

## Foreword

### Scope of this manual

This manual contains the specifications, functional description, operating instructions, schematic, parts locator and parts list for the SVR-200 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-200 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-200 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-200 without an antenna or appropriate RF load connected to the antenna connector.
- Do not operate the SVR-200 in the presence of unshielded electrical blasting caps or explosive environmental conditions.
- Do not operate the SVR-200 while refueling the vehicle or in the presence of explosive fumes.
- Do not operate the SVR-200 with persons standing closer than 2 feet from the mobile or repeater antenna.

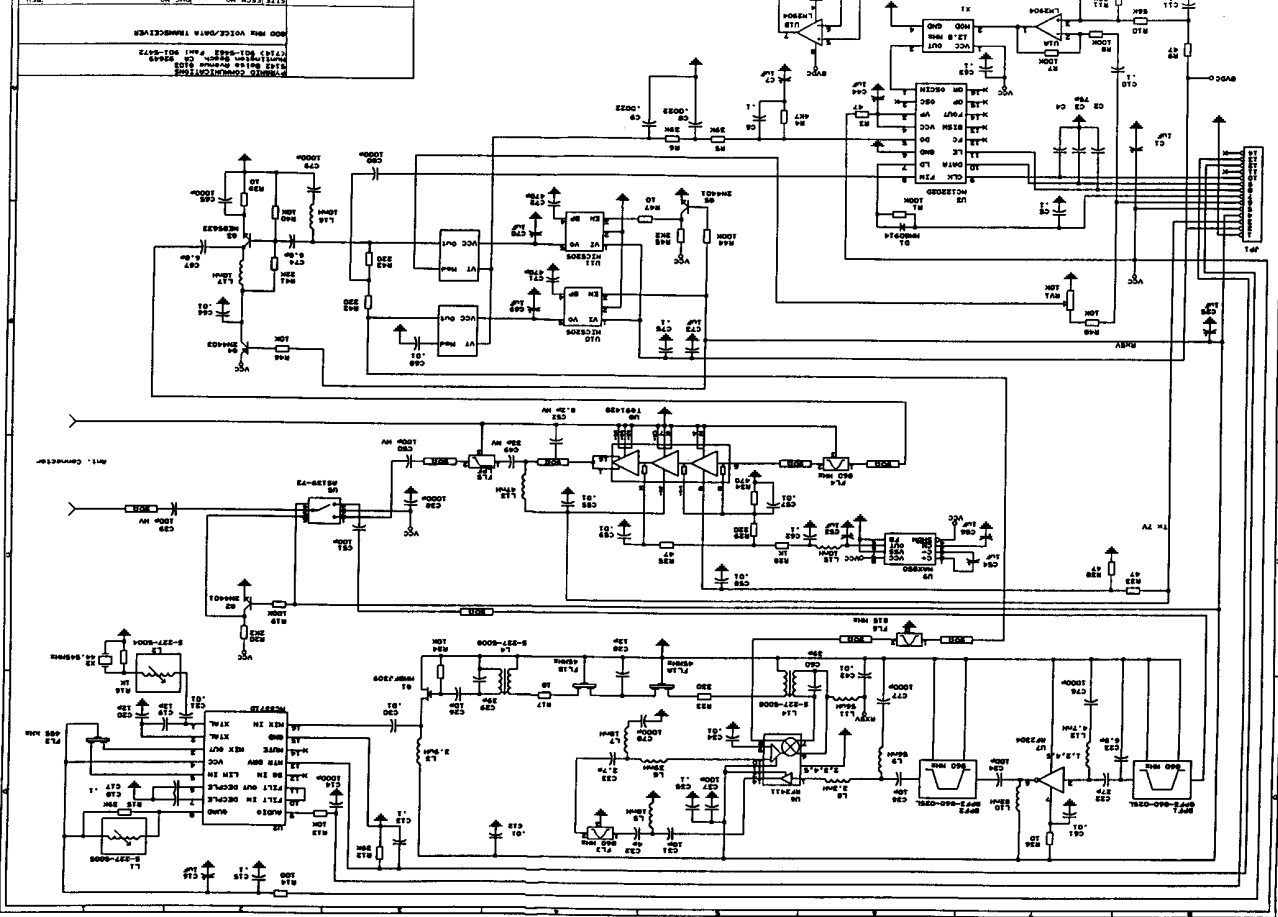
### FCC information

The SVR-200 complies with the FCC rules parts 90 and 22 for radio frequency transmitters. The user must apply for a license to operate the SVR-200 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-200 should be included in the FCC license application:

Type Acceptance: LRUSVR-200UD Parts 22 and 90  
Output Power: 0.25-2.0 watts continuously adjustable  
Emission designator: 16K0F3E  
Frequency band: 450-490 MHz  
Number of Channels: One, synthesized



## Installation

Before installing the SVR-200, ensure that the RF and repeater sections are properly aligned per the tuning instructions on page 7 & 8 of this manual. Additionally, ensure that the SVR-200 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 U1B will have an adjustment range of 0-100 mVPP. If J1 is removed, U1B 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-200 installation decreases local microphone audio at the mobile.
- J3 Used for testing the SVR-200 receiver and setting the lock tone deviation transmit level. If JP3 is shorted at power up, the SVR-200 receiver will be active all of the time and receiver audio will be heard at the speaker regardless of the repeater squelch setting or CTCSS tone decoded. Remove the jumper and turn the SVR-200 off to return to normal operation. If JP3 is shorted while power is applied, the SVR-200 will go into transmit mode and send lock tone for as long as the jumper is shorted. Remove the jumper to return to normal operation.
- J4 Used to internally tie the local mic input of the SVR-200 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-200 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) to the resistor to the remote enable line (blue).
- J9 Adds a pull up resistor (10K to 5VDC) to mobile COR line (violet)

### Make the connections between the mobile radio and the SVR-200 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-200 is programmed for de-emphasis (common data). If connected after pre-emphasis, ensure that the SVR-200 transmit audio path is programmed as flat.  
*White*
- 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).

U1	LM2904 dual op-amp	3410-01-2904
U2,U3	MC3403 quad op-amp	3410-01-3403
U4	MX-806ALH audio processor	3710-02-0806
U5	MX-805ALH sub-audio processor	3710-02-0805
U6	LM386 audio amp	3410-01-0386
U7	LM7805 1A regulator	3400-08-7805
U8	LM7808 1A regulator	3400-08-7808
U9	CD4094 shift register	3410-01-4094
U10	93C46 1Kbit Serial EPROM	3610-01-9346
U11	DS-1833-10 reset controller	3400-07-1833
U12	AT89C51-12JC Microprocessor	3610-02-8951
X1	4.032 MHz HC18/U	6000-07-4032
VARI	18V MOV	2580-02-0018
	Extruded aluminum case	8100-01-5010
	Aluminum end panel	8200-04-5010
	ABS Plastic front panel	8200-03-2502
	BNC PCB mount connector	7401-02-0002
	10ft. radio cable with DB-9F conn.	7500-10-1001
	Shorting block for JP1	7200-03-0102
	Mounting bracket	9600-05-0001
	RF interconnect board	9100-00-0001
	8-32 x 1/4" SS philips	8000-24-8324
	4-40 x 3/8" SS cap screw	8000-34-4406
	4-40 SS nut	8000-54-4400
	4-40 x 1/4" SS philips	8000-24-4404
	2-56 x 3/16" SS philips	8000-24-2563
	4-40 x 3/16" SS philips	8000-24-4403
	2-56 x 1/8" aluminum spacer	8000-65-2562
	Aluminum heat sink (U7 & U8)	8400-05-0001
	Righ Angle heat sink (RF module)	8400-05-0002

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- J1 Controls the maximum drive level of the transmit audio output to the mobile radio. If J1 is installed, output amp U1B will have an adjustment range of 0-100 mVPP. If J1 is removed, U1B can be adjusted between 0-5VPP.
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- J4 Used to internally tie the local mic input of the SVR-200 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-200 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) to the resistor to the remote enable line (blue).
- J9 Adds a pull up resistor (10K to 5VDC) to mobile COR line (violet)

**Make the connections between the mobile radio and the SVR-200 cable as follows:**

- Pin 1: Ground. Connect to the radio's chassis or ground plane.  
*Backshield*
- Pin 2: Mobile transmit audio. Connect to the mobile transmit audio path or tone input. If connected before pre-emphasis, ensure that the SVR-200 is programmed for de-emphasis (common data). If connected after pre-emphasis, ensure that the SVR-200 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).

U1	LM2904 dual op-amp	3410-01-2904
U2, U3	MC3403 quad op-amp	3410-01-3403
U4	MX-806ALH audio processor	3710-02-0806
U5	MX-805ALH sub-audio processor	3710-02-0805
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U7	LM7805 1A regulator	3400-08-7805
U8	LM7808D 1A regulator	3400-08-7808
U9	CD4094 shift register	3410-01-4094
U10	93C46 1Kbit Serial EPROM	3610-01-9346
U11	DS-1833-10 reset controller	3400-07-1833
U12	AT89C51-121C Microprocessor	3610-02-8951
X1	4.032 MHz HC18/U	6000-07-4032
VARI	18V MOV	2580-02-0018
	Extruded aluminum case	8100-01-5010
	Aluminum end panel	8200-04-5010
	ABS Plastic front panel	8200-03-2502
	BNC PCB mount connector	7401-02-0002
	10ft. radio cable with DB-9F conn	7500-10-1001
	Shorting block for JP1	7200-03-0102
	Mounting bracket	9600-05-0001
	RF interconnect board	9100-00-0001
	8-32 x 1/4" SS philips	8000-24-8324
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	4-40 SS nut	8000-54-4400
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	2-56 x 1/8" aluminum spacer	8000-65-2562
	Aluminum heat sink (U7 & U8)	8400-05-0001
	Righ Angle heat sink (RF module)	8400-05-0002

## Alignment

Before aligning the SVR-200, ensure that the mobile radio is aligned per the manufacturer's service procedure; ensure that the SVR-200 is properly programmed and the jumpers are set per the previous section. In order to properly align the SVR-200, 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 rear panel and the Phillips screw on the bottom. Slide the main circuit board out of the housing with the rear panel attached. Connect one service monitor to the SVR-200 BNC jack and the other to the mobile antenna jack. Connect the cable from the mobile radio to the SVR-200; turn on the mobile and activate the SVR-200.

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

### SVR-200 Transmitter

1. **Transmitter Output:** Short J3 and adjust RV10 for maximum. Adjust C523 on the RF board for maximum RF power output. Adjust RV10 250 mW. The SVR-200 case is integral to the voltage regulator heat sink and the unit should not transmit at full power when removed from the case for extended periods.
2. **Transmitter Frequency:** Adjust C851 on the RF board for the transmit frequency.
3. **Maximum deviation/lock tone deviation:** Adjust RV7 (lock tone deviation) for maximum. If the SVR-200 is programmed for sub-audible encode, adjust RV6 (CTCSS) for minimum. Adjust RV8 (repeater deviation) for 95% deviation. Adjust RV7 for 60% deviation. Remove J3.
4. **Mobile COR:** Measure the voltage at pin 7 of SVR-200 main connector P1 and record. Set the mobile service monitor for the mobile receive frequency, 1mV RF output and CTCSS modulation of 15%. Measure the voltage again at pin 7 and record. Turn the mobile service monitor off and adjust RV1 on the SVR-200 main board for the halfway point between the two voltage readings as read at pin 3 of U1.
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-200 mobile COR and repeater PTT LED's are on. Adjust RV5 on the SVR-200 main board for 60% deviation as read on the service monitor connected to the SVR-200. If programmed for sub-audible encode, remove the 1kHz tone deviation from the mobile service monitor and adjust RV6 on the SVR-200 main board for 15% deviation. Turn the RF output from the mobile service monitor off and ensure that the SVR-200 mobile COR and repeater PTT LEDs are off.
6. **Local mic repeat:** If the SVR-200 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-200 repeater PTT LED is on; adjust RV2 for 60% deviation as read on the service monitor connected to the SVR-200. Unkey the mobile radio.
7. **RF power out:** Short J3 and adjust RV10 for the operating power output. Open J3.
8. **PLL Lock Voltage:** Measure the voltage at the PLL test point adjacent to the VCO in the receive mode. ensure the voltage is between -1VDC and +1VDC. Short J3; ensure the voltage is between -3VDC and +3VDC. Open J3

## Notes

## Parts List

Reference	Description	Part #
C1, C5, C6, C9, C10, C12, C15, C18, C35, C37	1µfd chip capacitor	1010-53-5104
C2	22µfd 16V tantalum chip capacitor	1610-25-6226
C3, C4	068µfd chip capacitor	1010-53-5683
C7, C8, C13	220pfd chip capacitor	1010-53-5221
C11	0033µfd chip capacitor	1010-53-5332
C16	1000pfd chip capacitor	1010-53-5102
C17	0022µfd chip capacitor	1010-53-5222
C19, C20	22pfd chip capacitor	1010-53-5220
C21A, C21B	6.8µfd tantalum chip capacitor	1610-35-6685
C22, C31, C32, C33, C34, C39	100µfd electrolytic cap	1400-48-7107
C23, C24, C25, C26	0.47µfd tantalum chip capacitor	1610-34-6474
C27, C28, C29, C36	1.0µfd tantalum chip capacitor	1610-34-6105
C14, C30	2.2µfd tantalum chip capacitor	1610-34-6225
D1, D2, D3	BAV99 dual diode SOT23	3110-01-0099
D4, D5	Red LED	4003-04-0281
F1	3A Pica fuse	2600-05-0030
JF1	100* 3 position vertical header	7300-53-0103
P1	DB-9 M right angle PCB	7400-00-0011
P2	100* 14 position vertical header	7300-13-0114
P3	2.5mm right angle jack	7401-02-0050
P4	3.5mm right angle speaker jack	7401-02-0051
Q1, Q2, Q5-Q10	2N4401 NPN transistor	3010-01-4401
Q3	TIP 117 PNP transistor	3000-08-0117
Q4	TIP 30 PNP transistor	3000-08-0030
RV1, RV8, RV9	10K 3mm SMT pot	2030-08-8103
RV2, RV3, RV5, RV7	100K 3mm SMT pot	2030-08-8104
RV4, RV10	20K 3mm SMT pot	2030-08-8203
RV6	200K 3mm SMT pot	2030-08-8204
R82	10 Ohm chip resistor	2010-03-5100
R10, R23, R26, R41, R71, R72, R81	10K chip resistor	2010-03-5103
R8, R11, R16, R21, R22, R24, R30, R35, R43, R44, R73	100K chip resistor	2010-03-5104
R1, R2, R4, R6, R15, R17, R18, R31, R66, R74	22K chip resistor	2010-03-5223
R3, R12, R13, R75	2.2K chip resistor	2010-03-5222
R5, R14	820 Ohm chip resistor	2010-03-5821
R7, R48, R49, R63	5.6K chip resistor	2010-03-5562
R9, R47, R65	56K chip resistor	2010-03-5563
R19, R20	470K chip resistor	2010-03-5474
R25, R29, R34, R51	1.0M chip resistor	2010-03-5105
R27, R33, R36, R37, R38, R45, R46	33K chip resistor	2010-03-5333
R32, R70	27K chip resistor	2010-03-5273
R39, R40, R53	150K chip resistor	2010-03-5154
R42	330K chip resistor	2010-03-5334
R50, R77-R80	15K chip resistor	2010-03-5153
R54-R62, R64	330 Ohm chip resistor	2010-03-5331
R68, R69	4.7K chip resistor	2010-03-5472
R67	8.2 Ohm 1W resistor	2000-10-5829
TH1	10K NTC Thermistor	2400-08-5103

Pin 3:  
Blue

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.

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 collector output rated at 100mA at 50VDC.

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-200 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-200 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 unmuting line. If this line goes more positive during an unmuting condition, program the mobile COR line as active high (common data). If the line goes more negative during an unmuting 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-200 uses a voltage comparator as a COR threshold detector. RV1 sets the mobile COR threshold level and should be set for half way between the mute and unmuting levels at pin 7. Example: If Pin 7 is connected to a point that goes from 0VDC (mute) to 5VDC (unmute), set RV1 for 2.5VDC and program the mobile COR line as active high. If Pin 7 goes between 7.2VDC (mute) and 5.8VDC (unmute), set RV1 for 6.5VDC and program the mobile COR line as active low.

Pin 8:  
Brown

Local mic audio. If programmed for local mic repeat, the SVR-200 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-200 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.**

Install the SVR-200 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-200 mounts in the bracket using the four 8-32 x 1/4" machine screws. Do not use longer screws to mount the SVR-200 to the bracket or circuit damage may result.

## Programming

**Note to DOS 6.0 and higher users:** The memory manager automatically installed by DOS 6.0 and greater, defaults to a configuration that does not allow access to extended memory. The SVR-200 program needs access to extended memory and will not run if your computer disallows it. If you receive the error message:

Program too big to fit into memory

You must edit your autoexec.bat file. Add the following line:

```
SET CLIPPER = F50;E000
```

Save the file and reboot your computer.

### Using the Software

The SVR-200 personalization software is used to program the SVR-200 for all of the operating parameters and options. The software is menu driven and on-line help is available at any time by pressing F1.

To install the software on your computer type the following at the DOS prompt:

```
A:INSTALL or B:INSTALL
```

The install program will install the software onto your hard drive in a directory called SVR200. To run the program, type:

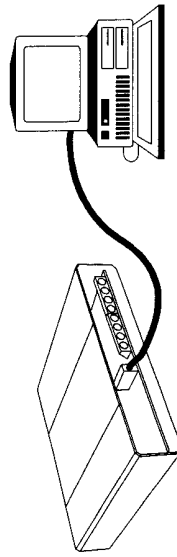
```
SVR200
```

The main menu bar will appear at the top of the screen, with the highlight on "FILE". Press <ENTER> or the first letter of any of the main menu bar items to activate a drop down menu of choices (clicking the left mouse button on any of the main menu bar items will have the same affect). When the drop down menus are displayed, any of the sub-menu items may be selected in the same way: by pressing the first letter of the item, by moving the highlight with the up/down arrow keys and pressing <ENTER> or by clicking the left mouse button on the desired item.

There is on-line help available at any time by pressing F1, or by clicking the left mouse button on the [HELP] icon in the upper right corner of the screen. Use the up/down arrow keys, pgup/pgdn keys or home/end keys to move through the help text. Pressing <ESC> or the right mouse button returns to normal program execution.

### Important Note:

Before attempting to program the SVR-200 start the software and ensure the FY-1 programming cable is plugged into the correct serial port. The com port may be selected under the "FILE" menu. Plug the FY-1 programming cable into P3 on the front of the SVR-200; the OPT LED on the SVR-200 front panel should be on continuously:



**P1.5** Serial clock line output. Serial data that is sent to the PLL, the E<sup>2</sup>PROM and the audio processor chips are clocked by each low-high-low transition on this line.

**P1.6** Serial data output. Data sent to U10, U4 and U5 are output on this line and clocked by P1.5.

**P1.7** Data input to the microprocessor. Serial data is read from U10 (E<sup>2</sup>PROM) and U5 (sub-audio processor) on this line.

**P2.0** Lock tone output. Lock tone encode is generated by this pin at power up and during lock tone test mode. All of the queuing tones are also generated by this pin for trunking operation.

**P2.1** Lock tone decode input, active high. The output of lock tone decoder U3D is input on this line and checked during receiver activity. If lock tone is detected, the microprocessor increments its priority counter and ceases activity as priority unit.

**P2.2** Repeater tx/rx output. This line is used to switch the repeater RF module between transmit (low) and receive (high). The output drives buffers Q7 and Q6. The output of Q6 switches Q5 on during receive to enable the 5V RX line and switches Q4 on during transmit for TX 7.5V. RV10 sets the TX 7.5V output level for RF power control.

**P2.3** Mobile PTT output, active low. This line is brought low to key the mobile radio during handheld to base repeat operations.

**P2.4** Mobile COR input. U1A is a threshold detector for the mobile COR input on pin 7 of P1. The output of U1A is read by the microprocessor on this port to determine if the SVR-200 should repeat base to portable. Polarity of this input is determined by PC programming.

**P2.5** Repeater COR input, active low. RSSI output from the RF module is sent to threshold detector U2D for comparison with the squelch setting at RV9. R47 and R70 provide hysteresis to prevent chatter. Repeater COR is used to enable the CTCSS decoder circuitry; the microprocessor will not decode the signal from U5 unless repeater COR is also active.

**P2.6** Chip select output for U4 (audio processor), active low. Serial data is sent to U4 on P1.6 and clocked by P1.5. These lines are shared by U5, U10 and the PLL; data is ignored by U4 unless the chip select line is asserted during data write operations.

**P2.7** Chip select output for U5 (sub-audio processor), active low. Serial data is sent to U5 on P1.6 and clocked by P1.5. These lines are shared by U4, U10 and the PLL; data is ignored by U5 unless the chip select line is asserted during data read and write operations.

**INT0** External interrupt #0. This line monitors the PLL lock detector output. The line is active high to indicate the PLL is functioning on frequency during transmit-receive and receive to transmit changes. The output will go briefly unlocked, then revert back to a locked condition. If the PLL does not achieve lock within 50mS, the transmitter will be disabled and the OPT LED will flash rapidly to alert the user that the unit should be brought in for service.

**INT1** External interrupt #1 active low. This line is used by U5 to signal the microprocessor that it has completed a decode cycle and data can be read. During receiver activity, this line will go active approximately every 122 mS in the presence of sub-audio signalling. During transmit mode and receiver activity without sub-audio signalling, this line will be inactive.

- T0** Test input, active low. Shorting J3 puts the microprocessor into test mode for alignment purposes. If shorted at power up, the receiver will operate open squelch mode and audio will be heard at the local speaker port regardless of carrier or tone input to the receiver. Although alignment is normally done with the RSSI output at TP1, a Sinead reading can be obtained using this mode of the test input. All other functions of the SVR-200 are disabled in this mode and power will have to be turned off then on to reset the unit.
- IF J3 is shorted after power has been applied, the microprocessor will enter the lock tone test mode, key the repeater and send the programmed lock tone for as long as J3 is shorted. Remove the short from J3 to return to normal operation.
- T1** On-air detect input. The on-air detect line (P1 pin 9) is used to detect local mic PTT from the mobile, and in trunking mode, this line is used to detect that the mobile transmitter is actually on the air. The input is buffered by Q10 and the polarity of the signal is determined by PC programming.
- TXD** Transmit data output for programming. Data is sent to the PC on this line at 300 baud, 8 data bits, 1 stop bit and no parity. This line is active only during programming mode.
- RXD** Receive data input for programming. Data is received from the PC on this line at 300 baud, 8 data bits, 1 stop bit and no parity. This line is also used to sense when the programming cable is inserted. If RXD is grounded, the SVR-200 operates in the normal mode. If this line is high, programming mode is entered and the OPT LED is on continuously.
- Reset** Active high input to reset the microprocessor. U11 provides a 350mSec delayed high signal to this pin during power up or if the 5V line falls below 4.5VDC.
- Xtal** The microprocessor uses a 4.032MHz xtal for all of the timing and program execution clock cycles. The output of the on board oscillator also drives the xtal input to U5. The output of U5 xtal oscillator drives the input of U4.

**Receiver**

- 1. Receiver front end:** Connect a DC voltmeter to TP1 on the SVR-200 main board. Set the service monitor connected to the SVR-200 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 Z201 and Z202 on the RF board for a maximum reading at TP1; adjust the RF output of the monitor accordingly to maintain an approximate reading of 1VDC at TP1. Adjust L205 on the RF board for a maximum reading at TP1.
- 2. Repeater squelch:** Adjust the service monitor RF output for .5µV. Adjust RV9 on the SVR-200 main board so the repeater COR LED is just on. Decrease the service monitor RF output to .35µV 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.
- 4. Local Rx audio:** Connect an 8 ohm speaker to P4 and set RV4 for the desired listening level. Turn off the CTCSS modulation of the service monitor connected to the SVR-200. Confirm that the repeater CTCSS and mobile PTT LED's are off.
- 5. Change the 1kHz tone modulation to the lock tone frequency.** Confirm that the PRI LED goes off after approximately .5 seconds.

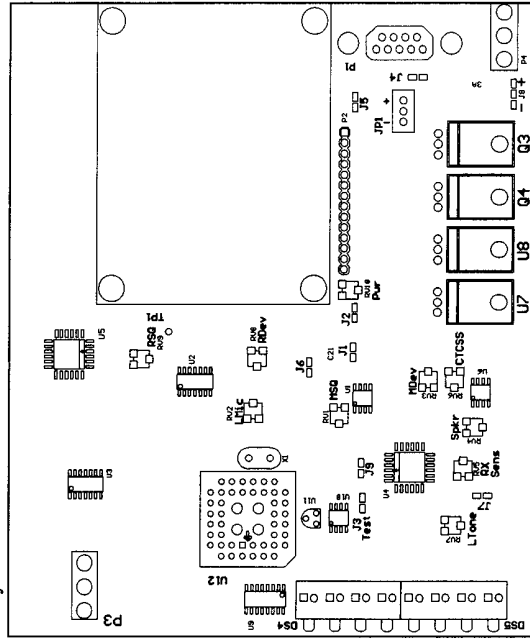


Figure 1

## Theory of Operation

### Receiver:

The receiver is a double-conversion superheterodyne type, designed for narrow band FM reception in the frequency range of 850-870 MHz. 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 RF input stage by the antenna switch U5. The RF signal is presented to bandpass filter BPF1 to improve sensitivity and then to the base of RF amplifier U7. The RF signal is then presented to a second bandpass filter BPF2.

**First LO:** The first LO signal is developed by the synthesizer and output through SAW filter FL6 for mixing with the incoming signal.

**First Mixer:** The RF signal amplified by U7 is further amplified and mixed with the first LO signal by U6. The difference component (45 MHz) is filtered by FL1A and FL1B and amplified by Q1.

**Second LO/Mixer:** The first I.F. signal is presented to U2 which performs the functions of second LO, second I.F. amp and mixer, FM discriminator and squelch. X2 (44.545 MHz) is the second LO crystal and is mixed with the 45 MHz first I.F. signal to produce the second I.F. frequency of 455 kHz. Ceramic filter FL2 provides selectivity for the 455 kHz signal.

**Detector/Squelch:** U2 demodulates the 455 kHz signal via quadrature coil L1 to produce the audio and noise components. The output of U2 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.

### Transmitter

The output of the transmit VCO is input to the driver transistor Q3. The output of Q3 drives the RF hybrid output amp U8 through SAW filter FL4. The final amp is a class C power amplifier and drives the output lowpass and harmonic filter FL5. U5 is the transmit output switch.

### 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 voltage divider R68, R69 and buffer amp U2A.

**Transmit audio path:** Receiver audio from the mobile is input to the mic amp portion of U4; PC programming of the SVR-200 provides flat response or +6db/octave pre-emphasis. The output of the mic amp is internally connected to the limiter and lowpass filter. When a condition to repeat exists (base to handheld) U4 audio is switched on and audio is presented to amplifier/limiter and lowpass filter to remove audio components above 3kHz. U4 provides -48db/octave of attenuation to out of band signals. Transmit audio is output on pin 22 of U4 and passes through the final lowpass filter U2C to remove any clock noise generated by U4's switched capacitive filters before being presented to the RF module on P2 pin 6.

**TX audio flat/de-emp:** If the mobile transmit audio output from the SVR-200 is connected after pre-emphasis in the mobile, set the response to flat. If connected before pre-emphasis or to the mic input, set the response to de-emp.

**RX audio flat/pre-emp:** If the receive audio coming from the mobile is connected to the discriminator or before de-emphasis, set the response to flat. If connected after de-emphasis, set the response to pre-emphasis.

**Lock tone frequency:** Select either 832.5 or 847.5 Hz.

**Local mic repeat:** Enables or disables the local mic repeat function; if enabled, ensure that the on-air polarity input is correctly configured.

**Pri-sampling:** Enables or disables the pri-sampling feature of the SVR-200. If used in multi-vehicle applications, this must be enabled for proper operation. During base to handheld repeat mode, the SVR-200 transmitter will switch to receive mode to check for other repeaters or handheld activity. If another repeater is detected (carrier without/wrong tone) the repeater will cease activity to prevent radio "collisions". If handheld activity is detected (carrier & correct tone) the SVR-200 will switch to handheld to base repeat mode.

**Courtesy Bleep:** (Firmware version 3.02 & above) Enables or disables the courtesy tone at the end of each handheld to base transmission. The tone verifies the handheld is within range of the repeater and transmission was successful. It also serves to notify other handheld users that the channel is clear for use.

**Sampling rate:** If pri-sampling is enabled, this selects the sampling interval. The range is 0.25 seconds to 2.5 seconds in .25 second increments. The higher this setting, the longer the handheld operator must wait before speaking after pressing PTT during base to handheld repeat mode, since the repeater may still be in transmit mode (there is no delay if the repeater is idle). If the interval is too short, some users may complain about the "chop" that is heard in the handholds.

### Radio

**Send:** Downloads the current configuration to the repeater. The program will prompt you to make the FY-1 connection and press the <SPACE> bar to begin downloading. Download takes approximately 5 seconds.

**Receive:** Uploads the current data from the repeater. The program will prompt you to make the FY-1 connection and press the <SPACE> bar to begin uploading. Upload takes approximately 4 seconds.

**Band:** Changes frequency bands for different versions of the repeater. If the band is changed, the frequency information is reset to default values; common data remains intact. The program will prompt you for confirmation before changing bands.

### Help

There are two help menu items: General explains how to use the mouse and menu system as well as general program information. About contains Pyramid's address and phone number for problems that may arise. Help is also available at any time by pressing F1 or clicking the left mouse button on the [HELP] icon in the upper right hand part of the screen.



## Menu selections

### File

**Load:** Allows you to load a previously saved file from disk. Enter the file name or press F2 for a directory of SVR-200 files. Only files with the .VR2 extension and legal DOS names will be loaded.

**Save:** Allows you to save the current configuration to disk. Enter the file name to save or press F2 for a directory of SVR-200 files. The file name entered under the common data menu is automatically inserted for file name to save. This name is also stored in the EPROM of the SVR-200 during write operations and will be the inserted file name if the radio data has just been uploaded. The program will prompt you before overwriting an existing file.

**Com1/2:** Allows you to change the com port setting for uploads and downloads to the radio. This setting is remembered by the program for the next session.

**Print:** Sends the current configuration to LPT1. Make sure the printer is on line and paper is loaded before executing this command.

**Quit:** Returns to DOS. 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.

### Data

**Frequencies:** Enter the transmit and receive frequencies as well as the encode and decode sub-audio data. The program will automatically round off the frequencies to the nearest channel step if incorrect data is entered. If incorrect sub-audio data is entered, a pop up window of correct choices will appear. To disable sub-audio encode operation, enter 0.0; sub-audio decode cannot be disabled.

**Common data:** Controls all of the options and input polarities of the SVR-200. Make sure all of the settings are correct for the type of mobile radio the repeater is connected to or improper operation may result.

All of the common data parameters (except for file name) can be toggled by using the up/down arrow keys to move the highlight, and the <ENTER> key to toggle. They can also be changed by clicking the left mouse button on the desired item.

**File name:** This data is stored in the EPROM of the SVR-200 during downloads. The file name is also automatically inserted for file save operations.

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

**Type of mobile:** Selects either trunking or conventional. If a trunking mobile is selected, the SVR-200 will go through the voice channel acquisition procedure during handheld to base repeat mode.

**On-air polarity:** Selects either active high or active low. This line is used to monitor the local mobile PTT for local mic repeat on conventional radios. On trunking radios, it is also used to determine if the mobile is actually on the air. Local mic repeat can be disabled under this section (see page 11).

**Receive audio path:** Receiver audio from the transceiver module is input on P2 pin 13 and presented to U5 pin 10 and pin 16. Pin 10 is the input of the receiver highpass filter to remove any sub-audible signals before being output on pin 11 and sent to U4 for receiver audio processing. Pin 16 is the input to the sub-audible tone decoder section of U5. Receive audio entering pin 7 of U4 is processed as flat, or -6db/octave depending upon PC programming. The receive audio then passes through the internal lowpass filters to remove unwanted noise and output on pin 21, where it is sent to the local receiver audio amp and mobile transmit audio output amp U1B. J1 selects either high sensitivity (open) or low sensitivity (shorted) and J2 selects the output impedance (600/2.2K Ohms).

**Sub-Audible tone signalling:** U5 processes the sub-audible signal from the receiver by comparing the incoming signal to previous samples in a noise correlator. If the signal is sufficiently coherent, the output of the comparator is counted by the internal circuitry and an interrupt is generated to the main microprocessor. U12 reads the data from U5 in 2 bytes: byte one contains the number of complete cycles detected within 122mS, and byte 2 contains the number of internal clock cycles elapsed for the remainder. U12 performs a comparison of minimum and maximum values allowed in a look up table and determines if the data is within the decode bandwidth for the programmed tone.

**In band tone signalling:** Audio from the transceiver is also fed to U3B where it is amplified and limited for input to the commutating switched capacitive filter made up by C23-C26 and P0.4-P0.7 of the microprocessor. The microprocessor outputs four identical signals with 90° phase difference on the respective port pins. The resultant wave form will be a function of the difference between the incoming signal frequency and the decode frequency output by the microprocessor. The signal is buffered by U3C and amplified by U3A before being rectified and filtered by D1 and C2. The resulting DC voltage is compared to the reference voltage by U3D. If the incoming signal is within the decode bandwidth, the output of U3D will be a logic 1 and read by the microprocessor.

**Logic and control:** U12 is an Atmel 89C51 microprocessor with flash EPROM 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, and repeater status indications via D4 and D5 led arrays.

The 89C51 has four 8 bit ports that interface with the rest of the hardware on the controller board; a brief description of each port follows:

- P0.0-0.3 Not Used.
- P0.4-0.7 These four lines make up the input to the switched capacitive filter network of C23-C26. During receive mode, the lock tone frequency will be output on each of these lines with a 90° phase difference between them at any given time. During transmit mode, these lines are in active and open collector.
- P1.0-P1.2 LED data is output on P1.0 line every 10mSec. Data is loaded into shift register U9 8 bits at a time and is clocked by P1.1. P1.2 latches the data into U9 for display.
- P1.3 PLL latch enable output to the RF module. During transmit to receive and receive to transmit transitions, this line is used to latch the serial data into the PLL shift registers. The serial data and clock lines are shared with U10 (EPROM) U4 (audio processor) and U5 (sub-audio processor).
- P1.4 EPROM chip enable, active high. Data is output to the EPROM on P1.6 and clocked by P1.5. Data is input from the EPROM on P1.7. P1.4 will go active during read and write operations with U10. U10 is written to every time the unit is programmed. U10 is read only at power up.