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Introduction:

Congratulations, you have purchased a very powerful tool for your group's repeater. The RLC-1 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-1 repeater controller consists of one repeater port, one linking port, four analog voltage inputs, four logical (dry contact) inputs, and five MOSFET output drivers. The repeater and linking ports can be configured to require combinations of COR and PL inputs for access. The RLC-1 has a single DTMF decoder that scans between the two receiver ports, thereby supporting DTMF control from all ports of the controller. Speed selectable Morse Code prompts the users in the programming of the controller's variables.

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 explain everything in a way that is easy to understand, but some questions are inevitable. If you have carefully read the manual and still have questions, call or fax us at (406) 482-7515 or write to us at

Link Communications, Inc
P.O. Box 1071
Sidney, MT 59270
Limited Warranty

COVERAGE:

Link Communications 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 will cover parts, labor and return shipping. If failure is caused by instances other than manufacturing defects, Link Communications will repair the product and bill the customer for parts and labor. Contact Link Communications for more information.

What Link Communications will not cover:

1. Too much voltage to the controller. The RLC-1 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.

THIS WARRANTY HOLDS ONLY TO THE ORIGINAL PURCHASER

HOW TO GET SERVICE
Please contact Link Communications for servicing information and authorization.

SOFTWARE
Link Communications holds the copyright on the RLC-1’s software and hardware. Changes to the software and copying of the software is prohibited without the written consent of Link Communications.
**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.

<table>
<thead>
<tr>
<th>RLC-1 Serial Number</th>
<th>_____________________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>RLC-1 Purchase Date</td>
<td>____________________________</td>
</tr>
</tbody>
</table>

**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 Products Used: Yes  No

**Misc:**
- 1 - User Base: Technical  Rag Chew  Personal
- 2 - Autopatch used on the System: Yes  No
- 3 - Frequency Adjustable Remote: 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-1. After that there is information concerning the other input and output features of the RLC-1: 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-1 Repeater Controller
(1) 2.50mm Power Connector
(3) DB-9 Male Solder Connectors
(1) DB-25 Male Solder Connector
(1) RLC-1 Manual

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

Step #2: Connect Power

- The RLC-1 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.

- When power is applied to the RLC-1 controller, the DTMF Valid LED will flicker, and the Repeater port transmitter will send out a CW message 'RESET ?'
Step #4: Connecting Your Receivers to the RLC-1

The main repeater and the link port connect to the RLC-1 using male DB-9 connectors (included).

**Main Port and Link Port**

1 - Ground Reference  
2 - PL Input (Active Low)  
3 - PTT Out (Active Low)  
4 - Audio Out (10K OHM)  
5 - Audio In (10K OHM)  
6 - Ground Reference  
7 - COR Input (Selectible Polarity)  
8 - Ground Reference  
9 - Ground Reference

**Connecting the Receiver COR:**  
- The first step in connecting your receiver is to locate a COR signal. This signal indicates if the receiver is active or inactive. The RLC-1 will accept either an Active high COR (Goes from ground to above 4 volts, or open), or an Active low COR (Goes from a voltage greater than 4 volts, to a ground, or goes from an open to a ground). The input impedance of the RLC-1 COR input is 10KΩ 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 Micro-Processor.**

**Selecting COR Polarity Jumpers:**  
Once you have determined the polarity of your COR signal, you need to tell the RLC-1 what the polarity is. This is accomplished using jumpers J4 for the Main Receiver COR, and J5 for the Link Receiver COR. When the jumper is connected across the 2 pins, the COR is expected to be Active Low. When the jumper is not connected across the 2 pins, the COR is expected to be Active High. The RLC-1 comes shipped with the COR's selected to be Active Low (Jumper Connected)

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, it can be connected to pin #2 of the appropriate connector in the same fashion as the COR input. See Commands C005..C006 for information on using the PL input.

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Connecting the Receiver Audio:
- 2 types of audio can be used on the RLC-1 controller:

Type 1: Deemphasized audio (Speaker Audio)
Type 2: Discriminator audio (Raw Unsquelched Audio)

- If type 1 audio is used, remove the appropriate jumper on the controller. This removes the
demphasis filter from the circuit. As the controller comes shipped, all ports are set up for type 1
audio.

J1 - Main Receiver Deemphasis Jumper
J2 - Link 1 Receiver Deemphasis Jumper

- If type 2 audio is used, place the appropriate jumper in circuit (over both pins). This will place a
- 6dB/octave deemphasis filter into the circuit. Some discriminators can not directly drive the
10KΩ input impedance. If this is the case, a pre-driver or different audio access point will be
required.

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

- The audio adjustments will be described in Step #5.

How the DTMF Decoder Works:
The RLC-1's DTMF decoding circuit uses a scanner that enables the controller to receive tones
from all the ports, without mixing the two receiver's audio together. This allows the receivers to
have total control of the DTMF decoder when its Receiver is active. Once the decoder has
detected a tone on one of the ports, it stops scanning and waits up to four seconds for the next
digit. It is reset at the beginning of each DTMF digit. If any of the DTMF digits are held for
longer than 4 seconds or there is a pause of 4 seconds between digits, the DTMF scanner will
resume scanning and all digits entered up to that point will be lost.

Step #5: Connecting Your Transmitters to the RLC-1

Transmitter PTT:
- The RLC-1 produces an active low PTT signal (ground when PTT is active). This output is
buffered with an open drain 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-1 provides a 10KΩ output impedance to your transmitter audio input.
- The transmitter audio is connected to pin #4 of the DB-9 connector.
- The audio levels will be adjusted in Step #5.
- If it is not already, the DB-9 plug can now be plugged into the appropriate jack on the main board. The link port is located to the left of the main port connector.

Step #5: Adjusting the RLC-1 Controller
Locate connector J10 on the RLC-1 (it is above the 2 voltage regulators). This test bus will provide the signals that we need to adjust the inputs on the RLC-1. 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 a meter, you will need to adjust to 1.4 volts RMS, which is equivalent to 2.0 volts peak-to-peak measured with an oscilloscope. In order to obtain an audio signal on J10, a valid COR or PL must be received (See Access Modes for the proper signal style).

Main Receiver: Transmitter Port Adjustment:
- Present a stable DTMF tone to the Main RX.
- Adjust the Main RX pot on pin 1 of J10 (Labeled MI) to 2 volts peak-to-peak.
- This pot is Labeled MAIN REC. R11
- Adjust the Main TX pot to obtain the desired deviation.

Link Receiver Port Adjustment:
- Present a stable DTMF tone to the Link RX.
- Adjust the Link RX pot on pin 2 of J10 (Labeled LI) to 2 volts peak-to-peak.
- This pot is Labeled LINK REC. R15
- Adjust the Main TX pot to obtain the desired deviation.

Main Transmitter Adjustment:
- Present the Main RX with the same DTMF tone used earlier.
- Adjust R19 (MAIN TRANS.) Pot to the desired deviation.
- Access to the Main TX Audio is available at J10, Pin 5 (Labeled MO)

Link Transmitter Adjustment:
- Present the Main RX with the same DTMF tone used earlier.
- Command Main-Link Connection using Command C000
- Adjust R25 (LINK TRANS.) Pot to the desired deviation.
- Access to the Link TX Audio is available at J10, Pin 6 (Labeled LO)

Beep Adjustment:
- Adjust R4, MAIN TONE until it "sounds" good, or about 1.5 Khz. Deviation
- Adjust R5, LINK TONE until it "sounds" good, or about 1.5 Khz. Deviation
Serial Port Interfacing

The RLC-1 has a serial terminal port for interfacing to any serial device, i.e. packet and serial terminal. This allows the user to monitor, control, and program all facets of the controller. The serial terminal carries highest priority for access and programming of the RLC-1. There is an 8 digit password needed to log on to the serial port of the controller, ensuring the security of the system. The format for the input password is simply "$[$$$$$$]", where "$" is any ASCII character. The serial system can not be accessed from the DTMF port decoder, only via a serial system. The RLC-1 output is the RS-232 standard, ±12V.

Pin-Out Serial P1 Connector

1 - No Connection
2 - RS-232 Data Output (To Your Terminal)
3 - RS-232 Data Input (From your Terminal)
4 - No Connection
5 - Ground Reference
6 - No Connection
7 - No Connection
8 - No Connection
9 - Ground Reference

Local Terminal Interfacing

When using a local ASCII terminal at the RLC-1’s location, an ASCII terminal can be used to communicate with the programming features of the RLC-1. The terminal's communication parameters must be set to:

Baud ............ 2400
Start Bits......... 1
Stop Bits .......... 1
Parity ............ N
Word Length ........ 8

These parameters will allow communication with the RLC-1. For system operations, see the next section "Operation and Programming Over the Serial Port".
Operation and Programming Over the Serial Port

The RLC-1’s serial port gives the controller the ability to communicate with the world over a digital radio link. The RLC-1 has a security key of 10 characters that must be entered properly in order to have the RLC-1 communicate with your computer terminal. The syntax of the initial password is as follows:

[$$$$$$$$$

"[" is the first character entered
"]" is the last character entered
"$" is any ASCII character except the ":" or "]"

The default password is: [ABCDEFGH]
Once the proper password has been entered, the RLC-1 will respond with the message

"RLC-1: LOG ON"

If you did not receive this message after you logged on, then check:
- Are you already logged on?
- Do you have the correct password, including CAPS LOCK?
- Is your serial port connected and configured correctly?

Once on the serial system, you have access to all features of the RLC-1, and several special commands only for the serial user. A very important note, all commands entered over the serial port must begin with a "[" and end with a "]" in order to be accepted.

Serial Command Structures:
- Upper Case Letters must be used
- You must log on before any control can take place
- Lack of activity on the serial port will cause an automatic log off after 1 minute

RLC-1 Command Entry:
- All command names must be 4 characters long
-- Command name "12" must be entered as "0012"
- No <EOF> key is needed in the data string
-- To do a keypad test, the normal DTMF tones are: C041*123456789*
-- Over the serial port the data string is: [C041123456789]
- Commands are entered exactly like over the are, except for the above "Rules"
- CW response will be over the Main Repeater port, unless the Command states Different
- Characters entered for RLC-1 Commands must be limited to the DTMF Tones
-- 0 1 2 3 4 5 6 7 8 9 A B C D * #
-- Do not use you <EOF> key in the string, it will cause incorrect execution of the command
Serial Commands Entry Format:
- All Serial Commands begin with the Letter "S"
- The Commands number from 00 .. 05

Serial Commands:
S00 - Dump of Command Names

C000 : C001 : C002 : .. C042:

S01 - Formatted Dump of the Output Lines, Input Lines, and Analog Lines

Outputs:
1 - N or F
2 - N or F
3 - N or F
4 - N or F
5 - N or F

Inputs:
1 - H or L
2 - H or L
3 - H or L
4 - H or L

Analog:
1 - Actual Dump of programmed Value
2 - Actual Dump of programmed Value
3 - Actual Dump of programmed Value
4 - Actual Dump of programmed Value

S02 - Dump of Selected Macro Position

Example: Two output lines turned on with one command
[

Macro 1:

C017 Plus 01:01
C017 Plus 02:00

]
**S03 - Change the Serial Systems Log-On Password Name**

This command allows the user to change the serial log-on password (Default ABCDEFGH) from its current name, to a new name. It is very important not to forget your serial log-on. If you forget your log-on name, controller re-initialization will be needed.

Format for programming:

\[S03 \#\#\#\#\# \$\$\$\$\$\$

\#\#\#\#\# is the Current Serial Password, 8 Characters in Length
\$\$\$\$\$\$ is the New Serial Password, 8 Characters in Length

The Serial Output:

```
[ Old: 
    \#\#\#\#\#\
    New: 
    \$\$\$\$\$\$ 
]
```

**S04 - System Configuration View Screen**

This command allows the user to view the system configuration for each port. The screen will show each ports access type, either COR or COR and PL. This command also allows the port configurations, either repeater port or a link port.

Configuration:

Access:
Main: COR (or) COR and PL (or) RX/TX Off
Link: COR (or) COR and PL (or) RX/TX Off

Connect Type:
Main: Repeater Port (or) Link Port -----, <-----, <----> Link: Repeater Port (or) Link Port
----- Indicates No Communication Between Ports
<----- Indicates Communication only 1 Direction
<----> Indicates Communication both Directions

**S05 - Serial System Log OFF**

This command logs the serial server off the RLC-1 Controller. The Serial Port Log-Off Message will appear when you Log-Off. If you do not Log-Off, the RLC-1 will automatically Log-Off after 1 Minute of Non-Activity.

"RLC-1: LOG OFF"

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Logical Latched Output Lines

The RLC-1 offers 5 logical control lines for site control. These 5 latched control lines are power MOSFETs in "open drain" configuration. Because the output lines are open drain, the user will not measure any voltage on the output lines, only an open or a ground. In order to check the condition of the control lines, a meter set to resistance will be needed. The meter will read an open when the control line is off and closed (connected to ground) when the control line is on. When using a semiconductor device as a latch, certain current limitations are imposed. The MOSFET used can sink (apply a ground), of 150mA. If this current is exceeded, the MOSFET will short and destroy the device. The RLC-II has a 30V zener clamping diode on each output line to protect the MOSFET from damage when using a relay on the output line. Figure #2 shows how to connect a relay to one of the output lines. (See Command Listing for output control line commands).

**Pin-Out Logical Latched Outputs P5 Connector**

01 - Output #1  
14 - Output #2  
02 - Output #3  
15 - Output #4  
03 - Output #5  
12 - Ground  
13 - Ground  
16 - Ground  
25 - Ground

![Figure #2 Relay Interfacing to a Control Line](image-url)
Logical Input Line

The RLC-1 offers the user 4 logical input lines. These lines recognize an open/ground input change. These lines are internally pulled up to +5 Volts and zener diode clamped to 5 Volts. This allows direct interface to higher voltage inputs that do not exceed +40 Volts. The application to site users is great: door open/closed magnetic contacts (See Figure #3a), local site controlled switches, and site power monitoring relays (See Figure #3b). These are just a few of the applications that the logical input lines can be used for.

Pin-Out Logical Inputs P5 Connector

17 - Input #1
18 - Input #2
19 - Input #3
20 - Input #4
04 - Ground
05 - Ground
06 - Ground
07 - Ground

Figure #3a Magnetic Door Alarm Interface

Figure #3b Local House Power Failure Alarm
Analog Input Telemetry Lines

The RLC-1 offers what most other controllers charge thousands for, 4 analog monitoring input lines. This is a nice feature that allows the site owner to monitor analog conditions like temperature, site voltages (See Figure #4a and following page), forward and reflected power, heat sink temperature, and much more. The RLC-1 comes set up to measure 0-4 Volts with 20mV resolution. Several voltage conversion faceplates are provided to convert an input voltage to another function. Included faceplates:

1 - Voltage 0.00 - 4.00 Volts
2 - Voltage 00.0 - 25.0 Volts *
3 - Celsius Temperature †
4 - Fahrenheit Temperature †

It is important not to apply over 10 volts to the RLC-1 analog inputs*. If this voltage level is exceeded, damage to the analog opamp will occur.

Pin-Out Analog Inputs P5 Connector

21 - Analog Input #1
08 - Ground Reference
22 - Analog Input #2
09 - Ground Reference
23 - Analog Input #3
10 - Ground Reference
24 - Analog Input #4
11 - Ground Reference

* To read voltages greater than 4.00 volts, you must use the voltage divider circuit shown on the next page. Please note that this circuit drops the voltage that actually reaches the input of the RLC-1 to 4 volts or less when the input to the divider is 25 volts or less.

† To read temperatures with the LMx35 temperature sensors, you should install the appropriate jumper: J6..J9. This provides power to the sensor. The jumpers should be removed for all other applications.

Figure #4a Site AC House Power Monitor
Other Analog Input Examples
Programming and Commands

This section of the manual first discusses some of the things you need to know that are common to all of the commands. It then has a list of the commands sorted according to their function, a list sorted according to the command name, and lastly a detailed description of what each command does and how it is used.

Command Names

The default command names all begin with the letter 'C'. This 'C' is part of the command name, not just an indication that it is a command. For example, to connect the link to the main port, you would enter the DTMF tones 'C', '0', '0', '0', '*'. This assumes that your DTMF pad has 16 keys (0-9, *, #, A-D); the letters corresponding to the numbered keys on a telephone (2=A,B,C) will not work. The command names can be changed with Command C038.

The <EOF> Key

The <EOF> key refers to the key that is used to tell the controller that the command has been entered (with the DTMF pad) and that it is time to act on it. It is also used to separate the command name from any parameters (extra data) it might have. The <EOF> key is '*' by default, but this can be changed with Command C039.

Programming Messages

Link, and ID messages in the RLC-1 can be changed to a message more specific to your controller. This is done with command C036, "Message Program Utility." These messages are composed of CW characters, the codes for which are found in the CW Table (Appendix A). Each character is identified by a two digit code (leading 0s are necessary for short codes). Each message has a specific maximum length, although not all messages have the same maximum. See Commands C036, and C037 for more information on message programming, and C014, C015 and C016 for CW frequency and speed.
Command Listing (by function)

Receiver Access Commands

Main Port:
- Selects Access Modes for Main Receiver
  -- COMMAND C005
- Selects COR and PL Access for Main Receiver
  -- COMMAND C005*2
- Selects COR Access for Main Receiver
  -- COMMAND C005*1
- Selects NO Access for Main Receiver
  -- COMMAND C005*0

Link Port:
- Selects Access Modes for Link Receiver
  -- COMMAND C006
- Selects COR and PL Access for Link Receiver
  -- COMMAND C006*2
- Selects COR Access for Link Receiver
  -- COMMAND C006*1
- Selects NO Access for Link Receiver
  -- COMMAND C006*0

Main Port - Link System Variables

Main - Link Only:
- Selects Main Port ON Link Port, TX and RX
  -- COMMAND C000
- Removes Main Port OFF Link Port, TX and RX
  -- COMMAND C002
- Allows Main Port to MONITOR Link Port RX, no TX
  -- COMMAND C001

Main and Link Port Timers:
- Programs Main and Link Port Timers:
  -- COMMAND C010* ### $$ (in 10mS Steps)

  - Programs Main and Link Port Time-Out Timers:
    -- COMMAND C011* ## $$ (in 1 Minute Steps)

  - Programs Main and Link Port ID Timer (When Port is in Loop Back)
    -- COMMAND C013* ## $$ (in 1 Minute Steps)
Main and Link Port Beeps:
- Programs Main Port Courtesy Beep
  -- COMMAND C007* ##...## (Courtesy Beep Data)

- Programs Link Port Courtesy Beep
  -- COMMAND C008* ##...## (Courtesy Beep Data)

- Programs Main and Link Port Courtesy Timers:
  -- COMMAND C013* ## $$ (in 10mS Steps)

- Programs Main - Link Port 'ON' Message
  -- COMMAND C036*3 ##...## (CW Code Data)

- Programs Main - Link Port 'MONITOR' Message
  -- COMMAND C036*5 ##...## (CW Code Data)

- Programs Main - Link Port 'OFF' Message
  -- COMMAND C036*4 ##...## (CW Code Data)

- Programs Main Port 'ID' Message
  -- COMMAND C036*1 ##...## (CW Code Data)

- Programs Link Port 'ID' Message
  -- COMMAND C036*2 ##...## (CW Code Data)

- Programs Main Port into Loop Back Mode (Repeater Mode)
  -- COMMAND C003*1

- Programs Link Port into Loop Back Mode (Repeater Mode)
  -- COMMAND C004*1

- Programs Main Port into Normal Linking Mode
  -- COMMAND C003*0

- Programs Link Port into Normal Linking Mode
  -- COMMAND C004*0

Command Name and Enter Key Name Change:
- Changes the Current Command Name to a New Command Name
  -- COMMAND C038*#### $$$$ (#-Old, $-New)
- Changes the Current <EOF> Digit to a New Name
  -- COMMAND C039*# (*-Old, #-New)
Analog Lines Reading

Analog Input #1:
- Read Analog Input #1
  -- COMMAND C019
- Programs Analog Input #1 Voltage/Temperature Faceplate
  -- COMMAND C024*1 $ (1-Line, $-Faceplate)
- Programs Analog Input #1 Offset Value
  -- COMMAND C023*1 $$ ($$-00..19 Offset Value, 10=No Offset)

Analog Input #2:
- Read Analog Input #2
  -- COMMAND C020
- Programs Analog Input #2 Voltage/Temperature Faceplate
  -- COMMAND C024*2 $ (2-Line, $-Faceplate)
- Programs Analog Input #2 Offset Value
  -- COMMAND C023*2 $$ ($$-00..19 Offset Value, 10=No Offset)

Analog Input #3:
- Read Analog Input #3
  -- COMMAND C021
- Programs Analog Input #3 Voltage/Temperature Faceplate
  -- COMMAND C024*3 $ (3-Line, $-Faceplate)
- Programs Analog Input #3 Offset Value
  -- COMMAND C023*3 $$ ($$-00..19 Offset Value, 10=No Offset)

Analog Input #4:
- Read Analog Input #4
  -- COMMAND C022
- Programs Analog Input #4 Voltage/Temperature Faceplate
  -- COMMAND C024*4 $ (4-Line, $-Faceplate)
- Programs Analog Input #4 Offset Value
  -- COMMAND C023*4 $$ ($$-00..19 Offset Value, 10=No Offset)

Keypad Test:
- Allows the User to Key in up to 20 DTMF Pad Tones
  -- COMMAND C041* ###...### (DTMF Keys)
Input Lines Reading

Input Line #1:
- Read Input Line #1
-- COMMAND C018*1 ('H' if High, 'L' if Low)

Input Line #2:
- Read Input Line #2
-- COMMAND C018*2 ('H' if High, 'L' if Low)

Input Line #3:
- Read Input Line #3
-- COMMAND C018*3 ('H' if High, 'L' if Low)

Input Line #4:
- Read Input Line #4
-- COMMAND C018*4 ('H' if High, 'L' if Low)
Output Lines Control, and Reading

Output Line Control:
- Output Line #1 'ON' (LOW)
  -- COMMAND C017*1 1
- Output Line #1 'OFF' (OPEN)
  -- COMMAND C017*1 0
- Output Line #1 Interrogate
  -- COMMAND C017*1

- Output Line #2 'ON' (LOW)
  -- COMMAND C017*2 1
- Output Line #2 'OFF' (OPEN)
  -- COMMAND C017*2 0
- Output Line #2 Interrogate
  -- COMMAND C017*2

- Output Line #3 'ON' (LOW)
  -- COMMAND C017*3 1
- Output Line #3 'OFF' (OPEN)
  -- COMMAND C017*3 0
- Output Line #3 Interrogate
  -- COMMAND C017*3

- Output Line #4 'ON' (LOW)
  -- COMMAND C017*4 1
- Output Line #4 'OFF' (OPEN)
  -- COMMAND C017*4 0
- Output Line #4 Interrogate
  -- COMMAND C017*4

- Output Line #5 'ON' (LOW)
  -- COMMAND C017*5 1
- Output Line #5 'OFF' (OPEN)
  -- COMMAND C017*5 0
- Output Line #5 Interrogate
  -- COMMAND C017*5
Command Listing (by function)

Macros

- Programs 1 of the 7 multiple command Macros
-- COMMAND C037*1-7

- Recalls Macro #1 COMMAND C025
- Recalls Macro #2 COMMAND C026
- Recalls Macro #3 COMMAND C027
- Recalls Macro #4 COMMAND C028
- Recalls Macro #5 COMMAND C029
- Recalls Macro #6 COMMAND C030
- Recalls Macro #7 COMMAND C031

Macros 1 .. 7 are 30 Keystroke Sequences

(See Command C032 for more Information)

DTMF Tone Muting

Mutes DTMF Transmitters:
- Toggles Mute Function for Main and Link Port Transmitters
-- COMMAND C009* # $ (#-1/0 Main, $-1/0 Link)
Command Listing (by name)

<table>
<thead>
<tr>
<th>Name:</th>
<th>Brief Functional Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C000</td>
<td>Link Port RX/TX Enabled <strong>ON</strong> Main Port System</td>
</tr>
<tr>
<td>C001</td>
<td>Link Port RX Enabled Monitor <strong>ON</strong> Main Port System</td>
</tr>
<tr>
<td>C002</td>
<td>Link Port Disabled <strong>OFF</strong> Main Port System</td>
</tr>
<tr>
<td>C003</td>
<td>Main Port Loop Back <strong>ON/OFF</strong></td>
</tr>
<tr>
<td>C004</td>
<td>Link Port Loop Back <strong>ON/OFF</strong></td>
</tr>
<tr>
<td>C005</td>
<td>Main Port System</td>
</tr>
<tr>
<td>C006</td>
<td>Link Port Access Mode #0,1,2</td>
</tr>
<tr>
<td>C007</td>
<td>Main Port Courtesy Beep Message Type #0,1,2</td>
</tr>
<tr>
<td>C008</td>
<td>Link Port Courtesy Beep Message Type #0,1,2</td>
</tr>
<tr>
<td>C009</td>
<td>DTMF Mute <strong>ON/OFF</strong> Main and Link Port</td>
</tr>
<tr>
<td>C010</td>
<td>Hang Timer Main and Link Port</td>
</tr>
<tr>
<td>C011</td>
<td>Time-Out Timer Main and Link Port</td>
</tr>
<tr>
<td>C012</td>
<td>Courtesy Timer Main and Link</td>
</tr>
<tr>
<td>C013</td>
<td>ID Timer Main and Link</td>
</tr>
<tr>
<td>C014</td>
<td>Main Port CW Frequency</td>
</tr>
<tr>
<td>C015</td>
<td>Link Port CW Frequency</td>
</tr>
<tr>
<td>C016</td>
<td>CW ID Speed</td>
</tr>
<tr>
<td>C017</td>
<td>Output Line 1-5 Interrogate, and Control</td>
</tr>
<tr>
<td>C018</td>
<td>Input Line 1-4 Interrogate</td>
</tr>
<tr>
<td>C019</td>
<td>Read Analog Input #1</td>
</tr>
<tr>
<td>C020</td>
<td>Read Analog Input #2</td>
</tr>
<tr>
<td>C021</td>
<td>Read Analog Input #3</td>
</tr>
<tr>
<td>C022</td>
<td>Read Analog Input #4</td>
</tr>
<tr>
<td>C023</td>
<td>Analog Input 1-4 Offset Adjust</td>
</tr>
<tr>
<td>C024</td>
<td>Analog Input 1-4 Faceplate Select</td>
</tr>
<tr>
<td>C025</td>
<td>Macro #1 Recall</td>
</tr>
<tr>
<td>C026</td>
<td>Macro #2 Recall</td>
</tr>
<tr>
<td>C027</td>
<td>Macro #3 Recall</td>
</tr>
<tr>
<td>C028</td>
<td>Macro #4 Recall</td>
</tr>
<tr>
<td>C029</td>
<td>Macro #5 Recall</td>
</tr>
<tr>
<td>C030</td>
<td>Macro #6 Recall</td>
</tr>
<tr>
<td>C031</td>
<td>Macro #7 Recall</td>
</tr>
<tr>
<td>C032</td>
<td>Macro 1-7 Keystroke Program</td>
</tr>
<tr>
<td>C033</td>
<td>Doug Hall RBI-1 Parameter Program</td>
</tr>
<tr>
<td>C034</td>
<td>Disable Input #4 Auto-Command Execution</td>
</tr>
<tr>
<td>C035</td>
<td>Send Port ID (Port Dependent)</td>
</tr>
<tr>
<td>C036</td>
<td>Program CW Message Utility</td>
</tr>
<tr>
<td>C037</td>
<td>Recall CW Message Utility</td>
</tr>
<tr>
<td>C038</td>
<td>Command Name Change Utility</td>
</tr>
<tr>
<td>C039</td>
<td>&lt;EOF&gt; Key Rename Utility</td>
</tr>
<tr>
<td>C040</td>
<td>Interrogate Main and Link System</td>
</tr>
<tr>
<td>C041</td>
<td>DTMF Keypad Test</td>
</tr>
<tr>
<td>C042</td>
<td>RLC-1 Remote Reset Utility</td>
</tr>
</tbody>
</table>

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In Depth Command Description:  C000..C002
Link Port RX / TX Control on Main Port

These commands allow the user to connect the link to or disconnect the link from the Main Port. This connection can be two-way or receive only. Receive only mode allows the Main Port to be used to monitor the link port without any traffic from the main port going out over the link port. The CW responses can be changed with Command C036.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link RX &amp; TX</td>
<td>C000*</td>
<td>LINK ON</td>
</tr>
<tr>
<td>RX Only</td>
<td>C001*</td>
<td>LINK M O N</td>
</tr>
<tr>
<td>Off</td>
<td>C002*</td>
<td>LINK OFF</td>
</tr>
</tbody>
</table>

Parameters: None

Defaults:
- Link Port Off of Main Port

No Error Messages:
In Depth Command Description: C003 and C004
Main and Link Port Loop-Back Enable/Disable

These commands allow the Main and Link ports to be converted to repeater ports or link ports. When the Main port is converted to a link port, the COR-PTT loop-back from the Main receiver to the Main transmitter is disconnected. When the Link port is converted to a repeater port, the COR-PTT loop-back from the Link receiver to the Link transmitter is connected. Both ports on the RLC-1 can be converted to links or repeaters, or any combination between the two systems.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Loop Back</td>
<td>C003*$*$</td>
<td>Main Port ID</td>
</tr>
<tr>
<td>Link Loop Back</td>
<td>C004*$*$</td>
<td>Link Port ID</td>
</tr>
</tbody>
</table>

Parameters:
- $ - 1 Enables Main / Link Port Loop Back
- 0 Disables Main / Link Port Loop Back

Defaults:
- Main Port Loop Back Enabled
- Link Port Loop Back Disabled

Error Message:
If the format is not correct, the RLC-1 will send a "E" error code.

ER1 - Too Many Digits Entered
ER2 - Invalid Mode Selected
In Depth Command Description: C005 and C006
Main and Link Access Mode

The RLC-1 offers the user the ability to select from three modes. These conditions are based on the state of the COR and PL (CTCSS) inputs. The RLC-1 will accept either an Active High COR (COR goes from ground, or 0 Volts to a point above 4 Volts), or an Active Low COR (COR goes from a voltage above 4 Volts, to ground, or 0 Volts). The COR polarity is selected using the 2 COR jumpers: J4 for Main port, and J5 for Link port. If the jumper is connected across the 2 pins, then the COR must be Active Low. If the jumper is not connected, then the COR is Active High.

PL (CTCSS) inputs must be Active Low in order for the RLC-1 to recognize activity. They can be inverted with a transistor if necessary. Either just COR or both COR and PL inputs must be active, depending on the access mode, in order for the RLC-1 to recognize the receiver.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Description</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>NO ACCESS</td>
<td>No transmit or receive allowed</td>
</tr>
<tr>
<td>1</td>
<td>COR ACCESS</td>
<td>COR activity trigger repeater</td>
</tr>
<tr>
<td>2</td>
<td>COR and PL ACCESS</td>
<td>COR/PL activity trigger repeater</td>
</tr>
</tbody>
</table>

This selection of modes allows the RLC-1 user to remotely control access to the controller during high traffic times.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mode 0</td>
<td>C005<em>0</em></td>
<td></td>
</tr>
<tr>
<td>Mode 1</td>
<td>C005<em>1</em></td>
<td>CW BEEP RSP</td>
</tr>
<tr>
<td>Mode 2</td>
<td>C005<em>2</em></td>
<td></td>
</tr>
</tbody>
</table>

| Link        |         |             |
| Mode 0      | C006*0* |             |
| Mode 1      | C006*1* | CW BEEP RSP |
| Mode 2      | C006*2* |             |

Parameters:
All parameters are incorporated into the chart above

Defaults:
- COR Access (Mode 1) for both ports

Error Messages:
If the format is not correct, the RLC-1 will send a "E" error code.
ER1 - Not a Valid Mode, Must be 0..2
ER2 - Digit Counter Error, Too Many digits Entered
In Depth Command Description: C007 and C008
Set Main and Link Courtesy Beep Type

The RLC-1 offers the user the ability to program a specialized courtesy beep for the link. The link beep will go out the main port when the link is enabled (C000 and C001) and the main port is in loop-back mode (C003*1). The main beep will go out the link port when the main-link port is enabled (C000) and the link port is in loop-back mode (C004*1). In order to send a courtesy beep out any port, the port must be configured as a repeater port. The courtesy beep generator can handle 2 types of beeps:

- Single tone with programmed duration and frequency
- Two tones sequential with programmed duration and tones

This allows nice tones to be generated when receiver activity disappears.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main</td>
<td>Single</td>
<td>C007<em>1 &amp;&amp;&amp;&amp; %</em></td>
</tr>
<tr>
<td></td>
<td>Dual</td>
<td>C007<em>2 &amp;&amp;&amp;&amp; % $$$$ ## @@</em></td>
</tr>
<tr>
<td></td>
<td>No Beep</td>
<td>C007<em>0</em></td>
</tr>
<tr>
<td>Link</td>
<td>Single</td>
<td>C008<em>1 &amp;&amp;&amp;&amp; %</em></td>
</tr>
<tr>
<td></td>
<td>Dual</td>
<td>C008<em>2 &amp;&amp;&amp;&amp; % $$$$ ## @@</em></td>
</tr>
<tr>
<td></td>
<td>No Beep</td>
<td>C008<em>0</em></td>
</tr>
</tbody>
</table>

Parameters:

&&&& determines the frequency for Tone #1: &&&& Counts
$$$$ determines the frequency for Tone #2: $$$$ Counts
%% is the length of Tone 1 in increments of 10mS
## is the length of Tone 2 in increments of 10mS
@@ is the length of Tone 1-Tone 2 Delay in increments of 10mS

Notes:

The Tone Table (Section 6) provides an equation and chart to aid in finding the number of counts necessary to generate a desired frequency.

Setting a mode 1 courtesy beep with a length of 0 will make a long test tone. It can be reset by simply changing the courtesy beep to the desired setting.

Defaults:
- Dual Tone Courtesy Beeps for both Main and Link

Error Messages:

If the format is not correct, the RLC-1 will send a "E" error code.

ER1 - Not a Valid Mode, Must be 0, 1 or 2
ER2 - Digit Counter Error, Check the number of digits entered

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In Depth Command Description:  C009
Main and Link Port Transmitter DTMF Mute Enable/Disable

The RLC-1 has the ability to mute the audio when DTMF digits are being entered. When muting is enabled, the RLC-1 will begin muting as soon as a valid DTMF digit is detected (a short "bleep" is inevitable) and continue muting as long as at least one digit is entered each second. This allows multiple tones to be muted without each one causing a "bleep." One second after the last tone ends, the audio is returned to normal. This command controls the muting audio routed to the Main and Link Transmitter.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main and Link Mute</td>
<td>C009* % $ *</td>
<td>CW BEEP RSP</td>
</tr>
</tbody>
</table>

Parameters:
- % - Controls Muting for the Main Port Transmitter
- $ - Controls the Muting for the Link Port Transmitter

1 - Muting Enabled
0 - Muting Disabled

Defaults:
- DTMF Muting is Disabled

Error Messages:
If the format is not correct, the RLC-1 will send a "E" error code.

ER1  - Too Many digits entered
ER2  - Number too Large

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In Depth Command Description:  C010
Main and Link Port Hang Timer

These commands allow for keeping each port's transmitter on for a specified time after the input signal disappears. The hang timers can vary from no hang time up to 9.99 seconds of transmitter delay. This feature can be used on full duplex links and with caution on half duplex links. When using this feature on half duplex links, the link transmitter will remain keyed while the hang timer is running, thereby disabling the link receiver. On full duplex links, the receiver is available for reception even while the transmitter is keyed.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main and Link</td>
<td>C010*### &amp; &amp; *</td>
<td></td>
</tr>
<tr>
<td></td>
<td>###-Main Port 10mS Step</td>
<td>CW BEEP RSP</td>
</tr>
<tr>
<td></td>
<td>&amp; &amp; -Link Port 10mS Step</td>
<td></td>
</tr>
</tbody>
</table>

Parameters:
- The hang time in increments of 0.01 seconds
- The value entered must not be 000

Defaults:
- Both Hang Timers: 2.00 Seconds

Error Message:
If the format is not correct, the RLC-1 will send an "E" error code.

ER1 - Too Few or too Many Digits Entered
ER2 - Entered Number is too Large
In Depth Command Description: C011
Main and Link Port Time Out Timer Values

The RLC-II offers time-out timers for both ports. They can be set for 01 to 99 minutes. The timers will keep track of a port's receiver traffic. After a specified time of being continuously active, the RLC-1 will disable the port's PTT circuit, turning the transmitter off. Using this feature is only needed with full duplex links and is rarely used. When using the port as a repeater port the user should conform to FCC regulations concerning timing for "automated control" of your transmitter.

The time-out features for the Main Port pertain only to Main's traffic. If, for example, Main's transmitter is consistently keyed by Link's receiver, Main will not time-out. If Main's transmitter is consistently keyed by Main's receiver, then after $$ minutes, the transmitter will be unkeyed until the carrier drops to reset that timer. This feature is also available on the Link port's transmitter.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main and Link</td>
<td>C011*$$</td>
<td>CW BEEP RSP</td>
</tr>
</tbody>
</table>

Parameters:

$$ is the timer value in minutes for the Main port
## is the timer value in minutes for the Link port

Defaults:

- Time-Out Timers set to 3 Minutes
- The value entered must not be 00

Error Messages:

If the format is not correct, the RLC-1 will send a "E" error code.

ER1 - Too Many Digits Entered
ER2 - Entered Number is larger that 99
In Depth Command Description:  C012
Main and Link Courtesy Beep Delay Timer

This command allows the user to set the Courtesy Beep Delay Timer. This timer is used to determine how long the delay will be between the times the receiver becomes inactive and the courtesy beep is sent. The use of the timer is to keep the courtesy beep from being sent every time the receiver becomes inactive. Since a courtesy beep will not be sent while the receiver is active, a courtesy beep will only be sent during periods of receiver inactivity longer than this timer. Normally it is set for 1 second.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main and Link</td>
<td>C012*$$ %*</td>
<td>CW BEEP RSP</td>
</tr>
</tbody>
</table>

Parameters:
- $$ is the main port timer value in increments of 0.1 second (0.0 to 9.9 seconds)
- $$ is the link port timer value in increments of 0.1 second (0.0 to 9.9 seconds)

Defaults:
- 1.0 Second Courtesy Timer
- The value entered must not be 00

Error Messages:
If the format is not correct, the RLC-1 will send a "E" error code.
- ER1 - Too Many Digits Entered
- ER2 - Number larger that 99
In Depth Command Description:  C013
Main and Link Port ID Timer

This command allows the user to vary the ID Timer. This timer is used to determine when to send the ID message. The timer is started when activity on the port begins. Normally this timer is set for 5-7 minutes; it can range from 01 to 99 minutes.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main and Link</td>
<td>C013*$$ ##*</td>
<td>CW BEEP RSP</td>
</tr>
</tbody>
</table>

Parameters:
- $$ is the timer value in minutes for the Main port
- ## is the timer value in minutes for the Link port

Defaults:
- 10 Minute ID Timer
- The value entered must not be 00

Error Messages:
- If the format is not correct, the RLC-1 will send a "E" error code.
  - ER1 - Too Many Digits Entered
  - ER2 - Number larger that 99

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In Depth Command Description:  C014 and C015  
Main and Link Port CW Frequency

This command allows the user to vary each port's CW frequency. This frequency is separate for each port because the RLC-1 has separate tone generators for each port. The frequency will not effect courtesy beep frequency, but will effect the CW ID's, CW BEEP RSP response, and ERROR messages. The number of counts necessary to get a desired frequency can be found using the Tone Look-up table at the end of the manual.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main CW Freq.</td>
<td>C014*$$$$*</td>
<td></td>
</tr>
<tr>
<td>Link CW Freq.</td>
<td>C015*$$$$*</td>
<td></td>
</tr>
</tbody>
</table>

Parameters:

$$$ is the frequency counts

Defaults:

- Main Port 1000 Hz.
- Link Port 1333 Hz.

Error Messages:

If the format is not correct, the RLC-1 will send a "E" error code.

ER1 - Too Many Digits Entered
ER2 - Number larger that 99

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In Depth Command Description:  C016
Program CW Sending Speeds

This command allows the user to select the CW (Morse code) sending speed. The speed can vary from 5 WPM to 25 WPM. Speeds can be chosen from 5,10,13,15,20,25 WPM.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set CW Speed</td>
<td>C016*$*</td>
<td>CW BEEP RSP</td>
</tr>
</tbody>
</table>

Parameter:
$ is the CW Sending Speed Code (1..6)

<table>
<thead>
<tr>
<th>Code</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5 WPM</td>
</tr>
<tr>
<td>2</td>
<td>10 WPM</td>
</tr>
<tr>
<td>3</td>
<td>13 WPM</td>
</tr>
<tr>
<td>4</td>
<td>15 WPM</td>
</tr>
<tr>
<td>5</td>
<td>20 WPM</td>
</tr>
<tr>
<td>6</td>
<td>25 WPM</td>
</tr>
</tbody>
</table>

Defaults:
- 20 WPM

Error Message:
If the format is not correct, the RLC-1 will send a "E" error code.

ER1 - Not a Valid CW Speed Code 1..6 Only
**In Depth Command Description: C017**  
Interrogate and Control Latched Outputs On/Off

This command allows the user to turn each of the logical output lines on or off or check the current state the line is in. Note that the outputs are buffered with open drain drivers; therefore on means that the line is pulled to ground (will sink current) and off means that the output is in a high impedance state and will not sink any current. Interrogation is accomplished by entering only the line requested. The RLC-1 will return either a 'F' if the line is off, or 'N' if the line is on.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Out #1 On/Off</td>
<td>C017<em>1 $</em></td>
<td>CW BEEP RSP</td>
</tr>
<tr>
<td>#2</td>
<td>C017<em>2 $</em></td>
<td></td>
</tr>
<tr>
<td>#3</td>
<td>C017<em>3 $</em></td>
<td></td>
</tr>
<tr>
<td>#4</td>
<td>C017<em>4 $</em></td>
<td></td>
</tr>
<tr>
<td>#5</td>
<td>C017<em>5 $</em></td>
<td></td>
</tr>
<tr>
<td>Out #1 Check</td>
<td>C017<em>1</em></td>
<td>'F' if Line is OFF</td>
</tr>
<tr>
<td>#2</td>
<td>C017<em>2</em></td>
<td></td>
</tr>
<tr>
<td>#3</td>
<td>C017<em>3</em></td>
<td>'N' if Line is ON</td>
</tr>
<tr>
<td>#4</td>
<td>C017<em>4</em></td>
<td></td>
</tr>
<tr>
<td>#5</td>
<td>C017<em>5</em></td>
<td></td>
</tr>
</tbody>
</table>

Parameters:
- $ - 1 To turn line ON
- $ - 0 To turn line OFF

Error Message:
If the format is not correct, the RLC-1 will send a "E" error code.

ER1 - Not a Valid Output Line
ER2 - Not a Valid Output Condition, Must be a 0 or 1
In Depth Command Description:  C018
Interrogate the Logical Input Lines

This commands allow the user to interrogate Logical Input Lines 1..4. When executed, the RLC-1 will check the status of the selected line and respond with the selected line's "H" if the line is High or Open, or "L" if the line is Low or Grounded.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read Logical #1</td>
<td>C018<em>1</em></td>
<td>'H' if High</td>
</tr>
<tr>
<td>#2</td>
<td>C018<em>2</em></td>
<td></td>
</tr>
<tr>
<td>#3</td>
<td>C018<em>3</em></td>
<td>'L' if Low</td>
</tr>
<tr>
<td>#4</td>
<td>C018<em>4</em></td>
<td></td>
</tr>
</tbody>
</table>

Parameters: None

Error Message:
If the format is not correct, the RLC-1 will send a "E" error code.

ER1 - Not a Valid Input Line
In Depth Command Description: C019..C022
Read the Analog Input Lines

These commands allow the user to read the Analog Input lines. To control the analog lines calibration (Offset), see Command C023. To set the scale each input is interpreted on, see Command C024.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read Analog #1</td>
<td>C019*</td>
<td>.## V Faceplate 1</td>
</tr>
<tr>
<td>#2</td>
<td>C020*</td>
<td>##.# V Faceplate 2</td>
</tr>
<tr>
<td>#3</td>
<td>C021*</td>
<td>### C Faceplate 3</td>
</tr>
<tr>
<td>#4</td>
<td>C022*</td>
<td>### F Faceplate 4</td>
</tr>
</tbody>
</table>

Parameters: None

Default:
- All Voltage Faceplates: 0.00V Faceplate #1
- All Offsets set to '10', No Offset

No Error Messages:
In Depth Command Description: C023
Analog Offset Adjust

This command allows for offset adjustment of the analog lines. This command is used to calibrate the information read in by the RLC-1. If a known voltage or current is not read correctly by the RLC-1 (is off by a few degrees or volts), that input can be calibrated by changing the offset associated with that analog line.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offset Adjust</td>
<td>C023*$ #**</td>
<td>CW BEEP RSP</td>
</tr>
</tbody>
</table>

Parameters:
$  Analog 1..4 Selected
## Offset Number, 00..19

- An offset value of 10 is equal to an offset of 0.
- An offset value of 19 is an offset of +9 counts
- An offset value of 01 is an offset of -1 counts
- An offset value of 09 is an offset of -9 counts

Example: You want to calibrate the reading of the battery voltage
- Read the voltage with a calibrated meter
- Read the voltage with the RLC-1
- Increase or decrease the Offset until the Voltage reading is correct

Example: You want to calibrate your LM135, LM235, LM335 temperature sensor
- With a voltage meter read the voltage at the analog input
- This voltage corresponds to Kelvin/100
- To convert Kelvin to Celcius, you subtract 273 from the number
  -- 2.85 Volts is actually 285K which is 12°C
- To Convert Celcius to Farenheit: Farenheit=(Celcius * 1.80) + 32
- Read the Temperature with the RLC-1
- Add or Subtract the Offset until the Temperature reading is correct

Error Messages:
If the format is not correct, the RLC-1 will send a "E" error code.

ER1 - Too many digits Entered
ER2 - Invalid Analog Line Selected
ER3 - Number to Large Entered
In Depth Command Description:  C024
Select Analog Input Scale

The RLC-1 has the ability to interpret the readings from the Analog Input Lines on several different scales with a variety of resolutions and ranges. This command allows the user to select which of several preprogrammed scales is attached to each of the analog input lines. Please note that this command selects only the way the input is interpreted; see Page 14 on the Analog Input Lines to select whether the actual input voltage is to be dealt with the 0..4V or 0..25V range. Command C023 allows the user to assign and adjust offsets for the analog input lines. Because the input circuits are not exactly alike, this offset adjustment may be needed to calibrate the lines.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select Scale</td>
<td>C024* &amp; $*</td>
<td>CW BEEP RSP</td>
</tr>
</tbody>
</table>

Parameters:

& is the Analog Input Line Selected (1..4)
$ is the Analog Input Scale Code (1..4)

Analog Input Scales:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Range</th>
<th>Read Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Voltage</td>
<td>0...4V ±0.01</td>
<td>#.# # V</td>
</tr>
<tr>
<td>2</td>
<td>Voltage</td>
<td>0..25V ±0.1</td>
<td>### # V</td>
</tr>
<tr>
<td>3</td>
<td>Celsius</td>
<td>-152...152 °±2</td>
<td>### C 'M'if Minus</td>
</tr>
<tr>
<td>4</td>
<td>Fahrenheit</td>
<td>-152...146 °±2</td>
<td>### F 'M'if Minus</td>
</tr>
</tbody>
</table>

Note: ±2 is only meant to indicate the resolution of the measurement, not its accuracy; that is dependent on the temperature sensing device and how well the system is calibrated.

Defaults:

- Voltage Template (0..4V, Code 1)

Error Messages:

If the format is not correct, the RLC-1 will send a "E" error code.

ER1 - Not Valid Analog Line
ER2 - Invalid Analog Faceplate
ER3 - Not Enough Digits
In Depth Command Description:  C025-C031

Recall Macro

This command allows the recall of a Macro position. Use of the command will allow the control operator to find what is located inside of the Macro position

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macro Recall</td>
<td>C025* - C031*</td>
<td>CW BEEP RSP</td>
</tr>
</tbody>
</table>

See Serial Command S02 for Macro Sequence Recall

See Command C032 for Macro Sequence Program

See Appendix #D for Macro Recording Sheets

No Error Messages:

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In Depth Command Description:  C032
Program Selected Macro Position

This command allows the programming of a selected macro position. (See Attached Macro Programming Sheets). The concept of macro programming is that the user can chain several command sequences together to form one new command, the macro.

Example: You want to set the repeater access mode to COR and PL, change the courtesy beep to a single short beep, and lengthen the ID timer to 10 Minutes. All commands will be executed by the Macro.

Solution: Use a Macro Cell to Accomplish the Task

Actual Commands that need to be executed:
- C005* 2 * ; Force COR and PL Access
- C007*1 1000 05 * ; Change the Courtesy Beep to Mode 1:1000HZ at 50mS
- C013* 10 01* ; Change Repeater's ID Timer to 10 Minutes, Link to 1 Minute

For this Example we will use Macro #1

C032* 1 C0052 A C0071100005 A C0131001 * CW Response CW BEEP RSP

Some Items to Note:
1) The commands are entered in 1 set of keystrokes
2) There are no <EOF> keys used within the Macro
3) Commands are entered with the additional data in each group
4) Command sequences are sepearted by the DTMF Digit 'A'
5) The CW Response "CW BEEP RSP" indicates Macro Sequence stored

Macro #1

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>2</td>
<td>A</td>
<td>C</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
<th>21</th>
<th>22</th>
<th>23</th>
<th>24</th>
<th>25</th>
<th>26</th>
<th>27</th>
<th>28</th>
<th>29</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5</td>
<td>A</td>
<td>C</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**Macro Specifics:**

Macro Positions 1 - 7 are 30 Keystroke Macros

Command Names that do not have additional Data are separated with an 'A' if additional commands are to follow, otherwise <EOF> to end the sequence.

Command Names that have additional data are entered in the order:
- Command Name (4 Digits)
- Then Additional Data
- Finally an 'A' if more commands are to follow, otherwise an <EOF> to end the sequence.

**Error Messages:**

If the format is not correct, the RLC-1 will send a "E" error code.

ER1 - Too Many Digits Entered
ER2 - No Such Macro Position
**In Depth Command Description: C033**

**Doug Hall RBI-1 Parameter Program**

This command allows the user to control an external Doug Hall RBI-1 interface. The RBI-1 will allow control of several Kenwood type mobile radios. This includes the single band, and dual band radios. Refer to the RBI-1 manual for more information.

For easy access to the radio's features by the end user, the keystrokes used to control the RBI-1 can be stored in one of the 7 Macros. (See Command C032 for Macro programming information). In order for the RLC-1 to send information out to the RBI-1, 3 of the RLC-1's output lines are needed. These three lines shift out the data to the interface, which in turn controls the remote radio. The lines user are:

- Output #3 ..... RBI-1 Remote Reset
- Output #4 ..... Data to RBI-1
- Output #5 ..... Clock to RBI-1

When using the RBI-1 features, the RLC-1 will change the way these lines are set. All data must be entered correctly in order to control the RBI-1. The RLC-1 will respond only after data has been shifted out correctly. The beep response is intended to verify that the keystrokes have been entered correctly.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write RBI-1 Inf</td>
<td>C033*! @ ### $ % &amp;*</td>
<td>CW BEEP RSP</td>
</tr>
</tbody>
</table>

Parameters:

- `!` is the Band Unit Selected
  -  0 = 1240 MHZ (Port 3)
  -  1 = 1250 MHZ (Port 3)
  -  2 = 140  MHZ (Port 0)
  -  3 = 220  MHZ (Port 0 or Port 1) Port 0 for Dual Band Radios
  -  4 = 440  MHZ (Port 0 or Port 2) Port 0 for Dual Band Radios
  -  5 = 1270 MHZ (Port 3)
  -  6 = 1280 MHZ (Port 3)
  -  7 = 1290 MHZ (Port 3)
  -  8 = 1260 MHZ (Port 3)
  -  9 = 430  MHZ (Port 0 or Port 2) Port 0 for Dual Band Radios
  -  A = 28  MHZ (Port Not Yet Defined)
  -  B = 52  MHZ (Port Not Yet Defined)
  -  C = 900  MHZ (Port not Yet Defined)
@ is the Power Level Selected, Does not work on all radios
  - 0 Low Power Mode
  - 1 High Power Mode
  - 2 Medium Power Mode
  - 3 Do Not Change the Power Setting

### is the Frequency Requested, 1Mhz, 100Khz, 10Khz, 5Khz

$ is the Radio Offset
  - 0 Minus Offset
  - 1 Plus Offset
  - 2 Simplex
  - 3 Minus 20 (1200 Only)

%% is the PL Tone Requested (Refer to the RBI-1 Manual for Frequency)

^ is the Access Mode Requested, Does not work on all radios
  - 0 COR Access, PL Decoder OFF
  - 1 PL Access, PL Decoder ON

& is the Encode Mode Requested, Does not work on all radios
  - 0 PL Encoder Disabled
  - 1 PL Encoder Enabled

Once all the variables are entered, the RLC-1 will send them to the RBI-1 using Out#4, and Out #5. When programming in the parameters, the RLC-1 will send a BEEP response.

Example:
Program the 147.380 + Repeater, COR access, PL Encode, TX PL 100 Hz, High Power

C033* 2 1 7380 1 12 0 1 *
  - (2) Band 2 (140-150 Mhz)
  - (1) High Power
  - (7380) Frequency
  - (1) Plus Offset
  - (12) 100 Hz. PL Frequency
  - (0) COR Access
  - (1) PL Encoder ON

Error Messages:
If the format is not correct, the RLC-1 will send an "E" error code.

ER1 - Too Many Digits Entered
ER2 - Number to Large
Reseting the RBI-1 Interface

An RBI-1 Reset might be needed if the interface does not respond to commands sent to it. If this occurs, the user may choose to reset it remotely. Any output line may be used, but for discussion we will use output line #3. To remotely reset the RBI-1, using either a macro, or individual keystrokes, turn output line #3 on, and then off. This will cause a reset of the interface. If you still can not control it, contact Link Communications.

No Error Messages:
Doug Hall RBI-1 Information

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 thru 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 still accomplished thru the microphone jack.

The RLC-1 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:

<table>
<thead>
<tr>
<th>Mode</th>
<th>140</th>
<th>220</th>
<th>440</th>
<th>1200</th>
<th>DUAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>TM-231</td>
<td>TM-331</td>
<td>TM-431</td>
<td>TM-531</td>
<td>TM-631+</td>
<td>TM-731+</td>
</tr>
<tr>
<td>TM-241</td>
<td></td>
<td>TM-441</td>
<td>TM-541</td>
<td></td>
<td>TM-701+</td>
</tr>
</tbody>
</table>
+ Dual Banders

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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 in close proximity to the Kenwood mobile radio to be used. Connect the RBI 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.

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.

<table>
<thead>
<tr>
<th>J2</th>
<th>Line Name</th>
<th>RLC-1 Connections</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RBI-1 RESET</td>
<td>2 RLC-1 Output #3, P5</td>
</tr>
<tr>
<td>2</td>
<td>&quot;S&quot; Meter output</td>
<td>..</td>
</tr>
<tr>
<td>3</td>
<td>Data</td>
<td>15 RLC-1 Output #4, P5</td>
</tr>
<tr>
<td>4</td>
<td>Clock/Strobe</td>
<td>3 RLC-1 Output #5, P5</td>
</tr>
<tr>
<td>5</td>
<td>Kenwood TX Audio (T Pot)</td>
<td>4 RLC-1 Link Connector Port</td>
</tr>
<tr>
<td>6</td>
<td>Kenwood RX Audio (R Pot)</td>
<td>5 RLC-1 Link Connector Port</td>
</tr>
<tr>
<td>7</td>
<td>COS from Kenwood RX</td>
<td>7 RLC-1 COR Input (Must be Inverted to Active Low)</td>
</tr>
<tr>
<td>8</td>
<td>PTT to Kenwood TX</td>
<td>3 RLC-1 PTT Output Link Connector Port</td>
</tr>
<tr>
<td>9</td>
<td>Ground</td>
<td>1 RLC-1 Ground Connection</td>
</tr>
</tbody>
</table>

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.

RADIO SETUP

The Kenwood radio's need certain parameters setup before they can operate from the RBI. Things such as STEP, etc. Since the memory channels in the radio aren't used we will reset the radio to default on all setup options. This can be found in your Kenwood operating guide.

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.

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

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 is 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 a toggled User function output. Initialize the User function to "1" on and save those in all your Macro's or the reset line will be held low and disabled. To reset just interrogate the user function, this will toggle the reset line and reset the RBI.

SUPPORT CROSS REFERENCE

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>CTCSS</th>
<th>CTCSS</th>
<th>CTCSS</th>
<th>MULTI</th>
<th>RF PWR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ENCODE</td>
<td>SELECT</td>
<td>DECODE</td>
<td>BAND</td>
<td>POWER</td>
</tr>
<tr>
<td>GENERIC</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>KENWOOD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TM-X21</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>TM-X31</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>TM-X41</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>TM-621/721</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>TM-631/731</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>TM-701</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

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In Depth Command Description: C034
Clear Input #4 Auto-Command Execution Name

This command allows the user to clear Input #4 High-Low and Low-High command names. These commands are called when Input #4 goes from one state to another. The RLC-I will recognize the change once every 30 Seconds. This time will filter out contact bounce. Programming of these commands is accomplished using C036 and C037. This command has the same effect as using C036 to program messages 7 and 8 to nothing.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear Input #4</td>
<td>C034*</td>
<td>CW BEEP RSP</td>
</tr>
</tbody>
</table>

Parameters: None

No Error Messages:
In Depth Command Description:  C035
Send Port's CW ID Message

This command allows recall of the calling port's "ID" message. This lets the user recall the ID that is programmed to the port. Operation of this command is similar to the Message recall command (C037*1 or C037*2). The RLC-1 looks where the DTMF tones came from and then routes the appropriate message to the port.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Send ID Message</td>
<td>C035*</td>
<td>Calling Port's ID</td>
</tr>
</tbody>
</table>

Parameters:  None

No Error Messages:
In Depth Command Description: C036
Message Program Utility

This command allows programming of the many messages on the RLC-1. Messages 1..6 are be CW (Morse Code), 7..8 execute the specified command. Refer C037 for the message numbers and maximum lengths.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Message</td>
<td>C036*$ %..%*</td>
<td>See Below</td>
</tr>
</tbody>
</table>

Parameters:
- $ is a one-digit code (0..8) representing the number of the message you wish to program.
- %% - This data must be 2 digits long per CW Character, up to the maximum message length (see C037), or 4 digits long if it is a command name (messages 7 and 8 only). See CW Tables for Character list.

Example: To Program 'KF7FW / R' for the Main Port ID

C036*1 20 15 07 15 32 36 27 *
    K    F    7    F    W    /    R

Example: To change the Main CW Beep Frequency when Input #4 goes from Low-High. Also we will change the frequency back when Input #4 goes from High-Low. This could be used as an open door alarm.

1) Use Macro #1 to change the frequency on a Low-High condition
2) Use Macro #2 to change the frequency on a High-Low condition
3) Macro #1 Program: C032 * 1 C014 0500 *
4) Macro #2 Program: C032 * 2 C014 1000 *
5) Low-High Command Name Call: C036* 8 C025 *
6) High-Low Command Name Call: C036* 7 C026 *

Error Messages:
- If the format is not correct, the RLC-1 will send a "E" error code.
- ER1 - No Such Message
- ER2 - Too Many Digits Entered for Selected Message
In Depth Command Description:  C037
Message Read Back Utility

This command reads back the preprogrammed CW (Morse Code) messages. This helps in determining what messages are programmed in without having to re-program them.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read Message</td>
<td>C037*$*</td>
<td>See Below</td>
</tr>
</tbody>
</table>

Parameters:

$ is a one-digit code representing the number of the message you wish to recall.

Message Number Description Maximum Length

0 RLC-1 Version 20 CW Characters
1 Main Port ID 20 CW Characters
2 Link Port ID 20 CW Characters
3 Link ON 20 CW Characters
4 Link OFF 20 CW Characters
5 Link MON 20 CW Characters
6 CW Response Message 5 CW Characters
7 Input #4 High-Low Command 1 Four Digit Command
8 Input #4 Low-High Message 1 Four Digit Command

Error Messages:

If the format is not correct, the RLC-1 will send a "E" error code.

ER1 - No Such Message
In Depth Command Description:  C038
Re-Program Command Name

This command allows the user to change any of the four digit preprogrammed command names to any combination of DTMF digits (excluding the <EOF> key) four digits or less in length. All command names that are less than four digits must be padded with leading zeros to four digits when using this command. Command name "12" would be entered as "0012". Command Name "1200" would be entered as "1200". Afterward, when executing those commands, any leading zeros can be omitted. This command is capable of changing its own name. Care should be taken to keep track of what name each command is changed to. Appendix C contains charts to assist you in this. It is highly recommended that you use them. It is possible to "lose" a command; if you don't know its name, you can't rename it. If this happens, you can either live without that command or re initialize the whole controller. The only exception to this is if you have a serial terminal and do a command dump with Serial Command [S00].

If two commands are given the same name, the one that has the lowest number in the manual will always be the one referenced. It can then be renamed, separating the two commands.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change Name</td>
<td>C038*&amp;&amp;&amp;&amp; $$$$ *</td>
<td>CW BEEP RSP</td>
</tr>
</tbody>
</table>

Parameters:
&&&& is the Command's Current Name
$$$$ is the Command's New Name

Example:
You want to rename the command to enable Link Port on the Main Port. This command is "C000." You want to rename it to "150".

C038 * C000 0150 *

CW Response:
CW BEEP RSP

Error Messages:
If the format is not correct, the RLC-1 will send a "E" error code.

ER1 - Too Many Digits Entered
ER2 - Number too Large
In Depth Command Description: C039
Set <EOF> Key

This command allows the user to change the <EOF> key. This key has two uses. First, if a
command has parameters (additional information after the command name), the <EOF> key is
used to separate the command name from that additional information (except when programming
a macro). Second, it can be used to tell the RLC-1 to execute a command that has been entered
into the controller, as an alternative to letting the COR drop. The <EOF> key cannot be used in
any command names.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set &lt;EOF&gt; Key</td>
<td>C039* &amp;*</td>
<td>CW BEEP RSP</td>
</tr>
</tbody>
</table>

Parameters:
* is the current <EOF> key
& is the new <EOF> key

Default:
*'* <EOF> Key

Error Messages:
If the format is not correct, the RLC-1 will send an "E" error code.

ER1 - Too Many Digits Entered
In Depth Command Description:  C040
Interrogate Main and Link Systems

This command allows the user to check the configuration of the "other port". When using this command, the RLC-1 will indicate what the port communication condition is in.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interrogate Ports</td>
<td>C040*</td>
<td>See Below</td>
</tr>
</tbody>
</table>

When the DTMF command is entered from the Main Port:
- If the Link Port is connected to the Main Port (C000), the CW Response is "M  N," Main is ON
- If the Link Port is Disconnected from the Main Port (C002), the CW Response is "M  F," Main is OFF
- If the Link Port is being Monitored by the Main Port (C001), the CW Response is "M  M," Main is Monitoring

When the DTMF command is entered from the Link Port:
- If the Main Port is Connected to the Link Port (C000 and C001), the CW Response is "L  N," Link is ON Main
- If the Link Port is Disconnected from the Main Port (C002), the CW Response is "L  F," Link is OFF

No Error Messages:
In Depth Command Description:  C041
DTMF Tone Pad Test

This command allows the user to test their DTMF tone pad. It allows up to 20 digits to be entered. After the command is executed, digits entered will be sent by CW.

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTMF Tone Test</td>
<td>C041*$$$$....$$*$</td>
<td>Keys Entered</td>
</tr>
</tbody>
</table>

Parameters:

$ is any key on the DTMF Tone Pad

Error Message:

If the format is not correct, the RLC-1 will send a "E" error code.

ER1 - Too Many Digits Entered

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In Depth Command Description:  C042
Remote Controller Reset

This command allows the user to remotely reset the RLC-1 Controller. This command acts like pushing the external reset switch or turning the power off and back on. It will not erase any of the messages you have programmed, etc. **NO REMOTE INITIALIZATION IS POSSIBLE, ONLY REMOTE RESETTING.**

<table>
<thead>
<tr>
<th>Description</th>
<th>Command</th>
<th>CW Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote Reset</td>
<td>C042*</td>
<td>RESET ?</td>
</tr>
</tbody>
</table>

No Error Messages:
## Appendix A - CW (Morse Code) Table

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

See Commands C036, and C037 for more information on message programming, and C014, C015 and C016 for CW frequency and speed.
Appendix B - Tone Look-Up Table

The frequency of the RLC-1 tone generator can be determined by applying the following formula or the table.

\[
\text{Counts} = \left( \frac{1,000,000}{\text{Frequency}} \right) - 1
\]

Tone Table, (100Hz to 2900Hz in 5Hz Steps)

<table>
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<th>COUNTS</th>
<th>FREQ</th>
<th>COUNTS</th>
<th>FREQ</th>
<th>COUNTS</th>
<th>FREQ</th>
<th>COUNTS</th>
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<td>3388</td>
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<td>685</td>
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<td>300</td>
<td>3332</td>
<td>495</td>
<td>2019</td>
<td>690</td>
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<td>110</td>
<td>9089</td>
<td>305</td>
<td>3277</td>
<td>500</td>
<td>1999</td>
<td>695</td>
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<td>1940</td>
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Appendix D - Macro Recording Sheets

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Appendix D - Macro Recording Sheets

Macro #5

Macro #6

Macro #7
Appendix D - Additional Macro Recording Sheets

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Appendix D - Additional Macro Recording Sheets

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16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

Macro #6

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
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Macro #7

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Appendix E - Initializing and Resetting the RLC-1

When the RLC-1 powers up or the reset button is pressed, a warm reset is processed. This reset will load the most recently programmed variables into the controller. The variables are stored in the nonvolatile EEPROM cell located inside the microprocessor. If the variables in the EEPROM get scrambled somehow, a cold boot will be needed. This cold boot resets all of the RLC-1’s variables to the factory settings - anything you have programmed will be lost. This cold boot is accomplished by pressing and holding the initialize switch and pushing the reset switch. You must hold the initialize switch down for at least 5 seconds when resetting. Once the controller has been initialized, the reset switch must be pushed and released. The RLC-1 takes about 15 seconds to re-initialize the EEPROM. The initialization process will be complete when the RLC-1 sends out the reset message "RESET ?". At this point you must press and release the reset switch.
Appendix F - Troubleshooting

**No Audio at Test Bus:**
- Check for main system power (+12 Volts plugged in).
  - Is there a valid COR signal present?
    -- Check the COR polarity jumper.
  -- Is the Access mode COR and PL? If so are both signals active?

**Have audio at the test bus, but not on the transmitter:**
- Are the output audio pots turned up (clockwise)?
- Is the transmitter connected to the audio output (high)?

**The CW Volume seems Low:**
- Turn up the pot marked "Main Tone" or "Link Tone."

**When I connect my COR, the RLC-1 will not accept it:**
- Does the COR go to ground when active?
  -- If so is the COR polarity jumper connected?
- Does the COR go above 4 volts when active?
  -- If so is the COR polarity jumper disconnected?
  - Can the COR sink 2mA when active?
- Does the 5V pull-up resistor conflict with your radio?
  -- Motorola R-100 Repeaters are susceptible to this
  -- Solution: open collector the driver on R-100 repeaters

**When I connect my serial terminal, I do not get any data:**
- Is your terminal set to 2400,N,8,1?
- Is your serial terminal plugged into P1 serial connector?
- Are all the RS-232 TX and RX and ground wires connected?
  - You should use a straight-through (not null-modem) cable in most cases.

**DTMF Valid LED flashes, but nothing happens**
- Is there a valid COR present?
- Is the transmitter hooked up?
- Is the RLC-1 in the Proper Access Mode (COR or COR and PL)?
Glossary:

**Dry Contact Input** - A input that is commonly used with a typical on/off switch for detecting such things as open doors.

**<EOF>** - The DTMF key that tells the controller that the command has been entered. It is also used to separate command names from the parameters.

**Kerchunk** - Quickly keying up and unkeying a receiver.

**Macro** - The RLC-1 supports macros that consist of a string of commands that can be repeated by executing the macro command.

**RX** - Receiver

**TX** - Transmitter

**WPM** - Words Per Minute. Rate at which CW (Morse Code) is sent.
Schematic Diagrams:
Board Layout
## Bill of Materials
### Link Communications RLC-1  Revision: A

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### Bill of Materials Cont...Link Communications RLC-1  Revision: A

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Condor Software Differences:

1) All commands entered from the Main port, for use on the Main port must begin with a '*'
followed by the normal command name.

2) All commands entered from the Link port must begin with the link pre-access name. This
name defaults to '99'. The command prefix for the link port is a '#'. In order to execute a
command the complete word '#99' must be entered. The link prefix name can be changed using
Command C033.

3) <EOF> or enter key defaults to a 'D', not a '*' as discussed in the manual

4) DTMF muting is controlled using Command C009. The muting function controls both the
audio and the TX PTT. The PTT is controlled when the port is configured as a link only;
otherwise only the audio is effected.

5) When entering data from the Main port, and the controller detects a '*' prefix, and the link port
RX/TX is connected to the main port, then the TX PTT for the link port is broken. The PTT is
enabled again when either the Main port receiver goes inactive, or a command is executed by
entering the 'D' key.

6) When the DTMF mute function is enabled (See Command C009) and a '#' is entered, the
DTMF mute function will be disabled only on the link port, for that sequence of tones. When a
COR drop occurs, the mute function will be re-enabled.

7) Doug Hall RBI-1 support is disabled when using the Condor Software.
In Depth Command Description:  C033
Link Pre-Access Name Program

This command allows the user to change the pre-access name for the link port. The name allows the users on the link system to access the controller when the correct name has been entered. The pre-access name must be entered for each command executed, and if the receiver access has been dropped since the last entry.

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<th>Description</th>
<th>Command</th>
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<tr>
<td>Change Pre-Acc.</td>
<td>C033*###</td>
<td>CW BEEP RSP</td>
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</table>

Parameters:

## is the New Pre-Access Name

Default: 99

Error Messages:

If the format is not correct, the RLC-1 will send a "E" error code.

ER1 - Too many or too few Digits Entered