SVR-200
Vehicular Repeater

This manual is intended for use by qualified technicians and includes all necessary information pertaining to the SVR-200 operation, circuit design and maintenance. Changes that occur after date of printing will be incorporated in supplemental service publications.

RF Exposure Warning:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This device's provided external duel antennas must be installed in accordance with provided instructions; and it mu be operated with minimum 20 cm spacing between the antennas and all person's body (excluding extremities of hands, wrist and feet) during wireless mode of operation. Further, this transmitter must not be co-located or operated in conjunction with any other antenna or transmitter.

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:

	VHF	UHF	800 MHz
Type Acceptance:	LRUSVR-200VB	LRUSVR-200UD	LRUSVR-200MA
Output Power:	0.25-2.0W	0.25-2.0W	0.1-1.0W
Emission designator:	11K0F3E/16K0F3E	16K0F3E	11K0F3E/16K0F3E
Frequency band:	150-174 MHz	450-490 MHz	850-870 MHz
Number of Channels:	One	One	One

Specifications

Transmitter:	**VHF**	**UHF**	**800**
Frequency Range:	150-174 MHz	450-490 MHz	850-870 MHz
Rf power out:	250mW - 2W	250mW - 2W	100mW - 1W
Spurious emissions:	-50dbc	-52 dbc	-50dbc
Freq stability -30°~+60°C:	3 PPM	5 PPM	1.5 PPM
Modulation:	11K0F3E[1] /16K0F3E	16K0F3E	11K0F3E[1]/16K0f3E
Hum and Noise:	-40db	-40db	-40db
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-200UD	LRUSVR-200MA
Industry Canada Approval:	Pending	2390 212 113A	Pending

Receiver:

Frequency Range:	150-174 MHz	450-490 MHz	850-870 MHz
RF sensitivity:	.4µV	.35µV	.35µV
Squelch sensitivity	.2µV to 2µV adjustable	.2µV to 2µV adjustable	.2µV to 2µV adjustable
Modulation acceptance:	±3.75 [1] /±7.5kHz	±7.5kHz	±3.75 [1] /±7.5kHz
Selectivity:	60db	60db	60db
Spurious/image rejection:	60db	60db	60db
IMD response:	60db	60db	60db
Frequency stability:	3 PPM	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	800 mA @ 2W	1.1A @ 2W	700mA @ 1W

Physical:

Dimensions:	5.275"W x 6"L x 1.12"H
Weight:	18 oz.
Case:	One piece extruded aluminium

[1] Narrowband operation is special order

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. The use of 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-200 operates on simplex frequencies; part of the multi-vehicle format dictates that all of the SVR-200s 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-200 via their mobile radio front panel or a separate switch. When the mobile radio is receiving carrier and proper tone, the SVR-200 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-200 can be programmed to give the handhelds priority in a conversation by periodically sampling for handheld activity (carrier and proper tone) during base to handheld transmissions. During sampling, if the SVR-200 detects a handheld transmission, it will cease transmissions, key the mobile radio and repeat handheld to base. This allows the handheld to respond during repeater hang time or during full duplex interconnect calls. Priority sampling can be enable/disabled through PC programming and the interval can be programmed between .25 seconds and 2.5 seconds in .25 second increments.

The SVR-200 has a fixed 3 minute time out timer for base to handheld transmissions. If the mobile COR is active for more than 3 minutes (and the SVR-200 is the priority unit) it will send a double blip and cease transmission until the mobile COR is inactive. The 3 minute time-out is in affect regardless of whether the SVR-200 is programmed for priority sampling or not.

Multi-vehicle operation

When the SVR-200 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 handheld or handheld to base transmissions. If another unit arrives on scene and is activated, it too will transmit the "lock tone"; when the first SVR-200 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-200 will not transmit it's 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-200s 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 decrementing their priority counters until one of them reaches the priority status and begins repeating the transmission. Since the SVR-200s 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-200s unkeys to check for handheld activity, it will detect the presence of the other active SVR-200 and increment it's priority counter and cease transmission. This is the self clearing mode to prevent radio collisions.

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-200 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-200 also has a local receive audio speaker jack that enables the person in the vehicle to monitor handheld to base transmissions that are being repeated through the mobile.

If the users wish to communicate handheld-handheld without accessing the mobile repeater, they may transmit on the same frequency without CTCSS (or a different CTCSS); the SVR-200 only responds to carrier and proper tone from the handhelds.

Trunking operation

When the SVR-200 is connected to a trunking mobile and the handheld operator wishes to access the system, they key their handheld briefly then release. The SVR-200 will attempt to acquire a voice channel on the trunking system by keying the mobile for 200mS 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-200 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-200 will transmit intercept tone to alert the handheld operator that the call attempt failed.

When the SVR-200 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 merely 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-200 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-200 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.

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 handheld to base.
RTX:	Repeater transmit indicator.
MCOR:	Mobile unmute detector indicating a condtion to repeat base to handheld.
MTX:	Mobile transmit indicator.
OPT:	Should be on steady during programming operations only. If OPT LED flashes at 10Hz rate, it is an indication that the PLL did not lock within the allotted 50mS and the unit should be serviced.

Installation

Before installing the SVR-200, ensure that the RF and repeater sections are properly aligned per the tuning instructions on pages 8-13 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 *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: *Black/Shield* Ground. Connect to the radio's chassis or ground plane.

Pin 2: *White* 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).

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 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-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 unmute 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 vsion or constitute a hazard during a vehicle collision. The SVR-200 mounts in the bracket using the four 8-32 x ¼" machine screws. Do not use longer screws to mount the SVR-200 to the bracket or ciruit damage may result.