GPH-CMD
PORTABLE RADIO
Service Manual

BK RADIO

TABLE OF CONTENTS

SECTION I
GENERAL INFORMATION

SECTION II
INSTALLATION AND PROGRAMMING

SECTION III
OPERATION

SECTION IV
THEORY OF OPERATION

SECTION V
MAINTENANCE

SECTION VI
ILLUSTRATED PARTS LIST

SECTION I
GENERAL INFORMATION

1.1 INTRODUCTION

This manual contains information about the physical, mechanical, and electrical characteristics of the BK Radio GPH-CMD radios.

1.2 DESCRIPTION

The GPH-CMD radios are self-contained VHF FM Radios covering the frequency range of 136MHz to 174MHz. The radios are multi-channel and digitally synthesized using a single crystal for frequency control. All models incorporate an EEPROM for the storage of data such as channel frequencies, Code Guards, and channel labels. All models also include low-battery and busy-channel indicators. Toggle switches can be programmed to control hi/low transmit power, channel scan, priority scan, repeater talk-around, and group scan. Status and channel information is displayed over a liquid crystal display. Connectors are provided on the side of the unit for an external antenna, microphone, speaker, and other optional accessories. A variety of twist-off battery packs are also available.

1.3 TECHNICAL CHARACTERISTICS

POWER SUPPLY:	One rechargeable nickel-cadmium or nickel-metal-hydride battery pack with temperature sensor or one alkaline battery pack

OPERATIONAL FEATURES:

Programmable Switches	User Selectable Transmit Code Guard
Dual Priority Scan	Frequency Display
Transmit Time-Out Timer	User Selectable Scan
Scan Delay	Busy Channel Indicate / Lockout
Tone Code Guard (CTCSS)	DTMF/ANI Encode
Digital Code Guard (CDCSS)	Interstitial Frequency Capability
Nuisance Channel Delete	TalkBack Scan

CHANNELS:	500 (25 groups of 20 channels)
OPERATING TEMPERATURE:	-30° to +60° C

PHYSICAL DIMENSIONS:

Weight:	20 oz. (24 oz. with large battery) 0.6 kilograms (0.7 kg with large battery)
Width:	2.55 in. (64.8 millimeters)
Depth:	1.5 in. (38.1 mm.)
Height:	6.6 in. (167.6 mm.) 7.8 in. (198.1 mm. with large battery)
ANTENNA TYPE:	Helical wound molded rubber flex (standard) BNC Helical wound molded rubber flex (optional)
CHANNEL SPACING:	15/30 and 12.5/25 kHz
CHANNEL INCREMENTS:	5.0/6.25/7.5 kHz

MAX CURRENT DRAIN:

Transmit 5 Watt:	1.5 amps
Receive:	255 mA
Receive Standby:	100 mA (battery save off) 20 mA (battery save on)

FCC IDENTIFICATION NUMBER: K95DPHX51 (5/2 Watt Models)

Specifications are subject to change without notice.

TRANSMITTER

	25 / 30 kHz	12.5 / 15 kHz
RF OUTPUT POWER:	5/2 Watts	5/2 Watts
SPURIOUS AND HARMONICS:	60 dB	60 dB
MODULATION DEVIATION:	5 kHz	2.5 kHz
FM HUM AND NOISE:	50 dB	45 dB
FREQUENCY STABILITY:	±2.5 PPM	±2.5 PPM
AUDIO DISTORTION:	3%	3%
AUDIO RESPONSE (per EIA):	+1 dB / -3 dB	+1 dB / -3 dB
MODULATION CHARACTERISTICS:	16K0F3E	11K0F3E

RECEIVER

	25 / 30 kHz	12.5 / 15 kHz
SENSITIVITY: 12dB SINAD	0.25μV	0.25μV
NOISE SQUELCH:	0.18μV	0.18μV
SELECTIVITY:	72 dB	60 dB
IMAGE AND SPURIOUS RESPONSES:	75 dB	75 dB
INTERMODULATION:	70 dB	70 dB
AUDIO RESPONSE (per EIA):	+1 dB / -3 dB	+1 dB / -3 dB
AUDIO OUTPUT (@ 5% Dist.):	500mW	500mW

Accessories

Use only BK Radio approved supplied or replacement antennas, batteries, and accessories. Use of non-BK Radio approved antennas, batteries, and accessories may exceed the FCC RF exposure guidelines. For a list of BK Radio approved accessories visit the following website: *http://www.relm.com*.

License Requirements

This equipment must be licensed by the Federal Communications Commission (FCC) before it may be used. Your BK Radio dealer can assist you in filing the appropriate application for the FCC, and will program each radio with your authorized frequencies and signaling codes.

Service Information

If you need service, contact your local BK Radio dealer equipped to service your radio. If you find it impractical to have service performed by your local dealer, contact BK Radio at the address below:

BK Radio
ATTN: Customer Service
7100 Technology Drive
West Melbourne, FL 32904
Voice (800) 422-6281
FAX (321) 953-7986

Specifications are subject to change without notice.

SECTION II
INSTALLATION AND PROGRAMMING

2.1 GENERAL INFORMATION

This section contains information concerning the installation and programming of BK Radio GPH-CMD radios.

2.1.1 UNPACKING AND INSPECTING EQUIPMENT

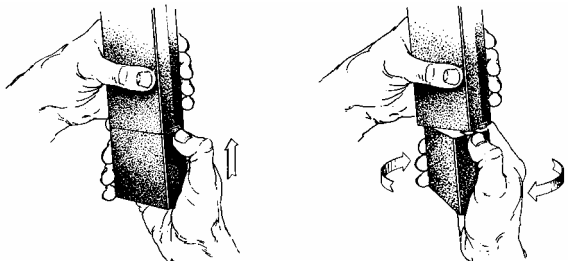
Exercise extreme care when unpacking the equipment. Make a visual inspection of the unit for evidence of damage incurred during shipment. If a claim for damage is to be made, save the shipping container to substantiate the claim. The claim should be promptly filed with the transportation company. It would be advisable to retain the container and packaging material after all equipment has been removed in the event that equipment storage or reshipment should become necessary.

2.1.2 BATTERY INSTALLATION

A. BK Radio battery packs are available in a variety of sizes and types for special applications. Rechargeable battery packs can be charged separately or while attached to a radio.

NOTE: For safety reasons, rechargeable battery packs are shipped uncharged or only partially charged. Therefore, a rechargeable battery pack should be properly charged before use.

B. To install the battery, locate the center hub on the radio base and place it in the recess of the battery pack. Position the pack approximately at a 30° offset, seating two metal studs in their recess. Apply upward pressure to the pack while twisting the pack to its final (in line with the radio) position. The metal tab will click, locking the pack in position.



C. To remove the battery pack, first turn the radio off. Then, as shown above, push up the metal tab on the side of the case while twisting the battery pack approximately 30° and remove it from the radio.

NOTE: All information programmed into the radio is maintained even when the battery pack is removed.

D. Periodically check the contacts on the battery pack for dirt that may prevent a good electrical contact with the charging base

WARNING: EXPLOSION HAZARD
Do not drop a battery pack into fire.
An explosion may occur.

2.1.3 ANTENNA INSTALLATION

Insert the flexible helical-wound antenna into the radio's antenna connector and turn it clockwise until it is firmly seated.

2.2 HOW TO PROGRAM RADIOS

You can program GPH-CMD radios in three different ways:

A. **BY KEYPAD** A radio can be programmed with its keypad and a programming plug, LAA0701. That procedure is described in this section.

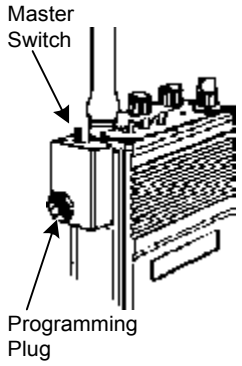
B. **BY CLONING** You can transfer a radio's programmed settings to another GPH-CMD or GPH radio by using a cloning cable, LAA0700. See "Cloning Radio Settings" in section 2.2.2.

C. **BY COMPUTER** With a computer, GPH-CMD programming software and an LAA0725 interface cable. That procedure is not described in this manual. Contact BK Radio for the programming cable and required software.

2.2.1 KEYPAD PROGRAMMING

Some radios are shipped with a door covering the keypad and display. Before programming, remove the door by removing the battery pack, engaging the door just below the speaker grill, and sliding the door downward. Replace the battery pack.

Make sure the battery pack is charged.



1. Insert the programming plug into the side connector of the radio. The push-button master switch will be on the top.

   NOTE: The cloning cable can be used as a substitute for the programming plug by inserting the end with the push-button master switch into the side connector of the radio.

2. Select a channel group to be programmed. See "Channel Groups" in section 3.8 of this manual.

3. Press and hold the master switch.

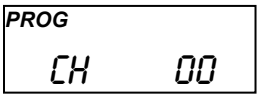
4. While holding the master switch, press and hold the **[FCN]** key. After approximately three seconds the LCD will display '**PSWRD-******'.

5. Release the **[FCN]** key and the master switch. The radio is now in the Password Entry Mode.

6. Enter the six-digit password code. Without the correct password code, you cannot proceed with programming.

   NOTE: New radios shipped from the factory are assigned the password code **000000**.

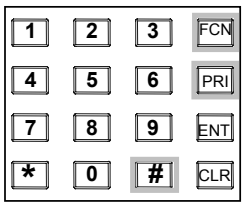
   If the password code is entered incorrectly, the radio will reset to normal operation. Try again, starting at step 2.



7. Press the **[ENT]** key to proceed to Programming Mode. The display will change to '**PROG CH 00**'.

   NOTE: Keypad Programming Mode cannot be entered when the radio is operating in the Command Group. If the display flashes "CMND GRP" when you try to enter Programming Mode, release the master switch and [FCN] key, and select a different group.

2.2.1.1 NAVIGATION



When Programming Mode is entered, programming starts (after password entry) with the Group Parameters (**CH 00**) for the currently selected group. To edit another Channel Group (GRP 01 - 25), press and hold the **[#]** key at any **CH** prompt to get the group selection prompt. Enter the number of the group to be programmed, or press the **[PRI]** key to increment to the desired group. Once the desired group is selected, press **[FCN]** to access the data. Press the **[FCN]** key repeatedly to cycle through the data fields, and then loop back to the **CH 00** entry point.

GROUP PARAMETERS (CH 00) include:

- Group Options: 1-12345678 (1-7 = undefined, 8 = group scan list bit)
- Group Label

To edit channel data, at the **CH 00** prompt enter the number of the channel to be programmed, or press the **[PRI]** key to increment to the desired channel. Press the **[FCN]** key repeatedly to cycle through the data fields, and then loop back to the CH entry point.

CHANNEL PARAMETERS (CH 01 - 20) include:

- Bandwidth (**[#]** key at **CH** prompt toggles Wide/Narrow)
- RX Frequency
- RX CxCSS
- TX Frequency
- TX CxCSS
- Channel Label

To edit global data (GRP 00), press and hold the **[#]** key at any **CH** prompt to get the group selection prompt. Enter '0' to select global data. Press **[FCN]** to access the data. Press the **[FCN]** key repeatedly to cycle through the data fields, and then loop back to the GRP 00 entry point.

GLOBAL PARAMETERS (GRP 00) include:

- Keypad Programming Password
- Global Options 1: Battery Saver, TX on PRI1, PRI1 Lock, Scan List Lock, Backlight Triggers, Beep Disable
- Global Options 2: Busy Channel Mode, ANI/DTMF Mode
- ANI ID
- TX Time-Out Timer
- Scan Delay
- Backlight Duration
- Priority 1 Channel
- Priority 1 Group: (skipped if Channel = OFF or MAIN)
- Priority 2 Channel
- Priority 2 Group: (skipped if Channel = OFF or MAIN)

2.2.1.2 GROUP PARAMETERS (CH 00)

Press the **[FCN]** key at the **CH 00** prompt to access group parameters.

2.2.1.2.1 GROUP OPTIONS: 1-12345678

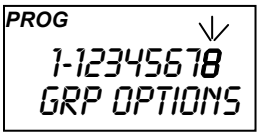
This is a group of eight individual options that can be enabled or disabled.

When an option is enabled, the corresponding number in the display will flash. When the option is disabled the number is steady. If you wish to change the option from enabled to disabled or vice versa, press the number key corresponding to that option.

OPTIONS 1 THROUGH 7

Reserved for future options.

OPTION 8: GROUP SCAN LIST

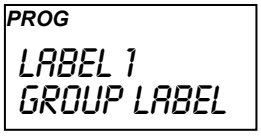


When Option 8 is enabled (flashing) the current group will be scanned when the radio is operating in Group Scan Mode.

Press the **[ENT]** key to store the group options settings into memory and advance to the next field.

Press the **[FCN]** key to advance to the next field without saving changes.

2.2.1.2.2 GROUP LABEL



After Group Options, the display will show the label for the Channel Group. Each Channel Group can have a label of up to twelve characters or spaces. The characters can include **0-9, A-Z, –, -, ., *, +, <, >, /, \, |, $, %, h, or blank**.

If no change is needed, press the **[FCN]** key to go back to the starting point for Channel 0 settings.

NOTE: Special software available from BK Radio lets you enter Group Labels and Channel Labels from a computer. Contact your dealer for information.

Changing The Group Label

Labels are edited from left to right. Pressing the **[PRI]** key moves the cursor to the next character. Pressing and holding the **[PRI]** key backspaces to the previous character.

The number keys 2 – 9 allow for entry of the letters printed on the respective keys. For example, the first press of the [2] key enters the letter A, the second press enters a B, the third press enters a C, and the forth press enters a 2. The letters Q and Z are entered with keys 7 and 9.

Keys 0 and 1 can be used to enter the following characters:

0: **0, space, –, _, ., *, +**

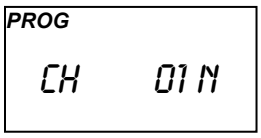
1: **1, <, >, /, \, |, $, %, h**

Press the **[ENT]** key to store changes and go back to the starting point for Channel 0 settings.

2.2.1.3 CHANNEL PARAMETERS (CH 01 – CH 20)

At the starting point for Channel 0, the display shows '**PROG CH 00**'. At this point, a channel number can now be entered to allow access to the frequencies and Code Guard values for that channel.

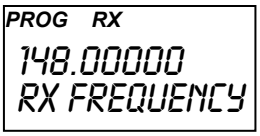
2.2.1.3.1 CHANNEL BANDWIDTH



Press '**1**' and the display will show '**PROG CH 01**'. This is the starting point for entering channel 1 values.

At this point, pressing the **[#]** key will toggle the channel's bandwidth setting. An 'N' will appear to the right of the channel number when the channel is set for 12.5/15 kHz channel spacing using the narrow band receiver filter. A 'W' appears when the channel is set for 25/30 kHz channel spacing using the wide band receiver filter.

2.2.1.3.2 RECEIVE FREQUENCY

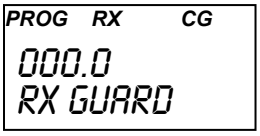


Press the **[FCN]** key to move to the '**RX FREQUENCY**' field. This is the receive frequency for channel 1 (in MHz).

If the displayed frequency is correct, press the **[FCN]** key to advance to the next field.

If a new frequency is desired, press the **[CLR]** key followed by the digits of the desired frequency. Then press the **[ENT]** key to store this frequency and automatically advance to the next field.

2.2.1.3.3 RECEIVE GUARD

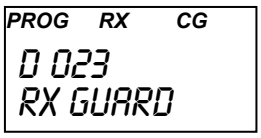


After the RX FREQUENCY is set, the '**RX GUARD**' field appears. This is the Code Guard value for Channel 1 receive.

NOTE: 0.0 indicates carrier squelch operation (no Code Guard).

If the displayed value is correct, press the **[FCN]** key to advance to the next field.

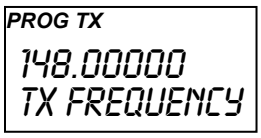
If a new value is desired, press the number keys 0 thru 9 to enter a Tone Code Guard value. See "Tone Code Guard Values" in section 2.3.



To enter a Digital Code Guard value press the **[#]** key, causing the letter '**D**' to appear followed by three zeros. Enter the desired digital code using keys 0 thru 7 (keys 8 & 9 do not respond). See "Digital Code Guard Values" in section 2.4. Pressing the **[PRI]** key after the three-digit code has been entered allows the digital code to be inverted. When the displayed value is correct, press

the **[ENT]** key to store the Code Guard value and automatically advance to the next field.

2.2.1.3.4 TRANSMIT FREQUENCY



After the RX GUARD is set, the '**TX FREQUENCY**' field appears. This is the transmitter frequency for Channel 1.

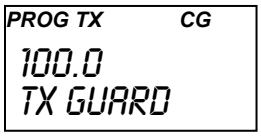
If it is correct, press the **[FCN]** key to advance to the next field.

If you wish to change it, press the **[CLR]** key followed by the frequency in MHz then **[ENT]** to store the new frequency and automatically advance to the next field.

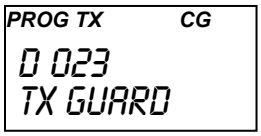
Only valid frequencies will be operable.

If you want to operate this channel as a receive-only channel, press the **[CLR]** key (setting the display to 0.0) followed by the **[ENT]** key. The transmitter will be locked off for this channel.

2.2.1.3.5 TRANSMIT GUARD

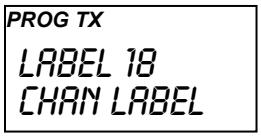


After the TX FREQUENCY is set, the '**TX GUARD**' field appears. This is the Code Guard value for Channel 1 transmit (0.0 indicates 'no guard'). If this value is correct press the **[FCN]** key to advance to the next field. To enter a new value, press the **[CLR]** key to reset the display to 0.0. Press the number keys to enter a Tone Code Guard value. See "Tone Code Guard Values" in section 2.3.



To enter Digital Code Guard, first press the **[CLR]** key, then the **[#]** key, causing the letter '**D**' to appear followed by three zeros. Enter the desired digital code using keys 0 thru 7 (keys 8 & 9 do not respond). See 'Digital Code Guard Values" in section 2.4. Pressing the **[PRI]** key after the three digit code has been entered allows the digital code to be inverted. When the displayed value is correct, press the **[ENT]** key to store the Code Guard and automatically advance to the next field.

2.2.1.3.6 CHANNEL LABEL



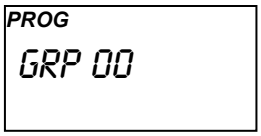
After the TX GUARD is set, the '**CHAN LABEL**' field appears. If this label is correct press the **[FCN]** key to proceed to the entry point.

If a new channel label is desired, follow the instructions under "Group Label" in section 2.2.1.2.2.

After the CHAN LABEL is set, the display will return to the Channel 1 starting point. If you wish to review the frequencies and Code Guard values in Channel 1, subsequent pressing of the **[FCN]** key will show each value and then return to the Channel 1 starting point.

At the starting point for Channel 1, the display will show '**PROG CH 01**'. Press the number keys for another channel number to gain access to the frequencies and Code Guard values for that channel. Each channel is then programmed using the same steps described for Channel 1.

2.2.1.4 GLOBAL PARAMETERS (GRP 00)



At any '**CH**' prompt, press and hold the **[#]** key to get the '**GRP**' prompt. Press '**0**' on the keypad. The display will show '**GRP 00**'. Press **[FCN]** to access global parameters.

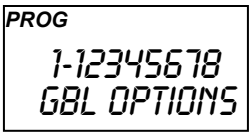
2.2.1.4.1 KEYPAD PROGRAMMING PASSWORD

The current keypad programming '**PASSWORD**' is displayed.

If no change is needed, press the **[FCN]** key to advance to the next field.

A new password can be entered by pressing number keys. Press the **[ENT]** key to store the new password and advance to the next field.

2.2.1.4.2 GLOBAL OPTIONS ONE: 1-12345678

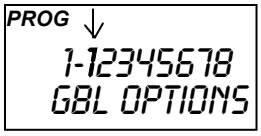


This is a group of eight individual options that can be enabled or disabled.

When an Option is enabled, the corresponding number in the display will flash. When the Option is disabled, the number is steady. If you wish to change the Option from enabled to disabled or vice versa, press the number key corresponding to that Option.

EXAMPLE: If Option 4 (Priority 1 Lock) is disabled, the 4 in the display will not be flashing. If the **[4]** key is pressed, the 4 in the display will flash, signifying that Priority 1 Lock is enabled. A subsequent press of the **[4]** key will disable Priority 1 Lock.

OPTION 1: BATTERY SAVER INHIBIT

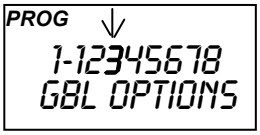


When Option 1 is enabled (flashing), the Battery Saver is turned off. The Battery Saver should be turned off only for getting proper voltage readings during service or for systems requiring fast squelch attack time.

NOTE: BK Radio current drain and battery life specifications are based on performance with the battery saver on.

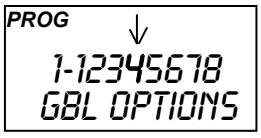
OPTION 2: RESERVED FOR FUTURE OPTIONS

OPTION 3: TRANSMIT ON PRIORITY 1



When Option 3 is enabled (flashing), transmissions will occur on PR1 (if PR1 isn't programmed OFF) when operating in Single or Dual Priority Scan Mode. To simulate BK Radio's Old-Style Priority Mode C, Transmit on Priority 1 must be enabled.

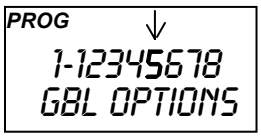
OPTION 4: PRIORITY 1 LOCK



When Option 4 is enabled (flashing) the user will not be able to change the designation of the Priority 1 Channel by selecting a channel and pressing the **[PRI]** key.

When Option 4 is disabled (steady) the user will be able to change the channel that is designated as Priority 1 Channel. See "Dual Priority Scan" on page 3-12.

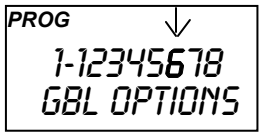
OPTION 5: SCAN LIST LOCK



When Option 5 is enabled (flashing), the user will not be able to use the **[ENT]** and **[CLR]** keys to add channels to and delete channels from the Scan List.

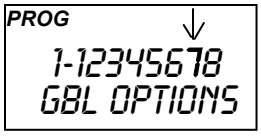
When disabled (steady), the user can alter the Scan List using the **[ENT]** and **[CLR]** keys. See "Change the Scan List" on page 3-11.

OPTION 6: BACKLIGHT ON DISPLAY CHANGE



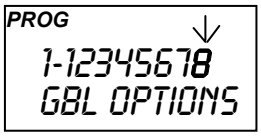
When Option 6 is enabled (flashing), the display backlight will illuminate each time the display receives input. This includes displayed changes in the selected channel or scan channel, and the **PR**, **TX**, and **SCN** annunciators. The display will not illuminate if Backlight Duration is set to **LITE OFF**. See "Backlight Duration" in section 2.2.1.4.7 below.

OPTION 7: BACKLIGHT ON KEY PRESS



When 0ption 7 is enabled (flashing), the display backlight will illuminate each time a key is pressed, even if pressing the key has no other effect. The display will not illuminate if backlight duration is set to **LITE OFF**. See "Backlight Duration" below.

OPTION 8: SILENT MODE



When Option 8 is enabled (flashing), all beeps, tones, and alerts from the radio's speaker are silenced. Only normal audio communication between radio users will be heard.

STORE GLOBAL OPTIONS SETTINGS

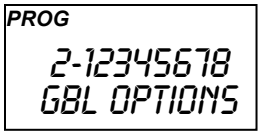
Once each option is set as desired, you can store the changes, discard the changes, or disable all displayed options.

Press the **[CLR]** key to disable all displayed options (steady).

Press the **[ENT]** key to store new displayed options settings into memory and advance to the next field.

Press the **[FCN]** key to advance to the next field without saving changes.

2.2.1.4.3 GLOBAL OPTIONS TWO: 2-12345678

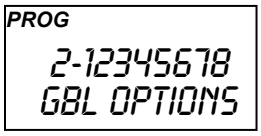


After the first group of Global Options is set, a second group is displayed.

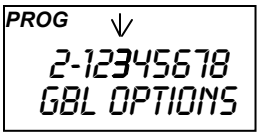
OPTION 1: RESERVED FOR FUTURE OPTIONS

OPTIONS 2 & 3: BUSY CHANNEL OPERATION

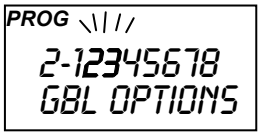
Options two and three are used to set Busy Channel operation. There are three types of busy channel operation available. They are described more fully under "Busy Channel" on page 3-16.



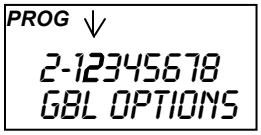
Busy Channel Off



Busy Channel Indicator



Busy Channel Lockout



Busv Channel Override

Busy Channel Modes include:

Busy Channel Indicator - The yellow LED illuminates when a signal is received on the channel selected, with or without the programmed receive Code Guard setting.

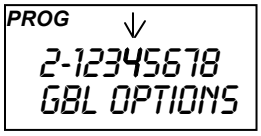
Busy Channel Lockout - The yellow LED illuminates and the transmitter PTT is disabled when a signal is received without the programmed receive Code Guard setting.

Busy Channel Override - This option is similar to Busy Channel Lockout except the transmitter PTT can be activated by rotating the Squelch knob clockwise off the Code Guard detent.

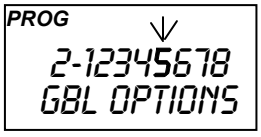
To set Busy Channel operation, use the following chart:

Busy Channel	Option 2	Option 3
Indication	Disable (Steady)	Enable (Flashing)
Lockout	Enable (Flashing)	Enable (Flashing)
Override	Enable (Flashing)	Disable (Steady)

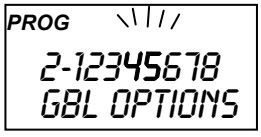
OPTIONS 4 & 5: ANI/DTMF MODE



ANI Only



DTMF Only



DTMF with Manual ANI

When Option 4 is enabled (flashing), the ANI ID number will be transmitted (as a DTMF tone sequence) with each press of the PTT switch. See "Automatic Numeric Identification (ANI)" in section 2.2.1.4.4 for instructions on setting the ANI number.

When Option 5 is enabled (flashing), the keypad becomes active for manual DTMF operation.

When Options 4 and 5 are both enabled (flashing), the ANI tone sequence will be transmitted only after the **[ENT]** key is pressed while the transmit PTT switch is activated. A sidetone of the ANI number transmitted will also be heard through the speaker.

OPTIONS 6 – 8: RESERVED FOR FUTURE OPTIONS

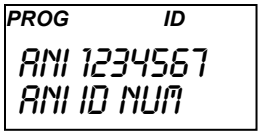
Once each option is set as desired, you can store the changes, discard the changes, or disable all displayed options.

Press the **[CLR]** key to disable all displayed options (steady).

Press the **[ENT]** key to store new displayed options settings into memory and advance to the next field.

Press the **[FCN]** key to advance to the next field without saving changes.

2.2.1.4.4 AUTOMATIC NUMERIC IDENTIFICATION (ANI)



After the Global Options are set, the display will indicate the '**ANI ID**' number (as many as seven digits may be used). The ID number can be used for either radio management or transmitted as a DTMF tone burst for ANI purposes. The ANI can be enabled or disabled. See "ANI/DTMF Mode" in section 2.2.1.4.3 above.

If no change is needed for the ID number, press the **[FCN]** key to advance to the next field.

A new number can be entered by pressing number keys. The digits will appear at the right of display and move to the left. Press the **[ENT]** key to store the new ID number and advance to the next section.

The existing ID number can be incremented one digit by pressing the **[PRI]** key.

Press the **[ENT]** key to store the new ID number and advance to the next field.

2.2.1.4.5 TRANSMITTER TIME-OUT TIMER

After the ID number is set, the '**Transmitter Time-Out Timer**' field is displayed. **0 SEC** means the Time-Out Timer is disabled.

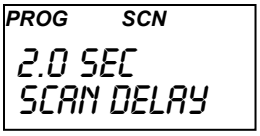
Press the **[PRI]** key to increase the Time-Out Timer duration by 15 seconds, with a maximum of 225 seconds (3 minutes, 45 seconds). Press the **[PRI]** key again to change the duration from 225 seconds to zero.

Press the **[CLR]** key to set the Time-Out Timer duration to zero.

Press the **[ENT]** key to store the changed setting and advance to the next field.

Press the **[FCN]** key to advance to the next field if no change is needed.

2.2.1.4.6 SCAN DELAY TIME



After the Time-Out Timer is set, the '**SCAN DELAY**' time is displayed.

Press the **[PRI]** key to increase the scan delay time by .5 seconds, up to 7.5 seconds. Press the **[PRI]** key again to change the time from 7.5 seconds to 0.

Press the **[CLR]** key to reset the scan delay time to 0.

Press the **[ENT]** key to store the changed setting and advance to the next field.

Press the **[FCN]** key to advance to the next field if no change is needed.

2.2.1.4.7 BACKLIGHT DURATION

After the Scan Delay is set, the display will show the current Backlight Duration setting. Available settings are **LITE OFF**, **1 SEC ON**, 1-second increments up to **6 SEC ON**, and **LITE ON**.

NOTE: Excessive battery drain will result if **LITE ON** is set and used for extended periods of time.

If no change is needed, press the **[FCN]** key to advance to the next field.

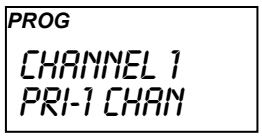
Press the **[CLR]** key to set backlight duration to zero and display **LITE OFF**.

Press the **[PRI]** key to increase backlight duration by 1 second increments from **LITE OFF**, to **1 SEC ON**, **2**, **3**, **4**, **5**, **6 SEC ON**, **LITE ON** (illumination remains on constantly) then back to **LITE OFF**.

Press the **[ENT]** key to store changes and advance to the next field.

Press the **[FCN]** key to advance to the next field without storing changes.

2.2.1.4.8 PRIORITY 1 CHANNEL



After Backlight Duration is set, the '**Priority 1 Channel**' is displayed**.** Any one of the 500 channels in the radios can be designated as the Priority 1 channel, or PR1 can be tied to the Channel Selector knob, or programmed **OFF**. If the radio is programmed to transmit on the first priority channel, transmissions will occur on PR1, if PR1 isn't programmed **OFF**, when operating in Single or Dual Priority Scan Mode.

If PR1 is a fixed channel and the **[PRI]** key on the keypad is not locked out during normal radio operation, the user can select a new group, if necessary, move the channel selector to a new channel and press the **[PRI]** key to choose a new PR1 channel.

Press the **[PRI]** key to cycle through the priority channel options.

Setting the channel to MAIN ties the PR1 channel to the Channel Selector knob.

Press the **[ENT]** key to store the new priority channel and advance to the next field.

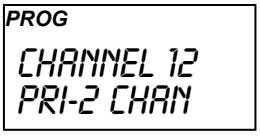
2.2.1.4.9 PRIORITY 1 GROUP

If the Priority 1 channel has been programmed as one of the 500 channels in the radio, the group where the channel resides must be designated. If PR1 has been tied to the Channel Selector knob (set to MAIN), or programmed OFF, the Priority Group field is skipped.

Press the **[PRI]** key to cycle through the priority group options, or press number keys to enter a group.

Press the **[ENT]** key to store the new priority group and advance to the next field.

2.2.1.4.10 PRIORITY 2 CHANNEL



After the Priority 1 Group is set, the '**Priority 2 Channel**' is displayed. Any one of the 500 channels in the radios can be designated as the Priority 2 channel, or PR2 can be tied to the Channel Selector knob, or programmed **OFF**.

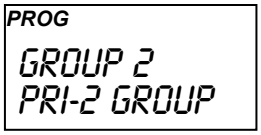
The PR2 channel cannot be altered during normal radio operation.

Press the **[PRI]** key to cycle through the priority channel options.

Setting the channel to MAIN ties the PR2 channel to the Channel Selector knob.

Press the **[ENT]** key to store the new priority channel and advance to the next field.

2.2.1.4.11 PRIORITY 2 GROUP



If the Priority 2 channel has been programmed as one of the 500 channels in the radio, the group where the channel resides must be designated. If PR2 has been tied to the Channel Selector knob (set to MAIN), or programmed **OFF**, the Priority Group field is skipped.

Press the **[PRI]** key to cycle through the priority group options, or press number keys to enter a group.

Press the **[ENT]** key to store the new priority group and advance to the next field.

2.2.1.4.12 OLD-STYLE BK PRIORITY SCAN

The radio can be programmed to mimic the Old-Style BK Priority Scan Modes as follows:

Mode	PR1	TX on PR1	PR2
A	Main	No	Off
B	Fixed Channel #	No	Off
C	Fixed Channel #	Yes	Off

See “Priority Scan” in section 3.11 of this manual for operational details of the Old-Style BK Priority Scan Modes.

2.2.1.4.13 REVIEW GLOBAL PARAMETERS (GRP 00)

Press the **[FCN]** key repeatedly to display each setting in **GRP 00**, and then return to the **GRP 00** starting point.

2.2.1.5 EXIT PROGRAMMING MODE

1. Rotate the OFF-VOL knob counterclockwise to the OFF position.
2. The radio will be in normal Operating Mode the next time it is turned on.

2.2.2 CLONING RADIO SETTINGS

Any “Master” radio (a GPH-CMD with the desired radio frequencies and settings) is capable of transferring its program to another GPH-CMD or GPH radio. The radio receiving the program is referred to as the “Slave” or “Clone.” The LAA0700 cloning cable will be required in the following procedure.

Data that can be cloned to another GPH-CMD radio includes:

- Group data
- Command Group data
- Global data
- UTXG Pick List

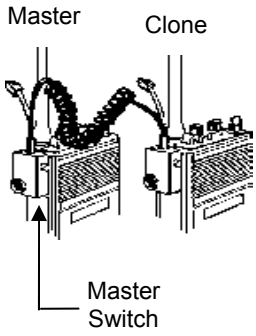
When the Master’s Command Group is cloned to a slave, the channel data that is ‘pointed to’ by the Command Group is transferred to a target group (not the Command Group) in the slave. The target group’s label in the slave will be set to “**CMND CLN**”.

Data that can be cloned to a standard GPH radio includes:

- Group data
- Command Group data

When cloning to a GPH radio, the Master’s global data is converted to group data in the slave, and only the first 16 channels are transferred.

When receiving an incoming clone from a GPH radio, the GPH-CMD radio ignores group data other than the group label and the group scan list bit. The GPH-CMD's global data and channels 17-20 are not disturbed.



NOTE: Some groups may be "locked" by PC programming to prevent them from being overwritten. Only "unlocked" groups will accept incoming clones.

1. Make sure the battery packs for both radios are charged.
2. Attach the master switch end of the cloning cable to the side connector of the Master radio.

   NOTE: One plug of the cloning cable has a push-button master switch. This plug must be attached to the Master radio.

PSWRD-******

3. Turn on the Master radio.
4. Put the Master radio in Programming Mode by pressing and holding the master switch then pressing and holding the **[FCN]** key until the display shows '**PSWRD-******'. Enter the 6-digit password. The display shows '**PROG CH 00**.'

PROG
CH 00

5. Connect the other plug of the cable to the side connector of the radio you want to clone.
6. Turn on the clone and set it to the desired channel group.

PROG|GPHCMD
GROUP 01

Press and Hold **[*]** Key to Change Target

PROG|GPH
GROUP 01

7. Press the **[*]** key on the Master radio keypad. The radio will respond showing the prompt '**PROG|GPHCMD**' on the first line and '**Group XX**' on the second line, where XX is the currently selected group (see Select A Group/Channel, section 3.8 of this manual, for details of how the group is selected).

   Long **[*]** keypresses will toggle the first line of the display between **PROG|GPHCMD**' and '**PROG|GPH**', if the second line of the display shows data that is valid to copy to the displayed target.

Data	Valid Target
GROUP 00	GPHCMD only
GROUP 01 - 25	GPHCMD, GPH
CMND GRP	GPHCMD, GPH
PICK LIST	GPHCMD only

PROG|GPHCMD
CMND GROUP

Press and Hold **[#]** Key to Change Data

PROG|GPHCMD
PICK LIST

8. Long **[#]** keypresses will cause the second line of the display to cycle through the data blocks that can be transferred to the target displayed on the first line.

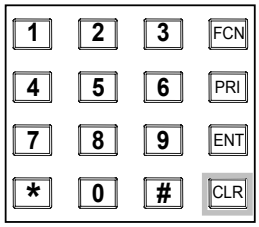
Target	Valid Data
GPHCMD	GROUP 00 or GROUP 01 - 25 CMND GRP PICK LIST
GPH	GROUP 01 – 25 CMND GRP

9. Once the target and data to be transferred have been selected, press the **[FCN]** key on the Master radio keypad. The top line of the display will flash '**CLONING**' while the program in the master is being downloaded to the clone.

10. If the download was successful, the display on the Master will again display the clone prompt (target and data to be transferred)**.**

    - To clone another channel group, press the Master radio's **[CLR]** key. Navigate to a '**CH**' prompt, then press and hold the **[#]** key to get the '**GRP**' prompt.

    - If cloning is finished, turn off the Clone and disconnect the cloning cable. Normal radio operation will occur when you turn on the Clone.



11. If the download was not successful, the master will flash '**FAILURE**' and multiple beeps will follow. Failure of downloading can be due to:

    - Improper connection

    - Failure to turn on the clone

    - Setting the clone in Programming Mode

    - Target radio's group 'locked' by PC Programming

    NOTE: To stop the '**FAILURE**' Mode, press **[CLR]**, turn off both radios, and try again, starting with Step 1 on the previous page.

2.3 TONE CODE GUARD VALUES

The Tone Code Guard system may be set for any frequency in the range of 67 to 255.9 Hz. However, since most systems adhere to the Electronic Industry Association (EIA) standards, tones should be selected from the following EIA list. In order to insure optimum performance, tone selection for use on the same radio frequency (RF) channel or adjacent channels in the same coverage area should be made from one of the Groups A, B, or C to the maximum degree possible. BK Radio guarantees optimum receiver performance only if tone frequencies below 220 Hz are chosen.

GROUP A		GROUP B		GROUP C
67.0 (XZ)	*151.4 (5Z)	71.9 (XA)	146.2 (4B)	74.4
77.0 (XB)	162.2 (5B)	82.5 (YZ)	156.7 (5A)	79.7
88.5 (YB)	173.8 (6A)	94.8 (ZA)	167.9 (6Z)	85.4 (YA)
*100.0 (1Z)	186.2 (7Z)	103.5 (1A)	*179.9 (6B)	91.5 (ZZ)
107.2 (1B)	203.5 (M1)	110.9 (2X)	192.8 (7A)	
114.8 (2A)	218.1 (M3)	*118.8 (2B)	210.7 (M2)	
123.0 (3Z)	233.6	127.3 (3A)	225.7 (M4)	
131.8 (3B)	250.3	136.5 (4Z)	241.8	
141.3 (4A)				

* 50/60 Hz power distribution systems could cause falsing.

The assignments in a given area shall be made from within one of the Groups: A, B, or C.

2.4 DIGITAL CODE GUARD VALUES

Codes for the Digital Code Guard system may be chosen from the following list. This can be done during the code programming of the system. Usually systems using direct unit to unit transmission (systems without mobile relays, repeaters, remote control, etc) may use codes from the table. Systems with relays etc. may use code variations for system control and operational efficiency. The system operator or engineer should be consulted regarding the operational requirement on such systems.

023	065	131	165	245	315	411	466	612	703
025	071	132	172	251	331	412	503	624	712
026	072	134	174	261	343	423	506	627	723
031	073	143	205	263	346	431	516	631	731
032	074	152	223	265	351	432	532	632	732
043	114	155	226	271	364	445	546	654	734
047	115	156	243	306	365	464	565	662	743
051	116	162	244	311	371	465	606	664	754
054	125								

SECTION III
OPERATION

3.1 INTRODUCTION

This section contains information concerning the operation procedures for the BK Radio GPH-CMD radios. The GPH-CMD radio has been designed to meet the tough requirements of today's communications environment. Please take a moment to read the information in this manual so you can get optimum performance from your new radio.

3.1.1 FEATURES

- Programmable Top Switches
- Programmable Keypad Menu
- Customizable Command Group
- User Selectable TX Code Guard
- DTMF/ANI
- Transmit Time-Out Timer
- Group Scan
- Scan Delay
- Talkback Scan
- Nuisance Channel Delete
- Dual-Priority Scan with Code Guard
- Alphanumeric Display
- Up to 500 Channels Available in 25 Groups of 20 Channels
- 2.5 kHz Interstitial Frequency Capability
- Keypad Lock

3.2 FCC REQUIREMENTS

Your radio must be properly licensed by the Federal Communications Commission prior to use. Your BK Radio dealer can assist you in meeting these requirements. Your dealer will program each radio with your authorized frequencies, signaling codes, etc., and will be there to meet your communications needs as your system expands.

3.2.1 RF ENERGY EXPOSURE AWARENESS AND CONTROL INFORMATION, AND OPERATIONAL INSTRUCTIONS FOR FCC OCCUPATIONAL USE REQUIREMENTS

BEFORE USING YOUR PORTABLE 2-WAY RADIO, READ THIS IMPORTANT RF ENERGY AWARENESS AND CONTROL INFORMATION AND OPERATIONAL INSTRUCTIONS TO ENSURE COMPLIANCE WITH THE FCC'S RF EXPOSURE GUIDELINES.

NOTICE: This radio is intended for use in occupational/controlled conditions, where users have full knowledge of their exposure and can exercise control over their exposure to meet FCC limits. This radio device is NOT authorized for general population, consumer, or any other use.

This 2-way radio uses electromagnetic energy in the radio frequency (RF) spectrum to provide communications between two or more users over a distance. It uses radio frequency (RF) energy or radio waves to send and receive calls. RF energy is one form of electromagnetic energy; other forms include electric power, radar, sunlight and x-rays. RF energy, however, should not be confused with these other forms of electromagnetic energy, which when used improperly can cause biological damage. Very high levels of x-rays, for example, can damage tissues and genetic material. The energy levels associated with radio waves from portable 2-way radios, when properly used, are not great enough to cause biological damage.

Experts in science, engineering, medicine, health and industry work with organizations to develop standards for exposure to RF energy. These standards provide recommended levels of RF exposure for both workers and the general public. These recommended RF exposure levels include substantial margins of protection. All 2-way radios marketed in North America are designed, manufactured and tested to ensure they meet government established RF exposure levels. In addition, manufacturers also recommend specific operating instructions to users of 2-way radios.

These instructions are important because they inform users about RF energy exposure and provide simple procedures on how to control it. Please refer to the following WEBSITES for more information on what RF energy exposure is and how to control your exposure to assure compliance with established RF exposure limits.

http://www.fcc.gov/oet/rfsafety/rf-faqs.html

http://www.osha.gov/SLTC/radiofrequencyradiation/index.html

3.2.2 FEDERAL COMMUNICATIONS COMMISSION REGULATIONS

The FCC rules require manufacturers to comply with the FCC RF energy exposure limits for portable 2-way radios before they can be marketed in the U.S. When 2-way radios are used as a consequence of employment, the FCC requires users to be fully aware of and able to control their exposure to meet occupational requirements. Exposure awareness can be facilitated by the use of a product label directing users to specific user awareness information. Your BK Radio 2-way radio has a RF exposure product label. Also, your BK Radio owner's and service manuals include information and operating instructions required to control your RF exposure and to satisfy compliance requirements.

3.2.3 COMPLIANCE WITH RF EXPOSURE STANDARDS

Your BK Radio 2-way radio is designed and tested to comply with a number of national and international standards and guidelines (listed below) for human exposure to radio frequency electromagnetic energy. This radio complies with the IEEE and ICNIRP exposure limits for occupational/controlled RF exposure environment at operating duty factors of up to 50% transmitting and is authorized by the FCC for occupational use only. In terms of measuring RF energy for compliance with the FCC exposure guidelines, your radio radiates measurable RF energy only while it is transmitting (during talking), not when it is receiving (listening) or in Standby Mode. Note: The approved batteries supplied with this radio are rated for a 5-5-90 duty factor (5% talk-5% listen - 90% standby), even though this radio complies with the FCC occupational RF exposure limits and may operate at duty factors of up to 50% talk.

Your BK Radio 2-way radio complies with the following RF energy exposure standards and guidelines:

United States Federal Communications Commission, Code of Federal Regulations; 47 CFR §§ 1.1307, 1.1310, 2.1091 and 2.1093

American National Standards Institute (ANSI) / Institute of Electrical and Electronic Engineers (IEEE) C95. 1-1992

Institute of Electrical and Electronic Engineers (IEEE) C95.1-1999 Edition

3.2.4 INDUSTRY CANADA COMPLIANCE

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numerique de la classe B est conforme à la norme NMB-003 Canada.

3.2.5 RF EXPOSURE COMPLIANCE AND CONTROL GUIDELINES AND OPERATING INSTRUCTIONS

To control your exposure and ensure compliance with the occupational/controlled environment exposure limits always adhere to the following procedures.

Guidelines:

- Do not remove the RF Exposure Label from the device.
- User awareness instructions must accompany device when transferred to other users.
- Do not use this device if the operational requirements described herein are not met.

Operating Instructions:

- Transmit no more than the rated duty factor of 50% of the time. To transmit (talk), push the Push-To-Talk (PTT) button. To receive calls, release the PTT button. Transmitting 50% of the time, or less, is important because this radio generates measurable RF energy exposure only when transmitting (in terms of measuring for standards compliance).

- Hold the radio in a vertical position in front of face with the microphone (and the other parts of the radio, including the antenna) at least one inch (2.5 cm) away from the nose. Keeping the radio at the proper distance is important because RF exposures decrease with distance from the antenna. Antenna should be kept away from eyes.

- When worn on the body, always place the radio in a BK Radio approved clip, holder, holster, case, or body harness for this product. Using approved body-worn accessories is important because the use of BK Radio or other manufacturer's non-approved accessories may result in exposure levels which exceed the FCC's occupational/controlled environment RF exposure limits.

- If you are not using a body-worn accessory and are not using the radio in the intended use position in front of the face, then ensure the antenna and the radio are kept at least one inch (2.5 cm) from the body when transmitting. Keeping the radio at the proper distance is important because RF exposures decrease with increasing distance from the antenna.

- Use only BK Radio approved supplied or replacement antennas, batteries, and accessories. Use of non-BK Radio approved antennas, batteries, and accessories may exceed the FCC RF exposure guidelines.

- For a list of BK Radio approved accessories visit the following website: *http://www.relm.com*.

CONTACT INFORMATION

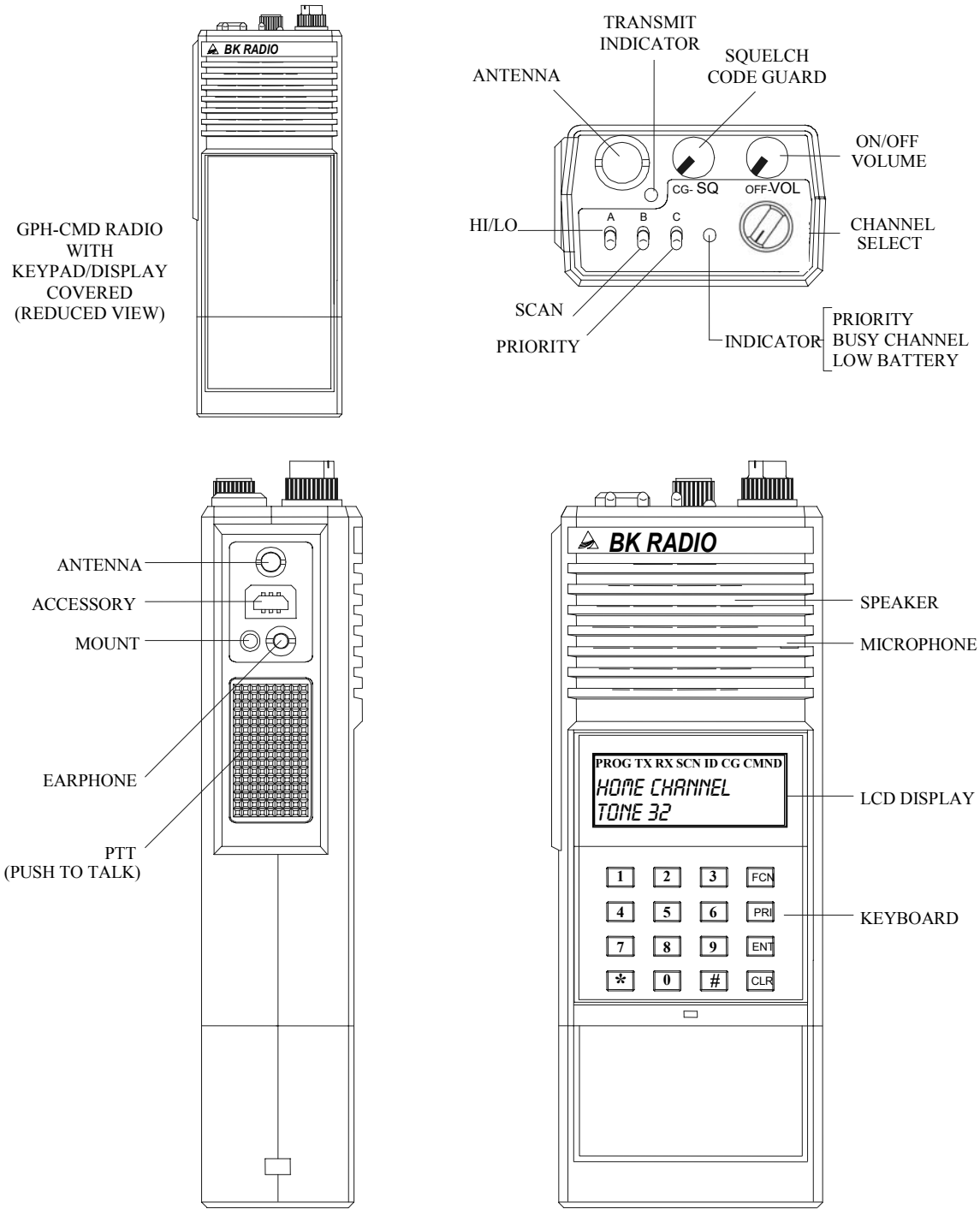
For additional information on exposure requirements or other information, visit website http://www.relm.com.

3.3 SAFETY PRECAUTIONS

- Do not operate the transmitter in close proximity to blasting caps.

- Do not operate the radio in an explosive atmosphere (petroleum fuels, solvents, dust, etc.) unless your radio is an intrinsically safe model designed for such use.

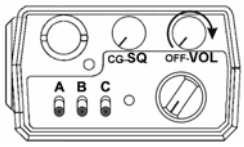
3.4 RADIO CONTROLS



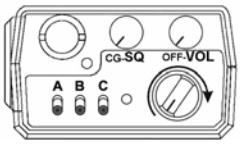
Alphanumeric Display

3.5 BASIC OPERATION

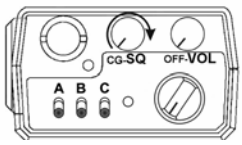
3.5.1 RECEIVE



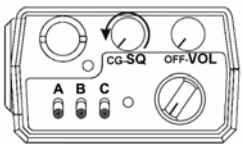
Turn power on by turning the Volume knob clockwise. A beep sounds, indicating the radio is operational. The LCD display shows the current channel.



Select a channel by rotating the Channel Selector knob. When the unstopped channel selector is rotated past the highest (20th) channel, the radio will emit a beep and remain on the highest channel. When rotated past the lowest (1st) channel, the radio will emit a beep and remain on the lowest channel.

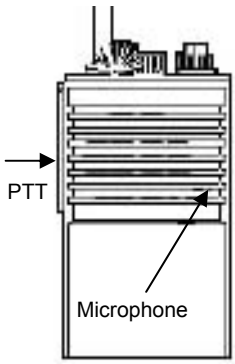


Adjust squelch and volume by turning the Squelch knob clockwise until you hear noise. Set the volume to a comfortable level. Then turn the Squelch knob counterclockwise until the noise stops. This is called the Threshold Squelch setting.



Turning the Squelch knob fully counterclockwise past the detent places the receiver in Code Guard. A message will be heard only when the proper Code Guard value is received.

3.5.2 TRANSMIT

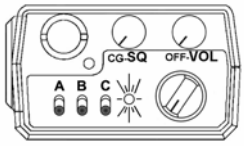


Press the PTT (Push-To-Talk) switch. When the transmitter is on, the red Transmit Indicator glows and **TX** appears in the display.

Talk in a normal voice with the microphone one to two inches from your mouth.

Release the PTT switch to stop transmitting.

If the Transmit Indicator does not glow when you press the PTT switch, the battery pack may need to be charged. If so, the display will indicate **LOBATT**, and the yellow Low-Battery Indicator will flash. If the Transmit Indicator does not glow and a tone sounds, you are on a receive-only channel or the channel is busy (if Busy Channel lockout is enabled). Select an authorized transmit channel.

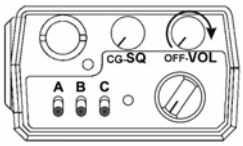


If the length of your message exceeds the preset Time-Out Timer setting, the transmitter automatically shuts off and a tone sounds. To continue transmission, release the PTT switch, and then press it again and continue talking.

3.6 CODE GUARD OPERATION

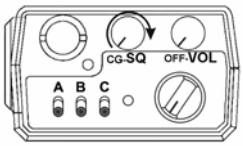
Code Guard™ allows one radio or a group of radios to be selectively called within a system. If the radio has been programmed with Code Guard, use the following receive and transmit instructions.

3.6.1 CODE GUARD RECEIVE

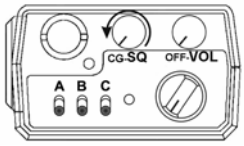


Turn power on by turning the Volume knob clockwise.

Select a Code Guard channel by turning the Channel Selector knob.

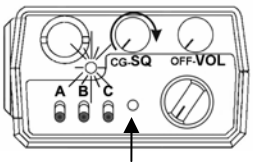


Adjust volume by turning the Squelch knob clockwise until a noise is heard. Set the volume to a comfortable level.



Set Code Guard Mode by turning the Squelch knob off (counterclockwise) into the Code Guard position. A message will be heard only when the proper Code Guard value is received.

3.6.2 CODE GUARD TRANSMIT

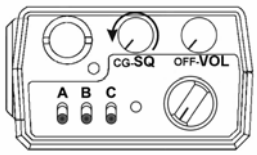


Busy Channel Indicator

Turn the Squelch knob on (clockwise) and monitor the Code Guard channel before transmitting, or, if Busy Channel operation is enabled, check the yellow LED.

NOTE: Do not transmit if the channel is busy.

Press the PTT switch. When the transmitter is on, the red Transmit Indicator glows and **TX** appears in the display.



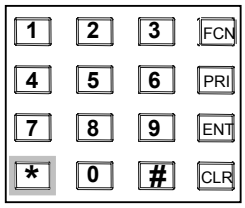
If monitoring the channel, reset the squelch knob to the Code Guard position to receive only the messages with the proper Code Guard value. During extended transmissions, the squelch can be left open until the exchange has ended.

Code Guard is a trademark of BK Radio, Inc.

3.7 COMMAND GROUP

The GPH-CMD radio allows construction of a Command Group of up to 20 channels, drawn from any of the programmed channels in the radio. To modify the Command Group (add or delete channels) all scanning functions (Channel Scan, Group Scan, and Priority Scan) must be turned OFF.

3.7.1 BUILDING A COMMAND GROUP

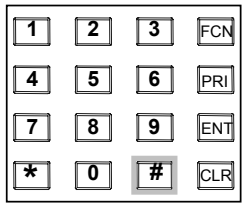


While operating in a group other than the Command Group (group 1 – 25), the user selects a channel in the radio and presses the **[*]** key to enter the channel into the Command Group. If a channel is on the scan list in its home group, it will also be on the Command Group's scan list. Unprogrammed channels cannot be added to the Command Group. Up to 20 channels may be entered.

After adding a channel, the display momentarily shows '**CMND CHAN XX**' where XX is the channel number (1 – 20). Parameters associated with each selected channel, such as Bandwidth, Scan, and Power settings, are also used while operating in the Command Group.

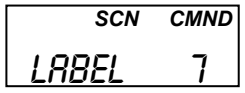
Once 20 channels are entered, subsequent presses of the **[*]** key will cause the radio to beep and momentarily display the message '**CMND FULL**'. When operating in the Command Group, the continuously rotating channel selector will "stop" at the highest programmed channel. For example, if only 4 channels are programmed, when the channel selector is rotated past the 4th channel the radio will beep and remain on the 4th channel.

3.7.2 OPERATING FROM THE COMMAND GROUP



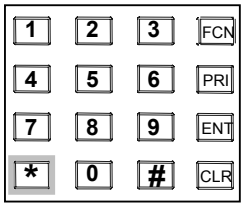
The Command Group can be entered by pressing the **[#]** key twice. Operation in the Command Group is indicated on the display by the '**CMND**' icon.

Adding or deleting a channel to/from the Command Group's scan list also changes the channel's status in its home group.



It is not valid for a priority channel to be set to a channel in the Command Group. If, while operating in the Command Group, the **[PRI]** key is pressed to designate a priority channel, the "target channel" that is pointed to by the Command Group channel, will be marked as the priority channel.

3.7.3 MODIFICATION OF THE COMMAND GROUP



When the Command Group is active, a short press of the **[*]** key deletes the knob-selected channel, while a long press (4 seconds) deletes all channels in the Command Group.

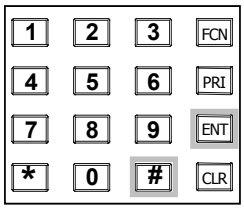
When a channel is deleted, the display momentarily shows '**CHAN DELETED**', and the following channels move up in the list. For example, if channel 5 is deleted, channel 6 becomes the new channel 5, channel 7 becomes the new channel 6, etc. When all channels are deleted, the radio beeps continuously and the display shows '**CMND EMPTY**' along with the '**CMND**' icon.

Exit the Command Group to add new channels.

3.8 CHANNEL GROUPS

Channels are arranged in 25 groups of up to 20 channels.

3.8.1 SELECT A GROUP/CHANNEL

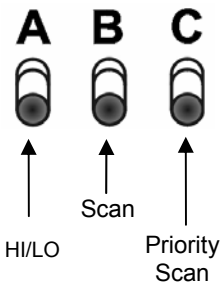


The rotary knob selects channels in the group selected by the keypad:

1. Press the **[#]** key on the keypad to display the current group number.
2. Press number keys for the new group number, or press **[#]** again to select the Command Group.

   When changing groups, invalid entries will not be accepted, and the radio remains in the previously selected group.
3. Press the **[ENT]** key or wait 5 seconds. The radio returns to normal operation for the new group, and the selected channel is displayed. All selected scanning functions affect only the channels in the group you are operating in.

3.9 PROGRAMMABLE TOP SWITCHES/FUNCTION MENU

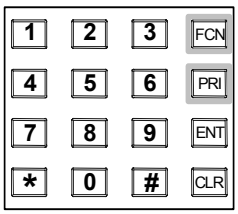


The following functions can be assigned to the three top switches or the keypad **[FCN]** key menu:

FUNCTION	FCN Key Menu Label
Low Power Select	TX LOW POWER
Channel Scan	CHANNEL SCAN
Priority Scan	PRI SCAN
Repeater Talk Around	TALK-AROUND
Group Scan	GROUP SCAN

Your dealer can also assign more than one function to the same top switch. For example, both low-power select and RTA could be enabled by the same switch.

NOTE: Assume for this manual that Switch 'A' has been programmed for HI/LO Transmit Power, Switch 'B' has been programmed for Scan, and Switch 'C' has been programmed for Priority Scan.



To access functions on the keypad **[FCN]** key menu:

1. Press the **[FCN]** key to display the function menu.
2. Repeatedly press **[FCN]** to step through the menu.
3. Press **[PRI]** to toggle the function on/off when the desired menu item is displayed.

When the display flashes, the function is enabled.

3.9.1 KEYPAD LOCK

To lock/unlock the keypad, press and hold the **[FCN]** key. When locked, "LOCKED" will be displayed if a key is pressed and a low beep will sound.

LOCKOUT EXCEPTIONS:

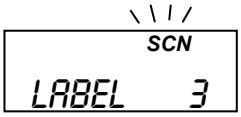
PTT unlocks the keypad during transmit for enabled DTMF key presses.

3.10 SCAN OPERATION

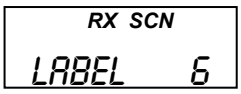
1. Slide Switch B (scan) up.

2. Slide Switch C (priority) down.

The display indicates scan operation by flashing **SCN.**



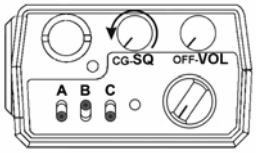
Scan operates only while the radio is not transmitting. The radio checks for signals on channels in the preset Scan List, as well as the channel selected by the Channel Selector knob.



When a signal is detected, scanning stops and the message is received. The received channel is shown in place of the transmit channel.

Once the signal ends, the radio continues to monitor the channel for the preset scan delay time before it resumes scanning.

3.10.1 SCAN CODE GUARD CHANNELS



1. Slide Switch B (scan) up.

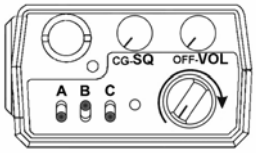
2. Turn the Squelch knob completely counterclockwise, past the detent, to the Code Guard position.

When a signal is detected, scanning stops while the radio checks for the proper Code Guard value. If the signal contains the proper Code Guard value, the radio receives the message. Otherwise, the radio resumes scanning immediately.

3.10.2 NUISANCE CHANNEL DELETE

If your radio is programmed for Nuisance Channel Delete and Channel Scan is assigned to a top switch (Switch B, for example), a Nuisance Channel can be temporarily removed from the Scan List by sliding Switch B down and then back up.

3.10.3 TRANSMIT WITH SCAN ON



When Switch B (scan) is up, the radio transmits on the channel selected by the Channel Selector knob unless Talkback Scan is enabled or “Transmit on Priority-1” is enabled (see Priority Scan operation).

1. Select a transmit channel by turning the Channel Selector knob.

2. Press and hold the PTT switch and talk in a normal voice.

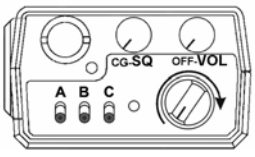
When the PTT switch is released, the radio continues to monitor the selected channel for the preset scan delay time before it resumes scanning.

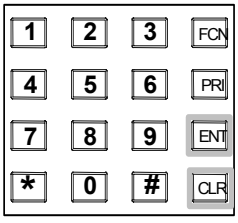
3.10.4 TALKBACK SCAN

If your radio is programmed for Talkback Scan, press PTT while a channel is active or while scan delay time remains. You will be responding on the transmit frequency of the received channel.

Talkback Scan will not work if Priority Scan is also on and your radio is programmed to always transmit on the Priority 1 channel.

3.10.5 CHANGE THE SCAN LIST





If the radio has not been programmed for Scan List Lock, the user may add or remove channels from the Scan List. If user changes are enabled, follow these steps to change the Scan List:

1. Slide Switches B (scan) and C (priority) down.

2. Select a channel to be added or removed from the Scan List by turning the Channel Selector knob. If the channel is already on the Scan List, **SCN** appears in the display.

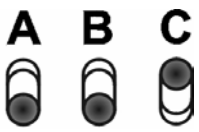
3. Press the **[ENT]** key to add a channel to the Scan List. A short beep sounds and **SCN** appears in the display.

4. Press the **[CLR]** key to remove a channel from the Scan List. A short beep sounds and **SCN** disappears from the display.

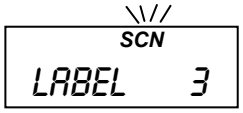
3.10.6 GROUP SCAN

Channels on each "Channel Scan List" in groups on the "Group Scan List" are scanned sequentially. The selected group is always scanned when Group Scan is enabled, even if that group is not on the Group Scan List.

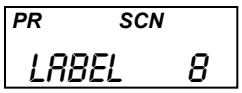
3.11 PRIORITY SCAN



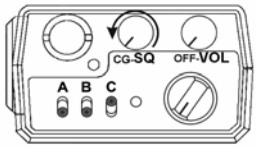
Priority Scan enables the radio to receive on any channel while monitoring for a message on the designated priority channel(s). The radio samples each priority channel at a preset rate (.25-2.0 seconds) regardless of activity on any other channel. Priority Scan operates only while the radio is not transmitting and can be used in combination with scan operation.



When Switch C (Priority) is up, the display flashes **SCN**. If a message is received on a priority channel, the Priority Indicator lights, and the radio receiver locks onto that channel for the duration of the transmission, unless a higher priority channel interrupts.



Priority Scan can be used in combination with Code Guard with:



- Switch C (Priority) up
- The Squelch knob in the Code Guard position (fully counterclockwise detent position) and
- The Priority Channel(s) programmed with Code Guard

If a message is received on a priority channel, the radio receiver locks on to the priority channel and checks to see if the proper Code Guard value is present. If the signal contains the proper Code Guard value, the radio receives the message. Otherwise, the radio will re-check the channel every 4 seconds, until the activity on the channel ceases.

3.11.1 DUAL PRIORITY SCAN

Up to two of the radio's 500 channels can be designated as priority channels. These two, PR1 and PR2, are periodically tested for activity, even if a different transmission is being listened to. Activity on PR2 preempts activity on any of the non-priority channels. Receptions on PR1 have priority over any other channel, including PR2.

Either priority channel can be programmed as a fixed channel, tied to the Channel Selector knob, or programmed OFF. If the radio is programmed to transmit on the first priority channel, transmissions will occur on PR1 when operating in Priority Scan Mode.

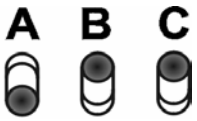
If PR1 is a fixed channel, and the **[PRI]** key is not locked out, the user can use the keypad to change groups, if necessary, move the channel selector to a new channel and press the **[PRI]** key to choose a new PR1 channel.

3.11.2 OLD-STYLE BK PRIORITY SCAN

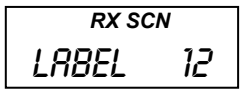
The radio can be programmed with one of three Priority Modes: A, B, or C. The table below shows how the priority channels and the transmit channels are selected in each mode.

	Mode A	Mode B	Mode C
Priority Channel	Channel Knob	Preset	Preset
Transmit Channel	Channel Knob	Channel Knob	Priority Channel

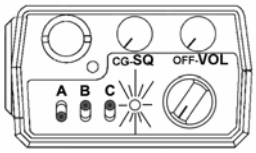
3.11.3 PRIORITY MODE A WITH SCAN



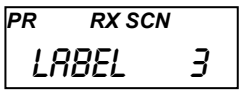
In Priority Mode A, the priority channel is set by the Channel Selector knob. Priority Mode A is seldom used by itself because the radio receives and transmits only on the knob-selected channel.



When Switches B (scan) and C (priority) are up, scanning occurs until an active scan channel is found. The radio receives the message while continuing to check the priority channel. The display shows the scan channel.

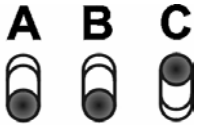


If the priority channel becomes active during this message, the Priority Indicator will light. The radio changes to the priority channel and holds for the duration of the message. The display shows the priority channel.

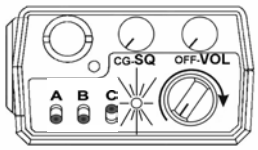


To reply to a message on the priority channel, press the PTT switch and the radio will transmit on the priority channel. Once activity ceases on the priority channel, the radio returns to scan operation.

3.11.4 PRIORITY MODE B



With Switch C (priority) up and Switch B (scan) down, the radio can receive on the knob-selected channel while sampling the priority channel. If the priority channel becomes active, the Priority Indicator lights up. The radio changes to the priority channel and holds for the duration of the transmission.

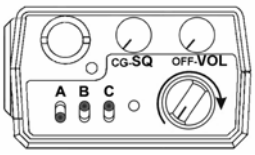


To reply to a message on the priority channel, use the keypad to change groups if necessary, turn the Channel Knob to select the priority channel, and then transmit.

3.11.4.1 PRIORITY MODE B WITH SCAN

With Switches B (scan) and C (priority) up, the radio scans until it locks on to an active channel. The radio continues to sample the priority channel while listening to the active scan channel.

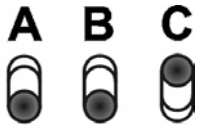
If activity occurs on the priority channel, the radio overrides the active scan channel, changes to the priority channel, and holds for the duration of the transmission.



To reply to a message on the priority channel, use the keypad to change groups if necessary, turn the Channel Knob to select the priority channel, and then transmit.

Once activity has ceased on the priority channel, the radio returns to scan operation.

3.11.5 PRIORITY MODE C



With Switch C (priority) up and Switch B (scan) down, the radio samples the fixed priority channel at the preset rate. If activity occurs on the priority channel, the radio changes to the priority channel and holds for the duration of the transmission.

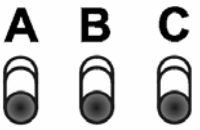
To reply to a message on the priority channel, press the PTT switch. The radio transmits only on the priority channel when Switch C (priority) is up. Once activity has ceased on the priority channel, the radio returns to the receive channel on the Channel Selector knob.

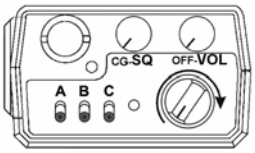
3.11.5.1 PRIORITY MODE C WITH SCAN

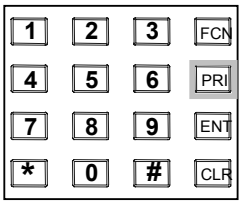
With Switches B (scan) and C (priority) up, the radio scans until it locks on to an active channel. The radio continues to sample the priority channel while listening to the active channel. If activity occurs on the priority channel, the radio overrides the active scan channel, changes to the priority channel, and holds for the duration of the transmission.

To reply to a message on the priority channel, press the PTT switch. The radio transmits only on the priority channel when Switch C (priority) is up. Once activity has ceased on the priority channel, the radio returns to scan operation.

3.11.6 CHANGE THE PRIORITY 1 CHANNEL







The fixed Priority 1 channel can be permanently set or can be changeable. If the radio has a changeable priority channel, use the following steps to make this change:

1. Slide Switches B (scan) and C (priority) down.

2. Use the keypad to change groups, if necessary. Turn the Channel Selector knob to the channel you want to enter as the new Priority 1 channel.

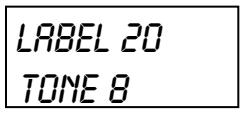
3. Press the **[PRI]** key. A short beep sounds and ***PR*** appears in the display, indicating that the displayed channel is now the Priority 1 channel.

   NOTE: If the radio is programmed for Dual Priority operation, only the Priority 1 channel can be changed with the **[PRI]** key.

   NOTE: A channel can be the priority channel even if it is on the Scan List. Due to multiple sampling of the same channel, however, maximum performance occurs when the priority channels are not on the Scan List.

3.12 USER TRANSMIT CODE GUARD

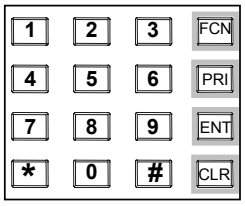
When the radio is being programmed with transmit and receive frequencies for each channel, a receive Code Guard value and a transmit Code Guard value can also be assigned to each channel. On channels that do not have a default transmit Code Guard programmed, the user can choose CxCSSs from a global UTXG Pick List containing 32 entries. To assign a UTXG for use on a channel, all scanning functions (Channel Scan, Group Scan, and Priority Scan) must be turned OFF.



The user selects a channel and then uses the keypad to enter a number from 1 to 32. When UTXG is active, the second line of the display will show the number of the selected list entry (TONE – XX). Once a UTXG is assigned to a particular channel, it will be stored and used with that channel whenever the channel is selected. Repeater Talk Around operation will use the pre-programmed RX CxCSS.

The UTXG Pick List can be viewed by pressing **[FCN] [1]**. The display will show:

TONE – 01	or	TONE – 01
XXX.X		DXXX



Press **[PRI]** to increment through the list or key in a number. Press **[ENT]** to exit the list viewer. (This feature is for viewing the list only. Pressing **[ENT]** when a list item is displayed does NOT associate the UTXG with the selected channel.)

Programming of the list (if programming is not locked out by PC software) can be accomplished as follows:

1. While viewing the list, press and hold the **[FCN]** key until the '**PROG**' annunciator lights.
2. Press **[CLR]** and then enter the new CxCSS. Press **[ENT]** to store the new value and return to the list viewer.

3.13 OTHER OPERATIONAL FEATURES

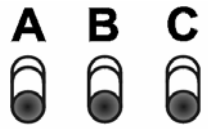
The BK Radio GPH-CMD Series is based on a microprocessor core that allows extra features and operational characteristics to be programmed into the radio. Your dealer can help define the best operational settings for your system and program them into the radio.

3.13.1 SCAN DELAY

Scan delay lets the radio receive a response to a transmission before scanning the other channels for activity. If you find that your scanner is restarting before message replies are received, you can ask your dealer to increase the scan delay time (0-7.5 seconds).

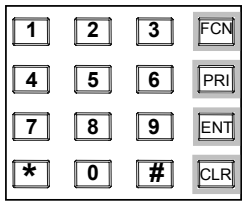
This timer is also used to allow for Talkback Scan.

3.13.2 HI/LO POWER



Each channel in the radio can be individually programmed to always transmit in Low-Power Mode, regardless of the position of the radio's top switch (or keypad **[FCN]** menu setting). If the programming for the channel allows high-power transmissions, the power level can be selected with a top switch or the keypad menu.

3.13.3 DTMF ENCODING



Radios can be programmed to enable DTMF (Dual Tone Multiple Frequency) encoding. To send DTMF tones (similar to the tones used by a standard push-button telephone):

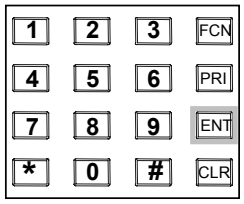
1. Press and hold the PTT switch.

2. Press any of the keys on the keypad.

You will hear a sidetone.

The **FCN**, **PRI**, **ENT**, and **CLR** keys respond as DTMF tones A, B, C, and D, respectively.

3.13.4 ANI ENCODING



ANI encoding (Automatic Numeric Identification), if enabled, transmits a sequence of DTMF tones each time you press the PTT switch. You will hear a sidetone. Your dealer can program the ANI number to be sent.

If DTMF and ANI are both enabled, the ANI tone sequence is transmitted only after the **[ENT]** key is pressed while the PTT switch is activated. You will hear a sidetone.

3.13.5 TIME-OUT TIMER

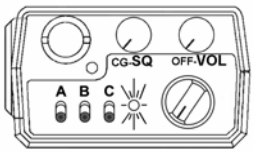
The transmit Time-Out Timer limits the duration of calls and guards against accidentally locking on the transmitter and tying up the radio system. Your dealer can program the duration of the Time-Out Timer (15-225 seconds, or disabled).

3.13.6 BUSY CHANNEL

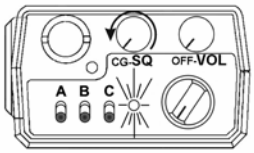
If the radio has been programmed for Busy Channel operation, it will operate in one of the following three Modes:

- Busy Channel Indication
- Busy Channel Lockout
- Busy Channel Lockout with Override

3.13.6.1 BUSY CHANNEL INDICATION



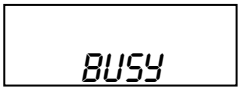
The yellow Busy Channel Indicator glows if there is carrier activity on the selected channel. If the selected channel is a Code Guard channel and the proper Code Guard value is not detected, the Busy Channel Indicator remains on for the duration of the carrier activity and no message is heard. During Scan and Priority Scan operation, the Busy Channel Indicator glows when activity is detected on any channel on the Scan List.



When scanning or priority scanning Code Guard channels with the Squelch knob in the Code Guard position and activity has been detected, the Busy Channel Indicator glows for the time period necessary to determine if the proper Code Guard value has been received. This will cause the Busy Channel Indicator to flash at various rates.

3.13.6.2 BUSY CHANNEL LOCKOUT

The Busy Channel Lockout feature applies only to those channels programmed with a receive Code Guard value. When carrier activity is detected on the channel selected, the radio checks the receive Code Guard value. If the proper Code Guard value is present, the radio can transmit on that channel, even if the Squelch knob is in the Code Guard position.



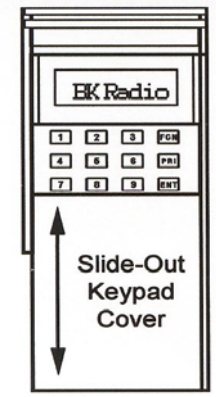
If the radio detects an incorrect value or carrier activity only, the transmitter is disabled. If an attempt is made to transmit, an alert tone will be generated and the display will show the word **BUSY** until the channel becomes available or the PTT switch is released, whether the Squelch knob is in or out of the Code Guard detent.

Channels not programmed with a receive Code Guard value can be used to transmit regardless of carrier activity.

3.13.6.3 BUSY CHANNEL LOCKOUT WITH OVERRIDE

This mode operates in the same manner as Busy Channel Lockout except that the user can override and transmit by turning the Squelch knob off the Code Guard detent. The transmitter is locked out only if the Squelch knob is set to the Code Guard detent.

3.14 ALPHANUMERIC DISPLAY



GPH-CMD radios may optionally have a slide-out keypad/display cover. To remove or install the cover, turn off the radio and remove the battery (see Battery Installation and Removal, section 2.1.2 of this manual).

Display annunciators indicate the following information:

ALPHANUMERIC	INDICATION
PR	-Priority Channel
PROG	-Programming Mode
TX	-Transmit
RX	-Receive
SCN	-Scan List Channel -Flashing SCN indicates scanning in progress, and RX SCN indicates receiving on a scanned channel.
ID	-*Programming Mode* - Automatic Numeric Identification (ANI)
CG	-*Programming Mode* – Code Guard
CMND	-Command Group Active

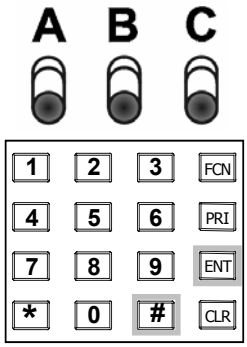
FIGURE 3-1 Liquid Crystal Display

GPH-CMD Series portable radios can be programmed with the following features:

3.14.1 DISPLAY BACKLIGHTING

The GPH-CMD radios can be programmed by your dealer to backlight the display when a signal is received or when a key is pressed. The time duration of the backlighting can also be programmed.

3.14.2 CHANNEL AND GROUP LABELS



The radio can be programmed with a label for each of the 25 channel groups and a label for each of the 20 channels within each group.

To display a group label, turn scanning functions off, then:

1. Press the **[#]** key on the keypad to display the group number.
2. Press and hold the **[#]** key to display the group label.
3. Press the **[ENT]** key or wait for about 5 seconds to revert to normal radio operation.

3.15 DEFINITIONS AND ACRONYMS

ANI	Automatic Numeric Identification
CG	Code Guard
CLR	Clear
Cloning	The process of copying data from one radio, called “master,” to other radios, called “slaves” or “clones.”
Code Guard	A sub-audible tone for selective calling and receiving.
Command Group	A group of up to 20 channels selected by the user from any of the 500 channels in the radio.
Detent	The click/hesitation you feel as you turn a knob from one position to another.
DTMF	Dual Tone Multiple Frequency
DTMF Tones	Tones that sound like those used by a standard push-button telephone.
ENT	Enter
FCN	Function
Individual Personality	The information programmed with a PC on both a global and by-channel basis that tells the radio exactly how to operate.
LCD	Liquid Crystal Display
PROG	Program
PRI	Priority
PTT	Push To Talk
RTA	Repeater Talk Around
RTX Channel	Ready to Transmit Channel
RX	Receive
SCN	Scan
SQ	Squelch
Squelch	A control that eliminates background noise.
Talkback Scan	When scanning, if a signal is present, the scan will stop and you will hear the signal. If you can then push the PTT switch to talk back to the person, you are in Talkback Scan Mode.
Time-Out Timer	A feature that limits the duration of calls.
TX	Transmit
UTXG	User Transmit Code Guard

SECTION IV
THEORY OF OPERATION

4.1 INTRODUCTION

This section contains the theory of operation for the BK Radio GPH-CMD radio. To help you understand the operation of the equipment, refer to the schematic diagrams in Section VI of this manual.

4.2 DESCRIPTION

The GPH-CMD radios are self-contained VHF FM Radios covering the frequency range of 136 MHz to 174MHz. The radios are multi-channel and digitally synthesized using a single crystal for frequency control. All models incorporate an EEPROM for the storage of Channel Frequency, Code Guard™, and Dual Tone Multiple Frequency/Automatic Numeric Identifier (DTMF/ANI) encode information. All models also include low-battery and busy-channel indicators. Toggle switches can be programmed to control Hi/Low Transmit Power, Channel Scan, Priority Scan, Repeater Talk-Around, and Group Scan. Status and channel information is displayed over a liquid crystal display Connectors are provided on the side of the unit for an external antenna, microphone, speaker, and other optional accessories. A variety of twist-off battery packs are also available.

4.3 THEORY OF OPERATION

Circuitry for the GPH-CMD Series radio comprises five major circuits:

- The RECEIVER, which consists of RF Preselectors, RF Preamplifier, Mixer, IF Filters, IF Amplifiers, FM IF IC, and Noise Squelch circuitry.

- The TRANSMITTER, which consists of a Power Amplifier, Harmonic Filter, Antenna Switch, and Power Control circuitry.

- The SYNTHESIZER, which consists of a Voltage Controlled Oscillator (VCO), VCO Buffer, Synthesizer Buffer, Synthesizer IC, Temperature Compensated Crystal Oscillator (TCXO) Reference, Loop Filter, VCO Coarse Tune Adaptive Filter, 3.0V and 4.5V Voltage Regulators.

- The SYSTEMS area, which consists of a Microprocessor, EEPROM, VCO Coarse Tune, Front End Tuning and Power Set, 3.3V Regulator, 5V Regulator, -15V Regulator, 7.0V Regulator and Low-Battery Shutdown, Receive Audio, Deviation Compensation and Squelch Adjustment.

- The DIGITAL SIGNAL PROCESSING (DSP) area, which consists of a Digital Signal Processor, Flash Memory, CODEC, TCXO, 1.5V and 3.3V Voltage Regulators.

4.3.1 RECEIVER

The Receiver is a dual-conversion design with intermediate frequencies of 16.9 MHz and 455 kHz. RF signals received at the antenna pass through the Antenna Switch and Front End. The Front End consists of an amplifier and two Microprocessor-tuned bandpass filters. The Front End amplifies the receive frequency and attenuates image, half IF, and other frequencies that degrade Receiver performance.

RF signals from the Front End enter a Mixer that converts them to 16.9 MHz. The 16.9 MHz IF signal passes through two crystal filters that provide adjacent channel selectivity. The IF amplifier then amplifies the signal and couples it to the 455 kHz IF integrated circuit. The 455 kHz IF IC consists of a Mixer, limiter, demodulator, and squelch circuit. The 16.9 MHz signal enters the Mixer and is converted to a 455 kHz IF signal. A ceramic filter at 455 kHz provides more adjacent channel selectivity. The signal is then amplified by the limiter and demodulated. Audio processing is then done on the options board. Filtered audio noise is used to provide a squelch indication.

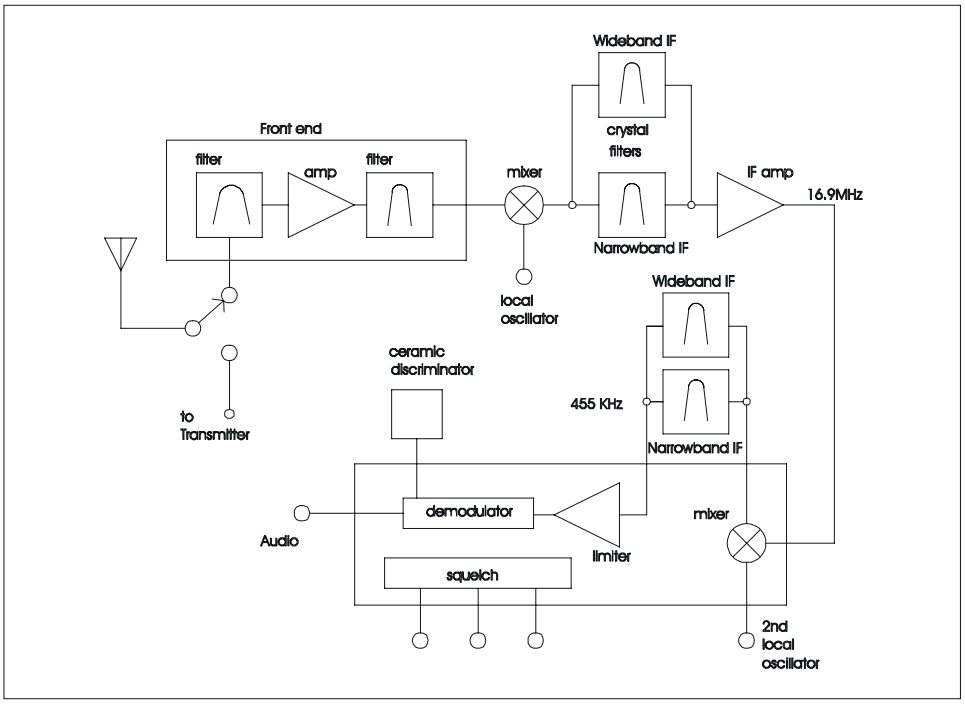


Figure 4-1 Receiver Block Diagram

A. RF Preselectors

The Preselectors provide greater than 75 dB of attenuation at the image frequency. Both bandpass filters are varactor tuned, which allows a wide frequency spread. Overall, the preselectors exhibit a bandwidth of 4.5 MHz. The preselectors consist of **L2**, **L3**, **L4**, **L5**, and associated circuitry.

B. RF Preamplifier

The RF Amplifier is a single-IC amplifier providing 22 dB of gain.

C. Mixer

The balanced diode Mixer converts the RF frequency to 16.9 MHz.

D. 1st IF Filters and IF Amplifier

The Crystal Filters are centered at 16.9 MHz and provide attenuation to frequencies adjacent to the receive frequency. There are two sets of 1st IF Filters - one for wideband (25/30 kHz) mode, and the other for narrowband (12.5/15 kHz) mode. The IF Amplifier provides 26 dB of gain at 16.9 MHz.

E. FM IF IC

The FM IF IC provides a second Mixer, a high-gain limiter, a demodulator, an OP-AMP, and a Schmitt trigger. The Mixer converts the 16.9 MHz signal to 455 kHz. The local oscillator for the Mixer consists of a 17.355 MHz crystal and associated circuitry. The 455 kHz signal is filtered by a ceramic filter. A limiter provides most of the gain for the Receiver. The FM signal is demodulated by the demodulator, the ceramic discriminator, and associated circuitry.

F. Noise Squelch

The demodulated audio is bandpass filtered with an active filter consisting of the internal OP-AMP of the FM IF IC and external circuitry. Squelch gain is controlled by the Microprocessor. The squelch noise is detected by the internal Schmitt trigger of the FM IF IC. The Microprocessor samples the Schmitt trigger output to determine signal level and squelch information.

4.3.2 TRANSMITTER

The Transmitter consists of four major blocks (see figure below):

A. Power Amplifier

B. Harmonic Filter

C. Antenna Switch

D. Power Control Circuit

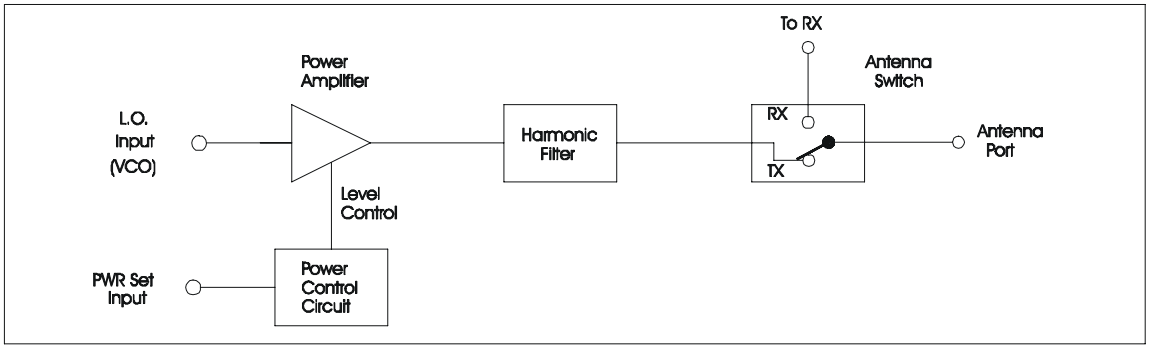


Figure 4-2 Transmitter Block Diagram

The Power Amplifier provides the necessary gain to amplify the VCO signal to a level of 5 Watts.

The Harmonic Filter is a seven-pole low-pass filter that provides rejection of the harmonics of the transmit frequency.

The Antenna Switch routes the RF signal from the Transmitter to the antenna port while in Transmit Mode. In Receive Mode, the antenna port is routed to the Receiver.

The Power Control circuit uses feedback to level the RF power from the Transmitter.

A. Power Amplifier

The Power Amplifier comprises two RF amplifier stages (see Figure 4-3 below). These are:

(1) Driver
(2) Integrated Power Module

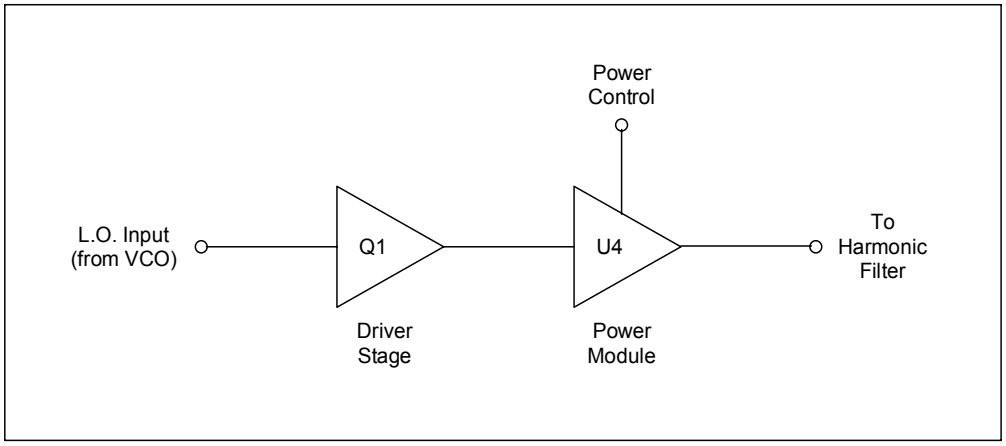


Figure 4-3 Power Amplifier Block Diagram

The Driver stage provides gain and isolation between the VCO and the Integrated Power Module.

The Integrated Power Module provides sufficient RF power to meet the radio's output power specification after losses in the Harmonic Filter and Antenna Switch. The DC current into the Integrated Power Module is monitored by the Power Control circuit.

B. Harmonic Filter

The Harmonic Filter attenuates the harmonics created by the Power Amplifier to meet or exceed the transmit spurious and harmonic specification. The passband input and output impedances of the filter are 50 Ohms.

C. Antenna Switch

The Antenna Switch connects either the Transmitter or Receiver to the antenna.

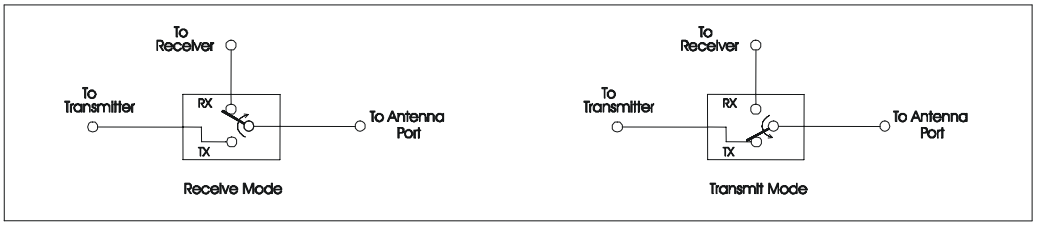


Figure 4-4 Antenna Switch Functional Block Diagram

In Transmit Mode, both pin diodes in the Antenna Switch are turned on, completing a signal path from the Transmitter and shunting the Receiver path to ground. In Receive Mode, both pin diodes are turned off, allowing RF signals to flow to the Receiver with the Transmitter output port removed from the circuit.

D. Power Control Circuit

The Power Control Circuit monitors the DC supply current to the Integrated Power Module. This current increases with RF output power and is kept constant by the Power Control circuit.

Current sensing is accomplished using a small resistance in the DC supply to the Integrated Power Module. The voltage developed across this resistance is fed to a bridge circuit and amplifier where it is compared to the "PWR SET" voltage. Any difference in the levels is amplified and used to control the bias current to the Integrated Power Module.

4.3.3 SYNTHESIZER

The Synthesizer generates an RF signal either to down-convert a desired receive frequency to a fixed IF or to drive the Transmitter. The synthesizer is essentially a phase-locked loop that locks the RF output of a Voltage Controlled Oscillator (VCO) to a very stable lower frequency reference. The DSP determines the frequency that the synthesizer produces by programming the dividers contained within the Synthesizer IC.

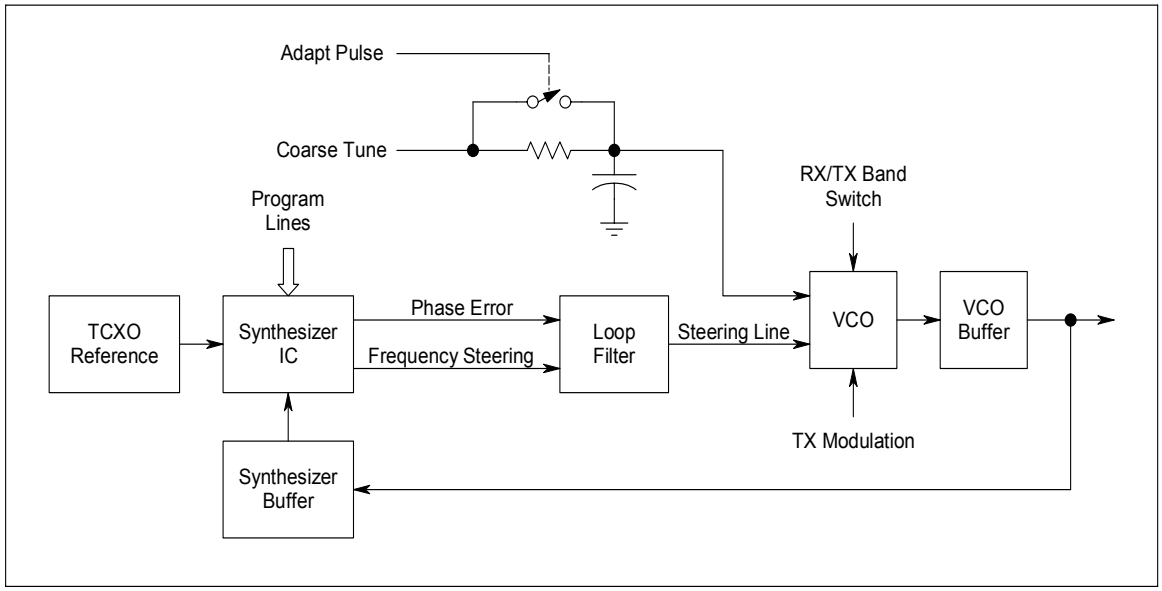


Figure 4-5 Synthesizer Block Diagram

A. Voltage Controlled Oscillator (VCO)

Transistor **Q4** provides the gain, and an L-C resonant tank circuit provides the frequency selectivity and phase shift necessary to produce an oscillator. Frequency control of the oscillator is accomplished by the tuning tank circuit comprised of mechanically adjustable transformer **T1** and varactors **CR4** and **CR5**. The cathode of **CR4,** connected to the Loop Filter, is used to lock the VCO to the desired carrier frequency. The anode of **CR4,** connected to the Coarse Tune Adaptive Filter, is used to pre-tune the VCO frequency within the lock range of the synthesizer. **CR5** is used in the Transmit Mode to modulate the carrier. The oscillator frequency range is 136-174 MHz in the Transmit Mode and 119.1-157.1 MHz in the Receive Mode (low side injection). The 16.9 MHz shift from receive to transmit is achieved by turning on PIN diode **CR3**, thus adding **L4** to the tank circuit. **Q5** and associated circuitry provide additional power supply filtering for the VCO. Diode **CR6** gives the filter a rapid power up response while maintaining a very low cutoff frequency.

B. VCO Buffer

The VCO Buffer is a cascode configuration with bipolar transistor **Q3** feeding common gate FET **Q21**. It isolates the VCO from the Receiver/Transmitter circuitry and provides enough power gain to supply a nominal level of +7 dBm in receive and +5 dBm in transmit.

C. Synthesizer Buffer

Synthesizer Buffer **Q2** provides isolation between the Synthesizer IC and Receiver/Transmitter circuitry and additional isolation between the Synthesizer IC and the VCO.

D. Synthesizer IC

Synthesizer chip **U6** contains a 5-bit integer reference divider and a main divider controlled by an 18-bit delta-sigma modulator. The delta-sigma fractional-N capability permits very fine frequency resolution while using a very high phase detector sample rate. The charge pump phase detector provides current pulses at the sample rate whose polarity and width are proportional to the phase error between the divided reference and the divided VCO. The phase detector gain is programmable and is adjusted across the operating frequency band to compensate for changes in VCO steering line sensitivity. A separate frequency steering output is available from **U6** that provides a low resistance connection to either the 4.5V supply or ground if a significant frequency error exists. In a locked condition, the frequency steering output is high impedance. **U6** also contains a direct digital modulation register that allows modulation signals within the bandwidth of the phase locked loop to be applied to the VCO by writing samples to the register.

E. TCXO Reference

The TCXO Reference, **Y1**, is a purchased module that provides ±2.5ppm stability over a temperature range extending from -30°C to +60°C. The direct digital modulation register within **U6** eliminates the need to pull the frequency of the Reference Oscillator in order to apply low frequency modulation to the VCO.

F. Loop Filter

The Loop Filter converts the phase detector current pulses into a filtered voltage that adjusts the VCO frequency in a direction to maintain phase and frequency lock between the divided reference and the divided VCO. The frequency steering output of **U6** is summed into the Loop Filter to reduce lock time when a significant change in VCO steering line voltage is required for a new programmed frequency.

G. VCO Coarse Tune Adaptive Filter

R26 and **C50** form a low cutoff frequency pole to filter out noise on the Coarse Tune line to the VCO. When changing to a new frequency that requires a different Coarse Tune voltage, switch **U11** is closed for a short time to allow the voltage on **C50** to change to the new value rapidly.

H. 3.0V Regulator

U12 provides a low noise regulated 3.0V supply that powers the TCXO Reference **Y1** and all sections of the synthesizer IC **U6** except the charge pump phase detector and frequency steering circuit.

I. 4.5V Regulator

U13 provides a low noise regulated 4.5V supply that powers the charge pump phase detector and frequency steering sections of the synthesizer IC **U6**.

4.3.4 SYSTEMS AREA

A variety of functions are included in the Systems area.

A 3.3V precision voltage regulator provides power to the Microprocessor and several other digital ICs in the radio. A 5.0V precision voltage regulator serves as the primary regulated analog supply in the radio. The 7.0V regulator is used to supply the VCO, VCO Buffer and Synthesizer Buffer. An output signal from the 7.0V regulator will alert the processor if the battery voltage falls too low for proper operation of this regulator. A -15V switching regulator generates the negative supply needed to produce the negative VCO Coarse Tune and Receiver Front End Tune/Transmitter Power Set signals.

Several special Transmitter features are implemented by the Microprocessor. These include Repeater Talk-Around, Busy Channel Lockout, DTMF Control, ANI Control, Sub-audible Code Guard Control, and Transmit Time-Out Timer.

Receive Mode special features provided by the Microprocessor include Channel Scan, Dual Priority Scan, Scan Hold Timer, and Battery Saver.

Other functions performed by the Microprocessor include: storing and retrieving hardware alignment and channel information, tuning the Receiver Front End, setting the Transmit power level, setting the squelch gain, interpreting the user switches, generating display information, and implementing remote and keypad programming modes.

A. Microprocessor

The Microprocessor **U1** receives inputs from user switches and controls radio functions such as adjusting the Transmitter deviation, tuning the Receiver, setting transmit power, time-out functions, etc.

B. EEPROM

The EEPROM **U7** stores channel information and hardware compensation values.

C. VCO Coarse Tune

D/A converter **U2** and amplifier **U10-A** allow the Microprocessor to set the VCO Coarse Tune voltage to any value within the range of 0V to -12V.

D. Front End Tuning and Power Set

D/A converter **U2** and amplifier **U10-B** allow the Microprocessor to set the Front End Tuning voltage in Receive Mode and the Power Set voltage in Transmit Mode to any value in the range of 0V to -15V.

E. 3.3V Regulator

U14 provides a regulated 3.3V supply for the Microprocessor and other digital circuitry in the radio.

F. 5V Regulator

U8 provides a regulated 5V supply for the Receiver and other analog circuitry in the radio.

G. 7.0V Regulator and Low-Battery Shutdown

A 7.0V Regulator is composed of **U3**, **Q10**, and associated circuitry. Regulator operation is monitored via **Q11**. The Microprocessor will shut down radio operation if a low-battery or 7.0V short circuit occurs. **Q1** is used to switch the regulator off during Battery-Saver Mode.

H. -15V Regulator

U5, **L8** and associated circuitry comprise a -15V switching regulator. **Q25** is used to switch the regulator off during Battery-Saver Mode.

I. Receive Audio

U9 is a 0.5 Watt Audio amplifier. Muting is controlled by the Microprocessor. The audio level out of **U9** is controlled by the analog potentiometer connected to the Volume Knob, **R51**.

J. Deviation Compensation

The transmit Deviation Compensation is accomplished by one of the two digital potentiometers in **U16**. At higher Transmitter frequencies, less voltage is needed for VCO modulation, so this circuit attenuates the signal. Also, when Code Guard tones are being transmitted, the deviation sensitivity is reduced so that overall deviation remains constant.

K. Squelch Adjustment

The second digital potentiometer in **U16** provides programmable attenuation between the discriminator audio output of the Receiver and the squelch threshold detection circuit of the Receiver. The Microprocessor reads the voltage on the wiper of the analog potentiometer connected to the Squelch Knob, **R85**, to determine the desired Squelch Level and programs **U16** so that the desired threshold level is achieved.

.

4.3.5 DIGITAL SIGNAL PROCESSING

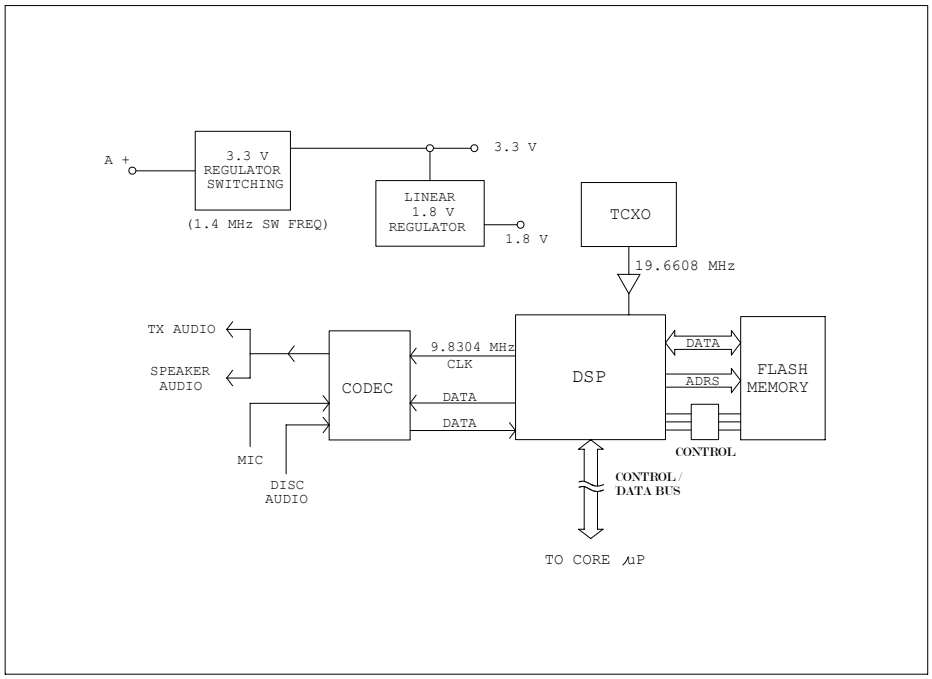


Figure 4-6 Digital Signal Processing Block Diagram

A. Digital Signal Processor

The Digital Signal Processor implements filters, tone generators, and other signal processing algorithms required for operation.

B. Flash Memory

The Flash Memory stores the Digital Signal Processor software.

C. CODEC

Converts analog signals to digital signals and vice versa.

D. TCXO

Provides a stable oscillator frequency for Digital Signal Processor.

E. Voltage Regulators

3.3 Volts is provided by a switching regulator. A linear regulator produces 1.5 Volts.

SECTION V
MAINTENANCE

5.1 INTRODUCTION

This maintenance section contains test and alignment procedures for an operational BK Radio GPH-CMD radio. This section also contains troubleshooting and assembly/disassembly procedures. An understanding of the theory of operation is recommended before maintenance is attempted. All LAA kits and programming items are available from BK Radio.

5.2 TEST EQUIPMENT REQUIRED

A. RF Signal Generator:	HP8640B or equivalent
B. Distortion Analyzer:	HP334A or equivalent
C. RF Voltmeter (optional):	Boonton 92C or equivalent
D. RF Power Meter:	HP435B with 30 dB pad or equivalent
E. Service Monitor:	HP8920A Service Monitor or equivalent
F. Digital Multimeter:	Fluke 8012A or equivalent
G. Computer	IBM PC or Compatible, with an RS-232 Serial Port
	LAA0725 Programming Cable
	LAA0746 GPH-CMD Programming Software
H. Portable Radio Tool Kit:	LAA0600
I. Test Cable Kit for E-Series Portable Radios:	LAA0608

5.3 OVERHAUL

5.3.1 ACCESSORIES

This section contains instructions to assist in determining, by inspection, the condition of GPH-CMD assemblies. Defects resulting from wear, physical damage, deterioration, or other causes can be found by these inspection procedures.

A. Capacitors, Fixed

Inspect capacitors for case damage, body damage, and cracked, broken or charred insulation. Check for loose, broken, or corroded terminal studs, lugs, or leads. Inspect for loose, broken, or improperly soldered connections. On surface mounted capacitors, be especially alert for hairline cracks in the body and broken terminations.

B. Capacitors, Variable

Inspect trimmers for chipped and cracked bodies, damaged dielectrics, and damaged contacts.

C. Chassis

Inspect the chassis for deformation, dents, punctures, badly worn surfaces, damaged connectors, damaged fastener devices, loose or missing hardware, component corrosion and damage to the finish.

D. Coils

Inspect all coils for broken leads, loose mountings, and loose, improperly soldered, or broken terminal connections. Check for crushed, scratched, cut, or charred windings. Inspect the windings, leads, terminals, and connections for corrosion or physical damage. Check for physical damage to forms and tuning slug adjustment screws.

E. Connectors

Inspect connectors for broken parts and other irregularities. Inspect for cracked or broken insulation and for contacts that are broken, deformed or out of alignment. Also check for corroded or damaged plating on contacts and for loose, improperly soldered, broken or corroded terminal connections.

F. Covers and Shields

Inspect covers and shields for punctures, deep dents, and badly worn surfaces. Also check for damaged fastener devices, corrosion, and damage to finish.

G. Flex Circuits

Inspect flex circuits for punctures and badly worn surfaces. Check for broken traces, especially near the solder contact points.

H. Fuse

Inspect for blown fuse and check for loose solder joints.

I. Insulators

Inspect insulators for evidence of damage, such as broken or chipped edges, burned areas and presence of foreign matter.

J. Jacks

Inspect all jacks for corrosion, rust, deformations, loose or broken parts, cracked insulation, bad contacts, or other irregularities.

K. Potentiometers

Inspect all potentiometers for evidence of damage or loose terminals, cracked insulation, or other irregularities.

L. Resistors, Fixed

Inspect the fixed resistors for cracked, broken, blistered, or charred bodies, and loose, broken, or improperly soldered connections. On surface mount resistors, be especially alert for hairline cracks in the body and broken terminations.

M. Terminal Connections Soldered

1. Inspect for cold-soldered or resin joints. These joints present a porous or dull, rough appearance. Check for strength of bond using the points of a tool.

2. Examine the terminals for excess solder, protrusions from the joint, pieces adhering to adjacent insulation, and particles lodged between joints, conductors, or other components.

3. Inspect for insufficient solder and unsoldered strands of wire protruding from conductor at the terminal. Check for insulation that is stripped back too far from the terminal.

4. Inspect for corrosion at the terminal.

N. Wiring/Coaxial Cable

Inspect wiring in chassis for breaks in insulation, conductor breaks, cut or broken lacing, and improper dress in relation to adjacent wiring or chassis.

5.3.2 CLEANING

A. Using a clean, lint-free cloth, lightly moistened with soap and water only, and remove the foreign matter from the equipment case and unit front panel. Wipe dry using a clean, dry, lint-free cloth.

B. Using a hand controlled dry-air jet (not more than 15 psi), blow the dust from inaccessible areas. Care should be taken to prevent damage by the air blast.

C. Clean the receptacles and plugs with a hand-controlled dry-air jet (not more than 25 psi), and a clean, lint-free cloth lightly moistened with soap and water only. Wipe dry with a clean, dry, lint-free cloth.

5.3.3 REPAIR

This section describes the procedure along with any special techniques for replacing damaged or defective components.

A. Connectors

When replacing a connector, refer to the appropriate PC board assembly drawing and follow the notes to ensure correct mounting and mating of each connector.

B. Crystal

The use of any other than a BK Radio crystal is considered an unauthorized modification.

C. Diodes

Use caution when soldering since excessive heat can damage the diode. Note the diode polarity before removal.

D. Integrated Circuits

Refer to Appendix A for mounting and soldering instructions.

E. Wiring/Coaxial Cable

When repairing a wire that has broken from its terminal, remove all old solder and pieces of wire from the terminal, restrip the wire to the necessary length, and resolder the wire to the terminal. Replace a damaged wire or coax with one of the same type, size, and length.

5.4 DISASSEMBLY/ASSEMBLY

5.4.1 BATTERY REMOVAL

To remove the battery pack, turn the radio off. Press up the metal tab on the side of the case while turning the pack approximately 30°. Remove the pack from the radio.

5.4.2 UNIT DISASSEMBLY

A. Covers

1. Remove the four screws from the radio rear cover (the side opposite the speaker grill).

2. Remove the two screws holding the heat sink shield to the rear cover, and remove the heat sink shield.

3. Loosen the PTT housing screw and separate the front cover from the main frame.

B. Options Board and Keyboard

1. Disconnect the zero insertion force connector J10 from the Options board by sliding the connector sleeve toward the top of the radio. This allows the flex cable to be unplugged.

2. Remove the five screws that secure the Options board to the keyboard and the front cover, and unplug the keyboard.

C. RX/TX Board

1. Unfasten the three retaining clip screws that secure the RX/TX board to the main frame.

2. Carefully remove the antenna coax from the RX/TX connector.

3. Lift up on the RX/TX board until it is disconnected from the Systems board.

D. Synthesizer and VCO

Remove the screw and unsolder the five tabs that secure the Synthesizer shield to the Systems board. Remove the shield halves from both sides of the Systems board.

E. Top Plate and Switch Board

1. Remove the channel select, volume, and the squelch knobs.

2. Remove the retaining fasteners from the channel select switch, volume control, and the squelch control.

3. Remove the bezel and inlay, retaining the channel select stop pins (if used).

4. Unfasten the four screws that secure the top frame assembly to the main frame (the screws are located on the side of the frame, two screws beside the channel select switch and two screws below the PTT housing).

5. Unsolder the audio jack wire from Systems board location **E13**.

5.4.3 ASSEMBLY

To assemble the unit, complete the disassembly procedure in reverse order.

5.5 ALIGNMENT PROCEDURES

The GPH-CMD radio uses manual alignment for receiver front end tuning, receiver IF alignment and VCO adjustment. Electronic tuning is provided for all other adjustments. You will need the GPH-CMD Editor Software and programming cable, available from BK Radio. Refer to the GPH-CMD Editor Help file for more complete details on using the program.

5.5.1 TEST SETUP

Mount the radio in a suitable fixture containing an adapter for supplying 10 VDC from a negative ground power supply. Turn off any radio features assigned to the keypad function menu and set the manual controls as follows:

Channel Selector:	Channel 1
Channel Group:	Group 1
On/Off Volume:	On, volume minimum
Monitor / Squelch	Unsquelched, fully clockwise
Radio Top Switches	Off (Toward front of radio)

Refer to Figures 5-1 and 5-3 for Transmitter and Receiver Test Setup. These figures show the interface between test equipment and the radio. See Figures 5-2 and 5-4 for location of the various adjustment components.

5.5.2 ALIGNMENT ORDER

When more than one adjustment is necessary, follow the order listed:

A. VCO Adjustment

B. Transmit Power

C. Reference Oscillator Frequency

D. VCO Modulation Sensitivity

E. Receiver IF Alignment

F. Receiver Front End Tuning

G. Receiver Front End Slope

H. Squelch

A. VCO Adjustment

The frequency range of the VCO must be tuned. If components in the VCO are replaced this adjustment may be necessary.

As the inductance value of the VCO resonator is manually tuned, the synthesizer U12 (Systems board) changes the voltage applied to varactor CR4 (Systems board) to maintain the programmed frequency.

Connect a suitable 50Ω RF load to the antenna output of the radio.

Follow the instructions for VCO Tuning Voltage Adjustment in the GPH-CMD Editor Software. This will allow you to adjust the Tuning voltage through an interactive, partially automated process.

B. Transmit Power

The high and low transmit power settings control the RF output of the transmitter. If components on the RT board are replaced this adjustment may be necessary.

Microprocessor U1 (Systems board) sets the transmitter power control voltage using DA converter U2 (Systems board). High and low power settings are stored in non-volatile memory.

Connect a suitable 50Ω power meter to the antenna output of the radio.

Follow the instructions for Transmit Power Adjustment in the GPH-CMD Editor Software. Check the power at low (136 MHz), mid (155 MHz), and high (174 MHz) frequencies. If any high power reading is below 5 Watts, readjust to obtain 5 Watts. If any low power reading is below 2 Watts, readjust to obtain 2 Watts.

C. Reference Oscillator Frequency

The GPH-CMD radio's transmit and receive frequencies are derived from the Reference oscillator. The Reference oscillator may require adjustment due to crystal aging or if components in the Reference oscillator circuit are replaced.

Compensation for error in the Reference oscillator is provided by a divide value in the synthesizer. The final setting is stored in non-volatile memory.

Connect a suitable attenuator and frequency counter to the antenna output of the radio. The attenuator must be capable of handling the full power output of the radio and protecting the input of the frequency counter. A 30 dB attenuator capable of 10 Watts is recommended.

Follow the instructions for TX Frequency in the GPH-CMD Editor Software.

D. VCO Modulation Sensitivity

This adjustment controls the maximum analog and digital mode FM deviation of the transmitter. If components in the VCO or Transmit Audio amplifier or filter are changed this adjustment may be necessary to maintain an FM deviation below 5 kHz (2.5 kHz for narrowband or digital mode).

The level of the Transmit Modulation is controlled using a digital potentiometer U18 (Systems board).

Connect a suitable attenuator and service monitor to the antenna output of the radio. Follow the instructions for TX Modulation in the GPH-CMD Editor Software.

E. Receiver IF Alignment

Coupling transformers in the IF section are manually tuned to optimize receiver distortion. If components in the mixer or IF circuitry are replaced this adjustment may be necessary to maintain specified receiver distortion.

As the transformers are manually tuned, the IF filter passband shape is affected.

To perform the adjustment:

1. Program 136 MHz receive frequency, wideband (25/30 kHz) mode. Turn the monitor/squelch control fully clockwise. Adjust the volume control to mid range.

2. Connect an RF signal generator tuned to 136 MHz to the antenna jack of the radio. Modulate the generator with a 1 kHz tone at 3 kHz deviation. Set the output RF level to 1 mVrms.

3. Connect a distortion analyzer to the radio speaker output.

4. Adjust T2 and T3 for the lowest audio distortion. Preset the cores to the top of the coil before making the adjustment. When adjusted for the lowest distortion, the top of the core should be in the upper half of the coil to prevent coil breakage.

F. Receiver Front End Tuning

Bandpass filters in the receiver front end are manually tuned to optimize reception at 136 MHz. If components in the bandpass filters, RF amplifier, or mixer are replaced this adjustment may be necessary to maintain specified RF sensitivity.

As the inductors of the bandpass filters are manually tuned, the passband is aligned with the incoming RF carrier, optimizing sensitivity.

To perform the adjustment:

1. Program 136 MHz receive frequency, wideband (25/30 kHz) mode. Turn the monitor/squelch control fully clockwise. Adjust the volume control to mid range.

2. Connect an RF signal generator tuned to 136 MHz to the antenna jack of the radio. Modulate the generator with a 1 kHz tone at 3 kHz deviation.

3. Connect a distortion analyzer to the radio speaker output.

4. Adjust the RF signal generator level to obtain a SINAD reading between 6 and 12 dB on the distortion analyzer.

5. Adjust L2, L3, L4, and L5 alternately to obtain the best SINAD reading. If necessary reduce the signal generator level to maintain a SINAD reading between 6 and 12 dB.

G. Receiver Front End Slope

Bandpass filters in the receiver front end are electronically tuned to optimize reception above 136 MHz. The tuning is customized using the receiver front end slope adjustment. If components in the bandpass filters, RF amplifier, or mixer are replaced this adjustment may be necessary to maintain specified RF sensitivity.

Four varactors are used in the receiver front end bandpass filters. The control voltage for these varactors changes to accommodate different receiver frequencies. The proper value is determined by microprocessor U1 (Systems board) using data stored in non-volatile memory. The voltage from DA converter U2 (Systems board) is amplified and applied to the varactors.

To perform the adjustment:

1. Program 174 MHz receive frequency, wideband (25/30 kHz) mode. Turn the monitor/squelch control fully clockwise. Adjust the volume control to mid range.

2. Connect an RF signal generator tuned to 174 MHz to the antenna jack of the radio. Modulate the generator with a 1 kHz tone at 3 kHz deviation.

3. Connect a distortion analyzer to the radio speaker output.

4. Adjust the RF signal generator level to obtain a SINAD reading between 6 and 12 dB on the distortion analyzer.

5. Follow the instructions for Receiver Front End in the GPH-CMD Editor Software. If necessary reduce the signal generator level to maintain a SINAD reading between 6 and 12 dB.

H. Squelch

1. Squelch adjustment is a semi-automated process that must be performed in both wideband and narrowband. The squelch adjustment is controlled using a digital potentiometer U18 (Systems board).

2. Wideband Mode

   With preset squelch (monitor/squelch control fully counterclockwise) the GPH-CMD audio should turn on at approximately 8 dB SINAD. If components in the IF filter or squelch filter are replaced, adjustment of the squelch may be necessary.

   To perform the adjustment:

   a) Program a receive frequency with no Code Guard, wideband (25/30 kHz) analog mode. Turn the monitor/squelch control fully clockwise. Adjust the volume control to mid range.

   b) Connect an RF signal generator tuned to the programmed receive frequency to the antenna jack of the radio. Modulate the generator with a 1 kHz tone at 3 kHz deviation.

   c) Connect a distortion analyzer to the radio speaker output.

   d) Adjust the RF signal generator level to obtain an 8 dB SINAD reading on the distortion analyzer.

   e) Follow the instructions for Receiver Front End in the GPH-CMD Editor Software.

3. Narrowband Mode

   This adjustment should always follow the wideband adjustment.

   To perform the adjustment:

   a) Program a receive frequency with no Code Guard, narrowband (12.5 kHz) analog mode. Turn the monitor/squelch control fully clockwise. Adjust the volume control to mid range.

   b) Connect an RF signal generator tuned to the programmed receive frequency to the antenna jack of the radio. Modulate the generator with a 1 kHz tone at 1.5 kHz deviation.

   c) Connect a distortion analyzer to the radio speaker output.

   d) Adjust the RF signal generator level to obtain an 8 dB SINAD reading on the distortion analyzer.

   e) Follow the instructions for Receiver Front End in the GPH-CMD Editor Software.

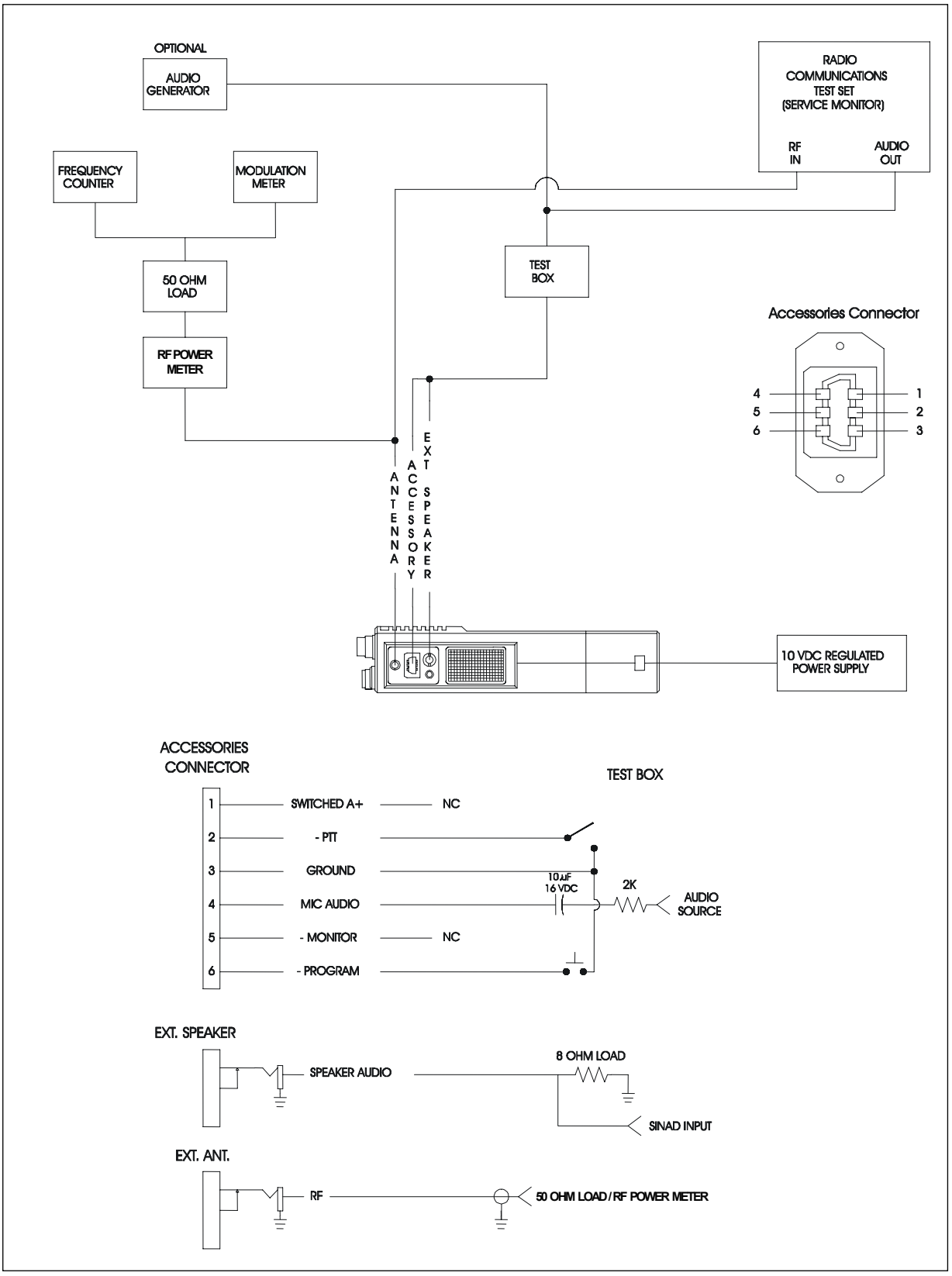


Figure 5-1 Transmitter Test Setup

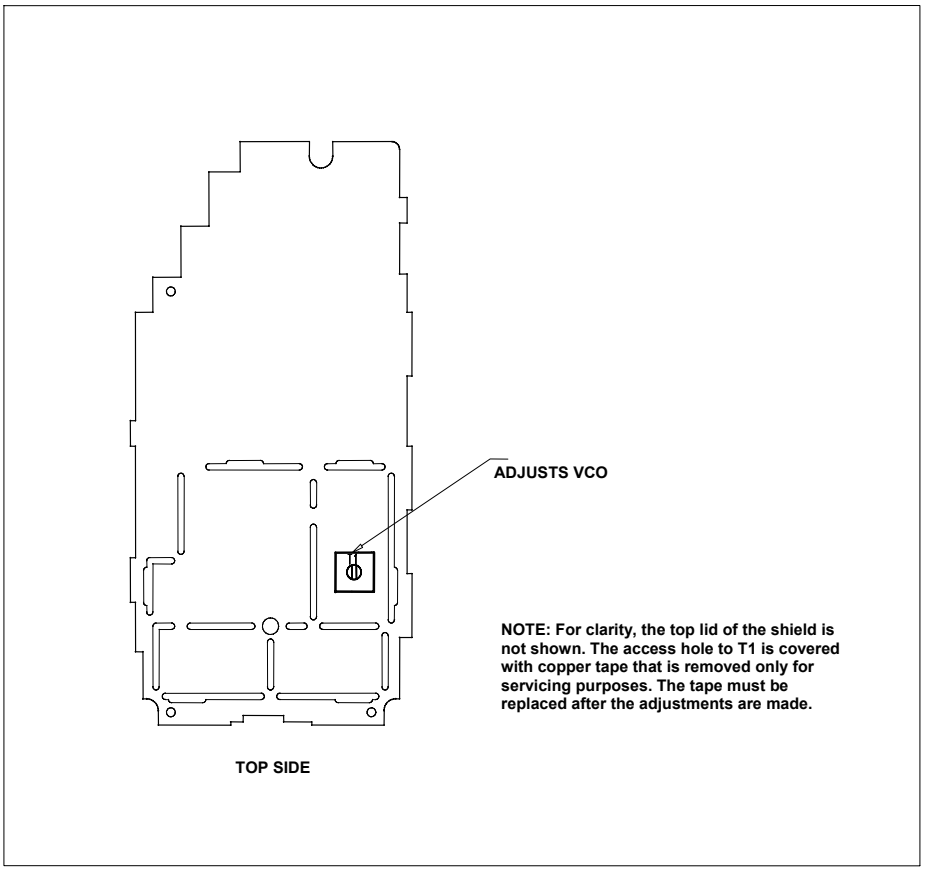


Figure 5-2 Systems Board Adjustments

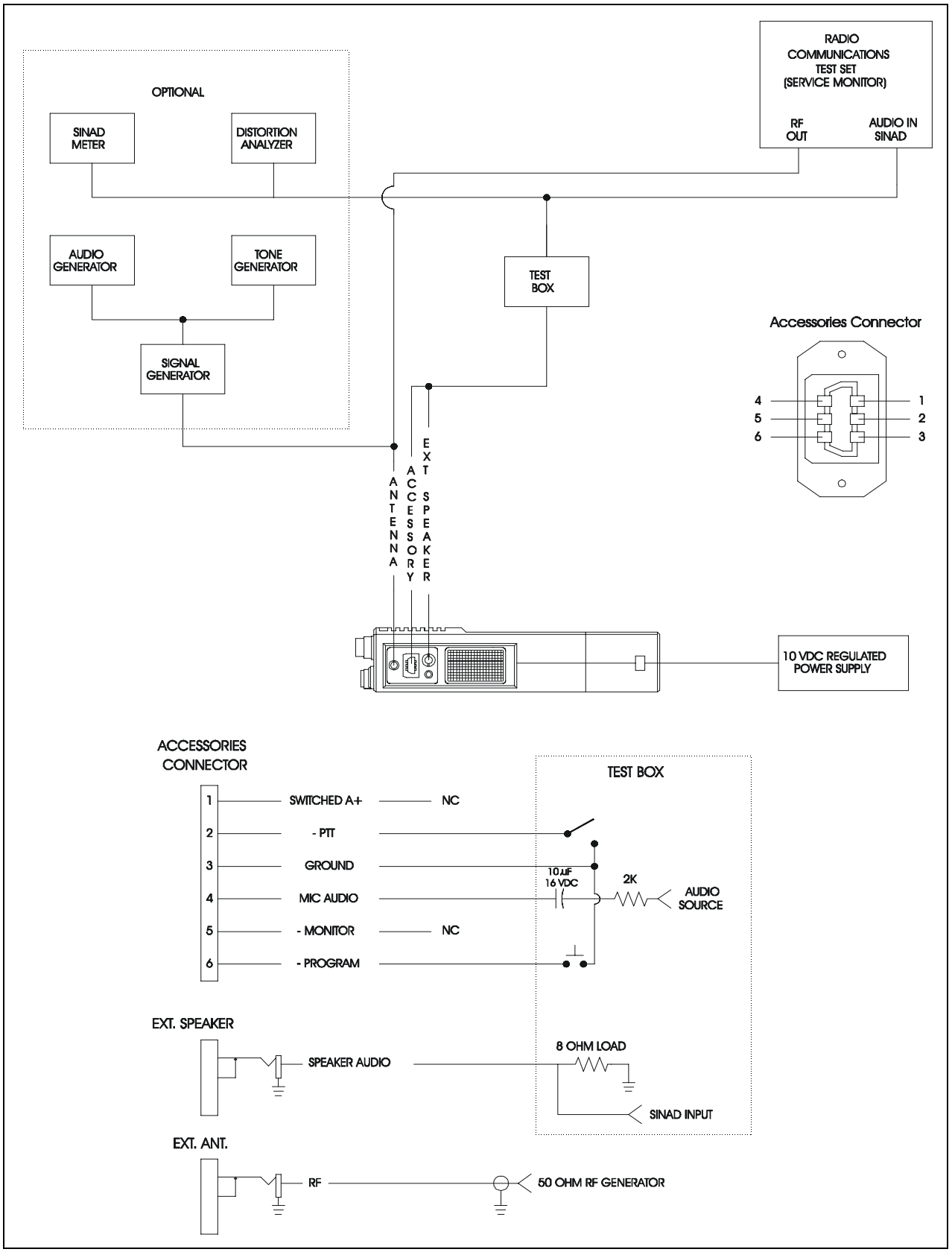


Figure 5-3 Receiver Test Setup

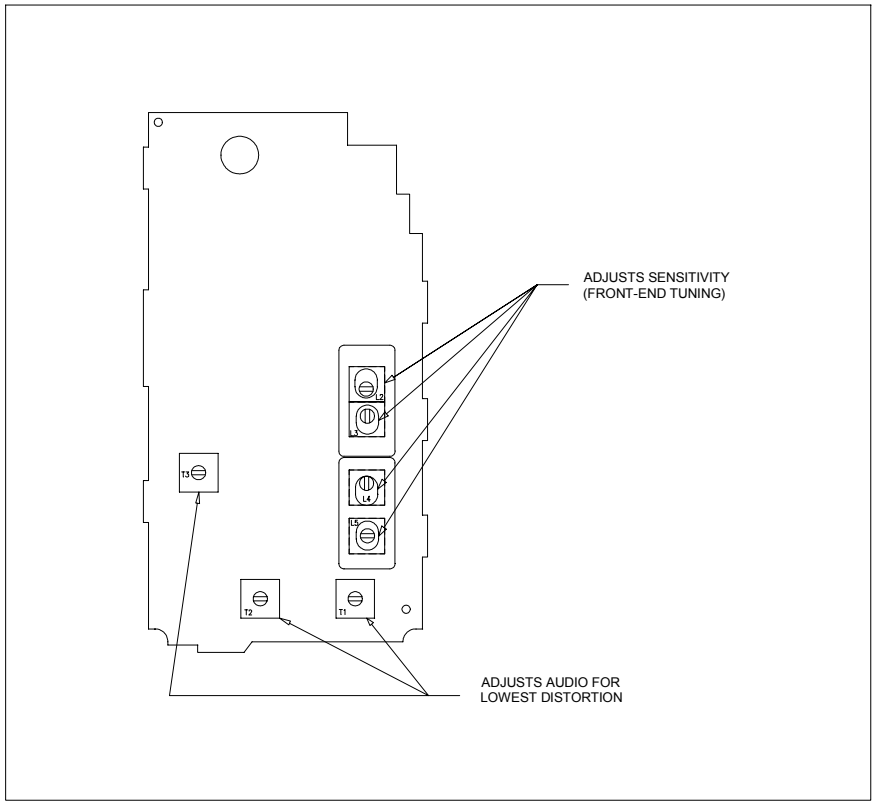


Figure 5-4 RX/TX Board Adjustments

5.6 TROUBLESHOOTING

Radio Will Not Transmit Red LED Does Not Light	-Invalid TX frequency programmed -Weak battery -VCO TX bandshift circuit failing -Open PTT path -Broken PTT switch
Radio Will Not Turn On	-Exhausted battery -Open fuse -Broken ON/OFF switch -Failing 5-volt regulator -Improper information in EEPROM
Radio Will Not Unmute	-Invalid RX frequency programmed -Internal squelch trimmer adjusted improperly -CAR PRES signal to microprocessor shorted or open -Audio amplifier failing -DISC AUDIO path open or shorted -RX AUDIO path open or shorted
Transmit Power Below Specification	-Software power adjustment incorrect -RF side connector jack failing -Harmonic filter failing -Power amplifier failing -Power control circuit failing -Antenna switch failing -VCO buffer failing
Code Guard Signal Not Being Transmitted	-No Code Guard signal programmed on transmit channel
Poor Battery Life	-Weak or defective battery -Transmitter power adjusted too high -Audio amplifier not switching off
Radio Unmutes With No Carrier Present When In Preset Condition	-Internal squelch trimmer adjusted improperly -Open or shorted CAR PRES signal
Sensitivity Does Not Meet Specification	-Front-end filters misaligned or failing -Software front-end tuning adjusted improperly -RF preamplifier failing -IF filter or amplifier failing -VCO buffer failing
Receiver Distortion Out Of Specification	-IF transformers mistuned -Audio amplifier failing
Low or No Transmitter Audio Modulation	-Transmit Analog or Digital Deviation misadjusted -Microphone failing -VCO modulation circuit failing

5.6 TROUBLESHOOTING (cont.)

Transmitter Audio Modulation Is Too High	-Transmit Analog or Digital Deviation misadjusted -VCO modulation circuit failing
Audio Output Power Does Not Meet Specification	-Audio power amplifier failing -FM demodulator IC failing
Radio Always Gives Low Battery Indication ("**LOBATT**" Message Displayed)	-Failing or shorted 8.2 volt regulator
Radio Will Not Function Properly At Band Edges	-VCO tuning voltage (**T1**) misadjusted -Shorted or open HI BAND signal to synthesizer loop amplifier
Transmitter Frequency Out Of ±2.5 PPM Specification	-XTAL frequency misadjusted -Failing temperature compensation circuit on Systems board -Failing XTAL
Audio Opening Without Receiving The Programmed Code Guard	-Monitor switch failing -Monitor switch buffer (Q8 on Systems board) failing
Insufficient Transmit Range	-Improper or defective antenna -Open antenna jack -Failing antenna match circuit
ANI or DTMF Tones Not Being Transmitted	-Radio not programmed for ANI or DTMF
Transmitted Digital Code Guard Will Not Unsquelch Other Radios	-DCG not programmed or not set for proper polarity
Will Not Enter Keyboard Programming Mode	-Improper password being entered -Open or shorted -PROGRAM signal

SECTION VI
ILLUSTRATED PARTS LIST

6.1 INTRODUCTION

This section helps you identify parts used in BK Radio's GPH-CMD radios. It includes Replacement Parts Lists for all major assemblies arranged from the Final Assembly down to an individual part level. Each List is followed by the corresponding Assembly Drawing (if required), Schematic Diagram and Parts Placement.

Parts itemized in the various lists meet BK Radio's design specifications and are the recommended replacement parts.

6.2 PARTS LIST DESCRIPTION

Replacement Parts Lists contain specific information on each part in the corresponding Assembly Drawing and Schematic Diagram. Sub-assemblies are also listed by a part number, helping you find the correct sub-assembly parts. Each part and Sub-assembly has a 12-digit number that is unique. Parts are usually identified by their schematic reference number or, in the case of an assembly, their item number.

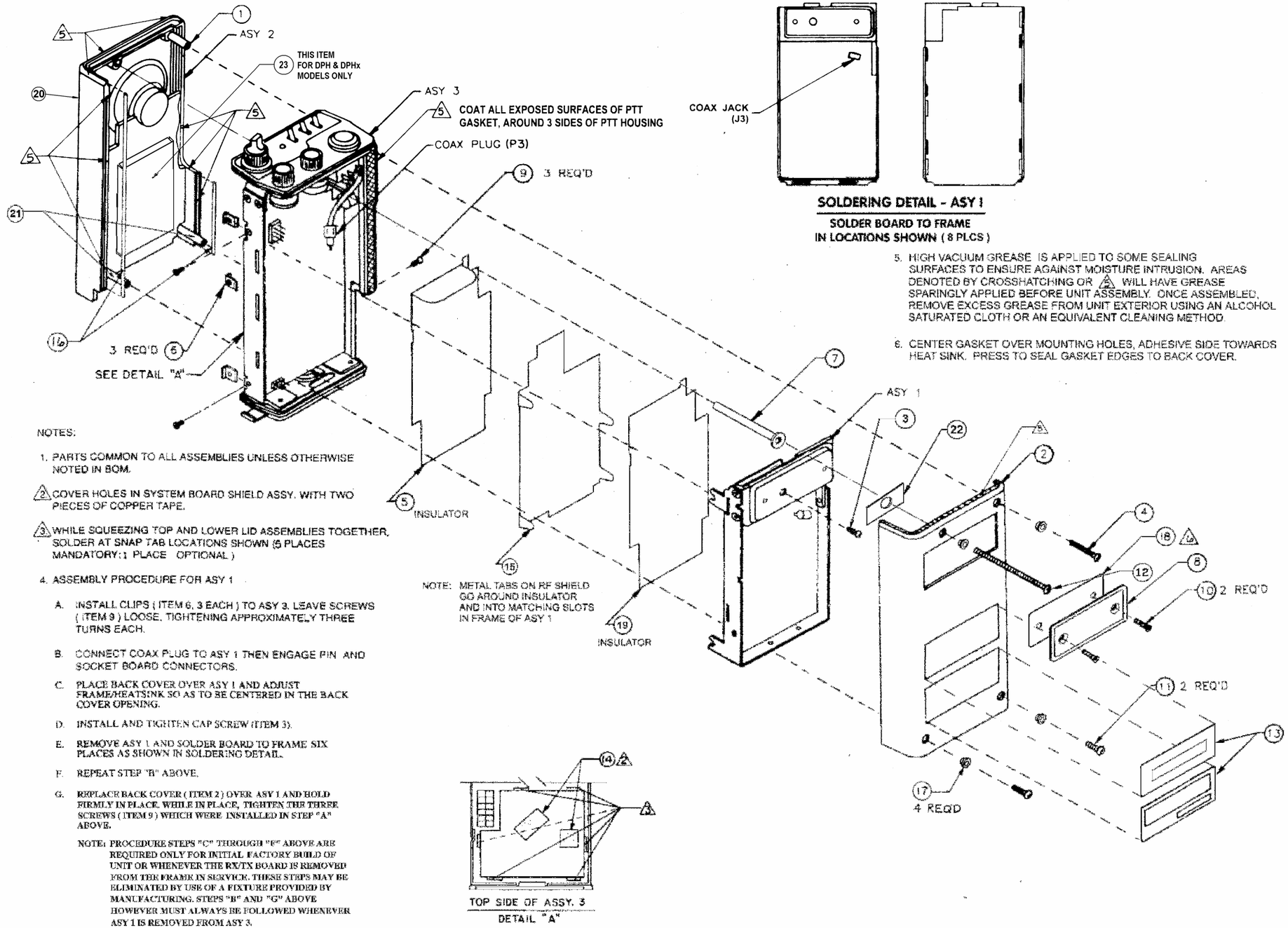
6.3 ASSEMBLY DRAWING SYMBOLS

Several symbols are used in the Assembly Drawings. One symbol helps to identify parts (or items) that are listed in the Drawing's corresponding Parts List. Another symbol references a specific Note that is on the Drawing. The symbols are (with examples):

	—	refers to Item 32 in the Replacement Parts Lists
ITM 32	—	also refers to Item 32 in the Replacement Parts Lists
	—	refers to Drawing's Note No. 6
L1	—	refers to Part L1 (also its Schematic Reference No.)
J14	—	refers to Part J14 (also its Schematic Reference No.)
2REQ'D	—	Indicates two of the Items are required in the Assembly

Table 6-1. Replacement Parts, Final Assembly

Item Reference Number	Part Number	Description
ITM 1	2813-20027-700	Standoff, .550
ITM 2	1411-60701-312	Back Cover, Metalized, 5W, Black
ITM 3	2803-30668-136	Scr, MS, 4-40, x 5/32, H, BHC,SS
ITM 4	2820-30603-018	Scr, MS, M2.5X.45X23, T1CR,PH, SS, BLKOX
ITM 5	3106-20036-000	Insulator, Sys-BD
ITM 6	2830-20028-401	Clip, 2-56, Tin, Plate
ITM 7	2800-20026-900	Standoff, .113ID
ITM 8	1411-40004-800	Plate,Mold,W/C'SINK HOLES,EP/GP_Portable
ITM 9	2801-30714-510	Scr, MS, 2-56X 3/16, T1CR, FH100, SS. PS
ITM 10	2820-20031-405	Screw, M2.5X5.0, FHP
ITM 11	2820-30603-017	Scr, MS, M2.5X.45X8, T1CR, PH, SS, BLKOX
ITM 12	2820-30603-019	Scr,MS, M2.5X.45X35, T1CR, PH, SS, BLKOX
ITM 13	2507-30923-801	Label,1.89"x0.79",Brady,B428,Mtl_Poly
ITM 14	1601-20033-303	Tape, Copper
ITM 15	2508-30904-302	Shield, w/ Finish, Modified
ITM 16	2512-20033-900	Gasket, Teflon, Cord
ITM 17	2844-20035-201	Washer, Shoulder
ITM 18	2512-20034-000	Gasket, Heatsink
ITM 19	3110-30904-401	Insulator, Rx/Tx Board, GPH
ITM 20	1411-60701-203	Cover,Front,MH,Blk
ITM 21	2813-20027-702	Standoff, 1.105"
ITM 22	3110-20034-300	Insulator, Mylar (Metal Case)
ITM 23	2508-30945-600	SHIELD,OPTION BOARD



SOLDERING DETAIL - ASY 1

SOLDER BOARD TO FRAME IN LOCATIONS SHOWN (8 PLCS)

NOTES:

1. PARTS COMMON TO ALL ASSEMBLIES UNLESS OTHERWISE NOTED IN BOM.

2. COVER HOLES IN SYSTEM BOARD SHIELD ASSY. WITH TWO PIECES OF COPPER TAPE.

3. WHILE SQUEEZING TOP AND LOWER LID ASSEMBLIES TOGETHER, SOLDER AT SNAP TAB LOCATIONS SHOWN (6 PLACES MANDATORY; 1 PLACE OPTIONAL)

4. ASSEMBLY PROCEDURE FOR ASY 1

   A. INSTALL CLIPS (ITEM 6, 3 EACH) TO ASY 3. LEAVE SCREWS (ITEM 9) LOOSE. TIGHTENING APPROXIMATELY THREE TURNS EACH.

   B. CONNECT COAX PLUG TO ASY 1 THEN ENGAGE PIN AND SOCKET BOARD CONNECTORS.

   C. PLACE BACK COVER OVER ASY 1 AND ADJUST FRAME/HEATSINK SO AS TO BE CENTERED IN THE BACK COVER OPENING.

   D. INSTALL AND TIGHTEN CAP SCREW (ITEM 3).

   E. REMOVE ASY 1 AND SOLDER BOARD TO FRAME SIX PLACES AS SHOWN IN SOLDERING DETAIL.

   F. REPEAT STEP "B" ABOVE.

   G. REPLACE BACK COVER (ITEM 2) OVER ASY 1 AND HOLD FIRMLY IN PLACE. WHILE IN PLACE, TIGHTEN THE THREE SCREWS (ITEM 9) WHICH WERE INSTALLED IN STEP "A" ABOVE.

   NOTE: PROCEDURE STEPS "C" THROUGH "F" ABOVE ARE REQUIRED ONLY FOR INITIAL FACTORY BUILD OF UNIT OR WHENEVER THE RX/TX BOARD IS REMOVED FROM THE FRAME IN SERVICE. THESE STEPS MAY BE ELIMINATED BY USE OF A FIXTURE PROVIDED BY MANUFACTURING. STEPS "B" AND "G" ABOVE HOWEVER MUST ALWAYS BE FOLLOWED WHENEVER ASY 1 IS REMOVED FROM ASY 3.

   PROCEDURE STEPS "C" THROUGH "F" ARE REQUIRED FOR 5W UNITS ONLY.

5. HIGH VACUUM GREASE IS APPLIED TO SOME SEALING SURFACES TO ENSURE AGAINST MOISTURE INTRUSION. AREAS DENOTED BY CROSSHATCHING OR ⚠5 WILL HAVE GREASE SPARINGLY APPLIED BEFORE UNIT ASSEMBLY. ONCE ASSEMBLED, REMOVE EXCESS GREASE FROM UNIT EXTERIOR USING AN ALCOHOL SATURATED CLOTH OR AN EQUIVALENT CLEANING METHOD.

6. CENTER GASKET OVER MOUNTING HOLES, ADHESIVE SIDE TOWARDS HEAT SINK. PRESS TO SEAL GASKET EDGES TO BACK COVER.

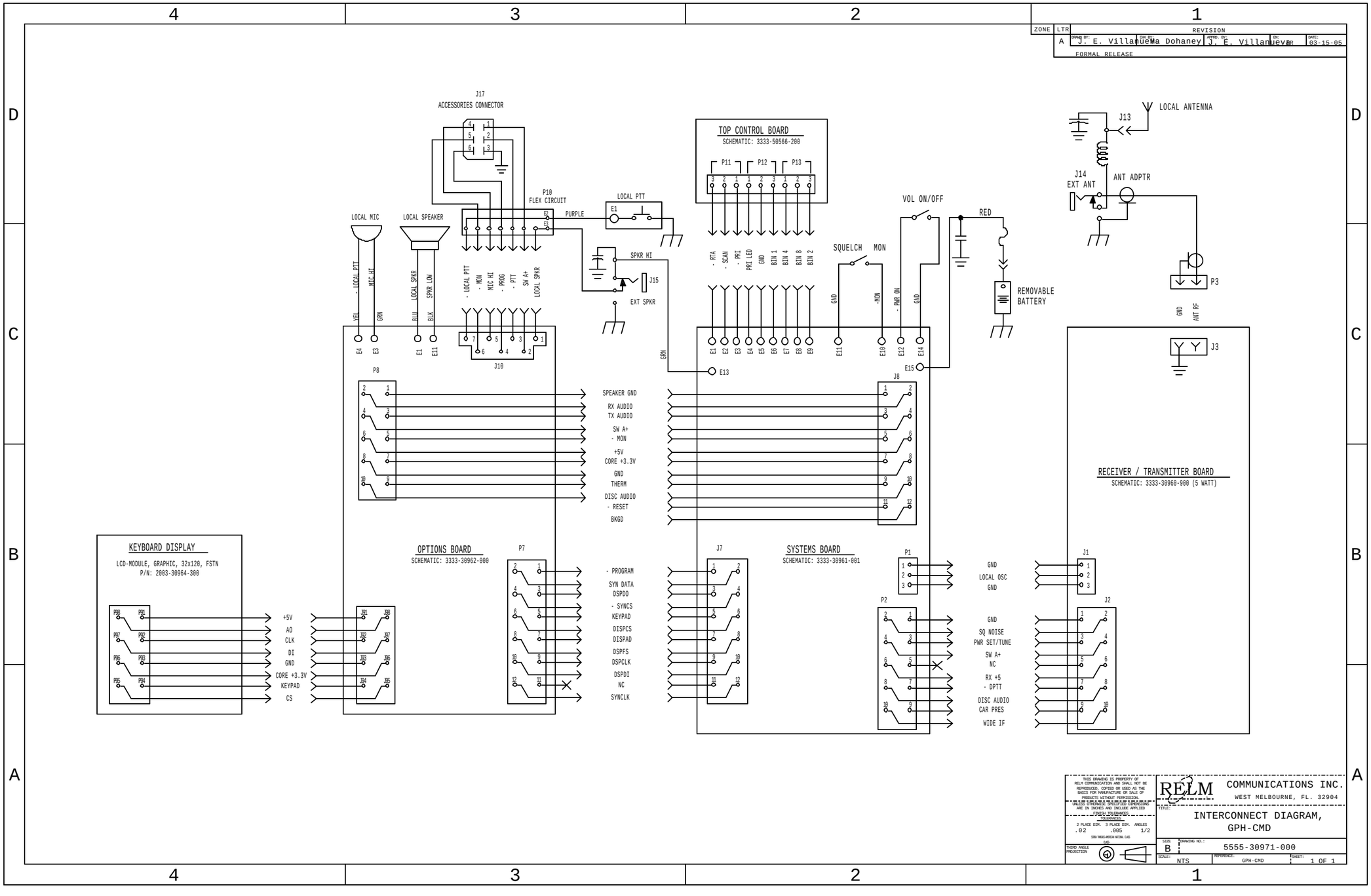
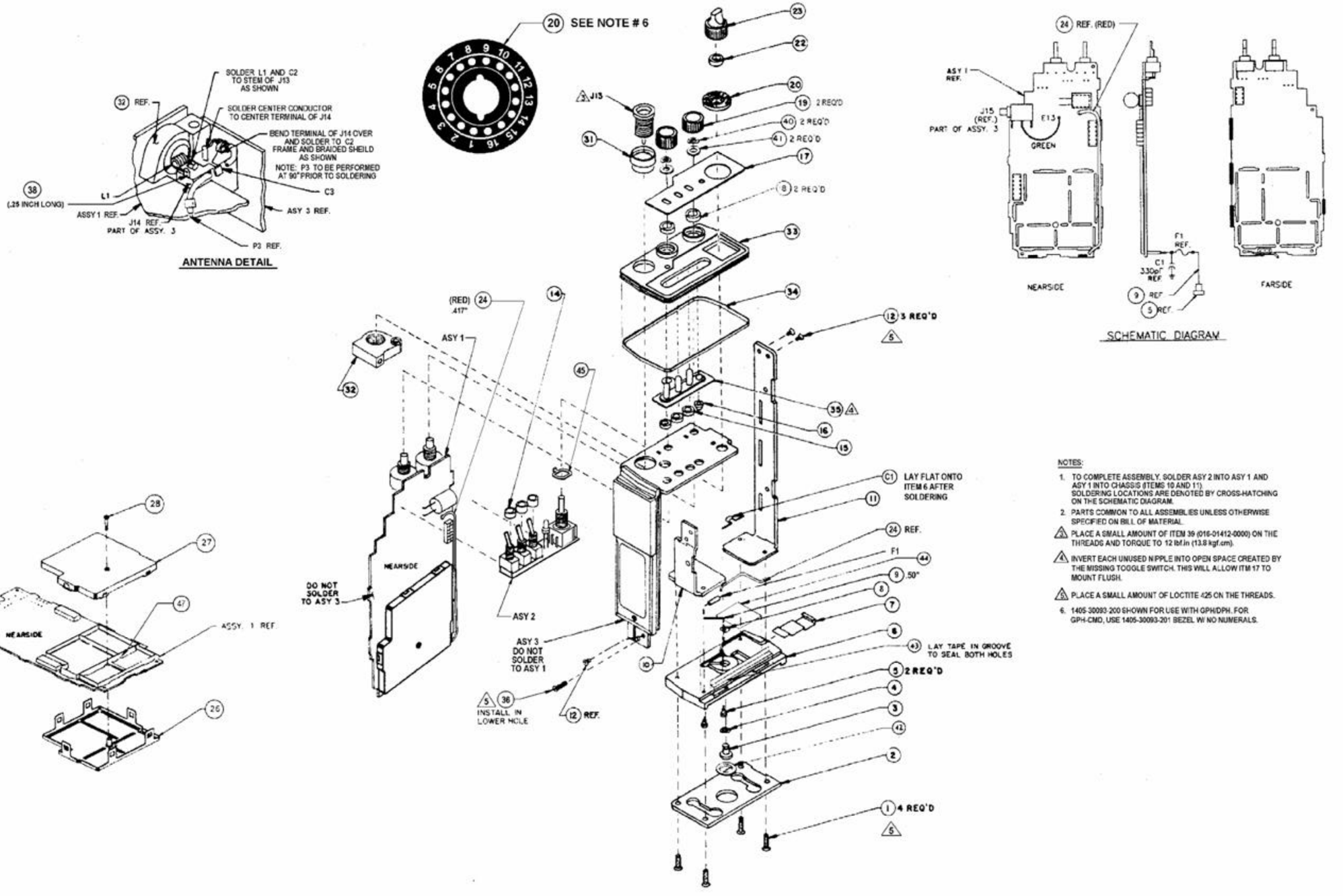

ZONE LTR REVISION
A J. E. Villanueva Dohaney J. E. Villanueva 03-15-05
FORMAL RELEASE
J17
ACCESSORIES CONNECTOR
P10
FLEX CIRCUIT
LOCAL MIC
LOCAL SPEAKER
LOCAL PTT
PURPLE
SPKR HI
EXT SPKR
J15
J10
P8
TOP CONTROL BOARD
SCHEMATIC: 3333-50566-200
P11
P12
P13
SQUELCH
MON
VOL ON/OFF
RED
REMOVABLE BATTERY
J8
E13
E15
LOCAL ANTENNA
J13
J14
EXT ANT
ANT ADPTR
P3
J3
RECEIVER / TRANSMITTER BOARD
SCHEMATIC: 3333-30960-900 (5 WATT)
SPEAKER GND
RX AUDIO
TX AUDIO
SW A+
- MON
+5V
CORE +3.3V
GND
THERM
DISC AUDIO
- RESET
BKGD
KEYBOARD DISPLAY
LCD-MODULE, GRAPHIC, 32x128, FSTN
P/N: 2003-30964-300
+5V
AO
CLK
DI
GND
CORE +3.3V
KEYPAD
CS
OPTIONS BOARD
SCHEMATIC: 3333-30962-000
P7
- PROGRAM
SYN DATA
DSPDO
- SYNCS
KEYPAD
DISPCS
DISPAD
DSPFS
DSPCLK
DSPDI
NC
SYNCLK
J7
SYSTEMS BOARD
SCHEMATIC: 3333-30961-001
P1
P2
GND
LOCAL OSC
GND
GND
SQ NOISE
PWR SET/TUNE
SW A+
NC
RX +5
- DPTT
DISC AUDIO
CAR PRES
WIDE IF
J1
J2
RELM COMMUNICATIONS INC.
WEST MELBOURNE, FL. 32904
INTERCONNECT DIAGRAM, GPH-CMD
5555-30971-000
B
NTS
GPH-CMD
1 OF 1

Table 6-2. Replacement Parts, System Frame Assembly

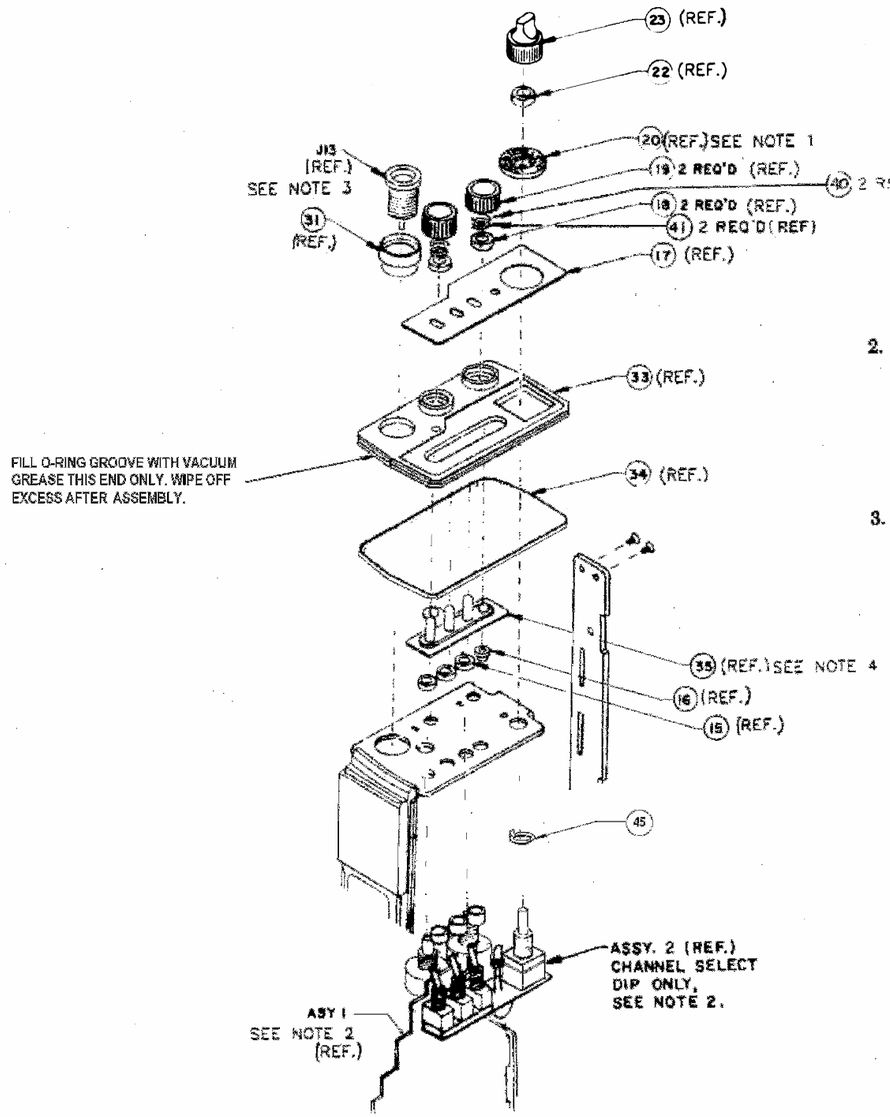
Item Reference Number	Part Number	Description
ITM 1	2801-30714-506	Scr, MS, 2-56, X9/32, T1CR, FH100, SS, PS
ITM 2	1400-40007-400	Brkt, Battery Latch Plate
ITM 3	2114-20031-300	Term, Contact, Positive
ITM 4	2847-20035-000	Washer, Curved, Spring
ITM 5	2114-20033-693	Term, Standoff, WHT
ITM 6	1411-50702-204	Latch Plate Housing, Modified, GPH
ITM 7	2830-40007-500	Spring, Latch
ITM 8	2510-20034-900	Ring, .125, 5100-12CMD
ITM 9	6024-00000-001	Wire Buss, 24GA, Tin/Copper
ITM 10	1403-40009-303	Chassis Lower, STL, LPU
ITM 11	1403-40009-203	Chassis, Side, STL, LPU
ITM 12	2801-30714-509	Scr, MS, 2-56, X 1/8, T1CR, FH100, SS, PS
ITM 14	2800-20027-400	Spacer, Switch
ITM 15	2856-20003-301	Nut, Spanner,M5X0.50 (0.250 X 0.065)
ITM 16	1411-40005-600	Bushing, LED, Molded, EP
ITM 17	2509-50704-912	Inlay,Top,EPH5141,
ITM 18	2856-20003-302	Nut, Spanner, M6X0.75 (0.300x0.075)
ITM 19	2402-40004-701	Knob, Vol/Sq
ITM 20	1405-30093-201	Chan,Bezel,Sw,Molded,20
ITM 23	2402-50541-603	Knob,Assy.,Channel-Select,W/Blank Inlay
ITM 24	6026-30315-803	Wire, Strnd, 26GA, 250V, Red Teflon
ITM 26	7011-20238-900	EPH/EPI,Lower-Lid,Assembly
ITM 27	7011-20238-800	EPH/EPI,Top-Lid,Assembly
ITM 28	2832-30737-505	Scr, 0-80X3/8, PHP
ITM 31	1411-40005-400	Antenna, Bushing, Molded, EP
ITM 32	1411-40005-700	Antenna, Nut, Molded, EP
ITM 33	1411-50701-404	Plate, Top, Blk, GPH
ITM 34	2512-20034-200	O Ring, 1.693 X .039
ITM 35	1411-40004-200	Boot, Sw,Molded, EP, Pos xxxo
ITM 36	2801-30714-510	Scr, MS, 2-56, X 3/16, T1CR, FH100, SS, PS
ITM 38	3102-00000-002	Tubing, Htshrk, BLK, Fit105, 3/32
ITM 40	2847-20035-001	Washer, Curved, Spring
ITM 41	2840-30191-936	Washer, .140x.281, Ss
ITM 42	2512-20031-600	Gasket, Latch, PLT HSG
ITM 43	1601-20032-700	Tape, microthin
ITM 44	1601-20073-401	Tape,Sealing,Tan,
ITM 45	2840-20028-600	Washer,Channel-Sel,
ITM 47	2508-40008-800	Shield,Fence_Assy,SHM,EP,
C1	1501-20082-515	Cap, Cd, LL, 330PF, 50V
C2	1524-20065-501	Cap, CDd, 4.7 PF, 100V
F1	5106-20046-109	Fuse, 4A, 125V, Mld, Axl
J13	2114-40007-600	Conn, Adptr, RF
L1	1801-20061-006	Ind, Fxd AW Coil, 6T, 22GA, "SEE TEXT"
P3	7011-30963-501	VHF_DPHX- Cable_Assy_Coax_Plug0-



NOTES:

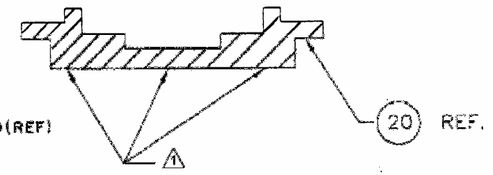
1. TO COMPLETE ASSEMBLY, SOLDER ASY 2 INTO ASY 1 AND ASY 1 INTO CHASSIS (ITEMS 10 AND 11). SOLDERING LOCATIONS ARE DENOTED BY CROSS-HATCHING ON THE SCHEMATIC DIAGRAM.
2. PARTS COMMON TO ALL ASSEMBLIES UNLESS OTHERWISE SPECIFIED ON BILL OF MATERIAL.
3. PLACE A SMALL AMOUNT OF ITEM 39 (016-01412-0000) ON THE THREADS AND TORQUE TO 12 lbf.in (13.8 kgf.cm).
4. INVERT EACH UNUSED NIPPLE INTO OPEN SPACE CREATED BY THE MISSING TOGGLE SWITCH. THIS WILL ALLOW ITM 17 TO MOUNT FLUSH.
5. PLACE A SMALL AMOUNT OF LOCTITE 425 ON THE THREADS.
6. 1405-30093-200 SHOWN FOR USE WITH GPH/DPH. FOR GPH-CMD, USE 1405-30093-201 BEZEL W/ NO NUMERALS.

Figure 6-3 System Frame Assembly
(Dwg. No. 0008-30932-900 Rev. E)



NOTES:

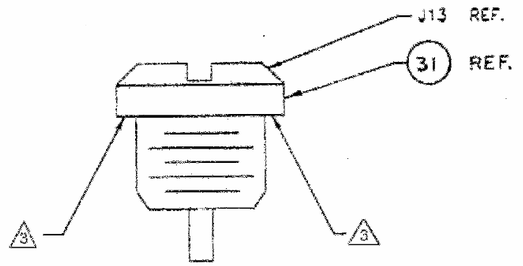
1. UNDERCOAT BOTTOM SURFACE OF BEZEL (ITEM 20) WITH VACUUM GREASE BEFORE INSTALLATION INTO TOP PLATE RECESS. ALLOW GREASE TO FILL ALL STOP PIN HOLES. KNOB WILL CONCEAL EXCESS GREASE.



UNDERCOAT ENTIRE SURFACE AS SHOWN

2. APPLY VACUUM GREASE TO THREADED BUSHING. FILL ALL THREADS BEFORE INSTALLING SPANNER NUT. INSTALLATION OF SPANNER NUT WILL FORCE VACUUM GREASE INTO RECESSES SEALING ALL POINTS OF MOISTURE ENTRY.

3. COAT FLANGE SURFACE WITH VACUUM GREASE AS SHOWN. WIPE OFF EXCESS AFTER INSTALLATION.



4. APPLY A THIN LAYER OF VACUUM GREASE TO THE CONTINUOUS SURFACE INDICATED. THIS LAYER WILL SEAL ALL POINTS OF MOISTURE ENTRY. WIPE OFF EXCESS AFTER INSTALLATION OF INLAY (ITEM 17).

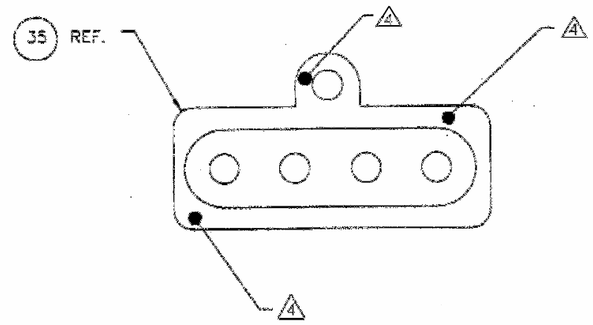
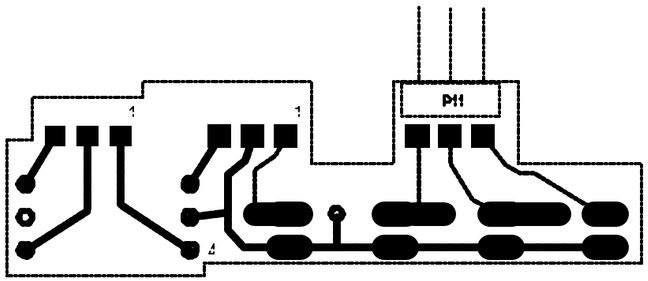


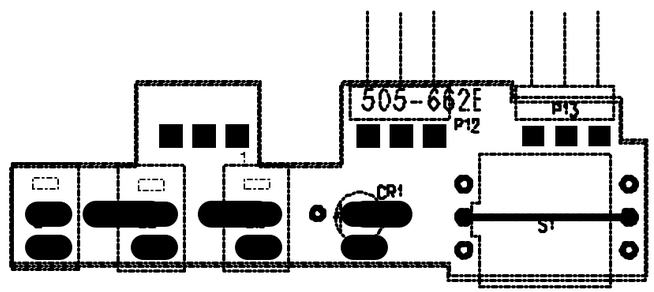
Table 6-3. Replacement Parts, Control Board (505-662 Rev. E)

Item Reference Number	Part Number	Description
Between PCB and S2,S3,&S4	1411-40004-300	Switch,Spacer,Molded,EP
	1700-50566-200	Bd,Pc,Cont,GPH
P11,P12,P13	2105-20031-703	Conn,Hdr,Rt_Angle,3_Pin
Between Top frame and switches S2, S3, and S4	2800-20027-400	Spacer,Switch
2 lengths .48"ea / Insulate leads of CR1	3101-00000-018	Tubing,Clear,Teflon,22GA
CR1	4810-20009-302	Di,LED,Yel.
S1	5111-30942-501	Switch, Rotary 16 pos, No Stop
S2,S3,S4	5114-20004-300	Switch,Toggle,W15mm-Lev,

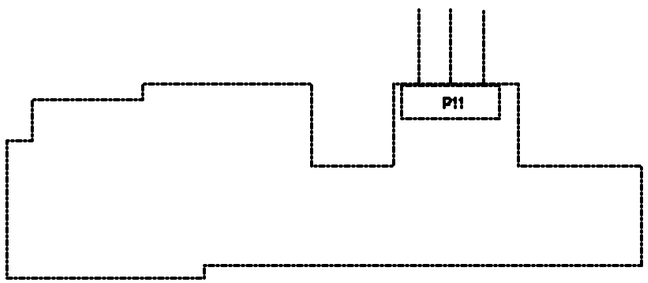
ZONE	LTR	REVISION				
		DRAWN BY:	CHK BY:	APPRD. BY:	ENG:	DATE:
	C	J.E. Villanueva	-	J. Delaby	BY-504	01-02
	E	J.E. Villanueva	-	J. E. Villanueva	BY-623	03-20-03

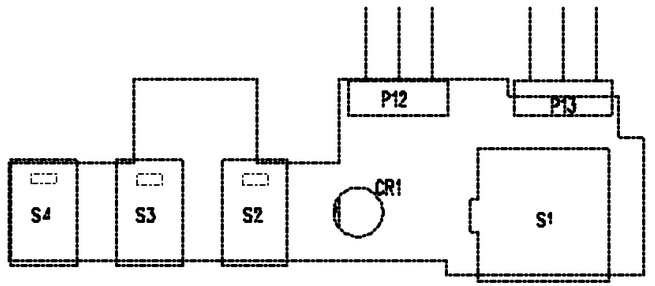


VIEWED FROM BOTTOM



VIEWED FROM TOP





UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE APPLIED FINISH TOLERANCES

TOLERANCES
2 PLACE DIM. .02 | 3 PLACE DIM. .005 | ANGLES 1/2

SCREW THREADS-AMERICAN NATIONAL CLASS

CLASS

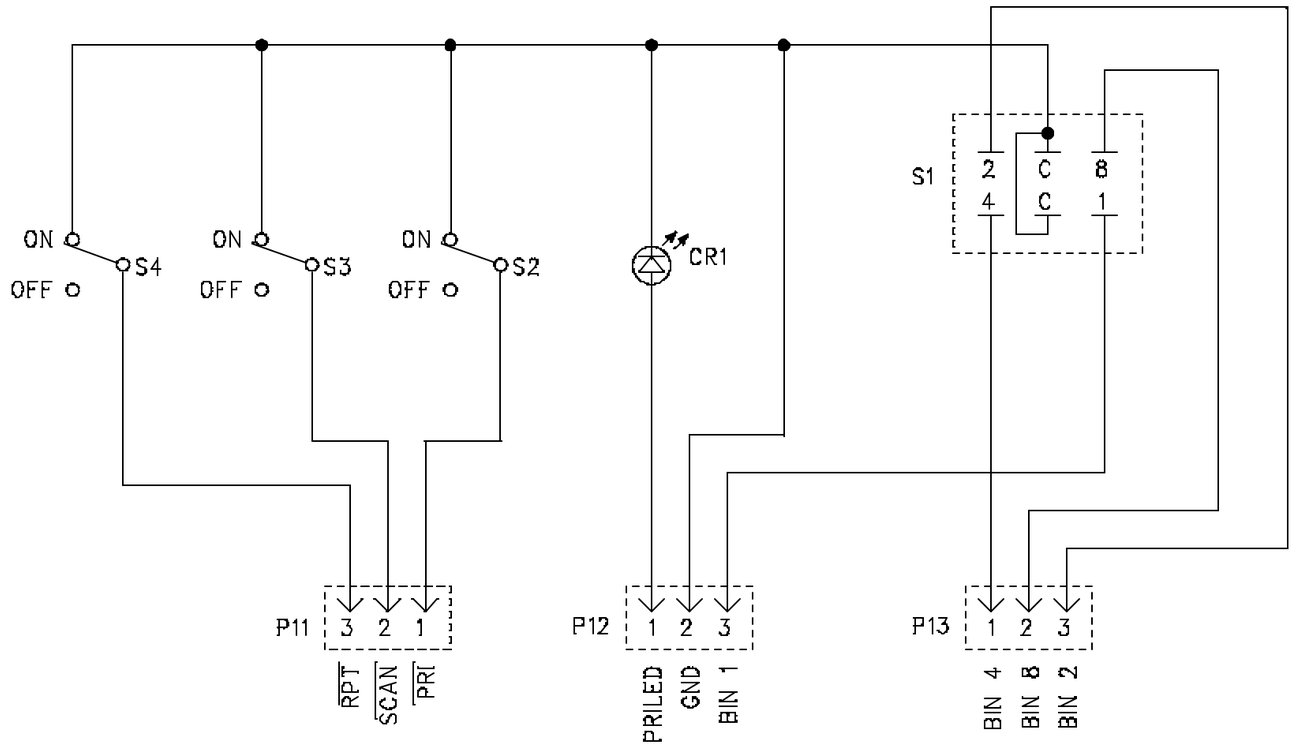
THIRD ANGLE PROJECTION

RELM COMMUNICATIONS INC.
WEST MELBOURNE, FL. 32904

TITLE: GPH CONTROL

SIZE: A | DRAWING NO: 8888-50566-200 REV. E

SCALE: 1 : 2 | REFERENCE: GPH, DPH | SHEET: 1 OF 1



NOTES:

1. BIN = BINARY.

S1 SWITCH POSITION (DPH/GPH)

CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1		*		*		*		*		*		*		*		*
2			*	*			*	*			*	*			*	*
4					*	*	*	*					*	*	*	*
8									*	*	*	*	*	*	*	*

* = CONNECTION TO GND

S1 SWITCH POSITION (GPH-CMD)

CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1		*	*			*	*			*	*			*	*	
2	*	*			*	*			*	*			*	*		
4																
8																

REV.	CHANGE	DATE
D	BY-720	03-15-05
C	BY-692	11-08-04
B	BY-503	04-27-01

REFERENCE
GPH
GPH-CMD

RELM COMMUNICATIONS INC.
WEST MELBOURNE, FL. 32904

UNLESS OTHERWISE SPECIFIED
DEC. ± FRACT. ± ANGLES ±
SCREW THREADS - AMERICAN NATIONAL CLASS

SCALE	DRAWN	CHECKED

TITLE
CONTROL BOARD
SCHEMATIC

3333-50566-200 REV. D

Table 6-4 Replacement Parts, System Board 5W (309-610 Rev. A)

Item Reference Number	Part Number	Description
ITM1	1700-30961-000	PCB, Systems
ITM2	1601-20000-901	Tape,Foam,1/2"Wx1/16"thk.
ITM3	2500-20061-300	Core,Threaded,
C1	1570-03102-271	Cap,CP,1000pf,10%,X7R,10V,0402
C2	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C3	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C4	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C5	1570-01105-271	Cap,CP,1uF,X7R,10%,16V,0805
C6	1570-01105-271	Cap,CP,1uF,X7R,10%,16V,0805
C7	1570-00104-272	Cap,Cp,.1uF,10%,X7R,25V,0603
C8	1570-01105-271	Cap,CP,1uF,X7R,10%,16V,0805
C9	1570-00103-273	Cap,CP,10nF,10%,X7R,50V,0603,
C10	1570-00104-272	Cap,Cp,.1uF,10%,X7R,25V,0603
C11	1570-00221-163	Cap,CP,220pF,NPO,5%,50V,0603
C12	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C13	1570-03569-123	Cap,CP,5.6pF,NPO,+/-.5pF,50V,0402
C14	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C15	1570-03689-123	Cap,CP,6.8pF,NPO,+/-.5pF,50V,0402
C16	1570-03339-113	Cap,CP,3.3pF,NPO,+/-.25pF,50V,0402
C17	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C18	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C19	1552-60463-121	Cap,Cp_Tant,1UF,20%,16V,80D,3216,
C20	1570-02106-778	Cap,CP,10uF,X5R,10%,1206
C21	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C22	1570-03100-123	Cap,CP,10pF,NPO,.+/-.5pf,50V,0402
C23	1570-03109-113	Cap,CP,1pF,NPO,.+/-.25pf,50V,0402
C24	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C25	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C26	1570-03159-113	Cap,CP,1.5pF,NPO,+/-.25pF,50V,0402
C27	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C28	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C29	1570-00560-163	Cap,CP,56pF,5%,COG,50V,0603,
C30	1570-00683-272	Cap,CP,.068uF,X7R,10%,25V,0603
C31	1570-03109-113	Cap,CP,1pF,NPO,.+/-.25pf,50V,0402
C32	1570-00221-163	Cap,CP,220pF,NPO,5%,50V,0603
C33	1552-60463-131	Cap,Cp_Tant,2.2UF,20%,20V,125D,3528,
C34	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C35	1570-03221-163	Cap,Cp,220PF,NPO,5%,50V,0402
C36	1570-00473-272	Cap,CP,.047uF,10%,X7R,25V,0603
C37	1570-00182-273	Cap,CP,1800pF,X7R,10%,50V,0603,
C38	1513-30790-820	Cap,E,220UF,+-20%,16V,85D,6.3X11mm,
C39	1570-00104-272	Cap,Cp,.1uF,10%,X7R,25V,0603
C40	1570-00104-272	Cap,Cp,.1uF,10%,X7R,25V,0603
C41	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C42	1570-03102-271	Cap,CP,1000pf,10%,X7R,10V,0402
C43	1570-00104-272	Cap,Cp,.1uF,10%,X7R,25V,0603
C46	1552-60463-124	Cap,Cp_Tant,4.7uF,20%,10V,80D,3216,
C48	1570-01105-271	Cap,CP,1uF,X7R,10%,16V,0805
C49	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C50	1572-00224-913	Cap,Cp,0.22uF, Film,5%,50V
C51	1570-00103-273	Cap,CP,10nF,10%,X7R,50V,0603,

Item Reference Number	Part Number	Description
C52	1570-00103-273	Cap,CP,10nF,10%,X7R,50V,0603,
C53	1552-60463-129	Cap,Cp_Tant,2.2UF,20%,6V,125D,3216,
C54	1570-03102-271	Cap,CP,1000pf,10%,X7R,10V,0402
C55	1572-00105-734	Cap,Cp,1.0uF,Film,20%,16V,1210
C56	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C57	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C58	1570-03102-271	Cap,CP,1000pf,10%,X7R,10V,0402
C59	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C60	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C61	1570-03509-113	Cap,Cp,5pF,NPO,+/-0.25pF,50V,0402
C62	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C63	1570-00473-273	Cp,Cap,.047uF,X7R,10%,50V,0603
C64	1570-03102-271	Cap,CP,1000pf,10%,X7R,10V,0402
C65	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C66	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C67	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C68	1570-00104-272	Cap,Cp,.1uF,10%,X7R,25V,0603
C69	1552-60463-113	Cap,Cp_Tant,10UF,20%,16V,80D,6032,
C70	1552-60463-121	Cap,Cp_Tant,1UF,20%,16V,80D,3216,
C71	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C72	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C73	1570-03102-271	Cap,CP,1000pf,10%,X7R,10V,0402
C74	1570-03102-271	Cap,CP,1000pf,10%,X7R,10V,0402
C75	1513-30254-778	Cap,E,470UF,+30-20%,16V,85D,10X12.5mm
C76	1570-00103-273	Cap,CP,10nF,10%,X7R,50V,0603,
C77	1570-03102-271	Cap,CP,1000pf,10%,X7R,10V,0402
C78	1570-00223-273	Cap,Cp,.022uF,X7R,10%,50V,0603
C79	1570-00105-777	Cp,Cap,1uF,X5R,10%,10V,0603
C80	1570-00223-273	Cap,Cp,.022uF,X7R,10%,50V,0603
C82	1570-03101-263	Cp,Cap,100PF,X7R,5%,0402
C83	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C84	1570-03101-263	Cp,Cap,100PF,X7R,5%,0402
C85	1570-03102-271	Cap,CP,1000pf,10%,X7R,10V,0402
C86	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C87	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C88	1570-03102-271	Cap,CP,1000pf,10%,X7R,10V,0402
C89	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C90	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C91	1570-03101-163	Cap,Cp,100PF,NPO,5%,50V,0402
C92	1570-02225-271	Cap,CP,2.2uF,X7R,10%,16V,1206
C93	1570-03102-271	Cap,CP,1000pf,10%,X7R,10V,0402
C94	1570-03102-271	Cap,CP,1000pf,10%,X7R,10V,0402
C95	1570-03102-271	Cap,CP,1000pf,10%,X7R,10V,0402
C96	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C97	1570-02225-271	Cap,CP,2.2uF,X7R,10%,16V,1206
C98	1570-03331-273	Cap,Cp,330pF,X7R,10%,50V,0402
C99	1570-01224-271	Cap,CP,.22uF,X7R,10%,16V,0805
C100	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C101	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C102	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C103	1570-01105-271	Cap,CP,1uF,X7R,10%,16V,0805
C104	1570-00103-273	Cap,CP,10nF,10%,X7R,50V,0603,
C105	1570-00103-273	Cap,CP,10nF,10%,X7R,50V,0603,
C106	1570-02106-778	Cap,CP,10uF,X5R,10%,1206

Item Reference Number	Part Number	Description
C107	1570-02106-778	Cap,CP,10uF,X5R,10%,1206
C108	1570-03150-163	Cap,CP,15pF,NPO,5%,50V,0402
C109	1570-03150-163	Cap,CP,15pF,NPO,5%,50V,0402
C110	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C111	1570-00104-272	Cap,Cp,.1uF,10%,X7R,25V,0603
C112	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C113	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C114	1570-03101-263	Cp,Cap,100PF,X7R,5%,0402
C115	1570-03470-163	Cap,Cp,47pF,NPO,5%,50V,0402
C116	1570-03470-163	Cap,Cp,47pF,NPO,5%,50V,0402
C117	1570-03470-163	Cap,Cp,47pF,NPO,5%,50V,0402
CR1	4824-30599-702	DI,SCHOTTKY,SOD-123
CR2	4824-30599-702	DI,SCHOTTKY,SOD-123
CR3	4824-50483-300	Di,Pin,SOT-23,
CR4	4824-30575-401	Di,Var,SOD.323
CR5	4824-20021-100	Di,Var,SOT-23,
CR6	4824-20008-500	Di,Sil,Switching-Dual,SOT-23,
CR7	4810-20009-303	Di,LED,Red,
FB1	2503-20022-300	Ferrite,Bead,Surfc,Mt
FB2	2503-20022-300	Ferrite,Bead,Surfc,Mt
FB3	2503-02102-410	Bead
FB4	2503-02102-410	Bead
FB5	2503-02102-410	Bead
FB6	2503-02102-410	Bead
FB7	2503-02102-410	Bead
FB8	2503-02102-410	Bead
FB9	2503-02121-505	Bead,Fer.
FB10	2503-02102-410	Bead,Ferrite,
FB11	2503-02121-505	Bead,Fer
FB12	2503-02121-505	Bead,Fer.
FB13	2503-02102-410	Bead,Ferrite
FB14	2503-02102-410	Bead,Ferrite
FB15	2503-02121-505	Bead,Fer.
FB16	2503-02121-505	Bead,Fer.
FB17	2503-02102-410	Bead,Ferrite
FB18	2503-02102-410	Bead,Ferrite
J7	2105-20017-606	Conn,Box_Strip,
J8	2105-20017-606	Conn,Box_Strip,
L1	1808-20013-617	Ind,Fxd_Coil,220NH,SMD
L2	1808-20013-614	Ind,Fxd_Coil,120NH,SMD
L3	1808-20013-618	Ind,Fxd_Coil,270NH,SMD
L4	1808-20013-619	Ind,Fxd_Coil,330NH,SMD
L5	1808-20013-628	Ind,Fxd_Coil,1000NH,SMD
L6	1808-20013-628	Ind,Fxd_Coil,1000NH,SMD
L7	1812-15003-020	Ind,Fxd_Coil,15nH,5%,0805
L8	1812-10014-251	IND,Fxd,Pwr,10 uH,10%
P1	2105-20035-821	Conn,Hdr,3_Pin,
P2	2105-20035-705	Conn.Square,5_Pin,.025Sq

Item Reference Number	Part Number	Description
Q1	4823-20046-700	Xstr,PMosfet,Sm_Sig,SOT23
Q2	4823-10367-900	Xstr,NPN,RF_Sm_Sig,SOT23,
Q3	4823-30562-201	Xstr,RF
Q4	4823-10367-900	Xstr,NPN,RF_Sm_Sig,SOT23,
Q5	4823-30741-401	Xstr,NPN,Rf_Sm_Sig,SOT-23,
Q6	4823-20046-700	Xstr,PMosfet,Sm_Sig,SOT2 3
Q7	4823-20046-700	Xstr,PMosfet,Sm_Sig,SOT23
Q9	4823-30680-105	Xstr,Dig,NPN,4.7K/4.7K,SC-70
Q10	4823-30669-001	Xstr,PNP,Sm_Sig,SOT23,
Q11	4823-30680-102	Xstr,Dig,NPN,47K/47K,SC-70
Q12	4823-30680-102	Xstr,Dig,NPN,47K/47K,SC-70
Q13	4823-30680-102	Xstr,Dig,NPN,47K/47K,SC-70
Q14	4823-30939-201	Trans, MOSFET, N-Channel, SC-70
Q15	4823-30680-104	Xstr,Dig,NPN,22K/22K,SC-70
Q16	4823-30680-102	Xstr,Dig,NPN,47K/47K,SC-70
Q18	4823-30680-010	Xstr,PNP,W/Bias,10K/10K,SOT-23,
Q19	4823-30680-105	Xstr,Dig,NPN,4. 7K/4.7K,SC-70
Q21	4823-50483-200	Xstr,NJFET,Rf_Sm_Sig,SOT-23,
Q23	4823-30939-201	Trans, MOSFET, N-Channel, SC-70
Q25	4823-30939-201	Trans, MOSFET, N-Channel, SC-70
R1	4734-01003-311	Res,CP,100K,1%,1/16W,0402
R3	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R4	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R5	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R6	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R7	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R8	4734-01009-311	Res,Cp,10_Ohms,1/16W,1%,0402
R9	4734-01002-311	Res,CP,10K,1%,1/16W,0402
R10	4734-01009-311	Res,Cp,10_Ohms,1/16W,1%,0402
R11	4734-01009-311	Res,Cp,10_Ohms,1/16W,1%,0402
R12	4734-01009-311	Res,Cp,10_Ohms,1/16W,1%,0402
R13	4734-01009-311	Res,Cp,10_Ohms,1/16W,1%,0402
R14	4734-01501-311	Res,CP,1.5K,1%,1/16W,0402
R15	4734-01500-311	Res,Cp,150,1/16W,1%,0402
R16	4734-01500-311	Res,Cp,150,1/16W,1%,0402
R17	4734-04750-311	Res,Cp,475 Ohm,1%,1/16W,0402
R18	4734-04750-311	Res,Cp,475 Ohm,1%,1/16W,0402
R19	4734-02009-311	Res,Cp,20_Ohms,1%,1/16W,0402
R20	4734-06811-311	Res,Cp,6.81K,1%,1/16W,0402
R21	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R22	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R23	4734-07502-311	Res,Cp,75K,1%,1/16W,0402
R24	4734-04752-311	Res,Cp,47.5K,1%,1/16W,0402
R25	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R26	4734-01004-311	Res,Cp,1M,1%,1/16W,0402
R27	4734-01004-311	Res,Cp,1M,1%,1/16W,0402
R28	4734-04122-311	Res,Cp,41.2K,1%,1/16W,0402
R29	4734-01500-311	Res,Cp,150,1/16W,1%,0402
R30	4734-01000-311	Res,Cp,100_ohm,1%,1/16W,0402
R31	4734-07871-311	Res,CP,7.87K,1%,1/16W,0402
R32	4734-03011-311	Res,CP,3.01K,1%,1/16W,0402
R33	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R34	4734-02009-311	Res,Cp,20_Ohms,1%,1/16W,0402

Item Reference Number	Part Number	Description
R35	4734-01000-311	Res,Cp,100_ohm,1%,1/16W,0402
R36	4734-02001-311	Res,CP,2K,1%,1/16W,0402
R37	4734-05112-311	Res,Cp,51.1K,1%,1/16W,0402
R38	4734-03571-311	Res,Cp,3.57K,1%,1/16W,0402
R39	4734-01502-311	Res,CP,15K,1%,1/16W,0402,
R40	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R41	4734-04322-311	Res,CP,43.2K,1%,1/16W,0402
R42	4734-01212-311	Res,Cp,12.1k,1/16W,1%,0402
R43	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R44	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R45	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R46	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R47	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R48	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R49	4734-05113-311	Res,Cp,511K,1%,1/16W,0402
R50	4734-02432-311	Res,Cp,24.3K,1%,1/16W,0402
R51	4750-20003-903	Res,Var,10K_Ohm,Linear_Taper,Panel
R52	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R53	4734-01000-311	Res,Cp,100_ohm,1%,1/16W,0402
R54	4734-01000-311	Res,Cp,100_ohm,1%,1/16W,0402
R55	4734-01000-311	Res,Cp,100_ohm,1%,1/16W,0402
R56	4734-03013-311	Res,Cp,301K,1%,1/16W,0402
R57	4734-04992-311	Res,Cp,49.9K,1%,1/16W,0402
R58	4734-02261-311	Res,Cp,2.26K,1%,1/16W,0402
R59	4734-02002-311	Res,Cp,20K,1%,1/16W,0402
R60	4734-01003-311	Res,CP,100K,1%,1/16W,0402
R61	4734-01003-311	Res,CP,100K,1%,1/16W,0402
R62	4734-02052-311	Res,Cp,20.5k,1/16W,1%,0402
R63	4734-05112-311	Res,Cp,51.1K,1%,1/16W,0402
R64	4734-01004-311	Res,Cp,1M,1%,1/16W,0402
R65	4734-04122-311	Res,Cp,41.2K,1%,1/16W,0402
R66	4734-03012-311	Res,CP,30.1K,1%,1/16W,0402
R67	4734-03012-311	Res,CP,30.1K,1%,1/16W,0402
R68	4734-08062-311	Res,Cp,80.6K,1%,1/16W,0402
R69	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R70	4734-04752-311	Res,Cp,47.5K,1%,1/16W,0402
R71	4734-04752-311	Res,Cp,47.5K,1%,1/16W,0402
R72	4734-01002-311	Res,CP,10K,1%,1/16W,0402
R73	4734-02000-311	Res,Cp,200_Ohms,1%,1/16W,0402
R74	4734-01213-311	Res,CP,121K,1%,1/16W,0402
R75	4734-01003-311	Res,CP,100K,1%,1/16W,0402
R76	4734-01002-311	Res,CP,10K,1%,1/16W,0402
R77	4734-01003-311	Res,CP,100K,1%,1/16W,0402
R78	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R79	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R80	4734-06191-311	Res,Cp,6.19K,1%,1/16W,0402
R81	4724-00132-233	Res,cp,1300_Ohm,1/10W,5%
R83	4734-00335-331	Res,Cp,3.3M,5%,1/16W,0402
R84	4734-02002-311	Res,Cp,20K,1%,1/16W,0402
R85	4750-20003-906	Res,Var, 50K Ohm,Linear Taper,Panel
R86	4734-01009-311	Res,Cp,10_Ohms,1/16W,1%,0402
R87	4734-01693-311	Res,Cp,169k,1/16W,1%,0402
R88	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R89	4734-02432-311	Res,Cp,24.3K,1%,1/16W,0402

Item Reference Number	Part Number	Description
R90	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R91	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R92	4734-01003-311	Res,CP,100K,1%,1/16W,0402
R93	4734-01004-311	Res,Cp,1M,1%,1/16W,0402
R94	4734-00335-331	Res,Cp,3.3M,5%,1/16W,0402
R95	4734-05113-311	Res,Cp,511K,1%,1/16W,0402
R96	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R97	4724-00332-233	Res,Cp,3300_Ohm,1/10W,5%,0805
R98	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R99	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R100	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R101	4734-01000-311	Res,Cp,100_ohm,1%,1/16W,0402
R102	4734-01000-311	Res,Cp,100_ohm,1%,1/16W,0402
R103	4734-01003-311	Res,CP,100K,1%,1/16W,0402
R104	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R105	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R106	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R107	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R108	4734-03572-311	Res,Cp,35.7K,1%,1/16W,0402
R109	4734-01000-311	Res,Cp,100_ohm,1%,1/16W,0402
R110	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R111	4718-50317-140	Res,Cp,0_Ohm,1/8W,5%,1206,
R112	4734-04992-311	Res,Cp,49.9K,1%,1/16W,0402
R113	4734-01003-311	Res,CP,100K,1%,1/16W,0402
R114	4734-02003-311	Res,Cp,200K,1%,1/16W,0402
R115	4734-01003-311	Res,CP,100K,1%,1/16W,0402
R116	4734-04992-311	Res,Cp,49.9K,1%,1/16W,0402
R117	4734-02492-311	Res,Cp,24.9K,1%,1/16W,0402
R118	4734-00000-008	Res,Cp,0_Ohms(Jumper),1/16W,1A,0402
R119	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R120	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R121	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R122	4734-01003-311	Res,CP,100K,1%,1/16W,0402
R123	4734-03092-311	Res,Cp,30.9K,1%,1/16W,0402
R124	4734-01003-311	Res,CP,100K,1%,1/16W,0402
R125	4734-03012-311	Res,CP,30.1K,1%,1/16W,0402
R126	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R127	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R128	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R129	4734-01000-311	Res,Cp,100_ohm,1%,1/16W,0402
R130	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R131	4734-01003-311	Res,CP,100K,1%,1/16W,0402
R132	4734-05622-311	Res,Cp,56.2K,1%,1/16W,0402
R133	4734-00000-008	Res,Cp,0_Ohms(Jumper),1/16W,1A,0402
R134	4734-01242-311	Res,Cp,12.4K,1%,1/16W,0402
R135	4734-02001-311	Res,CP,2K,1%,1/16W,0402
R136	4734-01003-311	Res,CP,100K,1%,1/16W,0402
R137	4734-02673-311	Res,Cp,267k,1/16W,1%,0402
R138	4734-02433-311	Res,Cp,243k,1/16W,1%,0402
R139	4734-04992-311	Res,Cp,49.9K,1%,1/16W,0402
R140	4734-02492-311	Res,Cp,24.9K,1%,1/16W,0402
R141	4734-09092-311	Res,Cp,90.9K,1%,1/16W,0402
R142	4734-01009-311	Res,Cp,10_Ohms,1/16W,1%,0402

Item Reference Number	Part Number	Description
T1	1800-20012-701	Ind,RF_Xfmr,11/4T,100MHz,Can,
U1	3134-20082-400	IC,MCU,QFB
U2	3134-30940-810	IC,DUAL,DAC
U3	3134-30670-409	IC,OPA,SO8,
U4	3134-30950-501	IC,P-Ch,30V,S0-8
U5	3134-30950-402	IC,DC/DC,Invert,SOT23-5
U6	3134-30577-404	IC,Freq_Syn,TSSOP
U7	3134-30747-819	IC,EEPROM,256K,2.5V,SO8
U8	3134-30670-403	IC,RGA, SO8,
U9	3134-30927-201	IC,BTL_Audio_Amp.,1W,
U10	3134-30670-413	IC,OPA,SO8
U11	3134-30906-202	IC,SW,SPST,SOT23-6
U12	3134-30950-304	IC,REG,ADJ,LDO,SOT-23
U13	3134-30950-304	IC,REG,ADJ,LDO,SOT-23
U14	3134-30670-403	IC,RGA,SO8,
U15	3134-30911-002	IC,OP_AMP,R/R,SOT-23
U16	3134-20083-001	IC,Dig,Pot,Dual,TSSOP
Y1	2390-30957-102	TCXO, 10.000MHz, SMD

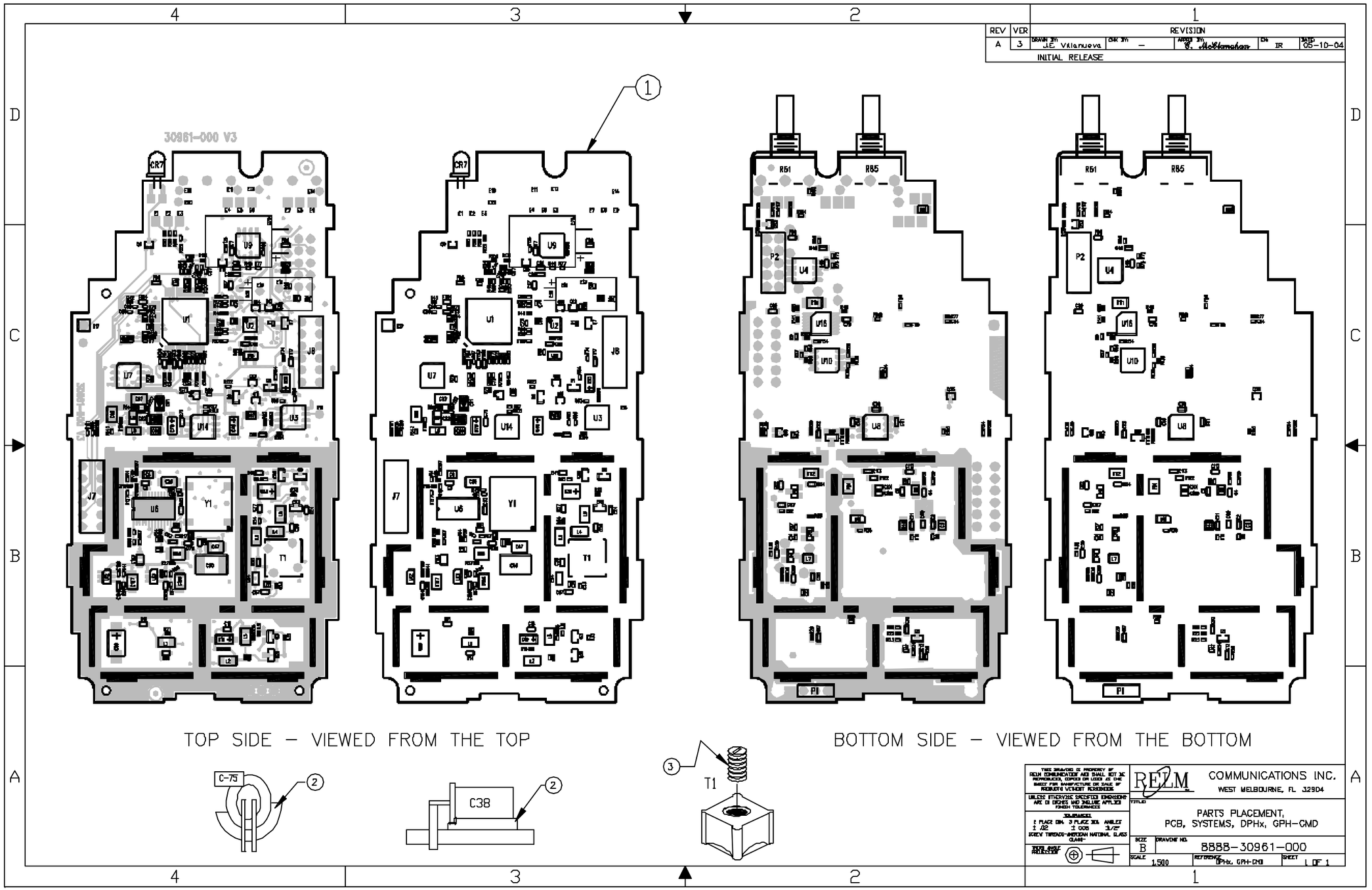
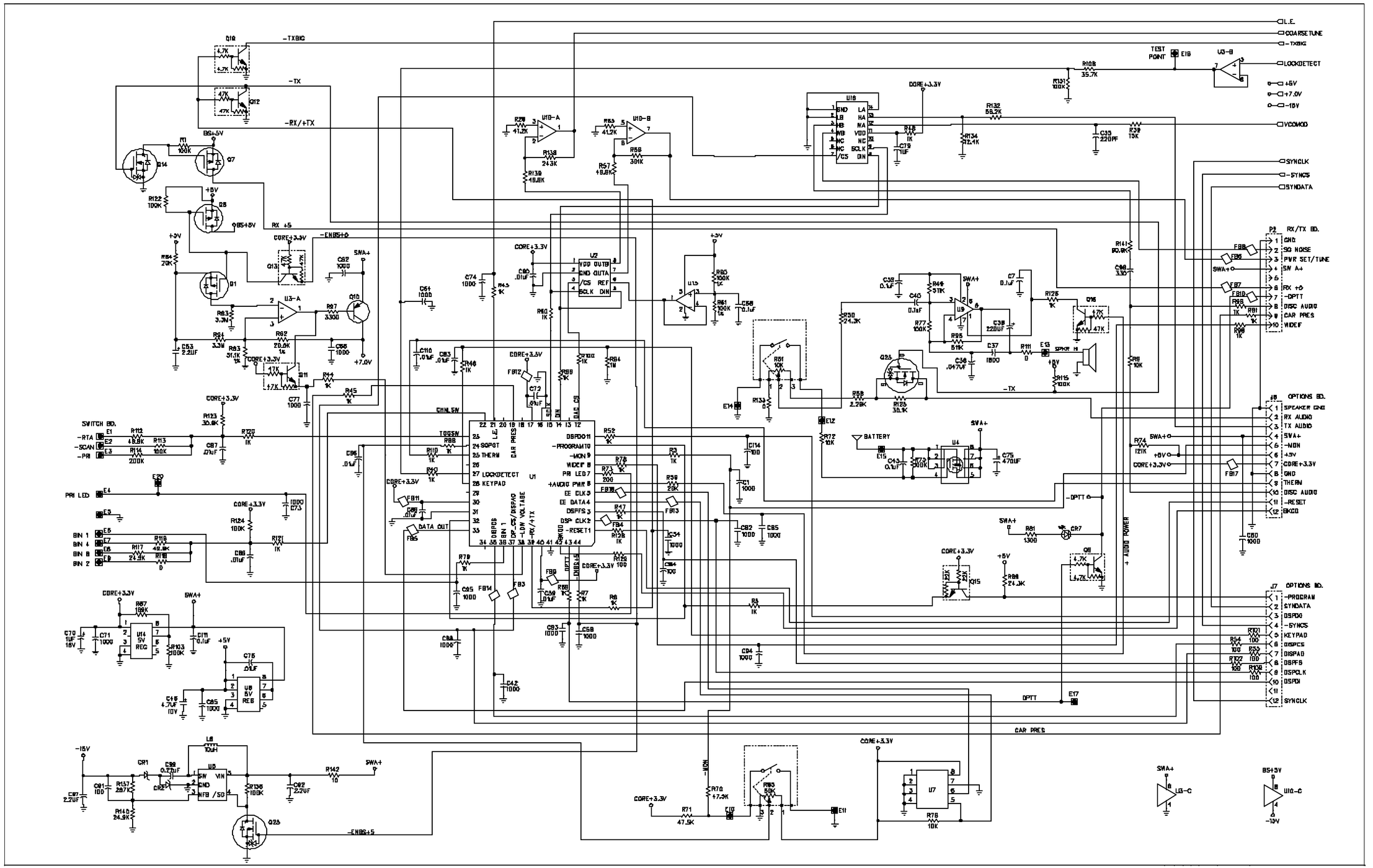
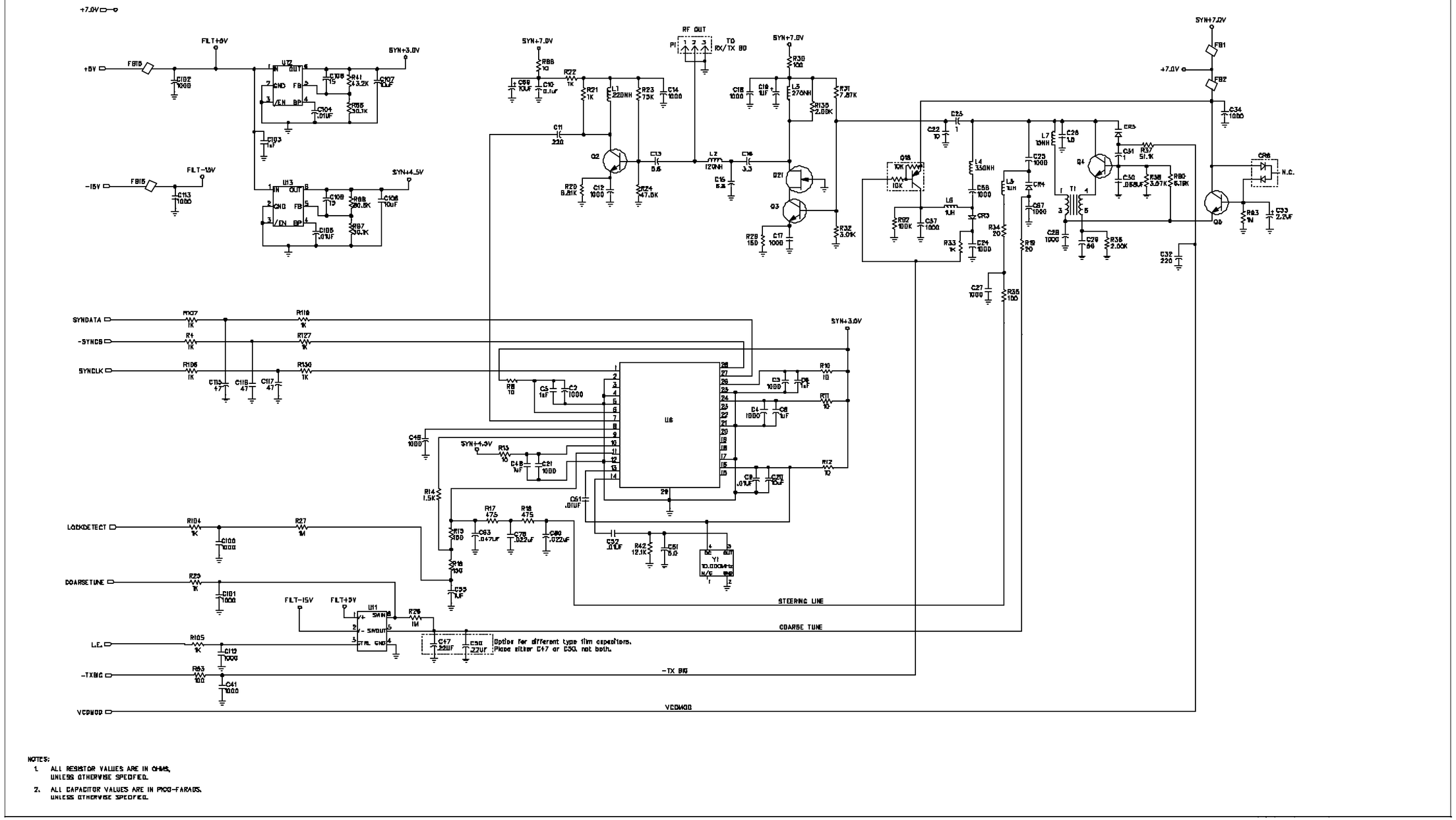


Figure 6-7 System Board (309-610 Rev. A)
(Dwg. No. 8888-30961-000 Rev. A)



BK RADIO **Figure 6-8 System Board Schematic (309-610 Rev.A)** Page 6-29

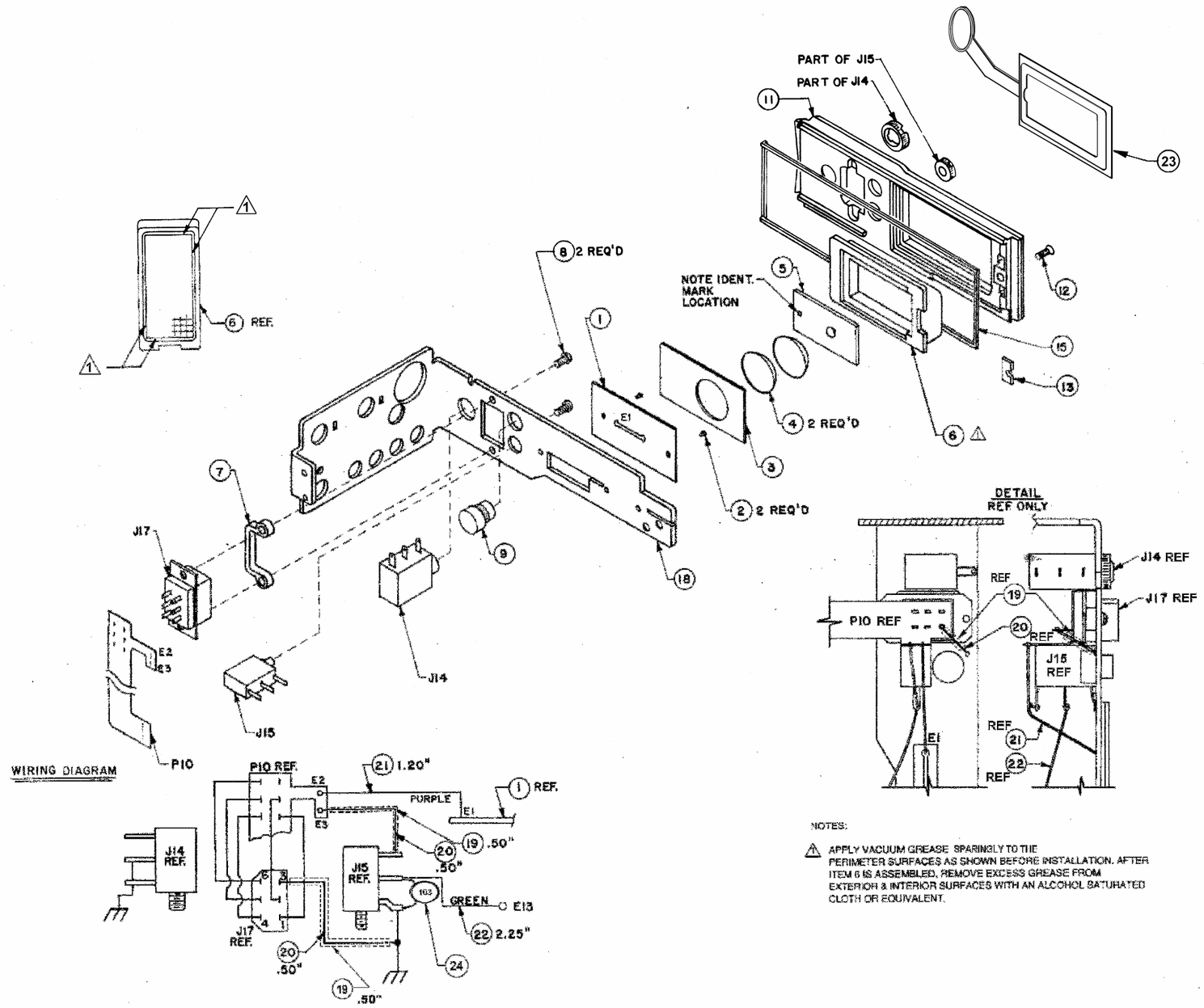
[Sheet 1]



NOTES:
1. ALL RESISTOR VALUES ARE IN OHMS, UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITOR VALUES ARE IN PICO-FARADS, UNLESS OTHERWISE SPECIFIED.

Table 6-5 Replacement Parts, Top Frame Assembly

Item Reference Number	Part Number	Description
ITM 1	1700-40011-000	Bd, Pc, PTTSW, EPH/ EPI/EPU/EPV
ITM 2	2883-20035-500	Rivet, .06X.125, Br
ITM 3	3110-20032-600	Snap, Dome, Alignment
ITM 4	5112-40010-900	Switch, Snap, Dome
ITM 5	1411-40005-500	Actuator, PTT, Molded, EP
ITM 6	1411-50703-000	PTT, Sw Boot, Molded, EP
ITM 7	1411-40005-900	Options, Plug-Spacer,Molded, EP
ITM 8	2820-30603-022	Scr,MS, 2X.40X6, T1CR, PH, SS
ITM 9	2858-40007-700	Nut Blind, Press
ITM 11	1411-50702-104	Housing, PTT, GPH
ITM 12	2801-30714-512	Scr, MS, 2-56, X5/16, T1CR, FH100, SS, BLKOX
ITM 13	3110-20032-500	Insulatr, Shim, PTT-HSG
ITM 15	2512-40011-200	Gasket, PTT
ITM 18	1403-50704-302	Chassis, Topframe, w/finish
ITM 19	3101-00000-018	Tubing, Clear, Teflon, 22GA
ITM 20	6024-00000-001	Wire, Buss, 24GA, Tin/Copper
ITM 21	6026-30315-808	Wire, 26GA, StrTef, Purple
ITM 22	6026-30315-806	Wire, Strnd, 26GA, 250V, Grn, Teflon
ITM 23	1411-40006-200	Conn, Side, Cvr, Molded, EP
ITM 24	1503-00103-007	CAP,CD,.01UF,50V,Z5U,
J14	2101-20033-100	Jack, 3.5MM
J15	2101-20033-001	Jack, Phono, 2.5MM
J17	2105-20032-300	Conn, Receptacle
P10	1700-60705-900	Bd,Pc, Flexcir, EPH/EPI/EPU/EPV



NOTES:

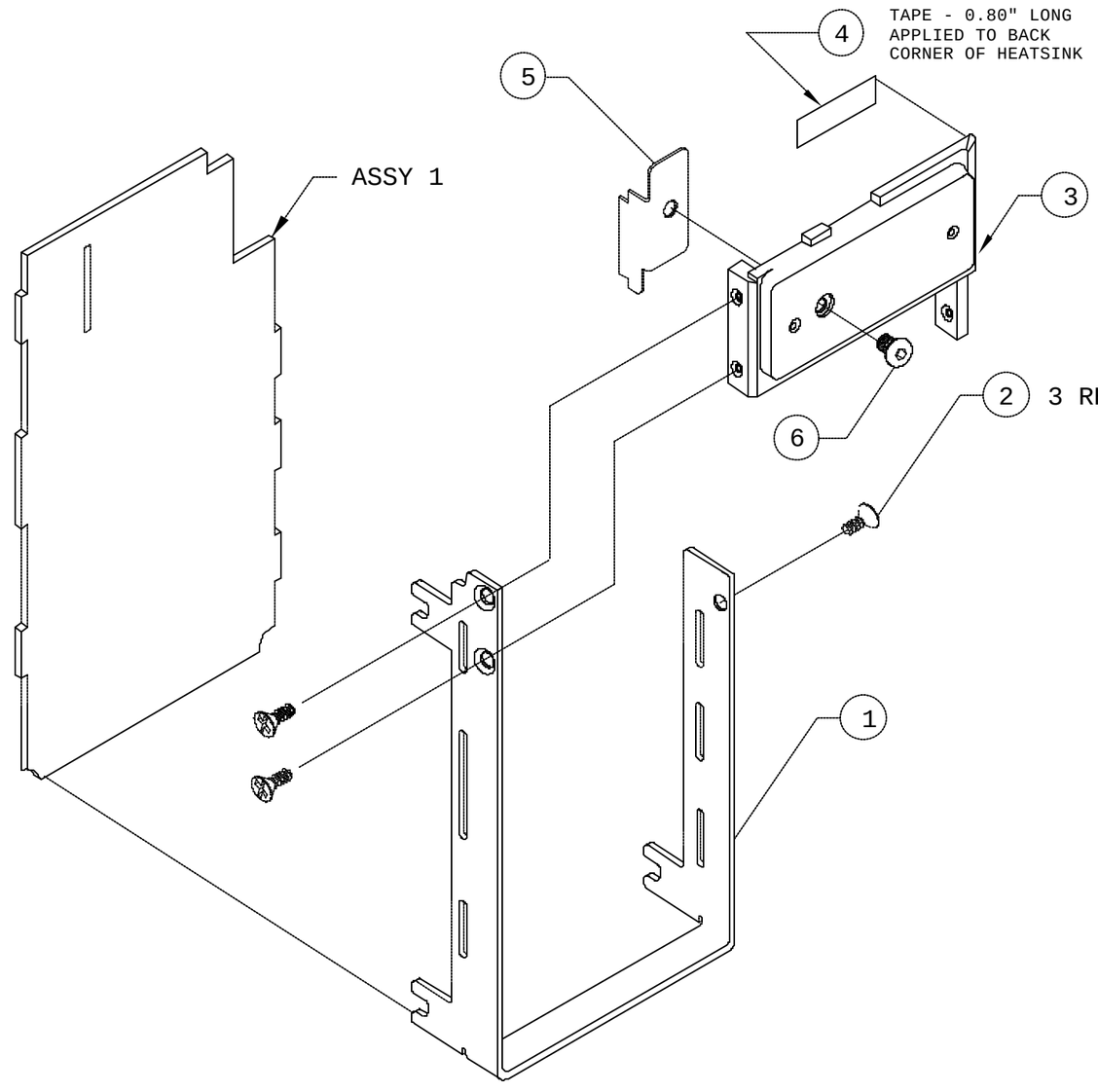
⚠ APPLY VACUUM GREASE SPARINGLY TO THE PERIMETER SURFACES AS SHOWN BEFORE INSTALLATION. AFTER ITEM 6 IS ASSEMBLED, REMOVE EXCESS GREASE FROM EXTERIOR & INTERIOR SURFACES WITH AN ALCOHOL SATURATED CLOTH OR EQUIVALENT.

Figure 6-10 Top Frame Assembly
(Dwg. No. 0008-30933-200 Rev. A)

Table 6-6 Replacement Parts, RX/TX Frame Assembly

Item Reference Number	Part Number	Description
ITM1	1403-40008-701	Chassis,Sulframe,Stl,EP,
ITM2	2801-30714-510	Scr,MS,2-56,X3/16,T1CR,FH100,SS,PS,
ITM3	5400-60705-100	Heatsink,Chromate, Only
ITM4	1601-20007-102	Tape,Mylar,.250W,
ITM5	5400-30961-901	Adaptor, Heatsink
ITM6	2803-30668-136	Scr, MS, 4-40, x 5/32, H, BHC,SS

ZONE	LTR	REVISION				
	A	DRAWN BY: J.E. Villanueva	CHK BY: -	APPD. BY: J. E. Villanueva	ENV: FR	DATE: 06-29-04
		FORMAL RELEASE IN ACAD 14				



NOTES:

1. DO NOT SOLDER ITEM 1 TO ASSEMBLY 1 UNTIL FINAL ASSEMBLY, UNLESS A FIXTURE IS USED.
2. PARTS COMMON TO ALL ASSEMBLIES UNLESS OTHERWISE NOTED IN B O M.
3. NOT USED IN GPH 2WATT ASSEMBLIES.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE APPLIED FINISH TOLERANCES.

TOLERANCES:
2 PLACE DEM. 3 PLACE DEM. ANGLES

THIRD ANGLE PROJECTION

RELM COMMUNICATIONS INC.
WEST MELBOURNE, FL. 32904

TITLE: RX/TX FRAME ASSEMBLY

SIZE: B | DRAWING NO.: 0008-30965-600 REV. A

SCALE: NTS | REFERENCE: DPHx | SHEET: 1 OF 1

Table 6-7. Replacement Parts, RX/TX Board 5 Watt (309-609 Rev A)

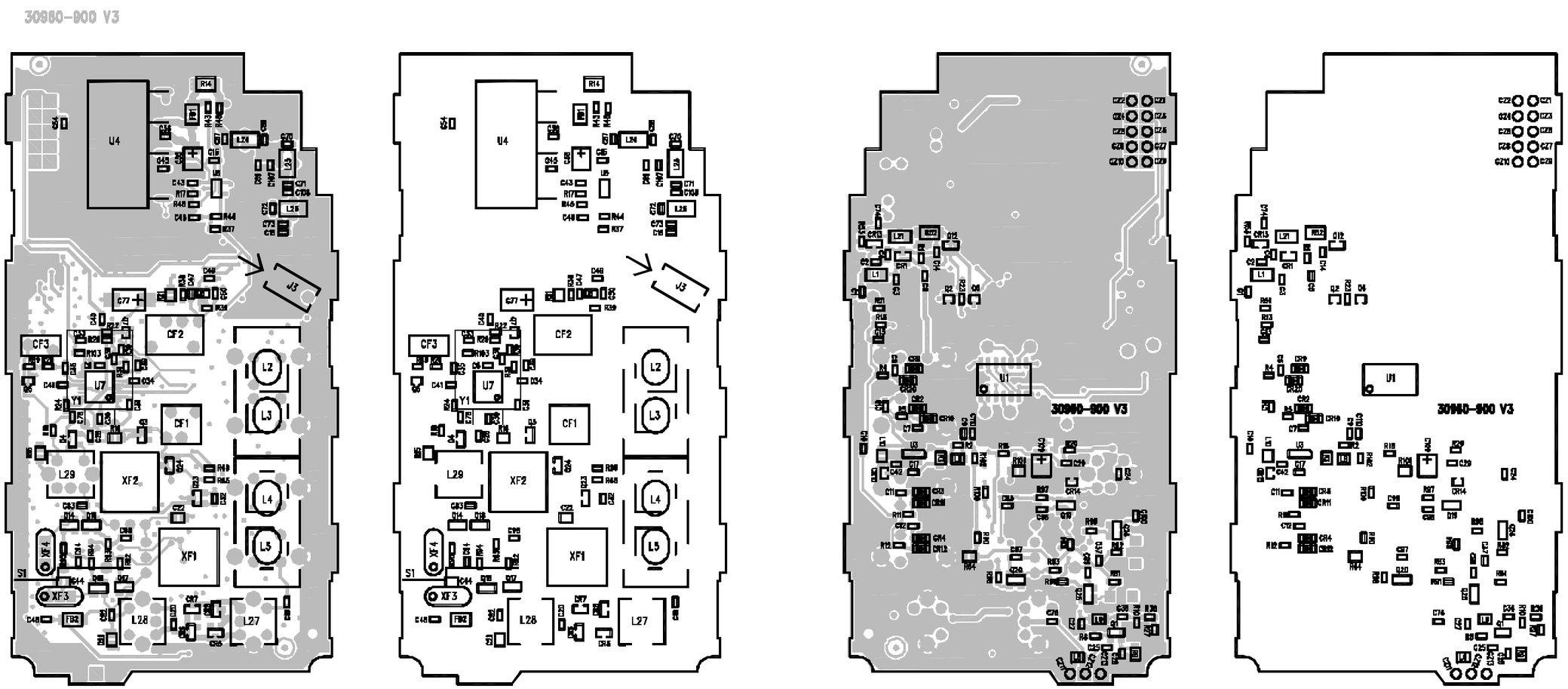
Item Reference Number	Part Number	Description
ITM1	1700-30960-900	PCB,GPH-CMD_5W_RX/TX
ITM2	1601-20000-903	Tape,Foam,3/8WX1/16th,
ITM3	2540-40000-202	Finger-Stk,3-Fingers
ITM4	2508-20029-701	Shield,30/12.5_RT,SHM,EP,
ITM5	3110-20019-400	Insulator,XTAL,
ITM6	6020-00000-001	Wire,Buss,20GA,Tin/Copper
C1	1570-00560-163	Cap,CP,56pF,5%,COG,50V,0603,
C2	1573-02519-133	Cp,Cap,5.1pF,S,+/-.25pF,250V,0603
C3	1573-02309-133	Cp,Cap,3.0pF,S,+/-.25pF,250V,0603
C4	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C5	1570-00360-163	Cp,Cap,36pF,NPO,5%,50V,0603
C6	1573-02270-163	Cp,Cap,27pF,S,5%,250V,0603
C7	1573-02270-163	Cp,Cap,27pF,S,5%,250V,0603
C8	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C9	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C10	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C11	1573-02270-163	Cp,Cap,27pF,S,5%,250V,0603
C12	1573-02270-163	Cp,Cap,27pF,S,5%,250V,0603
C13	1570-00104-272	Cap,Cp,.1uF,10%,X7R,25V,0603
C14	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C15	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C16	1573-02569-133	Cap,Cp,5.6pF,S,+/-0.25pF,250V,0603
C17	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C18	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C19	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C20	1570-00100-163	Cap,CP,10pF,5%,COG,50V,0603,
C21	1553-50525-320	Cap,Cp,39PF,10%,NPO,50V,0805,
C22	1553-50313-551	Cap,Cp,8.2PF,+-.25PF,NPO,50V,0805,
C24	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C25	1573-02270-163	Cp,Cap,27pF,S,5%,250V,0603
C26	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C27	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C28	1570-00103-273	Cap,CP,10nF,10%,X7R,50V,0603,
C29	1570-00103-273	Cap,CP,10nF,10%,X7R,50V,0603,
C30	1570-00121-163	Cap, CP, 120pF, 5%, NPO, 50V, 0603
C31	1570-00330-163	Cap,CP,33pF,5%,COG,50V,0603,
C32	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C33	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C34	1570-00473-273	Cp,Cap,.047uF,X7R,10%,50V,0603
C35	1570-00820-163	Cap,CP,82pF,5%,COG,50V,0603,
C36	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C37	1570-00103-273	Cap,CP,10nF,10%,X7R,50V,0603,
C38	1570-00561-163	Cp,Cap,560pF,NPO,5%,50V,0603
C39	1570-00561-163	Cp,Cap,560pF,NPO,5%,50V,0603
C40	1570-00331-163	Cap,CP,330pF,5%,COG,50V,0603,
C41	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C42	1570-00105-777	Cp,Cap,1uF,X5R,10%,10V,0603
C43	1570-00224-277	Cap,CP,0.22uF,10%,X7R,10V,0603,
C44	1553-50313-504	Cap,Cp,15PF,5%,NPO,50V,0805,
C45	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,

Item Reference Number	Part Number	Description
C46	1570-00223-273	Cap,Cp,.022uF,X7R,10%,50V,0603
C47	1570-00684-777	Cap,Cp,.68uF,X5R,10%,10V,0603
C48	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C49	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C50	1570-00104-272	Cap,Cp,.1uF,10%,X7R,25V,0603
C54	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C55	1552-60463-156	Cap,Tant,4.7uF,10%,25V,3528
C56	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C67	1573-02689-133	Cp,Cap,6.8pF,S,+/-.25pF,250V,0603
C68	1573-02689-133	Cp,Cap,6.8pF,S,+/-.25pF,250V,0603
C69	1573-02100-163	Cap,Cp,10pF,S,5%,250V,0603
C70	1573-02399-133	Cp,Cap,3.9pF,S,+/-.25pF,250V,0603
C71	1573-02120-163	Cp,Cap,12pF,S,5%,250V,0603
C72	1573-02109-123	Cap,Cp,1pF,S,+/-0.1pF,250V,0603
C73	1573-02689-133	Cp,Cap,6.8pF,S,+/-.25pF,250V,0603
C74	1570-00560-163	Cap,CP,56pF,5%,COG,50V,0603,
C76	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C77	1552-60463-113	Cap,Cp_Tant,10UF,20%,16V,80D,6032,
C78	1570-00103-273	Cap,CP,10nF,10%,X7R,50V,0603,
C82	1570-00103-273	Cap,CP,10nF,10%,X7R,50V,0603,
C83	1570-00103-273	Cap,CP,10nF,10%,X7R,50V,0603,
C94	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C95	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C96	1570-00103-273	Cap,CP,10nF,10%,X7R,50V,0603,
C97	1570-00103-273	Cap,CP,10nF,10%,X7R,50V,0603,
C98	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C99	1570-00103-273	Cap,CP,10nF,10%,X7R,50V,0603,
C100	1570-00103-273	Cap,CP,10nF,10%,X7R,50V,0603,
C107	1573-02829-163	Cap,Cp,8.2pF,S,+/-.25pF,250V,0603
C108	1573-02100-163	Cap,Cp,10pF,S,5%,250V,0603
C109	1552-60463-110	Cap,Cp_Tant,2.2uF,20%,16V,80D,
C110	1570-00105-777	Cp,Cap,1uF,X5R,10%,10V,0603
CF1	2700-30955-701	Fltr,Cer,455KHz
CF2	2700-30719-405	Filter,Cer.
CF3	2701-30598-502	Discrmntr,Cer,455KHz,
CZ1	2108-20017-401	Socket,Mini,Spring,
CZ2	2108-20017-401	Socket,Mini,Spring,
CZ3	2108-20017-401	Socket,Mini,Spring,
CZ4	2108-20017-401	Socket,Mini,Spring,
CZ5	2108-20017-401	Socket,Mini,Spring,
CZ6	2108-20017-401	Socket,Mini,Spring,
CZ7	2108-20017-401	Socket,Mini,Spring,
CZ8	2108-20017-401	Socket,Mini,Spring,
CZ9	2108-20017-401	Socket,Mini,Spring,
CZ10	2108-20017-401	Socket,Mini,Spring,
CZ11	2108-20017-401	Socket,Mini,Spring,
CZ12	2108-20017-401	Socket,Mini,Spring,
CZ13	2108-20017-401	Socket,Mini,Spring,
CR1	4824-20047-300	Di,Pin,SOT-23,
CR2	4824-30572-501	Di,Var.
CR3	4824-30572-501	Di,Var.

Item Reference Number	Part Number	Description
CR4	4824-30572-501	Di,Var.
CR5	4824-20008-600	Di,Schottky,SOT-23,
CR6	4824-20008-600	Di,Schottky,SOT-23,
CR7	4824-20008-600	Di,Schottky,SOT-23,
CR8	4824-20008-600	Di,Schottky,SOT-23,
CR9	4824-30572-501	Di,Var.
CR10	4824-30572-501	Di,Var.
CR11	4824-30572-501	Di,Var.
CR12	4824-30572-501	Di,Var.
CR13	4824-20047-300	Di,Pin,SOT-23,
CR14	4824-30541-303	Di,Dual,Schottky,SC-70
CR15	4824-30541-303	Di,Dual,Schottky,SC-70
CR20	4824-30572-501	Di,Var.
FB1	2503-20022-300	Ferrite,Bead,Surfc,Mt
FB2	2503-20022-300	Ferrite,Bead,Surfc,Mt
J3	2101-50521-200	MIN-PIN-JACK,TYP,LOW,
L1	1808-20013-648	Ind,Fxd_Coil,56NH@50MHz,SMD
L2	1800-20048-101	Ind,Var_Mld_Coil,3.5T,24GA,Tap@5/8T,
L3	1800-20048-102	Ind,Var_Mld,Coil,3.5T,24GA,Tap@7.8T,
L4	1800-20048-102	Ind,Var_Mld,Coil,3.5T,24GA,Tap@7.8T,
L5	1800-20048-100	Ind,Var_Mld_Coil,3.5T,24GA,Tap@3/8T,
L6	1812-82003-020	Ind, CP, 82nH, 5%,0805
L8	1812-82103-020	Ind,Cp,820nH,5%,0805
L9	1812-82103-020	Ind,Cp,820nH,5%,0805
L10	1812-82103-020	Ind,Cp,820nH,5%,0805
L21	1808-20013-630	Ind,Fxd_Coil,1.5UH@7.9MHz, SMD
L24	1801-20023-310	Ind,Fxd_AW_Coil,4T,24GA,0.133D,Lft_Hnd
L25	1801-20023-309	Ind,Fxd_AW_Coil,5T,24GA,0.139D,Lft_Hnd
L26	1801-20023-308	Ind,Fxd_AW_Coil,5T,24GA,0.136D,Lft_Hnd
L27	1800-20013-200	Ind,RF_Xfmr,P_8T,S_4T,2_PRI(4T),Can,
L28	1800-20048-300	Ind,RF_Xfmr,P_6T,S_15T, @16.9MHz,Can,
L29	1800-20048-200	Ind,RF_Xfmr,P_22T,S_13T, @16.9MHz,Can
Q1	4823-30741-302	Xstr,PNP,Rf_Sm_Sig_SOT-23
Q2	4823-30939-201	Trans, MOSFET, N-Channel, SC-70
Q3	4823-30680-020	Xstr,NPN,W/Bias,4.7K/10K,SOT-23,
Q4	4823-20006-400	LTB Xstr,NPN,VHF,Mixer,SOT23,
Q5	4823-30939-201	Trans, MOSFET, N-Channel, SC-70
Q6	4823-30680-101	Xstr,Digital,PNP,10K/47K,SC-70
Q7	4823-30939-201	Trans, MOSFET, N-Channel, SC-70
Q12	4823-30680-019	Xstr,PNP,W/Bias,4.7K/10K,SOT-23
Q14	4823-20020-600	Trans, MOSFET,SOT 143
Q16	4823-20020-600	Trans, MOSFET,SOT 143
Q17	4823-20020-600	Trans, MOSFET,SOT 143
Q18	4823-20020-600	Trans, MOSFET,SOT 143
Q19	4823-20020-600	Trans, MOSFET,SOT 143
Q20	4823-20020-600	Trans, MOSFET,SOT 143
Q23	4823-30680-002	Xstr,NPN,W/Bias,47K/47K,SOT-23
Q24	4823-20025-100	Xstr,NMosfet,Sm_Sig,60V100mA,SOT23,
Q25	4823-20020-600	Trans, MOSFET,SOT 143
Q26	4823-20020-600	Trans, MOSFET,SOT 143

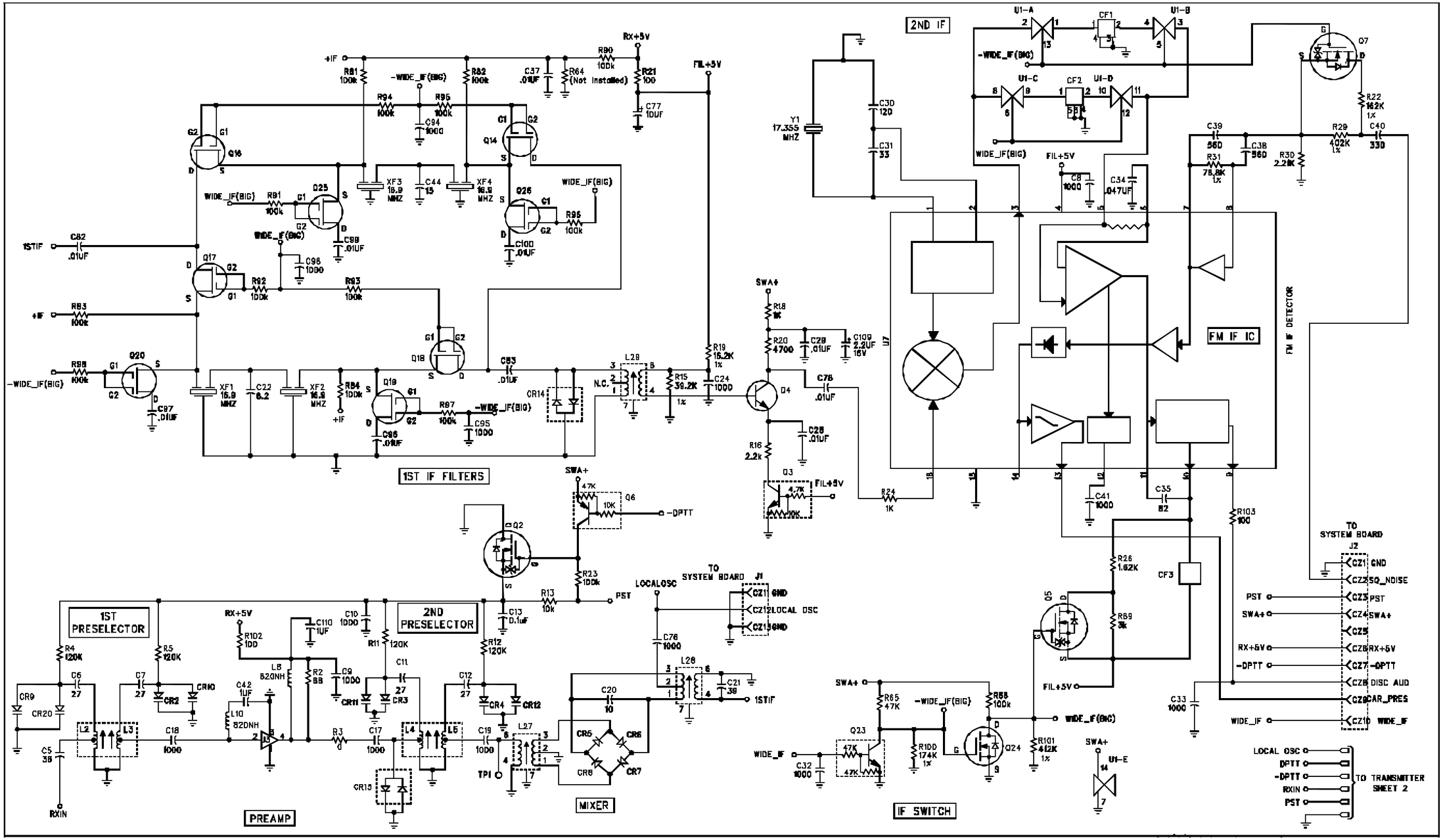
Item Reference Number	Part Number	Description
R1	4732-00334-531	Res,Cp,330K,5%,1/16W,0603
R2	4732-00680-531	Res,Cp,68_Ohm,1/16W,5%,0603
R3	4724-00000-009	Res,Cp,0_Ohm,0.1W,2A_Max0805
R4	4732-00124-531	Res,Cp,120K,5%,1/16W,0603
R5	4732-00124-531	Res,Cp,120K,5%,1/16W,0603
R8	4732-00222-531	Res,CP,2200,5%,1/16W,0603,
R9	4724-00560-233	Res,Cp,56_Ohm,5%,1/10W,0805
R10	4732-00181-531	Res,CP,180,5%,1/16W,0603
R11	4732-00124-531	Res,Cp,120K,5%,1/16W,0603
R12	4732-00124-531	Res,Cp,120K,5%,1/16W,0603
R13	4732-00103-531	Res,Cp,10K,5%,1/16W,0603
R14	4728-00019-945	Res,Cp,.10_Ohm,1/4W,10%
R15	4724-03922-213	Res,Cp,39.2K,1/10W,1%,0805
R16	4724-00222-233	Res,Cp,2200_Ohm,1/10W,5%,0805,
R17	4732-00151-531	Res,Cp,150_Ohm,5%,1/16W,0603
R18	4732-01622-511	Res,Cp,16.2K,1/16W,1%,0603
R19	4732-01622-511	Res,Cp,16.2K,1%,1/16W,0603
R20	4732-00472-531	Res,Cp,4.7K,5%,1/16W,0603
R21	4724-00101-233	Res,Cp,100_Ohm,1/10W,5%,0805,
R22	4732-01623-511	Res,Cp,162K,1%,1/16W,0603
R23	4732-00104-531	Res,CP,100K,5%,1/16W,0603
R24	4732-00102-531	Res,Cp,1K,5%,1/16W,0603
R26	4732-01621-511	Res,Cp,1.62K,1%,1/16W,0603
R27	4732-00181-531	Res,CP,180,5%,1/16W,0603
R29	4732-04023-511	Res,Cp,402K,1%,1/16W,0603
R30	4732-02211-511	Res,Cp,2.21K,1%,1/16W,0603
R31	4732-07682-511	Res,Cp,76.8K,1%,1/16W,0603
R36	4732-00300-531	Res,Cp,30_Ohm,5%,1/16W,0603
R37	4732-01132-511	Res,Cp,11.3K,1%,1/16W,0603
R38	4732-01103-511	Res,Cp,110K,1%,1/16W,0603
R39	4732-05112-511	Res,Cp,51.1K,1%,1/16W,0603
R43	4732-02001-511	Res,Cp,2K,1%,1/16W,0603
R44	4732-08872-511	Res,Cp,88.7K,1%,1/16W,0603
R45	4732-01003-511	Res,Cp,100K,1%,1/16W,0603
R46	4732-02001-511	Res,Cp,2K,1%,1/16W,0603
R51	4732-00473-531	Res,Cp,47K,5%,1/16W,0603
R52	4728-00621-335	Res,Cp,620_Ohm,1/4W,5%
R53	4732-00334-531	Res,Cp,330K,5%,1/16W,0603
R65	4732-00473-531	Res,Cp,47K,5%,1/16W,0603
R66	4732-00104-531	Res,CP,100K,5%,1/16W,0603
R81	4732-00104-531	Res,CP,100K,5%,1/16W,0603
R82	4732-00104-531	Res,CP,100K,5%,1/16W,0603
R83	4732-00104-531	Res,CP,100K,5%,1/16W,0603
R84	4732-00104-531	Res,CP,100K,5%,1/16W,0603
R89	4732-00302-531	Res,Cp,3K,5%,1/16W,0603
R90	4732-00104-531	Res,CP,100K,5%,1/16W,0603
R91	4732-00104-531	Res,CP,100K,5%,1/16W,0603
R92	4732-00104-531	Res,CP,100K,5%,1/16W,0603
R93	4732-00104-531	Res,CP,100K,5%,1/16W,0603
R94	4732-00104-531	Res,CP,100K,5%,1/16W,0603
R95	4732-00104-531	Res,CP,100K,5%,1/16W,0603
R96	4732-00104-531	Res,CP,100K,5%,1/16W,0603
R97	4732-00104-531	Res,CP,100K,5%,1/16W,0603

Item Reference Number	Part Number	Description
R98	4732-00104-531	Res,CP,100K,5%,1/16W,0603
R100	4732-01743-511	Res,Cp,174K,1%,1/16W,0603
R101	4724-04123-213	Res,Cp,412K,1%,1/10W,0805
R102	4732-00101-531	Res,Cp,100,5%,1/16W,0603,
R103	4732-00101-531	Res,Cp,100,5%,1/16W,0603,
S1	2508-20029-701	Shield,30/12.5_RT,SHM,EP,
U1	3134-30670-505	IC,BAS,SO14,
U3	3134-50394-077	IC,RFA,SOT143
U4	3132-30595-002	IC,RFA
U5	3134-30911-003	IC,OP_AMP,R/R,SOT-23
U6	3134-30950-302	IC,REG,ADJ,LDO,50ma,SC70
U7	3134-30670-620	IC,IF,FM,SSOP16
XF1	2705-20022-600	Fltr, Xtal,16.9MHz
XF2	2705-20022-600	Fltr,Xtal,16.9MHz
XF3	2705-20022-800	Fltr,Xtal,16.9MHz
XF4	2705-20022-800	Fltr,Xtal,16.9MHz
Y1	2301-20011-600	Xtal,2nd_Lo,17.355MHz,HC-18,
Z14	2508-20001-600	Shield,Can_Dual,SHM,LP,10X20X10MM,
Z15	2508-20001-600	Shield,Can_Dual,SHM,LP,10X20X10MM,



TOP SIDE – VIEWED FROM THE TOP

BOTTOM SIDE – VIEWED FROM THE BOTTOM



BK RADIO **Figure 6-13 RX/TX Board 5 Watt Schematic** Page 6-49
[Sheet 1]

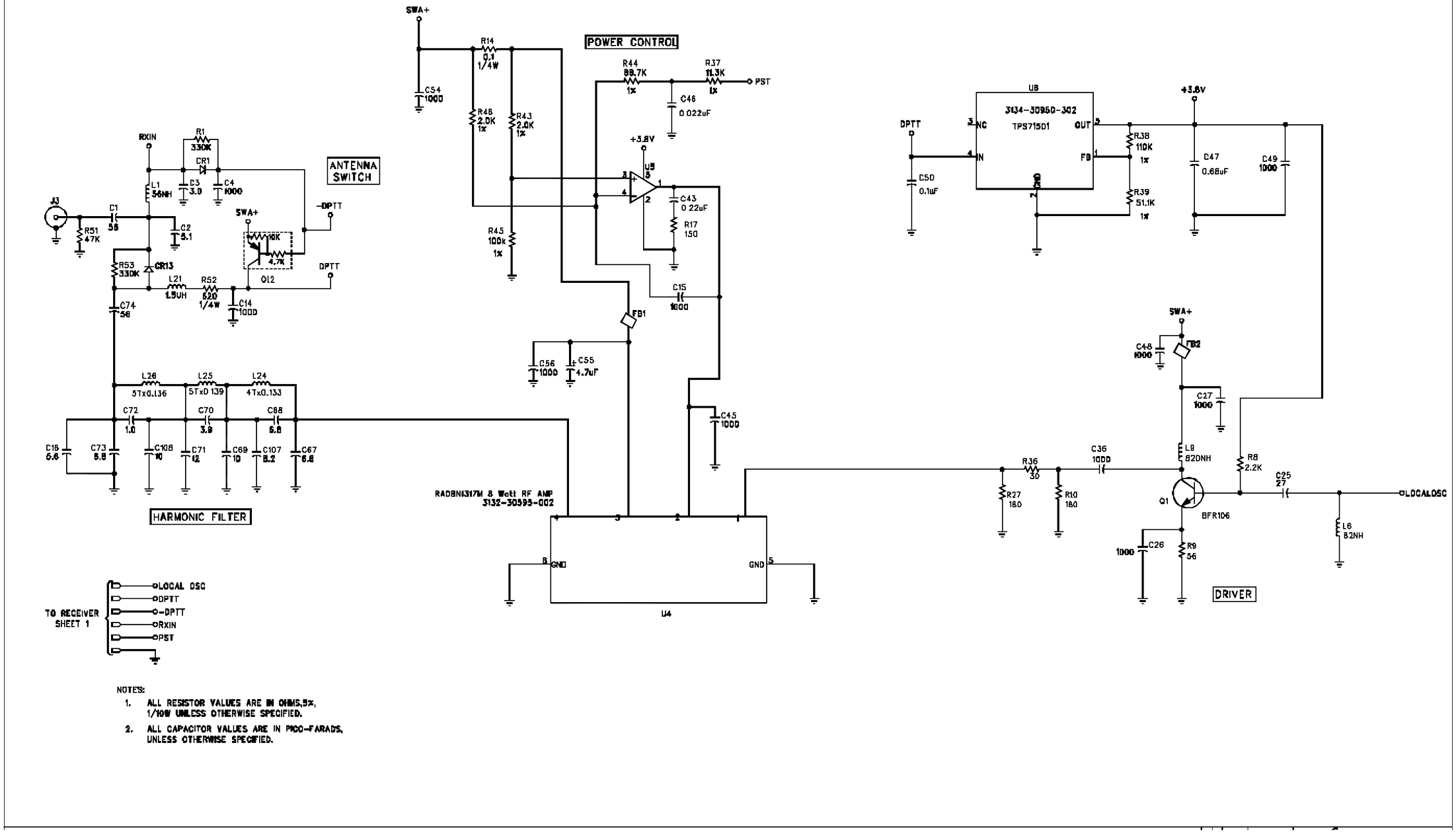

ANTENNA SWITCH
POWER CONTROL
HARMONIC FILTER
DRIVER
RADBN1317M 5 Watt RF AMP
3132-30595-002
U4
U8
3134-30950-302
TPS71501
+3.6V
SWA+
RXIN
DPTT
-DPTT
PST
LOCAL OSC
RXIN
TO RECEIVER SHEET 1
Q1
BFR106
Q12
CR13
L26
L25
L24
5Tx0.136
5Tx0.139
4Tx0.133
NOTES:
1. ALL RESISTOR VALUES ARE IN OHMS,5%, 1/10W UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITOR VALUES ARE IN PICO-FARADS, UNLESS OTHERWISE SPECIFIED.

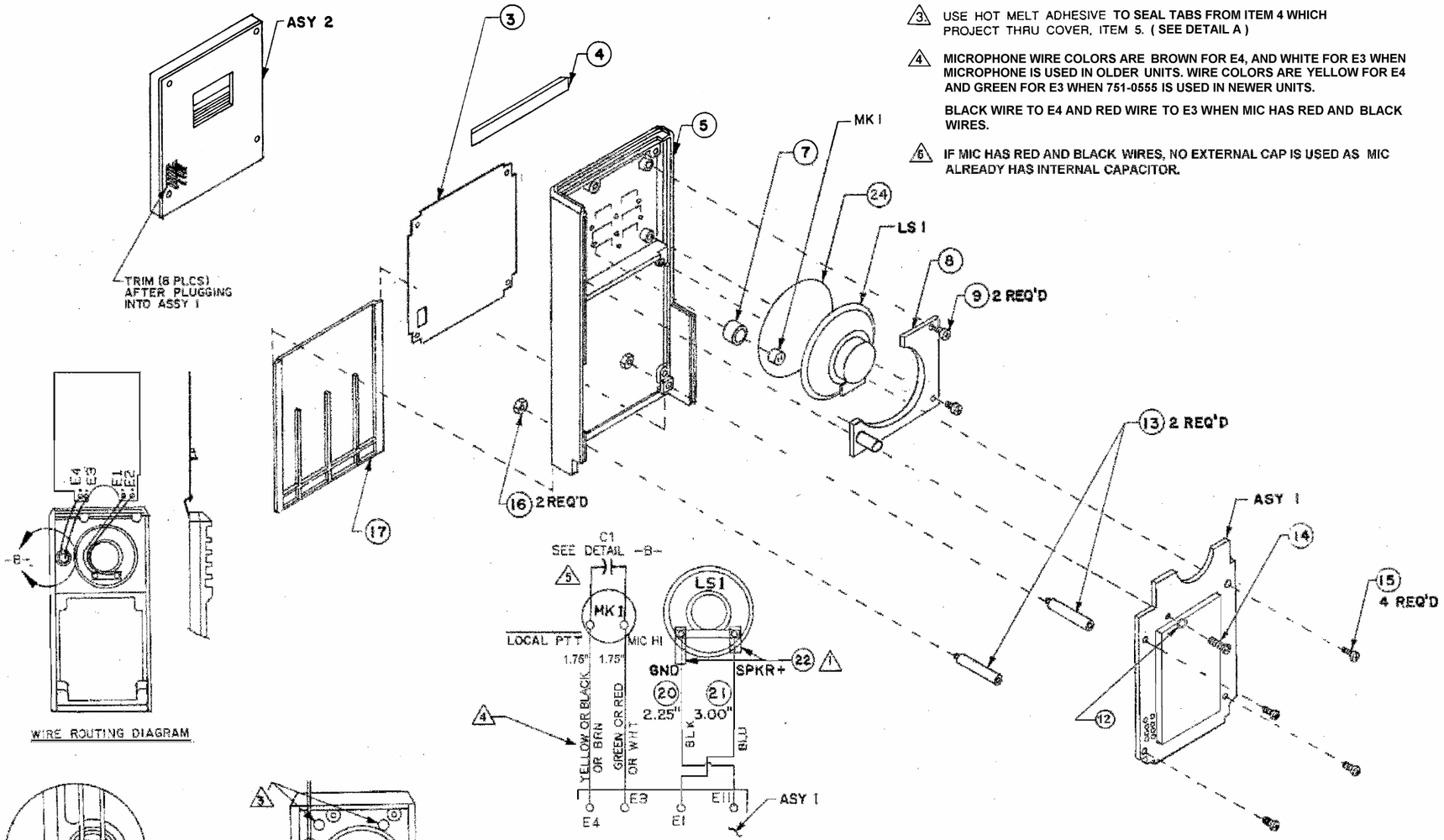
Table 6-8. Replacement Parts, Front Cover Assembly

Item Reference Number	Part Number	Description
ITM 3	2512-20034-101	Gasket, Kybd-Display
ITM 4	1411-60278-404	Inlay,Nameplate, No Pin
ITM 5	1411-60701-203	Cover,Front,MH,Blk
ITM 7	1411-40001-800	Bushing, Mic, Molded, EP
ITM 8	1411-40006-100	Spkr, Clip, Molded, EP
ITM 9	2807-30298-011	Scr, SIMMS, 2-56, 3/16, P, PH, ST, CAD/ZN
ITM 12	2843-00000-002	Washer, #2, Split-Lock, Cad-Steel.(Metal Case)
ITM 13	2813-20027-702	Standoff, LPU/MPU
ITM 14	2801-00437-006	Scr, MS, 2-56, X7/16, P, PH, ST, CAD
ITM 15	2816-30434-007	Scr,Plas,2-28,X9/32,P,PH,ST,BLKOX,
ITM 17	2506-30968-201	Cover-Blank,Display-Keyboard (Optional)
ITM 17	2506-30968-202	Cover w/Cut-Outs,Display-Keryboard (Optional)
ITM 17	2506-30968-301	Cover-Blank,Keyboard (Optional)
ITM 17	2506-30968-302	Cover w/Access Holes,Keryboard (Optional)
ITM 20	6026-30315-801	Wire, Strnd, 26GA, 250V, BLK-Teflon
ITM 21	6026-30315-807	Wire, 26GA, StrTef, Blue
ITM 22	3102-00000-002	Tubing,Htshrk,BLK,Fit105,3/32,
ITM 24	1406-20033-800	Grill, Cloth-Speaker
LS1	1301-20034-702	Spkr, 8 Ohm, 1 W,
MK1	1310-30956-000	Mic Cart,elec.
ASY 1		Option Board Assembly
ASY 2		Display Board Assembly

NOTES:

1. APPLY SHRINK TUBING (ITEM 22) TO SOLDER CONNECTIONS OF LSI, LENGTH: .20 FOR SPKR +, .70 FOR GND.
2. USE HOT MELT ADHESIVE **TO SECURE MICHROPHONE WIRES TO COVER, ITEM 5. (SEE DETAIL A)**
3. USE HOT MELT ADHESIVE **TO SEAL TABS FROM ITEM 4 WHICH** PROJECT THRU COVER, ITEM 5. **(SEE DETAIL A)**
4. **MICROPHONE WIRE COLORS ARE BROWN FOR E4, AND WHITE FOR E3 WHEN MICROPHONE IS USED IN OLDER UNITS. WIRE COLORS ARE YELLOW FOR E4 AND GREEN FOR E3 WHEN 751-0555 IS USED IN NEWER UNITS.**

   BLACK WIRE TO E4 AND RED WIRE TO E3 WHEN MIC HAS RED AND BLACK WIRES.
6. **IF MIC HAS RED AND BLACK WIRES, NO EXTERNAL CAP IS USED AS MIC ALREADY HAS INTERNAL CAPACITOR.**



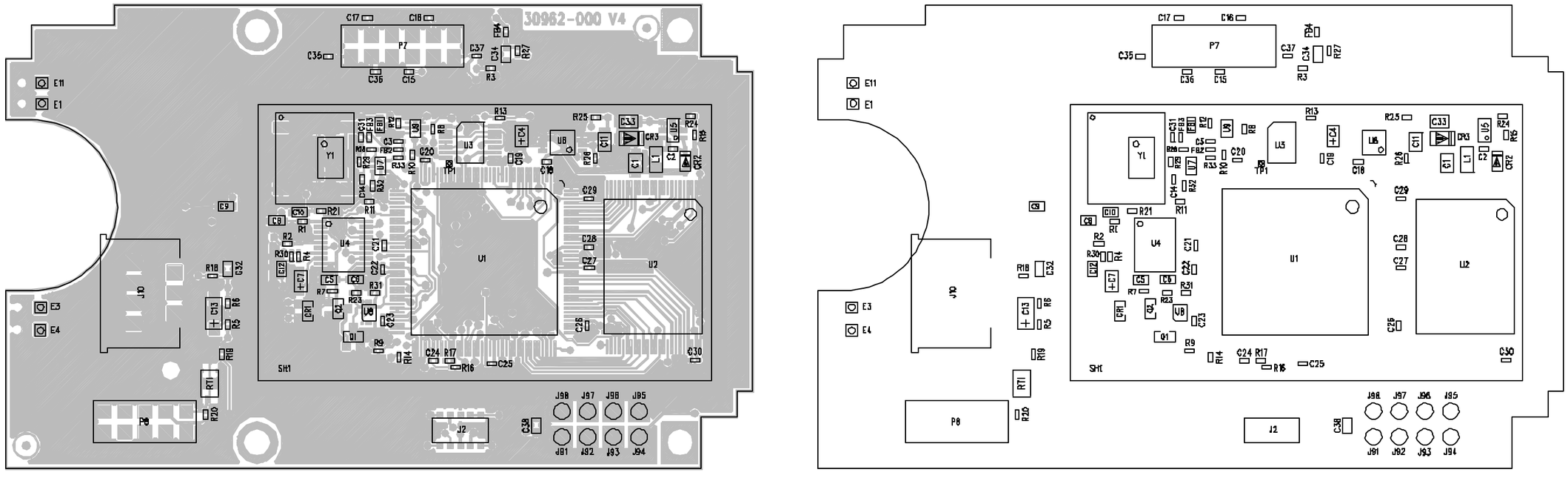
FRONT COVER ASSEMBLY
0008-30933-400 REV. C

Table 6-9 Replacement Parts, Options Board (309-620 Rev. E)

Item Reference Number	Part Number	Description
ITM1	1700-30962-000	PCB, OPTION BOARD
ITM2	2512-20035-900	Spacer,Resiliant
ITM3	2508-30945-600	SHIELD,OPTION BOARD
C1	1570-05106-788	Cap,Cp,10uF,X5R,+/-20%,6.3V,0805
C2	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C3	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C4	1552-60463-162	Cap,Tant,10uF,+/-20%,6.3V,2012
C5	1570-00104-261	Cap,Cp,0.1UF,5%,X7R,16V,0603
C6	1570-00104-261	Cap,Cp,0.1UF,5%,X7R,16V,0603
C7	1552-60463-162	Cap,Tant,10uF,+/-20%,6.3V,2012
C8	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C9	1570-00105-777	Cp,Cap,1uF,X5R,10%,10V,0603
C10	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C11	1570-05105-781	Cap,Cp,1uF,X5R,+/-20%,16V,0805
C12	1570-00104-261	Cap,Cp,0.1UF,5%,X7R,16V,0603
C13	1552-60463-158	Cap., Tant, 1uF, 10%, 20V
C14	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C15	1570-03101-263	Cp,Cap,100PF,X7R,5%,0402
C16	1570-03101-263	Cp,Cap,100PF,X7R,5%,0402
C17	1570-03101-263	Cp,Cap,100PF,X7R,5%,0402
C18	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C19	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C20	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C21	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C22	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C23	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C24	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C25	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C26	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C27	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C28	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C29	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C30	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C31	1570-03103-261	Cap,Cp,.01uF,5%,X7R,16V,0402
C32	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C33	1570-05105-781	Cap,Cp,1uF,X5R,+/-20%,16V,0805
C34	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
C35	1570-03101-263	Cp,Cap,100PF,X7R,5%,0402
C36	1570-03101-263	Cp,Cap,100PF,X7R,5%,0402
C37	1570-03101-263	Cp,Cap,100PF,X7R,5%,0402
C38	1570-00102-163	Cap,CP,1.0nF,5%,COG,50V,0603,
CR1	4824-20009-500	Di,Sil,Switching-Dual,SOT-23,
CR2	4824-30541-202	Di,Switching,
CR3	4824-30599-702	DI,SCHOTTKY,SOD-123
J10	2105-40012-107	Conn,Flex_Circuit,7_Pos,
J91	2108-20002-501	Socket,Mini,Spring,
J92	2108-20002-501	Socket,Mini,Spring,
J93	2108-20002-501	Socket,Mini,Spring,

Item Reference Number	Part Number	Description
J94	2108-20002-501	Socket,Mini,Spring,
J95	2108-20002-501	Socket,Mini,Spring,
J96	2108-20002-501	Socket,Mini,Spring,
J97	2108-20002-501	Socket,Mini,Spring,
J98	2108-20002-501	Socket,Mini,Spring,
P7	2105-20035-706	CONN_.025 SQUARE,6PIN
P8	2105-20035-705	Conn.Square,5_Pin,.025Sq
FB1	2503-02102-410	Bead,Ferrite
FB2	2503-02121-505	Bead,Ferrite
FB3	2503-02121-505	Bead,Ferrite
FB4	2503-02121-505	Bead,Ferrite
L1	1812-10014-251	IND,Fxd,Pwr,10 uH,10%
Q1	4823-30680-002	Xstr,NPN,W/Bias,47K/47K,SOT-23
Q2	4823-30680-010	Xstr,PNP,W/Bias,10K/10K,SOT-23,
R1	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R2	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R3	4734-01101-311	Res,Cp,1.1K,1%,1/16W,0402
R4	4734-02212-311	Res,CP,22.1K,1%,1/16W,0402
R5	4734-03011-311	Res,CP,3.01K,1%,1/16W,0402
R6	4734-02001-311	Res,CP,2K,1%,1/16W,0402
R7	4734-01002-311	Res,CP,10K,1%,1/16W,0402
R8	4734-01002-311	Res,CP,10K,1%,1/16W,0402
R9	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R10	4734-01502-311	Res,CP,15K,1%,1/16W,0402,
R11	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R12	4734-01502-311	Res,CP,15K,1%,1/16W,0402,
R13	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R14	4734-05621-311	Res,CP,5.62K,1%,1/16W,0402
R15	4734-01652-311	Res,CP,16.5K,1%,1/16W,0402,
R16	4734-04751-311	Res,CP,4.75K,1%,1/16W,0402
R17	4734-04751-311	Res,CP,4.75K,1%,1/16W,0402
R18	4734-02000-311	Res,Cp,200_Ohms,1%,1/16W,0402
R19	4734-00000-008	Res,Cp,0_Ohms(Jumper),1/16W,1A,0402
R20	4734-01003-311	Res,CP,100K,1%,1/16W,0402
R21	4734-01001-311	Res,CP,1.00K,1%,1/16W,0402
R23	4734-01002-311	Res,CP,10K,1%,1/16W,0402
R24	4734-01002-311	Res,CP,10K,1%,1/16W,0402
R25	4734-01009-311	Res,Cp,10_Ohms,1/16W,1%,0402
R26	4734-01003-311	Res,CP,100K,1%,1/16W,0402
R27	4734-01009-311	Res,Cp,10_Ohms,1/16W,1%,0402
R28	4734-01003-311	Res,CP,100K,1%,1/16W,0402
R29	4734-01003-311	Res,CP,100K,1%,1/16W,0402
R30	4734-01000-311	Res,Cp,100_ohm,1%,1/16W,0402
R31	4734-03920-311	Res,CP,392_OHMS,1%,1/16W,0402
R32	4734-02009-311	Res,Cp,20_Ohms,1%,1/16W,0402
R33	4734-02009-311	Res,Cp,20_Ohms,1%,1/16W,0402
RT1	5302-30958-201	Thermistor, 5%,SMD 1206

Item Reference Number	Part Number	Description
U1	3134-30949-710	IC,DSP
U2	3134-30949-800	IC, Flash Mem,
U3	3134-30949-900	IC,Quad 2-Input,Pos-NAND,
U4	3134-30950-000	IC, 16 Bit A/D & 16 Bit D/A,
U5	3134-30950-400	IC,Sw,Reg,3.3V,SOT-23
U6	3134-30950-305	IC,REG,1.5V,150mA,LDO,
U7	3134-30960-100	IC,Uni-Direct,Xlator,
U8	3134-30950-600	IC,T_Logic,ULP,D_Flp/Flp
U9	3134-30950-601	IC,T_Logic,ULP
Y1	2390-30957-100	TCXO, 19.6608 MHz, SMD



TOP SIDE – VIEWED FROM THE TOP

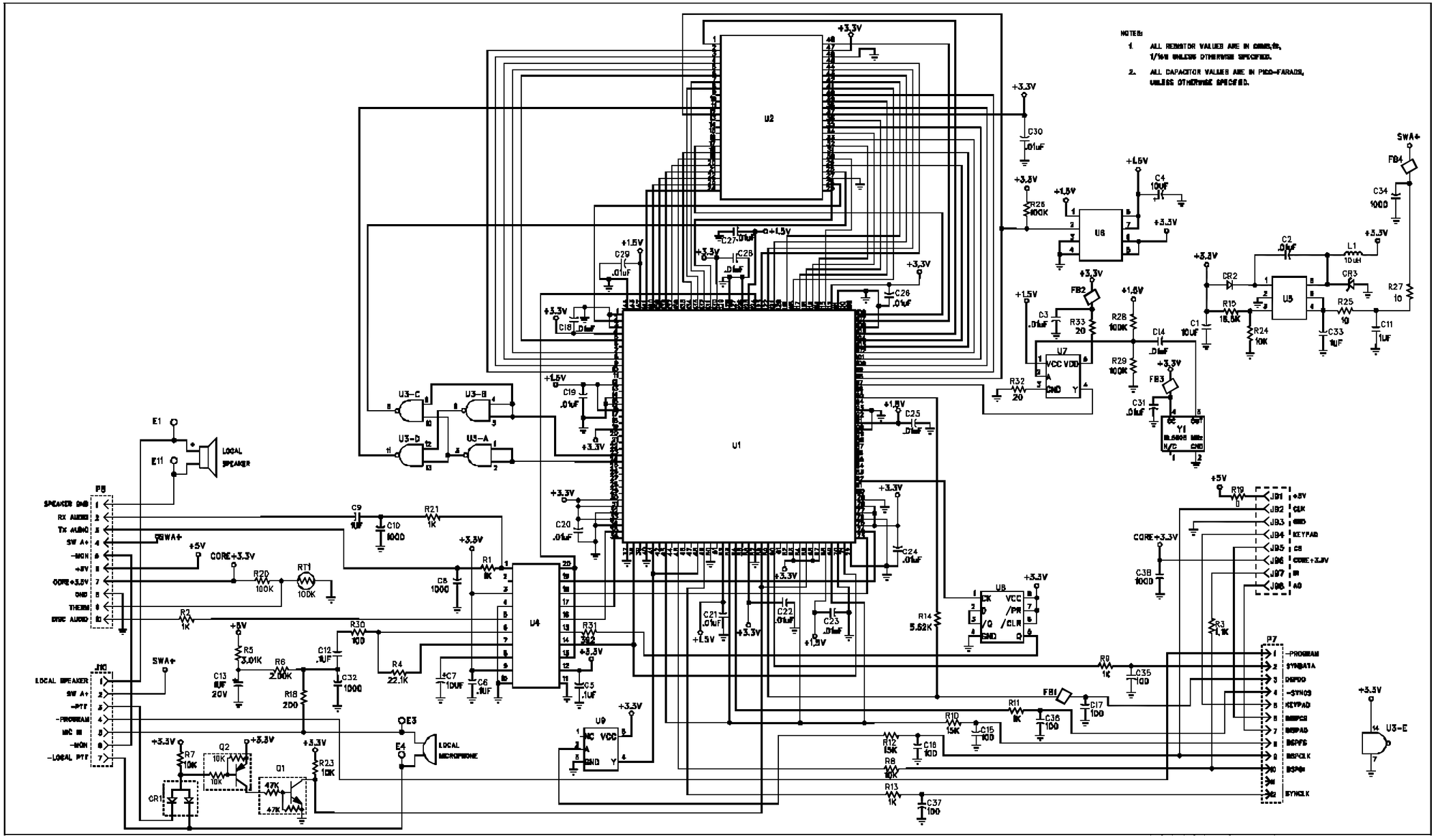
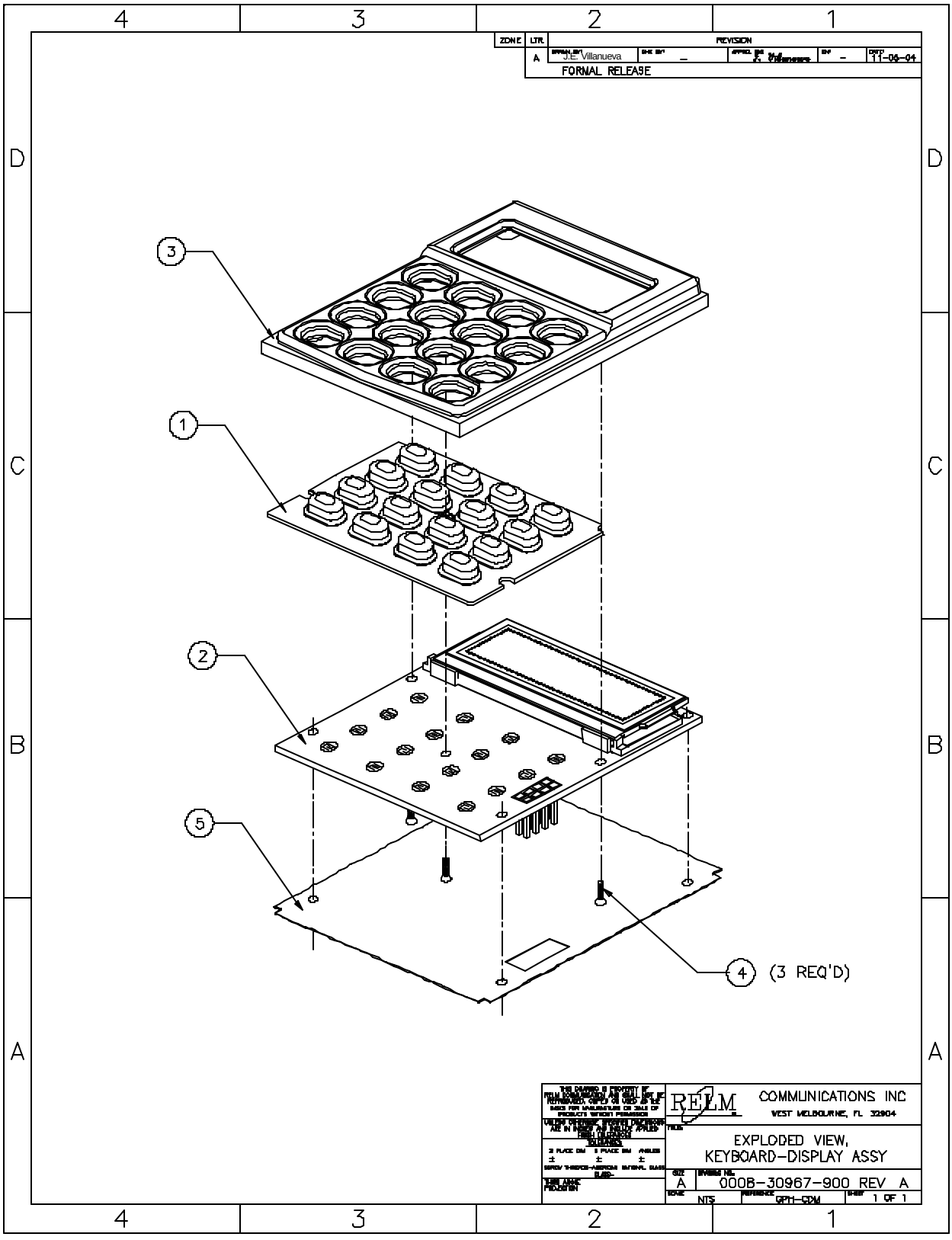

NOTES:
1. ALL RESISTOR VALUES ARE IN OHMS, 5%, 1/10W UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITOR VALUES ARE IN PICO-FARADS, UNLESS OTHERWISE SPECIFIED.
U1
U2
U4
U5
U6
U7
U8
U9
U3-C
U3-B
U3-D
U5-A
U3-E
+3.3V
+1.5V
+5V
CORE+3.3V
SWA+
LOCAL SPEAKER
LOCAL MICROPHONE
P8
P7
J10
E1
E11
E3
E4
Y1
Q1
Q2
CR1
CR2
CR3
FB1
FB2
FB3
FB4
RT1
SPEAKER GND
RX AUDIO
TX AUDIO
SW A+
-MON
+8V
CORE+3.3V
GND
THERM
DISC AUDIO
LOCAL SPEAKER
SW A+
-PTT
-PROGRAM
MIC IN
-MON
-LOCAL PTT
-PROGRAM
SYNDATA
DSPDO
-SYNCS
KEYPAD
DSPCS
DSPAD
DSPFS
DSPCLK
DSPdn
SYNCLK
JB1 +5V
JB2 CLK
JB3 GND
JB4 KEYPAD
JB5 CS
JB6 CORE+3.3V
JB7 IN
JB8 AO

Table 6-10 Replacement Parts, Keyboard/Display Assembly

Item Reference Number	Part Number	Description
Item 1	2001-30959-701	KEYBOARD, SILICONE
Item 2	2003-30964-300	LCD/Keyboard Assembly
Item 3	1411-30959-600	Insert Assembly,Black
Item 4	2816-30434-012	Scr,2-28x.156,FPH
Item 5	2512-20034-101	Gasket,Kybd-Display


4
3
2
1
D
C
B
A
ZONE
LTR.
REVISION
A
J.E. Villanueva
11-08-04
FORMAL RELEASE
3
1
2
5
4 (3 REQ'D)
RELM
COMMUNICATIONS INC
WEST MELBOURNE, FL 32904
EXPLODED VIEW,
KEYBOARD-DISPLAY ASSY
A
0008-30967-900 REV A
NTS
GPH-CDM
1 OF 1

APPENDIX A
INTEGRATED CIRCUIT DATA

INTRODUCTION

This appendix contains descriptions of certain integrated circuits as an aid to understanding the operation of this equipment. Detailed information on IC's containing basic logic elements, op-amps, and other simple circuits are not included in this appendix as their theory of operation is summarized below and the operation of such circuits within this equipment may be readily understood from a review of this summary and the schematic diagrams included in Section VI of this manual.

BASIC LOGIC ELEMENTS

BUFFER

$Z = A$

A	Z
0	0
1	1

INVERTER

$Z = \overline{A}$

A	Z
0	1
1	0

OR GATE

$Z = A+B+C$

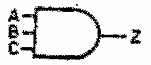
A	B	C	Z
0	0	0	0
1	0	0	1
0	1	0	1
0	0	1	1
1	1	0	1
1	0	1	1
0	1	1	1
1	1	1	1

NOR GATE

$Z = \overline{A+B+C}$

A	B	C	Z
0	0	0	1
1	0	0	0
0	1	0	0
0	0	1	0
1	1	0	0
1	0	1	0
0	1	1	0
1	1	1	0

AND GATE



$Z = ABC$

A	B	C	Z
0	0	0	0
1	0	0	0
0	1	0	0
0	0	1	0
1	1	0	0
1	0	1	0
0	1	1	0
1	1	1	1

NAND GATE

$Z = \overline{ABC}$

A	B	C	Z
0	0	0	1
1	0	0	1
0	1	0	1
0	0	1	1
1	1	0	1
1	0	1	1
0	1	1	1
1	1	1	0

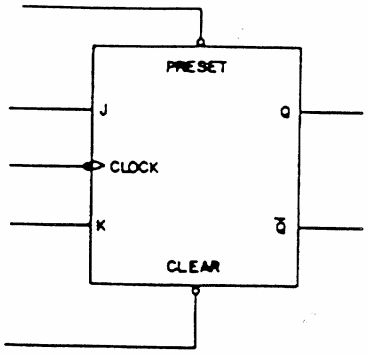
EXCLUSIVE OR GATE

$Z = A \oplus B$

A	B	Z
0	0	0
1	0	1
0	1	1
1	1	0

J K FLIP-FLOP

The flip-flop logic element is the basic data storage element of digital logic. It has two outputs that are always at opposite logic levels. That is, when one output is HI the other is LO. The flip-flop will remain in a particular state until that state is changed by an input signal.



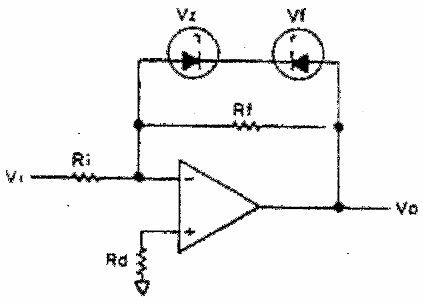
J	K	Q	$\overline{Q}$
L	L	Qo	$\overline{Q}$o
H	L	H	L
L	H	L	H
H	H	Toggle	

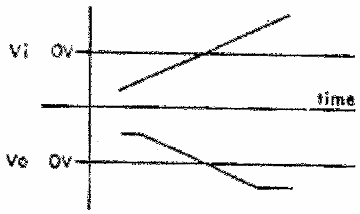
BASIC OP-AMP CIRCUITS

LIMITER

An output voltage may be limited to certain levels by selection appropriate zener diodes and placing them in parallel with the feedback resistor. Voltage limiting can be accomplished in both directions in this manner.

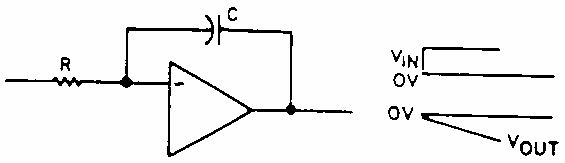
$$Vo\ (max) = Vz + Vf$$





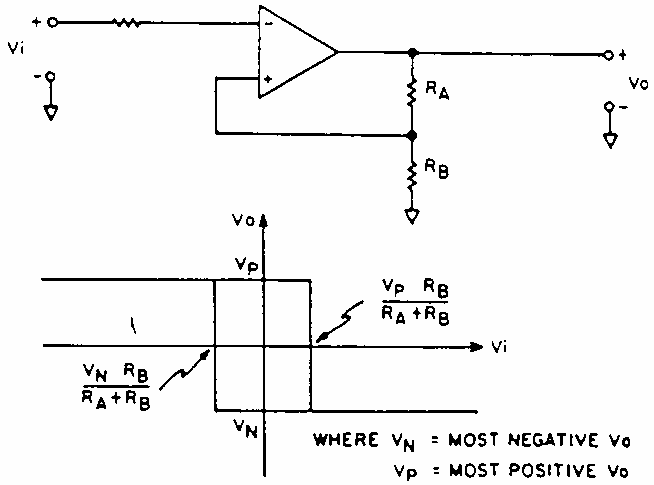
INTEGRATOR

An op-amp in which the only feedback element is a capacitor. The output of an integrator is a ramp, the slope of which is determined by the amplitude of the steady state input and the RC time constant.



ZERO CROSSING DETECTOR

The positive feed back path causes the output voltage to drive to the saturation potential of opposite polarity as the input voltage. Ideally, the output switches from one saturation level to the opposite saturation level as the input voltage passes through zero. Noise immunity demands the addition of R_B which requires that the input reach a certain magnitude after passing zero before the output will switch.

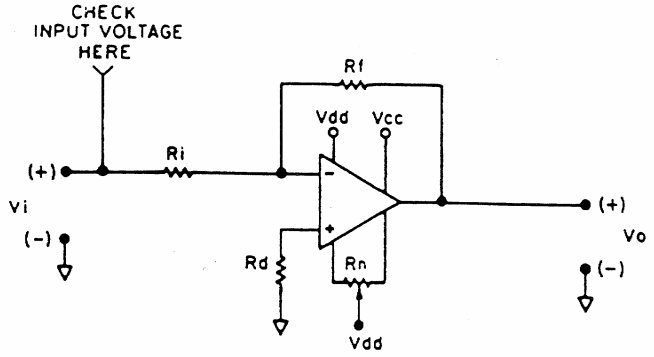


INVERTING OP-AMP AMPLIFIER

A voltage applied at the inverting (-) input will cause an output voltage (Vo) of opposite polarity as the applied voltage. The relationship of the input and output voltages is shown in the following equations:

$$Vo = (Rf/Ri)\ Vi \qquad GAIN = -(Rf/Ri)$$

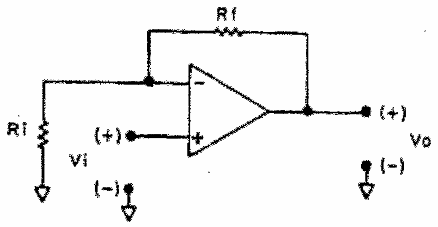
From the above equation, a zero input voltage should give a zero output if Rn has been adjusted to the null of the amplifier.



NON-INVERTING OP-AMP AMPLIFIER

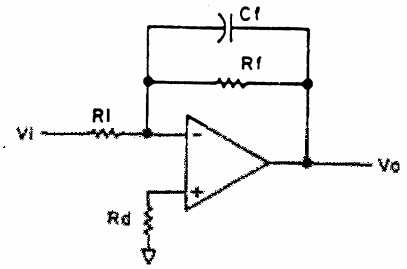
A voltage applied at the non-inverting (+) input will cause an output voltage (Vo) of the same polarity as the applied voltage. The relationship of the input and output voltages is shown in the following equations:

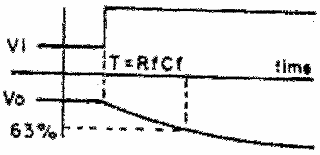
$$Vo = [1 + (Rf/Ri)]\ Vi \qquad GAIN = 1 + (Rf/Ri)$$



LOW PASS FILTER

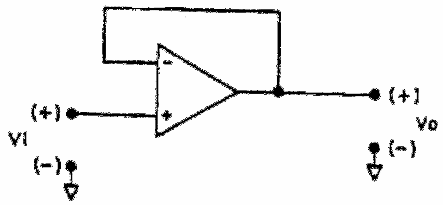
The low pass filter is a variation of an inverting op-amp circuit. The addition of capacitor Cf to the feedback network around the amplifier provides low pass filtering to the input voltage. The expression T = RfCf gives the time required for Vo to reach 63% of the final value.





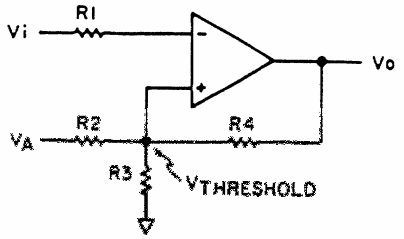
VOLTAGE FOLLOWER AMPLIFIER

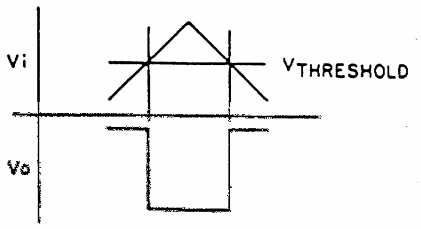
This configuration is a special case of the non-inverting amplifier previously discussed, with Rf equal to zero. Therefore the relationship of the input and output voltage reduces to Vo = Vi, or unity gain. It is used to provide high input impedance and buffering action.



THRESHOLD DETECTOR

Treshold detectors use positive feedback to toggle the op-amp output when the input voltage (Vi) is above or below a voltage level (V threshold) set by R2 and R3. R4 provides the positive feedback required for a clean switch from one saturation level to another. The voltage polarity (V_A) determines the initial output state of the amplifier and the polarity of the threshold being detected.

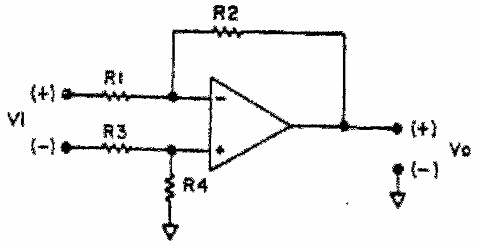




DIFFERENTIAL AMPLIFIER

The principal use of the differential amplifier is to translate signals, from sources referenced to some level other than signal ground, to signals referenced to signal ground. The relationship of the input and output voltages is shown in the following equations:

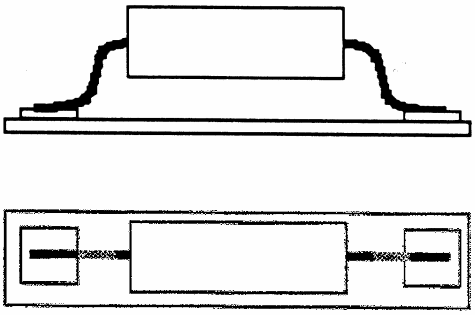
$Vo = -(Rf/Ri)\ Vi$, if $R1 = R3$ and $R2 = R4$ $\qquad$ $GAIN = -(Rf/Ri)$



SURFACE MOUNT COMPONENTS

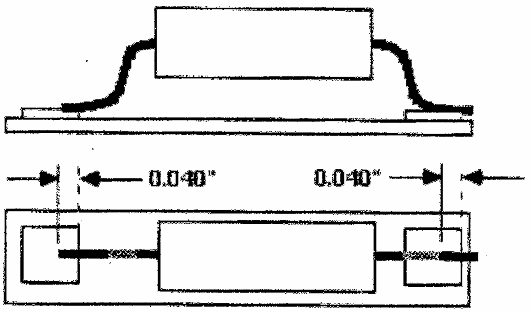
Round leaded and flat leaded components can be mounted on the surface of a board rather than through plated holes on a board.

The illustrations below demonstrate acceptable mounting practices for round leaded components on surface mount boards.



PREFERRED

Lead is centered on the pad. At least 0.040" (the thickness of a dime) is in contact with the pad. The lead does not overhang the pad.

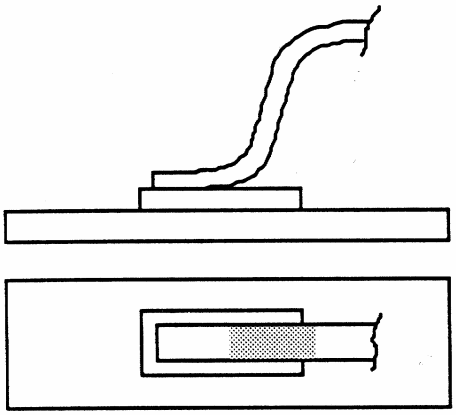


ACCEPTABLE MINIMUM

The lead has a minimum of contact area and has a slight overhang. The lead is not centered on the pad. The lead is at the edge of the pad. The contact area is not less than 0.040".

SURFACE MOUNT COMPONENTS (CON'T)

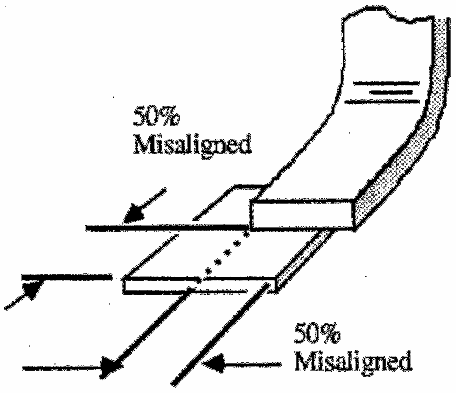
The illustrations below show acceptable ways of mounting flat leaded components.



PREFERRED

Lead is centered within the confines of the pad.

Heel rises before leaving pad area.

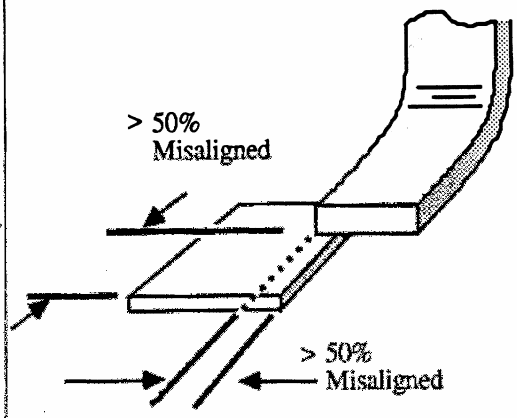


MINIMUM ACCEPTABLE

Lead misalignment is not more than 50%.

SURFACE MOUNT COMPONENTS (CON'T)

The illustration below shows an unacceptable way of mounting a flat leaded component.



UNACCEPTABLE - REWORK

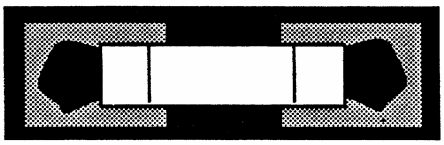
Lead is misaligned with the side of the pad or the length of the pad by more than 50%.

SURFACE MOUNT COMPONENTS (CON'T)

The following illustrations show acceptable solder height, amount of fillet, conductor spacing, and amount of allowable chip float.

The illustrations below show acceptable fillet heights.

TOP VIEW



SIDE VIEW

PREFERRED

Solder fillet height is 30% of the end height.

There is complete wetting of the pad and device end termination.

When the chips are wave soldered, it is permissible for the solder to come to the top or even over the cap of the end termination.

TOP VIEW

SIDE VIEW

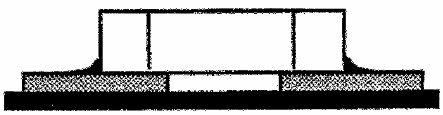
ACCEPTABLE

Solder fillet height is to the top of the end termination.

There is good wetting.

TOP VIEW

SIDE VIEW



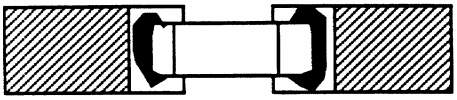
MINIMUM ACCEPTABLE

The fillet height is 10% of the end termination.

There is incomplete wetting of the pad and termination.

SURFACE MOUNT COMPONENTS (CON'T)

The illustrations below show acceptable amounts of solder applied to surface mount chips.

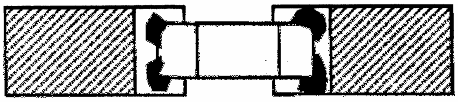


PREFERRED

The solder fillet is continuous around the perimeter of the chip termination.

There is good wetting of the land and termination.

Fillet height is approximately 30% of the termination height.

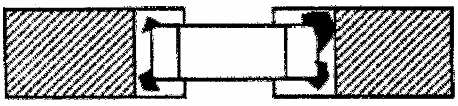


MINIMUM ACCEPTABLE

There is 50% solder coverage of the perimeter of the chip.

The fillet height is at least 10% of the termination height.

The illustration below shows a chip component that should be reworked because of insufficient solder. There is less than 50% solder coverage around the perimeter and bottom of the chip.



UNACCEPTABLE - REWORK

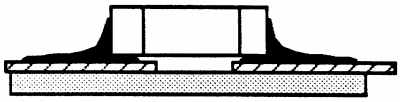
There is less than 50% solder coverage on the perimeter of the chip.

There is less than 50% solder coverage on the bottom of the chip.

The solder fillet is insufficient.

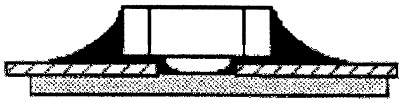
SURFACE MOUNT COMPONENTS (CON'T)

The two illustrations below show acceptable conductor spacing after solder flow. The spacing is not less than 50% of the original width or less than 0.005".



PREFERRED

The solder holds the chip to the pads and normal conductor spacings are maintained.



MINIMUM ACCEPTABLE

The spacing between the pads is reduced to 50% of the original spacing.

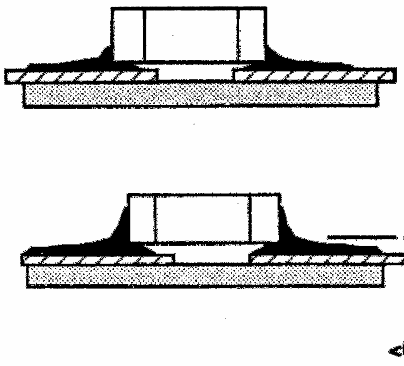
The illustration below shows an unacceptable chip component, where the spacing between pads is reduced by more than 50% because of excess solder. This component must be reworked.

REWORK - UNACCEPTABLE

The spacing between the pads is reduced by more than 50% because of excess solder.

SURFACE MOUNT COMPONENTS (CON'T)

The illustrations below show acceptable components that have not floated higher than 0.020" above their pads.



PREFERRED

The solder height is minimal.
The fillet is concave.
There is good wetting.
The chip is raised less than 0.020".

ACCEPTABLE

The solder has floated the chip off its adhesive (if used) but the amount of float is not greater than 0.020".

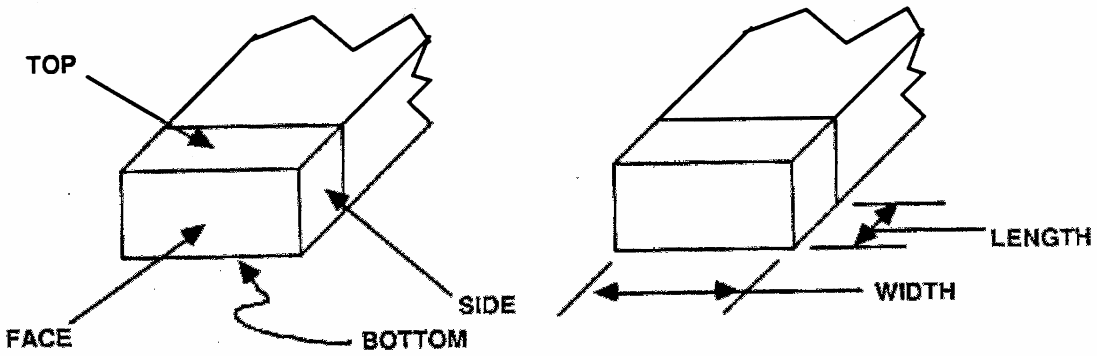
SURFACE MOUNT COMPONENTS (CON'T)

The criteria for acceptable and unacceptable end conditions in chip components are listed below.

You cannot have more than **20% of <u>any</u> <u>one</u> of the surfaces** of the end termination removed as a result of the soldering operation.

The end termination consists of five surfaces.

a. top
b. bottom
c. left side
d. right side
e. face



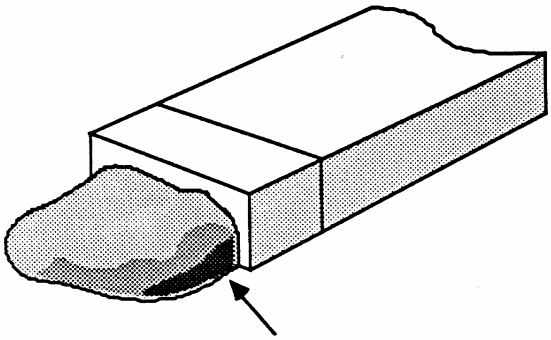
There shall be no visible evidence of a fractured solder connection.

Voids and pin holes are acceptable if the bottom of the hole is visible and good wetting is present - the fillet should be concave.

All deposits or residues of activated, RA, fluxes must be removed.

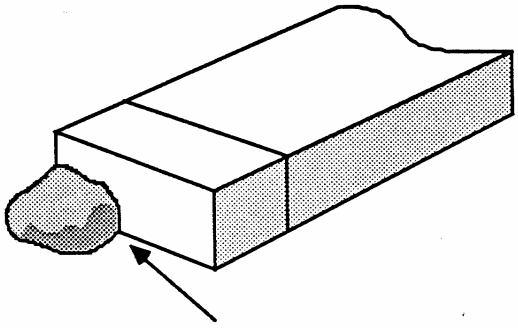
SURFACE MOUNT ASSEMBLIES (CON'T)

On mini-mica chip capacitors, the solder fillet shall be continuous on two sides for at least 50% of the component width.



GREATER THAN 50% COVERAGE OF CHIP WIDTH

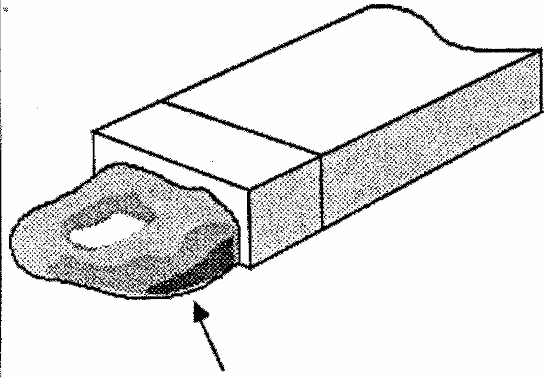
ACCEPTABLE



LESS THAN 50% COVERAGE OF CHIP WIDTH

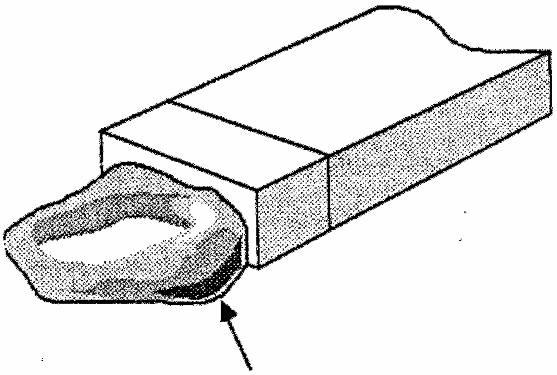
REWORK

Voids are permissible up to 80% of the coverage requirement.



VOID IS LESS THAN 80% OF THE SOLDER WIDTH

ACCEPTABLE



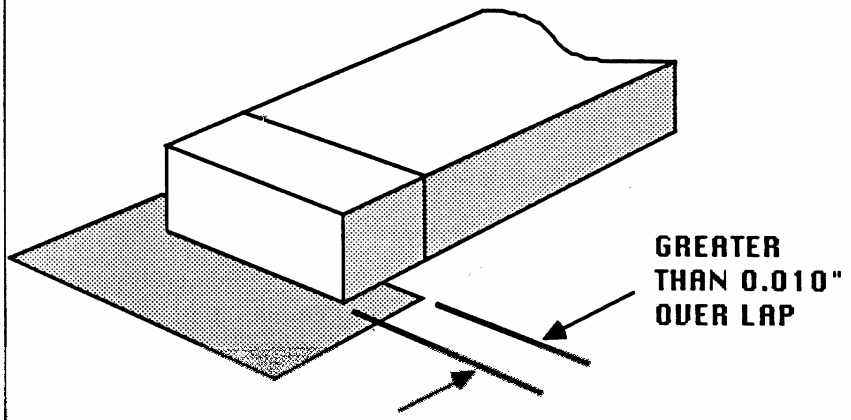
VOID IS GREATER THAN 80% OF THE SOLDER WIDTH

REWORK

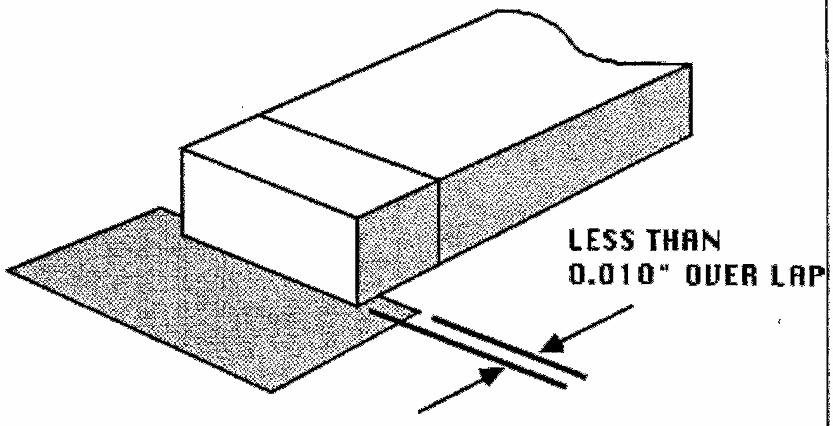
The minimally acceptable fillet shall rise from the pad to the edges of the capacitor that normally contacts the board and shall show a concave fillet.

SURFACE MOUNT COMPONENTS (CON'T)

The length part of the solderable end cap of the device should overlap the mounting pad by at least 0.010" (the thickness of two pieces of notebook paper).



ACCEPTABLE

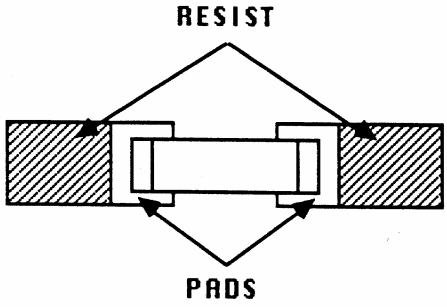


REWORK

SURFACE MOUNT COMPONENTS (CON'T)

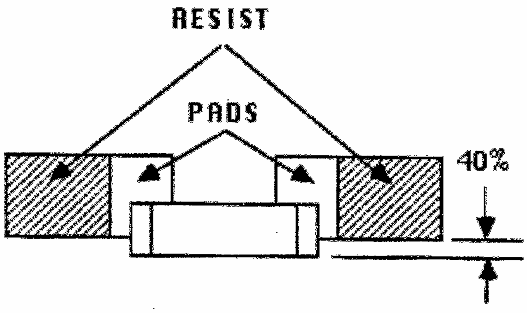
The illustrations below show the amount of chip misalignment that is acceptable.

The length part of the solderable end cap of the device should not be misaligned with the mounting pad by more than 50% of its length.



PREFERRED

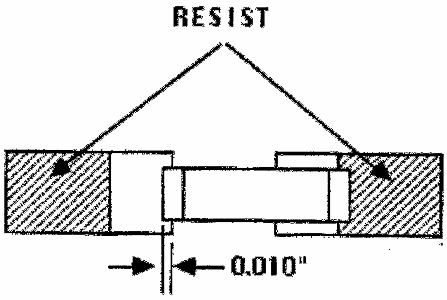
The part is evenly aligned between the two conductor lands (solder is not shown).



MINIMUM ACCEPTABLE

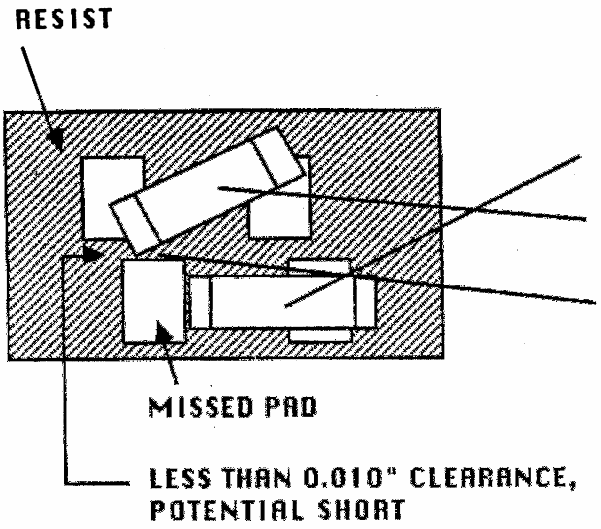
Part misalignment does not exceed 40% of the width.

Part overlap on the pads is not less than 0.010".



SURFACE MOUNT COMPONENTS (CON'T)

The illustration below shows an unacceptable amount of misalignment that should be reworked.



REWORK

The part does not overlap the pads.

Misalignment exceeds 50% of the width of the pad.

Poor positioning creating a potential short (**closer than 0.010" - the thickness of two sheets of paper**).