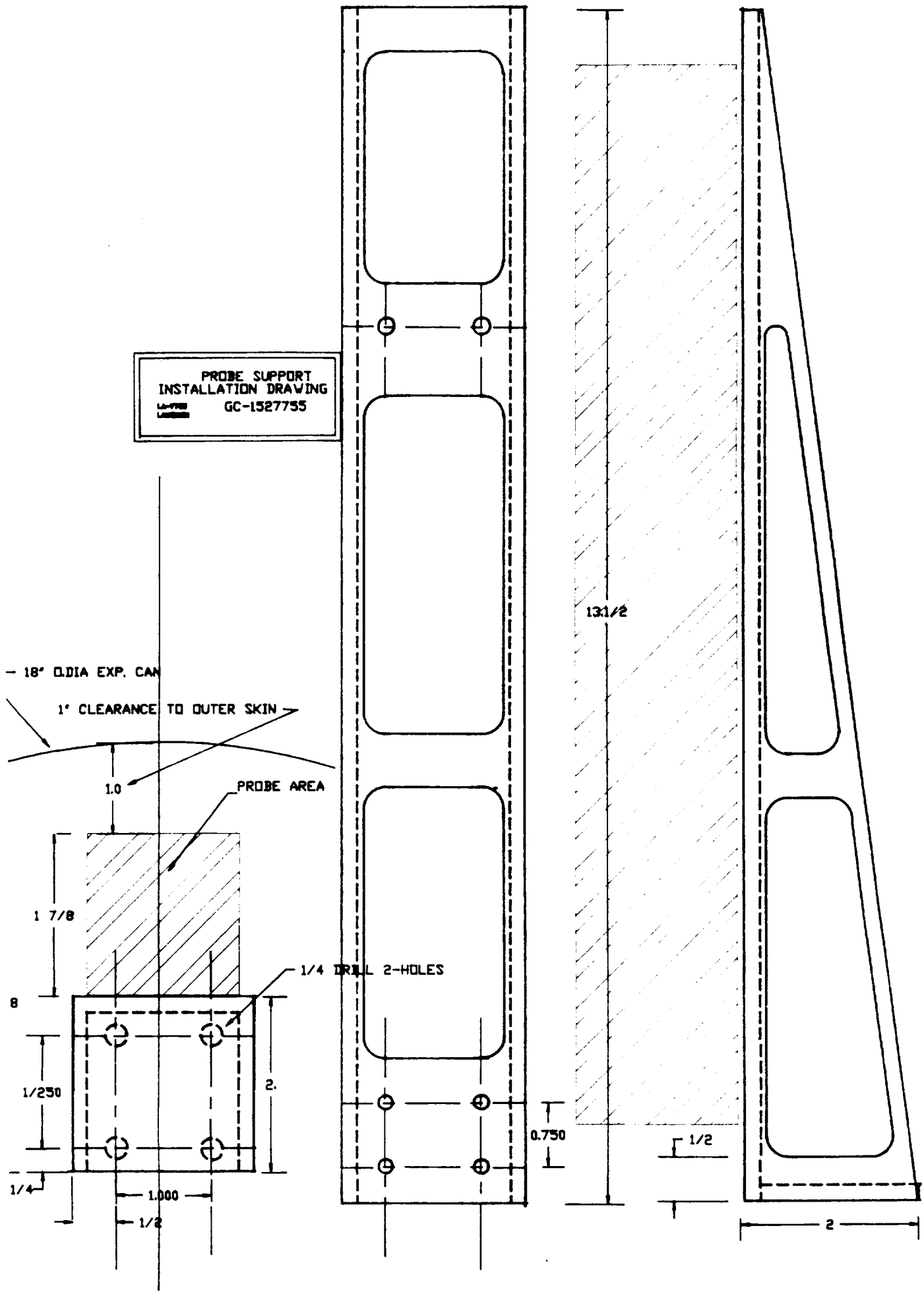


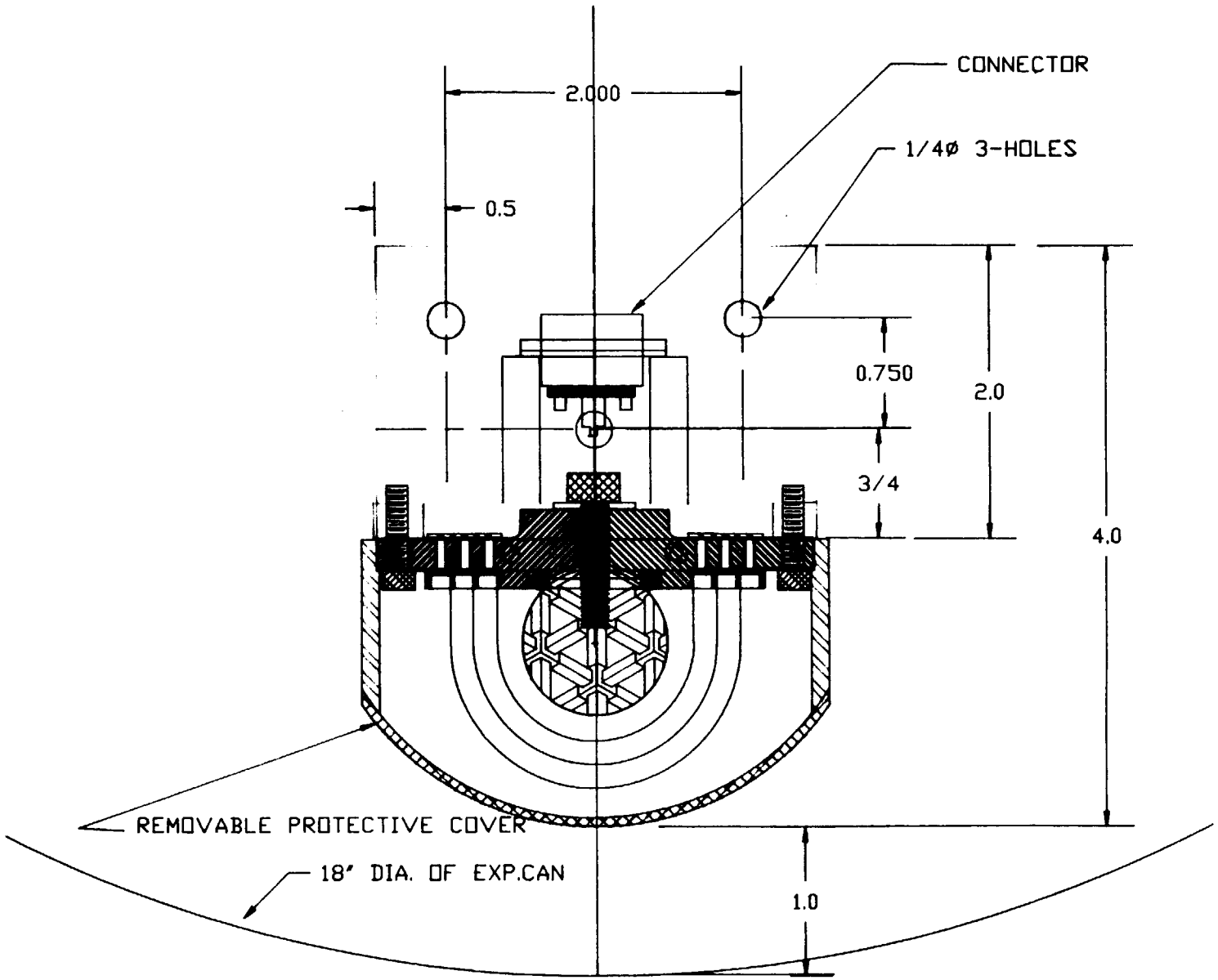
SOLAR FLUX MONITOR
LAYOUT FOR AFT EXPERIMENT SECTION



LANGMUIR PROBE

LAYOUT FOR AFT EXPERIMENT SECTION


PROBE SUPPORT
INSTALLATION DRAWING
GC-1527755
18" O.DIA EXP. CAN
1" CLEARANCE TO OUTER SKIN
1.0
PROBE AREA
1 7/8
1/4 DRILL 2-HOLES
8
1/250
2.
1/4
1.000
1/2
13 1/2
0.750
1/2
2

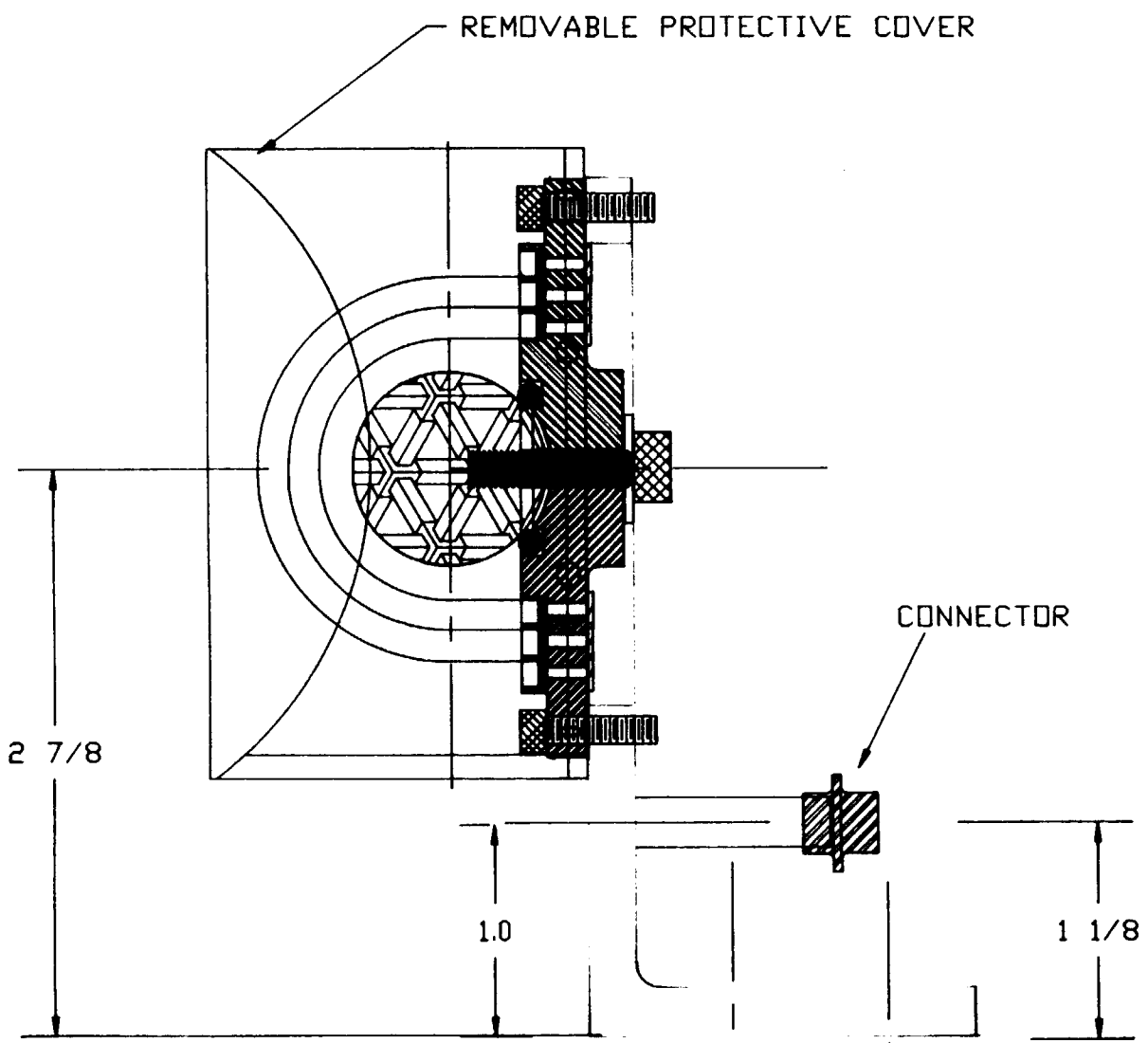


SOLAR FLUX MONITOR INSTALLATION DRAWING

TOP VIEW

3/26/92

EUV-7701

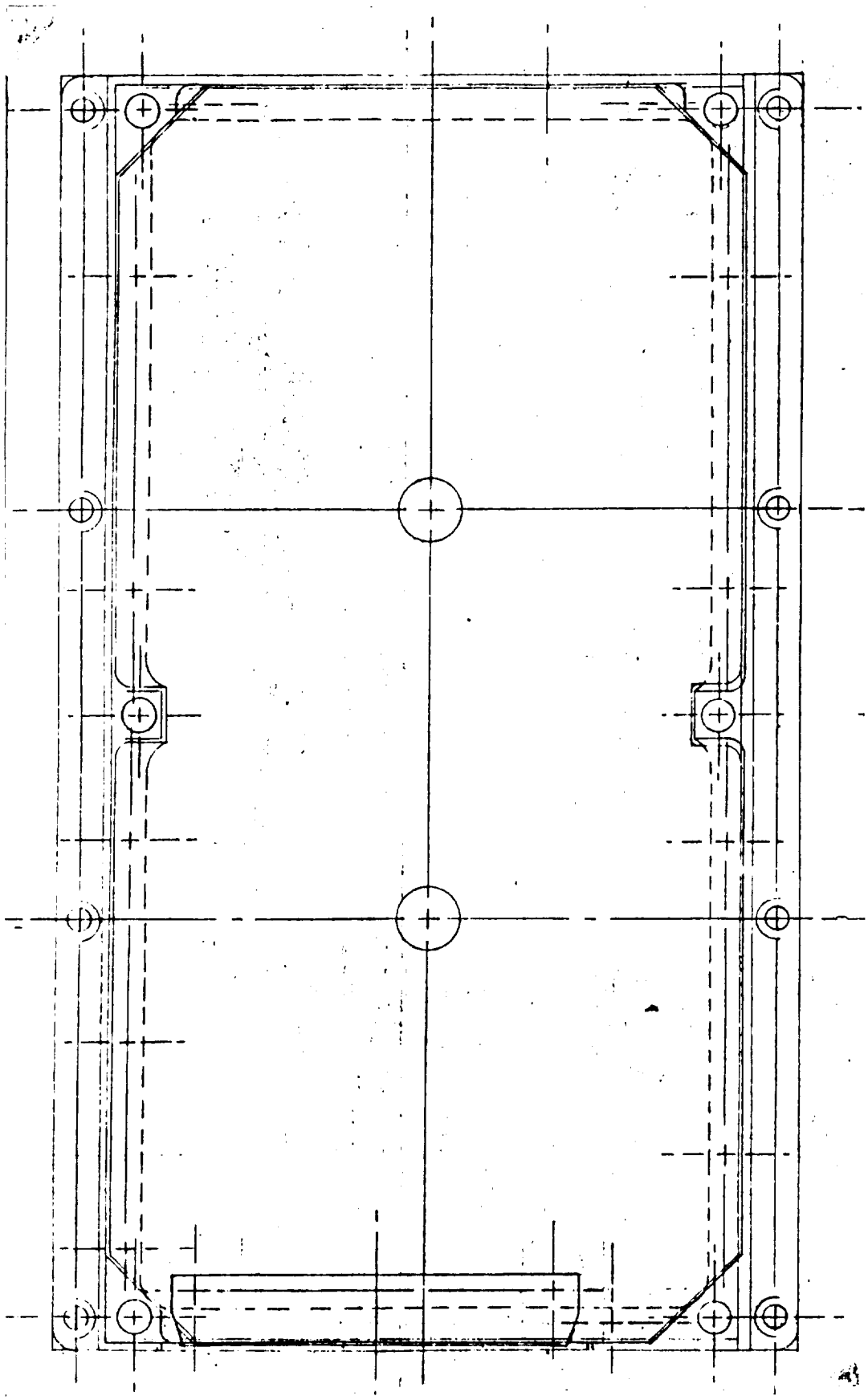


SOLAR FLUX MONITOR INSTALLATION DRAWING

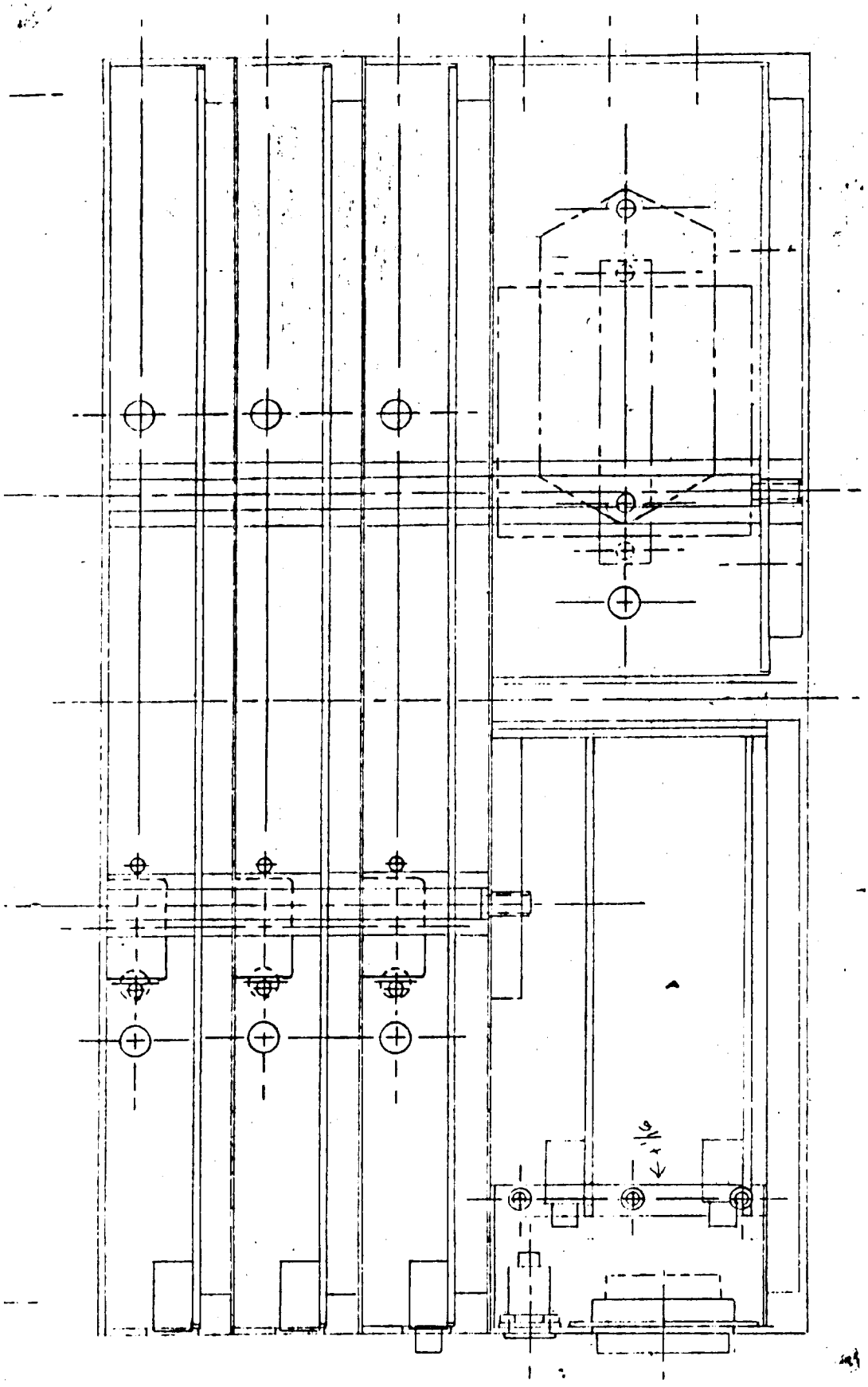
EUV-7701

3/26/92

SIDE VIEW

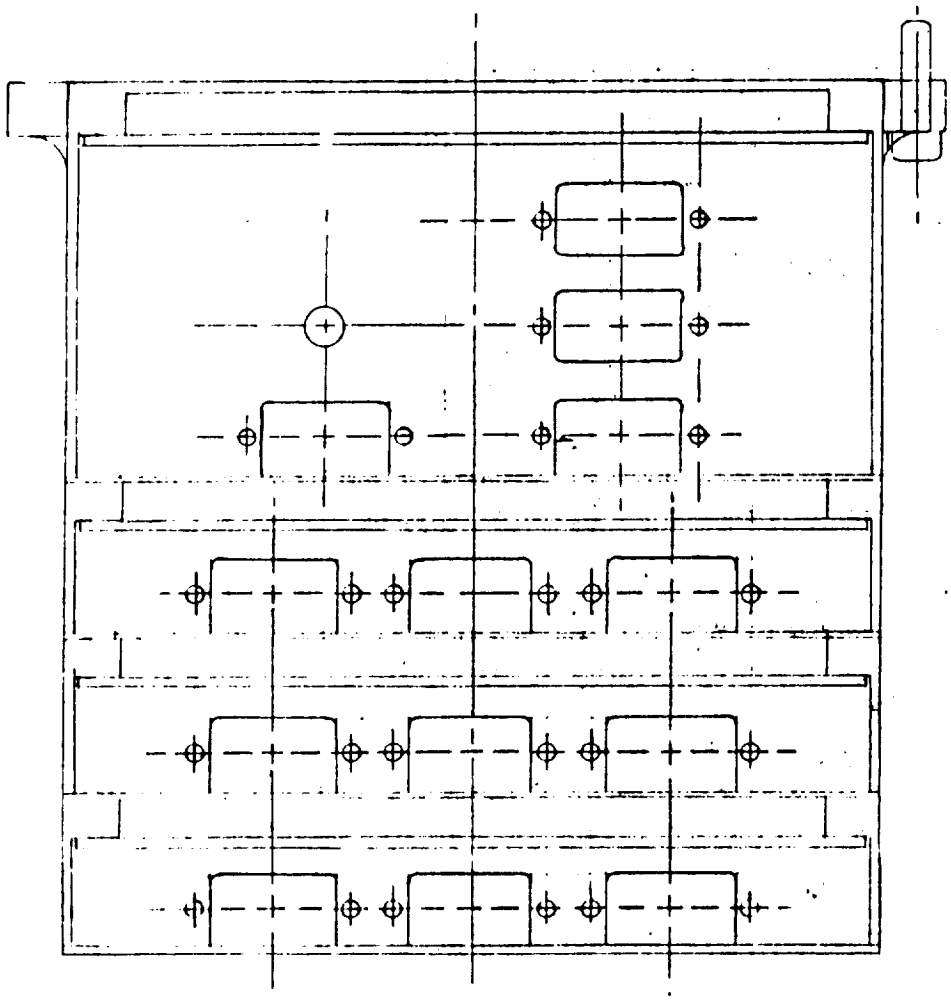


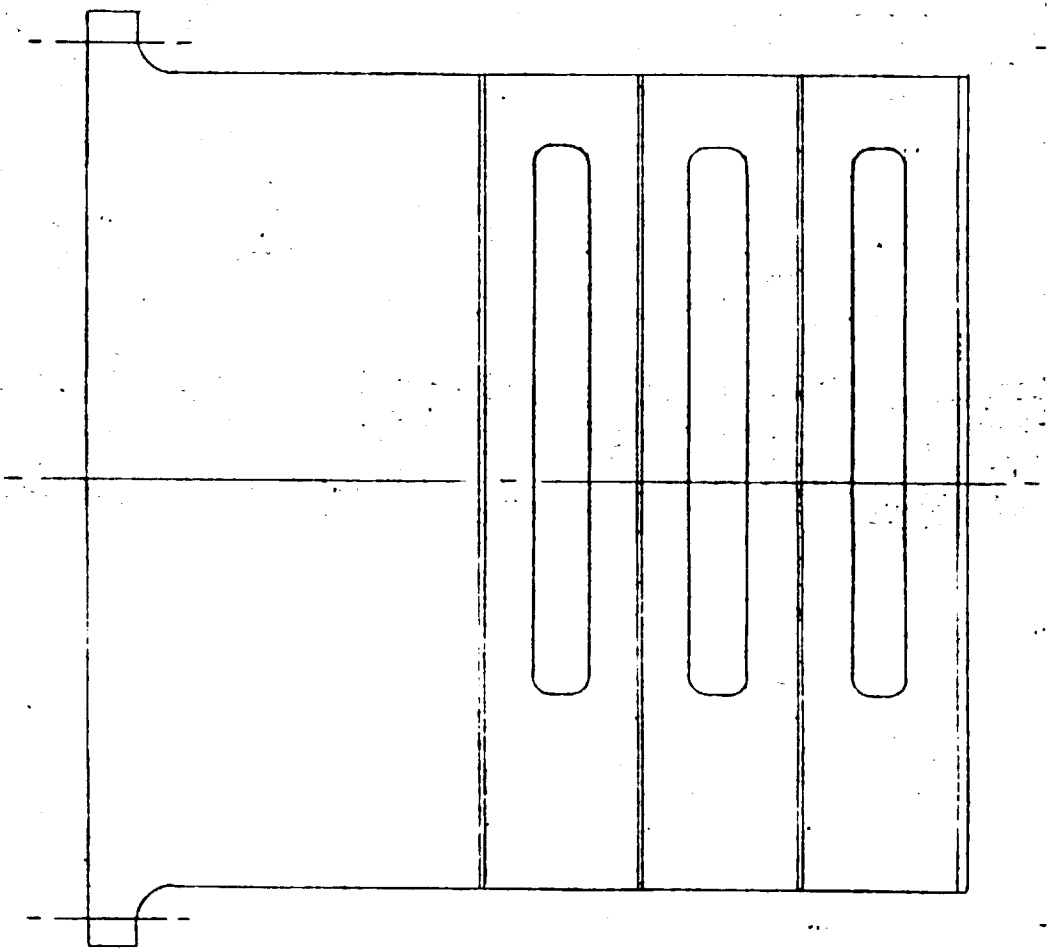
D-048-0001 PLAN



D-048-001 FRONT

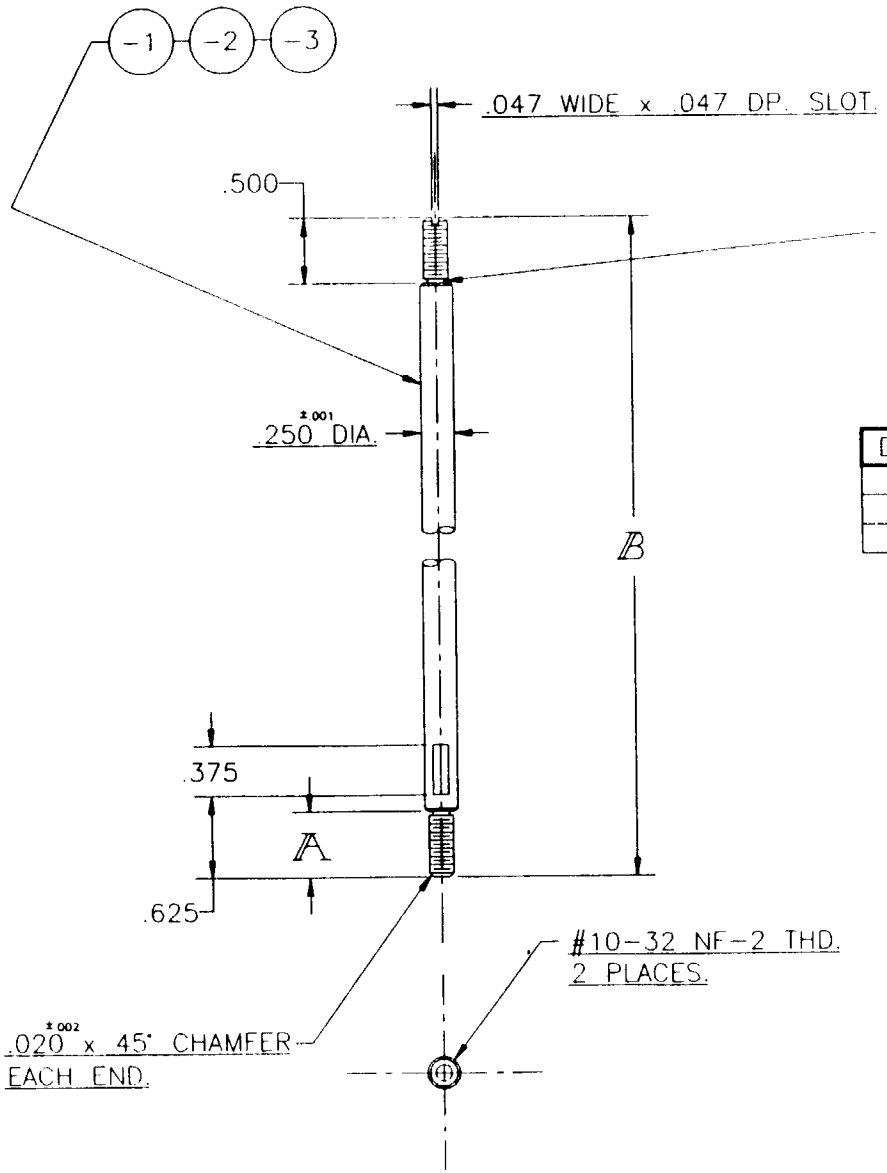
D-048-001 R.SIDE





D-048-001 L. SIDE

REVISION					
ZONE	LTR	DESCRIPTION	DFTMN	DATE	APPROVED



DASH NO.	NAME	A DIM.	B DIM.	# REQ'D.
-1	DECK POST	.500	3.950	6
-2	P.C. POST-LONG	.312	5.929	1
-3	P.C. POST-SHORT	.312	3.762	1

L. H. NO. REQ'D.	R. H. NO. REQ'D.	PART NO.	L. H. NO. REQ'D.	R. H. NO. REQ'D.	NAME	SIZE	MATERIAL DESCRIPTION
1			-3		P.C. POST-SHORT	.250 DIA x 3.762	304 ST'N ST.
1			-2		P.C.POST-LONG	.250 DIA x 5.929	304 ST'N. ST.
6			-1		DECK POST	.250 DIA x 3.950	304 ST'N. ST.

SPACE PHYSICS RESEARCH LABORATORY
COLLEGE OF ENGINEERING
THE UNIVERSITY OF MICHIGAN
ANN ARBOR, MICHIGAN

DESIGNED BY B.J.C.	APPROVED BY
DRAWN BY D.D.J.	SCALE FULL SIZE
CHECKED BY	DATE 5-12-92

THREADED DECK ROD
ELECTRONIC HOUSING ASS'Y.
FLIGHT SMF/ALP

PROJECT

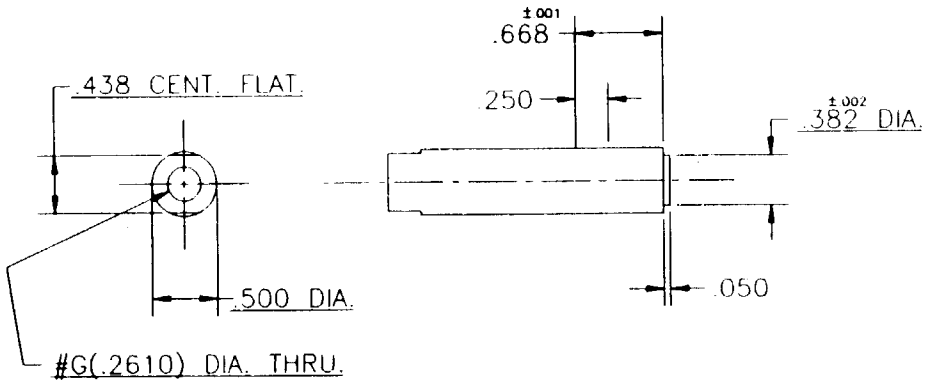
UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:
DIM. ENDING .00 ± .030 ANGULAR DIM. ± 30 MIN
DIM ENDING .000 ± .005

DWG. NO. B-048-002

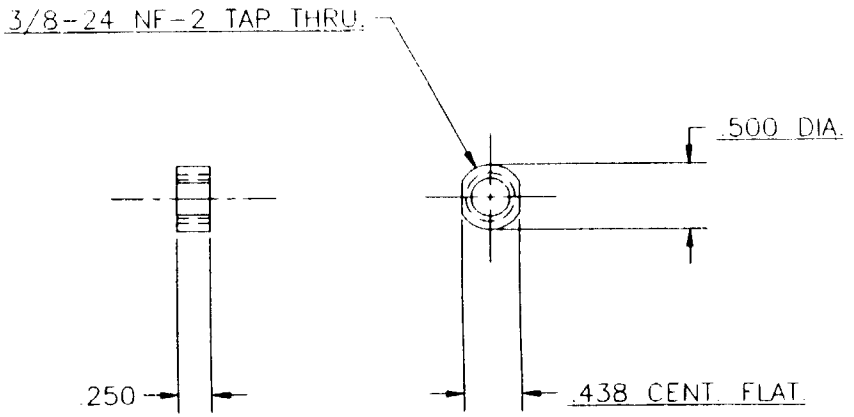
MAY 18 1992

REVISION					
ZONE	LTR	DESCRIPTION	DFTMN	DATE	APPROVED

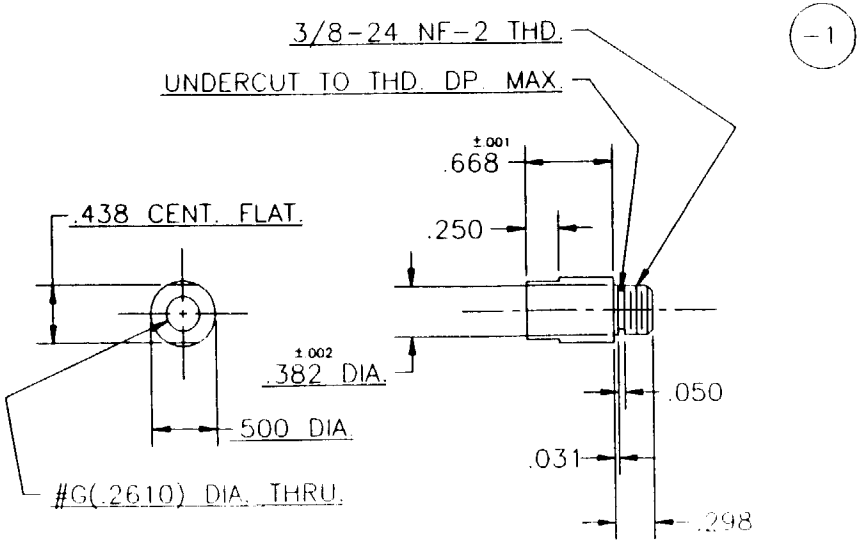
-2



-3



-1



NO. REQ'D. L. H.	NO. REQ'D. R. H.	PART NO.	NO. REQ'D. L. H.	NO. REQ'D. R. H.	NAME	SIZE	MATERIAL DESCRIPTION
6			-3		NUT	.500 DIA. x .250	6061-T651 AL.
1			-2		LONG SPACER	.500 DIA. x 2.155	6061-T651 AL.
6			-1		SHORT SPACER	.500 DIA. x .966	6061-T651 AL.

SPACE PHYSICS RESEARCH LABORATORY
COLLEGE OF ENGINEERING
THE UNIVERSITY OF MICHIGAN
ANN ARBOR, MICHIGAN

DESIGNED BY B.J.C.	APPROVED BY
DRAWN BY D.D.J	SCALE FULL SIZE
CHECKED BY	DATE 5-13-92

DECK SPACERS-POSTS & NUTS
ELECTRONIC HOUSING ASS'Y
FLIGHT SMF/ALP

PROJECT

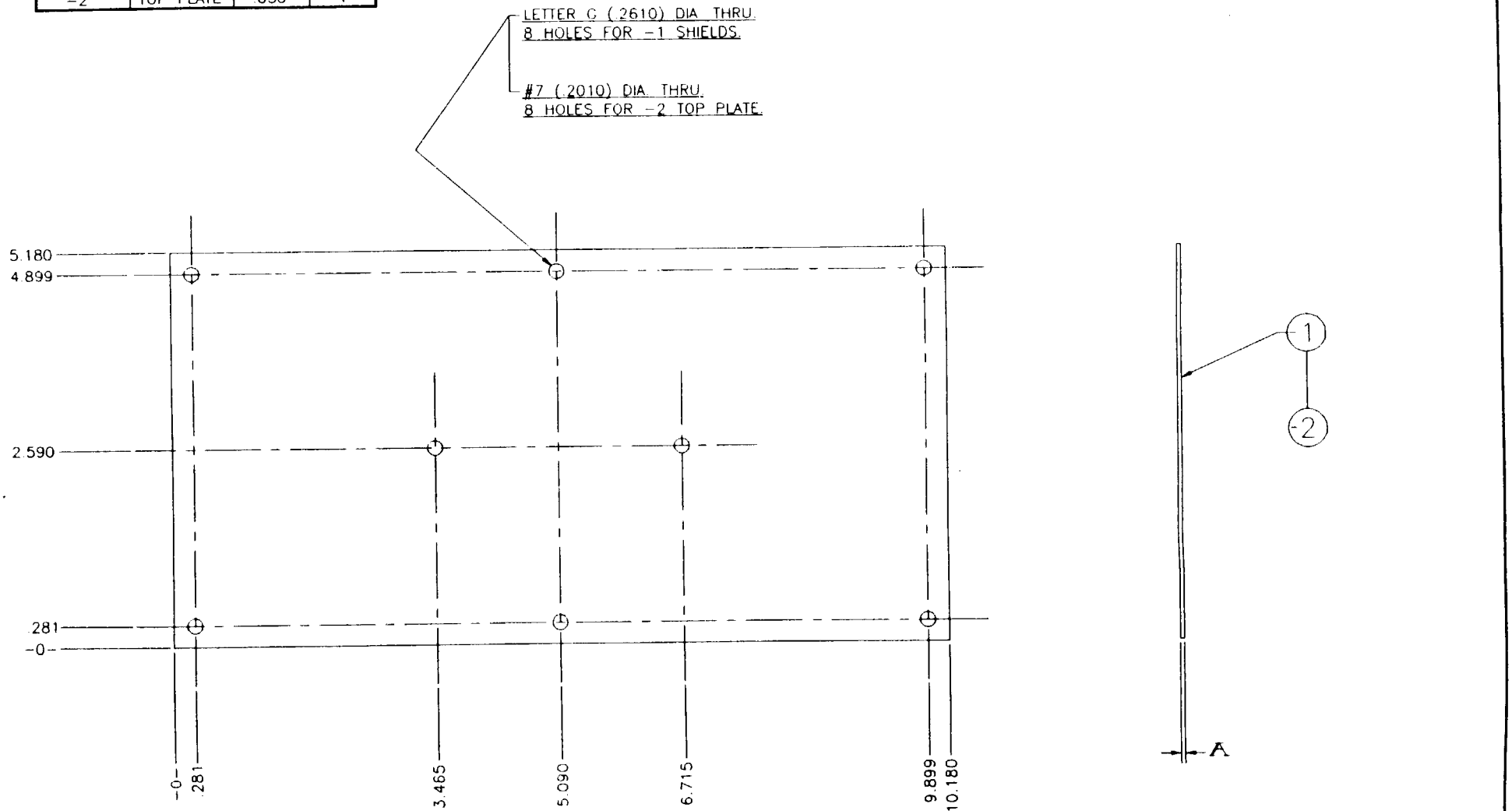
UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:
DIM. ENDING .00 ± .030
DIM. ENDING .000 ± .005
ANGULAR DIM. ± 30 MIN.

DWG. NO. B-048-003

MAY 1 0 19

ZONE	LTR	DESCRIPTION	DFTMN	DATE	APPROVED

DASH NO.	NAME	A DIM.	REQ'D
-1	SHIELD	.020	3
-2	TOP PLATE	.050	1



NOTE:
1. ALL HOLE DIM. .002
2. FINISH CHROMATE CONVERTION TYPE II -1 SHIELDS
3. BLACK ANODIZE -2 TOP PLATE

L.H.	R.H.	PART NO.	L.H.	R.H.	SHIELD/TOP PLATE	A x5.180x10.180	6061-T651 AL
NO. REQ'D.			NO. REQ'D		NAME	SIZE	DESCRIPTION

SPACE PHYSICS RESEARCH LABORATORY
COLLEGE OF ENGINEERING
THE UNIVERSITY OF MICHIGAN
ANN ARBOR, MICHIGAN

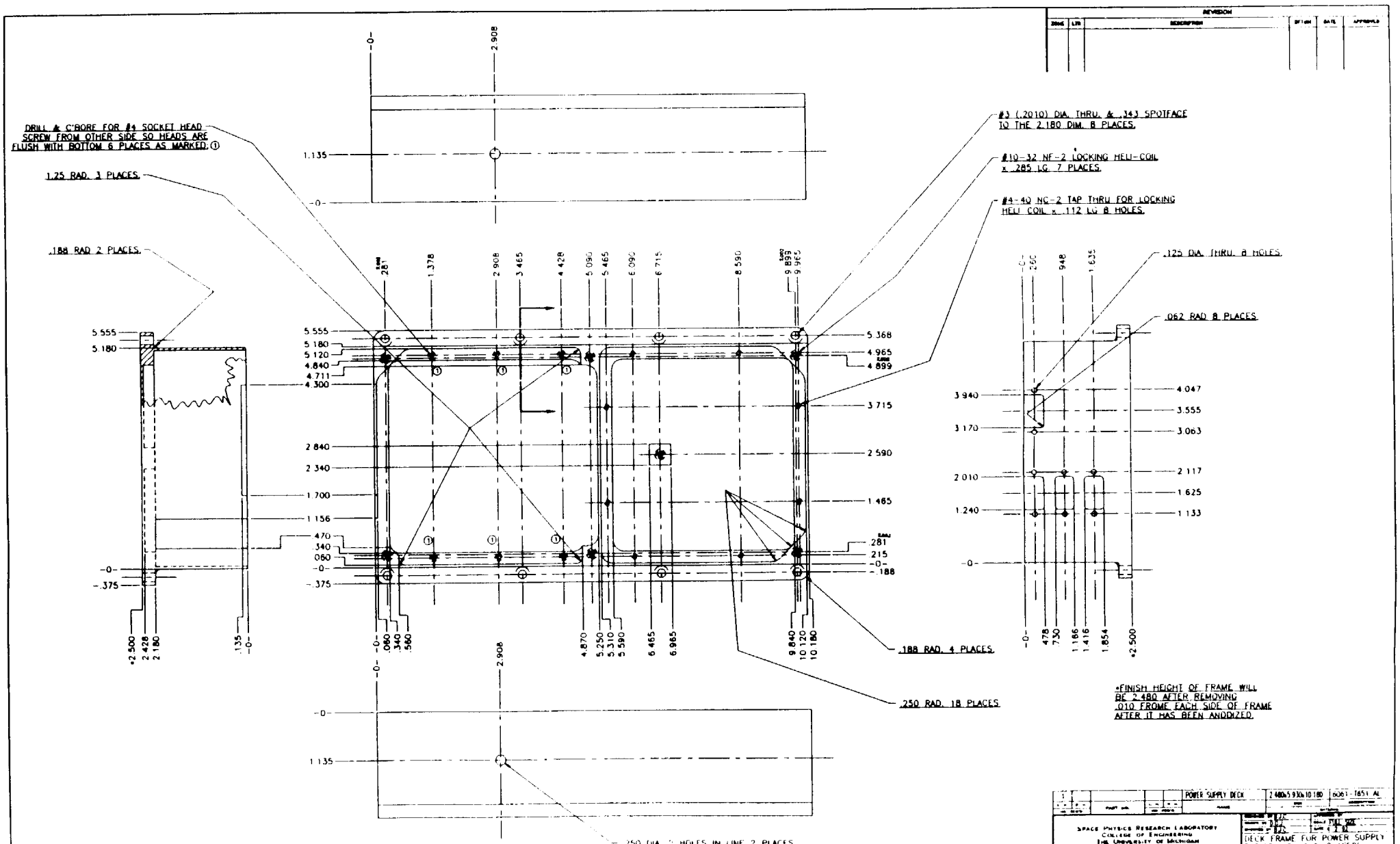
DESIGNED BY
DRAWN BY D D J
CHECKED BY
APPROVED BY
SCALE FULL SIZE
DATE 4-3-92

DECK SHIELD & TOP PLATE
ELECTRONIC HOUSING ASS'Y
FLIGHT SFM/ALP

PROJECT

UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:
DIM. ENDING .00 ± .030 ANGULAR DIM. ± 30 MIN.
DIM. ENDING .000 ± .005

DWG. NO C-048-004



REVISION					
ZONE	LTR	DESCRIPTION	BY/DR	DATE	APPROVED

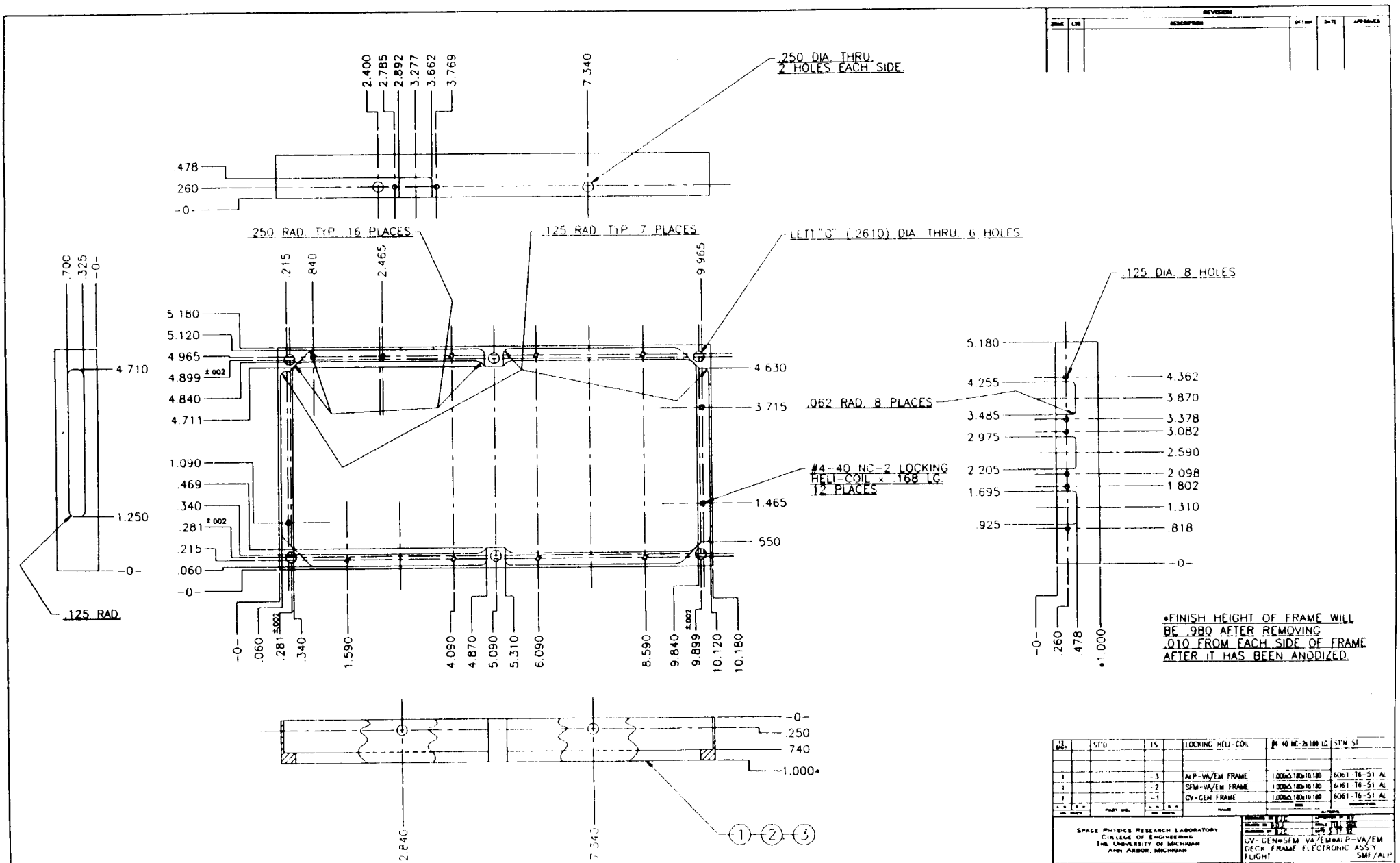
		POWER SUPPLY DECK	2.480±5.930±10.180	6061-T651 AL

SPACE PHYSICS RESEARCH LABORATORY
COLLEGE OF ENGINEERING
THE UNIVERSITY OF MICHIGAN
ANN ARBOR, MICHIGAN

DECK FRAME FOR POWER SUPPLY ELECTRONIC HOUSING ASSY. FLIGHT SFM/ALP

D-048-005

MAY 18 1992



REVISION				
ZONE	LTR	DESCRIPTION	DR NAME	DATE	APPROVED

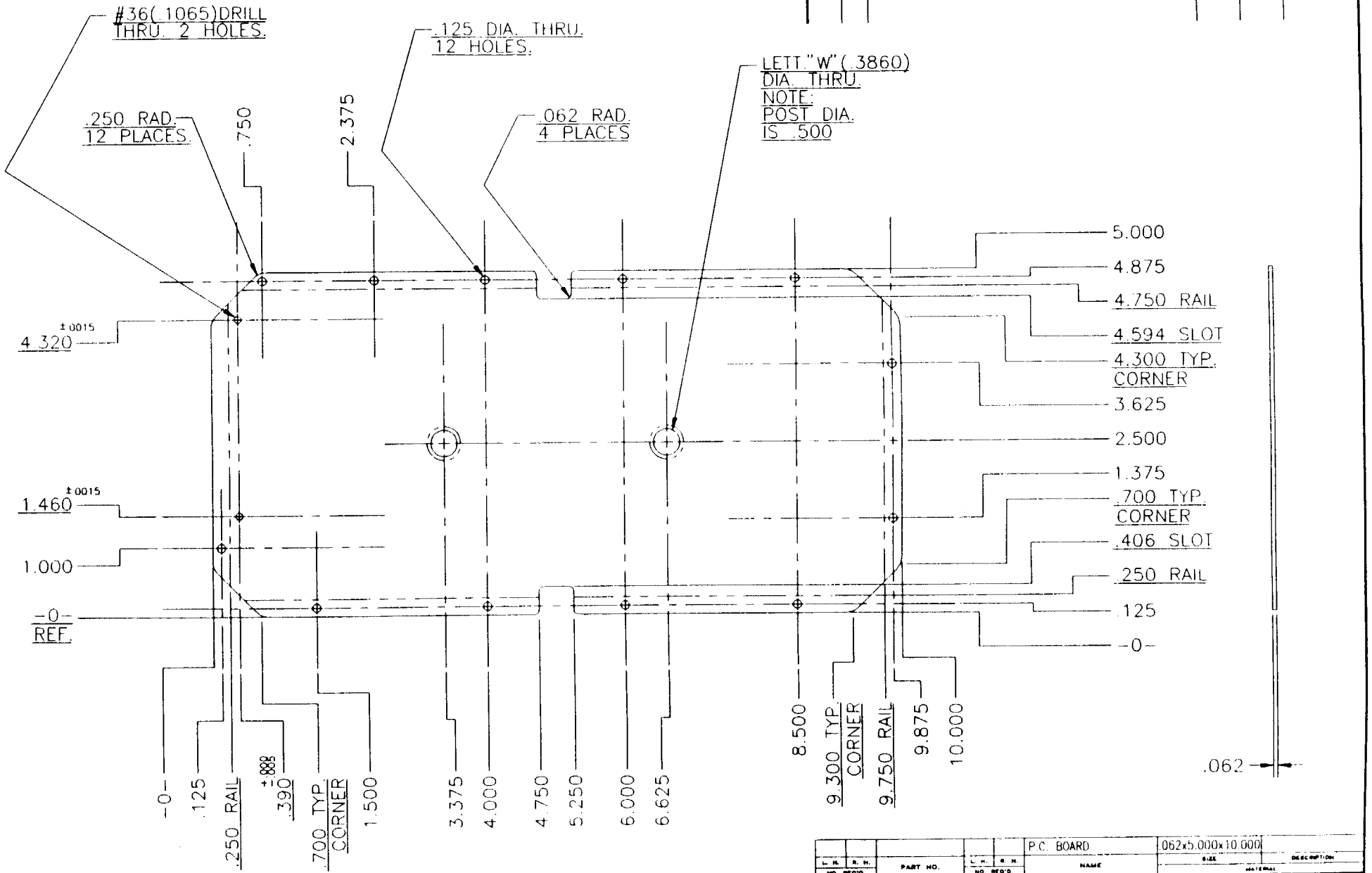
	STD	IS	LOCKING HELI-COIL	#4-40 NC-2 x .168 LG	STR ST
1		-3	ALP-VA/EM FRAME	1.000x5.180x10.180	6061-T6-51 AL
1		-2	SFM-VA/EM FRAME	1.000x5.180x10.180	6061-T6-51 AL
1		-1	GV-GEN FRAME	1.000x5.180x10.180	6061-T6-51 AL

SPACE PHYSICS RESEARCH LABORATORY
COLLEGE OF ENGINEERING
THE UNIVERSITY OF MICHIGAN
ANN ARBOR, MICHIGAN

GV-GEN•SFM VA/EM•ALP-VA/EM
DECK FRAME ELECTRONIC ASS'Y
FLIGHT SMF/ALP

DWG NO D-048-007

ZONE	LTR	DESCRIPTION	DFTMN	DATE	APPROVED



NOTE:

1. ALL PC LAYOUT WORK TO BE .050 FROM RAILS, BOARD EDGE(WHERE THERE IS NO RAIL) & POSTS.

L.H. NO REQ'D	R.H. NO REQ'D	PART NO.	L.H. NO REQ'D	R.H. NO REQ'D	NAME	SIZE	DESCRIPTION
					P.C. BOARD	.062x5.000x10.000	MATERIAL

SPACE PHYSICS RESEARCH LABORATORY
COLLEGE OF ENGINEERING
THE UNIVERSITY OF MICHIGAN
ANN ARBOR, MICHIGAN

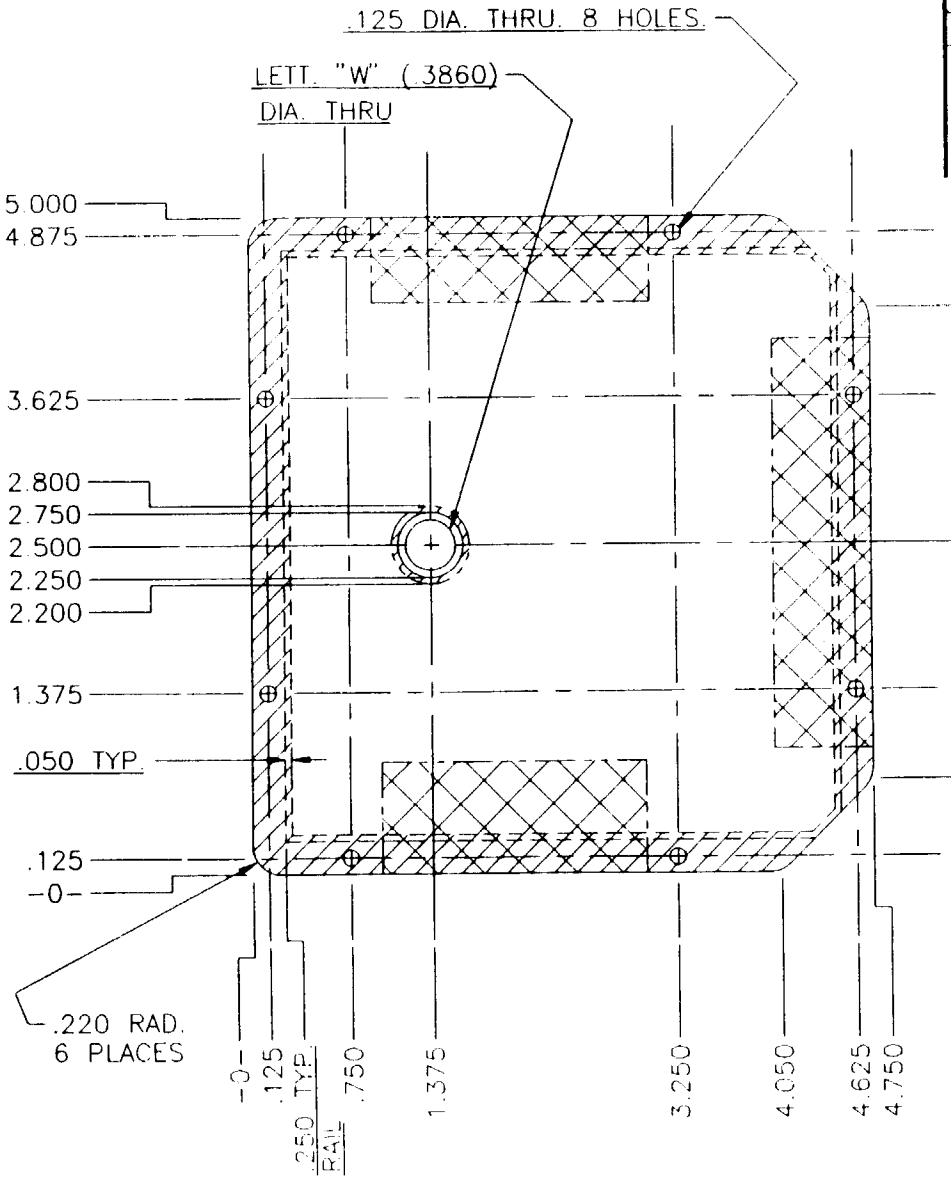
DESIGNED BY BJC	APPROVED BY NV
DRAWN BY DDJ	SCALE FULL SIZE
CHECKED BY BJC	DATE 2-5-92

P.C. BOARD MECH. LAYOUT FOR GV-GEN, SFM-VA/EM, & ALP-VA/EM FLIGHT SMF/ALP

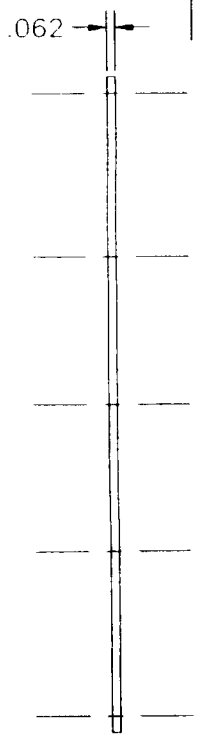
PROJECT

UNLESS OTHERWISE SPECIFIED TOLERANCES ARE: DIM ENDING .00 ± .030 ANGULAR DIM ± 30 MIN. DIM ENDING .000 ± .005

DWG NO C-048-008



REVISION					
ZONE	LTR	DESCRIPTION	DFTMN	DATE	APPROVED



NOTE:
NO P.C. LAYOUT WORK TO BE WITHIN AREA MARKED
PLUG AREA IS MARKED

1					P.C. BOARD	062x4.75x5.00	
L. H. NO REQ'D.	R. H. NO REQ'D.	PART NO.	L. H. NO REQ'D.	R. H. NO REQ'D.	NAME	SIZE MATERIAL	DESCRIPTION

SPACE PHYSICS RESEARCH LABORATORY
COLLEGE OF ENGINEERING
THE UNIVERSITY OF MICHIGAN
ANN ARBOR, MICHIGAN

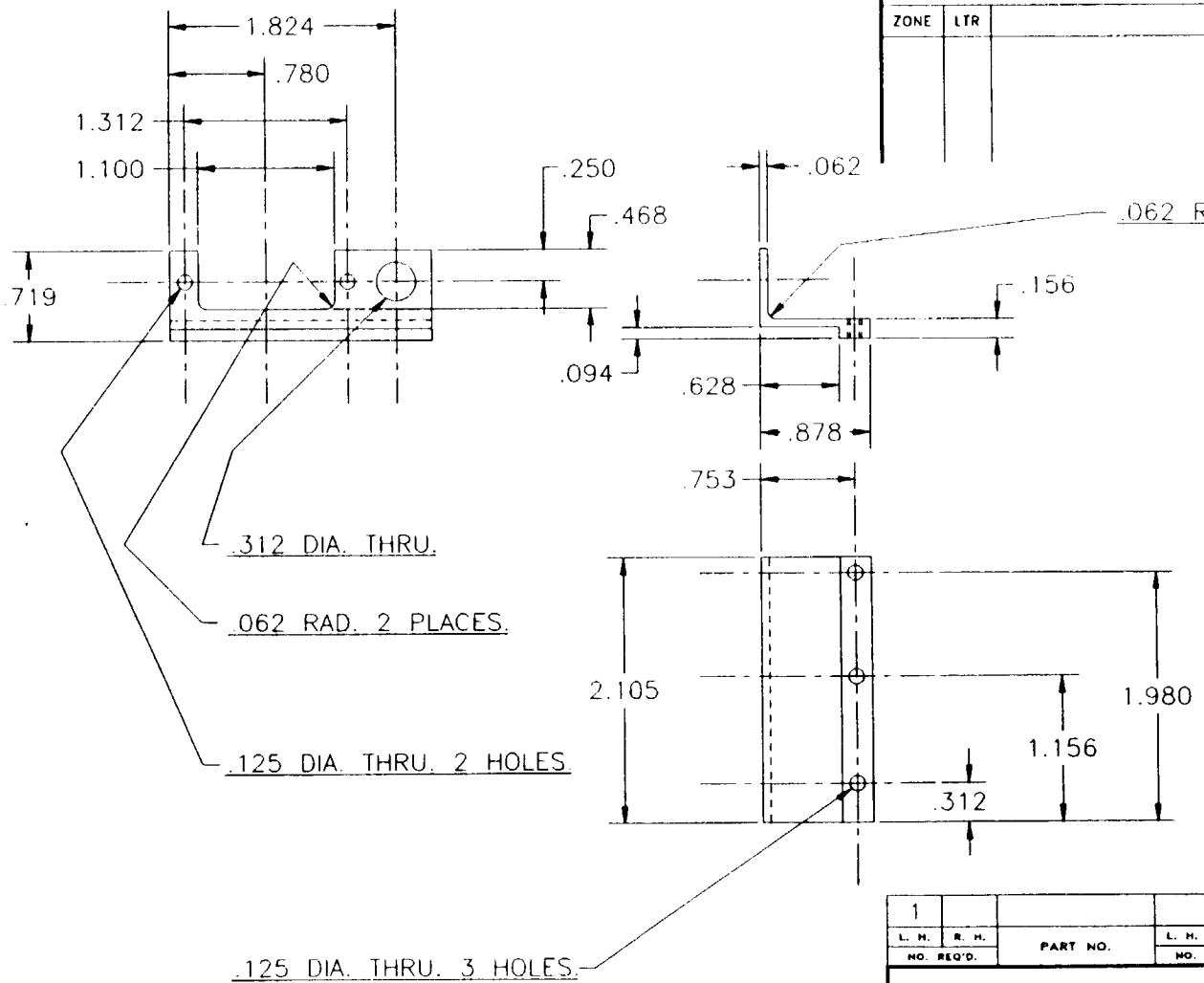
DESIGNED BY B.J.C.	APPROVED BY
DRAWN BY D.D.J.	SCALE FULL SIZE
CHECKED BY B.J.C.	DATE 4-1-92

P.C. BOARD MECH LAYOUT FOR POWER SUPPLY ELECTRONIC HOUSING ASS'Y
FLIGHT SFM/ALP

PROJECT

UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:
DIM. ENDING .00 ± .030 ANGULAR DIM. ± 30 MIN
DIM. ENDING .000 ± .005

DWG. NO. B-048-009



REVISION					
ZONE	LTR	DESCRIPTION	DFTMN	DATE	APPROVED

L. H. NO. REQ'D.	R. H. NO. REQ'D.	PART NO.	NAME	SIZE	MATERIAL DESCRIPTION
1			CONNECTOR BK'T	.719x.878x2.105	6061-T651 AL.

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DESIGNED BY BJC	APPROVED BY
DRAWN BY DDJ	SCALE FULL SIZE
CHECKED BY	DATE 4-9-92

CONNECTOR BK'T – PS DECK
ELECTRONIC HOUSING ASS'Y
FLIGHT SMF/ALP

PROJECT

UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:
DIM. ENDING .00 ± .030 ANGULAR DIM. ± 30 MIN.
DIM. ENDING .000 ± .005

DWG. NO. B-048-011

MAY 18 19

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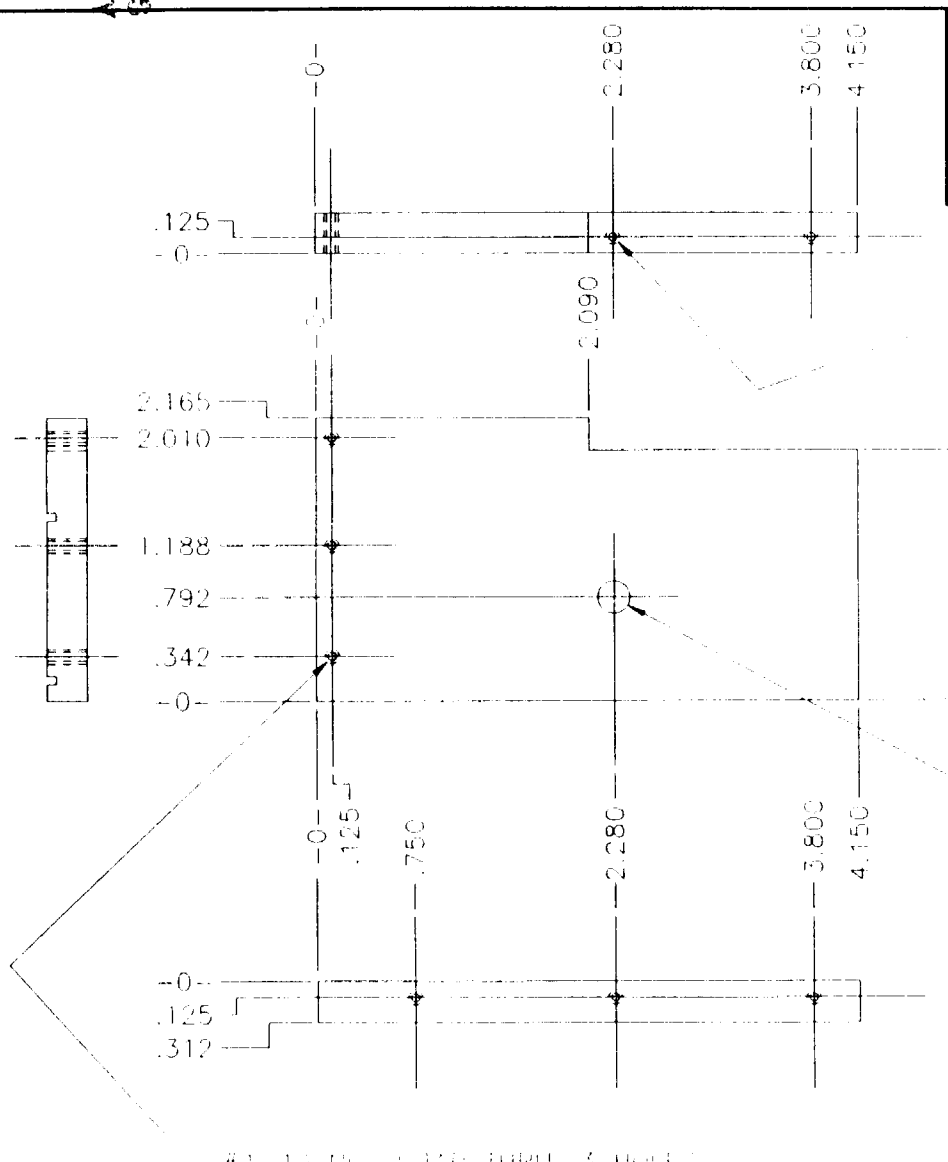
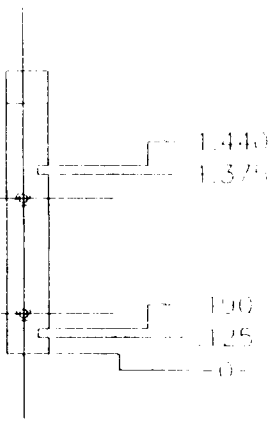
REVISION					
ZONE	LTR	DESCRIPTION	DFTMN	DATE	APPROVED





#4-40 UNC 2 TAP x .250 DP. 4 HOLES.

NOTE: BLACK ANODIZE MIL-A-8625C TYPE 2

NO. REQ'D. L.H.	NO. REQ'D. R.H.	PART NO.	NAME	SIZE	MATERIAL	DESCRIPTION
1			LONG SIDE PLATE	.312x2.165x4.150	6061-T651 AL	

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DESIGNED BY BJL
DRAWN BY DDJ
CHECKED BY
APPROVED BY
SCALE
DATE

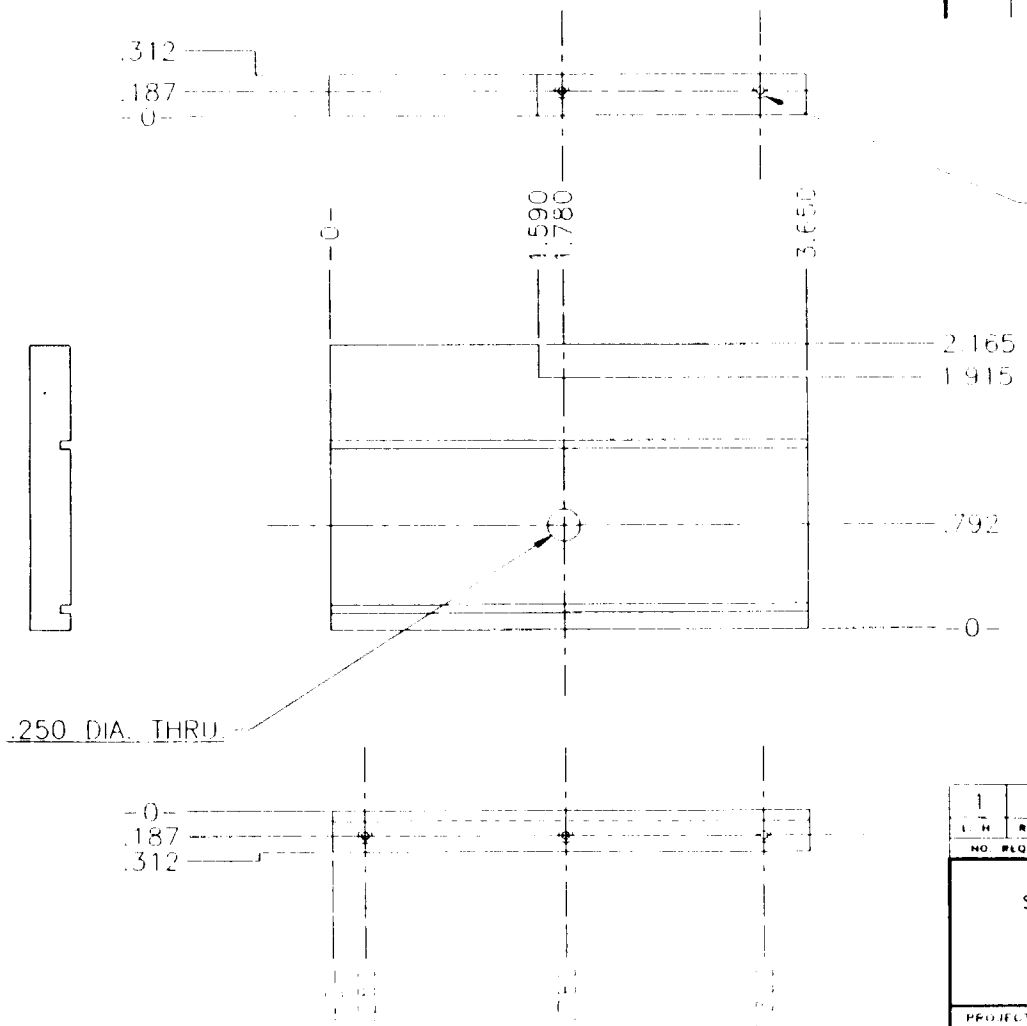
LONG SIDE PLATE FOR BD FRAME ASSY
FOR ENGINEERING EVALUATION ONLY
NOT FOR FLIGHT

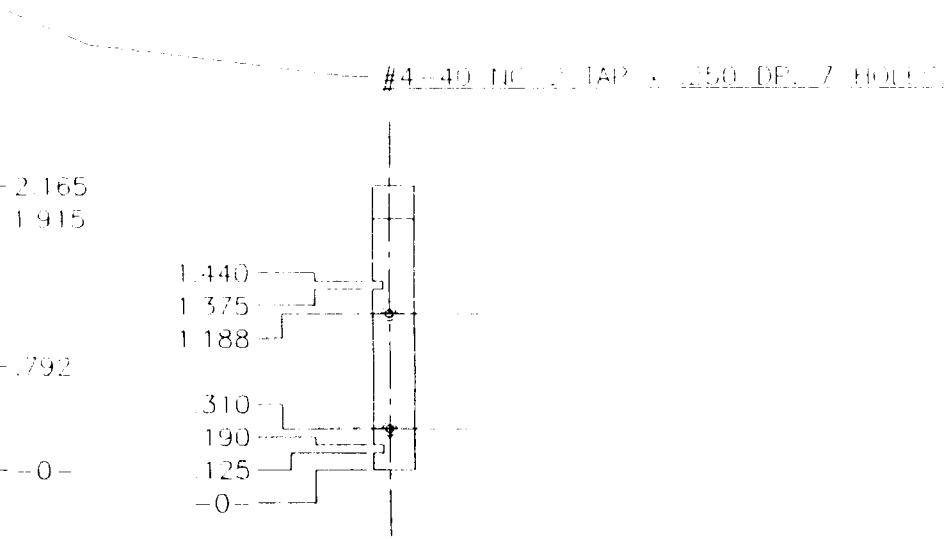
DWG. NO. [illegible]

PROJECT

UNLESS OTHERWISE SPECIFIED TOLERANCES ARE
DIM ENDING .00 ± .030 ANGULAR DIM
DIM ENDING .000 ± .005 ± 30 MIN

REVISION					
ZONE	LTR	DESCRIPTION	DFTMN	DATE	APPROVED





1							
L. H.	R. H.			L. H.	R. H.	SHORT SIDE PLATE	.312x2.165x3.650 6061-T651 Plate Al
NO. REQ'D.		PART NO.		NO. REQ'D.		NAME	SIZE MATERIAL DESCRIPTION

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DESIGNED BY [illegible] APPROVED BY
DRAWN BY DD SCALE [illegible]
CHECKED BY DATE [illegible]

SHORT SIDE PLATE PC. EL- [illegible]

PROJECT

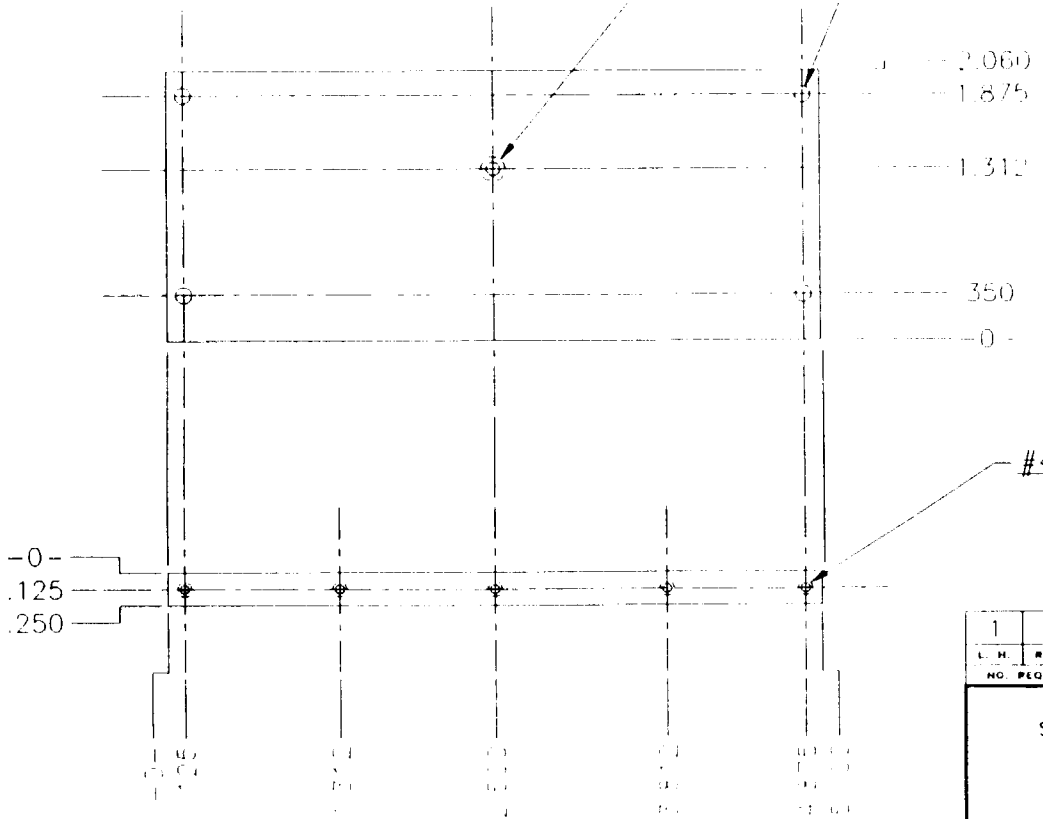
UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:
DIM ENDING .00 ± .030 ANGULAR DIM ± 30' MIN
DIM ENDING .000 ± .005

DWG NO [illegible]

REVISION					
ZONE	LTR	DESCRIPTION	DFTMN	DATE	APPROVED

#10-32 NF-2 TAP THRU

.125 DIA. THRU 4 HOLES



#4-40 NC-2 TAP x .312 DP. 5 HOLES.

NOTE: BLACK ANODIZE MIL-A-8625C TYPE II

1 L.H. NO. REQ'D.		PART NO.	L.H. NO. REQ'D.	R.H.	NAME	SIZE	MATERIAL	DESCRIPTION
					TOP PLATE	250x2.060x5.060	6061-T6 AL	

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DRAWN BY D.D.J.
CHECKED BY
APPROVED BY
SCALE
DATE 4-16-91

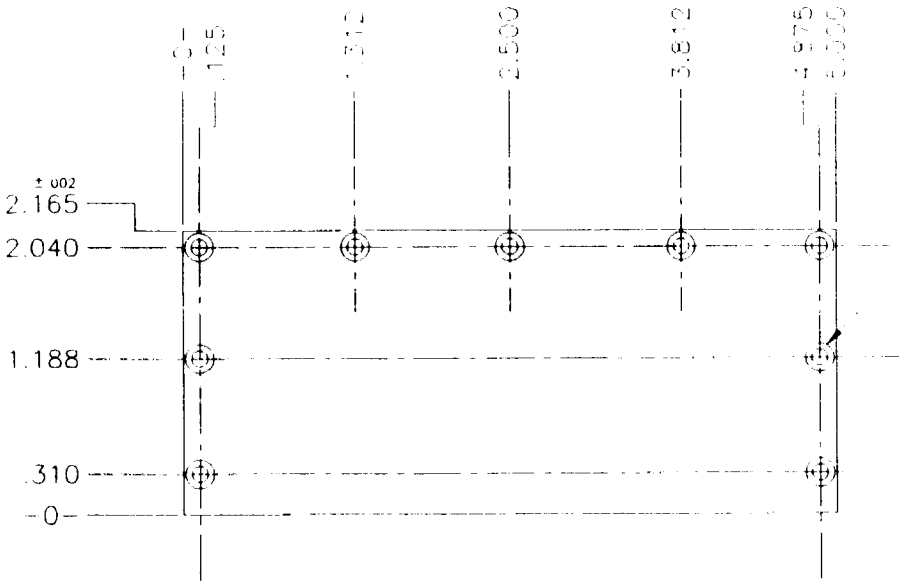
TOP PLATE P.S. BD. FRAME A

PROJECT

UNLESS OTHERWISE SPECIFIED TOLERANCES ARE
DIM. ENDING .00 ± .030 ANGULAR DIM
DIM. ENDING .000 ± .005 ± 30 MIN

DWG. NO.

REVISION					
ZONE	LTR	DESCRIPTION	DFTMN	DATE	APPROVED



.125 DIA. THRU & 82° CSK TO .240 MAX DIA. 9 PLACES

NOTE: BLACK ANODIZE Mil A-8625C TYPE 2

L. H. NO. REQ'D.	R. H. NO. REQ'D.	PART NO.	L. H. NO. REQ'D.	R. H. NO. REQ'D.	NAME	SIZE	MATERIAL DESCRIPTION
1					BACK PLATE	.062x2.165x5.000	6061-T651 AL

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DRAWN BY D.D.J.	SCALE FULL SIZE
CHECKED BY	DATE 4-16-92

BACK PLATE P.C. BD. FRAME ASSY. P.S. ELECTRONIC HOUSING ASSY FLIGHT SME (ALT)

PROJECT

UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:
DIM. ENDING .00 ± .030 ANGULAR DIM
DIM. ENDING .000 ± .015 ± 30' MIN

DWG. NO B-048 01

APPENDIX D

Measurement Mode Specifications

Modes of Operation

(revised October 7, 1992)

I. Solar Flux Monitor

1) Standard EUV Measurement Mode:

G1 = - 25V
G2 = +25V
G3 = - 15V
Target = sweep from **+20V to -36V** in 1V steps (57 total)
Telemetry: 1 reading of Decade & Vernier settings, 57 A/D values
= 1 word + 57 words = 58 words = 116 bytes

2) High Resolution EUV Measurement Mode:

G1 = - 25V
G2 = +25V
G3 = - 15V
Target = sweep from **+20V to -36V** in 0.25V steps (225 total)
Telemetry: 1 reading of Decade & Vernier settings, 225 A/D values
= 1 word + 225 words = 226 words = 452 bytes

3) Grid 1 Test Mode:

G1 = - 35V, - 30V, - 25V, - 20V, - 15V
G2 = +25V
G3 = - 15V
Target = sweep from **+20V to -36V** in 2V steps (29 total)
Telemetry: 5 * (1 reading of Decade & Vernier settings, 29 A/D values)
= 5 * (1 word + 29 words) = 150 words = 300 bytes

4) Grid 2 Test Mode:

G1 = - 25V
G2 = +15V, +20V, +25V, +30V, +35V
G3 = - 15V
Target = sweep from **+20V to -36V** in 2V steps (29 total)
Telemetry: 5 * (1 reading of Decade & Vernier settings, 29 A/D values)
= 5 * (1 word + 29 words) = 150 words = 300 bytes

5) Grid 3 Test Mode:

G1 = - 25V
G2 = +25V
G3 = - 25V, - 20V, - 15V, - 10V, - 5V
Target = sweep from **+20V to -36V** in 2V steps (29 total)
Telemetry: 5 * (1 reading of Decade & Vernier settings, 29 A/D values)
= 5 * (1 word + 29 words) = 150 words = 300 bytes

6) EUV Ion Retarding Potential Analyzer Mode:

G1 = - 10 V
G2 = sweep from -5V to +5V in 0.2V steps (51 total)
G3 = 0V
Target = 0V
Telemetry: 1 reading of Decade & Vernier settings, 51 A/D values
= 1 word + 51 words = 52 words = 104 bytes

7) EUV Electron Retarding Potential Analyzer Mode:

G1 = +10 V
G2 = sweep from -5V to +5V in 0.2V steps (51 total)
G3 = 0V
Target = 0V
Telemetry: 1 reading of Decade & Vernier settings, 51 A/D values
= 1 word + 51 words = 52 words = 104 bytes

8) EUV Cleaning Mode 1 (5 seconds):

G1 = + 50V
G2 = + 30V
G3 = + 15V
Target = +125V
Telemetry: None.

II. Advanced Langmuir Probe

1) Fast (5-point) ALP Mode:

Probe V_a = values determined by algorithm (5 total)
Telemetry: 1 reading of Decade & Vernier settings, 1 reading of kTe,
5 A/D & D/A values
= 1 word + 1 word + 2 * 5 words = 12 words = 24 bytes

2) Standard ALP Sweep Mode:

Probe V_a = sweep from -5 V to +5 V in 0.1V steps (101 total)
Telemetry: 1 reading of Decade & Vernier settings, 101 A/D values
= 1 (16-bit) word + 101 words = 102 words = 204 bytes

3) High Resolution ALP Sweep Mode:

Probe V_a = sweep from -1.7V to +1.7V in 0.04V steps (86 total)
Telemetry: 1 reading of Decade & Vernier settings, 86 A/D values
= 1 word + 86 words = 87 words = 174 bytes

4) Medium Resolution ALP Sweep Mode:

Probe V_a = sweep from -9kTe to +1kTe in kTe/8 steps (81 total), and a single reading at 2V above 1kTe
Telemetry: 1 reading of Decade & Vernier settings, 1 reading of kTe,
81 A/D values
= 1 word + 1 word + 81 words = 83 words
= 166 bytes

5) ALP Cleaning Mode 1 (5 seconds):

Probe V_a = +125 V
Telemetry: None.

Notes:

1) All data will be transmitted in packet form. The telemetry requiremets above do not include packet headers & terminators (start codes, mode ID, packet length, timestamp, checksum).

2) To avoid unnecessary redundancy, the housekeeping information will be sent in a separate packet.

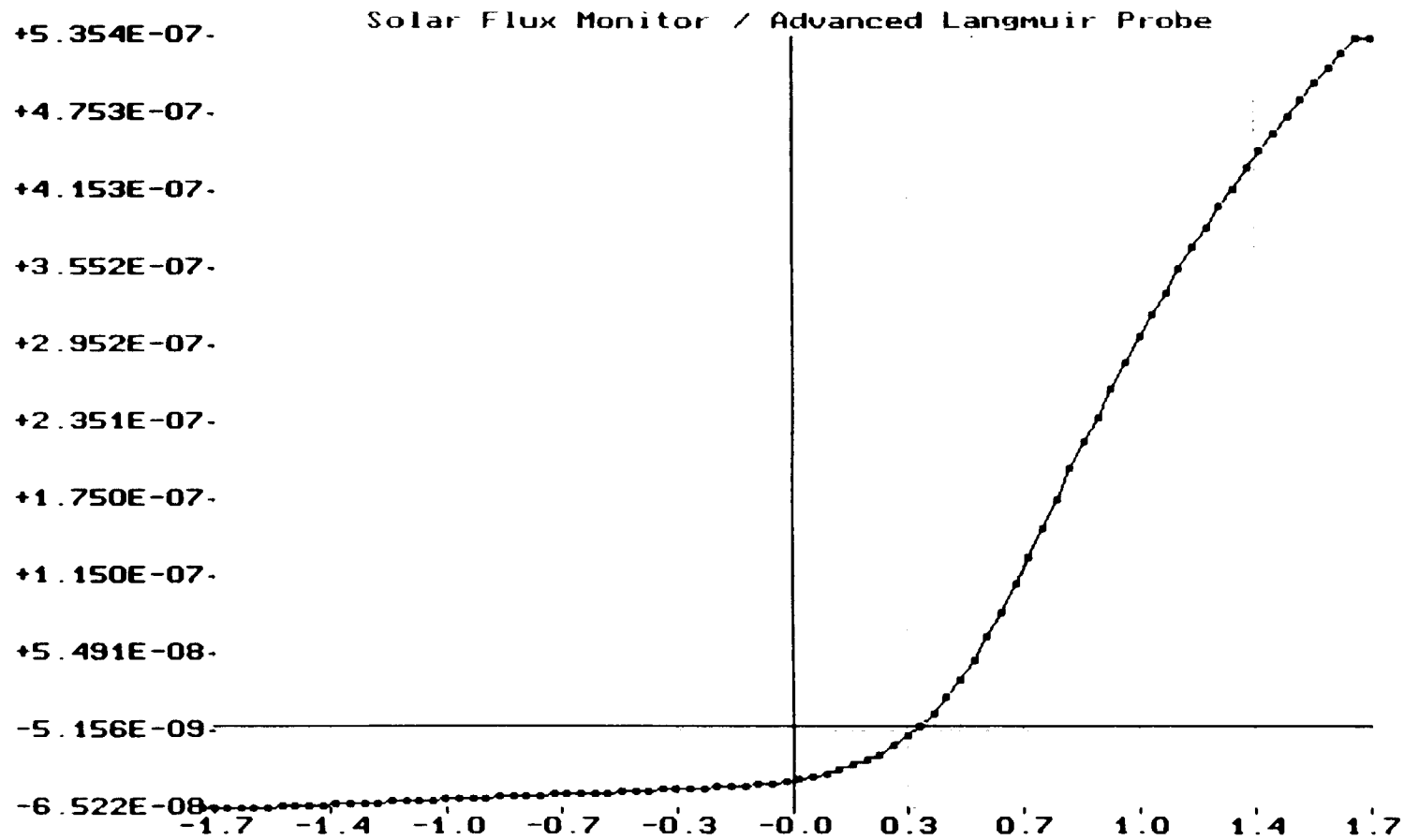
Langmuir Probe Five-Point Algorithm

1. Set Va=V1 (initial value = -5.0 V)
2. Set preamp and vernier so that A/D measures I1 = -3.3V
3. Set Va=V3 so that A/D measures I3 = -0.4715 * I1
4. Set Va=V4 so that A.D measures I4 = -4.0 * I1 (max. +5.0V)
5. Set Va=V2 = V1 + 2 * (V4 - V3) & measure I2
6. Set Va=V5 = V4 + 7 * (V4 - V3) & measure I5
7. Compute new V1 = -9 * (V4 - V3)
8. Telemeter V1,I1,V2,I2,V3,I3,V4,I4,V5,I5

(For mode which sweeps from -9kTe to +1kTe, kTe = V4 - V3)

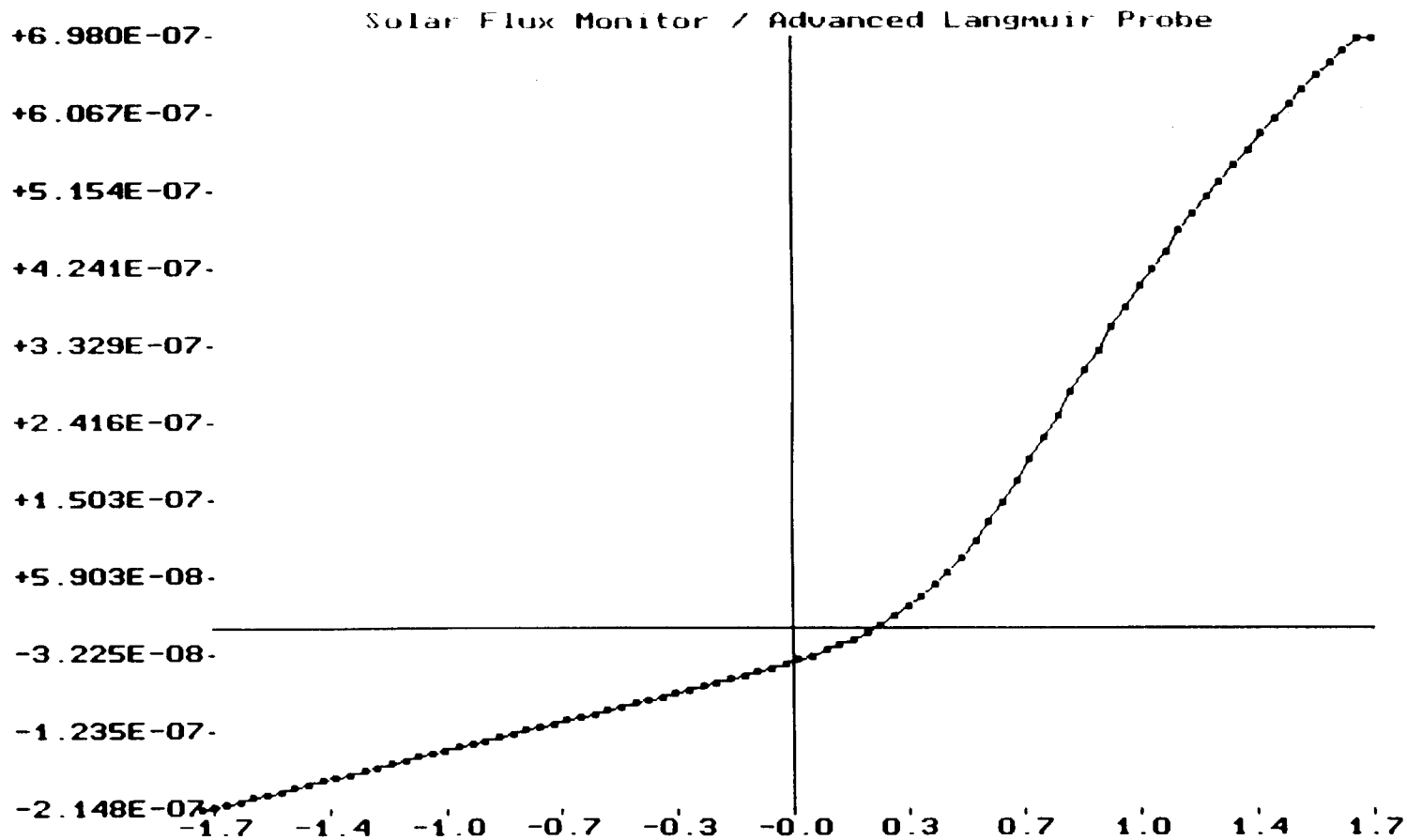
APPENDIX E

Representative Data from Sounding Rocket Flight



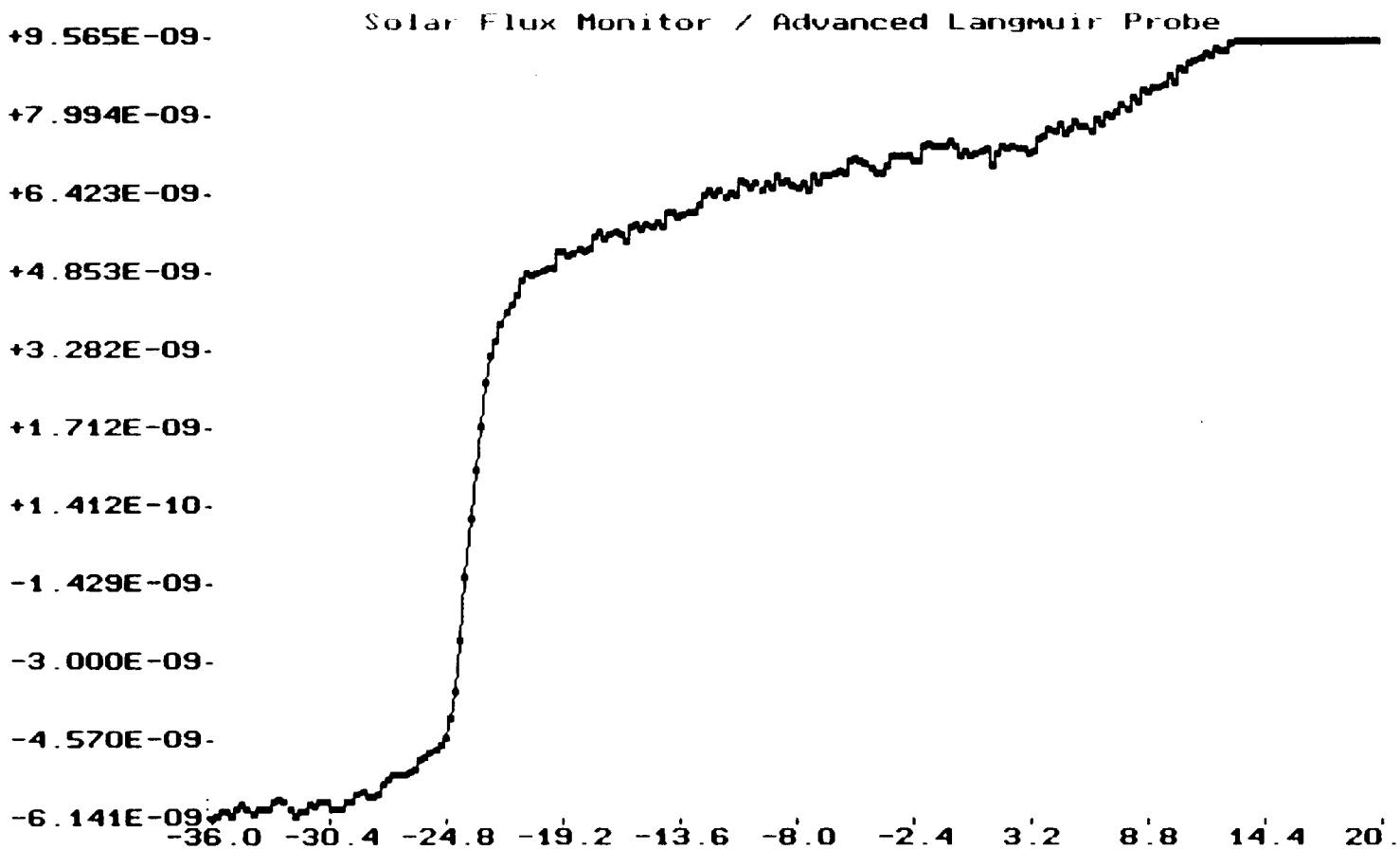
Process ID	Mode	Mode Start Time	Altitude (m)	Pre/Vern Gain
ALP_PROC	ALP_HR	10.305 = 2061	********	0x1AFF
Grid 1 (V)	Grid 2 (V)	Grid 3 (V)		Target (V)
*****	*****	*****		*****

Telemetry Source - GOODTM.ALP



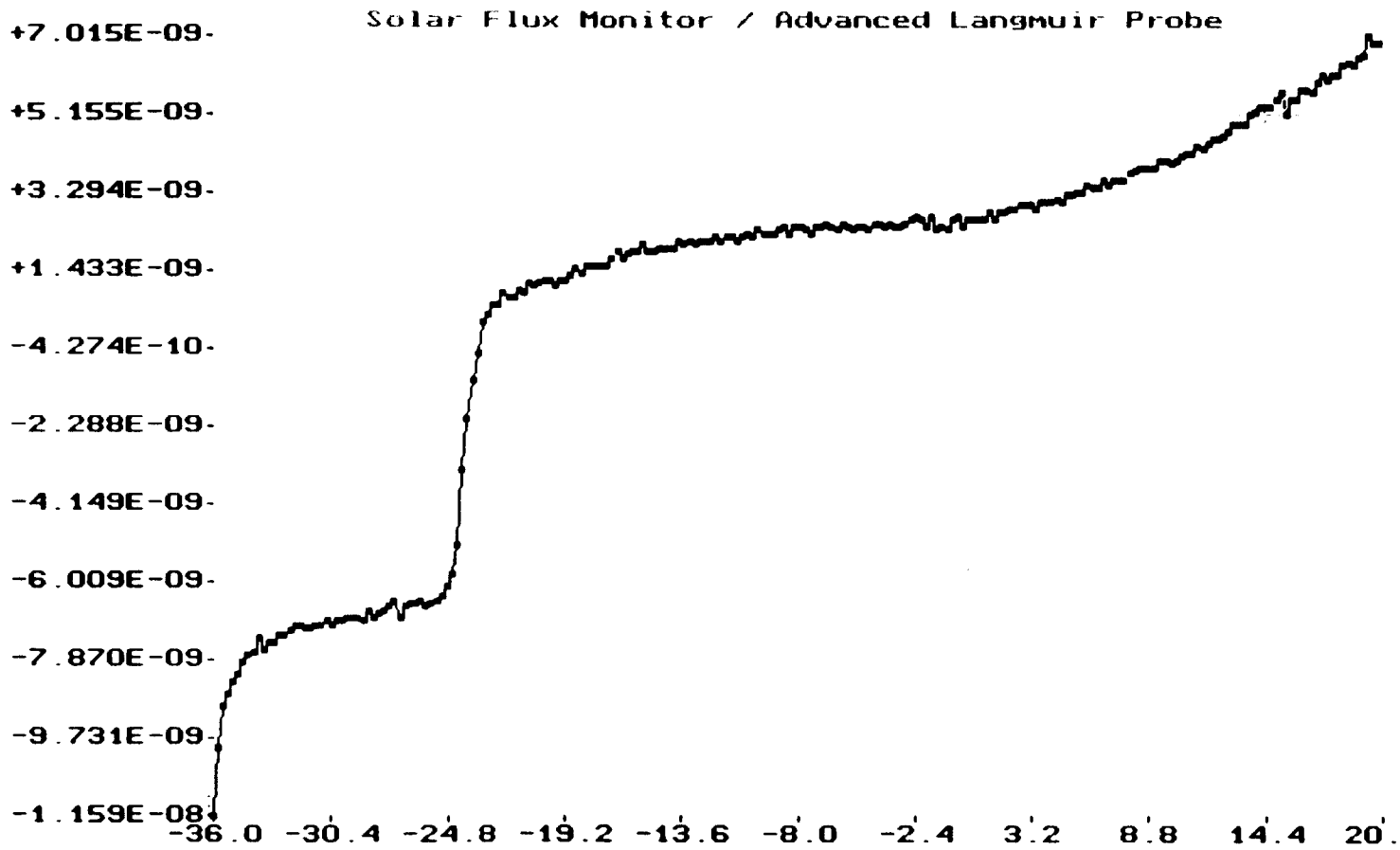
Process ID	Mode	Mode Start Time	Altitude (m)	Pre/Vern Gain
ALP_PROC	ALP_HR	7.730 = 1546	********	0x1000
Grid 1 (V)	Grid 2 (V)	Grid 3 (V)		Target (V)
*****	*****	*****		*****

Telemetry Source - GOODTM.ALP



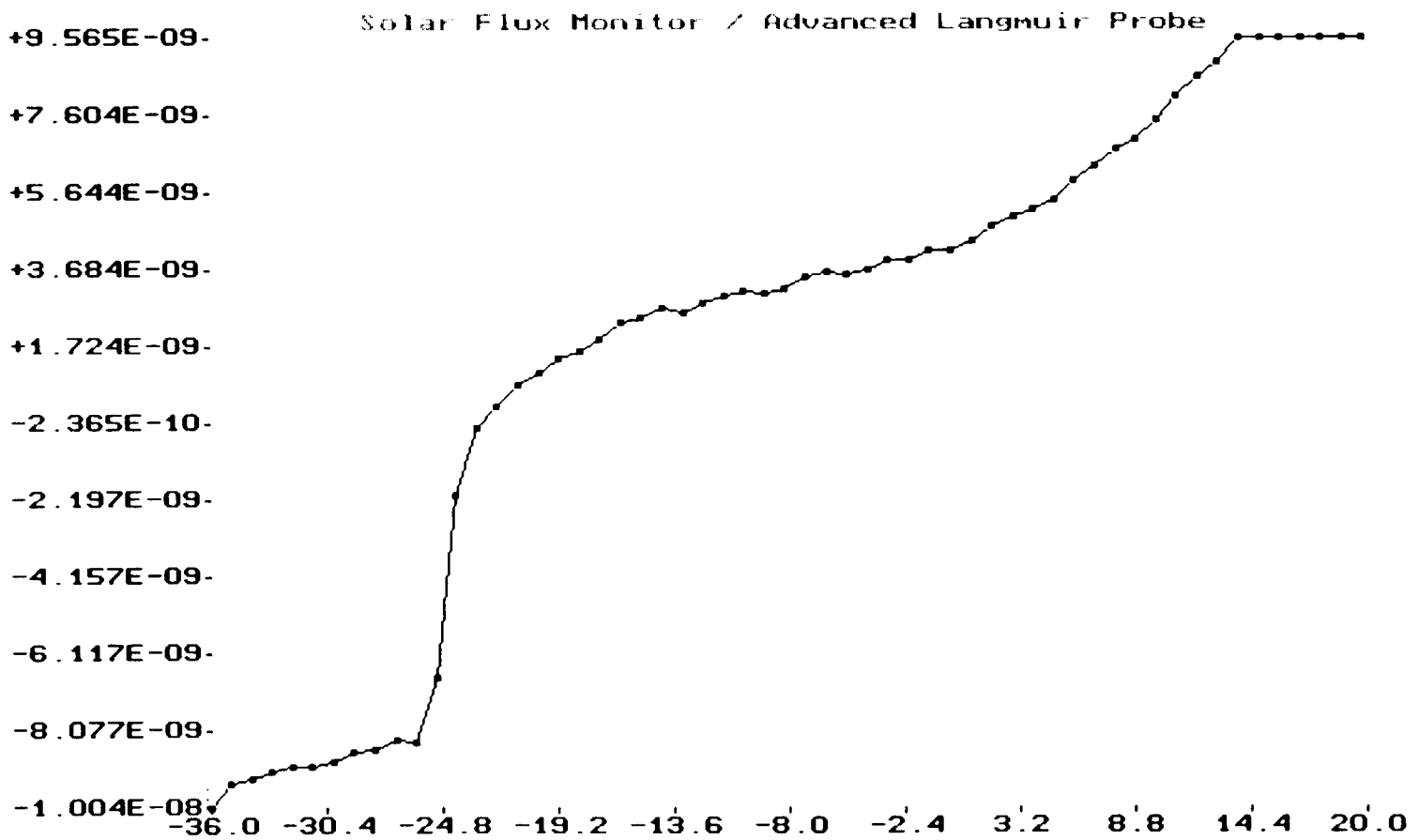
Process ID	Mode	Mode Start Time	Altitude (m)	Pre/Vern Gain
SFM_PROC	SFM_HR	300.355 = 60071	221622	0x3000
Grid 1 (V)	Grid 2 (V)	Grid 3 (V)		Target (V)
-25.0	+25.0	-15.0		SWEEP

Telemetry Source - GOODTM.SFM



Process ID	Mode	Mode Start Time	Altitude (m)	Pre/Vern Gain
SFM_PROC	SFM_HR	116.585 = 23317	149387	0x1000
Grid 1 (V)	Grid 2 (V)	Grid 3 (V)		Target (V)
-25.0	+25.0	-15.0		SWEEP

Telemetry Source - GOODTM.SFM



Process ID	Mode	Mode Start Time	Altitude (m)	Pre/Vern Gain
SFM_PROC	SFM_STD	304.950 = 60990	219322	0x3000
Grid 1 (V)	Grid 2 (V)	Grid 3 (V)		Target (V)
-25.0	+25.0	-15.0		SWEEP

Telemetry Source - GOODTM.SFM