MAINTENANCE MANUAL
INPUT/OUTPUT BOARD
19D902058G1 VEHICULAR
19D902058G3 MOTORCYCLE

TABLE OF CONTENTS

ERICSSON

SPECIFICATIONS*

Input Power		
A+	(J1-1)	13.8 Vdc, ± 20%
A+ IGN	(J1-2)	13.8 Vdc, ± 20%
Output Power		
A+ SW	(J2-11)	13.6 Vdc, ± 20%
+5V	(J6-25)	5.0 Vdc ± 5%
TX-SW-IGN	(J2-13)	13.6 Vdc, ± 20%
Maximum Input Current Drain (With Processor & Keypad Boards)		
A+	(J1-1)	
With Radio		2.6 amperes
Without Radio		400 mA
A+ IGN	(J1-2)	20 mA
Maximum Output Current Drain		
A+SW	(J2-11)	2.65 amperes
+5 VOLTS	(J6-25)	350 mA
TX-SW-IGN	(J2-13)	20 mA
Temperature Range		-30°C TO + 60°C (-22°F TO +140°F)
Logic Levels		
High (1)		4.0 ±1.0 Vdc
Low (0)		0.5 ± 0.5 Vdc
Horn Ring Input		
Power	(J1-3)	13.8 Vdc ± 20%
Current	(J1-3)	220 mA
Horn Ring Output		
Power	(J1-4)	13.6 Vdc ± 20%
Current	(J1-4)	220 mA
Audio Amplifier		
Filtering		De-emphasis per EIA RS-220
Minimum Power Supply Rejection		28 dB
Light Relay Drivers U8 and U9		
Minimum Current Sink		200 mA
Low Voltage maximum		1.5 Volts

* These specifications are intended primarily for the use of the serviceman. See the appropriate Specifications Sheet for the complete specifications.

DESCRIPTION

The I/O Board provides the control unit interface to all external equipment used in the vehicle or motorcycle radio system. The I/O Board interfaces the Processor Board and the following external equipment, when present:

- RANGR radio
- Vehicular Repeater
- Siren/PA unit
- Mobile Light unit

The Processor Board writes to the registers of the I/O Board to perform the interface functions to the radio system.

One register provides the audio routing and control of the VOL/SQ-HI and MIC-HI signals to the radio transmitter, and to the external siren/PA.

A register controls the horn enable/disable circuitry which routes the horn signal back to the horn relay, the Channel Guard disable signal to the radio, and the external PA push to talk.

One register performs additional radio control such as the radio push to talk, RX mute, and squelch disable. Vehicular repeater functions include the VRS enable signal, and the external siren/PA audio select lines PAl and PA2.

Another register controls the radio frequency selection and downloading, and one register controls the vehicle light array. Darlington drivers are used to interface to the light relay controls.The input lines are sampled by an analog multiplexer.

Both the squelch and volume levels are set by an electrically erasable potentiometer (EEPOT). This includes volume setting for VOL-ARM/SQ-ARM, PA-AUDIO, and GE*STAR signalling.

An analog switch routes the different audio signals to the radio transmitter, and to the external siren/PA. An audio amplifier provides the audio drive to the siren/PA and the headset.

The horn relay control enables or disables the routing of the horn power to the horn relay. A relay also controls the power of the control unit by switching the continuous A+ power to the A+ switched power. This also provides power to the logic devices on the I/O Board and the rest of the control unit through a 5 volt regulator.

CIRCUIT ANALYSIS

Jumpers on the I/O BOARD are used to configure the control unit for either vehicular or motorcycle operation.The jumper locations and functions are detailed in the following paragraphs. A block diagram is shown in Figure 1.

JUMPER CONFIGURATION

Jumpers J21, J22, J23, J24, J25, and J27 are used with shorting plugs P21, P22, P23, P24, P25, and P27 to configure the respective units for one of the two modes of operation.

For vehicular operation, the Darlington driver outputs are applied to J5 to operate the light relay controls. The light relay controls include R AMB, R RED, WIG WAG, CLR SPT, FRED, and R 180.

For motorcycle operation, the headset audio and controls are applied to connector J5. The headset interface includes S PTT, C PTT, MIC-PRE, MIC-LO, GND (logic ground), and PA-AUDIO (headset audio).

Jumper connections for the vehicular and motorcycle modes of operation are shown in Table 1.

JUMPER	POSITION OF PLUG	J5 CONNECTOR PIN	VEHICLE FUNCTION	MOTORCYCLE FUNCTION
J21	1 & 2 2 & 3	6	R DEK	PA AUDIO
J22	1 & 2 2 & 3	5	R RED	GND
J23	1 & 2 2 & 3	4	WIG WAG	S PTT
J24	1 & 2 2 & 3	3	* (SPARE)	C PTT
J25	1 & 2 2 & 3	2	CLR SPT	MIC HI
J27	1 & 2 2 & 3	1	F RED	MIC LO

Table 1 - Vehicle and Motorcycle Jumper Configuration

Jumper J26 is used for a future option. For the control unit, J26 is configured with pins 1 & 2 shorted (via P26), enabling the tri-state outputs of register U5 to pass the radio information to the mobile. This is accomplished by grounding the tri-state control input of U5. This is the standard configuration for the control unit.

Jumper J28 is used to configure the A+IGN power to be generated from the ignition switch or from the A+SW power generated internally in the control unit.

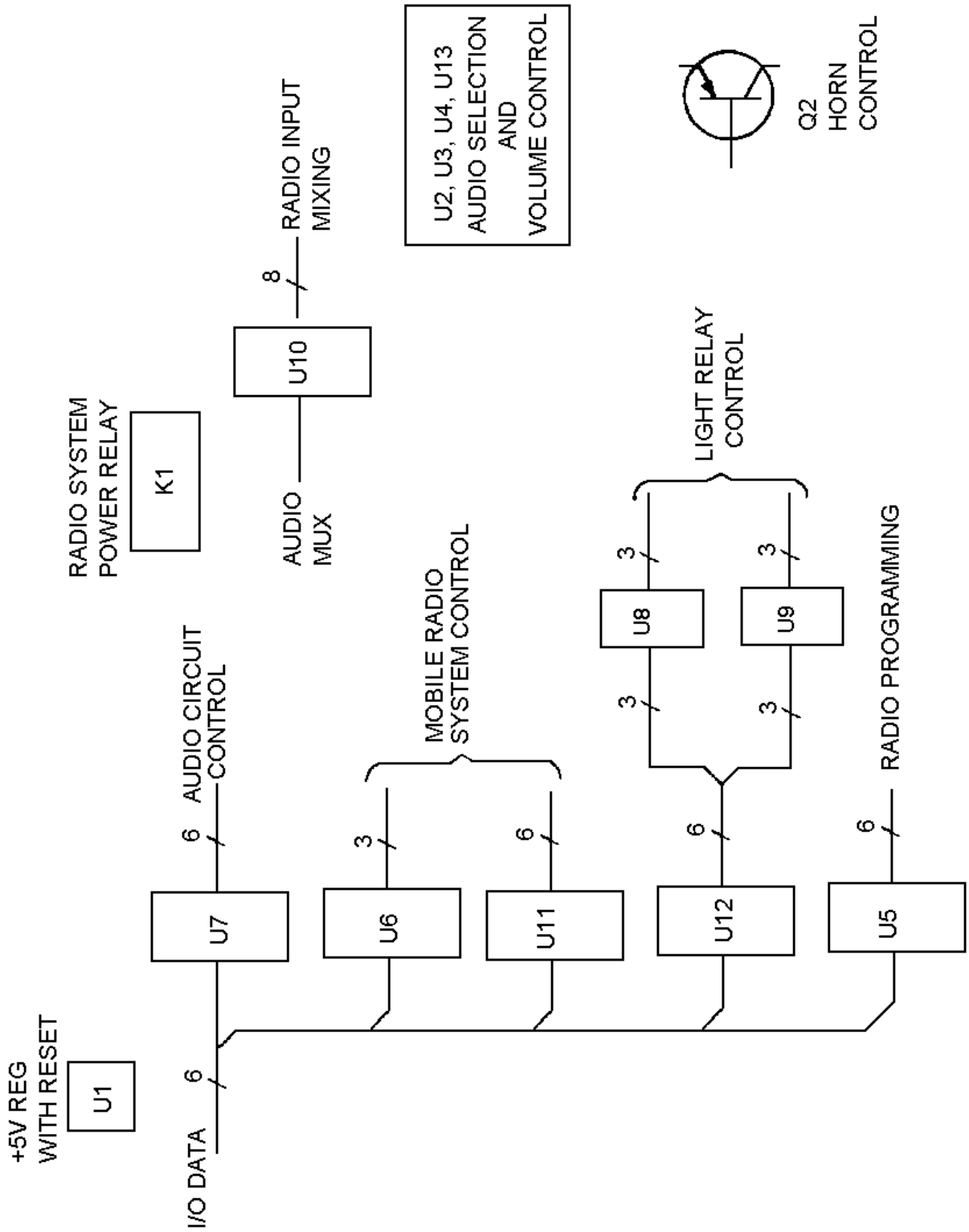


Figure 1 - I/O Board Block Diagram

The A+ IGN signal is the switched battery power through the ignition switch on the vehicle or motorcycle. A+SWIGN is the switched battery power through the relay K1 on the I/O Board. A+SW IGN is configured to be either A+ IGN or A+SW.

When shorting plug P28 is installed between 1 & 2 of J28, the radio is enabled for RF transmission when power is applied to A+ IGN. This is the standard configuration for the control unit

The only control unit function not operating when A+SW IGN power is removed is the SIREN.

When shorting plug P28 is installed between 2 & 3 of J28, the radio is enabled for RF transmission at all times (A+ SW is powered whenever the control unit and radio are powered).

The ignition sense configuration is shown in Table 2.

MEMORY-MAPPED PROCESSOR OUTPUT

The Processor Board of the control unit addresses the five registers on the I/O Board through memory-mapped output accesses.

Six data lines are captured by the I/O Board upon a rising edge of the appropriate clock line to the registers. In addition, the I/O-RESET line is used to reset or initialize (the output of the initialized register is a logic low on all output lines) four of the five registers to an initialized state upon a power up or watchdog timer reset (from the Processor Board).

The six data lines are I/O-DATA-0 through I/O-DATA-5. The individual clock lines to the registers are IO1C through IOSC.

Table 3 depicts clock lines to the appropriate register and the initialization state of each register.

JUMPER J28 AND SHORTING PLUG P28 POSITION	A+ SW IGN	RADIO TRANSMIT
1 & 2 (STANDARD)	ON OFF	ENABLED DISABLED
2 & 3	X	ENABLED (ON A+SW POWER)

Table 2 - A+ IGN Ignition Sense Configuration

REGISTER	CLOCK LINE	INITIALIZATION ON I/O-RESET
U7	IO1C	Y
U6	IO2C	Y
U12	IO3C	Y
U11	1O4C	Y
U5	IO5	N

Table 3 - I/O Board Memory Mapped Registers

Register U7 controls the audio routing and pot level settings.The register is capable of steering the microphone audio, Channel Guard tone, and GESTAR signalling to the radio transmitter. U7 is also capable of steering the received radio audio and volume setting feedback tone to the radio speaker, and also steers the received radio audio and microphone audio to the external PA unit.

Register U7 also provides the select line and the up/down control to the two electrically erasable potentiometers (EEPOT's) which adjust the squelch level to the radio and the audio level (or tone) to the audio path selected on the I/O Board.

Register U6 provides the horn ring disable control to inhibit the horn power from being passed to the horn relay circuit. U6 also provides the Channel Guard disable output to the radio. This control is the hookswitch or monitor function which routes the received audio to the radio speaker for monitoring prior to radio transmission.

In addition, register U6 generates the push to talk output to the external PA unit This enables the amplification of the PA AUDIO signal to the external PA speaker.

Register U12 provides the six light relay controls to the vehicle. These controls are R AMB, R RED, WIG WAG, CLR SPT, FRED, and R 180.

Register UI I provides various controls to the rest of the radio system. The register generates controls to the mobile radio to perform the push to talk function, the receiver mute function, and squelch disable function.

Register UI 1 also generates controls to the vehicular repeater to enable the VRS unit. Register UI 1 generates the external two siren/PA select inputs which determine the operating- mode initiated by a PA push to talk.

Register UI2 provides the operating frequency and download information to the mobile radio. Four out of the possible five frequency bits are provided in addition to the radio personality store signal and the radio reset (or initialization) signal.

Data to the individual registers on the I/O Board is captured or stored in the registers on the rising edge of the appropriate clock line. Table 4 shows the data lines and the corresponding output control function associated with each input on each of the five registers.

I/O DATA LINES I/O-DATA-X	REGISTER U7	REGISTER U6	REGISTER U12	REGISTER U11	REGISTER U5
0	VOL/MIC	X	LIGHT-RELAY-6	VRSEN	FB-1
1	VOL-CS	HORN-DIS	LIGHT-RELAY-5	RAD-PTT	FB-2
2	PA/MIC	X	LIGHT-RELAY-4	RX-MUTE	FB-3
3	SQ-CS	CG-DIS-OUT	LIGHT-RELAY-3	PA2	FB-4
4	GESTAR/VOL	X	LIGHT-RELAY-2	SQ-DIS	STORE
5	AUDIO-U/D	PA-PTT	LIGHT-RELAY-1	PA1	RESET
CLOCK LINE	IO1C	IO2C	IO3C	IO4C	IO5C

Table 4 - I/O Board Register Control and Function

SQUELCH AND AUDIO LEVEL SETTING

The squelch and audio levels are adjusted electronic through two electrically erasable potentiometers (EEPOT's), U4 and U3, respectively.

The EEPOT's provide a three line control to their internal resistance level setting. The three lines are AUDIO-U/D, AUDIO-INC, and SQ-CS (for the squelch level control EEPOT) or VOL-CS (for the audio level control EEPOT).

Each EEPOT is composed of a resistor array of 99 resistive elements. Between each element and at either end are tap points accessible to the wiper element.

The AUDIO-U/D input controls the direction of the wiper movement. The AUDIO-INC input is negative edge-triggered. Toggling AUDIO-INC moves the wiper and subsequently increments (if AUDIO-U/D is high) or decrements (if AUDIO-U/D is low) the wiper along the resistive element array. The EEPOT is selected when its select input (SQ-CS or VOL-CS) is low.

Although the EEPOT is capable of retaining the last value upon a power up, this nonvolatile feature of the EEPOT is not used in the control unit. The level setting of the EEPOT for squelch and all audio levels are retained in the EEPROM on the Processor Board.

SQUELCH LEVEL SETTING

The squelch EEPOT wiper input is derived from the received radio audio (VOL/SQ-HI).

Capacitors C16 and C32 provide a dc block from the received radio audio and the operating dc bias to the squelch EEPOT (U4). Resistor R28 maintains a bias level at the positive analog input of the squelch EEPOT (U4-3) at a nominal 2.5 volts.

The negative analog input of the squelch EEPOT (U4-6) is the return ground lead for the incoming received radio audio (VOL/SQ-LO). The wiper arm output (SQ-ARM) of the squelch EEPOT (U4-5) is applied to the mobile radio (J2-1) where squelch circuitry provides the CAS generated signal to the rest of the radio and the control unit.

The squelch EEPOT's wiper arm is varied from VOL/SQ-LO to VOL/SQ-HI in 99 steps through a table lookup by the microcomputer on the Processor Board.

AUDIO LEVEL SETTING

The audio EEPOT wiper input is derived from the analog multiplexer (U2A-14). The analog multiplexer switches the positive analog input to the audio EEPOT (U3) from the decoupled (dc blocked) received radio audio (VOL/ SQ-HI) or from the processor generated signalling (TONE).

One source of analog input to the audio EEPOT is TONE which is switched through the analog mux U2A. TONE is used by the Processor Board to generate a feedback volume setting tone to the radio speaker. TONE is sent to the audio EEPOT through the analog mux U2A to adjust the level of the beep tone heard in the radio speaker which sets the received radio volume to a comfortable listening level.

TONE is also used to couple the MIC-HI audio to the external siren/PA unit for the PA (public address) mode of operation. In this mode of operation, MIC-HI is ac coupled through capacitors CIS and C3I to the analog mux (U2B-I5). Resistor R27 sets up a dc bias point to the analog mux input. The analog mux switches the ac coupled MIC-HI signal over to TONE.

TONE is also used by the Processor Board to generate GESTAR signalling which also passes through the audio EEPOT for the purpose of adjusting modulation level.

Another source of analog input to the audio EEPOT is the received radio audio (VOL/SQ-HI) which is switched through the analog mux U2A. Capacitors CI6, C2O, and C32 provide a dc block from the received radio audio and the operating dc bias to the audio EEPOT (U3) through the analog mux, U2A.

The wiper arm output (VOL-ARM) of the audio EEPOT (U3-5) is sent to the mobile radio (J2-5) where it may be heard through the radio speaker. The wiper arm output is ac coupled (via capacitor C7) to the analog mux U2C where it can pass to the external siren/PA for the external radio and external PA mode of operation.

The audio EEPOT's wiper arm is varied from VOL/ SQ-LO to VOL/SQ-HI or TONE.

FAST SQUELCH ADJUSTMENT

The fast squelch adjustment potentiometer (R9) is used to provide an attenuated received radio audio to the Processor Board of the control unit for fast noise squelch detection. The RF detect threshold is set for a noise level of -I5 dBm.

The received radio audio that is sent to the positive analog input of the squelch EEPOT is ac coupled (via capacitor C5) and sent to the Processor Board through variable pot R9.

The FAST-SQUELCH signal is an attenuated version of the VOL/SQ-HI signal that is used by the processor to detect the presence of an RF carrier in PSLM applications.

The Processor Board uses a modified mobile radio CAS detector to provide a quick indication of noise squelch in the 6000 to 8000 Hz range.

The adjustment of the variable pot R9, producing FAST-SQUELCH, is performed in conjunction with the Processor Board of the control unit. The pot R9 is typically adjusted to produce a fast squelch (noise squelch) detect an RF signal strength threshold of -15dBm.

AUDIO PATH SELECTION

The audio paths on the I/O Board are selected and routed through the analog multiplexer U2 (sections A, B, and C).

The previous description on the audio EEPOT level setting is applicable to the operation of the audio path selection through the analog mux U2.

Section U2A routes either the incoming radio received audio (VOL/SQ-HI) or the TONE signal over to the input of the audio EEPOT U3.

The VOL/SQ-HI is the radio received (demodulated incoming RF carrier) audio on the receiver frequency or channel.

The TONE input can consist of either the Processor Board generated feedback tone (used in audible volume setting beeps during idle radio receive operations), the ac coupled MIC-HI audio (used in the external PA mode of operation), GESTURE to the radio transmitter.

The control line for analog mux U2A is GESTURE/VOL which is generated from register U7. If GESTURE/VOL is a logic low, the TONE signal is fed to the input of the audio EEPOT. If GESTURE/VOL is logic high, the ac-coupled radio received signal is fed to the input of the audio EEPOT.

Section U2B enables the routing of the ac coupled MIC-HI audio onto the TONE signal for external PA operation or for generating the GESTURE signalling to the transmitter of the radio.

The control line for the analog mux U2B is PA/MICA which is generated from register U7. If PA/MIC is a logic low, the ac-coupled MIC-HI audio is sent onto the TONE signal which is used for external PA operation. If PA/MICA is a logic high, the MIC-HI signal or GESTURE signalling is routed to the radio transmitter.

Section U2C enables the received radio audio or the microphone audio to be sent to the external PA unit, or the headset or GESTAR signaling to be sent to the radio transmitter.

The control line for the analog mux U2C is VOL/MIC which is generated from register U7. If VOL/MIC is a logic low, the external PA and headset audio is derived from the received radio audio or the microphone and GESTAR routed to the radio transmitter. If VOL/MIC is a logic high, the external PA and headset audio is quiet.

The allowable audio paths, controls, and descriptions are summarized in Table 5.

U2A CONTROL GESTAR/VOL	U2B CONTROL PA/MIC	U2C CONTROL VOL/MIC	FUNCTION
1	0	0	MIC HI AUDIO TO RADIO TRANSMITTER
0	1	0	VOLUME BEEPS TO RADIO SPEAKER
0	1	0	GESTAR SIGNALLING TO RADIO TRANSMITTER
1	0	0	VOL/SQ HI AUDIO TO RADIO SPEAKER
0	0	0	EXTERNAL PA OR MIC HI AUDIO TO PA
1	1	0	EXTERNAL RADIO OR VOL/SQ HI AUDIO TO PA
1	0	1	STANDBY MODE NO SIGNAL RX NO SIGNAL TX

Table 5 - Audio Path Selection and Control

RADIO CONTROL AND INTERFACE

The I/O Board provides the control and interface to the mobile radio. The mobile radio control functions are derived from registers U6, U12, U5, U1 1, and U12. The mobile radio and vehicular repeater outputs are sampled through the analog multiplexer UI0. The mobile radio audio interface is accomplished through the received radio audio and the microphone audio. In addition, several signals are inputted/outputted directly from the Processor Board with the I/O Board serving as a buffer.

The radio control and interface functions are classified according to radio receive output control, radio receive input control, radio transmit output control, radio transmit input control, and radio frequency selection and downloading.

Although not part of the mobile radio, the microphone provides inputs to the control unit to perform the radio control and interface.

RADIO RECEIVE INPUT CONTROL

The radio receive input controls consist of those input lines to the control unit that initiate the receiver functions of the mobile radio. The inputs include CG-DIS-IN, CAS, VOL/ SQ-HI, and LIM-CG-HI.

CG-DIS-IN is derived from the microphone connector-(J4-6) and the power connector (J1-5). This signal is also referred to as the hookswitch or monitor switch. When active low, this signal will disable the decoding of Channel Guard that is used to enable reception of incoming message transmissions. When inactive, the incoming transmissions are sent to the radio speaker if the decoded Channel Guard signal is valid. The Processor Board of the control unit performs the decoding of the incoming Channel Guard signal.

CAS is a radio generated signal that indicates the presence of an RF carrier on the mobile receive frequency. When active low, this signal will disable the incoming transmissions to be sent to the radio speaker. When inactive, the

incoming radio transmissions are enabled to be sent to the radio speaker. The Processor Board uses this signal as an input to determine whether to open the radio speaker for incoming audio. The Processor Board also contains a fast squelch detector, similar to the CAS detector used in the mobile radio, to provide a quick indication of RF carrier in PSLM applications.

VOl/SQ-HI is the radio received audio. This is the unfiltered (no de-emphasis filtering applied) demodulated RF received signal containing only voice or channel noise. VOl/SQ-HI is input to the squelch EEPOT U4 for a variable squelch setting to the radio and to the analog mux U2A (used in the audio path selection of the I/O Board). VOl/SQ-HI is also attenuated by pot R9 and sent to the Processor Board for input to the fast squelch detector used in PSLM (scan) applications.

LIM-CG-HI is the limited Channel Guard signal from the mobile radio. This is a TTL compatible signal that is sent to the Processor Board for additional re-limiting and decoding of the proper Channel Guard input

RADIO RECEIVE OUTPUT

The radio receive output controls consist of those output lines from the control unit that initiate the receiver functions of the mobile radio. Radio receive outputs include VOL-ARM, SQ-ARM, CG-DIS-OUT, SQ-DIS, and RX- MUTE.

VOL-ARM is the audio to be sent to the radio speaker. This signal is generated from the audio path selection on the I/O Board For radio functions, this audio consists of either the demodulated VOL/SQ-HI radio received audio or TONE (feedback volume beeps), both of which are attenuated through the EEPOT U3.

SQ-ARM is the attenuated version of VOL/SQ-HI that is sent to the mobile radio to be used as the input to the noise squelch detector which generates the radio's CAS signal. SQARM provides a variable radio squelch setting from the control unit

CG-DIS-OUT is an open collector output from the I/O Board to the mobile radio. This active low output is used by the mobile radio to disable the decoding of Channel Guard during incoming radio reception.

SQ-DIS is an open collector output from the I/O Board to the mobile radio. This active low output is used by the mobile radio to disable the noise squelch function and allows the audio on VOL-ARM to be sent to the radio speaker. This is used when volume beeps are generated.

RX-MUTE is an open collector output from the I/O Board to the mobile radio. This active low output is used by the mobile radio to mute the audio on VOL-ARM. This output is also used by the vehicular repeater to indicate that the mobile is receiving a signal with the correct Channel Guard tone. This initiates a repeat through the VRS to the personal.

RADIO TRANSMIT INPUT

The radio transmit input controls consist of those input lines to the control unit that initiate the transmitter functions of the mobile radio. The radio transmit inputs include C-7, S-7, MIC-HI, GESTAR, and MIC-PRE.

The C-PTT signal is an active low push to talk input to the I/O Board from the microphone to initiate transmission on the C channel frequency.

The C-PTT signal is an active low push to talk input to the I/O Board from the microphone to initiate transmission on the C channel frequency.

MIC-HI is the analog audio from the handheld microphone. This audio line is terminated in a 600 ohm resistor. Microphone bias is supplied from the radio through a pull up resistor to 9 Vdc. MIC-HI is also used in the audio path selection of the I/O Board to inject GESTAR signalling prior to voice transmission as well as routed to the external siren/PA unit for the external PA mode of operation.

MIC-PRE is the analog audio from the headset microphone. This audio signal is amplified by transistor QIS and associated circuitry. The amplified audio is coupled onto MIC HI. No dc bias is required by the headset.

GESTAR is an active low input to the 1/O Board from an external switch. This input initiates an emergency GESTAR signalling sequence to be transmitted from the mobile radio.

RADIO TRANSMIT OUTPUT

Radio transmit output controls consist of those output lines from the control unit that initiate the transmitter functions of the mobile radio. The outputs include MIC-HI and RAD- 7.

MIC-HI is the analog audio from the microphone. This audio line is terminated via a600 ohm pull up to 9 volts inside the radio. MIC-HI is also used in the audio path selection of the I/O Board, to inject GESTAR signalling prior to voice transmission, as well as routed to the external siren/PA unit for the external PA mode of operation.

RAD-PTT is an open collector output from the I/O Board to the mobile radio. This active low output is used by the mobile radio to initiate an RF transmission on the selected radio frequency channel.

FREQUENCY SELECT & DOWNLOAD

Mobile radio frequency selection and download controls consist of those lines that select the radio channel frequency and perform the download of radio information to the mobile radio. The signals that perform the radio channel frequency selection include FB-1, FB-2, FB-3, FB-4, FB-5, and ADV-CHANGE.

The frequency channel is selected by the TTL compatible data lines consisting of FB- 1, FB-2, FB-3, FB-4, FB-5, and ADV-CHANGE. Four of the five frequency select lines (FB-1 through FB-4) are generated from register U5 on the I/O Board. FBS is generated by the Processor Board and is buffered by the I/O Board to be sent to the mobile radio. ADVCHANGE is generated by the Processor Board and is buffered by the I/O Board and applied to the mobile radio.

FB-1 through FB-5 are active low outputs that select the radio channel frequency. ADV-CHANGE is an active high output that interrupts the mobile radio controller for a quick radio frequency change.

The signals that perform the radio frequency download include FB-5, ADV-CHANGE, CG-DIS-OUT, RESET, and STORE.

CG-DIS-OUT provides the latch control function of the serial download. FB-5 provides the bidirectional serial data. ADV-CHANGE provides the serial clock. STORE provides the radio EEPROM store signal. RESET provides the initialization of the radio prior to and after each download.

The format of the serial communications and data transfer is provided in the SERIAL DATA FORMAT document which depicts the protocol of the radio frequency download process.

VRS CONTROL & INTERFACE

The I/O Board provides the control and interface to the vehicular repeater system (VRS). The inputs from the vehicular repeater to the I/O Board include VRS-7, C-SEL, and S-SEL. The outputs to the vehicular repeater from the I/O Board include VRS-EN, RX-MUTE, VOL/SQ-HI, and MIC- HI.

VRS-EN is an active high output to the VRS unit to enable the vehicular repeater unit to function as part of the mobile radio system.

VOL/SQ-HI is the radio received audio that is also routed to the VRS unit for transmission.

MIC-HI is the microphone audio that is also routed from the VRS unit receiver.

RX-MUTE is routed to the mobile radio and the vehicular repeater to indicate that a signal with the correct Channel Guard has been received by the mobile radio.

LIGHT RELAY CONTROL

The I/O Board interfaces with the relay light controls of a vehicle.

Register U12 holds the value of the relay light control TTL level. The outputs of register U12 are applied to Darlington drivers U8 and U9. The Darlington drivers sink up to 200 ma of current through the customer supplied relay.

The light relay control holding registerUl2 outputs a TTL level to the corresponding Darlington driver input. The output of the Darlington driver either floats or sinks current through the customer supplied light relay.

The push-buttons are labeled R-DEK, R-RED, WIG-WAG, * (or SPARE), CLR-SPT, and F-RED and function as follows:R-AMB is used to flash both the rear amber and rear blue warning lamps simultaneously.

R-RED is used to flash both the rear red and rear blue warning lamps simultaneously.

WIG-WAG is used to provide power to the high beam flashing circuit.

CLR-SPT is used to provide power to the right-side clear spotlight.

F-RED is used to provide power to the front red warning lamps.

R 180 is used to activate the R18O warning lamp.

SIREN/PA CONTROL

The I/O Board interfaces to the siren/PA unit of the radio system. The interface functions include the generation of the wail siren sounder or the yelp siren sounder.

Interface to the PA functions include the generation of the external radio audio to the speaker or the external PA (microphone) audio to the public address speaker.

The controls are generated by TAPII and WAIL signal lines. These controls are primarily generated from U11-10 and U11-12, respectively. U11-10 drives the base of transistor Q7 through resistor RI2. U11-12 drives the base of transistor Q8 through resistor R13. TAPII is generated by Q7 and WAIL is generated by Q8. TAPII and WAIL are open collector outputs which are decoded by the siren/PA unit.

The emitters of transistors Q7 and Q8 are tied to the collector of transistor Q14. Transistor Q14 is capable of sinking current through the emitters of Q7 and Q8 when the A+SW-IGN power is active. This is when the control unit is turned on and the ignition switch of the vehicle or motorcycle is activated. Table 6 shows the siren/PA controls.

The audio interface to the siren/PA unit is PA-AUDIO, generated from the audio amplifier U13. The audio amplifier routes the radio received audio (VOL/SQ-HI) or the microphone audio (MIC-HI) to thePA unit in the external radio mode of operation or the external PA mode of operation, respectively.

FUNCTION	U11-12 WAIL	U11-10 TAPII	U6-10 PA PTT
EXTERNAL RADIO	1	1	0
EXTERNAL PA	1	1	0
OSCILL. WAIL	0	1	1
CONSTANT WAIL	1	0	1
YELP	0	0	1

Table 6 - Siren/PA Control

PA AND HEADSET AUDIO AMPLIFIER

The PA and headset audio amplifier consist of U13 and associated circuitry. Audio amplifier U13 drives the audio derived from the audio path selection to the siren/PA unit and to the headset. Audio selected to be routed to the siren/PA unit is the received radio audio (in external radio mode of operation), or the microphone (in the external PA mode of operation).

Audio amplifler U13 is capable of driving the 16-ohm impedance of the headset, used on the motorcycle control unit, as well as providing power (voltage) gain to both the headset and the siren/PA unit

Resistor R6 and Capacitor C6 provide a 6 dB per octave de-emphasis filter for the radio received audio on VOL/ SQ-HI.

Capacitor C8 provides a dc block on the audio to the headset and the siren/PA unit. Resistor R41 sets the maximum audio level to the headset Resistor R5 sets the maximum audio level to the siren/PA unit

Capacitor C17 provides the power supply ripple filtering for the audio amplifier. The audio amplifier U13 is powered from A+SW. Capacitor C17 serves to eliminate the alternator whine on the battery leads of the vehicle or motorcycle.

Capacitor C19 provides DC clocking and drive path for GE-STAR modulation into the microphone circuit. Resistor R29 and capacitor C24 provide additional stability. Capacitor C34 sets up the gain of amplifier U14.

HORN RING CIRCUIT

The horn ring circuit consists of Q1, Q2, Q3, and associated circuitry.

The horn ring circuit enables or disables the current path to the horn ring relay in the vehicle or the motorcycle. The horn ring circuit does not actually produce the current to the horn ring relay, rather it acts as a switch to pass or cut off the current generated by the horn switch, of the vehicle or motorcycle, to the horn ring relay.

The horn switch power is inputted on HORN-RING to the emitter of transistor Q2. Transistor Q2 passes the current to its collector path if it is turned on. Transistor Q2 is on if and only if transistor QI is on. Transistor QI is on if and only if transistor Q3 is off. The following descriptions apply if the control unit is powered on.

The control input to the horn ring circuit is HORNDIS. If no current is applied to HORN-RING (from the horn switch), then HORN-RET applies no current to the horn ring relay.

If the horn switch is pressed, current is applied to HORN-RING. The following description applies in this case.

If HORN-DIS is a logic high, transistor Q3 is turned on, sinking current through its collector to ground and away from the base of transistor Q1. Transistor Q1 is thereby turned off and does not draw current into its collector. Transistor Q2 is not biased on and therefore does not return its emitter input current (on HORN-RING) to its collector (HORN-RET). This disables the horn ring input current from being returned to the horn ring relay.

If HORN-DIS is a logic low, transistor Q3 is turned off, and thereby does not sink current away from the base of transistor Q1. Transistor Q1 has a base current drive and turns on, sinking current through its collector circuit to ground. Transistor Q2 has a bias base drive current applied to it and therefore turns on enabling the input current (on HORNRING) to be passed to the horn ring relay (HORN-RET).

Note that the current through resistors R1 and R19 is a trickle current which is necessary to operate transistors Q1, Q2, and Q3 as the horn-ring relay power return.

If the control unit is powered down, then HORN-DIS is a logic low and hence the horn ring circuit enables the horn switch current (HORN-RING) to be passed to the horn ring return (HORN-RET).

The HORN-RING signal is also sent to the Processor Board to detect the horn switch closure in an active siren mode of operation. ln an active siren mode of operation (wail or yelp), the HORN-RING current is disabled from going to HORN-RET and is sampled by the Processor Board to switch to one of the two siren modes.

Table 7 contains the horn return control functions of the horn ring circuit

A+SW 1=POWER ON 0=POWER OFF	**HORN-DIS** 1=HIGH 0=LOW	**HORN-RING** 1=CURRENT 0=NO CURRENT	**HORN-RET** 1=CURRENT 0=NO CURRENT
0	0	0 1	0 1
1	0	0 1	0 1
1	1	X	0

Table 7 - Horn Return Control

5-VOLT REGULATOR AND RESET

The 5-volt regulator circuit on the I/O Board consists of U1, C3, C4, C2, C1, and C18.

U1 is a +5 volt regulator with an external reset output. The reset output is an open collector active low signal that is used to initialize four of the five registers on the I/O Board as well as the Processor Board at a power up and power down condition.

Capacitors C1 and C2 provide input voltage filtering and ripple rejection. Capacitor C4 provides output voltage filtering and ripple rejection. Capacitors C3 and C18 provide the delay time for the reset pulse generated by U1.

On a power down condition, the reset output pulse from U1 is generated when the output voltage (5 volts nominal) drops to about 4.75 volts. On a power up condition, I/O-RESET is held low until the output voltage reaches a nominal 5 volts. At that point, the reset output is held low until a specified delay time has expircd. The duration of the power up reset pulse is 30 ± 10 msec.

Regulator reset pulse, I/O-RESET, is or-tied with the watchdog timer reset pulse generated from the Processor Board and also to CU-RESET used in the serial download programming of the control unit personality information contained in the EEPROM on the Processor Board.

POWER RELAY

Relay K1 is used to switch the continuous A+ battery power to the switched power supply A+SW. The switched A+SW supplies input power to devices on all three boards of the controI unit, either directly or through the +5 volt regulator U1.

When the control unit is powered down, the A+ power supply drain in the control unit is on the Processor Board through its relay control flip flop. The relay control flip flop generates RELAY-CTRL which is a low (approximately O volts) or a high (approximately 10 volts) level.

RELAY-CTRL is the input to Darlington driver U8-1. The output of the Darlington driver (RLY), U8-16, is sent to the relay coil K1-16.

When RELAY-CTRL is high, RLY is low and pulls current through the relay coil. The relay contacts close and route A+ power to the A+SW line. The relay also routes the A+SW-IGN power to the TX-SW-IGN line. The ignition power , A+SW-IGN, is typically derived from the ignition switch of the vehicle.

When RELAY-CTRL is low, RLY is high and it floats the relay coil high to A+. The relay contacts open and disconnects the A+ continuous power from the switched power A+SW. The relay contacts also disconnect the A+SW-IGN power from the TX-SW-IGN.

POWER DISTRIBUTION

Power requirements for the I/O Board of the control unit include A+ and A+SW-IGN. Power supplied by the I/O Board include A+SW, +SV, and TX-SW-IGN.

The A+ power is the continuous battery power. The power supply normally goes to relay K1. A+ is used as the voltage to the darlington drivers U8 and U9 for their internal diode protection. A+ power is input to the relay control flip flop, on the processor, to energize the coil of relay K1 through the darlington driver (U8-1 is the input and U8-16 is the output).

The A+SW power is the switched A+ power which enables the control unit to be turned on and off. The A+SW power is generated from the A+ power through relay KI. The A+SW power is used to power audio amplifier U13 on the I/O Board, provide a pullup voltage to VRS-EN for the vehicular repeater, generate the +5 volt power through regulator U1, power the LED's on the keypad board, and power the EL driver on the Processor Board.

The +5V power is generated from the A+SW power through 5 volt regulator U1. This power supply is the 5 volt logic power to devices on the I/O Board, the Processor Board, and the keypad board (of the control unit), it also provides a stable reference voltage for the LCD temperature compensation circuit and the photodetector circuit on the keypad board as well as the fast squelch operational amplifier on the Processor Board.

When the A+ SW signal is applied, all control unit functions are active except for TAPll and WAIL (siren functions). The siren functions are enabled when A+ SW IGN is active.

A+-SW-IGN is the switched power from the car battery to the control unit derived from the ignition switch of the vehicle or motorcycle. A+-SW-IGN is used to enable the siren functions.

TX-SW-IGN receives power from A+-SW whenever the control unit is turned on. This power is sent to the PA select driver transistors to disable the siren functions of the siren/PA unit, if the ignition switch is not turned on. TX-SW-IGN is also sent to the radio controller to inhibit transmissions if power is not applied to this line.

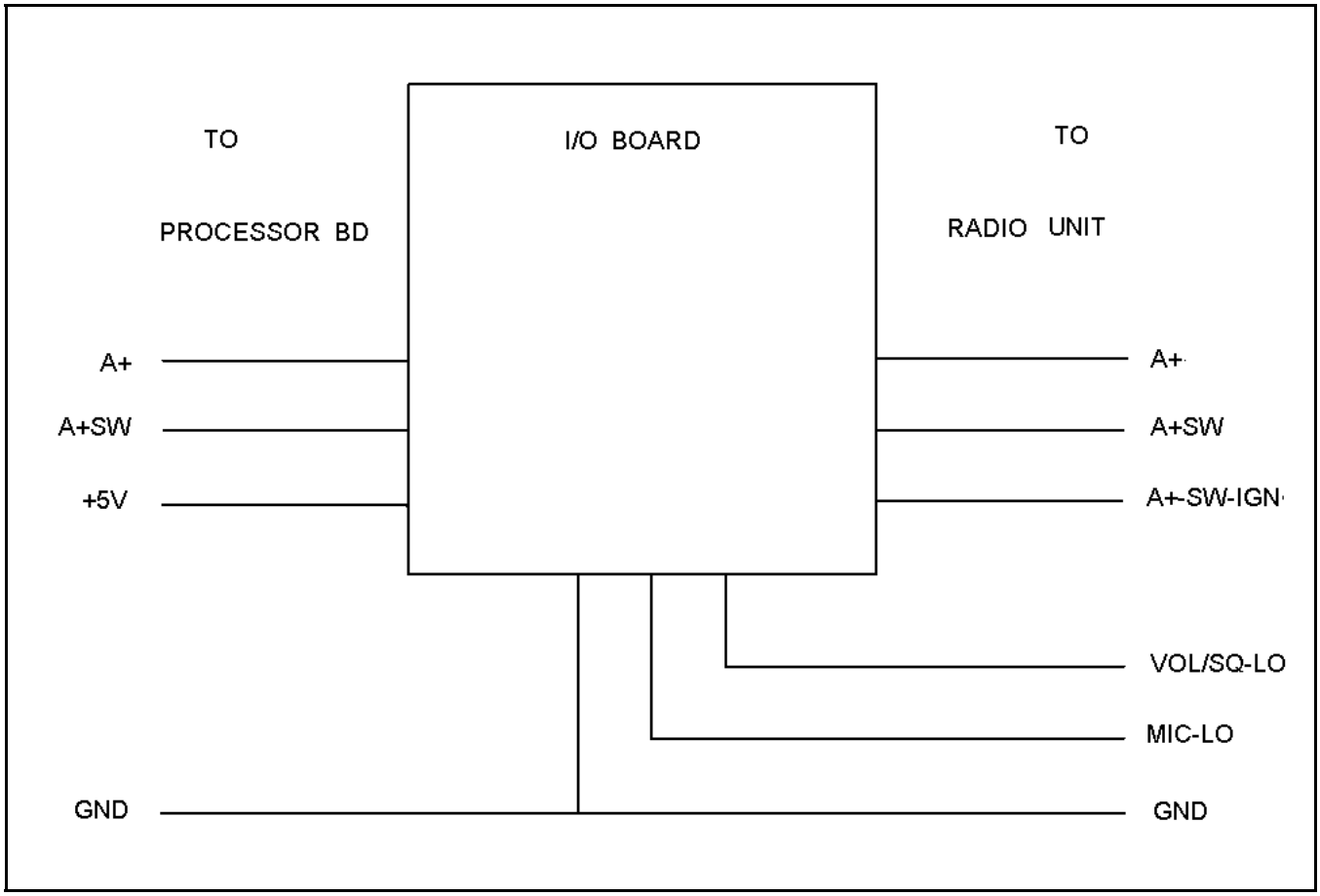


Figure 2 - I/O Board Power Distribution

The grounds used on the I/O Board are GND (logic ground and limited Channel Guard ground), VOL/SQ-LO (radio received audio ground), and MIC-LO (microphone audio ground). Figure 2 depicts the power distribution on the I/O Board.

RF BYPASSING

The I/O Board employs RF bypass capacitors in order to filter the fast switching digital signals and to prevent radio frequency noise burts from corrupting the digital signals. The I/O Board is interfaced to the Processor Board of the control unit, the mobile radio, the power system of the vehicle or motorcycle, the vehicular repeater system, the microphone, and the siren/PA unit.

The sensitive signals that are bypassed include those on the connectors that interface with the I/O Board.

I/O SIGNAL LINE PROTECTION

The I/O Board employs diode protection on input and output lines, in order to prevent excessive noise voltage spikes (from the environment) from causing damage to the controI unit components. The I/O Board is interfaced to the Processor Board of the control unit, the mobile radio, the power system of the vehicle or motorcycle, the vehicular repeater system, the microphone, and to the siren/PA unit. The sensitive signals that are diode protected are those on the J1, J2, J3, J4, andJ5 connectors that interface the I/O Board with the radio system units outside of the control unit. All input-output interface jacks for both vehicle and motorcycle operation are shown with signal levels in Tables 8 through 14.

CONNECTOR J1 PIN	SIGNAL NAME	INPUT (I)/ OUTPUT (O)	ANALOG (A)/ DIGITAL (D)	LEVEL VOLTS
1	A+	I	A	13.8
2	A+ IGN	I	A	0, 13.8
3	HORN RING	I	D	13.8, FLOAT
4	HORN RET	O	D	13.6, FLOAT
5	CG DIS IN	I	D	0, FLOAT
6	GESTAR	I	D	0, FLOAT
7	- - -	- - -	- - -	- - -
8	- - -	- - -	- - -	- - -
9	GND	I	A	0
10	SPKR 2	O	A	6.25 V rms
11	SPKR 1	O	A	6.25 V rms

Table 8 - J1 Ignition Connector I/O Definition

CONNECTOR J2 PIN	SIGNAL NAME	INPUT (I)/ OUTPUT (O)	ANALOG (A)/ DIGITAL (D)	LEVEL VOLTS
1	SQ ARM	O	A	0 - 0.300 (Vrms)
2	VOL/SQ LO	I	A	0
3	PA AUDIO	O	A	0 - 0.800 (Vrms)
4	VOL/SQ HI	I	A	0 - 0.300 (Vrms)
5	VOL ARM	O	A	0 - 0.300 (Vrms)
6	PA PTT	I	D	0, FLOAT
7	CNTRL A-	I	D	0, FLOAT
8	FB 1	O	D	TTL
9	FB 2	O	D	TTL
10	CAS	I	D	0, 9.0
11	A+SW	O	A	13.6
12	CD DIS OUT	O	D	0, FLOAT
13	TX SW A+	O	A	0, 13.6
14	RAD PTT	O	D	0, FLOAT
15	MIC LO	I	A	0
16	MIC HI	I	A	020 - .070 (Vrms)
17	SPKR 1	I	A	6.25 (Vrms) AT 10W
18	SPKR 2	I	A	6.25 (Vrms) AT 10W
19	GND	O	A	0

Table 9 - J2 Radio Control Connector I/O Definition

CONNECTOR J3 PIN	SIGNAL NAME	INPUT (I)/ OUTPUT (O)	ANALOG (A)/ DIGITAL (D)	LEVEL VOLTS
1	SQ DIS	O	D	0, FLOAT
2	TAPII	O	D	0, FLOAT
3	WAIL	O	D	0, FLOAT
4	CU RESET	I	D	0, FLOAT
5	GND	I	A	0
6	LIM CG HI	I	D	TTL
7	VRS PTT	I	D	0, 13.8
8	VRS EN	O	D	0, 13.8
9	RAD RESET	O	D	0, FLOAT
10	VRS EN	O	D	0, FLOAT
11	EE WR EN	I	D	0, FLOAT
12	RX MUTE	O	D	0, FLOAT
13	S SEL	I	D	0, FLOAT
14	ADV CHANGE	O	D	TTL
15	C SEL	I	D	0, FLOAT
16	STORE	O	D	TTL
17	FB 3	O	D	TTL
18	FB 4	O	D	TTL
19	FB 5	O	D	TTL

Table 10 - J3 Radio Control Connector I/O Definition

CONNECTOR J4 PIN	SIGNAL NAME	INPUT (I)/ OUTPUT (O)	ANALOG (A)/ DIGITAL (D)	LEVEL VOLTS
1	C PTT	I	D	0, FLOAT
2	S PTT	I	D	0, FLOAT
3	A+SW	O	A	13.8
4	MIC HI	I	A	.020 - .070 (V rms)
5	SPKR 1	O	A	6.25 (V rms)
6	CG DIS IN	I	D	0, FLOAT
7	SPKR 2	O	A	6.25 V rms
8	GND	I	A	0
9	MIC LO	I	A	0

Table 11 - J4 Connector I/O Definition

CONNECTOR J5 PIN (VEHICLE)	SIGNAL NAME	INPUT (I)/ OUTPUT (O)	ANALOG (A)/ DIGITAL (D)	LEVEL VOLTS
1	F-RED	O	D	0, FLOAT
2	CLR-SPT	O	D	0, FLOAT
3	R 180	O	D	0, FLOAT
4	WIG-WAG	O	D	0, FLOAT
5	R-RED	O	D	0, FLOAT
6	R-AMB	O	D	0, FLOAT
7	GND	I	A	0
8	---	---	---	---

Table 12 - J5 Connector I/O Definition (Vehicle)

CONNECTOR J5 PIN (MOTORCYCLE)	SIGNAL NAME	INPUT (I)/ OUTPUT (O)	ANALOG (A)/ DIGITAL (D)	LEVEL VOLTS
1	MIC-LO	I	A	0
2	MIC-HI	I	A	.003 - .010 (V rms)
3	C PTT	I	D	0, FLOAT
4	S PTT	I	D	0, FLOAT
5	GND	I	A	0
6	HD SET AUDIO	O	A	0 - 3 (V rms)
7	GND	I	A	0
8	---	---	---	---

Table 13 - J5 Handset Connector I/O Definition (Motorcycle)

CONNECTOR J6 PIN	SIGNAL NAME	INPUT (I)/ OUTPUT (O)	ANALOG (A)/ DIGITAL (D)	LEVEL VOLTS
1	I/O-DATA-0	I	D	TTL
2	I/O-DATA-1	I	D	TTL
3	I/O-DATA-2	I	D	TTL
4	I/O-DATA-3	I	D	TTL
5	I/O-DATA-4	I	D	TTL
6	I/O-DATA-5	I	D	TTL
7	IO1C	I	D	TTL
8	IO2C	I	D	TTL
9	IO3C	I	D	TTL
10	IO4C	I	D	TTL
11	IO5C	I	D	TTL
12	RELAY - CTRL	I	D	0, 13.8
13	GND	I	A	0
14	EE - WR - EN	O	D	0, FLOAT
15	AUDIO - INC	I	D	TTL
16	AUDIO - MUX	O	D	TTL, FLOAT
17	FAST - SQUELCH	O	A	0 - 0.3 (V rms)
18	LIM - CG - HI	O	D	TTL
19	TONE	I	A	0 - 0.3 (V rms)
20	ADV - CHANGE	I	D	TTL
21	FB - 5	I	D	TTL
22	HORN - RING	O	D	0 - 13.8
23	A+	O	A	13.8
24	A+SW	O	A	13.8
25	+5V	O	A	5
26	RESET	O	D	TTL

Table 14 - J6 Connector I/O Definition

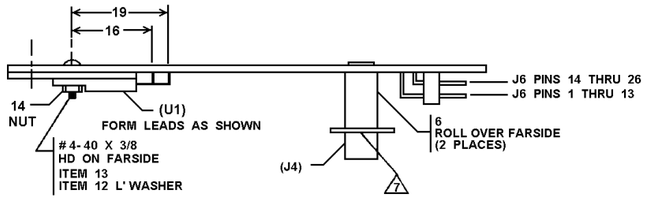
TROUBLESHOOTING

Afunctional test procedure for the I/O Board consists of exercising the board through the use of a standard "dumb" terminal and the test software called CHPSMON that is part of the operational code. Instructions for the CHPSMON tests and for the power continuity checks are contained in Maintenance Manual LBI-32952.

A summary of the Processor Board test commands, which are executable from the dumb terminal at the CHPSMON prompt, are listed below in Table 15.

WWG	WIG WAG RELAY CONTROL ON (X=1) OFF (X=0)
RMB	R AMB RELAY CONTROL ON (X=1) OFF (X=0)
RRD	R RED RELAY CONTROL ON (X=1) OFF (X=0)
FRD	F RED RELAY CONTROL ON (X=1) OFF (X=0)
CSP	CLR SPT RELAY CONTROL ON (X=1) OFF (X=0)
R18	R 180 RELAY CONTROL ON (X=1) OFF (X=0)
HRG	HORN RING DETECT
CGIN	DISPLAYS CG DIS IN
CPTT	(Z=2 DISPLAYS CPTT)
SPTT	(Z=3 DISPLAYS SPTT)
CSTR	(Z=4 DISPLAYS GESTAR)
CAS	(Z=5 DISPLAYS CAS)
VPTT	(Z=6 DISPLAYS VRS PTT)
CSEL	(Z=7 DISPLAYS CSEL)
SSEL	(Z=8 DISPLAYS SSEL)
TSTI V (OR M)	I/O BOARD AUTOMATIC TEST
REL	CONTROL NIT TURNS ITSELF OFF

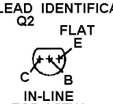
Table 15 - I/O Board CHPSMON Commands



CHIP DIODE IDENTIFICATION

CHIP TRANSISTOR IDENTIFICATION

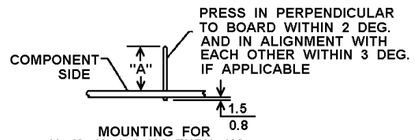
LEAD IDENTIFICATION
Q2



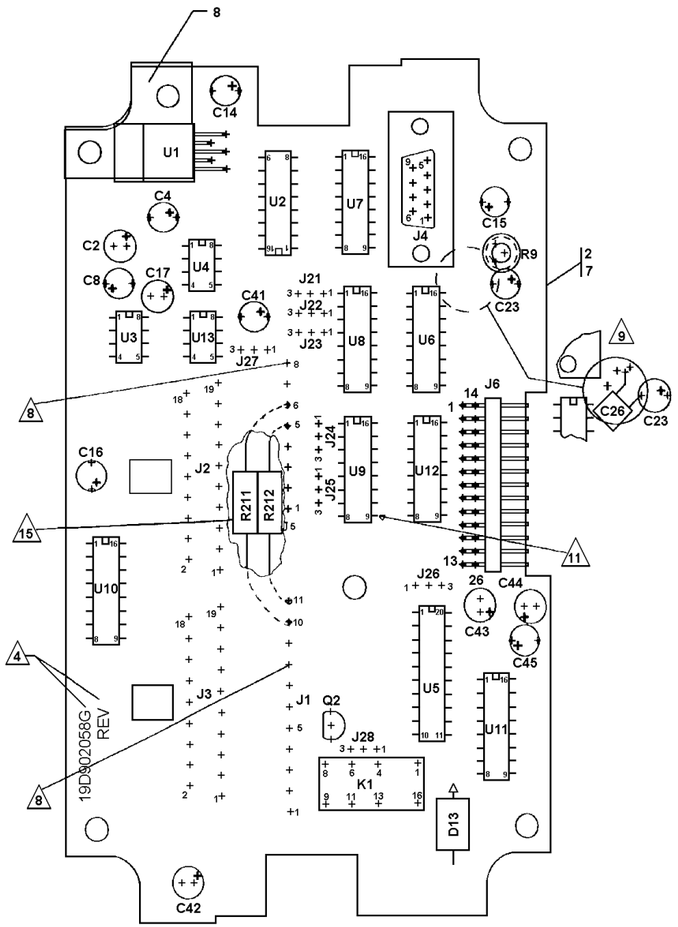
IN-LINE
TOP VIEW

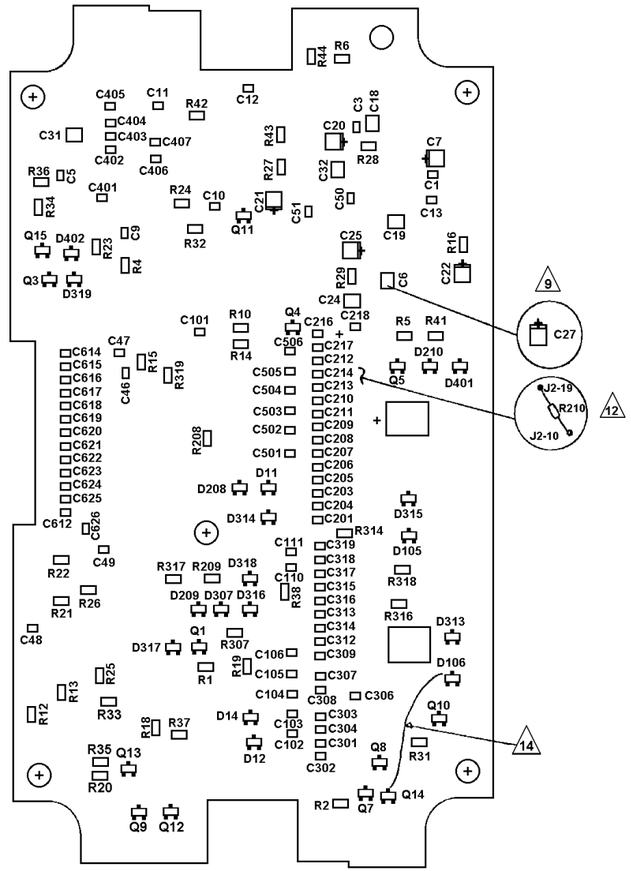
NOTE: CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION

JUMPER CONFIGURATION (FOR REF. ONLY)		
JUMPER	VEHICLE	MOTORCYCLE
P21	J21-1&2	OMIT
P22	J22-1&2	OMIT
P23	J23-1&2	J23-2&3
P24	J24-1&2	J24-2&3
P25	J25-1&2	J25-2&3
P26	J26-1&2	J26-2&3
P27	J27-1&2	J27-2&3
P28	J28-1&2	J28-2&3
	GROUP 1	GROUP 3



MOUNTING FOR
J1, J2, J3, J, & J21 THRU J28
A= 12.7 FOR J1, J2, J3, & J5
A= 6.7 FOR J21 THRU J28



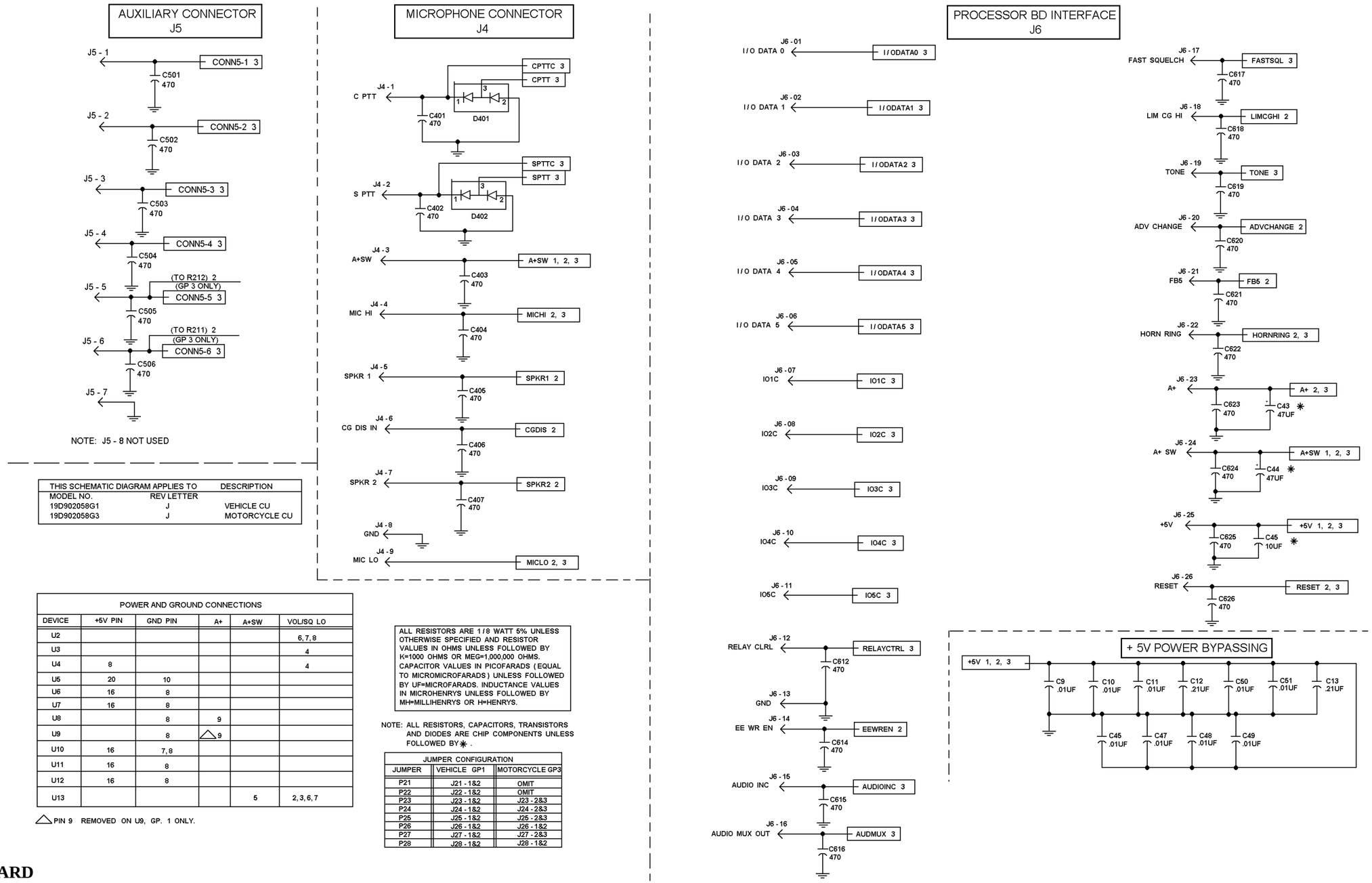


VIEW FROM BACKSIDE

1 NOTES:
1. SOLDER ALL ELECTRICAL CONNECTIONS.
2. COMPONENT LEADS TO PROTRUDE 1.5 MAX. BELOW SOLDER SIDE OF BOARD
3. INDICATES FRONT OF COMPONENT AUTO- INSERTION MACHINES.
4. MARK APPLICABLE GROUP AND REVISION PER 19A115740P1 ,.090 HIGH, COLOR BLACK FOR LATEST REVISION, SEE REVISION LETTER INDEX 19C850950.
5. THE FOLLOWING DEVICES ARE MOS DEVICES REQUIRING SPECIAL CARE PER 19A701294: U2, U3, U4, U5, U6, U7, U10, U11 & U12
6. CLEAN PER 19A701294
7. FIXTURING OF J4 TO ALIGN MOUNTING HOLES DURING SOLDERING OPERATION MAY BE REQUIRED.
9. OMIT PIN 8 ON J1 & J5 AND THESE HOLES TO BE FREE OF SOLDER.
9. IN GROUP 3, C27 REPLACES C6, AND C26 IS MOUNTED AS SHOWN. STAKE C26 TO PWB PER P7C-EA142P1.

11. REMOVE U9 PIN 9 ON GROUP 1 ONLY.
12. SOLDER R210, LEADS SLEEVED, BETWEEN J2-10 AND J2-19 ON SOLDER SIDE OF PWB.
13. CONNECT JUMPER WIRE ON SOLDER SIDE OF PWB BETWEEN J2-14 AND J1-7 ON GROUP 1 ONLY.
14. CONNECT JUMPER WIRE ON SOLDER SIDE OF PWB BETWEEN Q14-C AND D106-3 ON GROUP 1 ONLY.
15. SOLDER R211 AND R212, LEADS SLEEVED, BETWEEN J1-10 & J5-6, J1-11 & J5-5 ON SOLDER SIDE OF PWB.

I/O BOARD
(19D902058, Rev. 6)



THIS SCHEMATIC DIAGRAM APPLIES TO		DESCRIPTION
MODEL NO.	REV LETTER	
19D902058G1	J	VEHICLE CU
19D902058G3	J	MOTORCYCLE CU

POWER AND GROUND CONNECTIONS					
DEVICE	+5V PIN	GND PIN	A+	A+SW	VOL/SQ LO
U2					6, 7, 8
U3					4
U4	8				4
U5	20	10			
U6	16	8			
U7	16	8			
U8		8	9		
U9		8	△9		
U10	16	7, 8			
U11	16	8			
U12	16	8			
U13				5	2, 3, 6, 7

△PIN 9 REMOVED ON U9, GP. 1 ONLY.

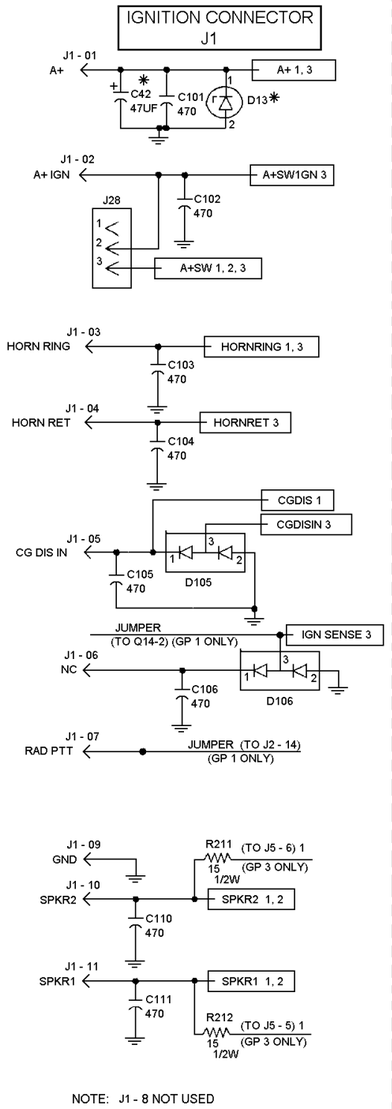
ALL RESISTORS ARE 1/8 WATT 5% UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

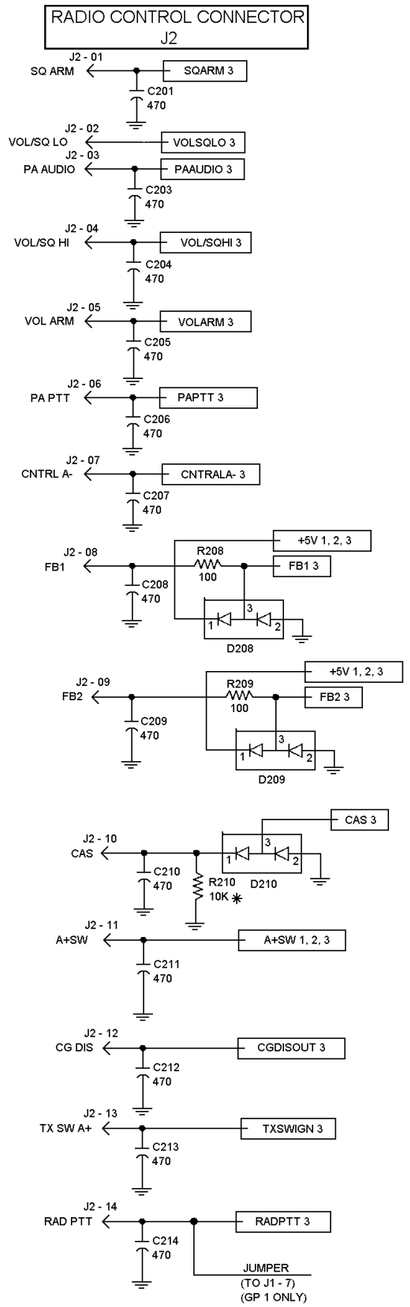
NOTE: ALL RESISTORS, CAPACITORS, TRANSISTORS AND DIODES ARE CHIP COMPONENTS UNLESS FOLLOWED BY *.

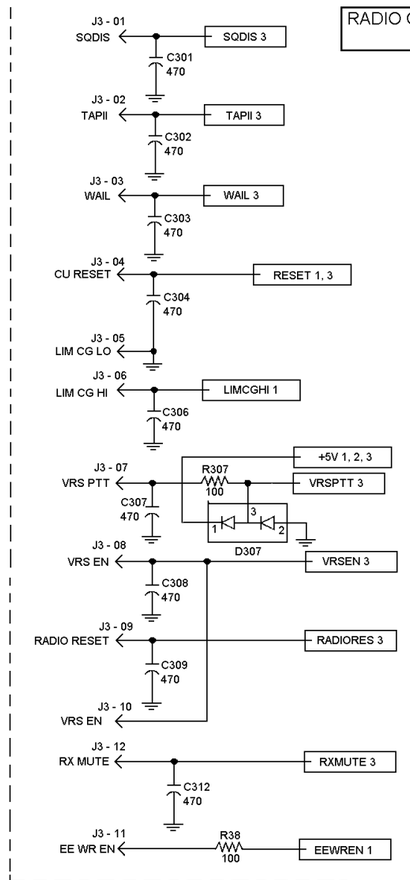
JUMPER CONFIGURATION		
JUMPER	VEHICLE GP1	MOTORCYCLE GP3
P21	J21 - 1&2	OMIT
P22	J22 - 1&2	OMIT
P23	J23 - 1&2	J23 - 2&3
P24	J24 - 1&2	J24 - 2&3
P25	J25 - 1&2	J25 - 2&3
P26	J26 - 1&2	J26 - 1&2
P27	J27 - 1&2	J27 - 2&3
P28	J28 - 1&2	J28 - 1&2

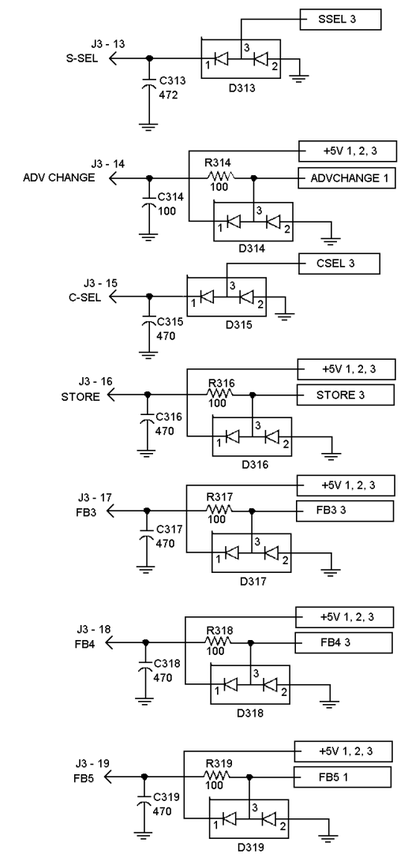
I/O BOARD

(19D902071, Sh. 1, Rev. 6)



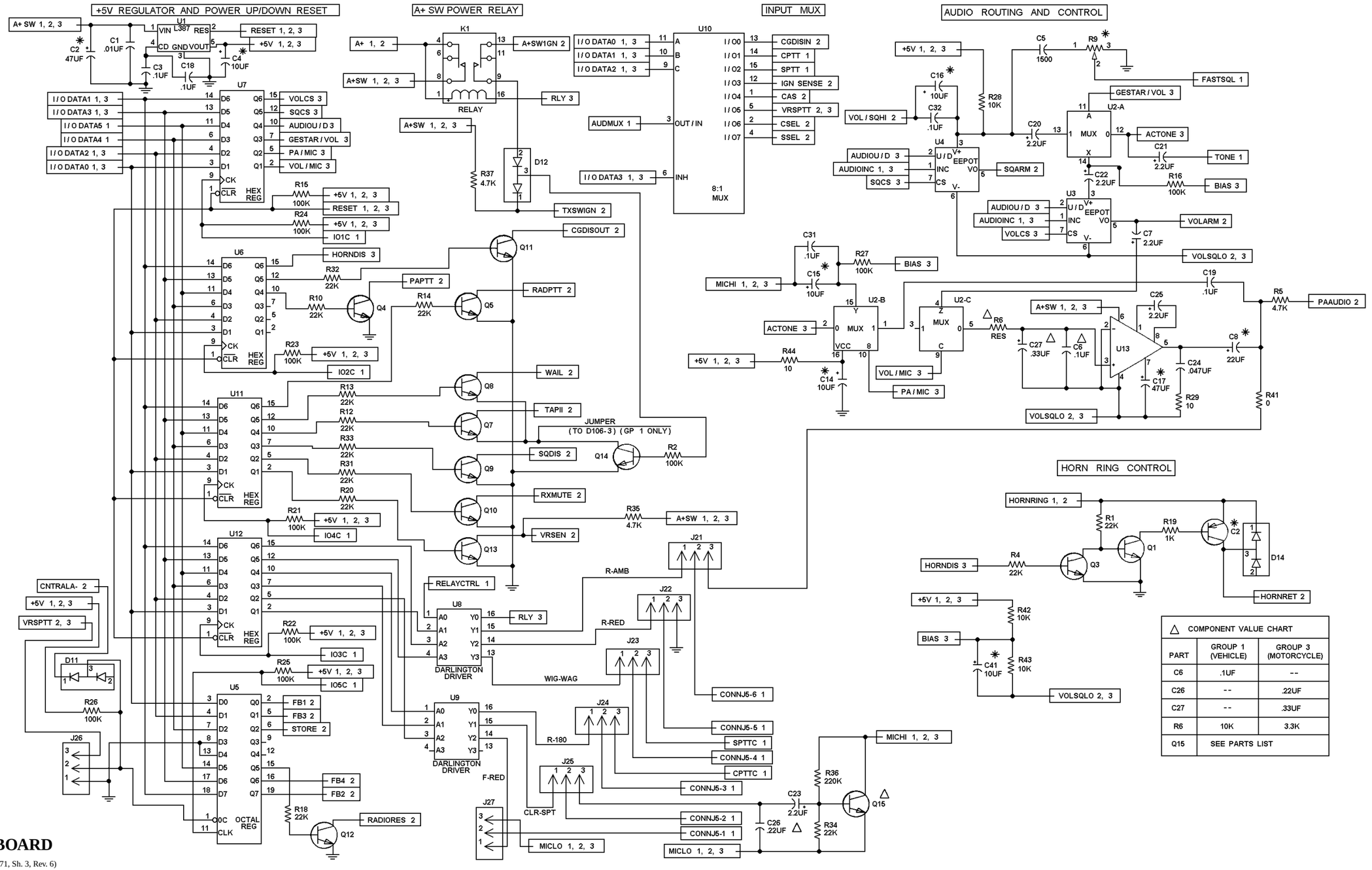






I/O BOARD

(19D902071, Sh. 2, Rev. 6)



I/O BOARD

(19D902071, Sh. 3, Rev. 6)

PARTS LIST

INPUT/OUTPUT BOARD
19D90058G1 VEHICULAR
19D902058G3 MOTORCYCLE
Issue 4

SYMBOL	PART NO.	DESCRIPTION
		- - - - - - - - - CAPACITORS- - - - - - - - -
C1	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C2	19704879P2	Electrolytic: 47 uF + or - 20%, 16 VDCW.
C3	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C4	19A701534P7	Tantalum: 10 uF + or - 20%, 16 VDCW.
C5	19A702052P6	Ceramic: 1500 pF + or - 10%, 50 VDCW.
C6	19A702052P26	Ceramic: 0.1 uF + or - 10%, 50 VDCW. (Used in G1).
C7	19A705205P19	Tantalum: 2.2 uF + or - 20%, 10 VDCW.
C8	19A701534P8	Tantalum: 22 uF + or - 20%, 16 VDCW.
C9 thru C13	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C14 thru C16	19A701534P7	Tantalum: 10 uF + or - 20%, 16 VDCW.
C17	19704879P2	Electrolytic: 47 uF + or - 20%, 16 VDCW.
C18 and C19	19A702052P26	Ceramic: 0.1 uF + or - 10%, 50 VDCW.
C20 thru C22	19A705205P19	Tantalum: 2.2 uF + or - 20%, 10 VDCW.
C23	19A701534P5	Tantalum: 2.2 uF + or - 20%, 35 VDCW.
C24	19A702052P22	Ceramic: 0.047 uF + or - 10%, 50 VDCW.
C25	19A705205P19	Tantalum: 2.2 uF + or - 20%, 10 VDCW.
C26	19A116080P109	Polyester: 0.22 uF + or - 10%, 50 VDCW. (Used in G3).
C27	19A705205P12	Tantalum, EIA STD. Dry Solid: sim to Sprague 293D. (Used in G3).
C31 and C32	19A702052P26	Ceramic: 0.1 uF + or - 10%, 50 VDCW.
C41	19A701534P7	Tantalum: 10 uF + or - 20%, 16 VDCW.
C42 thru C44	19A704879P2	Electrolytic: 47 uF + or - 20%, 16 VDCW.
C45	19A701534P7	Tantalum: 10 uF + or - 20%, 16 VDCW.
C46 thru C51	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C101 thru C106	19A702052P3	Ceramic: 470 pF + or - 10%, 50 VDCW.
C110 and C111	19A702052P3	Ceramic: 470 pF + or - 10%, 50 VDCW.
C201	19A702052P3	Ceramic: 470 pF + or - 10%, 50 VDCW.
C203 thru C214	19A702052P3	Ceramic: 470 pF + or - 10%, 50 VDCW.
C216 thru C218	19A702052P3	Ceramic: 470 pF + or - 10%, 50 VDCW.
C301 thru C304	19A702052P3	Ceramic: 470 pF + or - 10%, 50 VDCW.
C306 thru C309	19A702052P3	Ceramic: 470 pF + or - 10%, 50 VDCW.
C312 thru C319	19A702052P3	Ceramic: 470 pF + or - 10%, 50 VDCW.
C401 thru C407	19A702052P3	Ceramic: 470 pF + or - 10%, 50 VDCW.
C501 thru C506	19A702052P3	Ceramic: 470 pF + or - 10%, 50 VDCW.
C612	19A702052P3	Ceramic: 470 pF + or - 10%, 50 VDCW.
C614 thru C626	19A702052P3	Ceramic: 470 pF + or - 10%, 50 VDCW.
		- - - - - - - - - DIODES - - - - - - - - -
D11 and D12	19A700053P2	Silicon, fast recovery (2 diodes in series).
D13	19A703588P3	Zener, transient suppressor: sim to 1N6278A.
D14	19A700053P2	Silicon, fast recovery (2 diodes in series).
D105	19A705377P4	Silicon, hot carrier.
D106	19A700053P2	Silicon, fast recovery (2 diodes in series).
D208 and D209	19A700053P2	Silicon, fast recovery (2 diodes in series).
D210	19A705377P4	Silicon, hot carrier.
D307	19A700053P2	Silicon, fast recovery (2 diodes in series).
D313 and D314	19A705377P4	Silicon, hot carrier.
D316 thru D319	19A700053P2	Silicon, fast recovery (2 diodes in series).
D401 and D402	19A705377P4	Silicon, hot carrier.
		- - - - - - - - - JACKS - - - - - - - - -
J1 thru J3	19A701785P2	Contact, electrical; sim to Molex - 08 - 50 - 0404.
J4	19B209727P35	Plug, power: 9 contacts, sim to AMP 205734 - 1.
J5	19A701785P2	Contact, electrical; sim to Molex - 08 - 50 - 0404.
J6	19A702333P55	Connector: sim to Dupont 79257 - 126.
J21 thru J28	19A703248P11	Contact, electrical.
		- - - - - - - - - RELAYS - - - - - - - - -
K1	19B235003P1	Relay: sim to AROMAT DS2E - N 12V.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
Q2	19A702504P2	Silicon, PNP: sim to 2N4403.
Q3 thru Q5	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
Q7 thru Q14	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
Q15	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile. (Used in G1).
Q15	19A134739P2	Silicon, NPN. (Used in G1).
		- - - - - - - - - RESISTORS - - - - - - - - -
R1	19B800607P223	Metal film: 22K ohms + or - 5%, 200 VDCW, 1/8 w.
R2	19B800607P104	Metal film: 100K ohms + or - 5%, 200 VDCW, 1/8 w.
R4	19B800607P223	Metal film: 22K ohms + or - 5%, 200 VDCW, 1/8 w.
R5	19B800607P472	Metal film: 4.7K ohms + or - 5%, 200 VDCW, 1/8 w.
R6	19B800607P103	Metal film: 10K ohms + or - 5%, 200 VDCW, 1/8 w. (Used in G1).
R6	19B800607P332	Metal film: 3.3K ohms + or - 5%, 200 VDCW, 1/8 w. (Used in G3).
R9	19A705968P1	Variable, cermet.
R10	19B800607P223	Metal film: 22K ohms + or - 5%, 200 VDCW, 1/8 w.
R12 thru R14	19B800607P223	Metal film: 22K ohms + or - 5%, 200 VDCW, 1/8 w.
R15 and R16	19B800607P104	Metal film: 100K ohms + or - 5%, 200 VDCW, 1/8 w.
R18	19B800607P223	Metal film: 22K ohms + or - 5%, 200 VDCW, 1/8 w.
R19	19B800607P102	Metal film: 1K ohms + or - 5%, 200 VDCW, 1/8 w.
R20	19B800607P223	Metal film: 22K ohms + or - 5%, 200 VDCW, 1/8 w.
R21 thru R27	19B800607P104	Metal film: 100K ohms + or - 5%, 200 VDCW, 1/8 w.
R28	19B800607P103	Metal film: 10K ohms + or - 5%, 200 VDCW, 1/8 w.
R29	19B800607P100	Metal film: 10 ohms + or - 5%, 200 VDCW, 1/8 w.
R31 thru R34	19B800607P223	Metal film: 22K ohms + or - 5%, 200 VDCW, 1/8 w.
R35	19B800607P472	Metal film: 4.7K ohms + or - 5%, 200 VDCW, 1/8 w.
R36	19B800607P224	Metal film: 220K ohms + or - 5%, 200 VDCW, 1/8 w.
R37	19B800607P472	Metal film: 4.7K ohms + or - 5%, 200 VDCW, 1/8 w.
R38	19B800607P101	Metal film: 100 ohms + or - 5%, 200 VDCW, 1/8 w.
R41	19B800607P1	Metal film: 0 ohms (50 Milli-ohms Max), 1/8 w.
R42 and R43	19B800607P103	Metal film: 10K ohms + or - 5%, 200 VDCW, 1/8 w.
R44	19B800607P100	Metal film: 10 ohms + or - 5%, 200 VDCW, 1/8 w.
R208 and R209	19B800607P101	Metal film: 100 ohms + or - 5%, 200 VDCW, 1/8 w.
R210	3R151P103J	Composition: 4.7K ohms, 1/8 w.
R211 and R212	19A700113P19	Composition: 15 ohms + or - 5%, 1/2 w. (Used in G3).
R307	19B800607P101	Metal film: 100 ohms + or - 5%, 200 VDCW, 1/8 w.
R314	19B800607P101	Metal film: 100 ohms + or - 5%, 200 VDCW, 1/8 w.
R316 thru R319	19B800607P101	Metal film: 100 ohms + or - 5%, 200 VDCW, 1/8 w.
		- - - - - - INTEGRATED CIRCUITS - - - - - -
U1	19A704970P1	Linear: 5 Volt Regulator with Reset Output; sim to SGS L387.
U2	19A700029P38	Digital: CMOS Triple 2 Channel Multiplexer.
U3 and U4	19A705180P2	Potentiometer, digitally controlled: sim to CAT X9103P.
U5	19A704380P12	Digital: sim to 74HC374.
U6 and U7	19A700029P53	Digital: HEX D FLIP-FLOP. 4174B.
U8 and U9	19A134693P1	Silicon, 7 Darlington Transistor Array: 16 pins.
U10	RYT3066037/A	Digital: MULTIPLEXER.
U11	19A700029P53	Digital: HEX D FLIP-FLOP. 4174B.
U12	19A704380P9	Digital, High Speed CMOS: HEX D FLIP-FLOP.
U13	19A705647P1	Linear: Low Voltage Audio Power Amplifier; sim to National LM386N - 4.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A143578P67	Spacer, threaded, metallic. (Used with J4).
	19B234894P1	Plate. (Used with J1).
	N404P11B6	Lockwasher; internal: No. 4. (Used to secure U1).
	N80P9006B6	Machine screw, panhead: No. 4 - 40 x 3/8. (Used to secure U1).
	7141225P2	Hex nut: No. 4 - 40. (Used to secure U1).
	N404P11B6	Lockwasher; internal: No. 4.
	N80P9006B6	Machine screw, panhead: No. 4 - 40 x 3/8.

* COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

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Ericsson Inc.
Private Radio Systems
Mountain View Road
Lynchburg, Virginia 24502
1-800-528-7711 (Outside USA, 804-528-7711)

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