

**RELAY AND RELAY DRIVER TEST PROCEDURE**

1. GROUND TP12 (RUN/TEST). VERIFY THAT RELAYS K1-K5, AND K22 FOR 30 MHz TUNERS, ARE CLOSED.
2. GROUND TP11 (ELEMENTS IN/OUT) AND TP12 (RUN/TEST). VERIFY THAT RELAYS K6-K21, AND K23 FOR 30 MHz TUNERS, ARE CLOSED. VERIFY THAT RELAYS K1-K5 ARE OPEN.
3. INDIVIDUALLY CHECK EACH RELAY BY:
  - DISCONNECTING EITHER END OF L9.
  - APPLYING 13.8 V TO THE SWITCHED A+ INPUT (GRN).
  - GROUNDING THE APPROPRIATE TEST POINT TO ACTIVATE RELAY (TP1-TP8, TP17-TP28).
4. RECONNECT AND SOLDER L9. REMOVE GROUND FROM TP11 AND TP12.

**VSWR DETECTOR TEST PROCEDURE**

1. CONNECT RF OUT TERMINAL TO ANTENNA OR DUMMY LOAD.
2. APPLY +5 V TO TP13 TO ENABLE SLOW TUNING MODE (SWITCHING AT 2 Hz RATE).
3. TURN ON RADIO TO APPLY SWITCHED A+ TO TUNER.
4. MONITOR VOLTAGE AT U6-11 AND J8-39. VOLTAGE AT U6-11 SHOULD GRADUALLY DROP DURING THE TUNING SEQUENCE AS THE MATCHED CONDITION IS APPROACHED. U8-39 SHOULD BE LOW FOR APPROXIMATELY ONE SECOND DURING THE TUNING SEQUENCE.

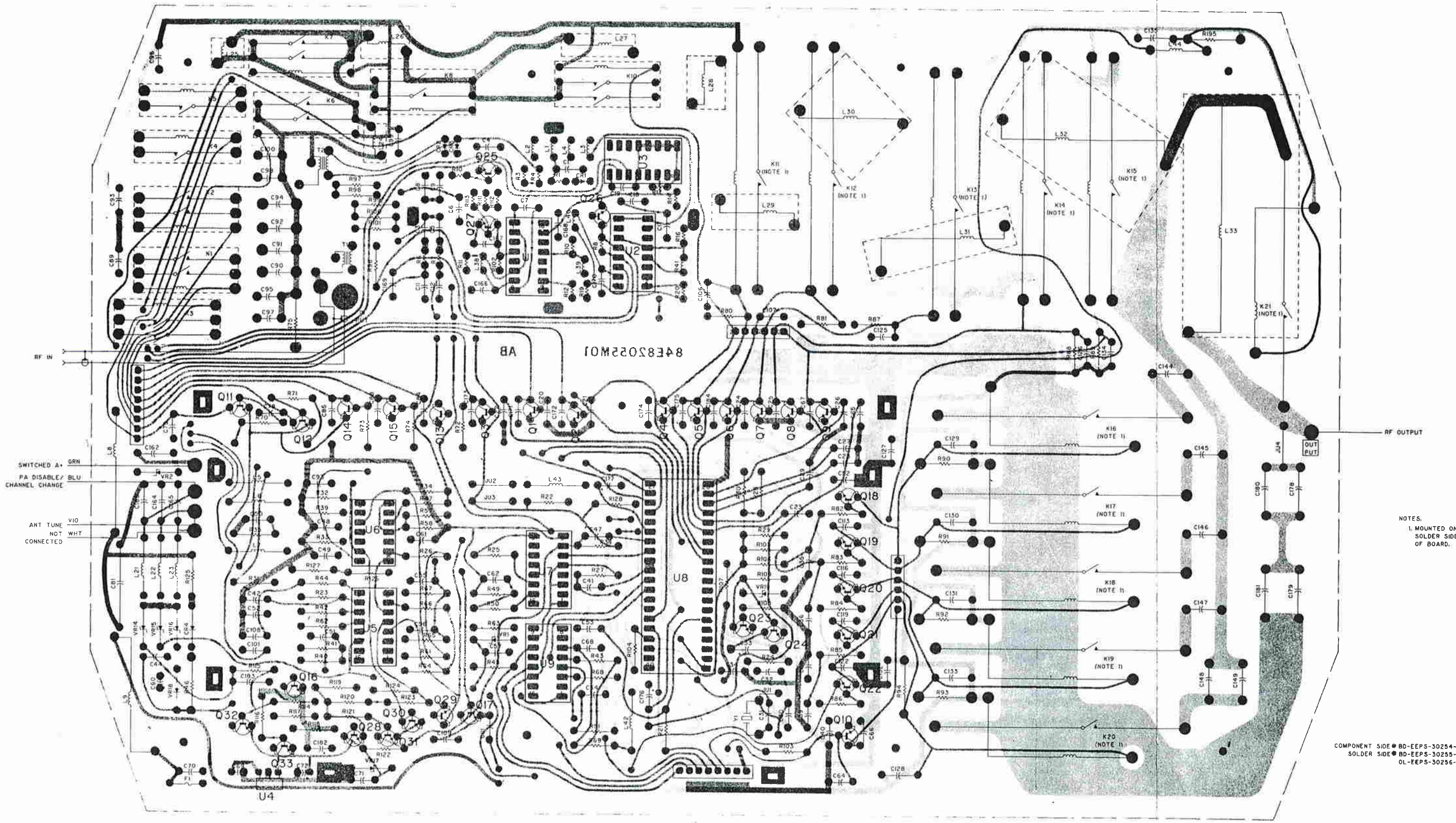
**PHASE DETECTOR TEST PROCEDURE**

1. DISCONNECT ANTENNA FROM RF OUT TERMINAL.
2. (T1960A AND T1962A MODELS ONLY.) CONNECT A 560 PF CAPACITOR FROM RF OUT TERMINAL TO GROUND.
3. GROUND TP11 AND TP12. UNSOLDER AND REMOVE EITHER END OF R112.
4. APPLY 3 WATT RF SIGNAL TO RF INPUT TERMINAL.
5. VARY FREQUENCY OF RF INPUT. MEASURE VOLTAGE AT U8-1. VOLTAGE SHOULD BE LOW WHEN INPUT FREQUENCY IS ABOVE 7.5 MHz.
6. RECONNECT AND SOLDER R112. REMOVE GROUND FROM TP11 AND TP12.

\*EEPS-30866-0



# Automatic Antenna Tuners 2-18 MHz



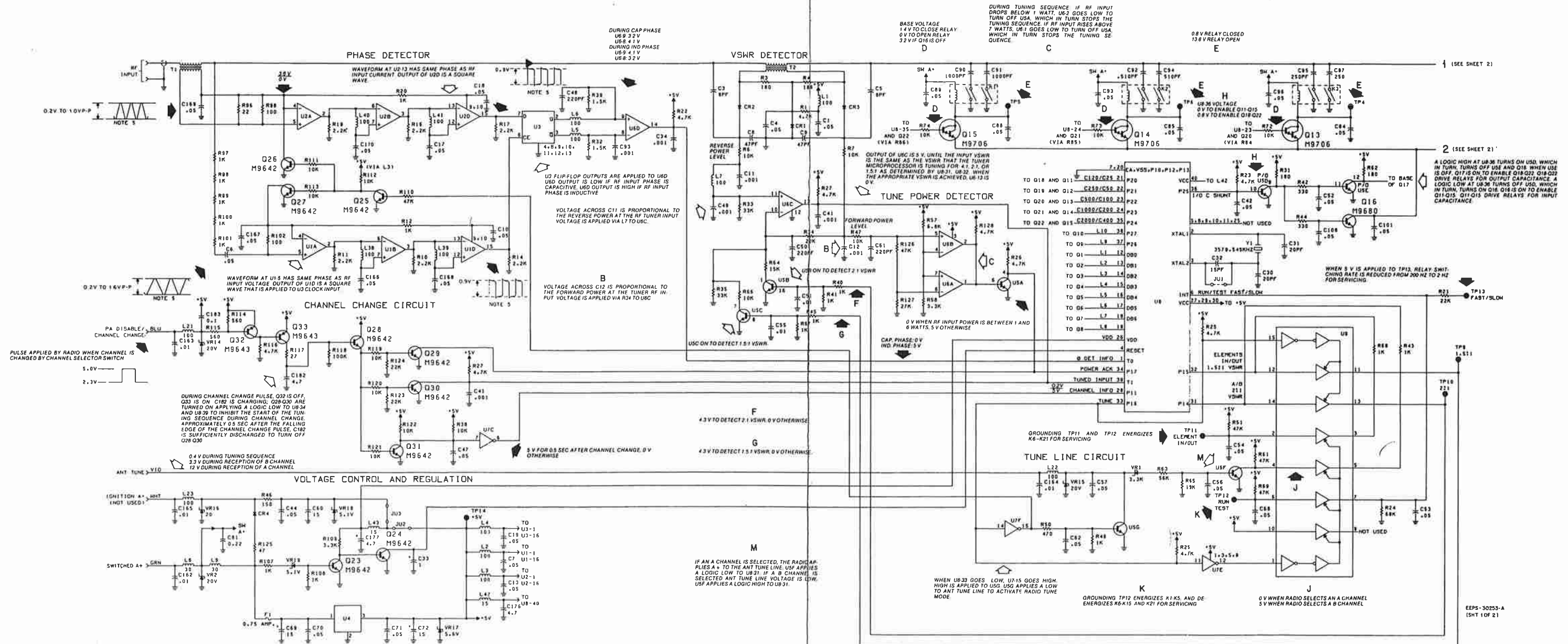
SHOWN FROM COMPONENT SIDE

NOTES:  
1. MOUNTED ON  
SOLDER SIDE  
OF BOARD.

COMPONENT SIDE ● 8D-EEPS-30254-O  
SOLDER SIDE ● 8D-EEPS-30255-O  
OL-EEPS-30256-A

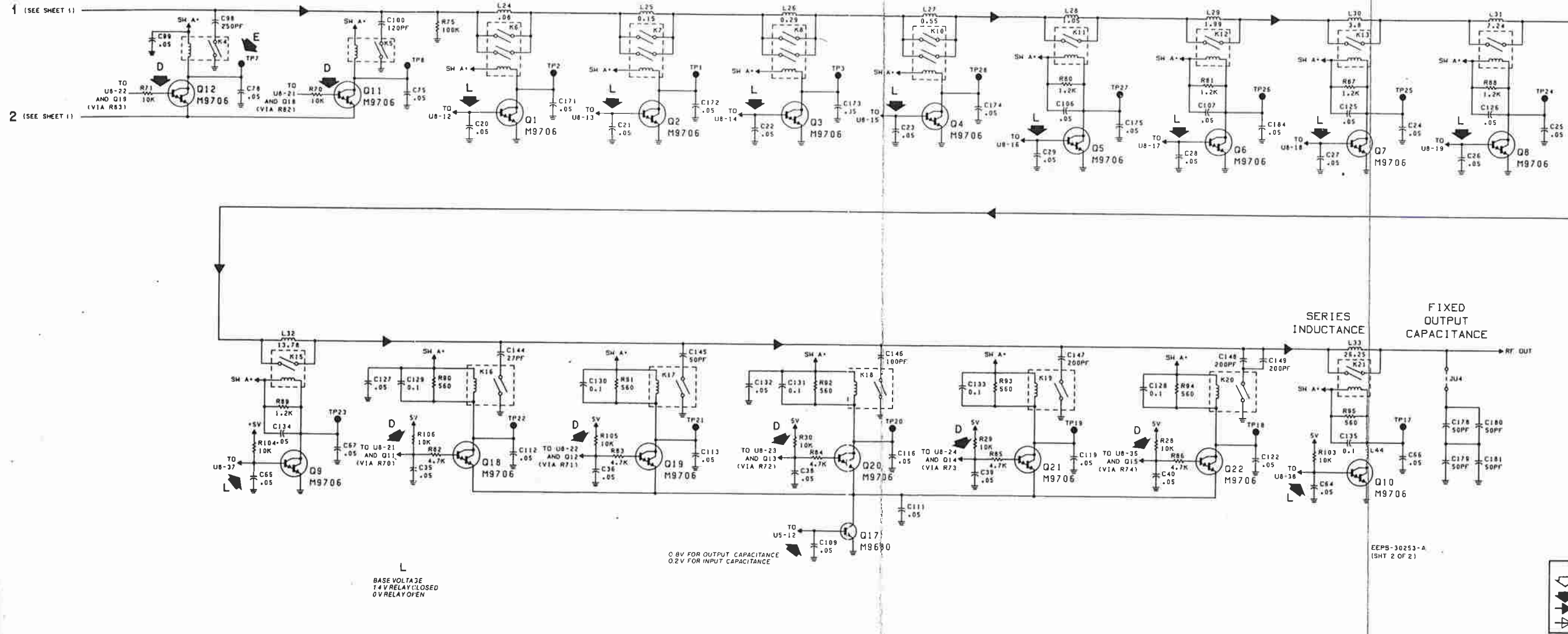
# Automatic Antenna Tuners

2-18 MHz



Automatic Antenna Tuner Schematic Diagram

# Automatic Antenna Tuners 2-18 MHz



### NOTES

- UNLESS OTHERWISE INDICATED, RESISTOR VALUES ARE IN OHMS; CAPACITOR VALUES ARE IN MICROFARADS; INDUCTOR VALUES ARE IN MICROHENRIES
- THIS DIAGRAM SHOWS POSITIVE LOGIC  
LOGIC "1" 2 TO 5.4 V DC  
LOGIC "0" 0 TO 1.9 V DC
- SOME INTEGRATED CIRCUITS ON THIS BOARD ARE CMOS DEVICES
- IC TYPES AND CONNECTIONS FOR THIS BOARD ARE AS FOLLOWS:

REFERENCE DESIGNATION	TYPE	VCC	GND
U1, U2	MC10115	1.16	8
U3	MC10131	1.16	8
U4	MC7805CP	1	2
U5	CA3081	3	15
U6	MC3302	3	12
U7	MC14049B	1	8
U8	8046	40.26	20
U9	MC14503	16	8

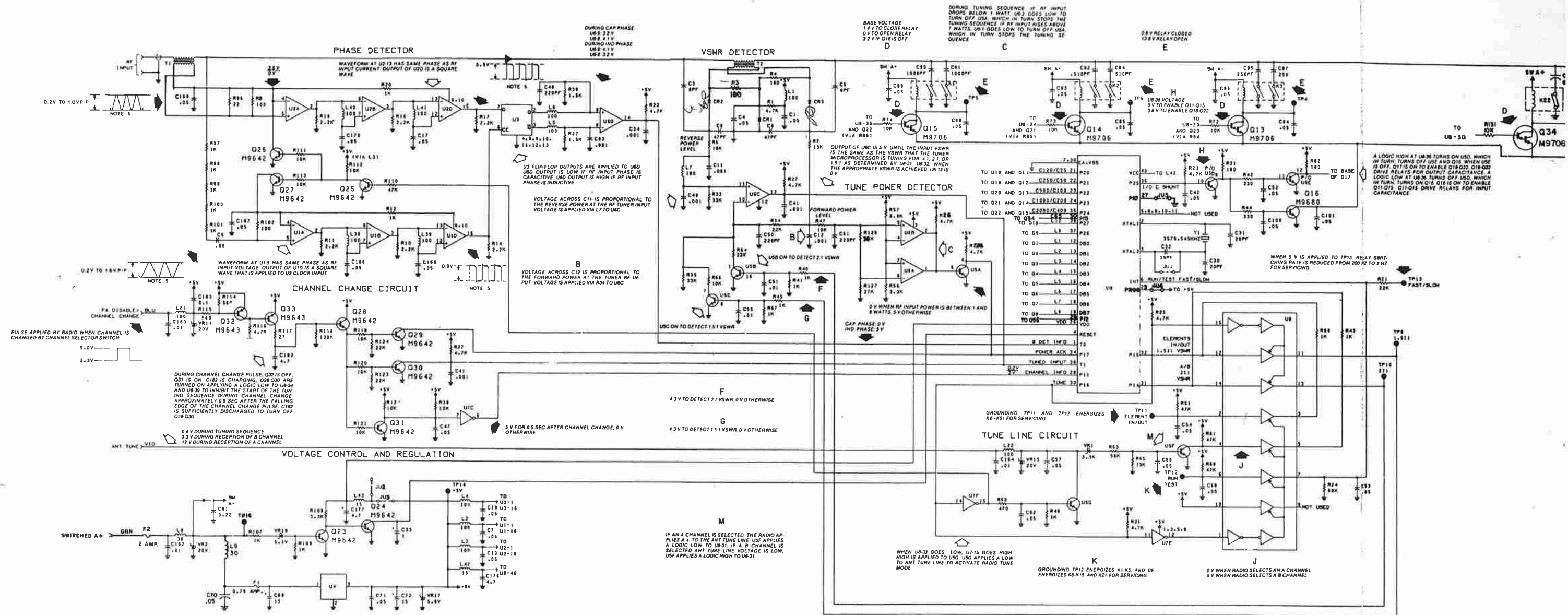
- PHASE DETECTOR WAVEFORMS AND VOLTAGES ARE MEASURED DURING TUNING SEQUENCE WITH A 2 MHz, 3 WATT LEVEL AT TUNER RF INPUT
- VOLTAGE SHOWN ABOVE LINE IS MEASURED DURING TUNING SEQUENCE. VOLTAGE SHOWN BELOW LINE IS MEASURED UNDER ALL OTHER CONDITIONS. FOR EXAMPLE 3.6V  
0.7
- MEASURED WITH TUNER COMPLETELY MISMATCHED AND A 2 MHz, 3 WATT SIGNAL AT TUNER RF INPUT.

### JUMPER TABLE

MODEL	JU1	JU2	JU3	JU4
T1959A	IN	IN	OUT	IN
T1961A	IN	IN	OUT	IN
T1962A	IN	IN	OUT	IN

EEPS-30253-A  
(SHT 2 OF 2)

Automatic Antenna Tuner  
Schematic Diagram



**PHASE DETECTOR**

WAVEFORM AT U2-13 HAS SAME PHASE AS RF INPUT CURRENT OUTPUT OF U20 IS A SQUARE WAVE

**VSWR DETECTOR**

OUTPUT OF U8C IS 5 V UNTIL THE INPUT VSWR IS THE SAME AS THE VSWR THAT THE TUNER MICROPROCESSOR IS TUNING FOR 4:1, 2:1 OR 1.5:1 AS DETERMINED BY U8-31, U8-32. WHEN THE APPROPRIATE VSWR IS ACHIEVED, U6 IS 0 V

**TUNE POWER DETECTOR**

FORWARD POWER LEVEL R47  
REVERSE POWER LEVEL R48

**CHANNEL CHANGE CIRCUIT**

PULSE APPLIED BY RADIO WHEN CHANNEL IS CHANGED BY CHANNEL SELECTOR SWITCH

DURING CHANNEL CHANGE PULSE, Q22 IS OFF, Q23 IS ON. C182 IS CHARGING, Q28-Q30 ARE TURNED ON APPLYING A LOGIC LOW TO U8-34 AND U8-36 TO INHIBIT THE START OF THE TUNING SEQUENCE DURING CHANNEL CHANGE APPROXIMATELY 0.5 SEC AFTER THE FALLING EDGE OF THE CHANNEL CHANGE PULSE, C182 IS SUFFICIENTLY DISCHARGED TO TURN OFF Q28-Q30

**VOLTAGE CONTROL AND REGULATION**

0.4 V DURING TUNING SEQUENCE  
1.3 V DURING RECEPTION OF A CHANNEL  
1.2 V DURING RECEPTION OF A CHANNEL

DURING TUNING SEQUENCE IF RF INPUT DROPS BELOW 1 WATT, U6-2 GOES LOW TO TURN OFF U5A, WHICH IN TURN STOPS THE TUNING SEQUENCE IF RF INPUT RISES ABOVE 1 WATT, U6-1 GOES LOW TO TURN OFF U5A, WHICH IN TURN STOPS THE TUNING SEQUENCE

BASE VOLTAGE 1.4 V TO CLOSE RELAY 0 V TO OPEN RELAY 3.2 V IF Q16 IS OFF

0.8 V RELAY CLOSED 1.3 V RELAY OPEN

**TUNE LINE CIRCUIT**

WHEN U8-33 GOES LOW, U7-15 GOES HIGH HIGH IS APPLIED TO U8-31. IF A B CHANNEL IS SELECTED ANY TUNE LINE VOLTAGE IS LOW, U5F APPLIES A LOGIC HIGH TO U6-31

GROUNDING TP11 AND TP12 ENERGIZES K6-K21 FOR SERVICING

WHEN U8-33 GOES LOW, U7-15 GOES HIGH HIGH IS APPLIED TO U8-31. IF A B CHANNEL IS SELECTED ANY TUNE LINE VOLTAGE IS LOW, U5F APPLIES A LOGIC HIGH TO U6-31

GROUNDING TP12 ENERGIZES K1-K5, AND DE ENERGIZES K6-K15 AND K21 FOR SERVICING

0 V WHEN RADIO SELECTS A B CHANNEL 5 V WHEN RADIO SELECTS A B CHANNEL

WHEN 5 V IS APPLIED TO TP12, RELAY SWITCHING RATE IS REDUCED FROM 200 Hz TO 2 Hz FOR SERVICING

WHEN 5 V IS APPLIED TO U8-36, WHICH IN TURN TURNS OFF U5E AND Q16. WHEN U5E IS OFF, Q17 IS ON TO ENABLE Q18-Q25. Q18-Q25 DRIVE RELAYS FOR OUTPUT CAPACITANCE. A LOGIC LOW AT U8-36 TURNS OFF U5E, WHICH IN TURN TURNS ON Q16. Q16 IS ON TO ENABLE Q17-Q25. Q17-Q25 DRIVE RELAYS FOR INPUT CAPACITANCE

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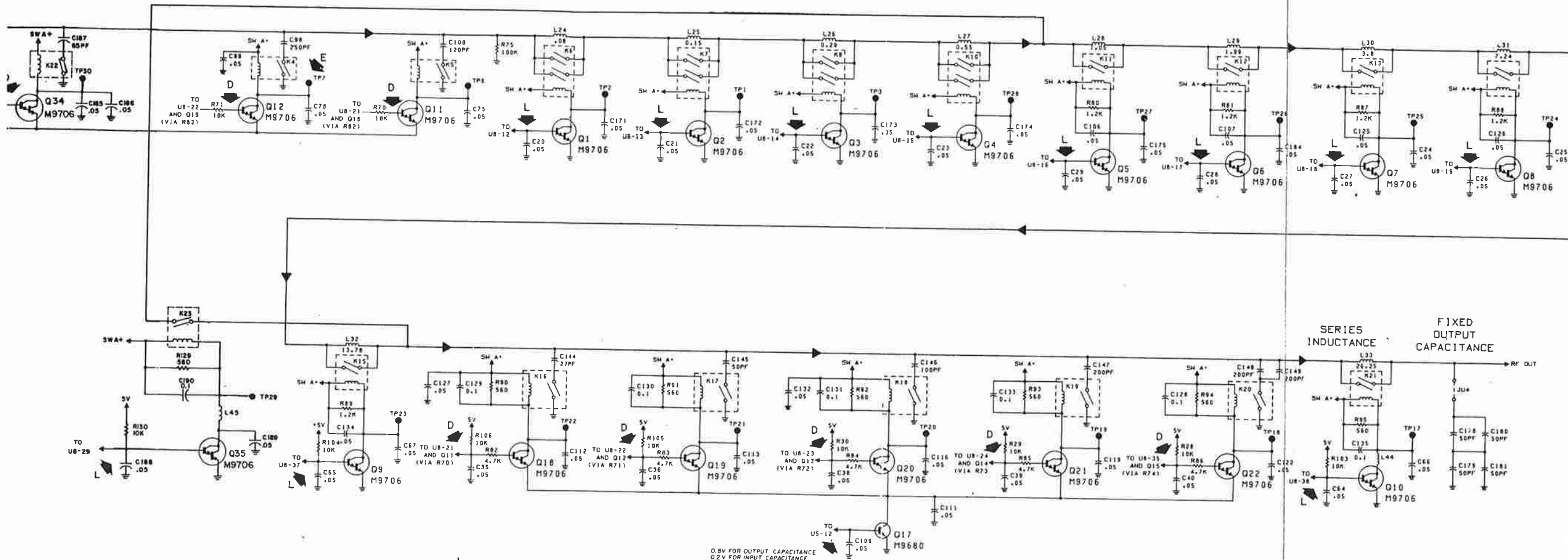
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# Automatic Antenna Tuner

2-301



L  
BASE VOLTAGE  
14V RELAY CLOSED  
0V RELAY OPEN

0.5V FOR OUTPUT CAPACITANCE  
0.2V FOR INPUT CAPACITANCE

SERIES  
INDUCTANCE

FIXED  
OUTPUT  
CAPACITANCE

73C02926G36-0

- NOTES
- UNLESS OTHERWISE INDICATED, RESISTOR VALUES ARE IN OHMS; CAPACITOR VALUES ARE IN MICROFARADS; INDUCTOR VALUES ARE IN MICRohenRIES.
  - THIS DIAGRAM SHOWS POSITIVE LOGIC:  
LOGIC "1" 2 TO 5.4V DC  
LOGIC "0" 0 TO 1.8V DC
  - SOME INTEGRATED CIRCUITS ON THIS BOARD ARE CMOS DEVICES
  - IC TYPES AND CONNECTIONS FOR THIS BOARD ARE AS FOLLOWS:

REFERENCE DESIGNATION	TYPE	VCC	GND
U1, U2	MC16115	1, 16	8
U3	MC10151	1, 16	8
U4	MC7805CP	1	2
U5	CA3081	15	15
U6	MC3302	3	12
U7	MC14049B	1	8
U8	8048	40, 26	20
U9	MC14503	16	8

- PHASE DETECTOR WAVEFORMS AND VOLTAGES ARE MEASURED DURING TUNING SEQUENCE WITH A 2 MHz, 3 WATT LEVEL AT TUNER RF INPUT.
- VOLTAGE SHOWN ABOVE LINE IS MEASURED DURING TUNING SEQUENCE. VOLTAGE SHOWN BELOW LINE IS MEASURED UNDER ALL OTHER CONDITIONS. FOR EXAMPLE: 3.8V 0V
- MEASURED WITH TUNER COMPLETELY MISMATCHED AND A 2 MHz, 3 WATT SIGNAL AT TUNER RF INPUT.

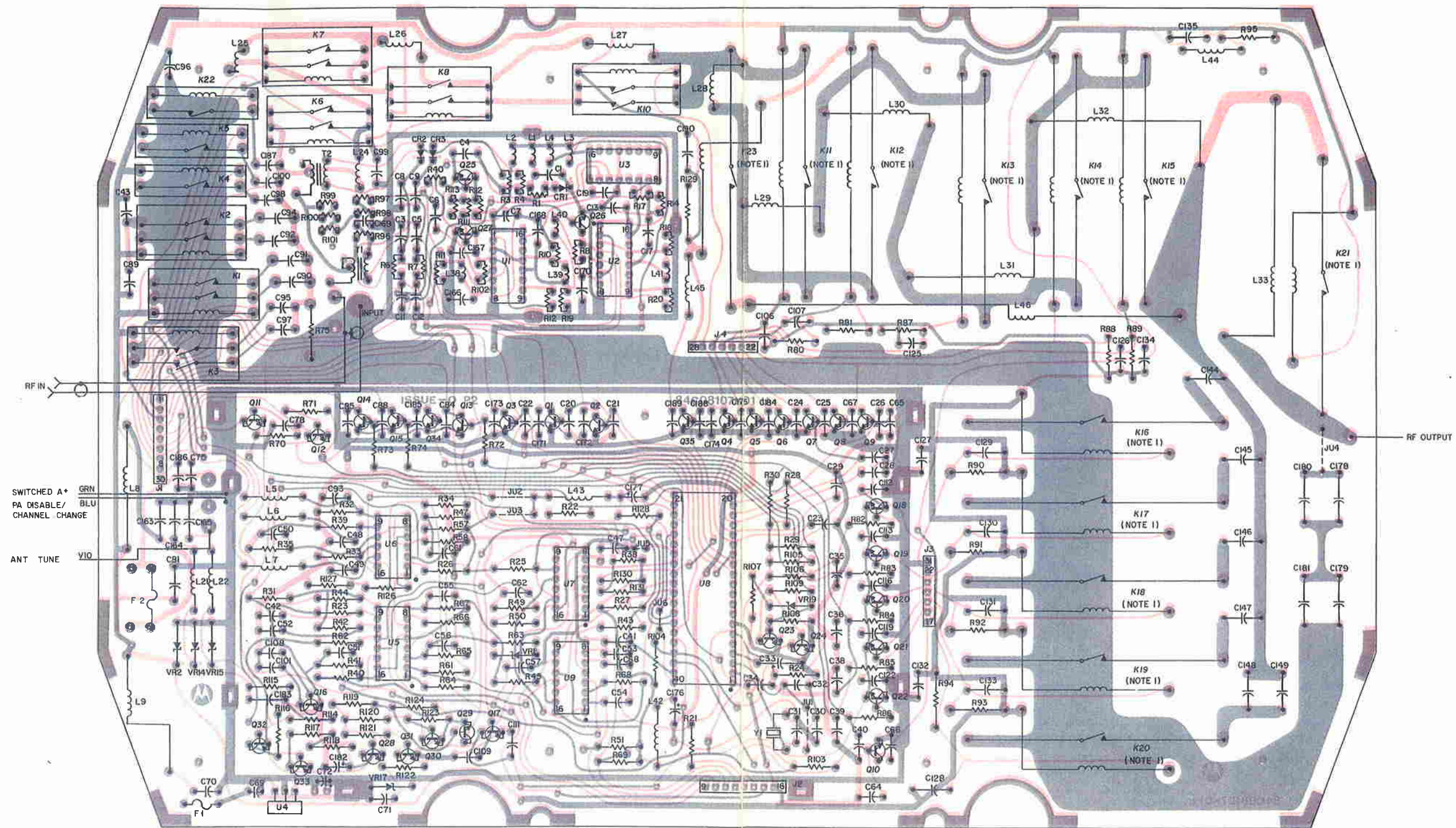
JUMPER TABLE

MODEL	JU1	JU2	JU3	JU4	JU5	JU6
F2280A	IN	OUT	IN	IN	OUT	IN
F2281A	IN	OUT	IN	IN	OUT	IN
F2282A	IN	OUT	IN	IN	OUT	IN

LEGEND:

- THEORY NOTE
- MAINTENANCE NOTE
- PRIMARY SIGNAL FLOW
- SECONDARY SIGNAL FLOW

# Automatic Antenna Tuners 2-30 MHz



NOTE 1. MOUNTED ON SOLDER SIDE OF BOARD.

SHOWN FROM COMPONENT SIDE

OVERLAY ● 79D02926665-0  
 SOLDER SIDE 79D02926666-0  
 COMPONENT SIDE ■ 79D02926667-0





Reference Symbol	Motorola Part No.	Description
R57	06-11009C69	6800
R58	06-11009C61	3300
R59, R60		not used
R61	06-11009C89	47k
R62	06-00125A31	180, 1/2 W
R63	06-11009C91	56k
R64	06-11009C81	22k
R65, R66	06-11009C73	10k
R67, R68	06-11009C49	1000
R69	06-11009C89	47k
R70-R74	06-11009C73	10k
R75	06-00125C97	100k $\pm$ 10% 1/2 W
R76-R79		not used
R80, R81	06-11009C51	1200
R82-R86	06-11009C65	4700
R87-R89	06-11009C51	1200
R90-R95	06-00125C43	560 $\pm$ 10% 1/2 W
R96	06-11009C09	22
R97-R101	06-11009C49	1000
R102	06-11009C25	100
R103-R106	06-11009C73	10k
R107, R108	06-11009C49	1000
R109	06-11009C61	3300
R110	06-11009C89	47k
R111-R113	06-11009C73	10k
R114-R115	06-11009C43	560
R116	06-11009C65	4700
R117	06-11009C11	27
R118	06-11009C97	100k
R119-R122	06-11009C73	10k
R123, R124	06-11009C81	22k
R125		not used
R126	06-11009C87	39k
R127	06-11009C83	27k
R128	06-11009C65	4700
R129	06-00125C43	560 $\pm$ 10% 1/2 W
R130, R131	06-11009C73	10k
<b>Transformers</b>		
T1, T2	25-83727K01	25 turns
<b>Integrated circuits</b> (see note 1)		
U1, U2	51-84561L54	61L54
U3	51-84561L55	61L55
U4	51-84561L76	61L76
U5	51-84561L65	61L65
U6	51-84371K74	71K74
U7	51-82884L02	CMOS, 84L02
U8	51-08022K01	microprocessor, 8749
U9	51-82884L74	84L74
<b>Zener diodes (see note 1)</b>		
VR1	48-82256C26	3.3 V
VR2	48-82256C39	20 V
VR3-VR13		not used
VR14, VR15	48-82256C39	20 V
VR16		not used
VR17	48-82256C12	5.6 V
VR18		not used
VR19	48-82256C15	5.1 V
<b>Crystal (see note 2)</b>		
Y1	48-82141M01	3.58 MHz

Reference Symbol	Motorola Part No.	Description
<b>Hardware</b>		
	01-80726D53	wire & lug
	01-80726D54	wire & lug
	01-80726D56	wire & lug
<b>Relay Assembly, includes:</b>		
K21	01-98209904	pad
	75-80202C01	relay
	80-84803F01	
	03-00134169	tapping screw, 4-40 x 1/4
	09-84186L01	40-contact socket for U8
	14-83967A03	shoulder washer, 2 used
	26-84354M01	shield
	26-84352M01	shield
	26-84353M01	shield
	42-02226C04	fuse holder, 2 used
	42-10217A02	tie strap
	42-10217A20	tie strap
	84-08107K01	printed circuit board

**Notes:**

1. For optimum performance, order diodes, transistors and integrated circuits by Motorola part numbers.
2. When ordering quartz crystals or ceramic resonators, specify carrier frequency, crystal or resonator frequency, and crystal or resonator type number.

**FHN5513A Antenna Tuner Housing**

PL-0178-O

Reference Symbol	Motorola Part No.	Description
	01-02718G13	RF lead
	01-80726D50	ground lead
	01-80733D97	RF cable and connector
	02-00009644	nut, 1/4-20, 5 used
	02-00120486	nut, 4-40, 2 used
	03-00134169	tapping screw, 4-40 x 1/4
	03-00134184	tapping screw, 4-40 x 5/16
	03-00138035	screw, 6-32 x 3/8, 13 used
	03-00138419	captive screw, 1/4-20 x 7/8
	03-02432C48	screw, 6-32 x 5/8, 2 used
	03-02432C85	screw, 10-32 x 3/8, 4 used
	03-02433C25	screw, 4-40 x 3/8, 2 used
	03-82898M01	screw, 4-40 x 1/2
	03-84686E01	captive screw, 6-32 x 7/16
	04-00114970	flat washer, 1/4
	04-00139951	lock washer, 1/4, 4 used
	04-00139952	lock washer, #4, 2 used
	04-02439C03	lock washer, #6, 3 used
	04-02439C05	lock washer, #10, 4 used
	04-02440C03	flat washer, #6, 3 used
	04-10057A13	insulating washer
	04-10058B19	plastic washer
	04-11008A02	sealing washer, 4 used
	07-02431C02	sprocket bracket
	07-02431C03	sprocket
	07-08453H01	bracket
	14-82884M01	feedthrough insulator
	15-08462H01	housing
	15-84355M01	shield cover
	27-08452H01	chassis
	29-00835302	ring tongue lug
	31-02340C09	terminal block
	32-82894M01	stand-off gasket, 2 used
	33-08323K01	nameplate
	42-10217A02	tie strap, 3 used
	42-10283A20	cable clip
	47-83033M01	threaded rod, 1/4-20
	54-08321K01	label
	54-08473K01	label
	54-83379A01	label, high voltage, 2 used
	58-08021K01	fitting
	58-08021K02	fitting