NATIONAL RADIO ASTRONOMY OBSERVATORY
GREEN BANK, WEST VIRGINIA

ECTRONICS DIVISION INTERNAL REPORT NO. 245

THE 1.3–1.8 GHz RECEIVER SYSTEM

ROGER D. NORROD

FEBRUARY 1984

NUMBER OF COPIES: 150

THE 1.2-1.8 GHz RECEIVER SYSTEM

Roger D. Norrod

TABLE OF CONTENTS

FIGURES

THE 1.3-1.8 GHz RECEIVER SYSTEM

I. Introduction

This report describes the design and construction of the 1.3-1.8 GHz receiver available for use on the 140-ft and 300-ft telescopes. The report is divided into four sections, including this introduction. Section II describes the receiver configuration, Section III gives detailed information on the cooled ortho-mode transition, and Section IV contains drawings, schematics, and wiring lists.

II. Receiver

A. Configuration

The receiver system consists of a front-end box (FEB) and a 70 inch control rack with several 19 inch electronic chassis installed. The FEB is a standard Green Bank type, designed for mounting in the prime focus Sterling mount. The FEB is equipped with eight thermoelectric heater/coolers and appropriate blowers so that the interior is maintained at 25°C. The controller used with the temperature control system is described in EDIR No. 81.

The control rack (Figure II-1) is mounted on casters and is located in the telescope control room when the receiver is in use. Section II-F describes the various chassis mounted in the control rack. Two 30-conductor cables and two 15-twisted pair cables carry control and monitor signals between the control rack and the FEB. AC power for the FEB is provided by the control rack through a 7-conductor cable. Wire lists for these cables

are contained in Section IV.

Figure II-2 is the FEB block diagram. The main components of the FEB are the feeds, the refrigerator dewar and dewar monitor/control chassis, four RF modules, and six printed circuit card slots.

The feeds are dual mode feeds designed by R. Fisher. They provide efficiency and spillover performance superior to the single mode type feeds. However, because of their narrow bandwidths, several are required to cover the receiver bandwidth. Three feeds have been constructed for use with the receiver:

1. 1333 MHz (1300-1365 MHz)
2. 1395 MHz (1360-1430 MHz)
3. 1665 MHz (1612-1270 MHz)

The interchangable feeds connect to the dewar waveguide input, 16.3 cm circular guide operated in the fundamental (TE_{11}) mode.

Inside the dewar and cooled to 20 K, an ortho-mode transducer (OMT) separates linear orthogonal polarizations into two coaxial outputs. Each polarization is then processed through identical channels, designated A and B. Stripline 30 dB couplers allow injection of noise calibration or sweep signals immediately after the OMT. A three stage, cooled FET amplifier follows, providing 30 dB of gain. Each channel is then filtered and amplified further in RF Module 1. A broadband detector is incorporated in this module to aid in trouble-shooting.

Transfer switches in RF Module 2 allow the user to switch to circular polarization. Circular polarization is obtained

by combining the two linear polarizations in a 3 dB, 90° hybrid. A motor-driven line stretcher is incorporated in channel A and provision is made to remotely adjust the cooled FET third stage gain in order to obtain phase and gain match at the input of the hybrid. Following the polarizer is a pair of SP5T RF switches which allows the user to select one of five filter networks in each channel. The filters available are:

1. 1335 MHz, 70 MHz bandwidth
2. 1395 MHz, 80 MHz bandwidth
3. 1665 MHz, 130 MHz bandwidth
4. ALL PASS
5. ALL STOP

The first three filters are intended for use with the feeds described previously and the last two are intended primarily for fault isolation. The filters in the two channels are switched concurrently. A broadband isolator and mixer follow the filter switches. Next, each channel is filtered with a 450 MHz low-pass filter and amplified to a level suitable for transmission down telescope cables to the control room. The power level in each channel at the output of the FEB is about -34 dBm/MHz when the telescope is on cold sky.

RF Module 3, LO Selector, provides the LO signal to the mixers on RF Module 2. A transfer switch is included that allows the user to use a single local-oscillator, driving both channels, or two local oscillators, driving each channel independently. The system is designed for use with the NRAO Universal Local

Oscillator (EDIR 82, 144, and 167). Broadband detectors are included in Module 3 for an indication of LO power and for an ALC signal for the ULO. The required mixer LO power is +7 dBm so that the ULO power needed at the FEB input, when one ULO drives both channels, is about +15 dBm.

RF Module 4, Noise Cal, generates broadband noise signals that are introduced into the RF channels via the cooled stripline couplers. Either of two levels may be selected and controlled manually or electronically at the control rack. The low cal level is approximately 2 K and the high cal level is approximately 200 K. A sweep signal may also be injected through Module 4 for swept gain tests.

Parts lists and schematics for the RF Modules are included in Section IV. The Refrigerator Dewar and Dewar Control/Monitor Panel are described in Section II-D and the printed circuit cards in Section II-E.

B. Performance

The receiver has been used on both the 300-ft and 140-ft telescopes. The system temperature on the 140-ft, on cold sky near the zenith, in both the 18 cm and 21 cm bands, is 23 K to 25 K. The noise budget is shown in Figure II-3. Laboratory measurements indicate that system temperature is constant over the entire 1.3-1.8 GHz frequency range, with the exception of a gradual increase below 1320 MHz. Aperture efficiency varies from about 58% at the center frequencies of the feeds, to 54% at the feed band edges. More detailed system performance data is presented in a report by H. E. Payne (EDIR 240).

C. Feeds

As discussed in Section II-A, the feeds used with this receiver system are dual-mode types, producing a shaped aperture power distribution which results in higher system efficiency and lower spillover noise contribution. When compared with the single-mode feed used with the old 18 cm receiver, efficiency increased from about 52% to about 58%, and the feed system temperature contribution decreased from about 13 K to about 6 K. The penalties paid for this improvement are reduced bandwidth and a variation of optimum focus across the feed band. H. E. Payne in EDIR 240 discusses the focus variation for the 1395 MHz and the 1665 MHz feeds.

Because it was not possible to design a high-efficiency feed to cover the entire receiver bandwidth, the receiver system was designed to accept interchangable feeds with a reasonable change-over time. Figure II-4 shows the FEB-feed combination. A feed may be taken off by removing eight 10-32 bolts which attach the feed waveguide flange to the dewar waveguide window, and sixteen 3/8-16 bolts which attach the feed mounting plate to the FEB frame. An O-ring provides a moisture seal between the feed plate and the FEB frame.

To insure that the feeds are centered in the Sterling mounts, the following procedure was used. Tapered pins were attached to the FEB frame and bushings installed in a blank feed plate. A circular plate with an accurately located center hole was then mounted at the center of the feed plate so that it could

be moved in two directions. The FEB was then mounted in the test range Sterling mount and, using a dial indicator, the circular plate was positioned at the center of rotation of the Sterling mount. This blank feed plate was then used to mark all other feed plates and has been retained for future use.

Each feed has a section of tapered waveguide that is the proper length to connect the feed to the dewar flange. Pick-up points are also provided on each feed for attachment of winch cables. The system is designed so that feeds can be changed without removing the FEB from the telescope. On the 300-ft this requires winching the feeds to and from the prime focus.

D. Dewar

The refrigerator dewar is shown in Figure II-5. The refrigerator is a commercial unit, CTI model 1020-CP. The dewar was constructed in Green Bank, using stainless steel (SS304L) for the outer shell, and aluminum (AL6061-T6) for the cover plate and thermal transition. The rectangular cover plate may be removed (Figure II-6) for access to the cold electronics. A copper (OFHC) heat shield at 70 K is used to reduce the radiation heat transfer to the 15 K station.

The OMT mounts to a thermal transition (Figure II-7) that provides mechanical support and thermal isolation. The thermal transition is a section of waveguide, with a gapped outer wall supported by six epoxy-fiberglass (G10) rods. One half of the transition is at room temperature and forms the dewar end plate. This half also contains the waveguide vacuum window. The window

is constructed by epoxying 2.5 inches of rigid foam (Emerson-Cuming Eccofoam PS-1.06) inside the waveguide. The foam is covered with a thin sheet (0.050 inch) of high-density polyethylene. The rigid foam provides mechanical support and the polyethylene provides a vacuum barrier. (See EDTN 118.) The OMT is strapped to the 15 K station with a section of OFHC copper 0.4" wide, 0.12" thick, and about 3" long. The strap was bent into shape and then annealed to remove stresses at the bends. Using this arrangement, the temperature difference between the OMT and the cold station is approximately 3 K.

Heaters, 600 ohm, 25 W, wirewound resistors, are mounted on the 70 K and 15 K stations for use when it is necessasry to rapidly warm the system. Diodes (Lakeshore DT-500KL) are mounted on the 15 K station and on the OMT to monitor the temperature. Electrical signals are fed into the dewar by two hermetic multi-pin connectors, JDW1 and JDW2. A schematic of the dewar is included in Section IV.

The Dewar Control/Monitor Panel (Figure II-8) contains the cooled FET amplifier bias boxes, a temperature readout unit (EDIR 204), and a vacuum monitor unit (Teledyne-Hastings DV-6). Selection of one of the temperature diodes, and control of the refrigerator heaters is performed at this panel. The refrigerator temperature and the vacuum monitor voltages are sent from this panel to the receiver control rack for remote indication. A schematic of the Dewar Control/Monitor Panel is included in Section IV.

E. FEB Electronics

Schematics and wiring lists for the FEB are included in Section IV. A brief functional description of the printed circuit cards follow.

Slot 1. Cal Control/Monitor Buffer. This card uses opto-isolators to convert the four differential cal digital signals coming from the control rack to open collector TTL signals. TTL buffers are also used to drive the wires carrying the cal monitor signals to the control rack.

Slot 2. Noise Source Driver. Current regulators for the diode noise sources. Terminals ANS and BNS must be pulled low to enable the noise sources.

Slot 3. Cal Attenuator Driver. Four LM337 voltage regulators are used to drive the diode attenuators which control the RF cals. The TTL cal control signals from Slot 1 are used to turn the attenuators ON (cal OFF) or vice versa. An opto-isolator is used to provide the cal monitor signal to provide the cal monitor signal to Slot 1.

Slot 4. Miscellaneous Control/Monitor Buffer. This card converts various contact closures from the RF transfer switches and DC relays to TTL signals used to drive indicators on the control rack.

Slot 5. FET Control and Monitor Card. DC relays are used to control the +- 15 V voltages used to bias the cooled FET amplifiers and the room temperature amplifiers that follow. The relays are controlled by switches on the control rack. The switched +15 V is used to drive opto-isolators for remote indication.

Slot 6. Analog Monitor Card. This card contains various circuits. LM317 voltage regulator is used to provide 24 V from the 28 V supply. Op-amps are used to drive the remote gain control input of the cooled FET amps. Additional op-amps are used to process the phase-shifter monitor voltage for remote indication.

Ratings of the power supplies in the FEB are:

1. 28 V, 1.8 A (50°C) ... Lambda LJS-10
2. 5 V, 5.0 A (50°C) ... Lambda LJS-13
3. +-15 V, 1.2 A (50°C) ... Lambda LND-Y-152

F. Control Rack

Schematics and wiring lists for the control rack and the installed chassis are included in Section IV. Table II-1 lists the panels installed in the rack, from top to bottom. Refer also to Figure II-1. A brief functional description of each chassis follows.

Control Chassis. Three digital panel meters and associated selector switches allow display of various voltages from the FEB. The left-hand meter displays the gate voltage of stages 1, 2 and 3 of the cooled FET amplifier in Channel A, the relative phase shift in the polarizer line stretcher on RF Module 2, and the LO power level at the Channel A mixer in milliwatts. The center meter displays the gate voltages and the LO power for Channel B. The right hand meter displays the refrigerator temperature, the dewar vacuum, and the FEB interior temperature. The vacuum display is a log scale with 1 V corresponding to a hard vacuum (< 1 micron) and 0 V corresponding to atmospheric pressure. Below the meters are two circuit breaker switches and associated indicator lights. The left-hand switch controls AC power to the control rack. The right-hand switch controls AC power to the FEB electronics. On the rear of the Control

Chassis is a toggle switch which controls the AC power to the FEB cooler fans. All three switches must be on to light the FEB power indicator. Three circuit cards inside the chassis perform the following functions:

1. Temperature Monitor Card. Amplifies and scales the FEB temperature sensor voltage for display on the panel meter.

2. LO Level Card. Amplifies and scales the LO detector voltages for display on the panel meters, and for a ULO ALC voltage.

3. Phase Shifter Monitor Card. Scales the phase monitor voltage and also the vacuum monitor voltage.

TABLE II-1

Control Rack Panels, Top Down

Panel	Size (in)
Blank	3 1/2
Control Chassis	8 3/4
Monitor Chassis	10 1/4
Oscilloscope	7
Bandpass Monitor	1 3/4
Vertex Rotating Horn Control Chassis	3 1/2
IF Monitor Chassis	5 1/4
Drawer	3 1/2
Blank	8 3/4
DC Power Supply Chassis	5 1/4
Outlet Strip	3 1/2

Monitor Chassis. A block diagram of the FEB is engraved on the front panel of this chassis. At this panel, the user can manually control the cals, turn the RF amplifiers on or off, control the polarizer and line stretcher, select the proper RF filter, and select the LO configuration. Potentiometers allow adjustment of the gain in the cooled FET amplifiers. Circuit cards inside the chassis perform the following functions:

1. Cal Control Logic Card. This card accepts the computer cal signal from card 3, and the manual control signals from the front panel switches, and drives the telescope cables with the selected cal signal.

2. Indicator Buffer Card. This card contains various buffer gates and limiting resistors used to drive the front panel LEDs.

3. Logic Input Buffer Card. This card accepts a TTL or 3C (0 V and -6 V) cal signal from the rear panel connectors and drives the Cal Control Logic Card. PCB switches allow the user to select TTL or 3C and normal or inverted logic.

BNC connectors on the rear panel accept 3C or TTL cal signals and route them to card 3. Note that, for the cal signals to operate, the cal signal must be connected to the proper BNC connector and the PCB switches on card 3 must be properly set.

Band Pass Monitor. This simple panel has a switch that controls the transfer switch on RF Module 1 and a BNC connector with the amplified detector voltage. A second BNC connector feeds the sweep input of RF Module 4, and provides a convenient place to connect a sweeper.

Vertex Rotating Horn Control Chassis. On the roof of the Cassegrain house of the 140-ft telescope is a sectorial

horn that can be rotated. Feeding this horn is a broadband noise source. This system is used for a rough check on the circular polarization axial ratio.

IF Monitor Chassis. This chassis contains two square-law detectors and related circuitry for use in monitoring the receiver total power. The tunnel-diode detectors are temperature controlled and have been adjusted for square-law to within +-1% over a 20 dB operating range. LEDs warn when the detectors are operating out of the calibrated range. A panel meter monitors the detector X1 or X10 voltage, and front panel BNC connectors are also available for monitoring. Rear panel connectors in parallel with the front are patched to the rack top plate for convenience.

DC Supply Chassis. This chassis contains DC power supplies used to power the remaining chassis in the rack. A front panel circuit breaker provides control of the supplies.

III. Orthomode Transducer

A. Design

The orthomode transducer (OMT) used in the 1.3-1.8 GHz receiver is a scaled version of a unit developed by ERA Technology of Surrey, England, under contract to NRAO. The unit supplied by ERA operates in S-band and is described in the final contract report (ERA Report No. 82-124). During construction of the L-band OMT, some modifications were made in the design which improved the performance.

The OMT may be considered as two functional blocks, a circular to quadridged waveguide transition and a quadridged waveguide to coaxial transition. In the final unit, these two blocks are integrated, but our first step was to build a scaled version of the quadridged to coaxial transition. We obtained the dimensions of the S-band unit from drawings supplied by ERA, and scaled by the factor 2.1/1.35. Two identical test units, consisting of circular waveguide with removable copper ridges, were constructed. A piston short was used for ease of adjustment. Originally, the probe outer and inner diameters were also scaled directly, but they were experimentally shown to be non-critical. So, we used the same dimensions on our probe as is used in the SMA connectors. This eliminated the need for steps or tapers in the coaxial line and significantly improved the transition performance. Other significant changes in the configuration were:

1. The probes were moved closer together. The probe to probe isolation was found to be strongly dependent on mechanical orthogonally but only weakly dependent on probe spacing. Isolation of the final transition was difficult to measure with our equipment but appeared to be 33 to 35 dB. With the probes closer, we were able to position the short for better match on both ports.

2. The steps in the orthogonal ridges were staggered. That is, they are uniform distances from the probes, rather than the short. This resulted in better uniformity between the probe responses with no measurable degradation in isolation.
3. The short was moved back from the end of the ridges. This resulted in an improved match at both ports.

Dimensions of the resulting transition are shown in Figure III-1. The performance of the two back-to-back units is shown in Figure III-2. Note the strong higher-order mode resonance at 1.48 GHz.

We then proceeded to design the complete transition. Dimensions for the quadridged to circular transition were obtained by again scaling the ERA drawings. Data from the drawings were curve-fit using a least-squares method; the radius of the outer shell to a sine curve and the ridge gap to a power-law curve. The circular waveguide diameter of the L-band OMT was selected so that the TE_{21} mode cutoff frequency was 1.8 GHz. The quadridged to circular transition described in the previous paragraph was then scaled by the factor 1.35/1.20. (We felt that it would be helpful to push the cutoff frequency lower.) The curve-fit equations were then scaled to provide smooth transitions between the end-points.

B. Construction.

In the first unit, it seemed that it might be useful to be able to adjust the ridge spacing. Hence, we decided not to electroform the ridges into place as ERA had. So, the OMT shell was electroformed on an aluminum mandrel and the mandrel removed in the usual fashion. In the meantime, the rdiges were machined out of OFHC copper plate. Then, slots were machined in the shell for acceptance of the ridges. This was a minor disaster. Internal stresses in the shell caused it to spring and twist out of shape when the slots were cut. However, the machinsit (W. Monk) was able, using clamps and shims, to mount the ridges and hold the shell in place. We then tested the unit electrically and found that only minor adjustments were necessary. The ridges were then soldered into place and the unit was ready for final tests.

C. Performance.

Figure III-3 shows the OMT return loss performance, including the waveguide window. The performance of the other port is virtually identical. The resonances near 1.45 GHz was expected from the quadridge prototype and the resonances above 1.8 GHz are probably TE_{21} modes. The resonance at 1.71 GHz is undesirable, however, since it is near the OH line at 1.72 GHz. This seems to be a mode trapped between the quadridge waveguide and the circular guide, and we feel it can be shifted out of the frequency band of interest by adjusting the length of the quadridged waveguide

if another OMT is constructed. As stated earlier, the polarization isolation is 33 to 35 dB.

The OMT has been cooled to 20 Kelvin dozens of times. There are no significant performance changes when cold, and there has been no failure of the unit. The OMT weighs 18 pounds and cool-down time of the system is about 9 hours.

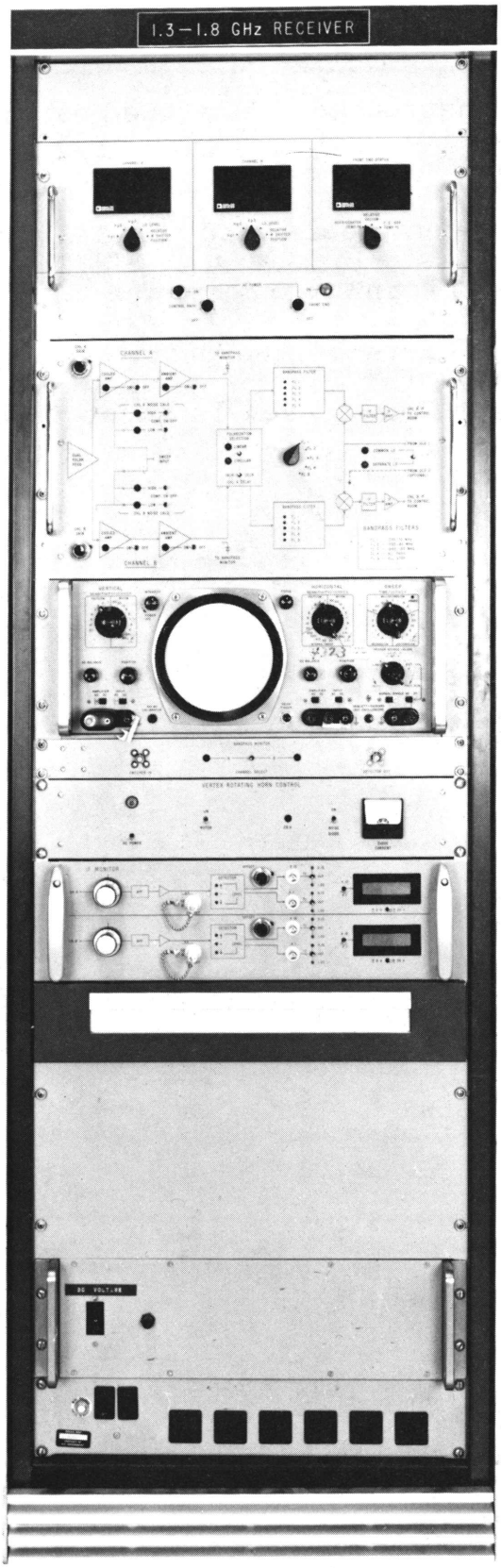


Figure II-1: Receiver Control Rack

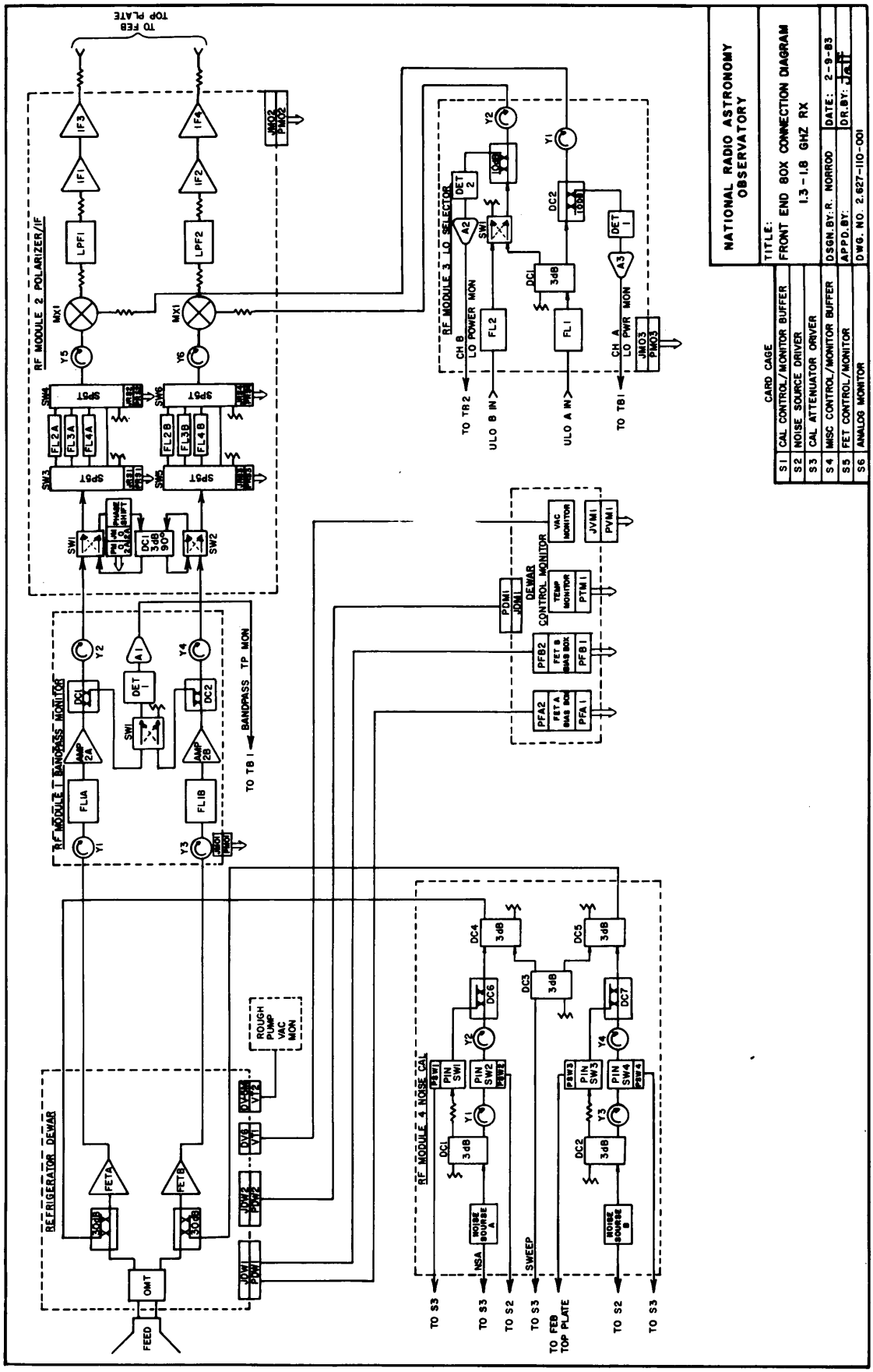


Figure II-2: Front-End Box Block Diagram

1.3-1.8 GHz Receiver

Noise Budget

	Physical Temperature	Noise Temperature or Loss	System Contribut
FET amplifier	16 K	9.0 K	9.0 K
Second stage	300 K	630.0 K	0.6 K
Cal coupler and 141 semirigid	16 K	0.15 dB	0.9 K
OMT	22 K	0.10 dB	0.8 K
Window	300 K	0.001 dB	0.1 K
Feed and waveguide	300 K	0.01 dB	0.6 K
Total receiver temperature			12.0 K
Scatter and spillover			5.5 K
Background and atmosphere			5.0 K
One-half of cal value			1.5 K
System temperature			24.0 K

Figure II-3: System Noise Budget

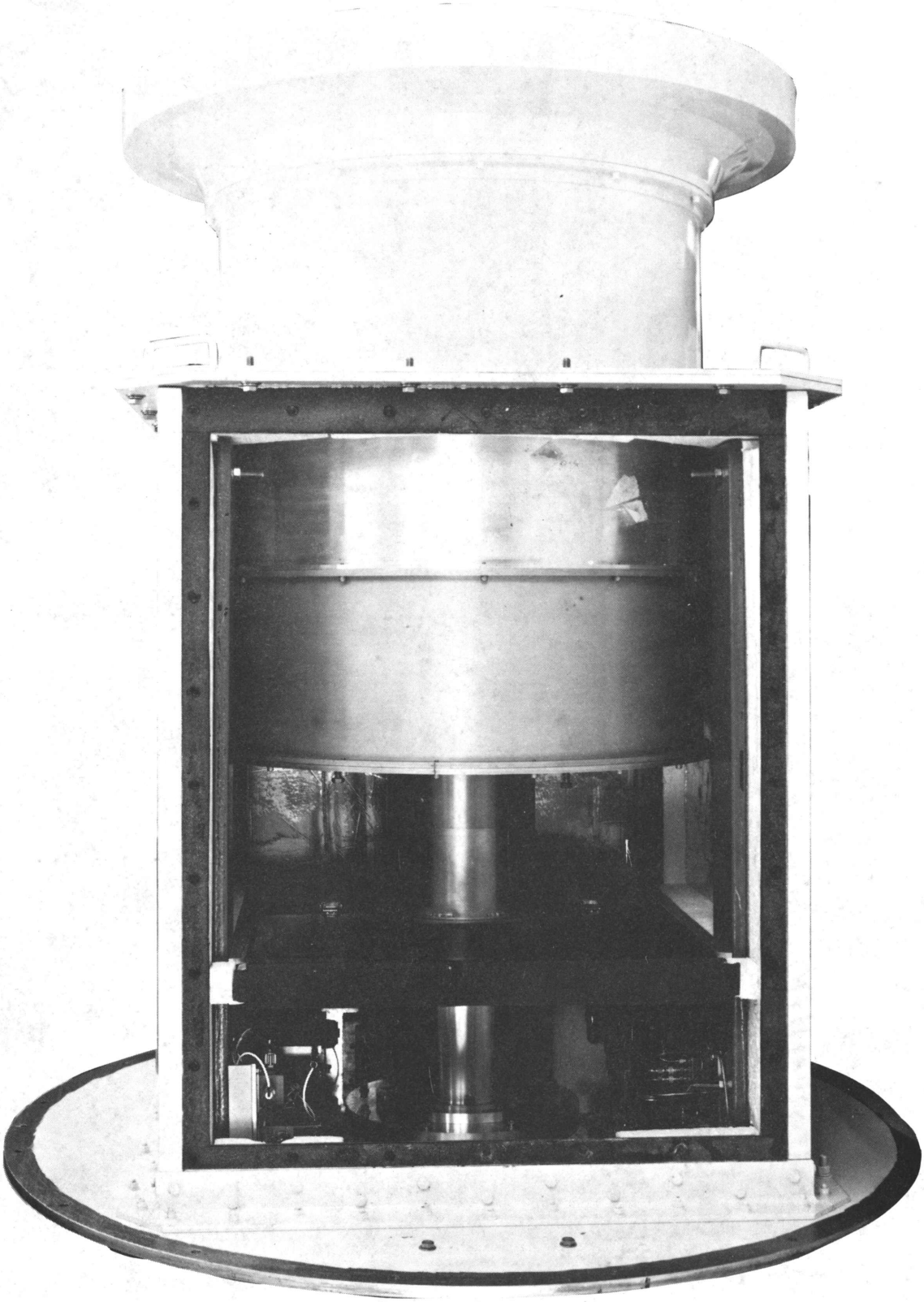


Figure II-4: Feed and Front-End Box

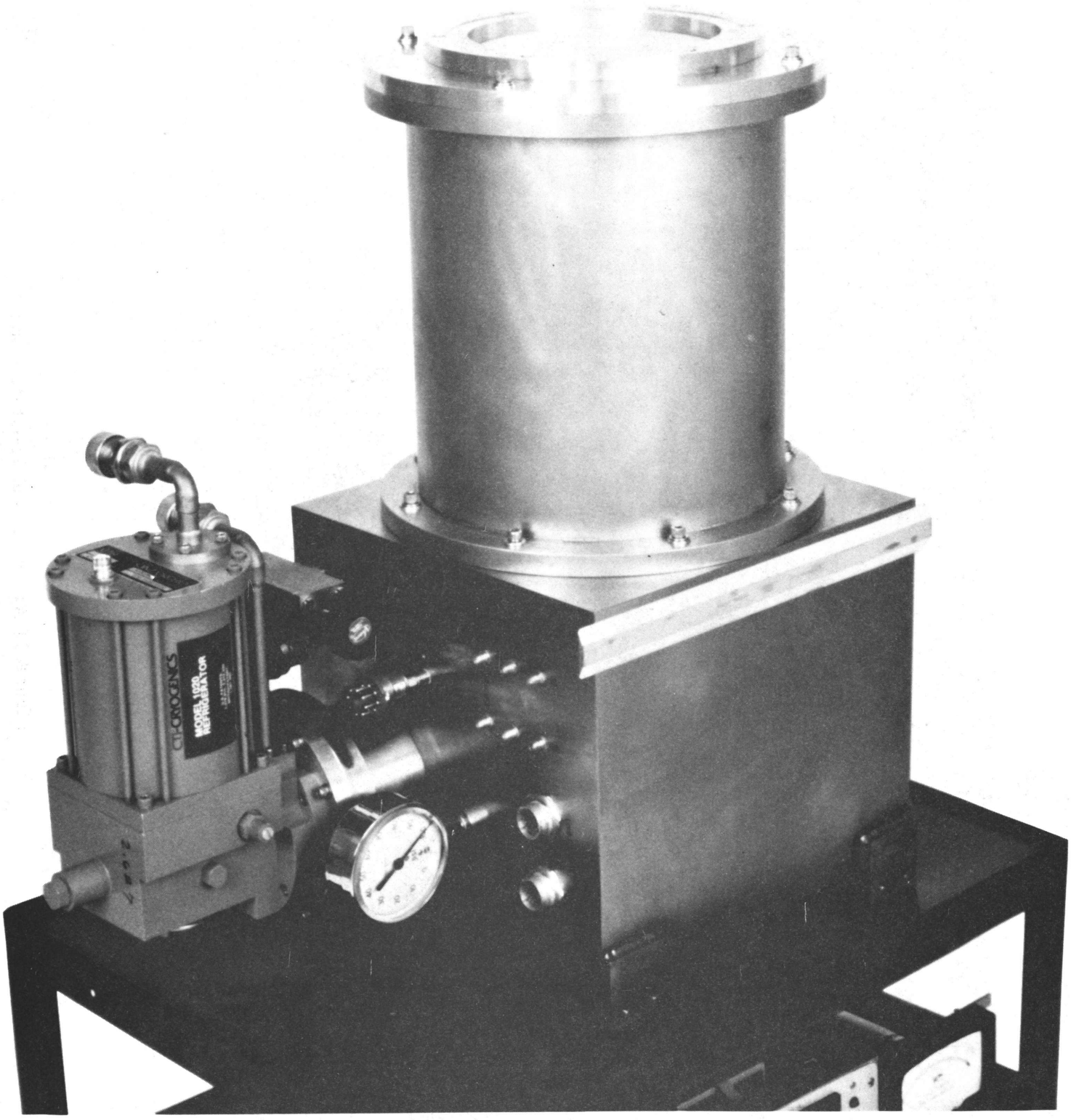


Figure II-5: Refrigerator/Dewar

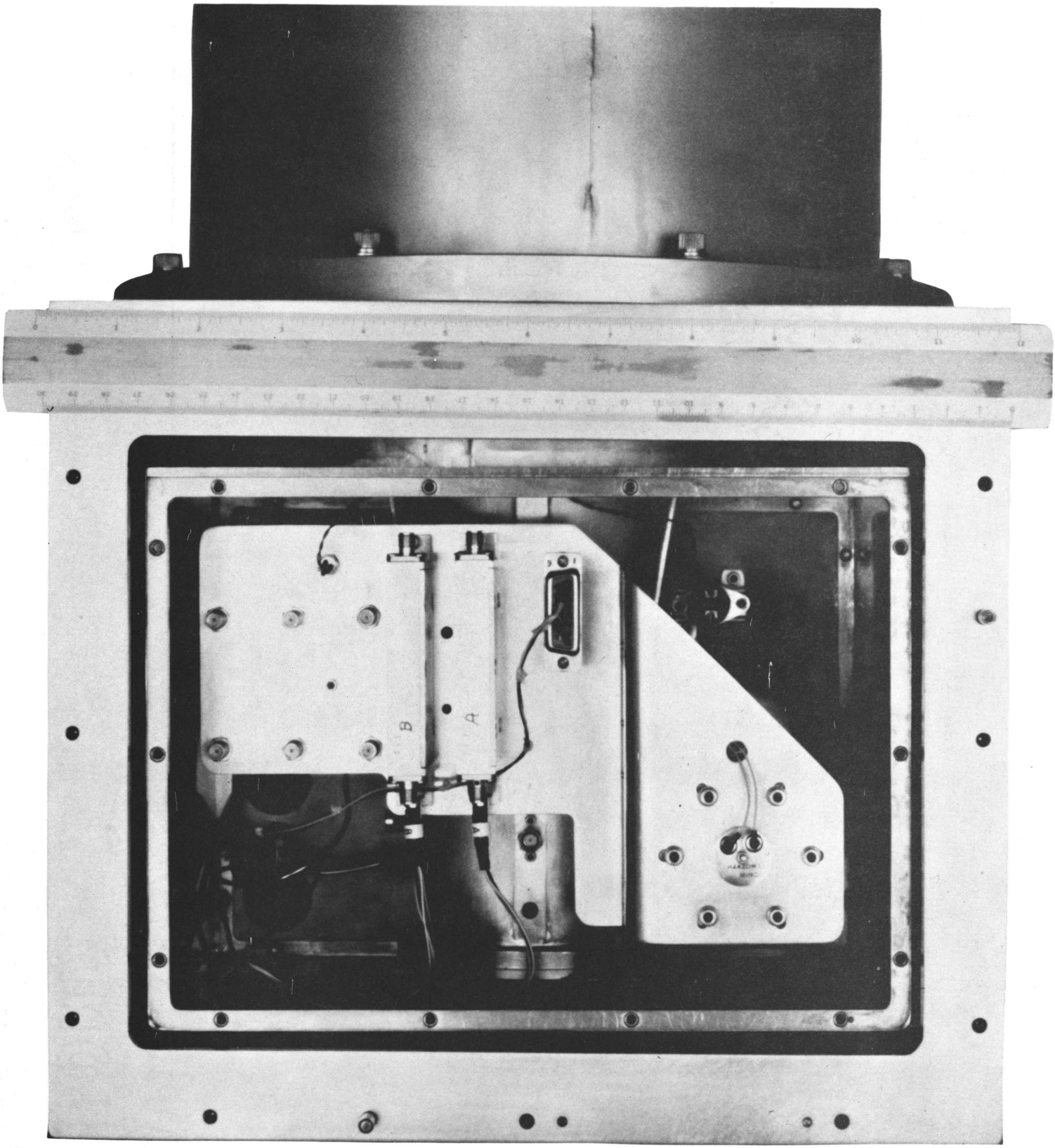


Figure II-6: Dewar with Access Cover Removed

Figure II-7: OMT and Thermal Transition

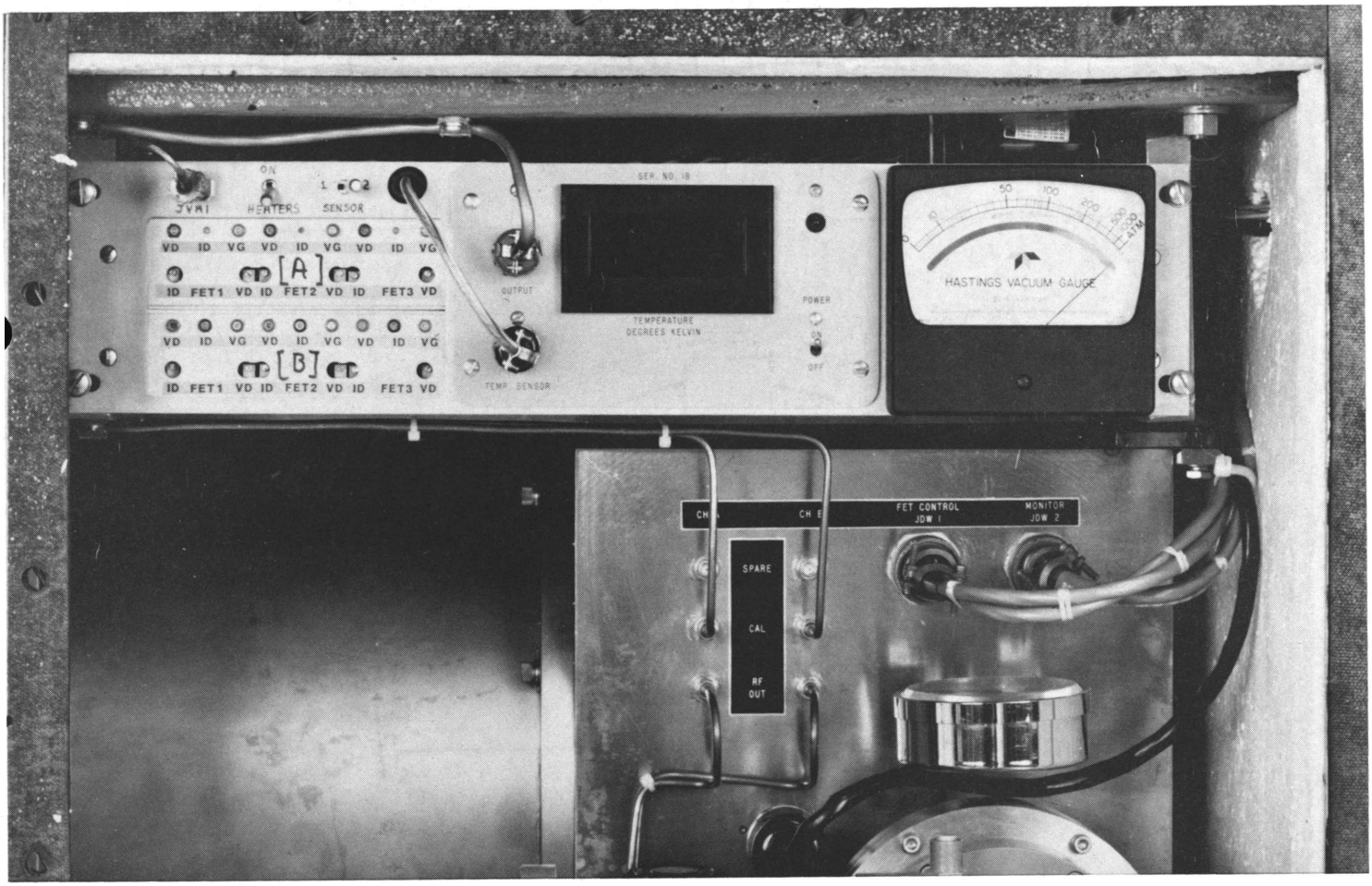


Figure II-8: Dewar Monitor/Control Panel

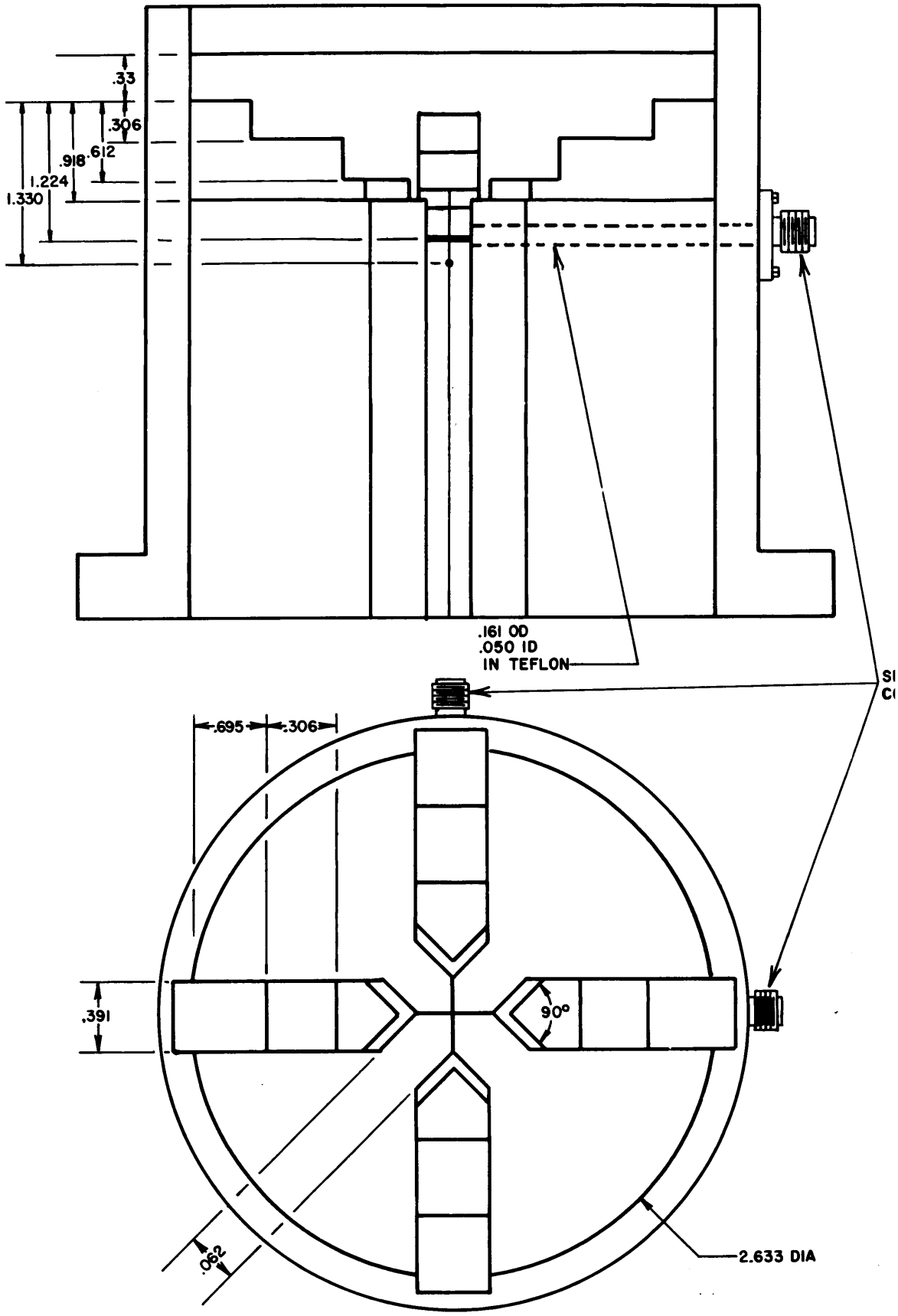


Figure III-1: Quadridged to Coaxial Transition

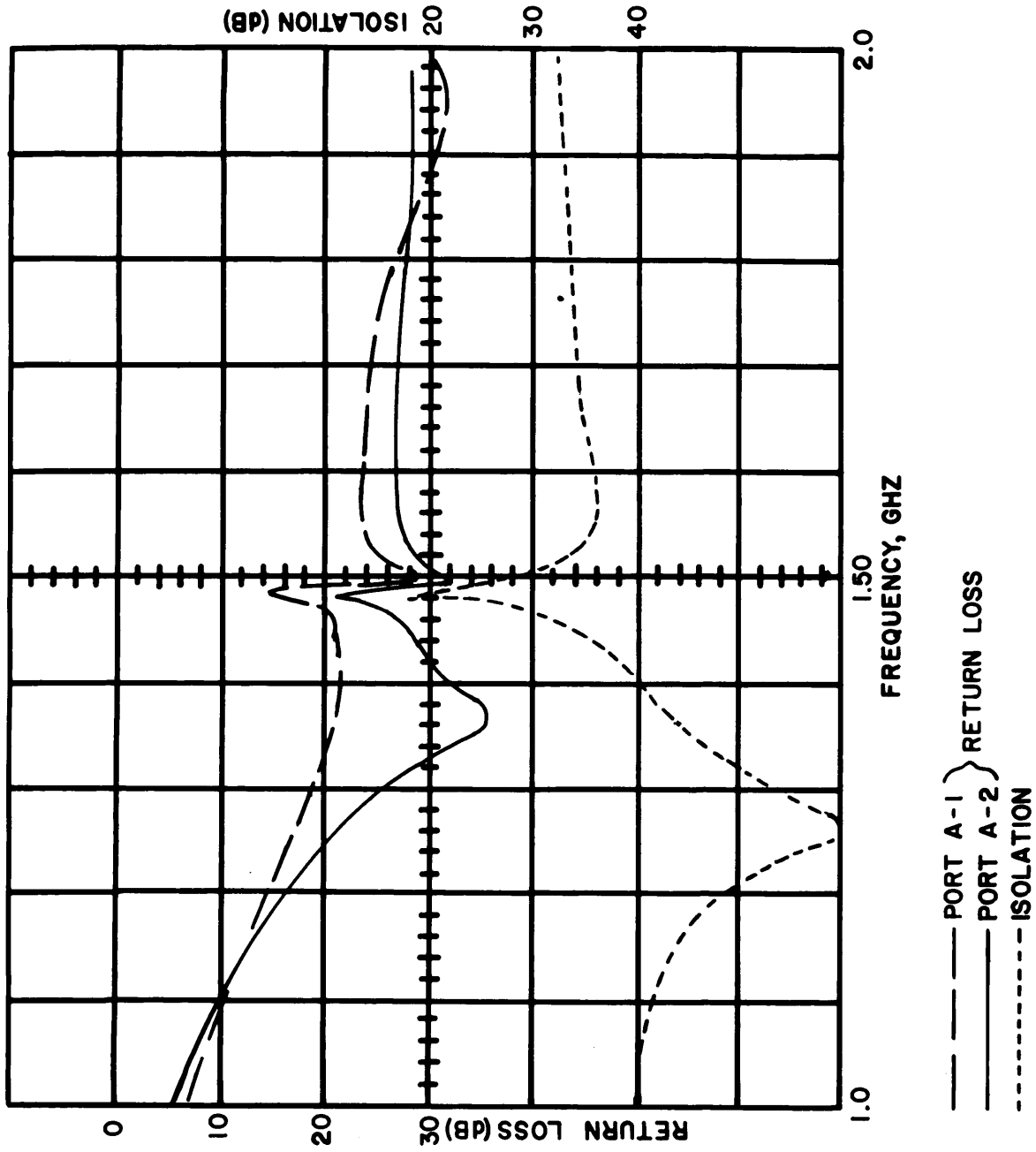


Figure III-2: Performance of Coaxial Transitions

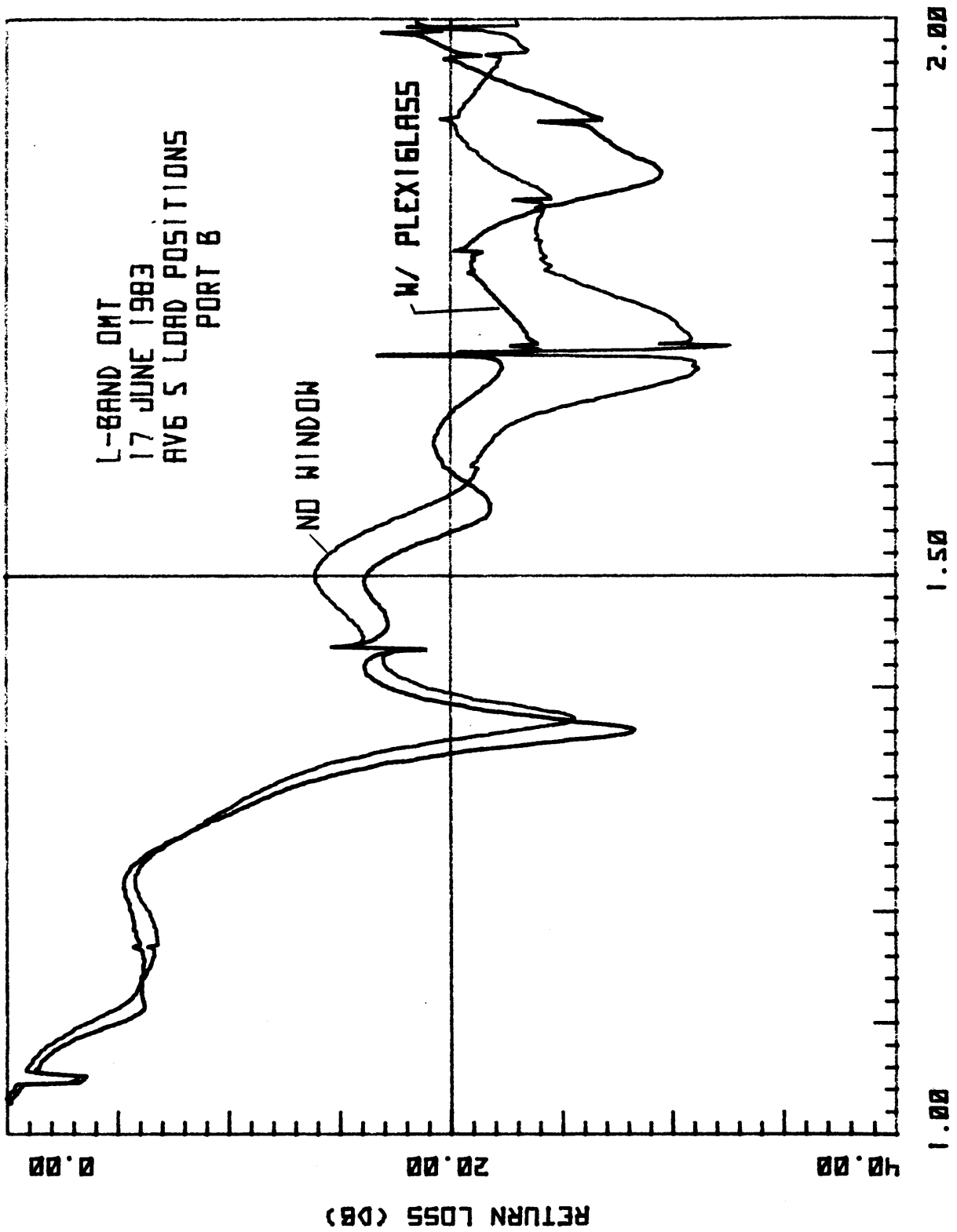


Figure III-3: OMT Return Loss

IV. Drawings

Drawings, schematics, and wiring lists are reproduced in this section. Fabrication drawings are not included but are on file in Green Bank. The documents are grouped according to major assemblies in the following order:

Control Rack

- Terminal Boards
- Control Chassis
- Monitor Chassis
- Vertex Horn Control Chassis
- IF Monitor Chassis

Front End Box

- Terminal Boards
- Dewar
- Dewar Monitor/Control Chassis
- RF Modules
- Cards and Card Slots
- Cable Connector Wiring Lists

LOCATION CONTROL RACK TB1

Tracer Color	Wire Color	Pin Letter	Term. No.	Function	Connect to
	Red	A	1	A LO-CAL	PMC1-A
Blue	Yellow	B	2	A LO-CAL	-B
	Shield	E			
	Red	C	3	A HI-CAL	PMC1-C
Purple	Yellow	D	4	A HI-CAL	-D
	Shield	J			
	Red	O	5	A LO LEVEL	PCR1-A
Gray	Yellow	P	6	A LO LEVEL RTN	-B
	Shield	H			
	Red	F	7	A VG1 MON	PCR1-C
Green	Yellow	G	8	A VG1 MON RTN	-D
	Shield	M			
	Red	T	9	A VG2 MON	PCR1-E
Yellow	Yellow	U	10	A VG2 MON RTN	-F
	Shield	N			
	Gray	K	11	A VG3 MON	PCR1-H
White	Yellow	L	12	A VG3 MON RTN	-J
	Shield	R			
	Blue	X	13	A FET GAIN CONTROL CW	PMC1-H
White	Yellow	Y	14	A FET GAIN CONTROL CCW	-J
	Shield	Q			
	Gray	Z	15	$\overline{\text{ANS}}$	PMC1-E
White	Red	a	16	RTN	-F
	Shield	S			
	Red	V	17		
White	Yellow	W	18		
	Shield	d			
	Red	m	19		
Black	Yellow	n	20		
	Shield	e			
	Red	b	21	THERMISTOR 1	BT1-C
Orange	Yellow	c	22	THERMISTOR 1 RTN	BT1-0
	Shield	k			
	Red	r	23	THERMISTOR 2	BT2-C
Red	Yellow	s	24	THERMISTOR 2 RTN	BT2-0
	Shield	x			
	Red	t	25	BANDPASS MON	BMP-B1-C
Brown	Yellow	u	26	BANDPASS MON RTN	BMP-B1-0
	Shield	y			
	Blue	f	27		
White	Gray	g	28		
	Shield	p			
	Red	h	29		
White	Blue	j	30		
	Shield	q			

C = 57.6 pF/ft wire-to-wire. C = 97.4 pF/ft wire-to-shield.

LOCATION CONTROL RACK TB2

Tracer Color	Wire Color	Pin Letter	TB2 Term. No.	Function	Connect to
	Red	A	1	B LO-CAL	PMC1-a
Blue	Yellow	B	2	B LO-CAL	-b
	Shield	E			
	Red	C	3	B HI-CAL	PMC1-c
Purple	Yellow	D	4	B HI-CAL	-d
	Shield	J			
	Red	O	5	B LO LEVEL	PCR1-a
Gray	Yellow	P	6	B LO LEVEL RTN	-b
	Shield	H			
	Red	F	7	B VG1 MON	PCR1-c
Green	Yellow	G	8	B VG1 MON RTN	-d
	Shield	M			
	Red	T	9	B VG2 MON	PCR1-e
Yellow	Yellow	U	10	B VG2 MON RTN	-f
	Shield	N			
	Gray	K	11	B VG3 MON	PCR1-h
White	Yellow	L	12	B VG3 MON RTN	-j
	Shield	R			
	Blue	X	13	B FET GAIN CONTROL CW	PMC1-h
White	Yellow	Y	14	B FET GAIN CONTROL CCW	-j
	Shield	Q			
	Gray	Z	15	$\overline{\text{BNS}}$	PMC1-e
White	Red	a	16	RTN	-f
	Shield	S			
	Red	V	17		
White	Yellow	W	18		
	Shield	d			
	Red	m	19	VACUUM MONITOR	PCR1-s
Black	Yellow	n	20	VACUUM MONITOR RTN	PCR1-t
	Shield	e			
	Red	b	21	DEWAR TEMP DEC PT1	PCR1-u
Orange	Yellow	c	22	DEWAR TEMP DEC PT2	-v
	Shield	k			
	Red	r	23	DEWAR TEMP MON	PCR1-w
Red	Yellow	s	24	DEWAR TEMP MON RTN	-x
	Shield	x			
	Red	t	25	FEB TEMP MON	PCR1-$\overline{\text{y}}$
Brown	Yellow	u	26	FEB TEMP MON RTN	-z
	Shield	y			
	Blue	f	27	PHASE SHIFTER MON	PCR1-AA
White	Gray	g	28	PHASE SHIFTER MON RTN	-BB
	Shield	p			
	Red	h	29	115 VAC MON	PCR1-CC
White	Blue	j	30	115 VAC MON RTN	-DD
	Shield	q			

C = 57.6 pF/ft wire-to-wire. C = 97.4 pF/ft wire-to-shield.

30 CONDUCTOR — 16 GA: CONNECTOR 30 COND-A (1.3-1.8 GHz Rx) 4Apr83 RDN

LOCATION CONTROL RACK TB3

Wire Color	Pin Letter	TB3 Term. No.	Function	Connect to
Orange Purple	A	1	REMOTE IND SUPPLY	PMC2-A
Orange Blue	B	2	" " RTN	PMC2-B, BMP-GND
Yellow White	C	3	" " $\overline{\text{A LO-CAL}}$	PMC2-C
Yellow	D	4	" " $\overline{\text{B LO-CAL}}$	PMC2-D
Red Purple	E	5	" " $\overline{\text{A HI-CAL}}$	PMC2-E
Red Blue	F	6	" " $\overline{\text{B HI-CAL}}$	PMC2-F
Orange Green	G	7	" " $\overline{\text{A RF MON}}$	BMP-I1-C
Yellow Black	H	8	" " $\overline{\text{B RF MON}}$	BMP-I2-C
Yellow Brown	J	9	" " $\overline{\text{A FET1}}$	PMC2-K
Black	K	10	" " $\overline{\text{B FET1}}$	PMC2-L
White Yellow	L	11	" " $\overline{\text{A FET2}}$	PMC2-M
Red Green	M	12	" " $\overline{\text{B FET2}}$	PMC2-N
Orange Yellow	N	13	" " $\overline{\text{LINEAR}}$	PMC2-P
Orange	P	14	" " $\overline{\text{CIRC}}$	PMC2-R
Brown	R	15	" " $\overline{\text{COMMON LO}}$	PMC2-S
Red	S	16	" " $\overline{\text{SEPARATE LO}}$	PMC2-T
Red Black	T	17		
Red Yellow	U	18	XFR SW SELECT SUPPLY	PMC2-V, BMP-SW1-0
Red Brown	V	19	" " LINEAR SELECT	PMC2-W
Orange Brown	W	20	" " CIRC SELECT	PMC2-X
Green	X	21	" " A RF MON SELECT	BMP-SW1-1
Orange White	Y	22	" " B RF MON SELECT	BMP-SW1-2
Orange Black	Z	23	" " COMMON LO SELECT	PMC2-a
Blue	a	24	" " SEPARATE LO SELECT	PMC2-b
Purple	b	25	RELAY CONTROL RTN	PMC2-c
Purple White	c	26		
Green White	d	27	RELAY CONTROL A FET1 PWR	PMC2-e
Green Black	e	28	" " B FET1 PWR	PMC2-f
Green Brown	f	29	" " A FET2 PWR	PMC2-h
Red White	g	30	" " B FET2 PWR	PMC2-j
Shield	l	Shield	GND @ BOX	PIG-TAIL

30 CONDUCTOR — 16 GA: CONNECTOR 30 COND-B (1.3-1.8 GHz Rx) 4Apr83 RDN Rev. 20Jul83

LOCATION CONTROL RACK - TB4

Wire Color	Pin Letter	TB4 Term. No.	Function	Connect to
Orange Purple	A	1	REMOTE IND. SUPPLY	PMC2-ℓ
Orange Blue	B	2	FEB RETURN	PMC2-m
Yellow White	C	3	CH A BAND 1 IND.	PMC2-n
Yellow	D	4	BAND 2 IND.	PMC2-p
Red Purple	E	5	BAND 3 IND.	PMC2-r
Red Blue	F	6	BAND 4 IND.	PMC2-s
Orange Green	G	7	BAND 5 IND.	PMC2-t
Yellow Black	H	8	CH B BAND 1 IND.	PMC2-u
Yellow Brown	J	9	BAND 2 IND.	PMC2-v
Black	K	10	BAND 3 IND.	PMC2-w
White Yellow	L	11	BAND 4 IND.	PMC2-x
Red Green	M	12	BAND 5 IND.	PMC2-y
Orange Yellow	N	13		
Orange	P	14		
Brown	R	15		
Red	S	16		
Red Black	T	17		
Red Yellow	U	18	28V FEB SUPPLY	PMC2-AA
Red Brown	V	19	BAND 1 SELECT	PMC2-BB
Orange Brown	W	20	2	PMC2-CC
Green	X	21	3	PMC2-DD
Orange White	Y	22	4	PMC2-EE
Orange Black	Z	23	5	PMC2-FF
Blue	a	24		
Purple	b	25		
Purple White	c	26	INCREASE PHASE SUPPLY	PMC2-HH
Green White	d	27	INCREASE PHASE RETURN	PMC2-JJ
Green Black	e	28	DECREASE PHASE RETURN	PMC2-KK
Green Brown	f	29	DECREASE PHASE SUPPLY	PMC2-LL
Red White	g	30		
Shield	l	Shield		

CONNECTOR: DESIGNATION PMC1 ; TYPE Cable ; 56 PINS

SMALL KEY 2 , LARGE KEY 1 ; PANEL E/P , (CABLE) E/P

Pin	To	Function	Pin	To	Function
A	TB1-1	A LO-CAL	u		
B	TB1-2	A LO-CAL	v		
C	TB1-3	A HI-CAL	w		
D	TB1-4	A HI-CAL	x		
E	TB1-15	ANS	y		
F	TB1-16	ANS RTN	z		
H	TB1-13	A FET GAIN CW	AA		
J	TB1-14	A FET GAIN CCW	BB		
K			CC		
L			DD		
M			EE		
N			FF		
P			HH		
R			JJ		
S			KK		
T			LL		
U			MM		
V			End 56 Pin → NN		
W					
End 20 Pin → X					
Y					
Z					
AA a	TB2-1	B LO-CAL			
BB b	TB2-2	B LO-CAL			
CC c	TB2-3	B HI-CAL			
DD d	TB2-4	B HI-CAL			
EE e	TB2-15	BNS			
FF f	TB2-16	BNS RTN			
HH h	TB2-13	B FET GAIN CW			
JJ j	TB2-14	B FET GAIN CCW			
KK k					
LL l					
MM m					
NN n					
PP p					
RR r					
SS s					
TT t					
End 38 → Pin					

Abbreviations:
Ex: S25-22 | J9-MM
Slot 25, Pin 22 | Elco J9, Pin MM

Elco Connectors: J1, J2, J3, etc.
Slot Connectors: S1, S2, S3, etc.
Pin No.'s -3, -X, -B,

CONNECTOR: DESIGNATION PMC2 ; TYPE Cable ; 56 PINS

SMALL KEY 2 , LARGE KEY 2 ; PANEL E/P , (CABLE) E/P

Pin	To	Function	Pin	To	Function
A	TB3-1	R.I. SUPPLY	u	TB4-8	CH B BAND 1 IND.
B	TB3-2	R.I. RTN	v	TB4-9	" " 2 "
C	TB3-3	A LO-CAL	w	TB4-10	" " 3 "
D	TB3-4	B LO-CAL	x	TB4-11	" " 4 "
E	TB3-5	A HI-CAL	y	TB4-12	" " 5 "
F	TB3-6	B HI-CAL	z		
H		SPARE	AA	TB4-18	28V FEB SUPPLY
J		SPARE	BB	TB4-19	BAND 1 SELECT
K	TB3-9	A FET1	CC	TB4-20	" 2 "
L	TB3-10	B FET1	DD	TB4-21	" 3 "
M	TB3-11	A FET2	EE	TB4-22	" 4 "
N	TB3-12	B FET2	FF	TB4-23	" 5 "
P	TB3-13	LINEAR	HH	TB4-26	INCREASE SUPPLY
R	TB3-14	CIRC	JJ	TB4-27	INCREASE RETURN
S	TB3-15	COMMON LO	KK	TB4-28	DECREASE RETURN PHASE
T	TB3-16	SEPARATE LO	LL	TB4-29	DECREASE SUPPLY
U			MM		
V	TB3-18	XFR SW SELECT	End 56 Pin → NN		
W	TB3-19	LINEAR S.			
End 20 Pin → X	TB3-20	CIRC S.			
Y		SPARE			
Z		SPARE			
AA a	TB3-23	COMMON LO S.			
BB b	TB3-24	SEPARATE LO S.			
CC c	TB3-25	RELAY RTN			
DD d					
EE e	TB3-27	A FET1 PWR			
FF f	TB3-28	B FET1 PWR			
HH h	TB3-29	A FET2 PWR			
JJ j	TB3-30	B FET2 PWR			
KK k					
LL l	TB4-1	REMOTE IND SUPPLY			
MM m	TB4-2	FEB RTN			
NN n	TB4-3	CH A BAND 1 IND			
PP p	TB4-4	" " 2 "			
RR r	TB4-5	" " 3 "			
SS s	TB4-6	" " 4 "			
TT t	TB4-7	" " 5 "			
End 38 → Pin					

Abbreviations:
Ex: S25-22 | J9-MM
Slot 25, Pin 22 | Elco J9, Pin MM

Elco Connectors: J1, J2, J3, etc.
Slot Connectors: S1, S2, S3, etc.
Pin No.'s -3, -X, -B,

4Apr83 RDN

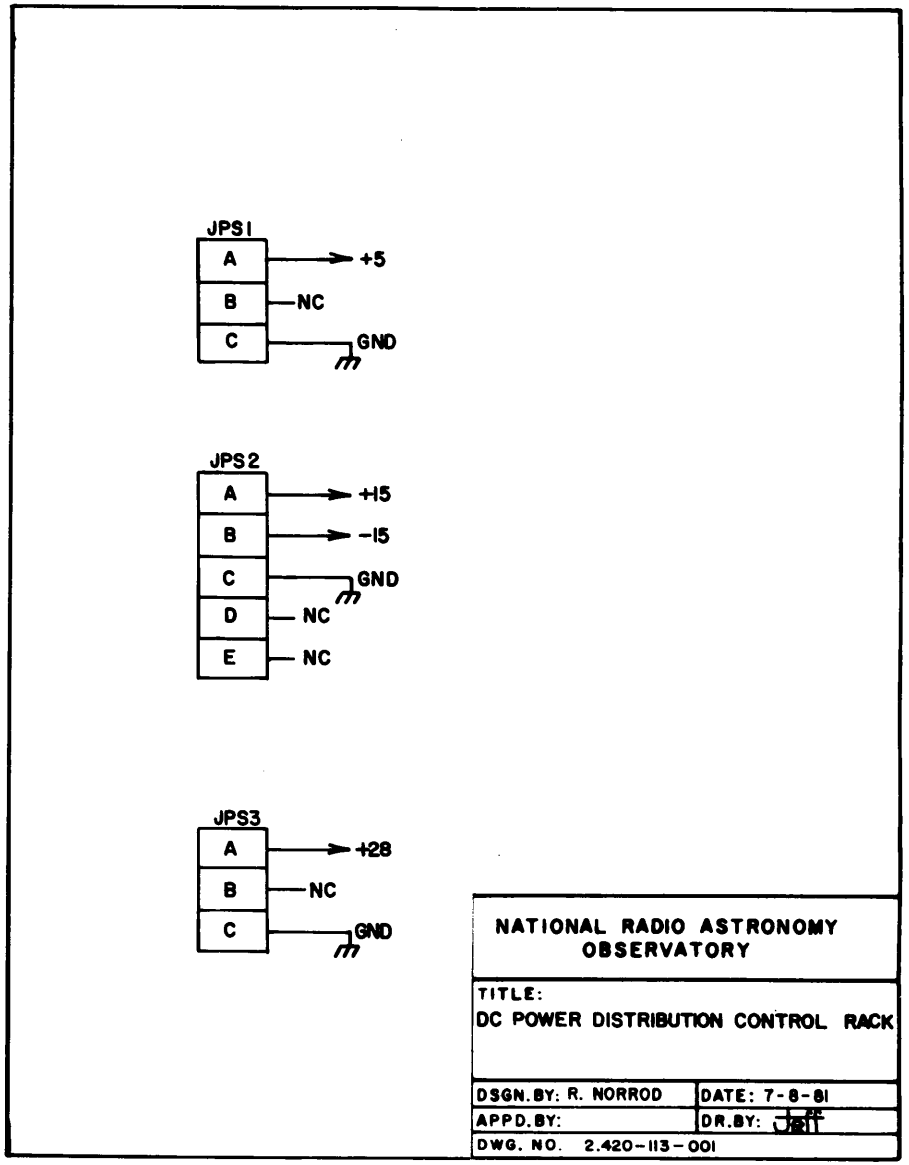
ELCO CONNECTOR LIST FOR BOX/RACK/DRAWER TERMINAL BOARDS TO CONTROL CHASSIS (1.3-1.8 GHz Rx Control Rack)

CONNECTOR: DESIGNATION PCR1 ; TYPE Cable ; 56 PINS

SMALL KEY 1 , LARGE KEY 1 ; PANEL E/P , CABLE E/P

Pin		To	Function
	A	TB1-5	A LO LEVEL
	B	TB1-6	A LO LEVEL RTN
	C	TB1-7	A VG1 MON
	D	TB1-8	A VG1 MON RTN
	E	TB1-9	A VG2 MON
	F	TB1-10	A VG2 MON RTN
	H	TB1-11	A VG3 MON
	J	TB1-12	A VG3 MON RTN
	K		
	L		
	M		
	N		
	P		
	R		
	S		
	T		
	U		
	V		
End 20 Pin →	W		
	X		
	Y		
	Z		
AA	a	TB2-5	B LO LEVEL
BB	b	TB2-6	B LO LEVEL RTN
CC	c	TB2-7	B VG1 MON
DD	d	TB2-8	B VG1 MON RTN
EE	e	TB2-9	B VG2 MON
FF	f	TB2-10	B VG2 MON RTN
HH	h	TB2-11	B VG3 MON
JJ	j	TB2-12	B VG3 MON RTN
KK	k		
LL	l		
MM	m		
NN	n		
PP	p		
RR	r		
SS	s	TB2-19	VACUUM MONITOR
TT	t	TB2-20	VAC. MON. RTN
End			

Pin		To	Function
	u	TB2-21	DEWAR DP 1
	v	TB2-22	DEWAR DP 2
	w	TB2-23	DEWAR TEMP MON
	x	TB2-24	DEWAR TEMP MON RTN
	y	TB2-25	FEB TEMP MON
	z	TB2-26	FEB TEMP MON RTN
	AA	TB2-27	PHASE SH. MON
	BB	TB2-28	PHASE SH. MON RTN
	CC	TB2-29	115 VAC MON
	DD	TB2-30	115 VAC MON RTN
	EE		
	FF		
	HH		
	JJ		
	KK		
	LL		
	MM		
End 56 Pin →	NN		



NATIONAL RADIO ASTRONOMY OBSERVATORY

TITLE: DC POWER DISTRIBUTION CONTROL RACK

DSGN. BY: R. NORROD	DATE: 7-8-81
APP'D. BY:	DR. BY:
DWG. NO. 2.420-113-001	

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.					
2.	3	Digital Panel Meter	DPM1-3	AD 2021	Analog Devices
3.	3	Switch, Rotary, 3 Wafer	SW1-3		
4.	1	Circuit Breaker, 10A	CB1	-01-31AL T11-1-10.0A	Airpax
5.	1	Circuit Breaker, 5A	CB2	-01-31AL T11-1-5.0A	Airpax
6.	1	Indicator, 115 V AC	I1		
7.	1	Indicator, 28 V, 40 mA	I2	327 Midget	
8.	1	Switch, Toggle, DPST	SW4		
9.	3	Connector, 56 Pin Panel, Protected	JCR1-3		
10.	1	Connector, 38 Pin Panel, Protected	JCR4		
11.	2	Connector, Circular, 3 Pin Bulkhead	JPS1,3		
12.	1	Connector, Circular, 5 Pin Bulkhead	JPS2		
13.	1	Connector, AC Female Panel Mount	JAC3		
14.	1	Connector, AC Male Panel Mount	JAC1		
15.	1	Connector, 5 Pin Female Panel Mount	JAC2		
16.	2	Connector, BNC Bulkhead, Isolated	BCR1, BCR2		
17.					
18.	1	Card Cage, 15 Pin x 5 Slots			
19.					
20.					

Parts List No.	Title:	Approved by:	Date:
2.627-105-001	Control Chassis 1.3-1.8 GHz Rx Sheet 1/2	Roger Norrod	9 July 1981 Rev. 6 April 1983

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
21.	1	PCB Assembly - AD 590 Temp Monitor Card	Slot 1	T2.420-101	NRAO
22.	1	PCB Assembly - LO Level Card	Slot 2	2.627-106 -001	NRAO
23.	1	PCB Assembly - Phase Monitor Card	Slot 3	2.627-103 -001	NRAO
24.					
25.	1	PCB Assembly - Meter Scaling Card	Slot 5	T2.420-105	NRAO
26.					
27.					
28.					
29.					
30.					
31.					
32.					
33.					
34.					
35.					
36.					
37.					
38.					
39.					
40.					

Parts List No.	Title:	Approved by:	Date:
2.627-105-001	Control Chassis Sheet 2/2	Roger Norrod	6 August 1981

1.3-1.8 GHz Receiver Control Rack RDN/8Jul81
ELCO CONNECTOR LIST FOR BOX/RACK/DRAWER CONTROL CHASSIS Rev/6Apr83

CONNECTOR: DESIGNATION J1CR1 ; TYPE ; 56 PINS

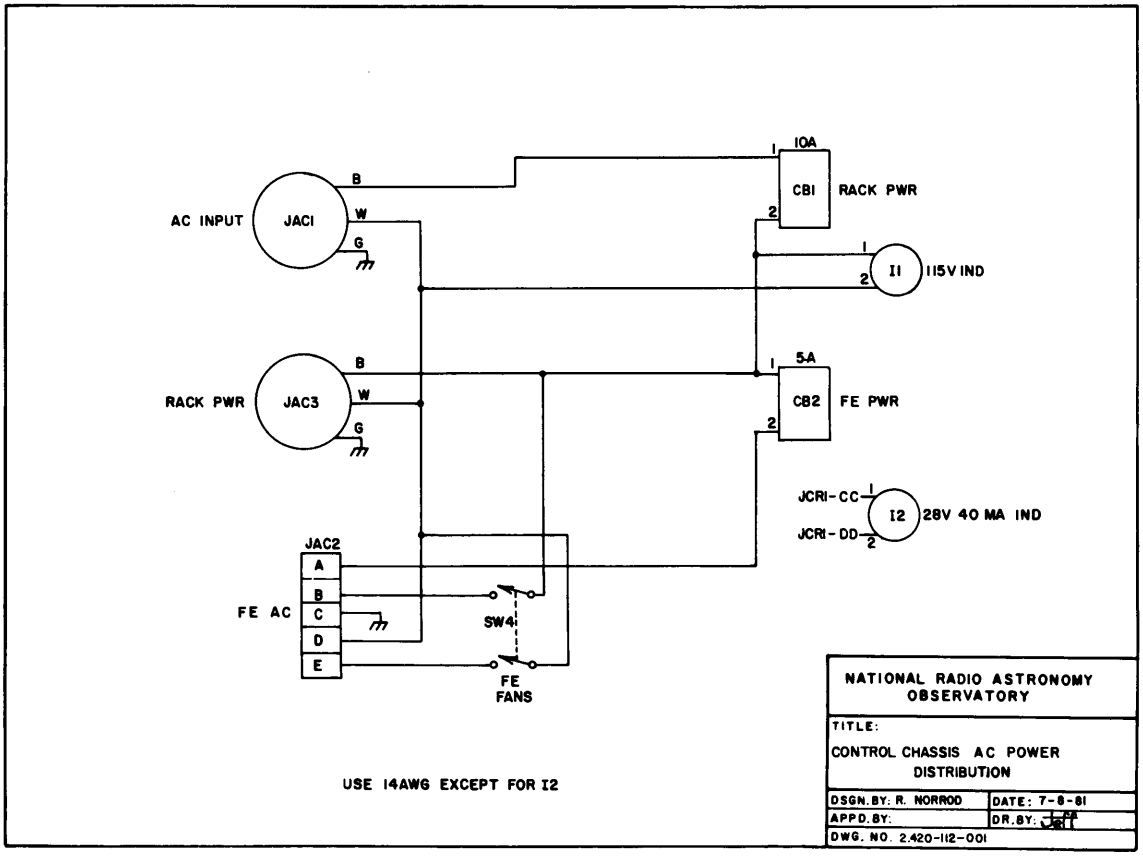
SMALL KEY 1 , LARGE KEY 1 ; PANEL E6 CABLE E/P

Pin	To	Function
A	S2-1	A LO LEVEL
B	S2-2	A LO LEVEL RTN
C	S5-1	A VG1 MON
D	S5-2	A VG1 MON RTN
E	S5-3	A VG2 MON
F	S5-4	A VG2 MON RTN
H	S5-5	A VG3 MON
J	S5-6	A VG3 MON RTN
K		
L		
M		
N		
P		
R		
S		
T		
U		
V		
W		
End 20 Pin → X		
Y		
Z		
AA a	S2-7	B LO LEVEL
BB b	S2-8	B LO LEVEL RTN
CC c	S5-7	B VG1 MON
DD d	S5-8	B VG1 MON RTN
EE e	S5-9	B VG2 MON
FF f	S5-10	B VG2 MON RTN
HH h	S5-11	B VG3 MON
JJ j	S5-12	B VG3 MON RTN
KK k		
LL l		
MM m		
NN n		
PP p		
RR r		
SS s	S3-B	VACUUM MONITOR
TT t	S3-D	VAC MON RTN
End 38 → Pin		

Pin	To	Function
u	SW3-W3-P1	DEWAR DP1
v	NC	DEWAR DP2
w	S5-13	DEWAR TEMP MON
x	S5-14	DEWAR TEMP RTN
y	S1-7	FEB TEMP MON
z	S1-3	FEB TEMP RTN
AA	S3-2	PHASE SH MON
BB	S3-4	PHASE SH RTN
CC	I2-1	115 VAC MON
DD	I2-2	115 VAC MON RTN
EE		
FF		
HH		
JJ		
KK		
LL		
MM		
End 56 Pin → NN		

Abbreviations:
Ex: S25-22 Slot 25, Pin 22 | J9-MM Elco J9, Pin MM

Elco Connectors: J1, J2, J3, etc.
Slot Connectors: S1, S2, S3, etc.
Pin No.'s -A, -B, -C, -D, -E, -F, -H, -J, -K, -L, -M, -N, -P, -R, -S, -T, -U, -V, -W, -X, -Y, -Z, -AA, -BB, -CC, -DD, -EE, -FF, -HH, -JJ, -KK, -LL, -MM, -NN, -PP, -RR, -SS, -TT.



1.3-1.8 GHz Receiver
CARD SLOT WIRING LIST
CONTROL RACK
RDN/8Jul81

FOR: BOX CONTROL CHASSIS CARD DPM 1

From	To	From	To
A		1	
B		2	
C		3	
D		4	SW1-W3-P5 (DPXX.X)
E		5	
F		6	
H		7	
J	GND	8	GND, SW1-W3-PO
K		9	SW1-W1-PO (IN+)
L		10	
M		11	
N	+5	12	
P		13	PIN 9
R		14	SW1-W2-PO (IN-)
S	SW1-W3-P4 (DPX.XX)	15	SW1-W3-P1,P2,P3 (DP.XXX)
T		16	
U		17	
V		18	
W		19	
X		20	
Y		21	
Z		22	

Abbreviations:

Ex: S 25-22
Slot 25, Pin 22

J9-MM
Elco J9, Pin MM

BNC Connectors: B1, B2, B3, etc.
Elco Connectors: J1, J2, J3, etc.
Slot Connectors: S1, S2, S3, etc.
Pin No.'s -3, -X, -B, -22, etc.

1.3-1.8 GHz Receiver
CARD SLOT WIRING LIST
CONTROL RACK
RDN/8Jul81

FOR: BOX CONTROL CHASSIS CARD DMP 2

From	To	From	To
A		1	
B		2	
C		3	
D		4	
E		5	
F		6	
H		7	
J	GND	8	GND, SW2-W3-PO
K		9	SW2-W1-PO
L		10	
M		11	
N	+5	12	
P		13	PIN 9
R		14	SW2-W2-PO
S	SW2-W3-P4	15	SW2-W3-P1,P2,P3
T		16	
U		17	
V		18	
W		19	
X		20	
Y		21	
Z		22	

Abbreviations:

Ex: S 25-22
Slot 25, Pin 22

J9-MM
Elco J9, Pin MM

BNC Connectors: B1, B2, B3, etc.
Elco Connectors: J1, J2, J3, etc.
Slot Connectors: S1, S2, S3, etc.
Pin No.'s -3, -X, -B, -22, etc.

1.3-1.8 GHz Receiver
CARD SLOT WIRING LIST
CONTROL RACK

RDN/8Jul81

FOR: BOX CONTROL CHASSIS CARD DPM 3

From	To	From	To
A		1	
B		2	
C		3	
D		4	SW3-W3-PO
E		5	
F		6	
H		7	
J	GND	8	GND
K		9	SW3-W1-PO
L		10	
M		11	
N	+5V	12	
P		13	PIN 9
R		14	SW3-W2-PO
S		15	
T		16	
U		17	
V		18	
W		19	
X		20	
Y		21	
Z		22	

Abbreviations:

Ex: S 25-22
Slot 25, Pin 22

J9-MM
Elco J9, Pin MM

BNC Connectors: B1, B2, B3, etc.
Elco Connectors: J1, J2, J3, etc.
Slot Connectors: S1, S2, S3, etc.
Pin No.'s -3, -X, -B, -22, etc.

1.3-1.8 GHz Receiver
CARD SLOT WIRING LIST
CONTROL RACK

RDN/8Jul81

FOR: BOX CONTROL CHASSIS CARD FEB TEMP MON

Slot S1 —

From	To	From	To
A		1	
B		2	
C		3	(FEB TEMP RTN) JCR1-$\bar{z}$
D		4	
E		5	(MON OUT) SW3-W1-P3
F		6	
H		7	(FEB TEMP MON) JCR1-$\bar{y}$
J		8	
K		9	GND, SW3-W2-P3
L		10	
M		11	
N		12	
P		13	+5V
R		14	
S		15	GND, SW3-W3-P3
T		16	
U		17	
V		18	
W		19	
X		20	
Y		21	
Z		22	

Abbreviations:

Ex: S 25-22
Slot 25, Pin 22

J9-MM
Elco J9, Pin MM

BNC Connectors: B1, B2, B3, etc.
Elco Connectors: J1, J2, J3, etc.
Slot Connectors: S1, S2, S3, etc.
Pin No.'s -3, -X, -B, -22, etc.

1.3-1.8 GHz Receiver
CARD SLOT WIRING LIST RDN/8Ju181
CONTROL RACK Rev.6Aug81

FOR: BOX CONTROL CHASSIS CARD LO MONITOR BUFFER

Slot S2 —

* 188 COAX

	From	To	From	To
	A		1	(A LO LEVEL) JCR1-A
	B		2	(A LO LEV RTN)JCR1-B
	C		3	SW1-W2-P4
	D		4	(A LO MON) SW1-W1-P4
	E		5	(ULO1 LEV) BCR1-C*
	F		6	+15
	H		7	(B LO LEVEL) JCR1-a
	J		8	(B LO LEV RTN)JCR1-b
	K		9	SW2-W2-P4
	L		10	(B LO LEVEL) SW2-W1-P4
	M		11	(ULO2 LEV) BCR2-C*
	N		12	(ULO2 LEV RTN)BCR1-O*
	P		13	(ULO2 LEV RTN)BCR2-O*
	R		14	-15
	S		15	GND
	T		16	
	U		17	
	V		18	
	W		19	
	X		20	
	Y		21	
	Z		22	

Abbreviations:

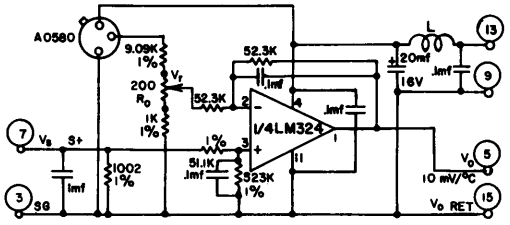
Ex: S 25-22
Slot 25, Pin 22

J9-MM
Elco J9, Pin MM

BNC Connectors: B1, B2, B3, etc.
Elco Connectors: J1, J2, J3, etc.
Slot Connectors: S1, S2, S3, etc.
Pin No.'s -3, -X, -B, -22, etc.

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.	1	Douglas Card Modified for 15 Pins			
2.					
3.	2	Capacitor, 1.0 µF, 100 V, Ceramic			
4.	2	Capacitor, 0.1 µF, 100 V, Ceramic			
5.	2	Capacitor, .022 µF, 100 V, Ceramic			
6.					
7.	2	Diode, Transzorb, 15 V		1N6377	General Semicond.
8.					
9.	2	IC, Op Amp, Low Drift	U1,2	OP-07 DH	Analog Devices
10.	2	IC, Op Amp	U3,4	741CK	
11.	8	Resistor, 100. K , Metal Film, 1%			
12.	4	Resistor, 1.00 K , Metal Film, 1%			
13.	2	Resistor, 249 ohm, Metal Film, 1%			
14.	2	Resistor, 3.48 K , Metal Film, 1%			
15.	2	Variable Resistor, 20 K, 10 T			
16.	2	Variable Resistor, 500 ohm, 10 T			
17.					
18.	4	Resistor, 10.0 K, Metal Film, 1%			
19.					
20.					

Parts List No.	Title:	Approved by:	Date:
2.627-106-001	LO Level Card Control Chassis - Slot 2 1.3-1.8 GHz Rx Control Rack	Roger Norrod	6 August 1981



ADJUST R_0 FOR V_o=0.200 VOLT WITH 293.2 mV SOURCE CONNECTED TO S+, SG IN PLACE OF SENSOR AD590
THEN $V_r \approx$ 293.2 mV (+20.0°C)

L = 1500uH, $R_s \approx 26\Omega$; NYTRONICS SWD1500

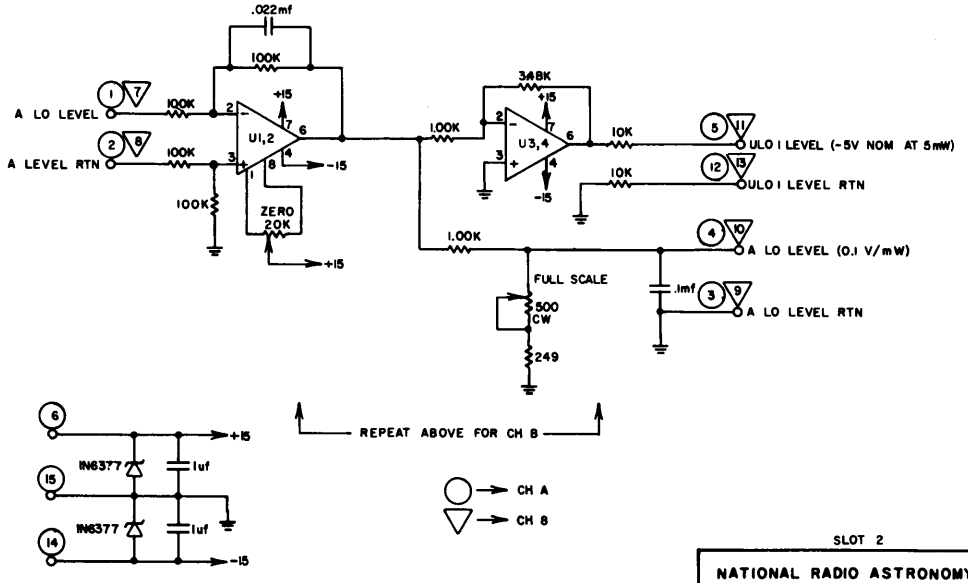
I_t = 1uA/KELVIN FROM ANALOG DEVICES AD590K TEMPERATURE SENSOR. MOUNT IN CLIP ON HEAT RADIATOR TO-52
V_s = 1mV/KELVIN ACROSS 1002Ω RESISTOR IN PARALLEL WITH 574KΩ INPUT TO LM324 AMP CIRCUIT

LM324 AMP CIRCUIT GAIN = $\frac{523K}{51.1K+1.002K}$

LM324: GROUND ALL UNUSED INPUT PINS

SLOT 1

NATIONAL RADIO ASTRONOMY OBSERVATORY	
TITLE: TEMPERATURE MONITOR	
DSGN.BY: R. NORROD	DATE: 12-12-83
APPD.BY:	DR.BY: Jeff
DWG. NO. 2627-102-001	



SLOT 2

NATIONAL RADIO ASTRONOMY OBSERVATORY	
TITLE: LO LEVEL CARD CONTROL CHASSIS 1.3 - 1.8 GHZ RX CONTROL RACK	
DSGN.BY: R. NORROD	DATE: 8-8-81
APPD.BY:	DR.BY: Jeff
DWG. NO. 2.627-107-001	

1.3-1.8 GHz Receiver

CARD SLOT WIRING LIST
CONTROL RACK

RDN/8Jul81
Rev.6Apr83

FOR: BOX CONTROL CHASSIS CARD PHASE SHIFTER MON

Slot S3 —

From	To	From	To
A		1	
B	VACUUM MONITOR JCR1-s	2	(PHASE SH MON) JCR1-AA
C		3	GND
D	VACUUM MONITOR RTN JCR1-t	4	(PHASE SH RTN) JCR1-BB
E		5	
F		6	+15V
H		7	
J	VAC OUT (+) SW3-W1-P2	8	(OUT +) SW1-W1-P5
K		9	GND
L	VAC OUT (-) SW3-W2-P2	10	(OUT -) SW1-W2-P5
M		11	
N		12	
P		13	
R		14	-15V
S		15	GND
T		16	
U		17	
V		18	
W		19	
X		20	
Y		21	
Z		22	

Abbreviations:

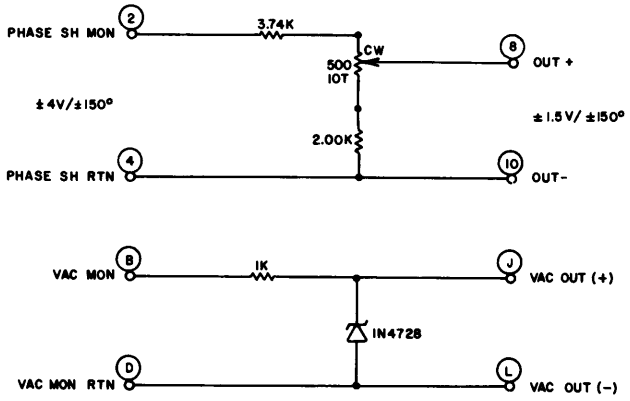
Ex: S 25-22
Slot 25, Pin 22

J9-MM
Elco J9, Pin MM

BNC Connectors: B1, B2, B3, etc.
Elco Connectors: J1, J2, J3, etc.
Slot Connectors: S1, S2, S3, etc.
Pin No.'s -3, -X, -B, -22, etc.

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.	1	Douglas Card, Modified to fit slot			
2.					
3.	1	Pot, 10 T, 500 ohm	89PR500	Helitrim	
4.					
5.	1	Resistor, 3.74 K, 1% Metal Film			
6.	1	Resistor, 2.00 K, 1% Metal Film			
7.					
8.	1	Resistor, 1 K, 1/4 W Carbon			
9.	1	Zener Diode, 3.3 V		1N4728A	
10.					
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					

Parts List No.	Title:	Approved by:	Date:
2.627-103-001	Phase Shifter Mon Card Control Chassis 1.3-1.8 GHz Rx Control Rack	Roger Norrod	26 August 1981



NOTE: PHASE INDICATION ACCURATE AT 1666 MHZ WHEN ADJUSTED TO ±150° F.S.

SLOT 3

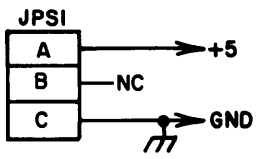
NATIONAL RADIO ASTRONOMY OBSERVATORY	
TITLE: PHASE SHIFTER MONITOR CARD CONTROL CHASSIS 1.3-1.8 GHZ RX CONTROL RACK	
DSGN. BY: R. NORROD	DATE: 8-26-81
APPD. BY:	DR. BY: Jeff
DWG. NO. 2.627-104-001	

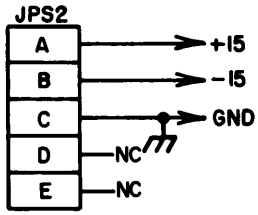
Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.					
2.	2	Connector, Elco, 56 Pin Protected	JMC1,2		
3.	2	Connector, Circular, 3 Pin Bulkhead	JPS1,3		
4.	1	Connector, Circular, 5 Pin Bulkhead	JPS2		
5.					
6.	4	BNC Panel Mount, Isolated	BMC1-BMC4		
7.					
8.	2	Pot, 10 Turn, 1 K Ohm	P1,2		
9.	1	Switch, Rotary, 1P5T, Non-Shorting	SW14		
10.	2	Counting Dial, Miniature			
11.					
12.	11	Indicator, LED, Red	I1-110, I12	MV5025	Monsanto
13.	2	Indicator, LED, Green	I11, I13	MV5253	Monsanto
14.	10	Indicator, LED, Red, Miniature	I14-123	HLMP-1301	HP
15.	4	Switch, SPDT Toggle	SW1-SW4		
16.	4	Switch, On-Off-On Toggle	SW6-SW9		
17.	3	Switch, MOM ON-OFF-MOMON Toggle	SW5, SW10, 11		
18.	2	Switch, DPDT Toggle	SW12, 13		
19.	1	Card Cage, 22 Pin x 5 slots			
20.					

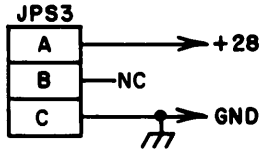
Parts List No.	Title:	Approved by:	Date:
2.627-104-001	Monitor Chassis, 1.3-1.8 GHz RX Sheet 1 of 2	Roger Norrod	9 July 1981 Rev. 6 April 1983

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.	1	PCB Assembly - Cal Control Logic	Slot 1	2.627-141 -001	NRAO
2.	1	PCB Assembly - Indicator Buffer	Slot 2	2.627-143 -001	NRAO
3.	1	PCB Assembly - Logic Input Buffer	Slot 3	2.627-145 -001	NRAO
4.	1	PCB Assembly - Filter Indicator Buffer	Slot 4	2.627-147 -001	NRAO
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					

Parts List No.	Title:	Approved by:	Date:
2.627-104-001	Monitor Chassis Sheet 2 of 2	Roger Norrod	10 August 1981







NATIONAL RADIO ASTRONOMY OBSERVATORY

TITLE:
DC POWER DISTRIBUTION MONITOR CHASSIS
1.3 - 1.8 GHZ RX CONTROL RACK

DSGN.BY: R. NORROD	DATE: 7-8-81
APPD.BY:	DR.BY:
DWG. NO. 2.420-212-001	

1.3-1.8 GHz Receiver

ELCO CONNECTOR LIST FOR BOX/RACK/DRAWER Monitor Chassis RDN/6Apr83

CONNECTOR: DESIGNATION JMC1 ; TYPE Panel ; 56 PINS

SMALL KEY 2, LARGE KEY 1 ; PANEL E/P CABLE E/P

Pin	To	Function
A	S1-A	A LO-CAL
B	S1-B	A LO-CAL
C	S1-E	A HI-CAL
D	S1-D	A HI-CAL
E	SW12-1A	ANS
F	SW12-0A	ANS RTN
H	P1-CW	A FET GAIN CW
J	P1-CCW, Arm	A FET GAIN CCW
K		
L		
M		
N		
P	GND	GND
R		
S		
T		
U		
V		
W		
X		
Y		
Z		
a	S1-M	B LO-CAL
b	S1-N	B LO-CAL
c	S1-S	B HI-CAL
d	S1-R	B HI-CAL
e	SW13-1A	BNS
f	SW13-0A	BNS RTN
h	P2-CW	B FET GAIN CW
j	P2, CCW, Arm	B FET GAIN CCW
k		
l		
m		
n		
p		
r		
s		
t		

End 20 Pin →

End 38 → Pin

Pin	To	Function
u		
v		
w		
x		
y		
z		
AA		
BB		
CC		
DD		
EE		
FF		
HH		
JJ		
KK		
LL		
MM		
NN		

End 56 Pin →

Abbreviations:
Ex: S25-22 | J9-MM

Elco Connectors: J1, J2, J3, etc.
Slot Connectors: S1, S2, S3, etc.

1.3-1.8 GHz Receiver

ELCO CONNECTOR LIST FOR BOX/RACK/DRAWER Monitor Chassis Rev. 20Jul83 RDN 9Jul82

CONNECTOR: DESIGNATION JMC2 ; TYPE Panel ; 56 PINS

SMALL KEY 2, LARGE KEY 2 ; PANEL E/P CABLE E/P

Pin	To	Function
A		R.I. SUPPLY
B	S2-21	R.I. RTN
C	S2-A	A LO-CAL
D	S2-B	B LO-CAL
E	S2-C	A HI-CAL
F	S2-D	B HI-CAL
H		Spare
J		Spare
K	S2-H	A FET 1
L	S2-J	B FET 1
M	S2-K	A FET 2
N	S2-L	B FET 2
P	S2-M	LINEAR
R	S2-N	CIRC
S	S2-P	COMMON LO
T	S2-R	SEPARATE LO
U		
V	SW10-0 ≠	XFR SW SELECT
W	SW10-1	LINEAR S.
X	SW10-2	CIRC S.
Y		SPARE
Z		SPARE
a	SW11-1	COMMON LO S.
b	SW11-2	SEP LO S.
c	SW1-0*	RELAY RTN
d		
e	SW1-2	A FET1 PWR
f	SW3-2	B FET1 PWR
h	SW2-2	A FET2 PWR
j	SW4-2	B FET2 PWR
k		
l	Anode I-14-23	REMOTE IND SUPPLY
m	SW5-0B	FEB RTN
n	S4-E	CH A BAND 1 IND
p	S4-F	2 "
r	S4-H	3 "
s	S4-J	4 "
t	S4-K	5 "

End 20 Pin →

End 38 → Pin

Pin	To	Function
u	S4-L	CH B BAND 1 IND
v	S4-M	2 "
w	S4-N	3 "
x	S4-P	4 "
y	S4-R	5 "
z		
AA	SW14-W1-P0, SW5-0A	28V FEB SUPPLY
BB	SW14-W1-P1	BAND 1 SELECT
CC	SW14-W1-P2	BAND 2 SELECT
DD	SW14-W1-P3	BAND 3 SELECT
EE	SW14-W1-P4	BAND 4 SELECT
FF	SW14-W1-P5	BAND 5 SELECT
HH	SW5-1A	INCREASE PHASE SUPPLY
JJ	SW5-1B	INCREASE RTN
KK	SW5-2B	DECREASE RTN
LL	SW5-2A	DECREASE SUPPLY
MM		
NN		

End 56 Pin →

≠ CONNECT SW10-0 and SW11-0 TOGETHER.

* CONNECT SW1-0, SW2-0, SW3-0, SW4-0 TOGETHER.

NOTE: TOGGLE SWITCH NOTATION--
-0 is SWITCH POLE
-1 is TERMINAL CONNECTED TO POLE IN POSITION LEFT OR UP.

Abbreviations:
Ex: S25-22 | J9-MM

Elco Connectors: J1, J2, J3, etc.
Slot Connectors: S1, S2, S3, etc.

1.3-1.8 GHz Receiver

CARD SLOT WIRING LIST Rev. 26Aug81

FOR: BOX MONITOR CHASSIS CARD CAL CONTROL LOGIC

Slot S1 — Connect at Card Connector

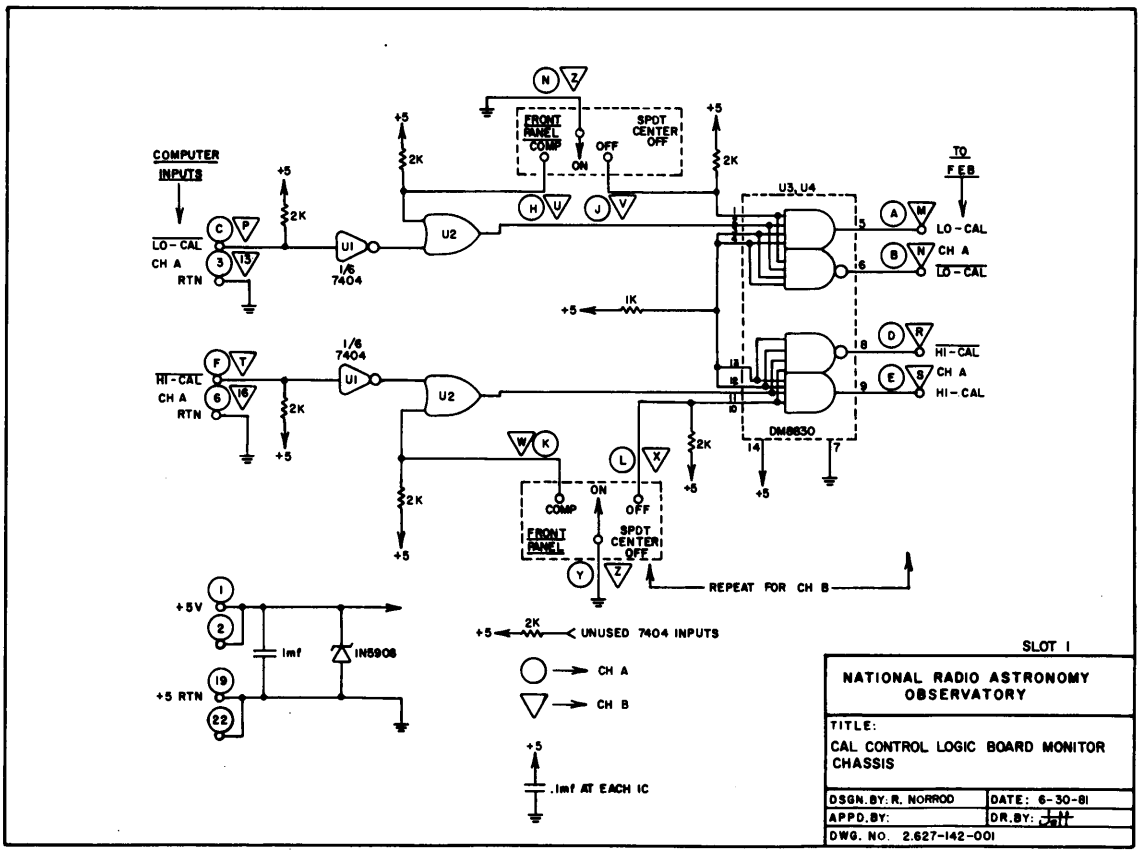
	From	To	From	To
	A	(A LO-CAL) JMC1-A	1	(+5 V) 5V BUS
	B	(A LO-CAL) JMC1-B	2	(+5 V)
	C	(COMP A LO) S3-18	3	(GND)
	D	(A HI-CAL) JMC1-D	4	
	E	(A HI-CAL) JMC1-C	5	
	F	(COM A HI) S3-17	6	(GND)
	H	(A LO COMP SEL) SW7-1	7	
	J	(A LO OFF SEL) SW7-2	8	
	K	(A HI COMP SEL) SW6-1	9	
	L	(A HI OFF SEL) SW6-2	10	
	M	(B LO-CAL) JMC1-a	11	
	N	(B LO-CAL) JMC1-b	12	
	P	(COMP B LO) S3-18	13	(GND)
	R	(B HI-CAL) JMC1-d	14	
	S	(B HI-CAL) JMC1-c	15	
	T	(COMP B HI) S3-17	16	(GND)
	U	(B LO COMP SEL) SW9-1	17	
	V	(B LO OFF SEL) SW9-2	18	
	W	(B HI COMP SEL) SW8-1	19	(GND)
	X	(B HI OFF SEL) SW8-2	20	
	Y	(SEL RTN) SW6, 7-0	21	
	Z	(SEL RTN) SW8, 9-0	22	(GND) 5V RTN

Abbreviations:

Ex: S 25-22
Slot 25, Pin 22

J9-MM
Elco J9, Pin MM

BNC Connectors: B1, B2, B3, etc.
Elco Connectors: J1, J2, J3, etc.
Slot Connectors: S1, S2, S3, etc.
Pin No.'s -3, -X, -B, -22, etc.



Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.	1	Douglas Card		11-DE-1	
2.					
3.	1	Capacitor, 1 µF Ceramic			
4.	4	Capacitor, 0.1 µF Ceramic			
5.					
6.	1	Diode, Transient Suppressor		1N5908	
7.					
8.	1	IC, Hex Inverter	U1	7404N	
9.	1	IC, Quad OR	U2	7432N	
10.	2	IC, Dual Line Driver	U3,4	DM8830	
11.					
12.					
13.	13	Resistor, 2 K Ohm, 1/8 W Carbon			
14.	2	Resistor, 1 K Ohm, 1/8 W Carbon			
15.	4	Socket, 14P, Wirewrap			
16.					
17.					
18.					
19.					
20.					

Parts List No.	Title:	Approved by:	Date:
2.627-141-001	Cal Control Logic Board Monitor Chassis	Roger Norrod	9 July 1981

1.3-1.8 GHz Receiver
CARD SLOT WIRING LIST RDN/9Jul83

FOR: BOX MOTOR CHASSIS CARD INDICATOR BUFFER

Slot S2 —

From	To		From	To	
A	(A LO-CAL)	JMC2-C	1	(+5V)	5V BUS
B	(B LO-CAL)	JMC2-D	2	(AEN)	SW12-1B
C	(A HI-CAL)	JMC2-E	3		
D	(B HI-CAL)	JMC2-F	4		I6-A
E		I1-A	5		I6-C
F		I1-C	6		I7-A
H	(A FET1)	JMC2-K	7		I7-C
J	(B FET1)	JMC2-L	8		I8-A
K	(A FET2)	JMC2-M	9		I8-C
L	(B FET2)	JMC2-N	10		I9-A
M	(LINEAR)	JMC2-P	11		I9-C
N	(CIRC)	JMC2-R	12		I10-A
P	(COMMON LO)	JMC2-S	13		I10-C
R	(SERR LO)	JMC2-T	14		I11-A
S			15		I11-C
T		I2-A	16		I12-A
U		I2-C	17		I12-C
V		I3-A	18		I13-A
W		I3-C	19	(BEN)	SW13-1B
X		I4-A	20		I13-C
Y		I4-C	21	(RI RTN)	JMC2-B
Z			22	(GND)	SW12-0B, SW13-0B, 5V RTN

Abbreviations:

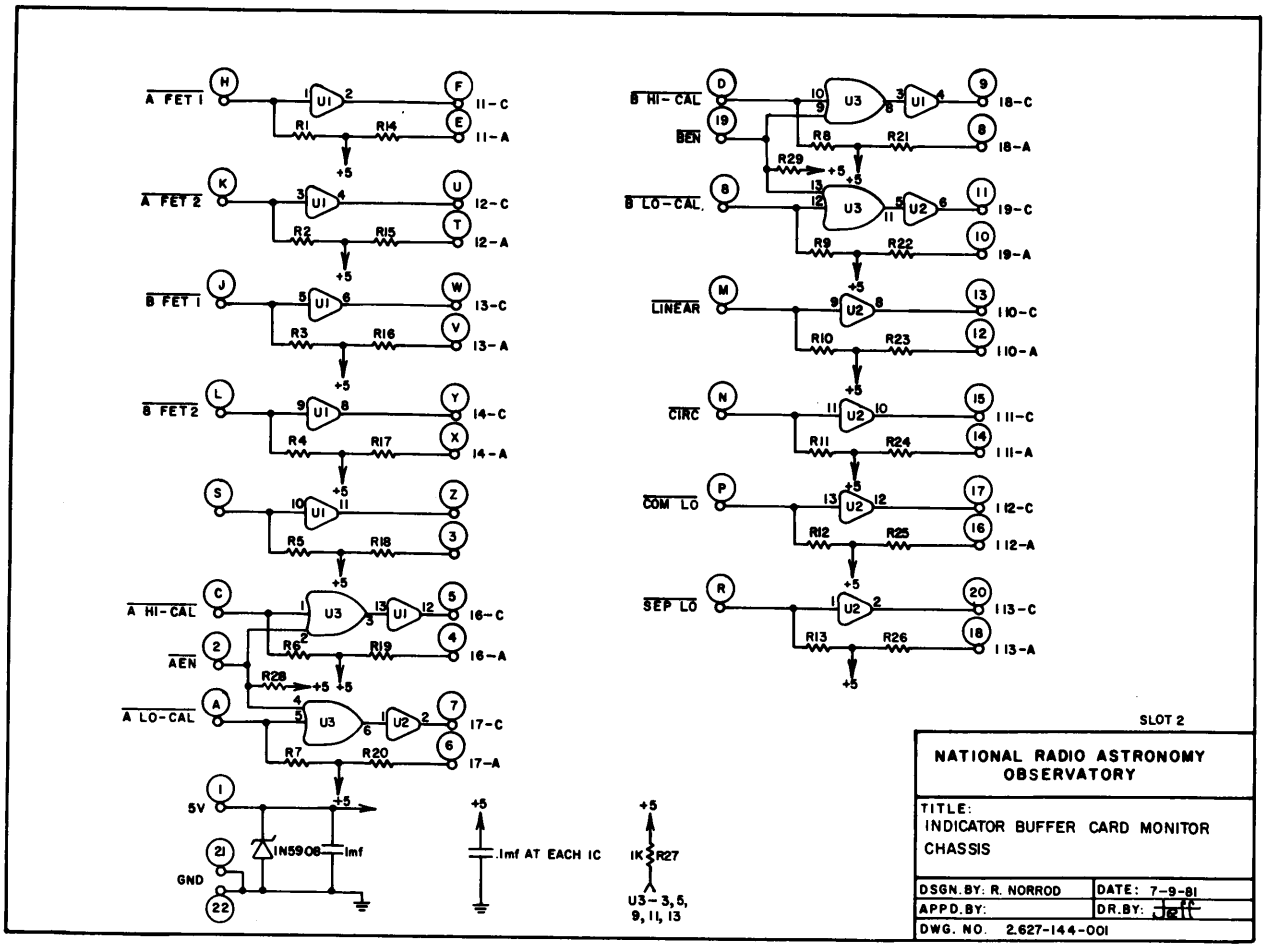
Ex: S 25-22
Slot 25, Pin 22

J9-MM
Elco J9, Pin MM

BNC Connectors: B1, B2, B3, etc.
Elco Connectors: J1, J2, J3. etc.
Slot Connectors: S1, S2, S3, etc.
Pin No.'s -3, -X, -B, -22, etc.

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.	1	Douglas Card		11-DE-1	
2.					
3.	1	Capacitor, 1 μF Ceramic			
4.	3	Capacitor, 0.1 μF Ceramic			
5.					
6.	1	Diode, Transient Suppressor		1N5908	
7.	2	Resistor, 120 ohm, 1/4 W Carbon, 5%	R24, R26		
8.	1	Resistor Array, 2 K x 13	R1-13	899-1-R2X	Beckman
9.	11	Resistor, 150 ohm, 1/4 W carbon, 5%	R14-R23, R25		
10.	3	Resistor, 1K ohm, 1/4 W carbon, 5%	R27-29		
11.	3	IC, Hex Open C Buffer	U1-U3	7407N	
12.	1	IC, Quad OR	U4	7432N	
13.	5	Socket, 14P, Wirewrap			
14.					
15.					
16.					
17.					
18.					
19.					
20.					

Parts List No.	Title:	Approved by:	Date:
2.627-143-001	Monitor Chassis, Indicator Buffer Card	Roger Norrod	9 July 1981



1.3-1.8 GHz Receiver
CARD SLOT WIRING LIST RDN/11Aug81

FOR: BOX MONITOR CHASSIS CARD INPUT LOGIC BUFFER

Slot S3 —

Connect at Card Connector

* - 188 COAX
-C - Center
-O - Shield

	From	To	From	To
A			1	(+5V) 5V BUS
B	(IN 3C4)		2	(+5V)
C	(SHIELD)		3	(GND) 5V RTN
D			4	(GND)
E			5	
F			6	
H	(SHIELD)		7	(GND) 15V RTN
J	(IN 3C3)		8	(-15V) -15V BUS
K			9	(IN3C2) BMC4-C *
L			10	(SHIELD) BMc4-O
M			11	
N			12	(INTTL2) BMC2-C *
P			13	(SHIELD) BMC2-O
R	(IN TTL4)		14	
S	(SHIELD)		15	(SHIELD) BMC1-O *
T	(SHIELD)		16	(INTTL1) BMC1-C
U	(IN TTL3)		17	(OUT1) S1-F, S1-T
V			18	(OUT2) S1-C, S1-P
W	(OUT3)		19	
X			20	(SHIELD) BMC3-O *
Y			21	(IN3C1) BMC3-C
Z	(OUT4)		22	

Abbreviations:

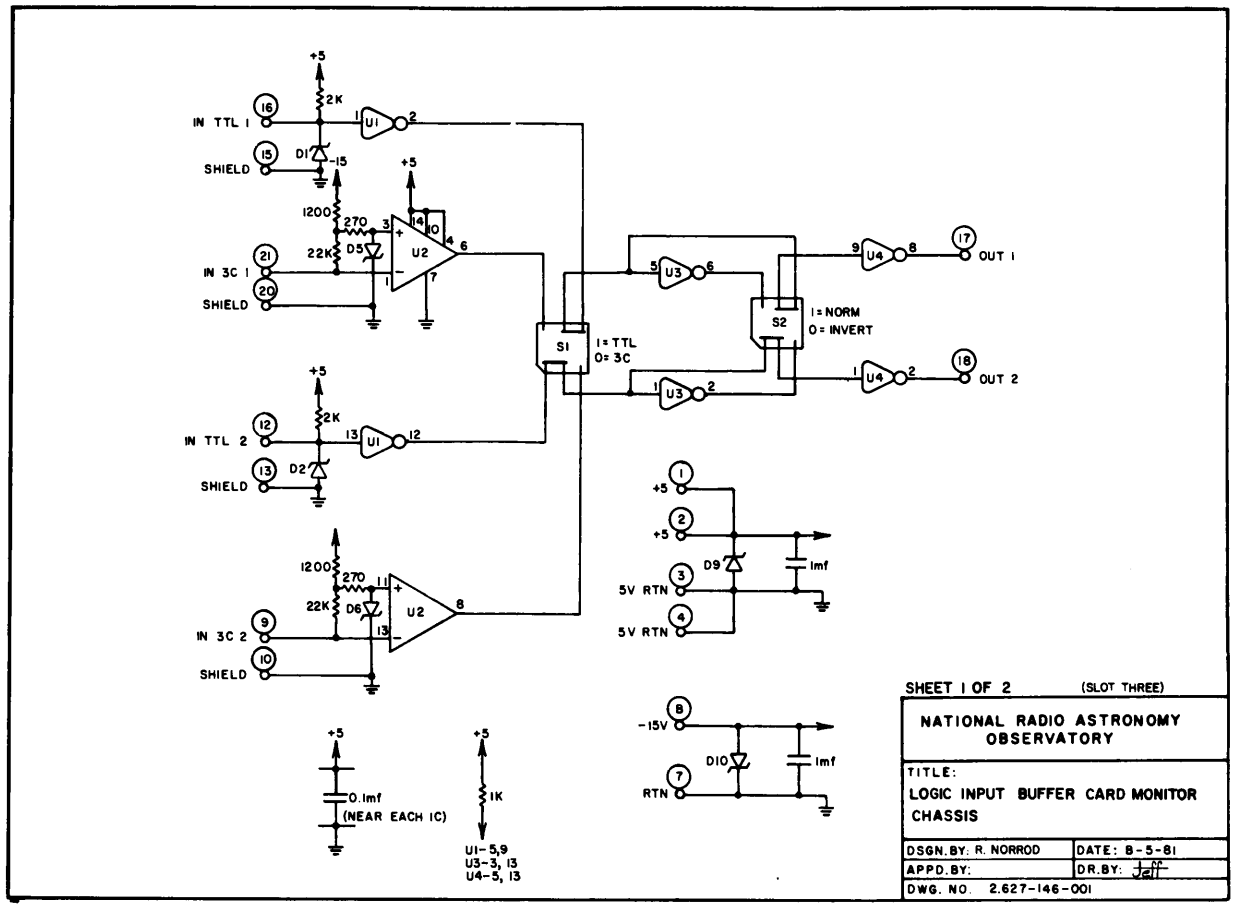
Ex: S 25-22
Slot 25, Pin 22

J9-MM
Elco J9, Pin MM

BNC Connectors: B1, B2, B3, etc.
Elco Connectors: J1, J2, J3, etc.
Slot Connectors: S1, S2, S3, etc.
Pin No.'s -3, -X, -B, -22, etc.

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.	1	Artwork		PC2.420-28	NRAO
2.					
3.	5	Capacitor, 0.1 µF			
4.	2	Capacitor, 1.0 µF			
5.					
6.	5	Diode, 5 V Transient Suppressor	D1-D4, D9	1N6373	
7.	1	Diode, 15 V Transient Suppressor	D10	1N6377	
8.	4	Diode, 3.3 V Zener	D5-D8	1N4728A	
9.					
10.	4	Resistor, 270 ohm, 1/4 W carbon			
11.	4	Resistor, 1200 ohm, 1/4 W carbon			
12.	4	Resistor, 22 K, 1/4 W carbon			
13.	4	Resistor, 2 K, 1/4 W carbon			
14.	1	IC, Hex Schmitt-Trigger Inverters	U1	7414N	
15.	1	IC, Hex Inverters	U3	7404N	
16.	1	IC, Hex Open-C Inverters	U4	7406N	
17.	2	IC, Dual Line Receiver	U2, U5	DM8820	National
18.	4	Switch, PCB 2P2T	S1-S4	230010G	Eeco
19.	5	Socket, 14 Pin PCB			
20.					

Parts List No.	Title:	Approved by:	Date:
2.627-145-001	Logic Input Buffer Card	Roger Norrod	5 August 1981

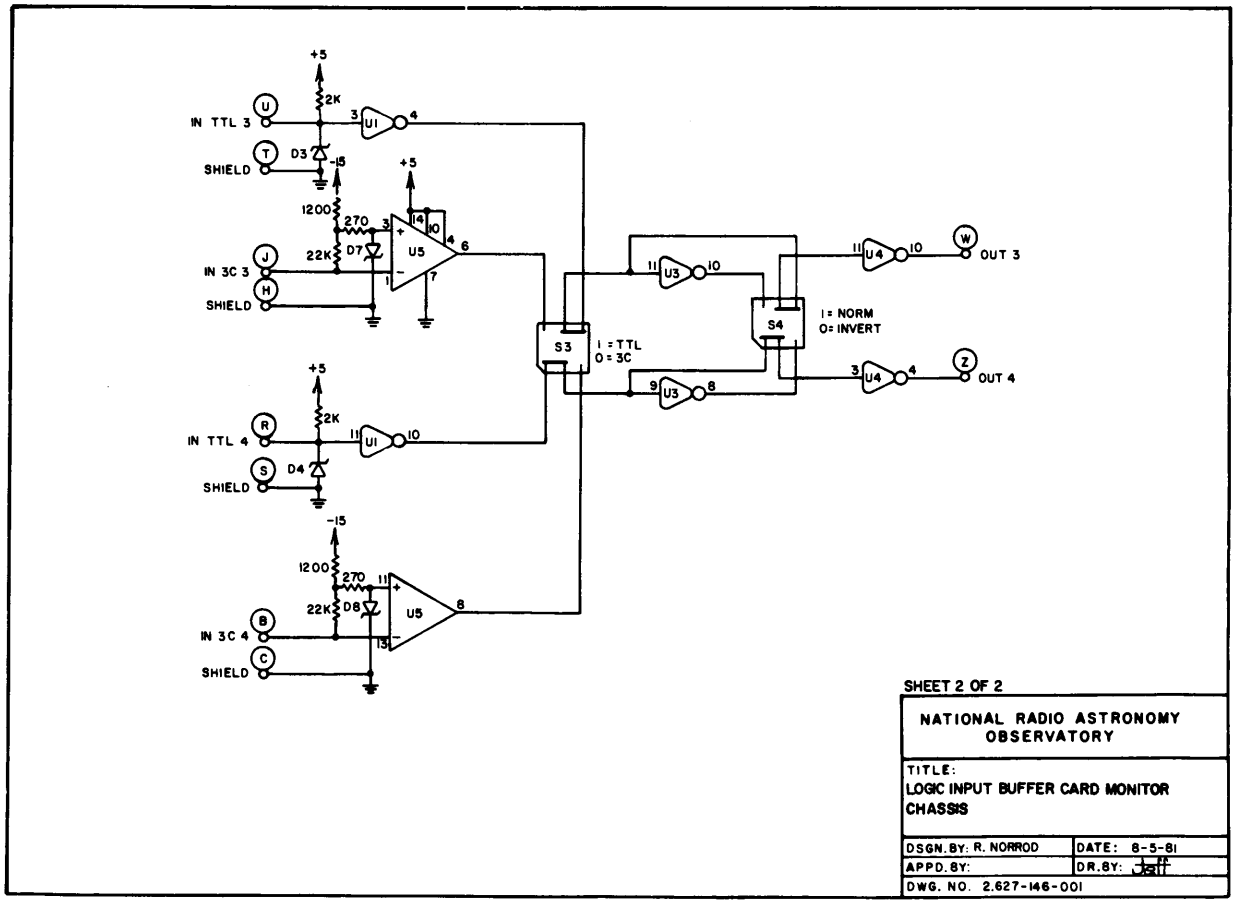


SHEET 1 OF 2 (SLOT THREE)

NATIONAL RADIO ASTRONOMY OBSERVATORY

TITLE:
LOGIC INPUT BUFFER CARD MONITOR CHASSIS

DSGN. BY: R. NORROD	DATE: 8-5-81
APPD. BY:	DR. BY: Jeff
DWG. NO. 2.627-146-001	



SHEET 2 OF 2

NATIONAL RADIO ASTRONOMY OBSERVATORY

TITLE:
LOGIC INPUT BUFFER CARD MONITOR CHASSIS

DSGN. BY: R. NORROD	DATE: 8-5-81
APPD. BY:	DR. BY: Jeff
DWG. NO. 2.627-146-001	

1.3-1.8 GHz Receiver
CARD SLOT WIRING LIST RDN

FOR: BOX MONITOR CHASSIS CARD FILTER INDICATOR BUFFER

Slot S4 —

	From	To	From	To
A			1	
B			2	
C			3	
D			4	
E	JMC2-n		5	I14-Cathode
F	-p		6	I15-C
H	-r		7	I16-C
J	-s		8	I17-C
K	-t		9	I18-C
L	-u		10	I19-C
M	-v		11	I20-C
N	-w		12	I21-C
P	-x		13	I22-C
R	-y		14	I23-C
S			15	
T			16	
U			17	
V			18	
W			19	
X			20	
Y			21	
Z			22	

Abbreviations:

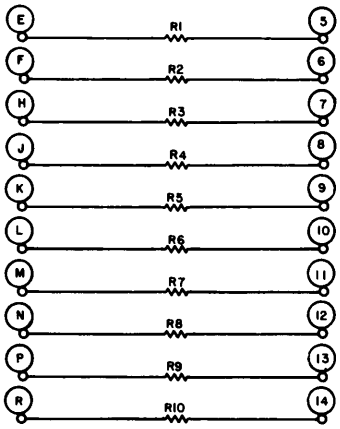
Ex: S 25-22
Slot 25, Pin 22

J9-MM
Elco J9, Pin MM

BNC Connectors: B1, B2, B3, etc.
Elco Connectors: J1, J2, J3, etc.
Slot Connectors: S1, S2, S3, etc.
Pin No.'s -3, -X, -B, -22, etc.

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.	1	Douglas Card		11-DE-1	
2.					
3.		Resistor, 1/4 W Carbon, 300 Ohm	R1-10		
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					

Parts List No.	Title:	Approved by:	Date:
2.627-147 -001	Filter Indicator Buffer Card 1.3-1.8 GHz Rx Monitor Chassis	Roger Norrod	6 April 83

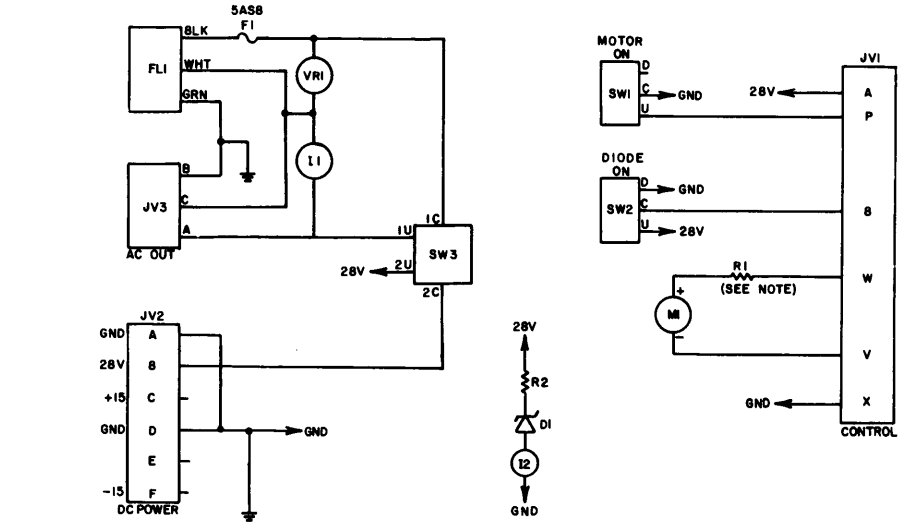


SLOT 4

NATIONAL RADIO ASTRONOMY OBSERVATORY

TITLE:
FILTER INDICATOR BUFFER
MONITOR CHASSIS
1.3-1.8 GHZ RX

DSGN. BY: R. NORROD	DATE: 4-6-83
APPD. BY:	DR. BY:
DWG. NO. 2.627-148-001	



NOTE: SELECTED SO THAT M1 FULL SCALE = 1.000V (10K NOM)

NATIONAL RADIO ASTRONOMY OBSERVATORY

TITLE:
VERTEX ROTATING HORN CONTROL PANEL
18 CM RX

DSGN. BY: R. NORROD	DATE: 1-8-82
APPD. BY:	DR. BY:
DWG. NO. 2.420-131-001	

BENDIX 194228-15S
30 CONDUCTOR — 16 GA: CONNECTOR VERTEX ROTATING HORN CONTROL

LOCATION 1.3-1.8 GHz RX CONTROL RACK TOP PLATE

Wire Color	Pin Letter	Term. No.	Function	Connect to:
Orange Purple	A		DIODE SW	PV1-B
Orange Blue	B			
Yellow White	C			
Yellow	D			
Red Purple	E			
Red Blue	F			
Orange Green	G			
Yellow Black	H			
Yellow Brown	J			
Black	K			
White Yellow	L			
Red Green	M			
Orange Yellow	N			
Orange	P		MOTOR RELAY RTN	PV1-P
Brown	R			
Red	S			
Red Black	T			
Red Yellow	U			
Red Brown	V		DIODE CURRENT -	PV1-V
Orange Brown	W		DIODE CURRENT +	PV1-W
Green	X			
Orange White	Y			
Orange Black	Z		GND	PV1-X
Blue	a		MOTOR RELAY 28 V	PV1-A
Purple	b			
Purple White	c			
Green White	d			
Green Black	e			
Green Brown	f			
Red White	g			
Shield	1	Shield		

RDN
3Feb82

BENDIX 194224-105
7-CONDUCTOR — 8 GA: CONNECTOR VERTEX ROTATING HORN AC

LOCATION 1.3-1.8 GHz RC CONTROL RACK TOP PLATE

Wire Color	Pin Letter	Term. No.	Function
AC STANDARD*			
Black	A	1	No. 1 AC Hot to Power Supplies
Red	B	2	No. 2 AC Hot to Fans
Shield	C	3	Shield
White	D	4	No. 1 AC Neutral to Power Supplies
Green	E	5	No. 2 AC Neutral to Fans
DC STANDARD*			
Black	A	1	+DC Source to Heat Pumps
Red	B	2	-DC Source to Heat Pumps
Shield	C	3	Shield
White	D	4	+DC Source to Heat Pumps
Green	E	5	-DC Source to Heat Pumps

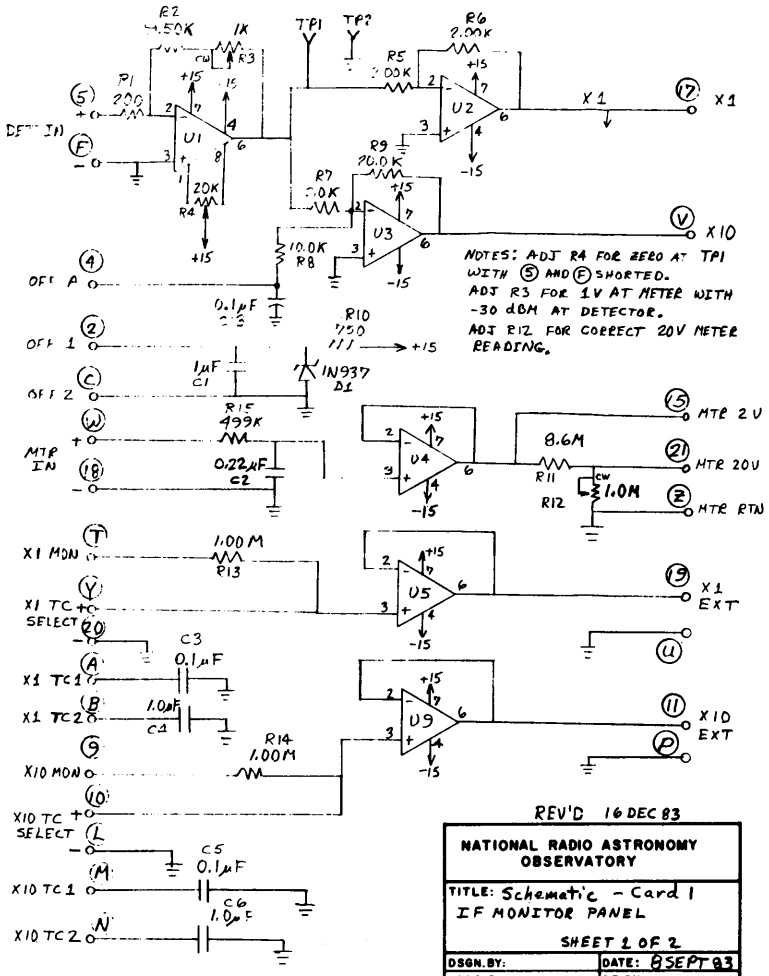
NON-STANDARD			Function	Connect to
Black	A		AC HOT	PV3-A
Red	B		NC	--
Shield	C		SAFETY GND	PV3-B
White	D		AC NEUTRAL	PV3-C
Green	E		NC	--

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.	1	Front Panel Assembly	A1	2.627-125-001	NRAO
2.	1	Detector Assembly	A2	2.627 130-001	NRAO
3.	1	Rear Panel		2.627-127-001	NRAO
4.	2	IF Amplifier	AMP1,2	WA-538	Q-Bit
5.	8	Connectors, BNC, RG-188 - Bulkhead	BNC1-8	31-318	Amphenol
6.					
7.	2	Power Divider	PD1,2	ZFSC-2-2	Mini-Circuits
8.	2	Amplifier, DC, X200	DA1,2	2.420-510-001	NRAO
9.	1	Transient Suppressor, 130 V AC	VR1	V130LA20A	GE
10.	1	Fuse Holder	F1		
11.	2	Bandpass Filter, 250 MHz, 10 MHz BW	FL1,3	6B120-250/10-B/B	K&L Microwave
12.	2	Bandpass Filter, 250 MHz, 40 MHz BW	FL2,4	6B120-250/40-B/B	K&L Microwave
13.	1	AC Input EMI Filter	FL5	5B4-5A	Corcom
14.					
15.	2	PC Card 1	PC1,2	2.627-135-001	NRAO
16.	1	PC Card, Heater Control	PC4	2.627-157-001	NRAO
17.	1	PC Card, LED Buffer	PC3	2.627-138-001	NRAO
18.	1	PC Card, Cage, 4 Cards			NRAO
19.	REF	WIRING DIAGRAM		2.627-132-001	
20.	REF	COMPONENT LAYOUT DRAWING		2.627-126-001	

Parts List No.	Title:	Approved by:	Date:
2.627-129-001	IF MONITOR PANEL	R. Norrod	29 Aug 83 Rev. 15 Sep 83

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.	2	Attenuator, Step 1 dB - 0-60 dB	AT1,2	3009-100	Weinschel
2.					
3.	4	BNC Feedthru, Isolated	BNC 1-4	31-4803	Amphenol
4.	2	BNC Feedthru	BNC 5,6	UG-492/U	
5.	2	Digital Panel Meter	DPM1-2	DM-3100U1	Datel
6.	10	LED, Green	LED 1-10	HLMP 1501	HP
7.	4	LED, Red	LED 11-14	HLMP 1301	HP
8.					
9.	2	Potentiometer, 10K, 10T	PT1,2	35005-2-103	Bourns
10.	2	Counting Turns Knob		H-494-3	Bourns
11.					
12.	3	Termination, 50 ohms, BNC	TM1,2	35650-51	Amphenol
13.					
14.					
15.	2	Handles, Latching			Zero-Pak
16.					
17.	4	Switch, Miniature Toggle, DPDT, ON-NONE-ON	SW1-4	JMT-223	JBT
18.	4	Switch, Miniature Toggle, DPDT, ON-OFF-ON	SW5-SW8	JMT-221	JBT
19.					
20.	REF	FRONT PANEL DETAIL	D SIZE	2627-128-001	

Parts List No.	Title:	Approved by:	Date:
2.627-125-001	IF MONITOR FRONT PANEL ASSEMBLY	R. Norrod	29 Aug 83 Rev. 15 Sept 83



REV'D 16 DEC 83

NATIONAL RADIO ASTRONOMY OBSERVATORY	
TITLE: Schematic - Card 1 IF MONITOR PANEL SHEET 1 OF 2	
DSGN. BY:	DATE: 8 SEPT 83
APPD. BY:	DR. BY:
DWG. NO. 2.627-136-001	

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.	1	Dual Detector Split Block		2.627-131-001	NRAO
2.	1	Detector Block Standoff 1		2.627-162-001	NRAO
3.	1	Detector Block Standoff 2		2.627-162-002	NRAO
4.					
5.					
6.	2	Detector	DT1,2	DOM 105D	Aertech
7.	1	Heater, 20 W	HR1	H4A20W115V	MINCO
8.	1	Thermister	RT1	SS15A/T42A91	Victory Engr.
9.	1	Triac	TR1	T4706D	RCA
10.	1	Thermostat, Open at 140 F	ST1	2450-B201A-T107	Elmwood
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					

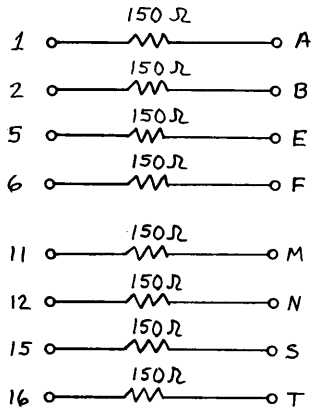
Parts List No.	Title:	Approved by:	Date:
2.627-130-001	Detector Assembly	R. Norrod	29 Aug 83

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.	1	Card			Douglas
2.	6	Op-Amp, Low Drift	U1-U5, U9	HA5135-5	Harris
3.	1	Quad Comparator	U6	LM339	National
4.	1	Hex Buffer, Open Collector	U7	7407N	
5.	1	Quad NAND	U8	7400N	
6.					
7.	7	Capacitor, Ceramic, 1.0 µF	C1, 4, 6, 7-9		
8.	6	Capacitor, Ceramic, 0.1 µF	C3, 5, 10-13		
9.	1	Capacitor, Ceramic, 0.22 µF	C2		
10.	1	Diode, Zener, Low Drift, 9 V	D1	1N937	
11.	1	Transient Suppressor, 5 V	D2	MPTE-5	General Semiconductor
12.	2	Transient Suppressor, 15 V	D3,4	MPTE-15	General Semiconductor
13.					
14.					
15.	1	Resistor, Variable, 10T, 1K	R3	89PR1K	Bourns
16.	1	Resistor, Variable, 10T, 20K	R4	89PR20K	Bourns
17.	1	Resistor, Variable, 1T, 1M	R12	62PAR1M	Bourns
18.	3	Socket 14 DIP			
19.	6	Socket 8 DIP			
20.	REF	SCHEMATIC		2.627-136-001	

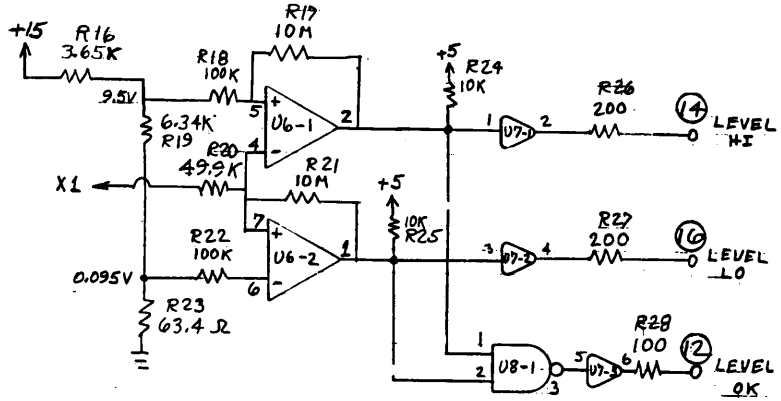
Parts List No.	Title:	Approved by:	Date:
2.627-135-001	IF Monitor Card 1 Sheet 1 of 2	R. Norrod	8 Sep 83 Rev. 16 Dec 83

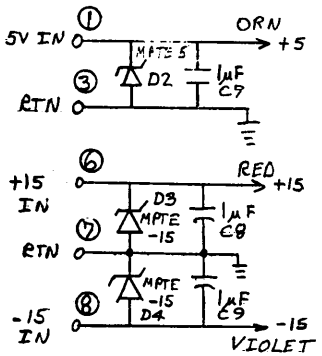
Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
21.	1	Resistor, Metal Film, 1%, 200 ohm	R1	RN55C-F	
22.	1	" " " 9.50 K	R2	"	
23.	3	" " " 2.00 K	R5-R7	"	
24.	1	" " " 10.0 K	R8	"	
25.	1	" " " 20.0 K	R9	"	
26.	1	" " " 750 ohm	R10	"	
27.	1	" " " 8.6 M	R11	RN20X	
28.	3	" " " 1.0 M	R13, R14	RN55C-F	
29.	1	" " " 499 K	R15	RN55C-F	
30.	1	" " " 3.65 K	R16	"	
31.	2	" " " 100 K	R18,22	"	
32.	1	" " " 6.34 K	R19	"	
33.	1	" " " 49.9 K	R20	"	
34.	1	" " " 63.4 ohm	R23	"	
35.					
36.	2	Resistor, Carbon, 1/8 W, 10 M	R17,21		
37.	2	" " " 10 K	R24,25		
38.	2	" " " 200 ohm	R26,27		
39.	1	" " " 100 ohm	R28		
40.	1	" " " 1 K	R29		

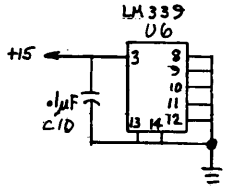
Parts List No.	Title:	Approved by:	Date:
2.627-135-001	IF Monitor Card 1 Sheet 2 of 2	R. Norrod	8 Sep 83 Rev. 16 Dec 83

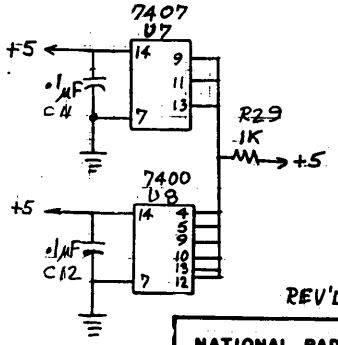


All Resistors 1/4 W Carbon









REV'D 16DEC83

NATIONAL RADIO ASTRONOMY OBSERVATORY	
TITLE: IF MONITOR CHASSIS LED BUFFER CARD SCHEMATIC	
DSGN. BY:	DATE: 15SEPT83
APPD. BY:	DR. BY:
DWG. NO. 2.627-138-001	

NATIONAL RADIO ASTRONOMY OBSERVATORY	
TITLE: SCHEMATIC - CARD 1 IF MONITOR PANEL SHEET 2/2	
DSGN. BY: RDN	DATE: 8SEPT83
APPD. BY:	DR. BY:
DWG. NO. 2.627-136-001	

Rev. 16 March 83

15 TWISTED PAIR — 18 GA: CONNECTOR 1.3-1.8 GHz RX - CHANNEL A - 7/13/81 (RDN)

LOCATION FRONT END BOX - TB1

Tracer Color	Wire Color	Pin Letter	TB1 Term. No.	Function	Connect to:
	Red	A	1	A LO-CAL	S1-5
Blue	Yellow	B	2	A LO-CAL	S1-3
	Shield	E			
	Red	C	3	A HI-CAL	S1-10
Purple	Yellow	D	4	A HI-CAL	S1-7
	Shield	J			
	Red	O	5	A LO LEVEL	MODULE 3 LOA OUT
Gray	Yellow	P	6	A LO LEVEL RTN	SHIELD
	Shield	H			
	Red	F	7	A VG1 MON	PFA1-D
Green	Yellow	G	8	A VG1 MON RTN	GND
	Shield	M			
	Red	T	9	A VG2 MON	PFA1-E
Yellow	Yellow	U	10	A VG2 MON RTN	GND
	Shield	N			
	Gray	K	11	A VG3 MON	PFA1-F
White	Yellow	L	12	A VG3 MON RTN	GND
	Shield	R			
	Blue	X	13	A FET GAIN CONTROL CW	S6-3
White	Yellow	Y	14	A FET GAIN CONTROL CCW	S6-4
	Shield	Q			
	Gray	Z	15	A NS	S2-3
White	Red	a	16	RTN	GND BUS
	Shield	S			
	Red	V	17		
White	Yellow	W	18		
	Shield	d			
	Red	m	19		
Black	Yellow	n	20		
	Shield	e			
	Red	b	21	THERMISTOR 1	RT1-1
Orange	Yellow	c	22	THERMISTOR 1 RTN	RT1-2
	Shield	k			
	Red	r	23	THERMISTOR 2	RT2-1
Red	Yellow	s	24	THERMISTOR 2 RTN	RT2-2
	Shield	x			
	Red	t	25	BANDPASS MON	MODULE 1 - BP OUT
Brown	Yellow	u	26	BANDPASS MON RTN	SHIELD
	Shield	y			
	Blue	f	27		
White	Gray	g	28		
	Shield	p			
	Red	h	29		
White	Blue	j	30		
	Shield	q			

C = 57.6 pF/ft wire-to-wire. C = 97.4 pF/ft wire-to-shield.

15 TWISTED PAIR — 18 GA: CONNECTOR 1.3-1.8 GHz RX - CHANNEL B, 7/13/81 (RDN)

LOCATION FRONT END BOX - TB2

Tracer Color	Wire Color	Pin Letter	TB2 Term. No.	Function	CONNECT TO:
	Red	A	1	B LO-CAL	S1-12
Blue	Yellow	B	2	B LO-CAL	S1-M
	Shield	E			
	Red	C	3	B HI-CAL	S1-14
Purple	Yellow	D	4	B HI-CAL	S1-13
	Shield	J			
	Red	O	5	B LO LEVEL	MODULE 3 - LO B OUT
Gray	Yellow	P	6	B LO LEVEL RTN	SHIELD
	Shield	H			
	Red	F	7	B VG1 MON	PFB1-D
Green	Yellow	G	8	B VG1 MON RTN	GND
	Shield	M			
	Red	T	9	B VG2 MON	PFB1-E
Yellow	Yellow	U	10	B VG2 MON RTN	GND
	Shield	N			
	Gray	K	11	B VG3 MON	PFB1-F
White	Yellow	L	12	B VG3 MON RTN	GND
	Shield	R			
	Blue	X	13	B FET GAIN CONTROL CW	S6-E
White	Yellow	Y	14	B FET GAIN CONTROL CCW	S6-C
	Shield	Q			
	Gray	Z	15	B NS	S2-5
White	Red	a	16	RTN	GND BUS
	Shield	S			
	Red	V	17		
White	Yellow	W	18		
	Shield	d			
	Red	m	19	VACUUM MONITOR	PVM1-A
Black	Yellow	n	20	VACUUM MONITOR RTN	PVM1-C
	Shield	e			
	Red	b	21	DEWAR TEMP DEC PT1	PTM1-C
Orange	Yellow	c	22	DEWAR TEMP DEC PT2	PTM1-D
	Shield	k			
	Red	r	23	DEWAR TEMP MON	PTM1-B
Red	Yellow	s	24	DEWAR TEMP MON RTN	PTM1-A
	Shield	x			
	Red	t	25	FEB TEMP MON	TS1-(-)
Brown	Yellow	u	26	FEB TEMP MON RTN	GND
	Shield	y			
	Blue	f	27	PHASE SHIFTER MON	S6-L
White	Gray	g	28	PHASE SHIFTER MON RTN	S6-10
	Shield	p			
	Red	h	29	115 VAC MON	TB5 - AC MON
White	Blue	j	30	115 VAC MON RTN	TB5 - AC MON RTN
	Shield	q			

C = 57.6 pF/ft wire-to-wire. C = 97.4 pF/ft wire-to-shield.

Rev. 16 March 83

30 CONDUCTOR – 16 GA: CONNECTOR 1.3-1.8 GHz RX F.E.B., 13 July 81 (RDN)

LOCATION FRONT END BOX - TB3 - 30C-A

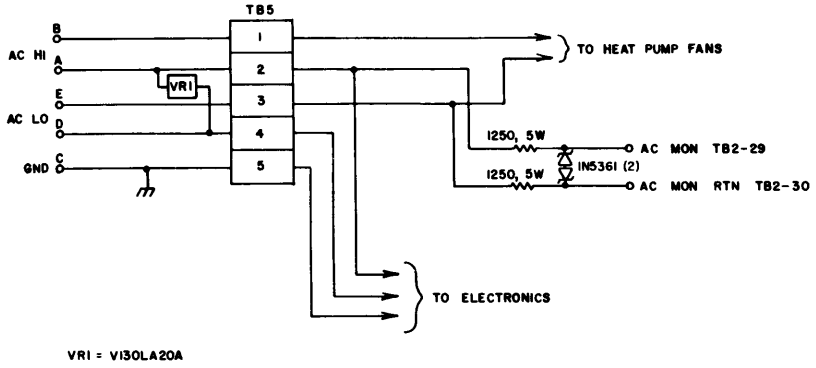
Wire Color	Pin Letter	TB3 Term. No.	Function	CONNECT TO
Orange Purple	A	1	REMOTE IND SUPPLY	S1-B
Orange Blue	B	2	" " RTN	GND
Yellow White	C	3	" " $\overline{\text{A LO-CAL}}$	S1-16
Yellow	D	4	" " $\overline{\text{B LO-CAL}}$	S1-X
Red Purple	E	5	" " $\overline{\text{A HI-CAL}}$	S1-18
Red Blue	F	6	" " $\overline{\text{B HI-CAL}}$	S1-Y
Orange Green	G	7	" " $\overline{\text{A RF MON}}$	S4-E
Yellow Black	H	8	" " $\overline{\text{B RF MON}}$	S4-10
Yellow Brown	J	9	" " $\overline{\text{A FET 1}}$	S4-N
Black	K	10	" " $\overline{\text{B FET 1}}$	S4-U
White Yellow	L	11	" " $\overline{\text{A FET 2}}$	S4-W
Red Green	M	12	" " $\overline{\text{B FET 2}}$	S4-S
Orange Yellow	N	13	" " $\overline{\text{LINEAR}}$	S4-9
Orange	P	14	" " $\overline{\text{CIRC}}$	S4-5
Brown	R	15	" " $\overline{\text{COMMON LO}}$	S4-14
Red	S	16	" " $\overline{\text{SEPARATE LO}}$	S4-20
Red Black	T	17		
Red Yellow	U	18	XFR SW SELECT SUPPLY	28 V
Red Brown	V	19	" " LINEAR SELECT	PMO2-B
Orange Brown	W	20	" " CIRC SELECT	PMO2-A
Green	X	21	" " A RF MON SELECT	PMO1-B
Orange White	Y	22	" " B RF MON SELECT	PMO1-A
Orange Black	Z	23	" " COMMON LO SELECT	PMO3-B
Blue	a	24	" " SEPARATE LO SELECT	PMO3-A
Purple	b	25	RELAY CONTROL RTN	GND
Purple White	c	26		
Green White	d	27	" " $\overline{\text{A FET 1 PWR}}$	S5-D
Green Black	e	28	" " $\overline{\text{B FET 1 PWR}}$	S5-14
Green Brown	f	29	" " $\overline{\text{A FET 2 PWR}}$	S5-L
Red White	g	30	" " $\overline{\text{B FET 2 PWR}}$	S5-21
Shield	l	Shield	GND @ BOX	

Rev. 16 March 83

30 CONDUCTOR – 16 GA: CONNECTOR 1.3-1.8 GHz RX F.E.B., 2 Nov. 82 (RDN)

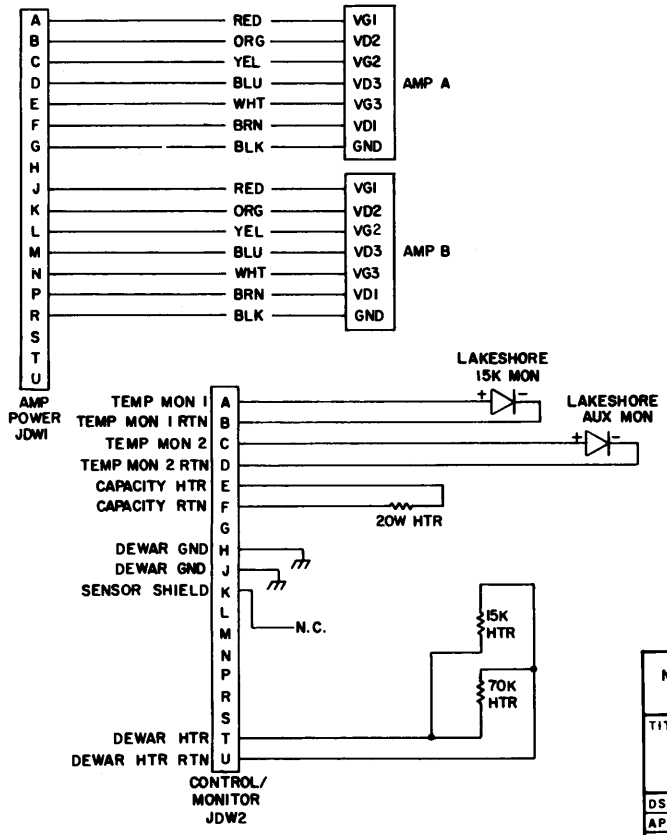
LOCATION FRONT END BOX TB4 30C-B

Wire Color	Pin Letter	TB4 Term. No.	Function	CONNECT TO
Orange Purple	A	1	REMOTE IND SUPPLY	+5 V
Orange Blue	B	2	REMOTE IND RTN	GND
Yellow White	C	3	CH A BAND 1 IND	PRS1-F
Yellow	D	4	BAND 2 IND	PRS1-G
Red Purple	E	5	BAND 3 IND	PRS1-H
Red Blue	F	6	BAND 4 IND	PRS1-J
Orange Green	G	7	BAND 5 IND	PRS1-K
Yellow Black	H	8	CH B BAND 1 IND	PRS3-F
Yellow Brown	J	9	BAND 2 IND	PRS3-G
Black	K	10	BAND 3 IND	PRS3-H
White Yellow	L	11	BAND 4 IND	PRS3-J
Red Green	M	12	BAND 5 IND	PRS3-K
Orange Yellow	N	13		
Orange	P	14		
Brown	R	15		
Red	S	16		
Red Black	T	17		
Red Yellow	U	18	BAND SELECT SUPPLY	28 V
Red Brown	V	19	BAND 1 SELECT	PRS1-A
Orange Brown	W	20	BAND 2 SELECT	PRS1-B
Green	X	21	BAND 3 SELECT	PRS1-C
Orange White	Y	22	BAND 4 SELECT	PRS1-D
Orange Black	Z	23	BAND 5 SELECT	PRS1-E
Blue	a	24		
Purple	b	25		
Purple White	c	26	INCR SUPPLY	PMO2A-A
Green White	d	27	INCR RTN	PMo2A-B
Green Black	e	28	DECR RTN	PMO2A-C
Green Brown	f	29	DECR SUPPLY	PMO2A-D
Red White	g	30		
Shield	l	Shield	GND @ BOX	



REVISED 10-5-83

NATIONAL RADIO ASTRONOMY OBSERVATORY	
TITLE: F E BOX AC DISTRIBUTION 1.3-1.8 GHZ RX	
DSGN. BY: R. NORROD	DATE: 2-22-83
APPD. BY:	DR. BY: Jeff
DWG. NO. 2.627-118-001	



REVISED 3-2-83

NATIONAL RADIO ASTRONOMY OBSERVATORY	
TITLE: DEWAR SCHEMATIC 1.3-1.8 GHZ RX	
DSGN. BY: R. NORROD	DATE: 12-22-82
APPD. BY:	DR. BY: Jeff
DWG. NO. 2.627-165-001	

RDN
9Feb83

ELCO CONNECTOR LIST FOR BOX/RACK/DRAWER 1.3-1.8 GHz RX FEB Rev. 2Mar83

CONNECTOR: DESIGNATION PDM1 ; TYPE Exposed ; 20 PINS

SMALL KEY _____. LARGE KEY _____ ; PANEL E/P. CABLE E/P

Pin	To	Function	Pin	To	Function
A	PDW2-A	TEMP MON 1 *	u		
B	-B	TEMP MON 1 RTN*	v		
C	-C	TEMP MON 2 *	w		
D	-D	TEMP MON 2 RTN*	x		
E	-E	CAPACITY HTR	y		
F	-F	CAPACITY HTR RTN	z		
H	-H	DEWAR GND	AA		
J	-J	DEWAR GND	BB		
K	-K	SENSOR SHIELD	CC		
L	-L		DD		
M	-M		EE		
N	-N		FF		
P	-P		HH		
R	-R		JJ		
S	-S		KK		
T	-T	HEATER	LL		
U	-U	HEATER RTN	MM		
V			End NN		
W			End 56 Pin →		
End 20 Pin → X					
Y					
Z					
AA a					
BB b					
CC c					
DD d					
EE e					
FF f					
HH h					
JJ j					
KK k					
LL l					
MM m					
NN n					
PP p					
RR r					
SS s					
TT t					
End 38 → Pin					

FUNCTION: CONNECTS DEWAR JDW2 to DEWAR CONTROL/MONITOR PANEL JDM1

* USE SHIELDED TWISTED PAIRS. CONNECT SHIELDS TO PIN K.

Abbreviations:
Ex: S25-22 Slot 25, Pin 22 | J9-MM Elco J9, Pin MM | Elco Connectors: J1, J2, J3, etc. Slot Connectors: S1, S2, S3, etc. Pin No.'s -3, -X, -B,

RDN
9Feb83

1.3-1.8 GHz RX FRONT END BOX

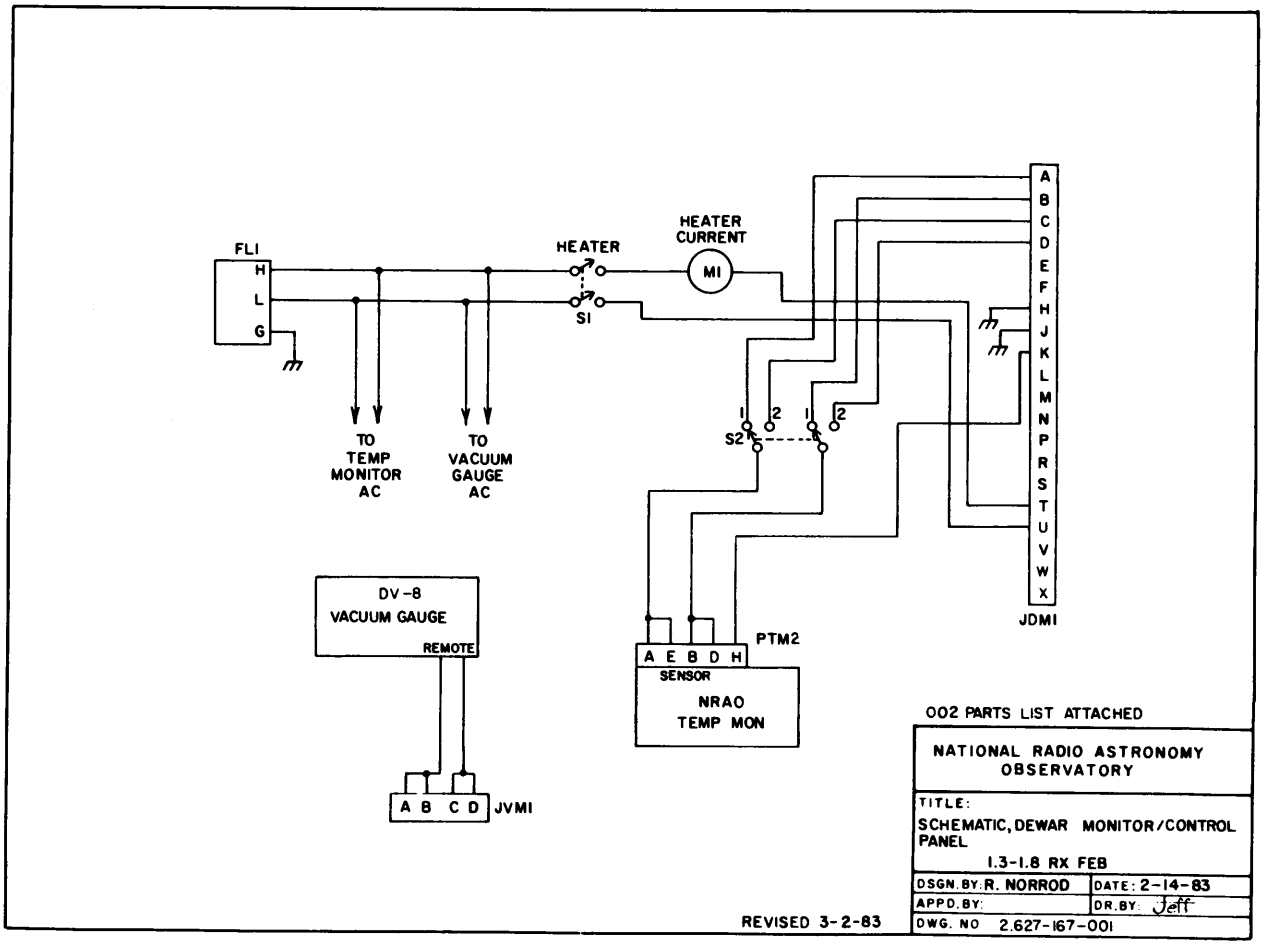
PDW1 -▶ JDW1 (DEWAR AMP POWER)

Pin	Connect to	Function
A	PFA2-A	FET A - VG1
B	-B	- VD2
C	-C	- VG2
D	-D	- VD3
E	-E	- VG3
F	-F	- VD1
G	-H	- GND
H		
J	PFB2-A	FET B - VG1
K	-B	- VD2
L	-C	- VG2
M	-D	- VD3
N	-E	- VG3
P	-F	- VD1
R	-H	- GND
S		
T		
U		

CONNECTOR TYPE:
KPT 06B14-18S or equivalent

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.	2	FET Bias Boxes		---	NRAO - CV
2.	1	Temperature Monitor Box		---	NRAO
3.	1	Vacuum Gauge		AUT-6	Teledyne-Hastings
4.					
5.	1	Meter, 0-3 Amp AC	M1		Simpson
6.	2	Switch, Toggle, DPDT			
7.					
8.	1	Connector, 20 P, Panel Mount Protected	JDM1	8016-20	Elco
9.	1	Connector, 4 Socket, Panel Mount	JVM1	126-45	Amphenol
10.	1	Connector, 5 Pin, Cable	PTM2	126-5P	Amphenol
11.					
12.					
13.					
14.					
15.					
16.	Ref	FAB Drawing		2.627-166 -001	NRAO
17.					
18.					
19.					
20.					

Parts List No.	Title:	Approved by:	Date:
2.627-167-002	Dewar Control/Monitor Panel 1.3-1.8 GHz Rx FE Box	Roger Norrod	14 February 1983



RDN
16Mar83

AMPHENOL 126 SERIES CIRCULAR CONNECTOR LIST

System: 1.3-1.8 GHz RX

Box/Rack/Drawer: Front End Box

Function: Dewar Remote Temp Monitor

Connector: Designation PTM1 → NRAO TEMP MON BOX OUTPUT ;

No. Pins 7 ; Type Cable, Female .

Pin	Connect to	Function
A	TB2-24	DEWAR TEMP MON RTN
B	TB2-23	DEWAR TEMP MON
C	TB2-21	DEC PT 1 (XX.X)
D	TB2-22	DEC PT 2 (XXX.)
E	NC	
F	NC	
H	NC	
J		
K		

4 Pin, use A, B, C, D.
5 Pin, use A, B, D, E, H.
7 Pin, use A, B, C, D, E, F, H.

R. Norrod
7-14-81

RDN
16Mar83

AMPHENOL 126 SERIES CIRCULAR CONNECTOR LIST

System: 1.3-1.8 GHz Rx

Box/Rack/Drawer: FEB

Function:

Connector: Designation PVM1 → JVM1 Dewar Control Panel ;

No. Pins 4 ; Type Male/Cable .

Pin	Connect to	Function
A	TB2-19	VACUUM MONITOR *
B		
C	TB2-20	VACUUM MONITOR RTN *
D		
E		
F		
H		
J		
K		

* USE SHIELDED TWISTED PAIR GROUND SHIELD AT TB2.

4 Pin, use A, B, C, D.
5 Pin, use A, B, D, E, H.
7 Pin, use A, B, C, D, E, F, H.

R. Norrod
7-14-81

NDN
16Mar83

AMPHENOL 126 SERIES CIRCULAR CONNECTOR LIST

System: 1.3-1.8 GHz RX

Box/Rack/Drawer: Front End Box

Function: FET A Power/Mon

Connector: Designation PFA1 →A FET BIAS BOX ;

No. Pins 9 ; Type Cable, Male .

Pin	Connect to	Function
A	S5-4	A FET1 +15
B	S5-H	A FET1 GND
C	S5-E	A FET1 -15
D	TB1-7	A VG1 MON
E	TB1-9	A VG2 MON
F	TB1-11	A VG3 MON
H		
J	S6-A	A FET GAIN
K		

4 Pin, use A, B, C, D.
5 Pin, use A, B, D, E, H.
7 Pin, use A, B, C, D, E, F, H.

R. Norrod
7-14-81

RDN
16 Mar83

AMPHENOL 126 SERIES CIRCULAR CONNECTOR LIST

System: 1.3-1.8 GHz RX

Box/Rack/Drawer: Front End Box

Function: FET B Power/Mon

Connector: Designation PFB1 →B FET BIAS BOX ;

No. Pins 9 ; Type Cable, Male .

Pin	Connect to	Function
A	S5-R	B FET1 +15
B	S5-16	B FET1 GND
C	S5-15	B FET1 -15
D	TB2-7	B VG1 MON
E	TB2-9	B VG2 MON
F	TB2-11	B VG3 MON
H		
J	S6-B	B FET GAIN
K		

4 Pin, use A, B, C, D.
5 Pin, use A, B, D, E, H.
7 Pin, use A, B, C, D, E, F, H.

R. Norrod
7-14-81

RDN
16Mar83

AMPHENOL 126 SERIES CIRCULAR CONNECTOR LIST

System: 1.3-1.8 GHz RX

Box/Rack/Drawer: Front End Box

Function: FET A Dewar Control

Connector: Designation PFA2 → JFA2;

No. Pins 7; Type Cable, Male.

Pin	Connect to	Function
A	PDW1-A	Fet A - VG1
B	" -B	" - VD2
C	" -C	" - VG2
D	" -D	" - VD3
E	" -E	" - VG3
F	" -F	" - VD1
H	" -G	" - GND
J		
K		

4 Pin, use A, B, C, D.
5 Pin, use A, B, D, E, H.
7 Pin, use A, B, C, D, E, F, H.

R. Norrod
7-14-81

RDN
16Mar83

AMPHENOL 126 SERIES CIRCULAR CONNECTOR LIST

System: 1.3-1.8 GHz RX

Box/Rack/Drawer: Front End Box

Function: FET B Dewar Control

Connector: Designation PFB2 → JFB2;

No. Pins 7; Type Cable, Male.

Pin	Connect to	Function
A	PDW1-J	FEB B-VG1
B	" K	" VD2
C	" L	" VG2
D	" M	" VD3
E	" N	" VG3
F	" P	" VD1
H	" R	" GND
J		
K		

4 Pin, use A, B, C, D.
5 Pin, use A, B, D, E, H.
7 Pin, use A, B, C, D, E, F, H.

R. Norrod
7-14-81

RDN
16Mar83

AMPHENOL 126 SERIES CIRCULAR CONNECTOR LIST

System: 1.3-1.8 GHz RX

Box/Rack/Drawer: Front End Box

Function: RF Module 1 Power/Control

Connector: Designation PM01 → JM01, RF Module 1 ;

No. Pins 9 ; Type Cable, Female .

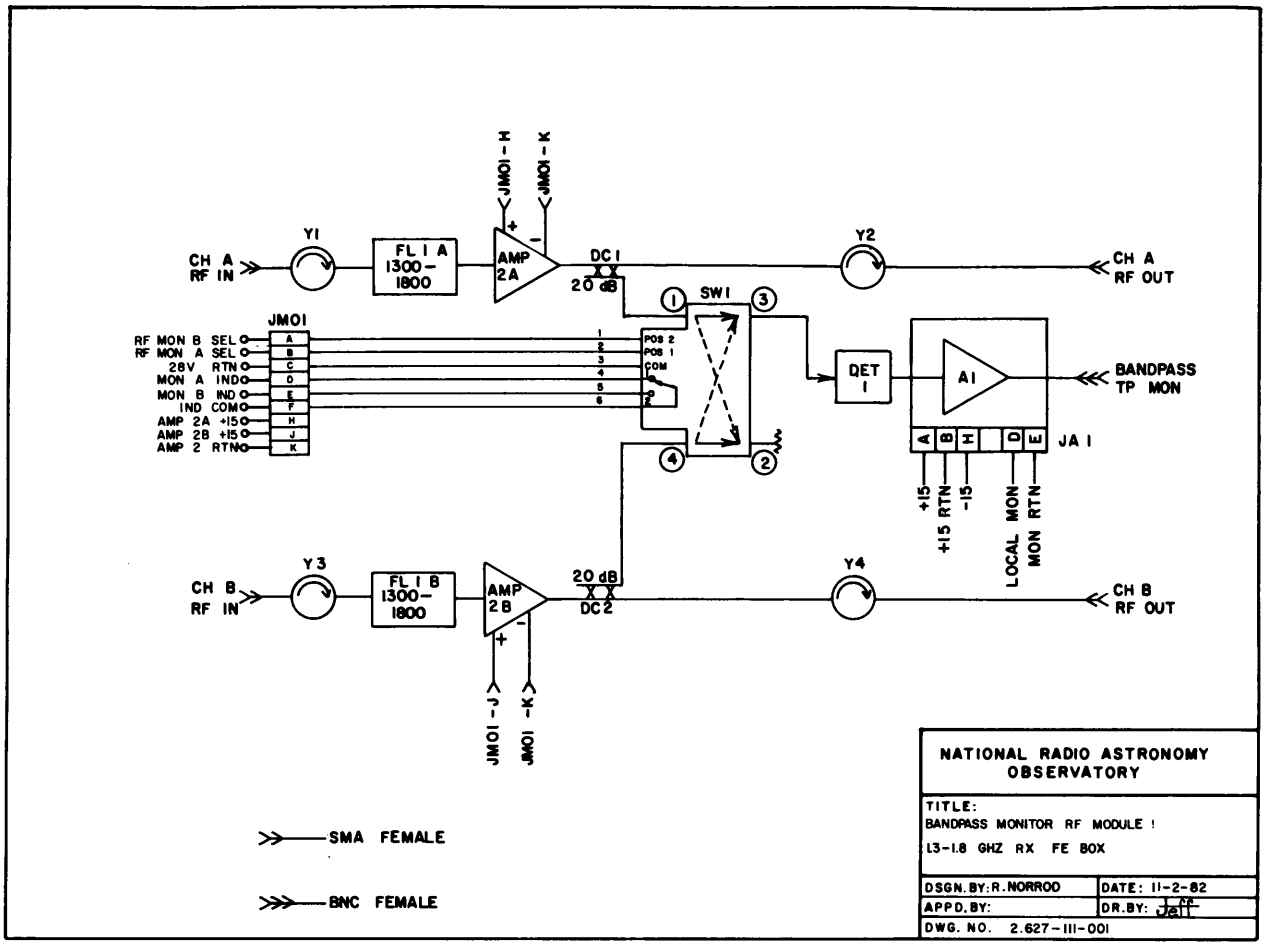
Pin	Connect to	Function
A	TB3-22	B RF MON SELECT
B	TB3-21	A RF MON SELECT
C	GND BUS	28 V RTN
D	S4-F	A RF MON IND
E	S4-12	B RF MON IND
F	GND BUS	IND COM
H	S5-12	A FET2 +15
J	S5-20	B FET2 +15
K	S5-M	FET2 RTN

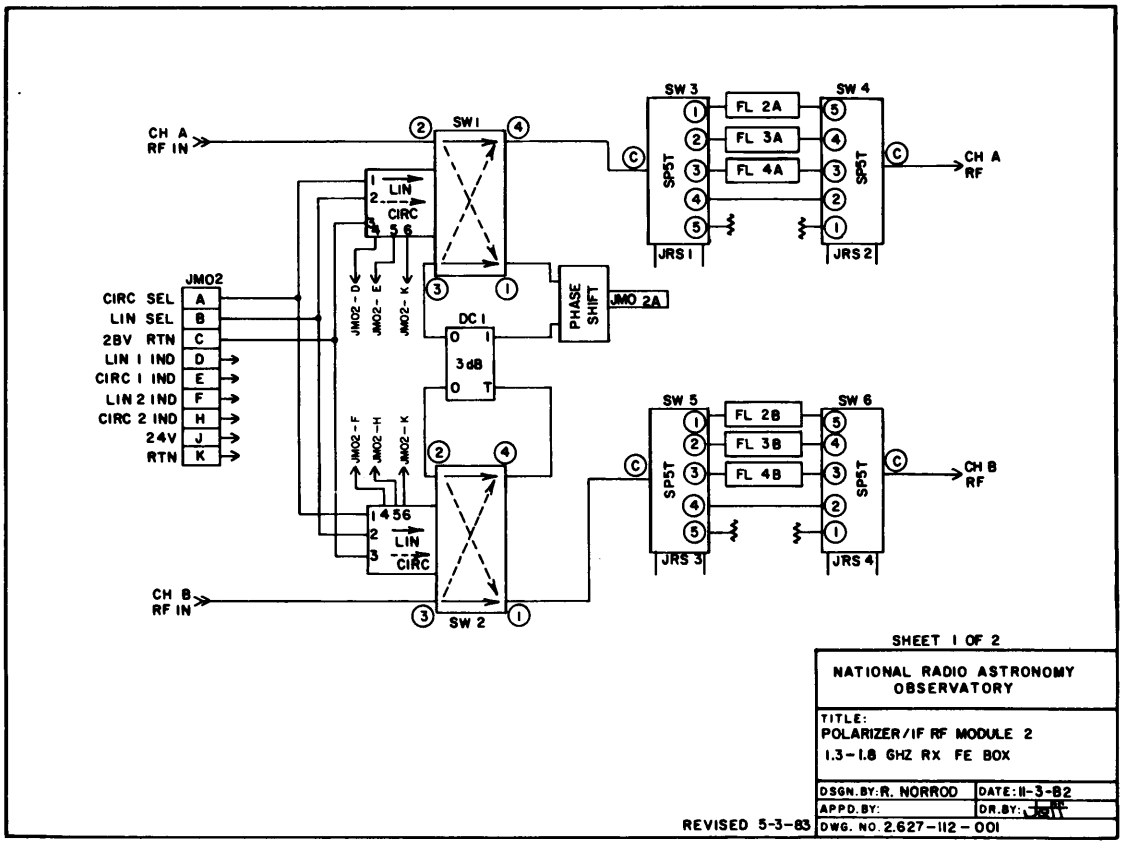
4 Pin, use A, B, C, D.
5 Pin, use A, B, D, E, H.
7 Pin, use A, B, C, D, E, F, H.

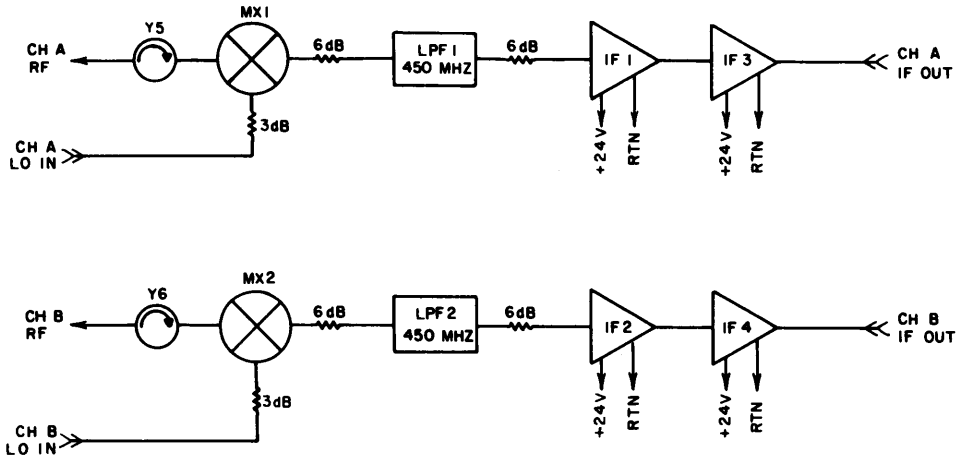
R. Norrod
7-14-81

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.	2	Amplifier, 1-2 GHz, 30 dB Gain	Amp 2A, 2B	ALD613401	Amplica
2.					
3.	2	Coupler, 1-2 GHz, 20 dB		8B120-1550/ X500-0P/0P	K&L
4.	2	Filter, Bandpass, 1300-1800	FL1A, 1B		
5.	4	Isolator, 1-2 GHz	Y1-Y4	2JC-1020	Western Microwave
6.					
7.	1	Transfer Switch, Latching, Indicating	SW1	700C-70200	Transco
8.	1	Detector, Tunnel Diode, Positive Polarity	DET 1	DOM-102BR	Aertech
9.	1	Termination, SMA male			
10.	1	DC Preamp Assembly	A1	2.420-510-001	NRAO
11.					
12.					
13.					
14.					
15.	1	Connector, 9 Pin	JM01	126-9P	Amphenol
16.					
17.					
18.					
19.					
20.					

Parts List No.	Title:	Approved by:	Date:
2.627-111-002	Bandpass Monitor RF Module 1 1.3-1.8 GHz Rx FE Box	Roger Norrod	2 November 1982


JMO1 - H
JMO1 - K
CH A RF IN
Y1
FL 1 A 1300 - 1800
AMP 2A
DC 1
20 dB
Y2
CH A RF OUT
SW1
JMO1
RF MON B SEL
RF MON A SEL
28V RTN
MON A IND
MON B IND
IND COM
AMP 2A +15
AMP 2B +15
AMP 2 RTN
POS 2
POS 1
COM
QET 1
A1
BANDPASS TP MON
JA 1
+15
+15 RTN
-15
LOCAL MON RTN
CH B RF IN
Y3
FL 1 B 1300 - 1800
AMP 2B
20 dB
DC 2
Y4
CH B RF OUT
JMO1 - J
JMO1 - K
SMA FEMALE
BNC FEMALE
NATIONAL RADIO ASTRONOMY OBSERVATORY
TITLE:
BANDPASS MONITOR RF MODULE 1
1.3-1.8 GHZ RX FE BOX
DSGN. BY: R. NORROD
DATE: 11-2-82
APP'D. BY:
DR. BY: Jeff
DWG. NO. 2.627-111-001


CH A RF IN
SW1
LIN
CIRC
JMO2
CIRC SEL
LIN SEL
28V RTN
LIN 1 IND
CIRC 1 IND
LIN 2 IND
CIRC 2 IND
24V
RTN
JMO2 - D
JMO2 - E
JMO2 - K
DC 1
3 dB
PHASE SHIFT
JMO 2A
SW 3
SW 4
FL 2A
FL 3A
FL 4A
SP5T
JRS 1
JRS 2
CH A RF
SW 5
SW 6
FL 2B
FL 3B
FL 4B
JRS 3
JRS 4
CH B RF
JMO2 - F
JMO2 - H
CH B RF IN
SW 2
SHEET 1 OF 2
NATIONAL RADIO ASTRONOMY OBSERVATORY
TITLE:
POLARIZER/IF RF MODULE 2
1.3-1.8 GHZ RX FE BOX
DSGN. BY: R. NORROD
DATE: 11-3-82
APP'D. BY:
DR. BY: Jeff
DWG. NO. 2.627-112-001
REVISED 5-3-83



SHEET 2 OF 2

NATIONAL RADIO ASTRONOMY OBSERVATORY

TITLE:
POLARIZER / IF RF MODULE 2
1.3 - 1.8 GHZ RX FE BOX

DSGN. BY: R. NORROD	DATE: 11-3-82
APPD. BY:	DR. BY: Jeff
DWG. NO 2.627-112-001	

REVISED 5-3-83

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.	2	Isolator, 1-2 GHz	Y5,6	2JC-1020	Western Microwave
2.	1	Coupler, 3 dB, 90° Hybrid	DC1	20153-3	Narda
3.	2	Transfer Switch, Latching	SW1,2	700C-20200	Transco
4.	2	Mixer	MX1, 2	ZLW-11	Mini-Circuits
5.	1	Phase Shifter, Modified for Motor Drive		9428A-28	ARRA
6.					
7.	4	RF Switch, SP5T with Indicator	SW3-SW6	5S02112	DB Products
8.					
9.	2	Bandpass Filter, 1300-1370 MHz	FL2A, B	6B120-1335/ X70-OP/OP	K&L
10.	2	Bandpass Filter, 1355-1435 MHz	FL3A, B	6B120-1395/ X80-OP/OP	K&L
11.	2	Bandpass Filter, 1600-1730 MHz	FL4A, B	6B120-1665/ X130-OP/OP	K&L
12.	2	Low Pass Filter, 450 MHz	LPF1, 2	4L2-450B11	Reactel
13.	2	Attenuator, SMA M/F, 3 dB			
14.	2	IF Amp, Modular, 16 dB Gain	IF1, 2	UTO-1002	Avantek
15.	2	IF Amp, 34 dB Gain, 1.5:1 VSWR, 5-500 MHz	IF3, 4	QB-538	Q-Bit
16.	4	Attenuator, SMA M/F, 6 dB			
17.	1	Connector, 9 Pin	JM02	126-9P	Amphenol
18.	1	Connector, 5 Pin, Cable Plug	PSV2	126-5P	Amphenol
19.	1	Connector, 5 Pin	JM02A	126-5P	Amphenol
20.					

Parts List No.	Title:	Approved by:	Date:
2.627-112-002	Polarizer/IF RF Module 2 1.3-1.8 GHz Rx FE Box	Roger Norrod	3 November 1982

RDN
2Nov83
Revised 3May83

1.3-1.8 GHz RX FRONT END BOX

RF MODULE 2 BAND SELECT

PRS1 → JRS1, RF MODULE 2

A - PRS2-E, TB4-19	POS 1 SELECT
B - PRS2-D, TB4-20	2
C - PRS2-C, TB4-21	3
D - PRS2-B, TB4-22	4
E - PRS2-A, TB4-23	5
F - TB4-3	POS 1 IND
G - TB4-4	2
H - TB4-5	3
J - TB4-6	4
K - TB4-7	5
L - GND BUS	SELECT COM
M - GND BUS	IND COM

PRS2 → JRS2, RF MODULE 2

A - RPS1-E, PRS3-E
B - PRS1-D, PRS3-D
C - PRS1-C, PRS3-B
E - PRS1-A, PRS3-A
F -
G -
H -
J -
K -
L - GND BUS
M - GND BUS

PRS1-4 = BENDIX PTO H-14-18S or equivalent.

RDN
16Mar83

AMPHENOL 126 SERIES CIRCULAR CONNECTOR LIST

System: 1.3-1.8 GHz RX

Box/Rack/Drawer: Front End Box

Function: RF MODULE 2 POWER/CONTROL

Connector: Designation PM02 →JM02, RF MODULE 2 ;

No. Pins 9 ; Type Cable, Female .

Pin	Connect to	Function
A	TB3-20	CIRC SELECT
B	TB3-19	LIN SELECT
C	GND BUS	28 V RTN
D	S4-3	LIN1 IND
E	S4-D	CIRC1 IND
F	S4-4	LIN2 IND
H	S4-C	CIRC2 IND
J	S6-P	+24 V
K	GND BUS	24 V RTN

4 Pin, use A, B, C, D.
5 Pin, use A, B, D, E, H.
7 Pin, use A, B, C, D, E, F, H.

R. Norrod
7-14-81

RDN
16Mar83
Revised 22Jun83

1.3-1.8 GHz RX FRONT END BOX

PHASE SHIFTER CONTROL/MONITOR

Connector Type: PTO 6B 12-8S
8 Pin
Cable, Female

Designation: PM02A → JM02A RF MODULE 2

Pin	Connect to	Function
A	TB4-26	Increase Phase Supply
B	TB4-27	Increase Phase Return
C	TB4-28	Decrease Phase Return
D	TB4-29	Decrease Phase Supply
E	NC	
F	+15 V Bus	Monitor Supply
G	S6-K	Phase Shift Monitor
H	-15 V Bus	Neg Monitor Supply

RDN
2Nov83
Revised 3May83

1.3-1.8 GHz RX FRONT END BOX

RF MODULE 2 BAND SELECT

PRS3 → JRS3, RF MODULE 2

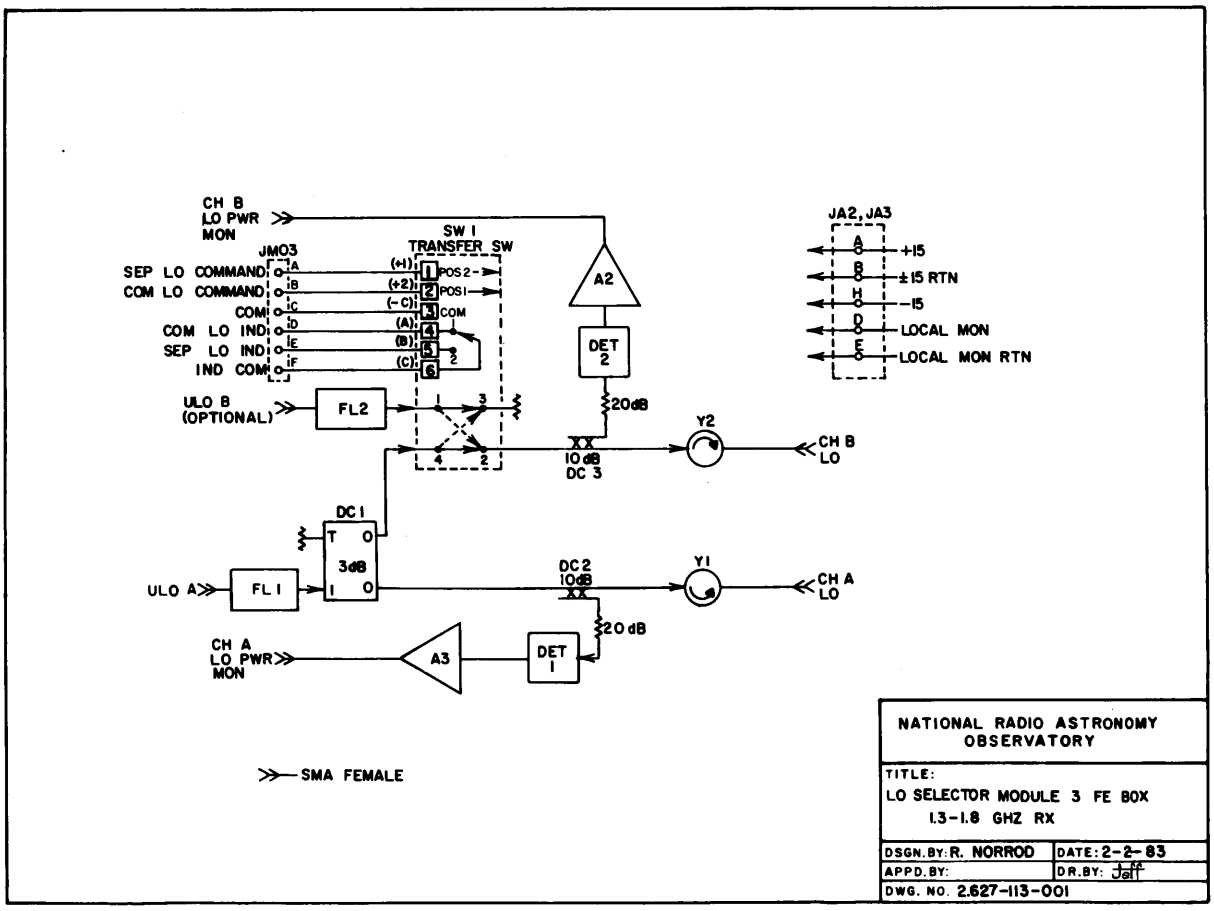
A - PRS2-E, PRS4-E
B - PRS2-D, PRS4-D
C - PRS2-C, PRS4-C
D - PRS2-B, PRS4-B
E - PRS2-A, PRS4-A
F - TB4-8
G - TB4-9
H - TB4-10
J - TB4-11
K - TB4-12
L - GND BUS
M - GND BUS

PRS4 → JRS4, RF MODULE 2

A - PRS3-E
B - PRS3-D
C - PRS3-C
D - PRS3-B
E - PRS3-A
F -
G -
H -
J -
K -
L - GND BUS
M - GND BUS

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.					
2.	1	Coupler, 3 dB	DC1	10015-3	Anaren
3.	1	Transfer Switch, Latching, Indicating	SW1	700C-70200	Transco
4.	2	Coupler, 10 dB	DC2,3	20063-10	Omni-Spectra
5.	2	Isolator, 1-2 GHz	Y1,2		
6.	2	Filter, Bandpass, 1-2 GHz	FL1,2	Cir-Q-Tel	IBM 6-1000AA
7.	2	Attenuator, SMA M/F, 20 dB			
8.	2	Termination, SMA Male			
9.	2	Detector, Positive	DET 1, 2	DOM 102 BR	Aertech
10.					
11.	2	Preamp Assembly	A2, A3	PC2.420-23	NRAO
12.					
13.	1	Connector, 9 Pin	JM03	126-9P	Amphenol
14.					
15.					
16.					
17.					
18.					
19.					
20.					

Parts List No.	Title:	Approved by:	Date:
2.627-113-002	Module 3 LO Selector 1.3-1.8 GHz RX FE Box	Roger Norrod	2 February 1983



RDN
16Mar83

AMPHENOL 126 SERIES CIRCULAR CONNECTOR LIST

System: 1.3-1.8 GHz RX

Box/Rack/Drawer: Front End Box

Function: RF MODULE 3 (LO Selector) Power/Control

Connector: Designation PM03 → JM03, RF Module 3;

No. Pins 9; Type Cable, Female.

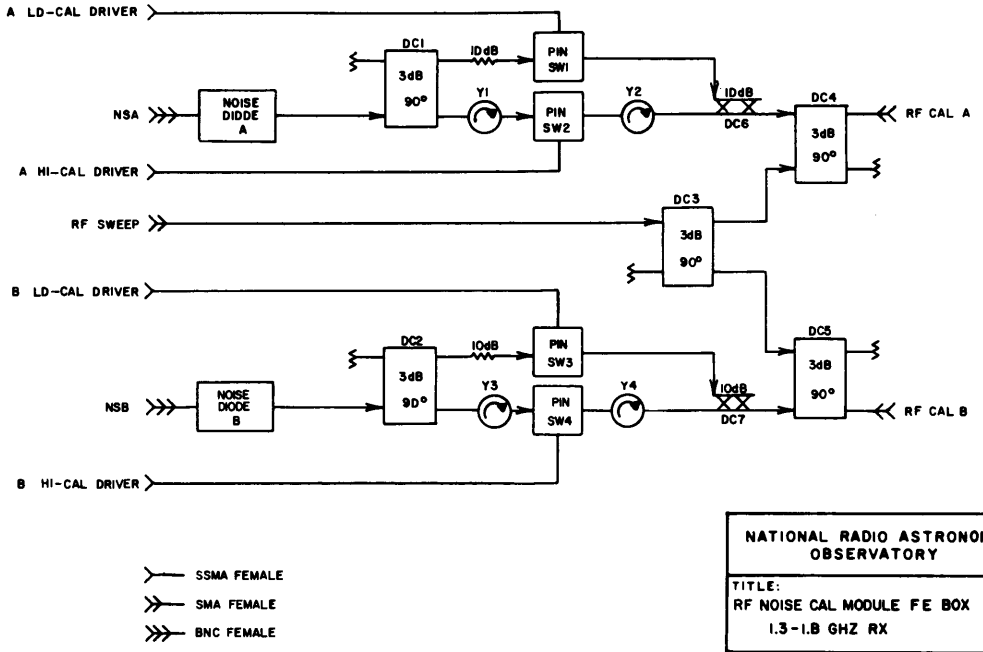
Pin	Connect to	Function
A	TB3-24	SEP LO SELECT
B	TB3-23	COM LO SELECT
C	GND BUS	28 V RTN
D	S4-15	COM LO IND
E	S4-17	SEP LO IND
F	GND BUS	IND COM
H	NC	
J	NC	
K	NC	

4 Pin, use A, B, C, D.
5 Pin, use A, B, D, E, H.
7 Pin, use A, B, C, D, E, F, H.

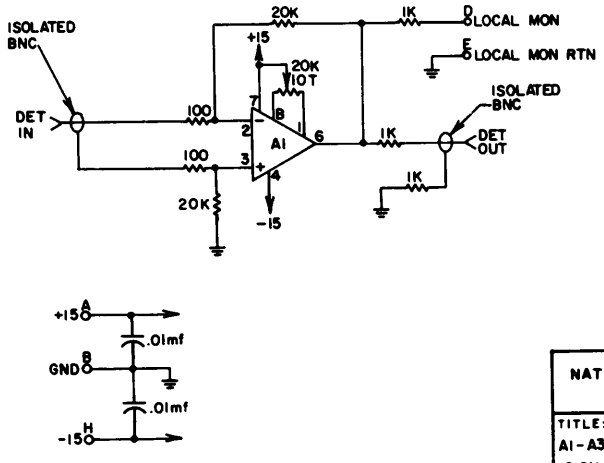
R. Norrod
7-14-81

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.					
2.	2	Diode Noise Source	ND A, B	MC5012	MSC
3.	5	Coupler, 3 dB	DC1-DC5	20153-3	Omni-Spectra
4.	4	Isolator, 1-2 GHz, SMA In/Out	Y1-Y4		
5.	4	Pin Attenuator	PIN SW1-4	33000C	HP
6.					
7.	2	Attenuator, SMA M/F, 10 dB			
8.	2	Coupler, 10 dB	DC6, 7	20063-10	Omni-Spectra
9.	5	Termination, SMA Male			
10.					
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					

Parts List No.	Title:	Approved by:	Date:
2.627-114-002	Module 4 RF Noise Cal 1.3-1.8 GHz Rx FE Box	Roger Norrod	2 February 1983



NATIONAL RADIO ASTRONOMY OBSERVATORY	
TITLE: RF NOISE CAL MODULE FE BOX 1.3-1.8 GHZ RX	
DSGN. BY: R. NDRRDD	DATE: 2-2-83
APPD. BY:	DR. BY: Jeff
DWG. NO. 2.627-114-DDI	



NATIONAL RADIO ASTRONOMY OBSERVATORY	
TITLE: A1-A3 X200 DETECTOR PREAMP 18 CM RX	
DSGN. BY: R. NORROD	DATE: 6-26-81
APPD. BY:	DR. BY: Jeff
DWG. NO. 2.420-510-001	

RDN
16Mar83

AMPHENOL 126 SERIES CIRCULAR CONNECTOR LIST

System: 1.3-1.8 GHz RX

Box/Rack/Drawer: Front End Box

Function: Detector Preamp Power

Connector: Designation PA1 - PA3 → DET PREAMPS A1-A3 ;

No. Pins 5 ; Type Cable, Female .

Pin	Connect to	Function
A	+15 V BUS	
B	GND BUS	
C		
D	NC	
E	NC	
F		
H	-15 V BUS	
J		
K		

4 Pin, use A, B, C, D.
5 Pin, use A, B, D, E, H.
7 Pin, use A, B, C, D, E, F, H.

R. Norrod
7-14-81

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.	1	Box 1" x 2"		2417	Pomona
2.	1	Artwork Negative		2.420-23	NRAO
3.	2	BNC Connector, Isolated Bulkhead			
4.					
5.					
6.	2	Capacitor, 0.1 μF			
7.					
8.					
9.	2	Resistor, 100 ohm	Metal Film, 1%		
10.	2	Resistor, 20.0 K	Metal Film, 1%		
11.	3	Resistor, 1.0 K	Metal Film, 1%		
12.					
13.	1	Potentiometer, 20 K		89PR20K	
14.	1	IC, Op-Amp, Low Drift		AD-OP07	Analog Devices
15.					
16.	1	Connector		126-5P	Amphenol
17.					
18.					
19.					
20.					

Parts List No.	Title:	Approved by:	Date:
2.420-510-001	Detector Preamp	Roger Norrod	26 June 1981 Rev. 9 August 1982

1.3-1.8 GHz Receiver
CARD SLOT WIRING LIST

RDN
3Feb83

FOR: BOX FRONT END BOX CARD CAL CONTROL/MONITOR BUFFER
PC 2.420-25

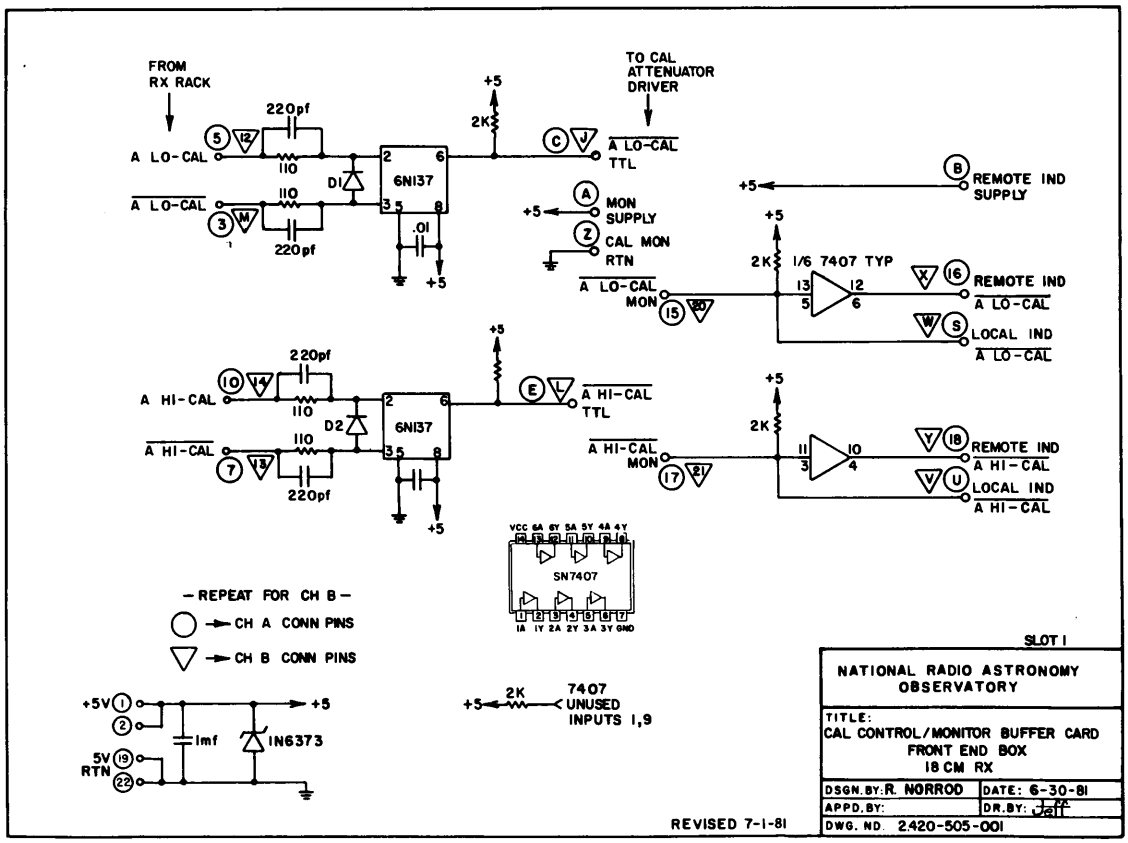
	From	To		From	To	
Slot S1 —	A	(MON SUPPLY)	S3-6	1	(+5V)	+5 BUS
	B	(REM IND SUP)	TB3-1	2	(+5V)	+5 BUS
	C	(A LOCAL TTL)	S3-3	3	(A LO-CAL)	TB1-2
	D			4		
	E	(A HI-CAL TTL)	S3-10	5	(A LO-CAL)	TB1-1
	F			6		
	H			7	(A HI-CAL)	TB1-4
	J	(B LO-CAL TTL)	S3-15	8		
	K			9		
	L	(B HI-CAL TTL)	S3-22	10	(A HI-CAL)	TB1-3
	M	(B LO-CAL)	TB2-2	11		
	N			12	B LO-CAL	TB2-1
	P			13	(B HI-CAL)	TB2-4
	R			14	(B HI-CAL)	TB2-3
	S	(A LO-CAL IND)	NC	15	(A LO-CAL MON)	S3-1
	T			16	(A LO-CAL RI)	TB3-3
	U	(A HI-CAL IND)	NC	17	(A HI-CAL MON)	S3-5
	V	(B HI-CAL IND)	NC	18	(A HI-CAL RI)	TB3-5
	W	(B LO-CAL IND)	NC	19	(GND)	GND BUS
	X	(B LO-CAL RI)	TB3-4	20	(B LO-CAL MON)	S3-13
	Y	(B HI-CAL RI)	TB3-6	21	(B HI-CAL MON)	S3-17
	Z	(CAL MON RTN)	S3-4	22	(GND)	GND BUS

Abbreviations:

Ex: S 25-22
Slot 25, Pin 22

J9-MM
Elco J9, Pin MM

BNC Connectors: B1, B2, B3, etc.
Elco Connectors: J1, J2, J3, etc.
Slot Connectors: S1, S2, S3, etc.
Pin No.'s -3, -X, -B, -22, etc.



Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.	1	Board Artwork		PC2.420-25	NRAO
2.					
3.	1	Capacitor, 1 μF			
4.	8	Capacitor, 220 pF			
5.	4	Capacitor, 0.01 μF			
6.					
7.	4	Diode, Light Emitting	D1, D2	MV5025	Monsanto
8.					
9.					
10.	9	Resistor, 2 K, 1/4 W, Carbon			
11.	8	Resistor, 110 K, 1/4 W, Carbon			
12.					
13.	4	Opto-Isolator	U1-4	6N137	HP
14.	1	IC, Hex Open C Buffer	U5	7407N	
15.					
16.	1	Transient Suppressor, 5 V (MPTE-5)		1N6373	General Semicond.
17.					
18.	1	Socket, 14 Pin Solder			
19.	4	Socket, 8 Pin Solder			
20.					

Parts List No.	Title:	Approved by:	Date:
2.420-505-001	Cal Control/Monitor Buffer 18 cm Rx	Roger Norrod	1 July 1981

1.3-1.8 GHz Receiver
CARD SLOT WIRING LIST

RDN
3Feb83

FOR: BOX FRONT END BOX CARD NOISE SOURCE DRIVER
PC 2.420-21

Slot S2 —

	From	To	From	To
	A		1	(28 V) 28V BUS
	B		2	(GND) GND BUS
	C		3	(ANS) TB1-15 MODULE
	D		4	(A CAL DRIVE) 4-N1SA*
	E		5	(BNS) TB2-15 MODULE
	F		6	(B CAL DRIVE) 4-NSB*
	H		7	
	J		8	
	K		9	
	L		10	
	M		11	
	N		12	
	P		13	
	R		14	
	S		15	
	T		16	
	U		17	
	V		18	
	W		19	
	X		20	
	Y		21	
	Z		22	

* SHIELDED WIRE, GND SHIELD.

Abbreviations:

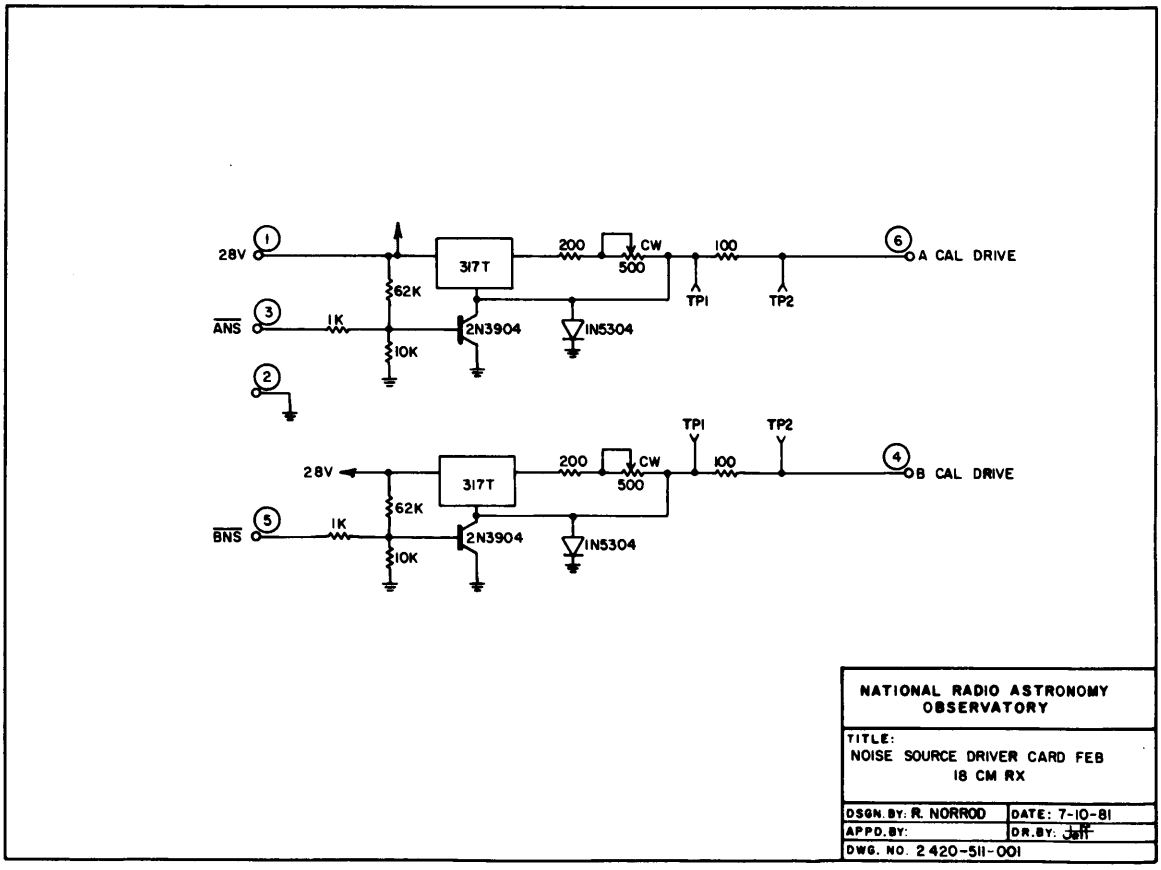
Ex: S 25-22
Slot 25, Pin 22

J9-MM
Elco J9, Pin MM

BNC Connectors: B1, B2, B3, etc.
Elco Connectors: J1, J2, J3, etc.
Slot Connectors: S1, S2, S3, etc.
Pin No.'s -3, -X, -B, -22, etc.

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.	Ref	Board Artwork		2.420-21	
2.					
3.	2	IC, Adjustable Regulator		LM317T	
4.	2	Transistor		2N3904	
5.	2	Diode		1N5304	
6.					
7.	2	Resistor, 100 ohm			
8.	2	Resistor, 200 ohm			
9.	2	Resistor, 1000 ohm			
10.	2	Resistor, 10 K ohm			
11.	2	Resistor, 62 K ohm			
12.					
13.	2	Resistor, Variable, 500 ohm			
14.					
15.					
16.					
17.					
18.					
19.					
20.					

Parts List No.	Title:	Approved by:	Date:
2.420-511-001	PCB Assembly: Noise Source Driver	Roger Norrod	10 July 1981



NATIONAL RADIO ASTRONOMY OBSERVATORY

TITLE:
NOISE SOURCE DRIVER CARD FEB
18 CM RX

DSGN. BY: R. NORROD	DATE: 7-10-81
APPD. BY:	DR. BY: Jeff
DWG. NO. 2420-511-001	

RDN
3Feb83
Revised 3May83

1.3-1.8 GHz Receiver
CARD SLOT WIRING LIST

FOR: BOX FRONT END BOX CARD CAL ATTENUATOR DRIVER
PC 2.420-22

Slot S3 —

From	To	From	To
A		1	(A LO-CAL MON) S1-15
B		2	(A LO-PIN DRIVE) M4-PSW1*
C		3	(A LO-CAL TTL) S1-C
D		4	(CAL MON RTN) S1-Z
E		5	(A HI-CAL MON) S1-17
F		6	(CAL MON SUPPLY) S1-A
H		7	(-15V RTN) GND BUS
J		8	(-15V) -15V BUS
K		9	(A HI PIN DRIVE) M4-PSW2*
L		10	(A HI-CAL TTL) S1-E
M		11	
N		12	
P		13	(B LO-CAL MON) S1-20
R		14	(B LO-PIN DRIVE) M4-PSW3*
S		15	(B LO-CAL TTL) S1-J
T		16	(CAL MON RET) NC
U		17	(B HI-CAL MON) S1-21
V		18	(CAL MON SUPPLY) NC
W		19	(-15V RTN) GND BUS
X		20	(-15V) -15V BUS
Y		21	(B HI-PIN DRIVE) M4-PSW4*
Z		22	(B HI-CAL TTL) S1-L

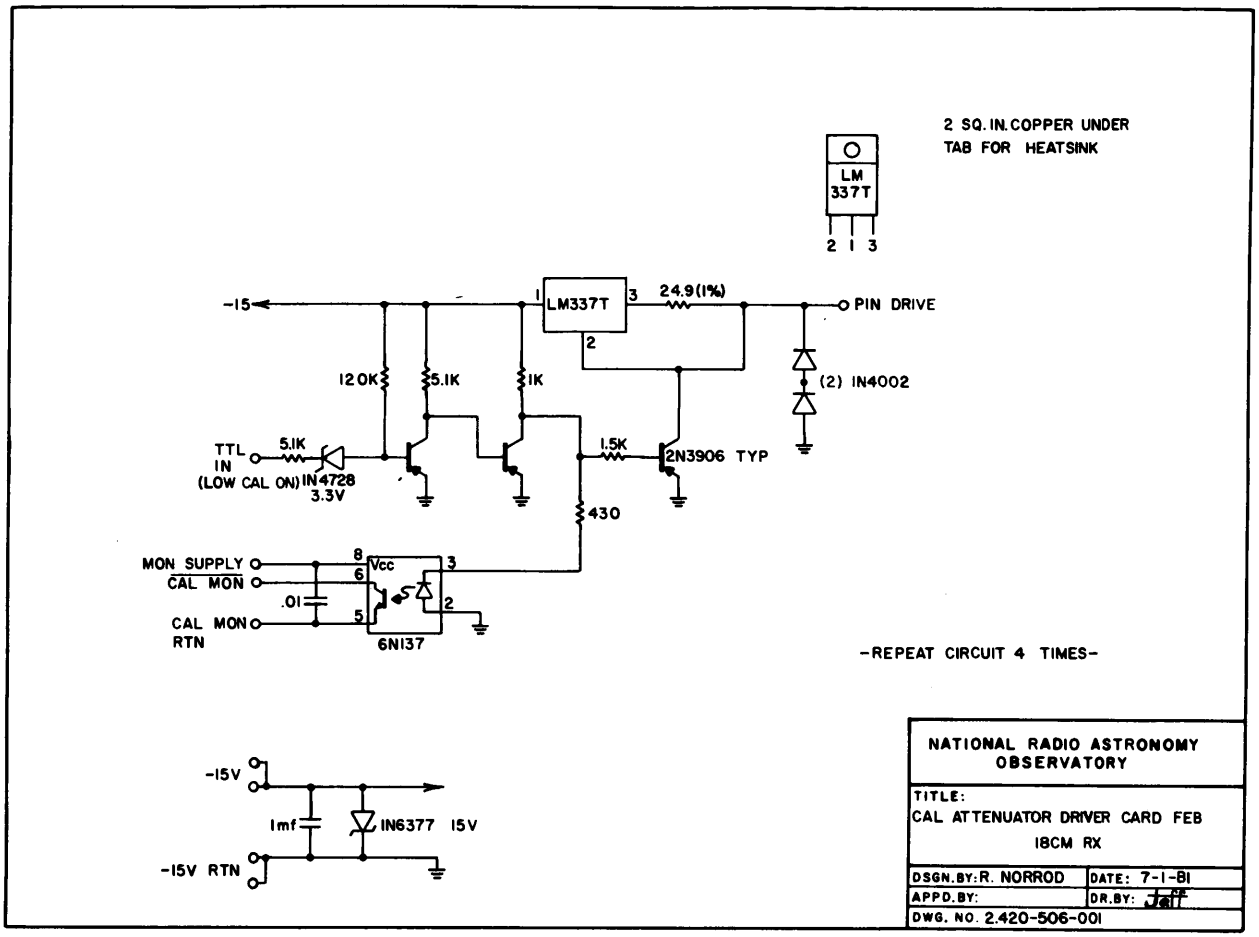
* SHIELDED WIRE, GND SHIELD.

Abbreviations:
Ex: S 25-22
Slot 25, Pin 22
J9-MM
Elco J9, Pin MM

BNC Connectors: B1, B2, B3, etc.
Elco Connectors: J1, J2, J3, etc.
Slot Connectors: S1, S2, S3, etc.
Pin No.'s -3, -X, -B, -22, etc.

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.	1	Board Artwork		PC2.420-22	NRAO
2.					
3.	1	Capacitor, 1 μF			
4.	4	Capacitor, 0.1 μF			
5.					
6.	4	Diode, Zener, 3.3 V		1N4728	
7.	8	Diode		1N4002	
8.	4	Resistor, 430 ohm, 1/8 W, Carbon			
9.	8	Resistor, 5.1 K, 1/4 W, Carbon			
10.	4	Resistor, 120 K, 1/4 W, Carbon			
11.	4	Resistor, 1 K, 1/4 W, Carbon			
12.	4	Resistor, 24.9 ohm, Metal Film, 1%			
13.	4	Resistor, 1.5 K, 1/8 W, Carbon			
14.	12	Transistor, PNP		2N3906	
15.	4	IC, Negative Regulator		LM337T	
16.	4	Opto-Isolator		6N-137	HP
17.	4	Socket, 8 Pin, Solder			
18.					
19.	1	Transient Suppressor, 15 V (MPTE-15)		1N6377	General Semicond.
20.					

Parts List No.	Title:	Approved by:	Date:
2.420-506-001	Cal Attenuator Driver 18 cm Rx	Roger Norrod	1 July 1981



1.3-1.8 GHz Receiver
CARD SLOT WIRING LIST

RDN
3Feb83
Revised 16Mar83

FOR: BOX FRONT END BOX CARD MISC CONTROL/MON BUFFER
PC 2.420-24

Slot S4 —

	From	To		From	To
A	NC		1		5V BUS
B	NC		2		5V BUS
C	PM02-H		3		PM02-D
D	PM02-E		4		PM02-F
E	TB3-7		5		TB3-14
F	PM01-D		6		
H	NC		7		
J			8		
K	NC		9		TB3-13
L			10		TB3-8
M	S5-3		11		
N	TB3-9		12		PM01-E
P			13		NC
R	S5-u		14		TB3-15
S	TB3-12		15		PM03-D
T	S5-13		16		
U	TB3-10		17		PM03-E
V	S5-K		18		NC
W	TB3-11		19		GND BUS
X			20		TB3-16
Y			21		GND BUS
Z			22		GND BUS

Abbreviations:

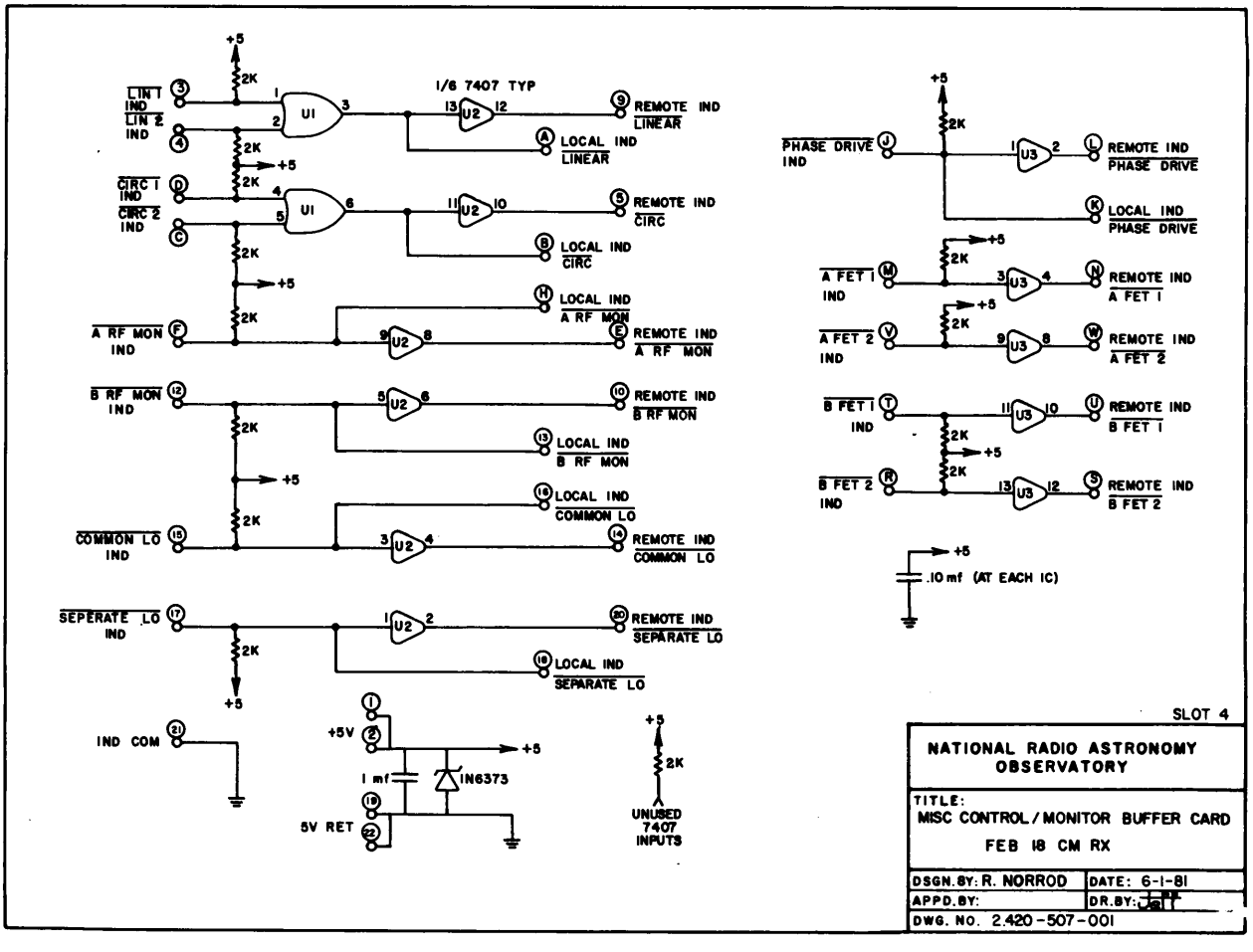
BNC Connectors: B1, B2, B3, etc.
Elco Connectors: J1, J2, J3, etc.
Slot Connectors: S1, S2, S3, etc.
Pin No.'s -3, -X, -B, -22, etc.

Ex: S 25-22
Slot 25, Pin 22

J9-MM
Elco J9, Pin MM

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.	1	Board Artwork		PC2.420-24	
2.					
3.	1	Capacitor, 1 μF			
4.	3	Capacitor, 0.10 μF			
5.					
6.	14	Resistor, 2 K, 1/4 W, Carbon			
7.					
8.					
9.	1	IC, Quad Two Input OR	U1	7432N	
10.	2	IC, Hex Open C Buffer	U2, 3	7407N	
11.					
12.	1	Transient Suppressor, 5 V (MPTE-5)		1N6376	General Semidond.
13.					
14.					
15.	3	Socket, 14 Pin Solder			
16.					
17.					
18.					
19.					
20.					

Parts List No.	Title:	Approved by:	Date:
2.420-507-001	Misc. Control/Monitor Buffer	Roger Norrod	1 July 1981



1.3-1.8 GHz Receiver
CARD SLOT WIRING LIST

RDN
3Feb83

FOR: BOX FRONT END BOX CARD FET CONTROL AND MONITOR
PC 2.420-26

Slot S5 —

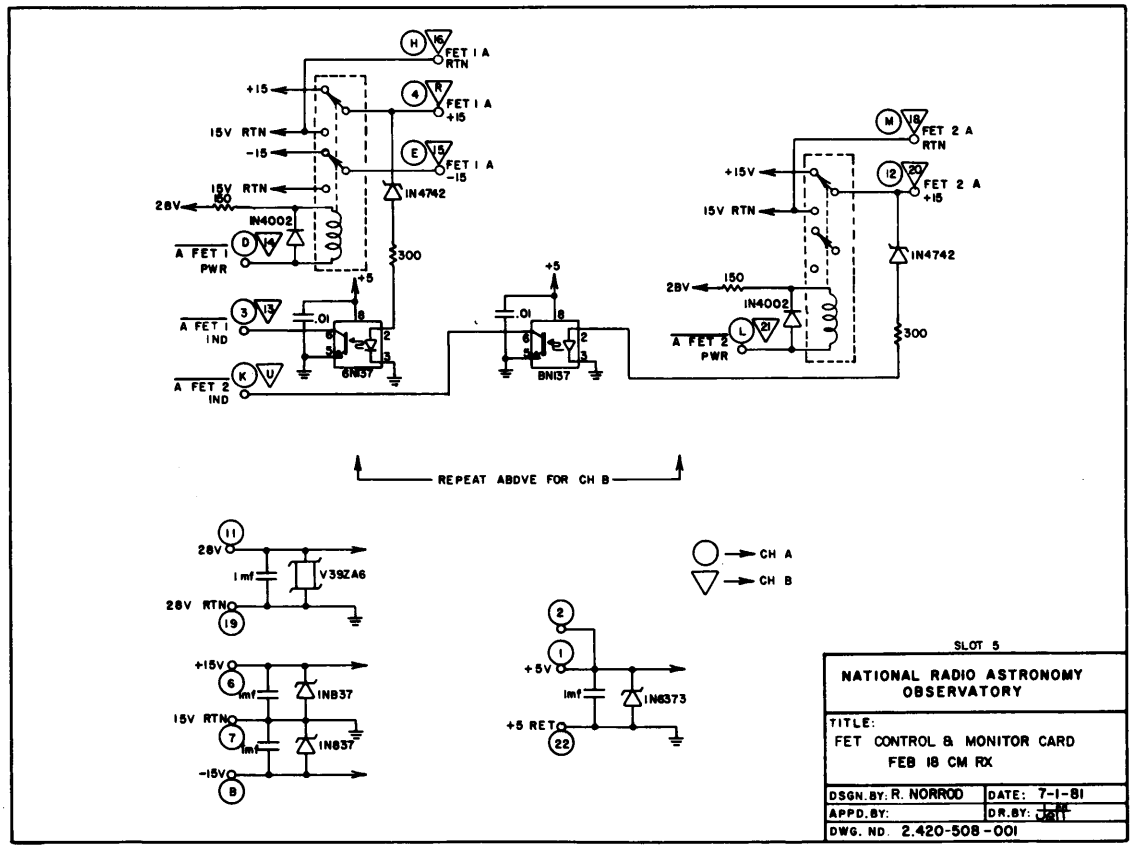
From	To		From	To	
A			1	+5V	5V BUS
B			2	+5V	5V BUS
C			3	(A FET1 IND)	S4-M
D	(A FET1 PWR)	TB3-27	4	(A FET1+15)	PFA1-A
E	(A FET1-15)	PFA1-C	5		
F			6	(+15 V)	+15 BUS
H	(GND)	PFA1-B	7	(GND)	GND BUS
J			8	(-15V)	-15 BUS
K	(A FET2 IND)	S4-V	9		
L	(A FET2 PWR)	TB3-29	10		
M	(GND)	PM01-K	11	(28 V)	28V BUS
N			12	(A FET2+15)	PM01-H
P			13	(B FET1 IND)	S4-T
R	(B FET1+15)	PFB1-A	14	(B FET1 PWR)	TB3-28
S			15	(B FET1-15)	PFB1-C
T			16	(GND)	PFB1-B
U	(B FET2 IND)	S4-R	17		
V			18	NC	
W			19	(GND)	GND BUS
X			20	(B FET2+15)	PM01-J
Y			21	B FET2 PWR	TB3-30
Z			22	(GND)	GND BUS

Abbreviations:

Ex: S 25-22
Slot 25, Pin 22

J9-MM
Elco J9, Pin MM

BNC Connectors: B1, B2, B3, etc.
Elco Connectors: J1, J2, J3, etc.
Slot Connectors: S1, S2, S3, etc.
Pin No.'s -3, -X, -B, -22, etc.



Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.	1	Board Artwork		PC2.420-26	
2.					
3.	4	Capacitor, 1 μF			Erie
4.	4	Capacitor, 0.01 μF			
5.	4	Diode, Zener, 12 V		1N4742	
6.	4	Diode		1N4002	
7.	4	Relay, DPDT, 24 V Coil		HP-11D-24	P&B
8.					
9.	4	Resistor, 150 ohm, 1/4 W, Carbon			
10.	4	Resistor, 300 ohm, 1/4 W, Carbon			
11.					
12.	4	Opto-Isolator		6N137	HP
13.					
14.	1	Transient Suppressor, 39 V		V39ZA6	GE
15.	2	Transient Suppressor, 15 V (MPTE-15)		1N6377	General Semicond.
16.	1	Transient Suppressor, 5 V (MPTE-5)		1N6373	General Semicond.
17.					
18.					
19.					
20.					

Parts List No.	Title:	Approved by:	Date:
2.420-508-001	FET Control/Monitor Card 18 cm Rx	Roger Norrod	1 July 1981

1.3-1.8 GHz Receiver
CARD SLOT WIRING LIST

RDN
3Feb83
Revised 16Mar83

FOR: BOX FRONT END BOX CARD ANALOG MONITOR CARD
PC 2.420-27

Slot S6 —

	From	To	From	To
	A	(A FET GAIN) PFA1-J	1	
	B	(B FET GAIN) PFB1-J	2	
	C	(B FET GAIN CCW) TB2-14	3	(A FET GAIN CW) TB1-13
	D		4	(A FET GAIN CCW) TB1-14
	E	(B FET GAIN CW) TB2-13	5	
	F		6	+15 V BUS
	H		7	GND BUS
	J		8	-15 V BUS
	*K	(PHASE POS) PM02A-G	9	(SHIELD)
	L	(PHASE SHIFT MON) TB2-27	10	(PHASE SHIFT RTN) TB2-28
	M		11	28 V BUS
	N		12	
	P	(24 V SUPPLY PM02-J	13	
	R		14	
	S		15	
	T		16	
	U		17	
	V		18	
	W		19	
	X		20	
	Y		21	
	Z		22	GND BUS

* SHIELDED WIRE.

Abbreviations:

Ex: S 25-22
Slot 25, Pin 22

J9-MM
Elco J9, Pin MM

BNC Connectors: B1, B2, B3, etc.
Elco Connectors: J1, J2, J3, etc.
Slot Connectors: S1, S2, S3, etc.
Pin No.'s -3, -X, -B, -22, etc.

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.	1	Board Artwork		PC2.420-27	NRAO
2.					
3.	4	Capacitor, 1 μF, 100 V, Ceramic			
4.	5	Capacitor, 0.01 μF, 100 V, Ceramic			
5.	1	Capacitor, 5 μF, 50 V, Electrolitic			
6.					
7.	2	Diode		1N4002	
8.	2	Diode, Transient Suppressor, 15 V		1N6377	General Semicond.
9.	1	Varistor, 39 V		V39ZA6	GE
10.	1	IC, Positive Adjustable Regulator		LM317T	National
11.	4	IC, Op-Amp		741CK	
12.	1	Resistor, 11.3 K	Metal Film, 1%		
13.	1	Resistor, 120 ohm	Metal Film, 1%		
14.	1	Resistor, 2.32 K	Metal Film, 1%		
15.	2	Resistor, 4.02 K	Metal Film, 1%		
16.	3	Resistor, 1.00 K	Metal Film, 1%		
17.	2	Resistor, 1.33 K	Metal Film, 1%		
18.	2	Resistor, 10.0 K	Metal Film, 1%		
19.	2	Resistor, 4.99 K	Metal Film, 1%		
20.					

Parts List No.	Title:	Approved by:	Date:
2.420-509-001	Analog Monitor Card Front End Box 18 cm Rx	Roger Norrod	6 August 1981 Rev. 22 June 1983