

High Energy Telescope
Interface Control Document
for the
Solar Energetic Particle
Central Electronics

HET-SEP_Central ICD

Revision A

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1. Scope and Revision History

This document describes electrical hardware interfaces and timing protocols for commands, data, discrete and power signals between the HET sensor and SEP central electronics (SEP_Central) as part of the SEP/IMPACT suite aboard each of the two STEREO spacecraft.

For details on software-related aspects of the HET-SEP_Central interface see the reference document 2.2.

The interfaces are conducted via internal unshielded rigid-flex harness that is 8 cm (3") long and terminated on the SEP_Central side by a Nanonics 51-pin, 2-row duallobe plug connector, as shown in Appendix 8.1. Pin redundancy is not mandatory, yet highly desirable.

<u>Rev.</u>	<u>Date</u>	<u>Description</u>
-	08/20/02	Initial release
A	03/19/03	Update Power Interface, Heaters and Appendices (I/F schematic, harness and power flow diagrams)

2. Applicable Documents

2.1 STEREO Mission Operations Center (MOC) to Payload Operations Center (POC) and to STEREO Science Center (SSC) Interface Control Document (ICD)
APL Drawing No. 7381-9045, Rev. A
[http://sprg.ssl.berkeley.edu/impact/dwc/ICD/MOC-POC ICD 07-10-2002.pdf](http://sprg.ssl.berkeley.edu/impact/dwc/ICD/MOC-POC%20ICD%2007-10-2002.pdf)

2.2 SEP Commanding and Users Manual Document No. STEREO-CIT-007.A
ftp://mussel.srl.caltech.edu/pub/stereo/docs/SEP_CommandingUserManual_A.pdf

2.3 Interface Control Document (ICD) for the IMPACT Investigation
APL Drawing No. 7381-9012, Rev. B, available at APL STEREO website

2.4 IMPACT LVPS Requirements, Rev. C
http://sprg.ssl.berkeley.edu/impact/dwc/ICD/LVPSRequirements_C.pdf

3. Command Interface

The Command Interface shall be used to transfer the following:

A. Commands from SEP_Central to HET	.	.	.	3.1 – 3.2.1
B. Command responses from HET to SEP_Central	.	.	.	3.3 – 3.4.1
C. Frame sync pulses from SEP_Central to HET	.	.	.	3.5 – 3.6.1
D. Reset pulses from SEP_Central to HET	.	.	.	3.7 – 3.8.1
E. Boot code from SEP_Central to HET	.	.	.	3.9

A. Transfer of commands from SEP_Central to HET

3.1 Protocol. Transfer of commands from SEP_Central to HET shall take place according to the Serial Data/Command Protocol shown in Figure 1 below.

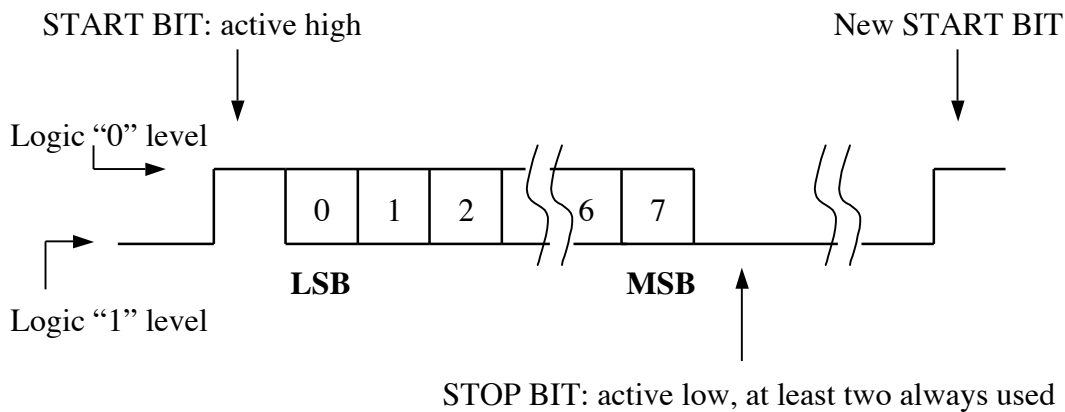


Figure 1 - Serial Data/Command Protocol
(Signal polarity shown at interface connector pins)

Note: Nominal baud rate = 57.6 kbaud

High baud rate was chosen to allow boot code transfer in a reasonably short time.

Actual rate on HET side = 57.97101 kbaud - generated from 32 MHz / (8*69)

Actual rate on SEP_Central side = 57.14286 kbaud - from 16 MHz / (8*35)

Difference in actual baud rates shall be within 2 %. In this case it is less than 1.5 %.

3.2 Signal Description.

3.2.1 HET CMD IN*. This 0 to +5 V digital signal is used to transfer commands from SEP_Central to HET. SEP_Central shall generate this signal. Its return line is HET MSTR RTN, which is tied to the signal ground (local chassis) on the SEP_Central side, while on the HET side it is separated from the local signal ground (local chassis) by 50 Ω. See Appendix 8.1 for details of the I/F schematic.

B. Transfer of command responses from HET to SEP_Central

3.3 Protocol. Transfer of command responses from HET to SEP_Central shall take place according to the Serial Data/Command Protocol described in Figure 1 and Section 3.1.

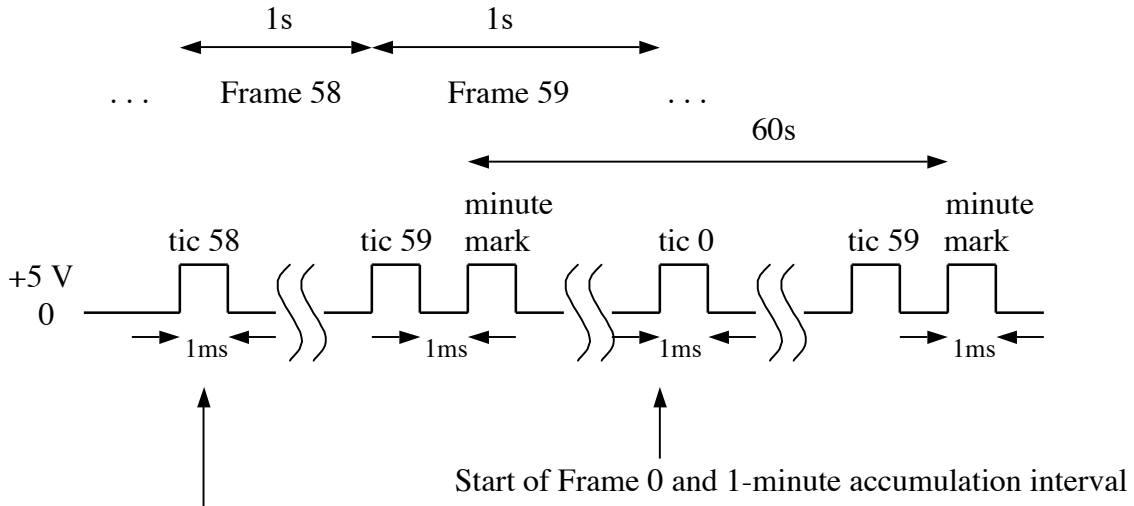
Note: In case of extremely long command responses (e.g., command table dump or memory dump) HET shall throttle the transfer rate of command responses so that SEP_Central buffer is not saturated.

3.4 Signal Description.

3.4.1 HET CMD OUT*. This 0 to +5 V digital signal is used to transfer command responses from HET to SEP_Central. HET shall generate this signal. Its return line is HET SUB RTN, which is tied to the signal ground (local chassis) on the HET side, while on the SEP_Central side it is separated from the local signal ground (local chassis) by 50 Ω . See Appendix 8.1 for details of the I/F schematic.

C. Transfer of frame sync pulses from SEP_Central to HET

3.5 Protocol. Transfer of frame sync pulses from SEP_Central to HET shall take place according to the Frame Sync Protocol shown in Figure 2 below.



FRAME SYNC: active high, 1s period, nominally 1ms long; double-pulsed every 60s to provide the 1-minute mark

Figure 2 – Frame Sync Protocol
(Signal polarity shown at interface connector pins)

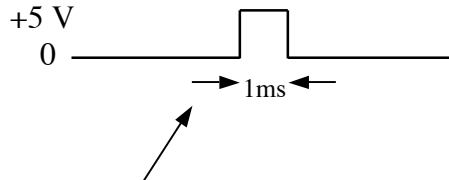
Note: Tic 0 follows the 1-minute mark by ~1 second and marks the beginning of Frame 0 as well as the beginning of 1-minute accumulation interval for HET.

3.6 Signal Description.

3.6.1 HET FRAME SYNC. This 0 to +5 V digital signal is used to transfer a frame-synchronizing signal from SEP_Central to HET. SEP_Central shall generate this signal. Its return line is HET MSTR RTN, which is tied to the signal ground (local chassis) on the SEP_Central side, while on the HET side it is separated from the local signal ground (local chassis) by 50 Ω. See Appendix 8.1 for details of the I/F schematic.

D. Transfer of reset pulses from SEP_Central to HET

3.7 Protocol. Transfer of reset pulses from SEP_Central to HET shall take place according to the Reset Pulse Protocol shown in Figure 3 below.



RESET PULSE: active high, nominally 1ms long, non-periodic

Figure 3 – Reset Pulse Protocol
(Signal polarity shown at interface connector pins)

3.8 Signal Description.

3.8.1 HET RESET. This 0 to +5 V digital signal is used to transfer a reset signal from SEP_Central to HET in order to reset the HET Minimum Instruction Set Computer (MISC). SEP_Central shall generate this signal. Its return line is HET MSTR RTN, which is tied to the signal ground (local chassis) on the SEP_Central side, while on the HET side it is separated from the local signal ground (local chassis) by 50 Ω . See Appendix 8.1 for details of the I/F schematic.

E. Transfer of boot code from SEP_Central to HET

3.9 Protocol. Transfer of boot code shall take place according to the Serial Data/Command Protocol described in Figure 1 and Section 3.1. For more details on this topic see the reference document 2.2.

4. Data Interface

The Data Interface is used for transfer of information from HET to SEP_Central. All HET data types (science, housekeeping and beacon) shall be formatted into CCSDS telemetry packets in order to be transferred over this interface.

4.1 Protocol. Transfer of data shall take place according to the Serial Data/Command Protocol described in Figure 1 and Section 3.1.

Note: Nominal baud rate = 57.6 kbaud

High baud rate was chosen to allow data packet transfer in a reasonably short time.

4.2 Signal Description.

4.2.1 HET DATA OUT*. This 0 to +5 V digital signal is used to transfer data from HET to SEP_Central. HET shall generate this signal. Its return line is HET SUB RTN, which is tied to the signal ground (local chassis) on the HET side, while on the SEP_Central side it is separated from the local signal ground (local chassis) by 50 Ω . See Appendix 8.1 for details of the I/F schematic.

4.3 CCSDS Packet.

4.3.1 Format Overview. Data transfer from HET to SEP_Central shall be carried out in the form of a standard 272-byte CCSDS telemetry packet that consists of the following:

- 6-byte Primary Packet Header (byte # 0-5, inclusive)
- 5-byte Secondary Packet Header (byte # 6-10, inclusive)
- 261-byte Application Data (byte # 11-271, inclusive)

For a detailed CCSDS telemetry packet format description see Appendix 8.4 or the reference document 2.1, and for details on the data location within the 261 bytes of Application Data see the reference document 2.2.

HET shall transfer its data to SEP_Central in the form of complete packets with the content of the Primary Packet Header defined as follows:

- Byte 0: 00001010 (MSB on the left. The 3 LSB's are part of APID below.)
- Byte 1: 01001110 (Part of 11-bit APID, e.g., 24E hex = 010 0100 1110.)
- Byte 2: 11xxxxxx ("No grouping" flag and Src. Seq. Ct. below.)
- Byte 3: xxxxxxxx (Source Sequence Count, total of 14 bits.)
- Byte 4: 00000001 (Packet Data Length, including Secondary Header,)
- Byte 5: 00001001 (but w/o Primary Header, in # of bytes-1, i.e., 265.)

HET shall zero-fill the Secondary Packet Header (byte # 6-10, inclusive), as this part of the packet shall be filled in by SEP_Central. The header contains 5 bytes of S/C time (4+1, i.e., truncated in the sub-seconds field from 2 bytes down to 1).

4.3.2 Checksum. The Checksum Byte is byte # 271, the last byte of the CCSDS packet. HET shall calculate checksum for its data packets and set the Checksum Byte such that the arithmetic sum of all 272 bytes in the packet, modulo 256, equals zero. SEP_Central shall verify checksums upon receiving HET packets. HET science packet gets the final checksum from SEP Central when S/C time is assigned to the Secondary Packet Header.

SEP Central shall combine HK data from all sensors to form a new SEP HK packet and shall calculate its checksum.

SEP Central shall combine beacon data from all sensors to form a SEP beacon data block and shall calculate its checksum. IMPACT IDPU shall assign the final checksum upon assembly of the IMPACT beacon packet.

4.3.3 APID and Rate Allocation. HET data packets shall carry an 11-bit APID (Application Process Identifier) in the hex range 24E-257 (inclusive), or 590-599 decimal. In order to fill in the required Primary Header information (bytes # 2-3) HET shall implement a separate 14-bit Source Sequence Counter for each unique APID it selects to use (including the one for zero-filled packets). The APIDs shall be designated by HET and distributed among its various packet types, shown below with their rate allocations (note that rates do not include packet headers):

- HET science data (rates, events, etc.) 6 packet/min (208.8 bit/s)
- HET HK data (11 Fixed, 30 Dribbled bytes) 1 packet/min (5.5 bit/s)
- HET beacon data (28 bytes) 1 packet/min (3.7 bit/s)

4.3.4 Transfer Schedule. Using the protocols in Figures 1 and 2 above, data packet transfer from HET to SEP_Central shall be based on a once-per-second pulse (frame sync) where the beginning of each 1-minute period is marked by a double pulse. SEP_Central shall generate the frame sync pulses and ensure that the 1-minute marks are synchronized to the UT minute intervals. HET shall make use of its internal timers and interrupts tied to the frame sync pulses to schedule data packet transfers. Frames of each minute shall be numbered 0-59. Beginning of frame 0 shall coincide with tic 0 immediately following the 1-minute mark. HET basic data accumulation interval shall be 1 minute long, beginning at tic 0.

SEP_Central collects data from three MISC-equipped sensors (LET/HET/SIT) in an alternating cyclical manner during the first 200 ms of each frame dedicated to a packet transfer from that particular sensor. Thus every sensor has a total of 20 dedicated data-transmission frames in every minute. HET shall transmit at least one packet to SEP_Central within the initial 200-ms window following tic 0, 3, 6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36, 39, 42, 45, 48, 51, 54 and 57.

Given the baud rate of 57.6 kbaud it takes ~52 ms to send one data packet. HET may send more than one packet during the 200-ms window or send a “dummy”, zero-filled, packet instead. HET data packets shall be transmitted over the entire 1-minute cycle (the regularity of packets helps in ground testing, e.g., with an oscilloscope triggering on the frame sync one can quickly verify the data content). SEP_Central shall not forward the zero-filled HET data packets to the IDPU. HET shall assign a unique APID to its zero-filled packets so that SEP_Central can recognize them. For more details on this topic see the reference document 2.2.

HET data packets received by SEP_Central during a given accumulation minute (N) shall contain HET data collected during the prior minute (N-1) and shall be transmitted to the IMPACT IDPU during the following minute (N+1). SEP_Central shall fill-in the UT portion of all packets received during minute (N) with the UT code associated with tic 0 of minute (N-1). In other words, the UT code of a packet shall refer to the beginning of the minute during which its data was accumulated.

4.4 Special Data Modes.

4.4.1 Accelerator Testing Mode. SEP_Central shall pay attention to just one sensor (HET), which can then use nearly 57.6 kbaud bandwidth of the serial data line. The data format from the sensor can be anything in this mode, or it could be in the form of multiple packets/second. HET shall throttle the transfer rate to a maximum value that is TBD, but close to the limit imposed by the 57.6 kbaud rate.

4.4.2 Variable Packet Rate. The number of packets/minute generated by HET, as well as the number of HET packets passed on by the SEP_Central shall be commandable. This would allow HET to make use of available bandwidth should any other SEP sensor become disabled.

5. Discrete Signal Interface

5.1 Protocol. SEP_Central shall provide a pair of connections between the HET sensor and the Spacecraft Thermal connector (SEP-J2) for the signals listed below. The two signals of the pair and their redundant lines shall be routed close together to avoid introduction of electric noise.

5.2 Signal Description.

5.2.1 HET S/C TEMP and HET S/C TEMP RTN. These are a pair of signals that connect to a spacecraft-monitored thermistor in the HET sensor (a modified “Minco Products” model S17624, flight P/N S102212PFY72B, 1 kohm Pt ribbon RTD sensor, +/- 100 °C). The thermistor is nominally powered by the S/C, with

SEP_Central only providing a connection between the S/C and HET sensor. Selection of the thermistor location in HET shall be coordinated with the SEP Thermal Engineer and in accordance with the reference document 2.3.

6. Power Interface

These signals are generated in SEP_Central and used to provide power to the HET sensor.

6.1 LVPS Protocol. SEP LVPS outputs listed below shall be shared among the SEP subsystems (LET/HET/SIT/SEP_Central) and regulated to $\pm 5\%$ (half load to full load). High frequency (LVPS-generated) ripple on the secondary outputs shall be less than 10 mV peak-to-peak at full load, as per reference document 2.4.

6.2 Signal Description.

6.2.1 HET PWR RTN. This line provides a return path for all analog and digital power signals from HET to SEP_Central. It is connected to the local chassis in both HET and SEP LVPS, therefore serving as a signal ground to which all analog and digital voltages are referenced.

6.2.2 HET +13A. This line provides analog power at +13 V, primarily used in the local +5 V series regulator. Its maximum current draw during the steady-state operation shall not exceed 4 mA.

6.2.3 HET -13A. This line provides analog power at -13 V, primarily used in the -5 V reference generator. Its maximum current draw during the steady-state operation shall not exceed 3 mA.

6.2.4 HET +6A. This line provides analog power at +6 V, primarily used in the local +5 V series regulator. Its maximum current draw during the steady-state operation shall not exceed 15 mA.

6.2.5 HET -6A. This line provides analog power at -6 V, used in HK ADC. Its maximum current draw during the steady-state operation shall not exceed 1 mA.

6.2.6 HET +2.6D. This line provides digital power at +2.6 V, primarily used for core supply of Actel gate array. Its maximum current draw during the steady-state operation shall not exceed 14 mA. Temporary peak load shall not exceed 34 mA.

6.2.7 HET +3.4D. This line provides digital power at +3.4 V, primarily used for I/O supply of Actel gate array, SRAM and 32 MHz clock oscillator in HET. Its maximum current draw during the steady-state operation shall not exceed 16 mA. Temporary peak load shall not exceed 34 mA.

6.2.8 HET +5.1D. This line provides digital power at +5.1 V, primarily used in the heater control and interface circuits: HC14 and HCT240. Its maximum current draw during the steady-state operation shall not exceed 1 mA.

6.3 SSD Bias Supply Protocol. Positive bias supply outputs (used on LET/HET/SIT) are controlled by a single switch located in SEP_Central and shall be turned on/off simultaneously for all three sensors. For information on the detector leakage current assumptions see Appendix 8.5.

6.4 Signal Description.

6.4.1 HET BIAS. This signal is shared between LET L3 and HET H1-6 detectors. Its nominal value shall be set for flight in the range of 50-250 V that is suitable to both LET and HET detectors. Inside LET/HET the current limit shall be set to 470 uA, allowing the bias supply output to droop 10 % from the nominal value while one short-circuited worst-case detector in the group (L3) draws 10 x its maximum leakage current (assumed for the end of detector life and at 40 °C), 305 uA, while the other LET/HET detectors draw their maximum leakage currents and continue normal operation.

7. Heaters

If heaters are needed for HET sensor, heater power shall be supplied by the STEREO spacecraft. SEP_Central shall provide a connection between the spacecraft and the HET sensor. SEP Thermal Engineer shall actively participate in selection of heater type and its location in the HET sensor.

SEP-J10 / SEP-P10

RIGID-FLEX

Double lines to Bias Supply

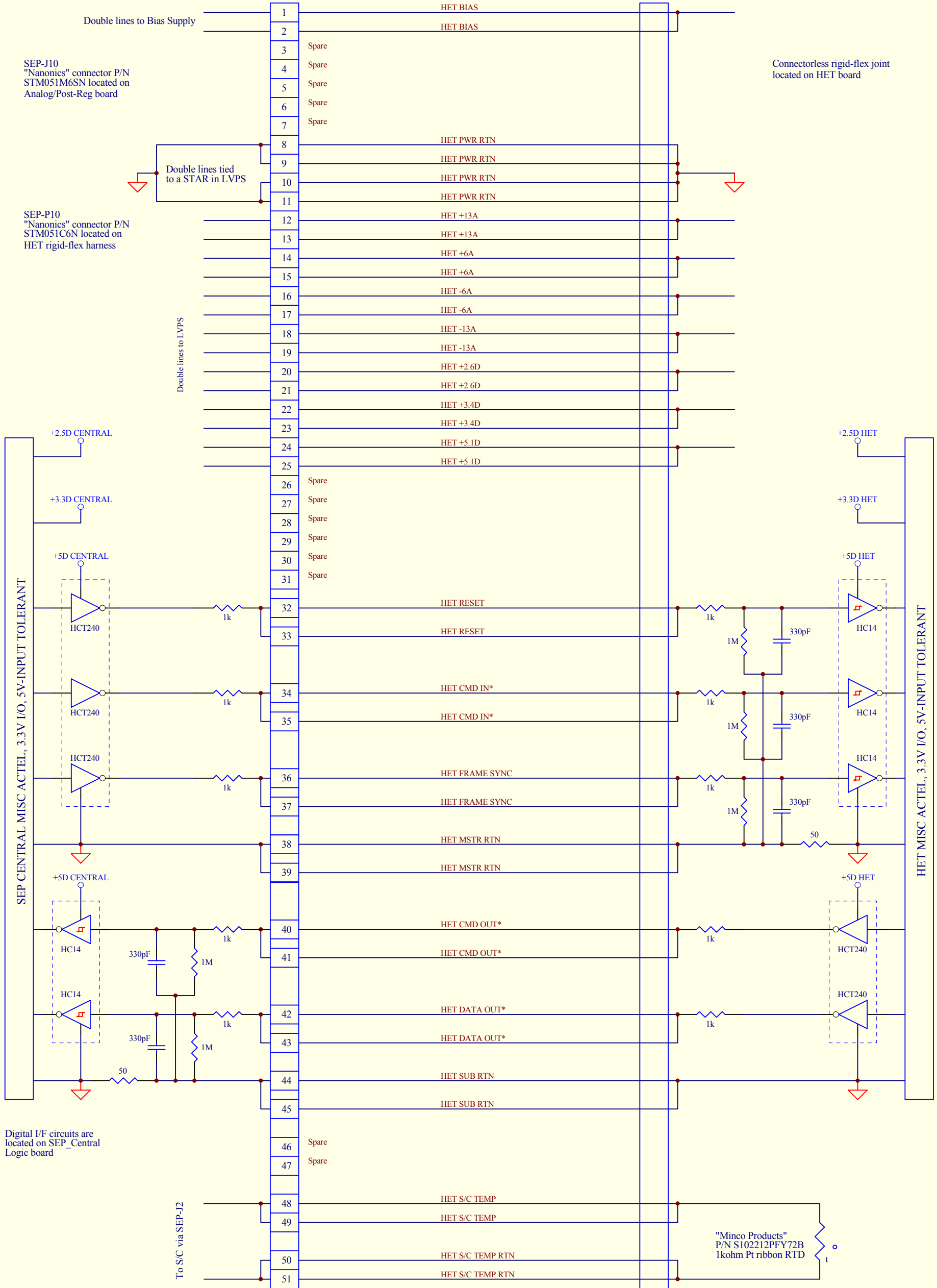
SEP-J10 "Nanotics" connector P/N STM051M6SN located on Analog/Post-Reg board

Connectorless rigid-flex joint located on HET board

SEP-P10 "Nanotics" connector P/N STM051C6N located on HET rigid-flex harness

Double lines tied to a STAR in LVPS

Double lines to LVPS

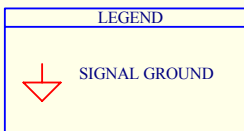


Digital I/F circuits are located on SEP_Central Logic board

To S/C via SEP-J2

INTERNAL HARNESS

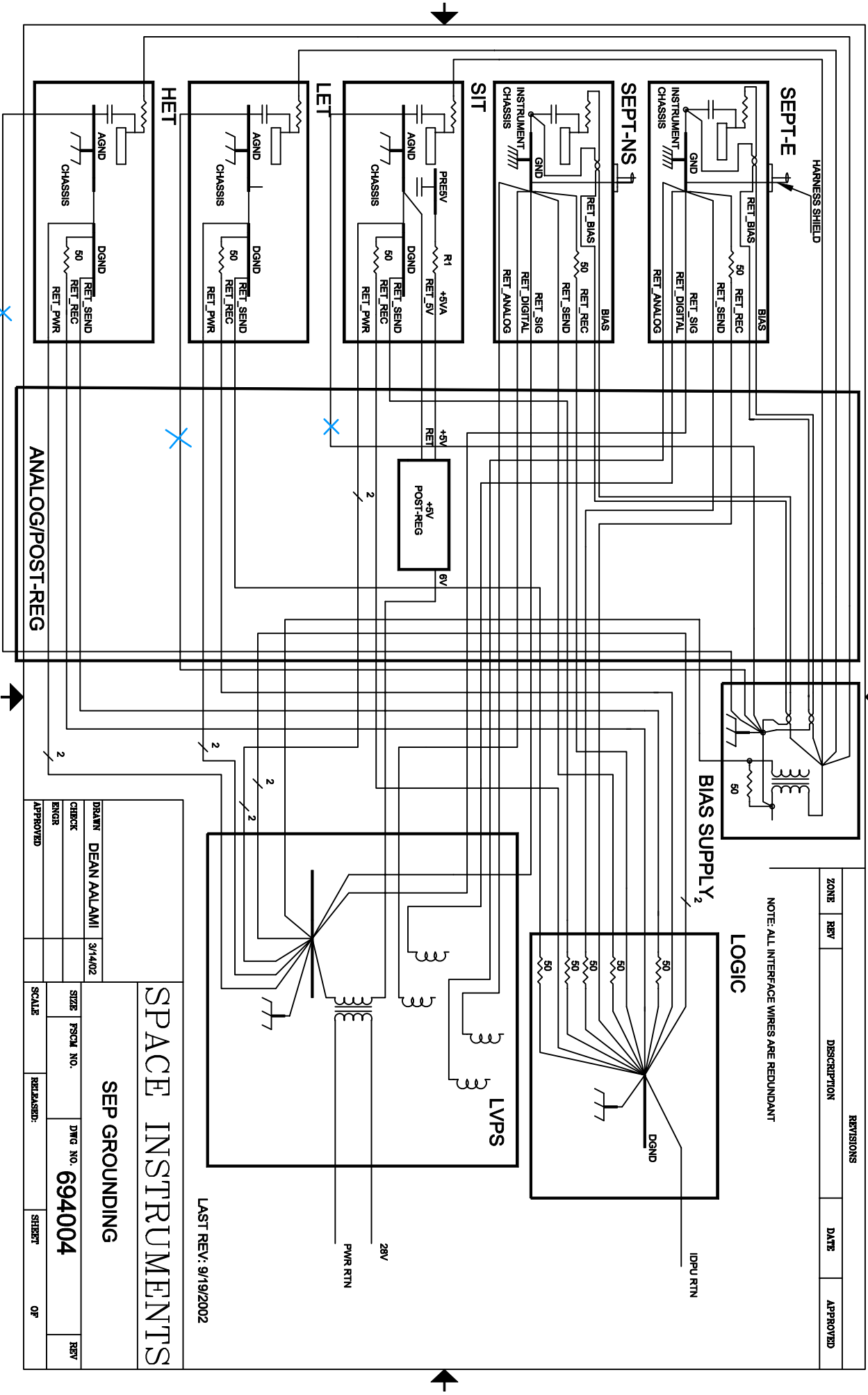
RIGI-FLEX CIRCUIT, LENGTH 8 cm (3")



Title HET-SEP_Central I/F Schematic		California Institute of Technology Space Radiation Laboratory 1201 E. California Blvd. MC 220-47 Pasadena, CA 91125		
Size:	Number: 100008			Revision:
Date: 14-Mar-2003	Sheet 1 of 1			
File: C:\Protel\Stereo\ICD\SEP ICD.Ddb - Documents\HET				

REVISIONS			DATE	APPROVED
ZONE	REV	DESCRIPTION		

NOTE: ALL INTERFACE WIRES ARE REDUNDANT



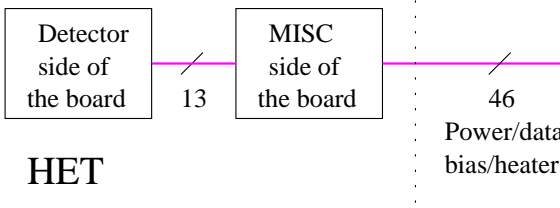
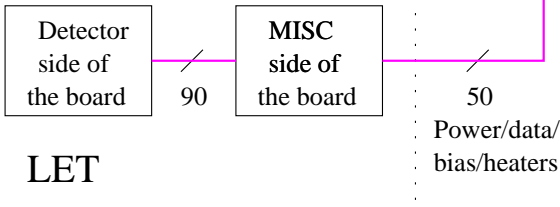
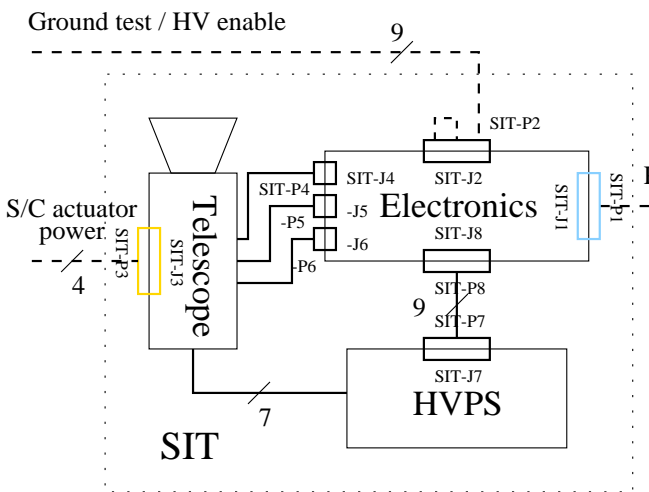
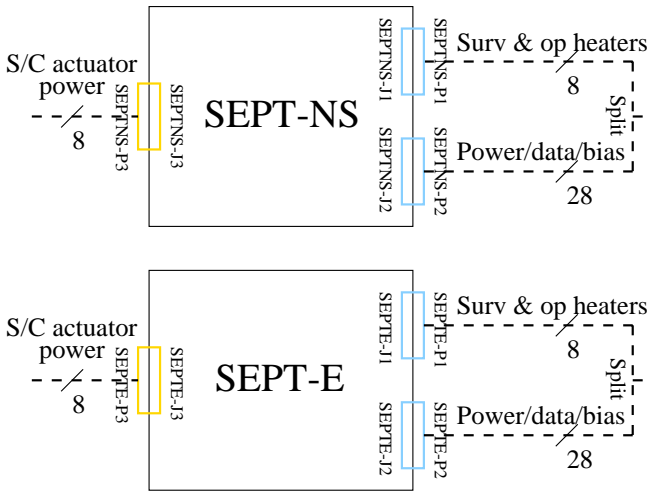
LAST REV: 9/19/2002

SPACE INSTRUMENTS

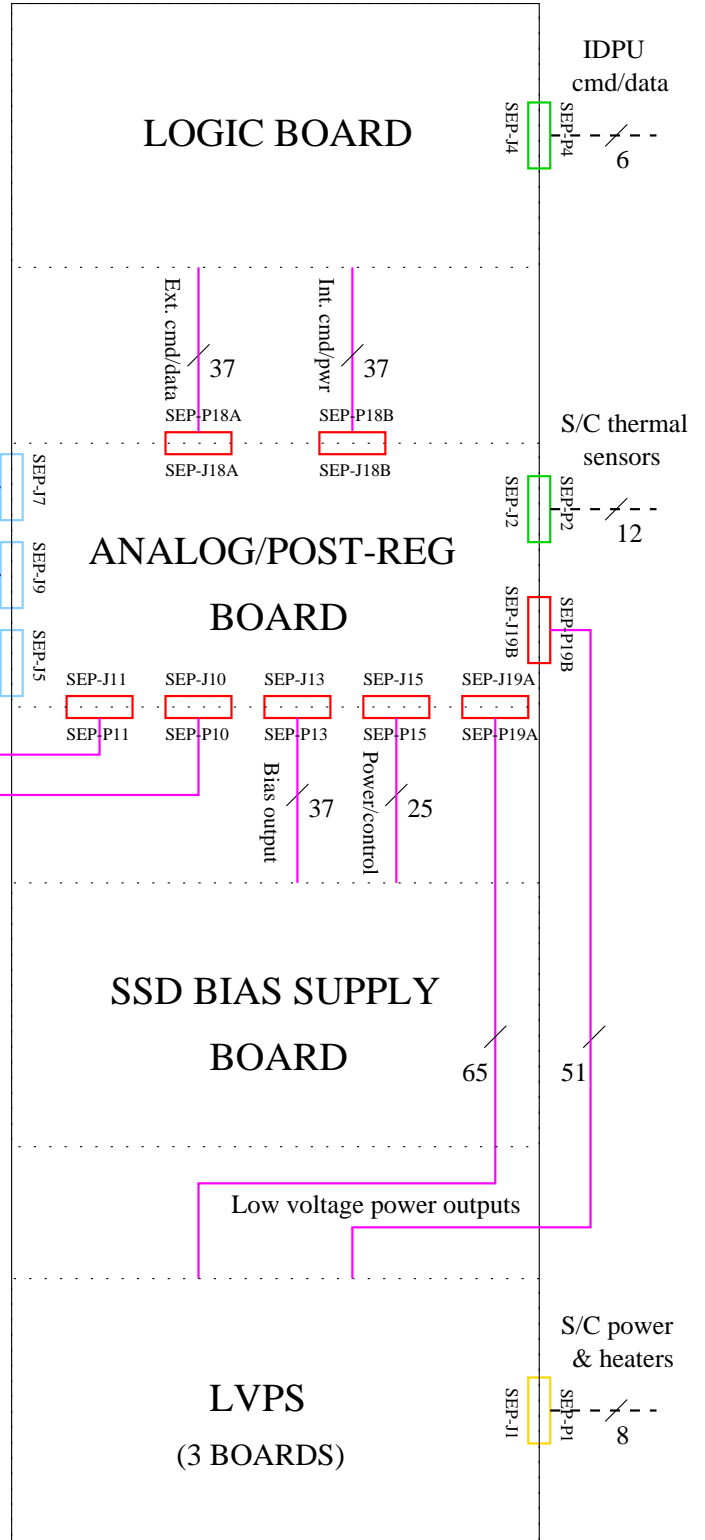
SEP GROUNDING

DESIGN	DEAN AALAMI	3/14/02	SIZE	PSOM NO.	DWG NO.	REV
CHECK			SCALE	RELEASED:	694004	
APPROVED						0P

Individual sensor boxes



Central electronics box



Legend:

- | | | | |
|---------------------|--|-------------------------------------|--|
| D connector pair | | Ext. (28 or 26 AWG, shielded) | |
| HD connector pair | | Int. harness (rigi-flex, no shield) | |
| Nanonics conn. pair | | Internal harness (no shield) | |
| MDM connector pair | | Connector type TBD | |

SEP Harness Diagram

BK 12/4/02

TELEMETRY PACKET

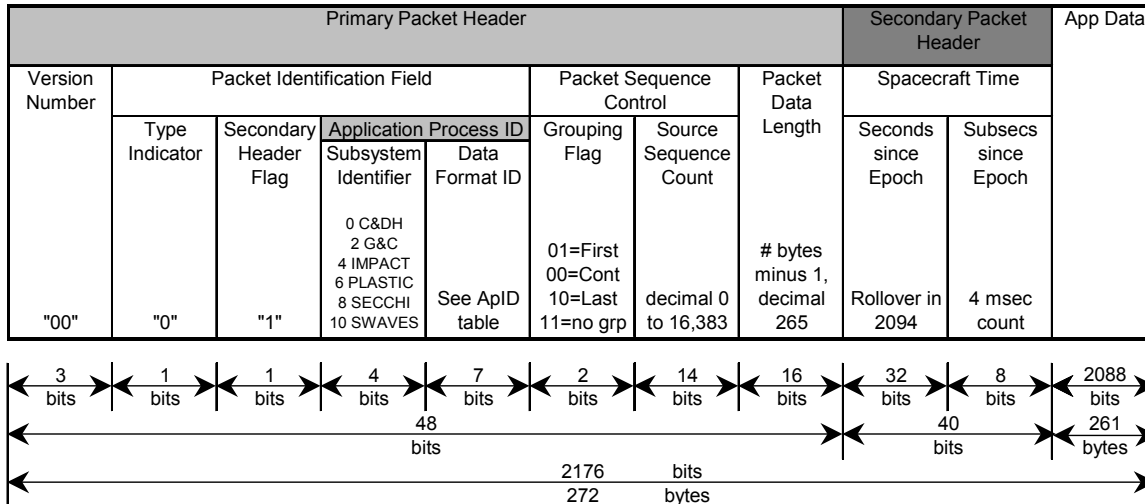


Figure 11. CCSDS Telemetry Packet Data Structure Diagram

Table 15. CCSDS Telemetry Packet Format

CCSDS Telemetry Packet				
Contents	Size (bits)	Size (bytes)	Type	Units/Range
PRIMARY PACKET HEADER				
Version Number	3	0.375	Binary	"00"
PACKET IDENTIFICATION FIELD				
Type Indicator	1	0.125	Binary	"0" designates a telemetry packet
Secondary Header Flag	1	0.125	Binary	0 = No secondary header 1 = Secondary Header Present
APPLICATION PROCESS IDENTIFIER				
Subsystem ID	4	0.500	Binary	0 = 0000 = C&DH 2 = 0010 = G&C 4 = 0100 = IMPACT 6 = 0110 = PLASTIC 8 = 1000 = SECCHI 10 = 1010 = SWAVES
Data Format ID	7	0.875	Binary	See ApID table
PACKET SEQUENCE CONTROL				
Grouping Flag	2	0.250	Binary	01 = First Packet 00 = Cont. Packet 10 = Last Packet 11 = No grouping
Source Sequence Count	14	1.750	Binary	Decimal range = 0 to 16,383 To ensure delivery order, increment this counter
Packet Data Length	16	2.000	Binary	Number of bytes in Secondary Header Fields + Application Data Field minus 1, For STEREO = (261 + 5) - 1 = decimal 265 = binary 00000000 10001001
SECONDARY PACKET HEADER				
SPACECRAFT TIME				
Seconds since Epoch	32	4.000	Binary	Seconds since Epoch Jan 01, 1958 00:00:00 UTC, Rollover in 2094
Subseconds	8	1.000	Binary	Subseconds (1/256)
Application Data	2088	261	Variable	Telemetry application data
TOTAL SIZE (bits & BYTES)	2176	272		

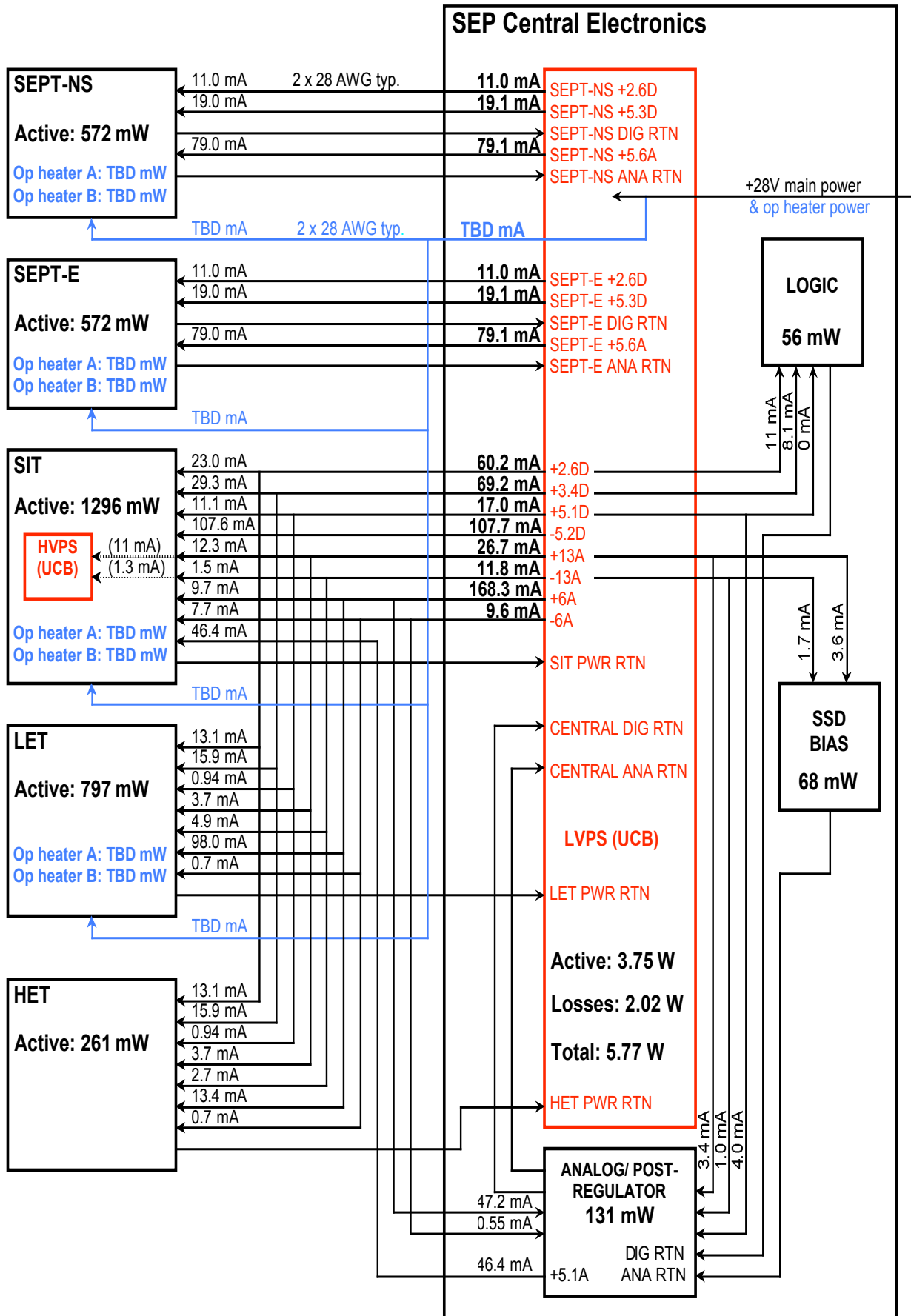
FSCM NO. 88898	SIZE A	DRAWING NO. 7381-9045	REV. A
SCALE	DO NOT SCALE PRINT		SHEET 46 of 62

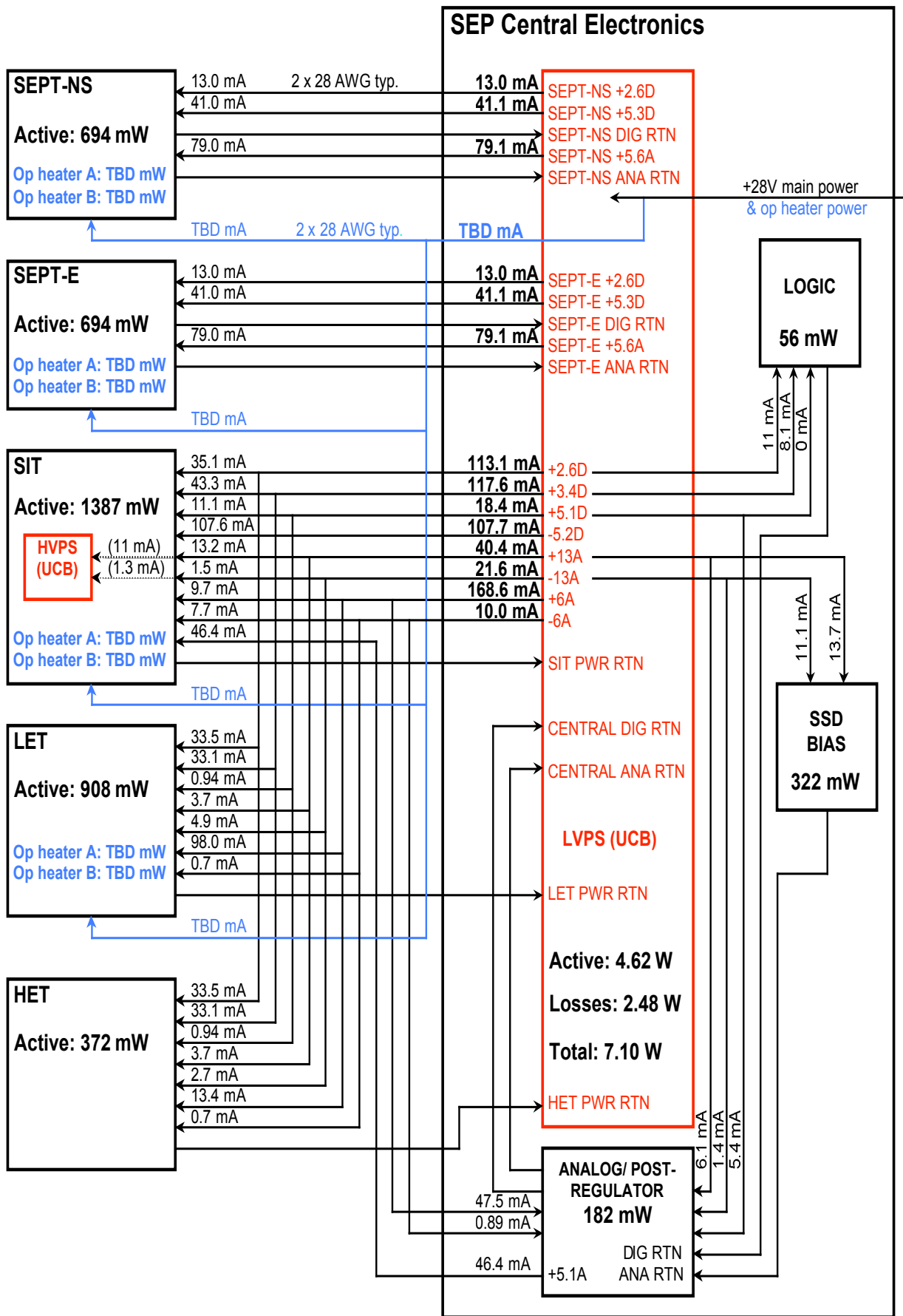
Positive supply: 300 V

Item No.	Name	Thick (um)	Area (cm^2)	Max volts	Max curr (uA)		Factor temp	Factor time	Max curr no rad dam (uA)	Damage Coeff (uA/cm^3)	Delta rad (uA)	Max curr (uA)
					20	40						
1	L1A1	20	2.00	30	1	7.25	2	14.49	100	0.40	14.89	
2	L1A2	20	2.00	30	1	7.25	2	14.49	100	0.40	14.89	
3	L1A3	20	2.00	30	1	7.25	2	14.49	100	0.40	14.89	
4	L1A4	20	2.00	30	1	7.25	2	14.49	100	0.40	14.89	
5	L1A5	20	2.00	30	1	7.25	2	14.49	100	0.40	14.89	
6	L2A	50	10.24	50	0.5	7.25	2	7.25	40	2.05	9.29	
7	L3A	1000	15.00	250	2	7.25	2	28.98	1	1.50	30.48	
8	L3B	1000	15.00	250	2	7.25	2	28.98	1	1.50	30.48	
9	L2B	50	10.24	50	0.5	7.25	2	7.25	40	2.05	9.29	
10	L1B1	20	2.00	30	1	7.25	2	14.49	100	0.40	14.89	
11	L1B2	20	2.00	30	1	7.25	2	14.49	100	0.40	14.89	
12	L1B3	20	2.00	30	1	7.25	2	14.49	100	0.40	14.89	
13	L1B4	20	2.00	30	1	7.25	2	14.49	100	0.40	14.89	
14	L1B5	20	2.00	30	1	7.25	2	14.49	100	0.40	14.89	
15	H1	1000	3.14	250	1	7.25	2	14.49	1	0.31	14.81	
16	H2	1000	3.14	250	1	7.25	2	14.49	0.1	0.03	14.52	
17	H3A	1000	12.57	250	1	7.25	2	14.49	0.1	0.13	14.62	
18	H3B	1000	12.57	250	1	7.25	2	14.49	0.1	0.13	14.62	
19	H4A	1000	12.57	250	1	7.25	2	14.49	0.1	0.13	14.62	
20	H4B	1000	12.57	250	1	7.25	2	14.49	0.1	0.13	14.62	
21	H5A	1000	12.57	250	1	7.25	2	14.49	0.1	0.13	14.62	
22	H5B	1000	12.57	250	1	7.25	2	14.49	0.1	0.13	14.62	
23	H6	1000	12.57	250	1	7.25	2	14.49	0.1	0.13	14.62	
24	SIT	500	6.1	160	1	7.25	2	14.49	3	0.92	15.41	
Totals positive supply					25.00				362.29	13.24		375.53 uA
Power (mW)					7.50				108.69			112.66 mW

Negative supply: 100 V

Item No.	Name	Thick (um)	Area (cm^2)	Max volts	Max curr (uA)	Factor temp 20	Factor temp 40	Max curr no rad (uA)	Damage Coeff (uA/cm^3)	Delta rad (uA)	Max curr (uA)
1	D0	300	0.53	80	0.06	7.25	2	0.87	200	3.18	4.05
2	D1	300	0.53	80	0.06	7.25	2	0.87	200	3.18	4.05
3	D2	300	0.53	80	0.06	7.25	2	0.87	200	3.18	4.05
4	D3	300	0.53	80	0.06	7.25	2	0.87	200	3.18	4.05
5	D4	300	0.53	80	0.06	7.25	2	0.87	200	3.18	4.05
6	D5	300	0.53	80	0.06	7.25	2	0.87	200	3.18	4.05
7	D6	300	0.53	80	0.06	7.25	2	0.87	200	3.18	4.05
8	D7	300	0.53	80	0.06	7.25	2	0.87	200	3.18	4.05
9	G0	300	0.58	80	0.06	7.25	2	0.87	200	3.48	4.35
10	G1	300	0.58	80	0.06	7.25	2	0.87	200	3.48	4.35
11	G2	300	0.58	80	0.06	7.25	2	0.87	200	3.48	4.35
12	G3	300	0.58	80	0.06	7.25	2	0.87	200	3.48	4.35
13	G4	300	0.58	80	0.06	7.25	2	0.87	200	3.48	4.35
14	G5	300	0.58	80	0.06	7.25	2	0.87	200	3.48	4.35
15	G6	300	0.58	80	0.06	7.25	2	0.87	200	3.48	4.35
16	G7	300	0.58	80	0.06	7.25	2	0.87	200	3.48	4.35
Totals negative supply					0.96				13.91	53.28	67.19 uA
Power (mW)					0.10				1.39		6.72 mW
Totals both supplies					25.96				376.20	66.52	442.72 uA
Power (mW)					7.60				110.08		119.38 mW





SEP Power Flow (Max.)

02/26/03