

VLA TECHNICAL REPORT #13

FRONT-END DEWAR ASSEMBLY

S. Maas

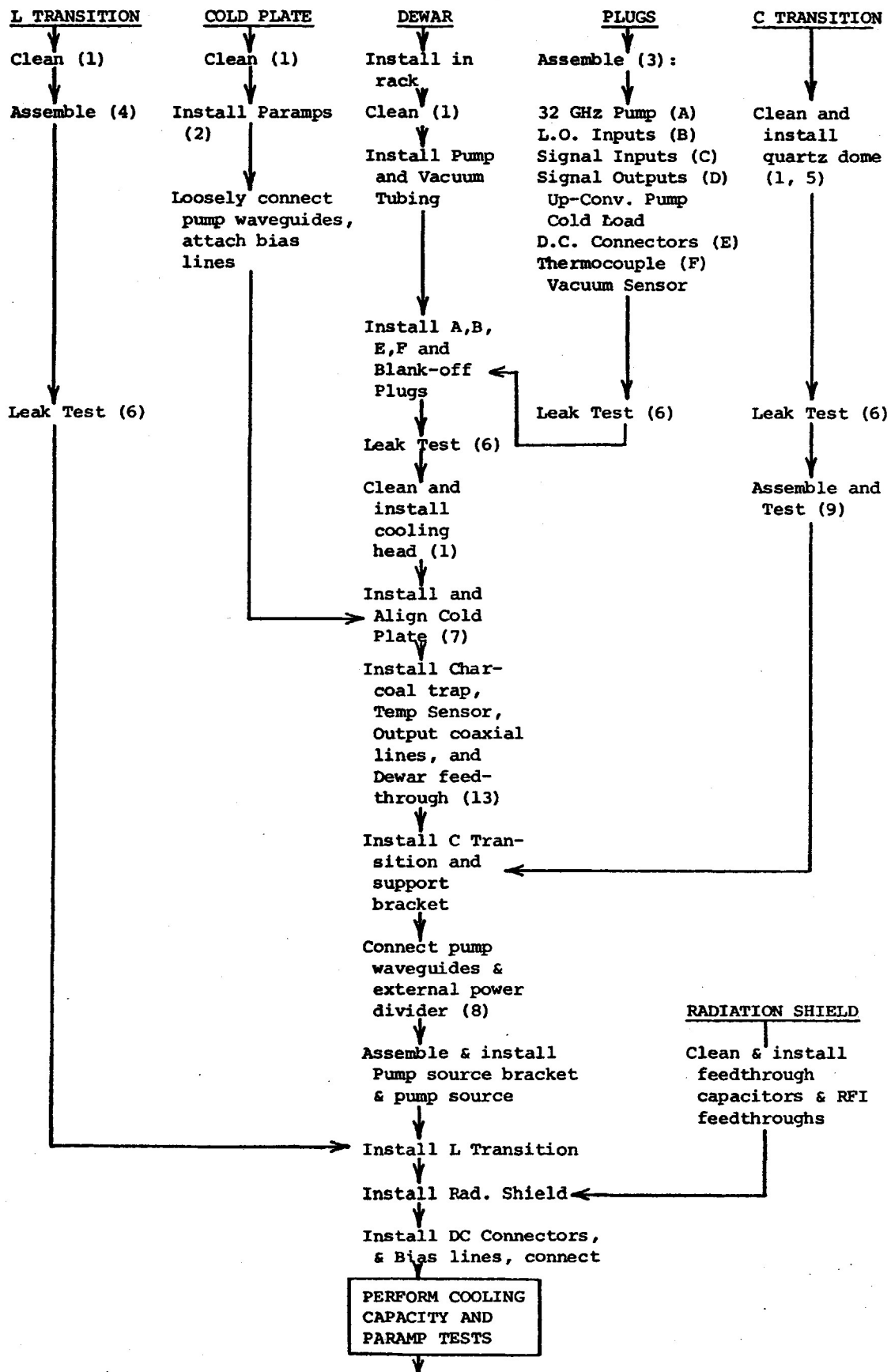
April 1975

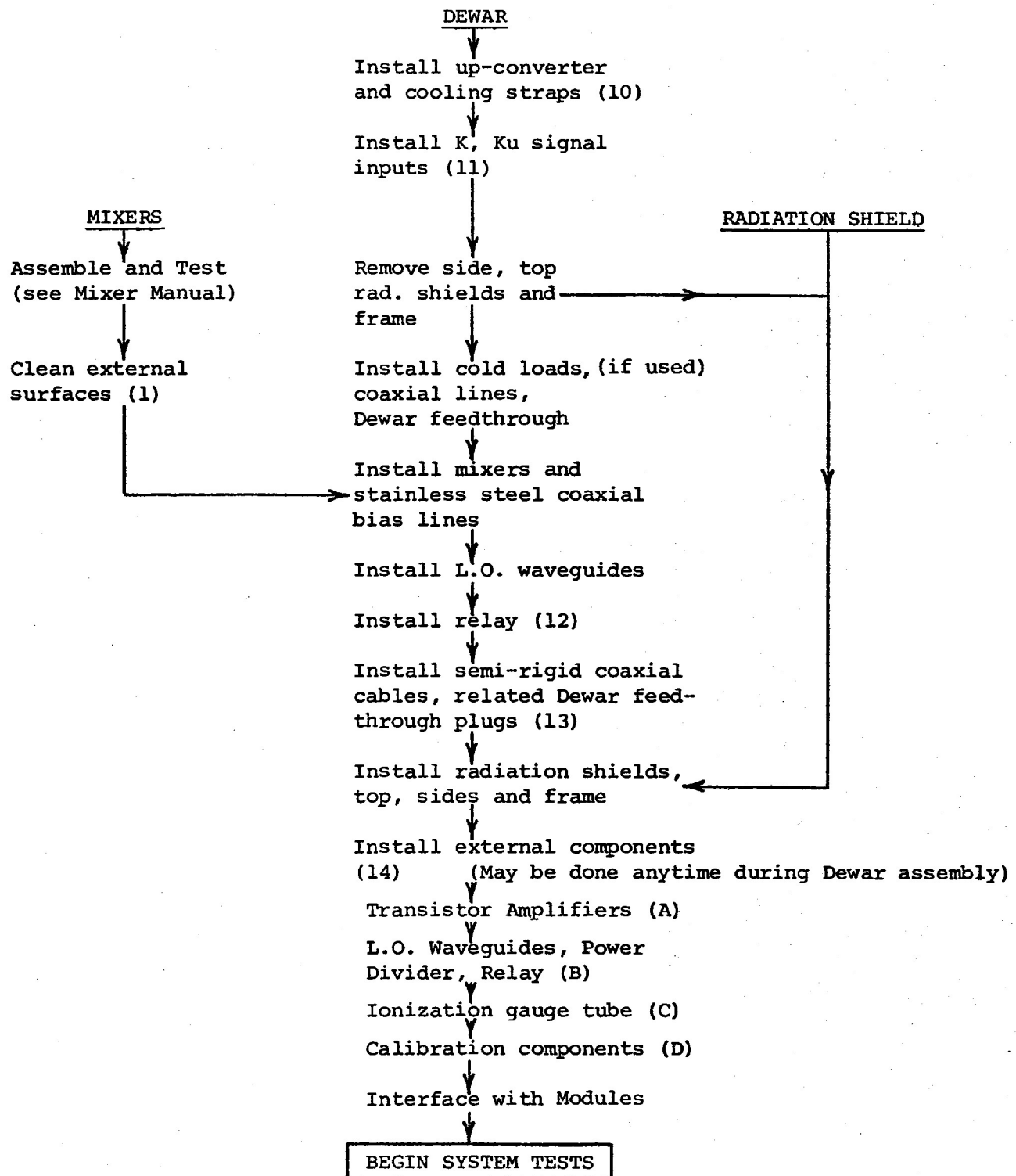
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DEWAR ASSEMBLY PROGRAM

NOTE: Numbers refer to instructions in Section III.





II. GENERAL REQUIREMENTS

Right angle OSM connectors have poor SWR and trap air which may cause a virtual leak. Consequently, they must not be used inside the Dewar and should be avoided elsewhere.

All components installed in the Dewar must be meticulously cleaned according to instructions in Section III, removing fingerprints, machinist's oil, and foreign particles.

"O" rings must not be heavily greased. A very light greasing, just barely enough to make the "O" ring feel tacky, is sufficient. Grease must be compatible with the "O" ring compound; refer to the "O" ring chart. Petroleum based lubricants must never be used with butyl rubber gaskets, or they will be damaged.

Copper semirigid cable used inside the Dewar should be gold plated. Plating must be done after fitting the cable and installing the body of the connector, but before the hood is attached to the connector (the hood is difficult to rinse completely after plating). Refer to the list of cables used in various applications.

Indium gaskets must be used between all mechanically connected surfaces where efficient heat transfer is necessary. Gaskets can be cut from .004" thick high purity indium sheet using a knife or scissors.

All internal wiring is done with teflon insulated stranded copper wire, consisting of seven .006" diameter (#34 AWG) wires.

Tasks listed in the Dewar Assembly Program, Section 1, are approximately in chronological order. It is important that this program be followed in the specified order, or it will be necessary to remove previously installed components sometime during assembly.

III. DETAILED ASSEMBLY INSTRUCTIONS

1. Cleaning

A. Dewar: The vacuum Dewar will have been cleaned and degreased, and shipped evacuated, so interval cleaning will ordinarily be unnecessary. If the dewar is shipped at atmospheric pressure or appears dirty (fingerprints, etc.) it should be cleaned with Freon T.F. or acetone. The working area must be well ventilated, as the vapors are poisonous. It will be necessary to remove all flanges and hole covers from the Dewar, and it will be easiest if the Dewar is mounted in the rack. The entire interior, including edges of openings and exterior "O" ring surfaces, should be wiped with a paper towel or Kimwipe wetted with the cleaning solvent, and the paper towel should be replaced frequently. When clean, no smears or smudges should be visible on the Dewar interior walls on close inspection.

B. General Technique for Other Components: All components used inside the vacuum chamber must be thoroughly cleaned with acetone or ethyl alcohol. The technique is the same as that for the Dewar. It is especially necessary that "O" ring grooves be cleaned of all foreign material. Waveguide interiors should not be cleaned because some are coated with a varnish which may be soluble in acetone or alcohol.

L and C transitions should be cleaned as they are assembled. After installation, external surfaces which are placed in the vacuum chamber should be cleaned a second time to remove contamination from handling.

All clean components, especially radiation shield pieces, should be stored in clean plastic bags and prevented from receiving scratches.

2. Paramp Installation

Unpack the paramps and inspect them for damage, and reinsert circular magnets which have been jarred loose in transit. Put a dab of Miller-Stephenson epoxy on adjustments if this has not already been done.

Make indium gaskets for the paramps by pressing sheet indium (.004" thick) over the paramp mounting surface and cutting off excess with a sharp knife or scissors. Install the amplifier stages with the pump flange pointing away from the center of the cold plate. The first stage must be in the upper right and bottom left corner of the cold plate, as viewed from the side on which the paramps are mounted.

Install interconnecting semirigid coaxial cables between the first and second, and second and third stages. Install pump waveguides using 2-56x1/2" socket cap screws. Do not tighten them.

Connect a 24" small-diameter teflon insulated wire to the bias terminal on each stage.

3. Dewar Feedthrough Plugs

Plugs and O-ring grooves should be cleaned as in Section 1. "O" rings must be lightly greased and all plugs must be leak tested before installation. Waveguide windows are installed with the high pressure side (the side with the largest glass area) outward.

A. Ka Plug: Assemble using a 2-013 "O" ring, type 51140 (MDL) window, and Ka attenuator. Use 4-40 x 3/8" socket cap screws.

B. K L.O. Plug: Assemble using a 2-016 "O" ring, type 1356 (MDL) window, and a K band variable attenuator. It will be necessary to drill out the holes in the flange on one end of each attenuator with a no. 32 drill. Use three 4-40 x 3/8" socket cap screws and a 4-40 x 3/8" stud, made from a 4-40 screw, in the hole where a screw cannot be used.

C. K & Ku Signal Plugs: Assemble using a 2-016 "O" ring and type 1348 (MDL) window for K, and 2-212 "O" ring and 1341 S (MDL) window for Ku, and one inch waveguide sections. Use 6-32 (Ku) and 4-40 (K) by 3/8" screws.

NOTE: K band signal and L.O. windows appear identical but are electrically different. Do not interchange them.

D. Signal Output, Cold Load: Use the plugs with "D" holes offset 45 degrees from mounting holes. Lightly grease the "O" ring in the OSM 208A connector, and install with the "O" ring on the outside of the plug.

E. Up-converter Pump: Assemble identically to (D), but use the flange without a 45° offset.

F. D.C. Connectors: Wire with appropriate small diameter wire with teflon insulation according to the wiring list for the connector.

G. Thermocouple Gauge: Install the thermocouple gauge by wrapping the threads with teflon tape and screwing it tightly into the plug.

4. Assemble L Transition

Assemble according to the assembly drawing. Do not touch the silver plated surfaces or they will tarnish. Clean the external surfaces before installing to remove fingerprints and other contaminants.

4. (cont.)

Use lightly greased 2-013 and 2-026 "O" rings in the teflon block.

5. Install Quartz Dome

Thoroughly clean the quartz dome and mating groove in the C transition body. Fill the groove with Varian Torr-Seal epoxy and place the dome into the groove. Rotate the dome a few degrees in order to work the epoxy around it. Leave it upright, and dry it without disturbance.

6. Leak Test

Leak test all components using a helium mass-spectrometer leak detector, and an appropriate test adapter. All components must be leak tested before installation in the Dewar (vacuum plumbing only may be leak tested along with the Dewar itself). Two tests should be made:

A. Pinpoint leaks, gross leaks: Connect the part to the leak detector. With the detector in test mode, spray helium around its edges and joints, from the top to the bottom. Any leak indication, on the 1×10^{-8} scale, is cause for rejection.

B. Diffusion: Cover the part with a plastic bag and fill the bag with helium. It may require several hours for the leak rate to stabilize. The leak rate should not exceed the following limits:

<u>PART</u>	<u>MAXIMUM LEAK RATE</u>	<u>AFTER (TIME)</u>
Plugs	10^{-8} cc/sec	15 min.
Transitions	10^{-7} cc/sec	15 min.
Dewar	10^{-5} cc/sec	6 hrs.

Plugs may be considered satisfactory if there is no visible indication on the 10^{-8} scale after 2 or 3 minutes.

7. Install and Align Cold Plate

Make an indium gasket for the end of the cooling head. Set the cold plate onto the cooling head and loosely install 6-32x3/4" screws, nuts and lock washers. Replace a K signal plug and the diametrically opposite Ku signal plug with alignment mandrels and shift the cold plate until the mandrel ends fall into the waveguide holes in the plate, and the mandrels can be screwed to the Dewar. Tighten the 6-32 mounting screws and remove the mandrels.

7. (cont.)

Remove two screws near the front of the Dewar and mount the platinum resistance (temperature) sensor and charcoal trap (refer to photograph). Wire the temperature sensor to the connector (see wiring lists), wrapping the wire around the cooling head.

A. Assembly of charcoal trap: Coat the inside of the charcoal trap body with Miller-Stephenson epoxy. Fill the trap with activated charcoal, and empty the excess. Force as much charcoal into the trap as possible, and be certain that all the inside surfaces are completely covered with charcoal granules.

B. Assembly of the temperature sensor: Solder the Rosemount 118G platinum resistance thermometer into the oval cutout in the copper sensor mount. Solder two wires to each lead, and fill the entire cutout with epoxy resin, taking care that the wires do not touch each other or the copper mount. Trim off the excess epoxy after it is dry.

8. Pump Waveguides

The pump waveguides may be connected by screwing them loosely to the flanges on their respective plugs, using 4-40 screws. Install the pump power divider; if any flanges do not quite fit, loosen the Dewar plug, move it, and retighten. When the power divider fits, tighten the pump waveguides at both ends.

Connect a directional coupler to the pump power divider input, and use a pump mounting bracket assembly to determine the hole locations on the mounting plate for the bracket. Drill and tap (6-32) these holes, after removing the power divider. Leave the divider off until assembly is almost finished.

9. C Transition Assembly and Test Procedures

A. Assembly: The C transition is assembled according to the assembly drawing. The outer conductor of the coaxial line is glued to the probe mount, using Varian Torr-Seal epoxy, after the probe has been installed and it can be ascertained that the probe and outer conductor are concentric.

B. Adjustment:

(1) Connect a waveguide termination to the transition. This device should have 35 dB or greater return loss.

B. (cont.)

(2) Connect the transition via the SMA connector to a swept frequency VSWR measuring system. Alternately adjust the 6-32 tuning screw, probe position, and backshort position until the VSWR is as low as possible in the range 4.4-5.1 GHz. The VSWR will be below 1.10.

(3) Tighten the locknut on the tuning screw and two 2-56 set screws for the backshort. Solder the backshort using low temperature solder (98°C).

(4) Insert the coaxial line/probe assembly .025 inches farther into the waveguide body and tighten the clamp. (The resulting extra probe height compensates for shrinkage of the probe as it cools).

10. Up-Converter Installation

Install the up-converter by attaching an 18 inch bias line to its bias terminal, an HP2800 hot carrier diode from the bias terminal to ground (cathode lead on the bias terminal), and connecting it to the L input transition coaxial connector.

Install the cooling strap from the cold stage flange to the 3 holes on the edge of the up-converter body. Use indium between all mating surfaces.

It may be necessary to bend the cooling strap slightly to obtain a precise fit.

11. K, Ku Signal Input Lines

The K and Ku input lines are individually fitted. Their length is determined by measuring the distance from the top outside surface of the Dewar to the cold plate, and subtracting 1.010 inches (1.000 inches for the Dewar plug, .010 inches for clearance).

When the lines are installed, be certain that they mate with the holes in the cold plate. Any offset can be seen with a mirror held at a 45° angle underneath the cold plate.

12. Coax Switch Assembly

(1) Remove and discard the black metal solenoid cover by unscrewing the large hex nut at the power connector. Remove and discard the concentric metal and rubber washers and the rubber "O" ring.

(2) Remove and save the three flat head screws and spacers, and remove the connector mounting plate. Discard the connector "O" ring.

(3) Set the switch on a table, with the SMA connector pointed down. Tape the switch assembly to its cover plate, so the cover plate will not be disturbed when the solenoid assembly is removed.

12. (cont.)

(4) Unscrew the three Phillips head screws in the solenoid assembly and remove it from the cover plate.

(5) Screw three stainless steel spacers into the threaded holes in the switch assembly and remove all tape. Do not invert the switch assembly.

(6) Remove and discard the four short plastic plungers.

(7) Without inverting the switch assembly, clean the top of the cover plate with freon. Then put a dab of epoxy cement over the six locating pin holes in the center of cover plate. Do not handle the switch assembly again until the epoxy is dry.

(8) Using the three Phillips head screws removed in Step 4, loosely mount the switch and solenoid assemblies on the radiation shield. Screw the screws into the stainless steel spacers one or two turns only.

(9) Insert four long plastic plungers into the remaining four holes in the solenoid assembly and the four opposing holes in the switch assembly. Note that one end of the plunger is drilled to fit over the pin in the hole in the switch assembly.

(10) Partially tighten the Phillips screws, and check the plungers to be certain they move freely. Then fully tighten the Phillips screws.

(11) Replace the connector mounting plate, flat head screws and spacers.

(12) Replace the large hex nut which holds the power connector to its mounting plate. Tighten it securely.

13. Coaxial Cable

Three types of .141" diameter semirigid coaxial cable are used in the Dewar. These are the following:

(1) Copper inner/outer conductor: All RF wiring where there is no desire to minimize heat transfer.

(2) Stainless steel inner/outer conductor: D.C., low frequency wiring where shielding is desired, and heat transfer through the cable is to be minimized.

(3) Beryllium copper inner conductor, .001" silver plate/stainless steel outer conductor: All RF wiring where heat transfer through the cable is to be minimized.

13. (cont.)

Cable (1) is used for paramp interconnections, mixer and up-converter outputs, and all external cables. (2) is used for bias lines from the radiation shield to the mixer body. (3) is used for up-converter lines, paramp output (Stage 3 to Dewar feedthrough) and cold load connection, if used.

All cables of type (1) used in the Dewar should be gold plated according to the standard gold plating specification. Plating must be done after the body of the connector has been soldered to the cable, and after it has been bent to shape, but before the hood is attached. No plating may be used on stainless steel cables.

Stainless steel mixer bias cables must be at least 6 inches long. All other stainless steel lines must be at least 12 inches long.

Do not use right-angle SMA connectors inside the Dewar, because they trap air and cause virtual leakage.

14. External Components

A. L.O. waveguides and relay are assembled beneath the L.O. input plugs on the underside of the Dewar. Use the photographs and block diagrams as a reference.

B. Transistor Amplifier and Isolators are mounted on "L" brackets on the left side of the Dewar above the paramp output feedthroughs. Use copper (type (1), section 12) cables, keeping the cable from the amplifier to the isolator as short as possible.

C. The ionization gauge, if used, is installed on the left side of the Dewar using a Varian gland seal brazed to a 1/2" Dewar plug.

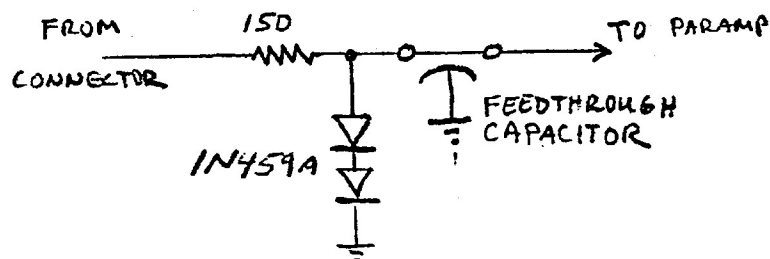
D. Calibration components - see calibration manual and block diagram.

IV. APPENDIX

4.1.1 20 Pin Connector Wiring (P1)

	FUNCTION	P1 - PIN LETTER	COLOR CODE
AB	Paramp Bias 1	A	Red
	Paramp Bias 2	B	Orange
	Paramp Bias 3	C	Yellow
	Up Converter Bias	D	Green
	Ku Mixer Bias	E	Blue
	K Mixer Bias	F	White
CD	K Mixer Bias	H	White
	Ku Mixer Bias	J	Blue
	Up Converter Bias	K	Green
	Paramp Bias 3	L	Yellow
	Paramp Bias 2	M	Orange
	Paramp Bias 1	N	Red
	Ground	P	Black
	Ground	R	Black
	Spare	S	
	Spare	T	
	Spare	U	
	Spare	V	
	Spare	W	
	Spare	Coax	

- NOTES: 1. After wiring the Dewar connectors, tie the "AB" and "CD" bundles and label them. Remove the labels after installation.
2. Connect a 150 ohm 1/8 watt resistor in series with the paramp bias line between the connector and the feedthrough capacitor mounted on the radiation shield. Connect two series-connected 1N459A diodes in parallel with the feedthrough capacitor, cathode grounded.



4.1.2 12 Pin Connector (P2) and Relay Connector

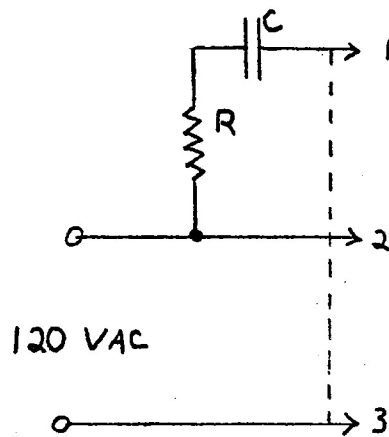
<u>FUNCTION</u>	<u>P2 CONN. (12 PIN)</u> <u>PIN LETTER</u>	<u>COLOR CODE</u>	<u>RELAY CONNECTOR</u> <u>PIN NO.</u>
Relay A: Com	A	Black	1
C	B	Brown	4
L	C	Red	5
Ku	D	Orange	7
K	E	Yellow	6
Spare	F		
Relay B: Com	H	Green	1
C	J	Blue	4
L	K	Violet	5
Ku	L	Grey	7
K	M	White	6
Spare	N		

4.1.3 Refrigerator Connector

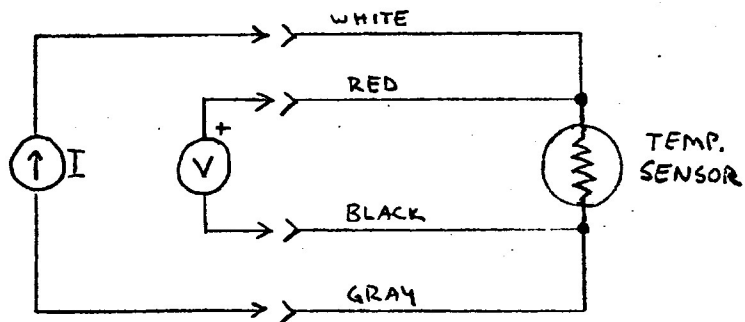
Pin No.

- | | | |
|---|------------------------|--------------|
| 1 | } | Heater Wires |
| 2 | | |
| 4 | Red - Temp. Sensor +V | |
| 5 | Black - Temp Sensor -V | |
| 6 | Gray - Temp Sensor -I | |
| 7 | White - Temp Sensor +I | |

4.1.4 Valve Motor Connector Wiring



Temp Sensor Wiring



4.1.5 RF Cables

Switch Input and Output

<u>FUNCTION</u>	<u>COMPONENT</u>	<u>SWITCH POSITION</u>
K Band Operation	K Mixer Output	2
Ku Band Operation	Ku Mixer Output	1
C Band Operation	C Transition Probe	4
L Band Operation	L Up Converter Output	3
	Paramp Input	C

4.2 O Ring Types - Vacuum Dewar

<u>PARKER SIZE NO.</u>	<u>COMPOUND</u>	<u>USE</u>	<u>PRECAUTIONS</u>
2-385	V747-75 Viton or B612-70 Butyl	Door gaskets - stainless steel Dewar (Vacronics)	
2-462	V747-75 Viton or B612-70 Butyl	Door gaskets - aluminum Dewar (VIA)	<u>Butyl Rubber</u> Do not use with petro- leum based vacuum grease; use silicon grease <u>ONLY</u>
2-222	V747-75 Viton 77-545 Viton	All 2-1/2" Dewar Plugs	
2-128	V747-75	C Band Transition	
2-139	V747-75	L Band Transition (Dewar interface)	
2-165	V747-75	Refrigerator	
2-013	V747-75	Pump waveguide (Ka) feedthrough plugs and L input transition center conductor seal	
2-212	V747-75	Ku input feedthrough plugs	
2-016	V747-75	K input feedthrough plugs K L.O. input plugs	
2-026	V747-75	L Trans. - outer conductor	

4.3 Commercially Supplied Components

<u>ITEM</u>	<u>NO/SYSTEM</u>
1. Waveguide Windows	
MDL Type: 51140 Ka Pump	6
1356 K L.O.	4
1341S Ku Signal	2
1348 K Signal	2
Specs: 1.15 SWR (All windows)	
.1 dB Loss (1341 & 1348)	
2. Flexible Waveguide	
K Band, 6" long	
Choke/Cover, Neoprene Jacket	1
Tech Systems, Inc.	
3. L.O. Attenuators	4
Atlantic Microwave AT420	
K Band Variable	
4. Waveguide Switch	
Waveline 877E	
28 Volt Failsafe	1
5. Termination Elements	
Atlantic Microwave TE281 M1 (Ka)	8
Atlantic Microwave DWG. A13627 (K)	2
6. Ka Band Crossguide Coupler	2
Special Order - Atlantic Microwave	
20 dB coupling ± 1.5 dB	
20 dB min. directivity	
Frequency 31.830 GHz $\pm .500$ GHz	
Silver Plated Brass	
VSWR 1.15 Main Line, 1.25 Aux. Line	
7. Platinum Resistance Thermometer - Rosemount 118G	1
8. Feedthrough Capacitors	
Erie 1250-003	8
9. RFI Feedthrough - OSM 238	4

4.3 Commercially Supplied Components (cont.)

10.	SMA Female/Female	6 (including cold loads)
	Hermetic Seal Feedthrough	4 (without cold loads)
	OSM 208A	
11.	Parametric Amplifier	2
	Comtech Laboratories	
	Spec. No. A13140N1	
12.	Parametric Up-Converter	2
	AIL, Inc.	
	Spec. No. A13150N2	
13.	Gunn-Effect Oscillator	2
	Varian VSA-9010	
	Spec. No. A13140N2	
14.	Coaxial Relay	2
	Transco 144C70100	
15.	Transistor Amplifier	2
	Locus RF623A	
16.	Isolator	2
	Wavecom I370600	

Commercially Supplied Components - Vacuum System

<u>COMPONENT</u>	<u>QTY/SYS</u>
1. Vacuum Dewar DWG. 13110M1	1
2. Vacuum Adapter, Dewar Flange/Conflat DWG.	1
3. Vacuum "TEE" Adapter VEECO FI-154 Part No. 6665-041-54	1
4. Coaxial Trap VEECO VS-161 Part No. 6651-152-00 Hose fitting toward roughing pump	1
5. Vacuum Pump Sargent-Welch 8805B 115V, 60 Hz Single Phase Power	1
6. Exhaust Filter Sargent-Welch 1417P	1
7. Solenoid-Operated High Vacuum Valve Model SOV-100-00-SB Normally closed 115VAC Solenoid Special Order: Conflat Flanges (2-3/4")	1
8. Vacuum Valve (Manual) 2-3/4" Conflat Flanges (supplied with dewar)	1
9. Vacuum Gauge Tube Hastings DV6-M	1

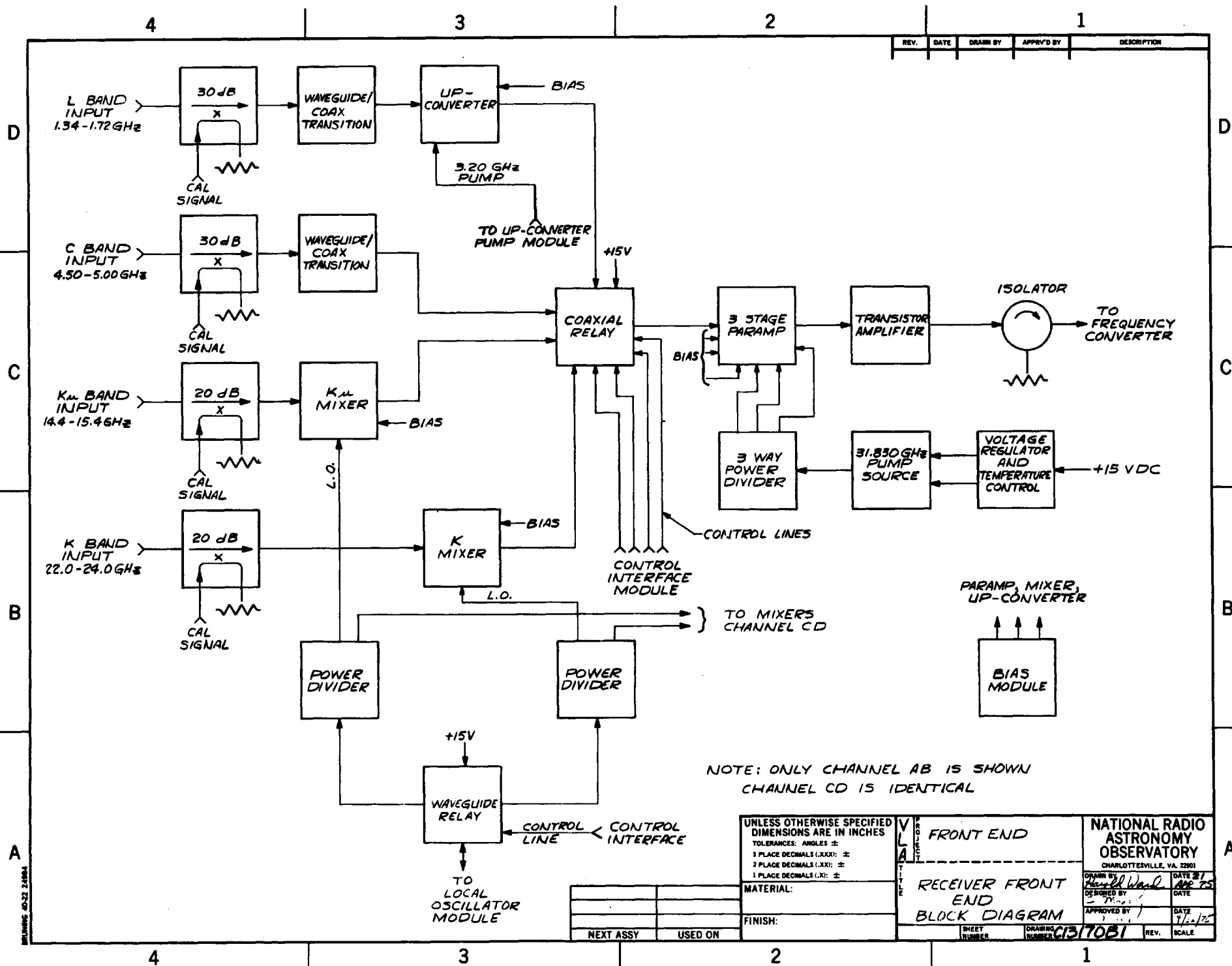
4.4 Gold Plating Specification for Coaxial Cables (Semirigid)

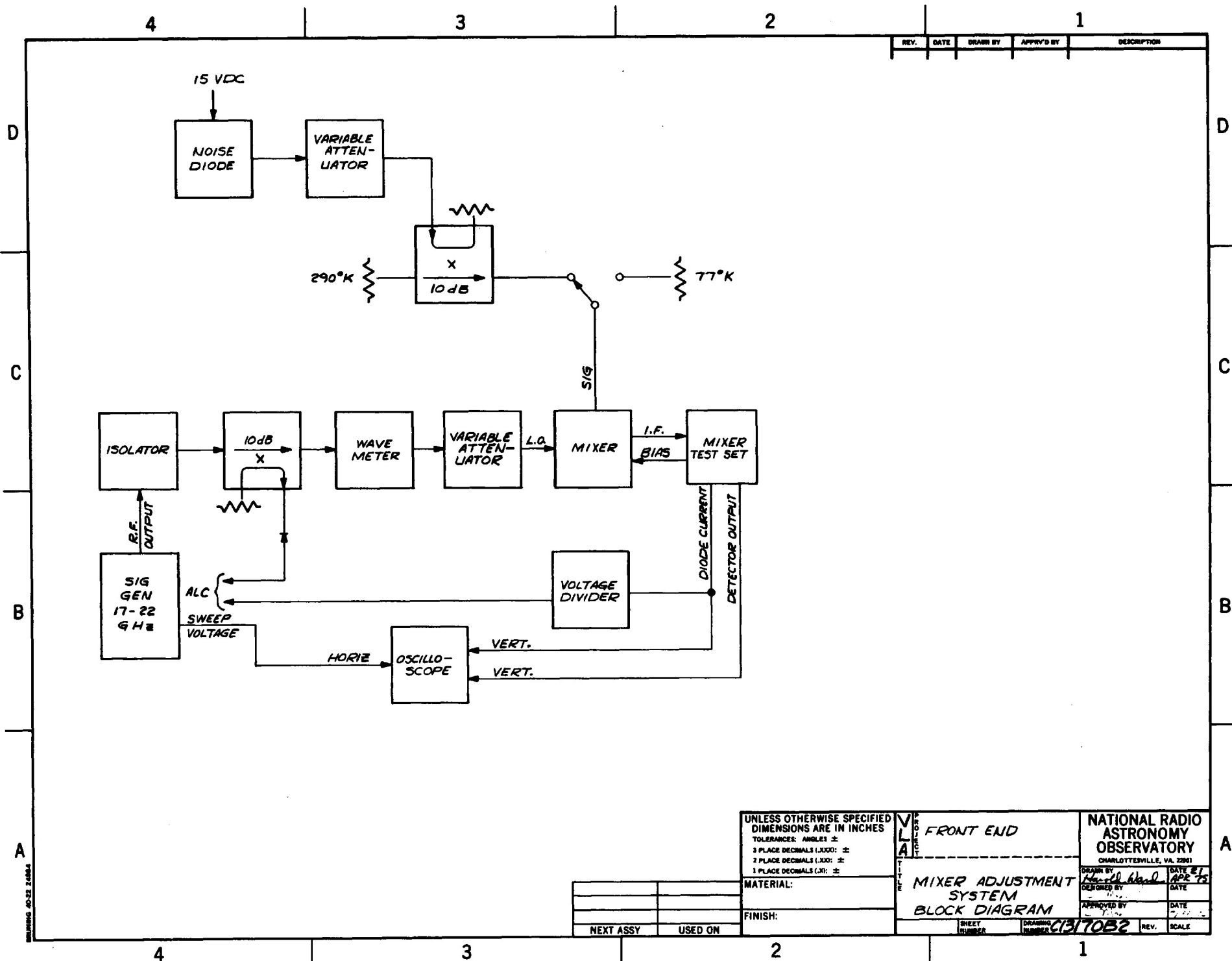
Gold plate per MIL-G-45204, Type I, Class 1

Defined as: Gold plate, 99.7% pure, .000050 inch thick, minimum.

Copper plate per MIL-C-14550, Class 3

Defined as: Copper plate, .0002 inch thick, minimum

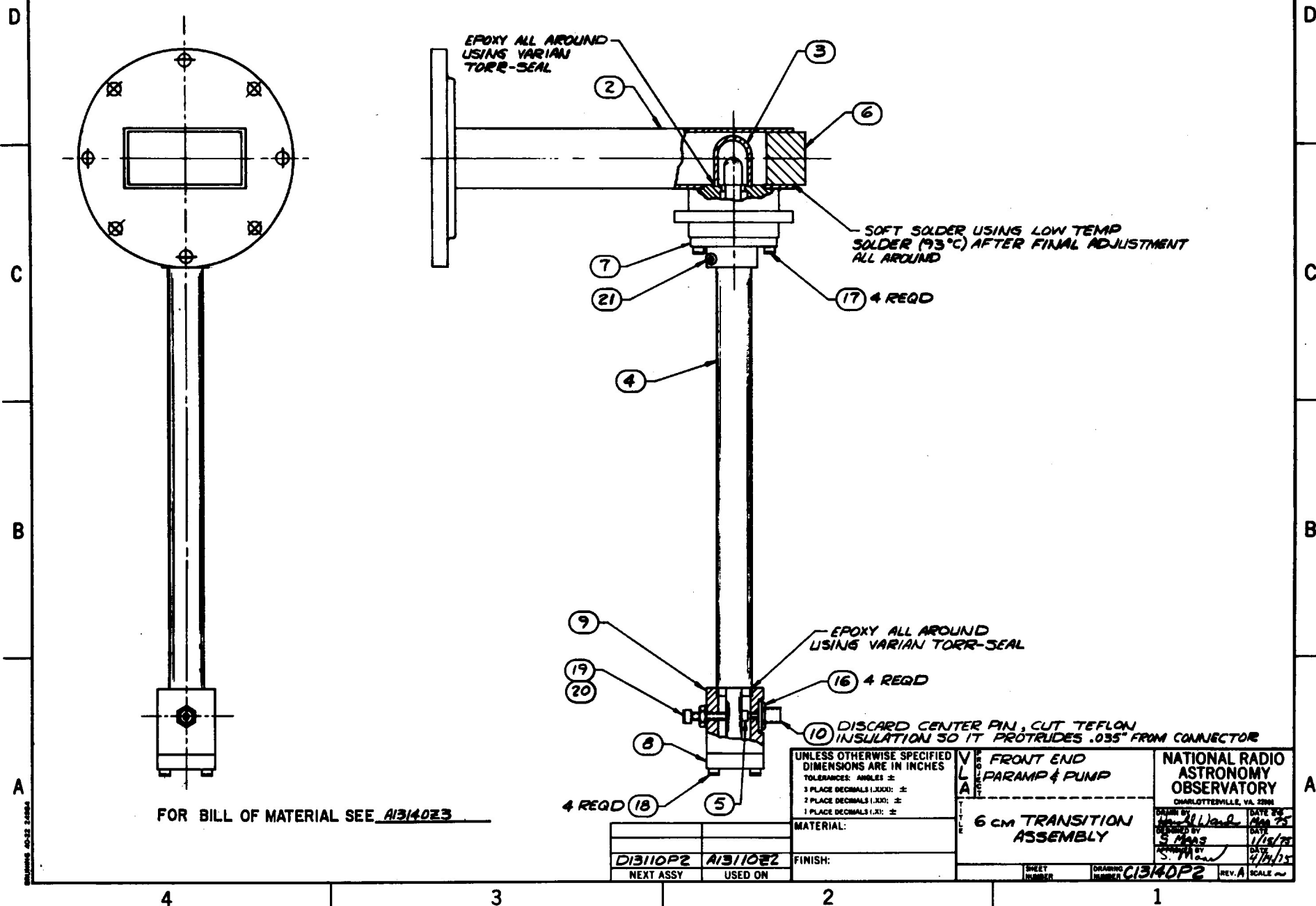




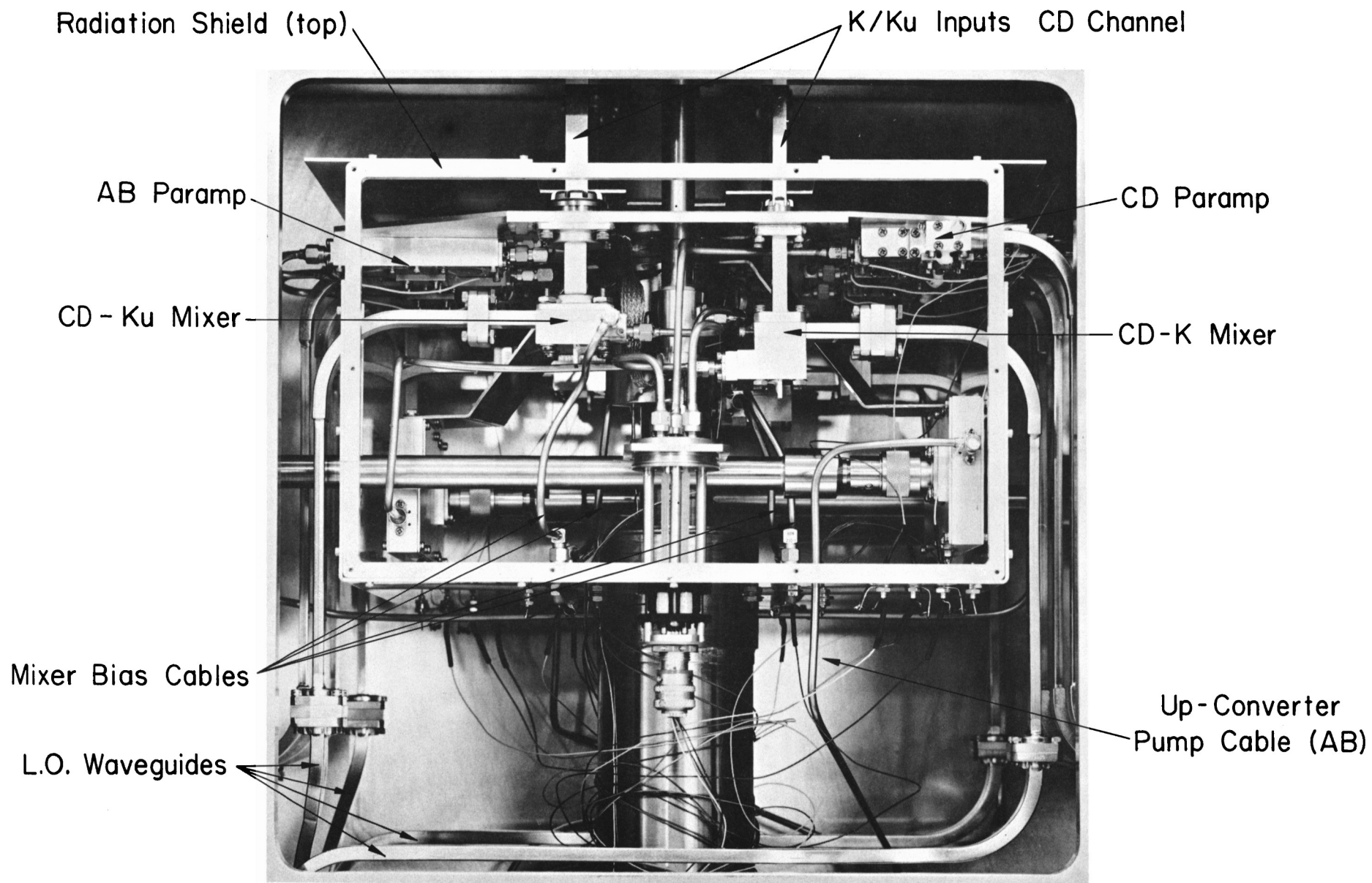


C	REV. 1/10/74	W. J. A.	0.2	ADDED DASH NO. THREE
B	1/10/74	N. H. A.	S. M. A.	RECEIVED 1/10/74
DATE	1/10/74	DESIGNED BY	APPROVED BY	REVISED DRAWING OF
REV. A	1/10/74	J. A. A.	M. B.	A2490M4 & B2490M4
V	140 FT. DEWAR			NATIONAL RADIO ASTRONOMY OBSERVATORY
L				
A				
L-BAND COAX TO WAVEGUIDE TRANSITION ASSY WITH TYPE "N" TAPER				CHARLOTTEVILLE, VA. 22901 DRAWN BY DESIGNED BY APPROVED BY
DATE 1/10/74	SHEET NUMBER	DRAWING NUMBER	C13170M39	
			REV. C	

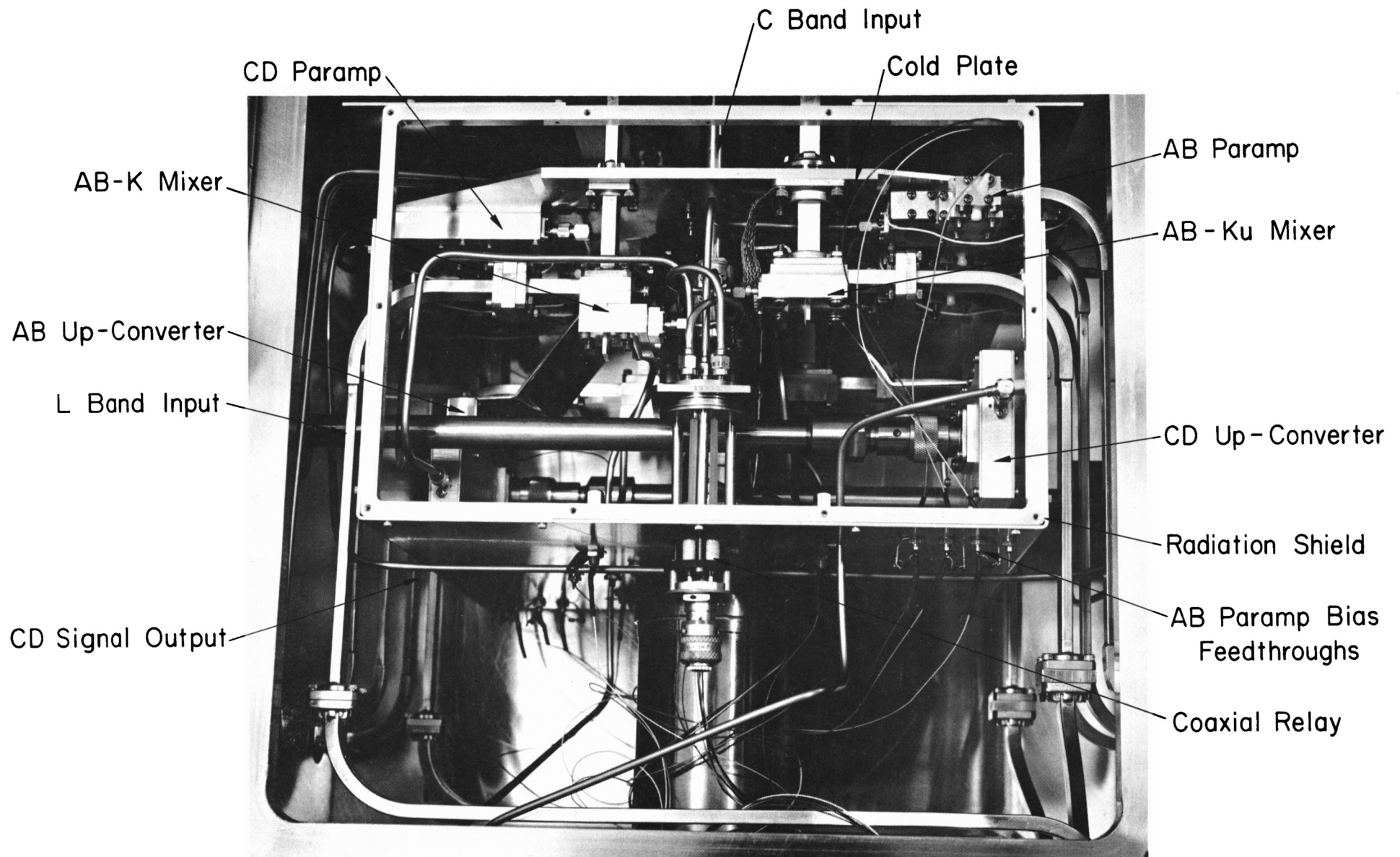
REV.	DATE	DRAWN BY	APPROVED BY	DESCRIPTION
A	1/15/75	BOEHL	S. Mas	RELEASED FOR MEMORIAL



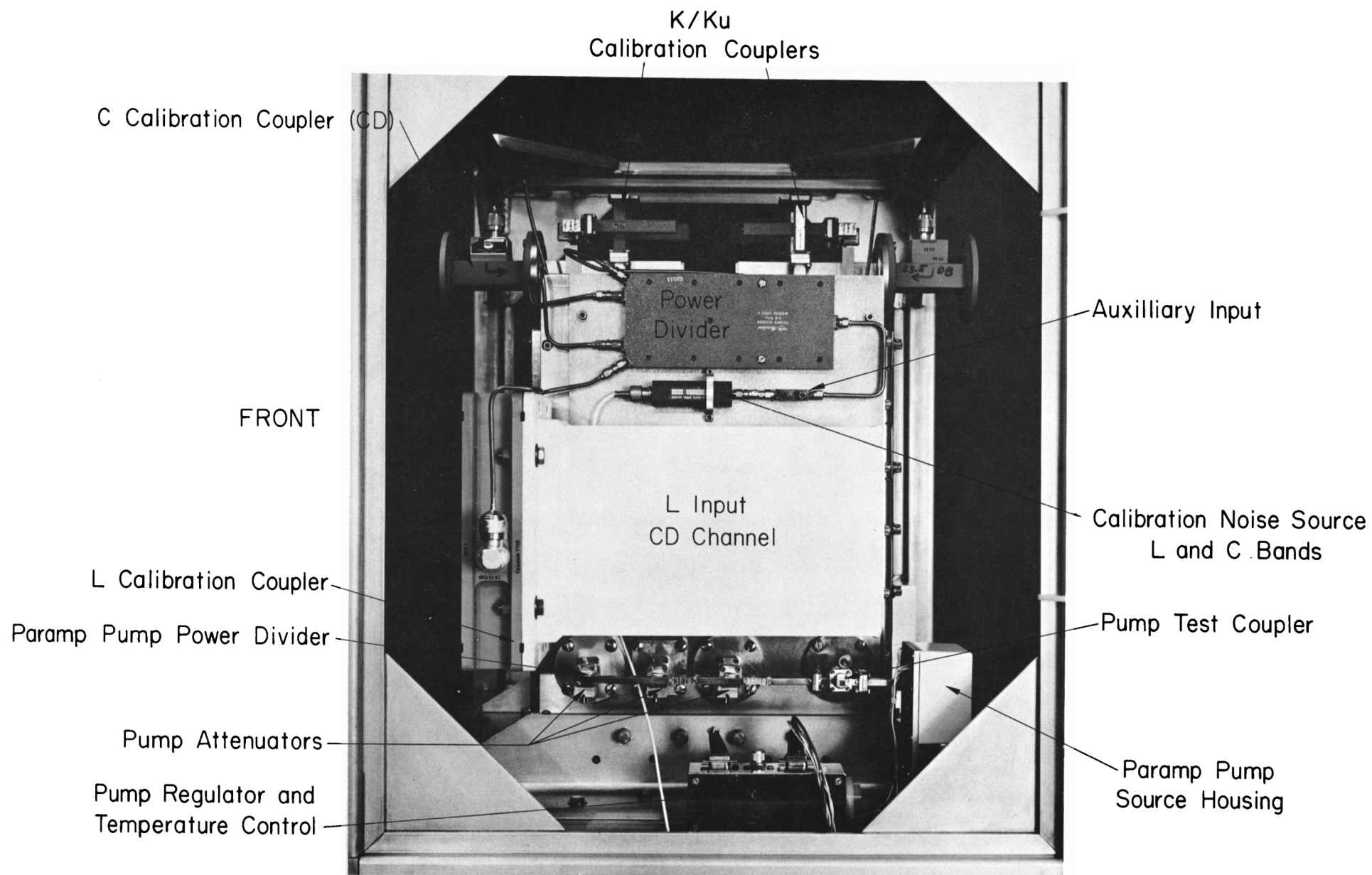
FOR BILL OF MATERIAL SEE A1314023

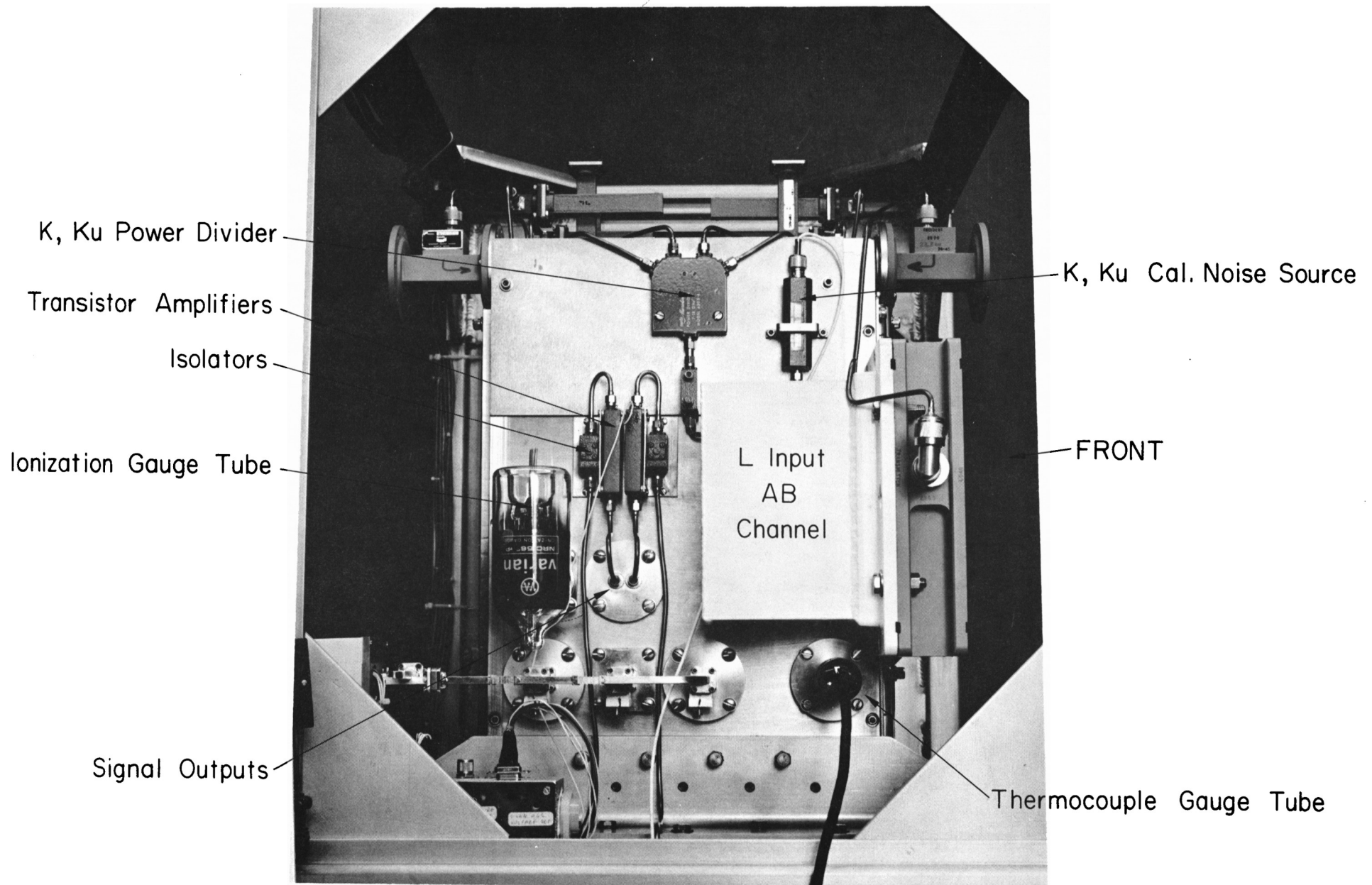


DEWAR INTERIOR - FRONT VIEW (the side of the radiation shield has been removed)

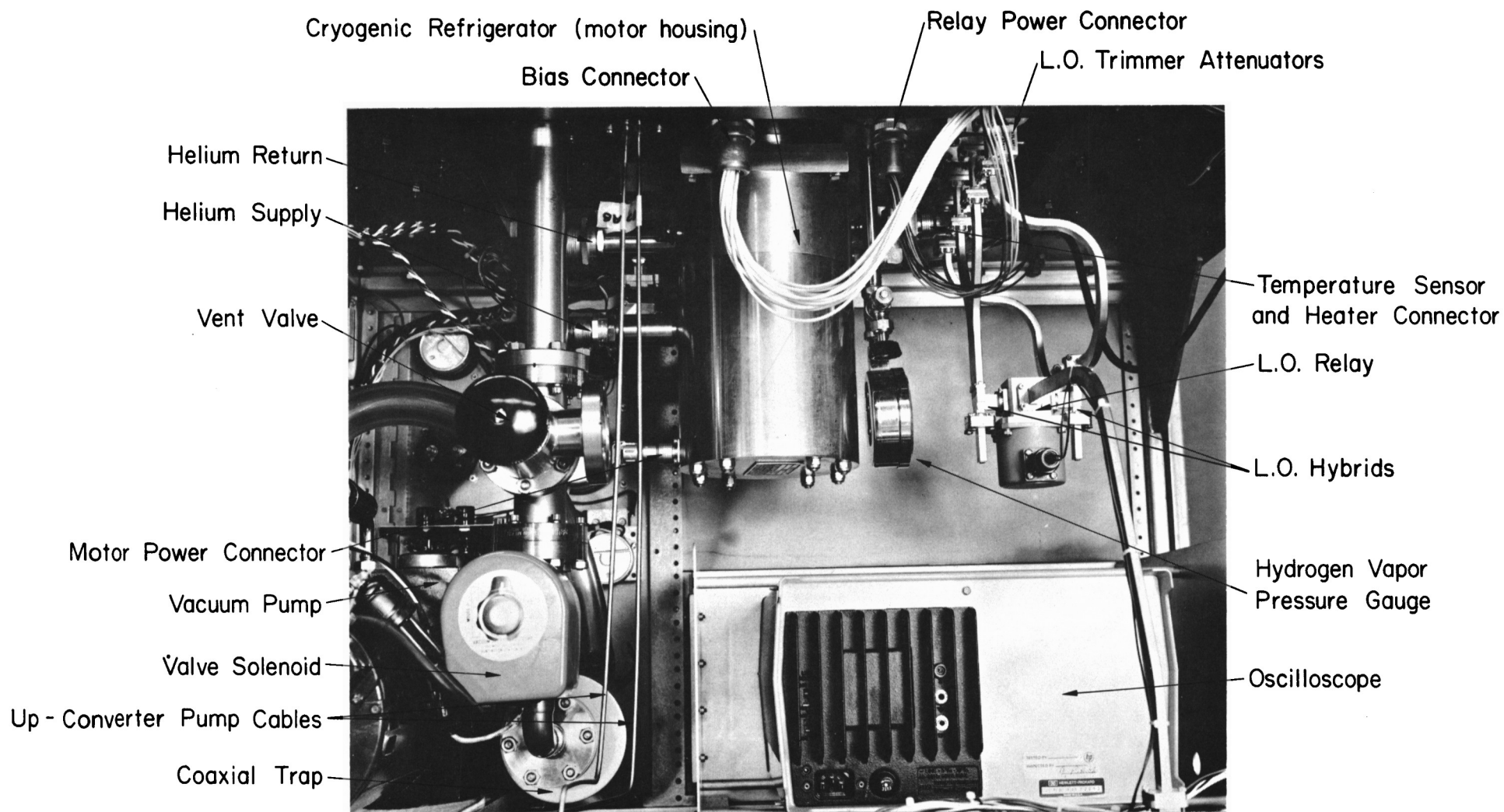


DEWAR INTERIOR - REAR VIEW (the side of the radiation shield has been removed)

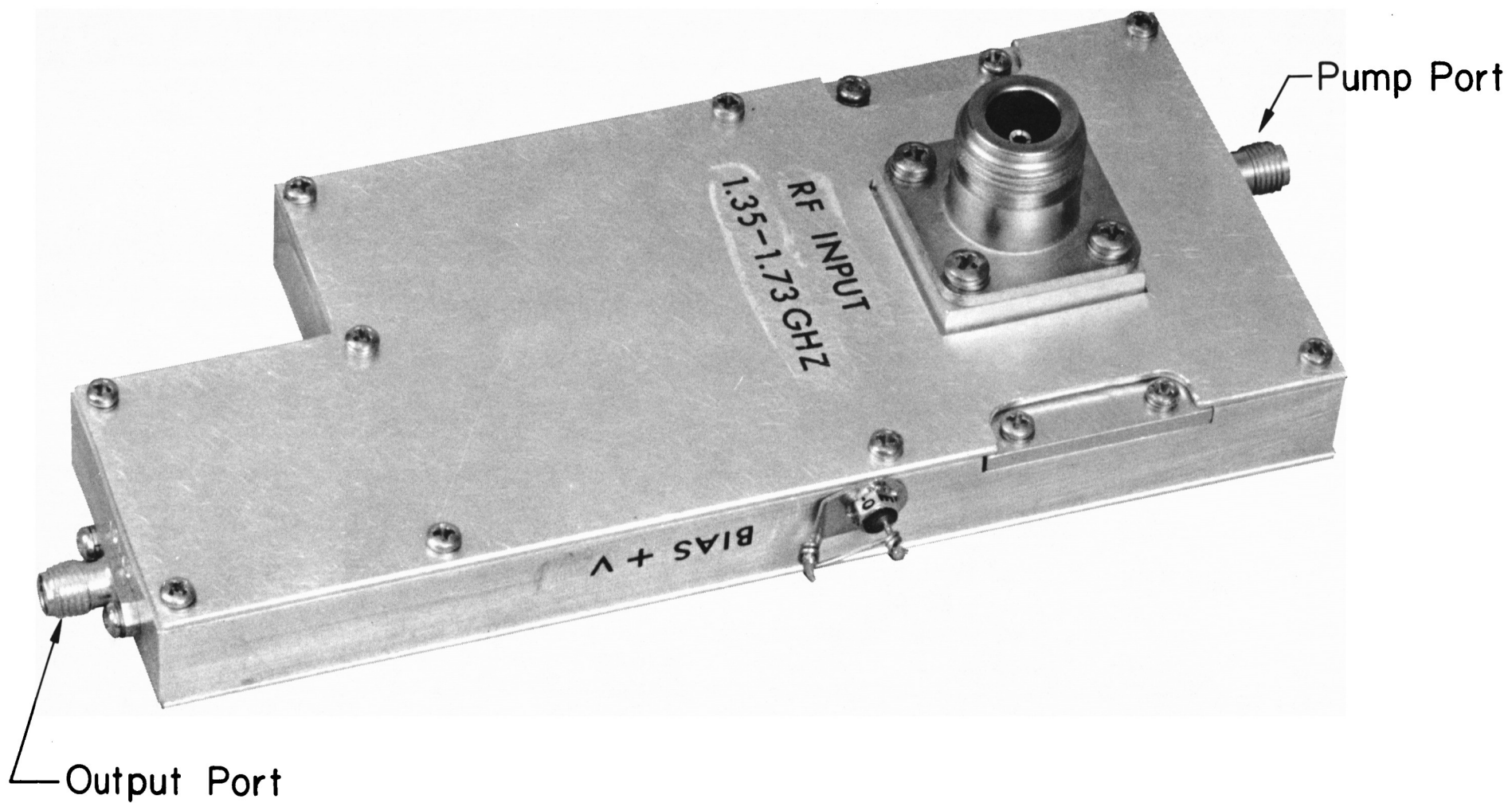




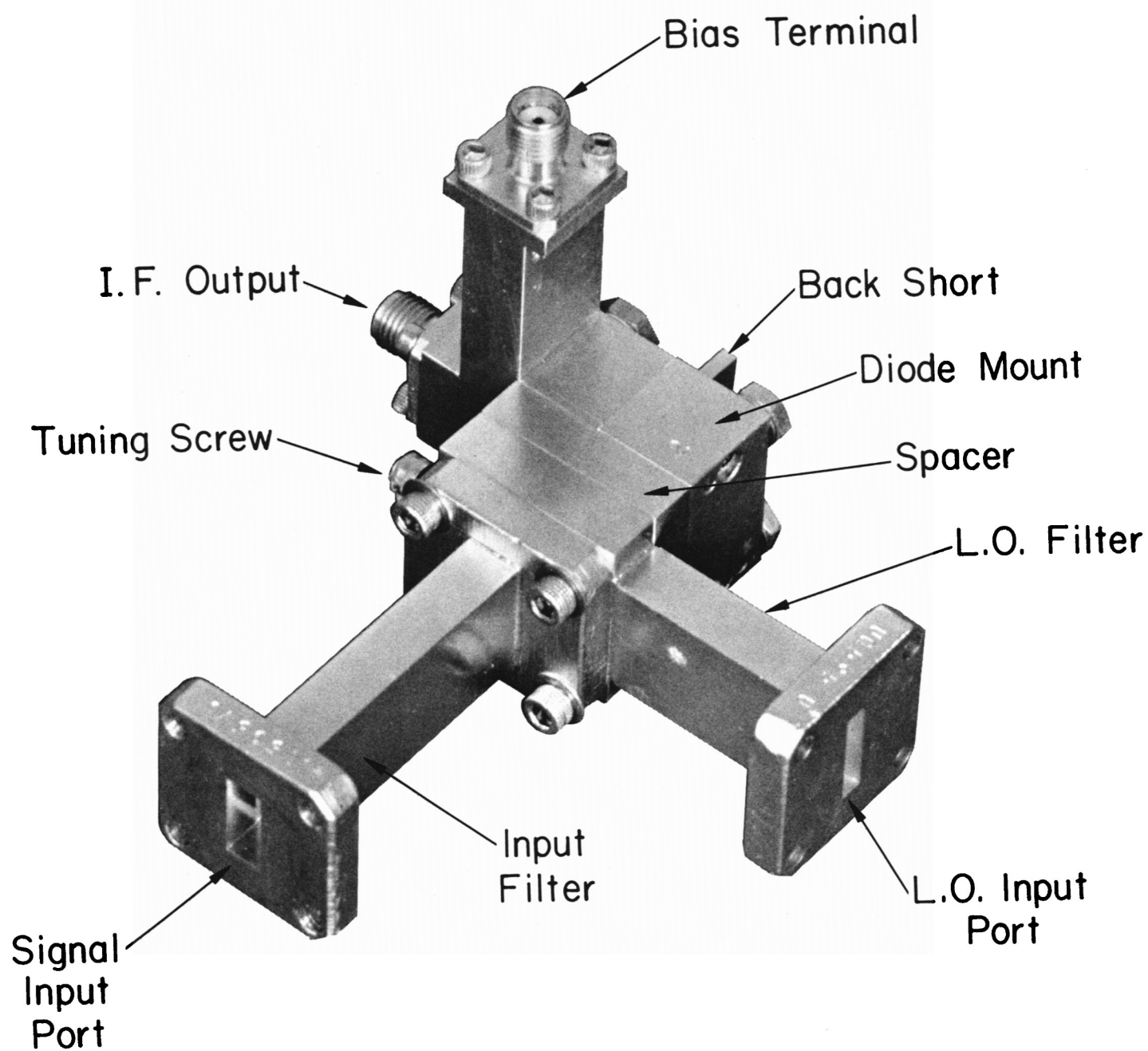
SIDE VIEW OF DEWAR



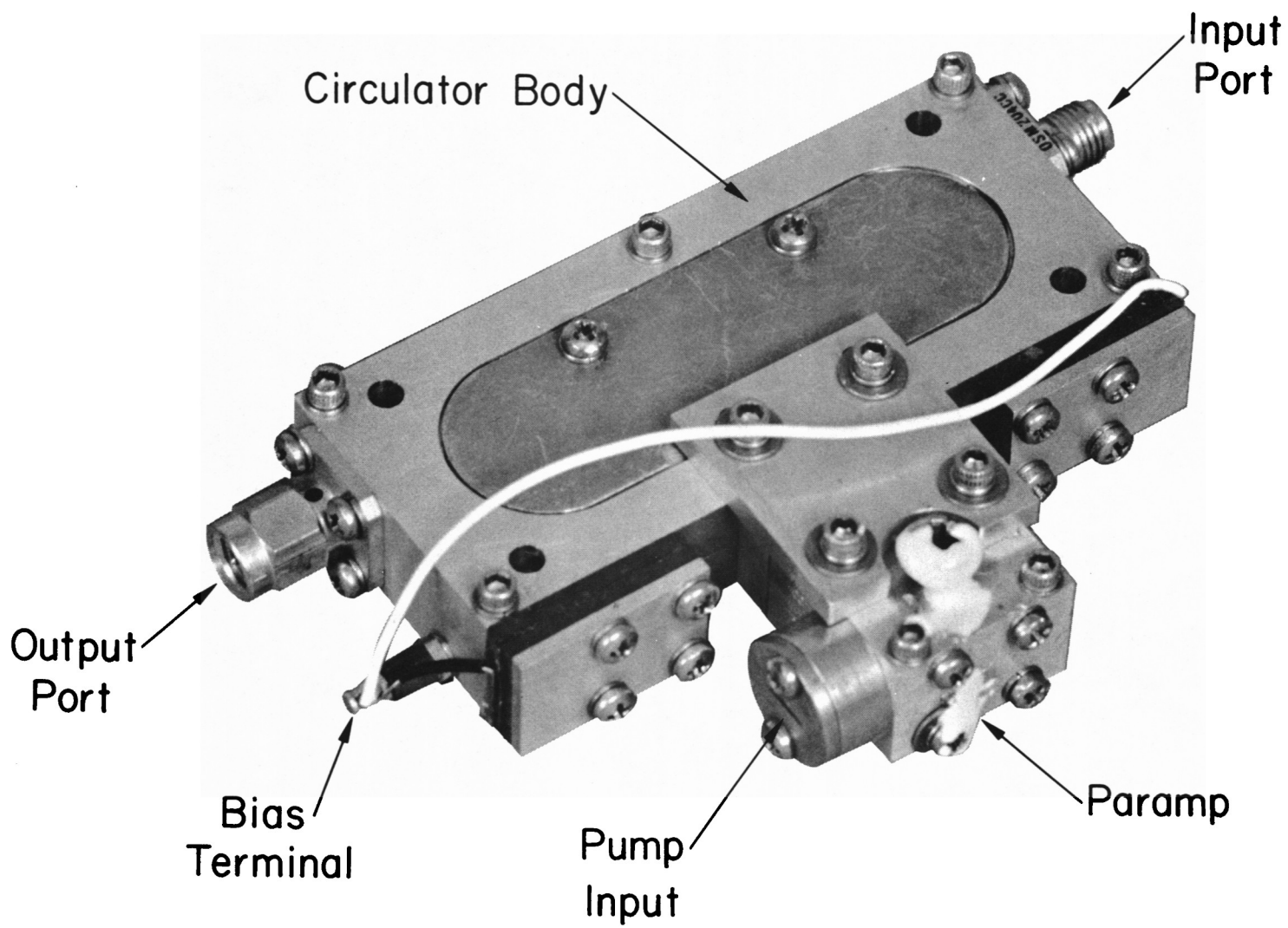
COMPONENTS UNDERNEATH THE DEWAR - REAR VIEW



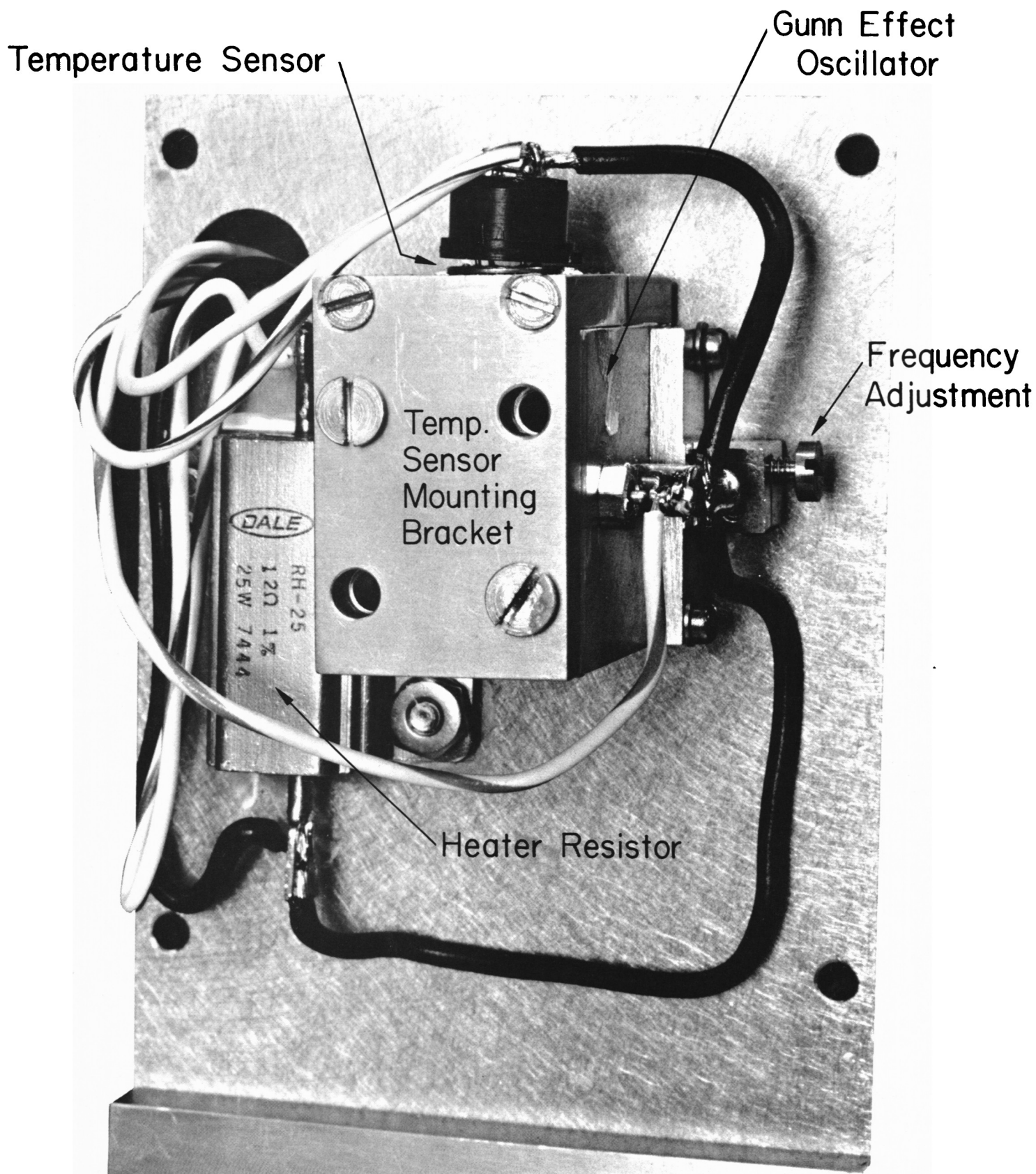
PARAMETRIC UP-CONVERTER



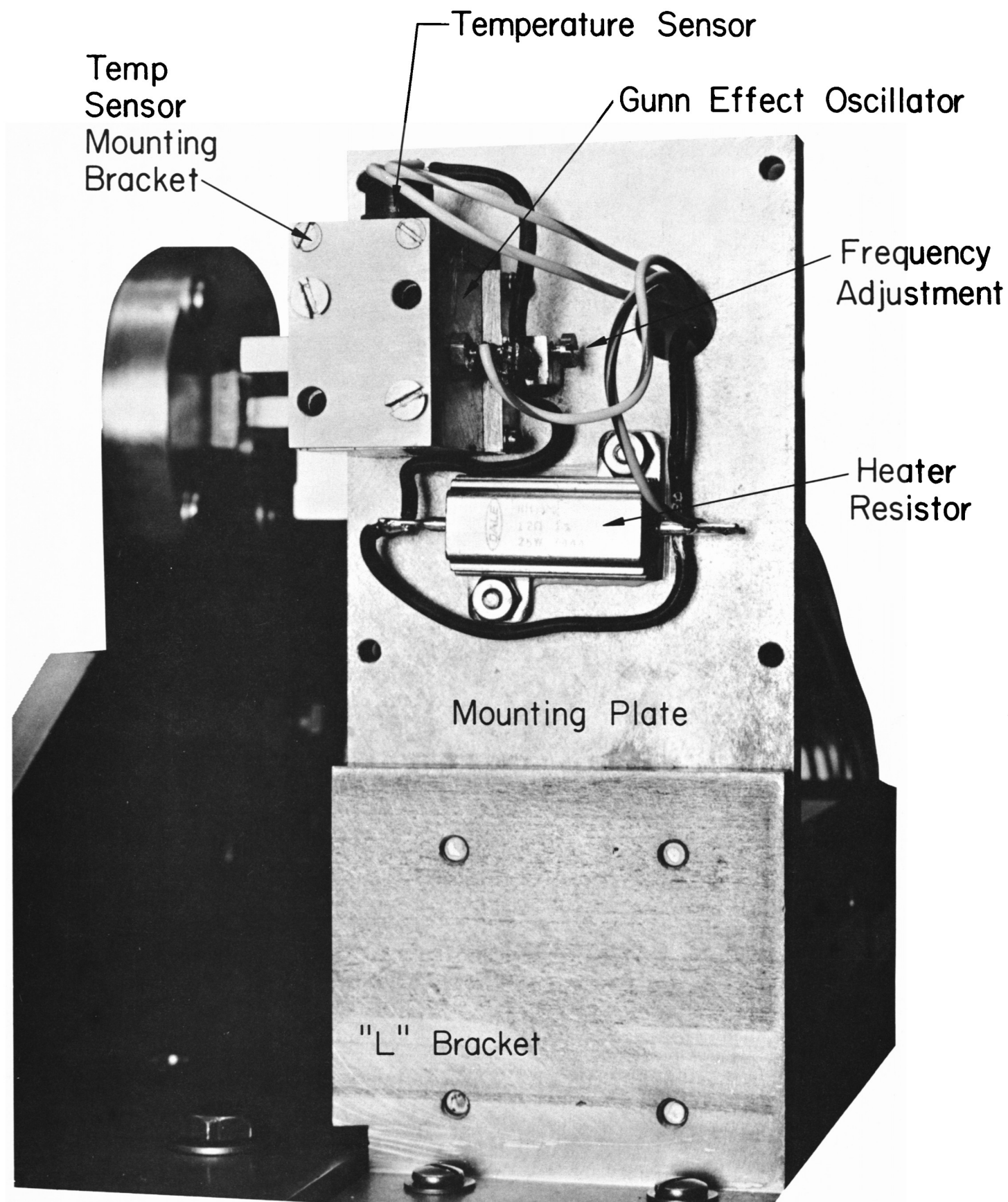
K BAND MIXER



PARAMETRIC AMPLIFIER STAGE



CD PARAMP PUMP SOURCE - REAR VIEW (cover removed)



AB PARAMP PUMP SOURCE - REAR VIEW (cover removed)