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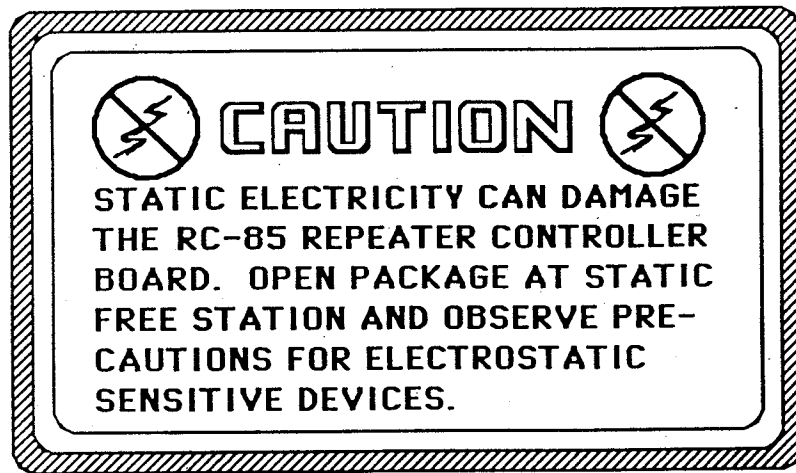
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RC-85 REPEATER CONTROLLER
Owner's Manual

**Firmware Version 3
with Version 4 and Version 5 Updates and
Command Code Summary**

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 ┌─────────────────────────────────────┐
 │  ⊗ CAUTION ⊗                         │
 │  STATIC ELECTRICITY CAN DAMAGE       │
 │  THE RC-85 REPEATER CONTROLLER       │
 │  BOARD. OPEN PACKAGE AT STATIC       │
 │  FREE STATION AND OBSERVE PRE-       │
 │  CAUTIONS FOR ELECTROSTATIC          │
 │  SENSITIVE DEVICES.                  │
 └─────────────────────────────────────┘
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Got a question? Be sure and check "Most Often Asked Questions, and Answers" in Chapter 10.

This manual
Converted to PDF by Daniel Ratzlaff - WWØF
March, 2002

4/87 Rev 3

RC-85 Repeater Controller Version 4

New Features ... Not in the V3 Manual!

User's Features
IC-900 Support
The new software supports IC-900 band units as remote base transceivers, interfaced via the FC-900. Refer to the FC-900 Manual for details.

Reverse Patch Answer Acknowledgement
When the reverse patch is answered over the air, a "beep-beep" acknowledgement is sent over the air to confirm connection.

Touch-Tone Access Up Message
When a user brings Touch-Tone Access up, the controller acknowledges with "up".

Control Operator
The following new Control Operator level commands are available. They are included in the command summary at the end of this section.

Macro Set Selection Commands
A fifth macro set is available. It is selected with the following Control Op command.

5   M5   **Macro Set 5 Select**   Selects Control Op Macro Set #5

Disable Autopatch Phone Number and Autodial Location Readback
68   NR   **Disable Autopatch Phone Number and Autodial Location Readback** (and dial without click)

This new command is mutually exclusive with the existing commands:
60   NC   Dial Needing Click
59   XC   Dial Without Click

Reverse Patch Mode 3
67   R3   **Reverse Patch Mode 3 select**

Mode 3 is similar to Mode 0 except that it is optimized for talkback paging applications. Upon answering the phone, the controller expects a four digit paging code. The paging sequence is activated over the repeater transmitter, and the caller is placed on the air. The call may be answered from the repeater and will then proceed as a reverse patch. If not answered within the programmable Talkout Timer period, the controller will hang up on the caller. Entering a # from the phone returns the controller to Mode 0 temporarily for the duration of the call.

Programming the Controller
Timers

*4012(period)	ID	ID Timer	Pending ID Period. Recommend 360 seconds for amateur repeater.
*4013(period)	RO	Ringout Timer	Determines how long reverse patch rings over the air. Phone stays off hook for 60 seconds, even if ringout is shorter or longer.
*4014(period)	TK	Talkout Timer	Reverse Patch Mode 3 Talkout period limit. If not "answered" from over the air during this period, the controller will hang up.
*4015(period)	AL	Alarm Timer	Limits the period that the alarm message will be generated over the air.

Command Code Prefixes
*5019(prefix)   Touch-Tone Pad Test Prefix

Avoiding Command Code Conflicts
Previously, each command code needed to have a prefix programmed. To avoid a potential conflict, it was recommended to program an "out of the way" prefix. Now it is possible to disable the command code by programming it empty. For example, if you will not use the Touch-Tone Pad Test, simply program (with the controller unlocked) *5019.

Version 5!
For the '96 and '85

Introduction
The new Version 5 firmware for your RC-96 or RC-85 Repeater Controller adds the following exciting features:

- **Time of day clock and calendar**
- **Scheduler**
- **Expanded vocabulary - FEMALE and sound effects**
- **Support of an HF remote base**
- **Miscellaneous additions and improvements**

These features are easily added to your existing Version 3 or Version 4 controller by simply plugging them in!

Description
The **time of day clock and calendar** is set with Touch-Tone programming commands, and is battery backed up to keep it running even if your controller loses power. You can choose 12 hour a.m./p.m. or 24 hour military format. Several time and date "run time variables" are like synthesized speech vocabulary, but instead of being fixed words, these variables say the time, date, a.m. or p.m., the day of the week, and morning/afternoon/evening when programmed into messages. These run time variables can be included in any messages (IDs, tail messages, bulletin boards, etc.) using the message editor.

The **scheduler** works in conjunction with the time of day clock and your existing macro sets. It relieves you of the chore of repetitively manually selecting different macro sets at different times of the day and days of the week. It's like an automatic control operator. With programming commands, you select the time and days (every day, weekends only, etc.) for automatic changeover of macro sets to automatically control everything from Control Op settings to remote bases and user function outputs.

We've added a new voice to your controller to announce the time - and *she'll* really perk up your repeater. She often goes by the name Juliet, and she joins Romeo in her new duties. Technically, Juliet is the **female synthesized speech** vocabulary, and along with some sound effects we've added, she brings the total vocabulary size of your controller to 535.

Many people have asked for the ability to hook up an **HF remote base** transceiver to their repeater so they could work HF from their handhelds. Now you can! The '85 and '96 controllers each have one link or remote base port, and now an HF radio can be connected to that port. (If you're already using

your link port for a fixed frequency, BCD, or FC-900 remote, the HF function is not available). With the '96 controller you'll need to add a low cost serial port board available from ACC. The '85 controller will connect to the HF radio as-is.

We selected the Kenwood TS-440S HF transceiver because of its clean interface and its popularity. You'll have a basic subset of control functions - frequency, mode, memory recall, and scan (<u>not</u> loading memories, operating the antenna tuner, controlling a rotor, etc.). The TS-440S is the **only** radio that we plan to support - if you like ICOM or Yaesu, try Kenwood. (We like all three! - we just don't support the other HF radios.) And if you have another in Kenwood's series, you may want to try it, but we've done all our testing with the TS-440S.

Finally, as our controller firmware continues to evolve, we've made a number of **miscellaneous additions and improvements** based on feedback from owners and users. The details are outlined at the end of this note.

WARNING: The field installation of the upgrade involves **some risk** - if you don't follow the instructions precisely, or if there is a mechanical problem such as a bent pin, it may be necessary to return the controller to ACC for repair. We've done everything possible to make the upgrade easy to install. ACC offers to perform the installation at no charge (except return shipping). If you would like us to perform the upgrade, return your controller and the upgrade kit to ACC *before attempting installation.* If you choose to perform the installation in the field, please recognize the small but finite risk.

WARNING: Version 5 firmware **requires 8Kx8 of E²PROM**. All RC-96 controllers are equipped with the necessary 8Kx8. *Very old RC-85 controllers* (shipped <u>approximately</u> before February, 1987, S/N 696) may have only 2Kx8 of E²PROM. If your old '85 contains a 2815, 2816, or 2817A at socket U27, then you need to upgrade the E²PROM to a 28C<u>64</u>. Contact the factory for availability <u>before attempting the installation</u>.

WARNING: If you connect your controller to a Kenwood TS-440S transceiver, we strongly recommend lightning protection for your repeater and site to avoid damage to the expensive HF radio.

WARNING: If you connect your controller to a Kenwood TS-440S transceiver and plan to operate on ten meters, be aware that RF emissions from the RC-85 controller may require addional shielding and filtering for effective operation. See Chapter 10 of the RC-85 Manual for suggestions.

WARNING: Do not tamper with the label on either supplied module.
Tampering with the labels will void all warranties.

Installation

The Version 5 upgrade consists of two modules which plug into existing sockets on your controller. They include the new EPROM program memory which contains the Version 5 firmware, and a time of day clock and calendar with its built-in lithium backup battery.

RC-96 Repeater Controller

1. <u>If your RC-96 controller has a Tone Panel option</u>, disable Touch-Tone Access Mode (COP 53) and select Carrier Access (COP 07). Unlock the controller and store these selections in Macro Set 1 before installing the new firmware. This will enable you to reprogram the Tone Panel information as required after installing the new firmware.

2. Remove power from the controller. Be sure that any backup battery is also removed from the controller before performing the following steps. Remove the top cover by removing the six side screws.

3. CAREFULLY, with the supplied IC extractor, remove the integrated circuit at location U29. Replace it with the U29 chip supplied with the upgrade (oriented so that the pin 1 notch on the chip matches the notch on the pc board).

4. CAREFULLY remove the integrated circuit at location U34. This chip will no longer be needed, and the socket at U34 will be left empty.

5. CAREFULLY remove the integrated circuit at location U31 - save it for later use in this step. Replace it with the clock module supplied with the upgrade. Now plug in the chip you just removed into the socket on the top of the clock module.

6. You should now have left over the original U29 and U34 chips from your controller. Go back over the last steps FOR THE '96 CONTROLLER, and be sure that the chips are plugged into their sockets in the proper orientation and with no bent pins.

7. Power up the controller - it should sign on with the V5.x message. Proceed to program the new functions of the controller as described the next sections.

RC-85 Repeater Controller

CAUTION: You must either have an 8Kx8 E^{2}PROM at location U27 or have obtained a 8Kx8 E^{2}PROM from ACC before performing the installation. If the chip at U27 is a 9864 or 28C64A or other part number ending with 64, then you may proceed. If the chip is a 2815, 2816, or 2817A (not ending in 64) then you must purchase an E^{2}PROM upgrade from ACC before attempting the installation. Call the factory to order the part.

1. Remove power from the controller. Be sure that any backup battery is also removed from the controller before performing the following steps. Remove the top cover of the '85 enclosure or otherwise gain access to the top of the printed circuit board.

2. CAREFULLY, with the supplied IC extractor, remove the integrated circuit at location U28. Replace it with the U28 chip supplied with the upgrade.

3. CAREFULLY remove the IC at location U27 - save it for possible later use in the step. Replace it with the clock module supplied with the upgrade.

Now, if the chip that you just removed is a 9864 or 2864 or something else 64, then plug it back into the socket on the top of the clock module. If the chip that you removed is a 2815, 2816, or 2817A, then plug in your new 28C64 obtained separately into the socket of the clock module.

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4. You should now have left over the original U28 chip from your controller, and possibly the 2815/16/17 chip. Go back over the last steps FOR THE '85 CONTROLLER, and be sure that the chips are plugged into their sockets in the proper orientation and with no bent pins.

5. Power up the controller - it should sign on with the V5.x message. Proceed to program the new functions of the controller as described in the next sections.

Initial Selections, Programming, and DIP switches

After powering up the controller with Version 5 firmware, be sure to do the following programming and selection steps to avoid unexpected difficulties. See the appendices for command summaries.

Control Op (Control Op root codes shown)

Disable the scheduler until you program the setpoints that you want - 102

If you have an FC-900 Interface connected to your controller, enable Link 2 if you have more than one band unit - 105. Otherwise, disable Link 2 - 106.

Disable the HF remote Base until and unless you connect a TS-440S - 108

Re-select your Reverse Patch Mode 0-4 - 54, 55, 56, 67, or 109 (new).

If your RC-96 controller has a Tone Panel option, enable tone encode (if programmed as encode and desired on) - 81

Programming (Programming commands shown)

Program your Control Op setup in macro sets so that what you've selected above isn't undone when you select a new macro set - *5911-*5915

Program Link COS to be high true (previous fixed condition) - *5411

If you have an FC-900 Interface connected to your controller, indicate which band units are present and which are absent - *530B P

If you have not connected a TS-440S HF transceiver to your controller, program an empty HF Command Prefix - *5020.

Program the five Permitted Area Codes as empty messages except for the ones you intend to use (i.e. 1-800, 1-408, etc.) - *1126-*1130.

When programming setpoints for the first time, zero out all unused setpoints by loading all zeros - *420S 0 0 0 00 00 1.

If your '96 has a Tone Panel option, reprogram all tone panel selections.

DIP Switch Summary

RC-85 Controller UF 1-3 directly at logic connector - 4,5,6=OFF, 7=ON
Single channel link - 4,7=ON, 5,6=OFF
Synth. link/remote and expanded UF - 4,5,7=ON, 6=OFF
Glitch-free synch. ... - 4,5,6,7=ON
FC-900 - 4,5,6=ON, 7=OFF
HF Remote Base - 4=ON, 5,6,7=don't care

RC-96 Controller UF 1-3 directly at R/C connector - 4,5,6,7=OFF
Synch. link/remote and expanded UF - 4=ON, 5,6,7=OFF
FC-900 - 4,7=ON, 5,6=OFF

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Operation

This section describes the operation of the various new features in Version 5. The new command codes (programming, control operator, and user) are also summarized later.

Clock / Calendar

The clock and calendar serves several purposes - the time can be played on request by entering a Demo user command; the time,date, and day of week can be included in any programmable message using the message editor; the time and day of week drive the scheduler which automatically selects macro sets.

Decide if you want your clock to operate in 12 hour format (a.m. and p.m.) or 24 hour format (military time). Set the time using *one* of the following two **programming commands** (entered with the controller *unlocked*). The command you chose will determine the format. It will also be necessary to load the scheduler setpoints below using the *same* format.

Set Time (12 hr mode)   *4100   AP   H10   H1   M10   M1
Set Time (24 hr mode)   *4100   H10   H1   M10   M1
AP: 1=p.m., 0=a.m. (12 hour mode only)
H10: tens hours, H1: ones hours, M10: tens minutes,M1: ones minutes

Example: It's 2:53:05 p.m. To set the clock using 12 hour mode, wait until nearly 2:54 and enter the command (with the controller unlocked) *4100 1 0254 and unkey. Time your command entry so that you unkey at 2:54:00 if you want to set the clock precisely.

Set Date   *4101   M10   M1   D10   D1   Y10   Y1
M10: tens month, M1: ones month, D10: tens day, D1: ones day, Y10: tens year, Y1:ones year

Example: The date is April 1, 1991. To set the calendar, enter the command (with the controller unlocked) *4101 04 01 91.

Set Day of Week   *4102 DOW
DOW (day of week):

> 0 = Sunday   4 = Thursday
> 1 = Monday   5 = Friday
> 2 = Tuesday   6 = Saturday
> 3 = Wednesday

Example: It's Friday (thank goodness). To set the day of week to Friday, enter the command (with the controller unlocked) *4102 5.

The current time of day can be played by users with the demo **user command** below.

Say Time of Day [Demo Prefix] 9

Scheduler

The scheduler works with your existing five macro sets, the new clock / calendar, and "setpoints" which you can program to tell the controller when to change over to a new macro set. The automatic selection of macro sets by the scheduler is identical to your manual selection using the Macro Set Select Control Operator command.

You've programmed the clock above, and this section gives programming information for setpoints.

There is room for ten setpoints which you can fill in as needed to arrange your "schedule". Each setpoint specifies certain information relating to the changeover. The day of the week can be a specific day (Monday, etc.), weekends (Saturday, Sunday), all weekdays (Monday through Friday), or every day of the week. You can also optionally specify an nth day of the month - i.e. third Monday of each month. The time for the changeover is defined by hours and minutes. Finally, the macro set to be loaded at the changeover is specified in the programming command shown below. Use the **programming command** below based on the 12 or 24 hour mode you selected when setting the clock.

Define setpoint (12 hr mode)   *420 S Nth DOW   AP H10 H1 M10 M1 M#
Define setpoint (24 hr mode)   *420 S Nth DOW   H10 H1 M10 M1 M#

S: Setpoint 0-9. Ten setpoints can be programmed. To erase a setpoint, enter all zeros for the setpoint and any macro set (like macro set 1, i.e. *420 S 0 0 0 0000 1).
Nth: The 1st, 2nd, 3rd, 4th, or ANY day of week of the month.
    0 = ANY   1 = first   2 = second   3 = third   4 = fourth
DOW (day of week):
    0 = Sunday   5 = Friday
    1 = Monday   6 = Saturday
    2 = Tuesday   7 = everyday
    3 = Wednesday   8 = weekdays
    4 = Thursday   9 = weekends
AP: 1 = p.m., 0 = a.m. (12 hour mode only)
H10: tens hours, H1: ones hours, M10: tens minutes, M1: ones minutes
M#: Macro set # 1-5

Example: Select macro set #3 every weeknight at 11:00 p.m. Use setpoint #5. The clock is in 12 hour mode. Enter the command (with the controller unlocked) *420 5 0 8 1 11 00 3.
Be sure you have selected the format you want to use (12 or 24 hour) using the Time command. *You must define setpoints using the same format as selected for the time.*

The following new **Control Operator** commands relate to the scheduler. The currently selected macro set number can be read back. The scheduler can be turned on and off, and the on/off status of the scheduler can be read back.

100   1-5   **Interrogate Current Macro Set**
101   S on   **Scheduler On**†
102   S off   **Scheduler Off**†
103   on/off **Interrogate Scheduler On/Off**

Female and Sound Effects Synthesized Speech

Thirty-two female words, 10 male words, and 8 sound effects are added to the vocabulary list. In addition, five "run-time variables" can be programmed into messages to play time and date related information as part of the messages. The vocabulary additions along with their message editor codes are shown below and in the programming summary.

Female

oh	*800	twelve	*812	good	*834
one	*801	thirteen	*813	morning	*841
two	*802	fourteen	*814	afternoon	*842
three	*803	fifteen	*854	evening	*843
four	*804	sixteen	*864	the	*821
five	*805	seventeen	*874	time	*822
six	*806	eighteen	*884	is	*823
seven	*807	nineteen	*894	o'clock	*824
eight	*808	twenty	*820		
nine	*809	thirty	*830		
ten	*810	forty	*840		
eleven	*811	fifty	*850		

Male

crane	*950	gauge	*961	pico	*932
device	*953	micro	*931	valve	*941
electrician	*943	mill	*971		
farad	*930	passed	*974		

Sound Effects

crowd	*892	tic	*860
explosion	*891	toc	*870
laser	*873	train	*883
phaser	*882	whistle	*881

Run-Time Variables

morning / afternoon / evening	*844 (female)
current time	*872 (female)
current a.m. / p.m.	*832 (female)
current date	*833 (female)
current day of week	*871 (male)

HF Remote Base

A Kenwood TS-440S HF transceiver can be connected to the controller and can be operated remotely through the repeater. Installation instructions for the transceiver are shown later in this note. This section describes the commands which relate to operation of the HF remote.

The HF remote base gets its own user command code prefix. The **programming command** for selecting the user level HF Prefix is:

> *5020 (prefix)

Example: Select HF remote base prefix as 1. Enter the command (while unlocked) *50201.

The **Control Op** can enable and disable the HF remote base:

107	HF Remote Base Enabled†	HE
108	HF Remote Base Disabled†	HD

The HF remote can be put into Receive Only, Receive/Transmit, and can be turned Off by users. In addition, frequency, mode, and memories can be selected. The **user commands** for these functions are:

Receive Only	[HF Prefix] 1
Receive/Transmit	[HF Prefix] 2
Off	[HF Prefix] 3
Frequency Interrogate	[HF Prefix] 8
Frequency Enter	[HF Prefix] (10M)M*HT(O(h(t)))

Examples (assuming HF Prefix = factory default value of 1):
14.23 MHz	= 1 14*23	3.89551 MHz	= 1 3*89551
7.255 MHz	= 1 7*255	21.3 MHz	= 1 21*30

Bump Up 100 Hz	[HF Prefix] 6
Bump Down 100 Hz	[HF Prefix] 4
Bump Up 500 Hz	[HF Prefix] 9
Bump Down 500 Hz	[HF Prefix] 7
Bump Up 20 Hz	[HF Prefix] A
Bump Down 20 Hz	[HF Prefix] B

Example (assuming HF Prefix = factory default value of 1): Bump HF frequency up 100 Hz: 1 6

Scan Down Slow	[HF Prefix] 7 1
Scan Up Slow	[HF Prefix] 7 3
Scan Down Medium	[HF Prefix] 7 4
Scan Up Medium	[HF Prefix] 7 6
Scan Down Fast	[HF Prefix] 7 7
Scan Up Fast	[HF Prefix] 7 9
Scan Stop	Carrier (key down VHF/UHF radio)

Example (assuming HF Prefix = factory default value of 1):
Scan up medium: 1 7 6. Stop scanning: key your radio.

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Mode   [HF Prefix] 1 (mode 1-4)
                         Mode: 1=USB, 2=LSB, 3=AM, 4=FM
Examples (assuming HF Prefix = factory default value of 1): USB = 1 1 1   LSB = 1 1 2

Memory   [HF Prefix] 5 (00-99)
Note: Memories must be *preprogrammed* into the HF transceiver.

VFO A   [HF Prefix] 5
Example (assuming HF Prefix = factory default value of 1): Select memory 54 which has been preprogrammed into the radio. Enter 1 5 54. To return the HF radio to VFO A, enter 1 5.

Tone Panel CTCSS Regeneration ('96 Only)
The existing Tone Panel programming commands are expanded to provide for several modes of regeneration of the incoming tone. Previously, only a fixed tone could be encoded. As a reminder, tone #1 must be programmed as encode (unlocked, *5100 1) in order to regenerate.

*5101 39   Regenerate incoming tone only while mobile present
*5101 40   Regenerate incoming tone until repeater carrier drops
*5101 41   Regenerate incoming tone only while mobile present (lockout
             others until repeater carrier drops)
*5101 42   Regenerate incoming tone until repeater carrier drops (lockout
             others until repeater carrier drops)

Tone position 2 is encoded continuously during phone patches (reverse patches and patches made by the mobile) in all four regenerate modes.

Example: We have four encode tones installed in positions 2-5. Encoder at position 1 should regenerate the incoming tone only while the mobile is present, and the controller should not respond to other incoming tones until the repeater carrier is allowed to drop. Enter the command (with the controller unlocked) *5101 41

Autopatch Toll Restrict Enhancement
In order to better accommodate densely populated locations where area codes are being split, five "Permitted Area Codes" have been added. These are entered as *messages* (either Morse or speech), i.e. "1415", "301", "1800".

In addition, "local calls" can be defined as maximum seven *or* eight digit (permitting "1"+ 7 digit calls while preserving 10 and 11 digit toll call protection). The 7 or 8 is programmed as a one character *message*. See the message list in Appendix C, *Programming Commands*

Don't Answer Telephone For Two Minutes
A new Control Op command - "Don't answer for 2 minutes" - makes it more convenient to share the '85/'96 phone line with an '850 and modem. See Appendix B, *Control Operator Commands*.

Interrogating Autodial Numbers
Telephone numbers stored in Autodial locations can be read out without dialing the number, including from the phone. See Appendix A, *User Commands*.

Installation of the HF Remote Base

In addition to your RC-85 or RC-96 Repeater Controller, you need:

From Kenwood:
Kenwood TS-440S
IC-10 IC kit (Intel or equivalent 8251A, RCA or equivalent CD4040B)
You do not need the IF-232C level translator.

From ACC:
For the RC-96 only, Serial Port Board (available from ACC)

Connections
The interconnections between the controller and the TS-440S include transmit audio, receive audio, push-to-talk (RC-96 only), and serial port for control. A COS or squelch signal may be used but is not readily accessible from the radio.

Be sure to install the '96 Serial Port Board as indicated in the instructions supplied with it to generate the Serial Out signal.

'85	'96	TS-440S
Tx Audio (J4-8)	Tx Audio (LINK-6, green)	AFSK IN
Link Rx Audio (J4-6)	Link Rx Audio (LINK-7, blue)	AFSK OUT or speaker jack
-	PTTL (LINK-4, orange)	PTT (ACC2 jack pin 13 or REMOTE "From standby switch"
CX3 (J3-11)	Serial Out (CNTL RX-6, green)	Serial Input (ACC1 jack pin 3, bottom pin)

For the RC-85 controller, DIP Switch 4 must be ON.

With the controller unlocked, program an HF command prefix (*5020 prefix). Assuming you are not using a COS, program the Link COS Logic Sense to "low true" (*5410). Enable the HF remote base with the Control Op command (prefix) 107.

With the HF remote turned on (see User Command summary), set link receive level on the controller ('96 = LRX, '85 = R2), and the mic gain on the TS-440 for HF transmit level.

Miscellaneous Improvements

The following changes have been made in V5 firmware.

• Reverse patch mode 4 is added which places the caller directly on the air. The caller can enter Touch-Tone # during the first five seconds to revert to mode 0 and be taken off the air for the remainder of the call. (# must be the first Touch-Tone digit entered.) Otherwise, after five seconds, the Touch-Tone decoder switches to the receiver to give the mobile Touch-Tone control over the radio-telephone interconnection.

• Control Operator command 110 causes a modulo 256 "keyup counter" to be spoken, which can provide rough information about repeater usage. The counter is cleared by the Control Operator Reset command.

• VHF/UHF remote base frequency readback can be inhibited when * is left out as a decimal point.

• Loading autodial locations from the phone automatically extends the telephone timer so the controller won't hang up.

• Band units not present in your IC-900 "stack" can be locked out from selection to avoid potential confusion. See Appendix C, *Programming Commands*.

• When using the FC-900, Link 2 can be disabled if you have only one band unit to avoid confusion. See Appendix B, *Control Operator Commands*.

• Bands can be swapped without Link 2 unit needing to be on.

• A band unit cannot be selected for both Link 1 and Link 2

• If Control Receiver COS becomes active while someone is controlling on the phone, control is returned properly to the phone after COS becomes inactive.

• The cover tone is automatically disabled if a user manually selects full duplex.

• Spare audio is properly muted by a signal on the repeater receiver.

• The unlock timer has been changed from one minute to two minutes.

• The speech letter "S" can be included in the Patch Dialing Prefix to generate Touch-Tone "*".

• RC-96 controller Tone Panel only ... Control Operator commands 81 and 91 turn encode on and off (previously enabled and disabled decode only). The state is stored in macro sets along with other setup information.

About this Manual...

Congratulations on owning an RC-85 Repeater Controller. This manual provides a description of the function, operation, and interface of the RC-85 controller.

Chapter 1 provides a brief introduction to the RC-85 controller and its capabilities in general terms, followed by its specifications and features.

Chapter 2 describes the basic installation of the controller into your repeater system, covering interface to the repeater transmitter and receiver, the phone line, and the power supply.

Chapter 3 provides an overview of the operation of the controller, including a description of command channels, access, ID algorithms, courtesy tones, etc.

Chapter 4 explains the structure of the RC-85 controller commands, and describes the operation of the command decoder.

Chapter 5 describes how to activate the features available to system users.

Chapter 6 details the capabilities available to Control Operators.

Chapter 7 explains how to remotely program the RC-85 controller using Touch-Tone Configuration commands.

Chapter 8 describes in detail the interface of the controller to other equipment in advanced installations, including PL, control receiver, talking S-meter, remote base, alarm, remote control logic output functions, and more.

Chapter 9 provides an overview of the theory of operation of the controller.

Chapter 10 offers troubleshooting hints in case of operational or installation difficulty, or component failure in the controller. It also includes many of the most often asked questions and answers.

Appendix I provides a summary of the Touch-Tone command codes.

Appendix II defines the physical characteristics of the RC-85 controller board, connector position and pinouts, DIP switch option selections, and adjustments.

Appendix III describes a special RCC telephone access paging mode.

Appendix IV provides the controller's hardware schematic.

The **Glossary** defines various terms used in the manual, while the **Index** provides a quick guide to location of various information alphabetized by subject.

Table of Contents

Chapter 1

Introduction and Specifications

The RC-85 Repeater Controller is a complete control system for two-way repeater stations. It's everything needed between the repeater's transmitter and receiver. The controller serves the traditional repeater control requirements, and adds a host of additional capabilities which make your repeater more useful. It introduces the concept of remote programming, which permits changing the repeater's characteristics from anywhere using a Touch-Tone command set.

For example, programming an IDer previously involved constructing a diode-matrix read-only memory to form the dits and dahs of Morse code. The RC-85 controller, on the other hand, allows you to edit ID messages with your Touch-Tone pad and store them in the board's non-volatile memory. But that's just part of the story - your repeater can talk to you! The IDs may be in natural sounding synthesized speech so your users don't have to be cw buffs to understand what the repeater is saying. Add to that the RC-85 controller's custom repeater oriented speech vocabulary of nearly 500 words, and you can easily construct informative ID messages for your repeater's users.

If there's a net tonight at 8 o'clock, one of the IDs can say, "Net tonight at 8, on WA6AXX, Repeater". Or on Fridays say, "TGIF, from WA6AXX, Repeater". Or change the ID messages for special events using any of the words in its nearly 500-word vocabulary, in seconds, from home, using your Touch-Tone pad.

The autopatch built into the RC-85 controller is second in capability only to ACC's RC-850 controller. Gone are the days of wrong numbers because of a fluttery signal or marginal decoding. No more fumbling to enter an access code, then the phone number, while you're trying to drive down the freeway. The RC-85 controller's built-in autodialer lets you dial stored numbers with simple two digit commands. Just tell it what autodial location you want, then the controller goes offhook, waits for dial tone, and dials the number for you in Touch-Tone or dial pulse. If the number you want isn't in one of the autodialer's 200 slots, enter the number as part of the patch command and it will be read back to you (in voice) to make sure you've entered it correctly before it dials!

The controller's support of synthesized remote base operation allows linking your repeater to other repeaters accessible from your site, extending the usable range of your system and making your radio equipment more valuable. PL access and control and a Touch-Tone access mode provide security and interference immunity. Two-tone paging allows selective calling through the repeater to standard pocket pagers, which means users don't have to be listening to be available.

Remote programming is the key to the flexibility and power of the RC-85 controller. Its Touch-Tone command set allows remote reprogramming of messages, autodial numbers, command codes, and more. The remotely programmed information is stored in a reliable E^{2}PROM, which combines the data integrity of a PROM with the flexibility of in-system reprogramming.

The RC-85 controller is fully compatible with ACC's Digital Voice Recorder.

This is just a sampling of the capability of the RC-85 Repeater Controller - read on to find out the whole story.

Specifications

Microprocessor	8085AH
Memory	Total 68K byte
	EPROM - 64 K byte
	E^{2}PROM - 2K byte
	RAM - 2K byte
Logic Inputs	Low 0 to .8 volts
	High 2.4 to 15 volts
	COS, Link COS, Control
	Receiver COS, PL, Courtesy
	Tone select, Alarm, Spares
Logic Outputs	Open collector, 60V, 100mA
	PTT, Link PTT, Control
	Outputs (3, expandable to 8)
Audio Inputs	Adjustable levels
	Receiver, Link Receiver,
	Control Receiver, spare
	mixer inputs
Audio Outputs	Transmitter Audio
	4V p-p level
Operating Temperature	-15 to +55ºC
Power	11.5 to 15V, 175 mA
Board Size	6" x 9"

Standard Features

❑ **Complete Standalone repeater controller**
❑ **Remotely programmable with Touch-Tone commands**
- Messages - over 25 (ID's, tails, Bulletin Boards, etc.).
    May include CW, synthesized speech, and DVR tracks (w/DVR)
- Morse code parameters - Speed - 12-30 WPM; Pitch - dc-3000 Hz
- Control Op and user command codes (12 prefix groups, up to 7 digits each)
- Courtesy tone selection (from 10 predefined sets)
- Timers - 10 sets, 0-30 minute with 1 second resolution
- Autodialer numbers (200)
- Non-volatile E^{2}PROM storage (no batteries)

❑ **Natural sounding speech synthesizer** for effective user/repeater interface
- Custom ham/repeater/public service vocabulary of nearly 500 words
- Letters, numbers, phoenetic alphabet
- Amateur radio terms - club, net, meeting, hamfest, amateur, etc.
- Days of the week, months of the year
- Weather, emergency, and public service words
- Easy to use interactive message editor

❑ **Autopatch / Autodial**
- Built-in telephone interface
- Store/forward, DTMF or rotary
- Optional phone number readback
- User Loadable Autodial (190 numbers)
- Emergency Autodial (10 numbers) with message readback
- Toll restrict - leading 1/0 and digit count
- Cover tone for semi-private patches
- Activity timer with warning warble

❑ **Reverse patch**
❑ **Talking S-Meter**
❑ **Paging -** two-tone sequential
❑ **Remote base** transceiver control - commandable frequency and mode (BCD type "thumbwheel" transceivers and Kenwood TS-711A/811A)
❑ **PL access and control modes**
❑ **Touch-Tone access mode** with programmable timeout
❑ **Remote control logic outputs -** 3 expandable to 8
❑ **Low distortion computer synthesized tone generation**
❑ **Courtesy Tones -** 10 selectable
❑ **Noise and kerchunker filtering**
❑ **Touch-Tone muting**
❑ **Control receiver provisions**
❑ **Alarm input**
❑ **Fully integrated CMOS 16 digit DTMF receiver**
❑ **Intelligent ID algorithm -** automatically selects from up to 7 programmable ID's
❑ **Tail messages -** 3, programmable repetition rate
❑ **Command acknowledgement** with unique messages
❑ **Built-in E^{2}PROM programmer** / eraser for remotely programmed parameters
❑ **Low power, single supply operation** with built-in battery backup circuitry
❑ **Fully socketed** with top quality machine contact IC sockets for reliability and easy service
❑ **Proven reliability** designed in, with watchdog timer, voltage monitoring circuitry, transient protection, conservative design
❑ **Compatible with ACC's Digital Voice Recorder**
❑ **Manual, "Getting Started" Cassette Tape, free telephone technical support**

Options

❏ **Subaudible tone decoder** (Communications Specialists TS-32)

❏ **FC-1 Frequency Control Board -** for frequency control of BCD remote base transceivers and remote control output expansion

❏ **AD-2 Audio Delay "Piggyback Board Kit" -** to *fully* mute Touch-Tone and squelch tails

❏ **FC-900 Interface -** for frequency control of ICOM IC-900 / 901 mobile transceivers

Chapter 2
Installing in Your Repeater

Contents

Introduction

The RC-85 controller is the new "brain" of your repeater, but to have its orders carried out it needs a few connections. It needs to know when there's a signal at the receiver's input, and it needs to be able to tell the transmitter when to turn on and off. The controller must be able to listen to audio from the receiver, both to hear Touch-Tone command codes you're sending it, and also because it passes receiver audio on to the transmitter. And finally, since the controller board has final say on what audio goes to the transmitter, it needs to connect to the transmitter's audio input.

Since all the control functions are handled internally by the RC-85 controller, the only connections absolutely necessary to the rest of the system are these four basic signals plus power. Connecting a phone line to the board lets you use the patch, reverse patch, and control over the phone capabilities. Other inputs and outputs from the controller allow you to build a "Super System" with a control receiver, remote base, PL operation, site alarm, Digital Voice Recorder, and remote control outputs. We'll go into these in Chapter 8, but for now let's just cover the basics.

## Interface Signals Required

➲ **Carrier-Operated-Switch (COS)** - logic input from receiver (J3 pin 1)
➲ **Push-to-Talk (PTT)** - logic output to transmitter (J3 pin 10)
➲ **Receiver Audio** - audio input from receiver (J4 pin 7)
➲ **Transmitter Audio** - audio output to transmitter (J4 pin 8)
➲ **Phone Line** - for patch, reverse patch, phone line control (J2)
➲ **Power** - last but not least (J1)

Carrier-Operated-Switch

The output from the receiver which indicates that a signal is present is called COS, or carrier-operated-switch. It's a logic signal which is at a particular logic state when a signal is at the receiver's input, or the squelch is open, and at the opposite state when the squelch is closed. Most receivers designed for repeater service have such a logic output, called "COS", "COR", "squelch gate", or something similar. With other receivers, such as transceivers put into repeater service, it's necessary to find a usable logic signal for COS. Look after the FM detector, following the noise amplifier and rectifier in the squelch circuit, for a usable signal. Contact the factory if you need help with your particular receiver.

Since signals from different receivers can vary in characteristics, the RC-85 controller is designed to accept a variety of logic levels and to accept "high true" and "low true" signals. The only requirements are that a logic low be less than .8 volts and a logic high be greater than 2.4 volts (up to about 15 volts). The COS input impedance is approximately 10K ohms so that it won't load down the circuitry providing the COS signal. A DIP switch on the controller board allows selection of high or low true, based on what your receiver provides (see "Setting DIP Switch Options" later in this chapter).

COS Input

Rin=10K
Vlow<.8V
Vhigh>2.4V
10K
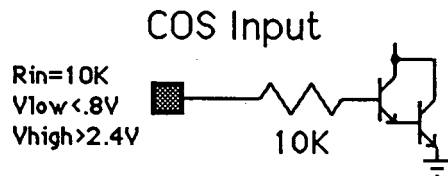
Push-to-Talk

The PTT (push-to-talk) signal is just as easy to interface to the transmitter. The controller provides a solid-state switch closure to ground capable of sinking up to about 100mA from a positive source. Most any transmitter has a keying line (PTT), so if a contact closure to ground normally keys the transmitter, you're in business. If a logic high keys your transmitter, the controller board also allows PTT high true operation, so that a pullup resistor on the output can define a logic one level to the keying logic. High or low true operation is selected by a DIP switch option (see "Setting DIP Switch Options" later in this chapter).

If your transmitter has *negative* voltage on the keying line, it's necessary to buffer PTT with a relay or other transistor circuitry. The PTT transistor switch is capable of keying positive voltages only and may be damaged if connected to a negative voltage. If greater than 100 mA is required for keying the transmitter, the PTT output can be buffered with a larger transistor or relay.

PTT Output

60V (off)
100 mA (on)
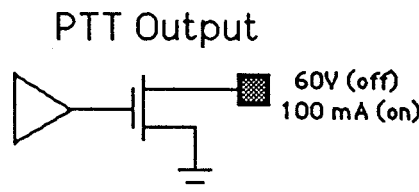
Receiver Audio

Audio from the receiver needs to be supplied to the controller. The receiver audio is mixed with other audio sources before being sent along to the transmitter.

The receiver audio input circuitry to the RC-85 controller allows for a variety of signal levels and impedances. The audio input is capacitively coupled, which means that a dc level may be present on the signal supplied. The level is internally adjustable so that a fairly wide range of input levels is acceptable, but for best results the input audio should be .5 to 2.5 volts peak-to-peak. If the level available is lower than this, the gain of the input stage can be increased by adding a resistor to the controller board at R6, which increases the gain of the non-inverting op amp input buffer to greater than one (gain = 1 + (100K / R6)). For example, if 300 mV p-p audio is available, installing a 33K resistor at R6 (gain=4) is equivalent to supplying 1.2 volts at the input and is well within the desired range.

The input impedance for receiver audio is 100K ohms so that audio may be picked off from anywhere inside the receiver without loading problems. No impedance matching is necessary. Find a point past the FM detector where the audio is de-emphasized and squelch gated to route to the controller.

Receiver Audio Input
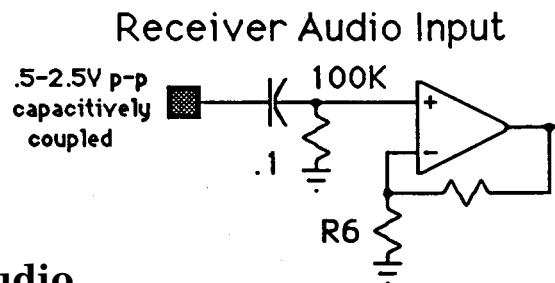
Transmitter Audio

Audio is supplied by the controller to the transmitter. The audio consists of receiver, speech synthesizer, tone, link, and phone patch audio, switched and mixed under the control of the computer in the RC-85 controller. The audio from the board is high level and low impedance so it's easy to find a good place to inject it into the transmitter. The microphone input may be OK, but it may be necessary to knock down the level with a resistor voltage divider. The level out of the controller is *fixed*. If the transmitter audio input is very sensitive, it may be best to reduce the gain of its audio input stage by changing a resistor value. The audio output is dc coupled - it may be necessary to capacitively couple to the transmitter depending on where the audio is injected. Remember to use a large enough capacitor to let the lows through - about 10 uF for input impedances as low as 600 ohms, and if it's an electrolytic capacitor, install it so that it's polarized correctly (controller output is at dc ground).

Transmitter Audio Output
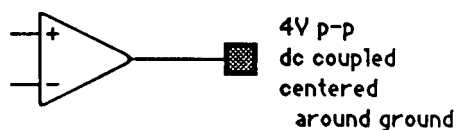
Telephone Line

The RC-85 controller may connect directly to the telephone line through connector J2. The controller is not polarity sensitive. Since all the autopatch, autodial, reverse patch, and control over the phone line functions are handled by the controller, connection to the phone line enables all these capabilities.

Note: Depending on your telephone service, you may require a protective coupler to comply with FCC Part 68 regulations.

Power

The RC-85 controller will operate from a supply voltage of 11.5 to 15 volts dc. Since the circuitry is primarily low power, high performance CMOS, its current requirements are less than about 200 mA. Low power single supply operation means it's easy to battery backup, along with the rest of your repeater, to keep it available in case the primary supply goes away. It also means that primary power can be borrowed from the existing system 12 volt supply. Good system design suggests avoiding unnecessary duplication of power supplies in the repeater system, so it shouldn't be necessary to dedicate a supply to the controller.

Inputs for your primary supply and an optional backup battery are provided at connector J1. The inputs are diode isolated so that the battery is normally isolated from the load through a back biased diode until the primary supply goes away, at which time the battery instantly begins supplying the power. The battery is only necessary to continue *operation* of the controller - remotely programmed information is stored in non-volatile memory and *does not require battery backup*. The controller does not provide trickle charging to the battery.

Two ground signals are located at the connector - one for the digital circuitry and the other for the analog circuitry. It's best to connect seperate wires from each ground back to the supply's ground to prevent digital noise from entering the audio signals. **BOTH GROUNDS MUST BE CONNECTED TO THE SUPPLY GROUND.**
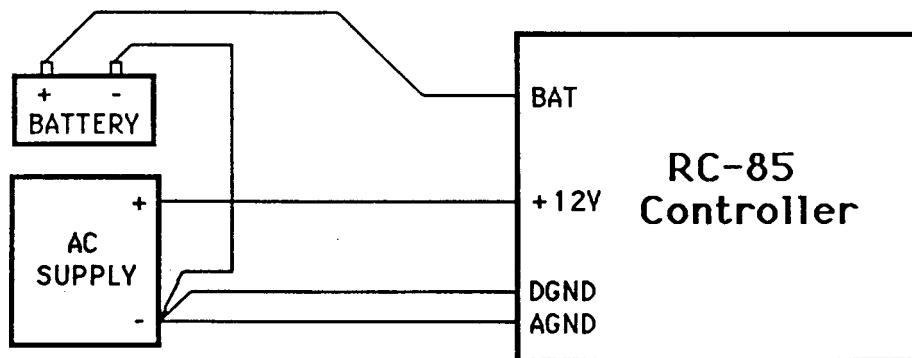
Wiring to Your Controller

The various interface signals to the controller board may be connected using the supplied mating connectors. Connector J1 uses the white 4 pin housing with the large crimp connectors. Connectors J3 and J4 use the 8 and 14 pin red housings with the small gold crimp connectors. It's a good idea to carefully solder the connectors after crimping them, being careful not to let the solder flow to the flexible portion of the pin. The pins may be inserted into the appropriate housings. Carefully install them so that the small clip on the pin can latch onto the square hole on each position of the housing (see diagram below).
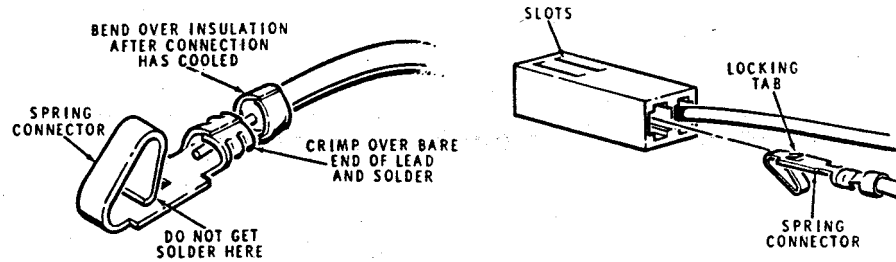
Setting DIP Switch Options

Switch settings on the RC-85 controller board select high or low true sense for the COS and PTT signals (see below). It's now necessary to set the switches correctly to properly control the repeater. Switch 1 selects COS sense and switch 2 selects PTT sense. Assuming you don't have a control receiver connected yet, switch 3 must be set ON so that the controller doesn't think that a control receiver is active, therefore grabbing the Touch-Tone decoder. The other switches should be left off for now. Chapter 8 provides details of switch selections for the various options.

INITIAL DIP SWITCH SETTINGS		
DESCRIPTION	ON	OFF
SW1 REPEATER RCVR COS	HIGH TRUE	LOW TRUE
SW2 REPEATER TX PTT	HIGH TRUE	LOW TRUE
SW3	ON	
SW4-8	OFF	

See Chapter 8 and Appendix II for additional details.

Setting Audio Levels

Several of the audio levels to the transmitter and phone may be adjusted using on-board pots. The levels of the speech synthesizer and tone generator are *fixed*, and the receiver audio levels (repeater and link receivers, R1 and R2) should be adjusted to match the speech synthesizer level. The phone level to the transmitter (R3) should be adjusted during a phone patch. The transmitter audio output level from the controller is then *fixed,* and the audio gain and deviation controls *in the transmitter* should be used to adjust the overall transmit level.

Remember that the RC-85 controller is an audio source to the transmitter, and its various audio levels should be balanced relative to each other. Do not confuse controller audio level adjustments with transmitter audio characteristics. The controller's levels are best set using an oscilloscope at its audio output, or yes, even by ear. **Levels on the board should not be adjusted by monitoring the transmitter deviation with a deviation meter.** Remember that the transmitter's pre-emphasis characteristics mean that higher frequency components result in wider deviation than low frequency components. A female voice will deviate wider than a male voice at the same level. A 1000 Hz cw note will deviate wider than a 440 Hz note. Balance the levels at the output of the controller with an oscilloscope, **then** adjust the transmitter's audio level and deviation controls using a deviation meter. Certain high frequency audio peaks may be allowed to clip in the transmitter's peak limiter. **Do not adjust the controller's audio pots based on deviation meter or service monitor readings.**

This completes the basic installation of the RC-85 Repeater Controller into your system. You're now ready to start commanding it, to construct ID messages, load autodial numbers, and to start using its many features - and to put it on the air!

Chapter 3
General Operation

Contents

Introduction

The RC-85 Repeater Controller brings your repeater to life by automatically
controlling the operation of the system and by responding to Touch-Tone
commands from its users. A system block diagram is shown below, illustrating
how the controller fits into a typical repeater system.

REPEATER BLOCK DIAGRAM
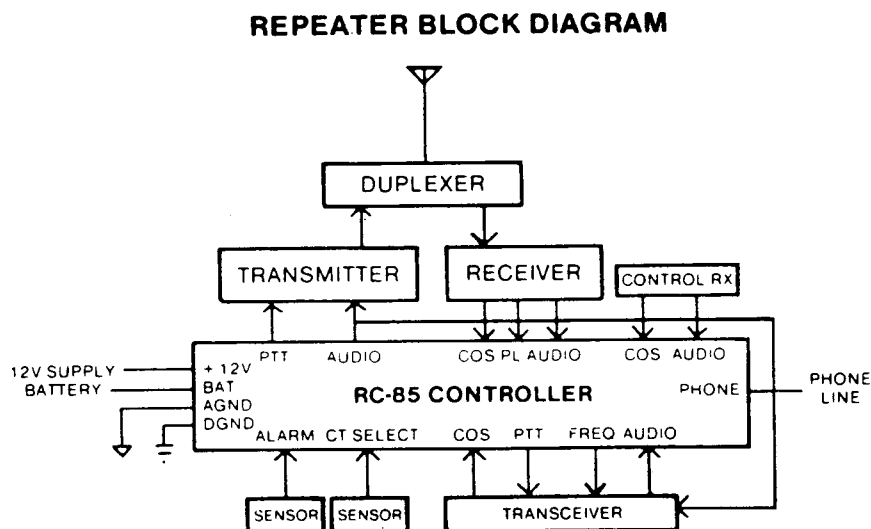
The controller's command decoder and command structure are described in detail in the next chapter. We'll describe here the command channels, along with access modes, ID, courtesy tone, tail messages, and other aspects of the controller's operation.

Command Channels

Commands may be entered over the main repeater receiver, the telephone, or through the control receiver. The Touch-Tone decoder is always connected to one channel based on priority levels. The control receiver has the highest priority - a signal present will grab the Touch-Tone decoder from the phone or the repeater receiver. The telephone has the next highest priority, followed by the repeater receiver with the lowest priority.

Command responses and acknowledgements are returned over the repeater transmitter to commands entered over the repeater receiver or control receiver. Command entered over the phone are responded to over the phone.

Control Over the Telephone Line

Calls into the repeater's phone line are answered by the controller after a programmable delay. The controller answers with a programmable message, such as "AXX control". The caller then has 15 seconds to enter a valid Touch-Tone command or the controller will hang up.

Valid Control Op commands automatically reload the timer to two minutes, allowing continuous Control Op activity over the phone. A user level Telephone Timer Extend command is available for reloading the timer for Digital Voice Recorder related activities. The controller may also be unlocked to allow Configuration commands to be entered.

User commands may be entered over the phone, including the Reverse Patch command code to activate the Reverse Patch. This code causes the transmitter to come up (if not already up) and "ring" for one minute or until answered over the air.

The operation described above applies to the Reverse Patch Mode 0. Two additional Control Op selectable modes modify the controller's response to phone ring. Mode 1 causes the repeater to automatically ring out as a reverse patch five seconds after answering the phone if no valid commands have been entered. This mode doesn't require the caller to have a Touch-Tone phone to use the reverse patch, yet still allows User, Control Op, and Configuration control over the phone. Mode 2 causes a reverse patch alert over the air without answering the phone until the reverse patch is answered by a user. If Mode 2 is selected, control may not be accomplished over the phone.

The Reverse Patch Mode is selectable with Control Operator commands and may be enabled or disabled as well.

Access

A high degree of flexibility is provided in access to the repeater and its command structure over the repeater receiver. A PL logic input, in conjunction with Control Operator commands, allows

1) Carrier access and carrier control
2) Carrier access and User command control, but PL required for Control Operator and Configuration control
3) Carrier access, but PL required for User Command, Control Operator, and Configuration control
4) PL access and PL control

In addition, a Touch-Tone Access Mode allows users to bring the repeater up and down with Touch-Tone commands. The TT Access Mode offers security, interference immunity, and allows co-sharing a channel with another repeater.

When enabled by the Control Op, the mode may be brought up and down by users with commands, and when brought up, may automatically go back down after a period of inactivity. The TT Access Mode timer may be set for any period up to half an hour, or may be disabled (by setting it to zero).

The TT Access Mode can be used in conjunction with PL access as well. When in PL access, the Touch-Tone Access mode selectively allows non-PL'd users to access the repeater.

ID Timing and Selection

Amateur repeaters in the U.S. are required to ID at least every 10 minutes when in use. The RC-85 controller offers an intelligent ID algorithm which selects one of seven remotely programmable Morse code and synthesized speech ID messages based on the circumstances.

The ease of remotely programming the ID messages and the custom repeater oriented speech vocabulary allow the repeater owner to include informational messages as part of the ID. Messages such as, "Meeting tomorrow at 8. This is WA6AXX, Repeater", can be entered in a minute or two.

If the repeater has not been in use for six minutes, and a new user comes up, the controller will ID after he unkeys with the "Initial ID Message". This message could say "Hi", or "Welcome", etc., followed by the call sign. If the new user holds his carrier up for a period greater than ten seconds, preventing generation of the Initial ID, the controller will send the "Forced CW ID Message" on top of him so that the repeater is ID'd.

After the Initial ID or Forced CW ID, the Pending ID Timer (six minutes) starts to run. When it times out, the controller looks for no repeater activity or for users to let the repeater carrier drop. If they do, the controller sends a "Pending

ID Message" at the end of the repeater hang time. The Pending ID can rotate between three ID messages for variety. In addition, a "Special ID Message" can be added to the rotation for special events. The Pending and Special IDs can conveniently contain informational messages, as they occur, without interfering with conversations on the repeater.

If the repeater carrier is not allowed to drop during the Pending ID period (such as if a conversation is in progress), the controller looks for a break between user's transmissions for a period of three minutes to work in the "Anxious ID Message". The Anxious ID could typically be a straight call sign Morse code ID or brief synthesized speech ID to minimize distraction to users.

Finally, if the controller isn't give the opportunity to ID between user's transmissions, it forces a "Forced CW ID Message" over the conversation in progress following timeout of the sixty second Forced CW ID Timer. The cycle then repeats and continues as long as there is repeater activity following an ID.

ID TIMING

PENDING ID PERIOD	ANXIOUS ID PERIOD	FORCED CW ID PERIOD
6 MINUTES	3 MINUTES	1 MINUTE
NO ID ATTEMPTED	PENDING ID ATTEMPTED	ANXIOUS ID ATTEMPTED
INITIAL OR OTHER ID	FORCED CW ID GENERATED	
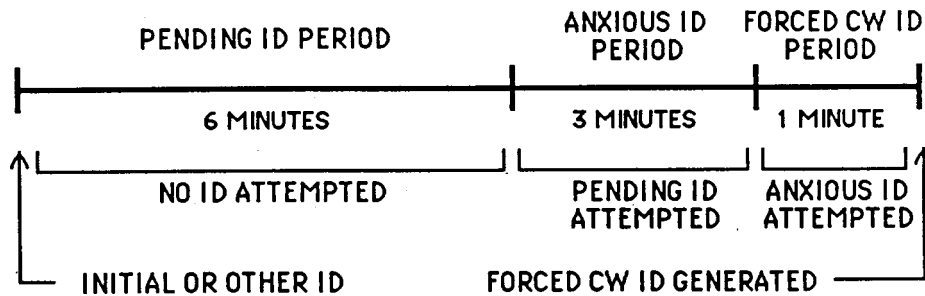
Courtesy Tone

Following each user's transmission, the repeater transmitter remains on for a programmable period (hang time) with a courtesy tone provided to indicate that the other use may transmit. The delay to the tone allows other stations to break into the conversation. The fact that the repeater carrier may stay up continuously during a conversation eliminates the "second squelch tail" in the user's receiver, replaced instead by a pleasant, selectable courtesy tone.

Ten different courtesy tone "sets" including "no tone" are defined in the firmware and may be chosen for use on the repeater with Control Op commands. A Courtesy Tone Select logic input to the controller chooses between the Control Op selected set and a second selectable set, allowing the courtesy tone to convey information (high / low power, emergency power, etc.). A third selectable tone set indicates a signal received on the link or remote base receiver, differentiating link signals from repeater signals.

Tail Messages

Up to three different tail messages may be programmed by the repeater owner and selected for use by the Control Operator. These messages are sent at the end of the hang time, just prior to dropping the transmitter carrier and can remind users of status of the machine of an approaching net or meeting. Some examples of tail messages which could be useful are "Net tonight", or "Weather alert!", or "PL". Tail messages may be composed of any words in the controller's vocabulary or any Morse code characters.

Tail messages are generated when users allow the repeater carrier to drop (at the end of the hang time) so that they don't interrupt a conversation in progress. They also will occur no more frequently than defined by the Tail Message Timer to keep them from becoming annoying. For example, if the Tail Message Timer is set to five minutes, tail messages will not occur more frequently than every five minutes.

Timeout Timer

The repeater's timeout timer is available to limit transmission duration in case of a continuous carrier at the repeater's receiver. The timer resets automatically when the signal at the receiver has gone away for 650 ms. Normally, a courtesy tone is generated at that time, however if an Anxious ID is waiting, the ID message will be generated in place of the courtesy tone and will be followed by the tone. In either case, the timeout timer resets at the beginning of the courtesy tone or Anxious ID.

If users don't wait for the courtesy tone and the total transmission time between timer resets exceeds the timeout timer value (repeater owner programmed and Control Op selected) the controller will announce "Repeater Time Out", and the transmitter will be shut off. When the signal at the input goes away for at least 650 ms, the transmitter will be re-enabled and will announce "Repeater Time Out Cancel".

The Control Op may disable the timeout timer and may reset it if it has timed out or is about to time out and the signal is still present at the receiver.

TAIL TIMING EXAMPLES
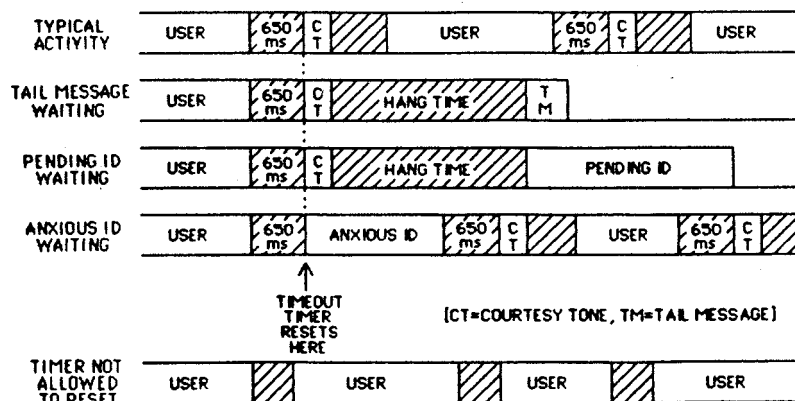
Touch-Tone Muting

Touch-Tone commands through the repeater are normally muted by the controller, both for security and so that users don't have to listen to the tones. Since about 50ms are required by the controller to detect that tones are present, a short "blip" will be heard on the first and second tones. Following the second tone, the muting overlaps to subsequent tones so that no further blips are heard. (The AD-1 Audio Delay board eliminates these Touch-Tone "blips".) The controller inserts a cover tone on the transmitter audio to indicate to users that someone is entering a Touch-Tone command. The pitch of the cover tone is programmable by the repeater owner.

Users may defeat the controller's Touch-Tone muting to send tones directly through to a linked repeater or to the telephone line if necessary.

The Control Op may disable Touch-Tone muting so that *all* tones pass through the repeater.

Noise and Kerchunker Filtering

The RC-85 controller provides filtering against noise and kerchunking on the repeater receiver. An algorithm filters against spurious noise on the receiver COS logic input, preventing static crashes and random noise bursts from bringing up the repeater. Kerchunker filtering prevents short transmissions from holding up the repeater transmitter, frustrating the kerchunker into making a "real" transmission to see if the repeater is up. The Kerchunker filter may be enabled or disabled with Control Op level commands.

In the Control Op selectable "Zero Hang Time Mode" neither the noise nor kerchunker filtering apply.
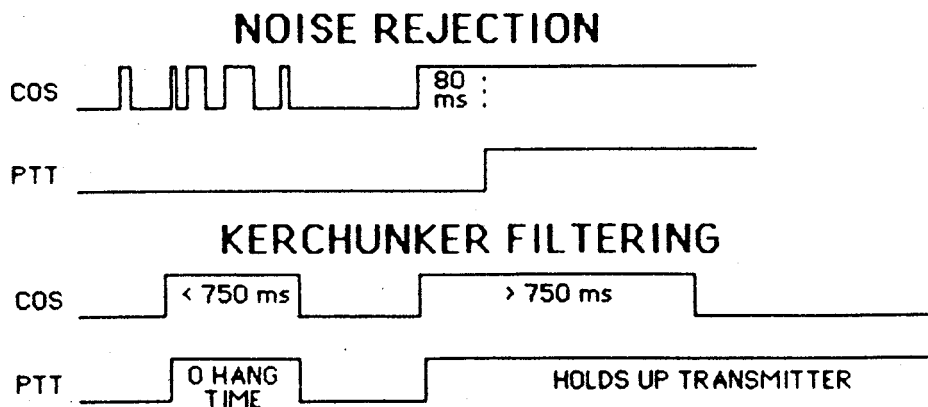
Chapter 4
Command Code Structure

Contents

Introduction

You speak to your new controller in a simple Touch-Tone command language.
Your controller speaks back to you in voice. Commands can be entered over the
air, or over the phone, or over a control receiver.

There are several levels of Touch-Tone commands which control the RC-85
controller. Your repeater group probably consists of three types of persons - the
repeater owner or technical group, the Control Operators, and the general users.
Therefore, there are three levels of commands in the controller.

User commands are those that would typically be made available to the
general users for activating the autopatch, remote base, bulletin board, and
other user type functions. The user command level is the lowest level of
command classification.

Control Operator commands are those which allow enabling and disabling
the various functions of the repeater and selection from various operating
modes. For example, the Control Op may select between carrier and PL access
or enable and disable the autopatch or autodialers.

Configuration commands change parameters of the repeater such as content
of the ID and tail messages, timer values, emergency autodial telephone
numbers, and command codes. Configuration commands are the most secure
type and require that the repeater be placed in a special mode to execute them
(unlocked). Typically, details on Configuration commands would be reserved for
the repeater owner or the repeater's technical group.

Note that all User and Control Op commands codes (except Touch-Tone Pad Test)
can be changed remotely with Touch-Tone Configuration commands.

User Commands

There are 13 classes of User commands, each with its own independent command code. User command codes consist of a prefix followed immediately by a command root. The prefix may be remotely programmed by the repeater owner using Configuration commands, while the command roots contain information related to the action desired. For example, if the User Loadable Autodial prefix is *, dialing autodial location 45 is done by entering the command *45. The * is the prefix, and is remotely changeable, while 45 is the root, which specifies the autodial location being called.

The User command code classifications include:

> **Touch-Tone Pad Test**
> **Autopatch**
> **User Loadable Autodial**
> **Emergency Autodial**
> **Patch Utilities (Cover Tone, Custom Hangup,**
>   **Timer Extend, Reverse Patch Answer, Redial)**
> **Patch Hangup**
> **User Loadable Autodial Load / Erase**
> **Reverse Patch**
> **S-Meter Readback**
> **Demonstration / Bulletin Board Messages**
> **Link / Remote Base**
> **Paging**
> **Touch-Tone Access Mode Up / Down**
> **Spare Audio Select**
> **User Function Remote Control Outputs**
> **Telephone Timer Extend**

Each User command classification may have an independent command code prefix, and codes may be changed at any time remotely by the repeater owner.

The operation of each the user commandable functions is described in the next chapter of the manual.

Control Operator Commands

Control Operator commands, those that enable and disable various repeater functions, and select operational modes consist of a command prefix which may be programmed by the repeater owner remotely with Configuration commands followed by a one or two digit root code. The command prefix may consist of between 1 and 7 digits so that Control Op commands may be made as secure as is necessary in your system. Control Op commands may be between 2 and 9 long - easy or secure, it's up to you.

Control Operator selections may be grouped into four "Macro Sets". That is, most of the enable / disable and mode selections can be grouped together and

stored in the controller's non-volatile memory using a Configuration command. The Control Op Macro Sets make it easy to select a special mode, like night operation, or net mode. One easy to remember Control Op macrocommand can, in effect, perform many commands.

One of the macro sets defines how the controller powers up. The repeater owner can specify what features are enabled and disabled and what modes are selected by storing a Control Op macro set.

The function of the various Control Op commands is described in the next chapter, and the command groups include:

> **Macro Set Selection**
> **Repeater Enable / Disable**
> **Repeater Timer**
> **Access / Control**
> **User Command Enable / Disable**
> **Link Enable / Disable**
> **Autopatch / Autodial**
> **Reverse Patch**
> **ID**
> **Tail Message**
> **Alarm Enable / Disable**
> **Speech Synthesizer**
> **Kerchunker Filter Enable / Disable**
> **Touch-Tone Mute / Unmute**
> **Zero Hang Time Mode Enable / Disable**
> **Low Courtesy Tone Select**
> **Initialize**

Configuration Commands

Configuration commands are the top secret, super secure commands which allow you to remotely change User and Control Op codes, ID and other messages, Morse code characteristics, courtesy tone selection, timer values, and Emergency Autodial numbers. Since Configuration commands need to be very secure to prevent tampering, they are accessible only when the controller is "unlocked". Unlocking the controller accesses the configuration commands. When the controller is locked in normal operation, any Configuration commands entered are ignored. The controller is unlocked by entering a long Touch-Tone "unlock" command. The actual command is field programmable by the repeater owner among ten billion possible codes and is unique to each controller.

While unlocked, the various ID and response messages in the controller may be edited, timer values may be changed, Emergency Autodial numbers may be reprogrammed, and command codes may be modified. After we've finished a sission of configuring, we "lock" back up the controller to that it's secure from tampering.

The classes of Configuration commands include:

> **Messages**
> **Tone Parameters**
> **Courtesy Tone Selection**
> **Timers**
> **Command Code Prefixes**
> **Emergency Autodial Numbers**
> **Misc. Selections**

Command Evaluation

The controller evaluates Touch-Tone commands to determine the function requested. Commands may be entered over the repeater receiver, the phone line, or the control receiver. When entered over either receiver, the controller examines the sequence of Touch-Tone digits sent during the transmission **after the carrier drops** (after the user unkeys his PTT). The controller examines the length of the command, as well as the digits present, and checks for a perfect match to valid commands before acting on the command received.

Special Keys

There are several special keys that affect operation of the command decoder. **Over the phone**, since the controller doesn't know when you've finished entering your command (since there's no carrier to drop), the controller looks for a special **command terminator key - the # key.** For example, to enter the command "123" over the phone, it should actually be entered as "123#", where the # indicates the completion of the command sequence. This applies to User, Control Op, and Configuration commands entered over the phone.

On rare occasions, it is desirable to force a command evaluation when a command is entered over the air. For example, if a weak carrier is present at the receiver input, the controller won't detect a carrier drop which would normally cause a command evaluation. **Over the air, the D key serves as an optional command terminator.** If a week carrier is present at the receiver input, and the Control Op wants to disable the repeater timer, and the Repeater Timer Disable command is 3A45, he may enter "3A45D" and the command will be accepted by the controller even though the carrier has not dropped.

Finally, when sending a command to the controller over the air, if you make a mistake part way though the sequence, a **# key will cancel the digits sent to that point** during the transmission, and the correct command may immediately follow the #. For example, if the desired command is 3A45, and you mistakenly enter 33, you may enter a # followed by 3A45, i.e. 33#3A45 entered over the air is interpreted by the controller at 3A45.

The # key sent as the first key of a sequence **unmutes Touch-Tone** for the remainder of the transmission and causes the controller to ignore the sequence.

Touch-Tone unmute is useful for entering telephone credit card numbers and passing tones through the remote base to other repeaters.

#	Command terminator for commands entered over the phone
D	Optional command terminator for commands entered over air
#	In middle of a sequence cancels preceding keys
#	As first key of a sequence unmutes Touch-Tone for remainder of sequence, controller ignores sequence

Command Decoder Timers

Several timers relating to command entry totally eliminate the effects of rare but unavoidable Touch-Tone decoder falsing on voice. A four second **interdigit timer** cancels a sequence where any digit occurs more than four seconds after the last digit. An eight second **"to end of transmission timer"** cancels any sequence where the last digit was received greater than eight seconds before the end of the transmission.

These timers help the controller discriminate between valid command sequences and the rare occasional false decode on voice.

These timers impose two simple but important requirements on command entry:

1) **Command sequences may not be entered v-e-r-y s-l-o-w-l-y,** because if more than four seconds elapses between digits, the controller will disqualify the command.

2) **Command sequences may not be entered at the beginning of a long transmission,** because if more than eight seconds elapses from the last digit to the end of the transmission, the sequence will be disqualified. A Touch-Tone command followed by the Gettysburg Address will not be accepted.

Chapter 5
How to Command the User's Features

Contents

Introduction

This chapter guides you step by step through the procedures for operating the user features of the RC-85 controller. Detailed examples are provided which you may try on your repeater as you read them.

Remember - you can't break your controller with Touch-Tone commands so feel free to play!

Testing Your Touch-Tone Pad

Since your Touch-Tone pad is used for entry of all commands to the controller, it may be a good idea to "check it out". The controller allows you to easily and thoroughly test your pad by letting you enter a sequence of keys, and it reads the sequence back to you in voice.

The first key of the sequence, which tells the controller that you're testing your pad, is "5", and then you can enter any sequence of up to 32 digits for readback. So to test your entire pad, for example, you can enter, all in one transmission:

5 123456789*0#ABCD

The controller responds by reading back everything after the "5" (* as Sierra, # as P). If a key doesn't decode, it won't be read back. To check a key for intermittent operation, you can press it several times:

5 3333

The controller should read back "3" four times if it decoded each time.

Command: 5 (sequence of up to 32 keys)

Example: User sends "5 123456".
             Controller says, "One two three four five siz".

Related Commands:
    Control Op   Pad Test Enable/Disable, User Command Enable/Disable

Activating the Autopatch

Now that you know that your tones decode properly, you can make a patch. The Autopatch command consists of the Autopatch prefix followed immediately by the phone number, all as one command. Try

(prefix) 7273330

The controller will say, "Autopatch", pause, then read back the phone number for verification and pause again. During either pause, if you want the controller to dial the number, click your rig's PTT briefly. By clicking your mike at the *first* pause, you prevent phone number readback. Waiting until the second pause lets you verify that the proper number was entered.

You can hear the controller dial the tones, although, for security, the actual tones heard over the air are not the phone number Touch-Tones. Optional phone number readback and Touch-Tone or dial pulse regeneration mean NO WRONG NUMBERS! If your phone line won't accept Touch-Tone, we'll show you how to make it pulse dial later in this chapter. Again, if you don't want the phone number read back, "click" your mike briefly after it says, "Autopatch", and it will dial the number immediately.

Command: (Autopatch Prefix) (telephone number)

Example: Autopatch Prefix = *
User sends "* 7273330".
> Controller says "Autopatch (pause) seven two seven three three three zero (pause)". User clicks his mike at either pause and controller dials the number

Hints: If you don't want your users to have to "click" their mikes to start dialing, select the Control Operator "Dial without click" mode.
To cancel the patch before it dials, enter any Touch-Tone during either pause.
If long distance is disabled by the Control Op, phone numbers beginning with 0 or 1 or longer than 7 digits will be ignored.
Phone numbers less than 4 digits are not accepted by the Autopatch - they must be dialed through either autodialer.
With long distance enabled, phone numbers up to 18 digits are accepted.
When the Autopatch Timer times out, the "30 seconds left" message is generated. The user may then enter the Patch Timer Extend command.
If the Activity Timer times out, a warning warble is generated - reset the activity timer by sending a brief transmission.

Related Commands:
Config   Phone Hangup Message, Patch Dialing Prefix, Autopatch Timer, Patch Activity Timer, Patch Timer Extend Timer, Autopatch Prefix, Patch Utilities Prefix, Patch Hangup Prefix, Touch-Tone/Dial-pulse signalling
Control Op   Autopatch E/D, Long Distance E/D, Patch Timer E/D, Cover Tone E/D/Always, Dial Needing/Without Click
User   Patch Cover Tone, Patch Timer Extend, Patch Hangup, Patch Custom Hangup, Redial

Hanging Up the Patch

The patch is normally hung up with Touch-Tone sequence, which may be as simple as # or a multidigit sequence. While the patch is up, simply enter the Patch Hangup command to take down the patch. The controller acknowledges with the "Phone Hangup" message. If the patch is not up, the Hangup command is ignored.

Command: (Hangup Command Code)

Example: Hangup Command Code = #
User sends "#".
> Controller disconnects the patch and announces the "Phone Hangup" Message.

Related Commands:

Config	Phone Hangup Message, Patch Hangup Command
Control Op	Control Op Onhook
User	Custom Hangup Code

Patch Redial

The phone number dialed is stored in a redial memory and is available for easy redial without the need to enter the entire phone number again. The redial memory is erased fifteen minutes after the attempted patch so that is doesn't remain indefinitely. Redial is useful in the case of a busy signal or other need to call back the same number.

Command: (Patch Utility Prefix) *

Example: Patch Utility Prefix = *
            User made a patch within the last 15 minutes, and the
            line was busy. He can redial by sending "* *".
                The controller says "Repeat dial" and dials the number.

Defining Your Own Hangup Code

In case of malicious patch hangup during a call, you may define your own three digit hangup code prior to making your call again. The Custom Hangup Code permits you to define the hangup code which inhibits the Patch Hangup command from hanging up the patch.

To define a custom hangup code, enter the command within 15 seconds of initiating the patch. The hangup code is returned to the normal code after completing the current patch or if the patch isn't initiated within 15 seconds.

**Command: (Patch Utility Prefix) (any 3 keys except # or D, and
                may not begin with 1 or 5)**

Example: Patch Utility Prefix = *
            User sends "* 3A7" within 15 sec. of starting the patch.
                Controller responds with "Cancel" and redefines the
                patch hangup code to 3A7.

Hints: If you forget the custom code you define, the Control Op
                can hand up the patch with the Phone Onhook Control
                Op command.
            If you start to enter a patch command and unkey and hear
                the controller say, "Cancel", wait 15 seconds to let the
                accidental Custom Hangup Code clear before retrying.
            Avoiding "1" as a leading digit of the Custom Hangup Code
                lets us allow the repeater owner to define User Loadable
                Autodialer Command Prefix with *, Extended User
                Loadable Autodialer Command Prefix with *1, and Patch
                Utility Prefix with *, without conflict. (Otherwise *121
                could be Custom Hangup or Extended Autodial.)

Related Commands:

Config	Patch Utility Command Prefix
Control Op	Control Op Onhook

Selecting the Cover Tone for Semi-private Patch

The controller offers a "cover tone" available during patches which results in muting of the mobile audio through the repeater replaced by the cover tone. The cover tone offers a degree of privacy by allowing only one side of the conversation to be heard on the air (the telephone side). The cover tone may be selected by the Control Operator to be always on, to be user selectable, or to be disabled. To activate the cover tone if in the user selectable mode, enter the Cover Tone Command before or during a patch. The cover tone selection is cancelled at the end of the patch and may be selected again for the next patch.

Command: (Patch Utility Prefix) *2

Example: Patch Utility Prefix = *, and User Selectable
User enters "* *2" before or during a patch.
Controller responds with "C", and the cover tone is
activated for the next / current patch.

Related Commands:

Config	Cover Tone Pitch, Morse Code Speed, Patch Utility Command Prefix
Control Op	Cover Tone E/D/Always On
User	Patch Hangup (cancels cover when "Cover Tone Enable" mode)

Extending the Patch Timer

When the user is notified by the controller that he has "30 seconds left", he may extend the patch timer with the Timer Extend command. Entering the Timer Extend command reloads the patch timer with the value defined by the repeater owner, allowing indefinite extension of the patch.

Command: (Patch Utility Prefix) *3

Example: Patch Utility Prefix = *
User sends "* *3" during patch after the controller
informed him that "30 seconds left", i.e. that the timer has
almost expired.
Controller says "Timer X" and reloads patch timer with
the Patch Timer Extend value.

Hints: The controller waits until the mobile is listening before saying,
"30 seconds left", to be sure he has an opportunity to
extend the timer.

Since the controller waits until the mobile is listening before
the warning, the actual patch duration may end up being
somewhat longer than the programmed patch timer <u>plus</u>
30 seconds.

The timer may be extended over and over, but no warning is
given before it times out again.

Related Commands:

Config   Patch Timer Extend Timer, Patch Utility Command
Prefix

Control Op   Patch Timer E/D

Loading and Erasing the User Loadable Autodialer

The Autopatch is convenient and reliable, but punching in all the numbers can
be tricky while you're zooming down the freeway. The autodialers allow quick,
easy access to frequently called numbers with just a few keys, instead of the
eight or more needed with the Autopatch. And the autodial numbers can be
loaded and changed remotely, so it's easy to keep up with new members and
users that move or want to add or delete numbers.

There are two banks of User Loadable Autodialer numbers - the first bank (Bank
0) holds locations 10-99, and the second bank (Bank 1) contains 100-199. Each
bank has its own load/erase command code prefix.

The phone number can be secured from readback when activating the autodialer
for security. The security option is selected when loading the number into
memory.

Even though the User Loadable Autodialer comes empty from the factory, first
ERASE a location, then LOAD a number into it. To erase a number, enter the
load/erase prefix followed by the location. To erase location 10, which is in the
first bank of numbers, the command is:

(prefix) 10

The controller responds with, "Autodial Cancel", and the location erased.

To load location 10 (first bank of autodial numbers) with the phone number
964-8034, the command is:

(prefix) 10 9648034

The controller responds to the command with, "Autodial write". From now on,
you can call location 10 with the User Loadable Autodial activate command.

Command: (User Loadable Autodial Load / Erase Prefix) (location)

Example: Autodial Bank 0 Load / Erase Prefix = 456
             User sends "456 40".
                 Controller says, "Autodial Cancel" and erases location 40.

**Command: (User Autodial L/E Prefix) (Location) (Phone Number)
             or (User Autodial L/E Prefix) * (Location) (Phone Number)
             [phone number secured from readback]**

Example: Autodial Bank 0 Load / Erase Prefix = 456
             User sends "456 40 9648034".
                 Controller says, "Autodial Write" and loads location 40
                 with the phone number 964-8034. Activating User
                 Loadable Autodialer allows phone number readback.

Example: Autodial Bank 1 Load/Erase Prefix = 457
             User sends "457 * 20 7498330".
                 Controller says, "Autodial Write" and loads location 120
                 with the phone number 749-8330. Activating User
                 Loadable Autodialer does not allow phone number
                 readback.

Hints: If you don't want users to be able to erase and change
             autodial numbers, either keep the autodialer locked
             with the Control Op command, or keep the L/E
             command code prefix secret.
             If an autodial location is secured from readback, the Control
             Op can bypass security option with User Autodialer
             Unhide mode.
             Write down what numbers are stored where so that you
             won't lose track of what's in the controller.

Related Commands:
   Config   User Loadable Autodial L/E Command Code Prefix,
                   Extended User Loadable Autodial L/E Command Code
                   Prefix
   Control Op   User Autodial Unlock / Lock, User Autodial Hide / Unhide
   User   User Loadable Autodialer Activate

Activating the User Loadable Autodialer
Phone numbers stored in the User Loadable Autodialer may be dialed by
entering the User Loadable Autodial command prefix followed by the autodial
location. To call location 10 (which is in Bank 0), enter:

        (prefix) 10

The controller responds with, "Autodial 10", pause, the phone number
"9648034", and pause. As with the Autopatch, briefly keying the mike at either
pause commands the controller to dial the number into the phone. If the Control
Op "Dial without click" mode is selected, the number will be dialed after the
second pause without needing to key the mike.

You can inhibit the phone number readback by clicking the mike at the first pause. Waiting until the second pause allows you to verify the contents on the autodial memory. You can also prevent phone number readback of an autodial slot by having selected the "security" option when loading the number into the User Loadable Autodialer. The Control Operator can bypass the security mode to allow verification of the numbers stored, if necessary, with the Unhide command.

If you've made a mistake entering the autodial command, you can cancel the request by entering any Touch-Tone during either pause, or by not clicking the mike if required.

Command: (User Loadable Autodial Prefix) (Location)

Example: User Loadable Autodial Prefix = *
User sends "* 40".
  Controller says "Autodial 40 (pause) nine six four eight zero three four", user clicks his mike at either pause and controller dials the number.

Hints: If you don't want your users to have to "click" their mikes to start dialing, selec the Control Operator "Dial without click" mode.
The Long Distance E/D Control Operator selection does not apply to the User Loadable Autodialer
One and three digit numbers can only be dialed from the User Loadable or Emergency Autodialers
The User Loadable Autodialer and Extended User Loadable Autodialer prefixes are totally independent. For example, they could be * and 9, or * and *1, or 94 and 95, or 3 and 697, etc.

Related Commands:
Config User Loadable Autodialer Timer, Patch Activity Timer, Patch Timer Extend Timer, User Loadable Autodialer Command Prefix, Extended User Loadable Autodialer Command Prefix, Touch-Tone/Dial-pulse signalling
Control Op User Loadable Autodial E/D, Patch Timer E/D, Cover Tone E/D/Always, Dial Needing / Without Click, User Loadable Autodial Hide / Unhide
User Patch Cover Tone, Patch Timer Extend, Patch Hangup, Patch Custom Hangup, Patch Redial

Activating the Emergency Autodialer
One hundred and ninety of the autodial numbers (location 10-199) are accessed with their prefix (Bank 0 or Bank 1) plus their two digit location number. But locations 0-9 are accessed with the Emergency Autodial Prefix followed by the location number. These autodial locations function somewhat differently in that the responses by the controller are not the locations and phone numbers, but are

programmable messages, like "Operator", "Fire", "Police", etc. These ten numbers are intended for emergency public service agencies, and the reponse indicates selection of the correct agency. The Emergency Autodialer does not require that the user click his mike to initiate telephone dialing. The patch is terminated just like the Autopatch and User Loadable Autodialer.

Command: (Emergency Autodial Prefix) (Location)

Example: Emergency Autodial Prefix = *
Emergency Autodial Location 1 Message = "Fire"
User sends "* 1".
   Controller says, "Fire", then dials the phone number
   stored in Emergency Autodial location 1. The user does
   not need to click his mike to emergency autodial.

Hint: It isn't necessary to click your mike to initiate dialing.
One and three digit numbers can only be dialed from the
   User Loadable or Emergency Autodialers.

Related Commands:
   Config   Autodial Service Messages, Emergency Autodial Timer,
   Patch Activity Timer, Patch Timer Extend Timer,
   Emergency Autodial Command Prefix, Emergency
   Autodial Numbers, Touch-Tone / Dial-pulse signalling
   Control Op   Emergency Autodialer E/D, Patch Timer E/D, Cover
   Tone E/D/Always
   User   Patch Cover Tone, Patch Timer Extend, Patch Hangup,
   Patch Custom Hangup, Patch Redial

Bringing Up the Reverse Patch From the Phone
The reverse patch may be activated by calling the controller on the phone. Three Control Op selectable modes are available.

Mode 0 operates as follows. The caller dials the repeater's phone number and the call is auto-answered with a programmable message such as "WA6AXX Repeater, Control". So far, the transmitter has not been affected, and users over the air are not aware of the call, except that they no longer have access to the Touch-Tone decoder (it's listening on the phone instead). The caller may then enter the reverse patch command, and the transmitter will activate with a "ring" signal to alert users that a call is waiting. The Touch-Tone decoder switches back to the receiver to await a user answering the reverse patch.

Mode 1 answers as in mode 0, but automatically starts to ring out after 5 seconds if no Touch-Tone command has been received. This mode allows callers without Touch-Tone phone to use the reverse patch while still allowing commands to be entered over the telephone.

Mode 2 causes the controller to ring out when a phone ring is detected, but the line is not answered until a repeater user enters the Reverse Patch Answer command over the air.

A special Telephone Access Paging mode is described in Appendix III and applies when DIP switch 7 is on. This mode is not intended for use in the Amateur service.

The following commands is relevent only in mode 0.

Command: (Reverse Patch Command)

Example: Reverse Patch Command = 1
Caller on the phone enters 1# (# is required as "command evaluation key" terminator on the phone). Controller activates transmitter and "rings" for one minute or until answered with Reverse Patch Answer command.

Hints: After the Reverse Patch Command is entered, the Touch-Tone decoder switches to the repeater receiver, so that the caller cannot enter additional Touch-Tone commands.
If you don't want to answer the reverse patch, the Patch Hangup command from over the air will terminate the ringout early.

Related Commnds:
 Config Phone Answer Message, Phone Answer Delay Timer, Autopatch Timer, Patch Activity Timer, Patch Timer Extend Timer, Reverse Patch Command Code (Patch Utilities Command Prefix), Patch Hangup Command Prefix
 Control Op Reverse Patch Enable / Disable, Patch Timer Enable / Disable, Cover Tone Disable/Enable/Always On, Reverse Patch Mode
 User Hangup, Custom Hangup, Cover Tone, Patch Timer Extend

Answering the Reverse Patch Over the Air

Repeater users over the air may answer a reverse patch call by entering the Reverse Patch Answer Command (which is simply the Patch Utility Command Prefix). After entering the command, the user must unkey in order to let the controller evaluate the command and connect the caller to the repeater.

Command: (Patch Utility Prefix)
Example: Patch Utility Prefix = *
User sends "*" while reverse patch is ringing.
Controller connects caller to the radio.

Hints: After entering the command, unkey and listen for telephone
             noise to be sure the patch is connected.
             When answering the reverse patch, identify yourself to the
             caller so that they will not be confused.

Related Commands:
   Config   Patch Utility Command Prefix, Autopatch Timer, Patch
                  Activity Timer, Patch Timer Extend Timer
   Control Op Reverse Patch E/D, Patch Timer E/D
   User   Hangup, Custom Hangup, Cover Tone, Patch Timer
                  Extend

Extending the Telephone Timer

When calling the repeater on the phone, the user may extend the telephone
timer from 15 seconds to two minutes. The command is effective only from the
telephone (nothing happens if entered over the air). This capability is useful
when calling to record or play back mail from the Digital Voice Recorder.

Command: (Telephone Timer Extend Command)

Example: Telephone Timer Extend Command = 0
             User calls the repeater on the phone to load voice mail
             into the Digital Voice Recorder. Controller answers the
             phone. User enters "0#" to extend the controller's timer.
             Controller says, "Two minutes". User may then activate the
             DVR mailbox. This command may be entered more than
             once if needed.

Reading Back Your Signal Strength

Assuming that an S-meter signal voltage is connected to the RC-85 controller,
users may interrogate their signal strength into the repeater. The controller
always measures the S-meter one-half second into each new transmission and
stores the reading. If the user happens to request his signal strength, the stored
reading is spoken in synthesized speech. The meter is calibrated in S units and
db from S0 to S9 plus 60.

Command: (S-meter Command)

Example: S-Meter Command = 8
             User's signal strength into the repeater is S9+20
             User keys down at least one half second and sends "8".
                 Controller says "S9 plus twenty".

Hint: Be sure to key down at least 1/2 second when entering the
                 command.

Related Command:
   Config   S-Meter Command Code

Commanding the Demo Messages and Bulletin Board

Users may call up several messages which may be programmed by the repeater owner to include information of interest to the users. They may also activate the various ID messages contained in the controller.

The response to the Bulletin Board 1 command would be the message stored in Bulletin Board 1, such as "Club meeting tomorrow at 8. See you at the meeting".

Command: (Demo Prefix) (0-8, *)

> **0 = Initial ID Message**
> **1 = Forced CW ID Message**
> **2 = Anxious ID Message**
> **3 = Pending ID Message 1**
> **4 = Pending ID Message 2**
> **5 = Pending ID Message 3**
> **6 = Special ID Message**
> **7 = Bulletin Board Message 1**
> **8 = Bulletin Board Message 2**
> *** = Firmware Revision Announcement**

Example: Demo Prefix = 3
User sends "3 *".
Controller says, "This is the Advanced Computer Controls RC-85 Repeater Controller, V3.0".

Related Commands:
Config	Demo Command Code Prefix
Control Op	User Command E/D

Bringing Up the Link / Remote Base

You may activate a link or remote base transceiver connected to the controller, allowing you to tie your repeater to other frequencies. The link may be activated in the listen only mode (repeater users monitor the link receiver but don't activate its transmitter), receive/transmit mode (users monitor its receiver and activate its transmitter when they talk into the repeater), and may be turned off.

In addition, users may change the frequency of the remote base transceiver with Touch-Tone commands so that they may link the repeater to any frequency.

The Link On Receive Only command brings up the link or remote in listen only mode. Signals received over the link transceiver bring up the repeater transmitter and are retransmitted over the repeater. Users may talk on the repeater, however, without interfering with the stations on the link frequency. Repeater users' audio overrides link audio to allow a conversation to take place in this mode.

The user may activate the link transmitter. Now repeater users are retransmitted over the link frequency and appear to listeners on the link frequency as any other user on that frequency. The link may be to other repeaters or to simplex frequencies.

Users may change the frequency of the transceiver by entering the desired frequency in a format similar to that of keyboard entry HT's, including provisions for selecting the transmit offset.

The Link Off command turns off receive and transmit capabilities of the link or remote base.

Several additional commands are available for control of the Kenwood TS-711A/ 811A remote base transceivers, if installed.

Commands:

(Link Prefix) 1	**Link On Receive Only**
(Link Prefix) 2	**Link On Receive / Transmit**
(Link Prefix) 3	**Link Off**
(Link Prefix) (mhtof)	**Link Frequency (MHz, hundreds kHz, tens kHz, ones kHz, xmit offset 1/minus, 2/simplex, 3/plus**
(Link Prefix) 4	**Kenwood mode FM**
(Link Prefix) 5	**Kenwood mode LSB**
(Link Prefix) 6	**Kenwood mode USB**
(Link Prefix) 7 00	**Kenwood subaudible tone off**
(Link Prefix) 7 (01-37)	**Kenwood subaudible tone on and frequency select**
(Link Prefix) * (01-40)	**Kenwood memory 1-40 recall**

Examples: Link Prefix = 7

User sends "7 1". Controller responds with current frequency and goes to receive only mode.

User sends "7 69401". Controller responds with "Six point nine four, minus" and programs remote base transceiver to 6.940 with minus transmit offset.

User sends "7 2". Controller responds with "Remote Base TX" and goes to transmit mode.

User sends "7 3". Controller responds with "Remote Base Off" and turns the remote base off.

User sends "7 4". Controller responds with "FM" and sets the Kenwood transceiver to FM mode.

User sends "7 7 00". Controller responds with "PL off" and turns off the subaudible encoder in the Kenwood transceiver.

User sends "7 7 10". Controller responds with "PL on" and turns on the subaudible encoder in the Kenwood transceiver to tone number 10.

User sends "7 * 15". Controller responds with "M" and recalls memory 15 in the Kenwood transceiver.

Hints: Return to VFO from memory operation by entering the
        frequency as mhtof.
        Subaudible tone and memory information are not stored
        in Macro Sets - only mhtof frequency.

Related Commands:
    Config   Link / Remote Base Command Code Prefix
    Control Op   User Command E/D

Unmuting Touch-Tone

At times it is desirable to pass Touch-Tone sequences through the repeater or
through to the phone line unmuted, without them being decoded by the RC-85
controller. For example, bringing up an autopatch on a repeater accessed
through the remote base would require passing tones through the controller to
the linked repeater. Another application would be passing a credit card number
or Sprint / MCI code through to the phone line.

Command: # (sequence)

Example: Pass MCI code and long distance phone number through to
        the phone line after an autopatch to the local MCI
        number.

        User sends "# 54321 408 555 1234" all during one
        transmission. Controller unmutes after the # and allows
        the MCI code and phone number to pass unmuted,
        while ignoring the sequence.

Hint: Be sure to send the # at the beginning of <u>each transmission</u>
        that you want unmuted.
        If you would like *all* Touch-Tones to be unmuted and
        would like the controller to decode the commands,
        use the Control Op selectable "Touch-Tone Unmute"
        mode.

Activating Pocket Pagers

The RC-85 controller can generate two-tone paging tones in response to Touch-
Tone commands entered from over the air or phone. These tones can activate
pocket pagers, and the capability offers an excellent selective calling system.
The tones are based on Motorola standard frequencies and timing. Both one
second / three second two-tone and eight second group call tones can be
generated.

The paging command consists of the paging prefix followed by the group number
and tone number of each of the two sequential tones.

Commands: (Paging Prefix)(A Group #)(A Tone #)(B Group #)(B Tone #)
        (Paging Prefix)(Group #)(Tone #) [group call]

Examples: Paging Prefix = xxx
> User sends xxxxx.
>> Controller sends two tone sequential tones, A tone Group #2 Tone #3 (669.9 Hz), B tone Group #1 Tone #5 (433.7 Hz).
> User sends xxx.
>> Controller sends eight second group call Group #3 Tone #6 (979.9 Hz).

Hints: When sent from the phone, the controller acknowledges with "PAGE", and waits for a break in a conversation over the air before sending the tones.

Related Commands:
>**Config** Paging Command Code Prefix
>**Control Op** User Command E/D

TWO-TONE SEQUENTIAL PAGING FREQUENCIES

TONE #	GROUP 1 CODE	FREQ	GROUP 2 CODE	FREQ	GROUP 3 CODE	FREQ	GROUP 4 CODE	FREQ	GROUP 5 CODE	FREQ	GROUP 6 CODE	FREQ
1	111	349.0	121	600.9	138	288.5	141	339.6	151	584.8	191	1153.4
2	112	368.5	122	634.5	108	296.5	142	358.6	152	617.4	192	1185.2
3	113	389.0	123	669.9	139	304.7	143	378.6	153	651.9	193	1217.8
4	114	410.8	124	707.3	109	313.0	144	399.8	154	688.3	194	1251.4
5	115	433.7	125	746.8	160	953.7	145	422.1	155	726.8	195	1285.8
6	116	457.9	126	788.5	130	979.9	146	445.7	156	767.4	196	1321.2
7	117	483.5	127	832.5	161	1006.9	147	470.5	157	810.2	197	1357.6
8	118	510.5	128	879.0	131	1034.7	148	496.8	158	855.5	198	1395.0
9	119	539.0	129	928.1	162	1063.2	149	524.6	159	903.2	199	1433.4
0	110	330.5	120	569.1	189	1092.4	140	321.7	150	553.9	190	1122.5

Taking the Touch-Tone Access Mode Up and Down

When the Touch-Tone Access Mode is enabled by the Control Op, users may bring the repeater up and down with the Touch-Tone Access command. TT Access is intended as an alternative to the need for PL.

Command: - - - [down]
> - - - [up]

Examples: Touch-Tone Access Mode Prefix = xxxx
> User sends "xxxx",
>> Repeater "goes to sleep" - i.e. TT Access down.
>> Repeater is effectively off.
> User sends "xxxx".
>> Repeater "wakes up".

Hints: The controller sends the Forced CW ID Message when going down, if necessary, to properly ID at the end of an exchange of transmissions.

When taken up, the Touch-Tone Access Mode Timer will take the repeater back down after a period of inactivity.

If in the Control Op selected PL Access Mode, Touch-Tone Access Up allows carrier access to the repeater. Touch-Tone Access Down or Disabled restores the need for PL to access the repeater.

Related Commands:
    Config   Touch-Tone Access Mode Timer, Touch-Tone Access Mode Command Code prefix
    Control Op Touch-Tone Access Mode E/D, PL Access

Activating the Spare Audio Function

Users may bring up an auxiliary audio source, such as a scanner, weather radio, etc. Entering the Spare Audio command causes the Spare Audio input to connect to the transmitter audio mixer and holds up the repeater transmitter PTT. The Spare Audio source may be shut off with #. A programmable timer is available to automatically shut down the Spare Audio function if a user forgets to turn it off.

Command: (Spare Audio Command)

Example: Spare Audio Command = 666
            User sends "666".
                Controller holds up transmitter and connects
                Spare / Link audio input to transmitter (turns off with #).

Hint: Avoid a single digit access command, because occasional Touch-Tone falsing could bring up the Spare Audio function.

Related Commands:
    Config   Spare Audio Command Code Prefix, Spare Audio Timer
    Control Op User Command E/D
    User   # Knockdown

Commanding the Remote Control Output Functions

Users may activate or interrogate up to eight remote control logic outputs (User Functions) from the controller. These outputs may be wired to various equipment in the repeater system for controlling high/low power, antenna selection, remote base band select, etc. In response to the command entry, the controller provides a high or low beep tone to indicate the current state of the output.

Certain of the UF outputs take on dedicated functions when various options are selected. For example, UF 3 becomes a Phone Line Busy output when in the Phone Line Shared mode. UF commands to dedicated outputs are ignored by the controller.

Commands: **(UF Prefix) (Output #1-8) (1 = on (low), 0 = off (high))**
(UF Prefix) (Output #1-8) [interrogate]

Examples: UF Prefix = 9
User sends "9 3 0".
Controller sends low tone, and output #3 turns off.
User sends "9 2 1".
Controller sends high tone, and output #2 turns on.
User sends "9 3".
Controller sends low tone, confirming off state.

Hints: See Chapter 8 for details of remote control logic output function.
Commands to UF 3 would be ignored when the Phone Line Shared mode is selected.
The UF output logic sense may be inverted with the UF Logic Sense Configuration command - i.e. high beep / "1" = output on, or low.

Related Commands:
Config User Function Logic Output Command Prefix, UF Logic Sense
Control Op User Command E/D

Chapter 6
How to Be a Control Operator

Contents

Introduction
This chapter describes the Touch-Tone commands available to the repeater's Control Operators.

Control Operator Commands
The Control Op commands permit enabling and disabling the various functions and selection of various operating modes. The Control Op command codes consist of a **prefix** which is remote programmable by the repeater owner (Control Op Command Code Prefix), followed by a one or two digit **root code** defined below and summarized in Appendix I. The prefix may be defined to be between one and seven digits, so that the Control Op commands may be between two and nine digits. The entire command is entered as one sequence, i.e. prefix-root as one transmission over the air, or prefix-root-# over the phone (# is required as the command evaluaton key over the phone).

The controller responds to each Control Op command with a unique response message so that the Control Op knows for sure that he entered the correct command. The format used for command description is as follows:

root code   response message   **command name(†)**   Command description

The † which follows many of the command names indicates that the command selection is stored in the Control Op Macro Sets.

Macro Set Selection Commands

Four commands allow "macro" selection of Control Op Command Macro Set 1, 2, 3 or 4. Each macro set stores the entire array of Control Op selections designated below with the †. The macro sets are stored by the repeater owner using the Store Macro Set Configuration commands. The macro sets also store the user selected state of the link / remote base, and the states of the eight User Function remote control logic outputs.

1	M1	**Macro Set 1 Select**	Selects Control Op Macro Set #1.
2	M2	**Macro Set 2 Select**	Selects Control Op Macro Set #2.
3	M3	**Macro Set 3 Select**	Selects Control Op Macro Set #3.
4	M4	**Macro Set 4 Select**	Selects Control Op Macro Set #4.

Example: Control Op Prefix = 123
Enter "123 2" to select Macro Set 2

Hints: The controller powers up and resets to Macro Set #1.
Macro sets simplify the work of the Control Op by requiring only a single command to carry out many routine Control Op chores.

Repeater Enable / Disable Commands

Two commands allow the Control Op to enable or disable the repeater's transmitter.

00	RE	**Repeater Enable**†	Enables repeater transmitter.
01	RD	**Repeater Disable**†	Disables repeater transmitter.

Example: Control Op Prefix = 3749101
Enter 3749101 01 to disable the repeater.

Hints: These commands are the repeater's "Big Switch".
While disabled, user commands are not recognized, but Control Op and Configuration commands are.

Repeater Timer Commands

Five commands affect the repeater's timeout timer, or "alligator". The Control Op may enable or disable the timeout timer and select one of two different timeout periods previously defined by the repeater owner with Configuration commands. Finally, the Control Op may clear the timer, either in anticipation of a station timing out the repeater, or after the repeater has been timed out. The timeout timer automatically clears after the signal timing it out goes away.

02	TE	**Repeater Timer Enable†**	Enables repeater timeout timer.
03	TD	**Repeater Timer Disable†**	Disables repeater timeout timer.
04	TL	**Repeater Timer Long†**	Selects long timeout timer.
05	TS	**Repeater Timer Short†**	Selects short timeout timer.
06	TC	**Clear Repeater Timer**	Cancels existing timeout condition, clears timeout timer.

Hint: If a carrier times out the repeater and remains present, the Control Op can clear the repeater timer if he can capture the other signal, but he must terminate the command with the "D" key to force a command evaluation over the air.

Access / Control Commands

The Control Op may select from four different carrier / PL operation modes and a Touch-Tone access mode. PL operation relies on an active high logic signal from an external PL decoder indicating to the controller that subaudible tone is present on a signal at the receiver.

The "Carrier Access / Control" mode allows full access and control without the need for PL. "PL Control Op Command" mode allows carrier access to the repeater, and carrier only for operating User commands, but requires PL for activation of Control Op (and Configuration) commands. "PL Control Op / User Command" mode requires PL for activation of User, Control Op, or Configuration commands, but allows carrier access to the repeater. Finally, "PL Access" requires PL for any level of control and for access to the repeater.

Touch-Tone access is brought up and down by the Touch-Tone Access User commands, and the Touch-Tone Access timer may automatically take the repeater down after a period of inactivity. When the mode is disabled by the Control Op, the Touch-Tone Access User commands have no effect.

07	CA	**Carrier Access / Control†**	Enables carrier access and control.
08	PC	**PL Control Op Command†**	Enables carrier access, PL required for Control Operator Touch-Tone commands.
09	PU	**PL Control Op / User Cmd†**	Enables carrier access, PL required for Control Op and User commands.
10	PL	**PL Access†**	PL required for access and control.
52	ME	**TT Access Mode Enable†**	Enables Touch-Tone Access Mode.
53	MD	**TT Access Mode Disable†**	Disables Touch-Tone Access Mode.

Hints: CA, PC, PU, and PL are mutually exclusive.
ME and MD are mutually exclusive, but TT Access may be enabled (ME) along with CA/PC/PU/PL condition.
When in PL Access, TT Access overrides the need to PL for access, and is an optional alternative to the need for PL.

User Command Enable / Disable Commands

The Control Op may enable or disable the User Command level. The disable command disables all Users Commands *except the Emergency Autodialer*, which may be left enabled while all other User Commands are disabled. The Pad Test Disable command allows just the Touch-Tone pad test to be shut off.

11	CE	**User Command Enable†**	Enables User Touch-Tone commands.
12	CD	**User Command Disable†**	Disables User Touch-Tone commands.
41	TE	**Pad Test Enable†**	Enables Touch-Tone Pad Test.
42	TD	**Pad Test Disable†**	Disables Touch-Tone Pad Test.

Hint: Disable the Emergency Autodialer as well as User
                      Commands to shut off all User class commands.

Link Enable / Disable Commands

The Control Op may enable or disable the link or remote base with these commands. When disabled, the Link User commands have no effect.

13	LE	**Link Enable†**	Enables link / remote base.
14	LD	**Link Disable†**	Disables link / remote base.

Hint: The Link frequency and mode, which are User command
                      functions, are also stored in the Macro Sets so that
                      selecting a Macro Set can enable the link and bring it up
                      on a certain frequency in receive only or receive / transmit.

Autopatch / Autodial Commands

The Control Op may enable or disable independently the Autopatch, User Loadable Autodialer, and Emergency Autodialer. When disabled, the related user command codes are ignored by the controller. Long distance may be enabled or disabled. When disabled, phone numbers with a leading zero or one, or longer than seven digits are not permitted by the Autopatch. The User Loadable Autodialer may be locked, which prevents erasing or loading phone numbers.

The patch timer, which includes the overall timer and the activity timer, may be enabled or disabled. (Seperate overall timer values are permitted for the Autopatch and each Autodialer, and for the activity timer.) The patch Cover Tone may be selected for all calls, may be shut off, or may be left user selectable (with the Patch Cover Tone User Command on a call by call basis).

The user may be required to click his mike to initiate Autopatch and User Loadable Autodial calls, or the controller may be set to "Dial Without Click". User Loadable Autodial phone number readback may be enabled by the Control Op even for phone numbers loaded with the security option - i.e. the numbers may be "unhidden".

The Control Op Offhook command performs one of two functions.
(1) When entered over the air, it activates the patch without regenerating signalling into the phone. The Control Op may then send tones directly into the phone.
(2) Entered over the phone after calling into the repeater, this command places the Control Op on the air. The Control Op keeps the Touch-Tone decoder on the phone and is responsible for hanging up. The patch timers protect against forgetting to enter the Hangup command.

The Control Op Onhook command may be used to hang up after calling the controller on the phone for a command session, or following the Offhook command. The Patch Hangup User Command (followed by a # over the phone) will also place the phone back on hook. The Onhook command may be used over the air to hang up the patch in case a user has defined a custom hangup code and forgotten the code he defined.

19	PE	**Autopatch Enable**†	Enables Autopatch.
20	PD	**Autopatch Disable**†	Disables Autopatch.
27	LE	**Long Distance Enable**†	Enables Autopatch long distance.
28	LD	**Long Distance Disable**†	Disables Autopatch long distance.
21	UE	**User Autodial Enable**†	Enables User Loadable Autodialer.
22	UD	**User Autodial Disable**†	Disables User Loadable Autodialer.
47	AU	**User Autodial Unlock**†	Unlocks User Loadable Autodialer.
48	AL	**User Autodial Lock**†	Locks User Loadable Autodialer.
57	UU	**User Autodial Unhide**†	Allows numbers loaded with security option to be read back.
58	UH	**User Autodial Hide**†	Allows numbers loaded with security option to remain hidden.
23	EE	**Emergency Autodial Enable**†	Enables Emergency Autodialer.
24	ED	**Emergency Autodial Disable**†	Disables Emergency Autodialer.
59	XC	**Dial Without Click**†	Enables dialing with user click.
60	NC	**Dial Needing Click**†	Requires user click to initiate dialing.
25	PT	**Patch Timer Enable**†	Enables patch overall and activity timers.
26	PX	**Patch Timer Disable**†	Disables patch timers.
49	TD	**Cover Tone Disable**†	Disables patch cover tone.
50	TE	**Cover Tone Enable**†	Enables patch cover tone - user selected.
51	TA	**Cover Tone Always On**†	Selects patch cover tone for all patches.
43	- -	**Control Op Offhook**	"Manually" takes phone offhook.
44	- -	**Control Op Onhook**	Places phone onhook (hangup)

Hints: When controlling from the phone, hang up with Control Op Onhook.

If someone forgets his custom hangup code, hang up with Control Op Onhook.

Emergency Autodial never requires user to click his mike to initiate dialing.

Disabling all patch timers can be *dangerous.*

Reverse Patch Commands

These commands allow the Control Op to enable or disable the Reverse Patch.
He may also select from one of three Reverse Patch modes.

45	XE	**Reverse Patch Enable†**	Enables the Reverse Patch.
46	XD	**Reverse Patch Disable†**	Disables the Reverse Patch.
54	R0	**Reverse Patch Mode 0†**	Selects phone line control / reverse patch.
55	R1	**Reverse Patch Mode 1†**	Selects auto-ringout after 5 seconds.
56	R2	**Reverse Patch Mode 2†**	Selects auto-ringout without answering.

Warning: One or more Reverse Patch modes may not be legal in the Amateur service.

ID Commands

The Control Op may select which ID messages are generated at Pending ID
times. Any of the Pending ID messages or the Special ID message may be
generated at each Pending ID time, or the controller may rotate between the
three Pending ID messages, or between the three Pending ID and the Special ID
messages.

29	P1	**Pending ID 1†**	Selects Pending ID 1.
30	P2	**Pending ID 2†**	Selects Pending ID 2.
31	P3	**Pending ID 3†**	Selects Pending ID 3.
32	SP	**Special ID†**	Selects Special ID.
33	RP	**Rotate Pending IDs†**	Rotates Pending ID 1-2-3.
34	RS	**Rotate Pending-Special IDs†**	Rotates Pending ID 1-2-3 - Special ID

Hint: These commands are mutually exclusive - only one is in effect at a time.

Tail Message Commands

The Control Op may select from three remotely programmable tail messages to
be generated occasionally just before the repeater carrier is allowed to drop. He
may also disable the tail message function. Tail messages are useful as
reminders of events to users, or to indicate repeater status or emergency
conditions.

35	T1	**Tail Message 1†**	Selects Tail Message 1.
36	T2	**Tail Message 2†**	Selects Tail Message 2.
37	T3	**Tail Message 3†**	Selects Tail Message 3.
38	TF	**Tail Message Off†**	Disables Tail Messages.

Hint: These commands are mutually exclusive - only one is in effect at a time.

Alarm Enable / Disable Commands
The Alarm Enable command arms the site alarm. Disabling the alarm clears an alarm condition latched into the controller and prevents further alarm activation until reenabled.

00	RE	**Alarm Enable**†	Enables site alarm.
15	AD	**Alarm Disable**†	Disables site alarm.

Hint: The Alarm Enable is the same as the Repeater Enable command.

Speech Synthesizer Commands
The Control Op may enable or disable the speech synthesizer. The Speech Enable command may reenable the synthesizer after a hardware fault or programming error which results in automatic disabling of the synthesizer. The Speech Disable command is available if the Control Op would like to temporarily shut off speech and revert to Morse code exclusively.

Normally, speech responses are interrupted by a signal at the receiver. The Force Speech Talkover command allows synthesized speech to sound on top of incoming user signals.

16	SE	**Speech Enable**†	Enables speech synthesizer.
17	SD	**Speech Disable**†	Disables (turns off) speech synthesizer.
39	SI	**Allow Speech Interrupt**†	Speech halted by user signal.
40	SO	**Force Speech Talkover**†	Speech overrides user signal.

Note: When speech is disabled, the Forced CW ID is generated in place of the other ID messages. Other command responses may not completely convert from speech to Morse, so operation in Speech Disable mode should be limited to special circumstances.

Kerchunker Filter Enable / Disable
The Kerchunker filter may be enabled or disabled.

61	KE	**Kerchunker Filter Enable**†	Enables kerchunker filter.
62	KD	**Kerchunker Filter Disable**†	Disables kerchunker filter.

Touch-Tone Mute / Unmute
The Control Op may cause Touch-Tone to be normally unmuted, although the keys will be evaluated by the command decoder. Unmuting Touch-Tone can be useful to hear tones being sent, to pass tones through to other control systems listening on channel (such as ShackMaster), etc.

63	TM	**Touch-Tone Mute**†	Touch-Tone normally muted.
64	TU	**Touch-Tone Unmute**†	Touch-Tone unmuted.

Zero Hang Time Mode Enable / Disable

A user transmission is normally followed by a Courtesy Tone and a programmable hang time. The hang time may be forced to zero so that the repeater transmitter directly follows the received signal. This mode can be useful for operating a ShackMaster station located at someone's home and for other purposes.

65	ZD	**Zero Hang Time Disable†**	Disables zero hang time.
66	ZE	**Zero Hang Time Enable†**	Enables zero hang time.

Low Courtesy Tone Select

The courtesy tone generated when the Courtesy Tone Select logic input is in the low state may be Control Op selected. (The logic input is internally pulled low so that if nothing is connected, it is in the low state.) This makes it possible for the Courtesy Tone to indicate which Macro Set is selected while allowing a hardware override to the CT input high tone.

70-79	CT	**Courtesy Tone Low Select†**	Selects CT0-9 for the CT logic input low state.

Initialize Command

The Initialize command causes the computer to perform a "soft restart", and is generally equivalent to pressing the reset button. The command initializes the state of the board and loads Control Op Macro Set #1

18	- -	**Reset**	Initializes microprocessor.

Chapter 7
Programming the Controller

Contents

Introduction

This chapter describes how the RC-85 repeater controller is remotely programmed by the repeater owner to customize many of its characteristics. The controller is programmed with Configuration commands which may be entered when the controller is unlocked. These commands cause information to be stored in the controller's non-volatile memory so that the information isn't lost if power fails. The various types of Configuration commands are described with examples shown.

Configuration Commands

Configuration commands allow remote Touch-Tone programming of the controller. They are accessed by placing the controller into a special "unlocked' mode where only Configuration commands are recognized. Unlocking the controller requires an "unlock command" unique to the controller, providing security against tampering. When entry of a series of Configuration commands is completed, the controller is "locked" up again for normal operation so that it's secure from unintended changes.

Unlocking and Locking

The controller normally operates in the "locked" mode where Configuration commands are protected and not accessible. To access the Configuration commands to make remote changes to the messages, timers, command codes, etc., the controller must be unlocked.

The "unlock code" is programmed by the repeater owner and can start with any key except 5, #, or D. The remainder of the code can contain any keys except # or D. If it becomes necessary to change the unlock code for security, it may be changed whenever necessary to any ten digit code, but it must be done at the site.

While the controller is unlocked, the "UL" prompt indicates that it is waiting for valid Configuration commands. Each entry of a valid command reloads the one minute unlock timer. If the timer times out, the controller automatically locks back up.

The controller is normally locked back up after a series of Configuration commands with the # key (## over the phone).

Programming the Unlock Code

The repeater owner may program his favorite ten digit sequence as the controllers unlock code. Simply flip DIP switch 8 "ON" and enter the desired ten digit Touch-Tone unlock code over any of the command channels. The controller writes the code into its non-volatile memory and responds by saying, "UL PGM". DIP switch 8 should be turned "OFF", and from then on the controller may be unlocked by entering the specified ten digit code (followed by # over the phone).

The ten digit code should not begin with 5 (Touch-Tone Pad Test prefix) and should not contain # or D.

Be sure to turn off DIP switch 8 after entering the desired unlock code.

Messages

Most of the Morse code and synthesized speech messages are remotely programmable, including IDs, tail messages, Emergency Autodial responses, telephone answer and hangup messages, alarm message, and two Bulletin Board messages.

Messages may only be entered or changed while the controller is unlocked. The message to be edited is selected with the appropriate Touch-Tone Configuration command. Then the message is entered based on Morse code character or speech vocabulary Touch-Tone representation, shown below.

Codes for Morse code and speech letters and numbers are based on their position on a telephone keypad. The first digit of the code indicates what button the letter appears on, and the second digit indicates whether it's the first, second, or third letter on the key. The letters Q and Z are represented by 70 and 90. Numbers are represented by 00 through 09. This logical layout makes it easy to enter letters and numbers with the Message Editor without having to look up the codes.

The additional synthesized speech vocabulary and Morse code punctuation characters are assigned two and four digit codes shown in the tables below.

Message Editor Commands

(see Chapter 7 - "Programming the Controller", for details)

Store Message in Memory	*0	(after completed editing a message)
Delete Last Character	*1	(to erase a mistaken character)
Read Back Message	*2	(to check what you've entered so far)
Abort Message Editor	*4	(to return to "UL" level without storing the message in memory)

Morse Code Character Codes

A	21	N	62	0	00	–		10
B	22	O	63	1	01	word	space	11
C	23	P	71	2	02	/		12
D	31	Q	70	3	03	AR		13
E	32	R	72	4	04	:		14
F	33	S	73	5	05	?		20
G	41	T	81	6	06	;		24
H	42	U	82	7	07	,		30
I	43	V	83	8	08	.		40
J	51	W	91	9	09	(		50
K	52	X	92			SK		60
L	53	Y	93			AS		80
M	61	Z	90					
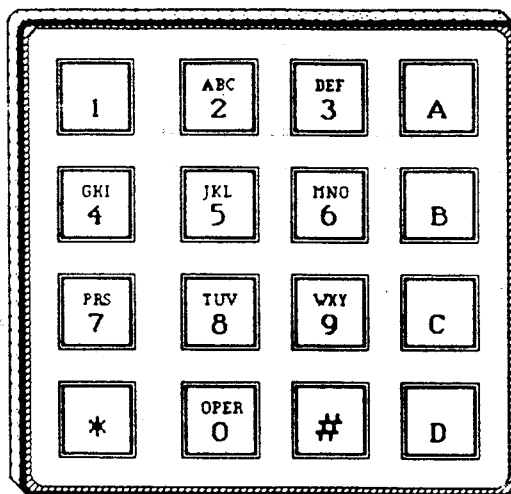
Examples: W = 91
3 = 03

Speech Synthesizer Vocabulary Codes

Word	Code	Word	Code	Word	Code	Word	Code
A	21	CENTER	*161	ESTIMATED	*212	HOME	*615
A.M.	*110	CHANGE	*875	EVACUATE	*213	HOTEL	*642
ABORT	*992	CHARLIE	*623	EVACUATION	*214	HOUR	*261
ABOUT	*855	CHECK	*865	EXIT	*761	HOURS	*655
ABOVE	*112	CIRCUIT	*720	EXPECT	*215	HUNDRED	*640
ACKNOWLEDGE	*114	CLEAR	*163				
ACTION	*115	CLIMB	*165	F	33	I	43
ADJUST	*944	CLOCK	*945	FAIL	*755	ICE	*262
ADVANCED	*916	CLOSED	*166	FAILURE	*216	ICING	*263
ADVISE	*116	CLUB	*926	FARENHEIT	*217	IDENTIFY	*264
AERIAL	*117	CODE	75	FAST	*925	IGNITE	*266
AFFIRMATIVE	*118	COME	*167	FEBRUARY	*218	IGNITION	*267
AIR	*120	COMPLETE	*721	FEET	15	IMMEDIATELY	*268
AIRPORT	*122	COMPUTER	*927	FIF-	50	IN	*270
ALERT	40	CONDITION	*168	FILED	*223	INBOUND	*271
ALL	*685	CONGRATULATIONS		FINAL	*224	INCH	*964
ALOFT	*124		*170	FIRE	*634	INCREASE	*272
ALPHA	*621	CONNECT	*940	FIRST	*225	INCREASING TO	*274
ALTERNATE	*125	CONTACT	*171	FIVE	05	INDIA	*643
ALTITUDE	*127	CONTROL	*624	FLAPS	*227	INDICATED	*275
AMATEUR	*917	CONVERGING	*172	FLIGHT	*228	INFLIGHT	*276
AMPS	*831	COUNT	*173	FLOW	*960	INFORMATION	*996
AND	74	COURSE	*174	FOG	*230	-ING (suffix)	*948
ANSWER	*128	CROSSWIND	*175	FOR	*231	INNER	*277
APRIL	*131	CURRENT	*177	FOUR	04	INSPECTOR	*785
AREA	*713	CYCLE	*951	FOURTH	*234	INTRUDER	*764
ARRIVAL	*132			FOXTROT	*633	IS	*733
AS	*133	D	31	FREEDOM	*235	IT	*281
AT	*742	DANGER	*712	FREEZING	*236		
AUGUST	*135	DAYS	*952	FREQUENCY	*610	J	51
AUTO	*918	DAYTON	*928	FRIDAY	*237	JANUARY	*282
AUTOMATIC	*741	DECEMBER	*181	FROM	64	JULIET	*651
AUTOPILOT	*136	DECREASE	*182	FRONT	*238	JULY	*283
AUXILIARY	*137	DECREASING	*183	FULL	*241	JUNE	*284
		DEGREES	*722				
B	22	DELTA	*631	G	41	K	52
BAND	*138	DEPARTURE	*185	GALLONS	*991	KEY	*285
BANK	*140	DIAL	*936	GATE	*845	KILO	*652
BASE	*141	DINNER	*186	GEAR	*244	KNOTS	*286
BATTERY	*142	DIRECTION	*752	GET	*962		
BELOW	*143	DISPLAY	*954	GLIDE	*245	L	53
BETWEEN	*660	DOOR	*955	GO	*895	LAND	*287
BLOWING	*144	DOWN	*654	GOLF	*641	LANDING	*288
BOARD	*145	DOWNWIND	*188	GREEN	*762	LATE	*956
BOOST	*146	DRIVE	*190	GROUND	*248	LAUNCH	*291
BOZO	*147	DRIZZLE	*191	GUSTING TO	*250	LEAN	*292
BRAKE	*148	DUST	*192			LEFT	*770
BRAVO	*622			H	42	LEG	*293
BREAK	*743	E	32	HAIL	*251	LESS THAN	*294
BROKEN	*151	EAST	*754	HALF	*252	LEVEL	*295
BUTTON	*993	ECHO	*632	HAM	*938	LIGHT	*934
BY	*152	-ED (suffix)	*193	HAMFEST	*946	LIMA	*653
		EIGHT	08	HAMVENTION	*947	LINE	*942
C	23			HAVE	*253	LINK	*998
CABIN	*153	ELEVATION	*196	HAZARDOUS	*254	LIST	*296
CALIBRATE	*735	ELEVEN	11	HAZE	*255	LOCK	*297
CALL	*751	EMERGENCY	*937	HEAVY	*257	LONG	*298
CALLING	*155	ENGINE	*198	HELP	*258	LOOK	*957
CALM	*156	ENTER	*955	HENRY	*260	LOW	*771
CANCEL	*664	EQUAL	*893	HERTZ	*684	LOWER	*310
CAUTION	*711	-ER (suffix)	*210	HIGH	*763	LUNCH	*311
CEILING	*158	ERROR	*211	HOLD	*963		

Word	Code	Word	Code	Word	Code	Word	Code
M	61	P	71	SEPTEMBER	*398	TOUCHDOWN	*458
MACHINE	84	P.M.	*358	SEQUENCE	*410	TOWER	*460
MAINTAIN	*312	PAPA	*671	SERVICE	*723	TRAFFIC	*461
MANUAL	*965	PARTIALLY	*361	SET	*885	TRANSMIT	*462
MARCH	*313	PASS	*774	SEVEN	07	TRIM	*463
MARKER	*314	PATCH	*966	SEVERE	*413	TUESDAY	*464
MAY	*315	PATH	*362	SEXY	*414	TURBULENCE	*465
MAYDAY	*316	PER	*364	SHORT	*415	TURN	*990
ME	*920	PERCENT	*675	SHOWERS	*416	TWELVE	12
MEAN	*317	PHONE	*914	SHUT	*765	TWENTY	20
MEASURE	*970	PLEASE	*967	SIDE	*417	TWO	02
MEETING	35	PLUS	*611	SIERRA	*673	-TY (suffix)	60
MEGA	*680	POINT	*674	SIGHT	*418		
MESSAGES	*625	POLICE	*968	SIX	06	U	82
METER	*620	POSITION	*780	SLEET	*423	UNDER	*775
MIKE	*661	POWER	*714	SLOPE	*424	UNIFORM	*682
MILES	*322	PRACTICE	85	SLOW	*983	UNIT	*715
MILLI	*825	PRESS	*781	SMOKE	*795	UNLIMITED	*467
MILLION	*323	PRESSURE	*935	SNOW	*425	UNTIL	*468
MINUS	*612	PRIVATE	*366	SOUTH	*790	UP	*650
MINUTES	*645	PROBE	*975	SPEED	*984	USE (noun)	*470
MIST	*324	PROGRAMMING	*367	SPRAY	*427	USE (verb)	*471
MOBILE	*958	PULL	*980	SQUAWK	*428		
MODERATE	*326	PUSH	*977	STALL	*431	V	83
MONDAY	*327			START	*730	VALLEY	*986
MONTH	*328			STOP	*731	VARIABLE	*473
MORE THAN	*330	Q	70	STORM	*433	VERIFY	*475
MOTOR	*972	QUEBEC	*670	SUNDAY	*434	VICTOR	*683
MOVE	*973			SWITCH	*725	VISIBILITY	*476
MUCH	*332			SYSTEM	*997	VOLTS	*750
		R	72				
		RADIO	*976				
N	62	RAIN	*374	T	81	W	91
NEAR	*333	RAISE	*375	TANGO	*681	WAIT	54
NEGATIVE	*334	RANGE	*981	TANK	*435	WAKE	*477
NET	25	RATE	*376	TARGET	*436	WAKE UP	*478
NEW	*335	READY	*783	TAXI	*437	WARNING	*480
NEXT	*336	REAR	*377	-TEEN (suffix)	14	WATCH	*481
NIGHT	*337	RECEIVE	*378	TELEPHONE	*438	WATTS	*815
NINE	09	RED	*744	TEMPERATURE	*724	WAY	*482
NO	*342	RELEASE	*381	TEN	10	WEATHER	95
NORTH	*772	REMARK	*382	TERMINAL	*440	WEDNESDAY	*484
NOT	*695	REMOTE	*910	TEST	*792	WELCOME	*913
NOVEMBER	*662	REPAIR	*745	-TH (suffix)	*441	WEST	*793
NUMBER	*734	REPEAT	*982	THANK YOU	*978	WHISKEY	*691
		REPEATER	80	THAT	*442	WILL	*912
O	63	RICH	*383	THE	24	WIND	*487
OBSCURED	*344	RIG	*384	THE (long e)	*443	WITH	*490
O'CLOCK	*345	RIGHT	*665	THE (short e)	*444	WRONG	*491
OCTOBER	*346	ROAD	*385	THIR-	13 or 30		
OF	*694	ROGER	*386	THIRD	*447	X	92
OFF	*614	ROMEO	*672	THIRTEEN	*448	X-RAY	*692
OHIO	*348	ROUTE	*388	THIS	*451		
OHMS	*933	RUNWAY	*390	THIS IS	65	Y	93
OIL	*350			THOUSAND	*644	YANKEE	*693
ON	*613			THREE	03	YELLOW	*794
ONE	01	S	73	THUNDERSTORMS	*452	YESTERDAY	*492
OPEN	94	-S (suffix)	*915	THURSDAY	*453	YOU	*493
OPERATION	*352	SAFE	*784	TIME	44	YOUR	*987
OPERATOR	*630	SAND	*391	TIMER	*732		
OSCAR	*663	SANTA CLARA	*392	TO	*455	Z	90
OTHER	*353	SATURDAY	*393	TODAY	*456	ZED	*988
OUT	*740	SCATTERED	*394	TOMORROW	55	ZERO	00
OUTER	*355	SECOND	*395	TONIGHT	45	ZONE	*494
OVER	*773	SECONDS	*635	TOOL	*985	ZULU	*690
OVERCAST	*356	SECURITY	*396	TORNADO	*457		
		SELECT	*397				

Several Message Editor **commands** control its operation:

Store Message in Memory - When you've completed editing the message and it's correct, it may be stored in the controller's non-volatile memory by entering *0 (*0# over the phone). There will be a brief delay as it's programming the E²PROM, then the controller will announce, "Write, UL", indicating a successful write operation and that it's ready for the next Configuration command.

Delete Last Character - If you make a mistake in entering a word or character, the last character entered can be deleted (i.e. backspace or rubout) with *1 (*1# over the phone). The deleted character is read back for confirmation. One character at a time can be deleted.

Read Back Message - At any time while editing a message, you can read back what's been entered so far with *2 (*2# over the phone). With long messages, it's a good idea to enter a few characters at a time and occasionally read back the entire message to verify that what you intended is what you've entered.

Abort Message Editor - At any time while editing a message, you can abort the operation without storing the message with *4 (*4# over the phone) and return to the "UL" prompt, ready to accept additional Configuraton commands or to lock up the controller.

To illustrate, here are two editing examples - a Morse code ID, for the Forced CW ID Message, and a speech Bulletin Board message. First, if the controller is not already unlocked, enter the unlock command. Then select the message to be edited with the command *1001 (*1001# over the phone). The controller responds by saying, "FI" to confirm selection of the Forced CW ID Message. Now you can enter the message you wish with Touch-Tone digits representing the characters you want. When you've entered the message, you can command it to be written into memory, and you're ready for the next Configuration command.

Example: Forced CW ID Message = "WA6AXX/R"

ENTER	RESPONSE	COMMENT
(unlock code)	UL	Unlock the controller
*1001	FI	Select Forced CW ID Message
912106	WA6 (cw)	Enter a few characters at a time
219292	AXX (cw)	
1271	/P (cw)	Woe! Error
*1	P (cw)	Delete last character
72	R (cw)	Enter correct character
*2	WA6AXX/R (cw)	Read back message
*0	Write	Store message in memory
	UL	Ready for next Configuration command

The next example is a synthesized speech message. You'll load the Bulletin Board Message #1 with "See you at the meeting tonight. Call AXX for INFO. 73."

ENTER	**RESPONSE**	**COMMENT**
(unlock code)	UL	Unlock the controller
*1123	B1	Select Bulletin Board #1 Message
2382*74224	See you at the	Enter a few characters at a time
354534	meeting tonight (pause)	
*75121929204	Call AXX for	
43623363	INFO	
34076003	(pause) 73.	
*2	See you at the meeting tonight. Call	
	AXX for INFO. 73.	
*0	Write	Store message in memory
	UL	Ready for next Config. command

Note that the *1 Delete Last Character command causes the last character entered to be deleted after it is read back to acknowledge. The *2 Read Back Message may be used at any time to read back what has been entered so far. The *4 Abort command would return you to the unlock command level, allowing you to quit without storing the message that you're editing.

Command		**Message Name**	**Response**	**Max # of**
Morse	**Speech**			**Characters**
*1000	***1100**	**Initial ID**	II	20
*1001	**- - - -**	**Forced CW ID**	FI	12
*1002	***1102**	**Anxious ID**	AI	12
*1003	***1103**	**Pending ID 1**	P1	24
*1004	***1104**	**Pending ID 2**	P2	24
*1005	***1105**	**Pending ID 3**	P3	24
*1006	***1106**	**Special ID**	SI	48
*1007	***1107**	**Tail Message 1**	T1	8
*1008	***1108**	**Tail Message 2**	T2	8
*1009	***1109**	**Tail Message 3**	T3	8
*1010	***1110**	**Autodial 0 Service**	E0	6
*1011	***1111**	**Autodial 1 Service**	E1	6
*1012	***1112**	**Autodial 2 Service**	E2	6
*1013	***1113**	**Autodial 3 Service**	E3	6
*1014	***1114**	**Autodial 4 Service**	E4	6
*1015	***1115**	**Autodial 5 Service**	E5	6
*1016	***1116**	**Autodial 6 Service**	E6	6
*1017	***1117**	**Autodial 7 Service**	E7	6
*1018	***1118**	**Autodial 8 Service**	E8	6
*1019	***1119**	**Autodial 9 Service**	E9	6
*1020	***1120**	**Phone Answer**	PH	16
*1021	***1121**	**Phone Hangup**	HG	8
*1022	***1122**	**Alarm**	AL	8
*1023	***1123**	**Bulletin Board #1**	B1	32
*1024	***1124**	**Bulletin Board #2**	B2	32
- - - -	***1125**	**Patch Dialing Prefix**	DX	6

(Each message may be either Morse *or* speech - there is one slot per message.)

Hints: Most vocabulary words occupy one character slot. Words beginning with *1, *2, *3, *4 or *9 occupy *two* character slots.

The Patch Dialing Prefix is not a message per se, but is the telephone dialing string that may precede all phone patches. For example, if the controller is connected to a PBX, it may be necessary to dial "9 pause" before all calls. Load speech "9 (pause)" into this message.

An *external tape player* may be addressed from any programmable message by selecting the message with the command "*1<u>3</u>XX" and loading the message with the speech letter "X". For example, to have Bulletin Board #2 address the external tape player, enter the command "*1324" and load the character "X" (92), then write the message into memory. See Chapter 8 for details of interfacing the external tape player.

Digital Voice Recorder tracks may be addressed from any programmable message. See Chapter 8 and the DVR manual for details.

Tone Parameters

The Morse code speed and pitch and the Cover Tone pitch may be changed using these commands. Speed is entered directly in words per minute, and pitch is entered in Hertz.

The Morse code speed applies to Morse code messages and the Cover Tone (patch cover and Touch-Tone cover), which is a Morse "T". The Cover Tone level is 6db below Morse level, and the Cover Tone can be made "invisible" if desired by setting a very low pitch.

*2000(speed)	**Morse Code Speed**	speed = 12 - 30 WPM
*2010(pitch)	**Morse Code Pitch**	pitch = 1 - 3000 Hz
*2020(pitch)	**Cover Tone Pitch**	pitch = 1 - 3000 Hz

Example: Set the Cover Tone Pitch to 440 Hz
Unlock the controller. Enter "*2020440" (or "*2020440#" over the phone). Controller responds with Forced CW ID message at the selected pitch.

Courtesy Tone Selection

Ten different predefined courtesy tone sets are stored in the controller's firmware and may be selected for use. Two courtesy tones are available for normal repeater use, based on the state of the Courtesy Tone Select logic input. The logic input low state tone is selected with a Control Op level command, and the logic input high state tone is selected by the Configuration command below. A third configurable tone applies to signals received through the remote base, and it differentiates remote base signals from those on the repeater frequency.

The ten courtesy tone sets are described below - but you really have to hear them for yourself!

CT Set #	Description
0	(no tone)
1	"Bumble Bee"
2	"Yellow Jacket"
3	"Shooting Star"
4	"Comet"
5	"Stardust"
6	"Duncecap"
7	"Piano Chord"
8	"Boop"
9	"Beep"

*3001(ct)	**CT SEL Logic High Tone**	ct = 0 - 9	CT
*3002(ct)	**Link Tone**	ct = 0 - 9	CT

Hint: If the "no tone" set is selected, users must still wait about 650 ms between transmissions to allow the timout timer to reset.

Timers

Several of the repeater's timers may be modified, including the hang timer, timout timers, patch related timers, and tail message timer. The timer value is entered directly is seconds, or in milliseconds for repeater hang time.

Certain of the timers may be disabled by setting their value to zero. Those that may safely be disabled are marked with $^\circ$. For example, it may be desirable to disable the Emergency Autodial Timer, relying on the activity timer for emergency calls. However, disabling the Tail Message Timer will cause tail messages to be generated at every tail. Disabling the Phone Answer Delay timer will cause the phone never to answer! Be careful!

*4000(period)	**Repeater Timeout Long$^\circ$**	(≈30-1799 sec)	TL
*4001(period)	**Repeater Timeout Short$^\circ$**	(≈15-1799 sec)	TS
*4002(period)	**Phone Answer Delay**	(≈10-≈60 sec)	PA
*4003(period)	**Autopatch Timer$^\circ$**	(0, ≈60-1799 sec)	AP
*4004(period)	**User Autodial Timer$^\circ$**	(0, ≈60-1799 sec)	AU
*4005(period)	**Emergency Autodial Timer$^\circ$**	(0, ≈60-1799 sec)	AE
*4006(period)	**Patch Activity Timer$^\circ$**	(0, ≈30-1799 sec)	AA
*4007(period)	**Patch Timer Extend Timer$^\circ$**	(0, ≈30-1799 sec)	TX
*4008(period)	**Tail Message Timer**	(≈60-1799 sec)	TM
*4009(period)	**Touch-Tone Access Timer$^\circ$**	(0, ≈30-1799 sec)	TA
*4010(period)	**Hang Timer**	(≈750-≈5000 <u>ms</u>)	HT
*4011(period)	**Spare Audio Timer**	(0, ≈15-1799 sec)	SP

Examples: Load the Patch Activity Timer with 45 seconds.
            While unlocked, enter "*4006 45" all as one
            transmission, or "*4006 45 #" over the phone.
         Load the Hang Timer to 3 1/2 seconds (3500 ms).
            Enter "*4010 3500".

Command Code Prefixes

Command code prefixes for Control Operator commands and the various classes of User commands may be changed remotely. The command prefix desired is entered directly as part of the Command Code Prefix Configuration commands.

*5000(prefix)	**Control Operator Command**	CMD
*5001(prefix)	**User Function Logic Output**	CMD
*5002(prefix)	**Emergency Autodial**	CMD
*5003(prefix)	**User Loadable Autodial**	CMD
*5004(prefix)	**Autopatch**	CMD
*5005(prefix)	**Link / Remote Base**	CMD
*5006(prefix)	**User Autodial Load / Erase**	CMD
*5007(prefix)	**Demo / Bulletin Board**	CMD
*5008(command)	**Reverse Patch (from phone only)**	CMD
*5009(command)	**Spare Audio (user cancels with #)**	CMD
*5010(prefix)	**Patch Utilities**	CMD
*5011(command)	**Patch Hangup**	CMD
	(load empty command to restore #)	
*5012(prefix)	**Paging**	CMD
*5013(prefix)	**Touch-Tone Access Mode Up / Down**	CMD
*5014(command)	**S-Meter Readback**	CMD
*5015(prefix)	**Extended User Autodial (Bank 1)**	CMD
*5016(prefix)	**Extended User Autodial Load / Erase**	CMD
*5017(command)	**Telephone Timer Extend**	CMD

Hint: To define the Patch Hangup command to be #, load an empty
            command, i.e. "*5011".

Emergency Autodial Numbers

The ten Emergency Autodialer telephone numbers are loaded or changed with these commands.

*520x(telephone number)   (x = autodial location 0-9)

Hints: A location may be erase and left empty by entering nothing
            for the phone number. For example, to erase slot 3, enter
            "*5203".
         The Emergency Autodial response messages are defined with
            the Message Editor.

Miscellaneous Selections

Various controller operating modes may be selected with the following Configuration commands. Either Touch-Tone or dial-pulse (rotary) signalling into the phone may be selected for patch operation. Control Operator and Configuration control may be permitted or not permitted through the repeater receiver (may be prohibited for overall security). The controller may be set up for shared or unshared use of the phone line (see Chapter 8 - Sharing the Phone Line). Finally, the logic sense of the User Function remote control logic outputs may be selected to be low true or high true.

*5400	**Touch-Tone patch signalling**	TT
*5401	**Dial Pulse signalling**	DP
*5402	**Enable control over repeater receiver**	EC
*5403	**Disable control over repeater receiver**	DC
*5404	**Phone line not shared**	PLU
*5405	**Phone line shared**	PLS
*5406	**UF Low True**	FL
*5407	**UF High True**	FH

Hints: The commands are mutually exclusive in pairs, i.e. you may select TT or DP, EC or DC, PLU or PLS, and UL or UH.
The EC and DC commands may not be entered through the repeater receiver.

Serial Transfer Strobe Logic Sense

The Transfer Strobe signal in the expanded UF output mode may be selectable high true or low true. The FC-1 board and the circuitry on page 8-6 requires high true.

*5408	**Serial Transfer High True**	STH
*5409	**Serial Transfer Low True**	STL

Store Macro Sets

The currently active Control Operator enable/disable and mode selections may be stored in one of four "Macro Sets" which may later be selected by the Control Operator with simple commands. One macro select Control Op command in effect performs many Control Op command functions. The macro sets also store the user state of the link/remote base and the UF remote control logic output states.

To store a macro set, simply set up the repeater as you wish to have it stored. The Store Macro Set commands take a snapshot of the current setup of the controller and stores it in the non-volatile memory in set 1, 2, 3 or 4.

*5911	**Store Macro Set #1**	MACRO
*5912	**Store Macro Set #2**	MACRO
*5913	**Store Macro Set #3**	MACRO
*5914	**Store Macro Set #4**	MACRO

Chapter 8
Interfacing to Other Equipment

Contents

Introduction

The basic interface of the RC-85 controller to the repeater system was described in detail in Chapter 2. There are many additional features of the controller which may optionally be used in your repeater. This chapter describes interfacing of those additional features to your repeater system.

PL Decoder

A PL decoder may be connected to the RC-85 controller to permit PL access and/ or control. Any decoder with an active high logic output may connect to the PL Logic Input on connector J3 (Logic Connector). A logic low must be less than .8 volts, and a logic high greater than 2.4 volts. If the decoder's output is "open-collector", tie a pullup resistor, approximately 10K, from the output to the 12 volt supply.

A popular tone decoder is the Communcations Specialists TS-32. The diagram below shows how the TS-32 may interface with the repeater receiver and the RC-85 controller (it is shown for PL *decode* only - the encode section may be used as you wish). The active high logic output (OUT-2) may drive the controller PL logic input (J3 pin 4) with a 10K pullup resistor to +12 volts. It's necessary to ground the Hang-up pin on the TS-32 to enable decoding.

Audio into the TS-32 Tone Input should come from a point in the receiver where sub-audible tones have not been filtered out - the proper point is receiver dependent and in some cases audio must be taken directly from the discriminator. Other receivers have wide frequency response, and subaudible tone is present at later points throughout the receiver.

The TS-32 includes a high pass filter which may be wired in-line with the receiver audio to the controller. The high pass filter removes the sub-audible tone components from the received signal so that they are not retransmitted. Use of the high pass filter in your installation is optional. Some systems are designed to allow user PL to pass unaffected, others filter out PL, and still others regenerate PL on the repeater transmitter.

COMM-SPEC TS-32 SUBAUDIBLE TONE DECODER INTERFACE
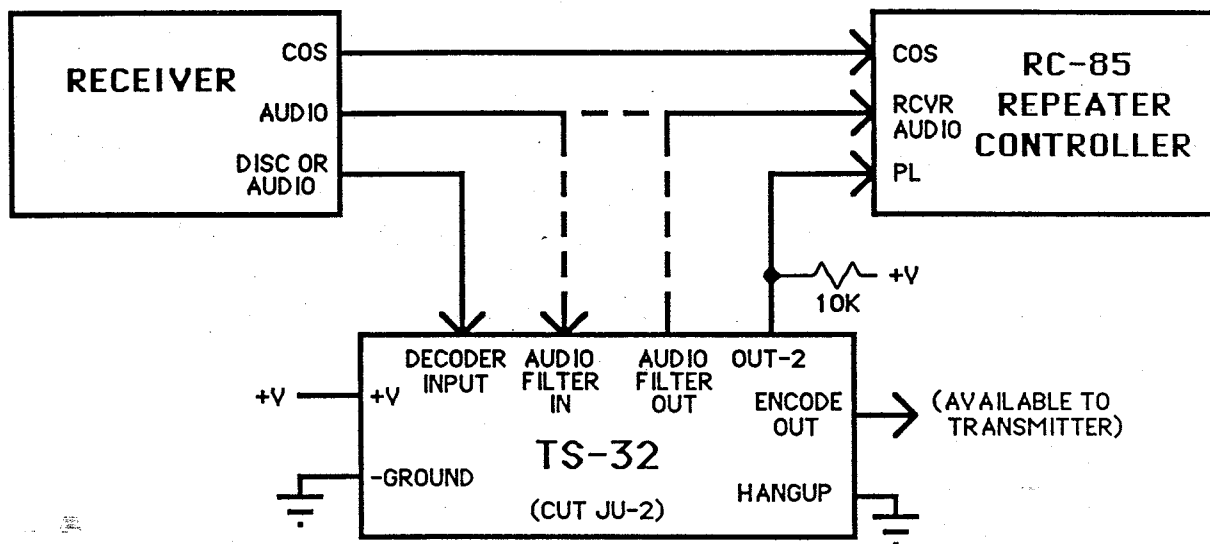
Talking S-Meter

The controller is capable of measuring a 0-5 volt S-meter signal and reading back the measurement to the user in synthesized speech on command. The signal should be conditioned if necessary to range from zero volts (S0) to approximately five volts (S9 plus 60) and should drive connector J4 pin 4. The signal may range between zero and twelve volts without damaging the controller.

As an example, the diagram below shows connection of a Spectrum Communcations SCR-200 S-meter signal output to the RC-85 controller. The meter should be disconnected and a 10K resistor placed from the signal output to ground. The signal may drive the controller directly. The resistor divides down the S-meter signal to an approximately zero to five volt range and also provides a discharge path for the emitter follower transistor in the receiver's S-meter circuit.

S-METER INTERFACE TO SPECTRUM SCR-200

```
┌──────────────────┐                    ┌──────────────────────┐
│                  │                    │        RC-85         │
│    SCR-200       │          ╱│S-METER │      REPEATER        │
│    RECEIVER   S-METER ──────┤ │ANALOG │     CONTROLLER       │
│                  │       ╲  ╱│ INPUT  │                      │
│                  │      10K                                  │
└──────────────────┘       ⏚                └──────────────────┘
```
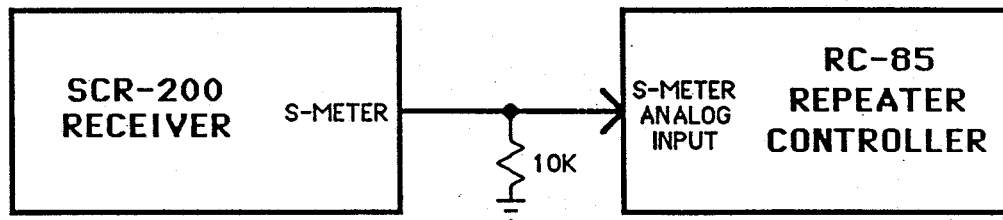
Control Receiver

An independent receiver may function as a control receiver and have command priority over other command channels in the system (repeater receiver and phone). The control receiver audio may connect to the Audio Connector J4 pin 5 and should be in the range of .5 to 2.5 volts peak-to-peak.

The COS signal should connect to the Logic Connector J3 pin 3. The COS may be high true or low true - DIP switch 3 should be set based on its logic sense - ON for high true, OFF for low true. If a control receiver is not connected, DIP switch 3 *must* be ON.

For greater security, a PL decode signal from the control receiver can replace the COS signal. PL would need to be transmitted on the control channel to activate the control receiver function.

CONTROL RECEIVER INTERFACE

```
┌──────────────────┐             ┌──────────────────────┐
│                  │     AUDIO   │CONTROL               │
│                  │       ──────▶│RCVR      RC-85       │
│    CONTROL       │             │AUDIO    REPEATER      │
│    RECEIVER      │             │        CONTROLLER     │
│                  │      COS    │CONTROL               │
│                  │       ──────▶│RCVR                  │
│                  │             │COS                   │
└──────────────────┘             └──────────────────────┘
```
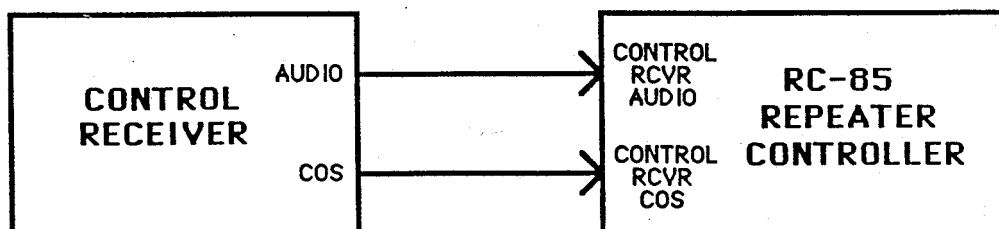
Site Alarm

The Site Alarm logic input to the controller provides an over-the-air alarm announcement when the alarm logic input is taken high. the alarm message is programmed with the Alarm Message Configuration command. The site alarm may be used as an indication of intrusion, over-temperature, water on the floor, or even as a weather radio storm alert or aviation ELT warning.

The alarm is activated by applying a high logic signal (2.4 - 15 volts) to the Alarm Input at J3 connector pin 7. The signal can be derived from other circuitry, such as a temperature sensor, or from a normally open switch which applies a voltage to the alarm input when closed. Alternatively, for more security in intrusion detection applications, a pull-up resistor on the board can normally be grounded by a normally closed switch, and if the switch is opened or if wires are cut, the alarm will be activated.

Activation of the site alarm causes the alarm message to be announced over the repeater transmitter at 15 second intervals, until cleared by a Control Op. The alarm condition is latching - meaning that once the logic input is taken high, the alarm condition continues even if the logic input is returned low. This insures that detectors such as limit switches for intrusion detect cause a continuing alarm that does not cancel once the switch is closed. The alarm condition should be removed before the alarm is re-enabled.

INITIAL DIP SWITCH SETTI			
	DESCRIPTION	ON	
SW1	REPEATER RCVR COS	HIGH TRUE	L(
SW2	REPEATER TX PTT	HIGH TRUE	L(
SW3		ON	
SW4-8		OFF	

See Chapter 8 and Appendix II for additional de

Remote Control Outputs

The RC-85 controller provides three open collector high voltage, high current remote control logic output functions which may be controlled by Touch-Tone commands. The remote control logic outputs may be used for such functions as high/low power select, antenna select, or control of other equipment at the repeater site.

The remote control outputs are controlled by User level commands and may be forced on or off, and may be interrogated. When any output is interrogated, a short (100us) pulse is generated on that output - that is, the output toggles to the opposite state and back. The pulse is too short to disturb equipment being controlled, but long enough to trigger a one-shot or 555 timer to stretch to any duration required.

One of the control outputs may become the Link PTT when a link or remote base transceiver is installed. Its function is DIP switch selectable.

The other logic outputs may have dedicated functions when certain options are selected. If commanded to the "Phone Line Shared" mode with a Configuration command, Control Output 3 (UF3) becomes an active low Phone Line In-Use output, which may be or-tied with other controllers at the site to indicate that another controller is currently using the phone line. See "Sharing the Phone Line" later in this chapter.

An external cartridge tape player may be interfaced to the controller and play ID, tail or Bulletin Board messages. The activation of these messages when loaded properly with the Message Editor may cause a one second pulse to be generated at Control Output 2 (UF2) to start the external device. The controller then monitors the External Device Busy logic input for indication of completion of the recorded message. See "External Tape Player" later in this chapter for details.

Expanded Remote Control Outputs

Two alternative modes (DIP switch selectable) use two or three of the outputs to serially shift out eight remote control logic functions plus remote base frequency information (see next section) - a total of 24 bits. The eight remote control output functions permit more extensive remote control of equipment at the site at the expense of several external IC's required to capture the data. The FC-1 Frequency Control Board is available from ACC for this purpose.

One expanded mode shifts the serial data out of two control outputs which function as a serial clock and serial data line. External shift registers capture the data and provide it to the system in a parallel format. Since the output data is disturbed as the new data is shifted into the registers, glitches appear on the recovered outputs, which is acceptable in many applications but not in others. Another mode is supported which adds a transfer pulse, which can load the new data into parallel registers after it's shifted, without glitches appearing on the recovered outputs. The FC-1 board, which uses 4094B shift / store registers, can recover the data in this mode.

In the expanded modes, the User Function outputs appear at the shift register outputs, just as they appeared directly at the control outputs in the direct mode. When Control Output 3 is redefined to be the transfer signal, the Link PTT appears at UF 8 in the shifted data stream. The logic sense of the UF outputs may be inverted with a Configuration command, which may be useful when buffering the recovered outputs with open collector transistors, as in the FC-1 Frequency Control Board.

CONTROL OUTPUT
MODE SELECTIONS

MODE / OUTPUT	NO LINK	SINGLE CHANNEL LINK	SYNTHESIZED LINK/REMOTE AND EXPANDED UF OUTPUTS	GLITCH-FREE SYNTHESIZED LINK/REMOTE AND EXPANDED UF OUTPUTS
CX1	UF 1	UF 1	SERIAL DATA	SERIAL DATA
CX2	UF 2	UF 2	SERIAL CLOCK	SERIAL CLOCK
CX3	UF 3	LINK PTT	LINK PTT	SERIAL TRANSFER
DIP SW. SETTINGS	SW4 OFF SW5 OFF SW6 OFF	SW4 ON SW5 OFF SW6 OFF	SW4 ON SW5 ON SW6 OFF	SW4 ON SW5 ON SW6 ON

SERIAL TIMING
AND BIT
DEFINITIONS

SERIAL CLOCK

SERIAL DATA

SERIAL TRANSFER

└─ SERIAL DATA TO REMOTE BASE AND EXPANDED UF ─┘   └── SERIAL DATA TO DVR ──┘
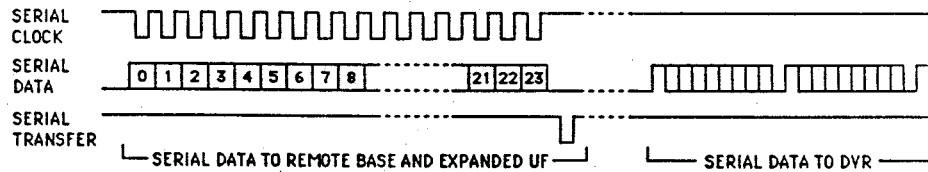
SERIAL DATA BIT DEFINITIONS					
0	UF1	8	MHz D0	16	10's KHz D0
1	UF2	9	MHz D1	17	10's KHz D1
2	UF3	10	MHz D2	18	10's KHz D2
3	UF4	11	MHz D3	19	10's KHz D3
4	UF5	12	PLUS/$\overline{\text{MINUS}}$	20	100's KHz D0
5	UF6	13	SIMPLX/$\overline{\text{DUPLX}}$	21	100's KHz D1
6	UF7	14	5/$\overline{0}$ KHz	22	100's KHz D2
7	UF8	15	LINK ON/$\overline{\text{OFF}}$	23	100's KHz D3

USER FUNCTIONS   LINK / REMOTE BASE
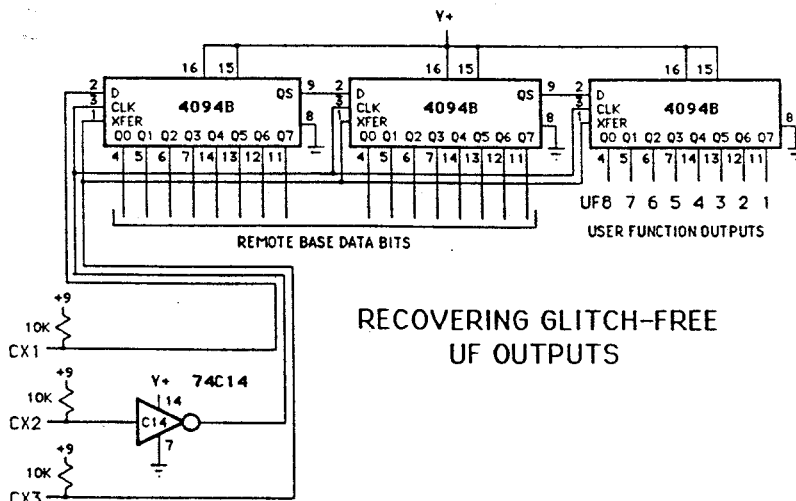
RECOVERING GLITCH-FREE
UF OUTPUTS

REMOTE BASE DATA BITS

UF8 7 6 5 4 3 2 1
USER FUNCTION OUTPUTS

Link / Remote Base

Touch-Tone user commands allow control of a transceiver which may tie the repeater to other frequencies. When the link is activated, a signal at the repeater receiver keys the link PTT, and a received signal on the link transceiver keys the repeater PTT.

In addition to activating the link function with Touch-Tone commands, the frequency of the link transceiver may be commanded with hardware control in two different formats: (1) BCD frequency values supplied at the controller's logic outputs in a serial format, and (2) serial ASCII data supplied for Kenwood TS-711A and TS-811A transceivers. The hardware interfaces allow remote control of the remote base frequency. Synthesized speech readback of the frequency verifies command entry.

A fixed frequency link or remote base transceiver may be controlled by the RC-85 controller by connecting link PTT, link COS, link receiver audio, and by driving the link transmitter with repeater transmitter audio.

BCD Frequency Interface
External shift register ICs capture the data shifted out of the controller and at the same time may perform any level translation required in interfacing to a particular radio. The format of the BCD frequency data is compatible with the ACC RC-850 Repeater controller (Link 1) and the ITC-32 Intelligent Touch-Tone Control Board.

Shown below is circuitry suitable for capturing the serial frequency information for interface to an ICOM IC-22U two meter transceiver as a synthesized remote base. Other BCD controlled radios may be used as well, such as the ICOM IC2/3/4A, Kenwood TR-7400, and many others. The FC-1 Frequency Control Board supplies the interface circuitry to the IC2/3/4A transceivers. Because offset circuitry design varies from rig to rig, use of other transceivers may require custom design.

IC-22U SYNTHESIZER INTERFACE
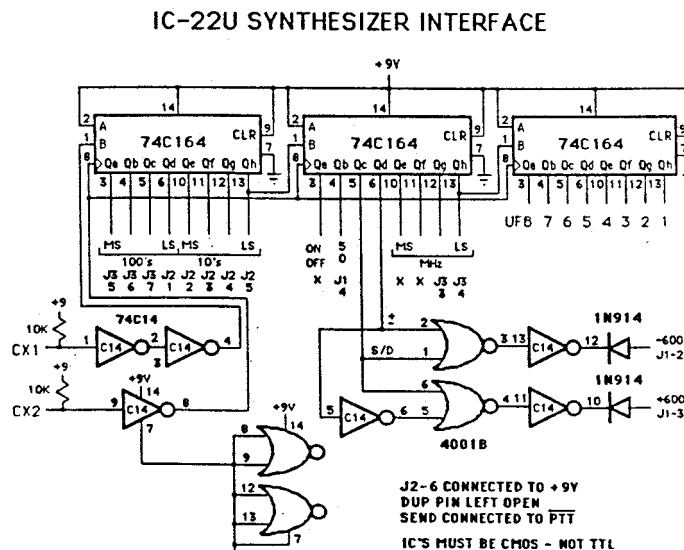
Kenwood Interface

As an alternative to supporting a BCD interface, the controller may connect directly to the serial control port of the Kenwood TS-711A or TS-811A transceivers. With the Kenwood transceivers, users may control frequency, mode, memory recall, and subaudible tone selection.

The Kenwood "IF-10A" option must be installed in the transceiver to provide the serial control port. The IF-232C" option is not needed.

Link PTT should drive the transceiver's Standby pin at pin 13 of ACC2.

Link COS is available at the Control Unit board (top side of the radio), connector 4, pin 8. The point is labeled "SC". You may attach to it by unplugging connector 4, removing pin 8, and tack soldering a small wire to the pin. Plug it back together and run the other end to an unused pin of ACC2.

Transmit and receive audio are available at ACC2 connector pins 11 and 13 respectively. Take transmit audio from the controller through a 10K pot to provide a transmit audio level adjustment into the transceiver.

The signal to the Kenwood serial input port is available at the controller CX1 output (J3 - Logic connector, pin 12). *DIP Switch 4 and 5 must be ON,* selecting either the Synthesized Link / Remote and Expanded UF Output mode or the Glitch-Free mode.

The CX1 output is an open collector driver, i.e., it relies on an external pullup resistor to set the logic high level. In these two modes, the output can serve several purposes, including (1) providing BCD frequency and expanded UF information to shift registers, (2) providing ASCII information to the Kenwood transceiver, and (3) providing ASCII information to the Digital Voice Recorder.

The serial input in the Kenwood transceiver is pulled up to +5V with a 1K resistor. If using an FC-1 board to recover expanded UF information, be sure that it operates at +5V supply. If connected to a Digital Voice Recorder, either provide a pullup to +5V or provide no additional pullup - do not pull CX1 up to +12V.
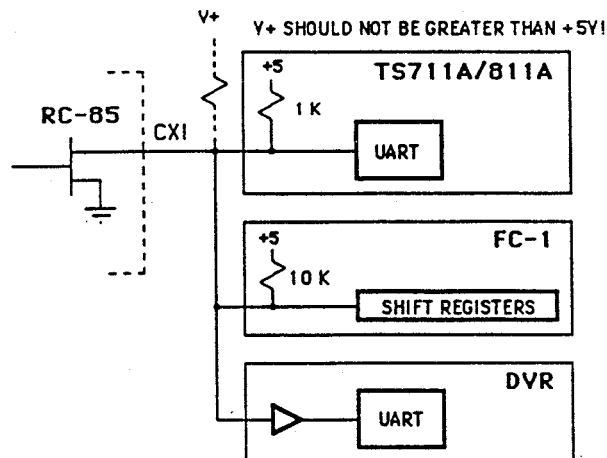
Spare Audio

User commands may allow selections of a weather radio, scanner, or other audio source. The audio input shares the Link / Remote Base receiver input and would typically be available if the link function is not used in the system. The audio is gated to the transmitter under computer control in response to the user commands, and the transmitter PTT is held active. The audio may be continuously present at the controller's audio input and no control signals to or from the audio source are required.

Note: Retransmission of another radio service through the Amateur service may not be legal.

External Tape Player

An external tape playback unit may be interfaced to the controller and addressed by any of the programmable messages. Examples of applications would include a tape recorded ID message or Bulletin Board accessible message.

When the controller generates a message which has been specified as an external device (*13xx message loaded with speech "X" - see Chapter 7 - Messages), a one second low going start pulse appears at User Function 2 (Control Output 2, or in the expanded mode at the recovered UF2). The controller then monitors the External Device Busy logic input until the signal goes low indicating end of message. Audio from the external device may drive the Direct Transmitter Mixer Audio Input (J4 pin 3) and should be level adjusted externally.

EXTERNAL TAPE PLAYER INTERFACE

```
┌─────────────────────────────┐        ┌─────────────────────┐
│                        UF2 │────────→│ START               │
│  RC-85       EXTERNAL      │←────────│ BUSY      TAPE      │
│  REPEATER    DEVICE BUSY   │         │          PLAYER     │
│  CONTROLLER  DIRECT TX     │         │ AUDIO               │
│              MIXER AUDIO   │←────────│ OUT                 │
│              INPUT         │         │                     │
└─────────────────────────────┘        └─────────────────────┘
```
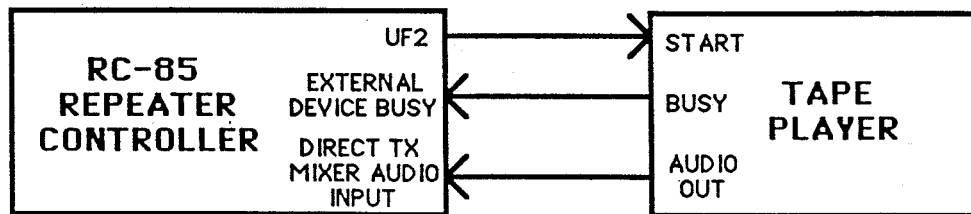
Digital Voice Recorder

ACC's Digital Voice Recorder may interface to the RC-85 controller so that any of the remotely recordable "tracks" may be addressed through the Message Editor. Control signals are passed to the DVR through Control Output 1 as part of the serial data stream supplied at that output in the expanded remote control output mode. Information from the DVR is supplied to the RC-85 controller through the External Device Busy logic input. Audio from the DVR drives the Direct Transmitter Audio Mixer input and may be level adjusted in the DVR. Audio should be supplied to the DVR from the repeater receiver.

Additional operational instructions for use of the Digital Voice Recorder with the RC-85 controller are supplied with the DVR.

DIGITAL VOICE RECORDER INTERFACE

```
┌─────────────────┐                    ┌─────────────────────┐
│                 │  UF1 ─────────────▶│ SERIAL              │
│    RC-85        │                    │ IN      DIGITAL     │
│  REPEATER       │ EXTERNAL ◀─────────│ BUSY     VOICE      │
│  CONTROLLER     │ DEVICE BUSY        │        RECORDER     │
│                 │ DIRECT TX          │ AUDIO               │
│                 │ MIXER AUDIO ◀──────│ OUT   AUDIO IN  COS │
│                 │ INPUT              └─────────────────────┘
└─────────────────┘                            ▲       ▲
                                  ┌────────────┴───────┴────┐
                                  │            AUDIO    COS  │
                                  │      RECEIVER           │
                                  └─────────────────────────┘
```
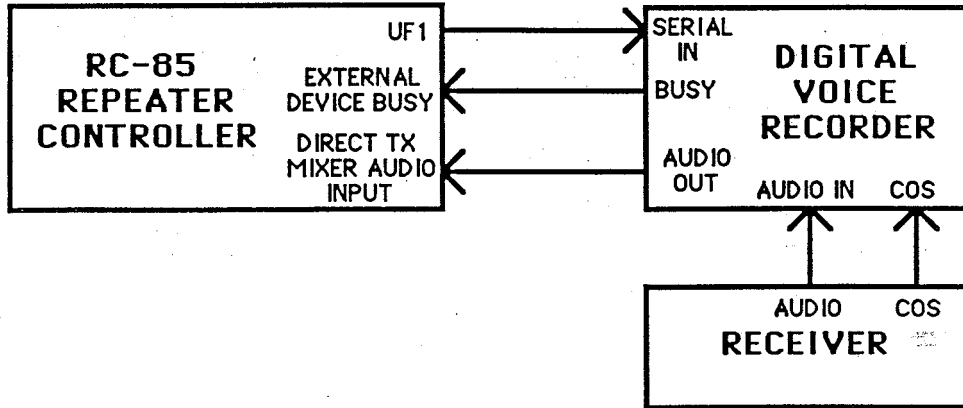
Sharing the Phone Line

Several controllers at a common repeater site can share one phone line with handshaking among controllers to indicate when the phone line is in use. Then the "Phone Line Shared" mode is selected with a Configuration command, User Function 3 becomes a low true phone line busy output, which may be or-tied with other controllers' Phone Line Busy inputs. When a user attempts to bring up the patch, and the phone line is in use by another controller, the RC-85 controller responds by saying "Busy". The the phone line is not in use, the patch proceeds, and the RC-85 controller pulls the busy output low to indicate to other controllers that the phone line is now in use.

MULTIPLE CONTROLLERS SHARING A COMMON PHONE LINE

```
                        ┌──────────────────────┐
                        │ PHONE LINE   RC-85   │────── TIP
                        │ BUSY IN              │
                        │ UF3 OUT   CONTROLLER │────── RING
                        └──────────────────────┘
                        ┌──────────────────────┐
                        │ PHONE LINE   RC-85   │
                        │ BUSY IN              │
                        │ UF3 OUT   CONTROLLER │
                        └──────────────────────┘
                        ┌──────────────────────┐
                        │ PHONE LINE   RC-85   │
                        │ BUSY IN              │
                        │ UF3 OUT   CONTROLLER │
                        └──────────────────────┘
   +V ─\/\─              ┌──────────────────────┐
        10K             │ PHONE LINE   RC-85   │
                        │ BUSY IN              │
                        │ UF3 OUT   CONTROLLER │
                        └──────────────────────┘
```
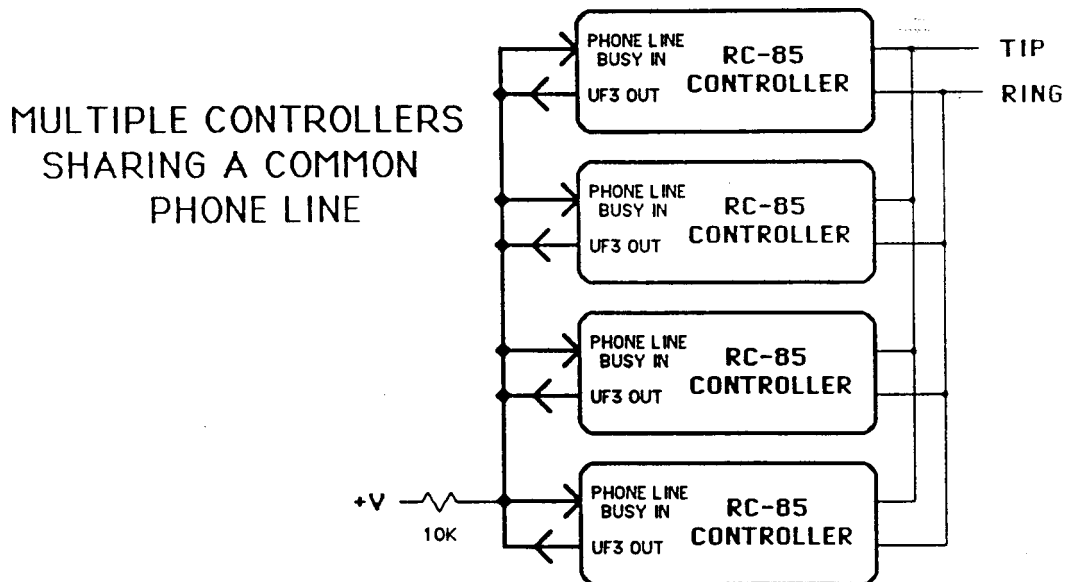
Chapter 9
How it Works

The RC-85 Repeater Controller is centered around a microcomputer with a software program contained in EPROM memory. Program stored in EPROM means that the controller is ready to go as soon as it's powered up. The microcomputer detects the logic inputs to the system and the Touch-Tone decoder information and controls the logic outputs, audio switching and mixing, speech synthesizer, and other circuits. More importantly, the computer directs operation of the various operational features of the controller, such as remote programming, autopatch, remote base linking, etc.

A block diagram of the RC-85 controller is shown below. The major functional blocks include the microcomputer, audio switching and mixing circuits, buffered I/O, speech synthesizer, tone generator, Touch-Tone decoder, and telephone interface. In addition, various protective circuits ensure reliable long term operation with automatic error recovery.

The microcomputer consists of an 8085 microprocessor with up to 128K byte paged EPROM program memory, 2K of E^2PROM re-programmable non-volatile memory, 2K or RAM, and various I/O circuits. Remotely programmed information is stored in the write protected E^2PROM.

The 3.58 MHz clock signal for the 8085 is derived from the Touch-Tone decoder chip. The CPU is automatically reset on powerup and will be reset whenever the supply voltage to the board drops below approximately 8 volts. The 8085 multiplexed address / data bus is demultiplexed by the 74HC373 octal latch, and its address space is decoded by the 74HC138 decoder.

The audio switching and mixing circuits consist of two active mixers, one for audio driving the repeater transmitter, and one for audio to the phone line. Selection of active sources into each mixer is supervised by the computer program in response to normal repeater operation and user commands.

The logic outputs from the board, for transmitter PTT and general remote control functions, are output ports buffered by high voltage / high current VMOS FET transistors. The logic inputs are buffered by an integrated transistor array which provides a universal logic level compatibility.

The speech synthesizer interfaces to the CPU through I/O ports and is controlled by the microcomputer program. The pot R40 adjustment sets the synthesizer clock frequency, setting the pitch of the voice.

The tone generator creates Morse code, courtesy tone, and Touch-Tone audio under control of the computer program.

The Touch-Tone receiver may connect to any of the audio input channels under control of the computer program. The receiver detects Touch-Tone audio and sends the information to the microcomputer to permit command evaluation.

The telephone interface provides the protective coupling between the op amp audio signals and logic control signals and the telephone line. It includes ring detect, off-hook control, impedance matching, and isolation.

RC-85 BLOCK DIAGRAM
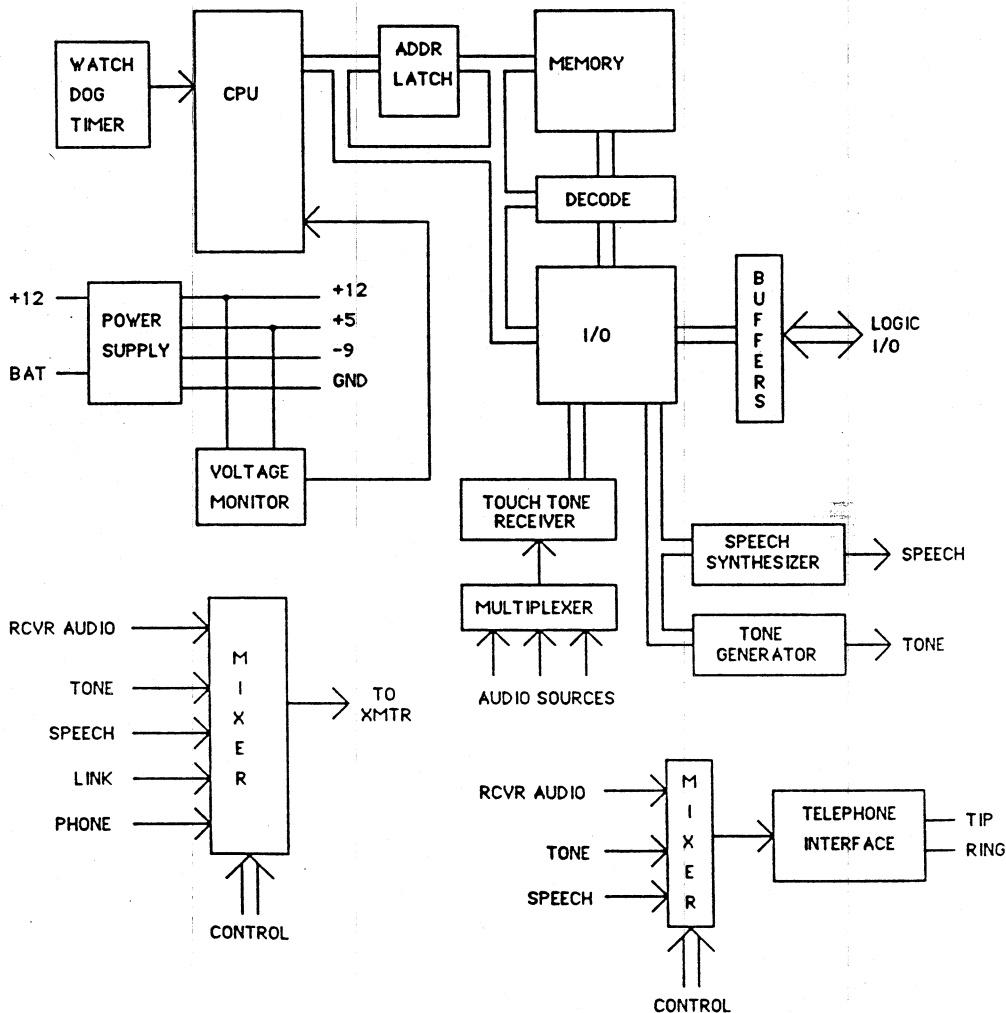
Chapter 10
In Case of Difficulty

Contents

Maintenance

The RC-85 controller is designed conservatively with high quality, reliable components, and it is very unlikely that a component failure will take the controller out of service. No periodic maintenance is necessary to ensure long life. Simply follow common sense in installing the controller, such as avoiding locating it in extremely hot or dirty areas. You should expect your RC-85 controller to run virtually forever.

Servicing

However, since Zap, the Lightning God, has been known to visit repeater sites, it's possible that it may become necessary to repair the controller at some time in its service life. The RC-85 controller includes transient protection to minimize the possibility of damage, and this protection should be supplemented with sound site engineering to minimize impact of lightning on all equipment in the system.

Since all ICs are socketed (in extremely reliable sockets), troubleshooting and repair should be relatively simple.

Of course, the controller may be returned to the factory for repair, but it would be desirable to attempt to diagnose and repair failures at the site when possible to minimize repeater down time. While all potential failure modes can't be anticipated, the guidelines will help isolate the problem to a particular component or area.

In general, hardware failures can be classified into two broad categories - those where the computer executes its program correctly, and those where it executes garbage or nothing at all. If the computer is executing its program correctly, as evidenced by partial operation of the controller, the failure is probably a peripheral or interface circuit. Otherwise, the problem is probably the CPU, memory, or decoding circuitry.

GENERAL CHECKLIST

- ICs firmly seated in sockets?
- Cable connectors properly inserted?
- +12 volt and 2 grounds connected properly?
- DIP switches set correctly and firmly?
- Any components hot? (careful!)
- *Both grounds connected?*

TROUBLE	**PROBABLE CAUSE**	**REMEDY**
Computer Dead	+12 volt supply not present	
	Defective supply	Repair supply
	Defective power wiring	Repair wiring
	+5 volt supply not present	
	Defective 7805 regulator	Replace regulator
	Defective IC overloading regulator	Locate and replace defective IC
	Oscillator not running	Replace xtal Y1
	Grounds not connected	Connect both grounds
No audio	-9 volt supply not present	Trace "V-"
Distorted Audio	Excessive input level	Reduce input level
	Excessive deviation	Reduce deviation control in transmitter
Logic Inputs Not Sensed	Defective input buffer	Replace U14
Logic Outputs Not Operating	Need pullup resistor to define high level	Add pullup resistor
	Defective output port	Replace 4724B
	Defective output buffer	Replace VN10KM
Touch-Tone Decode Unreliable	Audio clipping	Reduce level thoughout system
	Excessive twist	Flatten system frequency response

RF Interference

The controller users relatively high speed digital logic which results in signals with fast edges. The logic signals contain harmonic energy throughout the HF and VHF frequency ranges. Because the controller uses CMOS with somewhat slower edges that TTL or low power Schottky logic, the harmonic energy is lower than it would be in TTL based systems. Since a repeater system contains receivers sensitive to signals as low as fractions of a microvolt, it's possible for rf from the controller to interfere with the repeater or remote base receiver. It's even possible for rf energy to enter the transmitter and modulate the transmitted signal on unexpected frequencies.

In most installations, there is no difficulty because the receiver equipment is typically well shielded (to prevent transmitter energy from affecting it), and the antennas are some distance from the controller. If rf interference is a problem, several simple steps should elminiate or reduce the effects.

If the receiver equipment is not well shielded, it should be. Signals entering and leaving the receiver should go through feedthru capacitors. It may be desirable to add small chokes (about 10 uH), ferrite beads, or torroids in series with the signals where they reach the feedthru, to improve the effectiveness of the filtering.

RF energy entering the transmitter can be another source of RFI through intermodulation effects. Small chokes or beads on power and control lines entering the transmitter may be helpful as well.

Signals from the controller to external equipment may be filtered with small chokes or ferrite beads at its connectors, and cables may be shielded to eliminate radiation of rf energy.

Try to determine if the rf enters the receiver through the antenna or through some other path - put the receiver on a dummy load to see. If it's entering from the antenna, see if it's possible to increase the seperation. The antenna pattern is such that equipment located directly under the antenna is generally in a null, which reduces rf coupling. Shielding of cables may be helpful when rf enters at the antenna.

If the rf path is other than through the antenna, shielding and filtering of the interface cables should be improved.

RF energy from the controller varies with the computer's bus activity, or program execution. A continuous component is present at 146.76 MHz, which is the 41st harmonic of the controller's 3.579545 MHz crystal clock oscillator.

In general, the controller is not susceptible to rf from repeater equipment, unless it is exposed to very strong local fields.

Most Often Asked Questions (and Answers)

My controller acts erratically. What's wrong?
Be sure that you have connected both grounds to the power supply. The *both* need to get there. Check for high electrical noise at the site, such as from heavy duty motors or solenoids. Be sure that the power to the controller is stable - ac power at repeater sites can be very poor.

The probability of a defective IC, unless damaged by lightning or static electricity, is *very low*. Always suspect other causes before concluding that an IC is defective.

The controller doesn't mute Touch-Tone and doesn't decode any commands.
Check DIP switch 3 - this selects the control receiver COS logic sense. If you don't have a control receiver, switch 3 should be ON. If not, the controller thinks that the control receiver is active, and the Touch-Tone decoder is monitoring the control receiver audio input - not the repeater receiver.

Touch-Tone doesn't always decode. Why not?
The dynamic range of the Touch-Tone decoder is very wide so that if the receiver audio to the controller is between a few hundred millivolts and 2.5 volts p-p, it should decode. But some mobile and portable rigs transmit tone levels very hot, which causes clipping of the tones in the user's transmitter. If the level is hot enough to distort, the only solution is to reduce the tone level in the user's rig so that it transmits clean Touch-Tone. Other possibilities are non-flat frequency response somewhere between the user's transmitter and the controller, which causes the two tones of the Touch-Tone to be greatly different in level.

There are several other things to check. If you have a control receiver, be sure that it's squelch isn't opening when you don't suspect it is. Perhaps someone is calling the repeater on the phone, grabbing the Touch-Tone decoder. Be careful about who you give out your repeater number to.

The patch won't dial the phone number - it just reads back the number and beeps.
Don't forget that you need to click your mike during the pause to initiate dialing, unless you select the Control Op mode "Dial without click".

Why won't the controller accept commands from the phone?
Don't forget to terminate all Touch-Tone commands over the phone with a #. The # tells the controller to evaluate the command - without it, it'll just sit there.

Do I need to store a Control Op Macro Set whenever I make a change?
Only if you want changes in the Control Op setup to be stored for powerup or macro selection.

I don't measure anything on the logic outputs. Why not?

The logic outputs are open collector transistors. The transistor is either on, so that there's a path to ground, or it's an open circuit. To see a logic voltage level, you need to add a pullup resistor to define the logic high when the transistor is off. It's very tricky to try to measure resistance of the transistor output with an ohmmeter - don't try it. Just connect a pullup and look for a voltage.

I can't enter commands for a while after the controller hangs up the phone. What's going on?

When the controller hangs up, the phone company sometimes reverses the battery ("winks"), and this can be seen by the controller as a ring, so it picks up the phone again. Set the Phone Answer Delay timer longer than about 10 seconds. Just before the controller answers the phone, it looks back in time eight seconds to see if the phone was still ringing in that period. With a longer answer delay time, it will reject the "wink" as a ring.

How do I change the Patch Hangup code back to #?

Enter the Command Code Prefix Configuration command with an "empty" prefix, i.e. *5011 with nothing following. This tells the controller to look for a # for hangup.

Do I need to enter *0 to actually write configuration information into E²PROM?

No. The *0 command applies only to the message editor, so use it to write an edited message, but nothing else.

What information is stored in the E²PROM?

All Configuration commands result in storage of information in the E²PROM. Messages are stored after entering the *0. Control Op setup information is written into the E²PROM only when storing a Control Op Macro Set with the Configuration command. All User Loadable Autodial Load / Erase commands also write to the E²PROM.

When I programmed something with a Configuration command, the controller said, "E R, Write". What's wrong?

The "E R" message indicates that there was a problem writing into the E²PROM. If you get this message, contact the factory to help determine the nature of the failure.

How many digits can be in the autodial numbers?

All 200 autodial locations (10 Emergency and 190 User Loadable) may contain up to 11 digit phone numbers.

Why does the voice response wait up to a few seconds when I enter a Configuration command?

It's programming the E²PROM which takes about 100 ms per byte. The Special ID, as an example, will take almost 5 seconds to program - it's normal.

If the Touch-Tone Access Mode is enabled but down, will a reverse patch come through?

Yes. A reverse patch will bring up the TT Access Mode and load the TTAM timer. Assuming the timer is non-zero, it will time itself back down if there's no activity.

Sometimes when entering the Link Receive Only command, the controller reads back the frequency and other times it reads back "Remote Base R". What is the rule?

If the frequency is set to all zeros, it says, "Remote Base R". Otherwise it reads back the frequency.

When making a patch, there's a slightly longer delay (than with the old software) until it starts to dial. Why?

To avoid falsing the phone company's Touch-Tone decoder, the controller waits until it's finished "talking" before going offhook. Then it waits 1.5 seconds before starting to dial.

The controller doesn't always ID when the Touch-Tone Access Mode goes down. How come?

Generally it will ID when going down only when it's necessary, i.e., there was been some activity since the last ID. For example, if the TTAM timer is set to 20 minutes, if no activity causes it to time out, it won't generally be necessary to ID because it would have completed the ID cycle several minutes earlier.

What's the patch Activity Timer for?

The activity timer causes a patch to be terminated if the mobile drives out of range or otherwise goes away. The timer resets at the beginning and end of each transmission. If it's allowed to time out (no carrier or stuck carrier), there's a warning warble, and if there's still no "activity" within 10 seconds, it will hang up. The patch activity timer can be used along with, or instead of, the overall patch timers.

RC-85 Configuration Sheet

Messages

II	
FI	HI
AI	
P1	
P2	
P3	
SI	
T1	WELCOME TO THE REPEATER
T2	SEVEN-TY THREE
T3	WEATHER ALERT
PH	REPEATER CONTROL
HG	CALL COMPLETE
AL	INTRUDER ALERT
B1	QRU
B2	

Tone Parameters

Morse Code Speed	15
Morse Code Pitch	880
Cover Tone Pitch	440

Emergency Autodial Numbers

	Message	Phone Number
0	OPERATOR	0
1		
2		
3		
4		
5		
6		
7		
8		
9	NINE ONE ONE	911

Timers

Timeout Long	180
Timeout Short	45
Phone Answer	15
Autopatch	180
User Autodial	180
Emergency Autodial	600
Patch Activity	60
Patch Timer Extend	45
Tail Message	300
Touch-Tone Access	900
Hang Time (ms)	4000
Spare Audio	90

Command Code Prefixes

Control Op	123	Reverse Patch	1
UF Logic	9	Patch Utilities	*
Emerg. Autodial	*	Patch Hangup	*
User Autodial	*	Paging	2
Autopatch	*	TT Access	741
Link	7	S-Meter	8
User Autodial L/E	456	Ext. User Autodial	*1
Demo/BB	3	Ext. User Autodial L/E	457
Spare Audio	666	Telephone Timer Ext.	0
		Unlock	1234567890

Courtesy Tone Selection

CT Logic High	STARDUST
Link Tone	PIANO CHORD

Misc. Selections

Patch signalling	(TT) DP
Control over receiver	(EC) DC
Phone line share	(PLU) PLS
UF high/low true	FH (FL)
Patch Dialing Prefix	EMPTY

User Loadable Autodial Numbers

				130 _____	165 _____
				131 _____	166 _____
				132 _____	167 _____
				133 _____	168 _____
				134 _____	169 _____
10 _____	40 _____	70 _____	100 _____	135 _____	170 _____
11 _____	41 _____	71 _____	101 _____	136 _____	171 _____
12 _____	42 _____	72 _____	102 _____	137 _____	172 _____
13 _____	43 _____	73 _____	103 _____	138 _____	173 _____
14 _____	44 _____	74 _____	104 _____	139 _____	174 _____
15 _____	45 _____	75 _____	105 _____	140 _____	175 _____
16 _____	46 _____	76 _____	106 _____	141 _____	176 _____
17 _____	47 _____	77 _____	107 _____	142 _____	177 _____
18 _____	48 _____	78 _____	108 _____	143 _____	178 _____
19 _____	49 _____	79 _____	109 _____	144 _____	179 _____
20 _____	50 _____	80 _____	110 _____	145 _____	180 _____
21 _____	51 _____	81 _____	111 _____	146 _____	181 _____
22 _____	52 _____	82 _____	112 _____	147 _____	182 _____
23 _____	53 _____	83 _____	113 _____	148 _____	183 _____
24 _____	54 _____	84 _____	114 _____	149 _____	184 _____
25 _____	55 _____	85 _____	115 _____	150 _____	185 _____
26 _____	56 _____	86 _____	116 _____	151 _____	186 _____
27 _____	57 _____	87 _____	117 _____	152 _____	187 _____
28 _____	58 _____	88 _____	118 _____	153 _____	188 _____
29 _____	59 _____	89 _____	119 _____	154 _____	189 _____
30 _____	60 _____	90 _____	120 _____	155 _____	190 _____
31 _____	61 _____	91 _____	121 _____	156 _____	191 _____
32 _____	62 _____	92 _____	122 _____	157 _____	192 _____
33 _____	63 _____	93 _____	123 _____	158 _____	193 _____
34 _____	64 _____	94 _____	124 _____	159 _____	194 _____
35 _____	65 _____	95 _____	125 _____	160 _____	195 _____
36 _____	66 _____	96 _____	126 _____	161 _____	196 _____
37 _____	67 _____	97 _____	127 _____	162 _____	197 _____
38 _____	68 _____	98 _____	128 _____	163 _____	198 _____
39 _____	69 _____	99 _____	129 _____	164 _____	199 _____

Macro Sets 1, 2, 3, and 4

(RE) RD   (UE) UD   T1 T2 T3 (TF)

(TE) TD   (AU) AL   (RE) AD

(TL) TS   UU (UH)   (SE) SD

(CA) PC PU PL   (EE) ED   (SI) SO

ME (MD)   XC (NC)   (KE) KD

(CE) CD   (PT) PX   (TM) TU

(TE) TD   TD (TE) TA   (ZD) ZE

(LE) LD   (XE) XD   CT _1_

(PE) PD   (RO) R1 R2

(LE) LD   P1 P2 P3 SP (RP) RS

UF   1   2   3   4   5   6   7   8

LINK (OFF) RCV XMT   FREQ _6.520 S_

RC-85 Configuration Sheet

Messages

II _____
FI _____
AI _____
P1 _____
P2 _____
P3 _____
SI _____
T1 _____
T2 _____
T3 _____
PH _____
HG _____
AL _____
B1 _____
B2 _____

Tone Parameters

Morse Code Speed _____
Morse Code Pitch _____
Cover Tone Pitch _____

Emergency Autodial Numbers

	Message	Phone Number
0	_____	_____
1	_____	_____
2	_____	_____
3	_____	_____
4	_____	_____
5	_____	_____
6	_____	_____
7	_____	_____
8	_____	_____
9	_____	_____

Timers

Timeout Long _____
Timeout Short _____
Phone Answer _____
Autopatch _____
User Autodial _____
Emergency Autodial _____
Patch Activity _____
Patch Timer Extend _____
Tail Message _____
Touch-Tone Access _____
Hang Time (ms) _____
Spare Audio _____

Command Code Prefixes

Control Op _____
UF Logic _____
Emerg. Autodial _____
User Autodial _____
Autopatch _____
Link _____
User Autodial L/E _____
Demo/BB _____
Spare Audio _____

Reverse Patch _____
Patch Utilities _____
Patch Hangup _____
Paging _____
TT Access _____
S-Meter _____
Ext. User Autodial _____
Ext. User Autodial L/E _____
Telephone Timer Ext. _____
Unlock _____

Courtesy Tone Selection

CT Logic High _____
Link Tone _____

Misc. Selections

Patch signalling	TT DP
Control over receiver	EC DC
Phone line share	PLU PLS
UF high/low true	FH FL
Patch Dialing Prefix	_____

User Loadable Autodial Numbers

				130 _____	165 _____
				131 _____	166 _____
				132 _____	167 _____
				133 _____	168 _____
				134 _____	169 _____
10 _____	40 _____	70 _____	100 _____	135 _____	170 _____
11 _____	41 _____	71 _____	101 _____	136 _____	171 _____
12 _____	42 _____	72 _____	102 _____	137 _____	172 _____
13 _____	43 _____	73 _____	103 _____	138 _____	173 _____
14 _____	44 _____	74 _____	104 _____	139 _____	174 _____
15 _____	45 _____	75 _____	105 _____	140 _____	175 _____
16 _____	46 _____	76 _____	106 _____	141 _____	176 _____
17 _____	47 _____	77 _____	107 _____	142 _____	177 _____
18 _____	48 _____	78 _____	108 _____	143 _____	178 _____
19 _____	49 _____	79 _____	109 _____	144 _____	179 _____
20 _____	50 _____	80 _____	110 _____	145 _____	180 _____
21 _____	51 _____	81 _____	111 _____	146 _____	181 _____
22 _____	52 _____	82 _____	112 _____	147 _____	182 _____
23 _____	53 _____	83 _____	113 _____	148 _____	183 _____
24 _____	54 _____	84 _____	114 _____	149 _____	184 _____
25 _____	55 _____	85 _____	115 _____	150 _____	185 _____
26 _____	56 _____	86 _____	116 _____	151 _____	186 _____
27 _____	57 _____	87 _____	117 _____	152 _____	187 _____
28 _____	58 _____	88 _____	118 _____	153 _____	188 _____
29 _____	59 _____	89 _____	119 _____	154 _____	189 _____
30 _____	60 _____	90 _____	120 _____	155 _____	190 _____
31 _____	61 _____	91 _____	121 _____	156 _____	191 _____
32 _____	62 _____	92 _____	122 _____	157 _____	192 _____
33 _____	63 _____	93 _____	123 _____	158 _____	193 _____
34 _____	64 _____	94 _____	124 _____	159 _____	194 _____
35 _____	65 _____	95 _____	125 _____	160 _____	195 _____
36 _____	66 _____	96 _____	126 _____	161 _____	196 _____
37 _____	67 _____	97 _____	127 _____	162 _____	197 _____
38 _____	68 _____	98 _____	128 _____	163 _____	198 _____
39 _____	69 _____	99 _____	129 _____	164 _____	199 _____

Macro Set 1

RE RD	UE UD	T1 T2 T3 TF
TE TD	AU AL	RE AD
TL TS	UU UH	SE SD
CA PC PU PL	EE ED	SI SO
ME MD	XC NC	KE KD
CE CD	PT PX	TM TU
TE TD	TD TE TA	ZD ZE
LE LD	XE XD	CT ___
PE PD	RO R1 R2	
LE LD	P1 P2 P3 SP RP RS	

UF 1 2 3 4 5 6 7 8

LINK OFF RCV XMT   FREQ _____

Macro Set 2

RE RD	UE UD	T1 T2 T3 TF
TE TD	AU AL	RE AD
TL TS	UU UH	SE SD
CA PC PU PL	EE ED	SI SO
ME MD	XC NC	KE KD
CE CD	PT PX	TM TU
TE TD	TD TE TA	ZD ZE
LE LD	XE XD	CT ___
PE PD	RO R1 R2	
LE LD	P1 P2 P3 SP RP RS	

UF 1 2 3 4 5 6 7 8

LINK OFF RCV XMT   FREQ _____

Macro Set 3

RE RD	UE UD	T1 T2 T3 TF
TE TD	AU AL	RE AD
TL TS	UU UH	SE SD
CA PC PU PL	EE ED	SI SO
ME MD	XC NC	KE KD
CE CD	PT PX	TM TU
TE TD	TD TE TA	ZD ZE
LE LD	XE XD	CT ___
PE PD	RO R1 R2	
LE LD	P1 P2 P3 SP RP RS	

UF 1 2 3 4 5 6 7 8

LINK OFF RCV XMT   FREQ _____

Macro Set 4

RE RD	UE UD	T1 T2 T3 TF
TE TD	AU AL	RE AD
TL TS	UU UH	SE SD
CA PC PU PL	EE ED	SI SO
ME MD	XC NC	KE KD
CE CD	PT PX	TM TU
TE TD	TD TE TA	ZD ZE
LE LD	XE XD	CT ___
PE PD	RO R1 R2	
LE LD	P1 P2 P3 SP RP RS	

UF 1 2 3 4 5 6 7 8

LINK OFF RCV XMT   FREQ _____

Appendix A

User Commands

V5

Touch-Tone-Pad Test
(Pad Test Prefix) (sequence of up to 32 keys)

Autopatch
(Autopatch Prefix) (telephone number)

User Loadable Autodial Load
(Autodial Load/Erase Prefix)(Location)(Phone Number) or
(Autodial Load/Erase Prefix)*(Location)(Phone Number)
[phone number secured from readback]

User Loadable Autodial Erase
(Autodial Load/Erase Prefix) (Location)

User Loadable Autodial Readback
(Autodial Load/Erase Prefix)*(Location)

User Loadable Autodial
(User Loadable Autodial Prefix) (Location)

Emergency Autodial
(Emergency Autodial Prefix) (Location)

Reverse Patch Activate (from phone only)
(Reverse Patch Command)#

Reverse Patch Answer
(Patch Utility Prefix)

Extending the Telephone Timer (from phone only)
(Telephone Timer Extend Command)#

Patch Hangup

(Patch Hangup Command)

Patch Custom Hangup Code

(Patch Utility Prefix) (any 3 keys except # or D)

Patch Redial

(Patch Utility Prefix) *

Patch Full-Duplex

(Patch Utility Prefix) *1

Patch Cover Tone

(Patch Utility Prefix) *2

Patch Timer Extend

(Patch Utility Prefix) *3

BCD or Fixed Frequency Link / Remote Base

(Link Prefix) 1	Link On Receive Only
(Link Prefix) 2	Link On Receive / Transmit
(Link Prefix) 3	Link Off
(Link Prefix) (mhtof)	Link Frequency
(Link Prefix) (m*htof)	Link Frequency

FC-900 Link / Remote Base

(Link Prefix) 1	Link 1 On Receive Only
(Link Prefix) 2	Link 1 Receive / Transmit
(Link Prefix) 3	Link 1 Off
(Link Prefix) 4	Link 2 On Receive Only
(Link Prefix) 6	Link 2 Off
(Link Prefix) *	Swap Link 1 / Link 2 Bands
(Link Prefix) 1 x	Link 1 Band Select
(Link Prefix) 4 x	Link 2 Band Select

x = 0	1240	7	420
1	10 meter	8	1280
2	2 meter	9	1290
3	220	A	1270 (±20 MHz)
4	440	B	1270 (±12 MHz)
5	430	C	1250
6	6 meter		

(Link Prefix) (mhtof)	Link 1 Frequency
(Link Prefix) (m*htof)	Link 1 Frequency
(Link Prefix) 1 (m*htof)	Link 1 Frequency
(Link Prefix) 4 (m*htof)	Link 2 Frequency
(Link Prefix) 1 *	Link 1 Power Interrogate
(Link Prefix) 1 * 1	Link 1 High Power
(Link Prefix) 1 * 0	Link 1 Low Power
(Link Prefix) 7 xx	CTCSS Select (00=off, 01-38=on)

V5 | ## HF Remote Base

(HF Prefix) 1	Receive Only
(HF Prefix) 2	Receive / Transmit
(HF Prefix) 3	Off
(HF Prefix) 8	Frequency Interrogate
(HF Prefix) (10M)M*HT(O(h(t)))	
	Frequency Enter
(HF Prefix) 6	Bump Up 100 Hz
(HF Prefix) 4	Bump Down 100 Hz
(HF Prefix) 9	Bump Up 500 Hz
(HF Prefix) 7	Bump Down 500 Hz
(HF Prefix) A	Bump Up 20 Hz
(HF Prefix) B	Bump Down 20 Hz
(HF Prefix) 7 1	Scan Down Slow
(HF Prefix) 7 3	Scan Up Slow
(HF Prefix) 7 4	Scan Down Medium
(HF Prefix) 7 6	Scan Up Medium
(HF Prefix) 7 7	Scan Down Fast
(HF Prefix) 7 9	Scan Up Fast
Carrier	Stop Scan
(HF Prefix) 1 (mode)	Mode (1=USB,2=LSB,3=AM,4=FM)
(HF Prefix) 5 (00-99)	Memory
(HF Prefix) 5	Return to VFO A

S-Meter Readback
(S-Meter Command)

Demonstration / Bulletin Board
(Demo Prefix) (0-9, *)
          (0 = Initial ID Message)
          (1 = Forced CW ID Message)
          (2 = Anxious ID Message)
          (3 = Pending ID Message 1)
          (4 = Pending ID Message 2)
          (5 = Pending ID Message 3)
          (6 = Special ID Message)
          (7 = Bulletin Board Message 1)
          (8 = Bulletin Board Message 2)
V5   (9 = Time of Day Announcement)
          (* = Firmware Revision Announcement)

Unmuting Touch-Tone
(sequence)

Two-Tone Paging

(2-Tone Paging Prefix)(A Group number)(A Tone number)(B Group number)(B Tone number)

(2-Tone Paging Prefix)(Group number)(Tone number)[group call]

Memory Paging

(Memory Paging Prefix) xxx
      xxx = 000 - 999

Touch-Tone Access

(TT Access Mode Prefix) 0 [down]
(TT Access Mode Prefix) 1 [up]

Spare Audio Select

(Spare Audio Command)
knock down

User Function (Remote Control) Output Force & Interrogate

(UF Prefix) (Output #1-8) (1=on, 0=off)
(UF Prefix) (Output #1-8) Interrogate

Appendix B

Control Operator Commands

Macro Set Selection Commands

1 M1 **Macro Set 1 Select**   Selects Control Op Macro Set #1.
2 M2 **Macro Set 2 Select**   Selects Control Op Macro Set #2.
3 M3 **Macro Set 3 Select**   Selects Control Op Macro Set #3.
4 M4 **Macro Set 4 Select**   Selects Control Op Macro Set #4.
5 M5 **Macro Set 5 Select**   Selects Control Op Macro Set #5.

V5 **100** 1-5   **Interrogate Currently Selected Macro Set**
V5 **101** S on   **Scheduler On**   Enables scheduler.
V5 **102** S off   **Scheduler Off**   Disables scheduler.
V5 **103** on/off   **Interrogate Scheduler On / Off**

Repeater Enable / Disable Commands

00 RE **Repeater Enable**   Enables repeater transmitter.
01 RD **Repeater Disable**   Disables repeater transmitter.

Repeater Timer Commands

02 TE **Repeater Timer Enable**   Enables repeater timeout
                                                                 timer.
03 TD **Repeater Timer Disable**   Disables repeater timeout
                                                                 timer.
04 TL **Repeater Timer Long**   Selects long timeout timer.
05 TS **Repeater Timer Short**   Selects short timeout timer.
06 TC **Clear Repeater Timer**   Cancels timeout condition,
                                                                 clears timer.
65 ZD **Zero Hang Time Disable** Disables zero hang time.
66 ZE **Zero Hang Time Enable** Enable zero hang time.

Access / Control Commands

07	CA	**Carrier Access / Control**	Enables carrier access and control.
08	PC	**CTCSS COP Command**	Enables carrier access, CTCSS required for Control Op Touch-Tone commands.
09	PU	**CTCSS COP/User Cmd**	Enables carrier access, CTCSS required for Control Op and User commands.
10	PL	**CTCSS Access**	CTCSS required for access and control.
52	ME	**TT Access Mode Enable**	Enables Touch-Tone Access Mode.
53	MD	**TT Access Mode Disable**	Disables Touch-Tone Access Mode.
61	KE	**Kerchunker Filter Enable**	Enables kerchunker filter.
62	KD	**Kerchunker Filter Disable**	Disables kerchunker filter.
V5	**110**	**Keyup Counter**	Say number of keyups.

User Command Enable / Disable Commands

11	CE	**User Command Enable**	Enables User Touch-Tone commands.
12	CD	**User Command Disable**	Disables User Touch-Tone commands.
41	TE	**Pad Test Enable**	Enables Touch-Tone Pad Test.
42	TD	**Pad Test Disable**	Disables Touch-Tone Pad Test.
63	TM	**Touch-Tone Mute**	Mutes Touch-Tone through the repeater.
64	TU	**Touch-Tone Unmute**	Unmutes Touch-Tone through the repeater.

Link Enable / Disable Commands

	13	LE **Link Enable**	Enables link / remote base.
	14	LD **Link Disable**	Disables link / remote base.
V5	**105**	2E **FC-900 Link 2 Enable**	Enables FC-900 Link 2.
V5	**106**	2D **FC-900 Link 2 Disable**	Disables FC-900 Link 2.
V5	**107**	HE **HF Remote Base Enable**	Enables HF remote.
V5	**108**	HD **HF Remote Base Disable**	Disables HF remote.

Autopatch / Autodial Commands

19	PE	**Autopatch Enable**	Enables Autopatch.
20	PD	**Autopatch Disable**	Disables Autopatch.
27	LE	**Long Distance Enable**	Enables Autopatch long distance.
28	LD	**Long Distance Disable**	Disables Autopatch long distance.

21	UE	**User Autodial Enable**	Enables User Loadable Autodialer.
22	UD	**User Autodial Disable**	Disables User Loadable Autodialer.
47	AU	**User Autodial Unlock**	Unlocks User Loadable Autodialer.
48	AL	**User Autodial Lock**	Locks User Loadable Autodialer.
57	UU	**User Autodial Unhide**	Allows secured numbers to be read back.
58	UH	**User Autodial Hide**	Secures autodial numbers loaded w/ option.
23	EE	**Emergency Autodial Enable**	Enables Emergency Autodialer.
24	ED	**Emergency Autodial Disable**	Disables Emergency Autodialer.
60	NC	**Dial Needing Click**	Requires user click to initiate dialing.
59	XC	**Dial Without Click**	Enables dialing without user click.
68	NR	**No Phone Number Readback**	Disables phone number readback and disables autodial location read-back and enables dialing without user click.
25	PT	**Patch Timer Enable**	Enables patch timers.
26	PX	**Patch Timer Disable**	Disables patch timers.
49	TD	**Cover Tone Disable**	Disables patch cover tone.
50	TE	**Cover Tone Enable**	Enables patch cover tone - user selected.
51	TA	**Cover Tone Always On**	Enables patch cover tone for all patches.
69	FD	**Full-Duplex User Selectable ('96 only)**	Patches are half-duplex unless user selected to be full-duplex.
80	FA	**Full-Duplex Always ('96)**	All patches are full-duplex.
43	- -	**Control Op Offhook**	"Manually" takes phone offhook.
44	- -	**Control Op Onhook**	Places phone onhook (hangup).

<u>Reverse Patch Commands</u>

45	XE	**Reverse Patch Enable**	Enables Reverse Patch.
46	XD	**Reverse Patch Disable**	Disables Reverse Patch.
54	R0	**Reverse Patch Mode 0**	Selects phone control mode.
55	R1	**Reverse Patch Mode 1**	Selects automatic ringout after 5 sec.

	56	R2	**Reverse Patch Mode 2**	Selects auto. ringout w/out answering.
	67	R3	**Reverse Patch Mode 3**	Selects telephone access paging/phone line control
V5	**109**	R4	**Reverse Patch Mode 4**	Places caller directly on air.
V5	**104**		**Don't Answer Phone For 2 Minutes**	

ID Commands

29	P1	**Pending ID 1**	Selects Pending ID 1.
30	P2	**Pending ID 2**	Selects Pending ID 2.
31	P3	**Pending ID 3**	Selects Pending ID 3.
32	SP	**Special ID**	Selects Special ID.
33	RP	**Rotate Pending IDs**	Rotates Pending ID 1-2-3.
34	RS	**Rotate Pending-Special IDs**	Rotates Pending ID 1-2-3 - Special ID.

Tail Message Commands

35	T1	**Tail Message 1**	Selects Tail Message 1.
36	T2	**Tail Message 2**	Selects Tail Message 2.
37	T3	**Tail Message 3**	Selects Tail Message 3.
38	TF	**Tail Message Off**	Disables Tail Messages.

Alarm Enable / Disable Commands

00	RE	**Alarm Enable**	Enables site alarm.
15	AD	**Alarm Disable**	Disables site alarm.

Speech Synthesizer Commands

16	SE	**Speech Enable**	Enables speech synthesizer.
17	SD	**Speech Disable**	Disables (turns off) speech synthesizer.
39	SI	**Allow Speech Interrupt**	Speech halted by user signal.
40	SO	**Force Speech Talkover**	Speech overrides user signal.

Tone Panel Commands ('96 only, requres Tone Panel Option)

81-88	1E-8E	**Tone 1-8 Enable**	Enables CTCSS tone 1-8.
91-98	1D-8D	**Tone 1-8 Disable**	Disables CTCSS tone 1-8.

Logic Low Courtesy Tone Select

70	CT	**Select Courtesy Tone 0**	No tone
71	CT	**Select Courtesy Tone 1**	Bumblebee
72	CT	**Select Courtesy Tone 2**	Yellow Jacket
73	CT	**Select Courtesy Tone 3**	Shooting Star
74	CT	**Select Courtesy Tone 4**	Comet
75	CT	**Select Courtesy Tone 5**	Stardust
76	CT	**Select Courtesy Tone 6**	Dunce Cap
77	CT	**Select Courtesy Tone 7**	Piano Chord
78	CT	**Select Courtesy Tone 8**	Boop
79	CT	**Select Courtesy Tone 9**	Beep

Initialize Command

18	- -	**Reset**	Initializes controller, loads Macro Set 1.

Programming Commands

Morse	Speech			
*1000	***1100**	**Initial ID**	II	20
*1001	**- - - -**	**Forced CW ID**	FI	12
*1002	***1102**	**Anxious ID**	AI	12
*1003	***1103**	**Pending ID 1**	P1	24
*1004	***1104**	**Pending ID 2**	P2	24
*1005	***1105**	**Pending ID 3**	P3	24
*1006	***1106**	**Special ID**	SI	48
*1007	***1107**	**Tail Message 1**	T1	8
*1008	***1108**	**Tail Message 2**	T2	8
*1009	***1109**	**Tail Message 3**	T3	8
*1010-9	***1110-9**	**Autodial 0-9 Service**	E0-E9	6
*1020	***1120**	**Phone Answer**	PH	16
*1021	***1121**	**Phone Hangup**	HG	8
*1022	***1122**	**Alarm**	AL	8
*1023	***1123**	**Bulletin Board #1**	B1	32
*1024	***1124**	**Bulletin Board #2**	B2	32
	*1125	**Patch Dialing Prefix**	DX	6

	Morse	Speech			
V5	- - - -	***1126**	**Permitted Area Code 1**	P1	4
V5	- - - -	***1127**	**Permitted Area Code 2**	P2	4
V5	- - - -	***1128**	**Permitted Area Code 3**	P3	4
V5	- - - -	***1129**	**Permitted Area Code 4**	P4	4
V5	- - - -	***1130**	**Permitted Area Code 5**	P5	4
V5	- - - -	***1131**	**Max. # "Local" Digits (7 or 8)**	LD	1

Tone Parameters

*2000(speed)	**Morse Code Speed**	speed=12-30 wpm
*2010(pitch)	**Morse Code Pitch**	pitch=0-3000 Hz
*2020(pitch)	**Cover Tone Pitch**	pitch=0-3000 Hz

Courtesy Tone Selection

*3001(ct)	**CT SEL Logic High Tone**	ct = 0-9	CT
*3002(ct)	**Link Tone**	ct = 0-9	CT

Timers

*4000(period)	**Repeater Timeout Long**	(≈30-1799 sec)	TL
*4001(period)	**Repeater Timeout Short**	(≈15-1799 sec)	TS
*4002(period)	**Phone Answer Delay**	(≈10-≈60 sec)	PA
*4003(period)	**Autopatch Timer**	(0, ≈60-1799 sec)	AP
*4004(period)	**User Autodial Timer**	(0, ≈60-1799 sec)	AU
*4005(period)	**Emerg. Autodial Timer**	(0, ≈60-1799 sec)	AE
*4006(period)	**Patch Activity Timer**	(0, ≈30-1799 sec)	AA
*4007(period)	**Patch Timer Extend Timer**	(0, ≈30-1799 sec)	TX
*4008(period)	**Tail Message Timer**	(≈60-1799 sec)	TM
*4009(period)	**Touch-Tone Access Timer**	(0, ≈30-1799 sec)	TA
*4010(period)	**Hang Timer**	(≈750-≈5000 <u>ms</u>)	HT
*4011(period)	**Spare Audio Timer**	(0, ≈30-≈1799 sec)	SP
*4012(period)	**ID Timer**	(amateur - 360 sec, commercial - 540 or 1140 sec)	ID
*4013(period)	**Ringout Timer**	(≈10 - 120 sec)	RO
*4014(period)	**Mode 3 Paging Talkout Timer**	(≈10 - 60 sec)	TK
*4015(period)	**Alarm Timer**	(0, ≈10 - 1799 sec)	AL

V5

Clock Calendar and Scheduler

*4100 AP H10 H1 M10 M1 Set Time (12 hr mode)	time
*4100 H10 H1 M10 M1 Set Time (24 hr mode)	time
*4101 M10 M1 D10 D1 Y10 Y1 Set Date	DATE
*4102 DOW Set Day of Week	DOW
*420S Nth DOW AP H10 H1 M10 M1 M#	
** Define Setpoint (12 hr mode)**	SETPT
*420S Nth DOW H10 H1 M10 M1 M#	
** Define Setpoint (24 hr mode)**	SETPT

Tone Panel Frequency Selection (requires Tone Panel Option)

*5100 x   Tone #1 Encode (x=1) or Decode (x=0) TONE

*510T FF Tone (T) 1-8 Frequency Selection (FF) TONE

V5 [Tone #1/FF - 39=Regen. when mobile present, 40=Regen. continuous,
 41=Lockout/regen. when mobile present, 42=Lockout/regen. continuous]

Command Code Prefixes

*5000(prefix)	**Control Operator Command**	CMD
*5001(prefix)	**User Function Logic Output**	CMD
*5002(prefix)	**Emergency Autodial**	CMD
*5003(prefix)	**User Loadable Autodial**	CMD
*5004(prefix)	**Autopatch**	CMD
*5005(prefix)	**Link / Remote Base**	CMD
*5006(prefix)	**User Autodial Load / Erase**	CMD
*5007(prefix)	**Demo / Bulletin Board**	CMD
*5008(command)	**Reverse Patch (from phone only)**	CMD
*5009(command)	**Spare Audio**	CMD
*5010(prefix)	**Patch Utilities**	CMD
*5011(command)	**Patch Hangup**	CMD
*5012(prefix)	**Two-Tone Paging**	CMD
*5013(prefix)	**Touch-Tone Access Mode Up/Down**	CMD
*5014(command)	**S-Meter Readback**	CMD

*5015(prefix)	**Extended User Autodial (Bank 1)**	CMD
*5016(prefix)	**Extended User Autodial Load/Erase**	CMD
*5017(command)	**Telephone Timer Extend Command**	CMD
*5018(prefix)	**Memory Paging**	CMD
*5019(prefix)	**Touch-Tone Pad Test**	CMD
V5 ***5020(prefix)**	**HF Remote Base**	CMD

Emergency Autodial Numbers
*520x(telephone number)   x = location 0 - 9   Phone number

V5   ### FC-900 Band Unit Configuration
*530B P   **Band Unit Present / Absent**   FCBU

B: band unit (1=10M, 2=6M, 3=2M, 4=220,5=440,6=1200)
P: present / absent (1=present, 0=absent)

Misc. Selections

*5400	**Touch-Tone patch signalling**	TT
*5401	**Dial Pulse signalling**	DP
*5402	**Enable control over repeater receiver**	EC
*5403	**Disable control over repeater receiver**	DC
*5404	**Phone line not shared**	PLU
*5405	**Phone line shared**	PLS
*5406	**UF Low True**	FL
*5407	**UF High True**	FH
*5408	**UF Strobe High True ('85 only)**	STH
*5409	**UF Strobe Low True ('85 only)**	STL
V5 ***5410**	**Link COS Low True**	CL
*5411	**Link COS High True**	CH

Store Macro Sets 1-5
*5911-*5915   Store Macro Set #1-#5   MACRO

Pager Memories ('96 only)
*29 xxx f aaaa(aa)PAGE

     xxx = three digit memory number (000-999)
     f = pager format

0 = 1 second/3 second 2-tone		4 = DTMF
1 = 2.7 second/.8 second 2-tone		5 = five tone sequential
2 = .4 second/.8 second 2-tone		6 = siz tone sequential
3 = 8 second group call		

     aaaa(aa) = pager address
     two-tone - A group, A tone, B group, B tone
     two-tone group call - A group, A tone, A group, A tone
     DTMF - 4 or 6 digits (0-9, *, A, B, C), fill unused digits
       with D keys
     5/6 tone - wakeup tone, tones 1-5 (six digits) [for no
       wakeup tone, insert * as first digit]

Vocabulary

(Words noted with † are spoken with the female voice)

(PAUSE)	34
A	21
A.M.	*110
ABORT	*992
ABOUT	*855
ABOVE	*112
ACKNOWLEDGE	*114
ACTION	*115
ADJUST	*944
ADVANCED	*916
ADVISE	*116
AERIAL	*117
AFFIRMATIVE	*118
AFTERNOON†	*842
AIR	*120
AIRPORT	*122
ALERT	40
ALL	*685
ALOFT	*124
ALPHA	*621
ALTERNATE	*125
ALTITUDE	*127
AMATEUR	*917
AMPS	*831
AND	74
ANSWER	*128
APRIL	*131
AREA	*713
ARRIVAL	*132
AS	*133
AT	*742
AUGUST	*135
AUTO	*918
AUTOMATIC	*741
AUTOPILOT	*136
AUXILIARY	*137
B	22
BAND	*138
BANK	*140
BASE	*141
BATTERY	*142

BELOW	*143
BETWEEN	*660
BLOWING	*144
BOARD	*145
BOOST	*146
BOZO	*147
BRAKE	*148
BRAVO	*622
BREAK	*743
BROKEN	*151
BUTTON	*993
BY	*152
C	23
CABIN	*153
CALIBRATE	*735
CALL	*751
CALLING	*155
CALM	*156
CANCEL	*664
CAUTION	*711
CEILING	*158
CENTER	*161
CHANGE	*875
CHARLIE	*623
CHECK	*865
CIRCUIT	*720
CLEAR	*163
CLIMB	*165
CLOCK	*945
CLOSED	*166
CLUB	*926
CODE	75
COME	*167
COMPLETE	*721
COMPUTER	*927
CONDITION	*168
CONGRATULATIONS	*170
CONNECT	*940
CONTACT	*171
CONTROL	*624
CONVERGING	*172

COUNT	*173	EQUAL	*893
COURSE	*174	-ER (suffix)	*210
CRANE	*950	ERROR	*211
CROSSWIND	*175	ESTIMATED	*212
CURRENT	*177	EVACUATE	*213
CYCLE	*951	EVACUATION	*214
		EVENING†	*843
D	31	EXIT	*761
DANGER	*712	EXPECT	*215
DAYS	*952		
DAYTON	*928	F	33
DECEMBER	*181	FAIL	*755
DECREASE	*182	FAILURE	*216
DECREASING	*183	FARAD	*930
DEGREES	*722	FARENHEIT	*217
DELTA	*631	FAST	*925
DEPARTURE	*185	FEBRUARY	*218
DEVICE	*953	FEET	15
DIAL	*936	FIF-	50
DINNER	*186	FIFTEEN†	*854
DIRECTION	*752	FIFTY†	*850
DISPLAY	*954	FILED	*223
DOOR	*955	FINAL	*224
DOWN	*654	FIRE	*634
DOWNWIND	*188	FIRST	*225
DRIVE	*190	FIVE	05
DRIZZLE	*191	FIVE†	*805
DUST	*192	FLAPS	*227
		FLIGHT	*228
E	32	FLOW	*960
EAST	*754	FOG	*230
ECHO	*632	FOR	*231
-ED (suffix)	*193	FORTY†	*840
EIGHT	08	FOUR	04
EIGHT†	*808	FOUR†	*804
EIGHTEEN†	*884	FOURTEEN†	*814
ELECTRICIAN	*943	FOURTH	*234
ELEVATION	*196	FOXTROT	*633
ELEVEN	11	FREEDOM	*235
ELEVEN†	*811	FREEZING	*236
EMERGENCY	*937	FREQUENCY	*610
ENGINE	*198	FRIDAY	*237
ENTER	*955	FROM	64

FRONT	*238	IGNITION	*267
FULL	*241	IMMEDIATELY	*268
		IN	*270
G	41	INBOUND	*271
GALLONS	*991	INCH	*964
GATE	*845	INCREASE	*272
GAUGE	*961	INCREASING TO	*274
GEAR	*244	INDIA	*643
GET	*962	INDICATED	*275
GLIDE	*245	INFLIGHT	*276
GO	*895	INFORMATION	*996
GOLF	*641	-ING (suffix)	*948
GOOD†	*834	INNER	*277
GREEN	*762	INSPECTOR	*785
GROUND	*248	INTRUDER	*764
GUSTING TO	*250	IS	*733
		IS†	*823
H	42	IT	*281
HAIL	*251		
HALF	*252	J	51
HAM	*938	JANUARY	*282
HAMFEST	*946	JULIET	*651
HAMVENTION	*947	JULY	*283
HAVE	*253	JUNE	*284
HAZARDOUS	*254		
HAZE	*255	K	52
HEAVY	*257	KEY	*285
HELP	*258	KILO	*652
HENRY	*260	KNOTS	*286
HERTZ	*684		
HIGH	*763	L	53
HOLD	*963	LAND	*287
HOME	*615	LANDING	*288
HOTEL	*642	LATE	*956
HOUR	*261	LAUNCH	*291
HOURS	*655	LEAN	*292
HUNDRED	*640	LEFT	*770
		LEG	*293
I	43	LESS THAN	*294
ICE	*262	LEVEL	*295
ICING	*263	LIGHT	*934
IDENTIFY	*264	LIMA	*653
IGNITE	*266	LINE	*942

LINK	*998	N	62
LIST	*296	NEAR	*333
LOCK	*297	NEGATIVE	*334
LONG	*298	NET	25
LOOK	*957	NEW	*335
LOW	*771	NEXT	*336
LOWER	*310	NIGHT	*337
LUNCH	*311	NINE	09
		NINE†	*809
M	61	NINETEEN†	*894
MACHINE	84	NO	*342
MAINTAIN	*312	NORTH	*772
MANUAL	*965	NOT	*695
MARCH	*313	NOVEMBER	*662
MARKER	*314	NUMBER	*734
MAY	*315		
MAYDAY	*316	O	63
ME	*920	OBSCURED	*344
MEAN	*317	O'CLOCK	*345
MEASURE	*970	O'CLOCK†	*824
MEETING	35	OCTOBER	*346
MEGA	*680	OF	*694
MESSAGES	*625	OFF	*614
METER	*620	OH†	*800
MICRO	*931	OHIO	*348
MIKE	*661	OHMS	*933
MILES	*322	OIL	*350
MILL	*971	ON	*613
MILLI	*825	ONE	01
MILLION	*323	ONE†	*801
MINUS	*612	OPEN	94
MINUTES	*645	OPERATION	*352
MIST	*324	OPERATOR	*630
MOBILE	*958	OSCAR	*663
MODERATE	*326	OTHER	*353
MONDAY	*327	OUT	*740
MONTH	*328	OUTER	*355
MORE THAN	*330	OVER	*773
MORNING†	*841	OVERCAST	*356
MOTOR	*972		
MOVE	*973	P	71
MUCH	*332	P.M.	*358
		PAPA	*671

PARTIALLY	*361	RICH	*383
PASS	*774	RIG	*384
PASSED	*974	RIGHT	*665
PATCH	*966	ROAD	*385
PATH	*362	ROGER	*386
PER	*364	ROMEO	*672
PERCENT	*675	ROUTE	*388
PHONE	*914	RUNWAY	*390
PICO	*932		
PLEASE	*967	S	73
PLUS	*611	-S (suffix)	*915
POINT	*674	SAFE	*784
POLICE	*968	SAND	*391
POSITION	*780	SANTA CLARA	*392
POWER	*714	SATURDAY	*393
PRACTICE	85	SCATTERED	*394
PRESS	*781	SECOND	*395
PRESSURE	*935	SECONDS	*635
PRIVATE	*366	SECURITY	*396
PROBE	*975	SELECT	*397
PROGRAMMING	*367	SEPTEMBER	*398
PULL	*980	SEQUENCE	*410
PUSH	*977	SERVICE	*723
		SET	*885
Q	70	SEVEN	07
QUEBEC	*670	SEVEN†	*807
		SEVENTEEN†	*874
R	72	SEVERE	*413
RADIO	*976	SEXY	*414
RAIN	*374	SHORT	*415
RAISE	*375	SHOWERS	*416
RANGE	*981	SHUT	*765
RATE	*376	SIDE	*417
READY	*783	SIERRA	*673
REAR	*377	SIGHT	*418
RECEIVE	*378	SIX	06
RED	*744	SIX†	*806
RELEASE	*381	SIXTEEN†	*864
REMARK	*382	SLEET	*423
REMOTE	*910	SLOPE	*424
REPAIR	*745	SLOW	*983
REPEAT	*982	SMOKE	*795
REPEATER	80	SNOW	*425

SOUTH	*790	TIME	44
SPEED	*984	TIME†	*822
SPRAY	*427	TIMER	*732
SQUAWK	*428	TO	*455
STALL	*431	TODAY	*456
START	*730	TOMORROW	55
STOP	*731	TONIGHT	45
STORM	*433	TOOL	*985
SUNDAY	*434	TORNADO	*457
SWITCH	*725	TOUCHDOWN	*458
SYSTEM	*997	TOWER	*460
		TRAFFIC	*461
T	81	TRANSMIT	*462
TANGO	*681	TRIM	*463
TANK	*435	TUESDAY	*464
TARGET	*436	TURBULENCE	*465
TAXI	*437	TURN	*990
-TEEN (suffix)	14	TWELVE	12
TELEPHONE	*438	TWELVE†	*812
TEMPERATURE	*724	TWENTY	20
TEN	10	TWENTY†	*820
TEN†	*810	TWO	02
TERMINAL	*440	TWO†	*802
TEST	*792	-TY (suffix)	60
-TH (suffix)	*441		
THANK YOU	*978	U	82
THAT	*442	UNDER	*775
THE	24	UNIFORM	*682
THE (long e)	*443	UNIT	*715
THE (short e)	*444	UNLIMITED	*467
THE†	*821	UNTIL	*468
THIR-	13 or 30	UP	*650
THIRD	*447	USE (noun)	*470
THIRTEEN	*448	USE (verb)	*471
THIRTEEN†	*813		
THIRTY†	*830	V	83
THIS	*451	VALLEY	*986
THIS IS	65	VALVE	*941
THOUSAND	*644	VARIABLE	*473
THREE	03	VERIFY	*475
THREE†	*803	VICTOR	*683
THUNDERSTORMS	*452	VISIBILITY	*476
THURSDAY	*453	VOLTS	*750

W	91	**NUMBERS (MALE)**	
WAIT	54	NUMBER	*734
WAKE	*477	ZERO	00
WAKE UP	*478	OH	63
WARNING	*480	ONE	01
WATCH	*481	TWO	02
WATTS	*815	THREE	03
WAY	*482	FOUR	04
WEATHER	95	FIVE	05
WEDNESDAY	*484	SIX	06
WELCOME	*913	SEVEN	07
WEST	*793	EIGHT	08
WHISKEY	*691	NINE	09
WILL	*912	TEN	10
WIND	*487	ELEVEN	11
WITH	*490	TWELVE	12
WRONG	*491	THIRTEEN	*448
		THIR-(prefix)	13
X	92	-TEEN(suffix)	14
X-RAY	*692	TWENTY	20
		FIF-(prefix)	50
Y	93	HUNDRED	*640
YANKEE	*693	THOUSAND	*644
YELLOW	*794	MILLION	*323
YESTERDAY	*492	-TY(suffix)	60
YOU	*493	FIRST	*225
YOUR	*987	SECOND	*395
		THIRD	*447
Z	90	FOURTH	*234
ZED	*988		
ZERO	00	**NUMBERS (FEMALE)**	
ZONE	*494	OH†	*800
ZULU	*690	ONE†	*801
		TWO†	*802
SOUND EFFECTS		THREE†	*803
CROWD	*892	FOUR†	*804
EXPLOSION	*891	FIVE†	*805
LASER	*873	SIX†	*806
PHASER	*882	SEVEN†	*807
TIC	*860	EIGHT†	*808
TOC	*870	NINE†	*809
TRAIN	*883	TEN†	*810
WHISTLE	*881	ELEVEN†	*811

TWELVE†	*812	DIRECTIONS	
THIRTEEN†	*813	EAST	*754
FOURTEEN†	*814	NORTH	*772
FIFTEEN†	*854	SOUTH	*790
SIXTEEN†	*864	WEST	*793
SEVENTEEN†	*874		
EIGHTEEN†	*884	NAMES	
NINETEEN†	*894	CHARLIE	*623
TWENTY†	*820	DEE	31
THIRTY†	*830	HENRY	*642
FORTY†	*840	JAY	51
FIFTY†	*850	JULIET	*651
		KAYE	52
DAYS OF THE WEEK		MIKE	*661
DAYS	*952	OSCAR	*663
SUNDAY	*434	PAPA	*671
MONDAY	*327	ROMEO	*672
TUESDAY	*464	VICTOR	*683
WEDNESDAY	*484		
THURSDAY	*453	RUN-TIME VARIABLES	
FRIDAY	*237	M/A/E	*844
SATURDAY	*393	TIME	*872
		AM/PM	*832
MONTHS OF YEAR		DATE	*833
MONTH	*328	DAY OF WEEK	*871
JANUARY	*282		
FEBRUARY	*218		
MARCH	*313		
APRIL	*131		
MAY	*315		
JUNE	*284		
JULY	*283		
AUGUST	*135		
SEPTEMBER	*398		
OCTOBER	*346		
NOVEMBER	*662		
DECEMBER	*181		
COLORS			
GREEN	*762		
RED	*744		
YELLOW	*794		

Appendix II
Layout, Connectors, Switches and Adjustments

RC-85 BOARD LAYOUT
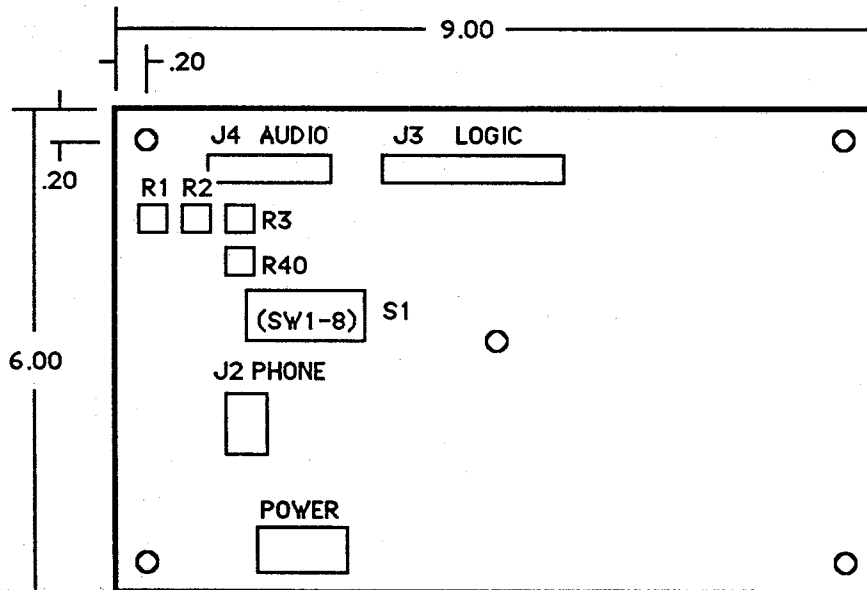
CONNECTORS

J1 - POWER	
PIN	**SIGNAL NAME**
1	Digital Ground
2	+12.6 Volts
3	Battery
4	Analog Ground

J2 - PHONE LINE	
PIN	**SIGNAL NAME**
1	Tip / Ring
2	Ring / Tip

J3 - LOGIC	
PIN	**SIGNAL NAME**
1	Repeater Receiver COS Input
2	Link Receiver COS Input (high true)
3	Control Receiver COS Input
4	PL Logic Input (high true)
5	Courtesy Tone Select Input
6	External Device Busy Input (DVR, tape)
7	Alarm Input
8	Phone Line Busy Input
9	Control Output 2 (CX2)
10	Repeater Transmitter PTT Output
11	Control Output 3 (CX3)
12	Control Output 1 (CX1)
13	Reset (external switch to ground)
14	Digital Ground

J4 - AUDIO	
PIN	**SIGNAL NAME**
1	Analog Ground
2	Direct Transmitter Mixer Audio Input
3	Direct Phone Mixer Audio Input
4	S-Meter Analog Input
5	Control Receiver Audio Input
6	Link Receiver / Spare Audio Input
7	Repeater Receiver Audio Input
8	Repeater Transmitter Audio Output

DIP SWITCH DEFINITIONS

	DESCRIPTION	ON	OFF
SW1	REPEATER RCVR COS	HIGH TRUE	LOW TRUE
SW2	REPEATER TX PTT	HIGH TRUE	LOW TRUE
SW3	CONTROL RCVR COS	HIGH TRUE	LOW TRUE
SW4	CONTROL OUTPUT MODE SELECTION	SEE TABLE BELOW	
SW5			
SW6			
SW7			
SW8	UNLOCK CMD DEFINE	DEFINE UL CODE	NORMAL

MODE / OUTPUT	NO LINK	SINGLE CHANNEL LINK	SYNTHESIZED LINK/REMOTE AND EXPANDED UF OUTPUTS	GLITCH-FREE SYNTHESIZED LINK/REMOTE AND EXPANDED UF OUTPUTS	FC-900 AND EXPANDED UF OUTPUTS
CX1	UF 1	UF 1	SERIAL DATA	SERIAL DATA	DATA
CX2	UF 2	UF 2	SERIAL CLOCK	SERIAL CLOCK	CLOCK
CX3	UF 3	LINK PTT	LINK PTT	SERIAL TRANSFER	TRANSFER
DIP SW SETTINGS	SW4 OFF SW5 OFF SW6 OFF SW7 ON	SW4 ON SW5 OFF SW6 OFF SW7 ON	SW4 ON SW5 ON SW6 OFF SW7 ON	SW4 ON SW5 ON SW6 ON SW7 ON	SW4 ON SW5 ON SW6 ON SW7 OFF

ADJUSTMENTS		
RECEIVER AUDIO LEVEL	R1	Adjust for 4 volts p-p at Transmitter Audio Output with signal present at receiver, to match synthesizer level.
LINK RECEIVER AUDIO LEVEL	R2	Adjust for 4 volts p-p at Transmitter Audio Out with Link in receive mode and signal present at link receiver.
PHONE AUDIO LEVEL	R3	Adjust for 4 volts p-p at Transmitter Audio Output during phone patch.
SPEECH SYNTH. PITCH	R40	Adjust for natural sounding synthesized speech.

Appendix III
Telephone Access Paging for RCC Applications

A modified "reverse patch" mode is available for special applications where two-tone signalling notifies the mobile station that an incoming call is waiting. The mode is selected by turning on DIP switch 7, which overrides the Reverse Patch mode selected by Control Operator commands.

The party calling into the repeater may dial the repeater's phone number, and the controller will answer the phone after the programmed "phone answer delay" period, speaking the "phone answer" message. The caller may enter a four digit paging code, consisting of the group#/tone# group#/tone# as described on page 5-15. However, no command code prefix, and no # command evaluation key are required - simply the four digit code. *This is the only command accepted from the phone in this mode.*

The controller acknowledges the command with "p a g e" over the phone and attempts to generate the two-tone sequence over the air, waiting until the repeater's carrier is about to drop, i.e. at the end of the repeater's hang time. This ensures that a conversation in progress will not be interrupted by the tone signalling. The Touch-Tone decoder listens to the repeater receiver, and the mobile station may answer the reverse patch with the Reverse Patch Answer command. If the call is not answered within one minute of the caller's command entry, the controller automatically terminates the attempt and hangs up after speaking the "phone hangup" message.

Typically, the mobile station would include a two-tone decoder which may sound an alarm or honk the horn when activated.
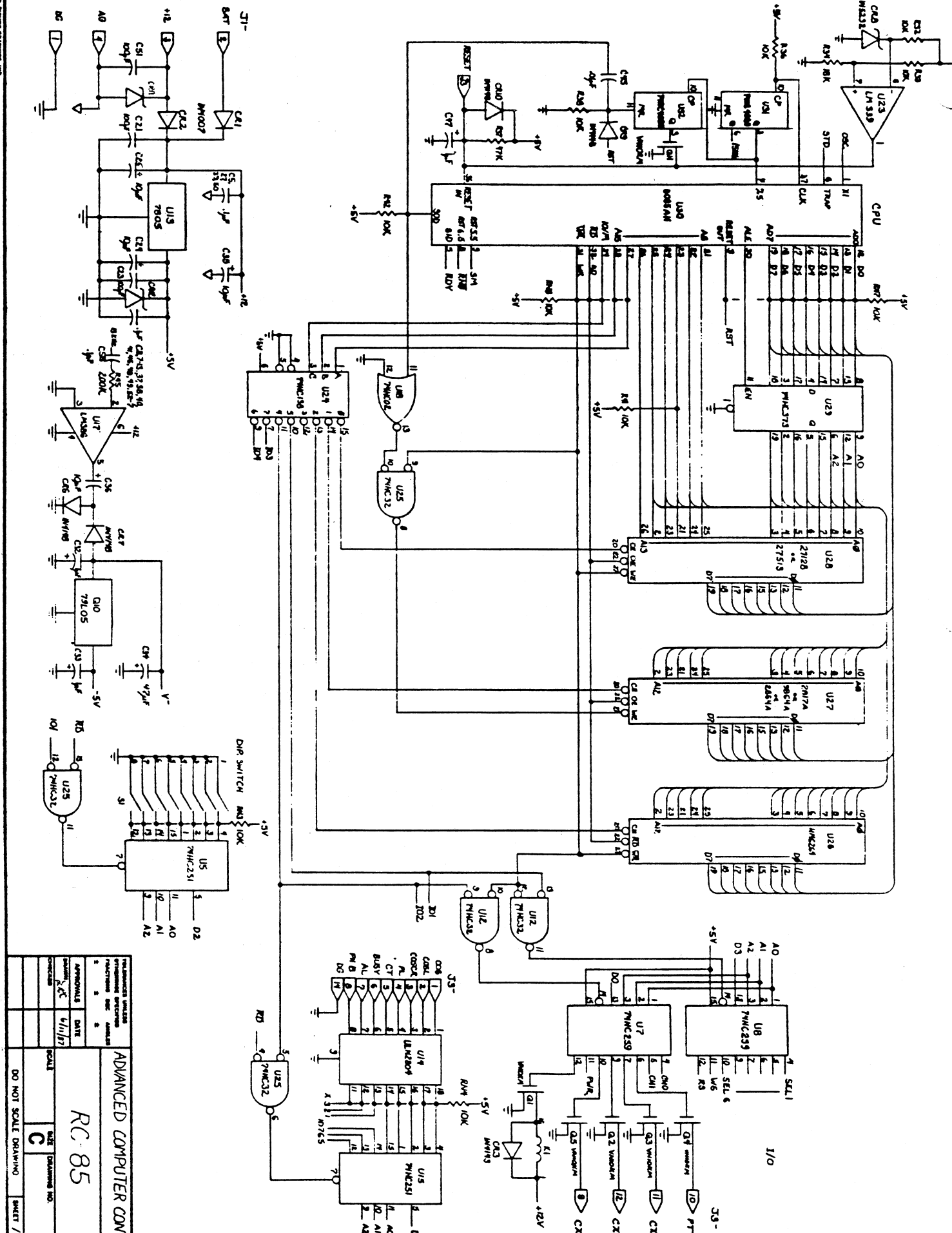
Appendix IV
Schematic

ADVANCED COMPUTER CONTROLS

RC-85

SIZE C

DO NOT SCALE DRAWING

SHEET 1 of 2

ADVANCED COMPUTER CONTROLS

RC-85

DRAWING NO. RC-85
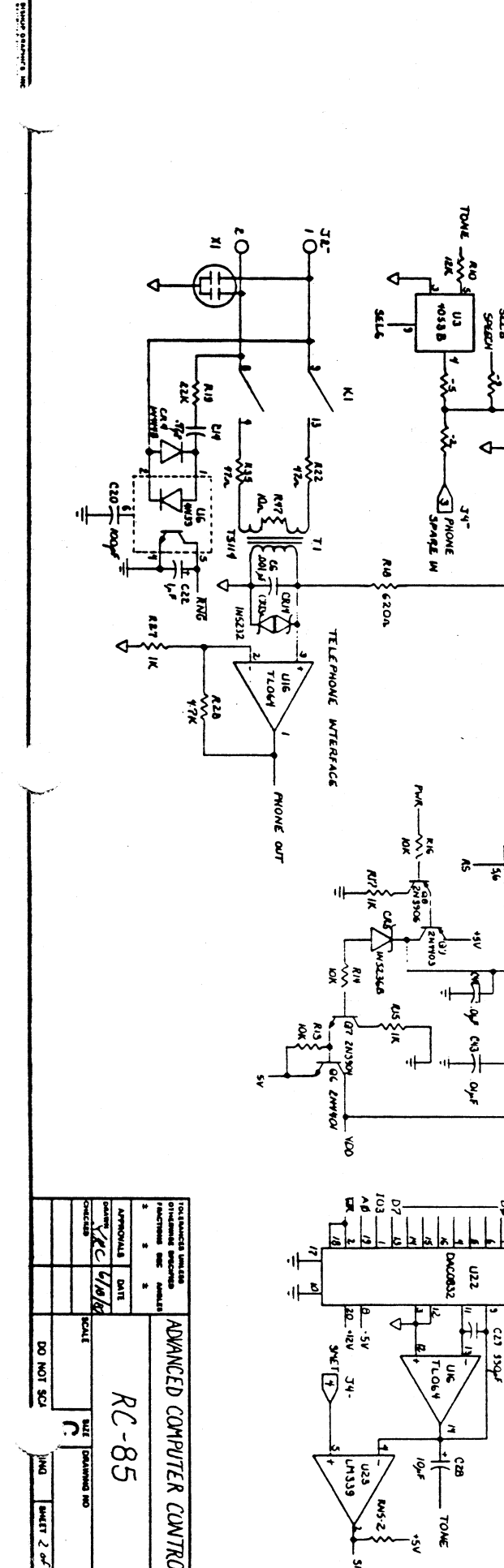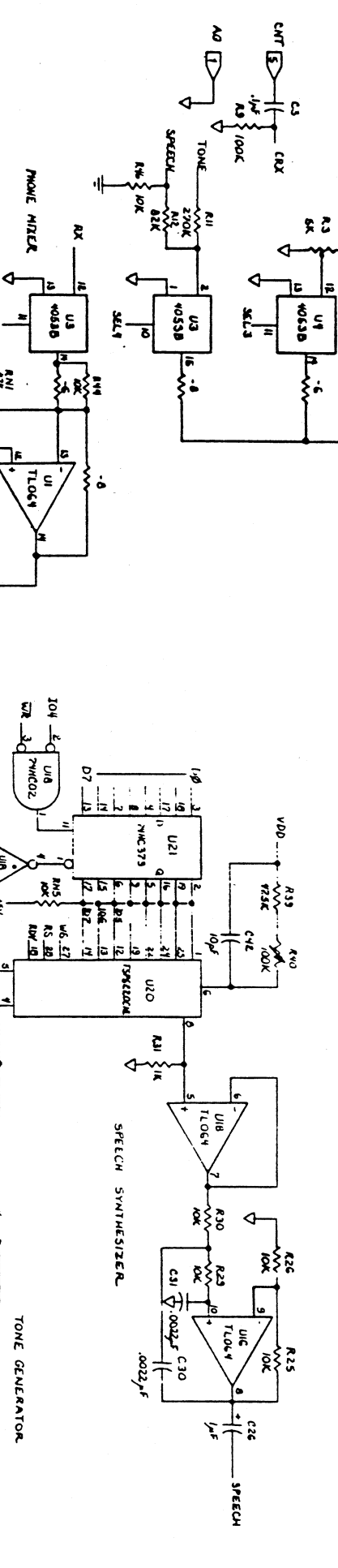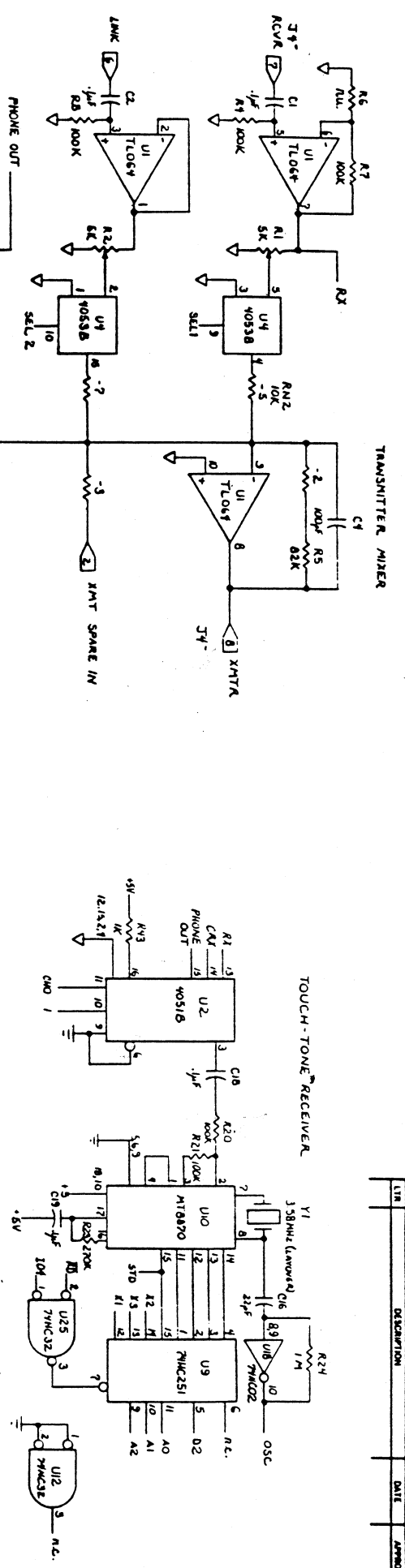
SHEET 2 of 2

Appendix V
Audio Delay Board Kit

Description

The AD-2 audio delay board delays the repeater receiver audio by 75 ms before reaching the repeater (and remote base) transmitter. The delay gives the '85 audio circuitry an opportunity to fully mute Touch-Tone (instead of passing "blips") and to fully mute squelch tails less than 75 ms in duration.

The benefit of squelch tail muting is pleasant listening - no crash, chunk, or click is heard at the end of users' transmissions. - just the courtesy tone. Touch-Tone blip muting has a variety of benefits, including pleasant listening, improved security, and elimination of sending tone blips through the remote base transmitter which could affect the linked repeater's control system.

The 75 ms delay is long enough to mute squelch tails in most receivers. Those receivers designed for a longer squelch tail may be modified in many cases by reducing a capacitor in the squelch circuit to reduce the tail duration.

Installation of the AD-2 board preserved the outstanding audio characteristics of the '85. Although low pass filtering is required on the board because of the sampled data nature of the delay line, flat frequency response is maintained to nearly 6 kHz.

The AD-2 board mounts in an existing IC socket on the '85 board. Three additional signals are picked up by soldering wires to points on the bottom of the '85 board. These three wires are connectorized on the AD-2 board for easy removal if necessary.

Installation

The board is supplied with mounting hardware for "board-only" and "rack-mount" '85s. In addition, a Molex connector and wire is supplied for connections to the bottom of the '85 board.

1. Cut the supplied wires to the following lengths. Strip about 1/8" insulation from one end, and about 1/4" insulation from the other end of each wire and tin each end.

      orange - 8.75"   green - 5.5"   red - 9.5"

2. Crimp a Molex pin on one end (the 1/4" stripped end) of each wire.

3. Install the Molex pins in the white connector housing. Be sure that when the Molex connector plus into the mating connector on the AD-2 board, the wires go to the pin labeled on the board as follows:

      orange - pin 1   green - pin 2   red - pin 3

4. Power down the RC-85 repeater controller, and remove the board from the cabinet. Solder the other end of the wires to points on the bottom of the '85 board as follows:

      orange - U31 pin 5
      green - U14 pin 18
      red - anode of CR1 and CR2 (farthest from the heat sink)

Mount the board back into the cabinet.

5. Remove IC U4 (4053B) from the RC-85 board, and plug it into U5 of the AD-2 board. Be sure to plug it in so that pin 1 is oriented properly.

6. If your repeater receiver's COS signal is low true, remove the jumper wire at JU1.

7. If yours is a "rack mount" '85, plug the 16 pin DIP plug on the botton of the AD-2 board into a single 16 pin socket as a spacer. (Three 16 pin sockets will be left over.) Unscrew the 4-40 screw at the corner of the board next to the J4 audio connector. Screw in the short standoff extender (see the assembly drawing on the following page). Mount the two short plastic spacers in the holes on the two diagonal corners of the AD-2 board using 4-40 screws. These will serve as supporting feet. Be sure that the socket spacer pins are straight, then carefully plug the AD-2 board into socket U4 on the RC-85 board. Screw a 4-40 screw into the standoff extender.

8. If yours is a "board only" '85, build a "socket spacer" consisting of four 16 pin sockets stacked (plugged into each other), and carefully plug the 16 pin DIP plug on the bottom of the AD-2 board into the socket spacer (be sure all the pins are straight before plugging them into the sockets). The socket spacer will allow the board to clear the J4 audio connector on the component side of the board. Unscrew the 4-40 screw at the corner of the board next to the J4 audio connector from your cabinet hardware. Screw in the long standoff extender. Mount the two long plastic spacers in the holes on the two diagonal corners of the AD-2 board using 4-40 screws. These will serve as supporting feet. Be sure that the socket spacer pins are straight, then carefully plug the AD-2 board into socket U4 on the RC-85 board. Screw a 4-40 screw into the standoff extender. See the assembly drawing for "board only" on the following page.

9. Plug the Molex connector into J1 on the AD-2 board. Be sure to polarize the connector properly.

10. Power up the RC-85 controller and repeater. Receive audio should be retransmitted through the repeater, but there should be a noticable delay. Readjust pot R1 on the '85 board if necessary to restore proper receiver audio level.

RC-85 Board Only
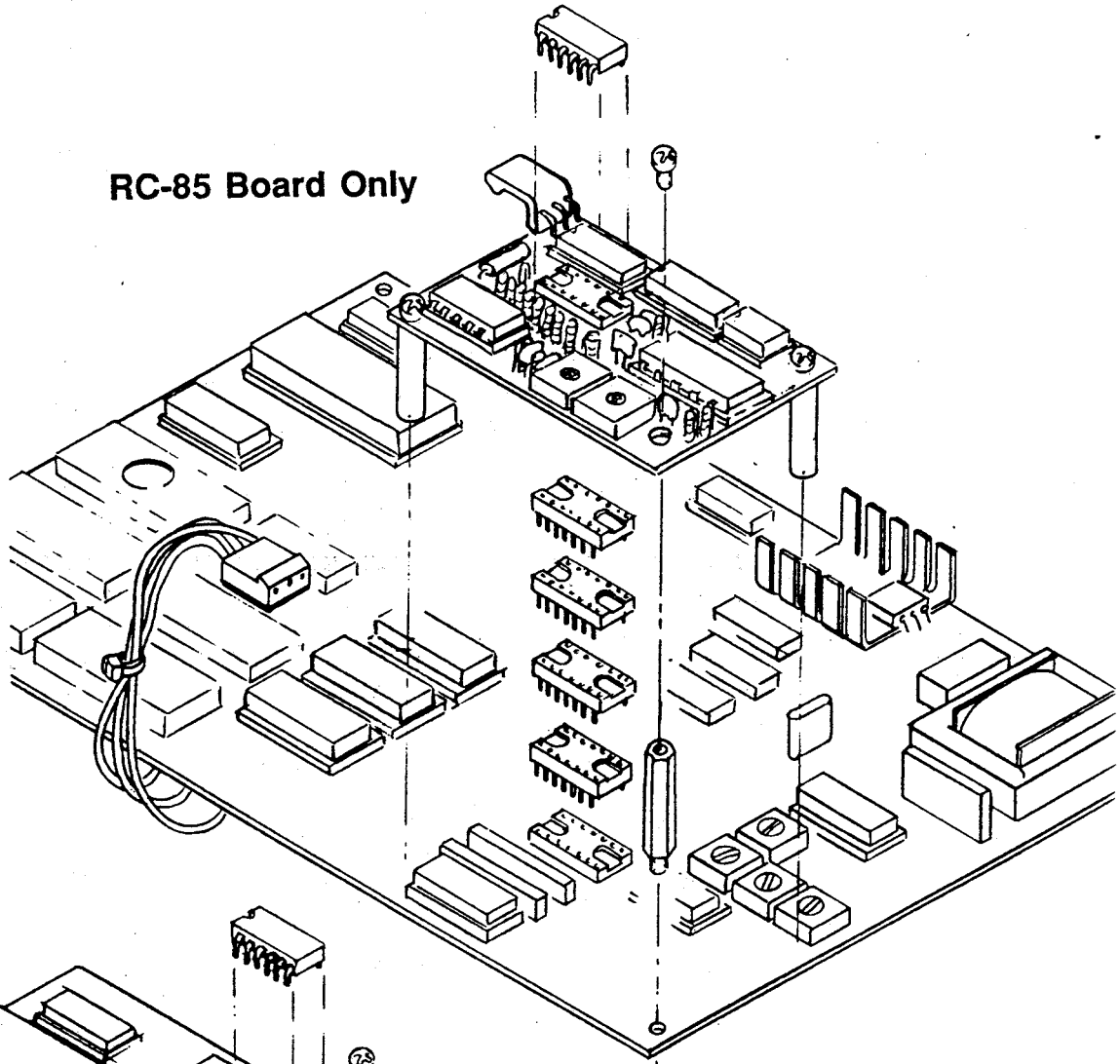
RC-85 Rack Mount
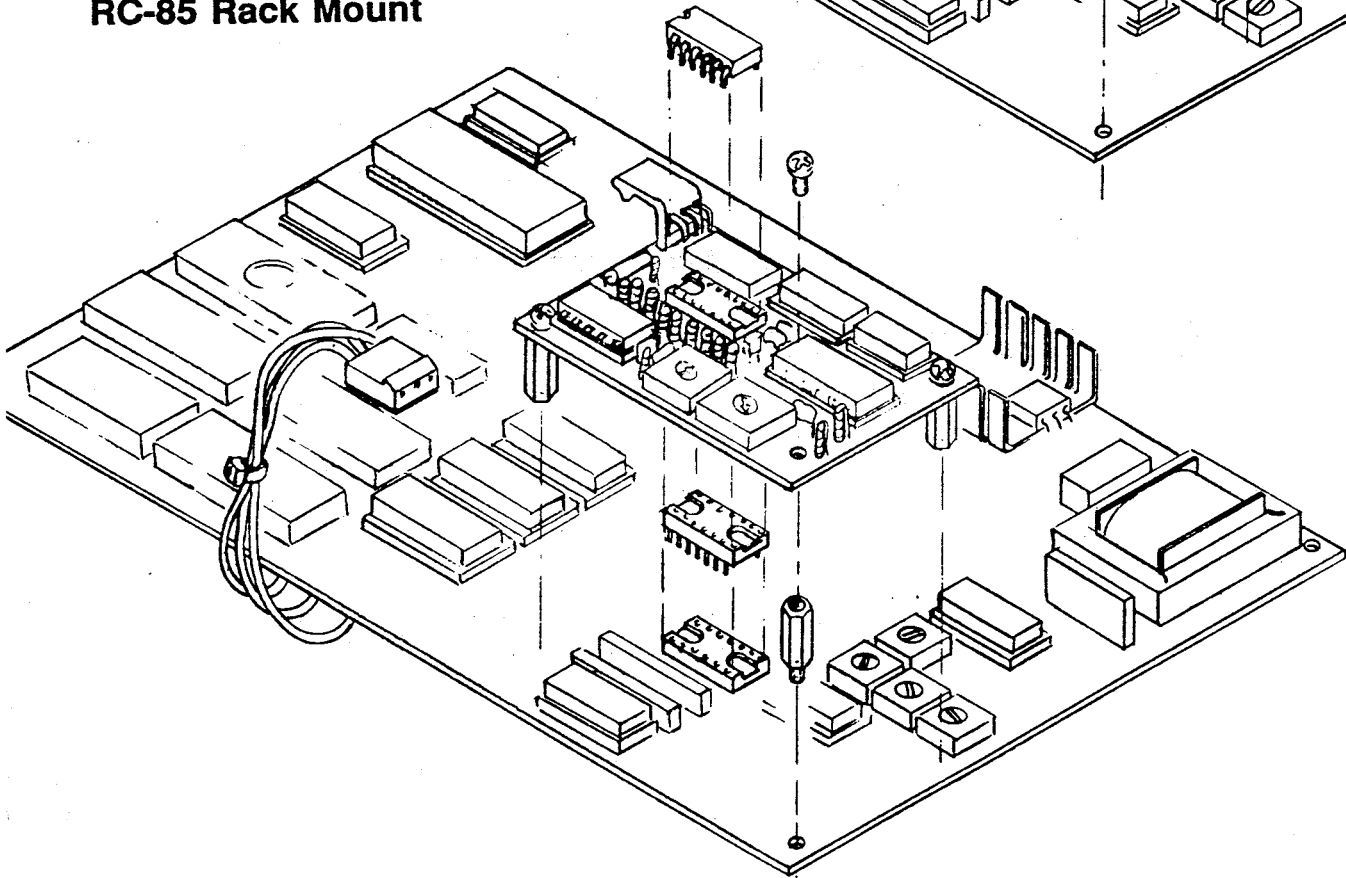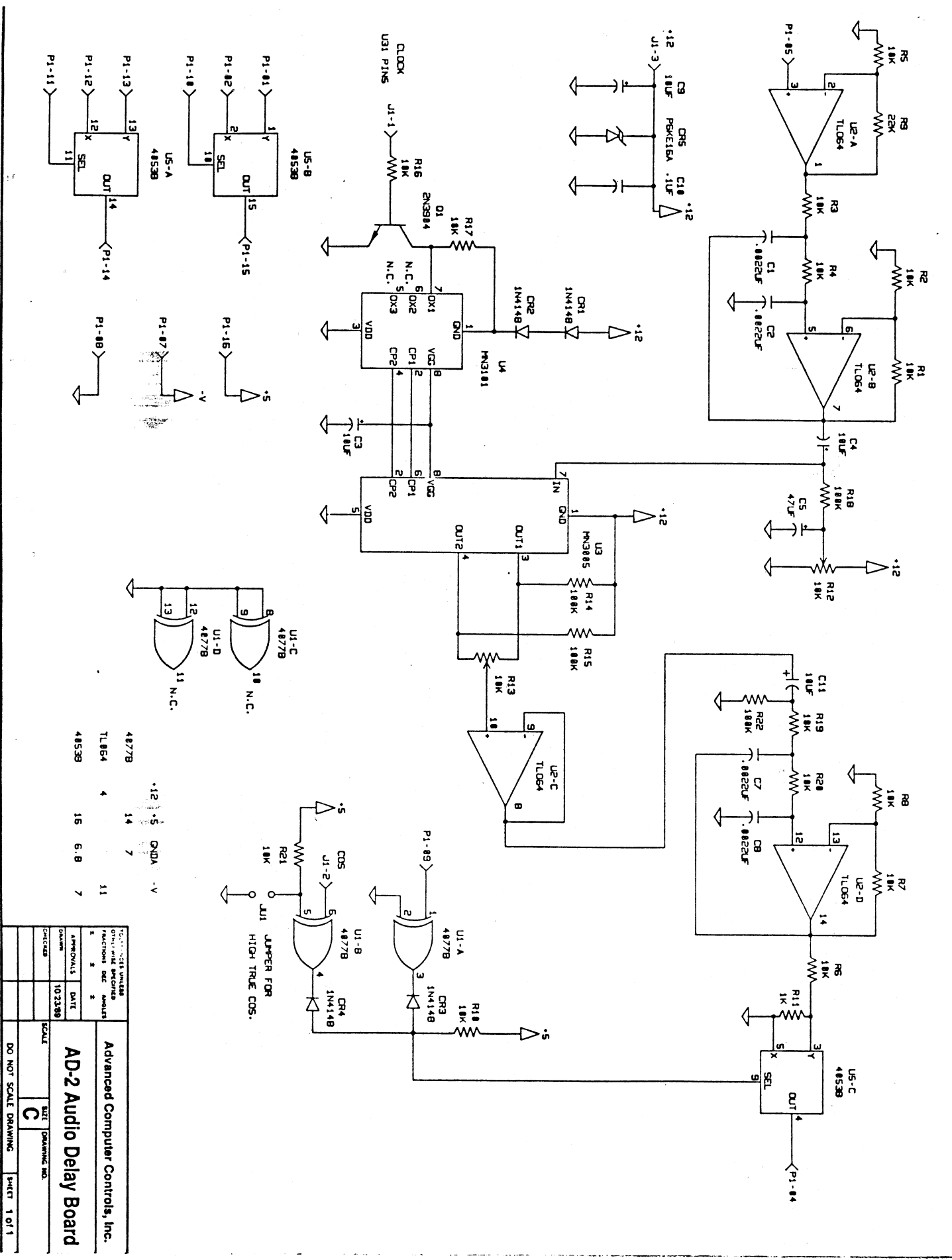
Advanced Computer Controls, Inc.

AD-2 Audio Delay Board

SIZE	DRAWING NO.
C	

DO NOT SCALE DRAWING

SHEET 1 of 1

Glossary

abort	Message Editor command to terminate editing session without writing message.
activity timer	Patch timer which resets at start and end of each transmission.
Anxious ID	ID attempted between user transmissions because it's getting late in the ID cycle.
alarm	Over the air indication of activated Alarm logic input.
autodialer	Speed dial patch where phone numbers are stored in memory.
Autopatch	Patch where user enters phone number of part of the command because the number isn't in an autodial location.
BCD	Binary Coded Decimal. Logic data format for control of remote base transceiver frequency synthesizer.
bulletin board	Synthesized speech or Morse code messages stored in memory by repeater owner which can be retrieved by users.
click	Short transmission by user to initiate dialing of Autopatch and User Loadable Autodialer.
command	Touch-Tone sequence which instructs controller to perform a function.
command channel	Audio source for Touch-Tone decoder, including repeater receiver, phone line, and control receiver.
command terminator key	Touch-Tone key which instructs controller that the entire command has been entered. Optional over the air, required over the phone.
configurable	Remotely changable by repeater owner using Touch-Tone commands.
Configuration commands	Touch-Tone commands which enable repeater owner to remotely program repeater characteristics.
controller	Device which supervises operation of the repeater system.
Control Operator	Class of person having access to Control Operator commands.
Control Operator commands	Touch-Tone commands available to the repeater's Control Operators.
control receiver	RF receiver having highest priority of Touch-Tone control.

COR	Carrier-operated-relay. Device which indicates signal present at receiver.
COS	Carrier-operated-switch. Same as COR.
courtesy tone	Indication to user that previous user has finished his transmission.
CPU	Central processing unit. The heart of the microcomputer.
custom hangup code	User definable hangup code which prevents malicious hangup of patch by jammer.
Digital Voice Recorder	ACC product which allows remote recording of voice messages with solid-state storage.
DIP switch	Dual-inline-package switch. Switch array on controller board which allows selection of certain options.
DVR	Digital Voice Recorder.
Emergency Autodialer	Autodialer which contains 10 emergency service phone numbers and reponse messages.
EPROM	Erasable-programmable-read-only-memory. Semiconductor memory device for storage of program and data.
E²PROM	Electrically-erasable programmable read-only-memory. In-system reprogrammable non-volatile memory.
firmware	Computer program stored in EPROM.
Forced CW ID	ID message attmepted when controller cannot generate a synthesized speech ID because a user is talking.
frequency synthesizer	Device in remote base transceiver which determines transmit and receive frequency of transceiver.
group call	Paging tone signalling format consisting of eight second continuous tone, for alerting a group of pagers with common "B" tone.
hang time	Period that repeater transmitter stays on after input signal goes away.
high true	Logic output where high state indicates active function.
Initial ID	ID message attempted when a new repeater user appears after a period of inactivity
interdigit timer	Timer which disqualifies a command sequence if too long a period between individual digits occurs.
Kerchunker filtering	Algorithm which discourages brief unidentified transmissions.

link	Hard wired connection to another repeater or to transceiver.
lock	User Loadable Autodialer state which prohibits entry or erasing of phone numbers. Also state of controller where Configuration command may not be entered.
low true	Logic output where low state indicates active function.
message editor	Portion of controller command set which allows repeater owner to construct Morse code and synthesized speech messages from the available character set and vocabulary.
Molex	Brand of electrical connector.
offhook	State of telephone circuit where call is in progress.
onhook	State of telephone circuit where call is not presently in progress.
open collector	Logic output consisting of solid state contact closure to ground without capability of sourcing current.
pad test	Command procedure which permits users to test their Touch-Tone pads for proper operation.
paging	Selective calling technique involving tone signalling.
patch	General term for phone patch, covering Autopatch, User Loadable Autodialer, Emergency Autodialer, and reverse patch.
Pending ID	ID message attempted when no repeater activity is in progress or when the repeater carrier is allowed to drop.
PL	Private Line. Continuous sub-audible tone signalling.
prefix	Portion of a Touch-Tone command which precedes the root portion.
program	Computer instructions stored in memory. Also the act of remotely configuring the controller.
PTT	Push-to-talk. Logic output from the controller which tells the transmitter to transmit.
QSO	Exchange of transmissions between users.
RAM	Random-access-memory. Semiconductor memory used for temporary storage by the controller.
RCC	Radio common carrier.
readback	Synthesized speech or Morse code acknowledgement by the controller.

regenerated Touch-Tone Touch-Tone audio synthesized by the controller into the phone line for improved patch reliability.

remote base Remotely controller Amateur radio station. Generally tied to repeater to allow shared access.

remote programming The ability to remotely change various characteristics of the controller.

repeater owner A person with access to Configuration commands.

reset Act of computer starting execution of its program from the beginning. Results from grounding Reset pin, entering the Reset Control Operator command, or protective circuitry.

reverse patch Phone patch initiated from the phone line.

root Portion of command following prefix

rubout Message Editor command which allows deleting last character entered.

site alarm Same as alarm.

spare audio input Audio input to the controller which may be selected by users for monitoring. May be used for weather radio or similar audio source. Same hardware input as Link Receiver.

Special ID ID message attempted at Pending ID time when selected by Control Operator.

speech synthesizer Electronic device which generates audio closely resembling human speech.

squelch tail Noise burst from FM receiver when input signal goes away.

subaudible tone Same as PL.

tail Period after user unkeys when repeater transmitter is still up.

tail message Synthesized speech or Morse code message generated just before repeater transmitter drops off.

timeout timer Timer which disables repeater transmitter if a continuous signal appears at repeater receiver for too long a period.

to end of transmission timer Timer which disqualifies a Touch-Tone command if too long a period elapses from the last Touch-Tone key to the end of the user's transmission.

Touch-Tone Access Mode Access mode which may be activated with user Touch-Tone commands.

two-tone sequential Paging tone signalling format consisting of a one second and three second tone sequence.

unlock	State of User Loadable Autodialer which permits entry and erasure of telephone numbers from memory. Also the state of the controller when Configuration commands are accepted.
unlock code	Touch-Tone command sequence which places the controller in the state where Configuration commands are accepted.
User commands	Class of Touch-Tone commands available to general repeater users.
User Function Logic Outputs	Logic outputs from the controller which may be remotely controlled with Touch-Tone commands for remote control of various equipment at the repeater site.
User Loadable Autodialer	Autodialer which contains 190 phone numbers which may be loaded and erased by users remotely by persons with access to User commands.
write	The act of storing Configuration information into memory using Configuration commands.

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