TYPE ACCEPTANCE

KING RADIO CORPORATION

MODEL KA 126

WEATHER RADAR ANTENNA/RECEIVER/TRANSMITTER

King Radio Corporation
400 North Rogers Road
Olathe, Kansas 66061 U.S.A.

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RON WEBER

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LEONARD MOORE

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GARY BURRELL
V.P. ENGINEERING

DATE: 12 - 17 - 80

Paragraphs are referenced to Part 2 FCC Rules for convenience.

2.983 Application for Type Acceptance

(a) The applicant is King Radio Corporation and will be the manufacturer of the KA 126 Antenna/Receiver/Transmitter

(b) The equipment to be considered for Type Acceptance is the King KA 126 Antenna/Receiver/Transmitter

(c) Quantity Production of the KA 126 Antenna/Receiver/Transmitter

(d) (1) The emission type would be P0 as listed in Section 2.201 of Part 2 of the FCC Rules and Regulations.

(2) The specification on transmitter frequency variation is 9345-9405MHz.

(3) The transmitter power is 6.0 Kilowatts peak minimum and 7.5 Kilowatts typical. No adjustment is provided.

(4) No maximum power rating is defined.

Operating Power will not be adjustable in field service and will be the maximum attainable with the magnetron used.

(5) The final RF device of the KA 126 is a magnetron (KPN 021-0051-00/01). The peak voltage applied to the magnetron is 7.5KV. The maximum value of peak current is 5.5 amps.

(6) Function of each electron tube or semiconductor or other active current device.

A 109 Hz pulse, produced in the indicator, is used as the pulse modulator trigger (PMT).

The Low level PMT is squared, and amplified by I301, Q345 and Q346. At this point a pulse of sufficient energy is produced to switch the SCR Q344. This switch shorts the voltage at the PFN. When the switch is open the voltage at the switch rings to approximately twice the 320V supply and is held by the blocking diode CR345. When Q344 is turned on the voltage across the primary of T341 goes to zero. This action produces the high level modulator pulse. The pulse excitates the magnetron (V101) producing the RF, that is delivered to the duplexer and phased array antenna.

Also in the modulator is a protection circuit. I341 is a one-shot , which, when activated, will turn off the power to the modulator by opening Q343. Q341 and Q342 are level shifters for this circuit. The protection circuit is activated by two methods. If the magnetron produces a strange impedance to the modulator transformer a ring back will occur. CR397 will rectify this ring and activate the shut down circuit. If a problem arrives in the modulator a DC component will appear at TP 343. This too, will trip the protection circuit.

(7) Complete Circuit diagrams are contained in Appendix A.

(8) The preliminary instruction book is contained in Appendix B.

(9) Tune Up Procedure

The KA 126 requires no alignment on either transmitter or modulator.

The Local OSCILLATOR consists of a mixer injection level adjustment and the mechanical frequency alignment. The adjustments are completed as follows:

A. Mixer Injection Level

1. Terminate the antenna with the King RF termination assembly (KPN 050-1932-00)

2. Connect a VOM (Simpson 260 or Equivalent) to the injection test jacks. Located on the mixer assembly the positive lead to the orange "+" terminal and the negative lead to the yellow "-" terminal. Set the VOM to the 50uA scale.

3. Slightly loosen the 4 hex head screws attaching the gunn oscillator to the antenna assembly.

4. Adjust the injection level attenuator AT101 until a level of 40$\pm$ 4uA is obtained.

5. Tighten the hex screws maintaining 40$\pm$ 4uA reading.

6. Measure the mixer current level from each test jack to ground (black test jack) if the two readings are unbalanced by more than 7uA the diodes should be replaced and the level reset.

7. Remove test leads.

B. Mechanical frequency adjust

1. Terminate the antenna with the King RF termination assembly (KPN 050-1932-00).

Paragraphs are referenced to Part 2 FCC Rules for convenience.

2.983 Application for Type Acceptance

(a) The applicant is Narco Avionics, Inc. and will be the manufacturer of the KA 126 Antenna/Receiver/Transmitter.

(b) The equipment to be considered for Type Acceptance is the Narco KA 126 Antenna/Receiver/Transmitter.

(c) Quantity Production of the KA 126 Antenna/Receiver/ Transmitter.

(d) (1) The emission type would be PO as listed in Section 2.201 of Part 2 of the FCC Rules and Regulations.

(2) The specification on transmitter frequency variation is 9345-9405MHz.

(3) The transmitter power is 6.0 Kilowatts peak minimum and 7.5 kilowatts typical. No adjustment is provided.

(4) No maximum power rating is defined.

Operating Power will not be adjustable in field service and will be the maximum attainable with the magnetron used.

(5) The final RF device of the KA 126 is a magnetron (P/N 021-0051-00/01). The peak voltage applied to the megnetron is 7.5KV. The maximum value of peak current is 5.5 amps.

(6) Function of each electron tube or semiconductor or other active current device.

A 109 Hz pulse, produced in the indicator, is used as the pulse modulator trigger (PMT).

The Low level PMT is squared, and amplified by I301, Q345 and Q346. At this point a pulse of sufficient energy is produced to switch the SCR Q344. This switch shorts the voltage at the PFN. When the switch is open the voltage at the switch rings to approximately twice the 320V supply and is held by the blocking diode CR345. When Q344 is turned on the voltage across the primary of T341 goes to zero. This action produces the high level modulator pulse. The pulse excitates the magnetron (V101) producing the RF, that is delivered to the duplexer and phased array antenna.

Also in the modulator is a protection circuit. I341 is a one-shot, which, when activated, will turn off the power to the modulator by opening Q343. Q341 and Q342 are level shifters for this circuit. The protection circuit is activated by two methods. If the magnetron produces a strange impedance to the modulator transformer a ring back will occur. CR397 will rectify this ring and activate the shut down circuit. If a problem arrives in the modulator a DC component will appear at TP 343. This too, will trip the protection circuit.

(7) Complete Circuit diagrams are contained in Appendix A.

(8) The preliminary instruction book is contained in Appendix B.

(9) Tune Up Procedure

The KA 126 requires no alignment on either transmitter or modulator.

The Local OSCILLATOR consists of a mixer injection level adjustment and the mechanical frequency alignment. The adjustments are completed as follows:

A. Mixer Injection Level

1. Terminate the antenna with the Narco RF termination assembly (P/N 050-1932-00)
2. Connect a VOM (Simpson 260 or Equivalent) to the injection test jacks. Located on the mixer assembly the positive lead to the orange "+" terminal and the negative lead to the yellow "-" terminal. Set the VOM to the 50uA scale.
3. Slightly loosen the 4 hex head screws attaching the gunn oscillator to the antenna assembly.
4. Adjust the injection level attenuator AT101 until a level of 40$\pm$ 4uA is obtained.
5. Tighten the hex screws maintaining 40$\pm$ 4uA reading.
6. Measure the mixer current level from each test jack to ground (black test jack) if the two readings are unbalanced by more than 7uA the diodes should be replaced and the level reset.
7. Remove test leads.

B. Mechanical frequency adjust

1. Terminate the antenna with the Narco RF termination assembly (P/N 050-1932-00).

2. Attach a VOM (Simpson 260 or equivalent) set on the +10VDC scale, to the AFC terminal on the Gunn Oscillator Assembly. Connect the negative lead to the ground.

3. After the sixty second warm-up period measure the AFC voltage (it may or may not be sweeping betweem 0 and +12VDC) Adjust the local oscillator manual frequency adjustment until the AFC becomes stable at 4.0 ± 3VDC. (Note: As the magnetron warms up the AFC will drift slowly. This is normal and not cause for concern.)

4. Remove the VOM leads.

10. Oscillator Circuits

The basic frequency of operation of the KA 126 is fixed by the selection of the magnetron (P/N 021-0057-00/01). The magnetrons are guaranteed to oscillate at a center frequency within a band of 9345 - 9405MHz. The maximum frequency change with anode temperature change (after warming) is -0.25MHz/°C.

The local oscillator is an electronically tuned gunn diode oscillator. The automatic frequency control (AFC) circuit provides the control signal to lock the local oscillator frequency to exactly 30MHz lower than the magnetron frequency.

11. Spurious Suppression

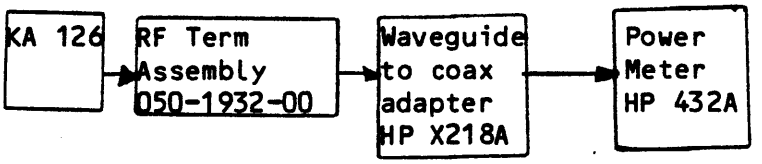
An ortho-tee balanced mixer is used in the receiver front-end to minimize spurious signal generation. The local oscillator frequency is suppressed in the output waveguide by the mixer, which provides 20db minimum of attenuation.

Modular construction is used throughout the KA 126. Effective shielding, and decoupling is used on all subassemblies having RF signals present.

(e)2.985 Radio Frequency Power Output

Requirement: The power which may be authorized for use at any station in the Aviation Services shall not be greater than the minimum required for satisfactory technical operation.

Procedure: Equipment was connected as shown. The transmitter was operated for 5 minutes.The average power was then measured using the power meter reading and RF termination coupling factor. Peak power is then obtained by adding in the duty cycle factor.



DATA: Power Meter Indication 13.4dBm
RF Termination Coupling Factor 21.6dB
Duty Cycle Factor 33.9dB

P peak = 13.9 + 21.6 + 33.9 = 69.4dBm or 8.7KW

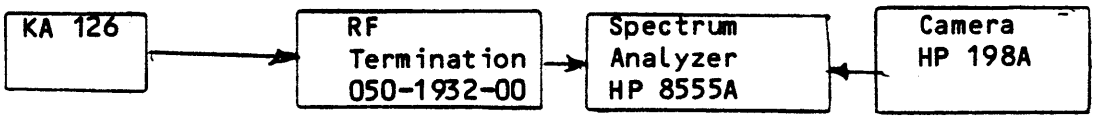
2.987 Modulation Characteristics

Not applicable for radar transmitters.

2.989 Measure Required: Occupied Bandwidth

The pulse characteristics and frequency spectrum of the KA 126 output was observed and photographed. The frequency spectrums were taken with the Hewlett Packard 8554 Spectrum Analyzer Figure 1.

Data was then tablulated from the frequency spectrum photos. A computer was then used to process the data and determine the percent of total power that was contained within a frequency delta around center frequency. The computer printout is shown on Page 7. The computer then determined the upper and lower 0.5% points and printed out the occupied bandwidth.



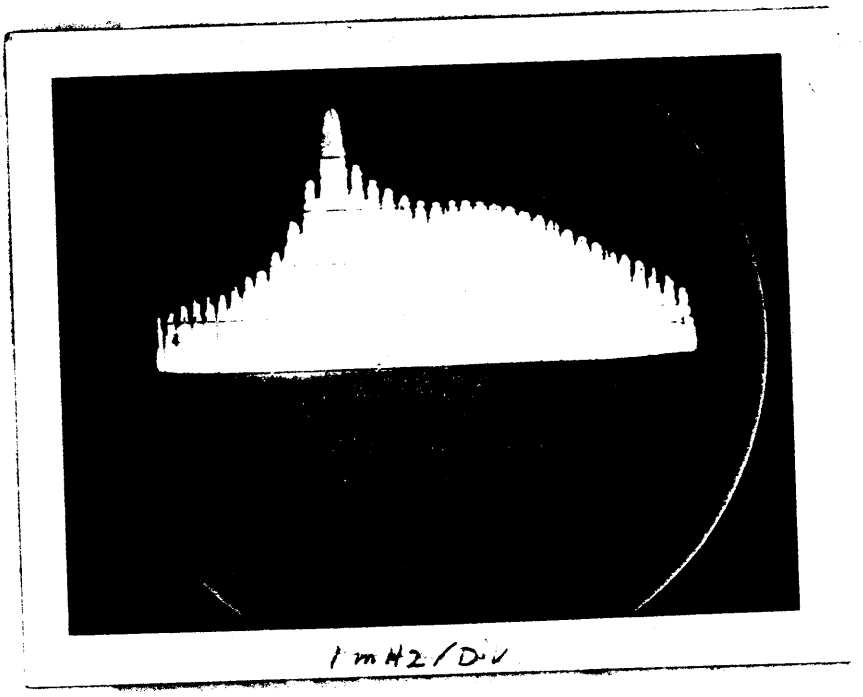
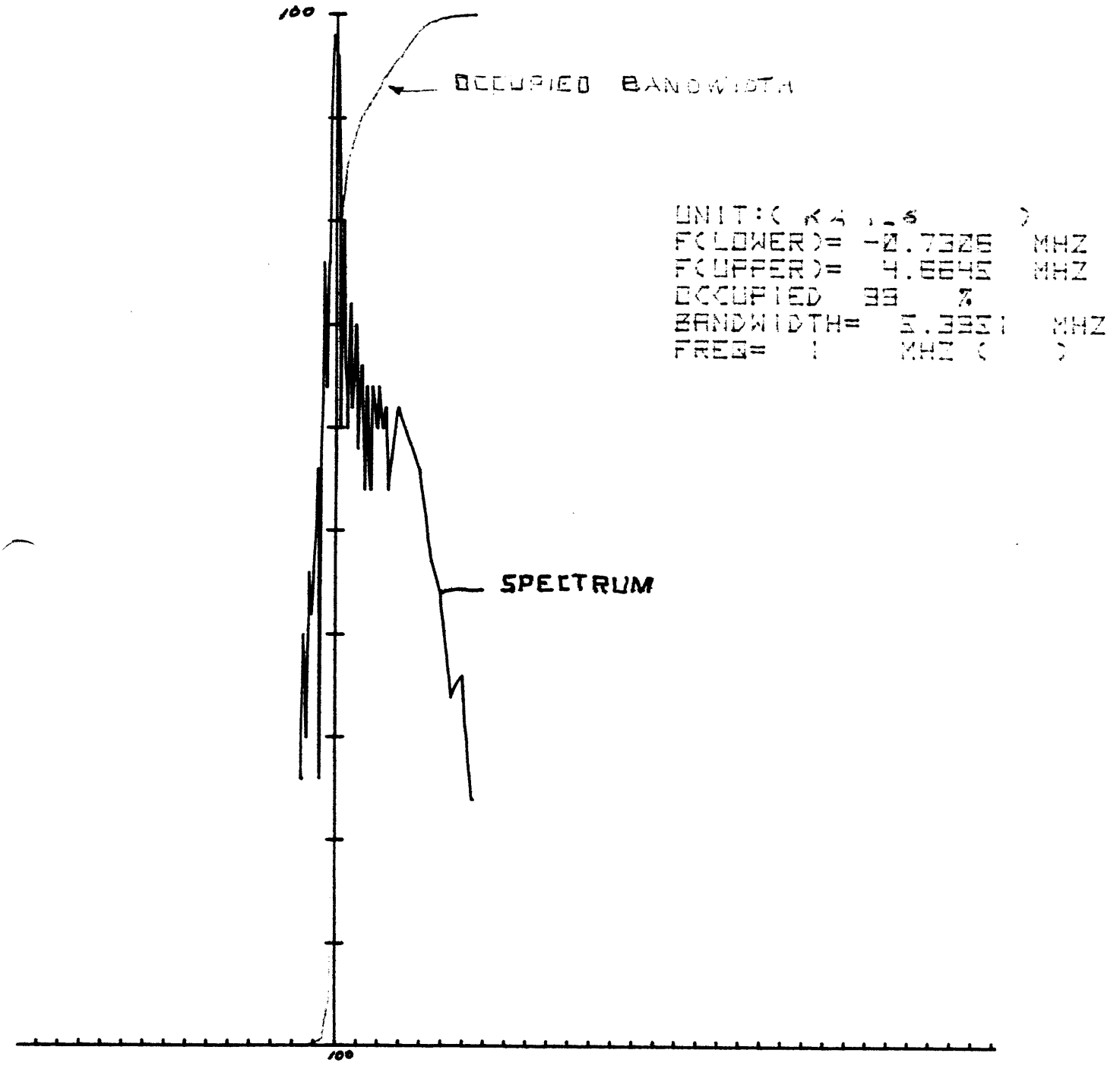


FIGURE 1 KA 126 MAGNETRON SPECTRUM

FCC OCCUPIED BANDWIDTH
99% ENERGY BANDWIDTH
CENTER FREQ = 9375 MHZ

	FREQ.	AMPL. DB	AMPL. V
1	-1.6000	37	1.9953E-04
2	-1.5000	30	1.0000E-03
3	-1.3000	35	3.1623E-04
4	-1.2000	27	1.9953E-03
5	-1.1000	29	1.2589E-03
6	-1.0000	27	1.9953E-03
7	-0.8000	22	6.3096E-03
8	-0.7000	37	1.9953E-04
9	-0.6000	19	1.2589E-02
10	-0.5000	12	6.3096E-02
11	-0.4000	18	1.5849E-02
12	-0.3000	12	6.3096E-02
13	-0.2000	5	3.1623E-01
14	-0.1000	1	7.9433E-01
15	0.1000	2	6.3096E-01
16	0.2000	9	1.2589E-01
17	0.2500	20	1.0000E-02
18	0.4000	10	1.0000E-01
19	0.6000	20	1.0000E-02
20	0.7000	14	3.9811E-02
21	0.8000	19	1.2589E-02
22	1.0000	15	3.1623E-02
23	1.1000	21	7.9433E-03
24	1.2500	17	1.9953E-02
25	1.4000	23	5.0119E-03
26	1.5000	18	1.5849E-02
27	1.7000	23	5.0119E-03
28	1.8000	18	1.5849E-02
29	2.0000	20	1.0000E-02
30	2.1000	18	1.5849E-02
31	2.3000	20	1.0000E-02
32	2.4000	19	1.2589E-02
33	2.5000	23	5.0119E-03
34	3.0000	19	1.2589E-02
35	4.0000	22	6.3096E-03
36	4.5000	26	2.5119E-03
37	5.0000	28	1.5849E-03
38	5.5000	33	5.0119E-04
39	6.0000	32	6.3096E-04
40	6.5000	38	1.5849E-04

F (LOWER) = -0.7306 MHZ
F (UPPER) = 4.6645 MHZ
OCCUPIED 99%
BANDWIDTH = 5.3951 MHZ
FREQ. = 9375



DIGITIZED SPECTRUM AND OCCUPIED DANDWIDTH

2.991 Spurious Emissions

1) Radio frequency voltage measurements at the antenna terminals.

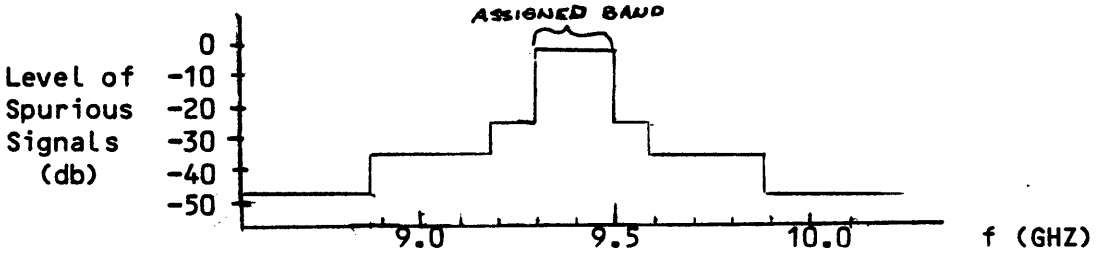
Requirements: The mean power of emission shall be attenuated below the mean output power of the transmitter in accordance with the following:

(i) On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: at least 25 decibels.

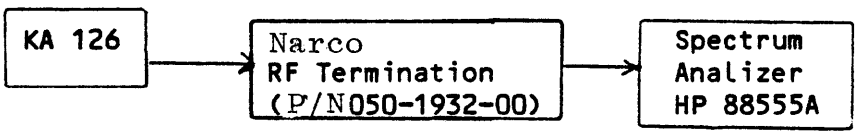
(ii) On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: at least 35 decibels.

(iii) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: 43 plus 10 $\log_{10}$ (mean output power in watts) = 47db.

These requirements can be translated in the following plot.



Procedure: The equipment was connected as shown below. The frequency spectrum was then scanned in search of spurious signals.



The conducted spurious emissions was scanned from 100MHz to 19 gHz data is as follows:

Frequency	Below Mean Transmitter Power
9345 MHz (L.O.)	62db

Only emission detected.

9.993 Field strength radiation

Reference level - The transmitter emission was measured straight on with the appropriate antenna.

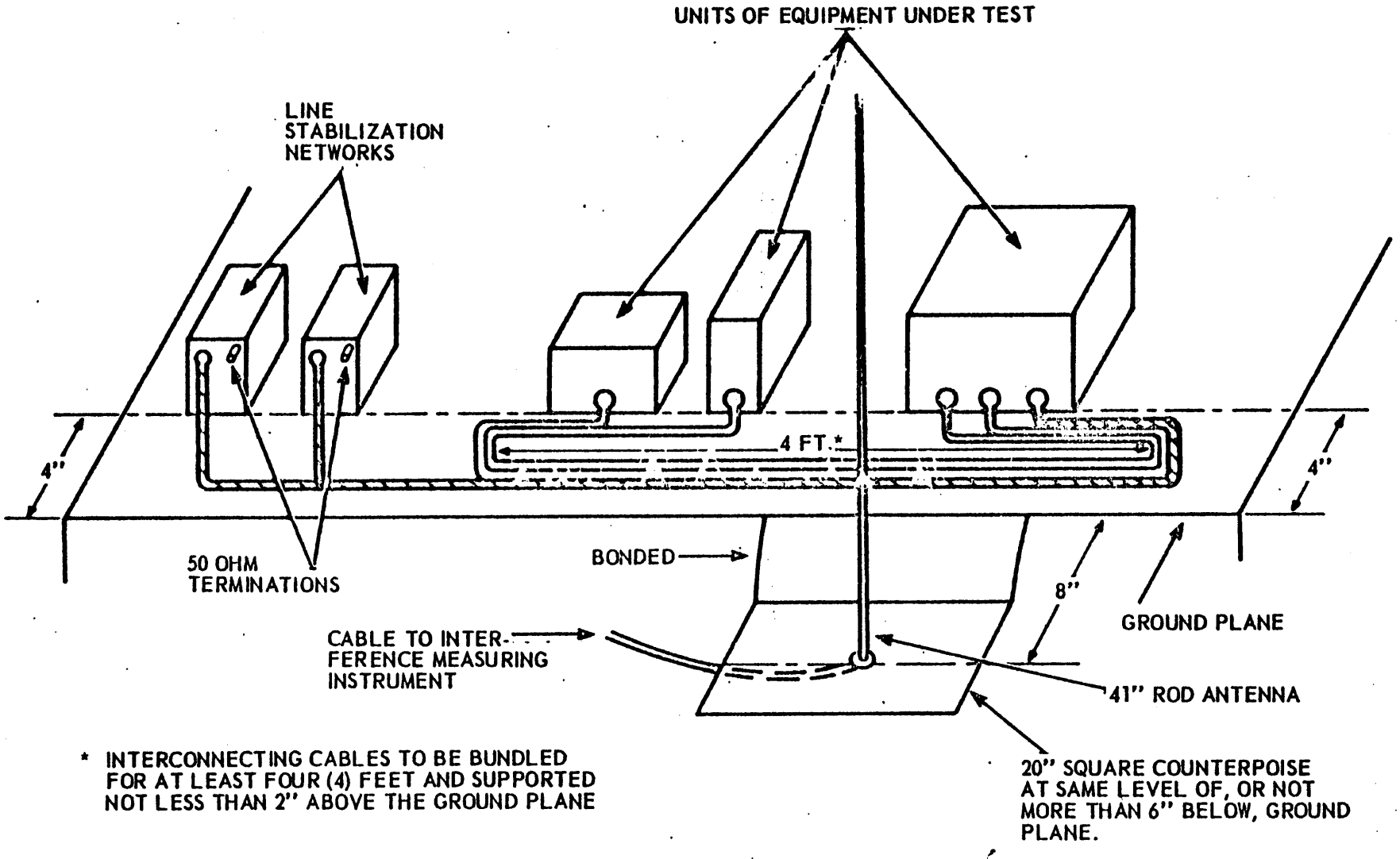


Figure 1 . Location of Rod Antenna and Arrangement of Equipment

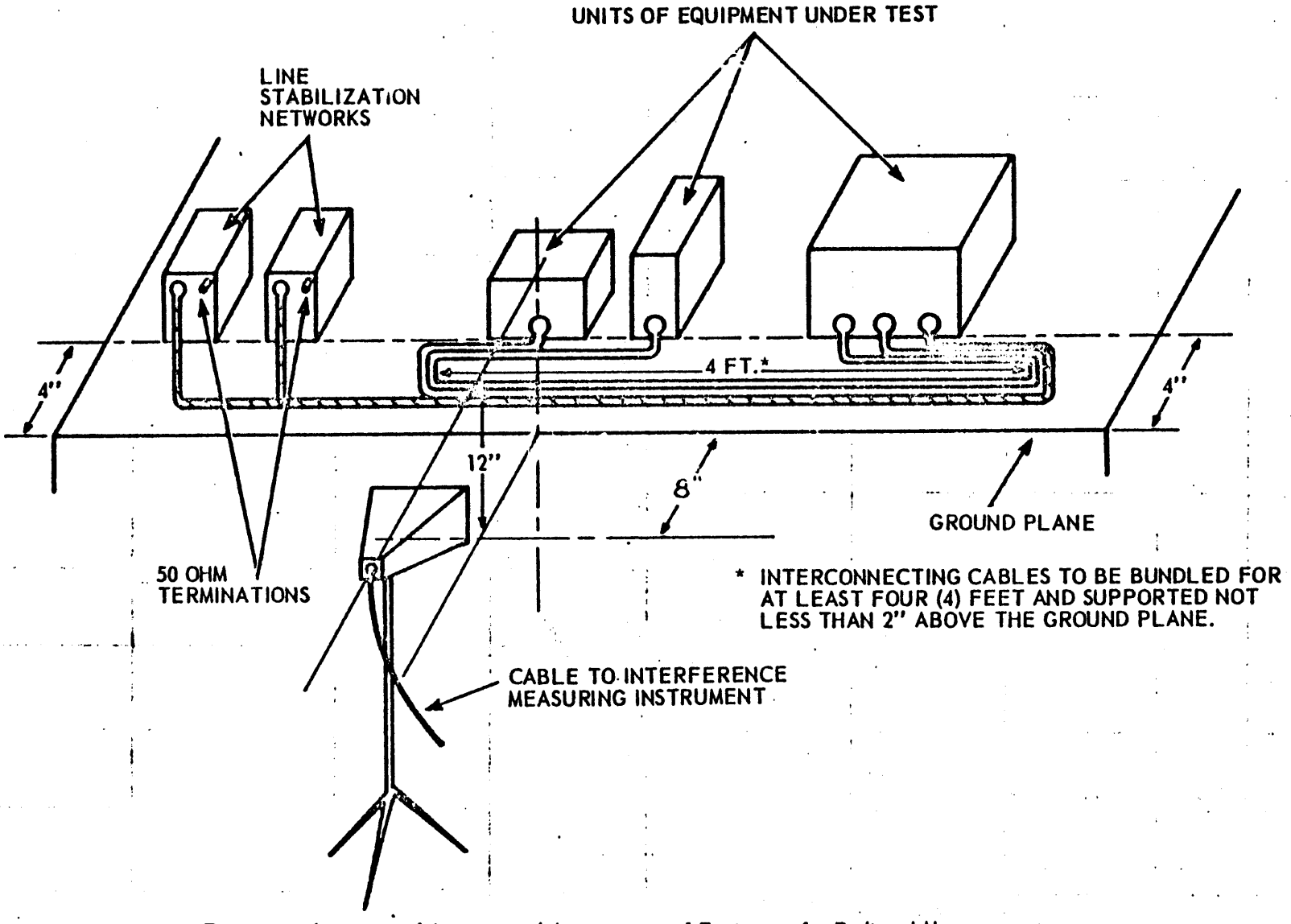


Figure 2. Location of Antenna and Arrangement of Equipment for Radiated Measurements.

Data

30db attenuator
6db cable loss
-2dbm signal level
26 gain of antenna

Antenna factor K= 20 log 9375 - 26 - 29.8 for 50 ohm system
K= 23.64

Since level of signal is peak, the bandwidth of the analyzer is set to require 25db be added to the reading or

Attenuator		Cable loss		Signal Level		Peak Factor	
30db	+	6db	-	2dbm	+	25db	= 59db

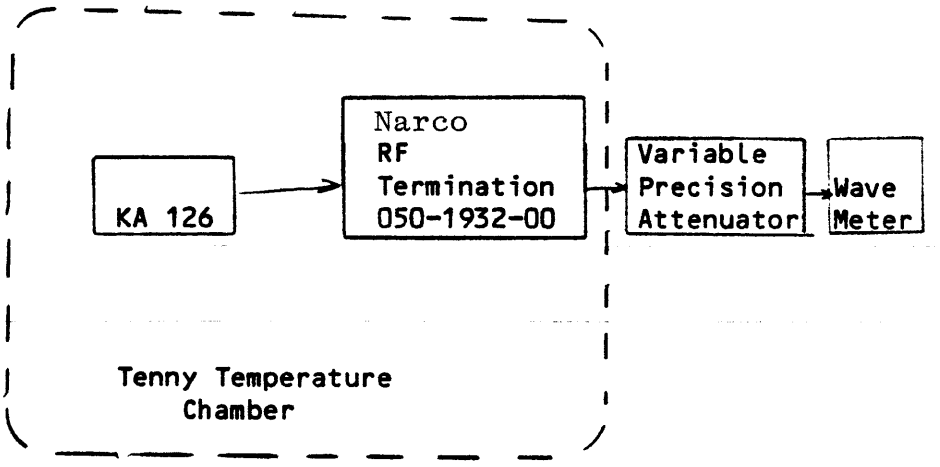
Adding antenna factor and db uv/m conversion factor
59 + 23.64 + 107 = 189.7db uv/meter

Emission Frequency (MHz)	Level (dbm)	Antenna Factor(db)	Field Strength (db uv/Meter)
.40	-65	+28.5	70.5
.46	-65	+29.8	71.8
.52	-60	30.8	77.8
.58	-58	32.0	81.0
3.70	-104	26.0	29.0
3.74	-103	26.0	30.0
9.4	-101	18.0	24.0
10.6	-105	19.3	21.3
13.7	-104	16.5	19.5
19.0	-89	15.7	33.7
24.0	-95	16.7	28.7
25.2	-90	16.8	33.8
26.5	-96	17.0	28.0
28.6	-93	18.0	32.0
31.0	-85	-2.1	21.9
32.5	-83	-1.1	22.3
33.8	-72	-1.3	33.9
41	-80	0.3	27.3
46	-88	1.3	20.3
47	-78	1.5	30.5
48	-70	1.7	38.7
52	-98	2.3	11.3
54	-94	2.7	15.7
62.5	-88	4.0	23.0
66	-91	4.5	20.5
79	-91	6.0	22.0
84	-89	6.5	24.5
120	-82	9.7	34.7
130	-87	10.3	30.3
9345 (L.O.)	-34	26	99.0

2.995 Frequency Stability

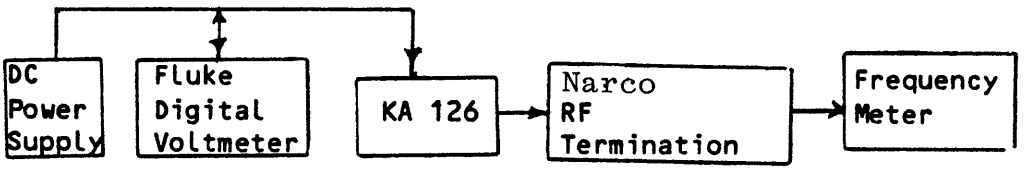
With the system set up as shown below, data was recorded on the transmitter frequency as follows:

Temperature (°C)	Frequency (MHZ)
-30	9402
-20	9400
-10	9399
0	9397
+10	9396
+20	9394
+30	9392
+40	9390
+50	9388



With the system assembled as shown below, the primary voltage was varied from 85% to 115% of normal.

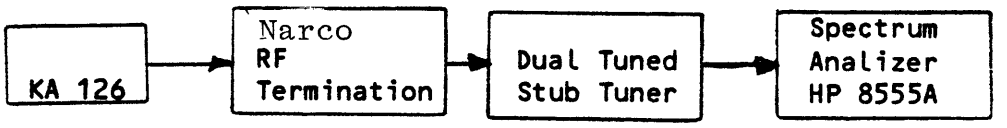
Primary Voltage	Frequency (MHz)
23.3 (85%)	9395
27.5 (100%)	9395
31.6 (115%)	9395



VOLTAGE VARIATION

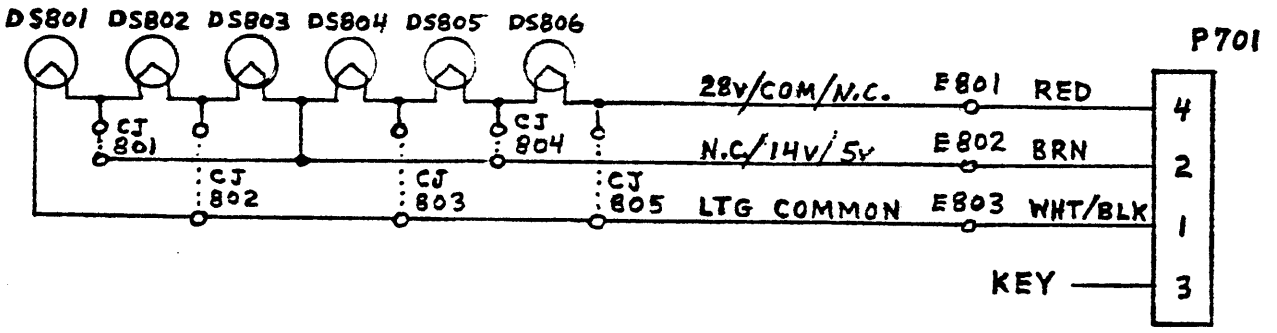
2.99 Frequency Spectrum to be investigated

With the transmitted frequency notched out by approximately 40db (see test set up), the spectrum was investigated from 1MHZ to 19GHZ. No subharmonics or harmonics were detected.



(F) Drawings of the serial tags are found in Appendix C.
(G) Photographs of the equipment is found in Appendix D.
(H) Not applicable.

APPENDIX A
COMPLETE CIRCUIT DIAGRAMS



NOTE:

1. Circuit jumpers CJ801 thru CJ805 used for 5 volt lighting only.

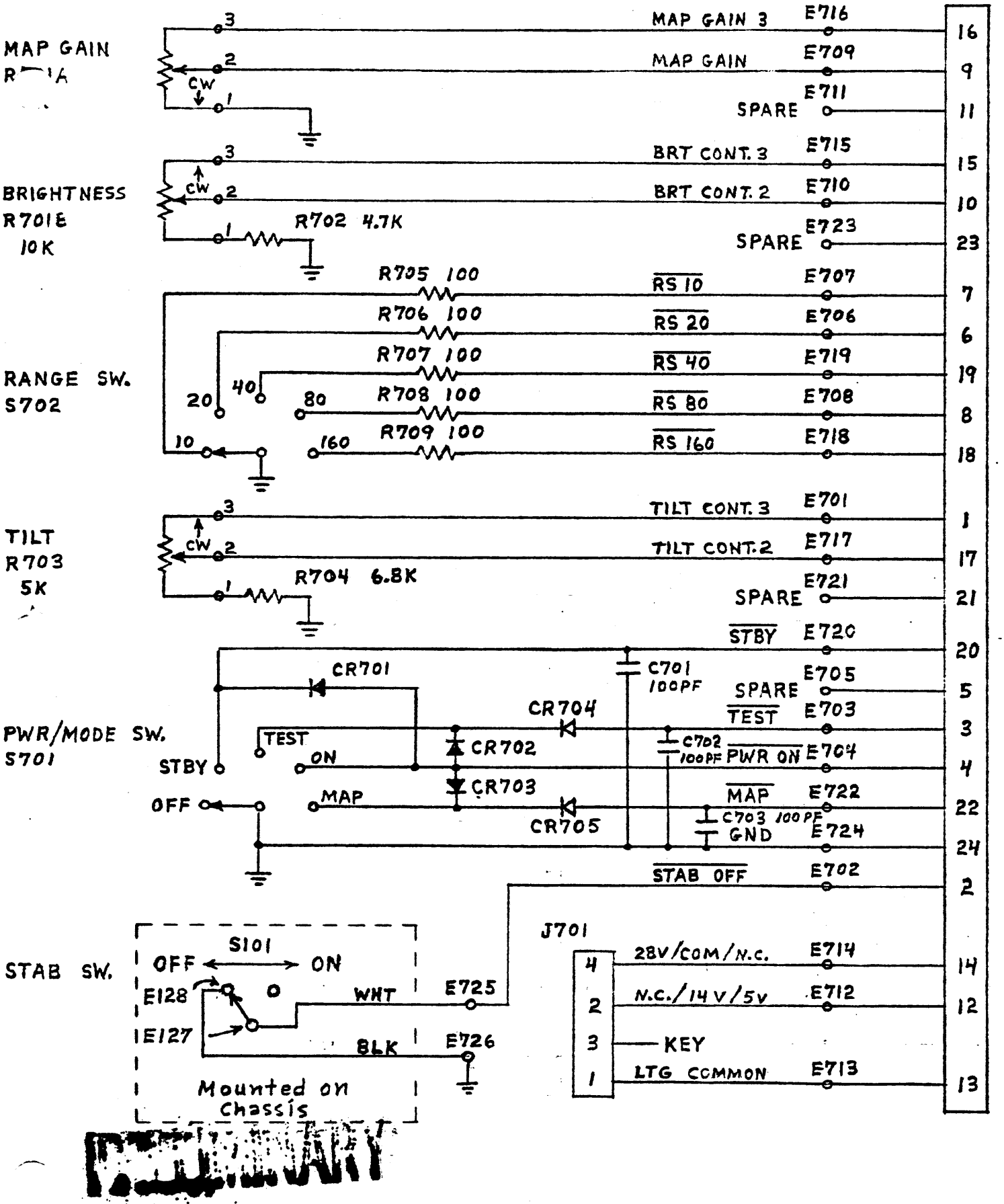
PRELIMINARY

PANEL LAMP SCHEMATIC

002-6280-00

11-6-80
Milton

P201



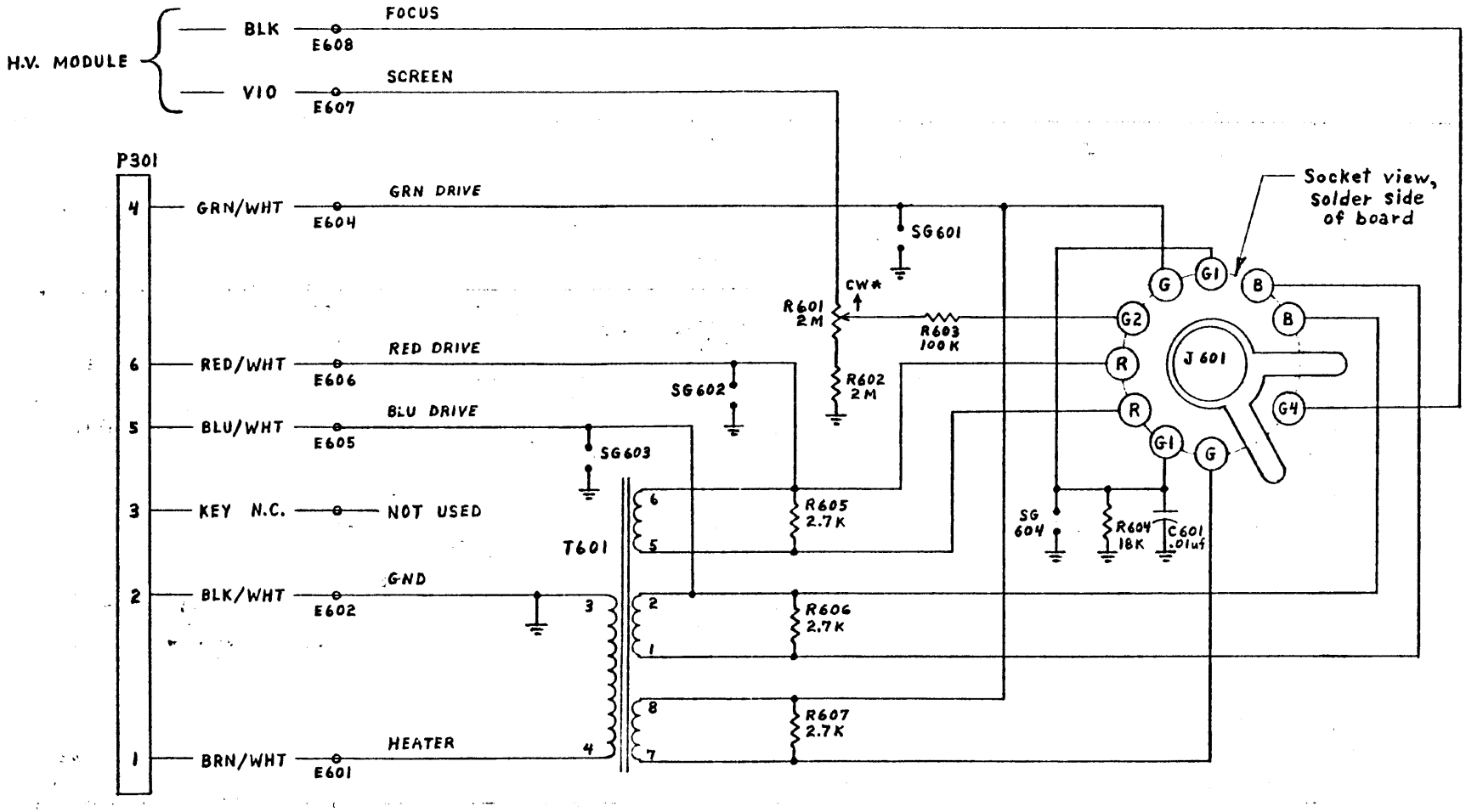
Note: All resistors EW 5%

PANEL CONTROL SCHEMATIC

002-6279-00

11-18-80

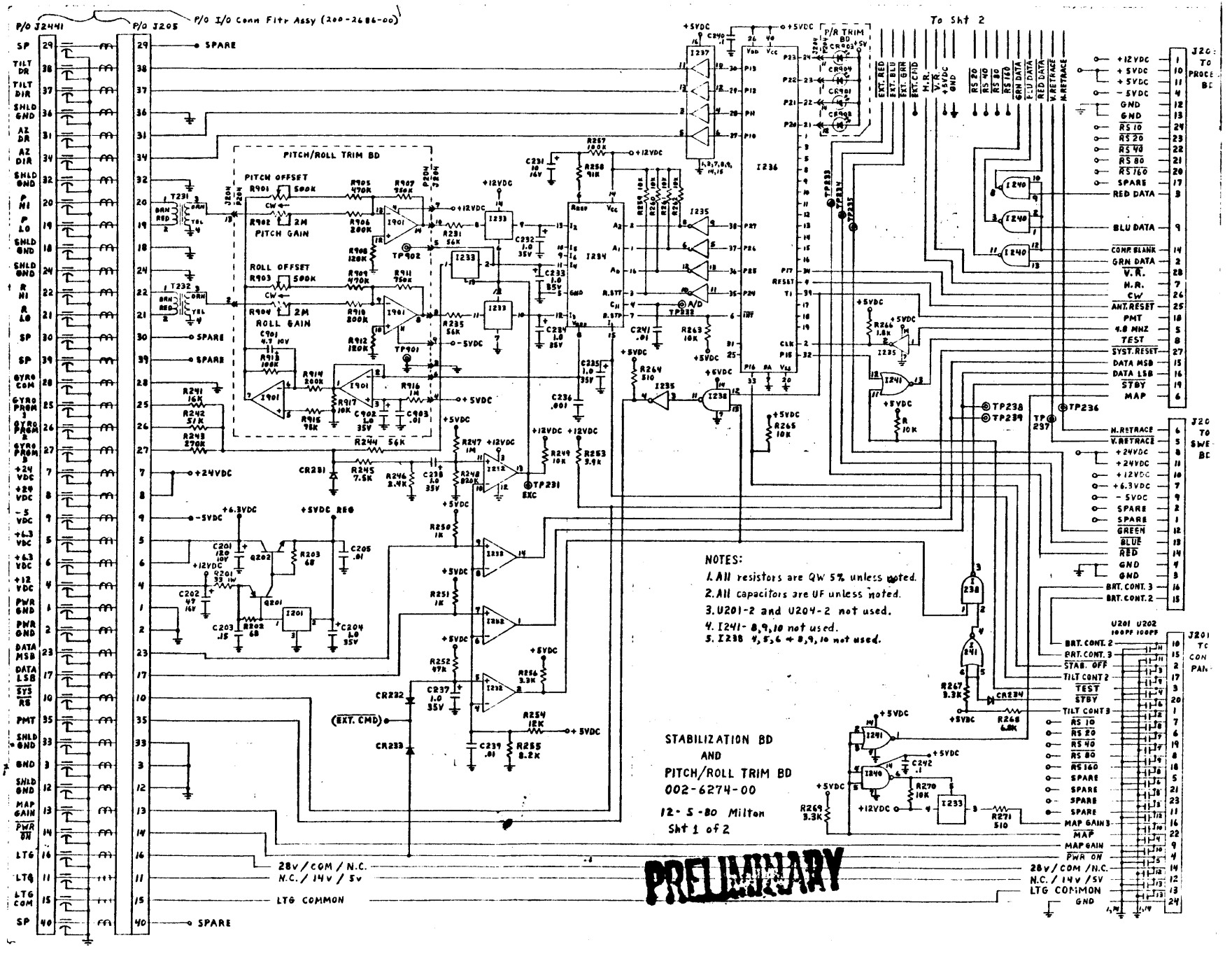
Milton

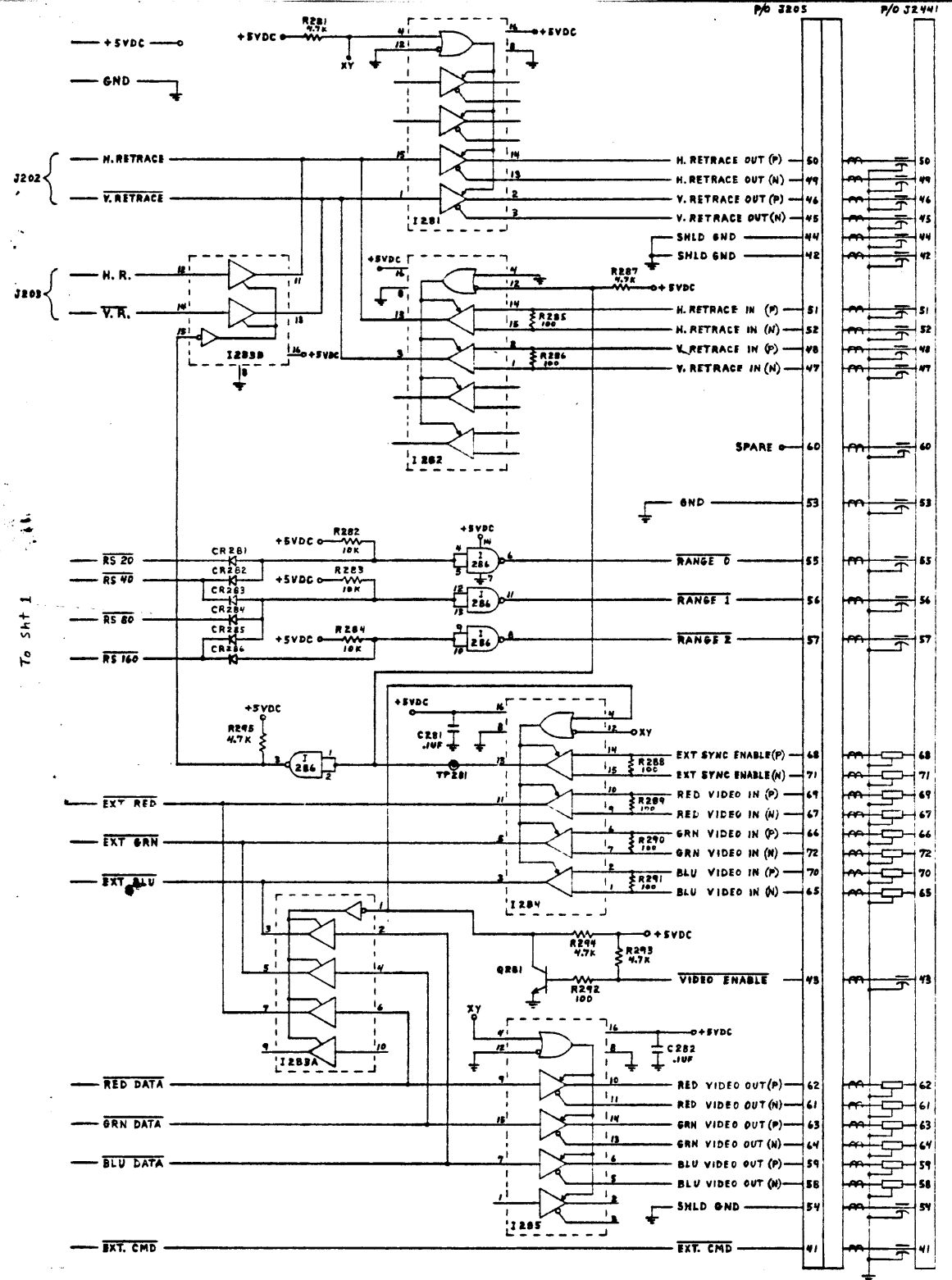


Note: * R601 rotation viewed from component side of P.C.Bd

PRELIMINARY

CRT BOARD
002-6278-00
10-31-80 Milton

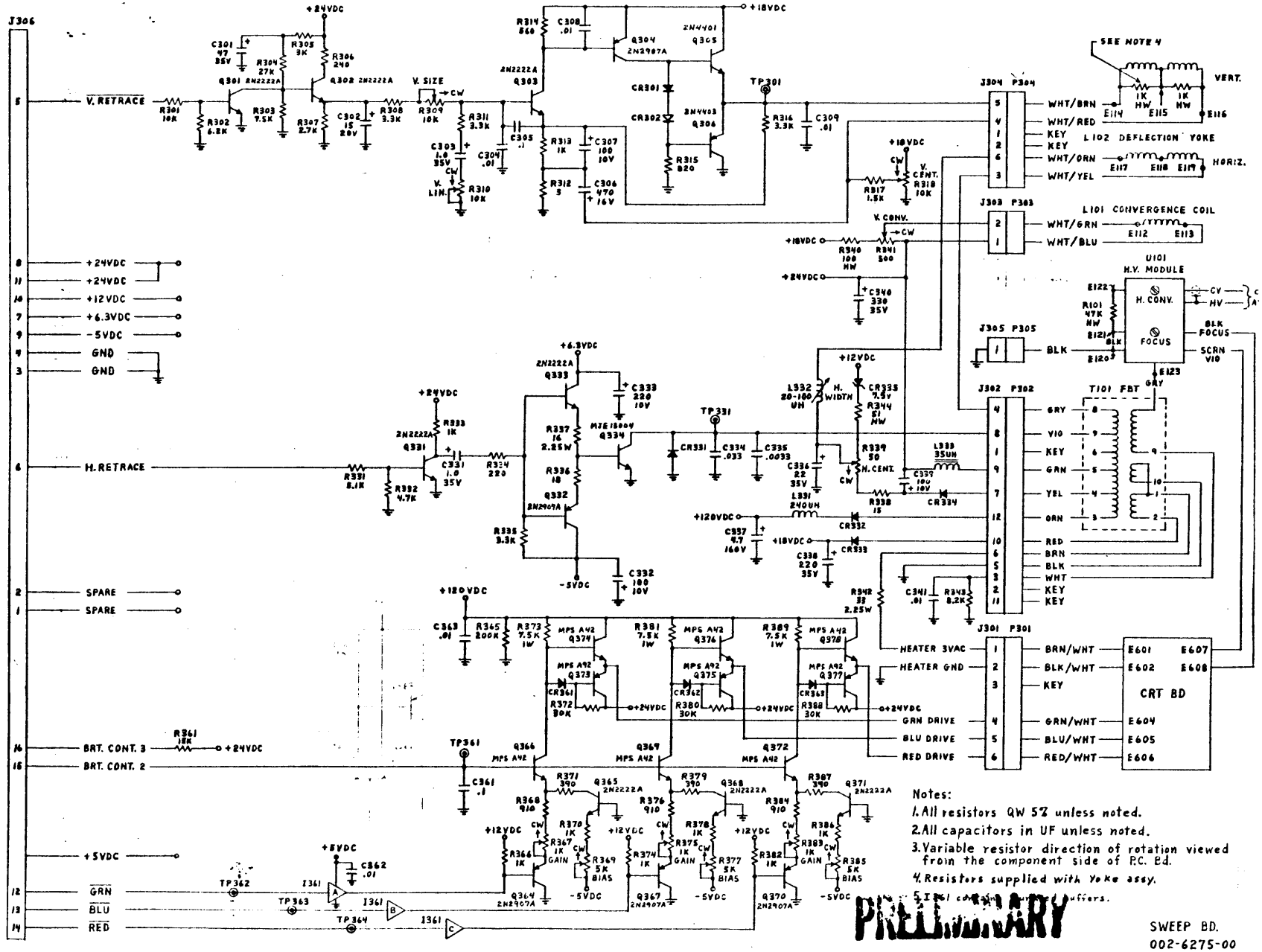

P/O J2441
P/O J205
P/O I/O Conn Fltr Assy (200-2686-00)
To Sht 2
PITCH/ROLL TRIM BD
PITCH OFFSET
ROLL OFFSET
PITCH GAIN
ROLL GAIN
P/R TRIM BD
STABILIZATION BD
AND
PITCH/ROLL TRIM BD
002-6274-00
12-5-80 Milton
Sht 1 of 2
NOTES:
1. All resistors are QW 5% unless noted.
2. All capacitors are UF unless noted.
3. U201-2 and U204-2 not used.
4. I241- 8,9,10 not used.
5. I238 4,5,6 & 8,9,10 not used.
PRELIMINARY
SPARE
+24VDC
-5VDC
+12VDC
+5VDC
+6.3VDC
+5VDC REG
28v/COM/N.C.
N.C./14v/5v
LTG COMMON
(EXT. CMD)
EXC
A/D
J206 TO PROCESSOR BD
J207 TO SWEEP BD
J201 TO CONTROL PANEL

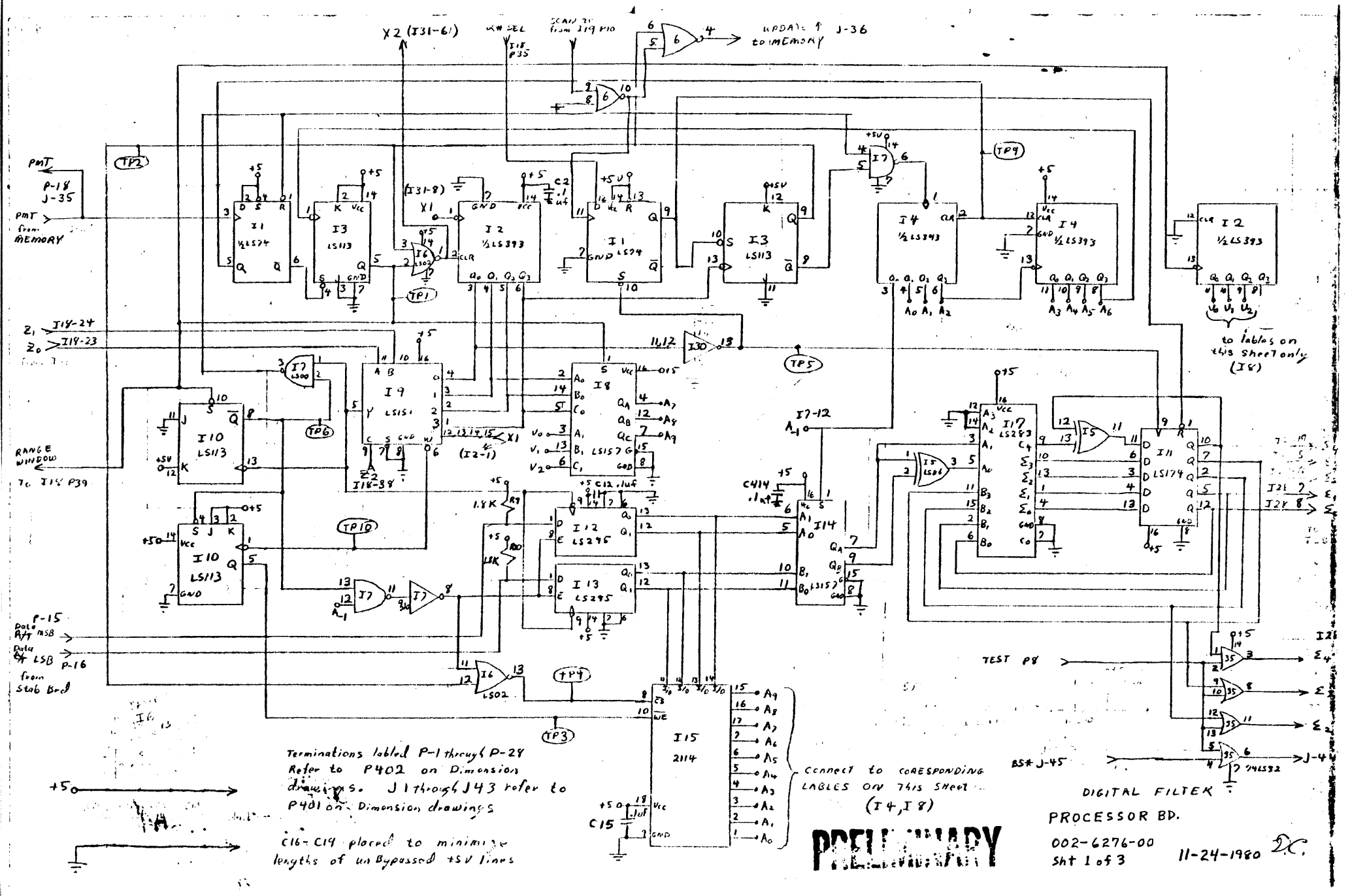


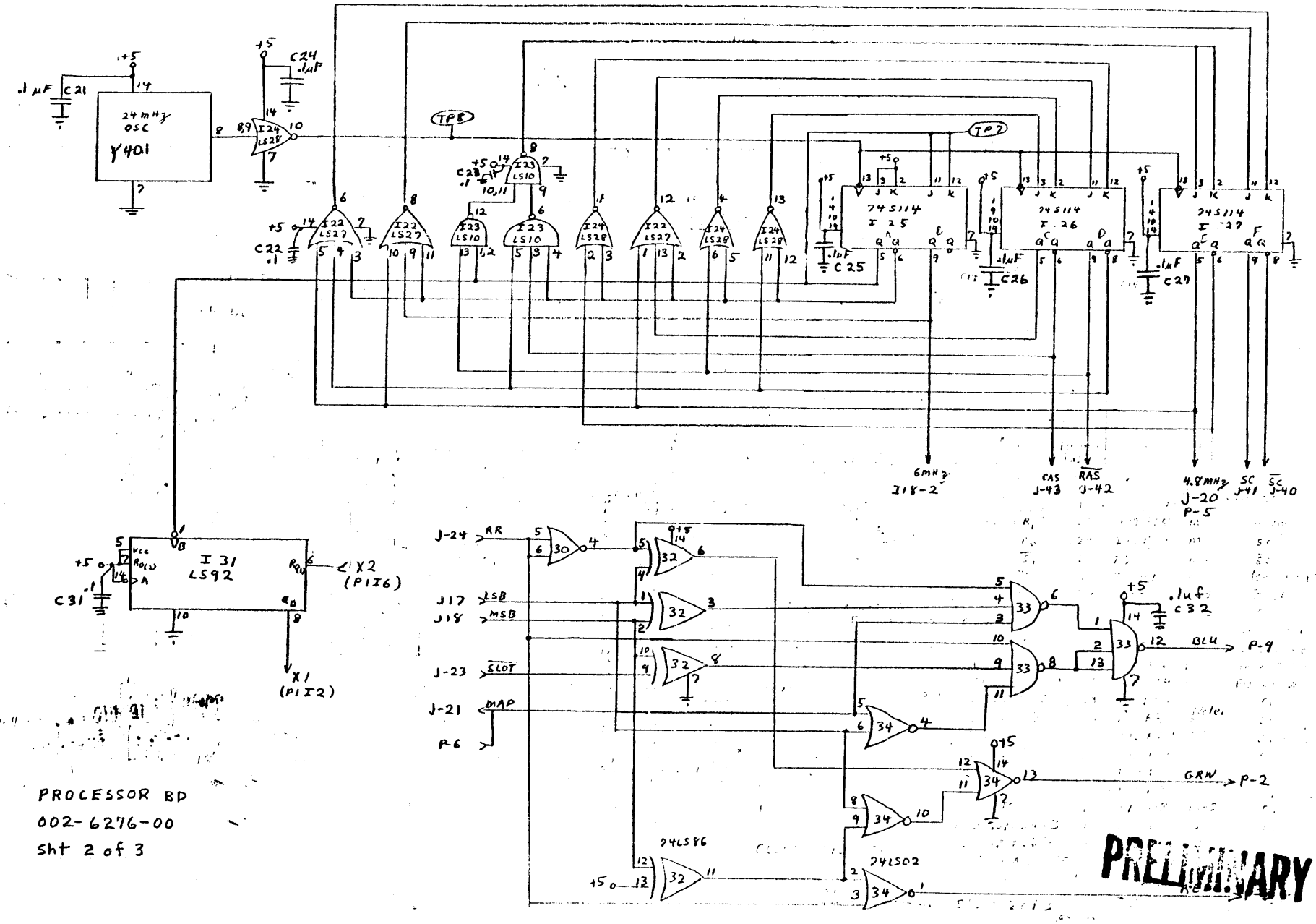
NOTE: 1. Resistors are ¼W 5%.
2. EXT. CMD = Gnd to enable the Radar Display.
3. Symbol no's 281-299

STABILIZATION BD.
002-6274-00
11-13-80
Sht 2 of 2
(Ext. Display Section)

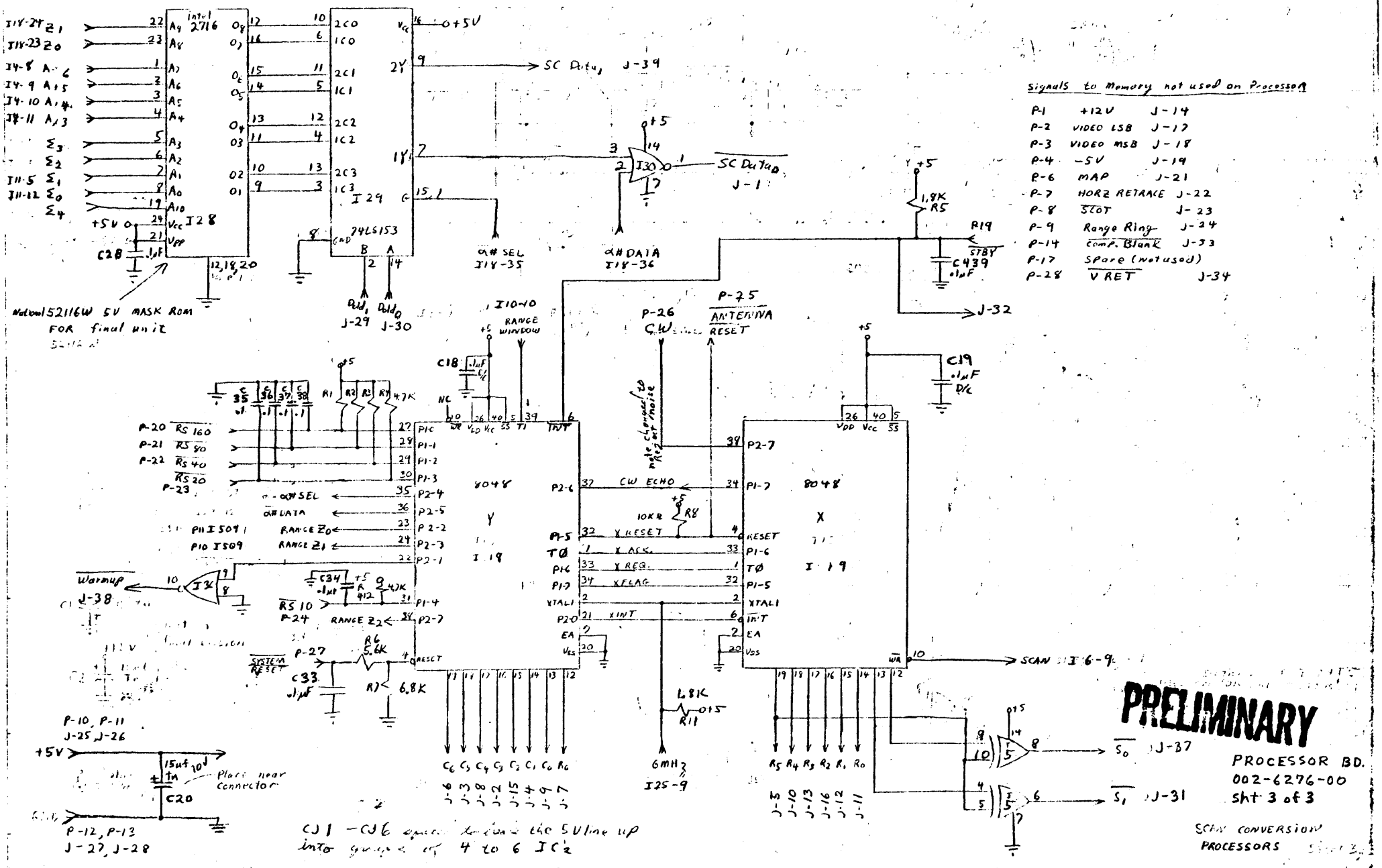
PRELIMINARY

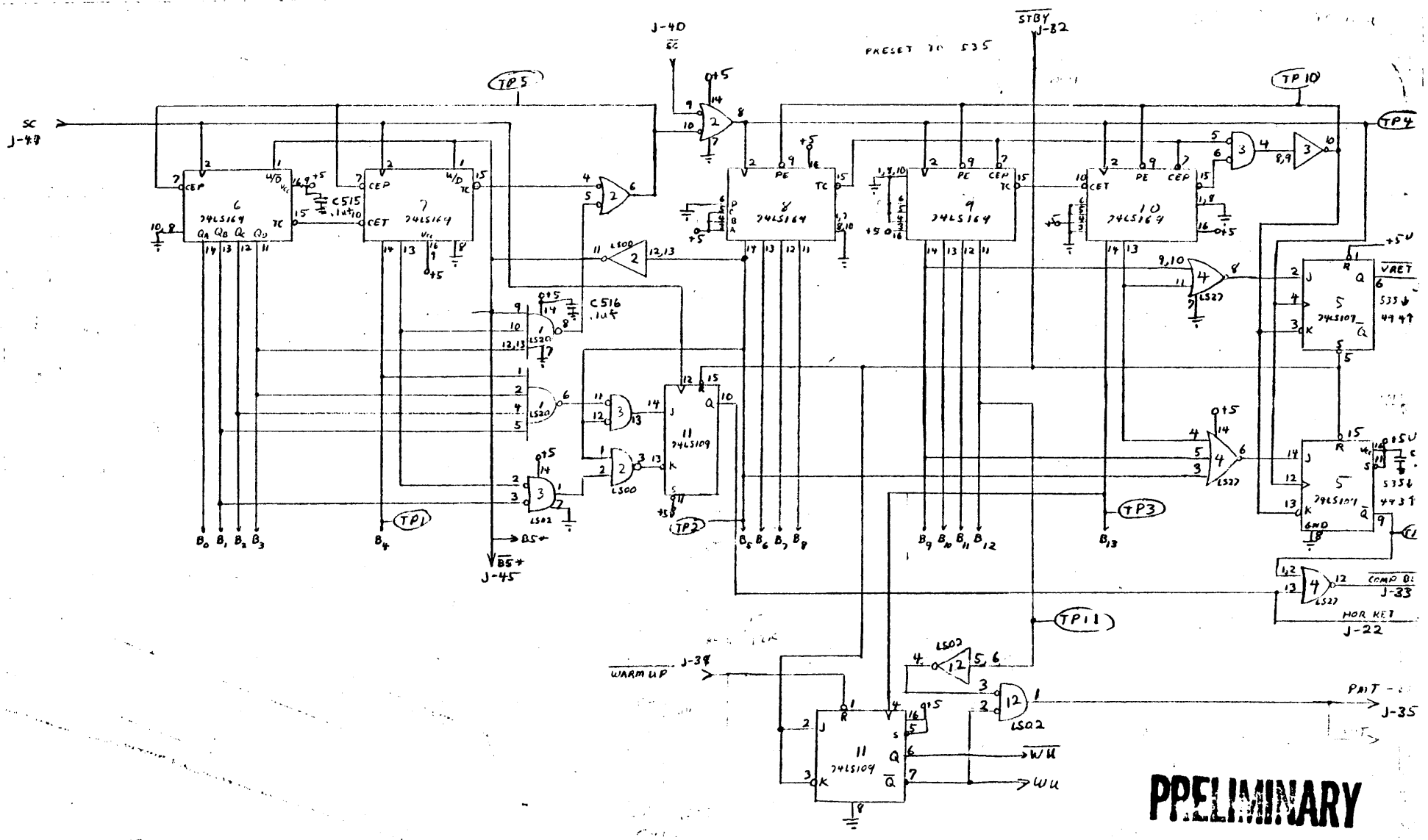

J306
V. RETRACE
H. RETRACE
+24VDC
+18VDC
+12VDC
+6.3VDC
-5VDC
GND
SPARE
BRT. CONT. 3
BRT. CONT. 2
GRN
BLU
RED
V. SIZE
V. LIN.
V. CENT.
V. CONV.
H. WIDTH
H. CENT.
TP301
TP331
TP361
TP362
TP363
TP364
J304 P304
WHT/BRN
WHT/RED
KEY
KEY
WHT/GRN
WHT/YEL
SEE NOTE 4
VERT.
HORIZ.
L102 DEFLECTION YOKE
J303 P303
WHT/GRN
WHT/BLU
L101 CONVERGENCE COIL
U101
H.V. MODULE
H. CONV.
FOCUS
CV
HV
BLK FOCUS
SCRN
J305 P305
BLK
J302 P302
GRY
VIO
KEY
GRN
YEL
ORN
RED
BRN
BLK
WHT
KEY
T101 FBT
J301 P301
HEATER 3VAC
HEATER GND
BRN/WHT
BLK/WHT
KEY
GRN/WHT
BLU/WHT
RED/WHT
GRN DRIVE
BLU DRIVE
RED DRIVE
CRT BD
E601
E602
E604
E605
E606
E607
E608
Notes:
1. All resistors QW 5% unless noted.
2. All capacitors in UF unless noted.
3. Variable resistor direction of rotation viewed from the component side of P.C. Bd.
4. Resistors supplied with Yoke assy.
5. I [illegible] buffers.
PRELIMINARY
SWEEP BD.
002-6275-00
11-3-80 Milton


X2 (I31-6)
SCAN SEL
SCAN DATA from I19 P10
UPDATE ↑ J-36 to MEMORY
PMT P-18 J-35
PMT from MEMORY
TP2
TP1
TP5
TP6
TP7
TP9
TP10
TP4
TP3
(I31-8)
X1
C2 .1 uF
I1 ½LS74
I2 ½LS393
I3 LS113
I4 ½LS393
I6 LS02
I7 LS00
I8 LS157
I9 LS151
I10 LS113
I11 LS174
I12 LS295
I13 LS295
I14 LS157
I15 2114
I17 LS283
I18 LS86
I30
Z1 I19-24
Z0 I19-23
RANGE WINDOW To I19 P39
I18-38
(I2-1)
X1
+5 C12 .1uf
1.8K R7
1.8K R8
C414 .1uF
I7-12 A-1
P-15 Data R/T MSB
Data LSB P-16 from Stab Bd
TEST P8
BS* J-45
J-4
to tables on this sheet only (I8)
Terminations labled P-1 through P-28 Refer to P402 on Dimension drawings. J1 through J43 refer to P401 on Dimension drawings
C16-C19 placed to minimize lengths of un Bypassed +5V lines
Connect to coresponding lables on 74ls sheet (I4, I8)
C15 .1uf
DIGITAL FILTER PROCESSOR BD.
002-6276-00
Sht 1 of 3
11-24-1980
PRELIMINARY



PROCESSOR BD
002-6276-00
Sht 2 of 3

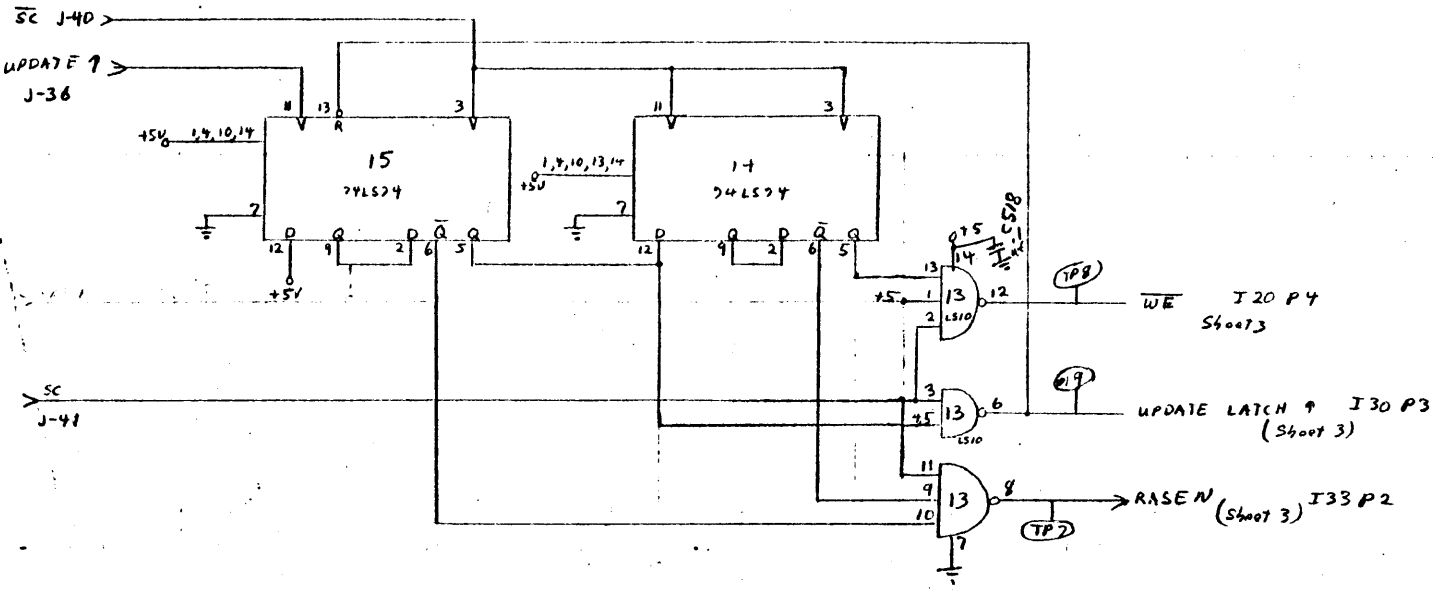

Signals to Memory not used on Processor A
P-1 +12V J-14
P-2 VIDEO LSB J-17
P-3 VIDEO MSB J-18
P-4 -5V J-19
P-6 MAP J-21
P-7 HOR2 RETRACE J-22
P-8 SLOT J-23
P-9 Range Ring J-24
P-14 comp. Blank J-33
P-17 Spare (not used)
P-28 V RET J-34
PRELIMINARY
PROCESSOR BD.
002-6276-00
sht 3 of 3
SCAN CONVERSION PROCESSORS



PRELIMINARY

Terminations labled J1 through J4 refer to P501 on Dimension Drawi

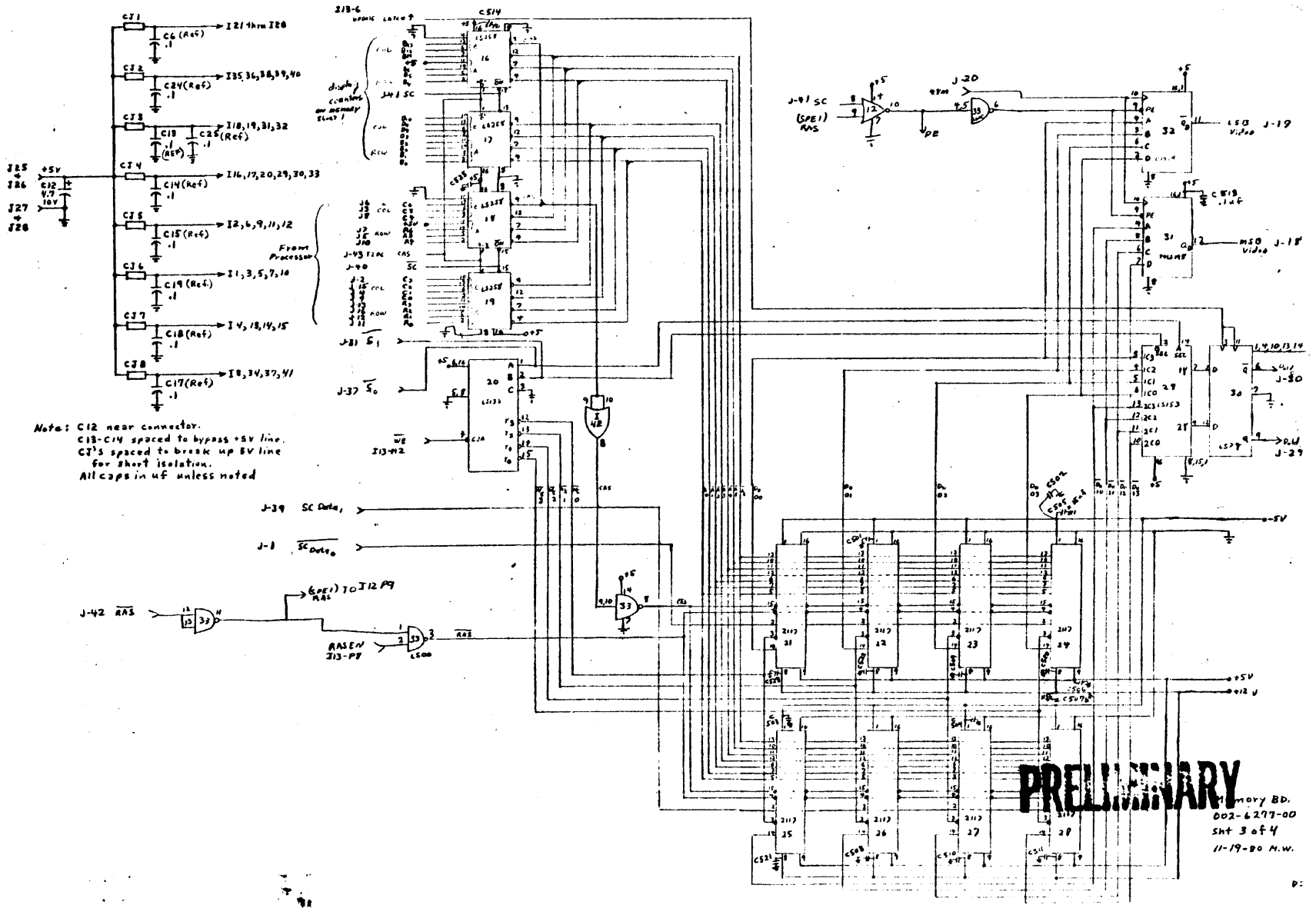
Memory Bd
002-6277-00
Sht 1 of 4
11-19-80 DC

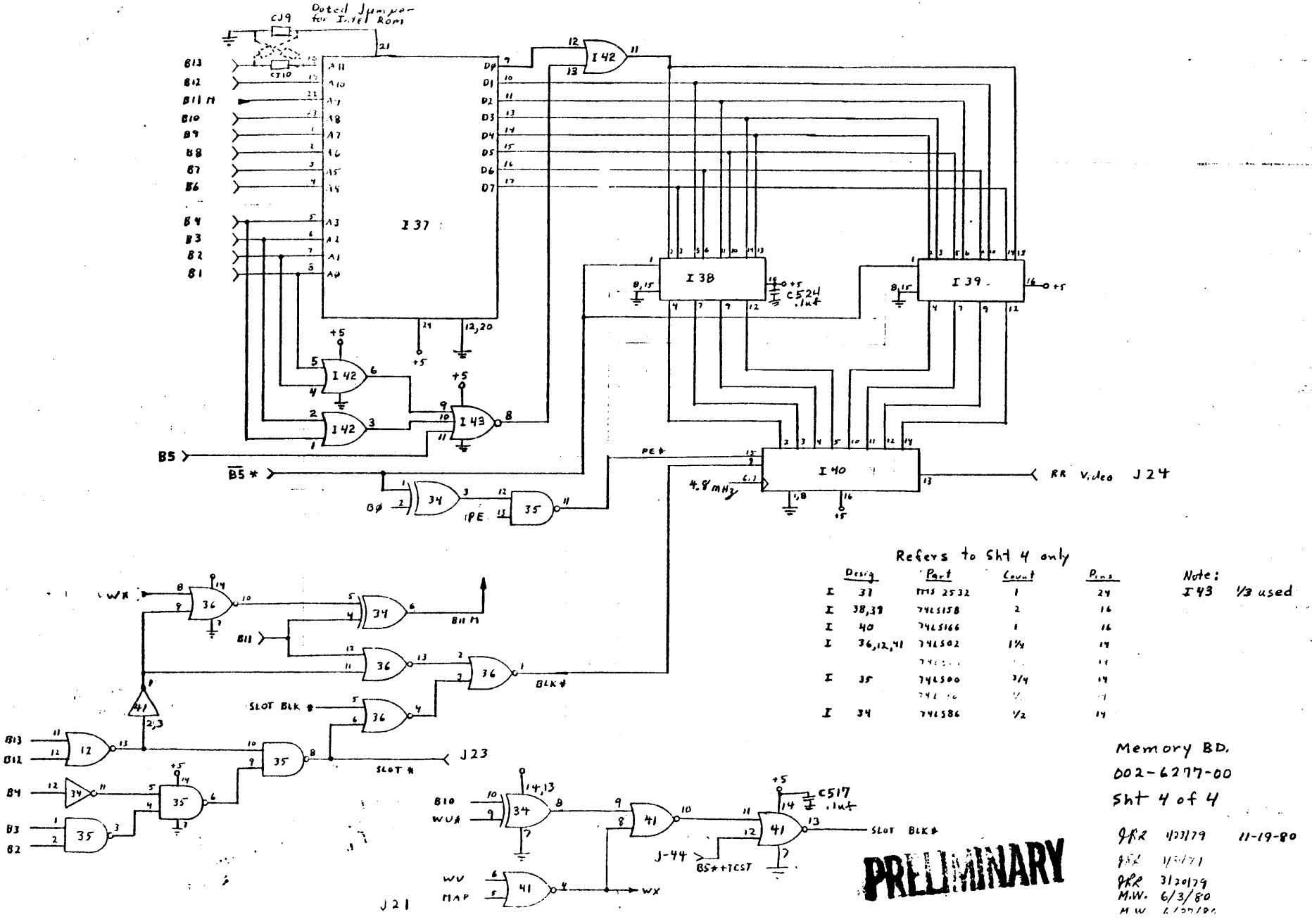


PRELIMINARY

Memory BD.
002-6277-00
Sht 2 of 4
11-19-80

DC


Note: C12 near connector.
C13-C14 spaced to bypass +5V line.
C3's spaced to break up 5V line for short isolation.
All caps in uf unless noted
PRELIMINARY
Memory BD.
002-6277-00
Sht 3 of 4
11-19-80 M.W.



Refers to Sht 4 only

	Desig	Part	Count	Pins
I	37	TMS 2532	1	24
I	38,39	74LS158	2	16
I	40	74LS166	1	16
I	36,12,41	74LS02	1½	14
I	35	74LS00	¾	14
I	34	74LS86	½	14

Note:
I43 ⅓ used

Memory BD.
002-6277-00
Sht 4 of 4

PRELIMINARY

PKR	4/27/79	11-19-80
PKR	1/31/79	
PKR	3/20/79	
M.W.	6/3/80	
M.W.	6/27/80	