MOTOROLA

REFERENCE SYNTHESIZER

MODEL TLN3024B
MODEL TLN3025C 2 PPB HSO
MODEL TLN3242A 30 PPB HSO

PERFORMANCE SPECIFICATIONS

Frequency Stability with 2 ppb HSO:	.0000002% From −30°C to +60°C Ambient (Ref 25°C) .000004% Long Term Aging
Frequency Stability with 30 ppb HSO:	.00003% From −30°C to +60°C Ambient (Ref 25°C) .000004% Long Term Aging
Frequency Stability without HSO:	Dependent upon the frequency stability of reference frequency source
Supply Voltage Requirements:	+13.8 V dc ±20%
FM Noise with EIA De-emphasis:	55 dB
Synthesizer RF Output Level:	More than 0.7 V p-p when loaded by uniboard

SYNTHESIZER INTERFACE REQUIREMENTS

HSO Power Supply Input Voltage:	13.8 V dc ±20%
HSO Power Supply Output Voltage:	11.25 V dc ±0.25 V
HSO Power Consumption:	13.5 Watts maximum
HSO RF Level:	More than 0.5 V rms @ 50 Ohms
Synthesizer RF Output Level:	More than 0.7 V p-p (2 ppb HSO); or more than 0.5 V p-p (30 ppb HSO) when loaded by uniboard
Synthesizer Supply Voltage:	+13.8 V dc ±20%
Synthesizer Current Drain:	200 mA maximum (2 ppb HSO); or 800 mA maximum (30 ppb HSO)

1. GENERAL DESCRIPTION

The *MSF 5000* high stability reference synthesizer is a slide mounted unit designed for use in Motorola base stations. Refer to Tables 1, 2 or 3 for the model breakdowns. The reference synthesizer provides an RF reference signal of 14.4 MHz to the *MSF 5000* station synthesizer located on the uniboard. The synthesizer also provides high stability by phase-locking to a 100 kHz, 1 MHz, 5 MHz (standard) or 10 MHz stability reference oscillator. Refer to the applicable reference synthesizer block diagram and/or schematic diagram as required for details.

The descriptions given herein are applicable to the three synthesizer models listed above except as noted otherwise.

Table 1. TLN3024B Reference Synthesizer Chassis Model Breakdown Chart

Model	Description
TKN8525A	Reference Synthesizer Tray Cabling Kit
TRN9910B	Reference Synthesizer Board
TRN9932A	Reference Synthesizer Tray Hardware

Table 2. TLN3025C High Stability Oscillator Synthesizer Chassis Model Breakdown Chart

Model	Description
TKN8655A	Reference Synthesizer Tray Cabling Kit
TRN7304A	Reference Synthesizer and Tray Hardware
TRN9812B	HSO Power Supply Board
TRN9910B	Reference Synthesizer Board

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Table 3. TLN3242A High Stability Oscillator Synthesizer Chassis Model Breakdown Chart

Model	Description
TKN8655A	Reference Synthesizer Tray Cabling Kit
TRN7636A	Reference Synthesizer and Tray Hardware
TRN9812B	HSO Power Supply Board
TRN9910B	Reference Synthesizer Board

2. FUNCTIONAL THEORY OF OPERATION (MODEL TLN3024B)

2.1 TRN9910B REFERENCE SYNTHESIZER BOARD 9.6 V AND 5 V REGULATORS

The 9.6 V regulator consists of a series pass transistor (Q11) which is driven by transistor Q12. Regulated 9.6 V dc is provided to all analog and RF circuits and is derived from the station A+ supply (typically 13.8 V dc).

The 5 V regulator is supplied from the regulated 9.6 V dc supply and provides regulated 5 V dc to the logic circuits requiring 5 V dc. This regulator consists of a 3-terminal integrated circuit, U11.

2.2 REFERENCE AMPLIFIER (Q1, Q2)

The reference amplifier amplifies the high stability oscillator signal to the proper level and shape for application to reference dividers U2 and U3.

2.3 REFERENCE DIVIDER (U2, U3)

The reference divider divides the high stability oscillator frequency down to 100 kHz for use in phase locking CE1, the 14.4 MHz oscillator. Reference frequencies of 100 kHz, 1 MHz, 5 MHz, or 10 MHz can be used by setting jumpers JU1 through JU9.

2.4 PHASE DETECTOR (U7)

One segment of U7 (a quad exclusive-OR gate) is used as a phase detector. The output consists of pulses at 200 kHz (twice the input frequency) having a width dependent on the phase error between the two input signals.

2.5 LOOP INTEGRATOR (Q9, ETC.)

Q9 amplifies the output pulses of U7 to approximately 8 volts peak-to-peak. R26, C23, R27 and C24 form an integrator which recovers the dc value of Q9's output pulses for use in controlling the frequency of CE1 (the 14.4 MHz VCXO).

2.6 14.4 MHZ VCXO (CE1)

CE1 is the VCXO which is phase-locked to the HSO. The output of CE1 (after amplification, etc.) is used to provide one of the phase detector (U7) inputs.

2.7 LOOP AMPLIFIER (Q4, Q5, Q6)

The loop amplifier amplifies and shapes the output signal of CE1 to the proper logic level for application to divide-by-12 dividers U4 and U5.

2.8 LOOP DIVIDER (Q4,Q5)

The loop divider divides the output frequency of Q6 by 144 to produce the 100 kHz signal to phase detector U7. The 100 kHz feedback signal is compared in phase to the 100 kHz signal derived from the HSO.

2.9 RF ENABLE SWITCH/OUTPUT AMPLIFIER (Q8, Q9, CR61, CR62)

Q8 and Q9 buffer the output of CE1 to prevent loading by the coaxial cable used to connect CE1 to the uniboard. CR61 and CR62 are PIN diodes used in a series shunt RF switch to attenuate the signal delivered to the uniboard if the synthesizer is out-of-lock. The output of the synthesizer (Q8 and Q9 emitters) is the frequency reference for the uniboard phase lock loop.

2.10 LOSS-OF-LOCK DETECTOR (U6, U7, ETC.)

The loss-of-lock detector indicates an out-of-lock condition whenever the steering line voltage (test point TP2) drifts outside the 0.5 V dc to 2.5 V dc range. Comparator output U6 pin 1goes high when the voltage at TP2 is less than 0.5 V dc and comparator output U6 pin 2 goes high when the voltage at TP2 is greater than 2.5 V.

The U6-1 and U6-2 outputs are combined in an exclusive OR gate whose output (U7-8) is applied to a RC delay circuit consisting of C41 and R50. The delay circuit prevents transmission during acquisition of an out-of-lock condition or other transient or oscillatory conditions. the output of the delay circuit is applied to comparator input U6-8. Comparator output (U6-14) controls the status of LED DS42 and also controls the rf enable switch (Q7, Cr61, CR62 and associated components).

Gate status for the out-of-lock and lock conditions are as follows:

Out-of-Lock: U6-1 or U6-2 is high, U7-8 is high, U6-14 is low and turns on DS42, U7-11 is low, Q7 is off, CR61 is reversed biased, and CR62 is forward biased thus shunting the rf output to ground.

Lock: U6-1 or U6-2 is low, U7-8 is low, U6-14 is high and keeps DS42 off, U7-11 is high, Q7 is on, CR61 is forward biased, and CR62 is reverse biased thus enabling the rf output to pass through the power amplifier.

Table 4. Operating Conditions Requiring Service

Condition	Remarks
U1 pin 7 > 3.5 V dc	Loss of reference signal or misalignment
U1 pin 7 oscillating from 0 V to 8 V	Reference source not warmed up or defective, possible misalignment.

3. FUNCTIONAL THEORY OF OPERATION (MODELS TLN3025C, TLN3242A)

3.1 GENERAL

The Models TLN3025C and TLN3242A High Stability Synthesizers are identical to the Model TLN3024B Reference Synthesizer except for containing two additional modules: a TRN9812B HSO Power Supply and a A2500 High Stability Oscillator (HSO). These two additional items are described in the following paragraphs. Refer to the previous information for the descriptions of the other boards used in the TLN3025C and TLN3242A High Stability Synthesizers.

3.2 TRN9812B HSO POWER SUPPLY

The TRN9812B HSO Power Supply provides a highly regulated 11.25 V dc output voltage that is used to operate the A2500 HSO. Q1 is the series pass transistor. Q3 senses any current change through divider string CR1, VR1, R9, R10, R11 and R3. An increase in output voltage at the collector of Q1 provides an increase in drive current at the base of Q3 through the divider string. This action decreases the drive at the base of Q2 which, in turn, decreases the drive to Q1 and lowers the output voltage, maintaining regulation. Overvoltage protection is provided by Q4 which turns on when the output voltage rises above 15 volts, and drives the gate of Q5 turning it on. Q5, when enabled, shorts the A+ input to ground which blows fuse F1.

3.3 HIGH STABILITY OSCILLATOR

High Stability Oscillator A2500 provides a very stable 5 MHz output that is used as the reference input to the synthesizer. The stability of the reference oscillator determines the overall stability of the synthesizer.

Table 5. Troubleshooting Chart

Symptom	Possible Causes
1. No RF Output	1. Out-of-lock detected 2. Q8, Q9 bad 3. CR61 open or CR62 is shorted
2. Out-Of-Lock (Reference Loop)	1. CE1 not properly tuned 2. CE1 defective 3. JU1-JU9 improperly installed 4. Loss of HSO signal or external reference signal 5. Defective amplifier (Q1, Q2) 6. Defective Loss-Of-Lock Detector Circuit

Table 6. Synthesizer Jumpering

Kit	Jumpers
TRN9910B Reference Synthesizer Board	JU6 and JU7 IN if reference frequency is 100 kHz JU3, JU4, JU5 IN if reference frequency is 1 MHz JU1, JU2, JU3 IN if reference frequency is 5 MHz JU1, JU3, JU8, JU(IN if reference frequency is 10 MHz

4. ALIGNMENT PROCEDURE

4.1 GENERAL

Monitor the transmitter output frequency with a frequency counter of adequate accuracy (typically accurate to ±1 Hz).

4.2 HIGH STABILITY OSCILLATOR (HSO)

The 2 ppb HSO should be allowed to warm up for at least 30 minutes and the 30 ppb HSO at least 10 minutes before proceeding with the alignment procedure. This is necessary for the oven in the oscillator to reach its operating temperature. The adjustment of the HSO frequency should be made following paragraph 4.3 and again following the entire procedure, if necessary.

4.3 14.4 MHZ VOLTAGE CONTROLLED CRYSTAL OSCILLATOR (VCXO)

Refer to the circuit board details in this instruction section for test point locations.

Adjust CE1 warp coil for 1.5 V (±0.1 V dc) at Test Point 2. A high resistance voltmeter must be used at this point.

4.4 OUT-OF-LOCK CHECK

Step 1. Remove power to the synthesizer (or the station).

Step 2. Re-apply power to the synthesizer (or the station). The Out-of-Lock indicator should remain lit for 0.5 to 5 seconds.

Step 3. The station should not be capable of being keyed while the Out-of-Lock indicator is lit.

5. OPERATIONAL TESTS

5.1 REGULATORS

Check for 9.6 V dc (±0.5 V), and 5 V dc (±0.1 V).

5.2 REFERENCE LOOP

A known working HSO is required at this point.

- Check for 100 kHz TTL signal at U7-2
- Check for 100 kHz signal at U7-1
- Check for 14 4 MHz TTL signal at Q6 collector
- Check that CE1 steering line (CE1-7) is set for +1.5 V dc (no AC).

parts list

TRN9910B Reference Synthesizer Board — PL-11485-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ±5%; 50V unless otherwise stated
C11 thru 19, 22	2113741B45	.01
C22	2311054H10	15 ±10%; 25V
C23,24	0811044A15	0.1; 63V
C25,26	2113741B45	.01
C31	2311054H10	15 ±10%; 25V
C32 thru 34	2113741B45	.01
C35	2311019A16	4.7 ±20%; 35V
C36 thru 40	2113741B45	.01
C41	2311019A21	10 ±20%; 35V
C42	2113741B45	.01
C61	2113740B49	100pF
C62,63	2113740B25	10pF
C64	2113741B45	.01
C65	2113740B49	100pF
C66,67	2113741B45	.01
C68	2113740B24	9.1pF
C69	2113741B45	.01
C81	2113741B53	.022
C82	2113740B32	20pF
C83	2311019A46	100 ±20%; 25V
C84	2311019A21	10 ±20%; 35V
C85	0811044A30	0.33; 50/63V
C86	2113741B45	.01
C87	2113740B32	20pF
C88	2311019A42	47 ±20%
C89	2311019A46	100 ±20%; 25V
C90	2311019A21	10 ±20%; 35V
C91	0811044A30	0.33; 50/63V
C92	2113741B45	.01
C93	2113740B32	20pF
		crystal: (see note)
CE1	5180291B02	referenced oscillator KXN1096A
		diode: (see note)
CR31,41	4883654H01	silicon
CR61,62	4880010E02	PIN
CR81	4883654H01	silicon
		light emitting diode: (see note)
DS42	4888245C28	red
		connector:
J5	2883143M06	plug, 3-pin
		jumper:
JU1 thru 3	0611009B23	resistor, 0 ohm
		coil:
L31	2482723H45	10uH
L61	2482723H35	23uH
L62	2482723H45	10uH
L63	2482723H33	14uH
		connector:
P6,9	0984231B02	receptacle, phono
		transistor: (see note)
Q1,2	4800869570	NPN
Q3	4800869642	NPN
Q4 thru 6	4800869570	NPN
Q7	4800869642	NPN
Q8	4800869570	NPN
Q9	4800869571	PNP
Q11	4800869807	PNP
Q12	4800869640	NPN
Q13	4800869642	NPN
		resistor, fixed: ±5%; 1/8W unless otherwise stated
R11	0611077A435	51
R12,13	0611077A76	1200
R14	0611077A43	51
R15	0611077A54	150
R16	0611077A74	1000
R17	0611077A59	240
R18	0611077A43	51
R19	0611077A67	510
R21	0611077A92	5600
R22	0611077A98	10K
R23	0611077A48	82
R24,25	0611077A76	1200
R26,27	0611077A92	5600
R28	0611077A98	10K
R31	0611077A43	51
R32	0611077A90	4700
R33	0611077A92	5600
R34,35	0611077A74	1000
R36	0611077B08	24K
R37	0611077B07	22K
R38	0611077A50	100
R39	0611077A84	2700
R40	0611077A64	390
R41	0611077A74	1000
R42	0611077A74	1000
R43	0611077A89	4300
R44	0611077A78	1500
R45	0611077B05	18K
R46 thru 49	0611077A74	1000
R50	0611077B15	47K
R51	0611077A94	6800
R52	0611077A80	1800
R53	0611077A98	10K
R54	0611077A68	560
R55	0611077B11	33K
R56	0611077A82	2200
R57	0611077A80	1800
R61	0611077A60	270
R62	0611077A74	1000
R63	0611077A82	2200
R64	0611077A74	1000
R65	0611077A86	3300
R66	0611077A74	1000
R67	0611077A86	3300
R68,69	0611077A54	150
R71	0611077A74	1000
R81	0611009A57	2200; 1/4W
R82,83	0611045A36	300; 1/2W
R84,85	0611049G60	41.2 ±1%; 1/4W
		integrated circuit: (see note)
U2,31	5184118K31	Decade Counter
U4,5	5184118K54	Divide by Twelve Counter
U6	5184320A51	Quad Comparator
U7	5184118K21	Quad Exclusive OR Gate
U11	5184320A47	+5V Voltage Regulator
		voltage regulator: (see note)
VR82	4883461E32	Zener; 8.2V
		non-referenced items
	5584300B02	HANDLE (4 used)
	5483865R01	LABEL, bar code
	2684881R01	SHIELD: 2.59 × 2.59"
	2684880R01	SHIELD: 2.52 × 1.37"
	2684878R01	SHIELD: 2.50 × 2.50"
	2684879R01	SHIELD: 2.63 × 1.48"
	0210971A16	NUT, hex: M3 × 0.5 (Q11)
	0383497N04	SCREW, machine: M3 × 0.5 × 8 (Q11)
	0484180C01	WASHER, shoulder (Q11)
	1483820M02	INSULATOR, heat conductive (Q11)
	2683192N01	HEAT SINK (Q11)
	0210971A16	NUT, hex: M3 × 0.5 (U11)
	0383497N04	SCREW, machine: M3 × 0.5 × 8 (U11)
	0484180C01	WASHER, shoulder (U11)
	1483820M02	INSULATOR, heat conductive (U11)
	2683192N01	HEAT SINK (U11)

TRN9932A Reference Synthesizer Hardware — PL-11165-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	0184864R01	CABLE ASSEMBLY (2 used)
	0310907A28	SCREW, machine: M3.5 × 0.6 × 10 (5 used)
	0384890R01	SCREW, machine: M3.5 × 0.6 (8 used)
	1584835R01	COVER, synthesizer
	2782906R01	CHASSIS, synthesizer
	3282796H01	GASKET: 38" lg
	3700085556	GROMMET, rubber (2 used)
	3883925R01	CAP, connector
	4210217A02	STRAP, tie: .091 × 3.62" (2 used)
	4210217A34	STRAP, tie: .140 × 6.1"
	4210347A03	CLIP, cable
	4283981P01	RETAINER
	6484172R01	PLATE, connector mtg

TKN8525A Reference Synthesizer Cables — PL-11167-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector:
J6	0984968D01	receptacle: single contact (p/o W10)
J8	0983360N07	receptacle: 3-contact (p/o W4)
J9	0984968D01	receptacle: single contact (p/o W7)
J10	0984968D01	receptacle: single contact (p/o W10)
		connector:
P5		consists of:
	1583142M10	housing, connect: 3-position (p/o W4)
	3982717M01	contact, receptacle: 2 used (p/o W4)
P2504	2882331G01	plug, coaxial (p/o W7)
		cable assembly:
W4	0180718E49	Synthesizer DC Power
W7	0180782D87	Reference Frequency Output
W10	0180709E96	Distributed Reference Input
		non-referenced items
	4210217A02	STRAP, tie: .091X3.62" (p/o W4)
	3083794C01	CABLE, coaxial: 33" lg (p/o W7)
	3083794C01	CABLE, coaxial: 48" lg (p/o W10)
	6483933R01	PLATE, connector mtg (p/o W10)

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R44	0611077A78	1500
R45	0611077B05	18K
R46 thru 49	0611077A74	1000
R50	0611077B15	47K
R51	0611077A94	6800
R52	0611077A80	1800
R53	0611077A98	10K
R54	0611077A68	560
R55	0611077B11	33K
R56	0611077A82	2200
R57	0611077A80	1800
R61	0611077A60	270
R62	0611077A74	1000
R63	0611077A82	2200
R64	0611077A74	1000
R65	0611077A86	3300
R66	0611077A74	1000
R67	0611077A86	3300
R68,69	0611077A54	150
R71	0611077A74	1000
R81	0611009A57	2200; 1/4W
R82,83	0611045A36	300; 1/2W
R84,85	0611049G60	41.2 ±1%; 1/4W
		integrated circuit: (see note)
U2,31	5184118K31	Decade Counter
U4,5	5184118K54	Divide by Twelve Counter
U6	5184320A51	Quad Comparator
U7	5184118K21	Quad Exclusive OR Gate
U11	5184320A47	+5V Voltage Regulator
		voltage regulator: (see note)
VR82	4883461E32	Zener; 8.2V
	non-referenced items	
	5584300B02	HANDLE (4 used)
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	0383497N04	SCREW, machine: M3 × 0.5 × 8 (Q11)
	0484180C01	WASHER, shoulder (Q11)
	1483820M02	INSULATOR, heat conductive (Q11)
	2683192N01	HEAT SINK (Q11)
	0210971A16	NUT, hex: M3 × 0.5 (U11)
	0383497N04	SCREW, machine: M3 × 0.5 × 8 (U11)
	0484180C01	WASHER, shoulder (U11)
	1483820M02	INSULATOR, heat conductive (U11)
	2683192N01	HEAT SINK (U11)

TRN9932A Reference Synthesizer Hardware — PL-11165-O

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	0310907A28	SCREW, machine: M3.5 × 0.6 × 10 (5 used)
	0384890R01	SCREW, machine: M3.5 × 0.6 (8 used)
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	2782906R01	CHASSIS, synthesizer
	3282796H01	GASKET: 38" lg
	3700085556	GROMMET, rubber (2 used)
	3883925R01	CAP, connector
	4210217A02	STRAP, tie: .091 × 3.62" (2 used)
	4210217A34	STRAP, tie: .140 × 6.1"
	4210347A03	CLIP, cable
	4283981P01	RETAINER
	6484172R01	PLATE, connector mtg

TKN8525A Reference Synthesizer Cables — PL-11167-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector:
J6	0984968D01	receptacle: single contact (p/o W10)
J8	0983360N07	receptacle: 3-contact (p/o W4)
J9	0984968D01	receptacle: single contact (p/o W7)
J10	0984968D01	receptacle: single contact (p/o W10)
		connector:
P5		consists of:
	1583142M10	housing, connect: 3-position (p/o W4)
	3982717M01	contact, receptacle: 2 used (p/o W4)
P2504	2882331G01	plug, coaxial (p/o W7)
		cable assembly:
W4	0180718E49	Synthesizer DC Power
W7	0180782D87	Reference Frequency Output
W10	0180709E96	Distributed Reference Input
	non-referenced items	
	4210217A02	STRAP, tie: .091X3.62" (p/o W4)
	3083794C01	CABLE, coaxial: 33" lg (p/o W7)
	3083794C01	CABLE, coaxial: 48" lg (p/o W10)
	6483933R01	PLATE, connector mtg (p/o W10)

TKN8496A Reference Synthesizer Power Supply Cable — PL-10619-O

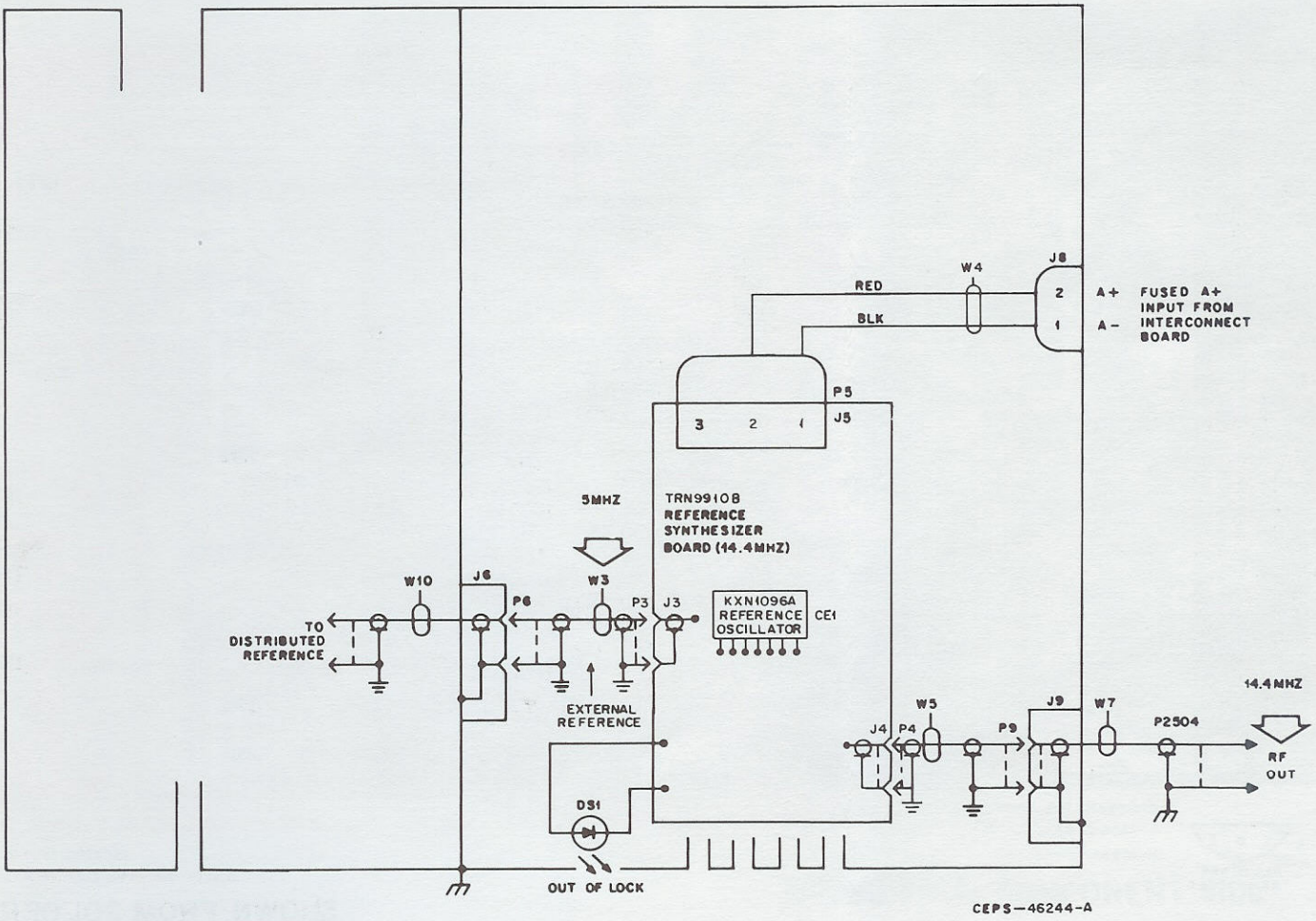
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse:
F700	6500052281	1 amp; 250V
		connector, plug:
P500	—	consists of:
	1583142M10	HOUSING, 3-position
	3982717M01	CONTACT, receptacle; 2 used
P8	2883943R01	male, 3 contact
		cable assembly:
W9	—	includes ref. items F700, P8, P500, and
	0983417R01	FUSEHOLDER
	4210217A02	STRAP, tie: .091 × 3.62"; 2 used

TKN8497A HSO Reference Synthesizer Power Supply Cable — PL-10618-O

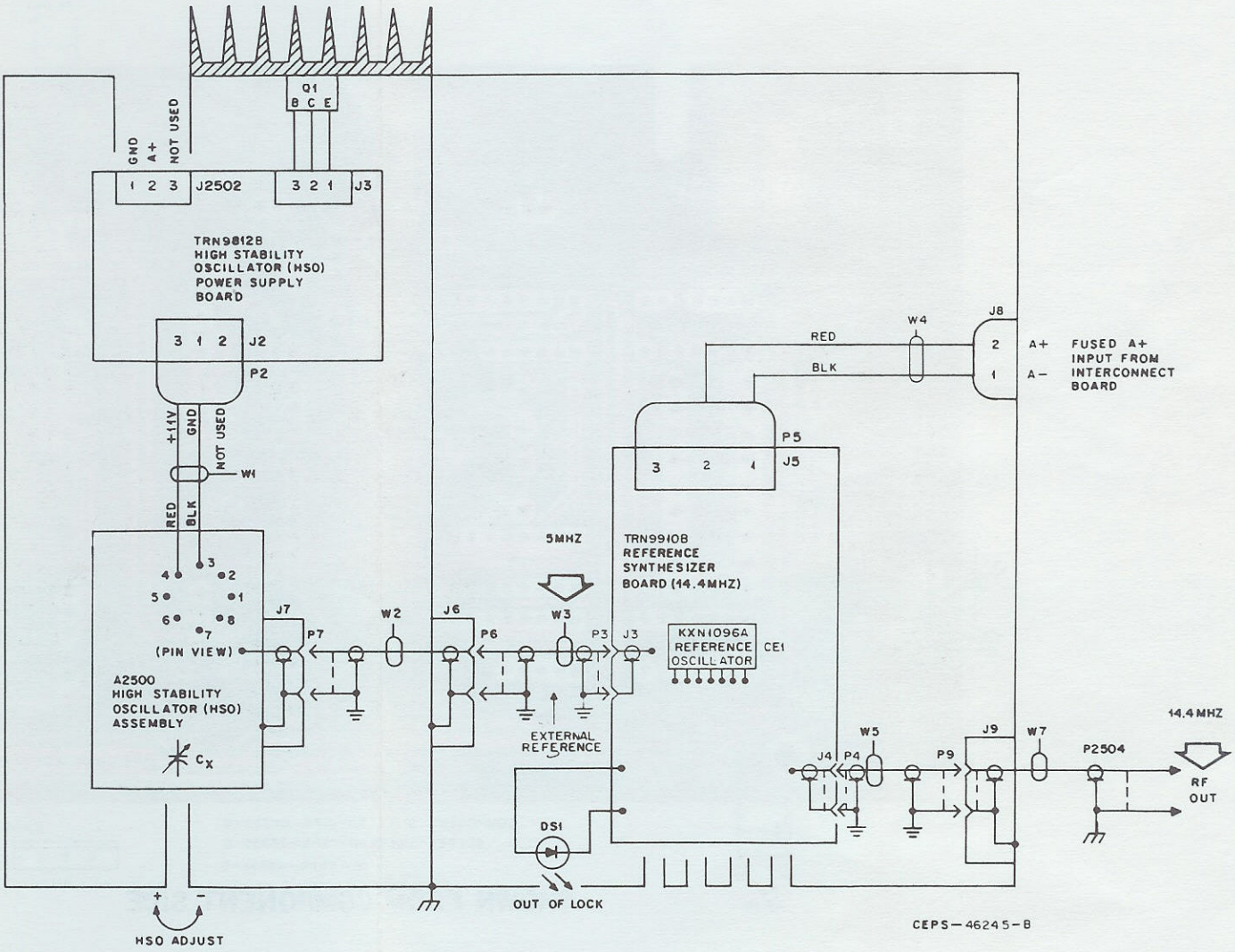
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse:
F700	6500052281	1 amp; 250V
		connector plug:
P8	2883943R01	CONNECTOR, male: 3-contact
P500	—	consists of:
	1583142M10	HOUSING, 3-position
	3982717M01	CONTACT, receptacle; 2 used
P2502	0983360N07	CONTACT, female: 3-contact
		cable assembly:
W8	—	Includes ref. Items F700, P2502, and
	0982845L02	CONNECTOR, crimp; 2 used
	0983417R01	FUSEHOLDER
	4210217A02	STRAP, tie: .091 × 3.62"; 5 used

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

TLN3024B REFERENCE SYNTHESIZER



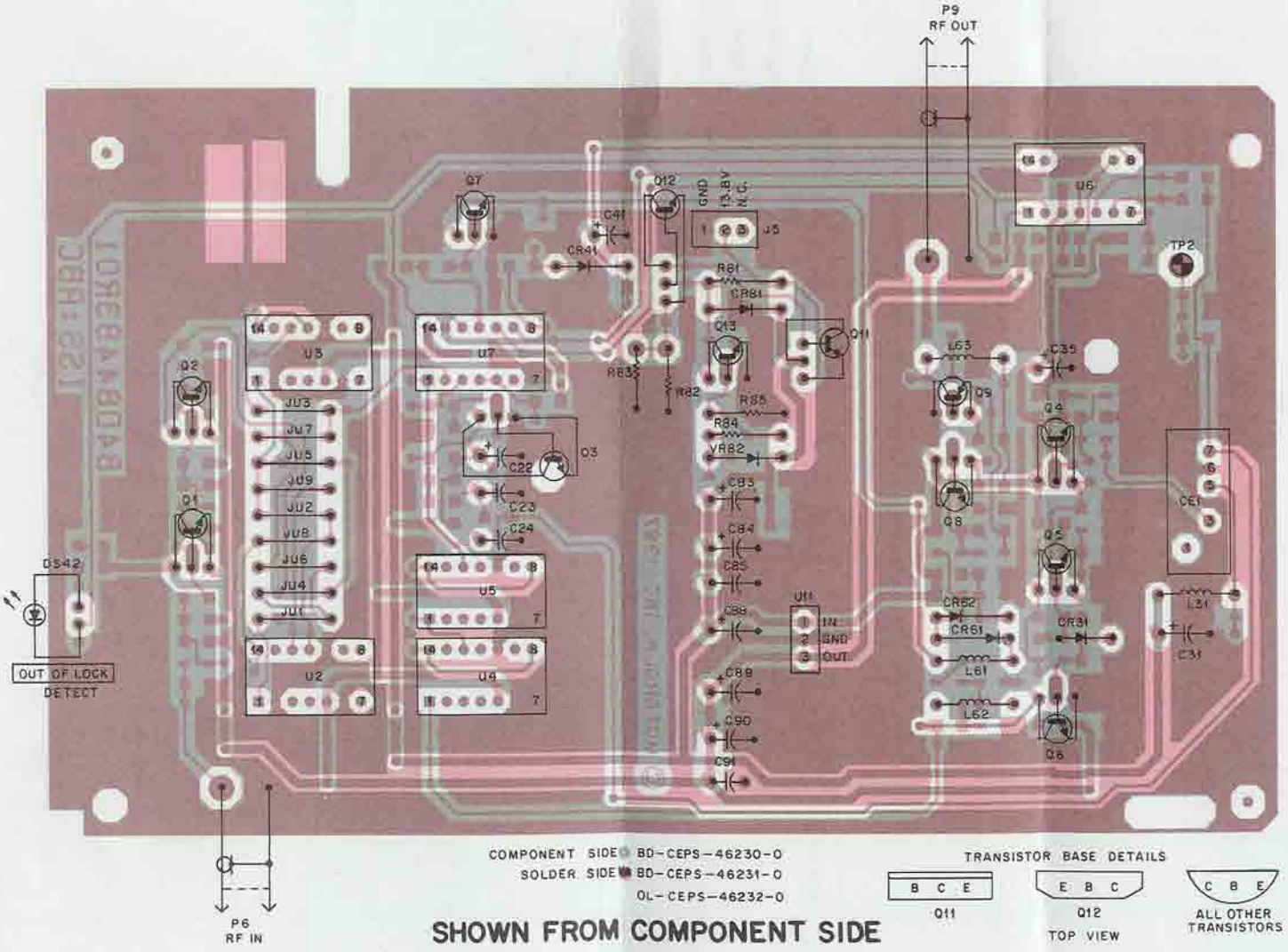
TLN3025C/TLN3242A REFERENCE SYNTHESIZER

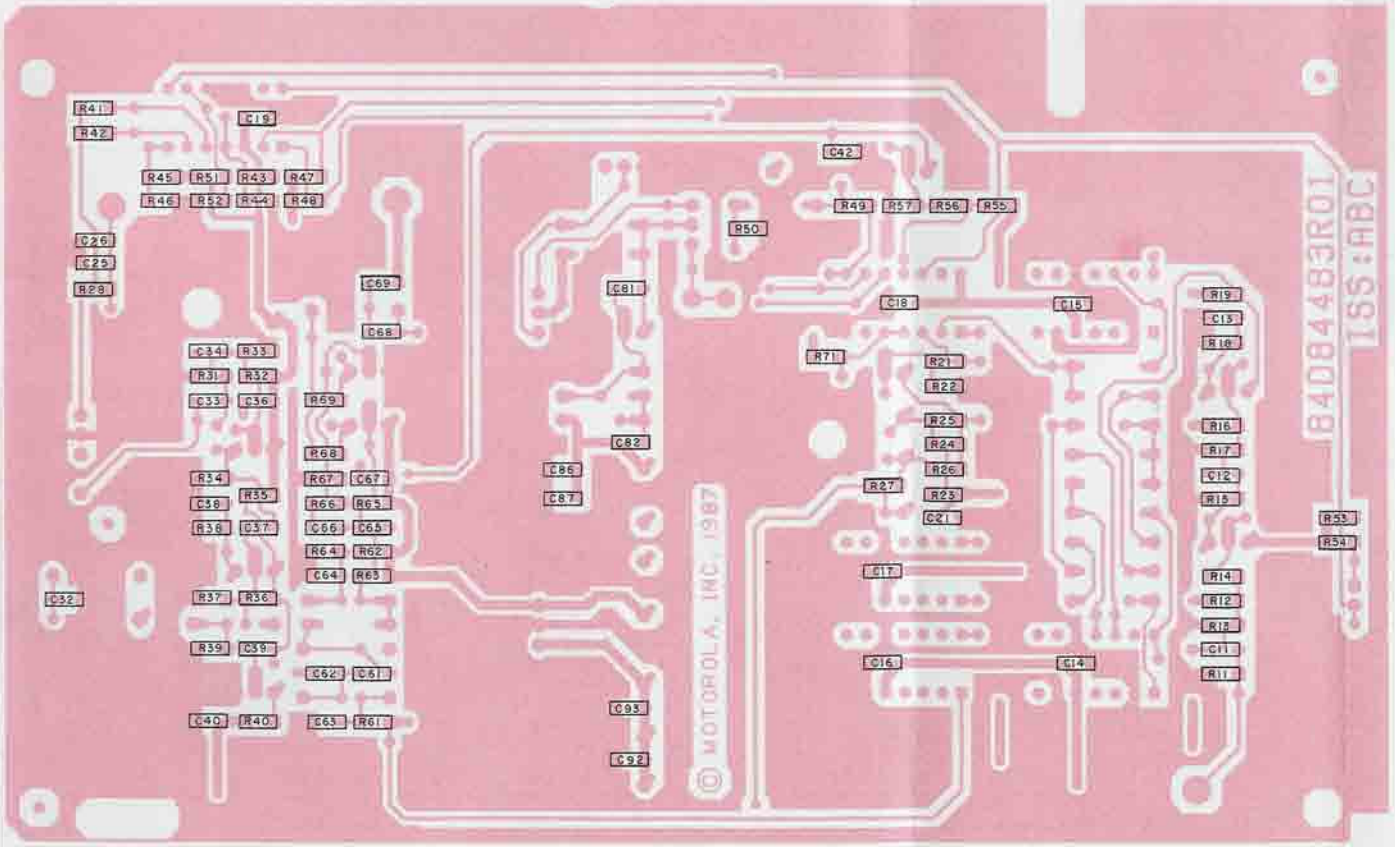


REFERENCE SYNTHESIZER
CIRCUIT BOARD DETAIL
ON NEXT PAGE

REFERENCE SYNTHESIZER

CIRCUIT BOARD DETAILS AND PARTS LISTS





OL-CEPS-46233-O

SOLDER SIDE ● BD-CEPS-46231-O(REV)

SHOWN FROM SOLDER SIDE

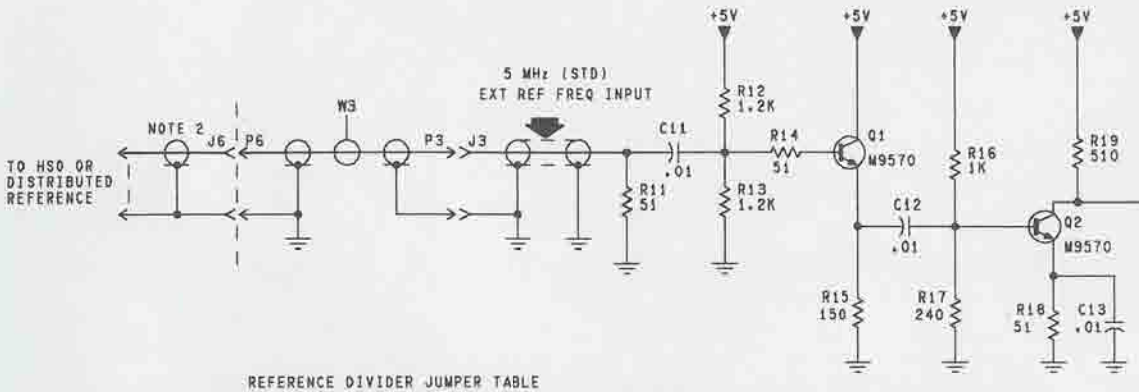
TKN8655A HSO Reference Synthesizer Cables PL-11933-O

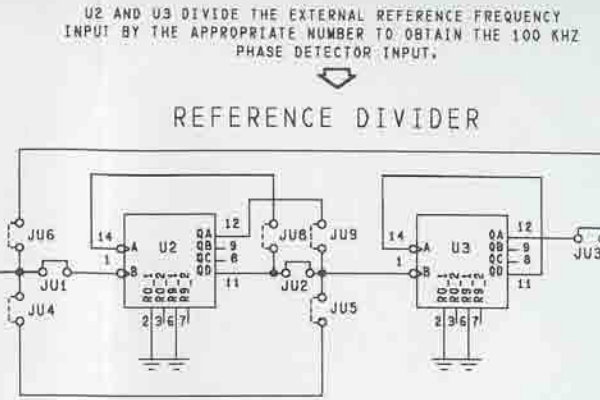
REF. SYMBOL	PART NO.	DESCRIPTION
		non-referenced items:
	0180718E49	CABLE ASSEMBLY, synthesizer power supply
		includes:
	0983360N07	CONNECTOR, receptacle: 3-contact
	1583142M10	HOUSING, connector: 3-con tact
	3982717M01	CONTACT, receptacle (2 used)
	4210217A02	STRAP, tie: .091x3.62" lg
	0180730E31	CABLE ASSEMBLY
		includes:
	1583142M08	HOUSING, connector: 4-con tact
	3982717M01	CONTACT, receptacle (4 used)
	4210217A02	STRAP, tie: .091x3.62" lg
	0180782D87	CABLE ASSEMBLY, output
		includes:
	0984968D01	CONNECTOR, receptacle: BNC type
	2882331G01	CONNECTOR, plug: coaxial: phono
	3083794C01	CABLE, coaxial (33" used)
	0180782D90	CABLE ASSEMBLY, HSO
		includes:
	0984968D01	CONNECTOR, receptacle: BNC type
	2883099K01	CONNECTOR, plug: BNC type
	3083794C01	CABLE, coaxial (7.75" used)

TRN7304A HSO Reference Synthesizer Hardware PL-11934-O

REF. SYMBOL	PART NO.	DESCRIPTION
		non-referenced items:
	0184864R01	CABLE ASSEMBLY, coaxial: in-cludes phono and BNC type connectors (2 used)
	0200132616	NUT, hex: 6-32x1/4x3/32x1/8" (4 used)
	0310907A28	SCREW, machine: M3.5x0.6x10 (7 used)
	0384890R01	SCREW, machine: M3.5x0.6 (10 used)
	1584835R01	COVER, synthesizer
	1584837R01	COVER, HSO
	2784836R01	CHASSIS, synthesizer
	3282796H01	GASKET, rfi (38" used)
	3883925R01	END CAP, panel mtg
	4210217A02	STRAP, tie: .091x3.62" lg
	4210347A03	CLAMP, cable
	4283981P01	RETAINER, cable
	4883851N05	CRYSTAL OSCILLATOR: 5.0 MHZ
	5483262P01	LABEL, Carrier Frequency Measurement
	6484172R01	PLATE, feedthru mtg

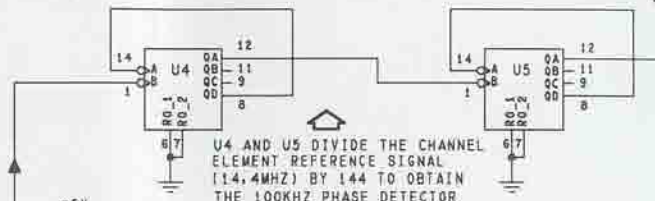
NOTE: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part number.

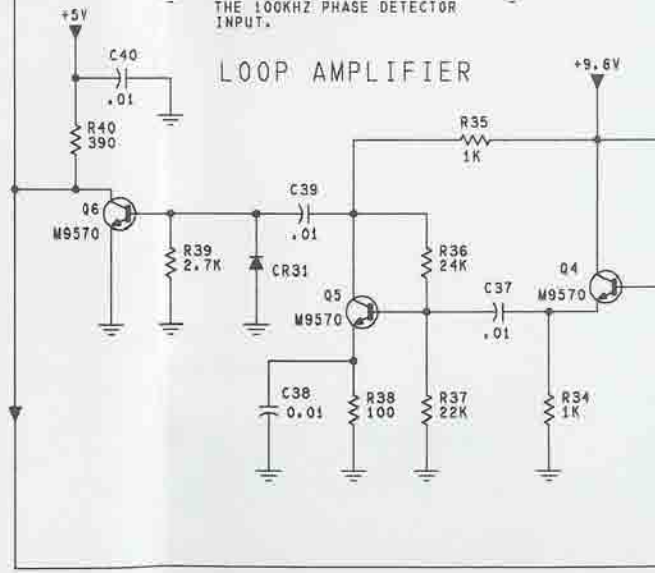


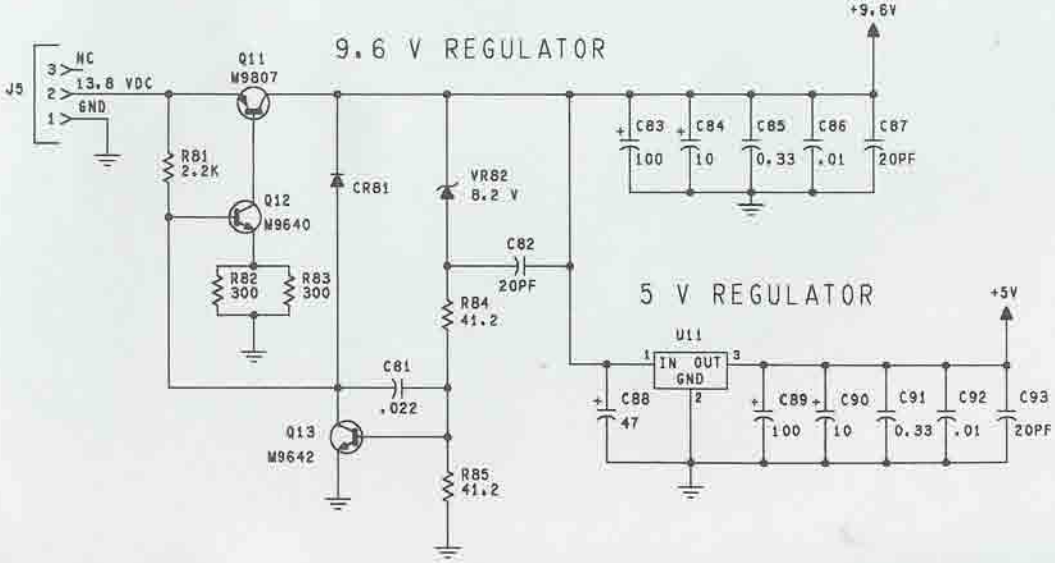


REFERENCE DIVIDER JUMPER TABLE

REFERENCE FREQUENCY	JU1	JU2	JU3	JU4	JU5	JU6	JU7	JU8	JU9
100 KHZ	OUT	OUT	OUT	OUT	OUT	IN	IN	OUT	OUT
1 MHZ	OUT	OUT	IN	IN	IN	OUT	OUT	OUT	OUT
5 MHZ (STD)	IN	IN	IN	OUT	OUT	OUT	OUT	OUT	OUT
10 MHZ	IN	OUT	IN	OUT	OUT	OUT	OUT	IN	IN







REFERENCE LOOP

AND U3 DIVIDE THE EXTERNAL REFERENCE FREQUENCY
BY THE APPROPRIATE NUMBER TO OBTAIN THE 100 KHZ
PHASE DETECTOR INPUT.

REFERENCE DIVIDER

U2 U3 JU1 JU2 JU3 JU5 JU7 JU8 JU9

100 KHz

DIVIDE-BY-12 DIVIDERS

U4 U5

100 KHz

U4 AND U5 DIVIDE THE CHANNEL ELEMENT REFERENCE SIGNAL (14.4MHZ) BY 144 TO OBTAIN THE 100KHZ PHASE DETECTOR INPUT.

LOOP INTEGRATOR

+9.6V

C21 .01
R23 82
C22 15
R24 1.2K
R25 1.2K

PHASE DETECTOR

U7
R21 5.6K
R22 10K
Q3 M9642
R26 5.6K
R27 5.6K
C23 0.1
C24 0.1

U7-3 HAS A 200 KHZ PULSE TRAIN WITH A PULSE WIDTH DETERMINED BY THE PHASE DIFFERENCE BETWEEN SIGNALS AT U7-1 & U7-2. THIS SIGNAL IS USED TO CONTROL THE FREQUENCY OF CE1.

IF THE LOOP INTEGRATOR OUTPUT IS NOT WITHIN THE PRESET WINDOW OF 0.5V TO 2.5V THEN THE LOOP WILL BE CONSIDERED OUT-OF-LOCK BY THE LOSS-OF-LOCK DETECTOR.

LOOP AMPLIFIER

+9.6V

R35 1K
C39 .01
CR31
R39 2.7K
R36 24K
Q5 M9570
C37 .01
Q4 M9570
R32 4.7K
C36 .01
C35 4.7
C34 .01
C33 .01
C38 0.01
R38 100
R37 22K
R34 1K
R33 5.6K
R31 51

+9.6V
C31 15
L31 10
C32 .01

VCC
OUT CE1 MOD
GND1 CASE GND2

R28 10K
TP2
C26 .01
C25 .01

IN-LOCK=1.50 VDC

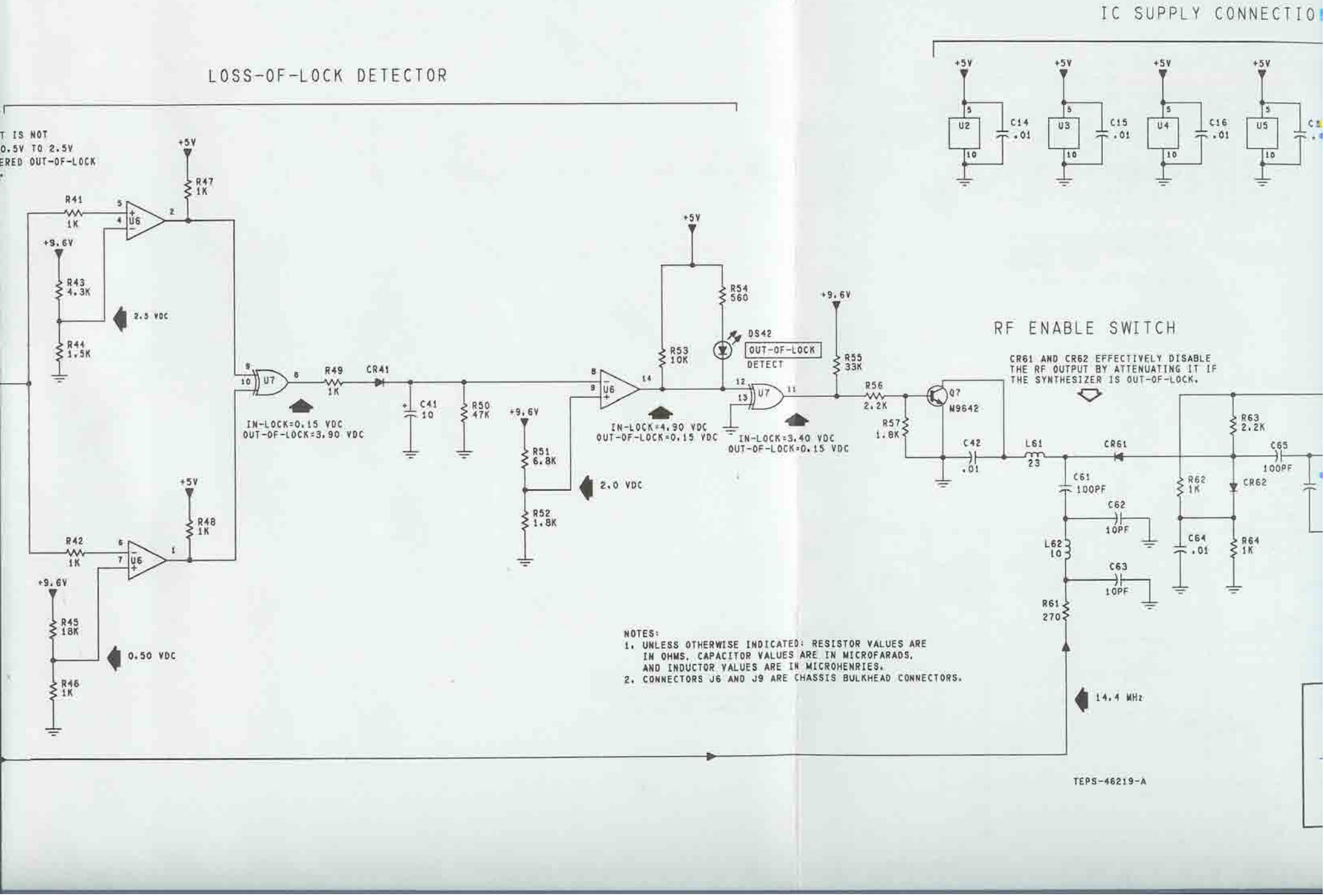
LOSS-OF-LOCK DETECTOR

+5V
R47 1K
R41 1K
U6
+9.6V
R43 4.3K
2.5 VDC
R44 1.5K

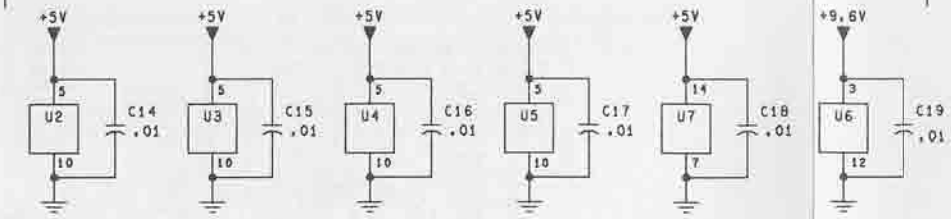
U7
R49 1K
CR41
C41 10
R50 47K

IN-LOCK=0.15 VDC
OUT-OF-LOCK=3.90 VDC

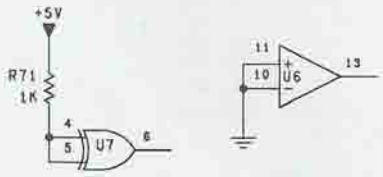
+5V
R48 1K
R42 1K
U6
+9.6V
R45 18K
0.50 VDC
R46 1K


IC SUPPLY CONNECTIO
+5V
U2
C14 .01
U3
C15 .01
U4
C16 .01
U5
LOSS-OF-LOCK DETECTOR
T IS NOT
0.5V TO 2.5V
ERED OUT-OF-LOCK
R47 1K
R41 1K
U6
+9.6V
R43 4.3K
2.5 VDC
R44 1.5K
R48 1K
R42 1K
R45 18K
0.50 VDC
R46 1K
U7
R49 1K
CR41
C41 10
R50 47K
IN-LOCK=0.15 VDC
OUT-OF-LOCK=3.90 VDC
R51 6.8K
2.0 VDC
R52 1.8K
R54 560
R53 10K
DS42
OUT-OF-LOCK
DETECT
IN-LOCK=4.90 VDC
OUT-OF-LOCK=0.15 VDC
IN-LOCK=3.40 VDC
OUT-OF-LOCK=0.15 VDC
R55 33K
R56 2.2K
R57 1.8K
Q7
M9642
C42 .01
RF ENABLE SWITCH
CR61 AND CR62 EFFECTIVELY DISABLE
THE RF OUTPUT BY ATTENUATING IT IF
THE SYNTHESIZER IS OUT-OF-LOCK.
L61 23
CR61
C61 100PF
C62 10PF
L62 10
C63 10PF
R61 270
14.4 MHz
R63 2.2K
C65 100PF
R62 1K
CR62
C64 .01
R64 1K
NOTES:
1. UNLESS OTHERWISE INDICATED: RESISTOR VALUES ARE
IN OHMS, CAPACITOR VALUES ARE IN MICROFARADS,
AND INDUCTOR VALUES ARE IN MICROHENRIES.
2. CONNECTORS J6 AND J9 ARE CHASSIS BULKHEAD CONNECTORS.
TEPS-46219-A

IC SUPPLY CONNECTIONS

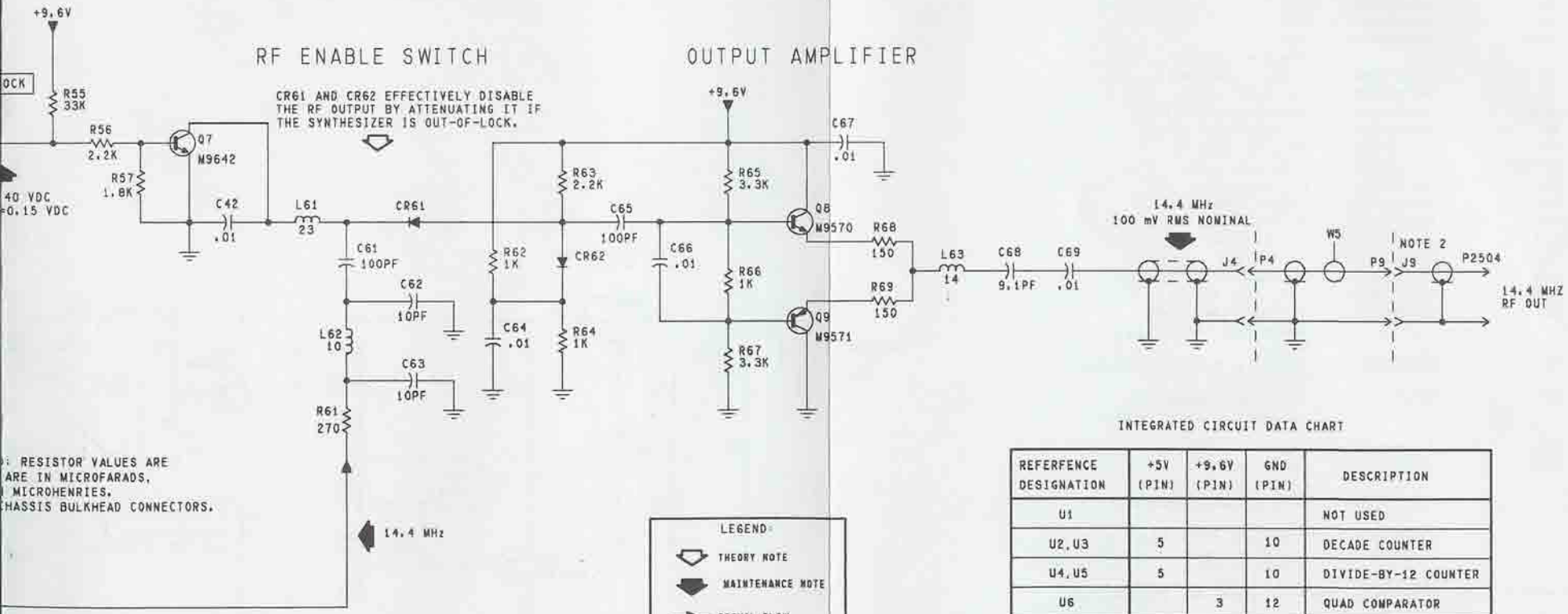


UNUSED CIRCUITS



RF ENABLE SWITCH

OUTPUT AMPLIFIER



: RESISTOR VALUES ARE
ARE IN MICROFARADS,
MICROHENRIES.
HASSIS BULKHEAD CONNECTORS.

TEPS-46219-A

LEGEND:
- THEORY NOTE
- MAINTENANCE NOTE
- SIGNAL FLOW
- CIRCUIT GROUND
- CHASSIS GROUND

INTEGRATED CIRCUIT DATA CHART

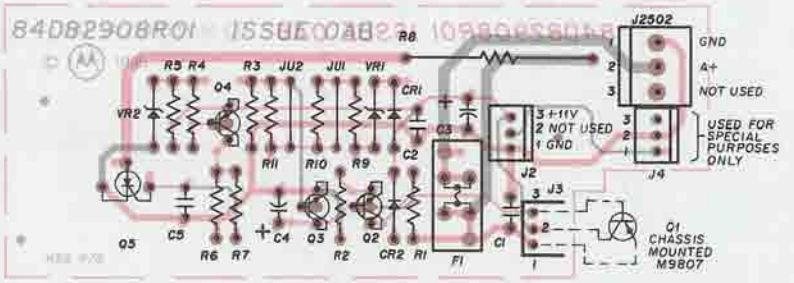
REFERFENCE DESIGNATION	+5V (PIN)	+9.6V (PIN)	GND (PIN)	DESCRIPTION
U1				NOT USED
U2, U3	5		10	DECADE COUNTER
U4, U5	5		10	DIVIDE-BY-12 COUNTER
U6		3	12	QUAD COMPARATOR
U7	14		7	QUAD EXCLUSIVE OR
U8 THRU U10				NOT USED
U11	3	1	2	+5V REGULATOR

HSO POWER SUPPLY
SCHEMATIC DIAGRAM, CIRCUIT

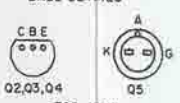
TRN9812B HSO/UHSO Power Supply PL-11561-B

REF. SYMBOL	PART NO.	DESCRIPTION
		capacitor, fixed:
C1	2113741B69	0.1 uF, ±5%; 50V
C3	2113741B69	0.1 uF, ±5%; 50V
C4	2313748G19	47 uF, ±20%; 35V
C6	2113741B45	0.01 uF, ±5%; 50V
C7	2113741B61	0.047 uF, ±5%; 50V
C9	2113741B37	4700 pF, ±5%; 50V
C10	2311049A19	10 uF, ±10%; 25V
C11	2113740B32	20 pF, ±5%; 50V
C12	2311049A21	22 uF, ±10%; 20V
C13	2113741B45	0.01 uF, ±5%; 50V
C14	2113741B69	0.1 uF, ±5%; 50V
		diode: (see note)
CR1	4884336R05	silicon
		fuse:
F1	6582847N30	2A, 250V
		connector:
P1	2884324M09	plug: 4-contact
P2502	2880004T03	plug: 3-contact
P2602	2884324M09	plug: 4-contact
		transistor: (see note)
Q1	4882605H02	silicon controlled rectifier
Q2,3	4813824A10	NPN
Q4	4800869807	PNP
Q5,6	4811056A08	PNP
		resistor, fixed:
R1	1782177B01	3 ohms, ±10%; 5W
R2	0611077B03	15K, ±5%; 1/8W
R3,4	0611077A68	560 ohms, ±5%; 1/8W
R5	0611077A30	15 ohms, ±5%; 1/8W
R6	0611086A41	180 ohms, ±5%; 1W
R7 thru 9	0611077A90	4.7K, ±5%; 1/8W
R10	0611077A50	100 ohms, ±5%; 1/8W
R11	0611009B23	0 ohms, ±5%; 1/4W
R12	0611077A40	39 ohms, ±5%; 1/8W
R13	0611077A36	27 ohms, ±5%; 1/8W
R14	0611009B23	0 ohms, ±5%; 1/4W
R15	0611077A98	10K, ±5%; 1/8W
R16	0611077A82	2.2K, ±5%; 1/8W
R17	0611077A54	150 ohms, ±5%; 1/8W
		integrated circuit: (see note)
U1	5182802R24	Digitally Controlled 50K Potentiometer
U2	5184320A47	+5V Voltage Regulator
		voltage regulator: (see note)
VR1	4882256C38	Zener, 9.1V
VR2	4882256C14	Zener, 15V
		non-referenced items:
	0784178T01	CLIP, mounting (used with Q4)
	0910548A04	FUSE BLOCK (used with F1)
	1483820M02	INSULATOR, heat conductive (used with Q4)
	2884177T01	HEAT SINK (used with Q4)

NOTE: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part number.

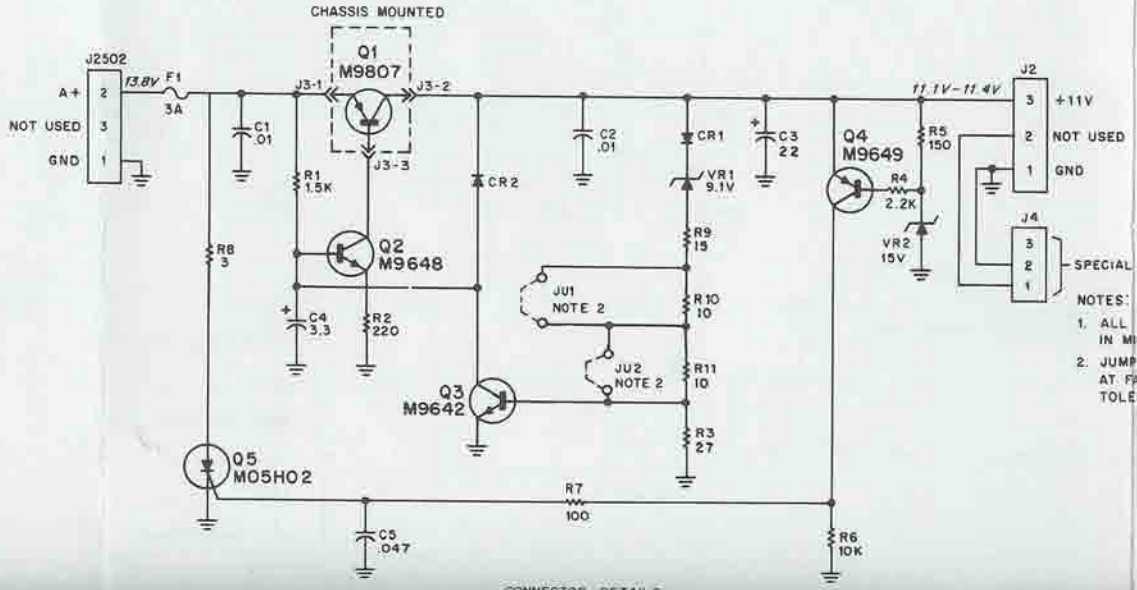


TRANSISTOR BASE DETAILS

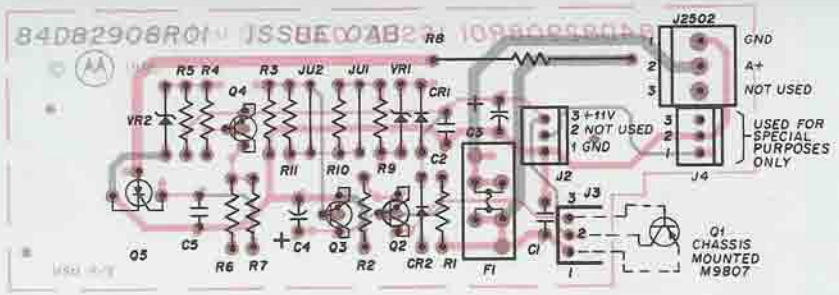


TOP VIEW

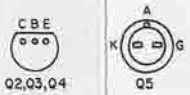
COMPONENT SIDE ● BD-BEPS-43877-O
SOLDER SIDE ● BD-BEPS-43878-O
OL-BEPS-43879-A
SHOWN FROM COMPONENT SIDE



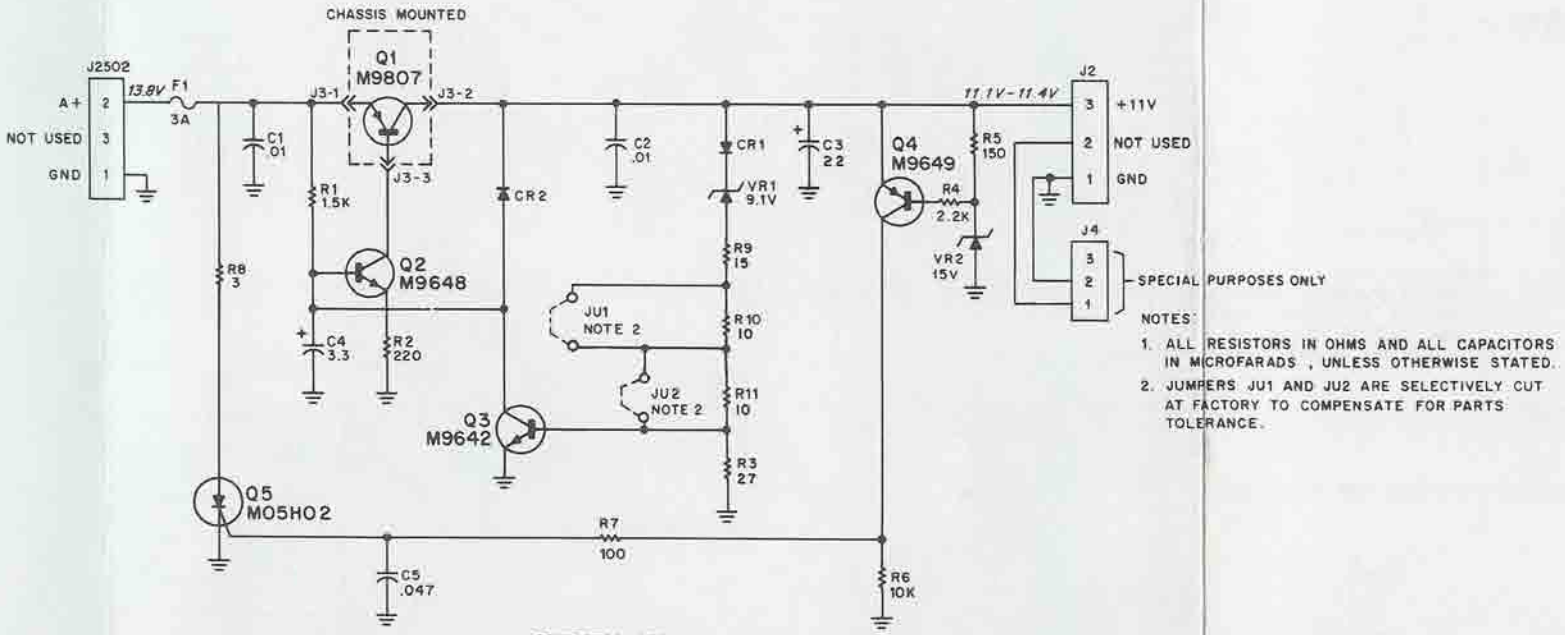
CONNECTOR DETAILS



TRANSISTOR BASE DETAILS



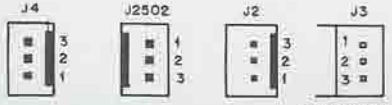
COMPONENT SIDE ● BD-BEPS-43877-O
SOLDER SIDE ● BD-BEPS-43876-O
OL-BEPS-43879-A
SHOWN FROM COMPONENT SIDE



NOTES:

1. ALL RESISTORS IN OHMS AND ALL CAPACITORS IN MICROFARADS , UNLESS OTHERWISE STATED.
2. JUMPERS JU1 AND JU2 ARE SELECTIVELY CUT AT FACTORY TO COMPENSATE FOR PARTS TOLERANCE.

CONNECTOR DETAILS



BEPS-43876-A