Maintenance Manual

CHP
MOTORCYCLE REPEATER

STATE OF CALIFORNIA

CALIFORNIA HIGHWAY PATROL

REQN # D202-1260-9540 DATED 11-23-95

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ERICSSON

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GENERAL DESCRIPTION

SUMMARY

The CHP Motorcycle Repeater is designed to operate with the existing Low Band RANGR® motorcycle radio, the S815 Control Unit and the MPS VHF portable radios. The repeater unit is compact, light weight and will mount directly on top of the existing RANGR with no additional mounting hardware required. The basis for this design is the standard M-PA personal radio. The M-PA **M**otor**C**ycle **R**epeater (**MCR**) consists of a weatherproof housing with an integral mounting plate, the M-PA radio, an I/O assembly, a RF attenuator and a new enclosure extension between the housing top and bottom covers. Figure 1 shows the Vehicular Repeater Assembly.

M-PA

The M-PA VHF portable radio operates in the 146 to 162 MHz frequency band and is used to provide all radio and control functions for the **MCR**.

Special software has been written which superimposes the repeater functionality on the standard radio operation. A programmable RF attenuator is placed between the portable's antenna connector and the **MCR**'s antenna connector. This attenuator is dip switch programmable to independently control the transmit power and the receive sensitivity and provides a 63.75 dB adjustment range in 0.25 dB steps under the control of the I/O Assembly.

I/O ASSEMBLY

The I/O Assembly provides simple logic signal buffering, RF attenuator control, a means of RF attenuator adjustment, input/output audio level adjustment pots, DC power regulators the 7.5 volt M-PA and a regulator for the 5 volt logic circuitry. This unit is located within the weatherproof housing within its own RF shielded container.

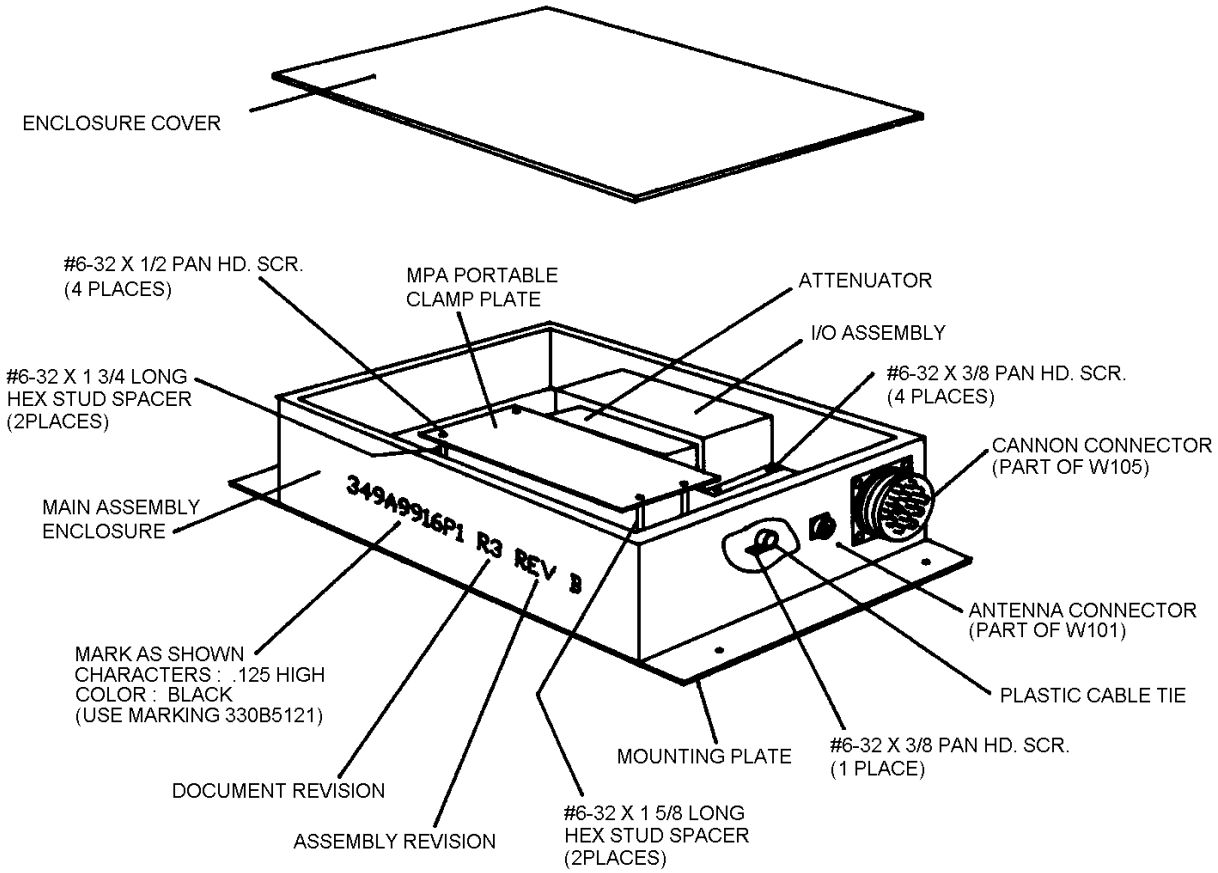


Figure 1 - M-PA Vehicular Repeater Assembly

SYSTEM OPERATION

The **MCR** extends communications from a fixed mobile (motorcycle) system to portable radios, permitting the vehicle operator to remain in continuous communication with the dispatch center or other radio system units when away from the motorcycle. A block diagram of the operation is shown in Figure 2.

There are three basic types of operation possible when the operator has left the motorcycle with the MPS portable radio.

1. One type is portable-to-base operation which uses the **MCR** to repeat any transmission from the MPS radio through the low band RANGR. This type is for communications with a dispatcher or for communications with other mobile units.

2. The second type of communications is base-to-portable communications where a dispatcher (or other mobile radio units) can communicate with the MPS operator through the **MCR**.

3. The third type of operation consists of using the MPS radio for portable-to-portable communications without activating the **MCR**.

In the portable-to-base operation, the **C**hannel **G**uard **(CG)** tone used by the selected MPS channel determines whether the “S” or “C” channel will be used by the low band RANGR. If a CG tone of 173.8 Hz is used, the “S” channel is selected for transmit; when the MPS operator unkeys, a 1000 Hz courtesy beep is transmitted by the **MCR** for approximately 30 milliseconds. This courtesy beep is an indication that the radio system is working and that the message was transmitted on the “S” channel. If a CG tone of 156.8 Hz is used, the “C” channel is selected for transmit and no courtesy beep is transmitted.

In the base-to-portable operation, the reverse of the portable-to-base operation takes place. Since the receiver of the MPS portable radio is programmed without the CG tone, all the MPS radios in the area will hear each other’s transmission directly, as well as the repeated reply from the base station.

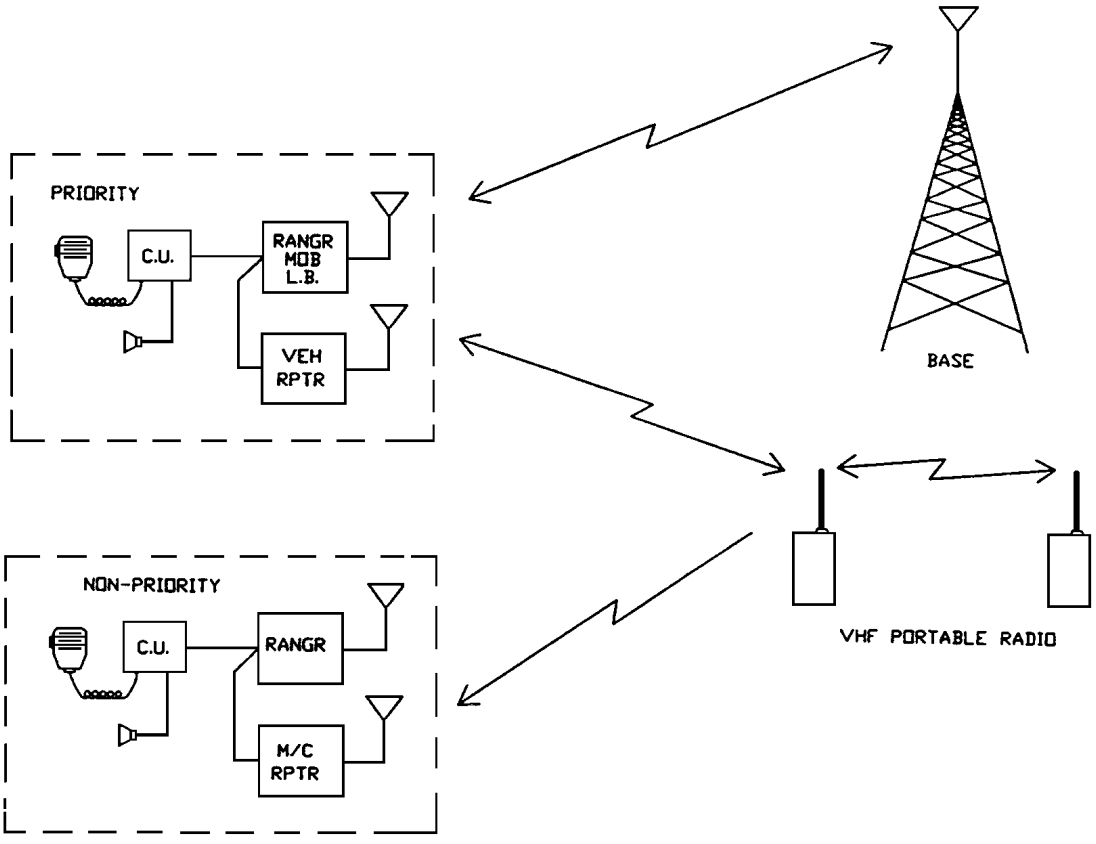


Figure 2 - Vehicular Repeater System

The portable-to-portable operation involves only the MPS radios and does not require the repeater functions of the **MCR**. A channel in the MPS which does not use Channel Guard is used for this type of communications. Note that when portable-to-portable communications do occur, all **MCR** systems will revert to a non-priority state which will cause a minimum 0.5 second delay in the beginning of the next repeated message while a priority **MCR** is re-established.

MCR PRIORITIZING

The **MCR** priority scheme is similar to the current CHP vehicular repeater system, in which a transmitted T90 signal at VHF causes all other activated repeaters to change to a non-priority state. However, in addition to preventing more than one radio from transmitting at the same time, the **MCR** priority scheme must defer priority to any four wheel vehicle, if one is present. This is required because a motorcycle is a much less desirable radio platform. Inter-system prioritization is accomplished in the following ways:

1. At turn on, the **MCR** sends a courtesy beep of a different frequency than the T90 signal and reverts to non-priority state. Since the frequency of the courtesy beep is different than the T90 signal used by the four wheel vehicles, the courtesy beep will allow a nearby vehicle repeater to remain in a priority state.

2. If, while an **MCR** is in the priority state and a low band signal is received, a fixed 100 millisecond delay is executed before the transmission is repeated. During this delay the **MCR** checks for presence of a VHF carrier. This delay is intended to allow a vehicular repeater time to respond first, and if it does, to reduce the **MCR** to a non-priority state.

3. Any VHF signal detected which does not have a 173.8 or a 156.8 Hz CG tone will reduce the **MCR** to a non-priority state. This feature also provides the user a manual means to reduce the priority of an **MCR** by keying the MPS on the portable-to-portable channel.

MCR-to-**MCR** priority is controlled by a 0.5 to 1 second random timer. At turn on, all **MCR**'s revert to the non-priority state, This means that when the first mobile or portable signal is detected, each unit will set its random timer and wait, all the time looking for another unit to take over. When its random timer expires and no other **MCR** VHF signals have been detected, the unit assumes the priority state and begins repeating. Any other units which have not timed out will see the activity from the first unit and remain in the non-priority state.

Figure 3 is a logic flow diagram of the **MCR** operation and Figure 4 shows how the repeater assembly is connected to the existing mobile radio.

PORTABLE INTERRUPT

During base-to-portable transmissions, the **MCR** transmitter will momentarily unkey to check (or "look back") for portable radio activity. The rate and duration of the look back are determined by which low band signal is active. If the "C" channel is active, the look back is once per second for approximately 60 milliseconds. If the "S" channel is active, the **MCR** look back is synchronized with the S815 Control Unit scan. For both "C" and "S" channels, if a VHF signal with the correct CG tone is detected, base-to-portable activity is stopped and the portable signal is repeated to the base. This allows the portable user to pre-empt inbound low band activity in the event of an emergency.

REMOTE REPEATER ENABLE

The **MCR** may be turned ON by either pressing the RPT control on the motorcycle S815 Control Unit or via the portable radio. A 30 millisecond courtesy beep is transmitted by the after it is turned ON.

A channel setting on the VHF MPS portable radio is programmed to transmit on the **MCR** frequency with a CG tone of 210.7 Hz. The **MCR** is turned ON when the CG tone is received for a duration of 2 to 2-1/2 seconds. This allows the **MCR** to be enabled via the MPS from any location within communication range of the **MCR** It should be noted that **Remote Repeat Enable** will not occur unless the S815 control unit has been initialized to the motorcycle mode of operation.

INSTALLATION

CONTROL CABLE

Each **MCR** is supplied with a cable with one end un-terminated. The un-terminated wires must be routed through the access hole in the mobile radio enclosure, then connected to the S815 control unit and motorcycle battery as shown in Figures 4 and 5.

MOUNTING

Remove the four (4) screws which hold the RANGR's top cover in place. Place the **MCR** on top of the RANGR cover and using the longer screws provided, secure the **MCR** to the RANGR. Install the VHF coaxial antenna cable on the antenna mounting bracket and route the unterminated end into the enclosure. Terminate the cable with TNC (male) connector provided and connect to the **MCR**. Attach the VHF antenna to the end of the antenna cable.

NEW ENCLOSURE COLLAR (Height Extension)

Remove the existing top cover. Replace the latching "catch" assembly in the bottom portion of the existing enclosure with two screws supplied. Install the gasket in the V grove portion of the new collar. The gasket requires no glue. Secure the collar to the bottom portion of the existing enclosure using four screws provided. Replace the top cover and secure with key operated latch.

Check the operation of the key operated latch. If the closure is similar to the operation of the old enclosure, the installation is finished. If considerable more effort is required to open and close the enclosure, the addition of a shim type space is required. The shim is to be installed under the catch mechanism inside the enclosure. Remove the two screws holding the catch, add the shim under the catch and replace the screws to secure the catch and shim.

ADJUSTMENTS

The **MCR** includes factory set RF attenuation values of 9.75 dB and 30.25 dB, respectively, for the transmit and receive functions.

R3 and R4 are the only other adjustments. Base-to-portable TX deviation is adjusted by R3 and portable-to-base TX deviation is adjusted by R4.

Initialize the **MCR** to the Motorcycle Mode of operation by depressing the **VOL**ume **Up** control on the S815 control unit while turning the power control from OFF to ON.

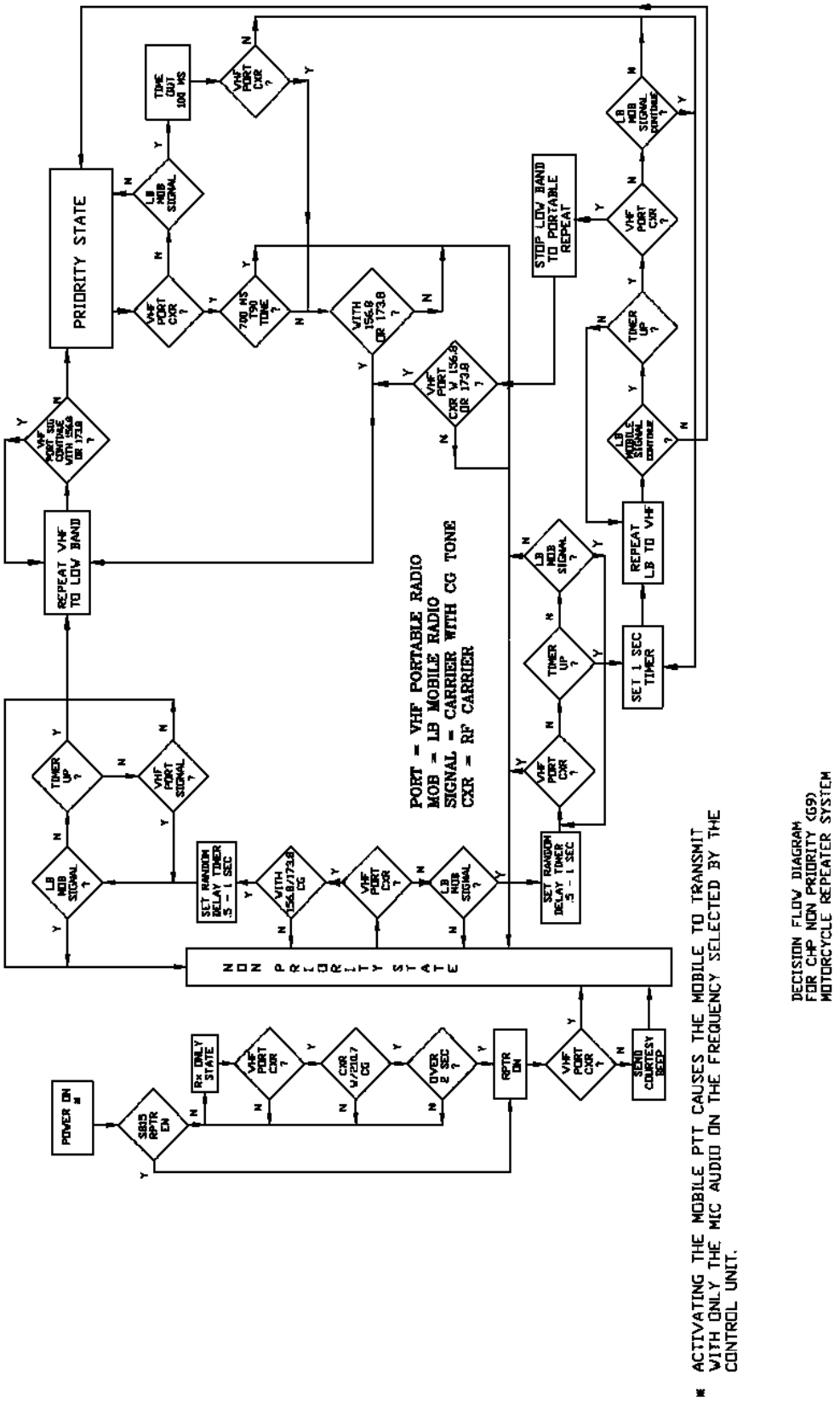
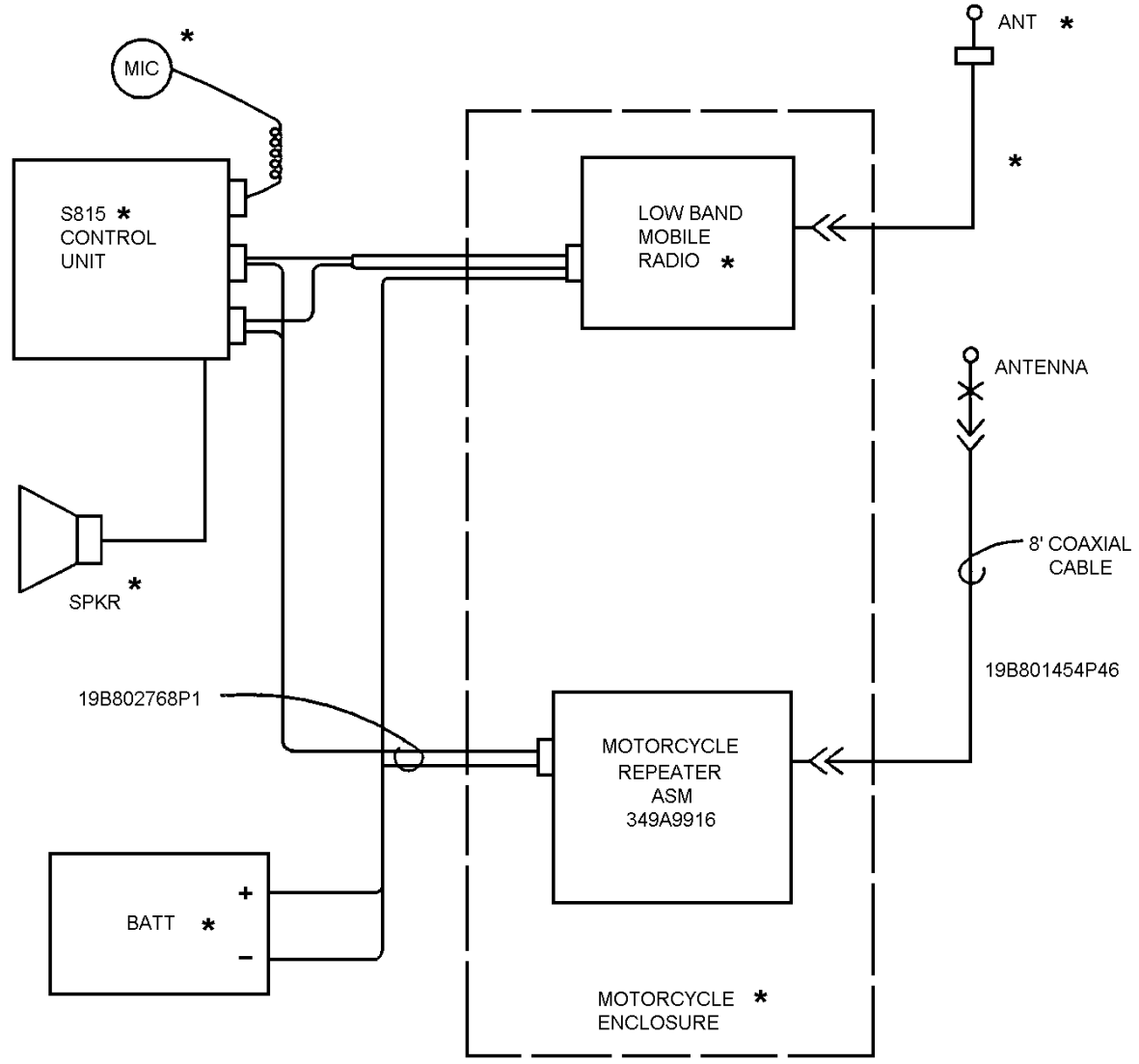
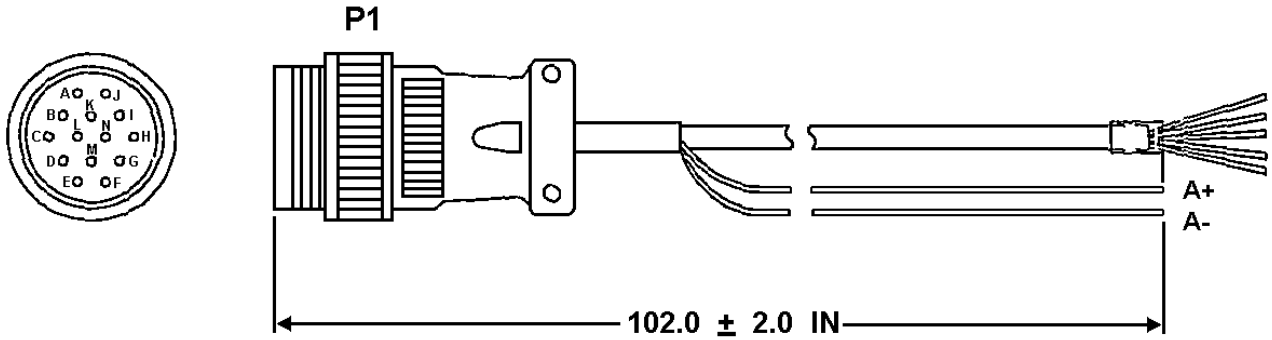


Figure 3 - Logic Flow Diagram For Motorcycle Repeater System



* THESE ARE EXISTING COMPONENTS

Figure 4 - Interconnection Diagram For CHP Motorcycle Repeater System



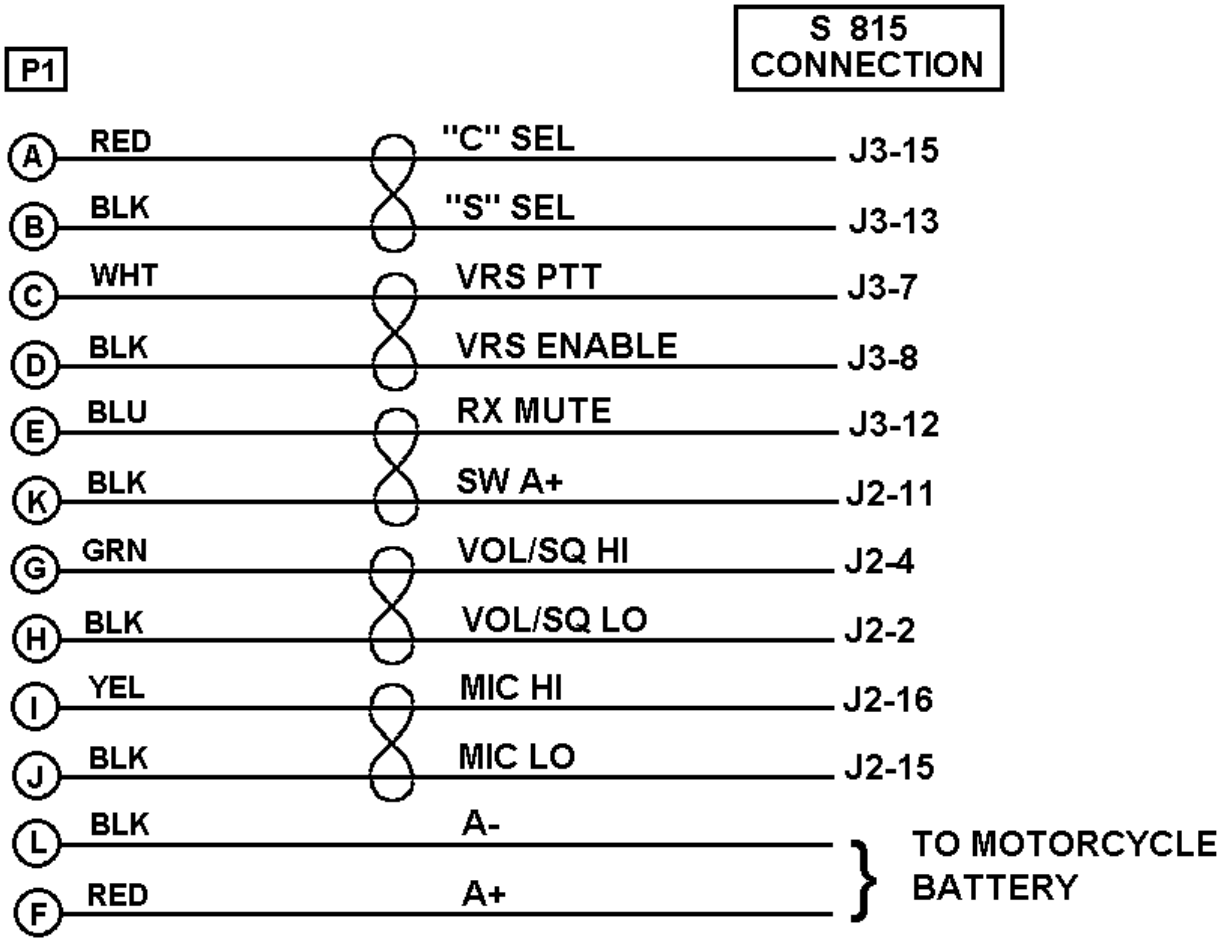


Figure 5 - Schematic Diagram of S815 Control Unit to Vehicular Repeater Control Cable (19B802768)

CIRCUIT DESCRIPTION

GENERAL DESCRIPTION

The M-PA Motorcycle Repeater (**MCR**) controls the repeater functions between the CHP low band RANGR motorcycle radio, S815 control unit and the MPS VHF portable radios. The **MCR** consists of a weather proof housing with mounting plate, an I/O assembly, a M-PA radio and interconnects. See Figure 6.

INTERCONNECTS

Figure 7 shows the block diagram for the **MCR**. VHF signals enter and leave the **MCR** through the antenna connector and are passed into a programmable attenuator by coaxial cable, W101. The attenuator and I/O Interface Board comprise the I/O assembly and are connected together by W104.

W102 is a coaxial connection between the attenuator and the M-PA. W103 connects the I/O to the M-PA from the I/O assembly. This I/O cable includes RX and TX audio, PTT sense, VRS Enable, Rx Mute and "C" and "S" Select. The I/O connects to the M-PA **U**niversal **D**evices **C**onnector **(UDC)**; that portion of W103 is 19B801971P11 and is shown in Figure 8. DC power is supplied to the M-PA battery connector as shown in Figure 9.

Other than the VHF antenna connection , all other electrical connections to the **MCR** are made through the Cannon system connector. Through this connection, DC supply, audio and logic are linked between the **MCR** and the motorcycle radio system. Figure 10 shows the details of W105 which connects the 12 signals from the Cannon connector to J1 of the I/O assembly.

M-PA

The M-PA used in the **MCR** is a standard VHF transceiver with customized tracking data and software. Through the modified tracking data, the transmitter output power is reduced to 2 watts and the squelch setting is adjusted to 16 dB SINAD. The M-PA is programmed with custom software to control the repeater operation and de-activate the control knobs and buttons on the M-PA. Control of the M-PA is provided through the UDC to the I/O assembly. More details of the standard VHF M-PA are covered in LBI-38378.

I/O ASSEMBLY

The I/O assembly consists of a programmable attenuator and a single PC board, the I/O interface board, housed in its own RF shielded case. The I/O assembly provides control signal buffering between the S815 control unit and the M-PA radio. In addition, the assembly provides audio level adjustment, attenuator control and DC supply for the M-PA.

DC power for the I/O assembly is controlled by U5, U6 and relay K1. K1 is the main power relay. When the S815 control unit is turned on, SW A+ goes to +13.8 volts. K1 is then energized, providing power to the **MCR** without subjecting the I/O board of the S815 control unit to the transmit current drain of the M-PA. Regulator IC U5 provides +8 volts for the M-PA. Regulator provides +5 volts for the logic operations of the I/O interface board.

The programmable attenuator switches between two defined values (RX and TX states). For RX, 30.25 dB of attenuation is added to lower the input VHF sensitivity of the M-PA. SW1 is set with positions 1, 4, 5, 6 and 7 as ON. Only during RX, U1 (a tri-state 8-bit latch) passes the correct settings to U7 which drives the attenuator. For TX, latch U2 is activated by the inversion of U4 and latch U1 is in tri-state. The TX attenuation is now determined by SW2 which is set with positions 1, 2, 3 and 6 as ON. This provides 9.75 dB of attenuation to the TX output of the M-PA, reducing the **MCR** TX output level to about 200 milliwatts.

R3 and R4 are 10-turn pots for adjusting TX audio sensitivity. R3 attenuates the low band RANGR's received signal (RANGR Volume Squelch Hi) before that audio is sent to Mic High of the M-PA. By adjusting R3, the deviation level of the M-PA (VHF signal) is set. Similarly, R4 seats the deviation level of the RANGR mobile (low band signal).

Logic buffering is required because of the different operating voltages between the M-PA and the S815. U4 is a NAND gate used to gate the RX Mute signal off until VRS Enable lead is high. U4 and U3 are also used as inverters to buffer the logic signals.

The Component Outline and Schematic diagrams are shown in Figures 11 through 15. The Parts List is shown on Pages 23 and 24.

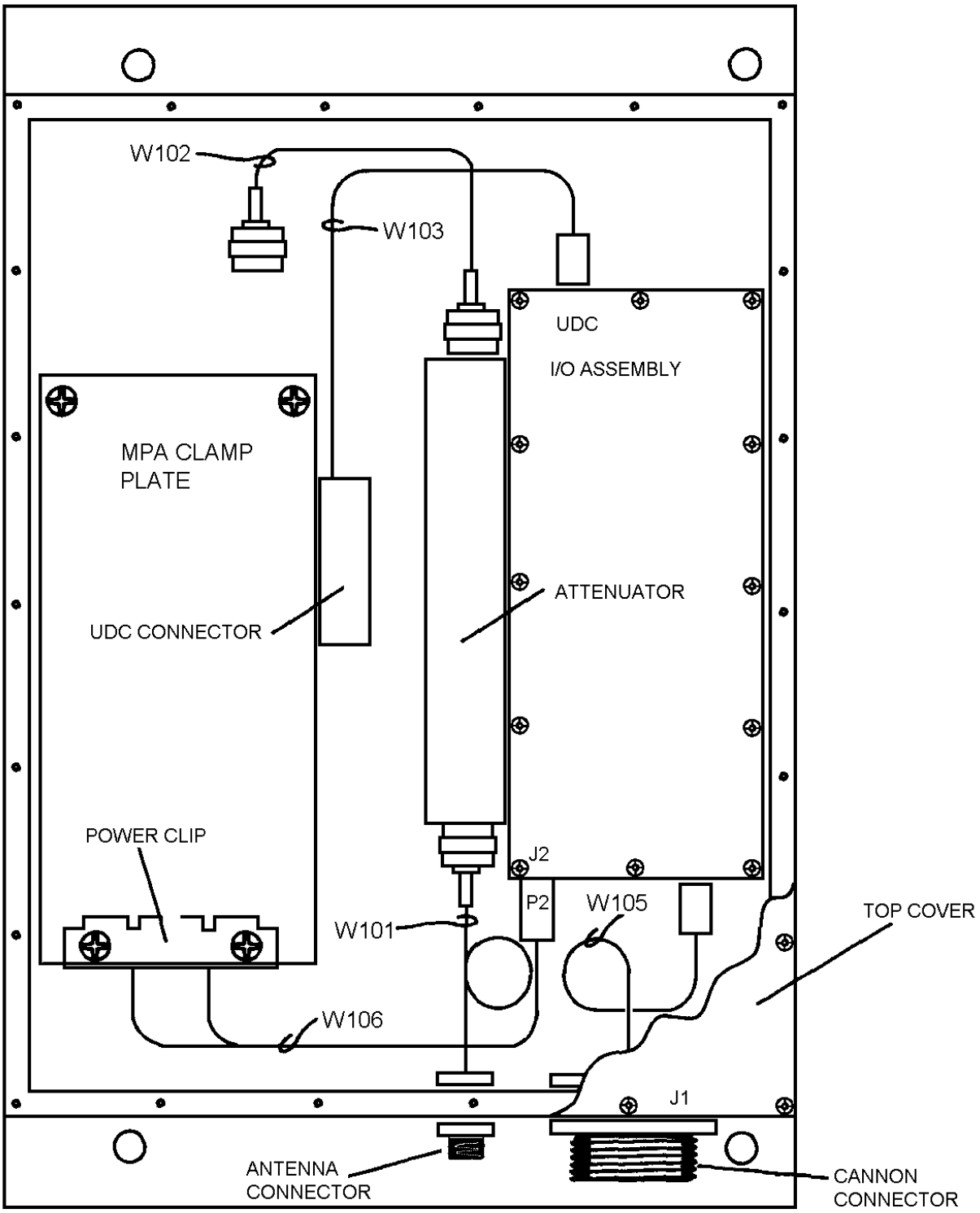


Figure 6 - Top View of the M-PA Motorcycle Repeater

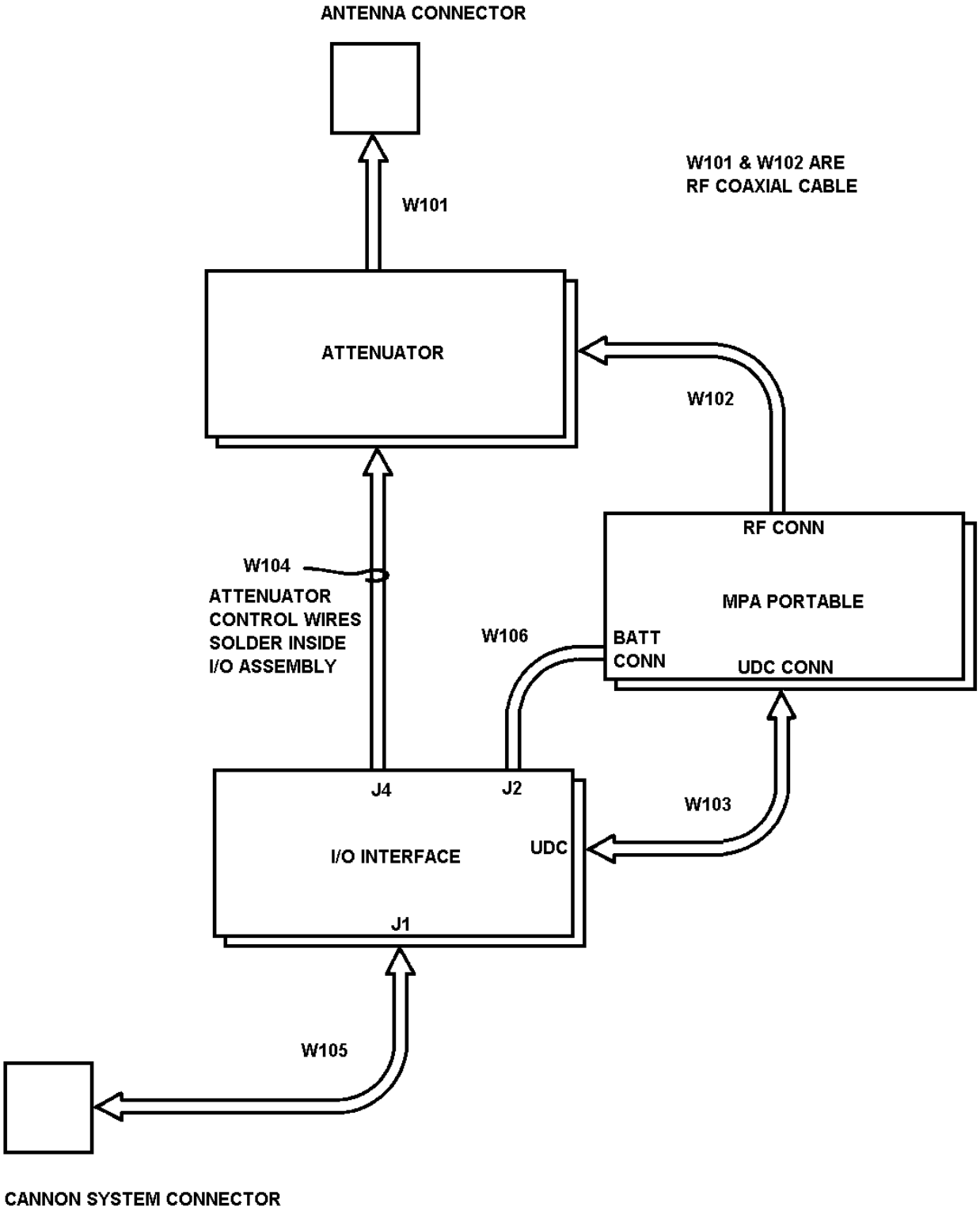


Figure 7 - Block Diagram for the M-PA Motorcycle Repeater

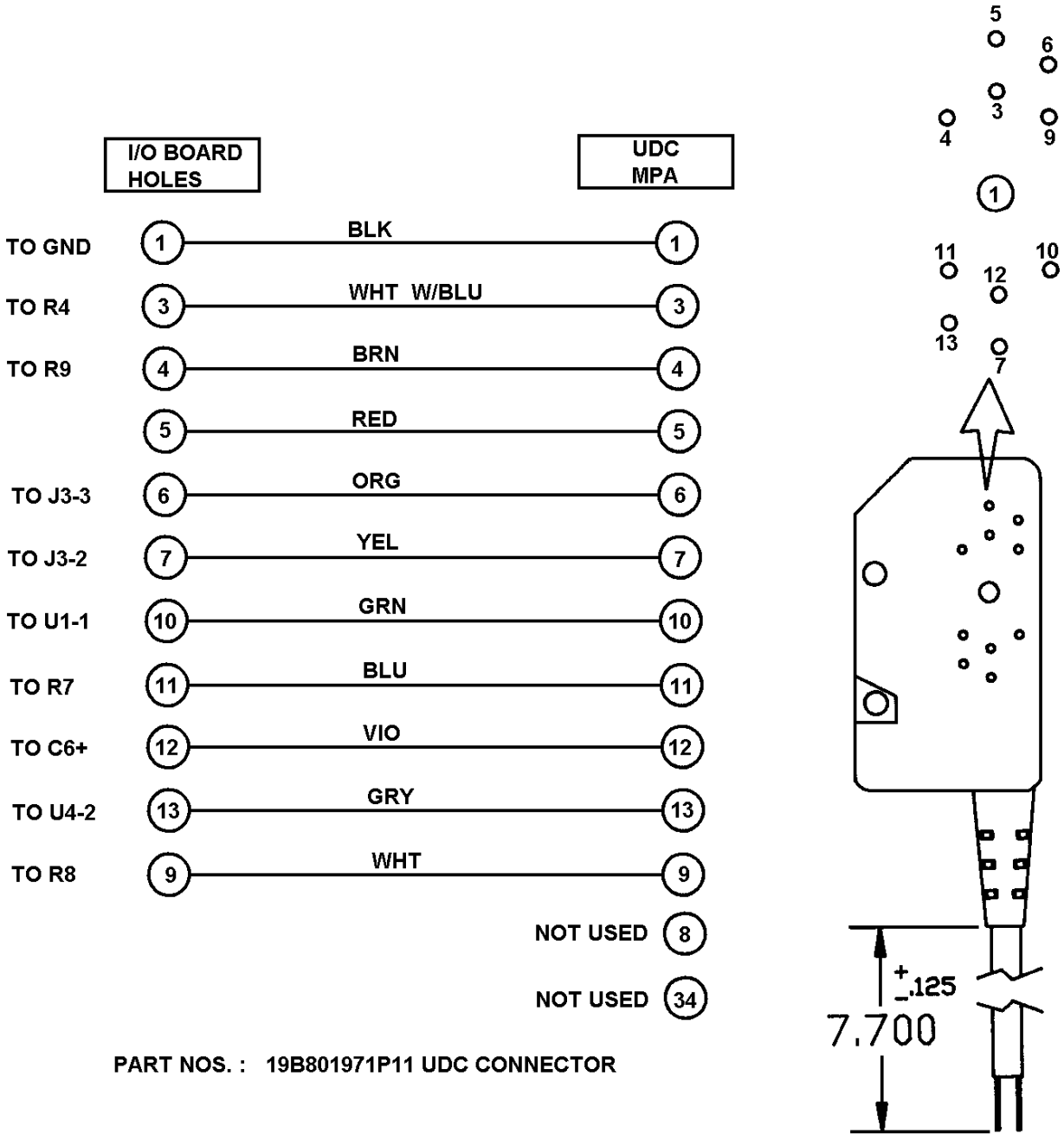


Figure 8 - I/O to M-PA Interface Cable

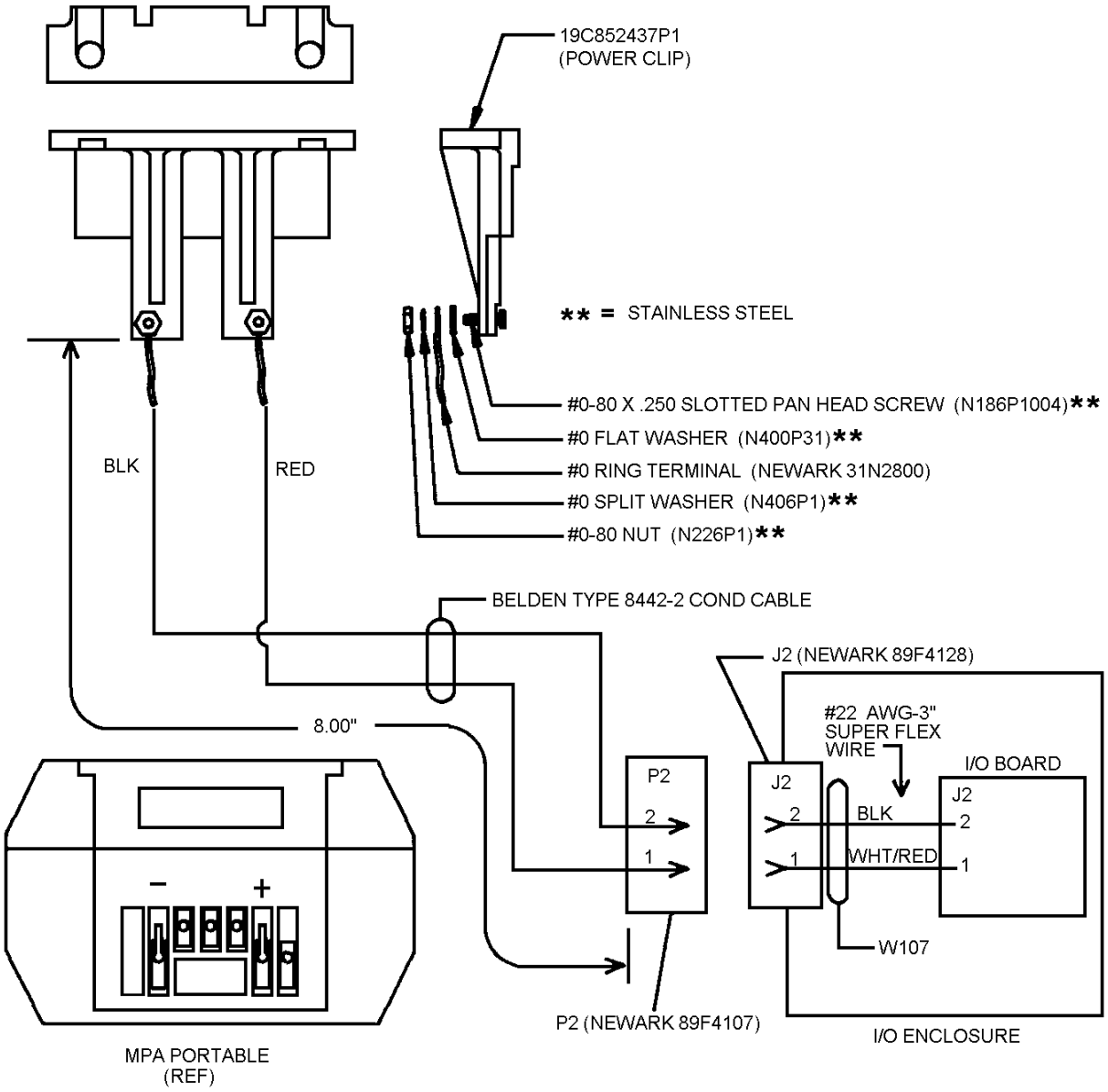


Figure 9 - M-PA Power Connection

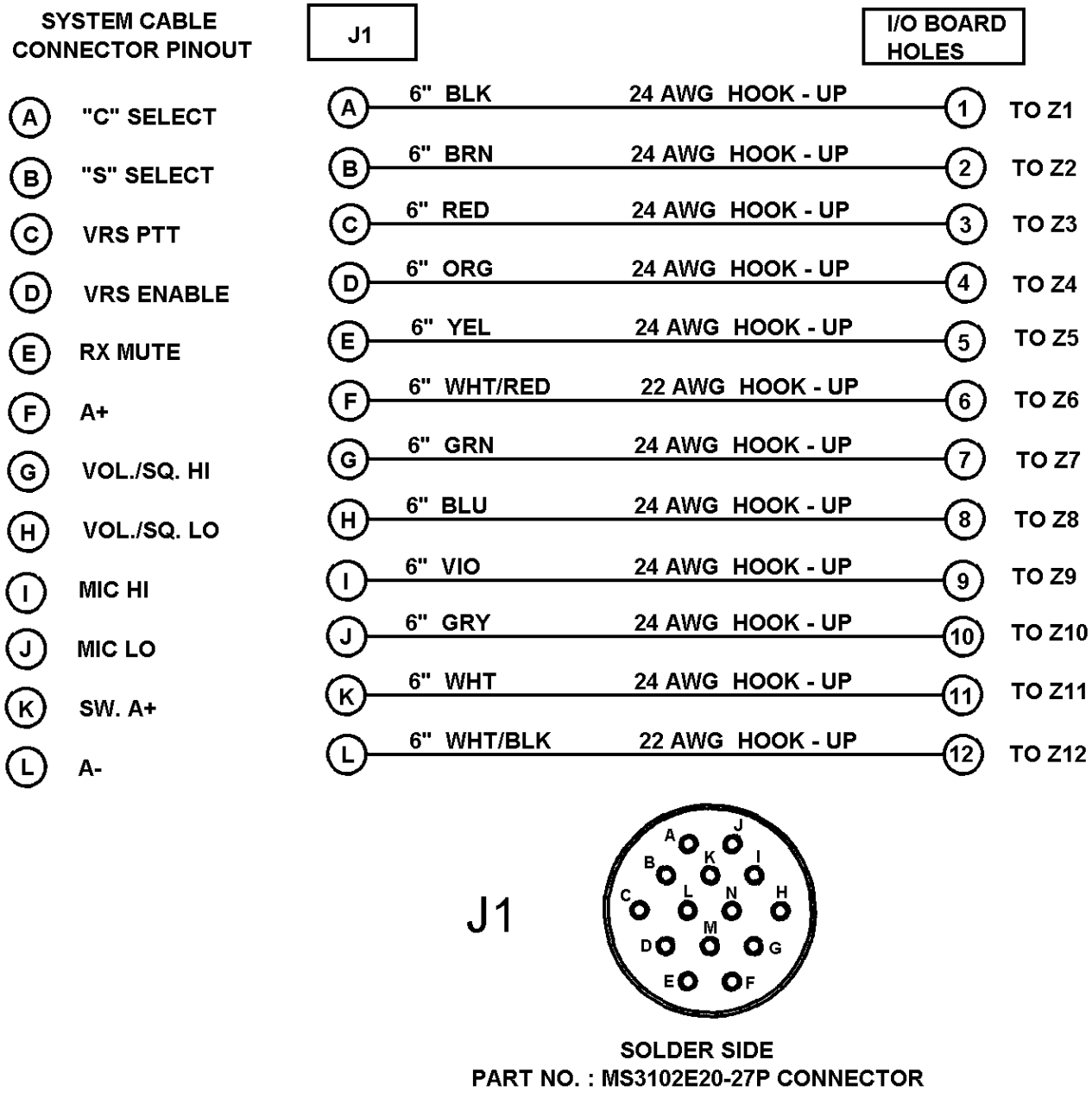
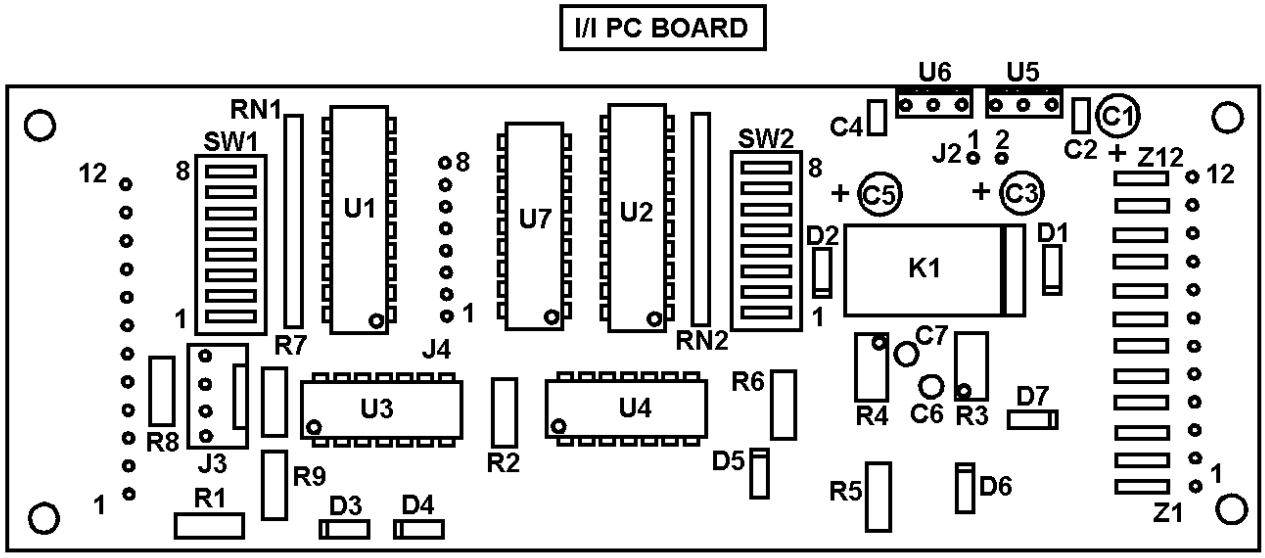


Figure 10 - Cannon System Connector to I/O Interface Cable



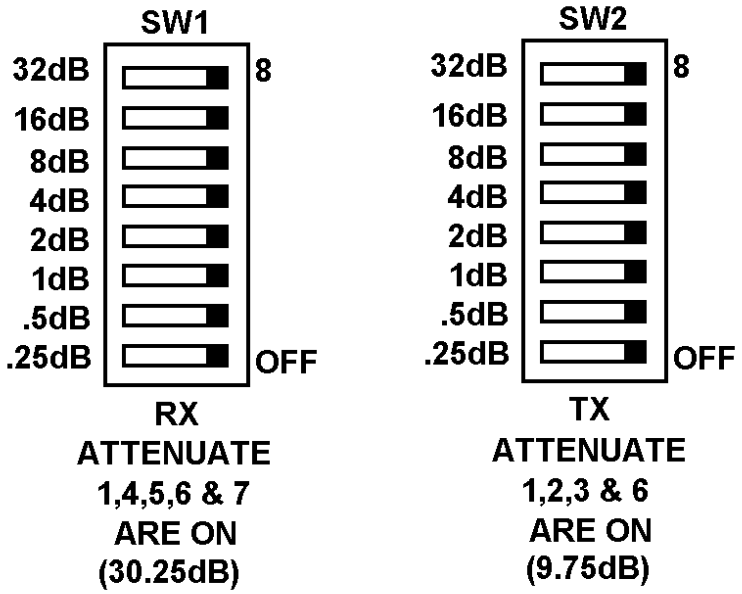


Figure 11 - I/O Interface Board - Layout

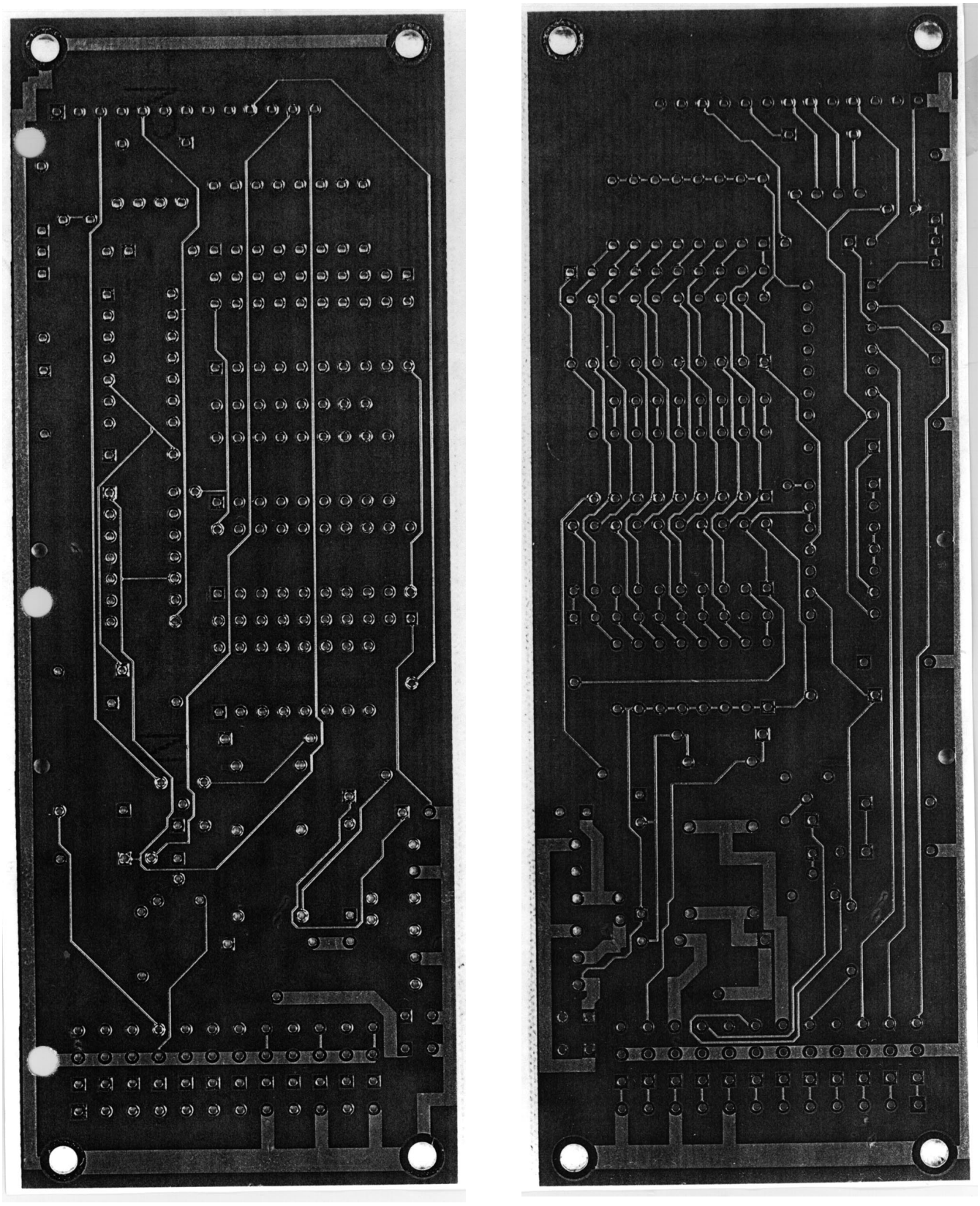


Figure 12 - I/O Interface Board - Solder & Component sides

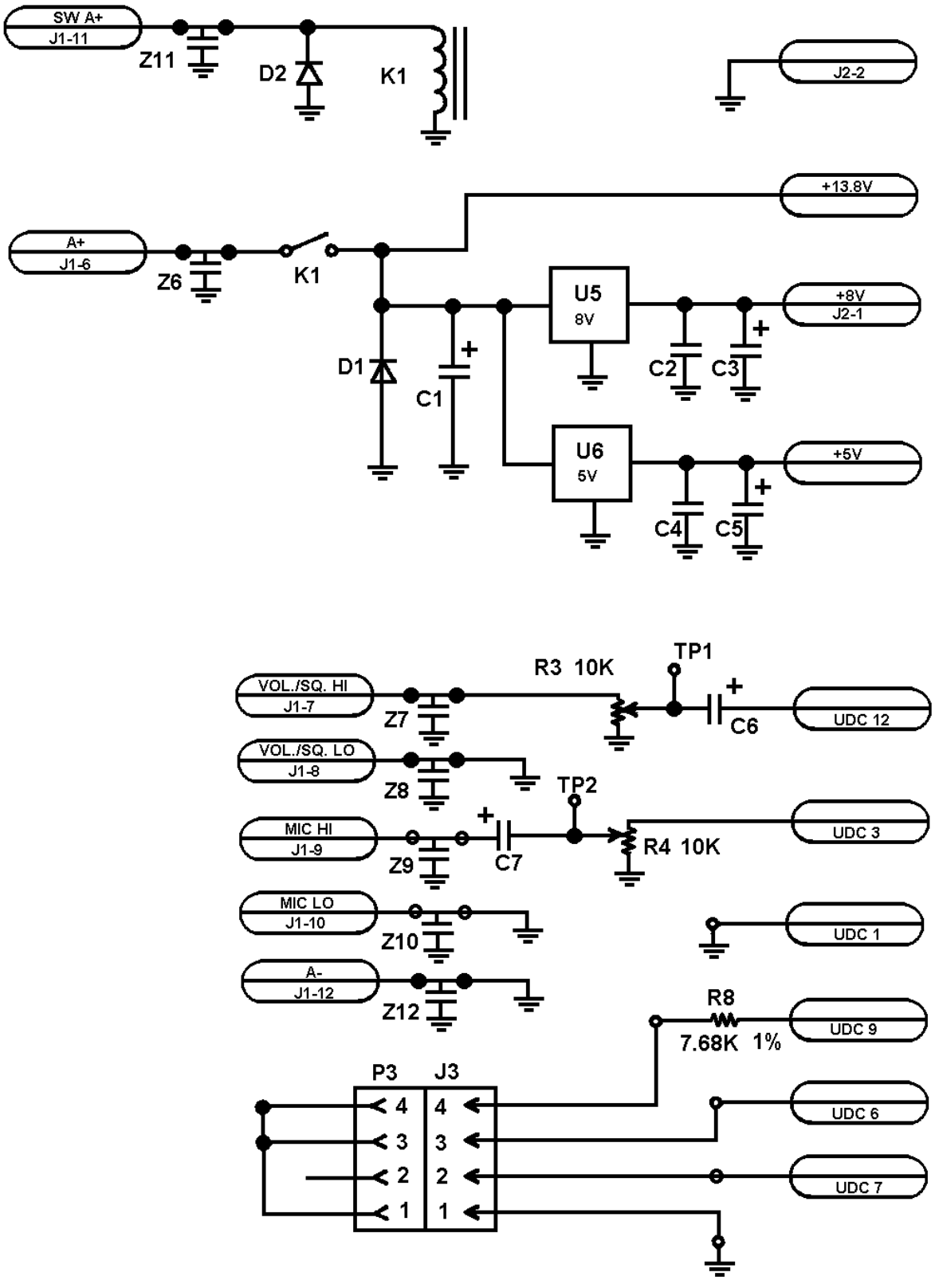


Figure 13 - Interface Board Schematic (Sheet 1 of 2)

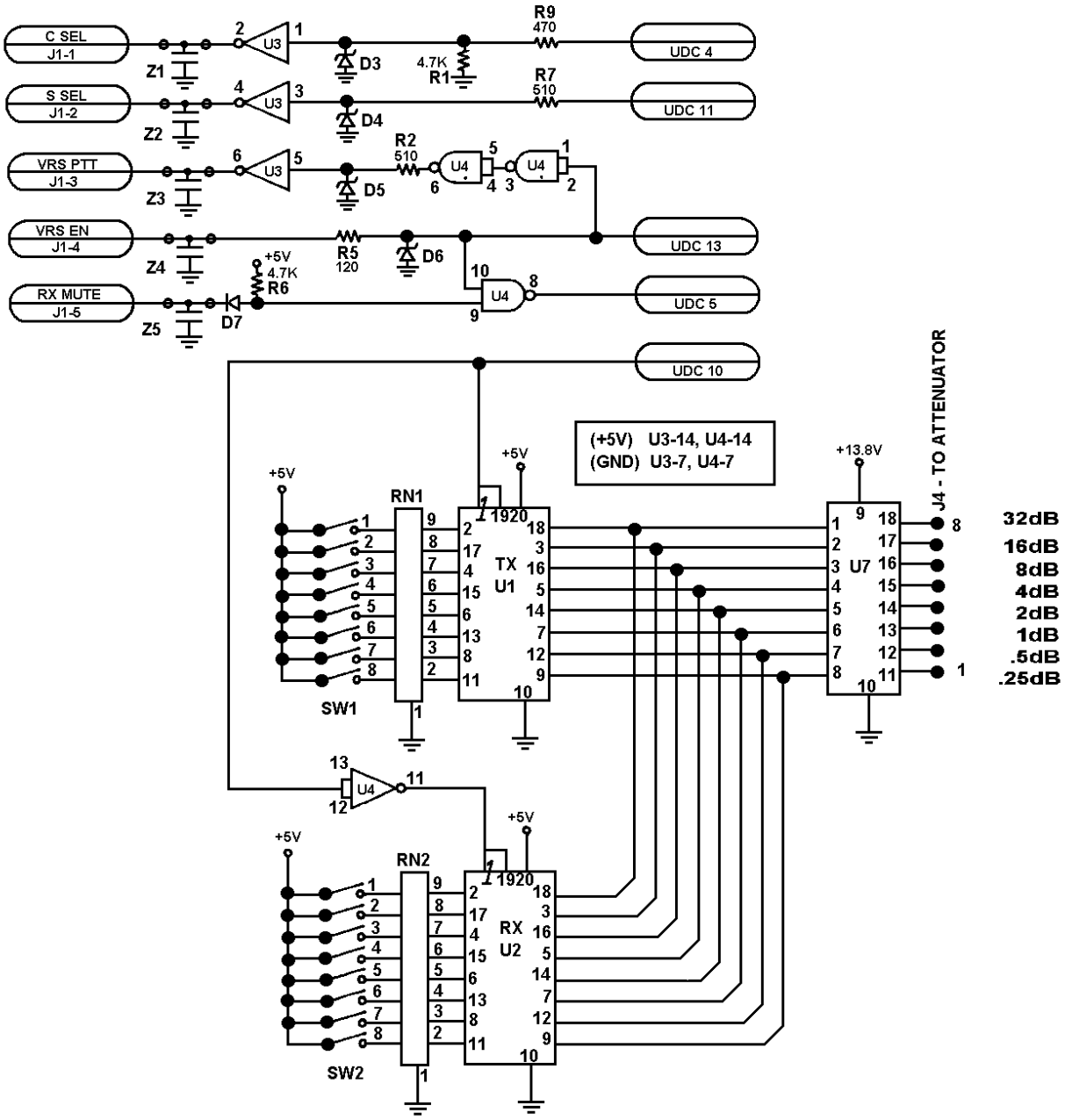


Figure 14 - Interface Board Schematic (Sheet 2 of 2)

PARTS LIST

PART #	DESCRIPTION/PART No.	QTY
LOOSELY SUPPLIED PARTS		
SLOTTED CAPTIVE SCREW	10-32 X 1.0000 (P/N SCFHMS18-8). (MAKK-O Industries, INC. 761 NEPPERHAN AVE. YONKERS, NY 10703) (914-376-0160).	4

PART	DESCRIPTION/PART No.	QTY
PARTS SUPPLIED ASSEMBLED		
ASSEMBLY ENCLOSURE	COMPAC S58010-212-0-CHP.	1
I/O ENCLOSURE	COMPAC R51230-175-1-CHP.	1
KAY ATTENUATOR	KAY 4550DL.	1
BASE PLATE	(PART 2; SEE SHEET 9).	1
MPA CLAMP PLATE	(PART 3; SEE SHEET 10).	1
MPA CLAMP PAD	(PART 4; SEE SHEET 11).	2
MPA POWER HARNESS	(SEE SHEET 18) (W106).	1
I/O BOARD	(SEE SHEETS 13-15A).	1
SYSTEM TO I/O CABLE	(SEE SHEET 16) (W105).	1
I/O TO MPA CABLE	(SEE SHEET 17) (W103).	1
MPA POWER CABLE	(SEE SHEET 18) (W107).	1
ATTEN. TO MPA RF CABLE	(SEE SHEET 18A) (W102).	1
ATTEN. TO SYSTEM RF CABLE	(SEE SHEET 18A) (W101).	1
PAN HEAD SCREW (STEEL)	6-32 x .375 (N90P13006B6).	S
PAN HEAD SCREW (STEEL)	6-32 x .500 (N80P13008B6).	4
SPLIT WASHER (STEEL)	*6 (N405P37B6).	S
FLAT HEAD SCREW (STEEL)	4-40 x .250 (N84P9004B6).	4
PAN HEAD SCREW (STEEL)	4-40 x .250 (N80P9004B6).	4
SOCKET HEAD CAP SCREW (S'STEEL)	4-40 x .375 (N171P9006).	8
SOCKET HEAD CAP SCREW (S'STEEL)	4-40 x .250 (N171P9004).	2
SPLIT WASHER (STEEL)	4-40 (N405P35B6).	18
THREADED SPACER (1/4 HEX STEEL)	4-40 x .375 (7142162P53).	4
THREADED STUD SPACER (1/4 HEX STEEL)	6-32 x 1.625 (19A138541P17).	2
THREADED STUD SPACER (1/4 HEX STEEL)	6-32 x 1.750 (19A138541P18).	2
FLAT HEAD SCREW	2-56 x .125 (PART OF ENCLOSURE).	68
CABLE TIE (PLASTIC)	3/16 SIZE (19A701863P4).	1
RUBBER GROMMET	MCMASTER CARR (9305K24).	2
NOTE 1: "S'STEEL" = STAINLESS STEEL		

Continued

INPUT/OUTPUT BOARD
PARTS LIST

SYMBOL	IDENTIFICATION #	DESCRIPTION
		---------- CAPACITORS ----------
C1, C3, C5	P914 - ND Digi-Key	47 microfarad cap, electrolitic.
C2, C4	P4812 - ND Digi-Key	.001 microfarad cap.
C6, C7	P055 - ND Digi-Key	.22 microfarad cap, tantalum.
		---------- DIODES ----------
Dl	1N4001	diode.
D2	1N914	diode.
D3-D6	1N52303BPH	4.7V zener diode.
D7	19A700047P2 (HP2811230)	Shottky diode.
		---------- JACKS ----------
J2	Newark 89F4128	DC Power Conn (J2 on W107).
J3	22-23-2041	Molex 4 pos connector.
		---------- RELAY ----------
K1	Aromat 9238ADS2E-M-DC12V	Relay, 2A - 30VDC.
		---------- PLUGS ----------
P3	22-01-3047	Molex 4 pos receptacle.
P3 contacts	08-50-0113	El contacts for P3.
		---------- RESISTORS ----------
R1, R6	H212CRP247	4.7K ohm resistor, .25W.
R2, R7	H212CRP151	510 ohm resistor, .25W.
R3, R4	Bourns 3299Y-1-103	10K ohm pot
R5	H212CRP112	120 ohm resistor, .25W.
R8	19A701250P286	7.68K ohm resistor, .25W 1%.
R9	H212CRP147	470 ohm resistor, .25W.
RN1-RN2	EXBF 10 E 103J	10K resistor network.
		---------- SWITCHES ----------
SW1-SW2	AMP 3-435640-9	8 position Dip switch.
		---------- FILTERS ----------
Z1-Z12	DSS306-55Y5S102M100 Murata	0.001 Microfarad EMI/RFI filter.
		---------- INTEGRATED CIRCUITS ----------
U1, U2	MM74C941N	op amp.
U3	GD74LS06	op amp.
U4	DM74LS00N	op amp.
U5	LM7805	5V regulator.
U6	LM7808	8V regulator.
U7	UDN2981A	

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