MOTOROLA
Mobile Products Division

SYNTOR X UHF
Common Circuits Board

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for HLN4797C/HLN5148A Common Circuits Board PW–1096

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5555 North Beach Street, Fort Worth, Texas 76137
T10001–A
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Common Circuits Board

1. Description

1.1 The common circuits board (as shown in the schematic at the end of this section) consists of the following circuits: (a) RF power control, (b) squelch, (c) IDC, and (d) regulator.

1.2 The theory of operation and troubleshooting information for each of these circuits except the regulator circuits and squelch circuit is presented in other sections of this manual as follows:

- RF power control: Transmitter Section
- IDC: Synthesizer Section

2. Theory of Operation (Regulator)

2.1 INTRODUCTION

The regulator supplies the voltages the radio needs. It consists of: (a) reference circuit, (b) +9.6V regulator, (c) +5.0V regulator, and (d) shutback circuit.

2.2 REFERENCE CIRCUIT

The reference circuit uses a zener diode (part of HY1001), and operational amplifier (U1001B), and a factory–adjusted resistor network to generate a reference voltage of approximately 7.0V at its output (U1001B–4). This reference output voltage is then used to generate both the 5.0V and 9.6V supply voltages.

2.3 9.6V REGULATOR

The 9.6V regulator is protected against short circuits. If a short circuit occurs in the regulator, it forward–biases CR1002, switching it on and removing the drive power from output transistor Q1001.

2.4 5.0V REGULATOR

The 5.0V regulator is protected against excessive output currents. A foldback current–limiting circuit senses the voltages across R1002 and R1003. If the output current reaches a predetermined level, Q1003 switches on, blocking the drive to output transistor Q1002.

2.5 SHUTBACK CIRCUIT

2.5.1 The shutback circuit is designed to turn off both regulators (the 5.0V and the 9.6V) whenever the supply voltage rises above (or goes below) a predetermined level. If the supply voltage reaches 20.5V, CR1005 turns on, causing Q1006 to turn on. Consequently, Q1005 loses its input drive, thus causing the 9.6V regulator to turn off. Moreover, this also forward–biases CR1003, thus causing the 5.0V regulator to turn off.

2.5.2 When the supply voltage (SW B+) falls below 9.0V, U1001A switches states, causing Q1006 to turn on and, consequently, both regulators to turn off. In this case, CR1004 causes the reference voltage to U1001A–1 to change in the shutback mode. Consequently, both regulators remain shut off until the supply voltages rise at least one volt above the critical level of 9.0V.

3. Regulator Troubleshooting Procedure

The regulator troubleshooting procedure covers the following situations:

- failure of both the 5.0V and 9.6V regulators
- failure of only the 5.0V regulator
- failure of only the 9.6V regulator

3.1 FAILURE OF BOTH REGULATORS

(1) Inspect P401 and the main front plug and verify that they are inserted properly.

(2) Measure SW B+ at P401 on the common circuits board. The normal indication is 10.5 to 16 V. If SW B+ is outside the normal range, the low or high–line shutdown circuit may have been activated, shutting off the regulators. Adjust SW B+ to the proper voltage and recheck the regulators' outputs. If SW B+ is zero, check the continuity of the SW B+ and ground lines to isolate the fault.

(3) Measure the voltage at the Q1006 collector. It should be less than 0.6V. If it is not, repair the shutback circuit.

(4) Measure the voltage at HY1001–9. It should be 7 + 0.1V. If it is not, repair the 7V reference circuit.

NOTE

If this procedure fails to remedy the problem then repair each regulator separately.

3.2 FAILURE OF 5V REGULATOR

(1) Check the output of the 9.6V regulator at P401–11 and verify that it is 9.6 +0.1V. If it is not, carry out the procedure in Section 3.1 above.

(2) With the radio turned off, check that the resistance between P401–12 and ground is greater than 100 ohms. If it is not, isolate the fault. (It will not necessarily be on the common circuits board.)

(3) With the power turned on, measure the voltage difference between U1001–12 and P401–12. It should be less than 2.5V. If it is, proceed to Step 5; otherwise go to Step 4.

(4) Isolate the component with the excessive voltage drop. An excessive drop across R1009 may be caused by:

- excessive Q1002 base current because of a defective transistor or open collector lead
- a fault in the 5V current limiter circuit (Q1003, R1004, R1005, and R1016) causing Q1003 to turn on
- shorted printed circuit board runner
- a defective R1009

An excessive drop across Q1002 or R1002 is probably due to a fault in the component with the abnormal voltage drop.

(5) Measure the voltage at U1001–13. It should be 5 + 0.1V. If it is, replace HY1001 or U1001; if not, repair the 7V reference circuit.

(6) Measure the voltage at HY1001–9. It should be 7 + 0.1V. If so, replace HY1001 or U1001; if not, repair the 7V reference circuit.

(7) Measure the voltage difference between U1001–14 and P401–12. It should be zero. If so, go to the next step; otherwise proceed as follows: if CR1003 is forward biased, repair the shutback circuit; otherwise replace R1010 or U1001.

(8) measure the voltage at U1001–12 and find out why the feedback loop does not function properly.

3.3 FAILURE OF 9.6V REGULATOR

(1) Check output voltage at P401–12. If it is 5.0V, go to the next step; otherwise, perform the procedure for failure of both regulators.

(2) Check output voltage at P401–11. It should be 9.6 +0.1V. If it is too low, go to Step 3; if too high, go to Step 6.

(2) Check output voltage at P401–11. It should be 9.6 +0.1V. If it is too low, go to Step 3; if too high, go to Step 6.

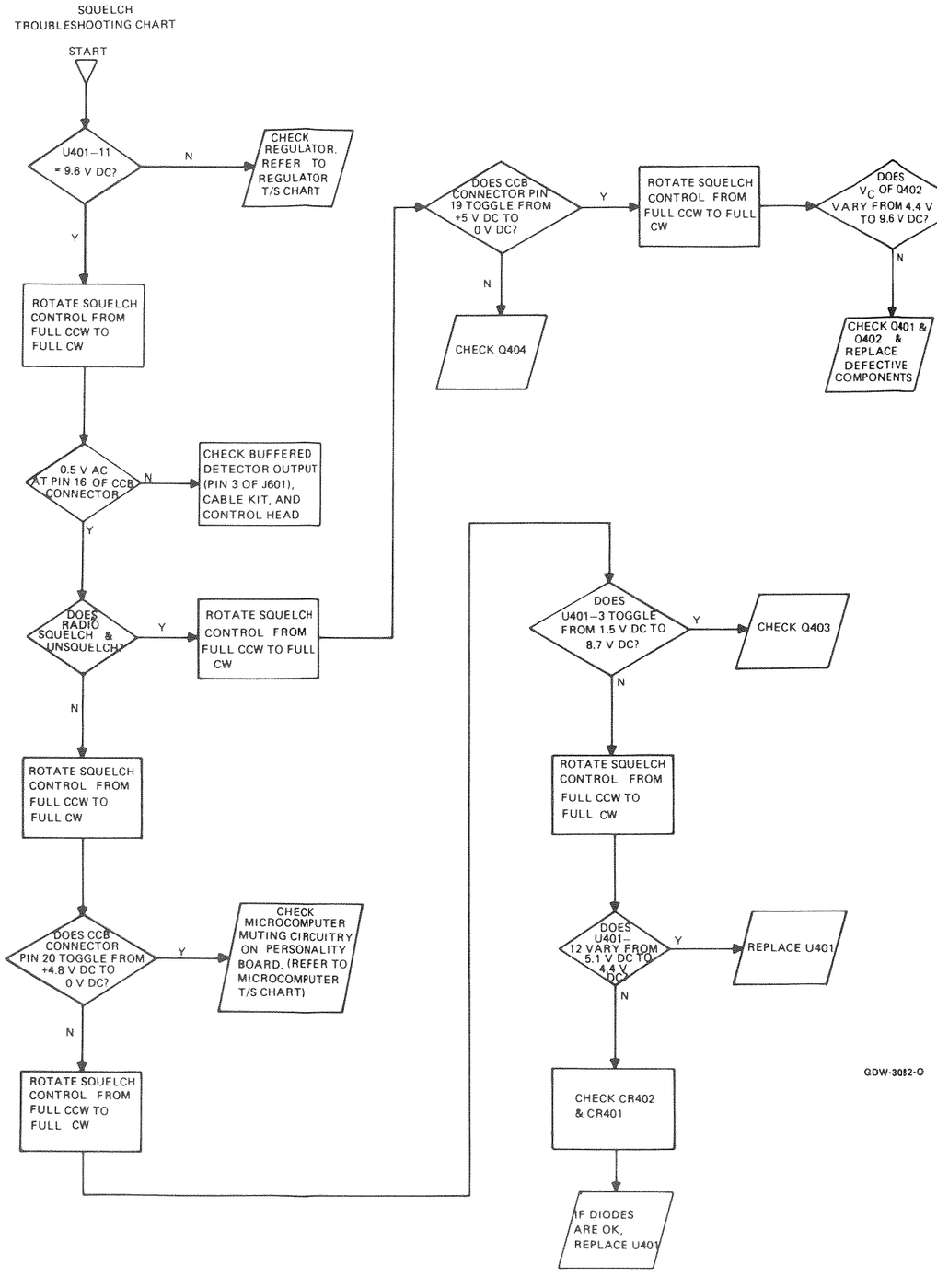
(3) With the radio turned off, check the resistance between P401–11 and ground. If it is greater than 30 ohms, go to the next step; otherwise, make the necessary checks to isolate the fault, which is not necessarily on the common circuits board.

(4) With power turned on, measure the voltage at Q1006 base. It should be greater than 10V. If it is, go to the next step; otherwise replace HY1001, U1001, or Q1006. A voltage higher than 2.5V but lower than 10V indicates that Q1006 may be defective.

(5) Replace Q1001 or repair the circuit board.

(6) Measure the voltage at Q1006 collector. It should be less than 0.5V. If it is, replace Q1001 or repair the circuit board; otherwise, replace U1001 or HY1001.

TROUBLESHOOTING CHART FOR SQUELCH



GDW-3082-O

SYMBOLS AND ABBREVIATIONS USED IN CHART

= ACTION

= DECISION

= FAULT

U401–11 = PIN 11 OF U401

CCB = COMMON CIRCUITS BOARD

CCW = COUNTERCLOCKWISE

CW = CLOCKWISE

T/S = TROUBLESHOOTING

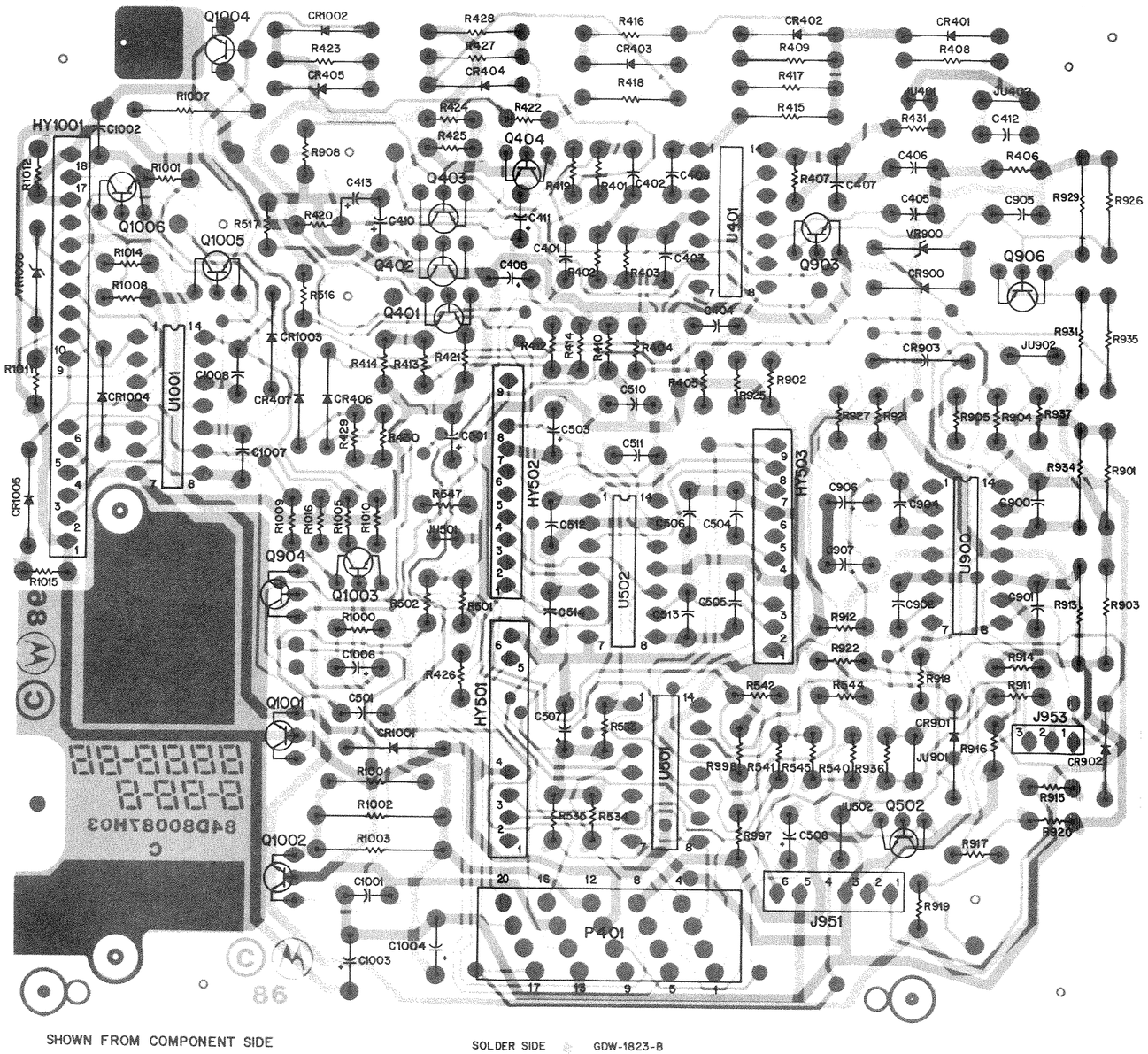
LT = LESS THAN

NOTES:

1. ALL VOLTAGES ARE DC.
2. CHANNEL SCAN MUST BE TURNED OFF TO TROUBLESHOOT THE SQUELCH.
3. IF THE SQUELCH TAIL LENGTH IS ALWAYS LONG OR ALWAYS SHORT, REGARDLESS OF THE SIGNAL STRENGTH, CHECK Q401, Q402 & ASSOCIATED CIRCUITRY.
4. ALL REFERENCES TO, AND TEST PROCEDURES FOR, SQUELCH OPERATION ARE NOT APPLICABLE TO TRUNKED RADIOS.

COMMON CIRCUITS BOARD

HLN5148A 30W Common Circuits Board
HLN4797C 78/100W Common Circuits Board



SHOWN FROM COMPONENT SIDE

SOLDER SIDE — GDW-1823-B
COMPONENT SIDE — GDW-1824-A
OVERLAY — GDW-1828-B

Schematic, Circuit Board Diagram, and
Parts List for HLN4797C/HLN5148A Common Circuits Board
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parts list

HLN4797C Common Circuits Board (78/100 Watt)
HLN5148A Common Circuits Board (30 Watt) — MXW–1830–C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
capacitor, fixed, uF, ±10%, 100V (unless otherwise stated)		
C401	08–11051A01	.001, ±5%, 63V
C402	08–11051A13	.1, ±5%, 63V
C403	21–11015B05	220 pF
C404	21–11014B47	82 pF, ±5%
C405	08–11051A07	.01, ±5%, 63V
C406	08–11051A03	.0022, ±5%, 63V
C407	21–11015B05	220 pF
C408	23–11013E57	10, ±20%, 25V, tantalum
C409	08–11051A07	.01, ±5%, 63V
C410	23–11013F57	1, ±20%, 35V, tantalum
C411	23–11013F59	2.2, ±20%, 35V, tantalum
C412	08–11051A05	.0047, ±5%, 63V
C413	23–84538G20	1.5, ±5%, 25V, tantalum
C501	23–11013E57	10, ±20%, 25V, tantalum
C502	08–11051A02	.0015, ±5%, 63V
C503	23–11013E57	10, ±20%, 25V, tantalum
C504	08–11051A02	.0015, ±5%, 63V
C505	08–11051A03	.0022, ±5%, 63V
C506	21–11014B47	82 pF, ±5%
C507–508	23–11013E57	10, ±20%, 25V, tantalum
C510	21–11014B47	82 pF, ±5%
C511–514	21–11014H32	20 pF, ±5%
C900–902	21–11014H32	20 pF, ±5%
C904	21–11014H32	20 pF, ±5%
C905	08–11051A16	.33, ±5% 63V
C906–907	23–11013B11	33, ±10%, 10V, tantalum (HLN4797C)
C906–907	23–84538G23	15, ±20%, 20V, tantalum (HLN5148A)
C1001	08–11051A13	.1, ±5%, 63V
C1002	21–11015B05	220 pF, ±10%
C1003	23–11019A39	47, ±20%, 16V, electrolytic
C1004	23–84538G06	47, ±20, 20V
C1006	08–11051A10	.033, ±5%, 63V
C1007	21–11015B05	220 pF
C1008	21–11014B47	82 pF, ±5%
diode (see note)		
CR401–407	48–11034A01	silicon
CR900–903	48–11034A01	silicon
CR1001–1005	48–11034A01	silicon
hybrid (see note)		
HY501	51–82142K12	resistor network
HY502	51–82142K13	resistor network
HY503	51–82142K14	resistor network
HY1001	01–80715D03	hybrid regulator
connector receptacle		
J951	28–84647L04	male, 6–pin
J953	28–84324M02	female, 3–contact
connector		
JU401	28–84318M06	2–pin plug
JU402	06–11009F23	jumper
JU501	28–84318M06	2–pin plug
JU502	06–11009F23	jumper
JU901–902	06–11009F23	jumper
transistor (see note)		
Q401–402	48–11043C05	NPN, type M8208
Q403	48–11043C06	PNP, type M8209
Q404	48–11043C05	NPN, type M8208
Q502	48–11043C25	FET, type M9660
Q903	48–11043C05	NPN, type M8208
Q904	48–84411L10	PNP, type M1110
Q906	48–11043C07	NPN, type M4307
Q1001	48–84413L05	PNP, type M1305
Q1002	48–84413L10	NPN, type M1310
Q1003	48–11043C05	NPN, type M8208
Q1004	48–00869640	NPN, type M9640
Q1005	48–11043C08	PNP, type M8212
Q1006	48–11043C06	PNP, type M8209
resistor, fixed, ohm, ±5%, 1/4 watt (unless otherwise stated)		
R401	06–11009E89	47k
R402	06–11009E61	3.3k
R403	06–11009E85	33k
R404	06–11009E69	6.8k
R405	06–11009E97	100k
R406	06–11009E33	220
R407	06–11009E53	1.5k
R408	06–11009A89	47k
R409	06–11009B06	220k
R410	06–11009E61	3.3k
R411	06–11009E33	220
R412	06–11009E73	10k
R413	06–11009E33	220
R414	06–11009E61	3.3k
R415	06–11009A73	10k
R416	06–11009A69	6.8k
R417–418	06–11009B02	150k
R419	06–11009E75	12k
R420	06–11009E73	10k
R421	06–11009E45	680
R422	06–11009F06	220k
R423	06–11009B20	820k
R424	06–11009E53	1.5k
R425	06–11009E59	2.7k
R426	06–11009E77	15k
R427	06–11009A69	6.8k
R428	06–11009A49	1k
R429	06–11009E85	33k

MXW–1830–C (2)

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R430	06–11009E93	68k
R431	06–11009E91	56k
R501	06–11009E49	1k
R502	06–11009E43	560
R516–517	18–80087E08	10k potentiometer
R533–535	06–11009F06	220k
R541	06–11009E73	10k
R542	06–11009E69	6.8k
R544	06–11009E81	22k
R545	06–11009E89	47k
R546	06–00867628	194k, ±10%, thermistor
R547	06–11009E25	100
R901	06–11009A65	4.7k
R902–903	06–11009E73	10k
R904	06–11009E57	2.2k
R905	06–11009E69	6.8k
R908	18–80087E08	10k potentiometer
R911	06–11009E65	4.7k
R912	06–11009E73	10k
R913	06–11009A55	1.8k
R914	06–11009E55	1.8k
R915	06–11049R91	10k, ±1%
R916	06–11049R79	7.5k, ±1%
R917	18–80087E05	2k, ±20% potentiometer
R918	06–11009F06	220k
R919	06–11049R91	10k, ±1%
R920	06–11049R79	7.5k, ±1%
R921	06–11009E15	39 (HLN4797C)
R921	06–11009E23	82 (HLN5148A)
R923	06–11009E49	1k
R925	06–11009E73	10k
R926	06–11009A75	12k
R927	06–11009E59	2.7k
R929	06–11009A39	390 (HLN4797C)
R929	06–11009A35	270 (HLN5148A)
R931	06–11009A41	470
R934	06–11009A61	3.3k
R935	06–11009A27	120
R997	06–11009E65	4.7k
R998	06–11009E97	100k
R1001	06–11009E49	1k
R1002–1003	06–80037G07	1.8, ±10%, 1/2W
R1004	06–11009A35	270
R1005	06–11009E59	2.7k
R1006	06–11009E35	270
R1007	06–11045A20	62, 1/2W
R1008	06–11009E43	560
R1009	06–11009E45	680
R1010	06–11009E65	4.7k
R1011	06–11009E81	22k
R1012	06–11009E35	270
R1014	06–11009F06	220k
R1015	06–11009E35	270
R1016	06–11009E59	2.7k
integrated circuit (see note)		
U401	51–80067C04	quad opamp, type 67C04
U501	51–84887K04	switch, type 87K04
U502	51–80067C04	quad opamp, type 67C04
U900	51–80067C01	quad opamp, type 67C01
U1001	51–80067C04	quad opamp, type 67C04
voltage regulator (see note)		
VR900	48–82256C12	zener, 5.6V
VR1000	48–82256C53	zener, 18V
mechanical parts		
	14–83820M02	heat conductive insulator
	04–84180C01	washer

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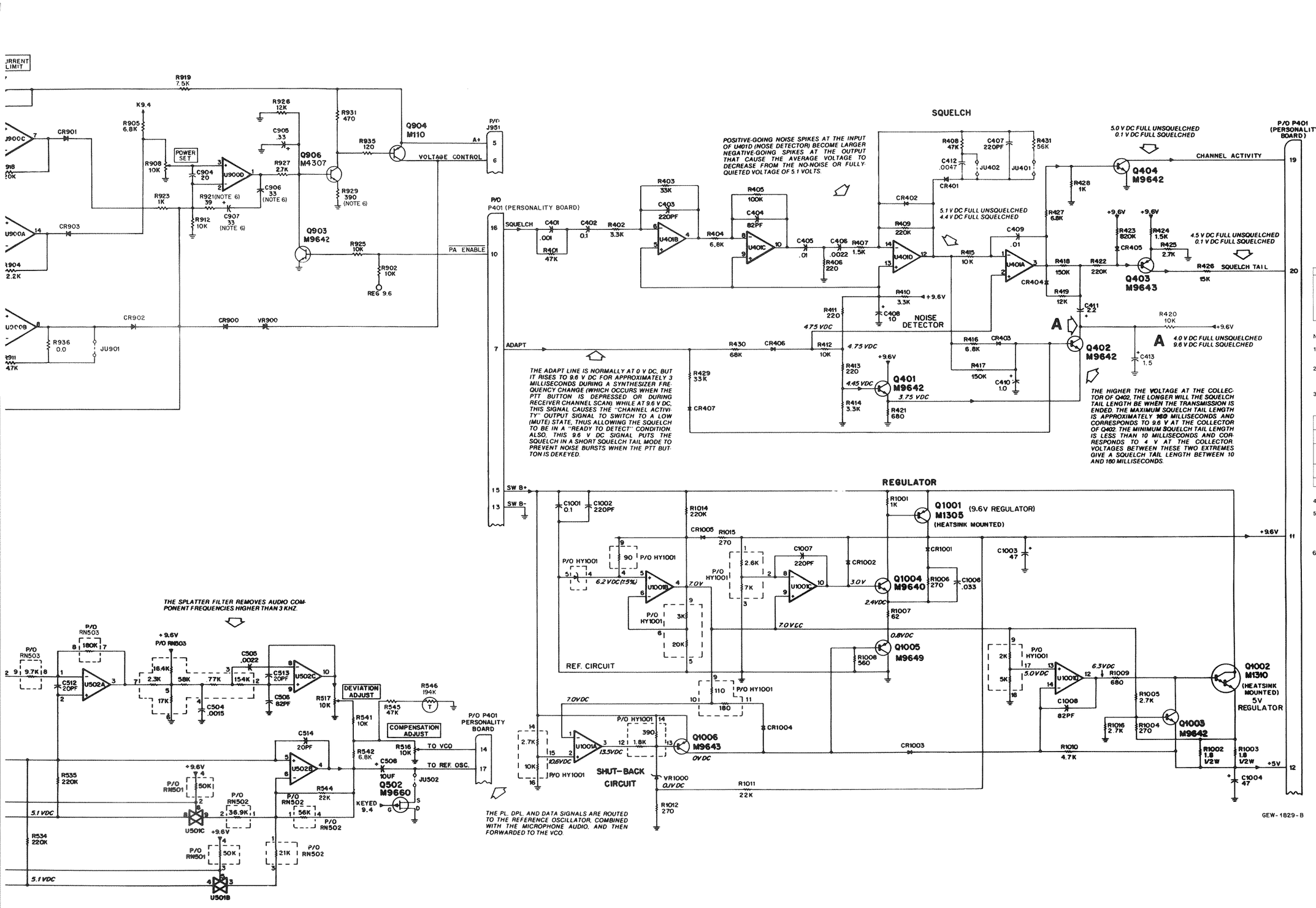
note: For best performance, order diodes, transistors, and integrated circuit devices by Motorola part number.

CURRENT LIMIT
R917 2K
R919 7.5K
R920 1% 7.5K
R915 1% 7.5K
R916 1% 7.5K
C902 20
U900C
CR901
R918 220K
K9.4
R905 6.8K
R908 10K
POWER SET
C904 20
U900D
R926 12K
C905 .33
R927 2.7K
C906 33 (NOTE 6)
R921(NOTE 6) 39
C907 33 (NOTE 6)
R912 10K
R923 1K
R931 470
Q904 M110
R935 120
Q906 M4307
R929 390 (NOTE 6)
P/O J951
A+
VOLTAGE CONTROL
P/O J951
1 CURRENT LIMIT
2 THERMAL
3
R937
JU902
R934 3.3K
C900 20
U900A
CR903
K9.4
R901 4.7K
R904 2.2K
R903 10K
Q903 M9642
R925 10K
R902 10K
REG 9.6
PA ENABLE
P/O J953
3 REFLECTED POWER
2
1 FORWARD POWER
R913 1.8K
C901 20
U900B
R914 1.8K
R911 4.7K
R936 0.0
JU901
CR902
CR900
VR900
P/O P401 (PERSONALITY BOARD)
16
10
7 ADAPT
15 SW B+
13 SW B-
SQUELCH
C401 .001
R401 47K
C402 0.1
R402 3.3K
R403 33K
C403 220PF
U401B
R404 6.8K
R405 100K
C404 82PF
U401C
C405 .01
C406 .0022
R406 220
R407 1.5K
R408 47K
C412 .0047
CR401
C407 220PF
JU402
JU401
R431 56K
CR402
R409 220K
U401D
R410 3.3K
+9.6V
C408 10
NOISE DETECTOR
4.75 VDC
R411 220
R412 10K
4.75 VDC
R415 10K
C409 .01
U401A
CR404
R418 150K
R419 12K
R422 220K
C411 2.2
A
R416 6.8K
CR403
R417 150K
C410 1.0
Q402 M964
R413 220
4.45 VDC
Q401 M9642
3.75 VDC
R414 3.3K
R421 680
R429 33K
CR407
R428 1K
R427 6.8K
5.1 V DC FULL UNSQUELCHED
4.4 V DC FULL SQUELCHED
POSITIVE-GOING NOISE SPIKES AT THE INPUT OF U401D (NOISE DETECTOR) BECOME LARGER NEGATIVE-GOING SPIKES AT THE OUTPUT THAT CAUSE THE AVERAGE VOLTAGE TO DECREASE FROM THE NO-NOISE OR FULLY-QUIETED VOLTAGE OF 5.1 VOLTS.
THE ADAPT LINE IS NORMALLY AT 0 V DC, BUT IT RISES TO 9.6 V DC FOR APPROXIMATELY 3 MILLISECONDS DURING A SYNTHESIZER FREQUENCY CHANGE (WHICH OCCURS WHEN THE PTT BUTTON IS DEPRESSED OR DURING RECEIVER CHANNEL SCAN). WHILE AT 9.6 V DC, THIS SIGNAL CAUSES THE "CHANNEL ACTIVITY" OUTPUT SIGNAL TO SWITCH TO A LOW (MUTE) STATE, THUS ALLOWING THE SQUELCH TO BE IN A "READY TO DETECT" CONDITION. ALSO, THIS 9.6 V DC SIGNAL PUTS THE SQUELCH IN A SHORT SQUELCH TAIL MODE TO PREVENT NOISE BURSTS WHEN THE PTT BUTTON IS DEKEYED.
REGULATOR
C1001 0.1
C1002 220PF
R1014 220K
CR1005
R1015 270
Q1001 M1305 (9.6V REGULATOR) (HEATSINK MOUNTED)
R1001 1K
CR1001
C1003 47
P/O HY1001
90
6.2 VDC (±5%)
U1002B
7.0V
2.6K
7K
C1007 220PF
U1002A
CR1002
3.0V
Q1004 M9640
R1006 270
C1006 .033
2.4VDC
R1007 62
0.8VDC
Q1005 M9649
R1008 560
REF. CIRCUIT
7.0 VCC
7.0VDC
110
180
CR1004
CR1003
Q1006 M9643
0VDC
U1001A
13.5VDC
10.6VDC
2.7K
10K
SHUT-BACK CIRCUIT
VR1000 0.0V DC
R1011 22K
R1012 270
2K
5K
U1001B
6.3V
5.0VDC
C1008 82PF
R1010 4.7K
THE PL, DPL, AND DATA SIGNALS ARE ROUTED TO THE REFERENCE OSCILLATOR, COMBINED WITH THE MICROPHONE AUDIO, AND THEN FORWARDED TO THE VCO
THE IDC ENABLE LINE IS USED TO GATE MICROPHONE AUDIO TO THE SYNTHESIZER VIA U501A. WHEN IDC ENABLE IS HIGH, AS IS NORMALLY THE CASE DURING TRANSMIT, THE MICROPHONE AUDIO IS ALLOWED TO PASS TO THE SYNTHESIZER. WHEN IDC ENABLE IS LOW, AS IS THE CASE DURING RECEIVE AND CERTAIN DATA TRANSMISSION FUNCTIONS, THE MICROPHONE AUDIO IS PREVENTED FROM PASSING TO THE SYNTHESIZER.
P/O P401
8 K9.4V
5 MIC HI
6 IDC ENABLE
4 PL/DPL ENABLE
3 PL/DPL
1 DATA ENABLE
2 DATA
IDC
+9.6V
JU501
R501 1K
R547 100
C501 10UF
R502 560
C502 .0015
P/O RN502
5K
C510 82PF
C511 20PF
U502D
R533 220K
C503 10
U501A
P/O RN503 9.7K
C512 20PF
U502A
THE SPLATTER FILTER REMOVES AUDIO COMPONENT FREQUENCIES HIGHER THAN 3 KHZ.
P/O RN503 180K
16.4K
2.3K
58K
77K
154K
17K
C504 .0015
C505 .0022
C513 20PF
U502C
C508 82PF
R517 10K
DEVIATION ADJUST
R541 10K
R545 47K
R546 194K
COMPENSATION ADJUST
P/O P401 PERSONALITY BOARD
R997 4.7K
R998 100K
1.5K
1.7K
P/O RN501
5.1 VDC
C507 10
R535 220K
C514 20PF
U502B
R542 6.8K
R516 10K
TO VCO
TO REF. OSC.
C508 10UF
JU502
Q502 M9660
KEYED 9.4
P/O RN501 50K
U501C
P/O RN502 36.9K
R544 22K
56K
R534 220K
U501B
21K



JUMPER	NORMALLY	REMARKS
JU401	OUT	IN FOR SECURENET
JU402	IN	OUT FOR SECURENET
JU501	OUT	IN FOR HHCH
JU502	IN	OUT FOR SECURENET
JU901	IN	NONE
JU902	IN	NONE
JU903	IN	NONE

NOTES:

1. UNLESS OTHERWISE INDICATED, RESISTOR VALUES ARE IN OHMS; CAPACITOR VALUES ARE IN MICROFARADS.
2. INTEGRATED CIRCUITS ON THIS BOARD ARE CMOS DEVICES. CONSEQUENTLY, PROPER CARE SHOULD BE TAKEN WHILE HANDLING THESE DEVICES.
3. TYPES AND CONNECTIONS FOR THE INTEGRATED CIRCUITS USED ON THIS BOARD ARE AS FOLLOWS:

REF. DESIG.	TYPE	VCC (PIN)	GND (PIN)	DESCRIPTION
U401, 502	29M06 OR 67C04	+9.6V (11)	(7)	QUAD OP AMP
U501	84L14 OR 73C01	+9.6V (14)	(7)	QUAD TRANSMISSION GATE
U1001	29M06 OR 67C04	B+ (11)	(7)	QUAD OP AMP
U900	67C01	K 9.4V (4)	(11)	QUAD OP AMP

4. ALL VOLTAGES SHOWN ARE REFERENCED TO A–.
5. ALL VOLTAGES SHOWN ON THE RF POWER CONTROL ARE MEASURED UNDER THE FOLLOWING CONDITIONS:
   (A) 13.6V (A+) VOLTAGE
   (B) 50-OHM RADIO TERMINATION
   (C) 105-WATT SET OUTPUT POWER
6. SEE PARTS LIST FOR THE VALUE OF THESE PARTS FOR THE 30W MODELS.

Schematic, Circuit Board Diagram, and
Parts List for HLN4797C/HLN5148A Common Circuits Board
PW–1096–D
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