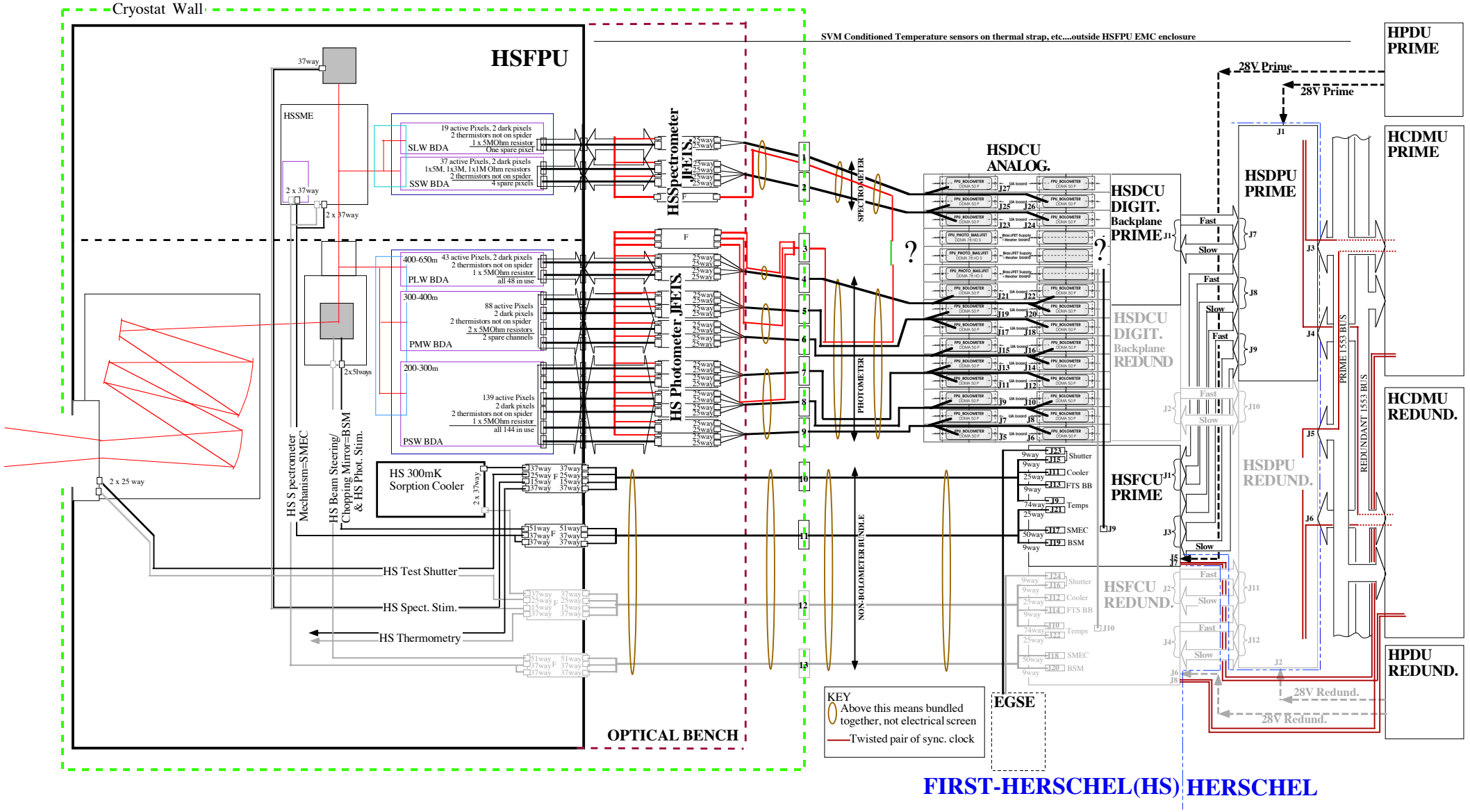
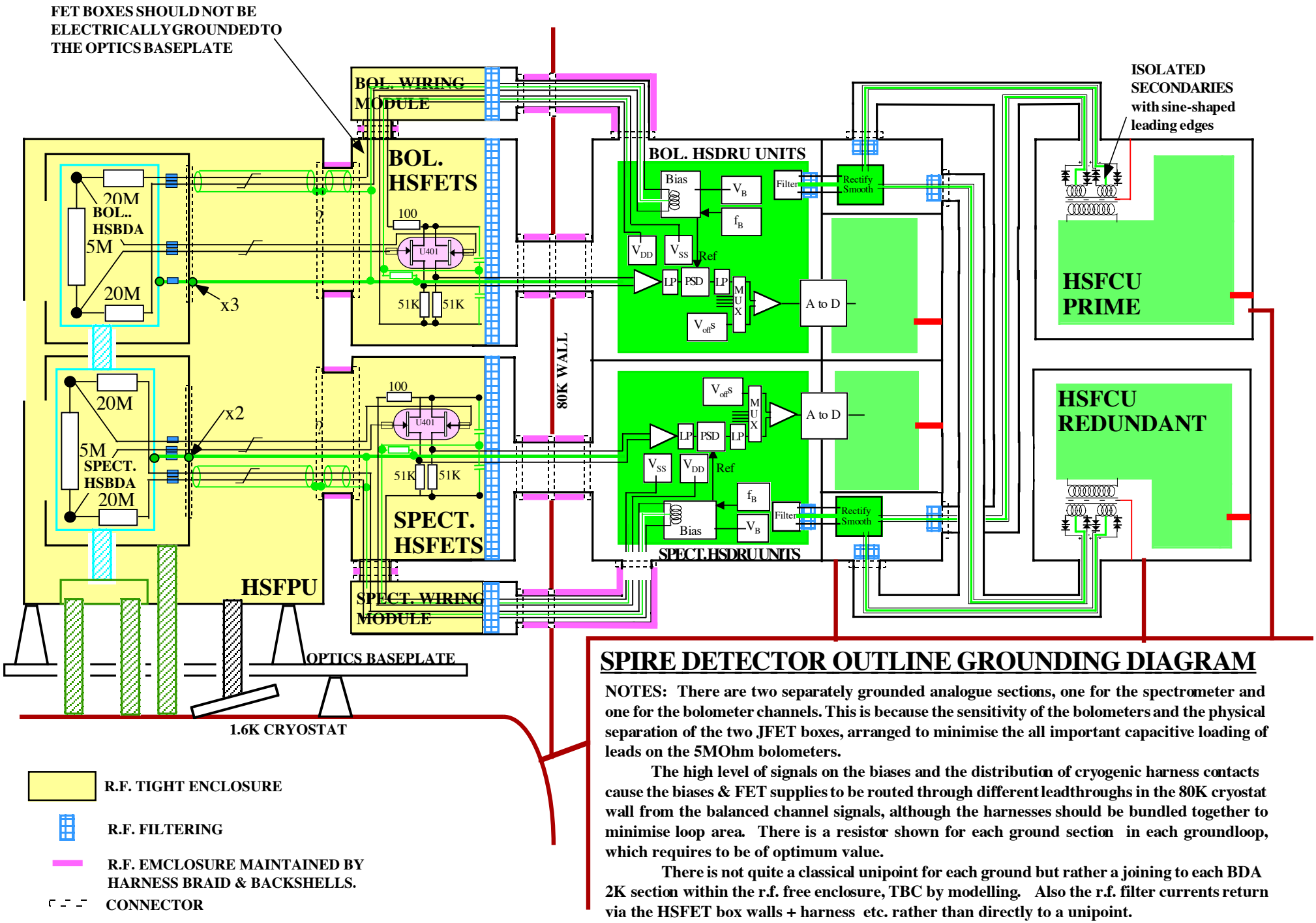
1. Instrument block diagram
2. Bolometer System Grounding diagram.
3. Non-bolometer Cryoharness listing
4. Some JFET box grounding I/F details


Cryostat Wall
HSFPU
SVM Conditioned Temperature sensors on thermal strap, etc....outside HSFPU EMC enclosure
37way
HSSME
2 x 37way
2 x 37way
19 active Pixels, 2 dark pixels
2 thermistors not on spider
1 x 5MOhm resistor
One spare pixel
SLW BDA
37 active Pixels, 2 dark pixels
1x5M, 1x3M, 1x1M Ohm resistors
2 thermistors not on spider
4 spare pixels
SSW BDA
HSSpectrometer JFETS.
400-650m
43 active Pixels, 2 dark pixels
2 thermistors not on spider
1 x 5MOhm resistor
all 48 in use
PLW BDA
300-400m
88 active Pixels
2 dark pixels
2 thermistors not on spider
2 x 5MOhm resistors
2 spare channels
PMW BDA
200-300m
139 active Pixels
2 dark pixels
2 thermistors not on spider
1 x 5MOhm resistor
all 144 in use
PSW BDA
HS Photometer JFETS.
2x51ways
2 x 25 way
HS S pectrometer Mechanism=SMEC
HS Beam Steering/ Chopping Mirror=BSM & HS Phot. Stim.
HS 300mK Sorption Cooler
2 x 37way
HS Test Shutter
HS Spect. Stim.
HS Thermometry
OPTICAL BENCH
SPECTROMETER
PHOTOMETER
NON-BOLOMETER BUNDLE
HSDCU ANALOG.
HSDCU DIGIT. Backplane PRIME
HSDCU DIGIT. Backplane REDUND
HSFCU PRIME
HSFCU REDUND.
Shutter
Cooler
FTS BB
Temps
SMEC
BSM
28V Prime
28V Prime
HPDU PRIME
HCDMU PRIME
HSDPU PRIME
HSDPU REDUND.
HCDMU REDUND.
HPDU REDUND.
PRIME 1553 BUS
REDUNDANT 1553 BUS
28V Redund.
28V Redund.
KEY
Above this means bundled together, not electrical screen
Twisted pair of sync. clock
EGSE
FIRST-HERSCHEL(HS)
HERSCHEL

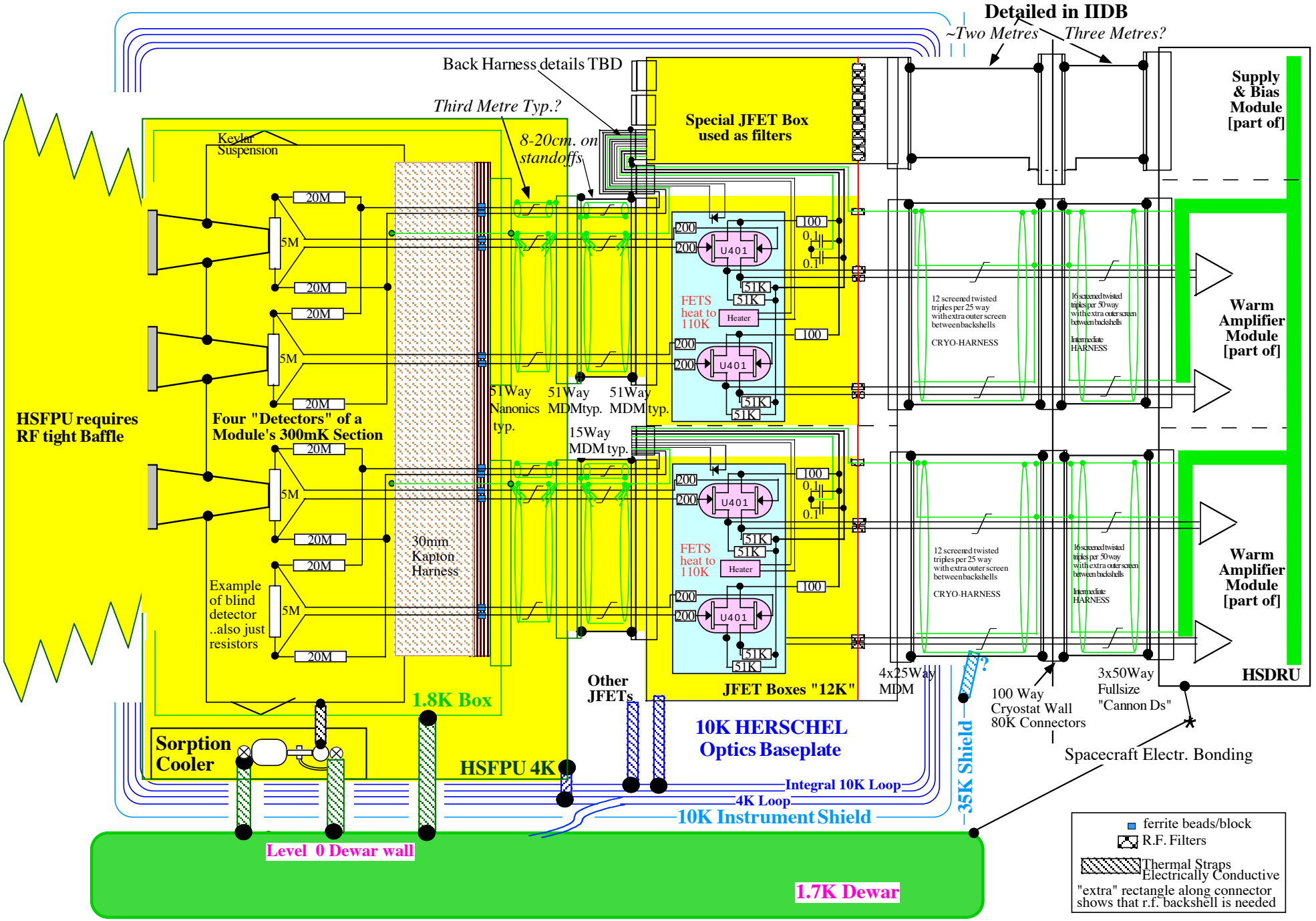


SPIRE DETECTOR OUTLINE GROUNDING DIAGRAM

NOTES: There are two separately grounded analogue sections, one for the spectrometer and one for the bolometer channels. This is because the sensitivity of the bolometers and the physical separation of the two JFET boxes, arranged to minimise the all important capacitive loading of leads on the 5MOhm bolometers.

The high level of signals on the biases and the distribution of cryogenic harness contacts cause the biases & FET supplies to be routed through different leadthroughs in the 80K cryostat wall from the balanced channel signals, although the harnesses should be bundled together to minimise loop area. There is a resistor shown for each ground section in each groundloop, which requires to be of optimum value.

There is not quite a classical unipoint for each ground but rather a joining to each BDA 2K section within the r.f. free enclosure, TBC by modelling. Also the r.f. filter currents return via the HSFET box walls + harness etc. rather than directly to a unipoint.


Detailed in IIDB
~Two Metres
Three Metres?
Back Harness details TBD
Third Metre Typ.?
8-20cm. on standoffs
Special JFET Box used as filters
Supply & Bias Module [part of]
Warm Amplifier Module [part of]
Warm Amplifier Module [part of]
HSDRU
Keylar Suspension
HSFPU requires RF tight Baffle
Four "Detectors" of a Module's 300mK Section
20M
5M
51Way Nanonics typ.
51Way MDMtyp.
51Way MDM typ.
15Way MDM typ.
U401
FETS heat to 110K
Heater
51K
100
0.1
200
12 screened twisted triples per 25 way with extra outer screen between backshells
CRYO-HARNESS
16 screened twisted triples per 50 way with extra outer screen between backshells
Intermediate HARNESS
30mm Kapton Harness
Example of blind detector ..also just resistors
1.8K Box
Other JFETs
JFET Boxes "12K"
4x25Way MDM
100 Way Cryostat Wall 80K Connectors
3x50Way Fullsize "Cannon Ds"
Spacecraft Electr. Bonding
Sorption Cooler
HSFPU 4K
10K HERSCHEL Optics Baseplate
Integral 10K Loop
4K Loop
10K Instrument Shield
35K Shield
Level 0 Dewar wall
1.7K Dewar
ferrite beads/block
R.F. Filters
Thermal Straps Electrically Conductive
"extra" rectangle along connector shows that r.f. backshell is needed

	No. of Cond. Pins	No. of shield pins	Max.allowed Conductor Res.(Ohms)	Mean Current (A)/condt.	Peak Current (A)/condt.	Remarks	Cernox Type or Connect.ID
AUXILIARY PRIME 10	*Total Pins in use=*			*98*	*[69therm]*		
Spect JFET chassis therm.	4	0.25	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1070
Phot JFET chassis therm.	4	0.25	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1070
FSFPU chassis therm.	4	0.25	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1070
Photometer 2K box	4	0.25	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1050
Spectrometer 2K box	4	0.33	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1050
M3,5,7 Optical Subench	4	0.33	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1050
Input Baffle Therm	4	0.34	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1050
30	28	2	37 way connector			All therm	*DCU J9*
FTS BB Flood Heater	2	0	30	3.00E-03	3.00E-03	Twisted Pair	
FTS BB Flood Heater(rob.)	2	0	30	3.00E-03	3.00E-03	Twisted Pair	
FTS BB Flood Therm.	4	0.5	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1070
FTS BB case nr. SOB I/F therm	4	0.5	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1070
FTS BB Point Stimulus	2	0	30			Twisted Pair	
15	14	1	37 way connector to two 15 ways			9therm+6	DCU J13+9
Pump heater	2	0	10	3.00E-02	3.00E-02	Twisted Pair	
Pump heater(rob.)	2	0	10	3.00E-02	3.00E-02	Twisted Pair	
Pump therm.	4	0.2	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1050
Evap. diag. heater	2	0	10	0.00E+00	0.00E+00	Twisted Pair	
Evap. therm.	4	0.2	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1030
Shunt therm.	4	0.2	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1030
Pump heat SW heater	2	0	10	1.60E-03	1.60E-03	Twisted Pair	
Evap. heat SW heater	2	0	10	1.60E-03	1.60E-03	Twisted Pair	
Pump heat SW heater(rob.)	2	0	10	1.60E-03	1.60E-03	Twisted Pair	
Evap. heat SW heater(rob.)	2	0	10	1.60E-03	1.60E-03	Twisted Pair	
Pump heat SW therm.	4	0.2	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1050
Evap. heat SW therm.	4	0.2	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1050
35	34	1	37 way connector			21therm+14	DCU J11+9
Shutter Actuator	2	0	10			Twisted Pair	
Shutter Heater	2	0	10			Twisted Pair	
Shutter Actuator Therm	4	0.5	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1070
Shutter Vane Position	4	1	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	
Shutter Actuator Therm	4	0.5	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1070
18	16	2	25 way connector			9therm+9	DCU J15+9
DRIVES PRIME 11	*Total Pins in use=*			*100*	*[19therm]*		
SMEC drive coil	2	1	10	8.00E-03	8.00E-03	Scr. Tw. Pair	
SMEC drive coil(rob.)	2	1	10	8.00E-03	8.00E-03	Scr. Tw. Pair	
SMEC drive coil volts	2	1	1000	2.50E-09	2.50E-09	Scr. Tw. Pair	
SMEC posn sensors	19	1	1000	1.00E-04	1.00E-04	TBD	
SMEC home/limit switches	18	1	1000	1.00E-03	1.00E-03	TBD	
SMEC Mechanism Temp	4	1	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1050
SMEC Launch Latch	2	0	10			Scr. Tw. Pair	
BSM Launch Latch sensor	2	0	1000			Twisted Pair	
SMEC/SOB I/F therm	4	1	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1070
62	55	7	two 37 way connectors			10thm+20+19+13	DCU J17+21
BSM chop drive coil	2	0.5	10	0.010	0.050	Scr. Tw. Pair	
BSM jiggle drive coil	2	0.5	10	0.010	0.050	Scr. Tw. Pair	
BSM chop drive coil(rob.)	2	0.5	10	0.010	0.050	Scr. Tw. Pair	
BSM jiggle drive coil(rob.)	2	0.5	10	0.010	0.050	Scr. Tw. Pair	
BSM chop posn. Sense	5	1	100	1.00E-04	1.00E-04	TBD	
BSM jiggle posn. Sense	5	1	100	1.00E-04	1.00E-04	TBD	
BSM therm	4	0.5	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1050
BSM Launch Latch	2	0	10			Twisted Pair	
BSM Launch Latch sensor	2	0	1000			Twisted Pair	
Phot. BB Point Stimulus	2	1	30			Twisted Pair	
BSM/SOB I/F therm	4	0.5	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1070
38	32	6	51 way connector			9therm+28	DCU J19+21

	No. of Cond. Pins	No. of shield pins	Max.allowed Conductor Res.(Ohms)	Mean Current (A)/condt.	Peak Current (A)/condt.	Remarks	Cernox Type or Connect.ID
AUXILIARY REDUNDANT 12	*Total Pins in use=*			*98*	*[69therm]*		
Spect JFET chassis therm.	4	0.25	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1070
Phot JFET chassis therm.	4	0.25	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1070
FSFPU chassis therm.	4	0.25	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1070
Photometer 2K box	4	0.25	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1050
Spectrometer 2K box	4	0.33	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1050
M3,5,7 Optical Sub-bench	4	0.33	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1050
Input Baffle Therm	4	0.34	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1050
30	28	2	37 way connector			All therm	DCU J10
FTS BB Flood Heater	2	0	30	3.00E-03	3.00E-03	Twisted Pair	
FTS BB Flood Heater (rob.)	2	0	30	3.00E-03	3.00E-03	Twisted Pair	
FTS BB Flood Therm.	4	0.5	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1070
FTS BB case nr. SOB I/F therm	4	0.5	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1070
FTS BB Point Stimulus	2	0	30			Twisted Pair	Unused?
15	14	1	See L.H.S.			9therm+6	DCU J14+10
Pump heater	2	0	10	3.00E-02	3.00E-02	Twisted Pair	
Pump heater (rob.)	2	0	10	3.00E-02	3.00E-02	Twisted Pair	
Pump therm.	4	0.2	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1050
Evap. diag. heater	2	0	10	0.00E+00	0.00E+00	Twisted Pair	
Evap. therm.	4	0.2	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1030
Shunt therm.	4	0.2	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1030
Pump heat SW heater	2	0	10	1.60E-03	1.60E-03	Twisted Pair	
Evap. heat SW heater	2	0	10	1.60E-03	1.60E-03	Twisted Pair	
Pump heat SW heater(rob.)	2	0	10	1.60E-03	1.60E-03	Twisted Pair	
Evap. heat SW heater(rob.)	2	0	10	1.60E-03	1.60E-03	Twisted Pair	
Pump heat SW therm.	4	0.2	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1050
Evap. heat SW therm.	4	0.2	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1050
35	34	1	37way connector			21therm+14	DCU J12+10
Shutter Actuator	2	0	10			Twisted Pair	
Shutter Heater	2	0	10			Twisted Pair	
Shutter Actuator Therm	4	0.5	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1070
[Shutter Vane Position]	4	1	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1070
Shutter Actuator Therm	4	0.5	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1070
18	16	2	25 way connector			9therm+9	DCU J16+10
DRIVES REDUNDANT 13	*Total Pins in use=*			*100*	*[19therm]*		
SMEC drive coil	2	1	10	0.00E+00	8.00E-03	Scr. Tw. Pair	
SMEC drive coil(rob.)	2	1	10	0.00E+00	8.00E-03	Scr. Tw. Pair	
SMEC drive coil volts	2	1	1000	2.50E-09	2.50E-09	Scr. Tw. Pair	
SMEC posn sensors	19	1	1000	1.00E-04	1.00E-04	TBD	
SMEC home/limit switches	18	1	1000	1.00E-03	1.00E-03	TBD	
SMEC Mechanism Temp	4	1	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1050
SMEC Launch Latch	2	0	10			Scr. Tw. Pair	
BSM Launch Latch sensor	2	0	1000			Twisted Pair	
SMEC/SOB I/F therm	4	1	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1070
62	55	7	two 37 way connectors			10thm+20+19+11	DCU J18+22
BSM chop drive coil	2	0.5	10	0.010	0.050	Scr. Tw. Pair	
BSM jiggle drive coil	2	0.5	10	0.010	0.050	Scr. Tw. Pair	
BSM chop drive coil(rob.)	2	0.5	10	0.010	0.050	Scr. Tw. Pair	
BSM jiggle drive coil(rob.)	2	0.5	10	0.010	0.050	Scr. Tw. Pair	
BSM chop posn. sense coil	5	1	100	1.00E-04	1.00E-04	TBD	
BSM jiggle posn. sense coil	5	1	100	1.00E-04	1.00E-04	TBD	
BSM therm	4	0.5	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1050
BSM Launch Latch	2	0	10			Twisted Pair	
BSM Launch Latch sensor	2	0	1000			Twisted Pair	
Phot. BB Point Stimulus	2	1	30			Twisted Pair	Unused?
BSM/SOB I/F therm	4	0.5	1000	2.50E-09	2.50E-09	Scr. Tw. Quad	CX-1070
38	32	6	51 way connector			9therm+28	DCU J20+22

Notes:

1. All screens insulated and no currents to be returned via above listed screens. The 100 CVV connectors are in the middle of this run. For end tails at FCU and FPU see Block diagram.
2. Outside of each of these cables to be separately r.f. screened in addition to wires shown in the tables and these screens joined to connector backshells
3. Mean current per conductor when that side (prime or redundant) is active...shall be zero in unpowered side. When 4 wires are used, 2 for current and 2 for voltage sense, mean current = half conditioning current (x fraction of time energised).
4. Peak current per conductor is for "derating" sizing and is the worst case for any one conductor in group over a timescale of 5 mseconds.
5. "(rob.)" means robustness and spells out that the harness includes duplicate wires for critical functions, permitting some wire breakages without forcing prime to redundant side switching
   ....such wires drive the same heater/coil as others, although might initially measure volts and amps rather than having identical function.
6. Fraction numbers of pins for shields means that sometimes more than one insulated signal ground shield terminates on a given pin.
7. If drive wires, which should be heavily filtered to remove unnecessary high frequencies anyway, are required by FIRST to be screened, these screens cannot pass through the number of pins available and should be chassis/backshell terminated.
8. The above listing applies from the FSFPU RF Filter outputs to the DCU warm electronics, excepting that the "tails" at the DCU end are partitioned to suit its connectors I.e. temperature sensors are regrouped.
   The choice of material and its gauge to keep below the required overall impedance end-to-end are to be specified by the harness supplier, the specification applying in the case of the cryostat running at working temperature.
   This suggests stainless steel for many of the conductors in the cryogenic element of the harness and brass for the remainder of them, plus brass for all the conductors in the other element outside the 100-way CVV connectors.