

**Pacific Research Solutions**  
**RI-200**  
**REPEATER and TELEPHONE INTERCONNECT**  
**USER MANUAL**

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## INTRODUCTION

Your controller represents the latest technological advances in repeater control systems. The RI-200 utilizes a microprocessor design providing all control functions for a single repeater on a main printed circuit board 3½ by 6 inches and a sub telephone interconnect board, 1½ by 3½ inches. The RI-200 does not require memory backup batteries, 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. The microprocessor and power supply are constantly monitored by a "WATCHDOG TIMER" and "POWER SUPPLY SUPERVISORY CIRCUITS" that maintain the operational integrity of the system. The RI-200 is easy to set up and use, only five interconnect wires are required to interface to your repeater. With three simple audio level adjustments, your repeater will be operational with the default user commands. Connecting to the telephone is provided with a RJ-11 telephone jack.

Once you are familiar with the macro command system you can customize your users, messages, and schedulers. We recommend that you read sections 1 and 2 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-200's many features.

The RI-200 repeater interconnect has the following features which together are not available in any other repeater controller in the industry:

- Full duplex telephone interconnect with a self-balancing hybrid.
- Transmit audio level, squelch level, CTCSS level and telephone level potentiometer adjustments are radio remotely adjustable.
- On board squelch circuit. You do not have to add in someone else's circuit. It's SmartSquelch™, An intelligent microprocessor controlled squelch and it's fast.
- On board CTCSS decoder and encoder. You do not have to add in an external decoder. It's clean and cost effective. The decoder and encode are remotely programmable. Multiple CTCSS tone decoded tone panel features are provided.
- A selectable sub audio reject filter is provided, to remove the received CTCSS sub-audio tone from being repeated.
- Optional DCS (Digital Controlled Squelch) decode and encode is available with the same features at CTCSS.
- DTMF tones maybe passed, muted, or regenerated.
- User programmable inputs and outputs.
- User programmable event scheduler. Command can be programmed to execute automatically.
- Built-in receiver audio level meter. You do not need a volt meter or scope to setup the receiver audio level.
- NON-VOLATILE EEPROM data storage. You never have to be concerned with replacement of the memory backup battery.
- User command macro editor. All user commands are completely programmable.
- All the repeater owner has to do is interface the repeater audio and remotely program the functions and feature desired.

The RI-200 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 receiver discriminator output must be connected to the RI-200 audio input in order for the squelch circuit to function properly and to provide excellent audio. **Do not connect the RI-200 audio input to the receiver speaker connections, as the squelch will not operate properly.** The RI-200 provides easy programming to customize user features or user commands by the ability to write and name simple macros. All messages and telemetry are also programmable.

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

**What is a RI-210?** The RI-210 is one model in a series of RI-200 repeater controllers designed specifically as a "Plug-N-Play" component for the Yaesu/Vertex VXR-5000 repeaters. This manual was written around the RI-200 repeater controller, which is a generic version, designed to interface with any repeater. Some features such as digital inputs and outputs are available on the board, but because Vertex repeater connectors are specialized, these connections are not directly available on a connector. If you have an application that requires these inputs and/or outputs, you can access them by making connections directly to the circuit board.

# GETTING STARTED

## 1.0 QUICK START

This section will cover the basics of installation and programming of your RI-200. You may also need to review section 2 for more details on connecting your RI-200 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.

### 1.1 UNPACKING THE RI-200

Inspect the carton for the following contents and if any of the items that you have ordered are missing or damaged, notify your RI-200 dealer or the factory that shipped the unit to you.

1. RI-200 Repeater controller board with mating DB15S connector. RI-210 does not come with the DB15S connector.
2. DB25 Connector used only with the RI-210.
3. UM-200 Printed user manual.
4. IC-200 Optional interconnect cable for connecting to another RI-200.

### 1.2 MOUNTING THE RI-200 REPEATER CONTROLLER

Skip to section 1.3 if you are installing a RI-210

1. An optional single controller enclosure or a standard 19 inch wide 1-3/4 inch high rack mounted enclosure is available. Mounting holes are provided for the repeater controller and for the front panel LED status boards within the enclosure.
2. The repeater builder can mount the RI-200 repeater controller in any enclosure of his choice. The enclosure that you selected 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. Mounting the RI-200 is accomplished by drilling four holes and mounting the unit with #4-40 standoffs.
3. Avoid installing the RI-200 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.

#### 1.2.1 INTERFACE YOUR RECEIVER AND TRANSMITTER

The RI-200 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 detail in section 2 of this manual. Once you have finished connecting your RI-200 to your repeater, you can continue with section 1.4 of this manual.

1. +12 Volts DC power source, J1 Pin 1.
2. DC ground, J1 Pin 9
3. Receiver Discriminator, J1 Pin 2.
4. Discriminator return, J1 Pin 10.
5. Transmitter audio, J1 Pin 3
6. Transmitter return, J1 Pin 11.
7. Transmitter keying circuit (PTT) active low, J1 Pin 4.
8. System ground, J1 Pin 5.

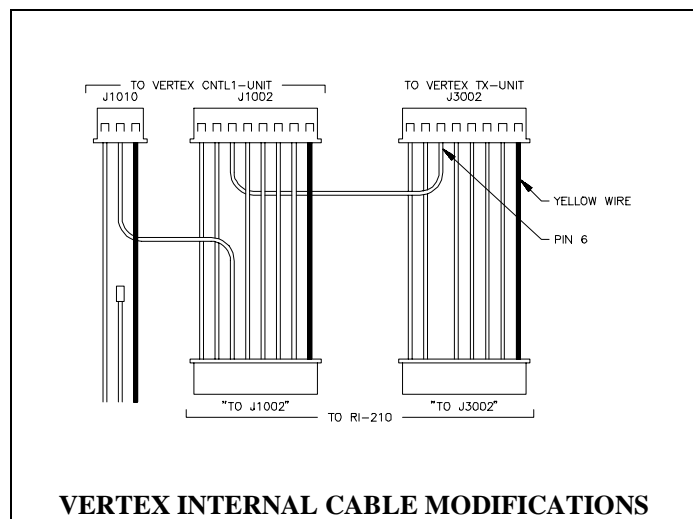
See section 2 for more complete details on proper interfacing to your repeater transmitter and receiver.

### 1.3 INSTALLING THE RI-210 REPEATER CONTROLLER

Skip to the next section if you are not installing the RI-210 into a VX-5000 repeater.

1. Start by removing the four screws holding the top cover on the Vertex repeater.
2. Install the Vertex programming cable and a dummy load on the TX ANT connector.
3. Connect power to the repeater and run the Vertex programming software that came with the vertex repeater.
4. Select the "CLONE" mode and use "F3" to copy the current repeater configuration to the program.
5. Go into the "Timer" menu and disable all of the "REPEATER" and "BASE" timers.
6. Go into the "Setup" menu and set the "Mode" to "Duplex", the "Beep" to "Disable" and "Hang" to "Quiet".
7. Because the RI-210 has its own CTCSS/DCS decoder, you will need to disable the Vertex CTCSS decoder. Last, go into the "Option" menu and disable the Vertex CTCSS tone decode. In some older models of the repeater, you will need to unplug the optional Vertex CTCSS decoder assembly.
8. Save these new values to the repeater by using "F4" key.
9. Disconnect the power and programming cable from the repeater
10. Place the RI-210 in the slot between the receiver and the exciter. The telephone jack should be located on the side closest to the power supply or RF power amp.
11. The mounting holes in the RI-210 should line up with the mounting tabs in the Vertex repeater. The RI-210 is held in place by the two screws that were supplied. The bottom of the RI-210 circuit board should line up with a card edge bracket in the bottom of the Vertex repeater.
12. There are four cables used to connect the RI-210 controller to the Vertex repeater. On the Vertex Control 2 board, you need to unplug the two pin connector plug J2007 and plug it into the two pin connector on the RI-210.
13. Unplug the four pin connector J2006 and plug it into the four pin connector on the RI-210.
14. Follow the diagram below. From the Vertex Control 1 board you need to unplug connector J1002. This connector has 8 wires going to it and the yellow wire is pin 1. Remove pin 6 contact from the housing. This can be done by using the tip of a x-acto knife to lift up on the plastic finger that holds the contact in the housing and remove the contact.
15. On the 8 pin cable supplied with the RI-210 controller, you will notice one of the housing is missing a contact at pin 6. Take the contact that you just removed and plug it into this housing.
16. Plug your connector housing with the missing contact, into the connector on the RI-210 marked "TO J3002".
17. Plug in the other connector housing with a free wire and contact into the connector on the RI-210 marked "TO J1002".
18. Plug in the last connector where you just installed a contact, into the Vertex controller where you removed the 8 pin cable in step 14.
19. Un-plug the 3 pin connector on the Vertex Control 1 board labeled "J1010".
20. Remove the center contact from this housing. This can be done by using the tip of an x-acto knife to lift up on the plastic finger that holds the contact in the housing and remove the contact
21. Plug the extra wire and contact coming from the RI-210 8 pin connector into the center position of this 3 pin plug. Reinstall the 3 pin plug into the Vertex Controller.
22. Insulate the last free contact so that it will not short out on anything.
23. On the Vertex repeater "ACC" connector, connect pin 13 "base" to pin 1 "ground", use the supplied DB25 connector.
24. Because the RI-210 is designed to function directly in the Vertex repeater, all input and output audio levels have been preset, however the receiver and transmitter audio levels and squelch gain may need minor adjustments. See Section 3.4 for details on this procedure.
25. Use the potentiometer on the top of the "TX UNIT" to adjust the DCS deviation.
26. Because the RI-210 controller may key up the repeater at any time. Make sure that you install a dummy load on the TX ANT connector before you reconnect power to the repeater for testing.

The repeater controller and telephone interconnect is now functional with the factory default commands, features, and messages. This allows operation of your new repeater within minutes of installation.





To utilize all the features, macros, and messages the repeater owner can customize a RI-210 by sending commands over the air or telephone. This manual should be completely understood to fully enjoy all of the RI-210's power and features.

## 1.4 SETTING UP YOUR REPEATER CONTROLLER

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. You will first hear a CW "OK" and then followed by the default CW ID "HELLO". The system LED should be the *only* LED on.
2. Apply a carrier without a CTCSS tone on the input of the repeater. The COS LED should come on.
3. Apply a carrier with a 100 Hz CTCSS tone on the input of the repeater. The COS and the CTCSS/DCS LED should come on. The SYS, AUX, DTMF and HOOK LED's should be flashing 4 times per second.
4. Apply a carrier with a DTMF tone on the input of the repeater. The DTMF LED should be on continuously.

When you are sending commands via DTMF, the controller is always in one of the 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. When the controller is in this mode you will hear an ascending 4 tone courtesy each time you un-key with a full quieting signal. If your signal is not full quieting, the courtesy will change to a descending 4 tone (weak signal). When you send the programming password, the RI-200 unlocks and will switch to a programming or System Command (S-Command) mode. When the controller is in this mode you will hear 2 tone courtesy each time you un-key with a full quieting signal. Again in this mode if your signal is not full quieting, the courtesy will change to a descending 4 tone.

Each time you send commands to the RI-200, you will get one of 3 responses. First, if you send any valid command without errors, the RI-200 will respond with a CW acknowledgment message "OK". This message is lower pitch and has the rhythm of "dah dah dah dah dit dah". Second, if you send an S-Command with an error or a user command that has an error in its programming, the RI-200 will respond with a CW error message "ERROR". This message is high pitch and has the rhythm of "dit di dah dit di dah dit dah dah dah di dah dit". Third, if you send an invalid command, the RI-200 will not respond with any message.

When you are programming your RI-200 over the air, it is important to have a full quieting signal to the repeater. As 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:

- 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 looks like some other valid command.
- If you move in and out of a 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-200 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. Note that if you are in the S-Command mode after 5 minutes have past without sending a command, the controller will lock itself. When this happens, you will hear a CW "OK" without sending a command.

### 1.4.1 DEFAULT USER COMMANDS

The controller comes programmed with some default User Commands. See section 5 for details on changing the command names or the commands themselves. You can use these commands only when the controller is locked.

- #1 Repeater (system) OFF.
- \*1 Repeater (system) ON and with CTCSS/DCS required to access repeater.
- \*2 Repeater (system) ON and with only a carrier needed to access repeater.
- \*3 Repeater (system) ON and with squelch open.
- #4 Repeater CTCSS tone encode OFF.
- \*4 Repeater CTCSS tone encode ON.
- #5 DTMF mute OFF.
- \*5 DTMF mute ON.
- #6 Carrier delay OFF.
- \*6 Carrier delay ON.
- \*7 Answer Telephone only if ringing.
- \*8 Telephone off-hook, simplex. You can include the telephone number with this command.
- \*9 Telephone off-hook, duplex. You must include the telephone number with this command.
- # Telephone on-hook.
- #0 Link OFF.
- \*0 Full duplex link ON, used if you have 2 repeaters tied together.
- A Key transmitter on for X time.

### 1.4.2 SETTING UP YOUR ID

You are now ready to change or setup the station identification, **ID message**. The factory default ID is "Hello". The following will show how this ID is programmed into the controller. Once you have reviewed this procedure, you may want to review section 5.4 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 has a 3 digit command number. See the default CW data table in section 4.5.31 for a list of all CW commands. The data for all messages or CW commands are stored in the same memory area as the macros. When entering a new message or changing a message, care should be taken to avoid damaging other data in the memory. The default "Hello" message uses the following CW commands;

- Character 1 = 001 Start Of Message
- Character 2 = 023 697 Hz tone
- Character 3 = 042 CW Speed, 16 WPM
- Character 4 = 088 CW Space
- Character 5 = 069 CW "H"
- Character 6 = 066 CW "E"
- Character 7 = 073 CW "L"
- Character 8 = 073 CW "L"
- Character 9 = 076 CW "O"
- Character 10 = 002 End Of Message

Review the following procedure to enter this “Hello” ID into the controller. Un-key your radio after each command, you should hear a CW “OK”. This will tell you that you did everything correctly. If you hear a CW “ERROR”, a mistake was made and the command was aborted.

<u>S-Command</u>	<u>Description</u>
1. 123456	Unlock the controller, you are in S-Command mode. You should notice a different courtesy tone.
2. 63 085	S-Command 63, set the memory data pointer (start line number pointer) to start line 085.
3. 31 001	S-Command 31, Enter message data into memory, Start Of Message.
4. 31 023	S-Command 31, Enter message data into memory, Set tone generator to 697 Hz.
5. 31 042	S-Command 31, Enter message data into memory, Set CW speed to 16 WPM.
6. 31 088	S-Command 31, Enter message data into memory, CW Space.
7. 31 069	S-Command 31, Enter message data into memory, CW “H”.
8. 31 066	S-Command 31, Enter message data into memory, CW “E”.
9. 31 073	S-Command 31, Enter message data into memory, CW “L”.
10. 31 073	S-Command 31, Enter message data into memory, CW “L”.
11. 31 076	S-Command 31, Enter message data into memory, CW “O”.
12. 31 002	S-Command 31, Enter message data into memory, End Of Message.
13. 64	S-Command 64, Terminate the end of this memory segment.
14. 68 085	S-Command 68, Trigger a message or macro at start line 085. Use this to test your message.
15. 69	S-Command 69, Lock the controller, you are done.

Now you are ready to enter your ID message. Use the above example to organize your message. There are blank table forms in the appendix that can be used to keep track of the data. 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.

MESSAGE TABLE									
Line #	D1	D2	D3	D4	D5	D6	D7	D8	NOTE
085	3	1	0	2	3	0	4	2	Default ID “HELLO”
086	0	8	8	0	6	9	0	6	
087	6	0	7	3	0	7	3	0	
088	7	6	C	D					

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 “31 001”.
2. Each of the next groups of three digits represents each of the CW commands.
3. The first of the CW commands “023” is the tone frequency.
4. The next CW command “042” is the CW speed.
5. After the CW speed are each of the characters you wish to use.
6. 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 “31 002” 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. You should still keep track of the memory used by your ID so that you will know what the next available start line is.

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 CW commands 101 through 166.

### 1.4.3 SETUP CTCSS/DCS DECODE

The RI-200 controller is equipped with 6 independent tone panels for 6 different internal functions. These tone panels will be discussed in greater detail later in the manual. The CTCSS/DCS LED will show when the controller is decoding a repeater CTCSS tone, even though this current decode is not being used in the controller operation. The SYS, AUX, DTMF and HOOK LED's will flash at a rate of 4 times per second when these tone panel functions are also decoding tones. These 6 tone panels have the following functions;

Tone panel #1, Repeater audio.

Tone panel #2, User commands.

Tone panel #3, S-Commands (commands for programming). This tone panel will also allow access of user commands.

Tone panel #4, Auxiliary input / output audio. Used when connecting two controllers together.

Tone panel #5, Telephone audio. Used to access, dial and pass audio to the telephone interconnect.

Tone panel #6, Dial Click. Used for dial click commands. See S-Command 49.

The controller comes programmed with 100 Hz CTCSS tone ready for use in all 6 tone panels. But before the controller will use this tone for operation, you must enable each of the functions associated with each tone panel. See S-Commands 01 for repeater, 14 for user and S-Commands, 34 for auxiliary, 49 for dial click and 72 for telephone access. You can enable or disable any combination of the CTCSS tones or DCS codes. See section 4.5.20 for more details. The following example assumes that you want to disable 100.0 Hz and enable 127.3 Hz for all tone panels. See the CTCSS tone table in section 4.5.20 for your specific tone number.

<u>S-Command</u>	<u>Description</u>
1. 123456	Unlock the controller, you are in S-Command mode.
2. 20 0 013 0	S-Command 20, Disable the 100.0 Hz tone for all tone panels.
3. 20 0 002 1	S-Command 20, Enable the 127.3 Hz tone for all tone panels.
4. 01 3	S-Command 01, Set repeater mode for COS + CTCSS/DCS.
5. 14 0 1	S-Command 14, Enable both macro and S-Command tone panels.
6. 72 1	S-Command 72, Enable telephone interconnect for CTCSS/DCS operation.
7. 69	S-Command 69, Lock the controller, you are done.

### 1.4.4 SET CTCSS/DCS ENCODE

The RI-200 controller comes pre-programmed with CTCSS/DCS regenerate mode on. This means that when an enabled repeater CTCSS tone or DCS code is decoded, the same tone or code is re-encoded on the repeater output. If you need turn off the encoder, or encode only one tone at all times, you will need to change this mode of S-Command 22. See section 4.5.22 for more details.

### 1.4.5 YOUR CONTROLLER SERIAL NUMBER

On the backside of the PC Board or panel you will find a label with your controller serial number. It is important to make note of this number in a safe place. Use the space provided in this section to make note of the serial number. This number can be used with S-Command 58 to reset the program or S-Command 59 to re-initialize the memory.

Controller serial number \_\_\_\_\_

### 1.4.6 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 6 digits password. You can use any of the DTMF characters in your password except for “C”. Do not use “C” in your password. 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 S-Command mode and accidentally send this password, you will turn off the system instead, oops!!

<u>S-Command</u>	<u>Description</u>
1.	Pick your new password, 1 to 6 digits. The default is 123456.
2. 123456	Unlock the controller, you are in S-Command mode.
3. 55 ??????	S-Command 55 and your new password.

If you make any mistakes, re-enter your new password. If you lock the controller with a mistake in the password, you will have to reset all the factory defaults to regain access to the S-Command mode again.

4. 69	S-Command 69, Lock the controller, you are done.
5. ??????	Check your new password, send “(Your password)”, you SHOULD hear a function complete “OK”.
6. 69	Re-lock the controller.

### 1.5 AUXILIARY INPUT/OUTPUT

The RI-200 has auxiliary input and output capability for connecting to another RI-200 repeater controller, or connecting to a single control receiver. By interfacing a second RI-200, two repeaters, two links or one repeater and one link maybe interconnected. Audio paths and a digital serial data path provide all the communication that is required when connecting two controllers together. This allows the two repeaters or links to operate separately or cross-connected. The digital serial data link is selected by S-Command 37 1. For added protection, the serial data link protocol contains an error check routine and if a unit does not receive valid data for four seconds, that RI-200 will return to a normal operating mode. This is to prevent a transmitter from staying keyed-down because of a serial data failure.

### 1.6 PROGRAMMING SOFTWARE

An optional programming software and cable are available. This software is designed to run in Windows 95 or NT and will allow you to read, change and save all parameters within the RI-200. For software installation, follow the instructions included with the software disk. The supplied programming cable has a circuit board and connector at one end and a flat cable connector at the other end. Make sure that the power is turned off on the repeater and controller before plugging the flat cable end into the RI-200 controller. The flat cable end plugs into the AUX connector on the controller. You will find a key on the flat cable connector. Align the key with the notch on the AUX connector of the RI-200 controller. At the other end of the cable is a circuit board with a connector, plug the connector directly into your computer COMM port. Now you can turn on the power to the repeater and controller. Make sure that you turn off the repeater / controller power before unplugging the programming cable.

**DANGER!!!** Do not use this cable for connecting 2 controllers together, damage will occur to the controllers.

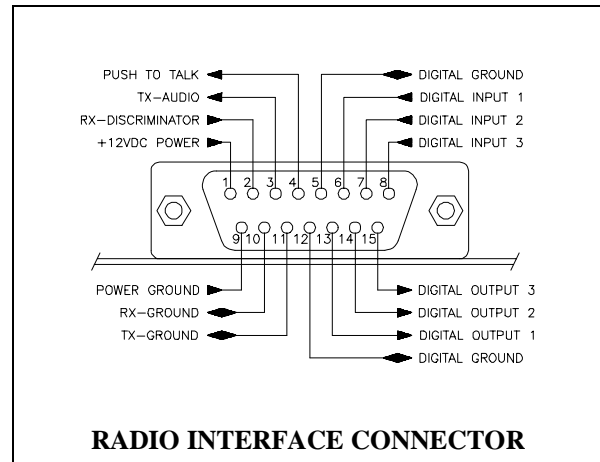
## REPEATER INTERFACE

### 2.0 REPEATER INTERFACE

If you have installed the RI-210 into the Vertex repeater, all of the required interface has been implemented for you. You can skip down to section 2.8. If you are installing the RI-200, you should continue with this section.

This section will cover connecting your RI-200 to your repeater in detail. The RI-200 is ready to interface to your repeater. To ensure a successful installation, please follow these few simple steps. Review this section completely and plan your repeater interface before you start making connections. Enjoy setting audio remotely from your radio. See section 3.4 of this manual for more details on making level adjustments.

The diagram on the right is an end view of the radio interface connector on your RI-200. Use the supplied DB-15 male connector for making all connections to the controller.



### 2.1 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 have 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-200 was designed to operate with flat audio response from the repeater receiver and transmitter. This means that no de-emphasis and pre-emphasis of the audio is performed on the repeater or controller. This leaves all of the emphasis filtering in the user's radio. The RI-200 controller does include a low pass filter that rolls off the very high audio frequency content to prevent adjacent channel splatter. The ideal interface between the RI-200 and a FM modulator is when a varactor diode is directly driven. However the RI-200 does have a de-emphasis filter that can be turned on for those applications where you may need to interface to a modulator with pre-emphasis. 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. The input connections to the RI-200 must be connected directly to the receiver's discriminator for the squelch to work properly. On some receivers this connection can be made to the squelch circuit input.

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. The RI-200 repeater controller has a built in audio level meter for setting the RX input level. See section 3.4 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.

### 2.2 POWER SUPPLY CONNECTIONS

The RI-200 operates on 12 volts DC nominal. The DC source voltage must be between 10 and 15 VDC. The controller typically draws 50 ma without the status LED's turned on. Connect the +12v to J1 pin 1. Connect J1 pin 9 to ground or the 12 V 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-200 repeater controller connection to the power supply must be over current protected.** Use of a one ampere fuse should be the largest capacity considered in your installation. A 250 ma fuse is best. When connected properly, the green LED on the status LED display will light when the power is applied and the system enable command is on.

### 2.3 REPEATER RECEIVER AUDIO CONNECTION

Since the RI-200 controller has the squelch or COR/COS circuits incorporated on board, the audio input **MUST BE** connected directly to the receiver discriminator output. Connect the receiver discriminator audio to the RI-200 J1 pin 2 and the receiver ground or audio return to J1 pin 10. **Do not connect to the speaker leads.** If you are not familiar with the repeater receiver, get assistance from someone knowledgeable on the subject or contact our factory for support. If your discriminator does not have adequate filtering for 455 kHz, you will have to provide for this filtering between the radio and controller. A 10mH inductor in line with a 1000pF capacitor to ground should work. You may need to adjust these values according to the output impedance of your discriminator. For best performance all audio connections should be made with shielded cable. The controller's audio path has a flat frequency response from 30 Hz through 4500 Hz except for the CTCSS high pass filter that cuts off at 300 Hz. When interfaced properly to the repeater receiver and transmitter, the controller will provide superb audio characteristics.

### 2.4 REPEATER TRANSMITTER AUDIO CONNECTIONS

Whenever possible, use a direct FM type modulator. However the RI-200 does have a de-emphasis filter that can be turned on for those applications where you may 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 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 11. If a FM modulator without pre-emphasis is not available, the RI-200 can be jumped to drive a phase modulator or modulator with pre-emphasis. This is done by selecting the de-emphasis mode, S-Command 02 3 and changing the position of the on board jumper. The on board jumper should be set with the shunt on the side closest to U10. The side with the shunt closest to J3 is for driving a non de-emphasis modulator.

### 2.5 REPEATER TRANSMITTER PTT OR TRANSMIT KEYING CONNECTION

The RI-200 repeater controller keys the transmitter at the required times. **WARNING** - As with all repeater controllers, the 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 (active low) a maximum of 60 ma of current. Connect J1 pin 4 to the repeater transmitter PTT.

### 2.6 DIGITAL INPUTS

The RI-200 has three digital inputs that can be used to trigger macros. These are C-MOS gates with a voltage swing of 0 to 5 VDC, TTL level. All digital inputs have 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 4.5.45 and 4.5.46 for additional information on programming these inputs. These inputs are located on J1 pins 6, 7 and 8. See the connector diagram on the previous page.

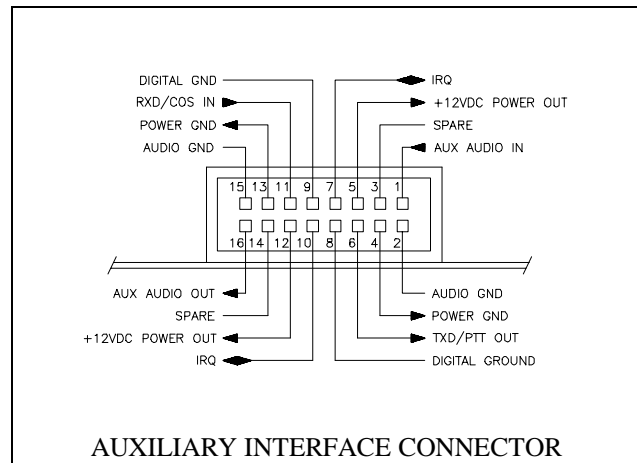
### 2.7 DIGITAL OUTPUTS

The RI-200 has three digital outputs whose states can be modified by S-Commands. Each of the three outputs can be individually commanded or forced into the high or low logic state or pulsed high for a desired duration of time. These are CMOS gates with a voltage swing of 0 to 5, VDC TTL levels. Using S-Commands (or macros that are composed of S-Commands), each output may be turned on or off or pulsed with the desired S-Commands. See Sections 4.5.46 and 4.5.47 for additional information on programming these outputs. These outputs are located on J1 pins 13, 14 and 15. See the connector diagram on the previous page.

## 2.8 CONNECTING TWO RI-200 REPEATER CONTROLLERS TOGETHER

You can connect two RI-200 repeater controllers together using the auxiliary interface connector. Over this port, the two controllers will exchange audio, PTT and command information. The PTT and S-Command information is sent between the two 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. The two radios may be a repeater and a link, two links, two repeaters or a remote base.

When you have two controllers connected together, you can clone one controller to another. See S-Command 38 mode 2. Cloning is the process of copying the setting from one controller to another controller.



Connect the two controllers together with the optional IC-200 interconnect cable. If you prefer to make your own cable, the connectors at each end of the 16 conductor flat ribbon cable are “pin flipped” with respect to each other.

Reference Macro Programming Section 5.0. 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 macro’s section 5.0. When building a macro with S-Commands that needs to be processed by another RI-200 controller, you simply insert an “A1” before the S-Command and its data within the macro. All data from the “A1” through the “C” S-Command separator will be sent to the second controller. Each controller in the system will need to have 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” prefix macro data. All “A3” assigned controllers will respond to the “A3” prefixed macro table data.

Note: The “controller unit address” is set with S-Command 38 and can be any address 1 through 9. The default address is 1, which can be used by both controllers, when only two controllers are connected together.

To transfer serial data between controllers, S-Command 37 must be in the default state mode 1 (37 1) serial port data transfer mode.

The RI-200 also has a digit state data mode. S-Command 37 mode 0 used when connecting to someone else’s controller. In this mode the auxiliary interface TTL level input and output digital signals are LOW TRUE or LOW ACTIVE. The COS input is the same as the RXD input and the PTT output is the same as TXD output.



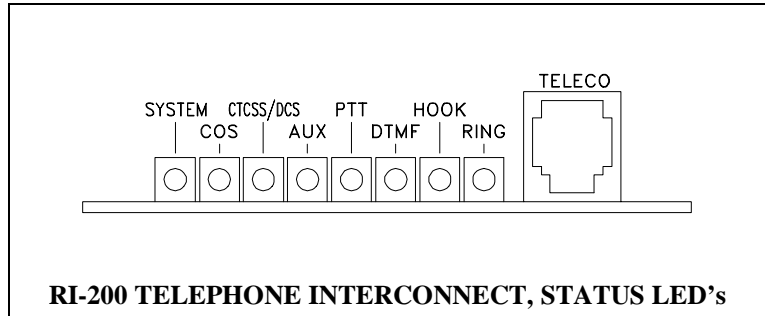
## OPERATING AND ADJUSTING THE CONTROLLER

### 3.0 OPERATING

There are two types of control operations, user commands and system commands. The system commands or (S-Commands) are the principle means for the repeater owner to configure and control the RI-200's basic operations. These commands typically change the characteristics of the system or turn on/off functions of the system. The user commands are commands that the repeater owner builds to customize the repeater for the users.

### 3.1 SYSTEM STATUS INDICATORS

The system status LED indicators will display the current status of the controller. S-Command 09 is provided to enable or disable (turn on or off) all status LEDs. This will lower the current drain of the controller and may be important in a solar or portable repeater configuration. With the status LEDs turned off, the controller will draw less than 60 ma. During the controller power on self-test, the RI-200 will turn on all of the status LEDs for 1 second. The status display also doubles as a receive level audiometer. When you press the "INIT" button after the power is on, the display will show receive deviation. When the LEDs labeled :SYSTEM" through the "PTT" are on, the input deviation is 1.5 KHz. When all LED's are on and the ring LED just came on, the input deviation is 2.5 KHz. The following is a list of status LEDs and their function.



When the LEDs labeled :SYSTEM" through the "PTT" are on, the input deviation is 1.5 KHz. When all LED's are on and the ring LED just came on, the input deviation is 2.5 KHz. The following is a list of status LEDs and their function.

INDICATOR	DESCRIPTION
SYSTEM	Shows when power is connected and the system is enabled or turned on (S-Command 01). This LED will also flash at a rate of 4 times a second when the controller is decoding an enabled S-Command CTCSS TONE or DCS CODE.
COS	Carrier Operated Switch, indicates when a signal is present at the receiver.
CTCSS/DCS	Continuous Tone Controlled Squelch System and Digital Coded Squelch, indicates when a sub-audio tone or digital code that has been enabled in the repeater CTCSS /DCS is present at the receiver.
AUX	Shows when there is activity coming from the AUX link port. This LED will also flash at a rate of 4 times a second when the controller is decoding an enabled Auxiliary CTCSS TONE or DCS CODE.
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). This LED will also flash at a rate of 4 times a second when the controller is decoding an enabled User Command CTCSS TONE or DCS CODE.
HOOK	Shows when the telephone is off-hook or a telephone call is in progress. This LED will also flash at a rate of 4 times a second when the controller is decoding an enabled Telephone CTCSS TONE or DCS CODE.
RING	The controller has detected an incoming ring signal from the telephone line.

### 3.2 DTMF COMMAND INPUT

Dual Tone Multi Frequency or DTMF is typically used in telephone system for dialing. The RI-200 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 without delay, 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, so you can use the "C" digit to perform the same as the un-key action. 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.

### 3.3 TELEMETRY MESSAGES

Telemetry or messages are sent from the controller to you in response to a repeater status or function. There are primarily three types of messages. 1) The station ID. 2) Courtesy messages, which occur after you un-key. 3) System functions (OK, ERROR and system status). Any of the messages may be modified with S-Command 31. The controller comes pre-programmed with default messages in response to any one of the following events:

EVENT	DESCRIPTION
Clock Set Courtesy	Courtesy message is sent after each user unkeys to let other users know when the time-out timer has been reset and it is OK to continue talking. This message occurs when the time clock has been set.
Weak Signal Courtesy	Replaces the courtesy message when the received signal is weak or noisy.
Clock not Set Courtesy	Replaces the courtesy message after power has been restored to the controller. This message is used when the time clock has not been set.
Un-lock Courtesy	Replaces the courtesy message when the controller is unlocked or in S-Command mode.
Post time-out	Generated when the time-out offender releases his PTT to inform the user of this condition.
Pre time-out	Generated just before the controller chops off the transmission of the user that timed out.
ID	This is the system identification, usually in CW. The factory default is "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.
Ring	Generated in response to someone calling on the telephone.
AP Answer	Message sent to someone calling on the phone when the controller is waiting for a password.
AP Function Complete	Generated on the telephone in response to an S-Command the controller understood and executed.
AP Error	Generated on the telephone in response to an S-Command the controller did not understand.
AP Ring Back	Generated on the telephone to identify that ringing is in process on the repeater.

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.

### 3.4 SETTING AUDIO LEVELS

The RI-210 is shipped with audio levels already set for the Vertex repeater, however final adjustments may be required. If you are installing a RI-200 or checking the RI-210 audio levels, use the following procedure.

**Warning:** Refer to section 3.8, 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. While holding down the initialization button, apply 12 VDC power. After all the LED's are turned on, you can release the initialization button and only the system data will be modified. If you continue holding the initialization button for more than fifteen seconds, the digital pots will be reset.

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

1. When entering your password for the first time, make sure the COS, CTCSS and DTMF status LED's are operating properly. Most of the startup problems will relate to discriminator audio level too low, too high, too much DTMF twist and/or audio distortion (or CTCSS level too high or low). If your discriminator does not have adequate filtering of the 455 kHz (second IF frequency), you will have to provide for this filtering between the radio and controller. The RI-200 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 use the "C" DTMF character for the command termination. This should only be necessary until you get the receiver and squelch properly set.

3. If you experience some problems decoding DTMF, the likely problem is that the tone levels are out of range. The DTMF decoder has 30+ dB dynamic range and decoding DTMF should not be a problem with a reasonable discriminator input level. The DTMF status LED lights when a tone is first decoded and remains lit until after either a function complete or a DTMF Inter-digit time-out. We have seen problems where one row or column did not decode properly. To test this, send one by one digit, all DTMF tone digits, letting the LED light drop off 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. You can identify this condition because of the courtesy message will be different.

### 3.4.1 SETTING RECEIVER INPUT GAIN (R3)

For the squelch and internal decoders to work properly, you need to set up the receiver input audio level. The receiver input audio level setting is a manual adjustment. Use the follow the procedure;

1. Apply the 12 VDC power source. Confirm the green system LED is on.
2. If the system LED is not on, see the section on troubleshooting.
3. Transmit a carrier on the repeater's input channel. Did the yellow COS light come on? Do not be surprised if the COS LED did not come on or is already on, as we have two adjustments to make before the squelch circuit will work correctly.
4. Generate a 1000 Hz tone at 1.5 or 2.5 kHz deviation on the repeater input.
5. Adjust the receiver audio pot on the front panel for a level of 0.44 Vrms (1.5 kHzD) or 0.73 Vrms (2.5 kHzD) at U1 pin 8. You can also skip to step 7.
6. If a service monitor is not available, you can use the number "5" button on a DTMF equipped radio. Most radios should be setup to deviate 1.5 kHz..
7. The RI-200 has a built in audio level meter. While you are sending your test tone, press the button on the circuit board labeled "INIT" The system LED's will operate as a level meter, the first red LED will indicate 1.5 kHz deviation and the last red LED will indicate 2.5 kHz deviation.
8. The receiver input level is adjusted by the multi turn pot R3 labeled "RCVR" located right of the radio interface connector.

### 3.4.2 SETTING SQUELCH STAGE GAIN (S-COMMAND 50)

The RI-200 uses digital pots for some of its level settings. The digital pots have electrical shaft positions called steps. Each pot has 64 steps, ranging from 0 to 63. There is an S-Command to set the pots to specific steps or allow up and down control of the pot. Each digital pot in the RI-200 has a default setting. See Section 4 for details on each default setting. If the squelch is open (COS LED on all the time), it will be necessary to use the "C" command terminator to get the controller to accept any command, including the password. The following procedure will outline how to set up the digital squelch pot.

1. Correctly enter the password.
2. Enter the squelch pot step value with the S-Command 50 [level], where the level is a pot step value between 00 and 63. See Section 4.5.50 for the factory default level. If the COS LED is on all the time, you need to set the pot to a higher level. Try sending 50 45.
3. If your squelch is too tight, you can try sending a 50 20.
4. For best performance, set the squelch pot 2 or 3 steps above the open squelch threshold.
5. Lock the controller, you have now completed the squelch level pot setup.

### 3.4.3 ADJUSTING THE REPEATER TRANSMITTER (S-COMMAND 12)

After hooking up the repeater transmitter audio and the repeater PTT keying circuit per Section 2, 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 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 remotely adjusted with a digital pot in the same manner as the squelch, except with S-Command 12. When you have finished this adjustment, you have a working repeater with all audio levels correctly adjusted.

### 3.5 SMARTSQUELCH™ AND NORMAL SQUELCH OPERATION

One of the most powerful features of the RI-200 controller is its built-in squelch circuit (COS). The RI-200 squelch circuit uses a discriminator noise band-pass filter, an adjustable amplifier (adjustable gain), an AC to DC conversion stage, into an ADC (Analog to Digital Converter) and then into the micro-controller. By using the micro, all the significant parameters of a squelch circuit can be implemented in software and are remotely configurable. In the normal mode, the squelch will operate similarly to that of a standard radio. You can change the squelch level and the upper and lower squelch threshold. In the SmartSquelch mode, the micro-controller performs math functions that are operated by an algorithm, resulting in a high performance squelch system. Many parameters of the SmartSquelch are remotely adjustable. The squelch starts with a fast 10 ms decay delay and extends this delay depending on the quality and type of the signal on the repeater's input. SmartSquelch also has another useful feature, the "weak signal message". If the RI-200 detects that a user is not full quieting on the repeater input, it will change the courtesy message to the "weak signal message", in place of the normal courtesy message.

### 3.6 CTCSS DECODE AND ENCODE OPERATION

CTCSS (Continuous Tone Controlled Squelch System) decode and encode is provided as a standard feature on the RI-200 using state of the art devices. All standard and non standard EIA CTCSS tones can be decoded or encoded. You may select 1, 2, 3 or up to all 50 CTCSS decode tones to operate the repeater. The controller has divided CTCSS decode into six independent tone panels. This allows you to assign a different group of tones for different functions. These tone panels have the following functions:

Tone panel #1, Repeater audio.

Tone panel #2, User commands.

Tone panel #3, S-Commands (commands for programming). This tone panel will also allow access of user commands.

Tone panel #4, Auxiliary output audio. Used when connecting multiple controllers together.

Tone panel #5, Telephone audio. Used to access, dial and pass audio to the telephone interconnect.

Tone panel #6, Dial Click. Used for dial click commands, see S-Command 49.

The controller comes programmed with 100 Hz CTCSS tone ready for use in all 6 tone panels. But before the controller will use this tone for operation, you must enable each of the functions associated with each tone panel. See S-Commands 02 for repeater, 14 for macro and S-Commands, 34 for auxiliary, 49 for dial click and 72 for telephone. The decode tones for these tone panels are selected with S-Commands 20. The factory default tone for all tone panels is 100.0 Hz. The default tone may be changed or additional tones added. Once you have selected the tones that you want to decode, you will need to enable each of the tone panels.

Each of the tone panels will indicate when a valid tone is being decoded via the display. A valid repeater CTCSS tone or DCS code is shown by the CTCSS/DCS LED on continuously. A valid S-Command, User Command, AUX, and telephone CTCSS tones or DCS codes are shown by SYS, AUX, DTMF and Hook LED flashing at a rate of 4 times a second. During the LED flash, the LED will only be on for 10mS.

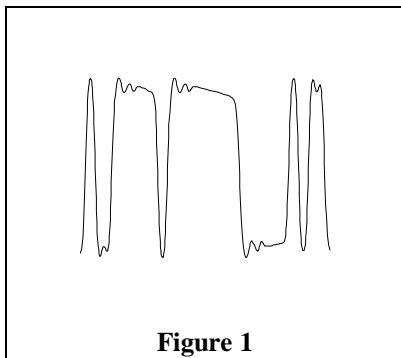
CTCSS encode tones may be any one of the 50 standard and non-standard tones (S-Command 21 and 22). The encode deviation level can be adjusted up and down from the default level (S-Command 23). The received CTCSS tones may be passed to the repeater transmitter, filtered (removed with a high pass filter with no tone going out the repeater transmitter), or the incoming tone may be filtered out and encoding of a CTCSS tone either on the same or a selected different frequency is possible. The CTCSS encode mode is set by S-Command 21 and allows you to run the tone at all times or only during decode of the incoming tone.

### 3.7 DCS DECODE AND ENCODE SETUP AND OPERATION

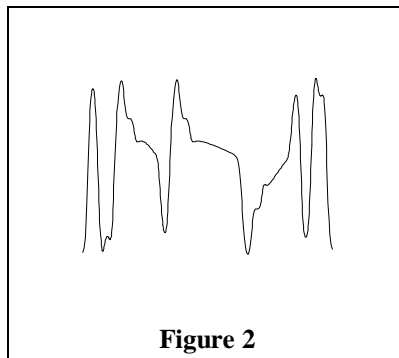
If you ordered your controller with the DCS (Digital Controlled Squelch) decode and encode option, you can also select any combination of DCS codes to operate your repeater. You have 104 standard DCS codes that can be used for decode or encode. The decode codes are selected with S-Command 20. The encode codes are selected with S-Command 21 and 22. Both CTCSS and DCS will operate together. The system operation for DCS is the same as CTCSS.

Depending on your repeater, you may have to change the polarity of the DCS TX/RX data. Once you have confirmed that your radio audio frequency response is correct, you can enable a DCS code for the repeater decode (S-Command 20). When you send that code to the repeater, check if the CTCSS/DCS LED goes on. If the controller does not decode DCS data, change the RX polarity (S-Command 25). If your radio will not decode the DCS data from the repeater, change the TX polarity (S-Command 25).

CTCSS (Continuous Tone Coded Squelch System) uses continuous tones below 300 Hz. A single tone is assigned for a group of users. When this tone is decoded by the repeater, the repeater will pass the users audio. Sometimes two tones next to each other can become confused with each other. In contrast, DCS uses digital data or code words. Each code word is unique and all code words may be used on the same channel without interference. At the end of the repeater transmission and 1/2 second before the transmitter un-keys, the controller will encode a 134 Hz tone that serves as a turn off code. For correct operation, the DCS data should have a FM deviation of 500 to 800 Hz.



**Figure 1**



**Figure 2**

Your transmitter and receiver waveforms should closely resemble the waveform diagram, figure 1. If this is the condition, then the low frequency response of your repeater should be adequate. If your waveform resembles figure 2, your modulator or discriminator does not have enough low frequency response. Figure 2 was created with a high pass filter with a corner frequency at about 5 Hz. Even with a cutoff this low, the filter strips vital data from the digital code word.

Because DCS may have extended periods of all ones and zeros, almost all components in the transmitter and receiver chain must be coupled down to at least 2 Hz or lower. This requirement means that certain transmitters and receivers must be modified before they are capable of DCS operation. Phase modulators, in particular, need special consideration because they theoretically are incapable of being directly modulated by DC, unlike direct FM modulation methods. Low frequency response is the primary requirement for DCS systems.

Unlike CTCSS, DCS signal spectrum occupies considerable more bandwidth. A poor low frequency response in the transmitter or receiver may not seriously distort a single frequency tone signal but may seriously degrade a wide band signal containing multiple frequency components. The distortion risk is especially high if the frequency response delays the wide band frequency components.

The RI-200 does include data error correction. But if too many errors occur, you may experience some blocking out of the decoder. Errors can occur because of unwanted low frequency energy. The DCS decoders can be effected by voice energy that falls below 300 Hz. Some radios do not remove this energy before transmission and can cause voice blocking of the decoder. The RI-200 has a sub audio filter that removes this low frequency energy before the audio is re-transmitted. This feature will increase the performance of the receiving radios. You may need to confirm that the radios used to operate the repeater, have some type of sub audio filtering.

You will find that it is extremely important for the receiver and transmitter to be on frequency to achieve maximum performance of the DCS function. Errors in the transmitter and receiver frequencies show up at the discriminator output as a step function. Because of the long time constant required for the low frequency response, a step function can block the decoder momentarily.

Before you start modifying your radio to operate DCS, make sure your service monitor is DCS capable. Some older monitors require modifications to obtain the low frequency audio response needed for DCS operation. If in doubt, contact the manufacturer.

Because there are so many radios that may need modification for DCS operation, we may not be familiar with your radio. For this reason, we may not be able to provide technical support for some radio modifications. We want to hear constructive and useful feedback. We appreciate having details about your successful modification of a radio for DCS operation.

### 3.8 INITIALIZATION PROCEDURE

There are two distinctive methods of re-initializing and returning to factory default data. Default data for each of the S-Commands are listed in section 4 and the System Command Table at the end of this manual. To initialize the RI-200 data, use the following procedure:

1. Turn power to the RI-200 off.
2. While depressing the initialization button, turn power back on.
3. Wait until all the status LED's turn on and release the initialization button.
4. During this initialization procedure all default data except the audio level digital pot positions were loaded into the repeater controller's "EEPROM" non-volatile memory. During the writing process to the EEPROM, all status LED's will remain on (approximately 3 to 5 seconds).
5. If you need to initialize the digital pot audio levels, during power on initialization continue holding the initialization button for more than fifteen seconds. Then release the button. This initialization loads all default data including the audio level digital pot positions.

Pressing the initialization button while power is applied after the fifteen seconds initialization time-out will not change any data or be detrimental. After the power has been on for fifteen seconds, the initialization button can be pressed to turn the LED display into a receiver audio level meter.

### 3.9 EVENT SCHEDULER

The RI-200 has an event scheduler which can be used to automatically execute commands at pre-programmed times of the day. For the scheduler to work, the system time clock must be set, using S-Command 43. See the programming section for more details. The scheduler uses the system clock to determine when to execute a command. Because the system clock does not have battery backup, it must be reset each time the power is restored to the repeater controller. You can also enable a courtesy message trigger that will let you know when the time clock needs to be reset.

#### **ENABLE THE "CLOCK NOT SET" COURTESY MESSAGE:**

1. Unlock the controller, send the password and un-key, you will hear a function complete.
2. Change the clock not set trigger from the standard courtesy message to the CW "RST" message, send "32 03 39" and un-key, you will hear a function complete.
3. You are done, send "69" to lock the controller.
4. You will now notice a new courtesy message.

Once the system time clock has been set and the schedulers have been setup, command will automatically execute. Eight individual schedulers are available. To setup the scheduler, use S-Command 44. See the programming section for more details.

# PROGRAMMING

## 4.0 PROGRAMMING

Customizing the RI-200 for your application is performed through programming. Programming is done with (System Commands) S-Commands and is performed over the air or over the telephone. Not only can you change any of the system parameters, but you can also change or create your own user commands.

The RI-200 contains powerful tools with 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 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 5 for additional information on this subject.

When controlling the RI-200, you are always in one of the two modes, never in both. To enter the programming mode the correct password (section 4.2) must be executed. To exit the programming mode and return back to the User Command mode the S-Command 69 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.
2. **Programming mode** where System Commands “S-Commands” are used to customize the repeater operation.

## 4.1 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 telling the computer. 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 this section will detail its own syntax.

## 4.2 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-200 controller will return an acknowledgment message (default is CW “OK”). 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. If the controller did not understand the S-Command you will get a CW error message (default is CW “ERROR”).

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 6 digits. Do not use a “C” in your password. 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 6 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”.
4. If you make any mistakes, re-enter the new password. 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.
5. You are done, send “69” to lock the controller.
6. Check your new password, send “(Your password)” and un-key, you will hear a function complete “OK”.
7. Re-lock the controller, send “69”

Should you forget your password, you will have to turn off power to the RI-200 controller, then simultaneously hold down the initialize switch on the controller and apply power to the controller. The controller will restore all of the factory default data. The password will again be the default 123456 and you will have to change it to a new secure password. You will also have to change all the default data to the desired settings again. Keep good notes on all S-Commands, their data, user commands and macros. Space has been provided at the end of the manual for these notes.

**Some controller owners have experienced the following problems:**

When the receiver input level or squelch is not setup correctly and the COS LED on the front panel will not go out. You need to check the receiver input level (Section 3.4.1) and/or adjust the squelch (Section 3.4.2). Until the squelch is properly adjusted, you will have to terminate all commands with a "C". This DTMF character performs the same function as Un-keying your radio.

The second problem is when you enter the correct password and you receive an "OK" message. A moment later you enter your password again. If this and following attempts, you receive an "ERROR" message. What happened? When the first password was executed and you received an "OK" message, you are in the S-Command or programming mode. In the S-Command mode and if your password does not look like an S-Command you will get an "ERROR" message because the controller thought that you entered an S-Command with bad data. If your password looks like a valid S-Command to the controller, you will have executed that S-Command instead of the password. For example, the default password is 123456. The first time you enter the password you get an "OK". If you send a 123456 again the controller will think you are trying to send a "12 3456" which tries to set the repeater TX level to an invalid level. The controller will respond with an "ERROR" message.

When you are finished programming, always re-lock your controller by sending the S-Command 69. Also, there is a time-out timer on the controller. When the controller is unlocked, the timer will re-lock the controller 5 minutes after the last valid S-Command. If you hear an "OK" and you did not expect it (as you did not enter an S-Command) then the controller has automatically executed the lock command.

#### **4.2.1 AUXILIARY CONTROLLER PASSWORD ACCESS**

When you have two RI-200's connected together, you can unlock and control the auxiliary controller. Unlocking another controller is done by adding an A1 to the end of the local controller's password. Once the auxiliary controller is unlocked you can send S-Commands to that controller as usual. Use the following example:

1. Assume the local controller password is 123456 and the auxiliary controller password is 987654.
2. Assume the local and auxiliary controller's unit address is 1.
3. From the local controller, send "123456A1" and unkey. You should hear a function complete, CW "OK".
4. The auxiliary controller is now un-locked and you can send S-Commands to that controller in the normal format.
5. When you are done, send S-Command 69 to lock the auxiliary controller.

#### **4.3 VALID S-COMMAND and DATA**

All DTMF digits are valid as data in an S-Command or as macro data. The DTMF character "C" is the only digit not valid as data, this character is used by the controller as a command terminator or instead of unkeying your radio. The RI-200 will validate all data with in an S-Command. If any of data fields are out of range, have an incorrect number of digits or missing digits, the RI-200 will not modify the S-Command data and will return with an error message.



## 4.4 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 3 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 rule. 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. All commands requiring multiple parameters, require leading zeros for each parameter except for the last parameter. Anytime an S-Command requires two data parameters such as S-Command 40 the first data parameter must have leading zeros and the second data parameter does not require leading zeros. If you are not sure, always use leading zeros especially when you are not yet familiar with the controller.

## 4.5 SYSTEM-COMMANDS (S-Commands)

The following sections will detail each of the S-Commands showing syntax, examples, and the default data values. To make S-Commands easier to locate, the last two digits of each sub-section numbers matches the S-Command number. To execute an S-Command you must first “unlock” the controller with the current password. When “unlocked” the user commands will not work. When you are done, “lock” the controller with S-Command 69. You are now in the user command mode.

When you are sending commands via DTMF, the controller is always in one of the 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. When the controller is in this mode, you will hear an ascending 4 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 descending 4 tone (weak signal). When you send the programming password, the RI-200 unlocks and will switch to a programming or System Command (S-Command) mode. When the controller is in this mode you will hear 2 tone courtesy each time you unkey with a full quieting signal. Again in this mode, if your signal is not full quieting, the courtesy message will change to a descending 4 tone.

Each time you send commands to the RI-200, you will get one of 3 responses. First, if you send any valid command without errors, the RI-200 will respond with a CW acknowledgment message “OK”. This message is lower pitch and has the rhythm of “dah dah dah dah dit dah”. Second, if you send an S-Command with an error or a user command that has an error in its programming, the RI-200 will respond with a CW error message “ERROR”. This message is high pitch and has the rhythm of “dit di dah dit di dah dit dah dah dah di dah dit”. Third, if you send invalid command, the RI-200 will not respond with any message.

When you are programming your RI-200 over the air, it is important to have a full quieting signal to the repeater. As 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:

- 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 looks like some other valid command.
- If you move in and out of a 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-200 is in the User Command mode while you are trying to send S-Commands and the other way around. Note that if you are in the S-Command mode after 5 minutes have past without sending a command, the controller will lock itself. When this happens, you will hear a CW “OK” without sending a command.

### 4.5.00 NO OPERATION

This is a null command and does not perform an internal function. Primarily, a NOP is used to write over data in a macro that is no longer desired.

SYNTAX: 00  
 DEFAULT: N/A  
 EXAMPLE: 00

### 4.5.01 SYSTEM MODE

System mode determines what conditions are required to key the repeater and pass audio from the repeater receiver to the repeater transmitter. When the system is in mode 0 (Off), the repeater will appear dead to the users and all functions like telephone and auxiliary are disabled. User and S-Command are still available. When the system is off, the "SYSTEM" status LED will also be off. All other LED's like COS and CTCSS will still show their associated status.

SYNTAX: 01 [Mode]  
 MINIMUM: 0  
 MAXIMUM: 6  
 UNITS: Mode 0 = System off.  
 Mode 1 = COS or carrier access only.  
 Mode 2 = Repeater CTCSS/DCS access only.  
 Mode 3 = COS and CTCSS/DCS access.  
 Mode 4 = Open squelch, the repeater will blow squelch noise.  
 Mode 5 = System on, repeat audio off but repeat PTT still on. Used for remote base operation.  
 Mode 6 = System on, repeat audio and PTT off. Used for remote base operation.  
 DEFAULT: Mode 1 = COS or carrier access only.  
 EXAMPLE: 01 0 Turns off or disables the Repeater PTT, Auxiliary PTT, and all telephone features.  
 01 3 Carrier and CTCSS or DCS required to operate the repeater

### 4.5.02 RECEIVER AUDIO SOURCE MODE

Select the receiver audio source for the transmitter. The HPF (High Pass Filter) removes the CTCSS tone so that it will not be passed to the repeater output. The LPF (Low Pass Filter) reduces bandwidth above 4.5 kHz. Use the de-emphasis filter if you plan to drive a transmitter with PM or pre-emphasis modulation.

SYNTAX: 02 [Mode]  
 MINIMUM: 1  
 MAXIMUM: 4  
 UNITS: Mode 1 = Includes a low pass filter (LPF) and a high pass filter (HPF), reject CTCSS tones.  
 Mode 2 = Include the low pass filter (LPF) only, pass CTCSS tones.  
 Mode 3 = Select the de-emphasis output for driving pre-emphasis modulation and reject CTCSS tones.  
 Mode 4 = Select the de-emphasis output for driving pre-emphasis modulation and pass CTCSS tones.  
 DEFAULT: Mode 1, Includes a low pass filter (LPF) and a high pass filter (HPF), rejects CTCSS tones.  
 EXAMPLE: 02 2 LPF, Low Pass Filter only, and pass CTCSS on the repeater output.

### 4.5.03 RESERVED FOR FUTURE COMMAND

### 4.5.04 REPEATER CARRIER DELAY TIMER

This is the time that the repeater transmitter stays keyed after the receiver input has dropped. The repeater carrier delay is set in tenths of seconds (100 mili-second) increments.

SYNTAX: 04 [Time]  
 MINIMUM: 0  
 MAXIMUM: 255 (25.5 Seconds)  
 UNITS: Tenths of Seconds (1/10 Seconds or 100 mili-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

### 4.5.05 FORCE PTT ON

Keys up or “locks on” the repeater transmitter for the selected number of seconds. This provides a constant repeater transmitter signal for running test, 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 [Seconds]  
 MINIMUM: 0 (Reset timer)  
 MAXIMUM: 3600 Seconds (equals one hour max.)  
 UNITS: Seconds  
 DEFAULT: 0  
 EXAMPLE: 05 120           Lock on the repeater transmitter for 120 seconds (2 minutes).  
           05 300           Lock on the repeater transmitter for 300 seconds (5 minutes)

### 4.5.06 REPEATER TELEMETRY MODE

CW telemetry is divided into 3 groups (ID, function complete/error and everything else including courtesy tones). This command sets the CW telemetry responses to one of four modes. 1 - Everything Off, 2 - ID only, 3 - function complete & ID only and 4 - all on. This command can be used to turn off the function complete and error messages while keeping the ID on.

If you omit the mode data, the controller will temporarily suspend the function complete or error message. This suspended message is one time only, not effecting the previously selected mode. This feature can be used to keep a function complete message from occurring during a macro or user command. More commonly used during an automatic command or scheduled command.

SYNTAX: 06 [Mode]  
 MINIMUM: (No Data)  
 MAXIMUM: 3 (All On)  
 UNITS: Mode 0 = Everything off  
           Mode 1 = ID only  
           Mode 2 = ID, function complete and function errors only.  
           Mode 3 = All On  
           No data = Temporarily suspend function complete or function error.  
 DEFAULT: Mode 3 = All On  
 EXAMPLE: 06 0           Turn off all telemetry responses  
           06 1           Turn on only the ID message.

### 4.5.07 ID INTERVAL TIMER

Select the time interval for the CW ID or station identification. The ID will try to be courteous in that it will wait for someone to un-key before the controller sends the ID. A cleanup ID will also occur after the repeater activity has stopped and the timer has elapsed.

SYNTAX: 07 [Time]  
 MINIMUM: 0 (Disable ID)  
 MAXIMUM: 255 (25.5 Minutes)  
 UNITS: Tenths of Minutes  
 DEFAULT: 100 (10.0 Minutes)  
 EXAMPLE: 07 55           5.5 Minutes between IDs

#### 4.5.08 COURTESY MESSAGE TIMER

The courtesy message timer is the selected time from 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 timing out, the courtesy message will be skipped. When the courtesy message is started, the repeater time out timer is also reset.

SYNTAX: 08 [Time]  
 MINIMUM: 0 (Disable Courtesy)  
 MAXIMUM: 99 (9.9 Seconds)  
 UNITS: Tenths of seconds (1/10 Seconds or 100 ms)  
 DEFAULT: 20 (2.0 Seconds)  
 EXAMPLE: 08 35                    3.5 Seconds

#### 4.5.09 LED STATUS DISPLAY ON/OFF

The LED status display serves no purpose when someone is not present at the repeater. This command can be used to turn the LED status display on or off to reduce controller current drain. In low power or solar powered systems, this function can be useful to reduce the controller total power consumption.

SYNTAX: 09 [Mode]  
 MINIMUM: 0 (Off)  
 MAXIMUM: 1 (On)  
 UNITS: Mode 1 = On, Mode 0 = Off  
 DEFAULT: Mode 1, On  
 EXAMPLE: 09 0                    Turns Status LED display off (reduce system current drain)

#### 4.5.10 REPEATER TIMEOUT TIMER

The time-out timer sets the maximum length of a single transmission for a user. 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. Before and after a timeout, the repeater will send a message to notify the user/s. These messages are called pre and post time-out messages.

The use of a "\*" in the time field will manually reset the timer if a user talks too long or if continuous noise on the repeater input has timed out the repeater. The timer can be reset by capturing the signal on the repeater input and by issuing the time-out reset S-Command. The reset command will need to be terminated with a "C" under the above condition. This command could be sent over the Auxiliary Link or telephone if needed.

SYNTAX: 10 [Time]  
 MINIMUM: \* (Manual reset), 0 (Disable time-out)  
 MAXIMUM: 255  
 UNITS: Tenths of minutes or 6 second increments.  
       "\*" = Manual reset time out timer.  
 DEFAULT: 30 (3.0 Minutes)  
 EXAMPLE: 10 10                    The user will time out the repeater in 1.0 minute.

#### 4.5.11 RESERVED FOR FUTURE COMMAND

#### 4.5.12 ADJUST REPEATER TRANSMITTER AUDIO LEVEL

See section 3.4.3 for additional information on the use of this command. This command is used to set the transmitter audio level by controlling a digital pot with 64 positions (0 to 63). This command will also accept "\*" up and "#" down adjustment for one step of the digital pot. Each up or down command increments or decrements the pot position by only one step.

SYNTAX: 12 [Level]  
 MINIMUM: 0 or # DOWN  
 MAXIMUM: 63 or \* UP  
 UNITS: 1 numeric pot positions.  
 DEFAULT: RI-200 = 31, RI-210 = 09  
 EXAMPLE: 12\*           Raises pot setting by one steps  
           12#           Lowers pot setting by one steps  
           12 15         Moves digital pot to position 15

#### 4.5.13 RESERVED FOR FUTURE COMMAND

#### 4.5.14 USER AND S-COMMAND CTCSS/DCS TONE PANEL ENABLE

Once you have selected and setup the CTCSS tones and DCS codes that you want to use for the User and System Commands, you then use this command to turn on the User and/or System Command tone panels for use. Use S-command 20 to setup the tones and codes for use. The User Command tone panel is used to select tones and codes that are required for user commands and telephone off-hook commands. The S-Command tone panel is used to select tones and codes that are required for the password and for programming the controller (S-Commands).

SYNTAX: 14 [Panel] [Mode]  
 MINIMUM: Panel 0 (Both), Mode 0 (Off)  
 MAXIMUM: Panel 2 (S-Command), Mode 1 (On)  
 UNITS: Panel 0 = Both, Panel 1 = User Commands, Panel 2 = S-Commands  
        Mode 0 = Off, Mode 1 = On  
 DEFAULT: All 0 (Off)  
 EXAMPLE: 14 0 1       Turn on both panels for use  
           14 1 0       Turn off the user command tone panel

#### 4.5.15 USER COMMAND DECODE ENABLE

This command is used to turn on or off any one of eight groups of user Command. When you build a user command, you are asked to identify one of eight groups to place the command into. You can then use this command to enable or disable any one of the eight groups. As an example, all telephone type commands can be placed into group 2 and all other commands are placed into group 1. When you use the telephone, you can include this S-Command in the telephone user command to turn on and off group 1. Now when the telephone is off-hook, you can disable all other commands. Also you could add a scheduled function to disable the user telephone commands during the night.

SYNTAX: 15 [Group] [Mode]  
 MINIMUM: Group 0 (All groups), Mode 0 (Off)  
 MAXIMUM: Group 8, Mode 1 (On)  
 UNITS: Group 0 = All groups, Group 1 to 8  
        Mode 0 = Off, Mode 1 = On  
 DEFAULT: Group 1 and 2 = 1 (On)  
 EXAMPLE: 15 0 0       Disable or turn off all User Commands to all groups  
           15 1 1       Enable or turn on User Commands to group 1

#### 4.5.16 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]  
 MINIMUM: 1 (0.1 Seconds)  
 MAXIMUM: 99 (9.9 Seconds)  
 UNITS: 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

#### 4.5.17 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]  
 MINIMUM: 0 (Disable all DTMF muting)  
 MAXIMUM: 99 (9.9 Seconds)  
 UNITS: Tenths of seconds (1/10 Seconds or 100 ms)  
 DEFAULT: 25 (2.5 Seconds)  
 EXAMPLE: 17 50           Set mute time to 5.0 Seconds

#### 4.5.18 DTMF MUTE CONTROL

This command is used to enable and disable the DTMF mute function for the repeater, auxiliary and telephone audio. Each of these items can be individually controlled.

SYNTAX: 18 [Mute] [Mode]  
 MINIMUM: Mute 0 (All items), Mode 0 (Off)  
 MAXIMUM: Mute 3 (Telephone), Mode 1 (On)  
 UNITS: Mute 0 = All items, Mute 1 = Repeater, Mute 2 = Auxiliary, Mute 3 = Telephone  
           Mode 0 = Off, Mode 1 = On  
 DEFAULT: All mute items are 1 (On)  
 EXAMPLE: 18 3 0           Turn off DTMF mute to or let DTMF tones pass to the telephone company

#### 4.5.19 SEND DTMF TONES ON REPEATER TRANSMITTER

This command is used to re-send or regenerate a DTMF string on the repeater transmitter. The data source for this command can come from the repeater input or data stored in a macro with the use of this S-Command. The controller regenerates DTMF tones with 150 ms tone ON time and 80 ms spacing. Valid DTMF digits are 0 through 9, A, B, D, \*, #. (C is the only non-valid digit as it is used to terminate a command). The DTMF regenerate buffer has a maximum length of 34 DTMF digits. This command can also be used in a macro to generate a DTMF string upon a user command.

SYNTAX: 19 [Data]  
 MINIMUM: 0 DTMF digits  
 MAXIMUM: 34 DTMF digits  
 UNITS: DTMF characters 0 through 9, A, B, D, \*, #. (C is the only non-valid digit).  
 DEFAULT: N/A  
 EXAMPLE: 19 1234567890\*#   Resends DTMF characters 1234567890\*# on repeater transmitter

### 4.5.20 TONE PANEL CTCSS TONE and DCS CODE DECODE ENABLE

The RI-200 controller is equipped with 6 independent tone panels for 6 different internal functions. These functions include the Repeater audio, User commands, S-Commands, Auxiliary output, Telephone and Dial click commands. Each CTCSS tone and DCS code may be independently enabled or disabled for each tone panel. You can have any number and/or combination of tones/codes enabled. Once the tones you need are enabled, use the appropriate S-Commands (01, 14, 34, 49 and 72) to enable each tone panel for use. When you set up your tone panels, keep in mind that you can have a tone for repeater use only. Another tone for Repeater, User commands and Telephone use. Yet another tone can be used for Repeater and S-Commands. This flexibility allows you to customize the repeater for each user.

If you plan to use DCS codes on your repeater, avoid using CTCSS tone frequencies 131.8 Hz and 136.5 Hz. The DCS protocol uses a tone near this frequency to terminate the DCS data. DCS is only available if you ordered your controller with the DCS option installed.

- SYNTAX: 20 [Tone Panel] [Tone Number] [Mode]
- MINIMUM: Tone Panel 0 (All), Tone number 000 (All tones and codes), Mode 0 (Off)
- MAXIMUM: Tone Panel 6 (Dial Click), Tone number 154 (DCS Code 754), Mode 1 (On)
- UNITS: Tone Panel 0 = All tone panels, 1 = Repeater, 2 = User Commands  
 Tone Panel 3 = S-Commands, 4 = Auxiliary out, 5 = Telephone, 6 = Dial Click  
 Tone Number 000 = All tones and codes, 001 through 154 see tone table below  
 Mode 0 = Off, Mode 1 = On
- DEFAULT: 013 = 100.0 Hz tone enabled for all panels
- EXAMPLE: 20 0 000 0      Disable all tones on all panels  
 20 0 013 1      Enable 100.0 Hz on all tone panels  
 20 1 025 1      Enable 151.4 Hz for the repeater tone panel

CTCSS DECODE AND ENCODE TONE (Hz)									
NUMBER	FREQ.	NUMBER	FREQ.	NUMBER	FREQ.	NUMBER	FREQ.	NUMBER	FREQ.
001	67.0	011	94.8	021	131.8	031	171.3	041	203.5
002	69.3	012	97.4	022	136.5	032	173.8	042	206.5
003	71.9	013	100.0	023	141.3	033	177.3	043	210.7
004	74.4	014	103.5	024	146.2	034	179.9	044	218.1
005	77.0	015	107.2	025	151.4	035	183.5	045	225.7
006	79.7	016	110.9	026	156.7	036	186.2	046	229.1
007	82.5	017	114.8	027	159.8	037	189.9	047	233.6
008	85.4	018	118.8	028	162.2	038	192.8	048	241.8
009	88.5	019	123.0	029	165.5	039	196.6	049	250.3
010	91.5	020	127.3	030	167.9	040	199.5	050	254.1
DCS DECODE AND ENCODE CODES									
NUMBER	CODE	NUMBER	CODE	NUMBER	CODE	NUMBER	CODE	NUMBER	CODE
051	023	072	131	093	251	114	371	135	532
052	025	073	132	094	252	115	411	136	546
053	026	074	134	095	255	116	412	137	565
054	031	075	143	096	261	117	413	138	606
055	032	076	145	097	263	118	423	139	612
056	036	077	152	098	265	119	431	140	624
057	043	078	155	099	266	120	432	141	627
058	047	079	156	100	271	121	445	142	631
059	051	080	162	101	274	122	446	143	632
060	053	081	165	102	306	123	452	144	654
061	054	082	172	103	311	124	454	145	662
062	065	083	174	104	315	125	455	146	664
063	071	084	205	105	325	126	462	147	703
064	072	085	212	106	331	127	464	148	712
065	073	086	223	107	332	128	465	149	723
066	074	087	225	108	343	129	466	150	731
067	114	088	226	109	346	130	503	151	732
068	115	089	243	110	351	131	506	152	734
069	116	090	244	111	356	132	516	153	743
070	122	091	245	112	364	133	523	154	754
071	125	092	246	113	365	134	526		

#### 4.5.21 SET MASTER and CROSS ENCODE CTCSS TONE or DCS CODE

This command is used to setup a master encode tone, this is a tone that is encoded regardless to the tone that was decoded. The master encode is selected by omitting the cross decode tone number. Cross-encode is where you specify a specific encode tone for each of the decode tones that you will be using. For an example, the controller can be set up so that when 100.0 Hz is decoded, 127.3 Hz tone is encoded. Or when DCS code 023 is decoded, tone 151.4 Hz is encoded. This command also works in conjunction with S-Command 25 to select the encode mode or when this tone or code is encoded. When setting up tones for cross encode, a value of 000 in the tone encode field will force the controller to use the master tone for the selected decode tone. To use the cross tone encoding mode, S-Command 22 must be set to mode 3.

Each tone or code has a number assigned to it as listed in the table in section 4.5.20. DCS is only available if you ordered your controller with the DCS option installed.

SYNTAX: 21 [Encode Tone Number] <Decode Tone Number>  
 MINIMUM: Encode 0 (No tone), Decode 0 (All tones)  
 MAXIMUM: Encode and Decode 154 (DCS code 754)  
 UNITS: Encode Tone Number 0 = No tone or Off, 0 = Master tone when decode tone is included, 001 - 154  
 Decode tone number (cross encode) is optional 0 = All decode tones, 0 – 154 tone number  
 DEFAULT: Master tone = 013 (100.0 Hz tone), All cross encode tones = 0 (Select master tone)  
 EXAMPLE: 21 20                      Sets master tone encode to 127.3 Hz  
 EXAMPLE: 21 0                        Sets master tone encode to off  
 EXAMPLE: 21 013 020                Encode 100.0 Hz when 127.3 Hz is decoded  
 EXAMPLE: 21 025 041                Encode 151.4 Hz when DCS code 023 is decoded

#### 4.5.22 TONE PANEL CTCSS TONE or DCS CODE ENCODE MODE

This command selects the CTCSS tone or DCS code, encode mode. Mode 0 will turn off all encoding. Mode 1 will encode the master tone at all times. Modes 2 and 3 regenerate tones ONLY when valid COS/CTCSS tones are decoded on the receiver input. Mode 2 is the most commonly used mode. Mode 3 can be used to cross encode, see S-Command 21. In all modes, the controller stops encoding the tones ½ second before the PTT drops. Make sure you have S-Command 02 in mode 1 (HPF - CTCSS filter on) when using this command in Modes 1, 2, or 3. DCS is only available if you ordered your controller with the DCS option installed.

SYNTAX: 22 [Mode]  
 MINIMUM: 0  
 MAXIMUM: 3  
 UNITS: Mode 0 = Off or no tone encoded.  
 Mode 1 = Encode tone is on all the time (encode tone or code is selected by master tone).  
 Mode 2 = Controller regenerates last DECODED tone or code.  
 Mode 3 = Controller encodes tone or code selected by S-Command 21 (cross encoding).  
 DEFAULT: Mode 2, Regenerate last decoded tone or code  
 EXAMPLE: 22 0                      Turns CTCSS / DCS encode off  
 22 1                                  Enables CTCSS / DCS encode on at all times.



### 4.5.23 INTERNAL FUNCTION CTCSS TONE or DCS CODE ENCODE

When activity occurs on some of the controller's internal functions, a specific tone or code can be encoded. This command is used to specify what tones will be encoded on the repeater transmitter when activity is detected from the ID, auxiliary input and telephone ringing. When specifying the encode tone for each of these functions, 4 additional encode modes are available. Tone 0 will disable encoding tones or codes during the above function. Using tone 155, the controller will use tones based on the mode of S-Command 22. Using tone 156, the controller will use the master tone selected by S-Command 21. With tone 157, the controller will use the tone that originates from another controller at the auxiliary input. The most common use for this command is to set the ID to be sent without any tone or code encode.

SYNTAX: 23 [Function] [Tone]  
 MINIMUM: Function 0 (All), Tone 0 (No tone)  
 MAXIMUM: Function 3 (Telephone), Tone 157 (Aux input)  
 UNITS: Function 0 = All functions, 1 = ID, 2 = Auxiliary, 3 = Telephone ringing  
 Tone 0 = No tone, Tone 1-154 = Specific Tones and Codes (See table in section 4.5.20),  
 Tone 155 = Default tone encode mode (S-Command 22), Tone 156 = Master tone,  
 Tone 157 = Aux input (Also see S-Command 35).  
 DEFAULT: All functions, tone 155 (Default tone)  
 EXAMPLE: 23 1 0           The ID will be sent without tone encode.  
 23 2 157           When the auxiliary input is active, the repeater will use the tone for the source auxiliary.

### 4.5.24 SET CTCSS/DCS ENCODE LEVEL

Use this command to make minor adjusts to the CTCSS / DCS encode level on the repeater transmitter. The level is adjusted in 0.86 dB steps and starts at the mid range.

SYNTAX: 24 [Level]  
 MINIMUM: 0 (- 2.58 dB)  
 MAXIMUM: 6 (+ 2.58 dB)  
 UNITS: 0.86 dB steps  
 DEFAULT: 3 (0.00 dB)  
 EXAMPLE: 24 5           Raises encode tone level by 1.72 dB from default

### 4.5.25 DCS TX/RX DATA POLARITY CONTROL

Depending on your repeater installation, you may have to change the polarity of the DCS TX / RX data. If the controller will not decode DCS data, change the RX polarity. If your radio will not decode DCS data from the repeater, change the TX polarity. DCS is only available if you ordered your controller with the DCS option installed.

SYNTAX: 25 [TX / RX] [Pol]  
 MINIMUM: TX / RX 0 (TX), Pol 0 (Non-inverted)  
 MAXIMUM: TX / RX 1 (RX), Pol 1 (Inverted)  
 UNITS: 0 = TX, 1 = RX, Pol 0 = Non-inverted, 1 = Inverted  
 DEFAULT: TX = 0, RX = 0  
 EXAMPLE: 25 1 0           Set RX polarity to Non-inverted

### 4.5.26 RESERVED FOR FUTURE COMMAND

### 4.5.27 RESERVED FOR FUTURE COMMAND

### 4.5.28 RESERVED FOR FUTURE COMMAND

### 4.5.29 RESERVED FOR FUTURE COMMAND

### 4.5.30 RESERVED FOR FUTURE COMMAND

### 4.5.31 MESSAGE EDITOR, INSERT TONE GENERATOR CW COMMANDS

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 tone generator or CW commands in sequence. Each of these commands consists of a 3 digit value and are used to tell the RI-200'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 as not to damage other data stored in the memory. Once a message is stored, it can be triggered for playback, this is done with message triggers (S-Command 32). Messages can also be imbedded directly inside a macro.

There are two types of messages. Messages that stand by themselves and are triggered by events within the controller. These messages are most common and 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 and are used in special applications.

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 8 digits. All messages and macros must start at the beginning of a line. Each line has a starting number from 001 to 999. Message triggers, user commands and triggers use the start line address as the start 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. This is done 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 (31 001) as the first entry. The following entries are the message itself (31 XXX). The message is completed with an "End of Message" command (31 002) and finally an end of data command (64) as 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 3 digits each.

When building a message that is contained within a macro, the messages must be short, a total of 32 digits or less. You use the standard macro edit process with S-Command 64 and the message edit S-command 31 with message data. No start or end of message commands are required. A 10 second beep would be entered as "64 31 026 134"

**SYNTAX:** 31 [CW Command]

**MINIMUM:** CW Commands 000 (Reset tone generator) see the following "CW Command Table".

**MAXIMUM:** CW Commands 166 (Delay 10 seconds) see the following "CW Command Table".

**UNITS:** 3 digit CW Commands.

**DEFAULT:** See default messages below.

**EXAMPLE:** See example in section 1.4.2

Start line 031	31 023 102 139 024 139 025 139 026 107 C D	Normal courtesy
Start line 035	31 026 102 139 025 139 024 139 023 107 C D	Weak signal courtesy
Start line 039	31 024 042 079 080 081 C D	Power on reset courtesy "RST"
Start line 042	31 030 102 150 026 150 023 118 C D	Post timeout
Start line 046	31 026 124 023 124 C D	Pre timeout
Start line 048	31 030 042 066 079 079 076 079 C D	Function error "ERROR"
Start line 052	31 025 040 088 076 072 C D	Function acknowledgment "OK"
Start line 055	31 152 026 102 142 023 142 026 142 023 142 026 142 023 142 026 110 C D	Auto patch ring
Start line 062	31 026 134 C D	10 Second test tone
Start line 064	31 030 113 139 025 113 C D	Un-lock courtesy
Start line 067	31 004 152 025 042 069 066 073 073 076 C D	Auto patch answer message "HELLO"
Start line 071	31 004 152 023 042 076 072 C D	Auto patch function acknowledgment "OK"
Start line 074	31 004 152 029 042 066 079 083 076 079 C D	Auto patch function error "ERROR"
Start line 078	31 004 026 102 142 023 142 026 142 023 142 026 142 023 142 026 110 C D	Auto patch ring back
Start line 085	31 023 042 088 069 066 073 073 076 C D	Station ID "HELLO"

### CW COMMAND DATA TABLE

Data	Operation	Data	Operation	Data	Operation	Data	Operation
000	Reset tone generator	042	CW speed, 16 WPM	084	CW "W"	126	Tone beep 2.5 Sec
001	Start of Message	043	CW speed, 17 WPM	085	CW "X"	127	Tone beep 3.0 Sec
002	End of Message	044	CW speed, 18 WPM	086	CW "Y"	128	Tone beep 4.0 Sec
003	Message to repeater	045	CW speed, 19 WPM	087	CW "Z"	129	Tone beep 5.0 Sec
004	Message to auto patch	046	CW speed, 20 WPM	088	CW Space	130	Tone beep 6.0 Sec
005	Message to auxiliary	047	CW speed, 21 WPM	089	CW End-of-message	131	Tone beep 7.0 Sec
006	N/A	048	CW speed, 22 WPM	090	CW End-of work SK	132	Tone beep 8.0 Sec
007	DTMF Tone 1	049	CW speed, 23 WPM	091	CW Break N	133	Tone beep 9.0 Sec
008	DTMF Tone 2	050	CW speed, 24 WPM	092	CW Double Dash BT	134	Tone beep 10 Sec
009	DTMF Tone 3	051	CW speed, 25 WPM	093	CW Comma ,	135	Delay 10 ms
010	DTMF Tone 4	052	CW "0"	094	CW Period .	136	Delay 20 ms
011	DTMF Tone 5	053	CW "1"	095	CW Slash /	137	Delay 30 ms
012	DTMF Tone 6	054	CW "2"	096	CW Question mark ?	138	Delay 40 ms
013	DTMF Tone 7	055	CW "3"	097	CW Colon :	139	Delay 50 ms
014	DTMF Tone 8	056	CW "4"	098	CW Semicolon ;	140	Delay 60 ms
015	DTMF Tone 9	057	CW "5"	099	CW Parentheses ( )	141	Delay 70 ms
016	DTMF Tone 0	058	CW "6"	100	CW "Wait"	142	Delay 80 ms
017	DTMF Tone *	059	CW "7"	101	Tone off	143	Delay 90 ms
018	DTMF Tone #	060	CW "8"	102	Tone on	144	Delay 100 ms
019	DTMF Tone A	061	CW "9"	103	Tone beep 10 ms	145	Delay 150 ms
020	DTMF Tone B	062	CW "A"	104	Tone beep 20 ms	146	Delay 200 ms
021	DTMF Tone C	063	CW "B"	105	Tone beep 30 ms	147	Delay 250 ms
022	DTMF Tone D	064	CW "C"	106	Tone beep 40 ms	148	Delay 300 ms
023	Tone at 697 Hz	065	CW "D"	107	Tone beep 50 ms	149	Delay 400 ms
024	Tone at 770 Hz	066	CW "E"	108	Tone beep 60 ms	150	Delay 500 ms
025	Tone at 852 Hz	067	CW "F"	109	Tone beep 70 ms	151	Delay 600 ms
026	Tone at 941 Hz	068	CW "G"	110	Tone beep 80 ms	152	Delay 700 ms
027	Tone at 1209 Hz	069	CW "H"	111	Tone beep 90 ms	153	Delay 800 ms
028	Tone at 1336 Hz	070	CW "I"	112	Tone beep 100 ms	154	Delay 900 ms
029	Tone at 1477 Hz	071	CW "J"	113	Tone beep 150 ms	155	Delay 1.0 Sec
030	Tone at 1633 Hz	072	CW "K"	114	Tone beep 200 ms	156	Delay 1.5 Sec
031	CW speed, 5 WPM	073	CW "L"	115	Tone beep 250 ms	157	Delay 2.0 Sec
032	CW speed, 6 WPM	074	CW "M"	116	Tone beep 300 ms	158	Delay 2.5 Sec
033	CW speed, 7 WPM	075	CW "N"	117	Tone beep 400 ms	159	Delay 3.0 Sec
034	CW speed, 8 WPM	076	CW "O"	118	Tone beep 500 ms	160	Delay 4.0 Sec
035	CW speed, 9 WPM	077	CW "P"	119	Tone beep 600 ms	161	Delay 5.0 Sec
036	CW speed, 10 WPM	078	CW "Q"	120	Tone beep 700 ms	162	Delay 6.0 Sec
037	CW speed, 11 WPM	079	CW "R"	121	Tone beep 800 ms	163	Delay 7.0 Sec
038	CW speed, 12 WPM	080	CW "S"	122	Tone beep 900 ms	164	Delay 8.0 Sec
039	CW speed, 13 WPM	081	CW "T"	123	Tone beep 1.0 Sec	165	Delay 9.0 Sec
040	CW speed, 14 WPM	082	CW "U"	124	Tone beep 1.5 Sec	166	Delay 10 Sec
041	CW speed, 15 WPM	083	CW "V"	125	Tone beep 2.0 Sec		

### 4.5.32 SET MESSAGE and EVENT TRIGGERS

This command is used to assign controller events to trigger messages or macros. Event triggers are items like ID, courtesy messages, function telemetry and power on events. These triggers point to a starting line in the macro data memory. When an event occurs, the trigger starts 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 999 macro line numbers or 0 for no message. Setting an event to start line 0 will disable that event from triggering anything. See section 5.4 for additional information in programming messages and triggers.

#### EVENTS:

Whenever power is lost and then restored to the controller, a flag is set and the Power On trigger occurs. This trigger then starts a macro. This function can be used to return your repeater to a certain configuration when power is turned on. A function complete ("OK" message) will occur when this process is used.

During the dialing process and when a telephone time-out error occurs, the controller will need to put the telephone back on hook. This trigger is used to tell the controller which macro you are using for the on-hook command. If you chose to change the factory default macro line position for the on-hook, you will need to reset this trigger to match. If the controller does not know the correct on-hook command, you may have problems if an on-hook time-out occurs.

SYNTAX: 32 [Trigger/Event] [Start line]

MINIMUM: Trigger 01 (Clock reset courtesy message), Start line 0 (Disable message or trigger)

MAXIMUM: Trigger 18 (Telephone hang up macro), Start line 999 (Macro data memory)

UNITS: Trigger number, Macro data memory start line

DEFAULT: See table below

EXAMPLE: 32 07 120 Sets ID event to start line 120

EXAMPLE: 32 02 0 Sets weak signal courtesy to no message

Trigger #	Messages and Events	Start line
01	Message, Clock reset courtesy	031
02	Message, Weak signal courtesy	035
03	Message, Clock not set courtesy	031
04	Message, Un-lock courtesy	064
05	Message, Acknowledge or function complete	052
06	Message, Function error	048
07	Message, Station ID	085
08	Message, Post time-out	042
09	Message, Pre time-out	046
10	Message, Telephone (auto-patch) Ring	055
11	Message, Reserved for future use	000
12	Message, Reserved for future use	000
13	Message, Telephone Answer	067
14	Message, Telephone Acknowledge	071
15	Message, Telephone Error	074
16	Message, Telephone Ring Back	078
17	Event, Power on macro	001
18	Event, Telephone hang up macro	017
19	Event, Telephone auto answer macro	023

### 4.5.33 RESERVED FOR FUTURE COMMAND

#### 4.5.34 AUXILIARY OUTPUT MODE

The auxiliary port allows you to connect multiple RI-200 controllers together or connect the RI-200 to someone else's existing controller. This command sets up the mode for the output of audio and PTT logic to another controller. These mode selections are valid with both serial data out and digital output modes (see S-Command 38).

SYNTAX: 34 [Mode]  
 MINIMUM: 0  
 MAXIMUM: 4  
 UNITS: Mode 0 = Auxiliary output is off or disabled.  
 Mode 1 = Auxiliary output when local COS is active.  
 Mode 2 = Auxiliary output when auxiliary CTCSS/DCS tone decode is detected.  
 Mode 3 = Auxiliary output when repeater COS and CTCSS/DCS tone decode is detected.  
 Mode 4 = Auxiliary output is continuously turned ON and squelch from local receiver is disabled.  
 DEFAULT: 0, Auxiliary output off.  
 EXAMPLE: 34 1            Mode 1, Auxiliary output when local COS is active.

#### 4.5.35 AUXILIARY INPUT MODE

The auxiliary port allows you to connect multiple RI-200 controllers together or connect the RI-200 to someone else's existing controller. This command selects the source controller address that will allow audio and PTT information to enter this controller. This command also selects whether the auxiliary audio is mixed with the local receiver audio or when the local receiver audio is active, the auxiliary audio is muted. Individual inputs can only be selected when the serial mode is selected with S-Command 38. When S-Command 38 digital mode is selected, enabling any of the source inputs will pass audio.

An optional "Encode Source" parameter is also available. This allows you to select a source controller address that when activity from that source occurs, the local controller will use the CTCSS/DCS decode data to determine what CTCSS or DCS to encode on the local TX. Also see S-Command 23 for selecting functions for this mode.

SYNTAX: 35 [Input] [State] [Mode] <Encode Source>  
 MINIMUM: Input 0 (All inputs), State 0 (Off), Mode 0 (Mute audio), Encode source 0 (No encode source)  
 MAXIMUM: Input 8, State 1 (On), Mode 1 (Mix audio), Encode source 8 (Tone # from controller address 8)  
 UNITS: Input 0 = All inputs, 1 – 8 = each input.  
 State 0 = Input off, State 1 = Input on.  
 Mode 0 = Mute auxiliary input audio when the local RX is active.  
 Mode 1 = Mix auxiliary audio with local RX audio.  
 Encode Source 0 = No source used, Source 1 – 8 = The source used for auxiliary CTCSS/DCS encode.  
 DEFAULT: All auxiliary inputs are 0 (Off).  
 EXAMPLE: 35 1 1 0        Turn on input 1 and use mute mode.  
 35 3 1 1 3        Turn on input 3 and use mix mode, also ref. input 3 tone for encode when aux is active.  
 35 0 0 0        Turn off all inputs

#### 4.5.36 AUXILIARY INPUT CARRIER DELAY TIMER

This is the amount of time that the repeater transmitter stays keyed after the auxiliary input has dropped. This carrier delay is set in tenths of seconds (100 ms) increments. Setting the auxiliary delay to zero seconds selects no carrier delay.

SYNTAX: 36 [Time]  
 MINIMUM: 0 (No delay)  
 MAXIMUM: 255 (25.5 Seconds)  
 UNITS: Tenths of seconds (1/10 seconds or 100 ms)  
 DEFAULT: 10 (1.0 Seconds)  
 EXAMPLE: 36 50        Set Auxiliary input carrier delay to 5.0 seconds.  
 36 0            Set Auxiliary input carrier delay to 0 seconds, no delay.

### 4.5.37 REGENERATE DTMF TONES FROM THE AUXILIARY INPUT

This command determines if DTMF tones from the auxiliary input will be regenerated on the local TX or not. Regenerated DTMF tones are 150 ms long with 80 ms spacing immediately following the end of the DTMF decoded string from another controller. With DTMF Mute On (S-Command 18) you can ensure quality DTMF tones to your link with this regeneration mode.

SYNTAX: 37 [Mode]  
 MINIMUM: 0  
 MAXIMUM: 1  
 UNITS: Mode 0 = Off, Mode 1 = On  
 DEFAULT: 0  
 EXAMPLE: 37 1                    Mode 1, regenerate DTMF digits on TX from auxiliary input.

### 4.5.38 MULTIPLE CONTROLLER DATA PROTOCOL and CLONING MODE

This command is used to setup the method by which multiple controllers can communicate. Mode 0 is typically used when connecting to someone else's controller. The input and output digital signals are TTL levels with LOW TRUE or LOW ACTIVE. The COS input is the same as the RXD input and the PTT output is the same as TXD output. Mode 1 is used when connecting multiple RI-200 controllers together. In mode 1 the controllers communicate with each other using serial data. Also in this mode, macro data from one controller can be used to function another controller. Mode 2 is used to send all configuration data, including user commands and macro data, from the local controller to another controller (cloning). To use this mode, connect two controllers together with the interface cable. At the controller that you want to copy data from, send S-command 38 2. You will hear a function complete and the local controller will start to send data. This will take 90 to 180 seconds. When the controller is done, you will hear a second function complete. Do not send commands to either controller during this process as errors may occur. Once the cloning process is complete, the controller will return to its previous serial mode.

SYNTAX: 38 [Mode]  
 MINIMUM: 0  
 MAXIMUM: 2  
 UNITS: Mode 0 = Digital I/O, Mode 1 = Serial Data I/O, Mode 2 = Cloning  
 DEFAULT: 1  
 EXAMPLE: 38 0                    Mode 0 selects the digital state port.  
           38 2                    This controller will send all perimeters to an attached controller.

### 4.5.39 RI-200 CONTROLLER UNIT ADDRESS

This command is used to assign each RI-200 a unique address when connecting multiple controllers together. The unit address is used in the serial data protocol so that multiple controllers can talk to each other. Valid unit addresses are 1 through 9 with default being 1. A controller with an S-Command address in its macro data will not process that S-Command. All other controllers connected to the auxiliary port will look for a matching address and execute the S-Command. An externally executable S-Command starts with the "A" prefix and the destination address like "A2". This will send the S-Command following the A2 to all controllers with the unit address of "2". When connecting multiple controllers together, you will have to assign each controller its own address.

SYNTAX: 39 [Address]  
 MINIMUM: 1  
 MAXIMUM: 9  
 UNITS: Unit address  
 DEFAULT: 1  
 EXAMPLE: 39 3                    Sets controller unit address to 3.

#### 4.5.40 DELAY TIMER MACRO TRIGGER

You can delay a macro to execute at some time in the future. Once this S-Command is setup and the timer expires, the macro pointed to by the “Start Line” field will execute. Note: This function will generate an “OK” function complete without a user command being sent. For example, this function can be used to turn on the CTCSS repeater tone panel after a preset time has expired.

SYNTAX: 40 [Start Line] [Time]  
 MINIMUM: Start Line 000 (disable function), Time 0 (reset timer)  
 MAXIMUM: Start Line 999 (macro start line), Time 7200 (seconds, 2 hours)  
 UNITS: Start Line 000 = Disable this function, Start line 001 – 999 Macro data start line  
 Time 0 = Reset timer, 1 – 7200 seconds (2 hours maximum)  
 DEFAULT: Start Line = 000, Time = 0  
 EXAMPLE: 40 000 0 Clears the timer, no macro will execute.  
 40 060 120 Execute macro at start line 60 in 2 minutes.

#### 4.5.41 RECEIVER INACTIVITY TIMER MACRO TRIGGER

The receiver inactivity timer can be used to reset the system when the repeater receiver becomes inactive for the preset time. Once the S-Command is setup, the timer is restarted each time the receiver activity goes away. When a time out occurs the macro pointed to by the “Start Line” field will execute. Note: This function will generate an “OK” function complete without a user command being sent. For an example, this function can be used to turn on the CTCSS tone decode after there has been no activity on the repeater for the set time.

SYNTAX: 41 [Start Line] [Time]  
 MINIMUM: Start Line 000 (disable function), Time 0 (reset timer).  
 MAXIMUM: Start Line 999 (macro start line), Time 2400 (in 6 second increments).  
 UNITS: Start Line 000 = Disable this function, Start line 001 – 999 Macro data start line.  
 Time 0 = Reset timer, 1 – 2400 in 6 second increments (1 to 240.0 minutes).  
 DEFAULT: Start Line = 000, Time = 0.  
 EXAMPLE: 41 000 0 Clears the timer, no macro will execute.  
 EXAMPLE: 41 022 55 Execute macro at start line 22 in 5.5 minutes.

#### 4.5.42 REGULAR INTERVAL MACRO TRIGGER

This command is used to trigger a macro start line at a regular timed interval. If you want to have a beacon ID every hour, you can use this command to trigger a macro line that starts the ID.

SYNTAX: 42 [Start Line] [Time]  
 MINIMUM: Start Line 000 (disable function), Time 0 (reset timer).  
 MAXIMUM: Start Line 999 (macro start line), Time 240 (minutes).  
 UNITS: Start Line 000 = Disable this function, Start line 001 – 999 Macro data start line.  
 Time 0 = Reset timer, 1 – 240 in minutes.  
 DEFAULT: Start Line = 000, Time = 0.  
 EXAMPLE: 42 123 10 Trigger macro starting at line number 123 every 10 minutes.  
 42 000 0 Disable this feature.

#### 4.5.43 SET CLOCK TIME

The system time clock is used by the scheduler (S-Command 44). This command is used to set the system time clock. If you wish to use the scheduler, the time clock must be reset after power is restored to the controller. Executing this command resets the flag that triggered the “Clock not Set” or “Clock Reset” courtesy messages, see S-Command 32. The time is set in a 24 hour format. If you plan to use the scheduler, you may want to change the “Clock not Set” message trigger to point to the Power on reset courtesy “RST” message.

SYNTAX: 43 [Hour] [Minutes]  
 MINIMUM: 0000  
 MAXIMUM: 2359  
 UNITS: Hours, Minutes  
 DEFAULT: Clock is not set when power is turned on.  
 EXAMPLE: 43 07 30 Set time to 07:30 AM

#### 4.5.44 SCHEDULER TO TRIGGER A MACRO

This is a simple scheduler, allowing you to instruct the controller to perform a macro at a certain time of the day. Eight individual schedulers are available. The time clock must be set properly after each time the power is restored (S-Command 43) for this command to work correctly. This command can be used to automatically turn on and off the repeater or telephone interconnect each day.

SYNTAX: 44 [Scheduler #] [Time] [Macro start line]  
 MINIMUM: Scheduler # 1, Time 0000, Macro start line 0 (disable scheduler).  
 MAXIMUM: Scheduler # 8, Time 2359, Macro start line 999.  
 UNITS: Scheduler # 1 to 8, Hours / Minutes, Macro start line 000 to 999.  
 DEFAULT: All schedulers disabled, macro start line 0.  
 EXAMPLE: 44 1 0730 32 Scheduler #1, Execute macro at start line 32 at 07:30 AM.

#### 4.5.45 LOGIC INPUTS and INTERNAL FUNCTIONS – STATE CHANGE TRIGGER

The controller has three digital inputs and seven internal functions that can be used to trigger macros. Each of these inputs or functions can be setup so when the state changes (falling and rising edges) for an input, a macro starting at macro line address 1 through 999 will be executed. To disable this function use 0 as the macro start line address. See section 2.0 and 2.6 for information on the pin numbers for each input. This function can be used to generate an alarm message or externally turn on/off a controller function.

SYNTAX: 45 [Bit] [State] [Macro start line]  
 MINIMUM: Bit 1, State 0 (Falling edge), Macro start line 0 (disable function)  
 MAXIMUM: Bit 9 (Aux PTT input), State 1 (Rising edge), Macro start line 999.  
 UNITS: Bit 1 = Input 1, 2 = Input 2, 3 = Input 3, Bit 4 = COS, 5 = Repeater CTCSS or DCS, 6 = PTT,  
 Bit 7 = AUX input COS, 8 = AUX input CTCSS or DCS, 9 = AUX input PTT  
 State 0 = Falling edge (High to Low), State 1 = Rising edge (Low to High)  
 Macro start line 0 = Disable, 1 – 999 = Macro start lines  
 DEFAULT: All bits set to 0  
 EXAMPLE: 45 1 0 10 Input #1 Falling edge triggers macro starting at line 10.  
 45 6 0 11 Repeater PTT Falling edge triggers macro starting at line 11.  
 45 1 1 12 Input #1 Rising edge triggers macro starting at line 12.  
 45 6 1 344 Repeater PTT Rising edge triggers macro starting at line 344.



#### 4.5.46 DIGITAL LOGIC OUTPUT, ON / OFF

The controller has three digital logic outputs. Each of these outputs can be directly turned on or off with this command. See section 2.0 and 2.7 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]  
 MINIMUM: Output 1, Mode 0 (Off)  
 MAXIMUM: Output 3, Mode 1 (On)  
 UNITS: Output number 1 through 3  
       Mode 0 = off, Mode 1 = on  
 DEFAULT: All outputs are off when power is turned on  
 EXAMPLE: 46 1 1       Turns output number 1 on

#### 4.5.47 DIGITAL LOGIC OUTPUT PULSED ON FOR X TIME

The controller has three digital logic outputs. Each of these outputs can be pulsed on for the programmed time duration, the output will go high for the programmed time and then low again. The time is programmed in tenths of seconds. See section 2.0 and 2.7 for information on the pin numbers for each output. This function can be used to turn on something external to the controller for a set time.

SYNTAX: 47 [Output ] [Pulse time]  
 MINIMUM: Output 1, Pulse time 0  
 MAXIMUM: Output 3, Pulse time 255 (25.5 Seconds).  
 UNITS: Output 1 through 3, Pulse time 0 to 255 in tenths of seconds  
 DEFAULT: All 0  
 EXAMPLE: 47 1 65       Pulses output number 1 high for 6.5 Seconds.

#### 4.5.48 RESERVED FOR FUTURE COMMAND

#### 4.5.49 DIAL CLICK CONTROL TRIGGER

Dial Click is a method of control where you can assign a number of key-ups on the repeater input that will cause a user command or macro to occur. The CTCSS tones or DCS codes that are required for Dial Click to operate are selected by S-Command 20. The Dial Click function uses a 2-second timer to check the spacing between each Dial Click. When a key up occurs, the timer is started. One Dial click is counted if the user un keys before the timer expires. If the user keys up again before the timer expires, another Dial Click is counted. Once the timer has expired, the program checks to see if no tone or code is active and how many Dial Clicks were counted. This information is then used to trigger a macro start line. Once you setup the Dial Click Control, you may need to experiment with a rate of key ups so that they are properly counted. If you key too quickly, the CTCSS or DCS decode delay may not be long enough to correctly count dial clicks. If you wait too long between key ups, the Dial Click timer may expire before you are finished.

A single key up Dial Click command works well with the telephone answer S-Command 82 9. Using 2 and sometimes 3 Dial Clicks to trigger a command can sometimes be false, the command maybe executed because of 2 quick keys or noise on the repeater input. You can also use multiple Dial Clicks to dial a number in the auto dial list using S-Command 92.

SYNTAX: 49 [Dial Clicks] [Macro start line]  
 MINIMUM: 1 Dial Click, Macro start line 0 (disable a dial click)  
 MAXIMUM: 9 Dial Clicks, Macro start line 999.  
 UNITS: Dial Clicks = 1-9, Macro start line = 0 - 999  
 DEFAULT: All Dial Clicks (1-9) = 0, disabled  
 EXAMPLE: 49 1 20       When 1 dial click occurs, execute macro at start line 20  
 EXAMPLE: 49 3 122     When 3 dial clicks occur, execute macro at start line 122

### 4.5.50 ADJUST SQUELCH

The RI-200 uses a digital pot to control the squelch level. This command is used to set the squelch level of the digital pot. The pot has 64 positions or steps, 00 through 63. You can also adjust squelch level by sending a “50 \*” to increment the level up one step and a “50 #” to decrement the level setting down one step. See section 3 for additional information on setting the squelch level.

SYNTAX: 50 [Level]  
 MINIMUM: Level 0 or # Down  
 MAXIMUM: Level 63 or \* Up  
 UNITS: 0 – 63 Pot position, \* and #.  
 DEFAULT: 31  
 EXAMPLE: 50 \* Adjusts squelch level setting up by one step.  
 EXAMPLE: 50 23 Sets squelch digital pot to position 23.

### 4.5.51 SET SQUELCH MODE

Use this command to select between the standard squelch mode and SmartSquelch™. In the SmartSquelch mode, the processor is used to analyze the signal to noise and determine when to close the squelch fast or add delays for mobile flutter or a hand held radio moving in and out of nulls. This algorithm will react as fast as 10 ms when the input signal is full quieting and a proportionally longer time to squelch closure when the input signal becomes noisier.

SYNTAX: 51 [Mode]  
 MINIMUM: 0 (Normal squelch)  
 MAXIMUM: 1 (SmartSquelch)  
 UNITS: Mode 0 = Normal Squelch, Mode 1 = SmartSquelch  
 DEFAULT: 1, SmartSquelch  
 EXAMPLE: 51 0 Selects normal squelch mode

### 4.5.52 DETAIL SQUELCH SETUP

The squelch system on the RI-200 can be fine-tuned for a given application. The following items may be changed to achieve a different result in your application. The best way to learn more about these adjustments is to experiment with them. Notice that each adjustment will have its own range.

**Upper Threshold:** This is the squelch upper threshold value that is compared to the squelch A/D converter value to determine when to close the squelch. Do not set upper threshold less than lower threshold.

**Lower Threshold:** This is the lower threshold value that is compared to the squelch A/D converter value to determine when to open the squelch. Do not set lower threshold more than upper threshold.

**Acquisition Time:** The SmartSquelch acquisition time is in 10 ms increments. This is the time that the squelch noise must be below the lower threshold in order to activate the COS.

**Delay Factor:** This delay is used to keep the squelch open for a weak or choppy signal. The delay factor is the maximum time in 10 ms increments that the squelch will remain open.

**Average Factor:** The average factor is used by SmartSquelch to determine how long of a period in 10 ms increments that noise history is used for processing.

**Weak Signal Threshold:** The SmartSquelch Weak Signal Message is triggered based on an evaluation of its noise history. The weaker a signal is, the longer a squelch delay will occur. The length of this time delay can be used to trigger the “weak signal” courtesy message.

SYNTAX: 52 [Item] [Value]  
 RANGE: Item 1 = Upper threshold, Value range = 75 – 200  
 Item 2 = Lower threshold, Value range = 50 – 150  
 Item 3 = Acquisition time, Value range = 0 – 50 in 10 ms increments  
 Item 4 = Delay factor, Value range = 0 – 255  
 Item 5 = Average factor, Value range = 0 – 50  
 Item 6 = Weak signal threshold, Value range = 3 to 50 in 10 ms increments  
 UNITS: Item 1 through 6, Value as listed in range.  
 DEFAULT: Item 1 Upper threshold = 160  
 Item 2 Lower threshold = 130  
 Item 3 Acquisition time = 8 (80 ms)  
 Item 4 Delay factor = 125  
 Item 5 Average factor = 25  
 Item 6 Weak signal threshold = 5 (50 ms)  
 EXAMPLE: 52 1 200      Sets new squelch upper threshold value to 200  
 52 2 90      Sets new squelch lower threshold value to 90

#### 4.5.53 RESERVED FOR FUTURE COMMAND

#### 4.5.54 SET KEY-CODE FOR USER COMMANDS

The key-code is a 1 to 4 digit sequence that would be required in front of all user commands. This function could be used as a site prefix so that all of your repeater sites would have the same user command suffix, while each site would have a distinctive prefix. The KEY-CODE or PREFIX can be from 0 to 4 DTMF digits long, but C and D can not be used as digits in the key-code. If zero key-code digits are entered in this command, the key-code function is disabled.

SYNTAX: 54 [Key-code]  
 MINIMUM: 0 digits (0 digits will disable the KEY-CODE)  
 MAXIMUM: 4 digits  
 UNITS: DTMF digits 0 through 9, \*, #, A and B  
 DEFAULT: 0 digits  
 EXAMPLE: 54      Disable the key-code.  
 54 \*123      Sets \*123 as the macro key-code or site prefix.

#### 4.5.55 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 6 digits long. “C” is the only digit that can not be used in a password. 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 4.2 of this manual.

SYNTAX: 55 [Password]  
 MINIMUM: 1 digit  
 MAXIMUM: 6 digits  
 UNITS: DTMF digits 0 through 9, \*, #, A, B and D  
 DEFAULT: 123456  
 EXAMPLE: 55 34\*685      The new password is now 34\*685  
 55 12      The new password is now 12

#### 4.5.56 PASSWORD FOR TELEPHONE INCOMING RING ACCESS

The telephone ring PASSWORD is used to start the ringing process on the repeater for incoming calls, also see S-Command 71, incoming call mode. This password is only used in S-Command 71 modes 3 and 4. The controller will answer the telephone company ringing and provide an answer message to the caller. After this message, the ring password is used to start the ring process on the repeater to let someone listening to the radio know that a caller is waiting on the telephone. The factory default password is 343 and can be changed to another password, from 1 to 6 digits long. "C" is the only digit that cannot be used in this password. Avoid using "A", "B" and "D" as these digits are not typically available on standard telephones. For more information, see section 6 of this manual, telephone interconnect.

SYNTAX: 56 [Telephone ring password]  
 MINIMUM: 1 digit  
 MAXIMUM: 6 digits  
 UNITS: DTMF digits 0 through 9, \* and #  
 DEFAULT: 343  
 EXAMPLE: 56 5419      The ring password is now 5419

#### 4.5.57 PASSWORD FOR TELEPHONE INCOMING CONTROL ACCESS

The telephone incoming control PASSWORD is used to access the User Command mode of the controller during an incoming telephone call. This password can only be used in S-Command 71 modes 2 through 4. The factory default password is 654381 and can be changed to password from 1 to 6 digits long. "C" is the only digit that can not be used in this password. Avoid using "A", "B" and "D" as these digits are not typically available on standard telephones. 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, see section 6 of this manual, telephone interconnect.

SYNTAX: 57 [Telephone control password]  
 MINIMUM: 1 digit  
 MAXIMUM: 6 digits  
 UNITS: DTMF digits 0 through 9, \* and #  
 DEFAULT: 654381  
 EXAMPLE: 57 3355      The control password is now 3355

#### 4.5.58 REMOTE SOFTWARE RESET

This command allows for a method to reset the controller remotely, same as a power on reset. You can also execute this command through a link (another attached RI-200 controller) or from the telephone. The serial number of your controller is required to operate this command. You can find the serial number of the controller located on the controller. Please make a note of the serial number and keep it in a safe place.

SYNTAX: 58 [Serial number]  
 MINIMUM: N/A  
 MAXIMUM: N/A  
 UNITS: Serial number is 8 digits long.  
 DEFAULT: Your RI-200 Serial number  
 EXAMPLE: 58 87654321      Resets the controller software only. This example will not be your serial number.

#### 4.5.59 REMOTE EEPROM INITIALIZE

This command allows you to reset your EEPROM (Non-Volatile Memory) data with factory defaults, remotely. You can also execute this command through a link (another attached RI-200 controller) or from the telephone. This S-Command is the same as if you were to press the initialization button on the controller and turn the power on. However the digital potentiometer gain settings will not be reset. The serial number of your controller is required to operate this command. The serial number of the controller is located on the controller. Please make a note of the serial number and keep it in a safe place.

SYNTAX: 59 [Serial number]  
 MINIMUM: N/A  
 MAXIMUM: N/A  
 UNITS: Serial number is 8 digits long.  
 DEFAULT: Your RI-200 Serial number.  
 EXAMPLE: 59 87654321 Initialize the EEPROM only. This example will not be your serial number

#### 4.5.60 USER TELEPHONE OFF-HOOK COMMAND NAMES

This command is used to name and setup a user command that will be used to dial the telephone. This is a special type of User Command, as it will allow extra digits after the command name, which are used as the telephone number that will be dialed. A normal User Command will not allow extra digits for dialing. This command requires the command number (up to 8 telephone commands are available), a command group number (see S-Command 15), the macro start line (the point in the macro data table where the command starts) and the command name. The macro data that is used for the telephone off-hook command, should always include the off-hook S-Command 82 to work correctly. The on-hook command does not require this type of telephone user command. For building on-hook commands, use a standard user command. To clear a user command name, send the S-Command and only the command number you want to clear. See section 5 for more information on creating user commands and macros.

SYNTAX: 60 [Telephone command] [Group] [Macro start line] [Command name]  
 MINIMUM: Telephone command 01, Group 1, Macro start line 000 (disable),  
 Command name 0 digits (remove command)  
 MAXIMUM: Telephone command 08, Group 8, Macro start line 999, Command name 4 digits  
 UNITS: Command number 01 – 08 , Group 1 – 8, Start line 000 - 999, Command name  
 DEFAULT: See default table below  
 EXAMPLE: 60 02 3 100 \*44 Telephone command number 2 is included in group 2,  
 points to macro start line 100 and the name is “\*44”

**DEFAULT TELEPHONE COMMAND NAMES**

Command Number	Group Number	Macro Start Line	D1	D2	D3	D4	Notes
01	2	013	*	8			Telephone off-hook, Simplex
02	2	019	*	9			Telephone off-hook, Duplex

#### 4.5.61 USER DEFINED S-COMMANDS, RENAME A SYSTEM COMMAND

This command is used to define a “User System Command”. User System Commands are S-Commands that are renamed for “User Commands”. These user commands allow extra digits after the command name which is passed along to the S-Command that it points to. See the example in the default macro name table, the “A” is used to force TX on for X time. If you were to enter an “A30”, this will force the TX on for 30 seconds. To clear a user system command, send the S-Command followed by the command number you want to clear. See section 5 for more information on programming macros.

- SYNTAX: 61 [Command number] [Group] [S-Command] [Command name]  
 MINIMUM: Command number 01, Group 1, S-Command 00, Command name 0 digits (remove the command)  
 MAXIMUM: Command number 21, Group 8, S-Command 99, Command name 4 digits  
 UNITS: Command number 01 - 21, Group 1 – 8, S-Command 00 - 99, Command name  
 DEFAULT: See default table below  
 EXAMPLE: 61 04 1 02 33 User system command 04 is included in command group 1, points to S-Command 02 and the name is “33”. S-Command 02 is repeater mode, “334” will open the squelch.

<i>DEFAULT USER SYSTEM COMMAND NAME</i>							
Command Number	Group Number	System Command	D1	D2	D3	D4	Notes
01	1	05	A				Lock on PTT

#### 4.5.62 USER COMMAND NAMES

These are normal User Commands. When a user enters a command in the locked mode, the program checks the User Command list to see if it is a valid command, the digits themselves and the total digits must be an exact match. If there are any extra digits in the command, the command will be rejected. Once the controller has found a match, the controller will get the macro start line where multiple S-Commands can be executed. To clear a User Command name, send S-Command 62 followed by the command number you want to clear. Each command is assigned a group number. You can use S-Command 15 to turn on or off each or all groups. See section 5 for more information on programming macros.

- SYNTAX: 62 [Command number] [Group] [Macro start line] [Command name]  
 MINIMUM: Command number 01, Group 1, Macro start line 000, Macro name 0 digits (remove the macro)  
 MAXIMUM: Command number 99, Group 8, Macro start line 999, Macro name 4 digits  
 UNITS: Command number 01 - 99, Group 1 – 8, Start line 000 - 999, Command name  
 DEFAULT: See default table below  
 EXAMPLE: 62 35 1 040 123 Command number 35, group 1, macro start line 40 and the name is “123”

<i>DEFAULT MACRO NAME TABLE</i>							
Command Number	Group Number	Macro Start Line	D1	D2	D3	D4	Notes
01	1	005	*	3			Open squelch
02	1	002	#	1			System off
03	1	004	*	1			CTCSS / DCS decode on
04	1	003	*	2			CTCSS / DCS decode off (Carrier only)
05	1	006	*	5			DTMF Mute on
06	1	007	#	5			DTMF Mute off
07	1	011	*	4			CTCSS tone encode on
08	1	012	#	4			CTCSS tone encode off
09	1	009	*	6			Carrier delay on
10	1	010	#	6			Carrier delay off
11	2	023	*	7			Answer telephone
12	2	017	#				Telephone on-hook
13	1	026	*	0			Link On, Duplex
14	1	029	#	0			Link Off

### 4.5.63 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) and 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 999 starting lines in the macro data memory.

SYNTAX: 63 [Macro start line]  
 MINIMUM: 1  
 MAXIMUM: 999  
 UNITS: Macro start line  
 DEFAULT: N/A  
 EXAMPLE: 63 7                      Sets the pointer to start on line number 7

### 4.5.64 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 and each line consisting of 8 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 each S-Command and its data is entered into the memory and you un-key, the controller will add a "C" 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 flag, 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 "C" for a command separator and "D" for end of macro. When planning your macro data usage, you need to allow space for these digits. See the default table below for an example.

SYNTAX: 64 [S-Command] [S-Command data]  
 MINIMUM: S-Command 00, S-Command data as required.  
 MAXIMUM: S-Command 99, S-Command data as required.  
 UNITS: S-Command, S-Command data  
 DEFAULT:

Start line 001	063C 340D	System reset, power on
Start line 002	010D	System off
Start line 003	011D	System on, COS access
Start line 004	013D	System on, CTCSS/DCS + COS
Start line 005	014D	System on, open squelch
Start line 006	1811D	Repeater mute on
Start line 007	1810D	Repeater mute off
Start line 009	0430D	Carrier delay on
Start line 010	040D	Carrier delay off
Start line 011	222D	CTCSS/DCS encode on
Start line 012	220D	CTCSS/DCS encode off
Start line 013	06C 701C 1830C 821C 062C 1510D	Telephone off-hook, simplex, dumb
Start line 017	063C 820C 1511D	Telephone on-hook
Start line 019	06C 702C 1831C 822C 062C 1510D	Telephone off-hook, duplex, smart
Start line 023	829C 062C 1831C 1510D	Answer a ringing telephone
Start line 026	343C 35111C A1343C A135111D	Link on
Start line 029	340C A1340D	Link off

EXAMPLE: 64 01 1                      S-Command 01 (repeater mode), S-Command data 1 (COS)  
 64 02 1                      S-Command 02 (RX source), S-Command data 1 (LPF & HPF)  
 64                                      End of macro  
 This macro will set the repeater in COS and set the audio source to (LPF & HPF)  
 The data will be stored in memory the following format (011C 021CD)

**4.5.65 RESERVED FOR FUTURE COMMAND****4.5.66 RESERVED FOR FUTURE COMMAND****4.5.67 RESERVED FOR FUTURE COMMAND****4.5.68 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 another and at the end of the second macro you jump back to the first.

SYNTAX: 68 [Macro start line]  
 MINIMUM: 1  
 MAXIMUM: 999  
 UNITS: 1 – 999 Macro start line  
 DEFAULT: N/A  
 EXAMPLE: 68 34            Jump to macro starting at line 34 and continue executing S-Commands

**4.5.69 EXIT S-COMMAND PROGRAMMING**

When you are finished making changes to S-Commands, use this command to lock the controller and exit the S-Command mode. If no S-Commands are executed for 5 minutes, a timer will automatically lock the controller for you.

SYNTAX: 69  
 DEFAULT: N/A  
 EXAMPLE: 69            Exit S-Command Programming mode

**4.5.70 TELEPHONE OUTGOING CALL MODE**

This command is used to setup how the controller operates when making outgoing telephone calls. Outgoing calls operate under the rules determine by modes 0 through 4. In mode 2, and if you are operating full duplex, you can listen to the caller while you are talking on the repeater. In mode 3, other people on the repeater will not be able to hear you talk to the caller. Mode 4 is the same as mode 3 except a tone is added to repeater TX when you talk to the caller.

SYNTAX: 70 [Mode]  
 MINIMUM: 0  
 MAXIMUM: 4  
 UNITS: Mode 0 = Disable outgoing call mode, no telephone call can be made.  
           Mode 1 = Simplex auto patch, telephone audio is muted when the repeater receiver is active.  
           Mode 2 = Duplex auto patch, telephone audio and repeater audio are mixed at the transmitter.  
           Mode 3 = Mute receiver audio, telephone and repeater audio are muted when the receiver is active.  
           Mode 4 = Repeat cover tone, a cover is added to the repeater audio when the receiver is active.  
 DEFAULT: 1, Simplex  
 EXAMPLE: 70 2            Set the telephone outgoing mode to duplex.



### 4.5.71 TELEPHONE INCOMING CALL MODE

This command is used to setup how the controller operates during incoming calls. In all modes, the controller will not act on incoming rings until the ring delay counter (S-Command 75) has expired.

- Mode 0: All ringing will be ignored.
- Mode 1: The repeater will begin ringing after the ring delay has expired and each time the incoming call rings but not more than the ring limit (S-Command 76).
- Mode 2: The controller will go off-hook without connecting the audio and start ringing the repeater for the total number of rings set by the ring limit. At this point and between each ring heard on the telephone from the controller, you can send the telephone control access password to put the telephone in the control mode. In this mode the repeater audio is still not connected to the telephone and you can begin using macro or access the S-Command with the system password.
- Mode 3: Operates the same as mode 2 but the controller will send an answer message when it goes off-hook and the caller must enter the ring password to start ringing on the repeater.
- Mode 4: Operates the same as mode 3 but a three digit CTCSS tone or DCS code number is required on the end of the ring password. You can also add up to an 8 digit DTMF string on the end of the CTCSS tone number. Mode 4 can be used for selective calling, i.e. a radio that has DTMF commands or CTCSS tone decoder to un-squelch the radio.
- Mode 5: Is auto answer. The controller will go off-hook and connect the telephone audio to the repeater after the ring delay counter expires.

SYNTAX: 71 [Mode]  
 MINIMUM: 0  
 MAXIMUM: 4  
 UNITS: Mode 0 = No incoming calls are allowed.  
 Mode 1 = Ring delay count - Ring repeater users.  
 Mode 2 = Ring delay count - Off-hook to allow control password - Ring repeater users.  
 Mode 3 = Ring delay count - Off-hook, answer message - Ring password required to ring repeater users and control password can be used to access command mode.  
 Mode 4 = Ring delay count - Off-hook, answer message - Ring password, CTCSS tone number and optional DTMF string can be included to be transmitted with ring to the repeater user. Control password can be used by the caller to access User Command mode.  
 Mode 5 = Ring delay count – Off-hook and connect telephone to repeater (Auto Answer).  
 DEFAULT: Mode 2  
 EXAMPLE: 71 3                    Set incoming mode 3

### 4.5.72 TELEPHONE CTCSS/DCS TONE PANEL ENABLE

Once you have setup the CTCSS tones and DCS codes that you want to use for accessing the telephone . This command is used to enable the telephone tone panel. Use S-command 20 to setup the tones and codes that you will be using. Make sure that you include the tones used for the telephone in the user command tone panel or you will not be able to control the telephone.

SYNTAX: 72 [Mode]  
 MINIMUM: Mode 0 (Off)  
 MAXIMUM: Mode 1 (On)  
 UNITS: Mode 0 = Off, Mode 1 = On  
 DEFAULT: 0 (Off)  
 EXAMPLE: 72 1                    Enable Telephone tone panel for telephone access.

#### 4.5.73 TELEPHONE INCOMING CALL CONTROL TIME-OUT

This time-out is used to hang up the telephone in the incoming call control mode if no DTMF activity is detected. Each time a control command is received over the telephone, the timer is reset.

SYNTAX: 73 [Time]  
MINIMUM: 0  
MAXIMUM: 14  
UNITS: Minutes  
DEFAULT: 3 Minutes  
EXAMPLE: 73 2           Set incoming call time out to 2 minutes.

#### 4.5.74 TELEPHONE INCOMING CALL RING AND COMMAND PASSWORD TIME-OUT

This time-out is used to hang up the telephone if no ring password or control password is detected within the preset time. This command is used with incoming call S-Command 71 modes 2 through 4.

SYNTAX: 74 [Time]  
MINIMUM: 1  
MAXIMUM: 120  
UNITS: Seconds  
DEFAULT: 30 Seconds  
EXAMPLE: 74 90           90 Seconds will be allowed for a ring or control password to be received.

#### 4.5.75 TELEPHONE INCOMING RING DELAY

The controller will count the incoming rings before it will begin any ringing on the repeater or go off-hook for control. Once the total incoming rings have expired and depending on the incoming call mode (S-Command 71), the controller will begin its incoming call procedure.

SYNTAX: 75 [Ring]  
MINIMUM: 0  
MAXIMUM: 15  
UNITS: Ring count  
DEFAULT: 4 Rings  
EXAMPLE: 75 2           Set ring delay counter for 2 rings.

#### 4.5.76 TELEPHONE TX RING LIMIT

This counter limits the total number of ring messages that are allowed to be transmitted over the repeater. Be careful when using the no limit mode, in S-Command 71 modes 2 – 4 the repeater will not stop ringing over the air.

SYNTAX: 76 [Ring]  
MINIMUM: 0 (No limit)  
MAXIMUM: 31  
UNITS: Ring limit  
DEFAULT: 8 Rings  
EXAMPLE: 76 15           Set maximum rings on the repeater to 15.

#### 4.5.77 TELEPHONE OFF-HOOK TIME-OUT TIMER

This command will limit the maximum duration of a telephone call. Once the telephone goes off-hook, this timer will start. Upon reaching the time-out the repeater user will hear a warning message and 30 seconds later the telephone will automatically go on-hook. During the 30 second warning message, you can re-send the off-hook user command to reset this timer.

SYNTAX: 77 [Time]  
MINIMUM: 0 (no time-out)  
MAXIMUM: 240  
UNITS: Minutes  
DEFAULT: 10 Minutes  
EXAMPLE: 77 30           Set off-hook time-out for 30 minutes

#### 4.5.78 TELEPHONE INACTIVITY ON RECEIVER TIME-OUT TIMER

During a telephone call and each time the repeater input changes state, COS on or off, this timer will be reset. If a time-out occurs before the input of the repeater changes state, the telephone will go on-hook. This timer is useful if someone operates out of range of the repeater or a transmitter locks up the repeater input.

SYNTAX: 78 [Time]  
MINIMUM: 0 (no time-out)  
MAXIMUM: 240  
UNITS: Seconds  
DEFAULT: 60 Seconds  
EXAMPLE: 78 120         Set inactivity on receiver time-out for 120 seconds.

#### 4.5.79 TELEPHONE INCOMING AGC AUDIO LEVEL

An AGC (Automatic Gain Control) is used in the audio from the telephone to the repeater transmitter. This command is used to set the initial AGC audio level from the telephone. The AGC will operate in a smaller range of this course setting. If the telephone audio is typically too low or too high, you can adjust the overall range of the AGC with this command. A larger value equals a higher level setting. You can turn off the AGC by setting the AGC to zero.

SYNTAX: 79 [Level]  
MINIMUM: 0 (Disable AGC)  
MAXIMUM: 7  
UNITS: Levels 1 through 7  
DEFAULT: 4  
EXAMPLE: 79 6           Set telephone AGC level to 6

#### 4.5.80 FLASH HOOK SWITCH

The RI-200 will function with a telephone line that has call hold or call waiting. This command is used to do a flash hook for 1/2 of a second. You can build a user command with a macro to call this S-Command for access to call waiting.

SYNTAX: 80  
DEFAULT: N/A  
EXAMPLE: 80           Telephone flash hook

### 4.5.81 TELEPHONE DTMF OR PULSE DIALING SELECT

This command is used to select between DTMF or pulse dialing over the telephone line. If pulse dialing is selected, all numbers in the access table, auto dial table and numbers placed at the end of a telephone off-hook macro will be pulsed dialed.

SYNTAX: 81 [Mode]  
 MINIMUM: 0  
 MAXIMUM: 1  
 UNITS: 0 = Tone dial, 1 = Pulse dial  
 DEFAULT: 0, Tone dial  
 EXAMPLE: 81 1 Telephone will convert all DTMF dial number to pulse dial.

### 4.5.82 TELEPHONE ON/OFF-HOOK AND ACCESS/ACCOUNT CODE

This command is used to put the telephone on and off-hook. When going off-hook, you can select one of up to 8 different dialing prefix that can be used for a long distance service access number or special PBX outside line number. Along with the dial prefix, you have 8 different account codes that can be stored for credit card use. Use S-Command 83 to program access and account codes for this dialing process. When this command is included in a telephone macro, it will check and use the access code table before dialing any number. After the telephone number is dialed, the controller will check for an account code to dial. When putting the telephone on-hook, use access code zero. You can also use access code 9 to answer a telephone that is currently ringing over the air. Access code 9 will return an error message if the telephone was not ringing over the air.

SYNTAX: 82 [Code]  
 MINIMUM: 0 (On-hook)  
 MAXIMUM: 9 (Answer if ringing in process)  
 UNITS: 0 = On-hook, 1-8 = Off-hook code, 9 = Answers the telephone if currently ringing over the air.  
 DEFAULT: N/A  
 EXAMPLE: 82 1 Go off-hook and dial access code if any then the telephone and account code if any.  
 82 0 Go on-hook, hang up  
 82 9 Answer the telephone if currently ringing over the air.

### 4.5.83 EDIT TELEPHONE ACCESS and ACCOUNT CODES

The access number is used to dial a string of digits before the telephone number or auto dialer number. The access number can be a long distance service access number or special PBX outside line number. The account number is dialed after the telephone number or auto dial number. The account number can be used for credit card dialing. When building an off-hook access and account code to operate with a credit card, you may have to test and experiment with delays between the access number and telephone number also the telephone number and account number to get the dialing process to work correctly. The access and account number that is used when dialing a number is determined by S-Command 82, the off-hook command. Valid digits are 0 through 9, \*, # and A for a two second pause.

SYNTAX: 83 [Type] [Off-hook code] [Number]  
 MINIMUM: Type 0 (Access code), Off-hook code 1, Number, 0 digits (clears number).  
 MAXIMUM: Type 1 (Account code), Off-hook code 8, Number 16 digits.  
 UNITS: See above  
 DEFAULT: Nothing stored.  
 EXAMPLE: 83 0 1 9A Store a 9 and pause 2 second for a PBX outside line for off-hook code 1.  
 83 0 2 Clear access position 02.  
 83 0 3 1800555555AA Setup to dial a long distance credit card company for off-hook code 3.  
 83 1 3 AA123456789 Pause and then dial the credit card number for off-hook code 3.

#### 4.5.84 TELEPHONE NUMBER AUTO-DIALER

The RI-200 supports 99 auto dial numbers and a last number re-dial. Use this command to store each of the auto dial numbers. Any number stored here will not be checked by the accept and reject tables when used. To access a stored auto dial number when sending the telephone user off-hook command, include \* and the auto dial storage number 01 through 99. \*00 is reserved to recall last number re-dial. When using auto dial numbers, the auto dial number is not stored into the last number re-dial buffer. Valid digits are 0 through 9, \*, # and A for a 2 second pause.

SYNTAX: 84 [Store position] [Telephone number]  
 MINIMUM: Store position 01, Telephone number 0 digits (clears auto dial number)  
 MAXIMUM: Store position 99, Telephone number 16 digits  
 UNITS: See above  
 DEFAULT: Nothing stored.  
 EXAMPLE: 84 01 15306729053      Store Pacific Research Solutions number in auto dial position 01  
           84 00                      Clear last number re-dial buffer

#### 4.5.85 SET AN AUTO-DIAL NUMBER FOR USE

This S-Command is used to set an Auto-Dial number in a macro for use in dialing a telephone number within a macro. This S-Command must be placed before the off-hook S-Command 82 in the macro. If this S-Command is used in a normal telephone dialing macro, this command will delete any number or auto dial code that was included in the users dialing process. This command is best used if you are building a macro that has a normal user command and will dial a preprogrammed number for the user.

SYNTAX: 85 [Auto dial position]  
 MINIMUM: 00 (Last number redial)  
 MAXIMUM: 99 (End of the Auto Dial table)  
 UNITS: Auto dial store positions  
 DEFAULT: N/A  
 EXAMPLE: 85 14                      Dial number stored in auto dial position 14 when off-hook occurs in the macro.

#### 4.5.86 TELEPHONE NUMBER ACCEPT TABLE ENABLE

This command will turn on/off the accept number table. If the accept table is off and the reject table is on, only numbers that do not match the reject table will be available for dialing. See section 6, telephone interconnect, of additional information on use of the accept and reject tables.

SYNTAX: 86 [on/off]  
 MINIMUM: 0  
 MAXIMUM: 1  
 UNITS: 0 = Off and 1 = On  
 DEFAULT: 0  
 EXAMPLE: 86 1                      Turn on the accept table.

#### 4.5.87 EDIT TELEPHONE NUMBER ACCEPT TABLE

The telephone number accept table is used to control which telephone numbers are allowed for dialing. If the reject table is turned off, only numbers in the accept table will be allowed for dialing. If the reject table is turned on and the controller does not find a match in the accept table, the controller will look for a match in the reject table. If the controller finds a match in the accept table, the controller will only look in the reject table positions 50 through 99 for a reject match. We call this an exception and can be used to reject specific numbers in a group of accepted numbers. You could reject all toll calls and accept one or two toll call area codes but reject a group of numbers in those area codes, like 976 numbers. Valid digits are 0 through 9, \*, # and A for one second pause. "\*" is used as wild cards digit and a "\*" at the end of the string acts as a wild card for multiple digits. You should include a "\*" at the end of all entries to limit extra digits from being used. See section 6, telephone interconnect, of additional information on use of the accept and reject tables.

SYNTAX: 87 [Accept position] [Telephone number]  
 MINIMUM: Accept position 00, Telephone number 0 digits (clears accept number)  
 MAXIMUM: Accept position 99, Telephone number 16 digits  
 UNITS: See above  
 DEFAULT: Nothing stored.  
 EXAMPLE: 87 00 15306729053\* Accept Pacific Research Solutions number for dialing, position 00  
 87 01 1213\* Accept all number in the 213 area code for dialing, position 01

#### 4.5.88 TELEPHONE NUMBER REJECT TABLE ENABLE

This command will turn on / off the reject number table. If the accept table is on and the reject table is off, only numbers that match the accept table will be available for dialing. See section 6, telephone interconnect, of additional information on use of the accept and reject tables.

SYNTAX: 88 [on/off]  
 MINIMUM: 0  
 MAXIMUM: 1  
 UNITS: 0 = Off and 1 = On  
 DEFAULT: 0  
 EXAMPLE: 88 1 Turn on the reject table.

#### 4.5.89 EDIT TELEPHONE NUMBER REJECT TABLE

The telephone number reject table is used to control which telephone numbers are not allowed for dialing. If the accept table is turned off, only numbers in the reject table will not be allowed for dialing. If the accept table is turned on and the controller does not find a telephone number match in the accept table, the controller will look for a match in the reject table. If the accept table is turned on and a telephone number does match in the accept table, the controller will only look for a match in reject table positions 50 through 99 for a reject match. We call this an exception and can be used to reject specific numbers in a group of accepted numbers. You could reject all toll calls and accept one or two toll call area codes but reject a group of numbers in those area codes, like 976 numbers. Valid digits are 0 through 9, \*, # and A for one second pause. "\*" is used as a wild card digit and a "\*" at the end of the string acts as a wild card for multiple digits. You should include a "\*" at the end of all entries to limit extra digits from being entered. See section 6, telephone interconnect, of additional information on use of the accept and reject tables.

SYNTAX: 89 [Reject position] [Telephone number]  
 MINIMUM: Reject position 00, Telephone number 0 digits (clears reject number)  
 MAXIMUM: Reject position 99, Telephone number 16 digits  
 UNITS: See above  
 DEFAULT: Reject position 00      411\*      Reject all calls to information  
           Reject position 01      0\*        Reject calls to the operator  
           Reject position 02      1900\*    Reject all 1-900 calls  
           Reject position 03      976\*     Reject all 976 calls  
           Reject position 04      911\*     Reject call to 911  
 EXAMPLE: 89 08 15306729053\*    Reject Pacific Research's number for dialing, position 08  
           89 09 1\*                    Reject all toll calls, position 09  
           89 50 1\*\*\*976\*            Reject all toll 976 number, position 50  
           89 51 12135551212\*       Reject 12135551212, position 51

#### 4.5.90 WAIT FOR DIAL TONE TIMER

During the dialing process the controller will check for dial tone. If dial tone is not detected within the set time, the controller will start dialing anyway. If this command is set in auto detect mode (zero value), the controller will give a busy message if dial tone is not detected. This mode could be used if the telephone line is shared with someone else and you want to check it for use before dialing.

SYNTAX: 90 [Time]  
 MINIMUM: 0 (Auto dial tone detect)  
 MAXIMUM: 99 (9.9 Seconds)  
 UNITS: Tenths of seconds (1/10 seconds or 100 ms)  
 DEFAULT: 50, 5.0 Seconds  
 EXAMPLE: 90 0                    Auto dial tone detect.

**4.5.91 RESERVED FOR FUTURE COMMAND**

**4.5.92 RESERVED FOR FUTURE COMMAND**

**4.5.93 RESERVED FOR FUTURE COMMAND**

**4.5.94 RESERVED FOR FUTURE COMMAND**

**4.5.95 RESERVED FOR FUTURE COMMAND**

**4.5.96 RESERVED FOR FUTURE COMMAND**

**4.5.97 RESERVED FOR FUTURE COMMAND**

**4.5.98 RESERVED FOR FUTURE COMMAND**

**4.5.99 RESERVED FOR FUTURE COMMAND**

## MACRO AND MESSAGE PROGRAMMING

### 5.0 MACRO PROGRAMMING INTRODUCTION

User commands and macro programming in the RI-200 repeater controller is the means by which you generate custom and secure commands for the repeater users to access. The User Command points to a macro, which is made up of one or more system commands or S-Commands. This group of S-Commands is called a macro and the digits that the repeater user sends to the repeater is called a User Command. Before building user commands and entering data into a macro, organize everything on the worksheets at the end of this manual. This planning effort will pay off with superior results.

In the RI-200 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. Telephone Commands, used for dialing the telephone.

#### IMPORTANT NOTE:

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

1. **Normal operating mode** where User Commands are functional.
2. **Programming mode** where S-Commands are used to setup 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 4.2) must be executed. To exit the programming mode and return back to the "User Command mode" or "Normal operating mode" the S-Command 69 is executed. Programming mode is often referred to as the controller "unlocked mode" and the Macro 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-Commands. When the user sends this type of command, any additional data required in the S-Command must be included in this command.

**TELEPHONE COMMAND:** Telephone commands are similar to standard user commands, except extra data is allowed to follow the command. The controller uses the extra data as the telephone number to dial. Only telephone off-hook and dial commands should be included in this group of commands.

**COMMAND NUMBER:** This is a memory location where the user command data is stored. Each type of user command has a range of memory locations starting with 01.

**GROUP:** When you build a user command, it is placed into one of 8 groups. This will allow you to enable and disable a single group of user commands without effecting every command. S-Command 15 is used to select which group to enable or disable. An example where you may want to use this feature is when you are using the telephone off-hook, you would want to disable other commands so they would not get processed when dialing a telephone number. Or, you may want to disable the telephone access at night without effecting other commands.



**START LINE:** The macro data memory is organized with 999 lines of data storage and each line consisting of 8 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 1 to 4 digits 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 programmed command until a match is found. The controller then reviews the command perimeters to determine how to handle the command.

**MACRO:** This is a string or group 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 it until an end of macro flag is found. Macros can also consist of only one S-Command.

## 5.1 PROGRAMMING STANDARD USER COMMANDS and MACROS

Macros are used for more elaborate functions, 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. See S-Commands 40 through 49 for more details.

When creating User Commands and macros, there are two memory locations that will require data entry. First you must create a user command which will include the name and some operating perimeters and the location of the macro start line. Each user command has a location in memory where all of the above perimeters are stored. The name is a 1 to 4 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 8 groups. Later you will be able to enable or disable any one of the 8 groups of commands. Finally the user command points to a macro start line where the controller will process S-Commands. The second memory location in the controller is the macro data memory. This is where the S-Commands are stored and processed. Worksheets at the end of the manual have been provided to help organize the data that will be used to create user commands and macros. The controller is shipped from the factory with some default user commands, review section 1.4.1 and S-Command 60 through 64.

**When programming user commands and macros, always follow these simple steps.**

1. Before you start, make a plan of what you want to do.
2. Use the supplied worksheets at the end of the manual and write down what you want to do.
3. Unlock the controller with your PASSWORD before starting.
4. Listen for the correct response from the controller “OK” or “ERROR”.
5. Make small changes each time and test as you go.
6. Keep careful track of the data in a macro so that you do not over write it with 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-200 has 99 standard command memory locations available for use. Each command memory locations have a number from 01 through 99, which are like a mailbox address. Into this box, you put where the macro data starts (macro start line), and then you give the command its functional name (user command). If you need to remove or clear a command, send the S-Command 62 followed by the command number only. In the following example, you will create a user command with “\*456” as the name.

1. Un-lock the controller with the password.
2. Send “62 20 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 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 or modify an existing macro, you first must tell the controller what line or starting position in the memory you want to start with, this is the macro starting line number. There are 999 lines of data in the macro data memory and each line will hold up to 8 digits or characters 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 and each time, un-key your radio 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. This process of entering an S-Command into the macro has no error checking of the S-Command and it’s data. When you reach the last S-Command in the macro, you will need to add an end of macro flag. This is done by sending S-Command 64 by it self. 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.

1. Un-lock the controller with your password.
2. Send “63 150” and un-key, you should hear a function complete CW “OK”. 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, you should hear a function complete CW “OK”. 64 is the macro editor command. 01 is the system mode S-Command. 3 is the repeater COS + CTCSS/DCS repeater access S-Command data.
4. Send “64 14 11” and un-key, you should hear a function complete CW “OK”. 64 is the macro editor command. 14 is the user command CTCSS/DCS tone panel control S-Command. 11 is the user command to enable S-Command data.
5. Send “64” and un-key, you should hear a function complete CW “OK”. 64 without data will tell the controller to insert a “D” to identify the end of this macro.
6. The data stored in the macro data memory at line 150 will look like “013C 1411C D”. This macro requires 10 digits of data storage, which means that it will consume 2 lines in the macro data memory (8 digits for each line). In this case, the next available start line will be 152. As you can see, you can easily create a macro that will consume more than 1 line of memory.

### **5.1.1 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 port. 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-200 controller, you simply insert an “A1” before the S-Command and it’s data into the macro. All data from the “A1” through the “C” (S-Command separator) will be sent to another controller with a 1 set as the controller address. In this setup, each controller in the system will have a controller number or controller address. When sending an S-Command to another controller, the controller with the same controller number as the “A” number in the S-Command, will execute that S-Command. In other words, all “A1” controllers will respond to “A1” prefix and macro data. All “A3” assigned controllers will respond to the “A3” prefixed macro data. The “controller unit 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, you should hear a function complete CW “OK”. This will set the macro start line pointer to line 152.
3. Send “64 A1 01 1” and un-key, you should hear a function complete CW “OK”. 64 is the macro editor command. A1 is the address of the controller that will execute the following S-Command. 19 is the CTCSS decode table control S-Command. . 01 is the system mode S-Command. 1 is the repeater COS access S-Command data.
4. Send “64” and un-key, you should hear a function complete CW “OK”. 64 without data will tell the controller to insert a “D” to identify the end of this macro.
5. The data stored in the macro table at line 152 will look like “A1011CD”.

## 5.2 TELEPHONE COMMANDS

Telephone commands are the same as standard commands, but they allow a method to pass along a telephone number to be checked by the accept and reject tables. The controller has 8 telephone commands available. Telephone commands are processed just like standard commands but the repeater user can include a telephone number or auto dial number along with the name. The telephone number that is entered with this command will be checked by the accept and reject table before it is allowed to be executed. In the macro data memory, the telephone off-hook S-Command 82 must be included for the command to operate correctly. On-hook S-Command 820 do not have to be processed by a telephone user command. This type of command is better placed in a standard user command as it does not require telephone number information.

## 5.3 USER S-COMMANDS

Think of user S-Commands as just renaming an S-Commands. In the RI-200, you have 21 user S-Commands available. User S-Commands are processed just like standard commands. User S-Commands can, but do not have to pass the 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 02 1 05 21” and un-key, you should hear a function complete CW “OK”. 61 is the user S-Command. The 01 is the user S-Command number. The 1 is the group number for this command. The 05 is the force PTT on for x time S-Command. The 21 is the name of the user S-Command.
3. Send “69” and un-key, you should hear a function complete CW “OK”. This locked the controller
4. Send “22 15” and un-key, you should hear a function complete CW “OK”. Next you should notice that the repeater transmitter will stay 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.

## 5.4 PROGRAMMING CW MESSAGE

CW messages are Morse code messages like the station ID, courtesy tones and system telemetry. The messages consist of tone generator or CW commands in sequence. Each of these commands consist of a 3 digit value and are used to tell the RI-200'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 as not to damage other data stored in the memory. Once a message is stored, it can be triggered for playback. This is done with the message triggers (S-Command 32). Messages can also be imbedded directly inside a macro.

There are two types of messages. First, 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.

The system memory is used for both macros and messages. This memory is organized with 999 lines of data storage and each line consisting of 8 digits. All message and macros must start at the beginning of a line. Each line has a starting line number from 001 to 999. 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, this is done with S-Command 63. Next you can start building you message but for the message to work correctly, you must include a “Start of Message” command (31 001) as the first entry. The following entries with (31 XXX) are the message CW commands. The message is completed with a “End of Message” command (31 002) and finally an end of data command (64) as 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 consumes 3 digits each.

When building a message that is contained within a macro. These message must be short, total of 32 digits or less. You use the standard macro edit process with S-Command 64 and the message edit S-command 31 with message data. No start or end of message commands are required. A 10 second beep would be entered as “64 31 026 134”

As an example, lets examine the system ID message. This message is the factory default ID “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 4.5.31 of this manual for a list of all CW commands. The data for all messages or CW commands are located in the same memory area as the macros. When entering a new message or changing a message, care should be taken to avoid damaging other data in the memory. The default “Hello” message uses the following CW commands:

CW command 1	= 001	Start Of Message
CW command 2	= 023	697 Hz tone
CW command 3	= 042	CW Speed, 16 WPM
CW command 4	= 088	CW Space
CW command 5	= 069	CW “H”
CW command 6	= 066	CW “E”
CW command 7	= 073	CW “L”
CW command 8	= 073	CW “L”
CW command 9	= 076	CW “O”
CW command 10	= 002	End Of Message

Review the following procedure to enter this “Hello” ID into the controller. Un-key your radio after each command, you should hear a CW “OK”. This will tell you that you did everything correctly. If you hear a CW “ERROR”, a mistake was made and the command was aborted.

<u>S-Command</u>	<u>Description</u>
1. 123456	Unlock the controller, you are in S-Command mode. You should notice a different courtesy tone.
2. 63 085	S-Command 63, set the memory data pointer (start line number pointer) to start line 085.
3. 31 001	S-Command 31, Enter message data into memory, Start Of Message.
4. 31 023	S-Command 31, Enter message data into memory, Set tone generator to 697 Hz.
5. 31 042	S-Command 31, Enter message data into memory, Set CW speed to 16 WPM.
6. 31 088	S-Command 31, Enter message data into memory, CW Space.
7. 31 069	S-Command 31, Enter message data into memory, CW “H”.
8. 31 066	S-Command 31, Enter message data into memory, CW “E”.
9. 31 073	S-Command 31, Enter message data into memory, CW “L”.
10. 31 073	S-Command 31, Enter message data into memory, CW “L”.
11. 31 076	S-Command 31, Enter message data into memory, CW “O”.
12. 31 002	S-Command 31, Enter message data into memory, End Of Message.
13. 64	S-Command 64, Terminate the end of this memory segment.
14. 68 085	S-Command 68, Trigger a message or macro at start line 085. Use this to test your message.
15. 69	S-Command 69, Lock the controller, you are done.

Use the above example to organize your message. Use the worksheets in the appendix to help in building messages and keeping track of the data. 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 concerned 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 089.

MESSAGE									
Line #	D1	D2	D3	D4	D5	D6	D7	D8	NOTE
085	3	1	0	2	3	0	4	2	Default ID "HELLO"
086	0	8	8	0	6	9	0	6	
087	6	0	7	3	0	7	3	0	
088	7	6	C	D					

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 "31 001".
2. Each of the next group of three digits represent each of the CW commands.
3. The first of the CW commands "023" is the tone frequency.
4. The next CW command "042" is the CW speed.
5. After the CW speed are each of the characters you wish to use.
6. 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 "31 002" and "64".

You can also use tones of various lengths and pauses in any of your messages, see CW commands 101 through 166. The next example will show you how to change the function complete message. The current function complete is stored at starting line 071 and used 3 lines of memory. In this example, the function complete will be two 1/10 second tones, first at 1206 Hz and the second at 770 Hz. The new message will require 19 digits of storage and with 8 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. 63 071	S-Command 63, set the memory data pointer (start line number pointer) to start line 071.
3. 31 001	S-Command 31, Enter message data into memory, Start Of Message.
4. 31 027	S-Command 31, Enter message data into memory, Set tone generator to 1209 Hz tone.
5. 31 112	S-Command 31, Enter message data into memory, Tone on for 100 ms.
6. 31 140	S-Command 31, Enter message data into memory, Pause for 60 ms.
7. 31 024	S-Command 31, Enter message data into memory, Set tone generator to 770 Hz
8. 31 112	S-Command 31, Enter message data into memory, Tone on for 100 ms
9. 31 002	S-Command 31, Enter message data into memory, End Of Message.
10. 64	S-Command 64, Terminate the end of this memory segment.
11. 68 071	S-Command 68, Trigger a message or macro at start line 071. Use this to test your message.
12. 69	S-Command 69, Lock the controller, you are done.

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

MESSAGE									
Line #	D1	D2	D3	D4	D5	D6	D7	D8	NOTE
071	3	1	0	2	7	1	1	2	New Function Complete
072	1	4	0	0	2	4	1	1	
073	2	C	D						

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. Your pre-time-out event and post-time-out event can be set to trigger the same message. You may not want the weak signal message, an easy way to disable it, is to point the weak signal event to the same message as the courtesy message. You can also completely disable a message by pointing the trigger to start line 000.

## **5.5 EXITING PROGRAMMING MODE**

Remember to execute an S-Command 69 to lock your controller 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 automatic function complete. Remember in the programming mode only S-Commands are functional. After exiting the programming mode, only user commands are functional.

## TELEPHONE INTERCONNECT

### 6.0 TELEPHONE INTERCONNECT

The RI-200 incorporates a highly intelligent telephone interconnect. This interconnect used a full duplex hybrid that is balanced each time an outgoing call is started. A telephone hybrid is a circuit that separates the transmit and receive audio from the telephone line before it is sent to the radio. Most hybrids are adjusted for maximum performance at the time of manufacturing. Over time and various telephone lines the performance of the hybrid is compromised. In the RI-200 the hybrid is balanced by the micro controller each time an outgoing call is initiated.

The RI-200 has an AGC (Automatic Gain Control) that is used to automatically adjust the audio level from the telephone line. The micro controller directly controls this AGC. The software monitors and avoids conditions that would cause pumping of the audio, a common problem with most other AGC circuits. You can set the initial level of the AGC and the controller will operate in a smaller range of this course setting. If the telephone audio is typically too low or too high, you can adjust the overall range of the AGC. You can also turn off the AGC, see S-Command 79.

During the dialing process the controller will check for dial tone. If dial tone is not detected within the set time, the controller will start dialing anyway. You can also set the controller in an auto dial tone detect mode. In this mode the controller will give a busy message if the dial tone is not detected. This mode could be used if the telephone line is shared with someone else and you want to check the telephone line for use before dialing.

When you start the call process, the controller performs several tasks before the telephone audio is connected to the repeater.

1. The user enters the telephone user command and telephone number to be dialed.
2. The controller checks the number to dial against the accept and reject tables.
3. The controller checks for dial tone.
4. The controller checks the access table for an access number to dial.
5. The controller checks to see if an auto dial number needs to be dialed.
6. The controller checks to see if a user entered number needs to be dialed.
7. The controller checks the account table for an account number to dial.
8. The controller balances the hybrid to the telephone line.
9. The controller sets up all of the time-out timers for the telephone call.
10. The controller connects the telephone audio to the repeater.

### 6.1 TELEPHONE INCOMING CALLS

The RI-200 supports both incoming and outgoing call modes. Under the incoming call mode, you can setup how the controller deals with an incoming call. The controller can be disabled from receiving a call or requiring a password, CTCSS tone and DTMF sequence to ring the repeater with various modes in between. Under the most sophisticated mode, you can selectively ring an individual radio. Up to 154,000 unique rings (154 different CTCSS tones / DCS codes and 3 digits DTMF string). Most of the incoming call modes can be setup to require a password from the caller, limiting a caller's access to the repeater. In some incoming call modes, you can use a control password and then send commands in the same manner that you would control the repeater over the radio. This mode would allow you to configure, write macros, issue user commands and S-Commands over the telephone. Review section 4.5.71 for more details.

In any of the incoming call modes, the ring delay counter (S-Command 75) must expire before the controller will begin ringing on the repeater. In S-Command 71 modes 2 through 4 the controller will answer the call before any actions are taken, repeater ringing or password requirement. Once the repeater starts ringing from an incoming call, the total number of rings can be limited by S-Command 76. In mode 5 the controller will answer the call and connect it directly to the repeater. This mode is called auto answer. For this mode to operate correctly, the controller must be told where the answer telephone macro is located. This is done with S-Command 32 event 19, the current default will correctly answer the telephone.

## 6.2 TELEPHONE USER COMMANDS

Telephone user commands are the same as “standard user commands” but they allow a method to pass along a telephone number to be checked by the accept and reject tables. You have storage available for up to 8 telephone commands. Telephone commands are executed by names just like user commands but you can include a telephone number or auto dial number along with the command. The telephone number that is entered with the telephone command will be checked by the accept and reject table before the associated macro is processed. In the macro data, the telephone off-hook S-Command 82 must be included for the macro to operate correctly. On-hook S-Command 820 does not have to be called by a telephone command. This type of command is better placed as a user command as it does not require telephone number information.

## 6.3 TELEPHONE INCOMING CONTROL

When controlling the repeater over the telephone, you do not have an un-key function as you would have with a radio. Also most telephones do not have “A,B,C,D” keys as used with most radios. For these reasons we have used the following procedures. After keying the command, wait for the inter digit timer to expire (S-Command 16), the default time is 3.5 seconds. When this timer expires, the controller will attempt to process the command. You can also terminate the command with a “# #” and the controller will process the command immediately. When controlling over the telephone line, you can connect to the radio using the off-hook command and hang up using the on-hook command. When commands are coming from the telephone and radio at the same time, the source of the first digit will cause the controller to continue receiving digits from the same source. Be careful when unlocking the controller over the telephone and the repeater is in use. If a user were to send a command over the repeater in this condition, the controller will process it as an S-Command.

## 6.4 TELEPHONE OUTGOING CALLS

The RI-200 supports various outgoing call modes. You can limit outgoing calls all together, setup calls for simplex operation, duplex operation, privacy and with a cover tone. Simplex is used to mute the telephone audio when there is activity on the repeater input. Duplex is used to mix the repeater audio with the telephone audio. In the privacy mode, the repeater audio is muted over the air. Cover tone mode is the same as privacy except a tone is added over the air when activity is on the repeater receiver. In both of these modes, other people monitoring the repeater would only hear the telephone audio. There are various timers that can also be set to limit the maximum length of the call.

The RI-200 can be setup to use up to 8 different access and account codes. The access codes are used to access outside lines when connected to a PBX or special telephone system. They can also be used to access special long distance carriers or turn off call waiting. When the RI-200 dials a telephone number, it first dials the access code than an auto dial number if used, than any numbers that were added to the end of the auto dial and finally the account code if available. The account code can be used with special long distance carriers or credit card calling. This number is dialed after the telephone number has been dialed.

If you plan to share the telephone line with other equipment or telephones, the RI-200 can be setup to check the telephone line for dial tone before dialing. This is done by setting S-Command 90 to zero (Auto Detect). If no dial tone is present or someone is talking on the telephone line when sending the off-hook command, the controller will give you a 30 second busy signal on the repeater output.

## 6.5 AUTO-DIALER and LAST NUMBER REDIAL

The RI-200 supports 99 auto dial numbers and a last number re-dial. Up to 16 digit numbers can be stored in each of the auto dial locations. Any number stored in the auto dialer will not be checked by the accept and reject tables when used. To access a stored auto dial number when sending the dial command, include \* and the auto dial storage number 01 through 99. Example, using the default off-hook user command, you would enter \*8 \*01 and un-key. The controller would go off-hook and dial the number stored in auto dial slot 01. \*00 is reserved to recall the last number dialed. Auto dial numbers are not stored in the last number re-dial when used.



## 6.6 TELEPHONE NUMBER ACCEPT and REJECT TABLES

You can control or limit the telephone numbers that are dialed, using the accept and reject tables. The telephone number accept table is used to control which telephone numbers are allowed for dialing. The telephone number reject table is used to control which telephone numbers are not allowed for dialing. If the controller finds a match in the accept table, the controller will only look in the reject table positions 50 through 99 for a reject, this part of the reject table is called an exception. This table can be used to reject specific numbers in a group of accepted numbers. There are several different ways you can use these tables depending on which of the tables are turned off or on.

- If both the accept and reject tables are turned off, any number will be allowed for dialing.
- If the accept table is turned on and the reject table is turned off, only numbers in the accept table will be allowed for dialing.
- If the accept table is turned on and the reject table is also turned on, the controller will look for a match in the accept table first. If it does not find a match in the accept table, the controller will look for a match in the reject table. If the controller finds a match in the accept table, the controller will only look in the reject table positions 50 through 99 for a reject match. We call this an exception and can be used to reject specific numbers in a group of accepted numbers.
- If the accept table is turned off and the reject table is turned on, only numbers in the reject table will not be allowed for dialing.

In the above tables, valid digits are 0 through 9, \*, # and A for two second pause. "\*" is used as a wild card digit and a "\*" at the end of the telephone number string acts as a wild card for multiple digits. You should include a "\*" at the end of all entries to limit extra digits from being entered and causing the controller to accept a number it should not.

## 6.7 TELEPHONE COMPANY INFORMATION

In compliance with the requirements of Part 68 of the FCC Rules and Regulations for connection of equipment to the telephone network and for your convenience, the following information is presented.

The telephone company may make changes to its communication facilities, equipment, operations or procedures, where such action is reasonable and required in its business and is not consistent with the rules and regulations in FCC Part 68 of the FCC Rules and Regulations. If such changes can be expected to render the RI-200 incompatible with the telephone company facilities, the telephone company shall give its customers adequate notice to make modifications to maintain uninterrupted service.

All connections to the telephone network must be made through standard plugs and standard telephone company jacks, or equivalent, in such a manner as to allow for easy and immediate disconnection of the terminal equipment. Before connecting the RI-200 to the telephone network, the telephone company must be notified for the installation of a Universal Service Order Code (USOC) RJ11 jack.

In the unlikely event that the RI-200 should ever fail to operate properly, it should be disconnected from the RJ11 jack to determine if the problem is with the telephone network or with the RI-200. If a problem is found with the RI-200, leave it disconnected until repaired or replaced.

## CIRCUIT DESCRIPTIONS

### 7.0 CIRCUIT DESCRIPTIONS

This section will cover the brief circuit description of the RI-200 repeater controller. Use the schematic on the following page for additional reference. Only the basic function of each circuit is covered, theory of operation is not covered.

- The input of the RI-200 has an adjustable gain stage, U1-7. R3 is used to set the gain of this stage.
- U1-8 is a low pass filter with a cutoff frequency of 4500 Hz. This filter is used to reduce adjacent channel splatter.
- The output of the low pass filter goes to U9 where a high pass filter is located with a cutoff frequency of 300 Hz. This filter can be turned on/off and is used to remove the receiver CTCSS tones.
- The output of the U9 high pass filter has a gain stage U1-14, with a gain of 2, used to return the audio level back to its original level. U9 has half the audio voltage range of the rest of the circuits.
- The output of U1-14 goes to the cross point switch and U3-8 a de-emphasis filter.
- U3-8 is a de-emphasis filter used primarily for the DTMF decoder and telephone audio. Audio from this filter can also be used for the transmitter.
- U4-7 is a low pass filter used to reject the voice band. The output of this filter feeds the CTCSS/DCS decoder.
- U9 is used for decoding CTCSS tones and DCS codes when the optional DCS function has been included in your controller. U9 can also be used to encode CTCSS tones.
- U2-7 is the noise filter for the RI-200 squelch circuit.
- The noise filter then goes to the U3-1, a gain stage used to adjust the squelch level. The output of the gain stage goes to the cross point switch, U6.
- The cross point switch U6, can connect any of the Y inputs to any of the X outputs. This switch is the primary method of audio routing in the RI-200.
- The output of the Cross point switch goes to several places. The first is U4-14 a summing amplifier used to mix all audio sources for the transmitter.
- The output of U4-14 feeds a digital potentiometer used to set the transmit modulation level.
- U5-7 is a buffer used to drive the repeater transmitter.
- Some of the audio in the controller will need pre-emphasis before the transmitter, U4-8. These audio's include the telephone, CTCSS/DCS, DTMF and sometimes the AUX audio.
- U5-8 is a buffer for the AUX audio output.
- The cross point switch is also used to control what audio goes to the U2-14 and U2-8 the AC to DC converter.
- The output of the AC to DC converter goes to an 8 bit analog to digital converter. This converter allows the microprocessor to read the squelch noise level, receiver audio level and the telephone audio level.
- U3-14 is a limiter used to limit the maximum audio level sent to the telephone line.
- U5-1 and U3-7 make up the hybrid for the telephone interconnect. The digital potentiometer in this circuit is controlled by the microprocessor to balance the telephone hybrid.
- The output of the hybrid goes to U3-1 a gain stage also used as the telephone AGC. The digital potentiometer in this circuit is controlled by the microprocessor where the AGC is controlled.
- The output of the telephone hybrid is coupled to the telephone line using T1.
- K1 is used as the hook switch and for pulse dialing.
- ZNR1 is a fast acting semi-conductor used for lightning protection. R70 and R71 are used as fuses for the telephone.
- U7 is an opto coupler used as a ring detector. The output of the ring detector goes to the microprocessor.
- U19 is an output driver used to drive the hook relay and the status LEDs.
- U8 is the DTMF decoder and encoder. The DTMF encoder is also used as the tone generator for the CW messages. R34 is used to set the level of the DTMF encoder and tone generator.
- U20 is used mainly as a CTCSS and DCS encoder when the DCS option is installed.
- U13 is an 8K x 8 EEPROM. This device holds all macros, message data and telephone number tables.
- U14 is a 512 x 8 EEPROM, software watch dog and power monitor circuit. The system parameters are stored in this device.
- U15 is the microprocessor, it also contains the program ROM and RAM.
- U17 is a digital buffer for the user digital input and output.
- U11 is the 5 volt power supply regulator. U12 is a minus 5 volt charge pump, which provides the minus 5 volt supply.

## **7.1 RI-200 REPEATER CONTROLLER SCHEMATIC**

## **7.2 RI-200 REPEATER CONTROLLER BOARD LAYOUT**

## 7.3 RI-200 REPEATER CONTROLLER PARTS LIST

QTY	DESCRIPTION	REFDES	PART NO.	VENDOR
1.0	PC BOARD, Repeater Interconnect		5100-0047	PACIFIC RES.
1.0	CAP, ELECT, 10uF, 50V	C21	ECR50-100	
2.0	CAP, ELECT, 1uF, 50V	C42,C65	ECR50-010	
5.0	CAP, ELECT, 22uF, 35V	C6,C43,C48-C50,C63	ECR35-220	
1.0	CAP, ELECT, 220uF, 35V	C47	ECR35-221	
5.0	CAP, ELECT, NP, 4.7uF, 50V	C1,C2,C17,C27,C30	NPECR50-4R7	
3.0	CAP, FILM, 0.001uF, 50V	C3,C14,C19	BF014D0102K	TOMPSON
1.0	CAP, FILM, 0.0027uF, 50V	C4	BF014D0272K	TOMPSON
1.0	CAP, FILM, 0.0047uF, 50V	C35	BF014D0472K	TOMPSON
2.0	CAP, FILM, 0.015uF, 50V	C9,C28	BF014E0153K	TOMPSON
2.0	CAP, FILM, 0.01uF, 50V	C23,C34	BF014E0103K	TOMPSON
1.0	CAP, FILM, 0.033uF, 50V	C32	BF014D0333K	TOMPSON
1.0	CAP, FILM, 0.068uF, 50V	C13	BF014D0683K	TOMPSON
1.0	CAP, FILM, 0.22uF, 250V	C20		ARCO
4.0	CAP, FILM, 0.22uF, 50V	C15,C18,C36,C44	BF024D0224K	TOMPSON
1.0	CAP, FILM, 0.33uF, 50V	C37	BF074D0334K	TOMPSON
23.0	CAP, MONO, 0.1uF, 50V	C7,C8,C22,C24-C26,C29,C31, C33,C38,C39,C51-C60,C62,C66	MCA50-104	
3.0	CAP, MONO, 100pF, 50V	C10-C12	MCR50-101	
1.0	CAP, MONO, 150pF, 50V	C5	MCR50-151	
4.0	CAP, MONO, 33pF, 50V	C40,C41,C45,C46	MCR50-330	
1.0	CAP, MONO, 470pF, 50V	C16	MCR50-471	
1.0	CAP, MONO, 680pF, 50V	C64	MCR50-681	
1.0	CAP, TANT, 1.0uF, 35V	C61	TCR35-010	
1.0	CONNECTOR, 2 PIN	J5	P0090712	YAESU
0.1	CONNECTOR, 3 PIN	JP1	PH1-025	SOLID ELECT
1.0	CONNECTOR, 4 PIN	J6	P0090713	YAESU
2.0	CONNECTOR, 8 PIN	J7,J8	P0090715	YAESU
1.0	CONNECTOR, DB15S RA	J1	DAL-15-PBT-Z	SOLID ELECT
1.0	CONNECTOR, RJ11	J4	BJ-66	SOLID ELECT
1.0	CRYSTAL, 11.0592 MHz	Y2	HC18-11.0592	
1.0	CRYSTAL, 3.579545 MHz	Y1	HC18-3.579545	
1.0	CRYSTAL, 4.00 MHz	Y3	HC18-4.00	
2.0	DIODE, 62 V ZENER	CR3,CR4	1N4759	
4.0	DIODE, POWER	CR5,CR12-CR14	1N4004	
7.0	DIODE, SIGNAL	CR1,CR2,CR6-CR8,CR10,CR11	1N4148	
2.0	HEADER, 10 PIN FLAT CABLE	J3,P3	LPH-10S	SOLID ELECT
1.0	HEADER, 16 PIN FLAT CABLE	J2	LPH-16L	SOLID ELECT
1.0	IC SOCKET, 28 PIN PLCC	U6	PLCC-28	SOLID ELECT
1.0	IC SOCKET, 40 PIN	U15	ED40DT	OST
2.0	IC SOCKET, 8 PIN	U13,U14	ED08DT	OST
1.0	IC, +5V REGULATOR	U11	7805	
1.0	IC, -5V CHARGE PUMP	U12	ICL7660CPA	HARRIS
1.0	IC, 10 SER/PAR DRIVER	U19	UCN5810A	ALLEGRO
1.0	IC, 512x8 SER EEPROM & W-DOG	U14	X25043P	XICOR
1.0	IC, 8 BIT SER ADC CONVERTER	U18	ADC0831CCN	NATIONAL
1.0	IC, 8Kx8 SERIAL EEPROM	U13	X25640P	XICOR
1.0	IC, 8x8 CROSS POINT SWITCH	U6	MT8808AP	MITEL
2.0	IC, CTCSS DECODER/ENCODER	U9,U20	MX805ADW	MX-COM
1.0	IC, DTMF EN/DECODER	U8	MT8880CE	MITEL

QTY	DESCRIPTION	REFDES	PART NO.	VENDOR
2.0	IC, HEX BUFFER	U10,U17	74HC14	
1.0	IC, MICROCONTROLLER	U15	P87C51FB	INTEL
1.0	IC, OPTO ISOLATOR	U7	4N36	
1.0	IC, QUAD DIGITAL POT	U16	X9241MP	XICOR
4.0	IC, QUAD OP-AMP	U1-U4	LMC660CN	NATIONAL
1.0	IC, QUAD OP-AMP	U5	MC34074	MOTOROLA
1.0	LED, GREEN T1-3/4	DS1	L-73CB/1GDA	KING BRIGHT
3.0	LED, RED T1-3/4	DS5,DS7	L-73CB/1IDA	KING BRIGHT
0.0	LED, RIGHT ANGLE SPACER	DS1-DS8	H-178C-1	BIVAR
4.0	LED, YELLOW T1-3/4	DS2,DS3,DS4,DS6,DS8	L-73CB/1YDA	KING BRIGHT
1.0	POP RIVET, 1/8"	U11		
1.0	RELAY, SPDT	K1	HS-211-11	HASCO
2.0	RES SIP, 10K X 5	RP1,RP4	RS5-103	
1.0	RES SIP, 1K X 9	RP3	RS9-102	
1.0	RES SIP, 4.7K X 7	RP2	RS7-472	
5.0	RES, 1%, 1/8W, 1.00K	R19-R22,R72	MF25-1001	
17.0	RES, 1%, 1/8W, 10.0K	R1,R2,R9,R11,R17,R26,R28,R29 R32,R35,R37,R38,R43,R47,R48 R50,R64	MF25-1002	
7.0	RES, 1%, 1/8W, 100K	R18,R24,R53,R54,R59,R60,R62	MF25-1003	
1.0	RES, 1%, 1/8W, 12.1K	R25	MF25-1212	
1.0	RES, 1%, 1/8W, 15.0K	R39	MF25-1502	
2.0	RES, 1%, 1/8W, 150K	R56,R63	MF25-1503	
3.0	RES, 1%, 1/8W, 2.00K	R15,R16,R66	MF25-2001	
2.0	RES, 1%, 1/8W, 20.0K	R10,R49	MF25-2002	
1.0	RES, 1%, 1/8W, 27.4K	R13	MF25-2742	
4.0	RES, 1%, 1/8W, 33.2K	R4,R12,R36,R42	MF25-3322	
4.0	RES, 1%, 1/8W, 47.5K	R5-R7,R55	MF25-4752	
6.0	RES, 1%, 1/8W, 4.99K	R8,R46,R52,R57,R73,R74	MF25-4991	
1.0	RES, 1%, 1/8W, 604	R23	CF25-601	
1.0	RES, 1%, 1/8W, 61.9K	R33	MF25-6192	
2.0	RES, 1%, 1/8W, 68.1K	R14,R51	MF25-6812	
1.0	RES, 1%, 1/8W, 82.5K	R27	MF25-8252	
4.0	RES, 5%, 1/4W, 10 OHM	R58,R67-R69	CF25-100	
3.0	RES, 5%, 1/4W, 1M	R40,R44,R65	CF25-105	
1.0	RES, 5%, 1/4W, 360K	R61	CF25-364	
4.0	RES, 5%, 1/4W, 51	R41,R45,R70,R71	CF25-510	
1.0	RES, 5%, 1/4W, 560K	R30	CF25-564	
1.0	RES, 5%, 1/4W, 820K	R31	CF25-824	
1.0	SHUNT	JP1	SHUNT-A	EW
1.0	SIDAC, 210 V	ZNR1	P2353AA	TECCOR
1.0	SWITCH, PUSH BUTTON	S1	B3F-3120	OMRON
1.0	TRANSFORMER, LINE 600:600	T1	TTC-105	TAMURA
1.0	TRANSISTOR, NPN SIGNAL	Q1	2N4400	
1.0	TRIM POT, 100K, 3/4" REC, MT	R3	RJC097P100K	TOCOS
1.0	TRIM POT, 10K, 3/4" REC, MT	R34	RJC097P10K	TOCOS
1.0	BRACKET, RI-210		3105-0048	PACIFIC RES.
2.0	IDC SOCKET, 10 PIN	J3,P3	SC-10-A-B	
6.0	SCREW, #4-40X1/4		SPPH4-40X0-1/4	
1.0	CABLE ASSEMBLY		T9206287	YAESU

## TROUBLESHOOTING

### 8.0 STANDARD TROUBLESHOOTING

This section provides procedures to solve some common problems that may occur with the RI-200. For technical and customer support, contact us at:

#### PACIFIC RESEARCH SOLUTIONS

Tel: 530-672-9053

Fax: 530-672-8749

email: pacres@directcon.net

PROBLEM	SOLUTION
No Green System LED	+12 VDC power source not connected or voltage below 8VDC minimum. S-Command 01 (system on/off) is off and or S-Command 11 (display on/off) is off If the unit has adequate voltage, and the S-Commands are correct, there may be some type of hardware failure.
No COS yellow LED	Confirm the receiver is on channel.
COS yellow LED on all the time	Confirm the receiver audio input level and the squelch level adjustments are correctly set. Check that the discriminator audio input is connected and working. If your discriminator does not have adequate filtering for 455 kHz, you will have to provide for this filtering between the radio and controller.
No CTCSS yellow LED	CTCSS may not be responding because either the controller or the input signal does not have the correct CTCSS tone. Confirm that the COS LED is working and the receiver audio level is correctly set.
No PTT red LED	If COS and PL operate properly, then check that the S-Command 01 and 02 are set correctly.
No DTMF yellow LED	Confirm that the COS and CTCSS LED is working and the receiver audio level is correctly set. CTCSS 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.
No Aux input yellow LED	Valid only when the Aux input is connected to another RI-100 controller or a control receiver. When connected to another RI-200 confirm all the Aux function are correctly enabled on both controllers
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 a S-Command within the macro.
You need to add "C" to the end of commands so the controller will decode them	You may be experiencing a problem with the COS always on. Check that the receiver and squelch levels are properly adjusted.

### 8.1 PROBLEM CHECK LIST

Use the following check list 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. You will first hear a CW "OK" and then the default ID "HELLO". The system LED should be the only LED on. If other LED's are on, see the above problem list.
3. Apply a carrier without a CTCSS tone on the input of the repeater. The COS LED should come on.
4. Apply a carrier with 100Hz CTCSS tone on the input of the repeater. The COS and the CTCSS LED should come on.
5. Apply a carrier with a DTMF tone on the input of the repeater. The DTMF LED should come on.

## GLOSSARY AND WARRANTY REPAIR

### 9.0 GLOSSARY

**ADC:** Analog to Digital Converter, this is a device or circuit that converts an analog voltage to a digital number.

**ANALOG:** A voltage that has multiple or dynamic levels within a given range.

**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 modify 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 interchangeable 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.

**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.



**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 is 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.

**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.

**PASSWORD:** A system access code that is used to secure access to all S-Commands in the RI-200. The repeater owner can change the password at anytime. **DO NOT FORGET YOUR 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-200 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.

**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.

**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.

**TELEMETRY:** Responses generated by the repeater controller in response to DTMF commands entered or in 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.

**tone 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.

**TOUCH TONE:** Used by telephone systems for dialing a telephone number (also see DTMF). Used in the RI-200 to enter desired functions or commands. Also see Macros and S-Commands.

**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.

## 9.1 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**

3050 Estepa Dr.  
Cameron Park, CA 95682  
Customer Service Dept.

Tel: 530-672-9053  
Fax: 530-672-8749  
email: [pacres@directcon.net](mailto:pacres@directcon.net)  
<http://www.directcon.net/pacres/>

## **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.

<b>RI-200 REPEATER CONTROLLER SYSTEM COMMAND LIST</b>				
<b>System Command</b>	<b>System Command Description and Data Format</b>	<b>Command Syntax</b>	<b>Factory Setting</b>	<b>Pwr on Recover</b>
00	No Operation Used for clearing a macro area	00	N/A	N/A
01	System mode Mode 0 = System off, 1 = COS, 2 = CTCSS/DCS, 3 = COS and CTCSS/DCS, 4 = Open squelch, 5 = No repeat audio, 6 = No repeat audio or PTT.	01 [Mode]	1 COS	Yes
02	RX Source mode Mode 1 = Reject sub audio, 2 = Pass sub audio, 3 = De-emphasis & reject sub audio, 4 = De-emphasis and pass sub audio.	02 [Mode]	1 Reject sub audio	Yes
03	Reserved	03 [ ]	N/A	N/A
04	Repeater carrier delay time Time = 0 - 255 in 1/10 second increments.	04 [Time]	30 3.0 Sec	Yes
05	Force on repeater PTT for set time Time = 0 - 3600 second.	05 [Time]	0 0 Sec.	No
06	Repeater telemetry mode No Mode = Suppress function complete and error one time. Mode 0 = Disable (off), 1 = ID only, 2 = Function complete and ID only, 3 = All enable (on).	06 [Mode]	3 All on	Yes
07	Station ID interval time Time = 0 - 255 in 6 seconds increments, 0 = Disable	07 [Time]	100 10.0 Min	Yes
08	Courtesy message timer, COS falling to start of message Time = 0 - 99 in 1/10 second increments, 0 = Disable	08 [Time]	20 2.0 Sec.	Yes
09	LED Status Display (lowers current drain) Mode 1 = Enable (on), 0 = Disable (off)	09 [Mode]	1 on	Yes
10	Repeater time-out time Time = 0 - 255 in 6 seconds increments, 0 = Disable, * = Reset	10 [Time]	30 3.0 Min.	Yes
11	Reserved	11 [ ]	N/A	N/A
12	Transmit audio output adjust Adj. = 0 - 63 or * up one count, # down one count	12 [Adj]	RI-200 = 31 RI-210 = 9	Yes
13	Reserved	13 [ ]	N/A	N/A
14	User and S-Command control CTCSS/DCS tone panel enable Panel 0 = Both, 1 = User-Commands, 2 = S-Commands Mode 1 = Enable (on), 0 = Disable (off)	14 [Panel] [Mode]	0 Both off	Yes
15	User command group decode enable Group = 0 - 8, 0 = All groups Mode 1 = Enable (on), 0 = Disable (off)	15 [Group] [Mode]	1&2 on 3 - 8 off	Yes
16	DTMF Decode Inter digit time Time = 1 - 99 in 1/10 seconds increments	16 [Time]	35 3.5 Sec.	Yes
17	DTMF Decode Mute time Time = 0 - 99 in 1/10 seconds increments, 0 = No mute	17 [Time]	25 2.5 Sec.	Yes
18	DTMF Mute control Mute 0 = All, 1 = Repeater, 2 = Auxiliary, 3 = Telephone Mode 1 = Enable (on), 0 = Disable (off)	18 [Mute] [Mode]	1 All on	Yes
19	Resend DTMF on repeater Digits = 0 to 9, A, B, D, *, # (34 digits max.)	19 [Digits]	N/A	No

<b>RI-200 REPEATER CONTROLLER SYSTEM COMMAND LIST</b>				
<b>System Command</b>	<b>System Command Description and Data Format</b>	<b>Command Syntax</b>	<b>Factory Setting</b>	<b>Pwr on Recover</b>
20	Tone panel CTCSS/DCS decode enable Panel 0 = All panels, 1 = Repeater, 2 = User Commands, 3 = S-Commands, 4 = Auxiliary, 5 = Telephone, 6 = Dial click Tone = 001 to 154 decode tone number, 000 = All Mode 1 = Enable (on), 0 = Disable (off)	20 [Panel] [Tone] [Mode]	All 013 100.0 Hz enabled	Yes
21	CTCSS/DCS master tone and cross encode setup Master Tone = 0 to 154 tone number, 0 = Disable. Encode Tone = 0 to 154 tone number, 0 = Use master tone. Decode Tone = 0 to 154 tone number, 0 = All.	21 [Master Tone] or 21 [Encode Tone] [Decode Tone]	013 100.0 Hz Master Tone	Yes
22	CTCSS/DCS encode mode Mode 0 = Off, 1 = Encode master tone, 2 = Regen decode tone, 3 = Regen with master tone or cross encode tone	22 [Mode]	2 Regen	Yes
23	Controller functions CTCSS/DCS encode tone Source 0 = All, 1 = ID, 2 = Auxiliary, 3 = Telephone ring Tone = 0 to 157 tone number, 0 = No tone, 155 = System default, 156 = Master tone, 157 = Aux source decode.	23 [Source] [Tone]	155 System Default	Yes
24	CTCSS/DCS encode level Level = 0 to 6 in 0.86 dB steps	24 [Level]	3	Yes
25	DCS TX/RX data polarity TX/RX 0 = TX, 1 = RX Pol 0 = Non-inverted, 1 = Inverted	25 [TX/RX] [Pol]	TX=0 RX=0	Yes
26	Reserved	26 [ ]	N/A	N/A
27	Reserved	27 [ ]	N/A	N/A
28	Reserved	28 [ ]	N/A	N/A
29	Reserved	29 [ ]	N/A	N/A
30	Reserved	30 [ ]	N/A	N/A
31	Message Editor, Insert Tone Generator or CW Commands Tone Data = 000 to 166, See table in section 4.5.31	31 [Tone Data]	N/A	N/A
32	Message and Event macro trigger Msg Trig 01 = Clock reset courtesy, 02 = Weak signal courtesy, 03 = Clock not set courtesy, 04 = Un-lock courtesy, 05 = Acknowledgment, 06 = Error, 07 = Station ID, 08 = Post time-out, 09 = Pre time-out, 10 = Ring, 13 = AP answer, 14 = AP ACK, 15 = AP Error, 16 = AP Ring Event Trig 17 = Power on macro, 18 = Telephone hang up 19 = Telephone auto answer Line = 0-999, 0 = Disable message or event trigger	32 [Msg/Event Trig] [Line]	See section 4.5.32	Yes
33	Reserved	33 [ ]	N/A	N/A

<b>RI-200 REPEATER CONTROLLER SYSTEM COMMAND LIST</b>				
<b>System Command</b>	<b>System Command Description and Data Format</b>	<b>Command Syntax</b>	<b>Factory Setting</b>	<b>Pwr on Recover</b>
34	Auxiliary output mode Mode 0 = Off, 1 = COS, 2 = AUX CTCSS/DCS, 3 = COS and AUX CTCSS/DCS, 4= Open squelch	34 [Mode]	0 Off	Yes
35	Auxiliary input mode Input = 0 – 8, 0 = All inputs State 1 = Enable (on), 0 = Disable (off) Mode 1 = Mix audio, 0 = Mute audio Source = 0 – 8, Aux CTCSS/DCS source for encode, 0 = Disable	35 [Input] [State] [Mode] <Source>	0 All off	Yes
36	AUX input, repeater carrier delay time Time = 0 to 255 in 1/10 second increments	36 [Time]	10 1.0 Sec	Yes
37	Regenerate DTMF from AUX input 1 = Enable (on), 0 = Disable (off)	37 [Mode]	0 Off	Yes
38	Multiple controller data link protocol mode Mode 0 = digital data, 1 = serial data, 2 = Clone controller	38 [Mode]	1 serial data	Yes
39	Controller Unit Address, serial communication Address = 1 through 9	39 [Address]	1	Yes
40	Delay timer macro trigger Line = Macro starting line number 0 to 999, 0 = Disable Time = 0 – 7200 Seconds, 0 = Reset timer	40 [Line] [Time]	0 disable	No
41	Receiver inactivity timer Line = Macro starting line number 0 to 999, 0 = Disable Time = 0 to 240.0 Minutes in 6 seconds increments	41 [Line] [Time]	0 disable	No
42	Schedule to trigger a macro at a regular interval Line = Macro starting line number 0 to 999, 0 = Disable Time = 0 to 240 Minutes	42 [Line] [Time]	0 disable	Yes
43	Set time clock Time = HHMM in 24 hour mode	43 [Time]	Not Set	No
44	Schedule to trigger a macro Sch = Scheduler 1 to 8 Time = HHMM in 24 hr mode Line = Macro starting line number 0 to 999, 0 = Disable	44 [Sch] [Time] [Line]	0 disable	Yes
45	Bit input, trigger a macro on state change Bit = 1-3 (Input number), 4 = COS, 5 = CTCSS/DCS, 6 = PTT, 7 = Aux in COS, 8 = Aux in CTCSS or DCS, 9 = Aux in active State 0 = Inactive or falling edge (Hi to Lo) State 1 = Active of rising edge (Lo to Hi) Line = Macro starting line number 0 to 999, 0 = Disable	45 [Bit] [State] [Line]	0 Disable	Yes
46	Bit output on/off Bit = 1-3 (Bit number) Mode 1 = On, 0 = Off	46 [Bit] [Mode]	0 off	No
47	Bit output pulse on for time Bit = 1-3 (Bit number) Time = 0 to 255 in 1/10 second increments	47 [Bit] [Time]	0	No
48	Reserved	48 [ ]	N/A	N/A
49	Dial Click Control Trigger Click = 1-9, Line = Macro starting line 0 to 254, 255 = disable	39 [Click] [Line]	0 Disabled	Yes

<b>RI-200 REPEATER CONTROLLER SYSTEM COMMAND LIST</b>				
<b>System Command</b>	<b>System Command Description and Data Format</b>	<b>Command Syntax</b>	<b>Factory Setting</b>	<b>Pwr on Recover</b>
50	Squelch adjust Adj = 0 to 63 or * up one count, # down one count	50 [Adj]	31	Yes
51	Set squelch mode Mode 0 = Normal, Mode 1 = SmartSquelch	51 [Mode]	1	Yes
52	Setup squelch Item 1 = Upper threshold, Value = 75 to 200 Item 2 = Lower threshold, Value = 50 to 150 Item 3 = Acquisition time, Value = 0 to 50 in 10 ms increments Item 4 = Delay factor, Value 0 to 255 Item 5 = Average factor, Value 0 to 50 Item 6 = Weak signal threshold, Value 3 to 50 in 10 ms inc.	52 [Item] [Value]	Item 1 = 160 2 = 130 3 = 8 4 = 125 5 = 25 6 = 5	Yes
53	Reserved	53 [ ]	N/A	N/A
54	Set Key code (prefix) for macros Key = 0 to 4 digits (C and D are NOT VALID)	54 [Key]	0 Digits	Yes
55	Set Password for S-Cmd access PW = 1 to 6 digits	55 [PW]	123456	Yes
56	Set Password for telephone incoming ring access PW = 1 to 6 digits	56 [PW]	343	Yes
57	Set Password for telephone incoming control access PW = 1 to 6 digits	57 [PW]	654381	Yes
58	Remote software reset Controller Serial Number (SN) is 8 digits	58 [SN]	Serial Number	N/A
59	Remote EEPROM initialize Controller Serial Number (SN) is 8 digits	59 [SN]	Serial Number	N/A
60	User telephone commands Cmd # = 01 – 08, Group = 1 – 8 Line = 000 to 999, Name = 1 - 4 digits	60 [Cmd #] [Group] [Line] [Name]	See sec. 4.5 60	Yes
61	User S-Commands commands, call S-Command Cmd # = 01 – 21, Group = 1 – 8 S-Cmd = 00 to 99, Name = 1 - 4 digits	61 [Cmd #] [Group] [S-Cmd] [Name]	See sec. 4.5.61	Yes
62	User commands Cmd # = 01 – 08, Group = 1 – 8 Line = 000 to 999, Name = 1 to 4 digits	62 [Cmd #] [Group] [Line] [Name]	See sec. 4.5.62	Yes
63	Macro and message editor, set starting line number pointer Line = 1 to 999	63 [Line]	N/A	N/A
64	Macro editor, insert an S-Command S-Cmd/Data = 00 to 99 and its data as req. for the S-Cmd No S-Cmd/Data for end of macro marker	64 [S-Cmd/Data]	See Section 4.5.64	Yes
65	Reserved		N/A	N/A
66	Reserved		N/A	N/A
67	Reserved		N/A	N/A
68	Jump to macro line Line = 1 – 999	68 [Line]	N/A	N/A
69	Exit system command mode	69	N/A	N/A

<b>RI-200 REPEATER CONTROLLER SYSTEM COMMAND LIST</b>				
<b>System Command</b>	<b>System Command Description and Data Format</b>	<b>Command Syntax</b>	<b>Factory Setting</b>	<b>Pwr on Recover</b>
70	Telephone outgoing call mode Mode, 0 = Disable AP, 1 = Simplex, 2 = Duplex 3 = Mute talk back, Simplex, 4 = Cover tone, Simplex	70 [Mode]	1 Simplex	Yes
71	Telephone incoming call mode Mode, 0 = Disable, 1 = Delay - On-hook - Ring TX 2 = Delay - Off-hook- Ring TX 3 = Delay - Off-hook - Ring PW required to ring TX 4 = Delay - Off-hook Ring PW, CTCSS tone # and optional DTMF string to ring TX (Tone and DTMF used during ring) 5 = Delay - Off-hook and connect telephone to repeater.	71 [Mode]	1	Yes
72	Telephone CTCSS/DCS tone panel enable Mode 1 = Enable (on), 0 = Disable (off)	72 [Mode]	0 off	Yes
73	Telephone incoming call control time-out DTMF inactive to on-hook Time = 0 to 15 minutes, 0 = no time-out	73 [Time]	3 minutes	Yes
74	Telephone incoming call ring command and PW time-out Time = 1 to 120 seconds	74 [Time]	30 seconds	Yes
75	Telephone incoming ring delay Ring = 0 to 15	75 [Ring]	4 Rings	Yes
76	Telephone TX ring limit Ring = 0 to 31, 0 = no limit	76 [Ring]	8 Rings	Yes
77	Telephone off-hook time-out Time = 0 to 240 minutes, 0 = no time-out	77 [Time]	10 minutes	Yes
78	Telephone, no activity on RX time-out Time = 0 to 240 seconds, 0 = no time-out	78 [Time]	60 seconds	Yes
79	Telephone AGC level set Level = 0 to 7 (0 = AGC off)	79 [Level]	4	Yes
80	Flash hook switch Used for call waiting and hold	80	N/A	N/A
81	Telephone dial tone/pulse select Mode 0 = tone, 1 = pulse	81 [Mode]	0 tone	Yes
82	Telephone on/off-hook, access and account code Code = 1 to 8 off-hook than code, 0 = on-hook, 9 = Answer ringing telephone	82 [Code]	N/A	No
83	Edit telephone access and account codes Type 0 = Access, 1 = Account Code = 1 to 8 memory location Number = 0 to 16 digits	83 [Type] [Code] [Number]	None	Yes
84	Telephone number auto-dial Store = 00 to 99 memory location Number = 0 to 16 digits (0-9, *, #, A = Pause) No number to clear a memory location *xx to recall stored number when dialing *00 to recall last number radial	84 [Store] [Number]	None	Yes
85	Set an auto-dial for use in a macro Auto-Dial = 0 - 99	85 [Auto-Dial]	N/A	No



<b>RI-200 REPEATER CONTROLLER SYSTEM COMMAND LIST</b>				
<b>System Command</b>	<b>System Command Description and Data Format</b>	<b>Command Syntax</b>	<b>Factory Setting</b>	<b>Pwr on Recover</b>
86	Telephone number accept table enable Mode 1 = Enable (on), 0 = Disable (off)	86 [Mode]	0 off	Yes
87	Edit telephone number accept table Accept = 00 to 99 table entry Number = 0 to 16 digits (0-9, * = Wild card)	87 [Accept] [Number]	None	Yes
88	Telephone number reject table enable Mode 1 = Enable (on), 0 = Disable (off)	88 [Mode]	0 off	Yes
89	Edit telephone number reject table Reject = 00 to 99 table entry Number = 0 to 16 digits (0-9, * = Wild card)	89 [Reject] [Number]	See Section 4.5.89	Yes
90	Wait for dial tone Time = 0 to 99 in 1/10 seconds increments (0 = Auto detect)	90 [Time]	50 5.0 Sec.	Yes
91	Reserved	91 [ ]	N/A	N/A
92	Reserved	92 [ ]	N/A	N/A
93	Reserved	93 [ ]	N/A	N/A
94	Reserved	94 [ ]	N/A	N/A
95	Reserved	95 [ ]	N/A	N/A
96	Reserved	96 [ ]	N/A	N/A
97	Reserved	97 [ ]	N/A	N/A
98	Reserved	98 [ ]	N/A	N/A
99	Reserved	99 [ ]	N/A	N/A

Use the following table to keep track the use of CTCSS and DCS decode for each tone panel. See S-Command 20 in section 4.5.20 for additional information on working with this table

CTCSS DECODE TONE (Hz) ENABLE TABLE								
NO.	FREQ.	RPT	U-Cmd	S-Cmd	AUX	TEL	Click	NOTES
001	67.0							
002	69.3							
003	71.9							
004	74.4							
005	77.0							
006	79.7							
007	82.5							
008	85.4							
009	88.5							
010	91.5							
011	94.8							
012	97.4							
013	100.0							
014	103.5							
015	107.2							
016	110.9							
017	114.8							
018	118.8							
019	123.0							
020	127.3							
021	131.8							
022	136.5							
023	141.3							
024	146.2							
025	151.4							
026	156.7							
027	159.8							
028	162.2							
029	165.5							
030	167.9							
031	171.3							
032	173.8							
033	177.3							
034	179.9							
035	183.5							
036	186.2							
037	189.9							
038	192.8							
039	196.6							
040	199.5							
041	203.5							
042	206.5							
043	210.7							
044	218.1							
045	225.7							
046	229.1							
047	233.6							
048	241.8							
049	250.3							
050	254.1							

DCS DECODE CODE ENABLE TABLE								
NO.	CODE	RPT	U-Cmd	S-Cmd	AUX	TEL	Click	NOTES
051	023							
052	025							
053	026							
054	031							
055	032							
056	036							
057	043							
058	047							
059	051							
060	053							
061	054							
062	065							
063	071							
064	072							
065	073							
066	074							
067	114							
068	115							
069	116							
070	122							
071	125							
072	131							
073	132							
074	134							
075	143							
076	145							
077	152							
078	155							
079	156							
080	162							
081	165							
082	172							
083	174							
084	205							
085	212							
086	223							
087	225							
088	226							
089	243							
090	244							
091	245							
092	246							
093	251							
094	252							
095	255							
096	261							
097	263							
098	265							
099	266							
100	271							
101	274							
102	306							

DCS DECODE CODE ENABLE TABLE								
NO.	CODE	RPT	U-Cmd	S-Cmd	AUX	TEL	Click	NOTES
103	311							
104	315							
105	325							
106	331							
107	332							
108	343							
109	346							
110	351							
111	356							
112	364							
113	365							
114	371							
115	411							
116	412							
117	413							
118	423							
119	431							
120	432							
121	445							
122	446							
123	452							
124	454							
125	455							
126	462							
127	464							
128	465							
129	466							
130	503							
131	506							
132	516							
133	523							
134	526							
135	532							
136	546							
137	565							
138	606							
139	612							
140	624							
141	627							
142	631							
143	632							
144	654							
145	662							
146	664							
147	703							
148	712							
149	723							
150	731							
151	732							
152	734							
153	743							
154	754							

Use the following table to keep track of the CTCSS and DCS cross encode values. See S-Command 21 in section 4.5.21 for additional information on working with this table.

CTCSS CROSS ENCODE TABLE											
DECODE		ENC	DECODE		ENC	DECODE		ENC	DECODE		ENC
001	67.0		040	199.5		079	156		118	423	
002	69.3		041	203.5		080	162		119	431	
003	71.9		042	206.5		081	165		120	432	
004	74.4		043	210.7		082	172		121	445	
005	77.0		044	218.1		083	174		122	446	
006	79.7		045	225.7		084	205		123	452	
007	82.5		046	229.1		085	212		124	454	
008	85.4		047	233.6		086	223		125	455	
009	88.5		048	241.8		087	225		126	462	
010	91.5		049	250.3		088	226		127	464	
011	94.8		050	254.1		089	243		128	465	
012	97.4		051	023		090	244		129	466	
013	100.0		052	025		091	245		130	503	
014	103.5		053	026		092	246		131	506	
015	107.2		054	031		093	251		132	516	
016	110.9		055	032		094	252		133	523	
017	114.8		056	036		095	255		134	526	
018	118.8		057	043		096	261		135	532	
019	123.0		058	047		097	263		136	546	
020	127.3		059	051		098	265		137	565	
021	131.8		060	053		099	266		138	606	
022	136.5		061	054		100	271		139	612	
023	141.3		062	065		101	274		140	624	
024	146.2		063	071		102	306		141	627	
025	151.4		064	072		103	311		142	631	
026	156.7		065	073		104	315		143	632	
027	159.8		066	074		105	325		144	654	
028	162.2		067	114		106	331		145	662	
029	165.5		068	115		107	332		146	664	
030	167.9		069	116		108	343		147	703	
031	171.3		070	122		109	346		148	712	
032	173.8		071	125		110	351		149	723	
033	177.3		072	131		111	356		150	731	
034	179.9		073	132		112	364		151	732	
035	183.5		074	134		113	365		152	734	
036	186.2		075	143		114	371		153	743	
037	189.9		076	145		115	411		154	754	
038	192.8		077	152		116	412				
039	196.6		078	155		117	413				

Use the following table to keep track of the user telephone commands that you create. See S-Command 60 in section 4.5.60 for additional information on working with this table. Also, do not forget to add to this table any default command that you may want to keep.

TELEPHONE COMMAND NAME TABLE							
Command Number	Group Number	Macro Start Line	D1	D2	D3	D4	Notes
01							
02							
03							
04							
05							
06							
07							
08							

Use the following table to keep track of the user S-Commands that you create. See S-Command 61 in section 4.5.61 for additional information on working with this table. Also, do not forget to add to this table any default command that you may want to keep.

USER S-COMMAND NAME TABLE							
Command Number	Group Number	System Command	D1	D2	D3	D4	Notes
01							
02							
03							
04							
05							
06							
07							
08							
09							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							

Use the following table to keep track of the user commands that you create. See S-Command 62 in section 4.5.62 for additional information on working with this table. Also, do not forget to add to this table any default command that you may want to keep.

USER COMMAND NAME TABLE							
Command Number	Group Number	Macro Start Line	D1	D2	D3	D4	Notes
01							
02							
03							
04							
05							
06							
07							
08							
09							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							

USER COMMAND NAME TABLE							
Command Number	Group Number	Macro Start Line	D1	D2	D3	D4	Notes
34							
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							
45							
46							
47							
48							
49							
50							
51							
52							
53							
54							
55							
56							
57							
58							
59							
60							
61							
62							
63							
64							
65							
66							



USER COMMAND NAME TABLE							
Command Number	Group Number	Macro Start Line	D1	D2	D3	D4	Notes
67							
68							
69							
70							
71							
72							
73							
74							
75							
76							
77							
78							
79							
80							
81							
82							
83							
84							
85							
86							
87							
88							
89							
90							
91							
92							
93							
94							
95							
96							
97							
98							
99							

Use the following table to keep track of the macro and message data. See S-Command 64 in section 4.5.64 and section 5.0 for additional information on working with this table. Also, do not forget to add to this table any default macros and messages that you may want to keep. There are 999 total start lines available. Only a limited number of tables have been supplied. Make copies if you need additional tables.

MACRO and MESSAGE DATA TABLE																		
Line	D1	D2	D3	D4	D5	D6	D7	D8	Line	D1	D2	D3	D4	D5	D6	D7	D8	NOTE
( )01									( )02									
( )03									( )04									
( )05									( )06									
( )07									( )08									
( )09									( )10									
( )11									( )12									
( )13									( )14									
( )15									( )16									
( )17									( )18									
( )19									( )20									
( )21									( )22									
( )23									( )24									
( )25									( )26									
( )27									( )28									
( )29									( )30									
( )31									( )32									
( )33									( )34									
( )35									( )36									
( )37									( )38									
( )39									( )40									
( )41									( )42									
( )43									( )44									
( )45									( )46									
( )47									( )48									
( )49									( )50									

MACRO and MESSAGE DATA TABLE																		
Line	D1	D2	D3	D4	D5	D6	D7	D8	Line	D1	D2	D3	D4	D5	D6	D7	D8	NOTE
( )51									( )52									
( )53									( )54									
( )55									( )56									
( )57									( )58									
( )59									( )60									
( )61									( )62									
( )63									( )64									
( )65									( )66									
( )67									( )68									
( )69									( )70									
( )71									( )72									
( )73									( )74									
( )75									( )76									
( )77									( )78									
( )79									( )80									
( )81									( )82									
( )83									( )84									
( )85									( )86									
( )87									( )88									
( )89									( )90									
( )91									( )92									
( )93									( )94									
( )95									( )96									
( )97									( )98									
( )99									( )00									

MACRO and MESSAGE DATA TABLE																		
Line	D1	D2	D3	D4	D5	D6	D7	D8	Line	D1	D2	D3	D4	D5	D6	D7	D8	NOTE
( )01									( )02									
( )03									( )04									
( )05									( )06									
( )07									( )08									
( )09									( )10									
( )11									( )12									
( )13									( )14									
( )15									( )16									
( )17									( )18									
( )19									( )20									
( )21									( )22									
( )23									( )24									
( )25									( )26									
( )27									( )28									
( )29									( )30									
( )31									( )32									
( )33									( )34									
( )35									( )36									
( )37									( )38									
( )39									( )40									
( )41									( )42									
( )43									( )44									
( )45									( )46									
( )47									( )48									
( )49									( )50									

MACRO and MESSAGE DATA TABLE																		
Line	D1	D2	D3	D4	D5	D6	D7	D8	Line	D1	D2	D3	D4	D5	D6	D7	D8	NOTE
( )51									( )52									
( )53									( )54									
( )55									( )56									
( )57									( )58									
( )59									( )60									
( )61									( )62									
( )63									( )64									
( )65									( )66									
( )67									( )68									
( )69									( )70									
( )71									( )72									
( )73									( )74									
( )75									( )76									
( )77									( )78									
( )79									( )80									
( )81									( )82									
( )83									( )84									
( )85									( )86									
( )87									( )88									
( )89									( )90									
( )91									( )92									
( )93									( )94									
( )95									( )96									
( )97									( )98									
( )99									( )00									

Use the following table to keep track of the telephone access and account codes. See S-Command 83 in section 4.5.83 and section 6.0 for additional information on working with this table.

<b>TELEPHONE ACCESS CODE TABLE</b>																	
Store	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	Notes
01																	
02																	
03																	
04																	
05																	
06																	
07																	
08																	

<b>TELEPHONE ACCOUNT CODE TABLE</b>																	
Store	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	Notes
01																	
02																	
03																	
04																	
05																	
06																	
07																	
08																	

Use the following table to keep track of auto dial numbers. See S-Command 84 in section 4.5.84 and section 6.0 for additional information on working with this table

<b>AUTO DIAL TABLE</b>																	
<b>Store</b>	<b>D1</b>	<b>D2</b>	<b>D3</b>	<b>D4</b>	<b>D5</b>	<b>D6</b>	<b>D7</b>	<b>D8</b>	<b>D9</b>	<b>D10</b>	<b>D11</b>	<b>D12</b>	<b>D13</b>	<b>D14</b>	<b>D15</b>	<b>D16</b>	<b>Notes</b>
01																	
02																	
03																	
04																	
05																	
06																	
07																	
08																	
09																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	
18																	
19																	
20																	
21																	
22																	
23																	
24																	
25																	
26																	
27																	
28																	
29																	
30																	
31																	
32																	
33																	

<b>AUTO DIAL TABLE</b>																	
<b>Store</b>	<b>D1</b>	<b>D2</b>	<b>D3</b>	<b>D4</b>	<b>D5</b>	<b>D6</b>	<b>D7</b>	<b>D8</b>	<b>D9</b>	<b>D10</b>	<b>D11</b>	<b>D12</b>	<b>D13</b>	<b>D14</b>	<b>D15</b>	<b>D16</b>	<b>Notes</b>
34																	
35																	
36																	
37																	
38																	
39																	
40																	
41																	
42																	
43																	
44																	
45																	
46																	
47																	
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49																	
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57																	
58																	
59																	
60																	
61																	
62																	
63																	
64																	
65																	
66																	
67																	



AUTO DIAL TABLE																	
Store	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	Notes
68																	
69																	
50																	
51																	
72																	
73																	
74																	
75																	
76																	
77																	
78																	
79																	
80																	
81																	
82																	
83																	
84																	
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86																	
87																	
88																	
89																	
90																	
91																	
92																	
93																	
94																	
95																	
96																	
97																	
98																	
99																	

Use the following table to keep track of the telephone number accept data. See S-Command 87 in section 4.5.87 and section 6.0 for additional information on working with this table.

TELEPHONE NUMBER ACCEPT TABLE																	
Store	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	Notes
01																	
02																	
03																	
04																	
05																	
06																	
07																	
08																	
09																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	
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19																	
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21																	
22																	
23																	
24																	
25																	
26																	
27																	
28																	
29																	
30																	
31																	
32																	
33																	

TELEPHONE NUMBER ACCEPT TABLE																	
Store	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	Notes
34																	
35																	
36																	
37																	
38																	
39																	
40																	
41																	
42																	
43																	
44																	
45																	
46																	
47																	
48																	
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56																	
57																	
58																	
59																	
60																	
61																	
62																	
63																	
64																	
65																	
66																	
67																	

TELEPHONE NUMBER ACCEPT TABLE																	
Store	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	Notes
68																	
69																	
50																	
51																	
72																	
73																	
74																	
75																	
76																	
77																	
78																	
79																	
80																	
81																	
82																	
83																	
84																	
85																	
86																	
87																	
88																	
89																	
90																	
91																	
92																	
93																	
94																	
95																	
96																	
97																	
98																	
99																	

Use the following table to keep track of the telephone number accept data. See S-Command 88 in section 4.5.88 and section 6.0 for additional information on working with this table. Also, do not forget to add to this table any default reject numbers that you may want to keep.

<b>TELEPHONE NUMBER REJECT TABLE</b>																	
<b>Store</b>	<b>D1</b>	<b>D2</b>	<b>D3</b>	<b>D4</b>	<b>D5</b>	<b>D6</b>	<b>D7</b>	<b>D8</b>	<b>D9</b>	<b>D10</b>	<b>D11</b>	<b>D12</b>	<b>D13</b>	<b>D14</b>	<b>D15</b>	<b>D16</b>	<b>Notes</b>
01																	
02																	
03																	
04																	
05																	
06																	
07																	
08																	
09																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	
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24																	
25																	
26																	
27																	
28																	
29																	
30																	
31																	
32																	
33																	

<b>TELEPHONE NUMBER REJECT TABLE</b>																	
<b>Store</b>	<b>D1</b>	<b>D2</b>	<b>D3</b>	<b>D4</b>	<b>D5</b>	<b>D6</b>	<b>D7</b>	<b>D8</b>	<b>D9</b>	<b>D10</b>	<b>D11</b>	<b>D12</b>	<b>D13</b>	<b>D14</b>	<b>D15</b>	<b>D16</b>	<b>Notes</b>
34																	
35																	
36																	
37																	
38																	
39																	
40																	
41																	
42																	
43																	
44																	
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<b>TELEPHONE NUMBER REJECT TABLE</b>																	
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