EMERGENCY MEASURES RADIO GROUP	**EMERGENCY MEASURES RADIO GROUP**
AMATEUR RADIO RAC EMERGENCY SERVICE	**OTTAWA ARES**

Two Names - One Group - One Purpose

Standard Radio Interface (SRI)
EMRG-210

PHASE 1: PHYSICAL INTERFACE STANDARD

Version: 1.0

EMRG PUBLIC

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Written by: Peter Gamble for the EMRG Management Team

TABLE OF CONTENTS

1.0 REVISION SUMMARY

Date of Change	Revision Number	Summary of Changes (Section #, type of change)
2003-10-26	0.1	Initial document created using template, based on original document
2004-11-25	0.2	• Change name to from 14 Pin Interface to Standard Radio Interface and apply latest document template • Change interface connector from 15 pin high density DA15video to standard DA15 connector
2004-11-29	0.3	• Update per review feedback
2004-12-05	0.4	• Add packet PTT and additional details and corrections in many areas. Major document re-write.
2005-12-05	0.5-Draft	• MAJOR REWRITE • Return pin 15 to be audio ground • Switch SG to pin 1 and PTT – Packet to pin 6 • Remove Internal Speaker + from SRI
2006-09-24	1.0	• Complete document review and issue as initial release version. • Updates and changes to add clarity and ensure accuracy with previous changes.

2.0 PURPOSE OF THIS DOCUMENT

This document defines an EMRG standard interface for radio communications signals. The interface will be used on radios, and devices that connect to radios, such as TNCs, Repeater controllers, User Interface and phone patches.

3.0 INTRODUCTION

3.1 OVERVIEW

Almost every piece of equipment has an audio and control interface of some type. It might be the microphone and speaker jacks on an Amateur radio, the multi pin jack on the back of a commercial radio, or the radio interface connections on a TNC. Some vendors maintain a standard within one or more model lines, but in general there are no manufacturer standards for these equipment interfaces. Each manufacturer uses a different type of connector and a different pin assignment.

Each time new equipment is purchased the matching connectors must also be purchased and new cables created to interface to other equipment. If there is only one set of equipment to connect together or multiple installations of the exact same equipment, a custom interface cable is wired to connect the desired radio(s) to the equipment. The equipment could be a TNC, Phone Patch, Repeater Controller or a Remote Console.

3.2 EMRG CHALLENGE

EMRG has many different radios and different pieces of accessory equipment, so there is an infinite number of possible interface connections. Custom User Interface boxes could be built to provide a common microphone, headphone system for users, with additional control options, but each radio has different wiring options. In order to be able to swap equipment in an emergency, extra interface cables for each combination would have to be built in advance, labelled and stored.

The drawing below shows the typical situation for EMRG where there are two different manufacturers of radio; Radio-1 & Radio-2, and two different makes of TNC; TNC-A & TNC-B. The TNC is used is this example, but equipment connecting to the radio could also be a Phone Patch, Repeater Controller or a Remote Console.

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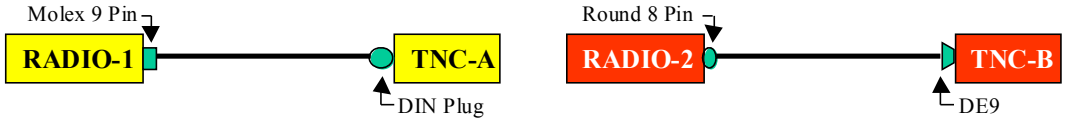
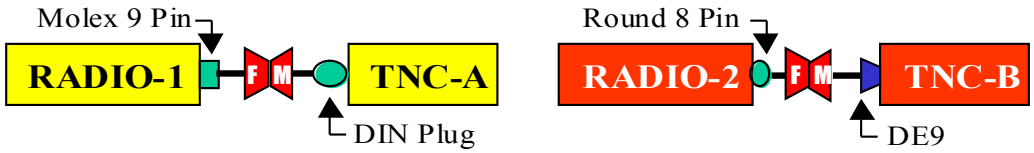


Each radio and TNC uses a different connector, so custom cables are required for each Radio - TNC installation. In an emergency, there is no way to swap equipment, such as to connect RADIO-1 to TNC-B, without building a new cable.

3.3 STANDARD RADIO INTERFACE

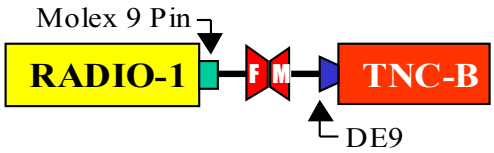
The solution to connecting different pieces of equipment together is to define a standard interface and build cables from each piece of equipment to the standard interface.

The figure below shows the same radios and TNCs shown in section 3.2, but now each device is wired to a standard connector.

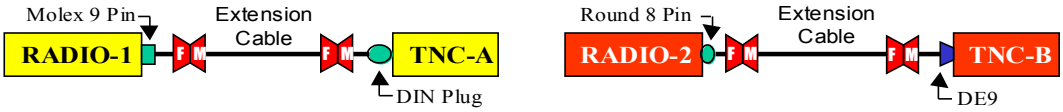


Implementing a standard interface will allow radios and peripherals to be swapped as required in an emergency. This means that if a radio fails in a phone patch, another radio equipped with the standard interface can be used in its place, without having to make adapter cables in the field.

The previous problem of connecting RADIO-1 to TNC-B is not a problem now, because the connection is made at the standard interface connector as shown below. It does not matter what connectors the Radio and TNC have.



The device connecting to the radio may not be a TNC, it could be a user interface for distributing microphone and speaker audio. With standard interface connectors, extension cables can be built various lengths to separate the radio and the connecting device.



3.4 PHYSICAL & ELECTRICAL INTERFACE

The first phase of the Standard Radio Interface (SRI) will define only the physical connections between radios, which solves 75% of the interconnection issues. Some equipment may require signal level adjustments for proper operation.

The second phase of the Standard Radio Interface will deal with the signal types and levels on each connection. For example there are a few radios that do not reference speaker audio to ground, microphone bias voltages are not all the same, and audio levels and impedance do not always match.

4.0 STANDARD CONNECTION SPECIFICATION

4.1 STANDARD CONNECTOR

The standard EMRG radio interface is the DA15 connector. The DA15 is similar in shape to the DE9 and DB25 and it's size is between the two. The DA15 was chosen for the following reasons;

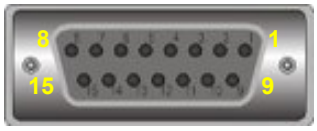
- contains enough pins for the signals that need to be assigned
- widely used in industry, so connectors are readily available for a reasonable price
- available in crimp pin or solder pin
- reasonable size for amateurs to work with
- not used very often in commercial or amateur radio systems, so there is no confusion about connectors

D connectors use letters to signify the number of pins; DE=9, DA=15 and DB=25. Typically DB is used incorrectly to refer to all D connectors.

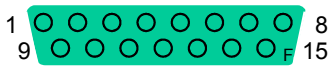
Several other connectors were considered, such as DE9, RJ45 and DIN. These connectors are readily available and easy to work with. The problem is that they don't have enough pins to bring out all the desired signals in one connector, plus the DE9 and RJ45 are commonly used in radios and computers and both are currently used for other purposes in amateur radio. To confuse things more, the RJ45 is commonly used as a microphone connector, but with different configurations for each manufacturer.

- **DA15F**: Wired to Radios. The radio may be used without anything connected to the DA15 connector, so the Female connector is used on radios, so there are no exposed pins.

DA15F (female) Connector



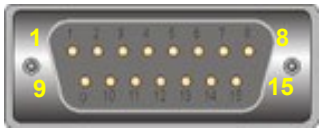
Front View



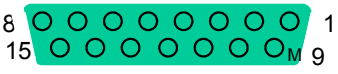
Back View
Wiring Connections

- **DA15M**: Wired to TNCs, controllers, Custom User Interfaces and phone patches. These devices are not used unless they are connected to a radio, so the exposed pins on the male connector are less of a potential problem.

DA15M (male) Connector



Front View



Back View
Wiring Connections

4.2 AUXILIARY POWER

Most devices that connect to a radio using the standard interface require 12 VDC power to operate. Typically these devices, such as a TNC, custom user interface, or phone patch do not require more than 1A. The SRI defines 2 pins to provide DC power. The 12 volt DC connection in the standard interface will be fused at 2 amps, meaning devices that require up to 1.3A can be supported.

See section 6.0 for more information on wiring the auxiliary 12 VDC power.

4.3 STANDARD CONNECTOR PIN OUT

PIN	Signal	DA 15M	DA 15F	Description	PACKET CONNECTIONS
1	SG GND	-	-	Signal Ground - Connect to common ground point	Ground
2	Microphone Audio	OUT	IN	Standard microphone connection on radio (Audio Input to TX -Before Pre-emphasis)	1200B TX IN (EMRG Standard)
3	PTT-Microphone	OUT	IN	Microphone PTT switch	1200B PTT (EMRG Standard)
4	Flat TX Audio	OUT	IN	Audio Input to TX -After Pre-emphasis (Inject CTCSS tone at this point)	1200B TX IN (Radios with dedicated 1200 Baud packet transmit connection)
5	Direct TX Inject	OUT	IN	Audio Input to TX (Typically at RF section)	9600B TX IN (Separate TX IN) 9600B & 1200B TX IN (Common TX IN)
6	PTT-Packet	OUT	IN	Packet PTT on radios with rear packet connector. typically mutes microphone when packet active	Dedicated packet connector –PTT Requires TNC to have Switch Interface
7	COR/COS	IN	OUT	Squelch Output or Input	Squelch Signal (Radio & TNC Option)
8	Aux Power +	IN	OUT	Auxiliary DC + (1.3 Amp for TNC or audio amp)	DC Power +
9	Aux Power -	IN	OUT	Auxiliary DC Ground	DC Power -
10	Receive Audio	IN	OUT	Constant Audio Output -before volume control	1200B RX OUT (Option)
11	Flat Receive Audio	IN	OUT	Audio Output from RX before De-emphasis (Includes CTCSS signal)	9600B RX OUT
12	Aux Input +	IN	OUT	Auxiliary Audio Input (Second Radio Monitor Only) Use External Speaker – for Aux Input -	
13	Spare			Available for future use	
14	External Speaker +	IN	OUT	For external speaker or Loop to Int SPK + for internal speaker	1200B RX OUT (EMRG Standard)
15	External Speaker -	IN	OUT	Audio Ground – Typically the same as pin 1. Available for situations where this is not the case.	

4.4 ASSUMPTIONS - EXPECTATIONS

4.4.1 Physical Vs Electrical Specification

The first phase of the Standard Radio Interface is the physical connections. Future development will define the electrical characteristics of the interface, with suggested circuits for signal inversion and level changes.

4.4.2 Supported Equipment

The standard radio interface must support all VHF/UHF radios, TNCs, repeater controllers and phone patches, and it should support as much other equipment as possible, including CB radios, HF radios, scanners and broadcast radios.

Radios supported can be base stations, mobiles or portable (handheld).

4.4.3 Equipment Wiring

Some radios provide most of the required connections on existing connectors. Adapter cables would be required from the radio's connector, to the standard interface.

If there are no external connections on the radio, or only a few, the standard interface can be wired directly into the radio.

For some radios the required connection points are readily available within the radio, while others require additional components such as resistors or transistors to be added. These components may need to be installed in an external mini box attached to the device, or integrated into the SRI cable.

4.4.4 PTT –Push To Talk

In the standard interface, the PTT signal refers to a normally high with low indicating a valid PTT signal. For equipment that does not provide this type of PTT output, additional circuitry will be required either in the radio or inside an attached box.

4.4.5 Speaker Ground

The standard interface is based on the speaker using ground as one connection. On radios that that require the speaker to be independent of the ground connection, a custom adapter will be required. (the design for this adapter has not been defined at this time)

4.4.6 Hook Switch

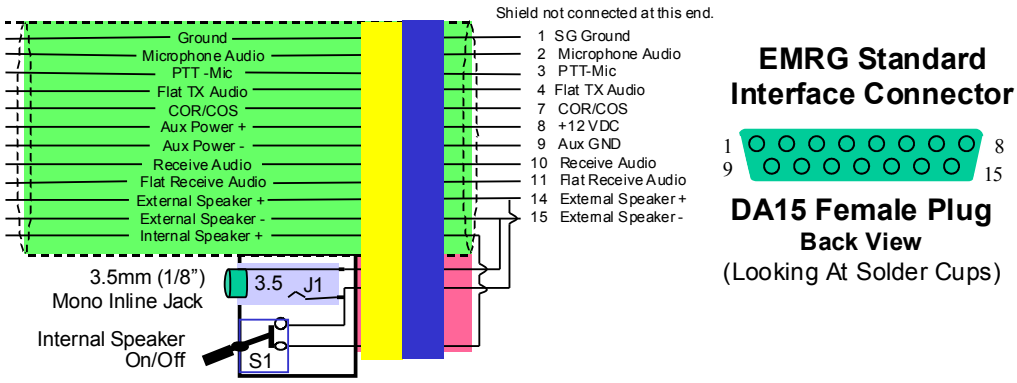
On commercial radios, the hook switch feature must be disabled or the hook switch pin must be grounded inside the radio. The hook switch lead is normally wired to the steel disk on the back of the microphone, so when the microphone is in it's clip, CTCSS is enabled on receive. When the mike is removed from the clip, the CTCSS on receive is removed.

4.4.7 Internal Speaker +

The internal speaker + connection is not wired to a pin on the standard interface because it only applies to the radio, and then only to some commercial radios. It is not used by any of the other interface devices.

The internal speaker + connection is wired in the same cable as the other signals, but is wired to a switch attached to the SRI cable. This provides the option of internal or external speaker, for situations when radios are being used with no external devices attached. The 3.5mm jack provides a connection for an external speaker.

The switch is wired in a small mini box near the SRI connector for the radio, to select Internal Speaker On/Off.



5.0 STANDARD INTERFACE CLASSES

5.1 THREE INTERFACE CLASSES

The standard interface defines a full set of interface signals that could be used for end user interfaces (Mic, PTT, Spk), repeaters (COS/COR, Flat TX/RX) and 9600 baud packet (direct TX inject). The full set of interface signals will not be available on some radios and will require internal connections for some signals. Internal connections to the radio may not be desired or possible on all radios.

There are three classes of standard interface, which define sub sets of signals that are required to serve specific requirements. Each interface class has a colour indicator to show which class the radio supports. Indicator colours must be included on the cable using heat shrink tubing or tape, or on the connector using paint. The three interface classes are;

BASIC Interface (RED)

- Supports custom user interfaces and 1200 baud packet radio
- Signals available using only microphone and external speaker jacks
- Indicator colour is RED

ENHANCED Interface (YELLOW)

- Supports all BASIC interface signals
- Supports devices that require a COS/COR indication from the radio, such as repeater controllers and phone patches without VOX.
- Signals may require connections inside the radio and may require modifications such as cutting traces or adding components
- Indicator colour is YELLOW

CUSTOM Interface (BLUE)

- Supports all BASIC interface signals
- May or may not support ENHANCED interface signals. IF the custom interface supports the ENAHNCED interface signals, the cable will have the yellow indicator for ENHANCED and the blue indicator for CUSTOM.
- Supports special applications such as 9600 baud packet radio as well as repeater controllers that provide CTCSS encode and decode.
- Signals require connections inside the radio and may require modifications such as cutting traces or adding components
- Indicator colour is BLUE
- Enhanced interfaces require a label to indicate which extra interface connections have been wired

5.2 BASIC STANDARD INTERFACE REQUIREMENTS

The BASIC Standard Radio Interface defines the minimum requirement to wire a standard interface. This also defines the minimum set of signals that can be obtained from a standard Amateur radio, using only the Microphone and Speaker jacks, plus an inline DC power connection.

The BASIC Interface signals include;

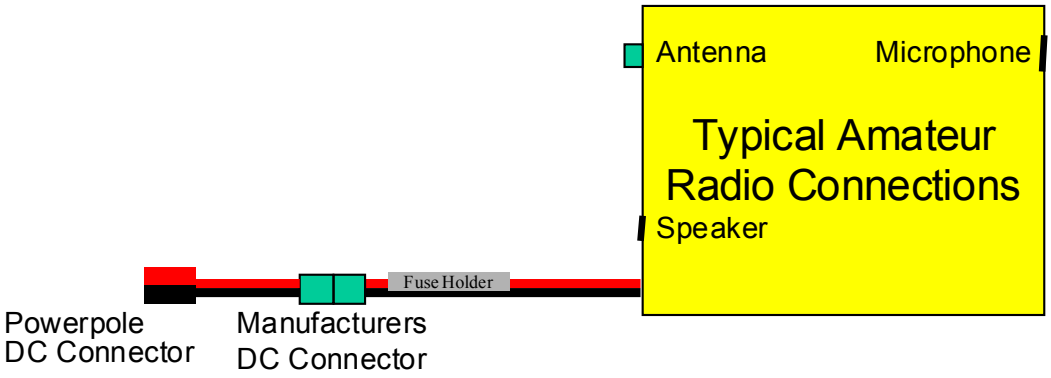
- Signal Ground
- Microphone Audio
- Microphone PTT
- Auxiliary Power +
- Auxiliary Power -
- External Speaker +
- External Speaker -

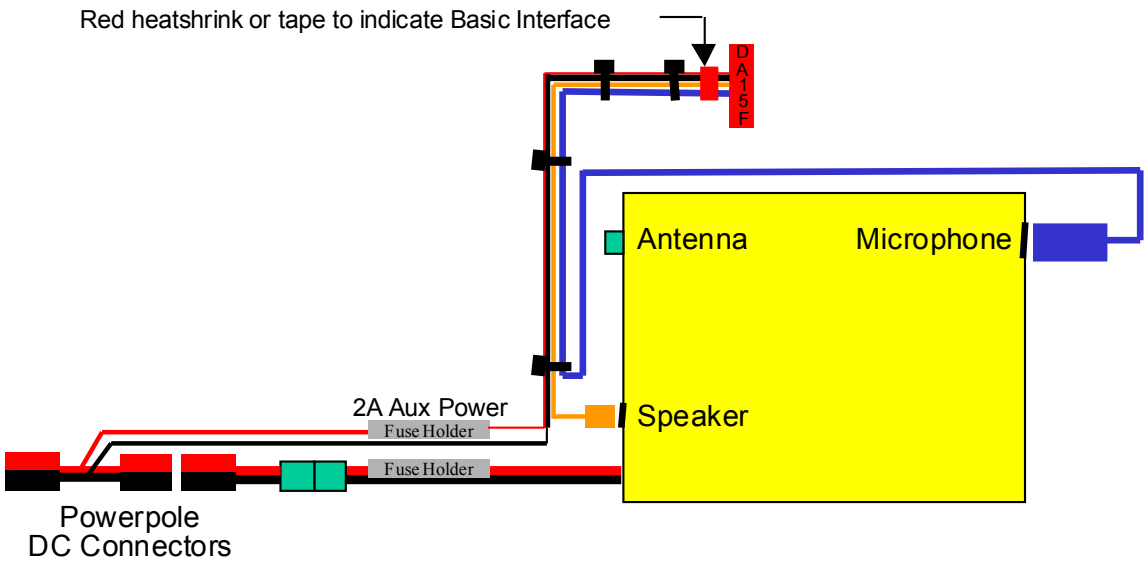
Connectors wired with the BASIC requirement must be labelled with red tape or heat shrink tubing on the cable, near the DA15 connector, or with a red marker or paint on the connector shell. This indicates that the device is wired to support the BASIC requirement.

5.2.1 BASIC INTERFACE PIN OUT

On a typical amateur radio, which has an external speaker jack and a microphone jack, the following pins are used. There are some commercial radios that only provide a microphone jack and a standard 3.5mm (1/8") speaker jack.

PIN	Signal	Description
1	SG Ground	Signal Ground
2	Microphone Audio	Audio Input to TX -Before Pre-emphasis (Standard microphone connection on radio)
3	PTT- Microphone	Microphone PTT
8	Aux Power +	Auxiliary DC + (1.3 Amp for TNC or audio amp)
9	Aux Power -	Auxiliary DC Ground
14	External Speaker +	External speaker +
15	External Speaker -	External speaker ground


Antenna
Microphone
Typical Amateur Radio Connections
Speaker
Fuse Holder
Powerpole DC Connector
Manufacturers DC Connector


Red heatshrink or tape to indicate Basic Interface
DA15F
Antenna
Microphone
Speaker
2A Aux Power
Fuse Holder
Fuse Holder
Powerpole DC Connectors

5.3 ENHANCED STANDARD INTERFACE REQUIREMENTS

The ENHANCED Standard Interface defines the BASIC interface signals, plus two additional signals; COS/COR and Receive Audio. Most radios will require an internal connection for these signals and may require additional components for COS/COR, usually a transistor.

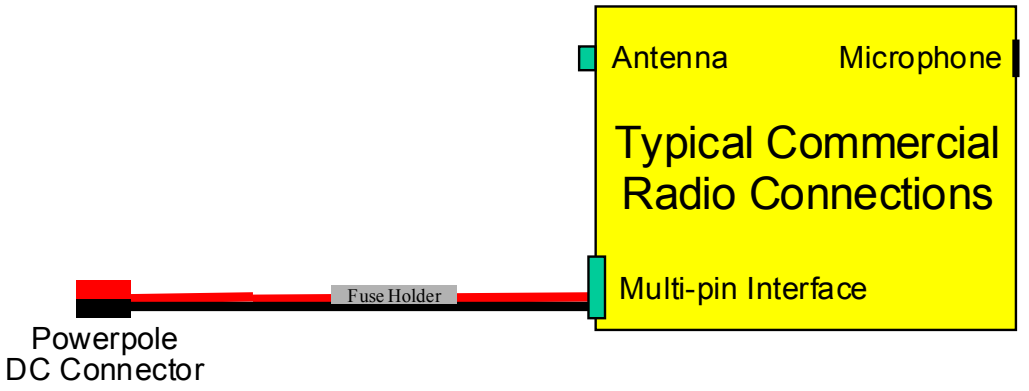
The ENHANCED Interface signals include;

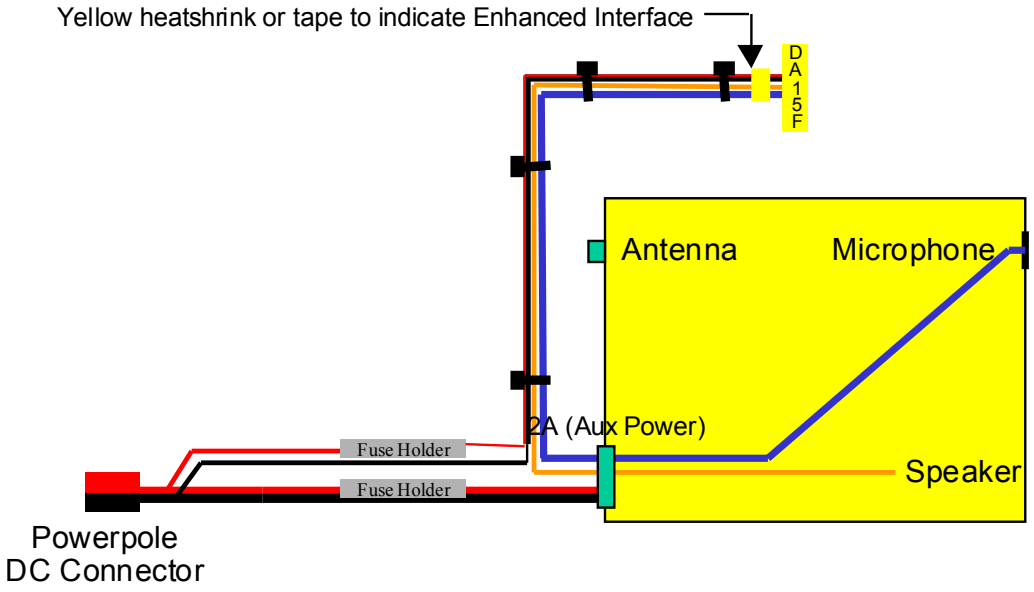
- Signal Ground
- Microphone Audio
- Microphone PTT
- COS/COR
- Auxiliary Power +
- Auxiliary Power -
- Receive Audio
- External Speaker +
- External Speaker -

Connectors wired with the ENHANCED requirement must be labelled with yellow tape or heat shrink tubing on the cable, near the DA15 connector or with a yellow marker or paint on the connector shell. This indicates that that the device is wired to support the ENHANCED requirement. ALL Enhanced interfaces will support the BASIC interface requirements so no additional marking is required.

5.3.1 ENHANCED INTERFACE PIN OUT

PIN	Signal	Description
1	SG Ground	Signal Ground
2	Microphone Audio	Audio Input to TX -Before Pre-emphasis (Standard microphone connection on radio)
3	PTT-Microphone	Microphone PTT
7	COR/COS	Squelch Output
8	Aux Power +	Auxiliary DC + (1.3 Amp for TNC or audio amp)
9	Aux Power -	Auxiliary DC Ground
10	Receive Audio	Constant Audio Output – before volume control
14	External Speaker +	External speaker +
15	External Speaker -	External speaker ground


Antenna
Microphone
Typical Commercial Radio Connections
Multi-pin Interface
Fuse Holder
Powerpole DC Connector

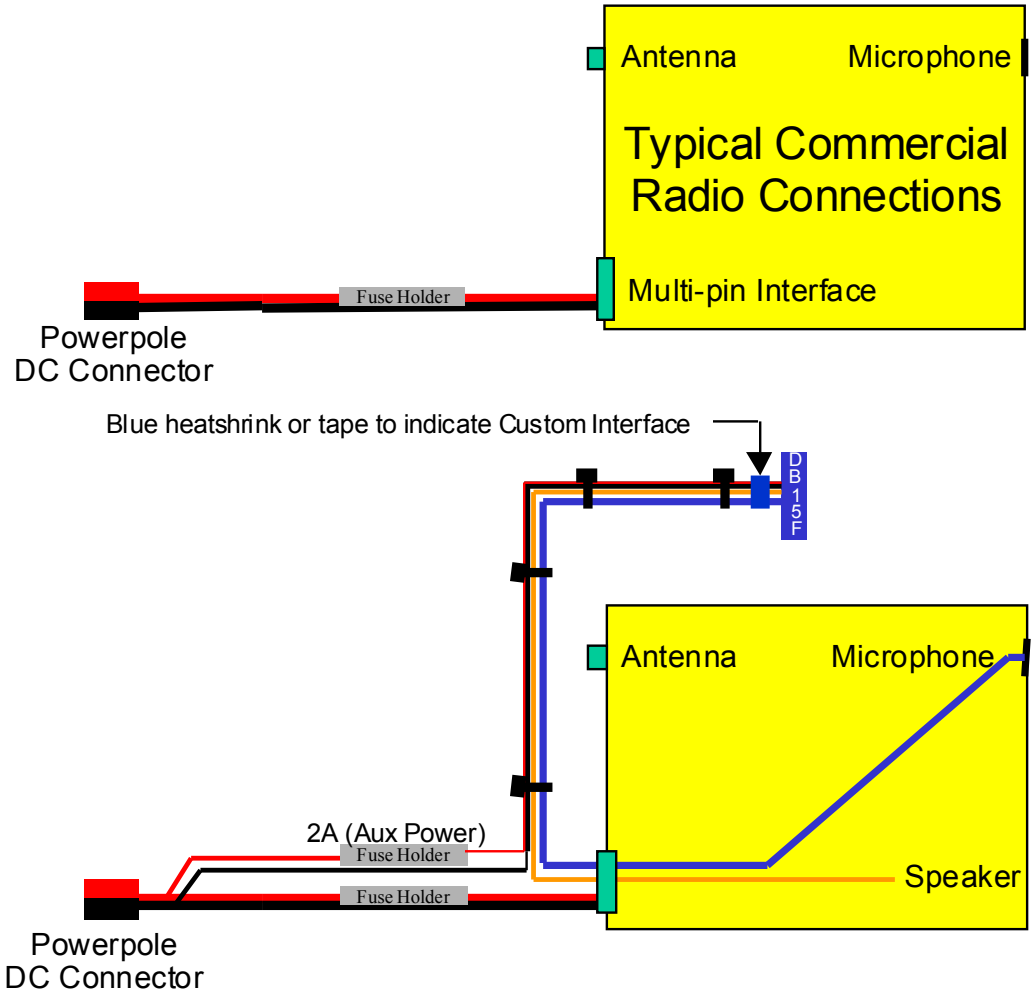

Yellow heatshrink or tape to indicate Enhanced Interface
DA15F
Antenna
Microphone
2A (Aux Power)
Fuse Holder
Fuse Holder
Speaker
Powerpole DC Connector

5.4 CUSTOM STANDARD INTERFACE

The CUSTOM Standard Interface defines the BASIC interface signals, plus a non standard set of additional signals, from the set of signals defined for the standard interface. Devices wired with the CUSTOM interface standard must be labelled to indicate which additional signals they support. Most radios will require an internal connection for the additional signals which may require additional components and traces to be cut.

There are Amateur radios which have a connector to support 9600 baud packet radio. This is an example where the interface is CUSTOM, but there is no internal radio wiring.

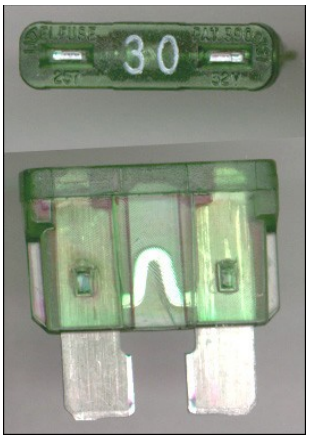
Connectors wired with the CUSTOM requirement must be labelled with blue tape or heat shrink tubing on the cable, near the DA15 connector, or with a blue marker or paint on the connector shel. This indicates that that the device is wired to support the CUSTOM requirement. If the connector also supports all the ENHANCED interface signals, an additional YELLOW indicator should be included with the blue.



6.0 AUXILIARY POWER

6.1 FUSE SELCTION

The preferred fuse type is the automotive ATO style fuses. These are small, flat plastic fuses that come in ratings from 1 amp to 40 amps.



ATO fuses are readily available and are very durable. The fuse holders for ATO fuses provide very secure connection and do not pull apart causing momentary power loss like inline glass fuse holders.

The fuse for auxiliary power is 2 amp. The 2 amp size selection is based on the requirement that the smallest wire that will be used for the standard interface is 24 gage. This size wire will support 2 amps in a bundled cable. By selecting the fuse rating of 2 amps, the current cannot exceed the operating rating of the cable. The cable will support higher current, but it will get warmer, and the fuse will not support more than the rated 2A for the wire.

The fuse will not support continued operation at its full load rating, so the actual maximum operating current for the fuse is lowered to 1.3 Amps. This allows the fuse to be 1.5 times greater than the rated current (1.3A x 1.5 = 1.95A).

6.2 AUXILIARY POWER WIRING

The auxiliary power can be wired permanently with the radio power cable, or it can be wired using a short adapter cable so the standard interface can be removed from the radio. Using a removable interface cable would typically be used on a personal Amateur radio.

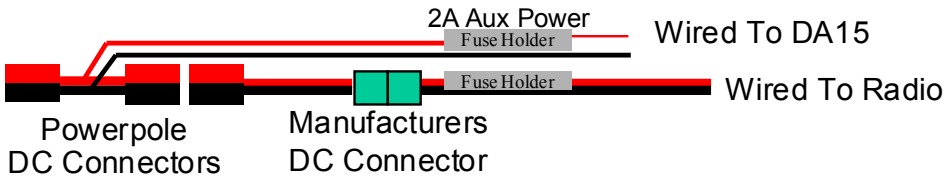
The fuse holder for the auxiliary power only needs to support 2 amps, and fuse holders with lower current ratings have small wire. The smaller wire size is preferred, because the smaller wire size is easier to work with. Even 16 gage wire is small enough to make it much easier to work with.

Typical ATP Fuse Holder

6.2.1 REMOVABLE AUXILIARY POWER CONNECTION

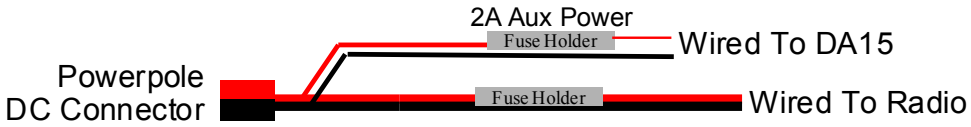
The removable auxiliary power connection option would typically be used on interface cables that are made so they can be removed from the radio. This option might be used on a personal amateur radio wired for the BASIC interface, where the other SRI connections to the radio microphone and speaker connectors.

Two Powerpole connectors are required to provide the removable auxiliary power connection. The figure below shows the wiring.



6.2.2 PERMANENT AUXILIARY POWER

On radios with an ENHANCED or CUSTOM interface, some of the interface signals will be wired directly into the radio, so there is no need to make the auxiliary power connection removable. The drawing below shows how to wire the auxiliary power to the radio power cable.



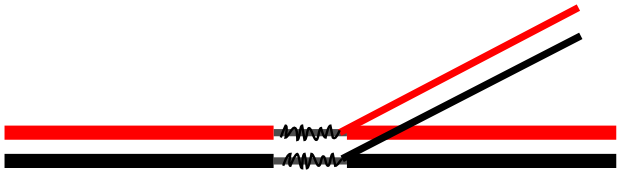
Some radios, typically Amateur radios, have the power wires connected permanently inside the radio, so there is a commercial DC connector on the power cable. Other radios, typically commercial radios, wire power directly to a connector on the back of the radio, so there is no connector in-line on the power cable.

6.2.3 CONNECTING THE WIRES

The auxiliary power connection for the removable and permanent connection are made the same way. The difference is that the removable connection is made from a short piece of red and black #14 or #12 wire, 15 cm (6 in) long, while the permanent connection is made to the radio power cable.

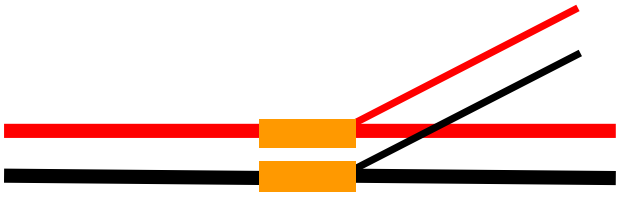
1. Strip a short section (1cm / ½ in) of insulation away from the wires.
   - On the removable interface, do this in the middle of the red and black wires.
   - On the permanent interface, do this as close as possible to the radio fuse holder or the commercial power connector, depending on the radio.

2. Take the wires that will connect to the auxiliary power terminals on the standard radio interface, strip the insulation from the ends and wrap each one tightly with the piece of power cable wire from which the insulation was removed. Twist the two red wires over each other so the joint is physically secure. Twist the two black wires over each other so the joint is physically secure.



Wrap the auxiliary power wires tightly with the main wires
Solder the connections

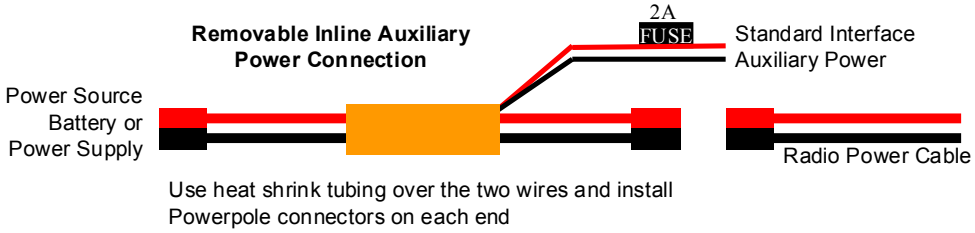
3. Solder each connection and cover each connection with heat shrink tubing.



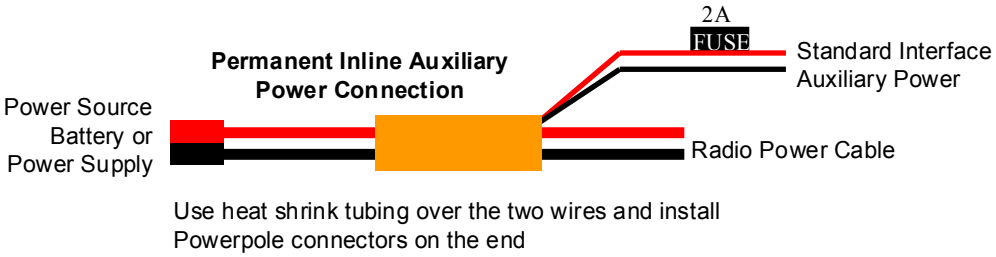
Use heat shrink tubing on each wire

4. Once each wire is soldered and heat shrink covered, put a single piece of heat shrink over both wires to hold them together.

5. For the removable connection, install Powerpole connectors on both ends of the short power cable. The wires can be shortened slightly depending on personal preference.



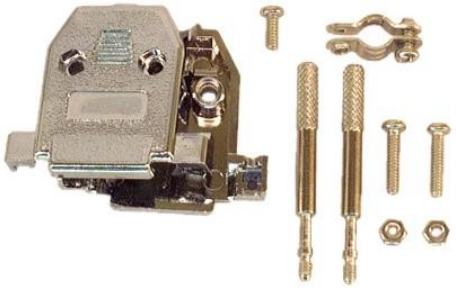
6. For the permanent connection, install a Powerpole connector on the end of the radio power cable.

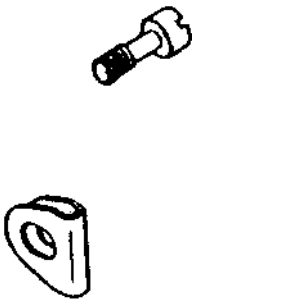


7.0 CONNECTOR HARDWARE

Connector hardware refers to the nuts and bolts that keep connectors locked together. The connector hoods sometimes come with hardware and sometimes it is a separate item. The hardware uses a 4-40 UNC thread.

The two pictures below show a hood with thumbscrews on the left and on the right is a common accessory hardware screw which has a metal clip that slides on the connector to keep the screw from falling off, which is used with a different style hood,.





There are two ways to lock connectors together. If both connectors have external screw threads, like those shown above, then a hex nut can be used between the two connectors.

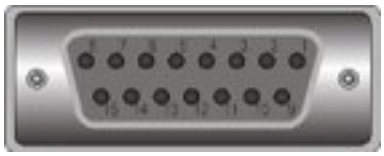
Jack Screws are typically used on chassis mounted connectors or patch panels, but they can also be used for some cable connectors.

Hex Nut

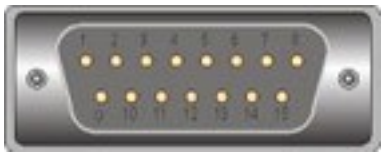
Jack Screw

For the EMRG Standard Interface, the DA15 Female connector will use a screw thread, while the DA15 Male connector will have a nut.

DA15 FEMALE



DA15 MALE



Use a Hex Nut for mounting a male plug that has screws. Use Loctite to secure the nut to the screw on the male connector. Be careful that the screw does not thread completely through the hex nut, leaving no room for the mating female connector screw.

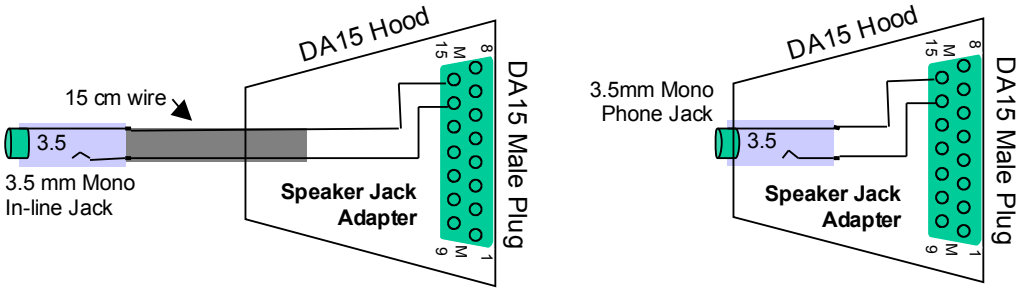
Use Jack Screws if possible for mounting male connectors. The entire treaded nut portion is available for the mating female connector. Use Loctite on the retaining nut that holds the Jack Screw to the male connector.

Connectors installed in a rack panel will require nuts, regardless of whether they are male or female connectors. Is this case, the jumper cables used to make the patches, will have screws on both ends.

8.0 ACCESSORIES

8.1 SPEAKER JACK ADAPTER

The speaker jack adapter provides a standard 3.5 mm (1/8 in) mono audio jack for a speaker, connected to a DA15 male plug. The DA15 plugs onto the radio SRI cable and an extension speaker with a 3.5 mm plug can then be used with a radio wired for the Standard Radio Interface.

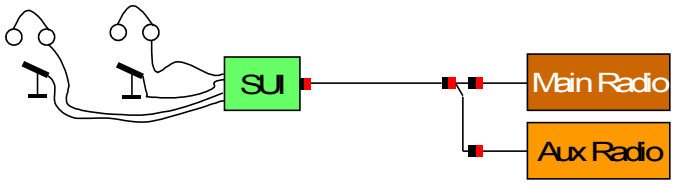


The adapter can be built with a chassis jack inside the DA15 plastic hood, or extended with an in-line jack on a short length of cable.

The adapter can be built with a different jack to support other speakers, or a dropping resistors and a stereo jack to make a headphone adapter. The adapter plugs onto the radios DA15 connector.

9.0 AUXILIARY AUDIO

The standard radio interface includes a signal called Auxiliary Input (pin 12) to extend audio from a second audio source. This is useful to monitor a local AM/FM radio for background information, an FRS radio used for local communications or a second Amateur radio frequency.



Auxiliary audio is only wired on devices that support the Standard User Interface (SUI). Devices such as radios, TNCs, repeater controllers and phone patches are not wired for auxiliary audio.

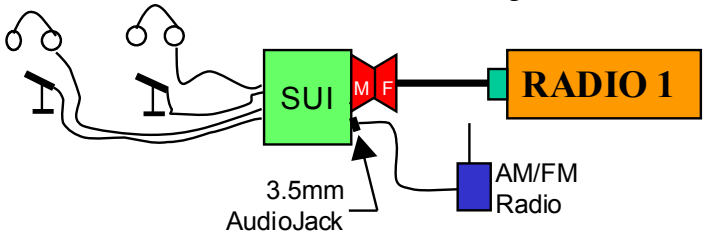
The Standard User Interface (SUI) must be wired to support auxiliary audio. This requires stereo headphones, so the user can listen to one radio in the left side and the other radio in the right side. The user interface control box must be equipped with a switch to select auxiliary audio on one side of the headphones and there must be an auxiliary volume control.

9.1 WIRING AUXILIARY AUDIO

There are two ways to access the Auxiliary Audio input.

9.1.1 AUXILIARY AUDIO JACK

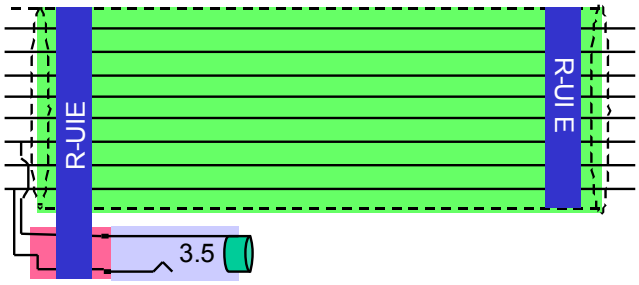
The first way to wire the Auxiliary Audio Jack is by taking a Standard User Interface device and wiring a 3.5 mm (1/8 in) mono jack in parallel with pins 12 & 15 on the SRI. The jack can be used to connect a second local audio source to the SRI device without accessing the SRI.



This is useful where a radio such as an AM/FM, FRS or Portable has an extension speaker jack, not the SRI and it is not convenient to insert an adapter between the Standard User Interface and the main radio. All that is required is a short cable with at 3.5mm mono plug to connect to the SUI and a plug on the other end that matches the auxiliary radio.

User Interface Extension cable can also be wired with an in-line 3.5 mm (1/8 in) mono jack in parallel with the DA15 male connector pins 12 & 15. This is required when the main and auxiliary radios are not located with the end user, so the auxiliary audio signal must be carried over the user interface extension.

Regular User Interface Extension (R-UIE)

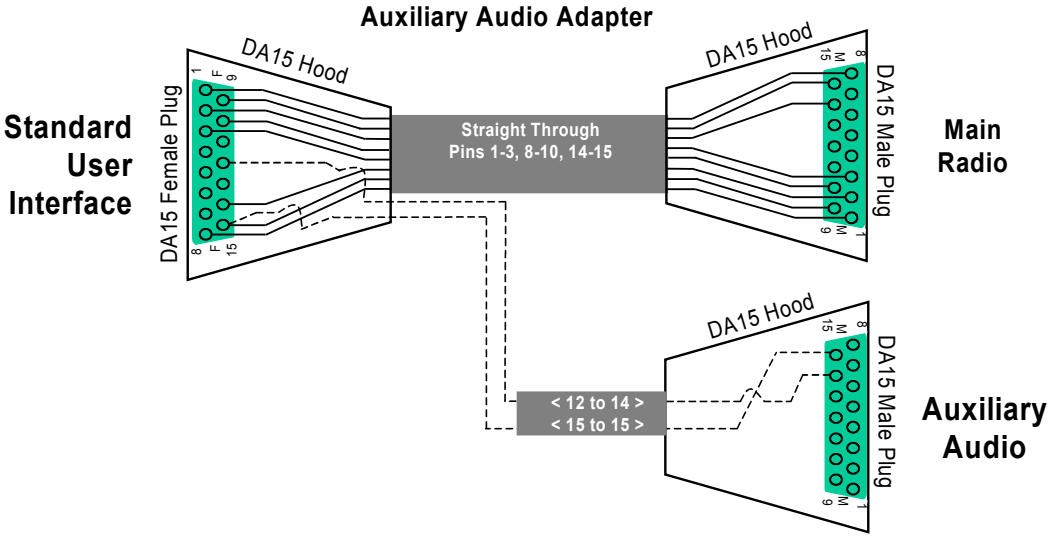


9.1.2 AUXILIARY AUDIO Y Adapter

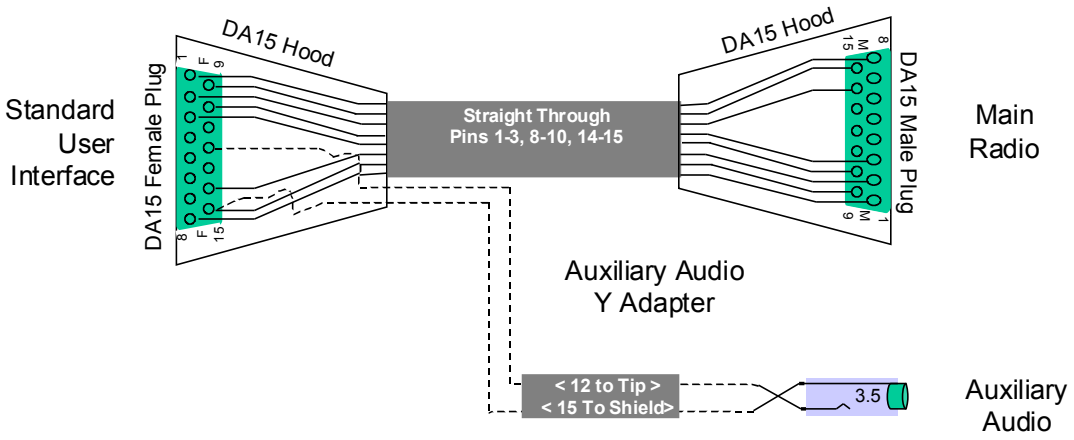
The second way to wire up auxiliary audio is with a Y adapter that can be inserted in-line between the main radio and the end user device, with or without an extension cord. If an extension cord is used the auxiliary audio source can be located with the user or with the main radio (at either end of the extension cable).

Y-Adapter – Main & Auxiliary Wired For SRI

If both audio sources, main & auxiliary are wired for the Standard Radio Interface, the following Y adapter can be used. The Y adapter could be plugged directly into the SUI, so the Main Radio is some distance away, but the Auxiliary Radio is coloacted



If the auxiliary audio source is wired with an extension speaker jack, such as a hand held portable or AM/FM radio, so there is no SRI available, the following Y adapter can be used.



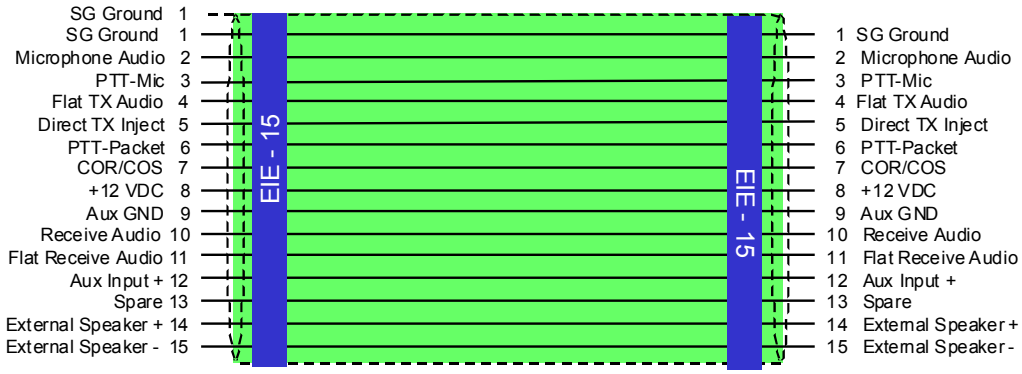
10.0 Extension Cables

Extension cables allow equipment or users to be located some distance from the radio. Each piece of equipment wired for the SRI has a 50 cm (18 in) length of cable.

Extension Cables can be divided into two types; Equipment or User, and two lengths Regular or Long. The driving factors are the purpose for the extension and signal loss over distance. There are physical limits to how far control, audio and DC signals can be extended.

10.1 EQUIPMENT INTERFACE EXTENSION -EIE

The Equipment Interface Extension (EIE) cable extends signals from a radio to other equipment such as a TNC, phone patch or repeater controller. Typically an extension cable would be used between two pieces of equipment where the equipment may be wired into a cabinet or other permanent installation. The cable includes all 15 pins, so any radio could be installed, without the need to change the extension cable to support other interface functions.



DA15M DA15F

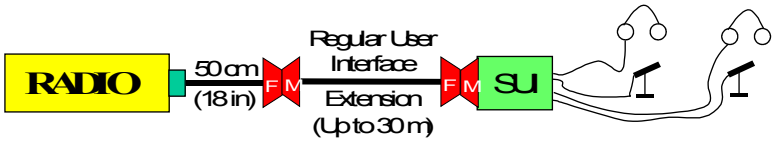
- Extends signals from a radio to a device such as a TNC, phone patch or repeater controller.
- Includes all 15 pins, so any radio could be installed, without the need to change the extension cable.
- The cable shield is connected to ground at the male connector end, but not at the female connector end.

10.2 USER INTERFACE EXTENSION - UIE

The User Interface Extension (UIE) cable extends signals from a radio wired for the SRI, to a user (radio operator) position. There are two types of UIE extensions; Regular (R-UIE) and Long (L-UIE).

10.2.1 Regular User Interface Extensions (R-UIE)

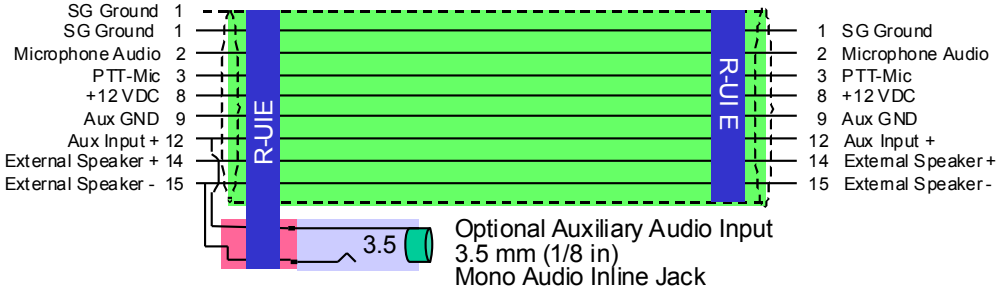
The Regular User Interface Extension (R-UIE) cable allows the radio and user interface to be separated up to 30 m (100 ft). This might be a short 1 metre cable so the radio sits on a shelf or longer so that the radio can sit on the other side of the room from the operator. This type of extension would be used at the Red Cross or EOC to connect the users to the remote mounted radios.



The cable is an 8 wire with common shield, such as Belden 9538. The Regular User Interface Extension (R-UIE) will include the following pins; 1-3, 8-9, 12, 14-15.

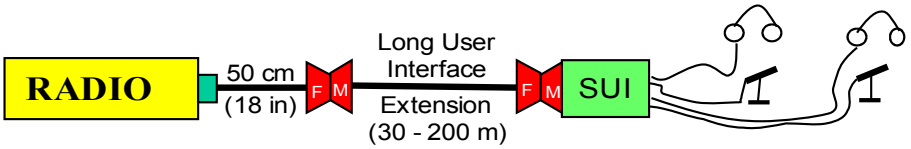
There will be some voltage drop along the length of the cable, so while the extension will support the full 1.3A rating for shorter distances, the current limit should be de-rated to 800mA for cables that are above 15 metres in length due to voltage loss.

Regular User Interface Extension (R-UIE)



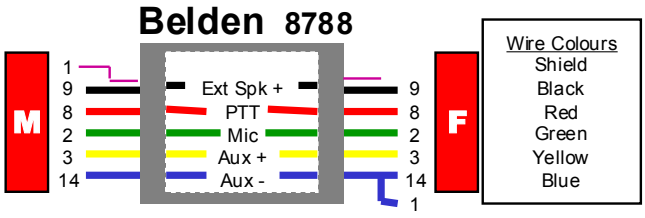
10.2.2 Long User Interface Extensions (L-UIE)

The Long User Interface Extension (L-UIE) is designed to allow the end users to be located a significant distance from the radio. The cable has individual shields on 3 of the 5 wires. The cable will extend the basic user signals as well as the 12 volts DC and the auxiliary audio.



The 12 VDC power will suffer voltage drop along the length of the cable, so the current supported is de-rated to 500mA for the long extension. The purpose of the DC supply is to power a Standard User Interface, which has LED indicators, PTT switching and microphone bias.

The 200 metre distance is a guess/hope, based on the results found in the UK for the CAIRO interface. The EMRG standard is using a different cable and has an additional signal, so the results may differ. Testing will be done to confirm the results before making the standard official.



Long User Interface Extensions (L-UIE) support up to 200 m (600 ft) [STILL TO BE VERIFIED] and would be used to extend the radio operators (users) over a long distance from the radio.

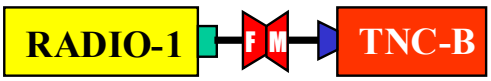
The L-UIE supports only a minimum functionality.

- Extends signals from a radio to a user interface
- Includes only basic connections required by the end user
- Includes Auxiliary Audio connection

11.0 PACKET RADIO

11.1 EMRG PACKET STANDARD - 1200 BAUD PACKET

The simplest packet system is a 1200 Baud TNC and a radio. The TNC is wired with a microphone connector for TX Audio & PTT, and a speaker plug for RX audio. The microphone is disconnected in order to connect the TNC to the radio.



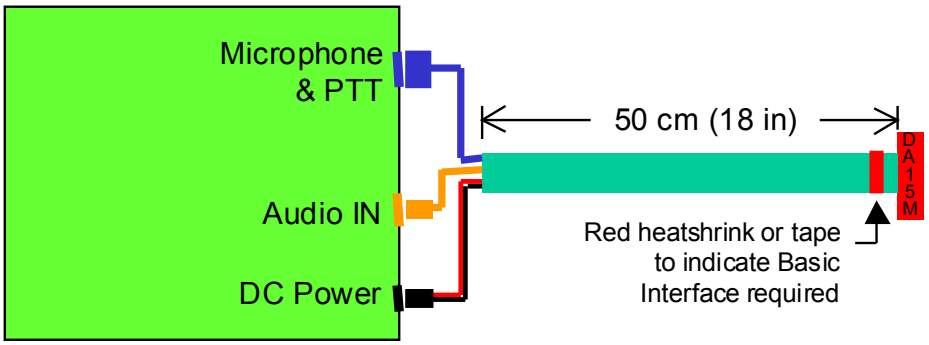
The EMRG Packet Standard will support 1200 baud packet, using the microphone input (pin 2) for TNC Transmit (TX), and the external speaker + (pin 14) for TNC Receive RX.

The TNC will wire to Standard Interface connections for microphone input, microphone PTT, and speaker output. This wiring method will work for all radios, with or without dedicated packet connections. All radios wired with the Basic Standard Interface (RED) will support the EMRG Packet Standard.

EMRG TNC STANDARD PACKET CONNECTIONS

DA15 Pin #	Wire Colour	Signal	DA 15M	Connection Point
1		SG GND	-	
2		Microphone Audio	OUT	
3		PTT-Mic	OUT	
8		Aux Power +	IN	
9		Aux Power -	IN	
14		External Speaker +	IN	
15		External Speaker -	IN	

Typical TNC Connections



11.2 DEDICATED PACKET RADIO CONNECTOR

Some Amateur radios have a separate connector, typically on the back of the radio, dedicated to Packet. The connector typically supports 1200 & 9600 baud transmit and receive, as well as a packet PTT.

The EMRG standard interface provides pins to support both dedicated 1200 & 9600 Baud packet connections. The radio is wired to the appropriate pins on the Standard Interface.

11.3 CAPABILITIES IN THE SRI

11.3.1 STANDARD INTERFACE TYPE

The EMRG standard interface supports 1200 & 9600 Baud packet with a common 1200 & 9600 Baud transmit connection or individual 1200 & 9600 Baud transmit connections.

PIN	Signal	DA 15M	DA 15F	PACKET CONNECTIONS
1	SG GND	-	-	Ground
2	Microphone Audio	OUT	IN	1200B TX IN (EMRG Standard)
3	PTT-Microphone	OUT	IN	1200B PTT (EMRG Standard)
4	Flat TX Audio	OUT	IN	1200B TX IN (Radios with dedicated 1200 Baud packet transmit connection)
5	Direct TX Inject	OUT	IN	9600B TX IN (Separate TX IN) 9600B & 1200B TX IN (Common TX IN)
6	PTT-Packet	OUT	IN	Dedicated packet connector –PTT Requires TNC to have Switch Interface
7	COR/COS	IN	OUT	Squelch Signal (Radio & TNC Option)
8	Aux Power +	IN	OUT	DC Power +
9	Aux Power -	IN	OUT	DC Power -
10	Receive Audio	IN	OUT	1200B RX OUT (Option)
11	Flat Receive Audio	IN	OUT	9600B RX OUT
14	External Speaker +	IN	OUT	1200B RX OUT (EMRG Standard)

RADIO WIRING

The connections that are supported by the radio are wired, those that aren't are not. The interface is labelled as Custom (BLUE) and indicates the custom connections that are supported. The Custom Interface includes the Basic Interface, plus some set of additional connections, in this case, for dedicated packet radio.

TNC WIRING

The simplest wiring for the TNC is the EMRG Packet Sstandard, which supports 1200 Baud packet using the microphone and speaker connections. The cable would be labelled with red to indicate it uses the Basic Standard Interface connections.

In order to use other connections in the Standard Interface, the TNC must be wired with switches that allow the TNC to use the additional connections in the Standard Interface, while also being able to support the EMRG Packet Standard. Section 11.4 **TNC Switch Interface** shows details on what is required.

11.3.2 PACKET PTT

On amateur radios with a rear connector for packet radio, this connector provides a PTT connection. The packet PTT mutes the microphone, while the standard microphone PTT will mute the packet input. The Standard Interface supports both PTT connections. Standard microphone PTT is on pin 3 and the packet PTT is on pin 1.

If a radio has a separate dedicated packet PTT connection, it is wired to pin 1 and the microphone PTT is wired to pin 3. Packet radio devices, such as a TNC, will always connect to the Microphone PTT on pin 3.

The TNC Switch Interface option is required on the TNC in order to use the dedicated packet radio connection. The same option is required for TNCs that support both 1200 & 9600 baud.

11.3.3 TNC Power

The Standard Radio Interface provides 12 VDC power on pin 8 (+) and pin 9 (-). The auxiliary power is provided for devices such as TNCs, which draw less than 1.3 Amps of current. Using the 12VDC on the standard interface allows the TNC to be connected with a single connector, plus there is no extra DC connector to attach.

11.3.4 9600 BAUD PACKET

The connection points in a radio for 1200 Baud packet are not the same as for 9600 Baud packet. The EMRG standard interface provides pins for these different connections, so radios that support both 1200 & 9600 Baud can be pre-wired.

Support for 9600 baud radios and TNCs will always use pins 1 (PTT), 5 (TX) and 11 (RX) as the default connections. This will be true for radios with a dedicated packet connection or radios that are modified to support 9600 baud.

On radios that are modified to support 9600 baud, where there is no dedicated packet PTT connection, the standard microphone PTT on pin 3 of the radio interface will be also wired to pin 1.

11.4 TNC 1200 BAUD SWITCH INTERFACE

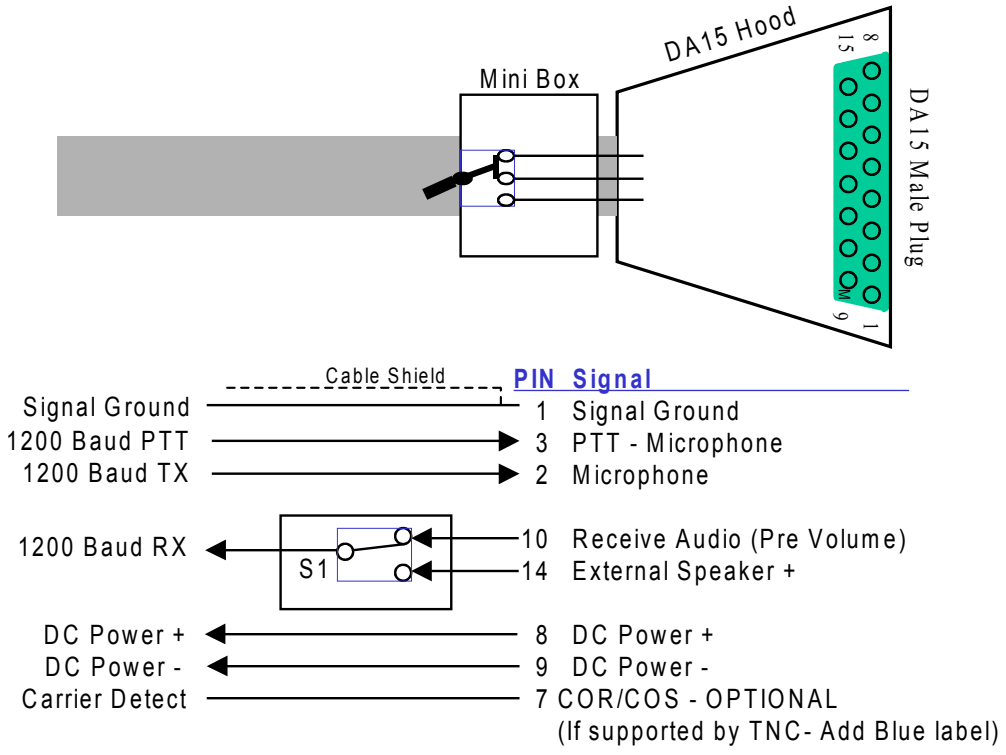
There are 2 1200 Baud Switch Interface Options. The first supports selection of 2 different receive audio sources, while the second selects optional Receive, Transmit and PTT.

11.4.1 Receive Audio Selection

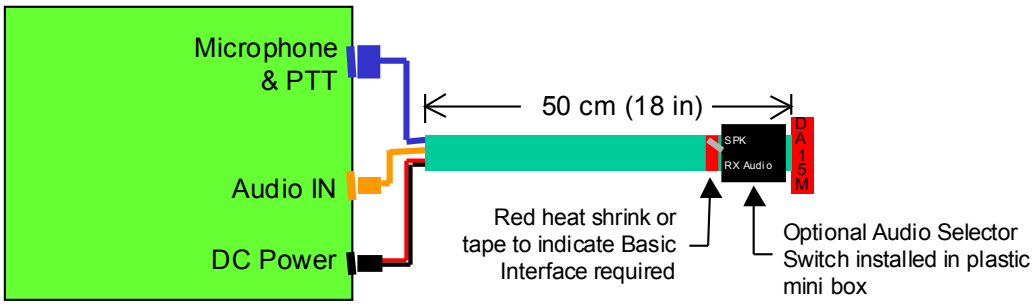
Some radios support a constant volume option, or this can be achieved by connecting to the volume control input. The advantage of a constant volume output is that the volume control can be turned down with no impact on the operation of the TNC.

In the future, the standard can be expanded to specify a level for the receive audio, so equipment could be configured and any radio/TNC combination would be operating with the same signal levels.

All EMRG TNCs will be wired with this switch option.

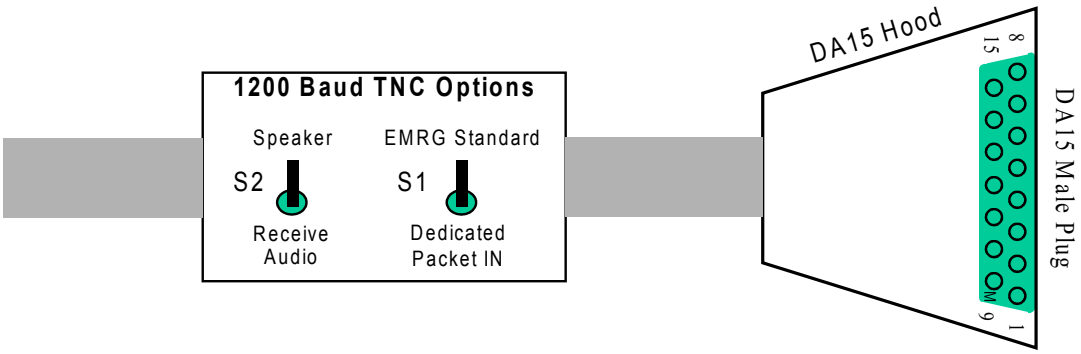


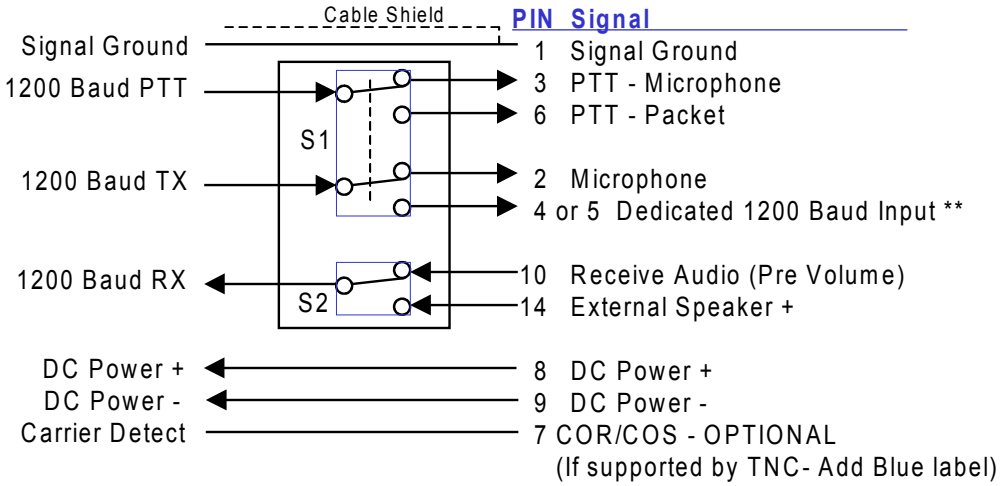
Typical TNC Connections



11.4.2 EMRG Standard – Dedicated Packet Connection

The TNC 1200 Baud Switch interface option would most often be used by an Amateur who wants to wire their TNC to use the dedicated packet connection on their radio, while also being able to support the EMRG Packet Standard.





The drawing shows how the switches would be enclosed in a mini box as part of the cable connecting the TNC to the SRI DA15M plug. The

individual signals are shown in the switch diagram. Descriptions for some of the key signals are listed below.

11.4.3 Transmit (TX) Audio

Some Amateur radios provide a rear connector for packet radio, with some of these using a common Transmit input for 1200 & 9600 baud packet. In the cases where they use a common input, a switch can be added to the TNC interface cable to select between the two connections; pin 2 for microphone or pin 5 for direct inject.

11.4.4 PTT – Packet

When a radio is equipped with a dedicated packet connector, the connector provides input and output connections, which includes PTT. The switch for the Transmit Audio is a DPDT type, which also switches the TNC PTT connection from Microphone PTT to Packet PTT.

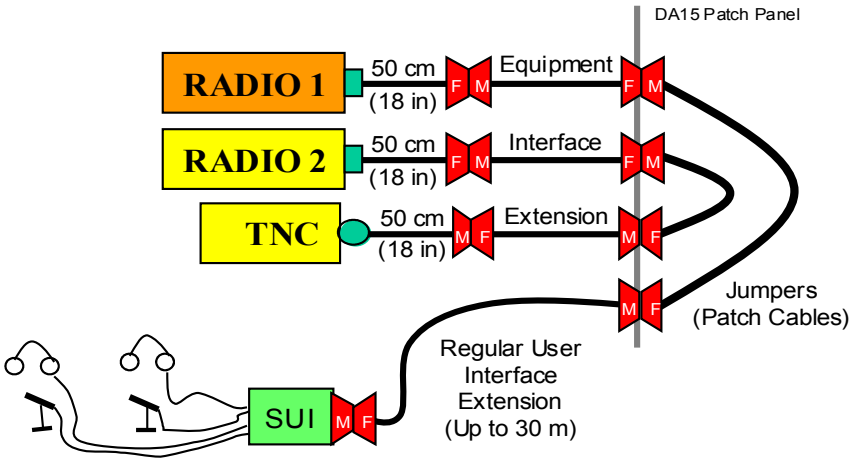
11.4.5 Receive (RX) Audio

Some radios support a constant volume output, which is tapped off at the volume control. By using this output, the volume control does not adjust the signal level. Some commercial radios are wired for this capability and EMRG will wire in this option on radios where the signal can be wired using internal connections.

12.0 PATCH PANELS

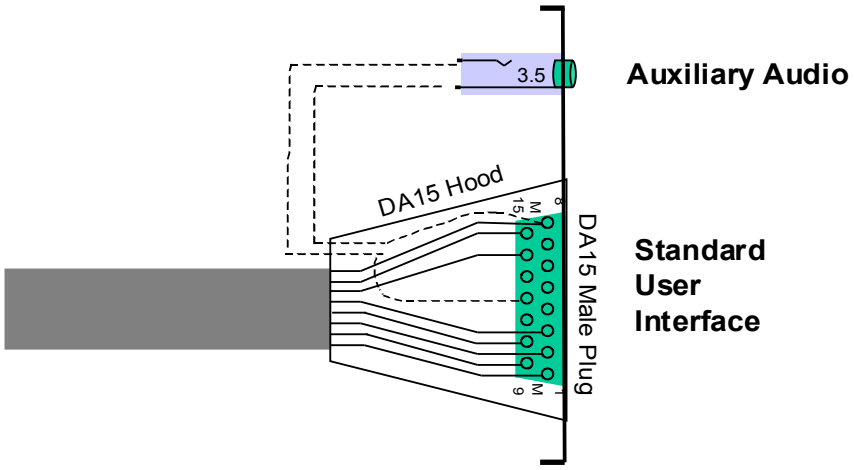
Patch Panels refers to any plate or small box that is used as part of a permanent configuration, to mount 1 or more SRI connectors. This could be a single connector at an operator position terminating a radio, 2 connectors for a radio and piece of equipment or a user interface, or a 16 position rack mount panel.

In the figure below, two radios, one TNC and one operator position are wired to a patch panel. Extension cables are installed from the equipment SRI and the SUI position, to the patch panel. Two jumpers are installed at the patch panel, one connecting Radio 1 to the Standard User Interface and one connecting Radio 2 to the TNC.

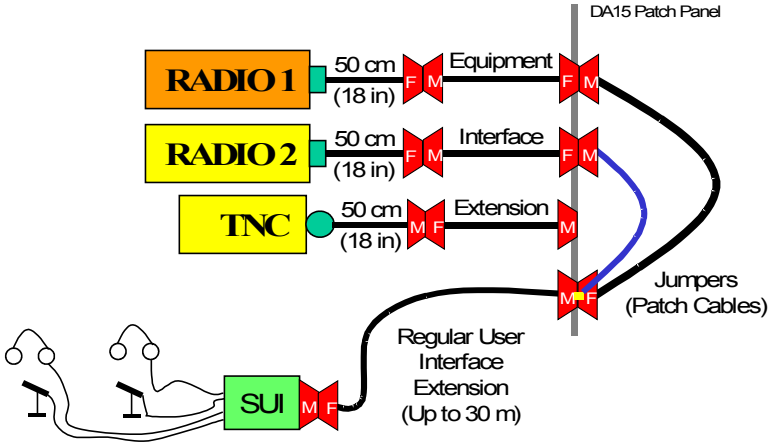


12.1 AUXILIARY AUDIO

Auxiliary audio can also be wired into a patch panel, for SUI connections. There is a 3.5mm jack installed in the patch panel, above the DA15 connector. The 3.5mm jack is wired to pins 12 and 15 on the DA15.

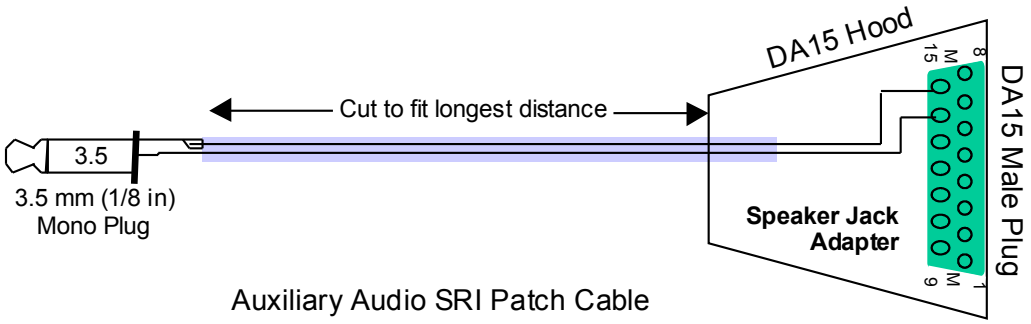


The figure below shows the same equipment connected to the patch panel as the previous drawing, but the TNC is not being used and Radio 1 is connected to the Auxiliary Audio jack using a custom patch cable with a DA15M to 3.5 mm (1/8 in) phone plug.



12.2 STANDARD INTERFACE TO 3.5MM PATCH CABLE

Patch cable with a DA15M to 3.5 mm (1/8 in) phone plug.



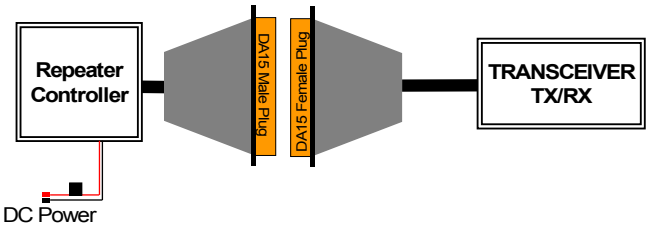
Auxiliary Audio SRI Patch Cable

13.0 REPEATERS

Repeaters are made up of a radio receiver and transmitter, as well as a controller. This equipment is permanently installed and the wiring is not usually changed.

13.1 TRANSMITTER – RECEIVER

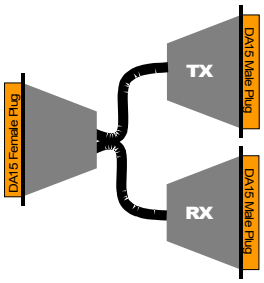
Repeaters can be configured using a full duplex transceiver, which can transmit & receive at the same time, or using a separate receiver and transmitter. For the purpose of the Standard Radio Interface, the radio device will always use a single connector, wired for a full duplex radio, with transmit & receive in the one connector.

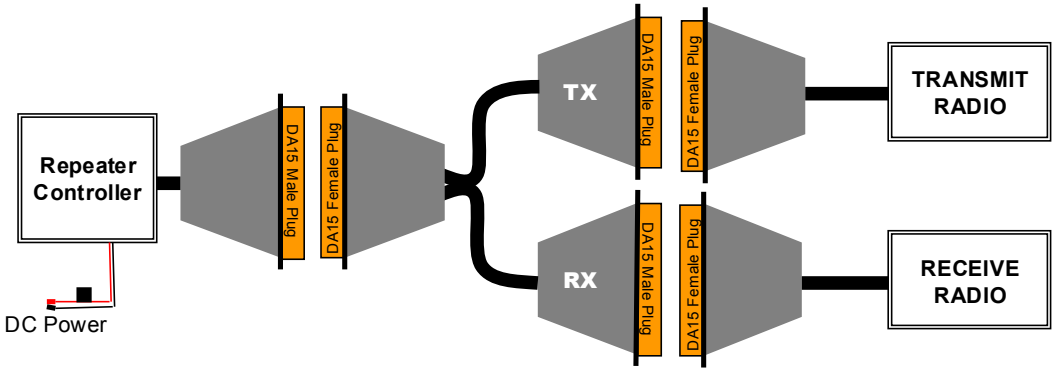


The drawing above shows the Repeater Controller and the Repeater Transceiver each wired to a single connector.

13.2 Y CABLE

If a repeater uses a separate Receiver and Transmitter, a Y cable will be used to connect the two radios to the controller port. This is the case when a repeater is made from two mobile radios.

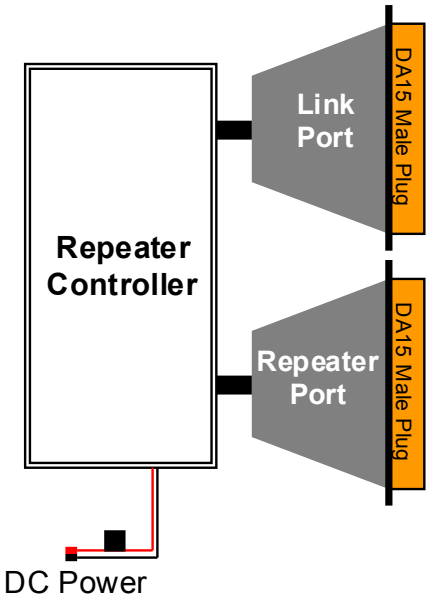




13.3 CONTROLLERS

Repeater Controllers come in various configurations, from a simple 1 port (single repeater) to multi-port controllers that add link ports or multiple repeaters from one controller.

Each port on a controller will be wired to a single standard interface. This includes all link ports and repeater ports. The controller will have it's own power connection, so it does not use the power from a radio. Power the controller directly allows for the removal of any radio without removing power from the controller.



13.4 CONTROLLER DC POWER

The repeater controller will be wired with it's own fused DC power connection, instead of getting power through the Standard Interface. Separate power is provided because some controllers require more current than the standard interface can supply and on a multi port controller, removal of the radio providing power would cause the controller to shut down, even if that radio was not being used at the time.

14.0 REFERENCE MATERIAL

14.1 AUDIO CONNECTIONS

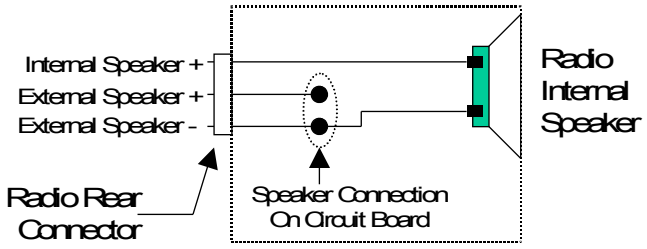
There are three audio output connections that can come from the radio;

1. External Speaker – Typically 8 Ohms, output level controlled by radio volume control
2. RX Audio - Squelched audio before the volume control. Provides a constant signal level regardless of where the speaker volume is set.
3. Flat RX Audio - Squelched audio before the de-emphasis circuits. Provides a constant raw audio signal, which is required for extracting CTCSS to a decoder and for 9600 Baud data.

14.2 COMMERCIAL RADIO SPEAKER CONNECTIONS

On most commercial radios there is no speaker jack. The only connection on the back of the radio is a multi-pin connector with 5 to 16 pins, depending on the make and model of radio. The type of connector will also vary by make and model. The multi-pin connector supplies power to the radio and provides any inputs or outputs for the radio.

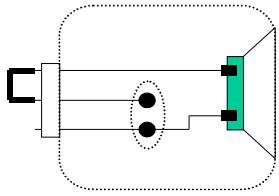
The radios internal speaker is wired to one of those pins, labelled Internal Speaker + or Int Spk +, as shown in the diagram.



The assumption in commercial radio is that the radio will be installed in a vehicle and will not be moved, so the installation tech will either connect up the internal radio speaker or install an external speaker.

Radio Speaker

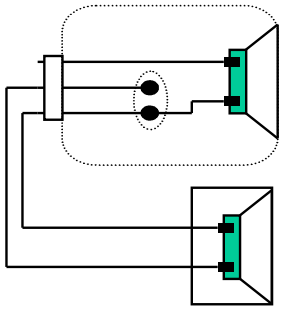
External jumper wire installed on the multi-pin connector, from Ext Spk + pin to Int Spk + pin.



No jumper = no audio

External Speaker

External speaker wired to Ext Spk + pin and Ext Spk - pin.



Typical Commercial Radio Speaker Wiring

14.3 HOOK SWITCH

Commercial radios typically use CTCSS tones, which are referred to by names such as PL for Motorola's Private Line or CG for General Electric's Channel Guard.

When different user groups share a common repeater, such as different companies renting space on a radio company's repeater, each user group has a different CTCSS tone. These shared repeaters are called Community Repeaters.

On a shared repeater, with different CTCSS tones for each user group (company), each user will only hear a signal, if it has their groups matching CTCSS tone. So if a user hears nothing, it can mean that no one is using the repeater, but there could be a user from another group with a different CTCSS tone.

Commercial radios use a control lead called Hook Switch, to disable the CTCSS tones, so a user can tell if anyone is using the repeater, regardless of CTCSS tone. The Hook Switch lead is normally grounded to enable CTCSS on receive and lifted from ground to disable CTCSS. The transmit (encode) CTCSS is always enabled.

The Hook Switch lead is wired to a special microphone clip, used for hanging the microphone when it is not in use. The button on the back of the microphone is metal and is wired to ground. When the mic is placed in its matching clip, the hook switch lead is wired to the grounded button on the back of the microphone, enabling CTCSS. When the user picks up the microphone, the ground is removed from the Hook Switch lead and CTCSS on receive is disabled. This is only required on systems that use multiple CTCSS tones on the same frequency.

When radios are not used with the Hook Switch option, the Hook Switch lead on the rear radio connector is jumpered to the ground pin, so the CTCSS on receive is always enabled.

Many commercial radios also have a MON button on the front of the radio, which when pressed, disables the CTCSS on receive. In some radios, if pressed twice, it also opens the squelch.

15.0 WIRING WORK SHEET

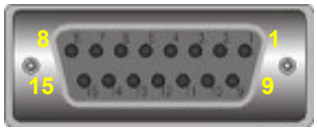
15.1 BASIC INTERFACE - RED

DA15 Pin #	Wire Colour	Signal	DA 15M	DA 15F	Connection Point
1		SG GND	-	-	
2		Microphone Audio	OUT	IN	
3		PTT-Mic	OUT	IN	
8		Aux Power +	IN	OUT	
9		Aux Power -	IN	OUT	
14		External Speaker +	IN	OUT	
15		External Speaker -	IN	OUT	

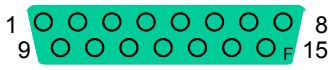
Device Type	{i.e. TNC, Radio}
Make	
Model	
Connector Type(s)	{i.e. RJ45, 8 Pin Round}

DA15 Type	**[ ] F = Female** = Radio **[ ] M = Male** = TNC, Phone Patch, Controller

DA15F (female) Connector

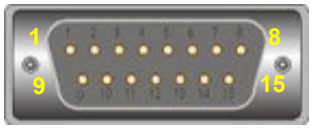


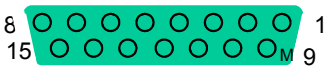
Front View



Back View
Wiring Connections

DA15M (male) Connector





Back View
Wiring Connections

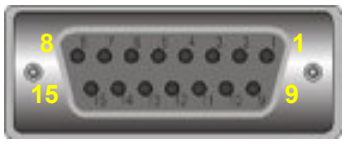
15.2 ENHANCED INTERFACE - YELLOW

DA15 Pin #	Wire Colour	Signal	DA 15M	DA 15F	Connection Point
1		SG GND	-	-	
2		Microphone Audio	OUT	IN	
3		PTT-Mic	OUT	IN	
7		COR/COS	IN	OUT	
8		Aux Power +	IN	OUT	
9		Aux Power -	IN	OUT	
10		Receive Audio	IN	OUT	
14		External Speaker +	IN	OUT	
15		External Speaker -	IN	OUT	

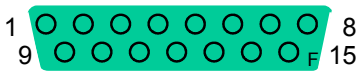
Device Type	{i.e. TNC, Radio}
Make	
Model	
Connector Type(s)	{i.e. RJ45, 8 Pin Round)

DA15 Type	**[ ] F = Female** = Radio **[ ] M = Male** = TNC, Phone Patch, Controller

DA15F (female) Connector

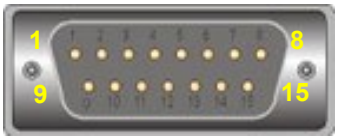


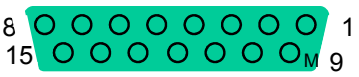
Front View



Back View
Wiring Connections

DA15M (male) Connector





Back View
Wiring Connections

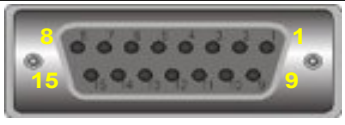
15.3 CUSTOM INTERFACE - EQUIPMENT INTERFACE EXTENSION (BLUE)

DA15 Pin #	Wire Colour	Signal	DA 15M	DA 15F	Connection Point
1		SG GND	-	-	
2		Microphone Audio	OUT	IN	
3		PTT-Mic	OUT	IN	
4		Flat TX Audio	OUT	IN	
5		Direct TX Inject	OUT	IN	
6		PTT-Packet	OUT	IN	
7		COR/COS	IN	OUT	
8		Aux Power +	IN	OUT	
9		Aux Power -	IN	OUT	
10		Receive Audio	IN	OUT	
11		Flat Receive Audio	IN	OUT	
12		Auxiliary Input +	IN	OUT	
13		Spare			
14		External Speaker +	IN	OUT	
15		External Speaker -	IN	OUT	

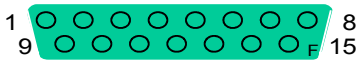
Device Type	{i.e. TNC, Radio}
Make	
Model	
Connector Type(s)	{i.e. RJ45, 8 Pin Round}

DA15 Type	**[ ] F = Female** = Radio **[ ] M = Male** = TNC, Phone Patch, Controller

DA15F (female) Connector

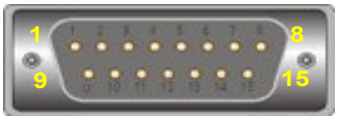


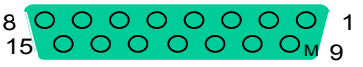
Front View



Back View
Wiring Connections

DA15M (male) Connector



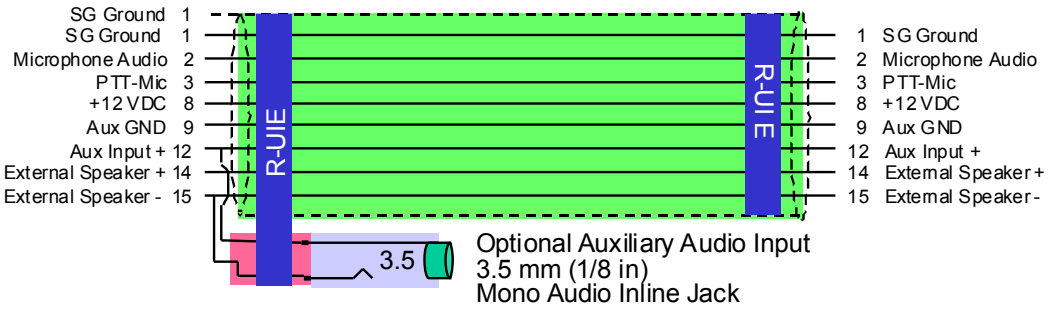


Back View
Wiring Connections

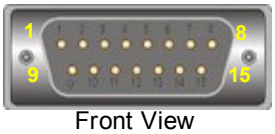
15.4 REGULAR USER INTERFACE EXTENSION

DA15 Pin #	Wire Colour	Signal	Connection Point
1		SG GND	
2		Microphone Audio	
3		PTT-Mic	
8		Aux Power +	
9		Aux Power -	
12		Auxiliary Input +	
14		External Speaker +	
15		External Speaker -	

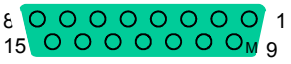
Regular User Interface Extension (R-UIE)



DA15M (male) Connector

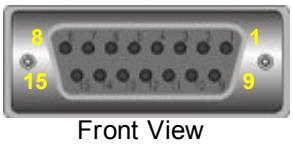


Front View

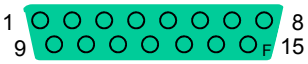


Back View
Wiring Connections

DA15F (female) Connector



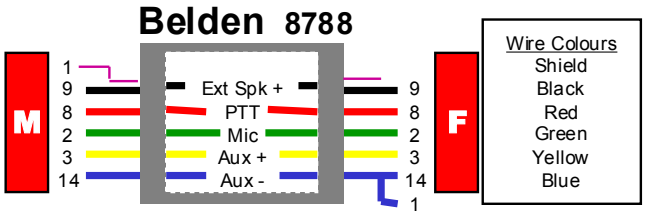
Front View



Back View
Wiring Connections

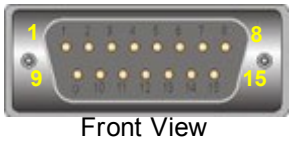
15.5 LONG USER INTERFACE EXTENSION

DA15 Pin #	Wire Colour	Signal	Connection Point
1		SG GND	
2		Microphone Audio	
3		PTT-Mic	
8		Aux Power +	
9		Aux Power -	
14		External Speaker +	

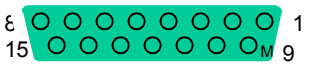


User Interface -Long Extension (30m - 200m)
Extends limited set of signals
(3 of the 5 wires have individual shields)

DA15M (male) Connector

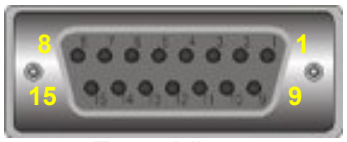


Front View

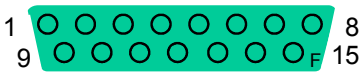


Back View
Wiring Connections

DA15F (female) Connector



Front View



Back View
Wiring Connections