RADIO TEST EQUIPMENT
MICROWAVE TEST SETS
J68392A TRANSMITTER-RECEIVER TEST SET
MAINTENANCE
J68392C IF AMPLIFIER

This section contains the adjustment and alignment procedures and the voltage information necessary for troubleshooting or adjusting the J68392C IF amplifier.

For the circuit description, refer to Section 104-415-100.

For the latest schematic, see SD-50565-01.

When the IF amplifier is to be adjusted, or after a component part has been replaced, check the input return loss, output return loss, variolosser adjustments, and amplitude response and gain, in that order.

CHART — PAGE

CHART 1

RETURN LOSS TEST

APPARATUS:

1—J68392A Transmitter-Receiver Test Set

1—J68387F IF Amplifier (Use spare amplifier of TD-3 transmitter-receiver bay.)

CHART 1 (Cont)	
STEP	**PROCEDURE**
1	On the test set power meter, set the POWER RANGE DBM switch to +10 and the INPUT CHANNEL switch to IF.
2	Set ATTEN 2 to 3 dB.
3	Connect a 372A patch plug between the IF OUT jack and the ATTEN 2 IN jack.
4	Connect a P2BJ 2-foot cord between the ATTEN 2 OUT jack and the IF PWR MTR jack. Observe the power meter indication. ***Requirement:*** -3.0 ±0.1 ***Note:*** This corresponds to +10 dBm at the IF OUT jack. If the requirement is not met, adjust the OUTPUT control on the IF sweep oscillator (rear of test set) until the requirement is met. If the requirement still cannot be met, refer to Section 104-415-504.
5	Remove the J68392C IF amplifier from the rear of the test set.
6	Using the P93M320 extender cable, connect the test set IF amplifier to its regular power connector, J29.
7	Prepare for the return loss test in accordance with Fig. 4, Steps 1 through 14.
8	Using a 368A termination, terminate the IF OUT jack on the test set IF amplifier.
9	Measure the return loss at the IF IN jack of the test set IF amplifier in accordance with Fig. 4, Steps 15 and 16. ***Requirement:*** Greater than 35 dB between 60 and 80 MHz If the requirement is not met, adjust IN RL 1 potentiometer and IN RL 2 capacitor to achieve the best return loss above 35 dB. If the requirement still cannot be met, troubleshoot the test set IF amplifier in accordance with Chart 4.
10	On the test set IF amplifier, remove the 368A termination from the IF OUT jack and disconnect the return loss bridge from the IF IN jack. Connect the 368A termination to the IF IN jack, and connect the return loss bridge to the IF OUT jack.
11	Measure the return loss at the IF OUT jack of the test set IF amplifier in accordance with Fig. 4, Step 16.

CHART 1 (Cont)	
STEP	**PROCEDURE**
	Requirement: Greater than 33 dB between 60 and 80 MHz If the requirement is not met, adjust the OUT RL inductor on the test set IF amplifier for the best return loss above 33 dB. ***Note:*** If the adjustment of the OUT RL inductor reaches the end of its range before the optimum return loss is obtained, the inductor may be rewired for higher or lower inductance, as required, by means of taps. If the requirement still cannot be met, troubleshoot the test set IF amplifier per Chart 4.

CHART 2

VARIOLOSSER ADJUSTMENTS

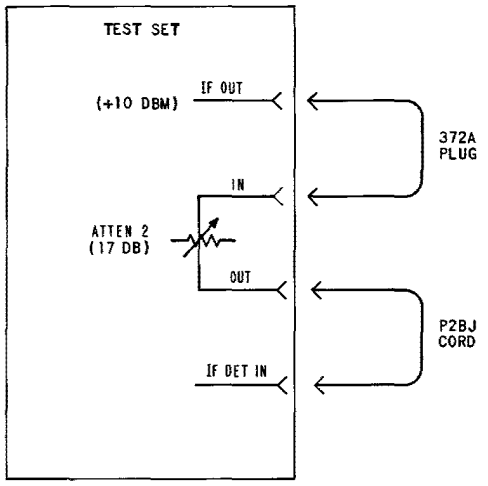
APPARATUS:

1—J68392A Transmitter-Receiver Test Set

1—KS-14510, L1 Volt-Ohm-Milliammeter (VOM)

1—ED-50433-10 IF Signal Inserter

STEP	PROCEDURE
1	Check the flatness of the IF sweep oscillator in accordance with the test outlined in Fig. 1.
2	Remove both covers from the J68392C test set IF amplifier. ***Note:*** If the conditions cannot be met in Steps 3, 7, 9 or 11, troubleshoot the test set IF amplifier in accordance with Chart 4.
3	Set the VOM to OHMS × 1. Connect the VOM between terminal 1 on the SLOPE 1 control (R21) and ground. Adjust the SLOPE 1 control until the VOM indicates 51 ohms. Repeat for SLOPE 2 control (R54).
4	Using the P93M320 extender cable, connect the test set IF amplifier to its regular power connector, J29.
5	Set the VOM to the 12 VDC scale.
6	Connect the VOM to pins 4 and 6 of connector P1 on the test set IF amplifier.

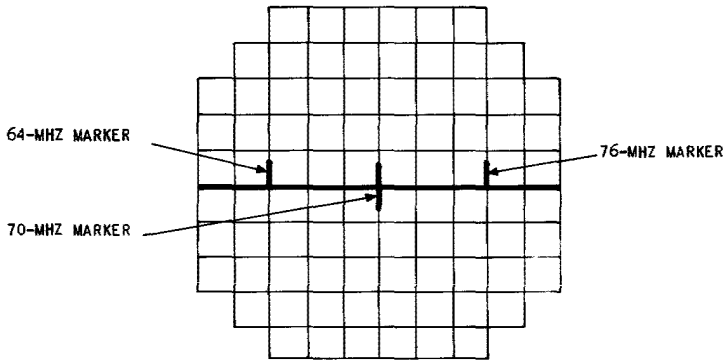


PREPARATION FOR TEST

1. SET ATTEN 2 TO 17 DB.
2. ESTABLISH THE TEST CONNECTIONS SHOWN.
3. SET THE FOLLOWING CONTROLS ON THE TEST SET:

UNIT	CONTROL	POSITION
CONTROL PANEL	FUNCTION IF SWEEP WIDTH IF CENTER FREQ IF MARKER AMPLITUDE IF MARKER FREQ CTR IF AMPL GAIN	IF-IF MAX CCW MIDRANGE MIDRANGE MIDRANGE MKR FREQ MAX CCW
OSCILLOSCOPE TIME BASE	POSITION MAGNIFIER SWEEP TIME VERNIER SINGLE-NORMAL	MIDRANGE X10 EXT MIDRANGE NORMAL
OSCILLOSCOPE DIFFERENTIAL AMPLIFIER	POSITION BANDWIDTH AMPLIFIER VERNIER SENSITIVITY AC-DC-OFF (+INPUT) AC-DC-OFF (-INPUT)	MIDRANGE 4 DC MIDRANGE 2MV/CM DC OFF

4. ADJUST THE TEST TRACE CONTROLS ON THE CONTROL PANEL TO CENTER THE TRACE ON THE OSCILLOSCOPE.
5. ADJUST THE VERNIER CONTROL ON THE OSCILLOSCOPE TIME BASE UNIT FOR 10 CENTIMETERS HORIZONTAL DEFLECTION ON THE OSCILLOSCOPE.
6. ADJUST THE IF MARKER FREQ CONTROL ON THE CONTROL PANEL FOR A 70 ±0.2 MHZ INDICATION ON THE COUNTER.
7. ADJUST THE IF SWEEP WIDTH AND IF CENTER FREQ. CONTROLS ON THE CONTROL PANEL TO OBTAIN THE OSCILLOSCOPE DISPLAY SHOWN AT LEFT.



8. VARY THE IF MARKER FREQ CONTROL ON THE FRONT PANEL OF THE TEST SET TO MOVE THE VARIABLE MARKER ACROSS THE 10 CM DISPLAY. OBSERVE THE COUNTER INDICATION.

   REQUIREMENT: THE COUNTER SHALL INDICATE 60 ±0.5 MHZ WHEN THE VARIABLE MARKER IS AT THE LEFT END OF THE TRACE AND SHALL INDICATE 80 ±0.5 MHZ WHEN THE VARIABLE MARKER IS AT THE RIGHT END OF THE TRACE. IF THE REQUIREMENT IS NOT MET, ADJUST THE IF SWEEP WIDTH AND IF CENTER FREQ CONTROLS UNTIL THE REQUIREMENT IS MET.

9. ADJUST THE REF TRACE CONTROLS ON THE CONTROL PANEL TO BRING THE REFERENCE TRACE INTO COINCIDENCE WITH THE TEST TRACE AT 70 MHZ.
10. INCREASE THE ATTENUATION OF ATTEN 2 BY 0.1 DB AND ADJUST THE VERNIER CONTROL ON THE OSCILLOSCOPE DIFFERENTIAL AMPLIFIER FOR 2 CENTIMETERS DEFLECTION; THEN RETURN ATTEN 2 TO ITS PREVIOUS SETTING. THIS CALIBRATES THE OSCILLOSCOPE FOR 0.05 DB PER CENTIMETER.

    REQUIREMENT: THE TEST TRACE SHALL BE FLAT TO WITHIN 0.01 DB BETWEEN 60 AND 80 MHZ. IF THIS REQUIREMENT IS NOT MET, ADJUST THE IF DET SLOPE CONTROL ON THE CONTROL PANEL FOR A FLAT TEST TRACE; THEN RECOINCIDE THE TRACES WITH THE TEST TRACE CONTROLS. IF THE REQUIREMENT STILL CANNOT BE MET, REFER TO SECTION 104-415-504.

Fig. 1—IF Sweep Oscillator Flatness Check

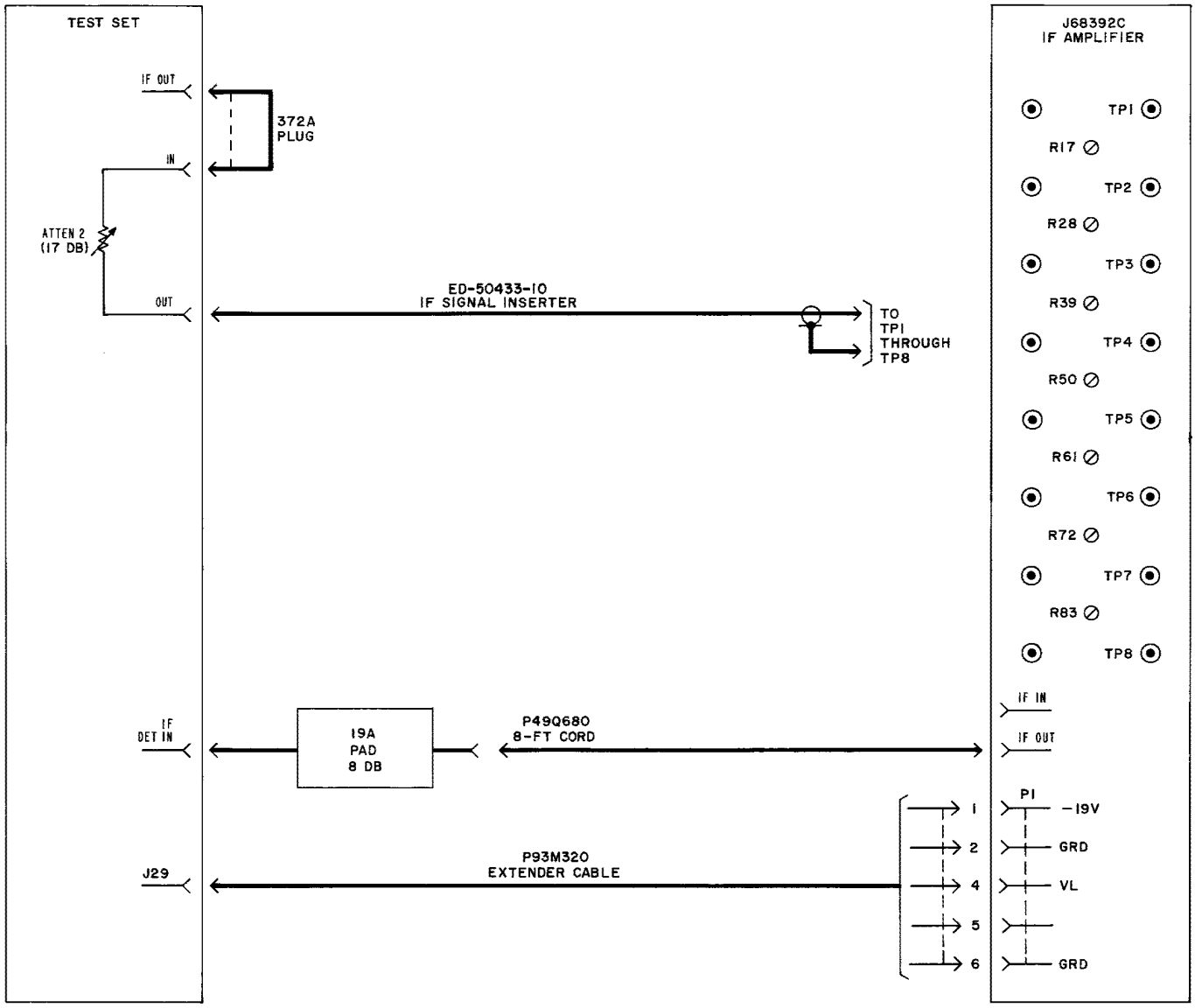


Fig. 2—Variolosser Adjustment

CHART 2 (Cont)

STEP	PROCEDURE
7	Adjust the IF AMPL GAIN control on the test set until the VOM indicates -6.0 volts.
8	Prepare for the test in accordance with Fig. 2. Connect the IF signal inserter to TP8.
9	Adjust ATTEN 2 until the two traces coincide at 70 MHz. ***Note:*** A negative amplitude response slope will be present on the test trace. A negative slope is one in which the 60-MHz end of the trace is higher than the 80-MHz end of the trace.
10	Connect the IF signal inserter to TP7 and adjust the R83 until the two traces coincide at 70 MHz.
11	Repeat Step 9, connecting the IF signal inserter, in order, to the test points listed below and adjust the applicable potentiometer. Set ATTEN 2 as indicated and, if necessary, adjust the IF AMPL GAIN control to maintain -6.0 volts across pins 4 and 6 of P1.
12	Replace the covers on the test set IF amplifier.

TEST POINT	POTENTIOMETER	ATTEN 2 SETTING
TP6	R72	Same as in Step 6
TP5	R61	Same as in Step 6
TP4	R50	3 dB greater than in Step 6
TP3	R39	3 dB greater than in Step 6
TP2	R28	3 dB greater than in Step 6
TP1	R17	6 dB greater than in Step 6

CHART 3

AMPLITUDE RESPONSE AND GAIN

APPARATUS:

1—J68392A Transmitter-Receiver Test Set

STEP	PROCEDURE
1	Prepare for the test in accordance with Fig. 5.

CHART 3 (Cont)

STEP	PROCEDURE
2	On the J68392C test set IF amplifier, adjust the SLOPE 2 control to remove any slope between 60 and 80 MHz. Maintain approximate coincidence of the traces by adjusting ATTEN 2. Adjust the SLOPE 1 control counterclockwise, and readjust the SLOPE 2 control clockwise to reduce the in-band bow shape to a minimum. ***Requirement 1:*** The amplitude response shall be flat within 0.03 dB over the 60- to 80-MHz band. ***Requirement 2:*** The sum of the setting of ATTEN 2 plus 30 dB shall be greater than 60 dB. ***Note:*** The 30-dB factor takes into account the 20-dB and 10-dB 19A pads connected to the IF IN jack. This requirement corresponds to an amplifier gain of 60-dB minimum.
3	Remove the 20-dB pad at the input of the test set IF amplifier.
4	Adjust the AMPL GAIN control to make the test and reference traces coincide at 70 MHz.
5	Adjust ATTEN 2 to make the traces coincide first at 60 MHz and then at 80 MHz. ***Requirement:*** The difference in the attenuator settings required to cause coincidence at 60 and 80 MHz shall be less than 0.2 dB. If any of the requirements are not met, troubleshoot the test set IF amplifier in accordance with Chart 4.

CHART 4

TROUBLESHOOTING

APPARATUS:

1—J68392A Transmitter-Receiver Test Set

1—KS-14510, L1 Volt-Ohm-Milliammeter (VOM)

STEP	PROCEDURE
1	Remove both covers from the J68392C test set IF amplifier.

CHART 4 (Cont)

STEP	PROCEDURE
2	Make the connections in accordance with Fig. 3.
3	Measure the voltages at points indicated in Fig. 6 and located in Fig. 7. The voltages presented are typical and are measured with respect to ground. ***Note:*** It may be necessary to make some measurements from the printed-wiring side of the board.

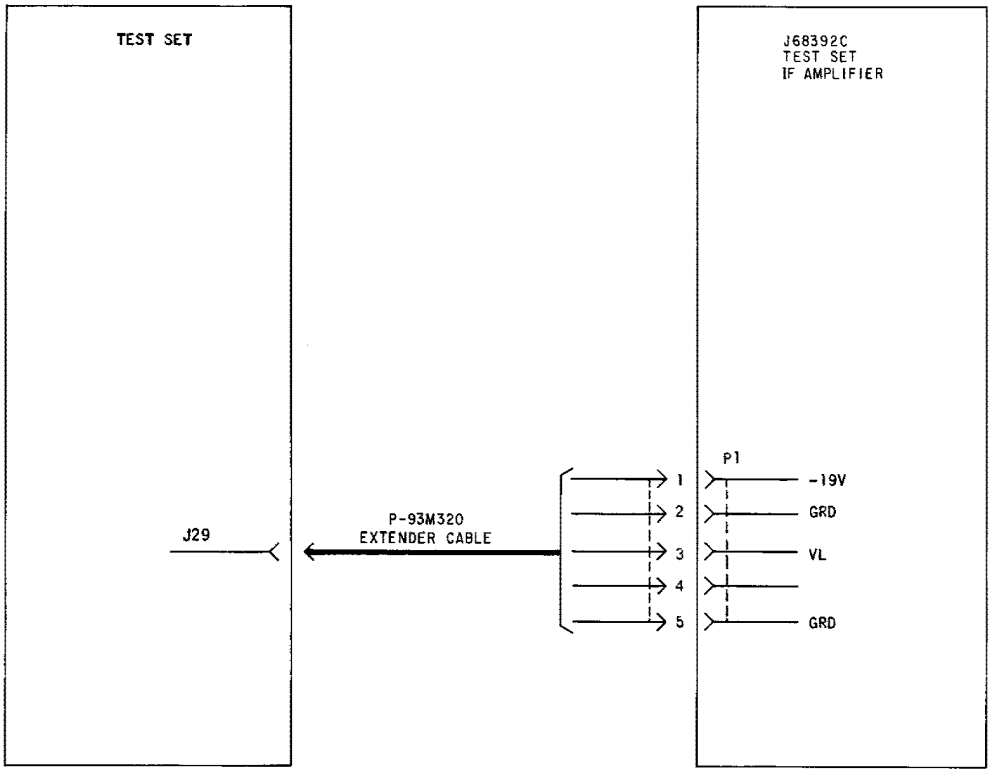
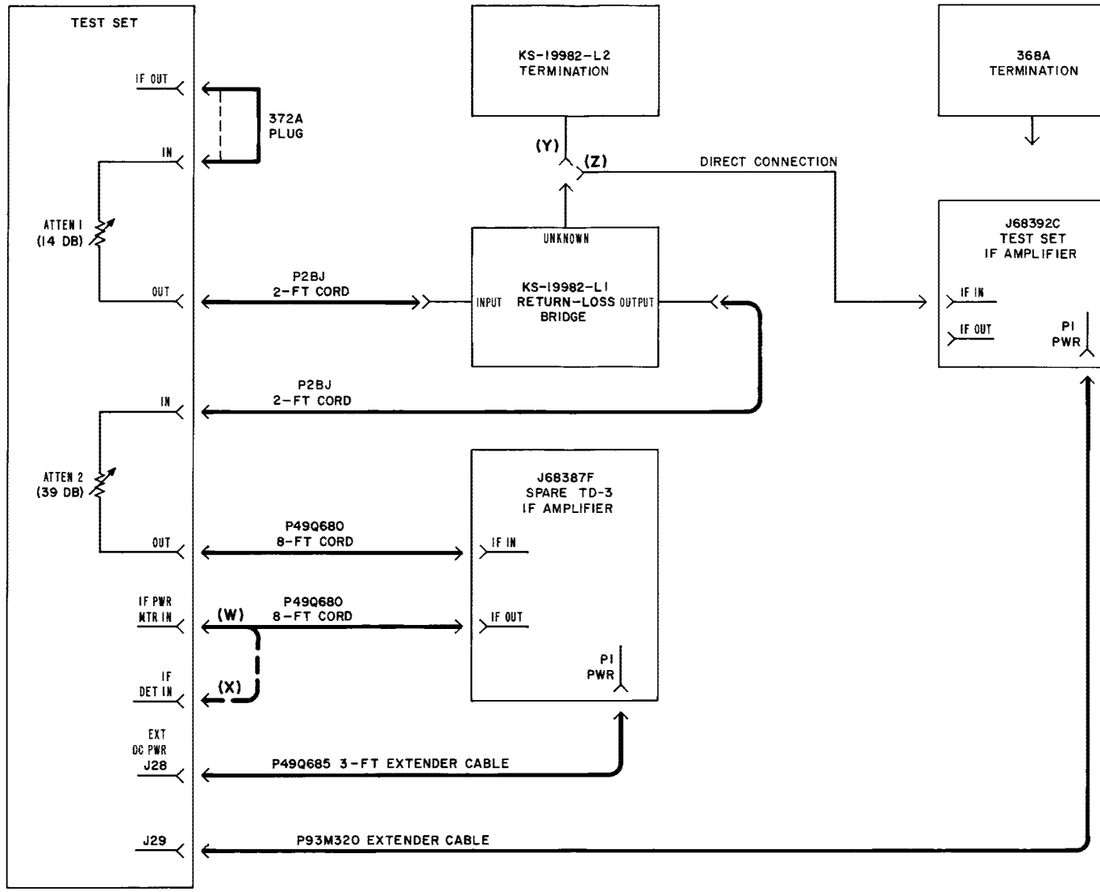
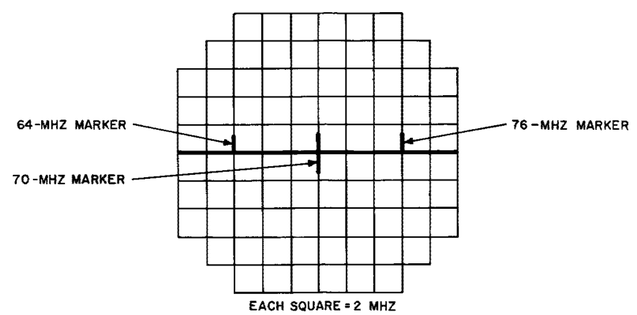


Fig. 3—Troubleshooting Test Setup





PREPARATION FOR TEST

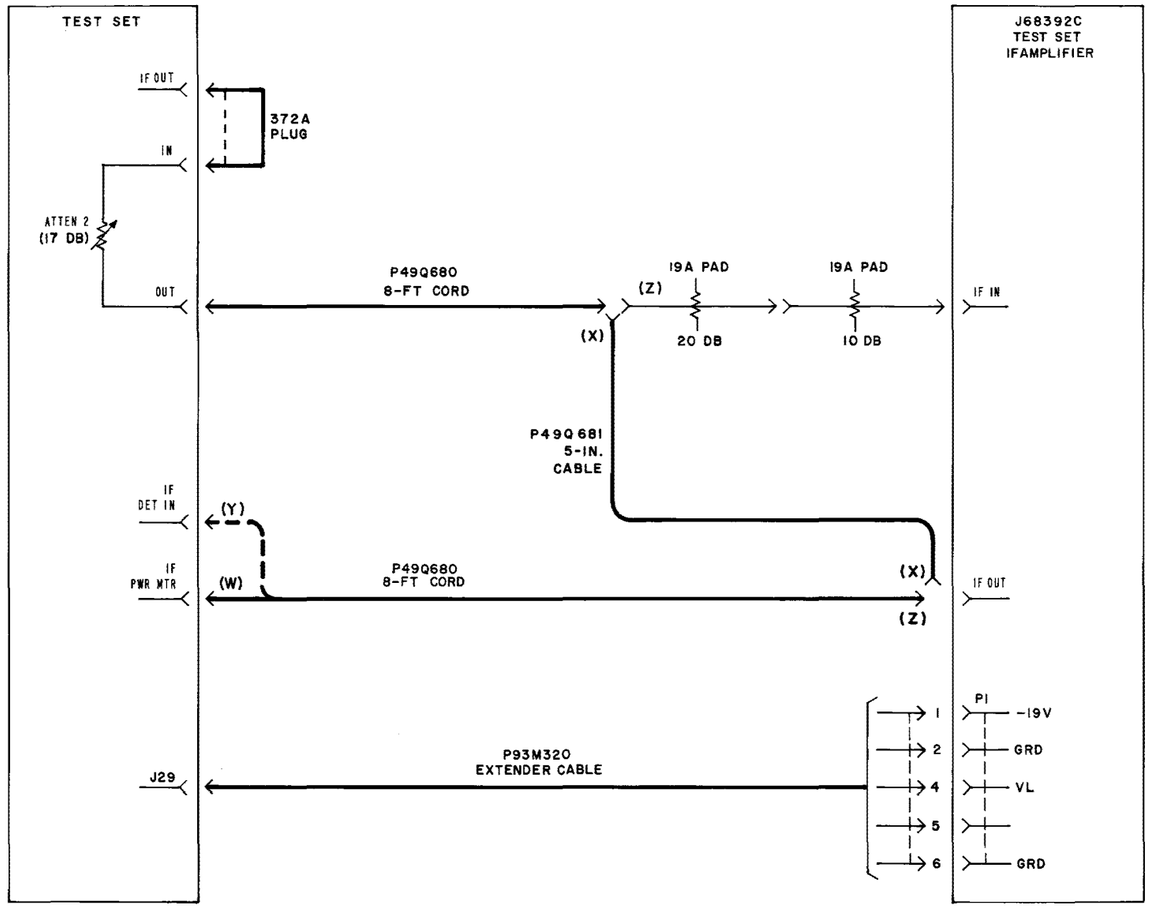
1. SET THE ATTENUATORS AS INDICATED.
2. ESTABLISH TEST CONNECTIONS USING OPTION (W).
3. MAKE THE FOLLOWING CONTROL SETTINGS ON THE TEST SET:

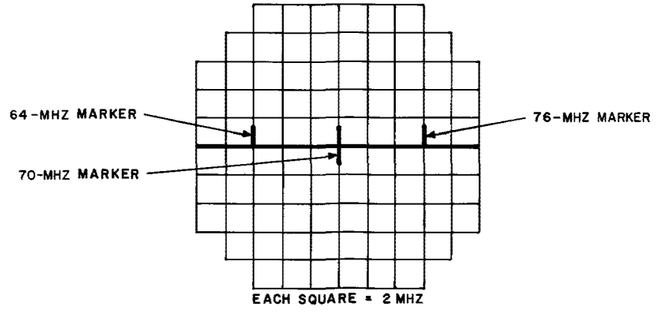
UNIT	CONTROL	POSITION
CONTROL PANEL	FUNCTION	IF-IF
	IF SWEEP WIDTH	MAX CCW
	IF CENTER FREQ	MIDRANGE
	IF MARKER AMPLITUDE	MIDRANGE
	IF MARKER FREQ	MIDRANGE
	CTR	MKR FREQ.
	IF AMPL GAIN	MAX CCW
OSCILLOSCOPE TIME BASE	POSITION	MIDRANGE
	MAGNIFIER	X10
	SWEEP TIME	EXT
	VERNIER	MIDRANGE
	SINGLE-NORMAL	NORMAL
OSCILLOSCOPE DIFFERENTIAL AMPLIFIER	POSITION	MIDRANGE
	BANDWIDTH	4
	AMPLIFIER	DC
	VERNIER	MIDRANGE
	SENSITIVITY	10 MV/CM
	AC-DC-OFF (+ INPUT)	DC
	AC-DC-OFF (- INPUT)	OFF
POWER METER	INPUTCHANNEL	IF
	POWER RANGE DBM	0

RETURN LOSS TEST

4. ADJUST ATTEN 2 FOR A -7 DBM INDICATION ON THE POWER METER AND RECORD THE SETTING OF ATTEN 2.
5. CHANGE CONNECTIONS TO OPTION (X).
6. ADJUST THE TEST TRACE CONTROLS ON THE CONTROL PANEL TO CENTER THE TRACE ON THE OSCILLOSCOPE.
7. ADJUST THE VERNIER AND POSITION CONTROLS ON THE OSCILLOSCOPE TIME BASE UNIT FOR APPROXIMATELY 10 CENTIMETERS HORIZONTAL DEFLECTION ON THE OSCILLOSCOPE.
8. ADJUST THE IF MARKER FREQ CONTROL ON THE CONTROL PANEL FOR A 70±0.2 MHZ INDICATION ON THE COUNTER.
9. ADJUST THE IF SWEEP WIDTH AND IF CENTER FREQ CONTROLS ON THE CONTROL PANEL TO OBTAIN THE OSCILLOSCOPE DISPLAY SHOWN AT LEFT.
10. VARY THE IF MARKER FREQ CONTROL ON THE FRONT PANEL OF THE TEST SET TO MOVE THE VARIABLE MARKER ACROSS THE 10 CM OSCILLOSCOPE DISPLAY. OBSERVE THE COUNTER INDICATION.
    REQUIREMENT: THE COUNTER SHALL INDICATE 60±0.5 MHZ WHEN THE VARIABLE MARKER IS AT THE LEFT END OF THE TRACE AND SHALL INDICATE 80±0.5 MHZ WHEN THE VARIABLE MARKER IS AT THE RIGHT END OF THE TRACE.
    IF THE REQUIREMENT IS NOT MET, ADJUST THE IF SWEEP WIDTH AND IF CENTER FREQ CONTROLS UNTIL THE REQUIREMENT IS MET.
11. ADJUST THE REF TRACE CONTROLS ON THE CONTROL PANEL TO BRING THE REFERENCE TRACE IN COINCIDENCE WITH THE TEST TRACE AT 70 MHZ.
12. INCREASE THE ATTENUATION OF ATTEN 2 BY 1 DB AND ADJUST THE VERNIER AND POSITION CONTROLS ON THE OSCILLOSCOPE DIFFERENTIAL AMPLIFIER FOR 2 CENTIMETERS DEFLECTION BETWEEN THE THE TRACES; THEN RETURN ATTEN 2 TO ITS PREVIOUS SETTING. THIS CALIBRATES THE OSCILLOSCOPE FOR 0.5 DB PER CENTIMETER.
13. CHANGE CONNECTIONS TO OPTION (Y).
14. SET ATTEN 2 TO 0.
    REQUIREMENT: THE TEST TRACE SHALL BE BELOW THE REFERENCE TRACE BETWEEN 60 AND 80 MHZ.
    IF THE REQUIREMENT IS NOT MET, REMOVE THE BOTTOM COVER FROM THE RETURN LOSS BRIDGE AND ADJUST THE INTERNAL CONTROLS UNTIL THE REQUIREMENT IS MET.
15. CHANGE CONNECTIONS TO OPTION (Z).
16. ADJUST ATTEN 2 UNTIL THE TRACES COINCIDE. THEN SUBTRACT THE SETTING OF ATTEN 2 FROM THE SETTING REQUIRED TO OBTAIN THE -7 INDICATION ON THE POWER METER. THE RESULT IS THE RETURN LOSS IN DB.

Fig. 4—J68392C IF Amplifier Return Loss Test Setup





1. SET ATTEN 2 TO 17 DB.
2. ESTABLISH THE TEST CONNECTIONS USING OPTIONS (W) AND (X).
3. MAKE THE FOLLOWING CONTROL SETTINGS IN THE TEST SET:

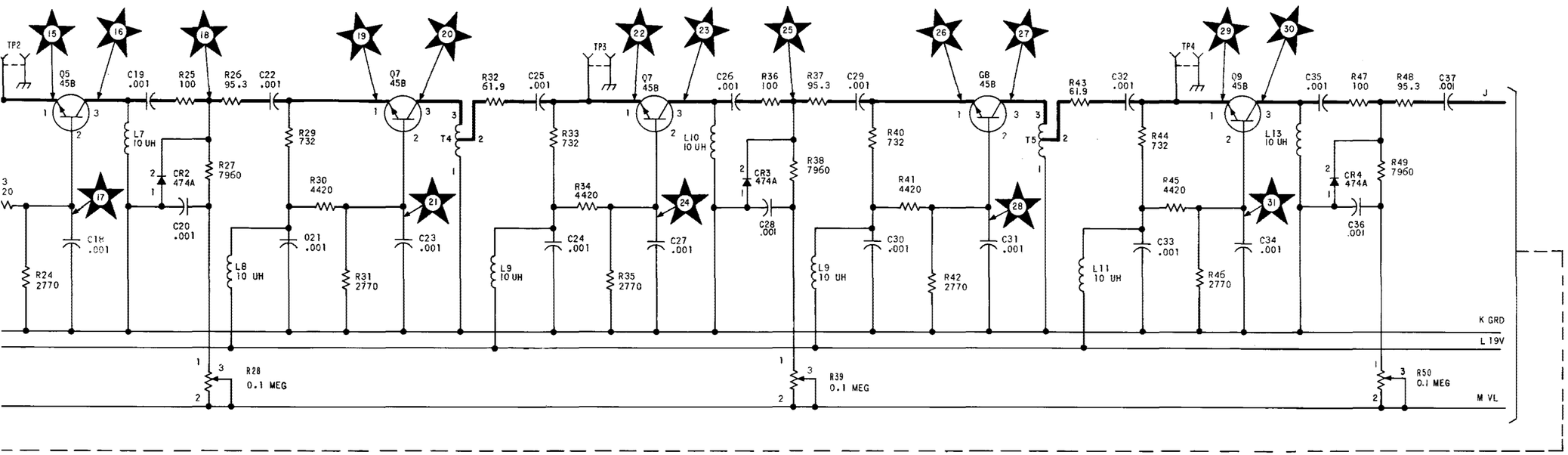
UNIT	CONTROL	POSITION
CONTROL PANEL	FUNCTION IF SWEEP WIDTH IF CENTER FREQ IF MARKER AMPLITUDE IF MARKER FREQ CTR IF AMPL GAIN	IF-IF MAX CCW MIDRANGE MIDRANGE MIDRANGE MKR FREQ MAX CW
OSCILLOSCOPE TIME BASE	POSITION MAGNIFIER SWEEP TIME VERNIER SINGLE-NORMAL	MIDRANGE X10 EXT MIDRANGE NORMAL
OSCILLOSCOPE DIFFERENTIAL AMPLIFIER	POSITION BANDWIDTH AMPLIFIER VERNIER SENSITIVITY AC-DC-OFF (+INPUT) AC-DC-OFF (-INPUT)	MIDRANGE 4 DC MIDRANGE 2 MV/CM DC OFF
POWER METER	INPUT CHANNEL POWER RANGE DBM	IF -5

4. ADJUST ATTEN 2 FOR A -2 INDICATION ON THE POWER METER (-7 DBM).
5. CHANGE OPTION (W) TO OPTION (Y).
6. ADJUST THE TEST TRACE CONTROLS ON THE CONTROL PANEL TO CENTER THE TRACE ON THE OSCILLOSCOPE.
7. ADJUST THE VERNIER AND POSITION CONTROLS ON THE OSCILLOSCOPE TIME BASE UNIT FOR APPROXIMATELY 10 CENTIMETERS HORIZONTAL DEFLECTION ON THE OSCILLOSCOPE.
8. ADJUST THE IF MARKER FREQ CONTROL ON THE CONTROL PANEL FOR A 70±0.2 MHZ INDICATION ON THE COUNTER.
9. ADJUST THE IF SWEEP WIDTH AND IF CENTER FREQ CONTROLS ON THE CONTROL PANEL TO OBTAIN THE OSCILLOSCOPE DISPLAY SHOWN AT LEFT.
10. VARY THE IF MARKER FREQ CONTROL ON THE FRONT PANEL OF THE TEST SET TO MOVE THE VARIABLE MARKER ACROSS THE 10 CM OSCILLOSCOPE DISPLAY. OBSERVE THE COUNTER INDICATION.

    REQUIREMENT: THE COUNTER SHALL INDICATE 60±0.5 MHZ WHEN THE VARIABLE MARKER IS AT THE LEFT END OF THE TRACE AND SHALL INDICATE 80±0.5 MHZ WHEN THE VARIABLE MARKER IS AT THE RIGHT END OF THE TRACE. IF THE REQUIREMENT IS NOT MET, ADJUST THE IF SWEEP WIDTH AND IF CENTER FREQ CONTROLS UNTIL THE REQUIREMENT IS MET.
11. ADJUST THE REF TRACE CONTROLS ON THE CONTROL PANEL TO BRING THE REFERENCE TRACE INTO COINCIDENCE WITH THE TEST TRACE AT 70 MHZ.
12. INCREASE THE ATTENUATION OF ATTEN 2 BY 0.1 DB AND ADJUST THE VERNIER AND POSITION CONTROLS ON THE OSCILLOSCOPE DIFFERENTIAL AMPLIFIER FOR 2 CENTIMETERS DEFLECTION BETWEEN THE TRACES: THEN RETURN ATTEN 2 TO ITS PREVIOUS SETTING. THIS CALIBRATES THE OSCILLOSCOPE FOR 0.05 DB PER CENTIMETER.

    REQUIREMENT: THE TEST TRACE SHALL BE FLAT TO WITHIN 0.01 DB BETWEEN 60 AND 80 MHZ. IF THIS REQUIREMENT IS NOT MET, ADJUST THE IF DET SLOPE CONTROL ON THE CONTROL PANEL FOR A FLAT TEST TRACE: THEN RECOINCIDE THE TRACES WITH THE TEST TRACE CONTROLS.
13. CHANGE OPTION (X) TO OPTION (Z)
14. ADJUST THE POWER INTO THE UNIT UNDER TEST BY ADJUSTING ATTEN 2 UNTIL THE TRACES APPEAR ON THE OSCILLOSCOPE.

Fig. 5—Amplitude Response Test Setup



NOTE:

NORMALLY WIRED PER OPTION (Z). IF MORE INDUCTANCE IS REQUIRED, USE OPTION (Y). IF LESS INDUCTANCE IS REQUIRED, USE OPTION (X).

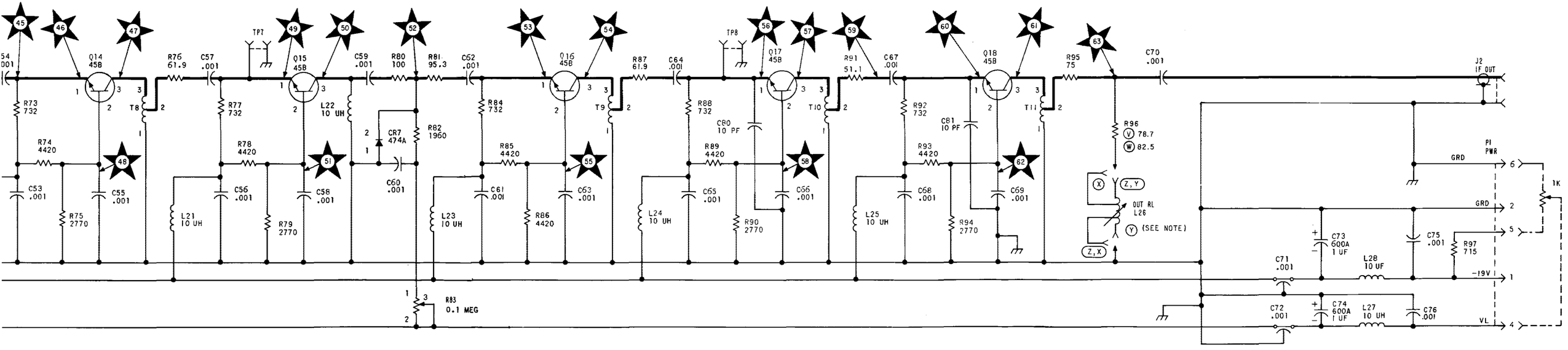
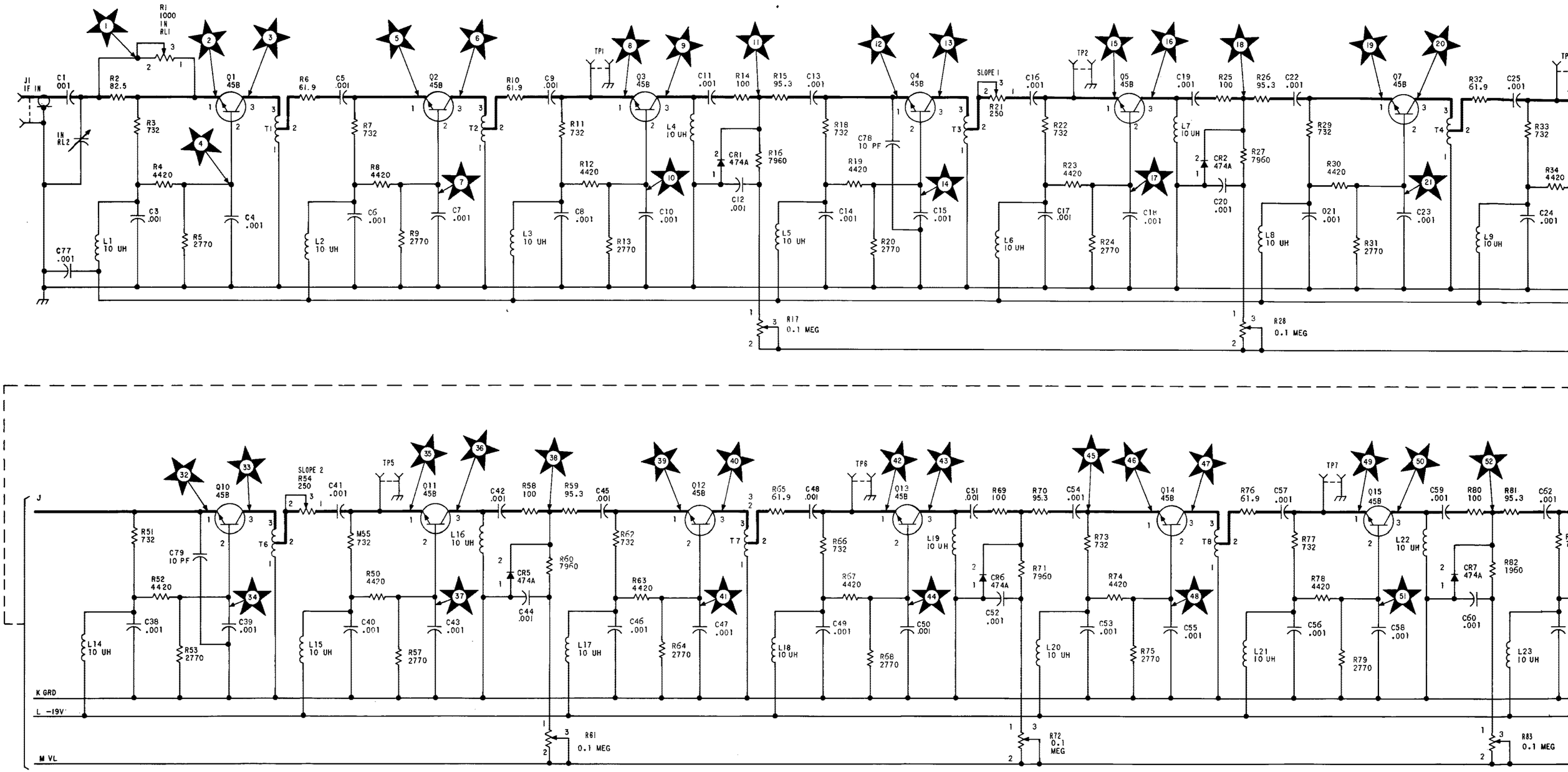


Fig. 6—J68392C IF Amplifier Schematic


J1 IF IN
C1 001
R1 1000 IN RL1
R2 82.5
Q1 45B
T1
R6 61.9
C5 .001
Q2 45B
T2
R10 61.9
C9 .001
TP1
Q3 45B
C11 .001
R14 100
R15 95.3
C13 .001
Q4 45B
T3
SLOPE 1
R21 250
C16 .001
TP2
Q5 45B
C19 .001
R25 100
R26 95.3
C22 .001
Q7 45B
R32 61.9
C25 .001
IN RL2
R3 732
R4 4420
C3 .001
C4 .001
R5 2770
L1 10 UH
C77 .001
R7 732
R8 4420
C6 .001
C7 .001
R9 2770
L2 10 UH
R11 732
R12 4420
C8 .001
C10 .001
R13 2770
L3 10 UH
L4 10 UH
CR1 474A
C12 .001
R16 7960
L5 10 UH
R17 0.1 MEG
R18 732
R19 4420
C14 .001
C78 10 PF
C15 .001
R20 2770
L6 10 UH
R22 732
R23 4420
C17 .001
C18 .001
R24 2770
L7 10 UH
CR2 474A
C20 .001
R27 7960
R28 0.1 MEG
R29 732
R30 4420
021 .001
C23 .001
R31 2770
L8 10 UH
R33 732
R34 4420
C24 .001
L9 10 UH
J
K GRD
L -19V
M VL
Q10 45B
T6
SLOPE 2 R54 250
C41 .001
TP5
Q11 45B
L16 10 UH
C42 .001
R58 100
R59 95.3
C45 .001
Q12 45B
T7
R65 61.9
C48 .001
TP6
Q13 45B
L19 10 UH
C51 .001
R69 100
R70 95.3
C54 .001
Q14 45B
T8
R76 61.9
C57 .001
TP7
Q15 45B
L22 10 UH
C59 .001
R80 100
R81 95.3
C62 .001
R51 732
C79 10 PF
R52 4420
C38 .001
C39 .001
R53 2770
L14 10 UH
R55 732
R50 4420
C40 .001
C43 .001
R57 2770
L15 10 UH
CR5 474A
C44 .001
R60 7960
R61 0.1 MEG
R62 732
R63 4420
C46 .001
C47 .001
R64 2770
L17 10 UH
R66 732
R67 4420
C49 .001
C50 .001
R68 2770
L18 10 UH
CR6 474A
C52 .001
R71 7960
R72 0.1 MEG
R73 732
R74 4420
C53 .001
C55 .001
R75 2770
L20 10 UH
R77 732
R78 4420
C56 .001
C58 .001
R79 2770
L21 10 UH
CR7 474A
C60 .001
R82 1960
R83 0.1 MEG
L23 10 UH

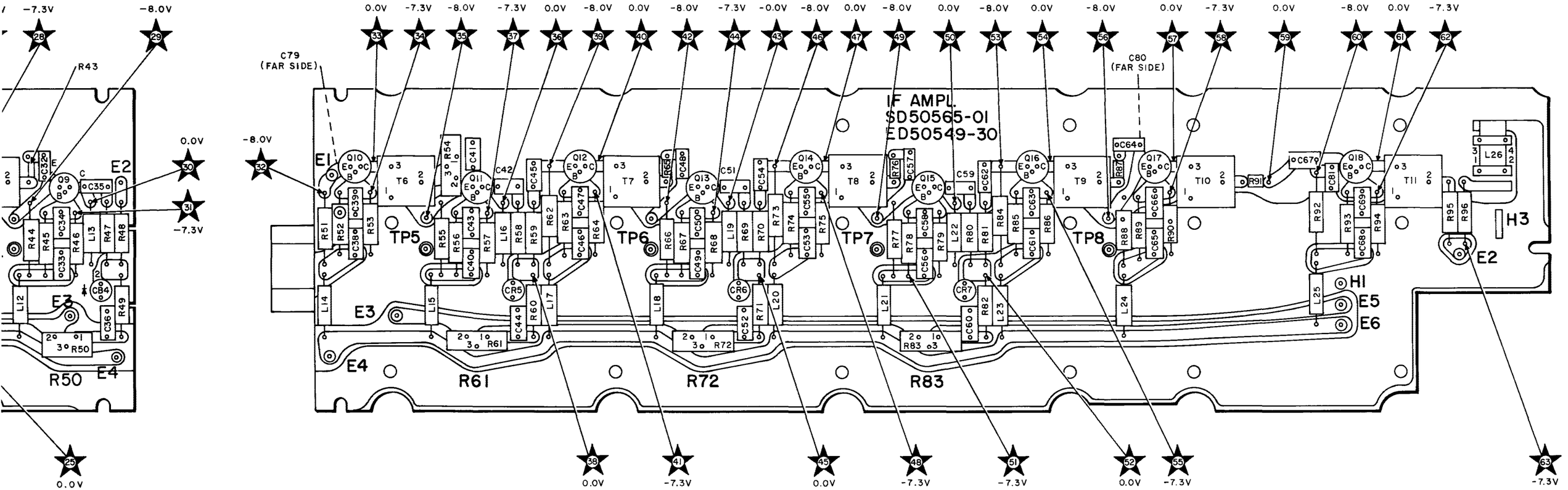
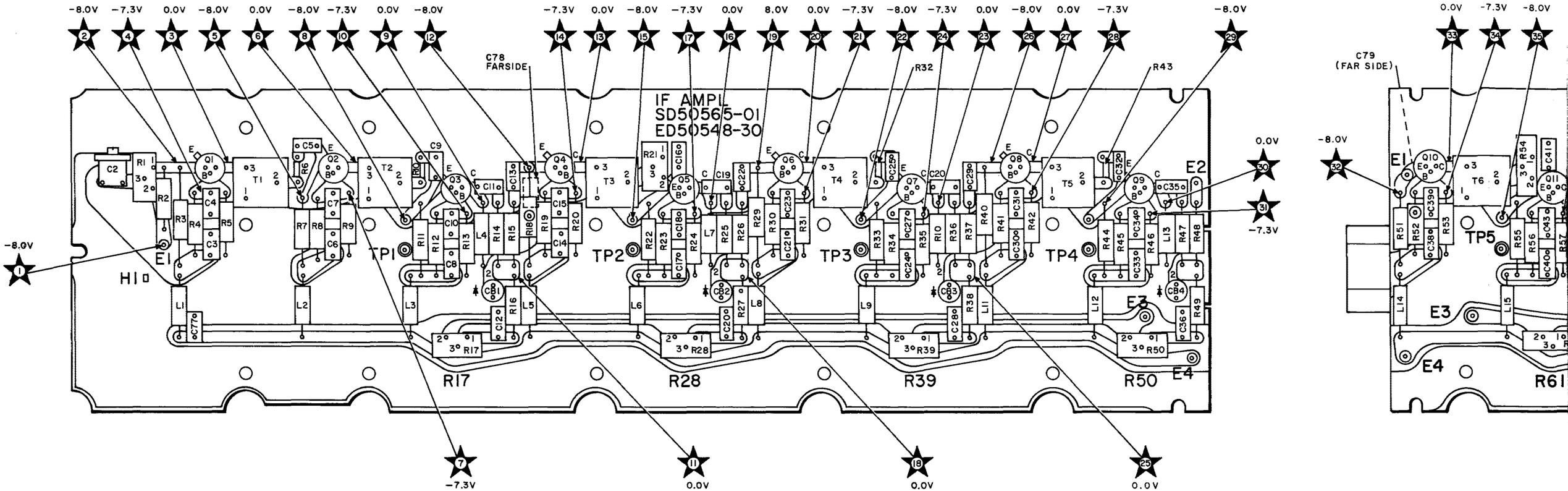


Fig. 7—J68392C IF Amplifier Test Points


IF AMPL
SD50565-01
ED50548-30
C78
FARSIDE
C79
(FAR SIDE)
R32
R43
-8.0V
-7.3V
0.0V
8.0V
E1
E2
E3
E4
TP1
TP2
TP3
TP4
TP5
H10
R17
R28
R39
R50
R61
-7.3V
0.0V
0.0V
0.0V