# Arcom

# RC-210 Repeater Controller

# Operations and Programming Manual

## Firmware version 3.55

## September 28, 2003

# TABLE OF CONTENTS

# Command Reference

## Command Structure

The RC-210 provides an extremely flexible command code structure. Each port is capable of being controlled independently, as well as controlling any other port.

There are 3 types of commands in the RC-210:

- **_Port Specific_** commands that only affect one port. .

- **_Global_** commands which aren't port specific.

- **_Programming_** commands that are used to program how the RC-210 operates.

Port Specific commands specific to a particular port. For example if you wanted to select a different courtesy tone on Port 1, you could do so without affecting the courtesy tone on the other ports.

Global commands are those which don't target a specific port. Macros are a good example, as they could affect anything in the controller, not necessarily a specific port (although macros can store commands that are port specific).

Programming commands are those which change the operating parameters of the RC-210. Some programming commands affect only a specific port. For example, programming the amount of hang time on Port 1. Other programming commands affect things that are not port specific. For example, programming the command code for recalling macros.

The controller evaluates and acts on entered DTMF digits under two conditions - upon COS closure of the receiver receiving the digits or upon receipt of the DTMF digit "D". For example, there is an interfering signal on the receiver you're currently using. Obviously the controller would never detect COS closure under this condition. By ending your entered command with a "D", you force the controller to act regardless of the COS state.

All commands come pre-programmed with default values from the factory, however all commands may be reprogrammed at any time and may be any length from 1 to 8 digits long. While it is possible to have single digit commands, this is not recommended for security purposes.

The default values for the various command codes are listed below, along with their description and syntax. An asterisk next to each description signifies the power up state of that function (this can be changed by programming).

## Port Specific Commands

### Enable/Disable

Each port's transmitter may be disabled individually to prevent keying by itself or other ports. This command completely disables the transmitter on that port, except for ID's

| | | |
|---|---|---|
| **1131** Port 1 Enable* | **2131** Port 2 Enable* | **3131** Port 3 Enable* |
| **1130** Port 1 Disable | **2130** Port 2 Disable | **3130** Port 3 Disable |

### Carrier/CTCSS Access

Each port supports an external CTCSS (or digital) decoder, the action of which may be controlled with these commands.

| | | |
|---|---|---|
| **1132** Port 1Carrier* | **2132** Port 2 Carrier* | **3132** Port 3 Carrier* |
| **1133** Port 1 CTCSS | **2133** Port 2 CTCSS | **3133** Port 3 CTCSS |

## Courtesy Tone Selection

Each port has 10 programmable courtesy tone sets.

**1134x** Port 1 Courtesy Tone      **2134x** Port 2 Courtesy Tone      **3134x** Port 3 Courtesy Tone
Select x = 1-10 (1*)                  Select x = 1-10 (1*)                  Select x = 1-10 (1*)

## TouchTone© Covertone

Whenever a DTMF digit is pressed, the receiver audio from that port is muted. Optionally, a covertone may be selected so users aren't faced with "dead air".

**1135** Port 1 Touchtone©      **2135** Port 2 Touchtone©      **3135** Port 3 Touchtone©
Cover tone ON*                   Cover tone ON*                   Cover tone ON*

**1136** Port 1Touchtone©      **2136** Port 2 Touchtone©      **3136** Port 3 Touchtone©
Cover tone OFF                   Cover tone OFF                   Cover tone OFF

## Kerchunk Filtering

Each port has its own filtering command to prevent users from "kerchunking" that port. When turned on, these filters require that users key up for at least 500 milliseconds (1/2 second) before the RC-210 will recognize it as a valid signal.

**1137** Port 1 Kerchunk Filter On      **2137** Port 2 Kerchunk Filter On      **3137** Port 3 Kerchunk Filter On
**1138** Port 1 Kerchunk Filter Off*   **2138** Port 2 Kerchunk Filter Off*   **3138** Port 3 Kerchunk Filter Off*

## Half/Full Duplex Operation

Each port may be defined as full duplex, where a signal on that port's receiver is retransmitted out that port's transmitter. Or it may be defined as half duplex, where a signal on that port's receiver is NOT retransmitted out that port's transmitter. For example, if you wanted to use Port 2 for a half-duplex/simplex remote base, you would not want its transmitter to be activated by its receiver. You would therefore define that port as being half duplex. Of course if you want to use a particular port (or all ports) for a repeater, that port needs to be defined as full-duplex.

**1141** Port 1 Full Duplex*      **2141** Port 2 Full Duplex       **3141** Port 3 Full Duplex
**1140** Port 1 Half Duplex       **2140** Port 2 Half Duplex*      **3140** Port 3 Half Duplex*

## Port 3 For Control Receiver

Port 3 may be designated as the *Control Port*. The *Control Port* is very special, as it is possible to take complete control of the controller and override the operation of the other ports.

Some owners like to monitor activity on their repeater(s) without actually revealing their presence but be able to take control immediately should the situation warrant. This is easily accomplished by using Port 3 as your *Control Port*. By using a dedicated (and not announced to the general public) half or full-duplex radio on Port 3, the Port to Port connect commands allow monitoring of the other ports. Activity on the other ports continues normally and you may enter DTMF commands normally in this condition, as may the other ports. ***Note: Port 3 must be defined as full-duplex in order to monitor other ports in this manner***

If you need to take control, use the Control Port Override ON command and activity on the Control Port receiver will lock out the other ports' DTMF decoders, mute the audio from the other ports and replace their audio with Port 3's audio. This gives you total control of your repeater. When you are done, you simply turn the Override off.

**1051** Control Receiver Override ON
**1052** Control Receiver OFF*

## Monitoring A Port from Other Ports

Any port may be selectively monitored by any other port. In the RC-210, with multiple monitor commands you can create any combination of monitoring from port to port.  This provides considerable flexibility in audio routing. Each of these monitoring commands is a **one-way** connection. In other words, if you select to monitor Port 2 from Port 1, activity on Port 1 will not be retransmitted on Port 2.

To create a two-way path between ports, you have two choices. You can either establish 2, one-way connections between ports or you could use the Linking Commands (this is explained below).

Assume a user on Port 1 wants to monitor activity on Port 2. The user enters command **A74** and a one-way connection is established, allowing the monitoring *of* Port 2 *by* Port 1. Now, activity on Port 2 is retransmitted out Port 1, but Port 1 is not retransmitted out Port 2. It doesn't matter what port is used to issue these commands.

| PORT 1 | PORT 2 | PORT 3 |
|---|---|---|
| **A74** Monitor Port 2 ON | **A71** Monitor Port 1 ON | **A72** Monitor Port 1 ON |
| **A76** Monitor Port 2 OFF* | **A73** Monitor Port 1 OFF* | **A7A** Monitor Port 1  OFF* |
| **A77** Monitor Port 3 ON | **A78** Monitor Port 3 ON | **A75** Monitor Port 2  ON |
| **A79** Monitor Port 3 OFF* | **A7C** Monitor Port 3 OFF** | **A7B** Monitor Port 2 OFF |

After monitoring for a while, the user decides that they want to join in the conversation. By issuing the command **A71**, activity on Port 1 is now retransmitted out Port 2. In other words, there is now a two-way connection between Ports 1 & 2.

A two-way connection made in the above manner can be taken down by first turning off monitoring from the port you are on from being monitored by the other port. Then stop monitoring that other port with a second command.  For example, if you have a two-way monitor between Ports 1 and 2, and you are actively using Port 1,  send the command  **A71** first so Port 1 activity does not appear on Port 2, then send  **A74** to stop monitoring Port 2. It can be taken down the other way, but if there is an interruption you will be transmitting Port 1 audio on Port 2 and not realize when Port 2 is busy.

## Linking Ports Quickly

You may also establish two-way connections (linking) between ports quickly and easily using one command. Likewise, you can also disconnect (unlink) ports using these commands.  *__Note: Even if you established port monitoring using the Monitor Commands above, you may use the Linking Commands to turn them off or modify them. In other words, the Linking Commands take precedence over Monitoring commands.__*

| | |
|---|---|
| **A11** | Link Port 1 to Port 2 |
| **A21** | Link Port 1 to Port 3 |
| **A31** | Link Port 2 to Port 3 |
| **A41** | Link all ports to all other ports |
| **A10** | Unlink Port 1 from Port 2* |
| **A20** | Unlink Port 1 from Port 3* |
| **A30** | Unlink Port 2 from Port 3* |
| **A40** | Unlink all ports from all other ports* |

## Mix Monitored Audio with This Port RX Audio

This function selects whether audio from the monitored port(s) is mixed with the audio from the monitoring port or muted when there is activity on the monitoring port.

| PORT 1 | PORT 2 | PORT 3 |
|---|---|---|
| **A71*1** Mix Monitored Audio ON* | **A74*1** Mix Monitored Audio ON* | **A77*1** Mix Monitored Audio ON* |
| **A71*2** Mix Monitored Audio OFF | **A74*2** Mix Monitored Audio OFF | **A77*2** Mix Monitored Audio OFF |

## Mute DTMF ON/OFF

This command selects whether DTMF digits received on the selected port are retransmitted or muted.

| PORT 1 | PORT 2 | PORT 3 |
|---|---|---|
| **1185** Mute DTMF ON* | **2185** Mute DTMF ON* | **3185** Mute DTMF ON* |
| **1186** Mute DTMF OFF | **2186** Mute DTMF OFF | **3186** Mute DTMF OFF |

## Speech Override ON/OFF

Setting the Override to OFF causes user audio to be mixed with Speech Chip Audio. Setting the Override to ON causes speech to be stopped if a signal appears on  that port's receiver. If that speech is an ID, it will revert to a CW ID.

| PORT 1 | PORT 2 | PORT 3 |
|---|---|---|
| **159** Speech Chip Override ON | **259** Speech Chip Override ON | **359** Speech Chip Override ON |
| **158** Speech Chip Override OFF | **258** Speech Chip Override OFF | **358** Speech Chip Override OFF |

## Enable/Disable Port DTMF

Each port may have its DTMF decoder disabled. This function is useful under several circumstances, such as when a user is causing problems. Another circumstance is when you use one port for connecting to a linking backbone and you want to avoid possible conflicts in codes between multiple repeaters listening to the backbone.

When disabled, that port will only respond to 7 commands:

The DTMF Enable code for that port
The codes for Macro 35,36,37,38,39 and 40

By programming one of the macros to connect that port to another port, you allow DTMF coming in from that port to establish a connection with other ports. Conversely you can program another macro to disconnect that port. By using two macros per port, you have a great deal of control over who has access to what by using this function.

| | | |
|---|---|---|
| **1151** Port 1 DTMF Enable* | **2151** Port 2 DTMF Enable* | **3151** Port 3 DTMF Enable* |
| **1150** Port 1 DTMF Disable | **2150** Port 2 DTMF Disable | **3150** Port 3 DTMF Disable |

## Require/Not Require CTCSS for DTMF

Each port may be configured to either require a user's signal to contain CTCSS or not require it, in order to enter DTMF commands. This selection controls DTMF access regardless of the state of the access required for repeater access on that port. In other words, it is possible to have a port configured for carrier squelch access, yet require CTCSS for DTMF commands to work.

| | | |
|---|---|---|
| **1160** Port 1 no CTCSS for DTMF* | **2160** Port 2 no CTCSS for DTMF* | **3160** Port 3 no CTCSS for DTMF* |
| **1161** Port 1 CTCSS for DTMF | **2161** Port 2 CTCSS for DTMF | **3161** Port 3 CTCSS for DTMF |

# Global Commands

## Auxiliary Audio Inputs

These inputs can be used for connecting external audio devices, such as a weather receiver. When turned on, the selected transmitter is locked on for a period selected by a programmable timer. After this timer times out, the audio is disconnected and the transmitter is unkeyed. Which port a particular input is routed to is determined by programming commands.

**1201**      Turn Auxiliary Audio Input 1 ON
**1200**      Turn Auxiliary Audio Input 1 OFF
**1203**      Turn Auxiliary Audio Input 2 ON
**1202**      Turn Auxiliary Audio Input 2 OFF
**1205**      Turn Auxiliary Audio Input 3 ON
**1204**      Turn Auxiliary Audio Input 3 OFF

## General Logic Outputs

There are 7 switched outputs that can be commanded on or off. They can also be pulsed ( 0.1 ms low, 0.1 ms open, 0.1 ms low). When an output is high, it is actually an open collector. If you need a logic high present, you can provide a pull up resistor (up to 100 vdc).

**A510** Logic Output 1 Open Collector        **A550** Logic Output 5 Open Collector
**A511** Logic Output 1 Low        **A551** Logic Output 5 Low
**A512** Logic Output 1 Pulsed (low, open, low)        **A552** Logic Output 5 Pulsed (low, open, low)

**A520** Logic Output 2 Open Collector        **A560** Logic Output 6 Open Collector
**A521** Logic Output 2 Low        **A561** Logic Output 6 Low
**A522** Logic Output 2 Pulsed (low, open, low)        **A562** Logic Output 6 Pulsed (low, open, low)

**A530** Logic Output 3 Open Collector        **A570** Logic Output 7 Open Collector
**A531** Logic Output 3 Low        **A571** Logic Output 7 Low
**A532** Logic Output 3 Pulsed (low, open, low)        **A572** Logic Output 7 Pulsed (low, open, low)

**A540** Logic Output 4 Open Collector
**A541** Logic Output 4 Low
**A542** Logic Output 4 Pulsed (low, open, low)

## Extended Logic Outputs

If you have connected external shift registers as explained in the Hardware Reference section of this manual, you have a total of 64 logic outputs available to you.

**A600xxy**    Logic Output xx (1-64) to state y
            y = 0        Logic low
            y = 1        Logic High
            y = 2        Pulsed output (low, open, low)

## Alarms

Each Alarm may be individually turned ON or OFF. While ON, if an alarm is triggered, it will either call a macro every 30 seconds or connect one of the Auxiliary Audio Inputs to the port of your choice. This continues until the Alarm TimeOut period occurs or until that Alarm is turned off (disabled). See the Programming Reference section for details about programming the timer or the Auxiliary Audio Inputs.

| **1190** | Alarm 1 Enabled | **1196** | Alarm 4 Enabled |
|------|-----------------|------|-----------------|
| **1191** | Alarm 1 Disabled | **1197** | Alarm 4 Disabled |
| **1192** | Alarm 2 Enabled | **1198** | Alarm 5 Enabled |
| **1193** | Alarm 2 Disabled | **1199** | Alarm 5 Disabled |
| **1194** | Alarm 3 Enabled | | |
| **1195** | Alarm 3 Disabled | | |

## Remote Base Operation

Any of the 3 ports may be used to connect a remote base radio. Version 2.1 and above of the RC-210 firmware supports several popular radios frequently used for remote base operation:

All Kenwood radios with a computer port to allow computer control
Yaesu FT-817, FT-847, FT-897, FT100D
Icom IC706MKII, IC706MKIIg

The type radio you plan to use with the RC-210 is selected by programming commands. Because of the different formats used with radios within the Yaesu line, you must also select which model you wish to use. See the Programming Reference section of this manual for details.

The commands to control the radio are:

**147xxx.xxx y**  Enter Frequency with transmit offset*.
Frequency entered must be padded with zeros to make it 6 digits long.

Examples:

1 4 7 1 4 6 6 4 0 3 = 146.640 plus offset
1 4 7 4 4 8 3 2 5 1 = 448.325 minus offset
1 4 7 0 1 4 1 9 5 2 = 14.195 no offset
1 4 7 0 0 7 1 5 0 2 = 7.150 no offset

*The last digit represents the repeater offset.
y equals
1 - minus
2 - simplex
3 - plus

**258xxy**  Enter CTCSS code and select encode and/or decode.  The 2 digit code used for a particular frequency is
shown in Appendix B. Y =:
0 = Tone Off
1 = Encode only
2 = Encode/Decode

Examples:
2 5 8 1 2 1 = 100.0 Hz encode only          *Note: Entering 0 0 for the CTCSS code turns off CTCSS, .*
2 5 8 1 9 2 = 127.3 Hz encode/decode          *in which case the value of y doesn't matter.*
2 5 8 0 0 0 = CTCSS off

**369x**  Mode select. x equals:          *Note: This command only has relevance if you're using a remote base radio*
1 = LSB                    *capable of multimode use.*
2 = USB
3 = CW          ***Note: Any port used for a remote base should be defined as half-duplex.***
4 = FM
5 = AM

10

## Macros

Macros allow the user to execute many different functions with one single command. Each macro may be assigned its own, unique command code, so that can you reassign multiple commands to one command code of your own choosing. See the Programming Reference section of the manual on how to program both the macro codes, as well as the macros themselves. The default code for recalling macros is:

**1090x**  Recall macro x (1-40) and execute.

Macros are also called from the Scheduler to automate commands. See the Scheduler section in the Programming section of this manual for details.


## Analog Meter Inputs

Analog measurement capability consists of an 8 channel 10 bit analog to digital converter capable of measuring 8 input voltages between 0 and a voltage called "Vref."  Signals may be provided from the receiver s meter and deviation metering circuits, from wattmeters, temperature sensors and other transducers. There are a number of meter face names you can use, including Volts, Amps, Watts, Degrees, Miles per Hour, and Percent. Scaling of these meterfaces is completely programmable by the owner.

The voltage from an external sensor is applied to the Analog to Digital (A/D) input, it is measured, and based on the way you setup the meter reference levels, it "Speaks" the measured value. Sensor voltages must be between 0 vdc and Vref, a maximum value that can either be the internal reference level of 2.56 vdc (generated on the CPU itself) or an "external" value (External to the processor) provided by the 5 volt regulator on the RC210. The setting of Vref is one of the issues involved in using the Meter Inputs. When a meter readback command is entered, the controller reads back a value that represents the average of several measurements. The A/D measurements are being taken every second and smoothed in the controller firmware to provide a stable reading.

Using the A/D or ADC (same thing) adds the ability to keep track of battery voltage, temperature, wind speed, repeater transmit power, etc. Also, high and low values are stored and can be read back by the user. Also, meter Highs and Lows can be reset using a command for each meter, or a global command to clear all the meter highs and lows with one command.

How to setup Meters, to calibrate them and use them is explained later in the Programming section of this manual

**1050 (channel 1 - 8)**  Readback current value


## Real Time Clock And Calendar

If the Real Time Clock has been set since the last power outage, this command will announce the current time.

**1100**  Announce current time

> *Note: If the Real Time Clock has not been set since the past power outage, the controller will say "Clock Not Set" .*

If the calendar has been set since the last power outage, this command will announce the current date

**1101**  Announce current date

> *Note: If the Calendar has not been set since the past power outage, the controller will say "Date Not Set" .*

# Programming The RC-210

## General Programming Overview

Each port on the RC-210 is programmed individually and the programming for one does not affect the others.  The programming commands for each port are identical - the only difference being the port you've "unlocked" to program. This makes it easier to remember the code for programming a particular command/function.

For example, the code to program the Initial ID Timer is *1002, regardless which port you wish to program. What differentiates which port is being programmed is determined by which port you unlocked through the use of its unlock code.

While you are in programming mode, there are two special commands available to you, other than programming commands. The first one allows you to press DTMF digit "C" at any time and the controller will respond with a port identifier. This is helpful should you lose track of which port you are currently programming

"ULP1"     Port 1 response
"ULP2"     Port 2 response
"ULP3"     Port 3 response

The second special command is actually a preface to any valid, non-programming command. While you are in program mode, you preface any valid user command with two "stars" ( * * ) and the controller will execute it without you having to leave program mode. For example, you've just programmed a new CTCSS enable command to be " 1 2 3 4" and you'd like to verify it works. You can enter * * 1 2 3 4 while still in program mode and the controller should respond with the correct message, indicating the command was accepted and executed. This verifies your programming.

## Unlock Code Programming

The RC-210 comes programmed with a default unlock codes for each port. To unlock any port for the first time, enter the default code.

**15281**     Port 1 default unlock code
**25281**     Port 2 default unlock code
**35281**     Port 3 default unlock code.

For example, to unlock Port 1 for the first time, enter 1 5 2 8 1 and unkey.  The controller will respond with "ULP1", indicating that Port 1 is now unlocked and ready to accept programming. The code to reprogram the unlock code is * 9 0 0 0 followed by up to 8 digits - those digits will become your new unlock code for that port.

***Note: For security reasons, you should try and use all 8 digits for the unlock codes. You can not use the DTMF digit "C" or "D" in your unlock codes!***

For example, you want to program the unlock code for Port 1 to "**22334455**". Key your radio and enter *** 9 0 0 0 2 2 3 3 4 4 5 5** and unkey. The controller should respond with "CODE". Your new code is now set and will stay set until you explicitly change it, even through power off cycles. It is suggested the first thing you do is reprogram the unlock code for each port.

Some owners prefer to use a prefix, followed by a command unlock code. This makes it even easier to remember the codes. For example, you could program Port 1 unlock code as **12463683** , Port 2 as **22463683** and Port 3 as **32463683**. Of course this is strictly up to you, but the flexibility of the RC-210 allows you this sort of freedom.

***Important: Write your unlock codes down and keep them in a safe place. Should you lose them, it is possible to reset them back to factory defaults. See "Resetting your unlock codes" on Page 43 for details on how to do this.***

To lock the controller when you're done programming, you use a single #. The controller will respond with "LOCK", confirming you are no longer in program mode.

When any port is unlocked, a timer is started. Should no valid DTMF digit be received at least every 2 minutes, the controller will automatically lock itself.

# Port Unique Versus Global Programming

There are two types of programming commands:

- Those that affect only the port you currently have unlocked. These are referred to *as Port Unique Programming Commands*, which may be done from any radio port. In other words, you can program Port 2 while actually using a radio connected to Port 1.

-  Those commands which are shared between all ports or don't apply to a specific port. These are referred to as *Global commands*. For example, reading an ADC channel or controlling a remote base radio.

## Port Unique Command Programming

### Timer Programming

Unless otherwise noted, all of the following commands may be programmed with only those digits necessary. In other words, if the value you wish to enter is "20", you need only enter "20". If you want to enter "1234", you simply enter "1234" for that programming command.

### Hang Time

Each port has its own programmable hang time when that port is configured for full-duplex operation (in half-duplex, there is no hang time).

**\*1000x** where "x" is the amount of hang time for that port's transmitter in seconds. The range is 1 to 255 seconds. The controller responds with "HANG".

### Time Out Timer

Each port is provided with a time out timer that will drop the transmitter should a signal appear on it's receiver input for longer than the programmed time out period (this only applies if that port is in full-duplex).

\***1001x** where "x" is the time out period for that port's transmitter in seconds. The range is 1 to 32767. The controller responds with "TME".  **Note: Programming the timer to zero disables it.**

### Initial ID Timer

This timer sets the amount of time the repeater must be idle before sending the Initial ID. For example, if you set this timer to 10 minutes and that port is in full-duplex and unused for at least 10 minutes, this ID will play upon initial keyup. It won't play again until the repeater sits idle for another 10 minutes.

**\*1002x** where "x" is the amount of time between ID's. The default is 10 minutes and there is really no need to change it, but it can be changed from 0 to 255 minutes. The controller responds with "IIDTME" and value you entered for x.

### Pending ID Timer

After the initial ID is sent, the Pending ID timer is started. While this timer is running, if during this time there is activity on that port, the Pending ID message will be sent. If activity continues, the Pending ID will be sent every period, programmed by its timer. If there is no activity after the initial keyup, no further IDs are sent until the Initial ID period has elapsed.

**\*1003x** where "x" is the amount of time the Pending ID waits after an Initial ID occurs. The default is 9 minutes and there is really no need to change it, but it can be changed from 0 to 255 minutes. The controller responds with "PIDTME".

## Fan Timer

The RC-210 provides a convenient method of controlling a cooling fan, while eliminating unnecessary wear and tear. When Port 1 is keyed, the fan is started and will remain on for a period determined by the Fan Timer. It will then automatically shut off.

**\*1004x** where "x" is the amount of time you want the fan to remain on after any transmitter unkeys in minutes. The range is 1 to 255 minutes. The controller responds with "FAN".

## Port Inactivity Timer

When ports are connected to other ports, this timer is started. If there is no receiver activity on this port for the period determined by this timer, it will automatically be disconnected (unlinked) from whichever port to which it was connected.

**\*1005x** where "x" is the amount of time a connected port should remain connected to *this* port if there no is activity for x minutes. The range is 0 to 255 minutes. The controller responds with "Port Timer Set". **Note: Programming the timer to zero disables it.**

## DTMF Mute Timer

If DTMF muting is enabled on a port, audio from its receiver is muted upon receipt of DTMF. Furthermore, if the DTMF Covertone is enabled on this port, it will be used during the mute period as well. When the COS closes, the receiver is again unmuted and (if enabled) the Covertone is stopped. But what happens if a signal remains on the receiver? Obviously, the receiver wouldn't unmute until after that signal went away.

To prevent this from becoming a problem. the DTMF Mute Timer will unmute the receiver and stop the Covertone after a DTMF digit is first received and after certain amount of time. As long as DTMF digits are received, this timer is reset and the muting and Covertone will continue until the user unkeys.

**\*1006x** where "x" is the amount of time in 100 milliseconds steps that the DTMF mute timer should generate DTMF cover tone and the receiver should remain muted between DTMF digits. The range is 0 to 9999 milliseconds (ms). For example, 1 = 100 ms, 7 = 700 ms, 50 = 5 seconds Regardless of this setting, the receiver will unmute and covertone will be stopped immediately upon COS closure or the receipt of DTMF "D".

## CTCSS Encode Dropout Timer

If you have connected the CTCSS encode control line to an external encoder, you can program this parameter to select how long encoded CTCSS will continue to be transmitted after the receiver COS drops.

**\*1007x** where "x" is the amount of time in seconds CTCSS should continue to be sent after COS closure. The range is 0 to 255 seconds.

***Note: programming a 0 disables the timer and the CTCSS encode line will "turn off" immediately upon COS closure.***

## Alarm Timers

When an alarm is triggered, a timeout timer starts to run. When this timer times out, that alarm will reset back to the off position. X equals the amount of time the timer should take to time out. The range is 1 to 255 minutes.

**\*1008x**   Set Alarm 1 Timeout
**\*1009x**   Set Alarm 2 Timeout
**\*1010x**   Set Alarm 3 Timeout
**\*1011x**   Set Alarm 4 Timeout
**\*1012x**   Set Alarm 5 Timeout

## Auxiliary Audio Timers

When you turn on one of the Auxiliary inputs, a timer is started. When this timer times out, that input will automatically be turned back off.

**\*1013x**   Set Auxiliary Input 1 Timeout
**\*1014x**   Set Auxiliary Input 2 Timeout
**\*1015x**   Set Auxiliary Input 3 Timeout

# Programming The RC-210 Command Codes

The RC-210 allows you to program your own custom command sequences for every command function. It is very important that you ensure you program a unique code for each function.  You may use any valid DTMF digit in any command except for "C" or "D" as these are reserved digits.

**Remember, when programming command codes each command MUST be unique. "12345" is unique from "54321" however.**

Take the time to plan your code strategy prior to actually programming. You can program each of the following codes to be anywhere from 1 to 8 digits long.

It is strongly suggested that you plan ahead by making a list of command codes you want to program and then double check them for duplicates. If you accidentally program the exact same code into more than one function, only the first occurrence will work with subsequent occurrences being ignored by the controller.  You will then have to identify with commands aren't working and re-program their code accordingly. Take the time to plan your code structure and you will avoid having to take these steps.

Some system owners prefer the concept of having a prefix for a certain group of commands in order to make them easier to remember.

 For example, you could group all port linking commands together and assign them to start with a prefix of "AB". Then it would be a simpler matter to remember that the digit that follows the prefix controls a specific function of port linking.

**AB1** - Link Port 1 to Port 2
**AB2** - Link Port 1 to Port 3
**AB3** - Link Port 2 to Port 3
**AB4** - Link all ports
**AB5** - Unlink Port 1 from Port 2
**AB6** - Unlink Link Port 1 from Port 2
**AB7** - Unlink Port 2 from Port 3
**AB8** - Unlink all ports

Of course, these are strictly examples and only limited by a maximum of 8 digits for each command and your imagination!

Other system owners prefer a different code scheme and will assign commands based on different groups of users, such as general users and authorized Control Operators. Only some commands will be given to each group, with the Owner reserving programming commands and other deemed critical functions only for themselves.

Again, this is totally up to you and how you wish to organize your system. The RC-210 gives you the flexibility to do it any way you want.

# The Differences Between Port Linking and Port Monitoring Programming

As explained in the Command Reference section of this manual, there are 2 types of port-to-port connections used in the RC-210. Port Monitoring is a one-way connection made between ports while Port Linking is a fast way to establish a two-way connection. As such, it is easy to grasp the concept of two-way linking as it relates to programming the codes used to accomplish it - you connect (or disconnect) two or more ports with one command. Hence programming the code used to accomplish this is pretty straightforward.

Programming the one-way port monitoring codes, however, takes a little more explanation.

Let's say that you want to program the code that needs to be entered by users in order to monitor Port 1 from Port 2. And you want that code to be "1234".

From the Programming command list, we see that the code we use to program this function is shown as:

**\*2004**      Set This Port To Next Port Monitor Code           Set the code used to monitor this port from the next port

"What the heck does this mean?",  you may ask.

Simply put, "This Port" refers the port that is currently unlocked for programming and "Next port" refers to the next port in sequence and "following port" refers to the port after the next port.

The following explains the relationships between ports when programming the appropriate codes:

**This Port**          **Next Port**          **Following Port**

Port 1  ⟶  Port 2  ⟶  Port 3

Port 2  ⟶  Port 3  ⟶  Port 1

Port 3  ⟶  Port 1  ⟶  Port 2
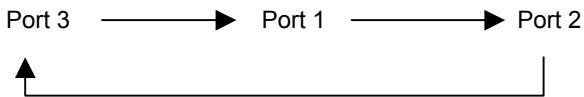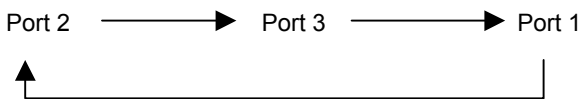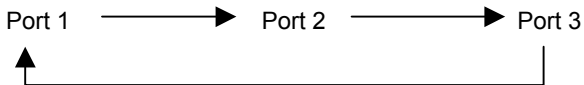
As you can see,  "next port" would be Port 2 in our example above. To program our example, we first unlock Port 1 with its Unlock Code, then we enter:

**\*2004 1 2 3 4**

Likewise, if we wanted to program the code that establishes a one-way connection from Port 3 to Port 2 to be "3 4 5 6", we can see from port relationships that we will actually program "This Port" (Port 3) to the "following port" (Port 2). We first unlock Port 3 and enter:

**\*2005 3 4 5 6**

Now, when a user enters "3 4 5 6", Port 3 will be monitored by Port 2

# List of Programming Codes

The following list gives you all the programming codes needed to custom program the RC-210. Before you actually start programming, it would be a good idea to look over the list and understand what each one does. If necessary, refer to the command descriptions in the Command Reference section of this manual.

## Port Specific Programming Commands

| Program Code | What It Programs | What It Means |
|---|---|---|
| *2000 | Set Transmitter Enable Code | Set the code used to enable that port's transmitter |
| *2001 | Set Transmitter Disable Code | Set the code used to disable that port's transmitter |
| *2002 | Set Carrier Squelch Code | Set the code used for carrier squelch access |
| *2003 | Set CTCSS Squelch Code | Set the code used for CTCSS squelch access |
| *2004 | Set This Port To Next Port Monitor Code | Set the code used to monitor this port from the next port |
| *2005 | Set This Port To Following Port Monitor Code | Set the code used to monitor this port to the following port |
| *2006 | Set This Port To Next Port Disconnect Code | Set the code used to disconnect this port from the next port |
| *2007 | Set This Port To Following Port Disconnect Code | Set the code used to disconnect this port from following port |
| *2008 | Set Monitor Mix Code | Set the code used to put this port into Monitor Mix |
| *2009 | Set Monitor Mute Code | Set the code used to put this port into Monitor Mute |
| *2010 | Set Courtesy Tone Select Code | Set the code used to select which Courtesy Tone is used |
| *2011 | Set DTMF Covertone ON Code | Set the code used to turn the DTMF Covertone ON |
| *2012 | Set DTMF Covertone OFF Code | Set the code used to turn the DTMF Covertone OFF |
| *2013 | Set Full Duplex Code | Set the code used to select Half Duplex for this port |
| *2014 | Set Half Duplex Code | Set the code used to select Full Duplex for this port |
| *2015 | Set Speech Override Code | Set the code used to select receiver audio mixed with speech |
| *2016 | Set Speech Stop Code | Set the code used to select receiver audio stops speech |
| *2017 | Set TT Mute ON Code | Set the code used to turn DTMF muting ON |
| *2018 | Set TT Mute OFF Code | Set the code used to turn DTMF muting OFF |
| *2019 | Set Kerchunk Filtering ON Code | Set the code used to turn Kerchunk filtering ON |
| *2020 | Set Kerchunk Filtering OFF Code | Set the code used to turn Kerchunk filtering OFF |
| *2021 | Set DTMF Enable Code | Set the code used to turn DTMF decoding ON |
| *2022 | Set DTMF Disable Code | Set the code used to turn DTMF decoding OFF |
| *2023 | Set Require CTCSS for DTMF ON Code | Set the code used to require CTCSS for DTMF |
| *2024 | Set Require CTCSS for DTMF OFF Code | Set the code used to allow DTMF regardless of CTCSS |

## Global Programming Commands

| Program Code | What It Programs | What It Means |
|---|---|---|
| *2050x | Set Macro Recall Code | Set the code used to recall a stored Macro for each Macro |
| *2051 | Set Control Receiver Override On Code | Set the code used to turn ON the Control Receiver |
| *2052 | Set Control Receiver Override Off Code | Set the code used to turn OFF the Control Receiver |
| *2053 | Set UF1 Code | Set the code used to control Logic Output 1 |
| *2054 | Set UF2 Code | Set the code used to control Logic Output 2 |
| *2055 | Set UF3 Code | Set the code used to control Logic Output 3 |
| *2056 | Set UF4 Code | Set the code used to control Logic Output 4 |
| *2057 | Set UF5 Code | Set the code used to control Logic Output 5 |
| *2058 | Set UF6 Code | Set the code used to control Logic Output 6 |
| *2059 | Set UF7 Code | Set the code used to control Logic Output 7 |
| *2060 | Set Extended UF Code | Set the code used to control the Extended Logic Outputs |
| *2061 | Set Read Clock Code | Set the code used to readback the time from the Clock |
| *2062 | Set Read Analog Channels Code | Set the code used to read the Analog Meter Faces |
| *2063 | Set Reset Meter Hi/Low Code | Set the code used to reset the stored high/low values |
| *2064 | Program ADC/Meter face | Program the various meter faces |
| *2065 | Program Reference Voltage | Program the Reference Voltage used on the Analog Channels |
| *2066 | Future Use | Future Use |
| *2070 | Set Alarm 1 On Code | Set the code used to turn ON Alarm 1 |
| *2071 | Set Alarm 1 Off Code | Set the code used to turn OFF Alarm 1 |
| *2072 | Set Alarm 2 On Code | Set the code used to turn ON Alarm 2 |
| *2073 | Set Alarm 2 Off Code | Set the code used to turn OFF Alarm 2 |
| *2074 | Set Alarm 3 On Code | Set the code used to turn ON Alarm 3 |
| *2075 | Set Alarm 3 Off Code | Set the code used to turn OFF Alarm 3 |

# Global Programming Commands (continued)

| Program Code | What It Programs | What It Means |
|---|---|---|
| **\*2076** | Set Alarm 4 On Code | Set the code used to turn ON Alarm 4 |
| **\*2077** | Set Alarm 4 Off Code | Set the code used to turn OFF Alarm 4 |
| **\*2078** | Set Alarm 5 On Code | Set the code used to turn ON Alarm 5 |
| **\*2079** | Set Alarm 5 Off Code | Set the code used to turn OFF Alarm 5 |
| **\*2080** | Set Remote Base Frequency Entry Code | Set the code used to enter a Remote Base Frequency |
| **\*2081** | Set Remote Base Mode Select Code | Set the code used to select a Remote Base Mode |
| **\*2082** | Set Remote Base CTCSS Select Code | Set the code used to set the Remote Base CTCSS functions |
| **\*2083x** | Set Radio Type | Select which type of radio is used as a Remote Base  1 = Kenwood, 2 = Icom, 3 = Yaesu |
| **\*2084x** | Set Yaesu Type | If Yaesu is selected, select which type format to use  x = 1 for FT-100D, 2 = FT817, FT-847, FT-897 |
| **\*2085** | Set Port1 To Port 2 Link On Code | Set the code used for a 2-way link between Ports 1 & 2 |
| **\*2086** | Set Port1 To Port 3 Link On Code | Set the code used for a 2-way link between Ports 1 & 3 |
| **\*2087** | Set Port2 To Port 3 Link On Code | Set the code used for a 2-way link between Ports 2 & 3 |
| **\*2088** | Set Link All Ports On Code | Set the code used to 2-way link all 3 ports |
| **\*2089** | Set Port1 To Port 2 Link Off Code | Set the code used to unlink Ports 1 & 2 |
| **\*2090** | Set Port1 To Port 3 Link Off Code | Set the code used to unlink Ports 1 & 3 |
| **\*2091** | Set Port2 To Port 3 Link Off Code | Set the code used to unlink Ports 2 & 3 |
| **\*2092** | Set Link All Ports Off Code | Set the code used to unlink all 3 ports from each other |
| **\*2093** | Set Read Date Code | Set the code used to read the Calendar |
| **\*2094** | Set Aux Audio 1 On Code | Set the code used to turn ON Auxiliary Audio 1 |
| **\*2095** | Set Aux Audio 2 On Code | Set the code used to turn ON Auxiliary Audio 2 |
| **\*2096** | Set Aux Audio 3 Off Code | Set the code used to turn ON Auxiliary Audio 3 |
| **\*2097** | Set Aux Audio 1 Off Code | Set the code used to turn OFF Auxiliary Audio 1 |
| **\*2098** | Set Aux Audio 2 Off Code | Set the code used to turn OFF Auxiliary Audio 2 |
| **\*2099** | Set Aux Audio 3 Off Code | Set the code used to turn OFF Auxiliary Audio 3 |
| **\*2100** | Set Aux Audio Port Routing | Set the port(s) out of which the Aux audio should be sent |
| **\*2101** | Program Aux Audio for Alarms | Selects (if any) Aux Audio inputs for use in Alarms |
| **\*2102** | Program Alarm Macro | Program which Macro and Alarm should use |
| **\*21999** | Reset Controller | Reset the controller |
| **\*4001** | Program Scheduler | Program the Scheduler to run automatic macros |
| **\*4002** | Program A Macro | Program a series of functions in one macro command |
| **\*4003** | Erase Macro | Erase a previously stored macro |
| **\*7001x** | Record DVR Message | Record a DVR Track  x = Track 1 to 20 |
| **\*7002x** | Erase DVR Message | Erase a DVR Track  x = Track 1 to 20 |
| **\*700399** | Erase ALL DVR Messages | Erases all DVR Tracks 1 to 20 |
| **\*7004x** | Remove last segment of DVR Message | Remove the last 200 ms. of Track 1 to 20 |
| **\*7005x** | Record DVR Message | Replace the last 200 ms. of Track 1 to 20 |
| **\*70060** | Recall Seconds Left | Tells you the remaining recording time available |

## Using The Digital Voice Recorder (DVR)

The RC-210 includes an on-board DVR that allows you to record up to 20 different "tracks" (messages) of audio. There is a total of 63 seconds recording time available, which can be divided up any way you like. You can have any combination of recorded tracks as long as the total time doesn't exceed the maximum recording time available. DVR tracks may be used in any programmable message, including ID's, link commands or other programmable messages. DVR Tracks 1 - 12 may be played as any other vocabulary word. However DVR Tracks 13 -20 may only be played from inside a macro. In other words, all DVR tracks (1 - 20) may be used in a macro, but only 1 - 12 may be used in a programmable message.

## Recording DVR Tracks

To record a track, the controller must have one of its ports unlocked (remember, this is a global programming command so it doesn't matter which port you unlock). The syntax is:

**\*7001x** where "x" is the track number you wish to record 1 - 20

The controller responds with the number of seconds of recording time you have available and then says "Ready". At this point it is waiting for you to key before actually starting to record. You must start recording within 5 seconds after the controller speaks "Ready" or the command will be canceled. Once started, simply unkey to stop recording and your message is will be stored in memory. Don't worry if it's not perfect, as you have some editing commands available with which to "clean it up".

## Playing A Recorded DVR Track

***While in programming mode***, you can use the following command to play back any recorded DVR Track. This is very useful to check the quality of your recording, both before and during editing.

**123x** where "x" is the DVR track to play 1- 20

## Erasing Tracks

Once a track is recorded, it cannot be recorded again without first erasing it  (this safeguard prevents you from accidentally recording over a previously recorded track). You can erase a particular track or, should you want to completely "wipe the slate clean", you may erase ALL tracks. When you erase tracks, the controller will let you know how many seconds recording time you have available after the track(s) is cleared.

**\*7002x** where "x" is the track number you want to erase 1 - 20

**\*700399** Erase all DVR tracks

## Editing Recorded Tracks

Rarely will a recorded track be perfect, especially at the end of that recording. The DVR will faithfully record (and playback) whatever it is asked to - squelch bursts and other noise may appear at the end of your recording. The RC-210 gives you 2 commands with which to remove (or add) the last 200 milliseconds of a recording, which is very effective at editing those noises from the end of your recordings.

Let's say you've recorded an ID in Track 10 but at the end of it, there is a squelch burst. You can remove the last part of this track in 200 milliseconds increments by using the following command

**\*7004x** where "x" is the Track number to remove the ending 200 millisecond segment.

I can then use the **\*\*123 10** command to play back Track 10 to see how it sounds.

It may be that you will need to remove more than one 200 millisecond segment - perhaps you stopped speaking and didn't unkey for longer time than you should have. You may remove as many segments as you need.

It is possible to remove too many segments, which results in chopping off too much from the end! Fortunately, the RC-210 lets you easily add back a previously removed segment with the following command

**\*7005x** where "x" is the Track number to add back the last removed 200 milliseconds segment.

You can add back as many segments as you need.

## Finding Out How Much Recording Time You Have Left

The DVR will keep track of the total amount of recording time you have used. It will also let you know how many seconds of recording time you have left every time you record or erase a track (or erase all tracks). In addition, you can also use the following command at any time you're in programming mode to find out how many seconds of total recording time remain.

***70061**   Read back the amount of available recording time, in seconds.

 Notes:

 *When editing tracks, you must do so before you record any new ones or the results may be unpredictable.*

 *Be ready to start speaking immediately when you start transmitting to minimize the amount of recording space used. You can not edit the beginning of a track.*

# *The Scheduler*

The Scheduler lets you automate many routine tasks by defining a specific day of the week, the hour of that day and the number of minutes past the hour you wish that task to run. Such a definition is called a *setpoint,* which is programmed to run a specific macro at a specific time of day.  Only macros may be run by the scheduler, however that macro may contain any command(s), including speech commands such as Time of Day.

### *Note: setpoints are one-shot events that occur only once at the scheduled time*

One example of a setpoint would be if you wanted to link Port 1 to Port 2 for a net that lasts for an hour every Tuesday at 7 PM. You'd define a macro to link Port 1 to Port 2, then define a setpoint to call that macro at 7 PM. After the net is over, another setpoint could be defined to call a different macro that disconnects the ports.

## How Do We Define Setpoints?

A programming commands allows us to program each setpoint by defining the time and day of week that setpoint should run and the macro to be executed. The format is:

**\*4001 SS DOW Hours Minutes Macro**

SS is the setpoint number 01-40 and must always be 2 digits

DOW is the day of week:

| | |
|---|---|
| 1 = Monday | 6 = Saturday |
| 2 = Tuesday | 7 = Sunday |
| 3 = Wednesday | 8 = weekdays |
| 4 = Thursday | 9 = weekends |
| 5 = Friday | 0 = everyday |

Hours and Minutes are the time in 24 hour format. For example, 10 24 = 10:24 am or 22 10 = 10:10 pm

### *Hint: The hours digits may be set to a wildcard value with a DTMF "0A". Setting the hours to "0A" causes a match every hour at "minutes" after.*

Macro is the macro to be executed at the appointed time and may be any macro you have defined 01-40. You must use 2 digits.

More than one setpoint can be run at a particular time. For example, if more than one setpoint qualifies at a particular time, the lowest numbered one will be run first, then the next and so on. You can cancel any previously defined setpoint by setting it to a time that will never occur, i.e 25 00 hours.

## Reoccurring Voice Messages

You may want to define a setpoint that announces the time every hour (using the hourly wildcard) during morning commute time on weekdays. Easy enough, we'll just program a setpoint to recall a macro that calls function 116 (Say Time), speak on Port 1 and call that macro with a scheduler setpoint to run every hour, starting at 6 AM.  The RC-210 will now speak the time every hour, on the hour. But we have a problem now - there is no way to stop the hourly announcements without actually reprogramming that setpoint so that it doesn't announce the time any more. Since the controller will now announce the time every hour, 24 hours a day,  this obviously doesn't work out the way we want!

So how can we stop that setpoint from continuing to run until we reprogram it? Without something to tell the scheduler to stop running that setpoint, in fact we can't. So once started, the controller is going to announce the time every hour until we do something about it.

In order to get around this problem, the RC-210 incorporates another set of commands that allow you to suspend a currently occurring setpoint without having to actually erase that setpoint.  These commands are known as the Suspend and Resume commands. What the Suspend command does is to prevent a setpoint from occurring by setting a flag. The RC-210's program then knows that since the Suspend flag is set, it shouldn't continue to execute that setpoint. To start it running again, we simply use another setpoint to run another macro that calls the Resume command. The setpoint to announce the time is now free to run once more.

It works like this:

First, we program up the needed macros:

**\*4002 02 162 116**          ←Macro 2 calls Say Time on Port 1
**\*4002 03 321**               ←Macro 3 sets the Resume flag
**\*4002 04 301**               ←Macro 4 sets the Suspend flag

***Note: Since Macro 1 is called at controller startup, it should never be used to announce the time, since the clock will never be set at startup.***

Now we program our setpoints:

**\*4001 01 8 0A 00 02**     ←Call Macro 2 every hour on weekdays
**\*4001 02 8 06 00 03**     ←Resume Macro 3 at 6 AM on weekdays (we don't need to use the Port setting here)
**\*4001 03 8 09 00 04**     ←Suspend Macro 4 at 9 AM weekdays (again, we don't need to use the Port setting)

Now the controller will announce the time every hour on Port 1, starting at 6 AM on weekdays and stop announcing at 9 AM


## Plan! Plan! Plan!

The most important step you can do is PLAN. You need to figure out exactly what you want the repeater to do, then how the scheduler should be programmed in order to accomplish that. The scheduler is pretty smart, but it can't read your mind!

First of all, let's decide on what we want the scheduler to do. Maybe you'd like to turn off certain features at night, leaving them on until later on the weekends for the night owls. Maybe you have a swap net on Mondays that you would like to monitor. You want to automatically link Port 1 to Port 2 5 minutes before the start time of the net and turn it back off when the net is over. During the weekday morning commute, you'd like to change to a different courtesy tone on Port 2 and announce the time every 15 minutes for the commuters.  You also want to put all ports into CTCSS access mode between midnight and 7 am on weekends. Remember that the scheduler can only call macros, so we need to define some macros to do our bidding

From the above, we first define our setpoints and the macro we'll store the function in:

| Setpoint | Time | Day | Macro | Description |
|---|---|---|---|---|
| 1 | 6:00 am | weekdays | 2 | Weekday mornings - change to courtesy tone #2 on Port 2, announce the time |
| 2 | 9:00 am | weekdays | 3 | Weekday mornings - change back to courtesy tone #1 on Port 2, stop announcing time |
| 3 | 7:00 pm | Monday | 5 | Turn link on for net |
| 4 | 8:00 pm | Monday | 6 | Turn link off after net ends |
| 5 | 12:00 am | weekdays | 7 | Change all ports to CTCSS access on weekends at midnight |
| 6 | 6:00 am | weekdays | 8 | Change all ports to carrier access on weekend mornings at 7 am |

# The Scheduler (continued)

We first need to program the appropriate macros to function those things we want changed:

**\*4002 02 163 061 116**   Program Macro 2 to change to courtesy tone #2 on Port 2 and announce the time.
**\*4002 03 060 301**       Program Macro 3 to change to courtesy tone back to #1 on Port 2 and suspend announcing the time.
**\*4002 04 321**           Program Macro 4 to resume running Macro 1
**\*4002 05 118**           Program Macro 5 to link Ports 2 & 3
**\*4002 06 122**           Program Macro 6 to unlink Ports 2 & 3
**\*4002 07 002 004 006**   Program Macro 7 to change all ports to CTCSS access
**\*4002 08 001 003 005**   Program Macro 8 to change all ports to carrier access

We can now program the scheduler setpoints:

**\*4001 01 8 0A 00 02**            Call Macro 2 at 6 AM on weekdays
**\*4001 02 8 09 00 03**            Call Macro 3 at 9 AM on weekdays
**\*4001 03 8 06 00 04**            Call Macro 4 at 6 AM to restart Macro 1
**\*4001 04 8 18 55 05**            Call Macro 5 at 6:55 PM to link Ports 1 & 2
**\*4001 05 8 20 00 06**            Call Macro 6 at 8 PM to unlink Ports 1 & 2
**\*4001 06 9 00 00 07**            Call Macro 7 at midnight on weekends
**\*4001 07 9 07 00 08**            Call Macro 8 at 7 AM on weekends.

As you can see, if you take the time to plan your setpoints, the RC-210 can handle many tedious chores for you, automatically.

## Macro Programming

The RC-210 allows for storing up to 40 different macro sets that are stored in non-volatile memory and can be recalled with a single command.  Each macro can store up to 15 different commands, including other macros. Each command in the RC-210 is assigned a Function Number (FN) that is used to store it in each macro (see the Macro List on the next page)

Macros are programmed by first entering the macro programming command for the macro you wish to program, followed by a series of up to 15, 3 digit function numbers to be programmed into that macro. The command syntax is:

**\*4002 mm** xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx

where "mm" are 2 digits representing the macro (01-40) to be programmed, followed by up to 15, 3 digit numbers where "xxx" represents those commands.
***Note: You do not have to enter all 15 commands, only those you want to be stored in that macro.***

For example, we want to program Macro 1 so it will turn on CTCSS Access on Port 1, connect Port 1 to Port 2 and change Port 2's courtesy tone to #4. By looking up these functions on the Macro Function Number chart, we see the function commands we want are 002, 019 and 059. We enter - all in one transmission:

**\*4002 01  002 019 059**

The controller responds with "M A C R O" and the number of the macro we just programmed.

We can even program macros to include other macros. For example, we want to create a macro that in addition to doing what Macro 1 already does, we also want it to change Port 1's courtesy tone to #9. Instead of having to repeat the commands previously stored in Macro 1, we can simply create a new macro containing the additional function and include Macro 1 as well:

**\*4002 02 054 401**

Macros may be embedded into other macros any number of times, up to the limit of 15 function commands per macro.

## Speech Control Within Macros

Normally, speech command acknowledgment is sent out to the port from which the command was entered. For example, if you link Ports 1 & 2, entering the command from Port 1, the command acknowledgment will only be sent to Port 1. Also in the case of Scheduler called macros, we need a way to tell the RC-210 which port(s) should be used when sending a speech announcement.

Under certain circumstances, you may want any such speech sent out to other ports as well. In the above case, it might be useful to have it sent to both ports involved so users on both ports are advised as to the current status of the link. One solution to this would have been for the firmware to automatically send speech to ports that are linked, but this creates a problem - what if one of the ports involved isn't used as a link but rather as a remote base? It's a bad idea to send speech acknowledgments and other "repeater" messages out a remote base, since a remote base should emulate the operation of a simplex radio. Simple solution you say - "Why not just program the controller to send speech messages out both ports, if the linked to port is configured to be half-duplex?"

With so many different system designs out there, many repeater systems use half-duplex links. If the controller did this routing automatically, you'd never be able to direct speech where you want it.

So it seems we need more a more flexible solution than an automatic one.

The solution is to allow you to select, within a macro, which port(s) should receive speech. In our example above, we decide we want speech to be sent out both Ports 1 & 2. We therefore program a macro that will link the two ports and also send speech to Ports 1 & 2:

**\*4002 10 165 118**

By recalling macro 10, Ports 1 & 2 will be linked, with the connect message being sent to both ports.

Now we can program another macro to disconnect the ports and send the speech where we want it:

**\*4002 11 165 122**

By recalling Macro 11, Ports 1 & 2 will be unlinked, with the disconnect message being sent to both ports.

***Important: If a macro contains a speech direct command, the speech direct function code must be the first one used in that macro. This is important as if it doesn't appear first within the macro, speech may or may not be properly directed.***

## List Of Port Direction Commands For Use In Macros

| | | | |
|---|---|---|---|
| **162** | Port 1 | **166** | Ports 1 & 3 |
| **163** | Port 2 | **167** | Ports 2 & 3 |
| **164** | Port 3 | **168** | All Ports |
| **165** | Ports 1 & 2 | | |

## Erasing Macros

You may erase any macro with the following command:

**\*4003** mm where "mm" is the macro number 01-40.

Or you can erase ALL macros with:

**\*400499**    Clears all Macros

## Startup Macro

Macro 1 is a special case in that it is run every time the controller is powered up or otherwise resets. This allows you to define a known startup state of your RC-210 whenever one of the above occurs.

You may include any command within Macro 1, including calling other macros from within Macro 1. But one thing to look out for is to make sure you don't call any macros (or include the commands directly within Macro 1) that include either the Say Time or Say Date commands. Since neither the clock nor calendar is set on powerup, you'd always receive the "Clock Not Set" or "Date Not Set" message. Hardly a useful message!

# Macro Function Number List

| FN | Description | FN | Description |
|---|---|---|---|
| 001 | Port 1 Carrier Access | 061 | Port 2 Courtesy Tone 3 |
| 002 | Port 1 CTCSS Access | 062 | Port 2 Courtesy Tone 4 |
| 003 | Port 2 Carrier Access | 063 | Port 2 Courtesy Tone 5 |
| 004 | Port 2 CTCSS Access | 064 | Port 2 Courtesy Tone 6 |
| 005 | Port 3 Carrier Access | 065 | Port 2 Courtesy Tone 7 |
| 006 | Port 3 CTCSS Access | 066 | Port 2 Courtesy Tone 8 |
| 007 | Port 1 Touchtone© Covertone ON | 067 | Port 2 Courtesy Tone 9 |
| 008 | Port 1 Touchtone© Covertone OFF | 068 | Port 2 Courtesy Tone 10 |
| 009 | Port 2 Touchtone© Covertone ON | 069 | Port 3 Courtesy Tone 1 |
| 010 | Port 2 Touchtone© Covertone OFF | 070 | Port 3 Courtesy Tone 2 |
| 011 | Port 3 Touchtone© Covertone ON | 071 | Port 3 Courtesy Tone 3 |
| 012 | Port 3 Touchtone© Covertone OFF | 072 | Port 3 Courtesy Tone 4 |
| 013 | Port 1 Enable | 073 | Port 3 Courtesy Tone 5 |
| 014 | Port 1 Disable | 074 | Port 3 Courtesy Tone 6 |
| 015 | Port 2 Enable | 075 | Port 3 Courtesy Tone 7 |
| 016 | Port 2 Disable | 076 | Port 3 Courtesy Tone 8 |
| 017 | Port 3 Enable | 077 | Port 3 Courtesy Tone 9 |
| 018 | Port 3 Disable | 078 | Port 3 Courtesy Tone 10 |
| 019 | Monitor Port 1 from Port 2 | 079 | Port 1 DTMF Muting ON |
| 020 | Monitor Port 1 from Port 3 | 080 | Port 2 DTMF Muting ON |
| 021 | Disconnect Port 1 from Port 2 | 081 | Port 3 DTMF Muting ON |
| 022 | Disconnect Port 1 from Port 3 | 082 | Port 1 DTMF Muting OFF |
| 023 | Port 1 Monitor Mute | 083 | Port 2 DTMF Muting OFF |
| 024 | Port 1 Monitor Mix | 084 | Port 3 DTMF Muting OFF |
| 025 | Monitor Port 2 from Port 1 | 085 | Control Receiver Override ON |
| 026 | Monitor Port 2 from Port 3 | 086 | Control Receiver Override OFF |
| 027 | Disconnect Port 2 from Port 1 | 087 | Read ADC Channel 1 |
| 028 | Disconnect Port 2 from Port 3 | 088 | Read ADC Channel 2 |
| 029 | Port 2 Monitor Mute | 089 | Read ADC Channel 3 |
| 030 | Port 2 Monitor Mix | 090 | Read ADC Channel 4 |
| 031 | Monitor Port 3 from Port 1 | 091 | Read ADC Channel 5 |
| 032 | Monitor Port 3 from Port 2 | 092 | Read ADC Channel 6 |
| 033 | Disconnect Port 3 from Port 1 | 093 | Read ADC Channel 7 |
| 034 | Disconnect Port 3 from Port 2 | 094 | Read ADC Channel 8 |
| 035 | Port 3 Monitor Mute | 095 | UF1 ON |
| 036 | Port 3 Monitor Mix | 096 | UF1 OFF |
| 037 | Port 1 Full Duplex | 097 | UF1 Pulse |
| 038 | Port 1 Half Duplex | 098 | UF2 ON |
| 039 | Port 2 Full Duplex | 099 | UF2 OFF |
| 040 | Port 2 Half Duplex | 100 | UF2 Pulse |
| 041 | Port 3 Full Duplex | 101 | UF3 ON |
| 042 | Port 3 Half Duplex | 102 | UF3 OFF |
| 043 | Port 1 Speech Override ON | 103 | UF3 Pulse |
| 044 | Port 2 Speech Override ON | 104 | UF4 ON |
| 045 | Port 3 Speech Override ON | 105 | UF4 OFF |
| 046 | Port 1 Speech Override OFF | 106 | UF4 Pulse |
| 047 | Port 2 Speech Override OFF | 107 | UF5 ON |
| 048 | Port 3 Speech Override OFF | 108 | UF5 OFF |
| 049 | Port 1 Courtesy Tone 1 | 109 | UF5 Pulse |
| 050 | Port 1 Courtesy Tone 2 | 110 | UF6 ON |
| 051 | Port 1 Courtesy Tone 3 | 111 | UF6 OFF |
| 052 | Port 1 Courtesy Tone 4 | 112 | UF6 Pulse |
| 053 | Port 1 Courtesy Tone 5 | 113 | UF7 ON |
| 054 | Port 1 Courtesy Tone 6 | 114 | UF7 OFF |
| 055 | Port 1 Courtesy Tone 7 | 115 | UF7 Pulse |
| 056 | Port 1 Courtesy Tone 8 | 116 | Say Time |
| 057 | Port 1 Courtesy Tone 9 | 117 | Say Date |
| 058 | Port 1 Courtesy Tone 10 | 118 | Link Port 1 to Port 2 |
| 059 | Port 2 Courtesy Tone 1 | | |
| 060 | Port 2 Courtesy Tone 2 | | |

| FN | Description | FN | Description |
|---|---|---|---|
| **119** | Link Port 1 to Port 3 | **152** | Alarm 1 ON |
| **120** | Link Port 2 to Port 3 | **153** | Alarm 2 ON |
| **121** | Link All Ports | **154** | Alarm 3 ON |
| **122** | Unlink Port 1 from Port 2 | **155** | Alarm 4 ON |
| **123** | Unlink Port 1 from Port 3 | **156** | Alarm 5 ON |
| **124** | Unlink Port 2 from Port 3 | **157** | Alarm 1 OFF |
| **125** | UnLink All Ports | **158** | Alarm 2 OFF |
| **126** | Play DVR Track 1 | **159** | Alarm 3 OFF |
| **127** | Play DVR Track 2 | **160** | Alarm 4 OFF |
| **128** | Play DVR Track 3 | **161** | Alarm 5 OFF |
| **129** | Play DVR Track 4 | **162** | Speech Out Port 1 |
| **130** | Play DVR Track 5 | **163** | Speech Out Port 2 |
| **131** | Play DVR Track 6 | **164** | Speech Out Port 3 |
| **132** | Play DVR Track 7 | **165** | Speech Out Ports 1 & 2 |
| **133** | Play DVR Track 8 | **166** | Speech Out Ports 1 & 3 |
| **134** | Play DVR Track 9 | **167** | Speech Out Ports 2 & 3 |
| **135** | Play DVR Track 10 | **168** | Speech Out All Ports |
| **136** | Play DVR Track 11 | **169** | DTMF Enable Port 1 |
| **137** | Play DVR Track 12 | **170** | DTMF Enable Port 2 |
| **138** | Play DVR Track 13 | **171** | DTMF Enable Port 3 |
| **139** | Play DVR Track 14 | **172** | DTMF Disable Port 1 |
| **140** | Play DVR Track 15 | **173** | DTMF Disable Port 2 |
| **141** | Play DVR Track 16 | **174** | DTMF Disable Port 3 |
| **142** | Play DVR Track 17 | **175** | Require CTCSS Port 1 |
| **143** | Play DVR Track 18 | **176** | Require CTCSS Port 2 |
| **144** | Play DVR Track 19 | **177** | Require CTCSS Port 3 |
| **145** | Play DVR Track 20 | **178** | Do not require CTCSS Port 1 |
| **146** | Auxiliary Audio 1 ON | **179** | Do not require CTCSS Port 2 |
| **147** | Auxiliary Audio 2 ON | **180** | Do not require CTCSS Port 3 |
| **148** | Auxiliary Audio 3 ON | **181** | Play Voice ID #1 |
| **149** | Auxiliary Audio 1 OFF | **182** | Play Voice ID #2 |
| **150** | Auxiliary Audio 2 OFF | **183** | Play Voice ID #3 |
| **151** | Auxiliary Audio 3 OFF | **184** | Play CW ID #1 |
|  |  | **185** | Play CW ID #2 |

**301 - 320**   Suspend Scheduler Setpoint 1 - 20
**321 - 340**   Resume Scheduler Setpoint 1- 20

**401 - 440   Macro 1 - 40 (these codes can only be used inside another macro. It is not possible to recall them directly)**

## Auxiliary Audio Inputs

Each of the 3 auxiliary inputs may be routed to any port's transmitter, or all of them.

**\*2100 x y** where "x" is the audio input and "y" is the port(s) that is sent the audio

| | |
|---|---|
| **x** = 1 Aux Input 1 | **y** = 1 Port 1 |
| **x** = 2 Aux Input 2 | **y** = 2 Port 2 |
| **x** = 3 Aux Input 3 | **y** = 3 Port 3 |
| | **y** = 12 Ports 1 & 2 |
| | **y** = 13 Ports 1 & 3 |
| | **y** = 123 Ports 1, 2 & 3 |

## Resetting The RC-210

At times it may be advantageous to reset the controller. Doing this does two things. Firstly, it verifies the operation of the hardware watchdog timer. If you enter the Reset command and for some reason the watchdog timer fails, you'll receive a message saying "Timer Not Set". As it is a fail-safe message, you should never hear it. Upon a successful reset, you'll hear the power up message with the version number.

In addition to testing the watchdog timer, the reset command also forces the controller to start the controller from a known condition Additionally if you have Macro 1 stored, the controller will run it upon reset.

**\*21999**     Reset the controller

***Note: Resetting the controller does not overwrite any custom programming you have made. In other words, a reset does not restore factory defaults***

## Setting the Real Time Clock And Calendar

It is necessary to set the Real Time Clock and Calendar before you'll be able to use the features they provide, such as the time readback and the Scheduler. When programming, it will read back the current time, in order to confirm your entry.

**\*5100 hh mm** where "hh" is the hours in 24 hour time and "mm" is the minutes. Both must consist of 2 digits

Examples:

| | |
|---|---|
| **\*5100 01 22** | Set the clock to 1:22 AM |
| **\*5100 15 04** | Set the clock to 3:04 PM |

**\*5101 mm dd yy**          Set the calendar to MM month, DD day, YY year. When programming, the controller will back the current day of the week, month, day and year in order to confirm programming.

Examples:

| | |
|---|---|
| **\*5101 06 11 03** | Set June 11, 2003 as the current date |
| **\*5101 10 04 11** | Set October 4, 2011 as the current date |

## CW Speed Programming

**\*8000x** where "x" is the speed of up to 2 digits. The allowable range is 5 - 50 wpm.

Examples:

**\*8000 5**    Program CW speed to 5 wpm

**\*8000 22**    Program CW speed to 22 wpm


## CW Tone Programming

To program the tone frequency of the various CW messages:

**\*8001x** where "x" is the tone frequency in Hz of up to 4 digits. The allowable range is 0 - 3500 hz.
*Note: If zero is entered, CW messages will be disabled.*

Examples:

**\*8001 800**    Program cw tone to 800 hz:
**\*80011000**    Program cw tone to 1000 hz:


## CW Message Programming

There are 2 CW ID messages, each of which may be programmed with up to 15 characters each (See Morse Code Character Table). They normally rotate as the Pending IDs. However if you have Speech Override ON and a signal appears on that port's receiver during a Voice ID, it will revert to CW and play CW message 2. To minimize disruption, it is recommended that you keep CW ID #2 as short as possible.

**\*8002xx-xx**  Program CWID #1
**\*8003xx-xx**  Program CWID #2

Examples

**\*8002 21 42 06 53 32 12 21 82 92**   Program "AH6LE/AUX" into ID #1
**\*8003 21 42 06 53 32 12 72**              Program" AH6LE/R" into ID #2

*Notes:*
*1)The spaces between characters in the above examples are not used in actual programming. They are shown only for clarification purposes.*
*2) If you exceed 15 characters, all characters that follow will be ignored.*

Figure 6 below shows the relationships between the codes and the layout of a standard Touchtone© pad. As you can see, it makes it easier to remember the code for a particular character without having to look up codes (Q and Z are treated as special cases).

*Fig 6 Morse Code Character Table*

| | | | | | |
|---|---|---|---|---|---|
| A | 21 | U | 82 | Word | |
| B | 22 | V | 83 | Space | 11 |
| C | 23 | W | 91 | - | 10 |
| D | 31 | X | 92 | / | 12 |
| E | 32 | Y | 93 | AR | 13 |
| F | 33 | Z | 90 | , | 14 |
| G | 41 | | | ? | 20 |
| H | 42 | 0 | 00 | SK | 60 |
| I | 43 | 1 | 01 | | |
| J | 51 | 2 | 02 | | |
| K | 52 | 3 | 03 | | |
| L | 53 | 4 | 04 | | |
| M | 61 | 5 | 05 | | |
| N | 62 | 6 | 06 | | |
| O | 63 | 7 | 07 | | |
| P | 70 | 8 | 08 | | |
| Q | 71 | 9 | 09 | | |
| R | 72 | | | | |
| S | 73 | | | | |
| T | 81 | | | | |
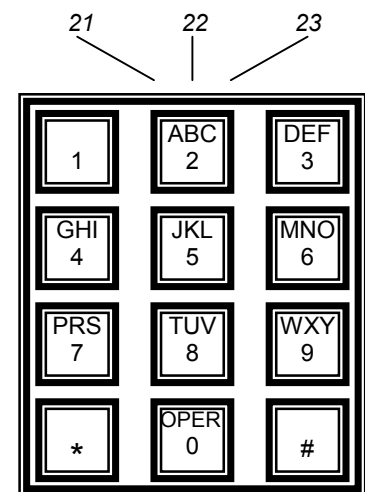
# Courtesy Tone Programming

There are 10 sets of courtesy tones for each port that you can custom program. Each Courtesy Tone can be defined with up to 4 tone segments, duration of those segments and delays between segments. Courtesy tones consist of:

Delay time from the end of a user transmission (when the squelch on a port closes)
The 1$^{st}$ tone segment
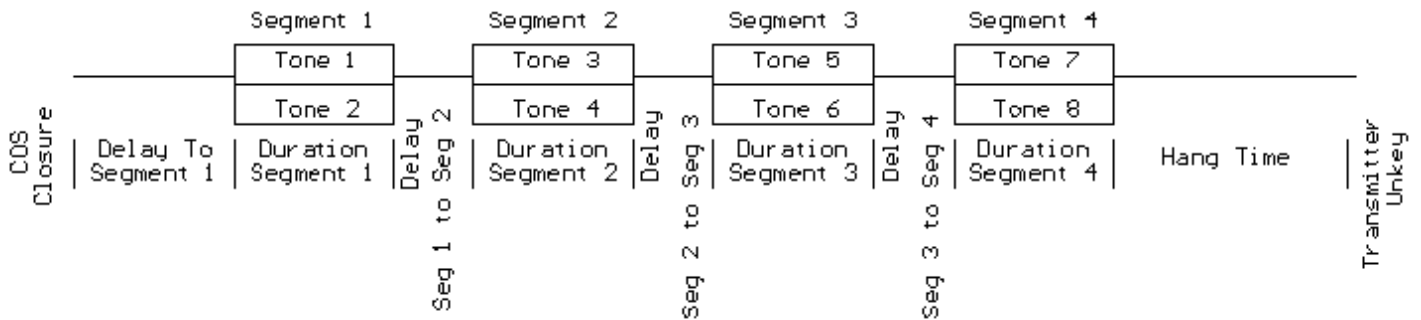Delay time from the end of the first tone segment.
A 2$^{nd}$ tone segment
Delay time from the end of the 2$^{nd}$ tone segment
A 3$^{rd}$ tone segment
Delay time from the end of the 3$^{rd}$ segment
A 4$^{th}$ tone segment



To program the courtesy tones, the following command is used. Each of the 4 segments have their own programming code.

**\*31CT** Delay to segment 1 # duration of segment 1 # Tone 1 # Tone 2 #
**\*32CT** Delay to segment 2 # duration of segment 2 # Tone 1 # Tone 2 #
**\*33CT** Delay to segment 3 # duration of segment 3 # Tone 1 # Tone 2 #
**\*34CT** Delay to segment 4 # duration of segment 4 # Tone 1 # Tone 2 #

CT refers to the courtesy tone set you wish to program and is entered as 01, 02, 03 and so on, up to 10. The delay and duration parameters are in milliseconds (ms) and the tone parameters are in hertz (hz). The # separators must be used.

While each segment allows two tones to be programmed, you can zero out either one for single tones.

Examples:

Program Courtesy Tone 1 to a single 1000 hz tone, 75 ms long, that starts 100 ms after COS closure:

**\*3101 100 # 75 # 1000 # 0 #**

Program Courtesy Tone 2 for multiple segments.
Segment 1 is dual tones - 880 and 660 hz, 75 ms long, that start 100 ms after COS closure
Segment 2 is dual tones - 1000 and 880 hz, 50 ms long, that start 75 ms after segment one finishes

**\*3102 100 # 75 # 880 # 660 #**
**\*3202 75 # 50 # 1000 # 880 #**

You can erase any segment by entering null information for it. For example, to completely erase Courtesy Tone 3, segment 3, you can enter

**\*3303 #**

## Programming Meter Faces:10-bit A/D Converters

The command syntax is:

**\*2064 P# M# X1# Y1# X2# Y2#**     P=Port 1 to 8  M=Meter Type 0 to 6  X1, Y1, X2, Y2 represent two calibration points. There must be 6 parameters entered to define a meter face, each value ending with #.

There are 8 meter faces corresponding to the 8 Analog inputs, with each meter face programmed with one of 6 values. The programming command consists the **input port**, meter **face type (name)**, and **4 values** representing:

- The low sensed voltage appearing on an input (X1)
- The low meter face reading (Y1)
- The high sensed voltage appearing on an input (X2)
- The high meter face reading (Y2)

Each meter face is calibrated with two *points* to define the sensor you wish to use on that channel. To clear a meter face, simply enter the input port number, then 0 for the meter face name and 4 more 0s to complete the 6 values needed to define a meter face.

A "Meter Face" is an imaginary software meter that is defined by selecting which of the 8 analog inputs you will use, what kind of measurement is being made (volts, amps, etc.) and two data points on the meter. While this may seem confusing at first, the advantage of this method is that it allows you complete flexibility in scaling a particular meter face to the voltage actually being measured.

The definable meter faces are:

    0  Meter OFF
    1  Volts
    2  Amps
    3  Watts
    4  Degrees
    5  MPH
    6  Percent

Note: The calibration data (X1, Y1, X2, Y2) is the actual data that you have measured multiplied 100 and rounded off to the nearest whole number. The controller divides your input values by 100 to reestablish the decimal point.

**Wattmeter example**: If the output of your wattmeter produces 0.25 volts for 10 watts and 2.1 volts for 40 watts you would multiply each of the calibration values by 100 before you enter them:

    .25 x 100 = 25            ←Low voltage actually appearing on the ADC pin (X1)
    10 X 100 = 1000           ←Low meter face reading (Y1)
    2.1 x 100 = 210           ←High voltage actually appearing on the ADC pin (X2)
    40 x 100 = 4000           ←High meter face reading (Y2)

We wish to use ADC channel 6 for the Watt meter sensor (meter face 3) using the above calibration data, so we would program:

**\*2064 6# 3# 25# 1000# 210# 4000#**

**Voltmeter example:** You want to use ADC channel 4 for a Voltmeter (Meter face 1) and you have a sensor that produces 0 volts when the voltage is 0, and it produces 2.5 vdc when the actual dc voltage is 20 volts. Multiplying the sensor and actual data by 100 and rounding produces X1=0 Y1=0 X2=250 Y2=2000. To define this meter, you would enter the following program codes:

**\*2064 4# 1# 0# 0# 250# 2000#**

Notice that the same programming code (\*2034) is used to setup each of the 8 ADC inputs.

**Percent (Quieting) Meter Example:** You want to assign ADC port 2 to Percent Quieting. You have a sensor that measures FM discriminator "noise" by rectifying it (similar to the way an S-meter works on FM). More noise means less quieting. You notice full quieting (100 percent) produces about 0.2 volts on the sensor, and no signal on the input (Zero percent) produces about 1.84 volts on the sensor.  X1=0 Y1=100% X2=1.84 Y2=0%. To define this "Percent quieting" meter on ADC port 2 with these values you enter:

 **\*2064 2# 6# 0# 10000# 184# 0#**

If someone with a full quieting signal accesses this meter, it might say "95 percent" or some reasonable indication of high quieting.

**Data Entry Limits:** Physical values must be between –327 and +327 AND the difference between High and Low cannot exceed 327. A range of 0 to 327 is okay, or –150 to +150. Also, calibration points should be in the range of actual expected meter readings.

## The Differences Between Accuracy And Precision

It is easy to become confused when the issues of precision and accuracy are raised.  Let's take a few minutes to understand what these terms mean in relation to the RC-210. The RC-210 can provide accurate measurements good to 3 decimal places of precision, if you take the time to setup the inputs correctly.  It might help to explain accuracy and precision to understand how to improve both:

**Accuracy** - The ability of a measurement to match the actual value of that which is being measured. For example, if you measure 3.32 volts, knowing the voltage you're measuring is actually 3.32 volts. The RC-210 has a built-in reference voltage of 2.56 volts that is supposed to be accurate. You can also provide an external reference voltage. The accuracy of the reference voltage, Vref, is the major factor in determining the overall accuracy  of the A/D conversion process.

**Precision** - The number of significant digits to which a value has been reliably measured. The precision of the RC-210 is dependent on the 10-bit A/D converter. With 10-bits, the A/D device can distinguish among 1024 separate values in the input, from 0 volts to Vref, which is roughly about 5 volts). If your sensor puts out 0 volts at the lowest expected level of the quantity it is measuring, and Vref (5.00 volts for example) at the highest expected level of the quantity you are measuring, you will have all 10 bits of precision available to measure the physical quantity.

The next major issue in getting precise measurements is the characteristics of the sensor you use (design, buy, etc.) and how well it matches the A/D converter measurement range (0 to Vref) when measuring physical quantities.

Suppose you want to measure 0 to 100 watts with a sensor and feed the sensor voltage to the controller to read back watts. You have a sensor to monitor the power of your repeater transmitter. You have measured the output of your sensor while measuring the power output on a calibrated watt meter and record the following values

At   0    watts the sensor produces 0.1 volts
At  100 watts the sensor produces 0.6 volts

As you can see, this is a small range of sensor voltage output -- only 0.5 volts. If Vref is 5 vdc, this is using only 10.0% of the full range of the A/D input. Therefore, only 10.0% of the possible 1024 distinct measurement values is being used, or about 102 distinct measurement points. The range of Watts being measured is 100 watts. Dividing this 100 watts by the 102 points of resolution means the meter will be able to resolve about 1 watt per "division" which is not bad! However if you wanted more precise readings, find a sensor that produces a wider output voltage. For example, a sensor that produces 0.2 volts at 0 watts, and 4.2 volts at 100 watts. Now the sensor voltage range is 4 volts of the 5.0 vdc Vref maximum. This is 80 percent of the 1024 points of resolution, or about 800 distinct measurement values. Now, for the same 100 watt range being measured, your improved sensor would now have a resolution of (100 watts) / (800 divisions)  = 0.125 watts per "division". As you can see, a sensor that uses more of the Vref voltage range increases the precision of your measurement.

In conclusion, the RC-210 can resolve a sensor voltage change of as small as Vref / 1024. However, as you can see from the above example, the resolution of the physical "thing" being measured is directly affected by the behavior of the sensor. For best results, try to find sensors that produce sensor output voltages between 0 and Vref over the range of desired physical measurements. This isn't an absolute requirement to get useful and accurate readings, but it will help increase the precision of the measurements.


## Programming the Reference Voltage Value for the A/D Converters

As it comes from the factory, the RC-210 comes with the reference voltage value programmed to 5.00 volts.  Since component tolerances obviously vary, you will want to measure the actual reference voltage of your RC-210 and then program that value into the controller.  *Note: This one reference voltage is used by all the A/D inputs. Setting it accurately will improve the measurement accuracy.*

**How to measure the Vref:** Using a high impedance, precision voltmeter (a digital, not an analog one is recommended) and with power applied to the RC-210, carefully measure the voltage at pin 21 of the I/O connector, J1. Write this voltage down - it is only necessary to include two decimal places). For example, if your meter displays "4.962", simply round it off to "4.96". Multiply this value by 100 as our value to enter as Vref. The example below shows how to enter this measured Vref.

**\*2065 4 9 6**

*Note: Do not apply voltages higher than 5.2 volts to any A/D channel input. It is best to keep any input voltages at or below Vref.*

# Measuring Voltages Higher Than Vref  - A Practical Example

The voltage applied to an A/D input cannot exceed Vref, which is 5.00 volts by default.

The first step is to decide what the range of actual voltages will be measured:

Suppose the Low end of expected actual voltage 10 volts, and the High end of the expected actual voltage is 18 volts

Since we realize that applying a voltage to the RC-210 higher than the programmed reference voltage will "pin" the meter face, we need to "scale" the actual voltage. This can be accomplished using either a pair of resistors as a voltage divider, or a variable resistor to get just a portion of the 18 volts as the maximum value to connect to the ADC input.  Using a 5-K pot would be a good choice.

What you want is to have the High end of voltage range (18 volts) to be less than Vref. If Vref is 5.00 volts, you might choose to set the resistor divider (or variable resistor) to produce 4.5 volts as the "sensor" voltage when the actual voltage is 18 volts.

If we look at the math, we see that 4.5 volts is 18 volts divided by 4 so the "sensor" needs to provide ¼ of the actual voltage. If the power supply is currently providing 13.8 volts, divide this by 4 to get 3.45 volts. If you are using a variable resistor (as shown in the Hardware Reference Manual), hookup your "sensor" to the battery, and adjust the pot to produce 3.45 volts on the wiper. This "sensor" will work fine with the ADC input. If the battery voltage ever gets to 18 volts, the wiper of the pot will see 4.5 volts, below the Vref of 5.0 volts, which is what is desired.

We then need to program the meter face used. For this example, we will use Meter 1 and assume the Voltage Reference Value has been left at the factory default of 5.00 volts:

**\*2064 1# 1# 250# 1000# 450# 1800#**

This programs Meter 1 to use the voltmeter meter face and tells the controller that when the sensor is 2.5 volts, this means the actual voltage is 10 volts, and when the sensor (ADC input) is 4.5 volts, the actual voltage is 18 volts.  Note that each of the calibration points is the actual measured value multiplied by 100 then rounded to the nearest whole value. This is done because there is no "decimal" point on the DTMF pad, so the controller assumes that the "real" values are whatever you put in, divided by 100.

Using the above example, you should be able to accommodate just about any external sensor.

## Alarm Programming

The RC-210 incorporates 5 alarm inputs that can be used to remotely monitor such things as a door open, high temperature of the repeater PA, etc. All you need do is supply a signal that goes to ground when active. When enabled (and triggered), each alarm will call a macro to execute. Alternately, you can program any alarm to route one of the Auxiliary Audio Inputs to the port of your choice.

For example, you could connect Alarm 1 to an over-temperature switch on the repeater's PA heatsink. You could program a macro that turned one of the logic outputs on (or off as needed) to select high/low power on the transmitter and speak a message to let you know. Should the PA overheat, the switch would pull Alarm 1 to ground, which in turn causes Alarm 1 to trigger, the repeater is placed in low power mode and an announcement is made over the air, every 30 seconds, until you clear it. Once the PA cools down to the point the Alarm is no longer triggered, you can put the repeater back into high power.

Or perhaps you want to connect a weather receiver with S.A.M.E. alerts at the repeater. All you need is a signal from the receiver that goes to ground whenever a S.A.M.E. alert is broadcast and connect the audio output to one of the Auxiliary Audio Inputs. By programming that Alarm to route that Auxiliary Audio Input to the port of your choice, you'll automatically be notified whenever the NOAA sends an alert.

## Using Auxiliary Audio Inputs With An Alarm

If we want to program an Alarm to turn on an Auxiliary Audio Input:

***2101 <Alarm #> <Use/Not Use>  <optional Port Identifier>**

Examples:

***2101 1 1 3**        Turn on Auxiliary Audio Input 3 when Alarm 1 is triggered:

***2101 5 1 2**        Turn on Auxiliary Audio Input 2 when Alarm 5 is triggered

***2101 3 0**          Alarm 3 doesn't use any Auxiliary Audio Input

*Note: when selecting not to use an Auxiliary Audio Input for a particular Alarm, entering a "0" will allow the use of a macro.  As in the example above, you do not need to use the optional Port number)*

## Using Auxiliary Audio Inputs With A Macro

If we want to program an Alarm to call a macro:

***2102 <Alarm #>  <Macro #>**

Examples:

***2102 5 22**        Alarm 5 calls Macro 22

***2102 1 5**          Alarm 1 calls Macro 5

*Note: If you use a Macro with an Alarm, you must first make sure to turn off any Auxiliary Audio Inputs for that Alarm, using the *2101 command.*

## Alarm Timers

Each of the 5 Alarms may be programmed for how long they remain active once they have been triggered.  All alarm timers may be programmed from 0 to 255 seconds.

***1008xx**    Alarm 1 Timeout Period
***1009xx**    Alarm 2 Timeout Period
***1010xx**    Alarm 3 Timeout Period
***1011xx**    Alarm 4 Timeout Period
***1012xx**    Alarm 5 Timeout Period

## Voice Message Editing

Many voice messages in the RC-210 may be custom programmed to suit the owner's needs by utilizing the included vocabulary and custom recorded messages stored in the digital voice recorder (DVR). First it needs to be understood what a "word" is:

Word - a letter, number, word or phrase represented by one number on the vocabulary list. For example: "Thank You", which is word #203.

| Command | Description | Maximum Number Of Words |
|---------|-------------|-------------------------|
| *8004 | Voice ID #1 | 10 |
| *8005 | Voice ID #2 | 10 |
| *8006 | Voice ID #3 | 10 |
| *8010 | Port 1 to Port 2 Connect | 5 |
| *8011 | Port 1 to Port 2 Disconnect | 5 |
| *8012 | Port 1 to Port 3 Connect | 5 |
| *8013 | Port 1 to Port 3 Disconnect | 5 |
| *8014 | Port 2 to Port 1 Connect | 5 |
| *8015 | Port 2 to Port 1 Disconnect | 5 |
| *8016 | Port 2 to Port 3 Connect | 5 |
| *8017 | Port 2 to Port 3 Disconnect | 5 |
| *8018 | Port 3 to Port 1 Connect | 5 |
| *8019 | Port 3 to Port 1 Disconnect | 5 |
| *8020 | Port 3 to Port 2 Connect | 5 |
| *8021 | Port 3 to Port 2 Disconnect | 5 |

## Resetting The Unlock Codes

Should you ever need to reset your unlock codes back to the factory defaults, you may do so without erasing your custom programming. You accomplish this by powering down the controller and temporarily grounding Port 3's CTCSS decode input. Leaving the temporary jumper in place, power up the controller. After the controller speaks its version number and says "READY", all 3 Unlock codes will be set back to their default values. You may then remove the temporary jumper.

# Updating The Firmware

The RC-210 was designed with ease of firmware upgrades in mind. This allows it to be easily upgraded in the field as new firmware versions are released.

In order to install these updates into the RC-210, you will need 2 things

- Free software from mcselec.com
- A programming cable between your PC's printer port and the RC-210's programming connector

## Downloading And Installing The Required Software On Your Computer

The programming software may be downloaded at the following web site:

http://www.mcselec.com/download_avr.htm

Download all four disks and the help files. You may want to download the manual as well, but this is optional. Follow the installation instructions at their website for installing the software.

## Programming Cable

In addition to the software, you will also need a special programming cable that connects from a printer port on your Windows® computer to the programming port on the RC-210.  You can purchase a programming cable from us for $25, or you can build one yourself.  If you're interested in purchasing one that is "plug and play", please visit:

http://www.ah6le.net/arcom/program.html

If you chose to build your own, you will need a male DB25, 3 ea. 100 ohm 1/4 watt resistors, a 10 pin, 2 X 5 IDC header connector and a 10 conductor cable. While not absolutely necessary, we recommend using a shielded cable if the length will be over 3 feet. In any case, the cable should not be longer than 5 feet.
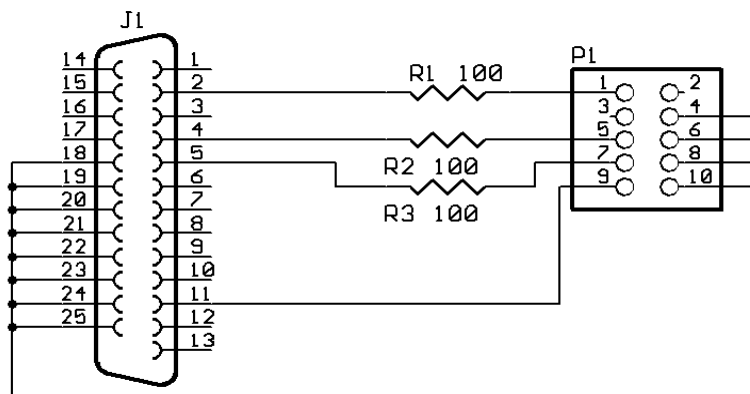
# Downloading Firmware Updates

Once you've installed the program on your computer and have the programming cable, you'll need to download the firmware update from our website:

http://www.ah6le.net/arcom/rc210/updates.html

We recommend that you create a directory dedicated to firmware updates. As an example, you could name it "updates", but you may call it anything you like. Once downloaded, unzip the update into this directory. Remember the location of this directory as you'll need it later. All updates contain 4 files - one with a .bas extension, one with a .cfg, another with a .dbg and finally one with a .bin extension.

**IMPORTANT: If you are running Windows XP® , it is very important that read the end of this section before actually trying to program your RC-210.**

# Configuring The Bascom Program For The First Time

When you first run Bascom, you need to configure certain things. Once you have done so, you should not have to change it unless you change the configuration of your computer's printer port.
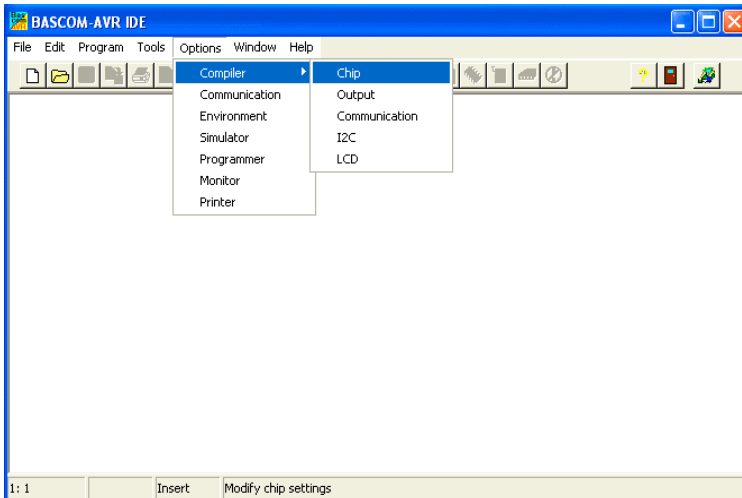
Open Bascom and click on Options > Compiler > Chip.

.
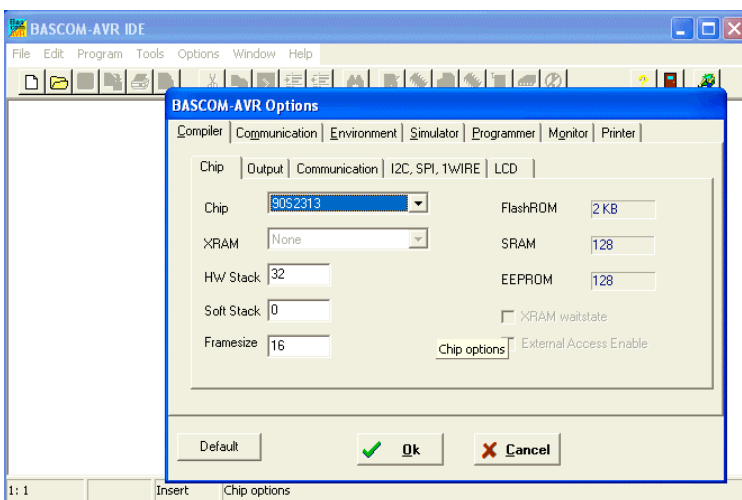
A new window will open. You may ignore what is presented for now. Click on the Programmer tab

In the Programmer window, click on the down facing arrow on the right side of the text box. Scroll down to select Sample Electronics programmer and double click on it.
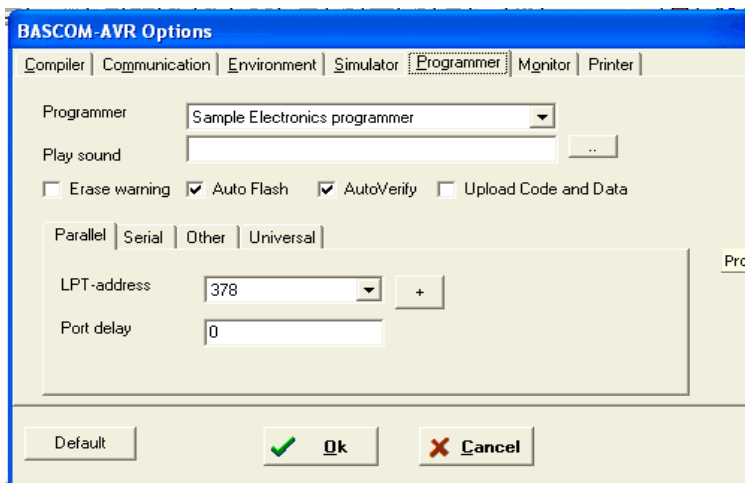
Check the Auto Flash checkbox. Click on the Parallel tab. If you're using Printer Port 1, LPT1 (the usual setting for most computers), you can leave the setting at 378, otherwise change it to the appropriate printer port. Click OK to save your settings.

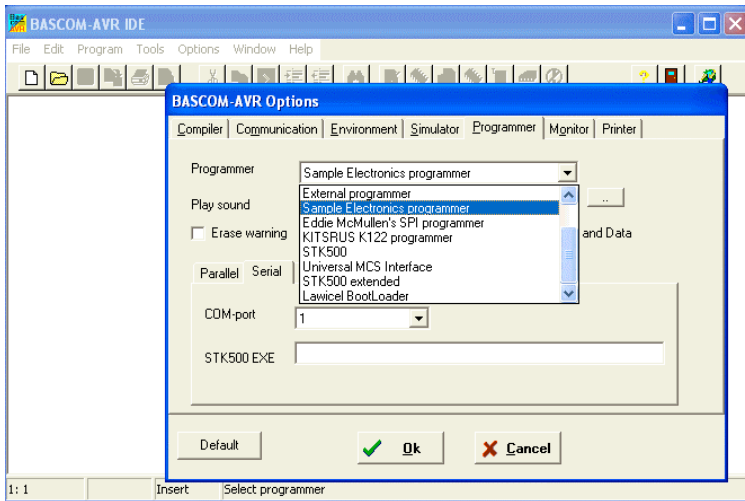Unless you change printer ports in the future, you shouldn't have to do this process again. From now on, you may start at the next step, after launching the program.

## Opening the Firmware Update
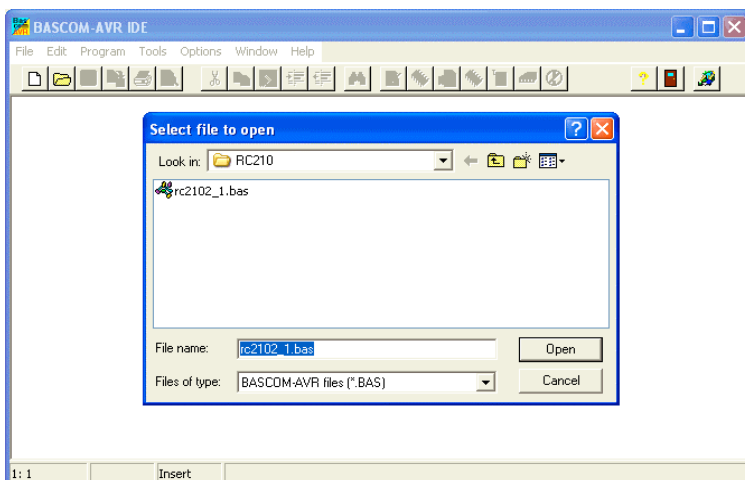
Click on File > Open.  Use the usual Windows® method to change to the directory where you unzipped the firmware update you downloaded from our website.

Once you find the update (it will always have the extension of .bas, although the overall name will change depending on the version number).

Click on the Open button.
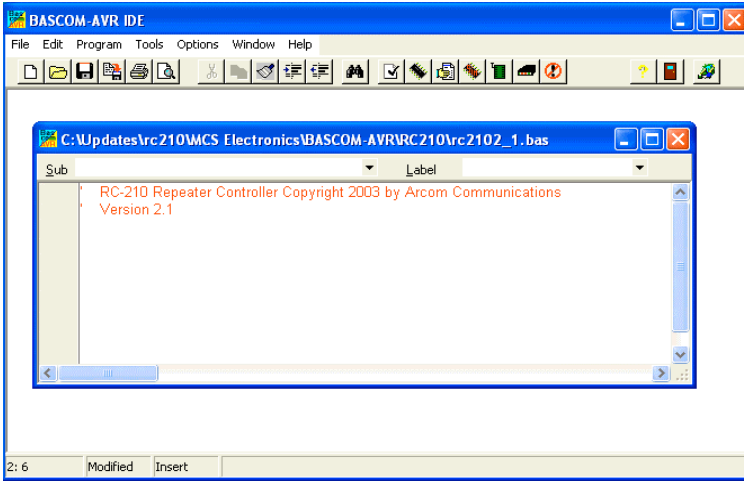
## Loading the Firmware Into The RC-210

You will see a new window with the version number of the firmware.

You are now ready to actually program your RC-210. Make sure the programming cable is plugged into your computer's printer port (the one you selected earlier) and your RC-210.  The RC-210 may be left powered up while connecting the cable.

**IMPORTANT! When connecting the RC-210 end of the cable to the programming connector J5, make sure the stripe on the cable is on the same side of the 10 pin connector as the number 1 on the PC board. Failure to heed this may damage your RC-210 or computer!**
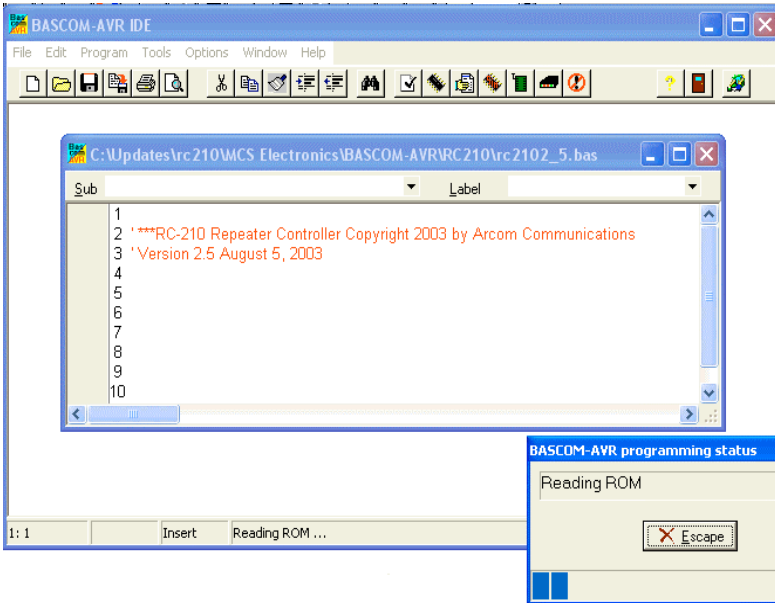


You are now ready to actually program your RC-210.

Press F4 on your keyboard and a new window will pop up, showing the progress of the write cycle of programming.
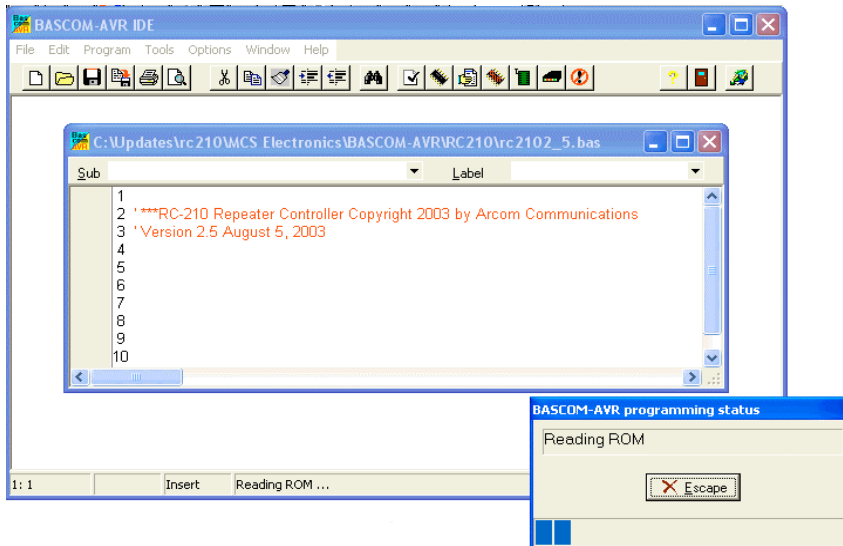
When the write cycle is over, you'll see a new window pop up. This indicates the program write is being verified as ok. Once this is done, the window should close. If you have no errors, your RC-210 should automatically reset and announce its sign-on message. You are now ready to go with the updated firmware!

# If You Are Running Windows® XP

Windows XP® is different from some other operating systems in that it constantly polls the hardware in your computer. While this doesn't usually cause any problems with peripherals normally connected to your computer, it can cause corruption of the upload to your RC-210. This doesn't damage anything but it does prevent your RC-210 from being properly programmed. Fortunately, there is an easy fix for this situation. All you need do is change a setting in your Windows® registry file. Don't worry, we've made this very easy for you to do by providing a file that will automatically make the required change, on our website:

http://www.ah6le.net/arcom/parport.zip

Once you have it, unzip the file and double click on the file within and your registry will be updated. Reboot your computer and you should be good to go!

***Note: This will not affect the operation of your printer nor anything else within your computer.***

Another thing you should check is the setting of the printer port, which is normally done in your computer's BIOS setup screen. You want to make sure your printer port (LPT1 if you're your computer only has one port to begin with) is set to "EPP".  If it isn't, change it (this won't affect other devices that connect to the printer port. As a matter fact, it will speed them up!) . Save the new setting and reboot your computer.

You are now ready to reprogram your RC-210!

# Appendix A

## Frequency Agile Radios Supported (Firmware Version 3.55)

Kenwood  - All model radios with a computer port to allow control of radio.

Yaesu - FT-817, FT-847, FT100D

Icom - IC706MKIIg, IC-746

## Factory Default Programming Values

When you first receive your RC-210, the following values are programmed as default:

### Port Specific

| | |
|---|---|
| Carrier/PL Access | Carrier squelch |
| Hang time | Port 1 - 5 seconds. Ports 2 & 3 - 3 seconds |
| Timeout | 3 minutes |
| Cw Tone | Port 1 - 600 hz. Ports 2 & 3 - 800 hz |
| CW Speed | 20 wpm |
| Monitor Mix | Yes |
| Port Enabled | Yes |
| Intertie to other ports | OFF |
| Full / Half Duplex | Port 1 - full duplex, Ports 2 & 3 - half duplex |
| Enabled | Yes |
| DTMF Covertone | ON |
| Courtesy Tone | 0 |
| DTMF Mute | ON |
| Speech Override | ON |
| Control Receiver | OFF |

### Global

| | |
|---|---|
| Logic Output 1 - 7 | Open |
| Alarm 1 - 5 | Disabled |
| Auxiliary Audio Inputs | OFF |
| Analog Meter Inputs | None defined |
| Macros | None programmed |
| Serial Output Select | Kenwood |
| Fan Turn Off Time | 5 minutes |

# Appendix B

CTCSS Codes

## Kenwood

| # | Freq | # | Freq | # | Freq | # | Freq |
|---|------|---|------|---|------|---|------|
| 01 | 67.0 | 11 | 97.4 | 21 | 136.5 | 31 | 192.8 |
| 02 | 71.9 | 12 | 100.0 | 22 | 141.3 | 32 | 203.5 |
| 03 | 74.4 | 13 | 103.5 | 23 | 146.2 | 33 | 210.7 |
| 04 | 77.0 | 14 | 107.2 | 24 | 151.4 | 34 | 218.1 |
| 05 | 79.7 | 15 | 110.9 | 25 | 156.7 | 35 | 225.7 |
| 06 | 82.5 | 16 | 114.8 | 26 | 162.2 | 36 | 233.6 |
| 07 | 85.4 | 17 | 118.8 | 27 | 167.9 | 37 | 241.8 |
| 08 | 88.5 | 18 | 123.0 | 28 | 173.8 | 38 | 250.3 |
| 09 | 91.5 | 19 | 127.3 | 29 | 179.9 | | |
| 10 | 94.8 | 20 | 131.8 | 30 | 186.2 | | |

## Yaesu

| # | Freq | # | Freq | # | Freq | # | Freq |
|---|------|---|------|---|------|---|------|
| 01 | 67.0 | 11 | 114.8 | 21 | 162.2 | 31 | 233.6 |
| 02 | 719 | 12 | 118.8 | 22 | 167.9 | 32 | 241.8 |
| 03 | 77.0 | 13 | 123.0 | 23 | 173.8 | 33 | 250.3 |
| 04 | 82.5 | 14 | 127.3 | 24 | 179.9 | | |
| 05 | 88.5 | 15 | 131.8 | 25 | 186.2 | | |
| 06 | 94.8 | 16 | 136.5 | 26 | 192.8 | | |
| 07 | 100.0 | 17 | 141.3 | 27 | 203.5 | | |
| 08 | 103.5 | 18 | 146.2 | 28 | 210.7 | | |
| 09 | 107.2 | 19 | 151.4 | 29 | 218.1 | | |
| 10 | 110.9 | 20 | 156.7 | 30 | 225.7 | | |

## Icom

| # | Freq | # | Freq | # | Freq | # | Freq |
|---|------|---|------|---|------|---|------|
| 00 | 67.0 | 13 | 103.5 | 26 | 159.8 | 39 | 199.5 |
| 01 | 69.3 | 14 | 107.2 | 27 | 162.2 | 40 | 203.5 |
| 02 | 71.9 | 15 | 110.9 | 28 | 165.5 | 41 | 206.5 |
| 03 | 74.4 | 16 | 114.8 | 29 | 167.9 | 42 | 210.7 |
| 04 | 77.0 | 17 | 118.8 | 30 | 171.3 | 43 | 218.1 |
| 05 | 79.7 | 18 | 123.0 | 31 | 173.8 | 44 | 225.7 |
| 06 | 82.5 | 19 | 127.3 | 32 | 177.3 | 45 | 229.1 |
| 07 | 85.4 | 20 | 131.8 | 33 | 179.9 | 46 | 233.6 |
| 08 | 88.5 | 21 | 136.5 | 34 | 183.5 | 47 | 241.8 |
| 09 | 91.5 | 22 | 141.3 | 35 | 186.2 | 48 | 250.3 |
| 10 | 94.8 | 23 | 146.2 | 36 | 189.9 | 49 | 254.1 |
| 11 | 97.4 | 24 | 151.5 | 37 | 192.8 | | |
| 12 | 100.0 | 25 | 156.7 | 38 | 196.6 | | |

# Vocabulary List

| | | | | | |
|---|---|---|---|---|---|
| 000 | ZERO | 060 | ALL | 119 | GOLF |
| 001 | ONE | 061 | AMATEUR | 120 | GOODBYE |
| 002 | TWO | 062 | AMPS | 121 | HELLO |
| 003 | THREE | 063 | AND | 122 | HELP |
| 004 | FOUR | 064 | ANSWER | 123 | HENRY |
| 005 | FIVE | 065 | APRIL | 124 | HERTZ |
| 006 | SIX | 066 | AUGUST | 125 | HIGH |
| 007 | SEVEN | 067 | AUTOMATIC | 126 | HOLD |
| 008 | EIGHT | 068 | AUXILARY | 127 | HOTEL |
| 009 | NINE | 069 | A.M. | 128 | HOUR |
| 010 | TEN | 070 | BAND | 129 | INDIA |
| 011 | ELEVEN | 071 | BANK | 130 | INDICATED |
| 012 | TWELVE | 072 | BASE | 131 | INTRUDER |
| 013 | THIRTEEN | 073 | BATTERY | 132 | IS |
| 014 | FOURTEEN | 074 | BELOW | 133 | JANUARY |
| 015 | FIFTEEN | 075 | BRAVO | 134 | JULIET |
| 016 | SIXTEEN | 076 | BREAK | 135 | JULY |
| 017 | SEVENTEEN | 077 | BUSY | 136 | JUNE |
| 018 | EIGHTEEN | 078 | BY | 137 | KILO |
| 019 | NINETEEN | 079 | CALIBRATE | 138 | LEFT |
| 020 | TWENTY | 080 | CALL | 139 | LIGHT |
| 021 | THIRTY | 081 | CANCEL | 140 | LIMA |
| 022 | FOURTY | 082 | CAUTION | 141 | LINK |
| 023 | FIFTY | 083 | CELCIUS | 142 | LOCK |
| 024 | SIXTY | 084 | CHANGE | 143 | LOW |
| 025 | SEVENTY | 085 | CHARLIE | 144 | MANUAL |
| 026 | EIGHTY | 086 | CHECK | 145 | MARCH |
| 027 | NINETY | 087 | CLEAR | 146 | MAY |
| 028 | HUNDRED | 088 | CLOCK | 147 | MEGA |
| 029 | THOUSAND | 089 | CODE | 148 | MESSAGES |
| 030 | MILLION | 090 | COMPLETE | 149 | METER |
| 031 | A | 091 | COMPUTER | 150 | MICRO |
| 032 | B | 092 | CONNECT | 151 | MIKE |
| 033 | C | 093 | CURRENT | 152 | MILES PER HOUR |
| 034 | D | 094 | CYCLE | 153 | MILLI |
| 035 | E | 095 | DANGER | 154 | MINUS |
| 036 | F | 096 | DATE | 155 | MINUTES |
| 037 | G | 097 | DECEMBER | 156 | MONDAY |
| 038 | H | 098 | DEGREES | 157 | NEGATIVE |
| 039 | I | 099 | DELTA | 158 | NET |
| 040 | J | 100 | DIRECTION | 159 | NO |
| 041 | K | 101 | DISPLAY | 160 | NORTH |
| 042 | L | 102 | DOWN | 161 | NOT |
| 043 | M | 103 | EAST | 162 | NOVEMBER |
| 044 | N | 104 | ECHO | 163 | NUMBER |
| 045 | O | 105 | ENTER | 164 | O'CLOCK |
| 046 | P | 106 | EQUAL | 165 | OCTOBER |
| 047 | Q | 107 | ERROR | 166 | OF |
| 048 | R | 108 | FAIL | 167 | OFF |
| 049 | S | 109 | FAILURE | 168 | ON |
| 050 | T | 110 | FEBRUARY | 169 | OPERATOR |
| 051 | U | 111 | FEET | 170 | OVER |
| 052 | V | 112 | FOXTROT | 171 | PAPA |
| 053 | W | 113 | FREQUENCY | 172 | PATCH |
| 054 | X | 114 | FRIDAY | 173 | PERCENT |
| 055 | Y | 115 | FROM | 174 | PHONE |
| 056 | Z | 116 | FULL | 175 | PICO |
| 057 | ABOVE | 117 | GET | 176 | PLEASE |
| 058 | ADJUST | 118 | GO | 177 | PLEASE WAIT |
| 059 | ALERT | | | 178 | PLUS |

| | | | | | | |
|---|---|---|---|---|---|
| 179 | POINT | 205 | THANK YOU | 231 | WELCOME |
| 180 | PORT | 206 | THE (long e) | 232 | WEST |
| 181 | POWER | 207 | THE (short e) | 233 | X-RAY |
| 182 | PROGRAM | 208 | THE TIME IS | 234 | YANKEE |
| 183 | P.M. | 209 | THIS | 235 | YESTERDAY |
| 184 | QUEBEC | 210 | THURSDAY | 236 | ZED |
| 185 | RADIO | 211 | TIME | 237 | ZULU |
| 186 | READY | 212 | TIMER | 238 | -ED |
| 187 | RECEIVE | 213 | TODAY | 239 | -ER |
| 188 | REMOTE | 214 | TOMORROW | 240 | -ING |
| 189 | REPEAT | 215 | TONIGHT | 241 | -S (makes plural) |
| 190 | REPEATER | 216 | TRANSMIT | 242 | -TH |
| 191 | ROMEO | 217 | TUESDAY | 243 | SILENCE (pause) |
| 192 | SATURDAY | 218 | UNDER | 244 | DVR TRACK 1 |
| 193 | SECONDS | 219 | UNIFORM | 245 | DVR TRACK 2 |
| 194 | SELECT | 220 | UP | 246 | DVR TRACK 3 |
| 195 | SEPTEMBER | 221 | USE (noun) | 247 | DVR TRACK 4 |
| 196 | SET | 222 | USE (verb) | 248 | DVR TRACK 5 |
| 197 | SIERRA | 223 | VICTOR | 249 | DVR TRACK 6 |
| 198 | SOUTH | 224 | VOLTAGE | 250 | DVR TRACK 7 |
| 199 | START | 225 | VOLTS | 251 | DVR TRACK 8 |
| 200 | STOP | 226 | WAIT | 252 | DVR TRACK 9 |
| 201 | SUNDAY | 227 | WARNING | 253 | DVR TRACK 10 |
| 202 | SYSTEM | 228 | WATTS | 254 | DVR TRACK 11 |
| 203 | TANGO | 229 | WEATHER | 255 | DVR TRACK 12 |
| 204 | TEMPERATURE | 230 | WEDNESDAY | | |

# Audio Spectrum Analyzer Software
# From InterFlex Systems

If you have an interest in obtaining a Real Time Audio Spectrum Analysis software package that uses your sound card to make measurements of audio amplitude, spectrum analysis, frequency response information, and can generate tones, white noise, pink noise, sweep tests, etc., Arcom Communications has arranged with InterFlex Systems Design Corporation of California to make their software available to owners of any ARCOM product, either the RC110 or RC210. You can view some details about the program at **http://www.interflex.com/arcom/** . Purchase information is available on that webpage.

## The RC-210 Development And Testing Team

### Programmers:

Ken Arck, AH6LE (formerly WA6EMV), CTO Arcom Communications
Jeffrey G. Towle, Ph.D., W6FCC (formerly WA4EGT), InterFlex Systems Design Corp

### Testers:

Danny Hamilton K4IGT
Terry Bartholomew NQ4Y
Les Fenison  KD7RY
Kris Schatz  KR7IS

# ARCOM COMMUNICATIONS NO-NONSENSE LICENSE AGREEMENT FOR THE OPERATING FIRMWARE OF THE RC-210 REPEATER CONTROLLER

**IMPORTANT - READ CAREFULLY**

This license statement and limited warranty constitutes a legal agreement ("License Agreement") between you (either as an individual or a single entity) and Arcom Communications for the software product ("Firmware") identified above, including any software, media, and accompanying on-line or printed documentation.

BY DOWNLOADING OR OTHERWISE USING THE FIRMWARE, YOU AGREE TO BE BOUND BY ALL OF THE TERMS AND CONDITIONS OF THIS LICENSE AGREEMENT.

Upon your acceptance of the terms and conditions of the License Agreement, Arcom Communications grants you the right to use the Firmware in the manner provided below.

This Firmware is owned by Arcom Communications and is protected by copyright law and international copyright treaty. Therefore, you must treat this Firmware like any other copyrighted material (e.g., a book), except that you may either make copies of the Firmware solely for backup or archival purposes or transfer the Firmware to a single hard disk provided you keep the original solely for backup or archival purposes.

You may transfer the Firmware and documentation on a permanent basis provided you retain no copies and the recipient agrees to the terms of this License Agreement. Except as provided in this License Agreement, you may not transfer, rent, lease, lend, copy, modify, translate, sublicense, time-share or electronically transmit or receive the Firmware, media or documentation.


TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, ARCOM COMMUNICATIONS DISCLAIM ALL OTHER WARRANTIES AND CONDITIONS, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, AND NON-INFRINGEMENT, WITH REGARD TO THE FIRMWARE, AND THE PROVISION OF OR FAILURE TO PROVIDE SUPPORT SERVICES. THIS LIMITED WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS. YOU MAY HAVE OTHERS, WHICH VARY FROM STATE/JURISDICTION TO STATE/JURISDICTION.

LIMITATION OF LIABILITY TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, IN NO EVENT SHALL ARCOM COMMUNICATIONS OR ITS SUPPLIERS BE LIABLE FOR ANY SPECIAL, INCIDENTAL, INDIRECT, OR CONSEQUENTIAL DAMAGES WHATSOEVER (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF BUSINESS PROFITS, BUSINESS INTERRUPTION, LOSS OF BUSINESS INFORMATION, OR ANY OTHER PECUNIARY LOSS) ARISING OUT OF THE USE OF THE FIRMWARE OR INABILITY TO USE THE FIRMWARE PRODUCT OR THE PROVISION OF OR FAILURE TO PROVIDE SUPPORT SERVICES, EVEN IF ARCOM COMMUNICATIONS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.