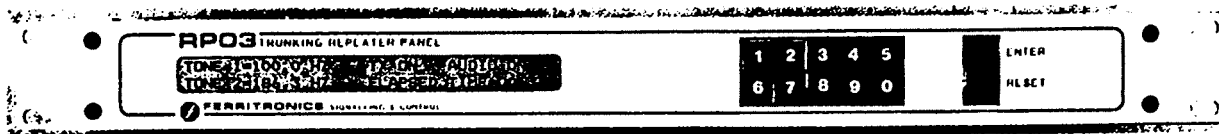


FERRITRONICS CCT

CTCSS Compatible Trunking

RPO4

**CCT REPEATER CONTROLLER
WITH REMOTE CONTROL**



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CLASS B - VERIFIED

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.

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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 \pm 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)	\pm 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 \leq 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

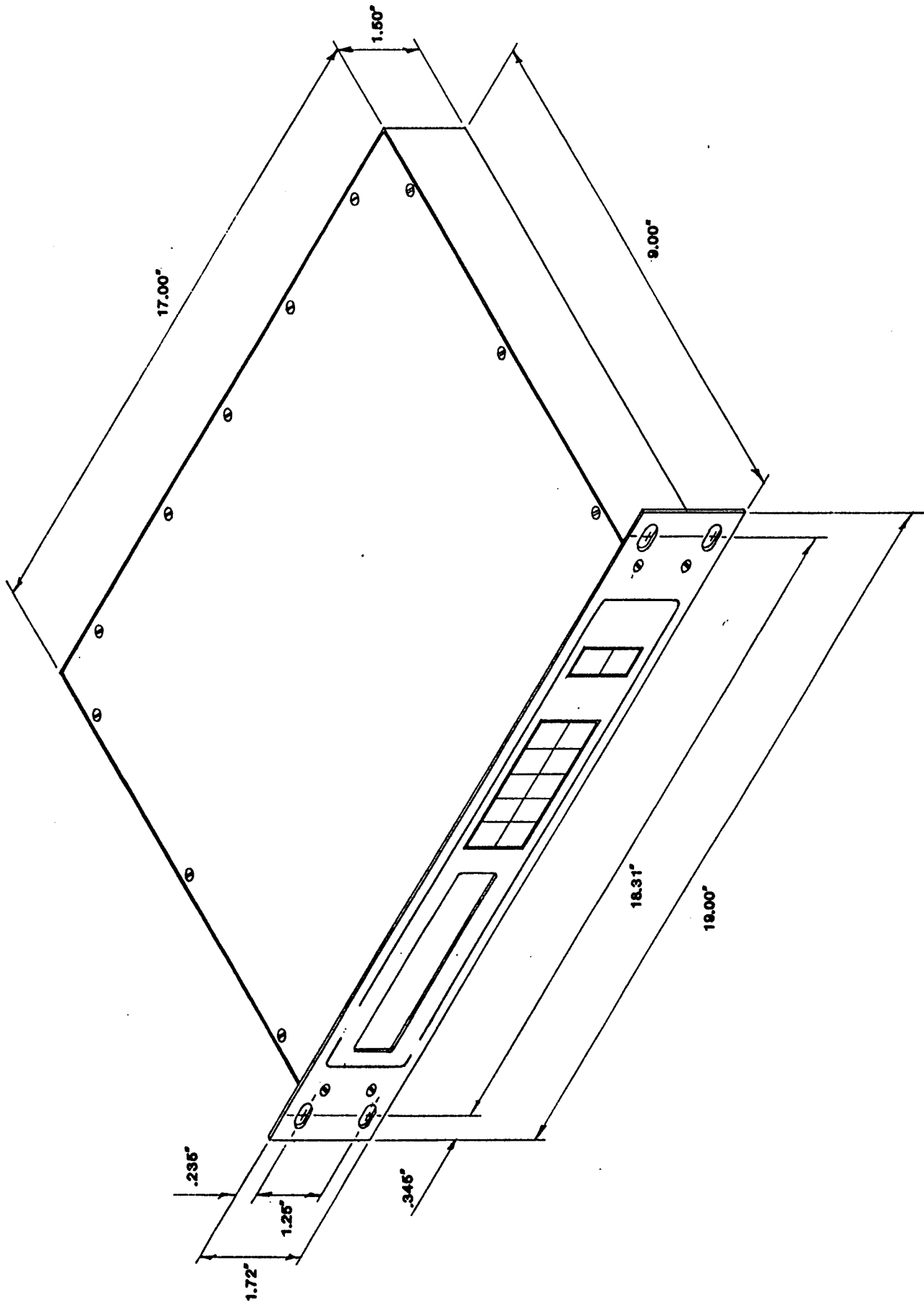
CARRIER DETECT TIMES ATTACK 100 mSec
DECAY 4.7 mSec

MODEM TRANSMITTER

FREQUENCY ACCURACY \pm 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



OUTLINE DRAWING

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:

<u>CONNECTION</u>	<u>NAME</u>	<u>DESCRIPTION</u>
TB1-1	TONE IN	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.
TB1-2	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.
TB1-3	AUDIO IN	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.

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 ≤ 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)

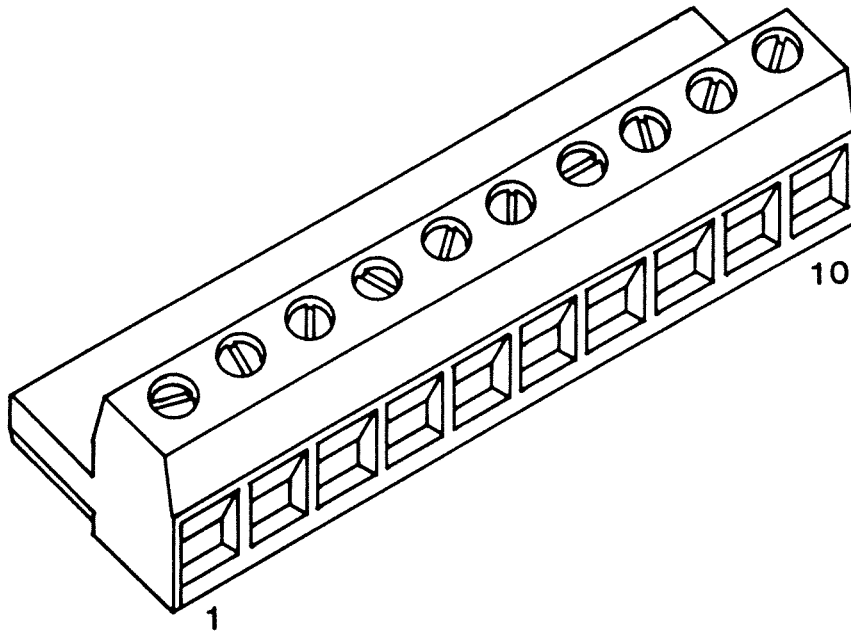


FIGURE 1

REPEAT AUDIO FILTER RESPONSE

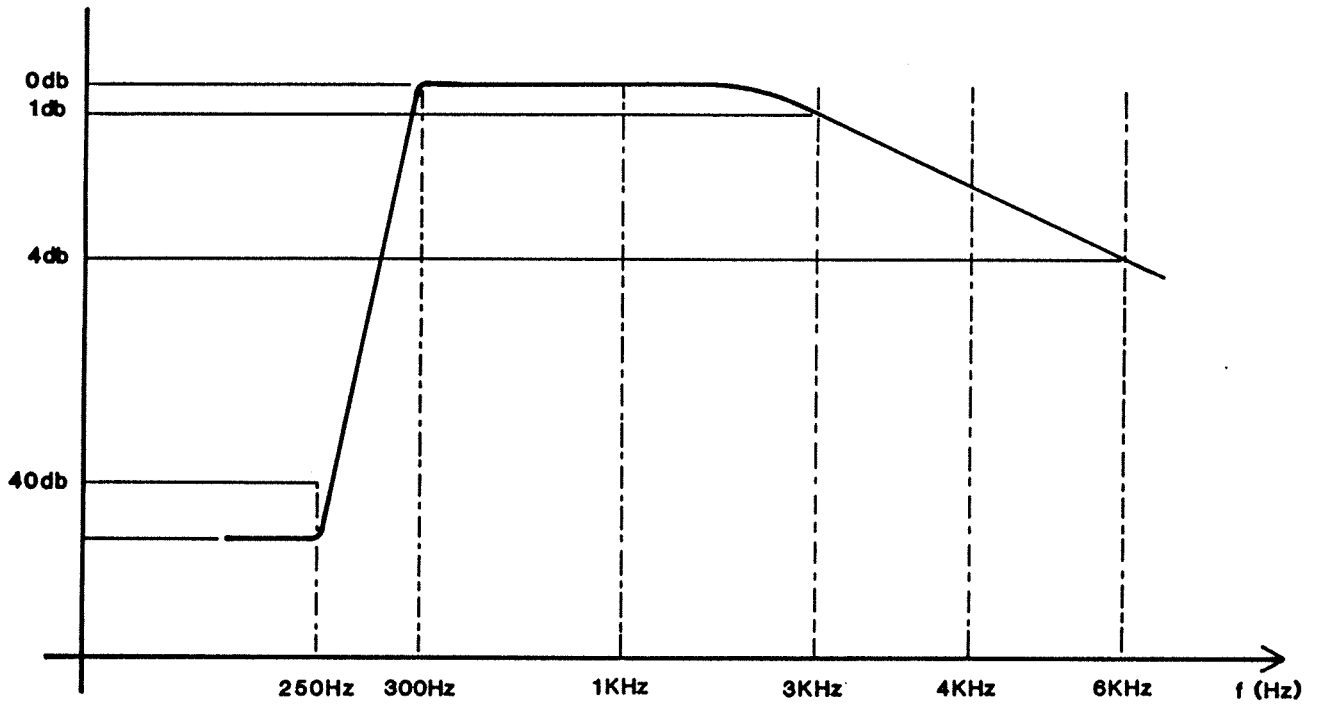


FIGURE 2

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 Byte' 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 RPO4 into local programming mode and select the 'Alignment - Set CTCSS Levels' function. Program the RPO4 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 RPO4 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

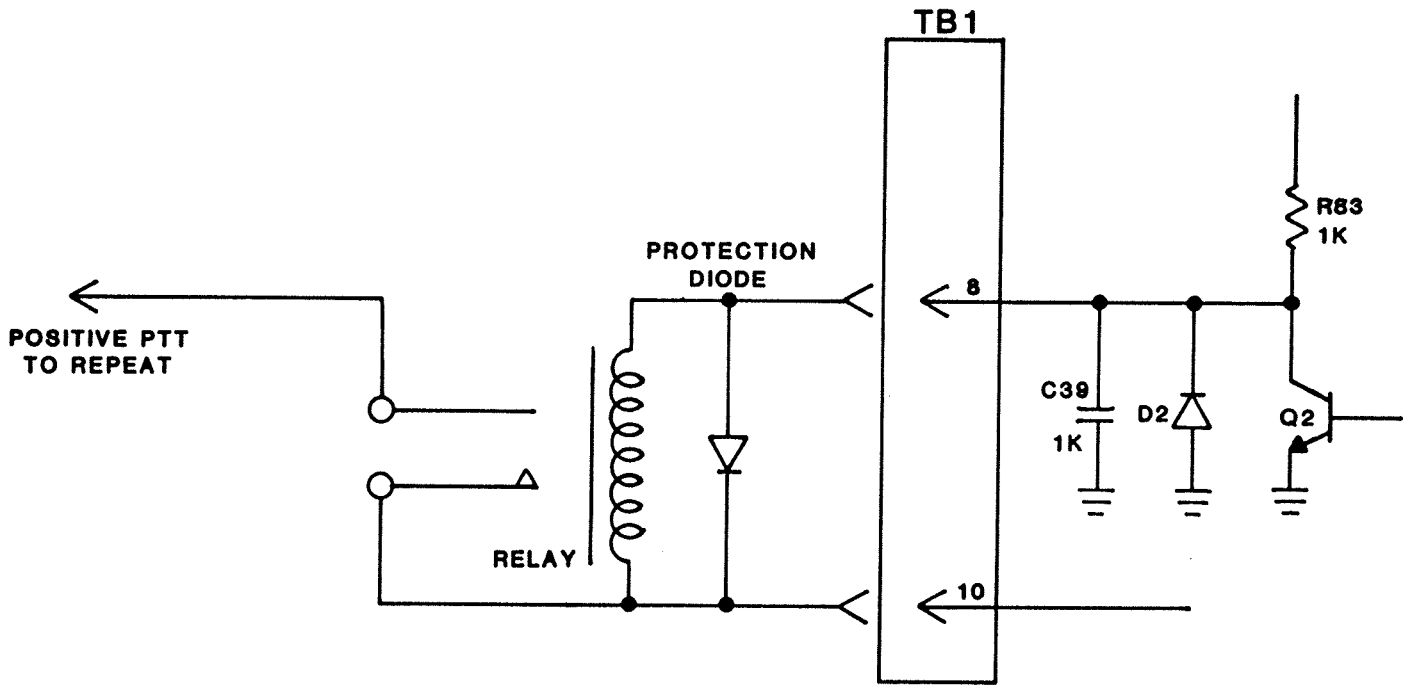


FIGURE 3

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 RP04.

- 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 RP04 begins tone decoding.
- KEY #3. EXTENDED PTT
- Sets the length of time which the RP04 keeps the TX keyed on after it switches off the CTCSS tones.
- KEY #4. DROPOUT TIMER
- Sets the length of time which the RP04 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 RP04 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 RP04 to automatically enter Programming Mode on power-up or when reset.

'IMPORTANT'

The 'JP2' jumper plug MUST be removed for normal operation - the RP04 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 RP04 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:

```
*** RP04 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 RP04 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 RPO4 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 RPO4 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 RPO4 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 RPO4 will briefly display:

```
CHECKING LOTONE: 88.5 HITONE: 162.2
```

If the entered tones were found in the memory, the RPO4 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 RPO4 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  
001: HTONE . / . 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 ACCUMULATATORS 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: LTONE = 67.0 / 67.0 HRS = 0000:00  
001: HTONE = . / . 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 (0) 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 RP04. This byte is stored in programmable memory. When the Control Byte option is selected, the RP04 briefly displays:

11 Reading Control Byte...

and then either:

COS is HIGH when Busy...
Press (0) to change, (ENTER) for next

or:

COS is GROUND when Busy...
Press (0) 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 RP04 will sense a call in progress from the repeater site's receiver when the RP04's COS input line is greater than +4 Vdc. The second case ("COS is Ground when Busy") means that the RP04 detects a received call in progress when COS is less than +3.5 Vdc. Pressing '0' 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 RP04 will display either:

PTT is HIGH to Xmit...
Press (0) to change, (ENTER) for next

or:

PTT is GROUND to Xmit...
Press (0) 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 RP04 will switch off (open) the current sink to key the repeater transmitter. The second case means that the RP04 will switch on (close) the current sink to transmit. Press '0' 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 RP04 will display:

--- Writing Control Byte---

and will copy the modified control byte from temporary memory to programmable memory. The RP04 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 RP04 waits after it detects an active COS level before it begins checking for tones. This delay allows the receiver's audio output and the RP04's filters to stabilize to prevent falsing. When the COS valid time option is selected, the RP04 will briefly display:

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

When '0' is pressed, the RP04 will display:

2] 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 RP04 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 RP04 keeps the transmitter keyed on after the RP04 switches off the repeated CTCSS tones. This eliminates the 'squelch tail' heard in the mobile units. When this option is selected, the RP04 will briefly display:

3] 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 (0) to INIT, (ENTER) to Quit>
```

Press '0' to initialize the EEPROM (pressing ENTER causes the RP04 to restart Programming Mode). When '0' 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 RP04.

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

The RP04 will display:

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

Each time the enter key is pressed, the RP04 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 RP04 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 RP04 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 RP04 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 RPO4 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 RPO4 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 RPO4 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 RPO4 is now generating the programmed tone, and R110 can be adjusted to set the tone level. To stop the tone, press '0'.

The RPO4 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 RPO4 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 RP04 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!/RPTR 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 time-out 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 can not proceed. If the parallel printer is not connected or not switched on, the message:

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

will be displayed. If the printer is not required to download billing information, press (0) 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 '5' or '0' 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 '0' 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 '0' 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 RP04 using the 'Set Parameters - Set Control Byte' function.

TB1-9 POWER GROUND

TB1-10 POWER +VE SUPPLY

-Connect to +13.6VDC \pm 20%. The RP04 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 RP04 to RESET if the power supply does not have sufficient current capacity.

Alignment

1) Transmitted CTCSS tone levels- use the RP04'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 RP04's 'Remote Control - Checkout AB07' function and select the 'Base Mode' test - the RP04 will key the Tx and generate FSK carrier. Using a communications monitor, adjust R3 on the AB07 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.

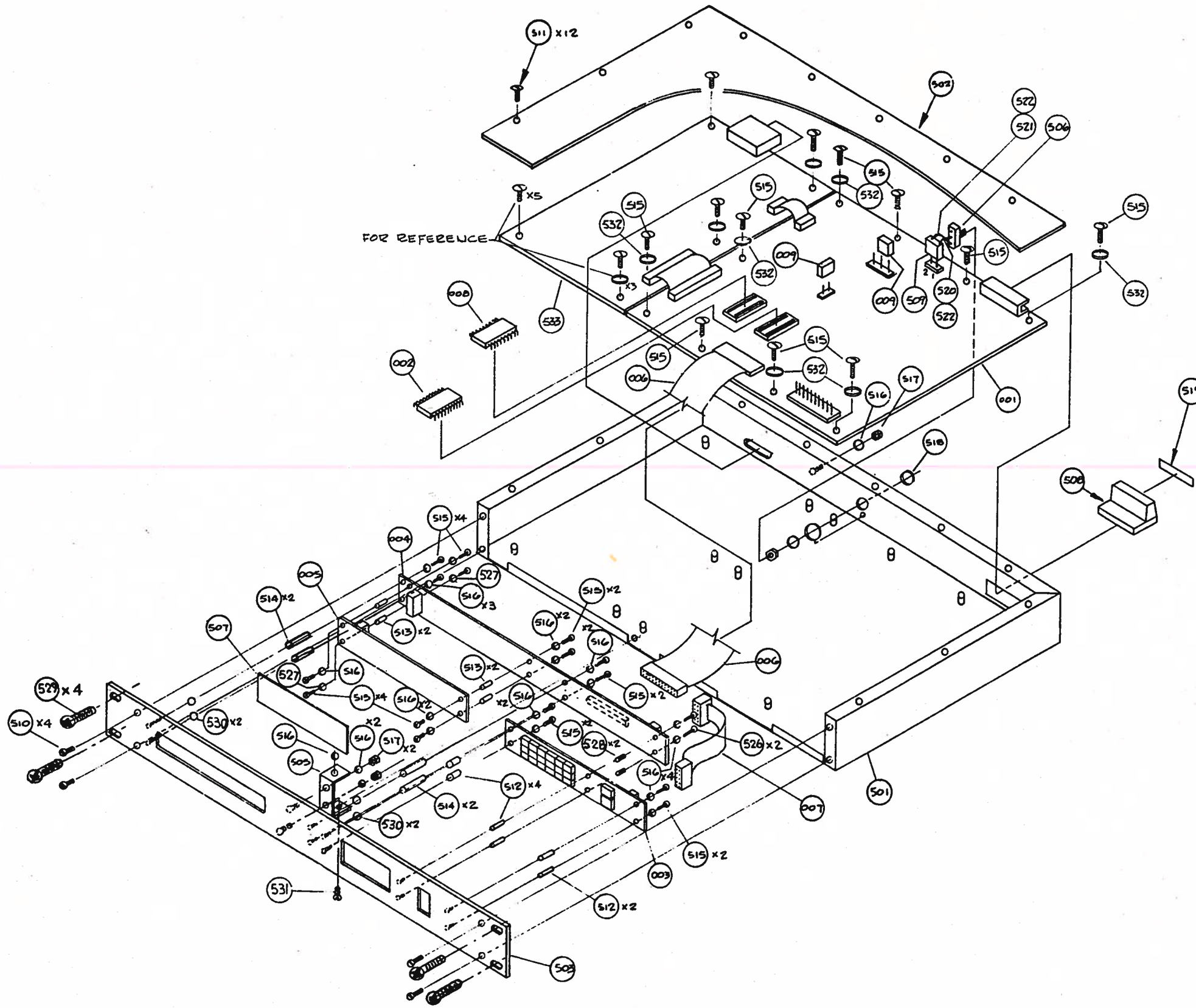
Adjust R1 for a signal amplitude of 1.0 Vpp (min) to 3.0 Vpp (max). The signal should not be clipped or distorted. Press RESET to stop the test and replace the PTT lead.

Parallel Printer Port

The RPO4 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 RPO4.

RPO4 (DB25) PIN #	PRINTER (36 PIN) PIN #	
1	1	STROBE - active low output from RPO4, signals printer that valid data is ready.
2	2	DATA BIT 1 - 8 parallel data output lines
3	3	" " 2 from RPO4 ; data format
4	4	" " 3 is 'true' (non-inverted)
5	5	" " 4 ASCII.
6	6	" " 5
7	7	" " 6
8	8	" " 7
9	9	" " 8
10	10	ACK - active low output from PRINTER, signals RPO4 that data has been read, and resets STROBE high.
11	11	BUSY - active high output from PRINTER, signals RPO4 that the printer is not ready to accept data - the printer may be: - busy printing. - 'OFF LINE' - indicating ERROR status (i.e. out of paper).
15	32	ERROR - active low output from printer to indicate out-of-paper, off-line or ERROR status.
17-25	19-30, 33	GROUND - signal ground in RPO4 and PRINTER.

FINAL ASSEMBLY DRAWING

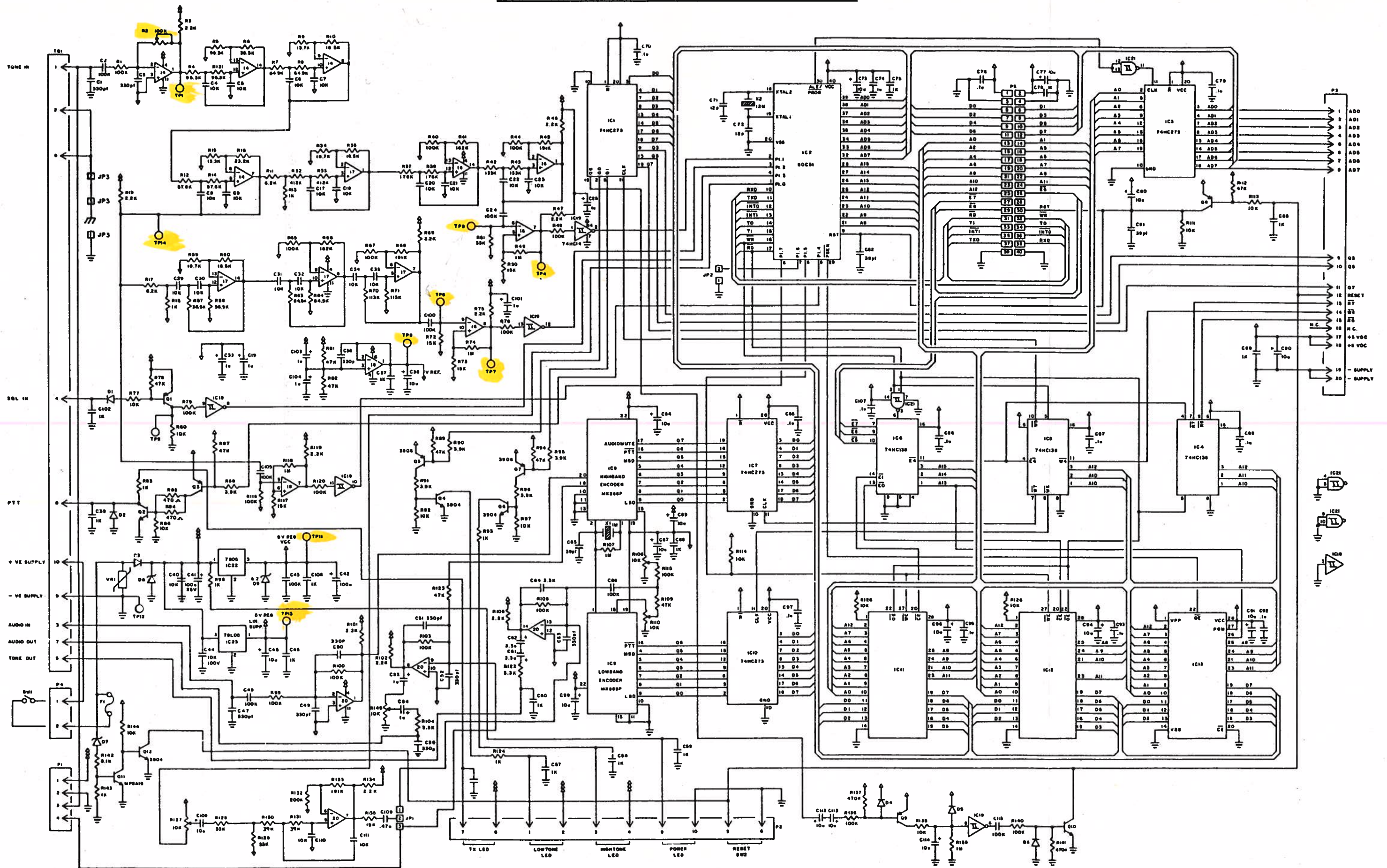


PARTS LIST

01A0010733 RP04 TRNKG. REP. C/W REMOTE CONTROL

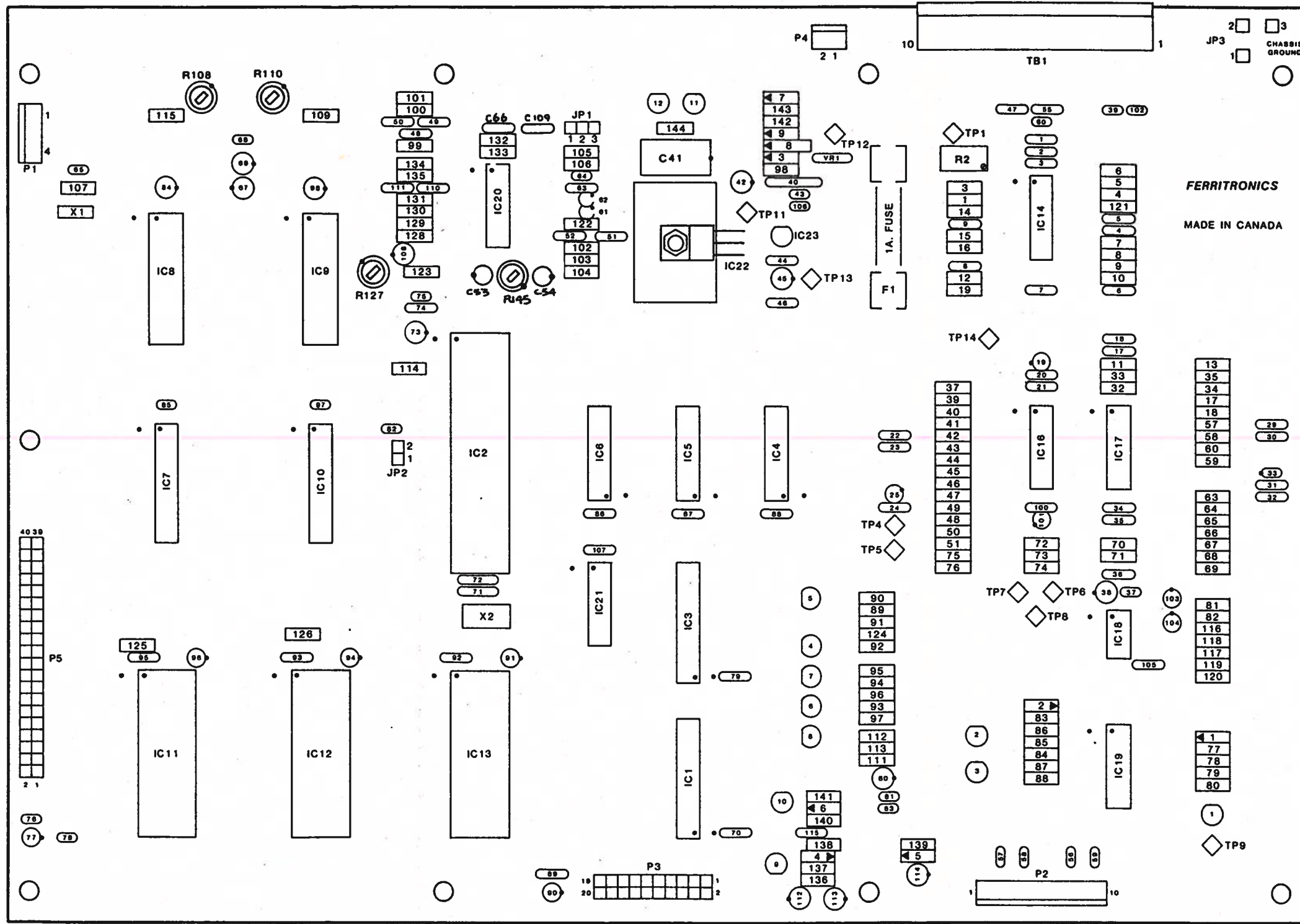
ITEM NO	PART NO	DESCRIPTION	QTY REQ	REMARKS
001	01A0010593	PCB FOR RPO3 TRUNKING REPEATER	1.	
002	01A0010879	EPROM, PROGRAMMED, RP04	1.	01A0010593 - IC13
003	01A0010594	KEYBOARD 10 + 2 (.5 SQ.)	1.	
004	01A0010737	LCD/KEYBOARD BUFFER ASS'Y	1.	
005	01A0010736	LCD DISPLAY ASS'Y	1.	
006	85AK010715	RIBBON CABLE ASS'Y (RP03)	1.	(J5 - J6)
007	85AK010719	14 LINE RIBB. CABLE ASS'Y (RP03)	1.	(J2 - J3)
008	29A0010718	EEPROM, BLANK XICOR X2864API-45	1.	01A0010593 - IC12
009	70-3187	JUMPER BAR	2.	FOR JP1,2
501	60D0010611	ENCLOSURE FOR TRUNKING	1.	
502	60B0010613	TOP COVER FOR TRUNKING	1.	
503	60C0010735	FRONT PLATE RPO3	1.	
506	41-2791	SWITCH TOGGLE SPDT	1.	SW1 (POWER)
507	35A0010740	WINDOW PLATE, ACRYLIC	1.	LCD
508	64A0010745	10 POS. TERMINAL BLOCK PLUG	1.	TB1
509	71A0002168	HOUSING 2 POSITION	1.	J4
510	74A0010720	SCREW 6-32X1/4 OHMS BLK OXIDE	4.	FRONT PLATE
511	74A0010564	SCREW 4-40 X 1/4 PHIL PHMS	12.	MOUNT LID
505	60A0010853	BRACKET, U	1.	FRONT PLATE TO LID
512	79-1593	SPACER 6/32 X 3/8 #1451B BRAHX	6.	MOUNT KEYBOARD
513	79-2730	SPACER-NYLON 6-32 X 1/2	4.	4 TO MT. LCD
514	79-1866	SPACER-ALUM HEX 1/4X3/4 X 6-32	4.	4 TO MT. BUFFER PCB
515	74A0010565	SCREW 6-32 X 1/4 PHIL PHMS	25.	9 TO MT. MAIN PCB 16 TO MT. BUFFER ASS'Y
516	76-0562	WASHER #6 INTERNAL STAR	20.	
517	75-0559	NUT 6/32 4 BLANK	3.	1 GRND STUD
518	75A0003153	NUT JBT #W-NU-18B	1.	(SW1)
519	82A0010747	MARKING STRIP CARD 25 X (1-10)	.1	(TB1)
520	85A0003033	LEAD WIRE 240A RED C/W CONN	1.	(J4 - 1)
521	85A0003034	LEAD WIRE 240A ORANGE C/W CONN	1.	(J4 - 2)
522	96-2402	HEAT SHRINK TUBING BLK 3/32"	.1	2 X 1/2 (SW1) TO MT. WINDOW PLATE
524	83-0602	SILASTIC CLEAR 3 OZ TUBES	1.	
525	59A0002383	LABEL SERIAL NUMBER	1.	
526	74A0010566	SCREW 6/32 X 5/8 PHIL PHMS	2.	TO MT. BUFFER ASS'Y
527	76-1569	WASHER 6 FLAT NYLON	2.	1 TO MT. LCD 1 TO MT. BUFFER ASSY
528	79A0010840	1/4 X 3/8 AL. SPACER RD. #6 HOLE	2.	KEYBOARD TO BUFFER ASS'Y
529	74A0010019	SCREW PHILL WASH HD 10-32X3/4	4.	SHIP LOOSE
530	76A0010366	WASHER LOCK SPLIT #6	4.	FRONT PLATE
701	98A0010733	MANUAL, RP04	1.	
801	97B0010716	SHIPPING CARTON-TRO1 REPEATER	1.	
531	74A0001374	SCREW 4-40 X 1/4 PHMS	1.	TO MT. U BRACKET TO CHASSIS
531	74A0001374	SCREW 4-40 X 1/4 PHMS	1.	TO MT. U BRACKET TO CHASSIS
532	76A0010878	WASHER # 6 EXTERNAL STAR	6.	TO MT. MAIN PCB
533	01A0010861	PCB ABO7(REMOTE CONT OPT-RP04)	1.	

MAIN PCB SCHEMATIC DIAGRAM



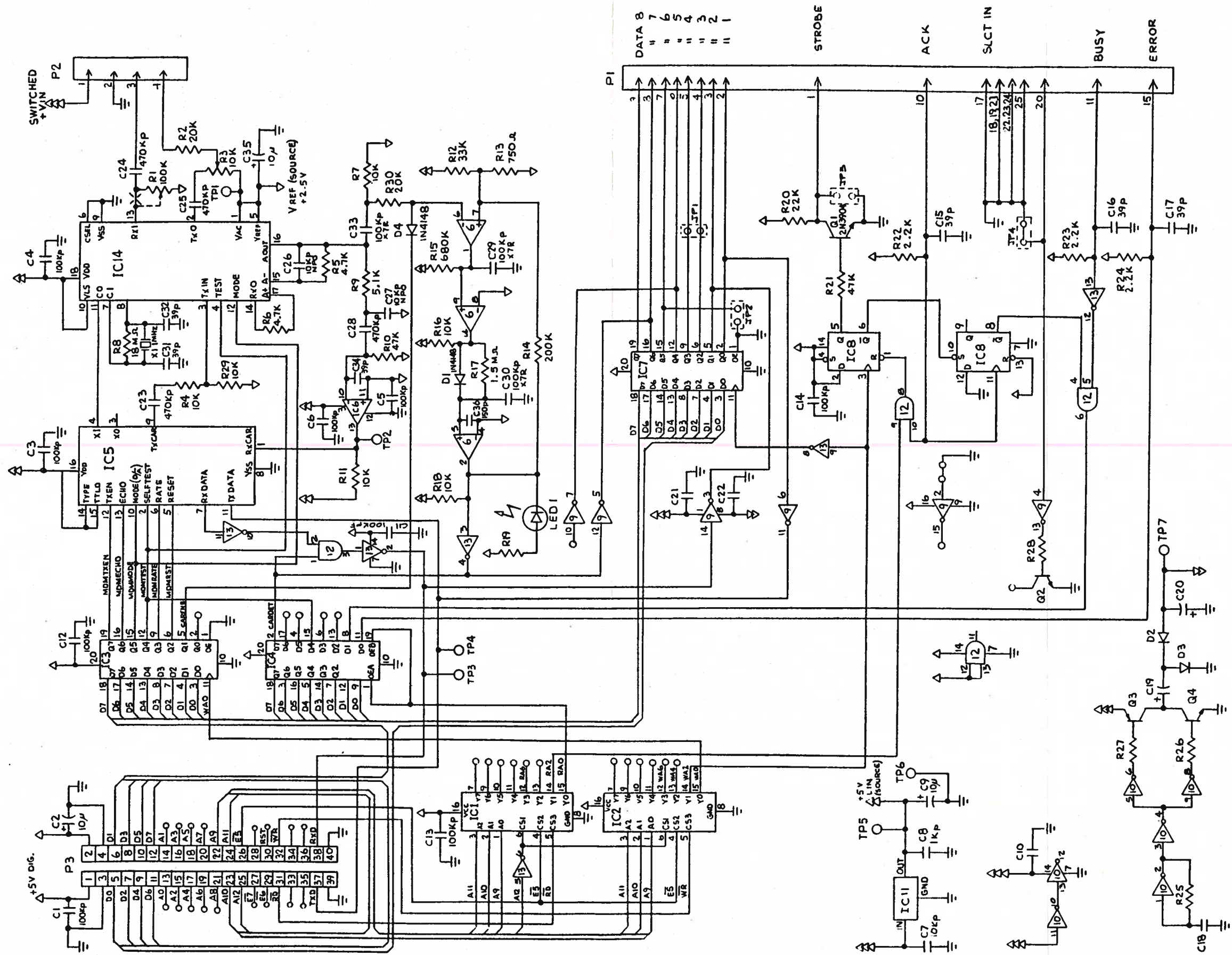
MAIN PCB COMPONENT LAYOUT

PARTS LIST 01A0010593 MAIN PCB ASSEMBLY

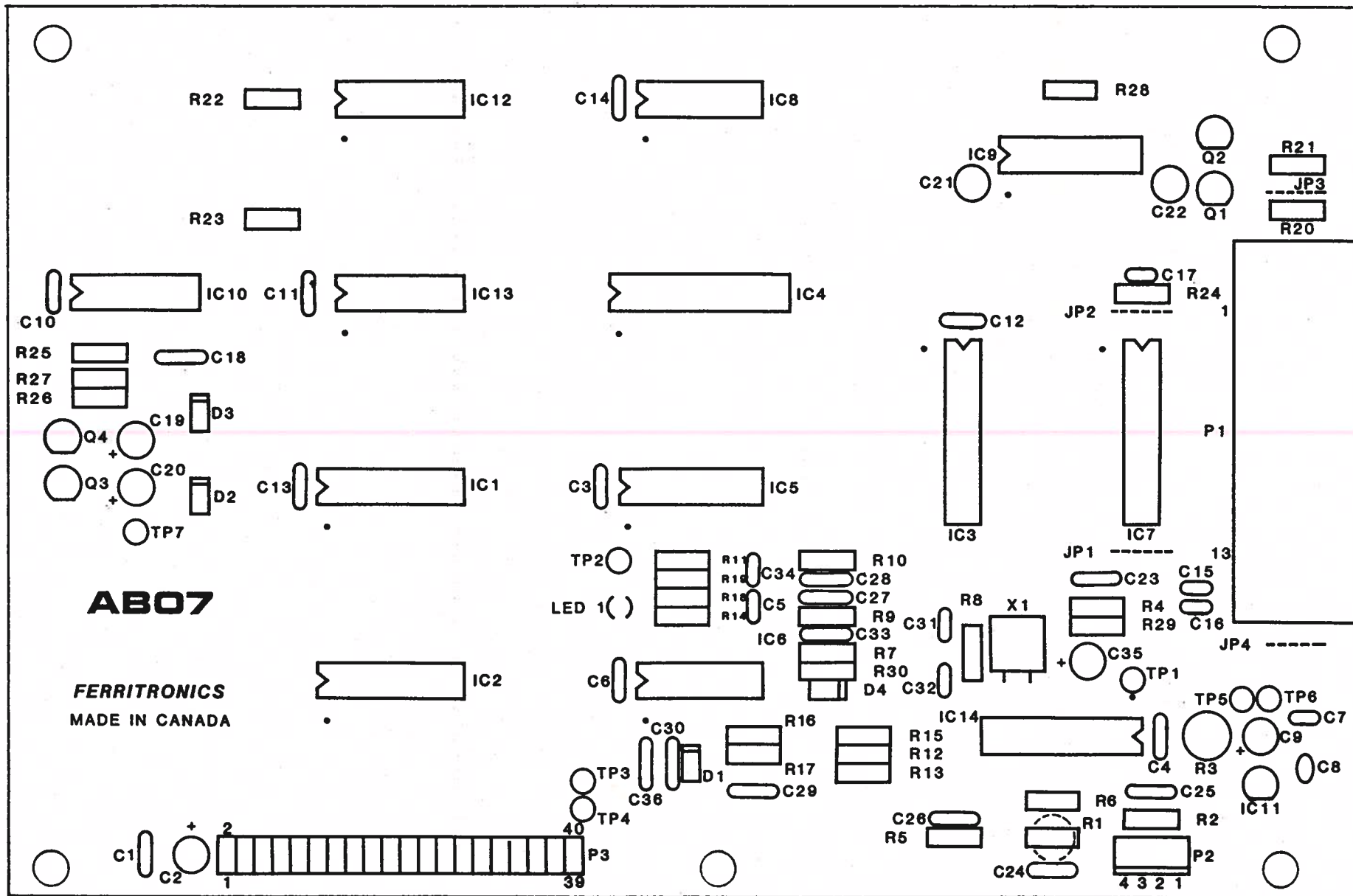


ITEM NO	PART NO	DESCRIPTION	QTY REQ	REMARKS
001	1880010593	PCB FOR TRUNKING REPEATER	1	
049	09-2266	TRIM POT 3/8 TOP ADJ 100 K	1	R2
002	10-0192	CAP CER DISC NPO 12.0 PF 5X	2	C71, 72
003	10-2605	CAP CER .39PF .1LB	3	C45, 81, 82
004	10-2607	CAP CERAMIC 330 PF	10	C1, 3, 35, 47, 49, 50, 51, 52, 53, 63
005	10-2606	CAP CERAMIC 1 KPF 100V 10X	15	C37, 39, 46, 56, 57, 58, 59, 60, 68, 75, 78, 83, 89, 102, 106
006	10-1986	CAP CER DIP NPO 3K3 PF 1X	1	C64
007	10-2431	CAP CER. DISC .01MFD 1000V 10K	2	C40, 44
008	10-2213	CAP CER DIP NPO 10 K PF 5X 50V	20	C4, 5, 6, 7, 8, 9, 17, 18, 20, 21, 22, 23, 29, 30, 31, 32, 34, 35, 110, 111
009	10-3189	CAP CER DIP X7R 100 K PF 10 X	16	C2, 24, 48, 66, 70, 79, 86, 87, 88, 92, 93, 95, 100, 105, 107, 115
010	10-1473	CAP CER DIP 25U 100 K PF 20X	5	C43, 74, 76, 85, 97
011	11-1669	CAP TANT DIP 1 MFD 20X 35V	8	C19, 25, 33, 53, 54, 101, 103, 104
093	120830474E	CAP CER X7R 50V 10X 470 K	1	C109
012	11-1379	CAP TANT DIP 3.3 MFD 20X 16V	2	C61, 62
013	11-1380	CAP TANT DIP 10 MFD 20X 20V	17	C38, 43, 67, 69, 73, 77, 80, 84, 90, 91, 94, 96, 98, 108, 112, 113, 114
014	11-3051	CAP ELECTRO PDA 100 MFD	1	C42
015	11-2214	CAP ELECT. 25V AXIAL 100 MFD	1	C41
016	20-1142	DIODE SIGNAL 1N4148	4	D1, 4, 5, 6
017	20-1105	DIODE SIGNAL 1N2070	2	D2, 3
090	21-1699	DIODE ZENER 6.2V 1W753A	2	D7, 9
018	26-2543	TRANS SIGNAL PNP 2N3906	6	Q1, 3, 5, 7, 8, 9
019	26-2544	TRANS. SIGNAL NPN 2N3904	4	Q4, 6, 10, 12
020	26A0010438	TRANS NPN MPB3704	1	Q2
021	28-1780	OP AMP QUAD LM324N	4	IC14, 16, 17, 20
022	28-1868	OP AMP DUAL LM358N	1	IC18
023	29A0010633	74HC273N D FLIP FLOP	4	IC1, 3, 7, 10
024	26-2252	TRANS SIGNAL NPN MPB-A18	1	Q11
025	29A0010654	74HC132N QUAD NAND	1	IC21
026	29A0010651	74HC14N HEX INVERTER	1	IC19
027	28A0010699	MX345P ENC/DEC.	2	IC8, 9
028	29A0010652	74HC138N 1 OF 8 DECODER	3	IC4, 5, 6
029	31A0010706	CPU 8 BIT T80C318H, INTEL	1	IC2
030	23-1955	VOLT SUPPRESSOR 20V RMS V332A1	1	VR1
032	24A0002005	VOLT REG +5V TO220 LM340T5	1	IC22
033	33A0002956	CRYSTAL 1MHz UM-1 HOLDER	1	X1
034	33A0010782	CRYSTAL 12.00 MHz HC49/U	1	X2
035	23-3232	VOLT SUPPRESSOR 18 V TVS518	1	D8
036	37006-1357	RES 1/4W 5X 470 OHMS	2	R84, 85
037	37006-1130	RES 1/4W 5X 1 K	7	R13, 18, 83, 93, 98, 124, 143
038	37006-1153	RES 1/4W 5X 2.2 K	11	R3, 19, 46, 47, 69, 75, 101, 102, 105, 119, 134
039	37006-1506	RES 1/4W 5X 3.3 K	2	R104, 122
040	37006-0959	RES 1/4W 5X 3.9 K	5	R88, 90, 91, 95, 96
041	37006-0507	RES 1/4W 5X 10 K	12	R77, 80, 86, 92, 97, 111, 113, 114, 125, 126, 138, 144
042	37006-0511	RES 1/4W 5X 15 K	5	R50, 72, 73, 117, 135
089	37006-0535	RES 1/4W 5X 470 K	2	R137, 141
043	37006-1116	RES 1/4W 5X 3.1 K	1	R142
044	37006-1508	RES 1/4W 5X 33 K	3	R51, 128, 129
045	37006-0522	RES 1/4W 5X 47 K	9	R78, 81, 82, 87, 89, 94, 109, 112, 123
046	37006-0527	RES 1/4W 5X 100 K	13	R1, 48, 76, 79, 99, 100, 103, 106, 115, 116, 120, 136, 140
047	37006-1402	RES 1/4W 5X 1 MEG	5	R49, 74, 107, 118, 139
088	37006-1460	RES 1/4W 5X 6.2 K	2	R11, 17
048	381A100103	TRIM POT 1/4 RD TOP ADJ 10 K	4	R108, 110, 127, 145
050	37005-1280	RES 1/4W 1X 16.5 K	3	R10, 35, 60
051	37005-1160	RES 1/4W 1X 18.7 K	2	R34, 59
053	37005-1322	RES 1/4W 1X 36.5 K	2	R57, 58
054	37005-1231	RES 1/4W 1X 38.3 K	1	R6
055	37005-1272	RES 1/4W 1X 13.3 K	1	R15
056	37005-1273	RES 1/4W 1X 13.7 K	1	R9
057	37005-1936	RES 1/4W 1X 84.5 K	2	R43, 64
058	37005-1880	RES 1/4W 1X 95.3 K	3	R4, 5, 121
059	37005-1304	RES 1/4W 1X 100 K	4	R40, 44, 65, 67
060	374811133	RES. 1/4W 1X 113K	2	R70, 71
061	374811333	RES. 1/4W 1X 133K	2	R42, 43
062	37005-1937	RES 1/4W 1X 162 K	2	R41, 66
063	37005-1290	RES 1/4W 1X 23.2 K	1	R16
064	37005-2294	RES 1/4W 1X 178 K	2	R37, 39
065	37005-1881	RES 1/4W 1X 191 K	3	R45, 68, 133
092	37006-0708	RES 1/4W 5X 39 K	2	R130, 131
066	37005-1818	RES 1/4W 1X 200 K	1	R132
067	3748114123	RES. 1/4W 1X 412K	2	R32, 33
068	37005-1418	RES 1/4W 1X 57.6 K	2	R12, 14
069	37005-1298	RES 1/4W 1X 64.9 K	2	R7, 8
070	42-2792	FUSE CLIP C.B. MOUNT	2	(F1)
071	42-3260	FUSE 1 AMP BUSS AOC1	1	F1
073	62-2958	HEAT SINK 1 X .710 TO220 PKOE	1	(IC22)
083	64A0010746	PHOENIX - 10 POS.	1	TB1
077	66-1954	SOCKET 40 PIN DIP	2	(IC2)
078	66-2192	SOCKET 28 PIN DIP	3	(IC11, 12, 13)
080	67A0010569	TEST PIN .025 SQ PHOS BRONZE	11	P3 - TEN
081	70-2026	WAFER DUAL ROW ON .100 CENTERS	31	JP2 - ONE P5 - TWENTY
072	70-2135	WAFER PINS ON .100 CENTERS	3	JP1
087	70-2170	WAFER POLARIZED 2 POSITION	1	P4
082	70-3119	WAFER 4 POSITION	1	P1
079	70A0010075	WAFER 10 POS. - FRICTION LOCK	1	P2
074	74-1086	SCREW 6/32 X 5/16 BHMS	1	(IC22)
075	75-0359	NUT 6/32 4 BLANK	1	(IC22)
076	76-0562	WASHER #6 INTERNAL STAR	1	(IC22)
091	33A0010722	MH 221 INSULATOR	1	(X2)

REMOTE CONTROL PCB SCHEMATIC DIAGRAM



REMOTE CONTROL PCB COMPONENT LAYOUT

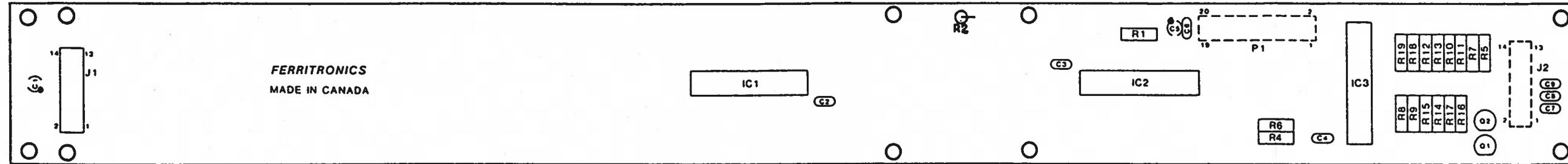


PARTS LIST

01A0010861 REMOTE CONTROL PCB ASSEMBLY

ITEM NO	PART NO	DESCRIPTION	QTY REQ	REMARKS
001	1880010861	PCB FOR AB07	1.	
002	29A0010865	GUAD 2-INPUT AND GATE	1.	IC12
003	29A0010651	74HC14N HEX INVERTER	1.	IC13
004	29A0010866	DUAL D FLIP-FLOP MC74HC74N	1.	IC8
005	29A0010652	74HC138N 1 OF 8 DECODER	2.	IC1, 2
006	29A0010762	OCTAL BUFFER/DRIVER MC74HC244N	1.	IC4
007	29A0010764	OCTAL D FLIP-FLOP MC74HC374N	2.	IC3, 7
008	28A0010867	CMOS LSI MC14412VP MOTOROLA	1.	IC5
009	29A0010869	VOLTAGE COMPARATOR LM339AN	1.	IC6
010	29A0010868	CMOS FILTER MC145440P	1.	IC14
011	26-2546	TRANS. SIGNAL NPN 2N3904	1.	Q1
012	24-2152	VOLT REG +5V TO92 LM78L05ACZ	1.	IC11
013	20-1142	DIODE SIGNAL 1N4148	2.	D1, 4
014	10-1473	CAP CER DIP Z5U 100 K PF 20%	9.	C1, 3-6, 11-14
015	10-1472	CAP CER DIP Z5U 10 K PF 20%	1.	C7
016	120C58102L	CAP CER DISK 1000V 1000PF	1.	C8
017	10-2605	CAP CER. 39PF .1LS	6.	C15, 16, 17, 31, 32, 34
018	10-1909	CAP CER DISC JK150 150 PF 10%	1.	C36
019	11-1380	CAP TANT DIP 10 MFD 20% 20V	3.	C2, 9, 35
020	120B30474E	CAP CER X7R 50V 10% 470 K	4.	C23, 24, 25, 28
021	10-3189	CAP CER DIP X7R 100 K PF 10 %	3.	C29, 30, 33
022	10-2213	CAP CER DIP NPO 10 K PF 5% 50V	2.	C26, 27
023	381A100103	TRIM POT 1/4 RD TOP ADJ 10 K	1.	R3
024	37006-0527	RES 1/4W 5% 100 K	1.	R1
025	37006-1202	RES 1/4W 5% 20 K	2.	R2, 30
026	37006-0507	RES 1/4W 5% 10 K	6.	R4, 7, 11, 16, 18, 29
027	37006-1153	RES 1/4W 5% 2.2 K	3.	R22, 23, 24
028	37006-1154	RES 1/4W 5% 4.7 K	2.	R5, 6
029	37006-1465	RES 1/4W 5% 18 MEG	1.	R8
030	37006-1116	RES 1/4W 5% 5.1 K	1.	R9
031	37006-0522	RES 1/4W 5% 47 K	2.	R10, 21
032	37006-1508	RES 1/4W 5% 33 K	1.	R12
033	37006-1573	RES 1/4W 5% 750 OHMS	1.	R13
034	37006-1155	RES 1/4W 5% 200 K	1.	R14
035	37006-0538	RES 1/4W 5% 680 K	1.	R15
036	37006-1136	RES 1/4W 5% 1.5 MEG	1.	R17
037	37006-0515	RES 1/4W 5% 22 K	1.	R20
038	33A0002956	CRYSTAL 1MHZ UM-1 HOLDER	1.	X1
039	69-2549	CONN. #DBP258CA CANNON	1.	P1
040	70-3119	WAFER 4 POSITION	1.	P2
041	70-2026	WAFER DUAL ROW ON .100 CENTERS	20.	P3
042	67A0010569	TEST PIN .025 SQ PHOS BRONZE	6.	TP1-6
043	74-0547	SCREW 4-40 X 3/8 PHMS	2.	TO MOUNT P1 TO PCB
044	75-0538	NUT 4-40 HEX	2.	TO MOUNT P1 TO PCB
045	76-0563	WASHER #4 INTERNAL STAR	2.	TO MOUNT P1 TO PCB
046	78-2570	FEMALE SCREW LOCK ASSEMBLY	1.	TO MOUNT P1 TO CHASSIS
047	74A0010565	SCREW 6-32 X 1/4 PHIL PHMS	5.	TO MOUNT PCB
048	85AK010741	RIBBON CABLE ASS'Y (4 COND)	1.	P3 TO RP03-P5
049	85AK010742	CABLE ASS'Y (4 COND)	1.	P2 TO RP03-P1
050	01A0010790	ADHESIVE FOAM (0.3 X 0.3)	1.	(X1)
051	76A0010878	WASHER # 6 EXTERNAL STAR	5.	TO MOUNT PCB

LCD/KEYBOARD BUFFER COMPONENT LAYOUT

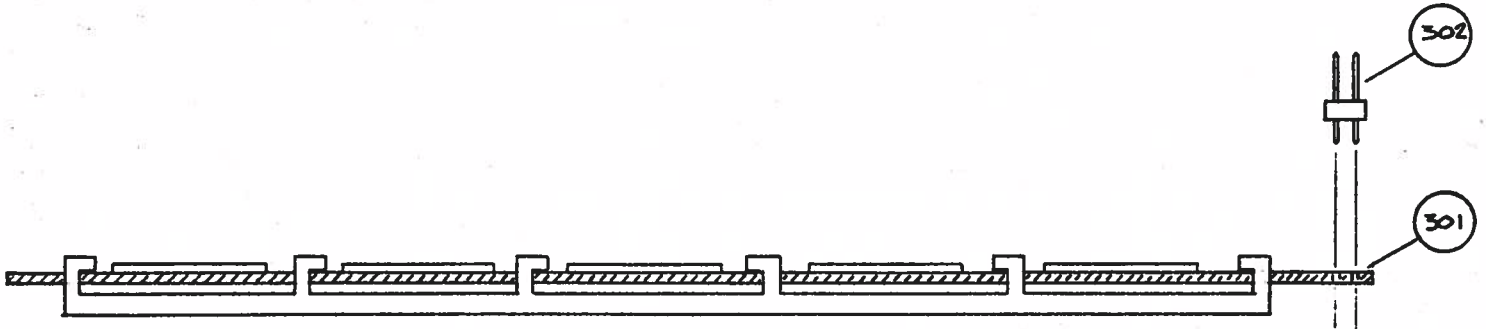


PARTS LIST

01A0010737 LCD/KEYBOARD BUFFER ASSEMBLY

<u>ITEM NO</u>	<u>PART NO</u>	<u>DESCRIPTION</u>	<u>QTY REQ</u>	<u>REMARKS</u>
100	18B0010737	PCB LCD/KEYB. BUFFER	1.	
301	29A0010764	OCTAL D FLIP-FLOP MC74HC374N	1.	IC 1
302	29A0010762	OCTAL BUFFER/DRIVER MC74HC244N	2.	IC 2, 3
303	26-2545	TRANS SIGNAL. PNP 2N3906	2.	Q 1, 2
304	10-2606	CAP CERAMIC 1 KPF 100V 10%	4.	C 6, 7, 8, 9
305	10-1473	CAP CER DIP 25V 100 K PF 20%	3.	C 2, 3, 4
306	11-1669	CAP TANT DIP 1 MFD 20% 35V	2.	C 1, 5
308	37006-0507	RES 1/4W 5% 10 K	6.	R 8, 9, 10, 11, 12, 13
309	37006-0516	RES 1/4W 5% 27 K	10.	R 4, 5, 6, 7, 14, 15, 16, 17, 18, 19
310	70A0010810	DUAL ROW HEADER NSH-20DB-S2-T	1.	P1
311	66A0010767	BOX CONN. SOCKET 14 POS. DUALROW	1.	J 1
313	70A0010807	DUAL ROW HEADER NSH-14DB-S2-T	1.	J 2
314	37006-2917	RES. 1/4 W 0 OHMS	2.	R 1, 2

LCD DISPLAY ASSEMBLY



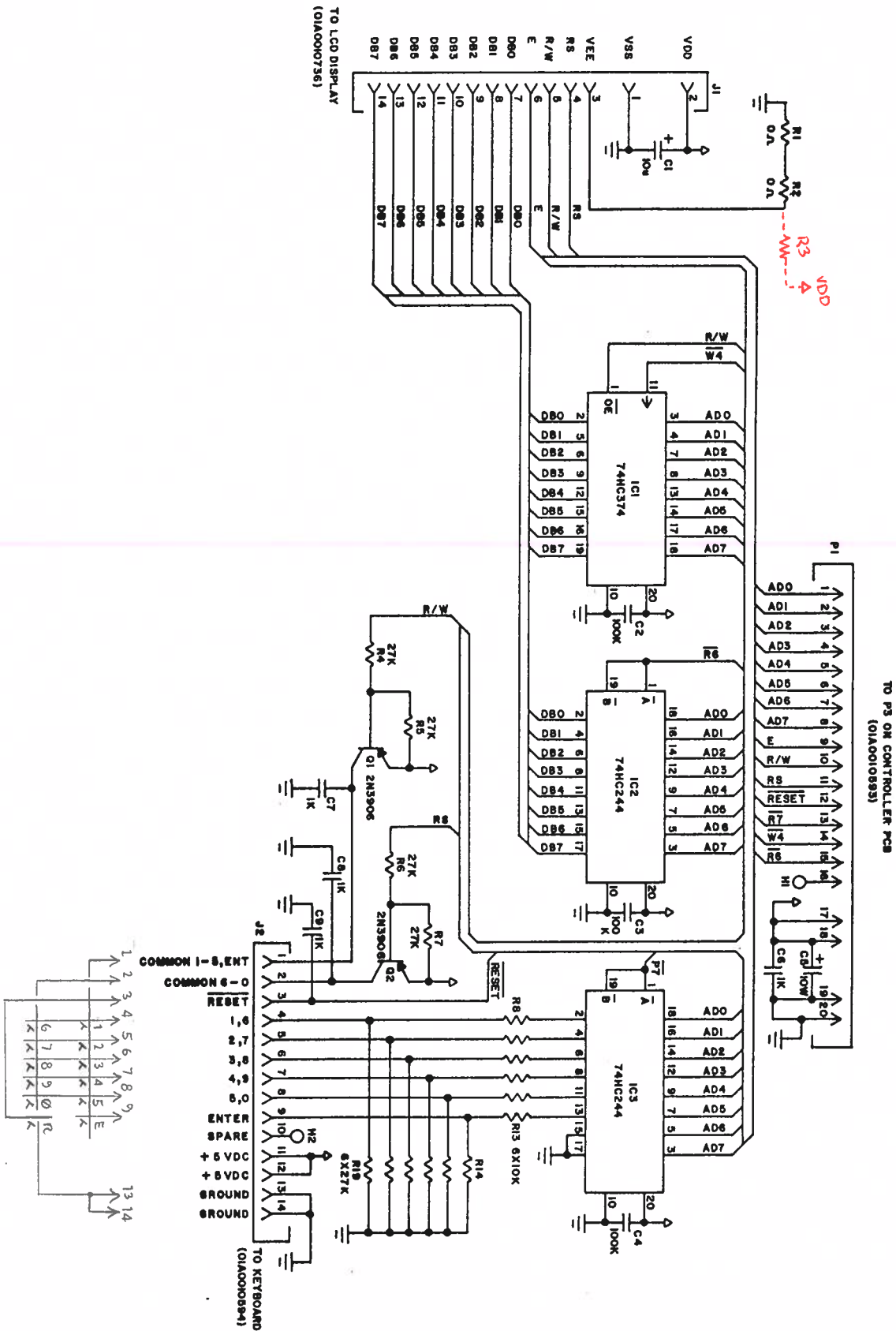
PARTS LIST

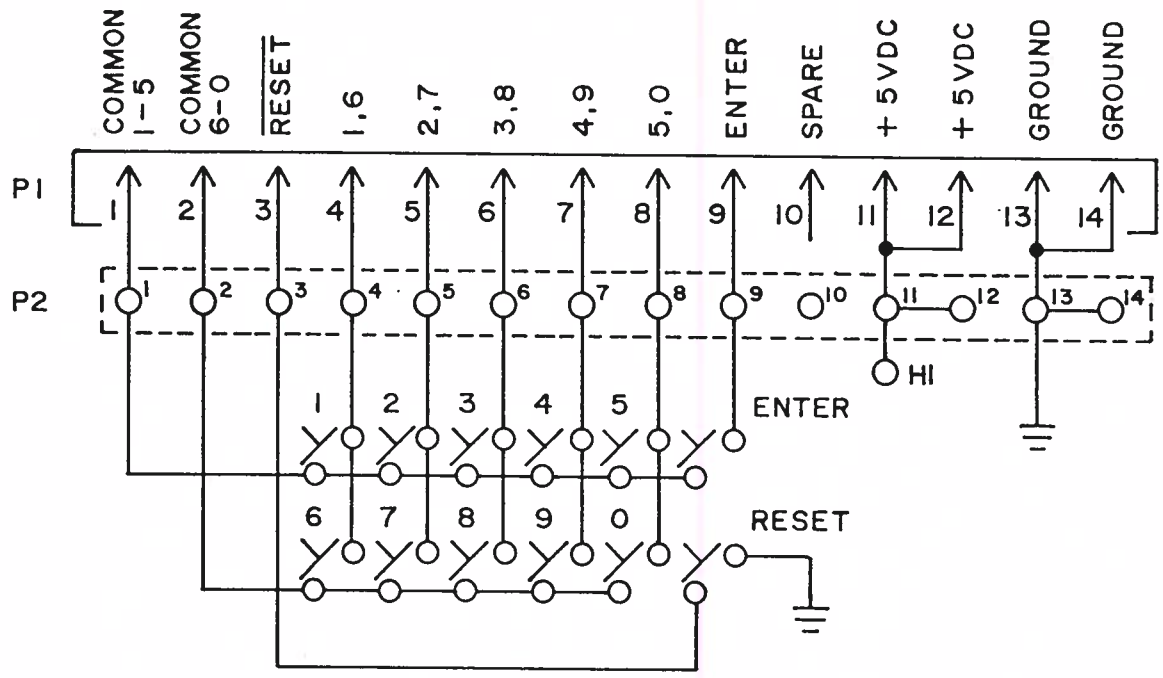
01A0010736 LCD DISPLAY ASSEMBLY

<u>ITEM NO</u>	<u>PART NO</u>	<u>DESCRIPTION</u>	<u>QTY REQ</u>	<u>REMARKS</u>
301	34A0010744	LCD DISPLAY(40 CHAR. X 2 LINES)	1.	
302	70A0010807	DUAL ROW HEADER NSH-14DB-S2-T	1.	P1

LCD/KEYBOARD BUFFER SCHEMATIC

DIAGRAM

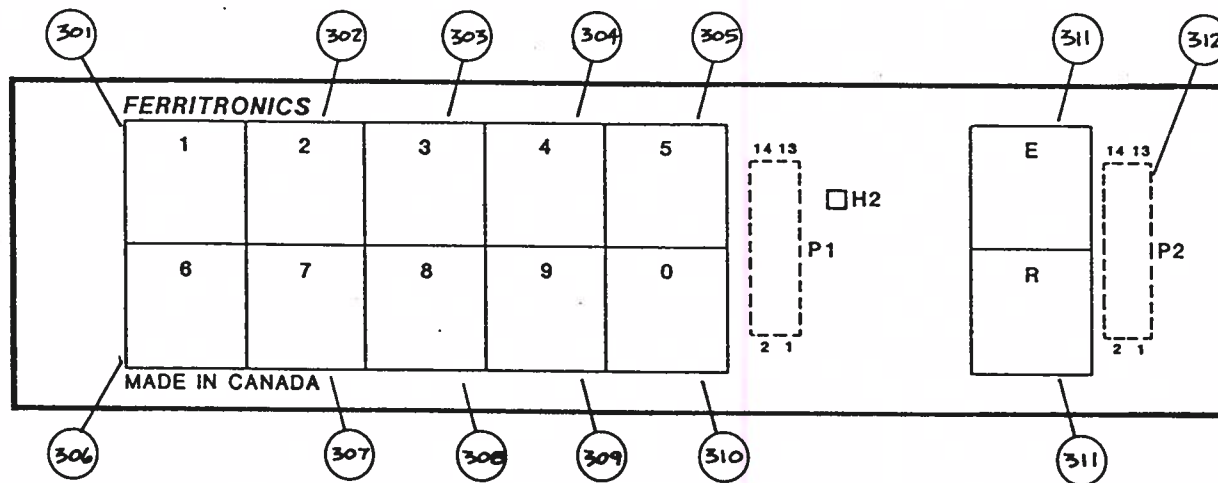
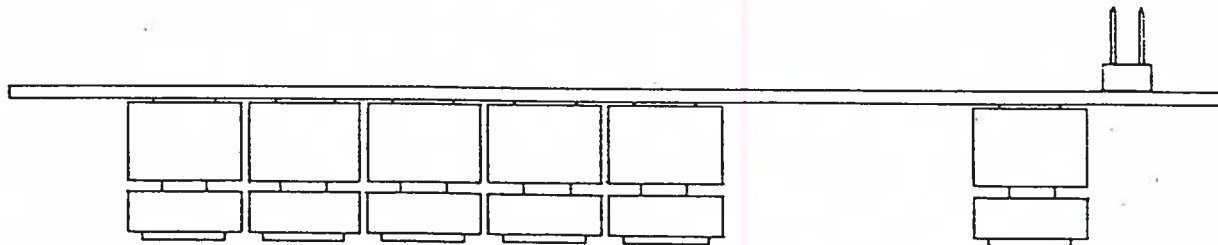




CHANGE/DATE	REV.	ISS.
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TITLE KEYBOARD FOR RP03	CHKD. BY	L. D.	DESIGN ENG.	RM	RELEASE DATE	Mar 25/87
	DRWN. BY	WH	APP'D. BY	RM	FILE	
	DATE	9 MAR 87	DATE	July 2/87		
	SCALE	NTS	DWG. NO.	03A0010594	ISSUE	1
	SHT.	1 OF 1				





CHANGE/DATE	REV.	ISS.

TITLE
TRUNK. REPEAT. KEYBOARD
ASS'Y DRAWING



FERRITRONICS
SIGNALLING AND CONTROL

CHKD. BY L.D.	DESIGN ENG L.M.	RELEASE DATE Mar 25 87
DRWN BY WH	APP'D BY L.M.	FILE L
DATE 10 MAR 87	DATE JUN 3 87	
SCALE N.T.S.	DWG NO 05A0010594	ISSUE 1
SHT. 1 OF 1		

S I N G L E L E V E L B O M L I S T I N G

04 01A0010594

KEYBOARD 10 + 2 (.5 SQ.)

PG 1

REV. A ECN NO. EFFECTIVE DATE MAR 19/87

ITEM NO	PART NO	L V DESCRIPTION	UNIT	QTY REQ	REMARKS
100	18B0010594	9 PCB 10 + 2 KEYBOARD	EA	1.	PCB ISS : E2
301	41A0010751	9 KEYSWITCH SN10606H1XXX-1	EA	1.	#1
302	41A0010752	9 KEYSWITCH SN-1-06-06-H-1-XXX-2	EA	1.	#2
303	41A0010753	9 KEYSWITCH SN-1-06-06-H-1-XXX-3	EA	1.	#3
304	41A0010754	9 KEYSWITCH SN-1-06-06-H-1-XXX-4	E	1.	#4
305	41A0010755	9 KEYSWITCH SN-1-06-06-H-1-XXX-5	EA	1.	#5
306	41A0010756	9 KEYSWITCH SN-1-06-06-H-1-XXX-6	EA	1.	#6
307	41A0010757	9 KEYSWITCH SN-1-06-06-H-1-XXX-7	EA	1.	#7
308	41A0010758	9 KEYSWITCH SN-1-06-06-H-1-XXX-8	EA	1.	#8
309	41A0010759	9 KEYSWITCH SN-1-06-06-H-1-XXX-9	EA	1.	#9
310	41A0010760	9 KEYSWITCH SN-1-06-06-H-1-XXX-0	EA	1.	#0
311	41A0010761	9 KEYSWITCH SN-1-02-02-N-1-NONE	EA	2.	R, E
312	70A0010807	9 DUAL ROW HEADER WTS-14-S1-T	EA	1.	P2 (P1 NOT USE
901	L-1000	9 ASSEMBLY LABOUR	MN	5	
902	L-1100	9 TEST LABOUR	MN	3	
903	L-1200	9 INSPECTION LABOUR	MN	1	

OK

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.