RLC-ICM
Icom IC-900/901 Band Module Controller

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

Introduction

You have purchased a powerful interface for remote control of the Icom IC-900/901 band modules. The modules support a large range of frequency synthesis that the RLC-ICM controls. The RLC-ICM interfaces the radios, provides receive and transmit audio level control, and separate PL encode/decode supports by using the options TS-64 tone module. The RLC-ICM is composed of 2 parts. Part 1 is the controller interface and part 2 is the radio interface. The radio interface is a module that plugs into the actual radio module. The RLC-ICM supports up to 4 of these interfaces. By reading this manual and following the enclosed examples most of your questions should be answered.

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 us at (406) 482-7515, fax at (406) 482-7547, E-Mail at linkcomm@netins.net or write us at.

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

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, labor, and shipping. Contact Link Communications Inc. for more information.

What Link Communications Inc. will not cover:

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

<u>THIS WARRANTY HOLDS ONLY TO THE ORIGINAL PURCHASER</u>

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

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

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Getting Started

The RLC-ICM interface will operate on all Link Communications Inc. products that support the Doug Hall RBI-1 interface. The RLC-ICM gets its input from the controller and then routes the information to the requested band unit. To get the RLC-ICM operational you will need to: make all of the hardware connections including building the cable to the controller, enter the setup commands, then use the RLC-ICM with the controller commands for the Doug Hall RBI-1 interface.

Default Settings

To initialize the RLC-ICM back to factory presets you need to place a jumper between 2 pins on a header connector. These pins are labeled 'T' and 'R'. When the jumper is placed across these 2 pins, and the interface goes through a power on reset cycle, all of the setup information programmed into the ICM will be erased and overwritten with preset values. These preset values cover the most widely used band modules.

There are 4 (10pin) ribbon cable connectors located on the ICM main board. These connectors are labeled 1-4 indicating what module number the controller will control when frequency and configuration information is entered. At initialization the module number is configured with the following information.

Module 1:
- Frequency band: 140-160 mhz
- Offset when in plus or minus mode: 600 khz
- Frequency: 146.520 simplex

Module 2:
- Frequency band: 220 mhz
- Offset when in plus or minus mode: 1.600 khz
- Frequency: 224.000 simplex

Module 3:
- Frequency band: 430-440 mhz
- Offset when in plus or minus mode: 5.00 khz
- Frequency: 446.000 simplex

Module 4:
- Frequency band: not defined
- Offset when in plus or minus mode: not defined
- Frequency: not defined

When the user sends a frequency from the controller to the RLC-ICM the interface will automatically determine what module to talk to from these definitions, or whatever you change them to with the setup commands.

Building a cable to interface the RLC-1 to the RLC-ICM interface

The cable used to communicate with the RLC-ICM consists of 2 cables summed into a single connector that connects to the interface.

Cable 1 is the audio cable | Cable 2 is the serial data cable, DB-25

Pin 1 **Ground Pin 9**   Pin 2 **Reset Pin 1**
Pin 2 No Connect   Pin 3 **Clock Pin 4**
Pin 3 **PTT Pin 8**   Pin 15 **Data Pin 3**
Pin 4 **Audio Out Pin 5**
Pin 5 **Audio In Pin 6 ***
Pin 6 No Connect
Pin 7 **COR Pin 7**
Pin 8 No Connect
Pin 9 No Connect

* Audio is discriminator audio. User must install appropriate audio de-emphasis jumper.

The female DB-9 on the RLC-ICM is used to pass data into the interface. The above tables '**bold**' typeface indicates what connections are made to this connector. Pin #2 will not be connected on this connector. The **COR** output from the RLC-ICM is low when active. All other signals can be interfaced without any special consideration.

Building a cable to interface the RLC-2 to the RLC-ICM interface

The cable used to communicate with the RLC-ICM consists of 2 cables summed into a single connector that connects to the interface.

Cable 1 is the audio cable | Cable 2 is the serial data cable

Pin 1 **Ground Pin 9**   Pin 1 No Connect
Pin 2 No Connect   Pin 2 **Clock Pin 4**
Pin 3 **PTT Pin 8**   Pin 3 **Reset Pin 1**
Pin 4 **Audio Out Pin 5**   Pin 4 No Connect
Pin 5 **Audio In Pin 6 ***   Pin 5 No Connect
Pin 6 No Connect   Pin 6 **Data Pin 3**
Pin 7 **COR Pin 7**   Pin 7 No Connect
Pin 8 No Connect   Pin 8 No Connect
Pin 9 No Connect   Pin 9 No Connect

* Audio is discriminator audio. User must install appropriate audio de-emphasis jumper.

The female DB-9 on the RLC-ICM is used to pass data into the interface. The above tables '**bold**' typeface indicates what connections are made to this connector. Pin #2 will not be connected on this connector. The **COR** output from the RLC-ICM is low when active. All other signals can be interfaced without any special consideration.

Building a cable to interface the RLC-3 to the RLC-ICM interface

The cable used to connect the RLC-3 to the RLC-ICM has two connectors on one end and one connector on the other. The end that plugs into the RLC-3 has a connector for the radio port (the bottom DB-9 on a radio card) and one for the serial port (the top connector on the radio card). The cables from these two connectors are both connected to the one DB-9 that plugs into the RLC-ICM.

RLC-ICM Pin# - Line Name	RLC-3 Connections Pin# - Line Name
1 - Reset	(optional) Connect to an output line on I/O board
	Connections to serial port on the radio card (top DB-9)
3 - Data	2 - RLC-3 SPI data output
4 - Clock/Strobe	3 - RLC-3 SPI clock output
	Connections to the radio port (bottom DB-9)
5 - TX Audio	4 - RLC-3 audio out
6 - RX Audio*	5 - RLC-3 audio in
7 - COS from RX	7 - RLC-3 COR input (set for active low)
8 - PTT to TX	3 - RLC-3 PTT output
9 - Ground	1 - RLC-3 ground connection

* Audio is discriminator audio. Turn de-emphasis switch on radio card on.

Power Connection

The user needs to provide +12v DC to the RLC-ICM interface. When DC is present, the Red LED will light. The polarity of the connector is **Center pin (+), Shield (-)**. The interface draws 65mA at 12volts.

Radio Interface Modules

The RLC-ICM requires the installation of the radio interface module inside the band units. This module allows the interface to communicate with the radio at a faster rate. The module contains the squelch pot and the power level selection. Squelch adjustment is made by adjusting the squelch pot. To loosen the squelch adjust the pot clockwise. To tighten the squelch adjust the pot counter clockwise. The power level is adjusted by selecting either H (High) or L (Low). Refer to your band unit manual for rf power output levels. The LED on the module indicates power to the radio.

Installation of the radio module is accomplished by first removing the front module cover (Grasp the cover on either side and gently remove). Second remove the (4) slotted screws located in the corners of the board. Carefully remove to original circuit board and set aside. Replace the board with the RLC-ICM radio interface and re-fasten the 4 screws. Plug the ribbon cable into the 10 pin connector with the cable towards the top of the interface. Re-place the radio's module cover and plug the ribbon cable into the appropriate radio slot.

Setup RLC-ICOM Interface with the RLC-1 Controller

The RLC-Icom interface allows the RLC-1 to control IC-900 band modules using the same commands as are used for the Doug Hall RBI-1.

The RLC-ICM default set-up configured:
- 140-160 mhz band as module 1
- 220 mhz band as module 2
- 430-440 mhz band as module 3

Configuration for the RLC-1 consists of sending a special configuration data stream using the RBI-1 software routines.

This command sets-up the interface to recognize the different band modules, and their location.

Format:
- C033 is the default command name.
- Band unit 0 is required
- Power level of 3 is required
- 1 Mhz is always a '9'
- Remote slots number from 6,7,8,9 correspond to slot 1,2,3,4
-- This data is entered in the 100 Khz position
- Offset of 3 is required
- 'SS' Set-up code is from the table below
- PL frequency of 31 is required
- PL on/off information of 10 is required

This format then translates into:
C033*039#SS33101 <unkey> of *
    Where # is the slot number 6=1, 7=2, 8=3, 8=4
    Where SS is the configuration information below

It is recommended to put the module 'ON' information into a macro that the user calls after a frequency is programmed into the RLC-ICM.

Example: Want to set-up module 4 as a 10meter module, then go to 29.600 simplex
1) C033*03990033101 * ; This assigns the 28 Mhz module to slot #4
    This only needs to be done only once after complete re-initialization is run.
2) C033*00960020000 * ; This assigns frequency 9600 with simplex operation
    Once the frequency is entered the RLC-ICM is in receive only mode
3) C033*03998533101 * ; This puts slot #4 into transmit and receive mode
    It is recommended to put this information in a macro for easier access

Programming the RLC-ICM with the RLC-1 controller

The RLC-1 controller does not have a specific command for setting up the RLC-ICM interface. Therefore the user must enter the programming strings using Command C033. The

Procedure:
- First tell the RLC-Icom which band module is plugged into each of its connectors. The setup codes are listed in the chart below. You will need to execute command C033 once for each setup code you wish to enter.

SS (the setup code)	Description
00	28 Mhz Module
05	50 Mhz Module
10	140..160 Mhz Module
15	220 Mhz Module
20	430..440 Mhz Module
25	1200 Mhz Module (not currently active)

The default setup for the RLC-Icom is to have connector 1 plugged into the 140..160 Mhz module, connector 2 plugged into the 220 Mhz module and connector 3 plugged into the 430..440 Mhz module. As an example, the following commands will enter those settings again:

C033*03961033101* ; Slot 1 band module assignment
C033*03971533101* ; Slot 2 band module assignment
C033*03982033101* ; Slot 3 band module assignment

- Second, you must tell each band module what size of offset to use when you select a plus or minus offset with commands C033. The setup codes follow:

SS (the setup code)	Description
30	100 Khz Offset
35	500 Khz Offset
40	600 Khz Offset
45	1 Mhz Offset
50	1.6 Mhz Offset
55	1.7 Mhz Offset
60	5 Mhz Offset
65	12 Mhz Offset
70	20 Mhz Offset

For example, to select a 100 Khz offset for the 140..160 Mhz module that is plugged into connector 1, enter C033*03964033101*

- Setup codes 75 and 80 are reserved for special offset memories, which are not yet supported.

- You should normally use commands C000, C001 and C002 to control turning the remote base on and off and monitoring it. Those commands treat the whole RLC-Icom interface as one unit, connecting to and disconnecting from it the same way they would a link port. In addition to these commands, you can tell the RLC-Icom interface to disable transmit on any combination of the band modules. The below setup codes disable and enable transmitting on individual modules:

SS (the setup code)	Description
85	Transmit and Receive Enabled
90	Transmit Disabled (receive only)
95	Transmit and Receive Disabled (module turned off)

For example, if you wanted to monitor the 140..160 Mhz module and the 220 module, but only transmit on 220, you could enter C033*03979033101* to disable transmitting on the 220 module on connector 2. If you then used C000 to connect the repeater port you were using to the port that the RLC-Icom is on, you would be able to transmit on the 140..160 Mhz module but not on the 220 Mhz module.

- If you have properly entered the above commands, the RLC-Icom is set up and ready to use. To enter frequencies, turn PL on and off, etc., use the RBI-1 commands in this section of the manual.

Setup RLC-ICOM Interface with the RLC-2 Controller

The RLC-Icom interface allows the RLC-1 to control IC-900 band modules using the same commands as are used for the Doug Hall RBI-1.

The RLC-ICM default set-up configured:
- 140-160 mhz band as module 1
- 220 mhz band as module 2
- 430-440 mhz band as module 3

Configuration for the RLC-2 (V3.05a software) consists of sending a special configuration command (C112) using the RBI-1 software routines.

This command sets-up the interface to recognize the different band modules, and their location.

Format:
> - C112 is the default command name.
> - X is the connector number on the RLC-ICM that the module you are setting up is
>   plugged into (1..4)
> - SS is the setup code described below

Procedure:
- First tell the RLC-Icom which band module is plugged into each of its connectors. The setup codes are listed in the chart below. You will need to execute command C112 once for each setup code you wish to enter.

SS (the setup code)	Description
00	28 Mhz Module
05	50 Mhz Module
10	140..160 Mhz Module
15	220 Mhz Module
20	430..440 Mhz Module
25	1200 Mhz Module (not currently active)

> The default setup for the RLC-Icom is to have connector 1 plugged into the 140..160 Mhz module, connector 2 plugged into the 220 Mhz module and connector 3 plugged into the 430..440 Mhz module. As an example, the following commands will enter those settings again:
> > C112*110*
> > C112*215*
> > C112*320

- Second, you must tell each band module what size of offset to use when you select a plus or minus offset with commands C033. The setup codes follow:

SS (the setup code)	Description
30	100 Khz Offset
35	500 Khz Offset
40	600 Khz Offset
45	1 Mhz Offset
50	1.6 Mhz Offset
55	1.7 Mhz Offset
60	5 Mhz Offset
65	12 Mhz Offset
70	20 Mhz Offset

For example, to select a 100 Khz offset for the 140..160 Mhz module that is plugged into connector 1, enter C112*130*.

- Setup codes 75 and 80 are reserved for special offset memories, which are not yet supported.

- You should normally use commands C000, C001 and C002 to control turning the remote base on and off and monitoring it. Those commands treat the whole RLC-Icom interface as one unit, connecting to and disconnecting from it the same way they would a link port. In addition to these commands, you can tell the RLC-Icom interface to disable transmit on any combination of the band modules. The below setup codes disable and enable transmitting on individual modules:

SS (the setup code)	Description
85	Transmit and Receive Enabled
90	Transmit Disabled (receive only)
95	Transmit and Receive Disabled (module turned off)

For example, if you wanted to monitor the 140..160 Mhz module and the 220 module, but only transmit on 220, you could enter C112*290* to disable transmitting on the 220 module on connector 2. If you then used C000 to connect the repeater port you were using to the port that the RLC-Icom is on, you would be able to transmit on the 140..160 Mhz module but not on the 220 Mhz module.

- If you have properly entered the above commands, the RLC-Icom is set up and ready to use. To enter frequencies, turn PL on and off, etc., use the RBI-1 commands in the controller manual.

Programming the RLC-ICM with the RLC-2

Programming a frequency into the RLC-ICM interface is accomplished using Command C116 if you are using the RLC-2. The format of the frequency entry is in your RLC-2 manual. The manual refers to the band module when referencing a frequency input. The below table lists the RLC-ICM frequencies with respect to the band numbers.

Band Numbers	Frequencies Covered
0	430 Mhz
1	1250 Mhz (Not Active)
2	140 Mhz
3	220 Mhz
4	440 Mhz
5	1270 Mhz (Not Active)
6	1280 Mhz (Not Active)
7	1290 Mhz (Not Active)
8	1260 Mhz (Not Active)
9	1240 Mhz (Not Active)
A	29 Mhz
B	50 Mhz
C	150 Mhz
D	160 Mhz

PL Frequency using the TS-64 PL module
The first 2 digits are the tone number, followed by the PL frequency

0	250.3	13	100.0	26	118.8	39	47.5	52	44.4
1	233.6	14	88.5	27	110.9	40	69.4	53	39.6
2	218.1	15	77.0	28	103.5	41	159.8	54	37.9
3	203.5	16	241.8	29	94.8	42	165.5	55	36.6
4	186.2	17	225.7	30	82.5	43	171.3	56	35.4
5	173.8	18	210.7	31	71.9	44	177.3	57	33.0
6	162.2	19	192.8	32	63.0	45	183.5	58	97.4
7	151.4	20	179.9	33	58.8	46	189.9	59	91.5
8	141.3	21	167.9	34	56.8	47	196.6	60	85.4
9	131.8	22	157.7	35	54.9	48	199.5	61	79.7
10	123.0	23	146.2	36	53.0	49	206.5	62	74.4
11	114.8	24	136.5	37	51.2	50	229.1	63	67.0
12	107.2	25	127.3	38	49.2	51	254.1		

RLC-2 Examples

Example: I want to go to 147.380 +600 with a PL of 100hz and encoding PL only.

1) Use the command C116 to send the data to the interface
2) Locate the 140-149.995 module as #2
3) Locate 100Hz PL as #13
4) Have encode on, and decode off

C116 will look like:
-P- C116 * 2 0 7380 1 13 0 1*
- Band module 2
- Power of '0', not used
- Frequency of 7.380
- Offset of '1' is plus offset
- PL of '13' which is 100hz
- Decode 'off'
- Encode 'on'

The information will be sent to the 2 meter module as previously set-up. The RLC-ICM defaults 2 meter module as slot#1 with a 600 khz offset.

Example: I want to go to add a 10 meter module in slot #4, and program the frequency to 29.600 simplex with no PL.

1) Use the command C112 to set-up the interface
2) Locate the 28-29.995 module as type #00
2) Use the command C116 to send the data to the interface
3) Locate the 28-29.995 module as #A

C112 will look like:
-P- C112 * 4 00 *

C116 will look like:
-P- C116 * A 0 9600 2 00 0 0*
- Band module A
- Power of '0', not used
- Frequency of 9.600
- Offset of '1' is minus offset

Command C112 configured the interface to route 10 meter requests to slot #4 and C116 handled the information transfer.

Setup and Programming the RLC-ICM with the RLC-3

See the RLC-3 manual section dealing with the Doug Hall RBI-1 interface. C139 is the setup command for software versions 1.44 through 1.48. Future software versions may use different commands. All of the RBI-1 commands apply to the RLC-ICM as well.

Special Considerations

1) There can only be 1 assigned module to each slot. Identically assigned modules will be handled in the order 1,2,3,4.

Example: I assigned 2 meter module to slot 1,4. I connected my 2 meter module to slot 4 and it does not function properly. What is the problem...

The RLC-ICM searches for the correct module type beginning with 1 and cycling up to 4. The first match the interface finds will get the information. The solution is to move your 2 meter module from slot #4 to slot #1.

2) Non-connected modules will give a valid COR signal and hang your controller.

Example: I assigned my 440 module to slot #3 but moved it to slot #2 and re-assigned it there. When I moved the module my transmitter on the controller stayed keyed all the time. What is the problem...

The COR coming from the radio module is active high when unsquelched. Because you previously had the 440 module on slot #3 and moved it, the COR signal from slot #3 just went active. If slot #3 was turned on before you moved it, the COR signal is being processed as though the module was still located on slot #3. The solution is to send the configuration command C112*395* to tell the RLC-ICM to remove slot #3 receive and transmit from the interface, thus causing slot #3 COR to go away. It is a good idea to tell the RLC-ICM to remove non-connected slots from the interface to keep this problem from occurring.

3) I get a valid COR from a slot that is enabled, but I do not get any audio.
The slots audio is broken, thus a jumper is available to re-make the receive audio path. The jumpers are labeled J11-J14. J11 is port 1, J12 is port 2, J13 is port 3, J14 is port 4. The jumpers need to be in-line when there is no TS-64 present. When the TS-64 is installed the jumper is removed. This allows the PL information to be filtered.

Another cause for this problem is the receive audio pot is turned down. Locate the module you are having the problem with and to the right is a bank of variable resistors. The pots are numbered according to the slot number. (Refer to the board layout for location) The pots location arrow should be located at about the 3 o'clock position for best audio. The other pots are for transmit level.

4) I don't seem to get any action when I program the RLC-ICM
First verify that your unit is wired correctly.
Second make sure your unit is powered.
Third make sure you have powered your radios +12v
Fourth make sure you get a response when programming
Last, call Link Communications Inc.

Installing the TS-64 tone module

The TS-64 module is available from:

Communications Specialists, Inc.
426 West Taft Ave.
Orange, CA 92665-4296
1-800-854-0547 Voice
1-800-850-0547 Fax

To install the TS-64 module you need to be able to de-solder small parts.
•   The small 9 pin connector needs to be removed from the circuit board.

•   Place the double stick tape on the back side of the board for spacing purposes

•   Line up the 9 pin connector and the dual row header pads before placing the module on the board. These pads will need to be thru-hold soldered to the RLC-ICM.

•   With small wires, carefully solder the wires to the RLC-ICM and the TS-64. Solder all the wires. These wires allow the interface to control the frequency of the tone module.

•   Remove the 2 pin shorting jumper nearest to the tone module. The jumpers are labeled J11-J14. J11 is port 1, J12 is port 2, J13 is port 3, J14 is port 4. The jumpers need to be in-line when there is no TS-64 present. When the TS-64 is installed the jumper is removed. This allows the PL information to be filtered.

Your PL encode level is located on the TS-64 module. PL tone levels should not exceed 500Hz deviation.

Schematic Drawings

Board Layouts

RLC-ICM
Internal Operation Test Points

The RLC-ICM ICOM IC900\901 module controller supports on-board function test points. These test points are supported in the software release V1.14. The test points are located towards the center of the interface. Test points are located on connector J10 which is a 5 pin male header connector.

The following signals are present on J10.

Pin 1 - Transfer complete (Data received without errors)
Pin 2 - Configuration data received (Set-up data received without errors)
Pin 3 - Error detected in transfer (Errors were encountered on the RLC-ICM)
Pin 4 - 1 second pulse output (Indicates program is running)
Pin 5 - Ground reference

When any data is sent to the RLC-ICM one of the above pins will change state. The active state is +5v or a (high). More than one state may be present at a time and the states will be active for 10 seconds (Except the 1 second pulse output).

Controller interfacing:

The user can use these pins for feedback to your RLC controller. When a frequency is selected on the interface, and the data was received without errors, pin #1 will go from the low (0v) state to the high (5v) state. When connected to an input line the controller can respond (Remote Base OK) for example. If an error is received during transfer pin #3 will go from the low (0v) state to the high (5v) state. When connected to an input line the controller can respond (Remote Base Error) for example. These lines simply tell the user that the data was received.

These lines can not directly interface to LED's, relays or any current "hungry" device. They are only designed for correct\error detection.

Questions or Suggestions:

Link Communications Inc.
P.O. Box 1071
115 2nd Ave. NE
Sidney, MT 59270-1071
Voice   +406-482-7515
Fax   +406-482-7547
E-mail: linkcomm@netins.net
FTP site: ftp.netins.net (cd\showcase\linkcomm)