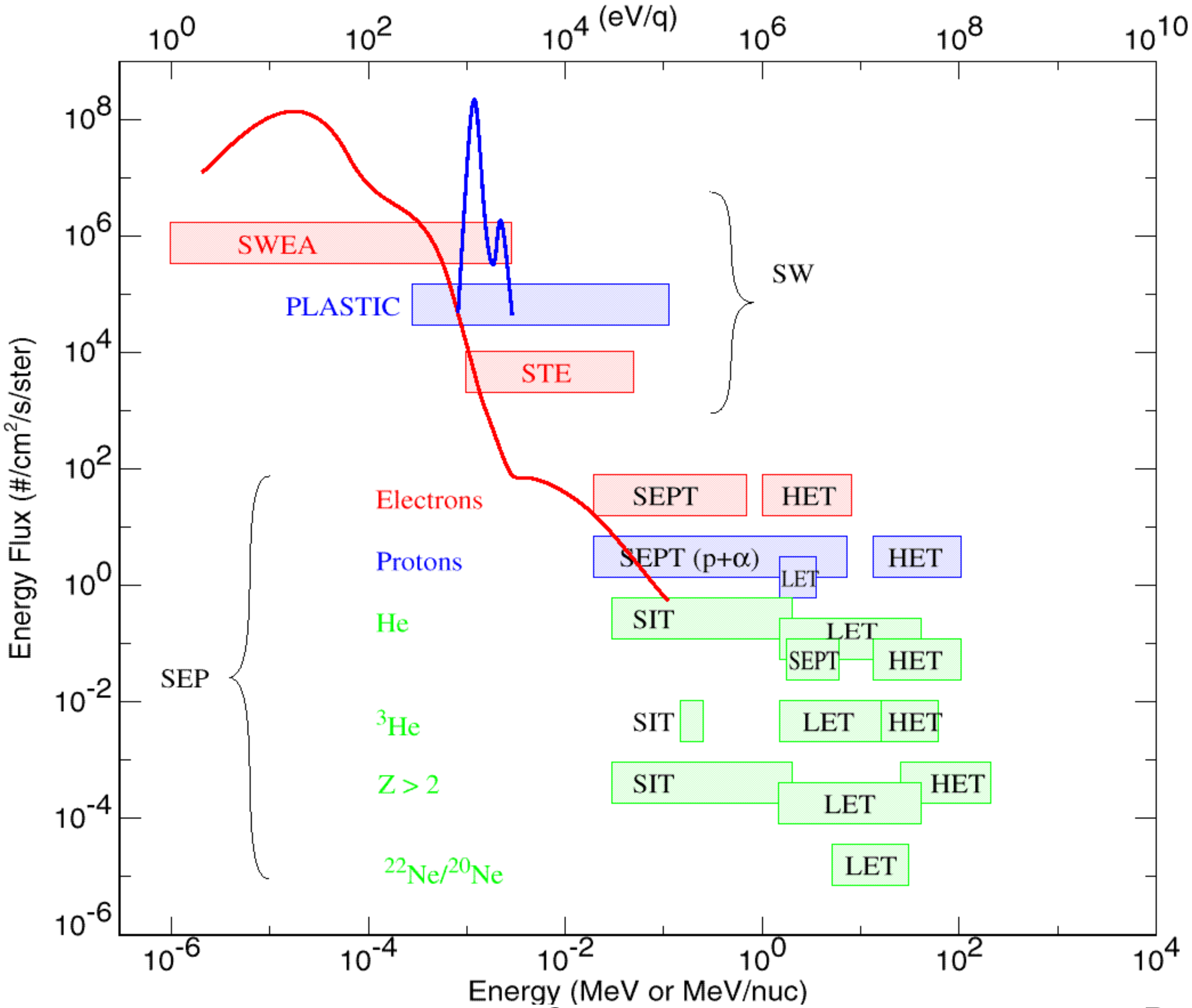
STEREO IMPACT OVERVIEW

SWEA/STE/Boom Peer Review

2001-March-6, U.C.Berkeley

David Curtis

IMPACT / PLASTIC Energy Coverage



David Curtis

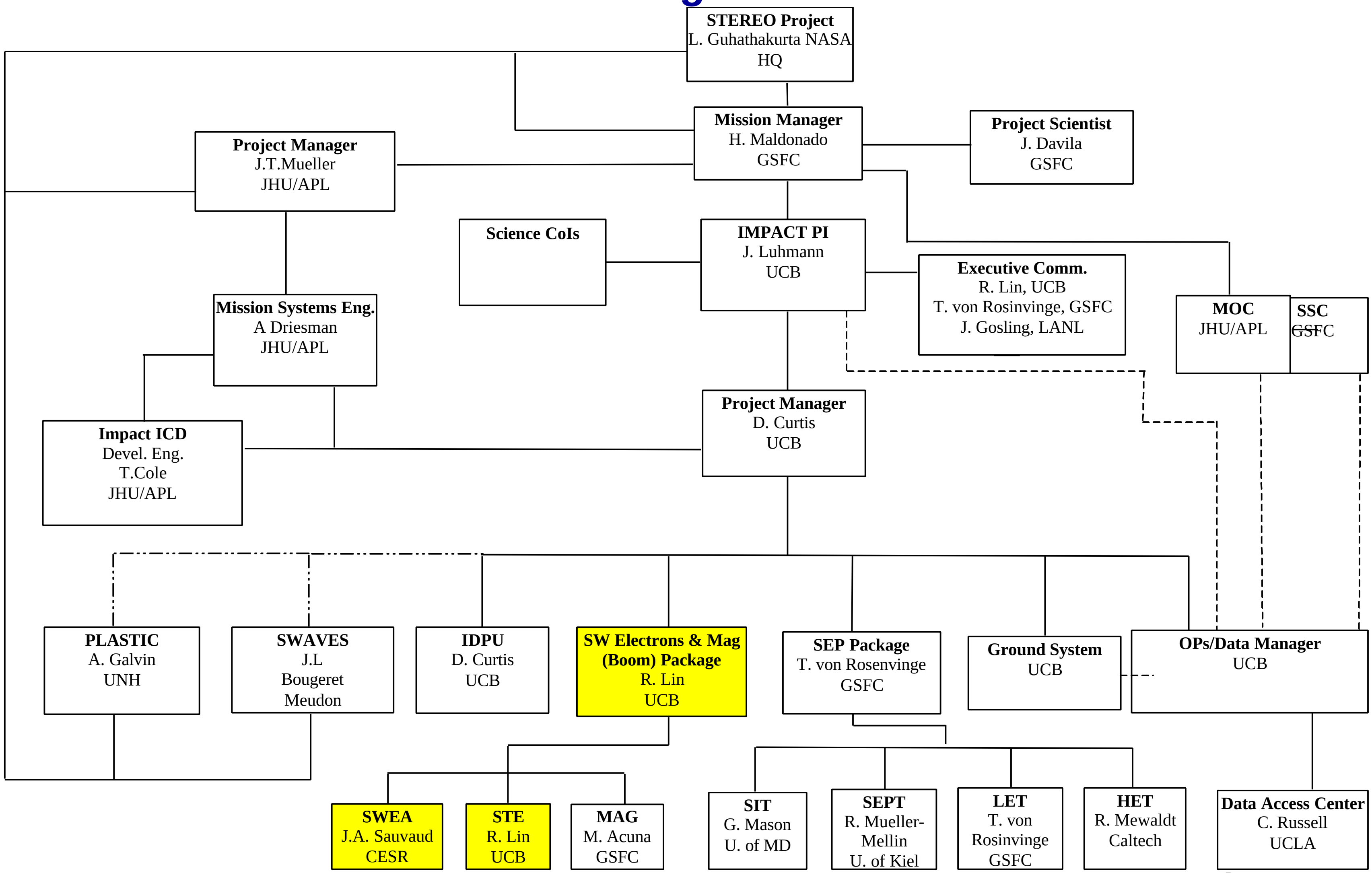
IMPACT Science Summary

Table A.1 IMPACT Summary

Experiment	Instrument	Measurement	Energy or Mag. field range	Mass (kg)	Power (w)	Data Rate (bps)	Time Res.	Instrument provider
SW	STE	Electron flux and anistropy	2-100 keV	0.35	0.20	64	16 s	UCB (Lin)
	SWEA	3D electron distrib., core & halo density, temp. & anisotropy	~0-3 keV	1.71	1.10	394	3D=1 min 2D=8s Mom.=2s	CESR (Sauvaud) + UCB (Lin)
MAG	MAG	Vector field	±500nT, ±65536 nT	0.25	0.0	154	1/8 s	GSFC (Acuna)
SEP	SIT	He to Fe ions	0.03-2 MeV/nuc	0.93	0.66	240	30 s	U. of Md. (Mason) + MPAE (Korth) +UCB (Curtis)
		^{3}He	0.15-0.25 MeV/nuc				30 s	
	SEPT	Diff. electron flux	20-400 keV	1.06	1.04	120	1 min	U. of Kiel (Mueller-Mellin) + ESTEC (Sanderson)
		Diff. proton flux	20-7000 keV				1 min	
		Anistropies of e,p	As above				15 min	
	LET	Ion mass 2-28 & anisotropy	1.5-40 MeV/nuc	0.51	0.18	320	1-15 min.	GSFC (von Rosenvinge) + Caltech (Mewaldt) + JPL (Wiedenbeck)
		^{3}He ions flux & anistropy	1.5-1.6 MeV/nuc				15 min.	
		H ions flux & anistropy	1.5-3.5 MeV				1-15 min.	
	HET	Electrons flux & anistropy	1-8 MeV	0.70	0.07	120	1-15 min.	Caltech (Mewaldt) + GSFC (von Rosenvinge) + JPL (Wiedenbeck)
		H	13-100 MeV				1-15 min.	
		He	13-100 MeV				1-15 min.	
		^{3}He	15-60 MeV/nuc				15 min	
	SEP Common	----	----	1.69	1.55	----	----	Caltech (Mewaldt) + GSFC (von Rosenvinge)
IMPACT Common	IDPU (+Mag Analog)	----	----	1.73	3.60	164 +524 Burst	----	UCB (Curtis)

IMPACT is a suite of 7 instruments built at 9 institutions by 31 Co-Investigators.

IMPACT Team Organization Chart



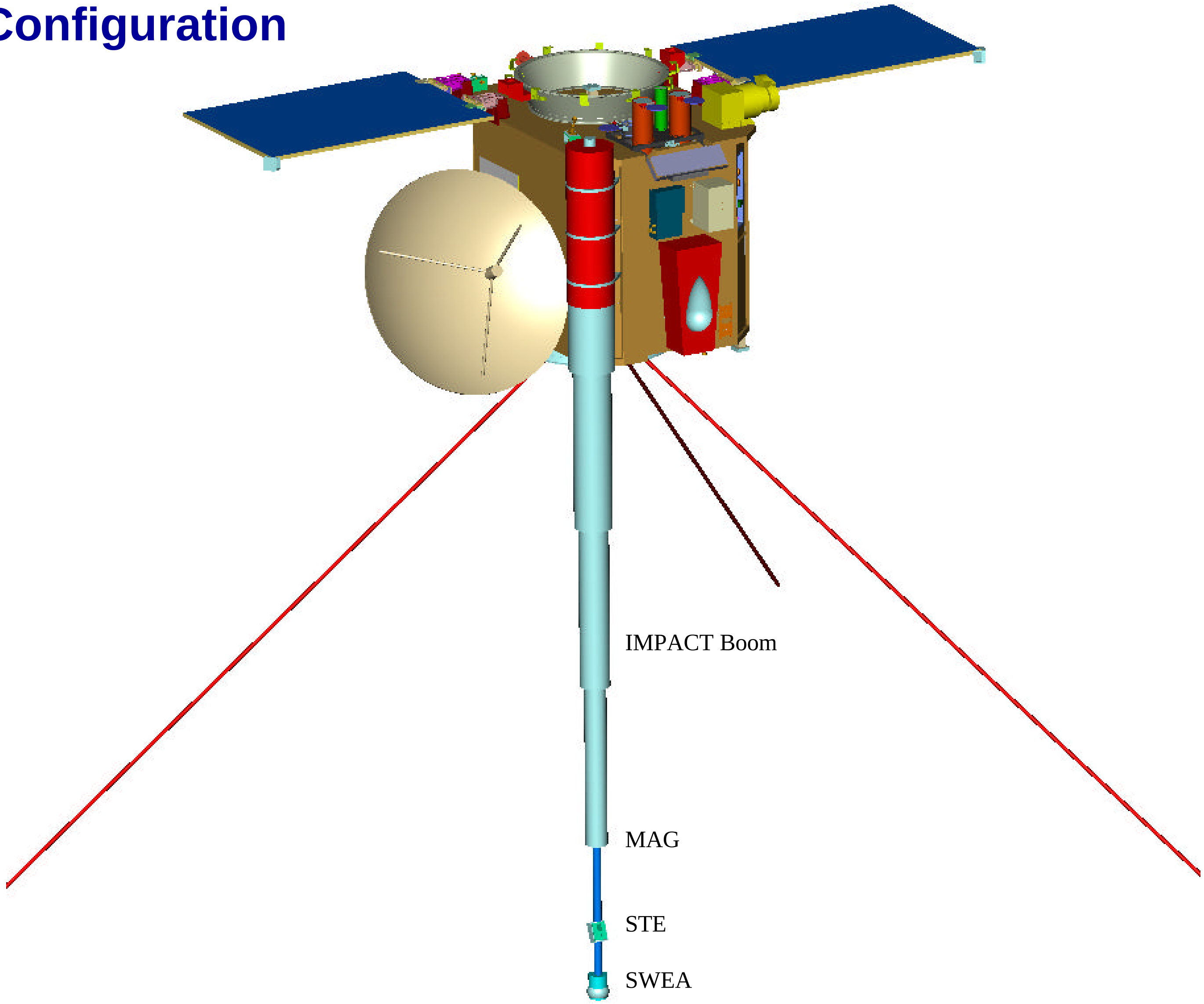
SWEA/STE/Boom Personnel

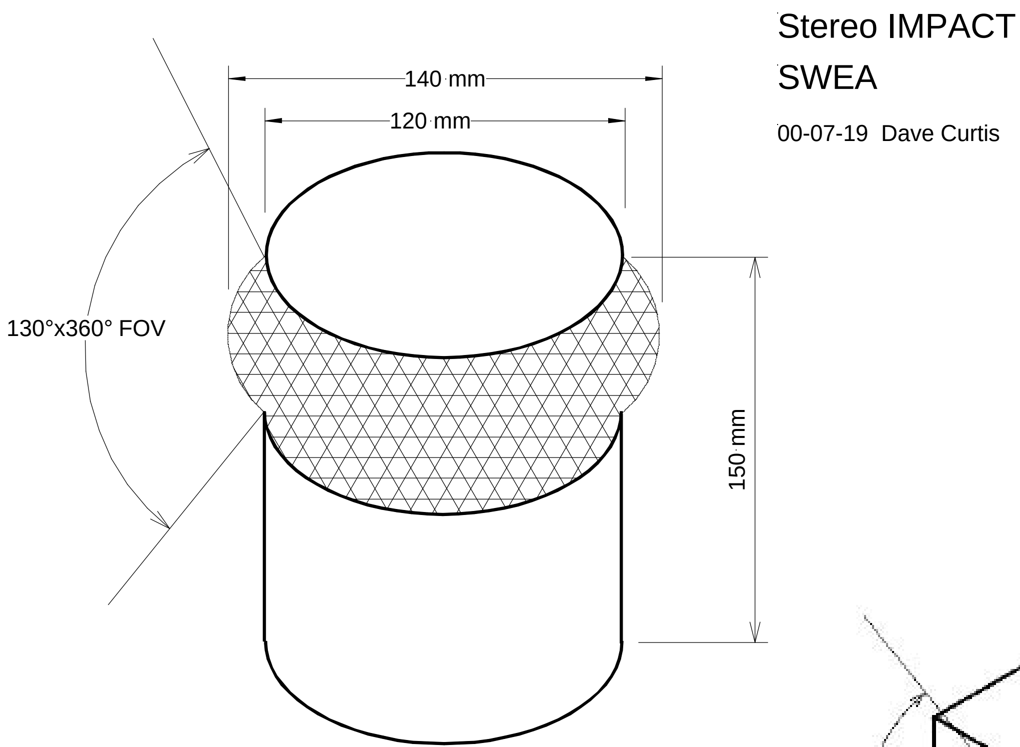
- **Janet Luhmann, IMPACT Principal Investigator , UCB jgluhman@ssl.berkeley.edu**
- **David Curtis, IMPACT Project Manager/System Engineer, UCB, dwc@ssl.berkeley.edu**
- **Bob Lin, Lead Solar Wind Science, STE Science Lead, UCB, boblin@ssl.berkeley.edu**
- **Davin Larson, SWEA/STE Science, UCB, Davin@ssl.berkeley.edu**
- **Robert Ullrich, IMPACT Boom Mechanical/Thermal, UCB, RUllrich@ssl.berkeley.edu**
- **Paul Turin, Mechanical, UCB, PTurin@ssl.berkeley.edu**
- **Steve McBride, SWEA/STE Interface Electrical, UCB, Mcbride@ssl.berkeley.edu**
- **Peter Berg, Power Supplies, UCB, pcb@ssl.berkeley.edu**
- **Robert Campbell, STE Detector Calibration/Test, UCB, rdc@ssl.berkeley.edu**
- **Dorothy Gordon, SWEA/STE Interface FPGA, Elf, dot@shell3.shore.net**
- **Bernhard Ludewigt, STE Lead, LBNL, Bernhard_Ludewigt@lbl.gov**
- **Michael Maier, STE Front End Electronics, LBNL, MRMaier@lbl.gov**
- **Craig Tindall, STE Detectors, LBNL, CSTindall@lbl.gov**
- **Jean-Andre Sauvaud, SWEA Science Lead, CESR, Jean-Andre.Sauvaud@cesr.fr**
- **Francis Cotin, SWEA Manager, CESR, Francis.Cotin@cesr.fr**
- **Jean Rouzaud, SWEA Mechanical, CESR, Jean.Rouzaud@cesr.fr**
- **Jean Louis Médale, SWEA Electrical, CESR, Medale@cesr.fr**
- **M. Cassignol, SWEA Thermal, CESR**
- **A. Fedorov, SWEA Analyzer & GSE, CESR**

SWEA/STE/Boom Responsibilities

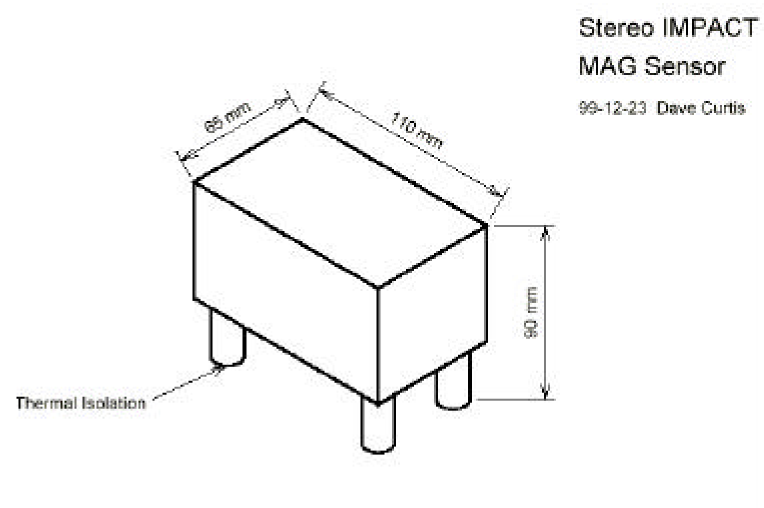
- **SWEA - CESR**
  - **Includes Electrostatic optics, MCP detector, HVPS, Preamps**
- **STE - UCB**
  - **Detectors and Preamp design from LBNL**
- **SWEA/STE Interface - UCB**
  - **Includes LVPS, STE Bias Supply, Controls, PHA, Accumulators, Interface to IDPU**
  - **Mounted in the base of SWEA**
- **MAG - GSFC (to be discussed in a later review)**
- **IMPACT Boom - UCB**
  - **Including Thermal**

Spacecraft Configuration

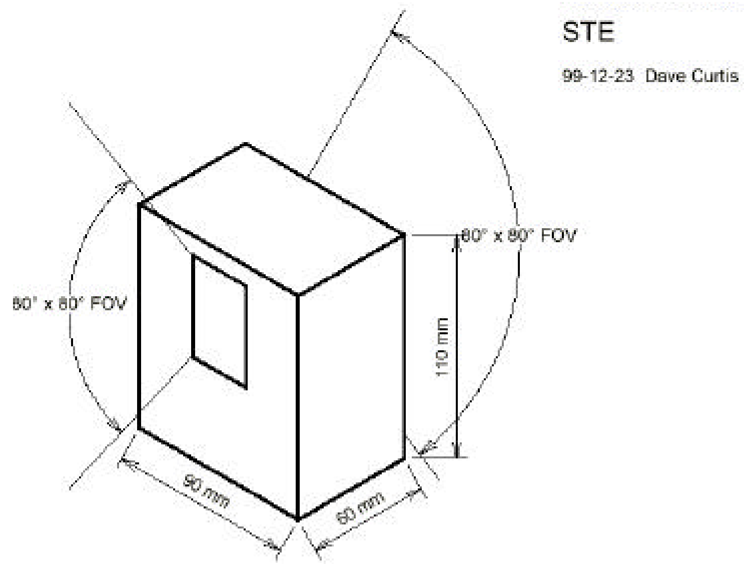




Stereo IMPACT
SWEA
00-07-19 Dave Curtis
140 mm
120 mm
130°x360° FOV
150 mm

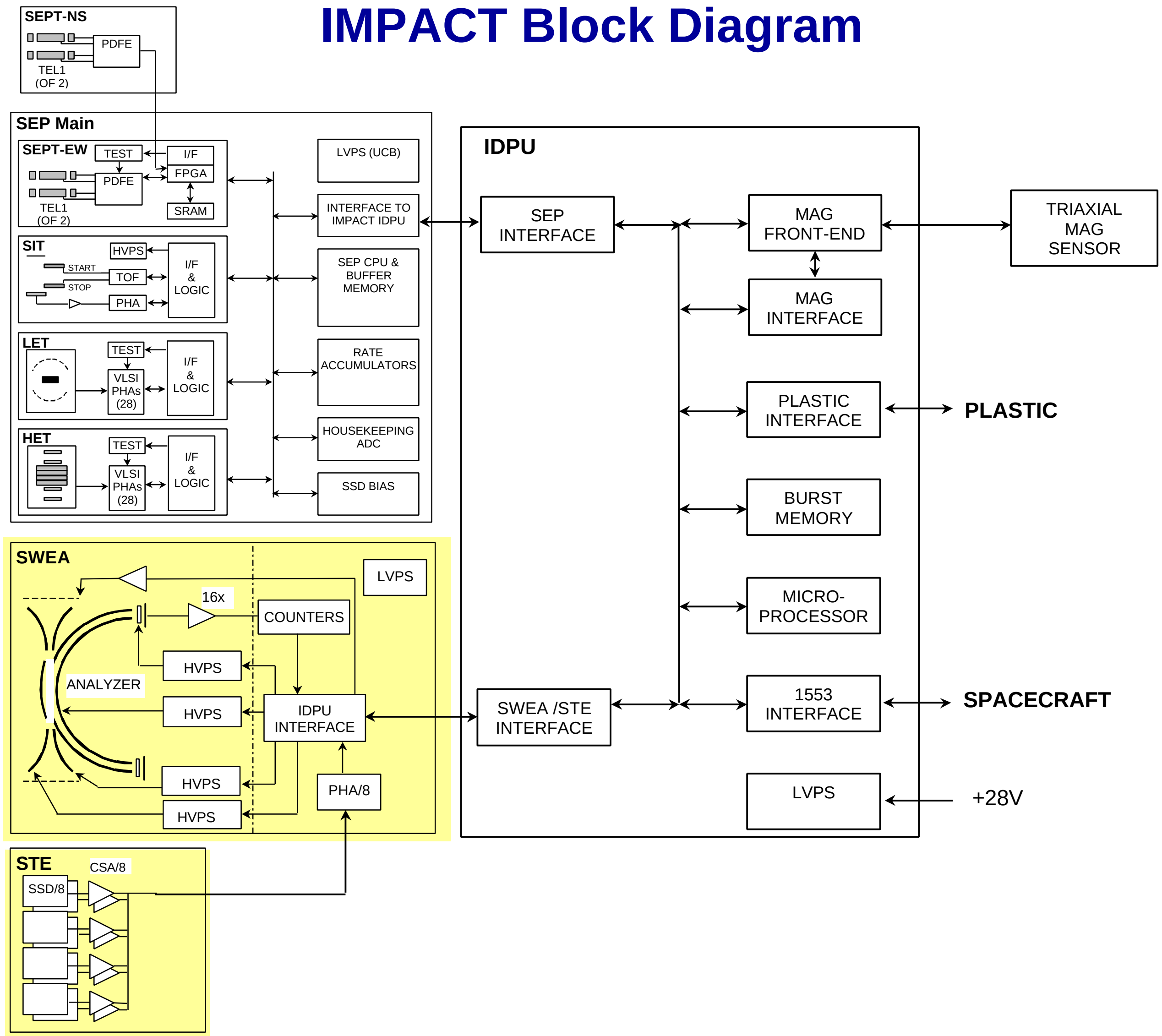


Stereo IMPACT
MAG Sensor
99-12-23 Dave Curtis
65 mm
110 mm
90 mm
Thermal Isolation



STE
99-12-23 Dave Curtis
80° x 80° FOV
80° x 80° FOV
110 mm
90 mm
60 mm

IMPACT Block Diagram



IMPACT Boom Instrument Requirements

- **MAG must be at least 3m from the nearest part of the spacecraft**
  - **Spacecraft magnetics will swamp desired measurement**
  - **Proximity of SWEA, STE, the IMPACT boom and harness to MAG sensors requires extra attention to magnetic cleanliness**
- **SWEA has a huge Field of View (almost 4-pi) which is impossible to provide except on the end of a long boom**
  - **4.5m to SWEA gets all but the ends of the Solar Arrays out of the FOV**
  - **SWEA is sensitive to spacecraft charging; farther away helps mitigate that sensitivity**
  - **The SWEA aperture must be kept out of sunlight**
- **STE also has a large FOV, and also wants to be passively cooled to near -50C**
  - **STE is sensitive to light, so nothing can impinge on the FOV that might cause glint**
- **The boom is in shadow, but some instruments may want to extend into sunlight for thermal considerations (e.g. MAG)**

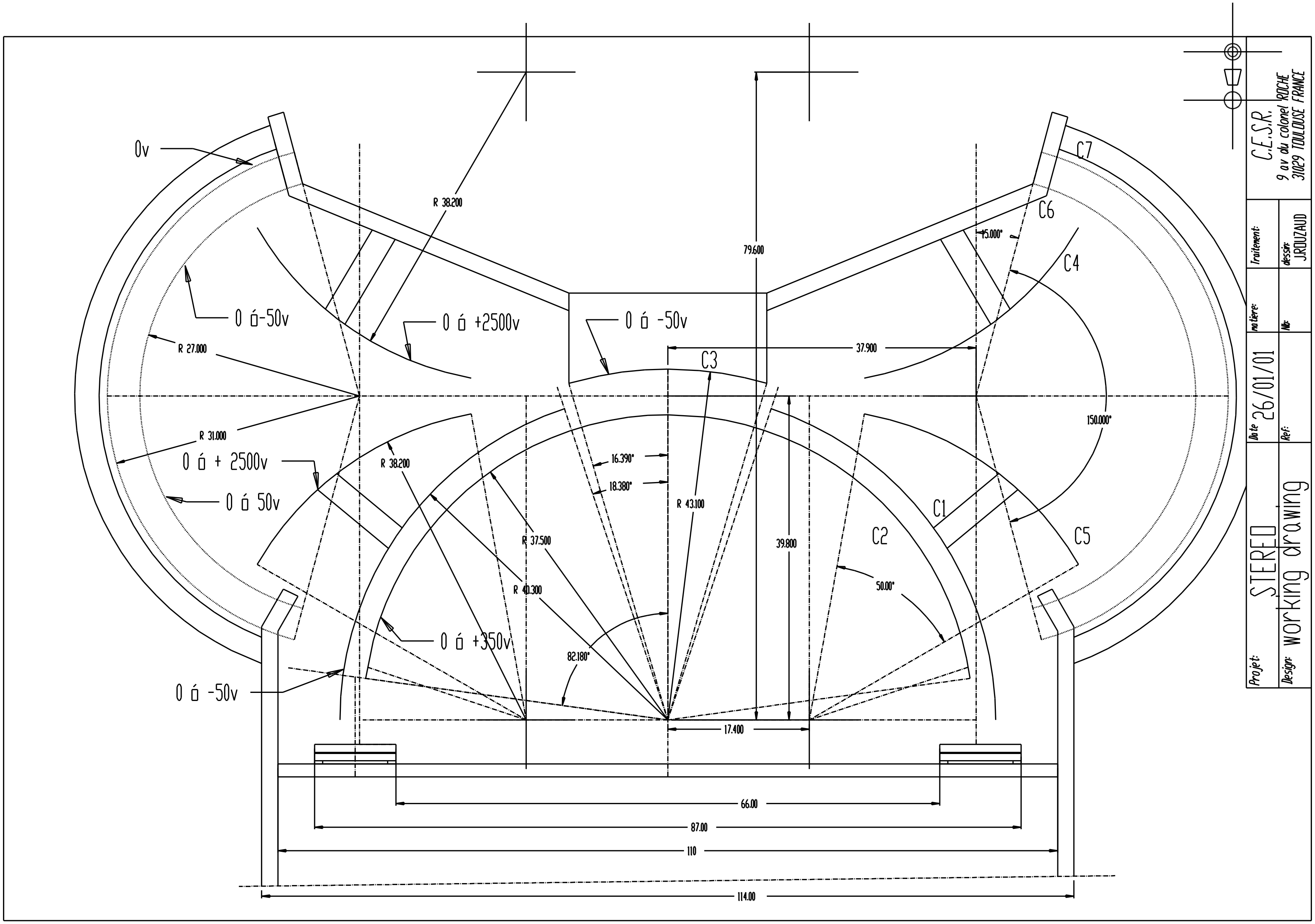
Boom Resources

Stereo Instrument Resource Estimates				
Instrument	**Mass, kg**	**Power, W**	**Volume, cc**	**bps**
SWEA:				
SWEA (CESR)	1.21	0.54	1000	394
SWEA/STE I/F	0.30	0.30	500	
SWEA/STE LVPS	0.20	0.26		
SWEA Total	1.71	1.10	1500	394
STE	0.35	0.20	600	64
MAG Sensor	0.25		500	154
Instrument/Boom Brackets	0.35			
Boom Totals	2.66	1.30	2600	612
Boom Allocation	12.00			
Boom Harness	0.83			

Some Controlling Documents

- IMPACT Phase A Report covers the top level instrument performance requirements
- IMPACT/Spacecraft ICD covers the spacecraft interface
- SWEA ICD covers the interface between CESR and UCB
- IMPACT Serial Interface document covers the data interface between SWEA/STE and the IDPU
- IMPACT PAIP covers the performance assurance requirements
- STEREO EMC and Contamination Control plans

SWEA Analyzer Design (CESR)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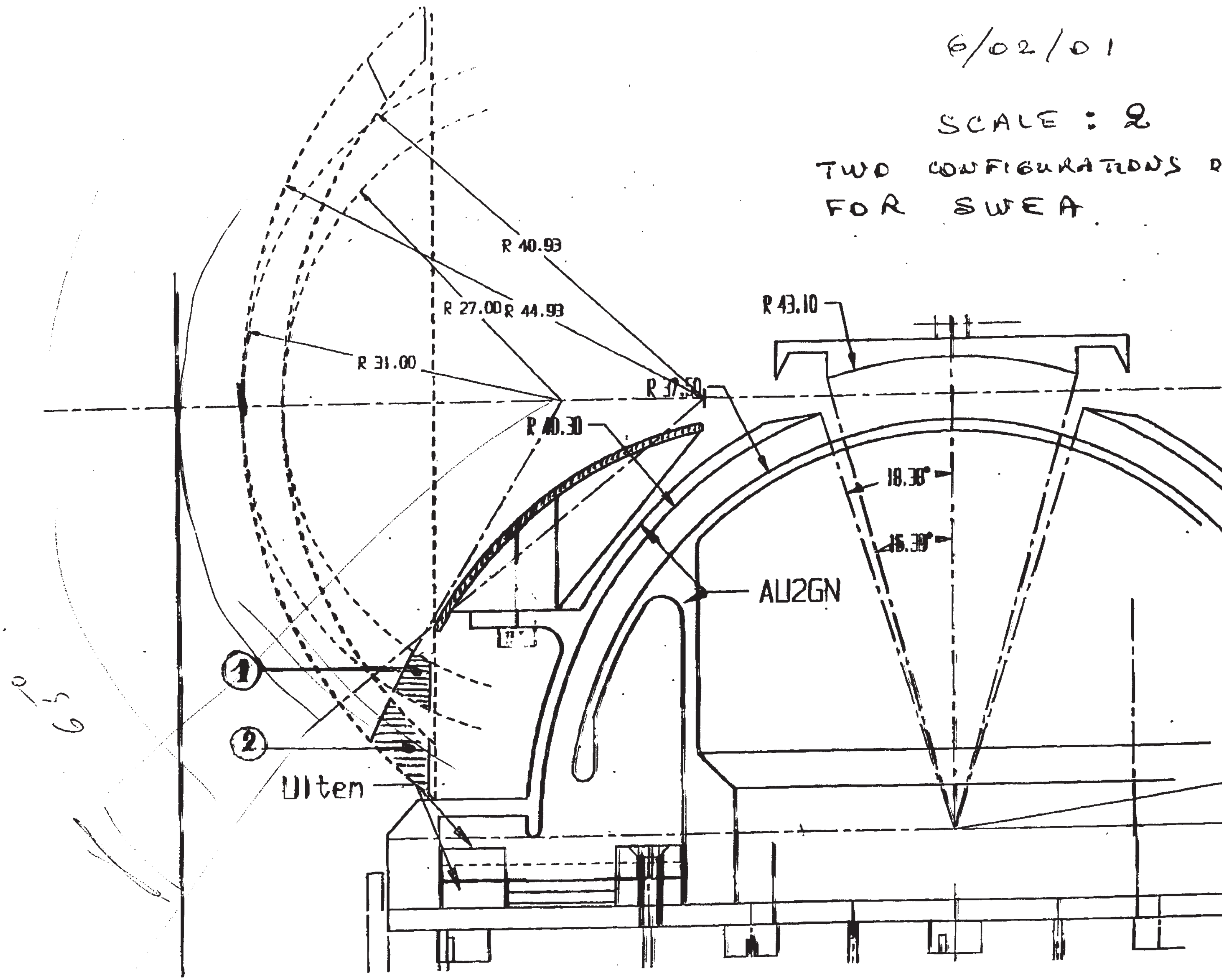
0 á-50v
0 á +2500v
0 á -50v
R 38.200
R 27.000
R 31.000
0 á + 2500v
0 á 50v
R 38.200
0 á +350v
0 á -50v
79.600
37.900
C3
C7
C6
C4
15.000°
150.000°
16.390°
18.380°
R 43.100
R 37.500
R 40.300
82.180°
39.800
C1
C2
C5
50.00°
17.400
66.00
87.00
110
114.00
C.E.S.R.
9 av du colonel ROCHE
31029 TOULOUSE FRANCE
Traitement:
dessin: J.ROUZAUD
matière:
Nb:
Date 26/01/01
Ref:
Projet: STEREO
Design: working drawing

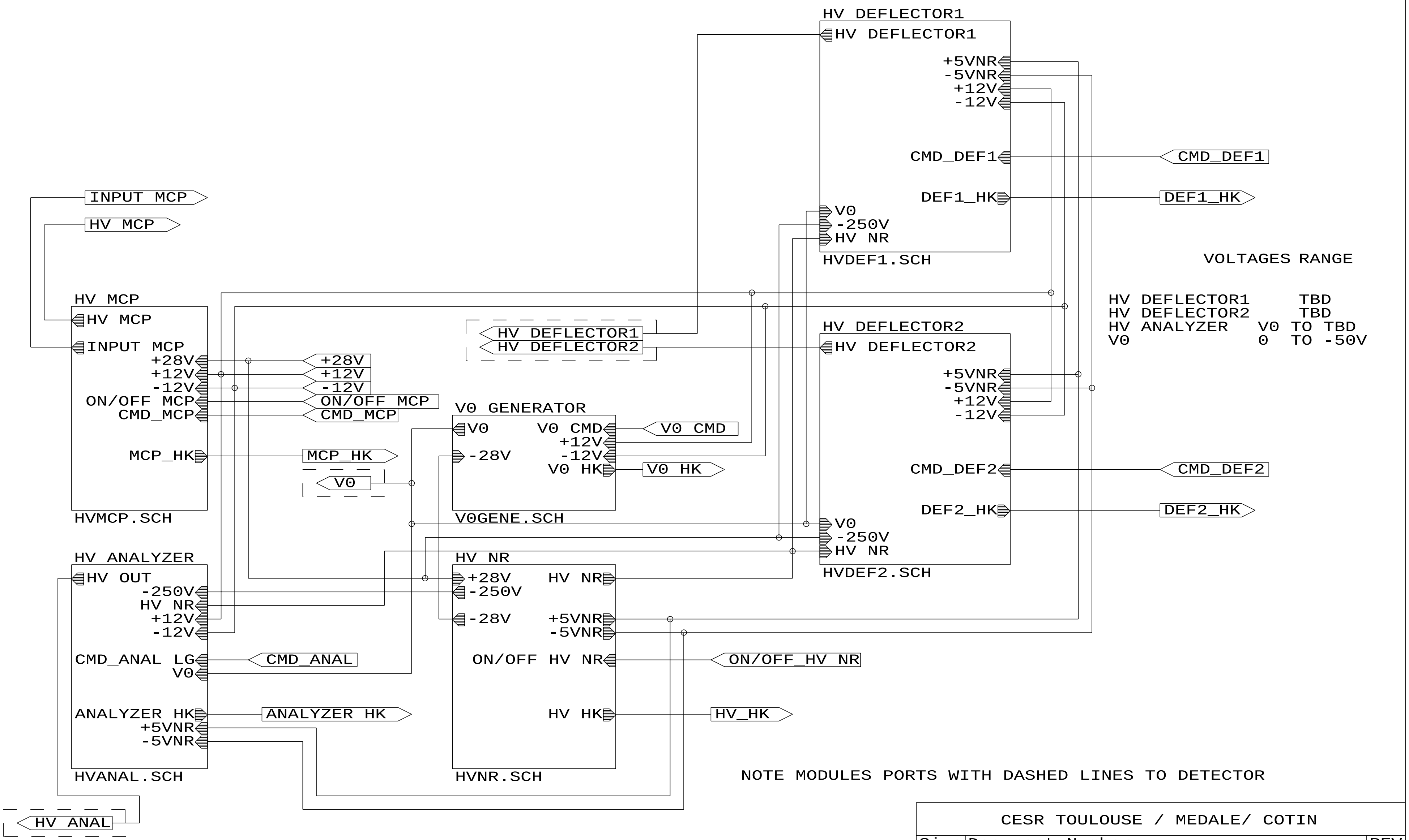
6/02/01

SCALE : 2

TWO CONFIGURATIONS OF GRIDS FOR SWEA.



SWEA Front End Electronics (CESR)



VOLTAGES RANGE

HV DEFLECTOR1	TBD	
HV DEFLECTOR2	TBD	
HV ANALYZER	V0	TO TBD
V0	0	TO -50V

NOTE MODULES PORTS WITH DASHED LINES TO DETECTOR

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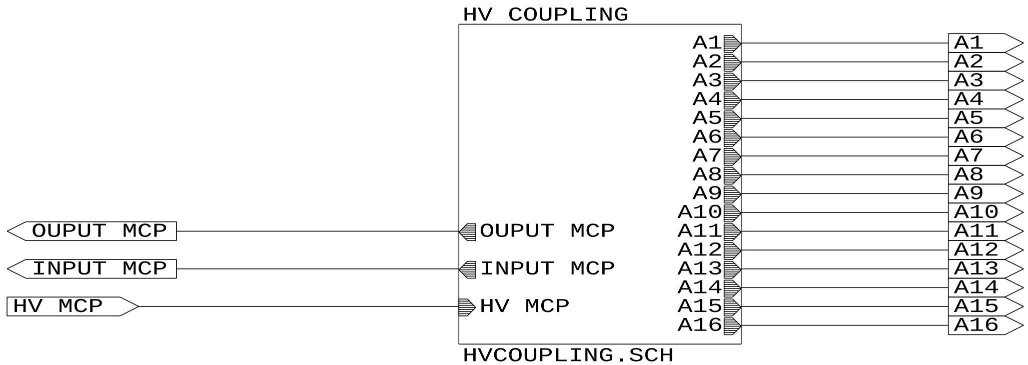

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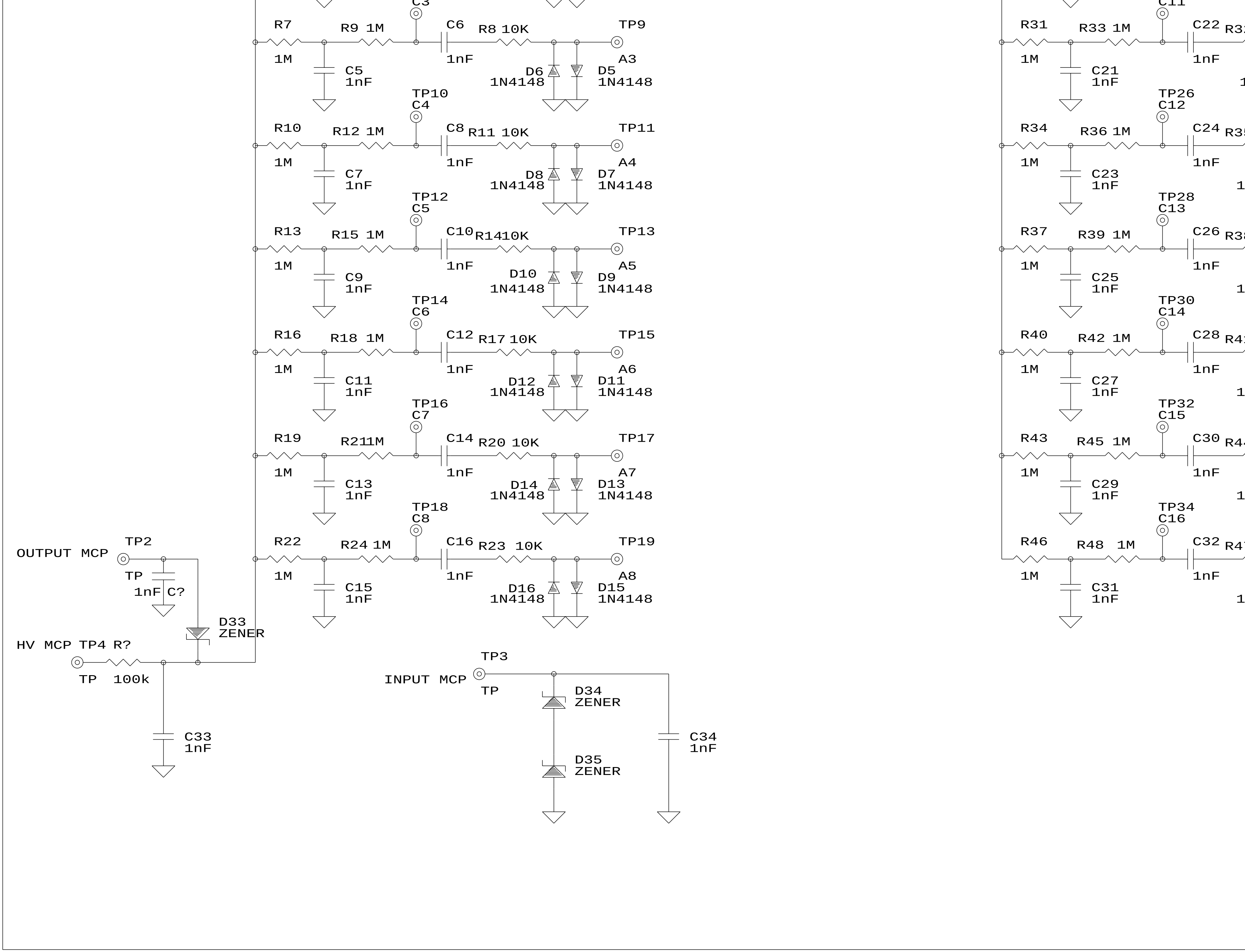

C3
R7
R9 1M
C6
R8 10K
TP9
1M
1nF
A3
C5
1nF
D6
1N4148
D5
1N4148
TP10
C4
R10
R12 1M
C8
R11 10K
TP11
1M
1nF
A4
C7
1nF
D8
1N4148
D7
1N4148
TP12
C5
R13
R15 1M
C10
R1410K
TP13
1M
1nF
A5
C9
1nF
D10
1N4148
D9
1N4148
TP14
C6
R16
R18 1M
C12
R17 10K
TP15
1M
1nF
A6
C11
1nF
D12
1N4148
D11
1N4148
TP16
C7
R19
R211M
C14
R20 10K
TP17
1M
1nF
A7
C13
1nF
D14
1N4148
D13
1N4148
TP18
C8
R22
R24 1M
C16
R23 10K
TP19
1M
1nF
A8
C15
1nF
D16
1N4148
D15
1N4148
OUTPUT MCP
TP2
TP
1nF C?
D33
ZENER
HV MCP TP4 R?
TP 100k
C33
1nF
TP3
INPUT MCP
TP
D34
ZENER
D35
ZENER
C34
1nF
C11
R31
R33 1M
C22
1M
1nF
C21
1nF
TP26
C12
R34
R36 1M
C24
1M
1nF
C23
1nF
TP28
C13
R37
R39 1M
C26
1M
1nF
C25
1nF
TP30
C14
R40
R42 1M
C28
1M
1nF
C27
1nF
TP32
C15
R43
R45 1M
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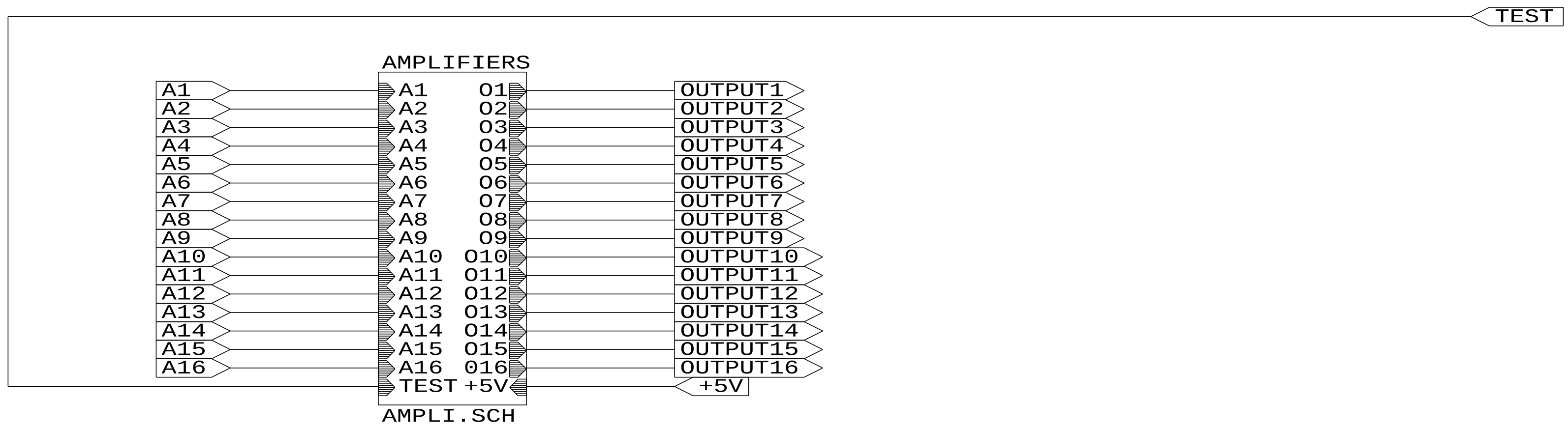
C31
1nF



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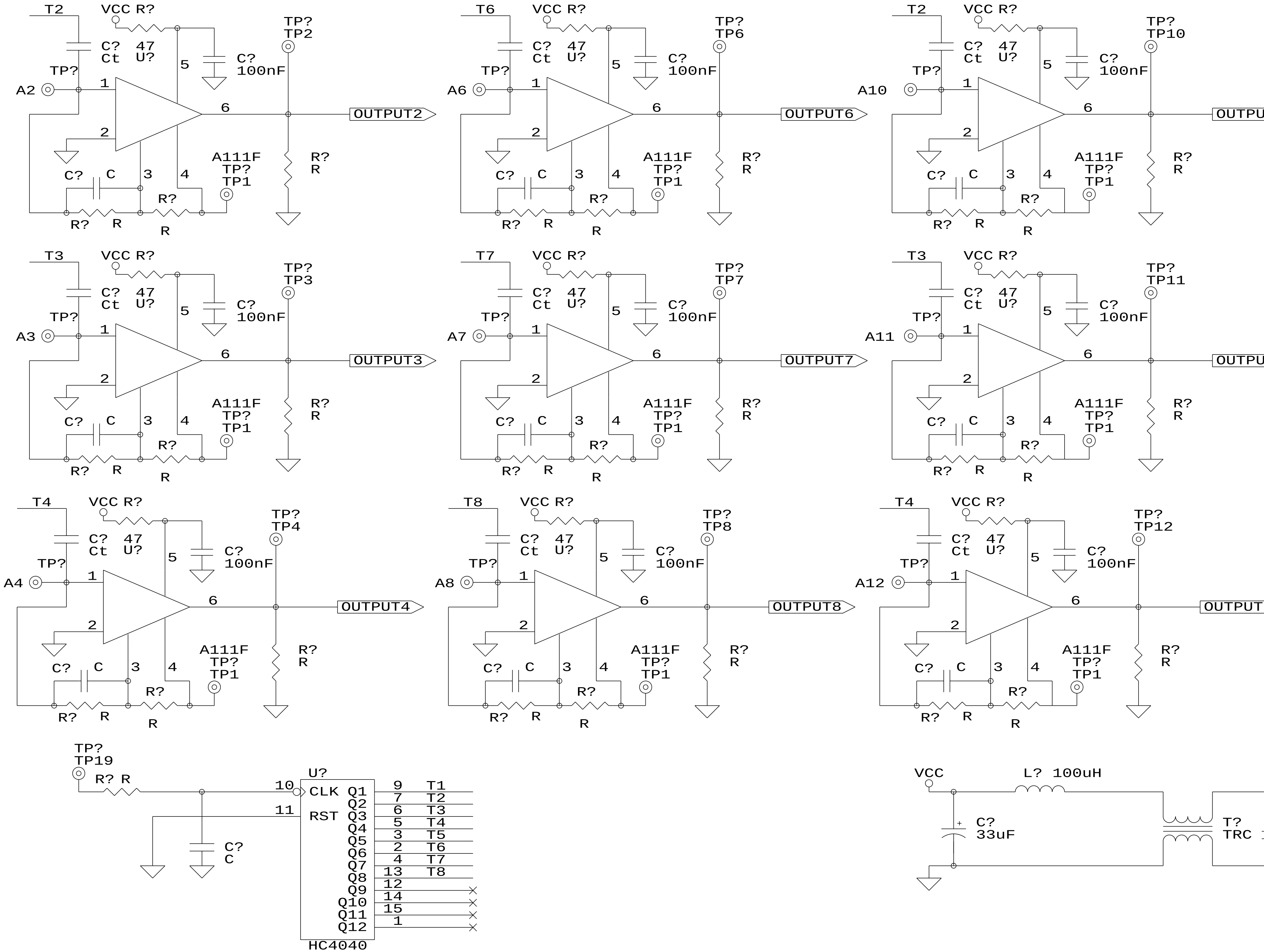
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C? 47
Ct U?
TP?
TP2
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C?
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TP?
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TP?
TP1
R?
R
C? C
3
4
R?
R? R
R
T6
VCC R?
C? 47
Ct U?
TP?
TP6
5
C?
100nF
TP?
A6
1
6
OUTPUT6
2
A111F
TP?
TP1
R?
R
C? C
3
4
R?
R? R
R
T2
VCC R?
C? 47
Ct U?
TP?
TP10
5
C?
100nF
TP?
A10
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OUTPU
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TP?
TP1
R?
R
C? C
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4
R?
R? R
R
T3
VCC R?
C? 47
Ct U?
TP?
TP3
5
C?
100nF
TP?
A3
1
6
OUTPUT3
2
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TP?
TP1
R?
R
C? C
3
4
R?
R? R
R
T7
VCC R?
C? 47
Ct U?
TP?
TP7
5
C?
100nF
TP?
A7
1
6
OUTPUT7
2
A111F
TP?
TP1
R?
R
C? C
3
4
R?
R? R
R
T3
VCC R?
C? 47
Ct U?
TP?
TP11
5
C?
100nF
TP?
A11
1
6
OUTPU
2
A111F
TP?
TP1
R?
R
C? C
3
4
R?
R? R
R
T4
VCC R?
C? 47
Ct U?
TP?
TP4
5
C?
100nF
TP?
A4
1
6
OUTPUT4
2
A111F
TP?
TP1
R?
R
C? C
3
4
R?
R? R
R
T8
VCC R?
C? 47
Ct U?
TP?
TP8
5
C?
100nF
TP?
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1
6
OUTPUT8
2
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R
C? C
3
4
R?
R? R
R
T4
VCC R?
C? 47
Ct U?
TP?
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5
C?
100nF
TP?
A12
1
6
OUTPUT
2
A111F
TP?
TP1
R?
R
C? C
3
4
R?
R? R
R
TP?
TP19
R? R
U?
10 CLK Q1 9 T1
Q2 7 T2
11 RST Q3 6 T3
Q4 5 T4
Q5 3 T5
Q6 2 T6
Q7 4 T7
Q8 13 T8
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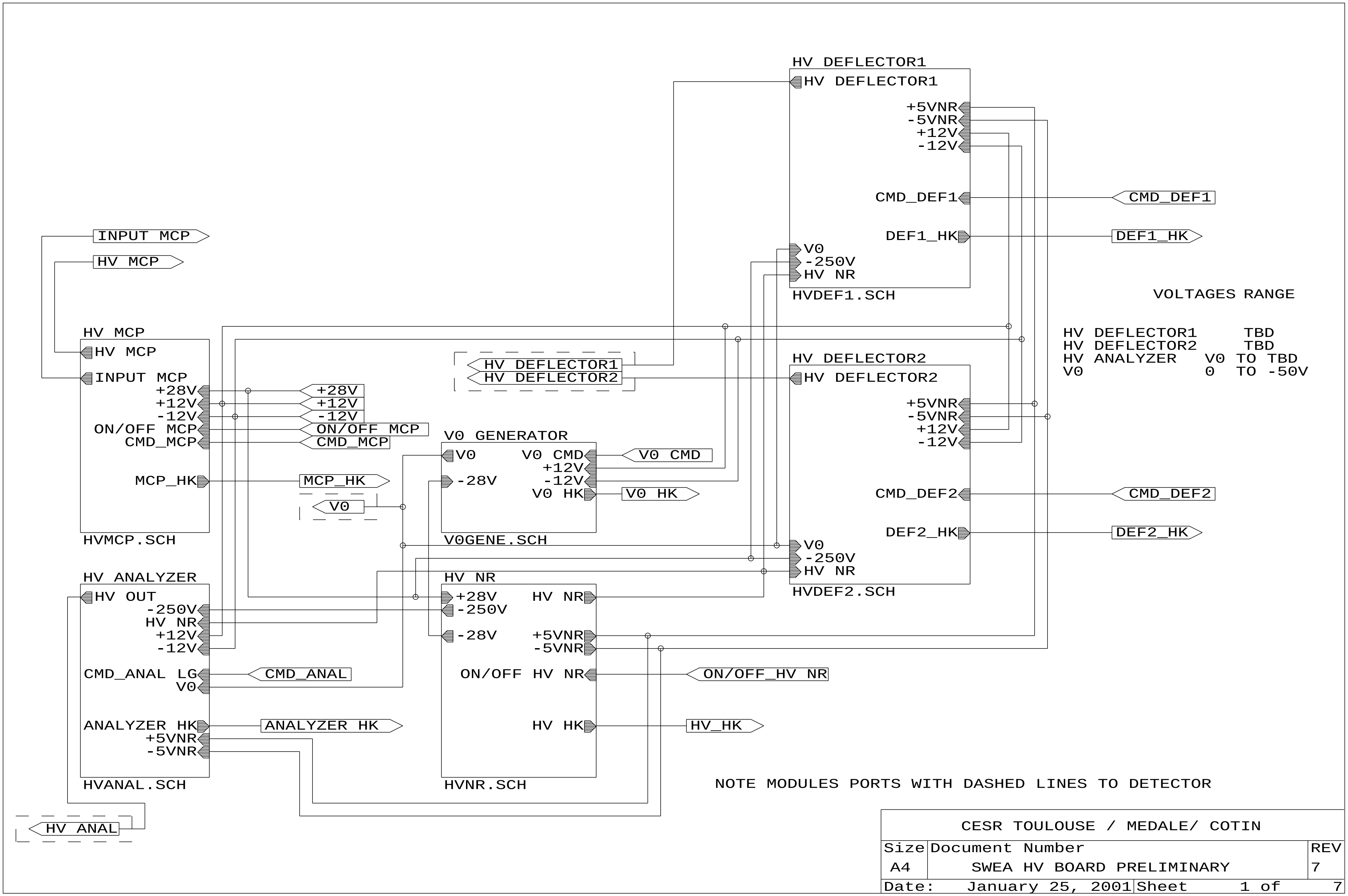
T?
TRC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-5VNR
+12V
-12V
CMD_DEF1
DEF1_HK
V0
-250V
HV NR
HVDEF1.SCH
CMD_DEF1
DEF1_HK
VOLTAGES RANGE
HV DEFLECTOR1 TBD
HV DEFLECTOR2 TBD
HV ANALYZER V0 TO TBD
V0 0 TO -50V
INPUT MCP
HV MCP
HV MCP
HV MCP
INPUT MCP
+28V
+12V
-12V
ON/OFF MCP
CMD_MCP
MCP_HK
HVMCP.SCH
+28V
+12V
-12V
ON/OFF MCP
CMD_MCP
MCP_HK
V0
HV DEFLECTOR1
HV DEFLECTOR2
HV DEFLECTOR2
HV DEFLECTOR2
+5VNR
-5VNR
+12V
-12V
CMD_DEF2
DEF2_HK
V0
-250V
HV NR
HVDEF2.SCH
CMD_DEF2
DEF2_HK
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V0
V0 CMD
+12V
-28V
-12V
V0 HK
V0GENE.SCH
V0 CMD
V0 HK
HV ANALYZER
HV OUT
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HV NR
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-12V
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V0
ANALYZER HK
+5VNR
-5VNR
HVANAL.SCH
CMD_ANAL
ANALYZER HK
HV NR
+28V
HV NR
-250V
-28V
+5VNR
-5VNR
ON/OFF HV NR
HV HK
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HV_HK
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NOTE MODULES PORTS WITH DASHED LINES TO DETECTOR
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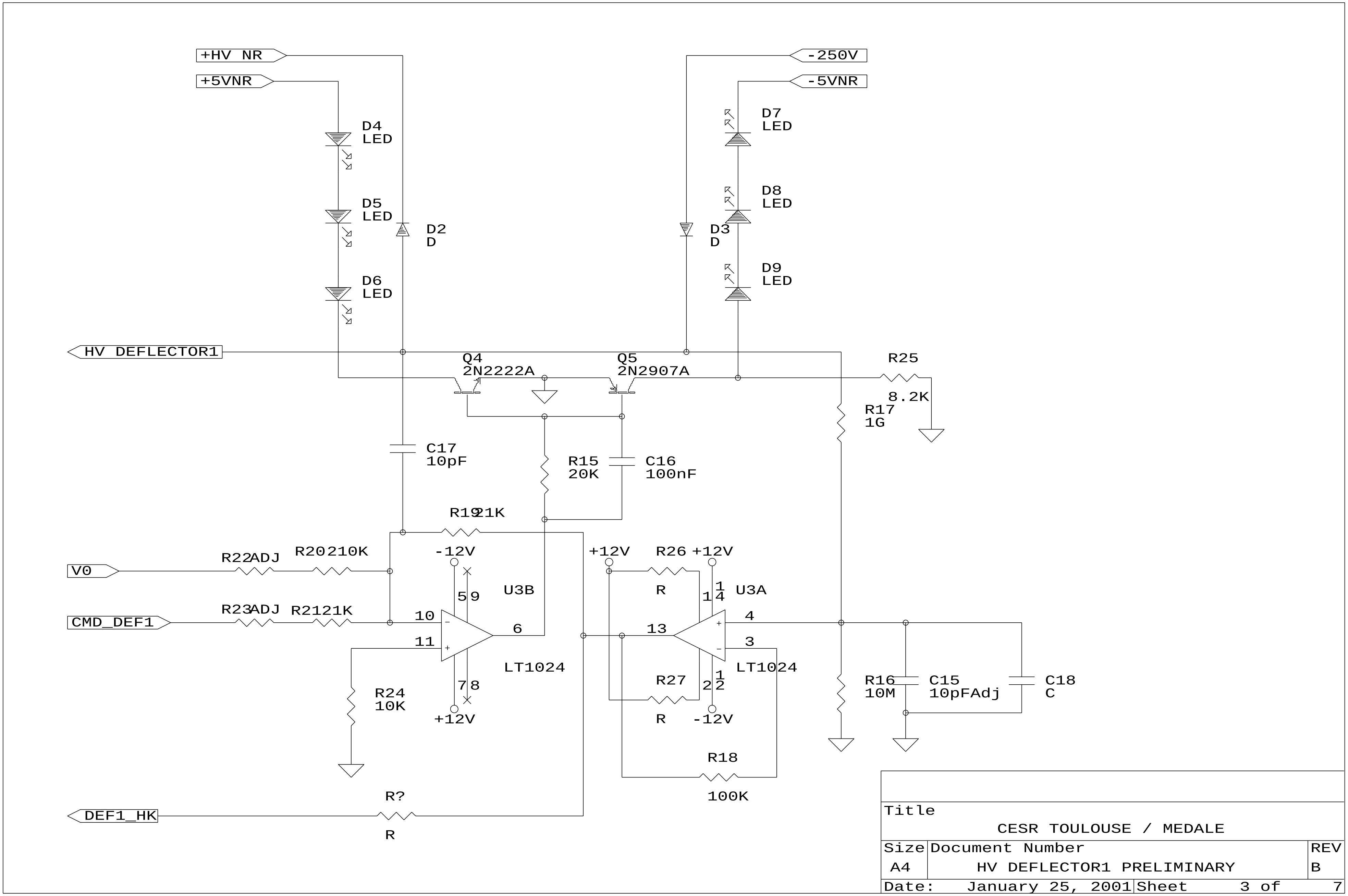
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-5VNR
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D9
LED
HV DEFLECTOR1
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Q5
2N2907A
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R17
1G
C17
10pF
R15
20K
C16
100nF
R19 21K
V0
R22 ADJ
R20 210K
-12V
+12V
R26
+12V
R
U3B
U3A
CMD_DEF1
R23 ADJ
R21 21K
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3
12
LT1024
LT1024
R24
10K
R27
R
+12V
-12V
R16
10M
C15
10pFAdj
C18
C
R18
100K
DEF1_HK
R?
R
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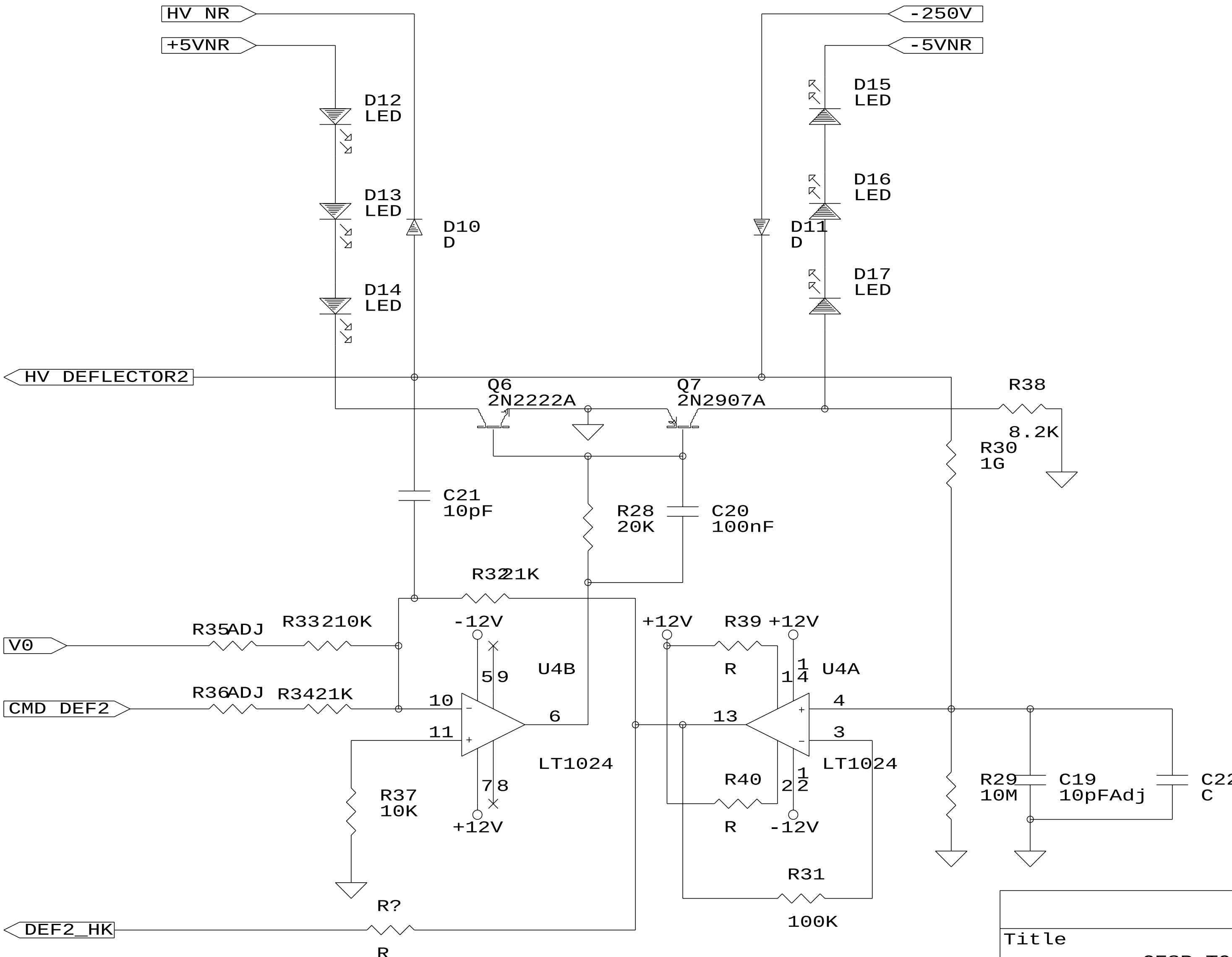
Sheet 3 of 7



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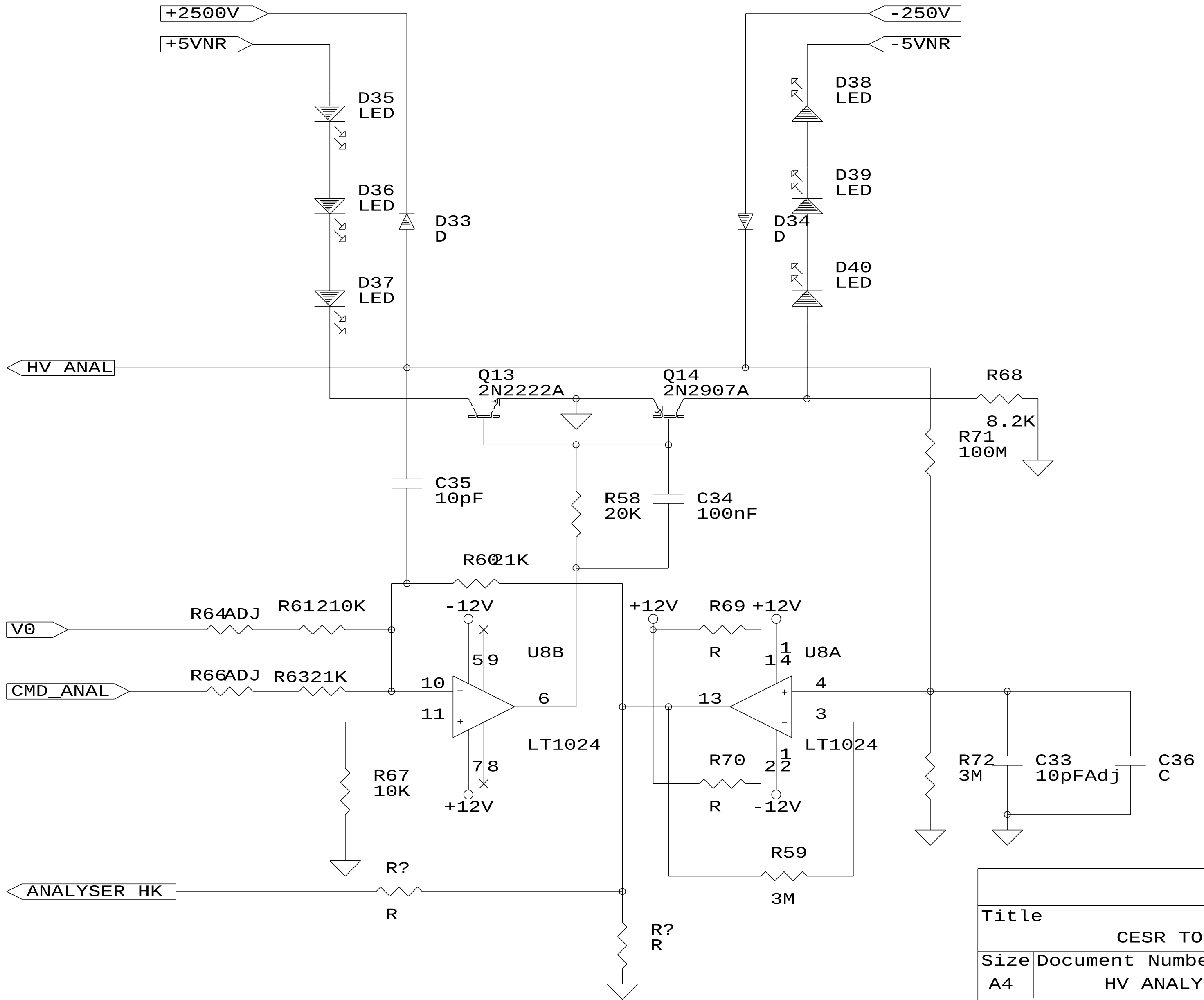

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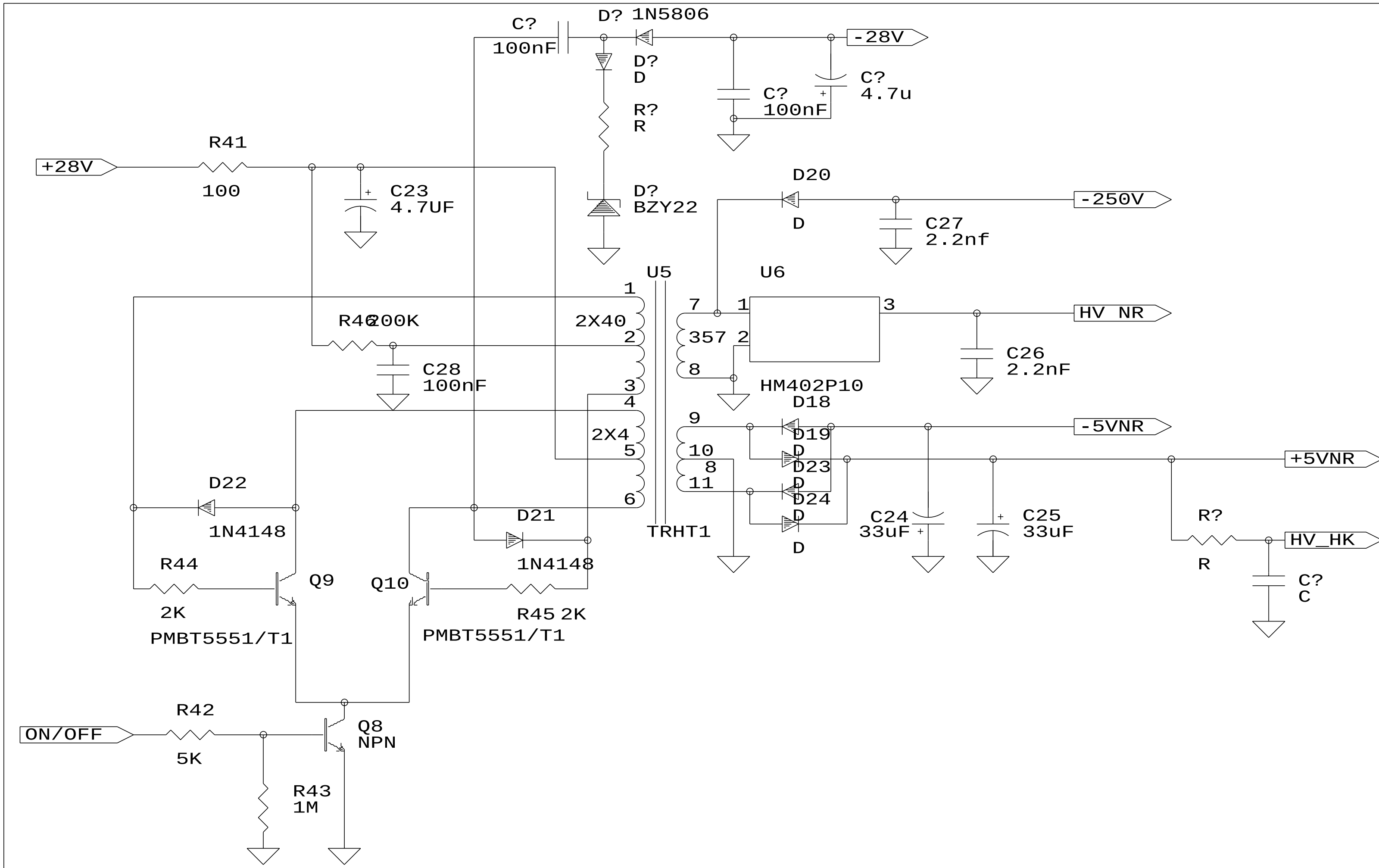

J.L MEDALE/CESR TOULOUSE		
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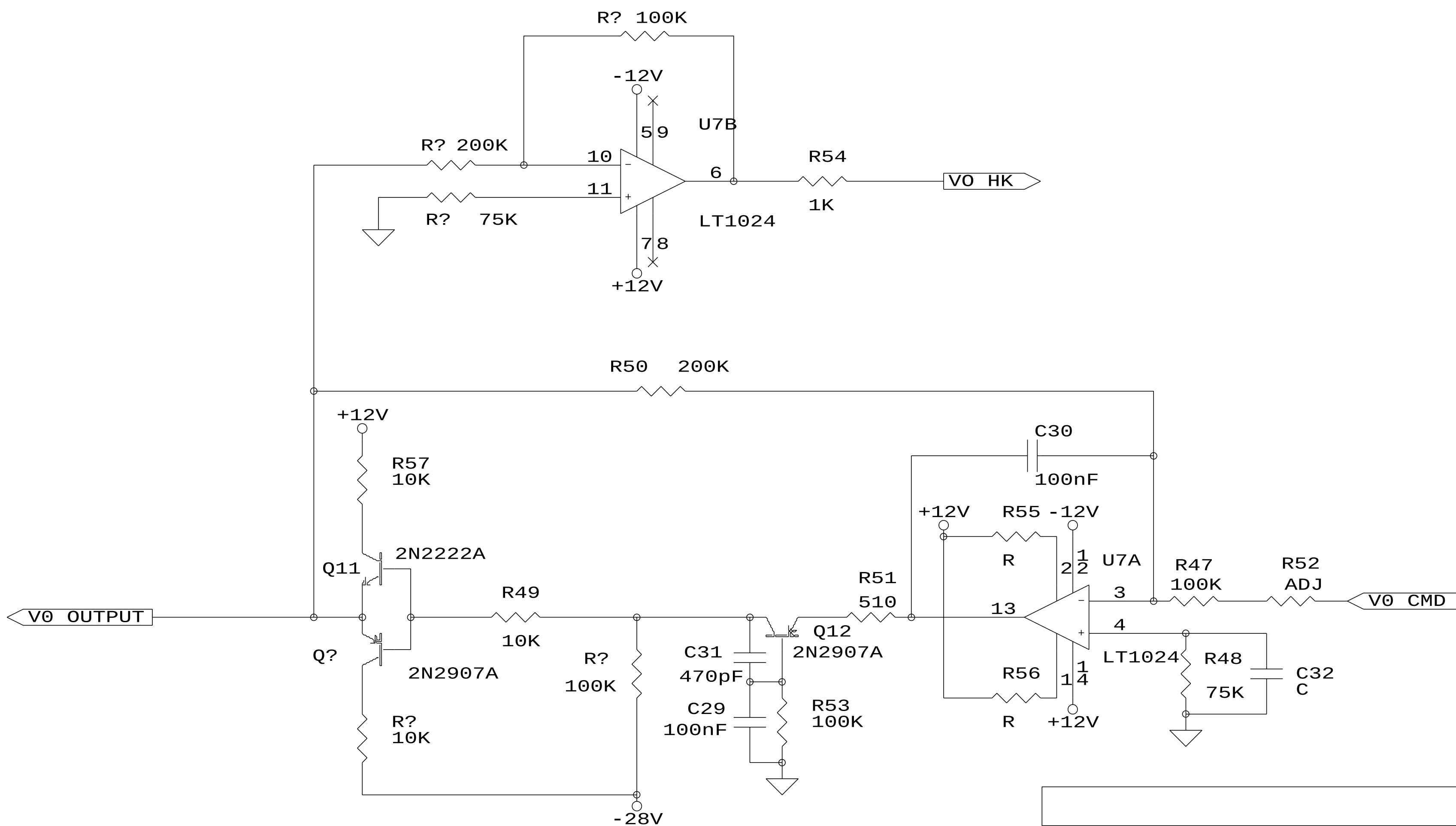

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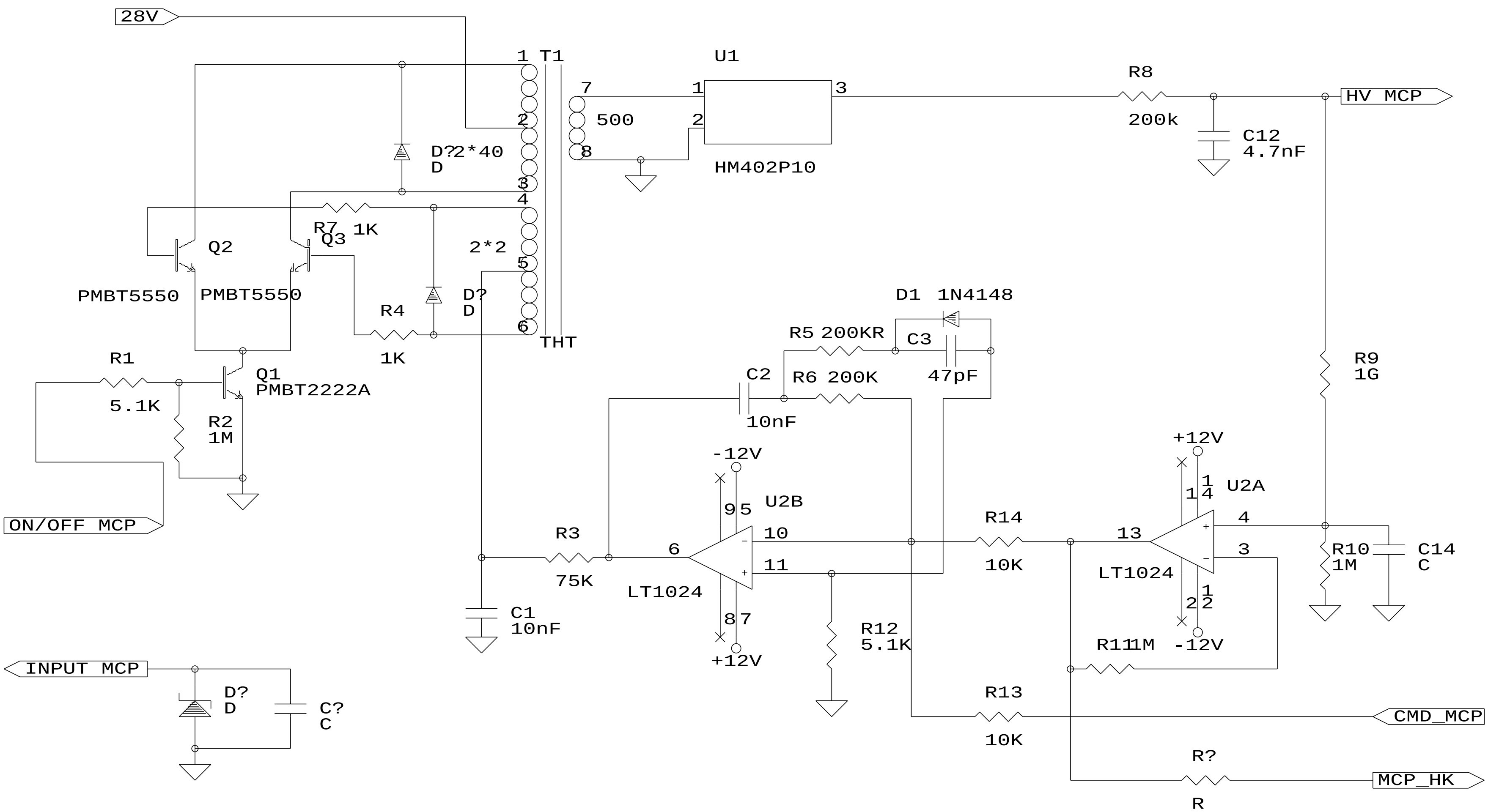


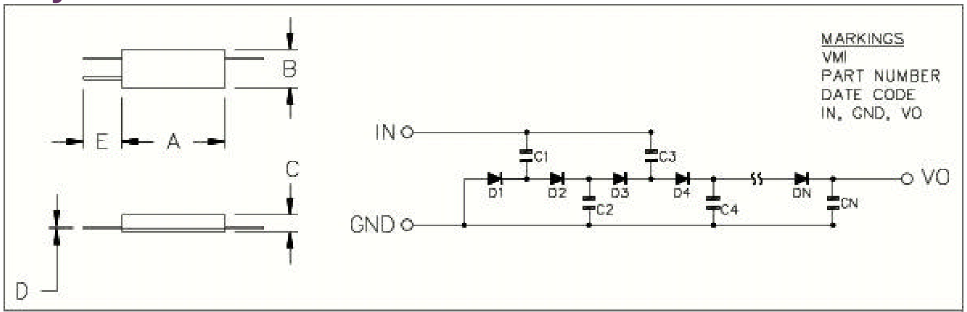
CESR TOULOUSE MEDALE		
Size	Document Number	REV
A4	HV MCP SWEA PROTOTYPE	5
Date: March 2, 2001	Sheet 2 of 7	

Positive Output Hybrid Multipliers

Electrical Characteristics

Part Number	Vin	Vout	Io	Frequency	# of Stages
HM202P08	560Vp-p	2000V	100µA	20-100kHz	8
HM202P10	560Vp-p	2000V	100µA	20-100kHz	10
HM402P08	900Vp-p	4000V	200µA	20-100kHz	8
HM402P10	900Vp-p	4000V	200µA	20-100kHz	10

Physical Characteristics



Part Number	A	B	C	D	E
HM202*	.660 in (16.8mm)	.250 in (6.3mm)	.115 in (2.9mm)	.012 in (0.3mm)	.250 in (6.3mm)
HM402*	.830 in (21.1mm)	.370 in (9.4mm)	.200 in (5.1mm)	.012 in (0.3mm)	.250 in (6.3mm)

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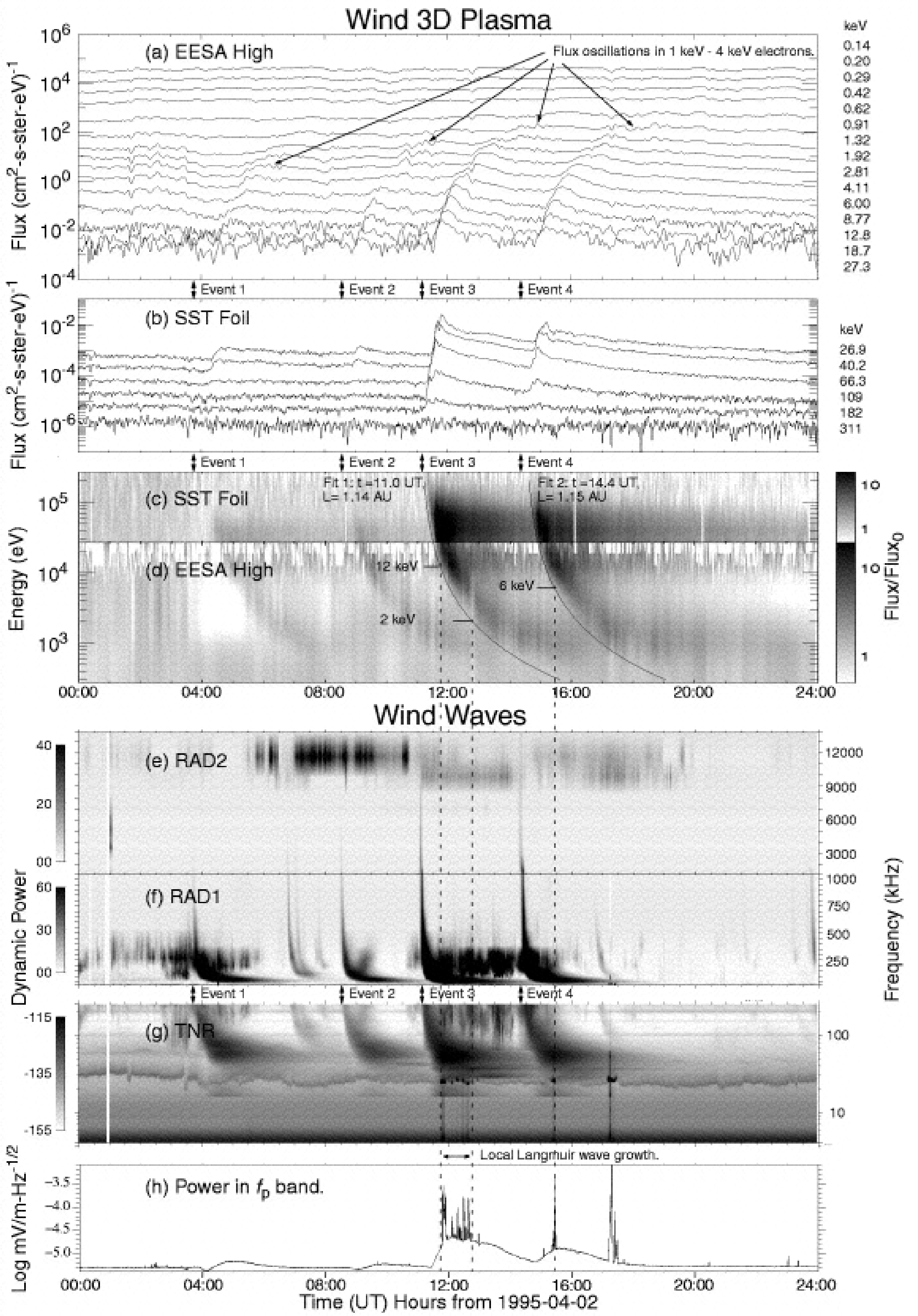
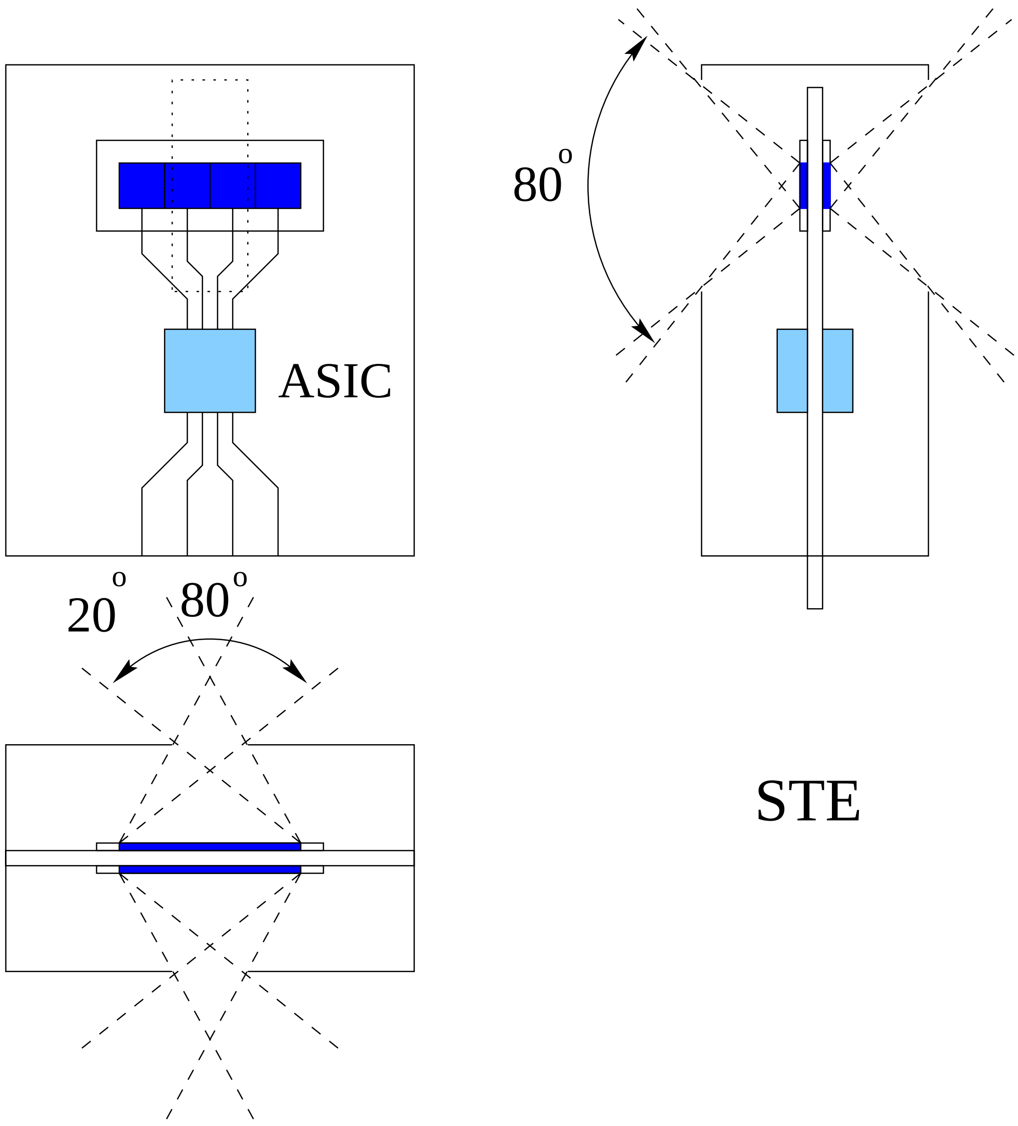
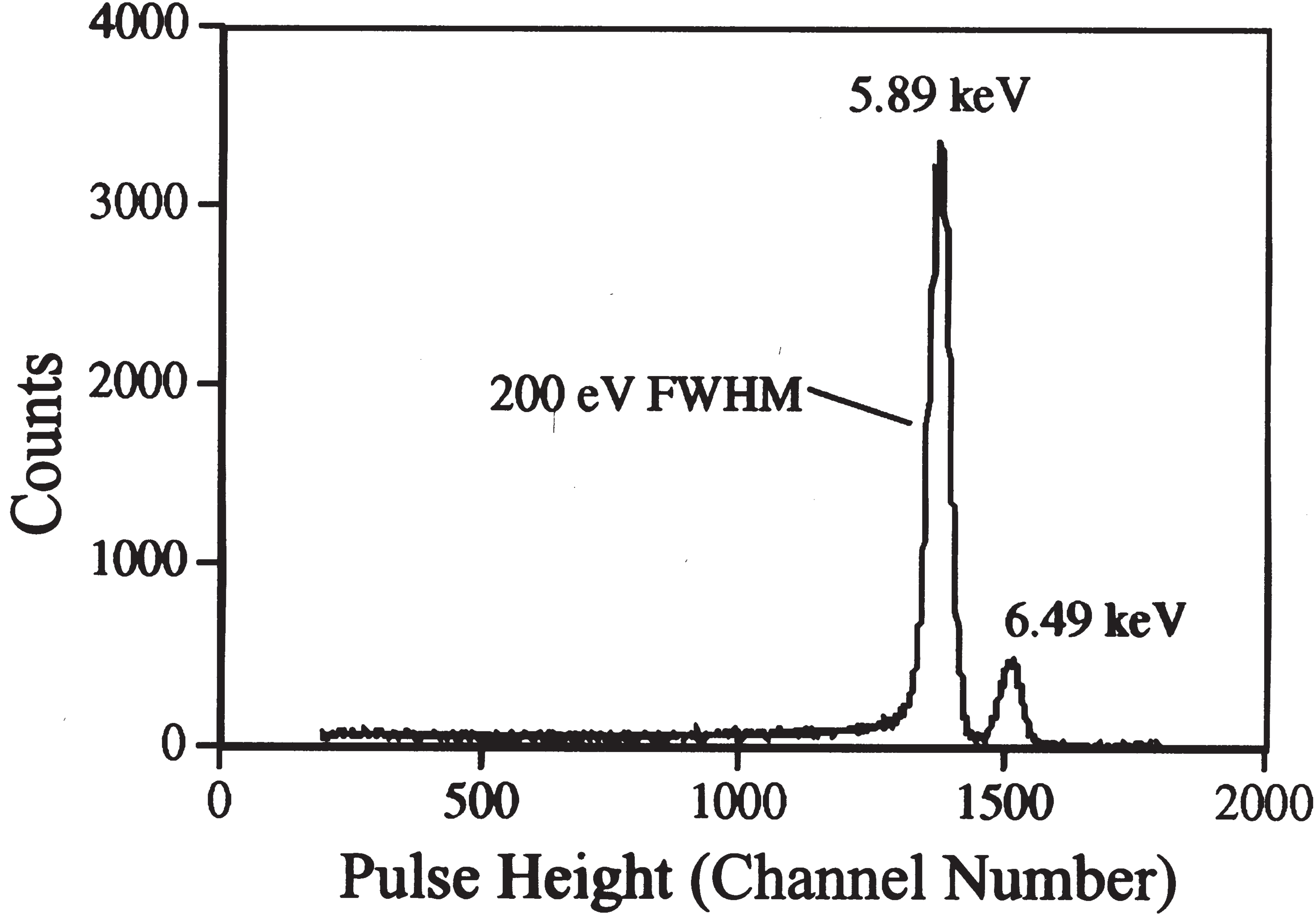
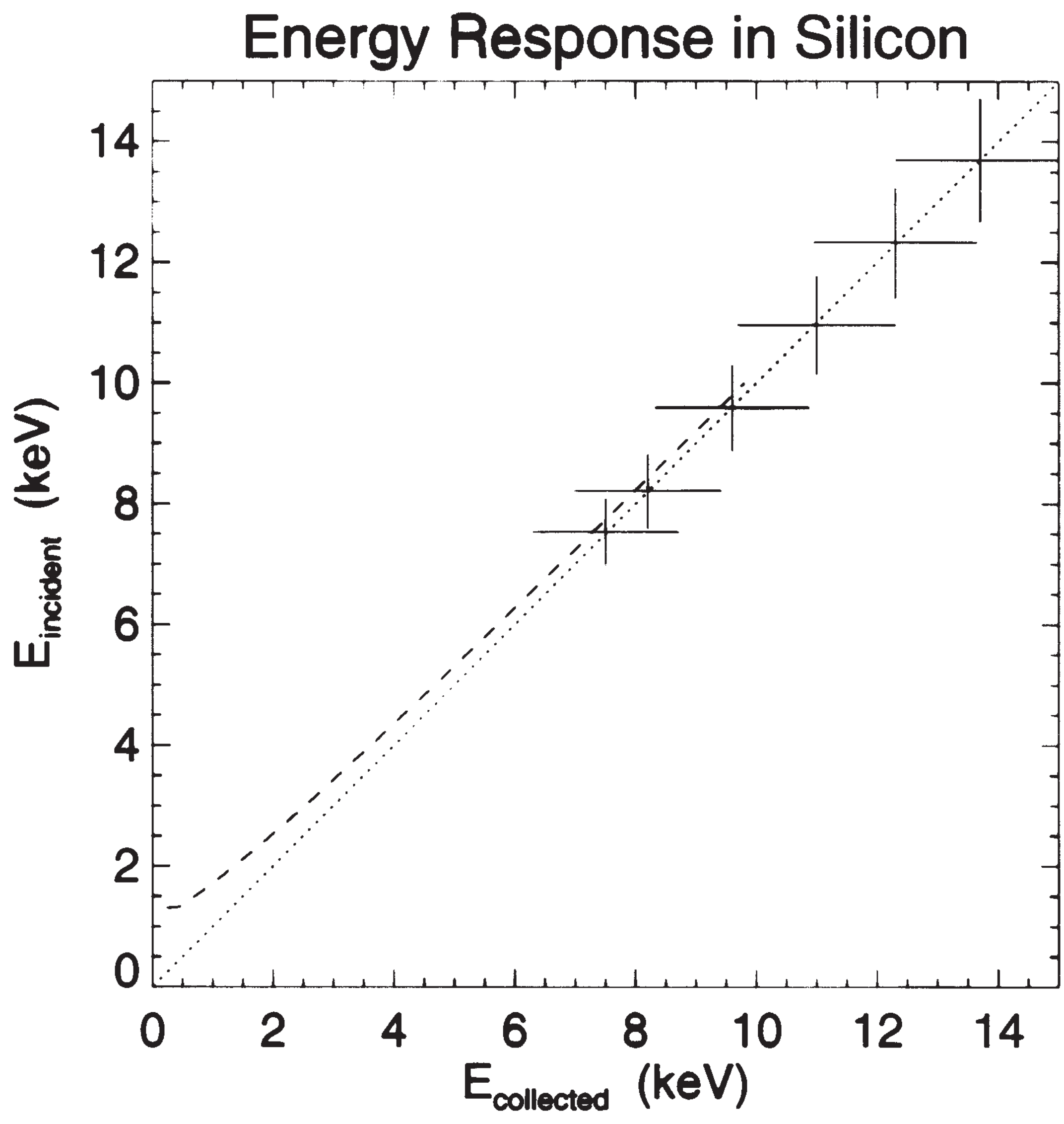
STE Detector Design


Wind 3D Plasma
(a) EESA High
Flux oscillations in 1 keV - 4 keV electrons.
Flux (cm2-s-ster-eV)-1
keV
0.14
0.20
0.29
0.42
0.62
0.91
1.32
1.92
2.81
4.11
6.00
8.77
12.8
18.7
27.3
Event 1
Event 2
Event 3
Event 4
(b) SST Foil
26.9
40.2
66.3
109
182
311
(c) SST Foil
Fit 1: t =11.0 UT, L= 1.14 AU
Fit 2: t =14.4 UT, L= 1.15 AU
(d) EESA High
12 keV
6 keV
2 keV
Energy (eV)
Flux/Flux0
00:00
04:00
08:00
12:00
16:00
20:00
24:00
Wind Waves
(e) RAD2
(f) RAD1
Dynamic Power
Frequency (kHz)
(g) TNR
Local Langmuir wave growth.
(h) Power in fp band.
Log mV/m-Hz-1/2
Time (UT) Hours from 1995-04-02


80o
ASIC
20o
80o
STE

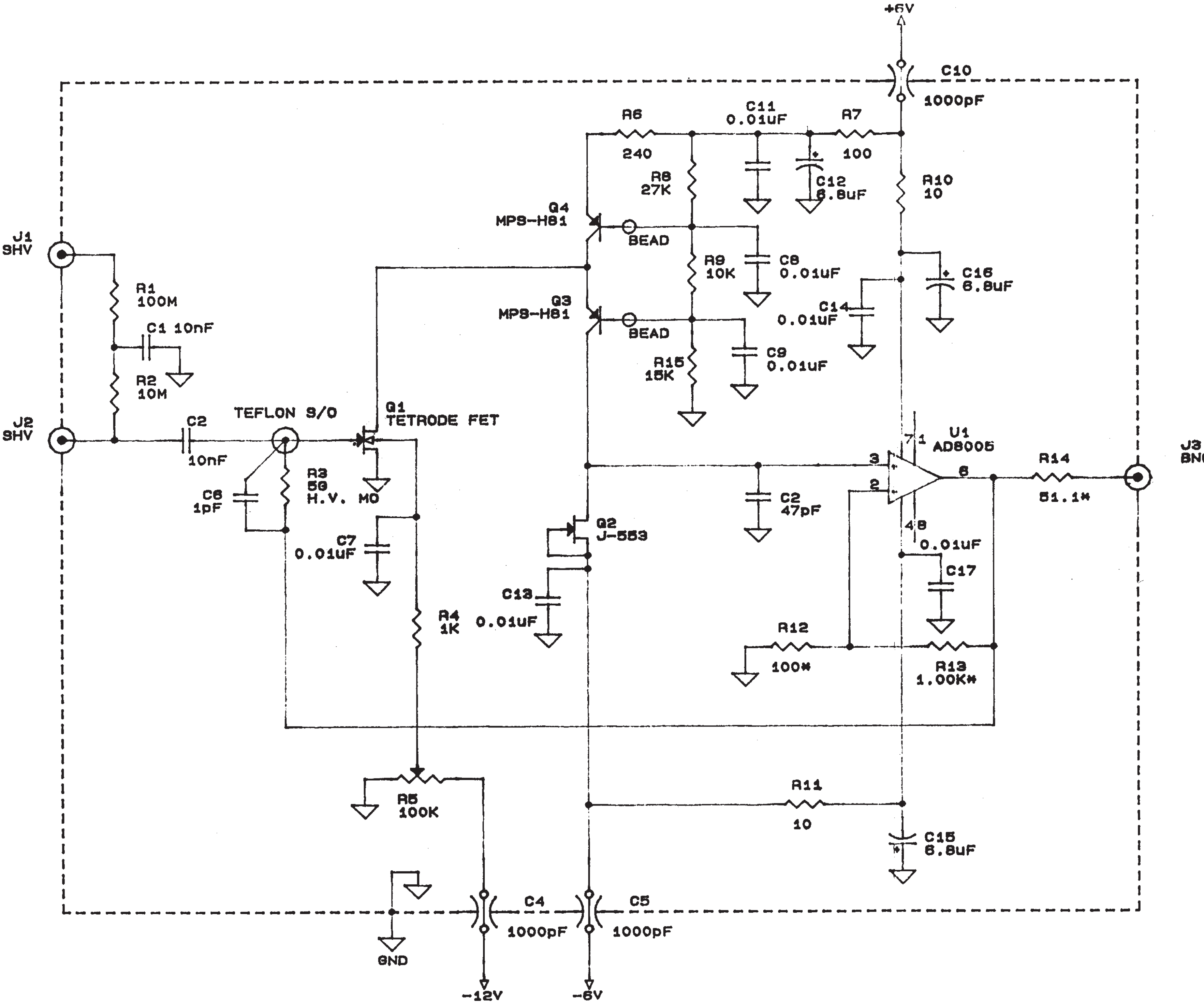


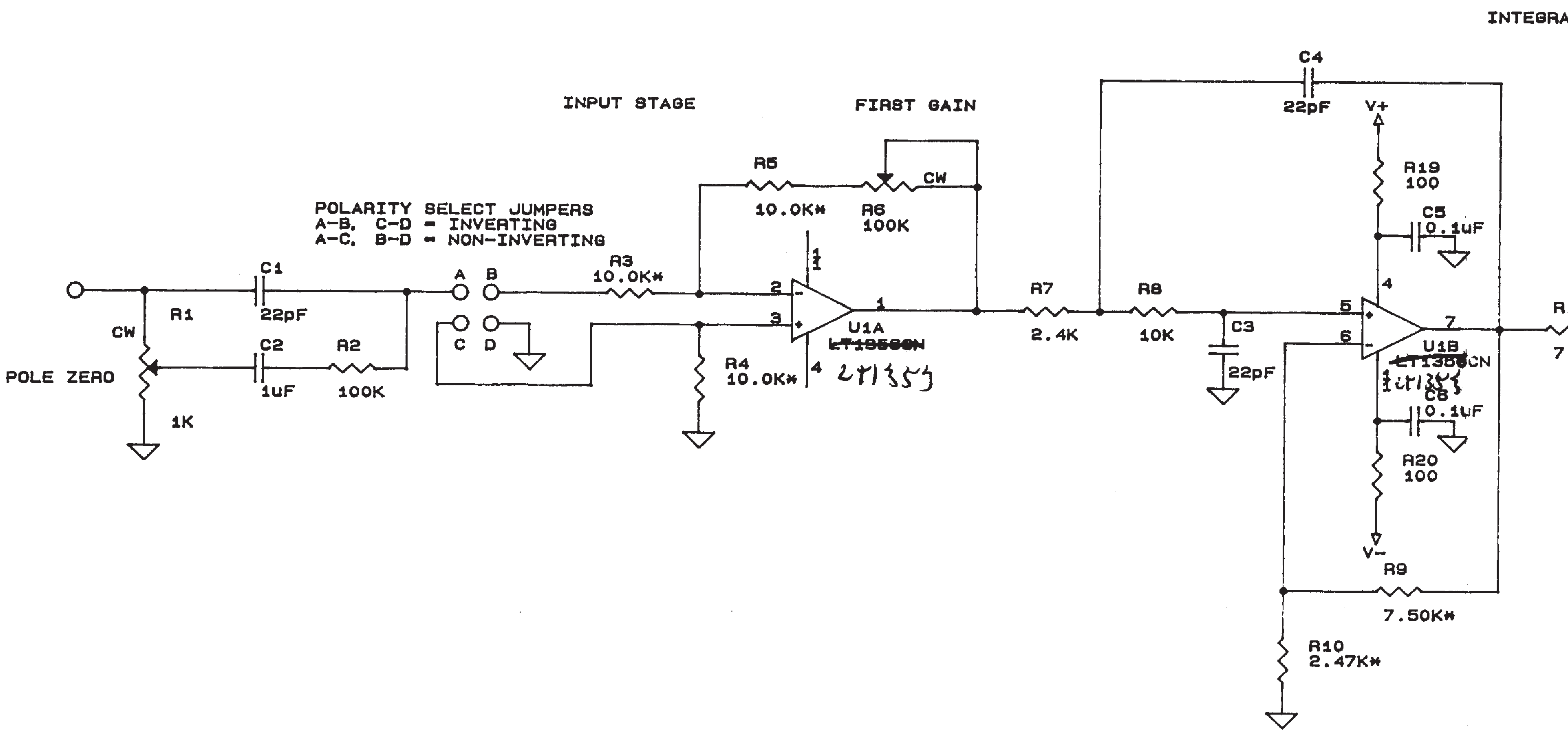
4000
3000
2000
1000
0
Counts
5.89 keV
200 eV FWHM
6.49 keV
0
500
1000
1500
2000
Pulse Height (Channel Number)



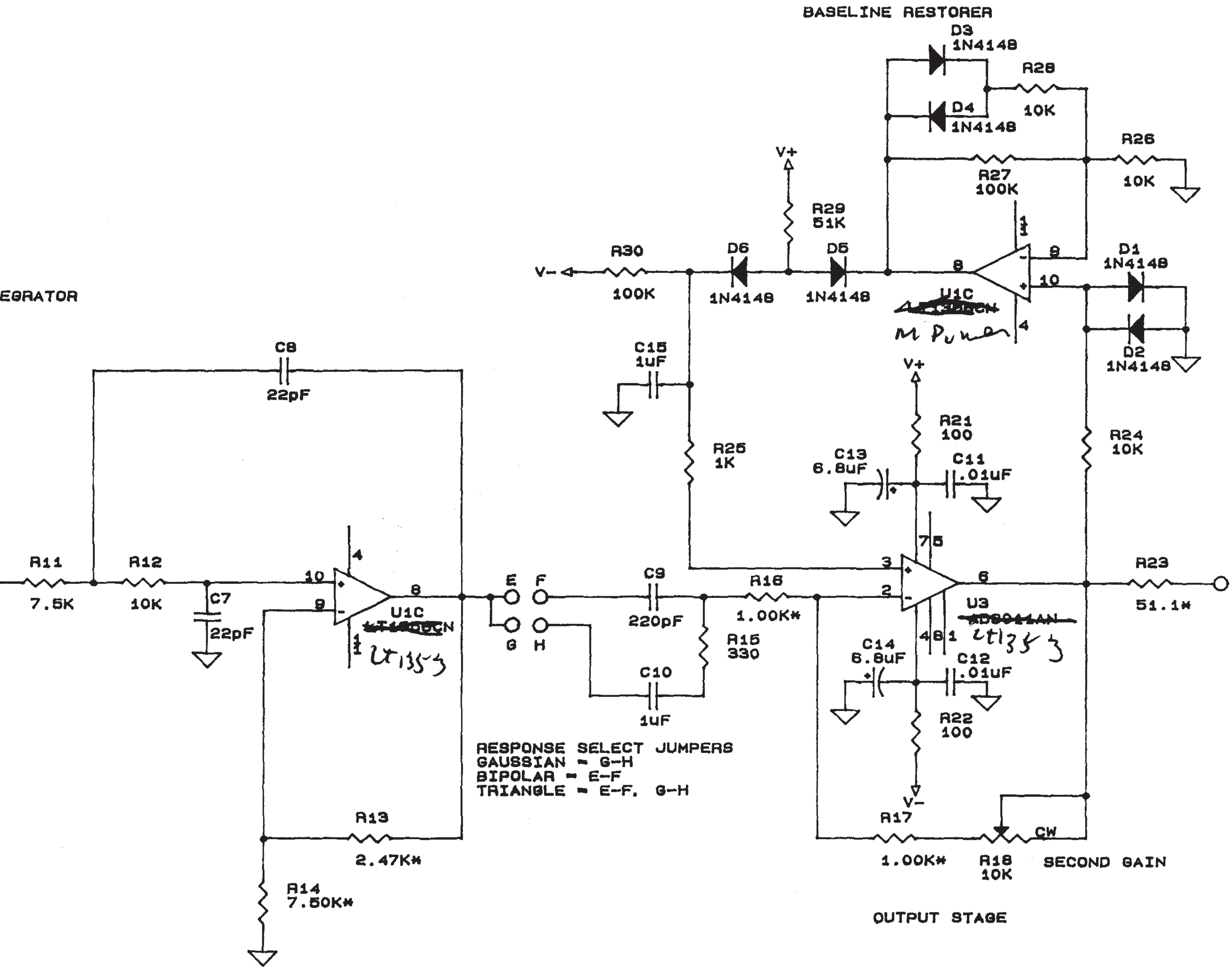
Energy Response in Silicon
E_incident (keV)
E_collected (keV)
0
2
4
6
8
10
12
14

STE Front End Electronics

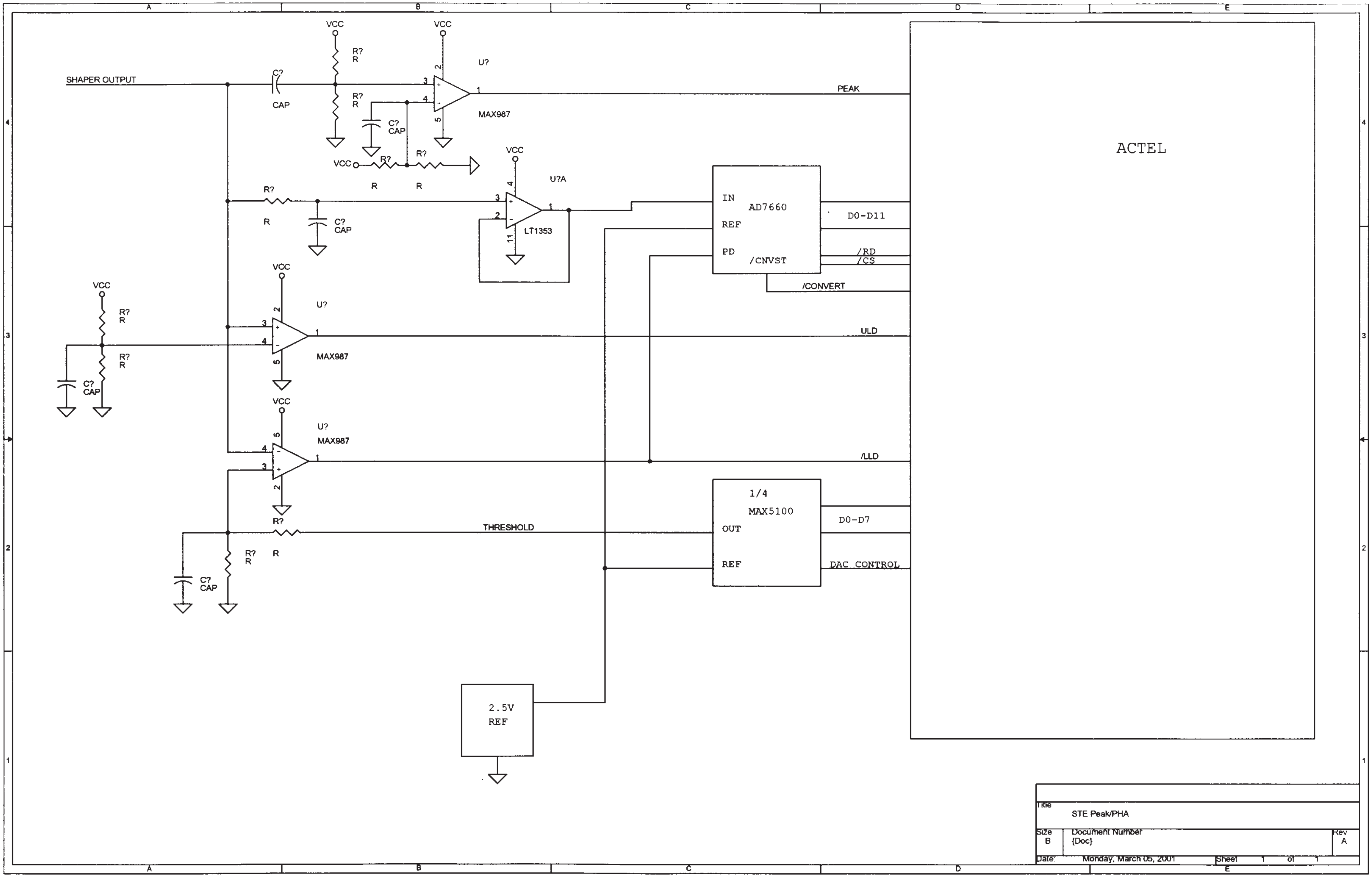

+6V
C10
1000pF
R6
240
C11
0.01uF
R7
100
R8
27K
C12
6.8uF
R10
10
Q4
MPS-H81
BEAD
R9
10K
C8
0.01uF
C16
6.8uF
Q3
MPS-H81
BEAD
C14
0.01uF
R15
15K
C9
0.01uF
J1
SHV
R1
100M
C1 10nF
R2
10M
J2
SHV
C2
10nF
TEFLON S/O
Q1
TETRODE FET
R3
5G
H.V. MO
C6
1pF
C7
0.01uF
U1
AD8005
R14
51.1*
J3
BNC
C2
47pF
Q2
J-553
0.01uF
C17
C13
0.01uF
R4
1K
R12
100*
R13
1.00K*
R5
100K
R11
10
C15
6.8uF
C4
1000pF
C5
1000pF
GND
-12V
-6V



INTEGRA
INPUT STAGE
FIRST GAIN
POLARITY SELECT JUMPERS
A-B, C-D = INVERTING
A-C, B-D = NON-INVERTING
C1
22pF
C2
1uF
R1
CW
POLE ZERO
1K
R2
100K
A
B
C
D
R3
10.0K*
R4
10.0K*
R5
10.0K*
R6
100K
CW
U1A
R7
2.4K
R8
10K
C3
22pF
C4
22pF
V+
R19
100
C5
0.1uF
U1B
C6
0.1uF
R20
100
V-
R9
7.50K*
R10
2.47K*



BASELINE RESTORER
D3 1N4148
D4 1N4148
R28 10K
R26 10K
R27 100K
V+
R29 51K
R30 100K
V-
D6 1N4148
D5 1N4148
U1C
D1 1N4148
D2 1N4148
EGRATOR
C8 22pF
C15 1uF
R25 1K
R21 100
C13 6.8uF
C11 .01uF
R24 10K
R11 7.5K
R12 10K
C7 22pF
U1C
E F
G H
C9 220pF
R16 1.00K*
R15 330
C10 1uF
U3
R23 51.1*
C14 6.8uF
C12 .01uF
R22 100
RESPONSE SELECT JUMPERS
GAUSSIAN = G-H
BIPOLAR = E-F
TRIANGLE = E-F, G-H
R13 2.47K*
R14 7.50K*
R17 1.00K*
R18 10K
CW
SECOND GAIN
OUTPUT STAGE



SHAPER OUTPUT
VCC
C?
CAP
R?
R
U?
MAX987
PEAK
U?A
LT1353
AD7660
IN
REF
PD
/CNVST
D0-D11
/RD
/CS
/CONVERT
ULD
/LLD
1/4
MAX5100
OUT
D0-D7
DAC CONTROL
THRESHOLD
2.5V
REF
ACTEL
Title
STE Peak/PHA
Size
B
Document Number
{Doc}
Rev
A
Date: Monday, March 05, 2001
Sheet 1 of 1

SWEA/STE Interface

SWEA/STE Interface Requirements, IDPU

- **Interface between SWEA and STE instruments and the IDPU**
- **IDPU Interface:**
  - **Mode Commands to control instrument settings**
    - **No high-bandwidth requirements; instrument runs itself**
  - **Data Readback**
    - **SWEA Counters, STE Accumulator, Housekeeping**
    - **About 50kbps throughput required**
    - **Sequencer to automatically sample & read out data**
  - **Common timebase clock for synchronized, low-jitter, deterministic sampling**
  - **Common interface design with other instruments to IDPU**
    - **Common development**
    - **Common GSE**
  - **Minimize number of wires down IMPACT boom**
  - **Meet EMC requirements**
- **Implementation Described in IMPACT Serial Interface document**

SWEA/STE Interface Requirements, SWEA

- **SWEA Interface:**
  - **Provide interface to the CESR-provided analyzer per the SWEA ICD**
  - **Voltage control for 5 analyzer voltages**
    - **MCP, VO, Analyzer, Deflector 1, Deflector 2**
    - **VO, Analyzer & Deflector Supplies must have programmable waveforms**
      - **625 samples/second, 2 second period**
    - **Analyzer and Deflector supplies are referenced to VO in the supplies to simplify controls**
    - **Analyzer requires a 16-bit DAC to get sufficient accuracy (5%) over the dynamic range (3000x)**
    - **Deflector supply controls should be multipliers based on Analyzer control to minimize dynamic range requirements (1% of Analyzer voltage)**
  - **Counters for Anode 16 pulses (logic pulses)**
  - **6 Voltage and one temperature housekeeping monitors**
  - **Test pulse generator (digital pulses), HV Enables (logic levels)**
  - **SWEA Cover Actuator power (switched 28V primary)**

SWEA/STE Interface Requirements, STE

- **STE Interface:**
  - 8 analog chains
    - Charge Sensitive Amplifier inside STE
    - Shaper
    - Discriminator (programmable threshold)
    - ADC (200x dynamic range, 5% DNL -> 14-16 bit ADC)
  - Pulse height analyzer
    - Programmable Energy binning to 16 log-spaced energy channels
    - 128-channel double-buffered accumulator (16E x 8 Det.)
    - 15KHz/detector throughput
  - Test pulse generator to test electronics
    - Ramped-amplitude tail-pulse generator
    - Capacitively coupled into preamp inputs
    - When pulser active, only allow events near pulse times
  - Temperature housekeeping monitor
  - Cover Actuator power (TBR)

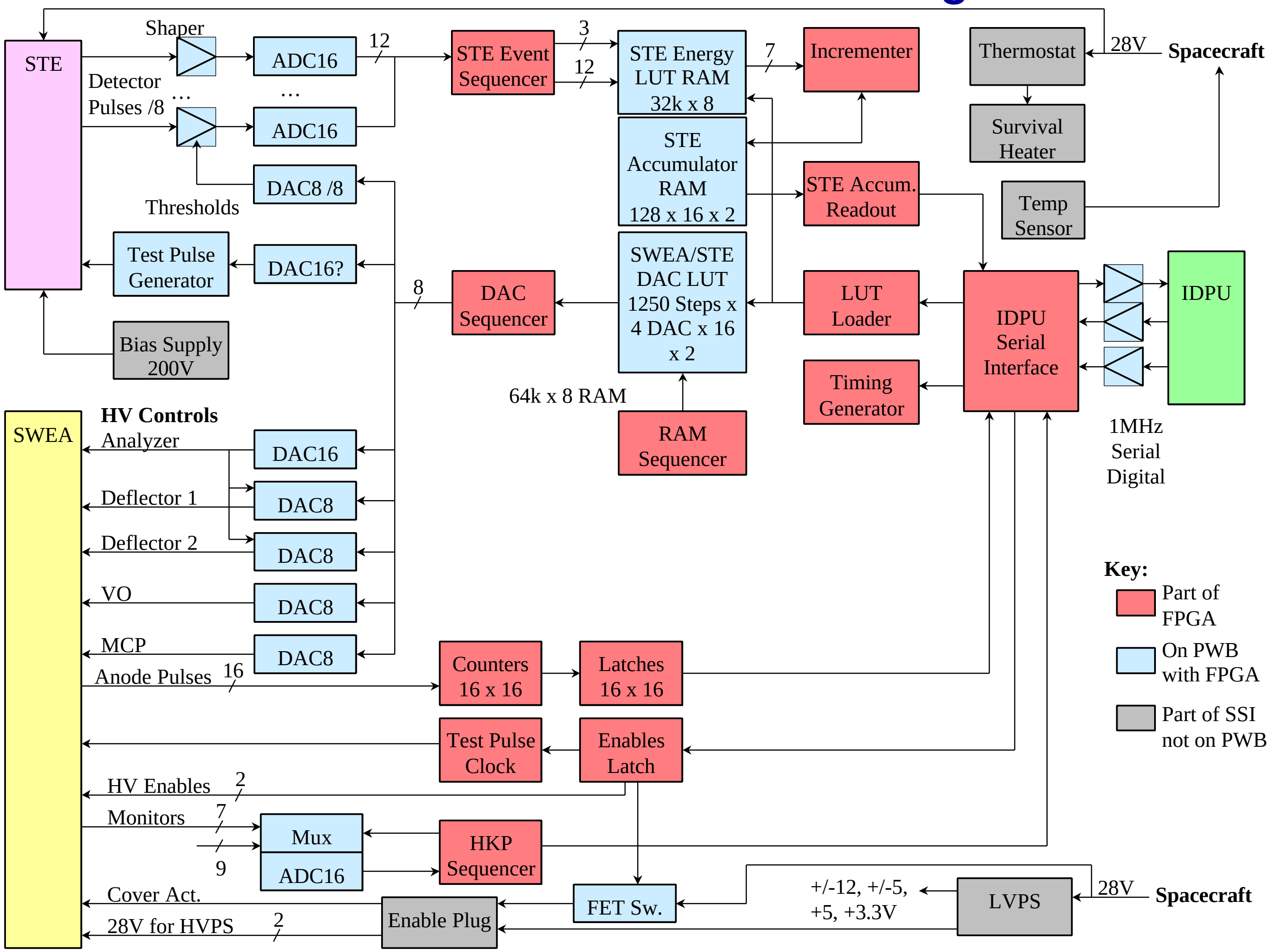
SWEA/STE Interface Requirements, Misc

- Miscellaneous Requirements
  - Survival heaters (thermostatically controlled)
    - SWEA and STE in parallel on one spacecraft circuit
    - SWEA heater/thermostat part of SWEA/STE Interface
  - Spacecraft-monitored temperature sensor (in SWEA)
    - Only one to minimize wires down boom; two instrument-monitored sensors when SWEA/STE is on.
    - Mounted in SWEA/STE Interface
  - Green-tag Enable Connector
    - Separate loops to enable:
      - MCP HV
      - Analyzer/Deflector HV
      - SWEA Cover

SWEA/STE Interface Requirements, Power

- **LVPS**
  - **Common design with SEP, IDPU, PLASTIC**
    - **Some minor differences**
    - **Meets EMC requirements (crystal controlled)**
  - **+3.3V, +5V Digital outputs**
  - **+/-5, +/-12V Analog supplies**
  - **+28V for SWEA HVPS**
  - **1.3W average power**
  - **+/- 5% regulation, 20mV ripple**
- **STE Bias Supply**
  - **200V fixed supply**
  - **very low current, ripple**
- **These supplies to be discussed at IDPU peer review**

SWEA/STE Interface Block Diagram



SWEA/STE Interface Logic

- **SWEA/STE Interface Logic implemented in an FPGA, augmented with a memory for Look-up tables (LUT) and STE accumulator**
- **Actel RT54SX32S baselined**
  - **Common FPGA selected for IMPACT team**
  - **Rad tollerant (100krads)**
  - **High Rel available**
  - **2880 logic modules**
- **Actel specification to be developed by SSL (Curtis)**
- **Actel design to be developed/tested by Elf**
  - **Same arrangement & personnel used on HESSI**
- **Power is constrained (budget is 100mW for the Logic)**
  - **1MHz clock looks adequate for sequencers**
  - **Asynchronous and/or slow clocks to be used where sensible**
    - **Ripple counters will be used for SWEA accumulators**
- **Attention will be given to good Actel design practices**

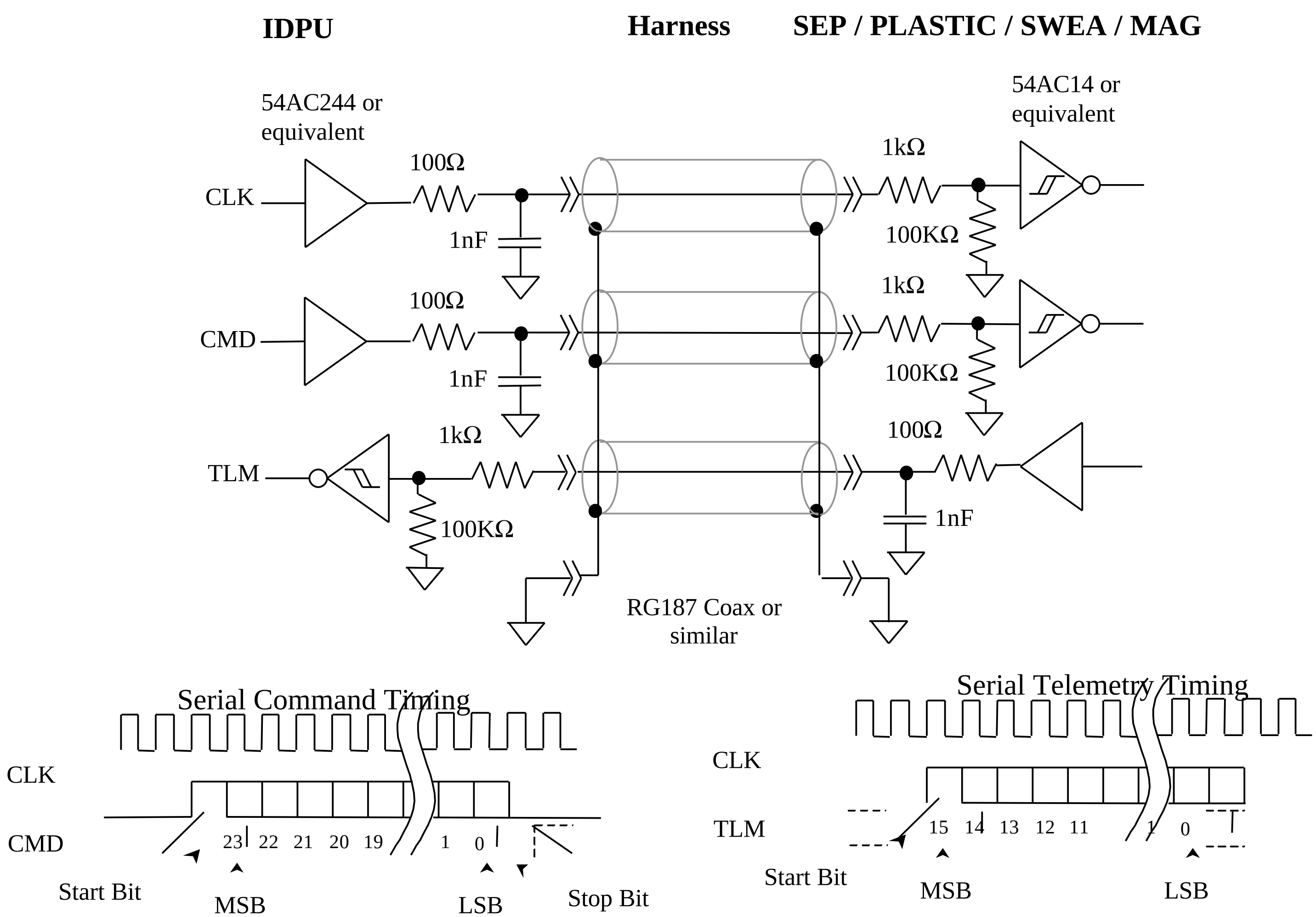
SWEA/STE Interface Memory Requirements

- **The memory is used for:**
  - **STE Energy Look-up Table**
    - **12-bit ADC output plus 3-bit detector ID results in a 4-bit energy bin number, plus the same 3-bit detector ID**
    - **32k x 8 bits**
  - **STE Accumulator**
    - **16 Energies, 8 Detectors, 16 bit accumulators, double-buffered**
    - **512 x 8 bits**
    - **Incrementer uses up to 4 memory cycles to increment an accumulator; Read, Increment, Write 8 LSB, repeat for 8 MSB on carry out of LSB**
  - **SWEA DAC Waveform Look-Up Table**
    - **Fastest waveform update rate is deflectors, at 625Hz**
    - **Typically only one DAC updated per step**
      - **code in RAM as 8-bit ID plus 8-bit value**
      - **Sequencer reads out DAC settings until STOP bit in ID set**
    - **2 second period; sized at 1250 samples * 4 DACs * 16 bits * 2 buffers = 20k x 8**

SWEA/STE Interface Memory Requirements (Continued)

- **Total Size requirement < 64Kbytes**
  - **Could reduce to 32Kx8 by using common STE LUT for all detectors**
  - **Will probably use common SRAM with IDPU - 512Kx8**
- **Access Rate:**
  - **STE Accumulation: 15,000 events/sec/det * 8 Det * 5 cycles/event = 600,000 cycles/second (includes LUT & Accumulate)**
  - **STE readout: 1MHz serial bitrate to IDPU (burst) = 125,000 cycles/second max (Note: reset accumulator following readout of full accumulator, so not bandwidth impact)**
  - **LUT Write: 1MHz serial bitrate from IDPU (burst) = 125,000 cycles/second max**
  - **SWEA LUT readout; Up to 5 DAC bytes need to be updated in one sample interval (625Hz) = 3,125 cycles/second MAX (Note: DACs are double-buffered)**
  - **Total bandwidth required: 853KHz**
  - **Using 1 RAM cycle per 1MHz clock, can allocate 8 fixed time slots at 125KHz: 5 for STE Accumulation, 1 for STE readout, 1 for LUT write, and one for SWEA LUT readout**

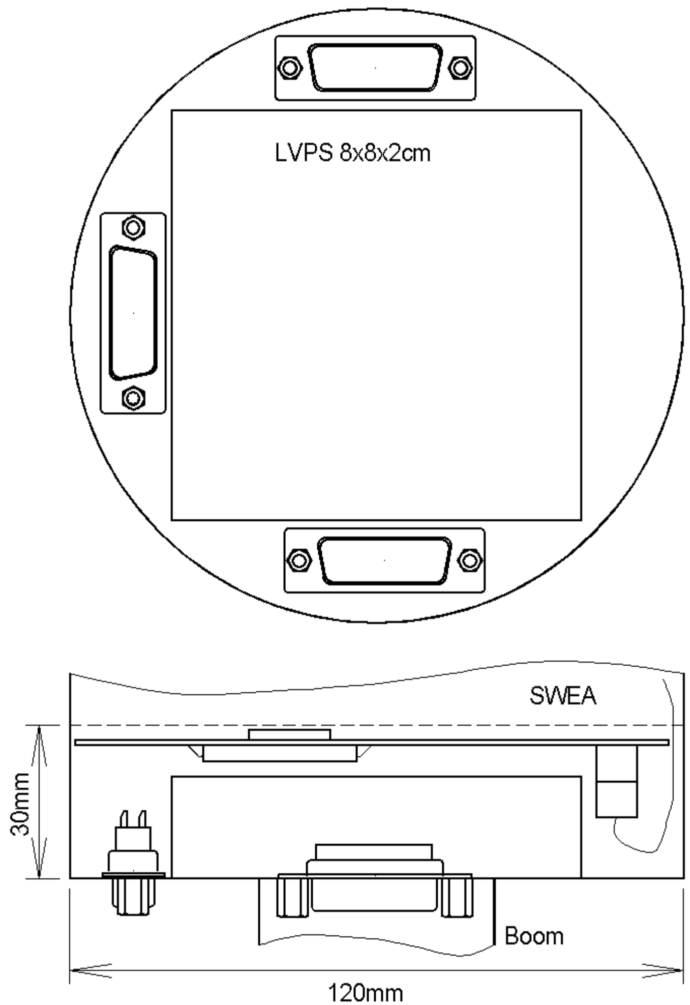
IDPU Serial Interface



IDPU Serial Interface

- As defined by IMPACT Serial Interface document
- Three-wire serial digital single-ended interface
  - Continuous 1MHz Clock
  - Serial Data Out (Command)
  - Serial Data In (Telemetry)
- R-C rise time limiters to reduce EMC
  - OK by Manning (SWAVES)
- Coax or shielded wire harness
  - Breadboard shows good waveforms and timing with an 8m harness
- No handshaking; system designed to handle maximum throughput at both ends
- No gating; start/stop bit synchronization like RS232
- 24 bit Commands in data out (8 bit ID, 16 bit data)
- Blocks of 16-bit Telemetry in
  - Blocks include an identifying header (5 bit ID, 10 bit block length)
- Synchronous 1-second time tic command

SWEA/STE Interface Layout



SWEA/STE Interface Mechanical

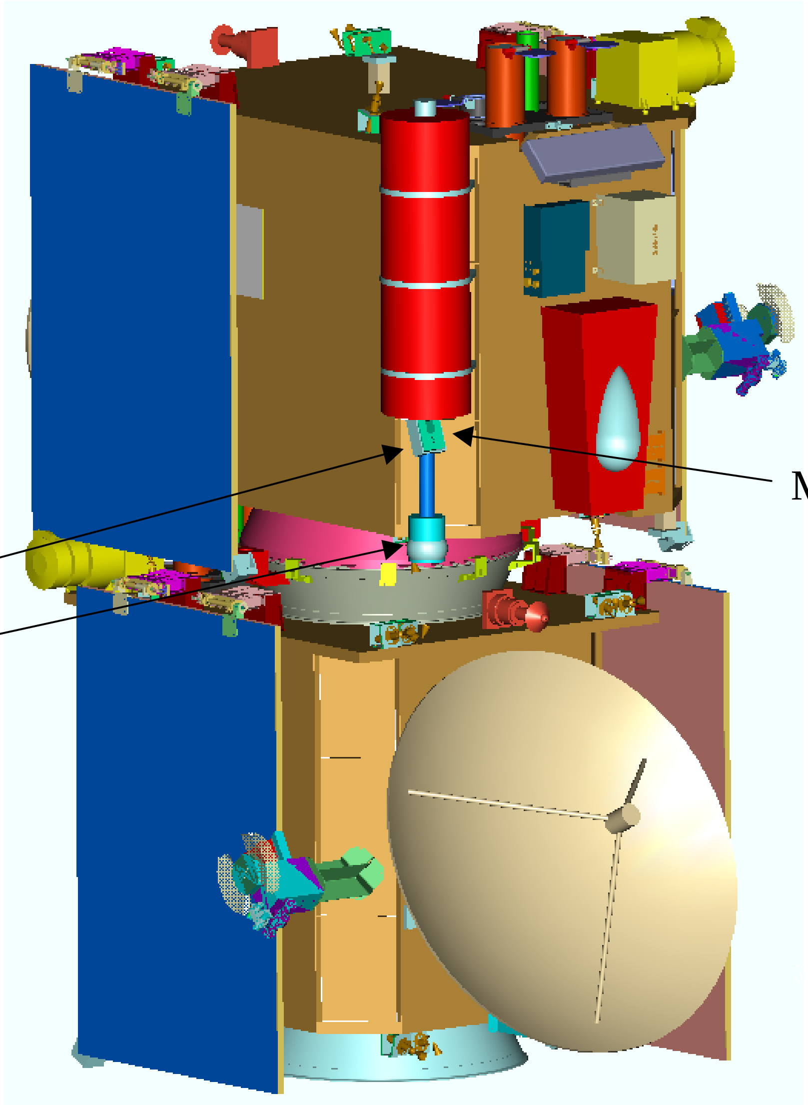
- **SWEA/STE Interface is mounted in the base of SWEA**
  - **UCB provides electronics mounted to the end-plate of the SWEA electronics enclosure**
- **Volume: 12cm diameter cylinder 3 cm long**
  - **LVPS takes 2cm, remainder fits on one PWB 12cm in diameter, 1 cm high**
  - **LVPS space allocation is probably too small**
    - **Baseline LVPS is 10x10x2 cm, plus we need to add Bias supply**
    - **Space is constrained be SWEA and STE FOV, and by undeployed boom length**
    - **Volume exists within these constraints, but will make a non-symmetric shape (TBR)**

Telescoping Boom
Mechanical

6 March 2001

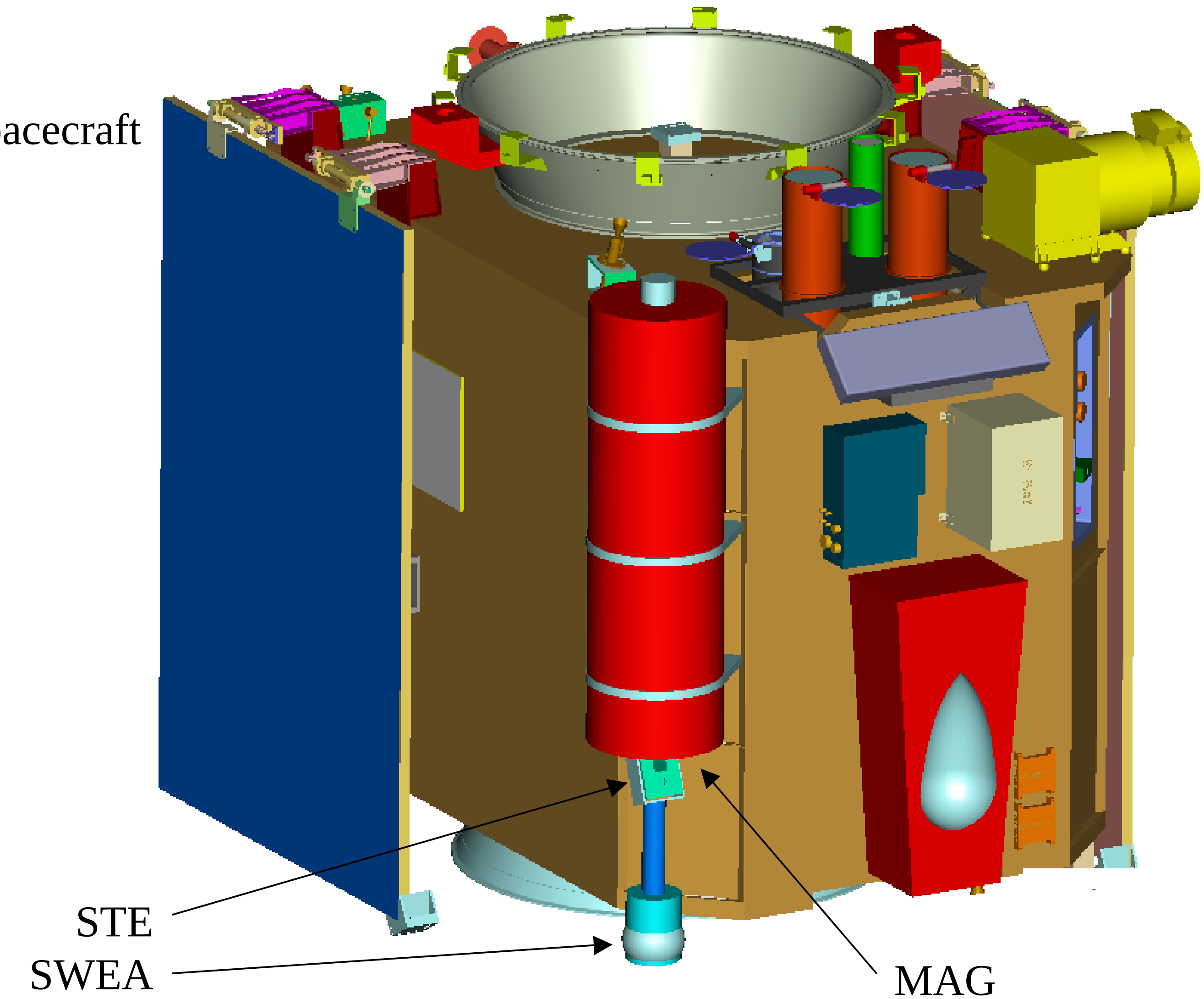
Robert Ullrich

Side view of stacked spacecraft with Impact Boom, stowed configuration.



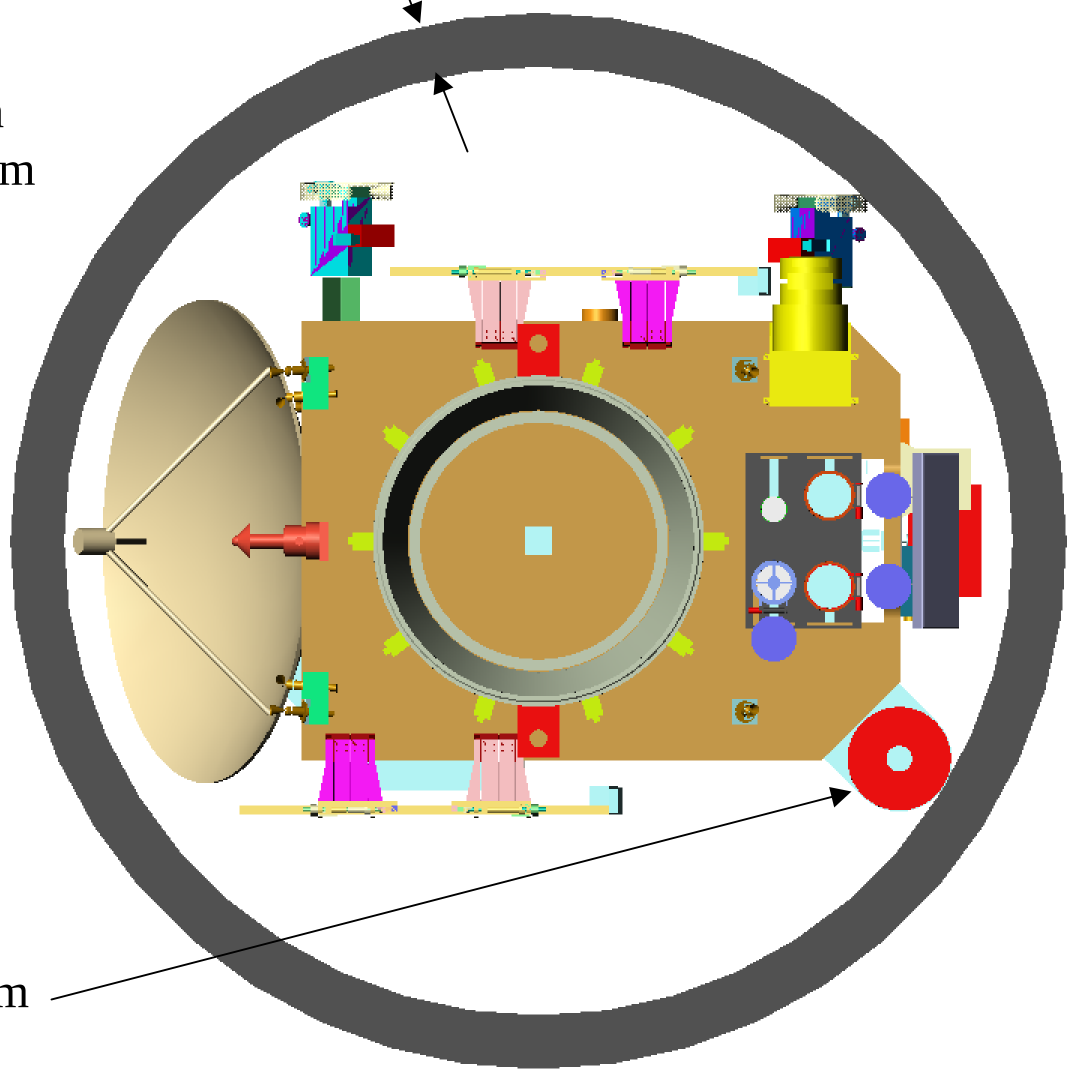
Artwork courtesy of APL/JHU, S. Layman

Side view of lower spacecraft with Impact Boom, stowed configuration.



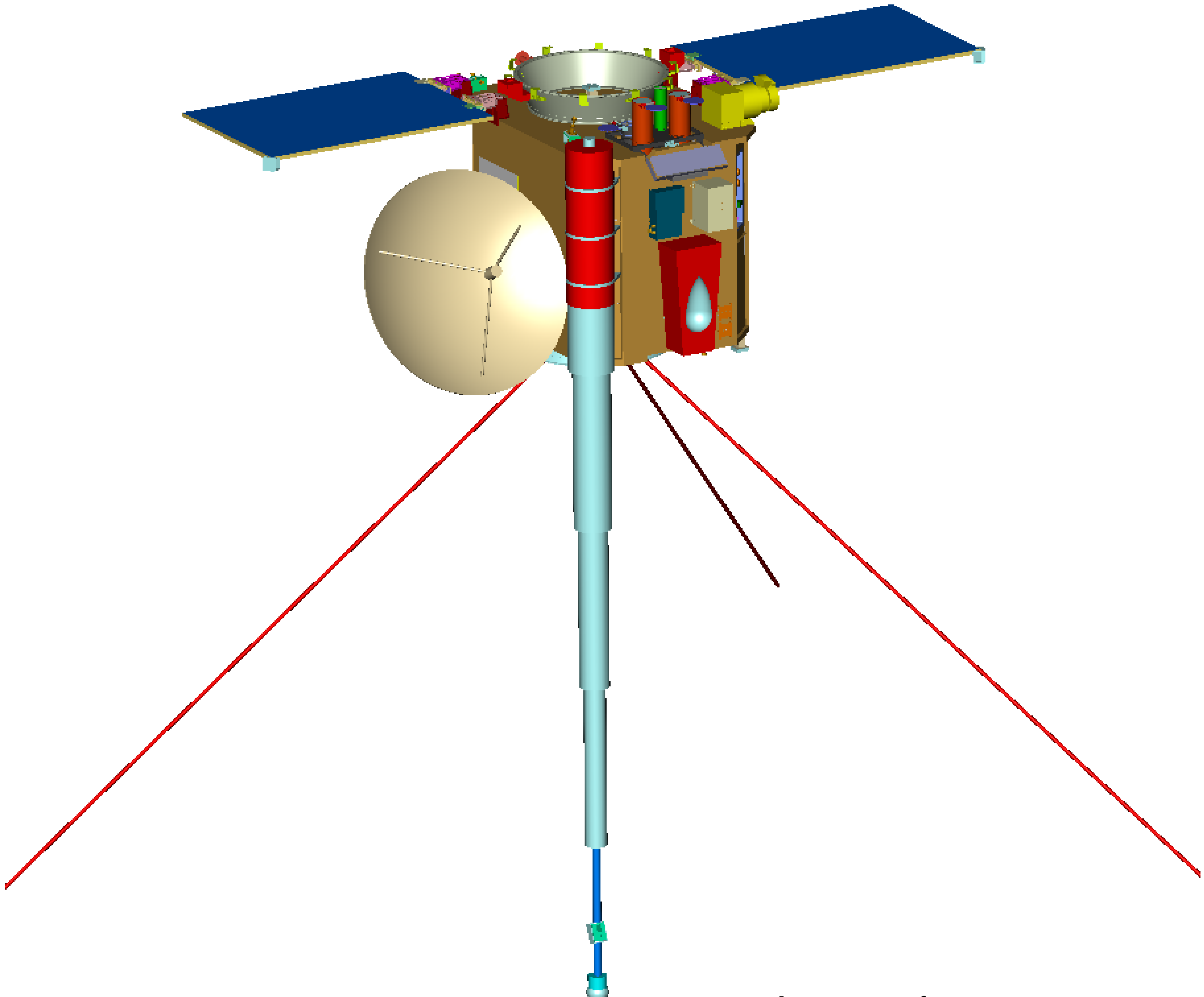
Artwork courtesy of APL/JHU, S. Layman

Bottom view of spacecraft in fairing, showing Impact Boom configuration and location

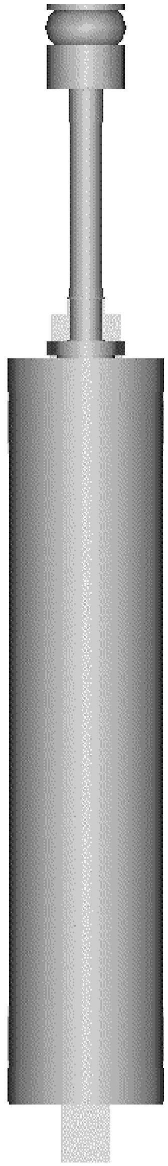


Artwork courtesy of APL/JHU, S. Layman

View of spacecraft with Impact Boom deployed.



Artwork courtesy of APL/JHU, S. Layman



Subsystem Breakout

Carbon Fiber (graphite) / Epoxy Tube Assembly

Deployment Stacer Assembly

Release Mechanism

Instrument Mounts

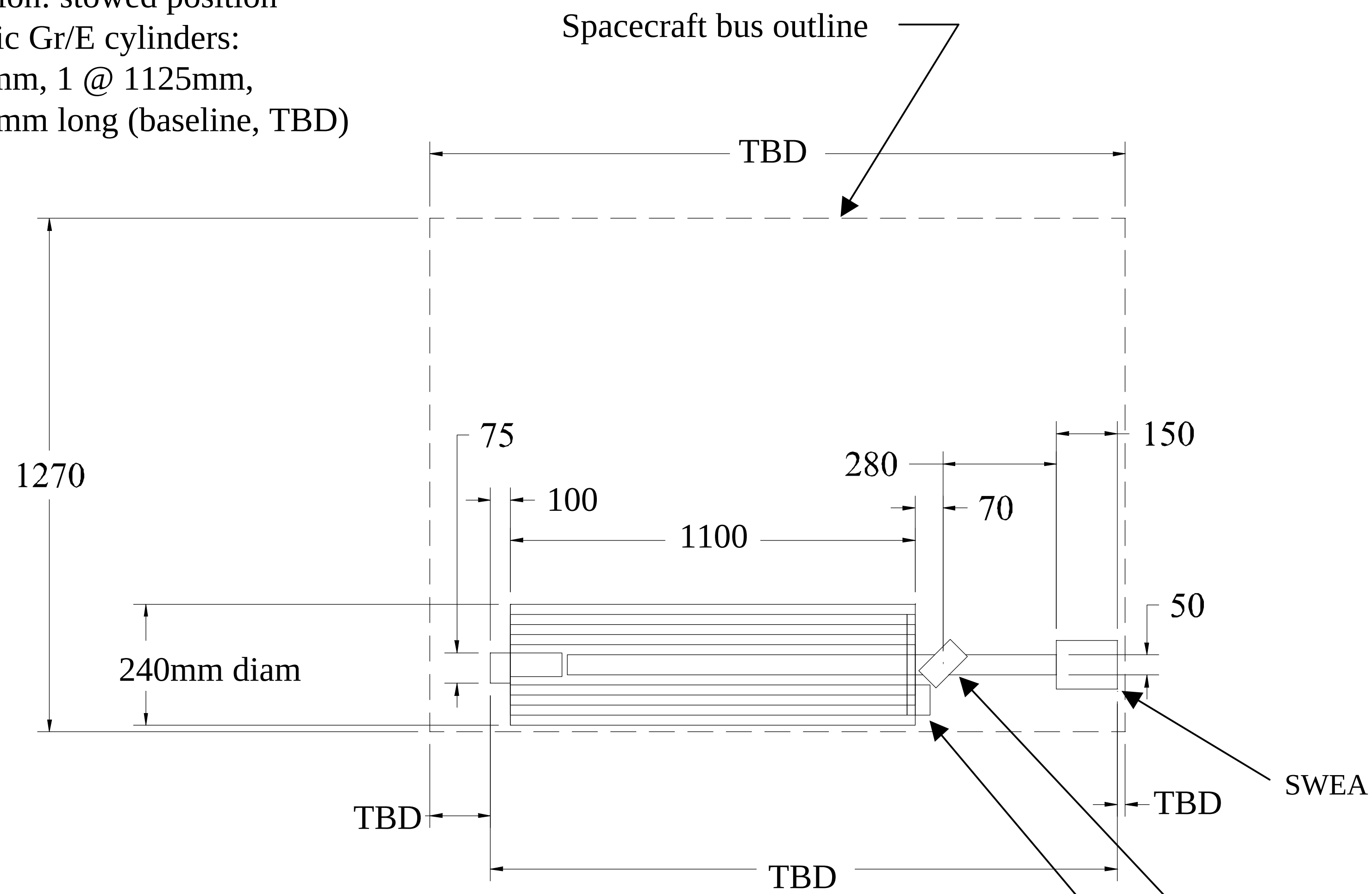
Harness / Spool / Bobbin

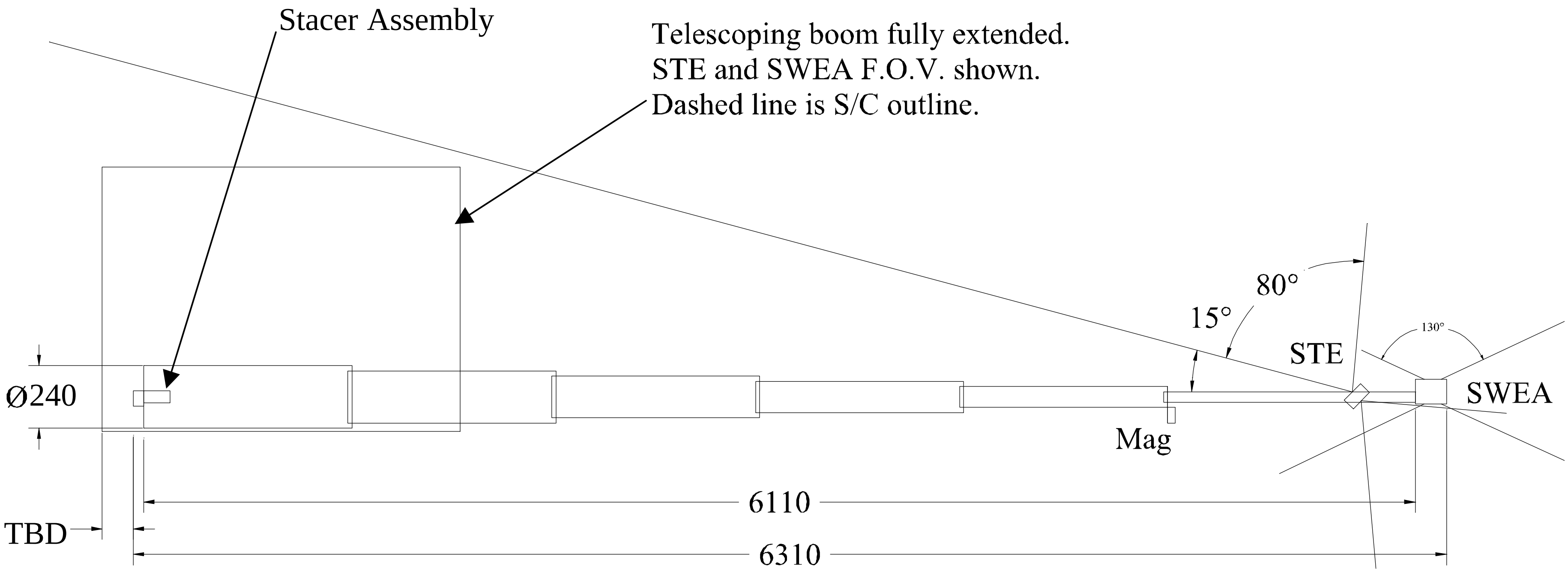
Interface to S/C

Miscellaneous

Stereo / Impact
Gr/E Tube

Boom section: stowed position
6 concentric Gr/E cylinders:
4 @ 1100mm, 1 @ 1125mm,
1 @ 1500 mm long (baseline, TBD)




Stacer Assembly
Telescoping boom fully extended.
STE and SWEA F.O.V. shown.
Dashed line is S/C outline.
80°
15°
130°
STE
SWEA
Ø240
Mag
6110
TBD
6310

Gr/E Tube Construction:

5 layers of 0.12 mm (5 mil) pre-preg cloth
Inner, middle & outer: 0-90 degree lay up
Sandwiched layers: 45 degree orientation
Overall thickness of tube: ~ .75 mm.

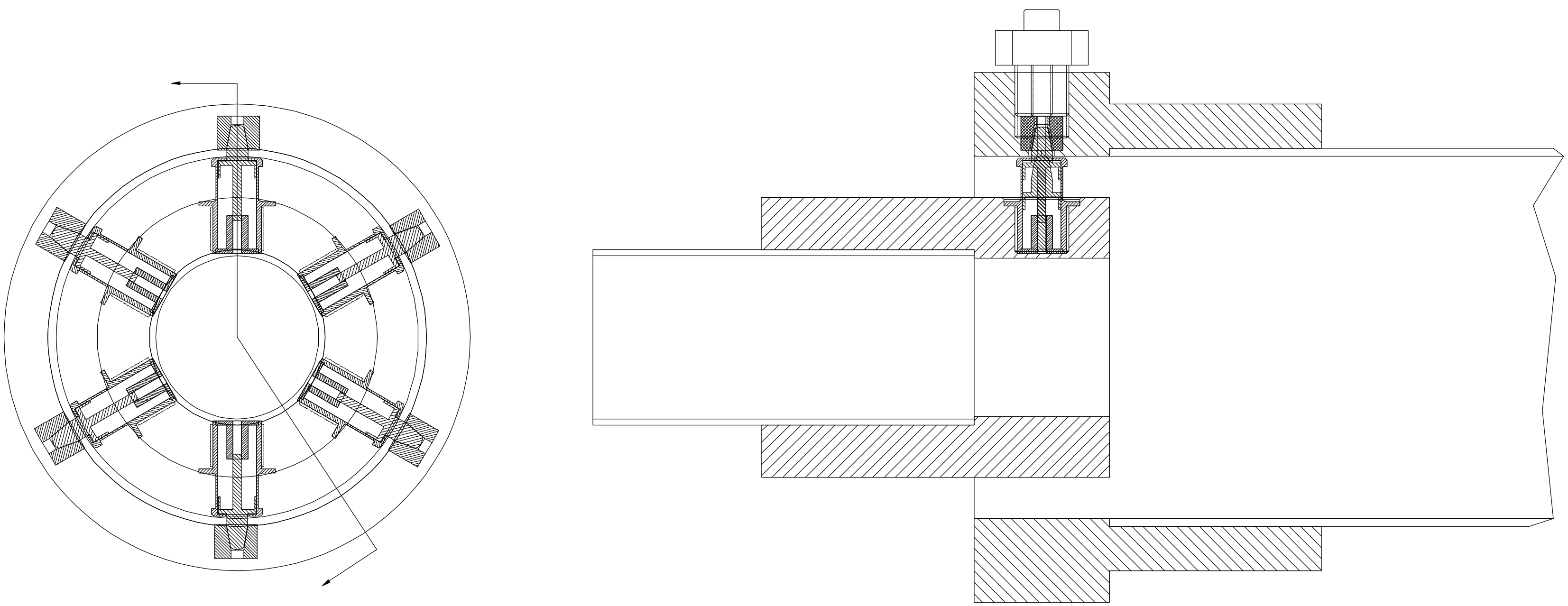
Fabrication Process:

Aluminum internal mandrel
Precut shapes, laid on to form
Vacuum bag with perforated release, bleeder cloth
Bake @ 177 deg. C until done :>)
Bead blast outer surface to ensure conductivity
Clean with alcohol

Assembly Process:

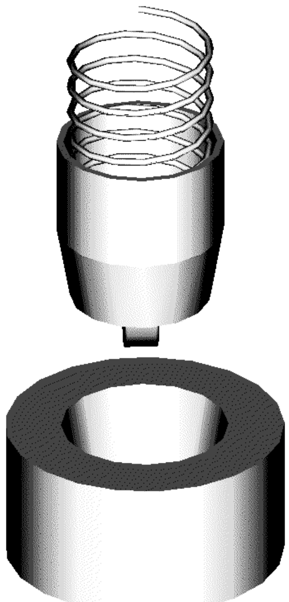
Pin & socket rings, instrument mounts, guide rails Hysol 9309 NA 2 part epoxy bonded to tubes
Positioning jigs
Room temp cure
Where required: conductive silver epoxy or aluminum tape

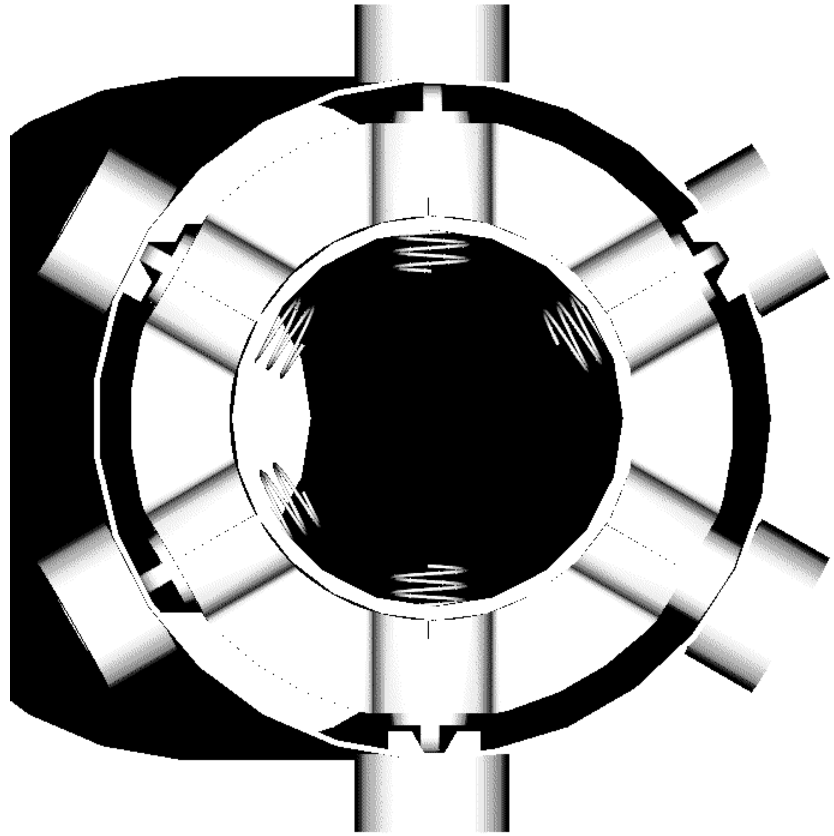
Locking Pin Technology Demonstrator: Section View



Stereo / Impact
Gr/E Tube

Locking pin and socket assembly:





Current design includes roller in tip of pin, to minimize particles and friction during deployment. Roller is guided by rails to preserve alignment with socket.

The deployment force is provided by a helically wound, flat strip spring called a Stacer. The Stacer design is based on the Polar Axial boom.

Deployed length is ~4m, material is Elgiloy (a stainless steel that Mario has said is OK)

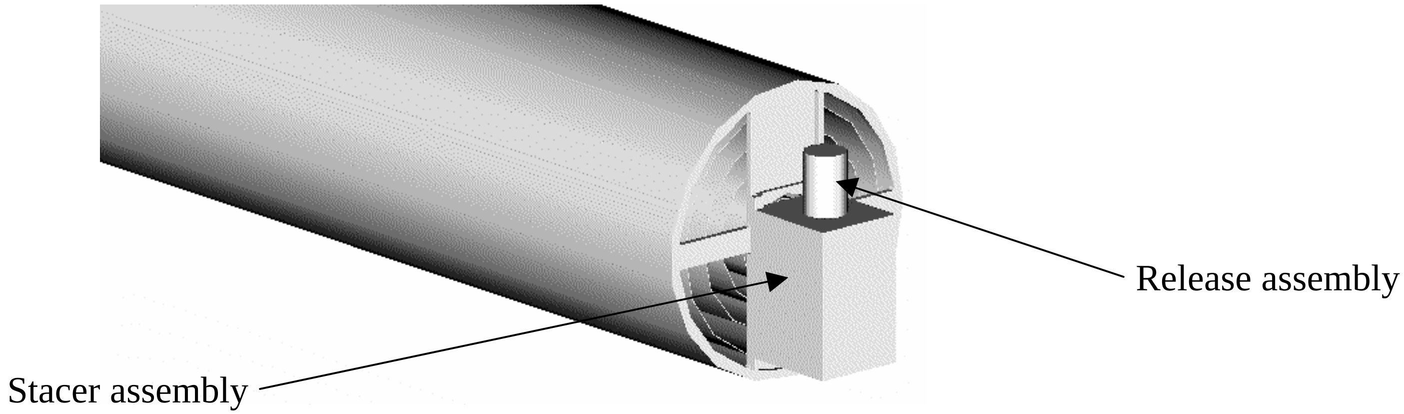
The assembly fits inside the inner tube, and is connected to it via a 'pushrod'.

The assembly mounts to the bottom end of the boom, and includes the cable storage and release mechanism.

To ensure initial motion, a deploy assist device consisting of springs pushing directly onto each tube end is used.

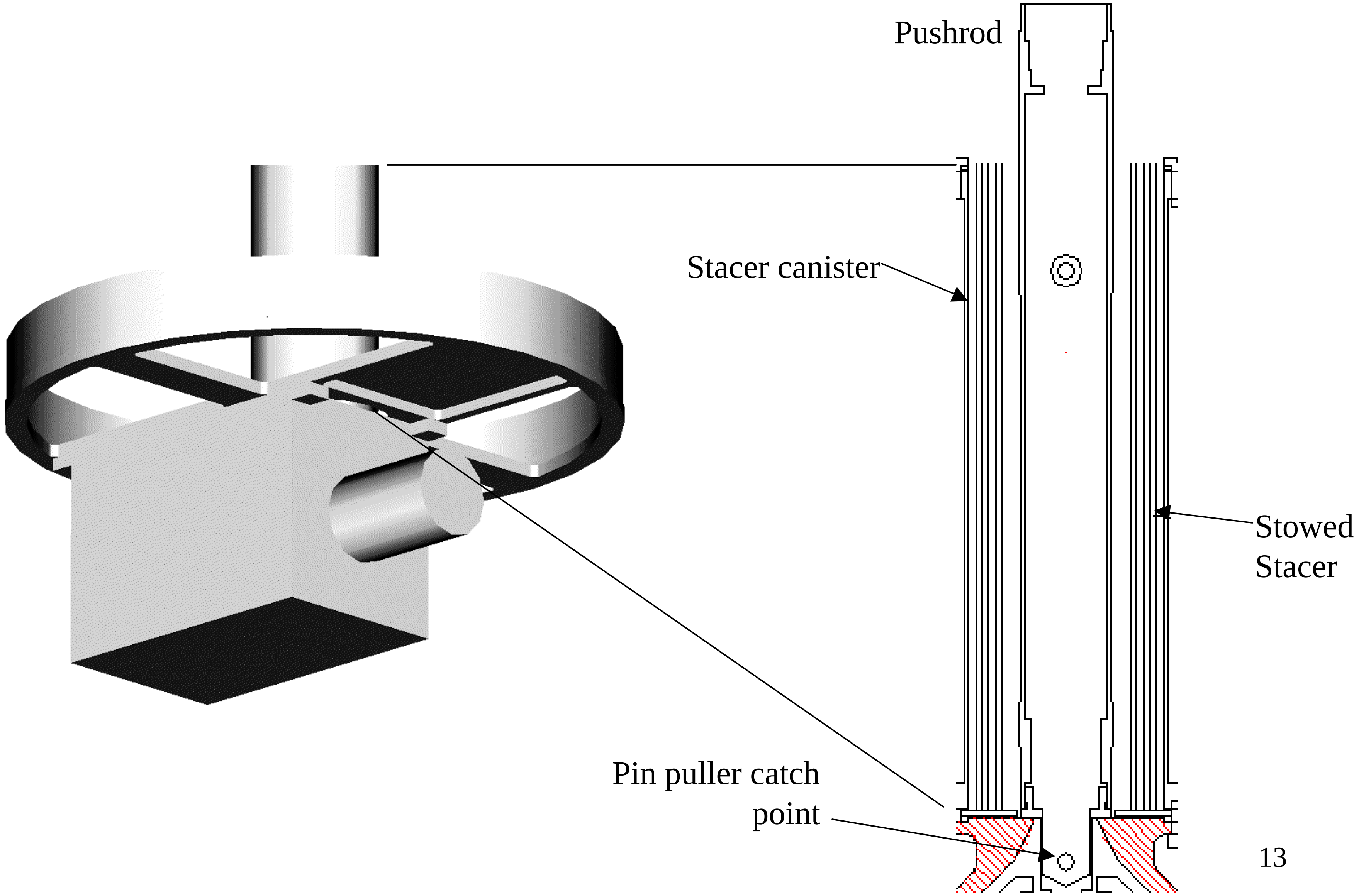
For launch, the tubes are retracted and held in place by guides on the magnetometer bracket, and on the Stacer mounting bracket. The assembly is released by the retraction of a pin, allowing the springs to expand.

The Stacer pushes the tubes out, and the harness is fed up through the center of the Stacer / tube(s). At the end of stroke, the pins seat in their sockets, and lock the boom out.



Stereo / Impact

Stacer Ass'y



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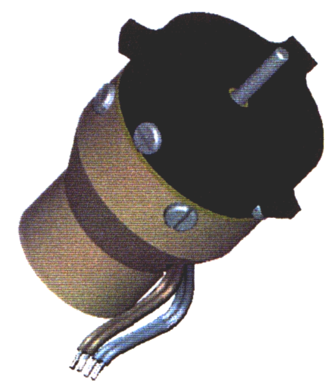
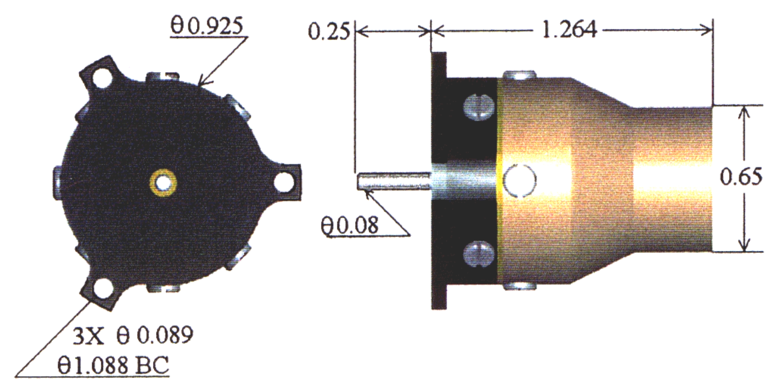
The Model P5-405-6RS is the latest addition to the P5 Pinpuller product line. It was specially designed for the Jet Propulsion Laboratory to be used aboard the Mars 2001 spacecraft. This embodiment incorporates redundant SMA (Shape Memory Alloy) triggers with integrated shut off switches, a convenient 3 ear mounting flange, and optional enclosure (as shown). As with all TiNi Pinpullers the P5-405-6RS uses the same ball-lock trigger mechanism developed under TiNi patent # 5,771,742 issued in June of 1998. Reset is achieved by manual re-extension of the pin via two access holes at the base of the pinpuller.

* Custom configurations as to pull force, retraction stroke, and mounting interface are readily attainable.





Stereo / Impact
Release Mechanism

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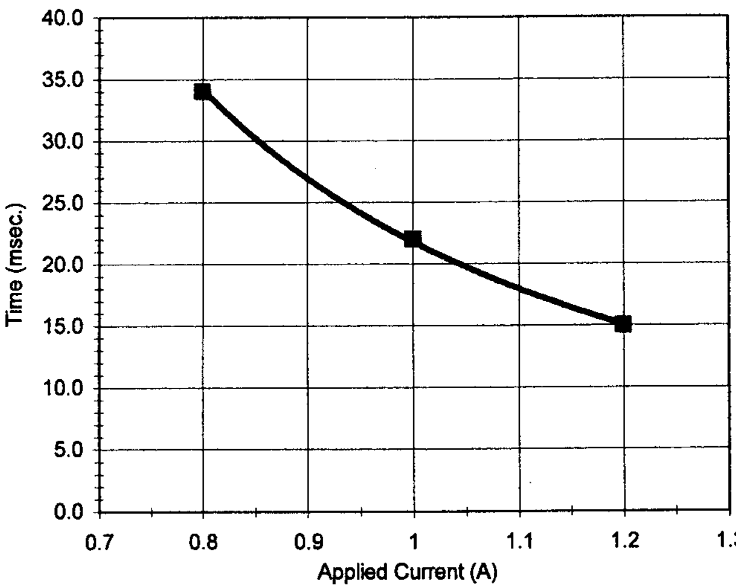
Function Time
(@ 20 °C)



Specifications

Pull Force	22.3 N	(5 lb-f)
Pull Stroke (minimum)	6.35 mm	(0.25 in)
Power Consumption	6 Watts @ 1 Amp	
Operational Current	0.5 to 1.5 Amp	
Actuator Resistance	6.0 ohms	
Life	> 100 cycles	
Minimum Operating Temp.	<-50 °C	(<-58 °F)
Maximum Operating Temp.	+70 °C	(+158 °F)
Mass	30 gm	(1.0 oz)

Features:

- Reusable
- Redundant SMA Trigger
- Integrated Shut-Off Switches

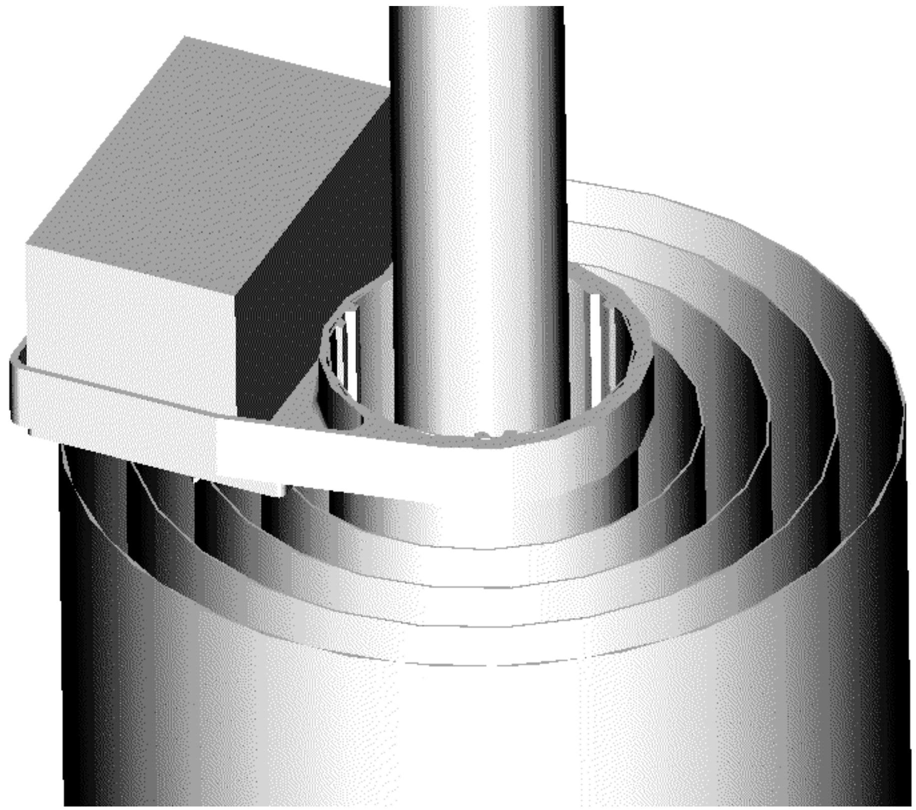
Magnetometer Mount

Fabricated from PEEK, Gr/E

Epoxy bonded to 88mm tube

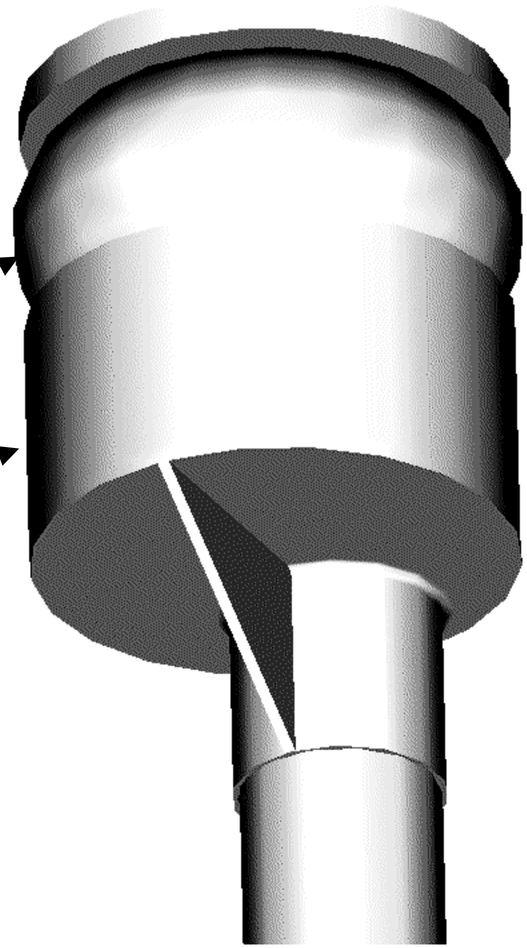
Incorporates tube centering feature (for launch)

No added sunshade (delta from Phase A)



SWEA Mount

Fab’ed from PEEK, epoxy bonded
Thermally isolated from Gr/E tube

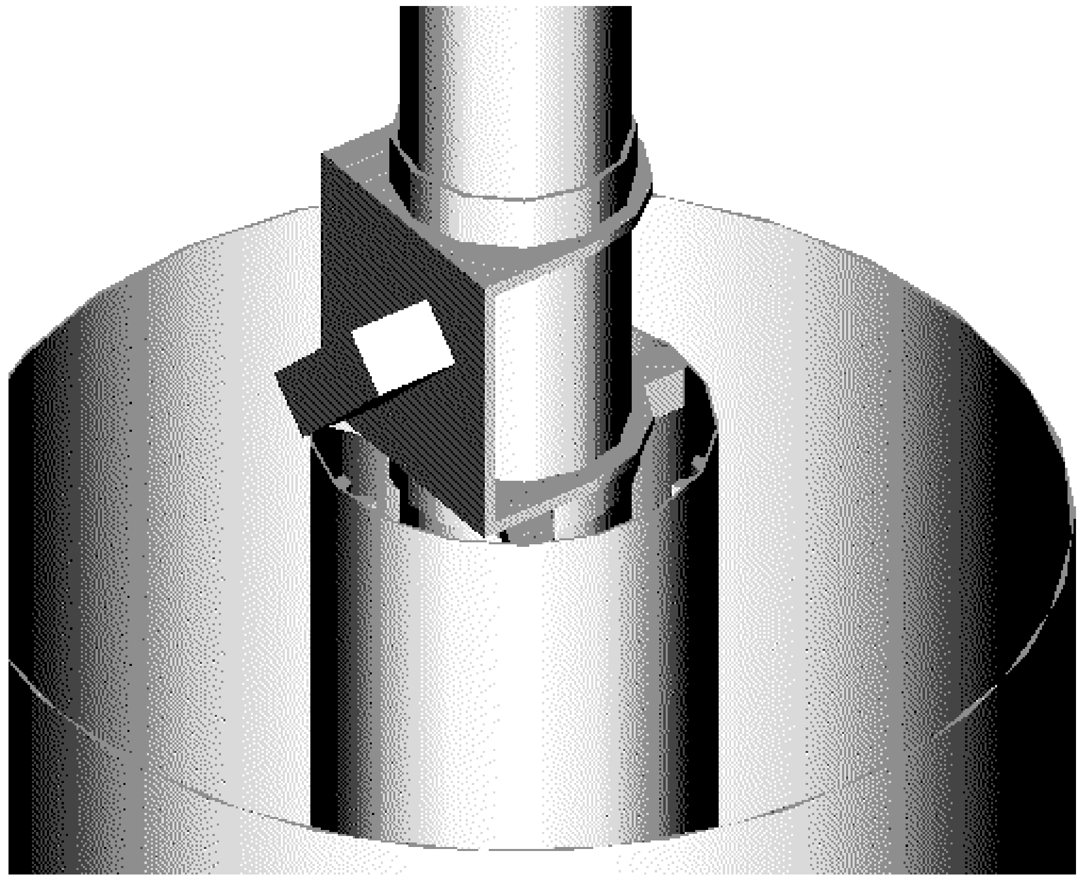


STE Mount

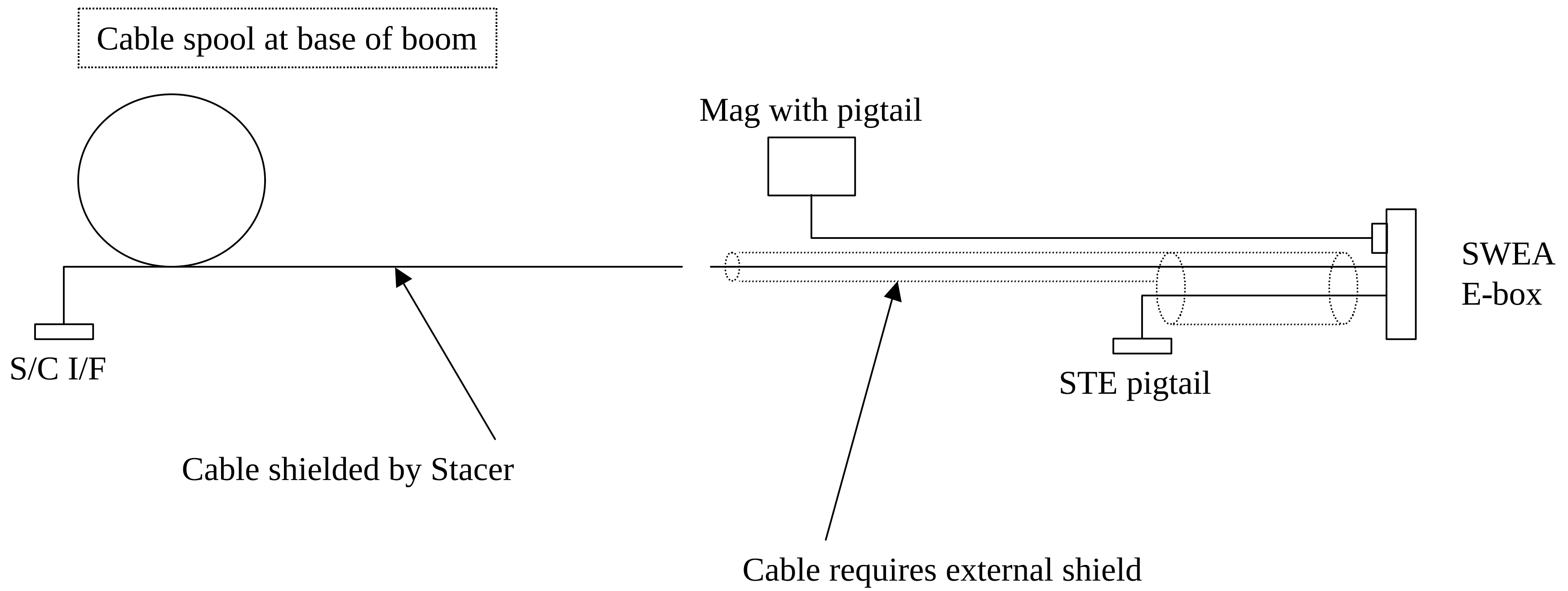
Fabbed from PEEK, epoxy bonded

Orientations for lead and lag S/C supported

Incorporates harness breakout for mag, shielded harness for SWEA (& STE)

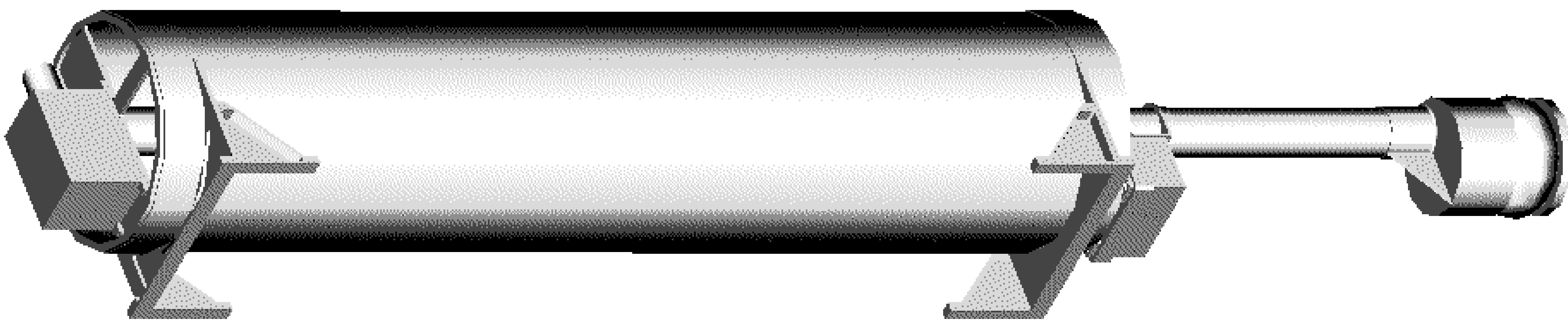


Stereo / Impact
Harness etc.



Proposed Mounting Configuration

Mounting rings can be positioned any location up to 1/3 of tube
4 bolt attachment to S/C
Harness I/F TBD



Thermal:

12 layer MLI to cover bottom cylinder of SWEA to lower side of STE mount, magnetometer
Tubes to be uncoated (light bead blast for ESD)
SWEA insulated from tube

Testing:

Thermal vacuum for tube assembly: deploy hot, cold; Qual then Acceptance levels
T/V for SWEA, STE mounted on smallest tube in separate cycles from tube ass'y. T/V
Vibe: Qual, Accept levels