VLBA Electronics Memo No. 56

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NATIONAL RADIO ASTRONOMY OBSERVATORY
Charlottesville, Virginia

November 25, 1985

MEMORANDUM:

TO: VLBA Electronics Group

FROM: S. Weinreb

SUBJECT: Front-End Design Changes

This memo summarizes the changes made in the front-end design from the design described in VLBA Technical Report No. 1 (August 29, 1984). These changes have been incorporated in the 10.7 GHz front-end, S/N 1, and will be incorporated in Neptune/Voyager 8.4 GHz front-ends, S/N 3 and later. Changes III-VIII which involve control circuits will be incorporated in all cooled VLBA front-ends except 43 GHz.

I. Gain Reduction

In order to increase the tolerance to interfering signals (see VLBA Electronics Memo No. 39), the post-amplifier gain has been reduced from 27 dB to 18 dB. The total power output of a receiver with input shorted is -44 dBm. This arises from -89 dBm input noise power (50K in 1.5 GHz bandwidth), 30 dB CRYOFET gain, 18 dB post-amp gain, and 3 dB cable and isolator loss.

II. Phase Cal Coupling

The coupling of the phase cal input jack to the receiver input has been increased from -56 dB to -46 dB at 10.7 GHz and lower frequencies and -37 dB for the 14.9 GHz front-end. This has been accomplished by a rearrangement of couplers (see Figure 1) on the RF components card and, in the 14.9 GHz case, an increase of coupling in the receiver input line from -30 dB to -25 dB.

III. Vacuum Sensor Circuit

It was found that some of the transformers used in the first build of vacuum sensor circuits had abnormally high temperature coefficients resulting in vacuum-sensor zero drift. The circuit has been replaced by a transformer-less design shown in Figure 2, Rev. B of D532005002. Circuit interfaces and calibration remain the same.

IV. Control Card Circuit

The mechanical relays used in the initial control cards generated interfering pulses to a monitor computer and also were sensitive to shock. The relays were replaced by solid-state, zero-crossing types shown in Figure 3, Rev. B of D532005003.

The dewar-vacuum trip point for turning on the refrigerator was changed from 1,000 µm to 50 µm.

V. HEMT Illumination Wiring

Initial tests of low-noise HEMT devices revealed that they were not time invariant at cryogenic temperatures unless they are illuminated with light. Wiring for two light-remitting diodes (LED's) was installed as shown in Figure 4. The LED monitor voltage will be approximately +5 volts if both LED's have correct voltage drop.

VI. Local Monitor and Control Panel

A small control panel which is mounted on a plug-in card was installed in the card cage; a schematic is given in Figure 5. The purpose was to provide all-in-one-place control and monitor of a front-end.

The panel contains a six-position cryogenics control switch with positions CPU, COOL, STRESS, OFF, PUMP, and HEAT. If the switch is not in the CPU position, a red indicator is illuminated and a CPU monitor bit is set low. The cryogenic mode selected is monitored whether selected manually or by the CPU; a green light is illuminated if COOL mode is selected manually or by the CPU.

A twelve-position monitor switch with a 4½ digit DVM is provided for metering the analog monitor points; a pin jack in parallel with the meter is provided on the panel.

VII. Third Cryogenic Control Bit

In order to remotely diagnose a vacuum leak in the dewar, a fifth cryogenic state, PUMP, was required; this necessitated a third control bit which has been labeled "X". The cryogenic control modes are:

Mode	X	C	$\bar{H}$	Octal	Comment
COOL	1	1	1	7	Normal
STRESS	1	0	0	4	Extra heat load
OFF	1	0	1	5	No cool, heat, or pump
PUMP	0	1	0	2	Pump only
HEAT	1	1	0	6	Fast warmup and pump

(The unused control codes should not be used but as presently wired: 0 = 4, 1 = 5, and 3 = 7.)

VIII. Connector Changes

A second 25-pin connector was added to accommodate 12-bits of front-end identification (ID) data (frequency, serial number, and modification state) and also allow more spare wires. The wiring of both 25-pin connectors was redistributed so J2 (DB25S socket on front-end) provides monitor connections and J5 (DB25P plug on front-end) provides DC power, cryogenic control, cal control, and ID. A third 9-pin connector, J4 (DB9S on front-end), was added to allow auxiliary connections to the front-end; at present the only auxiliary connections are two wires to the AC current monitor located on the 150-volt AC power supply and a second output (also on J2) of the pump request signal.

Pin connections for these connectors are given in the attached Tables I, II, and III. A suggested coding for the FREQUENCY ID code is given in Table IV. A "0" will be coded as a short-circuit to ground and a "1" will be denoted by an open circuit.

cc: P. Lilie

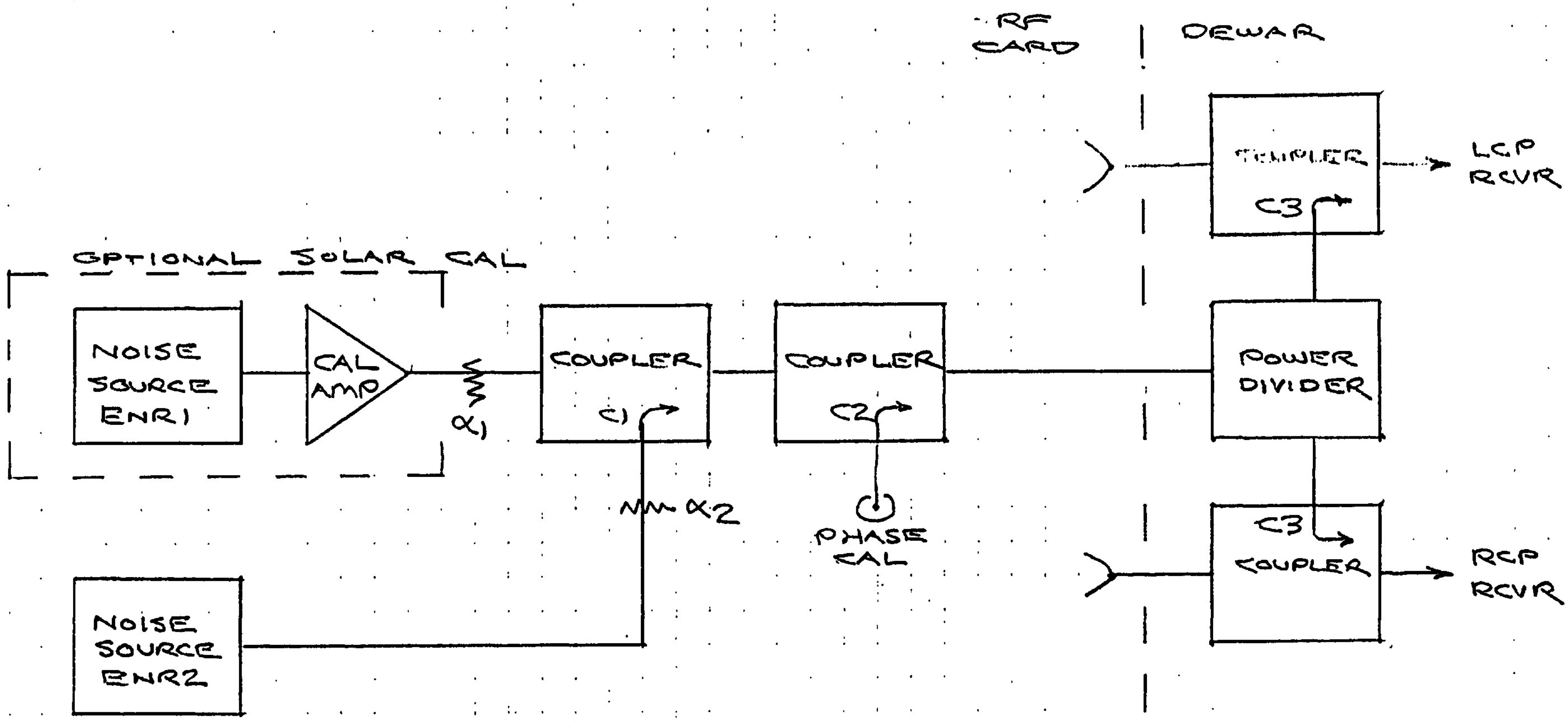

Figure 1 - Noise calibration block diagram

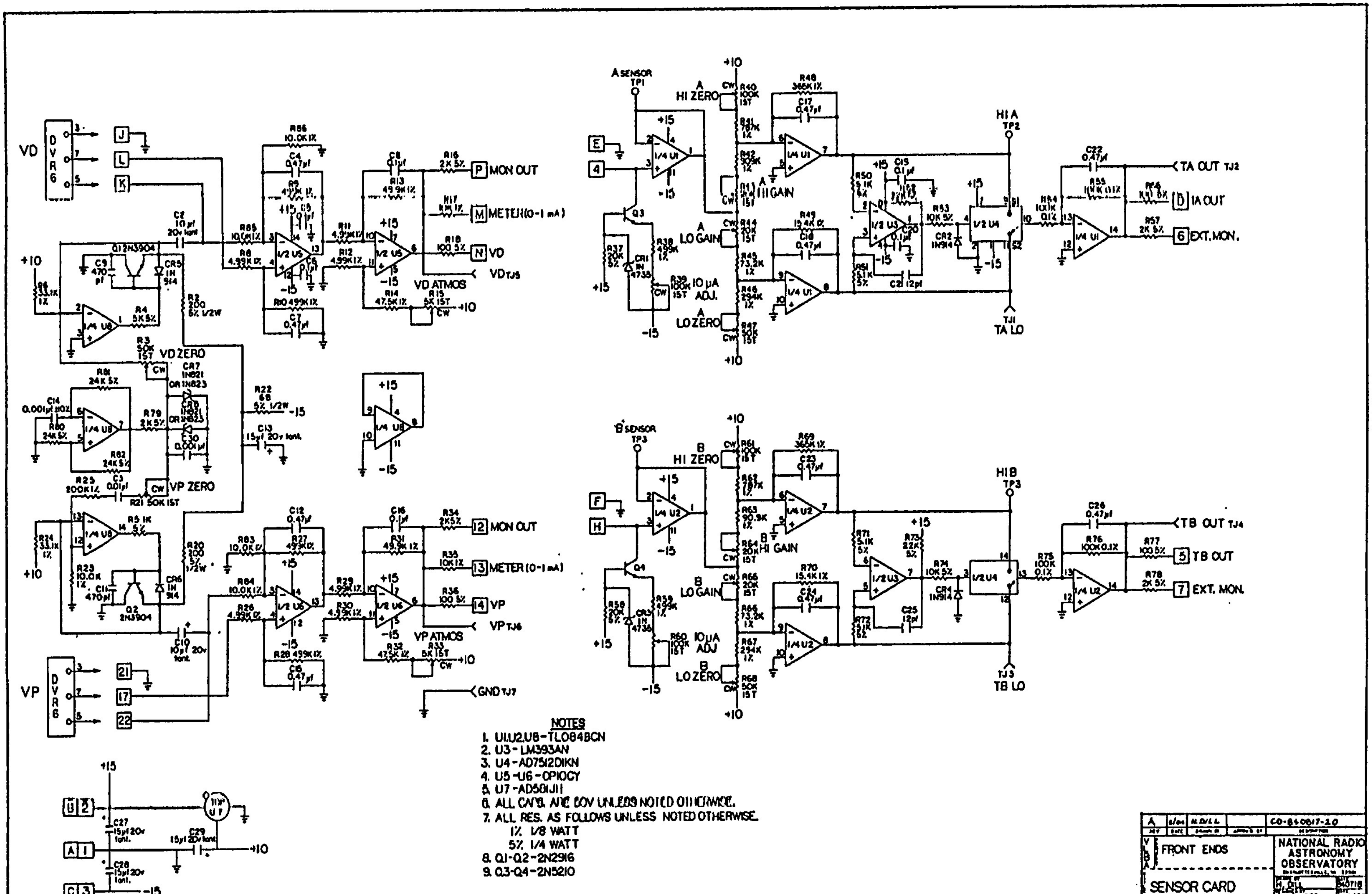

Figure 2 - Sensor card with transformer-less vacuum sensor drive

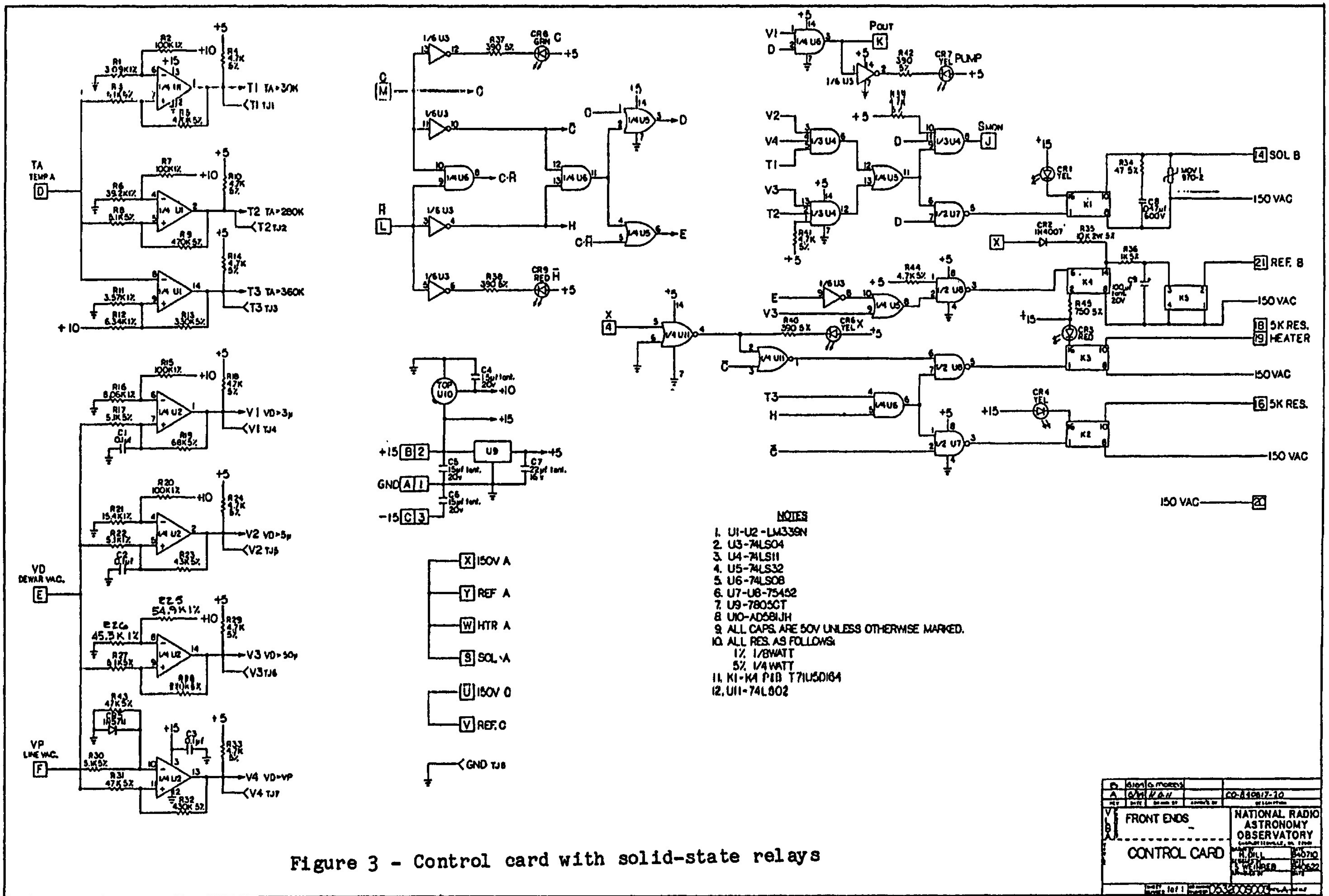

Figure 3 - Control card with solid-state relays

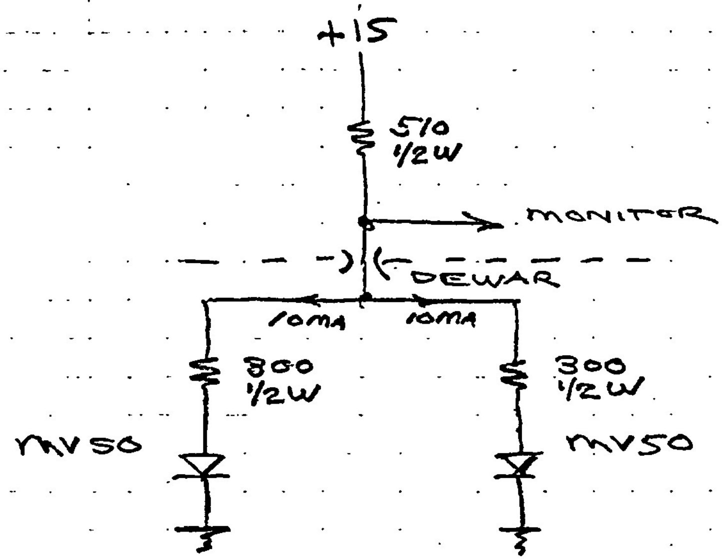

Figure 4 - LED power wiring

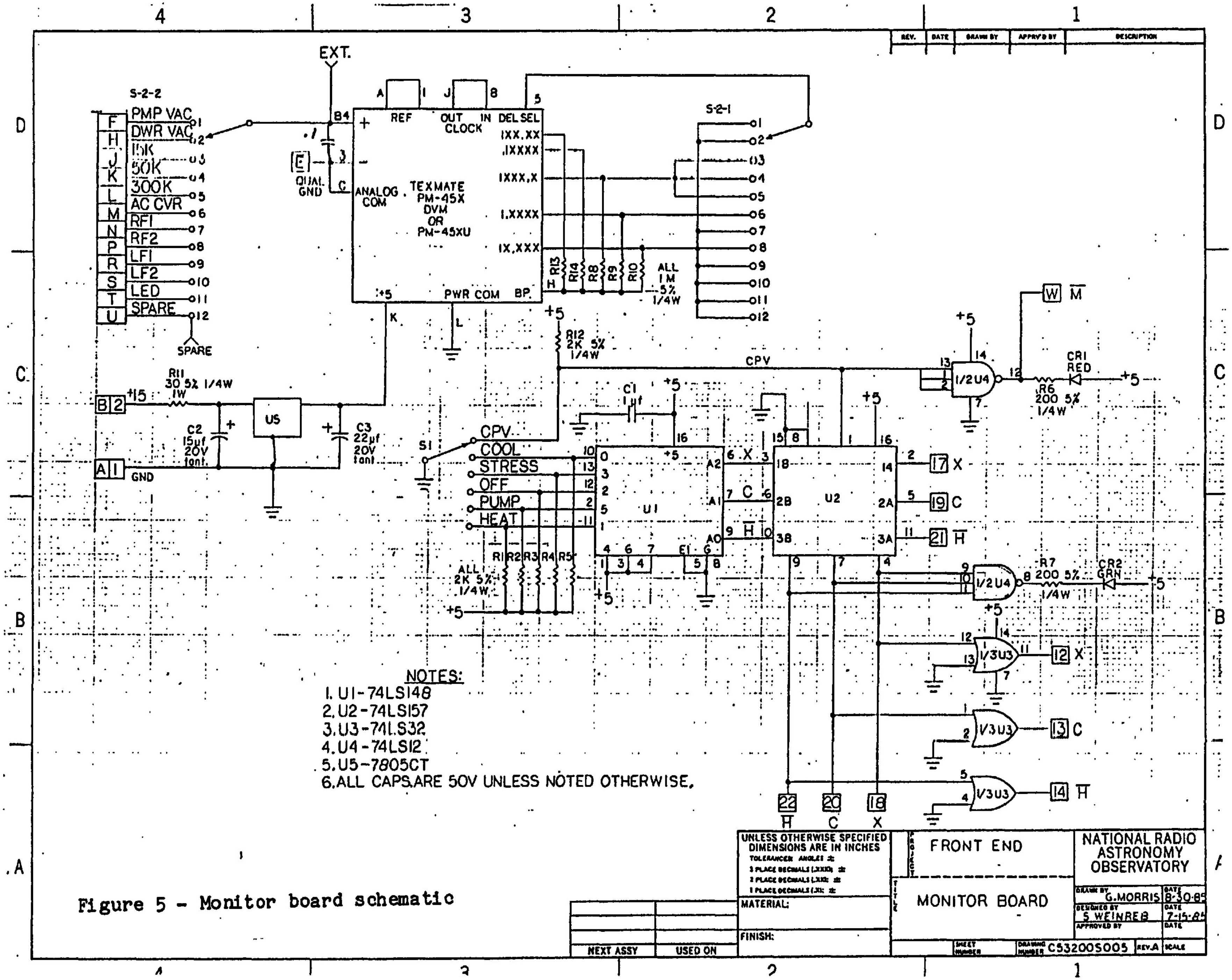

Figure 5 - Monitor board schematic

TABLE I

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

TABLE II

J5-PWR, CONTROL, AND ID (DB25P ON FRONT-END)		
Pin	Label	Function
1	GND	POWER GROUND
2	+15	600 mA
3	-15	100 mA
4		
5		
6	X	CONTROL BITS
7	C	
8	H	
9		
10		
11	CAL	28.0 V, 4-10 mA
12	HI CAL	28.0 V, ~ 50 mA
13	GND	
14	FØ	LSB
15	F1	FREQUENCY
16	F2	ID
17	F3	MSB
18	SØ	LSB
19	S1	SERIAL
20	S2	NUMBER
21	S3	MSB
22	MØ	LSB
23	M1	MODIFICATION
24	M2	
25	M3	MSB

TABLE III

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

TABLE IV

FREQUENCY ID CODE	
Code	Frequency
0	75
1	327/610
2	1.5
3	2.3
4	4.9
5	8.4
6	10.7
7	14.9
8	23
9	43
A	86
B	
C	
D	
E	8.4 VLA SN1-16
F	8.4 VLA SN17-32