OPERATION AND MAINTENANCE MANUAL

NAV-402AP

INC

NAV-402AP

MARKER, G/S, VOR, LOC, COMM, AND AUTO PILOT RAMP AND BENCH TEST SET

SUPPLEMENTAL MANUAL

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NOTICE

THIS MANUAL IS INCOMPLETE WITHOUT NAV-401L OPERATION AND MAINTENANCE MANUAL, PART NUMBER 1-09-0726, NOVEMBER, 1976, PRINTING.

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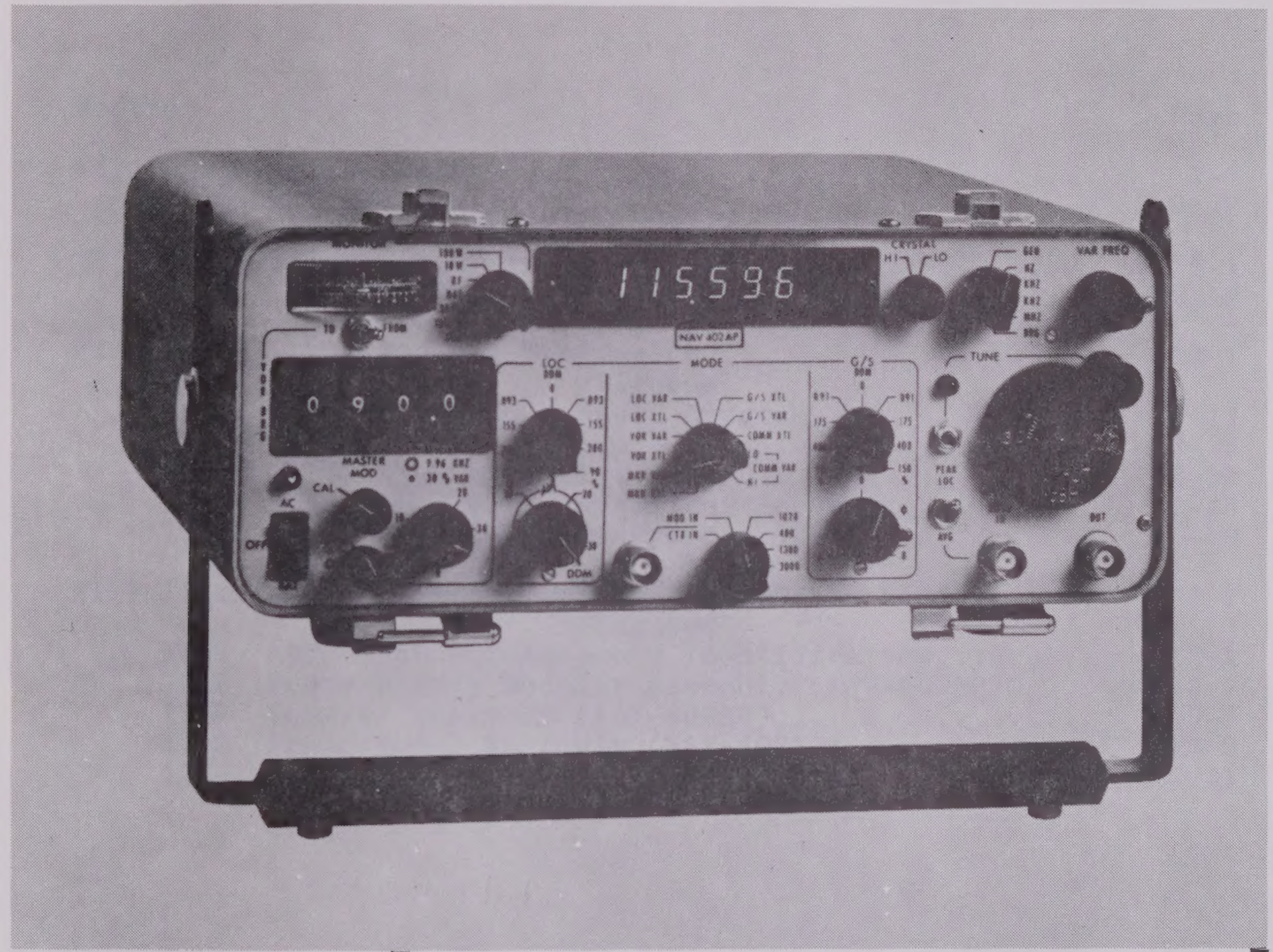
INTRODUCTION

Because of the basic simalarities between the NAV-402AP and NAV-401L Test Sets, the NAV-402AP Operation and Maintenance Manual is written as a supplement to the NAV-401L Operation and Maintenance Manual. All of the information contained in the NAV-401L Manual is applicable to both the NAV-401L and NAV-402AP test sets except as noted in the NAV-402AP supplement; all references to the NAV-401L in the NAV-401L Manual should be ignored. Information in the NAV-402AP Supplement is applicable only to the NAV-402AP Test Set.

The pages in the NAV-402AP Supplement can be inserted into tha basic manual. Page numbers followed by /AP should be inserted facing the existing page; i.e. page 1-1 is a right hand page and page 1-1/AP is a left hand page which should be inserted before page 1-1 so that it is facing that page. Paragraph numbers and figure numbers with the /AP suffixes contain information to be added to existing paragraphs or figures. Supplement paragraphs and figures without the /AP suffixes replace the entire paragraph or figure in the basic manual



NAV-402AP BENCH AND RAMP TEST SET

IFR INC

TABLE OF CONTENTS

SECTION I GENERAL INFORMATION

1-2. The NAV-402AP is a FCC Type-Accepted bench and ramp test set designed to meet the electronic functional requirements of Category I, Category II and Category III ILS systems, and Communication (COMM), Navigation (NAV) and Marker (MKR) systems.

1-10. The NAV-402AP contains features to allow testing of sophisticated autopilot systems. These features include the automatic sweep of the LOC DDM, two crystal controlled VOR frequencies, and two paired, crystal controlled LOC and G/S frequencies.

SECTION II TECHNICAL SUMMARY

RF OUTPUT

CRYSTAL CONTROL:

MKR XTL		75.000MHz
VOR XTL	LO:	108.000MHz
	HI:	112.800MHz
LOC XTL		108.100MHz
G/S XTL	LO:	329.600MHz
	HI:	334.700MHz
COMM XTL		126.900MHz

NOTE

- The G/S 329.600MHz and 334.700MHz crystals are paired with the LOC 110.500MHz and 108.100MHz crystals, respectively, of the dual LOC transmitter during simultaneous transmission of G/S and LOC signal in G/S XTL operation.
- Any crystal frequency may be specially installed in each band.

LOC SIGNAL

DDM:	.093, .155, .200 DDM and tone delete. Accuracy ±0.0013 DDM (± 1.3µA). Variable control ±0.4 DDM. (See Table 5-2). LOC modulation will automatically sweep about 0 DDM; peak amplitude adjustable from 0 to 30µA (±0.031 DDM).

3-7. CRYSTAL HI/LO SWITCH. THE CRYSTAL HI/LO switch (2) selects between the high and low frequency crystals in the G/S XTL and VOR XTL modes. In G/S XTL mode the switch also applies power to the appropriate localizer transmitter which is paired with each glide slope crystal if the LOC-PEAK/AVG switch is in the LOC-PEAK position.

3-10. VARIABLE FREQUENCY CONTROLS. The coarse and fine VAR FREQ controls (5) manually sweep the internal signal generator frequency, with cw rotation increasing the output frequency. The frequency MODE switch must be in one of the VAR positions for this mode of operation. The coarse control, the larger knob close to the front panel, gives from 1 to 2 MHz deviation per turn. The fine control, the small outer knob, gives approximately 20 to 40 kHz deviation per turn. Both controls are 10-turn pots.

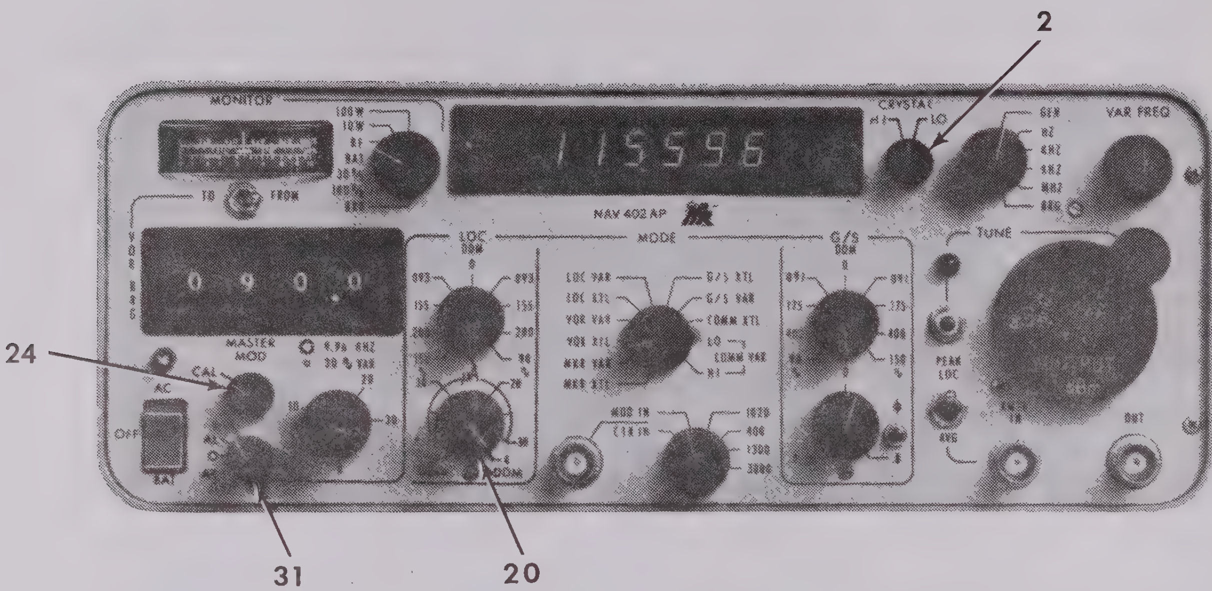
3-11. Phase Lock Circuit. All frequencies in the variable frequency modes are always phase locked. Phase lock is obtained every 25 kHz in all the variable frequency modes except for Glide Slope. Glide Slope frequencies are phase locked in 50 kHz increments.

3-12. The VAR FREQ controls are used to select the desired phase locked frequencies. Phase lock is indicated by the proper count on the frequency counter, 50 kHz increments for Glide Slope frequencies, 25 kHz increments on all other bands. It is necessary to adjust for the phase locked steps since the pull-in range of the phase lock circuit is less the 25 kHz. A phase lock on any frequency other than the 25 or 50 kHz steps is not valid and will have severe frequency modulation.

NOTE

> The variable frequency oscillator should not be adjusted to a frequency within ±5kHz of an XTAL frequency to avoid interaction between the oscillator circuits.

FRONT PANEL



2. Crystal Hi/Lo Switch

20. Localizer Variable
    DDM/DDM Sweep
    Amplitude Control

31. Localizer DDM Sweep Control

REAR PANEL

D. Fuse (½ampere, Slo-Blo)
   (½ ampere, Slo-Blo fuse also located
   inside case on card cage.)

Figure 3-1/AP. Controls, Indicators, and Connectors

3-26. LOCALIZER VARIABLE DDM/DDM SWEEP AMPLITUDE CONTROL. The Localizer Variable DDM and DDM Sweep Amplitude control (20) continuously varies the LOC pointer deflection from .4 DDM left through 0 DDM through .4 DDM right when the Localizer DDM Sweep control is in 0 position. Clockwise rotation gives right pointer-deflection. The LOC DDM control must be in the arrow position for operation. When the Localizer DDM Sweep control is in a sweep (S) position the amplitude of the LOC DDM sweep can be adjusted from 0 to 30μA (±0.031 DDM).

3-36A. LOCALIZER DDM SWEEP CONTROL. The Localizer DDM Sweep control (31) controls the sweep of the Localizer DDM. In 0 position the sweep is off. In the Arm Left (AL) and Arm Right (AR) positions the sweep circuitry is preset to 0 DDM and the sweep will start to the left (AL) or right (AR) when the control is placed in the Sweep (S) position. In the Arm positions, the LOC Variable DDM/DDM Sweep Amplitude control will vary the peak sweep amplitude from 0 to 30 μA with the LOC DDM control in the arrow position.

Table 4-1:

2/AP. VOR OPERATION

CRYSTAL HI/LO Switch	Use to select between the two crystals in VOR XTL mode.

Table 4-1:

3/AP. LOC OPERATION

LOC DDM Control	Stepped - Used for precise amounts of deflection and flag tests. VAR/Sweep Ampl - Used for checking auto-pilot servos, meter stickness, etc, or to set DDM sweep amplitude.
LOC DDM Sweep Control	Used to select initial direction of sweep start.

4/AP. G/S OPERATION

CRYSTAL HI/LO Switch	Use to select between the two crystals in G/S XTL mode.

6-9. On PC-3 the 90Hz and 150Hz square waves are processed through synthesizers to obtain low distortion sine waves. The 90Hz output is applied to the LOC and G/S centering adjust controls, then to the AUTO PILOT Sweep Generator and the LOC and G/S deviation switches. The 150Hz output is applied directly to the LOC and G/S deviation switches and the AUTO PILOT Sweep Generator. The Sweep output is applied to the LOC deviation switch. The 90Hz and the 150Hz signals are properly summed in the LOC and G/S deviation switches, and the output is applied to the 30Hz Sine Board, PC-4.

NOTE

The Overall Block Diagram for the NAV-402AP is identical to the NAV-401L except as noted on this sheet.

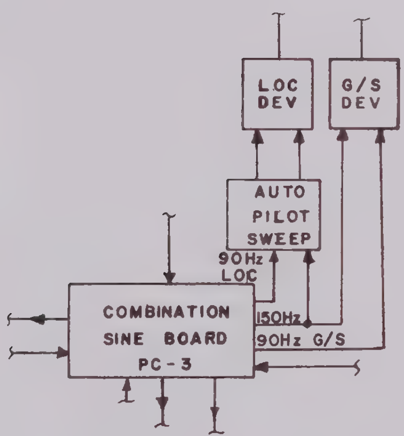


Figure 6-1/AP. Simplified Overall Block Diagram, NAV-402AP

NOTE

The Simplified Tone Generator
Block Diagram for the NAV-402AP
is identical to the NAV-401L except
as noted on this sheet.

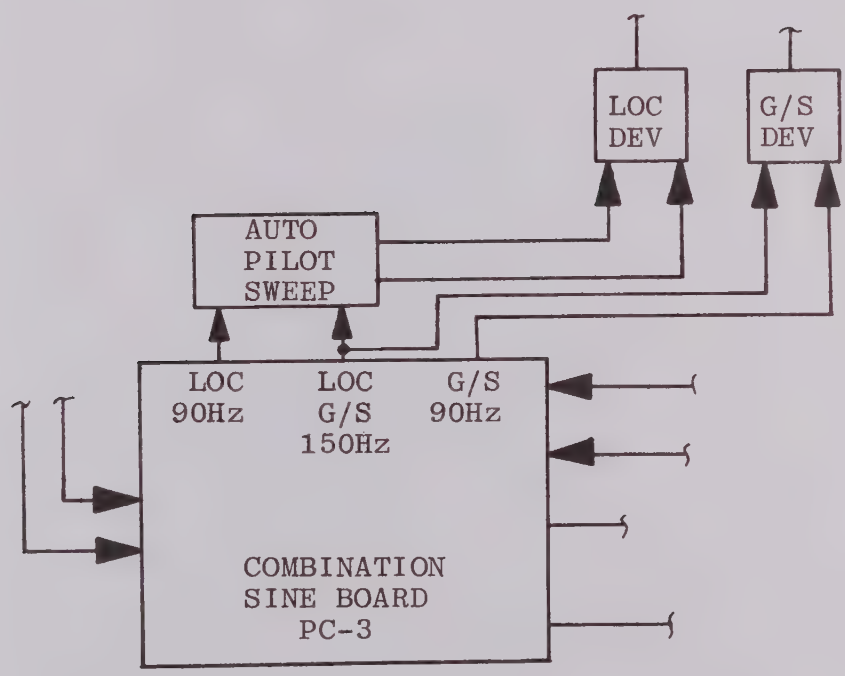


Figure 6-2/AP. Simplified Tone Generator Block Diagram.

6-26. All RF energy is generated in the test set by the oscillator assembly, assembly 5. Within the assembly are five crystal controlled oscillators and one variable-frequency oscillator, band-switched to cover from 72-78MHz and 107-156MHz. The MKR, LOC, and COMM oscillators each have one crystal. The VOR and G/S oscillators each have two selectable crystals. The crystal frequencies are those authorized for ramp use by the FAA. Special frequencies can be substituted if required.

6-33. A dual crystal controlled localizer transmitter is installed in the test set and is activated when the LOC-PEAK/AVG switch is in LOC-PEAK position in G/S XTL mode. The transmitter is installed for simultaneous operation with the glide slope transmitter. The frequency of each localizer transmitter is paired with a glide slope crystal frequency; the appropriate transmitter receives power through the CRYSTAL HI/LO switch. The output level of the localizer transmitters is approximately -18 dBm and is mixed with the G/S XTL RF in the Diode Protect Block.

6-37. Deleted.

7-11. ATTENUATOR OUTPUT LEVEL.

a. Adjust MASTER MOD control full ccw, but out of the detent (CAL) position, and set LOC-PEAK/AVG switch to AVG.
b. Set MODE switch to VOR XTL and CRYSTAL HI/LO switch to LO.
c. Connect power meter to OUT connector.
d. Adjust OUTPUT attenuator to -30 dBm.
e. Power Meter should indicate -30(±.5) dBm.
f. Adjust OUTPUT attenuator to -25 dBm.
g. Power meter indication should agree with the value recorded on the Attenuator Correction Chart, Section II, within ±.5 dBm.
h. Adjust OTUPUT attenuator to -20 dBm.
i. Power meter indication should agree with the value recorded on the Attenuator Correction Chart within ±.5 dBm.
j. Adjust OTUPUT attenuator to -15 dBm.
k. Power meter indication should agree with the value recorded on the Attenuator Correction Chart within ±.5 dBm.
l. Adjust OUTPUT attenuator -30 dBm.
l-1. Set CRYSTAL HI/LO switch to HI. Power meter should indicate -30(±2) dBm.
m. Set MODE switch to MKR XTL. Power meter should indicate -30(±2) dBm.
n. Set MODE switch to LOC XTL. Power meter should indicate -30(±2) dBm.
o. Set MODE switch to COMM XTL. Power meter should indicate -30(±2) dBm.

p. Set MODE swtich to COMM VAR.
q. Adjust VAR FREQ control to 144.0MHz. Power meter should indicate -30(±2) dBm.
r. Set MODE switch to G/S XTL. Power meter should indicate -30(±2) dBm.
r-1 Set CRYSTAL HI/LO to LO. Power meter should indicate -30(±2) dBm.
s. Adjust TUNE control until TUNE indicator comes on.
t. Set LOC-PEAK/AVG switch to LOC-PEAK. Power meter should indicate -15 to -20 dBm.
u. Set MONITOR switch to RF and tune transmitter output. Check that MONITOR meter needle is centered when transmitter is tuned.

7-12. RF FREQUENCIES.
a. Adjust VAR FREQ fine tune control full ccw into detent, phase lock, position.
b. Adjust MASTER MOD control full ccw but not into CAL (detent) position.
c. Connect external frequency counter to OUT connector.
d. Set MODE switch to VOR VAR.
e. Adjust VAR FREQ control to phase-lock output frequency at 110.000MHz. External frequency counter should indicate 110.000MHz, ±1kHz.
f. Disconnect external frequency counter.
g. Set Counter Mode switch to GEN.
h. Set MODE switch to MKR XTL. Counter should display marker crystal frequency, ±3kHz.
i. Set MODE switch to VOR XTL and CRYSTAL HI/LO switch to LO. Counter should display VOR LO crystal frequency, ±5kHz.
i-1 Set CRYSTAL HI/LO switch to HI. Counter should display VOR HI crystal frequency, ±5kHz.
j. Set MODE switch to LOC XTL. Counter should display localizer crystal frequency, ±5kHz.
k. Set MODE switch to G/S XTL. Counter should display glide slope HI crystal frequency, ±16 kHz.
k-1 Set CRYSTAL HI/LO switch to LO. Counter should display glide slope LO crystal frequency, ±16 kHz.
l. Set MODE switch to COMM XTL. Counter should display COMM crystal frequency, ±6 kHz.

7-18. LOC DDM SWEEP

a. Set MODE switch to LOC XTL.

b. Set Tone Select switch to MOD IN.

c. Set LOC DDM control to arrow position.

d. Adjust Localizer Variable DDM/DDM Sweep Amplitude control full cw to 30μA.

e. Set MASTER MOD to Cal and DDM Sweep control to AL.

f. Set G/S DDM to 150.

g. Connect oscilloscope to SIG GEN DEMOD connector and set vertical sensitivity to 0.1V/div.

h. Adjust oscilloscope controls to display a signal peak and set DDM Sweep control to S.

i. Check that the peak amplitude of the displayed signal sweeps approximately 0.15V.

j. Set G/S DDM to 90 and adjust display to observe a signal peak.

k. Check that the peak amplitude of the displayed signal sweeps approximately 0.15V.

8-8. GENERATOR OUTPUT FREQUENCIES.

a. Connect voltmeter to collector of Q703 or to FL711. See figure 12-12 for parts placement.
b. Adjust R746 (Volt Adj) for voltmeter indication of 10.5V, ±0.1V.

NOTE

Test Set frequency counter time base must be calibrated before proceeding. If paragraph 8-7 has not been performed prior to this procedure, it should be performed now or an external 400MHz frequency counter should be used at the OUT connector.

c. Set Counter Mode switch to GEN.
d. Set MODE switch to MKR XTL.
e. Adjust L710 for most stable oscillator operation. Counter should indicate 75.000MHz, ±3kHz.
f. If frequency is too high, up to 5pf may be added across crystal to lower frequency. If frequency is too low, crystal must be replaced.
g. Set MODE switch to VOR XTL.
h. Switch between HI and LO positions of the CRYSTAL HI/LO switch and adjust L711 for most stable oscillator operation. Counter should indicate 108.000MHz (LO) and 112.800MHz (HI), ±5kHz.
i. If frequency is too high, up to 5pf may be added across crystal to lower frequency. If frequency is too low, crystal must be replaced.
j. Set MODE switch to LOC XTL.
k. Adjust L714 for most stable oscillator operation. Counter should indicate 108.100MHz, ±5kHz.
l. If frequency is too high, up to 5pf may be added across crystal to lower frequency. If frequency is too low, crystal must be replaced.
m. Set MODE switch to G/S XTL.
n. Switch between HI and LO positions of the CRYSTAL HI/LO switch and adjust L712 for most stable oscillator operation. Counter should indicate 334.700MHz (HI) and 329.600 (LO), ±16kHz.

NOTE

Since the signal generator triples the oscillator frequency for glide slope operation, the crystals for G/S XTL are 111.566MHz (HI) and 109.866 (LO).

o. Set MODE switch to COMM XTL.
p. Adjust L713 for most stable oscillator operation. Counter should indicate 126.900MHz, ±6kHz.
q. If frequency is too high, up to 5pf may be added across crystal to lower frequency. If frequency is too low, crystal must be replaced.
r. Set MODE switch to MKR VAR.
s. Adjust VAR FREQ controls full cw.
t. Adjust L703 for minimum counter indication of 78MHz.

8-9. RF OUTPUT LEVEL.

a. Set MONITOR switch to RF.
b. Adjust TUNE control until TUNE indicator goes off.
c. Press Fine Tune switch and adjust TUNE control for minimum meter indication.
d. Adjust R386 (RF Level) to center meter needle in white band in center of scale.
e. Switch positions on MODE switch and tune transmitter to check that meter is centered on each band.
f. Set MODE switch to VOR VAR and adjust VAR FREQ for 114.000 MHz.
g. Adjust MASTER MOD control full ccw, out of detent position.
h. Connect power meter to OUT connector.
i. Adjust OUTPUT attenuator to -30dBm.
j. Loosen two set screws in attenuator knob closest to dial.
k. Hold dial at -30dBm setting and turn knob until power meter indicates -30dBm.
l. Tighten set screws. Dial and output RF level should agree from -30dBm to -120dBm. Refer to the Attenuator Correction Chart, Section II, for measured frequency response at time of manufacture.

8-16. LOC DDM SWEEP.

a. Connect an oscilloscope and a digital ac voltmeter (DVM) to the SIG GEN DEMOD connector on the back panel of the test set.
b. Set MODE switch to LOC XTL.
c. Adjust MASTER MOD to Cal and Tone Select to MOD IN.
d. Set LOC DDM control to arrow position and adjust LOC variable DDM/DDM Sweep Amplitude control full ccw.
e. Set DDM Sweep control to AL.
f. Set G/S DDM to 90 and note DVM indication.
g. Set G/S DDM to 150 and adjust R1426 (Centering) until DVM indication is the same as noted in step f, ±2mV.
h. On Auto Pilot Sweep Generator P.C. Board, set switch 3 of dip-switch S1401 to ON and switch 2 to OFF.
i. Connect Modulation Meter to RF OUT connector on test set front panel.
j. Set G/S DDM to 90 and record modulation meter indication.
k. Adjust DDM Sweep Amplitude full cw and adjust R1432 to obtain modulation meter indication that is 1.5% higher than the value recorded in step j.
l. Set switch 3 of S1401 to OFF and switch 2 to ON.
m. Connect frequency counter to pin 15 of X1405 (CD4029) and adjust R1404 (Sweep Rate Adj) to obtain counter indication of 3.2Hz.

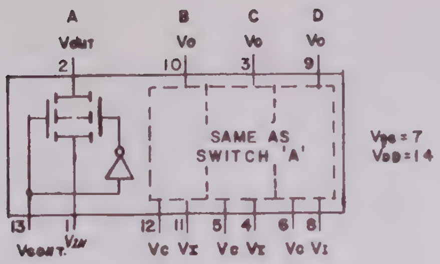
NOTE

With sweep rate adjusted to 3.2Hz, the LOC DDM will complete one sweep in 20 seconds. For different sweep times adjust clock frequency according to the following formula.

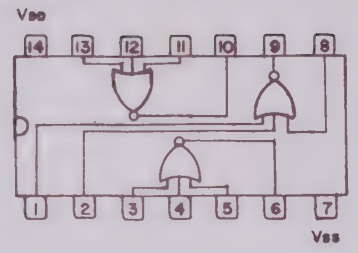
$$\text{CLOCK FREQUENCY} = \frac{64}{\text{SWEEP TIME}}\ \text{Hz}$$

Table 11-1/AP. IC Descriptions and Locations

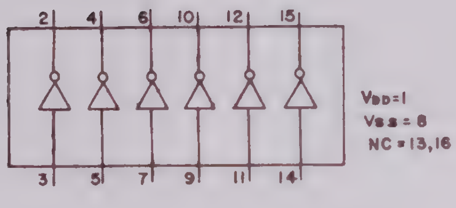
IC	Description	PC Board
CD4016/ CD4066	QUAD Bilaterial Switch (CMOS)	Auto Pilot Sweep Generator
CD4025	Triple 3-Input NOR Gate (CMOS)	Auto Pilot Sweep Generator
CD4027	Dual J-K Flip Flop (CMOS)	Auto Pilot Sweep Generator
CD4029	Presetable UP/Down Counter (CMOS)	Auto Pilot Sweep Generator
CD4049	Hex Buffer/Converter (CMOS)	Auto Pilot Sweep Generator



CD4016A*



CD4025A*



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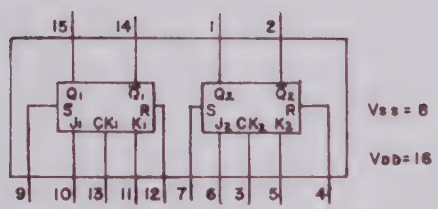

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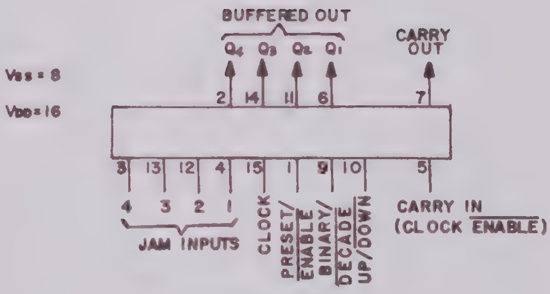


CD4029A*

*Used on NAV-402AP test sets only.

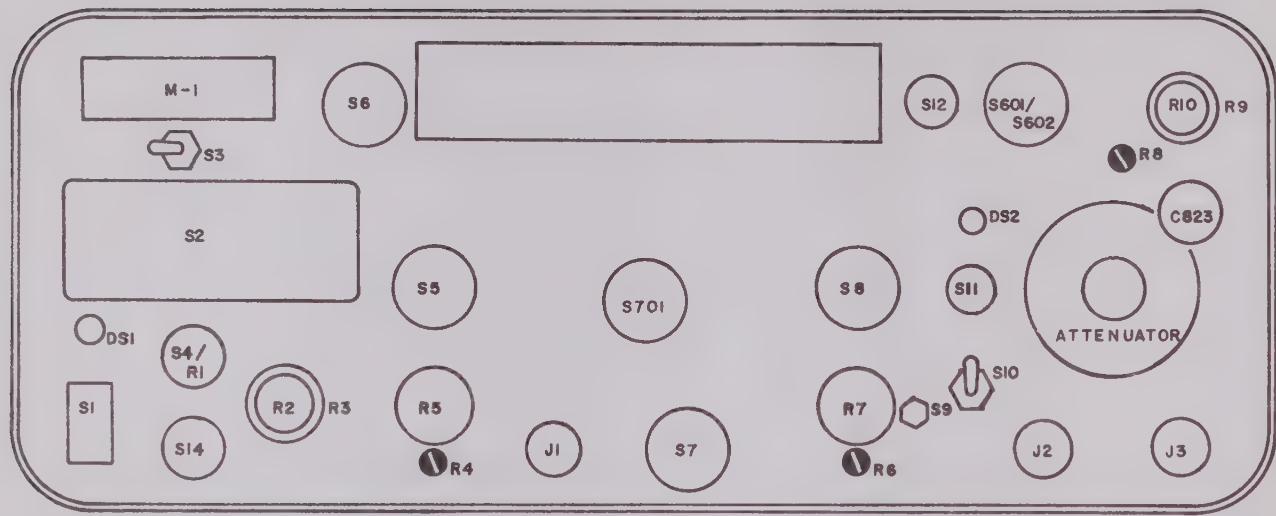
Figure 11-1. Integrated Circuit Guide (Sheet 3A of 3)

Table 12-1/AP. TROUBLESHOOTING CHART

Section	Symptom	Possible Cause
Power Supply	No +11V Output in AC Operation.	Fuse F1101 or F1102 open. CR1101 Bad. Short to ground on +11V supply line. Q224 open.
LOC DDM Sweep Generator	No LOC output with Sweep control in Off (0) position.	Q1401 bad. X1411 bad. Check input at pin 2 and pin 11 of X1411 for 90Hz and 150Hz, respectively.
	LOC receiver indicates needle is not centered in AL or AR operation.	SW1401-2 open or SW1401-3 closed. X1405 bad. X1407 bad. Check output of 1411B at pin 1.
	LOC output does not sweep.	Check CLOCK input at X1405 pin 15. X1401 bad. X1405 bad.
	LOC sweep output is incorrect.	X1405 bad. X1402 or X1403 bad. Check operation of each portion of X1406, X1407, X1408, X1409. X1410 bad.

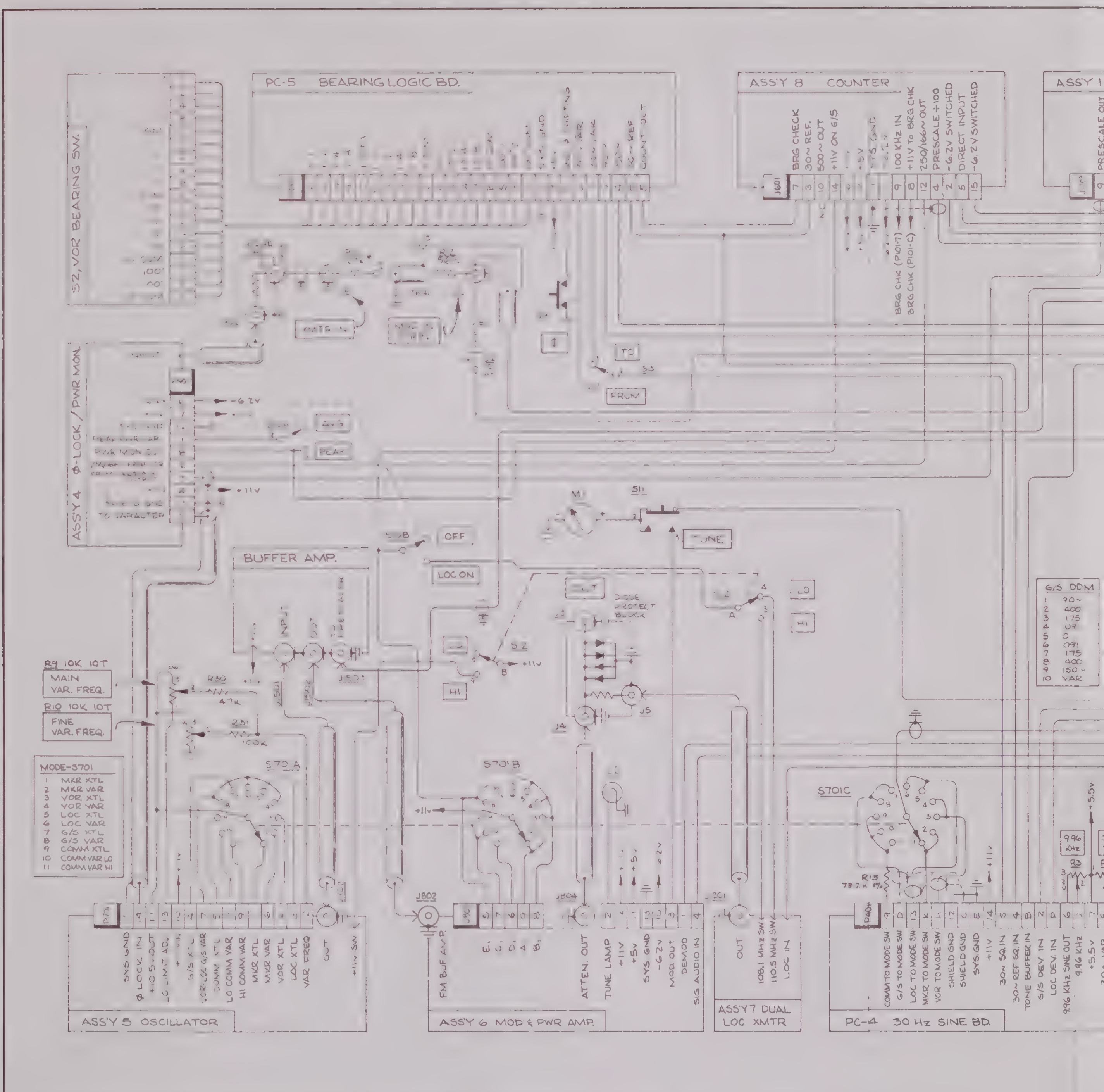
Table 12-2/AP. (cont'd)

Section	Symptom	Possible Cause
Generator Output Frequencies NOTE: Any adjustment in L711 and L712 requires check of both HI and LO crystal operation.	VOR XTL HI off frequency.	Y706 bad. L711 needs adjustment Q710 bad.
	No output on VOR XTL HI.	Y706 bad. Q710 bad. Q711 or Q715 bad.
	VOR XTL LO off frequency.	Y705 bad. L711 needs adjustment Q710 bad.
	No output on VOR XTL LO.	Y705 bad. Q710 bad. Q714 bad.
	G/S XTL HI off frequency.	Y701 bad. L712 needs adjustment Q706 bad.
	No output on G/S XTL HI.	Y701 bad. Q706 bad. Q713 bad. Q711 bad.
	G/S XTL LO off frequency.	Y707 bad. L712 needs adjustment Q706 bad.
	No output on G/S XTL.LO.	Y707 bad. Q706 bad. Q712 bad.
	HI/LO switch does not affect operation.	L711 bad. Check 11V switch at FL715.



FRONT PANEL

NAV-402AP CONTROL IDENTIFICATION



PC-5 BEARING LOGIC BD.
ASS'Y 8 COUNTER
BRG CHECK
30~ REF.
500~ OUT
+11V ON G/S
100 KHz IN
+11V To BRG CHK
250/166~OUT
PRESCALE ÷100
-6.2V SWITCHED
DIRECT INPUT
-6.2V SWITCHED
BRG CHK (P101-7)
BRG CHK (P101-C)
ASS'Y 1
PRESCALE OUT
S2, VOR BEARING SW.
ASSY 4 ϕ-LOCK / PWR MON.
TO VARACTOR
TO
FROM
S3
PEAK
OFF
TUNE
LOC ON
BUFFER AMP.
DIODE PROTECT BLOCK
LO
HI
R9 10K 10T
MAIN VAR. FREQ.
R10 10K 10T
FINE VAR. FREQ.
R30
47K
R31
100K
MODE-S701
1 MKR XTL
2 MKR VAR
3 VOR XTL
4 VOR VAR
5 LOC XTL
6 LOC VAR
7 G/S XTL
8 G/S VAR
9 COMM XTL
10 COMM VAR LO
11 COMM VAR HI
S701A
S701B
S701C
G/S DDM
1 70~
2 400
3 175
4 09
5 0
6 091
7 175
8 400
9 150~
10 VAR
J802
J804
J4
J5
R13
73.2K 1%
R3
9.96 KHz
SYS GND
ϕ LOCK IN
+10.5V OUT
LO LIMIT ADJ.
VOR LOC G/S VAR
COMM XTL
LO COMM VAR
HI COMM VAR
MKR XTL
MKR VAR
VOR XTL
LOC XTL
VAR FREQ
OUT
+11V SW
FM BUF AMP.
ATTEN. OUT
TUNE LAMP
+11V
+5V
SYS GND
-6.2V
MOD OUT
DEMOD
SIG AUDIO IN
OUT
108.1 MHz SW
110.5 MHz SW
LOC IN
COMM TO MODE SW
G/S TO MODE SW
LOC TO MODE SW
MKR TO MODE SW
VOR TO MODE SW
SHIELD GND
SHIELD GND
SYS GND
+11V
30~ SQ. IN
30~ REF SQ. IN
TONE BUFFER IN
G/S DEV. IN
LOC DEV. IN
9.96 KHz SINE OUT
9.96 KHz
+5.5V
ASS'Y 5 OSCILLATOR
ASS'Y 6 MOD & PWR AMP.
ASS'Y 7 DUAL LOC XMTR
PC-4 30 Hz SINE BD.

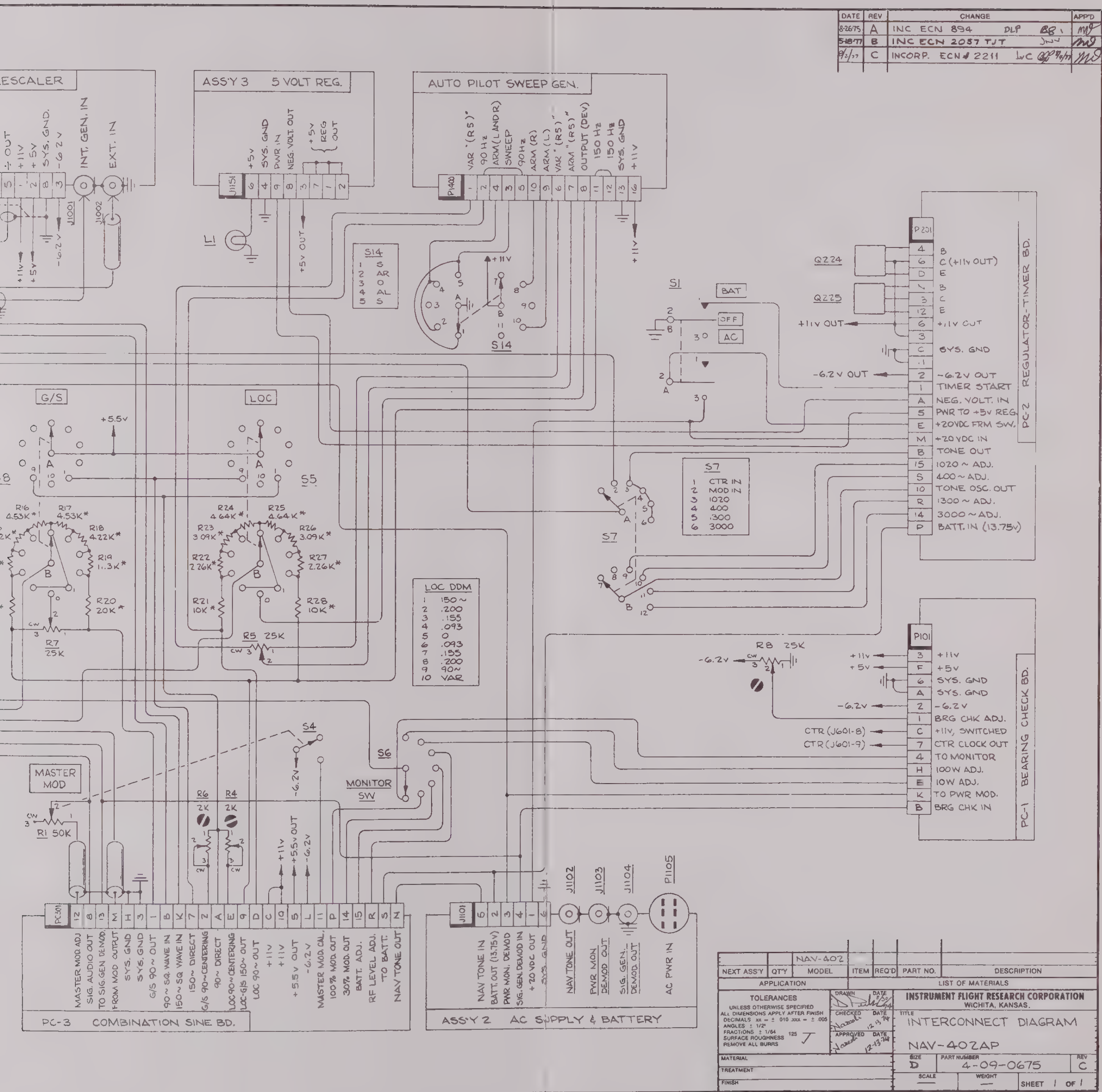

DATE | REV | CHANGE | APP'D
A INC ECN 894 DLP
B INC ECN 2057 TJT
C INCORP. ECN # 2211
ESCALER
ASS'Y 3 5 VOLT REG.
AUTO PILOT SWEEP GEN.
S14
S1
BAT
OFF
AC
G/S
LOC
S5
S7
1 CTR IN
2 MOD IN
3 1020
4 400
5 1300
6 3000
LOC DDM
1 150~
2 .200
3 .155
4 .093
5 0
6 .093
7 .155
8 .200
9 90~
10 VAR
R5 25K
R7 25K
R8 25K
R1 50K
MASTER MOD
S4
S6
MONITOR SW
R6 2K
R4 2K
Q224
Q225
P201
4 B
6 C (+11v OUT)
D E
B
3 C
12 E
6 +11v OUT
3
C SYS. GND
2 -6.2v OUT
1 TIMER START
A NEG. VOLT. IN
5 PWR TO +5v REG.
E +20VDC FRM SW.
M +20 VDC IN
B TONE OUT
15 1020 ~ ADJ.
S 400 ~ ADJ.
10 TONE OSC. OUT
R 1300 ~ ADJ.
14 3000 ~ ADJ.
P BATT. IN (13.75v)
PC-2 REGULATOR-TIMER BD.
P101
3 +11v
F +5v
6 SYS. GND
A SYS. GND
2 -6.2v
1 BRG CHK ADJ.
C +11v, SWITCHED
7 CTR CLOCK OUT
4 TO MONITOR
H 100W ADJ.
E 10W ADJ.
K TO PWR MOD.
B BRG CHK IN
PC-1 BEARING CHECK BD.
CTR (J601-8)
CTR (J601-9)
PC-3 COMBINATION SINE BD.
MASTER MOD ADJ
SIG. AUDIO OUT
TO SIG.GEN DEMOD
FROM MOD OUTPUT
SYS. GND
SYS. GND
G/S 90~ OUT
90~ SQ. WAVE IN
150~ SQ WAVE IN
150~ DIRECT
G/S 90~ CENTERING
90~ DIRECT
LOC 90~ CENTERING
LOC-G/S 150~ OUT
LOC 90~ OUT
+11v
+11v
+5.5v OUT
-6.2v
MASTER MOD. CAL.
100% MOD OUT
30% MOD OUT
BATT. ADJ.
RF LEVEL ADJ.
TO BATT.
NAV TONE OUT
ASS'Y 2 AC SUPPLY & BATTERY
NAV TONE IN
BATT. OUT (13.75v)
PWR MON. DEMOD
SIG. GEN. DEMOD IN
+20 VDC OUT
SYS. GND
J1102
J1103
J1104
P1105
NAV TONE OUT
PWR MON. DEMOD OUT
SIG. GEN. DEMOD OUT
AC PWR IN
NAV-402
NEXT ASS'Y | QTY | MODEL | ITEM | REQ'D | PART NO. | DESCRIPTION
APPLICATION
LIST OF MATERIALS
TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.
INTERCONNECT DIAGRAM
NAV-402AP
D 4-09-0675 C
SHEET 1 OF 1

FIGURE 12-1

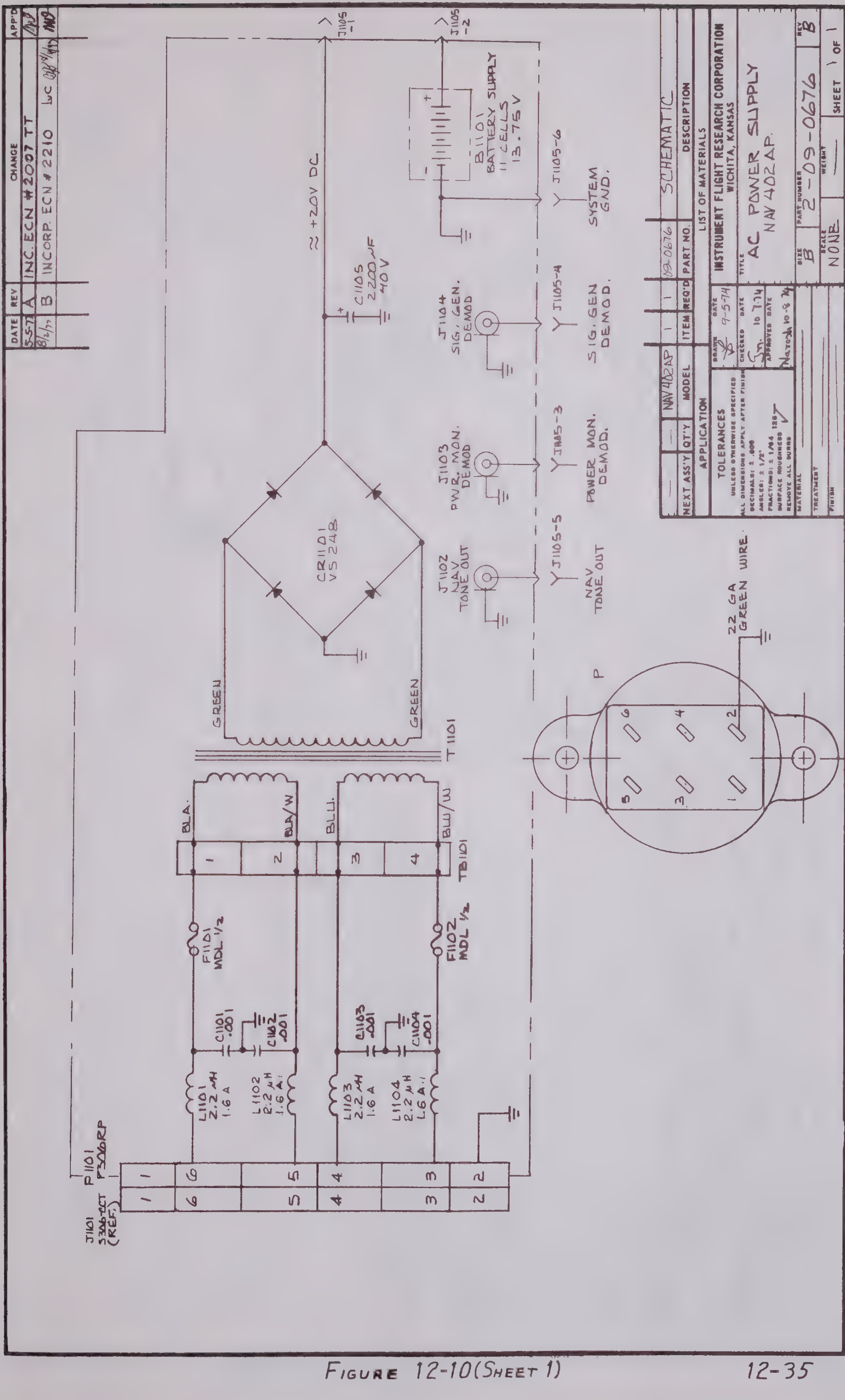
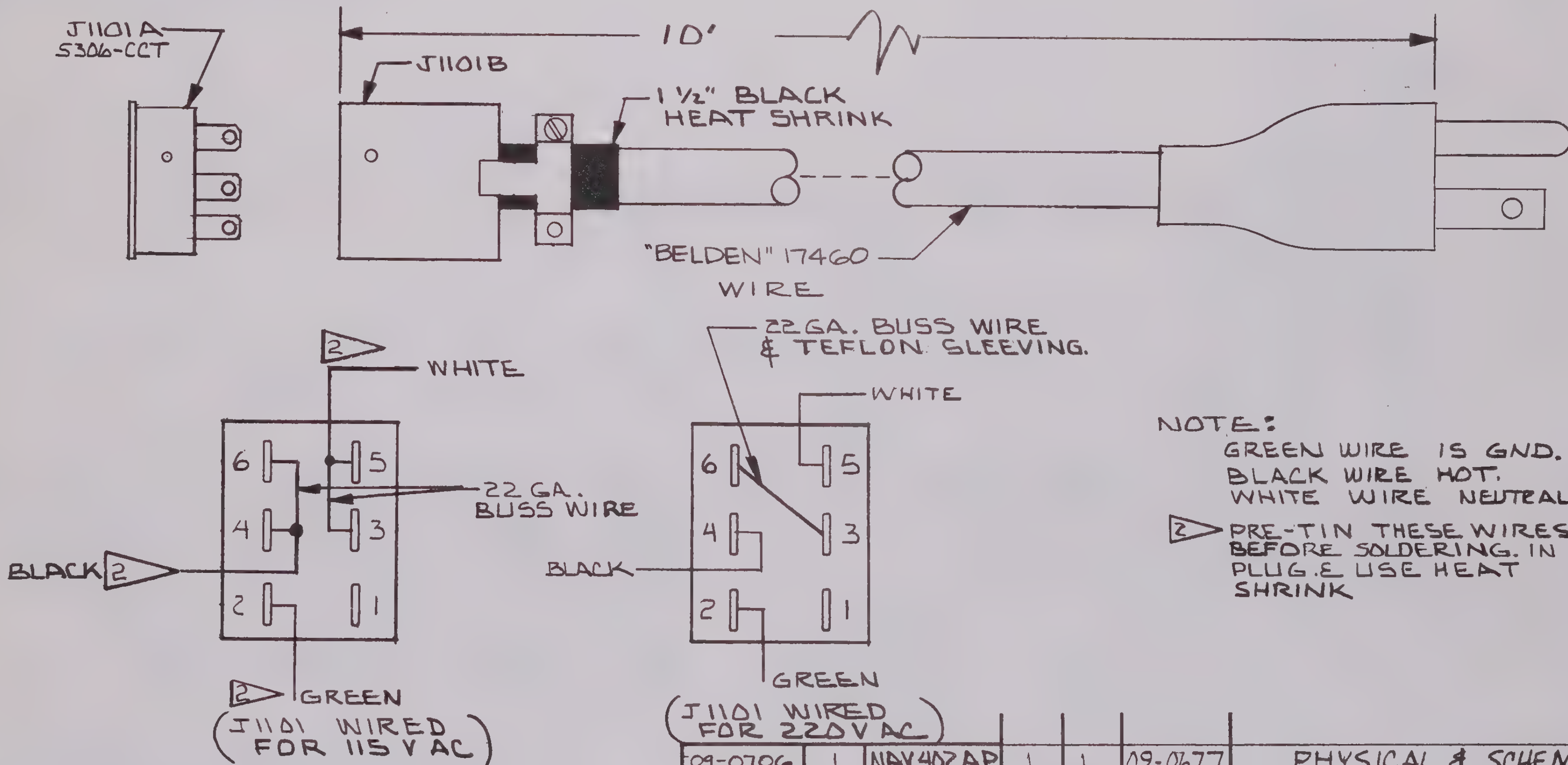


Figure 12-10 (Sheet 1)

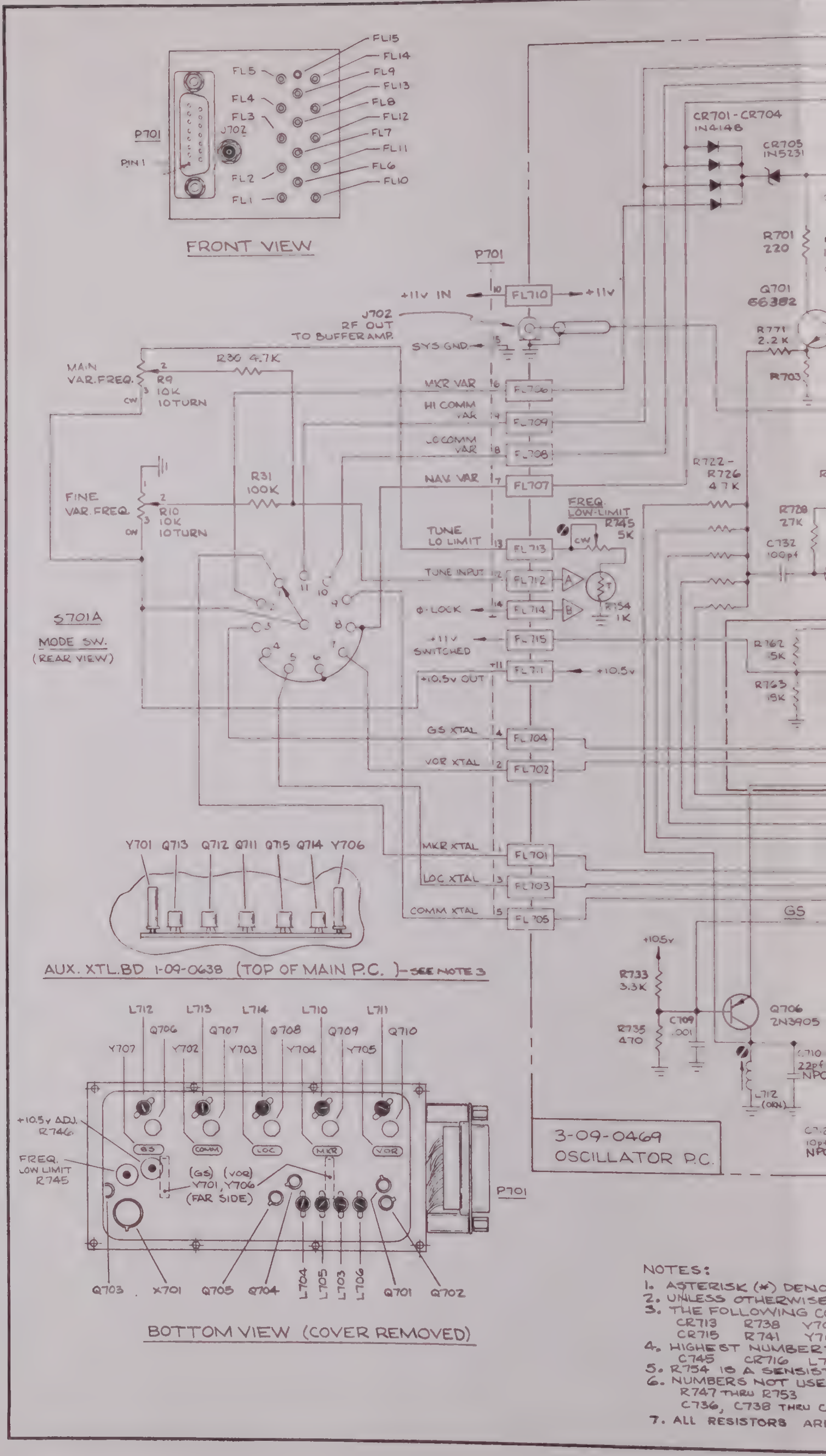
DATE	REV	CHANGE	APP'D
10-31-75	A	INCORP ECN #1077 SSD	



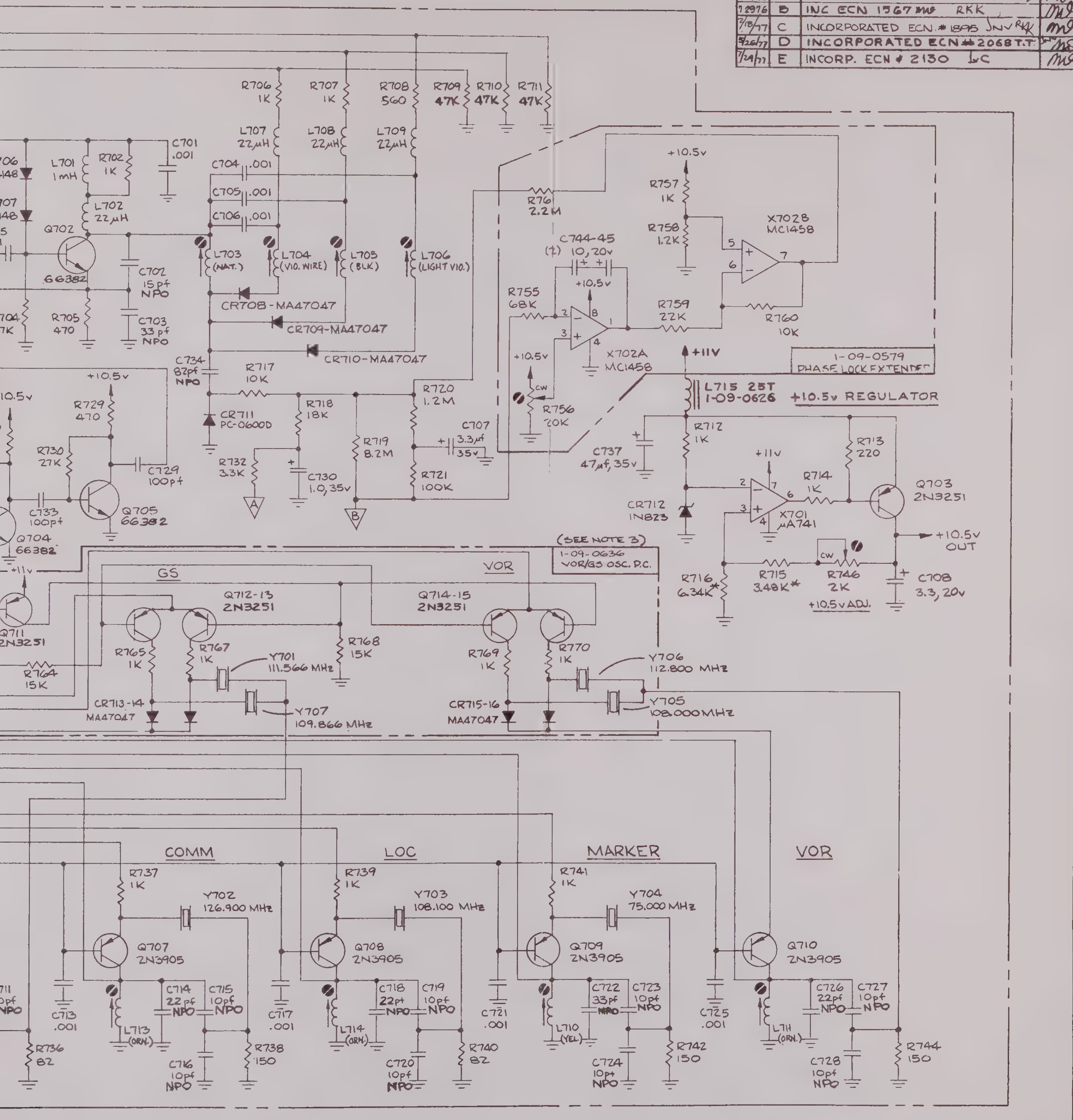
NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
09-0706	1	NAV402AP	1	1	09-0677	PHYSICAL & SCHEM.
APPLICATION			LIST OF MATERIALS			

TOLERANCES UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS APPLY AFTER FINISH DECIMALS: .xx = ± .010 .xxx = ± .005 ANGLES: ± 1/2° FRACTIONS: ± 1/64 SURFACE ROUGHNESS 125 REMOVE ALL BURRS	DRAWN [illegible] DATE 9-5-74 CHECKED [illegible] DATE 9-5-74 APPROVED [illegible] DATE [illegible]	INSTRUMENT FLIGHT RESEARCH CORPORATION WICHITA, KANSAS. TITLE AC POWER CORD NAV 402 AP.
MATERIAL — TREATMENT — FINISH —		SIZE A · PART NUMBER 1-09-0677 · REV A SCALE NONE · WEIGHT — · SHEET 1 OF 1

FIGURE 12-10 (SHEET 2)


FRONT VIEW
P701
PIN 1
J702
FL1
FL2
FL3
FL4
FL5
FL6
FL7
FL8
FL9
FL10
FL11
FL12
FL13
FL14
FL15
+11V IN
FL710
+11V
J702 RF OUT TO BUFFER AMP.
SYS GND.
MAIN VAR. FREQ.
R9 10K 10TURN
R30 4.7K
MKR VAR
FL706
HI COMM VAR
FL709
LO COMM VAR
FL708
NAV. VAR
FL707
FINE VAR. FREQ.
R10 10K 10TURN
R31 100K
TUNE LO LIMIT
FL713
FREQ. LOW-LIMIT R745 5K
TUNE INPUT
FL712
Φ-LOCK
FL714
R754 1K
+11V SWITCHED
FL715
+10.5V OUT
FL711
+10.5V
S701A
MODE SW.
(REAR VIEW)
GS XTAL
FL704
VOR XTAL
FL702
MKR XTAL
FL701
LOC XTAL
FL703
COMM XTAL
FL705
Y701 Q713 Q712 Q711 Q715 Q714 Y706
AUX. XTL.BD 1-09-0638 (TOP OF MAIN P.C.) - SEE NOTE 3
L712 L713 L714 L710 L711
Q706 Q707 Q708 Q709 Q710
Y707 Y702 Y703 Y704 Y705
GS COMM LOC MKR VOR
+10.5V ADJ. R746
FREQ. LOW LIMIT R745
(GS) (VOR) Y701, Y706 (FAR SIDE)
P701
Q703 X701 Q705 Q704 L704 L705 L703 L706 Q701 Q702
BOTTOM VIEW (COVER REMOVED)
CR701 - CR704 IN4148
CR705 IN5231
R701 220
Q701 66382
R771 2.2K
R703
R722 - R726 47K
R728 27K
C732 100pf
R762 15K
R763 15K
GS
+10.5V
R733 3.3K
R735 470
C709 .001
Q706 2N3905
C710 22pf NPO
L712 (ORN)
3-09-0469
OSCILLATOR P.C.
NOTES:
1. ASTERISK (*) DENO
2. UNLESS OTHERWISE
3. THE FOLLOWING C
CR713 R738 Y70
CR715 R741 Y7
4. HIGHEST NUMBER
C745 CR716 L7
5. R754 IS A SENSIST
6. NUMBERS NOT USE
R747 THRU R753
C736, C738 THRU C
7. ALL RESISTORS AR

DATE	REV	CHANGE	APP'D
3/16/76	A	INCORP. ECN #1368 WU SD	
7/29/76	B	INC ECN 1567 RKK	
7/18/77	C	INCORPORATED ECN. # 1895 JNV RKK	
9/26/77	D	INCORPORATED ECN # 2068 T.T.	
7/29/77	E	INCORP. ECN # 2130 LC	



S PRECISION RESISTOR, 1%, 1/4 W.
PECIFIED, CAPACITANCES ARE IN MFD (μf).
PONENTS ARE LOCATED ON THE MAIN OSC. P.C. (09-0469):

SED:
Q715 R771 X702
: 1K Ω, "TI" TM-7406.

, C731
4 W ± 10% UNLESS OTHERWISE SPECIFIED.

1-09-0699 1-09-0638		NAV-402AP				OSC. SCHEMATIC
NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
APPLICATION			LIST OF MATERIALS			

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .xx = ± .010 .xxx = ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

DRAWN D. Dahl DATE 7/3/74
CHECKED DATE 7/3/77
APPROVED DATE 12/19/74

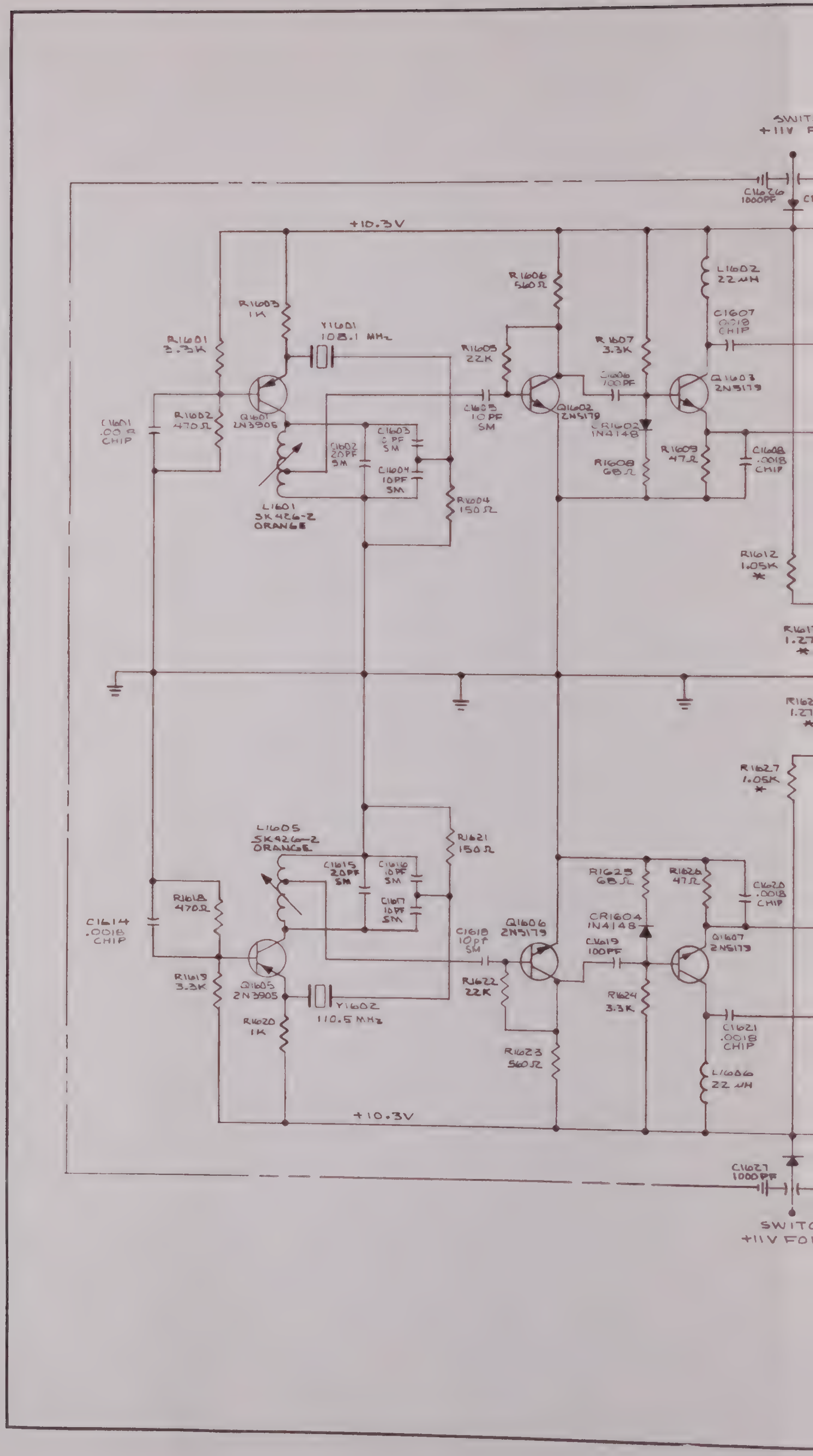
MATERIAL
TREATMENT
FINISH

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

TITLE OSCILLATOR SCHEMATIC
NAV-402AP

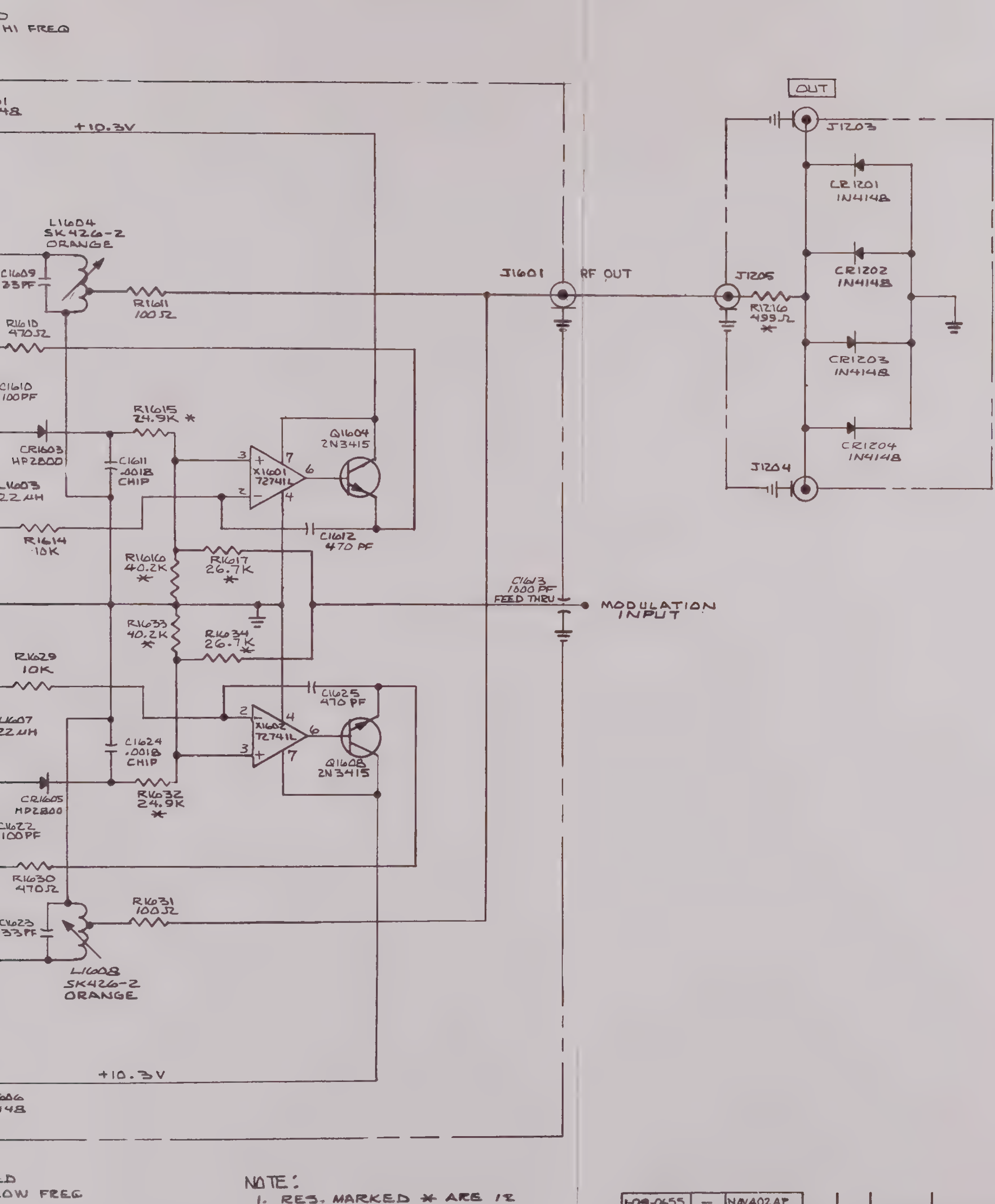
SIZE C | PART NUMBER 3-09-0666 | REV E
SCALE | WEIGHT | SHEET 1 OF 1

FIGURE 12-12



SWITCHED +11V
+10.3V
R1601 3.3K
R1602 470Ω
R1603 1K
Y1601 108.1 MHz
Q1601 2N3906
C1601 .0018 CHIP
C1602 20PF SM
C1603 6PF SM
C1604 10PF SM
R1604 150Ω
L1601 SK426-2 ORANGE
R1605 22K
R1606 560Ω
C1605 10PF SM
Q1602 2N5179
C1606 100PF
R1607 3.3K
CR1602 1N4148
R1608 68Ω
Q1603 2N5179
R1609 47Ω
L1602 22μH
C1607 .0018 CHIP
C1608 .0018 CHIP
C1626 1000PF
R1612 1.05K
R1627 1.05K
L1605 SK426-2 ORANGE
C1615 20PF SM
C1616 10PF SM
C1617 10PF SM
R1621 150Ω
R1618 470Ω
C1614 .0018 CHIP
R1619 3.3K
Q1605 2N3905
R1620 1K
Y1602 110.5 MHz
C1618 10pf SM
Q1606 2N5179
R1622 22K
R1623 560Ω
R1625 68Ω
CR1604 1N4148
C1619 100PF
R1624 3.3K
R1626 47Ω
C1620 .0018 CHIP
Q1607 2N5179
C1621 .0018 CHIP
L1606 22μH
C1627 1000PF
+10.3V
SWITCHED +11V

DATE	REV	CHANGE	APP'D
12-?-76	A	INCORP. ECN# 1854 WW	[illegible]



NOTE:

1. RES. MARKED * ARE 1%
2. LIST OF LAST USED P/N
   - Q1608
   - L1608
   - R1634
   - C1627
   - CR1606
   - Y1602
   - J1601
   - X1602
3. "SM" CAPS ARE "NPO" CAPS ON SOME UNITS

NEXT ASS'Y	QTY	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
1-09-0655	—	NAV402AP				
1-09-0654	—	NAV402AP	—	—	09-0658	SCHEMATIC
APPLICATION					LIST OF MATERIALS	

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .xx = ± .010 .xxx = ± .005
ANGLES: ± 1/2°.
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

DRAWN [signature] DATE 7-19-74
CHECKED [signature] DATE 12-13-4
APPROVED [signature] DATE 12-13-4

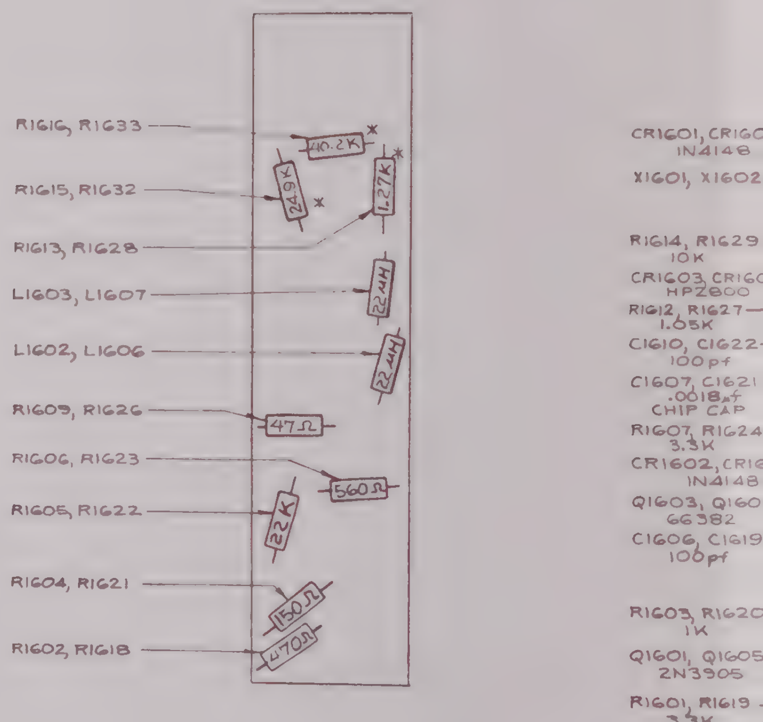
MATERIAL
TREATMENT
FINISH

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

TITLE DUAL LOC. XMTR SCHEMATIC

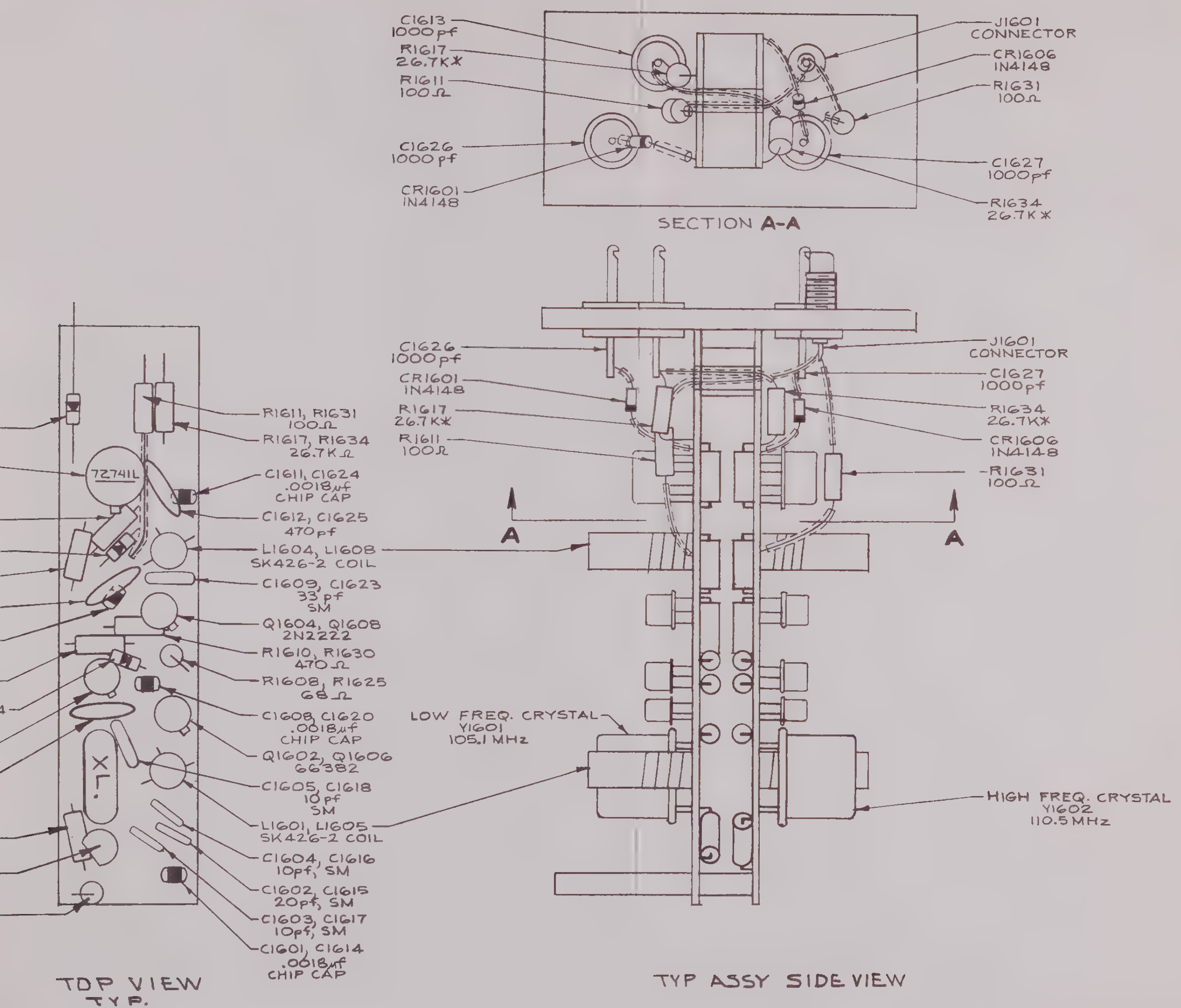
SIZE C | PART NUMBER 3-09-0658 | REV A
SCALE — | WEIGHT — | SHEET 1 OF 2

FIGURE 12-15 (SHEET 1)



BOTTOM VIEW
TYP

DATE	REV	CHANGE	APP'D
12-28-76	A	INCORP. ECN# 1854 UW	ML



1-09-0655	1	NAV402AP				
1-09-0654	1	NAV402AP	—	—	09-0658	ASSY VIEW OF SCHEM.
NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
APPLICATION			LIST OF MATERIALS			

TOLERANCES UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS APPLY AFTER FINISH DECIMALS: .xx = ± .010 .xxx = ± .005 ANGLES: ± 1/2° FRACTIONS: ± 1/64 SURFACE ROUGHNESS 125 REMOVE ALL BURRS	DRAWN DATE 7-22-74 CHECKED DATE 12-26-74 APPROVED DATE 12-16-74	INSTRUMENT FLIGHT RESEARCH CORPORATION WICHITA, KANSAS. TITLE DUAL LOC XMTR. SCHEMATIC ASSY VIEW
MATERIAL ——		SIZE C · PART NUMBER 3-09-0658 · REV A
TREATMENT ——		SCALE —— · WEIGHT —— · SHEET 2 OF 2
FINISH ——		

FIGURE 12-15 (SHEET 2)

DATE	REV	CHANGE	APP'D
10-29-75	C	INCORP ECN # 1069 BB	
2-12-76	D	INCORP ECN # 1316 SSD	

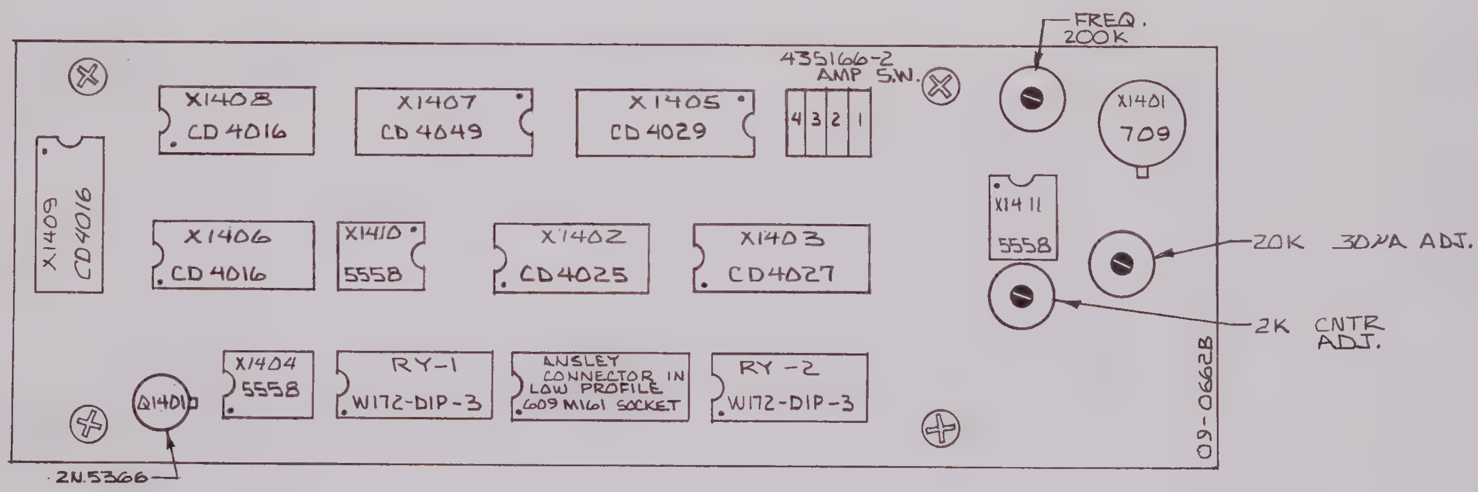


FIGURE 12-17 (SHEET 2)

(SHEET 1 IS SIZE 3)

NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
1-09-0661	1	NAV 402	1	1	209-0684	PHYSICAL

APPLICATION — LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

MATERIAL
TREATMENT
FINISH

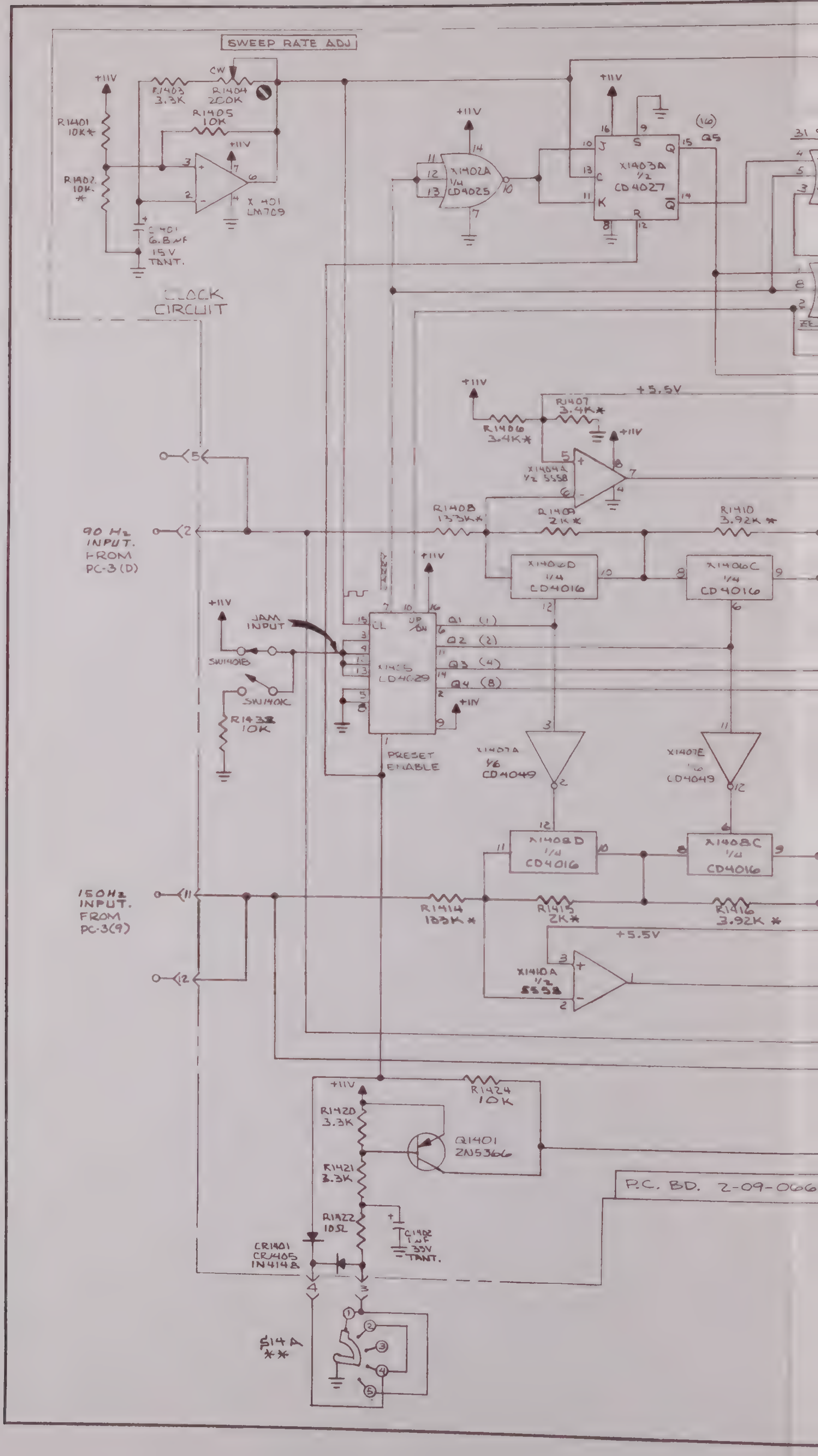
	DATE
DRAWN	10-11-74
CHECKED	12/10
APPROVED	12/11

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE: PHYSICAL DWG — AUTO PILOT SWEEP GEN.

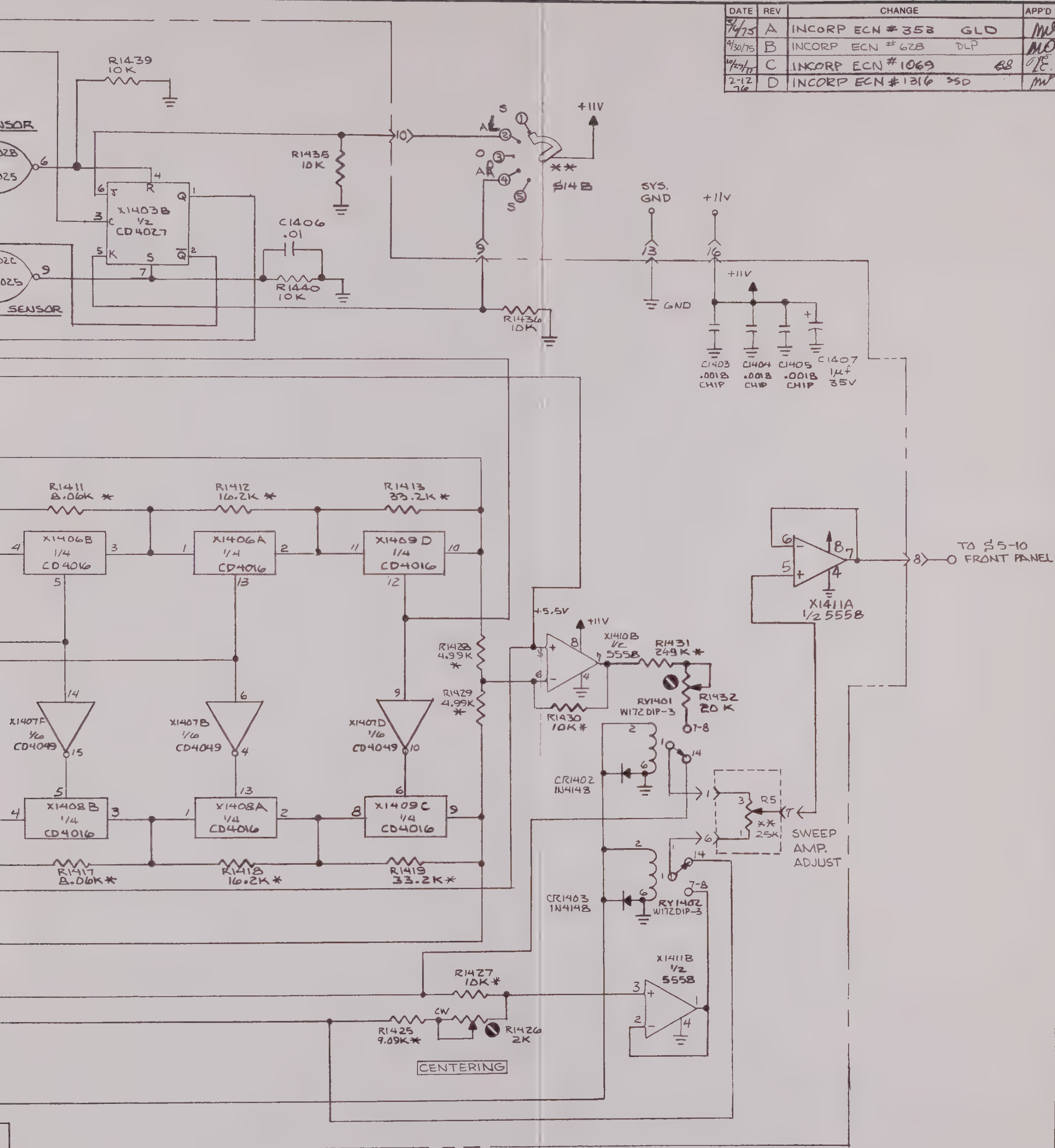
SIZE	PART NUMBER	REV
B	Z-09-0660	D

SCALE: NONE | WEIGHT: — | SHEET 2 OF 2



SWEEP RATE ADJ
CLOCK CIRCUIT
R1401 10K*
R1402 10K *
R1403 3.3K
R1404 200K
R1405 10K
C1401 6.8NF 15V TANT.
X1401 LM709
X1402A 1/4 CD4025
X1403A 1/2 CD4027
R1406 3.4K*
R1407 3.4K*
+5.5V
X1404A 1/2 5558
R1408 133K*
R1409 2K*
R1410 3.92K*
90 Hz INPUT. FROM PC-3(D)
X1406D 1/4 CD4016
X1406C 1/4 CD4016
JAM INPUT
SW1401B
SW1401C
R1433 10K
X1405 CD4029
PRESET ENABLE
X1407A 1/6 CD4049
X1407E 1/6 CD4049
X1408D 1/4 CD4016
X1408C 1/4 CD4016
150Hz INPUT. FROM PC-3(9)
R1414 133K*
R1415 2K*
R1416 3.92K*
X1410A 1/2 5558
R1424 10K
R1420 3.3K
R1421 3.3K
R1422 10Ω
Q1401 2N5366
C1402 1NF 35V TANT.
CR1401 CR1405 1N4148
P.C. BD. 2-09-066
S14A **

DATE	REV	CHANGE	APP'D
3/6/75	A	INCORP ECN # 358 GLD	MW
4/30/75	B	INCORP ECN # 628 DLP	MO
10/29/75	C	INCORP ECN # 1069	
2-12-76	D	INCORP ECN # 1316 SSD	MW



NOTE:
1. * INDICATES 1% RES.
2. ** MTD ON FRONT PANEL.
3. LAST RESISTOR - R1439,
   LAST CAPACITOR - C1407,
   LAST CHOKE - CR1404.

PARTS LIST 1-09-0661
ARTWORK 2-09-0662

(SHEET 2 IS SIZE 2)

1-09-0661	1	402	1	1	09-0660	SCHEMATIC
NEXT ASS'Y	QTY	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION

APPLICATION — LIST OF MATERIALS

TOLERANCES: UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS APPLY AFTER FINISH. DECIMALS: .xx = ± .010 .xxx = ± .005. ANGLES: ± 1/2°. FRACTIONS: ± 1/64. SURFACE ROUGHNESS 125. REMOVE ALL BURRS.

DRAWN: 7-1-74 — CHECKED: 12/11/74 — APPROVED: Nozedi 12/12/74

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

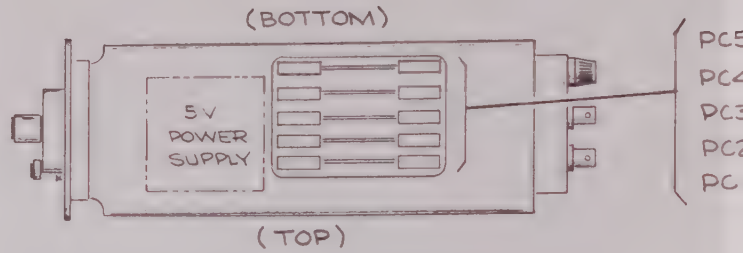
TITLE: AUTO PILOT SWEEP GEN (NAV-402)

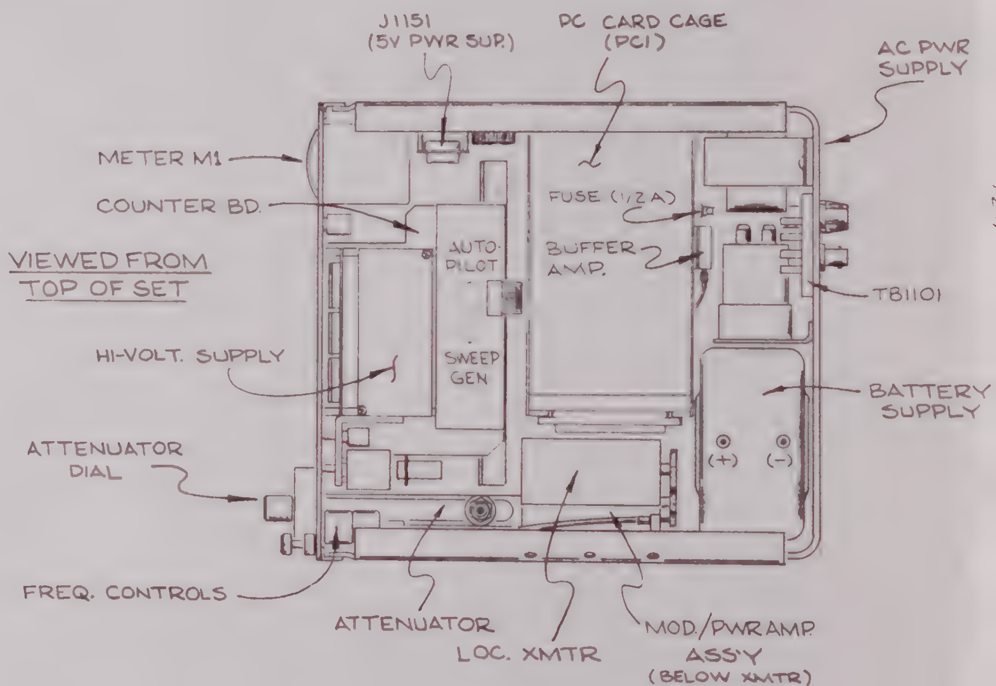
MATERIAL — TREATMENT — FINISH —

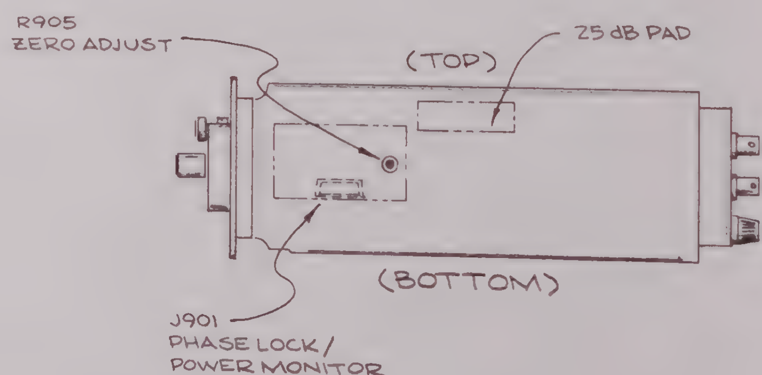
SIZE: C — PART NUMBER: 3-09-0660 — REV: D

SCALE: — WEIGHT: — SHEET 1 OF 2

Figure 12-17 (Sheet 1)

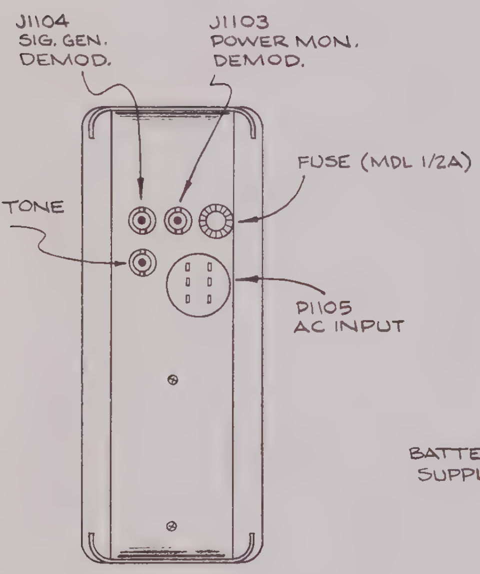

(BOTTOM)
5 V
POWER
SUPPLY
(TOP)
PC5
PC4
PC3
PC2
PC


J1151
(5V PWR SUP.)
PC CARD CAGE
(PC1)
AC PWR
SUPPLY
METER M1
COUNTER BD.
FUSE (1/2 A)
BUFFER
AMP.
AUTO-
PILOT
VIEWED FROM
TOP OF SET
TB1101
HI-VOLT. SUPPLY
SWEEP
GEN
BATTERY
SUPPLY
(+)
(-)
ATTENUATOR
DIAL
FREQ. CONTROLS
ATTENUATOR
LOC. XMTR
MOD./PWR AMP.
ASS'Y
(BELOW XMTR)

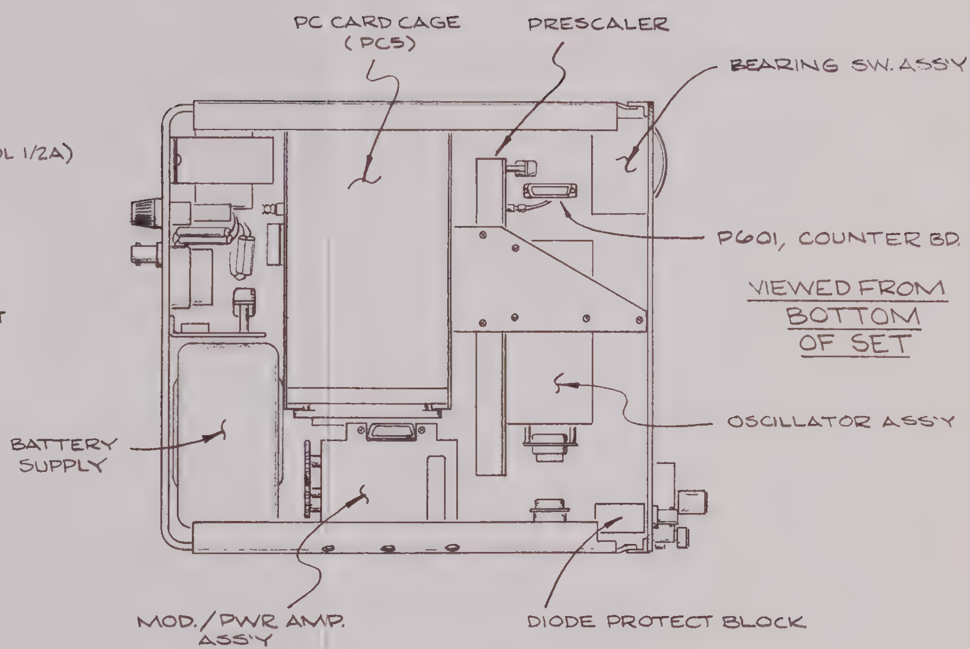

R905
ZERO ADJUST
25 dB PAD
(TOP)
(BOTTOM)
J901
PHASE LOCK /
POWER MONITOR

DATE	REV	CHANGE	APP'D

(BLK)
(BLU)
(GRN)
(RED)
(WHT)



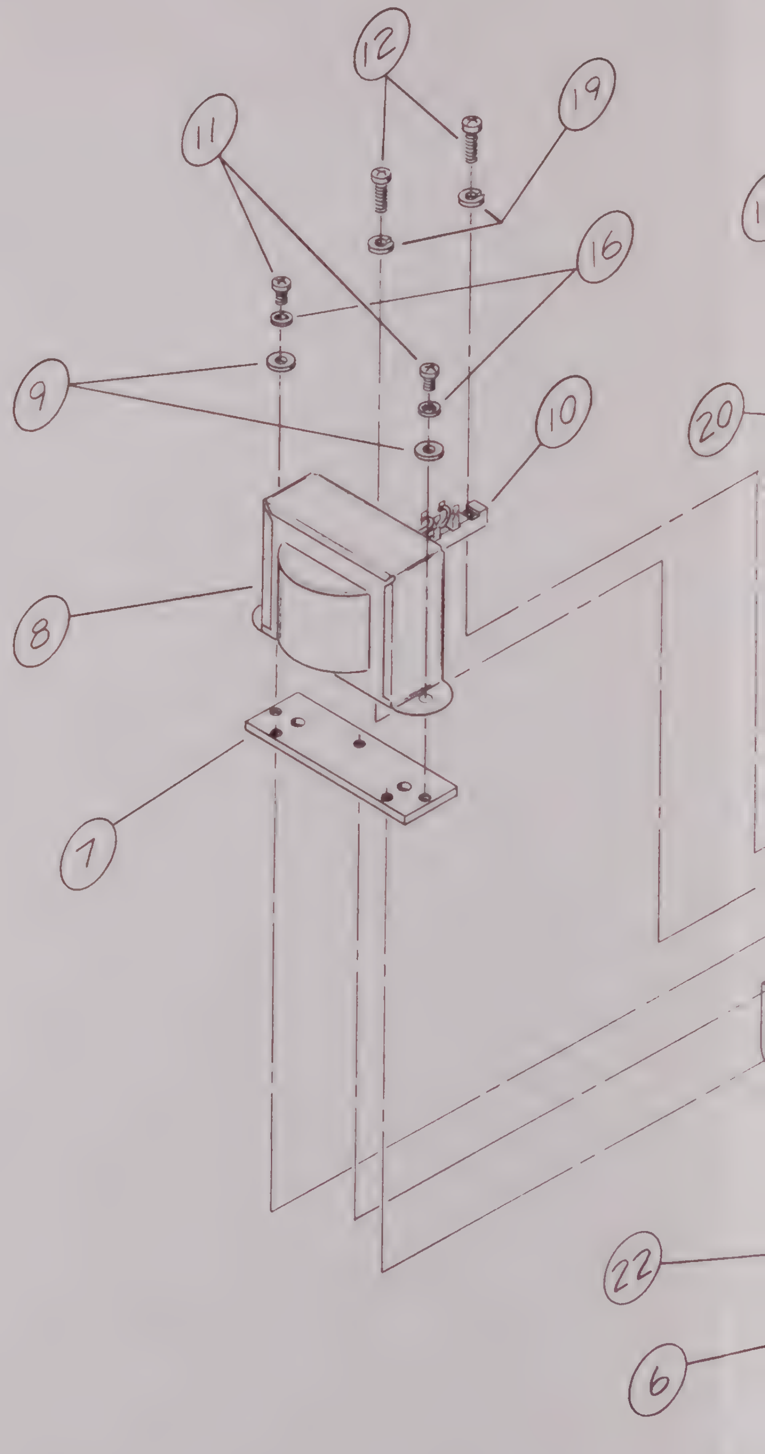
REAR PANEL



		NAV-402				
NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
APPLICATION			LIST OF MATERIALS			

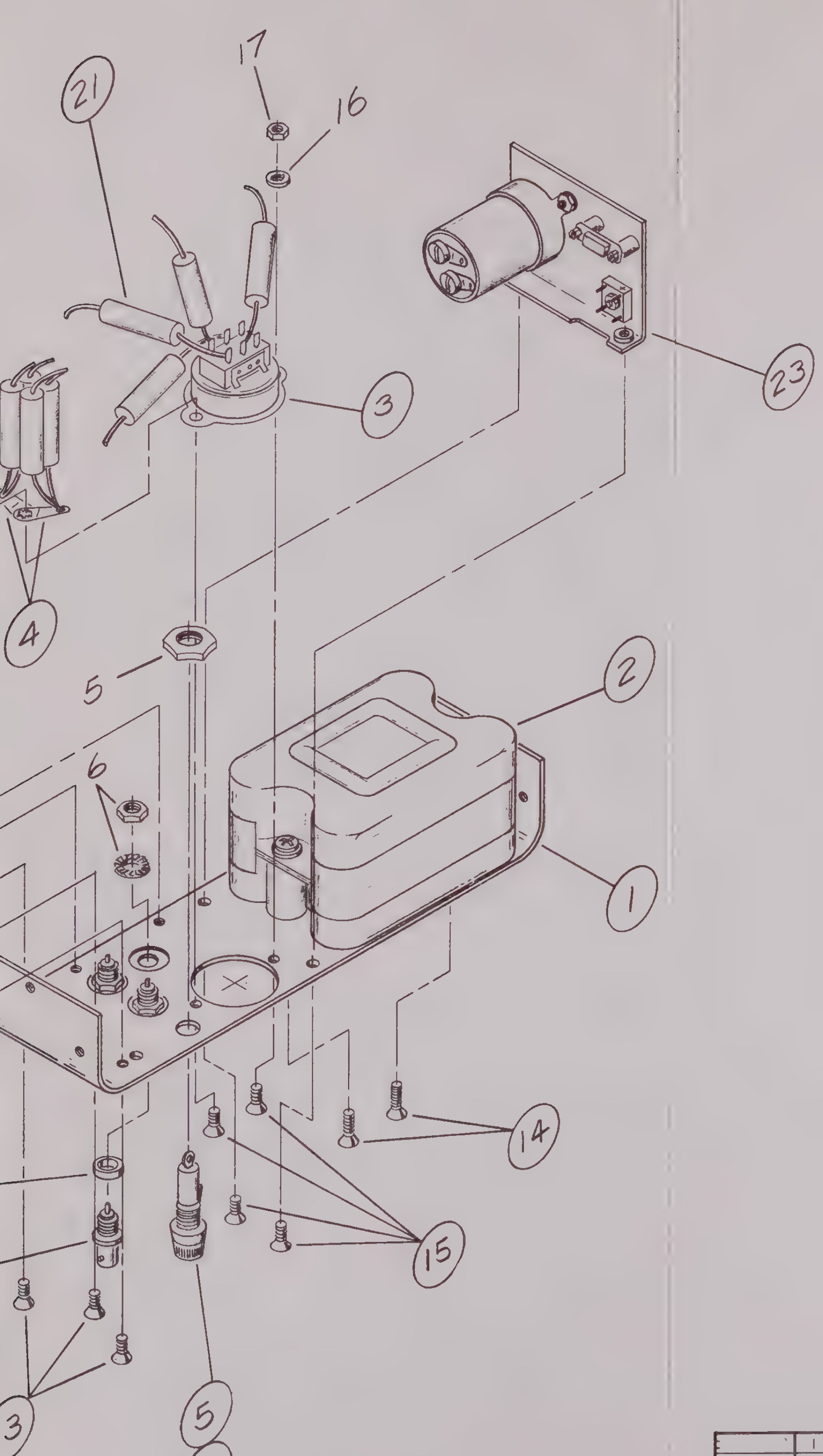
TOLERANCES UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS APPLY AFTER FINISH DECIMALS: .xx = ± .010 .xxx = ± .005 ANGLES: ± 1/2° FRACTIONS. ± 1/64 SURFACE ROUGHNESS 125 REMOVE ALL BURRS	DRAWN d.parks DATE 10/25/74 CHECKED MAH DATE 1/20/74 APPROVED Nerad DATE 12-15-74	INSTRUMENT FLIGHT RESEARCH CORPORATION WICHITA, KANSAS. TITLE SUB-ASSEMBLY IDENTIFICATION NAV-402
MATERIAL		SIZE PART NUMBER 3-09-0686 REV
TREATMENT		SCALE — WEIGHT —
FINISH		SHEET 1 OF 1

FIGURE 13-1



12
19
11
16
9
10
20
8
7
22
6

DATE	REV	CHANGE	APP'D



ITEM	REQ'D	PART NO.	DESCRIPTION
23	1	309-0408-101	RECTIFIER PANEL ASS'Y
22	3	2-76-0001-14	SPACER
21	4	2890-04	CHOKE 2.2 mH
20	4	.001uf 1KV	CAPACITOR
19	2	#4	SPLIT LKWASHER
18	1	AGC 2½	FUSE, 2½ AMP
17	2	#6-32	HEX NUT
16	3	#4	LKWASHER, INT. TOOTH
15	4	#6-32	SCREW, FT. HD. 82° x 3/8 L
14	2	#6-32	SCREW, FT. HD. 82° x 1/2 L
13	3	#6-32	SCREW, FT. HD. 82° x 3/16 L
12	2	#4-40	SCREW, BD. HD. 3/8 LONG
11	2	#6-32	SCREW, BD. HD. 3/16 LONG
10	1	4-170	TERMINAL STRIP
9	2		FLAT WASHER, 3/8 OD x 5/32 ID x .04 T
8	1	NT-859	TRANSFORMER
7	1	1-09-0267	TRANSFORMER MTG. BKT.
6	3	UG1094/U	BNC RF CONN. W/HDWARE
5	1	HKP	FUSEHOLDER W/NUT
4	2	#6	SOLDER LUG
3	1	P-306-RP	AC CONNECTOR, 6-PIN
2	1	1-00-0122	BATTERY PACK ASS'Y
1	1	3-09-0338	POWER SUPPLY CHASSIS

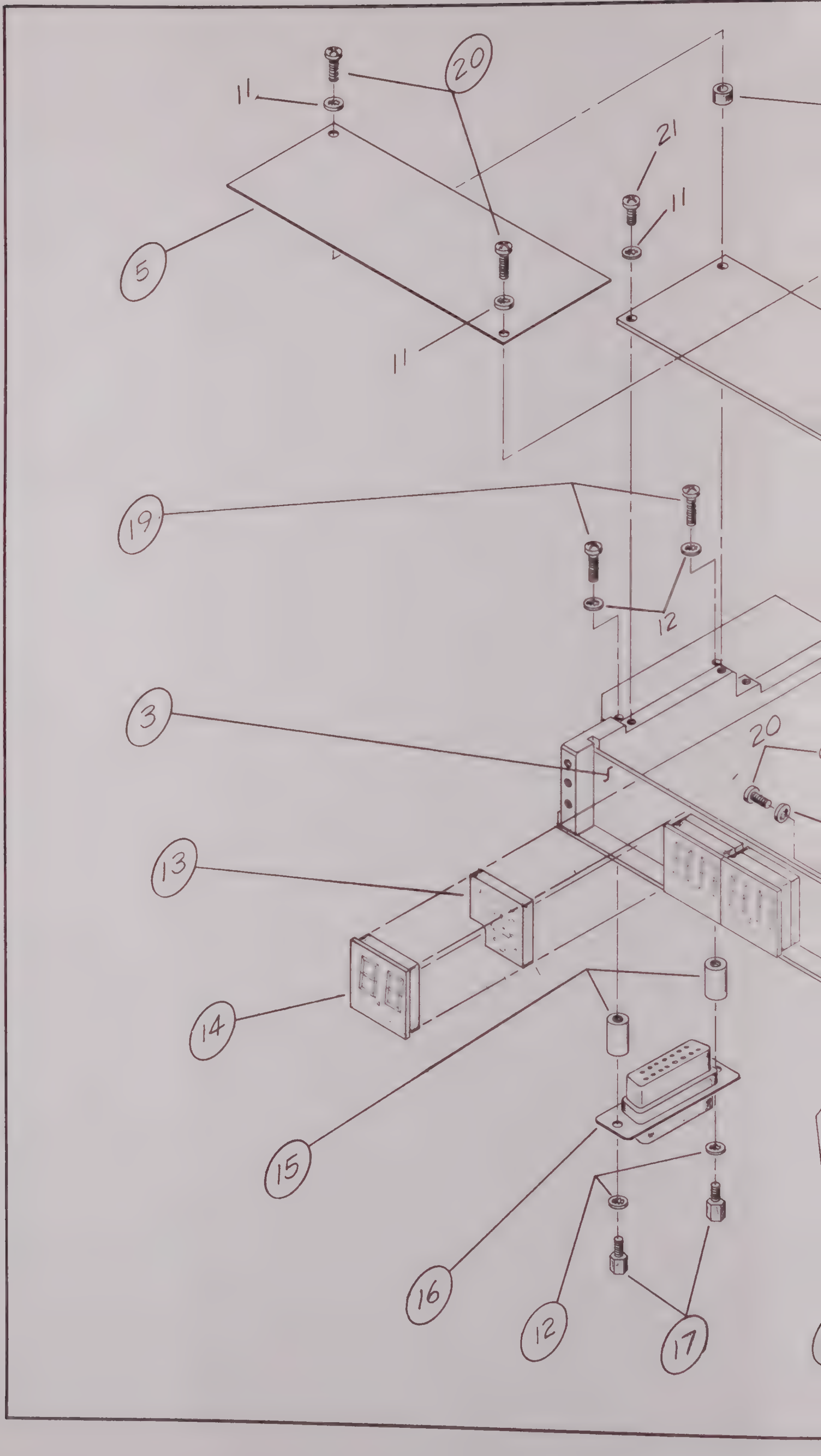
NEXT ASS'Y	QT'Y	MODEL
	1	NAV-402

APPLICATION

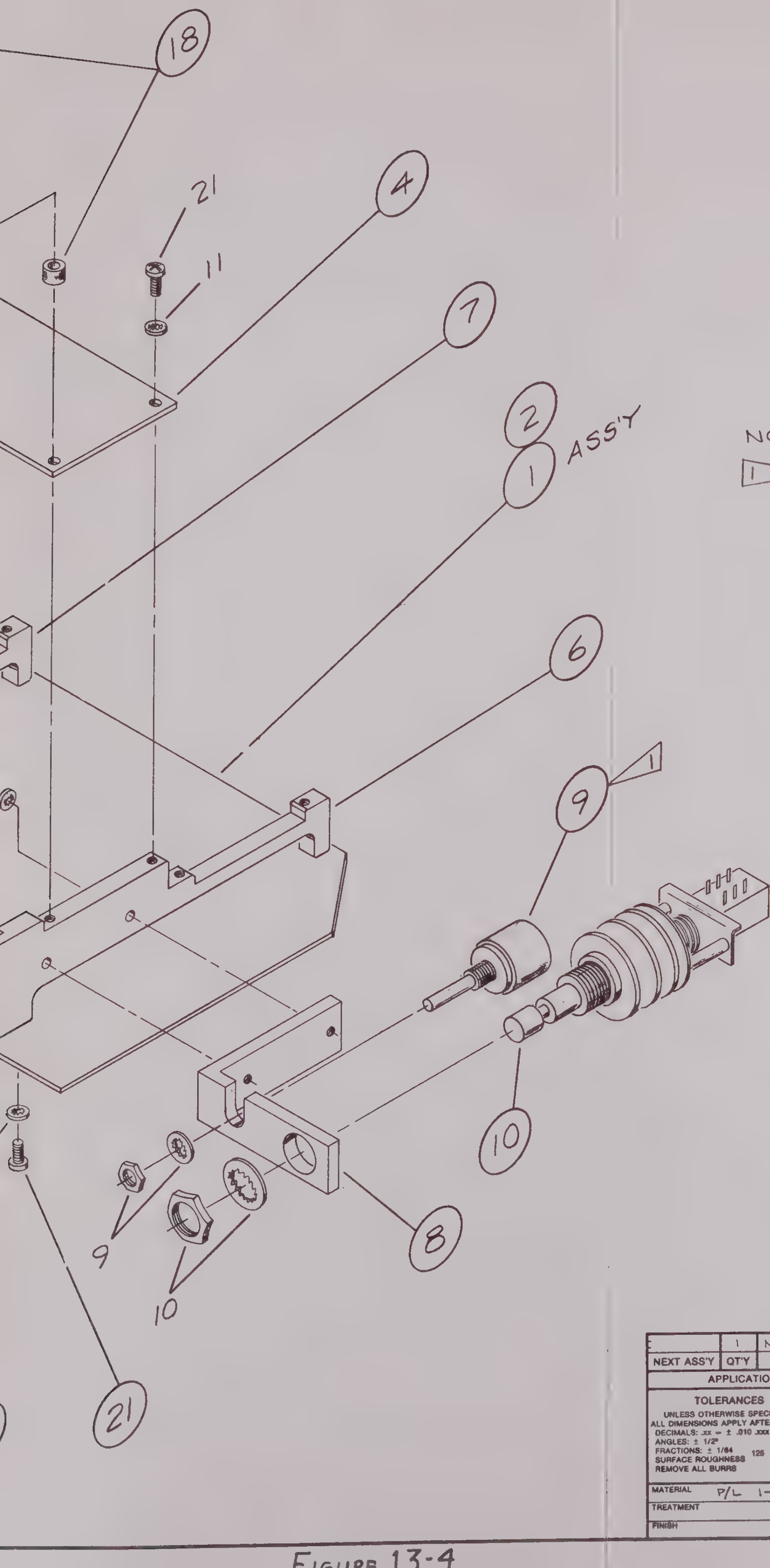
LIST OF MATERIALS

TOLERANCES UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS APPLY AFTER FINISH DECIMALS: .xx = ± .010 .xxx = ± .005 ANGLES: ± 1/2° FRACTIONS: ± 1/64 SURFACE ROUGHNESS 125 REMOVE ALL BURRS	DRAWN d.parks DATE 11/8/74 CHECKED MHL DATE 11-20-74 APPROVED Nazeel DATE 12-15-74	INSTRUMENT FLIGHT RESEARCH CORPORATION WICHITA, KANSAS. TITLE POWER SUPPLY MODULAR ASS'Y, EXPLODED VIEW NAV-402
MATERIAL P/L 1-09-0678 TREATMENT FINISH		SIZE — PART NUMBER 3-09-0690 REV SCALE — WEIGHT — SHEET 1 OF 1

FIGURE 13-2


20
11
21
11
5
11
19
12
12
3
20
13
14
15
16
12
17

DATE	REV	CHANGE	APP'D



NOTES:

1 SET STOPS FOR TWO POSITION SWITCHING.

NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
			21	6	#2-56	PHIL. BD. HD. X 1/4L
			20	4	#2-56	PHIL. BD. HD. X 5/16L
			19	2	#4-40	PHIL. BD. HD. X 1/4L
			18	2	2-16-0002-3	SPACER
			17	2	20418-2	"CINCH" SHELL-NUT
			16	1	205-206-1	"AMP" 15 PIN CONN.
			15	2	205-933-1	SPACER
			14	3	SP-732	"SPERRY" READOUT
			13	3	CS-732	"SPERRY" SOCKET
			12	4	#4	INT. TOOTH LK WASHER
			11	10	#2	INT. TOOTH LK WASHER
			10	1	39137-12125M	"GRIGSBY" SW.
			9	1	51C030-01-2-ADJN	"GRAYHILL" SW.
			8	1	1-09-0652	SWITCH BRACKET
			7	1	2-09-0670-1	MTG. BKT
			6	1	2-09-0670-2	MTG. BKT
			5	1	1-09-0685	H. VOLT PROTECTION SHIELD
			4	1	1-09-0558	HIGH VOLTAGE PWR SUPPLY
			3	1	1-09-0532	DIGITAL READOUT P.C. BD.
			2	1	1-09-0531	COUNTER P.C. BD.
	1	NAV-402	1	1	1-09-0689	COUNTER ASS'Y, COMPLETE
APPLICATION			LIST OF MATERIALS			

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .xx = ± .010 .xxx = ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

DRAWN: d. parks DATE: 11/14/74
CHECKED: MHL DATE: 11-20-74
APPROVED: Nassar DATE: 12-15-74

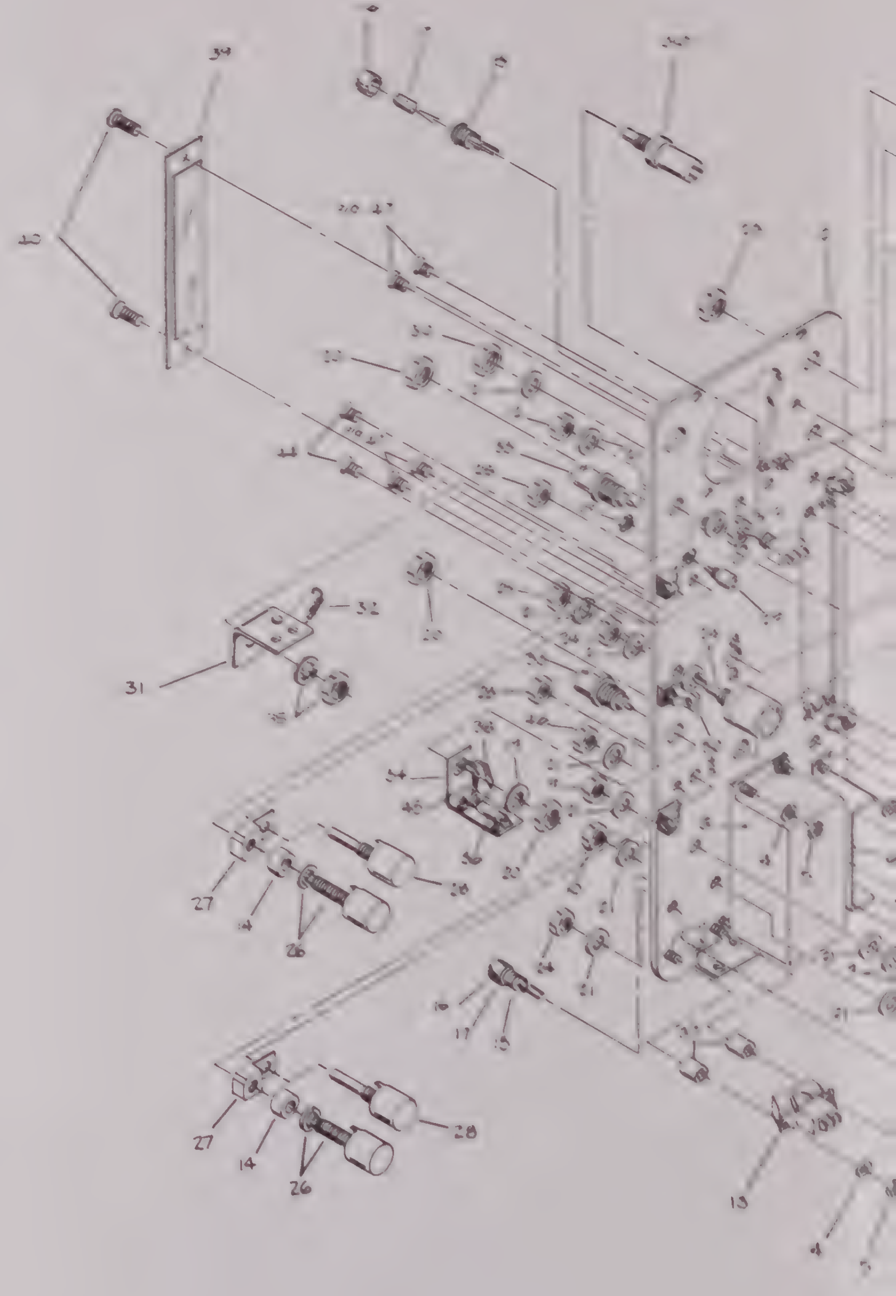
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

TITLE: COUNTER ASS'Y, EXPLODED VIEW NAV-402

MATERIAL: P/L 1-09-0689
TREATMENT
FINISH

SIZE: — PART NUMBER: 3-09-0695 REV
SCALE: — WEIGHT: — SHEET 1 OF 1

FIGURE 13-4



32
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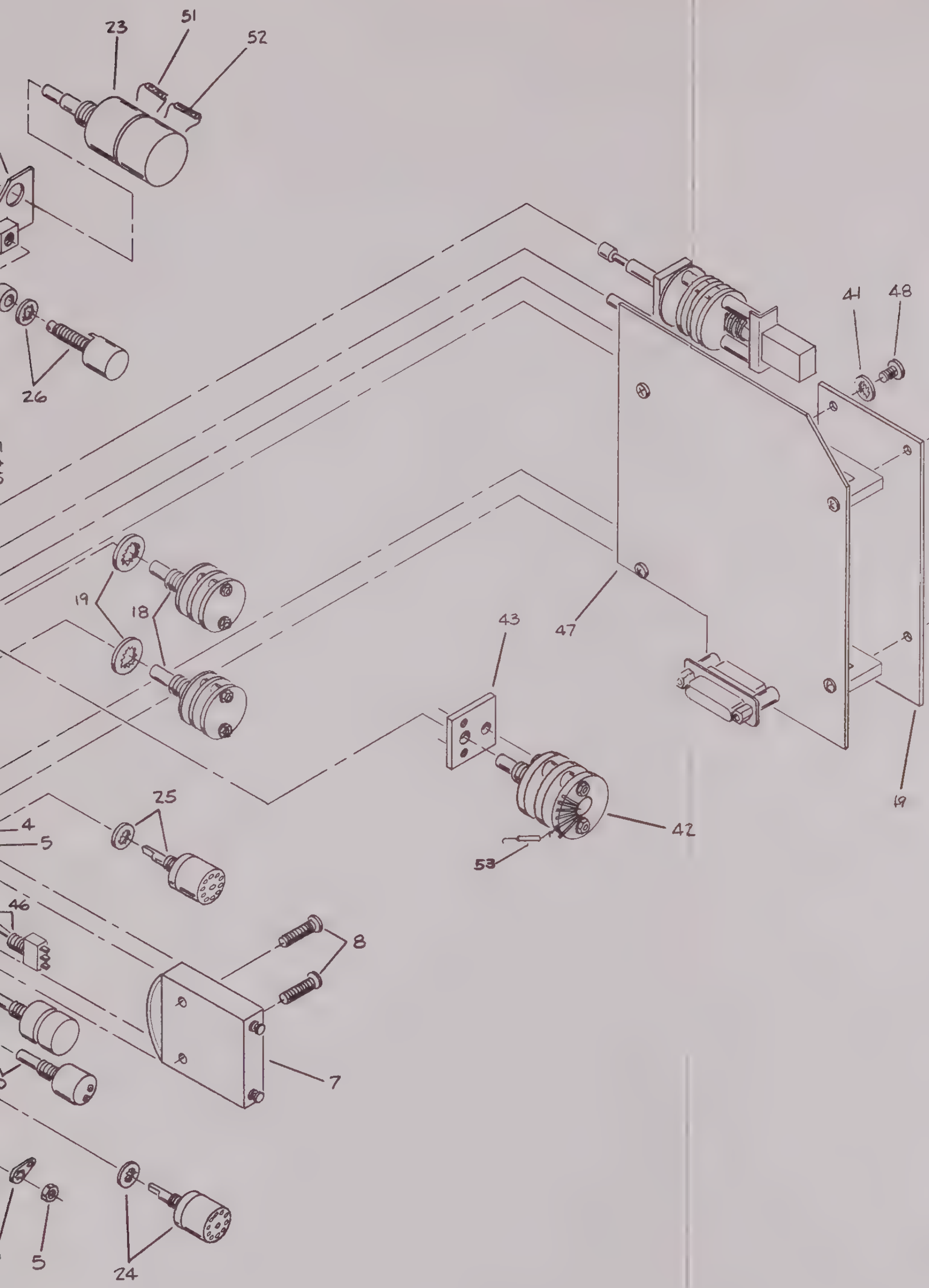
DATE	REV	CHANGE	APP'D
10-17-75	A	INCORP. ECN #1002 SSD	
5-18-77	B	INC. ECN #2057 TJT	



N/S: NOT SHOWN

ITEM	REQ'D	PART NO.	DESCRIPTION
53	1	RL07S 7322F	
52	1	RC07GF104K	RESISTOR 1/4W 10% 100K
51	1	RC07GF472K	RESISTOR 1/4W 10% 4.7K
N/S	1	1-09-0659	KNOB (XTAL HI/LO)
N/S	1	1-00-0133	KNOB (SWEEP CONTROL)
N/S	1	1-09-0379	DUAL KNOB (ATTEN.)
N/S	1	1-09-0386	DIAL ASS'Y (ATTEN.)
N/S	1	1-09-0220	KNOB, INNER (VAR. FREQ)
N/S	1	1-09-0219	KNOB, OUTER (VAR. FREQ)
N/S	1	1-09-0400	KNOB, INNER
N/S	1	1-09-0401	KNOB, OUTER
N/S	3	1-00-0056-1	KNOB (BAR)
N/S	3	1-00-00562	KNOB (BAR)
N/S	2	1-00-00571	KNOB
50	1	1-09-0473	PRESCALER MTG. BKT.
49	1	1-09-0661	AUTO PILOT SWEEP GEN.
48	4	#4-40	SCREW, BD. HD × 3/16L
47	1	1-09-0689	CNTR ASS'Y
46	1	CK7101	SW. (TO/FROM)
45	1	RC07GF560K	RESISTOR 1/4W 10% 56Ω
44	2	#2-56	SCREW FT. HD. × 3/16L
43	1	1-09-0499	MTG. PLATE, MODE SW.
42	1	1-76-0006	SW. (MODE)
41	4	#4	LOCKWASHER
40	2	#2-56	SCREW, BD. HD. BLACK × 3/16L
39	1	1-09-0551	BEZEL ASS'Y
38	1	1025-52	CHOKE 22µH
37	2	2-76-0001-39	SPACER
36	1	KIC35	TANT. CAP. 1µf 35V
35	2	UG1094	RF CONN.
34	1	1-09-0371	TERM. PLATE (EXT. IN)
33	1	1-09-0346	MTG. STUD
32	1	RL07S 2671F	RESISTOR 1/4W 1% 2.67K
31	1	1-09-0416	TERM. PLATE (XMTR INPUT)
30	1	46-101R	MOM. SW. (TUNE)
29	1	39-1	SPST SW. (Φ)
28	2	1-76-0003	POT (G/S & LOC VAR.)
27	2	1-09-0296	MTG. STUD
26	3	RV6LAYS A252A	POT (G/S & LOC CAL.)
25	1	51CD30-01 -1-ADJN	SP12POS SW. (MON. SW.)
24	2	51CD30-01 -2-ADJN	DP6POS SW.
23	1	850-10T	10T DUAL POT (FREQ)
22	—	—	—
21	10	2-760002-8	WASHER
20	2	3/8	HEX NUT
19	2	3/8	LOCKWHR
18	2	39727-1210 -3M-2	SW. (G/S & LOC)
17	2	229	GE BULB
16	2	RBP	LT LENS
15	2	BEP	LT BASE (TUNE & PWR)
14	3	2-760001-A	SPACER
13	1	CK7207-J1R	SW. (AC-OFF-BAT)
12	1	CK7201	SW. (PEAK/LOC-AVG)
11	2	1411-4	SOLDER LUG
10	1	1-76-0017	POT (CAL.)
9	1	1-76-0018	DUAL POT (0-10-20-30)
8	2	#4-40	SCREW, BD. HD. × 5/8L
7	1	1122HL	PWR MTR "INTL. INST"
6	1	2-09-0266	PWR MTR BKT.
5	10	#2-56	HEX NUT
4	9	#2	LOCKWASHER INT TOOTH
3	1	1-76-0009	BEARING SW. ASS'Y.
2	1	2-09-0668	FRONT PANEL (ENGRAVED)
1	—	1-09-0688	FRONT PANEL ASSY

LIST OF MATERIALS

NEXT ASS'Y	QT'Y	MODEL
1-09-0688	1	NAV-402

APPLICATION

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .xx = ± .010 .xxx = ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

DRAWN: d.parks DATE: 11/2/74
CHECKED: D. Parks DATE: 12/12/74
APPROVED: Hanesh DATE: 12-17-74

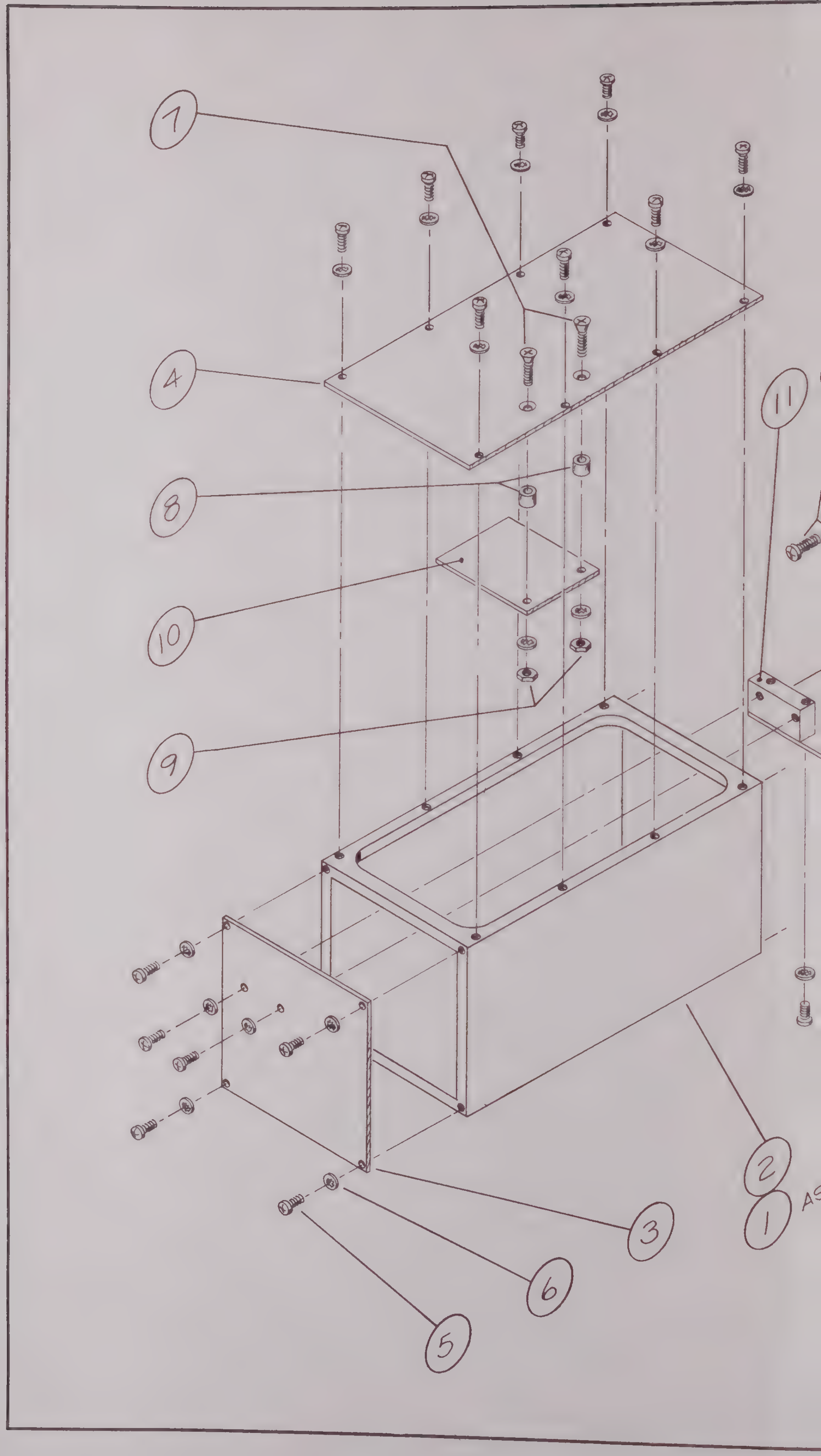
MATERIAL: P/LIST 1-09-0688
TREATMENT: —
FINISH: —

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

TITLE: FRONT PANEL MODULAR ASS'Y EXPLODED VIEW, NAV-402

SIZE: C | PART NUMBER: 3-09-0684 | REV: B
SCALE: — | WEIGHT: — | SHEET 1 OF 1

FIGURE 13-5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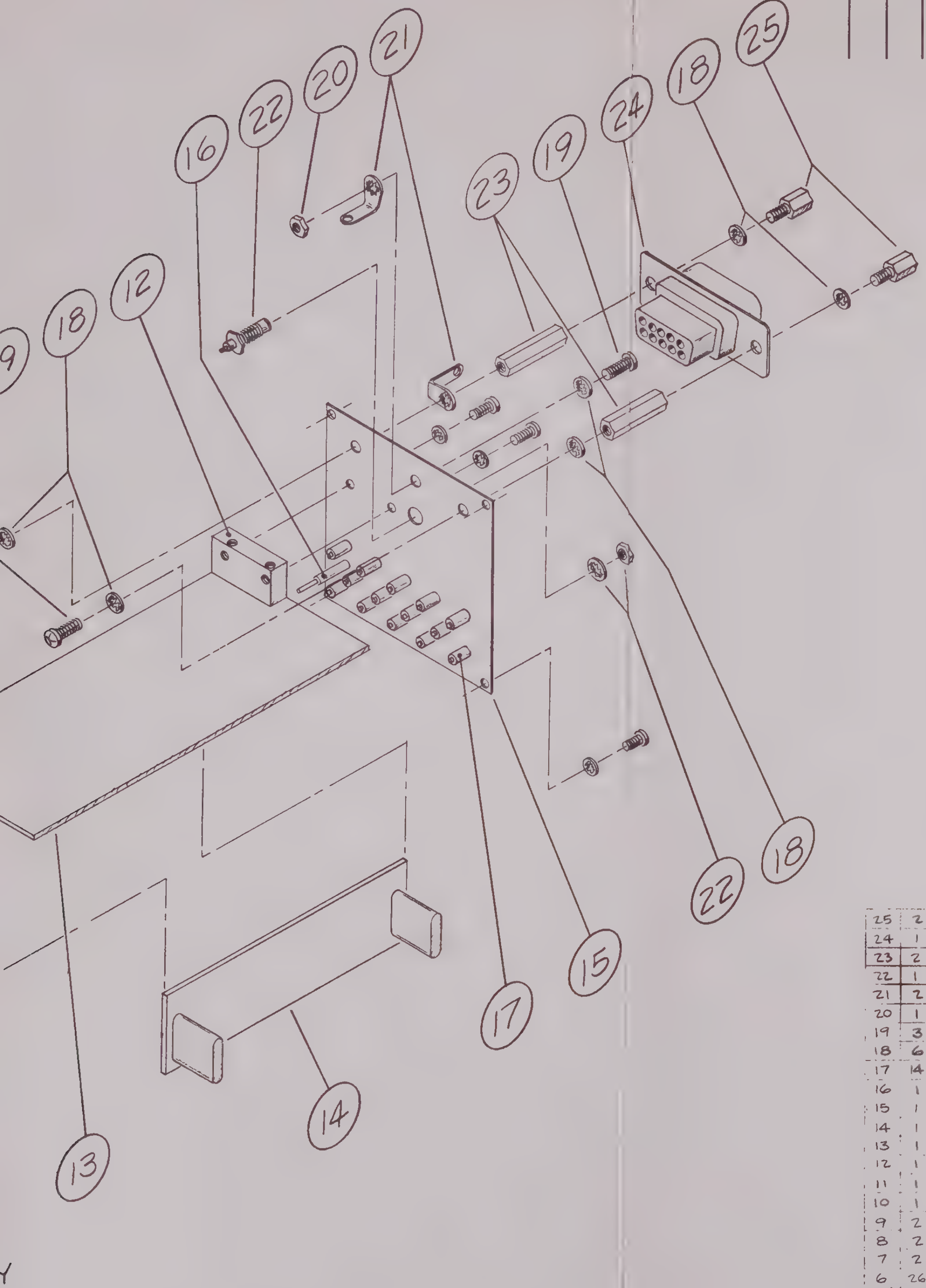
DATE	REV	CHANGE	APP'D



ITEM	REQ'D	PART NO.	DESCRIPTION
25	2	1-76-0013	SHELL NUT
24	1	205206-1	"AMP" 15-PIN PLUG
23	2	2-76-0001-44	SPACER
22	1	27-9	"AMERICON" RF CONN.
21	2	1410-10	#10 GROUND LUG
20	1	#4-40	HEX NUT
19	3	#4-40×1/4	SCREW, PHIL. BIND. HD.
18	6	#4	INT. TOOTH LKWASHER
17	14	1203-050	"ERIE" RF FEEDTHRU
16	1	859550-4	"AMP" FEEDTHRU FILTER
15	1	2-09-0664-1	END PLATE
14	1	1-09-0638	AUX. XTL OSC. BD. ASS'Y
13	1	1-09-0594	OSC. PC BD. ASS'Y
12	1	1-09-0478-2	SPACER, R. HAND
11	1	1-09-0478-1	SPACER, L. HAND
10	1	1-09-0656	PHASE LOCK RANGE AGC ASS'Y
9	2	#2-56	HEX NUT
8	2	2-76-0001-25	SPACER
7	2	#2-56×5/16	SCREW, PHIL. FLAT HD.
6	26	#2	INT. TOOTH LKWASHER
5	24	#2-56×3/16	SCREW, PHIL. BIND. HD.
4	1	2-09-0645	COVER
3	1	2-09-0664-2	END PLATE
2	1	3-09-0475	OSC. BOX.
1	1	1-09-0698	OSCILLATOR ASS'Y

LIST OF MATERIALS

NEXT ASS'Y	QT'Y	MODEL
	1	NAV-402

APPLICATION

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .xx = ± .010 .xxx = ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

DRAWN d.parks DATE 11/26/74
CHECKED MHG DATE 12/2/74
APPROVED [signature] DATE 12-15-74

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

TITLE OSCILLATOR ASS'Y, EXPLODED VIEW NAV-402

MATERIAL P/L 1-09-0698
TREATMENT —
FINISH —

SIZE — PART NUMBER 3-09-0697 REV
SCALE — WEIGHT — SHEET 1 OF 1

FIGURE 13-6

NAV-401L

MARKER, G/S, VOR, LOC, COMM, RAMP AND BENCH TEST SET

ifr

Manual Part Number: 1-09-0726

Serial Number Effectivity: 1636 and on

Date Printed: November, 1976

4053 Navajo Lane/Wichita, Kansas 67210 U.S.A./316/685-9271/TWX. 910-741-6952

LIMITED WARRANTY AND SERVICE INSTRUCTONS

A. WARRANTY

B. IFR, Inc., warrants that each new instrument manufactured by it is free from defects in material or workmanship under normal use and service for a period of two years from the shipping date. (NOTE: 90 day warranty on battery pack). Each instrument is functionally tested immediately prior to shipment. If, upon examination by IFR, the instrument is determined to be defective in workmanship or material, IFR will, subject to the conditions set forth below, either repair the defective part or replace it with a new part on a pro rata basis. IFR shall not be liable for any delay or failure to furnish a replacement part resulting directly or indirectly from any governmental restriction, priority or allocation or any other governmental regulatory order or action, nor shall IFR be liable for damages by reason of the failure of the instrument to perform properly or for any consequential damages. The warranty does not apply to any instrument that has been subject to negligence, accident, shipping damage, misuse or improper installation or operation, or that in any way has been tampered with, altered or repaired by any person other than an authorized IFR service organization or any employee thereof, or to any instrument whose serial number has been altered, defaced or removed, or to any instrument purchased within, and thereafter removed beyond, the continental limits of the United States. Annual certified calibration is not included in warranty.

C. All sales are FOB IFR Factory, Wichita. IFR will assume responsibility for freight charges on all legitmate warranty claims within thirty (30) days from the original shipping date. All legitimate warranty claims within thirty (30) to ninety (90) days should be shipped to IFR freight collect and will be returned freight collect. All freight on warranty claims after ninety (90) days will be paid by the customer.

D. This warranty shall, at IFR's option, become void if the equipment ownership is changed, unless the prior owner or the proposed owner obtains approval of continuation of the warranty prior to the change of ownership.

E. This warranty is in lieu of all other warranties, expressed or implied, and no one is authorized to assume any liability on behalf of IFR or impose any obligation upon it in connection with the sale of any instrument, other than as stated above.

F. CHANGES IN SPECIFICATIONS

G. The right is reserved to change the published specifications of the equipment at anytime and to furnish merchandise in accordance with current specifications without incurring any liability to modify equipment previously sold, or to supply new equipment in accordance with earlier specification except the classification of special apparatus.

H. SERVICE

I. When requesting service, the originator shall give IFR information concerning the nature of the failure and the manner in which the equipment was used when the failure occured. Type, model, and serial number should also be provided.

J. Do not return any products to the factory without first receiving authorization from the factory Customer Service Department.

CONTACT:

IFR, Inc.
4053 Navajo Lane
Wichita, Kansas 67210 USA

ATTN: Customer Service Department

PHONE: (800) 835-2350 (Customer Service Only)

TWX: 910-741-6952

K. Unless otherwise specifically requested, packaging for a return shipment shall be in the original container and packaging material. If the original container and material are not available, information as to suitable packaging techniques will be provided by the IFR Shipping Department.

L. Returned material claimed defective, but found to meet all previously applicable specifications, will be subject to a minimum evaluation charge consisting of the labor charges involved in the status determination of the material.

M. Returned material not accompained by statement of claimed defects may be returned at the originator's expense.

N. Any departure from the above instructions without specific factory authorization can be considered a breach of warranty and all expenses incurred as a result will be billed to the originator.

NAV-401L BENCH AND RAMP TEST SET

TABLE OF CONTENTS

Section Page

SECTION I

GENERAL INFORMATION

1-1. DESCRIPTION.

1-2. The NAV-401L is an FCC Type-Accepted bench and ramp test set designed to meet the electronic functional test requirements of Category I and Category II ILS Systems, Communication (COMM), Navigation (NAV), and Marker (MKR) Systems.

1-3. The NAV-401L is housed in a compact, portable case. It includes a signal generator with a variable attenuator which can be connected to the equipment under test by a radiated signal from a self-contained antenna or by a coax line. It can be operated under either crystal frequency control or in variable frequency mode in each band.

1-4. The NAV-401L generator can be modulated internally by a 1020Hz Indent tone, Marker, VHF Omnidirectional Range (VOR), Localizer (LOC) or Glide Slope (G/S) tones, or by an external signal.

1-5. The NAV-401L includes a six-digit counter which indicates the RF frequency of the signal generator on any band, the frequency of a COMM transmitter under test, any external signal input from 1 MHz to at least 300 MHz , or the VOR bearing selected at the bearing switch as a check on the digital bearing determining circuitry.

1-6. An RF power meter is built-in to measure COMM transmitter power from 0-10W or 0-100W either peak or average power by selecting a switch position located on the front panel. A COMM transmitter demodulation output permits viewing or listening to COMM modulation.

1-7. A built-in Modulation Meter measures the signal generator Percent of Modulation on any frequency band from 0-30% or 0-100%. Front panel controls permit quick setting of modulation percentages.

1-8. A 90° bearing check monitor allows quick verification of basic VOR bearing from the VOR demod signal.

1-9. A nickel-cadmium battery and built-in charging system permits completely portable operation for up to 2 hours continuous duty with the counter off, one hour continuous duty with the counter on. Any time the set is plugged to an AC line the battery is being charged. In battery operation, an automatic timer turns the set off after 6 to 10 minutes. The set can be recycled by pressing the BAT position of the power switch.

SECTION II

TECHNICAL SUMMARY

RF OUTPUT

POWER: Continuously variable from -7dBm to -127dBm (.1V to .1μV)

ATTENUATOR ACCURACY: ±2dB from -30 dBm to -127 dBm with calibrated stop at -7 dBm (See -7 dBm to -30 dBm Attenuator Correction Chart, Table 2-2

FREQUENCY SENSITIVITY: ±2dB, all bands

FREQUENCY RANGE:

MKR.................72MHz - 78MHz
VOR/LOC..........107MHz - 120MHz
COMM.......LO: 118MHz - 136MHz
HI: 134MHz - 156MHz
G/S ....327MHz - 337MHz

CRYSTAL CONTROL:

MKR XTL................75.000MHz
VOR XTL...............108.000MHz
LOC XTL...............108.100MHz
G/S XTL...............334.700MHz
COMM XTL..............126.900MHz

NOTE

Any standard frequency crystal may be specially installed in each band.

FREQUENCY ACCURACY:

Variable frequency operation with direct counter readout 0.001%

Phase lock operation allowing phase lock in 25 KHz increments on MKR, VOR, LOC, and COMM bands and 50KHz increments on G/S band..................0.001%

Crystal control operation 0.005%

MKR SIGNAL

TONES:	1020Hz (± 1%) Ident 400Hz (± 1%) 1300Hz (± 1%) 3000Hz (± 1%)
MODULATION:	Calibrated to 95(±5)% for each tone. Variable from 0% to 100%.

VOR SIGNAL

TONES:	30Hz (± .02%) Reference 30Hz Variable 9.96KHz (±.02%), ±480Hz Deviation 1020Hz (± 1%) Ident
MODULATION:	Calibrated to 30(±2)% for each tone. Variable from 0% to > 50%.
BEARING:	3600 digitally derived courses in 0.1 degree increments. Coarse accuracy ±0.1 degree.

LOC SIGNAL

TONES:	90Hz (± 0.02%) 150Hz (± 0.02%) 1020Hz (± 1%) Ident
MODULATION:	90Hz and 150Hz modulation levels calibrated to 20(±2)% or variable from 0% to 40%. Marker Tone modulation levels calibrated to 30(±2)% or variable from 0% to > 50%.
DDM:	.093, .155, .200 DDM and tone delete Accuracy ±0.0013 DDM (± 1.3μa). Variable control ±0.4 DDM. (See Table 5-2).
PHASE SHIFT:	90Hz and 150Hz phase locked to within 1°. Variable in 5° increments (See Table 5-3).

G/S SIGNAL

TONE:	90Hz (± .02%) 150Hz (± .02%)

MODULATION:	Calibrated to 40(±2)% for each tone. Variable from 0% to 80%.
DDM:	.091, .175, .40 DDM and tone delete. Accuracy ±0.0024 DDM (±2.0 μa). Variable control ±0.8 DDM. (See Table 5-2).
PHASE SHIFT:	90Hz and 150Hz phase locked to within 1°. Variable in 5° increments (See Table 5-3).

COMM SIGNAL

TONES:	Marker Tones
MODULATION:	Calibrated to 30(±2)% for each tone. Variable from 0% to > 50%.

INTERNAL MODULATION

1020Hz, 400Hz, 1300Hz, 3000Hz Tones (± 1%). 30Hz Reference, 30Hz Variable, 9.960kHz, 150Hz Tones (±.02%).

Calibrated Modulation Levels See Table 2-1.

Variable Modulation Levels

MKR 0-98%
VOR 0-60%
COMM 0-60%
LOC 0-60%
G/S 0-80%

EXTERNAL MODULATION

Typically a 10Hz to 20kHz, 5Vpp signal should produce 30% modulation for VOR, LOC, and COMM and 95% for MKR. G/S can not be externally modulated. Modulation can be varied over the same ranges as for the internal modulation modes.

DISTORTION

At circuit board test points

1020Hz	1% Max
400Hz	1% Max
1300Hz	1% Max
3000Hz	1% Max
30Hz Var	0.5% Max
30Hz REF	0.5% Max
90Hz	0.5% Max
150Hz	0.5% Max
9960Hz	1% Max

At back panel demodulated outputs (with filter, figure 2-1).

1020Hz	1% Max
400Hz	1% Max
1300Hz	1% Max
3000Hz	1% Max
30Hz	0.5% Max
90Hz	0.5% Max
150Hz	0.5% Max

(nonharmonic with no filter)

1020Hz	1.5% Max
400Hz	1.5% Max
1300Hz	1.5% Max
3000Hz	1.5% Max
30Hz	1% Max
90Hz	1% Max
150Hz	1% Max

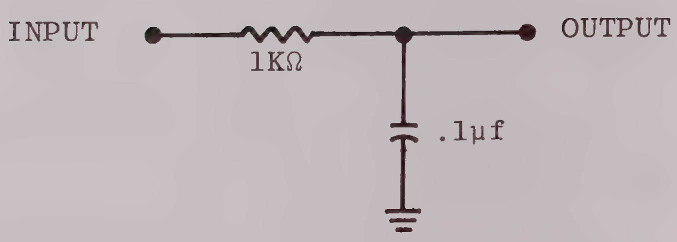


Figure 2-1. Low Pass Filter

COUNTER CHARACTERISTICS

FUNCTIONS:	Measures internal signal generator frequencies. Measures frequency of external COMM transmitter. Measures frequency of exteranl signal at Counter input. Displays internal VOR Bearing as selected on front panel.
CLOCK OSCILLATOR ACCURACY:	Accurate within ±.001% (Typical ±.0005% over normal temperature and period usage).
TIME BASE:	Hz ....1 sec. kHz........................1 sec. kHz......................0.1 sec. MHz......................0.1 sec.
EXTERNAL INPUT:	Range .....Hz,kHz - 1MHz to 10MHz kHz,MHz - 10MHz to 300 MHz (min) Impedence ......50Ω AC terminated Sensitivity.... .08Vrms (-9dBm) @ 10MHz .15Vrms (-3dBm) @ 200MHz .23Vrms (0dBm) @ 300MHz Maximum Power...250mW RF (+24dBm)

MONITOR METER CHARACTERISTICS

POWER METER:	Function....Measures COMM transmitter power from 0 to 100W Range ....0 - 100W 0 - 10W Accuracy.......±5% of full scale Maximum Input Power.....20W CW continuous duty

INPUT POWER VERSUS TIME LIMITS		
INPUT POWER (watts)	TIME LIMIT (minutes)	
	ON	OFF
20 - 40	5	20
40 - 80	1	20
80 - 100	0.5	20

RF LEVEL MONITOR: Center of scale indicates tuned transmitter

BATTERY LEVEL: Range....................0-30V
Accuracy.........±5% of reading

BEARING ERROR: Range...±0.5°(0° at meter center)

SPECTRAL PURITY

HARMONICS: Greater than 20dB below carrier level at -30dBm output level over entire frequency range.

BROADBAND NOISE: (10kHz Frequency Span, 300Hz Bandwidth, 10Hz Video Filter) Greater than 70dB below carrier level at ±50kHz.

NONHARMONIC SPURIOUS NOISE: Variable Frequency (25kHz) and Switching Regulator Frequency (10 to 30kHz) noise greater than 55dB below carrier level.

CLOSE-IN NOISE: (300Hz Bandwidth, 10Hz Video Filter)
108.MHz.......Greater than 68dB below carrier at ±20kHz.

334.7MHz......Greater than 62dB below carrier at ±20kHz.

POWER

BATTERY:	A 2.0 ampere-hour internal Nicad battery system permits ramp operation for approximately two hours with counter off. The battery charger continuously charges the battery whenever the test set is connected to AC power.
AC LINE:	105 to 120 VAC or 220 to 250 VAC, 50 to 400Hz, 25 watts.

PHYSICAL CHARACTERISTICS

WEIGHT:	17 pounds, complete
DIMENSIONS:	Width...............11.375 inches Hight................5.125 inches Depth...............16.125 inches

Table 2-1. Tone Modulation Levels

BAND	TONE								
	30Hz	9960Hz	90Hz	150Hz	1020Hz	400Hz	1300Hz	3000Hz	Ext*
MKR	XX	XX	XX	XX	95%	95%	95%	95%	95%
VOR	30%	30%	XX	XX	30%	30%	30%	30%	30%
LOC	XX	XX	20%	20%	30%	30%	30%	30%	30%
G/S	XX	XX	40%	40%	XX	XX	XX	XX	XX
COMM	XX	XX	XX	XX	30%	30%	30%	30%	30%

NOTE: 95% Modulation accuracy ±5% except EXT
40% Modulation accuracy ±2% except EXT
30% Modulation accuracy ±2% except EXT
20% Modulation accuracy ±2% except EXT
XX - Tone not available

*External Input approximately 5Vp-p. Input impedence is 20KΩ in series with 33μf.

SECTION III

OPERATION

3-1. INTRODUCTION.

3-2. The NAV-401L Ramp and Bench Test Set is a completely self-contained unit designed for functional and calibration testing of Marker (MKR), Instrument Landing System (ILS), VHF Omnidirectional Range (VOR), and Communication (COMM) avionics equipment. All necessary test signals are generated within the NAV-401L test set for bench or ramp operation. A general purpose frequency counter is included in the test set for measuring RF signal frequencies from 1MHz to 300MHz.

3-3. CONTROLS, INDICATORS, AND CONNECTORS.

3-4. Location of the controls, indicators, and connectors on the NAV-401L test set is shown in figure 3-1. The following paragraphs explain their functions in detail.

3-5. FRONT PANEL.

3-6. FREQUENCY MODE SWITCH. The MODE switch (1, figure 3-1) selects the frequency band to be used: MKR, VOR, Localizer (LOC), Glide Slope (G/S), or COMM. Each band except COMM is divided into two positions: a crystal controled frequency position, and a variable frequency position. COMM band utilizes three switch positions: a crystal controlled position, and two variable frequency positions. The VAR positions allow the signal generator to cover all the frequencies of each band.

3-7. DISPLAY TIME CONTROL. The Display Time control (2) varies the time to update the counter. CCW rotation will cause shorter time between updates and cw rotation will cause a longer time between updates. In the full cw position the count will be held indefinitely.

3-8. COUNTER MODE SWITCH. The Counter Mode switch (3) selects the source of the signal to be counted. In GEN position the frequency of the internal signal generator is displayed. In any of the Hz, KHz, KHz or MHz positions the counter measures the frequency of a COMM transmitter connected to the XMTR IN connector, or an external signal source. The external signal must be applied to the MOD IN/CTR IN connector. In the BRG position the input to the counter is the output of the digital bearing determining circuitry and the display should equal the VOR BRG switch indication. This provides a check on the bearing selection circuits. Also in the BRG position the bearing monitor circuitry checks the VOR modulation for proper operation at 90° . A pushbutton switch is incorporated into the switch which applies power to the counter readout components in either battery or AC power operation. This feature allows the main current-using part of the counter to be turned off to conserve battery power. It is highly recommended during portable operation to use the counter readout only when necessary.

3-9. METER BEARING CENTER ADJUST. The Meter Bearing Center Adjust (4) is used to center the MONITOR meter to set a reference level in internal bearing check operation. The MONITOR function selector should be in BRG position and the Counter Mode Switch should be in any position except BRG while the meter is being centered.

3-10. VARIABLE FREQUENCY CONTROLS. The coarse and fine VAR FREQ controls(5) manually sweep the internal signal generator frequency, with cw rotation increasing the output frequency. The frequency MODE switch must be in one of the VAR positions for this mode of operation. The coarse control, the larger knob close to the front panel, gives from 1 to 2 MHz deviation per turn. The fine control, the small outer knob, gives approximately 20 to 40 KHz deviation for its rotation.

3-11. Phase Lock Circuit. The phase lock circuit is activated by turning the fine tuning VAR FREQ control full counter clockwise to detent position. Phase lock can be obtained every 25 KHz on the variable frequency modes except for Glide Slope. Glide Slope frequencies are phase locked in 50 KHz increments.

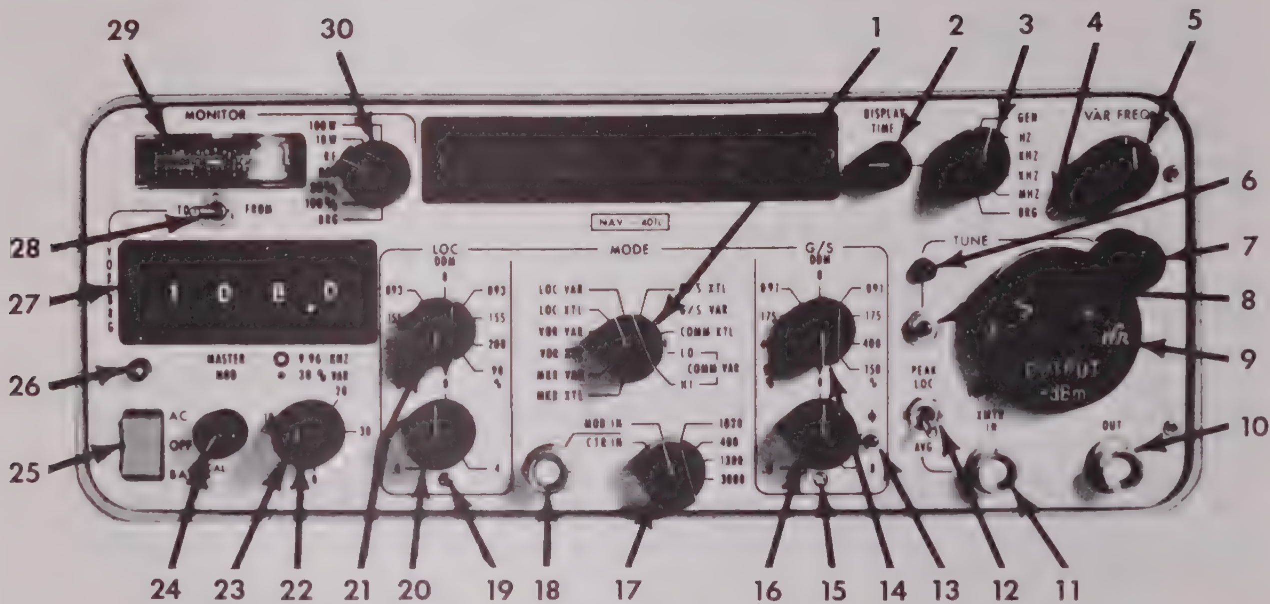
3-12. The coarse frequency pot is used to select the desired phase locked frequencies. Phase lock is indicated by the proper count on the frequency counter, 50 KHz increment for Glide Slope frequencies, 25 KHz increment on all other bands. It is necessary to adjust for the phase locked steps since the pull-in range of the phase lock circuit is less than 25 KHz. A phase lock on any frequency other than the 25 or 50 KHz steps is not valid and will have severe frequency modulation.

NOTE

> The variable frequency oscillator should not be adjusted to a frequency within ±5 KHz of an XTAL frequency to avoid interaction between the oscillator circuits.

3-13. TUNE CONTROL AND TUNE INDICATOR. The TUNE control (7) adjusts the tuning of the signal generator for optimum. It must be readjusted for each different frequency band used, when the variable frequency control changes the frequency more than a few megahertz in any one band, or when the attenuator is used in or changed in the attenuation range of -15 dBm to max RF output.

FRONT PANEL



1. Frequency Mode Switch
2. Display Time Control
3. Counter Mode Switch
4. Meter Bearing Center Adjust
5. Variable Frequency Controls
6. Tune Indicator
7. Tune Control
8. Fine Tune Switch
9. Output Attenuator Control
10. RF Output Connector
11. COMM Transmitter Input Connector
12. Avg/Peak/LOC Xmtr On Switch
13. 90/150Hz Variable Phase(ϕ) Switch
14. Glide Slope DDM Control
15. Glide Slope Centering Adjust
16. Glide Slope Variable DDM Control
17. Tone Select Switch
18. External Counter/Modulation Input Connector
19. Localizer Centering Adjust
20. Localizer Variable DDM Control
21. Localizer DDM Control
22. 30Hz Var Level Control
23. 9.96kHz Ref Level Control
24. Master Modulation Level Control
25. AC/Battery Power Switch
26. Power On Indicator
27. VOR Bearing Select Switches
28. VOR Bearing TO/FROM Switch
29. Monitor Meter
30. Monitor Meter Function Switch

REAR PANEL

A. NAV Tones Output
B. Signal Generator Demodulated Output Connector
C. COMM Transmitter Demodulated Output Connector
D. Fuse (1 ampere, Slo-Blo)
E. AC Power Connector

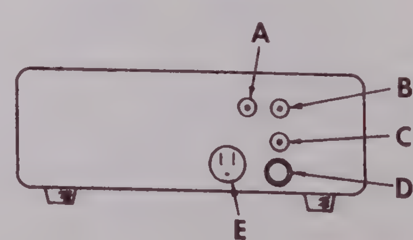


Figure 3-1. Controls, Indicators, and Connectors

The exact optimum tuning region is indicated by the TUNE indicator (6). The indicator will come on for an out-of-tune condition. Adjusting the TUNE control will cause the indicator to go off when the signal generator is properly tuned for the frequency in use.

3-14. FINE TUNE SWITCH. The Fine Tune switch (8) is used to fine tune the transmitter once the tuning is within the fine tune range and the TUNE indicator is off. When the Fine Tune switch is pressed, the TUNE control is adjusted for a minimum indication on the MONITOR meter.

3-15. OUTPUT ATTENUATOR CONTROL. The OUTPUT Attenuator control (9) is used to adjust the RF level of the signal generator output at the output (OUT) connector into a 50 ohm load. The attenuator dial is calibrated in -dBm, or dB below one milliwatt. The dial is accurate for output levels below -30 dBm but becomes slightly non-linear at output levels greater than -30 dBm. An Attenuator Correction Chart is included with each instrument. Also included is a chart converting -dBm to microvolts for servicing receivers whose sensitivities are specified in microvolts. See Section V, Table 5-1.

3-16. RF OUTPUT CONNECTOR. The OUT connector (10) provides the attenuated signal generator output to the equipment under test. The connector is diode protected against a COMM transmitter being inadvertently keyed, but precautions should be taken to assure this does not occur. The output is source terminated in 50 ohms.

3-17. COMM TRANSMITTER INPUT CONNECTOR. The XMTR IN connector (11) is the input to the power meter, and is connected with a 50 ohm cable to a COMM transmitter for power and frequency measurement purposes. Power indicated is either peak or average power. See paragraph 3-18. Transmitter frequency is indicated on the frequency counter readout with the counter mode switch in the Hz, KHz, KHz, or MHz positions. See paragraph 3-8. A 25 dB pad is used in series with the power circuit.

NOTE

> See the Technical Summary, Section II, for input power versus time requirements for the power meter.

3-18. AVG/PEAK POWER/LOC XMTR ON SWITCH. The AVG/PEAK-LOC switch (12) selects the function of the power meter. In PEAK position the power meter indicates the peak power amplitude of a COMM transmitter with modulation applied. The PEAK position also provides output from the separate localizer transmitter simultaneously with G/S signal when the frequency MODE switch is in G/S position (for checking auto pilots or course computers). In AVG position the power meter indicates the average RF power of a COMM transmitter and disregards power changes due to proper modulation.

3-19. 90/150 Hz VARIABLE PHASE (ϕ) SWITCH. Normally the 90 Hz and 150 Hz tones used for LOC and G/S modulation are phase-locked together. However, when the Variable Phase (ϕ) Mode switch (13) is pressed the 150 Hz phase relationship can be varied in 5° steps by use of the VOR BRG switches. If the VOR BRG switches are set to 000.0°, pressing the Variable Phase (ϕ) switch will produce no change of phase. For each 1° step of the BRG switch, the 150 Hz tone will be shifted +5° relative to the 90 Hz tone, which always remains constant in phase with respect to the 000.0° VOR BRG switch position. When 24° VOR BRG is selected the 90 and 150 Hz tones will be back to their original phase relationships. The 100° and 0.1° switches are not used for the phase shift. See Table 5-3 for the complete phase steps. When the VOR BRG selector is set to 12° the amplitude summation of 90 Hz and 150 Hz is the greatest.

3-20. GLIDE SLOPE DDM CONTROL. The G/S DDM control (14) selects the amount of G/S pointer deviation on an ILS indicator under test. Calibrations are in DDM (Difference in Depth of Modulation) and represent standard deflection, full scale, and greater than full scale deflections. CW rotation gives upward deflection; ccw rotation gives downward deflection. In either the 90 Hz or 150 Hz positions the opposite tone is deleted and the selected tone is at the same level as the on course value (40%) so that a flag test can be made. The LOC DDM control should not be on the 90 Hz or 150 Hz position when using the Glide Slope function because either the 90 Hz or 150 Hz tone will be deleted by the Localizer control. Continuous Wave operation can be obtained by placing the G/S DDM control on 150 Hz and the LOC DDM control on 90 Hz or vice versa.

3-21. GLIDE SLOPE CENTERING ADJUST. The G/S Centering adjust (15) varies the amplitude of the 90 Hz tone and is used as an exact course centering control for Glide Slope modulation.

3-22. GLIDE SLOPE VARIABLE DDM CONTROL. The G/S Variable DDM control (16) continuously varies the G/S pointer deflection from .8 DDM down through 0 DDM to .8 DDM up. CW rotation gives upward pointer deflection. The G/S DDM control must be in the arrow position for operation.

3-23. TONE SELECT SWITCH. The Tone Select switch (17) selects the modulation inputs to the internal signal generator or the input to the counter. In the MOD (Modulation) IN position, the MOD IN/CTR IN connector becomes the modulation input to the siganl generator. In any of the four tone positions, a tone is selected to modulate the various frequency bands selected by the frequency MODE switch except for the Glide Slope band, which cannot be externally modulated. In CTR (Counter) IN position the MOD IN/CTR IN connector is fed to the general purpose counter input.

3-24. EXTERNAL COUNTER/MODULATION INPUT CONNECTOR. The MOD IN/CTR IN connector (18) is the external input to the counter or the external modulation input to the signal generator. See paragraphs 3-8 and 3-23.

3-25. LOCALIZER CENTERING ADJUST. The Localizer Centering adjust (19) varies the amplitude of the 90 Hz tone and is used as an exact course centering control for Localizer modulation.

3-26. LOCALIZER VARIABLE DDM CONTROL. The LOC Variable DDM control (20) continuously varies the LOC pointer deflection from .4 DDM left through 0 DDM through .4 DDM right. CW rotation gives right pointer deflection. The LOC DDM control must be in the arrow position for operation.

3-27. LOCALIZER DDM CONTROL. The LOC DDM CONTROL (21) selects the amount of deviation of the LOC pointer of an ILS instrument under test. Calibrated in DDM, the switch positions correspond to standard deflection, full scale, and greater than full scale deflection. In either the 90 Hz or 150 Hz positions the opposite tone is deleted and the selected tone is at the same level as the on course value (20%) so that a flag test can be made. The Glide Slope DDM control should not be on the 90 Hz or 150 Hz position when using the Localizer function or the 90 Hz or 150 Hz tone will be deleted by the Glide Slope control. Continuous Wave operation can be obtained by placing the G/S DDM control on 150 Hz and the LOC DDM control on 90 Hz or vice versa.

3-28. 30 Hz VAR LEVEL CONTROL. The 30 Hz VAR Level Control (22) changes the percentage of modulation of the 30 Hz VAR tone of the VOR composite signal from 0 to 30%. It remains 30% as the knob is turned past the 30% line to the stop.

3-29. 9960 Hz REF LEVEL CONTROL. The 9.96 KHz Ref Level control (23) changes the percentage of modulation of the 9.960 KHz tone of the VOR composite signal from 0 to 30%. It remains 30% as the knob is turned past the 30% line to the stop.

3-30. MASTER MODULATION LEVEL CONTROL. The MASTER MOD control (24) controls the modulation level of all modulating tones. In the CAL (detent) position (full ccw) the modulation levels of each type of signal (LOC, G/S, etc) are fixed at their proper values of 20%, 30%, 40%, 95% etc. In other than the CAL position the control varies the level of modulation of any signal from 0 to approximately twice the normal level for that signal. For example, the VOR ident tone is 30% in CAL, and 0 to 60% in variable operation.

3-31. AC/BATTERY POWER SWITCH. The AC/BAT power switch (25) is a two position center off switch which controls power to the test set. When the switch is pressed to AC, the test set is powered from AC line power. The battery is charging anytime the test set is connected to AC power. If the switch is pressed to BAT, which is a momentary position, the battery timer is activated. The set will operate completely on battery power until the timer turns the set off or until the power switch is again pressed to BAT which will stop the timer and will turn the set off. The time limit for the battery timer is 6 to 10 minutes.

3-32. POWER ON INDICATOR. The Power Indicator (26) comes on when the NAV-401L has power applied from an AC or battery source.

3-33. VOR BEARING SELECT SWITCHES. The VOR BRG selector (27) consists of four thumbwheel switches which select the VOR bearing simulated by the VOR signal generator. The hundreds of degree switch is stopped at 3. Bearings from 360° through 399° are not valid: i.e., the bearing selector operates only from 0° through 359.9°.

3-34. VOR BEARING TO/FROM SWITCH. The TO/FROM switch (28) changes the selected VOR bearing to the reciprocal bearing for flag tests, etc.

3-35. MONITOR METER. The Monitor meter (29) is the multimeter for the NAV-401L which measures RF power, siganl generator RF output level, battery voltage, percent modulation of the signal generator, and an indication at 90° that the VOR bearing circuitry is functioning properly.

3-36. The MONITOR switch (30) selects the meter function. COMM transmitter power is measured on two scales, 0-10 watts and 0-100 watts. The RF position is used to indicate proper RF leveling of the signal generator. In BAT position the 0 to 30% scale is used to read the battery voltage. Less than 12.0V is a discharged battery condition and more than 15V is a fully charged battery condition. When the battery reaches a fully charged condition the battery charger circuit cuts off automatically. The 30% and 100% positions are used to measure the modulation level of the signal generator. In BRG position the VOR generator is checked at 90°. The center of the band is 0° and either left or right meter scale limits indicate ±0.5° error.

3-37. REAR PANEL

3-38. NAV TONE OUTPUT. The NAV TONE OUT connector (A) is the audio output to test the VOR bearing circuits or deviation circuits of LOC and G/S NAV receivers. The output level is variable with the MASTER MOD control from approximately 0-7Vpp into 1,000 ohm. The audio modulation for MKR and COMM signals is also available to the connector. Audio output is internally connected to the NAV-401L modulator.

3-39. SIGNAL GENERATOR DEMODULATED OUTPUT. The SIG GEN DEMOD connector (B) is the demodulated output of the signal generator. This output is provided for a monitoring capability and is not intended to feed VOR and ILS converters. If the output voltage available is adequate and the approximately +4.25 VDC component is not objectionable, the output can be used to drive a converter.

3-40. COMM TRANSMITTER DEMODULATED OUTPUT. The PWR MON DEMOD connector (C) is the detected output of a COMM transmitter. It is useful to display the modulation on an oscilloscope or listen to the modulation via an external amplifier.

SECTION IV

TYPICAL OPERATING AND FRONT PANEL CALIBRATION PROCEDURES

4-1. INTRODUCTION.

4-2. The NAV-401L is designed to be utilized as a completley self-contained bench and ramp test instrument of high accuracy for MKR, VOR, ILS and COMM equipment. Connection to the equipment under test, operation of the NAV-401L controls, and calibration of LOC and G/S course centering accuracy has been made as simple as possible. This simplicity is most justified by the greatly reduced time required to perform avionics system measurements. The technician spends his time repairing instead of chasing. Typical operating hints and control settings are outlined first, including Table 4-1, followed by front panel calibration procedures beginning with paragraph 4-16.

4-3. BENCH AND RAMP OPERATION.

4-4. There is no major differences in operation between bench testing and ramp testing; every function and control is identical in both cases. The most significiant difference is that the NAV-401L, being FCC Type Accepted, cannot be used in the VAR (Variable) frequency modes during ramp use. Any test signal radiated form the antenna must be crystal controlled. It is not authorized to externally modulate the NAV-401L on any band during ramp use. This includes microphones, audio generators, etc.

4-5. The other main difference is that it is not recommended to operate the counter readout any more than necessary during ramp testing to conserve battery power. A push-button switch is part of the counter mode switch to turn off power to the readout assembly.

4-6. NOTES ON RAMP OPERATION. It has been found through experience that all systems of a typical avionics package can be checked, with the sometime exception of marker beacon, by placing the NAV-401L in an upright position between the legs while sitting in the aircraft cockpit with the antenna extended two or three feet vertically. With the antenna on the RF output jack all receivers may be checked and indicators operated through their limits- VOR, LOC, and G/S. The COMM receiver may also be operated, if desired, modulating the NAV-401L with either the 400, 1020 Ident tone, 1300, or 3000 Hz tones.

4-7. On some installations the Marker antenna is located far aft on the fuselage and with the test set in the cockpit, coupled with a usually low receiver sensitivity (-35 to -45 dBm), not enough RF can be radiated to operate the receiver. Moving the NAV-401L outside the aircraft will normally give more than enough signal strength to completely check Marker audio and lights.

4-8. To check COMM transmitter frequencies from the cockpit, connect the antenna to the external input (XMTR IN) connector and select MHz on the Counter Mode switch. The test set will read out the COMM transmitter frequency when the transmitter is keyed.

4-9. BENCH OPERATION. Bench testing and alignment procedures usually dictate use of direct coax connections between the NAV-401L and the equipment under test. The attenuator dial readout is the RF level in dBm present at the RF Output jack into 50ohms. To make accurate sensitivity measurements the loss in dBm of the connecting coaxes must be known. See Table 4-1 for typical control settings.

CAUTION

> Most COMM receiver antenna connectors are also used for the COMM transmitter connector. Precautions should be taken not to key the transmitter with the COMM antenna connector fed to the NAV-401L RF Output connector. Damage to the attenuator and signal generator system may result from such inadvertent transmitter keying.

4-10. GENERAL PURPOSE COUNTER OPERATION. With the Tone Select switch in CTR IN position the NAV-401L counter may be utilized as a general utility counter. Frequencies from 1 MHz to 300MHz can be measured. The Counter Mode Switch can be used in any of the four time base positions: Hz, KHz, KHz, or MHz. See Technical Summary, Section II, for input sensitivities of the counter.

4-11. PORTABLE OPERATION. The built-in battery supply permits completely portable ramp operation for up to two hours with counter readout off and one hour with counter readout on. Battery power to the test set is controlled by a timer activated when the power switch is momentarily pressed to the BAT position. The timer allows ample time for most ramp equipment checks but protects against accidently leaving the set on.

4-12. Between the ramp usage periods the battery should be charged to maintain long life. The charger operation is automatic and is on whenever the NAV-401L is connected to AC power. The set does not have to be turned on. The charger electronically limits the charging current proportional to battery charge condition so overnight charging is recommended.

NOTE

> If the NAV-401L test set is used only for bench operation, the nickel-cadmium batteries can lose their storage ability. The test set should be periodically operated on battery power to allow the batteries to partially discharge.

4-13. Battery voltage is found by placing the MONITOR switch in BAT position. The 0 to 30% scale will show the voltage of the battery. Less than 12.5V indicates a discharged battery. Portable operation should never be attempted at this level. An automatic low voltage cut-off circuit will turn the NAV-401L off just below this level Normal battery charged condition will indicate 14V or greater.

4-14. To operate the LOC and G/S outputs simultaneously, first adjust all controls for normal G/S operation. Use only G/S XTAL mode. The output attenuator will vary the RF level of the G/S signal and the G/S DDM Controls will vary the centering of the G/S signal. Select the LOC with the LOC-PEAK/AVG switch. This activates a separate LOC generator within the NAV-401L. The generator output is combined with the G/S output at the output connector at a fixed level of -18dBm (approximately). The attenuator does not affect the LOC output level in this mode. The LOC DDM Controls will vary the centering of the LOC signal.

4-15. FRONT PANEL CALIBRATION PROCEDURES.

4-16. The following calibration procedures are not intended to be daily tests but used in a preventive maintenance program in a regular schedule, i.e., monthly.

4-17. LOC COURSE CENTERING CALIBRATION. Localizer course centering may be periodically calibrated or checked using the following step-by-step procedures.

a. Delete 90Hz signal by setting LOC DDM switch to 0 and G/S DDM switch to 150.
b. Set MODE switch to LOC XTL.
c. Connect digital voltmeter to SIGNAL GEN DEMOD jack on back panel of test set and record voltage level.
d. Delete 150Hz signal by setting G/S DDM switch to 90.
e. Center LOC by adjusting Localizer Centering Adjust Pot (R4) on front panel to obtain voltmeter indication equal to value recorded in step c (±0.001V).

4-18. G/S COARSE CENTERING CALIBRATION. Glide Slope course centering may be periodically calibrated or checked using the following step-by-step procedures.

a. Delete 90Hz signal by setting G/S DDM switch to 0 and LOC DDM switch to 150.
b. Set MODE switch to G/S XTL.
c. Connect digital voltmeter to SIGNAL GEN DEMOD jack and record voltage indication.
d. Delete 150Hz siganl by setting LOC DDM control to 90.
e. Center G/S by adjusting G/S Centering Adjust Pot (R6) on front panel to obtain a voltmeter indication equal to that recorded in step c (±0.001V).

4-19. VOR BEARING MONITOR CHECK. The VOR bearing system can be monitored at 90° by an internal Bearing Check Circuit accurate to 0.1°. This should not serve as the ultimate proof of performance, as the check accuracy is no greater that the accuracy of the bearing system itself, but it can show up errors in the VOR output and prevent placing improperly calibrated receivers in the field.

4-20. VOR BEARING MONITOR CHECK PROCEDURE.

a. Place MODE switch in VOR XTL or VOR VAR position.
b. Place MONITOR switch in BRG position.
c. Place Counter Mode switch in any position except BRG.
d. Place the Tone Select switch to CTR IN position.
e. Select 090.0 degrees on VOR BRG switches.
f. Place MASTER MOD control in CAL position.
g. Place both VOR tone level controls (30Hz VAR and 9.96 KHz) in full cw position.
h. Place TO/FROM switch in TO position.
i. Allow MONITOR meter to settle for 1 to 2 minutes. When any tendency to drift has ceased, adjust the Meter Bearing Center Adjust (R8), located to the lower right of the Counter Mode Switch, for an exact center-scale indication. Use the 0 to 100% scale. The pointer should indicate 50%.
j. Place Counter Mode switch in BRG position.
k. Wait for meter to settle and read the bearing error. The 50% scale division equals 0, and full scale left and right equals -0.5° and +0.5° error, respectively. Example: 30% = -0.2° and 80% = +0.3°.
l. Read the digital system output on the counter for a quick reference on that circuitry.

    NOTE: The counter will read the digital bearing system output at any heading.

m. Place the TO/FROM switch in FROM position.
n. Read bearing error on the top meter scale

Table 4-1. Typical Test Control Settings

1. MARKER OPERATION

MONITOR Meter & Switch	RF - To verify proper leveling of signal generator. 100% - Use to verify 95% modulation of signal generator.
Counter	GEN - To read out frequency of generator in crystal or variable modes.
MODE Switch	MKR XTAL - Mandatory in ramp operation; used on bench for standard marker center frequency. MKR VAR - Useful to check receiver bandwidths, etc. Can be phased locked in 25 KHz steps.
VAR FREQ Controls	Use as necessary in MKR VAR to check bandwidth of receiver.
TUNE Controls	Tune Generator output for tune indicator off and dip on meter.
OUTPUT Attenuator	Use as necessary to establish receiver sensitivities.
RF OUT Connector	Connect to receiver antenna connector, or attach antenna in ramp operation.
Tone Select Switch	Select tone- 1020 (Indent tone) 400, 1300, 3000 Hz as desired.
MASTER MOD Control	Set to CAL for 95% or variable from 0 to 98%.
Power Switch	AC or Battery as desired.

Table 4-1 (cont'd)
2. VOR OPERATION

MONITOR Meter & Switch	RF - To verify proper leveling of signal generator. 30% or 100% - Used to verify or set 30% modulation of each VOR modulating tone. BRG - Use to verify operation of bearing signal at 90° (Internally).
Counter	GEN - To read out frequency of generator in crystal or variable modes.
MODE Switch	VOR XTAL - Mandatory in ramp operation; used on bench for a very stable channel center frequency. VOR VAR - Can be phase-locked in 25 KHz steps for all channel bench operation or to check receiver bandwidths, etc.
VAR FREQ Controls	Use in VOR VAR mode to change VOR frequency either in 25 KHz steps or to continuously sweep frequency.
TUNE Controls	Tune generator output for tune light out and dip on meter.
OUTPUT Attenuator	Use as necessary to establish receiver sensitivities.
RF OUT Connector	To receiver antenna connector, or attach antenna in ramp operation.
Tone Select Switch	Select Ident Tone - 1020Hz (or others if desired)
30Hz VAR Level	Use to vary the modulation level of the 30 Hz component from 0 to 30%.
9.96 KHz Level	Use to vary the modulation level of the 9.96 KHz component from 0 to 30%.

Table 4-1 (cont'd)

MASTER MOD Control	Set to CAL for 30% each VOR tone or variable from 0 to 60% each tone.
Power Switch	AC or Battery as desired.
VOR BRG	To bearing desired for radial testing and alignment.
TO/FROM	Use to achieve exact reciprocals of bearings selected and flag test of indicators.

3. LOC OPERATION

MONITOR Meter & Switch	RF - To verify proper leveling of signal generator. 30% - Verify or set 20% modulation of each modulating tone and set course centering.
Counter	GEN - To read out frequency of generator in crystal or variable mode.
MODE Switch	LOC XTAL - Mandatory in ramp operation; used on bench for a very stable channel center frequency. LOC VAR - Can be phase-locked in 25 KHz steps for all channel bench operation or to check receiver bandwidths, etc.
VAR FREQ Controls	Use in LOC VAR mode. Change LOC frequency either in 25 KHz steps or to continuously sweep frequency.
TUNE Controls	Tune Generator output for tune light out and dip on meter
OUTPUT Attenuator	Use as necessary to establish receiver sensitivities.
RF OUT Connector	To receiver antenna connector, or attach antenna in ramp operation.
Tone Select Switch	Select Ident Tone - 1020Hz (or others if desired).

Table 4-1 (cont'd)

LOC DDM Control	Stepped - Used for precise amounts of deflection and flag tests. VAR - Used for checking auto-pilot servos, meter stickiness, etc.
MASTER MOD Control	Set to CAL for 20% each course tone and 30% Ident Tone, or variable 0 to 40% each course tone and 0 to 60% Ident Tone.
Power Switch	AC or Battery as desired.

4. G/S OPERATION

MONITOR Meter & Switch	RF - To verify proper leveling of signal generator. 100% - Verify or set 40% modulation of each modulating tone and set course centering.
Counter	GEN - To read out frequency of generator in crystal or variable mode.
MODE Switch	G/S XTAL - Mandatory in ramp operation; used on bench for a very stable channel center frequency. G/S VAR - G/S can be phase locked in 50 KHz steps for all channel bench operation or to check receiver bandwidths, etc.
VAR FREQ Controls	Use in G/S VAR mode to change G/S frequency either in 50KHz steps or to continuously sweep frequency.
TUNE Controls	Tune generator output for tune indicator off and dip on meter.
OUTPUT Attenuator	Use as necessary to establish receiver sensitivities.
RF OUT Connector	To receiver antenna connector, or to attach antenna in ramp operation.

Table 4-1 (cont'd)

G/S DDM Control	Stepped - Used for precise amount of deflection and flag tests. VAR - Used for checking autopilot servos, meter stickiness, etc.
MASTER MOD Control	Set to CAL for 40% each course tone, or variable 0 to 80%.
Power Switch	AC or Battery as desired.
LOC - PEAK/AVG Switch	LOC position if simultaneous G/S and LOC output desired. NOTE: Mode switch should be in G/S XTAL position.

5. COMM OPERATION (RECEIVER TESTS)

MONITOR Meter and Switch	RF - To verify proper leveling of signal generator. 30% or 100% - Verify or set 30% sine wave modulation tone.
Counter	GEN - To read out frequency of generator in crystal or variable mode.
MODE Switch	COMM XTAL - Mandatory in ramp operation; used on bench for a very stable channel center frequency. COMM VAR LO - Use to check COMM receiver channels 118.0 to 135.95 MHz. COMM VAR HI - Use to check COMM receiver channels 134.0 to 158 MHz.
VAR FREQ Controls	Use in COMM VAR modes to change COMM frequency in 25 KHz steps or to continuously sweep frequency.
TUNE Controls	Tune generator output for tune light out and dip on meter.
OUTPUT Attenuator	Use as necessary to establish receiver sensitivities.

Table 4-1 (cont'd)

RF OUT Connector	To receiver antenna connector, or attach antenna in ramp operation.
Tone Select Switch	Use to select tone frequency desired or for external modulation input (bench testing only).
MOD IN/CTR IN Connector	Use to apply external modulation to Signal Generator.
MASTER MOD Control	Set to CAL for 30% each tone selected or variable 0 to 60% modulation each tone.
Power Switch	AC or Battery as desired.

6. COMM OPERATION (TRANSMITTER TESTS)

MONITOR Meter & Switch	10W or 100W - Use to measure transmitter power. **CAUTION** Observe power versus time limits of power meter.
Counter	Hz, KHz - Use of measure transmitter frequency - KHz, MHz, HF or VHF bands.
LOC-PEAK/AVG Power Switch	Peak - Use to indicate increase in power during modulation. Avg - Use to indicate Avg power only disregarding modulation.
MOD IN/CTR IN Jack	Attach whip antenna for COMM frequency measurements in portable operation.
Tone Select Switch	To CTR IN position.
Power Switch XMTR IN Connector	AC or Battery as desired. Connect to COMM transmitter output.

SECTION V

REFERENCE CHARTS AND TABLES

Table 5-1. Correspondence Chart for Decibels, Volts, and Watts (50ΩLoad)

Decibels	Volts	Watts
+40dBw	709V	10,000W
+39dBw	633V	7,940W
+38dBw	563V	6,320W
+37dBw	501V	5,000W
+36dBw	447V	3,980W
+35dBw	399V	3,160W
+34dBw	355V	2,510W
+33dBw	317V	2,000W
+32dBw	282V	1,590W
+31dBw	252V	1,260W
+30dBw	224V	1,000W
+29dBw	200V	794W
+28dBw	178V	632W
+27dBw	159V	500W
+26dBw	141V	398W
+25dBw	126V	316W
+24dBw	112V	251W
+23dBw	100V	200W
+22dBw	89.1V	159W
+21dBw	79.5V	126W
+20dBw	70.9V	100W
+19dBw	63.3V	79.4W
+18dBw	56.3V	63.2W
+17dBw	50.1V	50.0W
+16dBw	44.7V	39.8W
+15dBw	39.9V	31.6W
+14dBw	35.5V	25.1W
+13dBw	31.7V	20.0W
+12dBw	28.2V	15.9W
+11dBw	25.2V	12.6W
+10dBw	22.4V	10.0W
+9dBw	20.0V	7.94W
+8dBw	17.8V	6.32W
+7dBw	15.9V	5.00W
+6dBw	14.1V	3.98W
+5dBw	12.6V	3.16W
+4dBw	11.2V	2.51W
+3dBw	10.0V	2.00W
+2dBw	8.91V	1.59W
+1dBw	7.95V	1.26W
0dBw = +30dBm	7.09V	1.00W = 1000mW
+29dBm	6.33V	794mW
+28dBm	5.63V	632mW
+27dBm	5.01V	500mW
+26dBm	4.47V	298mW
+25dBm	3.99V	316mW
+24dBm	3.55V	251mW
+23dBm	3.17V	200mW
+22dBm	2.82V	159mW
+21dBm	2.52V	126mW
+20dBm	2.24V	100mW
+19dBm	2.00V	79.4mW
+18dBm	1.78V	63.2mW
+17dBm	1.59V	50.0mW
+16dBm	1.41V	39.8mW
+15dBm	1.26V	31.6mW
+14dBm	1.12V	25.1mW
+13dBm	1.00V = 1000mV	20.0mW
+12dBm	891mV	15.9mW
+11dBm	795mV	12.6mW
+10dBm	709mV	10.0mW

Table 5-1 (cont'd)

Decibels	Volts	Watts
+9dBm	633mV	7.94mW
+8dBm	563mV	6.32mW
+7dBm	501mV	5.00mW
+6dBm	447mV	3.98mW
+5dBm	399mV	3.16mW
+4dBm	355mV	2.51mW
+3dBm	317mV	2.00mW
+2dBm	282mV	1.59mW
+1dBm	252mV	1.26mW
0dBm	224mV	1.00mW = 1000uW
-1dBm	200mV	794uW
-2dBm	178mV	632uW
-3dBm	159mV	500uW
-4dBm	141mV	398uW
-5dBm	126mV	316uW
-6dBm	112mV	251uW
-7dBm	100mV	200uW
-8dBm	89mV	159uW
-9dBm	79mV	126uW
-10dBm	70.9mV	100uW
-11dBm	63.3mV	79.4uW
-12dBm	56.3mV	63.2uW
-13dBm	50.1mV	50.0uW
-14dBm	44.7mV	39.8uW
-15dBm	39.9mV	31.6uW
-16dBm	35.5mV	25.1uW
-17dBm	31.7mV	20.0uW
-18dBm	28.2mV	15.9uW
-19dBm	25.2mV	12.6uW
-20dBm	22.4mV	10.0uW
-21dBm	20.0mV	7.94uW
-22dBm	17.8mV	6.32uW
-23dBm	15.9mV	5.00uW
-24dBm	14.1mV	3.98uW
-25dBm	12.6mV	3.16uW

Decibels	Volts	Watts
-26dBm	11.2mV	2.51uW
-27dBm	10.0mV	2.00uW
-28dBm	8.9mV	1.59uW
-29dBm	7.95mV	1.26uW
-30dBm	7.09mV	1.00uW = 1000nW
-31dBm	6.33mV	794nW
-32dBm	5.63mV	632nW
-33dBm	5.01mV	500nW
-34dBm	4.47mV	398nW
-35dBm	3.99mV	316nW
-36dBm	3.55mV	251nW
-37dBm	3.17mV	200nW
-38dBm	2.82mV	159nW
-39dBm	2.52mV	126nW
-40dBm	2.24mV	100nW
-41dBm	2.00mV	79.4nW
-42dBm	1.78mV	63.2nW
-43dBm	1.59mV	50.0nW
-44dBm	1.41mV	39.8nW
-45dBm	1.26mV	31.6nW
-46dBm	1.12mV	25.1nW
-47dBm	1.00mV = 1,000uV	20.0nW
-48dBm	891uV	15.9nW
-49dBm	795uV	12.6nW
-50dBm	709uV	10.0nW
-51dBm	633uV	7.94nW
-52dBm	563uV	6.32nW
-53dBm	501uV	5.00nW
-54dBm	447uV	3.98nW
-55dBm	399uV	3.16nW
-56dBm	355uV	2.51nW
-57dBm	317uV	2.00nW
-58dBm	282uV	1.59nW
-59dBm	252uV	1.26nW
-60dBm	224uV	1.00nW = 1000pW

Table 5-1 (cont'd)

Decibels	Volts	Watts
-61dBm	200uV	794pW
-62dBm	178uV	632pW
-63dBm	159uV	500pW
-64dBm	141uV	398pW
-65dBm	126uV	316pW
-66dBm	112uV	251pW
-67dBm	100uV	200pW
-68dBm	89.1uV	159pW
-69dBm	79.5uV	126pW
-70dBm	70.9uV	100pW
-71dBm	63.3uV	79.4pW
-72dBm	56.3uV	63.2pW
-73dBm	50.1uV	50.0pW
-74dBm	44.7uV	39.8pW
-75dBm	39.9uV	31.6pW
-76dBm	35.5uV	25.1pW
-77dBm	31.7uV	20.0pW
-78dBm	28.2uV	15.9pW
-79dBm	25.2uV	12.6pW
-80dBm	22.4uV	10.0pW
-81dBm	20.0uV	7.94pW
-82dBm	17.8uV	6.32pW
-83dBm	15.9uV	5.00pW
-84dBm	14.1uV	3.98pW
-85dBm	12.6uV	3.16pW
-86dBm	11.2uV	2.51pW
-87dBm	10.0uV	2.00pW
-88dBm	89.1uV	1.59pW
-89dBm	7.95uV	1.26pW
-90dBm	7.09uV	1.00pW = 1000fW
-91dBm	6.33uV	794fW
-92dBm	5.63uV	632fW
-93dBm	5.01uV	500fW
-94dBm	4.47uV	398fW
-95dBm	3.99uV	316fW

Decibels	Volts	Watts
-96dBm	3.55uV	251fW
-97dBm	3.17uV	200fW
-98dBm	2.82uV	159fW
-99dBm	2.52uV	126fW
-100dBm	2.24uV	100fW
-101dBm	2.00uV	79.4fW
-102dBm	1.78uV	63.2fW
-103dBm	1.59uV	50.0fW
-104dBm	1.41uV	39.8fW
-105dBm	1.26uV	31.6fW
-106dBm	1.12uV	25.1fW
-107dBm	1.00uV = 1,000nV	20.0fW
-108dBm	891nV	15.9fW
-109dBm	795nV	12.6fW
-110dBm	709nV	10fW
-111dBm	633nV	7.94fW
-112dBm	563nV	6.32fW
-113dBm	501nV	5.00fW
-114dBm	447nV	3.98fW
-115dBm	399nV	3.16fW
-116dBm	355nV	2.51fW
-117dBm	317nV	2.00fW
-118dBm	282nV	1.59fW
-119dBm	252nV	1.26fW
-120dBm	224nV	1.00fW = 1000aW
-121dBm	200nV	794aW
-122dBm	178nV	632aW
-123dBm	159nV	500aW
-124dBm	141nV	398aW
-125dBm	126uV	316aW
-126dBm	112nV	251aW
-127dBm	100nV	200aW
-128dBm	89.1nV	150aW
-129dBm	79.5nV	126aW
-130dBm	70.9nV	100aW

Table 5-1 (cont'd)

Decibels	Volts	Watts
-131dBm	63.3nV	79.4aW
-132dBm	56.3nV	63.2aW
-133dBm	50.1nV	50.0aW
-134dBm	44.7nV	39.8aW
-135dBm	39.9nV	31.6aW

Decibels	Volts	Watts
-136dBm	35.5nV	25.1aW
-137dBm	31.7nV	20.0aW
-138dBm	28.2nV	15.9aW
-139dBm	25.2nV	12.6aW
-140dBm	22.4nV	10.0aW

dBw - decibels referenced to one watt
dBm - decibels referenced to one milliwatt
V - volts
mV - millivolts (volts x 10^{3})
uV - microvolts (volts x 10^{6})
nV - nanovolts (volts x 10^{9})
W - watts
mW - milliwatts (watts x 10^{3})
uW - microwatts (watts x 10^{6})
nW - nanowatts (watts x 10^{9})
pW - picowatts (watts x 10^{12})
fW - femtowatts (watts x 10^{15})
aW - attowatts (watts x 10^{18})

Table 5-2. Correspondence Charts for 90Hz and 150Hz Tones

LOCALIZER

Tone Difference Values			Coarse Deviation Indicator	
90Hz and 150Hz % Modulation	DDM	Decibels	Deflections	Microamps
20.00, 20.00	0	0	Centered	0
15.35, 24.65	.093	4.114	Standard	90
12.25, 27.75	.155	7.102	Full Scale	150
10.00, 30.00	.200	9.542	More than full scale	194
0.00, 40.00	.4	Infinity	Full one tone delete other	387

NOTE:
- Standard CDI deflection = 60% of full scale (linear movement).
- Deflections in microamps apply to indicators with full scale deflection current of 150µA.

GLIDE SLOPE

Tone Difference Values			G/S Deviation Indicator	
90Hz and 150Hz % Modulation	DDM	Decibels	Deflection	Microamps
40.00, 40.00	0	0	Centered	0
35.45, 44.55	.091	1.988	Standard	78
31.25, 48.75	.175	3.622	Full Scale	150
20.00, 60.00	.400	9.542	More than full scale	343
0.00, 80.00	.8	Infinity	Full one tone delete other	686

NOTE
- Standard G/S indicator deflection = 53% of full scale (linear movement).
- Deflections in microamps apply to indicators with full scale deflection current of 150µA.

Table 5-3. 150Hz and 90Hz Tones Variable Phase Relationships

VOR BRG Switch Position	150Hz Phase Relative to 90Hz
000.0	0°
001.0	+5°
002.0	+10°
003.0	+15°
004.0	+20°
005.0	+25°
006.0	+30°
007.0	+35°
008.0	+40°
009.0	+45°
010.0	+50°
011.0	+55°
012.0	+60°
013.0	+65°
014.0	+70°
015.0	+75°
016.0	+80°
017.0	+85°
018.0	+90°
019.0	+95°
020.0	+100°
021.0	+105°
022.0	+110°
023.0	+115°
024.0	+120° or 0 ° *

* +120° will have the same phase relationship as 0°; therefore, only 1° through 12° BRG switch positions need be used.

SECTION VI

THEORY OF OPERATION

6-1. INTRODUCTION.

6-2. The purpose of Sections VI through XV is to give the technician all information to calibrate, repair, and prove the performance of the NAV-401L test set. This section gives information pertaining to the general theory of circuit operation. See figure 6-1, Simplified Overall NAV-401L Block Diagram.

6-3. TONE GENERATORS. See figure 6-2, Simplified Tone Generator Block Diagram.

6-4. Nine different audio tones or signals are utilized in the NAV-401L. They are the standard Ident tone (1020Hz), the three Marker tones (400Hz, 1300Hz and 3000Hz), the LOC and G/S tones (90Hz and 150Hz), the two VOR signals (30Hz Reference Phase and 30Hz Variable Phase), and the VOR subcarrier (9960Hz).

6-5. Four of the tones, 1020Hz, 400Hz, 1300Hz and 3000Hz, are generated on the Regulator-Timer Board PC-2. The Tone Select switch selects the frequency of a stable operational amplifier, RC oscillator. The tone output is applied through the MODE switch to the 30Hz Sine Board, PC-4, for combining with VOR and LOC signals, and modulation for MKR and COMM.

6-6. Four other tones are originated by the Bearing Logic Board, PC-5, the 30Hz Reference and 30Hz Variable Phase tones for the VOR signal and the 90Hz and 150Hz tones for LOC and G/S use. PC-5 generates only the square-wave outputs for these signals, they are converted to sine signals on other boards. Two outputs for the 30Hz Variable phase signal, 180° apart, are applied to the TO/FROM switch for reciprocal bearing selection before being converted to sine signals.

6-7. Within the Bearing Logic Board a system is incorporated to shift the phase of the 150Hz signal relative, to the 90Hz signal. The VOR BRG switches are utilized to achieve an exact phase shift from 0° to +60°, which is the worst case phase relationship.

6-8. The square wave outputs from the Bearing Logic Board are applied to two other boards for conversion to sine signals. The two 30Hz outputs go to the 30Hz Sine Board, PC-4. The 90Hz and 150Hz outputs go to the Combination Sine Board, PC-3.

6-9. On PC-3 the 90Hz and 150Hz square waves are processed through synthesizers to obtain accurate, low-distortion sine waves. The 90Hz output is applied to the LOC and G/S centering adjust controls and then to the LOC and G/S deviations switches. The 150Hz output is applied directly to the LOC and G/S deviation switches. The two signals are properly summed in the LOC and G/S DDM switches, and are applied to the 30Hz Sine Board, PC-4.

6-10. The 30Hz Variable and 30Hz Reference Phase VOR square wave are applied from the Bearing Logic Board, PC-5, to the 30Hz Sine Board, PC-4. On the PC-4 the two square waves are processed into accurate sine signals. The 30Hz Reference Sine output is then applied to the modulation input of a 9960Hz oscillator which is phase locked to the 30Hz Reference. Modulation is presented to FM modulate the 9960Hz output to an accurate ±480Hz deviation. This forms the reference subcarrier for the VOR signal.

6-11. The 30Hz Variable Sine output and the 9960Hz FM Sine output are applied to the 30Hz VAR and 9.96kHz level controls and then back into PC-4 for summing together to form the composite VOR signal. A tone input from the Regulator-Timer Board (see paragraph 6-6) can also be combined with the VOR signal for Ident checks, etc. The tone input is buffered before combining with the VOR signal. The entire VOR composite signal is then applied to the MODE switch for selection during the VOR mode of operation.

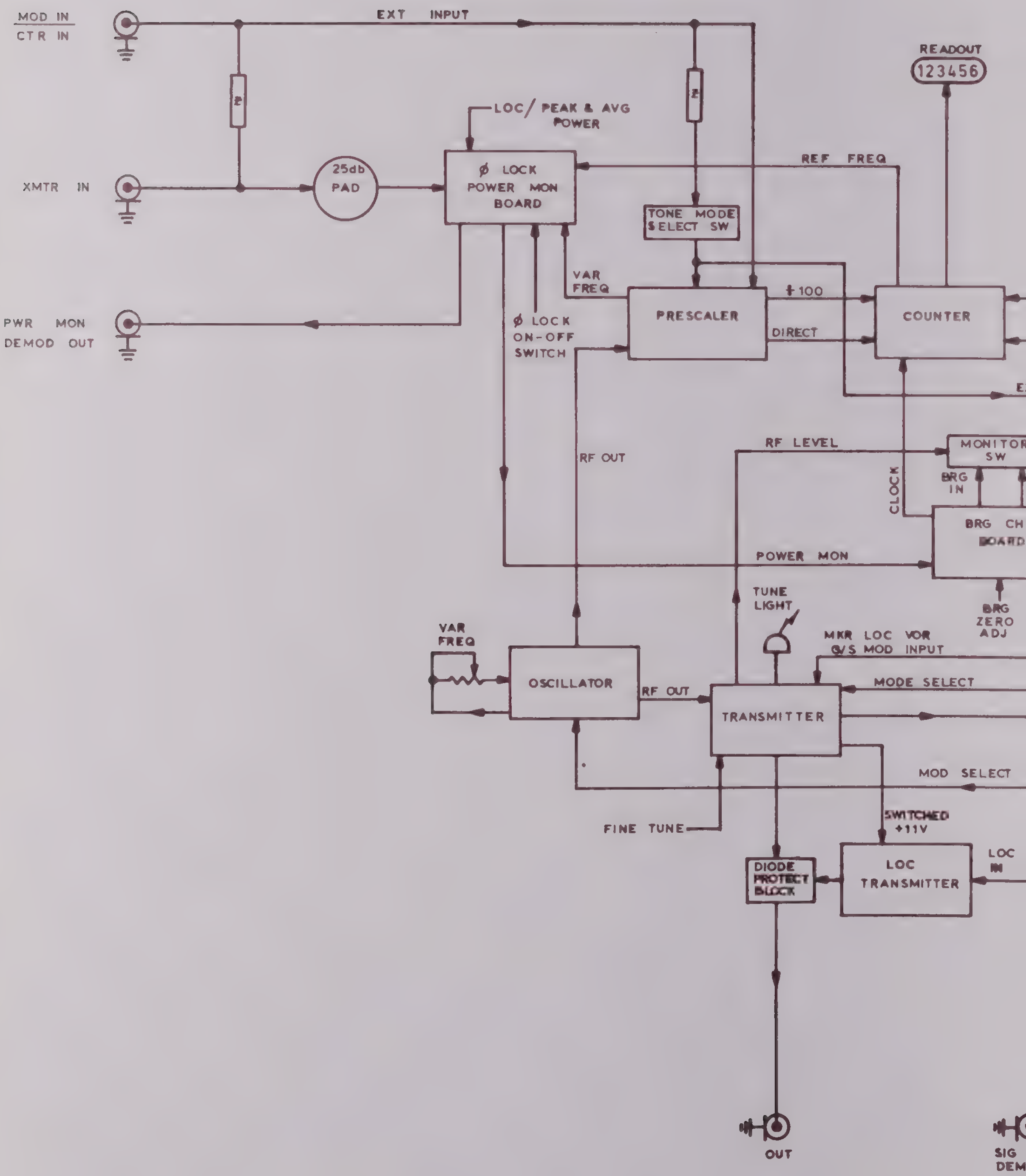
6-12. The LOC Deviation Switch input to PC-4 is buffered and then applied to the MODE switch for selection during the LOC mode of operation. At the buffer output, a tone from the Regulator-Timer Board (see paragraph 6-6) can be combined with the LOC signal for Ident checks, ect.

6-13. The LOC buffer output is presented at an output terminal of PC-4 to use as LOC modulation for the additional LOC generator utilized in the NAV-401L. Tone modulation cannot be added to this output.

6-14. The G/S Deviation Switch input to PC-4 is applied through a buffer amplifier to the MODE switch for selection during G/S mode of operation. No other tones can be added to the G/S signal.

6-15. The tone buffer output is applied directly to the MODE switch for MKR tones during the Marker mode of operation. A dropping resistor reduces the tone level at the MODE switch for use in the COMM modes. Modulation level is 95% for MKR and 30% for COMM.

6-16. The MODE switch selects the RF output desired nd the type of modulation needed for a particular mode. The selection modulation is applied to the Combination Sine Board, PC-3, where it is processed through either a fixed level buffer amplifier or through a variable level buffer amplifier. The fixed amplifier is used in MASTER MOD CAL position; the variable level amplifier is used in the uncalibrated MASTER MOD control position. In variable mode the position



MOD IN
CTR IN
EXT INPUT
READOUT
123456
LOC/ PEAK & AVG POWER
XMTR IN
25db PAD
ϕ LOCK POWER MON BOARD
REF FREQ
TONE MODE SELECT SW
VAR FREQ
PRESCALER
÷100
DIRECT
COUNTER
PWR MON DEMOD OUT
ϕ LOCK ON-OFF SWITCH
RF OUT
RF LEVEL
MONITOR SW
CLOCK
BRG IN
BRG CH BOARD
POWER MON
TUNE LIGHT
BRG ZERO ADJ
MKR LOC VOR G/S MOD INPUT
VAR FREQ
OSCILLATOR
RF OUT
MODE SELECT
TRANSMITTER
MOD SELECT
SWITCHED +11V
FINE TUNE
DIODE PROTECT BLOCK
LOC TRANSMITTER
LOC IN
OUT
SIG

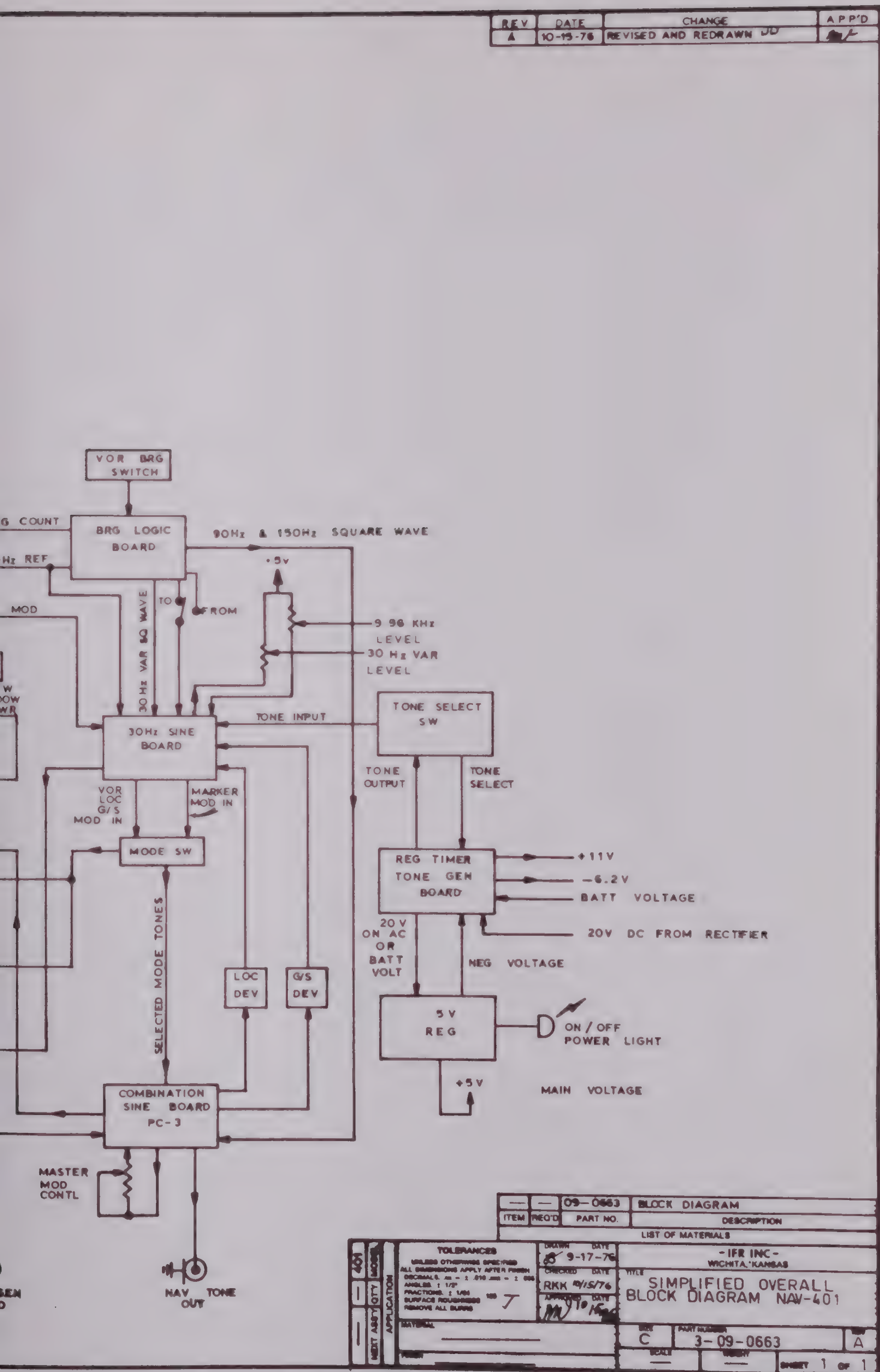

REV | DATE | CHANGE | APP'D
A | 10-15-76 | REVISED AND REDRAWN
VOR BRG SWITCH
G COUNT
BRG LOGIC BOARD
90Hz & 150Hz SQUARE WAVE
Hz REF
+5v
MOD
TO
FROM
30 Hz VAR SQ WAVE
9.96 KHz LEVEL
30 Hz VAR LEVEL
TONE INPUT
TONE SELECT SW
30Hz SINE BOARD
TONE OUTPUT
TONE SELECT
VOR LOC G/S MOD IN
MARKER MOD IN
MODE SW
REG TIMER TONE GEN BOARD
+11V
−6.2V
BATT VOLTAGE
20V DC FROM RECTIFIER
20 V ON AC OR BATT VOLT
NEG VOLTAGE
SELECTED MODE TONES
LOC DEV
G/S DEV
5 V REG
ON / OFF POWER LIGHT
+5V
MAIN VOLTAGE
COMBINATION SINE BOARD PC-3
MASTER MOD CONTL
NAV TONE OUT
09-0663 BLOCK DIAGRAM
ITEM | REQ'D | PART NO. | DESCRIPTION
LIST OF MATERIALS
TOLERANCES
401 | 1 | MODEL | QTY | NEXT ASSY | APPLICATION
DRAWN 9-17-76
CHECKED RKK 10/15/76
- IFR INC -
WICHITA, KANSAS
SIMPLIFIED OVERALL BLOCK DIAGRAM NAV-401
C
3-09-0663
A
SHEET 1 OF 1

FIG 6-1

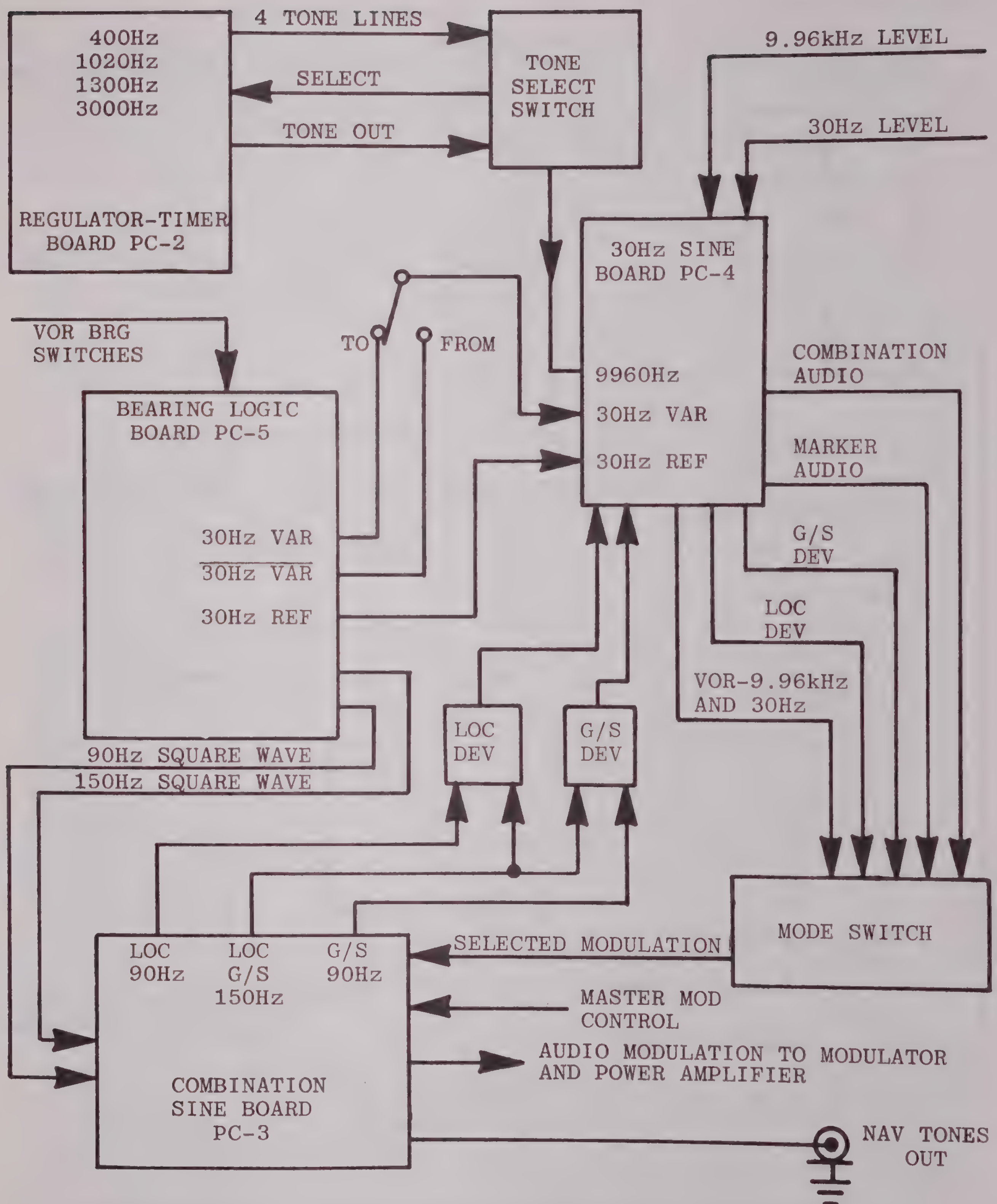


Figure 6-2. Simplified Tone Generator Block Diagram

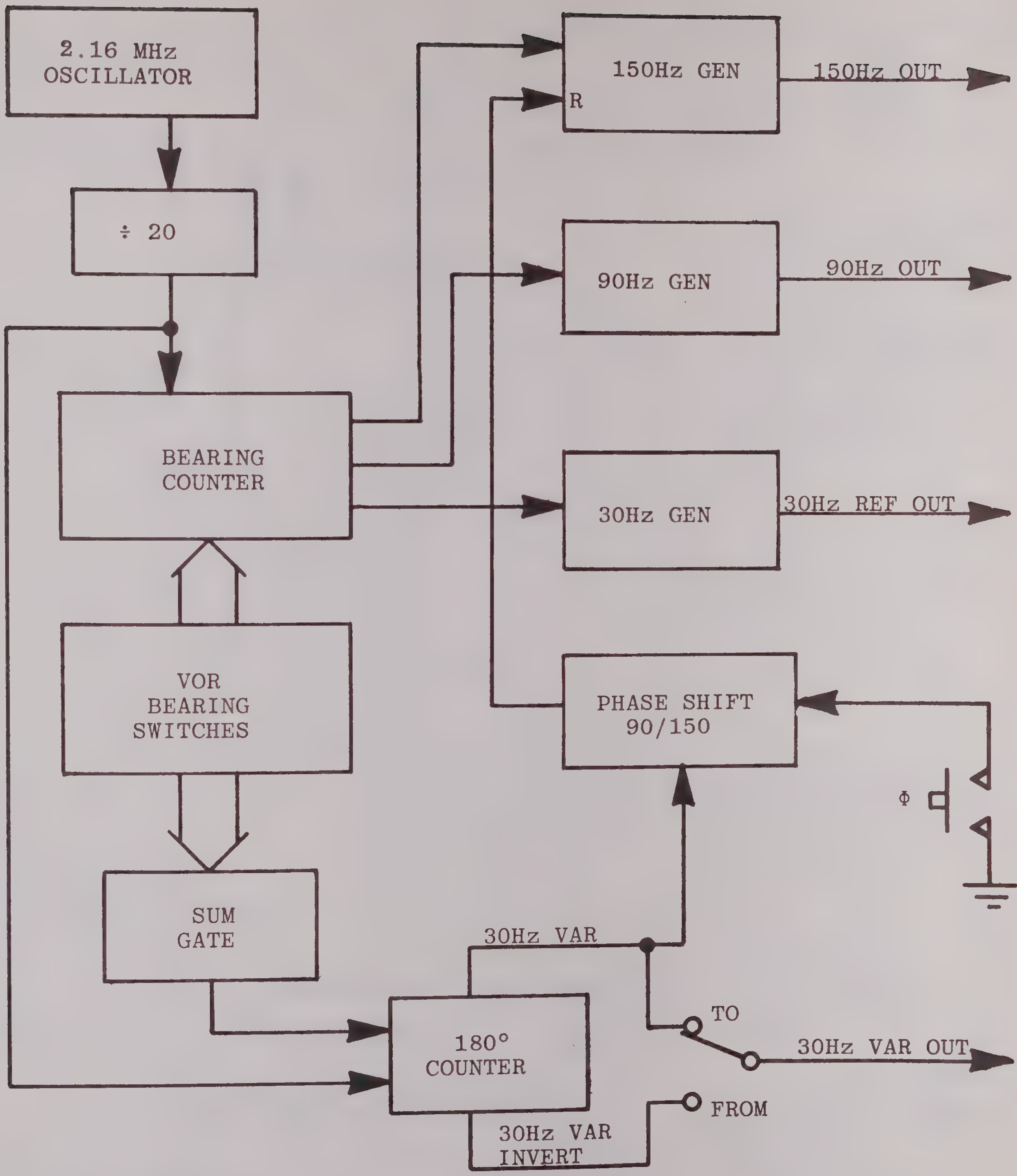


Figure 6-3. Simplified Bearing Generator Block Diagram

6-17. The modulation output from the fixed or variable amplifier is applied to the modulator input in the modulator and power amplifier, Assembly 6, and modulates the RF output of the test set. The modulation output of PC-3 is also applied through a separate buffer amplifier to the NAV TONE output connector on the rear of the test set.

6-18. BEARING GENERATOR. See figure 6-3, Simplified Bearing Generator Block Diagram.

6-19. The VOR bearing is generated in the NAV-401L by a crystal-controlled digital counting system. All involved circuitry except the bearing select switches is located on the Bearing Logic Board, PC-5. The 90Hz and 150Hz LOC and G/S tones are also generated on the Bearing Logic Board as a side product of the bearing counters.

6-20. A crystal oscillator and divider circuit on PC-5 generates a clock signal that has a time interval equal to 0.1° of bearing. The clock signal is applied to a counter that counts 3600 input impulses and then resets to begin a new count cycle. Gates and other logic circuits perform the count control for the counter. The output of the count control circuit forms the 30Hz Reference output.

6-21. Four thumbwheel switches sense counts in the bearing counter from 000.1° to 359.9°. The switch outputs are summed together through a common gate and applied as a start pulse to a counter.

6-22. Immediately after the start pulse is applied the counter begins counting clock pulses at a 0.1° rate. After 180° of pulses have been counted a counter control circuit stops the clock input and resets the counter. The output of the 180° counter system is a 30Hz square wave delayed from the start of the 30Hz Reference signal by the number of degrees selected in the VOR BRG switches. Two outputs are available 180° apart to simulate a TO or FROM signal.

6-23. The 90Hz and 150Hz tones are generated by picking off counts from the bearing counter and adding further division. By this method the 90Hz and 150Hz frequencies are both crystal controlled and phase-locked together.

6-24. The phase relationship between the 90Hz and 150Hz tones, normally locked in the proper relationship, can be varied by a special circuit. By using the reset from the 30Hz Variable output signal, the 150Hz tone can be stepped in 5° increments relative to the 90Hz tone using the bearing switches. Each 1° of bearing selected causes 5° of the 150Hz phase shift.

6-25. RF SECTION. See figure 6-4, Simplified RF Block Diagram.

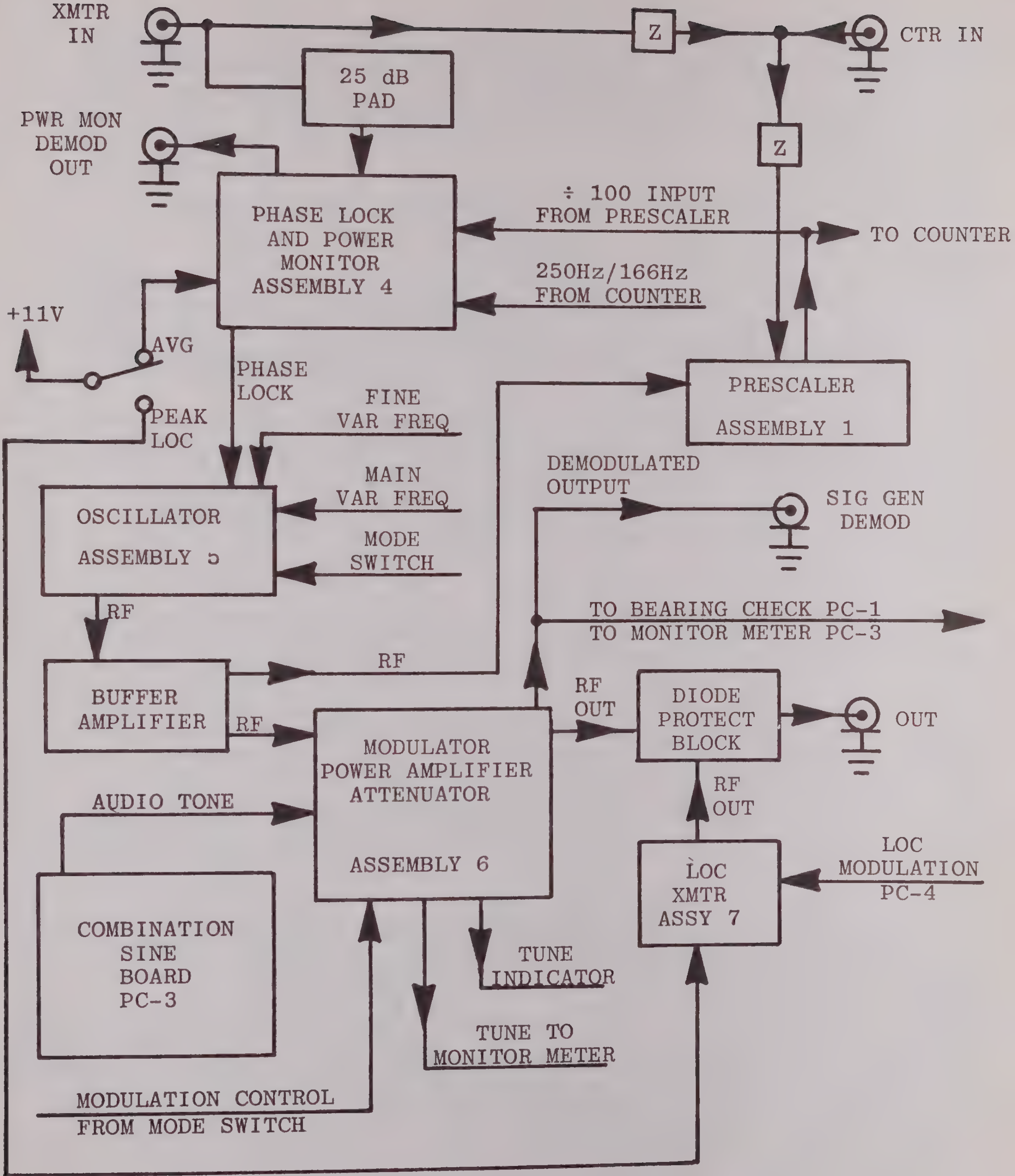


Figure 6-4. Simplified RF Generator Block Diagram

6-26. All Rf energy is generated in the NAV-401L by the oscillator assembly, assembly 5. Within the assembly are five crystal controlled oscillators and one variable-frequency oscillator, bandswitched to cover from 72-78MHz and 107-156MHz. The crystal frequencies are those authorized for ramp use by the FAA. Special frequencies can be substituted if required.

6-27. The oscillator output is fed through a buffer amplifier to the Modulation/Power Amplifier assembly. Within the assembly the modulator and power amplifier are designed as a servo control system with the RF output controlled by the modulator.

6-28. All RF is amplified and fed through the power amplifier with no frequency change except in G/S mode, where the input carrier frequency is trippled in the output stage. All power amplifier circuits are broadtuned except the output stage which must be peaked for proper output by a front panel tune control. The output stage directly feeds the input of an attenuator whose output is presented to a Diode Protect Block. The Protect Block guards against damage to the attenuator if a transmitter is connected to the OUT connector.

6-29. The RF output level at the attenuator input is detected and applied to the modulator input. The proper audio modulation is also applied to the modulator and power amplifier after being buffered by an amplifier on the Combination Sine Board, PC-3. The modulator collector-modulates the output stage of the power amplifier and requires a certain level of RF output to achieve the percent modulation requirements and RF level out of the output stage. Each of the five modes of operation requires a different detected voltage, which is determined by five gain switches in the modulator driven by Mode Control Lines from the Mode Switch.

6-30. The modulator output to the power amplifier may be connected to the MONITOR meter by the Tune Switch. The power amplifier is in perfect tune when the command voltage from the Modulator is minimum; therefore, when the TUNE switch is pressed, the Tune control is adjusted for a dip on the MONITOR meter.

6-31. The modulator output is also applied to a TUNE Indicator which comes on whenever the modulator is commanding more detected RF voltage when the power amplifier is tuned for. When the power amplifier is properly adjusted the TUNE Indicator will go off.

6-32. Because the percentage of modulation is directly controlled by the modulator, sampling the output of the modulator input amplifier can give a direct measurement of that percentage, as well as a relative indication of power amplifier tune condition. That output is applied to three places. The first place is the Combination Sine Board where the signal is split into two circuits: The Modulation Monitor circuit and the RF level meter circuit.

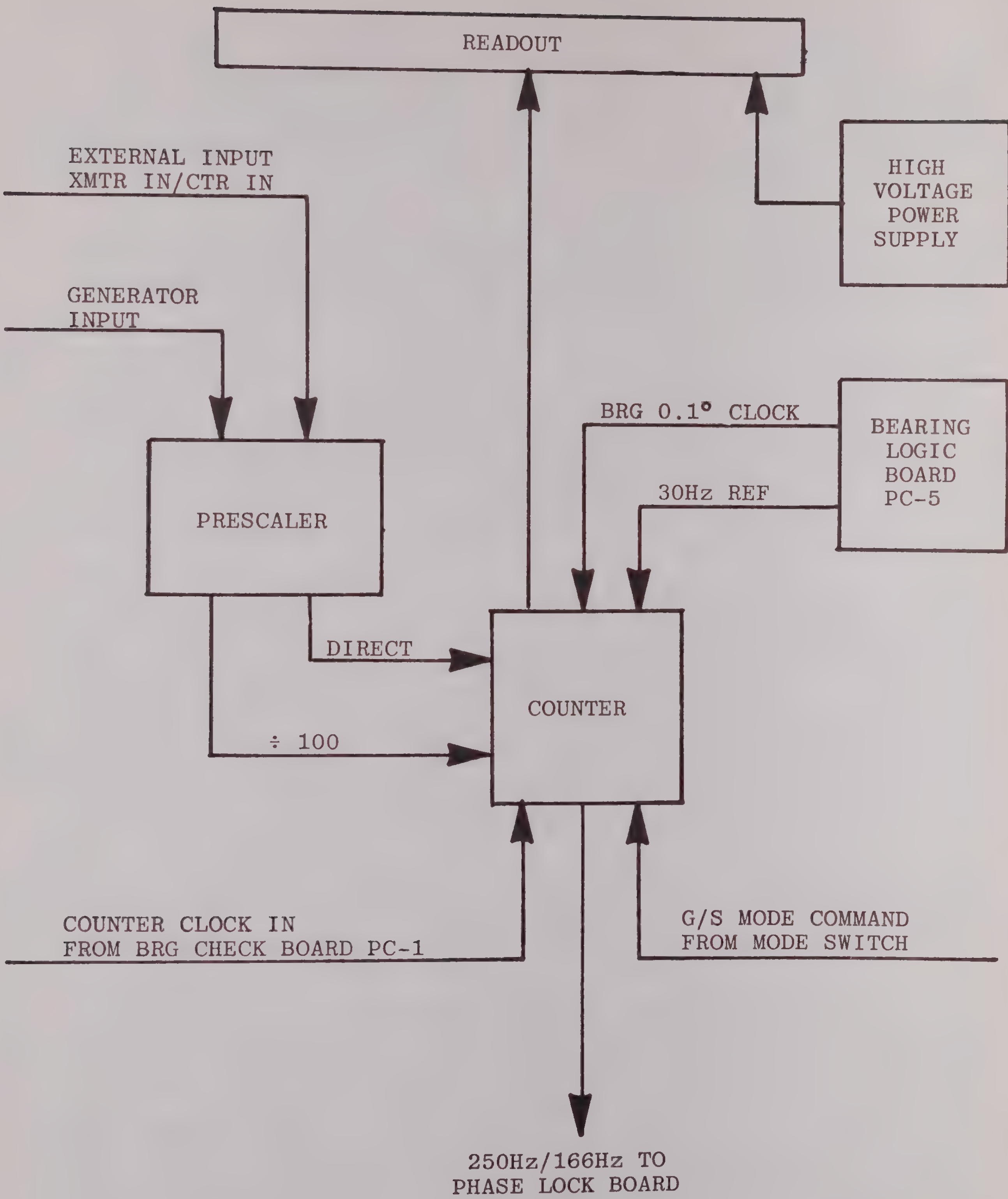


Figure 6-5. Simplified Counter Block Diagram

The second place is the SIG GEN DEMOD output connector on the rear of the test set for measuring with a precision meter for modulation determination purposes. The output is also applied to the Bearing Check Board, PC-1. During VOR operation, the modulation is demodulated to determine VOR relative bearing error in the RF output.

6-33. A separate localizer generator is installed in the set and is turned on when the LOC-PEAK/AVG power switch in LOC-PEAK position. The localizer generator frequency is chosen to pair with the 334.7MHz G/S XTL frequency and is fixed at 108.10MHz. Audio from the LOC DDM switch is applied to the generator to modulate the output. Output level is approximately -16 to -18 dBm and is mixed with the G/S XTL RF in the Diode Protect Block.

6-34. When the MODE switch is set to any VAR position, the oscillator can be phase locked in 25kHz increments or operated completely free-running. The phase-lock circuit is located on the Phase Lock/Power Monitor assembly, Assembly 4. G/S is phase locked at 50kHz increments.

6-35. The reference frequency for phase lock is 250Hz taken from the counter. The oscillator frequency is taken from the ÷ 100 prescaler output and compared against the 250Hz reference. The oscillator output frequency is set by the main VAR FREQ control. When the output frequency closely equals the nearest 25kHz step, the oscillator frequency is locked to that 25kHz step.

6-36. In G/S mode, the reference frequency for phase lock is 166Hz taken from the counter, and will phase lock at 50kHz steps.

6-37. When phase-lock operation is not desired the coarse VAR FREQ control gives very large frequency changes for any rotation and the Fine VAR FREQ control gives small frequency changes.

6-38. A COMM transmitter can be connected to theXMTR IN connector where the power is applied to a 25dB pad. The output of the pad is applied to the Power Monitor portion of Assembly 4. A monitoring circuit drives the monitor meter on one of two ranges, 0 to 10W or 0 to 100W. The output of the Power Monitor is applied to the rear panel connector PWR MON DEMOD to allow observing the COMM audio on an oscilloscope or listening to the audio with an external amplifier.

6-39. At the XMTR IN connector a small sample of the RF is taken and applied to the counter to measure COMM transmitter frequencies. The frequency may be displayed in any counter mode except GEN and BRG.

6-40. COUNTER SECTION. See figure 6-5, Simplified Counter Block Diagram.

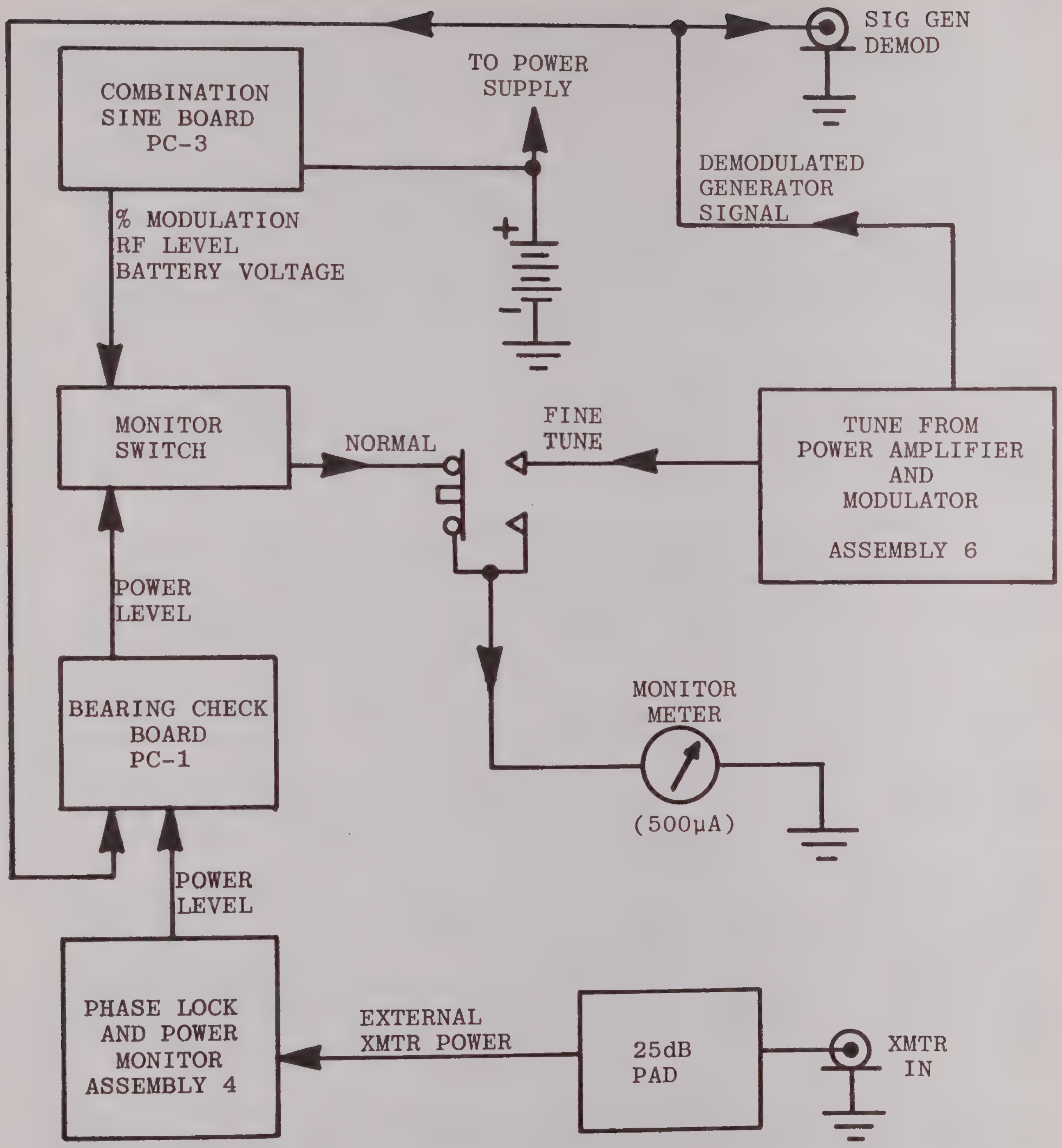


Figure 6-6. Monitoring Section Block Diagram

6-41. All count inputs to the counter except Bearing Check go through the Prescaler, Assembly 1.There are two inputs to the prescaler. One is applied fron the Buffer Amplifier assembly and is the count for the internal generator. This count input is switched to pass through the prescaler when the Counter Mode switch is in the GEN position.

6-42. The second input is applied from the MOD IN/CTR IN connector on the front panel. Also summed in this input at the front panel is the XMTR IN connector to measure COMM XMTR frequencies. This count input is switched to pass through the Prescaler when the Counter Mode Switch is in any positon except GEN or BRG.

6-43. Both inputs to the prescaler are presented at a direct count output and a ÷ 100 prescale output. Both of these outputs are applied to the counter, PC-6, where the direct output is counted in the Hz and first kHz mode switch positions. The ÷ 100 output is counted in the GEN, second kHz, and MHz positions. Through the operation of the Counter Mode switch, the output will be counted in GEN position and external of COMM XMTR inputs will be counted in Hz, kHz, kHz, and MHz positions.

6-44. In the BRG position, the gate time for the counter is the period of the 30Hz Reference square wave from the Bearing Logic Board. Count input is also from the Bearing Logic Board and is the output of the .1° divider gated by the VOR BRG switch output. The same number of .1° clock pulses will be applied to the counter as the number of bearing degrees selected. Those pulses are counted and displayed by the counter to 0.1°.

6-45. The clock source for the counter is from a 10MHz crystal oscillator located on the Bearing Check Board. The oscillator output frequency is divided to 100kHz and applied to the counter board where it is further divided to gate times of .1 sec and 1 sec.

6-46. On G/S mode the .1 sec time base is divided by three to effectively multiply the input count by three. On G/S the oscillator frequency is multiplied by three in the output stage of the power amplifier. Since the counter output from the power amplifier comes from the input of the power amplifier, that count can be trippled in the counter and display the same G/S frequency coming out of the power amplifier.

6-47. The minimum recommended operating voltage for the NAV-401L display is 160vDC. The output of the high voltage switching regulator is applied to the displays.

6-48. MONITORING SECTION. See figure 6-6, Monitoring Section Block Diagram.

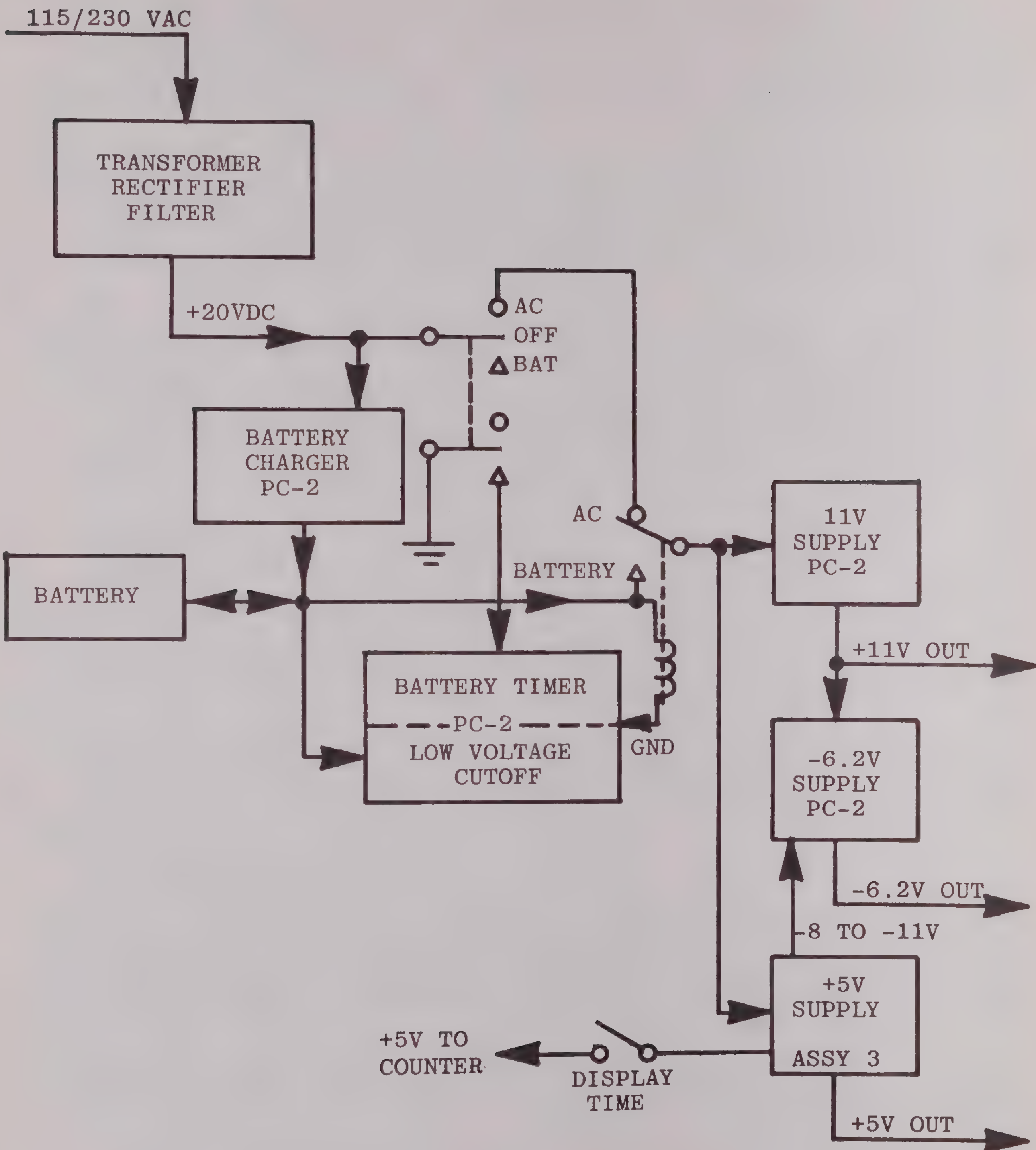


Figure 6-7. Power Supply Block Diagram

6-49. Three monitoring circuits are included on the Combination Sine Board, PC-3. The battery is connected to PC-3 where battery voltage is measured to detect a discharged condition.

6-50. The signal generator demodulated output from the power amplifier is applied to PC-3 where the DC level is sampled and applied to the meter for an RF level indication. The demodulation output is also processed to determine the accurate percentage of modulation. Two modulation ranges are used, 0 to 30%, and 0 to 100%.

6-51. Two monitor circuits are included on the Bearing Check Board PC-1. One is the Power Monitor circuit. The output from the Power Monitor assembly, Assembly 4, is applied to PC-1 where it is processed and applied to the meter as 0-10W or 0-100W power ranges.

6-52. The other monitor circuit on PC-1 is the bearing check system. The signal generator demodulated output from the power amplifier is further demodulated and broken down to the two 30Hz signals during VOR operation. The phase relationship of the reference and variable signals is compared at 90.0° and an error signal is produced. That error voltage is applied to the monitor meter for bearing check information accurate 0.1°.

6-53. POWER SECTION. See figure 6-7. Power Section Block Diagram.

6-54. The NAV-401L can be powered from two sources, an external 115 or 240 VAC source or the built-in 13.75V, 2.0AH capacity battery.

6-55. The Power Supply Assembly, Assembly 2, is located on the back panel of the test set. AC power is converted by a transformer and rectified to +20V DC whenever the test set is connected to an AC source. There is no AC line switching in the NAV-401L. The +20V is applied continuously to the Battery Charging circuit on PC-2. Whenever the test set is connected to AC power, the battery is being charged. The charger is self-limiting to charge a discharged battery at a high rate , and trickle-charge a fully-charged battery so that the set can be left continuously charging.

6-56. For operation from AC power the +20V is applied through the Line Switch to PC-2 and to Assembly 3, the +5V Supply. On PC-2 the +20V is regulated to +11V and applied to the test set. The +11V is also internally applied on PC-2 to the -6.2V regulator as a reference voltage. Negative voltage developed by the +5V switching regulator is also applied to PC-2 and dropped to -6.2V.

6-57. The +5V Supply applies +5V to the test set as a whole and a separate, switched +5V to the counter circuitry.

6-58. When using battery power, a 10 minute timer does the actual power switching. The Power Switch, when pressed to BAT, turns the timer on, which applies battery voltage to teh remainder of the power system in place of the +20V used in AC operation. After approximately 6 to 10 minutes the timer turns the set off. Pressing the Power Switch a second time will also turn the timer and set off.

SECTION VII

PERFORMANCE TESTS

7-1. INTRODUCTION.

7-2. The following steps give the procedures necessary to determine the overall performance of the NAV-401L. Each test should be done in the sequence given. Refer to Calibration Procedures, Section VIII, for adjustment procedures for any parameters which do not meet the specifications. If a failure or operational problem is encountered refer to Section XII, Troubleshooting, for guidance in locating the problem.

7-3. To maintain accurate measurements throughout the procedures, the test set signal generator output should be accurately tuned. The TUNE control should be fine tuned whenever the frequency is changed by more than a few megahertz in any band, whenever a different frequency band is selected on the MODE switch, and when the attenuator is changed in the output range of -20dBm to -7dBm.

7-4. PROCEDURES.

7-5. NAV TONES.

a. Set MODE switch to MKR XTL.
b. Set MASTER MOD control to CAL position.
c. Connect frequency counter to NAV TONE OUT connector on the back panel of the test set.
d. Set Tone Select switch to 1020.
e. Frequency counter should indicate between 1010Hz and 1030Hz.
f. Set Tone Select switch to 400.
g. Frequency counter should indicate between 396Hz and 404Hz.
h. Set Tone Select switch to 1300.
i. Frequency counter should indicate between 1287Hz and 1313Hz.
j. Set Tone Select switch to 3000.
k. Frequency counter should indicate between 2970Hz and 3030Hz.
l. Set Tone Select switch to CTR IN.
m. Set MODE switch to VOR XTL.
n. Adjust 9960Hz level control full ccw.
o. Adjust 30Hz VAR level control full cw.
p. Frequency counter should indicate 30Hz.
q. Adjust 9960Hz level control full cw.
r. Adjust 30Hz level control full ccw.
s. Frequency counter should indicate 9960Hz.
t. Disconnect the frequency counter and connect an oscilloscope to the NAV TONE OUT connector.
u. Adjust scope trigger and position controls to vertically center the display and position the sweep trigger point at the left edge of the horizontal centerline as shown in figure 8-2(A).

v. Set oscilloscope controls as specified in figure 8-2(B).
w. Check that deviation of expanded display (see fig. 8-2(B)) corresponds to Δt=48.5µs (±2.4µs).
x. Disconnect the oscilloscope and connect a frequency counter to the NAV TONE OUT connector.
y. Set MODE switch to LOC XTL.
z. Set G/S DDM control to 0.
aa. Set LOC DDM control to 90Hz.
ab. Frequency counter should indicate 90Hz.
ac. Set LOC DDM control to 150Hz.
ad. Frequency counter should indicate 150Hz.
ae. Disconnect frequency counter and connect oscilloscope to NAV TONE OUT connector.
af. Set LOC DDM control to 0.
ag. Set VOR BRG to 004.0.
ah. Press ϕ switch and note that the relative amplitude of the peaks of the waveform changes when the switch is pressed.

7-6. DDM CENTERING.

a. Connect digital voltmeter (DVM) to SIG GEN DEMOD connector on back of test set.
b. Set Tone Select switch to CTR IN.
c. Set LOC DDM to 0.
d. Set MODE switch to LOC XTL.
e. Set G/S DDM control to 150Hz.
f. Set MASTER MOD to CAL.
g. Note the DVM ac voltage indication (550mV, ±30mV).
h. Set G/S DDM control to 90Hz.
i. Note that DVM ac volt indication is within ±2mV of the indication noted in step g.
j. Set G/S DDM control to 0.
k. Set MODE switch to G/S XTL.
l. Set LOC DDM control to 150Hz.
m. Note the DVM ac voltage indication (1.100V, ±.060V).
n. Set LOC DDM control to 90Hz.
o. Note that DVM ac voltage indication is within ±2mV of the indication noted in step m.

7-7. DISTORTION.

a. Set MASTER MOD to CAL.
b. Connect audio distortion meter to NAV TONE OUT connector on back of test set.
c. Set MODE switch to MKR XTL.
d. Set Tone Select switch to 1020.
e. Distortion meter should indicate less than 1% harmonic distortion.
f. Set Tone Select switch to 400, 1300, and 3000 and check that the distortion meter indicates less than 1% harmonic distortion for each tone.
g. Set MODE switch to VOR XTL.
h. Adjust 9.96kHz level control full ccw.
i. Adjust 30Hz VAR level control full cw.
j. Set Tone Select switch to CTR IN.

k. Distortion meter should indicate less than 0.5% harmonic distortion.
l. Set MODE switch to LOC XTL.
m. Set G/S DDM control to 0.
n. Set LOC DDM control to 90.
o. Distortion meter should indicate less than 0.5% harmonic distortion.
p. Set LOC DDM control to 150.
q. Distortion meter should indicate less than 0.5% harmonic distortion.

7-8. PERCENT MODULATION OF TONES. Two procedures are presented for testing the percent modulation of tones. The procedure in paragraph 7-9 is the preferred procedure and uses a modulation meter to directly measure the modulation without removing the test set from the case. The procedure in paragraph 7-10 uses a digital voltmeter to make measurements so that the percent modulation of the tones can be calculated. This procedure requires the test set to be removed from the case. The alternate procedure should not be used if any internal repairs or adjustments have been made to the transmitter assembly.

7-9. Preferred Procedure.

a. Set MASTER MOD control to CAL.
b. Set MODE switch to MKR XTL.
c. Set MONITOR switch to 100%.
d. Set Tone Select switch to 1020.
e. Connect modulation meter to RF OUT connector.
f. Modulation meter should indicate 95(±5)%. Check that MONITOR meter indicates approximately 95% modulation.
g. Set MODE switch to VOR XTL.
h. Adjust 30Hz VAR and 9.96kHz level controls full ccw.
i. Modulation meter should indicate 30(±2)%. Check that MONITOR meter indicates approximately 30% modulation.
j. Set Tone Select switch to MOD IN.
k. Adjust 30Hz VAR level control full cw.
l. Modulation meter should indicate 30(±2)%.
m. Adjust 30Hz VAR level control full ccw and 9.96kHz level control full cw.
n. Modulation meter should indicate 30(±2)%.
o. Set MODE switch to LOC XTL.
p. Set LOC DDM control to 0.
q. Set G/S DDM control to 90.
r. Set MONITOR switch to 30%.
s. Modulation meter should indicate 20(±2)%. Check that MONITOR meter indicates approximately 20%.
t. Set G/S DDM control to 150.
u. Modulation meter should indicate 20(±2)%.
v. Set LOC DDM control to 90 and Tone Select switch to 1020.
w. Modulation meter should indicate 30(±2)%.
x. Set G/S DDM control to 0 and MONITOR meter function switch to 100%.
y. Modulation meter should indicate 40(±2)%. Check that MONITOR meter indicates approximately 40% modulation.
z. Set LOC DDM control to 150.

aa. Modulation meter should indicate 40(±2)%.
ab. Set MODE switch to COMM XTL.
ac. Modulation meter should indicate 30(±2)%.

7-10. Alternate Procedure.

a. Remove NAV-401L chassis from case (See Section IX).
b. Disconnect P802 from rear of transmitter assembly. See figure 12-13 for connector location.
c. Connect digital multimeter to SIG GEN DEMOD connector on back panel of test set and apply power to the test set.
d. Set MODE switch to MKR XTL and record dc offset voltage indication (approximately 260mV). Define this voltage as MKR V_1.
e. Set MODE switch to VOR XTL and record dc offset voltage indication (approximately 260mV). Define this voltage as VOR V_1.
f. Set MODE switch to LOC XTL and record dc offset voltage indication (approximately 260mV). Define this voltage as LOC V_1.
g. Set MODE switch to G/S XTL and record dc offset voltage indication (approximately 300mV). Define this voltage as G/S V_1.
h. Set MODE switch to COMM XTL and record dc offset voltage indication (approximately 260mV). Define this voltage as COMM V_1.
i. Remove power from the test set, connect P802 to transmitter assembly, and apply power to the test set.
j. Set MODE switch to MKR XTL and Tone Select switch to 1300.
k. Adjust MASTER MOD control to CAL and record dc voltage indication (approximately 4V). Define this voltage as MKR V_2.
l. Record ac voltage indication at SIG GEN DEMOD connector and define this voltage as MKR Vac.
m. Calculate the percent modulation for the 1300Hz tone by substituting the recorded voltages into the following equation.

$$\%\ \text{Mod} = \frac{\text{MKR Vac}}{\text{MKR } V_2 - \text{MKR } V_1} \times 1.414 \times 100\%$$

n. Percent modulation calculated in step m should equal 95(±5)%.
o. Set MODE switch to VOR XTL and Tone Select switch to CTR IN.
p. Adjust MASTER MOD control to CAL and 9.96kHz level control full ccw.
q. Adjust 30Hz VAR level control full cw.
r. Record dc voltage indication (approximately 4V) and define this voltage as VOR V_2.
s. Record ac voltage indication at the SIG GEN DEMOD connector and define this voltage as VOR Vac. Calculate the percent modulation for the 30Hz VAR tone by substituting the recorded voltages into the following equation.

$$\%\ \text{Mod} = \frac{\text{VOR Vac}}{\text{VOR } V_2 - \text{VOR } V_1} \times 1.414 \times 100\%$$

t. Percent modulation calculated in step s should equal 30(±2)%.

u. Adjust 30Hz VAR level control full ccw and 9.96kHz level control full cw. Record dc voltage indication (approximately 4V) at SIG GEN DEMOD connector and define this voltage as VOR V_2.

v. Record ac voltage indication as SIG GEN DEMOD connector and define this voltage as VOR Vac. Calculate the percent modulation for the 9.96kHz tone by substituting the new recorded voltages into the equation used in step s.

w. Percent modulation calculated in step v should equal 30(±2)%.

x. Adjust 9.96kHz level control full ccw and set Tone Select switch to 1020. Record dc voltage indication (approximately 4V) at SIG GEN DEMOD connector and define this voltage as VOR V_2.

y. Record ac voltage indication and define this voltage as VOR Vac. Calculate the percent modulation for the 1020Hz tone by substituting the new recorded voltages into the equation used in step s.

z. Percent modulation calculated in step y should equal 30(±2)%.

aa. Set Tone Select switch to CTR IN and MODE switch to LOC XTL.

ab. Set LOC DDM and G/S DDM switches to 0.

ac. Record dc voltage indication (approximately 4V) and define this voltage as LOC V_2.

ad. Set LOC DDM to 90.

ae. Record ac voltage indication at SIG GEN DEMOD connector. Define this voltage as LOC Vac and calculate the percent modulation for the 90Hz LOC tone by substituting the recorded voltages into the following equation.

$$\% \text{ Mod} = \frac{\text{LOC Vac}}{\text{LOC } V_2 - \text{LOC } V_1} \times 1.414 \times 100\%$$

af. Percent modulation calculated in step ae should equal 20(±2)%.

ag. Set LOC DDM to 150.

ah. Record ac voltage indication and define this voltage as LOC Vac. Calculate the percent modulation for the 150Hz LOC tone by substituting the new recorded voltages into the equation used in step ae.

ai. Percent modulation calculated in step ah should equal 20(±2)%.

aj. Set G/S DDM to 90 and Tone Select switch to 1020. Record dc voltage indication (approximately 4V) and define this voltage as LOC V_2.

ak. Record ac voltage indication and define this voltage as LOC Vac. Calculate the percent modulation for the 1020Hz Tone by substituting the new recorded voltages into the equation used in step ae.

al. Percent modulation calculated in step ak should equal 30(±2)%.

am. Set MODE switch to G/S XTL.

an. Set LOC DDM and G/S DDM controls to 0.

ao. Record dc voltage indication (approximately 4V) at SIG GEN DEMOD connector. Define this voltage as G/S V_2.

ap. Set G/S DDM to 90.

aq. Record ac voltage indication at SIG GEN DEMOD connector and define this voltage as G/S Vac. Calculate the percent modulation for the 90Hz G/S tone by substituting the recorded voltage into the following equation.

$$\% \text{ Mod} = \frac{G/S\ Vac}{G/S\ V_2 - G/S\ V_1} \times 1.414 \times 100\%$$

ar. Percent modulation calculated in step aq should equal 40(±2)%.

as. Set G/S DDM to 150. Record dc voltage indication (approximately 4V) and define this voltage as G/S V_2.

at. Record ac voltage indication and define this voltage as G/S Vac. Calculate the percent modulation for the 150Hz G/S tone by substituting the new recorded voltages into the equation used in step aq.

au. Set MODE switch to COMM XTL and Tone Select switch to 1020.

aw. Record dc voltage indication (approximately 4V) at SIG GEN DEMOD connector and define this voltage as COMM V_2.

ax. Record ac voltage a COMM Vac. Calculate the percent modulation for the 1020Hz tone by substituting the recorded voltages into the following equation.

$$\% \text{ Mod} = \frac{COMM\ Vac}{COMM\ V_2 - COMM\ V_1} \times 1.414 \times 100\%$$

ay. Percent modulation calculated in step ax should equal 30(±2)%.

7-11. ATTENUATOR OUTPUT LEVEL.

a. Adjust MASTER MOD control full ccw, but out of the detent (CAL) position, and set LOC-PEAK/AVG switch to AVG.

b. Set MODE switch to VOR XTL.

c. Connect power meter to OUT connector.

d. Adjust OUTPUT attenuator to -30dBm.

e. Power meter should indicate -30(±.5)dBm.

f. Adjust OUTPUT attenuator to -25dBm.

g. Power meter indication should agree with the value recorded on the Attenuator Correction Chart, Section II, within ±.5dBm.

h. Adjust OUTPUT attenuator to -20dBm.

i. Power meter indication should agree with the value recorded on the Attenuator Correction Chart within ±.5dBm.

j. Adjust OUTPUT attenuator to -15dBm.

k. Power meter indication should agree with the value recorded on the Attenuator Correction Chart within ±.5dBm.

l. Adjust OUTPUT attenuator -30dBm.

m. Set MODE switch to MKR XTL. Power meter should indicate -30(±2)dBm.

n. Set MODE switch to LOC XTL. Power meter should indicate -30(±2)dBm.

o. Set MODE switch to COMM XTL. Power meter should indicate -30(±2)dBm.

p. Set MODE switch to COMM VAR.
q. Adjust VAR FREQ control to 144.0MHz. Power meter should indicate -30(±2) dBm.
r. Set MODE switch to G/S XTL. Power meter should indicate -30(±2)dBm.
s. Adjust TUNE control until TUNE indicator comes on.
t. Set LOC-PEAK/AVG switch to LOC-PEAK. Power meter should indicate -15 to -20 dBm.
u. Set MONITOR switch to RF and tune transmitter output. Check that MONITOR meter needle is centered when transmitter is tuned.

7-12. RF FREQUENCIES.

a. Adjust VAR FREQ fine tune control full ccw into detent, phase lock, position.
b. Adjust MASTER MOD control full ccw but not into CAL (detent) position.
c. Connect external frequency counter to OUT connector.
d. Set MODE switch to VOR XTL.
e. Adjust VAR FREQ control to phase-lock output frequency at 110.000MHz. External frequency counter should indicate 110.000MHz, ±1kHz.
f. Disconnect external frequency counter.
g. Set Counter Mode switch to GEN.
h. Set MODE switch to MKR XTL. Counter should display marker crystal frequency, ±3kHz.
i. Set MODE switch to VOR XTL. Counter should display VOR crystal frequency, ±5kHz.
j. Set MODE switch to LOC XTL. Counter should display localizer crystal frequency, ±5kHz.
k. Set MODE switch to G/S XTL. Counter should display glide slope crystal frequency, ±16kHz.
l. Set MODE switch to COMM XTL. Counter should display COMM crystal frequency, ±6kHz.

7-13. BEARING CHECK (Using IFR Model CS-360 VOR Bearing Standard).

a. Set MODE switch to VOR XTL.
b. Adjust MASTER MOD control to CAL.
c. Set Tone Select switch to CTR IN.
d. Adjust 9.96kHz and 30Hz VAR level controls full ccw.
e. Set CS-360 controls for RF input and 90° bearings.
f. Connect OUT connector to CS-360 RF input connector.
g. Set VOR BRG switches to 090.0 and TO/FROM switch to TO. CS-360 should indicate bearing error of less than ±0.1°.
h. Set TO/FROM switch to FROM. CS-360 should indicate bearing error of less than ±0.1°.
i. Set MONITOR switch and Counter Mode switch to BRG. MONITOR meter needle should deflect to mid-scale
j. Set VOR BRG switches to 000.0.
k. Set CS-360 controls for 0° bearing. CS-360 should indicate bearing error of less than ±0.1°.

l. Set TO/FROM switch to TO. CS-360 should indicate bearing error of less than ±0.1°.
m. Disconnect CS-360.
n. Select each digit of each decade of the VOR BRG switches, one decade at a time, and note that the counter display indicates the bearing selected on the switches. Any switch setting greater than 360° is invalid and the display should continue to indicate 360.0.

7-14. FREQUENCY COUNTER.
a. Set Tone Select switch to CTR IN.
b. Set Counter Mode switch to Hz.
c. Connect signal generator to MOD IN/CTR IN connector.
d. Set signal generator output for 0dBm.
e. Vary signal generator frequency from 1MHz to 10MHz. Test set frequency counter should display signal generator frequency within ±0.001%.
f. Set Counter Mode switch to MHz.
g. Vary signal generator frequency from 10MHz to 300MHz. Test set frequency counter should display signal generator frequency within ±0.001%.

7-15. POWER METER.
a. Set MONITOR switch to 100W.
b. Apply 30 to 50 watts of unmodulated RF power through an accurate thruline power meter to the XMTR IN connector.
c. MONITOR meter indication should correspond to power meter indication within ±5 watts.
d. Set MONITOR switch to 10W.
e. Apply 4 to 8 watts of unmodulated RF power through an accurate thruline power meter to the XMTR IN connector.
f. MONITOR meter indication should correspond to power meter indication within ±0.5 watts.

7-16. BATTERY VOLTAGE AND TIMER.
a. Set MONITOR switch to BAT. MONITOR meter should indicate battery voltage on the 0-30% scale. For fully charged batteries, the meter should indicate 15V. Below 12V indicates discharged batteries.
b. Press Power switch to BAT position and start a stopwatch to check that the battery timer turns the test set off after 6 to 10 minutes.

7-17. SPECTRAL PURITY. The spectral purity test is an optional procedure which should be performed if repairs or internal adjustments, other than oscillator frequency adjustments, are made on the oscillator, buffer amplifier or transmitter.
a. Adjust MASTER MOD control full ccw, but not into the CAL (detent) position.
b. Adjust OUTPUT attenuator control to -30dBm.
c. Connect spectrum analyzer to OUT connector.
d. Set Spectrum analyzer controls to 10kHz/div frequency span and check that the harmonics over the entire frequency range of each band of the test set are greater than 20dB below the carrier level.

e. Set spectrum analyzer controls for a 300Hz resolution bandwidth and 10Hz video filter.
f. Set MODE switch to VOR XTL (108.000MHz) and check that close-in noise is greater than 68dB below the carrier level, beyond ±20kHz of the carrier frequency.
g. Check that broadband noise, beyond ±50kHz of the carrier frequency, is greater than 70dB below the carrier level.
h. Set MODE switch to G/S XTL (334.7MHz) and check that close-in noise is greater than 62dB below the carrier level, beyond ±20kHz of the center frequency.
i. Check that broadband noise, beyond ±50kHz of the carrier frequency, is greater than 70dB below the carrier level.
j. Set MODE switch to VOR VAR.
k. Adjust fine VAR FREQ control full ccw into the detent, Phase Lock, position and coarse VAR FREQ control for 110.000MHz.
l. Check that 25kHz phase lock loop reference frequency noise or 10 to 30kHz switching regulator noise is greater than 55dB below the carrier level.

PERFORMANCE TEST DATA SHEET

7-5. NAV TONES

1020Hz MKR	1010Hz	______	1030Hz
400Hz MKR	396Hz	______	404Hz
1300Hz MKR	1287Hz	______	1313Hz
3000Hz MKR	2970Hz	______	3030Hz
30Hz VAR VOR		______	(30Hz)
9960Hz VOR		______	(9960Hz)
480Hz VOR Deviation	46.1µs	______	50.9µs
90Hz LOC-G/S		______	(90Hz)
150Hz LOC-G/S		______	(150Hz)
90/150Hz Phase Shift		______	(✓)

7-6. DDM CENTERING

150Hz LOC Demod	520mV	______	580mV
90Hz LOC Demod		______	(±2mV)
150Hz G/S Demod	1.040V	______	1.160V
90Hz G/S Demod		______	(±2mV)

7-7. DISTORTION

1020Hz Harmonic	______	1%
400Hz Harmonic	______	1%
1300Hz Harmonic	______	1%
3000Hz Harmonic	______	1%
30Hz VAR Harmonic	______	0.5%
90Hz Harmonic	______	0.5%
150Hz Harmonic	______	0.5%

7-8. PERCENT MODULATION OF TONES

1020Hz MKR	90%	______	100%
1020Hz VOR	28%	______	32%
30Hz VAR VOR	28%	______	32%
9960Hz VOR	28%	______	32%
90Hz LOC	18%	______	22%
150Hz LOC	18%	______	22%
1020Hz LOC	28%	______	32%
150Hz G/S	38%	______	42%
90Hz G/S	38%	______	42%
1020Hz COMM	28%	______	32%

7-11. ATTENUATOR OUTPUT LEVEL

-30dBm, VOR XTL	-29.5dBm	______	-30.5dBm
-25dBm, VOR XTL		______	(±0.5dBm)
-20dBm, VOR XTL		______	(±0.5dBm)
-15dBm, VOR XTL		______	(±0.5dBm)
-30dBm, MKR XTL	-28dBm	______	-32dBm
-30dBm, LOC XTL	-28dBm	______	-32dBm
-30dBm, COMM XTL	-28dBm	______	-32dBm
-30dBm, 144.0 MHz	-28dBm	______	-32dBm
-30dBm, G/S XTL	-28dBm	______	-32dBm
LOC TRANSMITTER	-15dBm	______	-20dBm

7-12. RF FREQUENCIES

MKR XTL	______	(±3kHz)
VOR XTL	______	(±5kHz)
LOC XTL	______	(±5kHz
G/S XTL	______	(±16kHz)
COMM XTL	______	(±6kHz)

7-13. BEARING CHECK.

90° TO	-0.1°	______	+0.1
90° FROM	-0.1°	______	+0.1
0° FROM	-0.1°	______	+0.1
0° TO	-0.1°	______	+0.1

7-14. FREQUENCY COUNTER.

Hz - 1 to 10 MHz	______	(±0.001%)
MHz - 10 to 300 MHz	______	(±0.001%)

7-15. POWER METER

30 to 50 watts	______	(±5W)
4 to 8 watts	______	(±0.5W)

7-16. BATTERY VOLTAGE AND TIMER.

Voltage	12V	______	15V
Timer	6min.	______	10 min.

7-17. SPECTRAL PURITY.

Harmonics	______	20dB below carrier level
Broadband Noise at ±50kHz	______	70dB below carrier level
Nonharmonic Spurious Noise	______	55dB below carrier level
Close-In Noise at ±20kHz: 108MHz	______	68dB below carrier level
334.7MHz	______	62dB below carrier level

SECTION VIII

CALIBRATION PROCEDURES

8-1. INTRODUCTION.

8-2. This section presents the complete calibration procedures for the NAV-401L Test Set. For locations of test points and components, refer to the schematic diagrams and parts location guide in Section XII.

8-3. To maintain accurate measurements throughout the procedures, the test set signal generator output should be accurately tuned. The TUNE control should be fine tuned whenever the frequency is changed by more than a few megahertz in any band, whenever a different frequency band is selected on the MODE switch, and when the attenuator is changed in the output range of -20dBm to -7dBm.

8-4. CALIBRATION PROCEDURES.

8-5. POWER SUPPLY VOLTAGES.

a. Connect voltmeter to terminal 3 of PC-1.
b. Adjust R210, 11 volt regulator adjustment, on PC-2 to obtain a voltmeter indication of 11.00V(±.10V).
c. Connect voltmeter to terminal F of PC-1.
d. Adjust R1158, 5 volt regulator adjustment, on 5 Volt Regulator Board to obtain a voltmeter indication of 5.00V (4.90-5.00V).
e. Connect voltmeter to terminal 2 of PC-1. Voltmeter should indicate -6.20V (±.20V).

8-6. TONES.

A. 1020Hz, 400Hz, 1300Hz, 3000Hz.

a. Connect harmonic distortion meter to TP201 on PC-2. See figure 12-3 for test point location.
b. Set Tone Select switch to 1020.
c. Adjust R253, tone oscillator amplitude adjustment, and R273, tone oscillator centering adjustment, to obtain minimum distortion (1% maximum).
d. Set Tone Select switch to 400, 1300, and 3000 Hz positions and check that distortion for each tone is not more than 1%.
e. Connect frequency counter to TP201.
f. Set Tone Select switch to 1020 and adjust R262 on PC-2 to obtain a counter indication of 1020Hz (±5Hz).
g. Set Tone Select switch to 400 and adjust R260 on PC-2 to obtain a counter indication of 400Hz (±2Hz).
h. Set Tone Select switch to 1300 and adjust R266 on PC-2 to obtain a counter indication of 1300Hz (±5Hz).
i. Set Tone Select switch to 3000 and adjust R264 on PC-2 to obtain a counter indication of 3000Hz (±15Hz).

B. 30Hz Ref, 30Hz VAR, 90Hz, and 150Hz.

a. Connect frequency counter to TP501 on PC-5. See figure 12-6 for test point location.

b. Counter should indicate frequency of 2.160MHz (±432Hz). If frequency is not far off tolerance, the crystal may be padded by placing small values of capacitance in parallel with the crystal to lower the frequency or the series capacitor may be increased in value to raise the frequency.

C. 30Hz Sine and 9960Hz FM Output.

a. Connect harmonic distortion meter to the 30Hz VAR test point, TP403, on PC-4. See figure 12-5 for test point location.

b. Adjust R489, amplitude, and R492, centering, to obtain minimum distortion (below 0.5%).

c. Connect the harmonic distortion meter to the 30Hz Ref test point, TP401.

d. Adjust R406, 30Hz Ref amplitude adjustment, and R409, 30Hz Ref centering adjustment, to obtain minimum distortion (less than 0.5%).

e. Connect oscilloscope to 9960Hz test point, TP402, on PC-4.

f. Adjust R435, 480Hz deviation, full ccw until no frequency modulation is evident on the oscilloscope display.

g. Connect harmonic distortion meter to TP402.

h. Adjust R4016, 9.96kHz centering, and R451, 9.96kHz amplitude, to obtain minimum distortion (below 1.5%).

i. Connect channel 1 of a dual trace oscilloscope to the 30Hz Ref triangle waveform output, pin 6, of X401.

j. Use oscilloscope channel 2 to monitor phase lock pulse at collector (case) of Q406.

k. Adjust R437, 9.96kHz frequency adjustment, to position phase lock pulse coincident with zero crossing of rising portion of 30Hz Ref triangle wave. See figure 8-1.

l. Connect frequency counter to TP402. Counter should indicate frequency of 9960Hz (±1Hz).

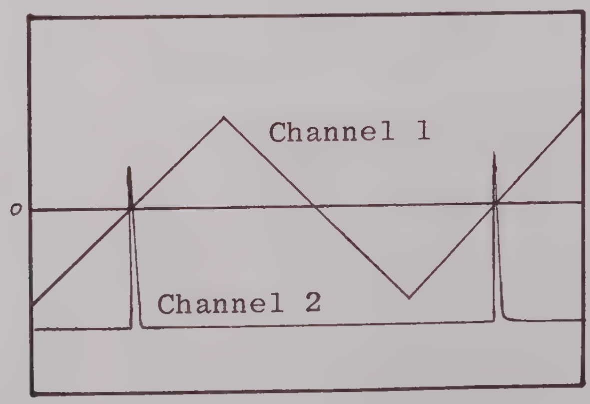


Figure 8-1. Phase Lock Pulse Adjustment

m. Connect oscilloscope to TP402 and set controls as specified in fugure 8-2(A).
n. Adjust scope trigger and position controls to vertically center the display and position the sweep trigger point at the left edge of the horizontal centerline as shown in figure 8-2(A).
o. Set oscilloscope controls as specified in figure 8-2(B).
p. Adjust R435 for a Δt of 48.5μs (±2.4μs) using the delayed sweep function to expand the display as shown in figure 8-2(B).

D. 90Hz and 150Hz Tones.
a. Connect harmonic distortion meter to 90Hz test point, TP301, on PC-3.
b. Adjust R306, 90Hz amplitude adjustment, and R312, 90Hz centering adjustment, to obtain minimum distortion (less than 0.5%).
c. Connect harmonic distortion meter to 150Hz test point, TP302.
d. Adjust R344, 150Hz amplitude adjustment, and R347, 150Hz centering adjustment, to obtain minimum distortion (less than 0.5%).

8-7. COUNTER CLOCK OSCILLATOR FREQUENCY. Two methods of calibrating the counter oscillator frequency are presented. Perform only the procedure which is best suited for the available equipment.

A. WWV Zero Beat Calibration.
a. Tune a receiver to NBS station WWV at 5, 10, or 15MHz. Use frequency with best signal strength and most stable output.
b. Connect one end of a test wire to 100kHz Output, TP107, on PC-1. See figure 12-2 for test point location.
c. Place free end of test wire near receiver antenna terminals so that signal is heard through receiver.
d. Adjust trimmer capacitor C123 on PC-1 for a zero beat between the 100kHz output and WWV carrier signal.

B. Phase Lock Time Base Calibration.
a. Set MODE switch to VOR VAR.
b. Adjust VAR FREQ fine adjustment control full ccw into the detent, phase lock, position.
c. Adjust VAR FREQ coarse adjustment control to phase lock on any frequency except VOR XTAL frequency.

NOTE

If the VAR FREQ oscillator is set to the VOR XTAL oscillator frequency, interaction between the two oscillators could result in calibration error.

d. Connect frequency counter to OUT connector.
e. Adjust OUTPUT -dBm level to obtain a stable counter indication.
f. Adjust trimmer capacitor C123 on PC-1 so that the NAV-401L counter indication is within 0.0005% of the frequency indicated on the frequency counter.

FM Deviation; ±480(±24)Hz

SCOPE SETTINGS

Vertical:
200mV/Div-Uncal

Horizontal:
Main Time Base
100µs/Div

Trigger:
Positive Slope

NOTE

Accuracy of calibration depends on oscilloscope sweep timing accuracy.

SCOPE SETTINGS

Vertical:
200mV/Div-Uncal

Horizontal:
Delay Time Base
10µs/Div

Trigger:
Positive Slope

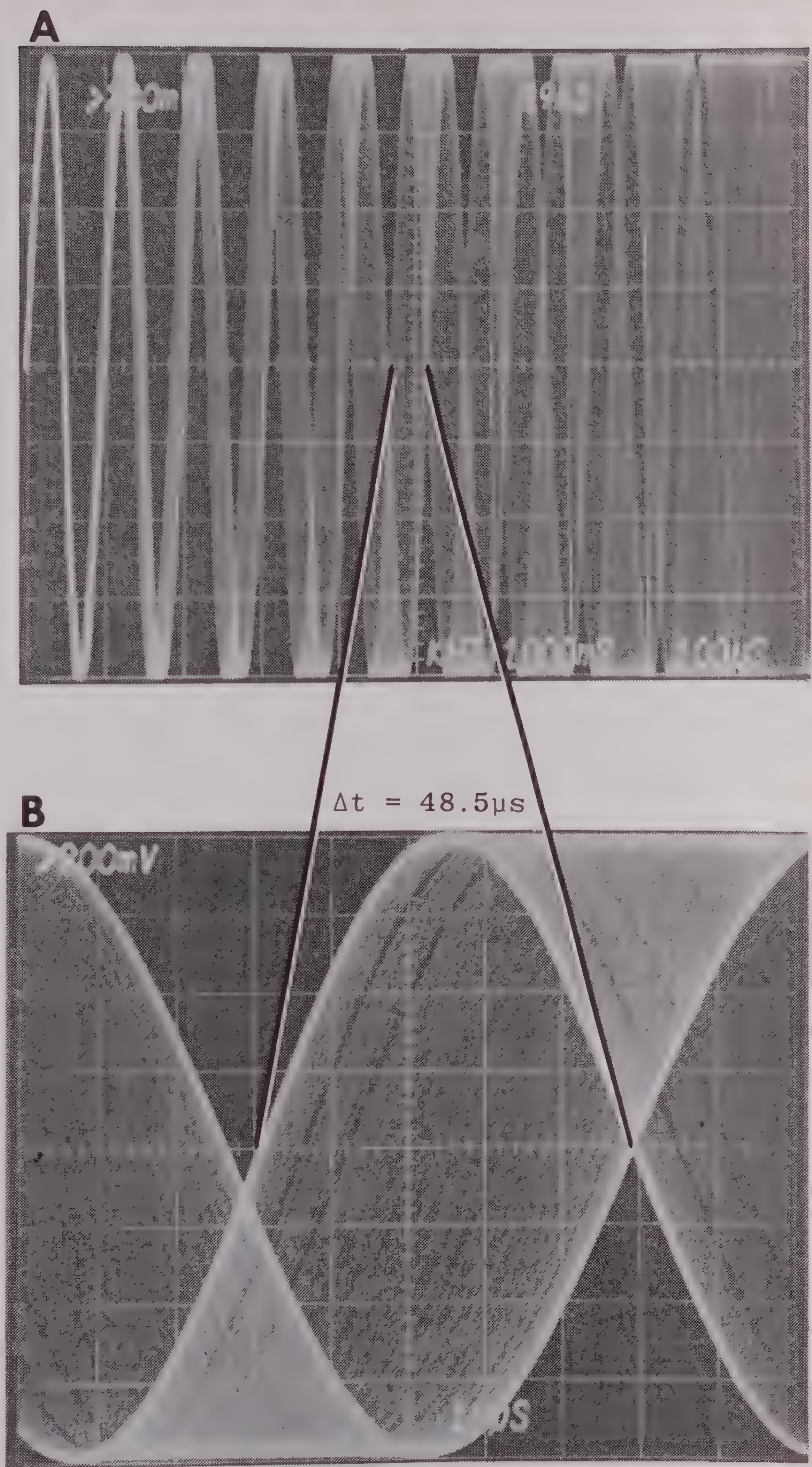


Figure 8-2. 9960Hz Deviation Adjustment

8-8. GENERATOR OUTPUT FREQUENCIES.

a. Connect voltmeter to collector of Q703 or to FL711. See figure 12-12 for parts placement.
b. Adjust R746 (Volt Adj) for voltmeter indication of 10.5V, ±0.1V.

NOTE

Test Set frequency counter time base must be calibrated before proceeding. If paragraph 8-7 has not been performed prior to this procedure, it should be performed now or an external 400MHz frequency counter should be used at the OUT connector.

c. Set Counter Mode switch to GEN.
d. Set MODE switch to MKR XTL.
e. Adjust L710 for most stable oscillator operation. Counter should indicate 75.000MHz, ±3kHz.
f. If frequency is too high, up to 5pf may be added across crystal to lower frequency. If frequency is too low, crystal must be replaced.
g. Set MODE switch to VOR XTL.
h. Adjust L711 for most stable oscillator operation. Counter should indicate 108.000MHz, ±5kHz.
i. If frequency is too high, up 5pf may be added across crystal to lower frequency. If frequency is too low, crystal must be replaced.
j. Set MODE switch to LOC XTL.
k. Adjust L714 for most stable oscillator operation. Counter should indicate 108.100MHz, ±5kHz.
l. If frequency is too high, up to 5pf may be added across crystal to lower frequency. If frequency is too low, crystal must be replaced.
m. Set MODE switch to G/S XTL.
n. Adjust L712 for most stable oscillator operation. Counter should indicate 334.700MHz, ±16kHz.

NOTE

Since the signal generator triples the oscillator frequency for glide slope operation, the crystal for G/S XTL is 111.566MHz.

o. Set MODE switch to COMM XTL.
p. Adjust L713 for most stable oscillator operation. Counter should indicate 126.900MHz, ±6kHz.
q. If frequency is too high, up to 5pf may be added across crystal to lower frequency. If frequency is too low, crystal must be replaced.
r. Set MODE switch to MKR VAR.
s. Adjust VAR FREQ controls full cw.
t. Adjust L703 for minimum counter indication of 78MHz

NOTE

Adjustment of L703 affects all the VAR bands. If L703 is adjusted, it will be necessary to adjust all of the other bands.

u. Set MODE switch to VOR VAR.
v. Adjust L704 for minimum counter indication of 120MHz.
w. Set MODE switch to COMM VAR LO.
x. Adjust L705 for minimum counter indication of 136MHz.
y. Set MODE switch to COMM VAR HI.
z. Adjust L706 for minimum counter indication of 158MHz.
aa. Repeat steps r thru z as required to insure that all bands are within desired ranges.
ab. Adjust VAR FREQ controls full ccw but do not set fine adjustment control into detent.
ac. Adjust R745 (Lower Limit) for maximum counter indications on each band as noted.

Band	Maximum Lower Limit
MKR VAR	72 MHz
VOR VAR	107 MHz
LOC VAR	107 MHz
G/S VAR	327 MHz
COMM VAR LO	117 MHz
COMM VAR HI	134 MHz

8-9. RF OUTPUT LEVEL.

a. Set MONITOR switch to RF.
b. Adjust TUNE control until TUNE indicator goes off.
c. Press Fine Tune switch and adjust TUNE control for minimum meter indication.
d. Adjust R386 (RF Level) to center meter needle in white band in center of scale.
e. Switch positions on MODE switch and tune transmitter to check that meter is centered on each band.
f. Set MODE switch to VOR XTL position.
g. Adjust MASTER MOD control full ccw, out of detent position.
h. Connect power meter to OUT connector.
i. Adjust OUTPUT attenuator to -30dBm.
j. Loosen two set screws in attenuator knob closest to dial.
k. Hold dial at -30dBm setting and turn knob until power meter indicates -30dBm.
l. Tighten set screws. Dial and output RF level should agree from -30dBm to -120dBm. Refer to the Attenuator Correction Chart, Section II, for measured frequency response at time of manufacture.

8-10. PERCENT MODULATION OF TONES. Two procedures are presented for calibrating the percent modulation of tones. The procedure in paragraph 8-11 is the preferred procedure and is the most accurate. The alternate procedure in paragraph 8-12 requires an accurate modulation meter and is less accurate than the preferred method.

8-11. Preferred Procedure.

a. Disconnect P802 from rear of transmitter assembly. See figure 12-13 for connector location.
b. Connect digital multimeter to SIG GEN DEMOD connector on back panel of test set and apply power to the test set.
c. Set MODE switch to MKR XTL and record dc offset voltage indication (approximately 260mV). Define this voltage as MKR V_1.
d. Set MODE switch to VOR XTL and record dc offset voltage indication (approximately 260mV). Define this voltage as VOR V_1.
e. Set MODE switch to LOC XTL and record dc offset voltage indication (approximately 260mV). Define this voltage as LOC V_1.
f. Set MODE switch to G/S XTL and record dc offset voltage indication (approximately 300mV). Define this voltage as G/S V_1.
g. Set MODE switch to COMM XTL and record dc offset voltage indication (approximately 260mV). Define this voltage as COMM V_1.
h. Remove power from the test set, connect P802 to transmitter assembly, and apply power to the test set.

A. MKR Tones.

a. Set MODE switch to MKR XTL and Tone Select switch to 1300.
b. Adjust MASTER MOD control to CAL and record dc voltage indication (approximately 4V). Define this voltage as MKR V_2.
c. Calculate the ac voltage for 100% modulation by substituting recorded values into the following equation.

$$\text{Vac for 100\% Modulation} = \frac{\text{MKR } V_2 - \text{MKR } V_1}{1.414}$$

d. Adjust MASTER MOD control until ac voltage indication at SIG GEN DEMOD connector is equal to the value calculated in step c.
e. Set MONITOR switch to 100%.
f. Adjust R391 (100% Mod) on PC-3 for full scale MONITOR meter indication of 100%.
g. Multiply the value calculated in step c by 0.30 to obtain the ac voltage required for 30% modulation.
h. Adjust MASTER MOD control until ac voltage indication at SIG GEN DEMOD connector is equal to the voltage calculated in step g.
i. Set MONITOR switch to 30%.
j. Adjust R389 (30% Mod) to obtain full scale MONITOR meter indication of 30%.

k. Set MASTER MOD control to CAL.

l. Multiply the value calculated in step c by 0.95 to obtain the ac voltage required for 95% modulation and adjust R433 (MKR) on PC-4 for an ac voltage indication at the SIG GEN DEMOD connector equal to the calculated value.

B. VOR Tones.

a. Set MODE switch to VOR XTL and TONE select switch to CTR IN.

b. Adjust MASTER MOD control to CAL and 9.96kHz level control full ccw.

c. Adjust the 30Hz VAR level control full cw and record the dc voltage indication (approximately 4V) at the SIG GEN DEMOD connector. Define this voltage as VOR V_2 and calculate the ac voltage required for 30% modualtion using the following equation.

$$\text{Vac for 30\% Modulation} = \frac{\text{VOR } V_2 - \text{VOR } V_1}{1.414} \times 0.30$$

d. Adjust R431 (30Hz VAR) to obtain an ac voltage indication at the SIG GEN DEMOD connector equal to the voltage calculated in step c.

e. Adjust 30Hz VAR level control full ccw and 9.96kHz level control full cw.

f. Record the dc voltage indication (approximately 4V) at the SIG GEN DEMOD connector and define this voltage as VOR V_2. Calculate the ac voltage required for 30% modulation using the equation in step c.

g. Adjust R432 (9.96kHz) to obtain an ac voltage indication at the SIG GEN DEMOD connector equal to the voltage calculated in step f.

h. Adjust 9.96kHz level control full ccw and set Tone Select switch to 1020.

i. Record the dc voltage indication (approximately 4V) at the SIG GEN DEMOD connector and define this voltage as VOR V_2. Calculate the ac voltage required for 30% modualtion using the equation in step c.

j. Adjust R4087 (VOR TONE) to obtain an ac voltage indication at SIG GEN DEMOD connector equal to the voltage calculated in step i.

C. LOC Modulation and Centering.

a. Set MODE switch to LOC XTL, and LOC DDM and G/S DDM switches to 0.

b. Record dc voltage indication (approximately 4V) at the SIG GEN DEMOD connector and define this voltage as LOC V_2. Calculate the ac voltage required to 20% modulation using the following equation.

$$\text{Vac for 20\% Modulation} = \frac{\text{LOC } V_2 - \text{LOC } V_1}{1.414} \times 0.20$$

c. Set G/S DDM switch to 150 and adjust R454 (LOC) to obtain an ac voltage indication equal to the voltage calculated in step b.

d. Set G/S DDM switch to 90 and adjust the Localizer Centering adjust pot (R4) on the front panel to obtain an ac voltage indication at the SIG GEN DEMOD connector equal to the voltage calculated in step b.

D. G/S Modulation and Centering.

a. Set MODE switch to G/S XTL, and LOC DDM and G/S DDM switches to 0.

b. Record dc voltage indication (approximately 4V) at the SIG GEN DEMOD connector and define this voltage as G/S V_2. Calculate the ac voltage required for 40% modulation using the following equation.

$$\text{Vac for 40\% Modulation} = \frac{\text{G/S } V_2 - \text{G/S } V_1}{1.414} \times 0.40$$

c. Set LOC DDM switch to 150 and adjust R482 (G/S) to obtain an ac voltage indication equal to the value calculated in step b.

d. Set LOC DDM switch to 90 and adjust the Glide Slope Centering adjust pot (R6) on the front panel to obtain an ac voltage indication at the SIG GEN DEMOD connector equal to the voltage calculated in step b.

E. COMM Modulation.

a. Set MODE switch to COMM XTL and Tone Select switch to 1020.

b. Record dc voltage indication (approximately 4V) at the SIG GEN DEMOD connector and define this voltage as COMM V_2. Calculate the ac voltage required for 30% modulation using the following equation.

$$\text{Vac for 30\% Modulation} = \frac{\text{COMM } V_2 - \text{COMM } V_1}{1.414} \times 0.30$$

c. Adjust R4010 (Comm) to obtain an ac voltage indication at the SIG GEN DEMOD connector equal to the voltage calculated in step b.

8-12. Alternate Procedure.

A. MKR Tones.

a. Set MODE switch to MKR XTL and Tone Select switch to 1300.

b. Connect modulation meter to OUT connector.

c. Adjust MASTER MOD control to obtain modulation meter indication of 100%.

d. Set MONITOR switch to 100%.

e. Adjust R391 (100% Mod) on PC-3 to obtain full scale MONITOR meter indication of 100%.

f. Adjust MASTER MOD control to obtain modulation meter indication of 30%.

g. Set MONITOR switch to 30% and adjust R389 (30% Mod) to obtain full scale MONITOR meter indication of 30%.

h. Adjust MASTER MOD control to CAL.

i. Adjust R433 (MKR) on PC-4 to obtain modulation meter indication of 95%.

B. VOR Tones.

a. Set MODE switch to VOR XTL and MASTER MOD control to CAL.
b. Adjust 9.96kHz Ref level control full ccw and 30Hz VAR level control full cw to 30% position.
c. Adjust R431 (30Hz VAR) for modulation meter indication of 30%.
d. Adjust 30Hz VAR level control full ccw and 9.96kHz Ref level control full cw to 30% position.
e. Adjust R432 (9.96kHz) for modulation meter indication of 30%.
f. Adjust 9.96kHz level control full ccw.
g. Set Tone Select switch to 1020.
h. Adjust R4087 (VOR Tone) for modulation meter indication of 30%.

C. LOC Modulation and Centering.

a. Delete 90Hz signal by setting LOC DDM switch to 0 and G/S DDM switch to 150.
b. Set MODE switch to LOC XTL.
c. Connect modulation meter to OUT connector.
d. Adjust R454 (LOC) for modulation meter indication of 20%.
e. Connect digital voltmeter to SIG GEN DEMOD connector and record voltage level.
f. Delete 150Hz signal by setting G/S DDM switch to 90.
g. Center LOC tones by adjusting Localizer Centering adjust pot (R4) on front panel to obtain voltmeter indication equal to value recorded in step e (±0.001V).

D. G/S Modulation and Centering.

a. Delete 90Hz signal by setting G/S DDM switch to 0 and LOC DDM switch to 150.
b. Set MODE switch to G/S XTL.
c. Connect modulation meter to OUT connector.
d. Adjust R482 (G/S) for modulation meter indication of 40%.
e. Connect digital voltmeter to SIG GEN DEMOD connector and record voltage indication.
f. Delete 150Hz signal by setting LOC DDM control to 90.
g. Center glide slope tones by adjusting Glide Slope Centering adjust pot (R6) on front panel to obtain a voltmeter indication equal to that recorded in step e (±0.001V)

E. COMM Modulation.

a. Set MODE switch to COMM XTL.
b. Set Tone Select switch to 1020.
c. Adjust R4014 (Comm) for modulation meter indication of 30%.

8-13. BEARING CHECK CIRCUIT.

a. Set MODE switch to VOR XTL and Tone Select switch to CTR IN.
b. Adjust MASTER MOD control to CAL and 30Hz VAR and 9.96kHz level controls full cw.
c. Adjust TUNE control until TUNE indicator goes off. Press fine tune switch and adjust TUNE control for minimum meter indication.
d. Connect oscilloscope to SIG GEN DEMOD connector and verify output to be a typical VOR signal.
e. Set MONITOR switch to BRG.

f. Set Counter Mode switch to BRG.
g. Set VOR BRG selectors to 090.0
h. Set TO/FROM switch to TO.
i. Connect digital voltmeter to TP-103 on PC-1.
j. Adjust R118 (Freq) for voltmeter indication of 5.5VDC.
k. Set Counter Mode switch to any position except BRG and allow test set to stabilize for several minutes.
l. Adjust Bearing Check Centering control (R8) (screwdriver adjust locater near Counter Mode switch) to full cw position.
m. Adjust R152 (Trim) to position MONITOR meter needle to right edge of scale.
n. Adjust Bearing Check Centering control to position MONITOR meter needle to center scale.
o. Set Counter Mode switch to BRG and allow meter movements to stop.
p. Alternately set TO/FROM switch to the TO and FROM positions and adjust R128 (Phase) to obtain same meter indication in both positions of TO/FROM switch.
q. Adjust R150 (Balance) for center scale meter indication.
r. Repeat steps l thru q as necessary to obtain center scale meter indication.

NOTE

If the test set has a bearing error of more than 0.4 degrees, the above procedure can not be performed Once adjusted, the bearing monitor circuit is intended to monitor the bearing output and quickly show if any deviation from normal operation exists.

8-14. COMM POWER CIRCUIT

a. Set MONITOR switch to 100W.
b. Apply 30 to 50 watts of unmodulated RF power through an accurate thruline power meter to the test set XMTR IN connector .
c. Adjust R160 (100W) on PC-1 to obtain MONITOR meter indication corresponding to power meter indication.
d. Set MONITOR switch to 10W.
e. Apply 4 to 8 watts of unmodulated RF power through an accurate thruline power meter to the test set XMTR IN connector.
f. Adjust R163 (10W) on PC-1 to obtain MONITOR meter indication corresponding to power meter indication.

8-15. BATTERY CHARGER

a. Disconnect red lead from battery and connect a 100ohm, 20 watt resistor. Connect other lead of resistor to ground.
b. Apply AC power to the test set.
c. Connect DC voltmeter across resistor.
d. Adjust R220 (Charge) for 16.1 volts (±.1 volts) across resistor.
e. Disconnect AC power cord from test set.
f. Replace resistor with external power supply (14 to 16 volts).

g. Set MONITOR switch to BAT position.
h. Adjust R393 (Battery) for MONITOR meter indication of power supply voltage on 0-30% scale.
i. Press Power switch to BAT position and use stopwatch to check that battery timer turns off test set after 6 to 10 minutes. To change battery timer delay, increase values of R246 (10 MEGΩ) or C214 (47μF) on PC-2 for longer delays or decrease values for shorted delays

CALIBRATION DATA SHEET

8-5.	POWER SUPPLY VOLTAGES.			
	11 Volt Regulator	10.90V		11.10V
	5 Volt Regulator	4.90V		5.00V
	-6.20 Volt Regulator	-6.00V		-6.40V
8-6.	TONES			
	A. 1020Hz, 400Hz, 1300Hz, 3000Hz			
	1020Hz Harmonic Distortion			1%
	400Hz Harmonic Distortion			1%
	1300Hz Harmonic Distortion			1%
	3000Hz Harmonic Distortion			1%
	1020Hz Frequency	1015Hz		1025Hz
	400Hz Frequency	398Hz		402Hz
	1300Hz Frequency	1295Hz		1305Hz
	3000Hz Frequency	2985Hz		3015Hz
	B. 30Hz Ref, 30Hz VAR, 90Hz, and 150Hz			
	2.160MHz Oscillator Frequency			(±432Hz)
	C. 30Hz Sine and 9960Hz FM Output			
	30Hz VAR Distortion			0.5%
	30Hz Ref Distortion			0.5%
	9960Hz Distortion			1.5%
	Phase Lock Pulse Adjust			(✓)
	9960Hz Frequency	9959Hz		9960Hz
	480Hz Deviation Δt	46.1µs		50.9µs
	D. 90Hz and 150Hz Tones.			
	90Hz Distortion			0.5%
	150Hz Distortion			0.5%
8-7.	COUNTER CLOCK OSCILLATOR FREQUENCY.			
	A. WWV Zero Beat Calibration			
	Zero Beat			(✓)
	B. Phase Lock Time Base Calibration			
	Output Frequency Discrepency			.0005%
8-8.	GENERATOR OUTPUT FREQUENCIES			
	10.5V Adjust	10.4V		10.6V
	MKR XTL			(±3KHz)
	VOR XTL			(±5KHz)
	LOC XTL			(±5KHz)
	G/S XTL			(±16KHz)
	COMM XTL			(±6KHz)
	MKR VAR Upper Limit	78MHz		
	VOR VAR Upper Limit	120MHz		
	COMM VAR LO Upper Limit	136MHz		
	COMM VAR HI Upper Limit	158MHz		
	MKR VAR HI Lower Limit			72MHz
	VOR VAR Lower Limit			107MHz
	LOC VAR Lower Limit			107MHz

G/S VAR Lower Limit		______327MHz
COMM VAR LO Lower Limit		______117MHz
COMM VAR HI Lower Limit		______134MHz
8-9. RF OUTPUT LEVEL		
RF Level - MONITOR Meter Centering		______(✓)
Set Dial, - 30dBm		______(✓)
8-10. PERCENT MODULATION OF TONES.		
A. MKR Tones		
MONITOR Meter - 100%		______(✓)
MONITOR Meter - 30%		______(✓)
1300Hz Tone		______(95%)
B. VOR TONES		
30Hz VAR		______(30%)
9.96KHz		______(30%)
1020Hz		______(30%)
C. LOC Modulation and Centering		
150Hz LOC		______(20%)
Center LOC		______(✓)
D. G/S Modulation and Centering		
150Hz G/S		______(40%)
Center G/S		______(✓)
E. COMM Modulation		
1020Hz Tone		______(30%)
8-13. BEARING CHECK CIRCUIT		
Center MONITOR Meter		______(✓)
TO/FROM Phase		______(✓)
Balance Meter		______(✓)
8-14. COMM POWER CIRCUIT		
100 Watt Adjust		______(✓)
10 Watt Adjust		______(✓)
8-15. BATTERY CHARGER		
Battery Charger	16.0V	______16.2V
MONITOR Meter Adjust		______(✓)
Battery Timer	6min.	______10 min.

SECTION IX

Disassembly and Assembly Instructions

9-1. INTRODUCTION.

9-2. This section presents instructions for disassembling and assembling the NAV-401L test set. The test set should only be disassembled when repair is proven to be necessary. Disassemble only as far as necessary, as indicated by the nature of the problem. The order of disassembly and assembly of electronic equipment can usually be determined through observation. In addition to assembly drawings given to this section, refer to the illustrated parts list in Section XIII for detailed assembly of sub-sections.

9-3. DISASSEMBLY PROCEDURES.

9-4. CASE REMOVAL. See figure 9-1.
- a. Remove four screws, two each on top and bottom of front edge of case located near each lid fastener.
- b. Remove four screws that secure the rear panel rubber feet to test set.
- c. Remove test set from front of case.

9-5. CARD CAGE ASSEMBLY. See figure 9-2. Remove two flat head screw securing card cage cover to card cage.

9-6. 5V REGULATOR BOARD. See figure 9-2.
- a. Remove six screw, three at rear and front of left side panel.
- b. Remove four screws securing card cage to top and bottom of left panel.
- c. Remove four screws in rectangular pattern of left side frame.

9-7. PHASE LOCK/POWER MONITOR CHASSIS. See figure 9-3.
- a. Remove three screws in triangular pattern near front of right side frame.
- b. Remove six screws three each at rear and front of right side panel.
- c. Remove two screws securing Attenuator/Power Amplifier assembly to right side panel.
- d. Remove two screw holding plug into connector. It may be necessary to remove the coax from 25dB pad to remove the board completely out of test.

9-8. ATTENUATOR/POWER AMPLIFIER ASSEMBLY. See figure 9-4.
- a. Remove two screws holding plug onto connector on bottom of Power Amplifier case and remove plug.

NOTE

> Before removing attenuator dial, a RF power meter capable of measuring down to -30dBm should be available for resetting the attenuator calibration. Carefully removing the dial without rotating the dial or the attenuator shaft can result in close calibration after reassembly.

b. Loosen two set screws closest to front of attenuator knob.
c. Loosen two set screws in generator tuning knob.
d. Remove attenuator dial, knob assembly and tuning knob together.
e. Remove four #2 flathead screws located on front panel around attenuator shaft.
f. Remove two #4 flathead screws on right side frome securing Power amplifier case to side frame. Remove Attenuator/Power Amplifier assembly from side frame.

9-9. COUNTER ASSEMBLY. See figure.
a. Remove two knobs from front panel, Display Time control and Counter Mode switch, by loosening the set screws.
b. Remove the bezel by removing black screws located at each side of the lens.
c. Remove four flathead screws,two on each side of readout cut-out hole, on front panel securing counter assembly.
d. Remove plug from side of PC board and remove counter assembly from case.
e. Remove readouts from counter assembly.
f. Remove two screws from the top of counter assembly securing high voltage power supply cover.
g. Remove four screws from Counter assembly securing the high voltage power supply to Counter rails.

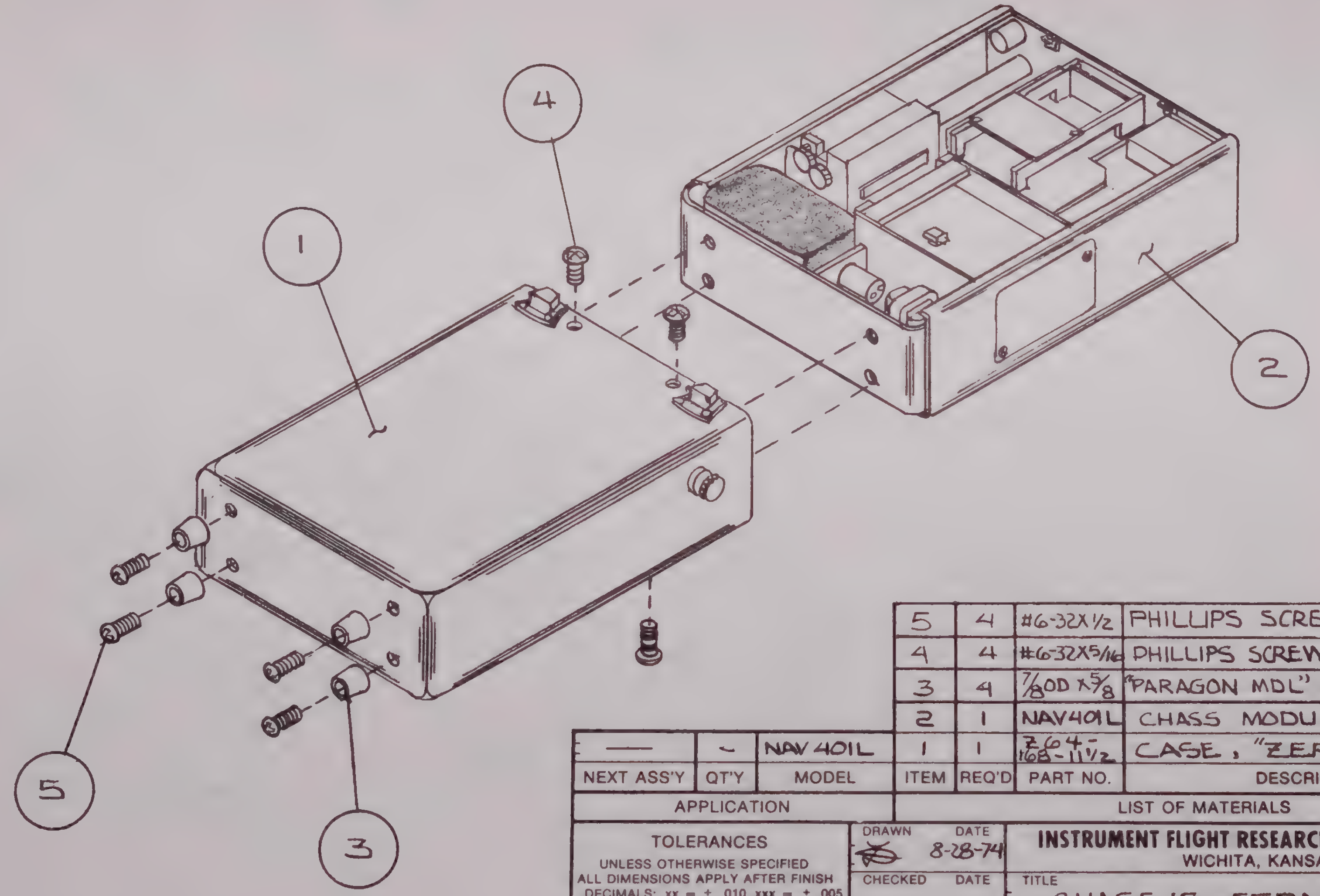
9-10. ASSEMBLY PROCEDURES.

9-11. In general, assembly of any component to the main case frame is the reverse order of disassembly. Reference may also be made to assembly drawings in the Illustrated Parts list, Section XIII.

NOTE

> Assembly of the power regulator transistors to the side of the card cage frame requires the spreading of a film of silicon grease, type General Electric G-624 Silicon Dielectric Compound, to both component surfaces.

DATE	REV	CHANGE	APP'D



ITEM	REQ'D	PART NO.	DESCRIPTION
5	4	#6-32X1/2	PHILLIPS SCREW, BIND HD.
4	4	#6-32X5/16	PHILLIPS SCREW, BIND HD.
3	4	7/8OD X 5/8	"PARAGON MDL" RUBBER FOOT
2	1	NAV401L	CHASS MODULAR ASS'Y.
1	1	Z64-168-11 1/2	CASE, "ZERO MFG. CO."

LIST OF MATERIALS

NEXT ASS'Y	QT'Y	MODEL
—	-	NAV 401L

APPLICATION

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .xx = ± .010 .xxx = ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

DRAWN DATE 8-28-74
CHECKED DATE
APPROVED DATE

MATERIAL
TREATMENT
FINISH

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

TITLE
CHASSIS SEPARATION FROM CASE (EXPLODED VIEW.)

SIZE | PART NUMBER 1-09-0508 | REV
SCALE NONE | WEIGHT — | SHEET 1 OF 1

FIG 9-1

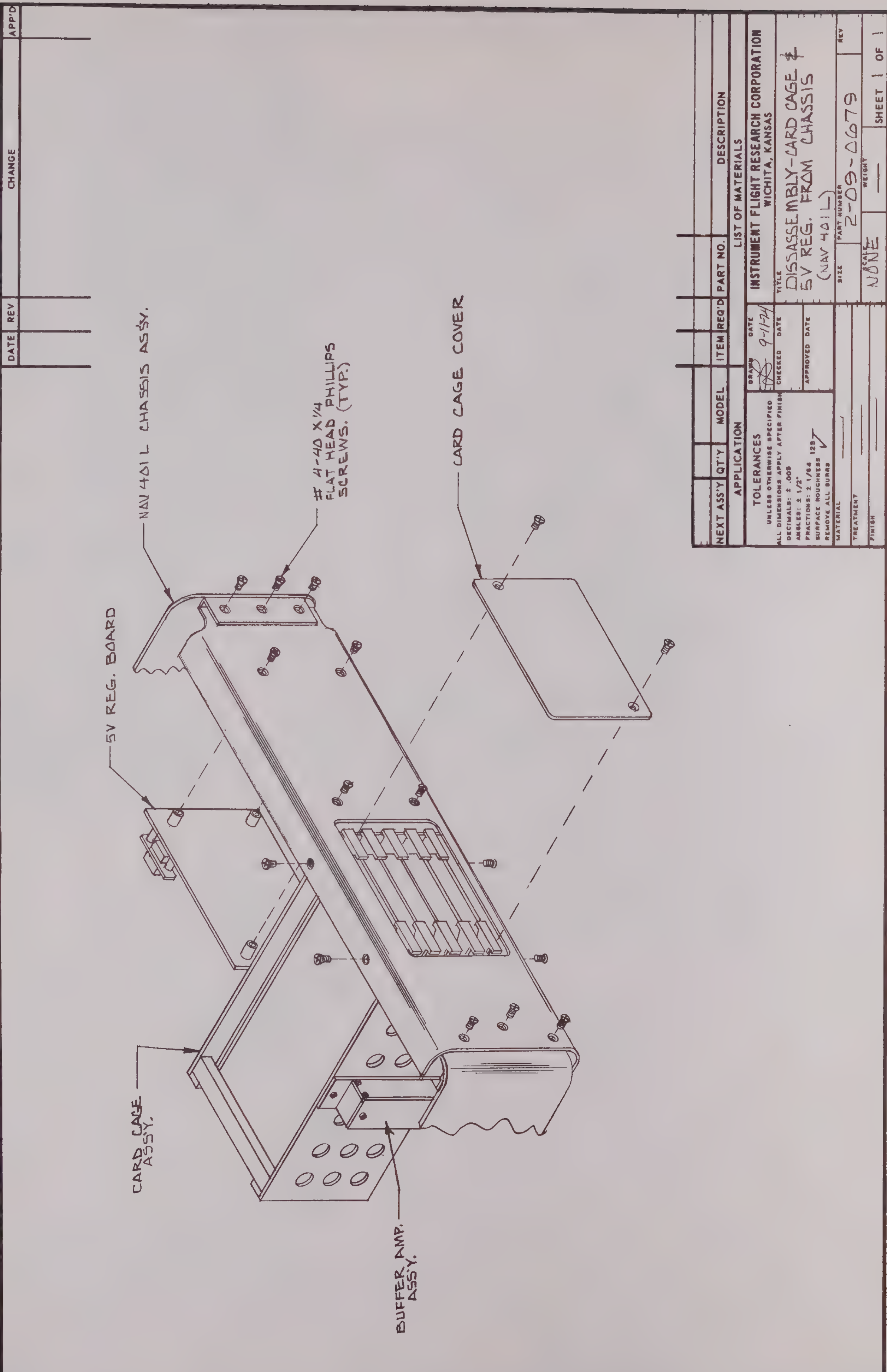
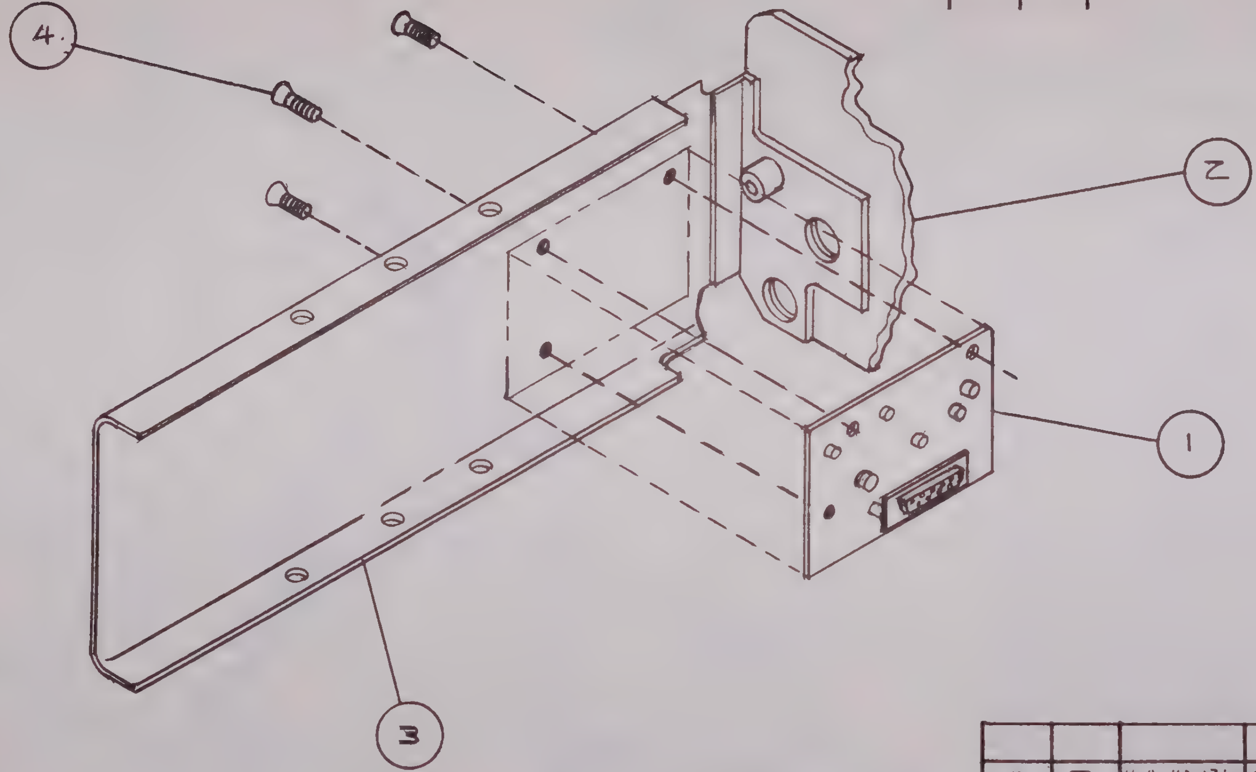

DATE
REV
CHANGE
APP'D
NAV 401 L CHASSIS ASSY.
4-40 X 1/4
FLAT HEAD PHILLIPS
SCREWS. (TYP.)
CARD CAGE COVER
5V REG. BOARD
CARD CAGE
ASSY.
BUFFER AMP.
ASSY.
NEXT ASS'Y
QT'Y
MODEL
ITEM
REQ'D
PART NO.
DESCRIPTION
APPLICATION
LIST OF MATERIALS
TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS
MATERIAL
TREATMENT
FINISH
DRAWN
DATE 9-1-74
CHECKED
DATE
APPROVED
DATE
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS
TITLE
DISSASSEMBLY-CARD CAGE &
5V REG. FROM CHASSIS
(NAV 401 L)
SIZE
PART NUMBER
2-09-0679
REV
SCALE NONE
WEIGHT —
SHEET 1 OF 1

FIG 9-2

DATE	REV	CHANGE	APP'D
8-29-74	A	REDRAWN LD.	



ITEM	REQ'D	PART NO.	DESCRIPTION
4	3	#4-40X3/16	PHILLIPS SCREW, FLAT HD.
3	1	3-09-0314	RIGHT FRAME
Z	1	3-09-0293	FRONT PANEL
1	1	1-09-0503	P/L Ø LOCK POWER MONITOR ASSY

LIST OF MATERIALS

NEXT ASS'Y	QT'Y	MODEL
—	—	NAV 401L

APPLICATION

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .xx = ± .010 .xxx = ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

DRAWN: LD DATE: 8-29-74
CHECKED DATE
APPROVED DATE

MATERIAL —
TREATMENT —
FINISH —

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

TITLE: Ø LOCK POWER MON. CHASSIS REMOVAL EXPLODED VIEW

SIZE: | PART NUMBER: 1-09-0510 | REV: A
SCALE: NONE | WEIGHT: — | SHEET 1 OF 1

FIG 9-3

DATE	REV	CHANGE	APP'D
8-29-74	A	REDRAWN LD.	

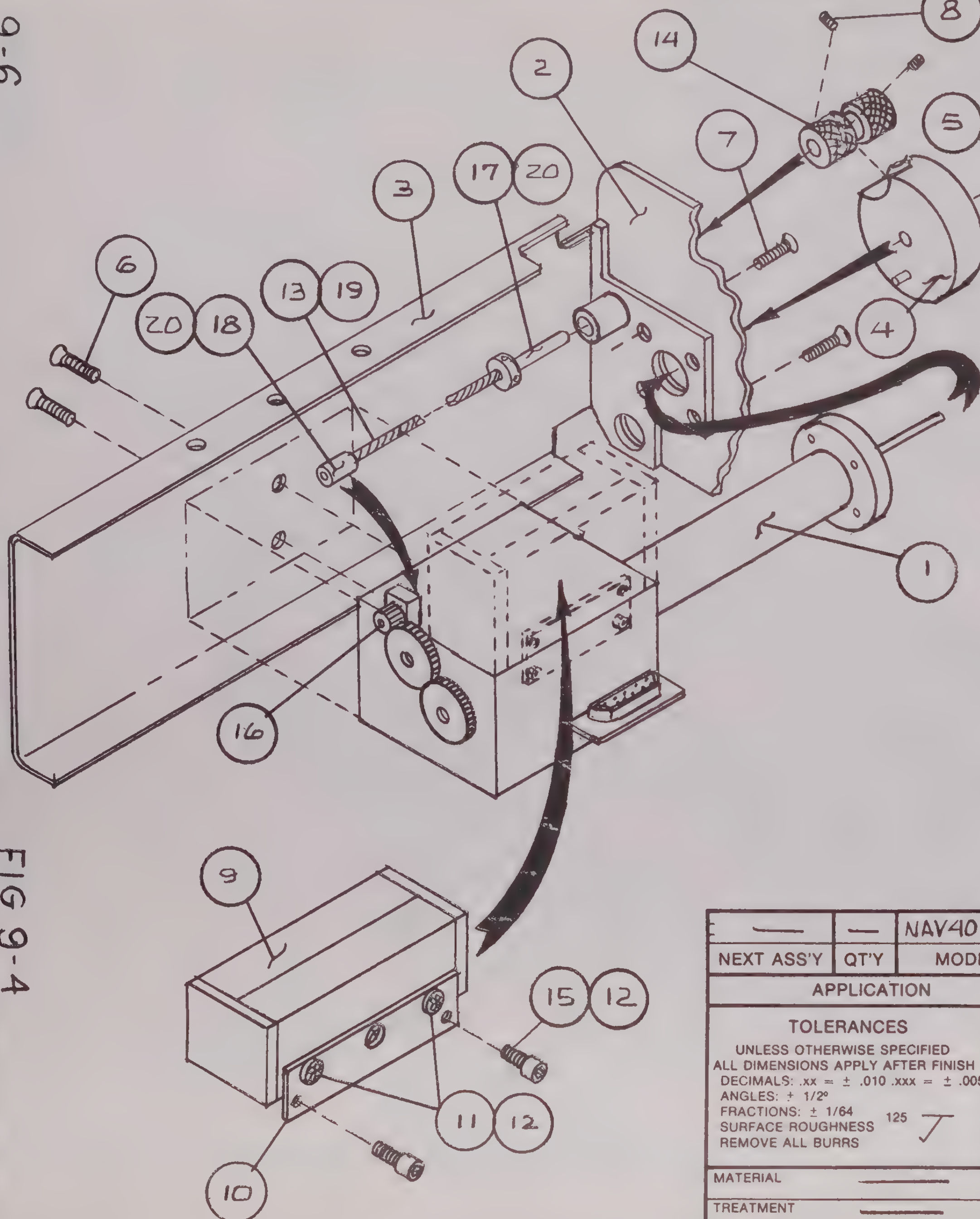


FIG 9-4

ITEM	REQ'D	PART NO.	DESCRIPTION
20	6	#2-56X3/32	SOCKET SET SCREW
19	1	6.20"	TEFLON TUBING.
18	1	1-09-0171	FLEX SHAFT ADPTR.
17	1	1-09-0170	FLEX SHAFT ADPTR.
16	1	2-09-0210	PINION GEAR
15	2	#2-56X3/16	SOCKET HD SCREW
14	1	1-09-0379	KNOB
13	1	1-09-0235	FLEX SHAFT
12	4	#2	INT. TOOTH L.W.
11	2	#2-56X3/16	PHILLIPS SCREW, BIND HD.
10	1	1-09-0538	LOCALIZER MTG. BRKT.
9	1	1-09-0589	LOCALIZER ASSY.
8	4	#2-56X 1/8	SOCKET SET SCREW
7	4	#2-56X3/16	PHILLIPS SCREW, FLAT HD.
6	2	#4-40X 3/16	PHILLIPS SCREW, FLAT HD.
5	1	2-00-0097	KNOB
4	1	3-09-0386	DIAL ASS'Y.
3	1	3-09-0314	RIGHT FRAME
2	1	3-09-0293	FRONT PANEL ASS'Y.
1	1	1-09-0497	ATTENUATOR ASS'Y.

LIST OF MATERIALS

NEXT ASS'Y	QT'Y	MODEL
—	—	NAV401L

APPLICATION

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .xx = ± .010 .xxx = ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

DRAWN — DATE 8-29-74
CHECKED — DATE
APPROVED — DATE

MATERIAL ——
TREATMENT ——
FINISH ——

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

TITLE: ATTENUATOR POWER AMP. REMOVAL EXPLODED VIEW

SIZE — PART NUMBER 1-09-0571 — REV A

SCALE NONE — WEIGHT —— — SHEET 1 OF 1

DATE	REV	CHANGE	APP'D

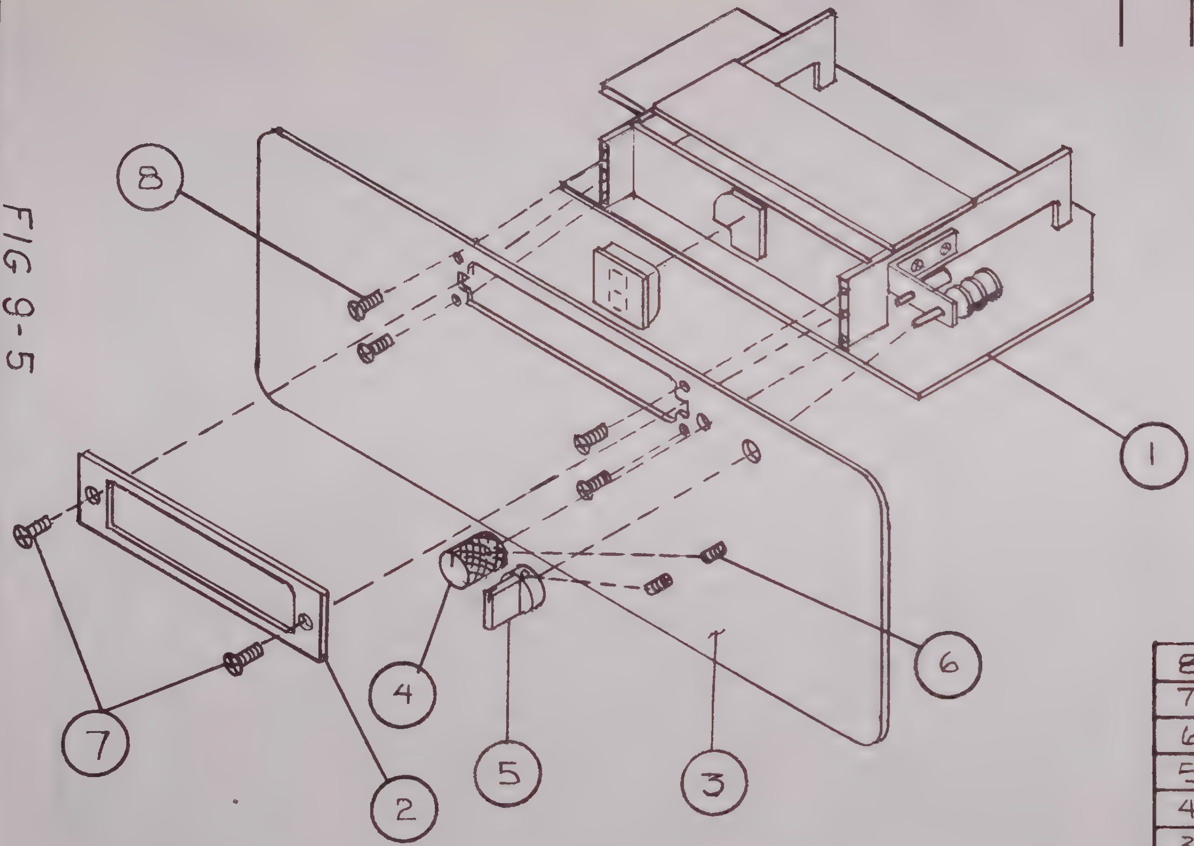


FIG 9-5

ITEM	REQ'D	PART NO.	DESCRIPTION
8	4	#2-56X1/4	PHILLIPS SCREW, FLAT HEAD
7	2	#2-56X1/2	PHILLIPS SCW, BND. HD. (BLK OXIDE
6	4	#2-56X1/8	SOCKET SET SCREW
5	1	1-00-0056	BAR KNOB
4	1	1-00-0057	ROUND KNOB
3	1	3-09-0293	FRONT PANEL
2	1	1-09-0551	BEZEL ASS'Y.
1	1	1-09-0561	COUNTER ASS'Y.

LIST OF MATERIALS

NEXT ASS'Y	QT'Y	MODEL
—	—	NAV401L

APPLICATION

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .xx = ± .010 .xxx = ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

MATERIAL —
TREATMENT —
FINISH —

DRAWN DATE 8-29-74
CHECKED DATE
APPROVED DATE

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

TITLE
COUNTER ASS'Y. REMOVAL EXPLODED VIEW.

SIZE
PART NUMBER 1-09-0572
REV
SCALE NONE
WEIGHT —
SHEET 1 OF 1

DATE	REV	CHANGE	APP'D
8-28-74	A	REDRAWN L.D.	

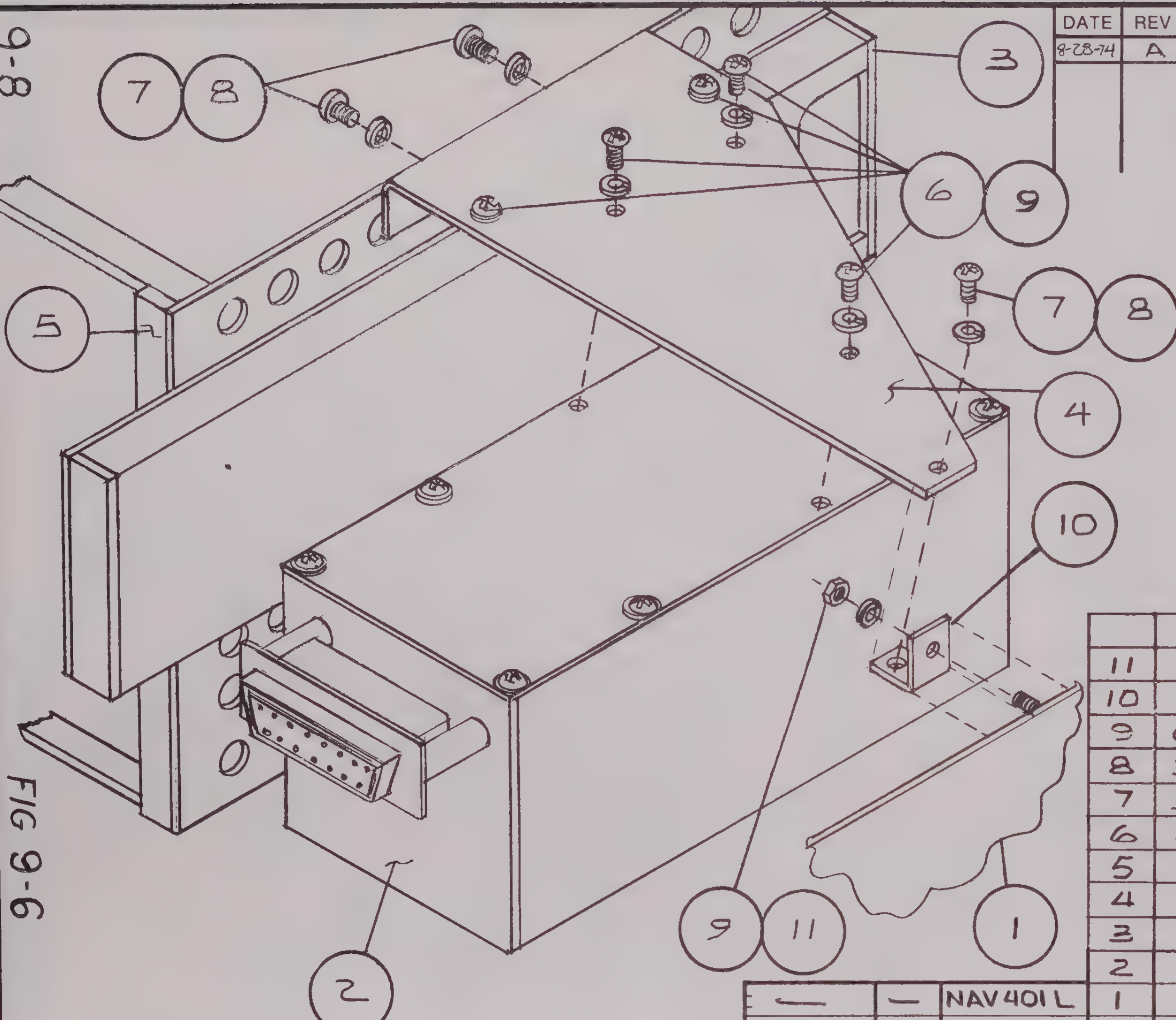


FIG 9-6

ITEM	REQ'D	PART NO.	DESCRIPTION
11	1	# 2-56	HEX NUT, SMALL PATTERN
10	1	1-09-0473	SUPPORT MTG. BRKT.
9	6	# 2	LOCKWASHER, INT. TOOTH
8	3	# 4	LOCKWASHER, INT. TOOTH
7	3	#4-40 X 3/16	PHILLIPS SCREW, BIND HD.
6	5	#2-56 X 1/4	PHILLIPS SCREW, BIND HD.
5	1	1-09-0462	P.C. CARD CAGE ASS'Y.
4	1	2-09-0472	SUPPORT, PRESCALER
3	1	1-09-0487	PRESCALER ASS'Y.
2	1	1-09-0484	OSCILLATOR ASS'Y.
1	1	3-09-0263	FRONT PANEL

LIST OF MATERIALS

NEXT ASS'Y	QT'Y	MODEL
—	—	NAV 401 L

APPLICATION

TOLERANCES

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .xx = ± .010 .xxx = ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

DRAWN	DATE 8-28-74
CHECKED	DATE
APPROVED	DATE

MATERIAL	—
TREATMENT	—
FINISH	—

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

TITLE
OSCILLATOR PRESCALER REMOVAL EXPLODED VIEW.

SIZE	PART NUMBER	REV
	1-09-0573	A

SCALE	WEIGHT	
NONE	—	SHEET 1 OF 1

SECTION X

INSPECTION/CHECK

10-1. INSPECTION.

10-2. This section provides general instructions for the visual inspection and checking of the NAV-401L test set. Care should be taken during inspection and cleaning to avoid breaking or shorting component leads.

10-3. CLEANING.

10-4. Internal chassis parts and frame should be wiped with a lint-free cloth moistened with rubbing alcohol. The front panel may also be cleaned with rubbing alcohol. The outside case should be cleaned with safety solvent if tar or oil is present, or soap and water if grime is present.

10-5. INSPECTION/CHECK.

10-6. PROCEDURES. If a failure has occurred, carefull visual inspection prior to detailed testing and troubleshooting may reveal the cause. Examine each subassembly, the main chassis, and components as indicated in the following steps.

a. Chassis. Inspect for tightness of subassemblies, damaged connectors, and corrision or damage to the metal surfaces. Surface corrosion may indicate damage inside the affected part.
b. Capacitors. Inspect for loose mounting, body damage, leakage, and corrosion around leads.
c. Connectors. Inspect all connectors for loose or broken parts or wiring, cracked insulation, and bad contacts. Do not disassembly the connectors within the test set.
d. Potentiometers. Any potentiometer that feels rough when rotated or produces circuit or voltage irregularities should be checked with an ohmmeter for proper operation.
e. Resistors. Inspect resistors for cracked, broken, charred, or blistered cases and loose or corroded connections.
f. Printed Circuit Boards. Check connectors for corrosion and damage and the mating plugs for similar damage. Inspect all mounted components for damage, including crystals and IC's. The board should be free of all foreign material.
g. Semiconductors. Inspect all diodes, rectifiers, and transistors for cracked, broken, charred, or distcolored cases.
h. Transformer. Inspect the transformer for signs of excessive heating, broken or charred insulation, or loose mounting hardware.

i. Wiring. Inspect all wiring for broken or loose ends and connections, and proper dress relative to other chasses parts. All laced wiring should be tight with ends securely tied.

SECTION XI

SEMICONDUCTOR AND IC GUIDE

11-1. INTRODUCTION.

11-2. This section contains information to aid in the troubleshooting and repair of semiconductor and integrated circuit components used in the NAV-401L test set. Paragraph 11-8 contains a brief introduction to digital IC's and gives brief descriptions of the various IC's used in the test set. The integrated circuits are listed in table 11-1 along with the printed circuit boards on which they are used. Figure 11-1 shows the pin-out diagrams and truth tables for the IC's.

11-3. COMPONENT REPLACEMENT.

11-4. The following guidelines should be followed when replacing components.

a. Use a low heat soldering iron, 40 watts or less, when installing or removing soldered parts.
b. Always remove power from the test set when working on any circuit.
c. Use small needle-nose pliers to heat-sink the leads of a transistor or diode while soldering.
d. Apply thermal compound to the mica insulators of the power transistors when mounting the transistors to the chassis. Use an ohmmeter to check for effectiveness of the insulation.
e. Never apply too much heat to the printed circuit board paths. If a device cannot be easily removed, cut the leads and remove them one at a time. Use desoldering wick to remove all solder around leads. Too much heat will break down the PC board material and loosen or remove paths from the board.

11-5. SEMICONDUCTORS.

11-6. A transistor tester should be used to properly evaluate transistors. If a tester is not available, an ohmmeter which draws less than one milliampere can be used. Many ohmmeters in high input impedance multimeters do not draw enough current through the transistor junction to allow for proper testing.

11-7. Never remove or replace a semiconductor with the supply voltage applied to the circuit. Transients may damage the semiconductor being replaced or components in the circuit. If a semiconductor is to be evaluated in an external test circuit no more voltage should be applied to the semiconductor than is normally used in the circuit from which it came.

Table 11-1. IC Descriptions and Locations

IC	Description	P.C. Board
LM305	Voltage Regulator	5V Regulator Board
MC1027	AC Coupled J-K Flip-Flop	Prescaler Board
MC1666	Dual Clocked R-S Flip-Flop	Prescaler Board
MC1692	Quad Line Receiver	Prescaler Board
CD4011	Quad 2 Input NAND Gate (CMOS)	30Hz Sine Board
CD4040	12 Stage Ripple-Carry Binary Counter/Divider (CMOS)	30Hz Sine Board
DM8880	High Voltage 7-Segment Decoder/Driver	Counter Assembly
SN7400	Quad 2-Input NAND Gate (TTL)	Bearing Logic Board Counter Assembly
SN7420	Dual 4-Input NAND Gate (TTL)	Bearing Logic Board
SN7430	Single 8-Input NAND Gate (TTL)	Bearing Logic Board
SN7473	Dual J-K Flip-Flop (TTL)	Bearing Logic Board Counter Assembly
SN7475	4-Bit Bistable Latches (TTL)	Counter Assembly
SN7490	Decade Counter (÷2,÷5,or ÷10) (TTL)	Bearing Chk Board Bearing Logic Board Counter Assembly
SN7492	Divide by 2,6, or 12 Counter (TTL)	Bearing Logic Board
SN74121	Retriggerable Monostable Multivibrators (TTL)	Bearing Logic Board
SN72558	Dual Operational Amplifier	Bearing Chk Board 30Hz Sine Board
SN72709	Compensated Operational Amplifier	30Hz Sine Board Regulator Timer Board Combination Sine Board Bearing Chk Board
SN72741	Operational Amplifier	Bearing Chk Board Regulator Timer Board Combination Sine Board 30Hz Sine Board Oscillator Assembly Modulator/Power Ampli- fier Assembly Localizer Assembly Phase Lock Pwr Monitor

11-8. INTEGRATED CIRCUITS.

11-9. The NAV-401L test set utilizes both linear and digital in-tergrated circuits. The digital integrated circuits include transistor-transistor logic (TTL), complementary metal-oxide-substrate logic (CMOS) and emitter-coupled logic (ECL) devices.

11-10. TTL, ECL, and CMOS devices each use different logic voltage levels. The low level, logic zero (0), for TTL devices is less than 0.8V and the high level, logic one (1), is more than 2.0V. ECL devices require less than 3.2V for logic zero level and more than 4.15V for logic one level. A +11V supply voltage is used for the CMOS IC's in the test set. A voltage less than 3V is logic zero and greater than 8V is logic one.

11-11. LM305 Voltage Regulator. The LM309 is an integrated voltage regulator designed for precision analog voltage regulation.

11-12. MC1027 Flip-Flop. The MC1027 is a high speed, 100MHz, ECL J-K flip-flop. The J and K inputs are four input OR gates.

11-13. MC1666 Flip-Flop. The MC1666 is an ECL dual clocked R-S flip-flop which requires a clock input to enable the set-reset inputs. The device is used as a high-speed dual storage element.

11-14. MC1692 Quad Line Receiver. The MC1692 contains four differential amplifiers with emitter followers, intended for use in sensing differential signals over long lines.

11-15. CD4011. The CD4011 is a quad two input CMOS NAND gate. All inputs of a NAND gate must be at logic one to obtain a logic zero output.

11-16. CD4040. The CD4040 is a CMOS 12-stage ripple-carry binary counter/divider which uses a master-slave flip-flop configuration for each stage. The device is used as a ÷332 frequency divider.

11-17. SN7400, SN7420, and SN7430 NAND Gates. Three types of TTL NAND gates are used; the SN7400 is a quad two-input NAND gate, the SN7420 is a dual four-input NAND gate and the SN7430 is an eight-input NAND gate. All inputs of a NAND gate must be at logic one to obtain a logic zero output.

11-18. SN7473 Flip-Flop. The SN7473 is a dual J-K master-slave flip-flop used for data storage and control.

11-19. SN7475 Latch. The SN7475 is a quad bistable latch which is used as a binary storage element.

11-20. SN7490 Counter. The SN7490 is a decade divider/counter with binary coded decimal (BDC) outputs. Divide by 2 and divide by 5 functions are also available in the device.

11-21. 7492 Divider. The SN7492 is a divider which can divide by 2, 6, or 12.

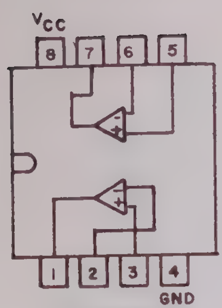
11-22. SN74121. The SN74121 is a monostable multivibrator with gated inputs. An external resistor and capacitor are chosen to select a pulse width from 40 nanoseconds to 40 seconds. Three inputs provide selective gating. The device is used to widen a narrow reset pulse.

11-23. SN72558. The SN72558 contains two operational amplifiers, each electrically similar to the SN72741. The op amps require no external frequency compensation.

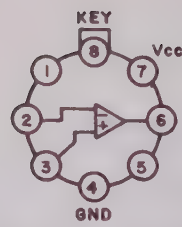
11-24. SN72709. The SN72709 is a high performance operational amplifier having high impedance differential inputs and a low impedance output. The op amp has provisions for external input and output frequency compensation.

11-25. SN72741. The SN72741 is a high performance operational amplifier with internal frequency compensation.

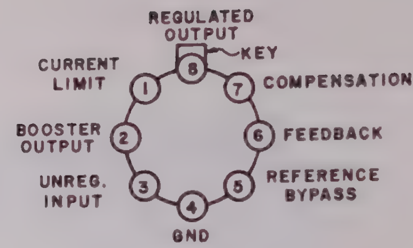
11-26. DM8880. The DM8880 is a high voltage seven-segment decoder/divider designed to decode BCD inputs and drive gas filled seven-segment display tubes.



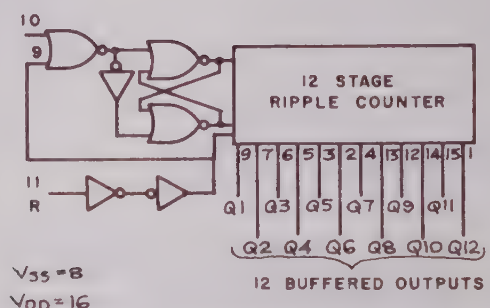
SN72558



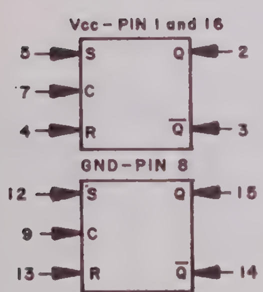
SN72741, LM307



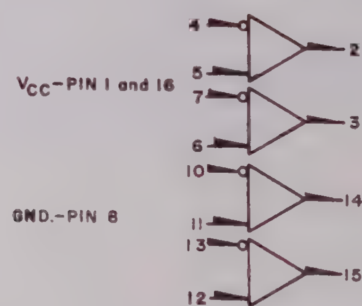
LM305



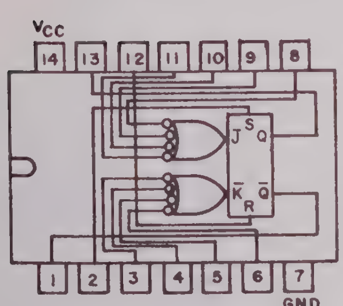
CD4040AE



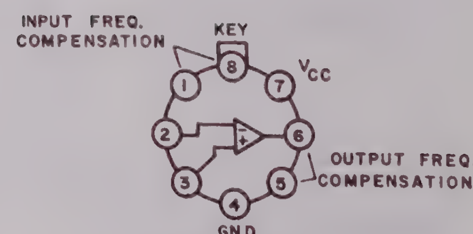
MC1666



MC1692



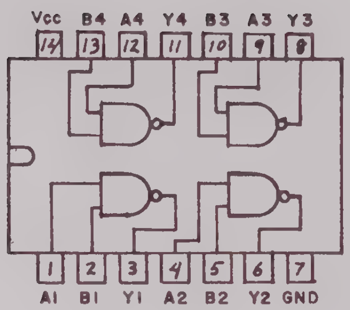
MC1027



SN72709
MC1709CG
LM709

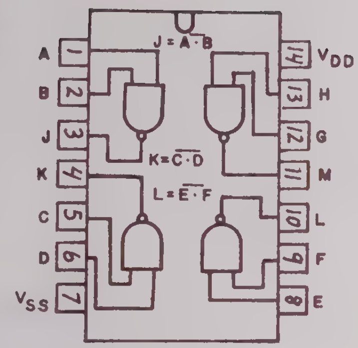
(Top Views)

Figure 11-1. Integrated Circuit Guide (Sheet 1 of 3)

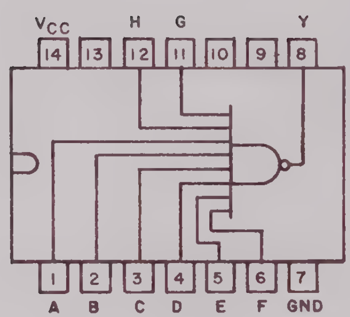


SN7400

INPUT		OUTPUT
A	B	Y
1	1	0
0	X	1
X	0	1



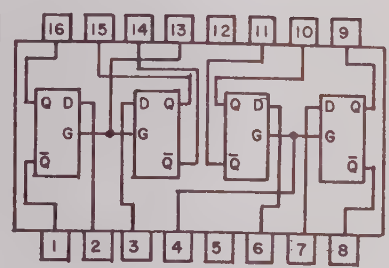
CD4011



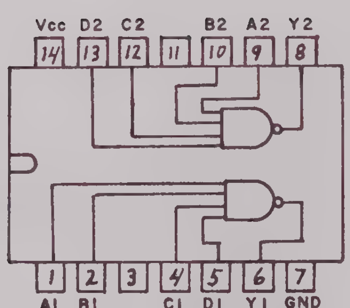
SN7430

INPUTS								OUTPUT
A	B	C	D	E	F	G	H	Y
1	1	1	1	1	1	1	1	0
all other states								1

INPUTS		OUTPUTS	
D	G	Q	$\overline{Q}$
0	1	0	1
1	1	1	0
X	0	Q_0	$\overline{Q}_0$

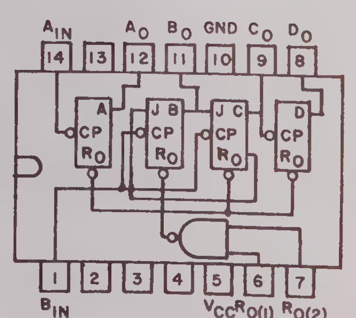


SN7475



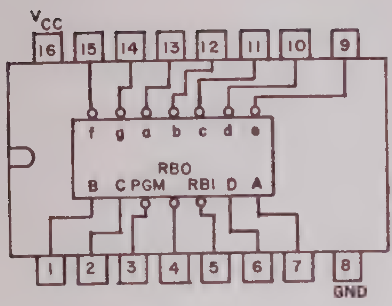
SN7420

INPUT				OUTPUT
A	B	C	D	Y
1	1	1	1	0
0	X	X	X	1
X	0	X	X	1
X	X	0	X	1
X	X	X	0	1



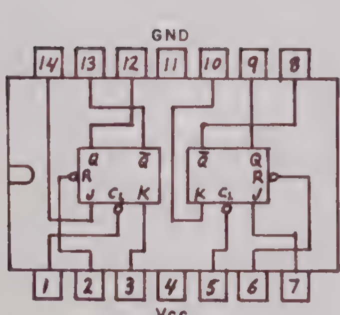
SN7492

Figure 11-1. Integrated Circuit Guide (Sheet 2 of 3)



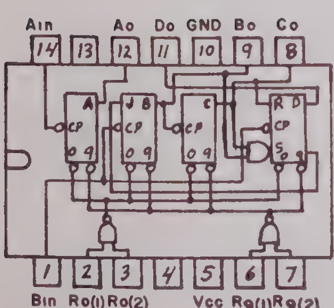
DM8880

	INPUTS						OUTPUTS						
	RBI	D	C	B	A	BI/RBO	a	b	c	d	e	f	g
0	1	0	0	0	0	1	0	0	0	0	0	0	1
1	X	0	0	0	1	1	1	0	0	1	1	1	1
2	X	0	0	1	0	1	0	0	1	0	0	1	0
3	X	0	0	1	1	1	0	0	0	0	1	1	0
4	X	0	1	0	0	1	1	0	0	1	1	0	0
5	X	0	1	0	1	1	0	1	0	0	1	0	0
6	X	0	1	1	0	1	0	1	0	0	0	0	0
7	X	0	1	1	1	1	0	0	0	1	1	1	1
8	X	1	0	0	0	1	0	0	0	0	0	0	0
9	X	1	0	0	1	1	0	0	0	0	1	0	0
BI	X	X	X	X	X	0	1	1	1	1	1	1	1

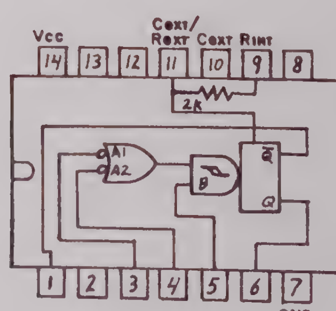


SN7473

INPUTS				OUTPUTS	
CLR	CLK	J	K	Q	$\bar{Q}$
0	X	X	X	0	1
1	⎍	0	0	Q_0	$\bar{Q}_0$
1	⎍	1	0	1	0
1	⎍	0	1	0	1
1	⎍	1	1	Toggle	



SN7490



SN74121

INPUT			OUTPUT	
A1	A2	B	Q	$\bar{Q}$
0	X	1	0	1
X	0	1	0	1
X	X	0	0	1
1	1	X	0	1
1	↓	1	⎍	⎍
↓	1	1	⎍	⎍
↓	↓	1	⎍	⎍
0	X	↑	⎍	⎍
X	0	↑	⎍	⎍

Figure 11-1. Integrated Circuit Guide (Sheet 3 of 3)

SECTION XII
TROUBLESHOOTING AND SCHEMATICS

12-1. INTRODUCTION.

12-2. This section contains information to aid in isolating and repairing some common malfunctions which might occur in the test set. Table 12-1 lists all the test points on each printed circuit board. The Troubleshooting Chart, table 12-2, is a guide to help isolate malfunctions which might occur in each section of the test set.

12-3. The Troubleshooting Chart contains only the most common symptoms and probable causes and can not isolate every possible malfunction. Schematics are included, starting with figure 12-1, to aid in detailed troubleshooting and circuit analysis. The component placement for each printed circuit board is included with each schematic.

12-4. Because of the complexity of the Power Amplifier and Attenuator assemblies, factory assistance should be sought prior to attempting any repairs to these assemblies.

Table 12-1. Printed Circuit Board Test Points

Test Points	Function
Bearing Check Board, PC-1	
TP101	REF 30Hz Sine Output
TP102	180° VAR 30Hz Sine Output
TP103	VOR Demod Output
TP104	9960Hz FM Oscillator Output
TP105	Phase Detector Output
TP106	0° VAR 30Hz Sine Output
TP107	100KHz Clock Output
Regulator-Timer Board, PC-2	
TP201	MKR Tone Oscillator Sine Output
Combination Sine Board, PC-3	
TP301	90Hz Sine Output
TP302	150Hz Sine Output

Table 12-1. (cont'd)

Test Points	Function
	30Hz Sine Board, PC-4
TP401	30Hz REF Sine Output
TP402	9960Hz FM Sine Output
TP403	30Hz VAR Sine Output
	VOR Bearing Logic Board, PC-5
TP501	2.16MHz Oscillator Output
TP502	90Hz Square Wave Output
TP503	150Hz Square Wave Output
TP504	30Hz REF Square Wave Output
TP505	Bearing Pick-Off
TP506	30Hz VAR Square Wave Output

Table 12-2. TROUBLESHOOTING CHART

Section	Symptom	Possible Cause
Power Supply	No +11V Output in AC operation	Fuse F1101 open. CR1101 Bad. Short to Ground on +11V supply line. Q224 open.
	No +11V Output in Battery operation	Battery voltage too low; low voltage detector in operation. K201 Bad - Coil or open contacts. Short to ground on +11V Supply line Q224 open
	+11V Output low	High current load on +11V supply line. Current protect circuit in operation
	No +5V Output	Check F1101, CR1101. Q1151 bad X1151 bad X1152 bad No Negative Voltage out from 5V Regulator.
	No -6.2V Output	(See No +5V Output) Check CR1151 & 1152. Q213 open. High current load on -6.2V supply. Q208 or Q209 bad. CR1152 or CR1153 open.
1020Hz, 400Hz, 1300Hz, 3000Hz Tone Generator	No Tone Output	X201 or X202 bad. Q216, Q217, Q214 or Q215 bad. Short on output line to GND.
	Frequencies not proper	X201 or X202 Bad (Check for offset output voltage level) Q216, Q217, Q214 or Q215 not saturating completely. C209 Bad

Table 12-2. (cont'd)

Section	Symptom	Possible Cause
	Distortion on output frequency	Check triangular wave at input to R270 (2.1K 1%). One of the stages of the synthesizer is bad. Check for voltages indicated on schematic. Check for DC level on output of synthesizer to be 5.5V
VOR BRG Generator 90Hz and 150Hz tones	Output 30Hz Ref or 30Hz VAR not at correct frequency	Check frequency at TP501. Should be 2.16 MHz ± .02%. If not: Check Y501 Check X505
	30Hz REF	Division of X511 X514, X519, X518, X517, X516 wrong. Check X511
	30Hz VAR	Division of X508, X507, X506, or control X509, X510 or X520 bad.
	30Hz REF output at TP504 not symetrical	Reset in 30Hz REF counter inop. X512, X510, X513, or X511 bad.
	No 30Hz VAR Signal	X504 bad X509 or X520 bad X510 bad X505 bad
	No 30Hz VAR sig at 0° Switch setting	X505 bad X504 bad
	Bearing Switches select incorrect headings.	Check diodes CR501 thru CR512. Isolate which line.

Table 12-2. (cont'd)

Section	Sympton	Possible Cause
		(1,2,4, or 8) is causing the wrong bearing X504 bad
	90Hz frequency Wrong	X515 Bad - Check for division by 12. Input to X515 wrong Check freq at TP501 and X511, X514, X519, X518, X510
	150Hz Frequency Wrong	X503 or X502 bad X501 bad Input to X503 wrong
	No Phase shift between 90Hz and 150 Hz signals	X501 bad S9 input broken 30Hz VAR system inoperative
30Hz REF and 30Hz VAR Sine Output. NOTE: The 30Hz REF and 30Hz VAR synthesizers are identical. Possible causes are given for REF section only. Refer to the corresponding component if problems occur in the 30Hz VAR section.	No 30Hz Sine Output	Check for square wave input at PC4-4. Q401, Q402, or Q403 bad. X401 bad. Short to GND on output of synthesizer.
	Distortion on 30Hz Sine wave.	X401 not centered. X401 bad. One of the stages of synthesizer bad. Check voltages according to schematic
	No 9960Hz Output	X405, X406, or X407 bad. Q409 and Q410 bad. Q409 or Q410 have poor saturation characteristic. Q408 bad.

Table 12-2. (cont'd)

Section	Symptom	Possible Cause
	9960 at wrong frequency	Check Operation of Q409, Q410, X405, X406 or X407.
	No 9960Hz Phase lock	Check CR458 Q404 or Q405 Bad. Q406, Q407 Bad. X403 or X404 Bad. Check CR454-CR457
	No FM modulation of 9960Hz signal	30Hz REF sine output inop.
	FM deviation improper	X405A bad. Check offset voltage. CR417, CR418, or CR419 bad. Q401 bad. Check R434 and R435 value.
	Distortion on 9960Hz sine output	X406 output wrong. Check P-P amplitude on pin 1 of X406. Check offset voltage. Heavy load at output. Check sine synthesizer. +5.5V supply not proper.
90Hz and 150Hz Sine Output NOTE: The 90Hz and 150Hz Sine Generators are identical. Causes are given for the 90Hz system only.	No 90Hz Output	No 90Hz square wave input. Q308 bad. Q303 or Q305 bad. X305 bad. C303 bad.
	Distortion on 90Hz output	X305 bad. One stage of sine synthesizer bad. Centering to X305 wrong. Check R312.

Table 12-2. (cont'd)

Section	Sympton	Possible Cause
	No G/S 90Hz sine output.	X307 bad. R6 input broken.
	No LOC 90Hz sine output	X308 bad. R4 input broken.
	No LOC and G/S 150Hz	X309 Bad.
Tones to Mode Switch	None of the tones present at NAV Tone output jack J1101	Q307, Q301, or Q302 bad. X303 bad. X301 bad. Short to ground at output jack.
	Tones present on Signal Generator Demod jack, J1104, but not on NAV tones out, J1101.	X301 bad or broken connection.
1020, 400, 1300, 3000Hz tones	No tones out	Check wiring to S7a (tone output) or S7B (tone select) X402 Bad
VOR tones	No tones out	No 5.5V to center of R2 and R3.
	No ident tone on VOR signal	X402 bad Ident tone Generator inop
LOC Tones	No LOC tone to Ident tone	X402 Bad
G/S Tones COMM Tones	No G/S tone No COMM tone	X407 bad X402 bad Check wiring on Mode switch.
Counter Clock Oscillator Frequency	No 100 kHz output to Counter board	Oscillator inop - Check Oscillator at collector of Q106 X110 or X111 bad Q107 or Q108 bad

Table 12-2. (cont'd)

Section	Symptom	Possible Cause
	Oscillator inoperative	Q105 or Q106 bad Y101 crystal bad
	Frequency will not zero to exactly 10 MHz	Check Y101. Q105 or Q106 bad C125
Generator Output Frequencies	Marker XTAL off frequency	Y704 bad L710 needs adjustment Q709 bad
	No MKR output on XTAL	Y704 bad Q709 bad
	VOR XTAL off frequency	Y705 bad L711 needs adjustment Q710 bad
	No VOR output on XTAL	Y705 bad Q710 bad
	LOC XTAL off frequency	Y703 bad L714 needs adjustment Q708 bad
	No LOC output on XTAL	Y703 bad Q708 bad
	G/S XTAL off frequency.	Y701 bad L712 needs adjustment Q706 bad
	No G/S output on XTAL	Y701 bad Q706 bad
	COMM XTAL off frequency	Y702 bad L713 needs adjustment Q707 bad
	No COMM output on XTAL	Y702 bad Q707 bad
	None of the frequency modes extends low enough in frequency	Low limit pot R745 should be reset CR705 bad

Table 12-2. (cont'd)

Section	Sympton	Possible Cause
	None of the frequency modes extend high enough in frequency	Follow the procedure as described in the Calibration Procedures, paragraph 8-8.
	VOR, LOC, G/S VAR band does not have broad enough frequency range	Adjust L705 and low frequency pot R745 as required.
	MKR, VAR band does not have broad enough frequency range.	Adjust L703 and low frequency pot R745 as required.
	LO COMM band needs more frequency range.	Adjust L705 and low frequency pot R745 as required.
	HI COMM band needs more frequency range.	Adjust L706 and low frequency pot R745 as required.
NOTE: Above frequency adjustment affects the other bands so it is necessary to check all other VAR bands after every adjustment.		
	No RF output at J702	Q704 or Q705 bad
	FM on RF output	10.5V Regulator bad 11V Regulator bad X701, Q703 or CR712 Bad.
Phase Lock Section	No Phase Lock	No input to Assembly 4 from Prescaler No input to Assembly 4 from Counter. No +11V input from S12
	Phase Lock difficult to achieve	Q954 or Q955 leaky. Q953 bad

Table 12-2. (cont'd)

Section	Sympton	Possible Cause
RF Output Level	Low RF output	Check Diodes CR1 thru CR4 in Diode protect block. P.A. not properly tuned. X802 bad. Q804. NOTE: If X802 is defective, the tune lamp may not go out. Q805 through Q809 is bad (depending on band used).
	Tune lamp will not go off	Q801, Q802, or Q803 bad No RF to XMTR X801 or X802 bad Overmodulation Input RF frequency out of bandwidth of tune frequency No RF In. Check Buffer amp out.
	Tune lamp will not come on	Q801, Q802, Q803 bad Defective bulb
	Meter does not indicate in white band on meter	P.A. not properly tuned R386 needs adjustment
Percent Modulation	No % Modulation Meter indication	X304 bad X302 bad P.A. not in proper tune No modulation being applied to modulator.

Table 12-2. (cont'd)

Section	Symptom	Possible Cause
	% Mod reads too high	Input tone distorted to modulator by large amount. Check Tone Out. One of the the FET Switch Q805 thru Q809 Shorted
	% Mod reads too low	Input tone to modulator low in level. Q805 thru Q809 bad X304 bad X302 bad
	100% scale and 30% scale do not agree together	R389 or R391 probably out of adjustment Q307 bad Q302 bad
LOC and G/S Centering	Not able to center LOC or G/S	Amplitude of 90Hz Sine output too high or low Amplitude of 150Hz Sine output too high or low X309 Bad LOC X308 bad G/S X307 bad.
Bearing Check Circuit	No VOR Demod at TP103	X101 or X102 bad 9960Hz oscillator inop. Check: X104 or X105 Q103 or Q104 bad Phase Lock loop inop Check: X102 Q101 Q102

Table 12-2. (cont'd)

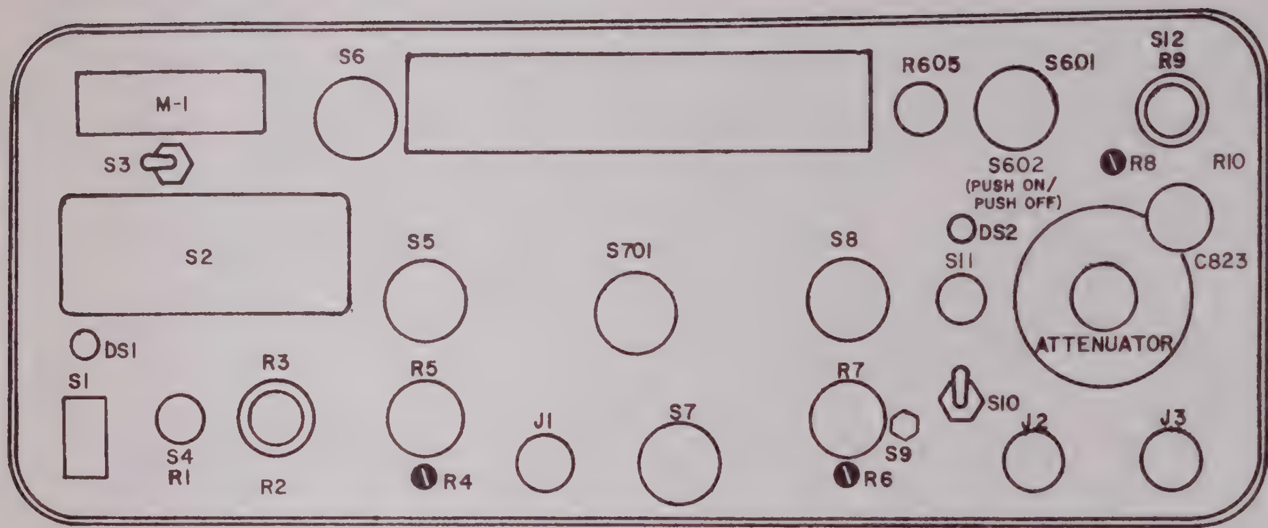
Section	Symptom	Possible Cause
	No 30Hz at TP101	No 30Hz output at TP103 X101 bad X102 bad
	No 0° VAR at TP106	X106 bad X101 bad
	No 180° VAR at TP102	X107 bad
	No detector voltage at TP105	X106 bad CR106- CR109 bad
	Unable to center meter	X109 Bad Balance Adjust R150 Phase Adjust R128 or Trim Adjust R152 Need Resetting. No 30Hz VAR Input to circuit (PC-1) No 9960Hz Input to circuit (PC-1). -6.2V or +11V not present
	Bearing Error	C403 and C412 bad or leaky X401 and X408 bad.
Power Meter	No power indication on meter	CR901 bad CR902 bad X901 bad
	Power meter reading low	25dB pad damaged. CR901 bad. R160 and R163 need adjustment.
	Meter does not indicate peak power readings	C903 bad Wiring to S10 open

Table 12-2. (cont'd)

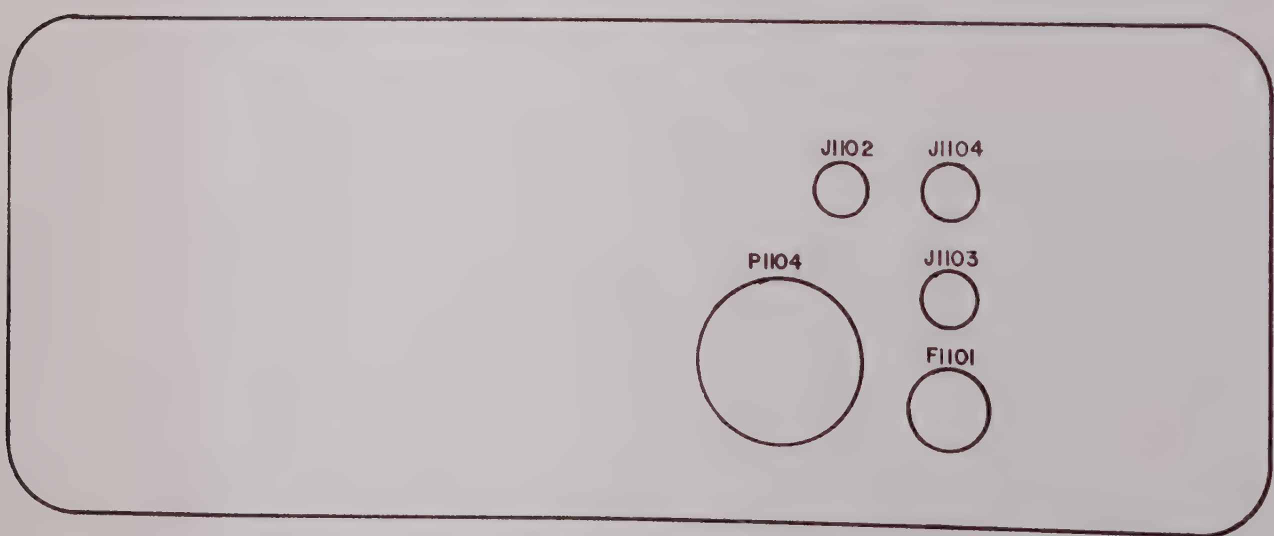
Section	Symptom	Possible Cause
	Power meter pegs without any input	X901 bad CR901 bad R905 can be adjusted
	Power meter reads but counter does not read frequency	No Prescaler output Input to prescaler may be shorted
Counter Operation	No count in GEN mode	No prescaler input No clock input from PC-1
	No count in external mode	No input to prescaler from front panel. Prescaler defective Q1001 or Q1004 bad X1008 bad
	No count in bearing mode	Q501 bad X504 bad X509 bad No 30Hz reference signal to counter
	No count in either generator or external modes	Time base dividers bad. Check X622 thru X628 X624 or X625 bad. Check X615 thru X620 for error.
	Wrong readout for known frequency input	Check X615 thru X620. Problem could be in readout circuit. Check X609 thru X614 Check X603 thru X608
	Wrong count in G/S mode	No 11V at Pin 14 X601 or X602 bad. X621 bad.

Table 12-2. (cont'd)

Section	Symptom	Possible Cause
	Segment of readout bad	Check the respective driver X603 thru X608
	Display time control inoperation	CR603 Bad. Q601 Bad. Q602 Bad.
Battery Charger	Battery does not maintain proper charge condition	One or more cells of the battery bad. Q218, Q219, or Q220 Bad. Q223 Regulator bad. CR207 or CR208 bad.
	Battery overheats during charging	Charger not current limiting. Q218, Q219, or Q220 bad. Check CR205 thru CR208.
Battery Timer	Timer will not start	K201 bad. Check CR211 thru CR213 Q205 Bad.
	Timer starts but turns off in a short time	Battery voltage low. CR211 bad. CR214 bad. Check Q201 thru Q203.
	Timer will not manually turn off	CR213 open
	Low Voltage Cutoff inop	Q204 Bad
	No pilot light	Defective bulb No 5V applied to lamp

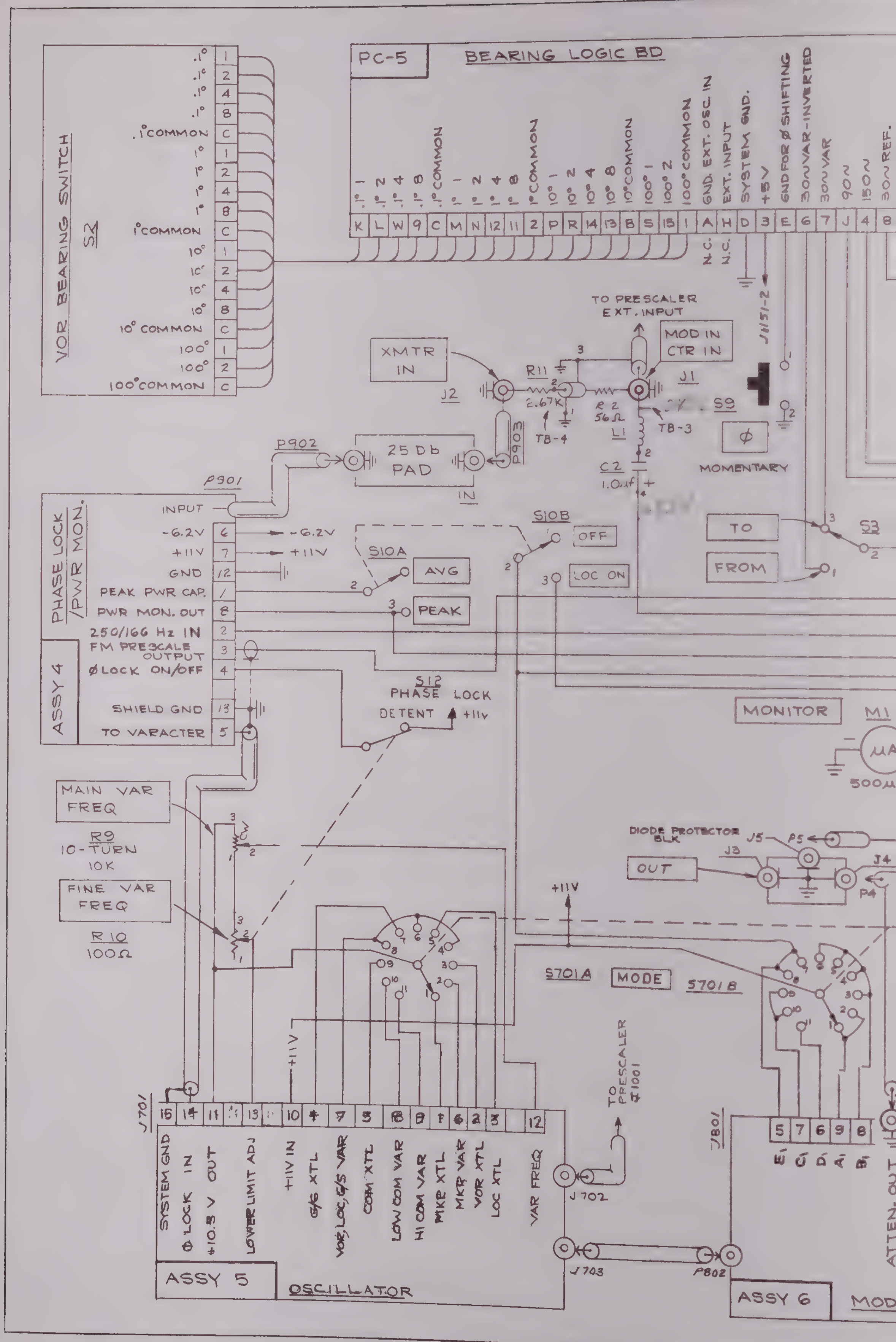


FRONT PANEL

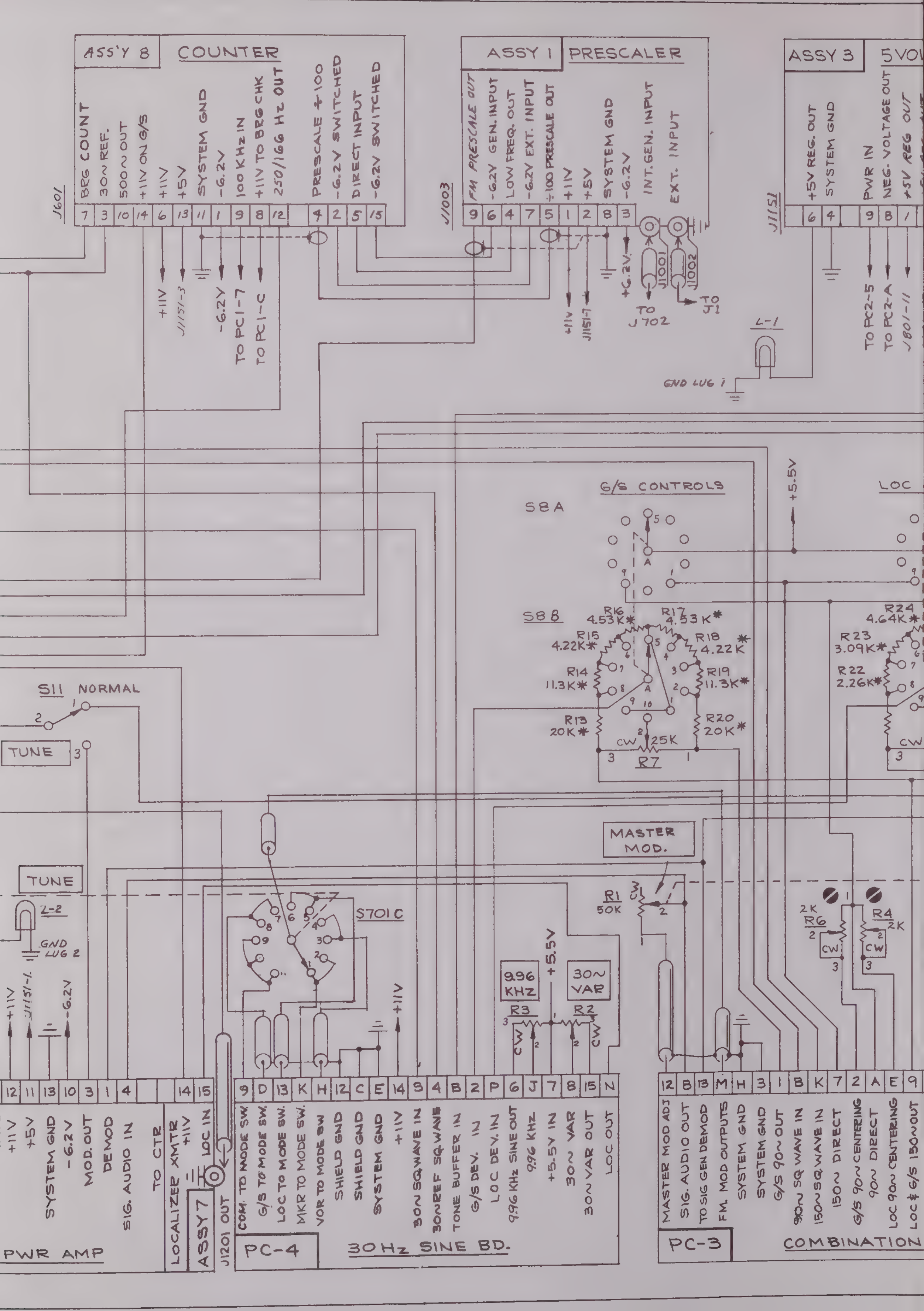


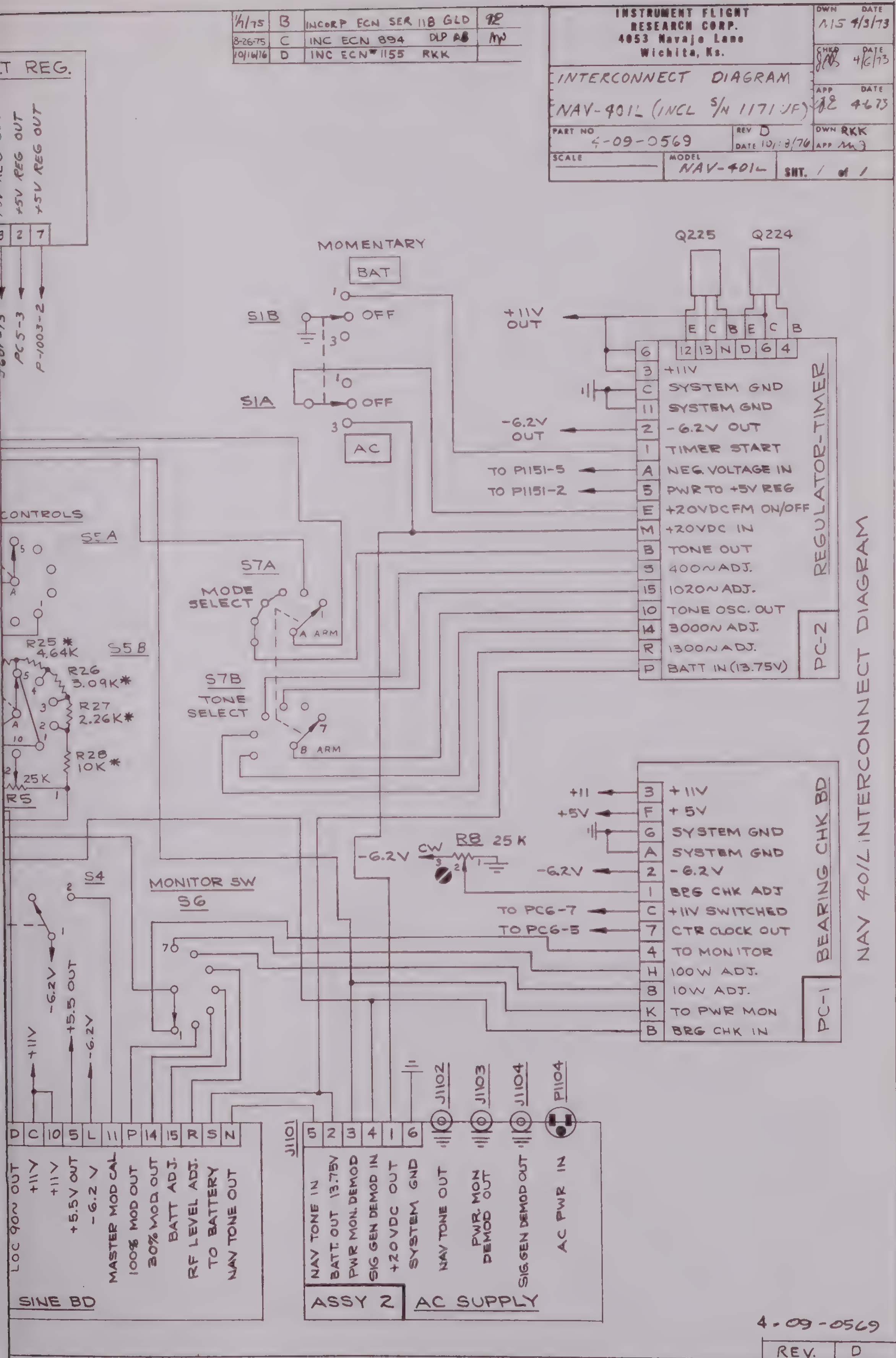
REAR PANEL

NAV-401L CONTROL IDENTIFICATION



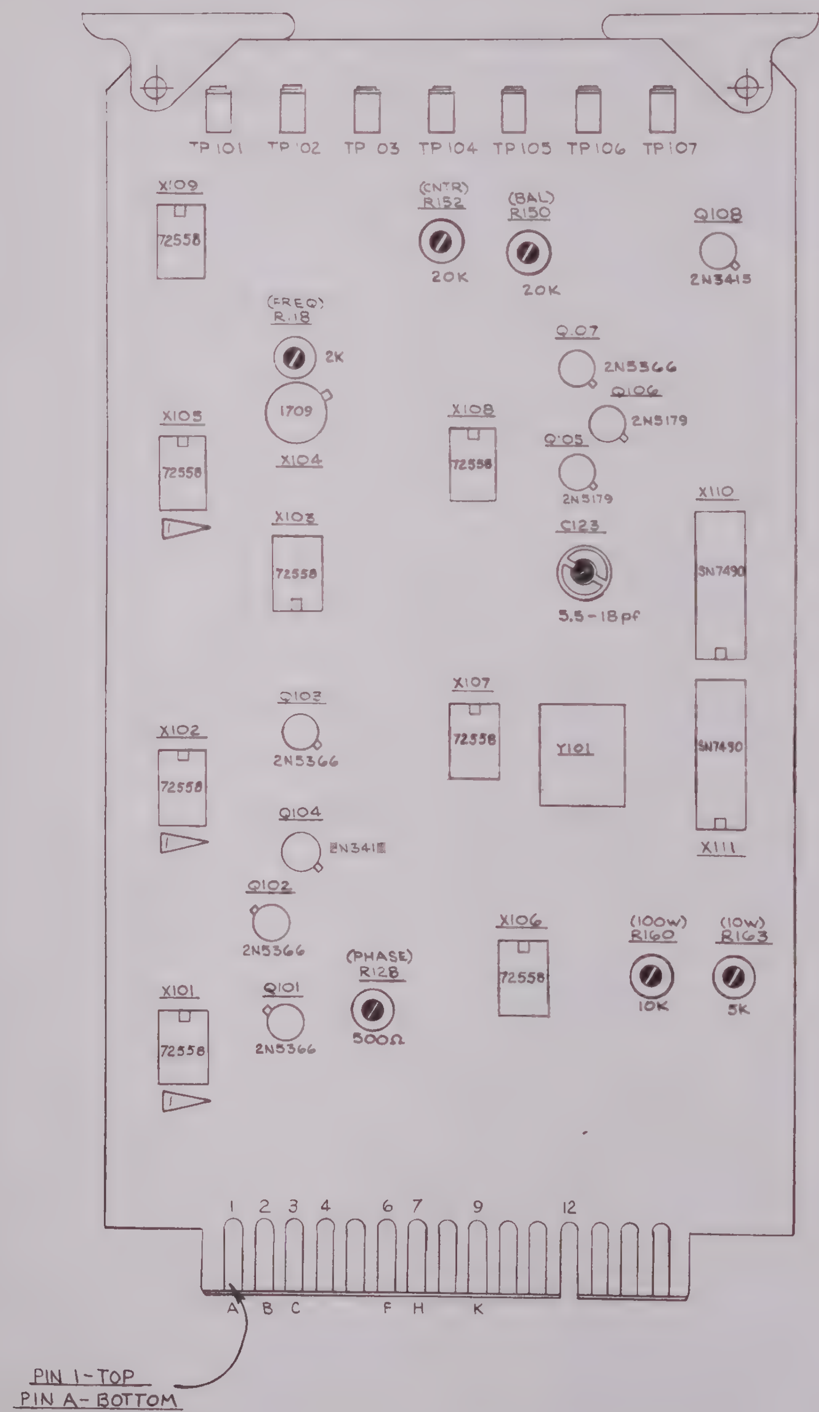
VOR BEARING SWITCH S2
PC-5 BEARING LOGIC BD
TO PRESCALER EXT. INPUT
MOD IN CTR IN
XMTR IN
J1
J2
R11 2.67K
R2 56Ω
L1
C2 1.0uf
TB-3
TB-4
S9
MOMENTARY
P902
P901
P903
25 Db PAD
PHASE LOCK /PWR MON.
ASSY 4
INPUT
-6.2V
+11V
GND
PEAK PWR CAP.
PWR MON. OUT
250/166 Hz IN
FM PRESCALE OUTPUT
ØLOCK ON/OFF
SHIELD GND
TO VARACTER
S10A
S10B
AVG
PEAK
OFF
LOC ON
TO
FROM
S3
S12
PHASE LOCK
DETENT
MONITOR
M1
500µA
MAIN VAR FREQ
R9 10-TURN 10K
FINE VAR FREQ
R10 100Ω
DIODE PROTECTOR BLK
OUT
J3
J4
J5
P4
P5
S701A
MODE
S701B
TO PRESCALER J1001
J701
SYSTEM GND
Ø LOCK IN
+10.5 V OUT
LOWER LIMIT ADJ
+11V IN
G/S XTL
VOR, LOC, G/S VAR
COM XTL
LOW COM VAR
HI COM VAR
MKR XTL
MKR VAR
VOR XTL
LOC XTL
VAR FREQ
J702
J703
P802
ASSY 5
OSCILLATOR
J801
ATTEN. OUT
ASSY 6


ASS'Y 8
COUNTER
BRG COUNT
30~ REF.
500~ OUT
+11V ON G/S
+11V
+5V
SYSTEM GND
-6.2V
100 KHz IN
+11V TO BRG CHK
250/166 Hz OUT
PRESCALE ÷ 100
-6.2V SWITCHED
DIRECT INPUT
-6.2V SWITCHED
J601
ASSY 1
PRESCALER
FM PRESCALE OUT
-6.2V GEN. INPUT
LOW FREQ. OUT
-6.2V EXT. INPUT
÷100 PRESCALE OUT
+11V
+5V
SYSTEM GND
-6.2V
INT. GEN. INPUT
EXT. INPUT
J1003
J1001
J1002
TO J702
TO J1
ASSY 3
5VO
+5V REG. OUT
SYSTEM GND
PWR IN
NEG. VOLTAGE OUT
+5V REG OUT
J1151
TO PC2-5
TO PC2-A
J801-11
L-1
GND LUG 1
+11V
J1151-3
-6.2V
TO PC1-7
TO PC1-C
+11V
J1151-7
+6.2V
G/S CONTROLS
S8A
S8B
+5.5V
LOC
R16 4.53K*
R17 4.53K*
R15 4.22K*
R18 4.22K*
R14 11.3K*
R19 11.3K*
R13 20K*
R20 20K*
CW 25K
R7
R24 4.64K*
R23 3.09K*
R22 2.26K*
S11 NORMAL
TUNE
TUNE
L-2
GND LUG 2
S701 C
MASTER MOD.
R1 50K
2K R6
R4 2K
9.96 KHZ
+5.5V
30~ VAR
R3
R2
+11V
J1151-1
-6.2V
+11V
+5V
SYSTEM GND
-6.2V
MOD. OUT
DEMOD
SIG. AUDIO IN
TO CTR
LOCALIZER XMTR +11V
LOC IN
J1201 OUT
ASSY 7
PWR AMP
COM. TO MODE SW.
G/S TO MODE SW.
LOC TO MODE SW.
MKR TO MODE SW.
VOR TO MODE SW
SHIELD GND
SHIELD GND
SYSTEM GND
+11V
30~ SQ. WAVE IN
30~ REF SQ. WAVE
TONE BUFFER IN
G/S DEV. IN
LOC DEV. IN
9.96 KHz SINE OUT
9.96 KHz
+5.5V IN
30~ VAR
30~ VAR OUT
LOC OUT
PC-4
30 Hz SINE BD.
MASTER MOD ADJ
SIG. AUDIO OUT
TO SIG GEN DEMOD
FM. MOD OUTPUTS
SYSTEM GND
SYSTEM GND
G/S 90~ OUT
90~ SQ WAVE IN
150~ SQ WAVE IN
150~ DIRECT
G/S 90~ CENTERING
90~ DIRECT
LOC 90~ CENTERING
LOC & G/S 150~ OUT
PC-3
COMBINATION



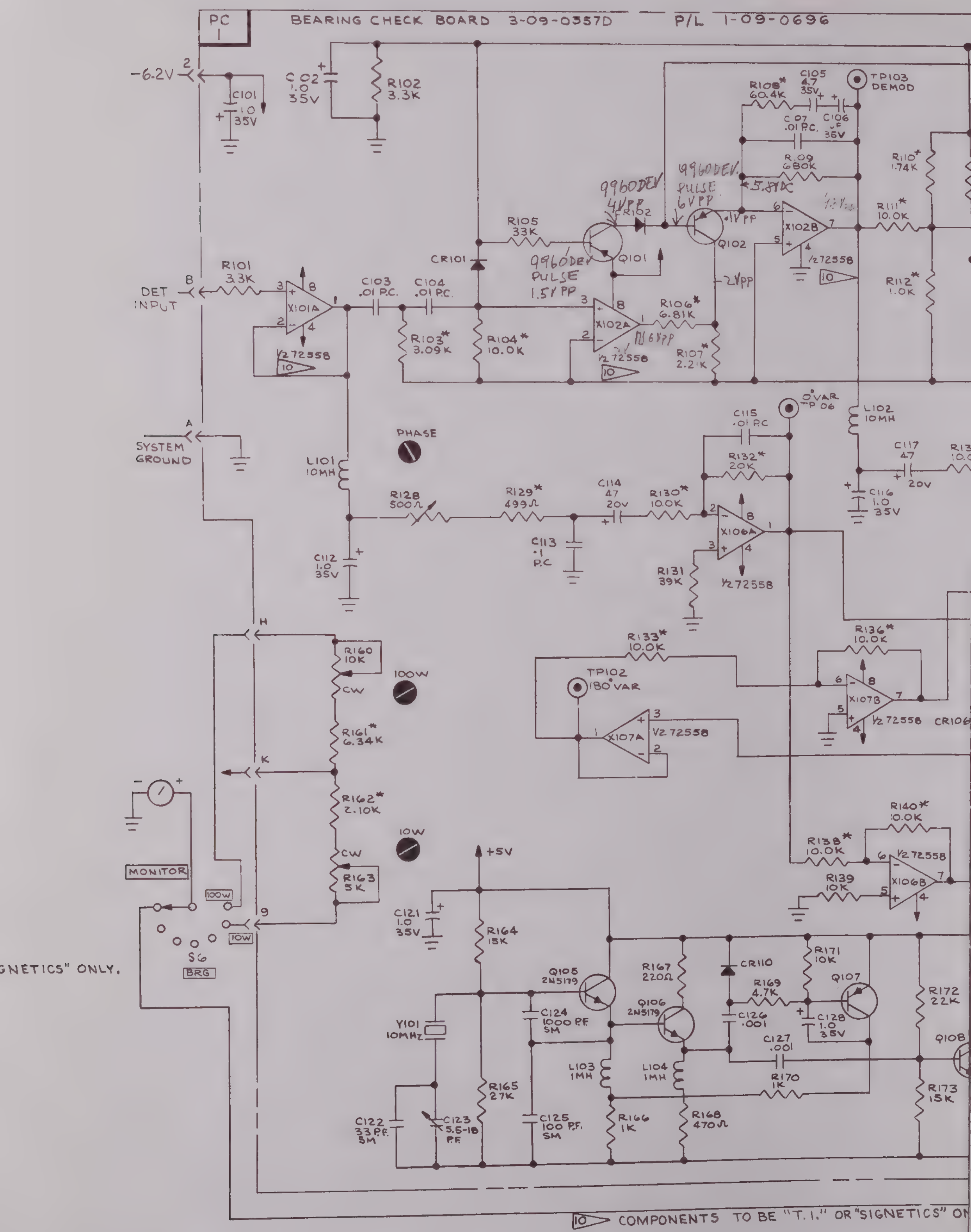
1/1/75 B INCORP ECN SER 118 GLD
8-26-75 C INC ECN 894 DLP
10/11/76 D INC ECN 1155 RKK
INSTRUMENT FLIGHT RESEARCH CORP.
4053 Navajo Lane
Wichita, Ks.
INTERCONNECT DIAGRAM
NAV-401L (INCL S/N 1171 UF)
PART NO 4-09-0569
REV D
DATE 10/18/76
MODEL NAV-401L
SHT. 1 of 1
DWN MS 4/3/73
CHKD 4/6/73
APP 4-6-73
DWN RKK
NAV 401/L INTERCONNECT DIAGRAM
T REG.
+5V REG OUT
+5V REG OUT
PC5-3
P-1003-2
MOMENTARY
BAT
S1B
OFF
S1A
OFF
AC
Q225
Q224
+11V OUT
-6.2V OUT
E C B E C B
12 13 N D 6 4
6
3 +11V
C SYSTEM GND
11 SYSTEM GND
2 -6.2V OUT
1 TIMER START
TO P1151-5
A NEG. VOLTAGE IN
TO P1151-2
5 PWR TO +5V REG
E +20VDC FM ON/OFF
M +20VDC IN
B TONE OUT
3 400∼ ADJ.
15 1020∼ ADJ.
10 TONE OSC. OUT
14 3000∼ ADJ.
R 1300∼ ADJ.
P BATT IN (13.75V)
REGULATOR-TIMER
PC-2
CONTROLS
S5A
S7A
MODE SELECT
A ARM
R25 * 4.64K
S5B
R26 3.09K*
R27 2.26K*
R28 10K*
25K
R5
S7B
TONE SELECT
B ARM
+11
3 +11V
+5V
F +5V
G SYSTEM GND
A SYSTEM GND
-6.2V
CW
R8 25K
-6.2V
2 -6.2V
1 BRG CHK ADJ
TO PC6-7
C +11V SWITCHED
TO PC6-5
7 CTR CLOCK OUT
4 TO MONITOR
H 100W ADJ.
8 10W ADJ.
K TO PWR MON
B BRG CHK IN
BEARING CHK BD
PC-1
S4
MONITOR SW
S6
-6.2V
+5.5 OUT
-6.2V
+11V
J1102
J1103
J1104
P1104
D C 10 5 L 11 P 14 15 R S N
LOC 90∼ OUT
+11V
+11V
+5.5V OUT
-6.2V
MASTER MOD CAL
100% MOD OUT
30% MOD OUT
BATT ADJ.
RF LEVEL ADJ.
TO BATTERY
NAV TONE OUT
SINE BD
J1101
5 2 3 4 1 6
NAV TONE IN
BATT. OUT 13.75V
PWR MON. DEMOD
SIG GEN DEMOD IN
+20VDC OUT
SYSTEM GND
NAV TONE OUT
PWR. MON DEMOD OUT
SIG. GEN DEMOD OUT
AC PWR IN
ASSY 2
AC SUPPLY
4-09-0569
REV. D

FIG 12-1



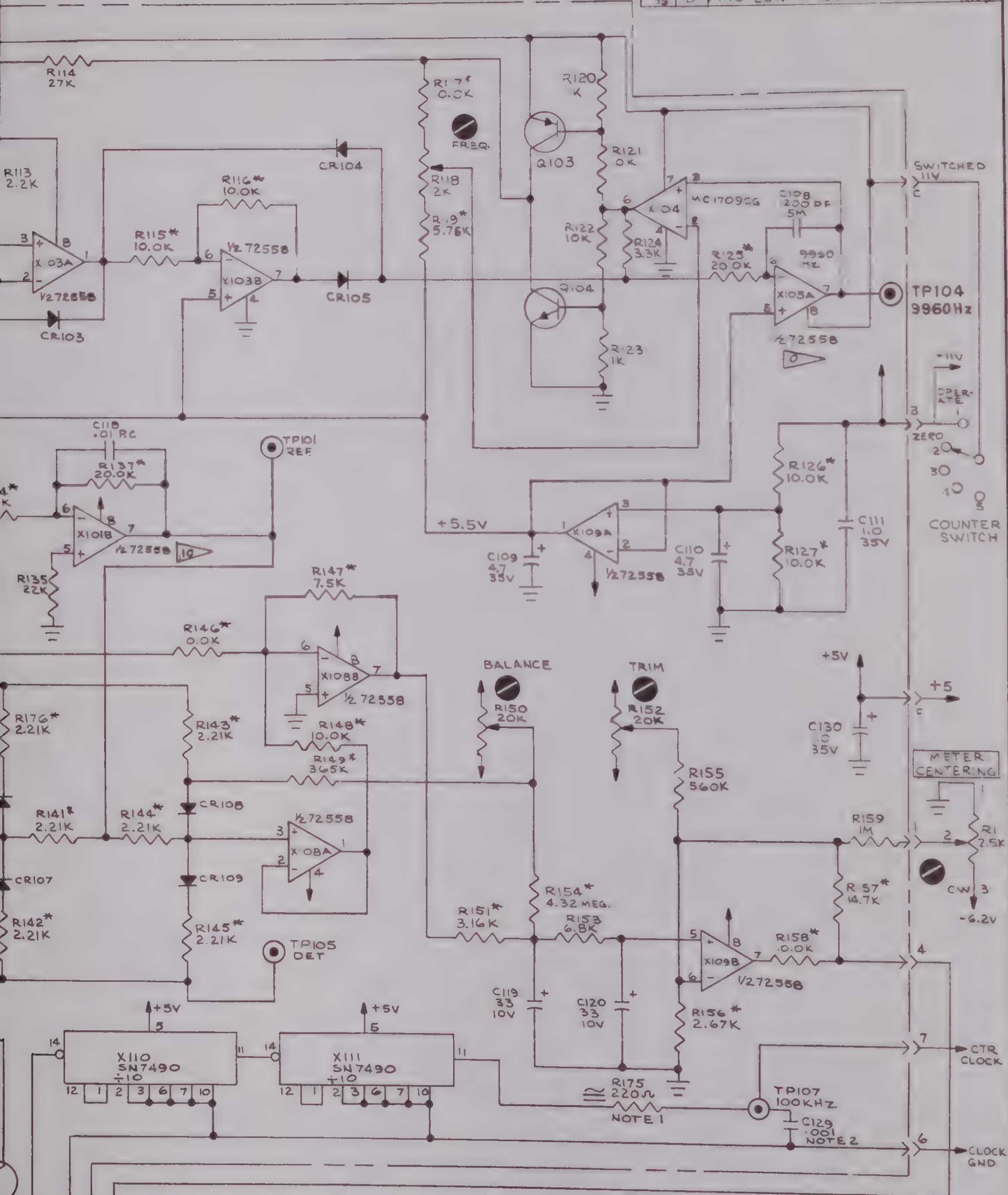
1	TO BEARING CENTER POT
A	SYSTEM GROUND
2	-6.2V
B	BEARING CHECK INPUT
3	+ 11V
C	+ 11V SW FROM COUNTER SW
4	TO MONITOR SW (BRG OUT)
6	CLOCK GROUND
F	+5V
7	CLOCK OUT TO COUNTER (100 K
H	TO MONITOR SW (100W)
9	TO MONITOR SW (10W)
K	TO POWER MONITOR
12	KEY

1 COMPONENTS TO BE "T.I." OR



PC 1
BEARING CHECK BOARD 3-09-0357D
P/L 1-09-0696
-6.2V
DET INPUT
SYSTEM GROUND
MONITOR
S6 BRG
100W
10W
PHASE
TP103 DEMOD
TP102 180° VAR
0° VAR TP 06
+5V
9960DEV 4VPP
9960DEV PULSE 6VPP
9960DEV PULSE 1.5VPP
GNETICS" ONLY.
10 COMPONENTS TO BE "T.I." OR "SIGNETICS" ON

DATE	REV	CHANGE	APP'D
10-15-75	A	INC ECN 1068 & 997	MJ
4-27-76	B	R1 NOW 2.5K WAS 25K	MJ
7-28-76	C	INC ECN #1525 RKK	MD
76	D	INC ECN # 691 RKK	MJ



1. R175 VARIES IN VALUE, OR BOARD HAS DIRECT JUMPER FROM P11 OF X111 TO TP-107.
2. C129 NOT USED IN SOME UNITS.
3. ALL RESISTORS MARKED WITH AN ASTERISK ARE 1% TOLERANCE.
4. ALL PNP TRANSISTORS ARE TYPE 2N5366 EXCEPT AS NOTED.
5. ALL NPN TRANSISTORS ARE TYPE 2N3415 EXCEPT AS NOTED.
6. ALL DIODES ARE IN4148 EXCEPT AS NOTED.
7. ALL UP ARROWS ARE +11V EXCEPT AS NOTED.
8. ALL DOWN ARROWS ARE -6.2V EXCEPT AS NOTED.
9. ALL CAPACITANCE IN µF EXCEPT AS NOTED.

NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
09-0696	1	NAV-401L				S/N 1418 & UP

APPLICATION — LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .xx = ± .010 .xxx = ± .005
ANGLES ± 1/2°
FRACTIONS ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

DRAWN GLD DATE 2/1/75
CHECKED MJ DATE 2/26/75
APPROVED MJ DATE 2/26/75

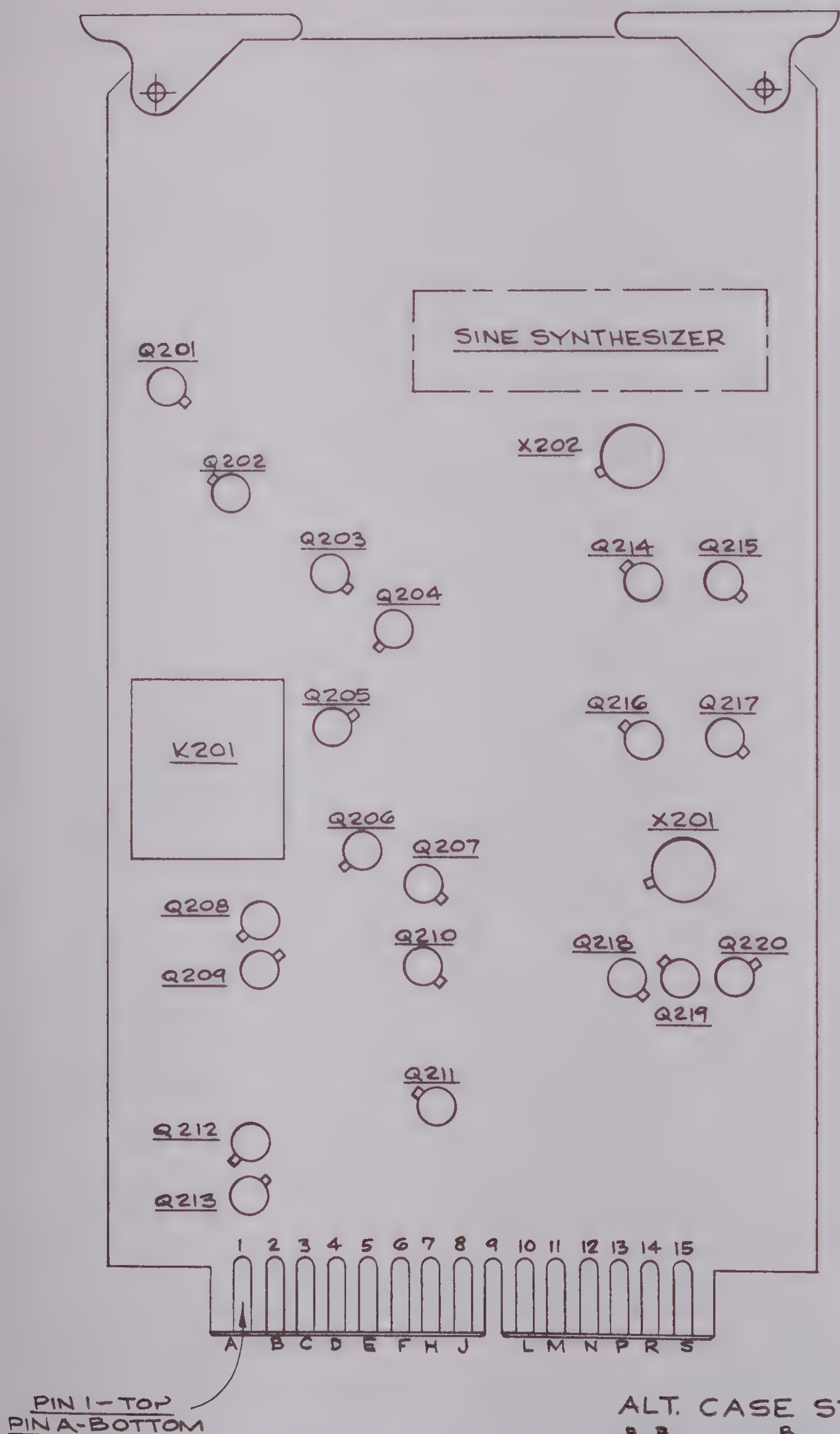
MATERIAL
TREATMENT
FINISH

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

TITLE: BEARING CHECK BOARD SCHEMATIC NAV-401L

SIZE C | PART NUMBER 3-09-0713 | REV D
SCALE | WEIGHT | SHEET 1 OF 2

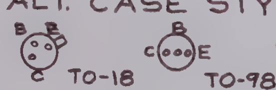
FIG 12-2



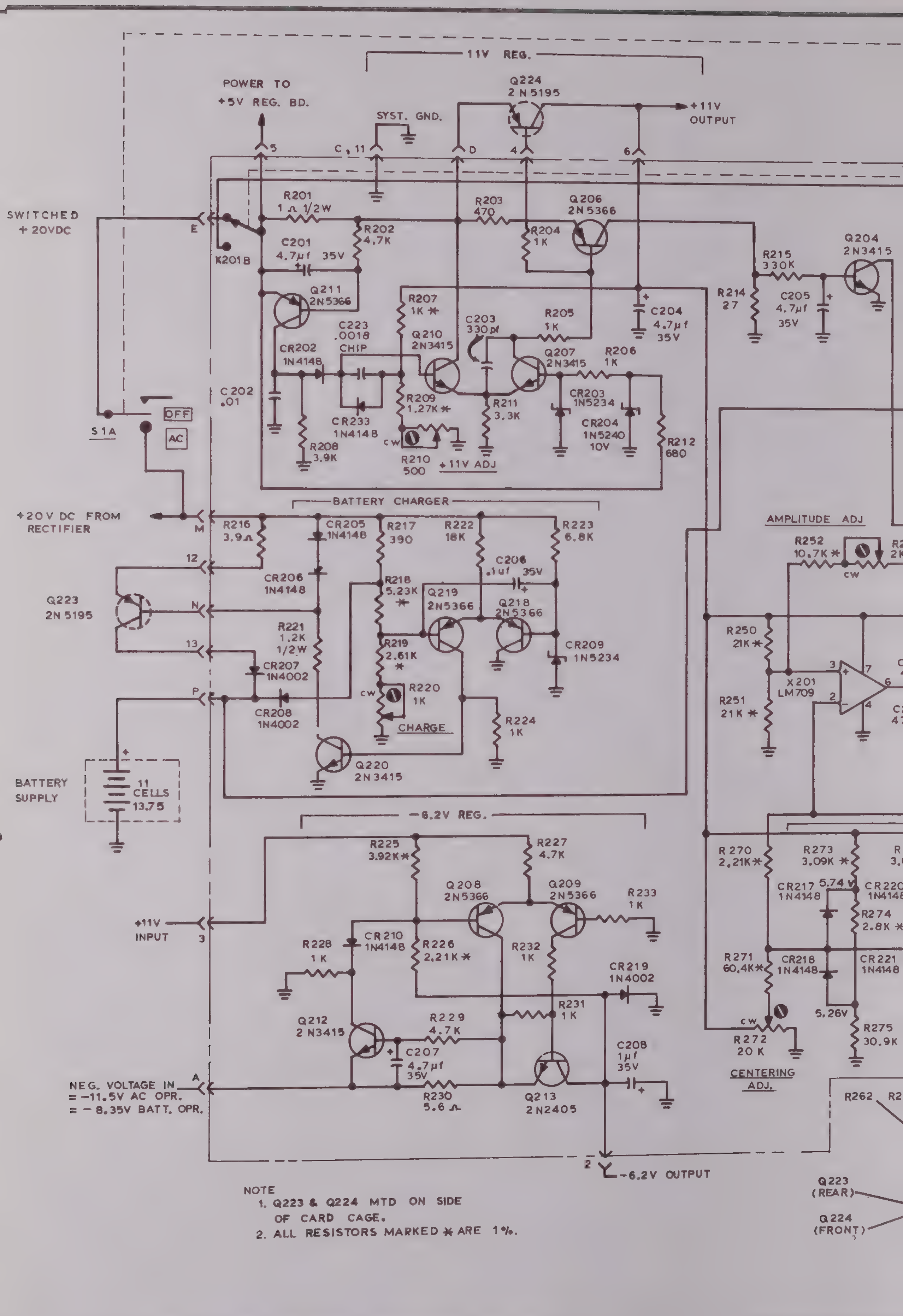
PC-2

1	TIMER START
A	NEG. VOLTAGE IN
2	-6.2V REG. OUT
B	TONE OUTPUT
3	+11V
C	SYSTEM GND
4	Q224 BASE
D	Q224 EMITTER
5	PWR TO +5V REG. BD.
E	SWITCHED +20VDC
6	Q224 COL., +11V REG. O
9	KEY
10	TO TONE SW. ARM
11	SYSTEM GND
M	+20VDC FROM RECTIF
12	Q223 EMITTER
N	Q223 BASE
13	Q223 COLLECTOR
P	TO BATT. SUPPLY (11.7 TO 14
14	TONE SW. 3000
R	TONE SW. 1300
15	TONE SW. 1020
S	TONE SW. 400

ALT. CASE STYLE CLOCKING



(Center pin forward)



NOTE
1. Q223 & Q224 MTD ON SIDE OF CARD CAGE.
2. ALL RESISTORS MARKED * ARE 1%.

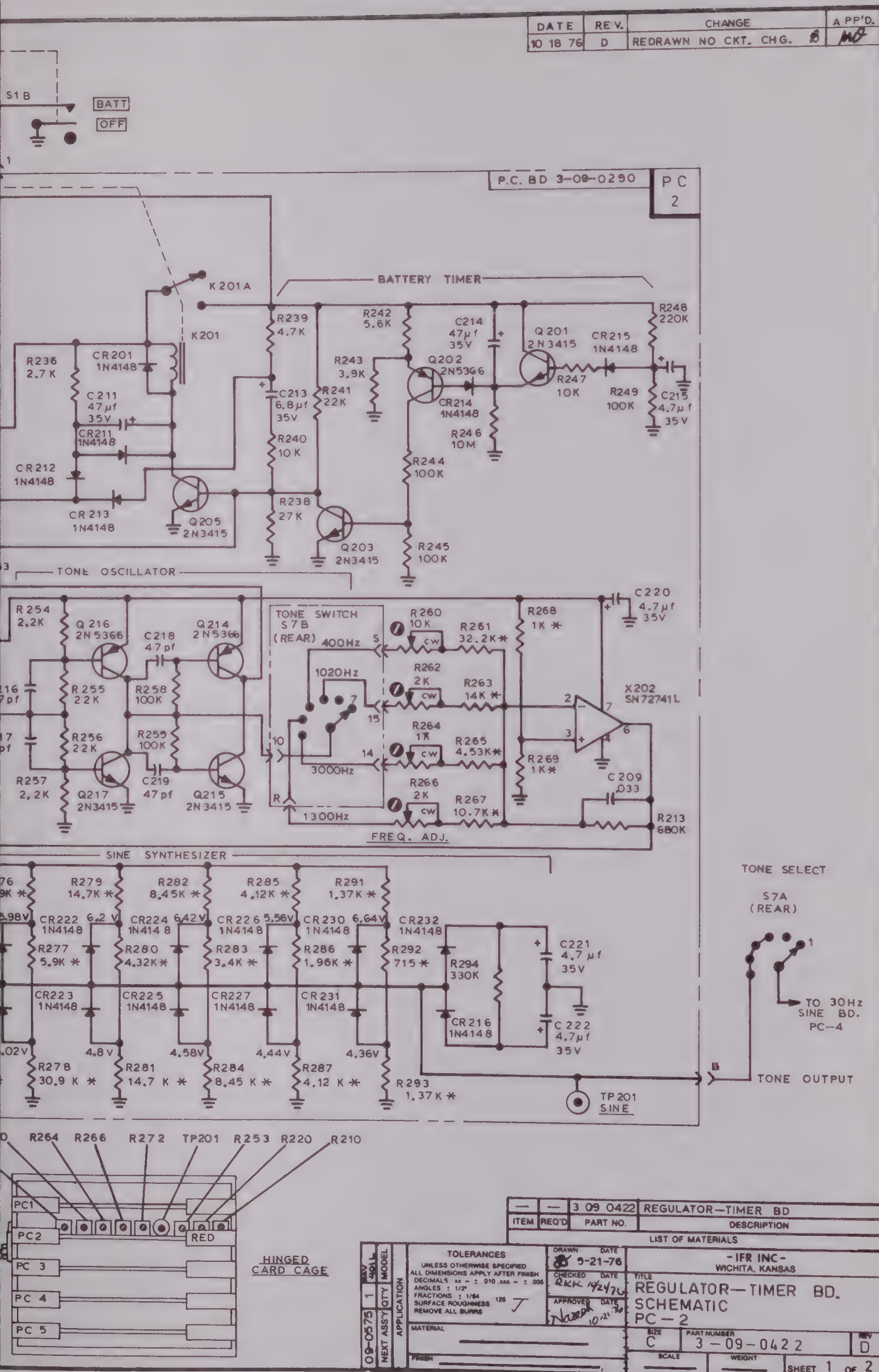
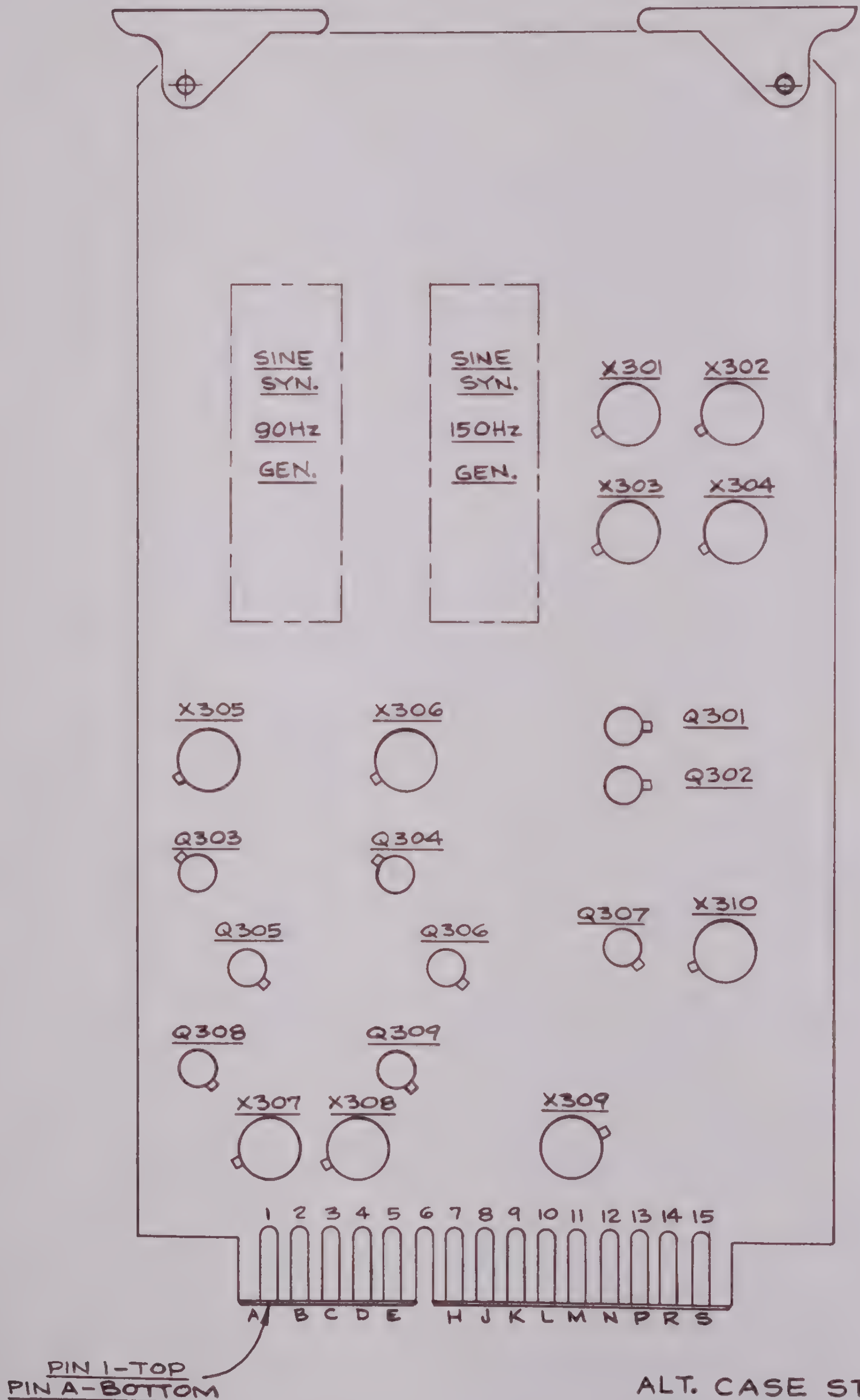

DATE
REV.
CHANGE
APP'D.
10 18 76
D
REDRAWN NO CKT. CHG.
S1B
BATT
OFF
P.C. BD 3-09-0290
PC 2
K201A
K201
BATTERY TIMER
R239 4.7K
R242 5.6K
C214 47μf 35V
Q201 2N3415
CR215 1N4148
R248 220K
R236 2.7K
CR201 1N4148
C211 47μf 35V
CR211 1N4148
CR212 1N4148
CR213 1N4148
Q205 2N3415
C213 6.8μf 35V
R241 22K
R240 10K
R238 27K
R243 3.9K
Q202 2N5366
CR214 1N4148
R247 10K
R249 100K
C215 4.7μf 35V
R246 10M
R244 100K
Q203 2N3415
R245 100K
TONE OSCILLATOR
R254 2.2K
Q216 2N5366
C218 47pf
Q214 2N5366
R255 22K
R258 100K
R256 22K
R259 100K
R257 2.2K
Q217 2N3415
C219 47pf
Q215 2N3415
TONE SWITCH S7B (REAR)
400Hz
1020Hz
3000Hz
1300Hz
R260 10K
R261 32.2K*
R262 2K
R263 14K*
R264 1K
R265 4.53K*
R266 2K
R267 10.7K*
FREQ. ADJ.
R268 1K*
C220 4.7μf 35V
X202 SN72741L
R269 1K*
C209 .033
R213 680K
SINE SYNTHESIZER
R279 14.7K*
R282 8.45K*
R285 4.12K*
R291 1.37K*
CR222 1N4148
CR224 1N4148
CR226 1N4148
CR230 1N4148
CR232 1N4148
6.2V
6.42V
5.56V
6.64V
R277 5.9K*
R280 4.32K*
R283 3.4K*
R286 1.96K*
R292 715*
R294 330K
C221 4.7μf 35V
CR223 1N4148
CR225 1N4148
CR227 1N4148
CR231 1N4148
CR216 1N4148
C222 4.7μf 35V
4.8V
4.58V
4.44V
4.36V
R278 30.9K*
R281 14.7K*
R284 8.45K*
R287 4.12K*
R293 1.37K*
TP201 SINE
TONE SELECT
S7A (REAR)
TO 30Hz SINE BD. PC-4
TONE OUTPUT
R264
R266
R272
TP201
R253
R220
R210
PC1
PC2
RED
PC 3
PC 4
PC 5
HINGED CARD CAGE
3 09 0422
REGULATOR—TIMER BD
ITEM
REQ'D
PART NO.
DESCRIPTION
LIST OF MATERIALS
TOLERANCES
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS .xx = ± .010 .xxx = ± .005
ANGLES ± 1/2°
FRACTIONS ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS
DRAWN
DATE
9-21-76
CHECKED
DATE
APPROVED
DATE
- IFR INC -
WICHITA, KANSAS
TITLE
REGULATOR—TIMER BD.
SCHEMATIC
PC — 2
SIZE
C
PART NUMBER
3-09-0422
REV
D
SCALE
WEIGHT
SHEET 1 OF 2
MATERIAL
FINISH
09-0575
1
NEXT ASSY
QTY
MODEL
APPLICATION

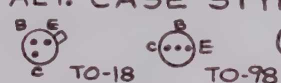
FIG 12-3



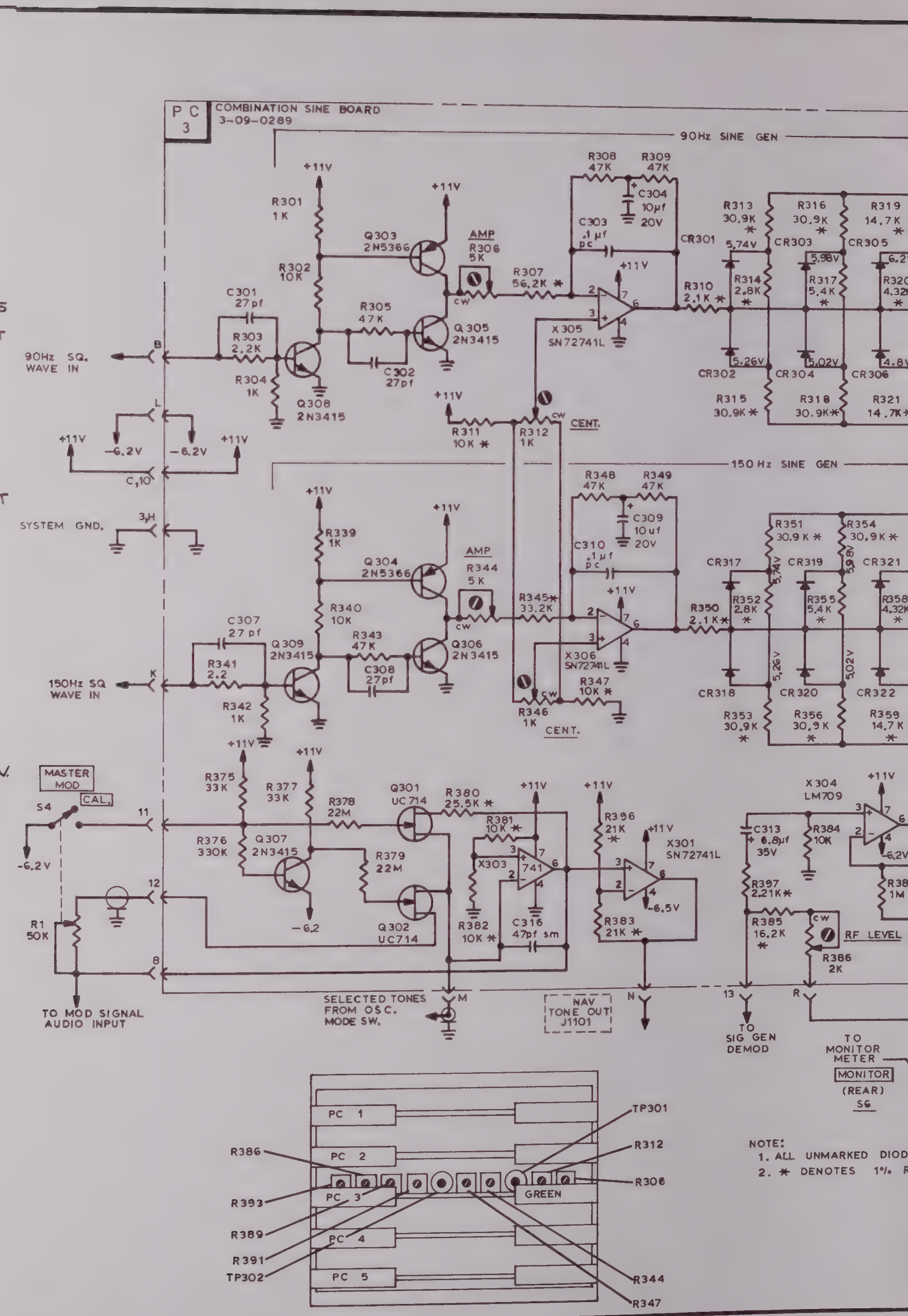
PC-3

1	G/S 90 Hz OUT
A	90 Hz OUT TO CTRING PC
2	G/S 90 Hz FROM CTRING P
B	90 Hz SQ. WAVE IN
3	SYSTEM GND
C	+11V
D	LOC 90 Hz OUT
5	+5.5V OUT
E	LOC 90 Hz FROM CTRING
6	KEY
7	150 Hz SINE WAVE OUT
H	SYSTEM GND
8	TO MOD. SIG. AUDIO IN
9	LOC & G/S 150 Hz OUT
K	150 Hz SQ. WAVE IN
10	+11V
L	-6.2V
11	MASTER MOD. CAL. S
M	MOD. FROM OSC. MODE
12	TO MASTER MOD. POT
N	NAV TONE OUT
13	TO SIG. GEN. DEMOD
P	100% MOD. OUT
14	30% MOD. OUT
R	RF LEVEL OUT
15	BATT. ADJ. OUT
S	BATT. IN (13.75V)

ALT. CASE STYLE CLOCKING



(Center pin forward)



PC 3
COMBINATION SINE BOARD
3-09-0289
90Hz SINE GEN
150 Hz SINE GEN
90Hz SQ. WAVE IN
150Hz SQ WAVE IN
SYSTEM GND.
MASTER
MOD
CAL.
S4
R1 50K
TO MOD SIGNAL AUDIO INPUT
SELECTED TONES FROM OSC. MODE SW.
NAV TONE OUT J1101
TO SIG GEN DEMOD
TO MONITOR METER
MONITOR
(REAR)
S6
RF LEVEL
AMP
CENT.
Q303 2N5366
Q305 2N3415
Q308 2N3415
Q304 2N5366
Q306 2N3415
Q309 2N3415
Q301 UC714
Q302 UC714
Q307 2N3415
X305 SN72741L
X306 SN72741L
X303 741
X301 SN72741L
X304 LM709
PC 1
PC 2
PC 3
PC 4
PC 5
GREEN
TP301
TP302
R386
R393
R389
R391
R312
R306
R344
R347
NOTE:
1. ALL UNMARKED DIOD
2. * DENOTES 1% R

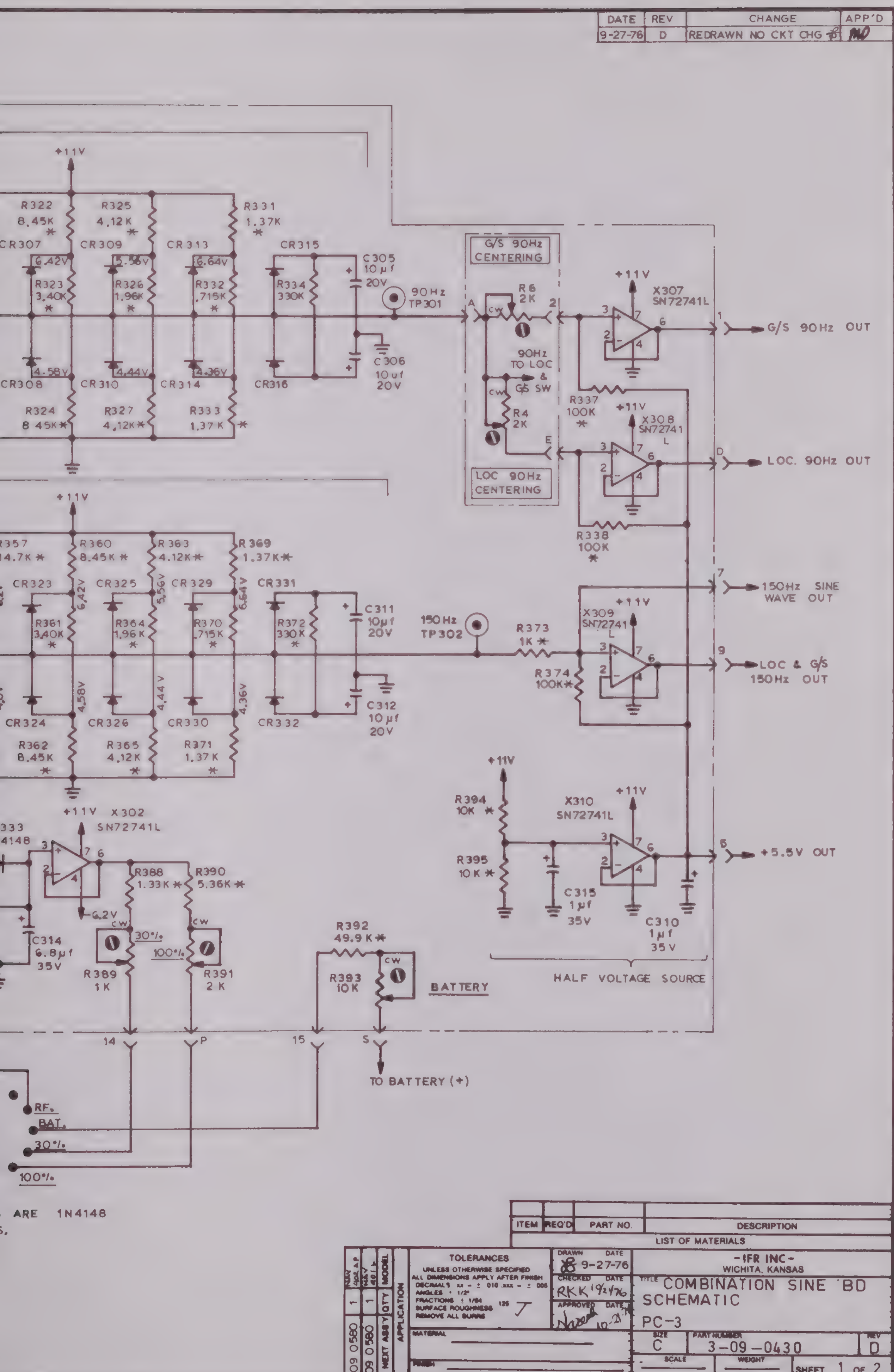
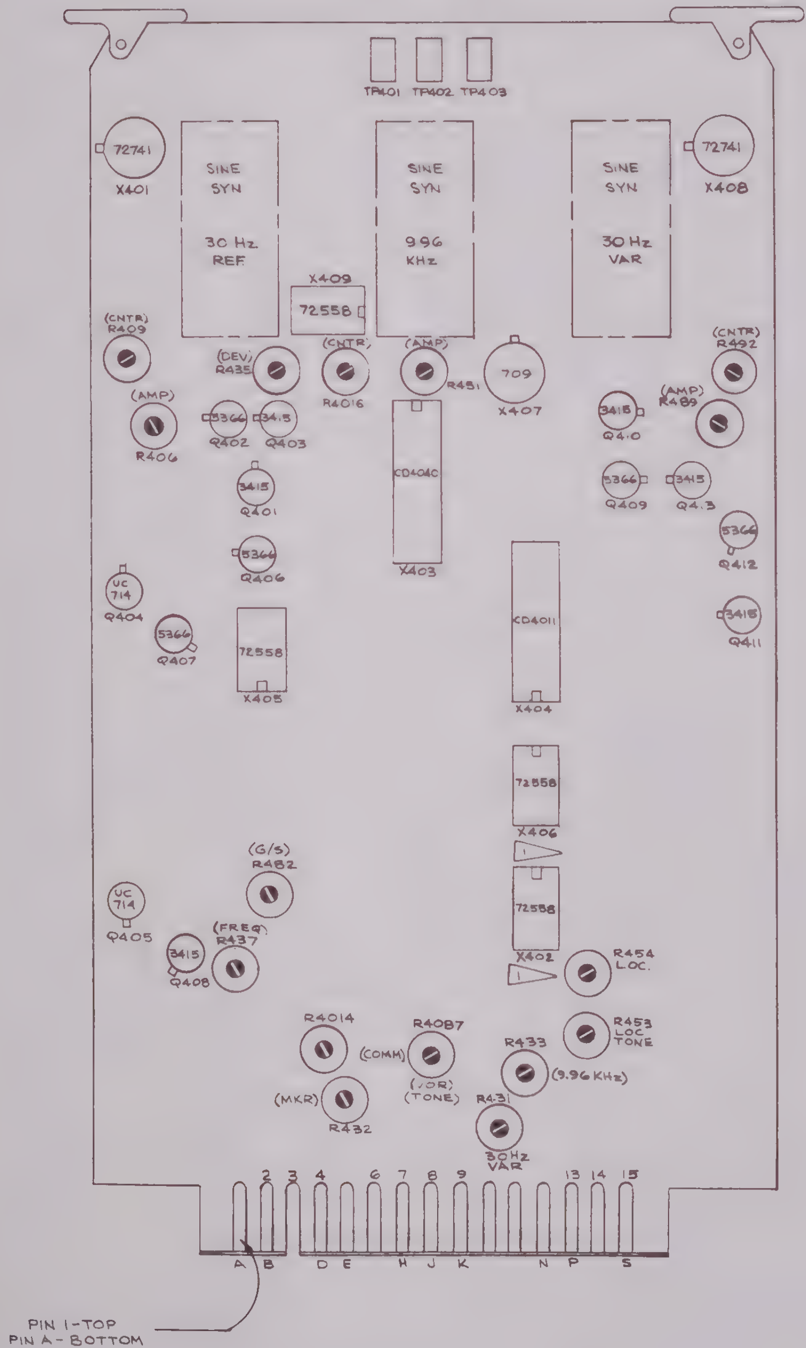
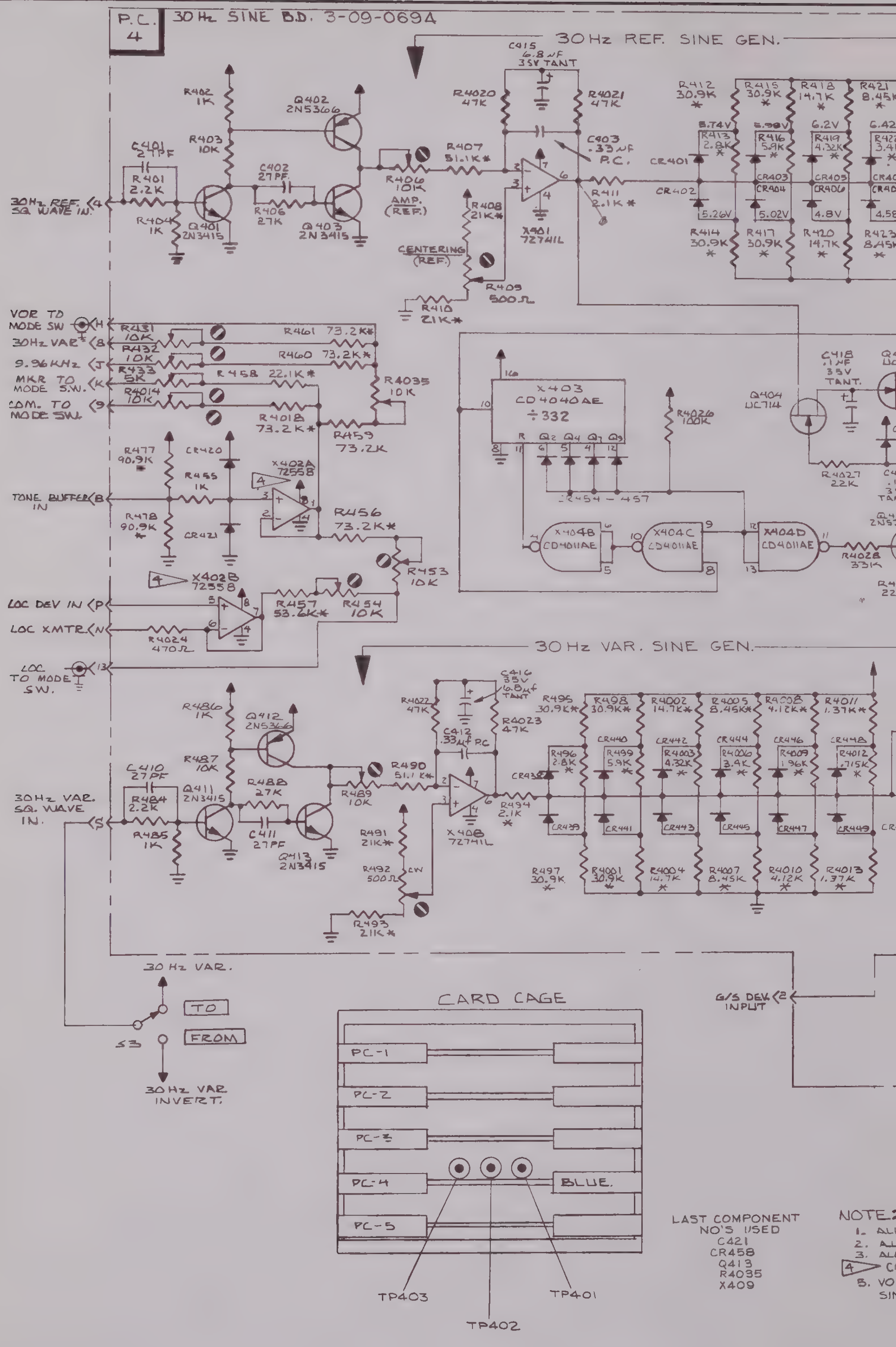

DATE REV CHANGE APP'D
9-27-76 D REDRAWN NO CKT CHG
+11V
R322 8.45K
R325 4.12K
R331 1.37K
CR307 CR309 CR313 CR315
R323 3.40K
R326 1.96K
R332 .715K
R334 330K
C305 10 µf 20V
90Hz TP301
G/S 90Hz CENTERING
R6 2K
X307 SN72741L
G/S 90Hz OUT
C306 10 uf 20V
90Hz TO LOC & G/S SW
R4 2K
CR308 CR310 CR314 CR316
R324 8.45K
R327 4.12K
R333 1.37K
R337 100K
X308 SN72741L
LOC. 90Hz OUT
LOC 90Hz CENTERING
R338 100K
R357 14.7K
R360 8.45K
R363 4.12K
R369 1.37K
CR323 CR325 CR329 CR331
150Hz SINE WAVE OUT
R361 3.40K
R364 1.96K
R370 .715K
R372 330K
C311 10µf 20V
150Hz TP302
R373 1K
X309 SN72741L
R374 100K
LOC & G/S 150Hz OUT
CR324 CR326 CR330 CR332
C312 10 µf 20V
R362 8.45K
R365 4.12K
R371 1.37K
R394 10K
X310 SN72741L
R395 10K
+5.5V OUT
C315 1µf 35V
C310 1µf 35V
HALF VOLTAGE SOURCE
X302 SN72741L
R388 1.33K
R390 5.36K
C314 6.8µf 35V
30%
100%
R389 1K
R391 2K
R392 49.9K
R393 10K
BATTERY
TO BATTERY (+)
RF.
BAT.
30%
100%
ARE 1N4148
ITEM REQ'D PART NO. DESCRIPTION
LIST OF MATERIALS
TOLERANCES
UNLESS OTHERWISE SPECIFIED
-IFR INC-
WICHITA, KANSAS
DRAWN 9-27-76
TITLE COMBINATION SINE BD SCHEMATIC PC-3
SIZE C
PART NUMBER 3-09-0430
REV D
SHEET 1 OF 2

FIG 12-4



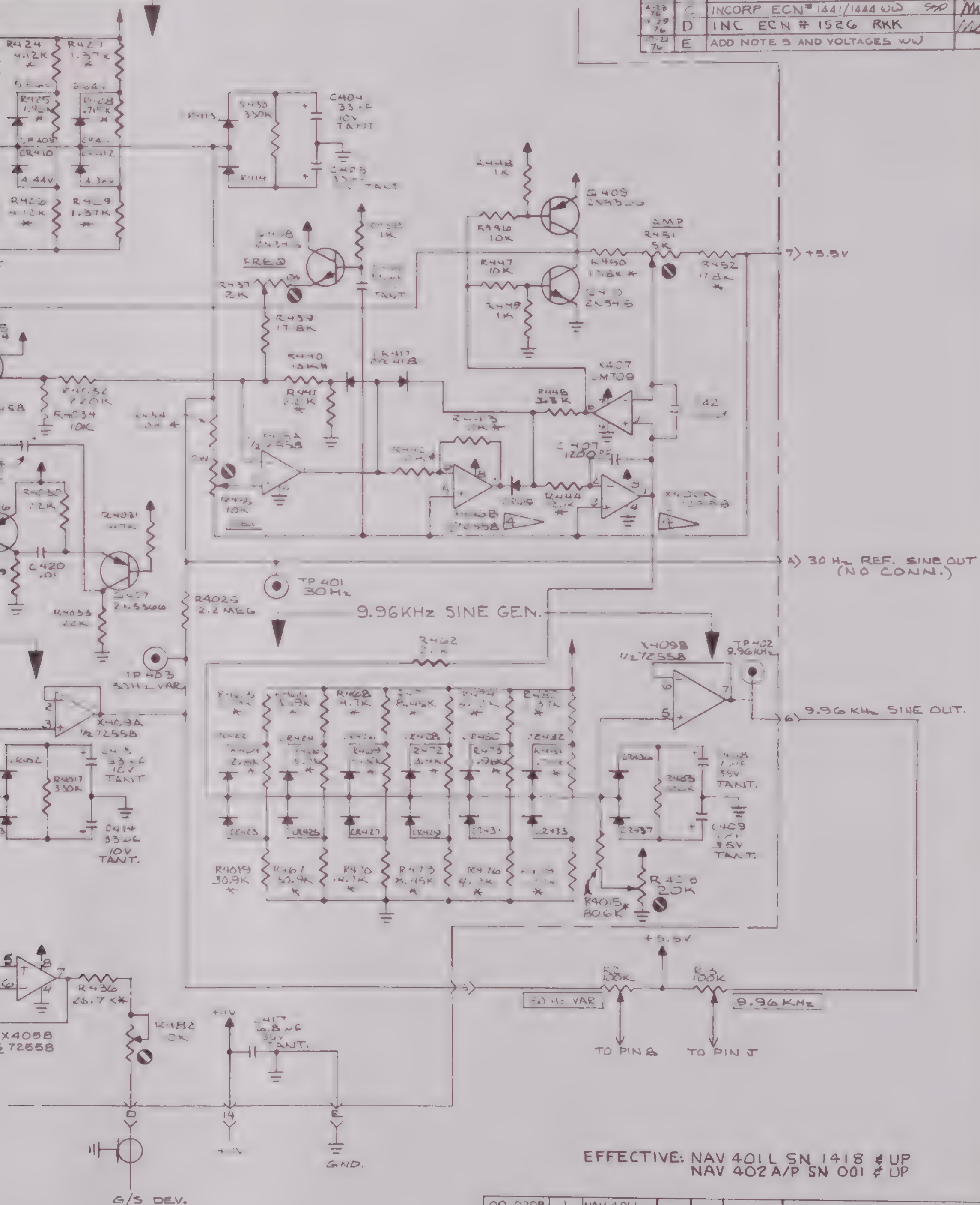
A	30 Hz REF (NO CONN.)
2	G/S DEV. INPUT
B	TONE BUFFER IN
3	KEY
4	30 Hz REF SQ WAVE IN
D	G/S DEV. OUT
E	SYSTEM GND
6	9.96 KHz SINE OUT
7	+5.5V IN
H	VOR TO MODE SW
8	30 Hz VAR
J	9.96 KHz
9	COMM TO MODE SW
K	MKR TO MODE SW
N	LOC XMTR
13	LOC TO MODE SW
P	LOC DEV IN
4	+11V
15	30Hz VAR SINE OUT
S	30Hz VAR SQ WAVE IN

1 COMPONENTS TO BE "T.I." OR "S


P.C. 4
30 Hz SINE BD. 3-09-0694
30 Hz REF. SINE GEN.
30 Hz REF. SQ. WAVE IN.
AMP. (REF.)
CENTERING (REF.)
X401 72741L
VOR TO MODE SW
30 Hz VAR
9.96 KHz
MKR TO MODE S.W.
COM. TO MODE SW.
TONE BUFFER IN
LOC DEV IN
LOC XMTR
LOC TO MODE SW.
X403 CD4040AE ÷332
X404B CD4011AE
X404C CD4011AE
X404D CD4011AE
X402A 72558
X402B 72558
30 Hz VAR. SINE GEN.
30 Hz VAR. SQ. WAVE IN.
X408 72741L
30 Hz VAR.
TO
FROM
S3
30 Hz VAR INVERT.
G/S DEV INPUT
CARD CAGE
PC-1
PC-2
PC-3
PC-4
PC-5
BLUE
TP403
TP402
TP401
LAST COMPONENT NO'S USED
C421
CR458
Q413
R4035
X409

NETICS" ONLY.

DATE	REV	CHANGE	APP'D
4-7-75	A	INCORP ECN # 564 GLO DLP	MO
8-26-75	B	INCORP ECN 972 DLP	MO
4-28-76	C	INCORP ECN# 1441/1444 WW SSP	MW
7-29-76	D	INC ECN # 1526 RKK	MD
10-21-76	E	ADD NOTE 5 AND VOLTAGES WW	



EFFECTIVE: NAV 401L SN 1418 & UP
NAV 402 A/P SN 001 & UP

UPWARD ARROWS ARE +11V UNLESS NOTED
DIODES ARE IN4148
RESISTORS MARKED * ARE 1%.
MPONENTS TO BE "T.I." OR "SIGNETICS" ONLY
TAGES ON "30Hz VAR. SINE GEN." AND "9.96KHZ
GEN." SAME AS "30HZ REF. SINE GEN."

09-0708	1	NAV 401 L				
09-0708	1	NAV 402 AP	1	1	09-0722	SCHEMATIC
NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO	DESCRIPTION
APPLICATION			LIST OF MATERIALS			

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS .xx = ± .010 .xxx = ± .005
ANGLES ± 1/2°
FRACTIONS ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

DRAWN SSL DATE 4 7 75
CHECKED MO DATE 4 9 75
APPROVED MO DATE 4 9 75

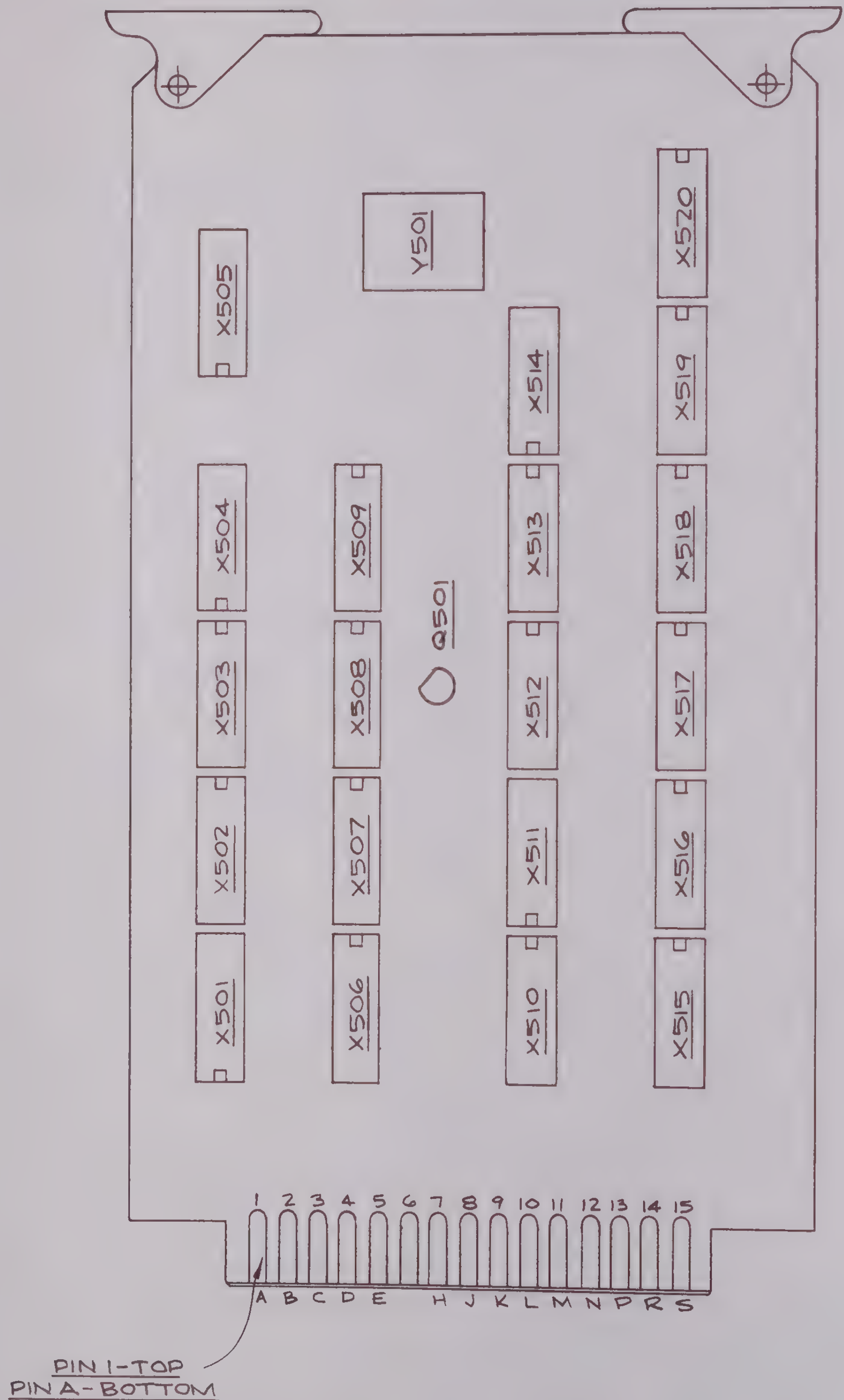
MATERIAL —
TREATMENT —
FINISH —

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE 30 Hz SINE BOARD SCHEMATIC
PC-4 NAV 402AP NAV 401 L

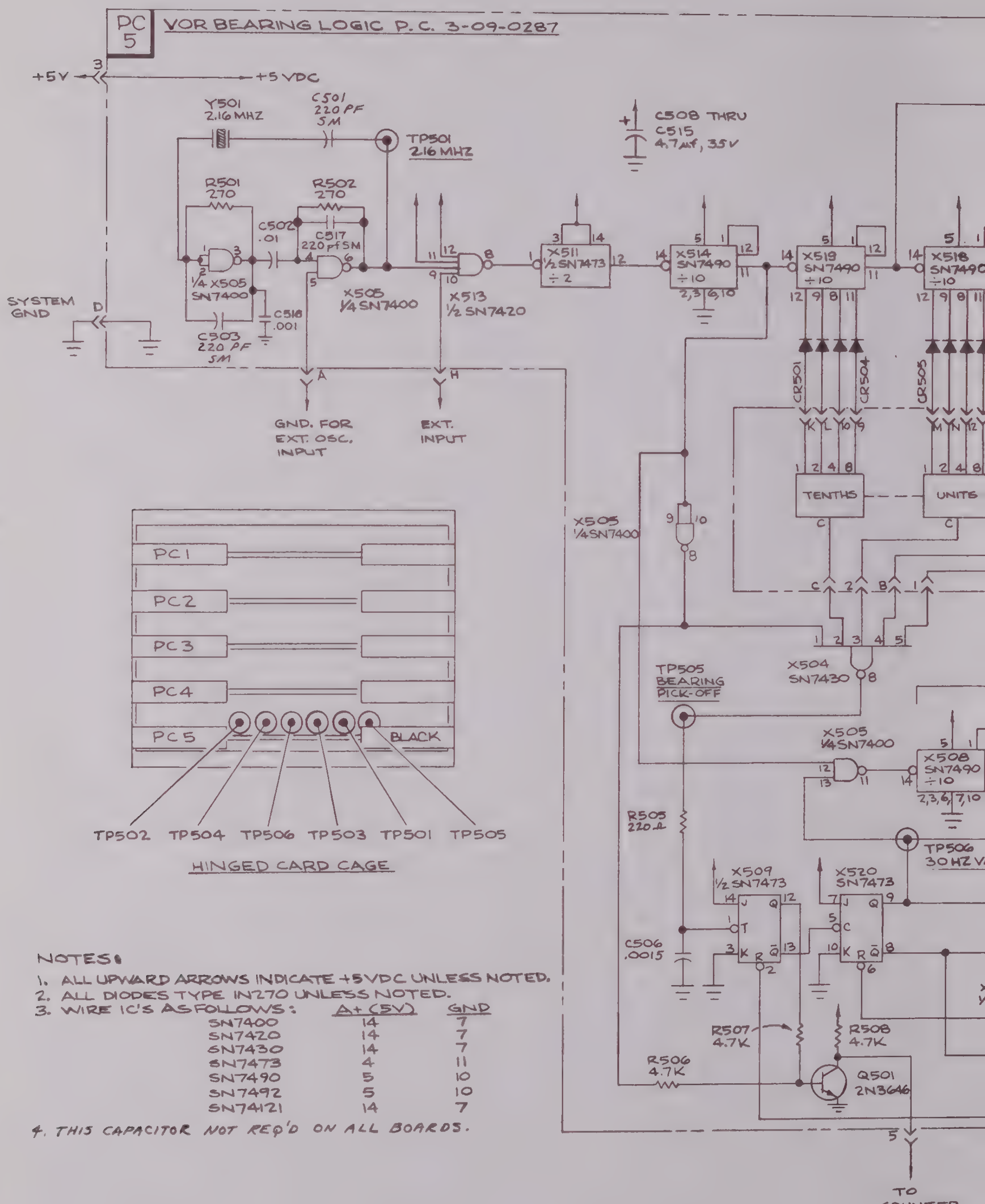
SIZE C | PART NUMBER 3-09-0722 | REV E
SCALE — | WEIGHT — | SHEET 1 OF 2

FIG 12-5



PC-5

1	100's COMMON-BRG SW
A	GND FOR EXT. OSC IN.
2	1's COMMON-BRG SW
B	10's COMMON-BRG SW
3	+5V
C	.1's COMMON-BRG SW
4	150 Hz
D	SYSTEM GND
5	TO COUNTER
E	GND FOR ϕ SHIFTING 90-
6	30 Hz VAR.-INVERT.
7	30 Hz VAR.
H	EXT. INPUT
8	30 Hz REF.
J	90 Hz
9	.1's 8
K	.1's 1
10	.1's 4
L	.1's 2
11	1's 8
M	1's 1
12	1's 4
N	1's 2
13	10's 8
P	10's 1
14	10's 4
R	10's 2
15	100's 2
S	100's 1



NOTES:

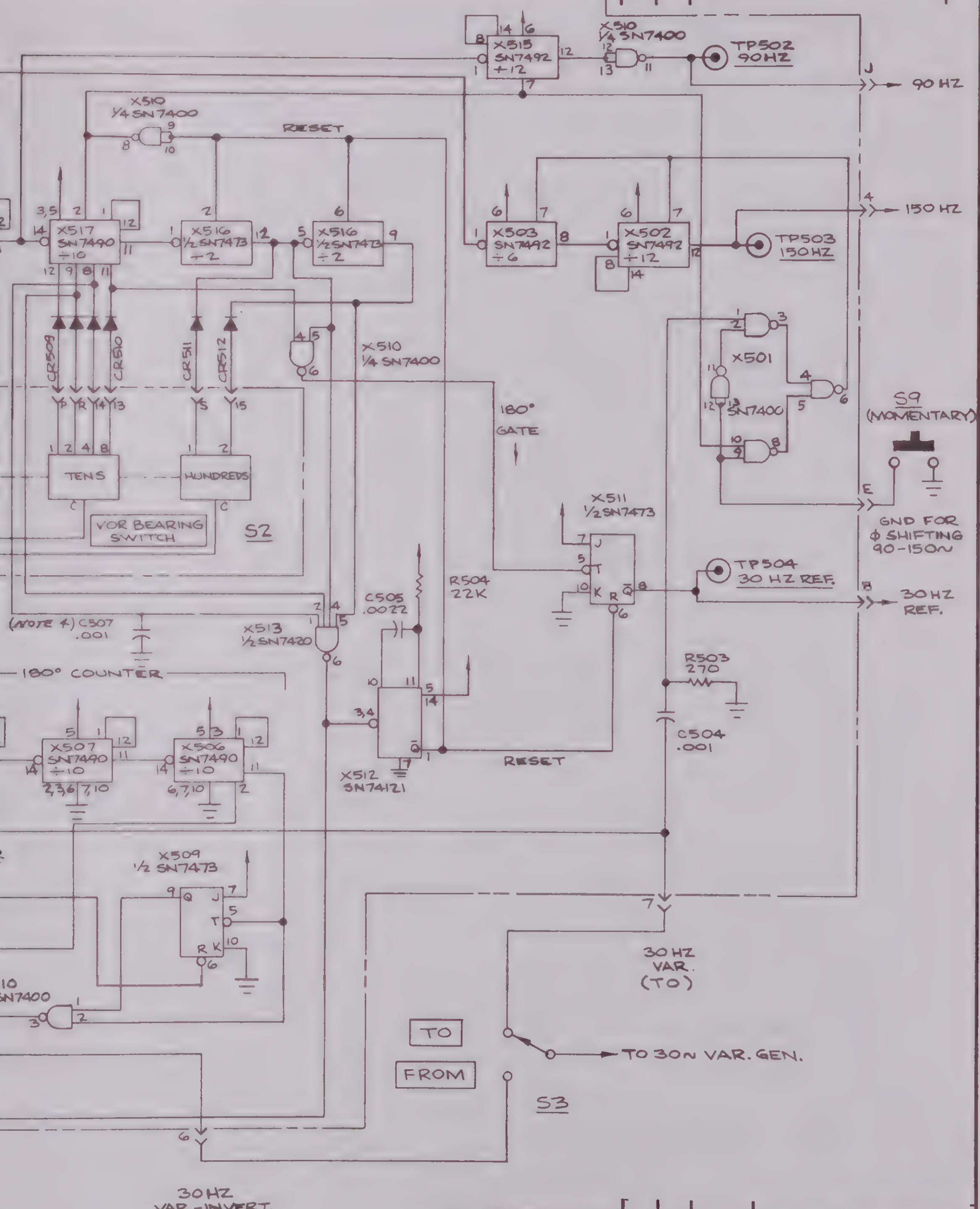
1. ALL UPWARD ARROWS INDICATE +5VDC UNLESS NOTED.
2. ALL DIODES TYPE IN270 UNLESS NOTED.
3. WIRE IC'S AS FOLLOWS:

	A+ (5V)	GND
SN7400	14	7
SN7420	14	7
SN7430	14	7
SN7473	4	11
SN7490	5	10
SN7492	5	10
SN74121	14	7

4. THIS CAPACITOR NOT REQ'D ON ALL BOARDS.

FIG 12

DATE	REV	CHANGE	APP'D
4-10-73	A	INC. ECN 1, REV A	
4-28-76	B	INCORP. ECN# 1443 ww 330	MK



NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
1-09-0581	1	NAV401	1	—	3-09-0427	VOR BEARING LOGIC SCHEMATIC

APPLICATION — LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS
MATERIAL —
TREATMENT —
FINISH —

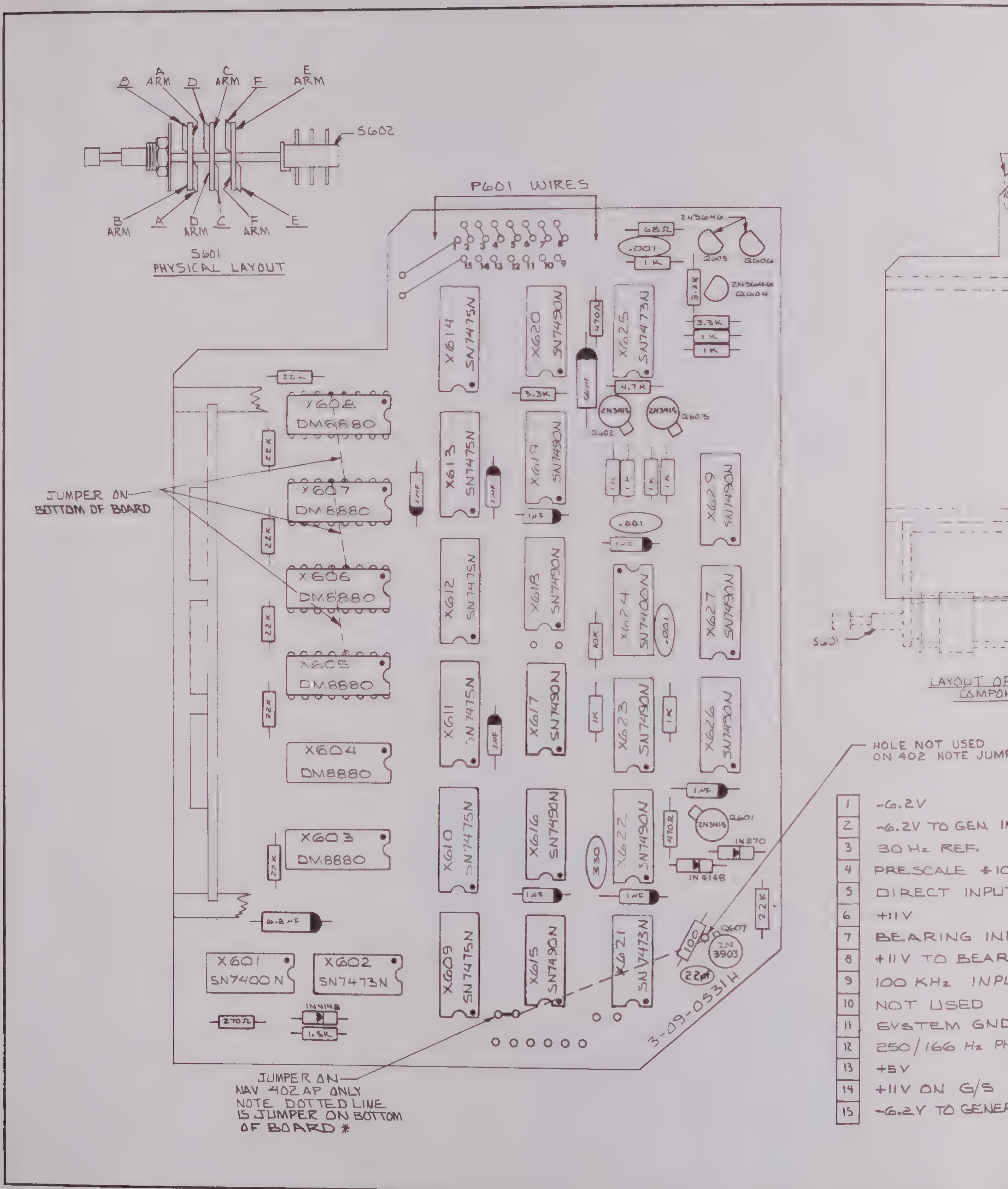
DRAWN D.Falk DATE 6/7/71
CHECKED DATE 4-19-73
APPROVED DATE 4-19-73

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

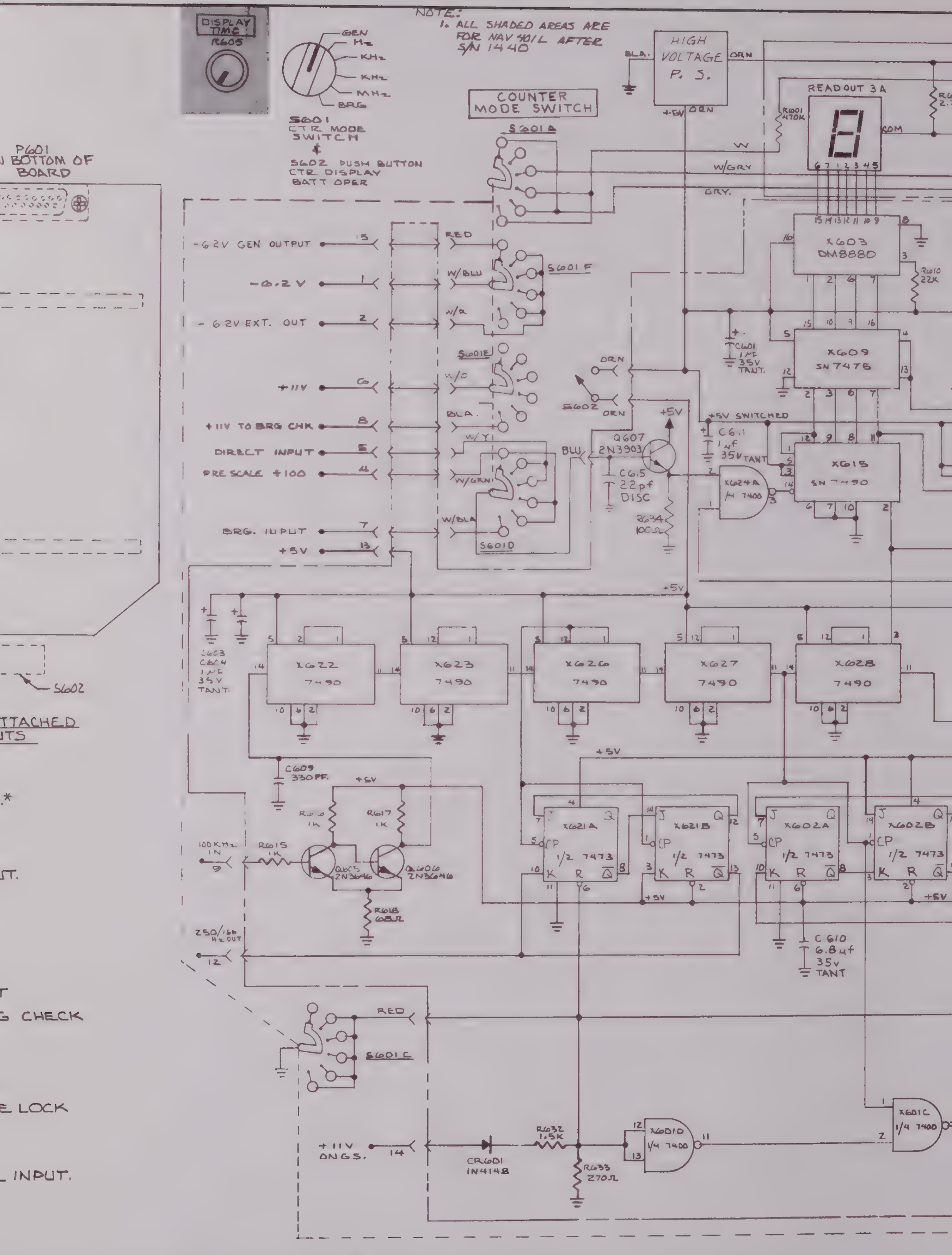
TITLE VOR BEARING LOGIC SCHEMATIC PG-5 NAV 401 & NAV-401L

SIZE C — PART NUMBER 3-09-0427 — REV B

SCALE — WEIGHT — SHEET 1 OF 2



A ARM
B
D
C ARM
F
E ARM
S602
B ARM
A
D ARM
C
F ARM
E
S601
PHYSICAL LAYOUT
P601 WIRES
JUMPER ON BOTTOM OF BOARD
X608 DM8880
X607 DM8880
X606 DM8880
X605 DM8880
X604 DM8880
X603 DM8880
X601 SN7400N
X602 SN7473N
X614 SN7475N
X613 SN7475N
X612 SN7475N
X611 SN7475N
X610 SN7475N
X609 SN7475N
X620 SN7490N
X619 SN7490N
X618 SN7490N
X617 SN7490N
X616 SN7490N
X615 SN7490N
X625 SN7473N
X624 SN7400N
X623 SN7490N
X622 SN7490N
X621 SN7473N
X629 SN7490N
X627 SN7490N
X626 SN7490N
2N3646
Q605
Q606
Q604
2N3415
Q602
Q603
2N3415
Q601
2N3903
Q607
IN270
IN4148
3-09-0531H
JUMPER ON NAV 402 AP ONLY
NOTE DOTTED LINE IS JUMPER ON BOTTOM OF BOARD *
S601
LAYOUT OF
COMPON
HOLE NOT USED ON 402 NOTE JUMP
1 -6.2V
2 -6.2V TO GEN. IN
3 30 Hz REF.
4 PRESCALE ÷10
5 DIRECT INPUT
6 +11V
7 BEARING IN
8 +11V TO BEAR
9 100 KHz INPU
10 NOT USED
11 SYSTEM GND
12 250/166 Hz PH
13 +5V
14 +11V ON G/S
15 -6.2V TO GENER



NOTE:
1. ALL SHADED AREAS ARE FOR NAV 401/L AFTER S/N 1440
DISPLAY TIME R605
S601 CTR MODE SWITCH
&
S602 PUSH BUTTON CTR DISPLAY BATT OPER
COUNTER MODE SWITCH
HIGH VOLTAGE P. S.
READOUT 3A
P601 BOTTOM OF BOARD
-6.2V GEN OUTPUT
-6.2V
-6.2V EXT. OUT
+11V
+11V TO BRG CHK
DIRECT INPUT
PRE SCALE ÷100
BRG. INPUT
+5V
+5V SWITCHED
X603 DM8880
X609 SN7475
X615 SN7490
X622 7490
X623 7490
X626 7490
X627 7490
X628 7490
X621A 1/2 7473
X621B 1/2 7473
X602A 1/2 7473
X602B 1/2 7473
X624A 1/4 7400
X601D 1/4 7400
X601C 1/4 7400
Q607 2N3903
Q605 2N3646
Q606 2N3646
C609 330PF.
C610 6.8uf 35v TANT
C601 1uF 35V TANT.
C611 1uf 35V TANT
C615 22pf DISC
C603 C604 1uF 35V TANT.
R634 100Ω
R615 1K
R616 1K
R617 1K
R618 68Ω
R601 470K
R610 22K
R632 1.5K
R633 270Ω
CR601 IN4148
100KHz IN
250/166 Hz OUT
+11V ON GS.
S601A
S601C
S601D
S601E
S601F
S602
ATTACHED
GEN
Hz
KHz
KHz
MHz
BRG

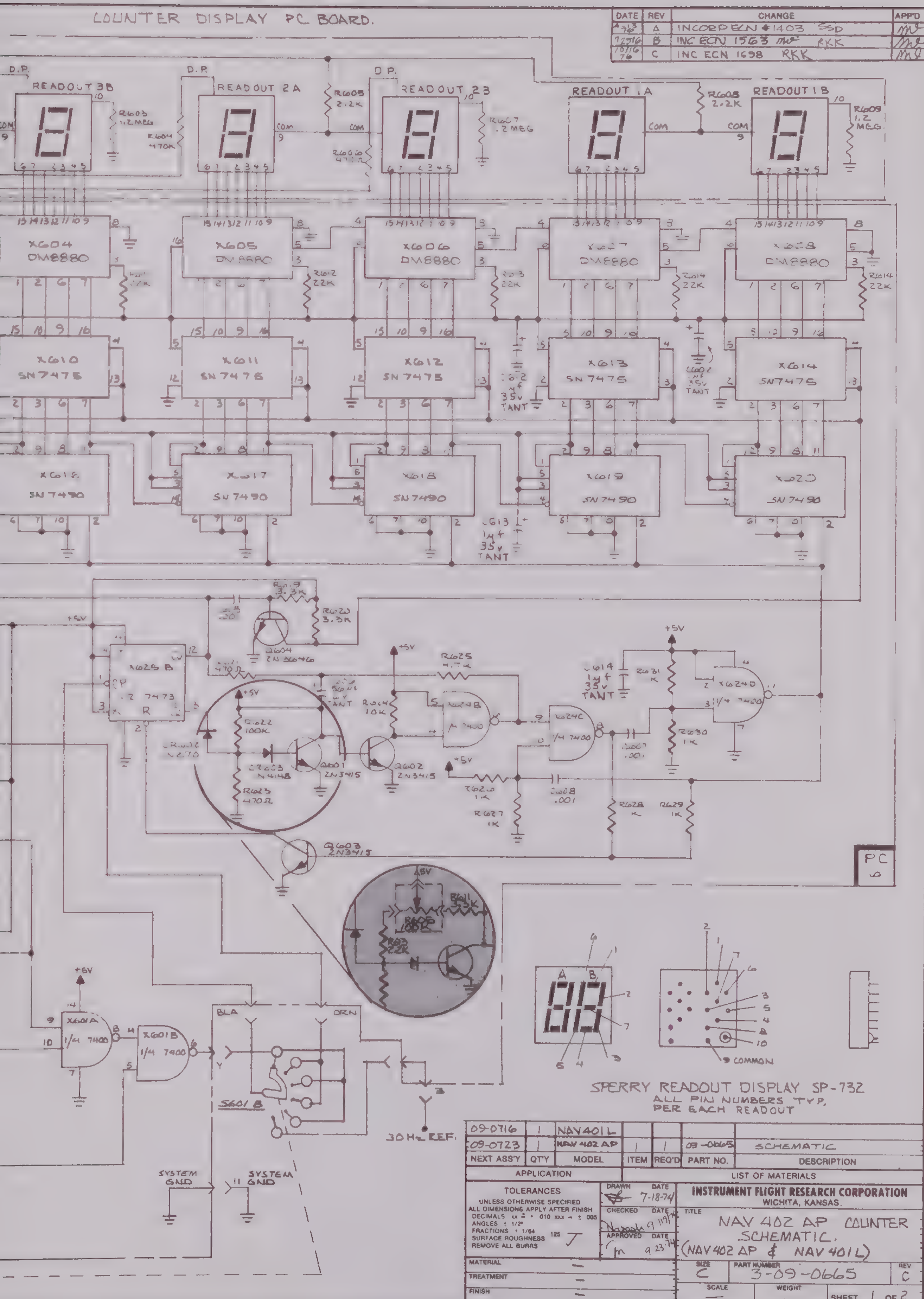

COUNTER DISPLAY PC BOARD.
DATE | REV | CHANGE | APP'D
A | INCORP ECN #1403 SSD
B | INC ECN 1563
C | INC ECN 1698 RKK
READOUT 3B
READOUT 2A
READOUT 2B
READOUT 1A
READOUT 1B
X604 DM8880
X605 DM8880
X606 DM8880
X607 DM8880
X608 DM8880
X610 SN7475
X611 SN7475
X612 SN7475
X613 SN7475
X614 SN7475
X616 SN7490
X617 SN7490
X618 SN7490
X619 SN7490
X620 SN7490
X625 B 7473
Q604 2N3646
Q601 2N3415
Q602 2N3415
Q603 2N3415
X624 D 1/4 7400
X624 C 1/4 7400
X601 A 1/4 7400
X601 B 1/4 7400
S601 B
30 Hz REF.
SYSTEM GND
SPERRY READOUT DISPLAY SP-732
ALL PIN NUMBERS TYP, PER EACH READOUT
COMMON
09-0716 | 1 | NAV 401L
09-0723 | 1 | NAV 402 AP | 1 | 1 | 03-0665 | SCHEMATIC
NEXT ASS'Y | QTY | MODEL | ITEM | REQ'D | PART NO. | DESCRIPTION
APPLICATION
LIST OF MATERIALS
TOLERANCES
UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS APPLY AFTER FINISH
DRAWN 7-18-74
CHECKED
APPROVED
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS
TITLE NAV 402 AP COUNTER SCHEMATIC (NAV 402 AP & NAV 401L)
SIZE C
PART NUMBER 3-09-0665
REV C
SHEET 1 OF 2

FIG 12-7

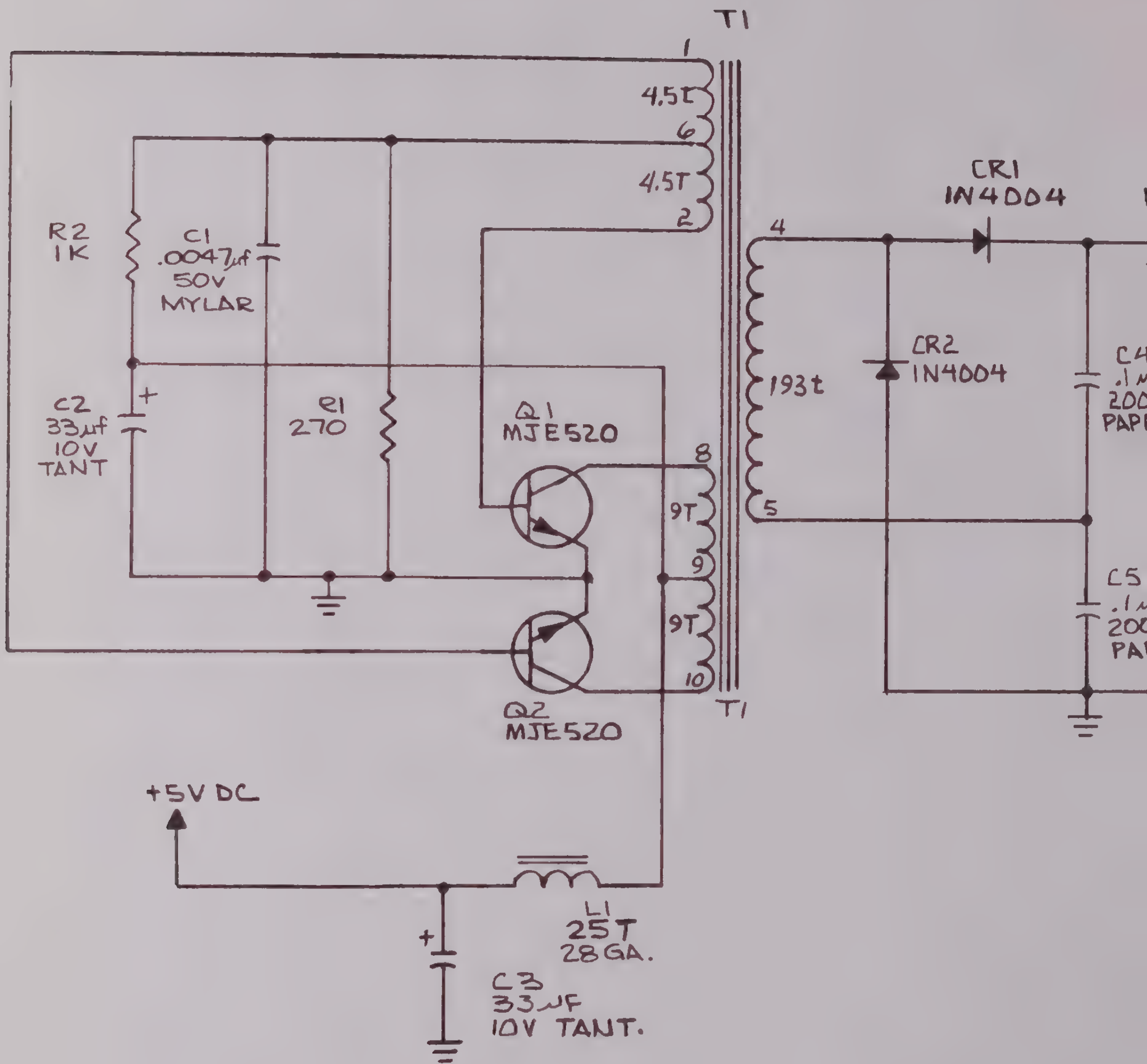
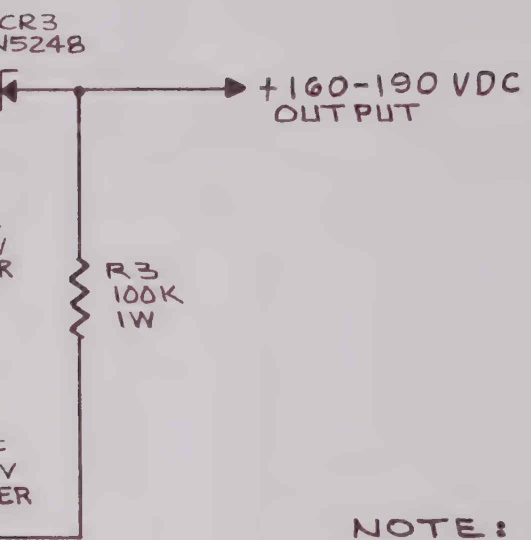

T1
1
4.5T
6
4.5T
2
R2
1K
C1
.0047μf
50V
MYLAR
C2
33μf
10V
TANT
R1
270
Q1
MJE520
8
9T
9
9T
10
Q2
MJE520
T1
4
193t
5
CR1
IN4004
CR2
IN4004
C5
+5V DC
L1
25T
28 GA.
C3
33μF
10V TANT.

FIG 12-8

DATE	REV	CHANGE	APP'D
10-10-75	B	INCORP ECN #1016 SSD	
7 29 76	C	INC ECN #1543 MD RKK	



NOTE:

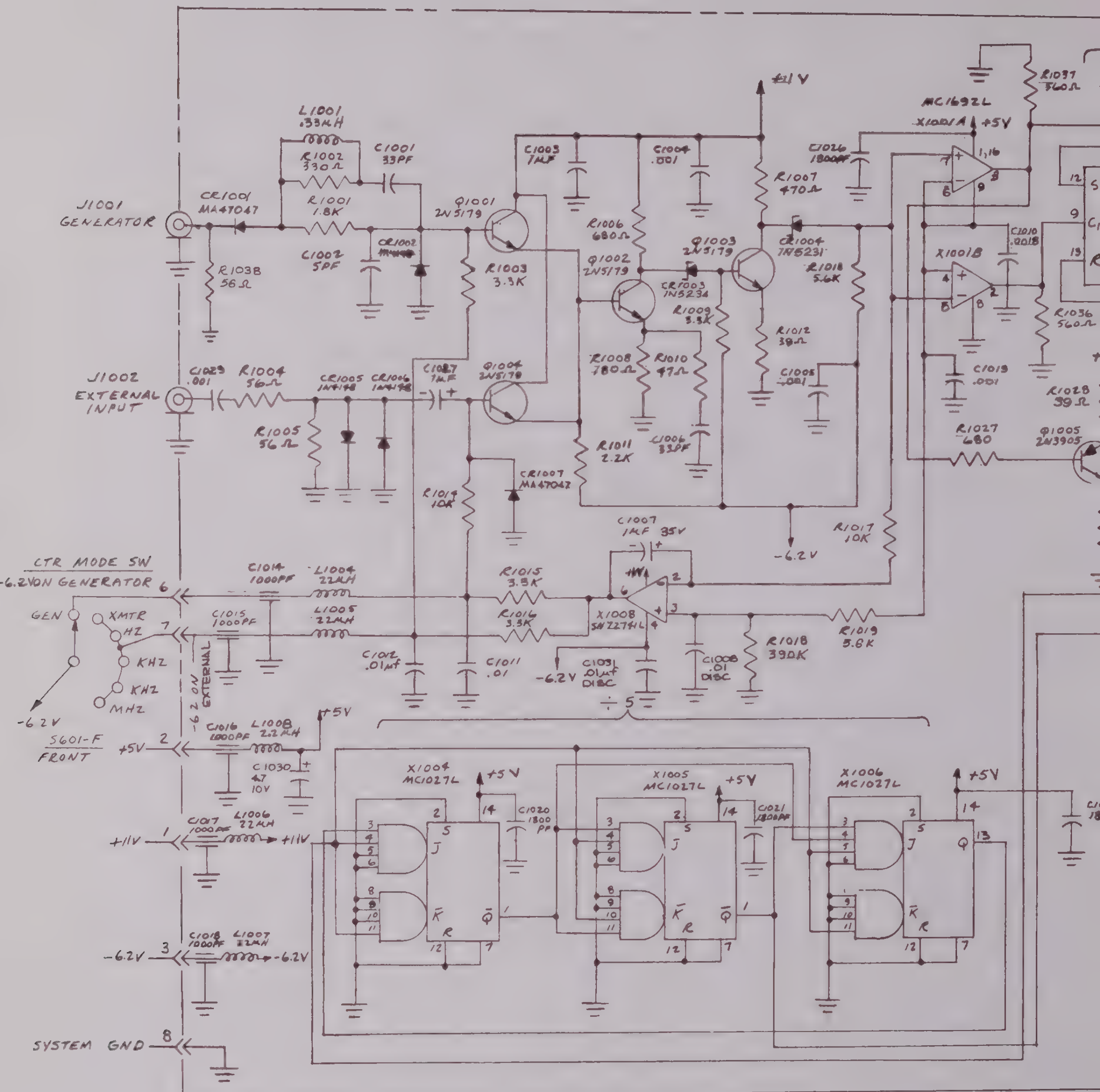
1. T1 IS AN ALADDIN TRANSFORMER P/N 326-0142 REV. "A"

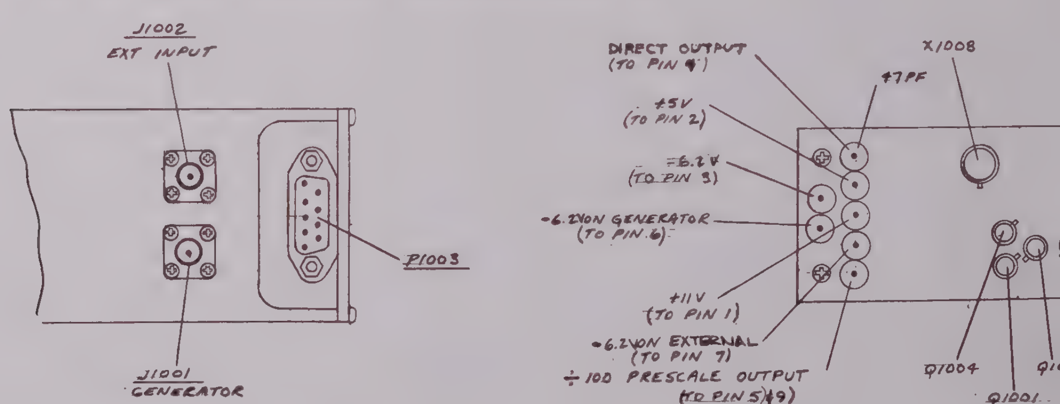
NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
09-0721	1	NAV402AP				
09-0721	1	NAV401L	1	1	09-0560	SCHEMATIC

APPLICATION — LIST OF MATERIALS

TOLERANCES UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS APPLY AFTER FINISH DECIMALS: ± .005 ANGLES: ± 1/2° FRACTIONS: ± 1/64 SURFACE ROUGHNESS 125 REMOVE ALL BURRS	DRAWN — DATE 9-13-74 CHECKED Naresh — DATE 9-23-74 APPROVED Naresh — DATE 9-24-74	INSTRUMENT FLIGHT RESEARCH CORPORATION WICHITA, KANSAS TITLE: HIGH VOLTAGE POWER SUPPLY SCHEMATIC
MATERIAL — TREATMENT — FINISH —		SIZE B — PART NUMBER 2-09-0560 — REV C SCALE — — WEIGHT — — SHEET 1 OF 1

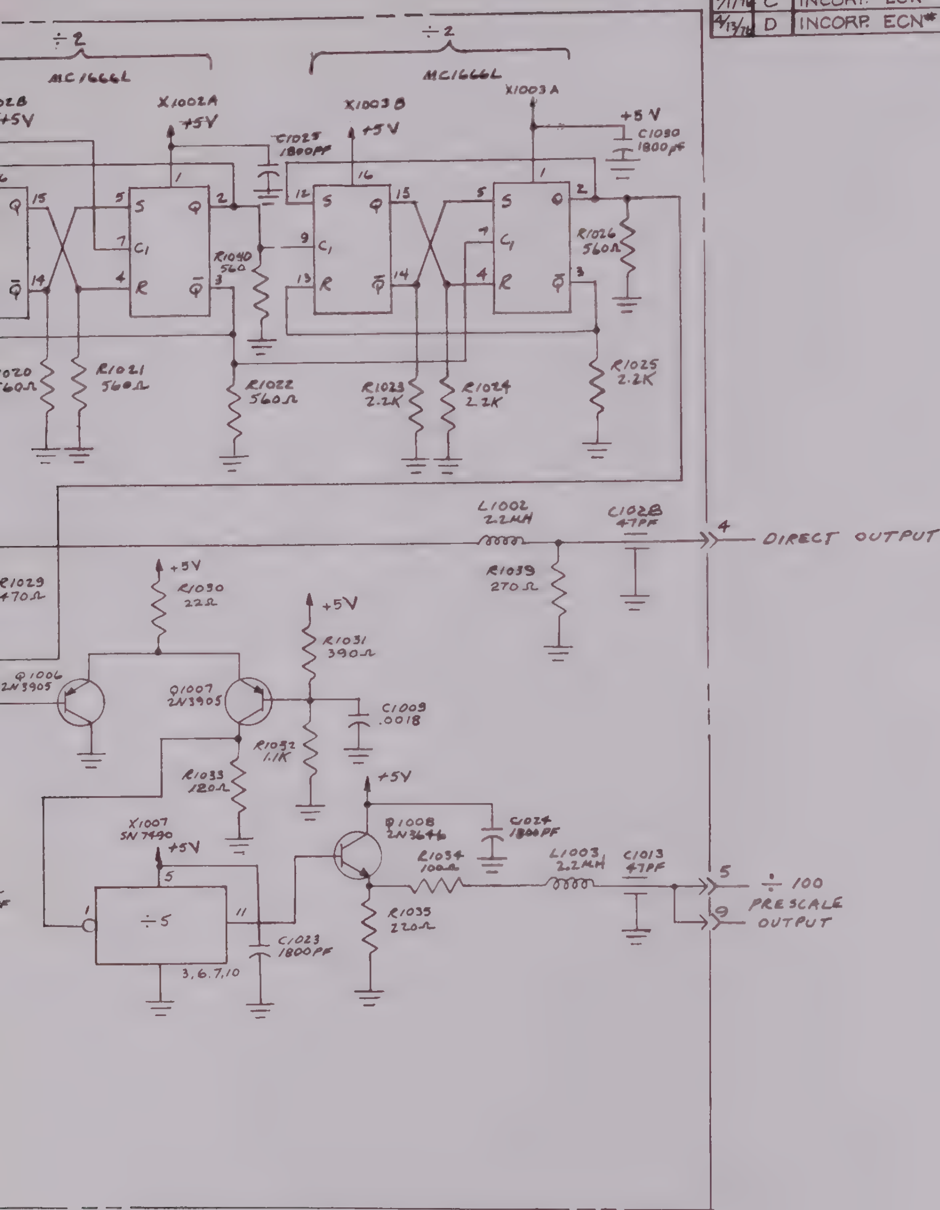
12-31/12-32

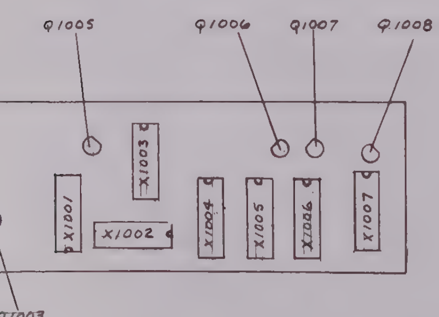

J1001
GENERATOR
J1002
EXTERNAL
INPUT
L1001
.33μH
R1002
330Ω
C1001
33PF
CR1001
MA47047
R1001
1.8K
C1002
5PF
CR1002
R1038
56Ω
C1029
.001
R1004
56Ω
CR1005
1N4148
CR1006
1N4148
R1005
56Ω
C1003
1MF
C1004
.001
Q1001
2N5179
R1003
3.3K
R1006
680Ω
Q1002
2N5179
Q1003
2N5179
CR1003
1N5234
R1009
3.3K
R1007
470Ω
CR1004
1N5231
R1013
5.6K
R1012
39Ω
C1005
.001
R1008
780Ω
R1010
47Ω
C1006
33PF
R1011
2.2K
C1027
1MF
Q1004
2N5179
CR1007
MA47047
R1014
10K
+11V
-6.2V
MC1692L
X1001A
+5V
C1026
1800PF
R1037
560Ω
X1001B
C1010
.0018
R1036
560Ω
C1019
.001
R1028
39Ω
R1027
680
Q1005
2N3905
R1017
10K
C1007
1MF 35V
R1015
3.3K
R1016
3.3K
X1008
SN72741L
R1019
5.6K
R1018
390K
C1008
.01
DISC
C1031
.01μf
DISC
C1012
.01μf
C1011
.01
CTR MODE SW
-6.2V ON GENERATOR
GEN
XMTR
HZ
KHZ
KHZ
MHZ
-6.2V
-6.2V ON EXTERNAL
C1014
1000PF
L1004
22μH
C1015
1000PF
L1005
22μH
÷ 5
S601-F
FRONT
C1016
1000PF
L1008
2.2μH
C1030
47
10V
C1017
1000PF
L1006
22μH
C1018
1000PF
L1007
22μH
SYSTEM GND
X1004
MC1027L
X1005
MC1027L
X1006
MC1027L
C1020
1800
PF
C1021
1800PF


J1002
EXT INPUT
P1003
J1001
GENERATOR
DIRECT OUTPUT
(TO PIN 4)
+5V
(TO PIN 2)
-6.2V
(TO PIN 3)
-6.2V ON GENERATOR
(TO PIN 6)
+11V
(TO PIN 1)
-6.2V ON EXTERNAL
(TO PIN 7)
÷ 100 PRESCALE OUTPUT
(TO PIN 5&9)
X1008
47PF
Q1004
Q1001

BOTTOM VIEW

DATE	REV	CHANGE	APP'D
3-20-74	A	INC. ECN # 1 LD.	
	B	INCORP. ECN # 767	
3/1/76	C	INCORP. ECN # 1341 AND 1347 WW	
4/13/76	D	INCORP. ECN # 1397 AND 1421 WW	





TOP VIEW
(CIRCUIT BD. ONLY)

3-09-0599	1	401L		1	1	3-09-0545	401L PRESCALER SCHEMATIC
NEXT ASS'Y	QT'Y	MODEL		ITEM	REQ'D	PART NO.	DESCRIPTION
APPLICATION							LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS
MATERIAL —
TREATMENT —
FINISH —

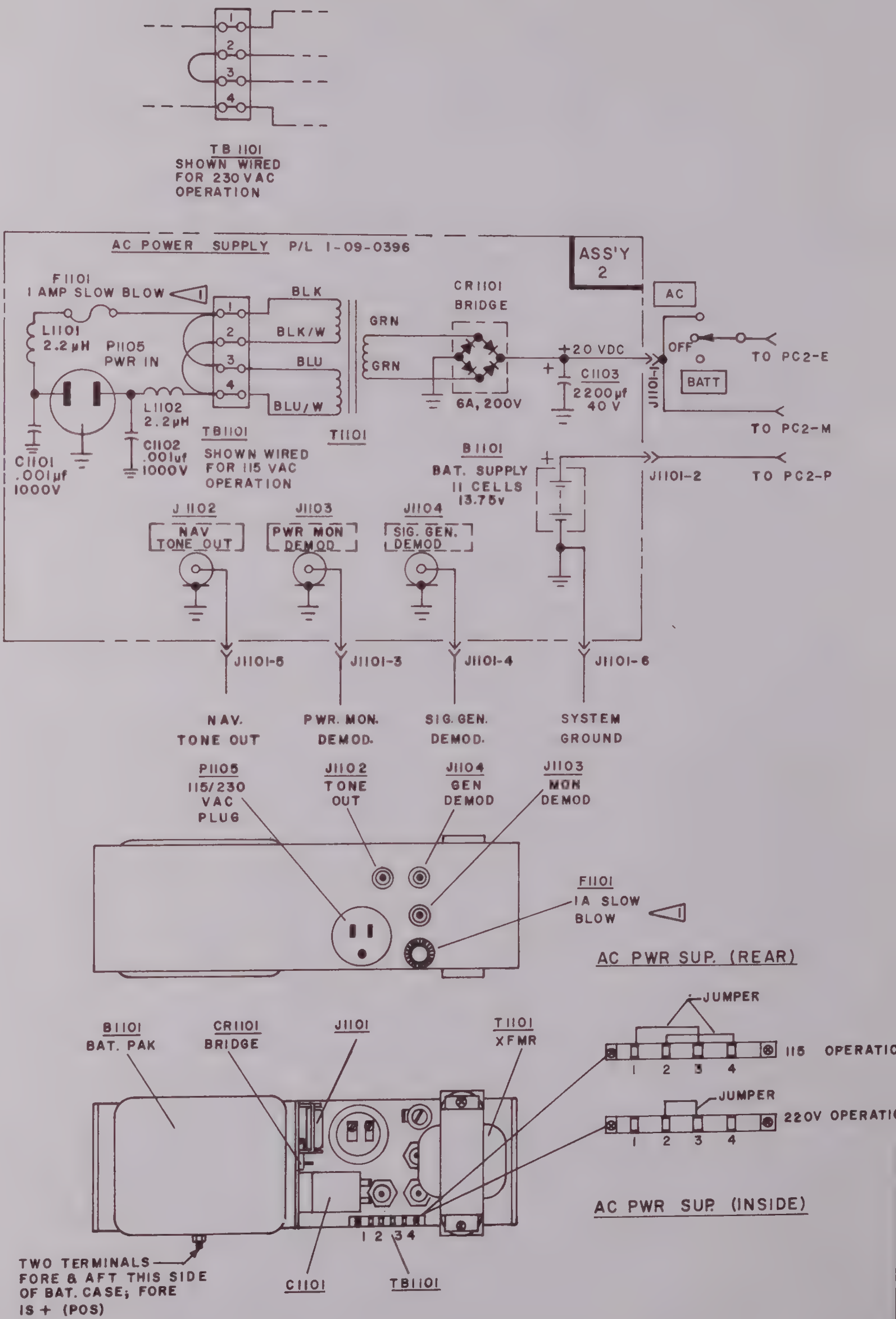
DRAWN JJG DATE 10/24/72
CHECKED DATE 4-19-73
APPROVED DATE 4-19-73

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE 401L PRESCALER SCHEMATIC
ASS'Y. 1

SIZE C PART NUMBER 3-09-0545 REV D
SCALE — WEIGHT — SHEET 1 OF 1

FIG 12-9



TB 1101
SHOWN WIRED FOR 230 VAC OPERATION
AC POWER SUPPLY P/L 1-09-0396
ASS'Y 2
F1101
1 AMP SLOW BLOW
L1101
2.2 µH
P1105
PWR IN
BLK
BLK/W
BLU
BLU/W
GRN
GRN
CR1101
BRIDGE
6A, 200V
+20 VDC
C1103
2200µf
40 V
J1101-1
AC
OFF
BATT
TO PC2-E
TO PC2-M
L1102
2.2µH
C1101
.001µf
1000V
C1102
.001uf
1000V
TB1101
SHOWN WIRED FOR 115 VAC OPERATION
T1101
B1101
BAT. SUPPLY
11 CELLS
13.75v
J1101-2
TO PC2-P
J1102
NAV TONE OUT
J1103
PWR MON DEMOD
J1104
SIG. GEN. DEMOD
J1101-5
J1101-3
J1101-4
J1101-6
NAV. TONE OUT
PWR. MON. DEMOD.
SIG. GEN. DEMOD.
SYSTEM GROUND
P1105
115/230 VAC PLUG
J1102
TONE OUT
J1104
GEN DEMOD
J1103
MON DEMOD
F1101
1A SLOW BLOW
AC PWR SUP. (REAR)
JUMPER
115 OPERATIO
JUMPER
220V OPERATI
AC PWR SUP. (INSIDE)
B1101
BAT. PAK
CR1101
BRIDGE
J1101
T1101
XFMR
TWO TERMINALS FORE & AFT THIS SIDE OF BAT. CASE; FORE IS + (POS)
C1101
TB1101

FIG 1

DATE	REV	CHANGE

N

N

1 AMP FUSE FOR 115V. 1/2 AMP FUSE FOR 220V.

ITEM	REQ'D	PART NO	DESCRIPTION
—	—	3-09-0745	A/C POWER SUPPLY SCHEMATIC

LIST OF MATERIALS

NEXT ASS'Y	QTY	MODEL
3-09-0612	1	1201L

APPLICATION

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS .xx ± .010 .xxx = ± .005
ANGLES ± 1/2°
FRACTIONS ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

MATERIAL
SEE DWG

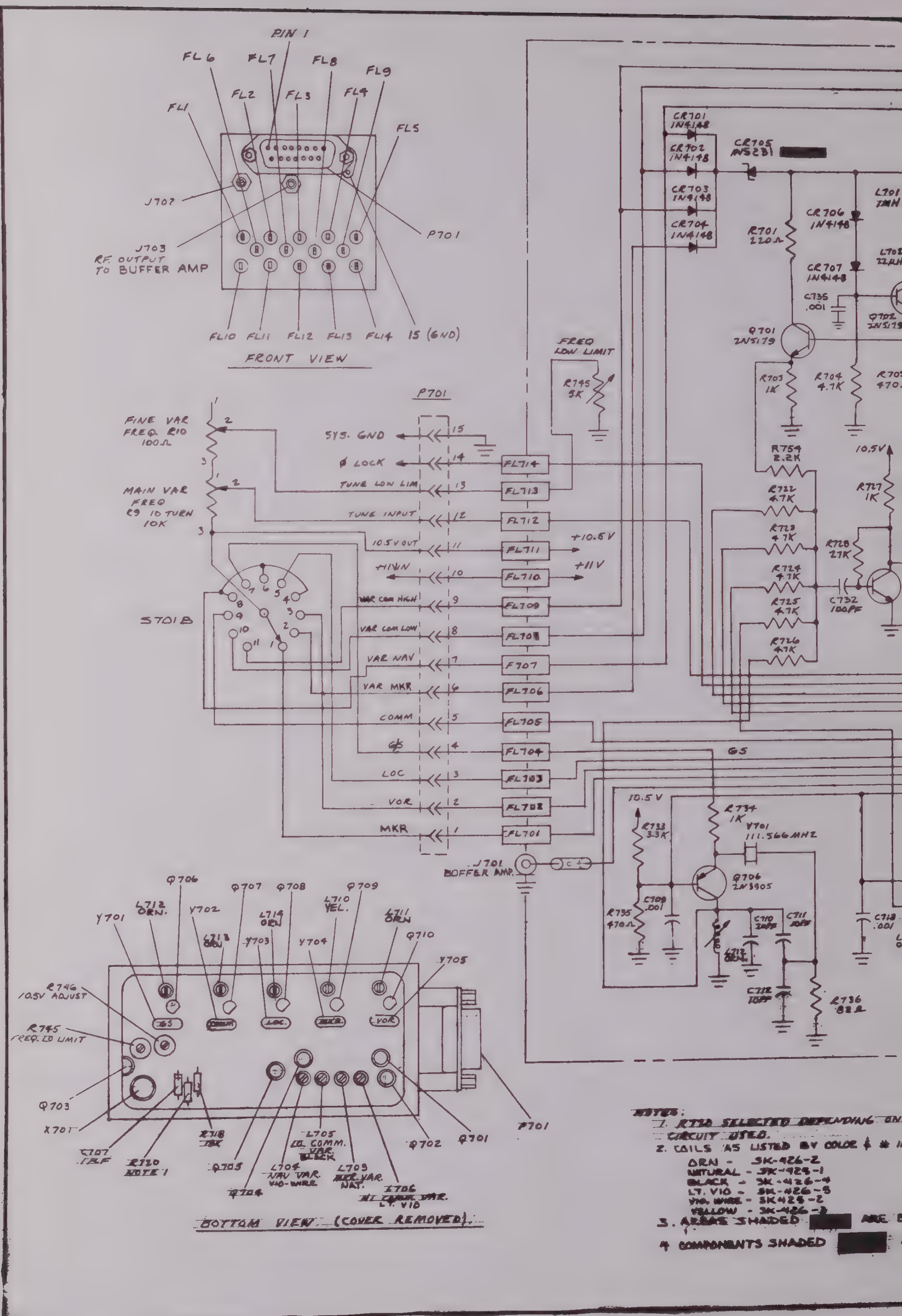
FINISH

DRAWN rkk DATE 9/3/76
CHECKED WW DATE 9-3-76
APPROVED MW DATE 9-3-76

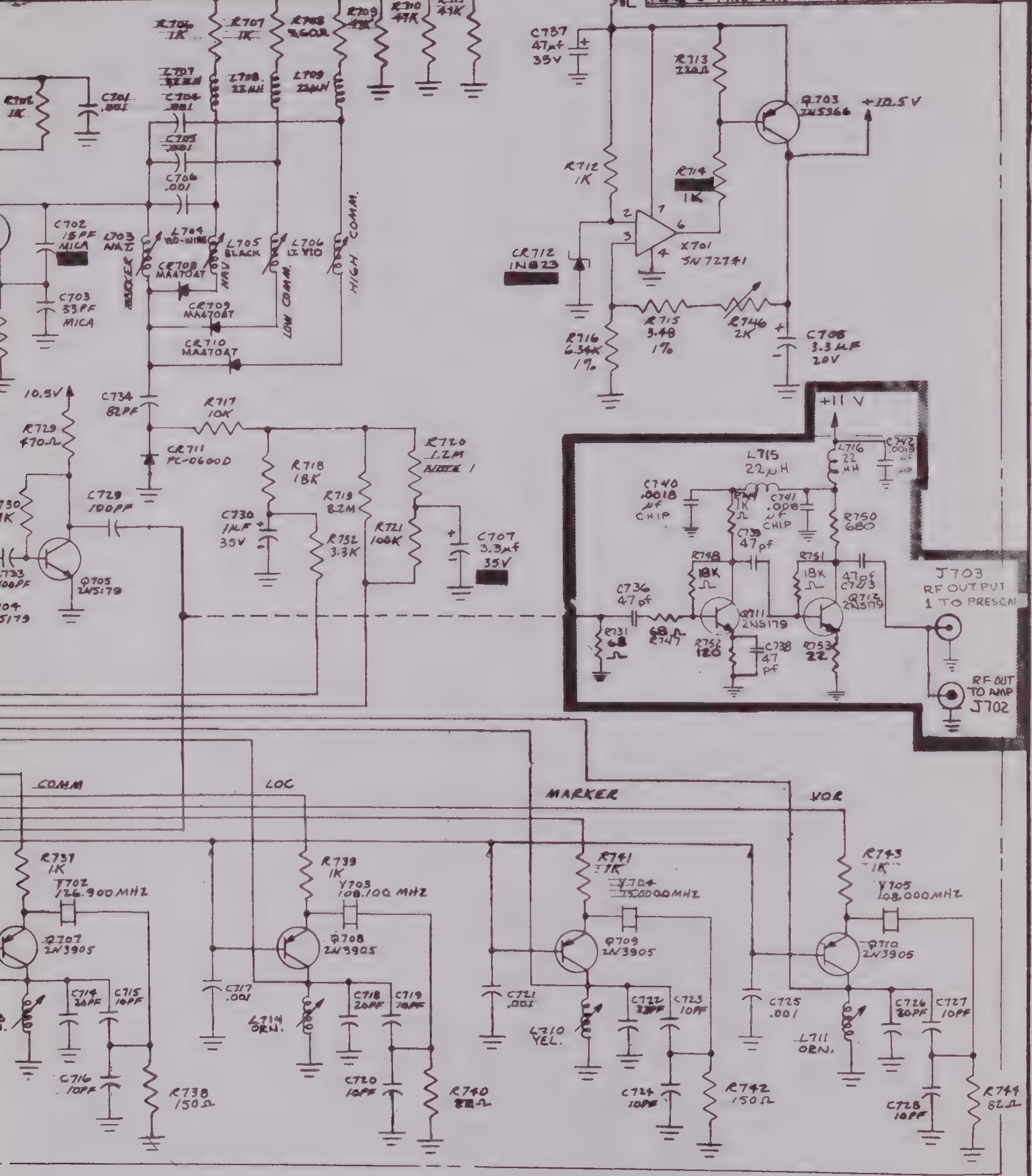
- IFR INC -
WICHITA KANSAS

TITLE
A C POWER SUPPLY SCHEMATIC
ASS'Y 2

SIZE C
PART NUMBER 3-09-0745
REV
SCALE 1:1
WEIGHT —
SHEET 1 OF 1


PIN 1
FL6 FL7 FL8 FL9
FL2 FL3 FL4 FL5
FL1
J707
J703
RF OUTPUT
TO BUFFER AMP
P701
FL10 FL11 FL12 FL13 FL14 15 (GND)
FRONT VIEW
FREQ
LOW LIMIT
R745
5K
P701
FINE VAR
FREQ. R10
100Ω
MAIN VAR
FREQ
R9 10 TURN
10K
S701B
SYS. GND
φ LOCK
TUNE LOW LIM
TUNE INPUT
10.5V OUT
HI V IN
VAR COM HIGH
VAR COM LOW
VAR NAV
VAR MKR
COMM
GS
LOC
VOR
MKR
FL714 FL713 FL712 FL711 FL710 FL709 FL708 F707 FL706 FL705 FL704 FL703 FL702 FL701
+10.5V
+11V
J701
BUFFER AMP.
CR701
1N4148
CR702
1N4148
CR703
1N4148
CR704
1N4148
CR705
1N5231
R701
220Ω
CR706
1N4148
CR707
1N4148
C735
.001
Q701
2N5179
Q702
2N5179
R703
1K
R704
4.7K
R754
2.2K
R722
4.7K
R723
4.7K
R724
4.7K
R725
4.7K
R726
4.7K
R728
27K
R727
1K
10.5V
C732
100PF
GS
10.5V
R733
3.3K
R734
1K
Y701
111.566MHZ
Q706
2N3905
R735
470Ω
C709
.001
C710
C711
C712
R736
82Ω
C718
.001
Q706 Q707 Q708 Q709
Y701
L712
ORN.
Y702
L713
ORN
L714
ORN
Y703
L710
YEL.
Y704
L711
ORN
Q710
Y705
R746
10.5V ADJUST
R745
FREQ. LO LIMIT
Q703
X701
C707
R730
NOTE 1
R718
Q705
Q704
L705
LO COMM. VAR.
BLACK
L704
NAV VAR.
VIO-WIRE
L703
MKR VAR.
NAT.
L706
HI COMM VAR.
LT. VIO
Q702
Q701
P701
GS
COMM
LOC
MKR
VOR
BOTTOM VIEW (COVER REMOVED).
NOTES:
1. R730 SELECTED DEPENDING ON
CIRCUIT USED.
2. COILS AS LISTED BY COLOR & # I
ORN - SK-426-2
NATURAL - SK-425-1
BLACK - SK-426-4
LT. VIO - SK-426-5
VIO. WIRE - SK425-2
YELLOW - SK-426-3
3. AREAS SHADED ARE
4 COMPONENTS SHADED

DATE	REV	
-79		INCORP ECN
6/6/74	A	INCORP ECN-2
	B	INC. ECN-3
	C	INC. ECN. # 4
	D	INCORP. ECN# 1367
	E	INC. ECN # 1540 RKK



PHASE LOCK

BODY OF DWG.

F PRIOR TO S/N 1311

F, UP TO S/N 1331 ONLY!

1-09-0594		401L			3-09-0049	OSCILLATOR SCHEM.
NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
APPLICATION					LIST OF MATERIALS	

TOLERANCES

DRAWN J/G 11/2/72

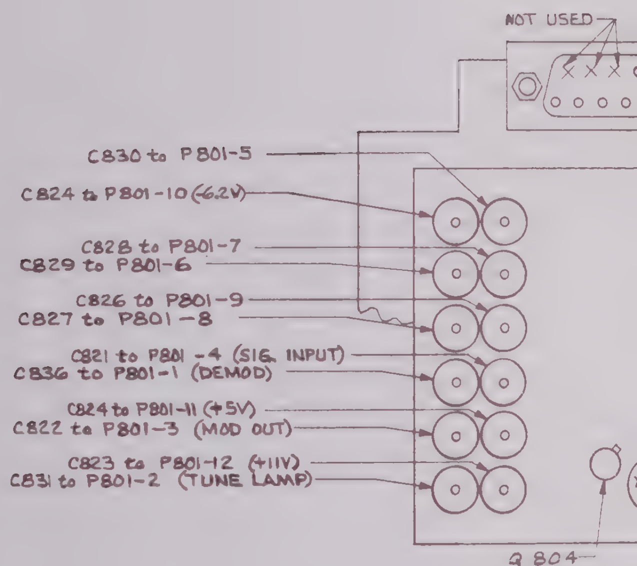
CHECKED 4-24-73

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

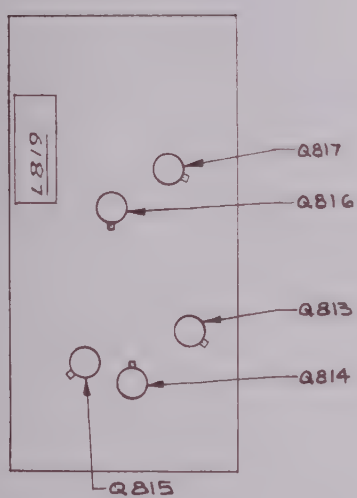
TITLE 401L OSCILLATOR SCHEMATIC (ASSY. 5)

SIZE C 3-09-0549 E

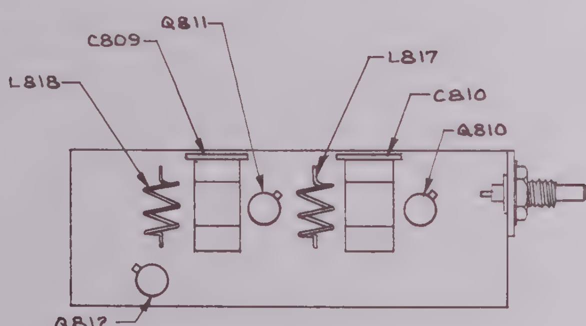
FIG 12-12



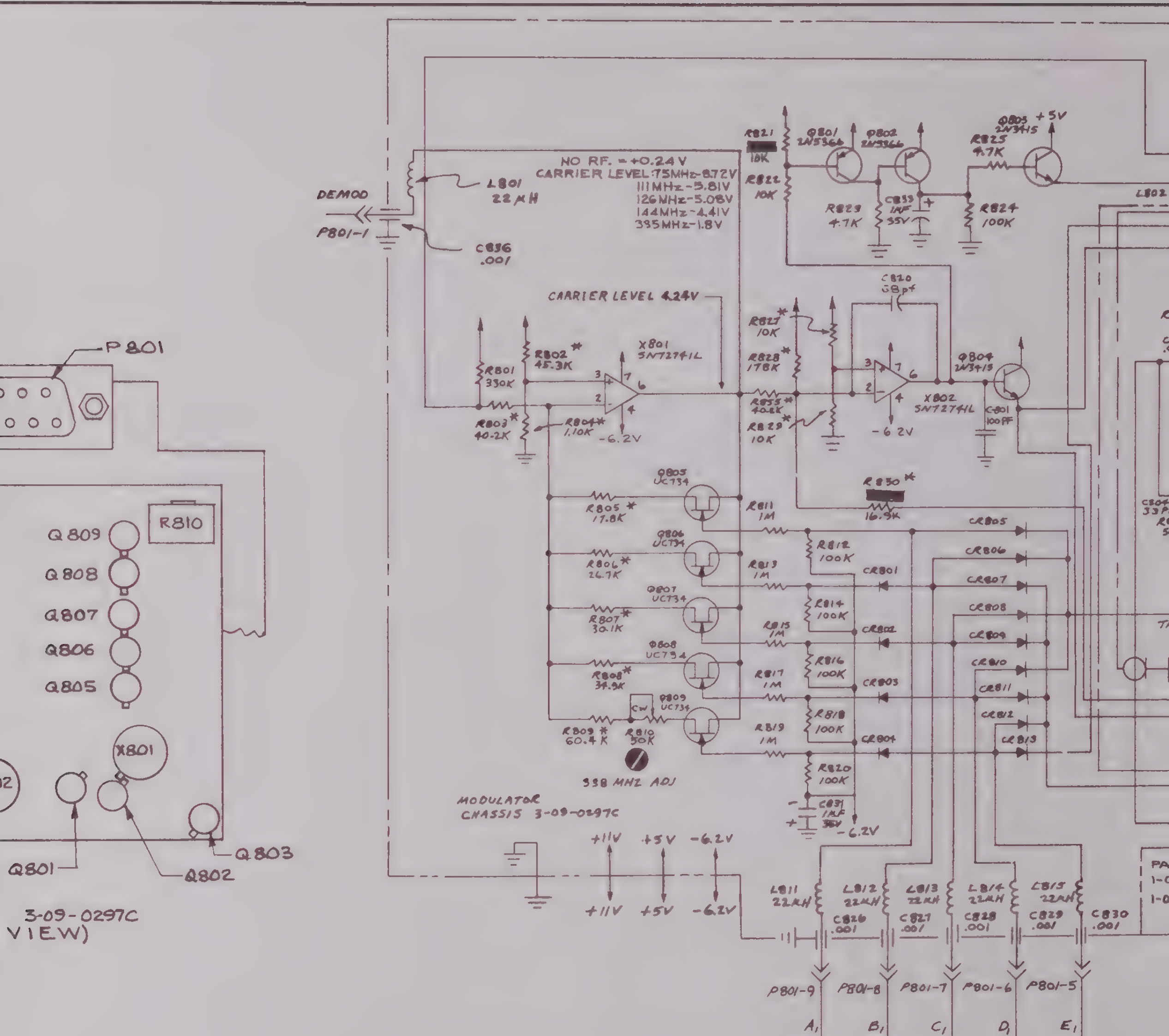
MODULATO
(TO



TRANSMITTER
1-09-0490

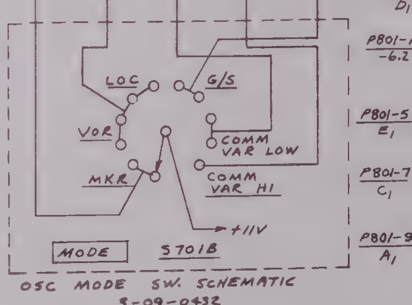


TRIPLER 1-09-0518



NOTES:

1. ALL UPWARD ARROWS UNLESS OTHERWISE SPECIFIED GO TO +11V.
2. L817 - 3T. OF #24 GAGE TINNED WIRE 1/8 DIA. 3/8" LONG TAPPED 1 1/2 T. FROM GND, AND FOR THE SECONDARY, 3/4 T. #24 GAGE TINNED WIRE WITH INSULATING SLEEVING.
   L818 - 3T OF #24 GAGE TINNED WIRE 1/8 DIA. 3/8" LONG TAPPED 1 1/2 T FROM GND.
   L819 [5] #26 TINNED WIRED ON .150 DIA. THREADED TEFLON FORM TAPPED 5T. FROM GND, COVERED WITH HEATSHRINK TUBING.
   L820 - 8T. OF #26 GAGE TINNED WIRE ON .150 DIA THREADED TEFLON FORM COVERED WITH HEATSHRINK TUBING.
3. K801, ELGIN ADVANCE RELAY # MU2C120D-24 12VDC, WIRING:



OSC MODE SW. SCHEMATIC
3-09-0432

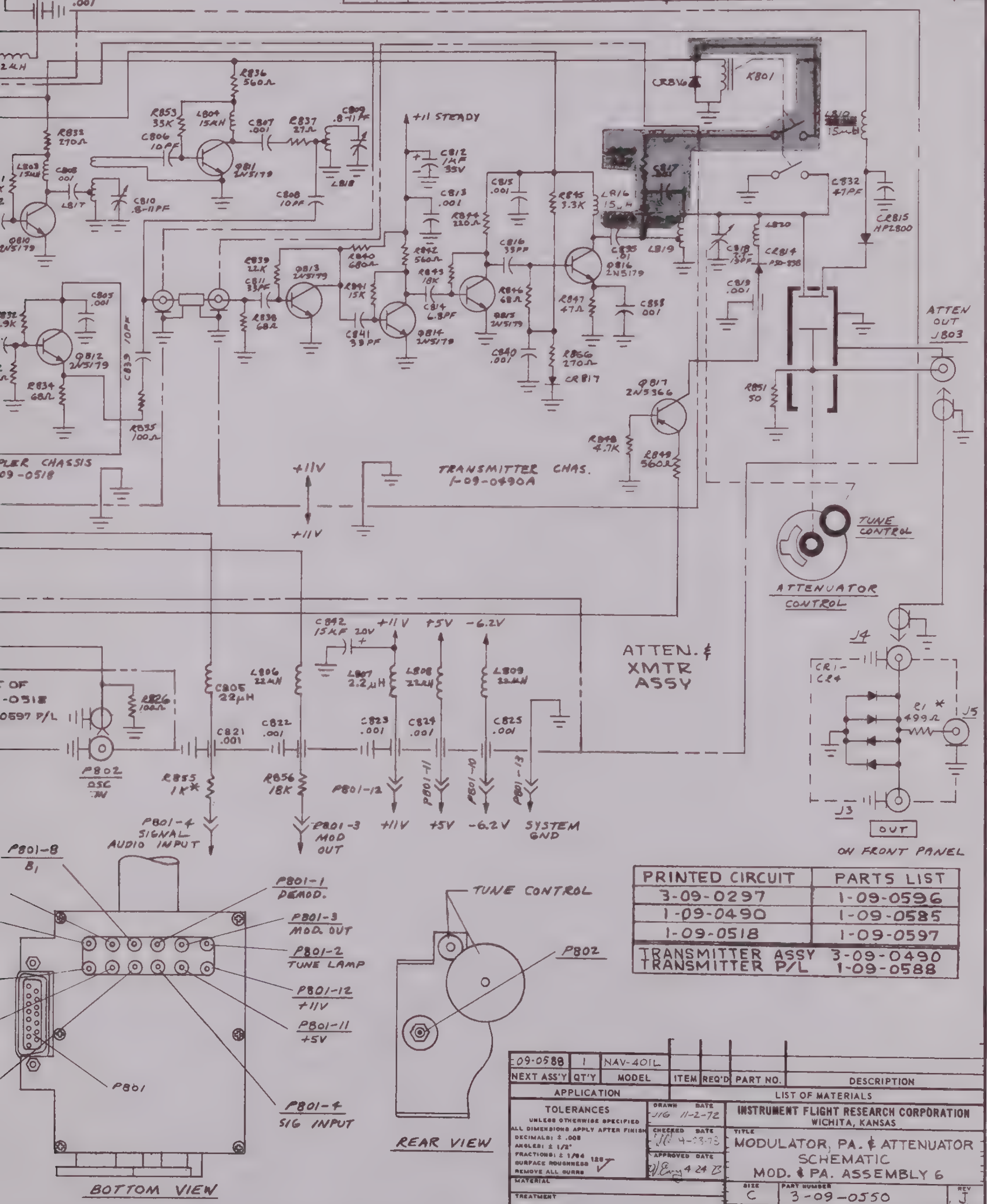
4. ALL DIODES TO BE IN4148 UNLESS OTHERWISE SHOWN.

[5] 12 TURNS THRU SN 1310. THEN 13 TURNS SN 1311 & UP

6. DATA IN SHADED AREAS EFF. THRU SN 1310 ONLY. DATA NOT SHADED EFF SN 1311 & UP.

H	12-4-75	INC ECN 166	
J	7-23-76	INC ECN 1576 RKK	

DATE	REV	CHANGE	APP'D
10-1-73	A	INCORPORATED ECN # 1	
10-1-73	B	INCORPORATED ECN # 2	
10-1-73	C	INCORPORATED ECN # 3	
10-1-73	D	INCORPORATED ECN # 4	
4-22-74	E	INCORPORATED ECN # 5	
8-13-74	F	INC. ECN # 6	
8-20-74	G	INC. ECN # 7	



PRINTED CIRCUIT	PARTS LIST
3-09-0297	1-09-0596
1-09-0490	1-09-0585
1-09-0518	1-09-0597
TRANSMITTER ASSY	3-09-0490
TRANSMITTER P/L	1-09-0588

NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
1-09-0588	1	NAV-401L				

APPLICATION — LIST OF MATERIALS

TOLERANCES UNLESS OTHERWISE SPECIFIED. ALL DIMENSIONS APPLY AFTER FINISH. DECIMALS: ± .005; ANGLES: ± 1/2°; FRACTIONS: ± 1/64; SURFACE ROUGHNESS 125; REMOVE ALL BURRS. MATERIAL. TREATMENT. FINISH.

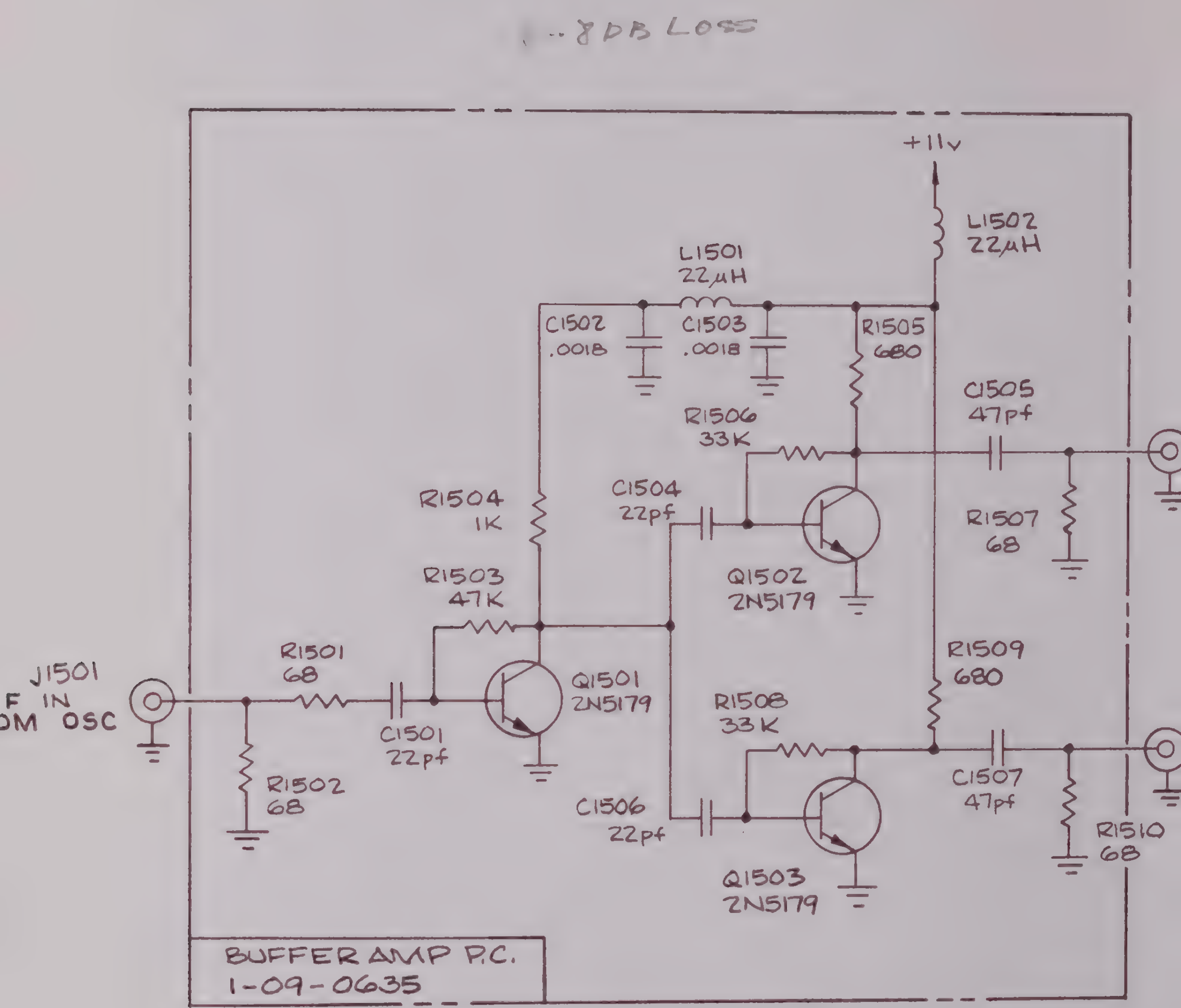
DRAWN JG 11-2-72 · CHECKED 4-23-73 · APPROVED 4-24-73

INSTRUMENT FLIGHT RESEARCH CORPORATION, WICHITA, KANSAS

TITLE: MODULATOR, PA. & ATTENUATOR SCHEMATIC MOD. & PA. ASSEMBLY 6

SIZE C · PART NUMBER 3-09-0550 · REV J · SHEET 1 OF 2

FIG 12-13

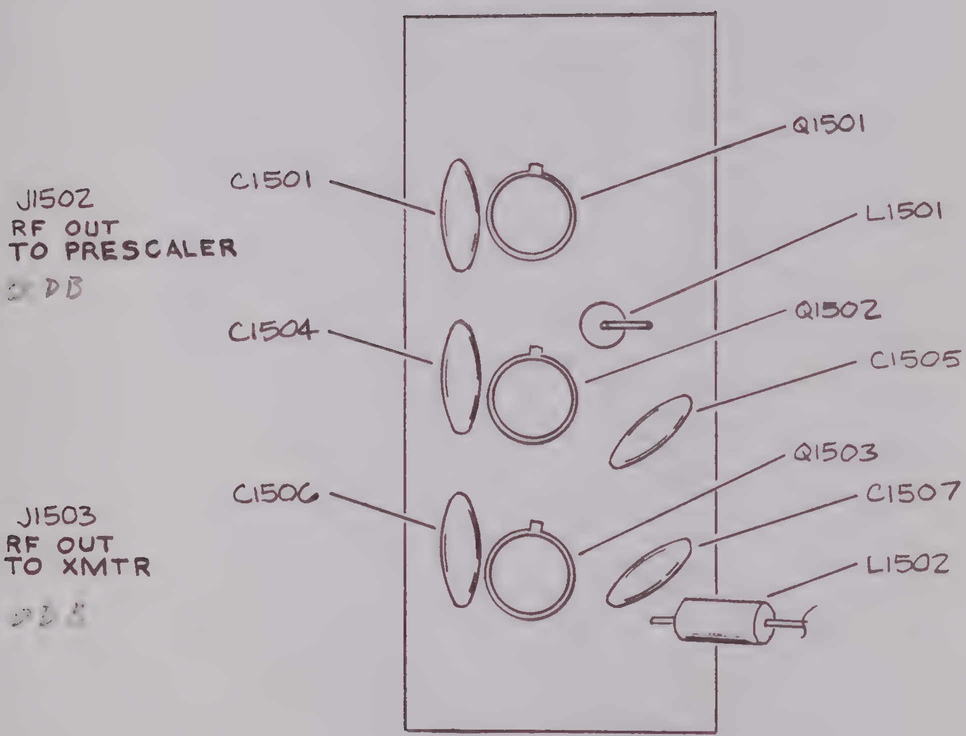


NOTES:

. HIGHEST NUMBERS USED –
C1507 L1502 Q1503 R1510

FIG 12-14

DATE	REV	CHANGE	APP'D

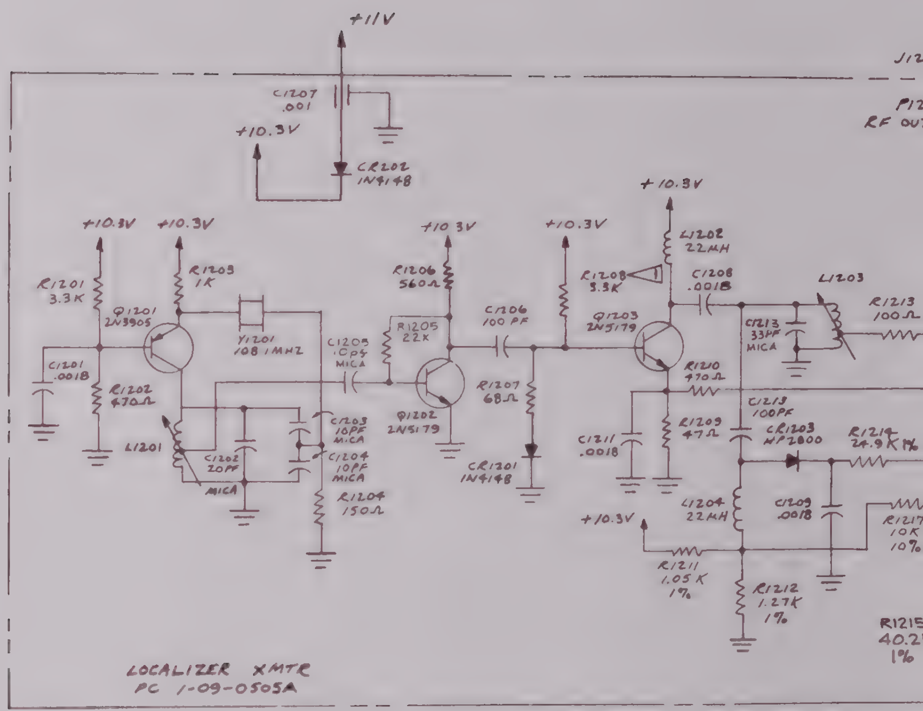


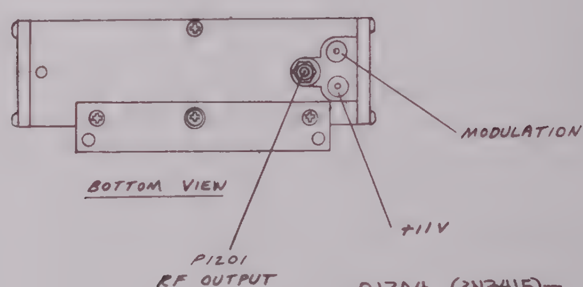
TOP VIEW OF P.C. BD.

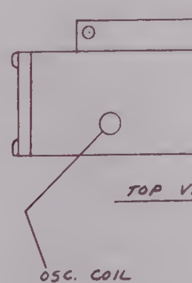
FIG 12-14

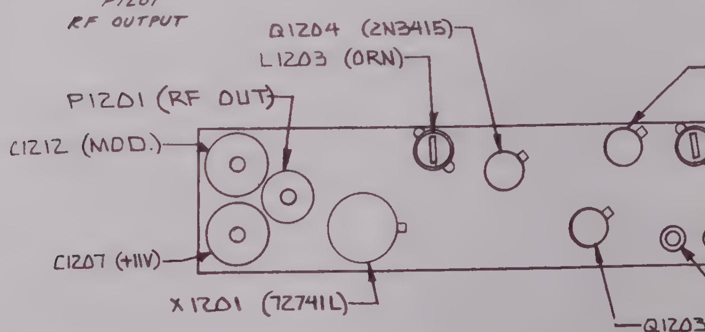
09-0637		NAV 401L NAV 402AP			09-0667	SCHEMATIC
NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
APPLICATION			LIST OF MATERIALS			

TOLERANCES UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS APPLY AFTER FINISH DECIMALS: ± .005 ANGLES: ± 1/2° FRACTIONS: ± 1/64 SURFACE ROUGHNESS 125 REMOVE ALL BURRS	DRAWN D. Parker DATE 7/8/74 CHECKED D. Parker DATE 7/12/74 APPROVED Nagesin DATE 9/24/74	INSTRUMENT FLIGHT RESEARCH CORPORATION WICHITA, KANSAS TITLE BUFFER AMP. SCHEMATIC NAV-402L
MATERIAL P/LIST 1-09-0634		SIZE PART NUMBER 2-09-0667 REV
TREATMENT —		SCALE — WEIGHT —
FINISH —		SHEET 1 OF 1

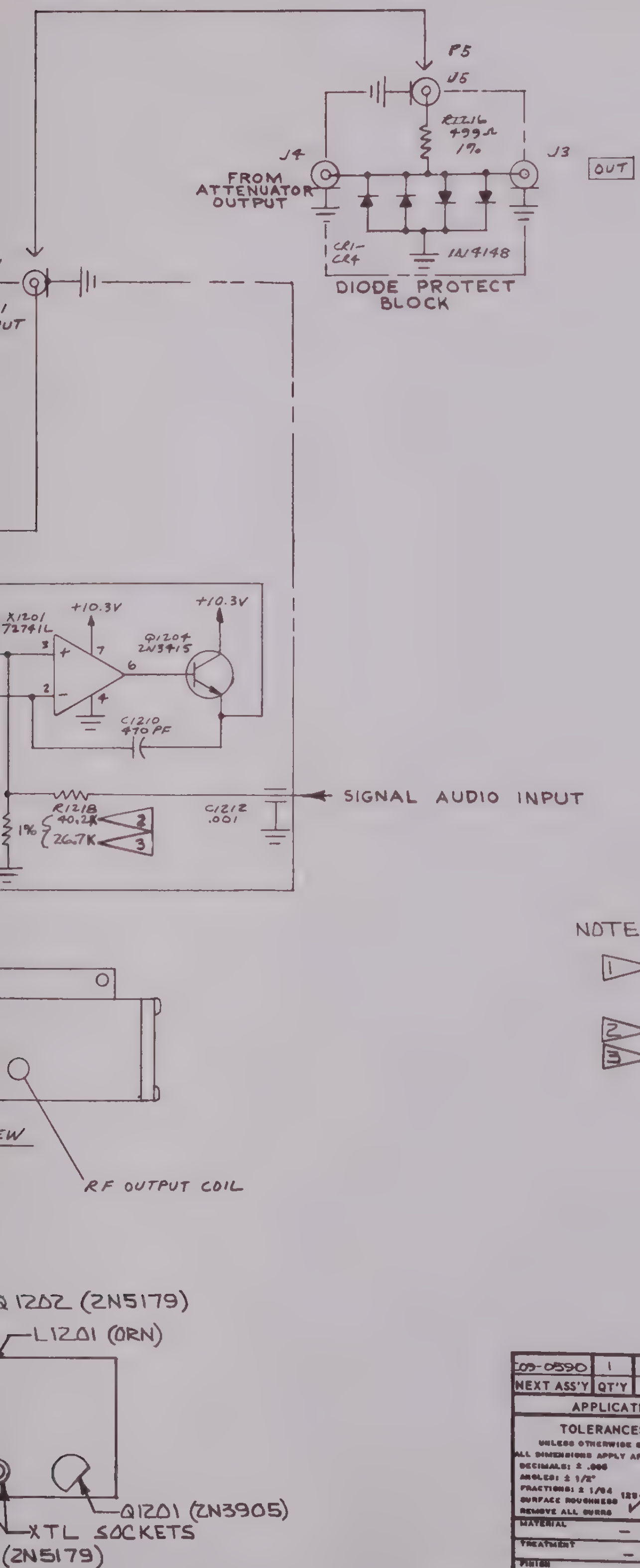

+11V
C1207 .001
+10.3V
CR202 1N4148
+10.3V
R1201 3.3K
Q1201 2N3905
R1203 1K
Y1201 108.1MHZ
C1201 .0018
R1202 470Ω
L1201
C1202 20PF MICA
C1203 10PF MICA
C1204 10PF MICA
C1205 .Cps MICA
R1204 150Ω
R1206 560Ω
R1205 22K
Q1202 2N5179
C1206 100 PF
R1207 68Ω
CR1201 1N4148
R1208 3.3K
Q1203 2N5179
L1202 22MH
C1208 .0018
C1213 33PF MICA
L1203
R1213 100Ω
R1210 470Ω
R1209 47Ω
C1211 .0018
C1213 100PF
CR1203 HP2800
R1214 24.9K 1%
L1204 22MH
C1209 .0018
R1217 10K 10%
R1211 1.05K 1%
R1212 1.27K 1%
R1215 40.2 1%
J12
P12
RF OU
LOCALIZER XMTR
PC 1-09-0505A


MODULATION
BOTTOM VIEW
+11V
P1201
RF OUTPUT


TOP V
OSC. COIL


Q1204 (2N3415)
L1203 (ORN)
P1201 (RF OUT)
C1212 (MOD.)
C1207 (+11V)
X1201 (72741L)
Q1203

DATE	REV	CHANGE	APP'D
8-30-74	A	INC. ECN # 1 LD.	MB
2-12-76	B	INCORP ECN #1247 SSD	MW
6-8-76	C	C1205 WAS 100pf, NOW 10pf MICA	MW



NOTE:

1. A 6.8K RES. MAY BE PARALLELED WITH R1208 (3.3K) IF LOW LEVEL RF OUTPUT PROB. EXISTS.
2. VALUE EFF PRIOR TO S/N 1311
3. VALUE EFF. S/N 1311 & UP.

NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
09-0590	1	401L	1	1	09-0548	SCHEMATIC
APPLICATION					LIST OF MATERIALS	

TOLERANCES UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS APPLY AFTER FINISH; DECIMALS: ± .005; ANGLES: ± 1/2°; FRACTIONS: ± 1/64; SURFACE ROUGHNESS 125; REMOVE ALL BURRS

MATERIAL —

TREATMENT —

FINISH —

DRAWN JJG 11/2/72 · CHECKED MB 4-25-73 · APPROVED 4-25-73

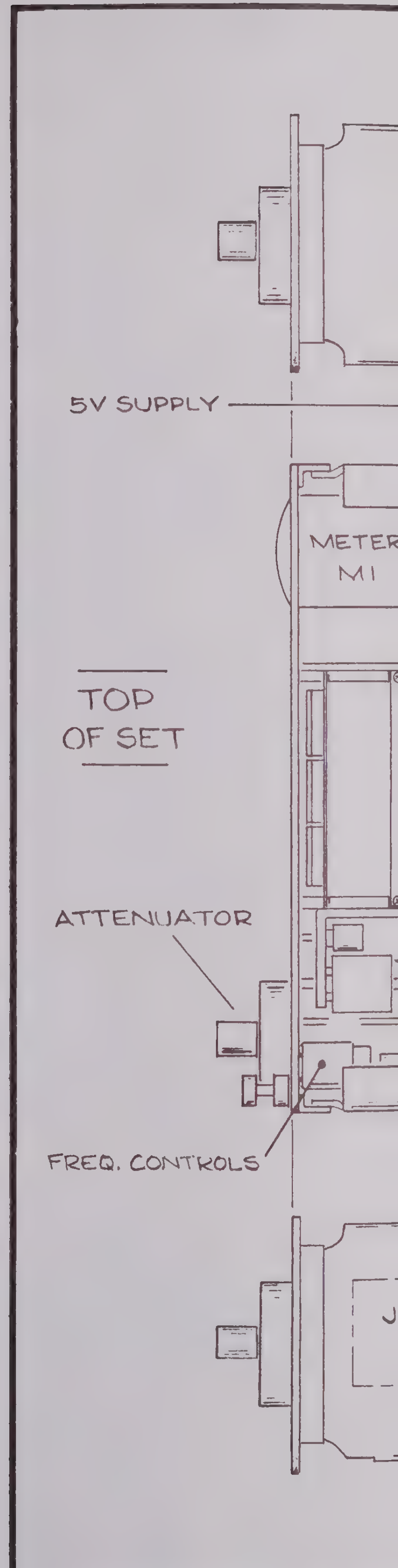
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE 401L LOCALIZER XMTR SCHEMATIC ASS'Y-7

SIZE C · PART NUMBER 3-09-0548 · REV C

SCALE · WEIGHT · SHEET 1 OF 1

FIG 12-15


5V SUPPLY
METER
M1
TOP
OF SET
ATTENUATOR
FREQ. CONTROLS

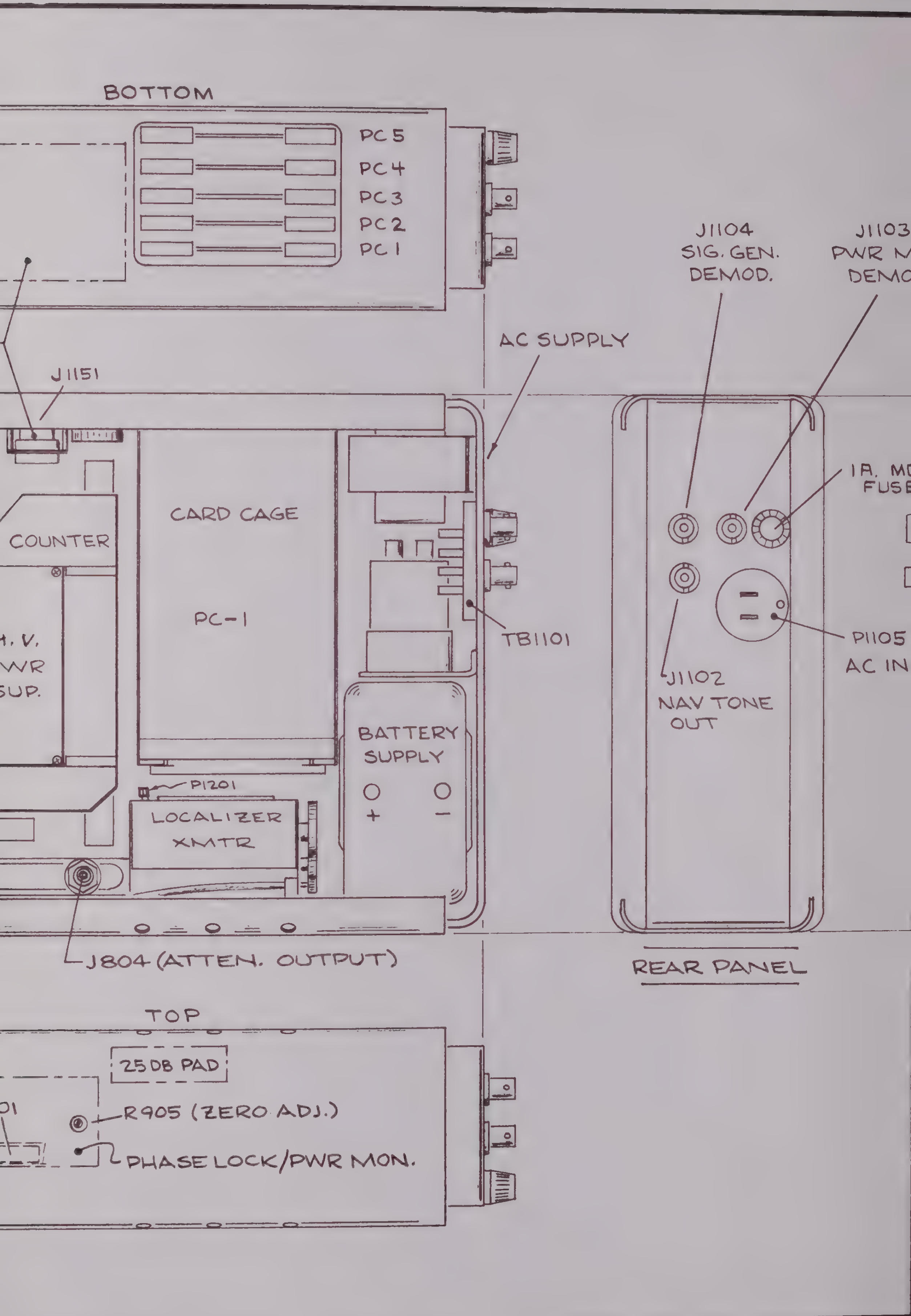
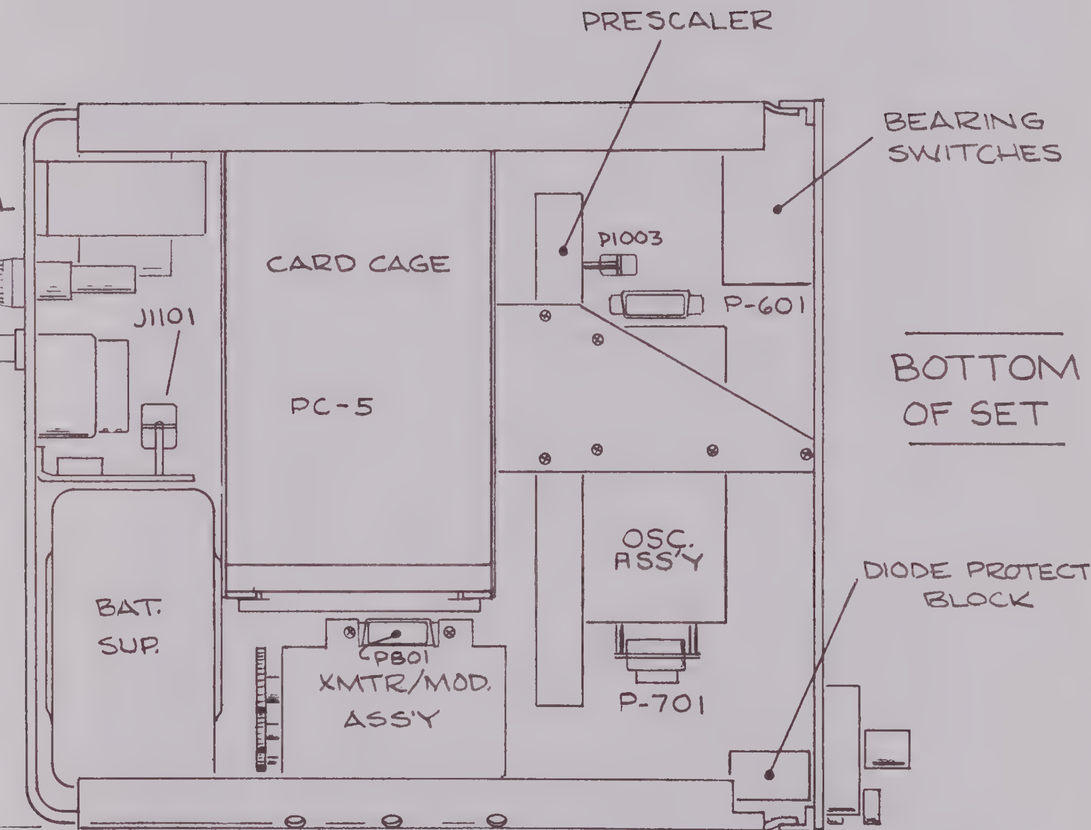

BOTTOM
PC 5
PC 4
PC 3
PC 2
PC 1
J1104
SIG. GEN.
DEMOD.
J1103
AC SUPPLY
J1151
CARD CAGE
COUNTER
PC-1
TB1101
P1105
AC IN
J1102
NAV TONE
OUT
BATTERY
SUPPLY
P1201
LOCALIZER
XMTR
J804 (ATTEN. OUTPUT)
REAR PANEL
TOP
25 DB PAD
R905 (ZERO ADJ.)
PHASE LOCK/PWR MON.

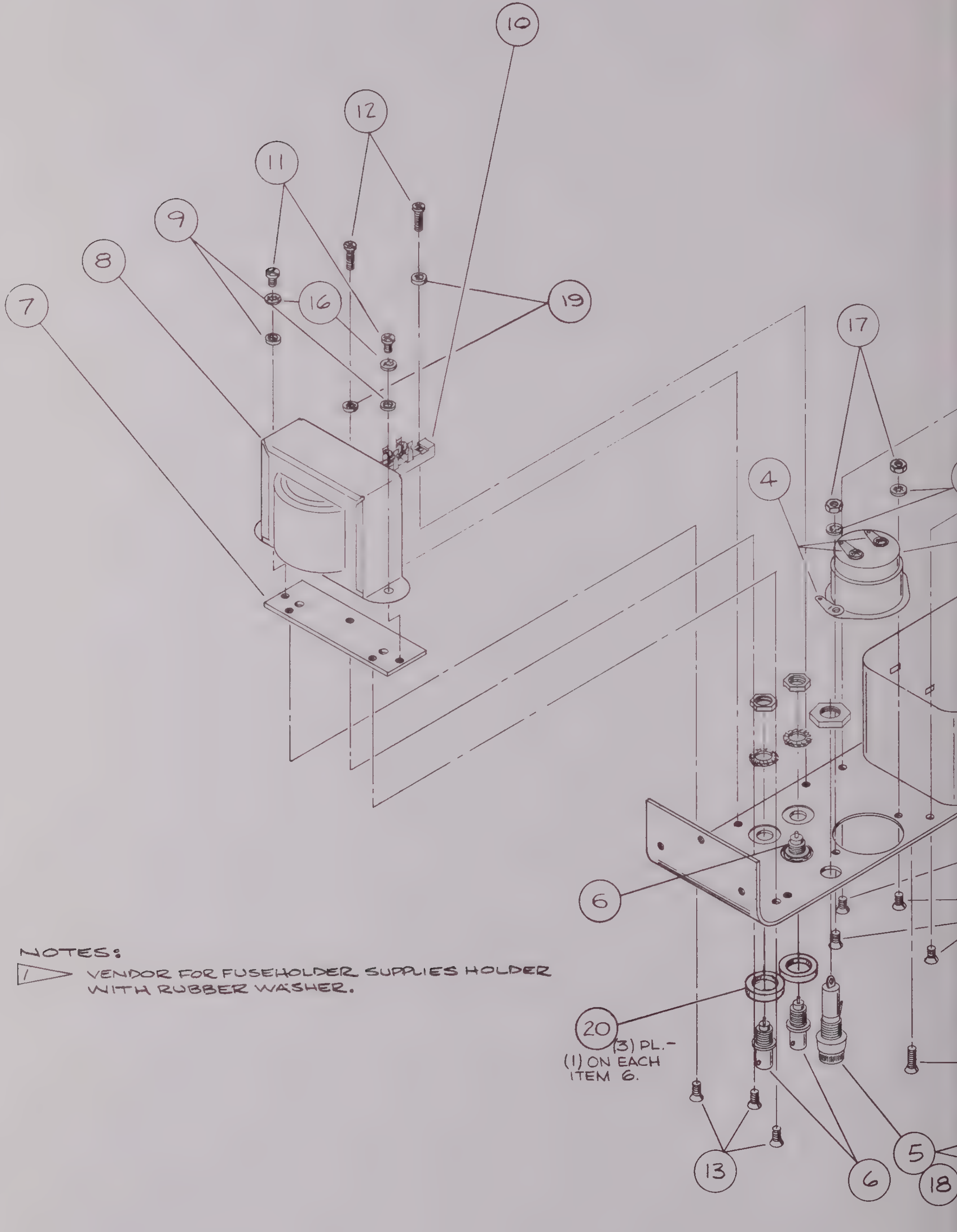
FIG 13-1

DATE	REV	CHANGE	APP'D



NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
APPLICATION			LIST OF MATERIALS			

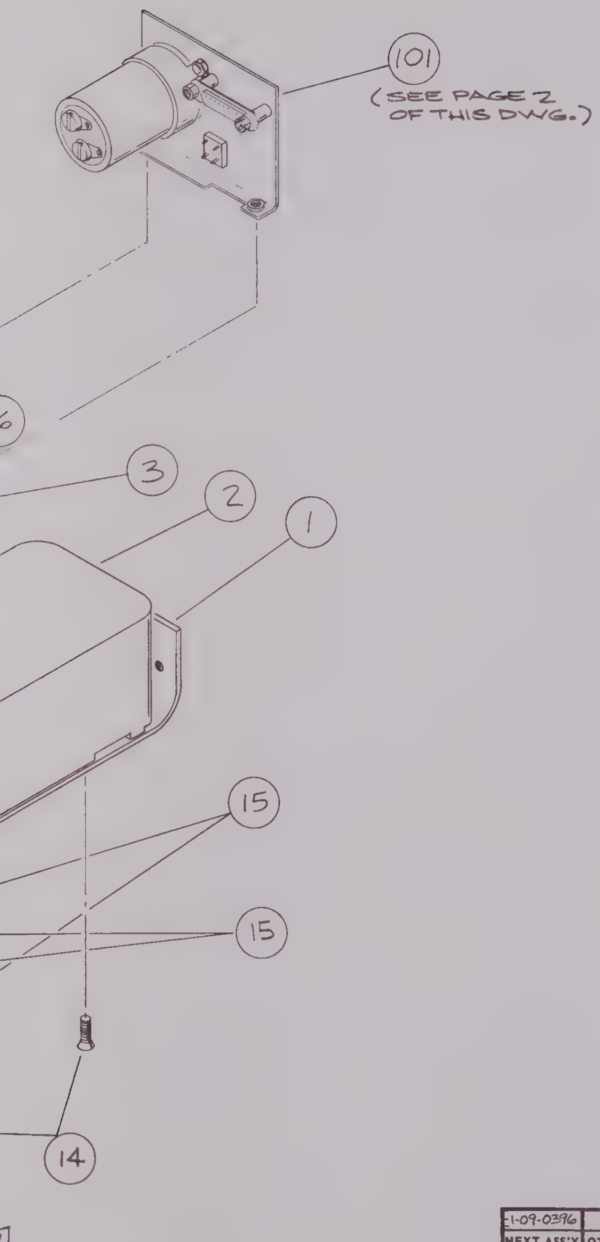
TOLERANCES UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS APPLY AFTER FINISH DECIMALS: ± .005 ANGLES: ± 1/2° FRACTIONS: ± 1/64 SURFACE ROUGHNESS 125 √ REMOVE ALL BURRS	DRAWN d.parks DATE 5/25/73 CHECKED [illegible] DATE 5-31-73 APPROVED V. Ewy DATE 5-31-73	INSTRUMENT FLIGHT RESEARCH CORPORATION WICHITA, KANSAS TITLE NAV-401 L SUB-ASSEMBLY IDENTIFICATION
MATERIAL — TREATMENT — FINISH —		SIZE B PART NUMBER 2-09-0574 REV SCALE — WEIGHT — SHEET 1 OF 1



NOTES:

1. VENDOR FOR FUSEHOLDER SUPPLIES HOLDER WITH RUBBER WASHER.

DATE	REV	CHANGE	APP'D
8/2/71	A	INCORP. C.N. C-1 DELETE 2 XISTORS	
3/13/72	B	INCORP. C.N. 2 CHG. A	TM
3/24/73	C	INCORP ECN #3	
2/13/75	D	INCORPORATED ECN #294 SSD	



ITEM	REQ'D	PART NO.	DESCRIPTION
20	3	2-76-0001-14	SPACER
19	2	#4	SPLIT LOCK WASHER
18	1	AGC 2 1/2	FUSE, 2 1/2 AMP
17	2	#6-32	HEX NUT
16	4	#6	LOCKWASHER, INT. TOOTH
15	4	#6-32	SCREW, FT. HD. 82° x 3/8
14	2	#6-32	SCREW, FT. HD. 82° x 1/2
13	3	#6-32	SCREW, FT. HD. 82° x 3/16
12	2	#4-40	SCREW, FILL. HD. 3/8 LONG
11	2	#6-32	SCREW, BD. HD. 1/4 LONG
10	1	4-170	'CINCH-JONES' TERMINAL STRIP
9	2		.156 ID x .375 OD x .049 THK TYPE 'A' PLAIN SS WASHER
8	1	NT-859	'NATIONAL' TRANSFORMER
7	1	1-09-0267	TRANS. MTG. BKT.
6	3	UG1094/U	BNC R.F. CONN. W/HDWARE
5	1	HKP	'BUSSMAN' FUSEHOLDER W/NUT
4	3	#6	SOLDER LUG
3	1	160-5	'AMPHENOL' AC RECEPTACLE
2	1	3-09-0217-1	BATTERY PACK ASS'Y
1	1	3-09-0338	POWER SUPPLY CHASSIS

LIST OF MATERIALS

NEXT ASS'Y	QT'Y	MODEL
1-09-0396	1	NAV400A

APPLICATION

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

DRAWN DATE 5/28/71
CHECKED DATE /71
APPROVED DATE 6-1-71

MATERIAL SEE P/LIST 1-09-0396
TREATMENT —
FINISH —

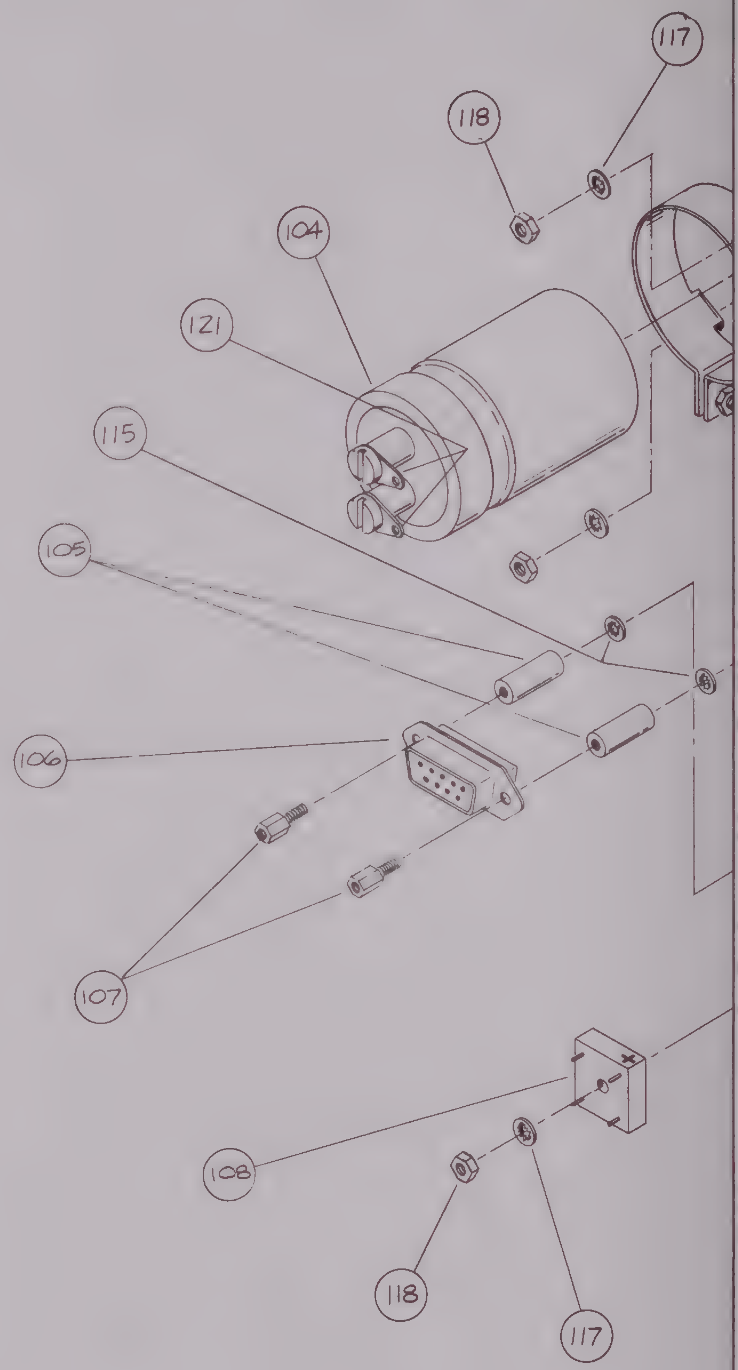
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE POWER SUPPLY MODULAR ASSY - EXPLODED VIEW

SIZE C | PART NUMBER 3-09-0408 | REV D

SCALE — | WEIGHT — | SHEET 1 OF 2

FIG 13-2


117
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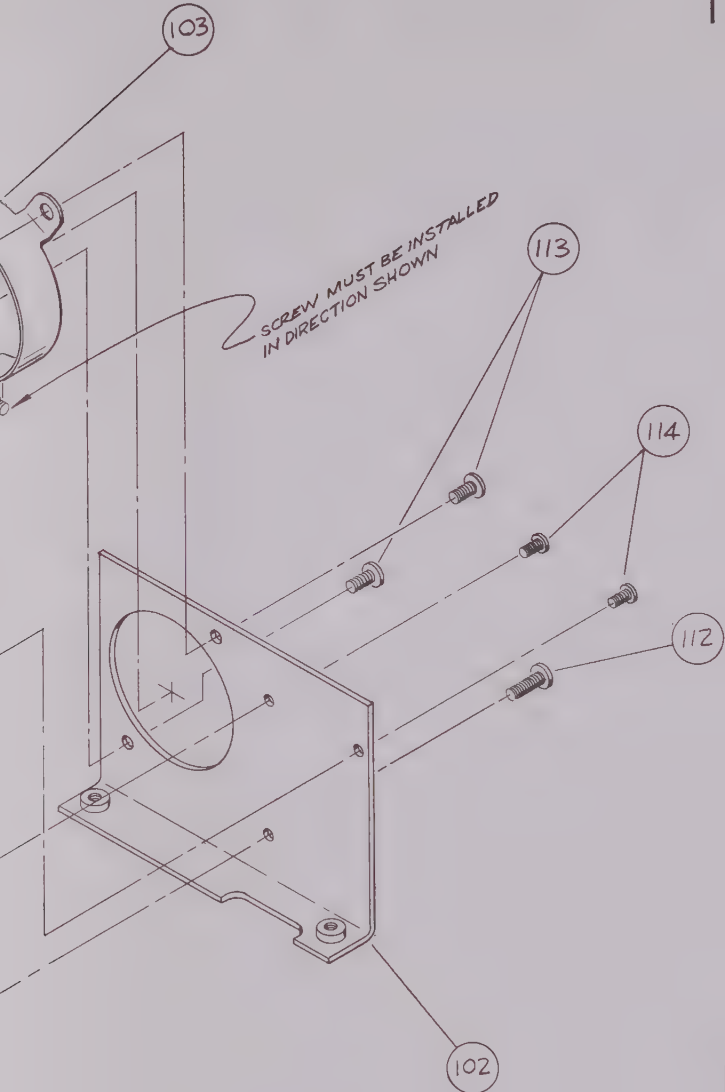
117

DATE	REV	CHANGE	APP'D



ITEM	REQ'D	PART NO.	DESCRIPTION
121	2	#10	SOLDER LUG
120	—		
119	2	—	#4 LOCKWASHER (SPECIAL) SUP. WITH #109
118	3	#6-32	HEX NUT
117	3	#6	LOCKWASHER, INT. TOOTH
116	2	#4-40	HEX NUT
115	2	#4	LOCKWASHER, INT. TOOTH
114	2	#4-40	SCREW, BD. HD. 1/4 LONG
113	2	#6-32	SCREW, BD. HD. 1/4 LONG
112	1	#6-32	SCREW, BD. HD. 3/8 LONG
111	2	#4-40	SCREW, BD. HD. 3/8 LONG
110	—		
109	2	2N5195	'MOTOROLA' TRANSISTOR W/HDWARE
108	1	VS248	'VARO' FULL WAVE RECT
107	2	D-20418-2	'CHINCH' CAP SCREW (IFR#1-76-0013)
106	1	17-10090	'AMPHENOL' 9-PIN CONNECTOR
105	2	2-76-0001-6	STANDOFF
104	1	2200µf 40V	'MALLORY' ELECTRO. CAP.
103	1	VR3	'MALLORY' MOUNTING RING
102	1	2-09-0116-1	RECT. PANEL
101	—	—	RECT. PANEL ASS'Y

LIST OF MATERIALS

NEXT ASS'Y	QT'Y	MODEL
SEE P. 1	1	NAV400A

APPLICATION

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
125

DRAWN	DATE
[illegible]	5/28/71
CHECKED	DATE
[illegible]	[illegible]/71
APPROVED	DATE
[illegible]	6-4-71

MATERIAL SEE MAT'L/LIST
TREATMENT —
FINISH —

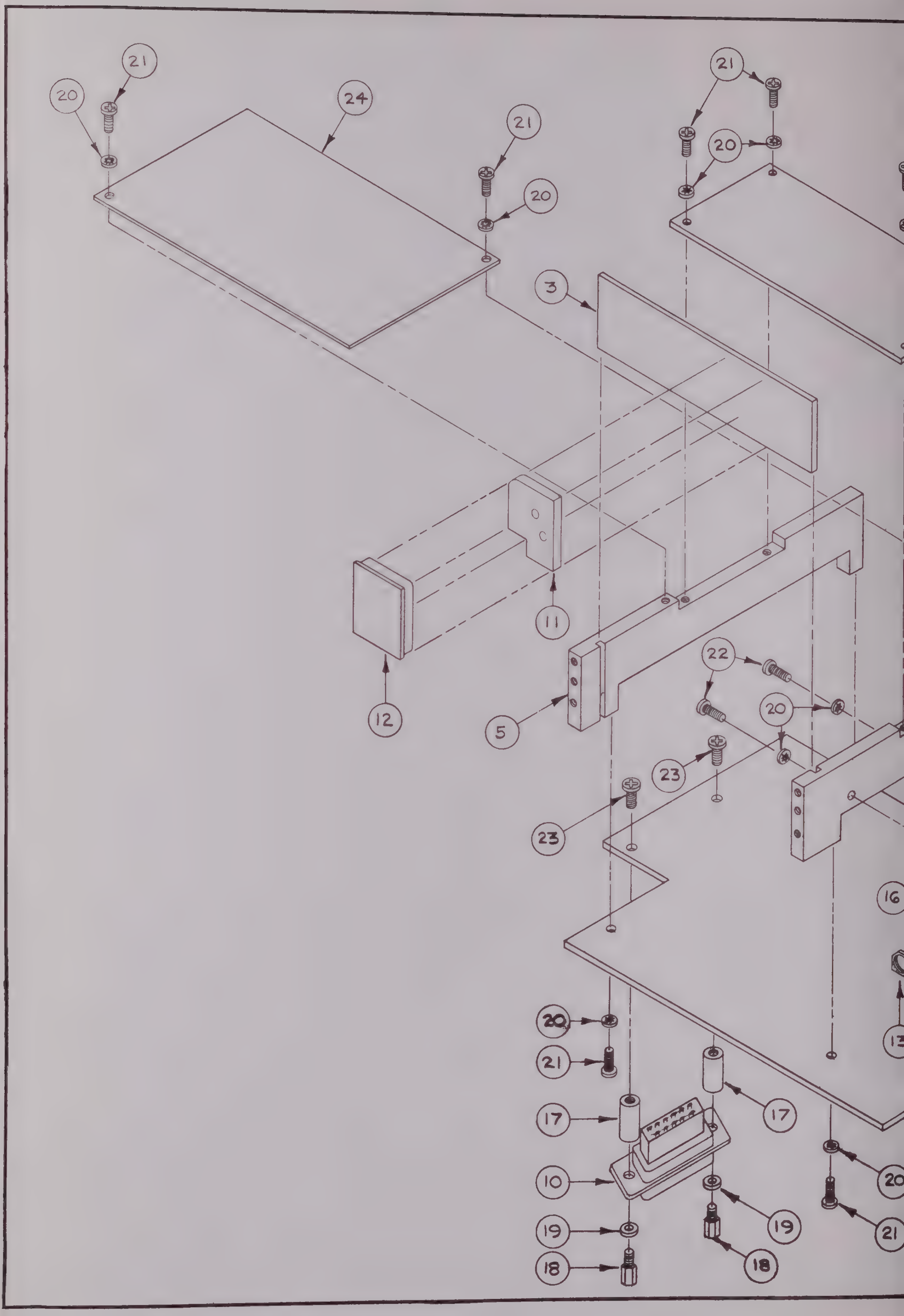
INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE
POWER SUPPLY
MODULAR ASS'Y
-EXPLODED VIEW

SIZE	PART NUMBER	REV
C	3-09-0408	A

SCALE	WEIGHT	SHEET
NONE	—	2 OF 2

FIG 13-3



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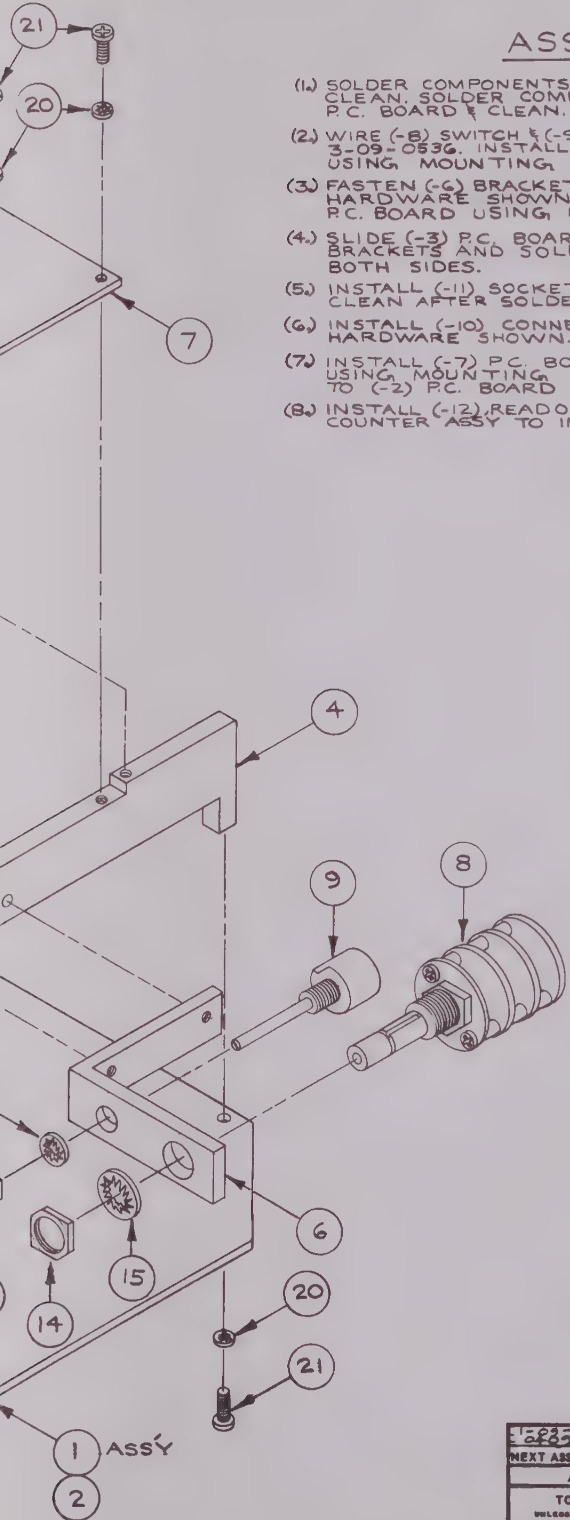
DATE	REV	CHANGE	APP'D



ASSY PROCEDURE

(1.) SOLDER COMPONENTS ON (-2) COUNTER READOUT P.C. BOARD & CLEAN. SOLDER COMPONENTS ON (-7) 200 VOLT PWR. SUPPLY P.C. BOARD & CLEAN.

(2.) WIRE (-8) SWITCH & (-9) POT TO (-2) P.C. BOARD PER DWG. 3-09-0536. INSTALL (-8) SWITCH & (-9) POT IN (-6) BRACKET USING MOUNTING HARDWARE SHOWN.

(3.) FASTEN (-6) BRACKET TO (-4) BRACKET USING MOUNTING HARDWARE SHOWN. FASTEN (-4) & (-5) BRACKETS TO (-2) P.C. BOARD USING MOUNTING HARDWARE SHOWN.

(4.) SLIDE (-3) P.C. BOARD INTO SLOTS OF (-4) & (-5) MOUNTING BRACKETS AND SOLDER TO (-2) P.C. BOARD, ALL PATHS BOTH SIDES.

(5.) INSTALL (-11) SOCKETS IN (-3) P.C. BOARD AND SOLDER. CLEAN AFTER SOLDERING.

(6.) INSTALL (-10) CONNECTOR TO (-2) P.C. BOARD USING MOUNTING HARDWARE SHOWN. SOLDER AND CLEAN.

(7.) INSTALL (-7) P.C. BOARD TO (-4) & (-5) MOUNTING BRACKETS USING MOUNTING HARDWARE SHOWN. WIRE (-7) P.C. BOARD TO (-2) P.C. BOARD PER DWG. 3-09-0536.

(8.) INSTALL (-12) READOUTS IN (-11) SOCKETS AND SEND ENTIRE COUNTER ASSY TO INSPECTION.

ITEM	REQ'D	PART NO.	DESCRIPTION
24	1	1-09-0568	INSULATOR
23	2	*4-40X 1/4	PHILLIPS SCREW, PAN HEAD
22	2	*2-56X 5/16	PHILLIPS SCREW, PAN HEAD
21	10	*2-56X 1/4	PHILLIPS SCREW, PAN HEAD
20	12	*2	INT. TOOTH LOCKWASHER
19	2	*2	FLAT WASHER
18	2	20418-2	"CINCH" SHELL-NUT
17	2	205 933-1	SPACER
16	1	—	WASHER (SUPPLIED WITH -9)
15	1	—	WASHER (SUPPLIED WITH -8)
14	1	—	NUT (SUPPLIED WITH -8)
13	1	—	NUT (SUPPLIED WITH -9)
12	3	SF-732	"SPERRY" READ-OUT
11	3	CS-732	"SPERRY" SOCKET
10	1	205-206-1	"AMP" 15 PIN CONNECTOR
9	1	RVGNAY 5D104A	100 K POT
8	1	39137-12125M	"GRIGSBY" SWITCH
7	1	1-09-0538	200 V. PWR. SUPPLY
6	1	2-09-0523	SWITCH BRACKET
5	1	2-09-0547-2	MOUNTING BRKT.
4	1	2-09-0547-1	MOUNTING BRKT.
3	1	1-09-0533	DIGITAL READOUT P.C. BD.
2	1	1-09-0531	COUNTER READOUT P.C. BD.
1	1	—	COUNTER ASSY

LIST OF MATERIALS

NEXT ASS'Y	QT'Y	MODEL
1-09-0505	1	NAV-401

APPLICATION

TOLERANCES UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

DRAWN: T. McC... DATE: 12/../72
CHECKED: V. ZIMMERMAN DATE: 1-23-73
APPROVED: ... DATE: 1-25-73

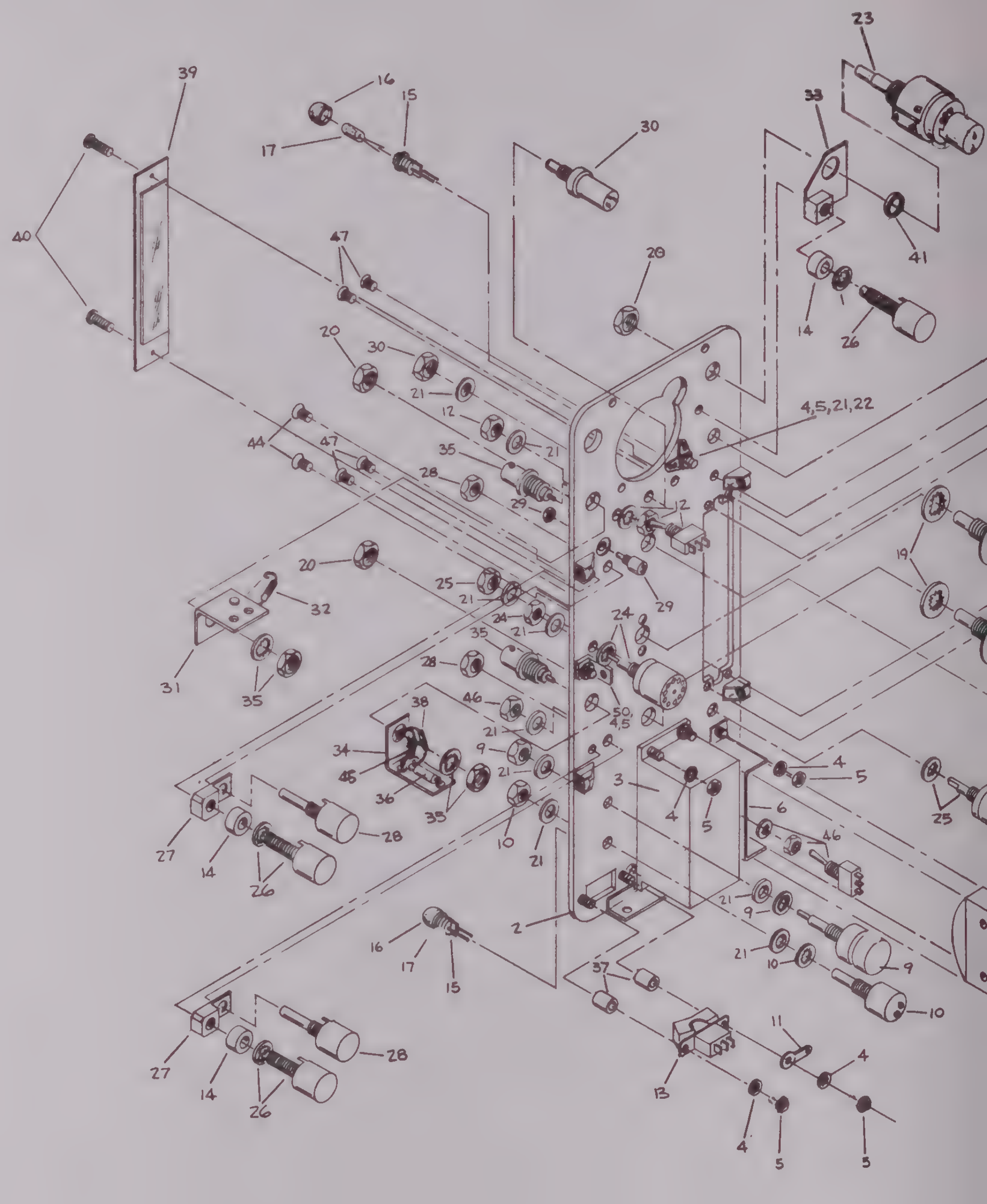
MATERIAL: SEE DESCRIPTION
TREATMENT: —
FINISH: —

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE: COUNTER ASSY MECHANICAL DETAILS NAV-401L

SIZE: C | PART NUMBER: 3-09-0562 | REV:
SCALE: 1:1 | WEIGHT: — | SHEET | OF

FIG 13-4



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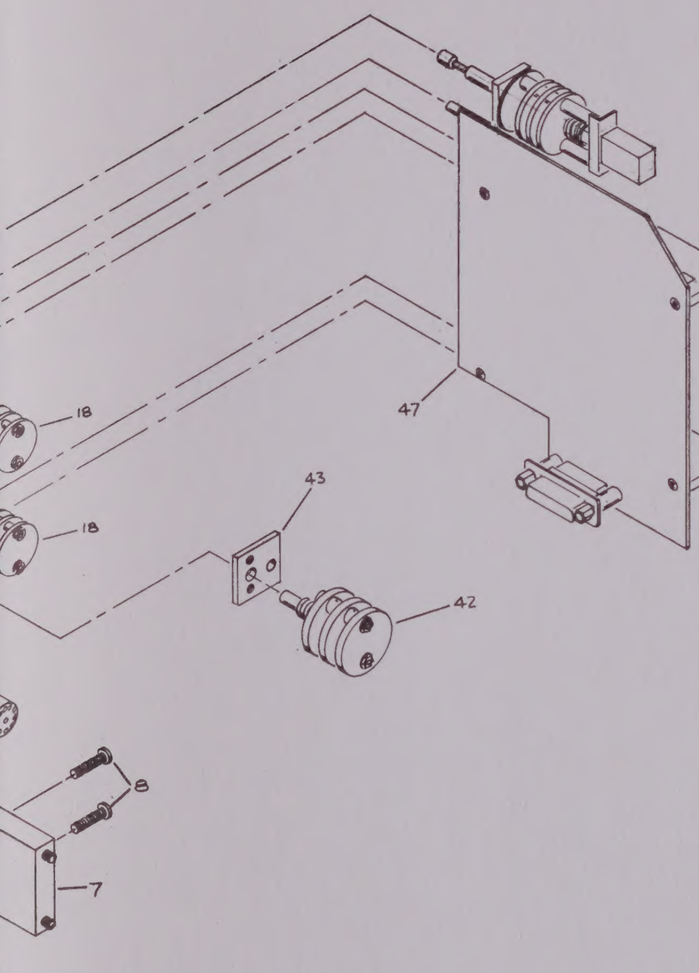
DATE	REV	CHANGE	APPD
7/12/71	A	C1, ADDED ITEM 45 FOR PWR SWITCH	
	B	INCORP ECN #1030	



N/S : NOT SHOWN

ITEM	REQ'D	PART NO.	DESCRIPTION
N/S	1	1-09-0220	KNOB, INNER (VAR. FREQ.)
N/S	1	1-09-0219	KNOB, OUTER (VAR. FREQ.)
N/S	1	1-09-0400	KNOB, INNER
N/S	1	1-09-0401	KNOB, OUTER
N/S	3	1-00-0056-1	KNOB
N/S	3	1-00-0056-2	KNOB
N/S	2	1-00-0057-1	KNOB
50	1	1-09-0473	PRESCALER MTG. BKT.
49	1	1-09-0379	DUAL KNOB (ATTEN.)
48	1	1-09-0386	DIAL ASSY (ATTEN.)
47	1	1-09-0561	COUNTER ASS'Y
46	1	CK7101	SW. (TO/FROM)
45	1	RC07GF560K	RESISTOR 1/4W 10% 56Ω
44	2	#2-56	SCREW FT. HD. x1/4 L
43	1	1-09-0499	MTG. PLATE, MODE SW.
42	1	1-76-0006	SW. (MODE)
41	1	76-0002-12	WASHER
40	2	#2-56	SCREW BD. HD. BLACK x 3/16L
39	1	1-09-0551	BEZEL ASS'Y
38	1	1025-52	CHOKE 22μH
37	2	76-0001-39	SPACER
36	1	T310A105 M035AS	TANTALUM CAP. 1μf 35V
35	2	UG 1094	RF CONN.
34	1	1-09-0371	TERM. PLATE (EXT. INPUT)
33	1	1-09-0346	MTG STUD
32	1	NA550-1 -2.67K	RESISTOR 1/4W 1%
31	1	1-09-0416	TERM. PLATE (XMTR INPUT)
30	1	46-101R	MOMEN. SW. (TUNE)
29	1	39-1	SPST SW. (Φ)
28	2	1-76-0003	POT 25K (G/S & LOC VAR)
27	2	1-09-0296	MTG. STUD
26	3	RVGLAYS A252A	POT 2.5K (BRG ADJ, LOC CAL G/S CAL)
25	1	31CD30-01 -1-ADJN	SP12POS SW. (MONITOR SW.)
24	1	31CD30-01 -2-ADJN	DP6POS SW. (MOD IN/CTR-1020-400---)
23	1	1-76-0059	10 T POT ASSY (VAR. FREQ.)
22	2	1413-4	GROUND LUG
21	10	2-76-0002-8	WASHER
20	3	3/8-32	HEX NUT
19	2	3/8	LOCKWASHER
18	2	39727-1210 -SM-2	SW. (G/S & LOC)
17	2	229	GE BULB
16	2	RBP	LIGHT LENS
15	2	BEP	LIGHT BASE (TUNE & PWR)
14	3	2-76-0001-19	SPACER
13	1	CK7207-J1	SW. (AC-OFF-BAT)
12	1	CK7201	SW. (PEAK/LOC-AVG)
11	1	1488-2	GROUND LUG
10	1	1-76-0017	POT 50K (CAL)
9	1	1-76-0018	DUAL POT 100K (0-10-20-30)
8	2	#4-40	SCREW BD. HD. x5/8L
7	1	76-0004	PWR METER
6	1	2-09-0266	PWR MTR BKT.
5	10	#2-56	HEX NUT
4	10	#2	LOCKWASHER, INT TOOTH
3	11	1-76-0009	BEARING SW. ASS'Y
2	1	3-09-0293	FRONT PANEL
1	—	1-09-0409	FRONT PANEL ASS'Y

LIST OF MATERIALS

NEXT ASS'Y	QT'Y	MODEL
09-0593	1	NAV 401

APPLICATION

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

MATERIAL: P/LIST 1-09-0409
TREATMENT: —
FINISH: —

DRAWN: d. parks DATE: 5/15/73
CHECKED: TM DATE: 6/1/73
APPROVED: DATE: 6-1-73

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE: FRONT PANEL MODULAR ASS'Y- EXPLODED VIEW-NAV401

SIZE: C PART NUMBER: 3-09-0576 REV: B

SCALE: — WEIGHT: — SHEET 1 OF 1

G 13-5