MOTOROLA INC.
Communications
Sector

MODEL QLN2812A

"CW" STATION IDENTIFIER FIELD MODIFICATION KIT

1. ATTACHMENT

-- QRN8424B/QRN8425B Station Identifier Instruction Section 5S-SP5821254

2. DESCRIPTION

The QLN2812A Field Modification Kit adds a QRN8425B "CW" Station Identifier Module to any T1-R1 or T2-R2 MSR 2000™ base station radio. The module is installed in module position 12 of the remote control interconnect board and interconnects to the station via the QKN7547A Interconnect Cable included with this option kit.

NOTE

On T2-R2 stations, the station identifier will identify on the transmit frequency preselected by the F1-F2 switch on the F2 module.

The QRN8425B "CW" Station Identifier Module is completely described in the attached 5S-SP5821254 instruction section. Refer to this instruction section for details relative to the module.

3. INSTALLATION

Interconnect the "CW" station identifier module (located in module position 12 of the remote control interconnect board) to the following pin locations on the interconnect board using the wire supplied as part of the QKN7547A Interconnect Cable.

- Module position 12, pin 3 connects to module position 2, pin 21. Disc
- Module position 12, pin 9 connects to module position 2, pin 7. Keyed A-
- Module position 12, pin 18 connects to module position 8, pin 14. PL inhibit

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Printed in USA, 4/6/87

68P06907D38-A
(1S-SP5820063)

- Module position 12, pin 20 connects to module position 5, pin 18.
- Module position 12, pin 24 connects to module position 7, pin 24.

4. ADJUSTMENT PROCEDURES

Adjustment and set-up procedures for the station identifier operation is as follows.

Step 1 -- Temporarily remove jumper JU2 on the identifier module. Rotate the SQ ADJUST control to its extreme counterclockwise position and the AUDIO LEVEL control to the center of its rotation. Attach the identifier module to an extender card and insert in module position 12 on the remote control interconnect board.

Step 2 -- Activate the identifier module (using the TEST switch located on the front panel of the module) and adjust the transmitter deviation, during an ID, for ±2kHz using the AUDIO LEVEL control.

Step 3 -- The identifier module monitors receiver R1 channel activity and will not ID when the quieting on R1 exceeds that set by the SQ ADJUST control on the identifier module. This control is normally factory adjusted for 10 dBq and can be adjusted to any desired quieting level.

Step 4 -- Apply an rf signal to the receiver sufficient to provide the desired quieting level. Key the transmitter momentarily using the XMIT switch on the station control module and adjust the SQ ADJUST control in the clockwise direction (in small increments and pausing approximately 6 to 7 seconds between settings) until the identifier module keys the station. If necessary, repeat this procedure.

Step 5 -- As shipped from the factory, the identifier module is jumpered for "Timed Interval Mode" type of operation as denoted on the schematic diagram in the attached 5S-SP5821254 instruction section. The timing interval is jumpered for 15 minutes and is also jumpered to provide PL stripping during an ID. If this type of operation is desired, reinstall jumper JU2. If not, jumper according to the operational choices stated in the attached 5S-SP5821254 instruction section, and then install the identifier module in module position 12 of the remote control chassis.

1. ATTACHMENTS

-- QRN8424B and QRN8425B Automatic Station Identifier Module Schematic Diagram and Circuit Board Detail 6-SP5821254
-- Parts List 6PL-SP5821254

2. DESCRIPTION

2.1 The QRN8424B and QRN8425B Automatic Station Identifier Modules identify a station by broadcasting the station's call sign using the international morse code. These modules also provide a local audio output signal while incorporating integrated circuitry to generate the morse code, and to control station identification conforming to FCC regulations. The QRN8424B module is used in Motorola Micor™ stations, while the QRN8425B module is used in MSR 2000™ stations. The module ID's at 20-25 wpm with a 1200 Hz tone. An audio level is included to set XMTR deviation (preset at the factory to ±2 kHz). A squelch control located on the module sets the level of RF quieting which prevents an ID sequence from occurring. (Preset at the factory for 10 dBq). The identifier provides the following transmitter control function outputs.

- Station PTT - Keys the station
- PL Inhibit - inhibits XMTR PL code (PL stations only)
- Audio - modulates station XMTR
- Local Audio - local speaker output

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Printed in USA, 3/30/89 (49)

68P06907V43-A
(5S-SP5821254)

Inputs to the identifier are:

- Ground
- +9.6 volts
- Inhibit - prevents an ID (used in special applications only)
- Keyed (A-) - indicates station XMTR activity
- RCVR DISC. - Discriminator audio indicates RCVR activity.

2.2 The identifier is designed so that it will not ID when the station is keyed, or when a received carrier is above a preset level as determined by a control on the module. The absense of these two conditions (for 5 sec.) causes the ID sequence to occur. The following four modes will trigger an ID:

- "Local" mode - local test switch causes an ID to occur regardless of station activity.
- "Aperiodic Exchange" mode - ID occurs at the tail end of a series of exchanges of transmissions. This is accomplished by sending the ID after no PTT has occurred for 5 seconds.
- "Timed Interval" mode - Station ID's at end of every 15/30 min. interval provided a PTT occurred during that interval.
- "Continuous" mode - Station ID's every 15/30 min. after monitoring for 5 seconds.

2.3 A "Disable" switch is provided on the module so that the identifier can be completely inhibited. The station's call sign is pre-programmed into a 256 x 4 PROM. To change the call sign a new PROM must be used. The PROM can also be programmed to delay the ID audio after the PTT has occurred (Set to 1 second at factory). A PL inhibit may also be programmed into the PROM to inhibit transmitter PL (factory set at 200 milliseconds after PTT).

3. THEORY OF OPERATION

(Refer to attached diagram 2-SP5821254)

3.1 The CWID circuitry generates the actual ID and controls when the ID should occur. Except for the squelch control IC U6 and one side of the audio level control R32, the circuit is powered by +5 volt which is regulated by a Zener regulator circuit consisting of R1, VS1, CR1, and C1.

3.2 Generation of the International Morse Code is achieved principally by a 256 x 4 bipolar PROM (U5) with three-state outputs; a divide by 64 counter U4; and a 1200 Hz clock. The 1200 Hz clock is provided by R16, C19, and inverters within U1. The clock rate is then applied back to U1 (pin 3), to U4-10 and to the NOR gate of U3 (pin 7). When the identifier is in the idle state (no ID occurring), U5-13 and U4-11 are held high by pullup resistor R21. This high holds the Q output of U4 at a logic zero and inhibits clocking of U4. U5 is held in the disabled state forcing its outputs O1 thru O4 into the high impedance three-state. Resistor R30 pulls U3-6 high and prevents the 1200 Hz clock pulse input at U3-7 from being gated to Q3 (no audio output). A momentary low on U5-13 and U4-11 from the test switch S2 or from CR9 enables U5 and U4. The outputs of U5 immediately go into the state for the zero address being applied from U4. The O1 output of U5 goes low, which maintains U4-11

and U5-13 in an enabled state, after the low from S2 or CR9 has been removed. The Q outputs of U4 (Q7 thru Q14) are incremented by one, for every 64 clock pulses occurring at U4-10. This incrementing address is applied to U5 and its outputs change according to its pre-programmed information. The O1 output of U5 remains low for the entire ID sequence. At the end of the ID, O1 goes high disabling U4 and U5 and the identifier is returned to its idle state.

3.3 During the ID sequence a high from the O2 output of U5 turns on Q1 and a low appears at the PL inhibit output (pin 18). This low is used by the station to transmit without PL if JU4 is in. A high from the O3 output of U5 turns on Q2 and provides a low at PTT output pin 8, which keys the station. A low from the O4 output of U5 gates the 1200 Hz clock pulses thru the NOR gate of U3, which turns on Q3. Q3 applies the clock pulses to audio level potentiometer R32. C26 and C27 shapes this 1200 Hz square wave into a sinewave, which is applied to the audio output module via pin 20 for modulating the station's transmitter.

3.4 Every 64 clock pulses represents approximately 53 ms. This is the rate at which the address on U5 is changing. A 53 ms duration tone is a Morse Code "dit" and a 3 x 53 ms tone is a "dah". Absense of the tone for 53 ms represents the spacing between "dits" and "dahs" and an absense of 3 x 53 ms represents the spacing between the Morse Code characters of the call sign. The O4 output of U5 is programmed to achieve this format. Closing S1 applies a high to U5-14, which disables U5 even if U5-13 is low. This does not affect any of the timing in the control circuitry.

3.5 The control circuitry consists of U1, U2, U6 and parts of U3. U2 is a timer type IC configured as an inverter with an approximate 5 second delay. Normally C21 is discharged and this low appearing on U2-2 and U2-6 forces the Q output U2-3 into the high state. Removal of the low from diodes CR3, CR4, CR5, CR6, and CR8 allows C21 to charge thru R19 and R20 toward +5 V. When the voltage on U2-2 and U2-6 reach 2/3 of +5 V the Q output goes low and a low going pulse provided by differentiator C22 and R23 is applied thru CR9 to U4 and U5, which starts an ID sequence. Reapplying the low from CR3, CR4, CR5, CR6, or CR8 discharges C21 thru C20. When the voltage on U2-2 and U2-6 reach 1/3 of +5 V the U2 Q output goes high. Charge time for C21 is approximately 5 seconds and discharge time is approximately 150 milliseconds.

3.6 U6 is a *Micor* squelch control IC. RCVR discriminator audio from module pin 3 is applied to U6-15 thru the SQUELCH control R3. A quieting signal (RF signal on RCVR frequency) whose quieting level is set by R3 allows U6-6 and U6-7 to be pulled high by R5, is inverted by U3 and applied to U2. This low holds C21 in a discharged state, and an ID sequence can not occur. An unquieted condition (RF signal below the level set by R3) forces U6-7 and U6-6 low, is inverted by U3 and allows C21 to charge if a low from CR3, CR5, CR6, or CR9 is not providing a discharge path for C21. Only after the RCVR is quieted above a preset level can an ID sequence occur. If the receiver is deleted from the station, JU6 is added to defeat this feature.

3.7 Module pin 13 is used an an external inhibit (used only in special applications). A low on pin 13 discharges C21 thru CR3 and prevents an ID if JU5 (normally out) is installed.

3.8 Module pin 9, when low, indicates a keyed station. A low on pin 9 is applied thru CR2 and R9 to U3 where it is inverted twice and the low from U3-3 thru CR5 prevents an ID sequence from occurring. This same low from U3-3 is also applied to a bistable (consisting of the NAND gate of U3 and an inverter in U3) thru the differentiator C18 and R12. If JU1 is out, this low sets the bistable output (U3-13) into the high state, which removes the ID inhibit. When an ID sequence occurs the low on U4-11 and U5-13 resets the bistable thru CR7 into the low state and prevents another ID from recurring.

3.9 U1 provides the 15/30 minute timing interval between ID sequences. The 1200 Hz clock is applied to U1-3 and internal counters count to 15 min. (JU3 out) or 30 min. (JU3 in). During this interval U1-13 is low and prevents an ID (provided) JU2 is in). At the end of the 15/30 minute interval U1-13 goes high and allows an ID to occur after 5 seconds of station inactivity. At the end of an ID sequence the logic high (reset) at U4-11 and U5-13 is applied thru differentiator C20 and R18 to U1-2 which resets the U1 counters back to zero and forces U1-13 low, preventing further ID sequences. With JU1 in the bistable is always set at a logic high allowing an ID to occur provided it is not inhibited by other means. Jumpers JU1 thru JU6 determine how and which of the four modes the CWID will operate. Refer to attached diagram 2-SP5821254 for circuit and jumper details. Refer to attached parts list 2PL-SP5821254 for parts details.

4. PROM PROGRAMMING INSTRUCTIONS

4.1 The automatic station identifier may be field programmed for any call sign using the following programming instructions. See "Theory of Operation" for detailed explanation of the Morse code "dit" and "dah" formats. The PROM is a Monolitic Memories 5301-1 256X4 bipolar device which may be programmed by many commercially available PROM programmers. Be sure that the proper equipment is available before attempting to program this device. All 256 4 bit memory locations within the PROM initially contain HEX F. These locations will be changed by programming to contain HEX E, HEX 6, or HEX A which allows the identifier to realize the desired Morse Code call sign.

4.2 HEX E - Keys the station without a tone output for approx. 53 ms.
HEX 6 - Keys the station with a tone output for approx. 53 ms.
HEX A - Dekeys the station but maintains transmitter PL inhibit for approx. 53 ms.
HEX F - Disables the PROM which forces the identifier into the idle state.

Each HEX number represents one memory location.

4.3 The factory normally sets the first 19 memory locations to a HEX E, which keys the station without any tone output for 53 ms x 19 1 sec. The ID sequence then follows and is itself followed by 8 HEX E's, which keeps the station keyed for approx. 1/2 sec. after the ID. The next 4 memory locations contain HEX A, which dekeys the station but maintains PL inhibit during reverse burst time, provided jumper JU4 is in. (Carrier Squelch stations do not require these HEX A's.) HEX F's follow and the ID sequence stops. Any number of keyup and keydown times may be used, provided no more than 256 memory locations are used.

4.4 Morse Code "dit" - requires two memory locations, first set at HEX 6, second set at HEX E.
Morse Code "dah" - requires four memory locations, first thru third set at HEX 6, fourth set at HEX E.

The HEX E's in the above format provide the necessary interval between "dits" and "dahs". The interval between Morse Code characters is provided by two memory locations containing HEX E's. Spacing between Morse Code "words" contains five HEX E's. If an error occurs during programming, the PROM must be discarded and a new PROM used. This PROM type cannot be reprogrammed.

4.5 EXAMPLE (Call Sign KNX3) PL STATION

CHARACTER	FORMAT	MEMORY LOCATION
1 sec. keyup	19 E's	0-18
K = — . —	666E6E666E	19-28
SPACING	EE	29-30
N = — .	666E6E	31-36
SPACING	EE	37-38
X = — .. —	666E6E6E666E	39-50
SPACING	EE	51-52
3 = ... — —	6E6E6E666E666E	53-66
1/2 sec. keydown	8E's	67-74
Maintain PL Inhibit	AAAA	75-78
STOP ID	F*	79-255

*This HEX F need not be programmed. It normally exists in all unprogrammed memory locations.

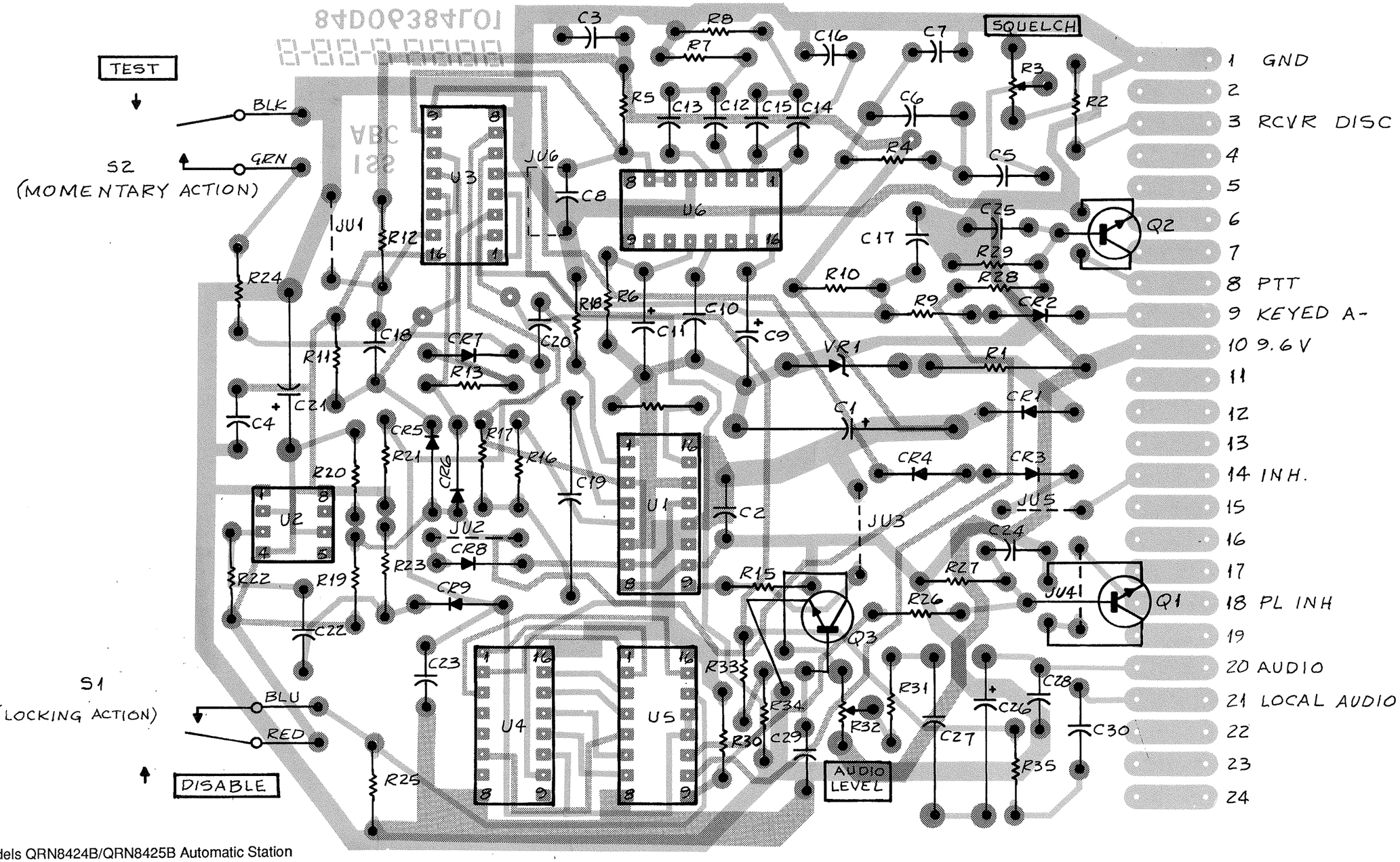
4.6 Be sure to install the PROM in the circuit board with pin 1 next to the white dot. DO NOT replace this PROM with any other device. The MMI5301-1 has special properties which allow it to interface with CMOS logic elements used on the identifier. Factory programmed PROM's can be obtained through a Motorola representative.

4.7 INTERNATIONAL MORSE CODE
. = "dit" — = "dah"

A . —	K — . —	U .. —	5 .....
B — ...	L . — ..	V ... —	6 — ....
C — . — .	M — —	W . — —	7 — — ...
D — ..	N — .	X — .. —	8 — — — ..
E .	O — — —	Y — . — —	9 — — — — .
F .. — .	P . — — .	Z — — ..	0 — — — — —
G — — .	Q — — . —	1 . — — — —	
H	R . — .	2 .. — — —	
I ..	S ...	3 ... — —	
J . — — —	T —	4 .... —	

Special Characters and Formats

a . — . —	e .. — ..	v .. — —
a or a . — — . —	n — — . — —	. (Period) . — . — . —
ch — — — —	o — — — .	DE (this is) (— ..) (.)



Models QRN8424B/QRN8425B Automatic Station Identifier Module Schematic Diagram and Circuit Board Detail
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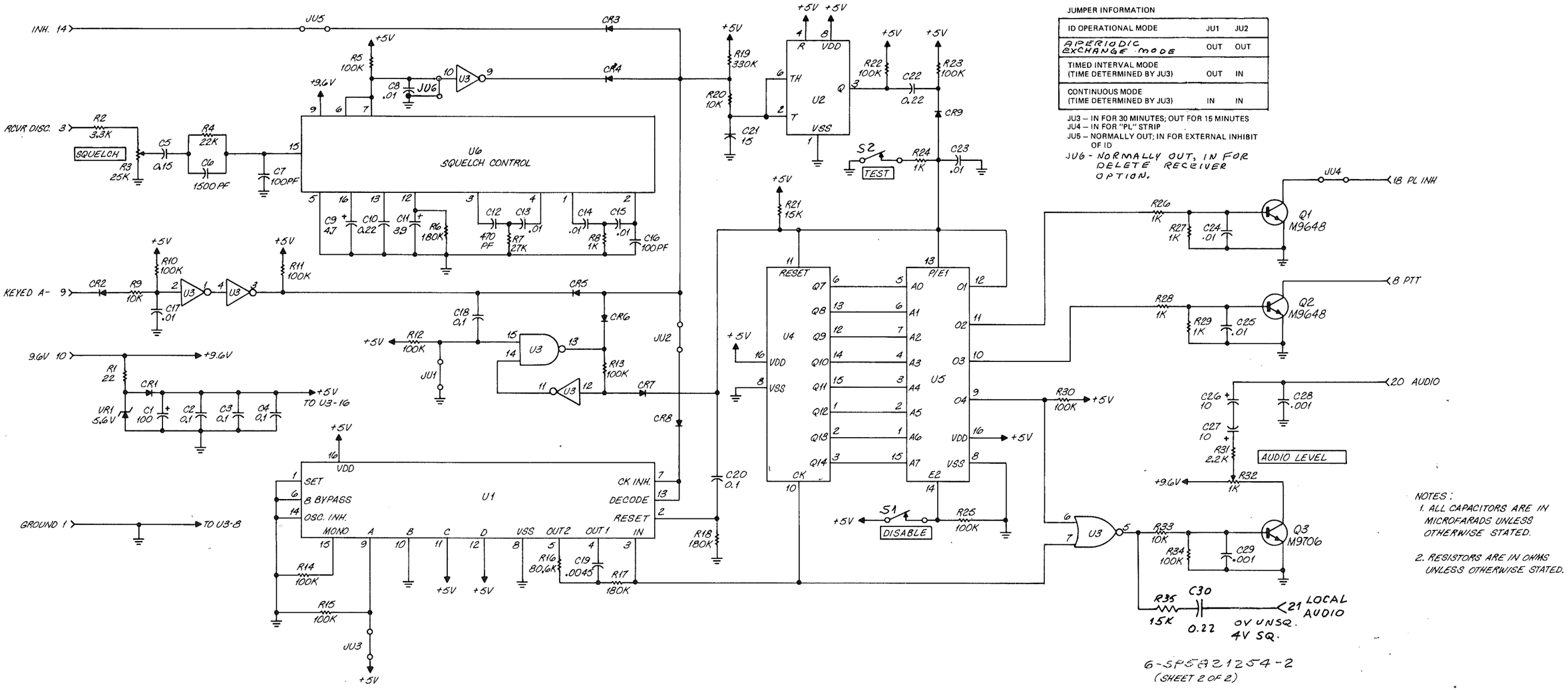
SHEET 1 OF 2

SHOWN FROM COMPONENT SIDE



JUMPER INFORMATION

ID OPERATIONAL MODE	JU1	JU2
APERIODIC EXCHANGE MODE	OUT	OUT
TIMED INTERVAL MODE (TIME DETERMINED BY JU3)	OUT	IN
CONTINUOUS MODE (TIME DETERMINED BY JU3)	IN	IN

JU3 – IN FOR 30 MINUTES; OUT FOR 15 MINUTES
JU4 – IN FOR "PL" STRIP
JU5 – NORMALLY OUT; IN FOR EXTERNAL INHIBIT OF ID
JU6 - NORMALLY OUT, IN FOR DELETE RECEIVER OPTION.

NOTES:
1. ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE STATED.
2. RESISTORS ARE IN OHMS UNLESS OTHERWISE STATED.

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Models QRN8424B/QRN8425B Automatic Station Identifier Module Schematic Diagram and Circuit Board Detail
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PARTS LIST

REF SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF
C1	2382783B05	100 ±20%; 10 V
C2, 3, 4	0884637L33	0.1 ±10%; 100 V
C5	0884637L21	0.15 ±10%; 100 V
C6	2100863291	1500 pF ±2%; 500 V
C7	2184494B04	100 pF ±5%; 100 V
C8	0884637L25	.01 ±10%; 400 V
C9	2384762H05	4.7 ±20%; 25 V
C10	0884637L22	0.22 ±10%; 100 V
C11	2384762H08	3.9 ±20%; 15 V
C12	2184494B19	470 pF ±5%; 100 V
C13, 14, 15	0884637L25	.01 ±10%; 400 V
C16	2184494B04	100 pF ±5%; 100 V
C17	0884637L25	.01 ±10%; 400 V
C18	0884637L33	0.1 ±10%; 100 V
C19	0884326A30	.0045 ±1%; 50 V
C20	0884637L33	0.1 ±10%; 100 V
C21	2383214C16	15 ±5%; 20 V
C22	0884637L22	0.22 ±10%; 100 V
C23, 24, 25	0884637L25	.01 ±10%; 400 V
C26, 27	2383214C06	10 ±20%; 15 V
C28, 29	0884637L29	.001 ±10%; 630 V
C30	0884637L22	0.22 ±10%; 100 V
		DIODE: (SEE NOTE)
CR1	4882466H13	silicon
CR2 thru 8	4883654H01	silicon
CR9	4882178A04	germanium
		TRANSISTOR: (SEE NOTE)
Q1, 2	4800869648	NPN; type M9648
Q3	4800869706	NPN; type M9706
		RESISTOR, fixed: ±5%; 1/4 W: unless otherwise stated
R1	1783122D09	22; 3 W
R2	0611009C61	3.3k
R3	1883083G08	var. 25k ±10%
R4	0611009C81	22k
R5	0611009C97	100k
R6	0611009D04	180k
R7	0611009C83	27k
R8	0611009C49	1k
R9	0611009C73	10k
R10 thru 15	0611009C97	100k
R16	0610621D79	80.6k ±1%; 1/8 W
R17, 18	0611009D04	180k
R19	0611009D10	330k

PARTS LIST

REF SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R20	0611009C73	10k
R21	0611009C77	15k
R22, 23	0611009C97	100k
R24	0611009C49	1k
R25	0611009C97	100k
R26 thru 29	0611009C49	1k
R30	0611009C97	100k
R31	0611009C57	2.2k
R32	1883083G28	var. 1k ±20%
R33	0611009C73	10k
R34	0611009C97	100k
R35	0611009C77	15k
		SWITCH, slide:
S1	4083204B01	spst
S2	4083468E01	spst
		INTEGRATED CIRCUIT: (SEE NOTE)
U1	5182884L62	programmable timer
U2	5184371K65	timer
U3	5182884L61	hex multifunction gate
U4	5182884L42	14 stage counter
U5	5106011M02	PROM (QRN8705A)
U6	5183977M16	squelch control
		VOLTAGE REGULATOR: (SEE NOTE)
VR1	4883461E34	Zener, 5.6 V
		MECHANICAL PARTS
	0300125790	SCREW, machine: 4-40 x 5/16"; 2 used
	6406813K42	PANEL, front (QRN8424B)
	6406813K24	PANEL, front (QRN8425B)
	0983011H01	CONNECTOR, contact; 24 used (QRN8424B)
	0983497F01	CONNECTOR, receptacle: 8-contact; 3 used (QRN8425B)
	0984924E02	SOCKET, IC; 16-contact (U5)

NOTE: For optimum performance, diodes, resistors, crystals and integrated circuits must be ordered by Motorola part numbers.