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MODEL F104, 2.3 GHZ CRYOGENIC FRONT-END

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Section 1. SYSTEM DESCRIPTION

1.1 Brief Block Diagram Description

This report describes a dual-channel, low-noise amplifier system intended for use as a radio astronomy receiver front-end. A frequency range of 2.1 to 2.4 GHz is covered with a receiver noise temperature of less than 15 K (noise figure less than 0.22 dB). With the addition of a waveguide quarter-wave plate in front of the receiver input flange, the dual-channels allow both left and right circularly-polarized (LCP and RCP) signals to be received.

A block diagram of the system is shown in Figure 1.1-1 and a photograph is shown in Figure 1.1-2. A 9.75 cm (3.837 inch) diameter circular waveguide, propagating both TE_{11} linearly polarized waves, provides the input to the system. A low-loss foam plug window in the waveguide supports a vacuum in a dewar which contains receiver components cooled to temperatures of 50 and 15 Kelvin by a closed-cycle, cryogenic refrigerator. The thermal barrier separating the room temperature and cryogenic portions of the input waveguide is achieved by a 0.5 mm (.020 inch) gap in the waveguide wall. A quad-ridged ortho-mode transducer (OMT) accepts the waveguide signal and extracts orthogonal linear polarizations. The two SMA coaxial-line outputs of the OMT are connected via directional couplers and semi-rigid coaxial lines to the inputs of three-stage HEMT/FET amplifiers with approximately 32 dB of gain. The amplifier outputs connect to commercial vacuum tight feed-thru connectors via 2.159 mm (.085 inch) diameter coaxial cables made of low thermal conductivity alloys.

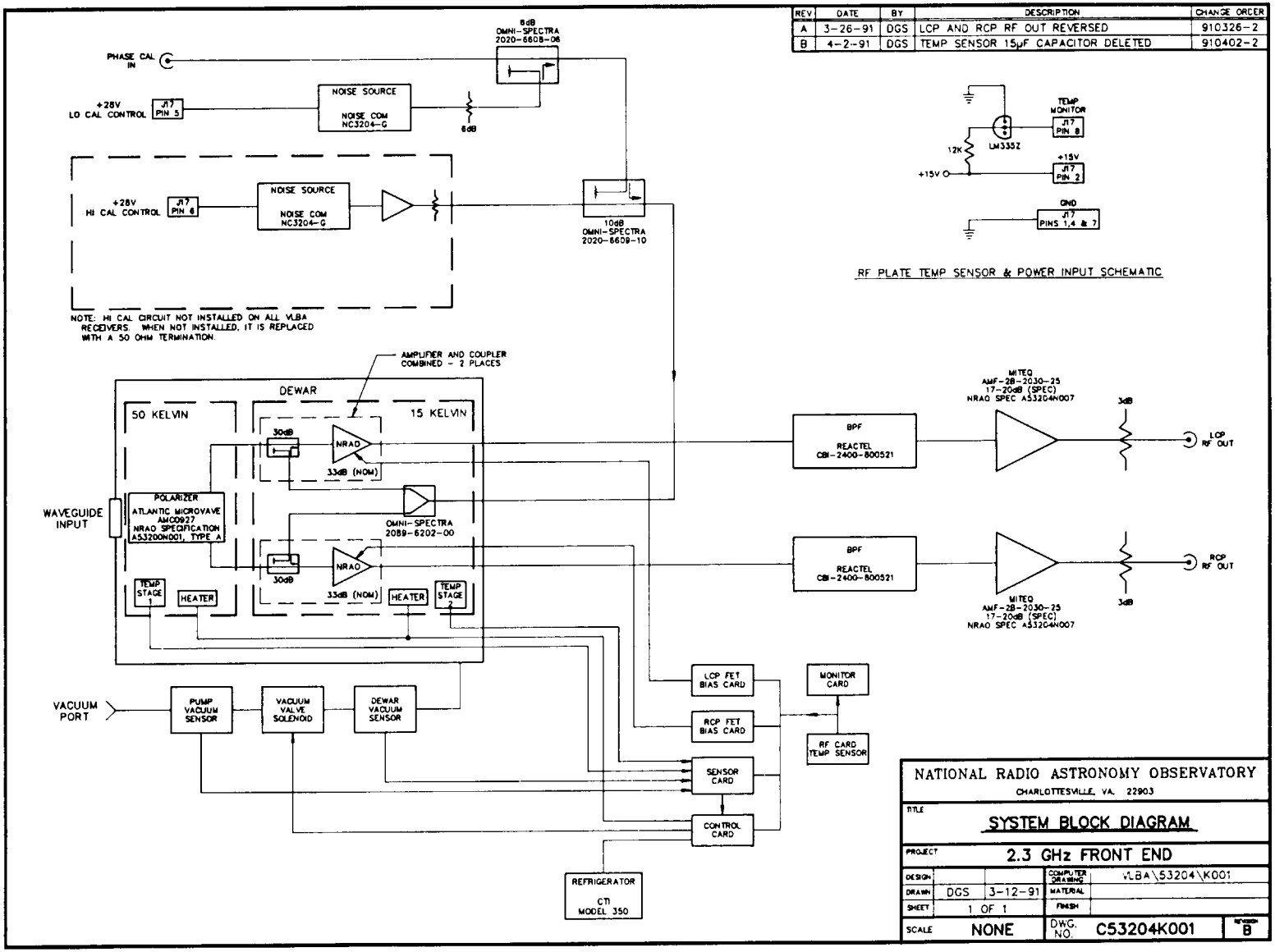


Figure 1.1-1
System Block Diagram

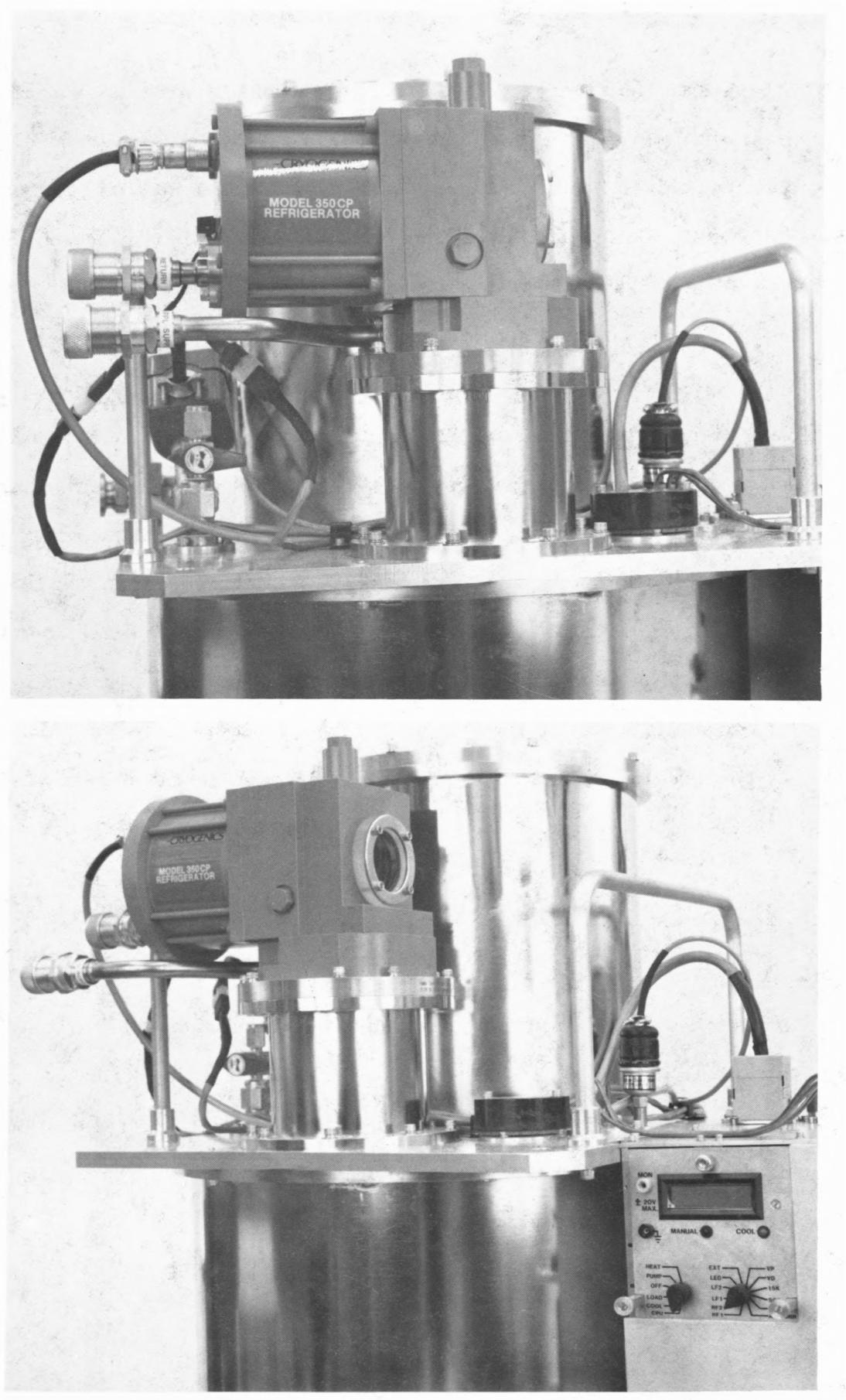


Figure 1.1-2
The VLBA 2.3 GHz Front-End

Attached to the front-end dewar is an electronics card cage containing five printed circuit boards. On one of these boards a local monitor/control panel is mounted. This small panel contains a six-position switch with positions CPU, COOL, STRESS, OFF, PUMP, and HEAT. The latter five positions place the front-end into each of its logical states; the CPU position allows the state to be determined by three control bits from the station computer. When not in the CPU position, a red indicator is illuminated and a monitor bit is set low. A twelve position monitor switch and a 4 1/2 digit DVM are available on the local panel for reading analog monitor points; a pin jack in parallel with the DVM is provided to connect a monitor point to other equipment or to meter external voltages. The dewar and pump port vacuum are monitored, along with dewar temperature, by sensors and circuitry on a sensor card in the attached card cage. The sensor outputs, AC power, and the three control bits are input to a control card which controls the vacuum solenoid, the refrigerator motor power, and dewar heaters. Two bias cards providing constant drain-current bias for the cooled GASFET amplifiers are included in the card cage. Details of the operation of the front-end card cage electronics package is provided in a separate report. Details of a preliminary version of the printed circuit cards is included in VLBA Technical Report No. 1.

The two dewar RF output signals feed room temperature bipolar transistor amplifiers having a noise figure less than 3.5 dB and 17 to 20 dB of gain. The amplifiers, bandpass filters, calibration noise sources, and related components are mounted on a RF plate that attaches to the front-end card cage. Three types of calibration signals are provided:

a) A low noise calibration signal, approximately 1.5 K, for continuous pulsed gain and noise calibration of the system.

b) A high noise calibration signal, approximately 7000 K, which may be useful for solar or other large signal observations. The components required to generate this signal have not been mounted, but may be added to later units as the need arises.

c) An externally applied signal, coupled -44 dB to both inputs, for the purposes of phase or time-delay calibration of the system.

The cryogenic components are cooled with a Cryogenic Technology, Inc., Model 350 refrigerator which requires an external helium compressor. Vacuum service, such as provided by a two-stage mechanical pump, is also required and is connected to the dewar through a solenoid-operated valve.

1.2 Specifications

Unless otherwise stated these specifications apply to the system at its cryogenic operating temperature, and over the frequency range 2.1 to 2.4 GHz. A set of test data similar to that which will be provided for each front-end is given in Appendix I.

1.2.1 Noise Temperature

The receiver noise temperature measured at the front-end waveguide input flange shall be less than 15 K. The noise temperature shall be measured with a properly calibrated liquid-nitrogen noise temperature standard and at 15 MHz intervals from 2.1 to 2.4 GHz.

1.2.2 Input Return Loss

The return loss for the two orthogonal linear TE_{11} modes in the input circular waveguide must be greater than 15 dB. This measurement may be performed with a coaxial reflectometer, a WR650 rectangular waveguide-to-coax adapter, and a well-matched WR650 to circular waveguide transition.

1.2.3 Front-end Gain

The gain through either channel measured from the front-end waveguide input flange to the RF Out jacks J6 and J7 shall be 46 ± 3 dB.

1.2.4 Phase Cal Coupling

The calculated coupling from the Phase Cal input jack J8 to the cooled GASFET amplifier inputs shall be -46 ± 2 dB.

1.2.5 Phase Cal Input Return Loss

The return loss at the Phase Cal input jack J8 shall be ≥ 20 dB.

1.2.6 Output Return Loss

The output return loss for the RCP and LCP channels, at RF Out jacks J6 and J7, shall be ≥ 20 dB.

1.2.7 Calibration Noise Temperature

The noise added to the system in each channel when +28 volts is applied to the Cal control line shall be 1.5 ± 1K and calibrated with an accuracy of ±0.1K.

1.2.8 Output Total Noise Power

With a room temperature waveguide load connected at the input waveguide flange, the noise power out of the RF Out jacks J6 and J7, measured with a broadband power meter, shall be -38 ± 3 dBm. The total noise power shall also be recorded with the following waveguide input conditions: short circuit; short circuit with Cal on; and short circuit with High Cal on.

1.2.9 Output Noise Power Stability

The receiver waveguide input shall be short-circuited and a test receiver with approximately 10 MHz I.F. bandwidth and 1 kHz post detection bandwidth connected to the RF Output jacks. With the receiver tuned near to the front-end center frequency, and gain adjusted for 5 ± 1 VDC output from the receiver, the peak-to-peak AC (> 2 Hz) receiver output shall be less than 250 mV peak-to-peak as viewed on an oscilloscope. This test shall be passed under conditions of light tapping upon the dewar, RF components, and coaxial cables. (The purpose of the test is to check for mechanical looseness, vibration sensitivity, 60 Hz modulation, and refrigerator induced gain modulation.)

1.2.10 Cold Station Temperatures

The temperature of the refrigerator first stage (as measured on the OMT connected to that stage) shall be ≤ 70 K; the second stage temperature as measured on the cold plate near the cooled amplifiers shall be ≤ 17 K.

1.2.11 FET Bias Data

The optimum drain voltage V_D, drain current I_D, and gate voltage V_g, at room and cryogenic operating temperatures, shall be recorded for each stage of the cooled amplifiers.

1.2.12 Cool-Down Time

The time required to cool the cryogenic components from 300 K to operating temperature shall be ≤ 12 hours.

1.2.13 Physical Weight and Size

The front-end shall weigh less than 118 pounds and shall have the outline shown in Figure 1.3-1.

1.3 Interface Description

Descriptions of the mechanical and electrical interfaces of the system follow.

1.3.1 Mechanical Interface

Locations of the input waveguide, helium supply and return ports, vacuum port, and mounting holes are shown in Figure 1.3-1.

The intended mounting concept is to align the front-end to the antenna feed using the large input waveguide flange and then take up most of the front-end weight with adjustable supports bolted through the .531" diameter holes in the four corners of the 16.25 inches square aluminum plate. When mounted, access should be provided so that the circuit cards, RF plate, or refrigerator motor and displacers can be removed without demounting the front-end assembly.

1.3.2 Vacuum and Helium Interface

The vacuum port connection is through a Leybold-Heraeus type KF16 flange, type 18321 centering ring, and type 18346 quick-disconnect clamp. A control signal on connector J2, PUMP REQUEST, is high when vacuum pumping is needed; this may be either used to turn on a pump or open a solenoid-operated valve to a pump manifold.

The helium interface is through Aeroquip 5400-S2-8 self sealing fittings. The helium supply pressure should be 270 ± 10 psi dynamic, and the return pressure is 60 ± 15 psi.

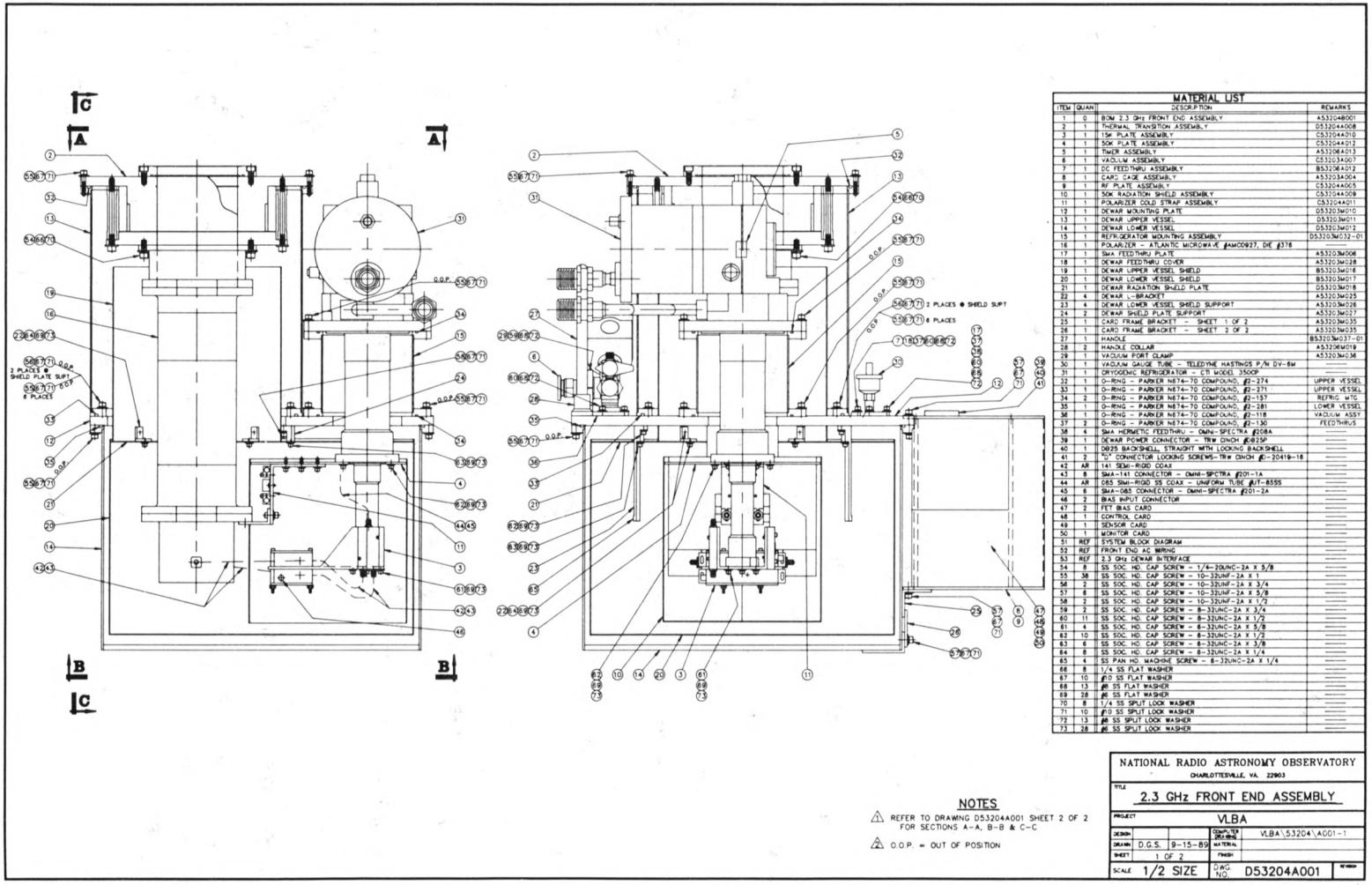


Figure 1.3-1
Front-End Outline and Interface Drawing

1.3.3 RF Interface

The RF outputs J6 and J7, and Phase Cal input J8, are coaxial type N female connectors. The return loss at these connectors will be ≥ 20 dB from 2.1 to 2.4 GHz. The RF Outputs connect in the VLBA system to the T104 2.3 GHz Converter Module. With 43 dB of front-end gain, the system following the front-end must have a noise figure, including cable losses, of less than 18 dB to add less than 1K to the receiver noise temperature.

1.3.4 Front-end DC Interface Connectors

The Monitor connector, J2, provides various analog and digital monitor functions. The Power, Control, and ID connector, J5, supplies front-end power, refrigerator and cal source controls, and a twelve-bit ID word. The Auxiliary connector, J4, is provided to interface with equipment related to the front-end, such as the refrigerator power supply and vacuum pump control. The pin assignments for these connectors are given in Tables I, II, and III. The front-end card cage is not designed to connect directly with the VLBA Monitor/Control bus, but a Front-end Interface Module F117 is provided to do so. Details of the F117 module is given in a separate report. Descriptions of the signals on the front-end DC connectors follow.

1.3.4.1 Power, Control, and ID Connector, J5

The circuitry is designed so that if this connector is unplugged the refrigerator will continue to run; this allows maintenance of a portion of the system without causing a warm-up. Note that if the 15 volt supplies are turned off while the AC voltage is applied, power will be applied to the refrigerator motor regardless of the condition of the dewar vacuum.

TABLE I

J2-MONITOR (DB25S ON FRONT-END)		
Pin	Label	Function
1	VP	PUMP VAC
2	VD	DEWAR VAC
3	15K	TEMP MON,
4	50K	10 mV/°K
5	300K	
6	AC I	AC CURRENT
7	RF1	RCP STAGE 1
8	RF2	OTHER STAGES
9	LF1	LCP STAGE 1
10	LF2	OTHER STAGES
11	LED	LED VOLTAGE
12	-	-
13	QGND	QUALITY GND
14	SENS	TEMP SENS A
15		
16		
17		
18		
19		
20	S	SOLENOID MON
21	P	PUMP REQ
22	$\overline{M}$	MANUAL MON
23	X	CONTROL
24	C	MODE
25	$\overline{H}$	MONITOR

TABLE II

J5-PWR, CONTROL, AND ID (DB25P ON FRONT-END)		
Pin	Label	Function
1	GND	POWER GROUND
2	+15	600 mA
3	-15	100 mA
4		
5		
6	X	CONTROL BITS
7	C	
8	$\overline{H}$	
9	$\overline{PA}$	FE PARITY (EVEN)
10		
11	CAL	28.0 V, 4-10 mA
12	HI CAL	28.0 V, ~ 50 mA
13	GND	
14	FØ	LSB
15	F1	FREQUENCY
16	F2	ID
17	F3	MSB
18	SØ	LSB
19	S1	SERIAL
20	S2	NUMBER
21	S3	
22	S4	
23	S5	MSB
24	MØ	MODIFICATION
25	M1	MSB

TABLE III

J4-AUXILIARY (DB9S ON FRONT-END)		
Pin	Label	Function
1	AC+	CURR MON, 10V/AMP
2	AC-	RETURN
3	P	PUMP REQUEST
4	GND	GROUND
5		
6		
7		
8		
9		

TABLE IV

FREQUENCY ID CODE		
Code	Frequency	$\overline{PA}$
0	75	0
1	327/610	1
2	1.5	1
3	2.3	0
4	4.9	1
5	8.4	0
6	10.7	0
7	14.9	1
8	23	1
9	43	0
A	86	0
B		
C		
D		
E		
F		

TABLE V

J1-AC POWER 150 VAC 2φ 0.5-1.0 A (DEUTSCH DM9606-3P ON FRONT-END)			
Pin	Label	Function	MS Pin Power Supply
1	Ø1	SHIFTED PHASE	A
2	Ø2	LINE PHASE	B
3	R	RETURN	C

The effect of the control bits on J5; C, NOT-H, and X; is shown in Table VI. Note that a control data failure which forces all bits high will keep the system in COOL mode. Although all zeros are not defined, it is currently interpreted as the STRESS state. There is no memory in the dewar control circuitry and switching from one mode to another can be performed without damage; the control card will not open the vacuum valve solenoid unless the pump port vacuum is sufficiently low, and also protects the dewar from overheating by the heaters. The control bits are TTL levels with each driving one LS load.

Table VI
Front-End Control States

C	H	X	Mode	Comment
0	1	1	OFF	No refrigerator power, heater power, or vacuum pumping.
1	1	1	COOL	Normal cooled operation.
0	0	1	STRESS	COOL with small added heat load to stress-test cryogenics.
1	0	1	HEAT	Fast warm-up of dewar with 65 watts of heat added. PUMP REQ becomes high when dewar vacuum is greater than 10 microns.
1	0	0	PUMP	No refrigerator or heater power. PUMP REQ high; vacuum solenoid open when manifold pressure less than dewar pressure.

The CAL control signal directly drives the calibration noise source. The CAL signal is turned on with +28 volts at 4 to 10 mA. The coefficient of calibration power output versus supply voltage is less than 0.1 dB/% for CAL.

The twelve bit ID word provided on J5 is functionally divided into four frequency ID bits, six serial number bits, and two modification ID bits. The frequency ID codes are given in Table IV. In the VLBA system, the frequency ID bits will be used for monitor and control address assignment. Accordingly, a parity bit (NOT-PA) is provided, giving the inverted Even parity of the four frequency bits. This bit is inverted in the Front-end Interface Module giving Odd parity of the M/C address. Low ID bits are connected to Ground; high bits are open-circuits. Pull-up resistors are required in the Front-end Interface Module F117.

1.3.4.2 Monitor Connector, J2

Six TTL digital monitor signals are provided on Monitor connector J2. The pump request signal, P, is a TTL level which is high if dewar vacuum pumping is required, and should be monitored and connected to the vacuum manifold control circuits. P is provided on both J2 and J4. The vacuum solenoid signal, S, is a TTL signal for monitor purposes; S is high when the vacuum valve is open. NOT-M, Manual Mon, is high if the manual control switch on the front-end card cage is in the CPU position. C, NOT-H, and X monitors are provided to indicate the active control state.

The analog monitor signals on J2 are provided for fault detection and isolation. The vacuum pressure as a function of the vacuum monitor voltages V_P and V_D is given in Figure 1.3-2.

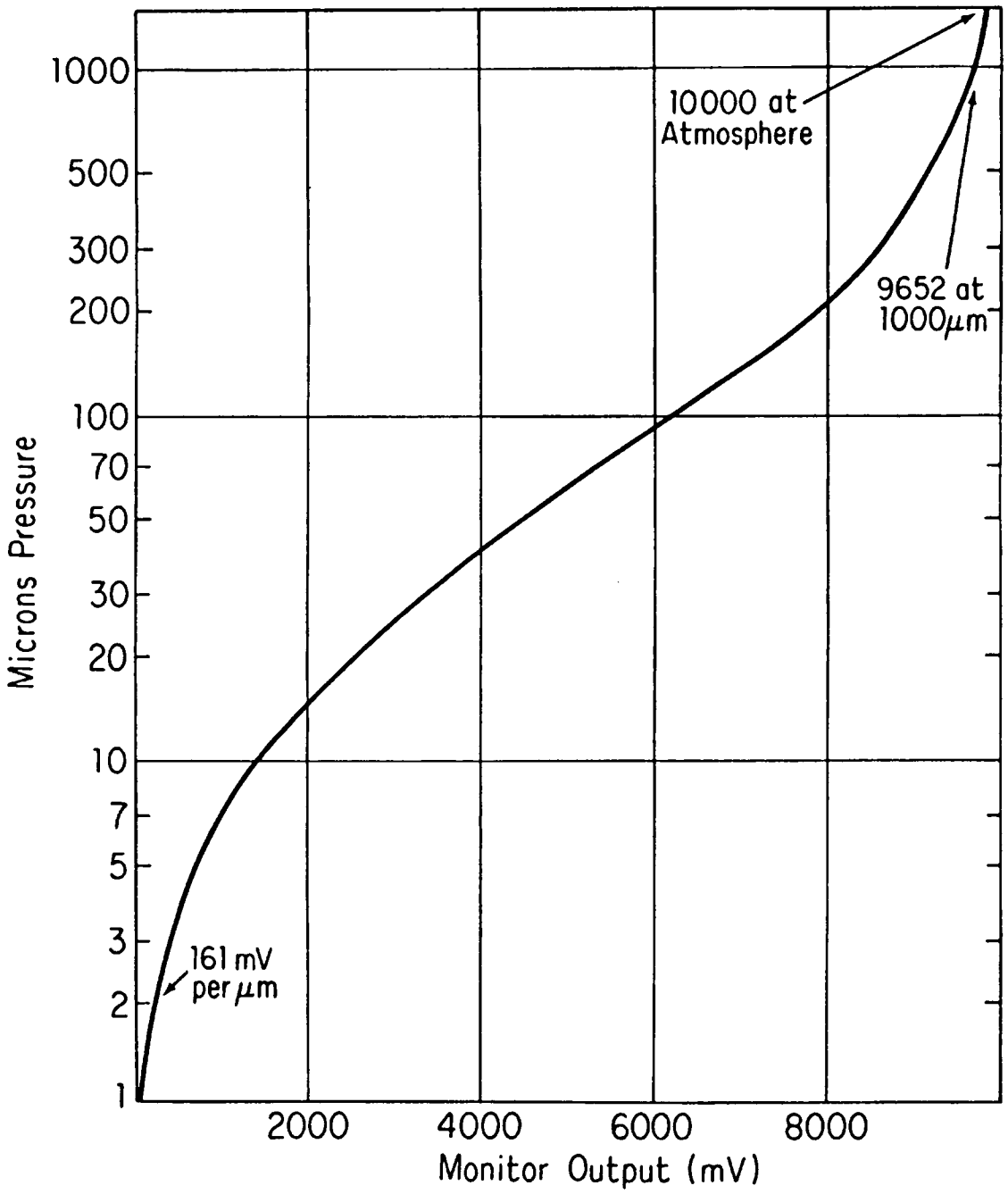


Figure 1.3-2
Vacuum Pressure as a Function of Monitor Output Voltage

Three linearized (10 mV/K) temperature monitors are provided: the refrigerator first (50 K) and second (15 K) stages, and an ambient (300 K) temperature, sensed on the RF Plate in the card cage. In addition, the refrigerator second stage temperature sensor voltage, buffered by a unity-gain amplifier, is provided (SENS). This output has a non-linear relation to temperature, but gives greater sensitivity and potential accuracy at low temperatures than the linearized 10 mV/K output.

RF1 and LF1 are the first stage gate voltages of the LCP and RCP cooled amplifiers, respectively. RF2 and LF2 are the voltage sum of the remaining stages' gate voltages for the two channels. A large change in any of the gate voltages usually means than one of the amplifier stages has a fault or that a problem exists in the bias card or the front-end wiring.

The output AC I is the signal fed into the front-end card cage at Auxiliary connector pins 1 and 2. The refrigerator power supply provided with the front-end produces this voltage (10 Volts/Amp) and is provided at J2 so that the station control computer can verify that power is applied to the refrigerator motor and/or other front-end AC components. The refrigerator motor, vacuum valve solenoid, and dewar heaters currents are summed into this monitor voltage. Typical currents in the various front-end modes are: COOL - 0.76 A, STRESS - 0.79 A, and HEAT - 0.40 A. The rms current drawn by the various loads are as follows:

Refrigerator Motor	0.76 amps
Vacuum Solenoid*	0.25 amps
Heaters in HEAT Mode	0.40 amps
Heaters in STRESS Mode	0.03 amps

*If the vacuum solenoid is powered but through a fault does not actuate, it will draw 0.40 amps.

Quality Ground, QGND, is provided on J2 as a low current return path for the front-end analog monitors. It should be isolated from the system power supply grounds at the circuitry measuring those voltages.

1.3.4.3 Auxiliary Connector, J4

This connector is provided to allow miscellaneous connections to the front-end. The AC current monitor and the Pump Request signal are explained in the above section.

1.3.5 AC Power Interface, J1

The CTI Model 350 refrigerator requires two-phase, 150 volt, 60 or 50 Hz AC power which is supplied into a three-pin receptacle, Deutsch DM9606-3P, with mating plug, DM9702-3S. The pin assignments are given in Table V. A simplified AC power schematic of the entire system, and a suggested power source schematic are shown in Figure 1.3-3. The P112 Model 350 Power Supply provides the proper voltages to run the refrigerator motor and is described in Section 2.9.

Note that the AC power cable may be removed from J1 and plugged directly into the refrigerator motor to keep the system cold while removing AC power from the control circuits.

1.4 System Parameter Budgets

The system noise temperature budget is given in Table VII. The front-end gain budget is given in Table VIII, and the estimated heat loads on the refrigerator second (15 K) stage is given in Table IX.

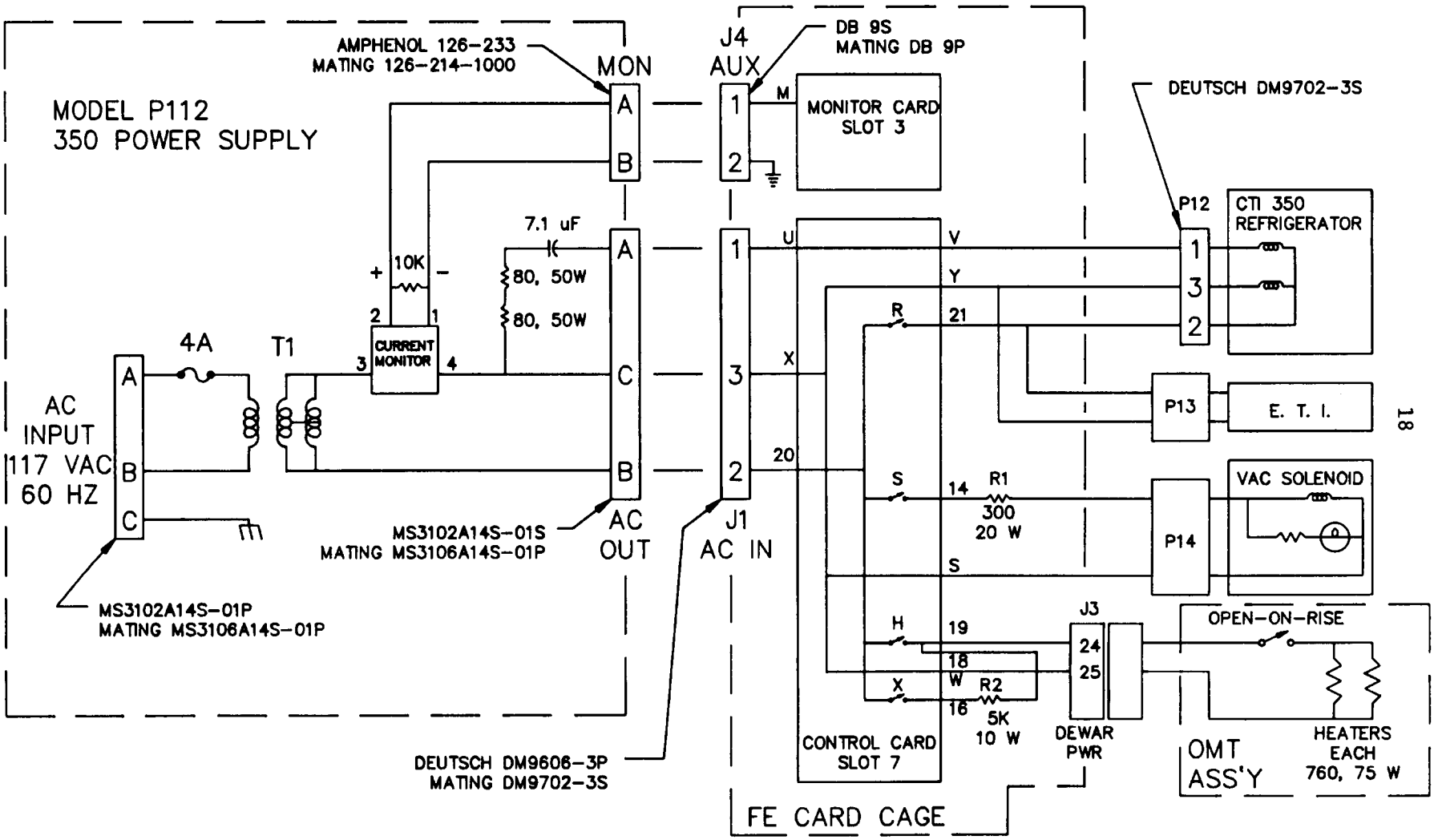


Figure 1.3-3

Front-end AC wiring and AC power supply schematic.

Table VII
System Noise Budget

Component	Physical Temperature	Noise Temperature or Loss	System Contribution
Amplifier	16 K	5.0 K	5.0 K
Post Front-end	300 K	18,000 K	0.9 K
Second Stage	300 K	530 K	0.5 K
Cal Coupler and Coax Cable	16 K	0.15 dB	0.9 K
OMT	50 K	0.10 dB	1.4 K
Window	300 K	0.001 dB	0.1 K
	TOTAL RECEIVER TEMPERATURE		8.8 K

Table VIII
Front-end Gain Budget

Input Losses	- 0.2 dB
3-Stage Amplifier	+ 32.0 ± 1.5 dB
9" .085" D. SS/AG Cable	- 0.6 dB
12" .141" D. CU/CU Cable	- 0.2 dB
Bandpass Filters	- 0.5 dB
3-Stage Post Amp	+ 18.5 ± 1.5 dB
Output Attenuator	- 3.0 dB
NET GAIN	+ 46.0 ± 3.0 dB

Table IX
Heat Load on Refrigerator Second Stage

Radiation	0.2 watts
Coaxial Lines to 300 K (4)	0.17
Coaxial Lines to 50 K (2)	0.66
No. 32 Brass Wire (16)	0.04
Amplifier DC Bias	0.4
TOTAL	1.5 watts

Section 2. COMPONENT DESCRIPTIONS AND OPERATIONAL NOTES

2.0 General

A number of key drawings are shown in Appendix II. These drawings include bill-of-materials (BOM) documents which index other drawings. Manufacturer's data sheets for commercial components used in this front-end are included in Appendix III. In Appendix IV, special test equipment needed to test or construct the front-end is described.

2.1 Vacuum Dewar

The vacuum dewar is formed of two cylindrical vessels, a third, smaller cylinder, and a one-half inch thick aluminum plate. The Top Vessel (called top because it will be nearer the sky in the VLBA cassegrain system) supports the thermal transition and the OMT. The refrigerator is supported at the correct position relative to the OMT by the small cylinder. The Lower Vessel supports no components, and so can be easily removed allowing access to the dewar internal components. All three of the cylinders bolt to the Dewar Mounting Plate, machined out of one-half inch thick aluminum. The cylinders are formed by rolling thin stainless-steel sheets, welding the seam, and welding flanges to the resulting cylinder. Many reliable dewars have been fabricated in this manner at NRAO.

2.1.1 Vacuum Pumping

The dewar interior volume is approximately 48 liters. The interior surfaces, the cryopumping charcoal on the 15 K plate, and especially the rigid foam used in the vacuum window construction, adsorb gases and water vapor that are difficult to remove by mechanical pumping. If a dewar has been open for several days in humid conditions, it can take more than four hours for a 127 liter/minute roughing pump to evacuate the dewar to a pressure of 50 microns. However, if a dewar has been stored under vacuum, the same pump can achieve 50 microns in less than 30 minutes. It is recommended that, before cooling the front-end prior to installing on the telescope, it be pumped at room temperature for twenty-four hours, if possible.

2.1.2 Radiation Shields

Two levels of radiation shields are used in the dewar to reduce the radiation loading on the refrigerator cold stations. The shields are constructed of thin aluminum sheets formed into the proper shapes. The first level of shielding is provided by a "floating" shield, one that is not thermally connected to the refrigerator. This shield consists of a Upper Vessel Shield, surrounding the thermal transition and OMT in the Upper Dewar Vessel, and a Lower Vessel Shield and Plate that surround the components in the Lower Dewar Vessel. These shields are supported from the Dewar Mounting Plate by brackets machined from epoxy-fiberglass type G-10.

The 50 K shield, shown in figure 2.1-3, is used to reduce radiation from the 15 K stage to the lower dewar vessel. The 50 K shield bolts directly to the 50 K plate and encases the 15 K plate, cooled amplifiers, activated charcoal and a power splitter for the cal signal.

2.1.3 System Cool-down Procedure

When preparing the front-end for installation on the telescope, it is recommended that the dewar be pumped, using the PUMP mode, for at least 24 hours prior to cooling. For routine tests or if the dewar has been stored under vacuum, that is not necessary. In either case, the following procedure should be followed:

1) Check that the compressor is operating and that the supply pressure is 270 ± 10 psi. Connect the refrigerator helium ports to the compressor lines, return line first.

2) Connect the front-end vacuum port to a pump or vacuum manifold.

3) Connect the Monitor connector J2, the Power connector J5, the Auxiliary connector J4, and the AC connector J1 to the proper cables. Check that the AC and DC power supplies are on. Using the meter on the local control panel, check that the monitor voltages are reasonable.

4) Check that the dewar vent valve is closed and capped and that, unless manual control will be used, the control switch on the card cage is in the CPU position.

5) Place the front-end into the COOL state, using either the local control panel or the station computer. From this point, the cool-down procedure is automatic. The front-end will generate a PUMP

REQUEST and when the pump vacuum becomes lower than the dewar vacuum, the vacuum valve solenoid will open. When the dewar vacuum becomes approximately 50 microns, the refrigerator motor will start. When the dewar vacuum becomes less than 5 microns, the PUMP REQUEST signal will become low.

Chart recordings of a typical cool-down and HEAT mode warm-up are shown in Figure 2.1-1. The cool-down time is approximately 12 hours to a final temperature of 10 K to 13 K on the second stage and 50 K to 55 K on the first stage. The second stage and cooled amplifiers reach operational temperature in less than five hours; the additional time is required to cool the OMT mass. The warm-up time with 65 watts of heat applied is five hours. The ratio of these times gives an average refrigerator cool-down power of 27.5 watts including 0.4 watts to compensate for FET DC bias power.

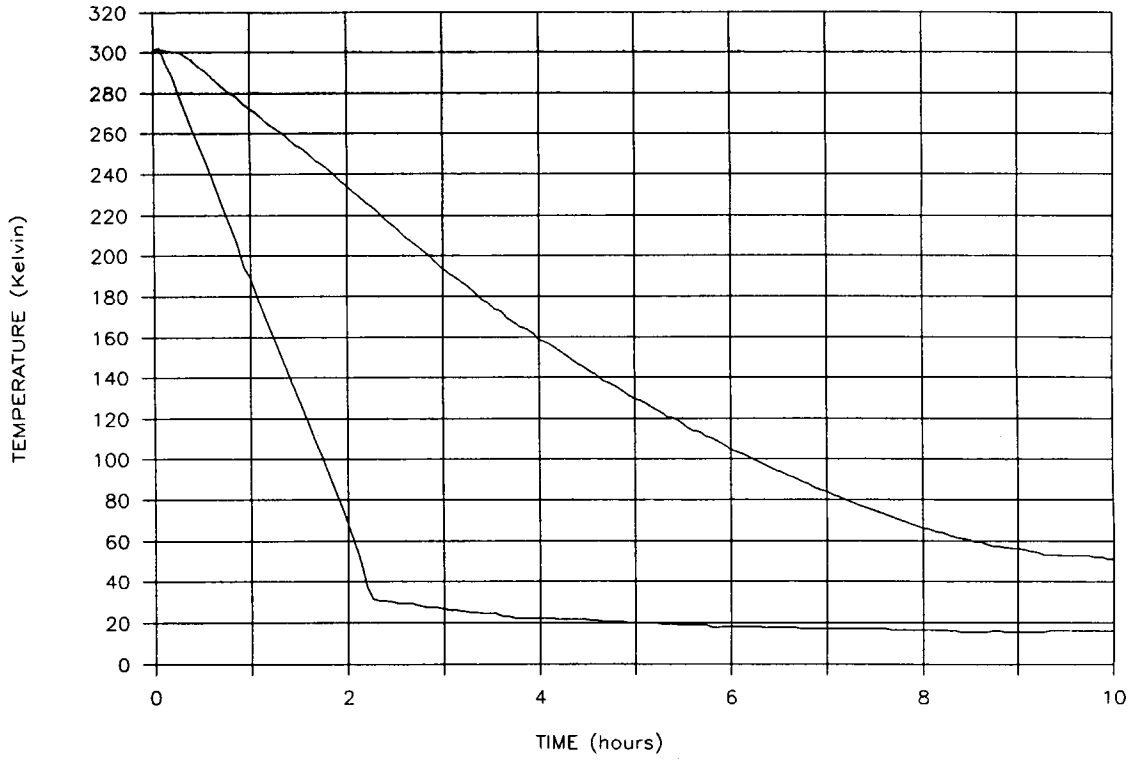


Figure 2.1-1
(a) Dewar Cool-down Record

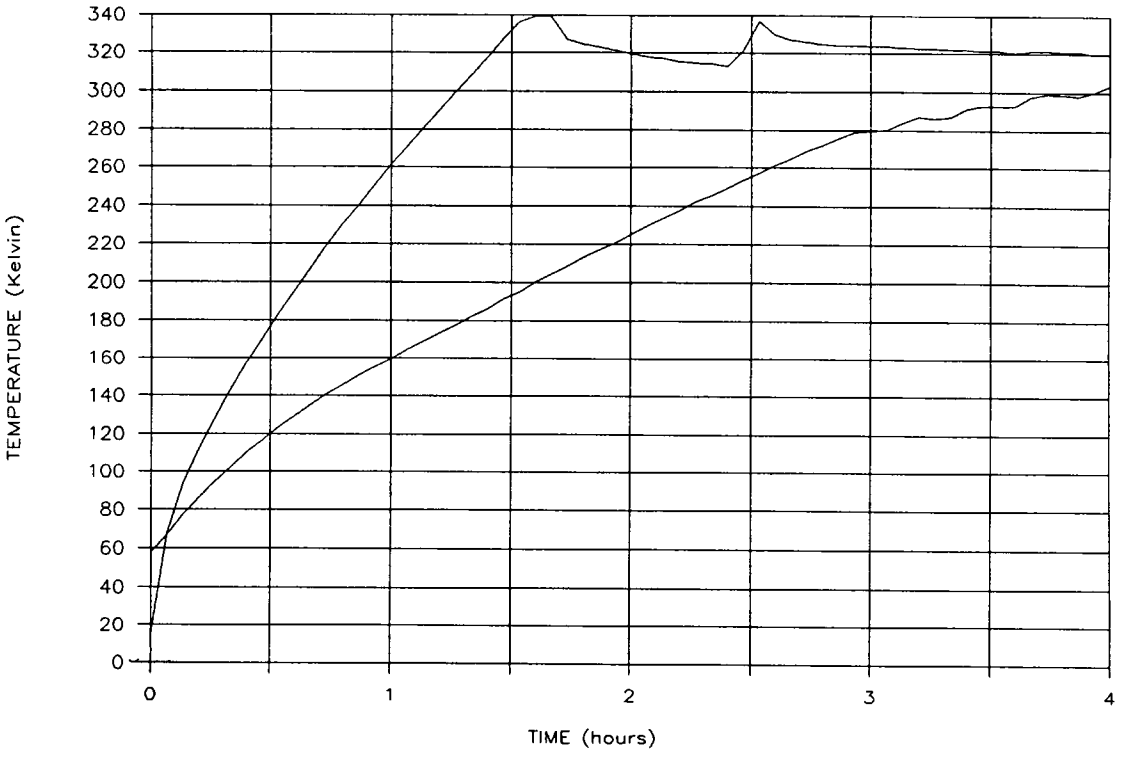


Figure 2.1-1
(b) Dewar Warm-up Record

2.1.4 Disassembly of Dewar

Figures 2.1-2 through 2.1-4 shows the steps necessary to disassemble the dewar so that the cooled components may be worked on. The steps are:

a) With the front-end warmed to room temperature, open the manual vent valve, bringing the dewar to atmospheric pressure. On a convenient work surface, invert the front-end so that the Lower Vessel is up.

b) Remove the two 10-32 screws attaching the card cage to the Lower Vessel, and the eight screws attaching the Lower Vessel to the Dewar Mounting Plate. Lift off the Lower Vessel. It will be necessary to loosen the screws attaching the card cage to the Dewar Mounting Plate and to then tilt the card cage out of the way so that the vessel flange will clear the card cage mounting tabs.

c) Remove the four 6-32 binder head screws attaching the Upper Vessel Shield to its supports, and remove the shield.

d) Remove the four 6-32 binder head screws attaching the Access Cover to the 50 K Heat Shield, and remove the cover. Remove the six 6-32 binder head screws attaching the 50 K Shield to the 50 K Plate, and remove the shield.

Access to any of the cooled components is now possible. Note that, to this point, no RF connections need be broken. If it should become necessary to remove the OMT, then additional steps are required:

e) Loosen and remove the .141 coax connecting the OMT to the cal couplers. Disconnect the connector on the OMT temperature sensor. Unsolder the wires connecting the DC feedthrus and the heaters. Remove the three 4-40 screws attaching the OMT heat strap to the 50K Plate.

f) Rotate the dewar assembly on the work surface, and remove the eight 10-32 screws attaching the Thermal Transition Dewar Cap to the Top Vessel. While supporting the small end of the OMT, carefully withdraw the Thermal Transition Assembly and OMT from the Top Vessel.

2.1.5 Reassembly of Dewar

When assembling or re-assembling the dewar, the following precautions should be observed:

a) Note the surfaces which must seal against an O-ring and be careful not to scratch these surfaces. When closing the dewar, check that there is no dirt or foreign objects on O-ring surfaces. Lubricate the O-rings with a small amount of vacuum grease and check during assembly that the O-rings are seated properly.

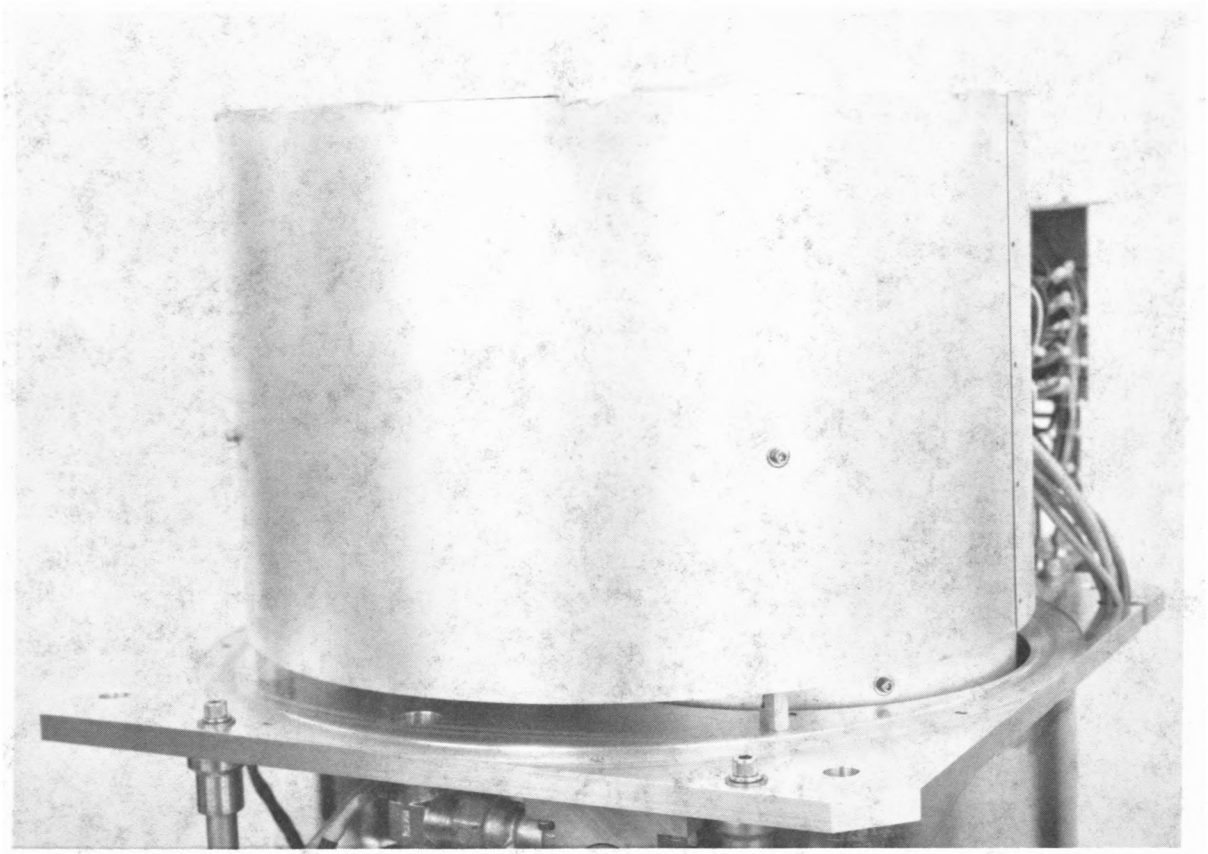


Figure 2.1-2
Dewar Lower Vessel Removed. The front-end is shown inverted and the lower vessel shield can be seen.

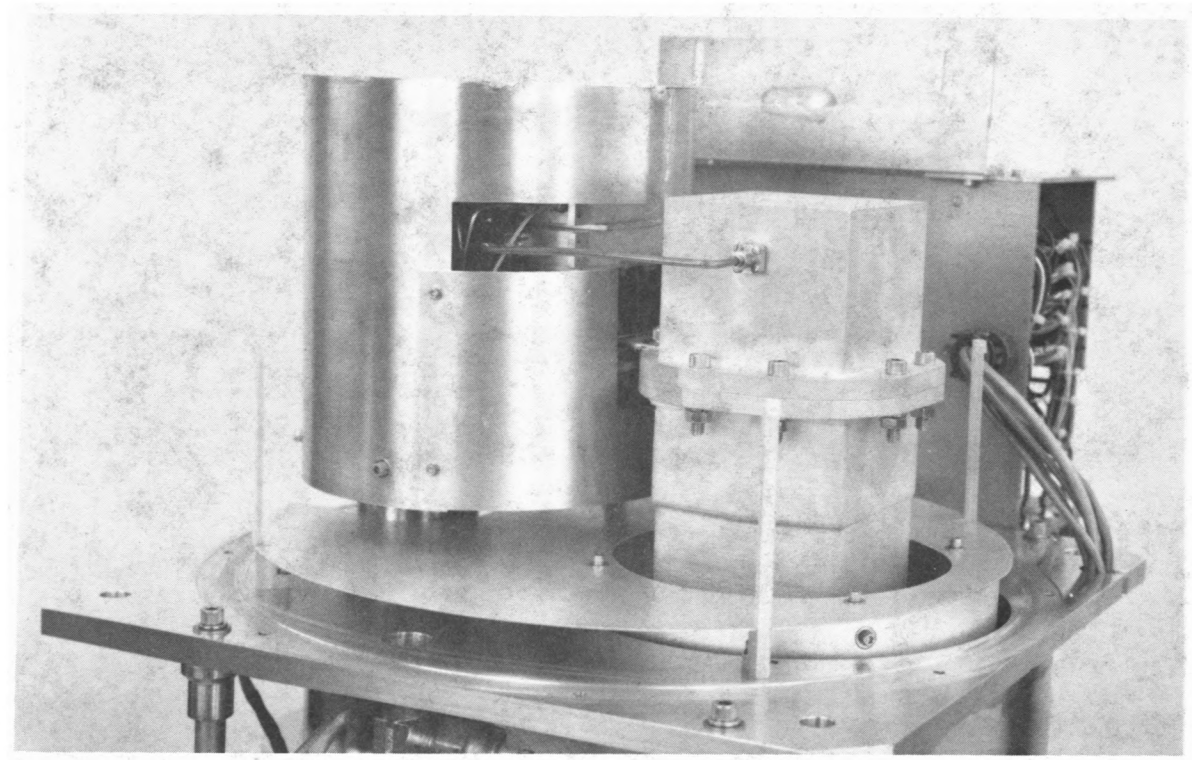


Figure 2.1-3
Lower Vessel Shield Removed. The 50 K shield and the polarizer can be seen.

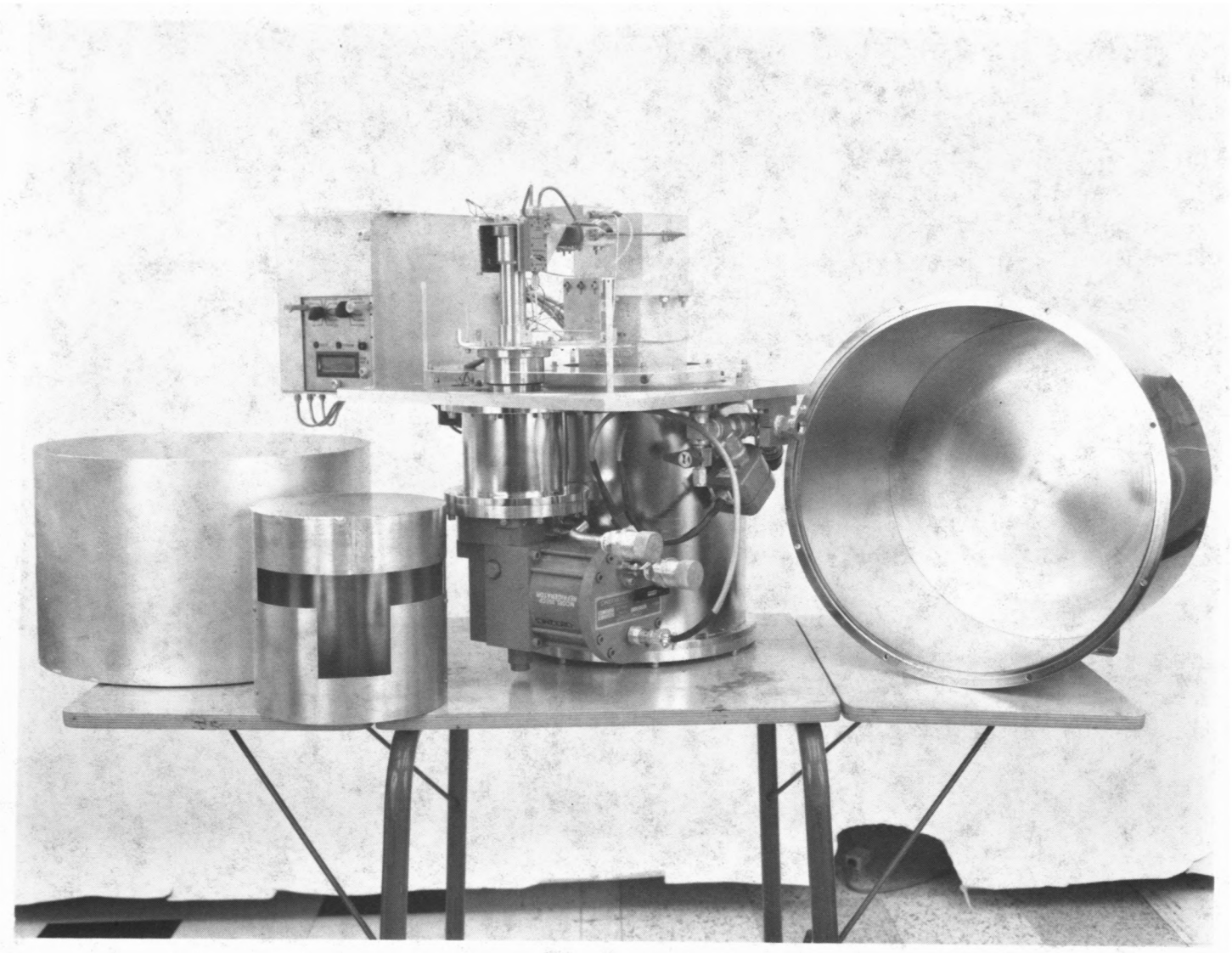


Figure 2.1-4
The Disassembled Dewar
From left to Right; The 50 K shield; The 15 K shield; The cooled components, refrigerator and upper dewar vessel; Lower dewar vessel

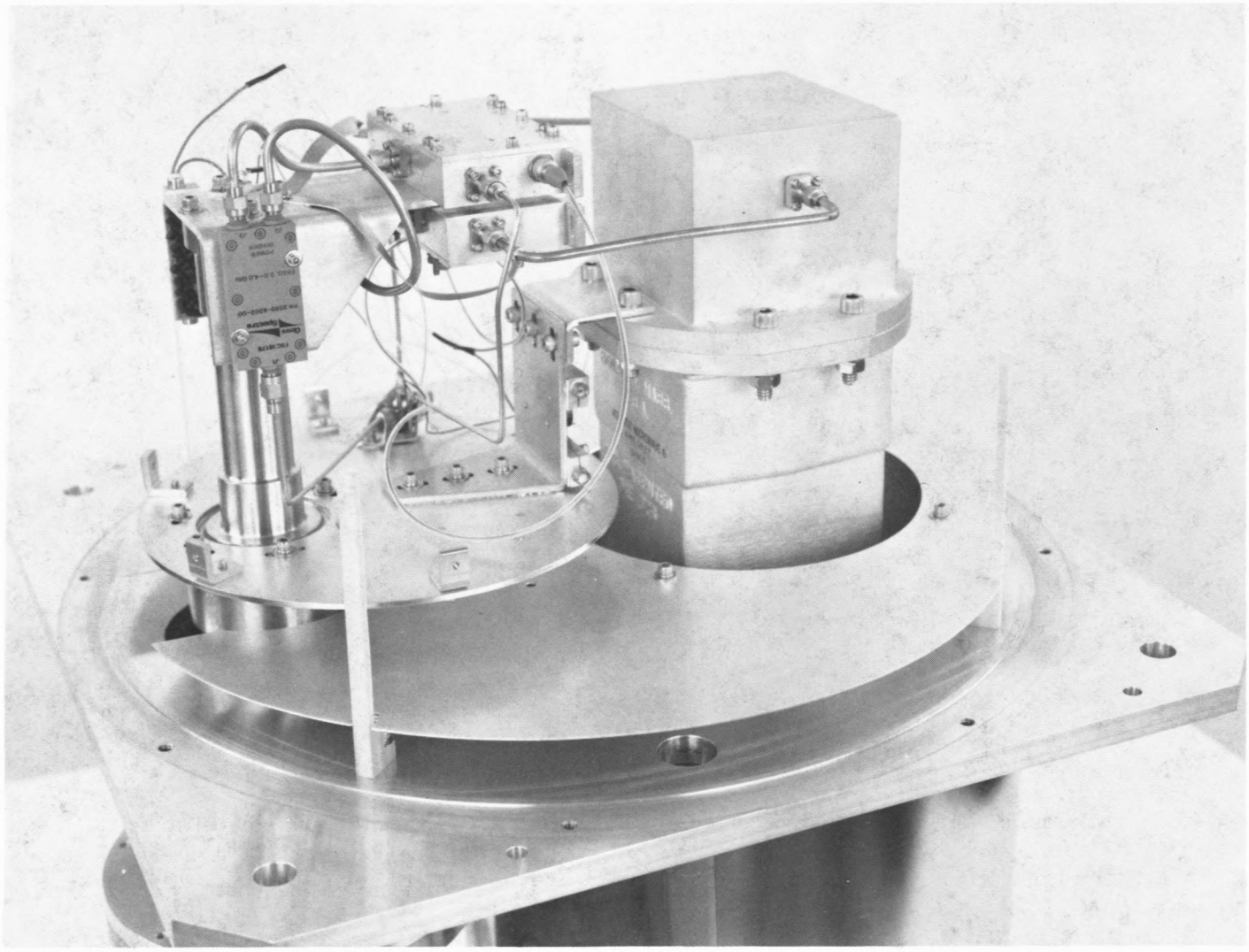


Figure 2.1-5
Close up of Cooled Components

b) The emissivity of surfaces is greatly increased by the presence of a film on the surface. (A doubling of the emissivity was noted for an aluminum surface cleaned with acetone compared to cleaning with Freon.) This is important for the interior of the dewar walls and exterior of the radiation shields. These surfaces should be initially cleaned with Freon and then not touched. The 15 K components should be kept reasonably clean but can be handled for maintenance without cleaning.

c) When closing the dewar, make sure all connections are made and are tight.

2.2 Waveguide Vacuum Window

A circular waveguide window is necessary to preserve vacuum within the cryogenics dewar. The window used in this system is formed by epoxying a 2.5 inch thickness of a rigid, closed-cell foam with 1.04 dielectric constant into a machined aluminum section of the 9.746 cm diameter circular waveguide. The low dielectric constant, strength, and low loss of this material allows the construction of a vacuum window with excellent microwave properties. Tests have shown that the window contributes a negligible amount to the input VSWR, and similar designs have given reliable service while under vacuum for years. Leak tests of samples of this foam and other potential window materials such as mylar or polyethylene have shown that the foam has excellent gas diffusion properties (NRAO EDTN No. 118 and 125).

One disadvantage of the foam is that it adsorbs moisture, slowing down the rough pumping process, and making it necessary to provide a water vapor seal on the external side of the window. to accomplish this seal a thin film of polyethylene or mylar, and an O-ring is used.

2.3 Waveguide Thermal Transition

Thermal isolation between the dewar input flange and the OMT at 50 K is provided by a 0.5 mm (0.020 inch) gap in the waveguide wall. A choke groove is used in the thermal transition gap. Insertion loss and return loss tests of the thermal transition assembly have shown no evidence of measurable energy radiating from the gap. The gap is supported by six tubes machined from 0.5 inch diameter, type G-10 epoxy-fiberglass rod stock. The calculated heat load through each support tube is 56 mW for 336 mW total conducted load.

The thermal transition is machined in two sections from 6061-T6 aluminum. The top section forms the top cover of the Top Vessel and contains the vacuum window material. The lower section is supported from the top section by the six support tubes and the OMT is bolted to its lower surface as seen in Figure 2.3-1.

2.4 Polarizer

The polarizer is a sloped-septum waveguide structure provided by a commercial vendor, Atlantic Microwave, model number AMC 0927, specification number A53200N001. The sloped-septum is mounted in square waveguide and separates the two circularly polarized waves to the two SMA output connectors. A simple screw-tuned adapter to circular waveguide is provided by the polarizer

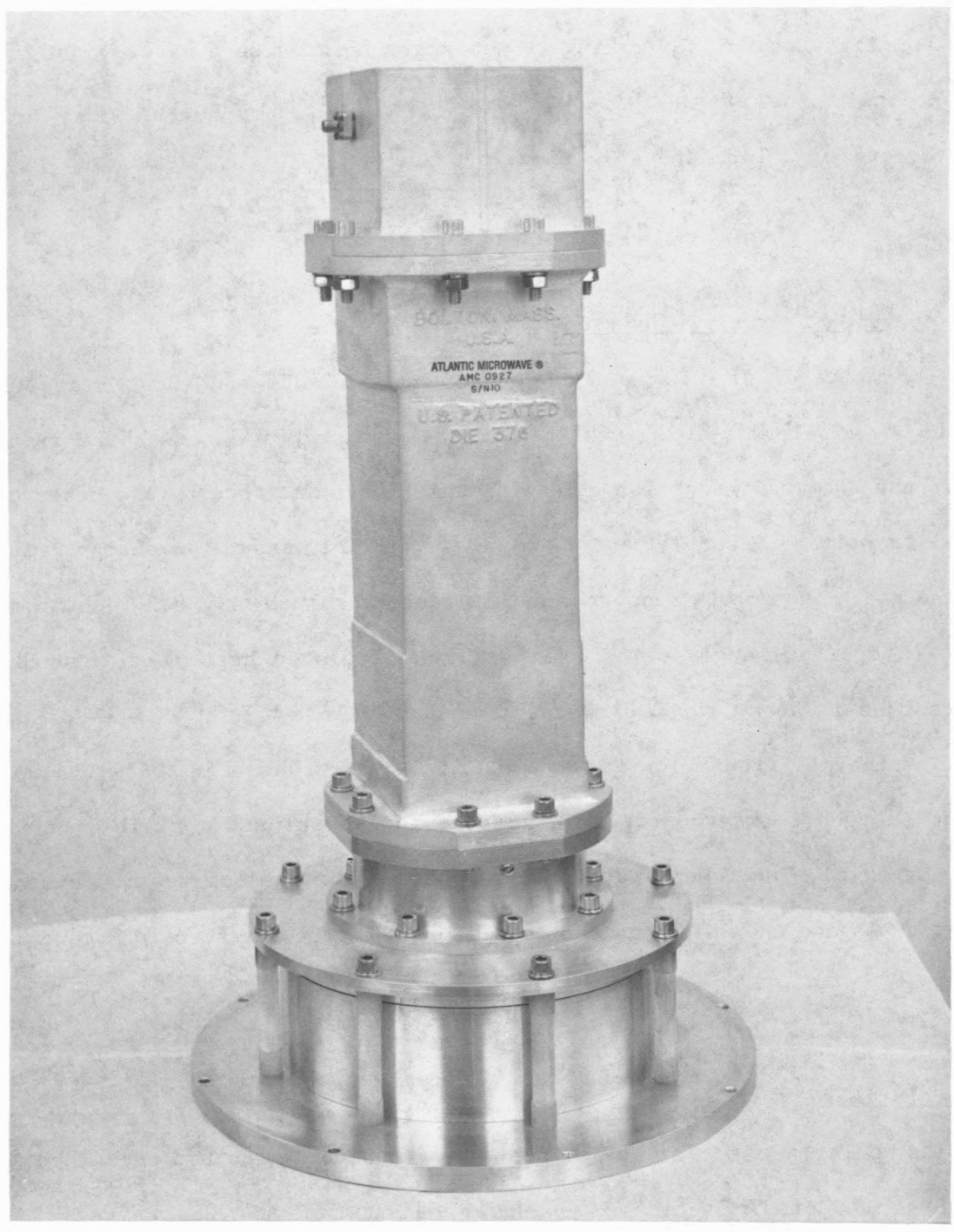


Figure 2.3-1
Polarizer and Thermal Transition

vender such that the input to the polarizer is a circular waveguide of 3.837 inches in diameter.

All joints of the polarizer are bolted including the SMA connectors. The polarizer is plated with 75 ± 25 microinches of gold to help reduce absorption of thermal radiation. The polarizer achieves greater than 25 dB of polarization isolation in the full frequency range and greater than 28 dB in the prime frequency range, where the full frequency range is 2.15 to 2.35 GHz and the prime frequency range is 2.20 to 2.30 GHz.

2.5 Noise Calibration System

The noise calibration components are shown in the block diagram, Figure 1.1.1. A 30 dB coaxial directional-coupler in each input signal line couples in a cal signal and an externally applied phase calibration signal. A coaxial power divider within the dewar splits the common calibration signal to the two receiver channels. The dewar calibration input is through a SMA hermetic feedthru; the coupling from this jack to each receiver input is approximately -34 dB (including 1 dB of cable losses).

The 10 dB coupler, which couples in the cal signal, will allow a high cal source to be added to the system as desired. It is advised to use a noise source followed by an amplifier and enough attenuation to give the proper amount of noise before the cooled amplifiers.

The cal signal originates in a 35 dB ENR noise source which drives through a 6 dB pad into the -6 dB port of a second coupler and into the -10 dB port of the first coupler. Allowing 1 dB for losses, the ENR referred to the receiver input is 35 - 6 - 6 - 10 - 1 - 34 = -22 dB which is 1.9 K. The CAL control line must supply +28 volts at 4 to 10 mA.

2.6 Cooled Amplifiers

A three-stage HEMT/FET amplifier is used to provide an initial gain of 32 dB. The first stage uses a HEMT while the remaining two stages uses FET. The noise temperature budget for the cooled RF components is given in Table VII. The typical power dissipated by each amplifier is 0.2 watts (see heat load budget in Table IX).

2.7 Dewar Internal Wiring and Coaxial Lines

There are 16 wires between the 300 K dewar RFI feedthru plate and the components at 15 K and two wires to the OMT temperature sensor. To reduce the heat load of these wires, a special brass wire is used. The wire is #32 soft brass (type 260) which gives a factor of 8 lower heat load and higher strength than copper at a sacrifice of 2.3 times greater resistance at 300 K. It is coated with polyurethene insulation which can be burned off with a soldering iron and is bonded into a red/green pair with polyvinyl butral which can be dissolved with alcohol. The wire is part number B2322111-001 from MWS Precision Wire in Chatsworth, CA. Within the dewar the wires are cut to a length of about 12 inches and the total heat load for 16 wires (Amplifier bias and 15 K temperature sensor) is 34 mW. For the 2 wires to the dewar heaters which must pass 0.42 amps, 12" of 7 x 38 AWG copper wire is used. The OMT temperature sensor is connected with brass wires.

The heat flow and attenuation of various types of coaxial cables at cryogenic temperatures are given in NRAO EDIR No. 223. The coaxial lines from the polarizer to the amplifier plates are fabricated of approximately 3 inch lengths of .141" copper coaxial line, giving .01 dB loss at 15 K. The .085"

coaxial lines between the 15 K components and 300 K have approximately 0.6 dB of RF loss and conduct approximately 40 mW of heat each.

2.8 RF Plate

All room temperature RF components are mounted on a 1/4 inch aluminum plate that attaches to the side of the front-end card cage. Semi-rigid coax connects the three dewar SMA feedthrus to corresponding feedthrus on the card cage, and hence to the RF plate. Power is supplied to the RF plate through a 9-pin type "D" connector. The noise sources and coupling networks are described in section 2.5; all of these are standard commercial components. The room temperature post amplifier used in this front-end is described in specification A53204N001.

2.9 Refrigerator Power Supply

The refrigerator motor requires two-phase (90 degrees phase difference) AC power and will operate at 120 to 160 volts RMS at 50 to 60 Hz. The P112 Model 350 Power Supply is designed to provide the proper voltages, derived from 120 volt, 60 Hz, single-phase power; the schematic is shown in Figure 2.9-1. An isolation transformer is used in the P112 with an unloaded output voltage of 160 volts RMS. The shifted phase output is obtained with a RC network. The resistance consists of two 80 ohm, 50 watt, 1% wirewound resistors in series. Total power dissipated in the resistors is approximately 45 watts. The capacitor is formed from a 7 μF oil-filled capacitor and

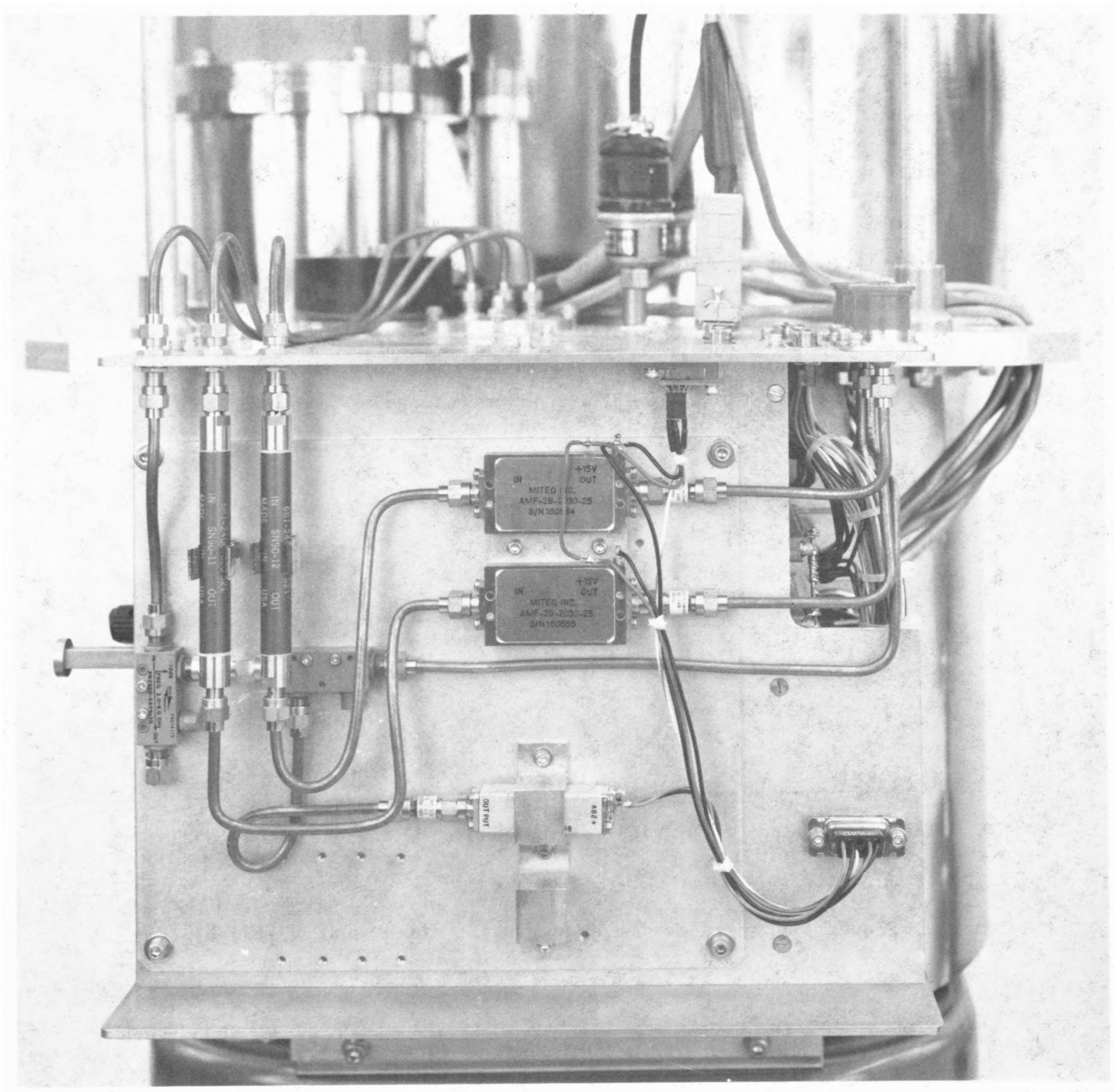


Figure 2.5-1
The RF Plate. The plate is shown mounted to the card cage. The band pass filters are at the top left, the post amps are at top right and the noise source is at bottom center. The high cal components are not mounted on this unit.

ceramic trimming capacitors in parallel to achieve the 7.1 μF nominal desired value. Experiments have shown that the capacitance value can vary by ± 0.2 uF without audible effect on the motor.

Included within the P112 is a device that senses the AC current delivered to the front-end. The current sensor produces a DC current proportional to the AC current (1 mA-DC/ 1 A-AC). A 10 K ohm resistor is provided across the DC terminals, resulting in a DC output voltage of 10 VDC/Amp when measured with a high impedance circuit. The DC sensor voltage is output on pins A and B of connector J3 on the front panel of the P112. These pins are normally wired to pins 1 and 2 of the front-end Auxiliary connector J4, so that the station computer can monitor the AC current via the Monitor/Control bus.

2.10 Front-end Card Cage

The card cage electrical interface signals are described in section 1.3 of this report. The card cage, the associated circuit cards, and test and calibration procedures are described in detail in a separate report. A preliminary version of the circuit cards are described in VLBA Technical Report No. 1.

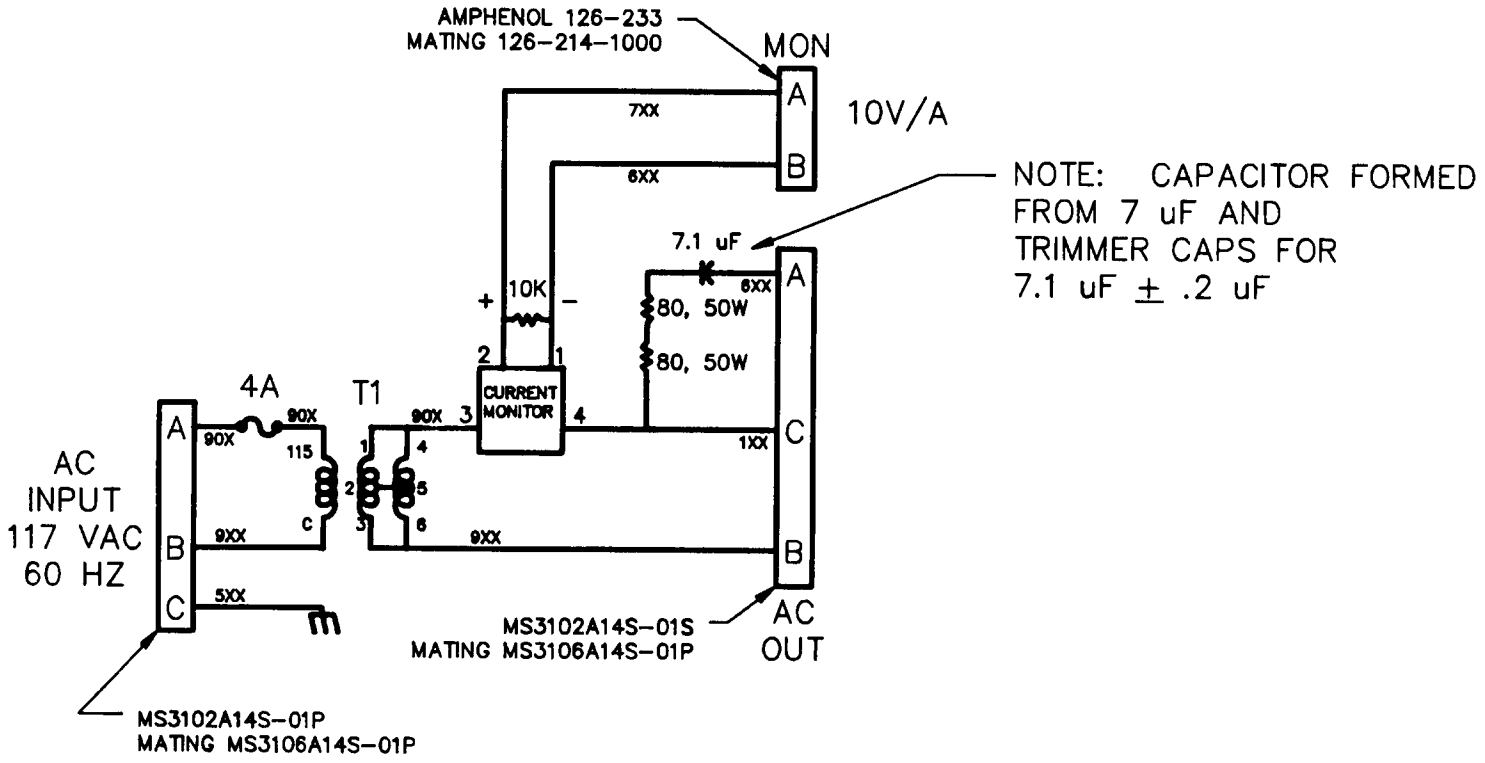


Figure 2.9-1

Schematic of the P112 refrigerator power supply.

Section 3 -- TROUBLESHOOTING

3.0 Introduction

This section gives a few suggestions for locating and correcting problems that may be experienced with the system.

3.1 Low or No Gain

Check the cooled HEMT/FET amplifier bias voltages. The gate voltages may be checked through the Monitor/Control bus, but if an abnormality is found, then the drain voltages and currents must be checked at test points on the bias cards. RF1 and LF1 are the amplifiers' first stage gate voltages. RF2 and LF2 is the voltage sum of the remaining stages' gate voltage. The signals RF1, RF2, LF1, and LF2 will normally range between 0 and -2 volts, and should not vary by more than ± .02 volts from the values recorded in the test data for each cooled amplifier. A value greater than zero volts (usually +14 volts) indicates insufficient drain current and less than -2 volts (usually -14 volts) indicates a drain circuit short. If a problem with a amplifier's bias conditions is noted, try replacing the applicable bias card. If that does not correct the problem, examine the Dewar Power connector, J3, and the dewar DC feedthrus for obvious problems. If all that fails, then the dewar will have to be opened to replace the amplifier.

If the cooled amplifiers' bias voltages are correct, measure the +15 V terminals on the postamps located on the RF Plate in the card cage. If the +15 volts is not correct, disconnect the RF Plate power connector and measure the voltage at pin 2. If that voltage is +15 ± 0.1 volts, then the RF Plate should be replaced; otherwise, locate the problem with the 15 volt supply.

If all the DC voltages appear correct, check all the RF connections for tightness. It may be possible to isolate the problem by observing a total power indicator while tapping or shaking the cables and RF components. If not, the front-end will have to be removed for servicing.

3.2 Cool-Down Failure

3.2.1 Refrigerator Motor Never Starts

The refrigerator motor will not start until the dewar vacuum becomes less than about 50 microns (4.5 volts on the V_D monitor). Check that the front-end is commanded to the COOL mode. Check that the vacuum valve solenoid is energized (indicator on the valve lit). If not, check that the pump vacuum (V_P monitor) is less than the dewar vacuum and that the PUMP REQ bit is high; if these appear reasonable, check that the AC voltage is present (an easy way is to unplug the AC cable from the card cage and plug it directly into the refrigerator motor). If the front-end vacuum valve is open, but the dewar and pump vacuums do not fall (refer to Section 2.1 for a discussion of the dewar pumping characteristics), command the front-end OFF to close the valve. The pump vacuum should then fall to near its blank-off pressure; if not, there is a problem with the pump or the vacuum manifold. If it does, there probably is a gross vacuum leak in the front-end dewar; refer to the next section.

If the dewar vacuum is less than 50 microns but the refrigerator still doesn't run, try connecting the AC power cable directly into the refrigerator motor. If it then runs, replace the control card in the card cage; if not, either the AC supply isn't working or the refrigerator will have to be serviced.

3.2.2 Refrigerator Runs, but System Doesn't Cool

In the event of a cool-down failure, it is often difficult to ascertain whether the problem is a vacuum leak which loads the refrigerator or a refrigerator problem which gives poor vacuum due to insufficient cryopumping. If initial checks of refrigerator motor current, refrigerator sound, and compressor supply and return helium pressures do not reveal the problem, it is necessary to warm up the front-end to room temperature and observe the vacuum with the refrigerator off. A leak tester may be necessary, but it is also possible to observe the rate of vacuum rise after pumping for greater than one hour at 300 K. The system is then commanded to OFF (closes solenoid valve) and a vacuum rise rate greater than 10 micron/min is indicative of a leak. Petroleum ether sprayed around the dewar O-ring joints may help locate a gross leak; the mechanical vacuum pump will begin to labor when the petroleum ether enters the dewar.

Refer to Section 2.1.5 for precautions to observe when reassembling the dewar. The cause of vacuum leaks is most often a missing, dirty, or pinched O-ring, or loose bolts that cause an O-ring to be less than fully compressed.

APPENDIX I

Sample Test Data

2.3 GHz VLBA Front End
Final Test Report
Assembly 53204A001

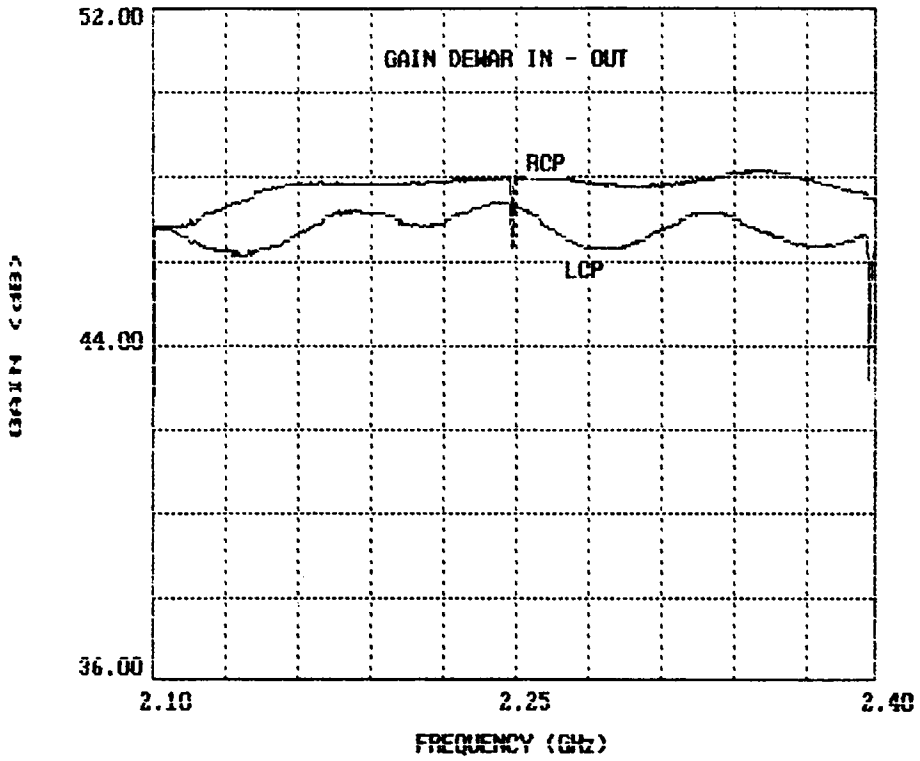
Card Cage S/N: 01 Date: 10/18/90
Dewar S/N: 01 Tested by: SIMMONS

Record Components' Model/Serial Numbers:

1. Refrigerator: model 350CP S/N 17795
2. Orthomode Transducer: Atlantic Microwave S/N 03
3. Monitor Card: MC-73
4. RCP Bias Card: BC-177
5. LCP Bias Card: BC-178
6. Sensor Card: SC-82
7. Control Card: CC-81
8. 15 K Temp Sensor: D60312
9. 50 K Temp Sensor: D60328
10. RCP Cryogenic Amplifier: 2250-14H
11. LCP Cryogenic Amplifier: 2250-15H
12. RCP Bandpass Filter: Reactel 6BI-2400-800S2I S/N 89-6
13. LCP Bandpass Filter: Reactel 6BI-2400-800S2I S/N 89-5
14. RCP Post Amplifier: Miteq AMF-2B-2030-25 S/N 154914
15. LCP Post Amplifier: Miteq AMF-2B-2030-25 S/N 154913
16. Low Cal Noise Source: Noisecom NC-3204-J S/N 4111
17. High Cal Noise Source: — NOT INSTALLED —
18. High Cal Noise Amplifier: — NOT INSTALLED —

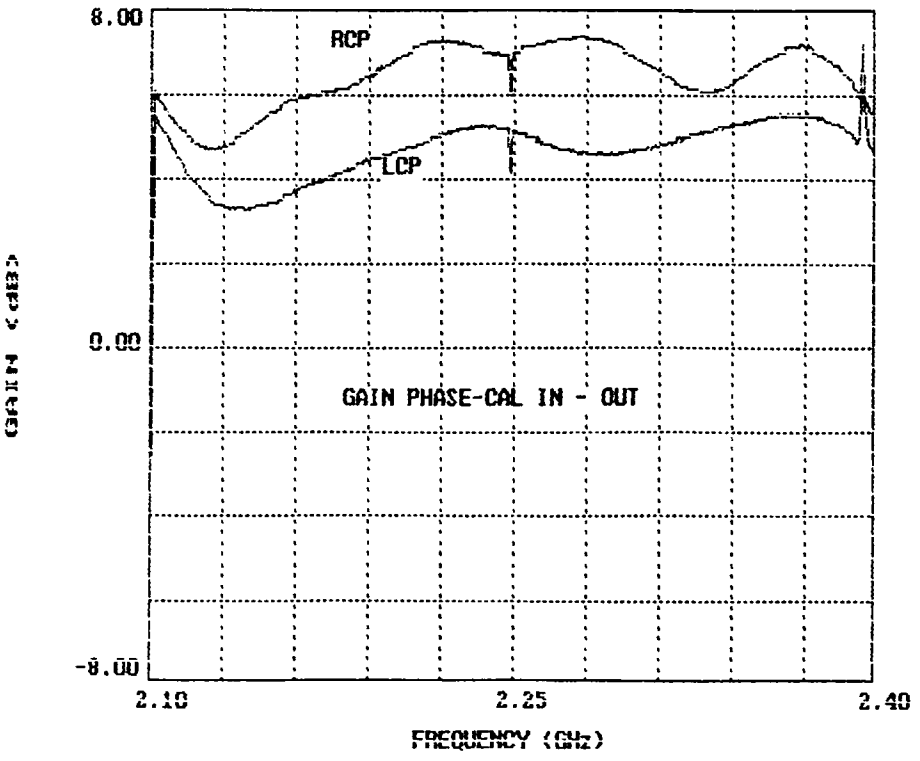
Attach Strip Recording of Dewar Cool-Down.

I - 2



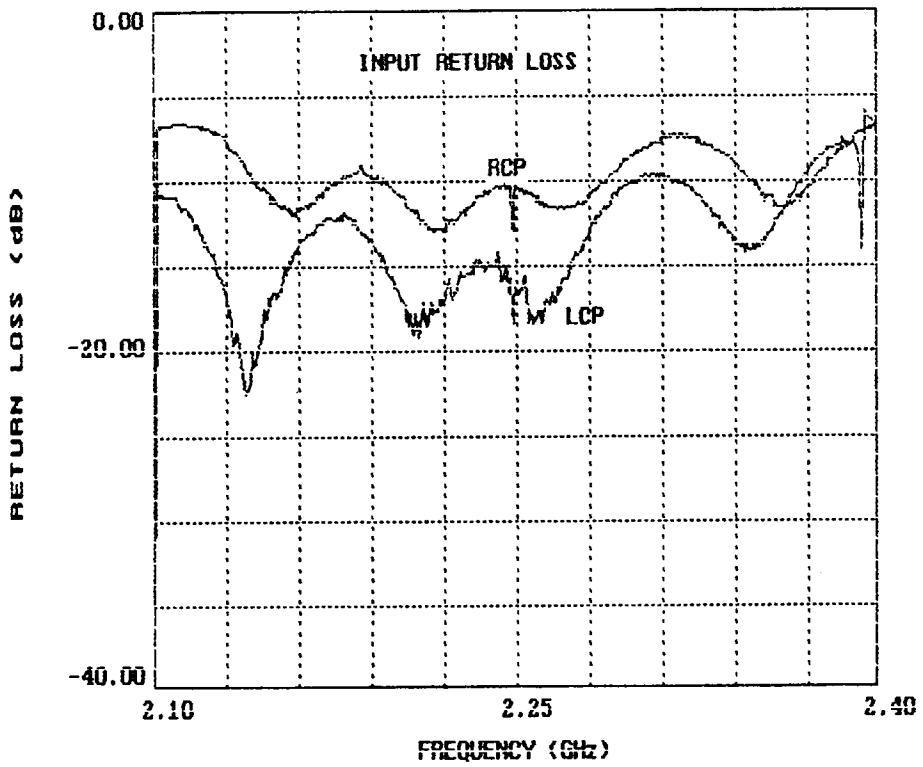
VLBA 2.3 GHz F.E. S/N 01

10/17/90



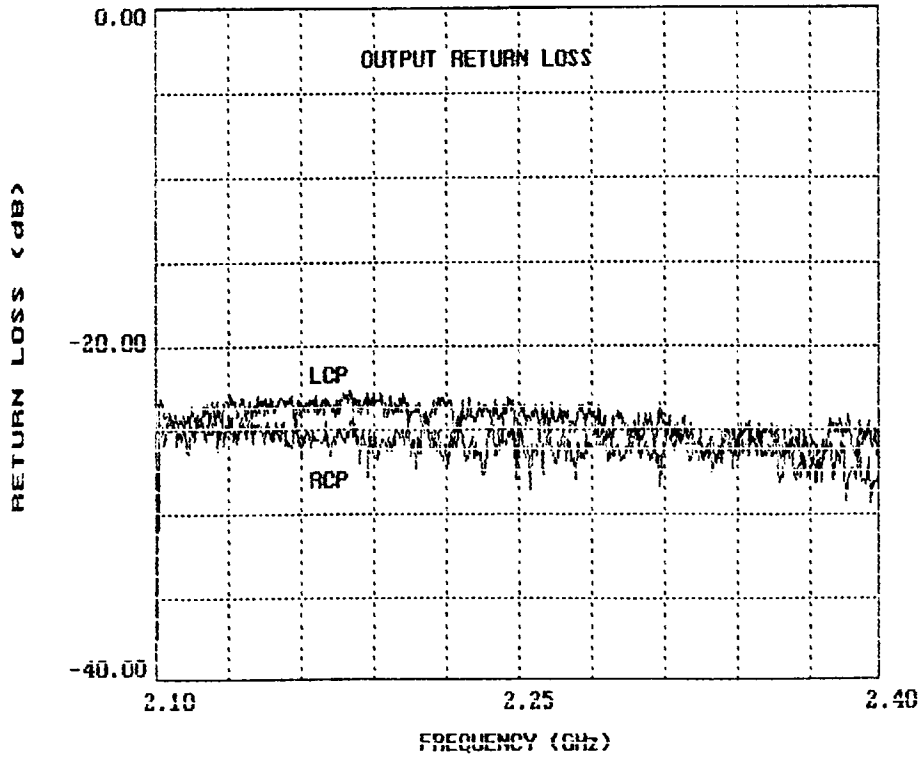
VLBA 2.3 GHz F.E. S/N 01

10/17/90



VLBA 2.3 GHz F.E. S/N 01

10/17/90



VLBA 2.3 GHz F.E. S/N 01

10/17/90

2.3 GHz VLBA Front End
Final Test Report
Assembly 53204A001

Card Cage S/N: 01
Dewar S/N: 01

Date: 10/17/90
Tested by: Simmons

FET Bias Settings

Stage	L-Channel Amp #				R-Channel Amp #			
	V_D	I_D mA	V_G 300 K	V_G 15 K	V_D	I_D mA	V_G 300 K	V_G 15 K
1	3.22	5.10	-.344	-.287	2.56	4.56	-.321	-.258
2	5.02	11.72	-.781	-.802	5.35	16.03	-.784	-.907
3	4.00	10.31	-.672	-.732	2.52	8.75	-.828	-.797

Total RF Power Out
Measured with HP436/8484A Power Meter

Input Condition	At 15 K		At 300 K	
	L-Channel dBm	R-Channel dBm	L-Channel dBm	R-Channel dBm
302 K Load	-38.97	-38.18	-44.59	-48.57
79.7 K Load	-44.09	-43.49	-48.12	-48.96
Short	-48.22	-47.37	-48.44	-48.96
Short + Cal	-47.80	-46.72	-48.33	-48.86
Short + HI Cal	NA	NA	NA	NA

2.3 GHz VLBA Front End -- Final Test Report -- Assembly 53204A001

Card Cage S/N: Ø1 Date: 10/17/90
Dewar S/N: Ø1 Tested by: Simmons

Output 1 dB Compression Point:

L-Channel			R-Channel		
2.10 GHz:	+2.64	dBm	2.10 GHz:	+0.35	dBm
2.25 GHz:	+2.40	dBm	2.25 GHz:	+0.12	dBm
2.40 GHz:	+2.11	dBm	2.40 GHz:	+0.32	dBm

Low Frequency Spectrum:

L-Channel
0-10 Hz

NOT AVAILABLE

R-Channel
0-10 Hz

NOT AVAILABLE

0-500 Hz

0-500 Hz

I - 6

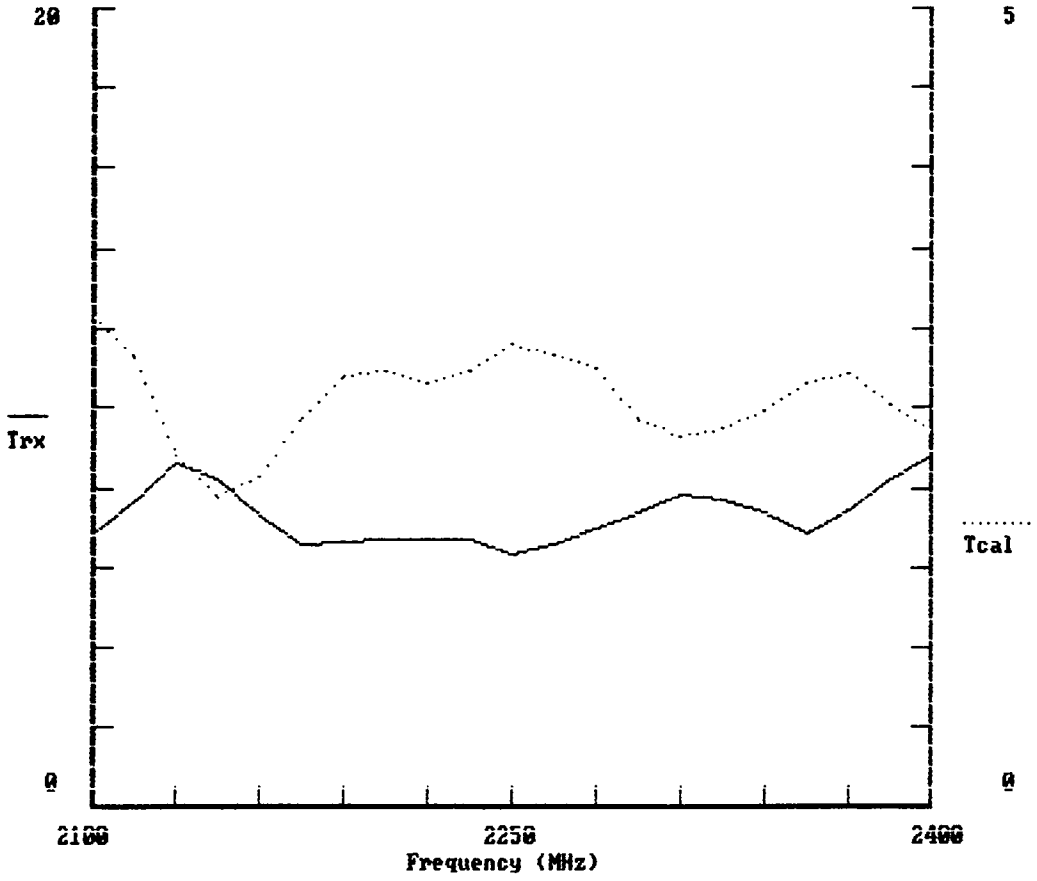
VLBA Receiver Calibration Record 10/17/90 13:51:13
RCP Polarization, Tested by SIMMONS
Comment : Tln = 78; Tcold = 84; Thot = 307:

Receiver : 2.3 GHz S/N 1 Mod 0 Parity OK
Solenoid OFF Pump Req FALSE CPU Control Cryo Mode : COOL (7)

15K Temp =	11.8	50K Temp =	46.6	300K Temp =	301.2		
AC Amps =	0.758	Dewr Vac =	-331	Pump Vac =	9949		
HEMT LED =	5.03	+15 Volt =	14.91	-15 Volt =	-15.15		
Cal Volt =	27.92	High Cal =	27.71				
FETS: LF1=	-0.287	LF2 =	-0.766	RF1 =	-0.259	RF2 =	-0.854

F(MHz)	Trx (K)	Tcal (K)	Thical (K)	Tshort (K)
2100.0	6.8	3.1	0.0	0.0
2115.0	7.6	2.8	0.0	0.0
2130.0	8.6	2.2	0.0	0.0
2145.0	8.2	1.9	0.0	0.0
2160.0	7.3	2.1	0.0	0.0
2175.0	6.6	2.4	0.0	0.0
2190.0	6.6	2.7	0.0	0.0
2205.0	6.7	2.7	0.0	0.0
2220.0	6.7	2.7	0.0	0.0
2235.0	6.7	2.7	0.0	0.0
2250.0	6.3	2.9	0.0	0.0
2265.0	6.6	2.8	0.0	0.0
2280.0	7.0	2.7	0.0	0.0
2295.0	7.4	2.4	0.0	0.0
2310.0	7.8	2.3	0.0	0.0
2325.0	7.7	2.4	0.0	0.0
2340.0	7.3	2.5	0.0	0.0
2355.0	6.8	2.6	0.0	0.0
2370.0	7.4	2.7	0.0	0.0
2385.0	8.2	2.5	0.0	0.0
2400.0	8.8	2.3	0.0	0.0

6 CONT.



VLBA 2.3 GHz F.E. S/N 01 - RCP
10/17/90 13:51:37

I - 8

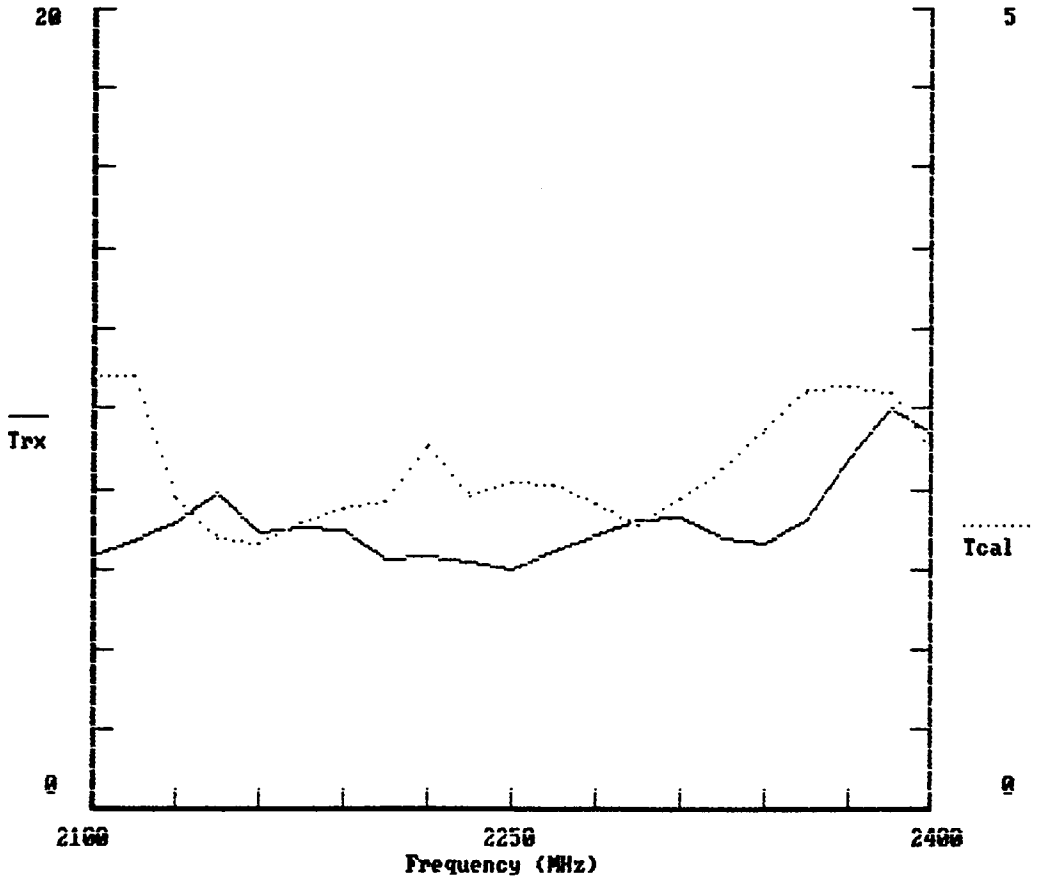
VLBA Receiver Calibration Record 10/17/90 13:35:04
LCP Polarization, Tested by SIMMONS
Comment : Tln = 78; Tcold = 84; Thot = 307:

Receiver : 2.3 GHz S/N 1 Mod 0 Parity OK
Solenoid OFF Pump Req FALSE CPU Control Cryo Mode : COOL (7)

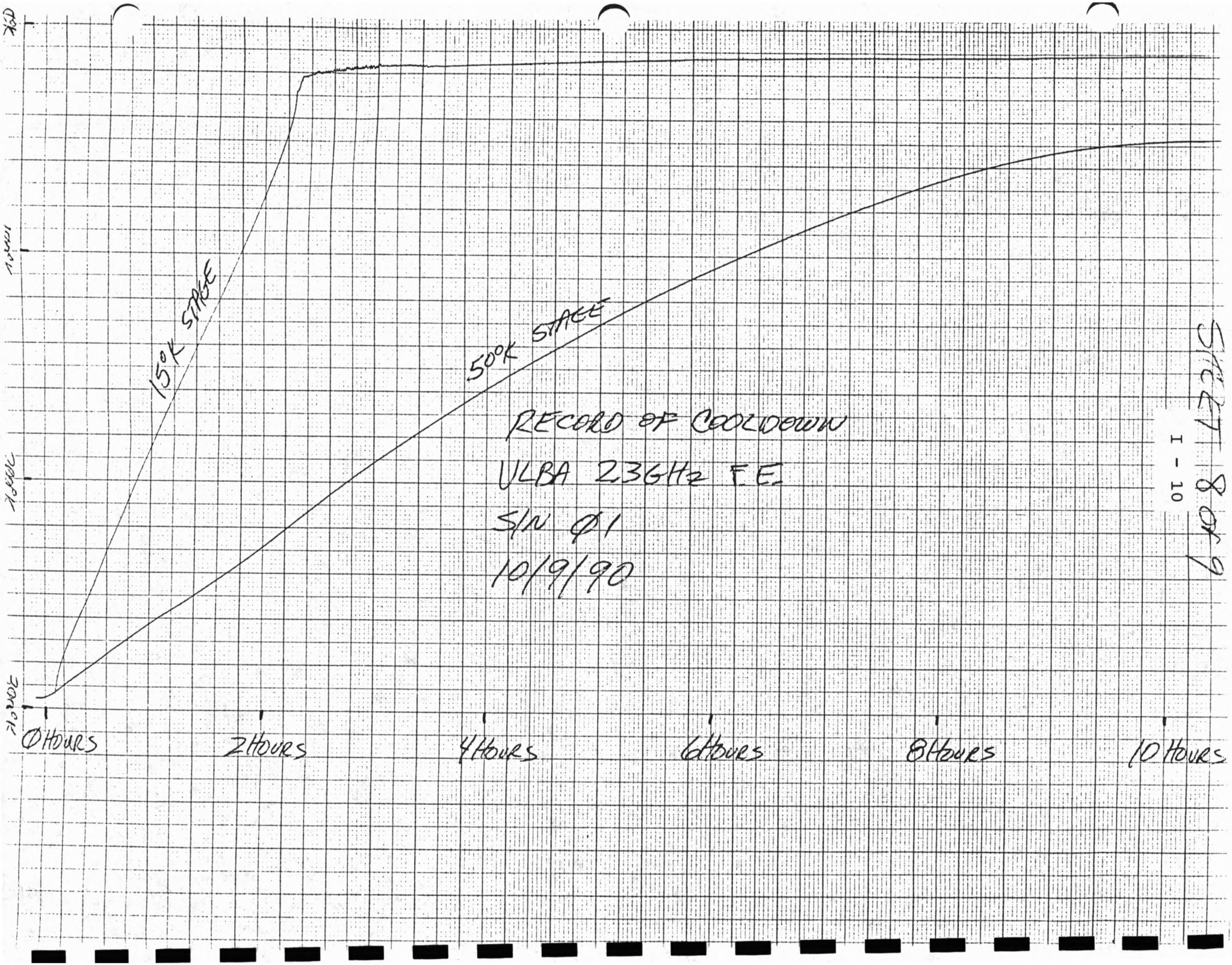
15K Temp =	11.8	50K Temp =	46.6	300K Temp =	301.2
AC Amps =	0.758	Dewr Vac =	-331	Pump Vac =	9949
HEMT LED =	5.03	+15 Volt =	14.91	-15 Volt =	-15.15
Cal Volt =	27.92	High Cal =	27.71		
FETS: LF1=	-0.287	LF2 =	-0.766	RF1 =	-0.259 RF2 = -0.854

F(MHz)	Trx (K)	Tcal (K)	Thical (K)	Tshort (K)
2100.0	6.3	2.7	0.0	0.0
2115.0	6.7	2.7	0.0	0.0
2130.0	7.2	1.9	0.0	0.0
2145.0	7.9	1.7	0.0	0.0
2160.0	6.9	1.7	0.0	0.0
2175.0	7.1	1.8	0.0	0.0
2190.0	7.0	1.9	0.0	0.0
2205.0	6.2	1.9	0.0	0.0
2220.0	6.3	2.3	0.0	0.0
2235.0	6.2	2.0	0.0	0.0
2250.0	6.0	2.0	0.0	0.0
2265.0	6.5	2.0	0.0	0.0
2280.0	6.8	1.9	0.0	0.0
2295.0	7.2	1.8	0.0	0.0
2310.0	7.3	1.9	0.0	0.0
2325.0	6.8	2.1	0.0	0.0
2340.0	6.6	2.4	0.0	0.0
2355.0	7.3	2.6	0.0	0.0
2370.0	8.7	2.6	0.0	0.0
2385.0	10.0	2.6	0.0	0.0
2400.0	9.3	2.2	0.0	0.0

7 CONT



VLBA 2.3 GHz F.E. S/N 01 - LCP
10/17/90 13:35:28


300°K
150°K
50°K
0 HOURS
2 HOURS
4 HOURS
6 HOURS
8 HOURS
10 HOURS
RECORD OF COOLDOWN
VLBA 2.3GHz F.E.
S/N #1
10/9/90
SHEET 8 OF 9
I - 10

RECORD OF WARM UP
VLBA 2.3GHz F.E.
S/N Ø1
10/17/90
Ø°K
100°K
200°K
300°K
50°K STAGE
15°K STAGE
ØHOURS
2HOURS
4HOURS
6HOURS
8HOURS

APPENDIX II

Drawings and Bill of Materials

The front-end is documented in the VLBA drafting system and associated drawings are filed there. Included in this appendix are assembly drawings, wiring lists and diagrams, and bill of materials, from which all associated documentation can be determined. The following is a list of documents included here:

Drawing No.	Title
A53204B001	BOM, 2.3 GHz Front End
C53204A010	Assembly, 15 K Plate
C53204A003	Assembly, 50 K Plate
D53204A008	Assembly, Thermal Transition
D53203A004	Assembly, 2.3 GHz F.E. Card Cage
A53203B004	BOM, 2.3 GHz F.E. Card Cage
C53204A005	RF Plate Assembly
A53204B005	BOM, RF Plate Assembly
C53203A007	Assembly, Vacuum
A53203B007	BOM, Vacuum Assembly
A53203N001	Spec, 2.3 GHz F.E. Postamp
A53203W001	2.3 GHz F.E. Card Cage Wiring List
B53203W002	2.3 GHz F.E. Card Cage Wiring Diagram
A53200B007-2	BOM, Model 350 Refrigerator Power Supply
C53204A011	Assembly, Polarizer Cold Strap

BILL OF MATERIALS
National Radio Astronomy Observatory
Green Bank, WV 24944

ITM	QTY	DESCRIPTION	PART NUMBER	MANUF
0	0	THIS IS - BOM, VLBA 2.3 GHZ FRONT END	A53204B001	NRAO
1	0	REF - ASSEMBLY, VLBA 2.3 GHZ FRONT END	D53204A001	NRAO
2	1	ASSEMBLY -- CARD CAGE	D53203A004	NRAO
3	1	ASSEMBLY -- INSPECTION COVER	C53206A007	NRAO
4	2	ASSEMBLY -- TEMPERATURE SENSOR	A53200A001	NRAO
5	1	ASSEMBLY -- RF PLATE	A53204A005	NRAO
6	2	ASSEMBLY -- BIAS CARD	D53200A002	NRAO
7	1	ASSEMBLY -- CONTROL CARD	D53200A004	NRAO
8	1	ASSEMBLY -- MONITOR CARD	D53200A006-02	NRAO
9	1	ASSEMBLY -- SENSOR CARD	D53200A003	NRAO
14	1	ASSEMBLY, DC FEEDTHRU	B53206A012	NRAO
15	1	ASSEMBLY, TIMER	A53206A013	NRAO
16	2	CRYOGENIC AMPLIFIER, 2.3 GHZ FET	A53204B101	NRAO
17	1	POLARIZER, 2.3 GHZ TYPE	A53200N001	ATL MW
23	1	DC FEEDTHRU COVER	A53206M060	NRAO
24	1	DEWAR TOP PLATE	D53204M003	NRAO
25	1	DEWAR CYLINDER, 2.3 GHZ	D53205M006-02	NRAO
26	1	DEWAR SIDE SHIELD, 2.3 GHZ	B53205M007-02	NRAO
27	1	DEWAR TOP SHIELD	C53204M007	NRAO
28	1	DEWAR BOTTOM PLATE	D53200M027	NRAO
29	1	DEWAR INSPECTION SHIELD	A53206M018	NRAO
30	2	DEWAR HANDLE	B53206M020	NRAO
31	2	DEWAR SHIELD SUPPORT	A53206M009	NRAO
32	1	DEWAR 70 K SHIELD CONNECTION	A53206M010	NRAO
33	1	POLARIZER COLD STRAP	B53204M038	NRAO
34	4	HANDLE COLLAR	A53206M019	NRAO
35	1	BOTTOM SHIELD	C53206M021	NRAO
36	0	.086 DIAMETER SS SEMI-RIGID COAX, AS REQ'D	JS-50085	PRES.TUBE
37	0	.141 DIA COPPER SEMI-RIGID COAX, AS REQ'D	--	--
41	1	CRYOGENIC REFRIGERATOR	MODEL 22	CTI
42	3	SMA FEEDTHRU (HERMETIC)	208A	OMNI-SPEC
43	1	CARD CAGE BRACKET	D53204M030	NRAO
44	2	O-RING (CYLINDER)	2-270	PARKER
45	1	O-RING (INSPECTION COVER)	2-251	PARKER
46	1	O-RING (THERMAL TRANSITION)	2-257	PARKER
47	1	O-RING (BIAS FEEDTHRU)	2-130	PARKER
58	8	NYLON STANDOFFS (SHORT)	--	--
60	1	O-RING (REFRIGERATOR)	2-144	PARKER
62	1	WAVEGUIDE COVER		NRAO
64	6	COAX CONNECTORS (.085 CRIMP-ON)	2001-7685-02	OMNI-SPEC
65	14	COAX CONNECTORS (.141 CRIMP-ON)	2001-7641-02	OMNI-SPEC
67	2	MALE-FEMALE SPACERS 8-32 X 1/2	60855	WALDOM
68	1	BRACKET, CAL SPLITTER	B53204M037	NRAO
69	1	REFRIGERATOR, 70K STRAP	B53204M039	NRAO
70	1	HEATER PLATE	B53204M040	NRAO

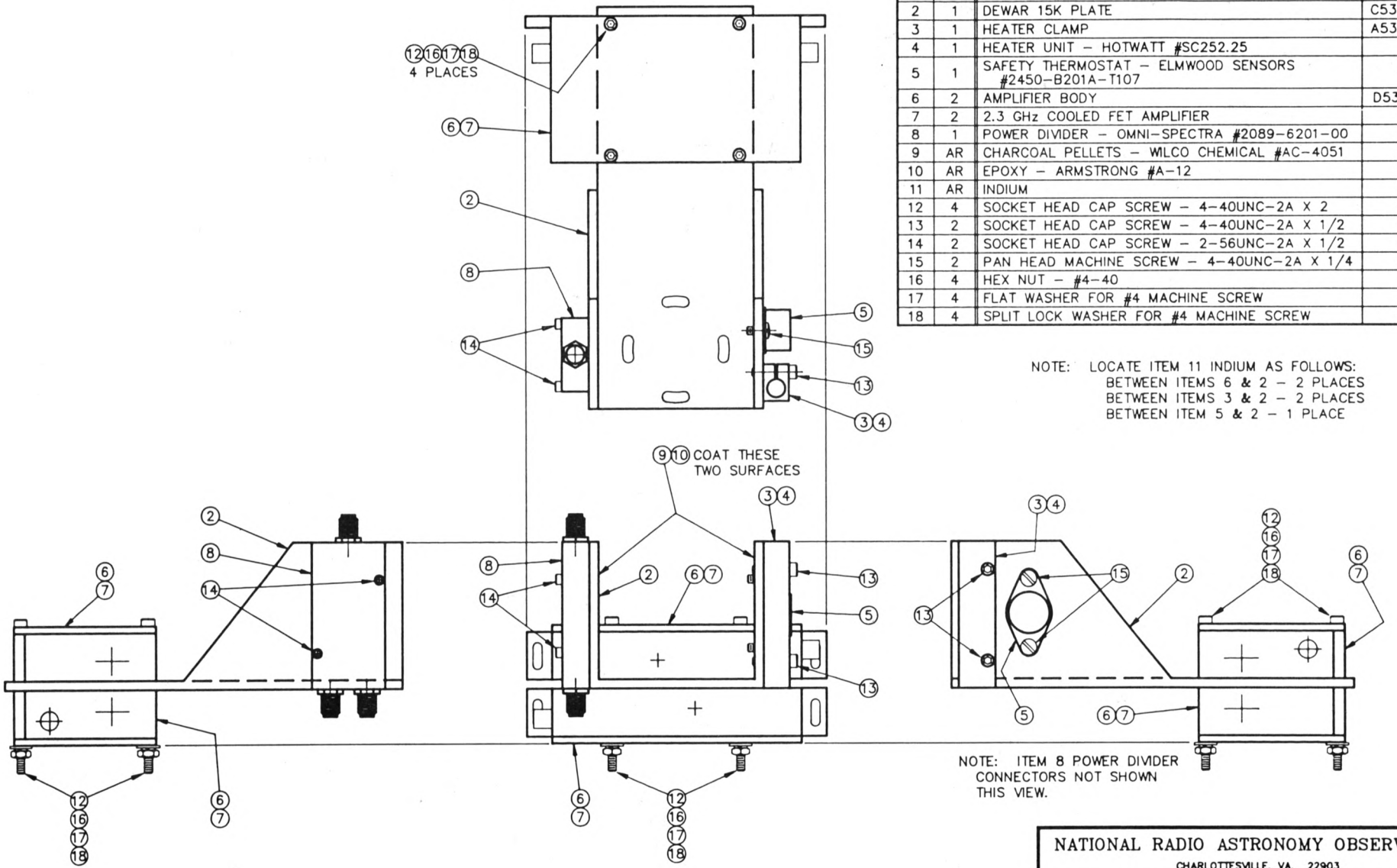
BILL OF MATERIALS
National Radio Astronomy Observatory
Green Bank, WV 24944

ITM	QTY	DESCRIPTION	PART NUMBER	MANUF
71	1	FE/FEED W/G SECTION	C53204M028	NRAO
72	1	WINDOW RING	D53204M026-01	NRAO
73	1	WINDOW HOLDING RING	D53204M026-03	NRAO
74	1	WINDOW INSERT	B53204M027	NRAO
75	8	POLARIZER STANDOFFS	D53204M004-03	NRAO
76	1	DEWAR WAVEGUIDE WINDOW	D53204M004	NRAO
77	1	15K COLD PLATE	B53204M036	NRAO
78	1	POWER SPLITTER	2089-6202-00	OMNI-SPEC
80	0	EPOXY, AS REQ'D	A-12	ARMSTRONG
81	0	ACTIVATED CARBON, AS REQ'D	GRADE JXC 6X8 MESH	WITCO
82	0	INDIUM, AS REQ'D		
83	1	HEATER	SC 252.25	HOTWATT
84	1	HEATER CLAMP	A53206M056-01	NRAO
85	1	SAFETY THERMOSTAT	2450-B201A-T107	ELMWOOD

MATERIAL LIST

ITEM	QUAN	DESCRIPTION	REMARKS
1	0	BOM 15K PLATE ASSEMBLY	A53204B010
2	1	DEWAR 15K PLATE	C53204M042
3	1	HEATER CLAMP	A53206M056
4	1	HEATER UNIT – HOTWATT #SC252.25	—
5	1	SAFETY THERMOSTAT – ELMWOOD SENSORS #2450–B201A–T107	—
6	2	AMPLIFIER BODY	D53204M101
7	2	2.3 GHz COOLED FET AMPLIFIER	—
8	1	POWER DIVIDER – OMNI–SPECTRA #2089–6201–00	—
9	AR	CHARCOAL PELLETS – WILCO CHEMICAL #AC–4051	—
10	AR	EPOXY – ARMSTRONG #A–12	—
11	AR	INDIUM	—
12	4	SOCKET HEAD CAP SCREW – 4–40UNC–2A X 2	—
13	2	SOCKET HEAD CAP SCREW – 4–40UNC–2A X 1/2	—
14	2	SOCKET HEAD CAP SCREW – 2–56UNC–2A X 1/2	—
15	2	PAN HEAD MACHINE SCREW – 4–40UNC–2A X 1/4	—
16	4	HEX NUT – #4–40	—
17	4	FLAT WASHER FOR #4 MACHINE SCREW	—
18	4	SPLIT LOCK WASHER FOR #4 MACHINE SCREW	—

NOTE: LOCATE ITEM 11 INDIUM AS FOLLOWS:
BETWEEN ITEMS 6 & 2 – 2 PLACES
BETWEEN ITEMS 3 & 2 – 2 PLACES
BETWEEN ITEM 5 & 2 – 1 PLACE



NOTE: ITEM 8 POWER DIVIDER CONNECTORS NOT SHOWN THIS VIEW.

II - 3

NATIONAL RADIO ASTRONOMY OBSERVATORY
CHARLOTTESVILLE, VA. 22903

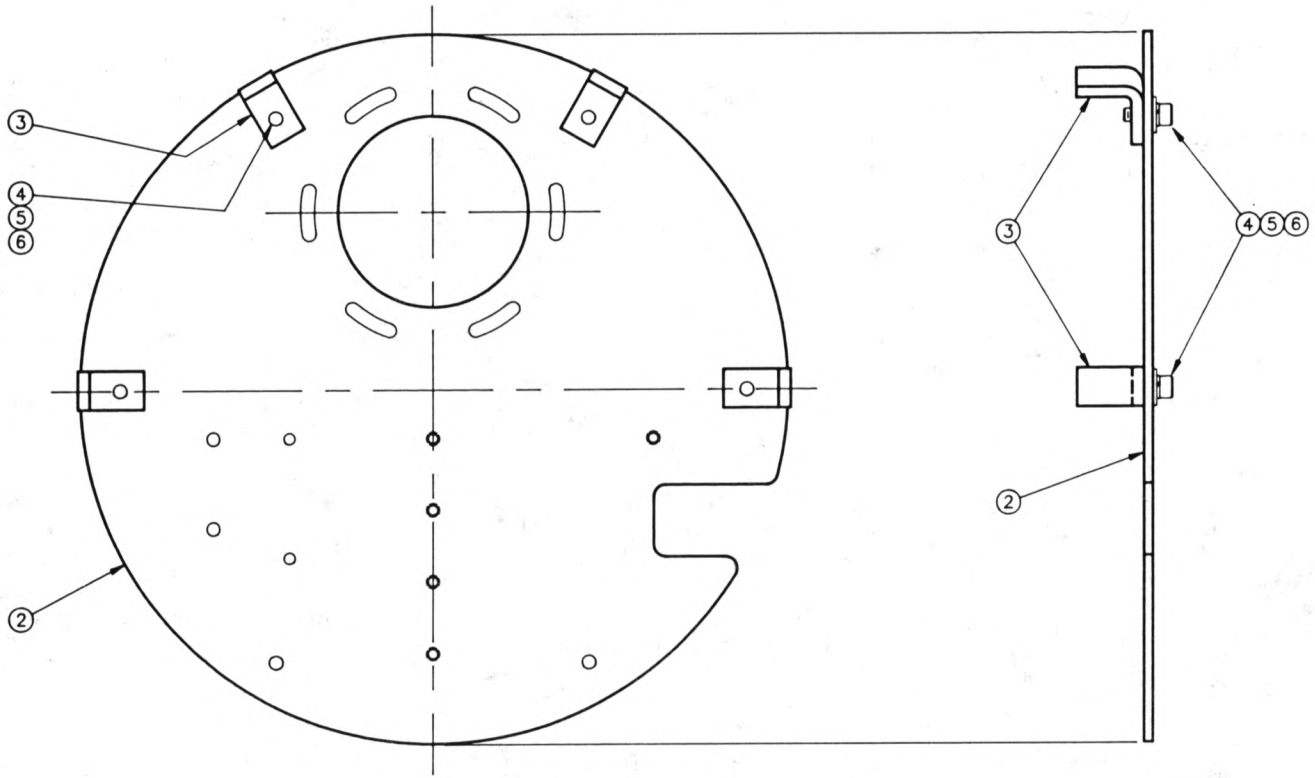
TITLE: 15K PLATE ASSEMBLY

PROJECT: VLBA 2.3 GHz FRONT END

DESIGN			COMPUTER DRAWING	VLBA\53204\A010
DRAWN	D.G.S.	8–3–89	MATERIAL	
SHEET	1 OF 1		FINISH	
SCALE	FULL		DWG. NO.	C53204A010
			REVISION	

MATERIAL LIST

ITEM	QUAN	DESCRIPTION	REMARKS
1	0	BOM DEWAR 50K PLATE ASSEMBLY	A53204B012
2	1	DEWAR 50K PLATE	B53203M013-01
3	4	DEWAR L-BRACKET	A53203M025
4	4	SOCKET HEAD CAP SCREW - 6-32UNC-2A X 3/8	—
5	4	SPLIT LOCK WASHER FOR #6 MACHINE SCREW	—
6	4	FLAT WASHER FOR #6 MACHINE SCREW	—
7	5	SOUTHCO INSERT	B53203M013-02



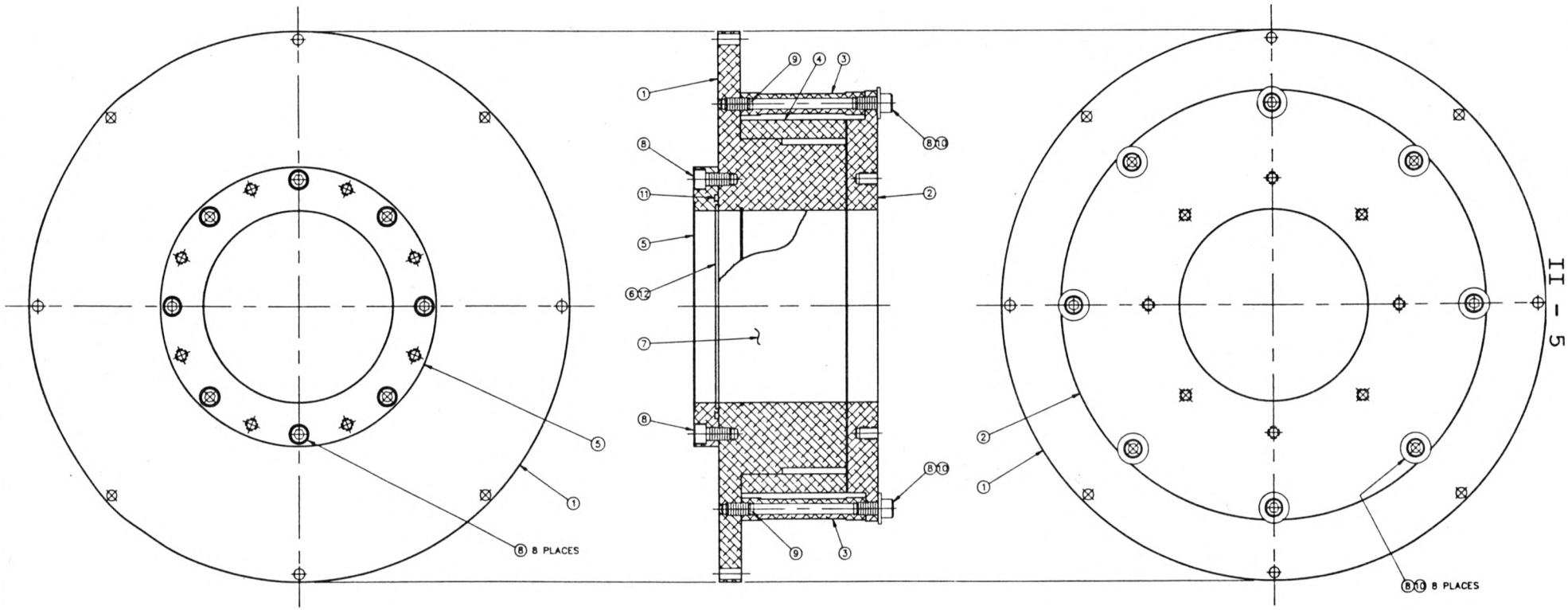
NATIONAL RADIO ASTRONOMY OBSERVATORY
CHARLOTTESVILLE, VA. 22903

TITLE: DEWAR 50K PLATE ASSEMBLY

PROJECT	VLBA 2.3 GHz FRONT END			
DESIGN			COMPUTER DRAWING	VLBA\53204\A012
DRAWN	D.G.S.	7-27-89	MATERIAL	
SHEET	1 OF 1		FINISH	
SCALE	FULL		DWG. NO.	C53204A012

MATERIAL LIST

ITEM	QUAN	DESCRIPTION	REMARKS
1	1	DEWAR CAP	D53204M041-01
2	1	POLARIZER MOUNTING PLATE	D53204M041-02
3	8	POLARIZER STANDOFF	D53204M041-03
4	1	DEWAR CAP RING	D53204M041-04
5	1	WINDOW RING	D53204M026-02
6	1	HOLDING RING	D53204M026-03
7	1	INSERT	B53204M027
8	16	S.S. SOCKET HEAD CAP SCREW ∅ 1/4-20UNC-2A X 1/2	——
9	8	STUD - 1/4-20UNC-2A X 1/2	——
10	8	FLAT WASHER FOR 1/4 MACHINE SCREW	——
11	1	O-RING, N674-70 COMPOUND - PARKER #2-156	——
12	AR	CELLOPHANE	——



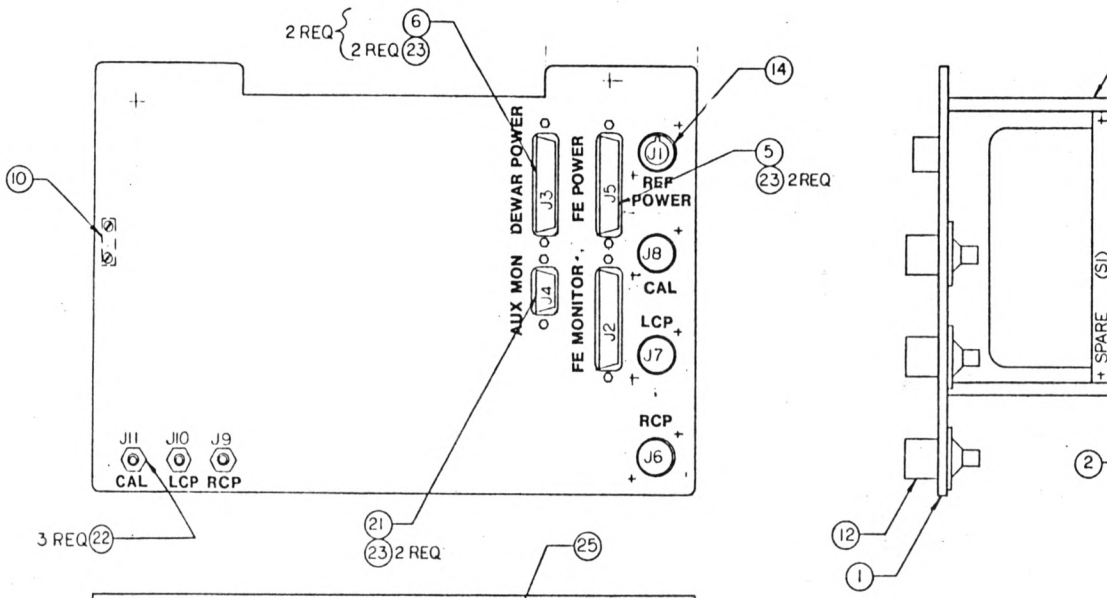
NOTE: ITEM 4 DEWAR CAP RING SHALL BE PRESSED ONTO ITEM 1 DEWAR CAP AS SHOWN.

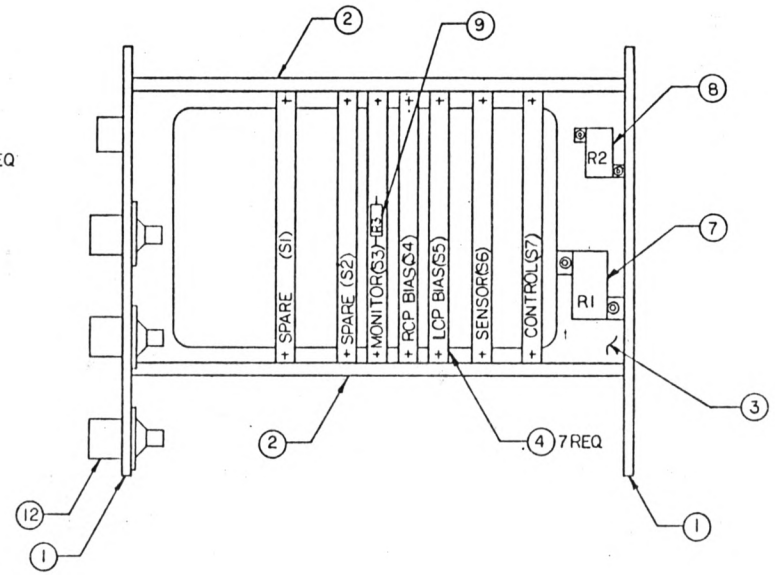
NATIONAL RADIO ASTRONOMY OBSERVATORY
CHARLOTTESVILLE, VA. 22903

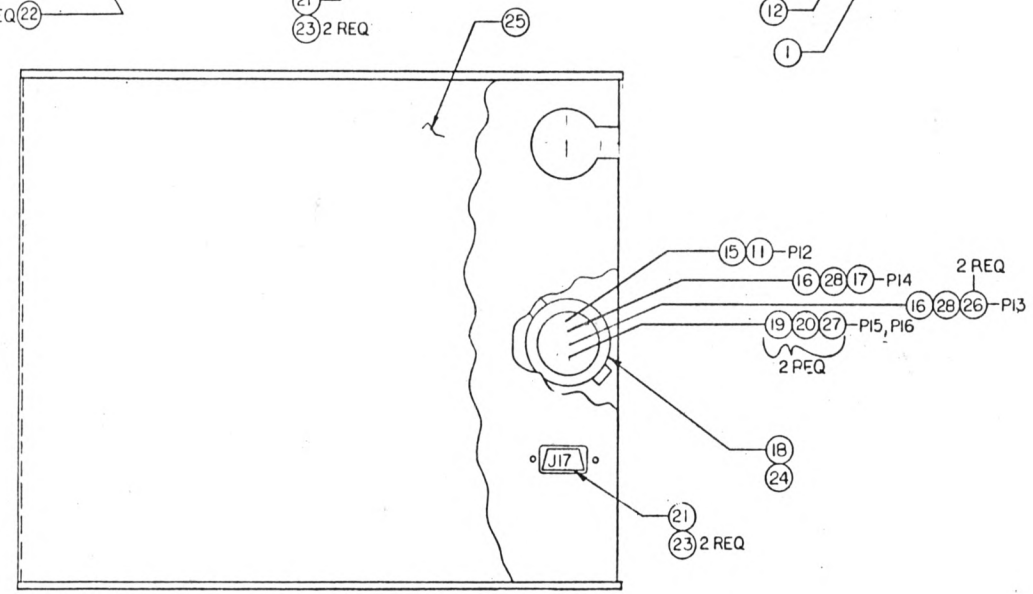
TITLE: THERMAL TRANSITION ASSEMBLY

PROJECT: VLBA 2.3 GHz FRONT END

DESIGN			COMP. TEP DRAWING	VLBA\53204\A008
DRAWN	D.G.S.	8-9-89	MATERIAL	
SHEET	1 OF 1		FINISH	
SCALE	FULL		DWG. NO.	D53204A008







37 REF
38 REF

BOM A53203B004

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES: ANGLES ± 3 PLACE DECIMALS (.XXX) ± 2 PLACE DECIMALS (.XX) ± 1 PLACE DECIMALS (.X) ±		VLBA PROJECT	1.5 GHz FRONT END	NATIONAL RADIO ASTRONOMY OBSERVATORY	
MATERIAL:		UNIT	CARD CAGE ASSY	DRAWN BY G MORRIS	DATE 9 2 94
FINISH:				DESIGNED BY	DATE
D53203A001				APPROVED BY	DATE
NEXT ASSY	USED ON		SHEET NUMBER	DRAWING NUMBER D53203A004	REV. SCALE 1:1

Sheet 1 of 2

BILL OF MATERIAL:	TITLE:	APPROVED BY/DATE:	PREPARED BY/DATE:	REV: DATE:
A53203B004	Card Cage/ 2.3 GHz F.E.		6/13/85	

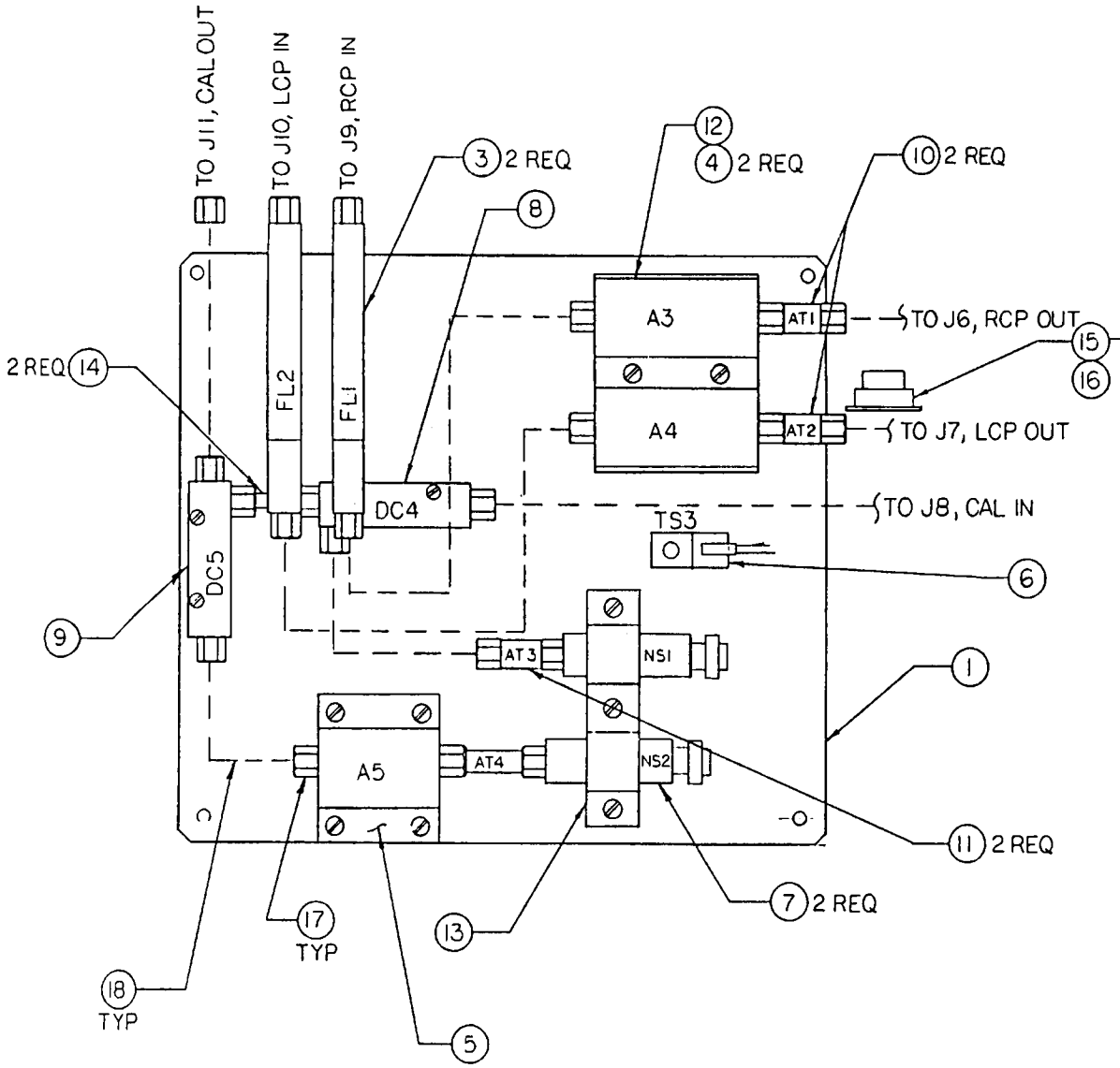
Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.	1	Card Frame Top, Bottom Plate		D53203M019	NRAO
2.	1	Card Frame Sides		D53203M020	NRAO
3.	1	Mother Board Plate		C53206M025	NRAO
4.	7	44 Pin Edge Card Connector	S1-S7	50-44A-30	TRW Cinch
5.	1	Connector, 25 Pin	J5	DBM-25P	TRW Cinch
6.	2	Connector, 25 Socket	J2, J3	DBM-25S	TRW Cinch
7.	1	Resistor, 300Ω 25W 1%	R1	RH-25	Dale
8.	1	Resistor, 5KΩ 10W 1%	R2	RH-10	Dale
9.	1	Resistor, 510Ω 1/2W 5% Carbon	R3	-	-
10.	1	Card Cage Bracket		A53203M038	NRAO
11.	AR	18 Gauge 3 Conductor Cable		M39076	Manhattan Cable
12.	3	SMA Type N Bulkhead	J6-J8	21011	Omni Spectra
13.	1	0-10,000 Hour Timer		CP-3	Curtis
14.	1	3 Conductor AC Input Connector	J1	DM9606-3P	Deutsch
15.	1	3 Conductor REF Power Connector	P12	DM9702-3S	Deutsch
16.	2	Molex Connector Receptacle	P13, P14	03-09-1022	Molex
17.	2	Molex Pin--Female (for P14)		02-09-1118	Molex
18.	1	Card Cage Clamp		AN3057-10	Amphenol
19.	2	8 Pin Vacuum Gauge Connector	P15, P16	78-S8	Amphenol
20.	2	8 Pin Vacuum Gauge Connector Backshell with Clamp		86-3-24	Amphenol

Continued

Sheet 2 of 2

BILL OF MATERIAL:	TITLE:	APPROVED BY/DATE:	PREPARED BY/DATE:	REV: DATE:
A53203B004	Card Cage/ 2.3 GHz F.E.		6/13/85	

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
21.	2	Connector, 9 Socket	J4, J17	DE-9S	TRW
22.	3	SMA Feedthru's	J9-J11	209A	Omni Spectra
23.	10	Type "D" Connector Screw Post		D-20418-2	TRW
24.	1	Card Cage Clamp Coupling Ring		MS3106A18	Amphenol
25.	1	Card Cage Cover		B53203M039	NRAO
26.	2	Molex Pin--Male (for P13)		02-09-2118	Molex
27.	AR	Jacketed 3-Wire 22 AWG Cable		8443	Belden
28.	AR	Jacketed 1 Twisted Pair 18 AWG		9740	Belden
29.	AR	Jacketed 25-Wire 22 AWG Cable		1181/25	Alpha
30.					
31.					
32.					
33.					
34.					
35.					
36.					
37.	REF	Card Cage Wiring List		A53203W001	NRAO
38.	REF	Card Cage Wiring Diagram		B53203W002	NRAO
39.					
40.					



POWER CONNECTOR WIRING

PIN	FN	CONNECT TO
1	GND	A3, A4 (−)
2	15	A3, A4 (+), TS3(4)
3	15	N.C.
4	GND	A5(−), TS3(2)
5	LO CAL	NS1(+)
6	HI CAL	NS2(+), A5(+)
7	GND	NS1 NS2(−)
8	TEMP MON	TS3(1)
9	SPARE	N.C.

19 REF
BOM A53203B005

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES: ANGLES ±
3 PLACE DECIMALS (.XXX): ±
2 PLACE DECIMALS (.XX): ±
1 PLACE DECIMALS (.X): ±
MATERIAL:
FINISH:
NEXT ASSY | USED ON

VLBA PROJECT: 1.5 GHz FRONT END

TITLE: RF PLATE ASSY

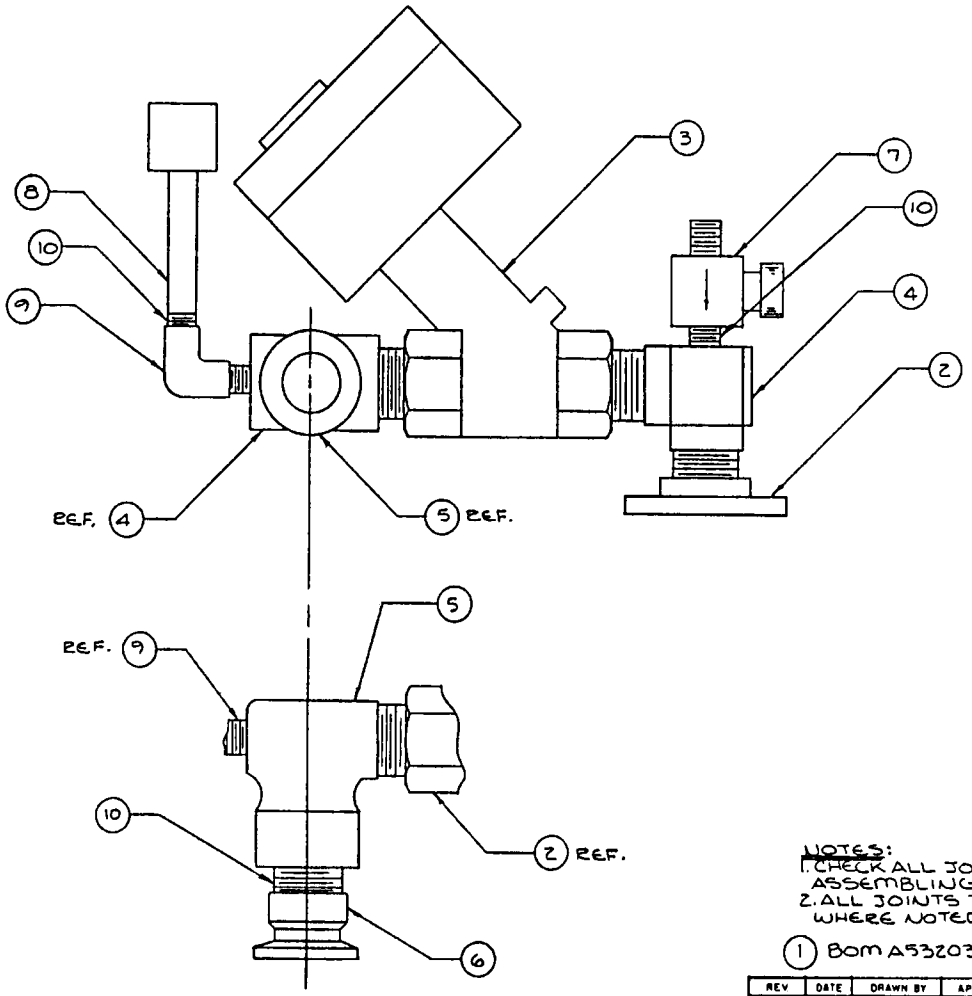
NATIONAL RADIO ASTRONOMY OBSERVATORY

DRAWN BY G MORRIS DATE 9-3-86
DESIGNED BY DATE
APPROVED BY DATE

SHEET NUMBER | DRAWING NUMBER C53203A005 | REV. | SCALE 1:1

BILL OF MATERIALS
National Radio Astronomy Observatory
Green Bank, WV 24944

ITM	QTY	DESCRIPTION	PART NUMBER	MANUF
0	0	THIS IS - BOM, RF PLATE	A53204B005	NRAO
2	0	REF - ASSEMBLY, RF PLATE	53204A005	NRAO
5	2	POST-AMP	A53204N002	MITEQ
6	1	CAL NOISE SOURCE W/OPTION SMA FEMALE OUTPU	NC3204G	NOISECOM
7	2	BANDPASS FILTER W/MOUNTING CLIPS	6B1-2400-800S21	REACTEL
8	2	ISOLATOR, SMA MALE IN/FEMALE OUT	V3I-2040-1	DITOM
10	1	COUPLER, 6 DB, 2-4 GHZ	2020-6608-06	OMNI-SPEC
11	1	COUPLER, 10 DB, 2-4 GHZ	2020-6609-10	OMNI-SPEC
12	1	ATTENUATOR, CAL (SELECT IN TEST)	292-XX	MIDWEST MW
13	1	HI CAL NOISE SOURCE W/SMA FEMALE OUT	NC3204G	NOISECOM
14	1	HIGH CAL AMPLIFIER (OPTIONAL)	A53204N001	MITEQ
15	1	ATTENUATOR, HI CAL (OPTIONAL)	292-XX	MIDWEST MW
16	1	TERMINATION (USE IF ITEMS 13-15 NOT IN)	4112P	EMC
18	0	SEMI-RIGID COAX, .141 DIA, AS REQ'D		
19	18	SMA CONNECTOR (.141 CRIMP-ON)	2001-7641-02	OMNI-SPEC
22	4	CIRCULATOR MOUNT	A53204M035	NRAO
23	1	MOUNT, NOISE SOURCE	A53203M023	NRAO
44	0	#22 STRANDED WIRE, AS REQ'D		



NOTES:
1. CHECK ALL JOINTS FOR LEAKS AFTER ASSEMBLING.
2. ALL JOINTS TO BE EPOXIED EXCEPT WHERE NOTED BY ITEM 10.

(1) BOM A53203B002

REV	DATE	DRAWN BY	APPRV'D BY	DESCRIPTION
VLBA PROJECT				1.5 GHz FRONT END
TITLE				VACUUM ASSY

NATIONAL RADIO ASTRONOMY OBSERVATORY
CHARLOTTESVILLE, VA. 22901

DRAWN BY G. MORRIS	DATE 9-13-85	
DESIGNED BY	DATE	
APPROVED BY	DATE	
SHEET NUMBER	DRAWING NUMBER C53203A007	REV / SCALE ~

Page No. 1 A53203B007-VACUUM ASSY
11/05/85

BILL OF MATERIALS
National Radio Astromomy Observatory
VLBA

ITEM NUM.	REF. DES.	MANUFACTURER	MANUFACTURER'S PART NUMBER	DESCRIPTION	QUAN. REQ.
1		NRAO	A53203B007	BOM VACUUM ASSY	0
2		NRAO	A53203M009	VACUUM FEEDTHRU	1
3		NRAO	B53206A008	SOLENOID ASSY	1
4		NRAO	A53206M029	ME FITTING REWORK	1
5		NRAO	A53203M031	SE FITTING REWORK	1
6		NRAO	A53206M050	VACUUM PORT FITTING	1
7		NUPRO	B-2P4T2	VENTING VALVE	1
8		TELEDYNE HASTINGS	DV-6R	VACUUM GAUGE TUBE	1
9		CAJON	B-2-SE	1/8 NPT STREET ELBOW	1
10				TEFLON TAPE	AR
11				EPOXY	AR

NATIONAL RADIO ASTRONOMY OBSERVATORY
Green Bank, WV 24944

SPECIFICATION: A53204N002 Date: 15 September 1986

TITLE: **2.3 GHz FRONT-END POST AMP**

PROJECT: VLBA

PREPARED BY: Richard F. Bradley Approved by: R.D. Hall

1.0 General

This specification sets forth the requirements for a microwave transistor amplifier. The amplifier will be used in a radio astronomy receiver system.

2.0 Electrical Specifications (18°C-28°C)

Frequency Range	2.0-3.0 GHz
Average Gain	17-20 dB
Gain Ripple	± 0.75 dB max
Noise Figure (23°C)	2.5 dB max
Input/Output VSWR (50 ohm)	2.0:1 max
Output 1 dB Compression	+5 dBm min

2.1 Stability

The unit shall be unconditionally stable. It shall exhibit no spurious output signals when a short circuit is connected to the input or output port and the short position varied over a six inch distance.

The unit shall exhibit no out-of-band (DC to 6 GHz) gain responses more than 6 dB above the average in-band gain.

Variation of the average gain with temperature over the range 18°C to 28°C shall be less than 0.03 dB/°C.

Variation of gain with bias voltages shall be less than 0.01 dB/100 mV.

2.2 Power Requirements

The voltage available to operate the unit is +15 V ± 0.5 V. The unit shall meet the gain-bias stability requirement in 2.1 over this voltage range.

SPECIFICATION: A53204N002 Date: 15 September 1986

TITLE: **2.3 GHz FRONT-END POST AMP**

PROJECT: VLBA

PREPARED BY: Richard F. Bradley Approved by: R.D. Hall

3.0 Environmental Specifications

Unless otherwise stated above, the unit shall meet the performance specifications under the following conditions:

Temperature ..... 0-50°C
Humidity 0-95%

The unit performance shall not be degraded after being subjected to storage temperatures of -40°C to 60°C and shocks of 30 G, 11 msec.

4.0 Mechanical Specifications

The amplifier package dimensions, exclusive of connectors, shall be 2.0" x 1.0" x 1.0" maximum. Mounting holes shall be provided on one amplifier face.

The input and output connectors shall be SMA jacks.

Solder terminals shall be provided for the DC voltage and ground.

5.0 Testing

The vendor shall certify that the unit meets or exceeds all performance requirements set forth in this specification. The unit will be tested upon receipt at NRAO, prior to acceptance.

VLBA 2.3 GHZ FRONT END

CARD CAGE

WIRING LIST

Note:

Unless noted all wire 22 AWG stranded. Noted types are:

Jacketed 3-wire 22 AWG cable; BOM Item 27.

Jacketed twisted pair 18 AWG cable; BOM Item 28.

Jacketed 3-wire 18 AWG; BOM Item 11.

Jacketed 25-wire 22 AWG; BOM Item 29. Strip the jacket off and use for wires going to J3.

18 AWG Stranded Wire.

18 AWG Solid Bus Wire

Ref: Bill Of Materials A53203B004
Wiring Diagram B53203W002

CARD SLOT WIRING LIST

SYSTEM: VLBA 2.3 GHZ FRONT END
ASS'Y: CARD CAGE
SLOT: 1
CARD: SPARE

DWG. NO.: A53203W001
DATE: October 23, 1985
BY: R. D. NORROD
SHEET: 2

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
A	GROUND	BUS	BUS	1	GROUND	J5-1 BUS	0XX
B	+15 VOLTS	BUS	BUS	2	+15 VOLTS	J5-2 BUS	2XX
C	-15 VOLTS	BUS	BUS	3	-15 VOLTS	J5-3 BUS	4XX
D				4			
E				5			
F				6			
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			

SPECIAL INSTRUCTIONS: 'BUS' SIGNIFIES 18 AWG SOLID BUS WIRE STRAPPED THROUGH ALL SEVEN CARD SLOT CONNECTORS.

CARD SLOT WIRING LIST

SYSTEM: VLBA 2.3 GHZ FRONT END
ASS'Y: CARD CAGE
SLOT: 2
CARD: SPARE

DWG. NO.: A53203W001
DATE: October 23, 1985
BY: R. D. NORROD
SHEET: 3

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
A	GROUND	BUS	BUS	1	GROUND	BUS	BUS
B	+15 VOLTS	BUS	BUS	2	+15 VOLTS	BUS	BUS
C	-15 VOLTS	BUS	BUS	3	-15 VOLTS	BUS	BUS
D				4			
E				5			
F				6			
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			

SPECIAL INSTRUCTIONS:

CARD SLOT WIRING LIST

SYSTEM: VLBA 2.3 GHZ FRONT END
ASS'Y: CARD CAGE
SLOT: 3
CARD: MONITOR CARD

DWG. NO.: A53203W001
DATE: September 3, 1986
BY: R. D. NORROD
SHEET: 4

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
A	GROUND	BUS	BUS	1	GROUND	BUS	BUS
B	+15 VOLTS	BUS S3-X	BUS 2XX	2	+15 VOLTS	BUS	BUS
C	-15 VOLTS	BUS	BUS	3	-15 VOLTS	BUS	BUS
D				4			
E	QUALITY GROUND	J2-13 S4-J	5XX	5			
F	PUMP VAC MON	J2-1 S6-14	8XX	6			
H	DEWAR VAC MON	J2-2 S6-N	6XX	7			
J	15K MON (TEMP A)	J2-3 S6-D	96X	8			
K	50K MON (TEMP B)	J2-4 S6-5	95X	9			
L	300K MON	J2-5 J17-8	92X	10			
M	AC CURRENT MON	J2-6 J4-1	1XX	11			
N	RCP GATE 1 MON	J2-7 S4-7	90X	12	X-MON	J2-23	7XX
P	RCP GATE 2,3 MON	J2-8 S4-6	904	13	C-MON	J2-24	9XX
R	LCP GATE 1 MON	J2-9 S5-7	94X	14	NOT H-MON	J2-25	3XX
S	LCP GATE 2,3 MON	J2-10 S5-6	97X	15			
T	LED MON	J2-11* J3-22	5XX	16			
U	SPARE MON	J2-12	1XX	17	X-CPU	J5-6	7XX
V				18	X-OUTPUT	S7-4	7XX
W	MANUAL MON	J2-22	902	19	C-CPU	J5-7	9XX
X	LED +15 VOLTS	S3-B*	2XX	20	C-OUTPUT	S7-M	9XX
Y				21	NOT H-CPU	J5-8	3XX
Z				22	NOT H-OUTPUT	S7-L	3XX

SPECIAL INSTRUCTIONS: CONNECT R3 (510 OHM, 1/2 WATT CARBON, BOM ITEM 9) ACROSS PINS S3-T,X.
KEY BETWEEN PINS 3 AND 4.

CARD SLOT WIRING LIST

SYSTEM: VLBA 2.3 GHZ FRONT END
ASS'Y: CARD CAGE
SLOT: 4
CARD: RCP FET BIAS

DWG. NO.: A53203W001
DATE: January 17, 1986
BY: R. D. NORROD
SHEET: 5

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
A	GROUND	BUS	BUS	1	GROUND	BUS	BUS
B	+15 VOLTS	BUS	BUS	2	+15 VOLTS	BUS	BUS
C	-15 VOLTS	BUS	BUS	3	-15 VOLTS	BUS	BUS
D	GATE 4	J3-19	7XX	4	GATE 4 MON	N.C.	
E	GATE 3	J3-17	98X	5	GATE 3 MON	S4-6	904
F	GATE 2	J3-15	4XX	6	GATE 2 MON	S3-P S4-5	904
H	GATE 1	J3-13	90X	7	GATE 1 MON	S3-N	90X
J	QUALITY GROUND	S3-E S5-J	5XX	8			
K	DRAIN 4	J3-20	902	9			
L	DRAIN 3	J3-18	6XX	10			
M	DRAIN 2	J3-16	3XX	11			
N	DRAIN 1	J3-14	25X	12			
P				13			
R				14			
S				15			
T				16			
U				17			
V				18			
W				19			
X				20			
Y				21			
Z	6 VOLT CONTROL	N.C.		22			

SPECIAL INSTRUCTIONS: SEE NOTE ON SHEET 1 PERTAINING TO CONNECTIONS TO J3. KEY BETWEEN PINS 4 AND 5.

CARD SLOT WIRING LIST

SYSTEM: VLBA 2.3 GHZ FRONT END
ASS'Y: CARD CAGE
SLOT: 5
CARD: LCP FET BIAS

DWG. NO.: A53203W001
DATE: January 17, 1986
BY: R. D. NORROD
SHEET: 6

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
A	GROUND	BUS	BUS	1	GROUND	BUS	BUS
B	+15 VOLTS	BUS	BUS	2	+15 VOLTS	BUS	BUS
C	-15 VOLTS	BUS	BUS	3	-15 VOLTS	BUS	BUS
D	GATE 4	J3-11	91X	4	GATE 4 MON	N.C.	
E	GATE 3	J3-9	9XX	5	GATE 3 MON	S5-6	97X
F	GATE 2	J3-7	97X	6	GATE 2 MON	S3-S S5-5	97X
H	GATE 1	J3-5	94X	7	GATE 1 MON	S3-R	94X
J	QUALITY GROUND	S4-J CHS GND	5XX	8			
K	DRAIN 4	J3-12	8XX	9			
L	DRAIN 3	J3-10	1XX	10			
M	DRAIN 2	J3-8	23X	11			
N	DRAIN 1	J3-6	20X	12			
P				13			
R				14			
S				15			
T				16			
U				17			
V				18			
W				19			
X				20			
Y				21			
Z	6 VOLT CONTROL	N.C.		22			

SPECIAL INSTRUCTIONS: SEE NOTE ON SHEET 1 PERTAINING TO CONNECTIONS TO J3. KEY BETWEEN PINS 4 AND 5.

CARD SLOT WIRING LIST

SYSTEM: VLBA 2.3 GHZ FRONT END
ASS'Y: CARD CAGE
SLOT: 6
CARD: SENSOR CARD

DWG. NO.: A53203W001
DATE: January 17, 1986
BY: R. D. NORROD
SHEET: 7

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
A	GROUND	BUS	BUS	1	GROUND	BUS	BUS
B	+15 VOLTS	BUS	BUS	2	+15 VOLTS	BUS	BUS
C	-15 VOLTS	BUS	BUS	3	-15 VOLTS	BUS	BUS
D	A MON OUT (15K)	S3-J S7-D	96X	4	TEMP SENSOR A	J3-2	96X
E	SENSOR A RTN	J3-1 S6-F	93X	5	B MON OUT (50K)	S3-K	95X
F	SENSOR B RTN	J3-3 S6-E	92X	6			
H	SENSOR B	J3-4	95X	7			
J	VAC TUBE DWR-1	P16-3	2XX*1	8			
K	VAC TUBE DWR-2	P16-5	0XX*1	9			
L	VAC TUBE DWR-3	P16-7	5XX*1	10			
M	VAC DWR LOCAL MON	N.C.		11			
N	VAC DWR MON	S3-H S7-E	6XX	12			
P				13			
R				14	VAC PUMP MON	S3-F S7-F	8XX
S	TEMP SENS A	J2-14	93X	15			
T	TEMP SENS B	N.C.		16			
U				17	VAC TUBE PUMP-3	P15-7	5XX*2
V				18			
W				19			
X				20			
Y				21	VAC TUBE PUMP-1	P15-3	2XX*2
Z				22	VAC TUBE PUMP-2	P15-5	0XX*2

SPECIAL INSTRUCTIONS:
*1 AND *2 - USE THREE CONDUCTOR JACKETED CABLE; BOM ITEM 27.
TERMINATE EACH IN ONE OF BOM ITEM 19; P15 AND P16. CABLE LENGTH TO BE DETERMINED IN ASSEMBLY.
SEE NOTE ON SHEET 1 PERTAINING TO CONNECTIONS TO J3.
KEY BETWEEN PINS 5 AND 6.

CARD SLOT WIRING LIST

SYSTEM: VLBA 2.3 GHZ FRONT END DWG. NO.: A53203W001
ASS'Y: CARD CAGE DATE: September 3, 1986
SLOT: 7 BY: R. D. NORROD
CARD: CONTROL CARD SHEET: 8

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
A	GROUND	BUS CHS GND	BUS 0XX*1	1	GROUND	BUS	BUS
B	+15 VOLTS	BUS	BUS	2	+15 VOLTS	BUS	BUS
C	-15 VOLTS	BUS	BUS	3	-15 VOLTS	BUS	BUS
D	TEMP A MON IN	S6-D	96X	4	X EVAC CONTROL	S3-18	7XX
E	VAC DWR MON IN	S6-N	6XX	5			
F	VAC PUMP MON IN	S6-14	8XX	6			
H				7			
J	S-SOL MON OUT	J2-20	98X	8			
K	P-PUMP REQ OUT	J2-21 J4-3	91X	9			
L	NOT H-NO HEAT CTRL	S3-22	3XX	10			
M	C-COOL CONTROL	S3-20	9XX	11			
N				12			
P				13			
R				14	SOLENOID RTN	R1-2	2XX*1
S	SOLENOID SUPPLY	P14-S	0XX*2	15			
T				16	RESISTOR LOAD	R2-1	0XX
U	150VAC IN, PHASE 2	J1-1	2XX*1	17			
V	150VAC REFR, PHA 2	P12-1	2XX*3	18	LOAD HEATER RTN	R2-2	TAN
W	DEWAR HEATER	J3-24	1XX	19	DEWAR HEATER RTN	J3-25	TAN
X	150VAC IN, PHASE 1	J1-3	0XX*1	20	150VAC RTN IN	J1-2	9XX*1
Y	150VAC REFR, PHA 1 TIMER	P12-3 P13-1	0XX*3 0XX*4	21	REFR RTN TIMER RTN	P12-2 P13-2	9XX*3 2XX*4
Z				22			

*1 - USE 18 AWG STRANDED WIRE. TWIST S7-U,X,20.
*2 - USE TWO CONDUCTOR JACKETED CABLE; BOM ITEM 28. CONNECT RED CONDUCTOR TO R1-1. OPPOSITE END TERMINATED IN P14; BOM ITEM 16.
*3 - USE THREE CONDUCTOR JACKETED CABLE; BOM ITEM 11. OPPOSITE END TERMINATED IN P12; BOM ITEM 15.
*4 - USE TWO CONDUCTOR JACKETED CABLE; BOM ITEM 28. OPPOSITE END TERMINATED IN P13; BOM ITEM 16.
LENGTHS OF CABLES TO BE DETERMINED IN ASSEMBLY. KEY BETWEEN PINS 6 AND 7.
SEE NOTE ON SHEET 1 PERTAINING TO CONNECTIONS TO J3. TWIST S7-W,19.

25 PIN D-CONNECTOR WIRING LIST

SYSTEM: VLBA 2.3 GHZ FRONT END
ASS'Y: CARD CAGE
TYPE: BULKHEAD (BOM ITEM 6)
SEX: FEMALE (SOCKET)
FUNC'T: FRONT END MONITOR

DWG. NO.: A53203W001
DATE: September 3, 1986
BY: R. D. NORROD
SHEET: 9
DESIGNATION: J2

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
1	VAC PUMP MONITOR	S3-F	8XX	14	TEMP SENS A	S6-S	93X
2	VAC DEWAR MONITOR	S3-H	6XX	15			
3	15K MON (TEMP A)	S3-J	96X	16			
4	50K MON (TEMP B)	S3-K	95X	17			
5	300K MON (AMBIENT)	S3-L	92X	18			
6	AC CURRENT MONITOR	S3-M	1XX	19			
7	RCP GATE 1 MON	S3-N	90X	20	S-SOL MON	S7-J	98X
8	RCP GATE 2,3 MON	S3-P	904	21	P-PUMP REQUEST	S7-K	91X
9	LCP GATE 1 MON	S3-R	94X	22	MANUAL MON	S3-W	902
10	LCP GATE 2,3 MON	S3-S	97X	23	X-MON	S3-12	7XX
11	LED MON	S3-T	5XX	24	C-MON	S3-13	9XX
12	SPARE MON	S3-U	1XX	25	NOT H-MON	S3-14	3XX
13	QUALITY GROUND	S3-E	5XX				

SPECIAL INSTRUCTIONS:

25 PIN D-CONNECTOR WIRING LIST

SYSTEM: VLBA 2.3 GHZ FRONT END
ASS'Y: CARD CAGE
TYPE: BULKHEAD
SEX: FEMALE (SOCKET)
FUNC'T: DEWAR POWER/MONITOR

DWG. NO.: A53203W001
DATE: September 3, 1986
BY: R. D. NORROD
SHEET: 10
DESIGNATION: J3

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
1	SENSOR A RTN	S6-E	93X	14	RCP DRAIN 1	S4-N	25X
2	SENSOR A (15K)	S6-4	96X	15	RCP GATE 2	S4-F	4XX
3	SENSOR B RTN	S6-F	92X	16	RCP DRAIN 2	S4-M	3XX
4	SENSOR B	S6-H	95X	17	RCP GATE 3	S4-E	98X
5	LCP GATE 1	S5-H	94X	18	RCP DRAIN 3	S4-L	6XX
6	LCP DRAIN 1	S5-N	20X	19	RCP GATE 4	S4-D	7XX
7	LCP GATE 2	S5-F	97X	20	RCP DRAIN 4	S4-K	902
8	LCP DRAIN 2	S5-M	23X	21	DEWAR GROUND	GND BUS	0XX
9	LCP GATE 3	S5-E	9XX	22	LED	S3-T	5XX
10	LCP DRAIN 3	S5-L	1XX	23			
11	LCP GATE 4	S5-D	91X	24	DEWAR HEATER	S7-W	1XX
12	LCP DRAIN 4	S5-K	8XX	25	DEWAR HEATER RTN	S7-19	TAN
13	RCP GATE 1	S4-H	90X				

SPECIAL INSTRUCTIONS:
SEE NOTE ON SHEET 1 PERTAINING TO CONNECTIONS TO J3.
TWIST J3-24,25.

9 PIN D-CONNECTOR WIRING LIST

SYSTEM: VLBA 2.3 GHZ FRONT END
ASS'Y: CARD CAGE
TYPE: BULKHEAD
SEX: FEMALE (SOCKET)
FUNC'T: AUXILIARY MONITOR

DWG. NO.: A53203W001
DATE: October 25, 1985
BY: R. D. NORROD
SHEET: 11
DESIGNATION: J4

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
1	AC CURRENT MONITOR	S3-M	1XX	6			
2	AC CUR. MON RTN	GND BUS	0XX	7			
3	PUMP REQUEST	S7-K	91X	8			
4	PUMP REQUEST RTN	GND BUS	0XX	9			
5							

SPECIAL INSTRUCTIONS:

25 PIN D-CONNECTOR WIRING LIST

SYSTEM: VLBA 2.3 GHZ FRONT END
ASS'Y: CARD CAGE
TYPE: BULKHEAD
SEX: MALE PINS
FUNC'T: DC POWER AND CONTROL

DWG. NO.: A53203W001
DATE: September 3, 1986
BY: R. D. NORROD
SHEET: 12
DESIGNATION: J5

PIN	FUNCTION	TO	COLOR	PIN		FUNCTION	TO	COLOR
1	GROUND	S1-1	0XX	14	ID	F0	GND BUS	0XX
2	+15 VOLT SUPPLY	S1-2	2XX	15		F1	N.C.	
3	-15 VOLT SUPPLY	S1-3	4XX	16		F2	GND BUS	0XX
4				17		F3	GND BUS	0XX
5	NOT-PA (PARITY)	N.C.		18	ID	SN0	*1	
6	X (EVAC CONTROL)	S3-17	7XX	19		SN1	*1	
7	C (COOL CONTROL)	S3-19	9XX	20		SN2	*1	
8	H (NO HEAT CTRL)	S3-21	3XX	21		SN3	*1	
9				22		SN4	*1	
10				23		SN5	*1	
11	CAL CONTROL	J17-5	8XX	24	ID	MOD0	*2	
12	HIGH CAL CONTROL	J17-6	8XX	25		MOD1	*2	
13								

SPECIAL INSTRUCTIONS:
*1 - SERIALIZE CARD CAGE ASSEMBLY BY GROUNDING APPROPRIATE BITS, SN0-SN5.
*2 - INDICATE CURRENT MODIFICATION BY GROUNDING APPROPRIATE BITS, MOD0-MOD1.

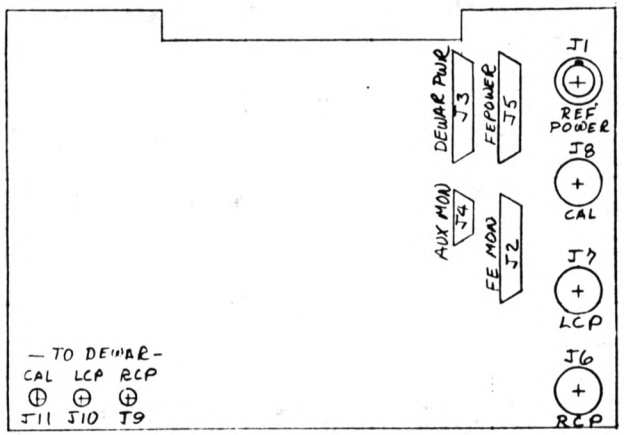
9 PIN D-CONNECTOR WIRING LIST

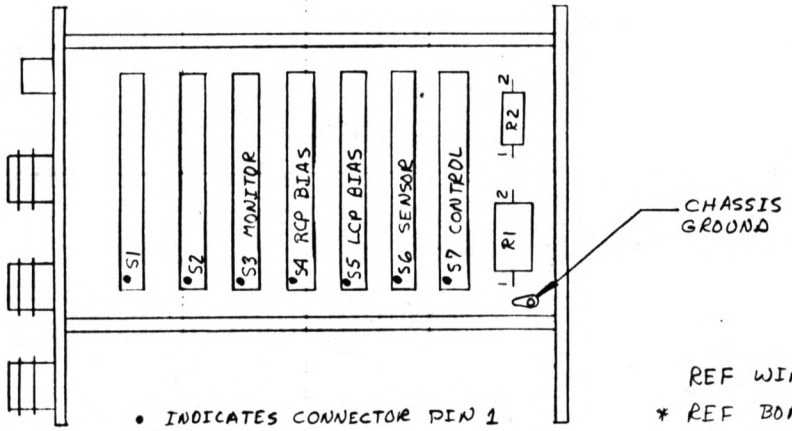
SYSTEM: VLBA 2.3 GHZ FRONT END
ASS'Y: CARD CAGE
TYPE: BULKHEAD
SEX: FEMALE (SOCKET)
FUNC'T: RF PLATE CONTROL

DWG. NO.: A53203W001
DATE: October 25, 1985
BY: R. D. NORROD
SHEET: 13
DESIGNATION: J17

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
1	GROUND	GND BUS	0XX	6	HIGH CAL CONTROL	J5-12	8XX
2	+15 VOLTS	+15 BUS	2XX	7	CAL RTN	GND BUS	0XX
3	-15 VOLTS	-15 BUS	4XX	8	300K TEMP MON	S3-L	92X
4	GROUND	GND BUS	0XX	9			
5	LOW CAL CONTROL	J5-11	8XX				

SPECIAL INSTRUCTIONS:



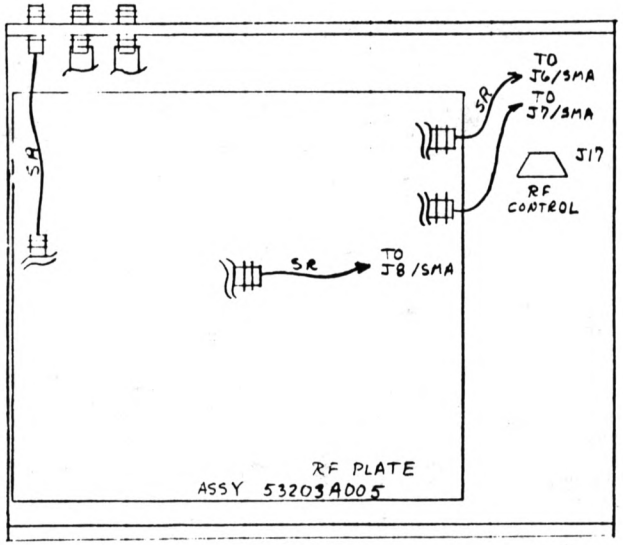


• INDICATES CONNECTOR PIN 1

SR INDICATES .141 SEMI-RIGID COAX WITH APPROPRIATE CONNECTORS

REF WIRING LIST A53203W001

* REF BOM A53203B004



DESG	FUNCTION	TYPE	BOM * ITEM
J1	REFRIGERATOR POWER INPUT	DM9606-3P	14
J2	FRONT END MONITOR	DBM-25S	6
J3	DEWAR POWER/MONITOR	DBM-25S	6
J4	AUXILIARY MONITOR	DE-9S	21
J5	FRONT END POWER	DBM-25P	5
J6	RCP RF OUT	N/SMA ADP	12
J7	LCP RF OUT	N/SMA ADP	12
J8	PHASE CAL IN	N/SMA ADP	12
J9	RCP RF IN	SMA/SMA	22
J10	LCP RF IN	SMA/SMA	22
J11	CAL OUT	SMA/SMA	22
P12	REFRIGERATOR POWER OUT	DM9702-3S	15
P13	ETI POWER	MOLEX	16
P14	VACUUM SOLENOID POWER	MOLEX	16
P15	PUMP VACUUM SENSOR	OCTAL	19
P16	DEWAR VACUUM SENSOR	OCTAL	19
J12	RF PLATE CONTROL	DE-9S	21

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES
ANGLES ±
3 PLACE DEC. (xxx) ±
2 PLACE DEC. (xx) ±
1 PLACE DEC. (x) ±

NATIONAL RADIO ASTRONOMY OBSERVATORY
GREEN BANK, W. VA. 24944

PROJ: VLBA 1.5 GHZ FE	TITLE: CARD CAGE WIRING DIAGRAM		
MATERIAL: —	DRAWN BY: RDN	DATE: 10/22/85	
FINISH: —	DESIGNED BY: RDN	DATE:	
	APPROVED BY:	DATE:	
SHEET NUMBER: 1/1	DRAWING NUMBER: B53203 W002	REV.	SCALE:

H T HALL 4-

Sheet 1 of 2

BILL OF MATERIAL: A53200B007*2 | TITLE: Model 350 Ref. Power Supply | APPROVED BY/DATE: | PREPARED BY/DATE: PDN 08/12/86 | REV: DATE:

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.	1	150 VAC Power Supply Case		D53200M003	NRAO
2.	1	Cover - Power Supply		B53200M004	NRAO
3.	1	Heat Sink		B53200M035	NRAO
4.	AR	18 AWG Wire			Alpha
5.	AR	22 AWG Wire			Alpha
6.	AR	Wire Ties		CT-3B	Caltronics
7.	1	Fuse Molder		341001	Little Fuse
8.	1	Fuse 4A		MTH-4	Buss
9.	1	Bulkhead - AC Connector Male	AC In	MS3102A14S -01P	Amphenol
10.	1	Bulkhead - AC Connector Female	AC Out	MS3102A14S -01S	Amphenol
11.	1	Mating Connector		MS3106A14S -01P	Amphenol
12.	1	Mating Connector		MS3106A14S -01S	Amphenol
13.	2	Back Shell		97-3057-6	Amphenol
14.	1	Bulkhead-4 Pin Female	Mon Out	126-233	Amphenol
15.	1	Mating Connector- 4 Pin Male		126-214-1000	Amphenol
16.	1	Back Shell Assembly		126-215	Amphenol
17.	14	Crimp-On Spade Terminal		T-2084	Waldon
18.	4	Slide-On Crimp Terminals		ST-2188	Waldon
19.	2	#8 Solder Lugs			Waldon
20.	AR	Heat Sink Compound		340	Dow Corning

Sheet 2 of 2

BILL OF MATERIAL: A53200B007-2	TITLE: Model 350 Ref. Power Supply	APPROVED BY/DATE:	PREPARED BY/DATE: RDN 08/12/86	REV: DATE:

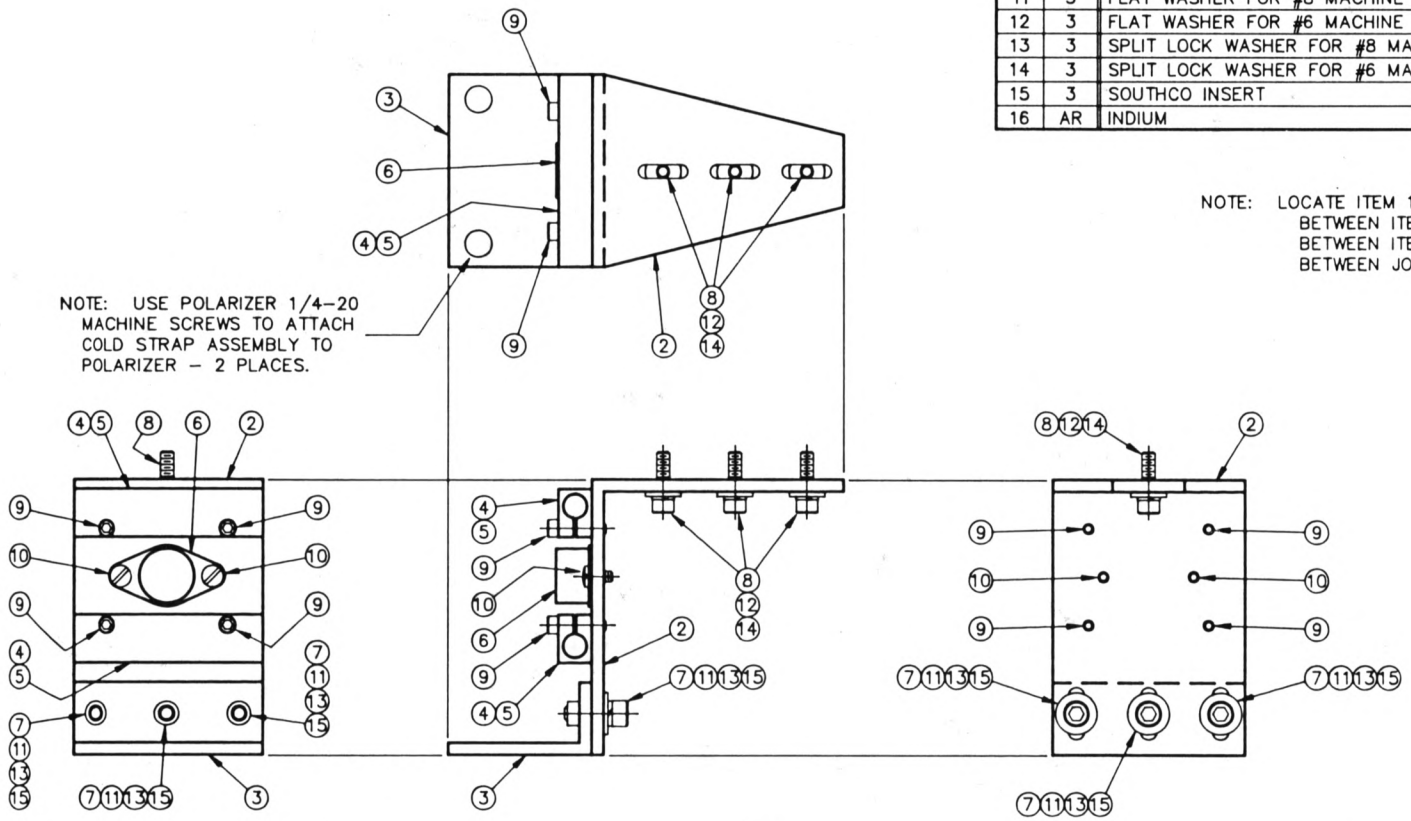
Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
21.	2	Resistor 80Ω 50W		RH-50	Dale
22.	1	Transformer		300-00	Todd/Systems
23.	1	Current Transducer		CTI-1	Ohio-Electronics
24.	1	Capacitor 7μF 330 VAC		RPN3307Z	Mallory
25.	1	Trimmer Capacitor		Selected in Test	Sprague
26.	1	Resistor 10K 1%		RN55C-1002	Dale
27.					
28.	1	10-32x1/2 Binder Head Screws			All-Metal
29.	12	4-40x3/8 Binder Head Screws			All-Metal
30.	8	4-40 Nuts			All-Metal
31.	12	#4 Flat Washers			All-Metal
32.	12	#4 Lock Washers			All-Metal
33.	4	4-40x1/2 Binder Head Screws			All-Metal
34.	11	8-32 Nuts			All-Metal
35.	11	#8 Lock Washers			All-Metal
36.	11	#8 Flat Washers			All-Metal
37.	1	#10 Lock Washers			All-Metal
38.	1	#10 Flat Washers			All-Metal
39.	1	Power Supply Label Artwork		A53200I012	NRAO
40.	REF	Schematic, 350 Power Supply		B53203W004	NRAO

MATERIAL LIST

ITEM	QUAN	DESCRIPTION	REMARKS
1	0	BOM POLARIZER COLD STRAP ASSEMBLY	A53204B011
2	1	COLD STRAP	C53204M043-01
3	1	COLD STRAP	C53204M043-02
4	2	HEATER CLAMP	A53206M056
5	2	HEATER UNIT - HOTWATT #SC252.25	—
6	1	SAFETY THERMOSTAT - ELMWOOD SENSORS #2450-B201A-T107	—
7	3	SOCKET HEAD CAP SCREW - 8-32UNC-2A X 1/2	—
8	3	SOCKET HEAD CAP SCREW - 6-32UNC-2A X 1/2	—
9	4	SOCKET HEAD CAP SCREW - 4-40UNC-2A X 1/2	—
10	2	PAN HEAD MACHINE SCREW - 4-40UNC-2A X 1/4	—
11	3	FLAT WASHER FOR #8 MACHINE SCREW	—
12	3	FLAT WASHER FOR #6 MACHINE SCREW	—
13	3	SPLIT LOCK WASHER FOR #8 MACHINE SCREW	—
14	3	SPLIT LOCK WASHER FOR #6 MACHINE SCREW	—
15	3	SOUTHCO INSERT	C53204M043-03
16	AR	INDIUM	—

NOTE: USE POLARIZER 1/4-20 MACHINE SCREWS TO ATTACH COLD STRAP ASSEMBLY TO POLARIZER - 2 PLACES.

NOTE: LOCATE ITEM 16 INDIUM AS FOLLOWS:
BETWEEN ITEMS 4 & 2 - 2 PLACES
BETWEEN ITEM 6 & 2 - 1 PLACE
BETWEEN JOINT OF ITEMS 2 & 3



NATIONAL RADIO ASTRONOMY OBSERVATORY
CHARLOTTESVILLE, VA. 22903

TITLE: POLARIZER COLD STRAP ASSEMBLY

PROJECT	VLBA 2.3 GHz FRONT END			
DESIGN			COMPUTER DRAWING	VLBA\53204\A011
DRAWN	D.G.S.	8-1-89	MATERIAL	
SHEET	1 OF 1		FINISH	
SCALE	FULL		DWG. NO.	C53204A011

APPENDIX III

Manufacturers' Data Sheets

APPENDIX IV

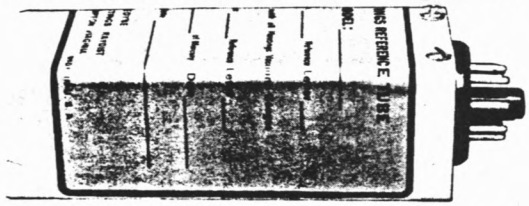
Special Test Fixtures

A wave guide cold termination (Assembly 53204A007) was fabricated to test the front-end. Four quartz fins are mounted in circular waveguide which is immersed in liquid nitrogen to provide the cold termination. A gapped waveguide and vacuum window similar to that used in the front-end is incorporated. Vacuum sensors, temperature sensors and heaters are included for control of the unit. Figure IV-1 shows photographs of the cold termination. When filled, the termination may be used in either a horizontal or vertical orientation and will remain cold for over 12 hours without refilling.

TELEDYNE HASTINGS-RAYDIST HAMPTON, VA (804) 723-6531 JUNE 85

reference tube

A QUICK CALIBRATION DEVICE FOR HASTINGS VACUUM GAUGES



The Hastings Reference Tube is an evacuated, sealed vacuum gauge tube accurately calibrated and marked at its exact pressure. It is electrically equivalent to our metal and Pyrex gauge tubes. It permits quick and easy recalibration of Hastings Vacuum Gauges by merely plugging the instrument into the reference and adjusting the calibration potentiometer until the instrument reads the exact pressure noted on the reference tube.

Equivalent Gauge Tube and Range			Reference Tube Model No.
Metal	Pyrex	Range	
DV-4D	DV-16D	0-20 mm Hg	DB-16D
*DV-5M	*DV-18	0-100 Microns Hg	*DB-18
DV-6M	DV-20	0-1000 Microns Hg	DB-20
DV-8M	DV-31	.01-10 Microns Hg	DB-31
DV-23	—	0-5000 Microns Hg	DB-33
DV-24	—	0-50 Torr	DB-44
DV-100	—	0-100 Torr	Not Available
DV-77	—	10^{-4} to 10^{-2} Torr	Not available
DV-100	—	0-100 Torr	Not available
DV-800	—	0-800 Torr	Not available

*State reference letter of your Gauge Tube type for matching purposes.

ADVANTAGES OF HASTINGS VACUUM INSTRUMENTS

- **Fully compensated for both temperature and rate-of-change of temperature**
- **Designed for panel mounting or in instrument cabinets.**

Hastings instruments have many exclusive advantages. Self contained, solid-state circuitry throughout assures long life and low maintenance costs. All instruments use frictionless, taut-band pivotless meters. Instruments are electrical to provide rapid response and permit remote installations.

Hastings gauge tubes can withstand great g-shock and vibration, using short firmly connected thermocouples with no suspended weld to an external heater. They are corrosion resistant and non-contaminating using noble metal thermopiles which assures stable calibration held indefinitely. Gauge tubes are easily cleaned with any suitable solvent. Each gauge tube is specifically designed and checked out for the range it covers, assuring maximum sensitivity.

gauge tubes

THE ONLY GAUGE TUBES COMPENSATED FOR BOTH AMBIENT TEMPERATURE AND RATE OF TEMPERATURE CHANGE

- **METAL** Constructed of nickel plated steel with plastic bases color coded to prevent mix-up.
- **PYREX GLASS** Available for high temperature and bakeable systems.
- **"R" SERIES** Ruggedized with a gold-plated hermetic seal base with monel housing for weather resistance.
- **STAINLESS STEEL** For weather-proof, corrosive and bakable applications. Withstands high over-pressurization. May be brazed or welded to system. Plain or threaded connection.

FOR PROPER ACCURACY AND PERFORMANCE, HASTINGS VACUUM GAUGES SHOULD ALWAYS BE USED WITH THE PROPER RANGE OF HASTINGS VACUUM GAUGE TUBES!

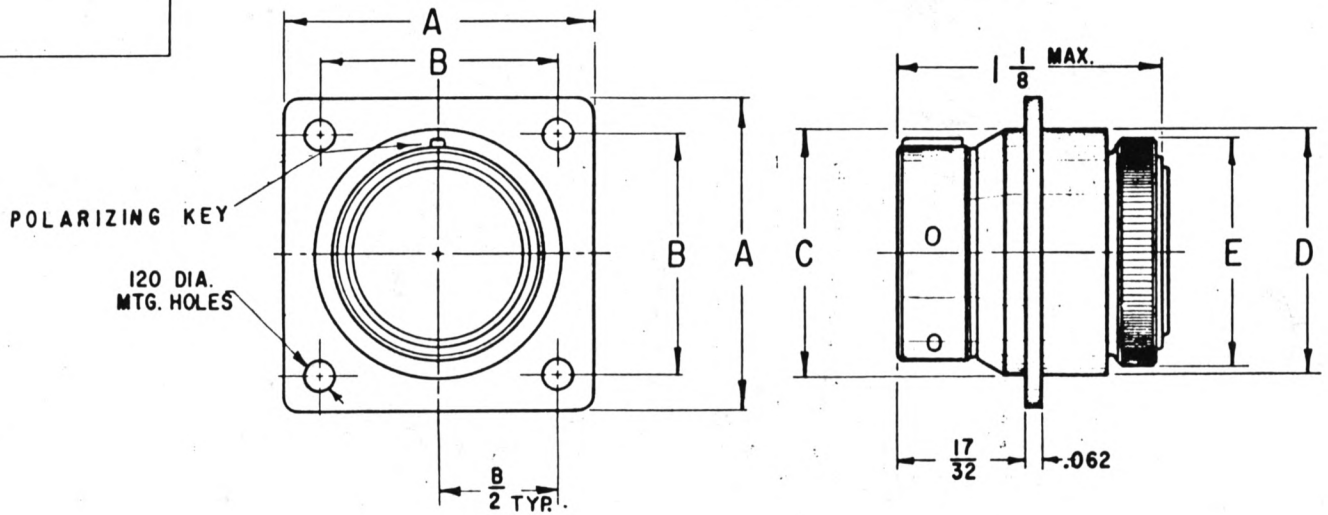
INSTRUMENT SERIES	RANGE	METAL TYPE	BASE COLOR	PYREX TYPE	"R" SERIES TYPE	STAINLESS STEEL TYPE
NV-8	10^{-5} torr 10^{-2} torr	DV-8	Green	DV-31	—	—
VT-5, CVT-15/25	0-100 μ Hg	DV-5M	Red	DV-18	—	—
VT-6, CVT-16/26, DAV-6, TV-4A, MRV-6, TV-47	0-1000 μ Hg	DV-6M	Yellow	DV-20	DV-6R	DV-36
VH-3, CVH-3/23	0-5 torr	DV-23	Orange	—	—	—
VT-4, CVT-14/24, DAV-4, TP-7A, MRV-4, TV-47	0-20 mm Hg	DV-4D	Purple	DV-16D	DV-4R	DV-34
VH-4, CVH-4/24	0-50 torr	DV-24	White	—	—	—
NV-100	0-100 torr	DV-100	Brown	—	—	—

MODEL DV-800 GAUGE TUBE is used with Wide Range Vacuum Gauges, Models NV-800 and DNNV-800. This linear voltage displacement transformer type is for the range of 0-800 torr.

MODEL DV-77 GAUGE TUBE is used with the Cold Cathode Ion Gauge, Model NV-77. Range is 10^{-4} to 10^{-2} torr. Replacement cathode-anode assemblies are available.

DM 9606-✱ P S

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL



PART NO.	A	B	C	D	E	WEIGHT IN LBS
DM 9606-3 P S	7/8	.625	9/16	39/64	1/2	P .0208 S .0230
DM 9606-7 P S	1	.719	43/64	11/16	41/64	P .0298 S .0338
DM 9606-12 P S	1 3/32	.813	13/16	13/16	49/64	P .0418 S .0493
DM 9606-19 P S	1 3/16	.906	15/16	15/16	57/64	P .0549 S .0673
DM 9606-27 P S	1 9/32	.968	1 1/8	1 1/16	1 1/32	P .0750 S .0927
DM 9606-37 P S	1 7/16	1.187	1 1/4	1 1/4	1 13/64	P .0976 S .1162
DM 9606-61 P S	1 25/32	1.437	1 9/16	1 9/16	1 33/64	P .1540 S .1894

NOTE:

1. SEE "GENERAL DESCRIPTION" FOR ELECTRICAL AND MATERIAL SPECIFICATIONS.
2. FOR AVAILABLE CONTACT ARRANGEMENTS AND ALTERNATE INSERT POSITIONS, SEE CATALOG PAGE # 14500. IN DM SECTION

NEXT ASSY	USED ON
APPLICATION	

TOLERANCES UNLESS OTHERWISE NOTED

FRACTIONS	±.015
DECIMALS	±.005
ANGLES	±0° 30'0"

MATERIAL

FINISH

ITEM	QTY	PART NUMBER	DESCRIPTION
LIST OF MATERIAL			

	SIGNATURE & DATE
DR	C. HASTINGS
CHK	R D Yates 5-3-61
PE	J. W. Fehling 5-3-61
APP	CED

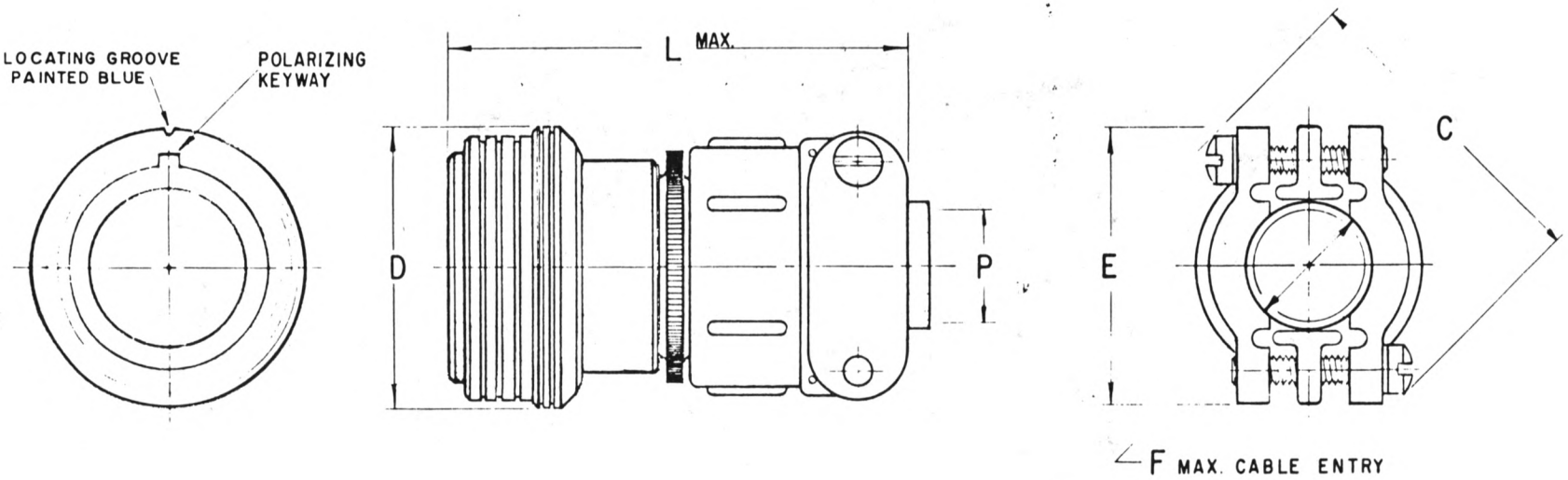
(ENVELOPE)

RECEPTACLE,
MINIATURE SQUARE
FLANGE MOUNTING TYPE
DM TYPE

SCALE | WT

The Deutsch Company
ELECTRONIC COMPONENTS DIVISION
Municipal Airport · Banning, California

DWG SIZE	CODE	SHEET
B	11139	DM 9606-✱ P S



PART NO.	C	D	E	F	L	P	WT. IN LBS.
DM 9702- 3 PS	1 1/16	23/32	13/16	1/4	2 3/32	1/8	.0506
DM 9702- 7 PS	1 1/8	29/32	7/8	5/16	2 3/32	7/32	.0582 .0758 .0806
DM 9702-12 PS	1 11/32	1 1/16	1 1/16	7/16	2 5/32	5/16	.1036 .1113
DM 9702-19 PS	1 1/2	1 3/16	1 5/32	9/16	2 7/32	7/16	.1302 .1416
DM 9702-27 PS	1 19/32	1 23/64	1 1/4	5/8	2 7/32	9/16	.1456 .1605
DM 9702-37 PS	1 7/8	1 1/2	1 15/32	3/4	2 7/32	5/8	.2093 .2303
DM 9702-61 PS	2 1/8	1 53/64	1 11/16	15/16	2 3/8	3/4	.3354 .3422

NOTE:

1. SEE "GENERAL DESCRIPTION" FOR ELECTRICAL AND MATERIAL SPECIFICATIONS
2. FOR AVAILABLE CONTACT ARRANGEMENTS AND ALTERNATE INSERT POSITIONS, SEE CATALOG PAGE # 14500, IN DM SECTION

1. DE-BURR ALL SHARP EDGES

TOLERANCES
FRACTIONS ± .015 DECIMALS ± .005 ANGLES ± ½°
UNLESS OTHERWISE SPECIFIED

MATERIAL	SPEC.	
MATERIAL	SPEC.	
MATERIAL	SPEC.	
FORGING	SPEC.	WT.

THE DEUTSCH COMPANY

(ENVELOPE)
PLUG, WITH CABLE CLAMP
QUICK DISCONNECT - PUSH-PULL TYPE

NO.	CHANGE	BY	DATE

DRAWN	C. HASTINGS
CHECKED	
APPROVED	
DATE 4-22-60	CODE 11139

DM 9702-* PS

OMNI SPECTRA
MERRIMACK, NH
(603) 424-4111

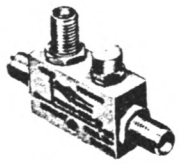
JUNE 85

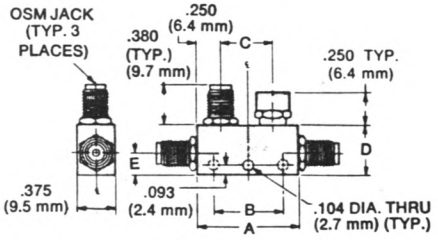
DIRECTIONAL COUPLERS

MINI COUPLERS • OCTAVE BANDWITH

- **Smallest and Lightest Couplers Available**
- **.5 Through 18 GHz Including Wideband Units**
- **High Directivity — Low VSWR**
- **Meets MIL-E-5400 and MIL-E-16400 Environments**

This complete line of mini-series coaxial stripline couplers features the smallest and lightest units available anywhere, typically measuring 1 inch by ½ inch by ⅜ inch thick and weighing only about ½ ounce. These units are the ultimate in performance and will consistently outperform their conservative specifications. All of the units use OSM female stainless steel precision connectors.





SPECIFICATIONS

PART NO.	CASE STYLE	FREQUENCY RANGE (GHz)	COUPLING (INCLUDES FREQUENCY SENSITIVITY) (dB)	FREQUENCY SENSITIVITY (dB)	INSERTION LOSS max (dB)	DIRECTIVITY min (dB)	VSWR (max.) PRI. LINE	VSWR (max.) SEC. LINE	POWER (INPUT) AVG. IN (W)	POWER (INPUT) AVG. REFL (W)	POWER (INPUT) PK (kW)
2020-6600-06	7	0.5-1.0	6 ±1.0	±0.60	0.15	25	1.10	1.10	50	4	4
2020-6601-10	7		10 ±1.0	±0.75	0.15	25	1.10	1.10	50	10	4
2020-6602-20	7		20 ±1.0	±0.75	0.15	25	1.10	1.10	50	50	4
2020-6603-30	7		30 ±1.0	±0.75	0.15	25	1.10	1.10	50	50	4
2020-6604-06	5	1.0-2.0	6 ±1.0	±0.60	0.20	25	1.15	1.15	50	4	4
2020-6605-10	5		10 ±1.0	±0.75	0.20	25	1.15	1.15	50	10	4
2020-6606-20	5		20± 1.0	±0.75	0.20	25	1.15	1.15	50	50	4
2020-6607-30	6		30 ±1.0	±0.75	0.20	25	1.15	1.15	50	50	4
2020-6608-06	3	2.0-4.0	6 ±1.0	±0.60	0.20	22	1.15	1.15	50	4	4
2020-6609-10	3		10 ±1.0	±0.75	0.20	22	1.15	1.15	50	10	4
2020-6610-20	3		20 ±1.0	±0.75	0.20	22	1.15	1.15	50	50	4
2020-6611-30	4		30 ±1.0	±0.75	0.20	22	1.15	1.15	50	50	4
2020-6612-06	2	2.6-5.2	6 ±1.0	±0.60	0.25	20	1.25	1.25	50	4	4
2020-6613-10	2		10 ±1.0	±0.75	0.25	20	1.25	1.25	50	10	4
2020-6614-20	2		20 ±1.0	±0.75	0.25	20	1.25	1.25	50	50	4
2020-6615-30	1		30 ±1.0	±0.75	0.25	20	1.25	1.25	50	50	4
2020-6616-06	2	4.0-8.0	6 ±.75	±0.50	0.25	18	1.25	1.25	50	4	4
2020-6617-10	2		10 ±.75	±0.50	0.25	20	1.25	1.25	50	10	4
2020-6618-20	2		20 ±.75	±0.50	0.25	20	1.25	1.25	50	50	4
2020-6619-30	1		30 ±.75	±0.50	0.25	20	1.25	1.25	50	50	4
2020-6620-06	2	7.0-12.4	6 ±1.0	±0.40	0.40	15	1.35	1.35	50	4	4
2020-6621-10			10 ±1.0	±0.50	0.40	17	1.35	1.35	50	10	4
2020-6622-20	1		20 ±1.0	±0.50	0.30	17	1.35	1.35	50	50	4
2020-6623-30	1		30 ±1.0	±0.50	0.30	17	1.35	1.35	50	50	4
2020-6624-06	2	7.0-18.0	6 ±1.0	±0.50	0.50	15	1.35	1.35	50	4	3
2020-6625-10			10 ±1.0	±0.75	0.50	12	1.45	1.45	50	10	3
2020-6626-20	1		20 ±1.0	±0.75	0.50	15**	1.45	1.45	50	50	3
2020-6627-30	8		30 ±1.0	±0.75	0.50	15**	1.45	1.45	50	50	3
2020-6628-06	2	12.4-18.0	6 ±1.0	±0.40	0.50	15	1.35	1.35	50	4	2
2020-6629-10			10 ±1.0	±0.50	0.50	12	1.45	1.45	50	10	2
2020-6630-20	1		20 ±1.0	±0.50	0.50	12	1.45	1.45	50	50	2
2020-6631-30	8		30 ±1.0	±0.50	0.50	12	1.45	1.45	50	50	2

MECHANICAL SPECIFICATIONS

CASE STYLE	A	B	C	D	E	W (lbs)	W (g)
1	1.000 (25.4 mm)	N/A	.500 (12.7 mm)	.546 (13.9 mm)	.219 (5.6 mm)	0.62	17.6
2				.500 (12.7 mm)		0.60	17.0
3	1.156 (29.4 mm)	.343 (8.7 mm)	.656 (16.7 mm)	.500 (12.7 mm)		0.64	18.2
4				.546 (13.9 mm)		0.67	19.0
5	1.781 (45.2 mm)	.937 (23.8 mm)	1.281 (32.5 mm)	.500 (12.7 mm)		0.82	23.2
6				.546 (13.9 mm)		0.87	23.3
*7	3.000 (76.2 mm)	1.000 (25.4 mm)	2.500 (63.5 mm)	.750 (19.1 mm)	.310 (7.9 mm)	1.50	43.0
8	1.000 (25.4 mm)	N/A	.500 (12.7 mm)	.625 (15.9 mm)	.219 (5.6 mm)	0.67	19.0

*NOTE Case style seven has four mounting holes located symmetrically to the two shown dotted in figure.

**12dB from 12.4 to 18.0 GHz.

NATIONAL RADIO ASTRONOMY OBSERVATORY
Green Bank, WV 24944

SPECIFICATION: A53204N002 Date: 15 September 1986

TITLE: **2.3 GHz FRONT-END POST AMP**

PROJECT: VLBA

PREPARED BY: Richard F. Bradley Approved by: R.D. Norrod

1.0 General

This specification sets forth the requirements for a microwave transistor amplifier. The amplifier will be used in a radio astronomy receiver system.

2.0 Electrical Specifications (18°C-28°C)

Frequency Range	2.0-3.0 GHz
Average Gain	17-20 dB
Gain Ripple	± 0.75 dB max
Noise Figure (23°C)	2.5 dB max
Input/Output VSWR (50 ohm)	2.0:1 max
Output 1 dB Compression	+5 dBm min

2.1 Stability

The unit shall be unconditionally stable. It shall exhibit no spurious output signals when a short circuit is connected to the input or output port and the short position varied over a six inch distance.

The unit shall exhibit no out-of-band (DC to 6 GHz) gain responses more than 6 dB above the average in-band gain.

Variation of the average gain with temperature over the range 18°C to 28°C shall be less than 0.03 dB/°C.

Variation of gain with bias voltages shall be less than 0.01 dB/100 mV.

2.2 Power Requirements

The voltage available to operate the unit is +15 V ± 0.5 V. The unit shall meet the gain-bias stability requirement in 2.1 over this voltage range.

SPECIFICATION: A53204N002 Date: 15 September 1986

TITLE: **2.3 GHz FRONT-END POST AMP**

PROJECT: VLBA

PREPARED BY: Richard F. Bradley Approved by: R.D. Hall

3.0 Environmental Specifications

Unless otherwise stated above, the unit shall meet the performance specifications under the following conditions:

Temperature ..... 0-50°C
Humidity 0-95%

The unit performance shall not be degraded after being subjected to storage temperatures of -40°C to 60°C and shocks of 30 G, 11 msec.

4.0 Mechanical Specifications

The amplifier package dimensions, exclusive of connectors, shall be 2.0" x 1.0" x 1.0" maximum. Mounting holes shall be provided on one amplifier face.

The input and output connectors shall be SMA jacks.

Solder terminals shall be provided for the DC voltage and ground.

5.0 Testing

The vendor shall certify that the unit meets or exceeds all performance requirements set forth in this specification. The unit will be tested upon receipt at NRAO, prior to acceptance.

VLBA 2.3 GHZ FRONT END

CARD CAGE

WIRING LIST

Note:

Unless noted all wire 22 AWG stranded. Noted types are:

Jacketed 3-wire 22 AWG cable; BOM Item 27.

Jacketed twisted pair 18 AWG cable; BOM Item 28.

Jacketed 3-wire 18 AWG; BOM Item 11.

Jacketed 25-wire 22 AWG; BOM Item 29. Strip the jacket off and use for wires going to J3.

18 AWG Stranded Wire.

18 AWG Solid Bus Wire

Ref: Bill Of Materials A53203B004
Wiring Diagram B53203W002

CARD SLOT WIRING LIST

SYSTEM: VLBA 2.3 GHZ FRONT END
ASS'Y: CARD CAGE
SLOT: 1
CARD: SPARE

DWG. NO.: A53203W001
DATE: October 23, 1985
BY: R. D. NORROD
SHEET: 2

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
A	GROUND	BUS	BUS	1	GROUND	J5-1 BUS	0XX
B	+15 VOLTS	BUS	BUS	2	+15 VOLTS	J5-2 BUS	2XX
C	-15 VOLTS	BUS	BUS	3	-15 VOLTS	J5-3 BUS	4XX
D				4			
E				5			
F				6			
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			

SPECIAL INSTRUCTIONS: 'BUS' SIGNIFIES 18 AWG SOLID BUS WIRE STRAPPED THROUGH ALL SEVEN CARD SLOT CONNECTORS.

CARD SLOT WIRING LIST

SYSTEM: VLBA 2.3 GHZ FRONT END
ASS'Y: CARD CAGE
SLOT: 2
CARD: SPARE

DWG. NO.: A53203W001
DATE: October 23, 1985
BY: R. D. NORROD
SHEET: 3

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
A	GROUND	BUS	BUS	1	GROUND	BUS	BUS
B	+15 VOLTS	BUS	BUS	2	+15 VOLTS	BUS	BUS
C	-15 VOLTS	BUS	BUS	3	-15 VOLTS	BUS	BUS
D				4			
E				5			
F				6			
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			

SPECIAL INSTRUCTIONS:

CARD SLOT WIRING LIST

SYSTEM: VLBA 2.3 GHZ FRONT END
ASS'Y: CARD CAGE
SLOT: 3
CARD: MONITOR CARD

DWG. NO.: A53203W001
DATE: September 3, 1986
BY: R. D. NORROD
SHEET: 4

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
A	GROUND	BUS	BUS	1	GROUND	BUS	BUS
B	+15 VOLTS	BUS S3-X	BUS 2XX	2	+15 VOLTS	BUS	BUS
C	-15 VOLTS	BUS	BUS	3	-15 VOLTS	BUS	BUS
D				4			
E	QUALITY GROUND	J2-13 S4-J	5XX	5			
F	PUMP VAC MON	J2-1 S6-14	8XX	6			
H	DEWAR VAC MON	J2-2 S6-N	6XX	7			
J	15K MON (TEMP A)	J2-3 S6-D	96X	8			
K	50K MON (TEMP B)	J2-4 S6-5	95X	9			
L	300K MON	J2-5 J17-8	92X	10			
M	AC CURRENT MON	J2-6 J4-1	1XX	11			
N	RCP GATE 1 MON	J2-7 S4-7	90X	12	X-MON	J2-23	7XX
P	RCP GATE 2,3 MON	J2-8 S4-6	904	13	C-MON	J2-24	9XX
R	LCP GATE 1 MON	J2-9 S5-7	94X	14	NOT H-MON	J2-25	3XX
S	LCP GATE 2,3 MON	J2-10 S5-6	97X	15			
T	LED MON	J2-11* J3-22	5XX	16			
U	SPARE MON	J2-12	1XX	17	X-CPU	J5-6	7XX
V				18	X-OUTPUT	S7-4	7XX
W	MANUAL MON	J2-22	902	19	C-CPU	J5-7	9XX
X	LED +15 VOLTS	S3-B*	2XX	20	C-OUTPUT	S7-M	9XX
Y				21	NOT H-CPU	J5-8	3XX
Z				22	NOT H-OUTPUT	S7-L	3XX

SPECIAL INSTRUCTIONS: CONNECT R3 (510 OHM, 1/2 WATT CARBON, BOM ITEM 9) ACROSS PINS S3-T,X.
KEY BETWEEN PINS 3 AND 4.

CARD SLOT WIRING LIST

SYSTEM: VLBA 2.3 GHZ FRONT END
ASS'Y: CARD CAGE
SLOT: 4
CARD: RCP FET BIAS

DWG. NO.: A53203W001
DATE: January 17, 1986
BY: R. D. NORROD
SHEET: 5

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
A	GROUND	BUS	BUS	1	GROUND	BUS	BUS
B	+15 VOLTS	BUS	BUS	2	+15 VOLTS	BUS	BUS
C	-15 VOLTS	BUS	BUS	3	-15 VOLTS	BUS	BUS
D	GATE 4	J3-19	7XX	4	GATE 4 MON	N.C.	
E	GATE 3	J3-17	98X	5	GATE 3 MON	S4-6	904
F	GATE 2	J3-15	4XX	6	GATE 2 MON	S3-P S4-5	904
H	GATE 1	J3-13	90X	7	GATE 1 MON	S3-N	90X
J	QUALITY GROUND	S3-E S5-J	5XX	8			
K	DRAIN 4	J3-20	902	9			
L	DRAIN 3	J3-18	6XX	10			
M	DRAIN 2	J3-16	3XX	11			
N	DRAIN 1	J3-14	25X	12			
P				13			
R				14			
S				15			
T				16			
U				17			
V				18			
W				19			
X				20			
Y				21			
Z	6 VOLT CONTROL	N.C.		22			

SPECIAL INSTRUCTIONS: SEE NOTE ON SHEET 1 PERTAINING TO CONNECTIONS TO J3. KEY BETWEEN PINS 4 AND 5.

CARD SLOT WIRING LIST

SYSTEM: VLBA 2.3 GHZ FRONT END
ASS'Y: CARD CAGE
SLOT: 5
CARD: LCP FET BIAS

DWG. NO.: A53203W001
DATE: January 17, 1986
BY: R. D. NORROD
SHEET: 6

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
A	GROUND	BUS	BUS	1	GROUND	BUS	BUS
B	+15 VOLTS	BUS	BUS	2	+15 VOLTS	BUS	BUS
C	-15 VOLTS	BUS	BUS	3	-15 VOLTS	BUS	BUS
D	GATE 4	J3-11	91X	4	GATE 4 MON	N.C.	
E	GATE 3	J3-9	9XX	5	GATE 3 MON	S5-6	97X
F	GATE 2	J3-7	97X	6	GATE 2 MON	S3-S S5-5	97X
H	GATE 1	J3-5	94X	7	GATE 1 MON	S3-R	94X
J	QUALITY GROUND	S4-J CHS GND	5XX	8			
K	DRAIN 4	J3-12	8XX	9			
L	DRAIN 3	J3-10	1XX	10			
M	DRAIN 2	J3-8	23X	11			
N	DRAIN 1	J3-6	20X	12			
P				13			
R				14			
S				15			
T				16			
U				17			
V				18			
W				19			
X				20			
Y				21			
Z	6 VOLT CONTROL	N.C.		22			

SPECIAL INSTRUCTIONS: SEE NOTE ON SHEET 1 PERTAINING TO CONNECTIONS TO J3.
KEY BETWEEN PINS 4 AND 5.

CARD SLOT WIRING LIST

SYSTEM: VLBA 2.3 GHZ FRONT END
ASS'Y: CARD CAGE
SLOT: 6
CARD: SENSOR CARD

DWG. NO.: A53203W001
DATE: January 17, 1986
BY: R. D. NORROD
SHEET: 7

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
A	GROUND	BUS	BUS	1	GROUND	BUS	BUS
B	+15 VOLTS	BUS	BUS	2	+15 VOLTS	BUS	BUS
C	-15 VOLTS	BUS	BUS	3	-15 VOLTS	BUS	BUS
D	A MON OUT (15K)	S3-J S7-D	96X	4	TEMP SENSOR A	J3-2	96X
E	SENSOR A RTN	J3-1 S6-F	93X	5	B MON OUT (50K)	S3-K	95X
F	SENSOR B RTN	J3-3 S6-E	92X	6			
H	SENSOR B	J3-4	95X	7			
J	VAC TUBE DWR-1	P16-3	2XX*1	8			
K	VAC TUBE DWR-2	P16-5	0XX*1	9			
L	VAC TUBE DWR-3	P16-7	5XX*1	10			
M	VAC DWR LOCAL MON	N.C.		11			
N	VAC DWR MON	S3-H S7-E	6XX	12			
P				13			
R				14	VAC PUMP MON	S3-F S7-F	8XX
S	TEMP SENS A	J2-14	93X	15			
T	TEMP SENS B	N.C.		16			
U				17	VAC TUBE PUMP-3	P15-7	5XX*2
V				18			
W				19			
X				20			
Y				21	VAC TUBE PUMP-1	P15-3	2XX*2
Z				22	VAC TUBE PUMP-2	P15-5	0XX*2

SPECIAL INSTRUCTIONS:
*1 AND *2 - USE THREE CONDUCTOR JACKETED CABLE; BOM ITEM 27.
TERMINATE EACH IN ONE OF BOM ITEM 19; P15 AND P16. CABLE LENGTH TO BE DETERMINED IN ASSEMBLY.
SEE NOTE ON SHEET 1 PERTAINING TO CONNECTIONS TO J3.
KEY BETWEEN PINS 5 AND 6.

CARD SLOT WIRING LIST

SYSTEM: VLBA 2.3 GHZ FRONT END
ASS'Y: CARD CAGE
SLOT: 7
CARD: CONTROL CARD

DWG. NO.: A53203W001
DATE: September 3, 1986
BY: R. D. NORROD
SHEET: 8

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
A	GROUND	BUS CHS GND	BUS 0XX*1	1	GROUND	BUS	BUS
B	+15 VOLTS	BUS	BUS	2	+15 VOLTS	BUS	BUS
C	-15 VOLTS	BUS	BUS	3	-15 VOLTS	BUS	BUS
D	TEMP A MON IN	S6-D	96X	4	X EVAC CONTROL	S3-18	7XX
E	VAC DWR MON IN	S6-N	6XX	5			
F	VAC PUMP MON IN	S6-14	8XX	6			
H				7			
J	S-SOL MON OUT	J2-20	98X	8			
K	P-PUMP REQ OUT	J2-21 J4-3	91X	9			
L	NOT H-NO HEAT CTRL	S3-22	3XX	10			
M	C-COOL CONTROL	S3-20	9XX	11			
N				12			
P				13			
R				14	SOLENOID RTN	R1-2	2XX*1
S	SOLENOID SUPPLY	P14-S	0XX*2	15			
T				16	RESISTOR LOAD	R2-1	0XX
U	150VAC IN, PHASE 2	J1-1	2XX*1	17			
V	150VAC REFR, PHA 2	P12-1	2XX*3	18	LOAD HEATER RTN	R2-2	TAN
W	DEWAR HEATER	J3-24	1XX	19	DEWAR HEATER RTN	J3-25	TAN
X	150VAC IN, PHASE 1	J1-3	0XX*1	20	150VAC RTN IN	J1-2	9XX*1
Y	150VAC REFR, PHA 1	P12-3	0XX*3	21	REFR RTN	P12-2	9XX*3
	TIMER	P13-1	0XX*4		TIMER RTN	P13-2	2XX*4
Z				22			

*1 - USE 18 AWG STRANDED WIRE. TWIST S7-U,X,20.
*2 - USE TWO CONDUCTOR JACKETED CABLE; BOM ITEM 28. CONNECT RED CONDUCTOR TO R1-1. OPPOSITE END TERMINATED IN P14; BOM ITEM 16.
*3 - USE THREE CONDUCTOR JACKETED CABLE; BOM ITEM 11. OPPOSITE END TERMINATED IN P12; BOM ITEM 15.
*4 - USE TWO CONDUCTOR JACKETED CABLE; BOM ITEM 28. OPPOSITE END TERMINATED IN P13; BOM ITEM 16.
LENGTHS OF CABLES TO BE DETERMINED IN ASSEMBLY. KEY BETWEEN PINS 6 AND 7.
SEE NOTE ON SHEET 1 PERTAINING TO CONNECTIONS TO J3. TWIST S7-W,19.

25 PIN D-CONNECTOR WIRING LIST

SYSTEM: VLBA 2.3 GHZ FRONT END
ASS'Y: CARD CAGE
TYPE: BULKHEAD (BOM ITEM 6)
SEX: FEMALE (SOCKET)
FUNC'T: FRONT END MONITOR

DWG. NO.: A53203W001
DATE: September 3, 1986
BY: R. D. NORROD
SHEET: 9
DESIGNATION: J2

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
1	VAC PUMP MONITOR	S3-F	8XX	14	TEMP SENS A	S6-S	93X
2	VAC DEWAR MONITOR	S3-H	6XX	15			
3	15K MON (TEMP A)	S3-J	96X	16			
4	50K MON (TEMP B)	S3-K	95X	17			
5	300K MON (AMBIENT)	S3-L	92X	18			
6	AC CURRENT MONITOR	S3-M	1XX	19			
7	RCP GATE 1 MON	S3-N	90X	20	S-SOL MON	S7-J	98X
8	RCP GATE 2,3 MON	S3-P	904	21	P-PUMP REQUEST	S7-K	91X
9	LCP GATE 1 MON	S3-R	94X	22	MANUAL MON	S3-W	902
10	LCP GATE 2,3 MON	S3-S	97X	23	X-MON	S3-12	7XX
11	LED MON	S3-T	5XX	24	C-MON	S3-13	9XX
12	SPARE MON	S3-U	1XX	25	NOT H-MON	S3-14	3XX
13	QUALITY GROUND	S3-E	5XX				

SPECIAL INSTRUCTIONS:

25 PIN D-CONNECTOR WIRING LIST

SYSTEM: VLBA 2.3 GHZ FRONT END
ASS'Y: CARD CAGE
TYPE: BULKHEAD
SEX: FEMALE (SOCKET)
FUNC'T: DEWAR POWER/MONITOR

DWG. NO.: A53203W001
DATE: September 3, 1986
BY: R. D. NORROD
SHEET: 10
DESIGNATION: J3

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
1	SENSOR A RTN	S6-E	93X	14	RCP DRAIN 1	S4-N	25X
2	SENSOR A (15K)	S6-4	96X	15	RCP GATE 2	S4-F	4XX
3	SENSOR B RTN	S6-F	92X	16	RCP DRAIN 2	S4-M	3XX
4	SENSOR B	S6-H	95X	17	RCP GATE 3	S4-E	98X
5	LCP GATE 1	S5-H	94X	18	RCP DRAIN 3	S4-L	6XX
6	LCP DRAIN 1	S5-N	20X	19	RCP GATE 4	S4-D	7XX
7	LCP GATE 2	S5-F	97X	20	RCP DRAIN 4	S4-K	902
8	LCP DRAIN 2	S5-M	23X	21	DEWAR GROUND	GND BUS	0XX
9	LCP GATE 3	S5-E	9XX	22	LED	S3-T	5XX
10	LCP DRAIN 3	S5-L	1XX	23			
11	LCP GATE 4	S5-D	91X	24	DEWAR HEATER	S7-W	1XX
12	LCP DRAIN 4	S5-K	8XX	25	DEWAR HEATER RTN	S7-19	TAN
13	RCP GATE 1	S4-H	90X				

SPECIAL INSTRUCTIONS:
SEE NOTE ON SHEET 1 PERTAINING TO CONNECTIONS TO J3.
TWIST J3-24,25.

9 PIN D-CONNECTOR WIRING LIST

SYSTEM: VLBA 2.3 GHZ FRONT END
ASS'Y: CARD CAGE
TYPE: BULKHEAD
SEX: FEMALE (SOCKET)
FUNC'T: AUXILIARY MONITOR

DWG. NO.: A53203W001
DATE: October 25, 1985
BY: R. D. NORROD
SHEET: 11
DESIGNATION: J4

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
1	AC CURRENT MONITOR	S3-M	1XX	6			
2	AC CUR. MON RTN	GND BUS	0XX	7			
3	PUMP REQUEST	S7-K	91X	8			
4	PUMP REQUEST RTN	GND BUS	0XX	9			
5							

SPECIAL INSTRUCTIONS:

25 PIN D-CONNECTOR WIRING LIST

SYSTEM: VLBA 2.3 GHZ FRONT END
ASS'Y: CARD CAGE
TYPE: BULKHEAD
SEX: MALE PINS
FUNC'T: DC POWER AND CONTROL

DWG. NO.: A53203W001
DATE: September 3, 1986
BY: R. D. NORROD
SHEET: 12
DESIGNATION: J5

PIN	FUNCTION	TO	COLOR	PIN		FUNCTION	TO	COLOR
1	GROUND	S1-1	0XX	14	ID	F0	GND BUS	0XX
2	+15 VOLT SUPPLY	S1-2	2XX	15		F1	N.C.	
3	-15 VOLT SUPPLY	S1-3	4XX	16		F2	GND BUS	0XX
4				17		F3	GND BUS	0XX
5	NOT-PA (PARITY)	N.C.		18	ID	SN0	*1	
6	X (EVAC CONTROL)	S3-17	7XX	19		SN1	*1	
7	C (COOL CONTROL)	S3-19	9XX	20		SN2	*1	
8	H (NO HEAT CTRL)	S3-21	3XX	21		SN3	*1	
9				22		SN4	*1	
10				23		SN5	*1	
11	CAL CONTROL	J17-5	8XX	24	ID	MOD0	*2	
12	HIGH CAL CONTROL	J17-6	8XX	25		MOD1	*2	
13								

SPECIAL INSTRUCTIONS:
*1 - SERIALIZE CARD CAGE ASSEMBLY BY GROUNDING APPROPRIATE BITS, SN0-SN5.
*2 - INDICATE CURRENT MODIFICATION BY GROUNDING APPROPRIATE BITS, MOD0-MOD1.

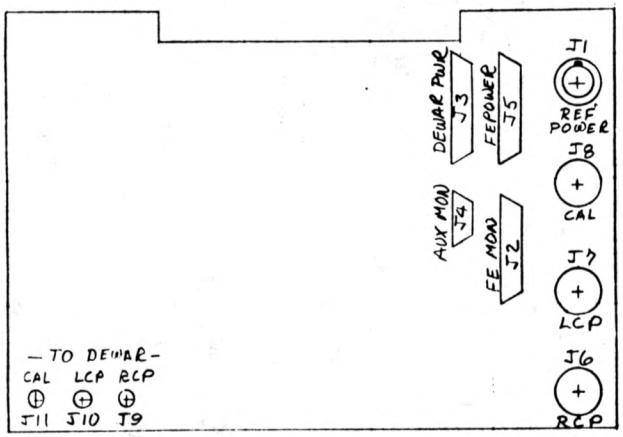
9 PIN D-CONNECTOR WIRING LIST

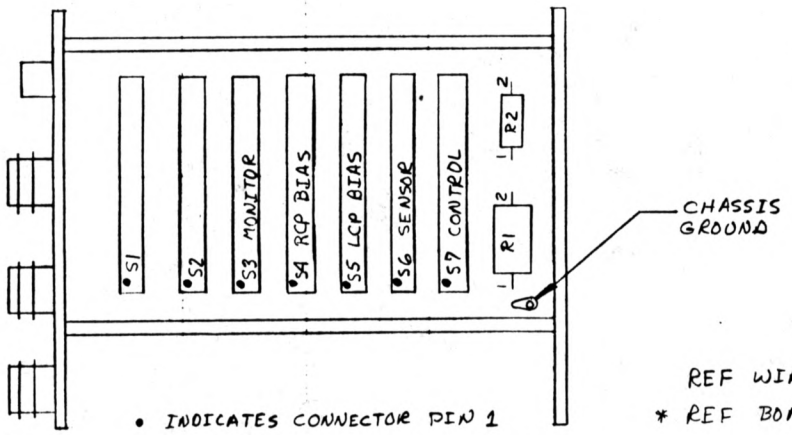
SYSTEM: VLBA 2.3 GHZ FRONT END
ASS'Y: CARD CAGE
TYPE: BULKHEAD
SEX: FEMALE (SOCKET)
FUNC'T: RF PLATE CONTROL

DWG. NO.: A53203W001
DATE: October 25, 1985
BY: R. D. NORROD
SHEET: 13
DESIGNATION: J17

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
1	GROUND	GND BUS	0XX	6	HIGH CAL CONTROL	J5-12	8XX
2	+15 VOLTS	+15 BUS	2XX	7	CAL RTN	GND BUS	0XX
3	-15 VOLTS	-15 BUS	4XX	8	300K TEMP MON	S3-L	92X
4	GROUND	GND BUS	0XX	9			
5	LOW CAL CONTROL	J5-11	8XX				

SPECIAL INSTRUCTIONS:



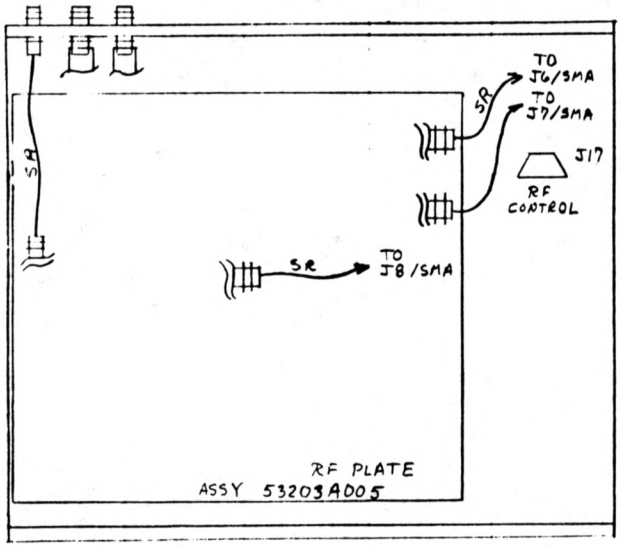


• INDICATES CONNECTOR PIN 1

SR INDICATES .141 SEMI-RIGID COAX WITH APPROPRIATE CONNECTORS

REF WIRING LIST A53203W001

* REF BOM A53203B004



DESG	FUNCTION	TYPE	BOM * ITEM
J1	REFRIGERATOR POWER INPUT	DM9606-3P	14
J2	FRONT END MONITOR	DBM-25S	6
J3	DEWAR POWER/MONITOR	DBM-25S	6
J4	AUXILIARY MONITOR	DE-9S	21
J5	FRONT END POWER	DBM-25P	5
J6	RCP RF OUT	N/SMA ADP	12
J7	LCP RF OUT	N/SMA ADP	12
J8	PHASE CAL IN	N/SMA ADP	12
J9	RCP RF IN	SMA/SMA	22
J10	LCP RF IN	SMA/SMA	22
J11	CAL OUT	SMA/SMA	22
P12	REFRIGERATOR POWER OUT	DM9702-3S	15
P13	ETI POWER	MOLEX	16
P14	VACUUM SOLENOID POWER	MOLEX	16
P15	PUMP VACUUM SENSOR	OCTAL	19
P16	DEWAR VACUUM SENSOR	OCTAL	19
J17	RF PLATE CONTROL	DE-9S	21

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES
ANGLES ±
3 PLACE DEC. (xxx) ±
2 PLACE DEC. (xx) ±
1 PLACE DEC. (x) ±

NATIONAL RADIO ASTRONOMY OBSERVATORY
GREEN BANK, W. VA. 24944

PROJ: VLBA 1.5 GHZ FE	TITLE: CARD CAGE WIRING DIAGRAM		
MATERIAL: —		DRAWN BY: RON	DATE: 10/29/82
FINISH: —		DESIGNED BY: RON	DATE:
		APPROVED BY:	DATE:
SHEET NUMBER: 1/1	DRAWING NUMBER: B53203 W 002	REV.	SCALE: —

H T HALL

Sheet 1 of 2

BILL OF MATERIAL: A53200B007-2	TITLE: Model 350 Ref. Power Supply	APPROVED BY/DATE:	PREPARED BY/DATE: RDN 08/12/86	REV: DATE:

Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
1.	1	150 VAC Power Supply Case		D53200M003	NRAO
2.	1	Cover - Power Supply		B53200M004	NRAO
3.	1	Heat Sink		B53200M035	NRAO
4.	AR	18 AWG Wire			Alpha
5.	AR	22 AWG Wire			Alpha
6.	AR	Wire Ties		CT-3B	Caltronics
7.	1	Fuse Molder		341001	Little Fuse
8.	1	Fuse 4A		MTH-4	Buss
9.	1	Bulkhead - AC Connector Male	AC In	MS3102145 -01P	Amphenol
10.	1	Bulkhead - AC Connector Female	AC Out	MS3102A14S -01S	Amphenol
11.	1	Mating Connector		MS3106A14S -01P	Amphenol
12.	1	Mating Connector		MS3106A14S -01S	Amphenol
13.	2	Back Shell		97-3057-6	Amphenol
14.	1	Bulkhead-4 Pin Female	Mon Out	126-233	Amphenol
15.	1	Mating Connector- 4 Pin Male		126-214- 1000	Amphenol
16.	1	Back Shell Assembly		126-215	Amphenol
17.	14	Crimp-On Spade Terminal		T-2084	Waldon
18.	4	Slide-On Crimp Terminals		ST-2188	Waldon
19.	2	#8 Solder Lugs			Waldon
20.	AR	Heat Sink Compound		340	Dow Corning

Sheet 2 of 2

BILL OF MATERIAL:	TITLE:	APPROVED BY/DATE:	PREPARED BY/DATE:	REV: DATE:
A53200B007-2	**Model 350 Ref. Power Supply**		RDN 08/12/86	

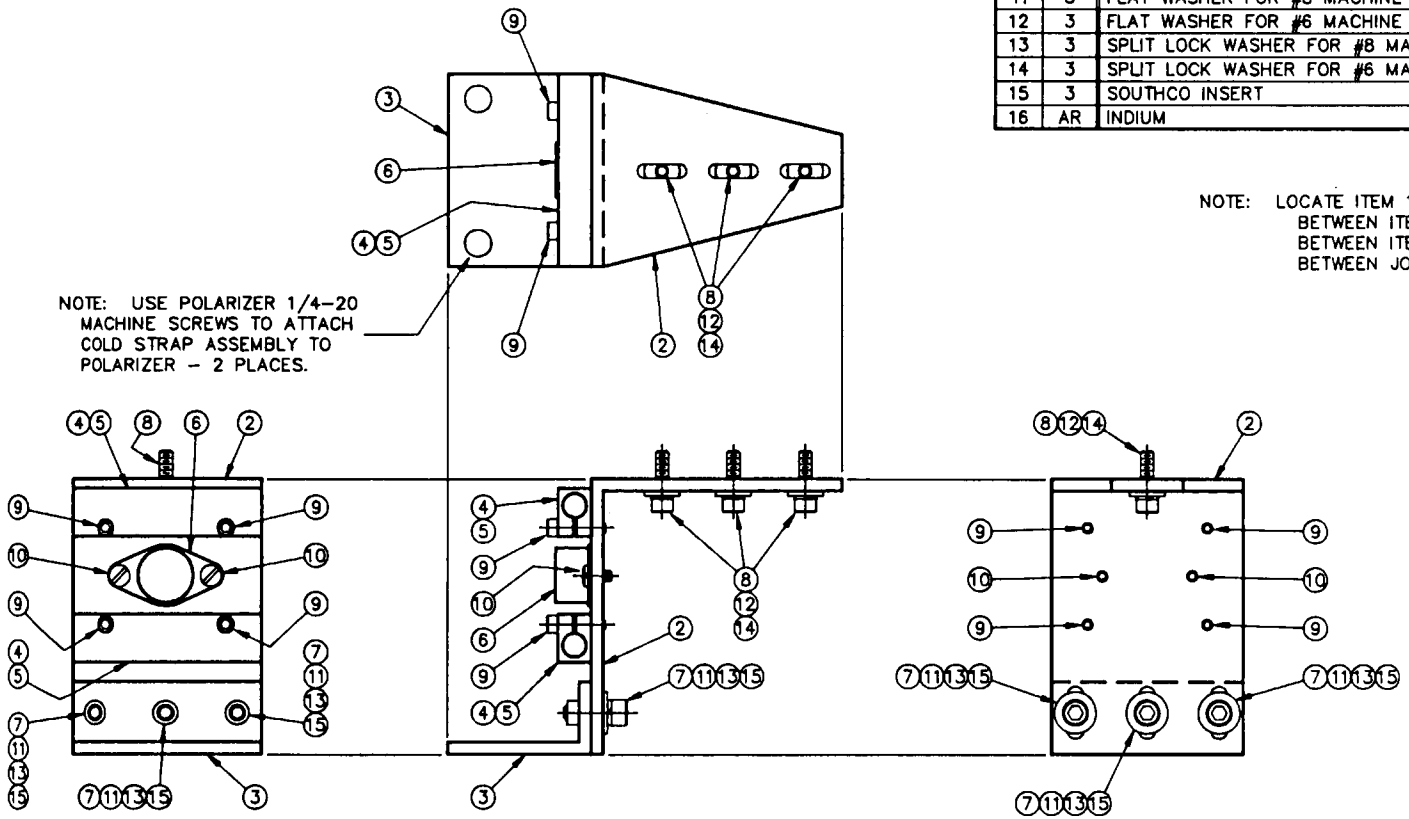
Item	Qty. Req.	Description	Designation	P/N	Suggested Manufacturer
21.	2	Resistor 80Ω 50W		RH-50	Dale
22.	1	Transformer		300-00	Todd/Systems
23.	1	Current Transducer		CTI-1	Ohio-Electronics
24.	1	Capacitor 7μF 330 VAC		RPN3307Z	Mallory
25.	1	Trimmer Capacitor		Selected in Test	Sprague
26.	1	Resistor 10K 1%		RN55C-1002	Dale
27.					
28.	1	10-32x1/2 Binder Head Screws			All-Metal
29.	12	4-40x3/8 Binder Head Screws			All-Metal
30.	8	4-40 Nuts			All-Metal
31.	12	#4 Flat Washers			All-Metal
32.	12	#4 Lock Washers			All-Metal
33.	4	4-40x1/2 Binder Head Screws			All-Metal
34.	11	8-32 Nuts			All-Metal
35.	11	#8 Lock Washers			All-Metal
36.	11	#8 Flat Washers			All-Metal
37.	1	#10 Lock Washers			All-Metal
38.	1	#10 Flat Washers			All-Metal
39.	1	Power Supply Label Artwork		A53200I012	NRAO
40.	REF	Schematic, 350 Power Supply		B53203W004	NRAO

MATERIAL LIST

ITEM	QUAN	DESCRIPTION	REMARKS
1	0	BOM POLARIZER COLD STRAP ASSEMBLY	A53204B011
2	1	COLD STRAP	C53204M043-01
3	1	COLD STRAP	C53204M043-02
4	2	HEATER CLAMP	A53206M056
5	2	HEATER UNIT – HOTWATT #SC252.25	—
6	1	SAFETY THERMOSTAT – ELMWOOD SENSORS #2450-B201A-T107	—
7	3	SOCKET HEAD CAP SCREW – 8-32UNC-2A X 1/2	—
8	3	SOCKET HEAD CAP SCREW – 6-32UNC-2A X 1/2	—
9	4	SOCKET HEAD CAP SCREW – 4-40UNC-2A X 1/2	—
10	2	PAN HEAD MACHINE SCREW – 4-40UNC-2A X 1/4	—
11	3	FLAT WASHER FOR #8 MACHINE SCREW	—
12	3	FLAT WASHER FOR #6 MACHINE SCREW	—
13	3	SPLIT LOCK WASHER FOR #8 MACHINE SCREW	—
14	3	SPLIT LOCK WASHER FOR #6 MACHINE SCREW	—
15	3	SOUTHCO INSERT	C53204M043-03
16	AR	INDIUM	—

NOTE: USE POLARIZER 1/4-20 MACHINE SCREWS TO ATTACH COLD STRAP ASSEMBLY TO POLARIZER – 2 PLACES.

NOTE: LOCATE ITEM 16 INDIUM AS FOLLOWS:
BETWEEN ITEMS 4 & 2 – 2 PLACES
BETWEEN ITEM 6 & 2 – 1 PLACE
BETWEEN JOINT OF ITEMS 2 & 3



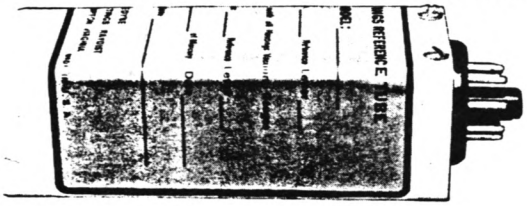
NATIONAL RADIO ASTRONOMY OBSERVATORY CHARLOTTESVILLE, VA. 22903			
TITLE: POLARIZER COLD STRAP ASSEMBLY			
PROJECT: VLBA 2.3 GHz FRONT END			
DESIGN		COMPUTER DRAWING	VLBA\53204\A011
DRAWN	D.G.S. 8-1-89	MATERIAL	
SHEET	1 OF 1	FINISH	
SCALE: FULL		DWG. NO. C53204A011	REVISION

APPENDIX III

Manufacturers' Data Sheets

reference tube

A QUICK CALIBRATION DEVICE FOR HASTINGS VACUUM GAUGES



The Hastings Reference Tube is an evacuated, sealed vacuum gauge tube accurately calibrated and marked at its exact pressure. It is electrically equivalent to our metal and Pyrex gauge tubes. It permits quick and easy recalibration of Hastings Vacuum Gauges by merely plugging the instrument into the reference and adjusting the calibration potentiometer until the instrument reads the exact pressure noted on the reference tube.

Equivalent Gauge Tube and Range			Reference Tube Model No.
Metal	Pyrex	Range	
DV-4D	DV-16D	0-20 mm Hg	DB-16D
*DV-5M	*DV-18	0-100 Microns Hg	*DB-18
DV-6M	DV-20	0-1000 Microns Hg	DB-20
DV-8M	DV-31	.01-10 Microns Hg	DB-31
DV-23	—	0-5000 Microns Hg	DB-33
DV-24	—	0-50 Torr	DB-44
DV-100	—	0-100 Torr	Not Available
DV-77	—	10^{-6} to 10^{-2} Torr	Not available
DV-100	—	0-100 Torr	Not available
DV-800	—	0-800 Torr	Not available

*State reference letter of your Gauge Tube type for matching purposes.

ADVANTAGES OF HASTINGS VACUUM INSTRUMENTS

- **Fully compensated for both temperature and rate-of-change of temperature**
- **Designed for panel mounting or in instrument cabinets.**

Hastings instruments have many exclusive advantages. Self contained, solid-state circuitry throughout assures long life and low maintenance costs. All instruments use frictionless, taut-band pivotless meters. Instruments are electrical to provide rapid response and permit remote installations.

Hastings gauge tubes can withstand great g-shock and vibration, using short firmly connected thermocouples with no suspended weld to an external heater. They are corrosion resistant and non-contaminating using noble metal thermopiles which assures stable calibration held indefinitely. Gauge tubes are easily cleaned with any suitable solvent. Each gauge tube is specifically designed and checked out for the range it covers, assuring maximum sensitivity.

gauge tubes

THE ONLY GAUGE TUBES COMPENSATED FOR BOTH AMBIENT TEMPERATURE AND RATE OF TEMPERATURE CHANGE

- **METAL** Constructed of nickel plated steel with plastic bases color coded to prevent mix-up.
- **PYREX GLASS** Available for high temperature and bakeable systems.
- **"R" SERIES** Ruggedized with a gold-plated hermetic seal base with monel housing for weather resistance.
- **STAINLESS STEEL** For weather-proof, corrosive and bakable applications. Withstands high over-pressurization. May be brazed or welded to system. Plain or threaded connection.

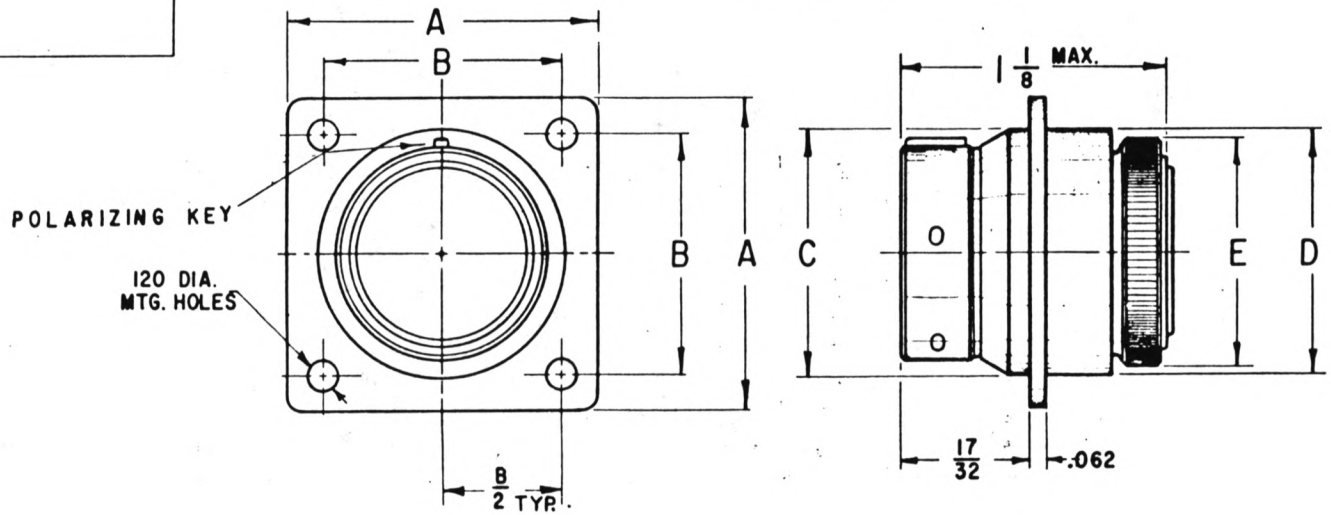
FOR PROPER ACCURACY AND PERFORMANCE, HASTINGS VACUUM GAUGES SHOULD ALWAYS BE USED WITH THE PROPER RANGE OF HASTINGS VACUUM GAUGE TUBES!

INSTRUMENT SERIES	RANGE	METAL TYPE	BASE COLOR	PYREX TYPE	"R" SERIES TYPE	STAINLESS STEEL TYPE
NV-8	10^{-5} torr 10^{-2} torr	DV-8	Green	DV-31	—	—
VT-5, CVT-15/25	0-100 μ Hg	DV-5M	Red	DV-18	—	—
VT-6, CVT-16/26, DAV-6, TV-4A, MRV-6, TV-47	0-1000 μ Hg	DV-6M	Yellow	DV-20	DV-6R	DV-36
VH-3, CVH-3/23	0-5 torr	DV-23	Orange	—	—	—
VT-4, CVT-14/24, DAV-4, TP-7A, MRV-4, TV-47	0-20 mm Hg	DV-4D	Purple	DV-16D	DV-4R	DV-34
VH-4, CVH-4/24	0-50 torr	DV-24	White	—	—	—
NV-100	0-100 torr	DV-100	Brown	—	—	—

MODEL DV-800 GAUGE TUBE is used with Wide Range Vacuum Gauges, Models NV-800 and DNNV-800. This linear voltage displacement transformer type is for the range of 0-800 torr.

MODEL DV-77 GAUGE TUBE is used with the Cold Cathode Ion Gauge, Model NV-77. Range is 10^{-6} to 10^{-2} torr. Replacement cathode-anode assemblies are available.

DM 9606-✱ P S	REVISIONS			
	SYM	DESCRIPTION	DATE	APPROVAL



PART NO.	A	B	C	D	E	WEIGHT IN LBS
DM 9606-3 P S	7/8	.625	9/16	39/64	1/2	P .0208 S .0230
DM 9606-7 P S	1	.719	43/64	11/16	41/64	P .0298 S .0338
DM 9606-12 P S	1 3/32	.813	13/16	13/16	49/64	P .0418 S .0493
DM 9606-19 P S	1 3/16	.906	15/16	15/16	57/64	P .0549 S .0673
DM 9606-27 P S	1 9/32	.968	1 1/8	1 1/16	1 1/32	P .0750 S .0927
DM 9606-37 P S	1 7/16	1.187	1 1/4	1 1/4	1 13/64	P .0976 S .1162
DM 9606-61 P S	1 25/32	1.437	1 9/16	1 9/16	1 33/64	P .1540 S .1894

NOTE:

1. SEE "GENERAL DESCRIPTION" FOR ELECTRICAL AND MATERIAL SPECIFICATIONS.
2. FOR AVAILABLE CONTACT ARRANGEMENTS AND ALTERNATE INSERT POSITIONS, SEE CATALOG PAGE # 14500. IN DM SECTION

NEXT ASSY	USED ON	ITEM	QTY	PART NUMBER	DESCRIPTION
APPLICATION		LIST OF MATERIAL			

TOLERANCES UNLESS OTHERWISE NOTED
FRACTIONS ±.015
DECIMALS ±.005
ANGLES ±0° 30'0"

MATERIAL

FINISH

	SIGNATURE & DATE
DR	C. HASTINGS
CHK	R D Yates 5-3-61
PE	J. M. Ferling 5-3-61
APP	CED

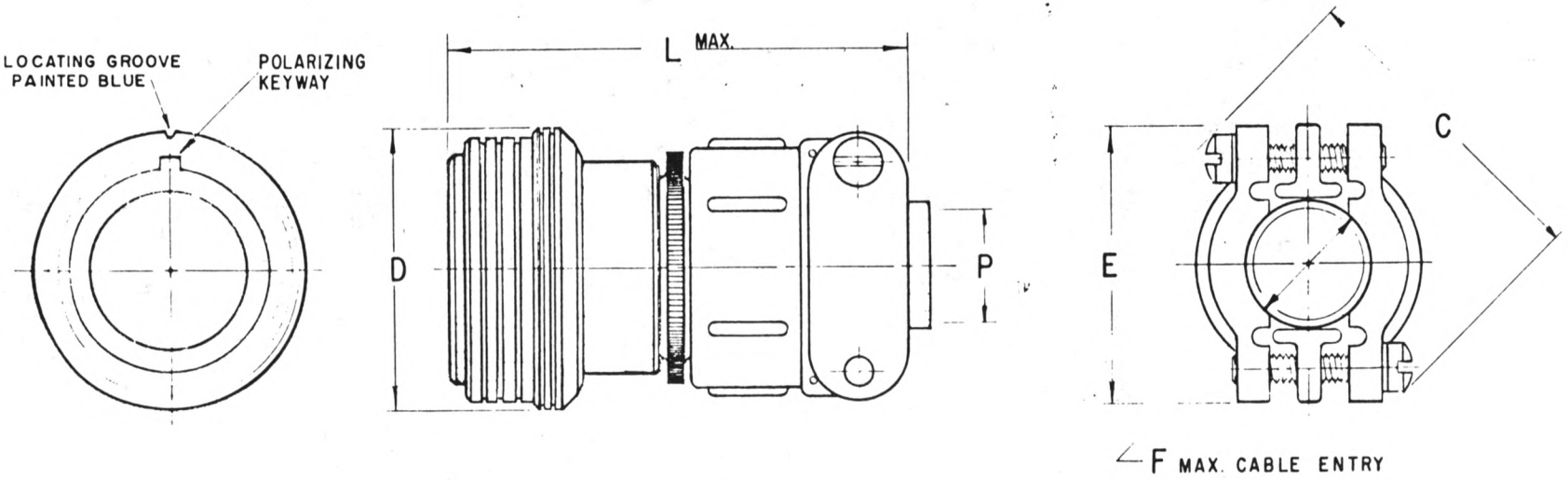
(ENVELOPE)

RECEPTACLE,
MINIATURE SQUARE
FLANGE MOUNTING TYPE
DM TYPE

SCALE | WT

The Deutsch Company
ELECTRONIC COMPONENTS DIVISION
Municipal Airport · Banning, California

B	DM 9606-✱ P S	
DWG SIZE	CODE 11139	SHEET



PART NO.	C	D	E	F	L	P	WT. IN LBS.
DM 9702- 3 P S	1 1/16	23/32	13/16	1/4	2 3/32	1/8	.0506
DM 9702- 7 P S	1 1/8	29/32	7/8	5/16	2 3/32	7/32	.0582
DM 9702-12 P S	1 11/32	1 1/16	1 1/16	7/16	2 5/32	5/16	.0758
DM 9702-19 P S	1 1/2	1 3/16	1 5/32	9/16	2 7/32	7/16	.0806
DM 9702-27 P S	1 19/32	1 23/64	1 1/4	5/8	2 7/32	9/16	.1036
DM 9702-37 P S	1 7/8	1 1/2	1 15/32	3/4	2 7/32	5/8	.1113
DM 9702-61 P S	2 1/8	1 53/64	1 11/16	15/16	2 3/8	3/4	.1302 .1416 .1456 .1605 .2093 .2303 .3354 .3422

NOTE:

1. SEE "GENERAL DESCRIPTION" FOR ELECTRICAL AND MATERIAL SPECIFICATIONS
2. FOR AVAILABLE CONTACT ARRANGEMENTS AND ALTERNATE INSERT POSITIONS, SEE CATALOG PAGE # 14500, IN DM SECTION

1. DE-BURR ALL SHARP EDGES

TOLERANCES
FRACTIONS ± .015 DECIMALS ± .005 ANGLES ± ½°
UNLESS OTHERWISE SPECIFIED

MATERIAL	SPEC.	
MATERIAL	SPEC.	
MATERIAL	SPEC.	
FORGING	SPEC.	WT.

THE DEUTSCH COMPANY

(ENVELOPE)
PLUG, WITH CABLE CLAMP
QUICK DISCONNECT - PUSH-PULL TYPE

NO	CHANGE	BY	DATE

DRAWN C. HASTINGS
CHECKED Brayshaw JWF
APPROVED CRD
DATE 4-22-60 CODE 11139

DM 9702-* P S

OMNI SPECTRA
MERRIMACK, NH
(603) 424-4111

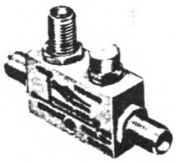
JUNE 85

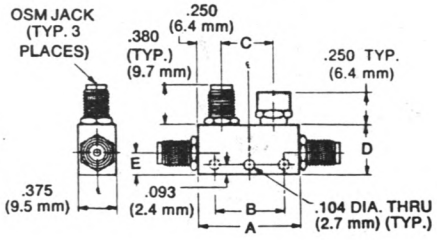
DIRECTIONAL COUPLERS

MINI COUPLERS • OCTAVE BANDWITH

- **Smallest and Lightest Couplers Available**
- **.5 Through 18 GHz Including Wideband Units**
- **High Directivity — Low VSWR**
- **Meets MIL-E-5400 and MIL-E-16400 Environments**

This complete line of mini-series coaxial stripline couplers features the smallest and lightest units available anywhere, typically measuring 1 inch by ½ inch by ⅜ inch thick and weighing only about ½ ounce. These units are the ultimate in performance and will consistently outperform their conservative specifications. All of the units use OSM female stainless steel precision connectors.





SPECIFICATIONS

PART NO.	CASE STYLE	FREQUENCY RANGE (GHz)	COUPLING (INCLUDES FREQUENCY SENSITIVITY) (dB)	FREQUENCY SENSITIVITY (dB)	INSERTION LOSS max (dB)	DIRECTIVITY min (dB)	VSWR (max.) PRI LINE	VSWR (max.) SEC LINE	POWER (INPUT) AVG IN (W)	POWER (INPUT) AVG REFL (W)	POWER (INPUT) PK (kW)
2020-6600-06	7	0.5-1.0	6 ±1.0	±0.60	0.15	25	1.10	1.10	50	4	4
2020-6601-10	7		10 ±1.0	±0.75	0.15	25	1.10	1.10	50	10	4
2020-6602-20	7		20 ±1.0	±0.75	0.15	25	1.10	1.10	50	50	4
2020-6603-30	7		30 ±1.0	±0.75	0.15	25	1.10	1.10	50	50	4
2020-6604-06	5	1.0-2.0	6 ±1.0	±0.60	0.20	25	1.15	1.15	50	4	4
2020-6605-10	5		10 ±1.0	±0.75	0.20	25	1.15	1.15	50	10	4
2020-6606-20	5		20± 1.0	±0.75	0.20	25	1.15	1.15	50	50	4
2020-6607-30	6		30 ±1.0	±0.75	0.20	25	1.15	1.15	50	50	4
2020-6608-06	3	2.0-4.0	6 ±1.0	±0.60	0.20	22	1.15	1.15	50	4	4
2020-6609-10	3		10 ±1.0	±0.75	0.20	22	1.15	1.15	50	10	4
2020-6610-20	3		20 ±1.0	±0.75	0.20	22	1.15	1.15	50	50	4
2020-6611-30	4		30 ±1.0	±0.75	0.20	22	1.15	1.15	50	50	4
2020-6612-06	2	2.6-5.2	6 ±1.0	±0.60	0.25	20	1.25	1.25	50	4	4
2020-6613-10	2		10 ±1.0	±0.75	0.25	20	1.25	1.25	50	10	4
2020-6614-20	2		20 ±1.0	±0.75	0.25	20	1.25	1.25	50	50	4
2020-6615-30	1		30 ±1.0	±0.75	0.25	20	1.25	1.25	50	50	4
2020-6616-06	2	4.0-8.0	6 ±.75	±0.50	0.25	18	1.25	1.25	50	4	4
2020-6617-10	2		10 ±.75	±0.50	0.25	20	1.25	1.25	50	10	4
2020-6618-20	2		20 ±.75	±0.50	0.25	20	1.25	1.25	50	50	4
2020-6619-30	1		30 ±.75	±0.50	0.25	20	1.25	1.25	50	50	4
2020-6620-06	2	7.0-12.4	6 ±1.0	±0.40	0.40	15	1.35	1.35	50	4	4
2020-6621-10			10 ±1.0	±0.50	0.40	17	1.35	1.35	50	10	4
2020-6622-20	1		20 ±1.0	±0.50	0.30	17	1.35	1.35	50	50	4
2020-6623-30	1		30 ±1.0	±0.50	0.30	17	1.35	1.35	50	50	4
2020-6624-06	2	7.0-18.0	6 ±1.0	±0.50	0.50	15	1.35	1.35	50	4	3
2020-6625-10			10 ±1.0	±0.75	0.50	12	1.45	1.45	50	10	3
2020-6626-20	1		20 ±1.0	±0.75	0.50	15**	1.45	1.45	50	50	3
2020-6627-30	8		30 ±1.0	±0.75	0.50	15**	1.45	1.45	50	50	3
2020-6628-06	2	12.4-18.0	6 ±1.0	±0.40	0.50	15	1.35	1.35	50	4	2
2020-6629-10			10 ±1.0	±0.50	0.50	12	1.45	1.45	50	10	2
2020-6630-20	1		20 ±1.0	±0.50	0.50	12	1.45	1.45	50	50	2
2020-6631-30	8		30 ±1.0	±0.50	0.50	12	1.45	1.45	50	50	2

MECHANICAL SPECIFICATIONS

CASE STYLE	A	B	C	D	E	WEIGHT (oz.)	WEIGHT (g)
1	1.000 (25.4 mm)	N/A	.500 (12.7 mm)	.546 (13.9 mm)	.219 (5.6 mm)	0.62	17.6
2				.500 (12.7 mm)		0.60	17.0
3	1.156 (29.4 mm)	.343 (8.7 mm)	.656 (16.7 mm)	.500 (12.7 mm)		0.64	18.2
4				.546 (13.9 mm)		0.67	19.0
5	1.781 (45.2 mm)	.937 (23.8 mm)	1.281 (32.5 mm)	.500 (12.7 mm)		0.82	23.2
6				.546 (13.9 mm)		0.87	23.3
*7	3.000 (76.2 mm)	1.000 (25.4 mm)	2.500 (63.5 mm)	.750 (19.1 mm)	.310 (7.9 mm)	1.50	43.0
8	1.000 (25.4 mm)	N/A	.500 (12.7 mm)	.625 (15.9 mm)	.219 (5.6 mm)	0.67	19.0

*NOTE Case style seven has four mounting holes located symmetrically to the two shown dotted in figure.

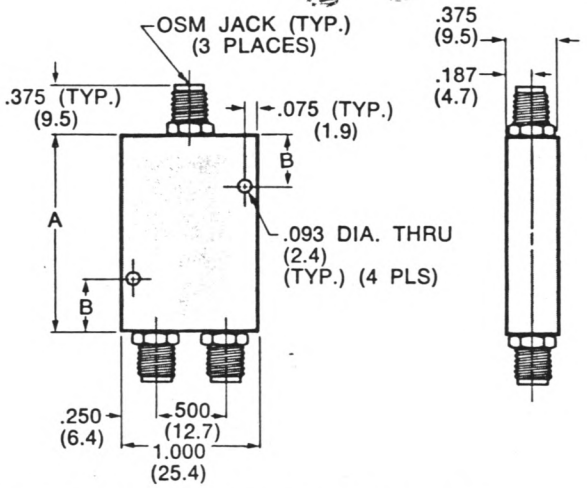
**12dB from 12.4 to 18.0 GHz.

POWER DIVIDERS

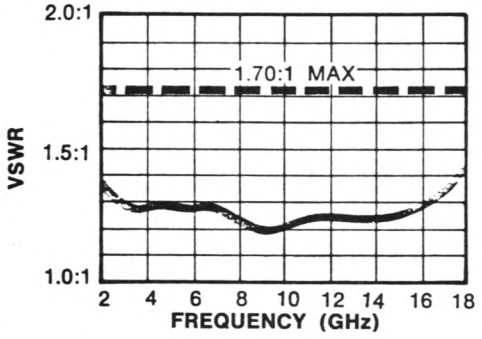
TWO-WAY • WILKINSON • ISOLATED

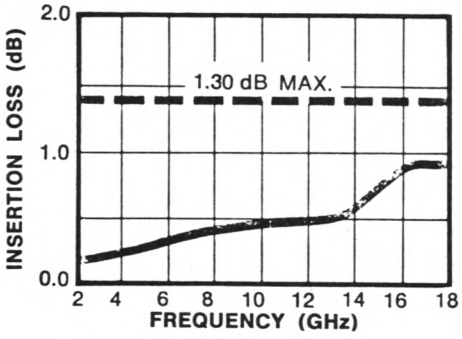
- **Excellent Amplitude And Phase Balance**
- **High Isolation Between Output Ports**
- **Low VSWR, Small Size And Light Weight**
- **Octave and Multi-Octave Frequency Coverage.**
- **Power: 10 Watts Input Maximum with Matched Terminations**
- **Meets MIL-E-5400 and MIL-E-16400 Environments**

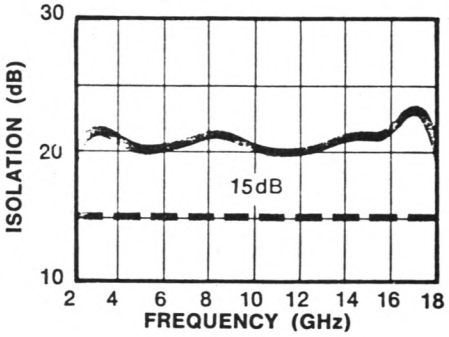
This series of two-way, in-phase stripline power dividers demonstrates excellent performance as well as small size and light weight. These octave and multi-octave power dividers have high isolation, low VSWR and excellent amplitude and phase balance. Their rugged construction meets MIL-E-5400 environmental conditions, making them ideal for high performance microwave systems.



TYPICAL PERFORMANCE PART NO. 2089-6208-00







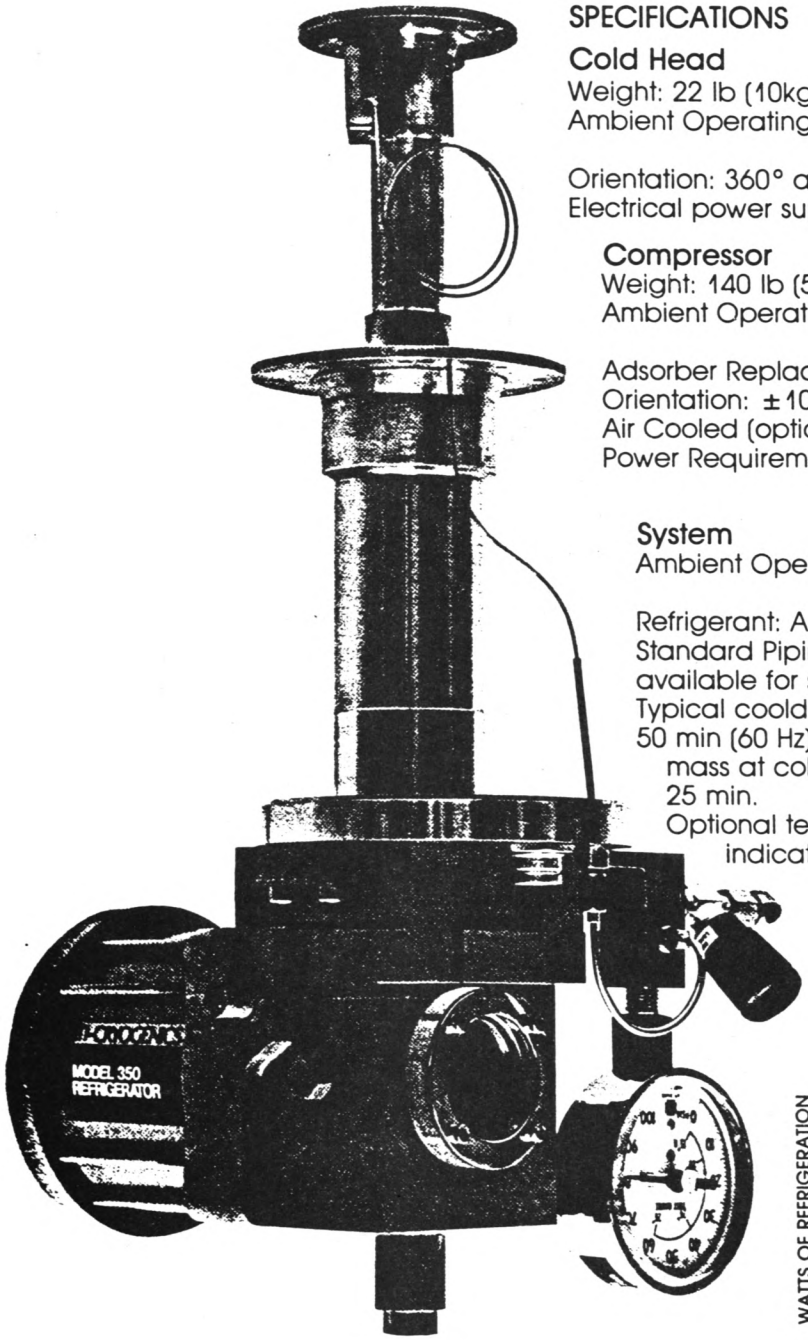
SPECIFICATIONS

PART NO.	FREQUENCY RANGE (GHz)	VSWR (max.)	ISOLATION dB (min.)	INSERTION LOSS dB (max.)	OUTPUT UNBALANCE AMP (dB)	OUTPUT UNBALANCE PHASE (deg.)	MAXIMUM INPUT POWER* (watts)	SIZE, INCHES (mm) A	SIZE, INCHES (mm) B	WEIGHT oz.	WEIGHT g
2089-6201-00	1.0-2.0	1.25	20	0.4	0.2	4.0	2.0	2.0 (50.8)	0.5 (12.7)	1.5	43
2089-6202-00	2.0-4.0	1.35	20	0.4	0.2	4.0	2.0	2.0 (50.8)	0.5 (12.7)	1.5	43
2089-6203-00	4.0-8.0	1.40	20	0.6	0.2	6.0	2.0	1.38 (35)	0.4 (10.2)	1.2	35
2089-6204-00	8.0-12.4	1.60	18	0.65	0.25	6.0	2.0	1.38 (35)	0.4 (10.2)	1.2	35
2089-6205-00	12.4-18.0	1.70	15	0.8	0.25	6.0	3.0	1.38 (35)	0.4 (10.2)	1.2	35
2089-6207-00	2.0-8.0	1.50	18	0.8	0.25	8.0	4.0	2.25 (57.2)	0.5 (12.7)	1.3	37
2089-6208-00	2.0-18.0	1.70	15	1.30	0.25	8.0	10.0	2.25 (57.2)	0.5 (12.7)	1.3	37
2089-6209-00	4.0-18.0	1.70	15	1.20	0.25	8.0	4.0	1.63 (41.4)	0.5 (12.7)	1.3	37
2089-6210-00	7.0-18.0	1.70	15	0.8	0.25	8.0	3.0	1.38 (35)	0.4 (10.2)	1.2	35

*Maximum input power with output loads of VSWR ≤ 2.0:1.
Derate to 10% of listed value when arbitrarily terminated.

OCT 84

CRYODYNE® MODEL 350 SC CRYOGENIC REFRIGERATION SYSTEM



SPECIFICATIONS

Cold Head

Weight: 22 lb (10kg)
Ambient Operating Range: −25°F to 125°F
(−32°C to 52°C)
Orientation: 360° any plane
Electrical power supplied through compressor

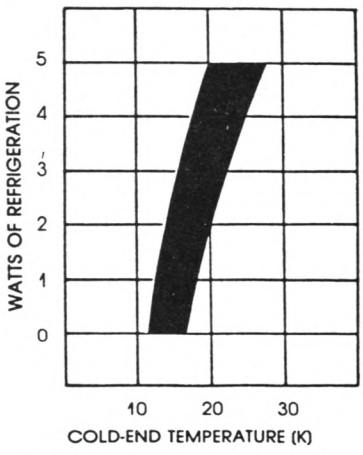
Compressor

Weight: 140 lb (59kg) approx.
Ambient Operating Range: 60°F to 100°F
(16°C to 38°C)
Adsorber Replacement: 10,000 hours
Orientation: ±10° from horizontal
Air Cooled (optional water cooled available)
Power Requirements: 1.5kW 208/230 vac, 1Ø,
50/60 Hz

System

Ambient Operating Range: 60°F to 100°F
(16°C to 38°C)
Refrigerant: Ambient temperature helium gas
Standard Piping: 10 feet. Optional piping available for separation distances up to 500 feet.
Typical cooldown time to 20K with no load:
50 min (60 Hz), 65 min (50 Hz). Each lb (.45kg) mass at cold end increases cooldown time 25 min.
Optional temperature sensors and indicators are available.

Cooling Capacity*



*Cold head performance will be within limits given here

CTI-CRYOGENICS
The pure performance company

CTI-CRYOGENICS

CRYODYNE(R) MODEL 350CP CRYOGENIC SYSTEM

DOMESTIC LIST

CATALOGUE NO.	SYSTEM	PRICE - F.O.B. WALTHAM, MASS.
50/60Hz		
3695600 G1	CRYODYNE Model 350CP Cryogenic system consisting of refrigerator unit (concentric configuration), SC air-cooled compressor unit (208V), standard 10' flexlines, installation tools, and manual.	$8,650.00
3695600 G2	CRYODYNE Model 350CP Cryogenic system consisting of refrigerator unit (concentric configuration), SC water-cooled compressor unit (280V), standard 10' flexlines, installation tools, and manual.	8,650.00

MAJOR COMPONENTS

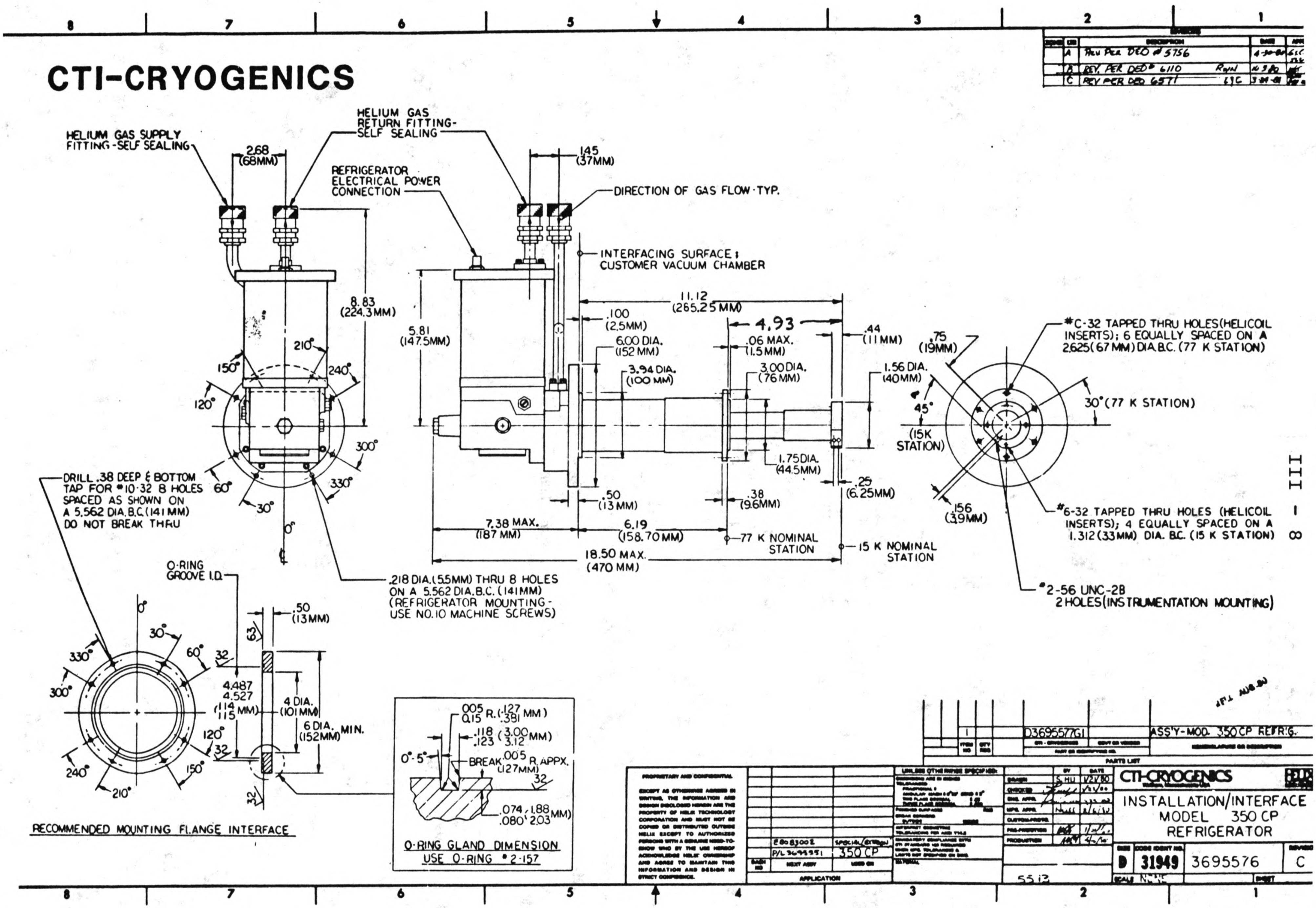
D3695576	Model 350CP Refrigerator unit	6,090.00
8032551 G2	SC Compressor unit (208V, 50Hz or 60HZ) Air-cooled	3,500.00
8032550 G2	SC Compressor unit (208V, 50Hz or 60Hz) Water-cooled	3,500.00

Shipping Weight: Approx. 240 lbs.

Effective January 1, 1984

Printed in U. S. A.

PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE


CTI-CRYOGENICS
A REV PER DEO # 5756
B REV. PER DEO # 6110
C REV PER DEO 6571
HELIUM GAS SUPPLY FITTING-SELF SEALING
HELIUM GAS RETURN FITTING-SELF SEALING
2.68 (68MM)
REFRIGERATOR ELECTRICAL POWER CONNECTION
1.45 (37MM)
DIRECTION OF GAS FLOW-TYP.
INTERFACING SURFACE; CUSTOMER VACUUM CHAMBER
8.83 (224.3MM)
5.81 (147.5MM)
11.12 (265.25 MM)
.100 (2.5MM)
4.93
.44 (11MM)
6.00 DIA. (152 MM)
.06 MAX. (1.5MM)
3.94 DIA. (100 MM)
3.00 DIA. (76 MM)
1.56 DIA. (40MM)
.75 (19MM)
*C-32 TAPPED THRU HOLES (HELICOIL INSERTS); 6 EQUALLY SPACED ON A 2.625 (67 MM) DIA.B.C. (77 K STATION)
30° (77 K STATION)
45°
(15K STATION)
1.75 DIA. (44.5MM)
.25 (6.25MM)
.50 (13 MM)
.38 (9.6MM)
.156 (3.9MM)
#6-32 TAPPED THRU HOLES (HELICOIL INSERTS); 4 EQUALLY SPACED ON A 1.312 (33MM) DIA. B.C. (15 K STATION)
7.38 MAX. (187 MM)
6.19 (158.70 MM)
77 K NOMINAL STATION
15 K NOMINAL STATION
18.50 MAX. (470 MM)
#2-56 UNC-2B 2 HOLES (INSTRUMENTATION MOUNTING)
DRILL .38 DEEP & BOTTOM TAP FOR #10-32 8 HOLES SPACED AS SHOWN ON A 5.562 DIA. B.C. (141 MM) DO NOT BREAK THRU
.218 DIA. (5.5MM) THRU 8 HOLES ON A 5.562 DIA. B.C. (141MM) (REFRIGERATOR MOUNTING-USE NO.10 MACHINE SCREWS)
O-RING GROOVE I.D.
.50 (13MM)
4.487 4.527 (114 115 MM)
4 DIA. (101MM)
6 DIA. MIN. (152MM)
RECOMMENDED MOUNTING FLANGE INTERFACE
.005 .015 R. (.127 .381 MM)
.118 .123 (3.00 3.12 MM)
BREAK .005 R. APPX. (.127MM)
.074 .080 (1.88 2.03 MM)
O-RING GLAND DIMENSION
USE O-RING #2-157
D3695577G1
ASS'Y-MOD. 350CP REFRIG.
PARTS LIST
PROPRIETARY AND CONFIDENTIAL
CTI-CRYOGENICS
INSTALLATION/INTERFACE MODEL 350 CP REFRIGERATOR
D 31949 3695576 C
350 CP
APPLICATION
III - 8

JUNE 85

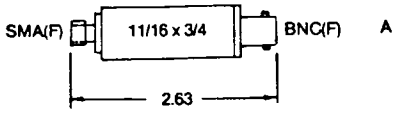
Precision Calibrated Coaxial Noise Sources - 10KHz to 18 GHz

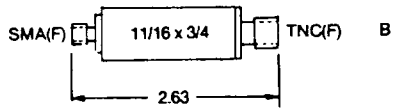
NC 3000 Series

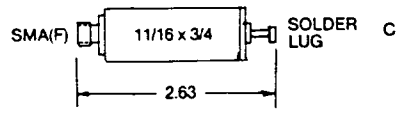
NOISE COM, INC.
HACKENSACK, NJ
(201) 488-4144
CAT NC 985

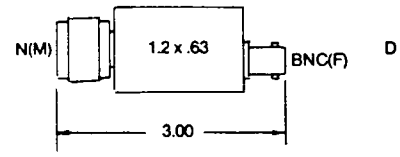
FEATURES:

- **Input power +28 volts, 25 ma. max.**
- **Noise output variation with temperature less than 0.01 DB/°C**
- **Noise output variation with voltage less than 0.1 DB/%V**
- **Operating temperature range -55°C to +85°C**
- **Calibration charts are supplied with each noise source**
- **Calibration points are listed on each noise source**
- **Noise output rise time and fall time <1 usec**
- **Noise diode is hermetically sealed**









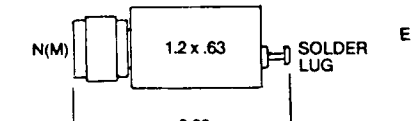
NOISE FIGURE METER COMPATIBLE TYPES:

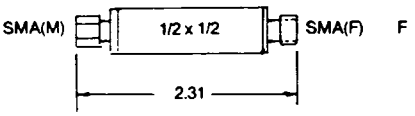
MODEL	FREQUENCY RANGE (GHz)	NOISE OUTPUT ENR (DB)	VSWR MAX	PACKAGE CODE*	CALIBRATION FREQUENCIES
NC 3101	.01 – 8	15.5 ± .5	1.2 on/off		.01, .1, 1.0 & 1GHz steps
NC 3102	.01 – 12.4	15.5 ± .5	1.2 on/off	A	
NC 3103	1 – 12.4	15.5 ± .5	1.2 on/off	to	1GHz steps
NC 3104	1 – 18	15.5 ± .5	1.35 on/off	H	
NC 3105	12 – 18	15.5 ± .5	1.35 on/off		

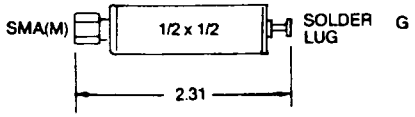
HIGH NOISE OUTPUT TYPES:

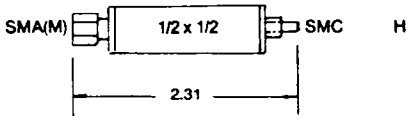
MODEL	FREQUENCY RANGE (GHz)	NOISE OUTPUT		PACKAGE CODE*	CALIBRATION FREQUENCY
		ENR (DB)	FLATNESS		
NC 3201	10 KHz – 1.1GHz	30 – 35	±1DB		0.1, .1, .5, 1.0
NC 3202	.001 – .6	30 – 35	±1DB		.01, .1, .6
NC 3203	1 – 2	30 – 35	±1DB	A	1, 1.5, 2.0
NC 3204	2 – 4	30 – 35	±1DB	to	1GHz STEPS
NC 3205	4 – 8	30 – 35	±1DB	H	
NC 3206	8 – 12	28 – 33	±1DB		
NC 3207	12 – 18	26 – 32	±1DB		

*Specify package code









RF CONNECTOR | BIAS CONNECTOR | PACKAGE CODE

OPTIONS

1. Housing A-E can be supplied with threaded mounting holes.
2. SMA connectors standard as shown. Alternate sex may be specified.
3. Input voltages as low as 15 volts are available in some models - consult factory.

GaAs FET Low Noise Wideband Amplifiers to 20 GHz

MITEQ

Model Number	Freq. (GHz)	Gain (Min.) (dB)	Gain Var. (Max.) (±dB)	Noise Figure (Max.) (dB)	VSWR (Max.) Input	VSWR (Max.) Output	Dynamic Range 1 dB Gain Comp. Output (Min., dBm)	Nom. DC Power (+15V, mA)	Outline
Standard Housings									
2-4 GHz									
AMF-1B-2040-25	2-4	10	.5	2.5	2:1	2:1	+5	25	8
AMF-2B-2040-25	2-4	22	.75	2.5	2:1	2:1	+10	75	9
AMF-3B-2040-25	2-4	34	1.0	2.5	2:1	2:1	+13	125	10
AMF-4B-2040-25	2-4	46	1.5	2.5	2:1	2:1	+13	175	11
AMF-5B-2040-25	2-4	58	1.5	2.5	2:1	2:1	+13	225	12
AMF-1B-2040-20	2-4	10	.5	2.0	2:1	2:1	+5	25	8
AMF-2B-2040-20	2-4	22	.75	2.0	2:1	2:1	+10	75	9
AMF-3B-2040-20	2-4	34	1.0	2.0	2:1	2:1	+13	125	10
AMF-4B-2040-20	2-4	46	1.0	2.0	2:1	2:1	+13	175	11
AMF-5B-2040-20	2-4	58	1.5	2.0	2:1	2:1	+13	225	12
AMF-1B-2040-18	2-4	10	1.0	1.8	2:1	2:1	+5	25	8
AMF-2B-2040-18	2-4	22	1.0	1.8	2:1	2:1	+10	75	9
AMF-3B-2040-18	2-4	34	1.0	1.8	2:1	2:1	+13	125	10
AMF-4B-2040-18	2-4	44	1.0	1.8	2:1	2:1	+15	200	11
AMF-5B-2040-18	2-4	60	1.5	1.8	2:1	2:1	+15	250	12
AMF-1B-2040-15	2-4	10	1.0	1.5	2:1	2:1	+5	25	8
AMF-2B-2040-15	2-4	22	1.0	1.5	2:1	2:1	+10	75	9
AMF-3B-2040-15	2-4	34	1.0	1.5	2:1	2:1	+13	125	10
AMF-4B-2040-15	2-4	44	1.0	1.5	2:1	2:1	+15	200	11
AMF-5B-2040-15	2-4	56	1.5	1.5	2:1	2:1	+15	250	12
2.6-5.2 GHz									
AMF-1B-2652-35	2.6-5.2	10	.5	3.5	2:1	2:1	+5	25	8
AMF-2B-2652-35	2.6-5.2	20	.75	3.5	2:1	2:1	+10	75	9
AMF-3B-2652-35	2.6-5.2	30	1.0	3.5	2:1	2:1	+10	125	10
AMF-4B-2652-35	2.6-5.2	40	1.5	3.5	2:1	2:1	+13	175	11
AMF-5B-2652-35	2.6-5.2	50	1.5	3.5	2:1	2:1	+13	225	12
AMF-1B-2652-30	2.6-5.2	10	.5	3.0	2:1	2:1	+5	25	8
AMF-2B-2652-30	2.6-5.2	20	.75	3.0	2:1	2:1	+10	75	9
AMF-3B-2652-30	2.6-5.2	30	1.0	3.0	2:1	2:1	+10	125	10
AMF-4B-2652-30	2.6-5.2	40	1.5	3.0	2:1	2:1	+13	175	11
AMF-5B-2652-30	2.6-5.2	50	1.5	3.0	2:1	2:1	+13	225	12

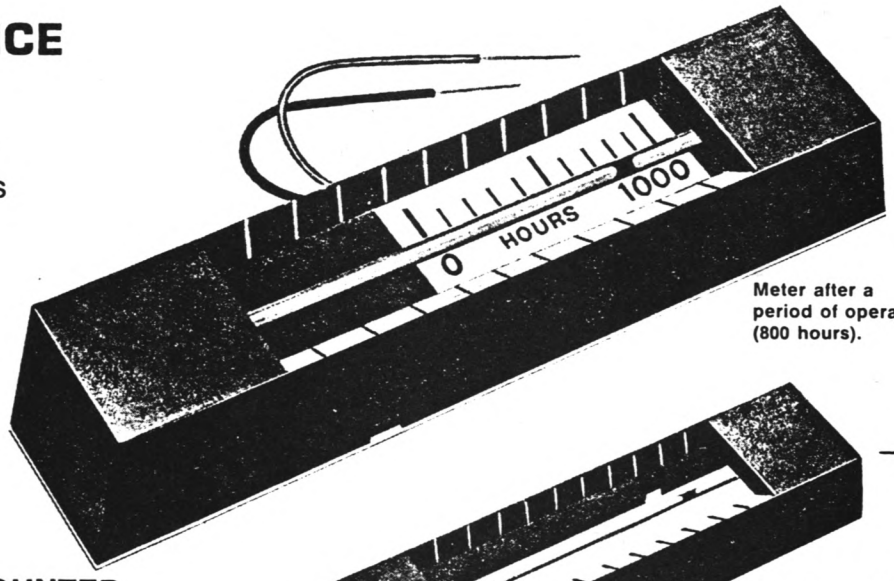
Curtis Instruments, Inc.
200 KISCO AVENUE
MOUNT KISCO, N. Y. 10549
TEL.: (914) 666-2971
TWX 710-571-2163

DATA SUMMARY

CP3-Series
Curtis Indachron
Elapsed Time Meter/Counter

FOR MAINTENANCE MONITORING

- Measures operating time
- Counts to Megahertz rates



Meter after a period of operation (800 hours).

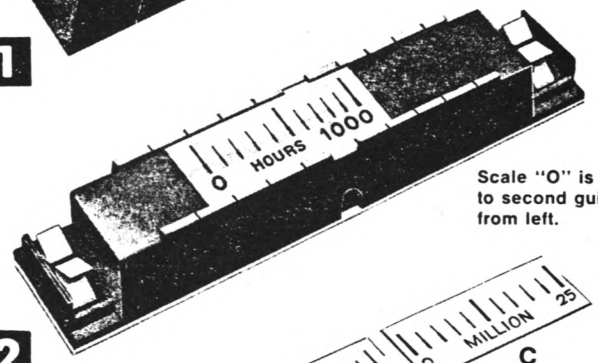
THE NEW CP3 SERIES CURTIS INDACHRON ELAPSED TIME METER/COUNTER

was developed as a low cost monitor for preventive maintenance scheduling, and other applications requiring a convenient, simple means of reset to zero in the field. It simplifies preventive maintenance scheduling and field service records reducing field service costs. Additionally, the actual hours of use or total cycles data has many areas of application.

Cost of the CP3 Series is under $4.00 in moderate production quantities. Typical applications are P/M scheduling for office machines, test instruments, appliances, computer elements, machine tools, etc.

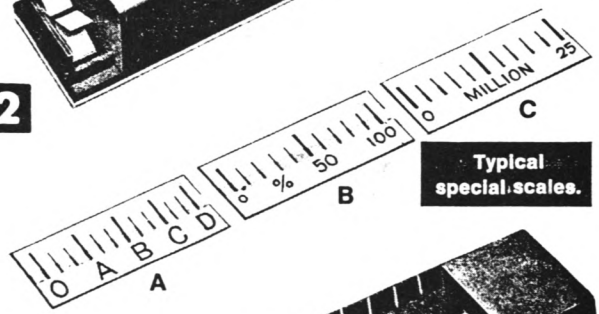
Cover removed. Dot is at second guideline from right.

1

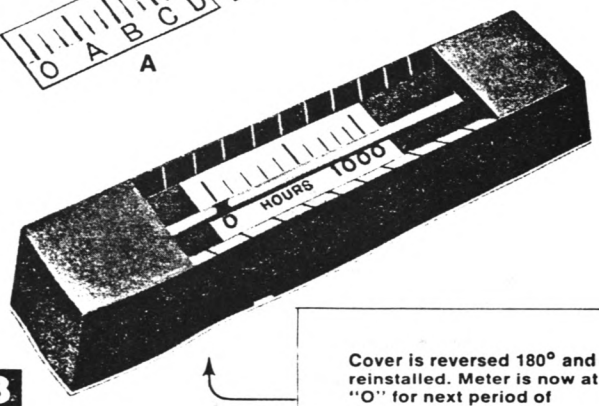


Scale "O" is set to second guideline from left.

2



Typical special scales.



3

Cover is reversed 180° and reinstalled. Meter is now at "O" for next period of operation.

FEATURES:

- Instant Field Reset to Zero
- Easy Readability
- Overrun Safety
- Infinite cycles
- Scales for any type of scheduling programs
- Models operate from any AC or DC Voltage
- Compact Size
- Counts Operation Cycles—from Pulsed Inputs

GENERAL DESCRIPTION

The heart of the Model 520 CP3 is the patented* Curtis mercury coulometer, in which the indicating dot travels longitudinally along a mercury filled capillary tube at a rate proportional to the flow of electric current through the instrument.

In the CP3 Series, the capillary tube is mounted on a window-cover assembly **1**. This plugs into

continued . . .

*U.S. Pat. 3,665,308, others pending

. . . continued

the bed which has a grooved channel in which the adjustable scale is mounted **2**. The scale can be set anywhere along the length of the meter and is ½ the length of the channel, providing for overrun safety should the meter run beyond the full scale time period.

To reset the instrument, the equipment maintenance man merely removes the cover from the bed and reverses it 180°. This places the dot downscale where it can start travel upscale again (the dot always moves from negative [−] to positive [+]). Inasmuch as the scale can be moved in its channel, it is positioned so that "zero" or any other marking can align with the new downscale position of the dot **3**.

To facilitate the rezeroing operation, the cover assembly has ten molded reference marks on the cover. These marks are matched by identical marks on the bed. To determine where to set the scale when rezeroing, note is made of the position of the indicating dot relative to the cover reference marks and the zero indice of the scale is simply moved to the corresponding mark on the bed.

Any type of scale markings can be used — in hours or in symbols that refer to various maintenance schedules or other procedures. Moreover, simple records can indicate how many times full or part scale has been "reversed" so that an infinite number of hours or readings can be made from a basically short-period scale. It never "runs out of time". A lens is molded into the window of the cover, doubling the readability of the indicating dot.

TECHNICAL DESCRIPTION

Operational Temperature: 0° to +50°C
Shock: 50 g 11 millisec
Vibration: 20 g 50-500 Hz
Attitude: Attitude insensitive

Storage Temperature: — 35° C to + 70° C

Materials: Body — ABS Flame Retardant High Modulus; Window — Acrylic ASTM D — 788, Grade 8

Terminations: 8″ wire leads, #26 ga. AWG, vinyl insulated

Standard Mounting: Adhesive backing with 3M #4032 polyurethene tape

Optional Mountings:
Code A: Threaded studs, no adhesive backing.
Code B: Frangible seal.
Code C: Non-threaded studs with adhesive backing.
Code D: Rear exit leads.
Code E: High current cover (11087-11437).
2 Milliampere Max. Current.
3.2 Milliampere-hours full scale.
Minimum hour range = 2.0 hours.
Code F: High current cover (11087-11686).
3.5 Milliampere Max. Current.
1.6 Milliampere-hours full scale.
Minimum hour range = 0.5 hours.

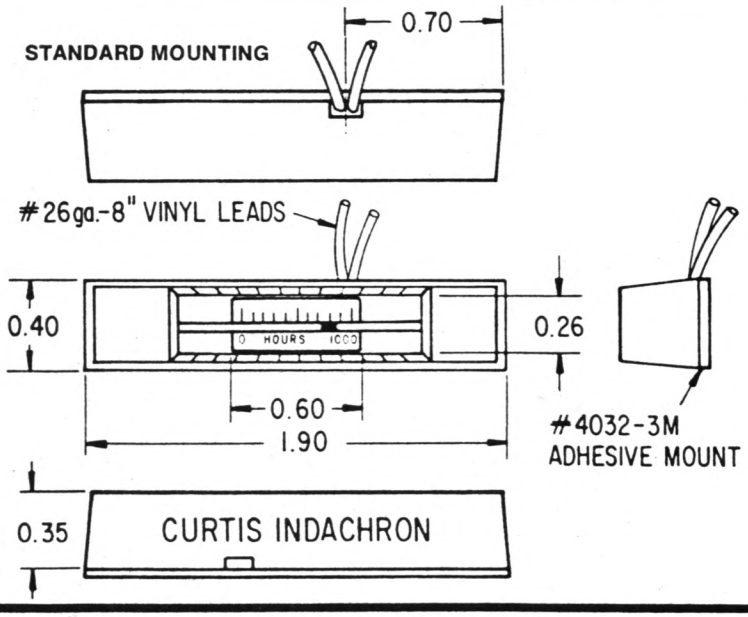
MODELS

MODEL 520 CP3: Operates from 115 VAC; incorporates a zener diode and resistor power supply rated to obtain proper current from 115 VAC input according to the desired time scale. Internally regulated for line voltage variations.

MODEL 420 CP3: Operates from any DC Voltage; incorporates resistors rated to obtain proper current for desired time interval from the specified DC voltage input.

MODEL 120 CP3: Operates from DC Current; is the lowest cost unit. It operates directly from current or pulse train established in the parent equipment to provide the desired time constant, i.e.: 1000 hours = 3.2 microamperes.

Scales: (See other side) Standard scale is ½″, 0-1000 hours. Other scales can be furnished as required. Any type scale marking can be used — in hours or in symbols that refer to various maintenance schedules or other procedures. **A**, **B** and **C** are typical customer applications.



Data and specifications subject to change without notice.

Printed in U.S.A.

Curtis Instruments, Inc.
200 KISCO AVENUE, MOUNT KISCO, N.Y. 10549 TEL: (914) 666-2971 TWX 710-571-2163

INSTALLATION AND MAINTENANCE INSTRUCTIONS

2-WAY DIRECT ACTING SOLENOID VALVES
NORMALLY CLOSED OPERATION – 3/8 AND 1/2 NPT

BULLETINS
8030
8031

ASCO

Form No. V-5304R2

DESCRIPTION

Bulletin 8030's are 2-way normally closed direct acting solenoid valves. Valves are constructed with forged brass or stainless steel bodies and soft seating for tight seating on low pressure service. Standard valves have a General Purpose NEMA Type I Solenoid Enclosure.

Bulletin 8031's are the same as Bulletin 8030's except the solenoids are equipped with an enclosure which is designed to meet NEMA Type 4 - Watertight, NEMA Type 7 (C or D) Hazardous Locations - Class I, Group C or D and NEMA Type 9 (E, F or G) Hazardous Locations - Class II, Groups E, F or G and are shown on separate sheets of Installation and Maintenance Instructions, Form Nos. V-5380 and V-5381.

OPERATION

Normally Closed: Valve is closed when solenoid is de-energized. Valve opens when solenoid is energized.

IMPORTANT: No minimum operating pressure required.

INSTALLATION

Check nameplate for correct catalog number, pressure, voltage and service.

TEMPERATURE LIMITATIONS

For maximum valve ambient and fluid temperatures, refer to chart below. The temperature limitations listed are for UL applications. For non UL applications, higher ambient and fluid temperature limitations are available. Consult factory. Check catalog number and wattage on nameplate to determine maximum temperatures.

CONSTRUCTION	COIL CLASS / WATT RATING	Catalog Number Prefix	Maximum Ambient Temp. °F	Maximum Fluid Temp. °F
A-C Construction (Alternating Current)	A / 10.5	None	77	180
	A / 15.4	None	77	200
	F / 10.5 or 15.4	FT	122	200
	H / 10.5 or 15.4	HT	140	200
D-C Construction (Direct Current)	A, F or H / 11.2	None, FT or HT	77	150
	A, F or H / 16.8	None, FT or HT	77	180

POSITIONING/MOUNTING

This valve is designed to perform properly when mounted in any position. However, for optimum life and performance, the solenoid should be mounted vertical and upright so as to reduce the possibility of foreign matter accumulating in the core tube area. For mounting bracket (optional feature) dimensions, refer to Figure 1.

PIPING

Connect piping to the valve according to marking on valve body. Apply pipe compound sparingly to male pipe threads only; if applied to valve threads, it may enter the valve and cause operational difficulty. Pipe strain should be avoided by proper support and alignment of piping. When tightening the pipe, do not use valve as a lever. Wrenches applied to valve body or piping are to be located as close as possible to connection point.

IMPORTANT: For the protection of the solenoid valve, install a strainer or filter suitable for the service involved in the inlet side as close to the valve as possible. Periodic cleaning is required depending on service conditions. See Bulletins 8600, 8601 and 8602 for strainers.

WIRING

Wiring must comply with Local and National Electrical Codes. Solenoid housings are provided with a 7/8 diameter hole, for 1/2 inch conduit. The general purpose solenoid enclosure may be rotated to facilitate wiring by removing the retaining cap or clip. CAUTION: When metal retaining clip disengages, it will spring upwards. Rotate enclosure to desired position. Replace retaining cap or clip before operating.

NOTE: Alternating Current (A-C) and Direct Current (D-C) solenoids are built differently. To convert from one to the other, it is necessary to change the complete solenoid including the complete solenoid base sub-assembly and core assembly.

SOLENOID TEMPERATURE

Standard catalog valves are supplied with coils designed for continuous duty service. When the solenoid is energized for a long period, the solenoid enclosure becomes hot and can be touched with the hand only for an instant. This is a safe operating temperature. Any excessive heating will be indicated by the smoke and odor of burning coil insulation.

MAINTENANCE

WARNING: Turn off electrical power supply and depressurize valve before making repairs. It is not necessary to remove the valve from the pipe line for repairs.

CLEANING

A periodic cleaning of all solenoid valves is desirable. The time between cleanings will vary, depending upon media and service conditions. In general, if the voltage to the coil is correct, sluggish valve operation, excessive leakage or noise will indicate that cleaning is required. Be sure to clean valve strainer or filter when cleaning solenoid valve.

PREVENTIVE MAINTENANCE

1. Keep the medium flowing through the valve as free from dirt and foreign material as possible.
2. While in service, operate the valve at least once a month to insure proper opening and closing.
3. Periodic inspection (depending on media and service conditions) of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. Replace any parts that are worn or damaged.

Form No. V-5304R2 PRINTED IN U.S.A. 1976 Automatic Switch Co.

ASCO Valves
FLORHAM PARK, NEW JERSEY 07932

IMPROPER OPERATION

1. **Faulty Control Circuit:** Check the electrical system by energizing the solenoid. A metallic click signifies the solenoid is operating. Absence of the click indicates loss of power supply. Check for loose or blown-out fuses, open circuited or grounded coil, broken lead wires or splice connections.
2. **Burned-Out Coil:** Check for open circuited coil. Replace coil, if necessary.
3. **Low Voltage:** Check the voltage across the coil leads. Voltage must be at least 85% of nameplate rating.
4. **Incorrect Pressure:** Check valve pressure. Pressure to valve must be within range specified on nameplate.
5. **Excessive Leakage:** Disassemble valve and clean all parts. Replace worn or damaged parts with a complete Spare Parts Kit for best results.

COIL REPLACEMENT

Turn off electrical power supply and disconnect coil lead wires. Determine valve size (NPT) and proceed in the following manner:

3/8 NPT CONSTRUCTION - Refer to Figure 2.

1. Remove retaining cap or clip, nameplate and housing. CAUTION: When metal retaining clip disengages, it will spring upwards.
2. Remove spring washer, insulating washer and coil. Insulating washers are omitted when a molded coil is used.
3. Reassemble in reverse order of disassembly paying careful attention to exploded view provided for identification and placement of parts.

1/2 NPT CONSTRUCTION - Refer to Figure 3.

1. Remove retaining cap or clip, nameplate and cover. CAUTION: When metal retaining clip disengages, it will spring upwards.
2. Slip yoke containing coil, sleeves and insulating washers off the solenoid base sub-assembly. Insulating washers are omitted when a molded coil is used. Slip coil, sleeves and insulating washers from yoke. For D-C Construction, a single fluxplate over the coil replaces yoke, sleeves and insulating washers.
3. Reassemble in reverse order of disassembly paying careful attention to exploded views provided for identification and placement of parts.

CAUTION: Solenoid must be fully reassembled as the housing and internal parts are part of and complete the magnetic circuit. Place insulating washers at each end of coil, if required.

VALVE DISASSEMBLY AND REASSEMBLY (Refer to Figures 2 and 3)

Depressurize valve and turn off electrical power supply. Proceed in the following manner:

1. Remove the retaining cap or clip and slip the entire solenoid enclosure off the solenoid base sub-assembly. CAUTION: When metal retaining clip disengages, it will spring upwards.
2. Unscrew solenoid base sub-assembly and remove body gasket, core assembly and core spring.
3. For normal maintenance, it is not necessary to disassemble the manual operator unless external leakage is evident. If disassembly is required, remove stem pin, stem and stem gasket.
4. All parts are now accessible for cleaning or replacement. Replace worn or damaged parts with a complete Spare Parts Kit for best results.
5. Reassemble in reverse order of disassembly paying careful attention to exploded views provided for identification and placement of parts.
6. Replace body gasket, core assembly and core spring. For 1/2 NPT Construction, be sure wide end of core spring goes into core first and closed end protrudes from the top of the core. Replace solenoid base sub-assembly and torque to 175 ± 25 inch pounds. Replace solenoid enclosure and retaining cap or clip.
7. After maintenance, operate the valve a few times to be sure of proper opening and closing.

SPARE PARTS KITS

Spare Parts Kits and Coils are available for ASCO valves. Parts marked with an asterisk (*) are supplied in Spare Parts Kits.

ORDERING INFORMATION FOR SPARE PARTS KITS

When Ordering Spare Parts or Coils Specify Valve Catalog Number, Serial Number and Voltage.

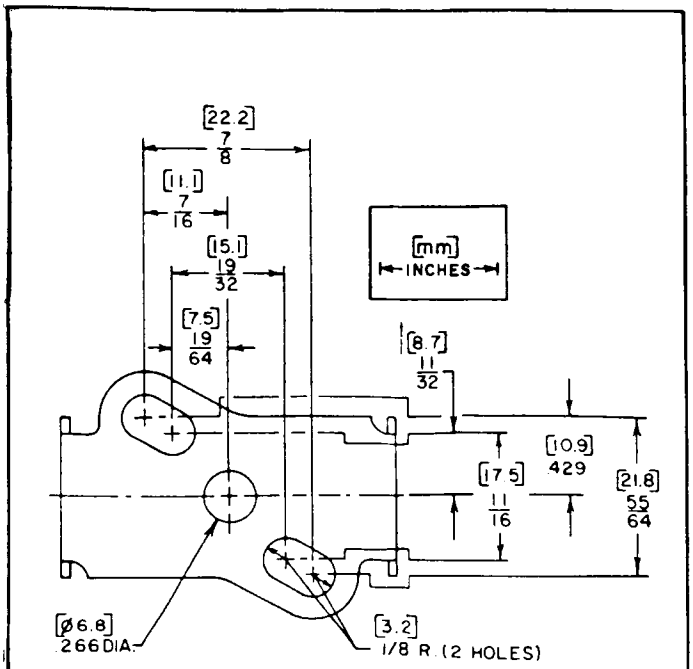
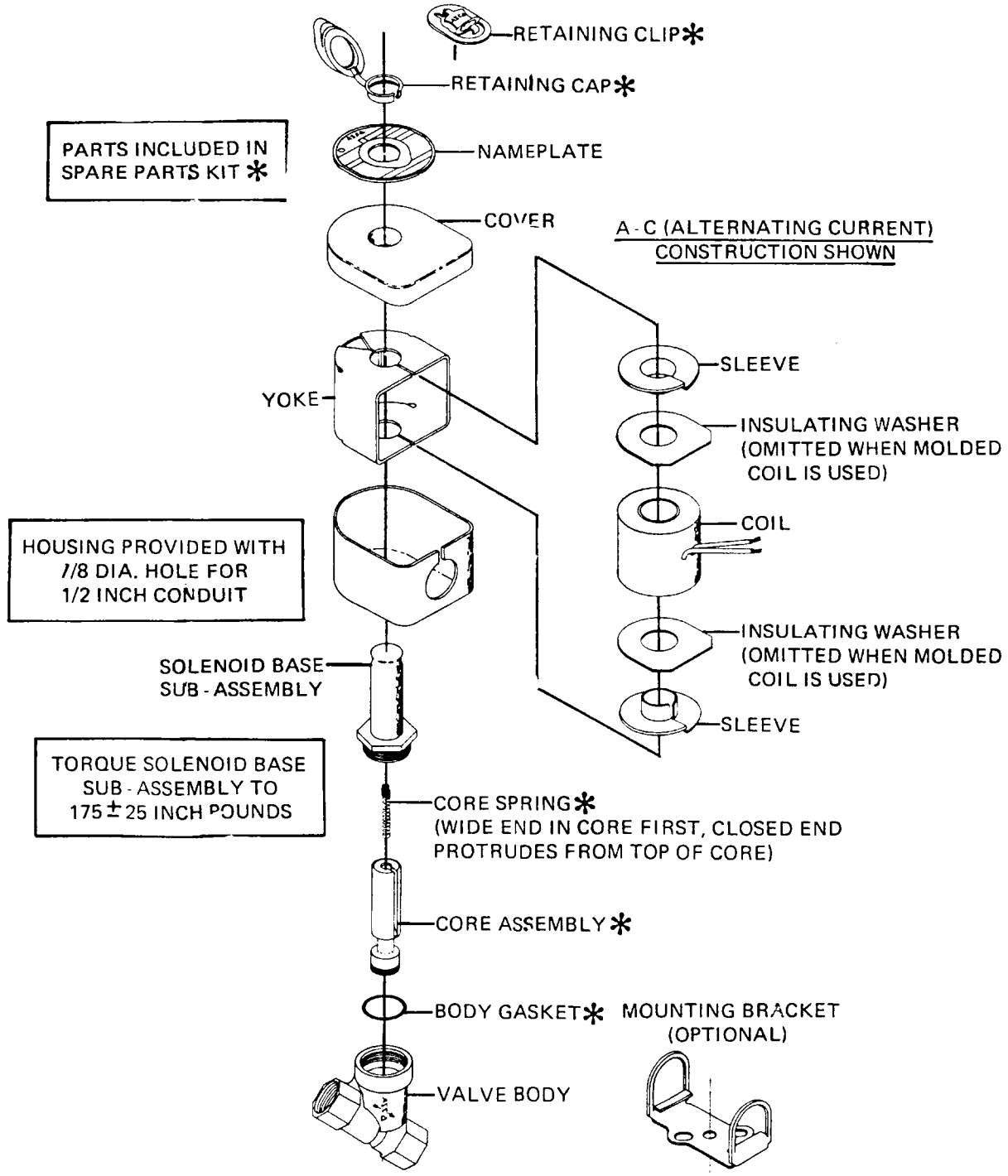


Figure 1. Dimensions for Mounting Bracket (Optional Feature)



Bulletin 8030 - 1/2 NPT
General Purpose Solenoid Enclosure Shown.

Figure 3. **For Explosion-proof/Watertight Solenoid Enclosure used on Bulletin 8031, See Form No. V-5381.**

ASCO Valves
Automatic Switch Co. FLORHAM PARK, NEW JERSEY 07932 Form No. V-5304R2 PRINTED IN U.S.A. 1976

MOLEX
2222 WELLINGTON CT.
LISLE, IL 60532

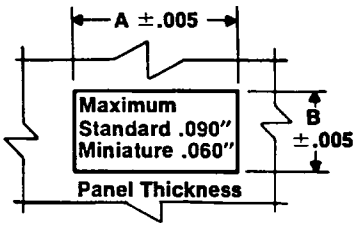
.093" Diameter Terminals • .198" Centers (Grid Pattern)

(SEE PAGES 10 AND 11 FOR DESCRIPTION)

STYLE		ELECTRICAL		RECEPTACLE ORDER NUMBERS				PLUG ORDER NUMBERS	
Circuits (a)	Model No.	Max. Amps	Max. Volts	With Mtg. Ears Only	With Holding Tabs Only	With Ears And Tabs	Without Ears Or Tabs	With Mtg. Ears	Without Mtg. Ears
1 (a)	1951	12	5,000	N/A	03-09-1014	N/A	N/A	N/A	03-09-2014
1	1619	12	250	N/A	03-09-1011	N/A	N/A	N/A	03-09-2011
2 (b)	1545	12	250	N/A	03-09-1022	03-09-1021	03-09-1023	03-09-2021	03-09-2022
2 (b)	1816	12	600	N/A	03-09-1028	N/A	N/A	N/A	03-09-2028
3	1396	12	250	N/A	03-09-1032	03-09-1031	03-09-1033	03-09-2031	03-09-2032
3 (b)	1816	9	600	N/A	03-09-1038	N/A	N/A	N/A	03-09-2038
4	1490	9	250	N/A	03-09-1042	03-09-1041	N/A	03-09-2041	03-09-2042
4 (c)	2163	9	250	N/A	03-09-1049	03-09-1040	N/A	03-09-2040	03-09-2049
4 (b)	1816	9	600	N/A	03-09-1047	N/A	N/A	N/A	03-09-2048
5	1653	9	250	N/A	03-09-1052	N/A	N/A	N/A	03-09-2052
5 (d)	2629	9	250	N/A	03-09-1057	N/A	N/A	N/A	03-09-2057 (d)
6	1261	9	250	03-09-1062	03-09-1064	03-09-1061	03-09-1063	03-09-2061	03-09-2062
9	1292	9	250	03-09-1092	03-09-1094	03-09-1091	03-09-1093	03-09-2091	03-09-2092
12	1360	7.5	250	03-09-1121	03-09-1126	03-09-1125	03-09-1122	03-09-2122	03-09-2121
15 (e, f)	1375	7.5	250	03-09-1151	N/A	03-09-1154 (e)	03-09-1152	03-09-2152	03-09-2153 (f)

N/A — Not available.

- Housings are molded nylon 6/6 Zytel 101 or equivalent.
- Housings are standard white, or at an additional cost may be dyed any of the following colors: Black, Blue, Brown, Green, Gray, Orange, Amber, Red, or Yellow.
- Integrally molded mounting ears snap-lock either the plug or receptacle into a panel without hardware. See Mounting Ear Detail.
- Tabs on the side of receptacles provide friction locking of connector housings.



(a) Electrical ratings are per circuit; UL and CSA recognized; except for Model 1951. Molex UL file card No. E29179; CSA file card No. 19980.

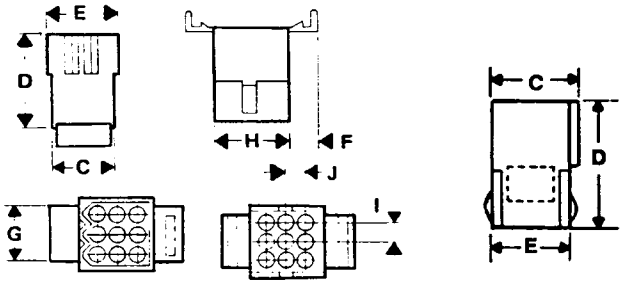
(b) Center spacing .248". Will accommodate: 14, 16 and 18 AWG with 1/32" insulation – 16 with 18 AWG (double crimp), each with 1/32" insulation. Model 1816 housings have positive lock rather than holding tabs.

(c) 4 circuits in square grid pattern.

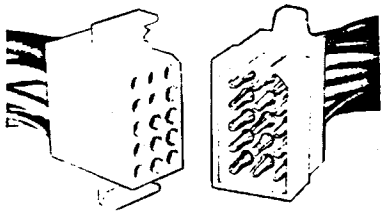
(d) Has positive lock rather than holding tabs; plug 03-09-2057 will mate also with 5-circuit receptacle Model 1653, part 03-09-1051, and 4-circuit receptacle Model 1490, part 03-09-1042.

(e) To order mating plug for receptacle part 03-09-1154 (with ears and locking tabs) specify only plug part 03-09-2154 (has pull tabs, no mounting ears).

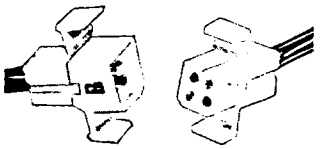
(f) Plug also is available with pull tabs and without mounting ears. Order part 03-09-2151.



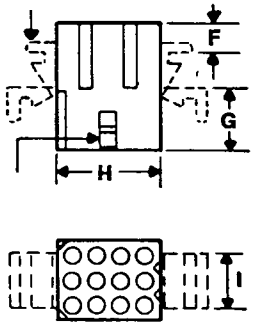
4-Circuit with Positive Lock



15-Circuit Plug with Pull Tabs



4 Circuits in Square Grid Pattern



STYLE		RECEPTACLE									PLUG									
Circuits	Model No.	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I	J
1	1951	N/A	N/A	N/A	1.859	.312 Dia.	N/A	N/A	N/A	N/A	N/A	N/A	.312 Dia.	2.25	.437 Dia.	N/A	N/A	N/A	N/A	N/A
1	1619	N/A	N/A	N/A	1.00	.234 Dia.	N/A	N/A	N/A	N/A	N/A	N/A	.241 Dia.	.968	.358 Dia.	N/A	N/A	N/A	N/A	N/A
2	1545	.725	.312	N/A	1.00	.250	N/A	.442	.536	.250	.800	.375	.257	.968	.352	N/A	.421	.639	.250	.532
2	1816	N/A	N/A	N/A	1.063	.265	N/A	N/A	.531	N/A	N/A	N/A	.265	1.031	.359	N/A	N/A	.656	N/A	.625
3	1396	.840	.312	.236	1.015	.236	.37	.44	.670	.24	.933	.375	.240	.97	.34	.37	.421	.77	.250	.666
3	1816	N/A	N/A	N/A	1.063	.265	N/A	N/A	.784	N/A	N/A	N/A	.254	1.031	.368	N/A	N/A	.921	N/A	.840
4	1490	1.038	.312	N/A	1.000	.236	.37	.437	.868	.236	1.131	.375	.24	.969	.338	.37	.421	.971	.24	.843
4	2163	.500	.600	N/A	1.000	.434	N/A	.442	.434	.312	.555	.695	.450	.969	.538	N/A	.421	.538	.312	.450
4	1816	N/A	N/A	N/A	1.063	.265	N/A	N/A	1.032	N/A	N/A	N/A	.265	1.031	.359	N/A	N/A	1.156	N/A	1.125
5	1653	1.238	.312	N/A	1.000	.243	N/A	.437	1.066	.243	1.331	375	.252	.969	.338	N/A	.421	1.075	.252	1.066
5	2629	N/A	N/A	N/A	1.000	.24	N/A	N/A	1.07	.24	N/A	N/A	.25	.969	.35	N/A	N/A	1.17	N/A	1.07
6	1261	.718	.600	N/A	1.015	.632	N/A	.442	.434	.563	.750	.695	.633	.969	.733	N/A	.421	.536	.563	.536
9	1292	.828	.725	N/A	1.015	.627	.37	.442	.666	.563	.937	.660	.630	.970	.730	.28	.56	.770	.198	.198
12 (a)(b)	1360	1.050	.655	N/A	1.015	.633	N/A	.442	.871	.563	1.155	.760	.633	.969	.737	N/A	.421	.975	.563	.975 (a)
15 (c)	1375	1.240	.655	N/A	1.015	.632	.37	.442	1.066	.563	1.343	.760	.629	.969	.734	.37	.421	1.169	.563	1.169

N/A — Not applicable. • Dimensions subject to nominal variation ±.005".

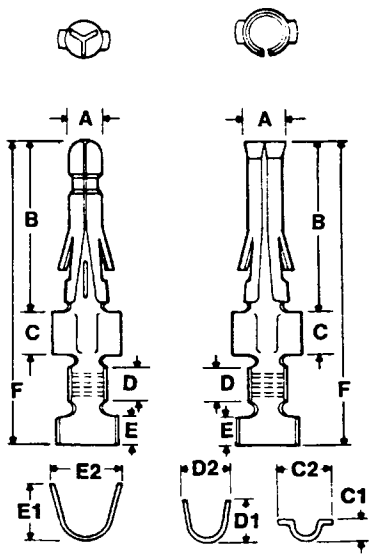
(a) 12-circuit plug, Model 1360, has alternate design of .844" Dim. J.

(b) 12-circuit receptacle with mounting ears and locking tabs 03-09-1125 mounting hole "B" dimension is .725 min.

(c) 15-circuit receptacle with mounting ears and locking tabs 03-09-1154 mounting hole "B" dimension is .725 min.

MODEL No.	A	B	C	D	E	F	G	H	C1	C2	D1	D2	E1	E2	H1	H2
1189 Female	.120	—	—	.120	.09	.865	—	—	.055	.150 Max.	.125	.140/.100	.190	.260/.180	—	—
1190 Male	.093	—	—	.120	.09	.865	—	—	.055	.150 Max.	.125	.140/.100	.190	.260/.180	—	—
1377 Female	.120	—	—	—	—	—	1.125	—	.055	.150 Max.	—	—	—	—	.050	.023
1376 Male	.093	—	—	—	—	—	1.125	—	.055	.150 Max.	—	—	—	—	.050	.023
1381 Female	.120	—	—	.120	.09	.865	—	—	.055	.150 Max.	.125	.140/.100	.140	.160/.100	—	—
1380 Male	.093	—	—	.120	.09	.865	—	—	.055	.150 Max.	.125	.140/.100	.140	.160/.100	—	—
1433 Female	.120	—	—	.120	.09	.865	—	—	.055	.150 Max.	.075	.095/.080	.075	.095/.080	—	—
1434 Male	.093	—	—	.120	.09	.865	—	—	.055	.150 Max.	.075	.095/.080	.075	.095/.080	—	—
1451 Female	.120	—	—	.120	.09	.865	—	—	.055	.150 Max.	.125	.120	.190	.210	—	—
1450 Male	.093	—	—	.120	.09	.865	—	—	.055	.150 Max.	.125	.120	.190	.210	—	—
2151 Female	.120	—	—	.120	.09	.865	—	—	.055	.150 Max.	.125	.120	.140	.130	—	—
2152 Male	.093	—	—	.120	.09	.865	—	—	.055	.150 Max.	.125	.120	.140	.130	—	—
2871 Female	.120	—	—	.120	.070	.865	—	—	.055	.150 Max.	.079	.107	.089	.109	—	—
2870 Male	.093	—	—	.120	.070	.865	—	—	.055	.150 Max.	.079	.107	.089	.109	—	—

Dimensions subject to nominal variation ±.005".



Molex makes terminals of various metals with optional plating finishes to satisfy specific operational requirements.

Brass, Tin Plated Terminals

Most applications are met by the standard Molex brass, tin plated terminal. Tin plating is applied prior to forming of the 30 per cent zinc, 70 per cent copper alloy material.

Suggested application is for more than 50 millivolt at 1 milliamp current usage.

Brass, Gold Plated Terminals

Gold plated brass terminals are best suited for low current use and where excessive corrosion is a factor, or when storage of two years or more for use is expected. Plating is applied after forming, except for selective area plating.

Suggested application is for use with less than 50 millivolt at 1 milliamp current.

Phosphor Bronze, Tin Plated Terminals

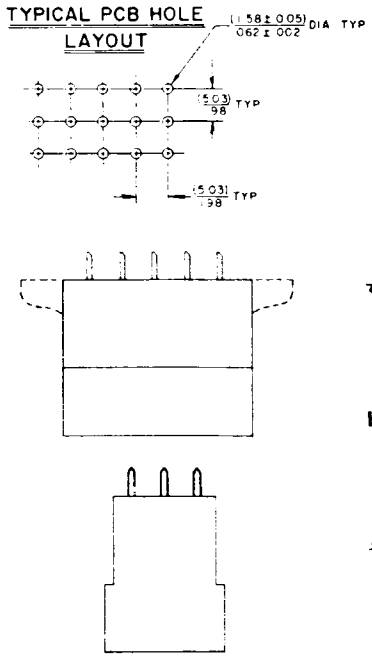
Improved mechanical characteristics, but reduced electrical characteristics are typical of tin plated phosphor bronze terminals. Conductivity is 15 per cent, compared with 28 per cent for tin-plated brass terminals.

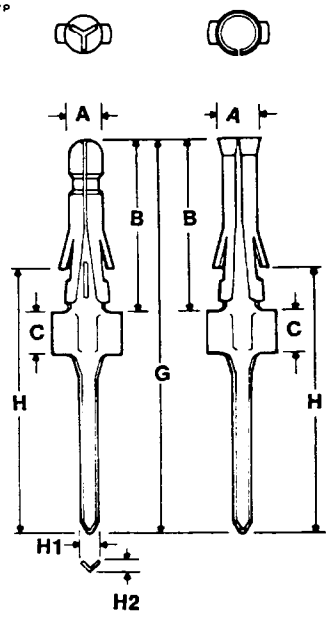
Suggested application is for use where a high number of insertion and withdrawal cycles is required.

Modified Copper, Tin Plated Terminals

Where higher current is employed, and insertion and withdrawal cycles are low, tin plated modified copper terminals are suggested.

These terminals have a conductivity of 65 per cent, compared with 28 per cent for tin plated brass and 15 per cent for tin plated phosphor bronze.





Electrical

Resistance

M/V voltage drop per amp, ±10%:

1st engagement 3.0 10th engagement 3.1

Probe about 1 inch from crimp barrel on 18 AWG stranded wire. Voltage drop includes mated terminals and both crimps. Tin material and plating.

High Voltage Test

Withstands 1500 volts RMS applied between adjacent terminals for 60 seconds, mounted in all housings.

Temperature Rise / Operating Range

30°maximum for all connectors at maximum rated current. Temperature range —40 C to 105°C.

Current Rating

Amperage rating UL listed.

Mechanical

Terminal Crimp Strength

Minimum pull-out force in pounds for AWG wire sizes:

14 — 35 lbs.	24 — 8 lbs.
16 — 30 lbs.	26 — 5 lbs.
18 — 25 lbs.	28 — 3 lbs.
20 — 15 lbs.	30 — 2 lbs.
22 — 10 lbs.	

Engage / Disengage Forces

Standard terminal of .010 stock 70/30 brass — average engage/disengage forces in plug/receptacle connector with ±30% tolerance, in pounds per circuit:

1-circuit 2.9/1.2	6-circuit 17.4/ 7.2
2-circuit 5.8/2.4	9-circuit 25.1/10.8
3-circuit 8.7/3.6	12-circuit 34.8/14.4
4-circuit 11.6/4.8	15-circuit 43.5/18.0
5-circuit 14.5/6.0	

Average insertion force ±30% male and female terminal in connector housing is 2.7 lbs.; retention, 20 lbs. minimum.

(See Page 2)

Terminal Model No.	HAND TOOLS			CRIMPING MACHINE	
	Crimping	Insertion	Extractor	Bench	Automatic
1189-1190	11-01-0002	Not Required	11-03-0006 (a) 11-03-0015	11-04-0006	Artos
1380-1381	11-01-0002	Not Required	11-03-0006 (a) 11-03-0015	11-04-0006	Artos
1433-1434	11-01-0006	11-02-0003	11-03-0006 (a) 11-03-0015	11-04-0006	Artos
1450-1451	11-01-0002	Not Required	11-03-0006 (a) 11-03-0015	11-04-0006	Artos
2151-2152	11-01-0002	Not Required	11-03-0006 (a) 11-03-0015	11-04-0006	Artos
2870-2871	11-01-0026	Not Required	11-03-0006 (a) 11-03-0015	11-04-0006	Artos

(a) Spring-loaded for automatic terminal ejection.

ORDERING DATA

TERMINALS			ORDER NUMBERS							
			Chain Form (a)				Loose Form			
			Male		Female		Male		Female	
Crimp Wire Size	Insulation Diameter	Model Nos.	With Detent	W/O Detent	With Dimple	W/O Dimple	With Detent	W/O Detent	With Dimple	W/O Dimple
14-20	.065-.160	1189 F 1190 M	02-09-2101	—	02-09-1101	02-09-1102	02-09-2103	—	02-09-1103	02-09-1104
18-22	.060-.120	1380 M 1381 F	02-09-2116	—	02-09-1116	02-09-1117	02-09-2118	—	02-09-1118	02-09-1119
18-24 (b)	.070 Max.	2870 M 2871 F	02-09-2136	—	02-09-1136	02-09-1138	02-09-2137	—	02-09-1137	02-09-1139
24-30	.030-.060	1433 F 1434 M	02-09-2141	—	02-09-1141	02-09-1142	02-09-2143	—	02-09-1143	02-09-1144
PC Tail	Hole Size: .060	1376 M 1377 F	—	—	—	—	02-09-2133	02-09-2134	02-09-1133	02-09-1134

(a) 8,000 terminals per reel—All chain form orders are rounded to the nearest full reel.
Chain form reels for Models:
1433 and 1434 contain 6,000 terminals.
2870 and 2871 contain 4,000 terminals.

(b) For fire-retardant insulated wire. F = Female M = Male

TERMINALS			ORDER NUMBERS							
			Chain Form (a)				Loose Form			
			Male		Female		Male		Female	
Crimp Wire Size	Insulation Diameter	Model Nos.	With Detent	W/O Detent	With Dimple	W/O Dimple	With Detent	W/O Detent	With Dimple	W/O Dimple
14-20 (b)	.065-.160	1189 F 1190 M	02-09-6101	—	02-09-5101	02-09-5102	02-09-6110	—	02-09-5110	02-09-5111
14-20 (c)	.065-.160	1189 F 1190 M	02-09-6100	—	02-09-5100	02-09-5103	02-09-6106	—	02-09-5106	02-09-5109
14-20 (d)	.065-.160	1189 F 1190 M	02-09-6107	—	—	02-09-5107	02-09-6109	—	—	02-09-5108
18-22 (d)	.060-.120	1380 M 1381 F	02-09-6121	—	02-09-5119	—	02-09-6124	—	02-09-5124	—
18-22 (e)	.060-.120	1380 M 1381 F	02-09-6117	—	02-09-5120	—	02-09-6118	—	02-09-5121	—
18-22 (c)	.060-.120	1380 M 1381 F	02-09-6122	—	02-09-5122	—	02-09-6123	—	02-09-5123	—
24-30 (c)	.030-.060	1433 F 1434 M	02-09-6144	—	02-09-5144	02-09-5146	02-09-6145	—	02-09-5145	02-09-5147
PC Tail (d)	Hole Size: .060	1376 M 1377 F	—	—	—	—	02-09-6132	02-09-6134	02-09-5131	02-09-5132

(a) 8,000 terminals per reel—All chain form orders are rounded to the nearest full reel.
Chain form reels for Models 1433 and 1434 contain 6,000 terminals.
(b) 0.00005 min. gold over 0.00010 min. copper plate.
(c) 0.00002 min. gold over 0.00003 min. nickel plate.
(d) 0.00003 min. gold over 0.00003 min. nickel plate.
(e) 0.00005 min. gold over 0.00010 min. nickel plate.
TERMINALS OVERALL GOLD PLATED AFTER FORMING.
SPECIAL PLATINGS AVAILABLE UPON REQUEST

F = Female
M = Male

TERMINALS			ORDER NUMBERS							
			Chain Form (a)				Loose Form			
			Male		Female		Male		Female	
Crimp Wire Size	Insulation Diameter	Model Nos.	With Detent	W/O Detent	With Dimple	W/O Dimple	With Detent	W/O Detent	With Dimple	W/O Dimple
18-22	.060-.120	2151 F 2152 M	02-09-2201	—	02-09-1201	02-09-1203	02-09-2202	—	02-09-1202	02-09-1204
18-22 (b)	.060-.120	2151 F 2152 M	—	—	—	—	02-09-6202	—	02-09-5202	—

(a) 8,000 terminals per reel—All chain form orders are rounded to the nearest full reel.

(b) 0.00002 min. gold over 0.00003 min. nickel plate.
TERMINALS OVERALL GOLD PLATED AFTER FORMING.
SPECIAL PLATINGS AVAILABLE UPON REQUEST

F = Female
M = Male

TERMINALS										
			Chain Form (a)				Loose Form			
			Male		Female		Male		Female	
Crimp Wire Size	Insulation Diameter	Model Nos.	With Detent	W/O Detent	With Dimple	W/O Dimple	With Detent	W/O Detent	With Dimple	W/O Dimple
14-20	.060-.160	1450 F 1451 M	02-09-2301	02-09-2302	02-09-1301	02-09-1302	02-09-2303	—	02-09-1303	02-09-1304

(a) 6,000 terminals per reel—All chain form orders are rounded to the nearest full reel.

F = Female
M = Male

APPENDIX IV

Special Test Fixtures

A wave guide cold termination (Assembly 53204A007) was fabricated to test the front-end. Four quartz fins are mounted in circular waveguide which is immersed in liquid nitrogen to provide the cold termination. A gapped waveguide and vacuum window similar to that used in the front-end is incorporated. Vacuum sensors, temperature sensors and heaters are included for control of the unit. Figure IV-1 shows photographs of the cold termination. When filled, the termination may be used in either a horizontal or vertical orientation and will remain cold for over 12 hours without refilling.