NATIONAL RADIO ASTRONOMY OBSERVATORY
Green Bank, West Virginia

VLBA TECHNICAL REPORT NO. 11

MODEL F110, 43 GHZ CRYOGENIC FRONT-END

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TABLE OF CONTENTS

LIST OF FIGURES

TABLES

APPENDICIES

43 GHz, CRYOGENICS 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 41 to 45 GHz is covered where a receiver noise temperature of less than 90 K (noise figure less than 1.174 dB) is achieved. The dual channels allow both left and right circularly-polarized signals (LCP and RCP) to be received.

A block diagram of the system is shown in Figure 1.1-1 and photographs are shown in Figure 1.1-2. A .200 inch (.0816 cm) diameter circular waveguide, propagating both TE_{11} circularly polarized modes, provides the input to the system. An iris matched window (see section 2.2) in the waveguide supports a vacuum in a dewar which contains receiver components cooled to a temperature of approximately 15 K (-258 C) by a closed cycle, cryogenic refrigerator. The thermal barrier separating the 300 K and 15 K portions of the input waveguide is achieved by a 0.003" (.0762 mm) gap in the waveguide wall (see section 2.3). A polarizer/orthomode transducer extracts the signal into the two orthogonal modes of circular polarization and via WR-22 waveguide, transmits the signal

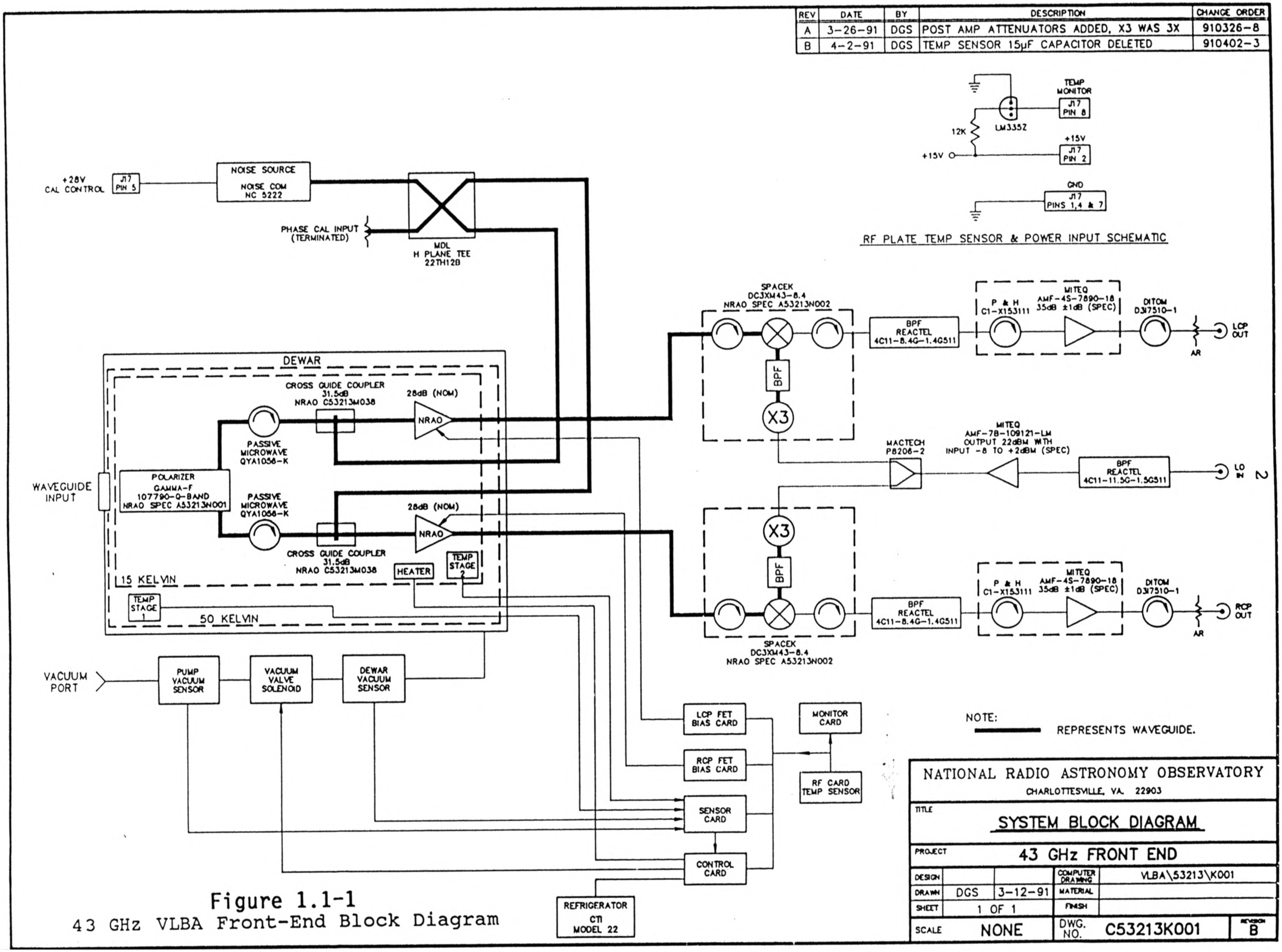


Figure 1.1-1
43 GHz VLBA Front-End Block Diagram

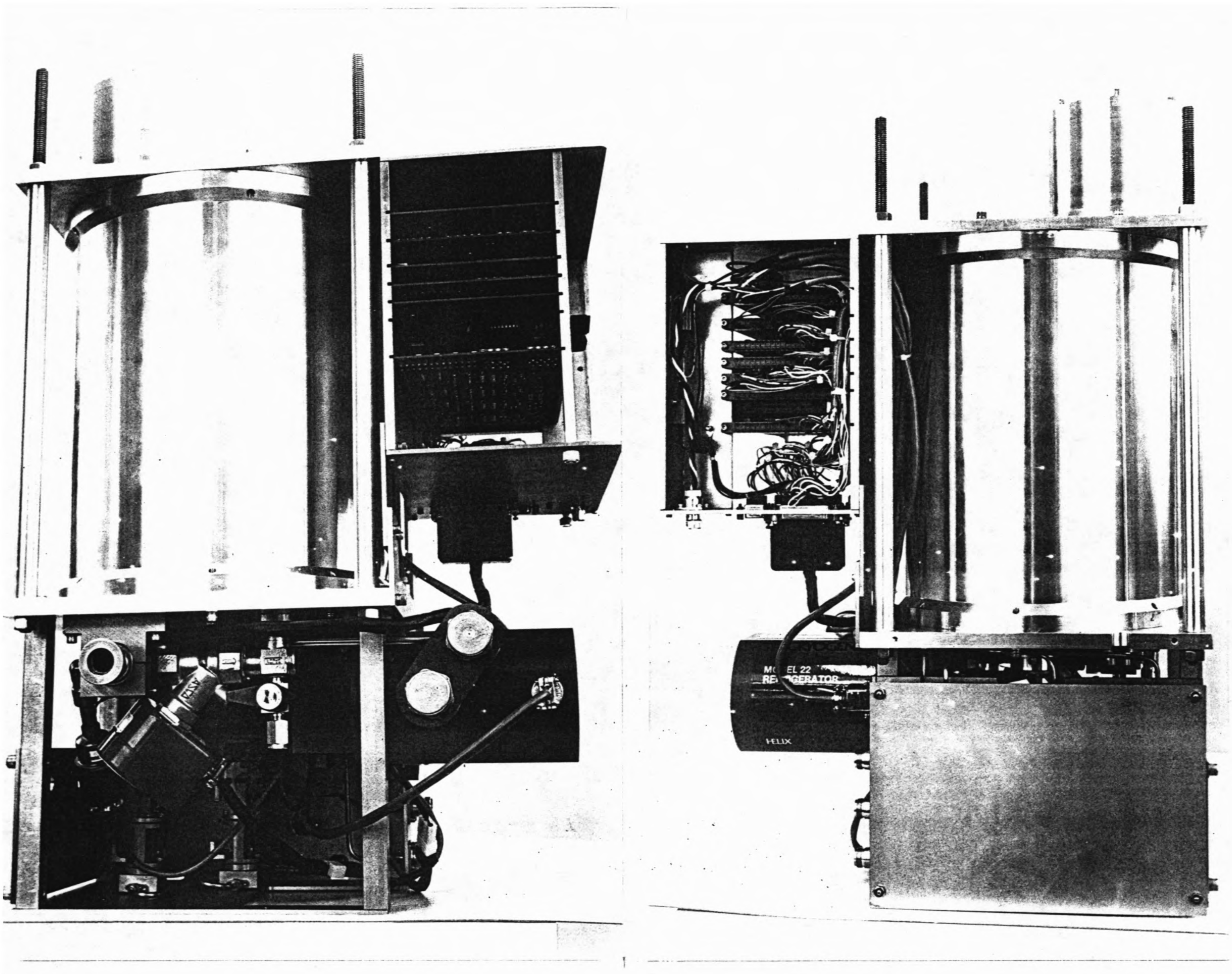


Figure 1.1-2
Assembled 43 GHz VLBA Front-End

through cryogenic isolators, into a directional coupler which allows noise to be inserted, and then into the cooled amplifiers. The Amplifiers are five stage HEMT amplifiers which provide approximately 30 dB of gain with a noise figure of approximately 0.691 (50 K). After amplification the signal is transmitted through various twists and bends using copper waveguide. The signal is then transmitted out of the dewar using gold plated stainless steel waveguides and waveguide windows.

The signal from the dewar is then mixed to a lower frequency by a dual-channel microwave mixing assembly that triples the local oscillator frequency before combining it with the incoming signal. A conversion loss of approximately 8 dB is present in the mixing process. The signals are then transmitted via semi-rigid coaxial line through isolators and into band pass filters with a center frequency of 8.4 GHz and a bandwidth of 1.4 GHz. The signal is sent through an isolator and then amplified by the second stage amplifiers. These amplifiers, with a noise figure of approximately 1.8 dB and a gain of 35 dB, transfer the signal to the output connectors on the front end, J6 and J7.

A calibration is present in the system, which injects noise between the cryogenic isolator and the HEMT amplifiers by means of a cross guide coupler. This coupling provides for approximately 31.5 dB of loss to reduce the magnitude of the calibration signal. The calibration signal enters the dewar through WR-22 stainless steal waveguide after it has been split by a hybrid tee.

Attached to the front-end dewar is a electronics card cage containing seven printed circuit boards. Three of these cards are used for controlling the gate voltage and drain current of the HEMT amplifiers inside the dewar. On one of these boards a local monitor and control panel is mounted. The panel contains a six-position switch with the positions CPU, COOL, STRESS, OFF, PUMP and HEAT. This switch allows the front end to be placed in one of its logical states or, by switching the panel to CPU, it will allow the front end to be controlled by three control bits from the station computer. A twelve position monitor switch and a 4 1/2 digit DVM are located on the panel for reading analog monitor points. The dewar vacuum, pump port vacuum, dewar temperature, various gate voltages and LED voltages can be monitored through this switch. The details for the card cage operation are contained in section 1.3.4.

The cryogenic components are cooled with a Cryogenics Technology, Inc., Model 22 refrigerator which requires an external helium compressor. Vacuum service 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 the specifications will apply to the frequency range 41 GHz to 45 GHz at the cryogenic operating temperature. 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 output of the system shall average approximately 70 K, with the upper limit throughout the band of 90 K. The noise temperature shall be measured with the feed horn in place and using absorber material in liquid nitrogen for the cold load and absorber material at room temperature for the hot load. The test will be done on an automated system which gives the noise temperature at 200 MHz intervals from 41 GHz to 45 GHz.

1.2.2 Input Return Loss

The input return loss must be greater than 18 dB throughout the band.

1.2.3 Calibration Coupling

The calculated coupling from the calibration input jack to the cooled amplifiers is -31.5 dB.

1.2.4 LO Input Power

The LO input power for the input connector J8 is +2 to -8 dBm and will have a stable phase to within 4 degrees in this power range.

1.2.5 Calibration Noise Temperature

As +28 volts is applied to the noise source, 8 K to 12 K of noise will be injected into both channel.

1.2.6 Output Return Loss

The output return loss for LCP and RCP channels at jack J6 and J7 shall be less than 15 dB over the frequency range.

1.2.7 Output Total Noise Power

With a short circuit plate across the input feed horn the noise power out of the left and right channels are approximately -30 dBm. The total noise power shall also be measured with a short circuit, the calibration signal turned on and the short circuit, the hot load and the cold load.

1.2.8 Output Noise Power Stability

The receiver waveguide input shall be short-circuited and a test receiver with approximately 10 MHz IF bandwidth and 1 KHz post detection bandwidth connected to RF Output jacks. With the receiver tuned near to the front-end center frequency, and the gain adjusted for 5 ± 1 VDC output from the receiver, the peak-to-peak AC (greater than 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 on the dewar, RF components and cables. The purpose of the test is to check for mechanical looseness, vibration sensitivity, 60 Hz modulation and refrigerator induced gain modulations.

1.2.9 Front-end Gain

The front end will have a minimum of 25 dB of gain throughout the dewar, with a minimum of 45 dB throughout the entire system.

1.2.10 Cold Station Temperatures

The temperature of the refrigerator's first stage shall be less than 55 K. The second stage as measured on the 15 K plate shall be less than 17 K.

1.2.11 HEMT Bias Data

The optimum drain voltage V_D, drain current I_D, and gate voltage V_g, at 300 K and the cryogenic operating temperature, shall be recorded for each of the five stages of the two cryofet amplifiers.

1.2.12 Cool-Down Times

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

1.2.13 Physical Weight and Size

The front end shall weigh less than 68 pounds and have the outline as shown in Figure 1.3-1

1.3 Interface Description

1.3.1 Mechanical Interface

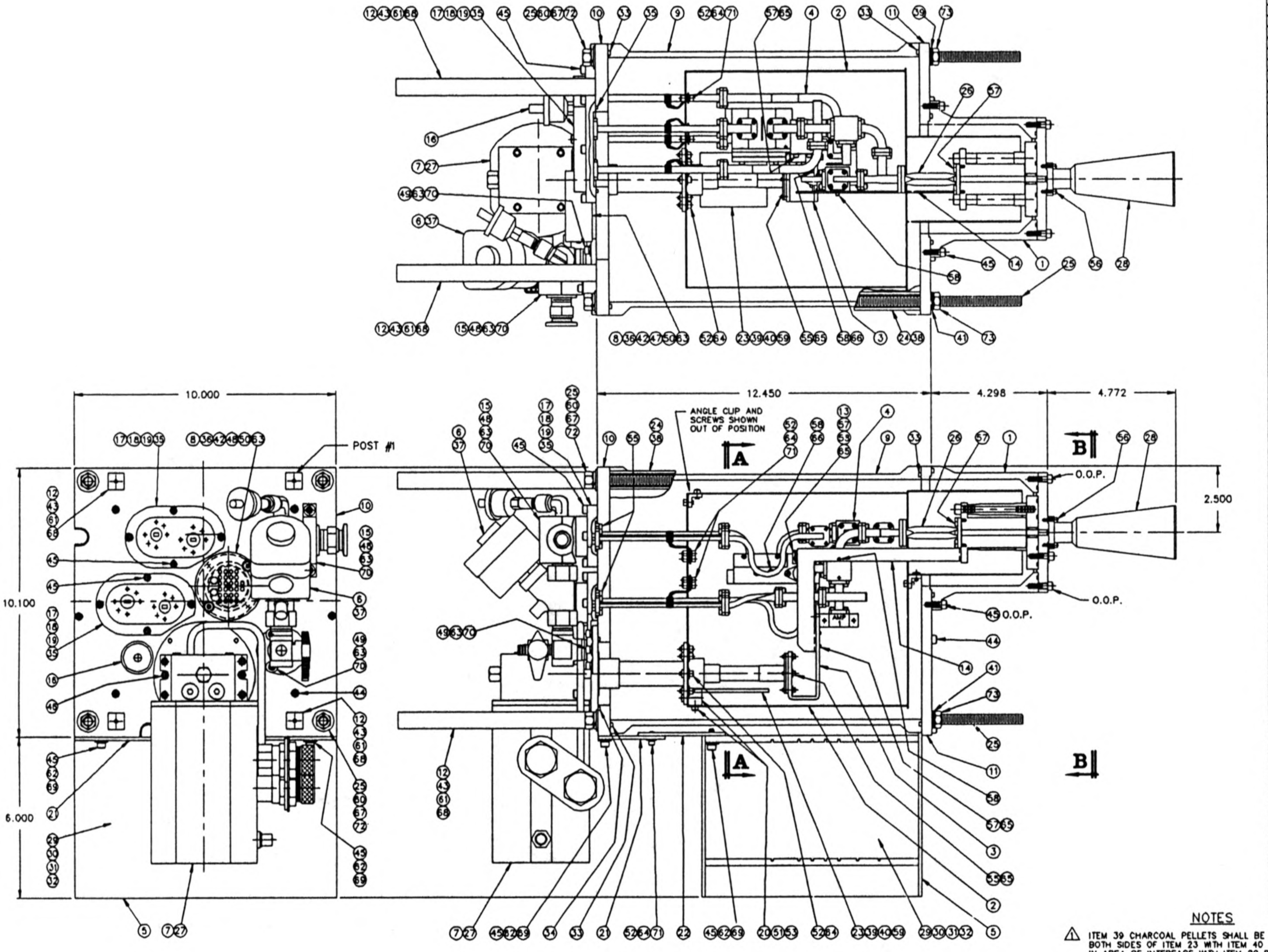
Locations of the input waveguide, helium supply and return, vacuum port, and mounting holes are shown in Figure 1.3-1.

In this system the feed horn is attached to the dewar such that the front end is previously aligned with the feed horn before installation on the telescope. The main support of the front end is contained on the four threaded rods bolted through the .531 inch diameter hole in the four corners of the upper dewar plate and the tapped holes in the four corners of the lower dewar plate. A brace plate is positioned at the side of the front end for additional stabilization on the antenna.

When mounted, access can be gained to the circuit cards of the card cage by removing the corner post of the card cage. The RF plate, refrigerator motor and displacers can also be removed without dismounting the front end.

1.3.2 Vacuum and Helium Interface

The vacuum port connection is through a Leybold-Heraeus type KF-16 flange, type 18321 centering ring and type 18346 quick



MATERIAL LIST			
ITEM	QUAN	DESCRIPTION	REMARKS
1	1	THERMAL TRANSITION ASSEMBLY	D53213A002
2	1	SHIELD ASSEMBLY	C53213A003
3	1	15K PLATE ASSEMBLY	C53213A010
4	1	AMPLIFIER & WAVEGUIDE ASSEMBLY	D53213A009
5	1	CARD CAGE ASSEMBLY	D53213A006
6	1	VACUUM ASSEMBLY	C53213A007
7	1	TIMER ASSEMBLY	A53206A013
8	1	DC FEEDTHRU ASSEMBLY	B53213A008
9	1	DEWAR CYLINDER	D53206M015
10	1	BOTTOM PLATE	D53213M010
11	1	TOP PLATE	D53213M011
12	1	MIXER ASSEMBLY	D53213A012
13	1	COLD STRAP – 15K PLATE/AMP 2 ISOLATOR	B53213M040
14	1	COLD STRAP – 15K PLATE/AMP 1/ISOLATOR/TRANSITION	C53213M041
15	1	VACUUM PORT CLAMP	A53203M036
16	1	VACUUM GAUGE TUBE – TELEDYNE HASTINGS P/N DV-6M	———
17	2	WAVEGUIDE PLATE	B53213M013
18	4	WAVEGUIDE PLATE IRIS	A53213M021
19	4	WAVEGUIDE PLATE WINDOW	A53213M020
20	1	70K SHIELD CONNECTING BLOCK	A53206M010
21	1	CARD CAGE BRACKET (ATTACHES TO DEWAR)	B53213M042
22	1	CARD CAGE BRACKET (ATTACHES TO CARD CAGE)	A53213M043
23	1	CHARCOAL PELLET PLATE	A53213M044
24	4	STOP TUBE	B53200M041-6
25	4	3/8-16 SS THREADED ROD	B53200M048-5
26	1	CIRCULAR POLARIZER	A53213N001 REV. B
27	1	CRYOGENIC REFRIGERATOR – CTI MODEL 22	———
28	1	CORRUGATED FEED HORN	C53213M023
29	3	FET BIAS CARD	———
30	1	CONTROL CARD	———
31	1	SENSOR CARD	———
32	1	MONITOR CARD	———
33	2	O-RING – PARKER N674-70 COMPOUND, #2-270	CYLINDER
34	1	O-RING – PARKER N674-70 COMPOUND, #2-144	REFRIGERATOR MOUNTING
35	2	O-RING – PARKER N674-70 COMPOUND, #2-142	WAVEGUIDE PLATE
36	1	O-RING – PARKER N674-70 COMPOUND, #2-130	DC FEEDTHRU
37	1	O-RING – PARKER N674-70 COMPOUND, #2-118	VACUUM ASSEMBLY
38	AR	PLASTIC SPIRAL WRAP	USED AT THREADED RODS
39	AR	CHARCOAL PELLETS	SEE NOTE 1
40	AR	EPOXY – ARMSTRONG #A-12	SEE NOTE 1
41	AR	THREADED ROD SHIM STOCK – REF. CV PO# B03410, PHOENIX SPECIALITY, .005 & .015 THICK ASSORTMENT	USED AT THREADED RODS
42	2	HEX MALE/FEMALE STANDOFF – BODY LENGTH = 1/2, HEX ACROSS FLATS = 1/4, MALE THREAD LENGTH = 3/8, FEMALE THREAD DEPTH = 7/16	DC FEEDTHRU
43	4	SS SOC. HD. CAP SCREW – 1/4-20UNC-2A X 1	MIXER ASSEMBLY POSTS
44	11	SS SOC. HD. CAP SCREW – 10-32UNF-2A X 7/8	T & B PLATES TO CYL
45	20	SS SOC. HD. CAP SCREW – 10-32UNF-2A X 5/8	CARDCAGE (6) WAVEGUIDE PLATE (8) TRANSITION (6)
46	2	SS SOC. HD. CAP SCREW – 10-32UNF-2A X 3/8	REFRIGERATOR MOUNTING
47	2	SS SOC. HD. CAP SCREW – 8-32UNC-2A X 7/8	DC FEEDTHRU
48	2	SS SOC. HD. CAP SCREW – 8-32UNC-2A X 3/4	VACUUM PORT CLAMP
49	3	SS SOC. HD. CAP SCREW – 8-32UNC-2A X 1/2	VACUUM ASSEMBLY
50	2	SS SOC. HD. CAP SCREW – 8-32UNC-2A X 3/8	DC FEEDTHRU
51	1	SS SOC. HD. CAP SCREW – 6-32UNC-2A X 5/8	70K SHIELD MTG BLOCK
52	16	SS SOC. HD. CAP SCREW – 6-32UNC-2A X 3/8	SHIELD TO REFRIG (8) WG GROUND STRAPS (4) CARD CAGE (4)
53	1	SS SOC. HD. CAP SCREW – 6-32UNC-2A X 1/4	COLD STRAP TO TRANSITION
54	1	SS SOC. HD. CAP SCREW – 6-32UNC-2A X 3/16	70K SHIELD MTG BLOCK
55	20	SS SOC. HD. CAP SCREW – 4-40UNC-2A X 3/8	15K PLATE TO REFRIG (4) WG TO WG PLATE (16)
56	4	SS SOC. HD. CAP SCREW – 4-40UNC-2A X 7/16	FEED
57	12	SS SOC. HD. CAP SCREW – 4-40UNC-2A X 1/4	POLARIZER TO TRANSITION (8) COLD STRAP TO 15K PLT (4)
58	6	SS SOC. HD. CAP SCREW – 2-56UNC-2A X 1/4	AMPLIFIER MOUNTING (4) COLD STRAP TO ISO (2)
59	1	SS PHILLIPS FLAT HD. MACH. SCREW – 6-32UNC-2A X 3/8	CHARCOAL PELLET PLATE
60	4	3/8 SS FLAT WASHER	THREADED RODS
61	4	1/4 SS FLAT WASHER	MIXER ASSEMBLY POSTS
62	6	#10 SS FLAT WASHER	CARD CAGE
63	7	#8 SS FLAT WASHER	VACUUM PORT CLAMP (2) VACUUM ASSEMBLY (3) DC FEEDTHRU (2)
64	16	#6 SS FLAT WASHER	SHIELD TO REFRIG (8) WG GROUND STRAPS (4) CARD CAGE (4)
65	8	#4 SS FLAT WASHER	15K PLATE TO REFRIG (4) COLD STRAP TO 15K PLT (4)
66	4	#2 SS FLAT WASHER	AMPLIFIER MOUNTING
67	4	3/8 SS SPLIT LOCK WASHER	THREADED RODS
68	4	1/4 SS SPLIT LOCK WASHER	MIXER ASSEMBLY POSTS
69	6	#10 SS SPLIT LOCK WASHER	CARD CAGE
70	5	#8 SS SPLIT LOCK WASHER	VACUUM PORT CLAMP (2) VACUUM ASSEMBLY (3)
71	8	#6 SS SPLIT LOCK WASHER	WG GROUND STRAPS (4) CARD CAGE (4)
72	4	3/8 SS HEX NUT	THREADED RODS
73	4	3/8 SS JAMB NUT – .234 THICK	THREADED RODS

NOTES

1. ITEM 39 CHARCOAL PELLETS SHALL BE ATTACHED TO BOTH SIDES OF ITEM 23 WITH ITEM 40 EPOXY EXCEPT IN AREA OF INTERFACE WITH ITEM 20 BLOCK.
2. REFER TO DRAWING D53213A001-1, SHEET 2 OF 2, FOR SECTIONS A-A & B-B.
3. O.O.P. = OUT OF POSITION
4. THIS ASSEMBLY IS USED WITH THE SYSTEMS UTILIZING POSPIESZALSKI'S AMPLIFIERS.

REV	DATE	BY	DESCRIPTION	CHANGE ORDER
A	12-7-90	DGS	AMP MTG SCREWS WERE 4-40, 4.772 WAS 4.702	901207-1
B	2-19-92	DGS	AMP 2 RELOCATED, WAVEGUIDE REDESIGNED	920219-1

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TITLE	43 GHz FRONT END ASSEMBLY			
PROJECT	VLBA			
DESIGN			COMPUTER DRAWING	VLBA\53213\A001-3
DRAWN	DGS	10-5-90	MATERIAL	
SHEET	1 OF 2		FINISH	
SCALE	1/2 SIZE		DWG. NO. D53213A001-1	REVISION B

Figure 1.3-1
43 GHz Dewar Interface

disconnect clamp. A control signal, PUMP REQUEST, is output through connector J2 by the control card when the vacuum pumping is needed. Pump request is used to turn on a pump and open a solenoid-operated valve to a pump manifold.

The helium interface is through Aeroquip 5400-S5-8 self-sealing fittings. The helium supply pressure should be 225 ± 5 psi static and 250 ± 10 psi dynamic and the return pressure should be 60 ± 15.

1.3.3 RF Interface

The connectors J6 and J7 are coaxial type N which provide the LCP and RCP RF outputs, respectively. The RF outputs supply a signal from 7.9 to 8.9 GHz which is only a window of the front-end's band and the location of that window is dependent on the setting of the local oscillator setting. It is advised to use a filter on these outputs before performing any other manipulations to the signal.

The coaxial type N female connector J8 is the input for the local oscillator signal which is tripled before being mixed with the RF signal. The input power of the local oscillator, at the input connector J8, must be between +2 dBm and -8 dBm.

1.3.4 Front-End DC Interface Connectors

The connection to the VLBA bus must be accomplished with a F101 front-end control module.

1.3.4.1 Front-End Monitor (J2)

The front end monitor (J2) provides analog and digital signals which describe the state of the system. The analog portion monitors the dewar/pump vacuum, temperatures, amplifier gate voltages, AC current and LED voltages. The dewar and pump vacuum monitored through J2 are provided for fault detection and isolation. They also provide protection of the vacuum to remain less or equivalent to the value of the pump port vacuum. The vacuum pressure as a function of the vacuum monitor voltages V_P and V_D are given in figure 1.3-2.

The refrigerators 15 K, 50 K and ambient temperature are monitored through J2. The 15 K and 50 K temperature sensors are located on the corresponding plates and the ambient temperature sensor is located on the RF plate. The temperature sensors used are Lake Shore Cryotronics Inc., Model DT-500KL. The output of these three temperature monitors are linearized (10mV/K), but the 15 K temperature voltage is buffered by a unity gain amplifier. 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.

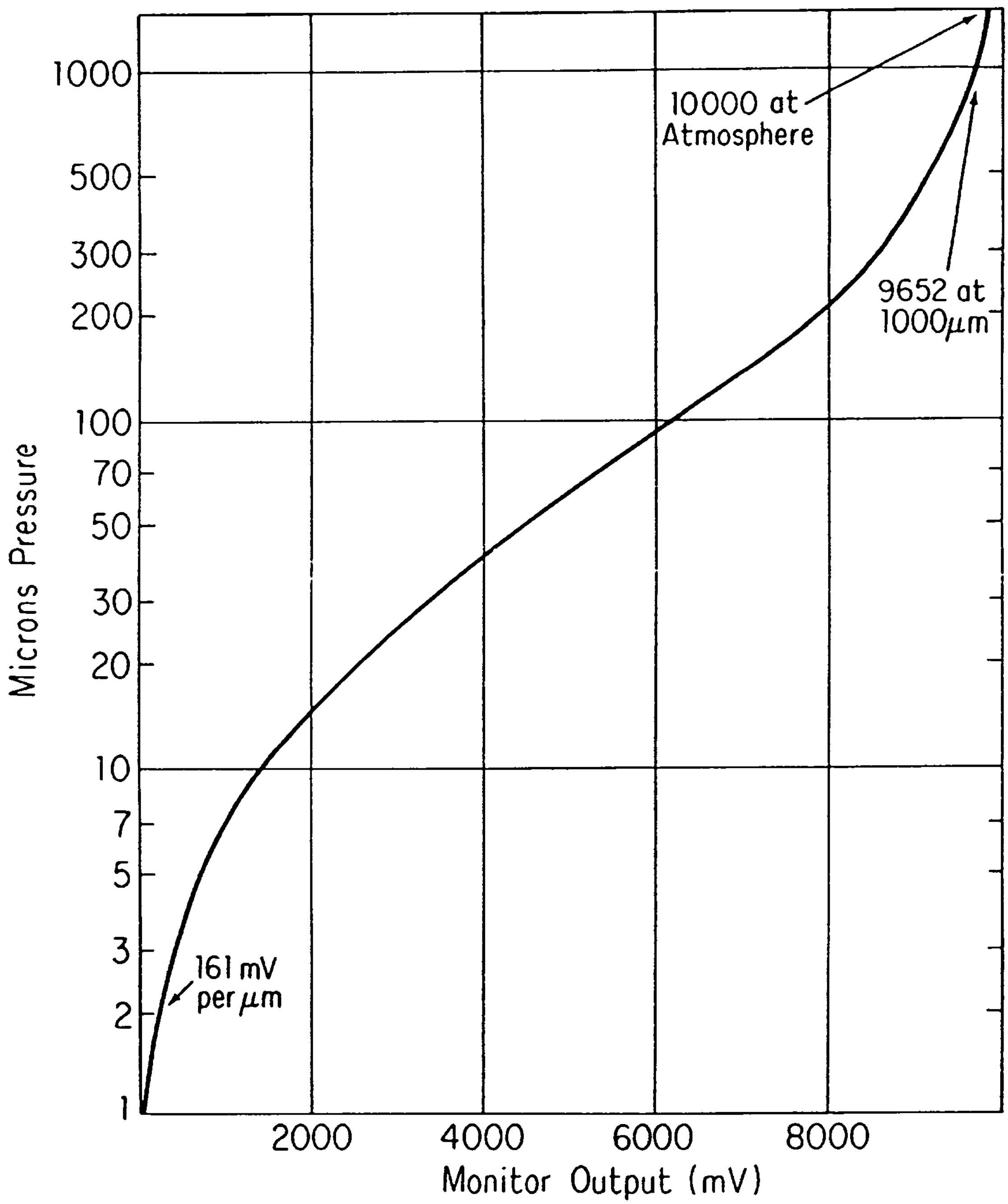


Figure 1.3-2
Vacuum Monitor Voltage vs Pressure

The front-end monitor connection also monitors the gate voltages through RF1, LF1, RF2 and LF2. The first stage gate voltages are given by RF1 and LF1. The average of the remainder of the gate voltages is given by RF2 and LF2. If a large change exists in one of these indicators, it usually implies that one of the amplifier stages has a fault, that a problem exists in the bias card or the front end wiring has a fault.

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 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 heater currents are summed in this monitor voltage. Typical currents in the various front-end modes are: COOL - 0.7 A, STRESS - 0.73 A, and HEAT - 0.45 A. The rms current drawn by the various loads are as follows:

Refrigerator Motor	0.7	amps
Vacuum Solenoid*	0.25	amps
Heaters in HEAT Mode	0.20	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.

Six TTL digital monitor signals are provided on the front-end monitor connector. The pump request signal (P) should be monitored and connected to the vacuum manifold control circuits. P is active if vacuum pumping is required. The condition of the solenoid is described by the vacuum solenoid signal, S. If S is active the vacuum valve is open. The manual monitor is high then the front-end is in the CPU position. Three bits X, C and NOT-H are used to indicate the state of the system. The logical state is determined according to Table I. The pin assignment of connector J2 is given in Table II.

1.3.4.2 Dewar Power/Monitor (J3)

This connection provides power to the bias voltages of the amplifier, dewar heaters and LEDs. The amount of power transferred to the bias network of the amplifiers can be adjusted using the bias card adjustment potentiometers in slots 1, 4 and 5 of the card cage. The bias of the first four stages of the RCP channel amplifier is controlled by the bias card in slot 4 and the bias of the first four stages of the LCP channel amplifier is controlled by the bias card in slot 5. Slot one is used to bias the fifth stage on both amplifiers, VD4, ID4 and VG4 is associated with the RCP channel amplifier and VD1, ID1 and VG1 is associated with the LCP channel amplifier.

Table I

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 33 watts of heat added. PUMP REQ becomes high when dewar vacuum is greater than ten microns.
1	0	0	PUMP	No refrigerator or heater power. PUMP REQ high; vacuum solenoid open when manifold pressure is less than dewar pressure

1.3.4.3 DC Power and Control (J5)

The DC Power and Control (J5) provides control of the cryogenic states, calibration signal and identification. By setting the X, C and NOT-H bits as specified in Table I the indicated states can be obtained. The state of all zeros is not defined but it will be interpreted as the stress state. There is no memory in the dewar control circuitry and switching from one

TABLE II

J2-MONITOR
(DB25S ON FRONT-END)

Pin	Label	Function
1	VP	PUMP VAC
2	VD	DEWAR VAC
3	15K	TEMP MON,
4	50K	10mV/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	SOLINOID MON
21	P	PUMP REQ
22	M	MANUAL MON
23	X	CONTROL
24	C	MODE
25	H	MONITOR

TABLE III

J5-PWR, CONTROL AND ID
(DB25P ON FRONT-END)

Pin	Label	Function
1	GND	POWER GROUND
2	+15	how many amps?
3	-15	how many ammps?
4		
5		
6	X	CONTROL BITS
7	C	
8	H	
9	PA	FE PARITY (EVEN)
10		
11	CAL	28.0 V how many amps
12		
13		
14	F0	LSB
15	F1	FREQUENCY
16	F2	ID
17	F3	MSB
18	S0	LSB
19	S1	SERIAL
20	S2	NUMBER
21	S3	
22	S4	
23	S5	MSB
24	M0	MODIFICATION
25	M1	MSB

TABLE IV

FREQUENCY ID CODE

Code	Frequency	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 2 PHASE
(DEUTSCH DM9606-3P ON FRONT-END)

PIN	Label	Function	MS Pin Power Supply
1	01	SHIFTED PHASE	A
2	02	LINE PHASE	B
3	R	RETURN	C

TABLE VI

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		

mode to another can be performed with out damage; the control card will only allow the solenoid to open if the pump port vacuum is sufficiently low and protects the dewar from overheating by the heaters. The control bits are TTL level with each driving one LS load.

The calibration control signal directly drives the calibration noise source. The calibration signal is turned on by 28 volts at 16 mA. The coefficient of calibration power output versus supply voltage is less than 0.1 dB/% for calibration.

The system identification is controlled by bits F0-F3, SN0-SN5, M0 and M1, as shown in Table III. The bits F0-F3 are the frequency identification code, which is given in Table IV. In the VLBA, the frequency identification bits will be used for the monitor and control address assignments. The serial number of the unit is contained in bits SN0-SN5. The bits M0 and M1 will be used to designate any modifications to the system. Low identification bits are connected to ground; high bits are open circuited. Pull up resisters are required in the front end control module F101.

To allow for the maintenance on the system while still in operation this connector (J5) may be unplugged and the refrigerator will continue to run. If the +15 volt supply is turned off with the AC power still connected, power will be applied to the refrigerator motor regardless of the condition of the dewar vacuum.

1.3.4.4 Auxiliary Connector (J4)

This connector is provided to allow miscellaneous connections to the front-end, the AC current monitor and the pump request signals are explained in section 1.3.4.1

1.3.5 AC Power Interface (J1)

The CTI Model 22 refrigerator requires two-phase, 150 vol, 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 suggested power source schematic are shown in Figure 1.3-3. The P111 Model 22 Power Supply provides the proper voltages to run the refrigerator motor and is described in section 2.12.

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 Systems Parameters Budget

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

Table VII
Front-End Gain Budget

Input Losses	-0.75 dB
5 Stage HEMT	+30.0 ± 3
SS WG	-0.4
Mixer	-8.0
BP Filter	-0.5
Post Amp	+35.0 ± 1
NET GAIN	+55.35 ± 4

Table VIII
System Noise Budget

COMPONENT	PHYSICAL TEMPERATURE (K)	NOISE TEMP OR LOSS (dB)	SYSTEM CONTRIBUTION (K)
HEMT amp	15	30.0	30.0
Mixer	300	1540.0	2.0
Second stage amp	300	170.0	1.0
Polarizer	15	.15	0.5
Vacuum Window	300	.05	3.5
Thermal Transition	15	.25	.9
Isolator	15	.4	1.4
TOTAL RECEIVER TEMPERATURE			39.3

Table IX
Heat Load on Refrigerator

Radiation	0.23 Watts
No. 32 Brass Wire (31)	0.07
Thermal Transition Standoffs (3)	0.17
Waveguide, SS with Gold Plating, 15 - 50 K, (2)	0.09
Waveguide, SS with Gold Plating, 50 - 300 K, (2)	0.34
Waveguide, SS, 15 - 50 K, (2)	0.01
Waveguide, SS, 50 - 300 K, (2)	0.06
HEMT DC Bias	0.67
TOTAL HEAT LOAD	1.64 Watts

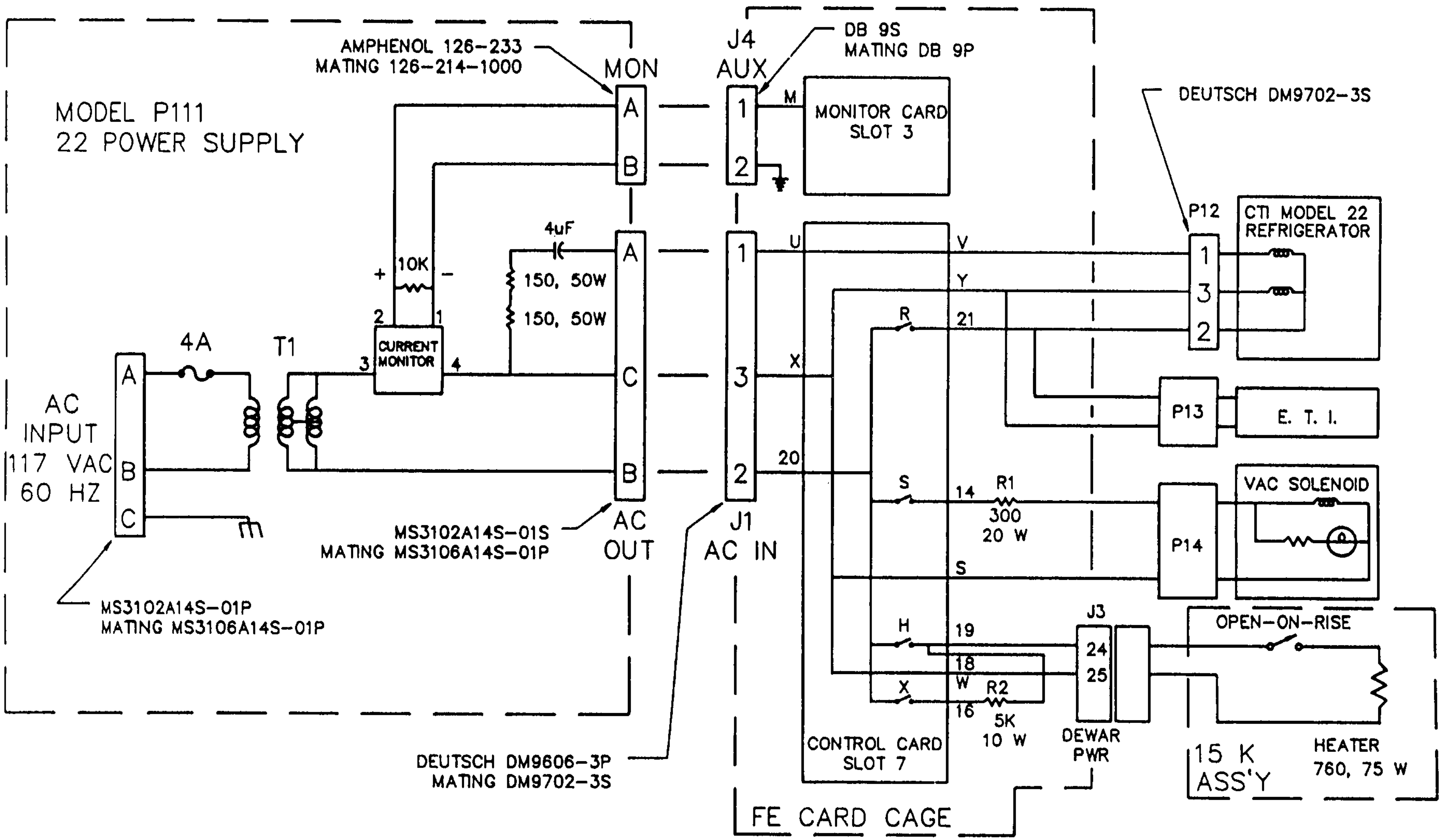


Figure 1.3-3
Front-End AC Wiring

Section 2: Component Description 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. Manufactures' data sheets for commercial components used in this front-end are included in Appendix III. In Appendix IV, special test equipment needed to test and construct the front end is described.

2.1 Vacuum Dewar

The vacuum dewar is a cylindrical vessel, formed from aluminum tubing capped with one-half inch thick aluminum end plates. The waveguide input flange is located on the Top Plate (so called because it will be nearer the sky in the VLBA cassegrain system). The refrigerator, vacuum manifold, DC and RF feedthru's are mounted on the bottom plate. All joints are sealed with O-rings; no welding is used.

2.1.1 Vacuum Pumping

The dewar interior volume is approximately 12 liters. The interior surfaces and the cryopumping charcoal on the 50K plate absorb gasses and water vapor that are difficult to remove by mechanical pumping. If a dewar has been open for several days in humid conditions, it takes a couple of 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 a vacuum, the same pump can achieve 50 microns in less than 30 minutes. It is recommended that, before cooling the front-end prior to installation on the telescope, it be pumped at room temperature for twenty four hours, if possible.

2.1.2 Radiation Shields

A single level of radiation shielding is used in the dewar to reduce the radiation loading on the refrigerator cold station. The shield is constructed of thin aluminum sheets formed into the proper shapes. A cylindrical shield is attached to the refrigerator first stage and is spaced away from the dewar outer cylinder by about 1/2 inch. The first circular shield is mounted by bolting it to the 50 K plate by the use of two L-brackets and the charcoal assembly. Bolted to the top of the large cylinder is a smaller cylinder which surrounds the thermal transition and polarizer.

2.1.3 System Cooldown 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, extended pumping 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 250 ± 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 connectors. Check that the AC and DC power supplies are on. Using the meter on the local control panel, check that the monitor voltages on the card cage are appropriate.

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 typical cooldown 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 12 K to 15 K on the second stage and 50 K to 70 K on the first stage. The warm up time with 33 watts of heat applied is five hours. The ratio of these times gives an average refrigerator cool-down power of 13 watts including 0.4 watts to compensate for HEMT DC bias power.

2.1.4 Disassembly of Dewar

Figures 2.1-2 through 2.1-4 show the front-end in a disassembled state. The steps necessary to disassemble the dewar so that cooled components may be worked on are:

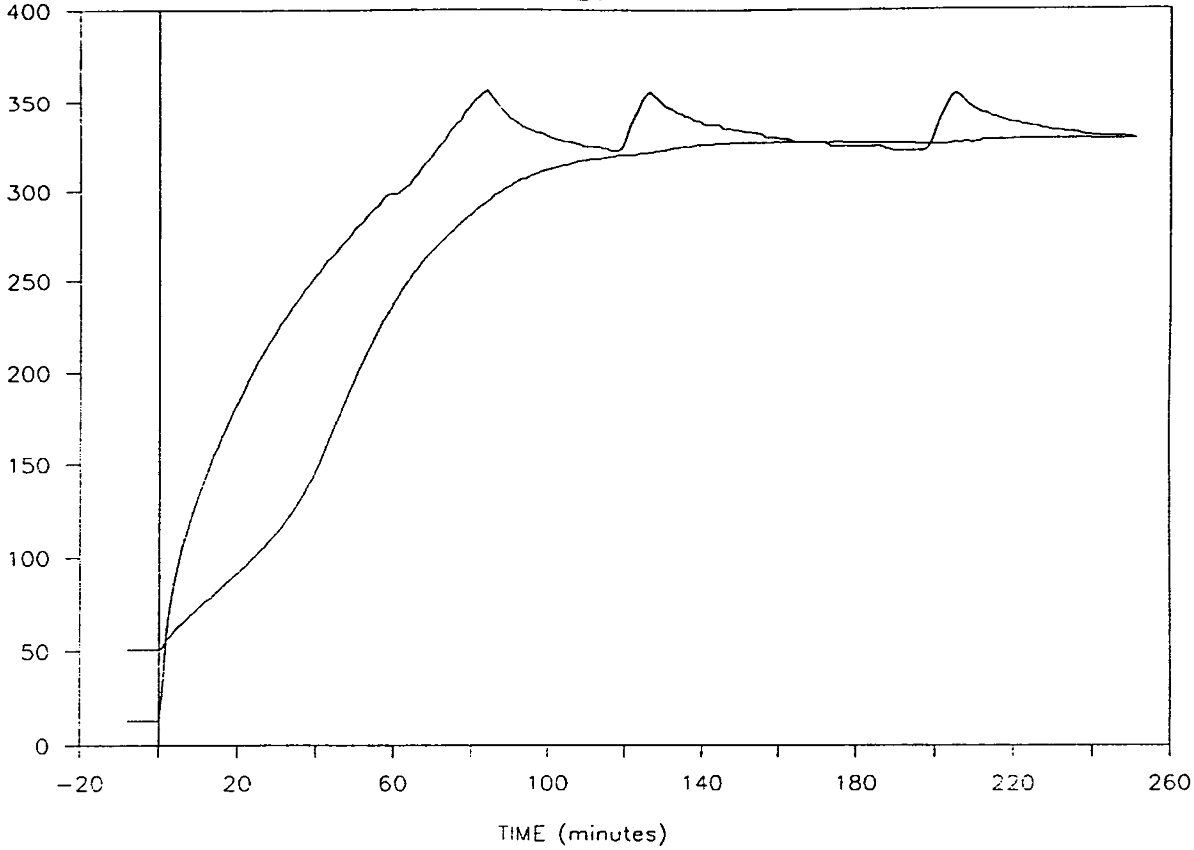


Figure 2.1-1
a) Front-end Warm-up Record

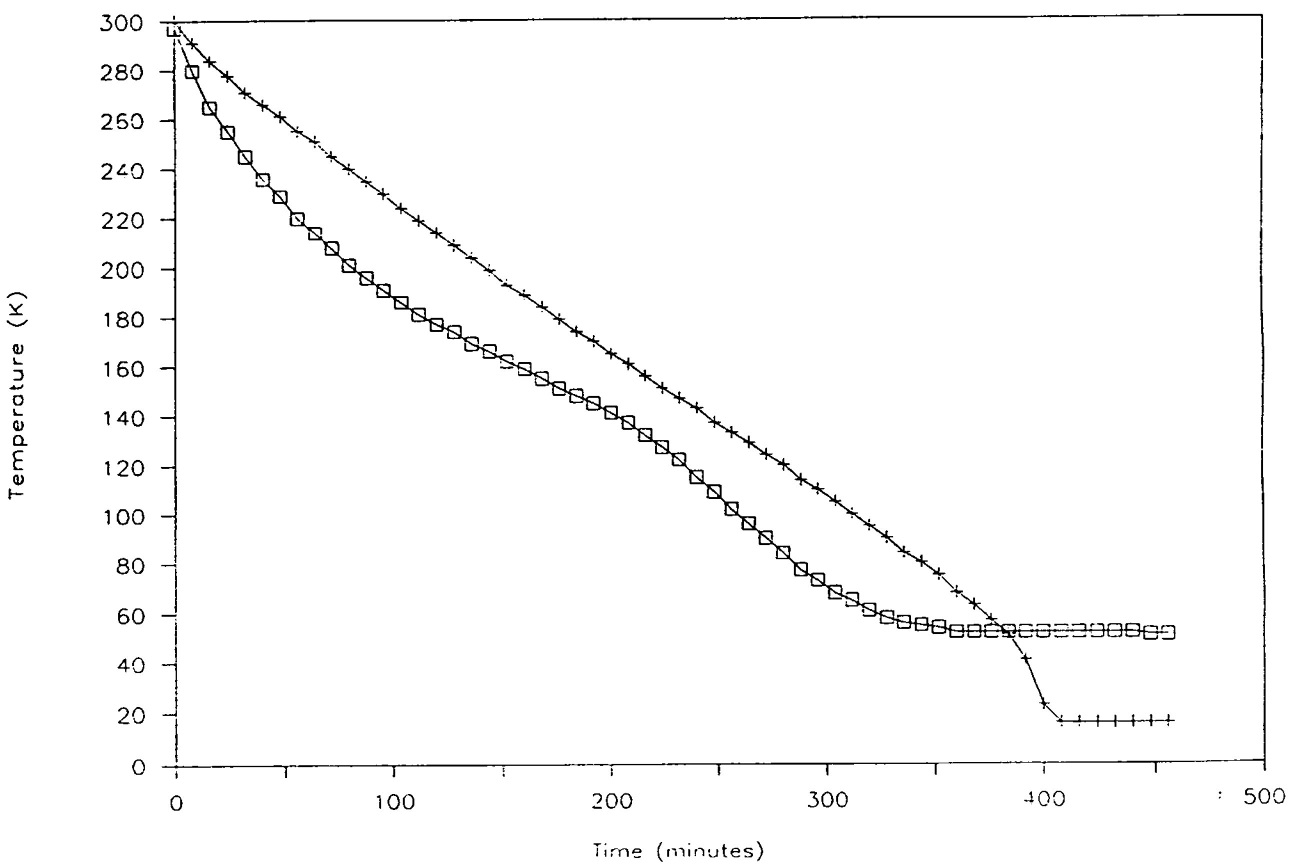


Figure 2.1-1
b) Front-end Cool-down Record

1) With the front-end warmed to room temperature, open the manual vent valve, bringing the dewar to atmospheric pressure. On a convenient work surface, place the front-end so that the top plate is accessible.

2) If the vacuum and helium lines are still attached, disconnect them for convenience. Remove the two screws attaching the card cage brace to the top plate of the dewar.

3) Remove the Feed Mounting Plate by removing all nine of the screws attaching the plate to the thermal transition housing and thermal transition assembly.

4) Remove the six 10-32 screws holding the Dewar Bottom Plate to the dewar cylinder and carefully lift up on the dewar and thermal transition housing.

5) Remove the three screws on the 50 K plate which holds the heat shield in place. Carefully lift up on this heat shield as was done with the dewar.

Access to any of the cooled components is now possible.

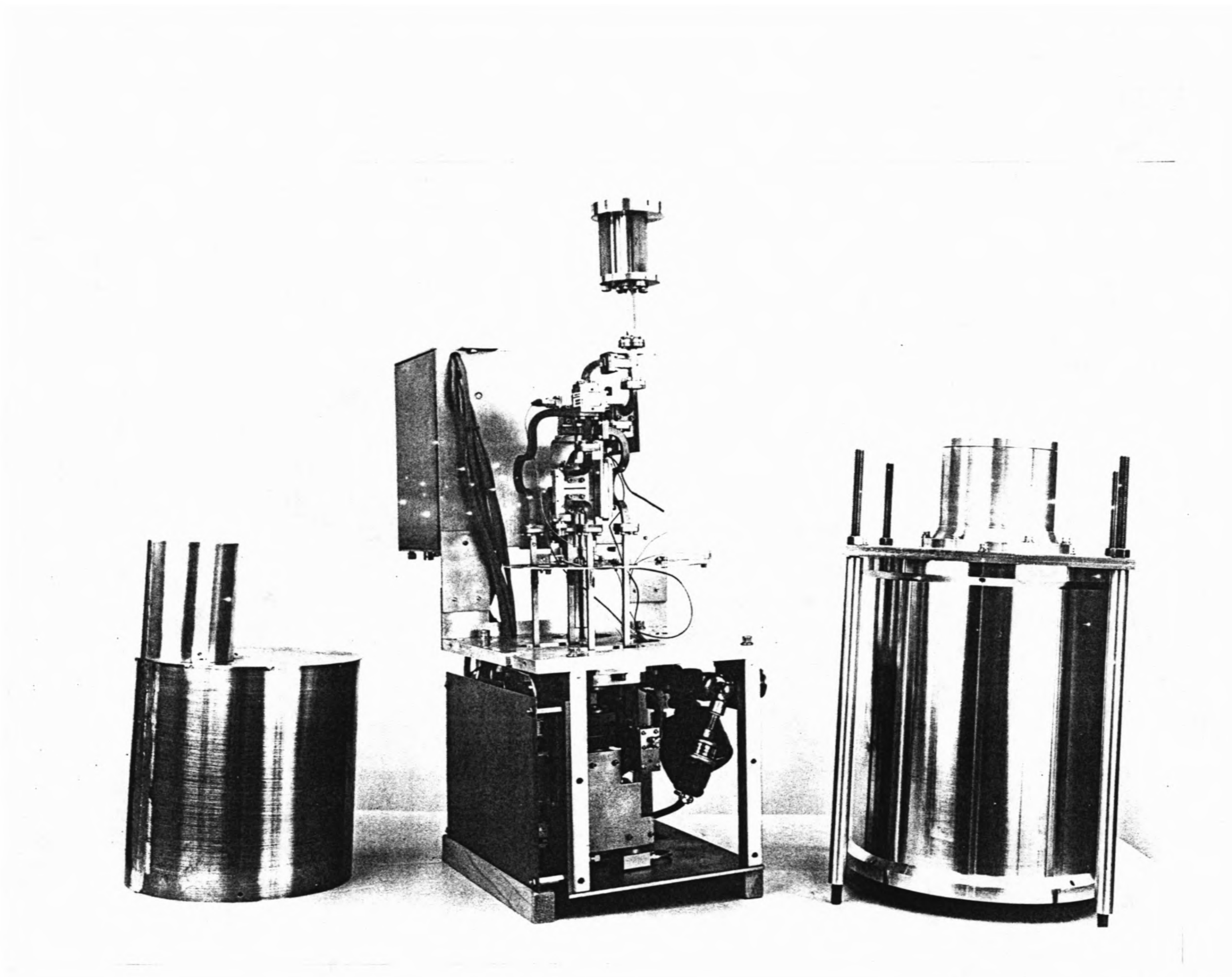


Figure 2.1-2
Disassembled Dewar
From Left to Right: Dewar, Top Plate and Thermal Transition Housing; Cooled Components, Card Cage, RF Components and Vacuum Assembly; Heat Shield Assembly;

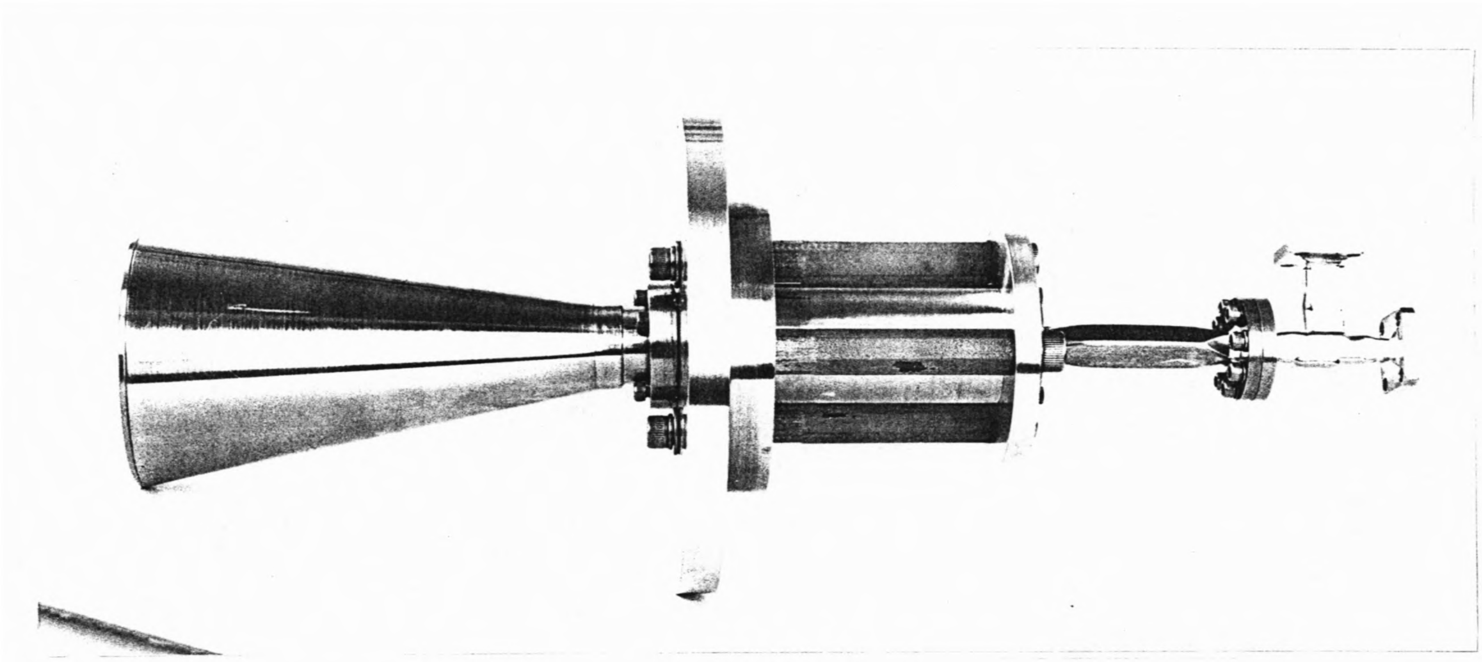


Figure 2.1-3
Input Section
From Left to Right: Feed Horn, Feed Horn Mounting, Thermal Transition and Polarizer

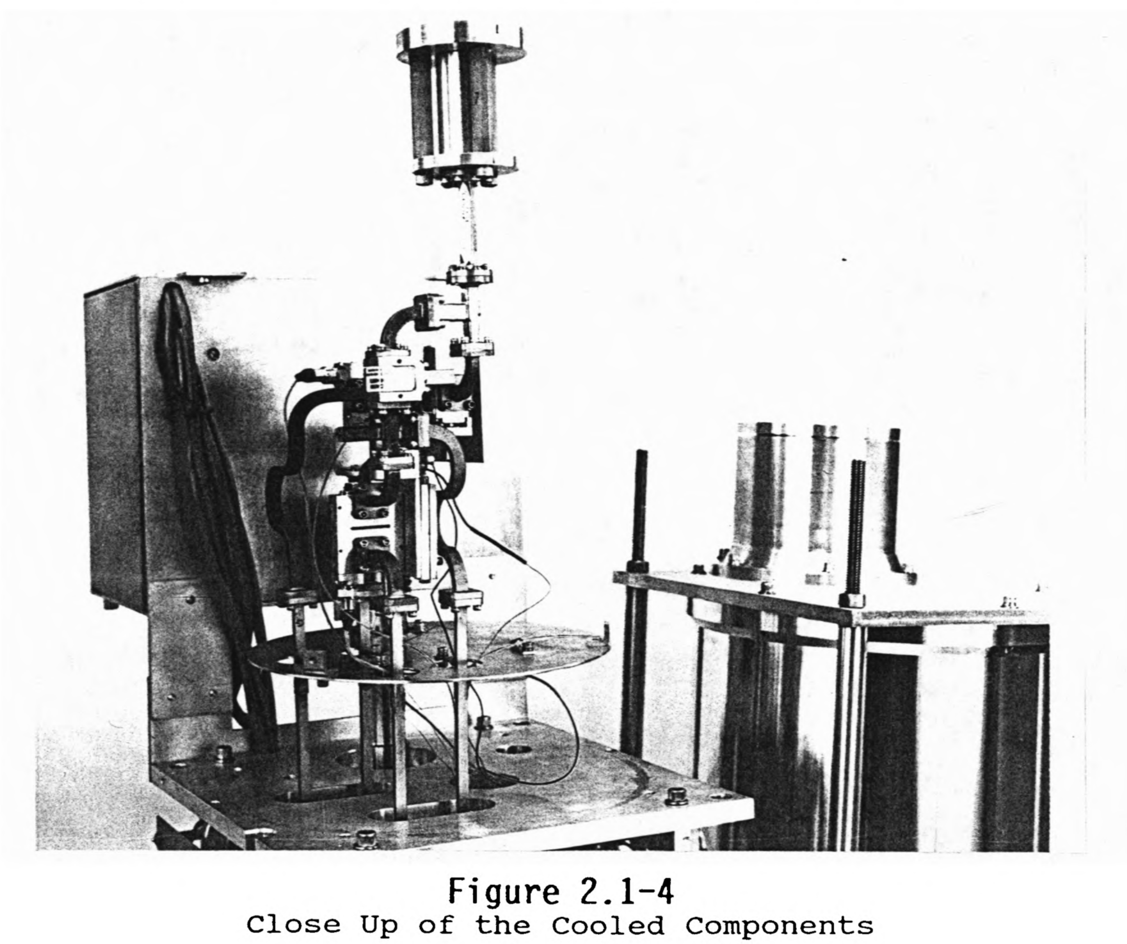


Figure 2.1-4
Close Up of the Cooled Components

2.1.5 Reassembly of the 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 any of these surfaces. When closing the dewar, check that there is no dirt or foreign objects on the 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.

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 the cleaning with freon. This is important for the interior of the dewar walls and exterior of the radiation shield. 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 a vacuum within the cryogenics dewar. The window used in this system is formed by epoxying a three mil piece of mylar onto a lip within the feed mounting plate. This mylar is also secured by an iris with an inside diameter of 0.170 inches.

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.

2.3 Waveguide Thermal Transition

Thermal isolation between the dewar input flange and the polarizer at 15 K is provided by a .003 inch (.0762 mm) gap in the waveguide wall. A choke grooved gap is used. Insertion loss (approximately 0.2 dB average) 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 three 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 168 mW total conduction load.

The thermal transition is machined in two sections from 6061-T6 aluminum. The top section bolts to the feed mounting plate which contains the mylar window which is described in section 2.2. The lower section is supported from the top section by the three support tubes and the polarizer is bolted to its lower surface. A picture of the thermal transition is shown in Figure 2.1-3.

2.4 Polarizer

The polarizer is a vaned waveguide structure provided by a commercial vendor, Gamma-f model number 107790, specification number A53213N001 Rev. B. The vanes within the first portion of the polarizer accomplish the conversion of circular to linear while the remainder provides the separation into left and right channels.

The input to the polarizer is a circular waveguide of .200 inches in diameter and the output is two waveguides which mate with WR-22. The through arm of the output of the polarizer contains the left circularly polarized signal converted to linear polarization while the side arm contains the right circularly polarized signal converted to linear polarization.

2.5 Noise Calibration System

The noise calibration components are shown in the block diagram, Figure 1.1-1. A 31.5 dB directional coupler in each input line, after the cryogenic isolators, couples in a calibration signal. The cal signal is transmitted into the dewar via WR-22 waveguide and similar feedthrus as used on the output to the cooled amplifiers. Before entering the dewar the cal signal is split by a hybrid tee, with one port terminated so that another calibration system can easily be added.

The noise added prior to the amplifiers, within the dewar , is injected into the dewar by using stainless steel WR-22 waveguide and waveguide windows. The excess noise is transmitted into the dewar using a configuration employing four cast bends, two E-plane bends and two H-plane bends, after being split by a Hybrid-Tee.

The noise signal is provided by a model NC5222 noise source from Noise Com. This noise source is active when 28 volts is applied. The power to the noise source is connected to connector J5, pin 11.

2.6 Cooled Amplifiers

The five stage HEMT amplifiers provide an initial gain of 30 dB with a noise temperature of approximately 40 K, as seen in the noise temperature budget, Table VIII. The typical power dissipated by each amplifier is 0.33 watts (see heat load budget in Table IX). For each system produced the proper bias conditions will be recorded with the test data.

2.7 Dewar Internal Wiring

There are 29 wires between the 300 K dewar RFI feedthru plate and the components at the 15 K and two wires to the 50 K stage. To reduce the heat load of these wires, a special brass wire is used. The wire is a #32 soft brass (type 260) which gives a factor of 8 lower heat load and a higher strength than copper at a sacrifice of 2.3 times greater resistance at 300 K. It is coated with polyurethane insulation which can be burned off with a soldering iron and is bonded into a red/green pair 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 twelve inches and the total heat load for 31 wires (HEMT bias, 15 K and 50 K temperature sensors) is about 66 mW. For the two wires on the dewar heaters which must pass 0.21 amps, twelve inches of 7x38 AWG copper wire is used.

2.8 Dewar Internal Waveguide

The internal waveguide configuration is dependent on the channel that is in question. Although the configuration is different, the electrical properties are similar, the total loss throughout the dewar is approximately 2 dB. All waveguide used is copper with rectangular cover flanges except for the two stainless steel pieces used to transmit the signal out of the dewar and the two stainless steel pieces used to transmit the cal signal into the dewar.

Before the cooled amplifier one waveguide bend, approximately 1.5 inches long, carries the signal into the cryogenic isolator, the cal coupler and then into the amplifier. After the amplifier, the path of the waveguide varies depending on the channel. The signal is then extracted from the dewar by two stainless steel waveguide sections which are 4.836 inches long and plated on the interior only, with 45 micro inches of gold. Each of these stainless steel waveguide sections contribute 0.216 Watts of heat lost through conduction.

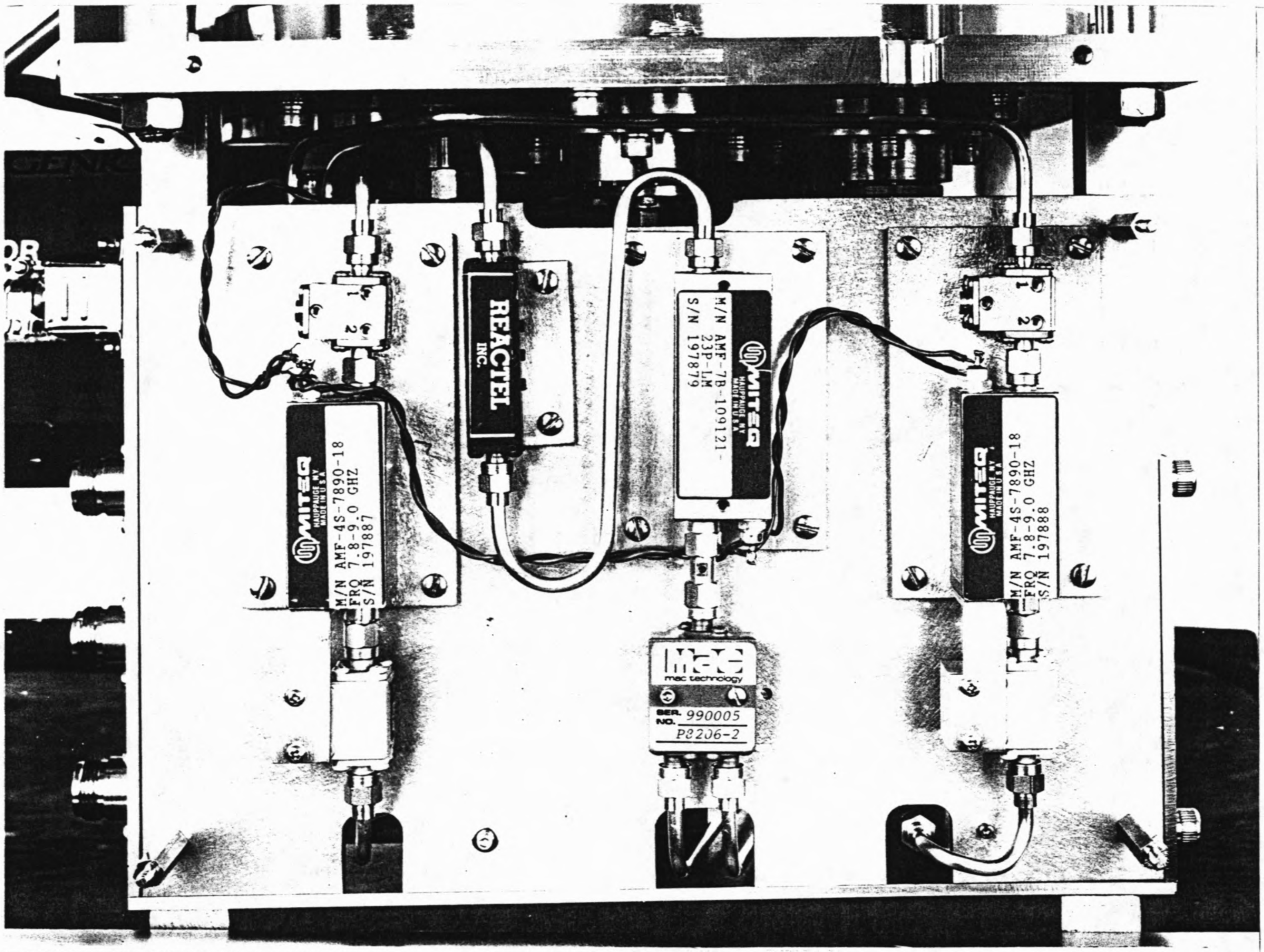


Figure 2.9-1
RF Plate

2.9 RF Plate

The RF Plate, as pictured in Figure 2.9-1, supports the two IF amplifiers, the LO's limiting amplifier, the LO's power splitter, the band pass filters and the isolators used on the IF amplifiers. Semi-rigid coax is used to transmit the signal from the mixer assembly to the IF amplifiers and from the IF amplifiers to the front-end output. Semi-rigid coax is also used at the input to the limiting amplifier and to carry the LO signal to the mixer after it has been split.

The IF amplifiers have a noise figure of less than 1.8 dB (150 K) with a gain of 35 ± 1 dB. The limiting amplifier provides +22 dBm output power when a signal is applied at +2 dBm to -8 dBm input power between 10.9 GHz and 12.1 GHz. The phase stability of the limiting amplifier, with respect to temperature, is .4 deg/K over the range of 273 K to 320 K.

All of the amplifiers are biased with a 15 volt supply. The limiting amplifier requires 325 milliamps of current while the IF amplifiers require 90 milliamps of current, for a total current load on the RF plate of 505 milliamps.

2.10 Mixer Assembly

The mixer assemblies are supplied by a commercial vendor, Spacek Labs, model DC3XM43-8.4, specification number A53213N002. The mixer assembly consists of a tripler, band pass filter, mixers and isolators. The mixers will have a conversion loss of less than 8 dB with a noise figure of less than 8 dB (1540 K). The mixers each require a bias voltage of 15 volts and a current load of 8 milliamps.

The mixer assembly receives the signal as it leaves the dewar and mixes it down such that the signal to be detected lies between 7.9 GHz and 8.9 GHz. A single channel of the mixer assembly is pictured in Figure 2.10-1.

2.11 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.

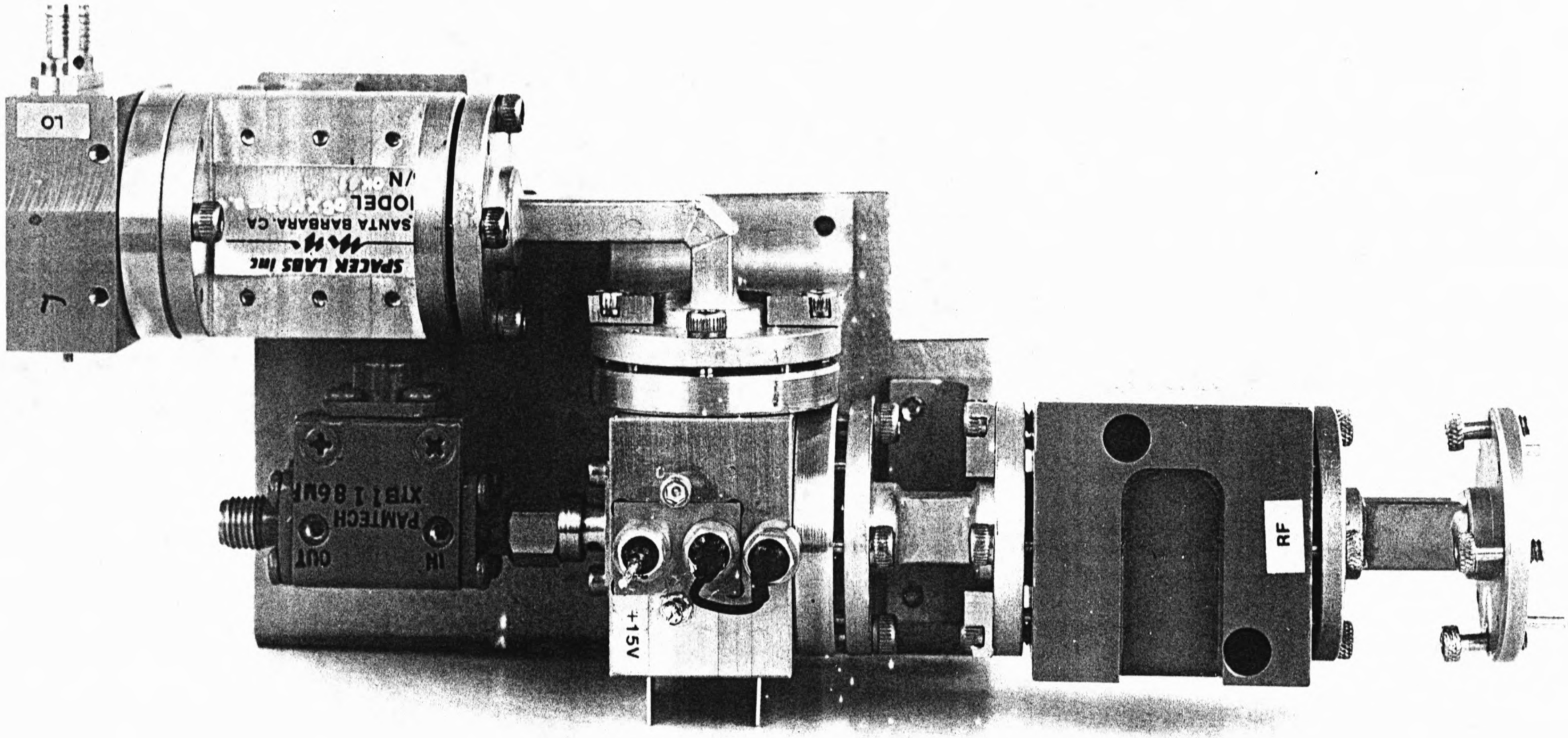


Figure 2.10-1
Mixer Assembly

2.12 Refrigerator Power Supply

The refrigerator motor requires two-phase (90 degree phase difference) AC power and will operate at 120 to 160 volts RMS at 50 to 60 Hz. The P111 Model 22 Power Supply is designed to provide the proper voltages, derived from 120 volt, 60 Hz, single phase power; the schematic is shown in Figure 2.12-1. An isolation transformer is used in the P111 with an unloaded output voltage of 160 volts RMS. The shifted phase output is obtained with an RC network. The resistance consists of two 150 ohm, 50 watt, 1% wirewound resistor in series. Total power dissipated in the resistors is approximately 45 watts. The capacitor is a 4 μF oil-filled capacitor.

Included within the P111 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 P111. 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 and control bus.

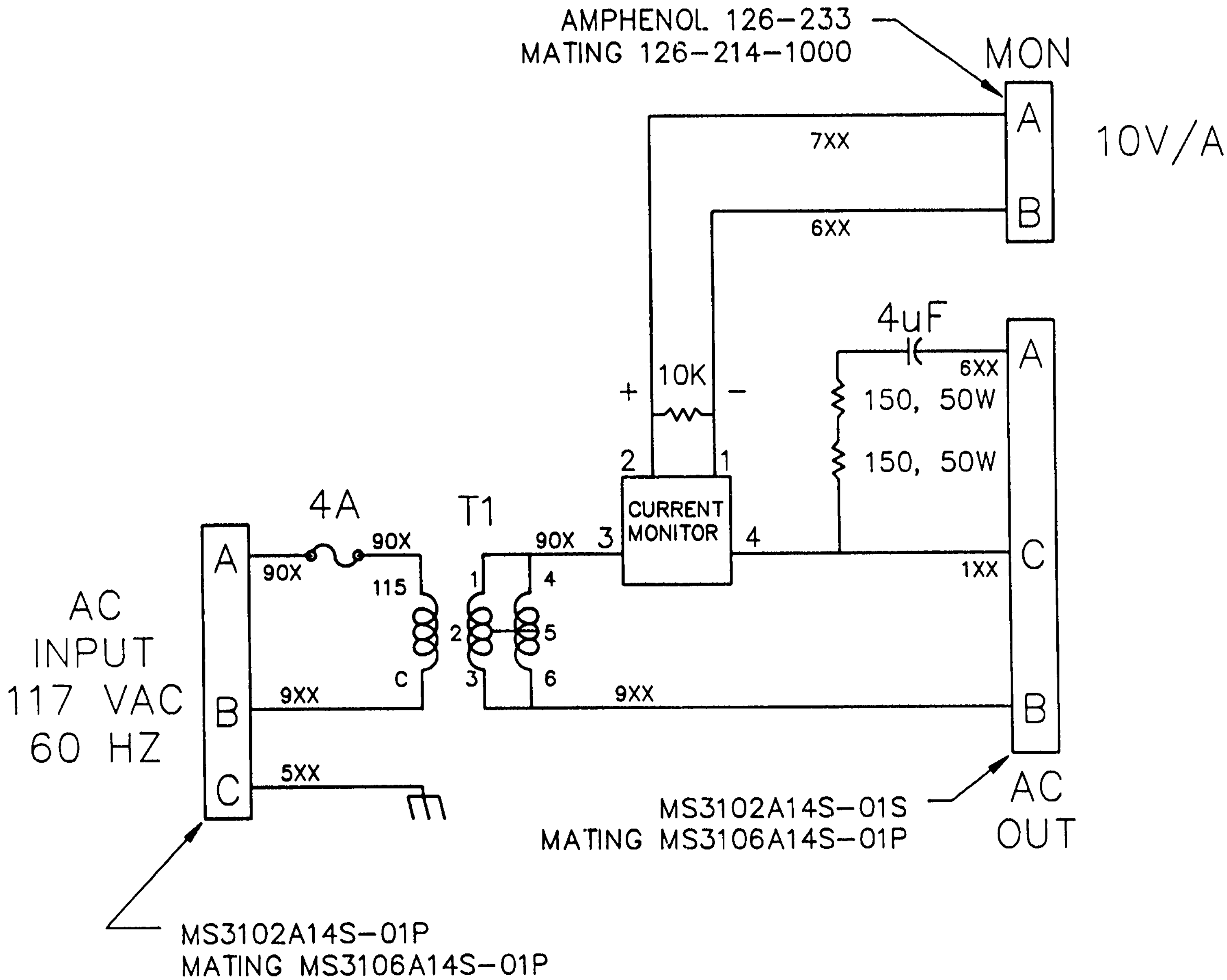


Figure 2.12-1
Schematic of P111 Refrigerator Power Supply

Section 3. TROUBLESHOOTING

3.0 Introduction

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

3.1 Low or No Gain

Check the cooled HEMT 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 card. RF1 and LF1 are the amplifiers' first stage gate voltages. RF2 and LF2 is the 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 amplifiers' 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 feedthru's 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 post amps located on the RF plate. If the +15 volts is not correct, unplug the RF plate and mixer power (J17) and measure the voltage at pin 2 of this connector. If that voltage is +15 ± 0.1 volts, then the individual RF components and mixers should be checked for proper power dissipation; 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 the 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 Cooldown 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 VD 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 (VP 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 cables 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 does not 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 is not working or the refrigerator will have to be serviced.

3.2.2 Refrigerator Runs, But System Does not Cool

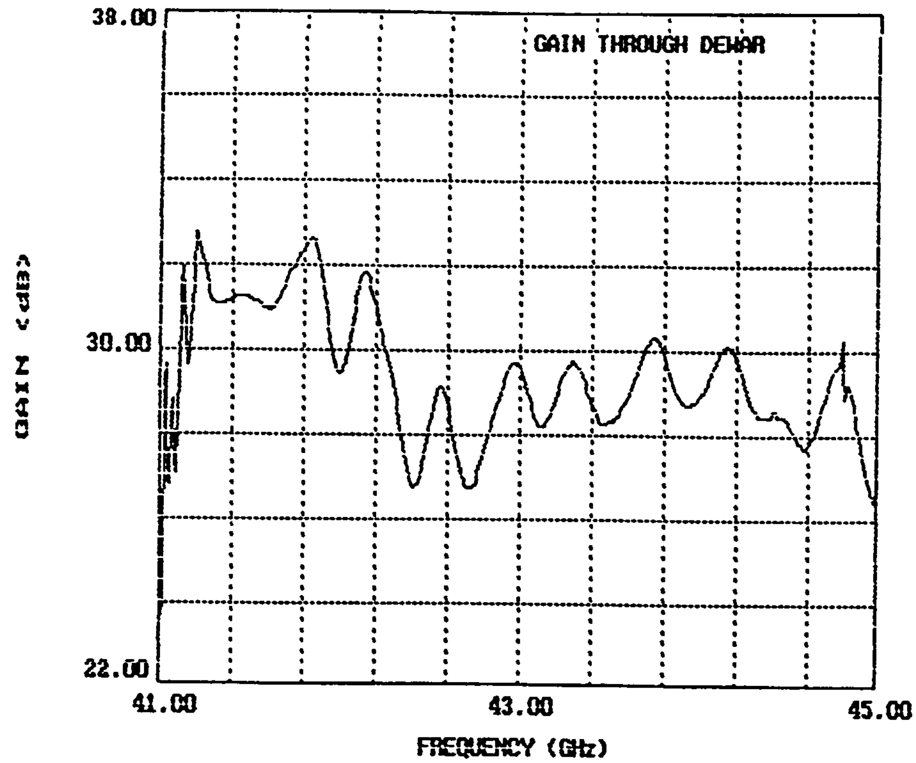
In the event of a cooldown failure, it is often difficult to ascertain whether the problem is a vacuum leak which loads the refrigerator or a refrigerator problem which gives poor vacuum due to insufficient cryopumping. If initial checks of refrigerator motor current, refrigerator sound, and compressor 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 microns/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 the 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 causes an O-ring to be less than fully compressed.

APPENDIX I

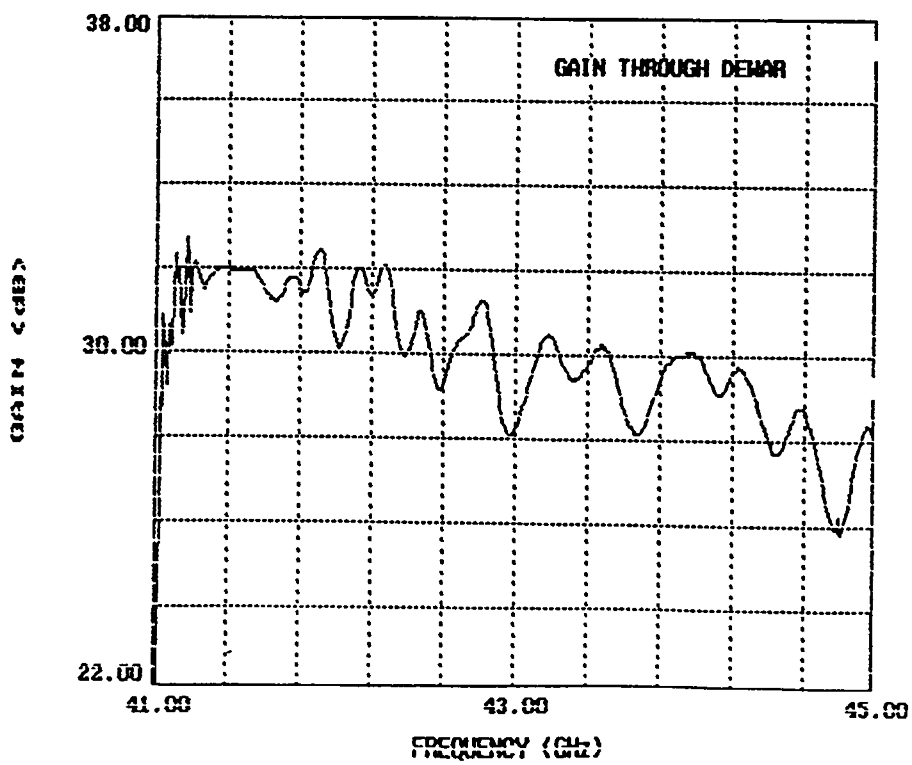
TEST DATA SAMPLE

I-1



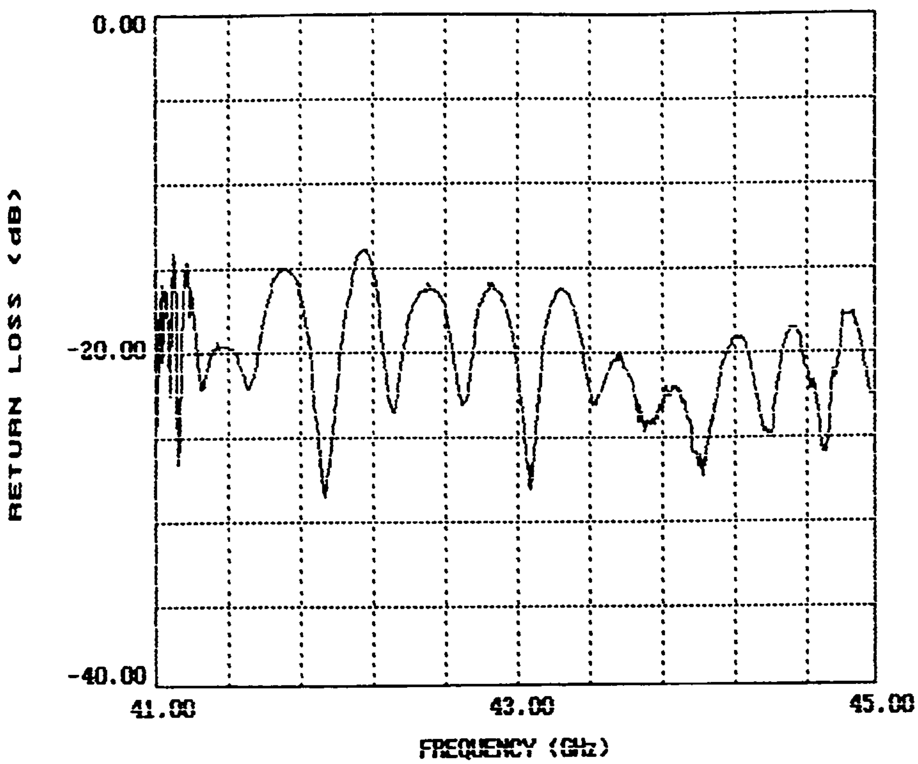
43 GHz ULBA FE SN 3

LCP

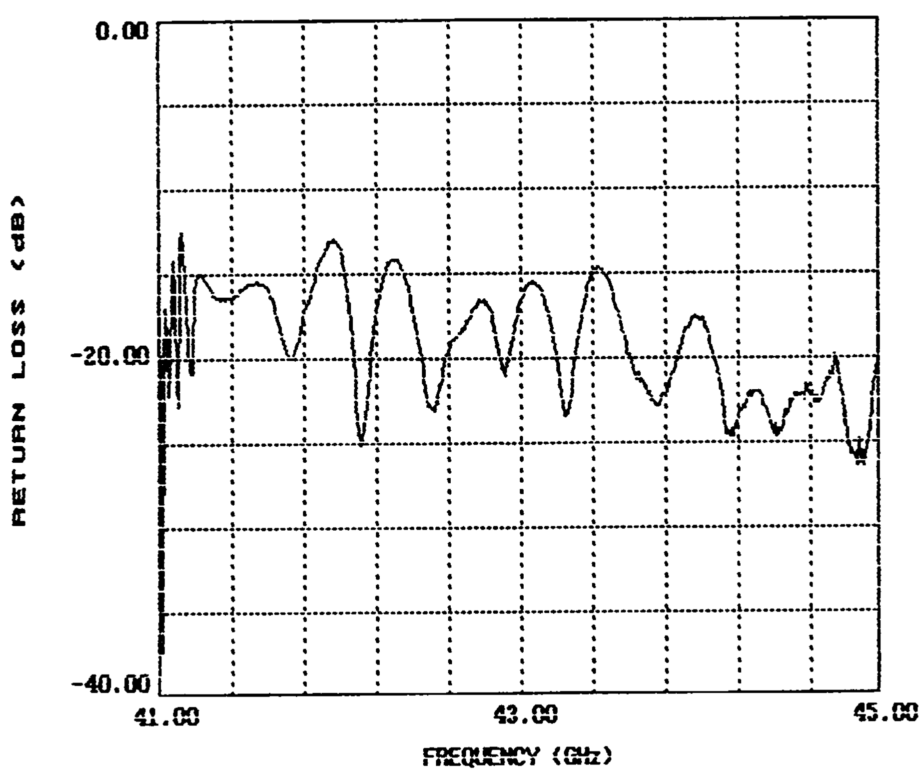


43 GHz ULBA FE SN 3

RCP

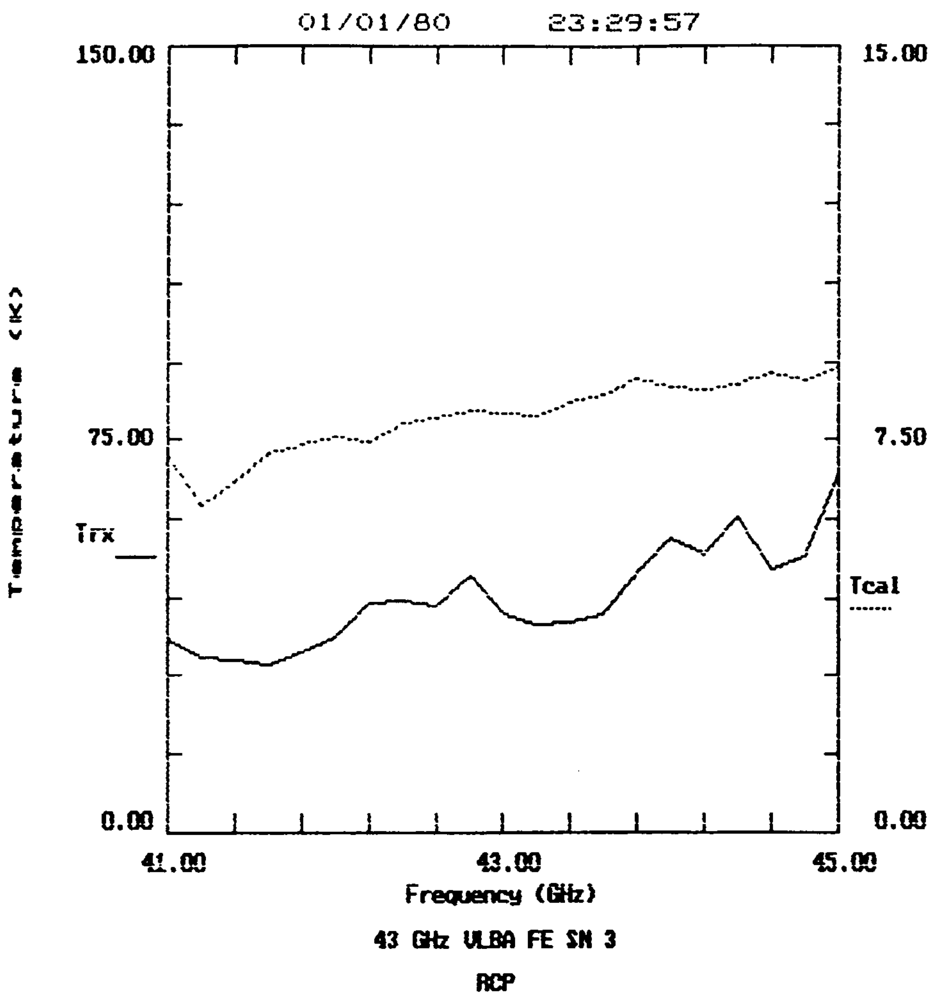


43 GHz ULBA FE SN 3
E- HORIZONTAL



43 GHz ULBA FE SN 3
E- VERTICAL

I-3


01/01/80 23:29:57
150.00
75.00
0.00
15.00
7.50
0.00
Temperature (K)
Trx
Tcal
41.00
43.00
45.00
Frequency (GHz)
43 GHz VLBA FE SN 3
RCP

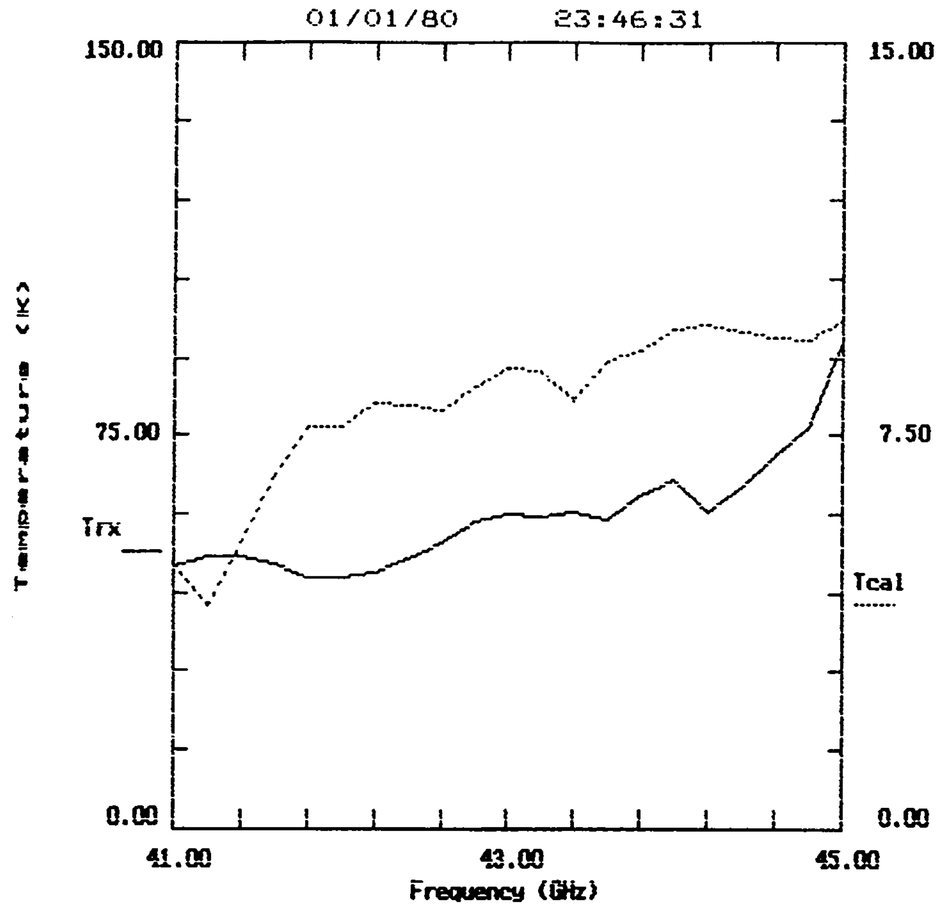
VLBA Receiver Calibration Record 01/01/80 23:28:58
RCP Polarization, Tested By MFM
Comment : FINAL TEST

Receiver : 43 GHz S/N 3 Mod 0 Parity OK
Solenoid OFF Pump Req FALSE Manual Control Cryo Mode : STRESS

(4)

15K Temp = 14.1 50K Temp = 53.2 300K Temp = 305.1
AC Amps = 0.047 Dewr Vac = 9.14 Pump Vac = 0.34
Sens Volt= 0.75 LoC Amps = 2398.21 HiC Amps = 2399.96
Cal Volt = 0.04 7.5V REF = 7.51 LED Volt = 10.000
FETS: LF1= 19.106 LF2 = 19.463 RF1 = 19.087 RF2 = 19.355

F(MHz)	Trx (K)	Tcal (dB)	Thical (K)	Tshort (K)
41.0	37.1	7.2	0.0	0.0
41.2	33.6	6.3	0.0	0.0
41.4	33.3	6.7	0.0	0.0
41.6	32.0	7.3	0.0	0.0
41.8	34.7	7.4	0.0	0.0
42.0	37.5	7.6	0.0	0.0
42.2	44.1	7.5	0.0	0.0
42.4	44.8	7.8	0.0	0.0
42.6	43.7	7.9	0.0	0.0
42.8	49.8	8.1	0.0	0.0
43.0	42.1	8.0	0.0	0.0
43.2	40.0	8.0	0.0	0.0
43.4	40.5	8.2	0.0	0.0
43.6	42.2	8.4	0.0	0.0
43.8	50.3	8.7	0.0	0.0
44.0	56.6	8.5	0.0	0.0
44.2	53.9	8.5	0.0	0.0
44.4	60.7	8.6	0.0	0.0
44.6	50.5	8.8	0.0	0.0
44.8	53.2	8.6	0.0	0.0
45.0	68.9	8.9	0.0	0.0



43 GHz VLBA FE SN 3

LCP

VLBA Receiver Calibration Record 01/01/80 23:45:30
LCP Polarization, Tested By MFM
Comment : FINAL TEST

Receiver : 43 GHz S/N 3 Mod 0 Parity OK
Solenoid OFF Pump Req FALSE Manual Control Cryo Mode : STRESS
、 4)

15K Temp = 13.6	50K Temp =	53.7	300K Temp =	305.1	
AC Amps = 0.047	Dewr Vac =	9.13	Pump Vac =	0.35	
Sens Volt= 0.79	LoC Amps =	2398.21	HiC Amps =	2399.96	
Cal Volt = 0.04	7.5V REF =	7.50	LED Volt =	10.000	
FETS: LF1= 19.106	LF2 =	19.463	RF1 = 19.087	RF2 =	19.355

F(MHz)	Trx (K)	Tcal (dB)	Thical (K)	Tshort (K)
41.0	50.3	5.1	0.0	0.0
41.2	52.3	4.2	0.0	0.0
41.4	52.1	5.5	0.0	0.0
41.6	50.6	6.7	0.0	0.0
41.8	48.0	7.7	0.0	0.0
42.0	48.2	7.7	0.0	0.0
42.2	49.3	8.1	0.0	0.0
42.4	51.8	8.1	0.0	0.0
42.6	54.8	8.0	0.0	0.0
42.8	58.8	8.4	0.0	0.0
43.0	60.0	8.8	0.0	0.0
43.2	59.7	8.7	0.0	0.0
43.4	60.7	8.2	0.0	0.0
43.6	59.2	8.9	0.0	0.0
43.8	63.5	9.1	0.0	0.0
44.0	66.6	9.5	0.0	0.0
44.2	60.6	9.6	0.0	0.0
44.4	65.4	9.5	0.0	0.0
44.6	71.1	9.4	0.0	0.0
44.8	76.9	9.4	0.0	0.0
45.0	92.8	9.7	0.0	0.0

43 GHz VLBA Front End
Final Test Report
Assembly 53213A001

FET BIAS SETTINGS

Card Cage S/N 03
Dewar S/N 03

Date 4-5-91
Tested By MFM

LEFT CHANNEL AMPLIFIER

	V_{ds}	I_{ds}	V_{gs} 15 K	V_{gs} 300 K
STAGE 1	1.51	3	-.895	-.927
STAGE 2	2.51	5.1	-.615	-.551
STAGE 3	2	5	-.855	-.884
STAGE 4	2.01	5.1	-.598	-.624
STAGE 5	2.73	10	-.298	-.286
Amplifier # B6				

RIGHT CHANNEL AMPLIFIER

	V_{ds}	I_{ds}	V_{gs} 15 K	V_{gs} 300 K
STAGE 1	1.51	3	-.876	-.926
STAGE 2	1.51	3.1	-.779	-.550
STAGE 3	1.5	3	-.902	-.884
STAGE 4	1.51	3.1	-.437	-.624
STAGE 5	1.6	5	-.334	-.439
Amplifier # B7				

43 GHz VLBA Front-End
Final Test Report
Assembly 53213A001

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

Card Cage S/N 03

Date: 4-5-91

Dewar S/N 03

Tested by: MFM

Input Condition	At 15 K					
	Local Oscillator Frequency (GHz)					
	L-Channel (dBm)					
	10.9	11.1	11.4	11.6	11.9	12.1
300 K Load	-21.89	-22.22	-23.36	-23.51	-25.40	-25.69
84 K Load	-25.63	-25.90	-26.83	-26.90	-28.33	-28.38
Short	-26.96	-27.22	-27.95	-27.99	-29.20	-29.12
Short + Cal	-26.75	-26.98	-27.68	-27.71	-28.97	-28.91

43 GHz VLBA Front-End
Final Test Report
Assembly 53213A001

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

Card Cage S/N 03

Dewar S/N 03

Date: 4-5-91

Tested by: MFM

Input Condition	At 15 K					
	Local Oscillator Frequency (GHz)					
	R-Channel (dBm)					
	10.9	11.1	11.4	11.6	11.9	12.1
300 K Load	-24.36	-23.83	-23.40	-27.78	-26.04	-26.90
84 K Load	-28.14	-27.66	-27.24	-27.50	-29.32	-29.88
Short	-29.48	-29.11	-28.62	-28.82	-30.39	-30.75
Short + Cal	-29.14	-28.82	-28.33	-28.53	-30.15	-30.56

43 GHz VLBA Front-End
Final Test Report
Assembly 53213A001

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

Card Cage S/N 03

Dewar S/N 03

Date: 4-5-91

Tested by: MFM

Input Condition	At 300 K					
	Local Oscillator Frequency (GHz)					
	R-Channel (dBm)					
	10.9	11.1	11.4	11.6	11.9	12.1
300 K Load	-29.01	-28.97	-29.01	-29.30	-30.66	-31.07
84 K Load	-30.11	-30.07	-30.08	-30.28	-31.45	-31.72
Short	-29.09	-29.05	-29.10	-29.35	-30.74	-31.13
Short + Cal	-29.12	-29.06	-29.11	-29.37	-30.76	-31.15

43 GHz VLBA Front-End
Final Test Report
Assembly 53213A001

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

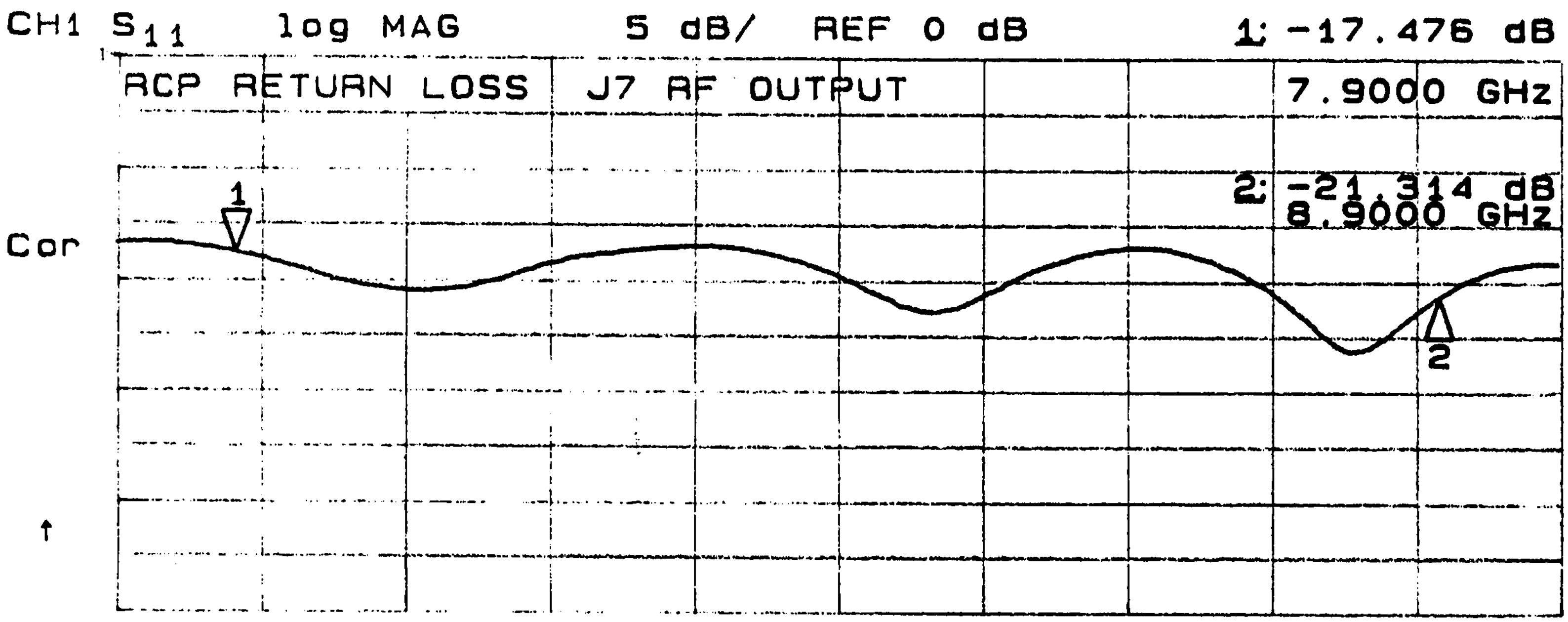
Card Cage S/N 03

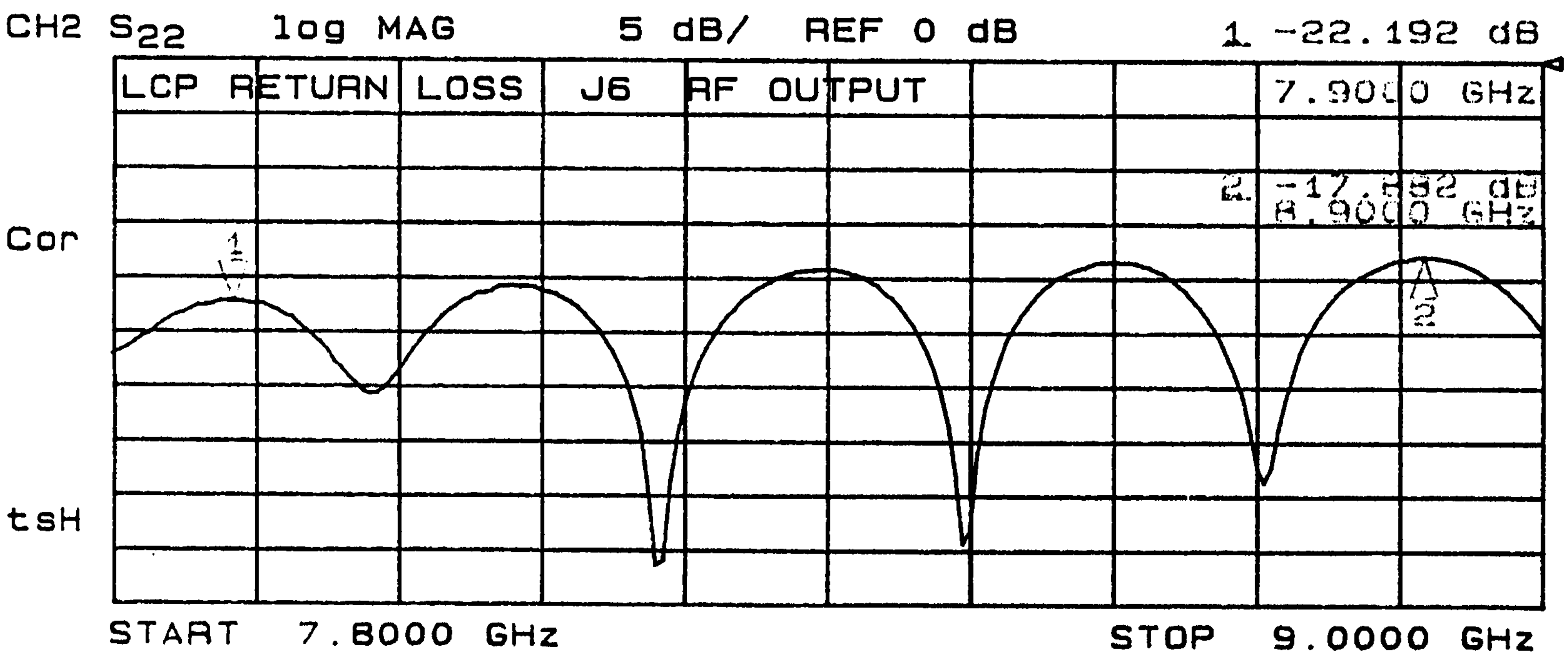
Date: 4-5-91

Dewar S/N 03

Tested by: MFM

Input Condition	At 300 K					
	Local Oscillator Frequency (GHz)					
	L-Channel (dBm)					
	10.9	11.1	11.4	11.6	11.9	12.1
300 K Load	-26.69	-26.57	-27.09	-27.00	-28.52	-28.72
84 K Load	-27.89	-27.79	-28.25	-28.15	-29.39	-29.44
Short	-26.69	-26.57	-27.10	-27.10	-28.53	-28.73
Short + Cal	-26.61	-26.49	-27.02	-26.93	-28.46	-28.66


CH1 S11 log MAG 5 dB/ REF 0 dB 1: -17.476 dB
RCP RETURN LOSS J7 RF OUTPUT
7.9000 GHz
2: -21.314 dB
8.9000 GHz
1
2
Cor


CH2 S22 log MAG 5 dB/ REF 0 dB 1 -22.192 dB
LCP RETURN LOSS J6 RF OUTPUT
7.9000 GHz
2
8.9000 GHz
1
2
Cor
tsH
START 7.8000 GHz
STOP 9.0000 GHz

I-12

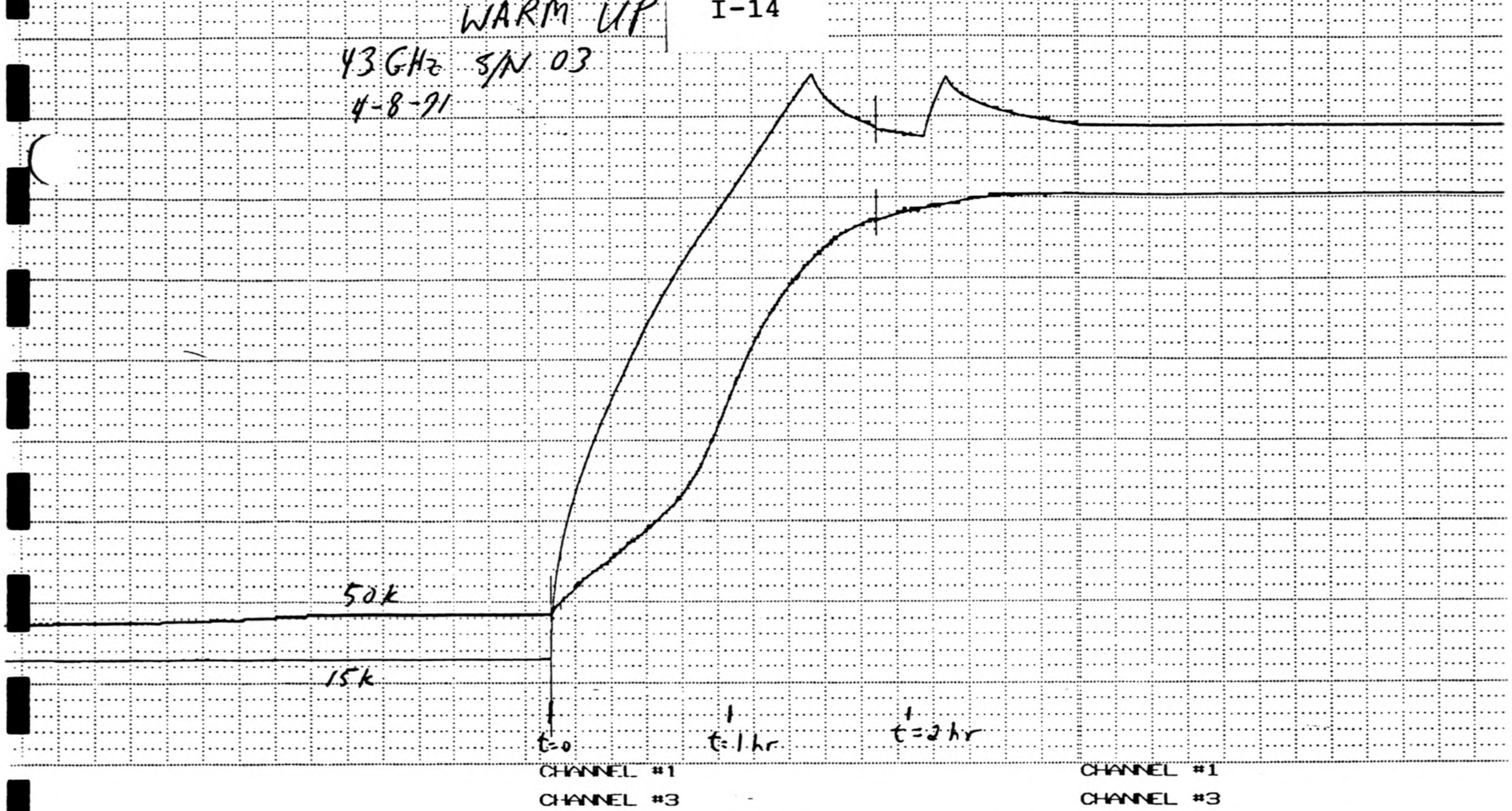
Sheet 13 of 14

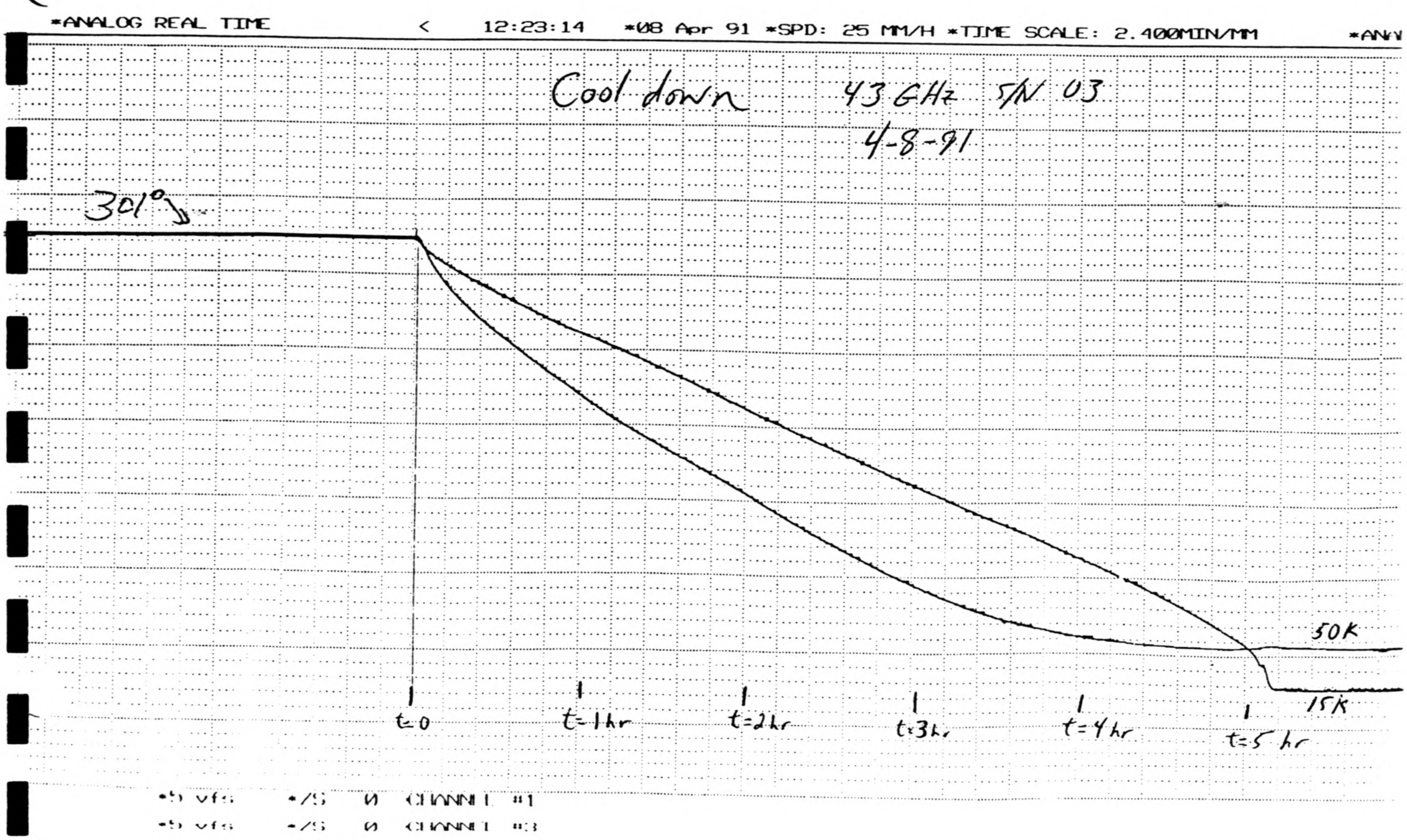
43 GHz VLBA Front End
Final Test Report
Assembly 53213A001

RECORD OF COMPONENTS' MODEL/SERIAL NUMBERS

Card Cage S/N: 03 Date: 4-9-91
Dewar S/N: 03 Tested By: MFM

1. Refrigerator: CTI Model 22 S/N 11J06767
2. Orthomode Transducer: Model 107790 S/N 104
3. Monitor Card: MC-77
4. RCP Bias Card: BC-187
5. LCP Bias Card: BC-188
6. 5th Stage Bias Card: BC-189
7. Sensor Card: SC-86
8. Control Card: CC-87
9. 15 K Temp Sensor: D60436
10. 50 K Temp Sensor: D60437
11. RCP Cryogenic Amplifier: B7
12. LCP Cryogenic Amplifier: B6
13. RCP Cryogenic Isolater: Model QYA1056-K S/N 113
14. LCP Cryogenic Isolater: Model QYA1056-K S/N 114
15. RCP Mixer Assembly: Spacek Model 3xM43-8.4 SN 9K16
16. LCP Mixer Assembly: Spacek Model 3xM43-8.4 SN 9K15
17. RCP Band Pass Filter: Reactel Model 4C11-8.4G-1.4GS11 SN 90-1
18. LCP Band Pass Filter: Reactel Model 4C11-8.4G-1.4GS11 SN 90-3
19. RCP Post Amplifier: Miteq Model AMF-4S-7890-18 SN 197888
20. LCP Post Amplifier: Miteq Model AMF-4S-7890-18 SN 197887
21. LO Limiting Amplifier: Miteq Model AMF-7B-109-121-LM SN 197879
22. LO Power Splitter: Model PS2OC-2 S/N 990005
23. Cal Noise Source: Noise Com NC5222 S/N 5114-9039


WARM UP
43 GHz S/N 03
4-8-91
50k
15k
t=0
t=1hr
t=2hr
CHANNEL #1
CHANNEL #3
CHANNEL #1
CHANNEL #3


*ANALOG REAL TIME < 12:23:14 *08 Apr 91 *SPD: 25 MM/H *TIME SCALE: 2.400MIN/MM
Cool down 43 GHz S/N 03
4-8-91
301°
50K
15K
t=0
t=1hr
t=2hr
t=3hr
t=4hr
t=5hr
*5 vfs +/S 0 CHANNEL #1
*5 vfs +/S 0 CHANNEL #3

APPENDIX II

List of BOM's, Drawings and Wiring List

BOM, Dewar Assembly	A53213B001
BOM, 15K Plate Assembly	A53213B002
DWG, 15K Plate Assembly	C53213A010
BOM, Thermal Transition	A53213B003
DWG, Thermal Transition	---
BOM, Mixer Assembly	A53213B004
DWG, Cal Splitter Ass'y	B53213A011
BOM, RF Plate	A53213B005
BOM, Cable Ass'y J1 to Dewar	A53213B006
BOM, Card Cage	A53213B007
BOM, Shield Assembly	A53213B008
BOM, Vacuum Assembly	A53206B006
DWG, Vacuum Assembly	C53213A007
BOM, Solenoid Assembly	A53206B008
BOM, Elapsed Time Indicator	A53206B013
DWG, ETI Assembly	A53206A013
BOM, Temperature Sensor	A53200B001
DWG, Ass'y Temp Sensor	A53200A001

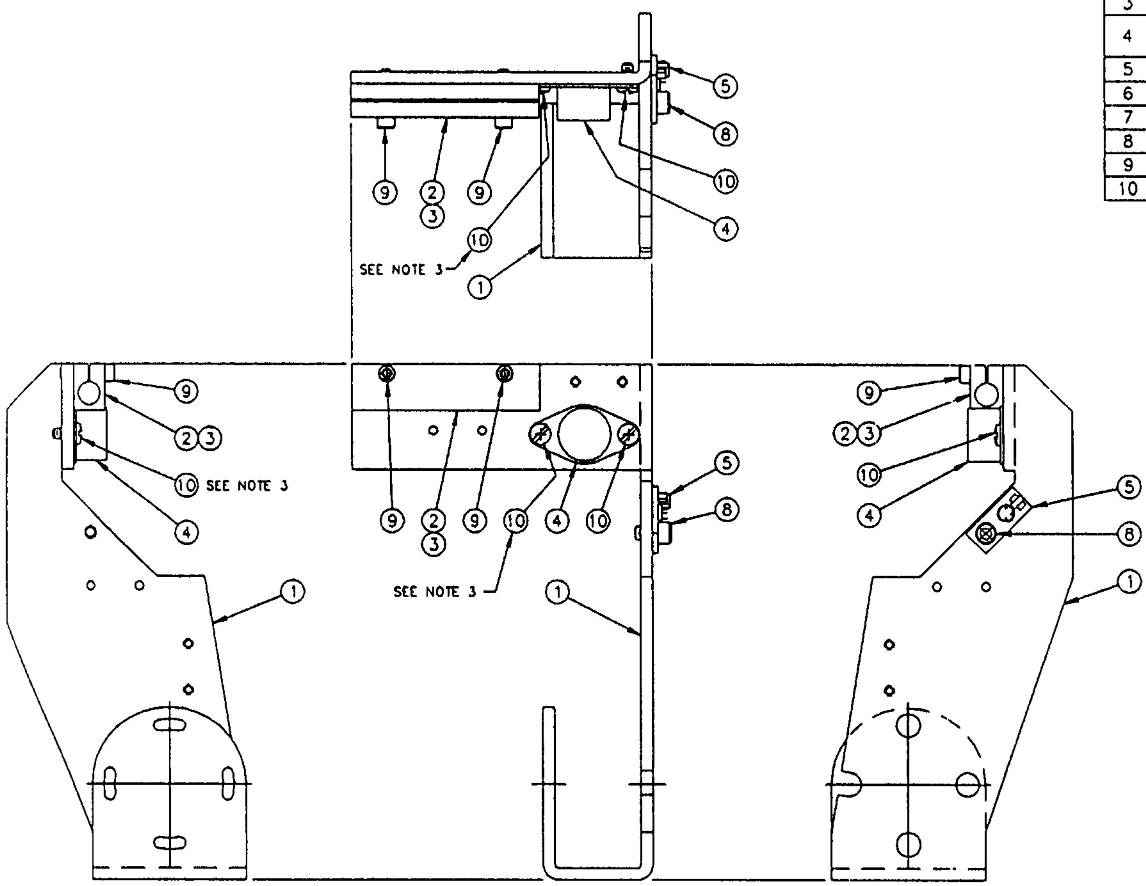
VLBA 43 GHz FRONT END
Bill of Material A53213B001
Title: Dewar Assembly

Item	Qty. Req.	Description	Part Number	Suggested Manufacturer
1.	Ref	Assembly Dwg. - Dewar	D53213A001-1	NRAO
2.	1	Assembly - Card Cage	D52306A005	NRAO
3.	2	Assembly - Temperature Sensor	A53200A001	NRAO
4.	3	Bias Card	D53206A002	NRAO
5.	1	Control Card	D53200A004	NRAO
6.	1	Monitor Card	D53200A006	NRAO
7.	1	Sensor Card	D53200A003	NRAO
8.	1	Shield Assembly	C53213A003	NRAO
9.	1	Assembly - 15K Plate	C53213A010	NRAO
10.	1	Assembly - Thermal Transition	D53213A002	NRAO
11.	1	DC Feed Thru	A53213M008	NRAO
12.	1	DC Feed Thru Cover	A53213M009	NRAO
13.	1	Thermal Transition Housing	D53213A002	NRAO
14.	1	Polarizer	107790-Q-Band	Gamma-f
15.	1	Dewar Top Plate	D53213M011	NRAO
16.	1	Dewar Bottom Plate	D53213M010	NRAO
17.	1	Dewar Cylinder	D53206M015	NRAO
18.	1	Dewar 70K Shield Connection	D53206M010	NRAO
19.	1	Polarizer Cold Strap	B53213M040	NRAO
20.	1	Cryogenic Refrigerator	Model 22	CTI
21.	2	Gold Plated WR-22 SS WG	B53213M035	NRAO
22.	2	WR-22 SS WG	B53213M035	NRAO
23.	2	Waveguide Plate	B53213M013	NRAO
24.	4	Threaded Rod	B53200M048	NRAO
25.	4	Stop Tube	B53200M041	NRAO
26.	1	O Ring (Refrigerator)	2-144	Parker
27.	2	O Ring (Cylinder)	2-270	Parker
28.	1	O Ring (Bias Feed Thru)	2-130	Parker
29.	1	O Ring (Thermal Transition Housing)	2-246	Parker
30.	1	O Ring (Thermal Transition Housing)	2-152	Parker
31.	1	Vacuum Assembly	C53213A007	NRAO

VLBA 43 GHz FRONT END
Bill of Material A53213B002
Title: 15K Plate

Item	Qty. Req.	Description	Part Number	Suggested Manufacturer
1.	Ref	Assembly 15K Plate	C53213A010	NRAO
2.	2	Cryogenic Amplifiers	D53213A009	NRAO
3.	2	Cryogenic Isolators	QYA1056-K	Passive Microwave
4.	2	Cross Guide Coiuplers	C53213M038	NRAO
5.	1	Theromstat		
6.	1	Assembly - Temperature Sensor	A53200A001	NRAO
7.	1	Heater	SC 252.25	HotWatt
8.	1	Heater Clamp	A53206M056	NRAO
9.	1	15K Cold Plate	C53213M039	NRAO
10.	3	Waveguide Elbows	B53213M006	NRAO
11.	2	Elbow/Offset Waveguide Section	B53213M006	NRAO
12.	AR	Indium		

REV	DATE	BY	DESCRIPTION	CHANGE ORDER
A	2-20-92	DGS	ITEM 1 REDESIGNED, COMPONENTS RELOCATED	920220-1
B	2-27-92	DGS	NOTE REGARDING ITEM 10 SCREWS ADDED	920227-1



MATERIAL LIST

ITEM	QUAN	DESCRIPTION	REMARKS
1	1	15K PLATE	C53213M039
2	1	HEATER CLAMP	A53206M056
3	1	HEATER UNIT - HOTWATT #SC252.25	——
4	1	SAFETY THERMOSTAT - ELMWOOD SENSORS #2450-B201A-T107	——
5	1	TEMPERATURE SENSOR ASSEMBLY	A53200A001
6	AR	INDIUM CONDUCTOR	SEE NOTE 1
7	AR	CHOTHERM CONDUCTOR	SEE NOTE 2
8	1	SOCKET HEAD CAP SCREW - 6-32UNC-2A X 1/4	SENSOR
9	2	SOCKET HEAD CAP SCREW - 4-40UNC-2A X 1/2	HEATER
10	2	PAN HEAD MACHINE SCREW - 4-40UNC-2A X 1/4	THERMOSTAT

NOTES

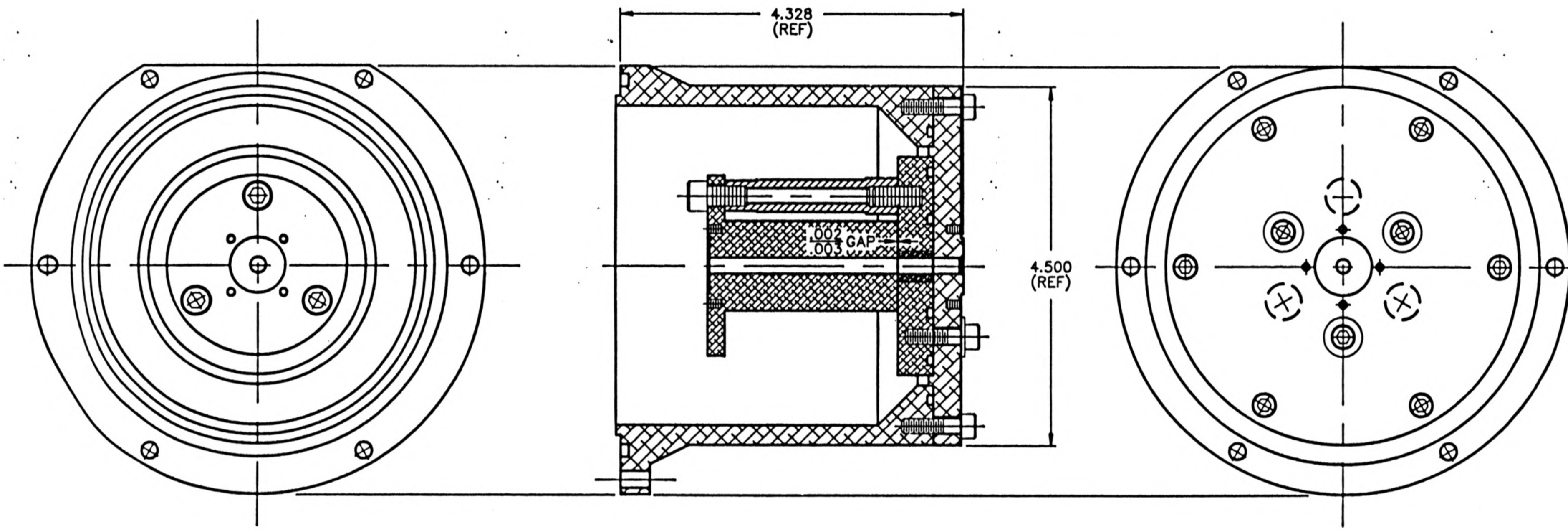
1. LOCATE ITEM 6 INDIUM AS FOLLOWS:
   BETWEEN ITEM 4 & 1
   BETWEEN ITEM 5 & 1
2. LOCATE ITEM 7 CHOTHERM BETWEEN ITEM 2 & 1.
3. ONE OF THE TWO ITEM 10 MACHINE SCREWS AS SPECIFIED AT LEFT MUST BE CUT OFF SO AS NOT TO PROTRUDE THRU ITEM 1 15K PLATE.
4. REFER TO DRAWING D53213A001-1 FOR 43 GHz FRONT END ASSEMBLY.
5. THIS ASSEMBLY IS USED WITH THE SYSTEM UTILIZING POSPIESZALSKI'S AMPLIFIERS.

NATIONAL RADIO ASTRONOMY OBSERVATORY
CHARLOTTESVILLE, VA. 22903

TITLE	15K PLATE ASSEMBLY			
PROJECT	43 GHz FRONT END			
DESIGN			COMPUTER DRAWING	VLBA\53213\A010
DRAWN	DGS	9-27-90	MATERIAL	
SHEET	1 OF 1		FINISH	
SCALE	FULL		DWG. NO. C53213A010	REVISION B

VLBA 43 GHz FRONT END
Bill of Material A53213B003
Title: Thermal Transition

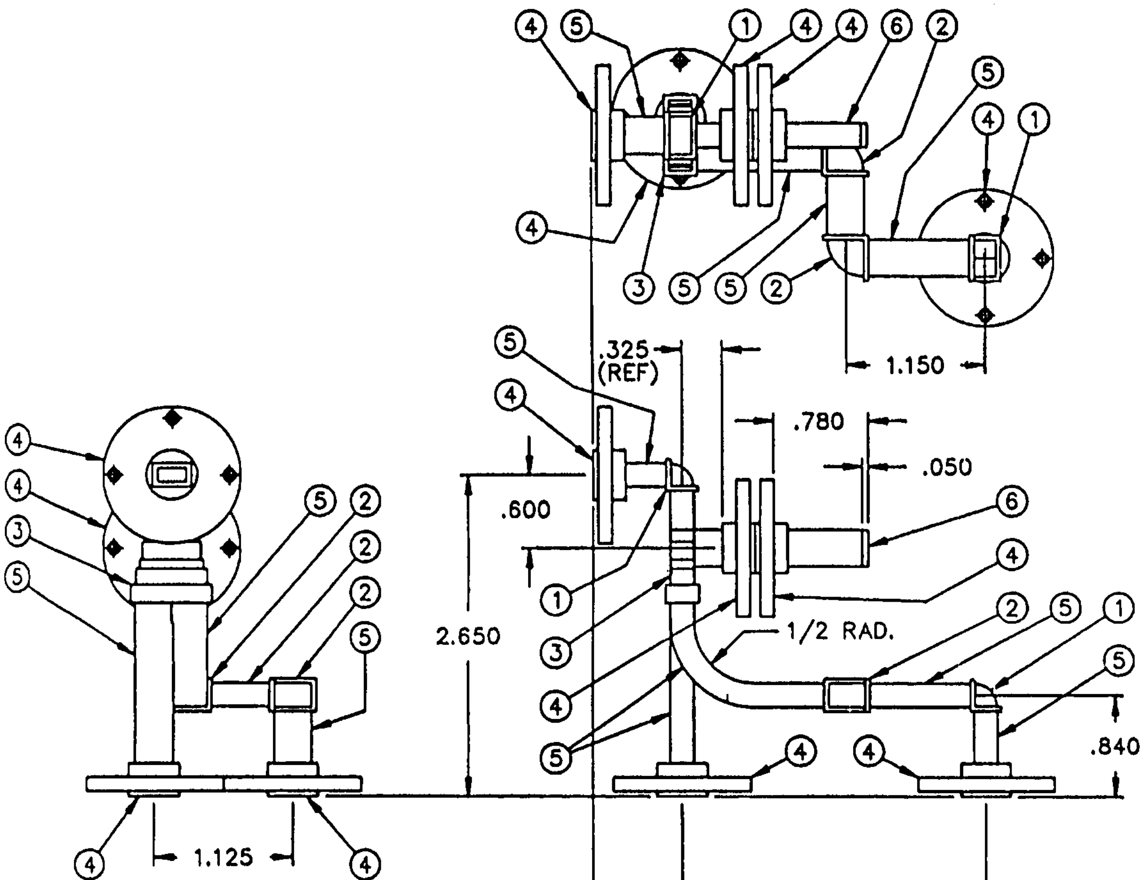
Item	Qty. Req.	Description	Part Number	Suggested Manufacturer
1.	1	Feed Mounting Plate	D53213M004-01	NRAO
2.	1	Choke Grove Plate	D53213M004-02	NRAO
3.	1	Choke Grove Plate Insert	D53213M004-03	NRAO
4.	1	Polarizer Mounting WG Section	D53213M003-02	NRAO
5.	3	Polarizer Standoff	D53213A004-07	NRAO
6.	1	Thermal Transition Housing	D53213M003-01	NRAO
7.	1	IRIS (.170 Inside Diameter)	D53213M004-05	NRAO
8.	1	Window	D53213M004-08	NRAO
9.	1	O Ring	2-140	Parker
10.	1	O Ring	2-121	Parker



ASSEMBLY

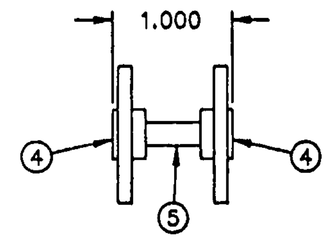
VLBA 43 GHz FRONT END
Bill of Material A53213B004
Title: Mixer Assembly

Item	Qty. Req.	Description	Part Number	Suggested Manufacturer
1.	2	Mixer	DC3XM43-8.4	Spacek Labs
2.	1	Noise Source	NC5222	NoiseCom
3.	1	Hybrid Tee	22TH12	MDL
4.	2	H-Plane Cast Bend	22BH11	MDL
5.	2	E-Plane Cast Bend	22BE11	MDL
6.	1	LCP Mixer Mounting Plate	B53213M029	NRAO
7.	1	RCP Mixer Mounting Plate	B53213M030	NRAO
8.	1	Brace Plate	B53213M026	NRAO
9.	4	Post	C53213M033	NRAO
10.	1	Cover	C53213M027	NRAO
11.	AR	WR-22 WG	B43213A011	NRAO
12.	2	Dewar to Mixer Waveguide Section	B43213A001	NRAO



CAL SPLITTER ASSEMBLY
1 ASSEMBLY REQUIRED

MATERIAL LIST		
ITEM	QUAN	DESCRIPTION
1	2	WAVEGUIDE ELBOW – WR22, STYLE 1E, MODEL #22BE11
2	2	WAVEGUIDE ELBOW – WR22, STYLE 1H, MODEL #22BH11
3	1	H PLANE FOLDED HYBRID TEE – WR22, MDL MODEL #22TH12
4	9	ROUND WAVEGUIDE FLANGE – WR22, Q BAND, MODEL #67B-006
5	AR	WR22 WAVEGUIDE
6	1	LOAD



DEWAR TO MIXER WAVEGUIDE SECTION
2 ASSEMBLIES REQUIRED

UNLESS OTHERWISE SPECIFIED
TOLERANCES

x/x = ±1/32
0.00 = ±.01
0.000 = ±.005
0.0000 = ±.0005

ALL DIMENSIONS ARE INCHES

NATIONAL RADIO ASTRONOMY OBSERVATORY CHARLOTTESVILLE, VA. 22903			
TITLE	CAL SPLITTER ASSEMBLY DEWAR TO MIXER WAVEGUIDE SECTION		
PROJECT	43 GHz FRONT END		
DESIGN LCB	7-2-90	COMPUTER DRAWING	VLBA\53213\A011
DRAWN DGS	10-1-90	MATERIAL	
SHEET	1 OF 1	FINISH	
SCALE	FULL	DWG. NO. B53213A011	REVISION

VLBA 43 GHz FRONT END
Bill of Material A53213B005
Title: RF Plate

Item	Qty. Req.	Description	Part Number	Suggested Manufacturer
1.	2	Band Pass Filters with Mounting Clips	4C11-8.4G-1.4G511	Reactel
2.	2	Isolators/SMA Male In/Female Out	D3I7510-1	Ditcom
3.	2	Miteq Low Noise Amplifiers	AMF-4S-7890-18	Miteq
4.	1	Limiting Amplifier	AMF-7B-109121-LM	Miteq
5.	1	Power Spliter	P8206-2	Mac Tech
6.	3	Individual Amp Mounting Plates	B53213M034	NRAO
7.	1	Amplifier Mounting Plates	C53213M025	NRAO
8.	1	Shield	A53213M028	NRAO
9.	3	Shims	A53213M021	NRAO

VLBA 43 GHz FRONT END
Bill of Material A53213B006
Title: Cable Assembly J1 to Dewar

Item	Qty. Req.	Description	Part Number	Suggested Manufacturer
1.	1	DC Feed Thru	A53213M008	NRAO
2.	1	DC Feed Thru Artwork	B53213I001	NRAO
3.	22	1000 pF, 200 V Feed-Thru Capacitor	7648-1011-102	Viclan
4.	2	3300 pf, 500 V Feed-Thru Capacitor	XS1F2-332H	US Microteck
5.	2	Connector, 7 Socket	EP-75-1	Microtech
6.	1	2 Pin Connector, Receptacle	GF-2	Microtech
7.	AR	24 AWG, 30 Conductor	5020	Alpha
8.	1	HD-20 Metal Shell Connector, Plug 37 Position	2074731	Amp
9.	1	"D" Connector, 37 Pin	205210-1	Amp
10.	AR	432 Soft Brass, Type 260, Bifilar Wire	B-2322111-001	MWS Precision Wire
11.	2	2 Pin Connector, Plug	GM-2	Microtech
12.	AR	AG Plated CU Steel -- use single wire	MS-7	Microtech
13.	AR	Heat Shrink Tubing 1/8 ID Clear	Fit-221-1/8 CLR	Allmetal

VLBA 43 GHz FRONT END
Bill of Material A53213B007
Title: Card Cage

Item	Qty. Req.	Description	Part Number	Suggested Manufacturer
1.	0	Assembly Card Cage	D53206A005	NRAO
2.	0	BOM Card Cage	A53206B009	NRAO
3.	1	Front Panel	C53213M024	NRAO
4.	1	Side Plate	B53206M063	NRAO
5.	1	Back Panel	C53206M067	NRAO
6.	1	Side Rail	A53206M061	NRAO
7.	1	Cover (side)	C53206M065	NRAO
8.	1	Top Side	D53206M069	NRAO
9.	1	HD-20 Metal Shell Connector, Plug 25 Position	205208-1	Amp
10.	1	HD-20 Metal Shell Connector, Receptacle 25 Position	205207-1	Amp
11.	1	HD-20 Metal Shell Connector, Receptacle 37 Position	205210-1	Amp
12.	3	SMA-Type N Bulkhead	21011	Omni Spectra
13.	7	Edge Card Connector, 44 Pin	50-44A-30	Cinch (TRW)
14.	7	Polarizing Key	50-PK-2	Cinch (TRW)
15.	1	Resistor, 300 25W 1%	RH-25 300	Dale
16.	1	Resistor, 5K 10W 1%	RH-10	Dale
17.	1	Cable Clamp	ECC-6	Voltrex
18.	1	AC Connector Jack, 3 Pin	DM9686-3P	Deutsch
19.	1	Bar	B53206M062	NRAO
20.	1	HD-20 Metal Shell Connector, Receptacle 9 Position	205283-1	Amp
21.	2	#10-32 S.S. Insert	74-13-210-24	Southco
22.	1	Cover	C53206M066	NRAO
23.	1	#10-32 x 3/8 lg. S.S. Socket Head Cap Screws	--	Allmetal
24.	6	#4 Ground Lug	988	Keystone
25.	1	End Plate	B53206M064	NRAO
26.	1	Wire List Card Cage	A53217W001	NRAO
27.	3	SMA Adapter, Plug/Jack	216	Omni Spectra
28.	2	Octal Socket Plug with Clamp	78-PF8-11	Amphenol
29.	4	Connector Jack Screw Kit (1 pr.)	D-20418-2	Cinch (TRW)
30.	2	2 Pin Connector Receptacle	03-09-1022	Molex
31.	2	Female .093 dia. Pin 20-14 AWG	02-09-1103	Molex
32.	1	Display Structure, 3 Socket	DM9702-3S	Deutsch
33.	3	#4-40 Captive Screw Assembly, 1/8" Panel	47-10-103-10	Southco
34.	2	#4-40 Captive Screw Assembly, 1/16" Panel	47-10-101-10	Southco
35.	1	#4-40 S.S. Insert	74103-104-24	Southco
36.	4	#4-40 Heli Coil Inserts S.S. Free Running 168	--	Helicoil
37.	2	3/32" dia. 1/4" long SS. Dowels	--	Allmetal
38.	0	Jacketed 3 Wire 22 AWG	8443	Belden
39.	0	Jacketed 2 Wire 18 AWG Twisted Pr.	9740	Belden

VLBA 43 GHz FRONT END
Bill of Material A53213B007
Title: Card Cage, Continued

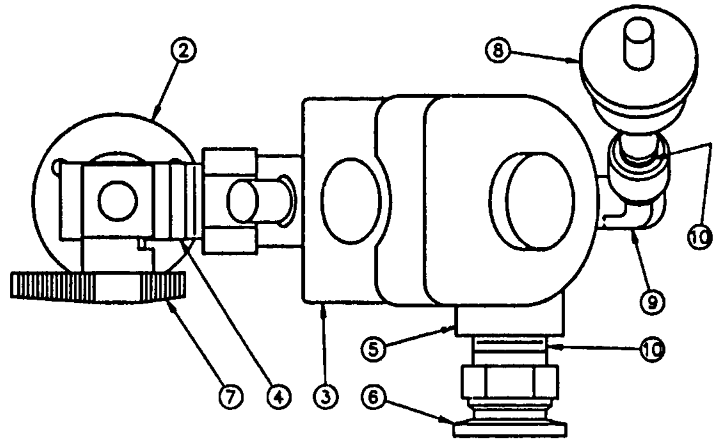
Item	Qty. Req.	Description	Part Number	Suggested Manufacturer
40.	0	Jacketed 2 Wire 22 AWG Twisted Pr.	8442	Belden
41.	0	Jacketed 3 Wire 18 AWG	M 39076	Manhattan Cable
42.	0	Heat Shrink Tubing 1/8 ID Clear	Fit-221-1/8 Clr	Alpha Wire
43.	0	Heat Shrink Tubing 1/4 ID Black	Fit-221-1/4 Blk	Alpha Wire
44.	0	Heat Shring Tubing 3/8 ID Black	Fit-221-3/8 Blk	Alpha Wire
45.	0	Heat Shrink Tubing 3/4 ID Black	Fit-221-3/4 Blk	Alpha Wire
46.	25	HD-20 Connector Contact-Pin	66506-9	Amp
47.	59	HD-20 Connector Contact-Socket	66504-9	Amp
48.	1	Rubber Bushing Type AN3420	9779-513-4	Amphenol
49.	2	Male .093 dia. Pin 24-18 AWG	02-09-2118	Molex
50.	1	Front Panel Silkscreen	D53213M024	NRAO
51.	0	Stranded 22 AWG Wire Colors as required	1855	Alpha Wire
52.	1	Resistor 510 1/2W 5%	RC20GF511J	Allen-Bradley
53.	0	Stranded 18 AWG Hook Wire	1857	Alpha Wire
54.	0	Solid 18 AWG Bus Wire	296	Alpha Wire
55.	2	Diode, 1N5355A (Zener 18V)	1N5355A	Motorola
56.	1	Connector Mounting Plate	B53213M031	NRAO

VLBA 43 GHz FRONT END
Bill of Material A53213B008
Title: Shield Assembly

Item	Qty. Req.	Description	Part Number	Suggested Manufacturer
1.	1	Bottom ShieLd	C53213M014	NRAO
2.	1	Side Shield	B53213M015	NRAO
3.	1	Top Shield	C53213M016	NRAO
4.	1	Transition Shield	B53213M018	NRAO

VLBA 43 GHz FRONT END
Bill of Material A53206B006
Title: Vacuum Assembly

Item	Qty. Req.	Description	Part Number	Suggested Manufacturer
1.	1	Assembly Solenoid	B53206A008	NRAO
2.	0	SE Fitting Rework	A53206M028	NRAO
3.	0	ME Fitting Rework	A53206M028	NRAO
4.	0	Vacuum Conn. Rework	A53206M050	NRAO
5.	1	1/8 NPT Brass Female Elbow	B-3-E	Cajon
6.	1	Vacuum Valve, 120V, 60 Hz Coil, 1/2" NPT	8030A17VH	ASCO
7.	2	Vacuum Gauge	DV-6R	Teledyne Hastings
8.	1	1/2 NPT Male Elbow	B-8-ME	Cajon
9.	1	1/2 NPT Brass Male Elbow	B-2-ME	Cajon
10.	1	1/2 NPT Street Elbow	B-8-SE	Cajon
11.	1	1/8 NPT Brass Street Elbow	B-2-SE	Cajon
12.	1	1/2 NPT Hex Nipple	B-8-HN	Cajon
13.	1	Male Flange Fitting Type KF-16	910-280-119	L&H
14.	1	Plug Valve, 1/8 NPT, Female	B-2P4T4	Nupro
15.	1	Plug Valve, 1/8 NPT, Male	B-2P4T2	Nupro

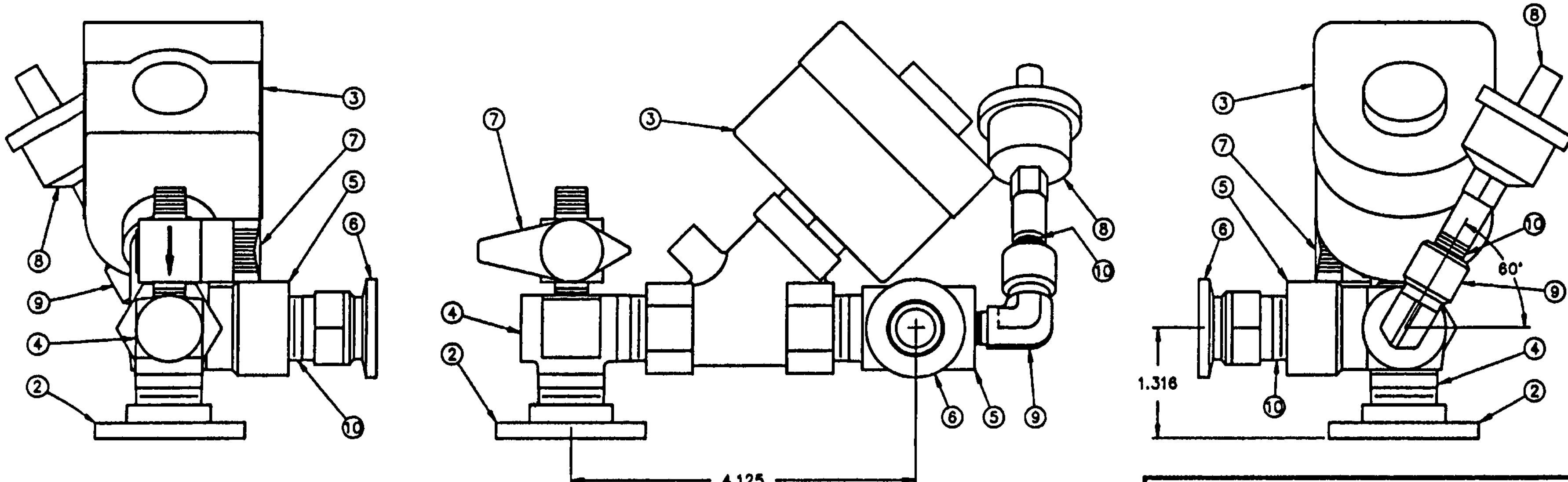


MATERIAL LIST

ITEM	QUAN	DESCRIPTION	REMARKS
1	0	BOM VACUUM ASSEMBLY	A53213B007
2	1	VACUUM FEEDTHRU	A53203M009
3	1	SOLENOID ASSEMBLY	B53206A008
4	1	ME FITTING REWORK	A53206M029
5	1	SE FITTING REWORK	A53203M031
6	1	VACUUM PORT FITTING	A53206M050
7	1	VENT VALVE – NUPRO #B-2P4T2	—
8	1	VACUUM GAUGE – TELEDYNE HASTINGS #DV-6R	—
9	1	1/8 NPT STREET ELL – CAJON #B-2-SE	—
10	AR	TEFLON TAPE	—
11	AR	EPOXY	SEE NOTE 2

NOTES

1. CHECK ALL JOINTS FOR LEAKS AFTER ASSEMBLY.
2. ALL JOINTS TO BE EPOXIED EXCEPT WHERE ITEM 10 IS NOTED.



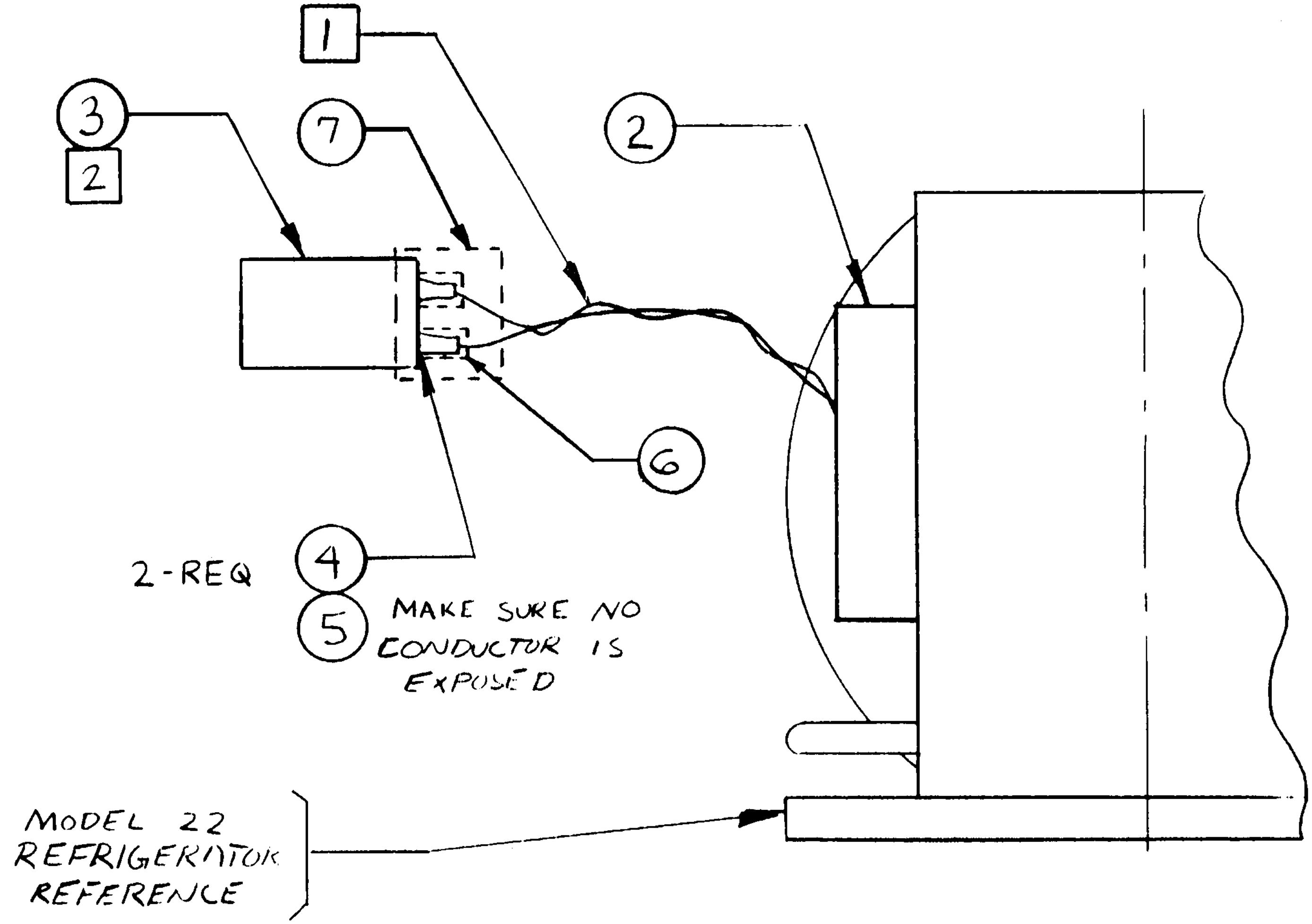
NATIONAL RADIO ASTRONOMY OBSERVATORY CHARLOTTESVILLE, VA. 22903	
TITLE	VACUUM ASSEMBLY
PROJECT	43 GHz FRONT END
DESIGN	
DRAWN	DGS 10-10-90
SHEET	1 OF 1
SCALE	FULL
COMPUTER DRAWING	VLBA\53213\A007
MATERIAL	
FINISH	
DWG. NO.	C53213A007
REVISION	

VLBA 43 GHz FRONT END
Bill of Material A53206B008
Title: Solenoid

Item	Qty. Req.	Description	Part Number	Suggested Manufacturer
1.	0	Assembly Solenoid	B53206A008	NRAO
2.	1	BOM A53206B007 (Ref)	Item 10	ASCO
3.	1	Indicator Light	45RN2111	Leecraft
4.	1	Romex Connector (1/2" Cond.), Aluminum		
5.	1	2-Pin Connector Plug, Molex	03-04-2022	Molex
6.	2	Male .093 dia. Pin 20-14 AWG	02-09-2103	Molex
7.	1	Solenoid Cover Rework	A53206M070	NRAO
8.	AR	Heat Shrink Tubing, 3/8 ID Black	Fit-221-3/8 Blk	Alpha
9.	AR	Heat Shrink Tubing, 3/4 ID Black	Fit-221-3/4 Blk	Alpha

VLBA 43 GHz FRONT END
Bill of Material A53206B013
Title: Elapsed Time Indicator

Item	Qty. Req.	Description	Part Number	Suggested Manufacturer
1.	0	Assembly Elapsed Time Indicator	A53206A013	NRAO
2.	1	Elapsed Time Indicator-Wide Range	520-CP3	Curtis
3.	1	2-Pin Connector Plug, Molex	03-09-2022	Molex
4.	2	Female .093 dia. 24-18 AWG	02-09-1118	Molex
5.	AR	All-Purpose Tubing 0.085 ID	PVC-105-12	Alpha
6.	AR	Heat Shrink Tubing 1/4 ID Black	Fit-221-1/4 Blk	Alpha
7.	AR	Heat Shrink Tubing 3/4 ID Black	Fit-221-3/4 Blk	Alpha



1 MOUNT CONNECTOR ON END OF STANDARD LEADS, MIN LENGTH 7".

2 NO SPECIFIC ARRANGEMENT OF WIRES CONNECTION TO PLUG.

NEXT ASS'Y D53206B001

1 BOM A53206B013

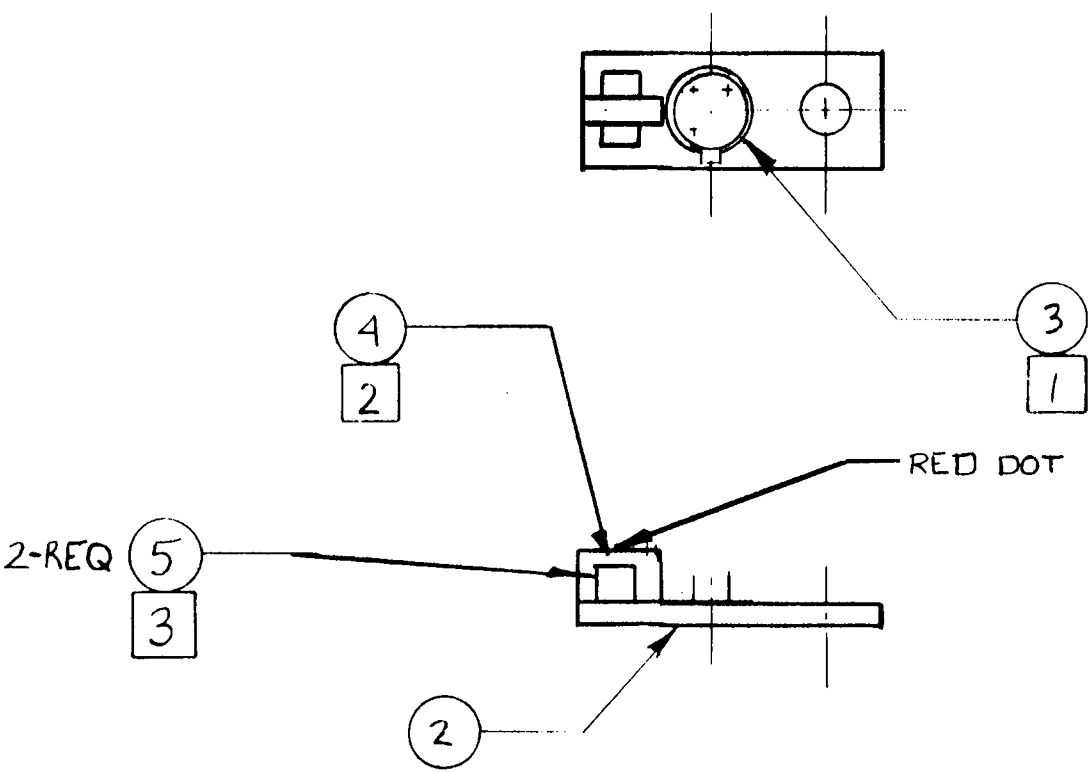
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES
ANGLES ±
3 PLACE DEC. (xxx) ±
2 PLACE DEC. (xx) ±
1 PLACE DEC. (x) ±

NATIONAL RADIO ASTRONOMY OBSERVATORY
VLBA

PROJ: 8.4 GHZ F.E.	TITLE: ETI ASS'Y		
MATERIAL: ~		DRAWN BY: H. DILL	DATE: 10.3.84
FINISH: ~		DESIGNED BY:	DATE:
		APPROVED BY:	DATE:
SHEET NUMBER:	DRAWING NUMBER: A53206A013	REV.	SCALE: ~

VLBA 43 GHz FRONT END
Bill of Material A53200B001
Title: Temperature Sensor

Item	Qty. Req.	Description	Part Number	Suggested Manufacturer
1.	0	Assembly Temperature Sensor	A53200A001	NRAO
2.	1	Temperature Sensor Mount	A53200M002	NRAO
3.	1	M/N Silica Diode Temp. Sensors	DT-500-KL	Lake Shore
4.	1	Connector, 2 Socket	GF-2	Microtech
5.	2	Chip Capacitor 680 pF	100-B-681-M-P-50	ATC



NOTES

1. SOLDER W/20E2
   ALIGN AS SHOWN
2. SOLDER W/ 60/40 RC
   PAINT RED DOT ON SIDE OF CONNECTER INDICATED WITH ARROW.
   EPOXY CONNECTOR BETWEEN CAPACITOR BLOCKS
3. SOLDER CAPACITOR AND LEADS W/ SN62 SOLDER.

1 BOM A53200B001

NATIONAL RADIO ASTRONOMY OBSERVATORY
VLBA

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ANGLES ± 3 PLACE DEC. (xxx) ± 2 PLACE DEC. (xx) ± 1 PLACE DEC. (x) ±	PROJ: COMMON F.E.	TITLE: ASS'Y TEMP SENSOR	
	MATERIAL: ~	DRAWN BY: H DILL	DATE: 840590
		DESIGNED BY:	DATE:
	FINISH: ~	APPROVED BY:	DATE:
	SHEET NUMBER: 1:1	DRAWING NUMBER: A53200A001 REV.	SCALE: 2X

VLBA 43 GHZ FRONT END

CARD CAGE

WIRING LIST

Note:

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

Jacketed 3-wire 22 AWG cable.

Jacketed twisted pair 18 AWG cable.

Jacketed 3-wire 18 AWG.

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

18 AWG Stranded Wire.

18 AWG Solid Bus Wire.

Ref: Bill Of Materials: A53213B001
Wiring Diagram: A53213W001

CARD SLOT WIRING LIST

SYSTEM: VLBA 43 GHZ FRONT END
ASS'Y: CARD CAGE
SLOT: 1
CARD: S+G 5 FET BIAS

DWG. NO.:A53213W001
DATE: July 12, 1990
BY: MIKE MASTERMAN
SHEET: 2

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
A	GROUND	BUS	BUS	1	GROUND BUS	J5-1	0XX
B	+15 VOLTS	BUS	BUS	2	+15 VOLT BUS	J5-2	2XX
C	-15 VOLTS	BUS	BUS	3	-15 VOLTS BUS	J5-3	4XX
D	RCP GATE 5	J3-34	91X	4	RCP GATE 5 MON	S4-4	9XX
E				5			
F				6			
H	LCP GATES	J3-30	92X	7	LCP GATE MON	S5-4	97X
J	QUALITY GND	J2-13	5XX	8		S3-E	5XX
K	RCP DRAINS	J3-35	6XX	9			
L				10			
M				11			
N	LCP DRAINS	J3-31	7XX	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 43 GHZ FRONT END
ASS'Y: CARD CAGE
SLOT: 2
CARD: SPARE

DWG. NO.: A53213W001
DATE: July 12,1990
BY: MIKE MASTERMAN
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 43 GHZ FRONT END
ASS'Y: CARD CAGE
SLOT: 3
CARD: MONITOR CARD

DWG. NO.: A53213W001
DATE: July 12, 1990
BY: MIKE MASTERMAN
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	S1-J 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

<u>SPECIAL INSTRUCTIONS</u>: 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 43 GHZ FRONT END
ASS'Y: CARD CAGE
SLOT: 4
CARD: RCP FET BIAS

DWG. NO.: A53213W001
DATE: July 12, 1991
BY: MIKE MASTERMAN
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 S4-5	7XX	4	GATE 4 MON	S1-4	
E	GATE 3	J3-17 S4-4	98X	5	GATE 3 MON	S4-6	904
F	GATE 2	J3-15 S4-5	4XX	6	GATE 2 MON	S3-P	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	905	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			

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

CARD SLOT WIRING LIST

SYSTEM: VLBA 43 GHZ FRONT END
ASS'Y: CARD CAGE
SLOT: 5
CARD: LCP FET BIAS

DWG. NO.: A53213W001
DATE: July 12, 1990
BY: MIKE MASTERMAN
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 S5-5	91X	4	GATE 4 MON	S1-7	
E	GATE 3	J3-9 S5-4	9XX	5	GATE 3 MON	S5-6	97X
F	GATE 2	J3-7 S5-5	97X	6	GATE 2 MON	S3-S	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	903	11			
N	DRAIN 1	J3-6	902	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 43 GHZ FRONT END
ASS'Y: CARD CAGE
SLOT: 6
CARD: SENSOR CARD

DWG. NO.: A53213W001
DATE: July 12, 1990
BY: MIKE MASTERMAN
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 J3-2	96X 96X	4	TEMP SENSOR A		
E	SENSOR A RTN	S7-D J3-1	93X	5	B MON OUT (50K)	S3-K	95X
F	SENSOR B RTN	S6-F J3-3	92X	6			
H	SENSOR B	S6-E 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	8XX
S	TEMP SENS A	S7-F 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 43 GHZ FRONT END
ASS'Y: CARD CAGE
SLOT: 7
CARD: CONTROL CARD

DWG. NO.: A53213W001
DATE: July 12, 1990
BY: MIKE MASTERMAN
SHEET: 8

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
A	GROUND	BUS	BUS	1	GROUND CHS	BUS GND	BUS 0XX*1
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 S3-18	96X 7XX	4	X EVAC CONTROL		
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	91X
W	DEWAR HEATER	J3-24	1XX	19	DEWAR HEATER RTN	J3-25	91X
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 4.3 GHZ FRONT END	DWG. NO.:	A53213W001
ASS'Y:	CARD CAGE	DATE:	July 12, 1991
TYPE:	BULKHEAD	BY:	MIKE MASTERMAN
SEX:	FEMALE	SHEET:	9
FUNC'T:	FRONT END MONITOR	DESIGNATION:	J2

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
1	VAC PUMP MONITOR	S3-F	8XX	14	TEMP SENS	AS6-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	9XX	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 REQUESTS	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 43 GHZ FRONT END
ASS'Y: CARD CAGE
TYPE: BULKHEAD
SEX: FEMALE (SOCKET)
FUNC'T: DEWAR POWER/MONITOR

DWG. NO.: A53213W001
DATE: July 12, 1990
BY: MIKE MASTERMAN
SHEET: 10
DESIGNATION: J3

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
1	SENSOR A RTN	S6-E	93X	19	RCP GATE 4	S4-D	7XX
2	SENSOR A (15K)	S6-4	96X	20	RCP DRAIN 4	S4-K	902
3	SENSOR B RTN	S6-F	92X	21	DEWAR GROUND X2	GND BUS	0XX
4	SENSOR B	S6-H	95X	22	LED X1	S3-T	5XX
5	LCP GATE 1	S5-H	94X	23			
6	LCP DRAIN 1	S5-N	902	24	DEWAR HEATER H1	S7-W	1XX
7	LCP GATE 2	S5-F	97X	25	DEWAR HEATER RTN H2	S7-19	91X
8	LCP DRAIN 2	S5-M	903	26			
9	LCP GATE 3	S5-E	9XX	27			
10	LCP DRAIN 3	S5-L	1XX	28			
11	LCP GATE 4	S5-D	91X	29			
12	LCP DRAIN 4	S5-K	8XX	30	LCP GATES	S1-H	92X
13	RCP GATE 1	S4-H	90X	31	LCP DRAINS	S1-N	7XX
14	RCP DRAIN 1	S4-N	905	32			
15	RCP GATE 2	S4-F	4XX	33			
16	RCP DRAIN 2	S4-M	3XX	34	RCP GATES	S1-D	90X
17	RCP GATE 3	S4-E	98X	35	RCP DRAINS	S1-K	6XX
18	RCP DRAIN 3	S4-L	6XX				

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

9 PIN D-CONNECTOR WIRING LIST

SYSTEM:	VLBA 43 GHZ FRONT END	DWG. NO.:	A53213W001
ASS'Y:	CARD CAGE	DATE:	July 12,1990
TYPE:	BULKHEAD	BY:	MIKE MASTERMAN
SEX:	FEMALE (SOCKET)	SHEET:	11
FUNC'T:	AUXILIARY MONITOR	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 43 GHZ FRONT END	DWG. NO.	153213W001
ASS'Y:	CARD CAGE	DATE:	July 12, 1990
TYPE:	BULKHEAD	BY:	MIKE MASTERMAN
SEX:	MALE PINS	SHEET:	12
FUNC'T:	DC POWER AND CONTROL	DESIGNATION:	J5

PIN	FUNCTION	TO	COLOR	PIN	FUNCTION	TO	COLOR
1	GROUND	S1-1	0XX	14	ID F0	N.C.	
2	+15 VOLT SUPPLY	S1-2	2XX	15	G F1	GND BUS	0XX
3	-15 VOLT SUPPLY	S1-3	4XX	16	G F2	GND BUS	0XX
4				17	F3	N.C.	
5				18	ID G SN0 *1		
6	X (EVAC CONTROL)	S3-17	7XX	19	G SN1 *1		
7	C (COOL CONTROL)	S3-19	9XX	20	G SN2 *1		
8	H (NO HEAT CTRL)	S3-21	3XX	21	G SN3 *1		
9	FE PARITY	GND	0XX	22	G SN4 *1		
10				23	G SN5 *1		
11	CAL CONTROL	J17-5	8XX	24	ID G MOD0*2		
12	HIGH CAL CONTROL	J17-6	1XX	25	G 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 43 HZ FRONT END
ASS'Y: CARD CAGE
TYPE: BULKHEAD
SEX: FEMALE (SOCKET)
FUNC'T: RF PLATE CONTROL

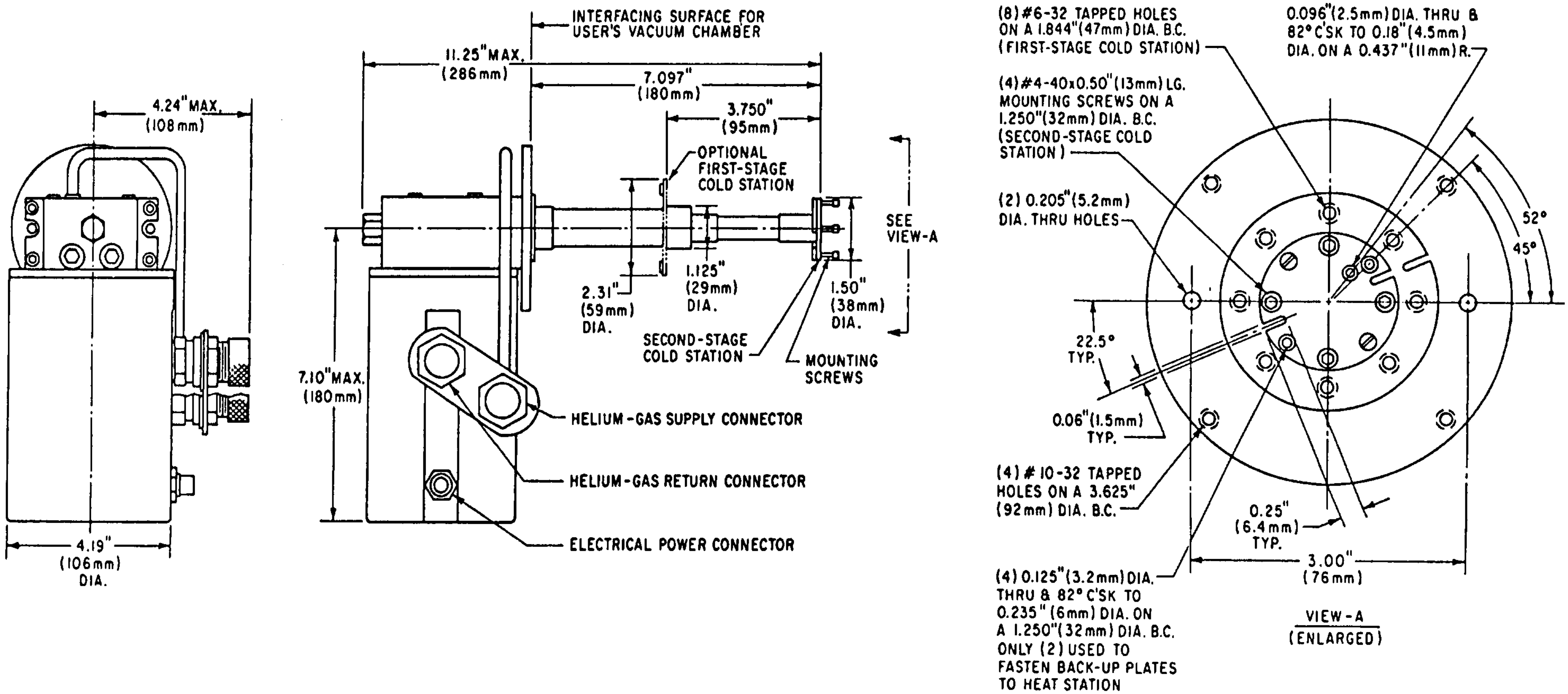
DWG. NO.: A53213W001
DATE: July 12, 1990
BY: MIKE MASTERMAN
SHEET: 13
DESIGNATION: J17

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

SPECIAL INSTRUCTIONS:

APPENDIX III

MANUFACTURES' DATA SHEETS

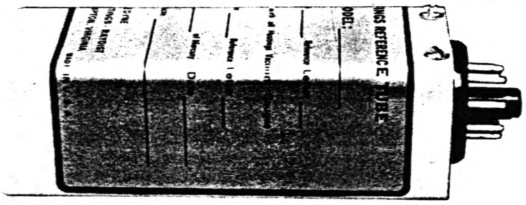


CTI-CRYOGENICS
266 Second Avenue
P. O. Box 9171
Waltham, MA 02254-9171

FIGURE 2-5. INSTALLATION INTERFACE OF THE MODEL 22 COLD HEAD

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

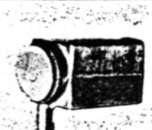
THE ONLY GAUGE TUBES COMPENSATED FOR BOTH AMBIENT TEMPERATURE AND RATE OF TEMPERATURE CHANGE

- **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!

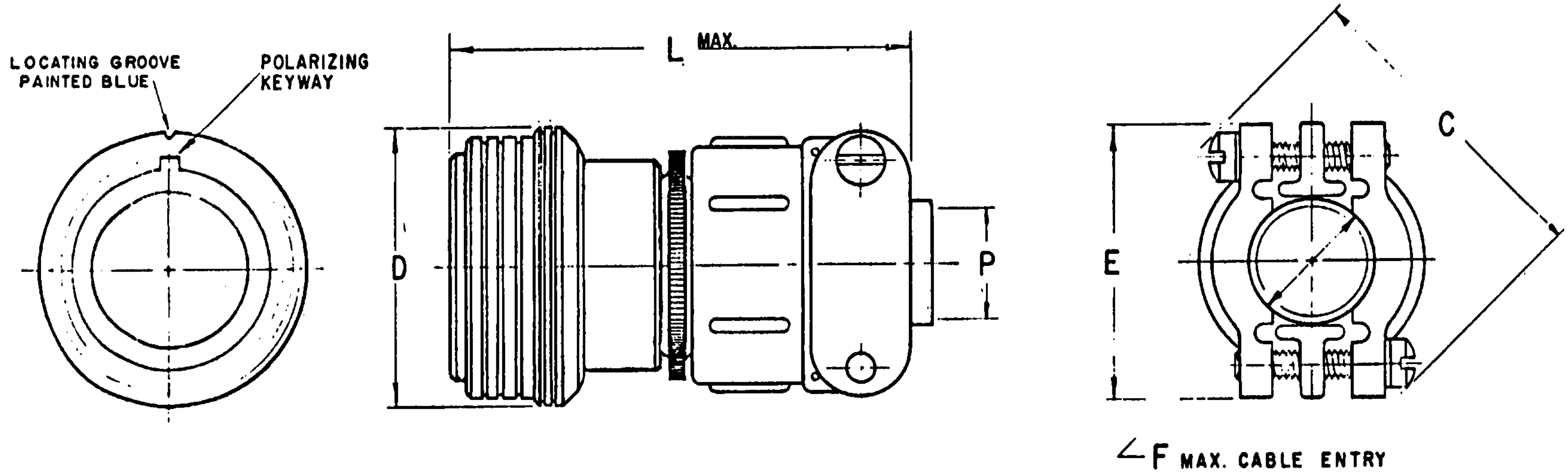
INSTRUMENT SERIES	RANGE	METAL TYPE	BASE COLOR	PYREX TYPE	"R" SERIES TYPE	STAINLESS STEEL TYPE
NV-8	10^{-5} torr 10^{-2} torr	DV-8	Green	DV-31	—	—
VT-5, CVT-15/25	0-100 µ Hg	DV-5M	Red	DV-18	—	—
VT-6, CVT-16/26, DAV-6, TV-4A, MRV-6, TV-47	0-1000 µ Hg	DV-6M	Yellow	DV-20	DV-6R	DV-36
VH-3, CVH-3/23	0-5 torr	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 9702-* P/S



III-3

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 / .0582
DM 9702- 7 P/S	1 1/8	29/32	7/8	5/16	2 3/32	7/32	.0758 / .0806
DM 9702-12 P/S	1 11/32	1 1/16	1 1/16	7/16	2 5/32	5/16	.1036 / .1113
DM 9702-19 P/S	1 1/2	1 3/16	1 5/32	9/16	2 7/32	7/16	.1302 / .1416
DM 9702-27 P/S	1 19/32	1 23/64	1 1/4	5/8	2 7/32	9/16	.1456 / .1605
DM 9702-37 P/S	1 7/8	1 1/2	1 15/32	3/4	2 7/32	5/8	.2093 / .2303
DM 9702-61 P/S	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

NO.	CHANGE	BY	DATE

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

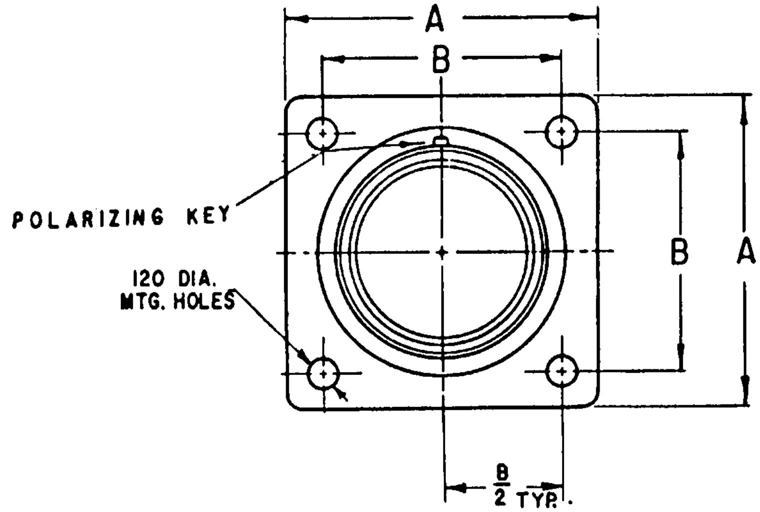
DRAWN C. HASTINGS
CHECKED
APPROVED
DATE 4-22-60 CODE 11139

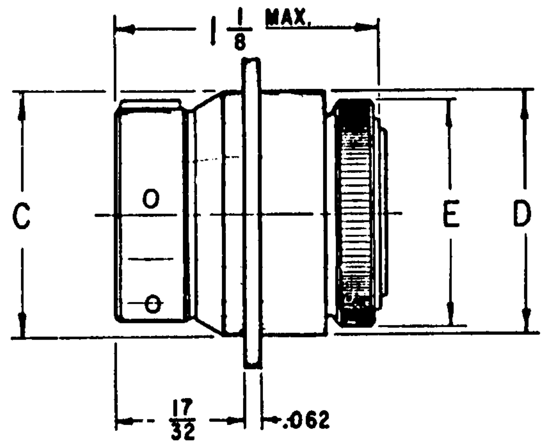
DM 9702-* P/S

FORM 1055 F

DM-4P (4-61)

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	.969	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 .1640 S .1894

III-4

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. W. Ferling 5-3-61
APP	CED

(ENVELOPE)

RECEPTACLE,
MINIATURE SQUARE
FLANGE MOUNTING TYPE
DM TYPE

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

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

SCALE | WT

- Stainless Steel Sheath
- Maximum Temperatures to 1250°F.
- Moderate Watt Density
- U.L. Recognized & CSA Certified (¼" & up)
- Supplied with 12" SF-1 Leads

HOTWATT, INC.
DANVERS, MA
(617) 777-0070

IN-STOCK HEATERS

STANDARD CARTRIDGE HEATERS

DIMENSIONS	CAT. NO.	WATTAGE	VOLTAGE	WATT DENSITY W/in²
1/8" × 1"	SC121	10W	120V	35
1/8" × 1"	SC121	15W	120V	50
1/8" × 1½"	SC1215	20W	120V	40
1/8" × 1½"	SC1215	25W	120V	50
1/8" × 2"	SC122	35W	120V	50
5/32" × 1"	SC151	10W	120V	25
5/32" × 1½"	SC1515	20W	120V	35
5/32" × 2"	SC152	35W	120V	40
3/16" × 1½"	SC1815	30W	120V	40
3/16" × 2"	SC182	35W	120V	35
3/16" × 3"	SC183	65W	120V	40
3/16" × 4"	SC184	90W	120V	40
3/16" × 4"	SC184	60W	120V	25
3/16" × 4"	SC184	100W	120V	45
¼" × 1"	SC251	20W	120V	35
¼" × 1¼"	SC251.25	20W	120V	25
¼" × 1½"	SC2515	30W	120V	30
¼" × 1½"	SC2515	30W	240V	30
¼" × 1½"	SC2515	50W	120V	50
¼" × 1½"	SC2515	50W	240V	50
¼" × 2"	SC252	50W	120V	35
¼" × 2"	SC252	50W	240V	35
¼" × 2¼"	SC252.25	75W	240V	50
¼" × 2½"	SC2525	65W	120V	35
¼" × 2½"	SC2525	65W	240V	35
¼" × 3"	SC253	100W	240V	45
¼" × 3½"	SC2535	90W	120V	35
"	SC2535	90W	240V	35
¼" × 4"	SC254	110W	120V	40
¼" × 4"	SC254	110W	240V	40
¼" × 4½"	SC2545	110W	120V	30
¼" × 4½"	SC2545	110W	240V	30
¼" × 7"	SC257	150W	120V	30
3/8" × 1"	SC371	30W	120V	40
3/8" × 1"	SC371	30W	240V	40
3/8" × 1½"	SC3715	30W	120V	20
3/8" × 1½"	SC3715	30W	240V	20
3/8" × 1½"	SC3715	50W	120V	40
3/8" × 1½"	SC3715	50W	240V	40
3/8" × 2"	SC372	70W	120V	35
3/8" × 2"	SC372	70W	240V	35
3/8" × 2"	SC372	100W	120V	50
3/8" × 2½"	SC3725	100W	120V	40
3/8" × 2½"	SC3725	100W	240V	40
3/8" × 3"	SC373	75W	120V	25
3/8" × 3"	SC373	75W	240V	25
3/8" × 3½"	SC3735	150W	120V	50
3/8" × 3½"	SC3735	150W	240V	50
3/8" × 4"	SC374	75W	240V	20
3/8" × 4"	SC374	220W	120V	50
3/8" × 4"	SC374	220W	240V	50
3/8" × 4½"	SC3745	250W	120V	50
3/8" × 4½"	SC3745	250W	240V	50
3/8" × 5"	SC375	280W	120V	50
3/8" × 5"	SC375	280W	240V	50
3/8" × 5½"	SC3755	100W	240V	15
3/8" × 6"	SC376	350W	120V	50
3/8" × 6"	SC376	350W	240V	50

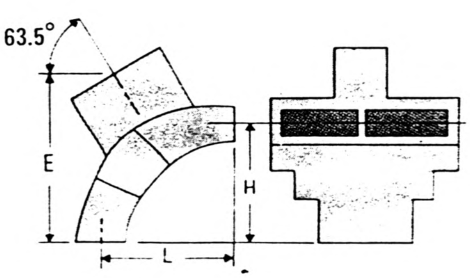
DIMENSIONS	CAT. NO.	WATTAGE	VOLTAGE	WATT DENSITY W/in²
½" × 1½"	SC5015	75W	120V	50
½" × 1½"	SC5015	75W	240V	50
½" × 1½"	SC5015	90W	120V	60
½" × 2"	SC502	120W	120V	50
½" × 2"	SC502	120W	240V	50
½" × 2½"	SC5025	80W	120V	25
½" × 2½"	SC5025	150W	120V	50
½" × 2½"	SC5025	150W	240V	50
½" × 3"	SC503	200W	120V	50
½" × 3"	SC503	200W	240V	50
½" × 4"	SC504	275W	120V	50
½" × 4"	SC504	275W	240V	50
½" × 5"	SC505	350W	120V	50
½" × 5"	SC505	350W	240V	50
½" × 6"	SC506	425W	120V	50
½" × 6"	SC506	425W	240V	50
5/8" × 2½"	SC6225	75W	240V	20
5/8" × 2½"	SC6225	200W	120V	50
5/8" × 2½"	SC6225	200W	240V	50
5/8" × 3"	SC623	250W	120V	50
5/8" × 3"	SC623	250W	240V	50
5/8" × 3½"	SC6235	300W	120V	50
5/8" × 3½"	SC6235	300W	240V	50
5/8" × 3½"	SC6235	350W	120V	60
5/8" × 4"	SC624	350W	120V	50
5/8" × 4"	SC624	350W	240V	50
5/8" × 5"	SC625	450W	120V	50
5/8" × 5"	SC625	450W	240V	50
5/8" × 6"	SC626	350W	120V	30
5/8" × 6"	SC626	400W	240V	30
5/8" × 6"	SC626	540W	120V	50
5/8" × 6"	SC626	540W	240V	50
5/8" × 7"	SC627	635W	120V	50
5/8" × 7"	SC627	635W	240V	50
¾" × 2½"	SC7525	230W	120V	50
¾" × 2½"	SC7525	230W	240V	50
¾" × 3½"	SC7535	350W	120V	50
¾" × 3½"	SC7535	350W	240V	50
¾" × 5"	SC755	500W	120V	50
¾" × 5"	SC755	500W	240V	50
¾" × 6"	SC756	650W	120V	50
¾" × 6"	SC756	650W	240V	50
¾" × 7"	SC757	760W	120V	50
¾" × 7"	SC757	760W	240V	50
¾" × 8"	SC758	750W	120V	40
¾" × 8"	SC758	885W	120V	50
¾" × 8"	SC758	885W	240V	50

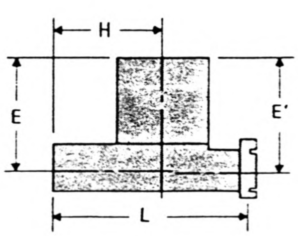
H plane folded hybrid tees

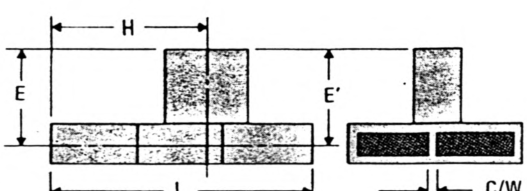
	ELECTRICAL DATA							MECHANICAL DATA						
Waveguide Size	*Operating Frequency GHz	MDL MODEL NUMBER	VSWR Maximum H Arm	VSWR Maximum E Arm	Isolation DB Min Between E&H Arms	Isolation DB Min Between Parallel Arms	Unbal DB Max	Dimensions (Inches) L	Dimensions (Inches) E	Dimensions (Inches) H	Common Wall Thickness (Inches)	Terminations E&H Arms	Terminations Parallel Arms	Recommended Dual Flange (12)
WR 10	91.75-95.75	10TH16-1[12]	1.25	1.25	34	19	.25	1.12	0.38	0.56	.040	COVER[16] / FLANGE	50FS12	10FS12
WR 15	50.0-60.0	15TH26-1[12]	1.30	1.30	35	18	.25	1.00	0.56	0.50	.040	UG385/U	15FS52	15SF52
	67.0-73.0	15TH16-1[12]	1.30	1.30	35	18	.25							
WR 22	43.5-45.5	22TH12	1.15	1.15	40	–	.20	1.04	0.60	0.60	.040	WG	CORRAL	–
WR 28	29.0-33.2	28TH42	1.25	1.25	35	22	.25	0.97	0.72	0.48	.040	WG	CORRAL	28FS12
	33.0-39.5	28TH22	1.35	1.35	35	22	.25							
	34.0-36.0	28TH12	1.20	1.20	35	22	.25							
WR 42	20.2-21.2	42TH22	1.20	1.20	40	20	.15	1.26	0.71	0.71	.090	WG	CORRAL	42FS32
	22.5-26.0	42TH12	1.15	1.20	35	25	.10	0.95	0.76	0.48	.090	WG	CORRAL	
WR 51	16.0-17.0	51TH22	1.12	1.15	40	28	.10	1.00	0.92	0.66	.040	WG	CORRAL	51FS12[3]
	16.50-19.65	51TH12	1.10	1.10	40	28	.10	1.39	0.92	0.80	.040	WG	CORRAL	51FS12[3]
	12.4-14.5	62TH32	1.10	1.10	40	28	.10	1.76	0.92	0.91	.040	WG	CORRAL	62FS52
	14.5-15.0		1.15	1.15	40	25	.10							
WR 62	13.5-15.6	62TH12	1.12	1.10	40	28	.10	1.61	0.91	0.92	.040	WG	CORRAL	62FS52[3]
	15.0-17.5	62TH22	1.12	1.10	40	28	.10	1.81	0.81	0.95	.090	WG	CORRAL	62FS92
	15.5-17.0	62TH42	1.08	1.10	40	30	.10							
WR 75	10.5-11.7	75TH12	1.10	1.10	40	28	.10	1.77	0.92	0.80	.050	WG	CORRAL	75FS12
	11.0-12.85	75TH22	1.15	1.15	40	25	.10	1.96	1.09	1.10	.050	WG	CORRAL	75FS12
WR 90	8.2-10.0	90TH32	1.15	1.25	40	24	.10	2.78	1.75	1.50	.120	WG	CORRAL	90FS112
	8.5-9.6		1.10	1.12	40	28	.10							
	8.5-9.6	90TH52	1.12	1.20	40	24	.10	1.47	1.12	0.75	.050	WG	CORRAL	90FS82[3]
	8.5-9.6	90TH12	1.10	1.10	40	28	.10	2.22	1.75	1.50	.050	WG	CORRAL	90FS82[3]
	8.5-9.6	90TH42	1.06	1.10	45	32	.10	2.78	1.75	1.50	.120	WG	CORRAL	90FS112[3]
	8.65-11.0	90TH62	1.25	1.25	40	20	.10	2.53	1.75	1.50	.120	WG	CORRAL	90FS112[3]
	8.8-11.2	90TH72	1.25	1.25	30	18	.10	1.27	1.12	0.82	.050[3]	COR.	CORRAL	NONE
	9.2-10.0		1.15	1.15	35	25	.10							
	10.2-12.4	90TH102	1.20	1.15	40	28	.10	2.18	1.18	1.20	.120	WG	CORRAL	90FS112
WR 90 tapered to WR 112	8.5-9.6	90TH22	1.10	1.10	40	28	.10	2.41	E = 1.25 / E′ = 1.30	1.50	.120	WR112 WG	WR90 / CORRAL	90FS122
WR 90 200 Hgt.	9.0-10.8	A90TH12	1.10	1.10	40	28	.10	2.00	0.98	1.10	.050	WG	CORRAL	
WR 102	9.5-10.5	102TH12	1.10	1.10	40	28	.10	2.75	1.75	1.56	.150	WG	CORRAL	

*All tees exhibit reasonable electrical characteristics over a broader frequency range than specified.
Maximum VSWR's specified does not indicate typical performance but only the highest VSWR over the operating range of the tee.

2. Available only in copper alloy with flanges.
3. This flange is integral cast to the tee.
7. Add 0.17 to Dimension "L" when using recommended dual flange.
8. E = E′ and H = H′ unless otherwise shown.
9. Available only in non-brazable aluminum with flanges.
10. Available only in aluminum with flanges.
13. No physical commonwall. .050 commonwall required by mating component to function electrically.
14. Parity output with two single flanges. 2100 FA27 CPR2100 Except Holes
    4 ½-13 Thr'd
    24 0.531 Dia.
15. No physical commonwall. .160 commonwall required by mating component to function electrically.
16. Similar to UG387/U





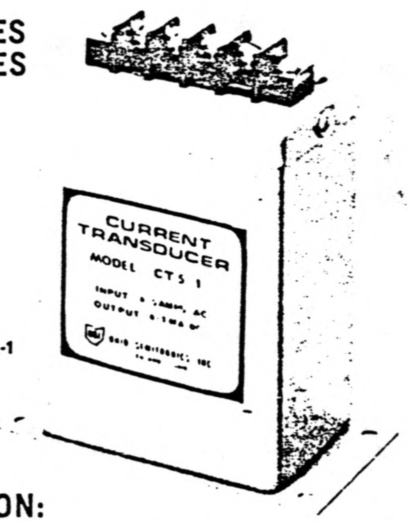


OSI

SPECIALISTS IN MEASUREMENT MONITORING, AND CONTROL OF CURRENT, POWER AND ENERGY

AC VOLTAGE AND CURRENT TRANSDUCERS

VT SERIES
CT SERIES



MODEL CT5-1

DESCRIPTION:

The VT (Voltage Transducers) and CT (Current Transducers) provide a 0 to 1 mA DC output related to the AC input signal to the transducer. Transducer output is derived from the average absolute value of the input and is calibrated in terms of the rms value for sine wave input.

Voltage transducers are available for 120, 240, 480 volt inputs at 50 to 500 Hz.

Current transducers are available with full-scale current input ranges from 1 to 1000 Amperes rms.

4-20 mA output available upon request.

MODEL	VOLTAGE (VAC) RANGE	OUTPUT CAL
VT120	0 to 150	1 mA @ 150V
VT240	0 to 300	1 mA @ 300V
VT480*	0 to 575	1 mA @ 575V

MODEL	CURRENT (AMPS AC) RANGE	OUTPUT CAL	CURRENT SENSOR DRAWING
CT1-1	0 to 1	1 mA @ 1A	Internal
CT5-1	0 to 5	1 mA @ 5A	Internal
CT10-1	0 to 10	1 mA @ 10A	Internal
CT20-1	0 to 20	1 mA @ 20A	Internal
CT5-100	0 to 100	1 mA @ 100A	W
CT5-200	0 to 200	1 mA @ 200A	W
CT5-300	0 to 300	1 mA @ 300A	W
CT5-400	0 to 400	1 mA @ 400A	X
CT5-600	0 to 600	1 mA @ 600A	X
CT5-1000	0 to 1000	1 mA @ 1000A	Y

* Includes OSI 226-145 Potential Transformer.

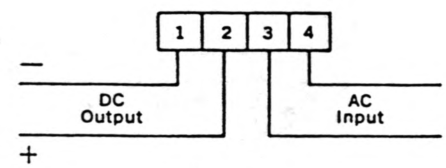
SPECIFICATIONS (Common to All Models):

ACCURACY (Calibration, linearity @ 25°C)	±0.5% FS
FREQUENCY RANGE	50 to 500Hz
RESPONSE TIME	400ms
TEMPERATURE EFFECT (from calibrated value) −20°C to +60°C	±1% of Reading
RIPPLE	<1% FS
FULL SCALE OUTPUT	1 mA DC
OUTPUT LOADING	0-10K ohms
OVERLOAD (Continuous)	
Voltage	Full Scale Rating
Current	2 X Rating
Except CT10-1 & CT20-1	1.25 Rating
1 Second Transients	50 X Rated Input
BURDEN	
Voltage	2.8VA FS
Current	1VA FS
OPERATING RANGE (Extended)	
Voltage	Full Scale
Current	1.2 X Rating
DIELECTRIC TEST: (Input/Output/Case) VT and CT	1500VAC

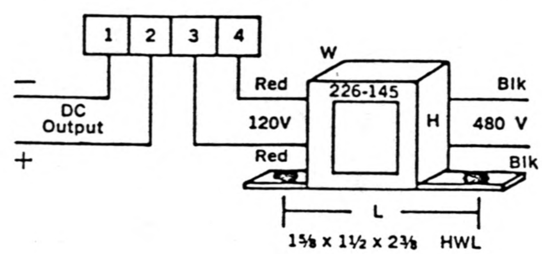
CASE SIZE DRAWING B, See Attached Drawing
CURRENT SENSOR DIMENSIONS, See Attached Drawing

VOLTAGE AND CURRENT TRANSDUCER CONNECTIONS

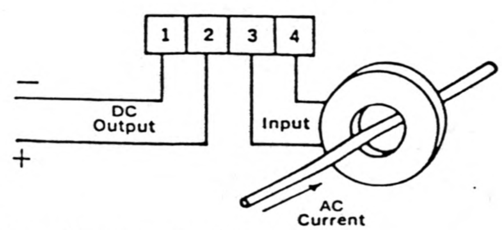
MODELS
CT5-1 THRU CT20-1
VT120 AND VT240



MODEL
VT480



MODELS
CT5-100 THRU CT5-1000



Current Transformer Phasing is not required

OHIO SEMITRONICS, INC. TWX 810-482-1630 PHONE 614/486-9561 DEPT EM 1205 CHESAPEAKE AVENUE COLUMBUS, OHIO 43212

III-8

Curtis Instruments, Inc.

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

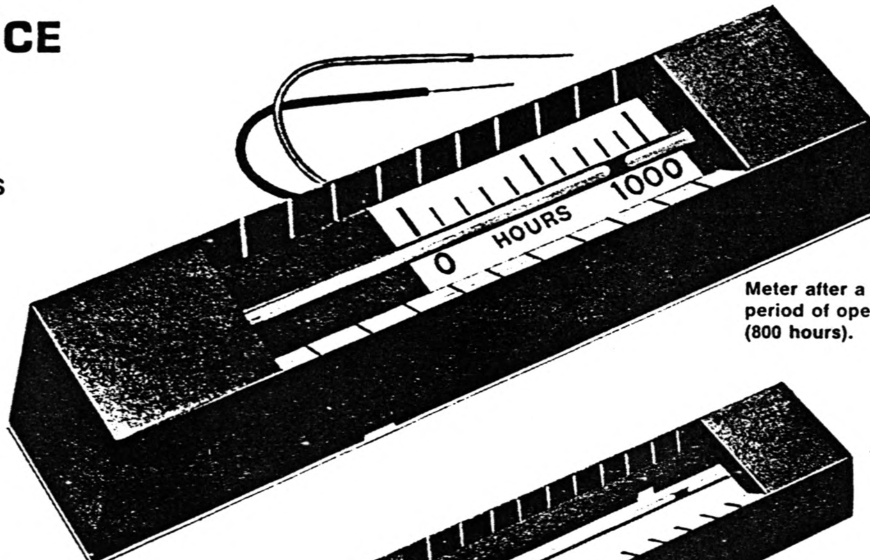
12-74

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.

FEATURES:

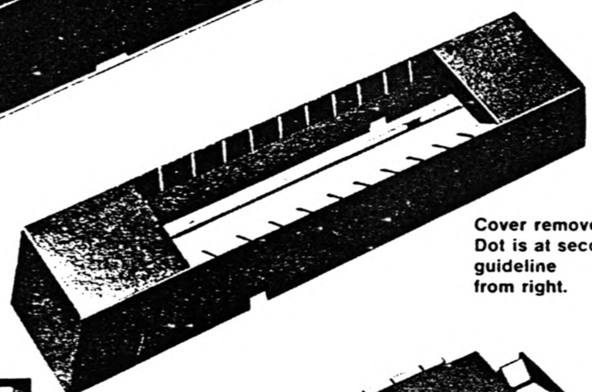
- Instant Field Reset to Zero
- Easy Readability
- Overrun Safety
- Infinite cycles
- Scales for any type of scheduling programs
- Models operate from any AC or DC Voltage
- Compact Size
- Counts Operation Cycles—from Pulsed Inputs

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.

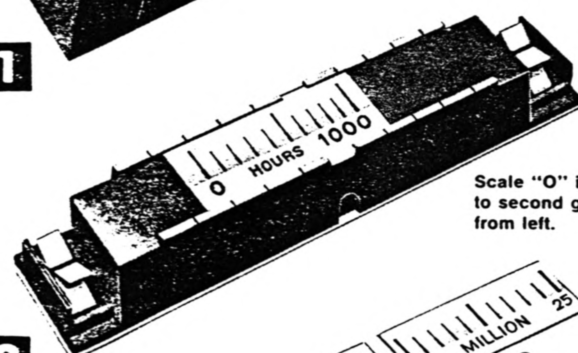
In the CP3 Series, the capillary tube is mounted on a window-cover assembly **1**. This plugs into

continued . . .



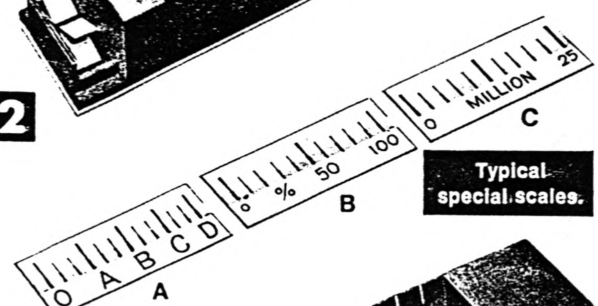
1

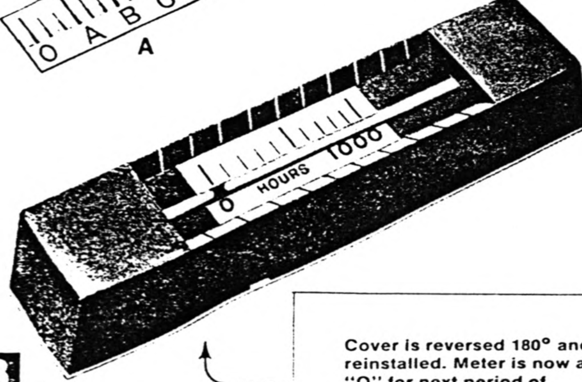
Cover removed. Dot is at second guideline from right.



2

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





3

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

*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 1/2 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.

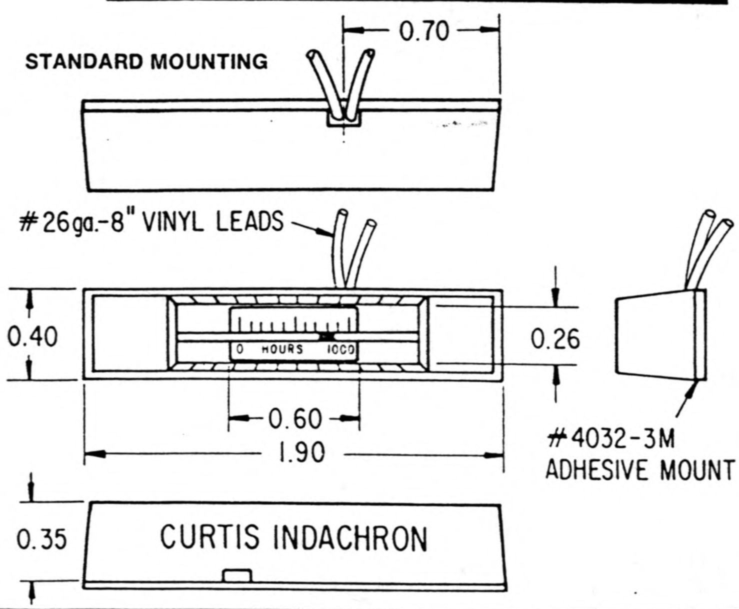
MODELS

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 1/2″, 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.



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.

ASCO Valves ASCO

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

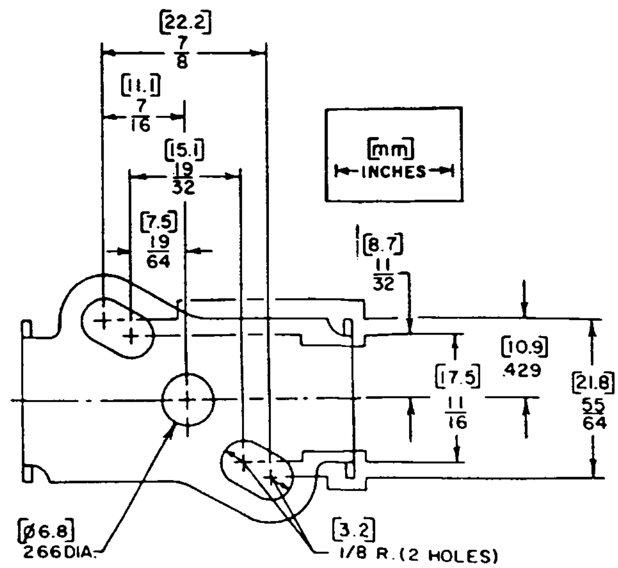
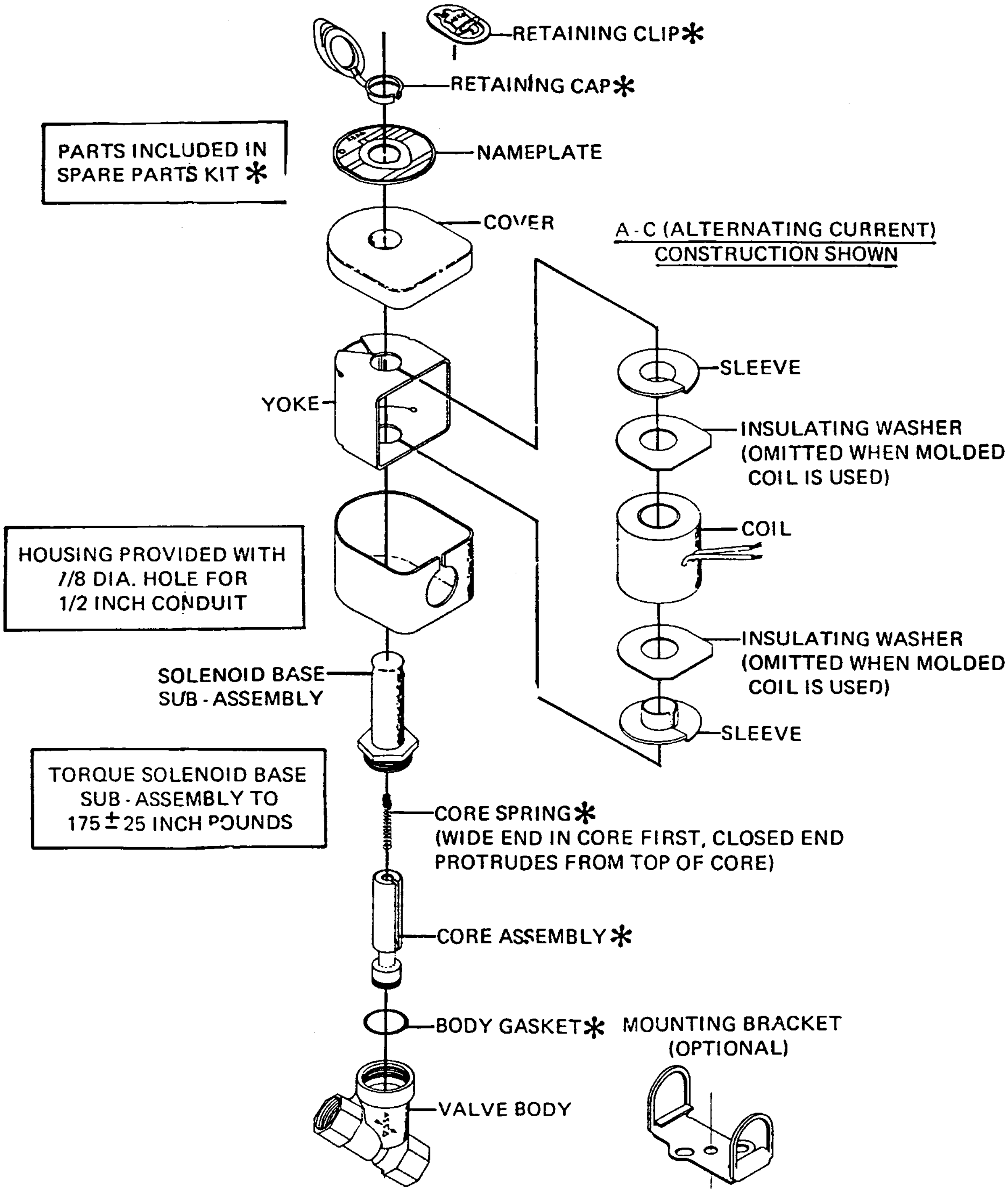


Figure 1. Dimensions for Mounting Bracket (Optional Feature)



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.

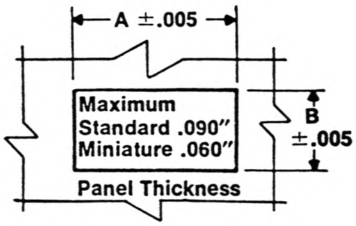
.093″ Diameter Terminals • .198″ Centers (Grid Pattern)

(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.

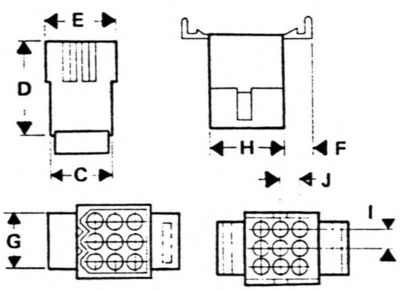
(b) Center spacing .248″. Will accommodate: 14, 16 and 18 AWG with 1/32″ insulation – 16 with 18 AWG (double crimp), each with 1/32″ insulation. Model 1816 housings have positive lock rather than holding tabs.

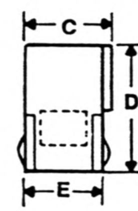
(c) 4 circuits in square grid pattern.

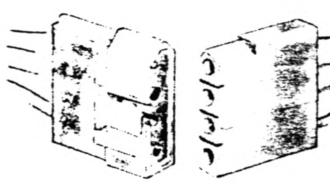
(d) Has positive lock rather than holding tabs; plug 03-09-2057 will mate also with 5-circuit receptacle Model 1653, part 03-09-1051, and 4-circuit receptacle Model 1490, part 03-09-1042.

(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).

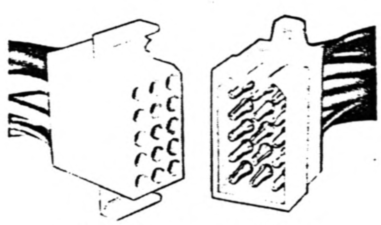
(f) Plug also is available with pull tabs and without mounting ears. Order part 03-09-2151.



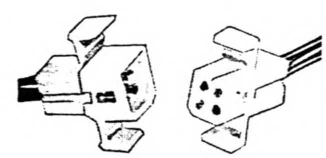




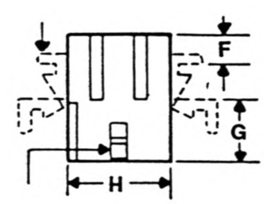
4-Circuit with Positive Lock

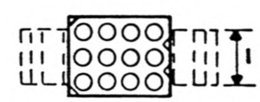


15-Circuit Plug with Pull Tabs



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″.

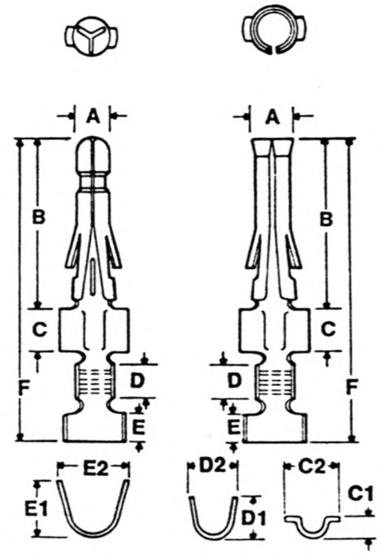
(a) 12-circuit plug, Model 1360, has alternate design of .844″ Dim. J.

(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

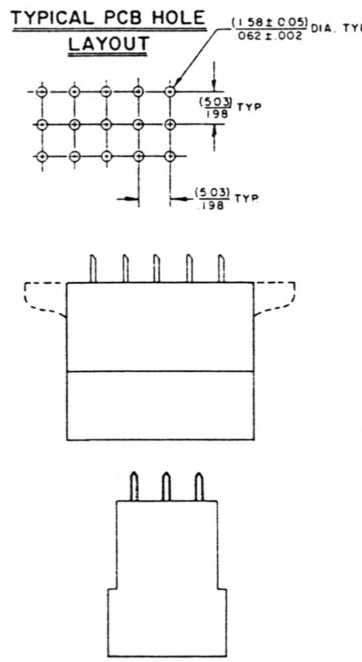
Improved mechanical characteristics, but reduced electrical characteristics are typical of tin plated phosphor bronze terminals. Conductivity is 15 per cent, compared with 28 per cent for tin-plated brass terminals.

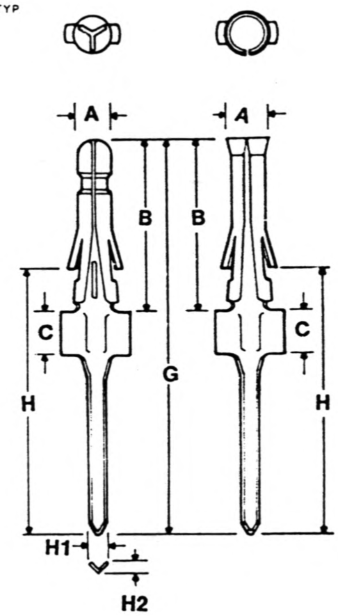
Suggested application is for use where a high number of insertion and withdrawal cycles is required.

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

Precision Calibrated Waveguide Noise Sources-18 GHz-50 GHz

NC 5000 Series

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 unit
- Calibration points are listed on each noise source
- Noise output rise time and fall time <usec
- Noise diode is hermetically sealed

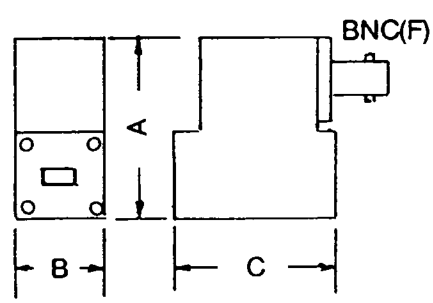
NOISE FIGURE METER COMPATIBLE - FULL BAND:

MODEL	FREQUENCY RANGE (GHz)	NOISE OUTPUT ENR (DB)	VSWR TYPICAL	MATING FLANGE	CALIBRATION FREQUENCIES	WAVEGUIDE
NC 5142	18 – 26.5	15.5 ± .75	1.3	UG595/u	1 GHz STEPS	WR-42
NC 5128	26.5 – 40	15.5 ± .75	1.3	UG599/u	2 GHz STEPS	WR-28

WAVEGUIDE	A	B	C
WR 42	1.72	.88	1.55
WR 28	1.5	.75	1.25
WR 22	1.5	1.13	1.25

HIGH NOISE OUTPUT - FULL BAND:

MODEL	FREQUENCY RANGE (GHz)	NOISE OUTPUT		MATING FLANGE	CALIBRATION FREQUENCIES	WAVEGUIDE
		ENR (DB)	FLATNESS			
NC 5242	18 – 26.5	25.0	± 1.5DB TYP ± 2.0DB max	UG595/u	1GHz STEPS	WR-42
NC 5228	26.5 – 40	23.0	± 2.0DB TYP ± 3.0DB max	UG599/u	2GHz STEPS	WR-28
NC 5222	33 – 50	21.0	± 2.0DB TYP ± 3.0DB max	UG383/u	2GHz STEPS	WR-22



HIGH NOISE OUTPUT - NARROW BAND:

MODEL	FREQUENCY RANGE (GHz)	NOISE OUTPUT		MATING FLANGE	CALIBRATION FREQUENCIES	WAVEGUIDE
		ENR (DB)	FLATNESS			
NC 5342	18 – 26.5 One GHz BAND*	25	±.5DB	UG595/u	MINIMUM	WR-42
NC 5328	26.5 – 40 One GHz BAND*	23	±.5DB	UG599/u	CENTER	WR-28
NC 5322	33 – 50 One GHz BAND*	21	±.5DB	UG383/u	MAXIMUM	WR-22
NC 5442	19.9 – 23.1	25	±.6DB	UG595/u		WR-42

For fast action on your NOISE needs, talk to Gary Simonyan

(201) 488-4144

OPTIONS:

1. Input voltages as low as 15 volts are available in some models. Consult factory.

NOTES: Bandwidths of one GHz may be specified anywhere in the band. Other bandwidths may be specified, however, wider bandwidths may result in a different flatness specification.

APPENDIX IV

SPECIAL EQUIPMENT

In doing the noise temperature test on the 43 GHz front-end a hot and cold load is required. A piece of microwave absorber placed over the feed horn has been found suitable for a warm load. It has been found microwave absorber soaked in liquid nitrogen works as a stable cold load at 43 GHz. Several materials were tested to encase the liquid nitrogen and microwave absorber and the product found to be most suitable was ECCOFOAM-PS from Emerson and Cuming. The material used has a relative dialectic constant of 1.04 and is the same material used to insure a vacuum in the L-band and S-band VLBA front-ends (see VLBA technical report number 2).