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# Foreword

## Scope of this manual

This manual contains the specifications, functional description, operating instructions, schematic, parts locator and parts list for the SVR-250 synthesized vehicular repeater.

This manual is intended for use by qualified service technicians to aid them with installation, interfacing, alignment and trouble shooting of the SVR-250 when used with other land mobile radios.

## Service manual revisions

Component changes, additions and deletions may occur in the circuit design to improve operation and will be reflected in future releases of this service manual. Specifications and circuit changes are subject to change without prior notice or obligation by Pyramid Communications.

## Safety Information

The SVR-250 is designed to operate within all applicable Federal regulations at the time of manufacture. Proper operation and service procedures will assure continued compliance with these regulations:

- Do not operate the SVR-250 without an antenna or appropriate RF load connected to the antenna connector.
- Do not operate the SVR-250 in the presence of unshielded electrical blasting caps or explosive environmental conditions.
- Do not operate the SVR-250 while refueling the vehicle or in the presence of explosive fumes.
- Do not operate the SVR-250 with persons standing closer than 2 feet from the mobile or repeater antenna.

## FCC information

The SVR-250 complies with the FCC rules parts 90 and 22 for radio frequency transmitters. The user must apply for a license to operate the SVR-250 transmitter pursuant to parts 90.243 and 90.247. Other FCC rules may apply depending on the class of service the user qualifies for. A complete listing of FCC rules and regulations may be ordered from:

Superintendent of Documents  
Government printing office  
Washington DC 20402

The following information pertaining to the SVR-250 should be included in the FCC license application:

	VHF	UHF	700/800/900 MHz
Type Acceptance:	LRUSVR-200VB	LRUSVR-200U	LRUSVR-200M
Output Power:	0.25-2.0W	0.25-2.0W	100mW-600mW
Emission designator:	11K0F3E/16K0F3E	11K0F3E/16K0F3E	11K0F3E/16K0F3E
Frequency band:	150-174 MHz	400-512MHz	764-806(700M), 806-824 or 850-870(800M) 897-902 or 936-941 (900M)
Number of Channels:	20	20	20

## Specifications

<b>Transmitter:</b>	<b>VHF</b>	<b>UHF</b>	<b>700/800/900 MHz</b>
Frequency Range:	150-174 MHz	405-425 MHz (UA) <sup>1</sup> 450-470 MHz (UD) 470-490 MHz (UE) <sup>1</sup>	764-776, 794-806 (MC,MD) 806-824, 850-870 (MB,MA) 897-902, 936-941 (ME,MF)
Rf power out:	250mW - 2W	250mW - 2W	100mW - 600mW
Spurious emissions:	-50dBc	-50 dBc	-50dBc
Freq stability -30°~+60°C:	1.5 PPM	1.5 PPM	1.5 PPM
Modulation:	16K0F3E/11K0F3E	16K0F3E/11K0F3E	16K0F3E <sup>2</sup> /11K0F3E
Hum and Noise:	-40/-37dB (25/12.5kHz)	-40/-37dB (25/12.5kHz)	-40/-37dB (25/12.5kHz)
Audio response (300-3kHz):	Flat or +6dB/octave	Flat or +6dB/octave	Flat or +6dB/octave
Audio distortion:	<3% @ 60% deviation	<3% @ 60% deviation	<3% @ 60% deviation
Local mic sensitivity:	300mV-5VPP	300mV-5VPP	300mV-5VPP
FCC Type Acceptance:	LRUSVR-200VB	LRUSVR-200U	LRUSVR-200M
Industry Canada Approval:	2390 195 458A	2390 212 113A	2390A-SVR200M

### Receiver:

Frequency Range:	150-174 MHz	405-425 MHz (UA) <sup>1</sup> 450-470 MHz (UD) 470-490 MHz (UE) <sup>1</sup>	764-776, 794-806 (MC,MD) 806-824, 850-870 (MB,MA) 897-902, 936-941 (ME,MF)
RF sensitivity:	.35μV	.35μV	.35μV
Squelch sensitivity:	.2μV to 2μV adjustable	.2μV to 2μV adjustable	.2μV to 2μV adjustable
Modulation acceptance:	±7.5/±3.75kHz	±7.5/±3.75kHz	±7.5 <sup>2</sup> /±3.75kHz
Selectivity:	60/57dB (25/12.5 kHz)	60/57dB (25/12.5 kHz)	50dB
Spurious/image rejection:	60db	60db	60db
IMD response:	60db	60db	60db
Frequency stability:	1.5 PPM	1.5 PPM	1.5 PPM
Audio response (300-3kHz):	Flat or -6db/octave	Flat or -6db/octave	Flat or -6db/octave
Audio output:	0-5VPP AC coupled	0-5VPP AC coupled	0-5VPP AC coupled
Local Rx Audio:	400 mW 8 Ohms	400 mW 8 Ohms	400 mW 8 Ohms

### Power Requirements:

DC Supply	13.6 VDC	13.6VDC	13.6VDC
Standby	170 mA	170mA	170mA
Receive	250 mA	250mA	250mA
Transmit	1 A @ 2W	1.5A @ 2W	700mA @ 600mW

### Physical:

Dimensions:	5.75"W x 8"L x 2.25"H
Weight:	36 oz.
Case:	One piece extruded aluminium

<sup>1</sup>405-425 and 470-490 available as special order Only

<sup>2</sup>16K0F3E & ±7.5kHz available on 806-824 and 850-870 MHz Only

## *Functional Description*

Generally, vehicular repeaters are used as mobile extenders in cross-band operation: the link is VHF/UHF/800 MHz simplex and the mobile is Lo-band, VHF, UHF or trunking. In-band operation is possible, but care must be taken to prevent interference between the mobile's higher power transmitter and the repeater receiver. Proper frequency selection and antenna placement are important even in cross-band operation, but especially for inband use. Low power pre-selector cavities may be placed in line with the repeater antenna cable since it is simplex and low power.

### **Important Note**

The SVR-250 is designed to operate on simplex frequencies; part of the multi-vehicle format dictates that all of the SVR-250s must be able to monitor all link traffic on site and be able to determine if a handheld is transmitting, or if other repeaters are transmitting. The handhelds must transmit CTCSS, but should be carrier squelch receive. ***The handhelds should not use CTCSS decode if the repeater is utilizing the multi-vehicle format***, as this will interfere with the priority sampling which is essential for multi-vehicle operation. Also, the handhelds would have to have different encode and decode tones in order for the repeater to be able to tell the difference between handhelds and other repeaters, so the handhelds would not be able to hear each other. ***The repeaters should not transmit CTCSS unless used only in a single vehicle environment.***

When the user leaves the vehicle, they activate the SVR-250 via their mobile radio front panel or a separate switch. When the mobile radio is receiving carrier and proper tone, the SVR-250 will begin transmitting on the handheld's receive frequency. The user is able to hear and respond to all radio traffic, including other handhelds at the site. The SVR-250 can be programmed to give the handhelds priority in a conversation by periodically sampling for handheld activity (carrier and proper tone) during base-to-portable transmissions. During sampling, if the SVR-250 detects a handheld transmission, it will cease transmissions, key the mobile radio and repeat portable-to-base. This allows the handheld to respond during repeater hang time or during full duplex interconnect calls. Priority sampling can be enabled/disabled through PC programming and the interval can be programmed between .25 seconds and 2.5 seconds in .25 second increments.

The SVR-250 has a programmable time out timer for base-to-portable transmissions. If the mobile COR is active for more than the programmed time (and the SVR-250 is the priority unit) it will send a double blip and cease transmission until the mobile COR is inactive. The time-out is in affect regardless of whether the SVR-250 is programmed for priority sampling or not.

### ***Multi-vehicle operation***

The SVR-250 has 2 different multi-vehicle priority formats; both are compatible with the existing SVR-200 and Motorola PAC/RT formats. The new SVR-250 with ESP™ logic has enhanced features that ensures a priority vehicle is selected and ready to transmit during the idle time rather than during voice transmissions. The 2 formats are explained below:

#### ***SVR-200 Legacy format***

When the SVR-250 is first activated, it will transmit a short "lock tone" that alerts the user that the system is functioning. It will then assume the priority status and be ready to repeat any base-to-portable or portable-to-base transmissions. If another unit arrives on scene and is activated, it too will transmit the "lock tone"; when the first SVR-250 detects the lock tone from the second unit, it will increment a "priority counter" and will no longer repeat any transmissions. The recently arrived unit will be the priority repeater, and the first unit will be 1 count away from priority. This process will continue for each unit that arrives at the site, creating a priority hierarchy for up to 256 vehicles, each with a unique count and only one unit at priority status. The SVR-250 will not transmit its lock tone if the radio channel is busy when first enabled. It will wait in non-priority status until all transmissions cease, then send its lock tone and become the priority unit.

Even though the other SVR-250s are not at priority status, they will continue to monitor the channel for activity. If the priority unit were to leave the scene or become disabled, the other units will detect the condition to repeat and determine that there is no priority unit repeating the transmission. They will then begin to decrement their priority counters until one of them reaches the priority status and begins repeating the transmission. Since the SVR-250s are all at different counts, only one will reach priority status and begin transmitting. The other units will sense the new priority repeater and cease counting down, preserving the priority hierarchy.

If another unit were to arrive from a different scene and it is still the active priority, there will be two active repeaters on the air when a condition to repeat exists. When one of the SVR-250s unkeys to check for handheld activity, it will detect the presence of the other active SVR-250 and increment its priority counter and cease transmission. This is the self clearing mode to prevent radio collisions.

### ***ESP™ Priority***

The SVR-250 Enhanced Sensor Priority works similar to the SVR-200 and PAC/RT formats and is completely backward compatible with those systems. The SVR-250 determines if there is a priority (and re-establishes the priority if missing) during idle time between conversations rather than at the critical start of a conversation. When a condition to repeat exists, the SVR-250 is always ready.

The priority SVR-250 will transmit a short tone burst every 10 seconds. This serves 2 purposes: It informs the handheld operator that they are still within range of the vehicle and it alerts the non-priority units that a priority vehicle is still on scene. As long as the non-priority units hear this "beacon" every 10 seconds, they preserve their counts and maintain the priority hierarchy. If the priority vehicle leaves the scene, after 10 seconds, the non-priority vehicles will not hear the "beacon" and begin counting down. When one of the counts=0, that SVR-250 will send lock tone for 800 mS, assume priority and begin sending the "beacon" tone every 10 seconds as before. Since the "beacon" tone must be heard every 10 seconds, it does not have busy carrier lock out and will send the tone if 2 handhelds are communicating directly or in the presence of co-channel interference.

### ***Local Mic Repeat***

If the handheld operator is out of the vehicle and their partner still in the vehicle were to key the mobile radio using the local mic, the SVR-250 will detect the local PTT and repeat the transmission to the other handhelds so that both sides of the conversation will be heard by everyone on the link. The local mic repeat function can be enabled/disabled via the PC software.

The SVR-250 also has a local receive audio speaker jack that enables the person in the vehicle to monitor portable-to-base transmissions that are being repeated through the mobile.

If the users wish to communicate portable-to-portable without accessing the mobile repeater, they may transmit on the same frequency without CTCSS (or a different CTCSS); the SVR-250 only responds to carrier and proper tone from the handhelds.

### ***Trunking operation***

When the SVR-250 is connected to a trunking mobile and the handheld operator wishes to access the system, they key their handheld briefly then release. The SVR-250 will attempt to acquire a voice channel on the trunking system by keying the mobile for 800mS and monitoring the on-air detect line from the mobile. If it does not see the radio transmit at all (system is busy), it will send a low tone to the hand held operator to alert them that the system is busy. The SVR-250 will automatically retry every 5 seconds and send busy tone to the handheld with each unsuccessful attempt to indicate progress of the call attempt. If unsuccessful after 30 seconds, the SVR-250 will transmit intercept tone to alert the handheld operator that the call attempt failed.

When the SVR-250 detects that the mobile is transmitting, it will continue to monitor the on-air line until the transmitter remains keyed for at least 250mS to ensure that the radio is not handshaking or retrying. After successful acquisition of a voice channel, it will continue to hold the mobile PTT active for 2 seconds and transmit a go-ahead blip to the handheld operator. The user then keys their handheld to speak on the voice channel. If the user does not key up within the 2 second period, the SVR-250 will unkey the mobile and send intercept tone as before.

If the user keys their handheld only once, or they key the first time for more than 1 second, the SVR-250 will cancel the call attempt and send intercept tone to the handheld operator. All of the queuing and error tones will only be sent if the handheld is not transmitting to ensure that the user hears the proper tones.

The SVR-250 can also be programmed to work in a similar way for use with the MSV mobile satellite phones, except the time delays are extended to work properly within the network.

### ***Emergency Operation***

The SVR-250 can be programmed for Emergency operation on a per channel basis. If enabled, the SVR-250 will scan for 2 different CTCSS tones or DCS codes. The secondary tone/code is used to indicate an Emergency condition from the portable and will assert an output pin when decoded. There are 2 different Emergency formats: Emg output only or Emg output with voice repeat. Emg output only will assert pin 10 on the main cable for as long as the secondary tone/code is being received; it is used as a momentary output to the mobile to initiate an Emergency sequence. This is the most common configuration with Motorola or MA/Com radios. Emg output with voice repeat will assert pin 10 as before, but will also key the mobile and repeat portable-to-base as long as the secondary tone/code is being received. This format is used with the Tait mobiles. Additionally, there is a solder jumper on the main logic PCB that determines if the Emg output signal pulls to ground (NO) or breaks ground (NC).

### ***Dual Tone Operation***

The SVR-250 normally requires its own frequency and earlier technology suffered when there was strong co-channel interference present. The SVR-250 can be programmed for dual CTCSS/DCS receive that will eliminate interference from co-channel users. The portable radios will still be carrier squelch receive, but the SVR-250s will be programmed with a CTCSS/DCS encode that is different from the primary tone/code decode. The secondary tone/code must be the same as the encode tone/code. During base-to-portable transmissions, the SVR-250 will sample as before. If it sees carrier and primary tone, it will reverse direction and repeat portable-to-base. If it sees secondary tone (another SVR-250 transmitting) it will cease transmission and become non-priority. If it sees carrier with no tone (or neither programmed tone) it will ignore the co-channel interference. If three consecutive samples have co-channel interference, the SVR-250 will change the sampling rate to 2.5S (maximum) to reduce the effects of the extended sample time, until the co-channel signal is no longer present.

***Dual Tone receive and Emergency operation are mutually exclusive.***

### ***Auxiliary Receiver Operation***

In operations where the vehicles do not transmit mobile-to-mobile (half duplex), the non-priority vehicular repeaters will not see mobile COR when a priority vehicular repeater keys its mobile during portable-to-base transmissions. This can cause the non-priority repeaters to incorrectly assume priority. The SVR-250 can be fitted with an additional 16 channel scanning receiver that is programmed for the mobile transmit frequency. This Auxiliary receiver can have up to 16 mobile transmit frequencies programmed into it and will provide the mobile COR indication needed for the non-priority repeaters to remain at non-priority. The Auxiliary receiver option can be programmed to operate on a per channel basis.



### ***Wide Band / Narrow Band Channels***

The SVR-250 can be programmed for Wide/Narrow band operation on a per channel basis. Wide band operation is 25kHz for UHF and 800 MHz, 30kHz for VHF. Narrow band is 12.5kHz for UHF and 800 MHz, 15kHz for VHF. VHF channels can be in 5 or 6.25kHz steps on a per channel basis. UHF is programmed in 12.5kHz steps. 700/800/900 MHz are programmed in 6.25kHz steps. 700 and 900 MHz are only available as narrow band (12.5kHz). In addition to changing the receiver bandwidth and transmitter modulation characteristics, the audio levels into and out of the SVR-250 are automatically adjusted so the levels at the mobile will be correct with either bandwidth selected.

### ***Courtesy Beep***

If enabled, the SVR-250 will send a short beep to the handheld user at the end of each portable-to-base transmission to confirm that the user is still within range.

### ***Power Up Channel***

The SVR-250 can be programmed to revert to the last channel used when powered down or a pre-programmed "Home" Channel.

### ***Full Duplex Operation***

The SVR-250 can be configured to operate full duplex and repeat portable-to-portable during portable-to-base transmissions, thereby extending coverage between portables as well as operating as a vehicular repeater. Full duplex operation requires hardware and firmware changes and is not field upgradeable. ***Full duplex operation is not compatible with multi-vehicle format and should only have 1 SVR-250 on scene.*** The SVR-250 configured for duplex operation will have separate Tx and Rx antenna connectors and requires an external duplexer or separate Tx and Rx antennas.

### ***LEDs***

The SVR-250 has a 2 digit channel display as well as eight status LEDs:

- CPU: Flashes at a 1 Hz rate to indicate proper operation of the microprocessor.
- PRI: When on, indicates that the unit is at priority count zero and will repeat all transmissions.
- RCOR: Repeater Carrier detect.
- RTONE: Repeater sub-audible decode; when on, indicates a condition to repeat portable-to-base.
- RTX: Repeater transmit indicator.
- MCOR: Mobile unmute detector indicating a condition to repeat base-to-portable.
- MTX: Mobile transmit indicator.
- OPT: Continuous illumination indicates Emergency/Dual Tone PL Decode. If OPT LED flashes at 10Hz rate, it is an indication that one of the PLLs did not lock within the allotted 50mS and the unit should be serviced.

## Installation

Before installing the SVR-250, ensure that the RF and repeater sections are properly aligned per the tuning instructions on pages 10-15 of this manual. Additionally, ensure that the SVR-250 jumpers are properly configured for use with the particular mobile radio that it will be connected to:

- J1 Controls the maximum drive level of the transmit audio output to the mobile radio. If J1 is installed, output amp U1A will have an adjustment range of 0-100 mVPP. If J1 is removed, U1A can be adjusted between 0-5VPP.
- J2 Controls the output impedance of the transmit audio line to the mobile radio. If connected to a low impedance point in the mobile, installing JP2 sets the output impedance to 600 ohms. If JP2 is open, the output impedance is 2.2Kohms. Install the jumper for radios that require a lot of modulation drive or that have low impedance microphone circuits. Remove the jumper if the SVR-250 installation decreases local microphone audio at the mobile.
- J4 Used to internally tie the local mic input of the SVR-250 to the transmit audio output line which is usually connected to the mic hi line in the mobile.
- J5 Used to internally tie the on-air detect input of the SVR-250 to the PTT output. Do so *only on conventional radios*; trunking radios *must have the on-air detect line connected to a line indicating that the radio is transmitting*.
- J6 Changes the maximum gain of the local mic input amp from unity (Out) to 10x (In).
- J7 Changes the maximum gain of the receive audio line input from unity (Out) to 7x (In).
- J8 Adds a pull up (+ position) or pull down (- position) resistor to the remote enable line (blue).
- J9 Adds a pull up resistor (10K to 5VDC) to mobile COR line (violet)
- J10 Connects the front panel on-off control to the remote enable line to enable the SVR-250 from the front panel.
- J11 Adds (Out) or removes (In) a 100KOhm resistor in series with the Tx audio line for applications with low level mic audio and alternator whine problems (see Service Bulletin 113).
- J13 Selects the Emergency output polarity: NO=pull to ground during Emg NC=break ground during Emg.

### ***Make the connections between the mobile radio and the SVR-250 cable as follows:***

Pin 1: **Ground.** Connect to the radio's chassis or ground plane.  
*Black/Shield*

Pin 2: **Mobile transmit audio.** Connect to the mobile transmit audio path or tone input. If connected before pre-emphasis, ensure that the SVR-250 is programmed for de-emphasis (common data). If connected after pre-emphasis, ensure that the SVR-250 transmit audio path is programmed as flat. Pin 2 is AC coupled and has an output impedance of 600 or 2.2Kohms (determined by J2). RV3 sets the transmit audio output level and J1 sets the adjustment range between 0-5VPP (J1 open) or 0-100mVPP (J1 shorted).  
*White*

Pin 3: **Remote enable/disable.** Connect to the radio's auxiliary output or a separate switch to remotely enable or disable the repeater. If this line goes high to activate the repeater, ensure that JP1 is set to the "+” position. If this line goes to ground, set JP1 to the "-” position. J8 has two positions to add a pull up (+) or pull down (-) resistor to this line if used with an open collector or dry contact output. J10 connects this line to the front panel on/off control.  
*Blue*



- Pin 4: *Green*     **Mobile PTT output.** Connect to mic PTT on the mobile radio, or a line that goes active low to transmit. Pin 4 is an open drain output rated at 2A at 15VDC.
- Pin 5: *Red*     **12 VDC input.** Connect to the radios 12V switched supply or a point capable of supplying at least 1.5A of current.
- Pin 6: *Yellow*     **Mobile receive audio.** Connect this line to the mobile receive audio path before the volume control. If pin 6 is connected before de-emphasis, ensure that the SVR-250 receive path is programmed as flat (common data). If connected after de-emphasis, program the receive path for pre-emphasis. Pin 6 is AC coupled and high impedance (>15K ohm). RV5 sets the receive audio level sensitivity; this input should be between 30mVPP and 5VPP. J7 sets the gain of the receive input amp. If open, the input has a maximum gain of one; if installed, the input has a maximum gain of 7.
- Pin 7: *Violet*     **Mobile COR detect.** This line is used to indicate when the SVR-250 should repeat the transmission to the handheld. Connect to a logic point in the radio that indicates proper tone and carrier have been detected or the audio unmute line. If this line goes more positive during an unmute condition, program the mobile COR line as active high (common data). If the line goes more negative during an unmute condition, program the mobile COR line as active low. The input from pin 7 is high impedance and does not have to go rail to rail. The SVR-250 uses a voltage comparator as a COR threshold detector and is factory set at 1.6VDC. The COR input must go at least 0.5VDC on either side of this threshold.
- Pin 8: *Brown*     **Local mic audio.** If programmed for local mic repeat, the SVR-250 will go into transmit mode and repeat the audio from this line whenever the mobile radio is keyed by the local mic. Connect this line to the mobile transmitter audio path before limiting or filtering. This input is AC coupled and high impedance (>5.6Kohms). The input level at this pin should be 300mV to 5VPP. RV2 sets the local mic sensitivity. If the mic high line has sufficient drive for this input, install J4 and leave pin 8 unconnected. J6 sets the gain of the local mic input amp. If open, the maximum gain is one; if installed, the maximum gain is 10.
- Pin 9: *Gray*     **On-Air detect.**  
**Trunking:** Connect to a point in the radio that indicates the mobile transmitter is actually on the air. This is not the same as mic PTT. If pin 9 goes positive during transmit, program the on-air detect line for active high (common data). If pin 9 goes to ground during transmit, program the on air detect line for active low.  
**Conventional:** Used for local mic repeat indication from the mobile. Connect pin 9 to pin 4 of the SVR-250 and program the on-air detect line for active low. Solder jumper J5 will connect pin 9 to pin 4 (PTT output) and can be used on *conventional systems only*. **Do not install J5 for trunking operation.**
- Pin 10: *Black/White*     **Emergency Output.** Connect to the Emergency input on the mobile radio. On Motorola radios, the Emergency input opens from ground on activation and jumper J13 should be in the "NC" position. On all other radios, the Emergency input pulls to ground on activation and jumper J13 should be in the "NO" position.

Install the SVR-250 in the vehicle using the supplied mounting bracket and hardware. Install the unit where it will be easily visible by the driver and will not interfere with the drivers vision or constitute a hazard during a vehicle collision. The SVR-250 mounts in the bracket using the four 8-32 x 1/4" machine screws. Do not use longer screws to mount the SVR-250 to the bracket or circuit damage may result.

## Alignment VHF

Before aligning the SVR-250, ensure that the mobile radio is aligned per the manufacturer's service procedure; Ensure that the SVR-250 is properly programmed and the jumpers are set per the previous section.

In order to properly align the SVR-250, you will need two service monitors and the mobile radio that the repeater will be installed with. Refer to figure 1 for alignment points.

Dis-assemble the repeater by removing the two cap screws on the front panel; disconnect the front panel from the main chassis by removing the 2 connectors. Remove the two cap screws from the rear panel and slide the main circuit board out of the housing with the rear panel attached. Re-connect the front panel to the main PCB. Connect one service monitor to the SVR-250 TNC jack and the other to the mobile antenna jack. Connect the cable from the mobile radio to the SVR-250 (See figure 4 on page 16). Turn on the mobile and activate the SVR-250.

Adjust the repeater squelch control (RV9) so that the repeater COR led is off. Adjust the mobile so that the audio is squelched.

### SVR-250 VHF Transmitter

1. **Transmitter Output:** Push S3 and adjust RV10 for maximum. Confirm the SVR-250 RF Power out is at least 2W. Adjust RV10 for 250 mW.
2. **Transmitter frequency:** Adjust the TCXO on the Tx RF board for the transmit frequency.
3. **Maximum deviation/lock tone deviation:** If the SVR-250 is programmed for sub-audible encode, adjust RV6 (CTCSS) for minimum. Adjust RV8 (repeater deviation) for 80% deviation; adjust RV6 for total 95% deviation (sub-audible and lock tone). If programmed for carrier squelch transmit adjust RV8 for 95% deviation. Release S3.
4. **Mobile COR:** Measure the voltage at TP2 on the SVR-250 main PCB and record. Ensure the mobile COR LED on the front panel is off. Set the mobile service monitor for the mobile receive frequency, 1mV RF output and CTCSS modulation of 15% deviation. Measure the voltage again at TP2 and record. Ensure the mobile COR LED on the front panel is on. The 2 voltages at TP2 must be at greater than 2.1VDC and less than 1.1 VDC.
5. **RX audio sensitivity/CTCSS deviation:** Set the service monitor connected to the mobile for the mobile receive frequency and 1mV RF output. Modulate the signal generator with a 1kHz tone at 60% deviation and CTCSS tone at 15% deviation. Ensure that the SVR-250 mobile COR and repeater PTT LED's are on. If the SVR-250 is programmed for sub-audible encode adjust RV5 on the SVR-250 main board for 75% deviation, adjust for 60% deviation if carrier squelch transmit, as read on the service monitor connected to the SVR-250. Turn the RF output from the mobile service monitor off and ensure that the SVR-250 mobile COR and repeater PTT LEDs are off.
6. **Local mic repeat:** If the SVR-250 is programmed for local mic repeat, key the mobile local mic and inject an audio signal into the local mic to produce 60% deviation on the service monitor connected to the mobile. Confirm that the SVR-250 repeater PTT LED is on; adjust RV2 for 60% deviation as read on the service monitor connected to the SVR-250. Unkey the mobile radio.
7. **RF power out:** Press S3 and adjust RV10 for the operating power output. Release S3.

**VHF Receiver**

1. **Receiver front end:** Connect a DC voltmeter to TP1 on the SVR-250 main board. Set the service monitor connected to the SVR-250 to the generate mode, receive frequency with a 1kHz tone and 60% deviation. Adjust the RF output of the monitor for a 1VDC reading at TP1. Adjust L1-L5 on the RF board for a maximum reading at TP1.
2. **Repeater squelch:** Adjust the service monitor RF output for .5 $\mu$ V. Adjust RV9 on the SVR-250 main board so the repeater COR LED is just on. Decrease the service monitor RF output to .3 $\mu$ V and ensure that the repeater COR LED is off.
3. **Transmit audio output:** Adjust the service monitor RF output for 1mV. Turn the CTCSS modulation on and set for 15% deviation. Confirm that the repeater COR, CTCSS and mobile PTT LED's are on. Adjust RV3 on the SVR-250 main board for 60% deviation as read on the service monitor connected to the mobile radio. Turn off the CTCSS modulation of the service monitor connected to the SVR-250. Confirm that the repeater CTCSS and mobile PTT LED's are off.
4. **Lock Tone Decode:** Change the 1kHz tone modulation to the lock tone frequency. Confirm that the PRI LED goes off after approximately .5 seconds.

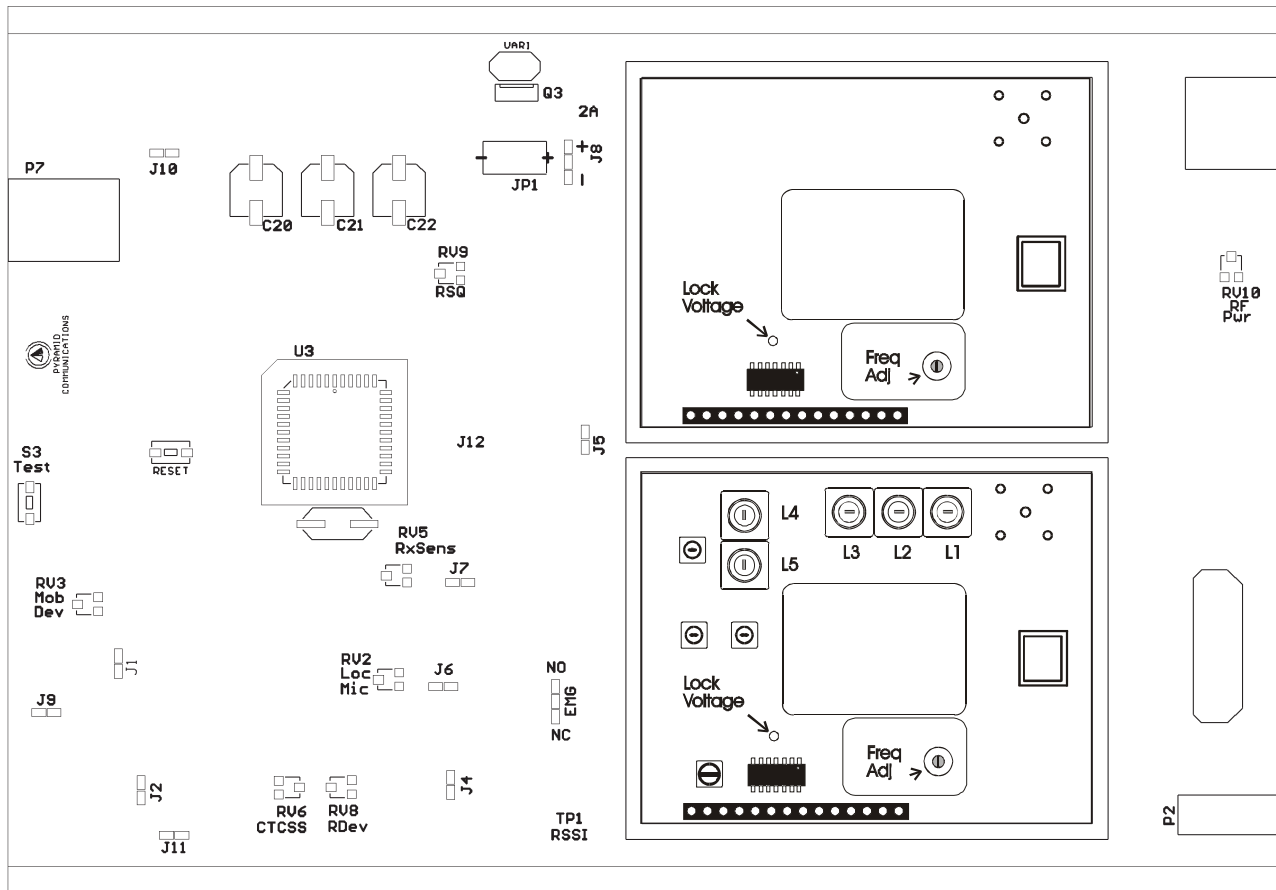


Figure 1

## *Alignment UHF*

Before aligning the SVR-250, ensure that the mobile radio is aligned per the manufacturer's service procedure; Ensure that the SVR-250 is properly programmed and the jumpers are set per the previous section.

In order to properly align the SVR-250, you will need two service monitors and the mobile radio that the repeater will be installed with. Refer to figure 2 for alignment points.

Dis-assemble the repeater by removing the two cap screws on the front panel; disconnect the front panel from the main chassis by removing the 2 connectors. Remove the two cap screws from the rear panel and slide the main circuit board out of the housing with the rear panel attached. Re-connect the front panel to the main PCB. Connect one service monitor to the SVR-250 TNC jack and the other to the mobile antenna jack. Connect the cable from the mobile radio to the SVR-250 (See figure 4 on page 16). Turn on the mobile and activate the SVR-250.

Adjust the repeater squelch control (RV9) so that the repeater COR led is off. Adjust the mobile so that the audio is squelched.

### *SVR-250 UHF Transmitter*

1. **Transmitter Output:** Push S3 and adjust RV10 for maximum. Confirm the SVR-250 RF Power out is at least 2W. Adjust RV10 for 250 mW.
2. **Transmitter frequency:** Adjust the TCXO on the Tx RF board for the transmit frequency.
3. **Maximum deviation/lock tone deviation:** If the SVR-250 is programmed for sub-audible encode, adjust RV6 (CTCSS) for minimum. Adjust RV8 (repeater deviation) for 80% deviation; adjust RV6 for total 95% deviation (sub-audible and lock tone). If programmed for carrier squelch transmit adjust RV8 for 95% deviation. Release S3.
4. **Mobile COR:** Measure the voltage at TP2 on the SVR-250 main PCB and record. Ensure the mobile COR LED on the front panel is off. Set the mobile service monitor for the mobile receive frequency, 1mV RF output and CTCSS modulation of 15% deviation. Measure the voltage again at TP2 and record. Ensure the mobile COR LED on the front panel is on. The 2 voltages at TP2 must be at greater than 2.1VDC and less than 1.1 VDC.
5. **RX audio sensitivity/CTCSS deviation:** Set the service monitor connected to the mobile for the mobile receive frequency and 1mV RF output. Modulate the signal generator with a 1kHz tone at 60% deviation and CTCSS tone at 15% deviation. Ensure that the SVR-250 mobile COR and repeater PTT LED's are on. If the SVR-250 is programmed for sub-audible encode adjust RV5 on the SVR-250 main board for 75% deviation, adjust for 60% deviation if carrier squelch transmit, as read on the service monitor connected to the SVR-250. Turn the RF output from the mobile service monitor off and ensure that the SVR-250 mobile COR and repeater PTT LEDs are off.
6. **Local mic repeat:** If the SVR-250 is programmed for local mic repeat, key the mobile local mic and inject an audio signal into the local mic to produce 60% deviation on the service monitor connected to the mobile. Confirm that the SVR-250 repeater PTT LED is on; adjust RV2 for 60% deviation as read on the service monitor connected to the SVR-250. Unkey the mobile radio.
7. **RF power out:** Press S3 and adjust RV10 for the operating power output. Release S3.

**UHF Receiver**

1. **Receiver front end:** Connect a DC voltmeter to TP1 on the SVR-250 main board. Set the service monitor connected to the SVR-250 to the generate mode, receive frequency with a 1kHz tone and 60% deviation. Adjust the RF output of the monitor for a 1VDC reading at TP1. Adjust BPF1 and BPF2 on the RF board for a maximum reading at TP1.
2. **Repeater squelch:** Adjust the service monitor RF output for  $.5\mu\text{V}$ . Adjust RV9 on the SVR-250 main board so the repeater COR LED is just on. Decrease the service monitor RF output to  $.3\mu\text{V}$  and ensure that the repeater COR LED is off.
3. **Transmit audio output:** Adjust the service monitor RF output for 1mV. Turn the CTCSS modulation on and set for 15% deviation. Confirm that the repeater COR, CTCSS and mobile PTT LED's are on. Adjust RV3 on the SVR-250 main board for 60% deviation as read on the service monitor connected to the mobile radio. Turn off the CTCSS modulation of the service monitor connected to the SVR-250. Confirm that the repeater CTCSS and mobile PTT LED's are off.
4. **Lock Tone Decode:** Change the 1kHz tone modulation to the lock tone frequency. Confirm that the PRI LED goes off after approximately .5 seconds.

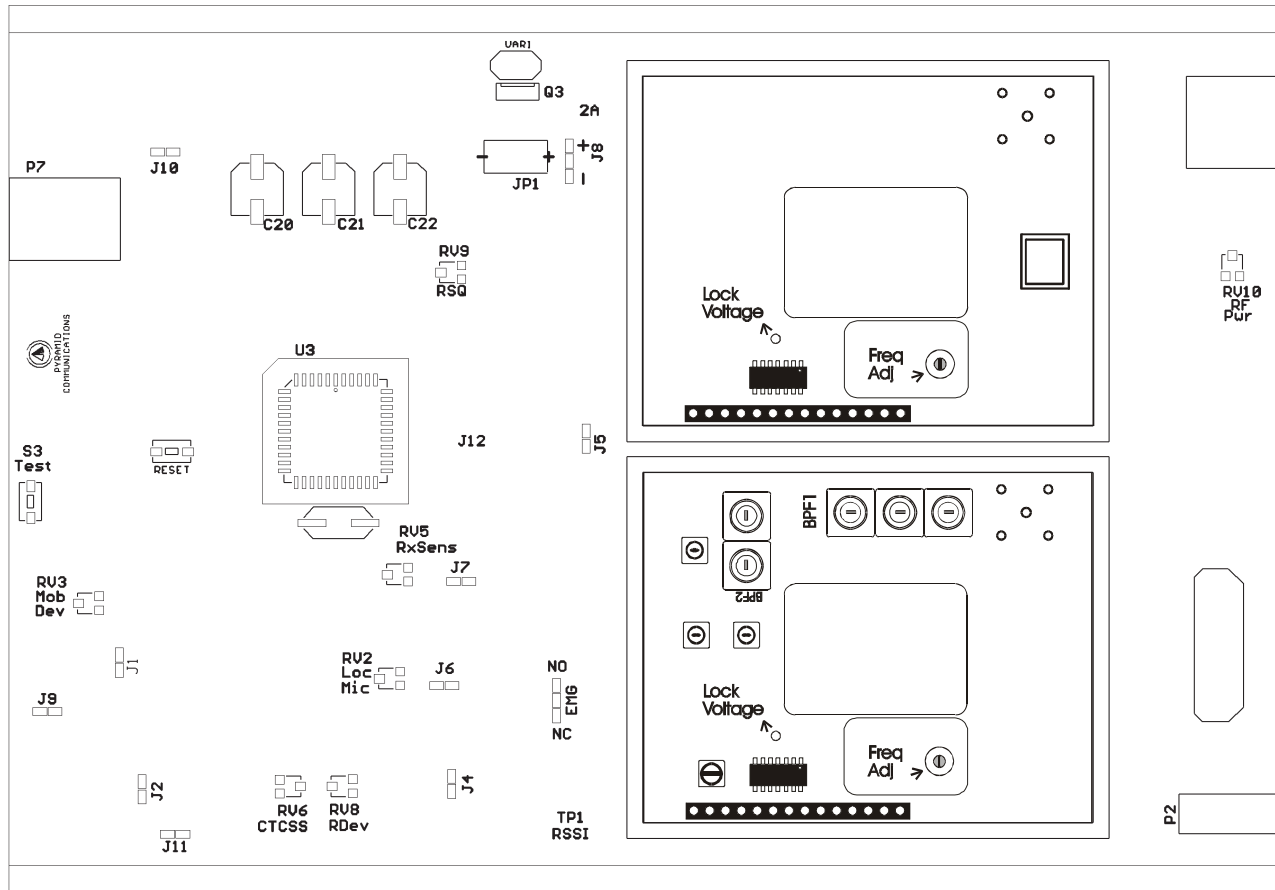


Figure 2

## Alignment 700/800/900 MHz

Before aligning the SVR-250, ensure that the mobile radio is aligned per the manufacturer's service procedure; Ensure that the SVR-250 is properly programmed and the jumpers are set per the previous section.

In order to properly align the SVR-250, you will need two service monitors and the mobile radio that the repeater will be installed with. Refer to figure 3 for alignment points.

Dis-assemble the repeater by removing the two cap screws on the front panel; disconnect the front panel from the main chassis by removing the 2 connectors. Remove the two cap screws from the rear panel and slide the main circuit board out of the housing with the rear panel attached. Re-connect the front panel to the main PCB. Connect one service monitor to the SVR-250 TNC jack and the other to the mobile antenna jack. Connect the cable from the mobile radio to the SVR-250 (See figure 4 on page 16). Turn on the mobile and activate the SVR-250.

Adjust the repeater squelch control (RV9) so that the repeater COR led is off. Adjust the mobile so that the audio is squelched.

### SVR-250 Transmitter

1. **Transmitter Output:** Push S3 and adjust RV10 for maximum. Confirm the SVR-250 RF Power out is at least 600mW. Adjust RV10 for 100 mW.
2. **Transmitter frequency:** Adjust the TCXO on the Tx RF board for the transmit frequency.
3. **Maximum deviation/lock tone deviation:** If the SVR-250 is programmed for sub-audible encode, adjust RV6 (CTCSS) for minimum. Adjust RV8 (repeater deviation) for 80% deviation; adjust RV6 for total 95% deviation (sub-audible and lock tone). If programmed for carrier squelch transmit adjust RV8 for 95% deviation. Release S3.
4. **Mobile COR:** Measure the voltage at TP2 on the SVR-250 main PCB and record. Ensure the mobile COR LED on the front panel is off. Set the mobile service monitor for the mobile receive frequency, 1mV RF output and CTCSS modulation of 15% deviation. Measure the voltage again at TP2 and record. Ensure the mobile COR LED on the front panel is on. The 2 voltages at TP2 must be at greater than 2.1VDC and less than 1.1 VDC.
5. **RX audio sensitivity/CTCSS deviation:** Set the service monitor connected to the mobile for the mobile receive frequency and 1mV RF output. Modulate the signal generator with a 1kHz tone at 60% deviation and CTCSS tone at 15% deviation. Ensure that the SVR-250 mobile COR and repeater PTT LED's are on. If the SVR-250 is programmed for sub-audible encode adjust RV5 on the SVR-250 main board for 75% deviation, adjust for 60% deviation if carrier squelch transmit, as read on the service monitor connected to the SVR-250. Turn the RF output from the mobile service monitor off and ensure that the SVR-250 mobile COR and repeater PTT LEDs are off.
6. **Local mic repeat:** If the SVR-250 is programmed for local mic repeat, key the mobile local mic and inject an audio signal into the local mic to produce 60% deviation on the service monitor connected to the mobile. Confirm that the SVR-250 repeater PTT LED is on; adjust RV2 for 60% deviation as read on the service monitor connected to the SVR-250. Unkey the mobile radio.
7. **RF power out:** Press S3 and adjust RV10 for the operating power output. Release S3.



**700/800/900 MHz Receiver**

1. **Receiver front end:** Connect a DC voltmeter to TP1 on the SVR-250 main board. Set the service monitor connected to the SVR-250 to the generate mode, receive frequency at  $.5\mu\text{V}$  RF output with a 1kHz tone and 60% deviation. Confirm a reading of  $1\text{VDC} \pm .2\text{VDC}$  at TP1.
2. **Repeater squelch:** Adjust the service monitor RF output for  $.5\mu\text{V}$ . Adjust RV9 on the SVR-250 main board so the repeater COR LED is just on. Decrease the service monitor RF output to  $.25\mu\text{V}$  and ensure that the repeater COR LED is off.
3. **Transmit audio output:** Adjust the service monitor RF output for 1mV. Turn the CTCSS modulation on and set for 15% deviation. Confirm that the repeater COR, CTCSS and mobile PTT LED's are on. Adjust RV3 on the SVR-200 main board for 60% deviation as read on the service monitor connected to the mobile radio. Turn off the CTCSS modulation of the service monitor connected to the SVR-250. Confirm that the repeater CTCSS and mobile PTT LED's are off.
4. **Lock Tone Decode:** Change the 1kHz tone modulation to the lock tone frequency. Confirm that the PRI LED goes off after approximately .5 seconds.

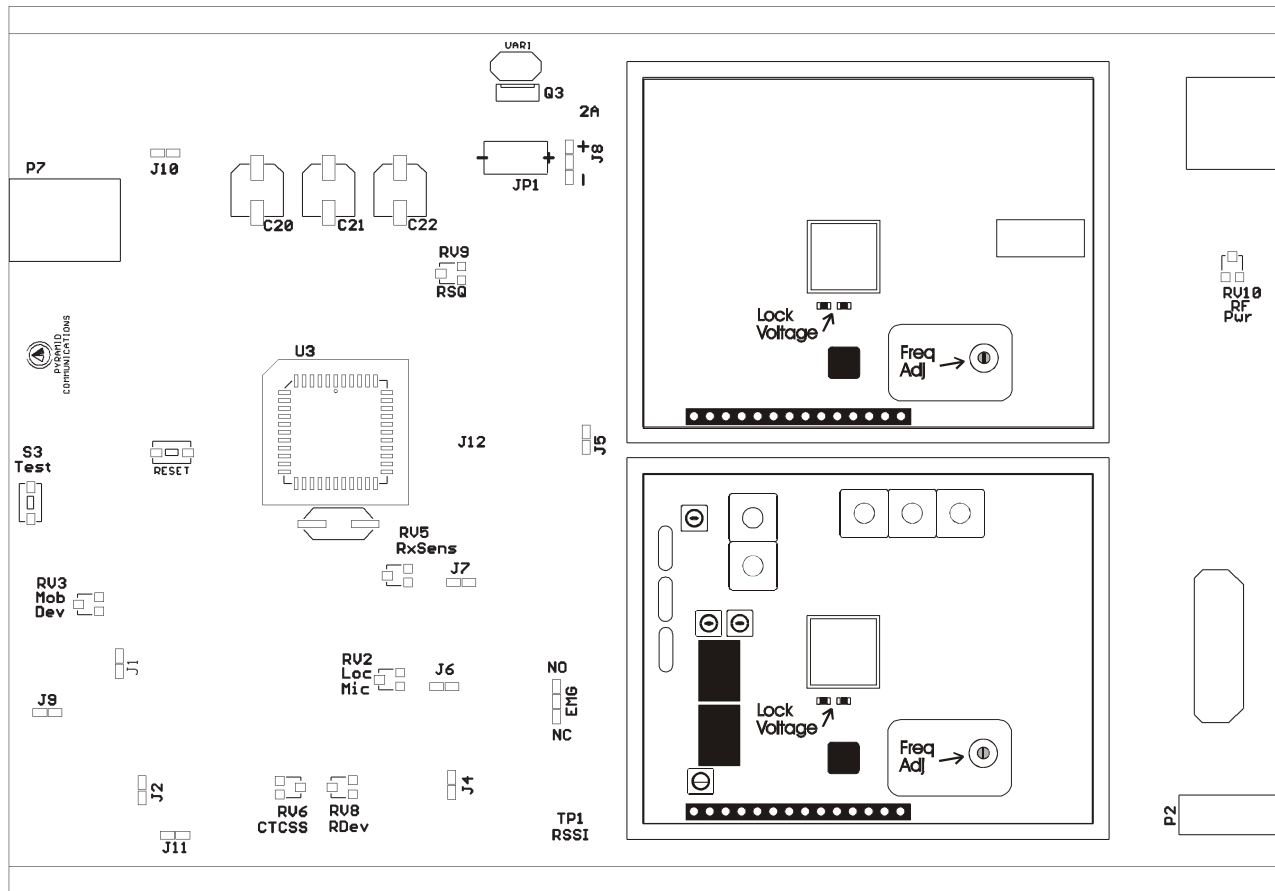


Figure 3

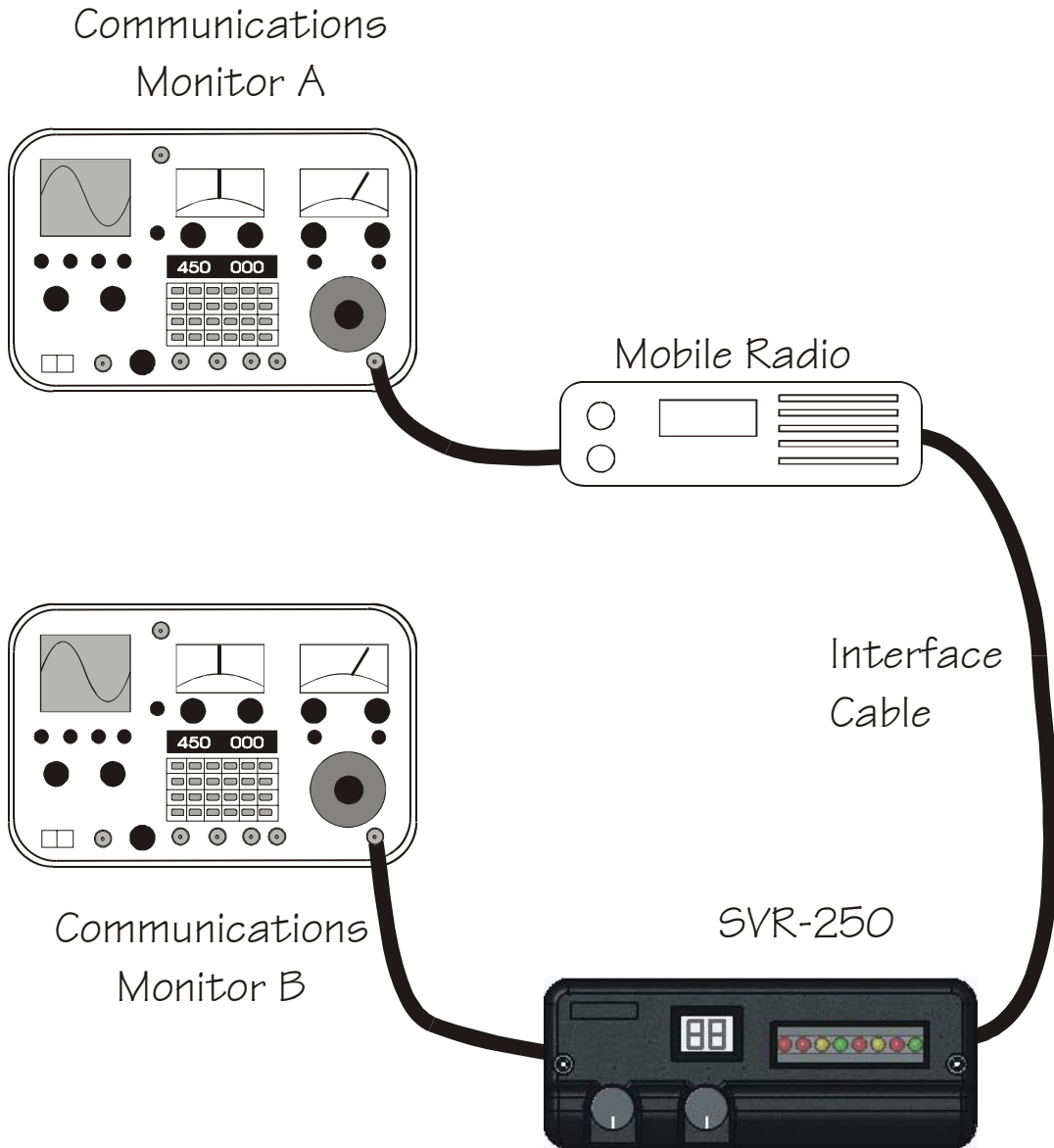


Figure 4

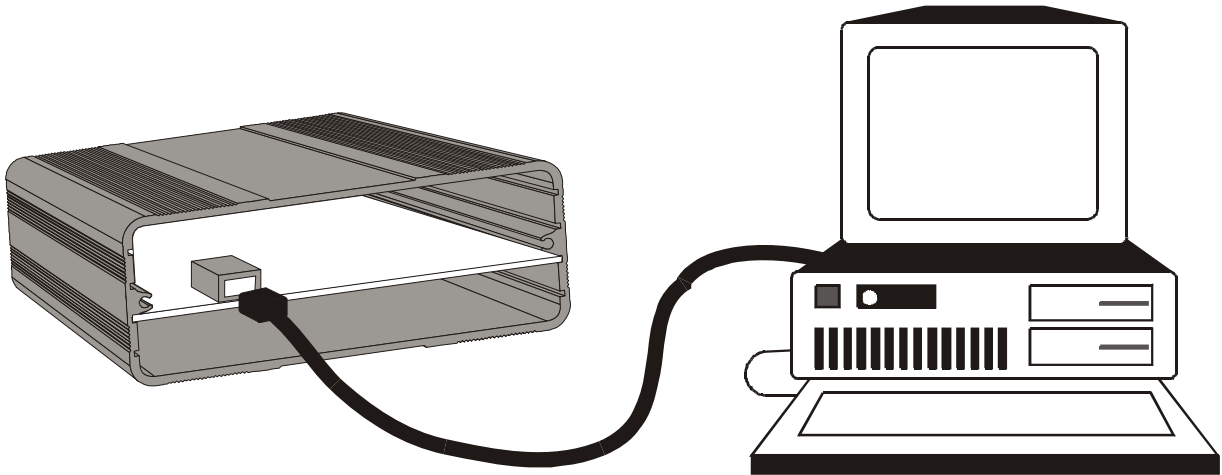
# Programming

## Using the Software

The SVR250CPS personalization software is used to program the SVR-250 for all of the operating parameters and options. The software is compatible with Windows 2000 and later operating systems. The software is menu driven and on-line help is available at any time by clicking the left mouse button on the HELP icon on the right side of the tool bar.

## Important Note:

Before attempting to program the SVR-250 start the software and ensure the FY-4 programming cable is plugged into the correct serial port. The com port may be selected under the "Transfer" menu. Plug the FY-4 programming cable into P7 on the front of the SVR-250; the channel indicator should show "PC".



## Menu selections

### File

**Open:** Allows you to load a previously saved file from disk. Enter the file name or select from the Windows Dialog box. Only files with the .V25 extension can be loaded.

**Save:** Allows you to save the current configuration to disk. Enter the file name to save as or select a previous file from the Windows Dialog box to overwrite. The .V25 extension is automatically added to the file name. The program will prompt you before overwriting an existing file.

**Print:** Sends the current configuration to the selected printer. Make sure the printer is on line and paper is loaded before executing this command.

**Exit:** You will be asked to confirm before exiting the program. The software will also prompt you if the configuration has changed since program start up and data has not been saved to disk.

**Common Data**

**File Name:** 15 character name for this profile stored in E<sup>2</sup>PROM.

**Number of Channels:** Select 1-20 channels

**Model:** Select either simplex or Duplex. Duplex operation requires hardware and firmware changes and is not field upgradable.

**Band:** Select the frequency band to match your SVR-250. Changing bands resets all data to default values (confirmation req.)

**COR Polarity:** Determines if the COR signal from the mobile is active high or low.

**On-Air Polarity:** Determines if the Tx indication from the mobile is active high or low.

**Mobile Type:** Select either Conventional, Trunking or MSV Satellite. If Trunking or MSV is selected, the SVR-250 will go through the voice channel acquisition procedure during portable-to-base repeat mode.

**Tx Audio:** If the mobile Tx audio from the SVR-250 to the mobile is connected after pre-emphasis, select Flat response. If connected before pre-emphasis or to the mic input, select De-Emp.

**Rx Audio:** If the Rx audio from the mobile to the SVR-250 is connected to the discriminator or before de-emphasis, select Flat response. If connected after de-emphasis, select Pre-Emp.

**Power Up Channel:** Select either Last Channel or Home Channel.

**Local Mic Repeat:** Enables or disables the local mic repeat function; if enabled, ensure the on-air polarity is set correctly and the Grey wire or J5 is configured correctly (see pages 8 & 9).

**ARS-250:** Check this box only if the ARS-250 Auxiliary receiver is installed. The ARS-250 is used by non-priority units to sense mobile transmitters in half-duplex systems.

**Outputs:** The SVR-250 has 4 general purpose outputs that can be programmed to follow the channel selector and output chan 1-4 (Single Output) or chan 1-15 (Binary Output), or Repeater Functions for Priority, Transmit and PL Decode. The outputs are open collector and active low. The outputs can also be disabled in software (None).

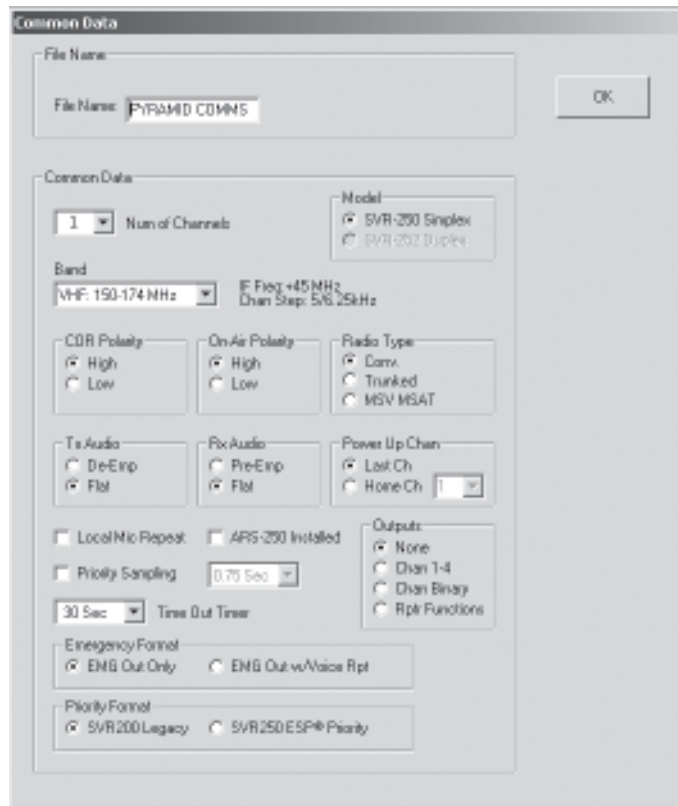
**Priority Sampling:** If the SVR-250 is used in a multi-vehicle environment, priority sampling must be enabled for proper operation.

**Sampling Rate:** If Priority sampling is enabled, this selects the sampling interval. Range is 0.25 seconds to 2.5 seconds in .25 sec increments. The higher this setting, the longer the handheld operator must wait before speaking after pressing PTT during base-to-portable sampling.


**Time Out Timer:** This is the maximum duration of a single base to portable transmission that will be allowed.

**Emergency Format:** Emg Out Only will assert pin 10 of the main connector for as long as secondary tone is decoded. Emg Out with voice will assert pin 10 but also repeat portable-to-base mode.

**Priority Format:** The SVR-250 has an enhanced signalling format to determine if the priority vehicle has left the scene during idle time. Select SVR-200 legacy to turn off this feature. Both formats are fully SVR-200 compatible.



**Channel Data**

 **Note:** The number of channels available is determined by the setting in Common Data.

**Tx and Rx Frequency:** Enter the Transmit and Receive frequencies for each channel. The frequency must be in the range for the band selected under Common Data and will be rounded to the nearest channel step.

**Squelch Type:** Select either CTCSS, DCS or Inverted DCS. These can be selected on a per channel basis, but cannot be mixed with a channel.

**Rx Code:** The primary tone/code, when received will put the SVR-250 into portable-to-base repeat mode.

**Emg/Dual Code:** The secondary tone/code, when received will initiate an Emergency sequence or confirm reception of other SVR-250s in an application with co-channel interference. Emergency and Dual tone are mutually exclusive. See page 6 for a complete description of these modes.

**Tx Code:** In normal operation, the SVR-250 does not transmit sub-audible signalling. If enabled, the Tx code should not be the same as the primary Rx Code. If Dual Tone mode is enabled, the Tx Code must match the secondary code.

**Lock Tone:** This is the tone burst first transmitted when the SVR-250 is enabled and sent every 10 seconds if ESP™ priority mode is selected. The tone must be the same in all vehicular repeaters in the system.

**PL Encode:** If selected, sub-audible transmit is enabled for that channel.

**EMG:** If selected, the Emergency function is enabled for that channel. **Emergency and Dual Tone are mutually exclusive.**

**Dual Tone:** If selected, the Dual Tone Receive function is enabled for that channel. **Emergency and Dual Tone are mutually exclusive.**

**NB:** If selected, the channel BW is 12.5/15 kHz. If not selected the channel BW is 25/30kHz. Low Band is 20kHz only. 700 and 900 MHz are 12.5kHz only.

**Courtesy Beep:** If selected, a short beep will be sent to the handheld user at the end of each portable-to-base transmission to confirm they are still within range.

**Aux Rx:** If enabled under common data and selected for a channel, the non-priority SVR-250s will look to the auxiliary receiver for mobile COR rather than to their own mobile radios.

Ch #	Rx Frequency	Tx Frequency	Squelch Type	Rx Code	Emg/Dual Code	Tx Code	Lock Tone	PL Enc	EMG	Dual Tone	NB	Courtesy Beep	Aux Rx
1	160.61000	160.61000	CTCSS	67.0	69.3	71.9	682.5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2	160.61000	160.61000	DCS	023	025	026	757.5	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3	160.61000	160.61000	INV DCS	023	025	026	832.5	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4	160.61000	160.61000	DCS	023	026	026	847.5	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
5	160.61000	160.61000	CTCSS	67.0	69.3	71.9	682.5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

OK

## ***Transfer***

**Send:** Downloads the current configuration to the SVR-250. The program will prompt you to make the FY-4 connection before downloading. Download takes approx 2 seconds.

**Receive:** Uploads the current configuration from the SVR-250. The program will prompt you to make the FY-4 connection before uploading. Download takes approx 1 second.

**Com Port:** Selects the serial port to use for uploading and downloading between the PC and the SVR-250. Comm ports 1-8 are supported.

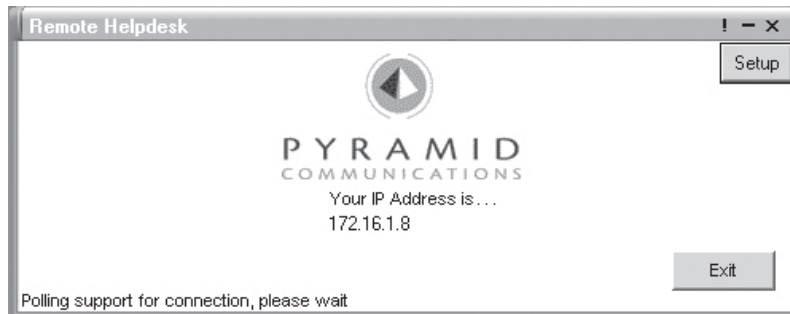
## ***Help***

On-line context sensitive help is available for all entry fields by selecting the field on a form and clicking on the Help Icon on the tool bar.

Additional help menu items:

**About:** Gives you version information about the software and contact information for Pyramid Communications.

**Remote Tech Support:** Remote Tech Support is a utility that allows the Customer Service Technicians at Pyramid Communications to remotely access your computer via the internet in order to troubleshoot any problems you might be having with the software or to assist you in operation of the program. Please call Pyramid Communications during normal business hours prior to selecting remote support. The Technician will give you a password to enter and the remote connection screen will appear:



Once the internet connection is made, the Technician will be able to see your computer screen at their location and assist you with the program. The remote connection is only active when this item is selected and can only be enabled by the local PC user.



## ARS-250 Programming

The ARS-250 is a 16 channel auxiliary scanning receiver that provides mobile COR to the SVR-250 logic in half duplex systems that do not repeat car to car. The ARS-250 mounts inside the SVR-250 extrusion and is programmed to the mobile transmit frequency. When the SVR-250 is at non-priority status and a portable-to-base repeat condition exists, the ARS-250 COR output is sampled rather than the mobile COR. The Aux Rx option can be enabled or disabled in the SVR-250 on a per channel basis.

The ARS-250 should be programmed with all mobile frequencies that will need to be monitored, including CTCSS or DCS if needed. Programming the ARS-250 is done through the same programming socket (P7) as the SVR-250, using the ARS-250CPS software:

### Common Data

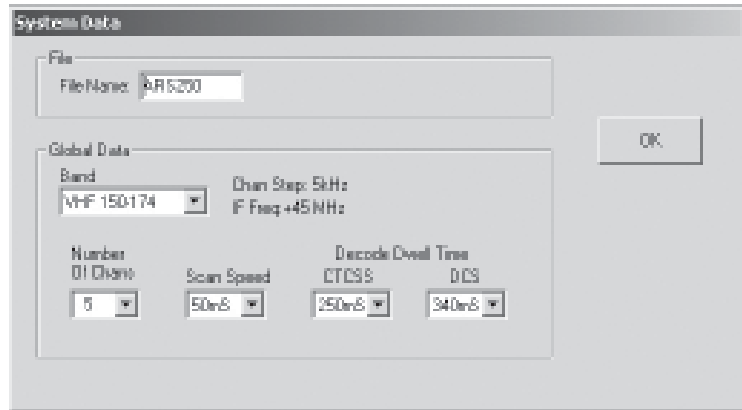
**File Name:** 15 character name for this profile stored in E<sup>2</sup>PROM.

**Band:** Select the frequency band to match your ARS-250. Changing bands resets all data to default values (confirmation required.)


**Number of Chans:** Select the number of channels to scan. Range 1-16.

**Scan Speed:** Scan speed is determined by the time spent on each channel looking for carrier. Default is 50mS (20 channels per second).

**Decode Dwell Time:** The amount of time the receiver will pause to look for CTCSS or DCS after Carrier is detected. If Dwell time is too short, the receiver may not decode properly.



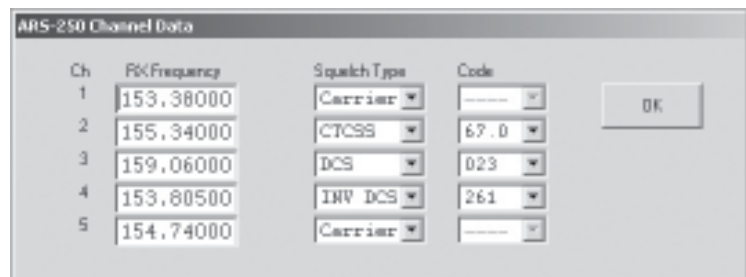
### Channel Data

 **Note:** The number of channels available is determined by the setting in Common Data.

**Receive Frequency:** Enter the Receive frequency for each channel. The frequency must be in the range for the band selected under Common Data and will be rounded to the nearest channel step.

**Squelch Type:** Select Carrier Squelch, CTCSS, DCS or Inverted DCS.


**Code:** Select the CTCSS tone or DCS/Inv DCS code for each channel.



# Flash Programming

The SVR-250 uses an Atmel 89C51RB2 microprocessor which contains the operating system. The chip can be reprogrammed in-circuit using Atmel's FLIP software and a PC running Windows 2000 or XP. The FLIP software can be downloaded from Pyramid's web site:

[www.pyramidcomm.com/support](http://www.pyramidcomm.com/support)

 **Warning- Do not attempt to re-flash the SVR-250 µP unless you are familiar with operation of the SVR-250 and reasonably competent using Windows software. If the µP is not programmed correctly, it can render the SVR-250 inoperable.**

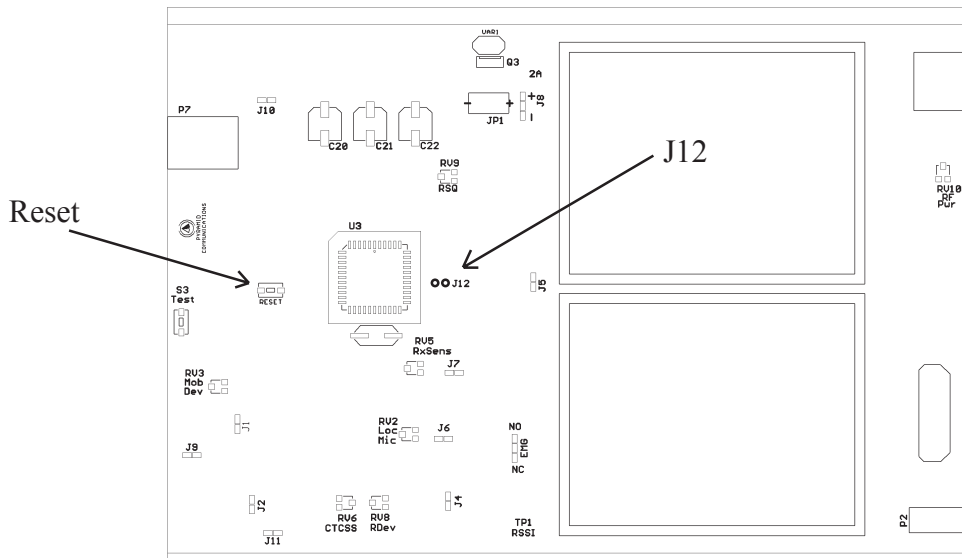
Install the software onto your PC; the download will include several config (.cfg) and hex data (.hex) files. Ensure these are copied into the `\Program Files\Atmel` directory on your computer. Perform the flash programming in the *EXACT* steps as outlined below:

Prior to starting the FLIP software, disassemble the SVR-250 by removing the 2 cap screws on the front panel. Disconnect the front panel from the main PCB by unplugging the 2 cables. Remove the 2 cap screws from the rear panel and carefully slide the entire assembly out of the extrusion. Reconnect the front panel to the main PCB.

Connect the radio cable to the SVR-250 and apply power. Connect the FY-4 DB9 connector to your computer and the modular connector to P7 at the front of the SVR-250 main PCB; the channel indicator should show "PC". Start the FLIP software. Install a shorting jumper onto J12.

### Flash Program U3:

1. Press the Reset switch S2. In the FLIP software, press F4 (load config) and locate the Atmel directory on your computer; select and load the **SVR250.cfg** file. The FLIP software will automatically establish communications with the IC in the SVR-250. If it does not, wait until it times out, click OK to close the error message, check the com port, cable etc., and start at the beginning of step **1**. When FLIP is successful, it will populate the device data fields on the right side of the PC screen. **Do not change any of these settings!**
2. On the left side of the screen, confirm the *Erase*, *Blank Check*, *Program* and *Verify* boxes are checked. In the center of the screen, confirm the **SVR-250.HEX** file is loaded. Click the **Run** button to flash U3 with the hex file. Each of the checked boxes will turn green in series as things progress. If any of them fail, verify all of the connections as above and start over at step **1**.



***Notes:***

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## *Theory of Operation*

### **Receiver:**

The receiver is a double-conversion superheterodyne type, designed for narrow band FM reception. The first local oscillator is derived from the frequency synthesizer. The second LO is crystal controlled.

**RF Stage:** The incoming RF signal from the antenna jack is directed to the first RF bandpass filter to improve selectivity and then to the input of the RF amplifier. The output of the RF amplifier is then presented to a second bandpass filter.

**First LO/Mixer:** The first LO signal is developed by the synthesizer and is mixed with the incoming signal to produce the first IF frequency (45 MHz). The IF frequency is filtered by FL1A and FL1B and amplified by the IF amplifier before being presented to the second LO/Mixer IC.

**Second LO/Mixer:** The first IF signal is presented to the second IF IC (MC3371) which performs the functions of second LO, second IF amp and mixer, FM discriminator and squelch. The second LO crystal (44.545 MHz) is mixed with the 45 MHz first IF signal to produce the second IF frequency of 455 kHz. Two 6 pole ceramic filters provides selectivity for the 455 kHz signal and are switchable between narrow band and wide band.

**Detector/Squelch:** The MC3371 demodulates the 455 kHz signal via quadrature coil to produce the audio and noise components. The output of the MC3371 is the recovered audio and the RSSI voltage (receiver signal strength indicator) which is compared by the controller board with a threshold voltage level for squelch setting.

### **VHF Transmitter**

The output of VCO buffer U8 is input to the predriver transistor U7. The output of U7 drives the RF driver Q8. The collector of Q8 is fed by the transmit 9V line from Q10. The final amp Q13 is a class C power amplifier and drives the output lowpass and harmonic filter, C47-C50 and L20-L22. D3 is the transmit output switch and L19 is a ¼ wave transmission line to isolate the receiver switching diode D2. RF output power is controlled by changing the bias on the gate of Q13 via the TX 9V line (pin 3) from the controller PCB.

### **UHF Transmitter**

The output of VCO buffer U6 is input to the predriver transistor U5. The output of U5 drives the RF driver transistor Q4. The collector of Q4 is fed by the transmit 9V line from Q5. The final amp Q3 is a class C power amplifier and drives the output lowpass and harmonic filter, C39-C42 and L26-L28. D3 is the transmit output switch and L14 is a ¼ wave transmission line to isolate the receiver switching diode D2. RF output power is controlled by changing the bias on the gate of Q3 via the TX 9V line (pin 3) from the controller PCB.

### **700/800/900 MHz Transmitter**

The output of the transmit VCO is buffered by U5 input to the driver transistor U1. The output of U1 drives the RF hybrid output amp U4 through lowpass filter FL3. The final amp U4 is a class C power amplifier and drives the output lowpass and harmonic filter FL4. U7 is the Tx/Rx antenna switch. RF output power is controlled by changing the voltage on pin 1 of U4 via the TX 9V line (pin 3) from the controller PCB.

## ***Control Board***

***Power Supply:*** DC power comes from the mobile radio via P1 pins 1 and 5. Fuse F1 and MOV VAR1 provide over current and voltage spike protection. Q3 is the remote enable/disable pass switch, controlled by Q1 and Q2 via P1 pin 3. Q3 output is switched 12VDC and is presented to audio amp U6, and voltage regulators U7 and U8. Bias voltage for the op-amp circuits is provided by U10 pin 10 and buffer amp U9D.

***Transmit audio path:*** Receiver audio from the mobile is input on pin 6 of P1 and routed to op amp U16B; RV5 sets the sensitivity. The output of U16B goes to the mic amp portion of U10; PC programming of the SVR-250 provides flat response or +6db/octave pre-emphasis. U10 provides all of the audio processing, limiting and filtering of the transmit audio. Transmit voice audio is output on pin 19 of U10, sub-audible signals on pin 20. U17B and U17C select the voice and subaudio paths from U10 (simplex) or U11 (duplex operation). The selected audio is summed by U9A & U9B and passes through the final lowpass filter U9C to remove any clock noise generated by U10 before being presented to the RF module on P4 pin 6.

***Receive audio path:*** Receiver audio from the receiver module is input on P5 pin 13 and routed to U10 pin 11. U10 provides all of the receive audio processing and filtering, in-band and subaudible tone decoding. The receive audio is output on U10 pin 22, where it is sent to the local receiver audio amp and mobile transmit audio output amp U1A. J1 selects either high sensitivity (open) or low sensitivity (shorted) and J2 selects the output impedance (600/2.2K Ohms). J11 inserts (open) or removes (shorted) a 100KOhm series resistor for radios with low level mic audio and alternator whine problems.

***RF Tx and Rx paths:*** For simplex operation, U15 switches the single TNC antenna connector P10 between the Tx and Rx module. In duplex operation, the coax between MCX connectors P8 and P9 is removed and the receive module is connected directly to TNC connector P11 via J14. If the Auxiliary receiver is installed, it shares the Rx module antenna connection via the RF attenuator comprised of R201-203. D4 forms the Tx RF detector and U12 is the Automatic Power Control for the transmitter. RV10 sets the reference voltage for the RF power out and control TX9V pass transistor Q4.

***LED Display:*** The front panel display contains 2 seven segment displays and 8 LED status indicators. The 3 displays are driven by 3 shift registers in series under control of the main  $\mu$ P and updated every 10mS via P3.

***Logic and control:*** U3 is an Atmel 89C51RB2 microprocessor with flash E<sup>2</sup>PROM memory. The microprocessor provides all of the logic and control functions for the repeater including mobile/repeater PTT output, local mobile PTT sense, mobile transmitter activity sense, audio switching, in-band & CTCSS detect, channel number and repeater status indications via front panel led arrays.