RP04

CCT REPEATER CONTROLLER
WITH REMOTE CONTROL
This equipment generates and uses radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

1. Reorient the computer with respect to the receiver.
2. Relocate the computer with respect to the receiver.
3. Move the computer away from the receiver.
4. Plug the computer into a different outlet so that the computer and receiver are on a different branch circuit.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>SECTION</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>SPECIFICATIONS</td>
<td>2</td>
</tr>
<tr>
<td>Outline Drawing</td>
<td>6</td>
</tr>
<tr>
<td>INSTALLATION PROCEDURES</td>
<td>7</td>
</tr>
<tr>
<td>STEP 1 - REAR CONNECTOR BLOCK WIRING</td>
<td>8</td>
</tr>
<tr>
<td>Rear Connector Block (Figure 1)</td>
<td>10</td>
</tr>
<tr>
<td>Repeat Audio Filter Response (Figure 2)</td>
<td>11</td>
</tr>
<tr>
<td>STEP 2 - JUMPERS AND LEVEL ADJUSTMENTS</td>
<td>12</td>
</tr>
<tr>
<td>Preliminary Adjustments</td>
<td>12</td>
</tr>
<tr>
<td>CTCSS Tone Level Adjustments</td>
<td>13</td>
</tr>
<tr>
<td>Audio Level Adjustments</td>
<td>14</td>
</tr>
<tr>
<td>A807 FSK Level Adjustments</td>
<td>14</td>
</tr>
<tr>
<td>Positive PTT Via Relay (Figure 3)</td>
<td>15</td>
</tr>
<tr>
<td>STEP 3 - PROGRAMMING INSTRUCTIONS</td>
<td>16</td>
</tr>
<tr>
<td>3.1.0 Introduction/Quick Look List</td>
<td>16</td>
</tr>
<tr>
<td>FUNCTION MENU</td>
<td>16</td>
</tr>
<tr>
<td>SET PARAMETERS MENU</td>
<td>17</td>
</tr>
<tr>
<td>ALIGNMENT MENU</td>
<td>18</td>
</tr>
<tr>
<td>REMOTE CONTROL FUNCTIONS MENU</td>
<td>18</td>
</tr>
<tr>
<td>3.1.1 Accessing the Programming Mode</td>
<td>20</td>
</tr>
<tr>
<td>NORMAL ACCESS - VIA ENTER KEY</td>
<td>20</td>
</tr>
<tr>
<td>INSTALLATION ACCESS - VIA JP2</td>
<td>21</td>
</tr>
<tr>
<td>LOCAL PROGRAMMING MODE</td>
<td>22</td>
</tr>
<tr>
<td>3.1.2 Quitting Programming Mode</td>
<td>22</td>
</tr>
<tr>
<td>3.1.3 Adding a User</td>
<td>22</td>
</tr>
<tr>
<td>3.1.3.1 Cross Tone Encoding</td>
<td>24</td>
</tr>
<tr>
<td>3.1.3.2 Quitting the ADD USER Function</td>
<td>25</td>
</tr>
<tr>
<td>3.1.3.3 ADD USER Error Messages</td>
<td>25</td>
</tr>
<tr>
<td>3.1.4 Delete User</td>
<td>26</td>
</tr>
<tr>
<td>3.1.4.1 Quitting the DELETE USER Function</td>
<td>27</td>
</tr>
<tr>
<td>3.1.4.2 DELETE USER Error Messages</td>
<td>27</td>
</tr>
<tr>
<td>3.1.5 View Users</td>
<td>28</td>
</tr>
<tr>
<td>3.1.5.1 Quitting the VIEW USERS Function</td>
<td>28</td>
</tr>
<tr>
<td>3.1.5.2 VIEW USERS Error Messages</td>
<td>28</td>
</tr>
</tbody>
</table>
# TABLE OF CONTENTS CONT'D

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1.6 CLEAR TIME/HIT Accumulators</td>
<td>28</td>
</tr>
<tr>
<td>3.1.6.1 All User (GLOBAL) CLEAR TIME/HITS</td>
<td>29</td>
</tr>
<tr>
<td>3.1.6.2 One User (INDIVIDUAL) CLEAR TIME/HITS</td>
<td>29</td>
</tr>
<tr>
<td>3.1.6.3 Quiting the CLEAR TIME/HITS Function</td>
<td>30</td>
</tr>
<tr>
<td>3.1.6.4 CLEAR TIME/HITS Error Message</td>
<td>30</td>
</tr>
<tr>
<td>3.1.7 Set Parameters</td>
<td>30</td>
</tr>
<tr>
<td>3.1.7.1 Changing the CONTROL BYTE</td>
<td>31</td>
</tr>
<tr>
<td>3.1.7.2 Changing the CDS VALID TIME</td>
<td>33</td>
</tr>
<tr>
<td>3.1.7.3 Changing the Extended PTT TIME</td>
<td>33</td>
</tr>
<tr>
<td>3.1.7.4 Changing the Dropout Timer</td>
<td>34</td>
</tr>
<tr>
<td>3.1.7.5 Changing the CALL TIMOUT Time</td>
<td>34</td>
</tr>
<tr>
<td>3.1.7.6 Changing the ACCESS CODE</td>
<td>35</td>
</tr>
<tr>
<td>3.1.7.7 Quiting the SET PARAMETERS Function</td>
<td>35</td>
</tr>
<tr>
<td>3.1.8 Initialize MEMORY</td>
<td>36</td>
</tr>
<tr>
<td>3.1.8.1 Initializing a Previously Programmed EEPROM</td>
<td>37</td>
</tr>
<tr>
<td>3.1.9 Alignment Program</td>
<td>38</td>
</tr>
<tr>
<td>3.1.9.1 Alignment Function 1: Threshold Dropout</td>
<td>38</td>
</tr>
<tr>
<td>3.1.9.2 Alignment Function 2: Charge/Discharge</td>
<td>38</td>
</tr>
<tr>
<td>3.1.9.3 Alignment Function 3: Max Read Time</td>
<td>38</td>
</tr>
<tr>
<td>3.1.9.4 Alignment Function 4: Set CTCSS Tone Levels</td>
<td>39</td>
</tr>
<tr>
<td>3.1.9.5 Alignment Function 5: Set Beep Tone Level</td>
<td>40</td>
</tr>
<tr>
<td>3.1.9.6 Quiting the ALIGNMENT Program</td>
<td>40</td>
</tr>
<tr>
<td>3.1.10 Remote Control Functions</td>
<td>41</td>
</tr>
<tr>
<td>3.1.10.1 Call Remote Unit</td>
<td>41</td>
</tr>
<tr>
<td>3.1.10.2 Store Control Tones</td>
<td>41</td>
</tr>
<tr>
<td>3.1.10.3 Checkout AB07</td>
<td>42</td>
</tr>
<tr>
<td>3.1.10.4 Test Printer</td>
<td>43</td>
</tr>
<tr>
<td>3.1.10.5 Quitting the Remote Control Function</td>
<td>43</td>
</tr>
<tr>
<td>Step 4 - Remote Programming With the RP04</td>
<td>44</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>44</td>
</tr>
<tr>
<td>1) Calling the Repeater</td>
<td>45</td>
</tr>
<tr>
<td>2) Establishing the Link</td>
<td>47</td>
</tr>
<tr>
<td>3) Logging - In</td>
<td>48</td>
</tr>
</tbody>
</table>
# TABLE OF CONTENTS CONT'D

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4) Remote Programming Mode</td>
<td>48</td>
</tr>
<tr>
<td>4.1 Remote Programming Mode Functions</td>
<td>49</td>
</tr>
<tr>
<td>4.1.1 Add User</td>
<td>49</td>
</tr>
<tr>
<td>4.1.2 Delete User</td>
<td>49</td>
</tr>
<tr>
<td>4.1.3 View User</td>
<td>49</td>
</tr>
<tr>
<td>4.1.4 CLEAR TIME/HIT Accumulators</td>
<td>49</td>
</tr>
<tr>
<td>4.1.5 Set Parameters</td>
<td>49</td>
</tr>
<tr>
<td>4.1.6 Initialize EEPROM</td>
<td>49</td>
</tr>
<tr>
<td>4.1.7 Alignment Functions</td>
<td>49</td>
</tr>
<tr>
<td>4.1.8 Remote Control Functions</td>
<td>49</td>
</tr>
<tr>
<td>4.1.8.1 Print User List</td>
<td>50</td>
</tr>
<tr>
<td>5) Logging Out</td>
<td>50</td>
</tr>
<tr>
<td>RPO4 Base Unit - Installation and Alignment</td>
<td>51</td>
</tr>
<tr>
<td>Parallel Printer Port</td>
<td>54</td>
</tr>
<tr>
<td>Final Assembly Drawing</td>
<td>55</td>
</tr>
<tr>
<td>Parts List (01A0010733 RPO4 Trnkg Rep. C/W Remote Contr.)</td>
<td>55</td>
</tr>
<tr>
<td>Main PCB Schematic Diagram</td>
<td>56</td>
</tr>
<tr>
<td>Main PCB Component Layout</td>
<td>57</td>
</tr>
<tr>
<td>Parts List (01A0010593 Main PCB Assembly)</td>
<td>57</td>
</tr>
<tr>
<td>Remote Control PCB Schematic Diagram</td>
<td>58</td>
</tr>
<tr>
<td>Remote Control PCB Component Layout</td>
<td>59</td>
</tr>
<tr>
<td>Parts List (01A0010861 Remote Control PCB Assembly)</td>
<td>59</td>
</tr>
<tr>
<td>LCD/Keyboard Buffer Schematic Diagram</td>
<td>60</td>
</tr>
<tr>
<td>LCD/Keyboard Buffer Component Layout</td>
<td>61</td>
</tr>
<tr>
<td>Parts List (01A0010737 LCD/Keyboard Buffer Assembly)</td>
<td>61</td>
</tr>
<tr>
<td>LCD Display Assembly</td>
<td>62</td>
</tr>
<tr>
<td>Parts List (01A0010736 LCD Display Assembly)</td>
<td>62</td>
</tr>
<tr>
<td>Warranty</td>
<td>63</td>
</tr>
<tr>
<td>Return Policy</td>
<td>63</td>
</tr>
</tbody>
</table>
INTRODUCTION

The RP04 is designed to convert a community repeater into a trunking repeater. It is part of the Ferritronics CTCSS Compatibility Trunking equipment (CCT).

As trunking provides for increased numbers of users, it is likely that more than the normal 37 EIA CTCSS tones will be required. Therefore, the RP04 can encode and decode an additional 240 CTCSS tone pairs. These pairs comprise a tone from a low frequency group and a tone from a high frequency group. The RP04 can also encode and decode all 37 EIA CTCSS tones.

The RP04 validates mobile radios equipped with Ferritronics mobile trunking units (MA10, MA11, etc). The validation process consists of decoding the mobile generated signal, validating the user, opening the repeat audio path, encoding the required signal to the receiving mobile and keying the transmitter. Transparent functions are the recording of the message length and the recording of the number of hits.
# SPECIFICATIONS

## GENERAL

**Frequency Range**
All 37 EIA specified CTCSS tone frequencies (67.0 Hz to 250.3 Hz) plus 1 non-EIA tone of 97.4 Hz.

## LOCAL CONTROL

A front panel mounted keypad and 2 line x 40 character LCD display provide user-friendly interactive control of the following functions:

**Programming Access Code (Site Address)**
Entry to Local Control Mode is contingent upon a correct 5 digit numerical code. This code is entered via the keypad and is user-programmable. The site address may be selected from a possible 100,000 combinations.

**Hit Accumulation per User Group**
up to 65,535

**Repeater Usage Time Accumulation per User Group**
65,535 minutes (1,092 hours 15 minutes)

**Dropout Delay Timer**
Adjustable; 0 to 255 seconds (4.25 minutes), in 1 second steps.

**Extended PTT Timer**
Adjustable; 0 to 25.5 seconds, in 0.10 second steps.

**Time Out Timer**
Adjustable; currently fixed at 5 minutes.

**Operating Temperature**
-30°C to +60°C

**Humidity**
0 to 90% non-condensing

**Dimensions**
refer to outline drawing.

**Weight**
3.3 lbs. (1.5 Kg)
ENCODER

Frequency Accuracy ±0.3% of the tone frequency, at 25°C.

Frequency Stability ±0.05% over the temperature range.

Output Impedance 3.3K ohms.

Output Level 4Vpp maximum with no load.

Distortion ≤ 5% T.H.D.

DECODER

Sensitivity
as per EIA RS220A method

≤ 14 dB SINAD

Bandwidth ± 1.0Hz

Decode Time Dual Tones Adjustable; factory set at 300 mSec at 14 db SINAD.

Single Tones dependant on dual tone decode time, typically if dual tone is set for 300 mSec, then single tone decode time is 350 mSec.

Decode Dropout Time Adjustable; factory set at 300 mSec.

Input Impedance 100 K ohms

INPUT/OUTPUT CONNECTIONS

Via a rear panel removable terminal block type connector.

Tone Input Connects to the receiver discriminator.

Squelch Input (C.O.S.) Connects to the output of the receiver’s squelch circuit. This is a digital signal.

PTT Output A transistor pulls to ground to key the transmitter. (VCE ≤ 0.4VDC at 400 mA DC).

Audio Input (High Pass Filter Input) Connects to the receiver discriminator or to an audio input/output connection in series with the receive audio path, intended for insertion of a high pass filter.
Audio Output (High Pass Filter Output) Connects to the input of the audio amplifier or to an audio input/output connection in series with the receive audio path intended for insertion of a high pass filter.

Tone Output Connects to the transmitter tone input. The transmitter must be capable of transmitting CTCSS tone frequencies.

Power Supply 13.6 VDC ±20% relative to ground. There is a rear panel mounted ON/OFF switch. A fuse (1A fast) is mounted on the PCB.

Current Consumption 150 mA at 13.6 VDC in STANDBY
190 mA at 13.6 VDC in DECODE.

REPEAT_AUDIO_PROCESSING

Pass Band Ripple
(300 - 3 KHz) ±1.0 dB

Pass Band
Gain (1 KHz) Adjustable up to 6.0 dB into no load.

Maximum Input Level 3.5 Vpp (1.25 Vrms) @ 1 KHz

Audio Input Impedance 100K ohms

Audio Output Impedance 3.3K ohms

Attenuation of Signalling Tones Greater than 30 dB for frequencies ≤ 250 Hz.

ADDITIONAL_INFORMATION

Remote control/downloading of repeater functions/information is available by the addition of a ‘Remote Control’ board AB07, Ferritronics Part Number 01A0010735. An additional RP04 equipped with the AB07 functions as the remote control unit.
AB07 REMOTE CONTROL PCB

GENERAL - MODEM

DATA RATE 300 baud
DATA FORMAT ASCII, 8 data bits, mark parity, 1 stop bit
MODULATION FREQUENCY SHIFT KEYING (FSK)
  -BASE (ORIGINATE) MODE: MARK - 2225 Hz
     SPACE- 2025 Hz
  -REPEATER (ANSWER) MODE: MARK - 1270 Hz
     SPACE- 1070 Hz

GENERAL- PRINTER CONNECTOR

DATA RATE > 1000 CPS (limited by printer speed)
DATA FORMAT 8 bit parallel ASCII
CONNECTOR DB25S - signals compatible with IBM-PC standard parallel printer interface cable

MODEM RECEIVER

INPUT IMPEDANCE > 150k ohms, in parallel with TONE IN connection (TB1-1)
SENSITIVITY < 30 db SINAD, per EIA RS220A at 3kHz transmitted deviation level
CARRIER DETECT TIMES ATTACK 100 mSec
DECAY 4.7 mSec

MODEM TRANSMITTER

FREQUENCY ACCURACY ± 0.5% TYP. a 25°C
OUTPUT IMPEDANCE > 20k ohms into the audio summing amplifier on the MAIN PCB
OUTPUT LEVEL 2.5 Vpp max. at AUDIO OUT (TB1-7), no load
INSTALLATION PROCEDURES

There are three steps to be carried out to install the RP04. These are:

STEP 1) electrical connection of the RP04 to the repeater via the rear connector block,
STEP 2) correct selection and level adjustment of the internal circuitry, and
STEP 3) programming of the RP04.

The RP04 is intended to be mounted into a 19" rack with other repeater equipment.

Electrical hookup should be done by a qualified technician.

To facilitate hookup it is best to locate the RP04 close to the repeater, although using shielded cable, which is recommended for some connections, will provide adequate shielding for cable lengths up to 10 feet.

All connections can be made to the detachable portion of the rear connector on the RP04 before installation. Refer to STEP 1 for details.

Adjustments are required for input signal level, output tone level (deviation), and repeat audio level. To do this the top cover of the RP04 will have to be removed and the unit turned on before adjustment can proceed. This adjustment procedure is described under STEP 2 - JUMPERS AND LEVEL ADJUSTMENT. Once the unit has been aligned, the top cover must be replaced before final installation.
INSTALLATION PROCEDURE

STEP 1 - REAR CONNECTOR BLOCK WIRING

Separate the rear connector block so that you are left with the terminal portion in hand. Refer to FIGURE 1. Proceed with the following connections:

<table>
<thead>
<tr>
<th>CONNECTION</th>
<th>NAME</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>TB1-1</td>
<td>TONE IN</td>
<td>Connect this to the de-emphasized discriminator output. All EIA tone frequencies must be passed to this input. Verify this by transmitting to the receiver using a communications monitor and varying the CTCSS tone frequency, making sure the encode deviation is the same for all tones. Use a shielded lead.</td>
</tr>
<tr>
<td>TB1-2</td>
<td>CHASSIS GROUND</td>
<td>TB1-2 and TB1-6 are both connected to chassis ground via JP3 2-3. TB1-2 or TB1-6 should have a ground wire connecting it to the rack.</td>
</tr>
<tr>
<td>TB1-3</td>
<td>AUDIO IN</td>
<td>This is the input to the repeat audio filter. This filter removes the signalling tones from the received audio. This should be connected to the de-emphasized discriminator output as the filter has a flat response between 300 Hz and 3.5 kHz. Some repeaters have a connection readily available for insertion of this high pass filter and should be used. The output of the filter is TB1-7. Refer to FIGURE 2 REPEAT AUDIO FILTER RESPONSE.</td>
</tr>
</tbody>
</table>
TB1-4  SQL IN  This digital signal is required from the repeater receiver to tell the RP04 when to decode. This eliminates 'falsing'. Adjust the receiver’s squelch pot for normal threshold position. It does not matter which polarity indicates an active channel. Refer to the 'Set Parameters' section in the programming instructions.

TB1-5  TONE OUT  Connect this to the tone input of the transmitter. It may be necessary to use a shielded lead. The transmit tone deviation is set by R108 (high tone and mid tone) and R110 (low tone). Refer to STEP 2 ‘Alignment’ section in the programming instructions.

TB1-6  CHASSIS GROUND  TB1-2 and TB1-6 are both connected to chassis ground via JP3 2-3. TB1-2 or TB1-6 should have a ground wire connecting it to the rack.

TB1-7  AUDIO OUT  This is the output of the repeat audio filter and should be connected to the voice audio input of the transmitter. Amplitude adjustment will likely be necessary, refer to STEP 2. Use a shielded lead.

TB1-8  PTT  This connection pulls to ground when a call is to be repeated. It must connect to the repeater’s TX key line. The transistor switch can pull 200 mADC at a VCE of \( \leq 0.4 \) VDC. Maximum sink current is 500 mADC.

If a positive PTT is needed, a relay will have to be used. Refer to FIGURE 3 for hookup.

TB1-9  CIRCUIT GROUND  Connect this to the ground of the repeater. Do not connect this ground to the rack.

TB1-10  +VE SUPPLY  Connect this to 13.6 VDC \( \pm 20\% \). The supply must be capable of delivering at least 200 mA.
REAR CONNECTOR BLOCK
(TERMINAL PORTION)

FIGURE 1
FIGURE 2
STEP 2 - JUMPERS AND LEVEL ADJUSTMENTS

Remove the top cover of the RP04.

JP1  Install JP1 2-3 so that an audible tone (approx. 1kHz) will be heard when the RP04 approaches the end of its call time out cycle. If the audible signal is not desired, remove JP1.

A future function will be implemented using JP1 1-2 so do not install it in this position now.

JP2  When the RP04 is received from the factory it does not contain a 5-digit access code which is normally required to enter the programming mode.

By inserting JP2 and powering up or resetting the RP04, the programming mode will be entered directly without having to enter the access code. At this point, an access code can be entered. Refer to STEP 3 PROGRAMMING INSTRUCTIONS, to enter or change an access code.

JP3  JP3 2-3 makes a connection between TB1-2, TB1-6 and chassis. Make sure TB1-2 or TB1-6 are then connected to the rack via a ground wire.

Preliminary Adjustments

The RP04 is shipped with JP2 (located beside the large IC in the center of the main PCB) installed. This jumper causes the RP04 to start in 'Programming Mode' immediately when powered-up to facilitate initial alignment and programming. Before attempting to install the RP04 it is recommended that the user read through Step 3 - Programming Instructions and become familiar with the various functions.

The basic purpose of the Programming Mode functions is to add, change and delete the parameters stored in user memory to 'customize' the RP04 to the user's repeater system. At any time, the user memory 'EEPROM' can be initialized to its factory - shipped condition by selecting the 'Initialize EEPROM' function, (Step 3 - section 1.8)
Before attempting to align the RP04, it will be necessary to program into the RP04 the active levels of the SQL IN (TB1-4) and PTT (TB1-8) connections. (SQL IN is also referred to as COS, for 'carrier - operated switch'). The 'active level' of COS is the voltage level which indicates a 'busy channel' (RF carrier present at the receiver's frequency). The active level of PTT is the voltage level which keys the transmitter. These levels are programmed into the RP04 using the 'Set Parameters - Set Control Bytes' function (Step 3 - section 1.7.1). Note that the RP04 is designed to operate transmitters requiring a connection to ground to key them ('PTT is GROUND to Xmit...'). If a positive voltage is required to key the transmitter (for example, to energize a relay coil inside the transmitter) the external relay circuit of FIGURE 3 may be used. (However, the RP04 should still be programmed 'PTT is GROUND to Xmit', since switching PTT to ground switches the positive voltage to the transmitter). Most of the Alignment functions require that the correct active levels of COS and PTT have already been programmed into the RP04.

CTCSS Tone Level Adjustments

Once the RP04 has been connected to the receiver at the repeater site, use a communications monitor to send a 210.7 Hz tone at the required deviation level (typically 300 Hz) to the receiver. Measure the high tone filter output (TP6 on the main PCB) with an oscilloscope or AC voltmeter, and adjust R2 for 2.5 volts p-p (900 mV RMS). Measure TP7 and observe a stable 5 Vpp square wave at the same frequency. Change the communications monitor to transmit 88.5 Hz at the same deviation level, and measure the low-tone filter output (TP5 on the main PCB) to verify that the signal is also approximately 2.5 volts p-p, or 900 mV RMS.

To set the Tx CTCSS tone levels, first remove the jumper plug at JP1 and place the RP04 into local programming mode by installing the jumper plug at JP2 and pressing RESET. Select the 'Alignment - Set CTCSS Levels' function (see Step 3, section 1.9) to generate a single 88.5 Hz tone with 'audio off'. This causes the RP04 to key the repeater transmitter via the PTT line (TB1 pin 8) and generate the selected low-tone at the TONE OUT connection (TB1 pin 5). Monitor the transmitted deviation level with the communications monitor, and adjust the low-tone encoder level (R110 on the main PCB) to the required deviation level (typically 300 Hz). On the RP04 press 0 to stop the tones (and turn off the transmitter) and then 'ENTER' to return to the 'Select Tones' prompt. Program the RP04 to generate a 210.7 Hz tone with audio off as before, and adjust the high-tone encoder level (R108 on the main PCB) to the same deviation level. When the adjustment is complete, press 0 and 'ENTER' to return to the 'Select Tones' prompt. As a check, use the 'Set CTCSS Levels' function to generate a dual tone and measure the total transmitted deviation level. When finished, press RESET to ensure that the tone encoders are disabled and the PTT line is inactive.
**Audio Level Adjustments**

Before adjusting the audio level, first determine if the call-timeout 'beep' tone is required and, if so, install the jumper plug at JP1 between pins 2 and 3.

To set the repeated audio level, place the RP04 into local programming mode and select the 'Alignment - Set CTCSS Levels' function. Program the RP04 to generate an arbitrary dual tone (such as 88.5/210.7) with 'audio on'. Apply a 1kHz signal of amplitude equal to the maximum audio output level of the receiver to the AUDIO IN connection, TB1 pin 3, and adjust the audio level control (R145 on the main PCB) for the required maximum transmitted deviation level.

To adjust the 'beep' tone, press '0' to stop the tones, then press '5' and '0' to restart the tones with 'audio off'. Press ENTER twice to return to 'Programming Mode' - the CTCSS tones and transmitter will still be on. Press '9' and '5' to select the 'Alignment - Set Beep Tone' function, and adjust R127 for the desired beep tone level. Press RESET when finished to turn off the transmitter.

**AB07 FSK Level Adjustments**

To set the received FSK level adjustment, set the communications monitor to transmit a 1kHz tone to the repeater receiver at maximum deviation, and place the RP04 into local programming mode. Select the 'Remote Control - Checkout AB07' function, and when the self-test is complete, press (2) to select the 'repeater mode' test. This sets the AB07 MODEM receive bandpass filter to a center frequency of 1170 Hz, and it is wide enough to pass the 1kHz tone. Measure the signal at IC14 pin 16 - (it should be a 1kHz sinewave) and adjust R1, [on the AB07 PCB], for an amplitude of 1.0 Vpp (min) to 3.0 Vpp (max).

The 'repeater mode' test also activates PTT to turn on the transmitter and sends FSK data via the AUDIO OUT (TB1 pin 7) connection. Adjust R3 on the AB07 PCB to set the transmitted FSK signal to the required deviation level. Check that the transmitted waveform is sinusoidal; clipping will cause level shifting and demodulation problems at the receiving end. Press 'ENTER' to stop test.
POSITIVE PTT VIA RELAY

FIGURE 3
STEP 3 — PROGRAMMING INSTRUCTIONS

1.0 Introduction/Quick Look List

The RP04 Trunking Repeater Panel can be programmed using its front panel keypad. There are 12 buttons, # 0-9, ENTER and RESET on this keypad.

There is one main list of functions which would be commonly used. This is the ‘FUNCTION MENU’. It is available for use upon entering the Programming Mode.

FUNCTION_MENU

KEY #1. ADD USER — add a single or dual tone user.
KEY #2. DELETE USERS — delete a single or dual user.
KEY #3. VIEW USERS — display the single or dual tones already programmed.
KEY #4. CLEAR TIME/HIT ACCUMULATORS — clear the accumulated TX time and hit values from an individual user in the memory.
KEY #5. SET PARAMETERS — see detailed list below.
KEY #6. INITIALIZE EEPROM — program default values into a new (blank) memory chip.
KEY #7. REMOTE CONTROL FUNCTIONS: see detailed list below.
KEY #8. not used
KEY #9. ALIGNMENT — see detailed list below.
KEY #0. EXIT PROGRAMMING MODE — restarts RP04 in normal Repeater Control operating mode.

There are three other menus, ‘SET PARAMETERS MENU’, ‘REMOTE CONTROL FUNCTIONS MENU’, and ‘ALIGNMENT MENU’. These are associated with ‘SET PARAMETERS’, ‘REMOTE CONTROL FUNCTIONS MENU’ and ‘ALIGNMENT’ respectively.
SET PARAMETERS MENU

Detailed list of SET PARAMETERS (KEY #5) functions: — these parameters are normally set during the initial installation of the RPO4.

KEY #1. CONTROL BYTE
   a) Set active polarity of SQL input (COS).
   b) Set active polarity of PTT output lines.
   c) Set TX Override, (holds PTT output inactive for Repeater Panel testing).
   d) Enable Call Timeout feature.

KEY #2. SQL (COS) VALID TIME
Sets the length of time which the carrier-operated squelch must be continuously on before the RPO4 begins tone decoding.

KEY #3. EXTENDED PTT
Sets the length of time which the RPO4 keeps the TX keyed on after it switches off the CTCSS tones.

KEY #4. DROPOUT TIMER
Sets the length of time which the RPO4 keeps the TX and CTCSS tones on after the received CTCSS tones fade or the COS input goes inactive. Received audio is not repeated during this interval.

KEY #5. CALL TIMEOUT
Sets the maximum length of time which a single call is repeated before the RPO4 interrupts the call. Three one-second tones are sent at ten-second intervals before the TX is switched off.

KEY #9. CHANGE ACCESS CODE
Allows the operator to change the five-digit access code stored in memory.

KEY #0. Returns the operator to the main Programming Mode menu.
ALIGNMENT MENU

Detailed list of ALIGNMENT (KEY #9) functions: these are used to align the RP04 during initial installation, or realign its internal parameters for special (non-standard) applications.

KEY #1. THRESHOLD/DROPOUT LEVELS
Sets the tone detect and dropout levels for the high-, mid-, and low-tone bands.

KEY #2. INCREMENT/DECREMENT PARAMETERS
Sets the rate of tone detect and dropout for the high-, mid-, and low-tone bands.

KEY #3. MAXIMUM READ TIME
Sets the maximum length of time after COS is valid that the RP04 spends decoding tones (if any) before it attempts to validate them.

KEY #4. CTCSS TONE LEVELS
Allows the operator to adjust the output (transmitted) levels of the RP04’s CTCSS tone encoders.

KEY #5. BEEP TONE LEVEL
Allows the operator to adjust the output level of the 1kHz Call Timeout ‘beep’ tone.

KEY #0. Returns the operator to the main Programming Mode menu.

REMOTE CONTROL FUNCTIONS MENU

Detailed list of Remote Control (KEY #7) functions: different functions are available, depending on whether the RP04 is operating in Local or Remote Programming Mode.
The Local Programming Mode functions operate as follows:

KEY #1. CALL REMOTE UNIT
Establishes a remote control link when the RP04 is used as a Remote Control terminal (Base unit) in the base station or office.

KEY #2. STORE CONTROL TONES
Allows the operator to store in memory (and change) the CTCSS tones which the RP04 Repeater Control Panel (Remote unit) recognizes as remote control tones.
KEY #3. CHECKOUT AB07
Performs a functional test of the FSK Modem part of the AB07 PCB, and will also transmit test data in either Base (originate) or Repeater (answer) mode to allow Rx input level and Tx output level adjustments.

KEY #4. TEST PRINTER
Checks the status of the parallel printer (if connected) and prints a test message.

KEY #0. Returns the operator to the Local Programming Mode menu.

The Remote Programming Mode functions operate as follows:

KEY #1: PRINT USER LIST
Causes the Remote unit to transmit the contents of the Valid User Table to the Base Unit, which displays the data on the LCD and prints it on the parallel printer.

KEY #2: CHANGE CONTROL TONES
Allows the operator to examine and change the CTCSS tones (programmed into memory) which the Remote unit recognizes as Remote Control tones.

KEY #0: Returns the operator to the Remote Programming Mode menu.
1.1 Accessing the Local Programming Mode

There are two ways to gain access to the local programming mode of the RP04:

NORMAL ACCESS — VIA ENTER KEY

Once the RP04 has been installed at the repeater site and is operating, pressing the ENTER key on the front panel will invoke the Programming Mode (as indicated on the front panel LC display).

IMPORTANT

If the RP04 is busy repeating a call (indicated on the front panel display) OR if the RP04 detects the COS is active, the ENTER key will be ignored until the call is completed and COS goes inactive.

(Once Programming Mode is active, however, the COS and tone inputs are ignored, and the repeater is effectively 'down').

When the ENTER key is pressed, the display will prompt:

*** PROGRAMMING MODE ***
ENTER ACCESS CODE>

Enter the five-digit access code, followed by pressing the ENTER key. If the password is not correct, the RP04 will display 'WRONG ACCESS CODE' and resume repeater operation. If the password is correct, the RP04 will prompt:

Press Function Key or (ENTER) for HELP
INSTALLATION ACCESS - VIA JP2

Initially, accessing of the Programming Mode, for alignment or testing, is done using the JP2 jumper plug. On the main printed circuit board near the microprocessor is a 2-pin header labelled 'JP2'. Shorting these two pins (using the jumper plug provided) will cause the RPO4 to automatically enter Programming Mode on power-up or when reset.

'IMPORTANT'

The 'JP2' jumper plug MUST be removed for normal operation - the RPO4 cannot be put into normal Repeater Control Mode with the jumper plug installed.
LOCAL PROGRAMMING MODE

Pressing a valid function number (i.e. '1' for 'ADD USER') will select that function and display the appropriate prompts. Pressing ENTER will step you through the 'FUNCTION MENU', displaying a function title and its function number each time the ENTER key is pressed. For example, after pressing ENTER once, the RPO4 will display:

PRESS (0) TO EXIT PROGRAMMING MODE>
or press (ENTER) to see next function

After pressing ENTER again, the display shows:

PRESS (1) TO ADD USER>
or press (ENTER) to see next function

At any point in the 'FUNCTION MENU', pressing ENTER displays the next function prompt and pressing a valid function number selects that function.

1.2 Quitting Programming Mode

To exit Programming Mode and resume normal repeater control operation, press '0' or 'RESET'.

The display will show:

*** RPO4 TRUNKING REPEATER PANEL ***

---------- STANDBY ----------

if COS is not active, or if COS is active but no valid tones are present.

1.3 Adding a User:

Once the RPO4 is in Programming Mode, pressing '1' will start the ADD USER function.

The display will show:

ADD USER: PRESS (1) FOR SINGLE TONE, (2) FOR DUAL, (ENTER) TO EXIT>
Adding a single or dual tone user follows the same basic procedures, i.e., if you wish to add a single CTCSS tone user to the memory, press (1).

The RP04 will display:

```
ENTER SINGLE TONE (4 DIGITS) (ENT)
```

i.e. for 67.0 Hz. press (0670) (ENTER)

All tone frequencies must be entered into the RP04 as four numbers, followed by pressing the ENTER key. Tone frequencies less than 100.0 Hz. must have a leading '0' to make up four digits. For example, when programming a single CTCSS tone of 88.5 Hz., press '0885' and then ENTER. Be sure to put a 4-digit # in before pressing ENTER or the program will restart the RP04 at the beginning of the ADD USER function. Entering a valid single CTCSS tone (such as 88.5 Hz.) will cause the RP04 to briefly display:

```
CHECKING LOTONE: 88.5 HITONE: .
```

The RP04 checks that the entered tone does not already exist in its memory as a valid single-tone user or as half of a valid dual CTCSS tone user.

The RP04 will then display:

```
CROSS TONES: (0) = YES, (ENT) = NO ?
```

If cross tones are desired, press (0), but if no cross tones are desired press (ENT). This will cause the RP04 to transmit the same CTCSS tone as the one just entered.

The RP04 will briefly display:

```
GRP: LTONE = 88.5/88.5 HRS = 0000:00
001: HTONE = . / . HITS = 00000
```

and then restart the ADD USER function.

The GROUP number ('GRP 001') shows how many entries there are in the memory (users are always added to the end of the table). The first tone display after 'LTONE =' is the received tone which the RP04 will check to validate the user. The tone after the '/' is the tone which will be transmitted when the call is repeated.
1.3.1 Cross Tone Encoding

When the RP04 displays:

CROSS TONES: (0) = YES, (ENT) = NO ?

pressing '0' will result in the prompt:

CROSS TONES: PRESS (1) FOR SINGLE TONE,  
(2) FOR DUAL, (ENTER) TO EXIT

For example, to translate a received CTCSS tone of 88.5 Hz. to a 
transmitted dual CTCSS tone pair of 100.0 Hz./151.4 Hz., 
press '2'.

The RP04 will display:

ENTER LOW TONE (4 DIGITS) (ENT) > 
i.e. for 79.7 Hz. press (0797) (ENTER)

Enter the low tone (100.0) first.

The RP04 will display:

ENTER HIGH TONE (4 DIGITS) (ENT) > 
i.e. for 146.2 Hz. press (1462) (ENTER)

Enter the high tone (151.4).

The RP04 will briefly display:

CHECKING LOTONE: 100.0 HITONE 151.4

and then (briefly):

GRP: LTONE = 88.5/100.0 HRS = 0000:00
002: HTONE = 151.4 HITS = 00000

indicating that a call received with a single CTCSS tone of 
88.5 Hz. will be repeated with a dual CTCSS tone pair of 
100.0 Hz. and 151.4 Hz. The RP04 will then restart the ADD USER 
function.
1.3.2 Quitting the ADD USER Function

To return to the Programming Mode prompt, press the ENTER key when the ADD USER prompt appears.

1.3.3 ADD USER Error Messages:

'SINGLE/DUAL TONE CONFLICT' - the single CTCSS tone entered already exists in the memory as one tone in a dual CTCSS tone pair; OR, one tone of the dual CTCSS tone pair entered already exists in the memory as a single CTCSS tone user.

'USER ALREADY EXISTS...' - the single or dual CTCSS tone(s) entered already exist in the memory.

'* CAN'T USE MIDTONE WITH DUAL TONES *' - a midtone (118.8 Hz. to 141.3 Hz.) cannot be used as the high-tone half of a dual CTCSS tone pair.
1.4 Delete User:

To delete a user from the memory, press 2 while in Programming Mode.

The RP04 will display:

DELETE USER: PRESS (1) FOR SINGLE TONE,
(2) FOR DUAL, (ENTER) TO EXIT>

Enter 1 if the user to be deleted is a single tone user; enter 2 if the user is a dual CTCSS tone user. For example, to delete the dual CTCSS tone user whose tone pair is 88.5 Hz./162.2 Hz., press 2.

The RP04 will display:

ENTER LOW TONE (4 DIGITS)(ENT)>
i.e. for 79.7 Hz. press (0797)(ENTER)

Enter the low-tone (88.5 Hz.).

The RP04 will then prompt:

ENTER HIGH TONE (4 DIGITS)(ENT)>
i.e. for 146.2 Hz. press (1462)(ENTER)

Enter the high-tone (162.2 Hz.).

The RP04 will briefly display:

CHECKING LOTONE: 88.5 HITONE: 162.2

If the entered tones were found in the memory, the RP04 will prompt on the lower line of the display:

Press (0) to delete, (ENTER) to Quit>

Press (0) to delete the displayed tones from the memory. (Pressing ENTER restarts the Delete User Function). When '0' is pressed, the RP04 will display:

ENTER ACCESS CODE>

Enter the five-digit access code and press ENTER.
The RP04 will display:

======= USER DELETED=======

and return to the start of the DELETE USER function. However, if you simply press ENTER when the 'ENTER ACCESS CODE' prompt appears, the user tones will not be deleted and the RP04 will restart at the 'PROGRAMMING MODE' (function select) point of the program.

1.4.1 Quitting the DELETE USER Function

To return to the PROGRAMMING MODE prompt, press the ENTER key when the DELETE USER prompt appears.

1.4.2 DELETE USER Error Messages:

'! USER NOT FOUND; CAN'T DELETE!' – the RP04 did not find the entered tone(s) in the memory.

'!!! FATAL WRITE ERROR...’ – the RP04 was unable to adjust the memory data due to a faulty EEPROM memory chip.

NOTE: when a user is deleted from the middle of the user table, the last user in the table is copied to the deleted user's Group # location. This keeps the user table contiguous ('no gaps') so that the table can be searched quickly when the RP04 is decoding and validating tones. It also means that the Group number is not permanently associated with any valid user tones.
1.5 **View Users**:

To display the contents of the memory, press 3 while in Programming Mode.

The RP04 will display:

```
VIEW USERS: PRESS (5) TO SCAN UP, (0) TO SCAN DOWN, (ENTER) TO QUIT
```

If you press '0', the RP04 will display the contents of the first valid user's entry in the table, for example:

```
GRP: LTONE = 67.0 / 67.0 HRS = 0001:08
     . / .  HITS = 00029
```

If you press and hold the '0' key, the RP04 will 'scan' down through the memory, displaying each entry for about one-half second. If you scan past an entry of interest, use the '5' key to scan up (backwards). To scan at a slower rate, use single key-presses.

1.5.1 **Quitting the View Users Function**

To return to the PROGRAMMING MODE prompt, press and hold the ENTER key until the prompt appears.

1.5.2 **VIEW USERS Error Messages**:

'User Memory is Empty (No Users)' - there are no entries in the memory to display.

1.6 **CLEAR TIME/HIT Accumulators**

To clear the accumulated time and hit values of a valid user entry, press '4' while in Programming Mode.

The RP04 will display:

```
CLEAR TIME/HITS: PRESS (5) FOR ONE USER, (0) FOR ALL USERS, (ENTER) TO QUIT >
```
1.6.1 **All User (GLOBAL) CLEAR TIME/HITS**

To clear the accumulators of ALL users in memory, press '0'. The
RP04 will display:

CLEAR ALL USER TIME/HIT ACCUMULATORS?
PRESS (0) TO CLEAR, (ENTER) TO QUIT >

Press '0' again. (Pressing 'ENTER' aborts the function.)
After a pause (time depends on the number of users in memory), the
RP04 will display:

ALL USER TIME/HIT ACCUMULATORS CLEARED!

and return to the Programming Mode prompt.

1.6.2 **One User (INDIVIDUAL) CLEAR TIME/HITS**

To clear the accumulators of an individual user, press '5'. The
RP04 will display:

CLEAR TIME/HITS: PRESS (1) FOR SINGLE,
(2) FOR DUAL, (ENTER) TO EXIT>

To clear the accumulators of a 67.0 Hz. single tone user, for
example, press '1'.

The RP04 will display:

ENTER SINGLE TONE (4 DIGITS) (ENT)>
i.e. for 67.0 Hz. press (0670) (ENTER)

After entering the single tone, the RP04 will briefly display:

CHECKING LOTONE: 67.0 HITONE:  .
PRESS (0) TO CLEAR, (ENTER) TO QUIT>

Press '0' to clear the accumulators. The RP04 will briefly
display the contents of the valid user entry showing the
accumulated time and hit values reset to zero, as follows:

GRP: LTON= 67.0 / 67.0 HRS = 0000:00
001: HTDN=  . /  . HITS = 00000

The RP04 will then restart the CLEAR TIME/HITS function.
1.6.3 Quitting the CLEAR TIME/HITS Function

To return to the PROGRAMMING MODE prompt, press ENTER when the CLEAR TIME/HITS prompt appears.

1.6.4 CLEAR TIME/HITS Error Messages

'User memory is empty (No Users)' - there are no single or dual tones programmed into the RP04.

'*** USER NOT FOUND ***' - the RP04 could not find the entered single or dual tone in its memory.

'!!! FATAL WRITE ERROR...' - the RP04 was unable to adjust the memory due to a faulty EEPROM memory chip.

1.7 Set Parameters

The SET PARAMETERS function is normally used when the RP04 is first installed at the repeater site. This function allows the operator to examine and change various programmable parameters which are stored in memory and used by the RP04 during normal operation. When shipped, the RP04's memory is programmed with default (typical) parameter values. However, it may be necessary to change some of the parameters to suit the equipment at the operator's repeater site.

To access the SET PARAMETERS function, press '5' while in Programming Mode. The RP04 will display:

SET PARAMETERS: PRESS (ENTER) FOR HELP,
PRESS (O) FOR PROGRAMMING MODE

The SET PARAMETERS function has a 'help menu' feature similar to the main Programming Mode. Pressing the ENTER key causes the RP04 to display (on the bottom line) the various sub-functions and the numbers which select them; for example, pressing '0' exits the SET PARAMETERS function and returns you to Programming Mode.
1.7.1 Changing the CONTROL BYTE

Pressing '1' while in SET PARAMETERS mode allows the operator to examine and change the Control Byte. The Control Byte sets the active polarity of the COS input and PTT output lines, and enables (or disables) the TX Override and Call Timeout features of the RPO4. This byte is stored in programmable memory. When the Control Byte option is selected, the RPO4 briefly displays:

1] Reading Control Byte...

and then either:

COS is HIGH when Busy...
Press (O) to change, (ENTER) for next

or:

COS is GROUND when Busy...
Press (O) to change, (ENTER) for next

depending on the current active state of the COS input line control. The first case ("COS is High when Busy") means that the RPO4 will sense a call in progress from the repeater site's receiver when the RPO4's COS input line is greater than +4 Vdc. The second case ("COS is Ground when Busy") means that the RPO4 detects a received call in progress when COS is less than +3.5 Vdc. Pressing 'O' will change the active COS level from one state to the other, as indicated on the display. Press ENTER when the required condition of the COS active state is displayed. The condition will be saved in temporary memory.

The RPO4 will display either:

PTT is HIGH to Xmit...
Press (O) to change, (ENTER) for next

or:

PTT is GROUND to Xmit...
Press (O) to change, (ENTER) for next

depending on the current state of the PTT output line control. The PTT output line will sink (switch to ground) a positive current of 400 milliamps (maximum). The first case means that the RPO4 will switch off (open) the current sink to key the repeater transmitter. The second case means that the RPO4 will switch on (close) the current sink to transmit. Press 'O' to select the required active condition of the PTT output, and then press ENTER. The PTT active state will be saved in temporary memory.
The RP04 will display either:

   TX Override is DISABLED (normal)...
   Press (0) to change, (ENTER) for next

or:

   TX Override is ENABLED, can't Xmit
   Press (0) to change, (ENTER) for next

The TX Override feature allows the installed RP04 and repeater receiver to be tested without keying the transmitter each time a valid user’s single or dual tone is detected. For normal repeater operation, the TX Override feature must be set to 'disabled'. Use the '0' key to select the required TX Override condition and press ENTER.

The RP04 will now display either:

   Call Timeout Disabled (normal)
   Press (0) to change, (ENTER) for next

or:

   Call Timeout Enabled
   Press (0) to change, (ENTER) for next

The call timeout feature will terminate a call in progress if the deviation of the call exceeds the time limit set by the Maximum Call Time parameter. Use the '0' key to enable or disable the call timeout feature, and press ENTER.

The RP04 will display:

    ---End of Control Byte---
    Press (5) to re-do, (ENTER) to QUIT

Pressing (5) will restart the Control Byte examine and change function; for example, to quickly verify the status of the Control Byte options, press (5) to restart at 'COS...', and press ENTER to view the state of each option. If all options are correct, press ENTER when the 'End of Control Byte' prompt appears again.
The RPO4 will display:

--- Writing Control Byte---

and will copy the modified control byte from temporary memory to
programmable memory. The RPO4 will then display the SET PARAMETERS
prompt.

1.7.2 Changing the COS VALID TIME

Pressing '2' while in SET PARAMETERS mode allows the operator to
examine and change the COS VALID TIME. This is the length of time
that the RPO4 waits after it detects an active COS level before it
begins checking for tones. This delay allows the receiver's audio
output and the RPO4's filters to stabilize to prevent falsing.
When the COS valid time option is selected, the RPO4 will briefly
display:

21 COS Valid Time is now 020 mSecond(s)
Press (0) to Change, (ENTER) to Quit>

When '0' is pressed, the RPO4 will display:

21 COS Valid Time is now 020 mSecond(s)
Press 3 digits (ENTER)>

To change the COS valid time to 60 milliseconds, for example,
press '060' and ENTER. The RPO4 will display the entered time and
prompt for a new time, or ENTER to quit. Pressing ENTER will
restart the SET PARAMETERS function.

1.7.3 Changing the Extended PTT TIME

Pressing '3' while in SET PARAMETERS mode allows the operator to
examine and change the extended PTT time. This is the length of
time which the RPO4 keeps the transmitter keyed on after the RPO4
switches off the repeated CTCSS tones. This eliminates the
'squelch tail' heard in the mobile units. When this option is
selected, the RPO4 will briefly display:

31 Extended PTT Time is now 00.3 Seconds
Press (0) to Change, (ENTER) to Quit>
When '0' is pressed, the RPO4 will display:

3] Extended PTT Time is now 00.3 Seconds
   Press 3 digits (ENTER)>

To change the extended PTT time to 0 seconds, for example, press '000' and ENTER. The RPO4 will display the entered time and prompt for a new time, or ENTER to quit. Pressing ENTER will restart the SET PARAMETERS function.

1.7.4 Changing the Dropout Timer

Pressing '4' while in SET PARAMETERS mode allows the operator to examine and change the dropout time. This is the length of time that the RPO4 keeps the transmitter keyed on after the COS input goes inactive. When this option is selected, the RPO4 will briefly display:

4] Dropout Delay Time is now 010 Sec(s)
   Press (0) to Change, (ENTER) to Quit>

When '0' is pressed, the RPO4 will display:

4] Dropout Delay Time is now 010 Sec(s)
   Press 3 digits (ENTER)>

To change the dropout time to 2 seconds, for example, press '002' and ENTER. The RPO4 will display the entered time, and prompt for a new time, or ENTER to quit. Pressing ENTER will restart the SET PARAMETERS function.

1.7.5 Changing the CALL TIMEOUT Time

Pressing '5' while in SET PARAMETERS mode allows the operator to examine and change the CALL TIMEOUT time. This is the maximum length of time allowed for a single call before the RPO4 keys off the transmitter. The RPO4 will send three one-second-duration warning beeps at ten-second intervals before terminating the call. (Note that the CALL TIMEOUT feature will only be active if it has been enabled with the CONTROL BYTE). When this option is selected, the RPO4 will briefly display:

5] Maximum Call Time is now 005 Minutes
   Press (0) to Change, (ENTER) to Quit>
When '0' is pressed, the RPO4 will display:

5] Maximum Call Time is now 005 Minutes
Press 3 digits (ENTER)

To change the CALL TIMEOUT time to 15 minutes, for example, press '015' and ENTER. The RPO4 will display the entered time and prompt for a new time, or ENTER to quit. Pressing ENTER will restart the SET PARAMETERS function.

1.7.6 Changing the ACCESS CODE

Pressing '9' while in SET PARAMETERS mode allows the operator to examine and change the 5-digit access code. When this option is selected, the RPO4 will display:

9] Access Code is now: 12345
Press (0) to Change, (ENTER) to Quit

To change the access code to 67890, for example, press (0). The RPO4 will display:

ENTER *NEW* ACCESS CODE
Press 5 digits (ENT), i.e. (12345)(ENT)

Now press '67890' and ENTER. The RPO4 will display:

9] Access Code is now: 67890
Press (0) to Change, (ENTER) to Quit

Pressing ENTER will restart the SET PARAMETERS function.

1.7.7 Quitting the SET PARAMETERS Function

Pressing '0' while in SET PARAMETERS mode will return the RPO4 to PROGRAMMING MODE.
1.8 **Initialize MEMORY**

The INITIALIZE MEMORY function is normally used when a new EEPROM memory chip has been installed in the RP04, or when an RP04 is moved to a different repeater installation. The INITIALIZE MEMORY function DELETES ALL USERS from MEMORY and resets all stored parameters to their default (factory) values, but will not alter the access code in a previously programmed MEMORY.

When initializing a new (blank) MEMORY, it is recommended that the JP2 jumper be installed to access the Programming Mode.

To INITIALIZE MEMORY, press '6' while in Programming Mode. If the EEPROM is a new (blank) part, the RP04 will display:

```
INITIALIZE EEPROM: Clears ALL users
and sets default parameter values

ENTER *NEW* ACCESS CODE>
Press 5 digits (ENT), i.e. (12345)(ENTER)
```

Pressing ENTER will quit the function and restart the RP04 in Programming Mode.

Pressing five digits and ENTER will set the RP04's access code number entered, and for verification the RP04 will display:

```
*NEW* ACCESS CODE IS> (number)
```

The RP04 will then initialize the memory and parameters, display:

```
***** EEPROM INITIALIZED *****
```

and restart the RP04 in Programming Mode. The RP04 is now ready for alignment, programming and installation.
1.8.1 Initializing a Previously Programmed EEPROM

When the INITIALIZE EEPROM function is selected and the RP04 determines (by the presence of an active access code stored in EEPROM) that the EEPROM has previously been initialized, the RP04 will display:

```
INITIALIZE EEPROM: Clears ALL users
and sets default parameter values

--- CAUTION: DELETES ALL USERS ---
Press (O) to INIT, (ENTER) to Quit>
```

Press 'O' to initialize the EEPROM (pressing ENTER causes the RP04 to restart Programming Mode). When 'O' is pressed, the RP04 will display:

```
--- CAUTION: DELETES ALL USERS ---
ENTER ACCESS CODE>
```

To initialize the EEPROM, enter the five-digit access code and press ENTER. If the access code was entered correctly, the RP04 will display:

```
OK
```

and then:

```
****** EEPROM INITIALIZED ******
```

and automatically restart at Programming Mode. If the access code was incorrect, the RP04 will display:

```
'WRONG ACCESS CODE'
```

and restart at Programming Mode without initializing the EEPROM. If the operator pressed ENTER to abort the function, the RP04 will also restart at Programming Mode without initializing the EEPROM.
1.9 Alignment Program

The ALIGNMENT Program is normally used at the factory to set certain software parameters in EEPROM memory. [The operator must use parts 4 and 5 to set the levels of the CTCSS and 1kHz 'beep' tones.

The software parameters of parts 1, 2 and 3 should not be altered by the operator, but the tone level adjustment functions are useful when testing and installing the RPO4.

To select the ALIGNMENT Program, press '9' while in PROGRAMMING MODE.

The RPO4 will display:

ALIGNMENT: PRESS (ENT) FOR HELP, or PRESS (0) FOR PROGRAMMING MODE>

Each time the enter key is pressed, the RPO4 will display, in sequence, each test function and the number-key which selects it.

1.9.1 Alignment Function 1: Threshold Dropout

This function is used at the factory to change the rate of tone detect and dropout levels in the RPO4 software. The operator should not alter these parameters.

1.9.2 Alignment Function 2: Charge/Discharge

This function is used at the factory to change the rate of tone detect and dropout in the RPO4 software. The operator should not alter these parameters.

1.9.3 Alignment Function 3: Max Read Time

This function is used at the factory to set the maximum time that the RPO4 will spend decoding for a single tone user. The operator should not alter this parameter.
1.9.4 Alignment Function 4: Set CTCSS Tone Levels

To set the CTCSS encode tone levels, press '4' while in ALIGNMENT mode.

The RP04 will briefly display:

4) SET CTCSS LEVELS: adjust R108 for
   HI/MIDTONES, adjust R110 for LOTONES

and then:

SELECT TONES: PRESS (1) FOR SINGLE,
(2) FOR DUAL, (ENTER) TO QUIT>

The procedure for entering a single or dual tone is the same as that for the ADD USER and DELETE USER functions. When the single or dual tone pair has been entered, (100Hz., for example), the RP04 will display:

CHECKING LOTONE: 100.0 HITONE: .
Press (5) for AUDIO ON, (0) for OFF>

This option allows the operator to switch the audio path (between AUDIO IN-TB1 pin 3 and AUDIO OUT-TB1 pin 7) on or off as required. Press '5' or '0' to select the AUDIO option. The RP04 will enable the tone encoders (in this case, the low-tone encoder will be programmed to generate 100.0 Hz. and the high-tone encoder will be disabled).

The display will read:

CHECKING LOTONE: 100.0 HITONE:
Press (0) to stop tones, (ENT) to quit

The RP04 is now generating the programmed tone, and R110 can be adjusted to set the tone level. To stop the tone, press '0'.

The RP04 will display:

CHECKING LOTONE: 100.0 HITONE:
Press (5) to start tones, (ENT) to Quit

Note that although the tone has been disabled, the audio path will still be switched on or off as selected. To enable the tone again, press '5'. Before the RP04 enables the tone encoder, it will prompt:

CHECKING LOTONE: 100.0 HITONE: .
Press (5) for AUDIO ON, (0) for OFF>
Press '5' or '0' to enable or disable the audio path. This prompt will appear each time before the tone encoders are enabled.

To quit the function and return to the ALIGNMENT prompt, press ENTER when the "start tones" or "stop tones" prompts are displayed. Quitting the function at the "Press '0' to stop tones" prompt will leave the tone encoder(s) enabled and the audio path option in effect; quitting the function at the "Press '5' to start tones" prompt will leave the tone encoders off, but leave the audio path option in effect. This allows the operator to select the "SET BEEP TONE LEVEL" function with the CTCSS tones and audio enabled or disabled as required.

1.9.5 Alignment Function 5: Set Beep Tone Level

To set the 1 kHz. beep tone level, press 5 while in TEST FUNCTIONS mode.

The RPO4 will display:

5) SET BEEP TONE LEVEL: adjust R127,
   Press and hold (ENT) to QUIT

It will then begin generating a 1 kHz tone at JP1 pin 2. A jumper bar must be connected between JP1 pins 2 and 3 for the 1 kHz tone to appear at the AUDIO OUT terminal, TB1 pin 7. Adjust R127 to set the 'beep' tone level. The 'beep tone' program checks the enter key once every second (this is the 'tick' heard in the 1 kHz tone).

To quit the function, press and hold the ENTER key for a second until the ALIGNMENT prompt appears.

1.9.6 Quitting the ALIGNMENT Program

To quit the ALIGNMENT program and restart PROGRAMMING MODE, press '0' when the ALIGNMENT prompt appears. This will disable the tone encoders and the audio path if left on by the "SET CTCSS TONE LEVELS" function.
1.10 Remote Control Functions

The following functions are associated with the Remote Programming Mode (Remote Control) feature of the RP04. One of these functions, 'CALL REMOTE UNIT', which allows the RP04 to operate as a remote control terminal, is described in detail in the section on Remote Programming. The other functions, which allow the operator to test and align the AB07 PCB and initialize the RP04 Repeater Panel for remote control, are described below.

To access the Remote Control functions, press '7' while in local Programming Mode. The RP04 will display:

REMOTE CONTROL: PRESS (ENT) for HELP, or
PRESS (0) for PROGRAMMING MODE >

The REMOTE CONTROL function has a 'help menu' similar to the main Programming Mode. Pressing the ENTER key causes the RP04 to display the numbers and descriptions of the various sub-functions; for example, pressing '0' exits the Remote Control functions and returns to Programming Mode.

1.10.1 Call Remote Unit

When the RP04 is used as a Base unit (Remote Control Terminal), pressing '1' causes the RP04 to establish a data link over an RF (radio) channel with another RP04 installed at a repeater site, and, once the link is established, act as a remote control terminal to program the remote unit. This is described in detail in the section on Remote Programming.

1.10.2 Store Control Tones

In order to perform Remote Control, the RP04 which is installed at the repeater site must be programmed to recognize a specific CTCSS tone (single or dual) as the tone which is transmitted by the Base station to initiate Remote Control.

To store the CONTROL TONES into the RP04's memory, press '2' when the REMOTE CONTROL prompt is displayed. The RP04 first checks to see if CONTROL TONES have already been programmed into memory. If they have, the RP04 will display them as shown:

CONTROL TONE(S): 67.0 250.3
Press (0) to Change, (ENTER) to QUIT >
Press (ENTER) to return to the Remote Control prompt. If no CONTROL TONES have been programmed, or if it is necessary to change the tones and ‘0’ is pressed, the RP04 will display:

ENTER CONTROL TONES: (1) = Single Tone,  
(2) = Dualtone, (ENTER) = Quit >

The CONTROL TONES are entered in the same manner as the ADD USER function (except that there is no prompt for cross-tone encoding). When the tones have been entered, the RP04 will display the new tones and prompt ‘0’ to change, ENTER to quit’ as shown above. Press (ENTER) to return to the Remote Control prompt.

1.10.3 Checkout AB07

When the Remote Control prompt is displayed, press ‘3’ to test and align the FSK MODEM section of the AB07 PCB. The RP04 will display:

3/REMOTE CONTROL: checking AB07

on the first line, and on the second line will display:

BASE MODE: OK!/RPRTR MODE: OK!

as it checks the originate (base mode) and answer (repeater mode) channels of the FSK MODEM. If the RP04 displays a blank or garbled second line, there is a problem. After the functional test, the RP04 will display:

AB07 ALIGNMENT: press (ENT) to Quit,  
(1) for Base Mode, (2) for Rptr Mode >

If the alignment function is not required, press ENTER to return to the REMOTE CONTROL prompt.

The AB07 ALIGNMENT function performs two tests at the same time. First, it initializes the FSK MODEM circuit in the mode selected by the operator, sets PTT active, and transmits a continuous sequence of FSK data to the AUDIO OUT connection, TB1 pin 7. This allows the operator to adjust R3 on the AB07 PCB for the correct transmitter deviation level. Second, the RP04 monitors the COS input and FSK CARRIER DETECT circuit, and will display any received data on the LCD. This allows the operator to check the FSK receiver circuitry if another RP04 or FSK signal generator is available. To stop the test, press RESET.

NOTE: Jumper JP-2 must be installed on the Main PCB for the test to run continuously. If JP-2 is not installed, the RP04 will run the test for approx. 12 seconds (the timeout delay of the watchdog reset circuit) and then reset.
1.10.4 Test Printer

The purpose of the PRINTER TEST function is twofold:

1) To perform a functional check of the parallel printer connected to the AB07 for remote billing information download purposes, and

2) to provide a means of locally downloading the billing information from the RP04 which is connected to the printer.

To test the parallel printer; connect it to the RP04, ensure that it has sufficient paper, and switch it on. On the RP04, select REMOTE CONTROL functions and press ‘4’. The RP04 will display:

4/REMOTE CONTROL: checking printer

If the printer responds correctly, the LCD will display:

*** PRINTER OK ***

and the printer should print "AB07 PRINTER TEST MESSAGE". If there is a printer fault, (for example, the printer is switched off, not ONLINE or out of paper), the RP04 will display:

!!! PRINTER NOT READY !!!

and return to the REMOTE CONTROL prompt. If the printer checks OK, then the RP04 will display:

PRINTER LOCAL USER LIST:
Press (0) to continue, (ENT) to quit >

Press ENTER to return to the REMOTE CONTROL prompt, or press ‘0’ to print out the list of valid users in the RP04’s memory. As each user entry is printed, it is also displayed on the LCD in the same format as the ‘VIEW USERS’ function. When all users have been printed, the program returns to the REMOTE CONTROL prompt.

1.10.5 Quitting the Remote Control Function

Pressing ‘0’ while the REMOTE CONTROL prompt is displayed will return the RP04 to Programming Mode.
STEP 4 - Remote Programming With the RP04

Introduction

The RP04 is designed to permit both local programming and programming by remote control over an RF (radio) channel, typically between a repeater site and a base station. The RP04 is essentially an RP03 Trunking Repeater Panel with an AB07 Remote Control Option PCB and software upgrade installed. The AB07 PCB converts the serial data (programming information) from the Trunking Repeater Panel to in-band audio tones (FSK) which is transmitted over the radio. The AB07 also provides a parallel printer port so that billing information can be 'downloaded' from the repeater site and printed out at the base station.

Two base station configurations for remote control are possible. The first consists of a 'spare' RP04 connected to a mobile or base station radio operating on the RF channel of the repeater to be remotely programmed. For flexibility, RP04's are designed to operate as either a repeater control panel or a base station remote control terminal. The second configuration consists of a 'standalone' AB07 connected as an interface between a base station radio and a personal computer running a remote control program. This document describes the 'RP04 - to - RP04' configuration.

There are 5 main steps involved in programming the RP04 Trunking Repeater Panel by remote control using a second RP04 as the base station remote control terminal.

They are:

1) 'call' the repeater.
2) 'establish a link'
3) 'log - in'
4) enter 'remote programming mode'
5) 'log - out'
Calling the Repeater

Before calling the repeater, first ensure that the RP04 base station remote control terminal (the 'Base unit') has been properly connected to the base station radio or a spare mobile. Monitor the channel to check that the repeater is not busy.

On the Base RP04, enter local Programming Mode, and select the REMOTE CONTROL function (press key #7). Press key #1 'CALL REMOTE UNIT'. The RP04 will display:

1/REMOTE CONTROL: checking AB07

and will then perform a quick self-check of the MODEM and printer functions. The RP04 should briefly display:

* BASE MODE: OK!/ RPTR MODE: OK

followed by:

*** PRINTER OK ***

If the RP04 displays 'AB07 OPTION NOT INSTALLED', or if the 'base mode/repeater mode' test fails, then the remote programming session cannot proceed. If the parallel printer is not connected or not switched on, the message:

!!! PRINTER NOT READY !!!
PRESS (O) to continue, (ENT) to Quit >

will be displayed. If the printer is not required to download billing information, press (O) to continue with the call. Otherwise, press (ENT) to abort the call and check the printer.

Once the self-check tests are complete, the RP04 will display:

Enter Control Tones: (1) = Single tone, (2) = Dual tone, (ENTER) = Quit >

At this point, enter the REMOTE CONTROL TONE(S) that were stored in the RP04 Repeater Controller Panel (the 'Remote unit') that you are calling. These tones will not be stored in the Base RP04 - they are only used to call the Remote RP04 and place it into Remote Programming Mode.
For example, if the Remote RP04’s remote control tones are 103.5 Hz and 203.5 Hz, press ‘2’ to indicate a dual tone and enter ‘1035 (ENTER)’ and ‘2035 (ENTER)’, when prompted for the high and low-tones, respectively. Once the CONTROL TONES have been entered, the RP04 will display:

*** SENDING CONTROL TONES ***

and then transmit the control tones to the Remote RP04 in three 1-second bursts. After each burst, the Base unit monitors the channel to check if the Remote RP04 has keyed the repeater transmitter and is sending the FSK answer-mode carrier (2225 Hz tone) – (the CONTROL TONES are not repeated by the Remote RP04). If the Base RP04 detects active COS and FSK carrier from the Remote RP04 it will attempt to establish a link with the Remote. However, if after three attempts the Base fails to raise the Remote in Remote Control Mode, the Base RP04 will display:

* CAN’T ESTABLISH LINK WITH REPEATER *
Press (0) To RETRY, (ENTER) To QUIT >

Pressing ‘0’ causes the Base RP04 to make 3 more attempts to raise the repeater by sending control tones; pressing ‘ENTER’ restarts the program at the REMOTE CONTROL prompt. If the Base detects active COS but no FSK carrier while sending control tones, it will display:

CHANNEL BUSY - PRESS (ENTER) to QUIT,
or PRESS (0) to BREAK IN >

Monitor the channel to see if a user has raised the repeater. Once the user’s call is complete and the repeater stops transmitting, the Base RP04 will automatically resume sending control tones. However, if the repeater is sending the 2225 Hz FSK carrier tone, press ‘0’. This will cause the Remote unit to quit Remote Control Mode and return to Standby. The Base unit will automatically resume sending control tones once the channel is free. It may be necessary to press ‘0’ two or three times to properly restart the Remote unit.
2) Establishing the Link

Once the Base unit has placed the Remote unit into Remote Control Mode and detected FSK carrier, it will display:

**** SENDING SIGNON ****

and print 'RP04' as it transmits the signon message to the Remote. The Remote unit will send back 'Ferritronics RP04 *' (which will also be displayed on the Base unit), and the Base unit will display:

*** LINK ESTABLISHED ***

and then wait for the Remote unit to initiate the 'log-in' procedure.

If the Remote unit does not properly receive the 'RP04' message ten seconds after entering Remote Control Mode, it will drop the link and restart in Standby, and the Base unit will display:

*** LOST REPEATER CARRIER ***
Press (0) to RETRY, (ENTER) to QUIT >

If the Base unit does not properly receive the 'Ferritronics RP04 *' reply from the Remote unit, it may display:

*** SENDING SIGNON ***
Press (0) to RETRY, (ENTER) to QUIT >

or it may 'hang' (that is, display a partially garbled reply but no 'RETRY' prompt) as long as the Remote unit is still sending FSK carrier.

NOTE: Any time the Base unit appears to 'hang', wait a few seconds and then press 'ENTER'. If the Remote unit does not send back any response in a few seconds, press '6'. The Base unit will then display:

*** LOCAL RESTART ***
Press (0) to RETRY, (ENTER) to QUIT >
3) **Logging In**

Once the Base and Remote units have established a link, the Remote unit will send (and the Base unit will display):

```
* REMOTE PROGRAMMING MODE *
ENTER ACCESS CODE >
```

Enter the 5-digit access code of the Remote unit, and press ENTER. Once ENTER is pressed, the Base unit will transmit the code to the Remote unit. If the access code is correct, the Remote unit will respond 'OK' and enter Remote Programming Mode; if the access code is not correct, the Remote unit will respond 'WRONG ACCESS CODE!' and then send the 'enter access code' prompt. The Remote unit will drop the link and enter Standby mode if a correct access code is not received after five attempts.

4) **Remote Programming Mode**

Once the Base and Remote units have established a link and the operator has 'logged-in' with the correct access code, the Remote unit will send:

```
* REMOTE PROGRAMMING MODE *
Press Function Key or ENTER for HELP
```

Remote Programming Mode operates in a manner similar to Local Programming Mode, with a few exceptions:

- The response time to a key-press entry is slower, since the key data must be transmitted to the Remote unit, and the response sent back, decoded and displayed on the Base unit,

- Some programming mode functions are not allowed, since they may cause system failure, and

- The Remote Control function (key #7) has a different structure.
4.1) **Remote Programming Mode Functions:**

4.1.1) **Add User**

(Function Key #1): - operates the same as in local programming mode.

4.1.2) **Delete User**

(Function Key #2): - operates the same as in local programming mode. **CAUTION:** it is possible to delete the CONTROL TONES from the VALID USER TABLE - but don’t do it. To change the CONTROL TONES by remote control, see REMOTE CONTROL (Function key #7).

4.1.3) **View Users**

(Function Key #3): operates the same as in local programming mode except that it is not possible to 'scan' the VALID USER TABLE by holding down the 'S' or 'O' keys - instead, each keypress 'steps' through the table one user at a time. Also, to EXIT 'VIEW USERS', press the ENTER key TWICE.

4.1.4) **CLEAR TIME/HIT Accumulators**

(Function #4): operates the same as in local programming mode.

4.1.5) **Set Parameters**

(Function Key #5): operates the same as in local programming mode except that the active levels of COS and PTT in the CONTROL BYTE function cannot be changed.

4.1.6) **Initialize EEPROM**

(Function Key #6): not executable by remote control.

4.1.7) **Alignment Functions**

(Function Key #9): not executable by remote control.

4.1.8) **Remote Control Functions**

(Function Key #7): two secondary functions are available from REMOTE CONTROL (key '7'). Pressing '1' selects 'Print User List' - this allows the operator to 'download' to the Base unit and print out a list of all valid users in the Remote unit's memory, including time and hit information for billing purposes or repeater usage information. Pressing '2' selects 'Store Control Tones' - this allows the operator to examine and change the Remote Control tones stored in the Remote unit's memory, and operates the same as in local programming mode. Pressing '0' returns the operator to the 'Remote Programming Mode' prompt.
4.1.8.1) Print User List

To download a list of valid users from the Remote Unit, ensure that the parallel printer is properly connected to the Base unit, switched on and set 'ONLINE', and press '1'. The Base unit will display:

PRINT USER LIST >

and pause while it checks the printer. If the printer is not ready, the Base unit will display an error message and then the 'Remote Programming Mode' prompt. If the printer checks OK, the Remote unit will first send a title line to be printed, and then will send blocks of user data. Each block is decoded by the Base unit, displayed on the LCD in 'VIEW USERS' format, and then printed as a single line. As each block is received by the Base unit, it will transmit for approximately one-half second to signal the Remote unit to wait while the data is printed. When all user data has been sent, the Remote unit will send 'END of USER DATA' which will be displayed and printed by the Base unit, and then the Remote unit will send the 'Remote Programming Mode' prompt.

If a printer error (such as a paper jam) occurs during the Print User List session, the Base unit will display:

!!! PRINTER NOT READY !!!
Press (0) to continue, (ENT) to Quit >

If possible, correct the fault, place the printer back 'ONLINE' and press 'O' to continue the download with no loss of data (if the printer was NOT switched off). If the printer fault cannot be quickly corrected, press ENTER to abort the download and then continue programming or 'log-out'. In any event, if the Remote unit does not receive any response from the Base unit after five minutes, it will 'timeout' and restart in Standby.

5) Logging - Out

To quit Remote Programming Mode and place the Remote unit back into normal Repeater Controller mode, press 'O' when the 'Remote Programming Mode' prompt is displayed. The Remote unit will turn off its transmitter and execute a restart, and the Base unit will display the 'Lost Repeater Carrier' message to indicate that the repeater is no longer transmitting.
RP04 Base Unit - Installation and Alignment

The RP04 Trunking Repeater Panel, when used as a Base station remote control terminal, is designed to operate half-duplex so that it can be connected to a radio transceiver, such a spare mobile or base station radio.

Once the repeater-site RP04 has been placed in Remote Control Mode, the repeater transmitter will remain on for the duration of the Remote Programming session so that trunking mobile units are denied access to the repeater. The Base unit, however, only transmits when it sends keypad data to the Remote unit, and to control the flow of user data received during the 'Print User List' function.

If a spare mobile radio is used, it must be programmed with the necessary Tx/Rx frequencies to access the repeater to be programmed, and any automatic channel-scanning circuits should be disabled. Also, any 'Busy Channel Lockout' feature should be disabled, since it may prevent the mobile from transmitting once the repeater transmitter is active.

The following is a list of the connections necessary to use a mobile radio with an RP04 Base unit:

TB1-1  TONE IN

-Using a shielded lead, connect to the de-emphasized discriminator (or detector) output prior to the squelch or audio-muting stage in the receiver section. Connect the shield to TB1-2 (GROUND).

TB1-3  AUDIO IN

-No connection required.

TB1-4  SQL IN

-This signal is required by the RP04 to monitor the presence of received RF carrier. It is usually connected to the squelch or audio-muting control signal. The polarity of this signal which indicates a busy channel must be programmed into the RP04 using the 'Set Parameters - Set Control Byte' function.

TB1-5  TONE OUT

-Using a shielded lead, connect to the 'tone input' of the transmitter modulator section. Connect the shield to TB1-6 (GROUND).
TB1-7     AUDIO OUT

-Using a shielded lead, connect to the 'microphone input' pin on
the microphone connector. It may be necessary to add a series
decoupling capacitor, and a series resistor to prevent incorrect
biasing and overloading of the mic preamp circuit. Connect the
shield to TB1-6 (GROUND).

TB1-8     PTT

-This connection pulls to ground to key the transmitter. If the
microphone PTT button switches the PTT line to ground to transmit,
then connect this terminal to the PTT line on the microphone
connector. The polarity of this signal which keys the transmitter
must be programmed into the RPO4 using the 'Set Parameters - Set
Control Byte' function.

TB1-9     POWER GROUND

TB1-10    POWER +VE SUPPLY

-Connect to +13.6VDC ±20%. The RPO4 draws approximately 200mA.
If the same power supply is used to operate the mobile radio, be
aware that momentary drops in supply voltage caused by keying the
mobile's transmitter may cause the RPO4 to RESET if the power
supply does not have sufficient current capacity.

Alignment

1) Transmitted CTCSS tone levels- use the RPO4's 'Alignment - Set
CTCSS Level' function to generate a mid-band low-tone (i.e. 88.5
Hz) with 'audio off'. Using a communications monitor, adjust R110
(low-tone encoder level) for the correct transmitted deviation
level. Repeat the procedure for a mid-band high-tone (i.e. 210.7
Hz), and adjust R108 (high-/mid-tone encoder level).

2) Transmitted FSK carrier level- use the RPO4's 'Remote Control -
Checkout ABO7' function and select the 'Base Mode' test - the RPO4
will key the Tx and generate FSK carrier. Using a communications
monitor, adjust R3 on the ABO7 for the correct deviation level (it
may also be necessary to adjust R145 on the main PCB). Check that
the FSK waveform is sinusoidal and not clipped or distorted.
3) Received FSK carrier level—temporarily remove the PTT lead from TB1-8, and use the 'Remote Control - Checkout AB07' function to select the 'Repeater Mode' test. Set the communications monitor to transmit a signal with 1kHz modulation at the correct deviation level to the mobile, and observe a 1kHz sinewave at IC14 pin 16 on the AB07 with an oscilloscope.

Adjust R1 for a signal amplitude of 1.0 Vpp (min) to 3.0 Vpp (max). The signal should not be clipped or distorted. Press RESET to stop the test and replace the PTT lead.
Parallel Printer Port

The RP04 has a DB-25S type connector on the rear panel for connection to a standard parallel - interface dot - matrix printer. A standard IBM - type parallel printer interface cable is required - it typically has a DB-25P connector at the 'computer' end, and a 36 pin connector at the 'printer' end. Below is a list of the pin numbers and signals used by the RP04.

<table>
<thead>
<tr>
<th>RP04 (DB25)</th>
<th>PRINTER (36 PIN)</th>
<th>PIN #</th>
<th>PIN #</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>STROBE - active low output from RP04, signals printer that valid data is ready.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DATA BIT 1 - 8 parallel data output lines</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&quot;</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&quot;</td>
<td>from RP04 ; data format</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&quot;</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&quot;</td>
<td>is 'true' (non-inverted)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&quot;</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&quot;</td>
<td>ASCII.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&quot;</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&quot;</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&quot;</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&quot;</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ACK - active low output from PRINTER, signals RP04 that data has been read, and resets STROBE high.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BUSY - active high output from PRINTER, signals RP04 that the printer is not ready to accept data - the printer may be:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- busy printing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- 'OFF LINE'</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- indicating ERROR status (i.e. out of paper).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ERROR - active low output from printer to indicate out-of-paper, off-line or ERROR status.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>17-25</td>
<td>19-30,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GROUND - signal ground in RP04 and PRINTER.</td>
<td>33</td>
</tr>
</tbody>
</table>
# PARTS LIST

<table>
<thead>
<tr>
<th>ITEM</th>
<th>PART NO</th>
<th>DESCRIPTION</th>
<th>QTY</th>
<th>SKU</th>
<th>SHRINK</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>01A0010733</td>
<td>RP04 TRNG, REP. C/W REMOTE CONTROL</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PCB FOR DIPD TRUNKING REPEATER**
1. 01A0010733 - 1IC13

**EPROM PROGRAMMED, RP04**
1. 01A0010739

**KEYWORD LG + 2 / 2.5 GB**
1. 01A0010794

**LCD KEYBOARD BUFFER ASS'Y**
1. 01A0010773

**LCD DISPLAY ASS'Y**
1. 01A0010776

**RIBBON CABLE ASS'Y (RP02)**
1. 01A0010715

**14 LINE RIBBON CABLE ASS'Y (RP03)**
1. 01A0010719

**ECRPLK BLANK ECOR 12644AP-1**
1. 01A0010718

**JUMPER BAR**
1. 07-2127

**ENCLOSURE FOR TRUNKING**
1. 6000101611

**TOP COVER FOR TRUNKING**
2. 6002101612

**TOP COVER FOR TRUNKING**
1. 6002012635

**SWITCH TOGGLE SPST**
1. 41-2791

**WASHING PLATE: ACRYLIC**
1. 0505010740

**10 POS TERMINAL BLOCK**
1. 6440010745

**HOGGING 2 POSITION**
1. 7140010321

**SCREW 6-32 X 1/4 PHILPMHS**
20. 7140010720

**SCREW 4-40 X 1/4 PHILPHMS**
12. 7140010664

**SUBJ, U**
1. 6440010653

**SPACE, 6-32 X 2/3 #41918 BRAZ**
4. 7179-0192

**SPACE, NIDOL HX 1/4X24 X 6-32**
4. 7179-0250

**SCREW 6-32 X 1/4 PHILPMHS**
29. 7174010269

**NUT 4D 4 BLANK**
1. 7500501893

**NUT 4/18-11.5**
1. 7500501383

**LEAD HINGE 240A RED/RED CONNECTOR**
1. 6504003030

**LEAD HINGE 240A GRADE **
1. 6504003044

**HEAT SHRINK TUBING BLK 3/32"**
1. 56-2402

**ELASTIC CLEAR 2 M2 TUBES**
1. 650-5062

**LABEL SERIAL NUMBER**
1. 5940030263

**SCREW 6-32 X 5/8 PHILPHMS**
1. 7144010266

**PLATE 6/8 PLAT NYLON**
1. 76-1589

**SCREW 1/4 X 3/24 AL:PLC RD. 4 HOLE**
1. 7940010840

**SCREW PHILLIP 10-32X1/4**
1. 7940010619

**WASH LOCK SPLIT 4#**
1. 6500010034

**MANUAL, RP04**
1. 7601010733

**SHIPPING CARTON-TRAY REPEATER**
1. 7940010171

**SCREW 4-40 X 1/4 PHILPHMS**
1. 7940010137

**SCREW 4-40 X 1/4 PHILPHMS**
1. 7940010978

**PCB AB9/REMOTE CONT DPT-RP04**
1. 01A0010661

---

**Additional Notes:**

1. **1 WIND STUD (M11)**
2. **1 WHT KEYBOARD ASS'Y**
3. **4 TO MT. LCD**
4. **4 TO MT. BUFFER PCB**
5. **16 TO MT. BUFFER ASS'Y**
6. **1 WHT KEYBOARD TO BUFFER ASS'Y**
7. **1 WHT BRACKET TO CONNECT**
8. **1 WHT BRACKET TO CONNECT**
9. **1 WHT BRACKET TO CONNECT**
10. **1 TO MT. MAIN PCB**
# LCD/KEYBOARD BUFFER COMPONENT LAYOUT

![Diagram of LCD/KEYBOARD BUFFER COMPONENT LAYOUT](image)

## PARTS LIST

**01A0010737 LCD/KEYBOARD BUFFER ASSEMBLY**

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>PART NO.</th>
<th>DESCRIPTION</th>
<th>QTY</th>
<th>REG</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>1B80010737</td>
<td>PCB LCD/KEYB. BUFFER</td>
<td>1.</td>
<td>IC 1</td>
<td></td>
</tr>
<tr>
<td>301</td>
<td>29A0010764</td>
<td>OCTAL D FLIP-FLOP MC74HC374N</td>
<td>1.</td>
<td>IC 2.3</td>
<td></td>
</tr>
<tr>
<td>302</td>
<td>29A0010762</td>
<td>OCTAL BUFFER/DRIVER MC74HC244N</td>
<td>2.</td>
<td>G 1.2</td>
<td></td>
</tr>
<tr>
<td>303</td>
<td>26-2545</td>
<td>TRANS SIGNAL PNP 2N3906</td>
<td>4.</td>
<td>C 6.7.8.9</td>
<td></td>
</tr>
<tr>
<td>304</td>
<td>10-2606</td>
<td>CAP CERAMIC 1 KPF 100V 10%</td>
<td>3.</td>
<td>C 2.3.4</td>
<td></td>
</tr>
<tr>
<td>305</td>
<td>10-1473</td>
<td>CAP CER DIP ZSU 100 K PF 20%</td>
<td>2.</td>
<td>C 1.5</td>
<td></td>
</tr>
<tr>
<td>306</td>
<td>11-1669</td>
<td>CAP TANT DIP 1 MFD 20% 35V</td>
<td>6.</td>
<td>R 8.9.10.11.12.13</td>
<td></td>
</tr>
<tr>
<td>308</td>
<td>37006-0507</td>
<td>RES 1/4W 5% 10 K</td>
<td>10.</td>
<td>R 4.5.6.7.14.15.16.17.18.19</td>
<td></td>
</tr>
<tr>
<td>309</td>
<td>37006-0516</td>
<td>RES 1/4W 5% 27 K</td>
<td>1.</td>
<td>J 1</td>
<td></td>
</tr>
<tr>
<td>310</td>
<td>70A0010810</td>
<td>DUAL ROW HEADER NSH-20DB-S2-T</td>
<td>1.</td>
<td>J 2</td>
<td></td>
</tr>
<tr>
<td>311</td>
<td>66A0010767</td>
<td>BOX CONNECTOR 14 POS DUALROW</td>
<td>2.</td>
<td>R 1.2</td>
<td></td>
</tr>
<tr>
<td>313</td>
<td>70A0010807</td>
<td>DUAL ROW HEADER NSH-14DB-S2-T</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>314</td>
<td>37006-2917</td>
<td>RES. 1/4 W 0 OHMS</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
LCD DISPLAY ASSEMBLY

PARTS LIST

01A0010736  LCD DISPLAY ASSEMBLY

<table>
<thead>
<tr>
<th>ITEM NO</th>
<th>PART NO</th>
<th>DESCRIPTION</th>
<th>QTY</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>301</td>
<td>34A0010744</td>
<td>LCD DISPLAY (40 CHAR. X 2 LINES)</td>
<td>1.</td>
<td>P1</td>
</tr>
<tr>
<td>302</td>
<td>70A0010807</td>
<td>DUAL ROW HEADER NSH-14DB-82-T</td>
<td>1.</td>
<td></td>
</tr>
<tr>
<td>ITEM NO.</td>
<td>PART NO.</td>
<td>L VALUE</td>
<td>DESCRIPTION</td>
<td>QTY</td>
</tr>
<tr>
<td>---------</td>
<td>----------</td>
<td>---------</td>
<td>-------------</td>
<td>-----</td>
</tr>
<tr>
<td>100</td>
<td>1BB0010594</td>
<td>9</td>
<td>PCB 10 + 2 KEYBOARD</td>
<td>EA</td>
</tr>
<tr>
<td>301</td>
<td>41A0010751</td>
<td>9</td>
<td>KEYSWITCH SN10606H1XXX-1</td>
<td>EA</td>
</tr>
<tr>
<td>302</td>
<td>41A0010752</td>
<td>9</td>
<td>KEYSWITCH SN-1-06-06-H-1-XXX-2</td>
<td>EA</td>
</tr>
<tr>
<td>303</td>
<td>41A0010753</td>
<td>9</td>
<td>KEYSWITCH SN-1-06-06-H-1-XXX-3</td>
<td>EA</td>
</tr>
<tr>
<td>304</td>
<td>41A0010754</td>
<td>9</td>
<td>KEYSWITCH SN-1-06-06-H-1-XXX-4</td>
<td>EA</td>
</tr>
<tr>
<td>305</td>
<td>41A0010755</td>
<td>9</td>
<td>KEYSWITCH SN-1-06-06-H-1-XXX-5</td>
<td>EA</td>
</tr>
<tr>
<td>306</td>
<td>41A0010756</td>
<td>9</td>
<td>KEYSWITCH SN-1-06-06-H-1-XXX-6</td>
<td>EA</td>
</tr>
<tr>
<td>307</td>
<td>41A0010757</td>
<td>9</td>
<td>KEYSWITCH SN-1-06-06-H-1-XXX-7</td>
<td>EA</td>
</tr>
<tr>
<td>308</td>
<td>41A0010758</td>
<td>9</td>
<td>KEYSWITCH SN-1-06-06-H-1-XXX-8</td>
<td>EA</td>
</tr>
<tr>
<td>309</td>
<td>41A0010759</td>
<td>9</td>
<td>KEYSWITCH SN-1-06-06-H-1-XXX-9</td>
<td>EA</td>
</tr>
<tr>
<td>310</td>
<td>41A0010760</td>
<td>9</td>
<td>KEYSWITCH SN-1-06-06-H-1-XXX-0</td>
<td>EA</td>
</tr>
<tr>
<td>311</td>
<td>41A0010761</td>
<td>9</td>
<td>KEYSWITCH SN-1-02-02-N-1-NONE</td>
<td>EA</td>
</tr>
<tr>
<td>312</td>
<td>70A0010807</td>
<td>9</td>
<td>DUAL ROW HEADER WTS-14-S1-T</td>
<td>EA</td>
</tr>
<tr>
<td>901</td>
<td>L-1000</td>
<td>9</td>
<td>ASSEMBLY LABOUR</td>
<td>MN</td>
</tr>
<tr>
<td>902</td>
<td>L-1100</td>
<td>9</td>
<td>TEST LABOUR</td>
<td>MN</td>
</tr>
<tr>
<td>903</td>
<td>L-1200</td>
<td>9</td>
<td>INSPECTION LABOUR</td>
<td>MN</td>
</tr>
</tbody>
</table>
LIMITED TWO YEAR WARRANTY

All Ferritronics equipment is warranted to be free of defects in material and workmanship on date of shipment. Original purchaser's exclusive remedy for defective goods will be repair or replacement of such defective goods returned to the Vendor, or a refund of the purchase price. Any unauthorized alteration or modification of the equipment by the purchaser or damage caused by external sources will void the warranty.

Materials are warranted for a period of two (2) years from date of shipment. Workmanship is warranted for a period of one (1) year. Repairs to correct defects identified in the first twelve (12) months following date of shipment will be made by Ferritronics free of charge.

Purchaser is required to allow Vendor a reasonable opportunity to inspect, test, or sample goods prior to approval of their return by Vendor, and to give written notice of the defects to Vendor prior to expiration of warranty, and to include dated proof of purchase with equipment being returned under warranty.

There are no other warranties expressed or implied which are applicable to Ferritronics equipment.

RETURN POLICY

Purchaser may return Ferritronics equipment for restocking and credit, provided notification has been given to the Vendor. All equipment returned will be subject to restocking charges.

The restocking charge for Standard products in original condition and returned to the Vendor within 30 days of shipment is 20% of the purchase price.

Purchaser is to include a Return Authorization, provided by the Vendor, with equipment shipped to Ferritronics for restocking.