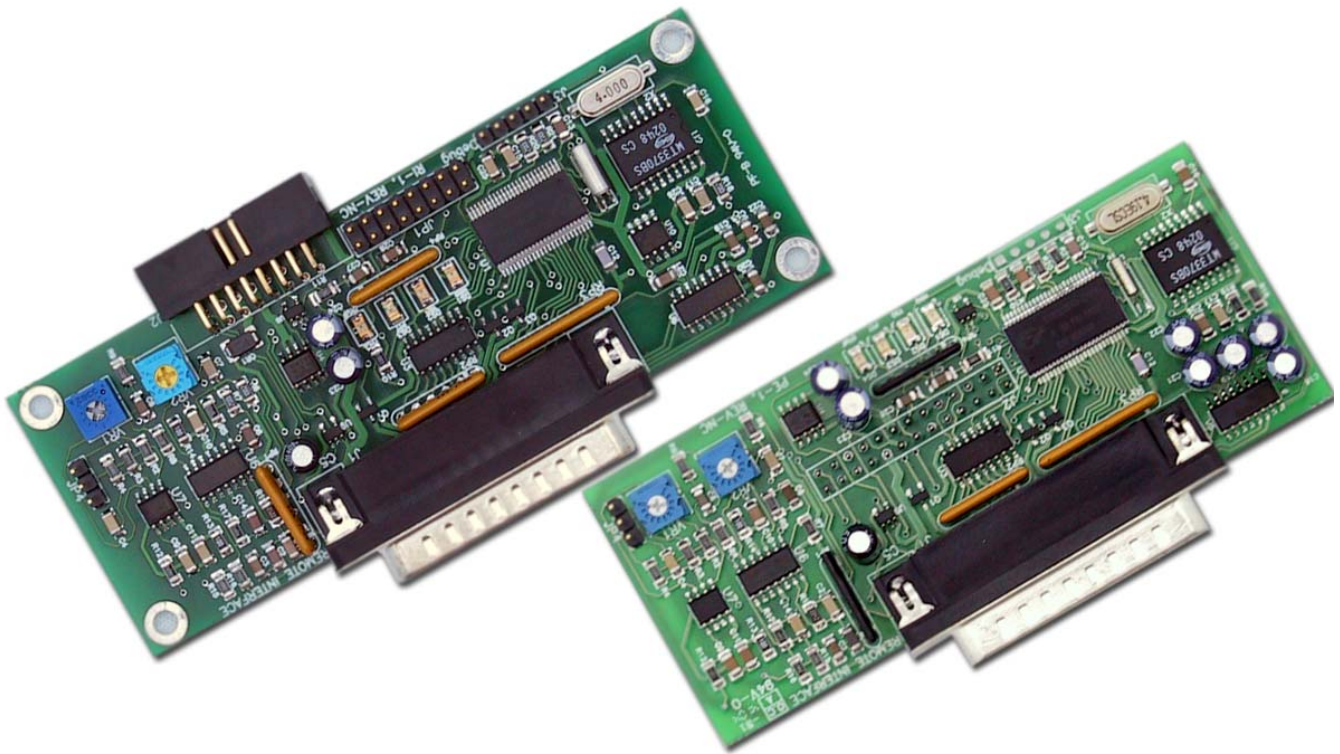


Pacific Research Solutions
RI-1 and PE-1
REPEATER CONTROLLER and PORT EXPANSION
USER MANUAL



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Revised 11.03.05 – RI-1 and PE-1 Version 1.01 User Manual

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SECTION 1

INTRODUCTION

What is the RI-1

The RI-1 is a standalone repeater controller that can be connected to an auxiliary buss to communicate with other RI-xxx controllers. Other than the difference in mechanical form, the functions and features of the RI-1 and PE-1 are the same. This manual will cover both controllers. Areas where there are differences between the controllers will be clearly pointed out.

What is the PE-1

The PE-1 is a standalone repeater controller that is installed inside the RI-300 controller chassis. It can communicate with the RI-300 controller over the auxiliary buss. Other than the difference in mechanical form, the functions and features of the PE-1 and RI-1 are the same. This manual will cover both controllers. Areas where there are differences between the controllers will be clearly pointed out.

Overview

Your controller represents the latest technological advances in repeater control systems. The RI-1 utilizes a microprocessor design, which provides all the control functions for a single repeater or link on a single printed circuit board. All program configurations are stored in a NON-VOLATILE EEPROM (Electrically Erasable Programmable Read Only Memory), which maintains its data even with the power disconnected. This EEPROM may be re-programmed by the user in order to change the system characteristics. A "WATCHDOG TIMER" and "POWER SUPPLY SUPERVISORY CIRCUIT" constantly monitor the microprocessor and power supply, maintaining the operational integrity of the system. The RI-1/PE-1 is easy to set up and use.

Once you are familiar with the macro command system, you can customize your user commands and messages. We recommend that you read sections 1 through 3, 7 and 8 of this manual first, to get familiar with the system and its basic operation. The other sections of this manual provide a more thorough explanation of the RI-1/PE-1's many features.

Feature List

The following are features of the RI-1 and PE-1 controller:

- Flash program memory. You can make firmware updates without changing any components.
- Auxiliary audio buss. Connect to other controllers for links, remotes and multiple repeater connections.
- The receiver audio level, auxiliary audio level and tone generator level may be remotely adjusted by radio.
- A selectable low pass audio filter is provided to remove adjacent channel splatter.
- DTMF tones may be passed, muted, or regenerated.
- A dual tone generator provides both level and frequency control.
- User programmable inputs and outputs exist for external sensing and control.
- NON-VOLATILE EEPROM data storage. You never have to be concerned with replacement of the memory backup battery.
- User command and macro editor. All user commands are completely programmable.

The RI-1 provides excellent audio quality. With proper consideration when interfacing the controller to the receiver and transmitter, your repeater will provide excellent audio to the users. Interfacing information is provided in numerous sections of this manual and support is available from the factory. The RI-1 provides for easy programming of customized user features or user commands by giving you the ability to write and name simple macros. All messages and telemetry are also programmable.

For the latest product documentation updates and information, visit our web site at "<http://www.pacres.com>".

SECTION 2

QUICK START

This section will cover the basics of installation and programming of your RI-1. You may also need to review section 4 or 5 for more details on connecting your RI-1 to your repeater. Once you have covered these basics, we recommend that you thoroughly review the complete manual in order to get the most out of your controller.

UNPACKING THE RI-1

Inspect the carton for the following contents and if any of the items that you have ordered are missing or damaged, notify your dealer or the factory that shipped the unit to you.

1. RI-1 or PE-1 Repeater controller board with mating DB25S connector.
2. User manual on CD.
3. Mounting hardware.

MOUNTING THE RI-1 REPEATER CONTROLLER

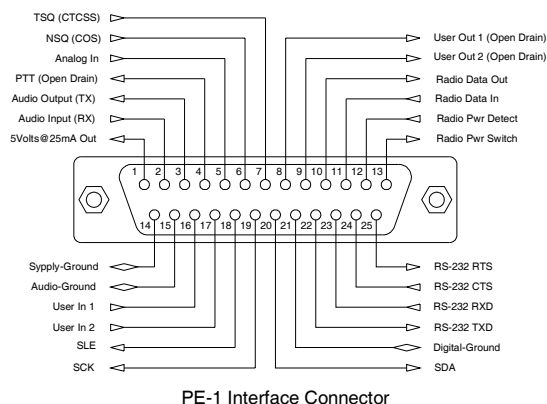
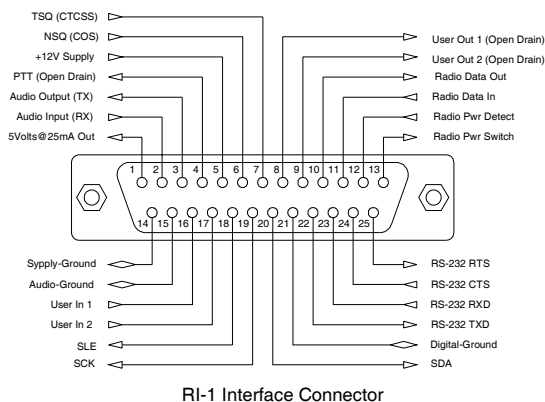
1. An optional single controller chassis is available. Mounting holes are provided for the repeater controller board within the enclosure.
2. The repeater builder can mount the RI-1 repeater controller in any enclosure of his choice. The enclosure that you select should be strong enough to mechanically protect the contents. The enclosure should be made of metal with good shielding properties. We do not recommend the use of a plastic enclosure in a RF environment. Mount the RI-1 unit with #4-40 standoffs on the mounting surface.
3. Avoid installing the RI-1 in the following places:
 - Directly above a transmitter or power amplifier because of heat and RF considerations.
 - Directly above any power supplies because of heat and 60 Hz coupling into the audio circuits.

INTERFACE YOUR RECEIVER and TRANSMITTER

The RI-1 repeater controller is very easy to interface with your repeater. Before you continue, you need to make the following connections. All connections are covered with greater details in section 4 of this manual. If you are installing the PE-1, you should go directly to section 5.

1. +12 Volts DC power source, J1 Pin 5. (Only on the RI-1, the PE-1 gets its power from the RI-300)
2. DC power ground, J1 Pin 21, J1 Pin 5.
3. Receiver audio, J1 Pin 2.
4. Receiver NSQ (Squelch), J1 Pin 6.
5. Receiver TSQ (CTCSS), J1 Pin 7, Optional.
6. Audio return and/or shield, J1 Pin 15.
7. Transmitter audio, J1 Pin 3
8. Transmitter keying circuit (PTT), J1 Pin 4.

See section 4 for more complete details on proper interfacing to your repeater transmitter and receiver.



SETTING AUDIO LEVELS

Adjusting the levels in your controller is very important, in order to achieve proper decoder operation and avoid clipping and distortion. See section 6 of this manual for more complete details on correct adjustment of the audio levels.

Receiver Gain

1. Generate a 1000 Hz tone at 5 kHz of deviation on the repeater input.
2. Using an AC volt meter, adjust VR2 for 0.77 volts AC RMS on U6 pin 7.

Signal Polarity

Verify that the NSQ, TSQ and PTT signals are of the correct polarity. This can be viewed with the LEDs on the circuit board or from the programming software. To change any of these signal polarities, use System Command 00 or the programming software (PS-3). See section 6 for more details on this subject.

Transmitter Level

The best method is to use a service monitor to measure the transmitter deviation. If a service monitor is not available, use any receiver that can be easily flipped back and forth between the repeater input and output channel while listening to the levels. Ideally, you will have the same transmit deviation going out of the repeater transmitter as coming in the receiver. Transmit a 3 KHz deviation tone on the repeater input channel. As you flip back and forth between the repeater input and output frequencies, then by listening, adjust the repeater transmitter audio level or deviation. This level is adjusted by the single turn pot, VR1. If you are operating the controller as a repeater, you will have to issue User Command “*1” to set the controller into a repeater mode.

OPERATION

Once you have connected your controller to a receiver / transmitter and adjusted the audio, you should then confirm its basic repeater or link operation. This can be done by transmitting a carrier in the input of the repeater and observing the “COS” LED turning on and off when you key and un-key. You should next see the “PTT” LED turn on while the repeater transmitter is on. Next, you can confirm the repeater audio path by listening to your self on the output of the repeater.

INITIAL SETTINGS

You are now ready to set the Station ID. This subject is not easily covered in a single paragraph. Therefore, we recommend that you go to section 8 of this user manual for this procedure.

SECTION 3 PS-3, PROGRAMMING SOFTWARE

An optional programming software and cable package is available. This software is designed to run under Windows 95/98, ME, NT, 2000 and XP. The software will allow you to read, change and save all parameters within your RI-1 controller. You can even load a controller firmware update (FLASH) to the controller over the programming port. For software installation, follow the instructions included with the software disk. The supplied programming cable is a special cable and has interface electronics built in. Do not try to build your own cable. You can plug this cable into the controller at any time with or without the controller powered on. With the RI-1, use the auxiliary connector J2. With the PE-1, use the connector on the front of the RI-300 controller labeled "MIC/PROG". The end of the cable with the D-Sub connector, plugs directly into your computer's COMM port. Make sure the power to the repeater and controller is turned on. The auxiliary buss will be disabled during the data transfer process when you are sending or receiving data using the programming software.

INSTALLATION

1. Install this program in a Windows 95, 98, ME, NT, 2000 and XP based environment.
2. From your floppy disk or CD ROM, run the setup program.
3. Follow the instructions from the setup program.
4. You can now click the PS-3 icon to start the programming software.

OPERATION

1. After you have installed your repeater controller, attach the programming cable to the programming port on the controller. Connect the other end of the cable to your PC serial communication port.
2. Start the programming software.
3. Select the "Serial Comm. Port" you are using.
4. You should notice that the "Active Controller" LED is lit. This means that the programming software is communicating with your controller. You may select an active controller for viewing or communicating at any time. Do this by clicking on an active controller LED or via the "View Controller" combo list. If none of the Active Controller LEDs show indication of a controller, check your Comm. Port number and the programming cable.
5. Before you send any data to your controller the first time, you need to make a template of your controller.
6. Go to "Controller" and "Get data from..." pick the "Start Button". This upload process will take about 90 seconds. You should notice the progress bar moving during this process.
7. Once this process is complete, select "File" and "Save As". Select the file or type "RI1.rdf", this is the startup template file. When the program asks if you want to replace this file, pick yes.
8. Each time you start the programming software the program will automatically load and start with the RI300.rdf file. Now each time you start the programming software, it will start with the defaults from your controller.
9. At any time, you can save your working data to a new file name. When making changes to your controller's data, it is good practice to save the repeater data file (rdf) with a dash number each time you make a change. This way, you can return to an older file that you know works if you make an error in your current file.

FLASHING the CONTROLLER'S PROGRAM

As new features are added and revisions are made to the RI-1, program updates are made available on our web site www.pacres.com. You can locate these changes under the RI-1 firmware and software page. Download these files from the web site and follow the install instructions. It is important to closely follow the instructions as you may otherwise damage your current installation. Once you have down loaded these updates, use the following procedure to flash the controller's program memory.

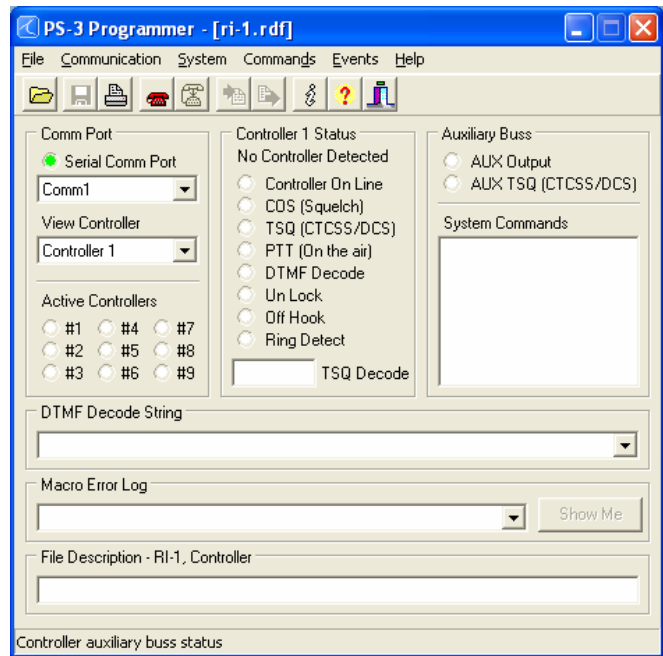
1. Connect your computer to the controller using the programming cable. Run the PS-3 Programming Software.
2. In the programming software, pick "Controller" then pick "Flash Program".
3. In the file list, select the new flash file you want to send to the controller. The last three digits of the file name indicate the file version.
4. Pick the "Open" button then the "Start" button. The flash process is automatic and will take 90 to 120 seconds to complete.

PROGRAMMING SOFTWARE MENU

The basic startup window contains the status items shown. Use the "View Controller" or pick the "Active Controller" light to select which controller on the auxiliary buss you want to monitor. Whenever you leave the cursor on a window item, the program will show a hint as to the associated System Command that is adjusted by that item. The following is a quick overview of menus and their functions.

Main Window

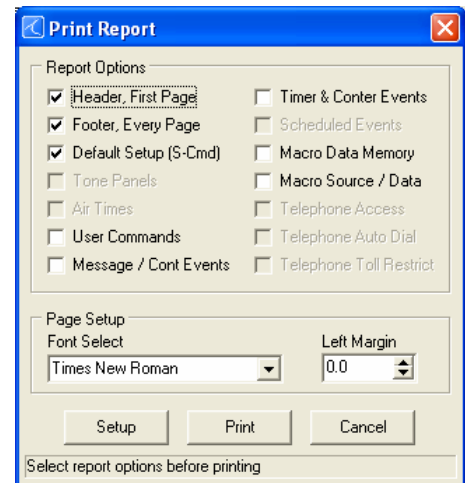
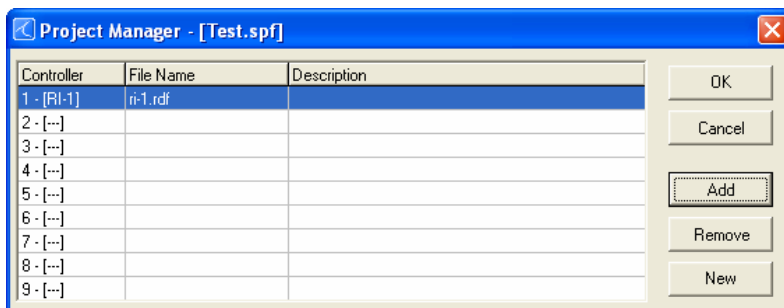
The main window shows the current activity of a selected controller on the buss. The "Active Controller" group displays all active controllers attached to the auxiliary buss. The "Controller x Status" group shows the status of the selected controller. The text just below this group's title will show the type of controller that the software has detected. The "Auxiliary Buss" group shows the auxiliary buss status of the selected controller. All System Commands sent over the auxiliary buss are also logged within this group. The "DTMF Decode String" shows and records the last 50 user and system commands. Each command has a date and time stamp with the tone squelch that was used during the command. The "Macro Error Log" will display errors in macros as reported from the controller. If an error is encountered when the controller executes a macro, the controller will report the location of the error to the programming software. You can select an error and pick the "Show Me" button to see the location of the error in your rdf file. At the bottom is a "File Description" group. This title will also show the type of controller file. This group is for your use to describe the actual file you are working with.



File

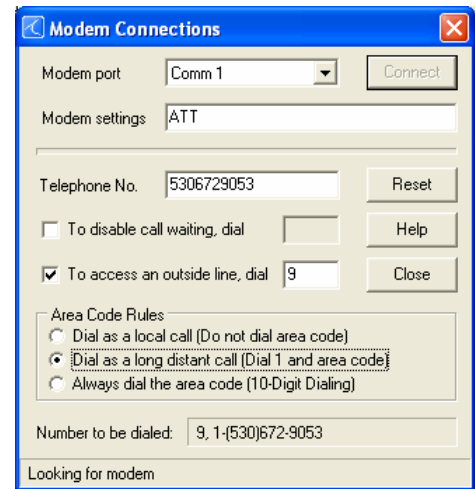
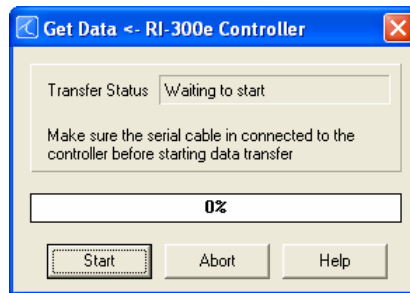
Used to both save and open repeater data files (rdf). The programming software uses the RI300.rdf file as a template file. Any changes you make to this file will be recalled each time that you run the program. Report printing is also available from this menu. In the report printing, you can select various items that you want to print. If you select all items for printing on a factory default set up, up to a 20 page report will be generated.

You can use the "Project Manager" to set up multiple files for applications where you have multiple controllers connected to the auxiliary buss. In this window, you select each rdf file for each controller that will be included in the system. In the future, you can open this System Project File (spf) and the software will load all rdf files used in you system. You can now select which rdf file you want to edit using the "View Controller" or "Active Controller" method.



Communication

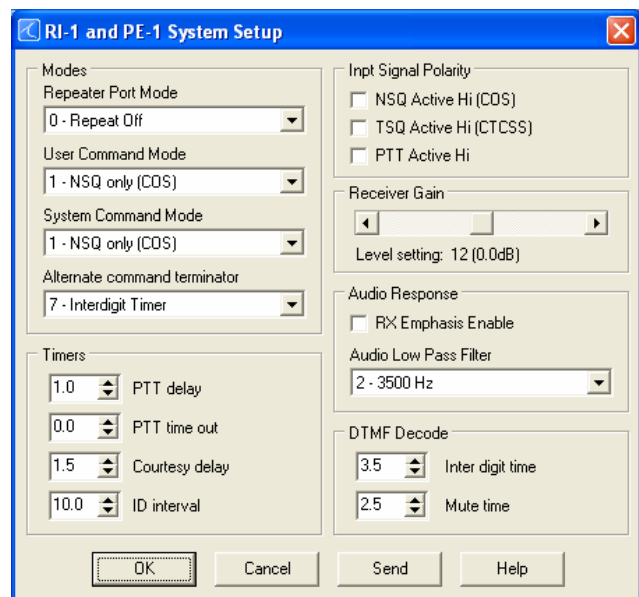
This menu is used to send data to and get data from the controller. You may also flash the program firmware to the controller. Any one of these functions may take as long as 3 minutes to complete. Do not interrupt the process once it is started. The repeater controller is allowed to be in use during the time that you are sending data to or getting data from the repeater. These data functions can be performed while the repeater is in use. You will also find a modem connect sub window here. This connection may be used to communicate to your controller via a modem.



System

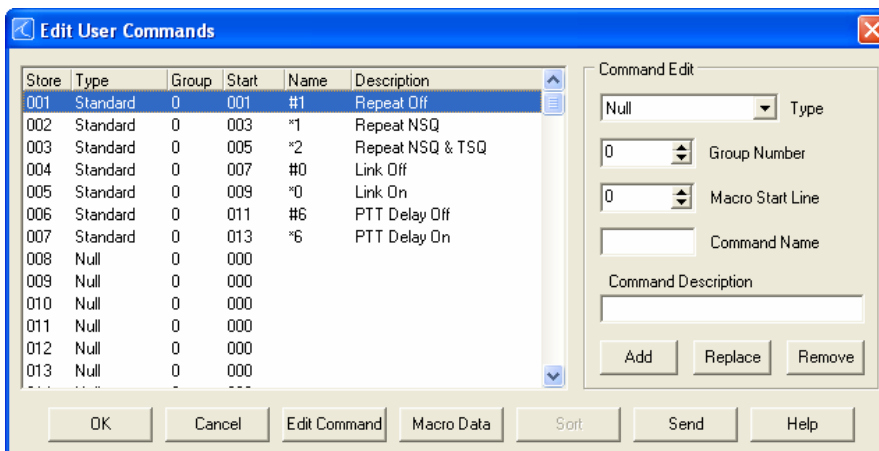
This menu is used to adjust the system, auxiliary, bit output and password functions. Each sub windows will have a "SEND" button you can use to send only that window's data to the controller.

In the "System Setup" dialog, you can adjust the operation of the controller and various timers. See the figure to the right.



Commands

This menu is used to set up all types of user commands and allow the editing of macro data. See section 12 for details on user commands and macro editing.



Events

This menu is used to set up messages, various internal event triggers and the scheduler.

Help

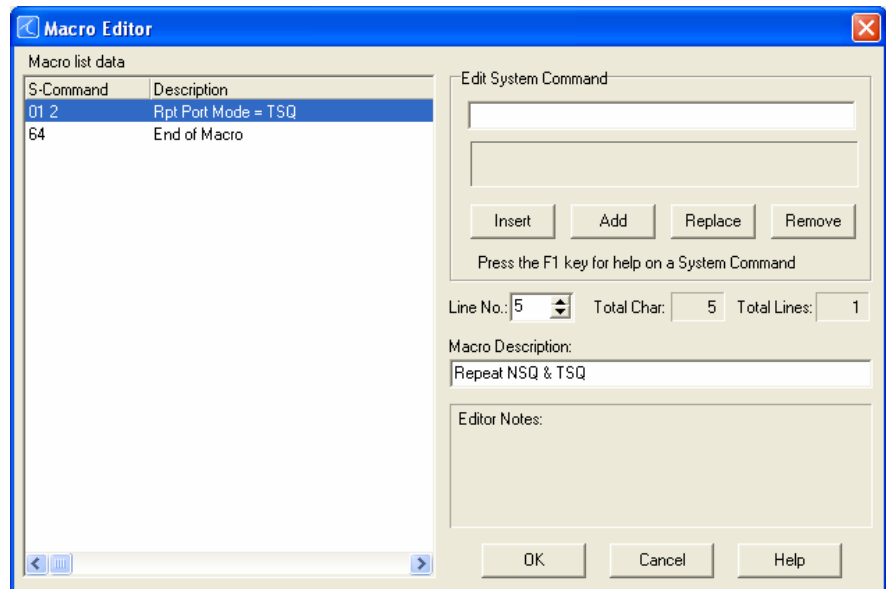
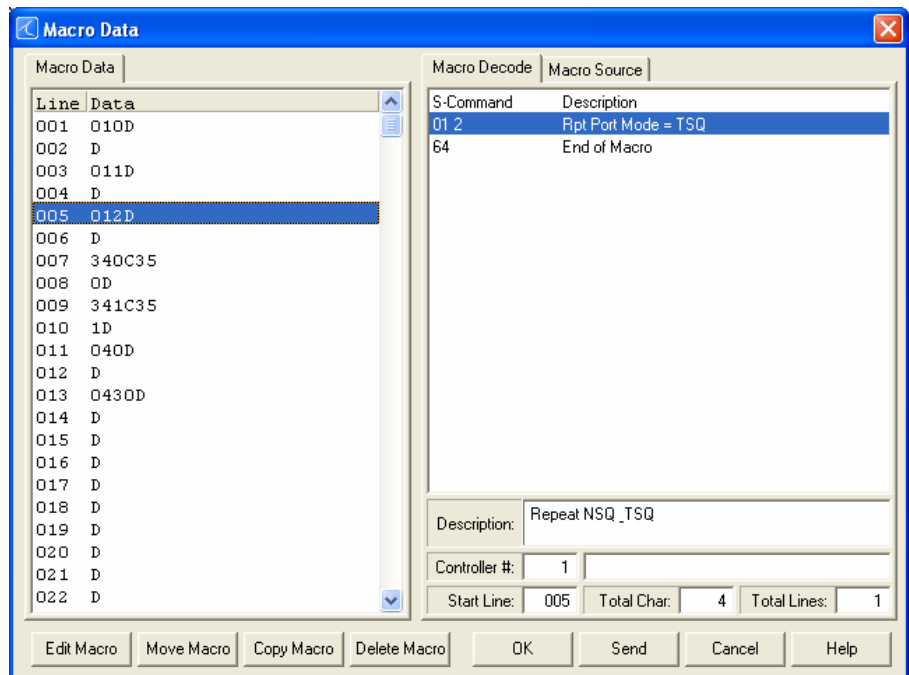
Use this menu to get help on any of the programming software items.

MACRO EDITING MENU

You can edit the macros associated with commands by clicking the “Edit Macro” button in any of the user command menus. In the “Edit Macro Data” sub window, you can pick various macro lines and display the decoded macro data. You can also pick the “Macro Source” tab to display all user commands, event triggers, calls and jumps that reference that macro.

When editing the macro data, you can right click the “Edit System Commands” box to get a System Command from a list. You can also right click the “Line No” box to get a view of the macro data when looking for an empty line to build your macro. On the left side of the macro decode window, you can drag and drop any System Command to change the order of the System Commands in the macro. Finally, you can enter a description to your macro. It should be noted that the description data is only saved to the .rdf file only and not saved to the controller.

The structure and syntax used to build any macro or message is the same structure you would use over the air with DTMF. Just as in building a macro over the air, you must include a “64” at the end of all macros to terminate the macro. Similar to building a macro over the air, the software will keep track of the total number of digits and lines used in a macro. Various errors are also displayed in this window.



MODEM INTERFACE

You should be able to use about any external modem that operates at 9600 baud or higher, can auto answer and operate in a dumb terminal mode. In this application, we used a US Robotics external modem to connect to the controller. On the back of the USR modem, you will find a configuration dipswitch. Set all of the dipswitches in the up position, except for switch 4, which will be down. When using other modems, consider the following settings:

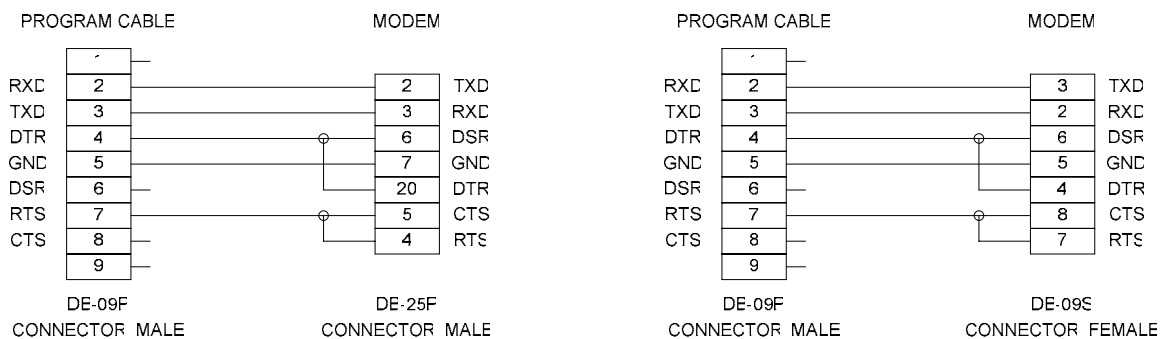
- Data Terminal Ready (DTR) - normal
- Suppress result code
- No echo, off line commands (Echo Off)
- Auto answer on first ring or higher, depending on shared telephone line
- Carrier detect - normal
- Dumb terminal mode, **disable command recognition**

For people who want to share the telephone line between the modem and the controller, we have three different methods available:

1. **Ring Delay:** With this method, you connect the telephone line to the modem and then connect the phone jack output from the modem to the controller. Set up the modem to answer on 2 more rings than the controller. Example: set the controller to answer after 2 rings and set the modem to answer after 4 rings. Then create a user command that sets S-Command 71 to mode 0, disabling incoming calls. When you want to establish a connection with the controller's modem, execute the user command and then call the modem the controller will not answer the call. Once you are finished or during the modem connection, reset the incoming call mode to 2 or higher. Now, the controller will answer calls before the modem answers.
2. **Call switch box:** This method uses a modem/voice switch box. This is a box that into which the telephone line plugs. The box modem port is connected to the modem and the box voice telephone port is connected to the controller. When a call comes in, the box will direct the call to the modem or controller.
3. **Power control:** With this method, you connect the telephone line to the modem and then connect the phone jack output to the controller. Connect a relay so that it will switch the power supply line of the modem. Use one of the controller's digital outputs to control the relay. Create two user commands to turn the relay on and off. Set the modem to answer on the first ring and the controller to answer on 2 or more rings. When you want to call the modem, execute the user command to power the modem and then call the modem. Once you are finished, send the user command to power down the modem. Now the controller will answer the calls and the modem will not.

Vertex Programming Cable to Modem Cable

If you are using the PL-3 ProgramLink, you can use a standard modem cable to connect your modem to the PL-3. If you are using the Vertex programming cable, you need to build a modem-to-modem cable because the Vertex cable works in the same manner as a modem. The following schematic shows how to build a modem-to-modem cable for a modem equipped with DB-25 connector or DB-09 connector.



U.S. Robotics 56K External Modem Set Up

1. Set the dipswitch on the modem. Set switch 3 and 8 down all others up.
2. Connect the modem to your computer using a standard computer-to-modem cable.
3. Run the Hyper Terminal program.
4. Set up Hyper Terminal to communicate to the comm. port to which the external modem is connected, 9600 baud, no parity, 8 data bits, and 1 stop bit. The baud rate used must be 9600 and cannot be changed.
5. Power the modem.
6. Type "AT", the modem should respond with "OK" if you do not get a response, do not proceed. You need to get the modem to respond before you continue. Check the cable, comm. port and switch settings.
7. Type "AT&F1&W0" (last digit is zero, not oh). This restores the factory defaults and saves these defaults to the EPROM. The modem will respond with "OK"
8. Type "ATI4" the modem should respond with the following information. Confirm that everything is set correctly set.

U.S. Robotics 56K FAX EXT Settings...

```

B0 E0 F1 M1 Q1 V1 X1 Y0
BAUD=9600 PARITY=N WORDLEN=8
DIAL=TONE ON HOOK CID=0

```

```

&A1 &B0 &C1 &D2 &G0 &H0 &I0 &K1
&M4 &N0 &P0 &R1 &S0 &T5 &U0 &Y1

```

```

S00=001 S01=000 S02=043 S03=013 S04=010 S05=008 S06=002
S07=060 S08=002 S09=006 S10=014 S11=070 S12=050 S13=000
S15=000 S16=000 S18=000 S19=000 S21=010 S22=017 S23=019
S25=005 S27=000 S28=008 S29=020 S30=000 S31=128 S32=002
S33=000 S34=000 S35=000 S36=014 S38=000 S39=000 S40=001
S41=000 S42=000

```

LAST DIALED #:

9. If you plan to use the Ring Delay method to connect to your modem, do the following
 - a. To change the number of rings on which to auto answer, to 4 rings, type "ATS0=4&W0" and the modem should respond with "OK". You can replace the "4" value with any value that will work for you application.
 - b. Turn the power to your external modem off and then on
 - c. Type "ATI4" to confirm that your new settings are now permanently saved.
10. Turn off the modem and disconnect it from your computer.
11. Change the modem dipswitch settings: (switch 4 down all others up).
12. Attach the modem to the controller using the appropriate cable as discussed early in this section.
13. Apply power to the modem. You are now ready to use the programming software to connect to your controller.

Modem Trouble Shooting

If you are still having problems connecting to your modem, try the following:

1. Restart Hyper Terminal, but set it to communicate to the comm. port that is attached to your internal mode.
2. Set Hyper Terminal to connect at 9600 baud, no parity, 8 data bits, and 1 stop bit.
3. Type "AT" and the internal modem should respond with "OK".
4. Type "ATD [telephone number]", replace [telephone number] with the telephone number to which the controller is connected.
5. After the modem connects, you should see the following message:

```
CONNECT 9600/ARQ/V32/LAPM
```

```
>10CG00GJ
>10CG00GJ
```

6. The ">10CG00GJ" is a message from the controller and should repeat every 2 seconds.
7. If the modem will not answer, check your dipswitch settings and cables.
8. When the modem is idle (not connected) you should see the following LED status:

AA = ON	CD=OFF	RD=OFF	SD=Flash every 2 seconds	TR=ON	CS=ON	ARQ=OFF
---------	--------	--------	--------------------------	-------	-------	---------
9. When the modem is connected you should see the following LED status:

AA = ON	CD=ON	RD=OFF	SD=Flash every 2 seconds	TR=ON	CS=ON	ARQ=ON
---------	-------	--------	--------------------------	-------	-------	--------
10. If you do not see the controller message, check all cables.

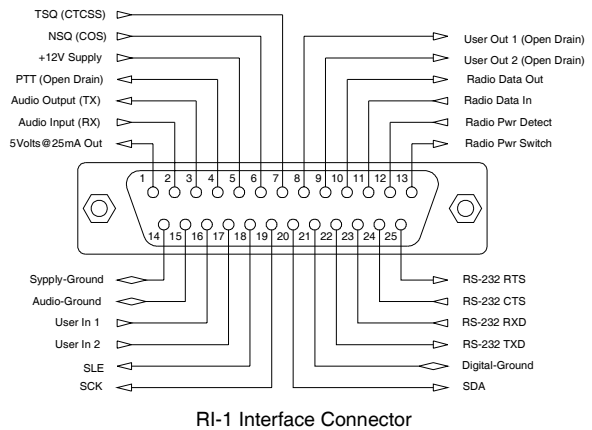
SECTION 4 INSTALLATION (RI-1)

If you are installing the PE-1 into the RI-300 chassis, you can skip to the next section.

This section will cover connecting your RI-1 to your repeater in detail. To ensure a successful installation, please follow these few simple steps.

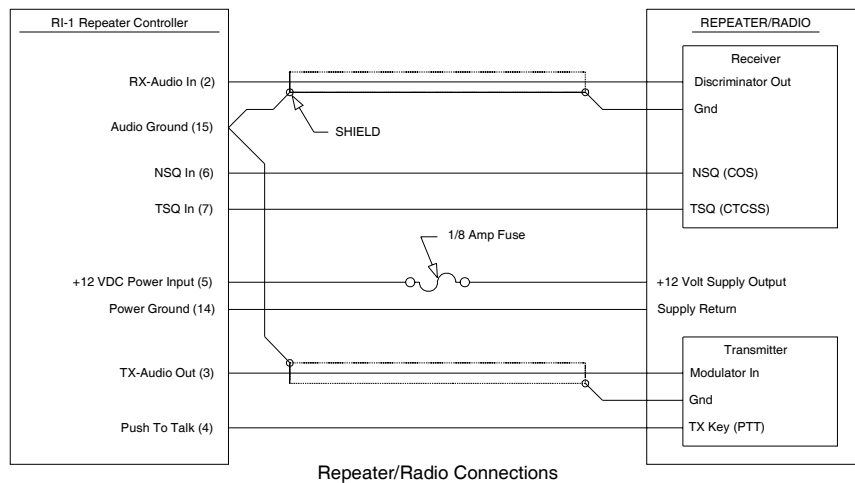
1. Review this section completely and plan you repeater interface before you start making connections.
2. Review section 6 of this manual for detailed information on making audio level adjustments.

The diagram on the right is an end view of the radio interface connector on your RI-1. Use the supplied DB-25S female connector for making all connections to the controller.



PROPER TECHNIQUES FOR QUALITY REPEATER AUDIO

Obtaining good audio in any repeater is based on understanding the design of the equipment. The audio in all frequency modulation (FM) transmitters or phase modulation (PM) transmitters has what is known as audio pre-emphasis. Pre-emphasis means that with increasing audio frequency the amount of the modulation will increase. The reverse is performed in all FM receivers and is called de-emphasis. The RI-1 was designed to operate with both emphasized and flat audio response from the repeater receiver and transmitter. This means that you can bypass the de-emphasis and/or pre-emphasis stage in the radio when possible. This leaves all of the emphasis filtering in the user's radio. The RI-1 will interface to emphasis audio when needed.



The RI-1 controller does include a low pass filter that rolls off the very high audio frequency content to prevent adjacent channel splatter. It is not advisable to drive the microphone input on the transmitters. Most transmitters have significant audio shaping, compensating for the microphone response and other characteristics.

Besides audio frequency response, you should consider the audio amplitude levels to and from the controller. If the levels to and from the repeater are small, it may be valuable to use shielded cable. We recommend shielded cables at all times. Use large signal levels whenever possible. On the other hand, do not let the audio signal get large enough where clipping occurs in any stage of the controller, the receiver, or the transmitter. See section 6 for more details on adjusting the audio levels in the controller. Consider and practice the above and you will have repeater audio that you and your repeater users will be proud of.

POWER SUPPLY CONNECTIONS (Pins 5 and 21)

The RI-1 operates on 12 volts DC nominal. The DC source voltage must be between 10 and 15 VDC. The controller typically draws less than 40 ma without the status LEDs on. Connect the +12v to J1 pin 5. Connect J1 pin 21 to ground or the 12v return side of the power supply. The repeater builder may elect to incorporate an on/off power switch on the +DC side. Most repeater owners switch the AC primary side of the power supply. **The RI-1 repeater controller connection to the power supply must be over-current protected.** Use of a 1/8 ampere fuse should be the largest capacity considered in your installation.

REPEATER RECEIVER AUDIO CONNECTION (Pin 2)

Connect the receiver discriminator audio when ever possible to pin 2 and the receiver ground or audio return to J1 pin 15. If the discriminator output is not available, you can connect to a de-emphasized output and set correctly select this type of audio. It is not advisable to connect the controller to the speaker leads. Most radio amplifiers have significant audio shaping and may lead to loss of audio response. If you are not familiar with the repeater receiver, get assistance from someone knowledgeable on the subject or contact our factory for support. For best performance all audio connections should be made with a shielded cable. The controller's audio path has a flat frequency response from 30 Hz through 3500 Hz. When interfaced properly to the repeater receiver and transmitter, the controller will provide superb audio characteristics.

NSQ and TSQ Input (Pin 6 and 7)

The RI-1 does not have its own squelch or CTCSS decoder. The radio or audio source must provide these functions. Connect the output of the radios squelch circuit to pin 6 (NSQ) and the CTCSS decoder, if used, to pin 7 (TSQ). These inputs are 0-5 volt logic input with a 22K pull-up resistor. Then can expect a logic or open collector source. They also can be programmed for active low and active high signals. If you are connecting to a device other than a radio, you can use the (NSQ) input to signal the RI-1 when a signal is available to process.

REPEATER TRANSMITTER AUDIO CONNECTIONS (Pin 3)

Use a direct FM type modulator whenever possible. The RI-1 does have a de-emphasis filter that can be turned on for those applications in which you need to interface to a modulator with pre-emphasis. It is not advisable to drive the microphone input on the transmitters. Most microphone inputs have significant audio shaping, compensating for the microphone response and other characteristics. Always use a shielded cable. Connect the controller transmit audio output J1 pin 3 to the input of the modulator. Connect the modulator ground or audio return to J1 pin 15. If a FM modulator without pre-emphasis is not available, the RI-1 can be jumped to drive a phase modulator or modulator with pre-emphasis. Do this by installing jumpers on JP4 pins 2-3. For FM modulation, install a jumper on JP4 pins 1-2. See section 16 for more information on this subject.

REPEATER TRANSMITTER PTT OR TRANSMIT KEYING CONNECTION (Pin 4)

The RI-1 repeater controller keys the transmitter at the required times. **WARNING** - As with all repeater controllers, this controller will key the transmitter at times you may not think of, such as when the ID is due. It never fails when you disconnect the antenna to connect an in-line wattmeter, the ID goes off or a repeater user arrives on the receiver input. Therefore, disconnect power to the repeater and controller before performing these operations. The controller PTT keying transistor sinks current, that is, the transistor pulls to ground the relay or keying stage in the repeater transmitter. This is by far the most common interface. Should you need to source a voltage to PTT, then contact Pacific Research Solutions for application notes. The keying transistor can sink or pull down a maximum of 120 ma of current. Connect J1 pin 4 to the repeater transmitter PTT.

DIGITAL INPUTS (Pins 16 and 17)

The RI-1 has two digital inputs on board that can be used to trigger macros. These inputs are C-MOS gates with a voltage swing of 0 to 5 VDC, TTL level. All digital inputs have a 10K ohm pull up resistors. Your application must "pull down" or sink current with either a transistor or TTL gate or equivalent. Upon detecting either a rising or falling edge or change in the state of an input, the controller automatically executes a macro. See Section 11, S-Command 45 for additional information on programming these inputs. These inputs are located on J1 pins 16 and 17. See the connector diagram on the previous page.

DIGITAL OUTPUTS (Pins 8 and 9)

The RI-1 has two digital outputs on board and is currently expandable up to ten, whose states can be modified by S-Commands. Each of the two outputs can be individually commanded or forced into the high or low logic state. These outputs are open drain FET transistors and can sink up to 120ma each. There are no pull-up resistors on these outputs. If pull-up resistors are needed, they must be provided by the user supplied interface. These outputs can sink current from a voltage sources as high as 24 volts DC. Using S-Commands (or macros that are composed of S-Commands), each output may be turned on or off. See Sections 11 S-Command 46 additional information on programming these outputs. These outputs are located on J1 pins 8 and 9. See the connector diagram on the previous page.

+5V Output (Pins 1)

This is a low current +5V supply output. This output can be used to power an interface circuit external to the controller. Do not draw more than 25mA from this output.

SERIAL DATA (Pins 18 through 20)

These signals are reserved for digital output expansion. This feature is to be added at a later time.

RADIO DATA (Pins 10 through 14)

These signals are reserved for serial communication to various radios. This feature is to be added at a later time.

RS-232 DATA (Pins 22 through 25)

These signals are used to communicate to various radios and EchoLink. See linking section for more details.

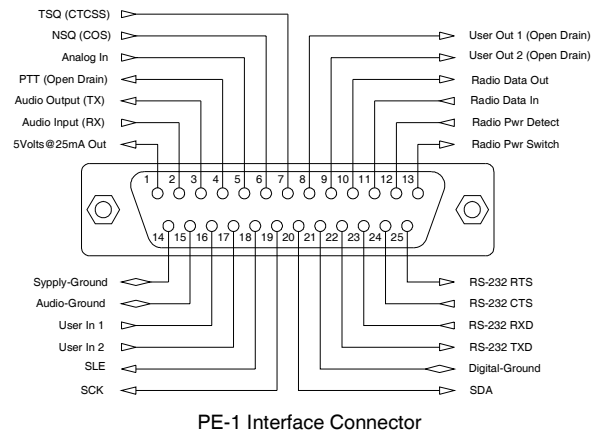
SECTION 5 INSTALLATION (PE-1)

The PE-1 (Port Expansion) board adds various features to the RI-300 controller. The RI-310 controller (Discontinued) cannot use the PE-1. For additional details, see the schematic in section 16. These features include:

- 1 full duplexed repeating audio port (input and output) with level adjustments.
- 2 digital inputs (5V logic). These bits are accessed via S-Command 45
- 2 digital outputs (open drain). These bits are accessed via S-Command 46.

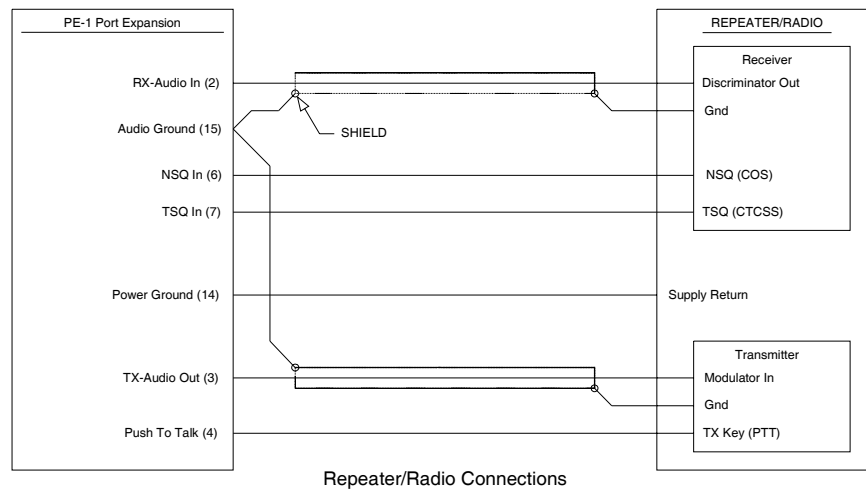
To install your PE-1, use the following steps.

1. Turn off power to the repeater and controller.
2. When working on your controller, use procedures to assure no static discharge occurs through the controller or PE-1.
3. Remove the cover of the RI-300 then remove the radio interface connector mounting studs and 2 screws that hold the analog board to the chassis.
4. The analog circuit board is the board that has a small transformer. Just behind the radio interface connector, you will find a black 26-pin socket header. Plug the PE-1 into this header, making sure all pins align. The DB-25 connector on the PE-1 should align in the same direction as the radio interface connector.
5. Carefully re-inspect your installation, making sure that you have all pins correctly aligned.
6. Re-install the analog board and PE-1 into the chassis, installing the 4 mounting studs on the 2 connectors.
7. You are now ready to use your PE-1.



PROPER TECHNIQUES FOR QUALITY REPEATER AUDIO

Obtaining good audio in any repeater is based on understanding the design of the equipment. The audio in all frequency modulation (FM) transmitters or phase modulation (PM) transmitters has what is known as audio pre-emphasis. Pre-emphasis means that with increasing audio frequency the amount of the modulation will increase. The reverse is performed in all FM receivers and is called de-emphasis. The PE-1 was designed to operate with both emphasized and flat audio response from the repeater receiver and transmitter. This means that you can bypass the de-emphasis and/or pre-emphasis stage in the radio when possible. This leaves all of the emphasis filtering in the user's radio. The PE-1 will interface to emphasis audio when needed.



The PE-1 controller does include a low pass filter that rolls off the very high audio frequency content to prevent adjacent channel splatter. It is not advisable to drive the microphone input on the transmitters. Most transmitters have significant audio shaping, compensating for the microphone response and other characteristics.

Besides audio frequency response, you should consider the audio amplitude levels to and from the controller. If the levels to and from the repeater are small, it may be valuable to use shielded cable. We recommend shielded cables at all times. Use large signal levels whenever possible. On the other hand, do not let the audio signal get large enough where clipping occurs in any stage of the controller, the receiver, or the transmitter. See section 6 for more details on adjusting the audio levels in the controller. Consider and practice the above and you will have repeater audio that you and your repeater users will be proud of.

GROUND CONNECTIONS (Pins 5 and 21)

The PE-1 get is power from the RI-300. No external power connection is required. However a ground connection is provided as a reference for digital signals.

REPEATER RECEIVER AUDIO CONNECTION (Pin 2)

Connect the receiver discriminator audio when ever possible to pin 2 and the receiver ground or audio return to J1 pin 15. If the discriminator output is not available, you can connect to a de-emphasized output and set correctly select this type of audio. It is not advisable to connect the controller to the speaker leads. Most radio amplifiers have significant audio shaping and may lead to loss of audio response. If you are not familiar with the repeater receiver, get assistance from someone knowledgeable on the subject or contact our factory for support. For best performance all audio connections should be made with a shielded cable. The controller's audio path has a flat frequency response from 30 Hz through 3500 Hz. When interfaced properly to the repeater receiver and transmitter, the controller will provide superb audio characteristics.

NSQ and TSQ Input (Pin 6 and 7)

The PE-1 does not have its own squelch or CTCSS decoder. The radio or audio source must provide these functions. Connect the output of the radios squelch circuit to pin 6 (NSQ) and the CTCSS decoder, if used, to pin 7 (TSQ). These inputs are 0-5 volt logic input with a 22K pull-up resistor. Then can except a logic or open collector source. They also can be programmed for active low and active high signals. If you are connecting to a device other then a radio, you can use the (NSQ) input to signal the PE-1 when a signal is available to process.

REPEATER TRANSMITTER AUDIO CONNECTIONS (Pin 3)

Use a direct FM type modulator whenever possible. The PE-1 does have a de-emphasis filter that can be turned on for those applications in which you need to interface to a modulator with pre-emphasis. It is not advisable to drive the microphone input on the transmitters. Most microphone inputs have significant audio shaping, compensating for the microphone response and other characteristics. Always use a shielded cable. Connect the controller transmit audio output J1 pin 3 to the input of the modulator. Connect the modulator ground or audio return to J1 pin 15. If a FM modulator without pre-emphasis is not available, the PE-1 can be jumped to drive a phase modulator or modulator with pre-emphasis. Do this by installing jumpers on JP4 pins 2-3. For FM modulation, install a jumper on JP4 pins 1-2. See section 16 for more information on this subject.

REPEATER TRANSMITTER PTT OR TRANSMIT KEYING CONNECTION (Pin 4)

The PE-1 repeater controller keys the transmitter at the required times. **WARNING** - As with all repeater controllers, this controller will key the transmitter at times you may not think of, such as when the ID is due. It never fails when you disconnect the antenna to connect an in-line wattmeter, the ID goes off or a repeater user arrives on the receiver input. Therefore, disconnect power to the repeater and controller before performing these operations. The controller PTT keying transistor sinks current, that is, the transistor pulls to ground the relay or keying stage in the repeater transmitter. This is by far the most common interface. Should you need to source a voltage to PTT, then contact Pacific Research Solutions for application notes. The keying transistor can sink or pull down a maximum of 120 ma of current. Connect J1 pin 4 to the repeater transmitter PTT.

DIGITAL INPUTS (Pins 16 and 17)

The PE-1 has two digital inputs on board that can be used to trigger macros. These inputs are C-MOS gates with a voltage swing of 0 to 5 VDC, TTL level. All digital inputs have a 10K ohm pull up resistors. Your application must "pull down" or sink current with either a transistor or TTL gate or equivalent. Upon detecting either a rising or falling edge or change in the state of an input, the controller automatically executes a macro. See Section 11, S-Command 45 for additional information on programming these inputs. These inputs are located on J1 pins 16 and 17. See the connector diagram on the previous page.

DIGITAL OUTPUTS (Pins 8 and 9)

The PE-1 has two digital outputs on board and is currently expandable up to ten, whose states can be modified by S-Commands. Each of the two outputs can be individually commanded or forced into the high or low logic state. These outputs are open drain FET transistors and can sink up to 120ma each. There are no pull-up resistors on these outputs. If pull-up resistors are needed, they must be provided by the user supplied interface. These outputs can sink current from a voltage sources as high as 24 volts DC. Using S-Commands (or macros that are composed of S-Commands), each output may be turned on or off. See Sections 11 S-Command 46 additional information on programming these outputs. These outputs are located on J1 pins 8 and 9. See the connector diagram on the previous page.

+5V Output (Pins 1)

This is a low current +5V supply output. This output can be used to power an interface circuit external to the controller. Do not draw more than 25mA from this output.

SERIAL DATA (Pins 18 through 20)

These signals are reserved for digital output expansion. This feature is to be added at a later time.

RADIO DATA (Pins 10 through 14)

These signals are reserved for serial communication to various radios. This feature is to be added at a later time.

RS-232 DATA (Pins 22 through 25)

These signals are used to communicate to various radios and EchoLink. See linking section for more details.

SECTION 6

ADJUSTMENTS

Adjusting the audio levels in your controller is very important, in order to avoid clipping or distorted audio. In this section you will find various features in the controller to help you through this process.

Warning: Refer to section 8, Initialization procedure. When a full controller initialization is performed all digital pot settings are returned to their default settings. **Do not perform the initialization procedure at this time.** During full controller initialization, all system settings, user commands, macros, messages, and digital pot settings will be returned to their defaults.

Note: If you are having startup problems, check the following items.

1. When entering your password for the first time, make sure the NSQ, TSQ and DTMF status LED's are operating properly. Most of the startup problems will relate to logic levels or audio level too low, too high, too much DTMF twist and/or audio distortion. The RI-1 design has a wide dynamic range for all of the decoders and should work in most conditions.
2. The un-key of your radio when sending a command is a normal command termination. If you are experiencing a problem when getting started or the COS is always on, you can send a command as normal and wait about 3.5 seconds from the last digit for the controller to try to process the command.
3. If you experience some problems decoding DTMF, the likely problem is that the tone levels are out of range. The DTMF decoder has a 30+ dB dynamic range, so that decoding DTMF should not be a problem with a reasonable discriminator input level. The DTMF status LED illuminates when a tone is first decoded and remains lit until after, either a function complete or at the completion of a DTMF Inter-digit time-out. If you experience problems where one row or column that did not decode properly. You may need to check the receiver level or frequency response. To test this, you send one digit at a time, checking all DTMF tone digits, letting the LED light go out after each one. Then test the next tone, confirming that all YOUR tones are being properly decoded.
4. If you send your password multiple times and receive an "ERROR" telemetry message, the controller may already be unlocked and in programming mode.

SETTING RECEIVER INPUT GAIN (R3)

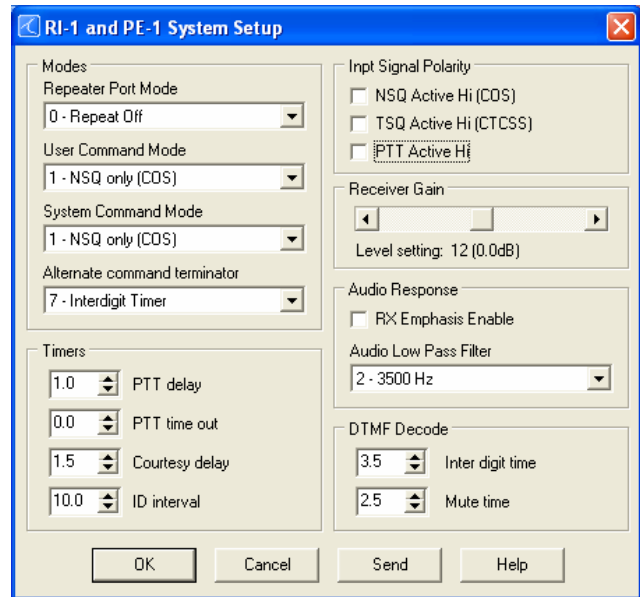
Setting the receiver input gain may be the most important adjustment in the controller. For the internal decoders (DTMF) to work properly, you need to set up the receiver input audio level correctly. The receiver input audio level setting is a manual adjustment. Please use the follow the procedure:

1. Apply the 12 VDC power source. Confirm that all 4 LEDs flash on for about 1 second. After power up, some LEDs may remain on. Do not be concern at this point as we have not completed adjusting your controller.
2. Transmit a carrier on the repeater's input channel. Did the yellow NSQ light come on? Do not be surprised if the NSQ LED did not come on or is already on, as we have adjustments to make before the NSQ logic will work correctly.
3. Generate a 1000 Hz tone at 5 kHz deviation on the repeater input.
4. Using an AC volt meter that has high frequency response, probe U6 pin 7 for 0.77 volts AC RMS. Use the supply ground for your negative connection.
5. The receiver input level is adjusted by the single turn pot VR2.

SELECTING NSQ, TSQ and PTT SIGNAL POLARITY

The polarity of the NSQ, TSQ and PTT signals are selectable. If you do not have the programming software to make this adjustment, you can still send DTMF commands to the controller, but you will have to wait for the inter-digit timeout to expire for the command to execute. To adjust these signal polarity, unlock the controller with the default password “123456”. You may not hear an acknowledgment because we have not adjusted the transmitter lever at this point. Next send System Command 000x, 001x and 002x to change the polarity of these signals. See section 11 for more details on this System Command. You must finish with System Command 691 to lock and save your changes.

You can also use the programming software (PS-3) to adjust these values. Click “System” and “System Setup”. See the group under “Input Signal Polarity” in the figure to the right. After you have made your changes, click the “Send” button to update the controller.



SELECTING RECEIVER EMPHASIS TYPE

If you are interfacing directly to the receiver’s demodulator, you will want to disable the controller’s receiver emphasis stage. For all other types of audios interface, including VoIP, you will want to enable the controller’s emphasis stage. This is done with System Command 003x. Use System Command 0030 (Factory Default) to disable the emphasis stage or use System Command 0031 to enable the controller’s emphasis stage. You can send this command over the AIR with DTMF or you can use the programming software (PS-3). If sending the command to the controller with DTMF, do not forget to unlock and lock/save your data. If using the programming software, click “System” and “System Setup”. See the group under “Audio Response” in the figure to the right.

SELECTING LOW PASS FILTER

A selectable low pass filter is provided to allow for interface with various types of modulation standards. This filter is used to prevent adjacent channel splatter. If you are operating on 20KHz or more channel spacing, we recommend you use the 3500Hz cutoff selection. If you are operating on 15KHz or less channel spacing, we recommend that you use the 2500Hz cutoff selection.

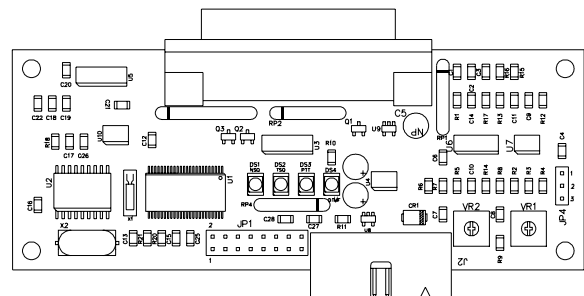
You can adjust this filter over the air using S-Command 03 or the programming software (PS-3) Click System and System Setup. See the group under “Audio Response” in the figure to the right.

FINAL ADJUSTMENT OF RECEIVER GAIN

Fine adjustments to the receiver gain can be made from over the air using S-Command 02 or the programming software (PS-3) Click System and System Setup. See the group under “Receiver Gain” in the figure to the right.

SELECTING TRANSMITTER EMPHASIS TYPE

If you are interfacing directly to a true FM type modulator, you will want to disable the controller’s transmitter emphasis stage. This is accomplished with a jumper (JP-4) on the circuit board. See the figure to the right. Pin 3 is located in the lower corner of the board. For modulators that are true FM and without emphasis, place jumper on pins 2 and 3. For all other types of modulators and audio interfaces, including VoIP, you will want to place the jumper on pins 1 and 2.



ADJUSTING THE REPEATER TRANSMITTER MODULATION

After hooking up the repeater transmitter audio and the repeater PTT keying circuit per Section 4, you will need to adjust the repeat TX audio level. The best method is to use a service monitor to measure the transmitter deviation. If a service monitor is not available, use any receiver that can be easily flipped back and forth between the repeater input and output channel while listening to the levels. Ideally, you will have the same transmit deviation going out of the repeater transmitter as coming in the receiver. Transmit a 3kHz deviation tone on the repeater input channel. As you flip back and forth between the repeater input and output frequencies, then by listening, adjust the repeater transmitter audio level or deviation. This level is adjusted with pot, VR1. If you operating the controller as a simplex link or remote base, enable the audio path from the source controller using System Command 35. Transmit audio on the source controller’s input and adjust VR1 for the correct level.

SETTING UP THE RI-1 AUXILIARY INTERFACE CONNECTOR

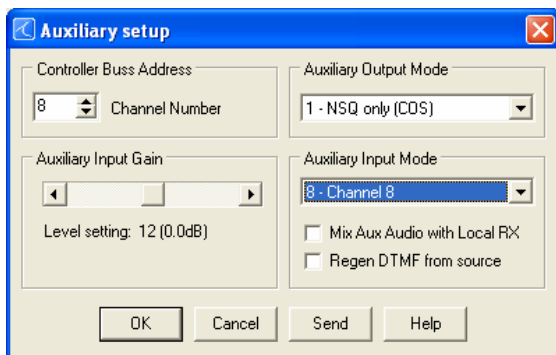
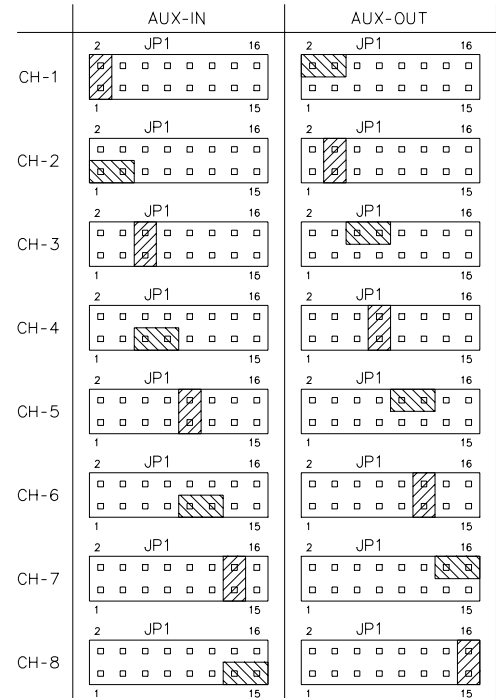
If you are working with the PE-1 or you do not have the RI-1 controller connected to another controller, you can skip this sub section.

The RI-1 does not support a full cross point switch on the auxiliary buss. This means that if you are going to connect the RI-1 to another RI-1 or RI-300, you will use jumper blocks need to select the input and output channels on the auxiliary buss. Use the diagram to the right to assist on jumper placement of each channel.

When deciding on setting jumpers, you must first decide on what channels you will be using. If you will be connecting an RI-300 to the RI-1, the RI-300 is default to output on channel 1 and the RI-1 is default on channel 8. You would then install a jumper on pins 1 and 2 so that the RI-1 can listen to the RI-300. You then place a jumper on pins 15 and 16 so that the RI-300 can listen to the RI-1.

All jumpers are placed in combination of one for AUX-IN and one for AUX-OUT. You should never place multiple jumpers for the AUX-IN or AUX-OUT.

After you have placed the jumpers, you then use System Commands 34 and 35 to enable and disable the input and output. You can also use the programming software (PS-3) to adjust these default values. Click System and Auxiliary Setup.



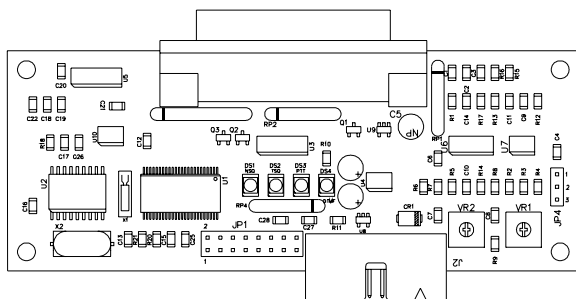
SECTION 7 OPERATION

Once you have connected your controller to a receiver / transmitter and adjusted the audio, you should then confirm its basic repeater operation. This can be done by transmitting a carrier in the input of the repeater and observing the “NSQ” LED turning on and off when you key and un-key. If you have enabled the Repeater Port Mode, System Command 01, you should next see the “PTT” LED turn on while the repeater transmitter is on. Next, you can confirm the repeater audio path by listening to yourself on the output of the repeater.

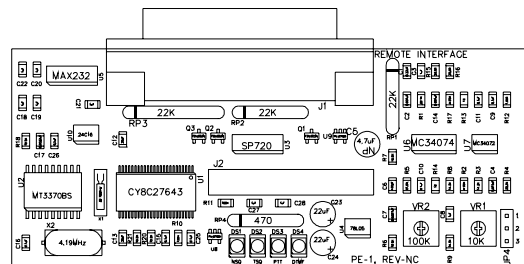
SYSTEM STATUS INDICATORS

The system status LED indicators will display the current status of the controller. During the controller power on self-test, the RI-1 will turn on all of the status LEDs for about 1 second. These LED’s are located in the middle of the circuit board, see the figure below.

INDICATOR	DESCRIPTION / FUNCTION
NSQ	Noise Squelch; indicates when a signal is present at the receiver.
TSQ	Repeater Tone Squelch indicates when a CTCSS (Continuous Tone Controlled Squelch System) or DCS (Digital Coded Squelch) has been enabled in the repeater tone panel and is present at the receiver.
PTT	Push-To-Talk; indicates when the controller is keying the repeater transmitter.
DTMF	Dual Tone Multi-Frequency; indicates when the controller is decoding DTMF (Touch-Tones).



RI-1 Controller



PE-1 Port Expansion

DTMF COMMAND INPUT

Dual Tone Multi Frequency (DTMF) is typically used in the telephone system for dialing. The RI-1 uses DTMF as the primary means for the owner and users to control and communicate with the repeater. DTMF is made up of eight tones with two of the eight turned on in each of the sixteen keystrokes. DTMF is used because of the reliability and ease of use in the audio transmission range. When sending commands to the controller, you must send each DTMF digit with a delay of 3.5 seconds or less between digits. Then un-key the transmitter. This action is the same as the "enter" key on your computer keyboard. If the squelch is open or not properly set, the controller will not be able to detect the un-key action. In this case you can wait for the inter-digit timer to expire, at which time the controller will attempt to process the command. Once the command is sent, the controller will respond with one of three actions.

1. CW “OK” is a result of a successful command.
2. CW “ERROR” is a result of an error in the data of a S-Command or macro.
3. No response, the controller did not receive the command or the command was not valid.

TELEMETRY MESSAGES

Telemetry or messages are sent from the controller to you in response to a repeater status or function. There are primarily four types of messages.

1. The station ID.
2. Courtesy messages, which occur after you un-key.
3. System functions (OK, ERROR).
4. User programmable messages. These may be CW messages that are created by the system operator.

Any of the controller's messages may be modified with S-Commands 30 and 31. The controller comes pre-programmed with default messages in response to any one of the following events:

EVENT	DESCRIPTION
Repeater Courtesy	A courtesy message is sent after each user un-keys to let the other users know when the time-out timer has been reset and that it is OK to continue talking. This message occurs when the time clock has been set.
Auxiliary Courtesy	This replaces the courtesy message when the received signal is weak or noisy.
Station ID	This is the system identification, can be either CW or Speech. The factory default is CW "HELLO". This ID is sent periodically as required by the FCC.
Function Error	Generated in response to an S-Command that the controller did not understand.
Function Complete	Generated in response to an S-Command the controller understood and executed.

It should be noted that when the controller is executing a macro, the function complete or function error is in response to the S-Commands within the macro. If you get a function error when controlling your system with a user command, you have an S-Command with an error within the macro.

INITIALIZATION PROCEDURE

There is only one method of re-initializing and returning to the factory default data. Default data for each of the S-Commands is listed in section 11 and the System Command Table at the end of this manual. To initialize the RI-1 data, use the following procedure:

1. Unlock the controller with DTMF or use the programming software "Send S-Cmd" dialog.
2. Send 5986 to the controller.

SECTION 8

INITIAL SETTINGS

This section will cover some items that you will need to modify before you put your repeater on the air. But first, confirm the following items to make sure that your controller is operational.

1. Turn on the power to the repeater.
2. Apply a carrier without a CTCSS tone on the input of the repeater. The NSQ LED should come on.
3. Apply a carrier with a DTMF tone on the input of the repeater. The DTMF LED should come on.

User and System Command Modes

The controller is always in one of two modes: (User Command mode or System Command mode) but never in both. Commands sent via DTMF will be interpreted depending upon the controller mode at the time that the command is received. When the power is first turned on, the controller is locked, and is in the User Command mode. After receiving the programming password in the User command mode, the RI-1 unlocks and will switch to the programming (System Command) mode. If no commands are sent for an extended period of time, the controller will lock itself. After you have finished sending System Commands, you can lock and save your changes or lock and discard your changes.

Command acknowledgment

Each time you send commands to the RI-1, you will get one of two responses. First, if you send any valid command without errors, the RI-1 will respond with a CW acknowledgment message "OK", or a function complete message of your design. The "OK" message is of low pitch and has the rhythm of "dah dah dah dah di dah". Second, if you send an S-Command with an error or a user command that has an error in its programming, the RI-1 will respond with a speech message: "ERROR."

When you are programming your RI-1 over the air, it is important to have a full quieting signal at the repeater. With a noisy signal, digits can be missed and the result of the command may not turn out the way you planned. The following is a list of some common problems people have encountered:

- If you move in and out of a RF null while sending a command such as when using a hand held, a digit may get missed. The received command then becomes invalid or worse yet, looks like some other valid command.
- If the RI-1 is in the User Command mode while you are trying to send S-Commands, or the controller is in the S-Command mode while you are sending User Commands, you will not get the results you are expecting. Note that if 5 minutes have past without sending a command while you are in the S-Command mode, the controller will lock itself. If the time-out should happen, you will hear an unexpected CW "OK", or a function complete of your design, automatically sent by the controller.

DEFAULT USER COMMANDS

The controller comes programmed with some default User Commands. See section 12 for details on changing the command names or the commands themselves. You can use these commands only when the controller is locked in User Mode.

- #1 Repeater mode OFF.
- *1 Repeater mode ON using NSQ to access repeater.
- *2 Repeater mode ON using NSQ and TSQ to access repeater.
- #6 Carrier delay OFF.
- *6 Carrier delay ON.
- #0 Link mode OFF.
- *0 Link mode ON, used if you have 2 repeaters tied together.

SETTING UP YOUR STATION ID

You are now ready to change or set up the station identification, **ID message**. The factory default CW ID is "Hello". The following will show you how this ID was programmed into the controller. Once you have reviewed this procedure, you may want to review section 13 for more details on programming messages before you start programming your own ID. You can also use this same technique to modify any of the system messages.

Each character of the ID message has a 2-digit command number. See the default CW data table in section 11, S-Command 31 for a list of all CW commands. The data (CW commands) for all messages are stored in the same memory area as the macros. Take care when entering a new message or changing a message, to avoid damaging other data in the memory. The default "Hello" message uses the following CW commands:

- Character 1 = 01 Start Of Message
- Character 2 = 00 Reset Tone Generator defaults
- Character 3 = 04 Set Tone Generator 1 to 500 Hz tone
- Character 3 = 99 Delay 1 second
- Character 6 = 59 CW "H"
- Character 7 = 56 CW "E"
- Character 8 = 63 CW "L"
- Character 9 = 63 CW "L"
- Character 10 = 66 CW "O"
- Character 11 = 02 End Of Message

As you can see in the above example, all CW commands have a start of message and a end of message. The body of the message is contained between the start and end.

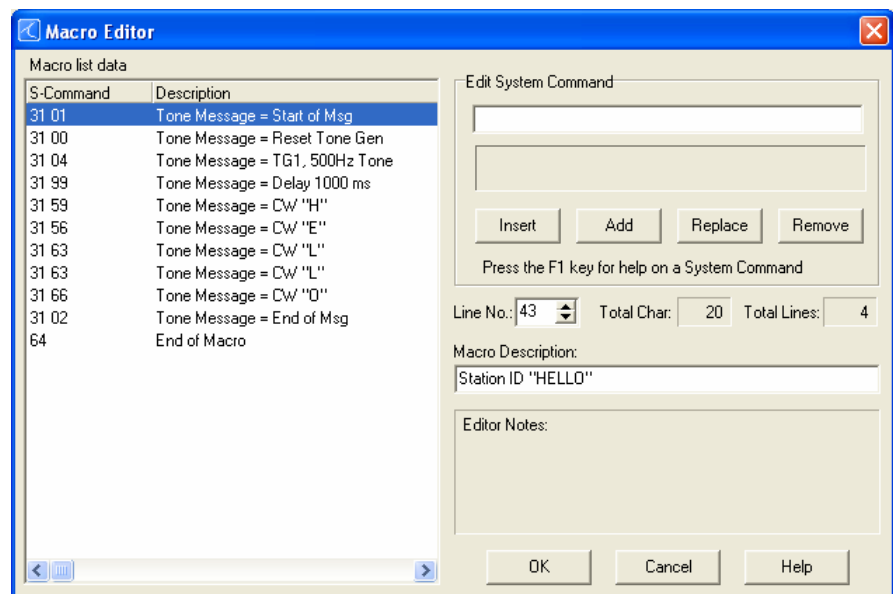
Review the following procedure to understand how this “Hello” ID was entered into the controller. When you un-key your radio after each command, you should hear the character number in speech. This will tell you that you did everything correctly. If you hear an “ERROR”, a mistake was made and the command was aborted.

You can also use the programming software to edit this message. Pick “Triggers” then pick “Messages”, highlight “Station ID” item 11 then pick “Edit Msg.”. You will see the message edit box as displayed on the right. Use the same message editing format to enter your message commands as shown below.

<u>S-Command</u>	<u>Description</u>
1. 123456	If you are using DTMF, unlock the controller, you are in S-Command mode. You should notice a different courtesy tone.
2. 63 043	If you are using DMF, S-Command 63 sets the memory data pointer (start line number pointer) to start line 038. If you are using the programming software, you can use the macro editor to select the start line.
3. 31 01	S-Command 31, Enter message data into memory, Start Of Message.
4. 31 00	S-Command 31, Enter message data into memory, Reset Tone Generator defaults
5. 31 04	S-Command 31, Enter message data into memory, Set Tone Generator 1 to 500 Hz tone.
6. 31 99	S-Command 31, Enter message data into memory, Delay 1 second
7. 31 59	S-Command 31, Enter message data into memory, CW “H”.
8. 31 56	S-Command 31, Enter message data into memory, CW “E”.
9. 31 63	S-Command 31, Enter message data into memory, CW “L”.
10. 31 63	S-Command 31, Enter message data into memory, CW “L”.
11. 31 66	S-Command 31, Enter message data into memory, CW “O”.
12. 31 02	S-Command 31, Enter message data into memory, End Of Message.
13. 64	S-Command 64, Terminate the end of this memory segment.
14.	If you are using the programming software, pick the “OK” button then pick the “Send” button to update the controller.
15. 68 043	If you are using DTMF, S-Command 68 will trigger the message or macro at start line 038. Use this to test your message. If you are using the programming software, you can use the “Send S-Cmd” dialog box to test this macro.
16. 69 1	If you using DTMF, S-Command 69 1 will lock the controller and save data, you are done.

Now you are ready to enter YOUR ID message. Use the above example to organize your message. It is important to know how the memory is organized so that you will know what the next available start line will be. The table below shows the default ID and how the above data was stored into memory.

The same data as above is illustrated here in the programming software. You can use the programming software to modify you ID, using the same syntax as described above.



Macro Data		
Line	Data	Description
043	310004	Station ID Message
044	995956	CW "HELLO"
045	636366	
046	CD	

1. The first two digits "31" make up the start of message marker. This data is automatically entered into memory as a result of the S-Command "31 01".
2. Each of the next groups of two digits represents each of the CW commands.
3. The first of the CW commands "00" resets this function to its defaults.
4. The "04", is the tone frequency for tone generator 1.
5. After the CW speed command, enter each of the characters you wish to use.
6. The last two data items are the end of message "C" and end of memory segment "D" commands. These two digits are the result of S-Commands "31 02" and "64".

Because the ID is the last item stored in the data memory, you do not need to worry about damaging other data in the memory. Please keep track of the memory used by your ID so that you will know the number of the next available start line.

Rather than using Morse code in some of your messages, you can use tones of various pitch or lengths with pauses in any of your messages. See the CW commands list. You can also use the same method as above to store a speech ID message, see section 11, S-Command 31.

Review the following procedure to enter "WXYZ / R" ID into the controller. When you un-key your radio after each command, you should hear the character function or the actual word in speech. This will tell you that you did everything correctly. If you hear an "ERROR", a mistake was made and the command was aborted.

S-Command	Description
1. 123456	Unlock the controller, you are in S-Command mode. You should notice a different courtesy tone.
2. 63 043	S-Command 63, set the memory data pointer (start line number pointer) to start line 043.
3. 31 01	S-Command 30, Enter message data into memory, Start Of Message.
4. 31 00	S-Command 30, Enter message data into memory, Reset to default values
5. 31 04	S-Command 30, Enter message data into memory, Set tone generator to 500Hz
6. 31 40	S-Command 30, Enter message data into memory, Set CW speed to 20wpm
7. 31 99	S-Command 30, Enter message data into memory, Delay one second.
8. 31 74	S-Command 30, Enter message data into memory, "W".
9. 31 75	S-Command 30, Enter message data into memory, "X".
10. 31 76	S-Command 30, Enter message data into memory, "Y".
11. 31 77	S-Command 30, Enter message data into memory, "Z".
12. 31 85	S-Command 30, Enter message data into memory, "/"
13. 31 69	S-Command 30, Enter message data into memory, "R"
14. 31 02	S-Command 30, Enter message data into memory, End Of Message.
15. 64	S-Command 64, Terminate the end of this memory segment.
16. 68 043	S-Command 68, Trigger a message or macro at start line 043. Use this to test your message.
17. 69 1	S-Command 69, Lock the controller and save data, you are done.

The table below shows the default ID and how the above data was stored into memory.

Macro Data		
Line	Data	Description
043	310004	Station ID Message
044	409974	CW "WXYZ /R"
045	757677	
046	8569CD	

1. The first two digits "31" are the start of message marker. This data is automatically entered into memory as a result of the S-Command "31 01".
2. Each of the next groups of two digits represents each of either the CW commands or words.
3. The first of the speech commands "99" is a pause for 1 second. This is used to keep messages from running together.
4. The actual speech message "WXYZ / R" is located after the delay.
5. The last two data items are the end of message "C" and end of segment "D" commands. These two digits are the result of S-Commands "31 02" and "64".

CHANGING YOUR PASSWORD

The controller comes pre-programmed with "123456" as the password to access the System Command (S-Command) mode. You can select a new 1 to 7-digit password. You can use any of the DTMF characters in your password. To reduce additional problems, compare your new password with the system commands to make sure it does not look like a system command. Example, do not use "010" as the password. If you are in the S-Command mode and accidentally send this password, you will turn off the system instead! Oops!!

You can also use the programming software to edit this message. Pick "Repeater" then pick "Passwords". You may then edit the "S-Command access" from this dialog box.

<u>S-Command</u>	<u>Description</u>
1.	Pick your new password, 1 to 7 digits. The default is 123456.
2. 123456	Unlock the controller, you are in S-Command mode.
3. 55 ??????	Enter S-Command 55 and your new password.

If you lock the controller with a mistake in the password, you will have to reset to all the factory defaults to regain access to the S-Command mode again.

4. 69 1	S-Command 69, Lock the controller and save your changes.
5. ??????	Check your new password, send "(Your password)", you SHOULD hear a function complete "OK".
6. 69 0	Re-lock the controller without saving changes.

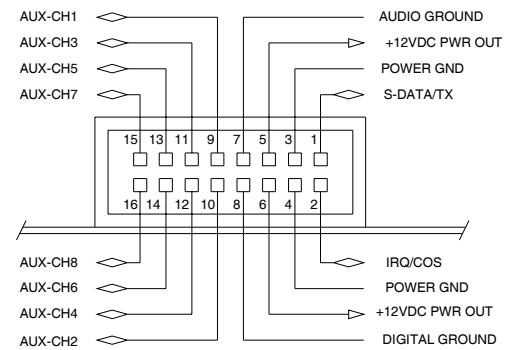
SECTION 9

AUXILIARY BUSS

The RI-1 has auxiliary input and output capability for connecting other RI-xxx repeater controllers together, or connecting to a single control receiver. Additional controllers will allow interconnection of multiple repeaters, remotes, links or a repeater with links and remotes. The Aux buss has eight audio channels and a digital serial data path to provide all the communication that is required when connecting multiple controllers together. For added protection, the serial data communication protocol contains an error check routine. If a controller does not receive valid data within four seconds, that controller will return to a normal operating mode. This feature is designed to prevent a transmitter from staying keyed-down because of a serial data communication failure.

CONNECTING MULTIPLE REPEATER CONTROLLERS TOGETHER

You can connect multiple RI-300 and/or RI-1 repeater controllers together using the auxiliary buss connector and a standard 16 pin flat cable. The cable should be pin to pin. Up to eight controllers can exist on one cable and the cable should have an overall length of no more than 6 feet. The auxiliary port has 8 audio channels in a full cross point configuration. This means that any controller can be connected to any other controller without interrupting other controllers on the buss. All controllers will exchange audio, PTT and command information. The PTT and S-Command information is sent between the controllers as serial data. A fixed data time-out timer is included in this protocol to protect against accidentally keying a transmitter. If data is not received for four seconds, the controllers will return to a normal operating mode. Any RI-300 and/or RI-1 controller attached to the buss can operate as a repeater, remote or link. This architecture of an independent controller for each radio port ensures maximum flexibility and reliable operation of your system.



Auxiliary Interface Connector

Auxiliary Buss and Programming Software

The auxiliary buss is disabled when using the programming port on any controller attached to the auxiliary buss, and during data transfer between the controller and your computer. The buss will be re-enabled when the data transfer is done.

Passing System Commands between Controllers

See section 12 and section 15 for more detailed information regarding this subject, passing systems commands between controllers.

Command information is sent from one controller to another by writing macros with data telling the controller to send S-Command information to another controller and not to process that S-Command within itself. To build a macro that will process S-Commands within the local controller, follow all the normal procedures in this manual and in the "Programming User Commands and Macros" section 12. To build a macro with S-Commands that will be processed by another RI-300 controller, you simply insert an "Ax" (where "x" is a numeral from 1 to 9) before the S-Command and its data within the macro. All data from the "Ax" through the "C" (S-Command separator) will be sent to the second controller. Each controller in the system will be assigned its own controller number. When sending a command to another controller, all controllers with the same controller number as the "A" number, will execute that S-Command. All "A1" controllers will respond to "A1" prefixed macro data. All "A3" assigned controllers will respond to the "A3" prefixed macro table data.

The controller number is also used to determine which audio channel that controller will use to output audio. You can then select which controllers you want to interconnect by turning on the correct audio inputs.

Note: The "controller unit address" is set with S-Command 39 and can be any address 1 through 9. The default address for the RI-1 and PE-1 is 8. Each controller on the buss will need to have its own unit address.

If using the RI-1, see section 6 for details on configuring the auxiliary audio channels.

SECTION 10

PROGRAMMING

Customizing the RI-1 for your application is performed through programming. Programming is done with System Commands (S Commands) and is performed over the air, over the telephone, or with the programming software. Not only can you change any of the system parameters, but you can also change or create your own user commands.

The RI-1 contains powerful tools in which to create User Commands and macros. User commands are commands that the user of the repeater will send to perform major functions, like making telephone calls. The user commands themselves will call macros that can contain many S-Commands. However, with the power to customize your repeater controller comes the responsibility of managing the memory where your custom commands will be stored. When creating new user commands, macros or messages, care should be taken to avoid damaging other data in the memory. See section 12 for additional information on this subject.

When controlling the RI-1, you are always in one of the two modes, never in both. To enter the programming mode the correct password (section 10) must be executed. To exit the programming mode and return back to the User Command mode the S-Command 69 0 or 69 1 is executed. Programming or S-Command mode is often referred to as the controller “unlocked mode” and the user command mode as the controller “locked mode”.

IMPORTANT NOTE: At all times the controller is in one of two command modes:

1. **Normal operating mode** where User Commands are functional (Locked).
2. **Programming mode** where System Commands (S-Commands) are used to customize the controller (Unlocked).

PROGRAMMING COMMAND FORMAT

Syntax is a common computer term, which means the format of a statement, command, or data that must be organized and entered such that the computer can recognize or understand what you are saying. The syntax of an S-Command consists of a two digit number ranging from 00 to 99, which identifies the S-Command itself. The S-Command is followed by data of various types and amounts. Each of the S-Commands listed in section 11 will detail its own syntax.

SYSTEM COMMAND MODE PASSWORD ACCESS

Prior to the access of any System Command or S-Commands, you must enter the valid password. Upon receipt of the valid password the RI-1 controller will return an acknowledgment message. At that time any system or S-Command may be issued. Any valid S-Command will also return the acknowledgment message (CW “OK”) or sometimes called a “function complete” telemetry or speech of the modified S-Command data. If the controller did not understand the S-Command, you will get an “ERROR” message.

The controller comes programmed with “123456” as the password to access the system command mode. You can change the password within the range of 1 to 7 digits. To reduce additional problems, check your new password with the system commands to make sure it does not look like a system command. Example, do not use “010” as the password. If you are in the system command mode and accidentally send the password “010”, you will turn off the system instead.

1. Pick your password, 1 to 7 digits. The default is 123456.
2. Unlock the controller, send "123456" and un-key, you will hear a function complete "OK".
3. Enter your new password, send "55 (Your password)" and un-key, you will hear a function complete "OK" not speech read back as this is considered to be sensitive data.
4. If you lock the controller with a mistake in the password, you will have to reset all the factory defaults to return to the default password. You can also use the programming software to fix the password.
5. When you are done, send "69 1" to lock the controller and save your new password.
6. Check your new password by sending "(Your password)" and un-key, you will hear "U" "L" in speech.
7. Re-lock the controller, send "69 0" this time, you do not need to save anything.

Forgot your Password?

Should you forget your password, you will have to use the programming software to correct it.

Some common Password problems

If the receiver input level or squelch is not set up correctly, the NSQ LED on the circuit board will not go out. Check your radio to make sure that it is correctly outputting a signal. You may also need to adjust the NSQ polarity with S-Command 00

Another common problem is the different modes (Unlocked and Locked) that can be confusing. After you enter the correct password, you then hear an "OK" message. A moment later (by mistake) you enter your password again. During this and following attempts, you receive an "ERROR" message. What happened? When the first password was executed and the controller was unlocked, you moved into the S-Command (programming) mode. While in the S-Command mode, (and if your password does not look like an S-Command) you should, and will, get an "ERROR" message because the controller was expecting an S-Command and saw your input as an S-Command with bad data. If your password looks like a valid S-Command to the controller, you will have executed an unexpected S-Command instead of the password. For example, if the default password were 123456, the response to the first time you entered the password would be an "OK" message. If you were to send a 123456 again, the controller will think you are trying to send a "12 3456" (which is not a valid S-Command). The controller should, and will, respond with an "ERROR" message.

Make sure to always re-lock your controller by sending the S-Command 69 1 (to save your changes) when you are finished programming. If you make a mistake while programming, you can send S-command 69 0 to lock your controller and NOT save your changes. There is also a time-out timer on the controller. When the controller is unlocked, the timer will automatically re-lock the controller 5 minutes after the last valid S-Command. When this occurs, you will hear "OK" message. Note that the controller will NOT save your changes when this timeout occurs.

VALID S-COMMAND and DATA

All DTMF digits are valid either as data in an S-Command or as macro data. Sometimes the DTMF character "C" and "D" are not valid as S-Command data within macros. The "C" and "D" characters are used by the macro programming. The RI-1 will check all data within an S-Command. If any of data fields are out of range, have an incorrect number of digits or have missing digits, the RI-1 will ignore both the S-Command and its data and will return an error message.

RULES FOR LEADING ZEROS IN S-COMMANDS

Leading zeros means that if a command requires a 3-digit value, whether the value is 001 or 100, a total of three digits must be used. All S-Command codes are two digits long. If the first digit of the S-Command is a zero it must always be entered. For most S-Command data, use the following rules:

1. If the data is a single parameter, then leading zeros are not required for the data. Example: The controller will see 01 or 1 as the same value if used as the last parameter.
2. All commands that require multiple parameters, require leading zeros for each parameter except for the last parameter. Example: Anytime an S-Command requires two or more data parameters (such as S-Command 40), the all data parameters must have leading zeros except for the last data parameter which does not require leading zeros.
3. If you are not sure, always use leading zeros especially when you are not yet familiar with the controller.

SECTION 11**SYSTEM COMMANDS**

The following section will detail each of the S-Commands showing syntax, examples, and the default data values. To execute an S-Command, you must first “unlock” the controller with the current password. When “unlocked”, user commands will not work. When you are done, “lock” the controller with S-Command 69 0 or 60 1. S-Command 69 0 will lock the controller without saving system changes, and 69 1 will lock the controller, saving the system changes. Some items are saved at the time you send the S-Command. The rest are saved on exiting the S-Command mode (S-Command 69 1). This difference is noted with each S-Command in the “SAVE” field as “RAM/EEPROM”.

The controller is always in one of two modes, (User Command or System Command) and never in both. When the power is first turned on, the controller is locked and in the User command mode. In this User mode, you will hear a single tone courtesy each time you un-key with a full quieting signal. If your signal is not full quieting, the courtesy message will change to a dual tone (indicating a weak signal). After you send the programming password, the RI-1 unlocks and will switch to a programming or System Command (S-Command) mode

Each time you send commands to the RI-1, you will get one of four responses.

1. If you send any valid command without errors, the RI-1 will respond with a CW acknowledgment message “OK”, or a function complete of your design. The “OK” message is of low pitch and has the rhythm of “dah dah dah dah di dah”.
2. If you send either an erroneous S-Command or a user command that has an error in its programming, the RI-1 will respond with the message “ERROR”.
3. If you send an invalid command, the RI-1 will not respond with any message.

When you are programming your RI-1 over the air, it is important to have a full quieting signal to the repeater. With a noisy signal, digits can be missed and the result of the command may not turn out the way you planned. The following lists some common problems people have:

- If you key up and send the first digit of the command before the CTCSS or DCS decodes a valid tone, the first digit is missed, and the command becomes invalid or worse yet, looks like some other valid command.
- If you move in and out of an RF null while sending a command, a digit may get missed, and the command becomes invalid or looks like some other valid command.
- If the RI-1 is in the S-Command mode, you may get errors if you are trying to send User Commands. Note that if you are still in the S-Command mode after 5 minutes have past without a command being sent, the controller will automatically lock. When this happens, you will hear an unexpected CW “OK” without sending a command.

S-Cmd 00 SIGNAL POLARITY

This command controls the polarity of the NSQ, TSQ and PTT signals. It is also used to set the type of RX audio that is connected to the controller (Emphasized and Non-emphasized audio).

As for signal polarity, setting the data value to 0 indicates an active low signal. Setting the data value to 1 indicates an active high signal. The factory default is active low on all signals, which is most common in many applications.

As for RX audio type, this controller will support both flat (discriminator) audio and emphasized audio. When connecting the controller to a audio source like EchoLink or IRLP, you will want to use emphasized audio.

SYNTAX: 00 [Item] [Mode]
 STORAGE: RAM/EEPROM
 PARAMETERS: Item 0 = NSQ (Noise Squelch), Mode 0 = Active Low, Mode 1 = Active High
 Item 1 = TSQ (Tone Squelch) , Mode 0 = Active Low, Mode 1 = Active High
 Item 2 = PTT (Push To Talk) , Mode 0 = Active Low, Mode 1 = Active High
 Item 3 = RX Audio Type (Tone Squelch) , Mode 0 = Flat (Discriminator), Mode 1 = Emphasized
 DEFAULT: Item 0 through 3 = Mode 0
 EXAMPLE: 0001 Change NSQ input to active High
 0031 Change RX Mode to Emphasized audio

S-Cmd 01 PORT RX REPEAT MODE

This command controls the conditions that are required to key the repeater and pass audio from the receiver to transmitter. This command does not affect the conditions when audio is sent or received from the auxiliary port. When the port repeat is in mode 0 (Off), audio is not routed from the receiver to the transmitter. When the controller port repeat is in mode 1, NSQ controls when audio is pass from the receiver to transmitter.

Modes 1 and 3 are used in normal repeater operation. Modes 2 and 4 are for special use operations. When using this controller as a remote base or non repeating link, this command should be set to mode 0.

SYNTAX: 01 [Mode]
 STORAGE: RAM/EEPROM
 PARAMETERS: Mode 0 = Repeat Off.
 Mode 1 = NSQ, Noise Squelch will switch audio. TSQ is ignored.
 Mode 2 = TSQ, Tone Squelch will switch audio. NSQ is ignored.
 Mode 3 = NSQ and TSQ, both Noise and Tone Squelch are required to switch audio from the receiver to the transmitter.
 Mode 4 = Open squelch. The receiver audio is routed to the transmitter at all times. Both NSQ and TSQ are ignored.
 DEFAULT: Mode 0 (Repeat audio is Off)
 EXAMPLE: 01 0 Turns off (disables) the repeat function of the controller
 01 3 NSQ and TSQ are required to repeat audio from the receiver to the transmitter

S-Cmd 02 RX GAIN ADJUST

This command is used to adjust or fine tune the receiver audio level. Coarse level adjustments are made with the manual potentiometer on the circuit board. After that, fine or remote adjustments of the receiver audio level can be made with this command.

SYNTAX: 02 [Level]
 STORAGE: RAM/EEPROM
 PARAMETERS: Level 0 to 24 = +/- 12db.
 Level 12 = 0db.
 DEFAULT: Level 12 (0db)
 EXAMPLE: 02 11 Reduce the receiver gain

S-Cmd 03 LOW PASS FILTER SELECT

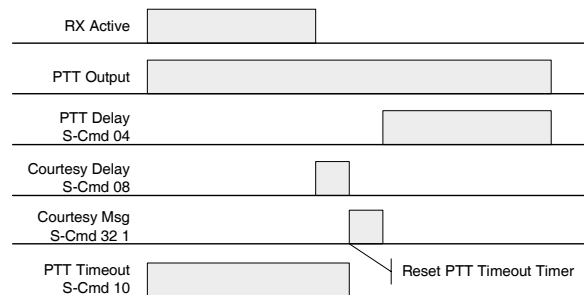
This controller has a low pass filter used to limit audio response to the transmitter. This filter removes high frequency audio that can cause adjacent channel interference. The filter is selectable for different application. If you are operating in a narrow band environment (12.5 to 15 KHz channel spacing) it is recommended to select the 2500 Hz cutoff frequency. If you are operating in a wide band environment (25 KHz or more channel spacing) it is recommended to use the 3500 Hz cutoff frequency.

- SYNTAX: 02 [Mode]
- STORAGE: RAM/EEPROM
- PARAMETERS: Mode 0 = 2500 Hz Cutoff.
 Mode 1 = 3000 Hz Cutoff..
 Mode 2 = 3500 Hz Cutoff..
 Mode 3 = 4000 Hz Cutoff..
 Mode 4 = 4500 Hz Cutoff..
- DEFAULT: Mode 1 (Reject Sub-Audio)
- EXAMPLE: 02 0 Turn off the sub-audio filter and pass CTCSS on the repeater output.

S-Cmd 04 TRANSMITTER PTT DELAY TIMER

This timer keeps the transmitter keyed after the receiver or auxiliary input has dropped. The repeater carrier delay is set in tenths of seconds (100 milliseconds) increments.

- SYNTAX: 04 [Time]
- STORAGE: RAM/EEPROM
- PARAMETERS: Time 0 = No carrier delay,
 1 to 255 = tenths of seconds
 (1/10 Seconds or 100 milli-seconds)
- DEFAULT: 30 (3.0 Seconds)
- EXAMPLE: 04 055 Set carrier delay to 5.5 seconds
 04 10 Set carrier delay to 1.0 second



S-Cmd 05 FORCE PTT ON

Keys up and “locks on” the transmitter for the selected number of seconds. This provides a constant transmitter signal for running tests such as measuring power output or checking signal coverage as you drive around. Once the timer has expired, it will not reset itself. You can clear or reset this timer by entering a zero value for the time.

- SYNTAX: 05 [Time]
- STORAGE: RAM (Power on reset = 0)
- PARAMETERS: Time 0 = Reset timer, 0.1 to 25.5 = Seconds, in tenth of second increments
- DEFAULT: 0
- EXAMPLE: 05 120 Lock on the repeater transmitter for 12.0 seconds
 05 255 Lock on the repeater transmitter for 25.5 seconds
 05 0 Reset this timer

S-Cmd 06 SUPRESS FUNCTION ACKNOLODGMET

This command is typically only used in macros and will suppress or enable the controller function acknowledgment for one time only. After a user command, the function acknowledgment is automatically played, unless a custom message in embedded in the command. Also, if an input or message event is detected, the controller will automatically suppress the function acknowledgment. This command can be used to suppress or force a functions acknowledgment outside the controller’s normal operation.

- SYNTAX: 06 [Mode]
- STORAGE: RAM
- PARAMETERS: Mode 0 = Clear or force a function suppression one time only.
Mode 1 = Suppress function acknowledgment one time only.
- DEFAULT: NA, User commands are not suppressed and all events are suppressed.
- EXAMPLE: 06 1 Suppress function acknowledgment one time only

S-Cmd 07 ID INTERVAL TIMER

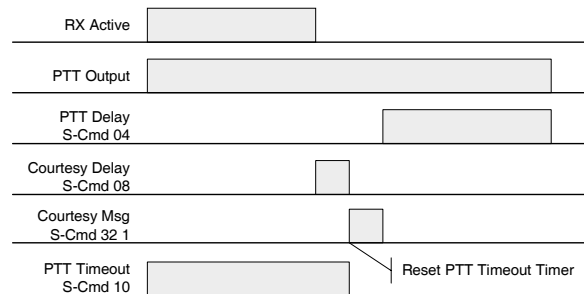
This command selects the time interval between instances of the CW ID (station identification). The ID will try to be courteous in that it will wait for the user to un-key before the controller sends the ID. A final station ID will also occur after the repeater activity has stopped and the timer has elapsed.

- SYNTAX: 07 [Time]
- READ BACK: 07
- STORAGE: RAM/EEPROM
- PARAMETERS: Time 0 = Disable ID, 1 to 255 = tenths of minutes (1/10 Minutes or 6 second increments)
- DEFAULT: 100 (10.0 Minutes)
- EXAMPLE: 07 55 Set 5.5 Minutes between IDs

S-Cmd 08 COURTESY MESSAGE TIMER

The courtesy message timer is the selected time between the end of COS (carrier dropping), to the start of a courtesy message. This applies to ALL types of courtesy messages. If the carrier is picked up prior to the courtesy timer expiration, the courtesy message will be skipped. When the courtesy message is started, the repeater time-out timer is reset.

- SYNTAX: 08 [Time]
- STORAGE: RAM/EEPROM
- PARAMETERS: Time 0 = Disable Courtesy,
1 to 99 = tenths of seconds (1/10 Seconds)
- DEFAULT: 15 (1.5 Seconds)
- EXAMPLE: 08 35 3.5 Seconds

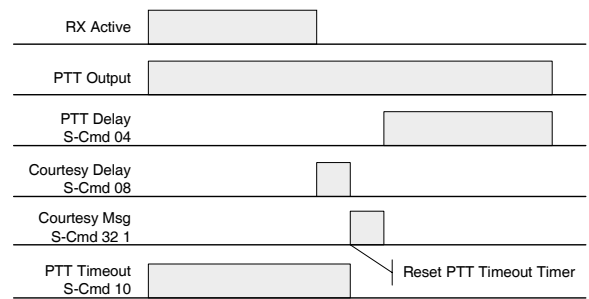


S-Cmd 09 RESERVED

S-Cmd 10 PTT TIMEOUT TIMER

The time-out timer sets the maximum time length of a single user transmission, not necessarily the repeater transmitter key time. When the user's transmission time has been exceeded, the repeater transmitter PTT is turned off, un-keyed. The COS must drop and the courtesy message started for this timer to reset.

SYNTAX: 10 [Time]
 READ BACK: 10
 STORAGE: RAM/EEPROM
 PARAMETERS: Time 0 = Disable time-out,
 1 to 255 = tenths of minutes, 6 second
 increments.
 DEFAULT: 0 (0 Disabled)
 EXAMPLE: 10 30 The repeater will time out
 after 3.0 minutes.



S-Cmd 11 ALTERNATE COMMAND TERMINATOR

In a normal command sequence, the drop of the NSQ and/or TSQ is used to tell the controller to start processing your command. You can select an alternate DTMF digit or mode that will also terminate a command, such as if the squelch were not working or if you wanted to string commands together.

If you use a DTMF digit to terminate a command, do not select a DTMF digit that you are using within a user command; for that command will not be processed.

If you use a minimum length command terminator, all user commands of less length or wildcard commands will be ignored. However, these commands can be processed after the drop of the COS or by the expiration of the inter-digit timer. If you use the minimum length command terminator, the controller starts looking and comparing standard user commands after the minimum command digit length has been met.

SYNTAX: 11 [Terminate]
 STORAGE: RAM/EEPROM
 PARAMETERS: Terminate 0 = None, COS or CTCSS/DCS, 1 = DTMF "A", 2 = DTMF "B", 3 = DTMF "C",
 4 = DTMF "D", 5 = DTMF "*", 6 = DTMF "#", 7 = DTMF Inter-digit timer only,
 8 = Minimum 1 digit commands and inter-digit timer,
 9 = Minimum 2 digit commands and inter-digit timer,
 10 = Minimum 3 digit commands and inter-digit timer,
 11 = Minimum 4 digit commands and inter-digit timer,
 12 = Minimum 5 digit commands and inter-digit timer,
 13 = Minimum 5 digit commands and inter-digit timer,
 14 = Minimum 6 digit commands and inter-digit timer,
 15 = Minimum 7 digit commands and inter-digit timer,
 16 = Minimum 8 digit commands and inter-digit timer.
 DEFAULT: 7 (Inter-digit timer)
 EXAMPLE: 11 10 Select Minimum 3 digit commands as the alternate command terminator

S-Cmd 12 RESERVED

S-Cmd 13 USER COMMAND DTMF MODE

You can use this setting to select NSQ and/or TSQ signals to allow decoding of User Commands. This setting is independent from the repeater or linking operation.

SYNTAX: 13 [Mode]
 STORAGE: RAM/EEPROM
 PARAMETERS: Mode 0 = Disable or turn off user command decoding.
 Mode 1 = NSQ Only, Mode 2 = TSQ Only, Mode 3 = NSQ and TSQ.
 DEFAULT: Mode 1, NSQ
 EXAMPLE: 13 3 Use both NSQ and TSQ to process User Commands

S-Cmd 14 SYSTEM COMMAND DTMF MODE

You can use this setting to select NSQ and/or TSQ signals to allow decoding of System Commands. This setting is independent of the repeater or linking operation.

SYNTAX: 14 [Mode]
 STORAGE: RAM/EEPROM
 PARAMETERS: Mode 0 = Disable or turn off user command decoding.
 Mode 1 = NSQ Only, Mode 2 = TSQ Only, Mode 3 = NSQ and TSQ.
 DEFAULT: Mode 1, NSQ
 EXAMPLE: 14 3 Use both NSQ and TSQ to process User Commands

S-Cmd 15 USER COMMAND GROUP DECODE ENABLE

This command is used to turn on or off any one of two groups of User Command. When you build a user command, you are asked to identify one of two groups into which the command is placed. You can then use this command to enable or disable any one of the two groups.

SYNTAX: 15 [Group] [Mode]
 STORAGE: RAM/EEPROM
 PARAMETERS: Group 0-1 = Each User Command is assigned a group
 Mode 0 = Group disable, turn off a user command group.
 Mode 1 = Group enable, turn on a user command group.
 DEFAULT: Group 0 = 1 (Enable), Group 1 = 0 (Disable)
 EXAMPLE: 15 0 0 Disable (turn off) group 0

S-Cmd 16 DTMF INTER-DIGIT TIME

This command sets the maximum time allowed between DTMF digits in a valid command sequence. If the Inter-digit timer times out before completing a command, the command will be terminated without execution.

SYNTAX: 16 [Data]
 STORAGE: RAM/EEPROM
 PARAMETERS: Data 1-99 = Time in Tenths of seconds (1/10 Seconds or 100 ms)
 DEFAULT: 35 (3.5 Seconds)
 EXAMPLE: 16 50 Sets Inter-digit time to 5.0 Seconds
 16 25 Sets Inter-digit time to 2.5 Seconds

S-Cmd 17 DTMF MUTE DELAY TIME

This command sets the time that audio is muted when DTMF tones are decoded. Use S-Command 18 to control the use of muting for the repeater, auxiliary and telephone audio.

SYNTAX: 17 [Time]
 STORAGE: RAM/EEPROM
 PARAMETERS: Data 1-99 = Time in Tenths of seconds (1/10 Seconds or 100 ms)
 DEFAULT: 25 (2.5 Seconds)
 EXAMPLE: 17 50 Set mute time to 5.0 Seconds

S-Cmd 18 RESERVED**S-Cmd 19 GENERATE DTMF OUT**

This command is used to regenerate a received DTMF string on the main port transmitter. The data source for this command can come from decoded DTMF digits or data within a macro. The controller regenerates DTMF tones with 120 ms tone ON time and 80 ms spacing. Valid DTMF digits are 0 through 9, A, B, C, D, *, #. (If a DTMF digit is used as an alternate command terminator, that digit may not be used as data in this command). The DTMF regenerate buffer has a maximum length of 15 DTMF digits. This command can also be used in a macro to generate a DTMF string upon a user command, however, DTMF B, C and D can not be used do to the special use of these digits within macros.

SYNTAX: 19 [Data]

STORAGE: RAM

PARAMETERS: Data = 1 to 15 DTMF characters 0 through 9, A, B, C, D, *, #. (B through D are not allowed in macros)

DEFAULT: N/A

EXAMPLE: 19 1234567890*# Resends DTMF digits 1234567890*# on main port transmitter

S-Cmd 20 REMOTE BASE INTERFACE MODE

This command is used to set select the mode and type of synthesized radio that will be connected to the controller's main port. Currently only EchoLink is supported. We will be adding more radios in the near future.

SYNTAX: 20 [Mode]

STORAGE: RAM/EEPROM

PARAMETERS: Mode 0 = **None**: This mode is used for repeater or full duplex link operation.

Mode 1 = **EchoLink**: In this mode, the controller used the RTS and CTS singles for EchoLink RX and TX. In this mode, serial data can be sent to EchoLink to select nodes and other features. All of these signals from the controller are RS-232 levels. No external level converters are needed.

DEFAULT: Mode 0

EXAMPLE: 20 1 Select EchoLink mode

S-Cmd 21 REMOTE BASE USER FUNCTIONS BITS

To be added in the near future.

S-Cmd 22 REMOTE BASE USER FUNCTION BYTE

To be added in the near future.

S-Cmd 23 REMOTE BASE RADIO FUNCTIONS BITS

To be added in the near future.

S-Cmd 24 REMOTE BASE FREQUENCY SET

This command is used to set the frequency for both transmit and receive frequency in of a synthesized radio that is connected to the controller.

SYNTAX: 24 [TX/RX] [Frequency] <Offset>

STORAGE: RAM/EEPROM (This value is not pushed onto the stack and will not reset during initialization)

PARAMETERS: TX/RX 1 = Transmit frequency, 2 = Receive frequency

Frequency = Up to 8 digits, First digit of frequency is the 100s MHz digit and trailing zeros are not required. Upper and Lower frequency limits set by S-Command 93

Offset (Optional for RX) #1 = Minus, #2 = Simplex, #3 = Plus

DEFAULT: N/A

EXAMPLE: 24 1 45445 Set the transmit frequency to 454.450 MHz

24 2 45945 Set the receive frequency to 459.450 MHz

S-Cmd 25 REMOTE BASE TSQ SELECT

To be added in the near future.

S-Cmd 26 REMOTE BASE TSQ MODE

To be added in the near future.

S-Cmd 27 REMOTE BASE TX POWER SELECT

To be added in the near future.

S-Cmd 28 REMOTE BASE SQUELCH ADJUST

To be added in the near future.

S-Cmd 29 REMOTE BASE VOLUME CONTROL

To be added in the near future.

S-Cmd 30 REMOTE BASE CUSTOM FUNCTION SET

To be added in the near future.

S-Command 31 TONE GENERATOR MESSAGE EDITOR

Tone generator messages include the station ID, courtesy tones and telemetry. This command is used to edit and store message data into the system memory. The messages consist of either tone generator or CW commands in sequence. Each of these commands consists of a 2-digit value and is used to tell the controller's tone generator what to do. These commands include setting the tone frequency, CW code speed, CW character, beeps and pauses. The messages are stored in the same memory area as macros. For this reason, it is important to manage and track the memory usage so as not to damage other data stored in the memory.

There are two types of messages that you will be creating and editing.

1. Messages that are triggered by the controller. These are the most common type of messages and include the station ID, courtesy and telemetry. S-Command 32 is used to define each message that is played when the associated event occurs.
2. Messages that are imbedded within macros. These messages are usually included with S-Commands in the same macro. These macros are typically triggered by a user command.

The system memory is used for both macros and messages. This memory is organized with 255 lines of data storage, each line consisting of 6 digits. All messages and macros must start at the beginning of a line. Each line has a starting number from 001 to 255. Both message triggers and user commands with triggers use the start line address as the starting location of the message or macro. To edit a message, you must first set a pointer to the start line where you want to start your message. Do this with S-Command 63. Next, start building your message. For the message to work correctly, you must include a "Start of Message" command (31 01) as the first entry. The following entries are the message itself (31 XX). The message is completed with an "End of Message" command (31 02), then finally an end of data command (64) as the last entry. For the purpose of tracking the amount of digits stored in memory, the "Start of Message" consumes 2 digits "31". The "End of Message" command consumes 1 digit "C". The end of data command consumes 1 digit "D". All other message commands consume 2 digits each.

Tone Generator Command Descriptions

RESET	Reset Tone generator TG1 = 1000Hz, TG2 = Off, Level = 4, CW Speed = 15wpm.
TG1	Tone generator #1, you can independently control frequency of this generator.
TG2	Tone generator #2, you can independently control frequency of this generator.
TONE	Predefined tones, used to set the frequency of the tone generator.
LEVEL	Sets the modulation level of the tone generator. "36" is full modulation (about 5 KHz deviation).
CW SPEED	Sets the speed of any CW characters following this command.
CW...	A specified list of Morse code characters used in a message
TONE ON	Turn on the currently configured tone generator to the defined destination.
TONE OFF	Turn off the currently configured tone generator to the defined destination.
DELAY	Sets the amount of delay between tone generator commands.

SYNTAX: 31 [CW Command]

STORAGE: EEPROM

PARAMETERS: 2 digit tone generator commands ranging from 00 to 99, see tone generator commands below

DEFAULT: See default messages below.

EXAMPLE: See example in section 8.

Default Tone Generator Messages

Start line 030	31 00 06 39 99 66 62 C D	Function acknowledgment "OK"
Start line 033	31 00 30 00 56 69 69 66 69 C D	Function error "ERROR"
Start line 037	31 00 06 98 92 96 C D	Main port RX courtesy
Start line 040	31 00 11 98 92 96 C D	Auxiliary input courtesy
Start line 043	31 00 04 99 59 56 63 63 66 C D	Station ID "HELLO"

Tone Generator Command List

TONE GENERATOR COMMAND TABLE					
Data	Operation	Data	Operation	Data	Operation
00	Reset tone generator	34	Set TG Level 8	68	CW "Q"
01	Start Of Message	35	Set TG Level 9	69	CW "R"
02	End Of Message	36	Set TG Level 10	70	CW "S"
03	TG1, Tone generator off	37	CW speed, 5 WPM	71	CW "T"
04	TG1, Tone at 500 Hz	38	CW speed, 10 WPM	72	CW "U"
05	TG1, Tone at 600 Hz	39	CW speed, 15 WPM	73	CW "V"
06	TG1, Tone at 700 Hz	40	CW speed, 20 WPM	74	CW "W"
07	TG1, Tone at 800 Hz	41	CW speed, 25 WPM	75	CW "X"
08	TG1, Tone at 900 Hz	42	CW "0"	76	CW "Y"
09	TG1, Tone at 1000 Hz	43	CW "1"	77	CW "Z"
10	TG1, Tone at 1200 Hz	44	CW "2"	78	CW Space
11	TG1, Tone at 1400 Hz	45	CW "3"	79	CW "+"
12	TG1, Tone at 1600 Hz	46	CW "4"	80	CW "-"
13	TG1, Tone at 2000 Hz	47	CW "5"	81	CW "("
14	TG1, Tone at 2500 Hz	48	CW "6"	82	CW "="
15	TG2, Tone generator off	49	CW "7"	83	CW Comma ","
16	TG2, Tone at 500 Hz	50	CW "8"	84	CW Period "."
17	TG2, Tone at 600 Hz	51	CW "9"	85	CW "/"
18	TG2, Tone at 700 Hz	52	CW "A"	86	CW "?"
19	TG2, Tone at 800 Hz	53	CW "B"	87	CW Colon ":"
20	TG2, Tone at 950 Hz	54	CW "C"	88	CW Semicolon ";"
21	TG2, Tone at 1000 Hz	55	CW "D"	89	CW "]"
22	TG2, Tone at 1200 Hz	56	CW "E"	90	CW "@"
23	TG2, Tone at 1400 Hz	57	CW "F"	91	Tone off
24	TG2, Tone at 1600 Hz	58	CW "G"	92	Tone on
25	TG2, Tone at 2000 Hz	59	CW "H"	93	Delay for 10 ms
26	TG2, Tone at 2500 Hz	60	CW "I"	94	Delay for 20 ms
27	Set TG Level 1	61	CW "J"	95	Delay for 50 ms
28	Set TG Level 2	62	CW "K"	96	Delay for 100 ms
29	Set TG Level 3	63	CW "L"	97	Delay for 200 ms
30	Set TG Level 4	64	CW "M"	98	Delay for 500 ms
31	Set TG Level 5	65	CW "N"	99	Delay for 1000 ms
32	Set TG Level 6	66	CW "O"		
33	Set TG Level 7	67	CW "P"		

Reset Tone Generator Command

The "Reset Tone Generator" command performs the following functions:

- Set TG1 = 1000Hz
- Set TG2 = Off
- Set Level = 4
- Set CW Speed = 15wpm

It is good practice to always reset the Tone Generator in all of your CW messages. You can also set each of the 4 items listed above in your message. If you do not address these items, their settings will be left over from the previous message played.

S-Cmd 32 SET MESSAGE EVENTS

This command is used to assign controller events to trigger messages. Event triggers are items like ID, courtesy messages and function telemetry. These triggers point to a starting line in the macro data memory. When an event occurs, the trigger instructs the controller to execute a message or command from the macro data memory. The default triggers can be changed so each event can trigger any of the 255 macro line numbers or 0 for no messages. Setting an event to start at line 0 will disable that event from triggering anything. See section 8 and 13 for additional information in programming messages and triggers.

Message Events: These are internal events that normally trigger messages. When the controller needs to play a message, it looks at the value in this event to determine what the address of the message or macro to play.

SYNTAX: 32 [Message Event] [Start line]
 STORAGE: EEPROM
 PARAMETERS: Message Event 1-5 = Message Event numbers listed in the table below
 Start Line 000 = Disable trigger, 001-255 (Macro data memory start line address)
 DEFAULT: See table below
 EXAMPLE: 32 4 120 Sets ID event to start line 120
 EXAMPLE: 32 2 0 Sets Auxiliary Input courtesy to no message

Trigger #	Messages Events	Start line
1	Repeater or main port RX courtesy	037
2	Auxiliary input courtesy	040
3	Message, Station ID	043
4	Message, Acknowledge	030
5	Message, Error	033

S-Cmd 33 RESET MESSAGE

This command is used to terminate a tone generator message already in process or all messages that are waiting to be played.

SYNTAX: 33 [Mode]
 STORAGE: N/A
 PARAMETERS: Mode 0 = Terminate current message already in process
 Mode 1 = Terminate current and all messages waiting to be played
 DEFAULT: N/A
 EXAMPLE: 29 1 Terminate current message and all messages waiting for playback

S-Cmd 34 AUXILIARY OUTPUT MODE

The auxiliary port allows you to connect multiple controllers together. This command sets up the mode for the output of audio and PTT logic to other controllers. The RI-xxx has 8 audio channels connected to the auxiliary buss. Use S-Command 39 and on board jumpers to assign a channel on which to output both audio and serial data. This command is then used to enable audio output on that channel. See section 15 “Setting Up Audio Channels” for more information on this subject.

SYNTAX: 34 [Mode]
 STORAGE: RAM/EEPROM
 PARAMETERS: Mode 0 = **Off:** Used to disable the auxiliary output. The controller will not send audio or control logic out the auxiliary buss for other controllers to receive.
 Mode 1 = **NSQ (COS):** The controller will send audio out the auxiliary buss when the local controller’s receiver is active; TSQ is ignored.
 Mode 2 = **TSQ (CTCSS):** The controller will send audio out the auxiliary buss when the local controller’s receiver is decoding TSQ (CTCSS); NSQ is ignored.
 Mode 3 = **NSQ and TSQ:** The controller will send audio out the auxiliary buss when the local controller’s receiver NSQ and TSQ are active.
 Mode 4 = **On:** The controller will send audio out the auxiliary buss at all times; both NSQ and TSQ are ignored.
 DEFAULT: Mode 0 (Auxiliary output off)
 EXAMPLE: 34 1 Mode 1, Auxiliary output when local COS is active.

S-Cmd 35 AUXILIARY INPUT MODE

The auxiliary port allows you to connect multiple controllers together. The RI-xxx has 8 audio channels connected to the auxiliary buss. Use this command and on board jumpers to assign a channel on which to receive audio. This command allows you to enable and disable audio on any one of the eight channels. Enabling an audio channel also enables input on the same serial data channel. See section 15 “Setting Up Audio Channels” for more information on this subject.

SYNTAX: 35 [Input]
 STORAGE: RAM/EEPROM
 PARAMETERS: Input: 0 = Off, 1–9 = Channel 1 to 9 on the auxiliary buss.
 DEFAULT: Auxiliary input is 0 (Off).
 EXAMPLE: 35 1 Turn on input 1
 35 0 Turn off input

S-Cmd 36 AUXILIARY INPUT MUTE/MIX MODE

This command selects whether the audio channel is mixed with the local receiver audio or muted when the local receiver audio is active. See section 15 “Setting Up Audio Channels” for more information on this subject.

SYNTAX: 36 [Mode]
 STORAGE: RAM/EEPROM
 PARAMETERS: Mode 0 = **Mute**: The controller will mute audio from the auxiliary input channel when the local receiver is active. Used when enabling audio from a half duplex link or remote base radio.
 Mode 1 = **Mix**: The controller will mix audio from the auxiliary input channel with the local receiver audio. Used when enabling audio from a full duplex link.
 DEFAULT: Mode 0 (Mute).
 EXAMPLE: 36 1 Mix mode

S-Cmd 37 REGENERATE FROM THE AUXILIARY INPUT

This function determines if DTMF tones from the auxiliary input will be regenerated on the local TX. Regenerated DTMF tones are 120 ms long. When the DTMF mute on enabled in another controller, you can ensure quality DTMF tones to your link by using this regeneration mode.

SYNTAX: 37 [Mode]
 STORAGE: RAM/EEPROM
 PARAMETERS: Mode: 0 =Off, 1 = On
 DEFAULT: 0
 EXAMPLE: 37 1 Regenerate DTMF digits on TX from auxiliary input

S-Cmd 38 AUXILIARY GAIN ADJUST

This command is used to adjust or fine tune the auxiliary input audio level.

SYNTAX: 38 [Level]
 STORAGE: RAM/EEPROM
 PARAMETERS: Level 0 to 24 = +/- 12db.
 Level 12 = 0db.
 DEFAULT: Level 12 (0db)
 EXAMPLE: 38 11 Reduce the receiver gain

S-Cmd 39 CONTROLLER UNIT ADDRESS

This command is used to assign a unique unit address to each RI-1 connected on the Auxiliary buss. When connecting multiple controllers together, you must assign each controller a unique unit address. Controllers on the buss can talk to each other using the serial data protocol if each controller has its own unit address. This unit address also defines the audio channel on which the controller will output audio on the auxiliary buss. Valid unit addresses are 1 through 9 with the default being 1. A controller at address 9 is different in that it can send and receive commands on the buss, but will not use an audio channel. A controller with a macro containing a unit address with an S-Command will process the S-Command in the addressed controller. The unit address and S-Command is sent to the auxiliary port. This address will be checked against the addresses of all the controllers connected to the auxiliary buss. A controller with a matching address will execute the S-Command. These externally executable S-Commands start with an "A" prefix and the destination unit address, e.g.: "A2". The S-Command following the A2 will be executed by a controller with the unit address of "2".

SYNTAX: 39 [Address]
 STORAGE: EEPROM
 PARAMETERS: Address 1-9 = Unit (controller) address on the auxiliary buss
 DEFAULT: 1
 EXAMPLE: 39 3 Sets controller unit address to 3.

S-Cmd 40 DELAY TIMER EVENT

With this command, you can delay the execution of a macro to some time in the future. There are 2 timers available. When the selected timer expires, the macro located at the specified address in the "Start Line" field will be executed. An application example could be to turn on the CTCSS repeater tone panel after a preset time has expired. Note: This function automatically suppress the "OK" (function complete) without any additional instructions included in the macro. You can use S-Command 06 re-enable the function message. This command is a one time only. Once you set up a timer and the timer expires, the timer is reset and ready to be setup again. A default can be stored in non-volatile memory (EEPROM) to produce a power on reset macro.

SYNTAX: 40 [Timer] [Start Line] [Time]
 STORAGE: RAM (Return to default at power on reset)
 PARAMETERS: Timer 1-2 = Timer number
 Start Line 000 = Disable this function, 001-255 Macro data start line
 Time 0 = Reset timer, 1-255 1/10 second increments (25.5 seconds maximum)
 DEFAULT: All timers, Start Line = 000, Time = 0
 EXAMPLE: 40 1 000 0 Clear timer 1, no macro will execute.
 40 2 060 120 Timer 2 will execute macro at start line 60 in 12.0 seconds.

S-Cmd 41 RECEIVER INACTIVITY TIMER EVENT

The receiver inactivity timer can be used to set an item within the system when the repeater receiver becomes inactive for the preset time. There are 2 timers available. Once this timer is started, it is restarted after each occurrence of receiver activity. When a time-out occurs, the macro pointed to by the "Start Line" field will execute. An application example: A controller in COS mode can use this function to turn on the CTCSS tone decode after there has been no activity on the repeater for the set time. **Note:** This function automatically suppress the "OK" (function complete) without any additional instructions included in the macro. You can use S-Command 06 re-enable the function message. This command is a one time only. Once you set up a timer and the timer expires, the timer is reset and ready to be setup again. A default can be stored in non-volatile memory (EEPROM) to produce a power on reset macro.

SYNTAX: 41 [Timer] [Start Line] [Time]
 STORAGE: RAM (Return to default at power on reset)
 PARAMETERS: Timer 1-2 = Timer number
 Start Line 000 = Disable this function, 001 - 255 Macro data start line.
 Time 0 = Reset timer, 1-255 in 6 second increments (1 to 25.5 minutes).
 DEFAULT: All timers, Start Line = 000, Time = 0.
 EXAMPLE: 41 1 000 0 Clear timer 1, no macro will execute.
 41 2 022 55 Timer 2 will execute macro at start line 22 after 5.5 minutes.

S-Cmd 42 REGULAR INTERVAL EVENT

This command is used to configure a timer that will trigger a macro at a Start Line address at a regularly timed interval. There are 2 timers available. You can use this timer to trigger a macro line that starts the ID, if you want to have a beacon ID.

SYNTAX: 42 [Timer] [Start Line] [Time]

STORAGE: RAM/EEPROM

PARAMETERS: Timer 1-2 = Timer number

Start Line 000 = Disable this function, 001 – 255 Macro data start line.

Time 0 = Reset timer, 1-255 in 6 second increments (1 to 25.5 minutes).

DEFAULT: All timers, Start Line = 000, Time = 0.

EXAMPLE: 42 1 123 100 Timer 1 will trigger macro starting at line number 123 every 10.0 minutes.
42 2 000 0 Disable timer 2.

S-Cmd 43 RESERVED**S-Cmd 44 RESERVED**

S-Cmd 45 PORT INPUT – STATE CHANGE EVENT

The controller has two digital inputs on board that can trigger macros. Each of these inputs can be configured to act on either a negative or positive state change (falling and rising edges). When the controller detects any changes in these inputs or functions, a macro starting at the “Macro Start Line” (1 through 255) will be executed. To disable an input or function, use 0 as the Macro Start Line. See section 4 and 5 for information on the connector pin numbers for each input. This feature can be used to generate an alarm message on change of an input state.

SYNTAX: 45 [Bit] [Macro start line]

STORAGE: RAM/EEPROM

PARAMETERS: Bit 1 = Input 1 falling edge (High to Low), Bit 2 = Input 1 rising edge (Low to High)
 Bit 3 = Input 2 falling edge (High to Low), Bit 4 = Input 2 rising edge (Low to High)
 Macro start line 0 = Disable, 1 – 255 = Macro start lines

DEFAULT: All bits set to 0

EXAMPLE: 45 1 10 Input #1 Falling edge triggers macro starting at line 10.
 45 2 11 Input #1 Rising edge triggers macro starting at line 11.

S-Cmd 46 PORT OUTPUT ON / OFF

The controller has two digital outputs on board and is expandable to 10 outputs. Each of these outputs can be directly turned on or off with this command. See section 4 and 5 for information on the pin numbers for each output. This function can be used to turn on something external to the controller.

SYNTAX: 46 [Output] [Mode]

READ BACK: 46 [Output]

STORAGE: RAM (Return to default at power on reset)

PARAMETERS: Output 1-1 = On board outputs
 Mode 0 = off (logic low), 1 = on (logic high)

DEFAULT: All outputs are off or logic low when power is turned on

EXAMPLE: 46 1 1 Turns output number 1 on or logic high

S-Cmd 47 through 54 RESERVED**S-Cmd 55 PASSWORD FOR S-COMMAND ACCESS**

The PASSWORD is used to unlock the controller for access to the S-Commands. The factory default password is 123456 and can be changed to another set of digits from 1 to 7 digits long. When selecting a password, you should avoid using one that is similar to a user command or the exact equivalent to an S-Command and its data. For more information on passwords, see section 10 of this manual.

SYNTAX: 55 [Password]

STORAGE: EEPROM

PARAMETERS: Password = 1 to 7 DTMF digits 0 through 9, *, #, A through D

DEFAULT: 123456

EXAMPLE: 55 34*685 The new password is now 34*685
 55 12 The new password is now 12

S-Cmd 56 RESERVED**S-Cmd 57 RESERVED**

S-Cmd 58 REMOTE SOFTWARE RESET

This command allows a method for resetting the controller remotely, just the same as if you were to do a power on reset.

SYNTAX: 58

STORAGE: N/A

PARAMETERS: Hard coded 19

DEFAULT: N/A

EXAMPLE: 58 19 Resets the controller software only.

S-Cmd 59 REMOTE EEPROM INITIALIZE

This command allows you to remotely reset your EEPROM (Non-Volatile Memory) data with factory defaults.

SYNTAX: 59

STORAGE: N/A

PARAMETERS: Hard coded 86.

DEFAULT: 86

EXAMPLE: 59 86 Initialize the EEPROM only.

S-Cmd 60 RESERVED**S-Cmd 61 RESERVED**

S-Command 62 DEFINING USER COMMANDS

S-Command 62 provides the means to create a user commands. There are four types of User Commands. Each type is discussed below. To clear a User Command name, send S-Command 62 followed by the command number you want to clear.

When the controller is locked (User command mode) and a user sends a command, the controller compares this incoming command with the list of commands defined by this S-Command. The controller compares the length of the command and the digits in the command, looking for a match. If the controller finds a match, it will look up the macro start line and then execute the macro.

The types of User Commands are:

Standard: Standard user commands must match exactly with a command in the stored list. Both the digits themselves and the total number of digits must match. If there are any extra digits in the command, the command will be rejected.

S-Commands: This type is used to define a “User System Command”. User System Commands are S-Commands that are renamed as “User Commands”. These created user commands allow appended digits after the command name, digits which are passed along to the S-Command to which it points. Specify the number of the S-Command you want to execute instead of the number of the macro start line as used in the Standard type User Command. The S-Command value should include one leading zero. Example: S-Command 05 should be entered as “005”.

Wildcard: Wildcard commands allow extra digits to be included within the command. These extra digits can then be passed to one or more S-Commands within the macro called by that wildcard command. Multiple groups of digits can be passed to multiple S-Commands within the macro. The wildcard command’s digits will replace all instances of “Bxx” in the macro with the digits from the user command. Within the Bxx wildcard, the first “x” is an index and defines the first position of the wildcard data to use. The first character in the wildcard data is numbered as character zero (0). The second “x” is the number of characters to be used from the wildcard. A Zero (0) placed here will cause the controller to use all the remaining characters in the wild card. See the following example:

Define a wildcard command with “14” as the name of the command. This command will set the frequency of a 2-meter remote base radio. When the user enters “14652” the controller will find “14” as a user command, and define 652 as the wildcard data. In the macro called by User command 14, include the following S-Command: (91 12 14 B00 #2).

The “91 12” will set the receive frequency. The “14” defines the first two digits in the frequency. The “B00” tells the controller to use all the characters in the wild card. The “#2” sets the transmitter to simplex. You could create a “14*” and “14#” command to set plus and minus offsets. The end effect is the same as programming S-Command “91 12 14652 #2”.

In this example, define a wildcard command with “*5” as the name of the command. This command will send a key-down transmitter time to a controller attached to the auxiliary buss. When the user enters “*5355” the controller will find *5 as a user command, and define 355 as the wildcard data. In the macro called by User command *5, include the following S-Command: (A B01 05 B10). The “A” will address a controller on the auxiliary buss. The “B01” will get the first (number 0) character “3”, and append it to the “A” part of the command, defining the third controller on the auxiliary buss as the one to which the S-Command is sent, (A3). The “05” S-Command will set the TX on for “x” time. The “B10” will tell the controller to use all the remaining digits (55) starting with the digit numbered 1. The end effect is the same as programming S-Command “A3 05 55”

SYNTAX: 62 [Command number] [Command type] [Group] [Macro start line] [Command name]

STORAGE: EEPROM

PARAMETERS: Command number 01 – 26
 Command type 0 = None or Null Command, 1 = Standard, 2 = User S-Commands, 3 = Wildcard
 Groups: 0 – 1. Each command is also assigned a group number. You can use S-Command 15 to turn on or off each or all groups of User Commands. See section 12 for more information on programming macros
 Start line: 000 – 255
 Command name 1 to 5 characters.

DEFAULT: See default table below

EXAMPLE: 62 15 1 0 040 123 (Standard command number 15 is included in command group 0, points macro start line 40 and the name is “123”)
 62 25 2 1 005 33 (User system command 25 is included in command group 1, points to S-Command 05 and the name is “33”. S-Command 05 is force PTT on for set time, “3315” will force the PTT on for 1.5 seconds)
 62 13 3 1 130 8872 (Wild card command number 13 is included in command group 1, points to macro start line 130 and the name is “8872”)

DEFAULT USER COMMANDS

Command Number	Command Type	Group Number	Macro Start Line	Command Name	Notes
01	Standard	0	001	#1	Repeat mode Off
02	Standard	0	003	*1	Repeat mode NSQ (COS)
03	Standard	0	005	*2	Repeat mode NSQ (COS) and TSQ (CTCSS)
04	Standard	0	007	#0	Link Off
05	Standard	0	009	*0	Link On
06	Standard	0	011	#6	PTT Delay off
07	Standard	0	013	*6	PTT Delay on

S-Cmd 63 MACRO EDITOR, SET STARTING LINE NUMBER POINTER

Macros are one or more S-Commands strung together. Messages are also stored in the same memory area as macros. To build a macro or message, you must first tell the controller where the macro or message will start (Macro Start Line). Then enter S-Commands (S-Command 64) or CW-Commands (S-Command 31) into the macro data memory. This command is used to set the macro start line pointer. The controller will keep track of the exact position in the macro data memory as you enter data. There are 255 starting lines in the macro data memory.

SYNTAX: 63 [Macro start line]
 READ BACK N/A
 STORAGE: RAM
 PARAMETERS: Macro start line 000 through 255
 DEFAULT: N/A
 EXAMPLE: 63 7 Sets the pointer to start on line number 7

S-Cmd 64 MACRO EDITOR, INSERT S-COMMANDS

The system memory is used for both macros and messages. This memory is organized with 999 lines of data storage with each line consisting of 24 digits. Once you have set the macro start line pointer (S-Command 63), you can begin to enter S-Commands into the macro data memory. One or more S-Commands can be strung together and the data is allowed to continue through additional lines until the end of the macro is reached. When you enter S-Commands and their data into memory, the controller will add a "C" so as to separate the S-Commands. It is important to know how the controller stores data, so that you can allow for this digit when keeping track of memory usage. The last entry of your macro is an end of macro character, "D" which is used to terminate the macro. Send "64" without data, and the controller will put a "D" into the macro data memory for you. The controller uses a "C" for a command separator and "D" for end of macro. You need to allow space for these digits when planning your macro data usage. See the default table below for an example.

SYNTAX: 64 [S-Command] [S-Command data]
 READ BACK N/A
 STORAGE: EEPROM
 PARAMETERS: S-Command 00-99
 S-Command data as required by each command
 DEFAULT:
 EXAMPLE: 64 01 1 S-Command 01 (repeater mode), S-Command data 1 (COS)
 64 03 1 S-Command 03 (low pass filter), S-Command data 1 (3000Hz)
 64 End of macro
 This macro will both set the repeater in COS and the low pass filter.
 The data will be stored in memory the following format (011C 031CD)

S-Cmd 65 RESERVED**S-Cmd 66 READ / WRITE SYSTEM DATA**

The RI-1 controller stores all of its system data on EEPROM, a non-volatile memory. It also has temporary RAM memory locations for storing this same system data. These RAM locations hold the systems data that is used in operating the controller. When you first turn on the power, the controller will copy the EEPROM data into this first RAM data location. You can modify this RAM data and then by using the WRITE command, save your changes to the EEPROM. Or, you may have system RAM that has been modified, and you can READ the EEPROM data back into the RAM, returning the controller to a normal state. When power is first turned on, the controller will copy the EEPROM to the RAM locations. Only S-Commands that are labeled with "STORAGE: RAM/EEPROM" have data that is affected by this command.

SYNTAX: 66 [Operation]
 READ BACK N/A
 STORAGE: RAM
 PARAMETERS: Operation 0 = READ system data from EEPROM
 Operation 1 = WRITE system data to EEPROM
 DEFAULT: N/A
 EXAMPLE: 66 1 Copy the system RAM to the EEPROM

S-Cmd 67 RESERVED**S-Cmd 68 MACRO LINE JUMP**

This command can be used at the end of a macro to jump to another macro start line number. You can also use this command to test or execute a macro when you are in the S-Command mode. Be careful not to create a loop where at the end of one macro you jump to a second macro, and at the end of the second macro you jump back to the first.

SYNTAX: 68 [Macro start line]
 READ BACK N/A
 STORAGE: N/A
 PARAMETERS: 1 – 255 Macro start line
 DEFAULT: N/A
 EXAMPLE: 68 34 Jump to macro starting at line 34 and continue executing S-Commands

S-Cmd 69 EXIT S-COMMAND PROGRAMMING

When you enter the programming mode, the controller will copy the current system EEPROM data into the system RAM (See S-Command 66 for a detailed description on system memory). After you make changes, you can exit the programming mode (lock the controller) and save your changes to the EEPROM or recall the old data from the EEPROM, not saving your changes. If no S-Commands are executed for 5 minutes, a timer will automatically lock the controller for you and discard your changes.

SYNTAX: 69 [Save]

READ BACK N/A

STORAGE: N/A

PARAMETERS: 0 Discard changes
1 Save changes

DEFAULT: N/A

EXAMPLE: 69 1 Exit S-Command Programming mode and save system RAM to the EEPROM

S-Cmd 70 through 99 RESERVED

SECTION 12

USER COMMANDS and MACROS

User commands and macro programming in the RI-1 repeater controller is the means by which you generate custom and secure commands for the repeater users to access. The RI-1 controller is event driven, which means anything that changes or is triggered, is an event. Events can consist of User Commands, Messages, Bit input change, Timers, and Jumps. All events point to a position (Start Line) in the controller's macro memory where the command for that event is carried out. This place in the controller's memory is where one or more System Commands (S-Commands) are stored and executed. This group of S-Commands is called a macro. The set of DTMF digits sent by a user over the air to run a complex function is called a User Command. Before building User Commands and entering data into macro memory, layout and organize everything you want to do on paper. This planning effort will pay off with superior results.

The flow diagram on the right shows how the controller will process a DTMF command (User Command or System Command). The command is stored in the command buffer and when the controller detects the end of the command, the controller will begin processing it. First, the controller checks the command mode. From there, you can follow the path of the command, including the point at which a user command runs through its macro data. On the right side of the flow diagram, you can see how the controller handles a message or a controller event.

In the RI-1, there are five distinctive types of functions or events that point to (call) macros. User commands start at the top of the flow diagram and all other events start at the "Message or Controller Event" position.

1. User Commands, all types.
2. Message Events, courtesy, ID and telemetry.
3. Timed Events, delayed, inactivity and interval.
4. Bit Input, change of an input status.
5. Jumps, from within a macro.

In the RI-1 there are three distinctive forms or types of User Commands.

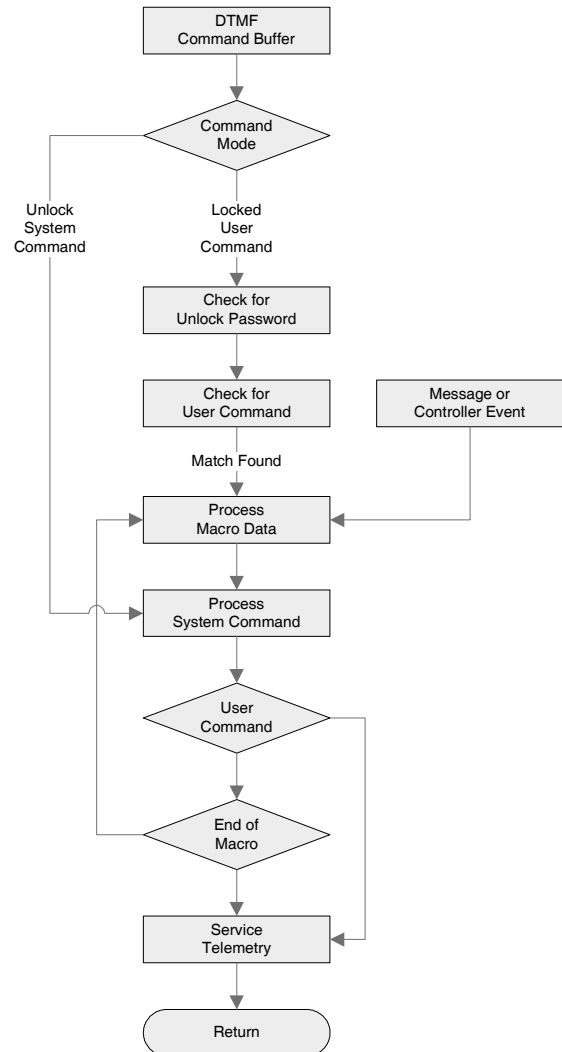
1. Standard User Commands, used for most all applications.
2. User defined S-Commands, used to directly rename an S-Command as a user command.
3. Wildcard Commands, used to pass extra user command data to the S-Commands within the macro.

IMPORTANT NOTE:

At all times the controller is in **one of two command modes**:

1. **Normal operating mode** in which User Commands are functional.
2. **Programming mode** in which S-Commands are used to set up the repeater.

The controller is always in one of the two modes and never in both. To enter the programming mode, the correct password (section 10) must be executed. To exit the programming mode and return back to the "User Command mode" or "Normal operating mode", the S-Command 69 0 (quit and discard changes) or 69 1 (quit and save changes) must be executed. Programming mode is often referred to as the controller "unlocked mode" and the user command mode as the controller "locked mode"



DEFINITION of TERMS

STANDARD USER COMMAND: This is a command that the repeater user would use to control predefined functions of the repeater. When the user sends this type of a command, the controller will look for an exact match including the total number of digits. Once a match has been identified, the controller will then process a macro that is defined by the user command.

USER S-COMMAND: This type of command is the renaming of an S-Command. When the user sends this type of command, any additional data required in the S-Command must be appended to this command.

WILDCARD COMMAND: These commands are similar to standard user commands, except extra data is allowed to follow the command. The controller will save the extra data and uses all or part of the data to fill in missing data in System Commands within the macro.

COMMAND NUMBER: This is a memory location where the user command data is stored. There are 200 locations to store user commands.

GROUP: When you build a user command, it is placed into one of two groups. This will allow you to enable and disable a single group of user commands without affecting every command. S-Command 15 is used to select which group to enable or disable.

START LINE: The macro data memory is organized with 255 lines of data storage, each line consisting of 6 digits of data. The beginning of each line is numbered with what is called the macro "Start Line". The user commands, scheduler, events and timers use the start line to tell the controller where to start processing the macro. When building a macro, you can allow the data in a single macro to use multiple lines.

COMMAND NAME: This is a 1 to 5 digit "name" that the repeater user will key into their DTMF equipped radio to control the repeater. When the controller receives a command, it is compared with every stored programmed command until a match is found. The controller then reviews the command parameters to determine how to handle the command.

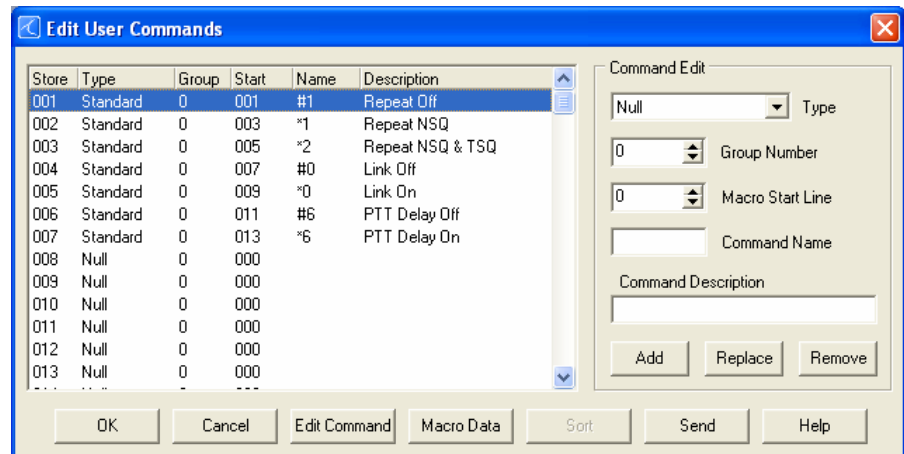
MACRO: This is a number of S-Commands that are grouped together. When the controller is asked to process a macro, it gets each S-Command in the macro and processes each command until an end of macro flag is found. Macros can also consist of only one S-Command.

PROGRAMMING STANDARD USER COMMANDS and MACROS

User Commands are a simple string of digits that point to a more elaborate function (macro), usually containing and controlling the execution or processing of multiple S-Commands. Also, there are some internal functions and events that will trigger a macro directly. These functions include power on initialization, time of day scheduler, digital inputs, internal functions and timers.

There are two parts when creating user commands and macros. First you must create a user command, which will include a name, some operating parameters, and the location of the macro start line. Each user command has a location in memory where all of these parameters are stored. The name for the command is a 1 to 5 digit value that the repeater user will send to control the operation of the repeater. In some respects, this is the name of the memory location where the user command is stored. Each user command can be organized into one of eight groups. Later, you will be able to enable or disable any one of the eight groups of commands. Finally, the user command points to a macro start line where the controller will process S-Commands. The controller is shipped from the factory with some default user commands; review section 8 and S-Command 62 through 64.

The programming software can provide a great platform to create user commands. Pick “Commands” then pick “User Commands”. In this window, you can create new and edit existing user commands. After you have created a new command, you can highlight that command in the table on the left, than pick the “Edit Command” button. This will take you to the macro data editor and the macro start line defined by the user command.



Some things you may like to know:

- You can right pick the macro start line box to view the macro memory when you are looking for an empty location to store your macro data.
- You can double pick a command listed in the left table. That command information will be transferred to the “Command Edit” group on the right.
- When you pick the “Add” or “Replace” button, the data in the “Command Edit” group on the right will be placed in the table on the left at the highlighted store position.
- If you use the “Send” button on this window, only the data associated to user commands and modified macros will be sent.

When programming user commands and macros over the air with DTMF, always follow these simple steps.

1. Before you start, make a plan of what you want to do.
2. If you are using DTMF over the air, Unlock the controller with your PASSWORD before starting.
3. Listen for the correct response from the controller “OK” or “ERROR”.
4. Make small changes each time and test as you go.
5. Keep careful track of the memory space used by the data in a macro, so that you do not overwrite another macro.

Example of programming a standard user command and macro

When a repeater user sends a command, the controller checks the command with the programmed commands for an exact match. The RI-1 has 26 command memory locations available for use. Each command memory location has a number from 01 through 26. These numbers are like a mailbox address. Into this box, you put the address at which the macro data starts (macro start line), and then you give the command (user command) its functional name. In the following example, you will use DTMF commands to create a standard user command with “*456” as the name.

1. Un-lock the controller with the password.
2. Send “62 20 1 1 150 *456” then un-key, you should hear a function complete CW “OK”.
3. This is what you did:
 - 62 = S-Command to define a user command.
 - 20 = Command number, the memory location or mail box number.
 - 1 = The command type, in this example, a standard command.
 - 1 = The group number for this command.
 - 150 = Macro data start line number.
 - *456 = Command name the user will send to execute the command.

Example of programming macro data into the macro data memory:

Anytime you begin to write a new macro, or modify an existing macro, you first must tell the controller at what line in the memory you want to start; this is the macro starting line number. There are 255 line positions for data in the macro data memory and each line will hold up to 6 digits of data. After you start entering S-Commands into the macro data memory, the controller will keep track of what line and character position you are on. Once you set the macro line pointer, you are ready to enter your S-Commands. You enter one S-Command at a time into the memory; each time, un-key your radio and wait for the controller to respond with a “function complete” message. The controller will insert a “C” between each S-Command to separate each S-Command in the macros. There is no error checking of the S-Command and its data in this data entering process. After the last S-Command in the macro, an end of macro marker is required. Do this by sending S-Command 64 by itself. The controller will insert a “D” character as an End of Macro character or marker. The following example will turn off the CTCSS tone panels for the repeater and user command control.

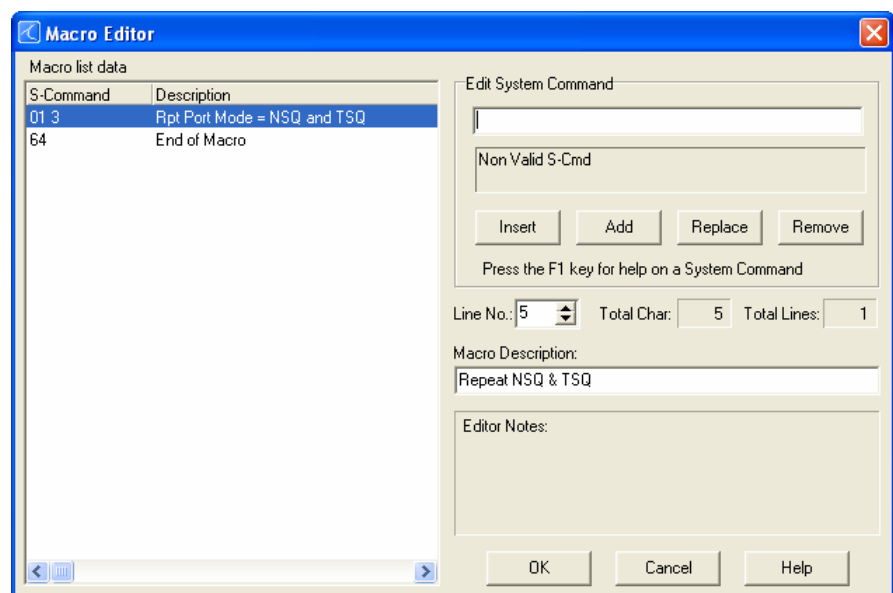
Example:

1. Un-lock the controller with your password.
2. Send “63 150” and un-key. This will set the macro start line pointer to line 150 as used in the user command example above.
3. Send “64 01 3” and un-key. The “64” is the macro editor command. “01” is the system mode S-Command. The “3” is the repeater COS + CTCSS/DCS repeater access S-Command data.
4. Send “64” and un-key. “64” without data will tell the controller to insert a “D” to mark the end of this macro.
5. The data stored in the macro data memory at line 150 will look like “013CD”. This macro requires 5 digits of data storage, which means that it will consume one line of the macro data memory (24 digits for each line). In this case, the next available start line will be 151. However, you can easily create a macro that will consume more than one line of memory.

You can also use the programming software to edit your macro.

Some things you may like to know:

- You can right click the “Edit System Command” window to pick from a list of S-Commands.
- If you enter the first two digits of the S-Command, you can type F1 to get some help on that S-Command.



Passing S-Commands to Another Controller

S-Commands can be sent from one controller to another when you have multiple controllers connected together via the auxiliary buss. This is done by including the destination controller's address in front of the S-Command. When the destination controller address leads the S-Command, that S-Command is not executed in the source controller. When you have an S-Command that needs to be executed in another RI-xxx controller, you simply insert (for example) an "A1" into the macro before the S-Command and its data. All data from the "A1" through the "C" (S-Command separator) will be sent to the controller which has a "1" set as its controller address. Each controller in the system will have its own address. When sending an S-Command to another controller, the controller with the same address as the "A" number in the S-Command will execute that S-Command. In other words, a controller with address 1 will respond to an S-Command with an "A1" prefix. A controller with address 3 will respond to an S-Command with an "A3" prefix. The "controller address" is set with S-Command 39 and can be any address from 1 through 9. For controllers to communicate in this format, S-Command 38 must be in the default state mode 1, serial port mode. The following example will send an S-Command to another controller to turn off the CTCSS/DCS tone for that controller.

1. Un-lock the controller with your password.
2. Send "63 152" and un-key. This will set the macro start line pointer to line 152.
3. Send "64 A1 01 1" and un-key.
The "64" is the macro editor command. A1 is the address of the controller that will execute the following S-Command.
The "01" is the system mode S-Command.
The "1" is the repeater COS access S-Command data.
4. Send "64" and un-key. The "64" without data will tell the controller to insert a "D" to mark the end of this macro.
5. The data stored in the macro table at line 152 will look like "A1011CD".

USER S-COMMANDS

Think of user S-Commands as just renamed S-Commands. User S-Commands are processed just like standard commands. User S-Commands can, but do not have to, pass a data field to the actual S-Command.

Use the user S-Commands for simple applications. Use standard commands for applications with multiple S-Commands. The following example will allow a user to lock on the repeater transmitter for a set time.

1. Un-lock the controller with your password.
2. Send "61 25 2 0 005 21" and un-key.
The "61" is the user S-Command.
The 25 is the user command storage location.
The 2 is the command type, User S-Command.
The "0" is the group number for this command.
The "005" is the force PTT on for x time S-Command. This item requires a leading zero.
The "21" is the name of the user S-Command.
3. Send "69" and to lock the controller and save your data.
4. Send "22 150" and un-key, you should hear a speech message "fifteen seconds". You should notice that the repeater transmitter has stayed keyed for 15 seconds. The "22" is the name of the user S-Command and the 15 was the data that is passed to S-Command 05.
5. You now have a user command to force on the repeater transmitter.

WILDCARD COMMANDS

Wildcard commands allow extra digits to be included with the command. These extra digits can then be passed to one or more S-Commands within the macro called by that the wildcard command. Multiple groups of digits can be passed to multiple S-Commands in the macro. The wildcard command's digits will replace all "Bxx" in the macro with the digits from the user command. Within the Bxx wildcard, the first "x" is an index and defines the first position of the data to use. The first character in the wildcard data is character zero (0). The second "x" is the number of characters to use in the wildcard. Zero (0) will cause the controller to use the remaining characters in the wild card. See the following example:

Define a wildcard command with "14" as the name of the command. This command will set the frequency of a 2-meter remote base radio. When the user enters "14652" the controller will define 652 as the wildcard data. In the macro, include the following S-Command (91 12 14 B00 #2). The "91 12" will set the receive frequency. The "14" defines the first two digits in the frequency. The "B00" tells the controller to use all characters in the wild card. The "#2" sets the transmitter to simplex. You could create a "*14" and "#14" command to set plus and minus offsets. The end effect is the same as programming S-Command "91 12 14653 #2".

In this example, define a wildcard command with "*5" as the name of the command. This command will send a key transmitter time to a controller attached to the auxiliary buss. When the user enters "*5355" the controller will define 355 as the wildcard data. In the macro, include the following S-Command (A B01 05 B10). The "A" will address a controller on the auxiliary buss. The "B01" will get the first character (3) and add it to the command, defining the controller on the auxiliary buss that will receive the S-Command. The "05" will set the TX on for x time. And the "B10" will tell the controller to use the remaining digits (55) starting from digit 1, the second digit. The end result is the same as programming S-Command "A3 05 55"

EXITING PROGRAMMING MODE

Remember to execute an S-Command 69 0 to lock and discard your changes or 69 1 to lock and save your changes when you are finished with the programming mode. The controller will also exit the S-Command mode after 5 minutes of no DTMF activity. You may discover this by an unexpected automatic function complete. Remember in the programming mode only S-Commands are functional. After exiting the programming mode, only user commands are functional.

SECTION 13**MESSAGES, CW**

The controller supports two types of messages, speech and CW. This section will outline both types and show examples. You should always keep in mind that all messages are triggered by some event within the controller.

There are two types of messages. First, there are messages that stand by themselves and are triggered by events within the controller. These messages include the ID and courtesy tones. The second type of message is one that is imbedded within a macro. These are messages with S-Commands in the same memory segment or macro.

PROGRAMMING CW MESSAGES

CW messages are Morse code messages such as the station ID, courtesy tones and system telemetry. These messages consist of tone generator or CW commands in sequence. Each of these commands consists of a 2-digit value and is used to tell the RI-1's tone generator what to do. The RI-1 has 2 tone generators that can operate simultaneously. These generators are controlled by commands that allow you to set the tone frequency, level, CW code speed, CW character, and a number of beeps and pauses. The messages are stored in the same memory area as macros. For this reason, it is important to manage and track the memory usage as not to damage or overwrite other data stored in the memory. Once a message is stored, it can be triggered for playback by user command or any type of controller event. This is done with the message triggers (S-Command 32). Messages can also be imbedded directly inside a macro, with other S-Commands.

CW Message memory usage

The system memory is used for both macros and messages. The memory is organized with 255 lines of data storage with each line consisting of 6 digits. All message and macros must start at the beginning of a line. Each line has a starting line number from 001 to 255. Message triggers, user commands and triggers use the start line address as the starting location of the message or command. To edit a message, you must first set a pointer to the start line where you want to start your message. Do this with S-Command 63. Next, you can start building your message. For the message to work correctly, you must include a "Start of Message" command (31 01) as the first entry. After the first entry, the entries that follow are of the form: (31 XX), and are the CW message commands. Complete the message with an "End of Message" command: (31 02). Finally, an end of data command (64) is the last entry. For the purpose of tracking the amount of data stored in memory, the "Start of Message" consumes 2 digits ("31"). The "End of Message" command consumes 1 digit ("C"). The end of data command consumes 1 digit ("D"). All other message commands consume 2 digits each.

CW Messages within a user command macro

When building a message that is contained within a macro, use normal macro editing process (S-Command 64). However, when you arrive at your message, use the message edit process (S-Command 31).

Default CW station ID example

Let's examine the default system ID message "HELLO". The following will show how this ID is programmed into the controller. You can use this same technique to modify any of the system messages. Each character of the ID has a 3-digit command number. See the CW data table located in section 11 S-Command 31 of this manual for a list of all CW commands. The message data for all CW commands are located in the same memory area as the macros. When entering a new message or changing a message, please take care to avoid damaging other data in the memory. The default "Hello" message uses the following CW commands:

Character 1	= 01	Start Of Message
Character 2	= 00	Reset Tone Generator defaults
Character 3	= 04	Set Tone Generator 1 to 500 Hz tone
Character 3	= 99	Delay 1 second
Character 6	= 59	CW "H"
Character 7	= 56	CW "E"
Character 8	= 63	CW "L"
Character 9	= 63	CW "L"
Character 10	= 66	CW "O"
Character 11	= 02	End Of Message

Review the following procedure to enter this “Hello” ID into the controller. After you un-key your radio after each command, you should hear the CW command number read back in speech. This will tell you that you did everything correctly. If you hear an “ERROR” message, a mistake was made and the command was aborted.

S-Command	Description
1. 123456	If you are using DTMF, unlock the controller, you are in S-Command mode. You should notice a different courtesy tone.
2. 63 043	If you are using DMF, S-Command 63 sets the memory data pointer (start line number pointer) to start line 038. If you are using the programming software, you can use the macro editor to select the start line.
3. 31 01	S-Command 31, Enter message data into memory, Start Of Message.
4. 31 00	S-Command 31, Enter message data into memory, Reset Tone Generator defaults
5. 31 04	S-Command 31, Enter message data into memory, Set Tone Generator 1 to 500 Hz tone.
6. 31 99	S-Command 31, Enter message data into memory, Delay 1 second
7. 31 59	S-Command 31, Enter message data into memory, CW “H”.
8. 31 56	S-Command 31, Enter message data into memory, CW “E”.
9. 31 63	S-Command 31, Enter message data into memory, CW “L”.
10. 31 63	S-Command 31, Enter message data into memory, CW “L”.
11. 31 66	S-Command 31, Enter message data into memory, CW “O”.
12. 31 02	S-Command 31, Enter message data into memory, End Of Message.
13. 64	S-Command 64, Terminate the end of this memory segment.
14.	If you are using the programming software, pick the “OK” button then pick the “Send” button to update the controller.
15. 68 043	If you are using DTMF, S-Command 68 will trigger the message or macro at start line 038. Use this to test your message. If you are using the programming software, you can use the “Send S-Cmd” dialog box to test this macro.
16. 69 1	If you using DTMF, S-Command 69 1 will lock the controller and save data, you are done.

Use the above example to organize your message. It is important to know how the memory is organized so that you know what the next available start line will be. The table below shows the default ID and how the above data was stored into memory. We should also note that the station ID is the last default data item stored in the system memory. When you build your first ID message, you do not need to be concern that it will overlap with anything else in the memory, unless you have added additional commands or messages after this message. Currently the next available memory start line for use is 046.

Macro Data		
Line	Data	Description
043	310004	Station ID Message
044	995956	CW “HELLO”
045	636366	
046	CD	

1. The first two digits “31” are the start of message marker. This data is automatically entered into memory as a result of the S-Command “31 01”.
2. Each of the next groups of two digits represents each of either the CW commands or words.
3. The first of the speech commands “99” is a pause for 1 second. This is used to keep messages from running together.
4. The actual speech message “WXYZ / R” is located after the delay.
5. The last two data items are the end of message “C” and end of segment “D” commands. These two digits are the result of S-Commands “31 02” and “64”.

Custom tone generator CW message example

You can also use tones of various lengths and pauses in any of your messages; see CW commands. The next example will show you how to change the repeater courtesy message. The current message is stored at starting line 037 and used 3 lines of memory. In this example, the function complete will be two 1/10-second tones, first at 1200 Hz and the second at 700 Hz. The new message will require 16 digits of storage and with 6 digits per line available, we will be able to store this message in the same memory location as the old message.

S-Command	Description
1. 123456	Unlock the controller, you are in S-Command mode. You should notice a different courtesy tone.
2. 63 037	S-Command 63, set the memory data pointer (start line number pointer) to start line 030.
3. 31 01	S-Command 31, Enter message data into memory, Start Of Message.
4. 31 00	S-Command 31, Reset CW function (TG1 = 1000Hz, TG2 = Off, Level = 4, CW Speed = 15wpm).
5. 31 10	S-Command 31, Set TG1 to 1200Hz.
6. 31 92	S-Command 31, Tone On.
7. 31 96	S-Command 31, Delay 100mS.
8. 31 06	S-Command 31, Set TG1 to 700Hz.
9. 31 96	S-Command 31, Delay 100mS.
10. 31 02	S-Command 31, Enter message data into memory, End Of Message.
11. 64	S-Command 64, Terminate the end of this memory segment.
12. 68 037	S-Command 68, Trigger a message or macro at start line 037. Use this to test your message.
13. 69 1	S-Command 69, Lock the controller and save your data, you are done.

The finished message should consume memory as shown in the following table.

Macro Data		
Line	Data	Description
037	310010	New Courtesy Message
038	929606	
039	96CD	

A message in the system memory is triggered by an event. Using S-Command 32, you can control which event will trigger or start which message. You can build multiple courtesy messages. With S-Command 32, you can change the courtesy message for different controller modes without having to reprogram the message. An easy method to disable a message, is to point that message event macro start line 000.

EXITING PROGRAMMING MODE

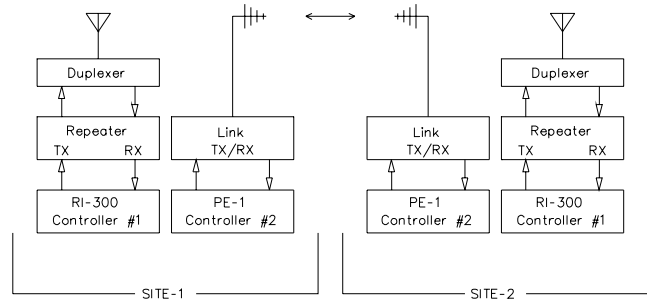
Remember to execute an S-Command 69 0 to lock and discard your changes or 69 1 to lock and save your changes when you are finished with the programming mode. The controller will also exit the S-Command mode after 5 minutes of no DTMF activity. You may discover this by an unexpected automatic function complete. Remember in the programming mode only S-Commands are functional. After exiting the programming mode, only user commands are functional.

SECTION 14 LINKING and REMOTE BASE

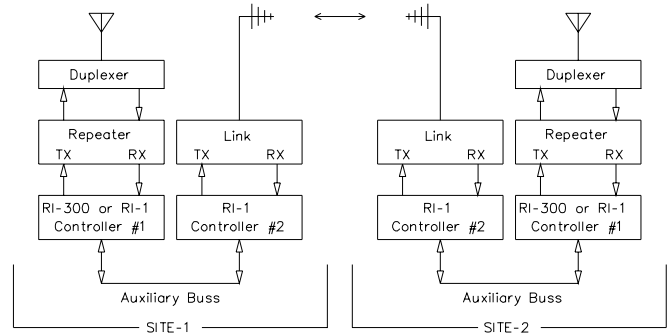
Linking is a method of connecting two different repeater sites using simplex or full duplex radios. Link radios are not intended to be used as user inputs nor outputs; they are simply a dedicated radio path between repeater sites. If you intend to control one site from another, you should only consider using full duplex link radios. Linking with simplex radios only works best for communication from site to site without controlling. The following shows four typical examples of linking, but the RI-1 and RI-300 controller is not limited to these examples.

EXAMPLES OF LINKING

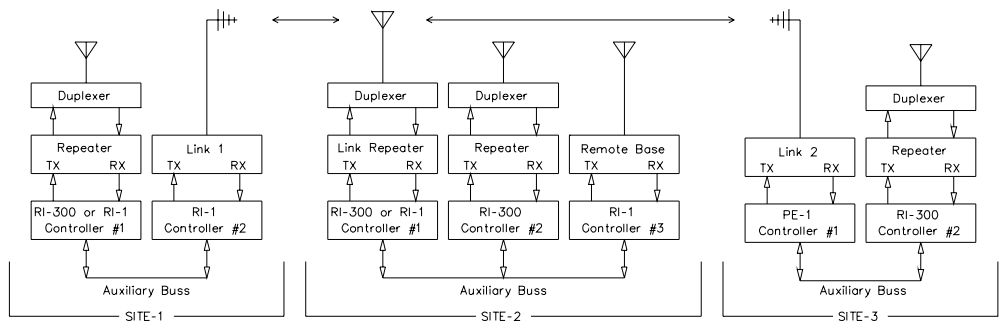
In our first example, two sites are able to communicate to each other on a simplex single channel link. This example is simple and low cost, but user commands or control functions are not easily passed from site to site. This type of link is reserved for an application where independent repeater sites want to communicate to each other but control functions will not be passed between sites. A typical amateur application is one in which two or more UHF repeater sites (440-450 MHz) will communicate with each other on 2 meters, e.g., 146.460 MHz.



Our next example is the same as the first, except we have used RI-1 controllers in place of PE-1 port expansion. You could also have used the RI-1 for the main repeater port. This example, as well as the first, can be modified to support a full duplexed link.

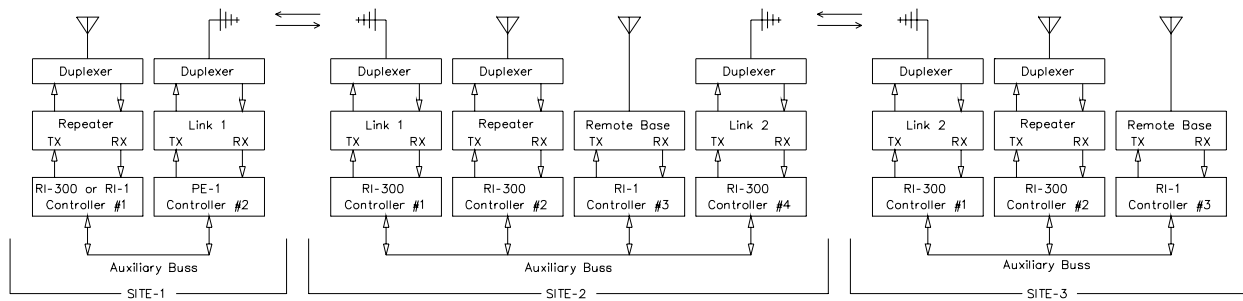


In our next example, site 2 is using a full duplex link repeater as a link hub. All other sites use a simplex link radio to communicate with each other through the link repeater, site 2. In this example, the link radios at site 1 and 3 can be configured in either manner as shown by the first two examples. Communication



occurs in the same way that mobile users would access an ordinary single repeater to communicate with each other. In this example, all sites can perform control functions on site 2. The main limitation is that site 2 cannot easily control site 1 nor 3. And the audio from multiple sites cannot be mixed throughout the system.

In our last example, we will use full duplex links between all sites. Each of these sites can include a repeater, remote base radio and telephone. In this example, users can talk to each other and pass control functions from site to site. The traffic on this type of link can be considered similar to a telephone party line. In this application, each repeater at each site can be connected or disconnected from the links.



In systems like these, using the RI-300/RI-310 controller makes it possible to both use telephones and control remote base radios between sites. Site 1 could even use a remote base radio on site 3 without interfering with the repeater operation of site 2. The RI-300 is so flexible that you can add or move links from any site without impact to the rest of the system.

THE CONTROLLER’S AUXILIARY BUSS ARCHITECTURE

The auxiliary buss is a passive, 16-pin flat cable on which you can attach up to 8 controllers. Each controller has eight audio channels that are connected to the buss. Each channel of the buss will have a controller assigned to output audio on that channel. S-Command 39 controls this audio channel assignment. A controller that has been assigned address 1 will use channel 1 of the audio buss. This is the channel on which the controller will output audio onto the buss. In this type of architecture, each controller on the auxiliary buss acts as PORT to the system. Each port is simply an input and output connection between a radio and the system. Then within the controller, each port can be configured to operate as a repeater, link or remote base. Because you can add ports or controller to the system as needed, the system can grow to meet the needs.

Controller settings vary based on the type of port configuration that the controller is assigned. There are primarily three different controller/port configurations.

- Repeater port** This is the main controller for the system. This is typically a full duplex port on which the users access the system.
- Link port** This is typically a full duplex port that is used to link sites together.
- Remote Base port** This is typically a simplex radio that can be used to communicate with other repeaters or simplex mobile users.

There are mainly 3 System commands used to configure the above modes.

- S-Command 01** Controls the operation of the repeater function of the main port.
- S-Command 34** Controls the operation of the audio out on the auxiliary buss from the local receiver.
- S-Command 35** Controls the operation of the audio in from the auxiliary buss to the local transmitter.

The auxiliary buss also has serial data and buss request signals. Each controller on the bus will send packets of information about itself to the buss. This information is used by other controller to determine when to accept and pass audio from the buss to their transmitter. S-Commands from one controller to another may also be included in these packets. The buss has a buss request signal. This signal is used to help keep the controller’s data packets from crashing into each other.

Even though the auxiliary buss has only 8 audio channels, you may notice that S-Command 39 will allow you to assign a 9th address. This feature allows you to attach a 9th controller to the buss that will not require any audio interaction but you still can send and receive system commands from this 9th controller.

SETTING UP AUDIO CHANNELS

The auxiliary audio buss is set up to work with flat audio (audio without emphasis). If your application requires something other than flat audio, you may change the emphasis to and from the receiver and transmitter port using JP4 an S-Command 00 3.

To set up the auxiliary buss for multiple controllers, you must first define a unique address (Using S-Command 39) for each controller on the buss. This address will also be the address of the audio channel that is used by the assigned controller. A controller that has been assigned address 1 will use channel 1 of the audio buss. The RI-1 also requires that you jumper the audio channel that you plan to use. This is addressed by JP-1. See Section 6 “Setting up the RI-1 Auxiliary Interface Connector”.

For best operation of your system, use S-Command 34 to enable each controller to output audio on the auxiliary buss at all times. The mode of S-Command 34 will determine when audio is output to the buss. When audio is output onto the buss, the sending controller will send the correct data packets so that other controllers will know to process input audio from the buss.

Now that you have set up a controller address for the auxiliary buss and enabled audio from each controller to the buss, you are ready to route audio. At this point, routing audio is as simple as enabling an input on a controller or defining to what channels a controller will listen. This function is controlled by S-Command 35 and can be set as a default mode or integrated into a user command with a macro. S-Command 36 will allow you to define what audio from the buss is mixed with the controller’s receiver audio or is muted when the controller’s receiver audio is active. The RI-1 is limited to receiving audio from the auxiliary buss on only 1 predefined channel. This channel is controlled by JP-1. See Section 6 “Setting up the RI-1 Auxiliary Interface Connector”.

If you have two repeaters connected to the buss and you wanted to build a user command to connect them together, the user command would call a macro that would only need two S-Commands. The first S-Command 35 would enable this controller’s input channel from the other controller. The second S-Command would enable the other controller’s input channel from this controller. Since the second command is coming from the first controller, it would have the “Ax” prefix to the S-Command 35. If you chose to mix all audio, the users on each repeater could be full duplex and would be able to have a continuous 2-way conversation just like a telephone.

If you have attached a dedicated controller/port on the auxiliary buss with either a half duplex radio or simplex remote, you may not want to repeat audio through that radio. To avoid a repeat audio path, use S-Command 01 mode 0. This will keep the radios receive audio from being routed to its transmitter. When using these modes, do not try to repeat the buss audio by having the controller listen to its own auxiliary buss channel.

PASSING S-COMMANDS BETWEEN CONTROLLERS

When creating a user command that is decoded by one controller, but is intended to adjust a value in another controller, you can create macros that pass S-Commands from one controller to another via the auxiliary buss. Send these commands by adding the destination controller’s address to the front of the S-Command within a macro. If you want controller/port #1 to send an S-Command to controller/port #2, you simply insert an “A2” in front of the S-Command (and its data) into the macro. All data from the “A2” through the “C” (S-Command separator) will be sent to the controller with an address of 2 (S-command 39).

You can also call a macro in another controller using S-Command 68. It should be noted that a jump (S-Command 68) will function the same as a call in this configuration. This procedure of calling macros in other controllers is best, because it reduces the total amount of data that must be sent on the auxiliary buss. This is because each time a controller sends an S-Command to another controller on the buss, the controller has to wait for a return acknowledgment before it can continue with the macro. You should avoid conditions where controller #1 calls a macro in controller #2 and then the macro in controller #2 calls a macro in controller #1 or any other controller. However, additional calls within controller #2 would be OK.

If you want a message played in another controller, it is best to build the message in the other controller. Then call the macro line from the first controller. This will start the message and allow macro control to return back to the calling controller.

LINK SET UP

When setting up a controller as a full duplex link port, start with the following S-Command defaults:

01 1 through 3	Repeat audio path on for a full duplex repeating link
or	
01 0	Repeat audio path off for a non repeating link
04 ?	Adjust repeat carrier delay as needed
34 ?	Set auxiliary output mode as required
35 ?	Set auxiliary input mode as required
36 ?	Set auxiliary input Mix/Mute mode
39 ?	Set controller address as required

REMOTE BASE SET UP

When setting up a controller as a simplex remote base port, start with the following S-Command defaults:

01 0	Repeat audio path off
04 0	No repeater carrier delay
07 0	Disable station ID
08 0	Disable courtesy message
15 ?	Disable user commands if required
32 ?	Disable any messages that you may not want to use
34 ?	Set auxiliary output mode as required
35 ?	Set auxiliary input mode as required
36 ?	Set auxiliary input Mix/Mute mode
39 ?	Set controller address as required

When changing frequencies on the remote base radio, it is best to build macros in the remote base radio that act like memory channels. These macros should include frequency, CTCSS/DCS and any other mode changes that you need. From the repeater controller you could then build a macro that will call the desired memory channel macro.

You can also build a user command that uses a wildcard to send direct frequency information to a remote base radio, see section 12 "Wildcard Commands".

CONTROL RECEIVER

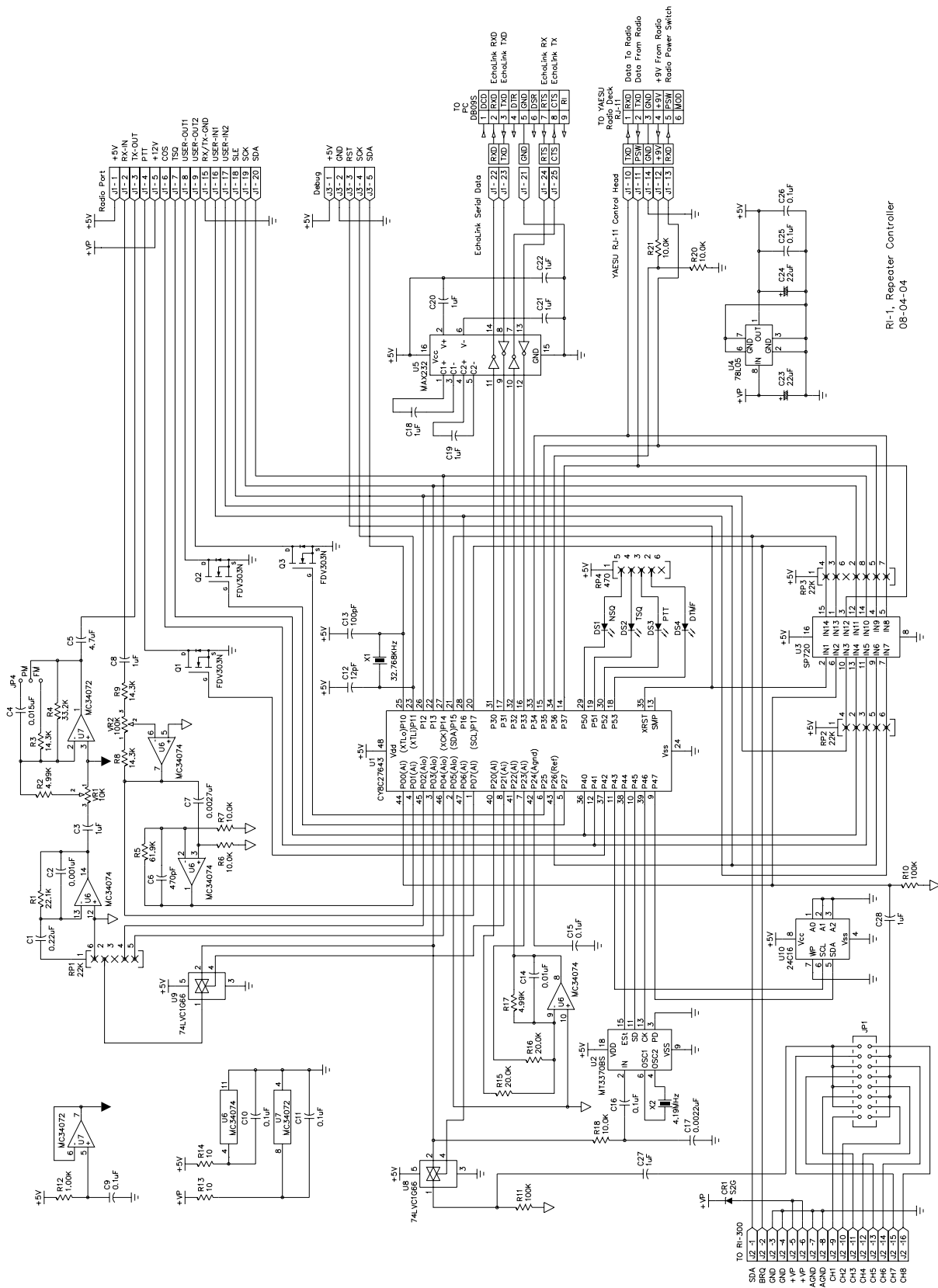
The RI-1 or PE-1 can be used as a control receiver to the RI-300 or another RI-1. When setting up a port as a control receiver, you will typically disable all audio input and output, S-Command 01, 34 and 35. You would then build user commands and macros in the control receiver port that would call macros in the main repeater port to turn on or off required features.

SECTION 15**CIRCUIT DESCRIPTIONS**

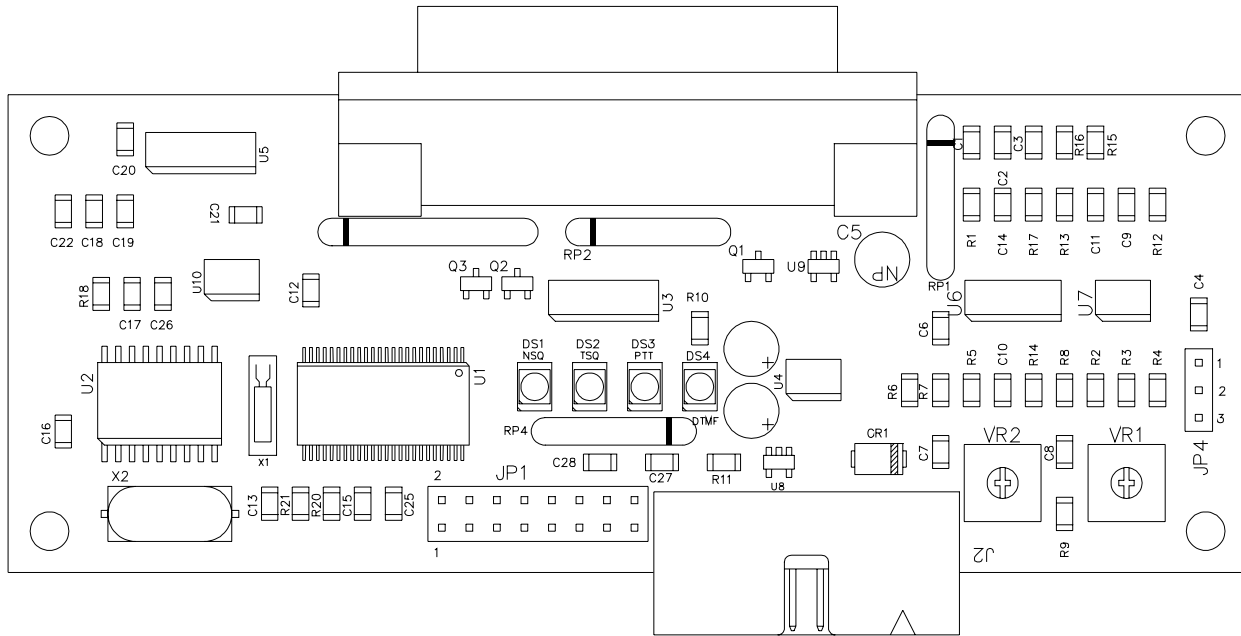
The following sections will cover the brief circuit description of the RI-1 and PE-1 controller's circuit board. Use the schematic on the following pages for additional reference. Only the basic function of each circuit is covered, theory of operation is not covered.

CONTROLLER BLOCK DIAGRAM

RI-1 CIRCUIT BOARD SCHEMATIC



RI-1 CIRCUIT BOARD ASSEMBLY



RI-1 CONFIGURATION JUMPERS

JP4 – TX Modulation Select:

If you are interfacing directly to a true FM type modulator, you will want to disable the controller’s transmitter emphasis stage. This is accomplished with a jumper (JP-4) on the circuit board. See the figure to the right. Pin 3 is located in the lower corner of the board. For modulators that are true FM and without emphasis, place jumper on pins 2 and 3. For all other types of modulators and audio interfaces, including VoIP, you will want to place the jumper on pins 1 and 2.

JP1 – Auxiliary Buss Select:

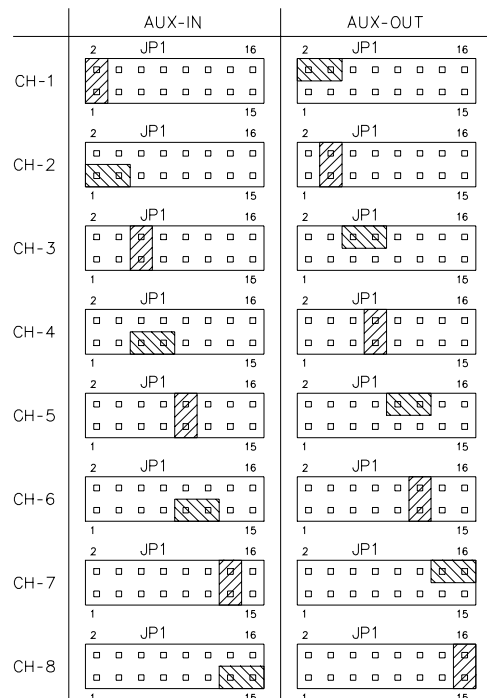
If you are working with the PE-1 or you do not have the RI-1 controller connected to another controller, you can skip this sub section.

The RI-1 does not support a full cross point switch on the auxiliary buss. This means that if you are going to connect the RI-1 to another RI-1 or RI-300, you will use jumper blocks need to select the input and output channels on the auxiliary buss. Use the diagram to the right to assist on jumper placement of each channel.

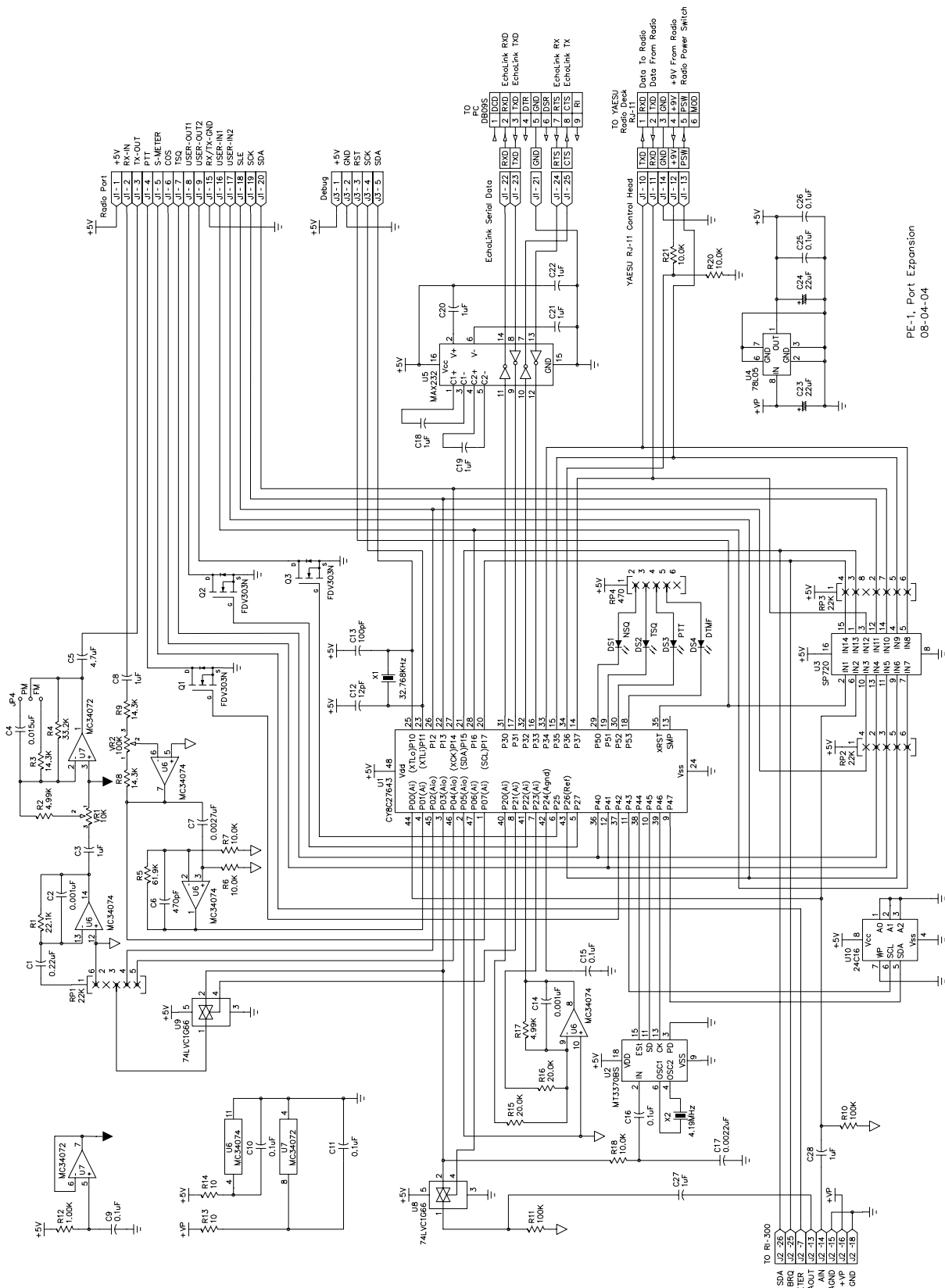
When deciding on setting jumpers, you must first decide on what channels you will be using. If you will be connecting an RI-300 to the RI-1, the RI-300 is default to output on channel 1 and the RI-1 is default on channel 8. You would then install a jumper on pins 1 and 2 so that the RI-1 can listen to the RI-300. You then place a jumper on pins 15 and 16 so that the RI-300 can listen to the RI-1.

All jumpers are placed in combination of one for AUX-IN and one for AUX-OUT. You should never place multiple jumpers for the AUX-IN or AUX-OUT.

After you have placed the jumpers, you then use System Commands 34 and 35 to enable and disable the input and output. You can also use the programming software (PS-3) to adjust these default values. Click System and Auxiliary Setup.

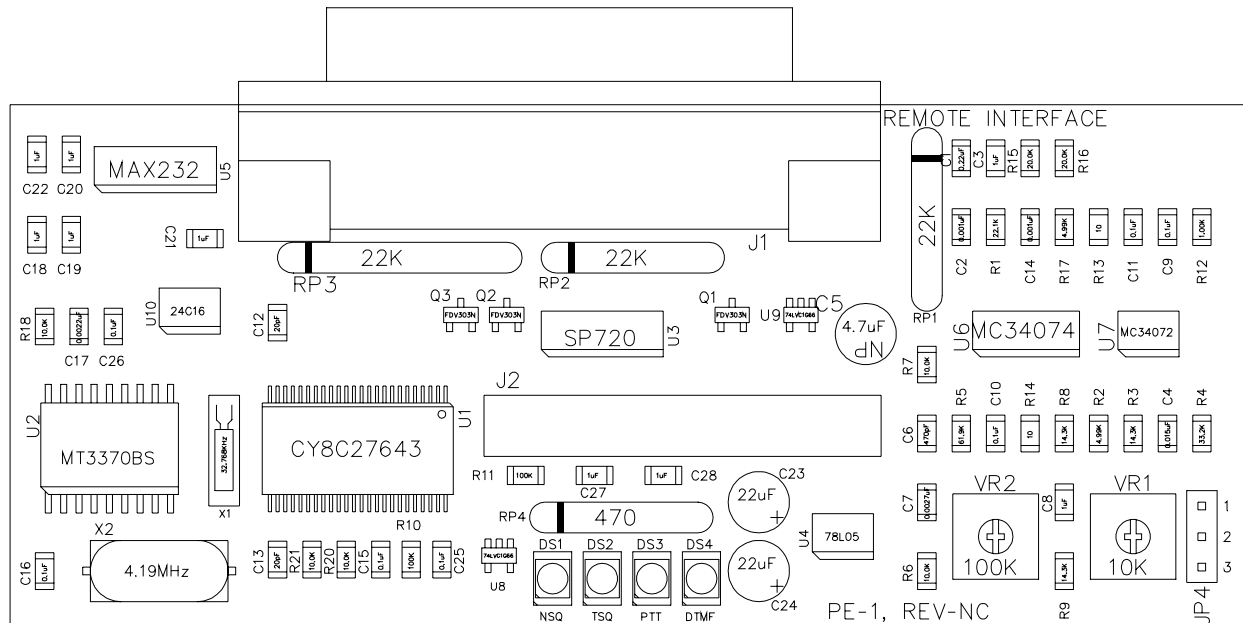


PE-1 CIRCUIT BOARD SCHEMATIC



PE-1, Part Expansion
08-04-04

PE-1 CIRCUIT BOARD ASSEMBLY



PE-1 CONFIGURATION JUMPERS

JP4 – TX Modulation Select:

If you are interfacing directly to a true FM type modulator, you will want to disable the controller’s transmitter emphasis stage. This is accomplished with a jumper (JP-4) on the circuit board. See the figure to the right. Pin 3 is located in the lower corner of the board. For modulators that are true FM and without emphasis, place jumper on pins 2 and 3. For all other types of modulators and audio interfaces, including VoIP, you will want to place the jumper on pins 1 and 2.

SECTION 16**TROUBLESHOOTING**

This section provides procedures to solve some common problems that may occur with the RI-1. Use the following checklist if you are experiencing problems with your controller.

1. Confirm that you have 12 VDC power connected to the correct pins.
2. Turn on power to the repeater. All LEDs should flash for about 1 second. If other LED's remain on, see the following problem list.
3. Apply a carrier without a TSQ signal. The NSQ LED should come on.
4. Apply a carrier with a TSQ signal. The NSQ and the TSQ LED should come on.
5. Apply a carrier with a DTMF tone on the input of the repeater. The DTMF LED should come on.
6. With the controller connected to your computer and programming software running. Check all DTMF decode by sending all DTMF characters.

PROBLEM	SOLUTION
No LED Flash when applying power	+12 VDC power source not connected or voltage below 8VDC minimum. If the unit has adequate voltage, there may be some type of hardware failure.
No NSQ yellow LED	Confirm the receiver is on channel.
NSQ yellow LED on all the time	Confirm the receivers squelch circuit is working. Check the signal polarity, S-Command 00
No TSQ yellow LED	Confirm the receivers CTCSS circuit is working. Check the signal polarity, S-Command 00
No PTT red LED	If NSQ and TSQ operate properly, then check that the S-Command 01 or 35 are set correctly.
No DTMF yellow LED	Confirm that the NSQ and TSQ LED are working and the receiver audio level is correctly set. NSQ tone may not be correctly set for DTMF control. This LED should light with the beginning of the first valid DTMF and go out with a function complete or the inter-digit timer, timing out.
Password will not respond	The unit is not recognizing the password that is being sent, this can occur because of an error in sending the Password or the system password was accidentally changed. In order to get to a known password, the system EEPROM will need to be re-initialized.
Error message when functioning a user command	The function error is in response to an error in an S-Command within the macro. You can use the programming software to locate this error.

SECTION 17**GLOSSARY**

- BOM:** Beginning Of Message. This is a character that is entered at the beginning of a message data sequence.
- CARRIER DELAY:** The time a repeater transmitter remains on after a valid receiver signal input.
- CLOCK:** The system clock utilized to meet the needs of the time operated scheduler.
- CONTROL CODES:** The sequence of DTMF digits sent to perform a command or function.
- CONTROL OPERATOR:** Any repeater operator, designated to control or modifies the repeater's operation.
- COR:** Carrier Operated Relay. An old term referring to the detection of a signal present on a repeater input.
- COS:** Carrier Operated Switch. This is used interchangeably with COR
- COURTESY MESSAGE:** A message or tone or set of tones that are transmitted on the repeater output after a user finishes a transmission to let other user know it is ok to begin a new transmission.
- CPU:** Central Processing Unit. This is the microprocessor or the brain of your controller.
- CTCSS:** Continuous Tone Controlled Squelch System. A sub-audio tone in the range between 67 Hz and 250 Hz use for access to the repeater, auxiliary, and DTMF command entry. Also known as, Private Line or PL (Trademark of Motorola), Channel Guard or CG (Trademark of GE) and Quiet Channel (Trademark of RCA).
- DCS:** Digital Coded Squelch. Sub-audio encoded data that can be used to control access to the repeater.
- DECREMENT:** To reduce a value by one or more counts.
- DEFAULTS:** Pre-set values that define the system characteristics. A default is the value that the unit is set to when supplied from the factory.
- DIGITAL INPUTS:** 0-5 VDC (TTL level) CMOS input. An input can be used to trigger or initiate a Macro.
- DIGITAL OUTPUTS:** TTL levels, CMOS digital output. Each output can be individually changed in state by either an S-Command or from within a Macro.
- DISABLED:** Turned off or not active.
- DISCRIMINATOR:** This is a circuit in the radio's receiver that converts the RF information to audio information, sometimes called a detector.
- DTMF:** Dual Tone Multi Frequency. Used by telephone systems for dialing, also referred to as touch-tone.
- EEPROM:** A special type of non-volatile memory that retains its programming information without power.
- ENABLED:** Turned on or active.
- EOC:** End Of Command. This is a character is entered at the end of a command sequence.
- EOM:** End Of Macro or Message. This is a character is entered at the end of the macro or message sequence.
- EVENT TRIGGER:** When an event occurs in the controller, the controller will trigger a macro. Events can be messages, timers, clock, digital inputs, etc.

FLASH PROM: A programmable Read Only Memory that can be electrically erased and programmed while remaining in the circuit. This device is typically used to store the controller's program.

FUNCTION: A valid command or control sequence executed by the controller.

FUNCTION COMPLETE: Telemetry response generated by the controller following execution of a valid command.

HOOK: This is like the hook switch on a standard telephone. Off-hook means the hand set is off the telephone and on-hook means the hand set in on the telephone.

INTER-DIGIT TIMER: Sets the maximum allowed time in seconds between valid DTMF digits.

INCREMENT: To increase a value by one or more counts.

INITIALIZE: To set up the minimum data requirement for the system.

KEY CODE: A programmable code that is used with a command code to provide security of the command codes.

LINK: This is when another radio or repeater is used to connect two repeater systems together. Links can be configured as duplex, half duplex or simplex.

MACROS: Macros allow the repeater owner to define user commands that execute one or more S-Commands thus customizing the commands for your repeater.

MICROCONTROLLER: A type of microprocessor that contains RAM, ROM, some I/O, etc. into one IC package. This significantly reduces RFI noise generated by the controller board as all interconnects are very short.

MUTE: Turning off the receiver audio to the transmitter. Mute is usually turned on when DTMF commands are being received and processed in order that the tones are not applied to the repeater transmitter. This would limit other people at ground level from decoding your commands and breaking into your repeater.

NSQ: Noise Squelch. A circuit that detects high frequency noise to determine when a signal is present on the receiver input. The squelch circuit is typically used to gate the voice audio.

PASSWORD: A system access code that is used to secure access to all S-Commands in the RI-1. The repeater owner can change the password at anytime. **DO NOT FORGET YOU'RE PASSWORD** or you will have to initialize the controller which will load default data and you will have to reload all your macros and other information.

PL: Private Line or PL is a Trademark of Motorola for the EIA standard sub-audio tones used for repeater access.

PTT: Push to Talk is the keying of a transmitter. The RI-1 controller generates PTT to your repeater when a proper user is on the repeater input or when the controller is generating telemetry or carrier delays.

REMOTE BASE: This is a repeater system that has radio attached that is remotely controllable by the repeater user.

SCHEDULER: At specified times of the day when macros are automatically executed.

S-COMMAND: A system command code tells the controller to perform a function or set the controller in a given configuration.

SECURITY: Security is the limiting of access. Password protection is provided for security.

SQUELCH: This is a circuit that detects high frequency noise to determine when a signal is present on the receiver input. The squelch circuit is typically used to gate the voice audio.

STATION ID: This is Morse code message of the FCC station license number. This message is sent at a regular interval during use of the repeater.

SYSTEM COMMAND: Also called S-Command, an instruction that tells the system to perform a function.

SYSTEM OPERATOR: This is the owner or person who is responsible for the programming and final operation of the repeater system.

TELEMETRY: This is the signal(s) generated by the repeater controller in response to DTMF commands that are entered, or a response to time-outs and courtesy tones.

TOGGLE: To change state, turns on if off or turns off if on.

STONE PANEL: A function that allows multiple CTCSS tones or DCS codes to operate or access the repeater.

STONE REMOTE: A means of remotely controlling the repeater or base station with audible tones. Typically used to control a base station over a distance pair of wires.

STONE SQUELCH: A sub-audio (CTCSS tones) or digital data (DCS codes) used to squelch the repeater system audio.

TSQ: Tone Squelch. A sub-audio (CTCSS tones) or digital data (DCS codes) used to squelch the repeater system audio.

TOUCH TONE: Used by telephone systems for dialing a telephone number (also see DTMF). Used in the RI-1 to enter desired functions or commands. Also see Macros and S-Commands.

USER: This is a person that uses the repeater system. This person may have user command rights but typically will not be able to perform programming or system functions

USER COMMAND: A command that a repeater user would send to the repeater to set its' mode. User commands point to macros, which contain S-Commands.

WATCHDOG TIMER: A hardware counter set to count for a predetermined time. If the count is reached without being restarted, the watchdog timer resets the microcontroller. This is the means to reset the system in the case of a software or hardware error. The software program restarts the watchdog timer periodically whenever the system is not operating correctly.

SECTION 18**LIMITED WARRANTY**

PACIFIC RESEARCH SOLUTIONS will repair this product with new or rebuilt parts free of charge in the United States for a period of 1 year from the date of the original purchase, in the event of a defect in the material or workmanship.

This warranty is extended only to the original purchaser. A purchase receipt or other proof of date of original purchase will be required before warranty performance is rendered. This warranty only covers failures due to defects in materials or workmanship, which occurs during normal use. It does not cover damage which occurs in shipment or failures which are caused by products not supplied by **PACIFIC RESEARCH SOLUTIONS** or failures which result from an accident, misuse, abuse, neglect, lightning, mishandling, misapplication, alteration, faulty installation, modification, or serviced by anyone other than **PACIFIC RESEARCH SOLUTIONS** or authorized service centers of **PACIFIC RESEARCH SOLUTIONS** or damage that is attributed to **ACTS OF GOD**.

If a problem with the product develops during the warranty period, you may contact your dealer. If the problem is not handled to your satisfaction, you may contact us in writing at:

PACIFIC RESEARCH SOLUTIONS

6166 Enterprise Dr., Unit - D.
Diamond Springs, CA 95619
Customer Service Dept.

Tel: 530-672-9053

Fax: 530-672-8749

email: pacres@pacres.com

<http://www.pacres.com>

LIMITS AND EXCLUSION

There is no other expressed warranty except as listed above. **PACIFIC RESEARCH SOLUTIONS** is not liable for indirect incidental or consequential damages in connection with the use of this product including but not limited to, any cost or expense of providing substitute equipment or services during period of malfunction or non-use and or, any destruction to and or loss of property or bodily injury.

This warranty gives you specific legal rights and you may have other rights, which vary from state to state.

SECTION 19**SYSTEM COMMAND TABLE**

S-Cmd	Command Description and Data Format	Command Syntax	Factory Setting	Stored Location
00	Signal Polarity Item 0 = NSQ, 1 = TSQ, 2 = PTT (0=Active Lo, 1=Active Hi) Item 3 = RX Audio Type (0=Flat, 1=Emphasized)	00 [Item] [Mode]	All 0	RAM EEPROM
01	Repeater Port Mode Mode 0 = Off, 1 = NSQ only, 2 = TSQ Only, 3 = NSQ & TSQ, Mode 4 = Open Squelch.	01 [Mode]	0, Off	RAM EEPROM
02	RX Gain Adjust Level 0-24 [-24db to +27db]	02 [Level]	12, 0db	RAM EEPROM
03	Low Pass Filter Select 0 = 2500Hz, 1 = 3000Hz, 2 = 3500Hz, 3 = 4000Hz, 4 = 4500Hz	03 [Select]	2, 3500Hz	RAM EEPROM
04	Repeater carrier delay time Time = 0 to 255 in 1/10 second increments	04 [Time]	30, 3.0 Sec	RAM EEPROM
05	Force on repeater PTT for set time Time = 0 to 3600 second	05 [Time]	0 Sec.	Power On
06	Suppress Function ACK one time Mode 0 = Clear Suppress, 1 = Suppress function complete/error one time	06 [Mode]	0	RAM
07	ID interval time Time = 0 to 255 in 6 seconds increments, 0 = disable	07 [Time]	10.0 Min.	RAM EEPROM
08	Courtesy message timer, COS falling to start of message Time = 0 to 99 in 1/10 second increments, 0 = disable	08 [Time]	1.5 Sec.	RAM EEPROM
09	Reserved			
10	Transmitter time-out Time = 0 to 255 in 6 seconds increments, 0 = disable, * = Reset timer	10 [Time]	0 0.0 Min.	RAM EEPROM
11	Alternate command terminator Terminate 0 = None (COS Only), 1-4 = A-D, 5 = *, 6 = #, 7 = Inter-digit timer, 8 = Min 1 digit cmds, 9 = Min 2 digit cmds, 10 = Min 3 digit cmds, 11 = Min 4 digit cmds, 12 = Min 5 digit cmds, 13 = Min 6 digit cmds, 14 = Min 7 digit cmds, 15 = Min 8 digit cmds	11 [Terminate]	7 Inter-digit	RAM EEPROM
12	Reserved			
13	User Command control NSQ/TSQ mode Mode 0 = Off, 1 = NSQ, 2 = TSQ, 3 = NSQ & TSQ	14 [Mode]	1, NSQ	RAM EEPROM
14	System Command control NSQ/TSQ mode Mode 0 = Off, 1 = NSQ, 2 = TSQ, 3 = NSQ & TSQ	14 [Mode]	1, NSQ	RAM EEPROM
15	User command group enable Group = 0 to 1 Mode 0 = Disable (off), 1 = Enable (on)	15 [Group] [Mode]	0, On 1, Off	RAM EEPROM
16	DTMF Decode Inter digit time Time = 1 to 99 in 1/10 seconds increments	16 [Time]	35 3.5 Sec.	RAM EEPROM
17	DTMF Decode Mute time Time = 0 to 99 in 1/10 seconds increments, 0 = No mute	17 [Time]	25 2.5 Sec.	RAM EEPROM
18	Reserved			
19	Resend DTMF Digits = 0 to 9, *, #, A, B, C, D (15 digits max.)	19 [Digits]	N/A	N/A

S-Cmd	Command Description and Data Format	Command Syntax	Factory Setting	Stored Location
20	Set Remove Base type Mode 0 = None, 1 = EchoLink Serial Data, 8 = Doug Hall RBI-1, 10 = Generic Data Radio	20 [Mode]	0	RAM EEPROM
21	Remote Base User Function Bits Bit 0 – 7 Mode 0 = Low (Off), 1 = High (On)	21 [Bit] [Mode]	0	RAM EEPROM
22	Remote Base User Function Byte Value = 0 to 255	22 [Value]	0	RAM EEPROM
23	Radio Function Bits Func 0 = Mode 0 = Disable (off), 1 = Enable (on)	23 [Func] [Mode]	All 0	RAM EEPROM
24	Set transmit and receive frequency TX/RX 1 = Transmit, 2 = Receive Freq = Frequency starting at 100s MHz (8 digits max) TX Offset #1 = Minus, #2 = Simplex, #3 Plus <optional>	24 [TX/RX] [Freq] <TX Offset>	N/A	RAM EEPROM
25	Remote Base TSQ Select			RAM EEPROM
26	Remote Base TSQ Mode			RAM EEPROM
27				
28				
29				
30				

S-Cmd	Command Description and Data Format	Command Syntax	Factory Setting	Stored Location
31	Tone generator data Tone Data = See tone data table	31 [Tone Data]	N/A	N/A
32	Message Events Msg	32 [Event] [Line]	See Table	RAM EEPROM
33	Message Reset Mode 0 = Terminate current, Mode 1 = Terminate all	33 [Mode]	N/A	N/A
34	AUX output mode Mode 0 = Off, 1 = NSQ, 2 = TSQ, 3 = NSQ + TSQ, 4= Continuous	34 [Mode]	0 off	RAM EEPROM
35	AUX input mode Input = 1 - 9, 0 = Off	35 [Input]	0 off	RAM EEPROM
36	AUX input MUTE/MIX Mode Mode 0 = Mute, Mode 1 = Mix	36 [Mode]	0 Mute	RAM EEPROM
37	Regenerate DTMF from AUX Input Mode 0 = Off, Mode 1 = On	37 [Mode]	0 Off	RAM EEPROM
38	AUX Input Gain Adjust Level 0-24 [-24db to +27db]	38 [Level]	12, 0db	RAM EEPROM
39	Controller Unit Address, serial communication Address = 1 through 9	39 [Address]	1	RAM EEPROM
40	Delay timer macro trigger Timer = 1 to 2 Line = Macro starting line 001 to 255, 000 = disable Time = 0 to 25.5 Seconds, 0 = disable	40 [Timer] [Line] [Time]	All = 0	RAM EEPROM
41	Receiver inactivity macro trigger and timer Timer = 1 to 2 Line = Macro starting line 001 to 255, 000 = disable Time = 0 to 25.5 Minutes, 6 sec. increments, 0 = disable	41 [Timer] [Line] [Time]	All = 0	RAM EEPROM
42	Schedule to trigger a macro at a regular interval Timer = 1 to 2 Line = Macro starting line 001 to 255, 000 = disable Time = 0 to 25.5 Minutes, 6 sec. increments, 0 = disable	42 [Timer] [Line] [Time]	All = 0	RAM EEPROM
43	Reserved			
44	Reserved			
45	Bit input, trigger macro on state change Bit = Line = Macro starting line number 1 to 255, 0 = disable	45 [Bit] [Line]	All 0 Disable	RAM EEPROM
46	Bit output on/off Bit = 1-2 (Output number) Mode 0 = Disable (off), 1 = Enable (on)	46 [Bit] [Mode]	0 off	Power On
47	Reserved			
48	Reserved			
49	Reserved			

S-Cmd	Command Description and Data Format	Command Syntax	Factory Setting	Stored Location
50	Reserved			
51	Reserved			
52	Reserved			
53	Reserved			
54	Reserved			
55	Set Password for programming, S-Cmd access PW = 1 to 7 digits			
56	Reserved	55 [PW]	123456	RAM EEPROM
57	Reserved			
58	Remote software reset			
59	Remote EEPROM initialize	58 19	19	N/A
60	Reserved	59 86	86	N/A
61	Reserved			
62	Name user macro commands Cmd = 01 to 26, Type 1 = Standard, 2 = User S-Cmds, 3 = Wildcard, Group = 0 to 1, Line = 001 to 255, Name = 1 to 5 digits			
63	Macro editor, set start line number pointer Line = 001 to 255	62 [Cmd] [Type] [Group] [Line] [Name]	See Table	EEPROM
64	Macro editor, insert an S-Command S-Cmd = 00 to 99 and Data = as req. for S-Cmd End = "D" or no data for last S-Cmd within macro	63 [Line]	N/A	N/A
65		64 [S-Cmd] [Data][End]	See Table	EEPROM
66	Read / Write system data Action 0 = Read from EEPROM, 1 = Write to EEPROM, <i>This command only affects command stored locations that are in bold & italic.</i>			
67	Reserved	66 [Action]	N/A	N/A
68	Jump to Macro Line Line = 1 to 255			
69	Exit system command mode Save 0 = Exit with out saving changes to EEPROM, 1 = Save to EEPROM and exit S-Cmd mode <i>Save only affects command stored locations that are in bold & italic.</i>	69 [Save]	N/A	N/A

S-Cmd	Command Description and Data Format	Command Syntax	Factory Setting	Stored Location
70	Reserved			
71	Reserved			
72	Reserved			
73	Reserved			
74	Reserved			
75	Reserved			
76	Reserved			
77	Reserved			
78	Reserved			
79	Reserved			
80	Reserved			
81	Reserved			
82	Reserved			
83	Reserved			
84	Reserved			
85	Reserved			
86	Reserved			
87	Reserved			
88	Reserved			
89	Reserved			
90	Reserved			
91	Reserved			
92	Reserved			
93	Reserved			
94	Reserved			
95	Reserved			
96	Reserved			
97	Reserved			
98	Reserved			
99	Reserved			

SECTION 20**FACTORY DEFAULTS****DEFAULT USER COMMANDS**

Name	Number	Type	Group	Start Line	Description
#1	01	Standard	0	001	Repeater Off
*1	02	Standard	0	003	Repeater NSQ
*2	03	Standard	0	005	Repeater NSQ & TSQ
#0	04	Standard	0	007	Link Off
*0	05	Standard	0	009	Link On
#6	06	Standard	0	011	Carrier Dealy Off
*6	07	Standard	0	013	Carrier Delay On (3 Seconds)

DEFAULT MACRO DATA

Start line 001	010 D	Repeater Off
Start line 003	011 D	Repeater NSQ
Start line 005	013 D	Repeater NSQ & TSQ
Start line 007	340 C 350 D	Link Off
Start line 009	341 C 351 D	Link On
Start line 011	040 D	Carrier Delay Off
Start line 013	0430 D	Carrier Delay On (3 Seconds)
Start line 030	31 00 06 39 99 66 62 D	Function acknowledgment "OK"
Start line 033	31 00 30 00 56 69 69 66 69 D	Function error "ERROR"
Start line 037	31 00 06 98 92 96 D	Main port RX courtesy
Start line 040	31 00 11 98 92 96 D	Auxiliary input courtesy
Start line 043	31 00 04 99 59 56 63 63 66 D	Station ID "HELLO"