Cross-Connect Interface

User Manual

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TASC Systems Inc. • Langley, BC • Canada

Preface

This document describes the installation, commissioning and operation of TASC Systems Cross-Connect System. Hardware and software described in this document is subject to on-going development and improvement. Consequently there may be minor discrepancies between the information in this document and the performance and design of the hardware and software.

Periodically throughout this manual, you will find text such as this, which has been shaded and bolded with a pointing finger to catch your attention. These are special notes and tips to assist you.

Before connecting any equipment to any FAC product, it is important to read the Installation & Adjustments section of this document in its entirety. Application of voltages and signal levels in excess of the built-in protection devices could seriously damage the FAC and the equipment it is being connected to.

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TASC Systems is continuously working to improve system performance and expand product capabilities. Specifications and features contained within this document are subject to change without notice.

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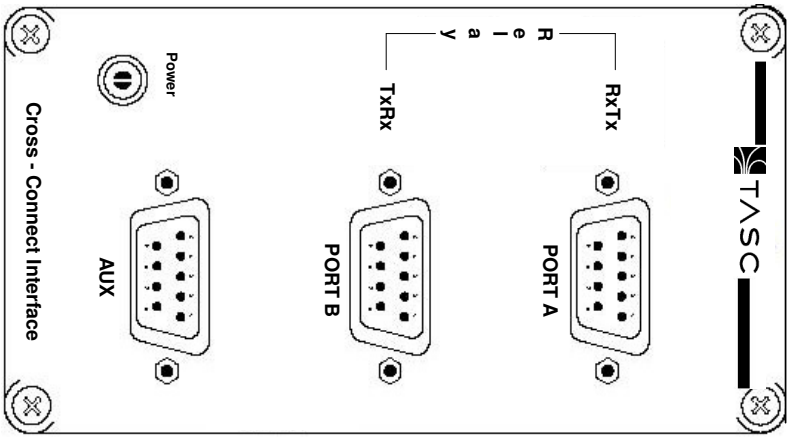

Figure 1 Cross-Connect Interface

Introduction

The Cross-Connect Interface is a device to create a portable tactical repeater and link using two portable or mobile two-way radios. The two primary ports are connected to radios which create a relay function. The AUX port was designed as a 600 ohm audio output that sums both sides of the repeating conversation onto one point that is intended to interface to an audio recording device.

Theory of Operation

Operation between the two primary radios can be in one direction only, as in a conventional repeater, or in either direction, making a bi-directional relay. The third port (AUX) has two functions, one being the primary source for 12VDC to power the Cross-Connect and secondly, is the 600 ohm balanced audio output that carries both sides of the two primary radios conversation intended to connect to an audio recording device. See Figure 2 for a picture overview of the operation of the Cross Connect used as a radio relay. This setup shows a repeater radio system linked to the Cross-Connect repeater mode. To use the Cross-Connect with a repeater system, hang times and lockout times must be setup properly to ensure correct operation. The white telephone box from the AUX port is the 600 ohm audio output from the Cross-Connect. It has a standard RJ-11 jack for interfacing to most any audio recording device.

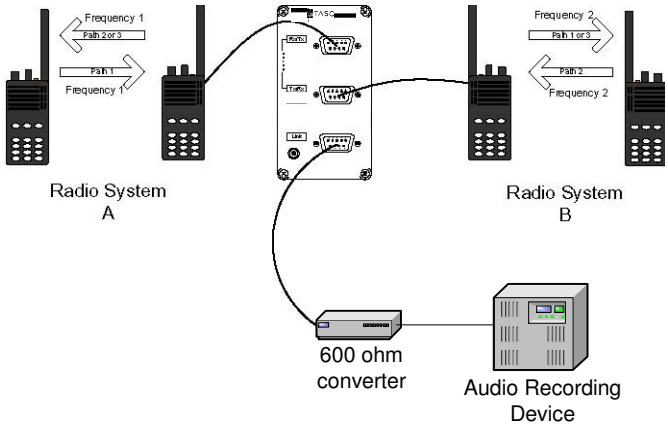

Figure 2 Relay Operation

All connections are virtually identical in operation in the bi-directional (relay) mode shown in Figure 2. The Cross-Connect uses receive audio from each radio to feed transmitter audio to the other radios and to key the PTT of these other radios. Received audio is coupled to the other radios' TX audio input. A resistor located in the cable of the transmitting radio sets the transmit audio level. The receive audio line is also monitored to determine when the receiver is active.

Caution: The received audio from these radios must be squelched. If a radio's receiver is not active, then the Cross Connect needs complete silence so it will not key up the other radio's transmitters. When receive is active, PTT in the other radios is triggered. During this time, repeat in other directions is disabled. When the receiving radio squelches, the PTT circuit releases after a ¼ second delay.

Specifications

Table 1 Specifications

Supply Current	<5.0 mA (idle), <20 mA (active)
Supply Voltage	9-20 VDC
Weight	6 oz.
Operating Temperature	-30° C. to +60° C.
PTT Attack Time	75 microseconds
PTT Release Time (Relay)	.25 seconds
PTT Release Time (Repeat)	.25 seconds to 3.75 seconds (adjustable)
RX Input Level	2-10 V Peak to Peak
RX Input Impedance	100 ohms (6.8K optional)
TX Output Level	5 mV to 2.5 V Peak to Peak (set by resistor in radio cable)
TX Output Impedance	100 ohms

Cables Connections

The Cross-Connect Interface connects two radios via cables that must be configured for a specific radio. Connections to the unit are made through 9-pin D connectors. Complete cables are available for specific radios. For portable radios that combine external Mic and PTT on the same connector, see Appendix B.

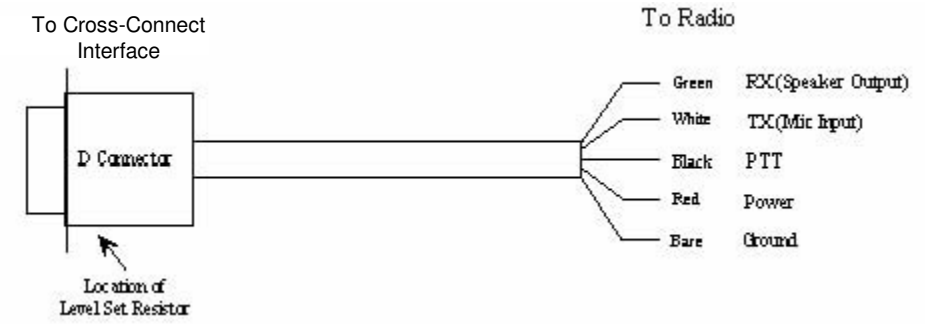

Figure 3 Cross-Connect Cable

Connections to the Cross-Connect are as follows:

Table 2 9-Pin D-Sub Connections

Pin	Name	Description
1	Ground	Connect to radio ground
2	PTT	Connection to assert external PTT
3	TX Out	Connect to microphone input
4	Level Set	Connect to one end of level set resistor
5	NC	No connection
6	Power	Connect to radio power
7	RX In	Connect to external speaker output
8	Level Set	Connect to one end of level set resistor
9	NC	No Connection

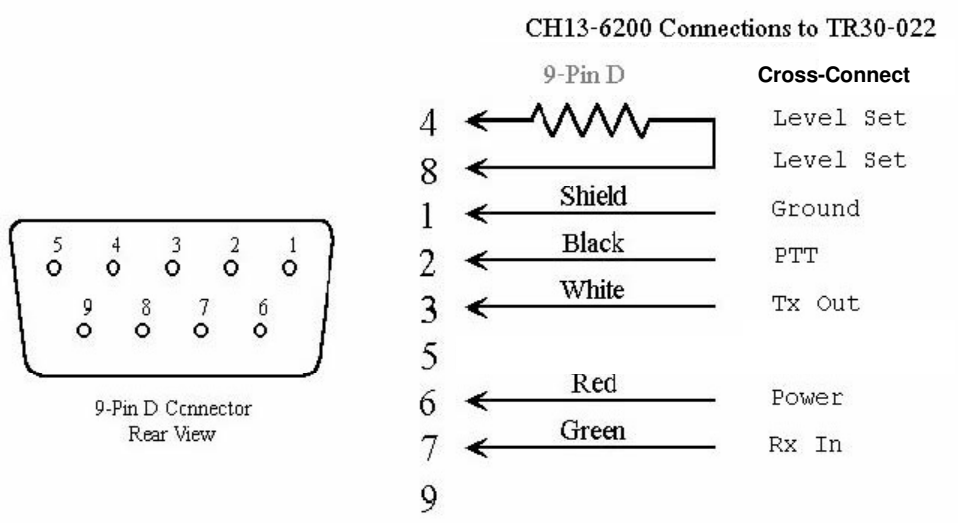

Figure 4 9-Pin D-Sub Connection

Two pair shielded cable is used (Belden 8723) for cable assembly. A male 9-pin D Connector is required for the Cross-Connect end, connected as shown in figure 6. The other end requires the specific connector that mates to the radio to be used.

Level Set Resistor

The volume of the receiving radio and the level set resistor determines the audio level sent to the transmitting radios. This level set resistor is installed in the cable connected to the transmitting radio. The following chart shows recommended values for the Level Set resistor based on the transmit audio level requirements for the transmitting radio. The Mic input level shown is the peak to peak voltage level needed to produce full deviation in the transmitter. Solder the Level Set resistor ($^{1}/_{8}$ or ¼ watt) between pins 4 and 8 of the cable's 9-pin D connector (see figure 6).

Table 3 Level Set Resistor Values

Mic Input Level	5-15 mV	15-50 mV	50-150 mV	150-500 mV	500-1500 mV	1.5-2.5 V.
Resistor Value	330 Ω	1K Ω	3.3K Ω	10K Ω	33K Ω	100K Ω

With the correct level set resistor installed, proper deviation (not too low, but not excessively clipped) can be set by adjusting the volume control of the receiving radio. The goal is to make incoming and outgoing deviation as nearly equal as possible.

Setup

To use the Cross-Connect, connect a cable (see Cables Section) to each radio to be used with the unit. Then connect the other end of each cable to a port on the device. Plug in the provided 12VDC power supply and your audio recording device to the RJ-11 jack of the white 600 ohm converter.

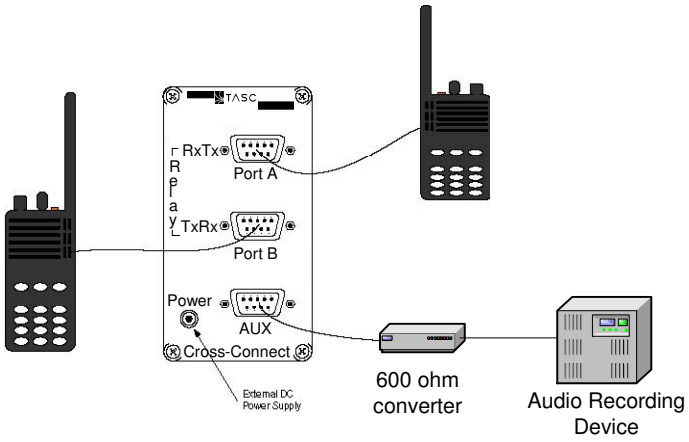

Figure 5 Cross-Connect Connections

Separate each radio as for away from the others and the Cross-Connect as possible. It is important that no radio should be operating on the same frequency as any of the other radios. Frequencies used on VHF should be separated as far as possible. UHF frequencies can normally be split 5 MHz apart. If receiver de-sense occurs during operation, a duplexer may need to be used. External antennas may be needed on portables if RF interference occurs.

After the radios are connected to the Cross-Connect, turn on each radio and adjust the receive volume for normal audio levels. Further adjustment may be necessary later.

In the Relay mode, one radio should be set to one system's transmit and receive frequencies. The other radio should be set to the second system's transmit and receive frequencies. Transmitting on one system should cause the radio with the **other** system's setup, connected to the Cross-Connect, to transmit. The audio should be heard on that other system. If the audio level is too low in volume, turn up the receive volume on the radio connected to the Cross-Connect with the transmitting system's setup. Exact levels can be set using a service monitor if desired (see Appendix D). The volume adjustments should be done in both directions (both systems transmit and receive).

If an audio recording device is connected to the AUX port, it will transmit whenever a radio connected to one of the other ports is receiving. If the radio on the Link port is receiving, the radios connected to the other ports will transmit (both of them in Relay mode and only the TX radio in Repeat mode).

The Cross-Connect is now set for use. Place the radios and the Cross-Connect in a location that will maximize coverage. The radios connected to the Cross-Connect do not have to be in the same band. In this way they can be used to create a cross-band repeater. The Cross-Connect can also be used as a mobile relay, a radio link, a tactical repeater, or a temporary gateway between systems.

Warranty

Limited One-Year Warranty.

Contact Information

Phone: Cartel Communication Systems Inc. 1-800-663-0070

Appendix A: Changing RX Input Impedance:

As built by the factory, the Cross-Connect has an RX input impedance of 100 ohms. The RX input is intended to be fed from the speaker output of a radio. In situations where it is desired to feed RX audio from a higher impedance source, either R3, R12 or R20 (depending on which port RX is being fed from) can be removed to increase the input impedance to 6.8K.

1. Use a Phillips Screwdriver to remove the four screws on the Cross-Connect box.
2. Use a soldering iron to remove the desired impedance resistor. See figure 10 for resistor locations.
3. Solder the new impedance resistors on the locations desired. See figure 10 for resistor locations.
4. Replace the Cross-Connect box cover and tighten the screws.

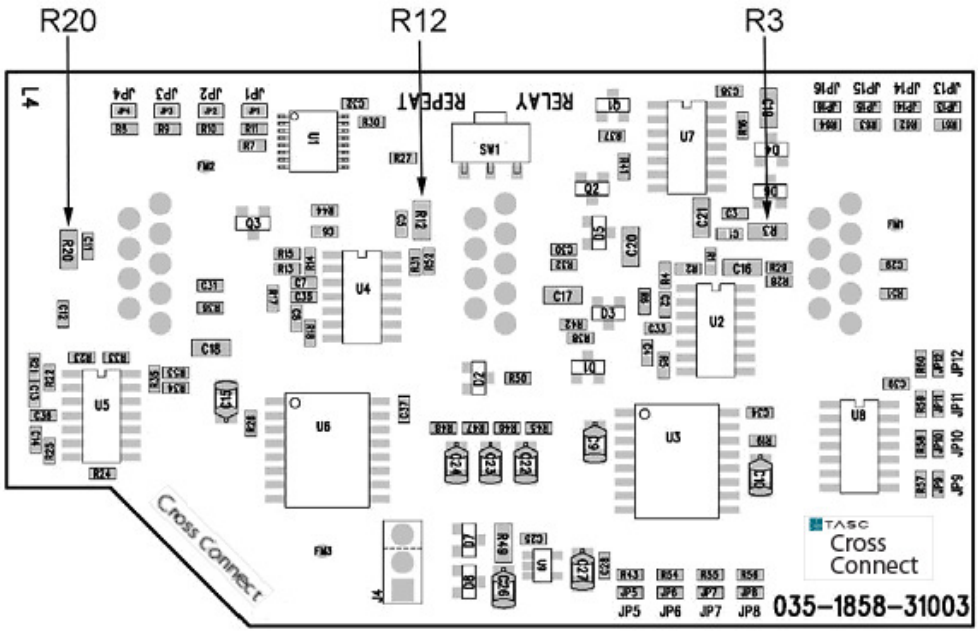

Figure 6 RX Input Impedance Resistors

Appendix B: Portable Radios with Combined External Mic Audio and PTT

Several portable radios combine external PTT with external Mic audio onto the same conductor. In this case, the Cross-Connect must also combine these functions in order to properly operate the radio. The diagram below illustrates how PTT and Mic audio are normally combined. The cable will have to be modified to combine the signals. Resistor values for R_a (audio) and R_p (PTT) can be copied from the radio manufacturer's external speaker-mic used on that specific radio.

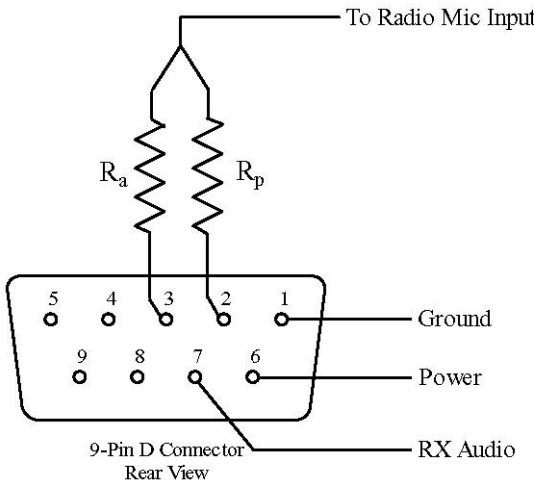

Figure 7 Setup for Shared Mic & PTT Line

Appendix C: Adjusting Lockout Time

The lockout time is set by a resistor/capacitor combination for each port. These combinations are in conjunction with capacitors C19, C20, C21. The 3 capacitors have a value of 1 µF. With this value capacitor; the total resistance can be changed to set the delay value according to Table 5. A series of four resistors are in parallel with each of these capacitors. The total resistance is selected by soldering or opening each jumper (JP) adjacent to each resistor in the series. The jumpers used for port 1 are: JP13, JP14, JP15, & JP16. The jumpers used for port 2 are: JP9, JP10, JP11, & JP12. The jumpers used for port 3 are: JP5, JP6, JP7, & JP8. The jumpers soldered or left open set the lockout times for each port as shown in Table 5.

To adjust the lockout time for each port, refer to the chart below and connect the corresponding jumpers inside the Cross-Connect. The connections for jumpers can be made using a solder bridge; using zero ohm resistors is also adequate but not strictly necessary. The jumpers are set at the factory (using zero ohm resistors) for a 0.30 second hang-time on all ports. Note that it is very important that at least one of the jumpers be unsoldered (open). If all jumpers are soldered, the Cross-Connect will malfunction.

Caution: Do not solder at least one of the jumpers. If all jumpers are soldered, then one of them must be unsoldered.

1. Use a Phillips Screwdriver to remove the four screws on the Cross-Connect box.
2. Solder the jumpers (using a solder bridge or zero ohm resistor) for the desired lockout time according to Table 5 for the desired port. See Figure 12 for locations of the jumpers.
3. Reattach the Cross-Connect box cover and tighten the screws.

Table 5 Available Lockout Times, Jumper settings per port

Lockout	Port:	1	2	3	1	2	3	1	2	3	1	2	3
Time	Jumper:	JP5	JP9	JP13	JP6	JP10	JP14	JP7	JP11	JP15	JP8	JP12	JP16
0.30 sec.		Open			Soldered			Soldered			Soldered		
0.67 sec.		Soldered			Open			Soldered			Soldered		
0.97 sec.		Open			Open			Soldered			Soldered		
1.42 sec.		Soldered			Soldered			Open			Soldered		
1.73 sec.		Open			Soldered			Open			Soldered		
2.09 sec.		Soldered			Open			Open			Soldered		
2.39 sec.		Open			Open			Open			Soldered		
3.03 sec.		Soldered			Soldered			Soldered			Open		
3.33 sec.		Open			Soldered			Soldered			Open		
3.70 sec.		Soldered			Open			Soldered			Open		
4.00 sec.		Open			Open			Soldered			Open		
4.45 sec.		Soldered			Soldered			Open			Open		
4.76 sec.		Open			Soldered			Open			Open		
5.12 sec.		Soldered			Open			Open			Open		
5.42 sec.		Open			Open			Open			Open		
Invalid		Soldered			Soldered			Soldered			Soldered		

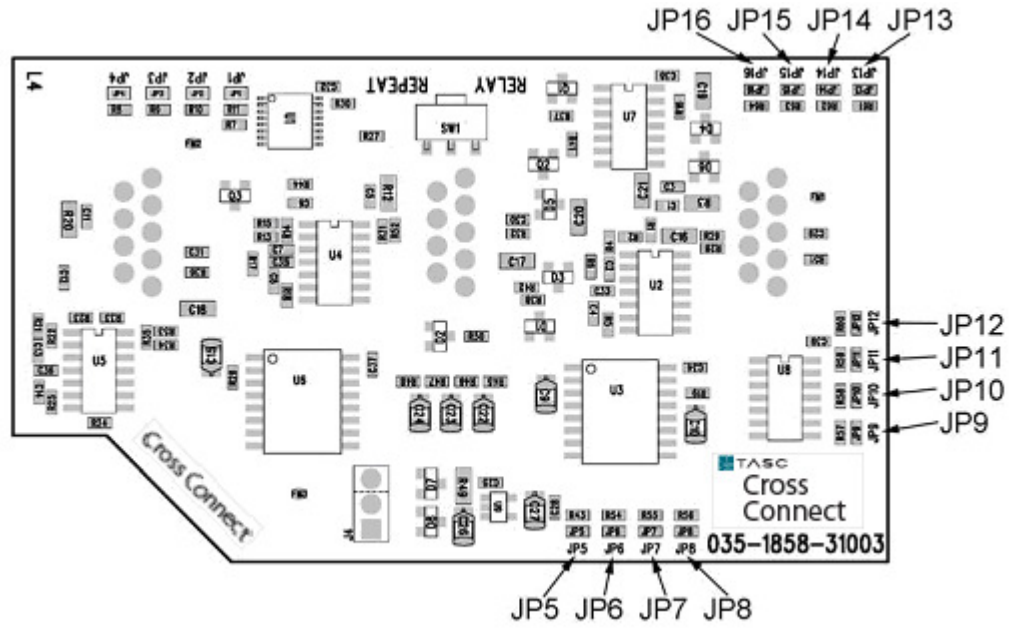

Figure 8 Lockout Jumper Locations

Appendix D: Setting Levels with Service Monitor

If exact input and output levels are desired, a service monitor can be used to set up the levels. Inject a carrier modulated with a 1Khz tone at 3Khz deviation into Radio 1, the radio connected to the top port of the Cross-Connect. Monitor the TX output of Radio 2, the radio connected to the middle port on the Cross Connect, and adjust the receive volume of Radio 1 until Radio 2's deviation is 3Khz.