

***RLC-5 2 Port Communications Controller
Software Version 1.43
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***Link Communications, Inc.
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Introduction:

Congratulations, you have purchased a very powerful tool for your group's repeater. The RLC-5 may seem complicated and intimidating at first, but don't worry. Setting it up and programming it are easy and straightforward, once you have read the manual. Please take the time to read it before you try to start programming. This will save you a lot of confusion and frustration, as it should answer most of your questions.

The RLC-5 communications controller supports 2 radio ports which can each control a repeater or a link. The radio ports can be configured to require one of several combinations of COR and PL inputs for access. The RLC-5 has a DTMF decoder per radio port and one for the autopatch, thereby supporting DTMF control from all ports of the controller. CW messages prompt the users in the programming of the controller's variables; IDs and alarms based on the inputs can use CW or DVR messages.

This manual consists of three main sections: setup and interfacing, programming and commands, and the appendices with commonly referenced tables and charts. A glossary has also been included at the end to explain some of the terms and abbreviations that are used throughout the manual.

We have attempted to provide you with information that is easy to understand, but some questions are inevitable. If you have carefully read the manual and still have questions, call us at (406) 482-7515, fax us at (406) 482-7547, or write to us at:

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Limited Warranty

COVERAGE:

Link Communications Inc. warrants that its products will be free from defects in materials and workmanship for a period of one year from the date of shipment. During this time, Link Communications Inc. will cover parts, labor and return shipping. If failure is caused by instances other than manufacturing defects, Link Communications Inc. will repair the product and bill the customer for parts and labor. Contact Link Communications Inc. for more information.

What Link Communications Inc. will not cover:

1. Too much voltage to the controller. The RLC-5 operates at +11V to +15V, negative ground.
2. Damage to the controller by lightning, accident, or incorrect power hook-up.
3. Incorrect unit installation.
4. Damage caused by shipment (damage claims are handled by the carrier).
6. Repairs by other than Link Communications Inc.

THIS WARRANTY HOLDS ONLY TO THE ORIGINAL PURCHASER

HOW TO GET SERVICE

Please contact Link Communications Inc. for servicing information and authorization.

SOFTWARE

Link Communications Inc. holds the copyright on the RLC-3's software and hardware. Changes to the software, copying of the software is prohibited without the written consent of Link Communications, Inc.

SOFTWARE UPDATES

Link Communications Inc. will provide FREE Software updates for 6 months from the date of purchase. The owner must return replaced software chips to Link Communications Inc. in order to obtain further software updates. Software updates costs will be determined at the release of the update. Manual inserts and shipping are additional.

User Survey (Optional)

A knowledge of the user base will allow us to better serve you in the future by helping us develop more specialized software and hardware. Please take a few minutes and fill out this questionnaire.

RLC-5 Serial Number _____

RLC-5 Purchase Date _____

Application: (Circle All That Apply)

Ownership:

- 1 - Privately Owned Repeater
- 2 - Club Owned Repeater
- 3 - Group Owned Repeater
- 4 - Commercial Business Repeater
- 5 - Other _____

Installation:

- 1 - Wide Coverage Repeater with Chain Links
 - Port to Port Linking
- 2 - Full Duplex Links
- 3 - Half Duplex Links
- 4 - VHF Repeater: Power _____ Make _____
- 5 - UHF Repeater: Power _____ Make _____
- 6 - Link Ports Used as Repeater Ports: Yes No
- 7 - Serial Data Used to Control Repeater: Yes No
- 8 - Other Amateur Repeaters At the Site: Yes No
- 9 - Other Link Communication Inc. Products Used: Yes No

Misc:

- 1 - User Base: Technical Rag Chew Personal
- 2 - Autopatch used on the System: Yes No
- 3 - Frequency Adjustable Remotes: Yes No
- 4 - Linking to Other Repeaters: Yes No
- 5 - Linking Closed Access: Yes No
- 6 - PL Required on Main Repeater: Yes No Varies
- 7 - PL Required on Linking System: Yes No Varies

Please Return to: Link Communications Inc.
P.O. Box 1071
Sidney, MT 59270

Comments:

Setup and Interfacing

This section of the manual contains everything you should need to know to get your repeater controller up and running. The numbered steps cover the basics, through connecting your radios and adjusting the RLC-5. After that there is information concerning the other input and output features of the RLC-5: the serial interface, the logical output and input lines, and the analog input lines.

Step #1: Check the Packing List

Your package should contain the following items:

- (1) RLC-5 Repeater Controller
- (1) 2.50mm Power Connector
- (4) DB-9 Male Solder Connectors (1 for each radio port)
- (1) DB-9 Male Solder Connector for the serial port
- (1) RLC-5 Manual

If any of these parts are missing, contact Link Communications Inc.

Step #2: Connect Power

- The RLC-5 was designed to run off of 12V DC. 11V to 14V should work fine.

- Locate the 2.50mm power connector included in your parts bag.

- Unscrew the plastic outer shield and thread your power and ground wires through it (20 gauge suggested).

- Solder the +12V wire to the center pin of the 2.50mm connector.

- Solder the ground wire to the shield of the 2.50mm power connector.

- Screw on the plastic outer shield.

Step #3: Connecting Your Receivers to the RLC-5

The radios connect to the RLC-5 using a male DB-9 connector (included). The pinout for each of the two radio ports is listed below.

Radio Ports

- 1 - Ground
- 2 - PL Input (Active High/Low)
- 3 - PTT Out (Active Low)
- 4 - Audio Out (to the transmitter) 600 Ω
- 5 - Audio In (from the receiver) 10K Ω
- 6 - Ground
- 7 - COR Input (Active High/Low)
- 8 - Ground
- 9 - Ground

Connecting the Receiver COR

The first step in connecting your receiver is to locate an active receiver signal. If the voltage goes from a voltage above 5 volts to ground when a signal is present, the signal is active low. The RLC-5 accepts active low COR signals by default, but this can be changed for one or both of the radio ports with command C013. The signal must be able to sink 4mA to ground. The input impedance of the RLC-5 COR input is 10K Ω and it is diode clamped with internal pull-up resistors. This allows it to handle input voltages of up to 40 volts without damage to the controller. **The COR input must not go below 0V (ground); this would damage the controller's COR/PL input.** Using one of the supplied DB-9 Male connectors, connect your COR signal to pin #7.

Connecting a PL Input (optional)

If you wish to use a PL (CTCSS) decoder on any of the receivers, its detect line can be connected to pin #2 of the appropriate connector in the same fashion as the COR input. You will probably also want to use the audio filter on the PL decoder board to filter the PL signal out of the receiver's audio before it goes to the RLC-5. See command C005 for instructions about telling the controller to require PL for access.

Connecting the Receiver Audio

- 2 types of audio can be used on the RLC-5 controller:

Type 1: De-emphasized audio (Speaker Audio)

Type 2: Discriminator audio (Raw Unsquelched Audio)

- If type 1 audio is used, remove the audio jumper for the radio port. This removes the de-emphasis filter from the circuit. If you are using discriminator audio, connect the jumper across the 2 pins. The filter will not allow PL to pass through the controller. Contact Link Communications Inc. if you need to pass PL through the controller.

- The audio input is connected to pin #5 of the male DB-9 connector

- The audio adjustments will be described in Step #4.

Jumper J6 - Port 1 Audio Filter De-emphasis jumper

Jumper J7 - Port 2 Audio Filter De-emphasis jumper

Step #4: Connecting Your Transmitters to the RLC-5

Transmitter PTT

- The RLC-5 produces an active low PTT signal (ground when PTT is active). This output is buffered with an open collector type driver capable of sinking 150mA. There is a built in 30V zener clamping diode to protect the PTT MOSFET from the high voltage spikes that can be caused by interfacing to a PTT relay coil. Your transmitter PTT input should be connected to pin #3 of the DB-9 connector.

Transmitter Audio

- The RLC-5 provides a 10KS output impedance to your transmitter audio input.

- The transmitter audio is connected to pin #4 of the DB-9 connector.

- If it is not already, the DB-9 plug can now be plugged into the appropriate jack on the link card. The radio port is the lower DB-9 on the link card (with the DB-9s toward you).

Step #5: Adjusting the RLC-5 Controller

- Locate connector J1 on the RLC-5's main board. (It is the 10 pin female connector located near the tone level adjustments). This test bus will provide the signals that we need to adjust the audio inputs on the RLC-5. In order to maintain audio deviation during channel switching, all of the receiver inputs must be set to the same level. These signals can be measured with an oscilloscope or an AC voltmeter. If you are using an AC voltmeter, remember that it reads AC signals as RMS values. In order to obtain an audio signal on J1, a valid COR or PL must be received. Once a valid access signal is received, the RLC-5 will un-squelch the audio and be present on J1.

Receiver Port Adjustment:

- Connect the receiver port that is receiving a signal to all connected transmitter ports.

Transmitter Port Adjustment:

- Present a stable Tone or DTMF tone to the receiver that you are adjusting.
- Adjust the 'RX' pot so that the signal on J1 is 1 volt peak-to-peak for the active receiver
- Adjust the 'TX' pots on all other connected transmitters to obtain the desired deviation.
- Your transmitters should not need any additional adjustments once one receiver is set up.

Follow the above adjustment steps for all other connected receivers

Tone Generators Adjustment:

- Generate a tone test sequence using RLC-5
- Adjust "TN" pot on the RLC-5 port card to the desired deviation
- 1.5Khz deviation is typical

Serial Port Interfacing

The RLC-5 has a full duplex serial terminal port for interfacing to any serial device, i.e. packet, modems and serial terminals. This allows you to monitor, control, and program all facets of the controller.

RS-232 Signals and Interfacing

The RLC-5 input and output is the RS-232 standard, $\pm 12V$. The pinout is standard for a 9-pin serial connector. To connect to a terminal or computer's 9-pin serial connector, use a straight-through cable (not a null modem) with at least pins 2, 3, and 5 connected. To connect to a computer with a 25-pin serial connector, you can use a standard 9 to 25-pin converter or wire your own cable. To wire your own, connect the RLC-5's pins 2, 3, and 5 to the computer's 3, 2, and 7 respectively. The other lines are not used. If connecting to a modem, follow the directions below, or add a null-modem adapter.

Communications Parameters

After connecting your terminal, computer, or modem (either packet or telephone) to the RLC-5, you need to make sure that the communications parameters match on both ends. The default settings for the RLC-5 are 9600 N81:

Baud (Default)	9600
Start Bits	1
Stop Bits	1
Parity	None
Word Length	8

You can change the baud rate the RLC-5 with command C036. Information about programming using the serial port can be found in Appendix F.

Modem Setup

Most modems need to have some settings changed to work properly with the RLC-5. To do this, connect the modem to a computer or terminal. The needed cable is described below:

<u>Computer (DB-9 Female)</u>	<u>Modem (DB-25 Male)</u>
2	2
3	3
5	7
	4 & 5 Jumped
	6 & 8 & 20 Jumped

Type "AT" (without the quotes) and press enter. You should get a response of "OK". If you do not, check the connections.

To reset the modem to factory defaults, type "AT&F" and press enter.

To set the modem to answer after three rings, type "ATS0=3" and press enter.

(To check that setting, enter "ATS0?" and press enter.)

To ignore the RTS signal (which the controller doesn't use), type "AT&R1" and press enter.

To keep the modem from sending result codes to the controller, type "ATQ1" and press enter.

To keep the modem from echoing commands, type "ATE0" and press enter.

To set the modem's speak for high volume, type "ATL3" and press enter.

To save the settings in the modem's non-volatile memory, type "AT&W" and press enter.

Now you should be ready to connect the modem to the controller. You will have to modify the cable you used to connect the the computer or make a new cable. The connections follow:

<u>Controller (DB-9 Male)</u>	<u>Modem (DB-25 Male)</u>
2	2
3	3
5	7
	2 & 5 Jumped
	6 & 8 & 20 Jumped

Inputs, Outputs and Analog

The RLC-5 has one output line built in. An optional IO board can be added which provides 8 analog input lines, 8 high/low input lines and 8 open-collector type output lines (subject to change). Contact Link Communications for availability of the external I/O board.

Output Lines:

The output line provided on the RLC-5 has its own connector. This connector has three screw terminals, for 12V, the output, and ground. The output line can be controlled using command C089.

Getting Started

This section contains general information that you will need to know to use the RLC-5. It does not contain very much information that you can't find elsewhere, but it is provided to help you get on the air without having to read the whole manual. It explains some basic things about how the controller works, how to enter commands, and provides some examples to get you started. If at any point you are confused, read the more lengthy descriptions of what each command does in the Command Reference section.

Reset and Power Up

When the RLC-5 resets (this occurs when the reset button is pressed and released, you power up the controller, or command C037 is executed), the reset macro is executed. This macro is user programmable and defaults to sending "Reset" in CW. See command C057 event 00 if you wish to change this message. This message is the first message that you will hear. The message sent will only go out port 1 of the RLC-5. When this message is sent you know that one of the following events have occurred:

- 1) Power to the controller has just been turned on
- 2) The user has pressed and released the "RESET" button
- 3) The Reset command (C037) has been executed by the controller or the user
- 4) The controller's watchdog timer has expired. This is an internal protection timer that resets the controller if it quits operating normally.

The EOF key

The EOF key is a name used to describe the digit that forces a command to be executed. This key defaults to the '*' key but can be changed to any digit using command C078. It is recommended that the assigned key be a digit not used by any other command names (*, A, B, and D work fine, # is usable, but not ideal). This is important so that commands are not executed when they are not intended to be executed. Some other controllers use the 'D' key.

When and Where do I use the EOF key?

To Force Execution:

After you enter a command name, there are two ways you can cause it to execute. The first is to press the EOF key (*). The second is to unkey your transmitter. There are advantages and disadvantages to each method. For example, C009 can be executed two ways:

Method #1: C009*

Method #2: C009 <Receiver Access Drop>

Method #1 executes by forcing command execution with the '*'. When this is done the response begins immediately, and does not wait for the receiver access to drop. The advantage of this type of execution is the command executes immediately, allowing you to enter multiple commands without unkeying between them. The disadvantage is that you will probably miss part of the CW response. This method must be used if your receiver's squelch is stuck open, because the controller will not be able to tell if you unkey.

Method #2 executes when the receiver goes inactive. The advantage of this type of execution is the response is not sent until after the receiver goes inactive, therefore allowing you to hear the complete message. The disadvantage is that the command will wait on receiver activity before executing a command. This is a problem if your receiver's squelch is locked open and you need to shut down or enable PL on your system. With Method #2 the command would never execute because the receiver's squelch never closed.

Both methods are always available, so you can use whichever one you choose at the time. If you want to enter a bunch of commands without unkeying and you don't care about the responses, use Method #1. If you want to hear the responses, use Method #2. Method #1 is always used in the manual.

After a command name before more information:

Another time that you may need to use the EOF key is if the command you are using requires data following the command name. An example of this type of command is C000, which connects two ports together. After you enter the command name, you must press the EOF key, then the two port numbers you wish to be connected together, then use either of the methods described above to make the command execute:

C000*12 <unkey or press *>.

In other words, the EOF key indicates the end of the command name and the beginning of the data for commands that require data after the command name.

Autoexecution

There is a way to make the controller enter the EOF key for you as soon as it recognizes that you have entered a valid command name. This is called "autoexecution". With autoexecution is turned on, the above example would become C000 <controller recognizes command name and enters the EOF for you> 12 <unkey or press *>, so all you have to enter is C00012*. If the command does not require data after the command name, it will be executed immediately when the controller automatically enters the EOF, just like Method #1 above. If you key and enter C009C009, command C009 will be executed twice, even if you don't unkey. See command C080 for more information.

'*' up Autopatch

Many people use '*' as their autopatch up code. Since the RLC-5 uses '*' as the default EOF digit, it can not be used as a command name without changing the EOF digit to something else. To avoid this problem, command C082 has been added to let you use the '*' as both the EOF key and the autopatch up code.

How do I change the EOF key?

You can change the EOF key using Command C080. All ports including the serial port default to using '*' as the EOF digit.

How to program your Beeps and Messages

Courtesy Beeps:

The RLC-5 supports separate courtesy beeps on each port. Courtesy beeps on the controller are referred to as "Courtesy Beep Slots". The word slot indicates that any type of beep, CW message, or command can be stored in these slots. In order to make the controller "beep" for a courtesy beep simply program the courtesy beep macro to generate a tone. Multiple beeps are generated by programming the courtesy beep macro to send several tones in sequence. If you want a CW message for your courtesy beep, program the courtesy beep macro to send a CW message. This flexibility allows anything in the controller to be generated when it is time to send a courtesy beep. For more information on courtesy beeps refer to Command C040 and the examples presented in that section.

CW Messages:

The RLC-5 has a single tone generator that can send CW (or other tones) out one or more ports at the same time (it must send the same thing out all of those ports). The CW speed and tone type can be set with commands C031 and C032. Command C030 is used to send CW messages.

Example: I want to send the link on message out ports 1,2,3 then send a message out port 1 with a different CW frequency.

- 1) Audio Routing variable for the macro is C042
- C042* 1 2 3* Routes message to ports 1,2,3
- 2) Command C030 is the CW message send
- C030*20 15 07 15 32 40 24 23* "K F 7 F W ON"
- 3) Command C043 Kills all responses following this command
- C043* Kill responses
- 4) Command C000 connects ports
- C000*1 2* Connect port 1 to port 2
- 5) Command C000 connects ports
- C000*1 3* Connect port 1 to port 3
- 6) Have Macro 170 call Macro 171
- C171* Call a Macro #171
- 7) Command C043 Kills all responses following this command
- C043* Kill responses
- 8) Command C032 sets the CW frequency
- C032*1 1500* Set port 1 CW frequency to 1500 Hz.
- 9) Audio Routing variable for the macro is C042
- C042* 1* Routes message to port 1
- 10) Command C030 is the CW message send
- C030*17 18* "H I"
- 11) Command C043 Kills all responses following this command
- C043* Kill responses
- 12) Command C032 sets the CW frequency
- C032*1 0880* Change back port 1 CW frequency to 880 Hz.

We will use 2 macros for this example, C170 and C171
Command C053 programs the macros

Macro programming keystrokes:

- C053*170 042 123* Command #1
- C053*170 030 20 15 07 15 32 40 24 23* Command #2
- C053*170 043* Command #3
- C053*170 000 12* Command #4
- C053*170 000 13* Command #5
- C053*170 171 Command #6

- C053*171 043* Command #7
- C053*171 032 1 1500* Command #8
- C053*171 042 1* Command #9
- C053*171 030 17 18* Command #10
- C053*171 043* Command #11
- C053*171 032 1 0880* Command #12

Now rename Command C170 to your Link ON command name. Refer to C010.

When the macro C170 is executed you will hear:

- KF7FW ON out Port 1,2,3 then
- HI out Port 1

How to Configure a Port as a Repeater

The RLC-5 controller can support a repeater on either or both ports. This allows for multiple stand alone repeaters operating at the same time, on the same controller. We will describe how to configure and setup a port as a repeater. Simply follow our example to configure other ports as a repeater.

Configure the ports connection: C000 * 1 1*

This command connects port 1 receiver to ports 1 transmitter. When you do this, Port 1's receiver will cause a PTT on Port 1's transmitter.

Configure the port's Hang timer:

- C020*06 200*

This command set the hang timer to 200 * 10mS = 2 seconds

Configure the ports ID'er:

- C085*1 1*

This command enables the ID'er for port 1. The ID timer defaults to 10 minutes.

Programming in your ID:

Macros 151 and 153 are set aside for your initial ID and your rotating ID for port 1. The ID's can be send in CW or with the DVR. Both options will be discussed below:

CW Example: I want both the CW ID's to be "KF7FW/R"

- Macro 151 is assigned as the Initial ID, Macro 153 is assigned as the rotating ID.

- Erase the current contents of both macros: C052*151* and C052*155*

- Macro programming

--- C053*151 030 20 15 07 15 32 36 27* "KF7FW/R"

--- C053*153 030 20 15 07 15 32 36 27* "KF7FW/R"

DVR Example:

- Macro 151 is assigned as the Initial ID, Macro 153 is assigned as the rotating ID.

- First record the DVR messages:

- We will use DVR slots 25 and 26 (each will hold up to a 5 second message).

- C027*25* Erase the old message

- C026*25<unkey> <key and speak your ID message><unkey>. This will record a message in DVR slot 25.

- C025*25<unkey>. This will play DVR slot 25 so you can listen to it. If you want to change it, repeat these three steps using C027, C026 and C025.

Repeat the above steps for DVR slot 26. The commands will be:

- C027*26* Erase old message

- C026*26<unkey> <key and speak your ID message><unkey>. This will record a message in DVR slot 26.

- C025*26<unkey>. This will play DVR slot 26 so you can listen to it.

- Erase the current contents of both ID macros: C052*151* and C052*155*

- Program the ID macros to play the DVR messages:

--- C053*151 025 025*
--- C053*153 025 026*

The message routing is taken care of inside the controller.

Configure the courtesy beep:

The courtesy beep for port 1 is already configured and stored in Macro 155. When you execute C155 or kerchunk the repeater, you will get a "beep" that is generated by this macro. To program your own beeps, refer to the earlier section "Beeps and Messages" or take a look at Command C040.

Configure the time-out timer:

The time-out timer defaults to 3 minutes and is programmable with Command C020. The time-out timer messages are not programmed. If you want the controller to send a message before timing out, program a macro to send the message and use command C057 to executed that macro at the right time.

Now your port is configured as a repeater port.

System Timers

The RLC-5 supports total user programming of all the system timers. This allows the user to define exactly how the RLC-5 works. The system timers are programmed using Command C020 and recalled with Command C021. Refer to Command C021 for timer definitions.

Message Start Delay Timer:

- 00 - Message Start Delay Timer, TX 1
- 01 - Message Start Delay Timer, TX 2
- 02 - Message Start Delay Timer, TX 3

Courtesy Beep Delay Timer:

- 03 - Courtesy Beep Delay Timer, Receiver 1
- 04 - Courtesy Beep Delay Timer, Receiver 2
- 05 - Courtesy Beep Delay Timer, Receiver 3

Transmitter Hang Timer:

- 06 - Hang Timer, Transmitter 1
- 07 - Hang Timer, Transmitter 2
- 08 - Hang Timer, Transmitter 3

DTMF Mute Timer:

- 09 - DTMF Mute Timer, Transmitter 1
- 10 - DTMF Mute Timer, Transmitter 2
- 11 - DTMF Mute Timer, Transmitter 3

I/O Polling Timer:

- 12 - I/O Polling Timer (100) 1 second

Reserved Timers:

13 .. 25 - Reserved for future enhancements

Impolite ID Timer:

- 26 - Impolite ID Timer, Transmitter 1
- 27 - Impolite ID Timer, Transmitter 2

Initial ID Timer:

- 28 - Initial ID Timer, Transmitter 1
- 29 - Initial ID Timer, Transmitter 2

Pending ID Timer:

- 30 - Pending ID Timer, Transmitter 1
- 31 - Pending ID Timer, Transmitter 2

Timeout Timers:

- 32 - Time Out Timer, Receiver 1
- 33 - Time Out Timer, Receiver 2
- 34 - Time Out Timer, Receiver 3

Preaccess Tone Timers:

- 35 - Preaccess Tone Timer, Transmitter 1
- 36 - Preaccess Tone Timer, Transmitter 2
- 37 - Preaccess Tone Timer, Transmitter 3

Preaccess Timers:

- 38 - Preaccess Timer, Port 1
- 39 - Preaccess Timer, Port 2
- 40 - Preaccess Timer, Port 3

User Timers:

- 41 - User Timer 00
- 42 - User Timer 01
- 43 - User Timer 02
- 44 - User Timer 03
- 45 - User Timer 04

The Autopatch

The RLC-5 supports a full/half duplex module that plugs into the 30 pin SIM connector on the controller. Your controller is configured with the autopatch when a FCC Type Registered DAA (Data Access Arrangement) board is connected to the 30 pin socket.

Autopatch Adjustment:

There are 4 audio adjustments for the autopatch port:

Patch Input: This adjusts the volume of the person using the phone as heard over the air.

Patch Output: This adjusts the volume of the person using the autopatch as heard on the phone.

DTMF Level: This adjusts the level of the DTMF used to dial the phone numbers.

Tones: This adjusts the level of the CW heard from the phone.

DTMF Level Adjustment:

The most critical audio adjustment is the DTMF level the phone company sees. This level can range from 100mV up to 1000mV or 1 volt RMS. The procedure for adjusting the DTMF is to generate a DTMF sequence (See Command C033) and measure the voltage. Adjust the DTMF level until it is between the above levels. Usually no adjustment is needed when you receive your controller. If the autopatch dials correctly and consistently, there is no reason to adjust this any more.

Audio Output - Audio to Phone Line Adjustment:

To adjust the audio out of the RLC-5 call a party on the phone and adjust the audio level to a point which is acceptable to the listening party. There is no exact level to set the audio because of the difference in line conditions.

Audio Input - Audio from Phone Line Adjustment:

To adjust the audio into the RLC-5 call a party on the phone and adjust the audio level to a point which is acceptable over the air. There is no exact level to set the audio because of the difference in line conditions.

Audio level changes when the phone is active:

If you use the autopatch in full duplex mode (see C121, default is half duplex), there will be a small increase in the repeater's audio level when the autopatch is active. This increase is caused by the hybrid transformer on the autopatch DAA board. This level "adds" to your repeat level when the autopatch is active. This only occurs when the autopatch is configured as full duplex (A mode when both the Phone and Repeater audio is heard, like a normal phone). When the autopatch is configured as half duplex, the phone audio is muted when the repeater's receiver is active, and unmuted when the repeater's receiver is inactive.

Command Reference Section

This section contains in-depth descriptions of all of the commands in the controller. Most of them are organized by topic, so that related commands are next to each other. The commands you will need to get started are generally located closer to the front of the manual than commands you use less often. To quickly find a particular command, use the table of contents at the beginning of this manual.

Port Configuration

How the Port Connections Work:

The RLC-5 has two radio ports plus an autopatch port (if you have the optional autopatch). Each of the radio ports can be configured to control either a repeater or a link/remote base. In addition, the ports can operate totally independently, one can monitor the other, or they can be completely connected, so that they act together.

To make a port a repeater, you connect its receiver to its transmitter with command C000; for example C000*11* connects port 1's receiver to its transmitter. This means that when the receiver's squelch opens (COR signal goes active), the transmitter will be keyed and will repeat the audio from the receiver.

When two different ports are connected together, port 1 and port 2 for example, when port 1's receiver goes active, port 2's transmitter will key and send its audio, and vice versa.

When one port monitors another port, C001*12* for example, port 1 will transmit the audio received from port 2, but port 2 will not transmit the audio from port 1.

Command C061 provides a quick way to disconnect all ports from a specified port.

Other Port Settings:

Several other variables can be set for each port. For example, you can tell the controller to require just COR or both COR and PL for access with C005. You can control whether received DTMF digits are muted or allowed to be transmitted with C007. Some of these settings apply only to the radio ports; others apply to the autopatch port (port 3) as well.

Command C013 allows you to set the active COR and PL level for each port.

Command Description: C000 ***Connect one Port to another Port***

This command allows you to connect one radio port to another radio port. It is also used to put a port into "repeater mode", by connecting that port to itself. "Connecting a port" means that the audio in and keying source from each port become the audio out and PTT source for the other port. Connecting a port to itself makes the audio that comes in your repeater's receiver go out your repeater's transmitter, making it into a repeater. If you connect two different ports together, they will hear the activity from the other port.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5  Description      *          Command          *          Response      5
K)))))))))3)))))))))3)))))))))M
5  Connect Port    *C000* X Y          *          X 'N' Y      5
94444444444444444444N44444444444444444444444444444444N4444444444444444448

```

Note:

If you want a one-way connection, where port A can monitor port B but port B can not hear port A, use command C001.

Parameters:

- C000 is the default command name
- X is the first port to connect
- Y is the second port to connect

Default:

- All port default as links

Example:

Connect Port 1 to Port 2
 "C000 * 1 2" CW response "1 'N' 2 "

Want Port 1 as a repeater port
 "C000 * 1 1" CW response "1 'N' 1"

Command Description: C001

Monitor one Port from another Port

This command allows you to monitor one radio port from another radio port.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5  Description      *          Command          *          Response      5
K)))))))))3)))))))))3)))))))))3)))))))))3)))))))))M
5  Monitor Port    *C001* X Y          *          X 'M' Y      5
94444444444444444444N44444444444444444444444444444444N44444444444444444448

```

Parameters:

- C001 is the default command name
- X is the doing the monitoring of port Y
- Y is the port being monitored

Default:

- All port default as links

Example:

Monitor Port 2 by Port 1

"C001 * 1 2" CW response "1 'M' 2"

Command Description: C002

Disconnect one Port from another Port

This command allows you to disconnect one radio port from another radio port.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K))))))))))))3))))))))))))))))))))3))))))))))))))))M
5Disconnect Port *C002* X Y * X 'F' Y 5
94444444444444444444N44444444444444444444444444444444N444444444444444444448

```

Parameters:

- C002 is the default command name
- X is the first port to disconnect
- Y is the second port to disconnect

Default:

- All port default as links

Example:

Disconnect Port 1 from Port 4

"C002 * 1 2" CW response "1 'F' 2"

Port 1 is currently a repeater port and you want the port configured as a link port.

"C002 * 1 1" CW response "1 'F' 1"

Command Description: C003,C004

Recall a Port's Connections

This command allows you to find out where Port X's receiver or transmitter is connected.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5  Description      *          Command          *          Response      5
K)))))))))3)))))))))3)))))))))3)))))))))3)))))))))M
5 Interrogate RX   *C003* X          *          X 'C' 1 .. 2   5
K)))))))))3)))))))))3)))))))))3)))))))))3)))))))))M
5 Interrogate TX   *C004* X          *          X 'C' 1 .. 2   5
94444444444444444444N44444444444444444444444444444444N444444444444444444448

```

Parameters:

- C003 is the default command name. This command finds what transmitters receiver 'X' is routed to.

- C004 is the default command name. This command finds what receivers are routed to transmitter 'X'.

Default:

- All port default as links

Example:

Port 1 is connected to port 2
 "C003 * 1" CW response "1 'C' 2"

Ports 1,2 are connected to port 2
 "C004 * 2" CW response "2 'C' 1 2"

Command Description: C005

Set Up a Port's Access Mode

This command allows you to set up a port's access mode.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K)))))))))3)))))))))3)))))))))3)))))))))3)))))))))M
5 Access Mode *C005* X Y * See Below 5
94444444444444444444N44444444444444444444444444444444N444444444444444444448

```

Parameters:

- C005 is the default command name.
- X is the port number (1..2)
- Y is the port's access mode
- 0 ==> No Access
- 1 ==> COR Access
- 2 ==> PL Access
- 3 ==> COR and PL Access
- 4 ==> COR or PL Access

Default:

- All ports default to COR access

CW Response:

- 0 - No
- 1 - C O R
- 2 - P L
- 3 - C A P
- 4 - C O P

Example:

You want to change port 2's mode to CAP (mode 3):

C005 * 2 3 CW Response "2 3"

Command Description: C006

Recall a Port's Access Mode

This command allows you to recall a port's access mode.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5  Description      *          Command          *          Response      5
K)))))))))3)))))))))3)))))))))3)))))))))3)))))))))M
5  Access Mode     *C006* X          *          See Below     5
94444444444444444444N44444444444444444444444444444444N44444444444444444448

```

Parameters:

- C006 is the default command name.
- X is the port's access mode
 - 0 ==> No Access
 - 1 ==> COR Access
 - 2 ==> PL Access
 - 3 ==> COR and PL Access
 - 4 ==> COR or PL Access

Default:

- All ports default to COR access

CW Response:

- 0 - No
- 1 - C O R
- 2 - P L
- 3 - C A P
- 4 - C O P

Command Description: C007, C008

Configure and Check DTMF Mute from a Selected Port

These commands allow you to program and recall whether DTMF mute is turned on or off for a selected port.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K)))))))))3)))))))))3)))))))))3)))))))))3)))))))))M
5 Set Mute *C007* X Y * X N/F 5
K)))))))))3)))))))))3)))))))))3)))))))))3)))))))))M
5 Recall Mute *C008* * All Muted Ports 5
94444444444444444444N44444444444444444444444444444444N44444444444444444448

```

Parameters:

- C007 is the default command name.
- X is the requested port (1..2)
- Y is the Mute Enable/Disable flag
 - 1 ==> Enable DTMF mute on the selected port
 - 0 ==> Disable DTMF mute on the selected port



Default:

- DTMF Mute is Off

DTMF mute recall is provided to allow you to check what ports are Enabled for DTMF muting. If the port number is read back the port is configured for DTMF mute. If the response is "C," no ports have DTMF muting enabled.

Command Description: C009

Recall Entire Controller's Crosspoint

This command allows you check the audio crosspoint conditions on all radio ports on the controller. This command will check the connected conditions and both show the crosspoint map on the RS-232 serial port, and will CW the conditions out the port that DTMF requested the conditions.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5  Description      *          Command          *          Response      5
K)))))))))3)))))))))3)))))))))M
5 Recall XPT      *C009*          *          See Below    5
94444444444444444444N44444444444444444444444444444444N44444444444444444448

```

Parameters:

None

CW Response:

The CW response will only be sent if a receiver is connected on the selected port. If a receiver is connected to a port's transmitter, the controller will send RX "R" connect "C" TX "T" where RX and TX are the port numbers of the receiver and transmitter, respectively. Note that port 3 is the autopatch port.

CW Format:

```

1 'C' <TX1> <TX2> <TX3>
2 'C' <TX1> <TX2> <TX3>
3 'C' <TX1> <TX2> <TX3>

```

Serial Format:

TX	1	2	3
RX	1	.	.
	2	.	.
	3	.	.

Command Names

How Command Names and Command Numbers are Used

The RLC-5 controller has 249 commands. These commands can be executed either by DTMF over the air or RS-232 serial from the serial port. When the commands are executed they do a certain task. When you manipulate commands the controller requests a command number of only 3 digits.

Command C062 can be used to change the beginning of a whole range of command names. This is useful for changing the 'C' at the beginning of the command names to a '#' or some other digit that can be entered from a telephone, for example.

Command Names:

The name that the user has assigned to a command is referred to as the "Command Name" This name can vary in length from 1 to 6 digits. The name can be composed of both DTMF data and ASCII data from the serial port. This flexibility allows the user determine access to commands solely by their command name. If you only want some commands to be executed from the RS-232 serial port, then assign a Command Name that contains ASCII (Keyboard) data. That command can not be executed from the DTMF keypad anymore.

Remember: Command names are the commands the user executes

Command Numbers:

The command number refers to what the RLC-5 internally uses. Whenever the user programs anything in the controller that calls another command name, the command number must be entered. Default command name C000 is internally 000. Command C249 has a number of 249. A quick way of remembering what the command number assigned to a command is to refer to the manual. The command numbers are simply the command without the 'C' attached.

Command Name <--> Command Number

Command Name ---> Command number is accomplished with Command C012

Command Number ---> Command name is accomplished with Command C011

Command Description: C010

Change Command Names

This command allows you to re-name the command names on the controller. The names can be from 1 to 6 digits in length.

```

6444444444444444L4444444444444444444444444444L44444444444444444444444444447
5 Description * Command * Response 5
K)))))))))3)))))))))3)))))))))M
5Re-name Command *C010* XXX YYYYYY * See Below 5
9444444444444444N4444444444444444444444444444N44444444444444444444444444448

```

Parameters:

- C010 is the default command name.
- XXX is the command's number. It is the same as the last three digits of the command name as listed in the manual. Examples: The command number for this command (C010) is 010. For command C123, the command number is 123. The command number is always three digits. Renaming the command does not change the command number - you still use the command number as listed in the manual.
- YYYYYY is the new command name.
 - You only enter as many digits for the command name as the length you want the new name to be. You do not need to enter any leading digits for the command name.

```

XXX Y      - New command name is 1 digit in length
XXX YY     - New command name is 2 digits in length
XXX YYY    - New command name is 3 digits in length
XXX YYYY   - New command name is 4 digits in length
XXX YYYYY  - New command name is 5 digits in length
XXX YYYYYY - New command name is 6 digits in length

```

Default:

- Command names begin with C000 and end with C299

The CW response is XXX **IS** YYYYYY **ED** (Number of Digits of Extra Data)

- Extra data is the amount of additional data needed for that command.
- If the letter 'V' is sent, the next number spoken is the minimum data accepted.
- If the letter 'C' is sent, the command is not found.

Example #1: Want to re-name command C013 to ABCD12

- 1) Command Number is 013
- 2) New command name is ABCD12
- 3) C010 * 013 ABCD12
- 4) CW response: 13 **IS** ABCD12 **ED** 0

Note that the current command name does not matter at all, only the command number (the last three digits of the command name in the manual) and the new name.

Command Description: C011, C012

Recall Information about a Command Name

This command allows you to recall certain attributes of the controller's command names.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5  Description      *          Command          *          Response      5
K)))))))))3)))))))))3)))))))))3)))))))))3)))))))))3)))))))))3)))))))))M
5  Name of Cmd     * C011*XXX          *          See Below      5
K)))))))))3)))))))))3)))))))))3)))))))))3)))))))))3)))))))))3)))))))))M
5  Number of Cmd  * C012*YYYYYY      *          See Below      5
94444444444444444444N44444444444444444444444444444444N444444444444444444448

```

Parameters:

- C011 is the default command name.
- This command recalls the command name of the associated command number
- XXX is the command number ranging from 000-299 command

CW Response:

The CW response is XXX **'IS'** YYYYYYY **'ED'** (Number of Digits of Extra Data)

- Extra data is the amount of additional data needed for that command.
- If the letter 'V' is sent, the next number spoken is the minimum data accepted.
- If the letter 'C' is sent, the command is not found.

Parameters:

- C012 is the default command name.
- This command recalls the command number for the associated command name
- YYYYYYY is the command name with default command name of C000-C999

CW Response:

The CW response is "Command Number (000-299)" **'IS'** YYYYYYY.

Command Description: C013

Set COR and PL Active Levels

This command allows you to select whether the COR and PL inputs are active low or active high. The default is active low; when the controller sees a COR line go to ground, it thinks that the receiver is getting a signal. If you have a radio or PL detector that goes high when active, you can use this command to tell the RLC-5 to consider high to be the active level.

```

64444444444444444444L4444444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K))))))))))))))3))))))))))))))))))))))))))3))))))))))))))))))M
5 Set Active Lvl *C013*P C L * P C L 5
5 Set To Default *C013*P 0 0 * P 0 0 5
94444444444444444444N4444444444444444444444444444444444N444444444444444444448

```

Notes:

- This command does not affect the input circuits at all; it does not disable the built-in pullup resistors on the RLC-5's COR and PL inputs.
- If you are not able to enter commands using DTMF, you may need to temporarily fool the RLC-5 into thinking that your receiver's active level is different than it is. For example, if your receiver outputs an active high COR signal to the RLC-5, the RLC-5 will not accept DTMF commands from that receiver until its COR polarity is changed with this command. You could solve this problem by temporarily disconnecting the COR line from the receiver and manually attaching it to ground. This will cause the RLC-5 to think that the receiver is active (COR line is active low by default). You will have to disconnect that line from ground or press the '*' key to simulate unkeying after entering each command.

Parameters:

- C013 is the default command name.
- P is the port to select the active levels for.
- C is the COR polarity, 0 for active low, 1 for active high.
- L is the PL polarity, 0 for active low, 1 for active high.

Default:

- All COR and PL inputs default to active low.

Example:

Change Port 2's COR input to active high:
 "C013 *210" CW response "2 1 0"

Command Description: C014..C019
Not Currently Used

Timers

How the Timer System Works

The RLC-5 timer system uses two types of timers. Timers for things that usually happen within 10 seconds or so run at a rate of 100 counts per second, or one count every 10 milliseconds. The delay between when you unkey and when a courtesy beep is sent would be an example. Timers that usually run longer than 10 seconds are set in one second increments. Most of the timers are started automatically by the controller and do something automatically when they expire. You can manually start and stop them using commands C022 and C023.

Courtesy Beep Delay Timer:

This timer specifies the minimum time between when a receiver unkeys and when its courtesy beep will be sent out connected repeater ports. The courtesy beep can also be delayed by other tones in the tone queues and the message start delay timer.

- This timer is programmed in 10mS increments from 001-9999
- If a timer value of 000 is entered, the transmitter will hang on the air forever.
- This timer defaults to 100 (1 Sec.)

03 - Courtesy Beep Delay Timer, Receiver 1

04 - Courtesy Beep Delay Timer, Receiver 2

05 - Courtesy Beep Delay Timer, Receiver 3

Transmitter Hang Timer:

This timer holds the transmitter PTT active after the receiver goes inactive.

- This timer is programmed in 10mS increments from 001-9999
- If a timer value of 000 is entered, the transmitter will hang on the air forever.
- This timer defaults to 001 (10 ms = 1/100 Sec.)

06 - Hang Timer, Transmitter 1

07 - Hang Timer, Transmitter 2

08 - Hang Timer, Transmitter 3

DTMF Mute Timer:

This timer controls the amount of time the receiver entering DTMF stays muted. This timer needs to be short so the instances of "Voice Falsing" does not mute the audio too long. Voice falsing is the phenomenon that occurs when your voice sounds like a DTMF digit. If you set this timer too long and the DTMF decoder falses, you will have a long gap in your voice (for the length of this timer). The mute timer begins to run after the release of the DTMF key.

- This timer is programmed in 10mS Increments from 001-999
- If a timer value of 000 is entered, your audio will be muted forever, thus do not enter a value of 000, only 001..9999
- This timer defaults to 100 (1 Sec.)

09 - DTMF Mute Timer, Transmitter 1

10 - DTMF Mute Timer, Transmitter 2

11 - DTMF Mute Timer, Transmitter 3

I/O Polling Timer:

This timer determines how often the controller checks to see if any of the input lines have changed from high to low or low to high or if any analog alarm conditions have changed. If you want quicker response to changes, shorten this timer. If you don't want to hear about changes that happen more often than every minute or so, lengthen it to a minute. The default is one second.

- defaults to (100) 1 second

12 - I/O Polling Timer (100) 1 second

Reserved Timers:

13 .. 25 - Reserved for future enhancements

Impolite ID Timer:

This timer waits until either the timer expires or activity goes away before sending an ID.

- This timer is programmed in 1 Sec increments from 001-9999
- If a timer value of 000 is entered, the controller will not interrupt a conversation to send an ID. Note that in this case, the 10 minute ID requirement could be broken.
- This timer defaults to 020 (20 Sec.)

26 - Impolite ID Timer, Transmitter 1

27 - Impolite ID Timer, Transmitter 2

Initial ID Timer:

This timer times the amount of inactivity before an initial ID is sent.

- This timer is programmed in 1Sec increments from 001-9999
- If a timer value of 000 is entered, the controller will never send an initial ID. Note that in this case, the 10 minute ID requirement could be broken.
- This timer defaults to 600 (10 Minutes)

28 - Initial ID Timer, Transmitter 1

29 - Initial ID Timer, Transmitter 2

Pending ID Timer:

This timer times inner activity ID timer so a proper Pending ID can be send during activity.

- This timer is programmed in 1Sec increments from 001-9999
- If a timer value of 000 is entered, the controller will never send a rotating ID. Note that in this case, the 10 minute ID requirement could be broken.
- If this timer is set to be longer or the same length as the initial id timer, the pending id will never be sent because the initial id takes priority. It should normally be set at least a minute shorter than the initial id to allow the pending id a chance to be sent, or the impolite id if there is activity, before the initial id timer expires.
- This timer defaults to 540 (9 Minutes)

30 - Pending ID Timer, Transmitter 1

31 - Pending ID Timer, Transmitter 2

Timeout Timers:

This timer times the how long each receiver has been active. If the receiver is active longer than the length of this timer, it is disabled until it goes inactive, and its time out event is executed (see command C057, events 39..46). It is reset and the time out clear event is executed when a timed out receiver goes inactive.

- This timer is programmed in 1 second increments from 001-9999
- If a timer value of 000 is entered, the controller will never time-out.
- This timer defaults to 180 (3 Minutes)

32 - Time Out Timer, Receiver 1

33 - Time Out Timer, Receiver 2

34 - Time Out Timer, Receiver 3

Preaccess Tone Timers:

These timers are used to limit how long the preaccess tone will run. The tone can also be stopped by other things, such as a DTMF character being entered on the port the tone is being set out of or the preaccess timer expiring (since indicating that a link has been preaccessed is what dial tone is used for most). If you want to generate tone that can't be stopped by any of these things, use command C040 and generate the tone.

- This timer is programmed in 1Sec increments from 001-9999
- If a timer value of 000 is entered, this timer will never stop the dial tone.
- This timer defaults to 8 seconds

35 - Preaccess Tone Timer, Transmitter 1

36 - Preaccess Tone Timer, Transmitter 2

37 - Preaccess Tone Timer, Transmitter 3

Preaccess Timers:

These timers control how long the "window" of access is between when you enter the preaccess code and when you have to enter a DTMF digit or be locked out. It starts running again as soon as each DTMF digit is released, and will lock you out if it expires. When it expires, it throws away whatever DTMF digits have been entered so far and won't accept any more commands until the controller is accessed again. It also stops the preaccess tone when it expires.

- This timer is programmed in 1Sec increments from 001-9999
- If a timer value of 000 is entered, this timer will never expire.
- This timer defaults to 8 seconds

38 - Preaccess Timer, Port 1

39 - Preaccess Timer, Port 2

40 - Preaccess Timer, Port 3

User Timers:

These timers are not normally used by the controller. They are provided for your use. You can start them running by executing command C022 and stop them with C023 (or they will stop automatically when they expire). Also, when one of these timers expires, the corresponding special macro (see Appendix D) is automatically executed. This allows you to start these timers when certain things in the controller happen, and do something when the timer expires. These timers are programmed in one second increments.

41 - User Timer 00

42 - User Timer 01

43 - User Timer 02

44 - User Timer 03

45 - User Timer 04

Advanced Command Description: C022

Restart a Selected Timer

This command allows you to reset and restart a selected timer back to its original value. The timer will then begin to run again from its original value.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K))))))))))3))))))))))))))))))3))))))))))))))M
5 Restart Timer * C022*XX * See Below 5
94444444444444444444N44444444444444444444444444444444N44444444444444444448

```

Parameters:

- C022 is the default command name.
- XX is the selected timer to be programmed (See Command C020 for Timers)

CW Response:

T - CW character 'T' which is "Beep-Beep"

Advanced Command Description: C023

Reset a Selected Timer

This command allows you to reset and cancel a timers operation. It has not effect if the timer is not currently running.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5  Description      *           Command           *           Response      5
K)))))))))3)))))))))3)))))))))3)))))))))3)))))))))M
5  Reset Timer     * C023*XX           *           See Below     5
94444444444444444444N44444444444444444444444444444444N44444444444444444448

```

Parameters:

- C023 is the default command name.
- XX is the selected timer to be programmed (See Command C020 for Timers)

CW Response:

'I' - CW character 'I' which is "Beep-Beep"

Command Description: C024
Not Currently Used

Messages

How the Message Sending Commands Work:

The RLC-5 can send several different types of "messages," CW, DVR, tones, and DTMF (out the autopatch port only). These messages are usually sent by programming a macro to call one of the message sending commands, but they can be called directly as well. For example, C030*000102* will send "012" in CW. C050*170030000102* will program macro 170 to send the same. Macro 170 can then be executed by entering C170*. A similar process will work for all of the message sending commands.

Command Description: C026 ***Record a DVR Message***

This command allows you to record a DVR message. There are 35 message slots available. You can record a message that fits in one slot, or let a message overlap multiple (consecutive) slots. Slots 00..25 are about one second long. Slots 00..09 are often used to record the digits "zero," "one," etc. Slots 25..29 are often used to record IDs. The other slots are available for you to use in any way you wish.

```

6444444444444444L4444444444444444444444444444L44444444444444444444444444447
5 Description * Command * Response 5
K)))))))))3)))))))))3)))))))))3)))))))))3)))))))))M
5 Record Slot YY * C026* YY * 5
5 Rec YY..ZZ * C026* YY ZZ * 5
9444444444444444N4444444444444444444444444444N44444444444444444444444444448

```

Parameters:

- C026 is the default command name.
- YY is the DVR slot number, two digits per slot.
- ZZ (optional). If ZZ is not included, the DVR will stop recording when slot YY is full. If ZZ is included, the DVR will record from the beginning of slot YY to the end of slot ZZ.

Notes:

- There are two ways to start and stop the recording. It may be helpful to watch the "Record" LED until you get used to it. The easiest way is to enter the command as shown above, unkey, key and speak the message, then unkey. With this method, the DVR starts recording as soon as you key to speak the message and stops when you unkey or when it reaches the end of the slot, whichever comes first. The other method is useful for recording messages while using the reverse autopatch function. To use it, enter the command as shown above, then a '*'. As soon as you release the '*' digit, the DVR will begin recording. It will stop when you press another DTMF digit or when it reaches the end of the slot, whichever comes first. Either way, you must begin recording within several seconds of entering the command or you will have to enter the command again.
- When the DVR stops recording because you unkey or press a DTMF digit, it attempts to back up and erase the squelch tail or DTMF burst so that your message sound clean. When it stops recording because it reaches the end of a slot, it does not back up to avoid wasting record time.

Command Description: C027

Erase DVR Message(s)

This command allows you to delete one or a range of DVR messages. If an erased message is later played, it will sound like a short pause. There is no way to "un-erase" a message once it is erased.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5  Description      *           Command           *           Response      5
K)))))))))3)))))))))3)))))))))3)))))))))3)))))))))M
5 Del 00..34       * C027* YY           *           See Below      5
5 Del Multiple    * C027* YY ZZ       *           See Below      5
94444444444444444444N44444444444444444444444444444444N444444444444444444448

```

Parameters:

- C027 is the default command name.
- YY is the DVR slot number to erase, two digits per slot
- ZZ (optional). If ZZ is not included, only one slot will be erased. If ZZ is included, the DVR will delete slots YY through ZZ.

***Command Description: C028-C029
Not Currently Used***

Advanced Command Description: C031

Set CW Speed for a Selected Port

This command allows you to set up the CW systems speed in words per minute. The maximum CW speed the FCC allows is 20 WPM, but the controller will handle 05..50 words per minute.

```

64444444444444444444L4444444444444444444444444444444444L44444444444444444444444444444444447
5  Description      *          Command          *          Response      5
K)))))))))3)))))))))3)))))))))3)))))))))3)))))))))3)))))))))3)))))))))3)))))))))3)))))))))M
5  CW Speed        *  C031*YY          *          None          5
94444444444444444444N4444444444444444444444444444444444N44444444444444444444444444444444448

```

Parameters:

- C031 is the default command name.
- YY is the desired speed in words per minute (5..50). It will be the same for all ports.

Default:

20 words per minute

Note:

There is no CW response to this command to make it easier to change the CW speed in the middle of a CW message. For example, you can write a macro that sends a few CW characters, changes the CW speed, then sends a few more characters, then changes the CW speed back. When the macro is executed, the CW speed changes will occur at the proper places in the message.

Advanced Command Description: C032

Set CW Tone Type

This command allows you to set up the CW tone frequency used by the CW system.

```

64444444444444444444L44444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K)))))))))3)))))))))3)))))))))M
5 CW Frequencies * C032*X * None 5
94444444444444444444N44444444444444444444444444N444444444444444444448

```

Parameters:

- C032 is the default command name.
- X is the tone type chosen from the table below. It is the same for all radio ports.

<u>X</u>	<u>Frequencies</u>	<u>Description</u>
0	350, 440	Dial Tone
1	400	Special #1
2	440	Alert Tone
3	440, 480	Audible Ring
4	440, 620	Pre-empt
5	480	Bell High Tone
6	480, 620	Reorder (Bell Low)
7	350	Special #2
8	620	Special #3
9	941, 1209	DTMF *

Default:

Special #3: X=8

Note:

There is no CW response to this command to make it easier to change the CW tone type in the middle of a CW message. For example, you can write a macro that sends a few CW characters, changes the CW tone type, then sends a few more characters, then changes the CW tone type back. When the macro is executed, the CW tone type changes will occur at the proper places in the message.

Advanced Command Description: C035

Send a Serial Message out the RLC-5 Port

This command allows you to send a custom message out the controller's serial port. If the message is entered with DTMF, the serial message will only contain DTMF digits. If the message is entered using the RS-232 port, then the message will contain whatever characters you enter. This command can be used to output logging information, to make a modem dial a phone number, to output error messages, etc.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K))))))))))3))))))))))3))))))))))3))))))))))M
5 Sends Message * C035* Y .. Y * None 5
94444444444444444444N44444444444444444444444444444444N44444444444444444448

```

Parameters:

- C035 is the default command name.
- Y is the data to be sent over the RS-232 port
- The message length is limited to the maximum command length (about 50 characters) or if used in a macro, by the space left in a macro. If you need a longer message, split it up between several macros and use one macro to call the next macro in the sequence.

Notes:

- To change the baud rate, see command C036.
- Serial generated by this command is sent regardless of what caused this command to execute. Some other serial messages in the controller are only sent if you are executing commands from the serial port.
- You should not make the controller send a lot of serial really often (more than one message every couple of seconds or so), because it can cause the CW to sound uneven.

Advanced Command Description: C036

Set Up RS-232 Serial Baud Rate

This command allows you to set up the baud rate for the RLC-5's main serial port that is typically connected to a serial terminal or computer. See commands C035 for more information about sending serial messages.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K))))))))))))))3))))))))))))))))))))))))))3))))))))))))))))))M
5 Baud Rate * C036* XXXX * See Below 5
94444444444444444444N44444444444444444444444444444444N44444444444444444448

```

Parameters:

- C036 is the default command name.
- XXXX is the actual baud rate (leading 0s are optional)
You can enter any standard baud rate from 300-9600

Default:

9600 Baud rate selected

CW Response:

There is no response for this command

Command Description: C037

Remotely Reset the Controller

This command allows you to remotely reset the RLC-5 controller. This does exactly the same thing as turning the power off and back on or pressing the reset switch on the board. It will not cause you to lose any of your programming - that is only possible by being at the site of the controller and following one of the initialization procedures described in Appendix E.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K))))))))))3))))))))))3))))))))))3))))))))))3))))))))))M
5 Remote Reset * C037* * None 5
94444444444444444444N44444444444444444444444444444444N444444444444444444448

```

Parameters:

- C037 is the default command name.

CW Response:

The user will hear the contents of the reset macro sent. This message defaults to "RESET?". To delete this message, disable the reset macro. See Command C057, C058, C059 for macro definitions.

Command Description: C038-C039
Not Currently Used

Command Description: C040

Send a Tone

This command causes a tone to be sent out the ports specified by the routing variable (see Appendix A for information about the routing variable). Most courtesy beeps use one tone at a time, although many have several tones in sequence. This type of courtesy beep would be generated by calling this command several times from a macro, sending a different tone type each time (see examples on the following pages).

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K)))))))))3)))))))))3)))))))))3)))))))))M
5 Tone Generate * C040*LLL DDD T * No Response 5
94444444444444444444N44444444444444444444444444444444N44444444444444444448

```

Parameters:

- C040 is the default command name.
- LLL is a 3 digit number representing the length of the tone in 10mS increments
- DDD is a 3 digit number representing the delay after this tone before the next one in 10mS increments
- T is the tone type from the below table.

<u>T</u>	<u>Frequencies</u>	<u>Description</u>
0	350, 440	Dial Tone
1	400	Special #1
2	440	Alert Tone
3	440, 480	Audible Ring
4	440, 620	Pre-empt
5	480	Bell High Tone
6	480, 620	Reorder (Bell Low)
7	350	Special #2
8	620	Special #3
9	941, 1209	DTMF *

CW Response:

There is no response for this command

Note about Courtesy Beeps

The RLC-5 courtesy beeps are not simply a programmable beep. When it is time to send a courtesy beep, the RLC-5 decides which ports should receive the courtesy beep, sets the audio routing variable to those ports (see Appendix A), and calls that port's courtesy beep automatic macro (see C057). This makes it possible for you to make your courtesy beep do a lot more than just beep. If you call command C040 (send One Tone Chord), it will beep. If you call C040 more than once in the courtesy beep macro, it will beep more than once (see examples below). If you call C030, it will send CW. If you really want to, you could do several of the above.

Since most people want a sequence of beeps for their courtesy beep, we will provide some examples. Note that to get a single-beep courtesy beep, you just call C040 once from the courtesy beep macro. To get a three tone sequence, you call C040 three times within that macro.

Example: I want port 1's courtesy beep to be a 1/2 second burst of dial tone (tone type 0):

1) Locate the courtesy beep macro for port 1 in the discription for C150..C249.

- Macro 155 is Port 1's courtesy beep macro

2) C052 deletes the old contents of a macro

C052*155*

3) C053 appends a command onto the end of a macro

C053*155 040 050 001 0*

050 is the duration of the beep in 10 millisecond increments

001 is the delay between beeps in 10 millisecond increments

0 is the tone type for dial tone

Example: We want to send a half second of the DTMF '*' tone after the dial tone programmed above.

1) C053 appends a command onto the end of a macro

C053*155 040 050 001 9*

Now macro 155 has two commands in it, the first to send dial tone and the second to send DTMF '*'. They will both happen in sequence when a courtesy beep needs to be sent.

Example: Want to send out a CW message 'EP' to indicate emergency power out port 2's repeater port.

1) Locate the courtesy beep macro for port 1 in Appendix D.

- Macro 156 is Port 2's courtesy beep macro

2) C052 deletes the old contents of a macro

C052*156*

3) C053 appends a command onto the end of a macro, C030 sends a CW message

C053*156 030 14 25 *

14 is the CW character 'E'

25 is the CW character 'P'

Advanced Command Description: C044

Recall the Ports in the Current Audio Routing Variable

This command allows you to determine what ports audio is being sent out of without having a radio tuned to each of the transmitters. It sends a list of numbers which represent the ports that are included in the audio routing variable at the time it is executed (see Appendix A for more information about audio routing variables). If it is executed directly, it will tell you what port you are executing commands from.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K))))))))))3))))))))))3))))))))))M
5 Recall ARV * C044* * See Below 5
94444444444444444444N44444444444444444444444444444444N44444444444444444448

```

Example:

You want to know what transmitters are hearing the courtesy beep that is generated when port 3's receiver unkeys. Solution: append this command to the end of the courtesy beep macro (159) for port three so it will send the number of the ports that just heard the courtesy beep:

```
C053*159 044
```

To delete command C044 from the courtesy beep macro when you are tired of hearing it, use command C055 and you will not have to delete the whole macro and program it again.

CW Response:

The response for this command will list all the ports in the routing variable.

Advanced Command Description: C045 Set Up Default Audio Routing Variables

This command allows you to configure where the CW is routed during serial programming, scheduler events, etc. By using this command, you can specify which of the 4 radio ports tone responses will be routed to when commands are executed by one of the several sources listed. See Appendix A for more information about audio routing variables. Command C046 allows you to recall these settings.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K))))))))))))))3))))))))))))))))))))))))3))))))))))))))))))M
5 Audio Route * C045*X Y..Y * See Below 5
94444444444444444444N44444444444444444444444444444444N44444444444444444448

```

Parameters:

- C045 is the default command name.
- X is the default audio routing variable to change
 - 0 - commands entered from the serial port
 - 1 - commands executed by the auto execution macros
- Y is a list of the ports that the audio will be sent out of
 - If no digits are entered for Y, the audio will not be sent anywhere

CW Response:

'X' 'IS' 'Y..Y' where 'Y' are the ports programmed to respond in CW to events.

Advanced Command Description: C046

Recall the Audio Routing Variable Defaults

This command allows you to determine what the audio routing variable will default to when commands are executed from the serial port, scheduler, etc. It is the companion command to C045.

```

64444444444444444444L4444444444444444444444444444444444444L4444444444444444444444444444444444444447
5 Description * Command * Response 5
K))))))))))))))3))))))))))))))))))))))))))3))))))))))))))))))))M
5 Recall ARV * C046*X * See Below 5
94444444444444444444N4444444444444444444444444444444444444N4444444444444444444444444444444444444448

```

Parameters:

- X is the default audio routing variable to recall
- 0 - commands entered from the serial port
- 1 - commands executed by the scheduler
- 2 - commands executed by the reset macro (Event table #00 See C057)

CW Response:

'X' 'IS' 'Y..Y' where 'Y' are the ports programmed to respond in CW to events.

Command Description: C047

Start Tone Generator

This command allows you to generate a tone down for a given time down the port that requested this command. This command is used to give you an indication that access to the controller has been accomplished. This is not pre-access, simply a tone generation. The tone is routed to the port that DTMF requested the command. This command is used in conjunction with the pre-access macros.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K))))))))))3))))))))))3))))))))))3))))))))))M
5Start Tone Gen. * C047* * See Below 5
94444444444444444444N44444444444444444444444444444444N444444444444444444448

```

Parameters:

- C047 is the default command name.

Killing the tone once it is running:

- 1) You can kill the tone with a DTMF digit on the port dial tone is present.
- 2) When the tone timer expires (See Command C020)

CW response:

There is no response for this command

Command Description: C049
Not Currently Used

Macro Commands

What a macro is:

There are at least two common understandings of what a macro is. The RLC-5 currently supports the more flexible of the two types; eventually it may support both. The kind the RLC-5 supports could be called a "multiple command macro" because it provides a way to execute a sequence of internal commands in response to one command from the user. In other words, this kind of macro contains a list of commands that are executed in order when the macro is executed. If you commonly want to connect your repeater port to a couple of link ports and turn DTMF muting on and change your courtesy beep, you could program a macro to execute the appropriate commands. This type of macro is very similar to the macros that many word processors and other computer programs allow you to make to automate things that you do often.

The other commonly used kind of macro (that the RLC-5 does not currently support) could be called a "snapshot macro". It allows you to set up the controller the way you like it, take a snapshot of it, and restore the controller to that configuration at any time by recalling the snapshot. While this may be convenient, it is also limiting. Consider an example: you and a buddy have two standalone repeaters running off of one RLC-5 controller. You are setting up one repeater and he is setting up the other. There are also two links running on the controller; we will call them Link A and Link B. You set up your repeater to be connected to Link A and take a snapshot. You then disconnect your repeater from Link A and connect it to Link B and take another snapshot. Now you can easily switch back and forth between the two configurations just by recalling the appropriate snapshot. The next day your buddy sets up his repeater port in a similar way. Now we start having problems. You want your repeater port to be connected to Link A, so you recall your snapshot. He wants to connect his repeater port to Link B so he recalls his snapshot. When he recalls his snapshot, it messes up your repeater port, changing it to whatever configuration it was in when he saved his snapshot. Neither of you can control your repeater ports independently of the other because the snapshots you saved don't just save the way one or two ports are set up, they save the way the whole controller is set up. This isn't a big problem with a simple controller with only one repeater port, but it gets very complicated when you start dealing with multiple repeaters and links.

The solution to the dilemma illustrated above is to use multiple command macros that do exactly what you want them to and nothing else. If you want a macro to connect you to Link A and not to Link B, make a multiple command macro to disconnect your repeater from Link B and connect it to Link A. Executing this macro will not interfere with anything else that is going on in the controller like a snapshot would.

Command Description: C050

Program a Single Command Macro Sequence

This command allows you to program a macro to contain one command. It does exactly the same thing as deleting the macro with command C052, then appending it with C053. If you want a macro to contain more than one command, you can program the first command in the macro with this command, but you will have to use another command like C053 to append the rest of the commands in the macro onto the end.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K))))))))))))))3))))))))))))))))))))))3))))))))))))))))))M
5 Macro PGM * C050* WWW XXX Z..Z* * OK 5
94444444444444444444N44444444444444444444444444444444N444444444444444444448

```

Parameters:

- C050 is the default command name.
- WWW is the macro number for this sequence to be stored in
- XXX is the command number to be executed by the macro
- Z..Z is the additional data associated with command XXX

Example:

- Want to execute command C031 using macro 180
- C030 with 20 additional digits (01,02,03,04,05,06,07,08,09,00)

```
C050 * 180 030 01020304050607080900 *
```

Notes:

- If you get error 10 when you execute this command, you are probably trying to put more in a macro than it has room to hold. Macros 150..199 are about 50 characters long; 200..249 are about 20 characters long.

CW Response:

'T' - CW character 'T' which is "Beep-Beep"

Command Description: C052

Delete Macro

This command deletes a macro. If it is executed after it has been deleted, nothing will happen. There is no way to "undelete" a macro that has been deleted.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K))))))))))3))))))))))))))))))3))))))))))))))M
5 Delete Macro * C052*XXX * See Below 5
94444444444444444444N44444444444444444444444444444444N444444444444444444448

```

Parameters:

- C052 is the default command name.

Format:

C052 * XXX

- XXX is the command number of the macro to delete.

CW Response:

'I' - CW character 'I' which is "Beep-Beep"

Command Description: C053

Append a Command to a Macro

This command allows you to add a command to a macro. If the macro was empty (contained no commands), it becomes the first command in the macro.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K))))))))))3))))))))))))))))))3))))))))))))))))M
5 Macro Append * C053* (See Below) * OK 5
9444444444444444N44444444444444444444444444444444N4444444444444444448

```

Parameters:

- C053 is the default command name.

Format:

C053 * WWW XXX Z..Z ...

- WWW is the macro number for this sequence to be stored in
- XXX is the command number within a macro
- Z..Z is the additional data associated with command XXX

Example:

Want to execute command C031 using macro 223

- Delete the old contents of macro 223

```
-- C052*223
```

- C030 with 20 additional digits (01,02,03,04,05,06,07,08,09,00)

```
-- C053 * 223 030 01020304050607080900 *
```

Notes:

- If you get error 10 when you execute this command, you are probably trying to put more in a macro than it has room to hold. Macros 150..199 are about 50 characters long; 200..249 are about 20 characters long.

CW Response:

T - CW character 'T' which is "Beep-Beep"

Command Description: C054

Copy a Macro

This command allows you to copy a macro. It deletes whatever used to be in the destination macro and replaces it with a copy of whatever is in the source macro.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K))))))))))3))))))))))3))))))))))M
5 Macro Copy * C054*XXX YYY * See Below 5
94444444444444444444N44444444444444444444444444444444N444444444444444448

```

Parameters:

- C054 is the default command name.
- XXX is the number of the source macro
- YYY is the number of the destination macro

Notes:

- You can use this command to copy between macros of different lengths, provided that there is room for the contents of the source macro in the destination macro. If there is not room, you will get an error 11. Macros 150..199 are about 50 characters long; 200..249 are about 20 characters long.

CW Response:

'XXX' 'C' 'YYY' : 'C'opy

Advanced Command Description: C056

Insert a Command in a Macro

This command allows you to insert a command in a macro without deleting the following commands. This is useful for adding a command to the beginning or middle of a macro. The commands inside of the macro are numbered 00, 01, 02... so the first command is numbered 00. It may be helpful to execute command C051 to recall the contents of the macro so that you know where you want to insert the new command.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K))))))))))3))))))))))3))))))))))3))))))))))M
5 Insert CMD * C056*XXX YY ZZZ DDD... * OK 5
94444444444444444444N44444444444444444444444444444444N4444444444444444448

```

Parameters:

- C056 is the default command name.
- XXX is the number of the macro
- YY is the where inside of the macro to insert the new command (00, 01, 02...)
 - If YY is larger than the number of commands in the macro, the new command will be appended to the macro.
- ZZZ is the command number of the command to insert
- DDD is the data for the above command

Notes:

- If you get error 10 when you execute this command, you are probably trying to put more in a macro than it has room to hold. Macros 150..199 are about 50 characters long; 200..249 are about 20 characters long.

CW Response:

'T' - CW character 'T' which is "Beep-Beep"

Command Description: C057

Set Event Triggered Command

This command allows the user to assign a macro or command call when an event occurs in order to get response or action to occur. These are useful for alarming, and interrogating events that occur.

```

64444444444444444444L4444444444444444444444444444444444L44444444444444444444447
5 Description * Command * Response 5
K)))))))))3)))))))))3)))))))))3)))))))))3)))))))))M
5 Event Table *C057*YY ZZZ * See Below 5
94444444444444444444N4444444444444444444444444444444444N444444444444444444448

```

Parameters:

- C057 is the default command name
- YY is the Event Number
- ZZZ is the command number to call when an event occurs

Default:

- All events are disabled
- When an event is programmed, the event is enabled


CW Response:

"XX 'N/F' ###"

- XX is the event number
- N indicates the event is enabled, F indicates the event is disabled
- ### is the command number the event calls

Note: the events available for use are listed on the next page.

Event Table:

00 - Reset Macro	44 - Error Code 10
01 - Port 1 Initial ID (Macro 151)	45 - Error Code 11
02 - Port 2 Initial ID (Macro 152)	46 - Error Code 12
03 - Port 1 Pending ID (Macro 153)	47 - Error Code 13 (Bad Autopatch #)
04 - Port 2 Pending ID (Macro 154)	48 - Any RX Connected to Port 1 Active
05 - Port 1 Courtesy Beep (Macro 155)	49 - Any RX Connected to Port 2 Active
06 - Port 2 Courtesy Beep (Macro 156)	50 - Any RX Connected to Autopatch
07 - Port 1 Timed Out	51 - All RX Connected to Port 1 Inactive
08 - Port 2 Timed Out	52 - All RX Connected to Port 2 Inactive
09 - Autopatch Timed Out	53 - All RX Connected to Autopatch
10 - Port 1 Time Out Clear	54 - Before Autopatch Off Hook
11 - Port 2 Time Out Clear	55 - After Autopatch On Hook
12 - Autopatch Time Out Clear	56 - Reverse Autopatch Answer
13 - User Timer #1	57 - Hang-up message
14 - User Timer #2	
15 - User Timer #3	
16 - User Timer #4	
17 - User Timer #5	
18 - Port 1 COR just went active	
19 - Port 2 COR just went active	
20 - Autopatch COR just went active	
21 - Port 1 COR just went inactive	
22 - Port 2 COR just went inactive	
23 - Autopatch COR just went inactive	
24 - Port 1 PL just went active	
25 - Port 2 PL just went active	
26 - Port 1 PL just went inactive	
27 - Port 2 PL just went inactive	
28 - Port 1 Port just went active	
29 - Port 2 Port just went active	
30 - Autopatch just went active	
31 - Port 1 Port just went inactive	
32 - Port 2 Port just went inactive	
33 - Autopatch Port just went inactive	
34 - Error Code 00	
35 - Error Code 01	
36 - Error Code 02	
37 - Error Code 03	
38 - Error Code 04	
39 - Error Code 05	
40 - Error Code 06	
41 - Error Code 07	
42 - Error Code 08	
43 - Error Code 09	

Command Description: C058

Recall Event Triggered Command

This command allows the recall of what macro or command an event will jump to when a change occurs.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K)))))))))3)))))))))3)))))))))M
5 Event Table *C058*XX * See Below 5
94444444444444444444N44444444444444444444444444444444N444444444444444444448

```

Parameters:

- C058 is the default command name
- XX is the Event Number

Default:

All events are disabled

CW Response:

"XX 'N/F' ###"

- XX is the event number
- **N** indicates the event is enabled, **F** indicates the event is disabled
- ### is the command number the event calls

Command Description: C059 ***Enable/Disable Event Triggered Command***

This command allows the enable/disable control of the automatic event calling.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K)))))))))3)))))))))3)))))))))M
5 Event Control *C059*XX 1 (Enable) * See Below 5
5 Event Control *C059*XX 0 (Disable) * See Below 5
94444444444444444444N44444444444444444444444444444444N444444444444444444448

```

Parameters:

- C059 is the default command name
- XX is the Event Number

Default:

- ```
"XX 'N/F' ###"
```
- XX is the event number
  - **N** indicates the event is enabled, **F** indicates the event is disabled
  - ### is the command number the event calls

All events are disabled

### CW Response:

- ```
"XX 'N/F' ###"
```
- XX is the event number
 - **N** indicates the event is enabled, **F** indicates the event is disabled
 - ### is the command number the event calls

Advanced Command Description: C060

Set Serial Port's Case Sensitivity

This command allows you to select whether or not the serial port converts all characters that you type to upper case or not. The default is to convert them, because all of the default command names are in upper case (they must be to be executed by DTMF). Converting all of the characters makes it impossible to do a few things, however, such as programming serial messages that contain lower case letters.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K))))))))))))3))))))))))))))))))))3))))))))))))))))M
5 Case Sensit. * C060*X Y * See Below 5
94444444444444444444N44444444444444444444444444444444N44444444444444444448

```

Parameters:

- C060 is the default command name.
- X is 1 to make the serial port case sensitive (no automatic conversion to upper case)
0 to make the serial port convert all characters entered to upper case
- Y is 1 to send line feeds (the default), 0 not to send them. Sometimes not sending line feeds avoids problems with modems. They can be added back in when carriage returns are received by most communications programs.

CW Response:

There is no response for this command

Command Description: C061

Disconnect all Ports from a Radio Port

This command allows you to disconnect all of the other radio ports from one radio port with one command. Please note that if you execute this command for a repeater port, it will disconnect it from itself, breaking it out of repeater mode. To make it a repeater again, you will have to use command C000. If you only want to break some of the connections to a port, see commands C001 and C002.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K))))))))))3))))))))))3))))))))))3))))))))))M
5Disconnect Port *C061*X..X * See Below 5
94444444444444444444N44444444444444444444444444444444N444444444444444444448

```

Shortcut:

If you want to break all of the connections to several ports, list all of them. For example: C061 *12345678* breaks every connection in the whole crosspoint.

Parameters:

- C061 is the default command name
- X is the port to disconnect all other ports from

Example:

Disconnect all other ports from Port 4
 "C061 * 4"

CW Response:

'X' 'C': Where 'C' indicates Clear

***Advanced Command Description: C063..C069
Not Currently Used***

Preaccess Commands

What preaccess is:

Preaccess is a method of specifying which controller you are trying to DTMF command that is used by several linking systems. A common configuration would be to enter the "*" key before commanding the local repeater, "#99" before commanding a distant controller via a link, and "#98" before commanding a different controller on the linking system. The advantage of requiring the user to "preaccess" a controller before commanding it is that you can use the same command names on each controller without confusion as to which one you are talking to. This was a very simplified description, but it should give you the idea.

What you need to know:

Because the preaccess system works quite differently from the way the RLC-5 normally works, there is a lot involved with changing back and forth. Commands C070 and C071 have been provided to make the conversion to preaccess easy and painless. You can convert a port back to non-preaccess mode with C072. The rest of the commands in this section are used to make preaccess work, but you do not need to access them directly, so just ignore them if you want to.

You always configure one port at a time for preaccess, so you can set up one port for preaccess and leave another port alone. This allows you to have a mixed system. This might be useful if you want to try out preaccess on one port without forcing all of the users of a repeater on a different port to change the way they do things. It also allows you to use the RLC-5 to interface between linking systems that do things differently.

Command Description: C070

Configure a Repeater for Preaccess

This command sets up a port as a repeater on a preaccess style system. It does not do anything that you can not do with other commands, it just does a lot of things in one step to make things easier for you. After executing this command for a port, that port will still be connected to other ports according to the crosspoint settings (see commands C000, C001 and C002). It will mute all touch tones from its own receiver and all connected receivers. Touch tones entered from that port will go out all connected transmitters that do not have DTMF muting turned on, as normal. The force-execution (EOF) digit will be "D" instead of the default "*". The "*" key will cause the preaccess command to be executed which will isolate this port from all connected ports and allow local control commands (commands intended to be executed on this controller) to be entered. This "local control mode" will end when the preaccess timer (see command C020 for more info) expires. This timer is reset when DTMF tones are entered.

```

6444444444444444L4444444444444444444444444444L44444444444444444444444444447
5  Description      *           Command           *           Response      5
K)))))))))3)))))))))3)))))))))3)))))))))3)))))))))3)))))))))M
5  Rep Preaccess * C070*X YYY           *           See Below      5
9444444444444444N4444444444444444444444444444N44444444444444444444444444448

```

Format:

- C070 is the default command name.
- X is the port to make a preaccess repeater (1..4)
- YYY is the macro assigned to preaccess (162.199). You can choose any unused macro in this range. The controller will automatically program it and change its name. You can check to make sure that a macro is empty with C151.

Notes:

It is possible to do exactly what this command does by entering a list of other commands. That list and another list describing how to reverse the effects of this command without using C172 are on the next page.

CW Response:

'X' **IS RPT** 'YYY' Where 'X' is the Port # and 'YYY' is the preaccess macro.

Setting up Repeater Preaccess Manually:

You could do exactly what command C070 does by executing the following list of commands from port X. It is included for your information, not because we recommend doing it this way. If it already works the way you want it to, there is no reason to read this section. Note: X is the port number to change to a preaccess repeater and YYY is the preaccess macro number as listed below):

if X = 1, and YYY = 170 (Macro 170 used for this example)

if X = 2, and YYY = 171 (Macro 171 used for this example)

if X = 3, and YYY = 172 (Macro 172 used for this example)

if X = 4, and YYY = 173 (Macro 173 used for this example)

C000*XX*	make port X into a repeater
C052*YYY*	delete the old contents of the preaccess macro
C053*YYY077X*	append to preaccess macro the command to isolate the port when preaccessed
C053*YYY074*	append to preaccess macro the command to preaccess the port so you can execute all of the commands
C072*X1*	require preaccess on that port
C080*X1*	turn on autoexecution
C078D*	change force-execution key from '*' to 'D'
C010YYY*D	change name of preaccess macro to '*'

Turning Off Preaccess for a Port:

C072 is the easy way to turn off preaccess for a port. This explanation is included only for your information. There is no reason you need to read this, unless you want to understand how the controller does preaccess. Here is a list of commands to change the things that C070 does back to factory defaults. You can modify them to change things to what you like. Note that X and YYY are the port and macro numbers as defined above.

C078*D	change the force-execution key from 'D' to '*'
C080X0*	turn autoexecution off
C072*X0*	turn off the preaccess requirement for port X
C002*11*	turn the port into a link
C052*YYY*	delete the old contents of the preaccess macro
C010*YYCYYY	name the command back to CYYY

Command Description: C071

Configure a Link for Preaccess

This command sets up a port as a link on a preaccess style system. It does not do anything that you can not do with other commands, it just does a lot of things in one step to make things easier for you. After executing this command for a port, that port will still be linked to all connected ports (see commands C000, C001 and C002). The difference is that all commands entered from that port will be ignored except for the preaccess macro. This allows DTMF tones to be passed through the link without it trying to execute them and sending out a lot of error messages. To make the controller accept commands entered from that link port, you must execute the preaccess macro by entering #99 (or whatever your site access code is - you set it with this command). The preaccess macro will execute several commands including C074 which allows you to enter other commands until the preaccess timer (see C020) expires. This is useful for linking systems because all of the controllers on the system can use the same command names, and you can select which controller you want to execute your commands by entering that site's preaccess code (like #99) then the commands you want it to execute. If you desire (and specify it with this command), the preaccess macro will also start dial tone to signal that the site has been accessed.

```

6444444444444444L4444444444444444444444444444L4444444444444444447
5 Description * Command * Response 5
K)))))))))3)))))))))3)))))))))3)))))))))3)))))))))M
5 Link Preaccess * C071*X Y ZZ MMM * See Below 5
9444444444444444N4444444444444444444444444444N4444444444444444448

```

Format:

- C071 is the default command name.
- X is the port to set up as a preaccess link
- Y is 0 for no preaccess tone when accessed, 1 for preaccess tone
- ZZ is the last two digits of the site access code
 - For example if ZZ is 99, the site access code will be #99.
 - The site access code can be changed to anything up to six digits long by renaming the preaccess macro to that access code.
- MMM is the macro assigned for your preaccess data (150..199)

Notes:

To do what this command does manually, you could execute the list of commands on the following page. To reverse the effects of this command, use C072.

Notes on MMM:

You must assign a macro that contains the preaccess information. The macro number must be between 150..199 in order to be large enough for all the needed commands. It is important to keep in mind where your ID and Courtesy beep slots are located (Default slots 150..162).

CW Response: 'X' **IS LNK** 'MMM' N/F ## where 'X' is the Port # and 'MMM' is the preaccess macro, 'N/F' is the tone indication, and ## is the 2 digit site code.

Setting up Link Preaccess Manually:

You could do exactly what command C071 does by executing the following list of commands from port X. It is included for your information, not because we recommend doing it this way. If it already works the way you want it to, there is no reason to read this section. Note: X is the port number to change to a preaccess link and YYY is the preaccess macro number as listed below):

if X = 1, and YYY = 170 (Macro 170 used for this example)

if X = 2, and YYY = 171 (Macro 171 used for this example)

if X = 3, and YYY = 172 (Macro 172 used for this example)

if X = 4, and YYY = 173 (Macro 173 used for this example)

C002*XX*	make port X into a link
C052*YYY*	delete the old contents of the preaccess macro
C053*YYY047*	append to preaccess macro the command to preaccess tone (if desired)
C053*YYY074*	append to preaccess macro the command to preaccess the port so you can execute all of the commands
C010*YYY#99*	change name of preaccess macro to '#99'
C072*X1*	require preaccess on that port
C080*X1*	turn on autoexecution
C078D*	change force-execution key from '*' to 'D'

Advanced Command Description: C072

Turn Off Preaccess for a Port

This command allows undoes what C070 and C071 do. It changes a repeater or link port that is set up for preaccess back to a non-preaccess link port, the way it comes from the factory or is after re-initializing.

```

64444444444444444444L4444444444444444444444444444444444L4444444444444444444447
5 Description * Command * Response 5
K)))))))))3)))))))))3)))))))))M
5 Preaccess Off * C072*X * See Below 5
94444444444444444444N4444444444444444444444444444444444N44444444444444444448

```

Format:

- C072 is the default command name.
- X is the port for which to turn preaccess off (1..4)

CW Response:

'X' 'IS' 'N/F'

Advanced Command Description: C073 Recall Ports with Preaccess Requirement

This command allows you to determine which ports require preaccess.

```

64444444444444444444L4444444444444444444444444444L444444444444444444447
5  Description      *          Command          *          Response      5
K)))))))))3)))))))))3)))))))))M
5  Preaccess        * C073*          *          See Below    5
94444444444444444444N4444444444444444444444444444N444444444444444444448

```

Format:

- C073 is the default command name.

CW Response:

- The response will correspond with the ports requiring preaccess
- 'C' indicates no ports are preaccessed

Advanced Command Description: C074

Allow Access To a Port that Requires Preaccess

This command allows commands to be executed on the port the command is executed from until the preaccess timer which it starts (see command C020 for more info on timers) runs out. It is usually called from the preaccess macro (see Appendix D) for that port, so that when that preaccess macro is executed, it temporarily allows access to the rest of the commands in the controller.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K))))))))))3))))))))))3))))))))))3))))))))))M
5 Allow Access * C074* * See Below 5
94444444444444444444N44444444444444444444444444444444N44444444444444444448

```

Format:

- C074 is the default command name.

CW Response:

There is no response for this command

Advanced Command Description: C076

Recall Stop Access Conditions

This command allows you to recall the conditions that will stop access on a port. See Command C075 for descriptions of the conditions.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K))))))))))3))))))))))3))))))))))3))))))))))M
5 Allow Access * C076*P * See Below 5
94444444444444444444N44444444444444444444444444444444N444444444444444444448

```

Format:

- C076 is the default command name.
- P is the port for which to recall the stop access conditions (1..4)

CW Response:

'Port number (X) 'N/F' (Y) 'N/F' (Z) 'N/F'

Where:

- P is the port for which to set the stop access conditions (1..4)

Advanced Command Description: C077

Isolate a Port from the Rest of the System

This command breaks the audio and ptt links between the specified port and all other ports in the system until the preaccess timer (which it starts) runs out. It temporarily overrides but does not change the crosspoint connections you may have set with command C000 and C001. It is useful for isolating a port while you enter local control commands without the tones going down any connected links. It is usually called from the preaccess macro of a port configured as a repeater. This macro is usually named '*', the local control key.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5  Description      *           Command           *           Response      5
K)))))))))3)))))))))3)))))))))3)))))))))3)))))))))3)))))))))M
5  Allow Access    * C077*X           *           See Below     5
94444444444444444444N44444444444444444444444444444444N44444444444444444448

```

Format:

- C077 is the default command name.
- X is the port for which to allow access (1..2)

CW Response:

There is no response for this command

Advanced Command Description: C078

Set the EOF digit for a port

This command allows you to specify which DTMF digit will be used to force a command to be executed without unkeying. It will also be used to separate the command name from the data you provide. It defaults to '*' for all ports.

```

64444444444444444444L4444444444444444444444444444444444L44444444444444444444447
5 Description * Command * Response 5
K)))))))))3)))))))))3)))))))))3)))))))))3)))))))))3)))))))))3)))))))))M
5 Change EOF * C078*X Y * See Below 5
94444444444444444444N4444444444444444444444444444444444N4444444444444444444448

```

Format:

- C078 is the default command name.
- X is the port for which to change the force-execution digit (EOF)
 - 1..4 indicate the corresponding port
 - 5 indicates the serial port
- Y is the new digit to use

Notes:

Trying to change the current state of the EOF digit to what it currently is will cause an "extra data too short" error message because when you enter it, the command will execute too soon. This error message can be ignored, because the digit is already what you were trying to change it to.

When changing the digit from the serial port, any key on the keyboard can be used. If you set the digit for one of the ports to a non-DTMF digit, that port will be forced to unkey to execute commands. This is not recommended. Program the force-execution digits for 1..4 to a valid DTMF character.

CW Response:

'X' 'IS' 'Y'

Advanced Command Description: C081

Recall Automatic Force-Execution for a Port

This command allows you to recall whether or not the requirement that a command name be followed by a "*" (or other digit if it the force-execution digit has been changed) is turned on. See C080 for more information.

```

64444444444444444444L4444444444444444444444444444444444L4444444444444444444447
5 Description * Command * Response 5
K)))))))))3)))))))))3)))))))))M
5 EOF Required * C081* * See Below 5
94444444444444444444N4444444444444444444444444444444444N44444444444444444448

```

Format:

- C081 is the default command name.

CW Response:

The response will list all the ports set-up for auto-execution

Command Description: C083

Do Nothing

This command does nothing. After executing, it returns an OK error code like most other commands do. It is used as the default command to execute for commands like C082 and C057..

```

64444444444444444444L4444444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K))))))))))3))))))))))3))))))))))M
5 Do Nothing *C083 * See Below 5
9444444444444444N4444444444444444444444444444N444444444444444448

```

Parameters:
- C083 is the default command name

Command Description: C084
Not Currently Used

ID Control

How the IDs Work:

Whenever an ID needs to be sent, the appropriate automatic macro is called. You program your IDs by programming those macros (see Appendix D for macro definitions). The following group of commands allow you to disable IDing for a port or change how the periodic IDs are sent.

Advanced Command Description: C086 Recall Which Ports have IDs Enabled

This command lists the ports that have IDing enabled. If all ports do, it send "1234".

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K))))))))))3))))))))))3))))))))))M
5 En/Disabled? * C086* * See Below 5
94444444444444444444N44444444444444444444444444444444N444444444444444444448

```

Format:

- C086 is the default command name.

CW Response:

The response lists the ports that have ID's enabled

***Command Description: C087..C089
Not Currently Used***

Command Description: C089 Turn Output Line On/Off

This command allows you to turn the output line on or off. The output is an active low open collector driver, so on means that it applies a ground to that output. Off means that the output is open, or not hooked to anything.

```

64444444444444444444L4444444444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K)))))))))3)))))))))3)))))))))M
5 Output On/Off * C089*Y * See Below 5
94444444444444444444N4444444444444444444444444444444444444N444444444444444444448

```

Note: to provide customized messages when turning output lines on or off, use a macro that both executes this command and the send a CW message command (C030).

Format:

- C089 is the default command name.
- Y is 0 to turn the line off, 1 to turn it on.

CW Response:

'Y' 'IS' 'N' or 'Y' 'IS' 'F' Where 'N' is On and 'F' is Off

The I/O Interface

About the I/O System:

The optional I/O board for the RLC-5 provides 4 high/low input lines, 8 output lines and 4 analog input lines. They are all handled totally separately in software; each command applies to only one of the three types of lines. Each type will be described below.

Please note that you can control how often the RLC-5 checks the input line and analog alarms by using C020 to change the reset value of timer 12. The default is to check the alarms once per second.

Connector Pinout:

The connections to the I/O Interface are made through the DB-25 connector. The pin assignments are shown in each section below and on the schematic at the end of this manual. Also shown for the input lines is the ground pin on the DB-25 that is nearest the input line pin. Electrically all of the ground pins are the same. Pin 1 is also ground, but is not listed.

High/Low Input Lines:

Description	Pin on DB-25	Nearest Ground
High/Low Input #1	21	9
High/Low Input #2	20	8
High/Low Input #3	19	7
High/Low Input #4	18	6

The high/low input lines are used to detect whether a line is "high" or "low". High means that the voltage read by that line is above approximately 2.5 volts. Low means that the voltage is below about 1 volt. The range between 1 volt and 2.5 volts is indeterminate. If the line is not connected, a 10K internal pullup resistor to 5 volts will make the line read high. This pullup allows you to easily read whether a switch is open or closed. Simply connect the switch between the input line and ground. If the switch is closed, the input will read low. If the switch is open, the pullup resistor will make the input line read high. The input line can handle voltages up to +20 volts. Do not apply negative voltage to an input line.

Input lines can be used in three ways.

- Command C090 can read an input line and tell you whether it is high or low.
- There is also a way to assign a custom CW message to each state of an input line, such as "door open" and "door shut" (instead of high and low). To do this, program the CW messages you want to be spoken for the high and low states into the input line macros (See Command C057 for input line macro assignments). You can then cause the

appropriate message to be sent by executing command C091.

- If you want a message to be sent whenever an input line changes from high to low or low to high, you can cause the macros you programmed in the step above to automatically be executed at those times by enabling an "input line alarm" with command C092. You could use this feature along with a door switch to tell you when someone opens or closes a door.

Output Lines:

Description	Pin on DB-25
Output #1	13
Output #2	25
Output #3	12
Output #4	24
Output #5	11
Output #6	23
Output #7	10
Output #8	22

The output lines are "open collector" outputs. That means that they can connect the output line to ground (turn it on) or disconnect it (turn it off). The output lines never output any voltage. The way they are commonly used is to connect one lead of the coil of a relay (or whatever else you want to control) to 12 volts and the other lead to an output line. When the output is turned on and applies a ground, the coil of the relay will be energized and will turn the relay on. The output line can "sink" (apply a ground) of about 150 milliamps.

Connecting an output line directly to a power supply and turning it on will destroy the output driver IC. Make sure that whatever you are turning on and off draws less than 150mA.

The output lines can be turned on and off with C093 and C094. You can recall whether a line is currently on or off with command C095. If you want to send a custom message when you turn an output on or off, program one of the user macros to speak the message you want, execute C043 (to suppress the rest of the CW responses), and then turn the output line on or off.

Analog Input Lines:

Description	Pin on DB-25	Nearest Ground
Analog Input #1	17	5
Analog Input #2	16	4
Analog Input #3	15	3
Analog Input #4	14	2

The analog input lines are designed to read a voltage on one of two ranges: 0 to 5 volts, or 0 to 25 volts. You can select which range is used with DIP switches 1..4 on the I/O board. If the switch is on, you will be using the 0 to 25 volt scale, because it "divides" the input voltage by 5. No matter which way the switch is set, most of the discussions about the analog inputs will send the voltage input as being 0 to 5 volts since the voltage divider is in hardware and the software doesn't know whether the divider is turned on or not. If you do have the divider turned on, just remember that 5 volts to the software means 25 volts to you. This scaling can be compensated for in software with command C102.

The RLC-5 provides a lot of flexibility in how it reads the analog input lines. Unfortunately, this also makes things a little bit complicated. Charts have been provided so that you can use the input lines without understanding how all of the math works, but if you have a unusual application, the RLC-5 can handle that as well. The following paragraphs explain what some of the options are when reading analog lines. The way you select from those options is described with the commands themselves.

"Resolution" refers to how many digits after the decimal place you want to know about. Temperature is usually read to the nearest degree, zero digits after the decimal. When reading a battery or power supply's voltage, you probably want to hear more than "thirteen volts" or "fourteen volts", something like "thirteen point six volts". To obtain this kind of reading, you would specify one digit after the decimal point.

The "conversion ratio" specifies how the controller interprets the voltage it detects. It could also be called the "scale" or "meter faceplate". If you are measuring wind speed, you may want a reading that varies from zero to 100 MPH. If wind direction, zero to 360 degrees. If pH, zero to 14. If temperature, way below zero to a hundred degrees or more. No matter what scale you want the reading to use, the voltage going into the analog line must be between 0 volts and 5 volts (or 0 and 25 with the voltage divider on). If you have a sensor to measure something in the physical world that can provide a voltage that varies between 0 volts and 5 volts (or 25...), you can set up the conversion ratio to handle it. The point of this discussion is to make it clear that the controller does not care what the real-world quantity is, it just needs a variable voltage and the proper conversion ratio, and it can handle it. You tell the RLC-5 what the conversion ratio is by specifying two points:

- The first is what real world quantity would cause the sensor to output 0 volts. In many cases this is zero. For example, if you are using a small motor with a propeller to detect wind speed and the wind is not blowing, you will get 0 volts. But what about temperature? If our sensor outputs 0 volts for zero degrees, how would we get negative temperature readings? The analog lines can only accept positive voltages. The answer is that we use a temperature sensor that outputs about 2.73 volts at zero degrees, less than that when below zero and more than that when above zero. So our first conversion point for temperature says that it would have to be 460 degrees below zero to get 0 volts out of the sensor.
- The second point we set specifies what real world quantity would cause the sensor to output 5 volts (or 25 with the voltage divider turned on). If your wind speed detector outputs 5 volts when the wind is blowing 150 MPH, this point would be 150. For the temperature sensor (we use the National Semiconductor LM335Z), it would have to be 440 degrees out to get 5 volts out of the sensor.

"Calibration" refers to correcting for small errors in a reading. If your the controller tells you it is 85 degrees when it is 88, you can calibrate it to correct for the small error. If it is way off, you probably have the conversion set wrong.

You can also set "analog alarms". These will cause a macro to be executed whenever the value read on one of the analog lines goes above or below a preset value. See commands C104..C07 for more information.

If you want to use an analog input to control a rotor, see Appendix F.

I/O Interface Commands:

- C090 Read Whether Input Line is High or Low
- C091 Execute Input Line High or Low Macro
- C092 Enable/Disable Input Line Alarm
- C093 Turn Output Line On
- C094 Turn Output Line Off
- C095 Recall Whether Output Line is On or Off
- C100 Read Analog Input Line
- C101 Set Resolution For Analog Input
- C102 Set Conversion Ratio For Analog Input
- C103 Calibrate an Analog Input
- C104 Set an Analog Alarm
- C105 Set Analog Alarm Hysteresis
- C106 Enable/Disable an Analog Alarm
- C107 Recall Analog Lines in Alarm
- C108 Recall Analog Line Configuration

Command Description: C093

Turn Output Line On

This command allows you to turn an output line on. The outputs are active low open collector drivers, so on means that they apply a ground to that output. Off means that the output is open, or not hooked to anything.

```

64444444444444444444L4444444444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K)))))))))3)))))))))3)))))))))M
5 Output On * C093*Y * See Below 5
5 Outputs On * C093*Y..Y * See Below 5
94444444444444444444N4444444444444444444444444444444444444N444444444444444444448

```

Note: to provide customized messages when turning output lines on or off, use a macro that both executes this command and the send a CW message command (C030).

Format:

- C093 is the default command name.
 - Y is the output line number (1..8)
- Note: Multiple output lines can be turned on with one call to this command by entering more than one port number here.

CW Response:

'Y' 'IS' 'N' Where 'N' is On

your battery voltage with one digit after the decimal point (100mV resolution) and waste a little resolution, or use two digits after the decimal point (10mV) and exceed the resolution of the converter.

Let us suppose that we are trying to read the voltage supplied by a 3 volt battery pack with 3 digits after the decimal point (1mV resolution). Remember that the converter has only 20mV resolution (let us suppose it is exactly 5mV for this example). If the battery voltage is 3.021 volts, the converter will round it to 3.020. If the voltage is 3.025 volts, the converter will round it to 3.030. No matter what you do, the last digit read will always be 0 or 5. The number read back by the controller will sound like it has 10mV resolution, but the reading will only have 20mV resolution.

If all of this has confused you, ignore it and select 0 digits after the decimal point (or leave it alone if you haven't changed it - 0 digits is the default).

Custom Analog Conversion Scales:

If the conversions provided in the chart are what you need, don't bother reading this section. It describes how to come up with your own conversions.

The conversion is simply a linear ratio. You provide a reading that corresponds with 0 volts at the processor (after the voltage divider) and another number that corresponds with 5 volts at the processor, and the controller just does a linear interpolation.

First we will describe some of the conversions in the table, then illustrate how to come up with your own:

0 to 5 volt, 1 volt resolution, no voltage dividers:

This is about as straightforward as it can get. When it reads 0, it converts it to zero. When the processor reads 5 volts, it converts it to 5 volts.

0 to 5 volt, 1/10 volt resolution, no voltage dividers:

When it reads 0, it converts it to zero. To get 1/10 volt resolution, we need to use one digit after the decimal point. Because of this we have to assume one decimal point when we enter the conversion points. When the processor reads 5 volts, we need to convert to 50, which with one assumed decimal place, is 5.0 volts.

0 to 5 volt, 1/100 volt resolution, no voltage dividers:

When it reads 0, it converts it to zero. To get 1/100 volt resolution, we need to use two digits after the decimal point. When the processor reads 5 volts, we tell it to convert it to 500, which with one assumed decimal place, is 5.00 volts.

Temperature in Celsius, 1 degree resolution, no voltage dividers:

The key to figuring this one out is knowing how the LM335 temperature sensor works. It provides an output voltage of 10mV per degree kelvin. It should therefore output zero volts at zero degrees kelvin. Zero degrees kelvin is minus 273 degrees celsius, so that is our first conversion point, -273. The 5 volt conversion point would be reached at $5V/10mV$ per degree = 500 degrees kelvin, or 227 degrees celsius (above zero). This is our other conversion point.

Temperature in Fahrenheit, 1 degree resolution, no voltage dividers:

This conversion is very similar to the one for celsius temperature. 0 degrees kelvin is -460 degrees fahrenheit. 500 degrees kelvin is 440 degrees fahrenheit.

0 to 25 volt, 1 volt resolution, with the voltage divider:

The difference between this and the 5 volt conversion is the voltage divider. The divider cuts the received voltage to 1/5 before passing it on to the processor. In other words, the zero point does not change, but the full-scale reading is now 25 rather than 5 volts. Since we want it to read 25 volts when we give it 25 volts, the zero point is 0 and the full scale point is 25. Seems too easy, doesn't it?

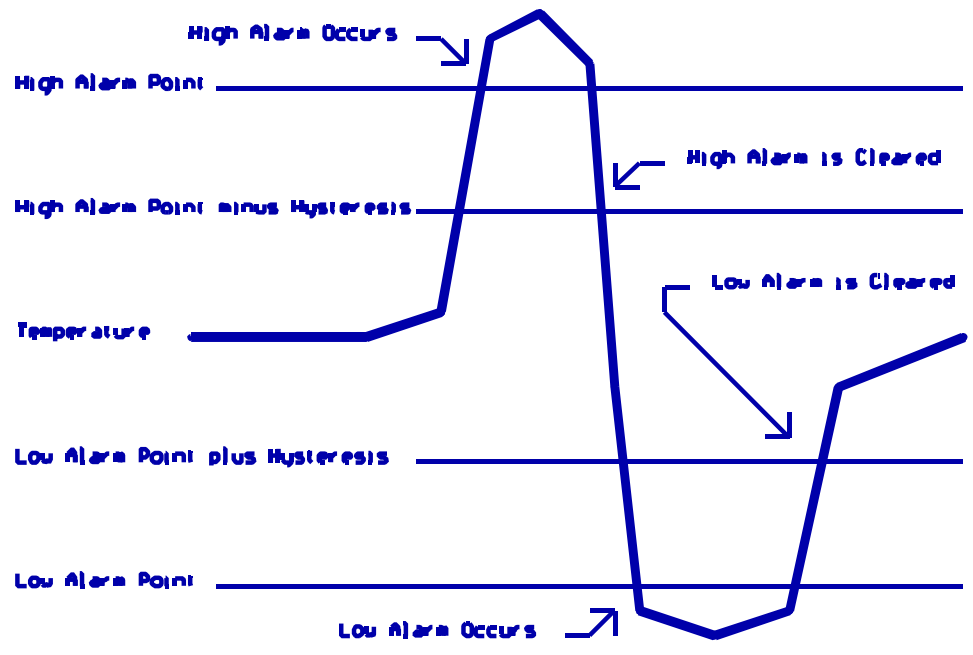
The other resolutions of the 0 to 25 volt conversions are left to a comparison with the 5 volt conversions.

One more example will illustrate how to develop a conversion that is not listed in the chart. Let us assume that we want to read the wind speed at our site and that we have an anemometer (wind speed detector) that reads 10 volts at 100 MPH. Since the maximum voltage is between 5 and 25 volts, it will work nicely with the voltage divider in the circuit. We will assume that 0 volts are produced when the wind is not blowing and that it increases linearly from there. That sets our zero point to be zero. We must calculate our full scale reading as if it will occur at 25 volts, even though the sensor will never put out that much voltage, because that is the 5 volt full scale reading at the processor times the 5:1 voltage divider ratio. What we need to know is how fast the wind would have to blow to give us a 25 volt signal. A simple ratio will give us the answer:

$$\frac{100 \text{ MPH}}{10 \text{ volts}} = \frac{X \text{ MPH}}{25 \text{ volts}}$$

$$\text{Cross Multiplying: } 100 * 25 = 10 * X, \quad 2500 = 10 * X, \quad X = 250 \text{ MPH}$$

We now know that the low point is 0, the high point is 250, and that we need to use the voltage divider.



The Autopatch

Configuring the Autopatch:

C110 allows you to specify whether or not you want the autopatch to read back the number it is about to dial. It can be read back in CW or with the DVR. If you choose to use the DVR, you must record the digits 0..9 in DVR slots 0..9.

Autopatch Up Commands:

There are four different commands that can be used to access the autopatch:

- **Manual Off Hook: C111.** This command connects the radio port to the phone line without dialing any numbers. You can dial phone numbers without DTMF regeneration by executing this command, waiting for dial tone, and entering the number on your DTMF pad. Since the tones are not captured and regenerated but go out directly onto the phone line, there is no long distance checking, etc.
- **Normal Forward Dial: C112.** This command is the one you would usually make available to users. Two digit numbers will access autodial slots, 4 through 11 digit numbers will be checked against the dialing tables (explained later), then regenerated over the phone line. If you have specified pre-dial digits (such as a '9' to get out of a local PBX) with command C115, they will be dialed first.
- **Special Forward Dial: C113.** This command is similar to the normal forward dial but it bypasses the dialing table checks. It is the most convenient way to bypass all of the long distance checking. It will dial any predial digits that you have programmed with C115.
- **Special Forward Dial without Predial Digits: C109.** This command is the same as the above command except that the predial digits are not dialed before the rest of the number.

Using '' for the Autopatch Up Command:*

You can use the '*' digit to execute any of the above autopatch commands, even if '*' is your EOF digit. This will allow you to use the patch by simply keying up, pressing '*', then the phone number you wish to dial. See command C082 for more information.

Hanging Up:

No matter which command was used to bring up the autopatch, command C114 will hang it up. If you want to have more than one hang up command, just make several different macros call C114.

Connected Repeaters:

Any repeaters that are connected to or monitoring the port you make the autopatch call from will also be included in the autopatch call. For example, if you have connected repeaters and someone wants to make a call from one of them, you can bring the patch up for them from the other one.

Predial Digits:

Autopatches that are on a PBX often have to dial a '9' or some other combination of digits to reach the outside world. The RLC-5 has the ability to dial these digits for you. You can tell it what digits to dial and how long of delays to use before and after these "predial digits" with command C115. These digits will be dialed before every number that is dialed with the forward dial commands. You can chose whether or not they should be dialed before each autodial number. This allows you to dial numbers that do not require the predial digits by putting them in an autodial slot.

The Autodialer:

There are 100 user macros, the last 50 macros are 20 digits in length. These last 50 macros can be used as autodial slots. The macros can support up to a 16 digit number. To program them, enter C050*MMM113NN..NN* where MMM is the macro number (200..249) and NN..NN is the phone number to be dialed. For example, to program macro 205 to dial the number (406) 482-7515, enter C050*2051134064827515*. To use that autodial, enter C112*5* or C112*05*.

Limiting Call Length:

The time out timer for the autopatch port is the total length of the call. You can set the length of this timer with Command C020. When the timer expires, it initially hangs up the autopatch, then it executes the autopatch port's time out event (See Commands C057,58,59) If you would like a message sent when this happens, have the macro assignment in Command C057 call a macro. This macro should be programmed to send the CW message or other indication that the patch has timed out.

Thirty seconds before the patch times out, three beeps will be sent both out the radio port and to the telephone to warn the users that the patch is about to time out. Twenty seconds before time out, two beeps are sent, and at ten seconds before, one beep is sent. The CW characters 'S', 'I', and 'E' are used for these warning beeps.

If you want to reset the patch time out timer during a call, use command C023 to reset the time out timer for the autopatch port (timer 41): C023*41. Of course you can write a macro to do this.

How the Dialing Tables Work:

The Allowed-Prefixes Table:

The RLC-5 supports 5 (Area Code) + (Prefix) number filter slots. These slots can contain a "wildcard" digit which the controller sets as the '#' digit. The user can enable all prefixes within an area code by entering:

(ACD) ### - where the "ACD" is the allowed area code, and the ### says to ignore the prefix following the area code.

Nuisance Number Disallow Table:

The RLC-5 supports a 5 nuisance number dis-allow table. If the user enters a number that is found in the nuisance table, the controller will throw away the entered number. The number can vary from 1..11 digits in length.

Advanced Command Description: C109 ***Forward Dial with no Long Distance Checking or Predial***

This command is the same as C113, except that the predial digits (see C115) are not dialed before the number. One of the times this would be useful is when you need to dial an internal extension on a PBX, but you have the predial digits set to dial out. You would not normally make this command available to the average user, because it would allow them to dial any number, including long distance numbers. This command can be called from a macro to make "autodial numbers".

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5  Description      *          Command          *          Response      5
K)))))))))3)))))))))3)))))))))M
5 Dial Number      * C109*Y..Y          *          See Below      5
94444444444444444444N44444444444444444444444444444444N4444444444444444448

```

Format:

- C109 is the default command name.
- Y..Y is the phone number you want to dial

Note: if you want to get rid of the '*' between the command name and the phone number, look into command C082.

CW Response:

The response depends on the configuration of the autopatch readback (see C110). If the response is 'AP F', the patch needs to be configured with C110.

Examples:

- You want to dial the number 1 (406) 482-7515: C113*14064827515 <unkey>
- You want to dial the above number as an autodial number using macro 200: C050*20011314064827515 <unkey>. Now executing macro 200 will dial the number. You can rename macro 200 to A00 (for "Autodial 00") or any other name with C010 like this: C010*200A00 <unkey>.

Command Description: C112 *Normal Forward Dial*

This is the normal autopatch up command you would make available to your users if you want an open autopatch. It will only dial numbers 5 to 11 digits long, and those numbers only if they are enabled with command C117 and not blocked with C119. The combination of these three commands should give you the ability to block all long distance numbers. If you wish to dial numbers shorter than 5 digits, longer than 11 digits, or numbers that are not allowed by C117 or C119, use command C113. Command C114 can be used to hang up the patch.

```
64444444444444444444L4444444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K))))))))))3))))))))))))))))))))3))))))))))))))M
5 Dial Number * C112*Y..Y * See Below 5
94444444444444444444N4444444444444444444444444444444444N444444444444444444448
```

Format:
- C112 is the default command name.
- Y..Y is the phone number you want to dial

- Notes:
- If you want to get rid of the '*' between the command name and the phone number, look into command C082.

CW Response:
The response depends on the configuration of the autopatch readback (See C110). If the response is 'AP F', the patch needs to be configured with C110.

Command Description: C114

Hang up the Autopatch

This is the command to use to hang up the autopatch, no matter which of the three autopatch up commands you used to take it off-hook.

```

64444444444444444444L4444444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K))))))))))3))))))))))))))))))))3))))))))))))))M
5 Hang Up * C114* * See Below 5
94444444444444444444N44444444444444444444444444444444N44444444444444444448
    
```

Format:

- C114 is the default command name.

CW Response:

Normally 'AP F'. If you want to change this message, use a macro to hang up the patch. Program that macro to send the message you want, then call C043 to silence all further messages, then call this command.

Advanced User Note:

If you have changed the way error 0 and error 1 are handled (with C057), you may notice an error 0 or error 1 message being sent by CW or out the serial port when the patch is hung up. This is because the number that was dialed (sent down the phone line) was echoed by the imperfect hybrid in the autopatch and decoded by the autopatch port's DTMF decoder. Since the telephone is not allowed to execute commands during a forward patch call, these digits cause an error. The default error handlers (commands 134..147) which are called by C057 when these errors occur, will not be seen or heard in this case, so it will only affect you if you have changed these error handlers.

Advanced Command Description: C119 Set Nuisance Number Slot

This command allows you to set one of the slots in the allowed prefix table. For a description of this table and how to use it, see the autopatch section before command C110.

```

64444444444444444444L4444444444444444444444444444444444L44444444444444444444447
5 Description * Command * Response 5
K))))))))))3))))))))))))))))))))))))3))))))))))))))))M
5 Set Nuisance * C119*S N..N * See Below 5
9444444444444444N4444444444444444444444444444N44444444444444444444444444448

```

Format:

- C119 is the default command name.
- S is the slot number (0..4)
- N..N is the whole number to be blocked (do include the last four digits of the phone number). The '#' digit is a wildcard that matches any digit.

CW Response:

'S' **IS** 'N..N' Where 'N' is the masked number

Command Description: C121, C122 ***Set and Recall Half-Duplex Mode for a Selected Port***

These commands allow you to program and recall whether the specified port will be treated as a half or full duplex port. The default is half duplex. Currently the setting is only used for the autopatch. In full-duplex mode, audio from the phone is sent regardless of whether the port that is using the patch is keyed or not. In half-duplex mode, the phone audio is muted whenever the radio port is keyed. This setting may also be used for other things later.

```

64444444444444444444L44444444444444444444444444444444L44444444444444444447
5 Description * Command * Response 5
K))))))))))3))))))))))3))))))))))3))))))))))3))))))))))M
5Set Half-Duplex * C121* X Y * 'X' 'IS' 'N'or'F' 5
K))))))))))3))))))))))3))))))))))3))))))))))3))))))))))M
5 Recall * C122* *All Half-Dup Ports 5
94444444444444444444N44444444444444444444444444444444N44444444444444444448

```

Parameters:

- C121 is the default command name.
- X is the requested port (1..4)
- Y is the Half-Duplex on/off setting. It is set for the ports that *use* the autopatch, not for the autopatch port itself. In other words, if your repeater is on port 1 and you want to make it use the autopatch in full duplex mode, enter C121*10*.
- 1 => make the selected port half duplex
- 0 => make the selected port full duplex

Default:

- half duplex

Note:

When the patch is used in full duplex mode, the repeat audio from the person using the autopatch will sometimes be louder than normal. This is caused by a combination of the characteristics of the telephone line and of the autopatch hybrid. This will not occur when the patch is in half-duplex mode.

Command Description: C124 ***Reverse Autopatch Logon***

When you have the reverse patch set up for control mode (mode 2) with C123 and you call the controller, it will answer and give you 9 seconds to enter the reverse patch logon code followed by a '*'. That logon code is actually the name of this command. C123 automatically renames this command to the logon code for you. Information is given below to help you understand how to use the reverse patch in control mode.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5 Description * Command * Response 5
K)))))))))3)))))))))3)))))))))M
5 Reverse Answer * C124* * 'ACS' 5
94444444444444444444N44444444444444444444444444444444N4444444444444444448
    
```

Parameters:

- C124 is the default command name.

How to use reverse patch mode 2:

- Set it up with C123.
- Change the names of any commands that you want to be able to execute from the phone so that they do not contain the characters 'A', 'B', 'C' or 'D', because these digits are not available on most telephone keypads.
- Call the controller.
- When the controller answers, enter the reverse patch logon code followed by a '*' (or whatever the EOF digit is for the autopatch port).
- You can now enter any of the commands just as you would from a radio port, except that since you can't unkey to force them to execute, you must press a '*' after entering each command.
- Before hanging up, you should tell the controller to hang up so that it does not remain on the phone line. Do this by executing C114. If you do not hang up the phone, it will time out and hang itself up. If you do not tell the controller to hang up and someone calls the controller before it times out, they will not have to enter the access code to enter commands.

Command Description: C125

Reverse Autopatch Over the Air Answer

This command allows the user on the air to answer the ringing phone. This command is the same as Command C111, Manual Off Hook except it requires that the phone is ringing before the controller takes the phone off hook.

```

64444444444444444444L4444444444444444444444444444444444L44444444444444444444444444444444447
5 Description * Command * Response 5
K))))))))))3))))))))))3))))))))))3))))))))))M
5 Reverse Answer * C125* * See Below 5
9444444444444444N4444444444444444444444444444444444N4444444444444444444444444444444448

```

Parameters:
- C125 is the default command name.

CW Response:
There is no response for this command.

Command Description: C126 Set Reverse Autopatch Ring Length

This command allows the user to setup the over the air ring length.

```

64444444444444444444L44444444444444444444444444444444L444444444444444444447
5  Description      *          Command          *          Response      5
K)))))))))3)))))))))3)))))))))3)))))))))3)))))))))M
5  Ring Set-up     * C126*XXX          *          See Below      5
94444444444444444444N44444444444444444444444444444444N4444444444444444448

```

Parameters:

- C126 is the default command name.
- XXX is the length of the ring tone
- Defaults to 1 Second (100)

Note:

The ring tone is sent once for every time the phone line coming into the controller rings. This command will not change how fast the ring tone is sent.

Suggestions:

Do not make the length of the ring tone too long. The controller will stack up tone requests and could still be ringing over the air after the phone has answered if the length of the tone is longer than the delay between rings from your phone company. This is especially true if you have distinctive ringing (several short rings instead of one long one).

CW Response:

'XXX'

Blocking Execution from Certain Ports

Purpose of these commands:

The following three commands allow you to mark certain commands so that they can not be executed from certain ports. You might want to use this command to make it so your autopatch cannot be accessed from the link ports. If you are using one of the ports as a control port, you could make all of the commands in the controller so they could only be executed from that control port. You could call these commands from the scheduler to disable some or all of the commands at night. This adds a lot of security to your controller.

Caution:

Because these commands can keep you from executing commands, they can lock you out of your own controller. If you have a terminal or computer hooked up to the serial port, these commands cannot lock you out, so you don't have to worry about it. Also, you can always re-initialize the controller (see Appendix E), but that erases all of your programming and you have to be at the site to do it. In other words, be careful what commands you block and what ports you block their execution from. If you don't want to use these functions and you want to erase their names so that they cannot be entered accidentally, enter the following commands:

```
C010*127*
C010*128*
C010*129*
```

These commands erase the names of command numbers 127, 128 and 129 so that they cannot be executed without renaming them to a valid name.

If you think you have locked yourself out, execute the following sequence of commands from every port you can get touch tones to, or just from the serial port (where it will always work). If they are executed they will allow access to every command from every port.

```
C128*1000XXX*
C128*2000XXX*
C128*3000XXX*
C128*4000XXX*
```


Advanced Command Description: C129 Recall Blocked Ports

This command allows you to recall which ports are blocked from executing a command.

```

64444444444444444444L4444444444444444444444444444444444L444444444444444444447
5 Description * Command * Notes 5
K)))))))))3)))))))))3)))))))))M
5 Recall Blocked * C129*CCC * See Below 5
94444444444444444444N4444444444444444444444444444444444N444444444444444444448

```

Format:

- C129 is the default command name.
- CCC is the first command number to block

CW Response:

'CCC' where 'CCC' is the first command to be blocked

Doug Hall's RBI-1 Support

What is the RBI-1 Interface:

Doug Hall Electronics' Remote Base Interface (RBI-1) allows the RLC-5 to control the Kenwood series TM-X21 and TM-X31 mobile radios. The RBI-1 converts the data output by the RLC-5 into a format that the radios can use. Up to four bands can be supported by one RBI-1 interface, which plugs into one of the RLC-5's radio ports and the optional I/O board (required). The audio, COR and PTT interface is made through the RLC-5's radio port and the signals that control the RBI-1 and ultimately the radio come from the I/O board. More information about the RBI-1, including the address and phone number for Doug Hall Electronics, is included on the following pages. Link Communications Inc. does not sell the RBI-1 interface.

Interfacing and Setup:

It is very easy to interface the RBI-1 to the RLC-5. A description of the needed cable is provided on one of the following pages. You can build it yourself or order one from Link Communications Inc. The radio is connected to the RBI-1's microphone connector with a cable supplied with the RBI-1. The only other connections are power, ground and antenna to the radio. The RBI-1 gets its power from the radio.

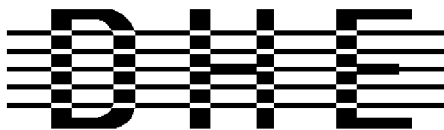
Configuring the RLC-5 to control the RBI-1 consists of a single command. You need to tell the RLC-5 which band unit you want to use (command C130).

Using the RBI-1:

Using the RBI-1 is very straightforward. There are separate commands to do each of the following tasks:

- C130 - select the band unit, set the power level, set the format used to set the offset
- C131 - set the frequency (and optionally the offset)
- C132 - set the PL (CTCSS) frequency, turn the PL encoder on or off, turn the PL decoder on or off
- C133 - recall the frequency and offset

If there are combinations of settings that you use often, you may want to program user macros to select those settings. This is the easiest way to get "memories" or "presets".



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INTRODUCTION

The DHE Remote Base Interface (RBI-1) Adapts the Kenwood series TM-X21 and TM-X31 mobile radios to several brands of Repeater Controllers. The RBI model 1 converts the serial data stream from the controller and directly controls the Kenwood Mobile radio. All connections to the Kenwood radio are made through the microphone jack. In the maximum configuration using a Kenwood TM-701 Dual Band Mobile you can control Frequency, CTCSS encode On/Off, RF power level, Offset, Power On/Off, and Band. This is all accomplished through the microphone jack.

The RLC-5 Format supports the following functions:

- Full frequency control, 4 ports/radios, and 4 bands.
- Transmitter power HI/MED/LOW
- CTCSS Frequency select, Encode on/off, Decode on/off.
- 20 and -12 Mhz offsets on 1200.

The Supported Kenwood Mobile Radios are as follows:

<u>140</u>	<u>220</u>	<u>440</u>	<u>1200</u>	<u>Dual Band</u>	
TM-221	TM-421	TM-421	TM-521	TM-621+	TM-721+
TM-231	TM-431	TM-431	TM-531	TM-631+	TM-731+
TM-241		TM-441	TM-541		TM-701+

+ Dual Banders

SUPPORT CROSS REFERENCE

<u>FUNCTION</u>	<u>CTCSS</u> <u>ENCODE</u>	<u>CTCSS</u> <u>SELECT</u>	<u>CTCSS</u> <u>DECODE</u>	<u>MULTI</u> <u>BAND</u>	<u>RF PWR</u> <u>POWER</u>
GENERIC	Y	Y	Y	Y	Y
TM-X21	Y	N	N		N
TM-X31	Y	Y	Y		Y
TM-X41	Y	Y	Y		Y
TM-621/721	Y	N	N	Y	N
TM-631/731	Y	N	N	Y	N
TM-701	Y	Y	Y	Y	Y

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SPECIFICATIONS

Microprocessor:	INTEL 87C51 Series 12MHz
Connections:	
Power:	RCA Phono + center pin.
Controller:	9 Pin female "D" Connector
Expansion:	9 Pin male "D" connector.
Radios:	4 8 Pin Modular Compatible with Kenwood PG-4H cable. 1 PG-4H provided. Additional cables available from Kenwood or DHE.
Adjustments:	"T" (VR1) Radio transmit audio level adjust. "R" (VR2) Radio receive audio level adjust.
Audio:	Radio Transmit 0.050V to 2.5V Input. (response controlled by capacitor removal). Impedance 15K. Radio Receive 0.020V to 2.5V Output. (response controlled by capacitor removal). Impedance 5K.
"S" Meter output:	0 to +5V 0V = no signal, 5V = > "S" 9. Output impedance approx 5K.
Expansion output:	8 outputs, ground active, Sink 500mA each, 1A maximum total.
Power Requirements:	+10 to +14 Vdc @ 23mA.
Size:	1.5" X 5.1" X 5.5"

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INSTALLATION

Place or mount the RBI-1 in close proximity to the Kenwood mobile radio to be used. Connect the RBI-1 with the provided PG-4H Cable from the 8 pin modular jack marked "RADIO" to the Kenwood Microphone jack. Only Port 1 (140/DUAL) will support a Dual Band radio. Port 1 is the only Port the 140 Mhz radio can be connected to.

The RBI will support all 4 bands (140/220/440/1200) as follows:

If Port one is filled, Port 2 is for 220 only, Port 3 is for 440 only, Port 4 is for 1200 only. Basically, if the selected band is unavailable on Port 1 it will go to the port hard assigned to that band.

RBI-1 Connector J2 Pin# - Line Name

RLC-5 Connections Pin# - Line Name

1 - RBI-1 RESET
2 - "S" Meter output
3 - Data
4 - Clock/Strobe

Connections to the optional I/O Board (DB-25)

Output #6, P1 pin 23 on the I/O Board Connector (optional) connect to analog input
Output #8, P1 pin 23 on the I/O Board Connector
Output #7, P1 pin 22 on the I/O Board Connector

5 - Kenwood TX Audio (T Pot)
6 - Kenwood RX Audio (R Pot)
7 - COS from Kenwood RX
8 - PTT to Kenwood TX
9 - Ground

Connections to the radio port (DB-9)

4 - RLC-5 audio out
5 - RLC-5 audio in
7 - RLC-5 COR input (Set the COR to active low with C013)
3 - RLC-5 PTT output
1 - RLC-5 ground connection

In case it wasn't clear, there is only one connector on the RBI-1 that goes to the RLC-5. It is connected to two different connectors on the RLC-5. The DB-9 connector provides the audio, COR and PTT connections. The DB-25 connector provides the control signals.

Audio receive level from the Kenwood to the Controller is controlled by VR2 (R). The audio level from the Controller to the Kenwood is adjusted by VR1 (T). Refer to your manuals for additional adjustments in your controller.

Capacitor C5 (10uF) Inside the RBI-1 Interface must be removed and replaced with a 1uF/25V Tantalum Capacitor for the Audio to sound correct.

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RADIO SETUP

The Kenwood radios need certain parameters set up before they can be controlled from the RBI-1, such as STEP. Since the memory channels in the radio aren't used, you should reset the radio to make sure all of the settings are set to the factory defaults. Instructions about how to do this can be found in your Kenwood operating guide or in the list below.

TM-701	Hold the MR key down during power on to reset.
TM-X21	Hold the VFO/M and M.IN keys down during power on to reset.
TM-621/721	Hold the F key down during power on to reset.
TM-631/731	Hold the MR key down during power on to reset.
TM-X31	Hold the MR key down during power on to reset.
TM-X41	Hold the VFO key down during power on to reset.

Set the step size to 5KHz. (25Khz on 1200 Mhz units)

Set dual band radio's to single band.

Set power to desired setting. Remember, remote base transmitters can have a high duty cycle because it will be transmitting during all activity on the Repeater side. The mobile radio's used in a remote base configuration should be set to low power in most cases.

Set VFO/MEM to VFO for external frequency input.

Set CTCSS for desired frequencies. When using TM-X31/X41 series it will be set by the controller and will override your initial setting.

Set CTCSS Decode to off.

Set ABC and AL to off on models that support it.

Turn off Repeat functions.

Once these have been set, connect the Mike jack to the RBI. Reset the RBI to initialize the radio to the controller and get them in sync.

Any time there are manual changes from the radio front panel, the RBI and the Radio can get out of sync. This will require a RBI reset to correct. We recommend hooking the reset line from the RBI to an output from the controller. To reset the RBI-1, turn the output line on and back off. If you do not turn the line back off, the reset line will be held low, disabling the RBI-1. A macro can be used to let you toggle the output line with a single command.

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Command Description: C134..C147

Error Messages

These commands are used by the RLC-5 to send your error codes and responses. The controller calls these commands when a specific error occurs. These responses can be changed by making C057 call a macro instead of these commands when an error occurs and programming that macro to send a different message.

C134 - Error #0	Command Length not Matched: CW Response ER0
C135 - Error #1	Command Name not found: CW Response ER1
C136 - Error #2	Execution Blocked: CW Response ER2
C137 - Error #3	Extra Data too Long: CW Response ER3
C138 - Error #4	Extra Data too Short: CW Response ER4
C139 - Error #5	Command Name Decoded OK: CW Response ER5
C140 - Error #6	Command Executed OK: CW Response ER6
C141 - Error #7	Internal Error, Null Macro Pointer: CW Response ER7
C142 - Error #8	Internal Error, Null Function Pointer: CW Response ER8
C143 - Error #9	Nested Macro Depth Limit Reached: CW Response ER9
C144 - Error #10	Invalid Variable Length Data Length: CW Response ER10
C145 - Error #11	Invalid Value Entered: CW Response ER11
C146 - Error #12	Command Doesn't Exist: CW Response ER12
C147 - Error #13	Bad Autopatch Number: CW Response ER13

On re-initialization of the RLC-5 controller, the system will automatically write the above commands into the macro assign table. Refer to Command C057 for the macro assign programming. If you do not want an error message to be spoken, simply disable the error number in the macro assign table (See Command C059).

***Command Description: C148,C149
Not Currently Used***

Macros

The following 100 commands are the macros. They can be executed by entering their name just like any other command, C153<unkey> for example. They can also be renamed with C010 and blocked with C130. For information about programming macros, see the explanation before Command C050.

Appendix A

The Audio Routing Variable System

Explanation of the System

The key to controlling messages on the RLC-5 is understanding what the audio routing variable needs to be in each different situation. Fortunately, the RLC-5 does most of the work for you. When any command is executed by the user (either by DTMF or the serial port) or by the controller itself (to send an ID, courtesy beep, etc.), the audio routing variable is automatically set to send the audio to the logical place. You only need to concern yourself with this information if you wish to change the way the audio is routed. The value of the audio routing variable in several situations is listed below:

- When a command is executed by DTMF, the audio routing variable is set to send all of the responses to the port that the DTMF input came from.
- Before a time out, time out clear, or any ID macro is executed, the audio routing variable is set to send the message to the relevant port.
- Before a courtesy beep is sent, the audio routing variable is set to send the beeps to the right ports (repeater ports connected to the receiver that just unkeyed).

You probably noticed in the list above that the audio routing variable automatically sends the audio where you would normally want it to go. The only reason you need to know about it is because there are a few situations where the controller cannot know where you want the audio to go.

A situation exists for commands entered from the serial port. Since the controller sends serial responses to the commands that you execute, you don't have to worry about CW responses if you don't want to. There are times, however, when you want to hear the CW messages that are generated. You can use C045 to specify which ports get the audio that is caused by the serial port. The RLC-5 defaults to sending these messages out of port one, but you can send them to any ports you want to, or to no ports at all (they will be thrown away).

C045 can also be used to control where the audio that is generated by the reset macro goes, although this same functionality could be achieved by just making C042 the first command in the reset macro.

Suppressing Command Responses in Macros:

There is one other time when you will often want to change the audio routing variable. Suppose that you have programmed macro 33 to connect ports 2 and 3 to the main repeater on port 1. Your macro would probably execute C000*12* and C000*13* to do this. The CW responses from these commands would be "1 'N' 2 and 1 'N' 3" . It wouldn't take very long to get tired of hearing that long message. To replace it with a nice short message like "link on", do the following:

Insert command C043 (suppress audio) as the first command in the macro:

```
C056*183 00 043
```

If you executed the macro at this point, it would be silent.

Insert the new CW response message even before that: "LK ON"

```
C056*183 00 030 21 20 40 24 23 *
```

Now the macro will do the following:

Send the CW message "LK ON" (command number 030)

Suppress the audio (set the audio routing variable to no ports, command number 043)

Connect ports 1 and 2 (throws the responses away)

Connect ports 1 and 3 (throws the responses away)

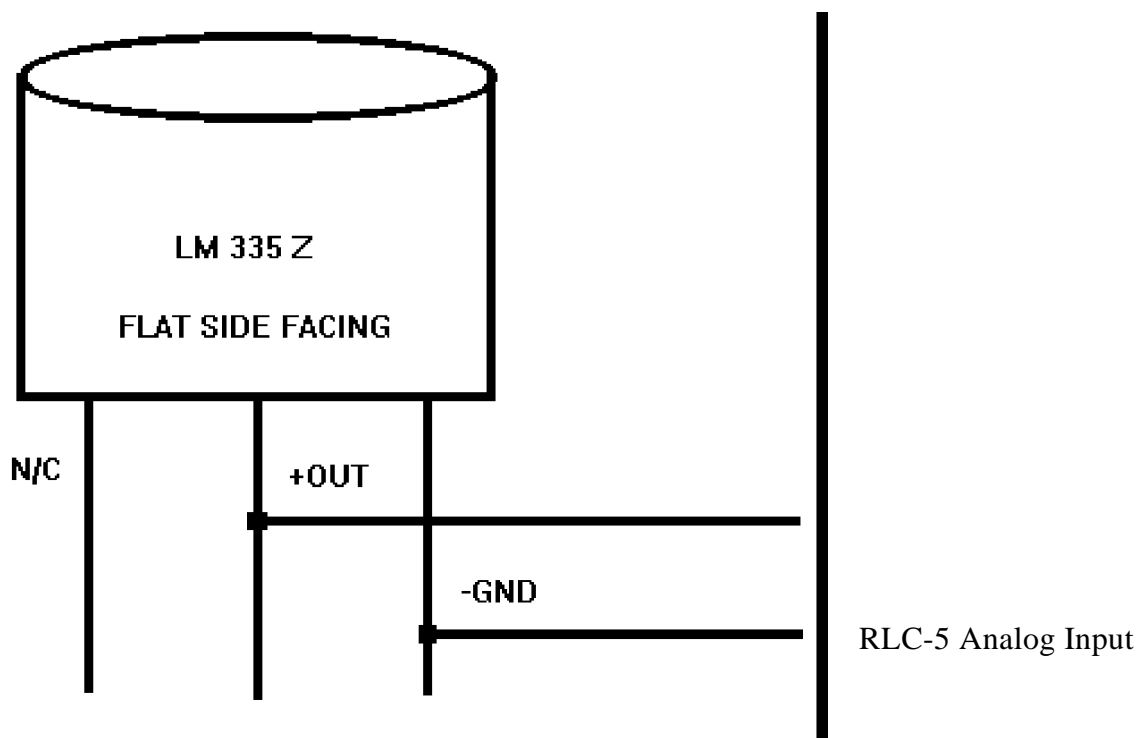
The same process can be used to suppress or change the response from any macro. Any commands that are executed after command C043 in a macro will be silent.

Appendix B

Using the LM335 Temperature Sensor (Requires Optional I/O Board)

The RLC-5 supports the National Semiconductor LM335Z temperature sensor. The sensor converts temperature into voltage. This voltage is read by the controller's ADC (Analog-Digital Converter) which allows the controller to read a voltage. When using the LM335Z sensor, the sensor needs to be powered in order for the temperature to be read. Powering the sensor is accomplished by turning the appropriate dip switch 'ON'. The dip switch contains 8 switches, 4 for power and 4 for the voltage dividers. Follow the below chart when connecting an LM335Z temperature sensor.

Analog Input #1	Switch 1 ON	Switch 5 OFF	I/O Pin #5 (IN), Pin #17 (GND)
Analog Input #2	Switch 2 ON	Switch 6 OFF	I/O Pin #4 (IN), Pin #16 (GND)
Analog Input #3	Switch 3 ON	Switch 7 OFF	I/O Pin #3 (IN), Pin #15 (GND)
Analog Input #4	Switch 4 ON	Switch 8 OFF	I/O Pin #2 (IN), Pin #14 (GND)



LM335Z Temperature Probe Connections Diagram

Appendix C CW Code Table

CW Code Table

6444444444444444L4444444444444444L4444444444444444L444444444444444447																
5	00	-	0	*	13	-	D	*	26	-	Q	*	39	-	AR	5
5	01	-	1	*	14	-	E	*	27	-	R	*	40	-	SPACE	5
5	02	-	2	*	15	-	F	*	28	-	S	*	41	-	PAUSE	5
5	03	-	3	*	16	-	G	*	29	-	T	*				5
5	04	-	4	*	17	-	H	*	30	-	U	*				5
5	05	-	5	*	18	-	I	*	31	-	V	*				5
5	06	-	6	*	19	-	J	*	32	-	W	*				5
5	07	-	7	*	20	-	K	*	33	-	X	*				5
5	08	-	8	*	21	-	L	*	34	-	Y	*				5
5	09	-	9	*	22	-	M	*	35	-	Z	*				5
5	10	-	A	*	23	-	N	*	36	-	/	*				5
5	11	-	B	*	24	-	O	*	37	-	.	*				5
5	12	-	C	*	25	-	P	*	38	-	?	*				5
9444444444444444N4444444444444444N4444444444444444N444444444444444448																

Appendix D

Automatic Macro Explanations, See Command C057

The following is a list of the macros that are automatically executed by the controller at certain times. Because they are executed automatically when something happens they are called "automatic" macros. The only difference between automatic and user macros is who (or what) decides that they should be executed. They are named according to the function that they usually perform. If you want to change how something works, you can change what commands the macro executes to suit your own desires. An example of this would be changing a pending ID macro to send your repeater's ID rather than the example ID that is programmed in at the factory.

You can execute any of these macros by entering its name, which is "C" and then the macro's number and a "*" (example C150*). This is useful for finding out what is already in the macros. You find out even more about what is in a macro by recalling its contents with command C051* then the macro's number. If you do this from a serial terminal, it will be relatively easy to understand. If you do it from a DTMF pad, the CW message may seem long and complicated. You can learn a lot about how the controller works by looking at what is inside of the macros with C051. C051 also tells you how many percent full a macro is. Macros 150..199 can store 50 keystrokes of information, and Macro 200..249 can store 20 keystrokes of information.

Macro 150. This macro should not be used. It is used by the controller for temporary storage and therefore gets overwritten often.

Macros 151..154. These macros are automatically called when it is time to send an ID. You will want to erase (with command C052) what is in these macros when you get the controller and put your own ID messages in these macros. It may be helpful to study the way these IDs are programmed at the factory (use command C051) so that you can make yours work the same way.

Macros 155..156 are executed when it is time to send a courtesy beep. You would normally call command C040 from this macro to generate the tones of your courtesy beep. If you want your courtesy beep to contain several beeps in sequence, you can call C040 multiple times within one macro, once for each beep. Examples of programming courtesy beeps are included with the instructions for command C040.

In case you were wondering, before this macro is automatically called after you unkey, the audio routing variable is set to make the tones go to the proper ports, so you do not have to worry about that at all. Just call the commands you want to be executed when it is time for a courtesy beep (you could send beeps, CW messages...) and the audio will automatically be sent to the correct ports. To change the courtesy beep timers, see command C020.

Macro 157 is called by command C114 when you hang up the autopatch. It normally sends "AP F" in CW, but you can program it to send something else, such as a DVR message. For example, C050*157025029* will program it to play DVR slot 29.

Appendix E

Reset and Initialization

The terms "reset" and "initialization" refer to totally different things on the RLC-5. The controller is "reset" when any of the following things happen:

- the power is turned off and back on
- the reset button on the motherboard is pressed and released
- command C037 is executed

Resetting the controller does not cause you to lose any of your programming. It does restart all of the timers and a lot of other internal variables. If the controller is not doing what you think it should, try resetting it and see if things straighten out.

"Initialization" (sometimes called "re-initialization") resets all of the controller's internal settings back to the factory defaults. It does cause you to lose all of your programming. You will almost always have to initialize the controller when you install a new version of software, but rarely otherwise. If you are trying to learn to program the RLC-5 and you mess things up, you can use this to put everything back the way it is supposed to be. Initialization does not hurt the RLC-5 in any way - there is no EEPROM or anything to wear out. To reinitialize the RLC-5, follow one of the two methods below:

Method #1: Press and hold the INIT button on the motherboard. Turn on the power. Wait for about 3 seconds (or longer). Release the INIT button.

Method #2: Turn the power on. Press and hold the INIT button. Press and release the RESET button. Wait at least 3 seconds. Release the INIT button.

If you are successful you will hear the message "**I-N-I-T**" out of the transmitter that is hooked to port 1 and see the message "All settings have been reset to factory defaults" on the serial terminal.

Appendix F

Programming with the Serial Port

Entering commands from the serial port works almost exactly the same way as with DTMF tones from a radio. The characters you enter on the keyboard are treated the same way as the digits on your radio keypad. Of course you can enter digits on the keyboard that you can not enter from a keypad, which gives you a little additional flexibility. Some of the things you can do from the keyboard that you cannot do from a DTMF pad are:

- Back up. If you type a digit you did not mean to type, simply press the backspace key and delete it.
- Press the Enter key. This tells the controller to try to execute whatever you have typed so far. This is exactly the same as unkeying your radio to force a command to execute.
- Store a bunch of commands in a file on your computer that you can upload them without typing them again. See the section on using a serial upload file later in this Appendix..
- Note: Do not put any spaces in the commands you enter from the serial port. The only exception to this if you are programming a serial message with command C032 and you want a space in your serial message.

Example: I want to execute Command C009 to see which ports are connected together:

Over the air:

<Key radio> C009 <Unkey or press "*">

From the serial port:

<ENTER>

You will see the serial port prompt "DTMF>". This indicates that the characters you enter are being treated just as if they were entered by DTMF from a radio port

C009 <Enter or press "*">

Example: I want to execute Command C000 to connect ports 1 and 3 together:

Over the air:

<Key radio> C000*13 <Unkey or press "*">

From the serial port:

<ENTER>

C000*13 <Enter or press "*">

Now try C009 (the first example) again. The crosspoint will show that ports 1 and 3 are not connected.

CW responses to commands entered serially:

By now you may have noticed that most commands provide both a CW and a serial response. Every command that is executed from the serial port or a radio port by DTMF will always provide a serial response. You can control whether or not you get responses to the commands you enter serially with command C045. Using that command you can tell the RLC-5 to send the responses out any port, more than one port, or nowhere at all. Normally it sends them out port one, so if you haven't heard the CW yet, you can hook up and transmitter to port 1, enter serial commands, and hear the CW responses.

Using a serial upload file:

A very convenient way to set up your controller if you have a computer is to type all of the commands that you use to set up your controller in a file using a word processor. Save the file in ASCII format. Load your communications program and make sure you are talking to the RLC-5 by hitting return and making sure you get the "DTMF>" prompt. Now do an ASCII upload of the file that you saved all of your commands in. Test the stuff you uploaded and if you want to make a change, go back to your editor and change it in the file. Now upload it again. By setting up your controller this way, you have a permanent record of everything you have done. If something ever gets messed up on the controller, all you have to do is initialize it (see Appendix E) and re-upload your file. Also, when you get a new version of software (which will almost always require you initialize), you will probably only have to make minor changes to your file to make it work with the new software version. This will definitely save you time in the long run. An example will illustrate the idea:

- Using your favorite editor, enter the following (including the comments):

```

; this is an upload file
C045*0*      Turn off the CW responses to serial commands
C000*12*    Connect ports one and two
C007*11*    Turn DTMF muting on for port 1
C045*01*    Turn on CW responses to serial commands to port 1
C030*24 20* Send the CW 'OK'

```

- Save the file as SETUP or some other name of your choice. Make sure you save the file in ASCII format if you are using a word processor that embeds control codes.
- Load your communications program.
- Hit <enter> and watch for the "DTMF>" prompt from the RLC-5. If you do not get it, check your cable and setup in your communications software.
- You may want to tell your communications program to open a log file at this point. It will come in handy for checking if any of the commands cause errors during the upload.

- Find the setup screen for "ASCII Transfers" and set the end of line delay to at least one second. If you do not do this, the RLC-5 will not have enough time to send its serial command responses back and it will miss data. This delay may have to be longer if you use very slow baud rates (below 2400 baud). If you can not find this setting, try double or triple spacing your upload file or putting several '~' characters at the end of each line.
- Start an ASCII upload of your file.
- Close the log file if you opened one.
- Try out your new settings. C009 will check the crosspoint and C008 will check the DTMF muting.
- Go back to your editor, make the required changes, and repeat the cycle.

Note about comments in serial upload files: If you always end your commands with a star, you can space or tab over to the right and add comments. You can also put comments on a line without a command by using a space or semicolon (" ;") as the first character on the line.

Note about capital letters: By default the RLC-5 converts everything you type to capital letters. This is because DTMF characters are always treated as capital letters and it avoids confusion. However, there may be a time when you would like to enter lower case letters, such as when you send serial messages with command C035. At those times you can turn off the conversion to all capital letters with command C060, program the serial messages, then turn the conversion back on.

Appendix G

ASCII Chart

This chart may be helpful when programming serial messages with C035. Not all of the codes are included because not all of them are universally used and some don't print well.

032	072 H	112 p	153 Ö	193 2	233 1
033 !	073 I	113 q	154 Ü	194 0	234 S
034 "	074 J	114 r	155 ¢	195 /	235 *
035 #	075 K	115 s	156 £	196)	236 4
036 \$	076 L	116 t	157 ¥	197 3	237 N
037 %	077 M	117 u	158 P _t	198 G	238 ,
038 &	078 N	118 v	159 f	199 K	239 1
039 '	079 O	119 w	160 á	200 9	240 /
040 (080 P	120 x	161 í	201 6	241 ±
041)	081 Q	121 y	162 ó	202 =	242 \$
042 *	082 R	122 z	163 ú	203 ;	243 #
043 +	083 S	123 {	164 ñ	204 :	244 !
044 ,	084 T	124	165 Ñ	205 4	245 "
045 -	085 U	125 }	166 ^a	206 >	246 ÷
046 .	086 V	126 ~	167 °	207 N	247 .
047 /	087 W	128 Ç	168 ç	208 J	248 E
048 0	088 X	129 ü	169 1	209 L	249 @
049 1	089 Y	130 é	170 ¬	210 H	250 ·
050 2	090 Z	131 â	171 ½	211 F	251 %
051 3	091 [132 ä	172 ¼	212 B	252 ⁿ
052 4	092 \	133 à	173 ¡	213 ?	253 ²
053 5	093]	134 å	174 «	214 C	254 ■
054 6	094 ^	135 ç	175 »	215 0	255
055 7	095 _	136 ê	176 !	216 P	
056 8	096 `	137 ë	177 "	217 -	
057 9	097 a	138 è	178 #	218 +	
058 :	098 b	139 ì	179 *	219 S	
059 ;	099 c	140 î	180 1	220 (
060 <	100 d	141 ì	181 I	221 %	
061 =	101 e	142 Ä	182 M	222 '	
062 >	102 f	143 Å	183 D	223 &	
063 ?	103 g	144 É	184 @	224 "	
064 @	104 h	145 æ	185 <	225 ß	
065 A	105 i	146 Æ	186 5	226 '	
066 B	106 j	147 ô	187 7	227 B	
067 C	107 k	148 ö	188 8	228 E	
068 D	108 l	149 ò	189 E	229 F	
069 E	109 m	150 û	190 A	230 µ	
070 F	110 n	151 ù	191 ,	231 J	
071 G	111 o	152 ÿ	192 .	232 M	

