Installation and Operation Manual

SNV-12
Signal-and-Noise Voter

Designed and Manufactured by:
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FEDERAL COMMUNICATIONS COMMISSION
(FCC) COMPLIANCE NOTICE:
RADIO FREQUENCY INTERFERENCE NOTICE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case users will be required to correct the interference at their own expense.

CAUTION

Changes or modifications to this equipment not expressly approved by Raytheon could void the user's authority to operate this equipment.

NOTICE

Raytheon reserves the right to make changes to the equipment and specifications without prior notice.

PROPRIETARY STATEMENT

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Glossary

CIM	Console Interface Module	The SNV-12 module that interfaces the voter to a console.
COR	Carrier Operated Relay	A signal from a receiver that gives a positive indication that a carrier or signal is being received and that the receiver is unsquelched. It has the same function as Carrier Operated Squelch (***COS***).
COR Lock		A voting mode in which, once a site is voted, it stays voted until all sites become squelched (the voting sequence ends), regardless of changes in relative signal qualities. Also called ***Voting Lock***.
COS	Carrier Operated Squelch	See ***COR***.
CPM	Control Processor Module	The SNV-12 module that controls all aspects of system operation.
Default TX Site		When the voter is first turned on and before any ***TX Steering*** is applied (or after the expiration of the ***Holdover Timer*** following the application of TX steering), all console and Repeat Mode transmissions are sent to the Default TX Site. This can either be set to the ***Home Site*** or set to ***Multicast***.
Dipswitch	Dual In-Line Package Switch	A multi-unit switch that fits into a standard DIP integrated circuit footprint. Usually contains eight or ten individual switches.
DSP	Digital Signal Processing	
EIA Keying Sequence	Electronic Industries Association	The keying tone sequence specified by the EIA is supported by the SNV-12.
Guard Tone		A tone sent continuously from a receiver to indicate a good link between the receiver and the voting system. Absence of guard tone at any time indicates a line fault. Compare with ***Pilot Tone***.
Hangtime		A system with hangtime will remain in the transmit mode for the duration of the set hangtime beyond the time indicated by any keying inputs. The hangtime prevents momentary transmitter unkeying during brief pauses in the transmission.
Holdover Timer		Determines how long transmit-steered console transmissions and ***Repeat Mode*** voted audio retransmissions will be sent to the steered site, rather than to the ***Default TX Site***.
Home Site		One of the ***Default TX Site*** Selections. The Home Site is the lowest-numbered TX-eligible SVM. A general coverage transmitter is usually installed at the Home Site.
Multicast		One of the ***Default TX Site*** Selections. When the unit is set to Multicast, all TX-eligible sites are keyed by console or ***Repeat Mode*** transmission (some restrictions apply).
PCB	Printed Circuit Board	
Pilot Tone		A tone sent from a remote receiver site to indicate a squelched receiver condition. The pilot tone is notched out of the RX audio. Also called "line proving tones" or "idle tone". Compare with ***Guard Tone***.
Primary Site		When several receive sites share a single transmitter, the site associated with the transmitter is the Primary Site. The other sites in the group are Auxiliary Sites. See also ***RX Groups***.
Repeat Mode		Voted audio is retransmitted through all sites or through all sites in an ***RX Group***. Also called ***Voted Site Talk-through***.

Glossary

RX Groups		Associating a single transmitter with a group of receivers, or other operations in which groups of sites function as a single unit. Also referred to as ***TX Groups***.
RX	Receiver or Receiving	
RX Only Site		Each SVM can be designated as an "RX only" site, and the SNV-12 will not allow any keying via these sites.
SNR	Signal-to-Noise Ratio	
STARS	Smart Transmit and Receive Steering	Raytheon's transmit steering algorithm, based on the history of which receiver site was voted best during the end of the voting sequence, rather than simply on which receiver was voted last.
SVM	Site Voter Module	The SNV-12 module that interfaces voting receivers and applies a variety of DSP algorithms to the RX audio input.
TX	Transmit or Transmitter	
TX Eligible		Each SVM is TX eligible (allowed to transmit) as long as it has not been designated an **RX Only Site**, or is not the designated **Primary Site** in an **RX Group** that does contain a Primary Site. Primary Sites lose TX-eligibility if the they experience a Line Fault and Group Lockout with Primary Site Failure is enabled. Otherwise, SVMs do not lose TX-eligibility if they experience a Line Fault or are set to Disable.
TX Source Priority		Either a dispatcher at the console or the users in the field have priority regarding which audio source is transmitted and when. With simplex systems, **Console Priority** allows the dispatcher to terminate currently voted communications, while **Field Priority** prevents this. With duplex systems, voting and transmitting can occur simultaneously, so the TX Source Priority determines whether console transmissions are allowed to preempt the retransmission of voted audio.
TX Steering, Automatic		Console transmission routing based on "last-best" voted receiver. See also ***STARS***.
TX Steering, Function Tone Guided		Console transmission routing based one of seven function tone embedded in the EIA Keying Tone sequence that accompanies the Console TX Audio input.
TX Steering; Manual, Latched		Console and voted audio repeat mode transmission routing based on logic input or RS-232 command. The routing stays in effect until the logic input is removed or the RS-232 command is rescinded.
TX Steering; Manual, Momentary		Console and voted audio repeat mode transmission routing based on a pulsed (momentary) logic input or an RS-232 command. The routing stays in effect until the ***Holdover Timer*** expires.
Voted Site Talkthrough		Voted audio is retransmitted through all sites or through all sites in a group. Also called ***Repeat Mod***e.
Voting Lock		A voting mode in which, once a site is voted, it stays voted until all sites become squelched (the voting sequence ends). Also called ***COR Lock***.

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1 Overview

1.1 Scope

This instruction manual provides the information necessary to install and operate the SNV-12 DSP-based, 12 Site Voter.

1.2 Description

1.2.1 General

The SNV-12 will select, from up to 12 individual sites (or 36 in an expanded system), the input with the best signal quality. For FM receivers, the SNV-12 votes based on the noise level present in the received signals. Alternatively, a full Signal-to-Noise Ratio (SNR) calculation works best with AM or HF systems. Individual plug-in Site Voter Modules (SVMs) use digital signal processing (DSP) to measure noise and speech signal levels and to calculate the SNR. Pilot tones or External COR inputs may be used to inform the voter when the voting receiver is unsquelched. A Control Processor Module (CPM) controls the Site Voter Modules and a Console Interface Module (CIM) provides monitoring of the voted signal. Together they provide an interface to a command console or computer terminal.

1.2.2 Card Cage and Backplane

The Card Cage is a 19" wide EIA standard rack-mounted Eurocard cage equipped with a backplane board that the modules are plugged into. The modules PC Boards are 100 x 220 mm. The card cage height is 5.25" (3RU) tall, 19” wide, with a depth of 11". An AC input module and a power transformer assembly are located on a metal panel that is mounted to the backplane. The AC module is a combination AC line filter, power cable connector, input voltage selector and fuse holder. The backplane interfaces the outside world via D-subminiature and terminal strip connectors, and internally to the plug-in modules via 60-pin card edge connectors. No active or passive electrical components reside on the backplane board.

1.2.3 Power Supply Module

The Power Supply is a single-board module that plugs into the left-most slot in the backplane. The power supply's backplane connector is offset relative to the connectors for the other modules; this prevents improper location of the Power Supply Module in the slots reserved for the other cards. In turn, these other modules cannot be plugged into the Power Supply slot. The Power Supply incorporates a dual-primary line transformer with a bridge rectifier and filter capacitors to provide a +15V unregulated DC bus. The bus feeds a linear regulator that supplies all modules with +12 VDC, and the bus also feeds a switching regulator that provides -12 VDC. Each individual Site Voter Module contains a switching +5V regulator operating from the +15V bus. The Power Supply can be powered by either 115 or 230 VAC or +12 VDC. A trickle charger output is provided at the DC Supply terminals for use with battery backup operation.

1.2.4 Console Interface Module

The Console Interface Module is the interface between the voting system and a dispatcher's audio console; it takes in console audio for transmission and supplies the voted audio signal. To facilitate setup and troubleshooting, the CIM's front panel speaker can be set to monitor either voted audio or a combination of console transmit input audio and voted output audio. All transmit audio is processed in this module, and then routed onto the backplane's TX Audio Bus to be picked off by SVMs as directed by the CPM. The CIM can be set to detect EIA sequences in the incoming Console TX audio to be used for transmitter keying, and to condition audio output to transmitters by adding keying tones. Variable digital audio delay allows console transmit audio signals to be delayed to prevent loss of first syllables until all system keying delays (including slow-to-key repeaters) are past.

1.2.5 Control Processor Module

The SNV-12's Control Processor Module controls the entire voter via an internal high-speed serial bus; it requests and receives Signal Quality or SNR, Noise Level, COR Presence (receiver squelched/unsquelched state) and Speech Present information from each Site Voter Module. PTT inputs are presented on an interrupt basis (rather than by the module polling process) for quick response. This information is used to make decisions that involve voting and transmit steering, etc. The CPM also provides an RS-232 serial port that allows programming and monitoring of all SNV-12 functions via an external computer or serially interfaced console. The CPM-3 adds an Ethernet port for in-system programming and an enhanced web browser-based user interface for controlling and monitoring the SNV-12 system. The front panel of the CPM Module contains a Fault LED, along with three other LEDs that indicate the unit's status in an expanded system, labeled: Master, Expansion 1 Expansion 2. In expanded systems, up to three SNV-12 chassis may be connected together to create a voting system of up to 36 sites. The CPM-3 has an additional LED on the front panel, labeled LINK, to indicate network link status.

1.2.6 Site Voter Module

The SNV-12 may house as many as 12 Site Voter Modules. Each of these modules interface with an external radio receiver (and/or transmitter) and measures the Noise and Signal levels of its receive audio. The signal-quality information is passed on to the CPM module for use as the basis for voting. Other features and functions of this module include speech detection (for line fault determination), adjustable RX audio delay, and transmit audio output. Front panel switches allow any site to be eliminated from voting or to be "Selected" as a voted site regardless of its signal quality. Front panel LEDs indicate if the associated site is disabled, voted, or selected for receive or transmit. Other LEDs indicate if the site's receiver is unsquelched, when TX audio is being steered through this module to a transmitter at the associated site, and if the module (or site) is experiencing a fault condition.

System transmitters should be connected to this module (rather than the CIM) as only the SVM TX outputs have the special TX audio features such as keying tones, hangtime, TX audio delay, etc. The SVM module takes TX audio from the TX Audio bus on the voter backplane and routes it through a gain stage and 600 ohm transformer on its way to the rear panel terminal block. No processing of TX audio occurs on the SVM; this is all done on the CIM Module.

1.2.7 Compatibility With Previous-Version Modules

The SNV-12 hardware has been upgraded several times to provide enhanced performance (and sometimes to deal with component obsolescence). We are very careful to provide compatibility between hardware revisions to the fullest extent possible. The following serves as a guide to compatibility between the various versions of voter modules.

At power-up, the CPM module checks the revision of hardware installed in the chassis, along with the software revision currently installed in each module. The CPM will verify that the most current version of software (within the CPM) for each module type is the version that's currently loaded in that module. If the CPM notes any "not latest version" software, the CPM will load the proper software into the module.

Incompatibility problems may occur if an attempt is made to place new version hardware modules into a chassis without also updating the CPM software. For example, if an SVM-2 is installed in an older chassis that contains only SVM-1 modules, along with a CPM-1 that has software from before the SVM-2 module was designed, the CPM-1 will be unable to recognize the SVM-2 and will ignore it.

There is an easy and inexpensive way to resolve such difficulties- simply contact Customer Service for a firmware IC to update a CPM-1 module, or download new CPM-3 code directly from our website.

In all cases, we strongly recommend that you use the most recent version of CPM software due to the addition of improvements and bug fixes. See Section 8 of this manual for more complete information regarding how to update software as well as a software revision history.

1.2.7.1 Console Interface Module

There are three versions: The CIM-1, the CIM-2, and the CIM-2A. All versions are compatible with all other hardware versions of other modules, but to use the current CIM-2A modules in an older chassis, the SNV-12's CPM-1 module must have revision 3.37 or higher. All revisions of CPM-3 software are OK.

NOTE: Latest revisions of CPM-1 and CPM-3 software always preferred.

1.2.7.2 Site Voter Module

There are two versions: The SVM-1 and the SVM-2. All versions are compatible with all other hardware versions, but the SVM-2 modules must have an appropriately recent version of software in the SNV-12's CPM-1.

SVM-1: All revisions CPM-1 and CPM-3 software are OK

SVM-2: CPM-1 software must be Rev 4.00 or higher. All revisions CPM-3 are OK.

NOTE: Latest revisions of CPM-1 and CPM-3 software always preferred.

1.2.7.3 Control Processor Module

There are two versions: The CPM-1 and the CPM-3. All versions are compatible with any versions of SVM and CIM modules, though CPM-1 software may require updating as mentioned above. Again, the most recent version of software is always recommended.

1.2.8 Specifications

Table 1-1: Specifications	
Site Voter Module RX Audio Inputs & Console TX Audio Input	
Input Impedance TX Audio (CIM-2)	Balanced 600 ohms or unbalanced 50k ohms.
Input Impedance RX Audio (SVM-2)	Balanced 600 ohms or 10k ohms, or unbalanced 10k ohms.
Input Level	-30 to +10 dBm, adjustable.
Pilot Tone Sensitivity	-24 dBm when set for 0 dBm audio.
RX Input Audio Delay	0 to 450 msec in 30 msec steps.
Voted Audio Output & Transmit Audio Outputs	
Output	Balanced 600 ohms.
Output Level	-20 to +11 dBm, adjustable.
Frequency Response	100 to 3000 Hz ±1 dB. (An internal HPF can be disabled to extend low frequency response to approx. 40 Hz.)
Absolute Output Delay	Less than 10 milliseconds.
Distortion	Less than 1%, 120 to 3200 Hz @ 0 dBm.
Voting Comparator	
Switching Time Between Sites	Less than 1 millisecond.
Unselected Output Rejection	Better than 60 dB.
Output Impedance	Balanced 600 ohms.
Voting Threshold	0 through 7 dB in 1 dB steps.
Parallel Control Inputs	
Input Impedance	10k to 47k ohm pull-up to +5V.
Threshold	+2.5V Nominal.
Input Signal Range	+30 VDC.
Protection Up To	±200 VDC.
Parallel Control Outputs	
Output Type	N-Channel Open Collector Transistor.
Maximum Sink Current	50 mA.
Maximum Open Circuit Voltage	+60 VDC.
SVM-2 E&M Interface	
E&M Input (COR)	COR Active: Input Open Circuit or 0 VDC or Higher. COR Inactive: Input Voltage –10 VDC or Lower.
E&M Output (PTT)	Relay Contact Closure (To internal ground or to external terminal).
Serial Control/Status Interface	
Serial Port	RS-232 DCE connector. Baud Rates: 300, 1200, 2400, 4800, 9600, 19200, 38400, and 57600.
Ethernet Port	RJ-45 Connector for 10/100 Ethernet
General/Environmental	
AC Input Power	115 or 230 VAC +/- 15%, 47-63 Hz, 100 VA type, 130 VA max.
DC Input Power	+11 to +15 VDC @ 5A, nom.
Size	5.25” H x 19” W x 11” D (13.3 x 48.3 x 28 cm).
Operating Temperature	-20 to +60 degrees C.
Storage Temperature	-40 to +85 degrees C.

Table 1-1: Specifications	
Humidity	Up to 95% @ 55 degrees C.
Shock	MIL-STD-810D, Method 516.3, Procedure VI.
Vibration	MIL-STD-810D, Method 514.3, Category I.
Regulatory Compliance	
FCC part 15	RFI Emissions
TUV	Safety for USA and Canada

Table 1-2 Equipment and Accessories Supplied

SNV-12 Chassis - P/N 5951-800000

Quantity	***Item***	***P/N***
1	SNV-12 Chassis Includes 19" Modular Card Cage, 3U (5.25") High, Plus These Modules: PSM-1A Power Supply Module CPM-3 Console Interface Module CIM-2A Control Processor Module	 5951-813000 5061-101000 5041-100000
1	Operation & Maintenance Manual	5951-800200
1	Accessory Kit	5951-800150

Consisting of*:*

Qty	*Part Number*	*Description*
1	0313-037770	Line Cord
1	0360-009100	Conn., cable, D-9 plug
1	0360-015000	Conn., cable, D-15 receptacle
1	0360-015100	Conn., cable, D-15 plug
2	0650-100000	Fuse, 3AG, 10A, 250V, fast-acting, fuses low voltage DC bus (F1)
2	0640-016100	Fuse, 5x20mm, 1.6A, 250V, time delay, for 230 VAC operation (F2)
2	0640-030100	Fuse, 5x20mm, 3A, 250V, time delay, for 115 VAC operation (F2)
2	0650-200200	Fuse, 3AG, 20A, 32V, fast-acting, for DC operation (F3)
1	0827-000001	Cable clamp for DB-9 connectors
2	0827-000004	Cable clamp for D15 connector
5	0837-103200	Truss head screw, 10-32, 3/8" for rack mounting
5	0848-100001	Nylon washer, #10 for rack mounting
1	5951-707000	Extender card assembly

SVM-2 Site Voter Module - P/N 5952-112000

Quantity	***Item***
1	Site Voter Module Plug-in module. As many as 12 Site Voter Modules may be plugged into the SNV-12 Chassis. Unused Site Voter Module slots on the Chassis are covered with blank plates.

To purchase an SNV-12 Signal-To-Noise Voter, order one Chassis and as many Site Voter Modules as desired (one per voting receiver; up to 12 per Chassis). For example, to order an SNV-12 Voter with 5 Site voter Modules, request for one piece P/N 5951-800000 and 5 pieces P/N 5952-112000. Additional site Voter Modules can be ordered at a later date and easily installed in the chassis. Unused Site Voter Module slots are covered by blank plates.

Table 1-3 Optional Equipment - Not Supplied

Item	*P/N*	*Description*
Battery Backup Kit	5951-895000	Back-up Battery and Cabling
Expansion Cables	5951-896024 5951-896036	Connects 2 Chassis to Create a 24 Site Voting System Connects 3 Chassis to Create a 36 Site Voting System
PTG-10 Pilot Tone Generator	5970-900000	Adds Pilot Tones to Remote Receiver Audio (See Section 7)

2 Field Setup Guide

2.1 General

This Quick Start Guide describes a typical SNV-12 installation with multiple receivers, a single transmitter, and a dispatch console. The SNV-12 voter can be set up for a wide variety of other system configurations; please refer to the manual for advanced capabilities and options.

The SNV-12 is configured and adjusted at the factory for the following;

- FM receivers (Use line audio, not discriminator audio)
- 1950 Hz pilot tone from all receivers (The PTG-10 Pilot Tone Generator is available from Raytheon)
- E&M Console keying input to voter (relay closure to ground or low level logic input signal activates the voter's PTT input)
- Hard-wired transmitter keying output (open collector transistor pulls transmitter PTT low; relay contact closure optional – see next page)
- Full Duplex (each SVM module set to simultaneously transmit and receive)
- Repeat Mode from Home Site (voted audio is retransmitted via SVM module #1)
- Console Priority (dispatcher transmissions preempt retransmission of voted audio)
- All audio is 600 ohm balanced; input/output audio levels are initially set to -10dBm

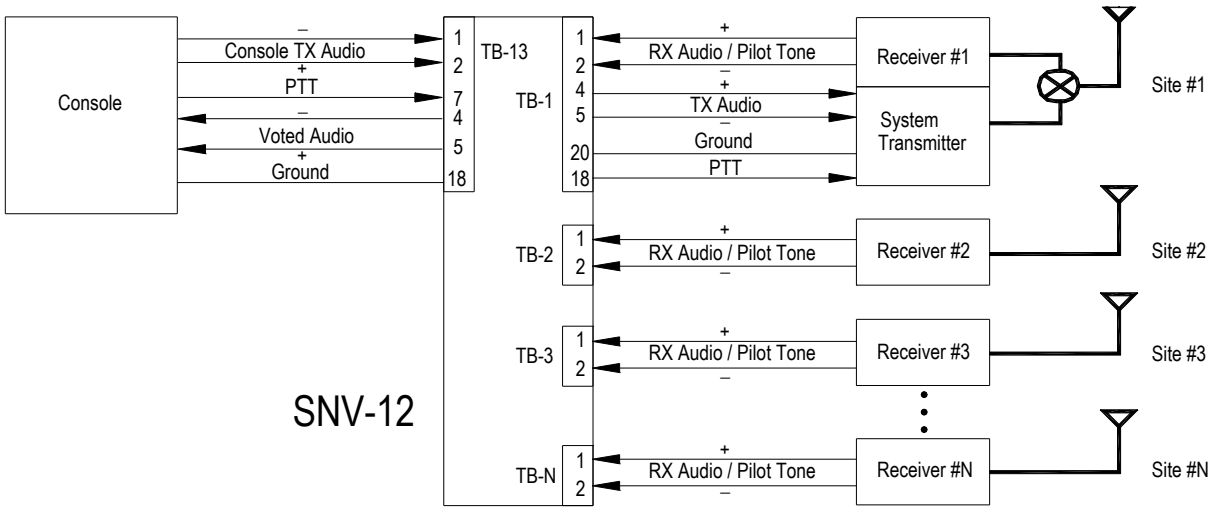

Figure 2-1 Quick Start Block Diagram

2.2 Basic Installation Instructions

Refer to manual sections 3, 4 and 5 for more complete instructions and explanations.

1) **Unpack** - Refer to Table 1-2 and the Installation Section of the manual.

2) **Pilot Tone** - For 2175 Hz pilot tone (rather than 1950 Hz), change switch SW2-1 from "1" to "0" on each SVM module that uses 2175 Hz.

3) **Transmitter Keying** - If a relay contact closure to ground is needed, change JP4 of SVM-2 #1 to pins 2&3 "E&M". If EIA keying tones are used to key the transmitter, change CIM module switch SW2-1,2,3 from "0,0,0" to "1,1,1".

4) **Console Keying** - If EIA keying tones will be sent from the console to the voter, change CIM module switch SW2-6 from "0" to "1".

5) **TX / RX Site Connections** - The transmit site must be connected to SVM-2 #1, which resides in the left most slot as viewed from the front of the voter. SVM-2 #1 interfaces its transmitter and receiver via rear panel terminal block TB1:

Audio from receiver:	use TB1 terminals 1(+) & 2
Audio to transmitter:	use TB1 terminals 4(+) & 5
PTT output to transmitter:	use TB1 terminal 18 (not needed with EIA keying output)
Ground to transmitter:	use TB1 terminal 20

6) **RX Site Connections** - Connect the inputs to the SVM modules via the rear panel TB2 through TB12:

Audio from receiver site 2:	use TB2 terminals 1(+) & 2
Audio from receiver site 3:	use TB3 terminals 1(+) & 2
⋮	
Audio from receiver site 12:	use TB12 terminals 1(+) & 2

7) **Console Connections** - The console interfaces the SNV-12 CIM module via rear panel TB13:

Console TX audio to voter:	use TB13 terminals 1 & 2(+)
Voted audio to the console:	use TB13 terminals 4 & 5(+)
PTT input to voter:	use TB13 terminal 7 (not needed with EIA keying input)
Ground to voter:	use TB13 terminal 18

8) **Connect Power** - 110 VAC or 12 VDC. When power is applied, the unit will self-test. The CPM-3 Fault LED will flash until the unit is fully ready to begin operation. The unit may also be set for 220 VAC; see the Installation Section of the manual for details.

9) **Adjust Audio Levels** - RX audio at each SVM must be adjusted as detailed in Section 3.12.6.6. TX audio must be set for proper transmitter operation. If a console is used, its audio to the voter's CIM console TX audio input must also be adjusted as detailed.

2.3 Module Configuration Sheets

The following sheets are the current "Quick Reference Help Sheets" as of the time of the printing of this manual. A laminated set of the latest sheets is included with this manual.

Chassis, Power Supply, and CIM Module

SNV-12 Configuration Settings and Adjustments (0=Off, 1=On)			
Chassis Rear Panel:	**Designator**	**Factory Setting**	**Switch Choices**
AC Line Voltage Rear Panel	AC Input Module	110 VAC (Unless Customer Specifies 220 VAC)	**110 VAC**/ 220 VAC (nominal)
Power Supply Module:	**Designator**	**Factory Setting**	**Switch Choices**
Charger ON/OFF (PSM-1A Module)	SW3	OFF	**OFF = Charger Disabled**, ON = Charger Enabled
CIM Module Configuration:	**Designator**	**Factory Setting**	**Switch Choices**
Console TX Audio Delay	SW1	60 ms	0=0, 1=30ms, **2=60**, 3=90, 4=120, 5=150, 6=180, 7=210, 8=240, 9=270, A=300, B=330, C=360, D=390, E=420, F=450ms
Transmitter Control; TX Output Key Tones [For Function Tone Guided TX Steering, also enable Key Tone Detection (CIM SW2-6) and select groups on SVM modules] [EIA sequence standard levels (relative to voice): Alert +10 dB, Function 0dB, Hold -20 dB Optional levels (see CIM-2A switch SW4-3): Alert 0 dB, Function -10 dB, Hold, -20 dB]	SW2-1, 2, 3	Key Tones Disabled	*SW2-1 SW2-2 SW2-3 Status* **0 0 0 Disabled** 1 0 0 1950 Hz (single, constant) 0 1 0 2175 Hz (single, constant) 1 1 0 2600 Hz (single, constant) 0 0 1 2950 Hz (single, constant) 1 0 1 Reserved 0 1 1 Function Tone Guided TX Steering 1 1 1 EIA F1 (1950 Hz) function tone
Key Tone Output Level Relative to Voice Audio (Single Tones Only – Does not apply to EIA)	SW2-4, 5	-5 dB	*SW2-4 SW2-5 Attenuation* 0 0 -20 dB 1 0 -15 dB 0 1 -10 dB **1 1 -5 dB**
EIA Key Tone Detection-Console TX Audio Input Unless CPM SW1-5 is Off, EIA Key Tones will not enable or disable Repeat Mode	SW2-6	Disabled	**0= EIA Key Tone Detection Disabled** 1= EIA Key Tone Detection Enabled 1950 Hz = Key 1550 Hz = Enable Repeat Mode (CPM SW1-5 must be Off) 1450 Hz = Leave Repeat Mode (CPM SW1-5 must be Off)
Site Unsquelch Time Limiter (three minute limit)	SW2-7	Disabled	**0= Disabled**, 1= Enabled
High Pass Filter (Cuts 100 Hz & lower)	SW2-8	Engaged	**0= Engaged**, 1= Removed
TX Source Priority Selection	SW3-1	Console	**0=Console**, 1= Field

CIM Module (continued)

SNV-12 Configuration Settings and Adjustments (0=Off, 1=On)			
CIM Module Configuration:	**Designator**	**Factory Setting**	**Switch Choices**
Simplex Mode; Voting Hold Off After TX	SW3-2, 3	1 Second	*SW3-2 SW2-3 Voting Hold Duration* 0 0 0.5 sec **1 0 1.0 sec** 0 1 1.5 sec 1 1 2 sec
TX Hangtime Duration Applies only to voted audio retransmissions when the voter is in Repeat Mode; Does not add hangtime to console transmissions unless SW3-8 is also Enabled.	SW3-4, 5	1 Second	*SW3-4 SW3-5 Hangtime Duration* 0 0 0 sec 1 0 0.5 sec **0 1 1.0 sec** 1 1 2.0 sec
PTT / UNSQ Output Configuration; These switches configure both the PTT/UNSQ output available at P2-5 and TB13-8, and the PTT/UNSQ relay at pins 13 through 16 of TB13	SW3-6, 7	PTT	*SW3-6 SW3-7 P2-5 Output Configuration* **0 0 PTT Only** 1 0 Unsquelched 0 1 Directed Active High Unsq. (CIM-2 Only) 1 1 Same, Delayed 200 ms (CIM-2 Only)
Console TX Hangtime (duration set by SW3-4,5)	SW3-8	Disabled	**0= Disabled**, 1= Enabled
Repeat Audio Mixed with Console TX Audio Unit must also be in Repeat Mode (CPM SW3-7 On) and set to Console Priority (CIM SW3-1 Off) to enable this feature	SW4-1, 2	Not Mixed	*SW4-1 SW4-2 Repeat Audio Mix Level* **0 0 No Repeat Audio Mixed** 1 0 Mix at -6 dB relative to Console TX Audio 0 1 Mix at -3 dB 1 1 Mix at 0 dB (No Attenuation)
EIA Key Tone Output; Alternate Level	SW4-3	Standard	**0= Standard,** 1= Lowered Amplitude (see CIM SW2-1,2,3)
PTT Input Polarity: Active Low or Active High	SW4-4	Active Low	**0= Active Low**, 1= Active High
Alternate TB13-17 function (Repeat Enable)	SW4-5	Disabled	**0= Disabled,** 1 = Enabled (**Leave at 0 with CPM-1**)
Alternate TB13-12 function (STARS Enable)	SW4-6	Disabled	**0= Disabled,** 1 = Enabled (**Leave at 0 with CPM-1**)
Spare Switches – Leave Off	SW4-7 to SW4-8	OFF	**0= OFF;** Reserved for future use
Voted Audio Output Level	R67 (potentiometer)	-10 dBm	Voted Audio to Console or Other External Device
Console TX Input Audio Level	R50 (potentiometer)	-10 dBm	Console TX Audio to Voter
Speaker: Internal or External	JP1 (jumper plug)	Internal	**Internal = 1&2**, External = 2&3
Console TX Input	JP2	600 ohm Balanced	**600 ohm Balanced (2&3)** or 47K ohm Single-Ended (1&2)
Voted Audio Mute Input	JP7	***Active Low***	**Active Low (1&2)** or Active High (2&3)
PTT/Unsquelch Output Configuration	JP8	***+5V, 47k Pull-up***	**+5V, 47k Pull-up (1&2)** or +12V, 10k Pull-up (2&3)
Console PTT Input Configuration	JP9	Logic Level Input	**Logic Level = 1&2;** E&M = 2&3

CPM Module

SNV12 Configuration Settings and Adjustments 0=Off, 1=On			
CPM Configuration	**Designator**	**Factory Setting**	**Switch Choices**
Serial Port Baud Rate	SW1-1, 2, 3	9600	**SW1-1 SW1-2 SW1-3 Baud Rate** 0 0 0 300 1 0 0 1200 0 1 0 2400 1 1 0 4800 **0 0 1 9600** 1 0 1 19.2K 0 1 1 38.4K 1 1 1 57.6K
Serial Port Enable/Disable	SW1-4	Disabled	**0=Disabled**, 1=Enabled
Repeat Mode is EIA controlled (version 4.08 & later)	SW1-5	Disabled	0=Enable, **1=Disabled**
Pilot Tone EOT Noise Cancellation	SW1-6	Disabled	**0=Disabled,** 1=Enabled for all SVM-2 Modules
Manufacturing Test	SW1-7	Disabled	**0=Disabled**, 1= Enabled ***MUST BE DISABLED***
Default TX Site Selection	SW1-8	Home Site	**0= Home Site**, 1=Multicast
Voting Criteria; Signal Quality Difference	SW2-1, 2, 3	1 dB	*SW2-1 SW2-2 SW2-3 Difference* 0 0 0 Test Only – NOT For Field Use **1 0 0 1 dB** 0 1 0 2 dB 1 1 0 3 dB 0 0 1 4 dB 1 0 1 5 dB 0 1 1 6 dB 1 1 1 7 dB
Front Panel Disable Reported As SVM Fault Note: Applies only to RS-232 status report	SW2-4	Standard Status Word	0=Front Panel Disable not reported as fault **1=Disable reported as fault**
Line Fault Detection Timer Delay Setting	SW2-5, 6	60 Seconds	SW2-5 SW2-6 Line Fault Delay 0 0 OFF 1 0 5 seconds 0 1 15 seconds **1 1 30 seconds**
STARS (TX Steering)	SW2-7	Disabled	**0= STARS Disabled**, 1= STARS Enabled
Software Normal/Update Setting	SW2-8	Normal	**0= Normal**, 1= CPM will update software at power up

CPM Module (continued)

SNV12 Configuration Settings and Adjustments 0=Off, 1=On			
CPM Configuration	**Designator**	**Factory Setting**	**Switch Choices**
Transmit Steering; Hold-Over Timer Setting	SW3-1, 2	10 seconds	*SW3-1 SW3-2 Hold-Over Timer* 0 0 Infinite 1 0 3 seconds **0 1 10 seconds** 1 1 30 seconds
Voting Locked on Active COR (Also called COR Lock)	SW3-3	Disabled	**0=Voting Lock Disabled** (Normal Voting) 1= Voting Lock Enabled
Voting Locked on Data Detection Not supported in s/w versions above 3.38 for SVM-1, or mixed SVM-2/SVM-1 chassis. Supported in all s/w versions for SVM-2s.	SW3-4	Disabled	**0=Voting locked on DATA Disabled**, 1= Voting locked on DATA Enabled
Duplex/Simplex Operation	SW3-5	Duplex	0= Simplex Operation, **1= Duplex Operation**
Group Lockout on Primary Site Failure	SW3-6	Disabled	**0= RX Group Lockout Disabled** 1= RX Group Lockout Enabled
Repeat Mode	SW3-7	Enabled	0= Repeat Mode Disabled, **1= Repeat Mode Enabled**
Vote Indication Hold After Squelch	SW3-8	Disabled	**0 = Disabled**, 1 = Enabled
Voting Criteria: Voting Transition Timer Applies to SW4 unless COR Lock (Voting Lock) is enabled via CPM SW3-3	SW4 ***Note Dual Function***	250 ms ***Note Dual Function***	0=Test Only – Not For Field Use , 1=50ms, 2=100ms, 3=150ms, 4=200ms, **5=250ms**, 6=300ms, 7=350ms, 8=400ms, 9=500ms, A=1 sec, B=1.5 sec, C=2 sec, D=2.5 sec, E=3 sec, F= 5 sec
COR Lock Onset Delay Timer Applies to SW4 when COR Lock (Voting Lock) is enabled via CPM SW3-3	SW4 ***Note Dual Function***	200 ms ***Note Dual Function***	0=Undelayed COR Lock, 1=100ms, 2=125ms, 3=150ms, 4=175ms, **5=200ms**, 6=225ms, 7=250ms, 8=275ms, 9=300ms, A=350ms, B=400ms, C=450ms, D=500ms, E=550ms, F= 600ms

SVM Module

SNV12 Configuration Settings and Adjustments 0=Off, 1=On			
Site Voter Module Configuration	**Designator**	**Factory Setting**	**Switch Choices**
Receive (Site) Audio Delay	SW1	0 ms (No delay)	**0=0ms**, 1=30ms, 2=60, 3=90, 4=120, 5=150, 6=180, 7=210, 8=240, 9=270, A=300, B=330, C=360, D=390, E=420, F=450ms
Pilot Tone/Guard Tone Frequency	SW2-1	1950 Hz Pilot Tone & 2175 Hz Guard Tone	0=2175 Hz Pilot Tone and 1950 Hz Guard Tone **1=1950 Hz Pilot Tone and 2175 Hz Guard Tone**
COR Type	SW2-2, 3	Pilot Tone	*SW2-2 SW2-3 COR Type* 0 0 None, Unsquelched, COR always active 1 0 Hardwired COR input **0 1 Pilot Tone Used** 1 1 Audio Level COR, for squelched receivers
Guard Tone Operation	SW2-4	Disabled	**0=Disabled**, 1=Enabled
Applies Only If SW2-2, 3 Set for Hardwired COR or Pilot Tone:	***Note Dual Function***	***Note Dual Function***	***Note Dual Function***
TB1-TB12 Pin 16 Configuration	SW2-5	TX Selected Out	0=Unsquelch Out, **1=TX Selected Site Out**
Site Designation	SW2-6	RX & TX Site	0=RX-Only Site, **1=RX & TX (site can transmit & receive)**
-OR-	***-OR-***	***-OR-***	***-OR-***
Applies Only If SW2-2, 3 Set For Audio Level COR:	***Note Dual Function***	***Note Dual Function***	***Note Dual Function***
Audio Level COR Threshold	SW2-5, 6	Lowest Threshold	*SW2-5 SW2-6 Audio Derived COR Threshold* 0 0 Highest Threshold (lowest sensitivity) 1 0 0 1 **1 1 Lowest Threshold (highest sensitivity)**
COR Input Polarity: Active Low Active High	SW2-7	Active Low	**0= Active Low**, 1= Active High
High Pass Filter (Cuts 100 Hz and lower)	SW2-8	Engaged	**0= Engaged**, 1= Removed

SVM Module (continued)

SNV12 Configuration Settings and Adjustments 0=Off, 1=On			
Site Voter Module Configuration	**Designator**	**Factory Setting**	**Switch Choices**
RX Group	SW3-1, 2, 3	Rx Groups Disabled	*SW3-1 SW3-2 SW3-3 Group* **0 0 0 Disabled; Not a member of an RX group** 1 0 0 RX Group #1 0 1 0 RX Group #2 1 1 0 RX Group #3 0 0 1 RX Group #4 1 0 1 RX Group #5 0 1 1 RX Group #6 1 1 1 RX Group #7
RX Group Primary Site Designation	SW3-4	Not a Primary Site	**0=Not a Primary Site**, 1= Primary Site
Voting Mode: FM mode or AM/HF mode	SW3-5	FM mode	**0=FM Mode**, 1=AM/HF Mode
Simplex Repeat When Voted	SW3-6	Disabled	**0= Disabled**, 1= Enabled
Line Equalization /AGC Level Controls Line EQ Setting If SW5-1 (SVM-2) Disabled Controls AGC Setting If SW5-1 (SVM-2) Enabled (SVM-1 Users See Manual)	SW3-7, 8	Disabled	*SW3-7 SW3-8 Equalization Level / AGC Level (dBm)* **0 0 No Equalization / 1.5 to -1.5** 1 0 Minimal / -1.5 to -4.5 0 1 Medium / -4.5 to -7.5 1 1 Highest / -7.5 to -10.5
Pilot Tone AGC (SVM-1 Users See Manual)	SW5-1	Disabled	**0= Disabled**, 1= Enabled
Pilot Tone Notch Filter (SVM-1 Users See Manual)	SW5-2	Enabled	**0= Enabled**, 1= Disabled
Term Block Pin 19 Function Configuration	SW5-3	TX Inhibit Input	**0= TX Inhibit Input**, 1=Unsquelch Inhibit Input
COR Onset Delayed with RX Audio	SW5-4	COR Not Delayed	**0= COR Not Delayed**, 1=COR Delayed with RX Audio
Pilot Tone Detector Sensitivity	SW5-5	Full Sensitivity	**0= Full Sensitivity,** 1=Detector Sensitivity Reduced
RX Audio Output Delay	SW5-6, 7	Disabled	**00=Disabled**, 01=100ms, 10=200ms, 11=400ms
Spare Switch – Leave Off	SW5-8	OFF	**0= OFF;** Reserved for future use
RX Audio Input Level	R45 (potentiometer)	-10 dBm	Audio from associated Voting Receiver
TX Audio Output Level	R62 (potentiometer)	-10 dBm	Console or Repeat Audio to associated Transmitter
RX Audio Input Impedance High/Low	JP1 (jumper plug)	Low (600 ohms)	**Low Z = 1&2**; High Z = 2&3
RX Audio Input – Balanced / Unbalanced	JP2 (jumper plug)	Balanced	**Balanced = 1&2;** Unbalanced = 2&3
Hardwired COR Input Configuration	JP3 (jumper plug)	Logic Level Input	**Logic Level = 1&2;** E&M = 2&3
PTT Output Configuration	JP4 (jumper plug)	Logic Level Output	**Logic Level (Open Collector) = 1&2**; E&M = 2&3
TX Inhibit; Term Block Pin 19 Input Config.	JP5 (jumper plug)	Active Low	**Active Low = 1&2**; Active High = 2&3
E&M Output Configuration	JP6 (jumper plug)	Ground	**Ground = 1&2,** Return to Term Block pin 10 = 2&3

NOTE: SW5 and JP2 thru JP6 available only with SVM-2. JP6 SVM-2 Rev E & higher.

3 Installation

3.1 General

This section provides the instructions for unpacking, inspection, installation and set-up. Also included are directions for reshipment of damaged parts or equipment. See Section 8.2 for a list of features supported in various software versions, beginning with revision 2.50.

3.2 Unpacking and Inspection

After unpacking the unit, retain the carton and packing materials until the contents have been inspected and checked against the packing list. If there is a shortage or any evidence of damage, do not attempt to use the equipment. Contact the carrier and file a shipment damage claim. A full report of the damage should also be reported to the Customer Service Department. The following information should be included in the report:

- Order Number
- Equipment Model and Serial Numbers
- Shipping Agency
- Date(s) of Shipment
- The Customer Service Department can be reached by phone at (919) 790-1011 (enter "0" for the operator and request technical assistance), by fax at (919) 790-1456. Upon receipt of this information, we will arrange for repair or replacement of the equipment.

3.3 Reshipment of Equipment

If it is necessary to return the equipment to the manufacturer, a Returned Material Authorization (RMA) number must first be obtained from Raytheon. This number must be noted on the outside of the packing carton and on all accompanying documents. When packing the unit for reshipment, it is best to use the original packaging for the unit; if this is not possible, special attention should be given to providing adequate packing material around connectors and other protrusions, such as front panel controls. Rigid cardboard should be placed at the corners of the unit to protect against corner damage during shipment. Failure to protect the front panel corners is the most common type of shipping damage experienced on returned equipment.

Shipment should be made prepaid consigned to:

Raytheon Company
Customer Service Department
5800 Departure Drive
Raleigh, North Carolina 27616
USA

Plainly mark with indelible ink all mailing documents as follows:

GOODS RETURNED FOR REPAIR

Mark all sides of the package:

FRAGILE - ELECTRONIC EQUIPMENT

Inspect the package prior to shipment to be sure it is properly marked and securely wrapped.

3.4 Installation Overview

NOTE: The installation steps in the remainder of Section 3 are intended to be performed by a trained technician only and should not be performed by the communications system operator.

Five steps are needed to properly install the SNV-12. These steps are:

1. Provide mechanical mounting for the unit. If the unit is to be used in a mobile or transportable application, additional support should be provided to the rear of the unit. See Section 3.5 for instructions regarding air circulation requirements and other mechanical mounting considerations.
2. Provide the proper primary power for the unit.
3. Provide proper grounding and surge protection.
4. Interconnect the unit with the communications system via the unit's backplane connectors.
5. Check all internal set-ups and adjustments per Sections 3.9 through 3.12.

The SNV-12 is then ready to begin normal operation.

3.5 Mechanical Installation

Careful attention to the following installation suggestions should result in the best unit/system performance. Figure 3-1 provides overall unit dimensions.

The SNV-12 must be installed in a structure that provides both protection from the weather and assurance of ambient temperatures between -20 and +60 degrees C. Since the unit is neither splash proof nor corrosion resistant, it must be protected from exposure to salt spray. When the unit is mounted in a cabinet with other heat-generating equipment, the use of a rack blower is suggested to keep the cabinet interior temperature rise to a minimum.

NOTE: If the SNV-12 is used in a transportable or mobile configuration additional mechanical mounting should be provided to support the weight of the unit. The front panel is insufficient for supporting the SNV-12's weight when not mounted in a stationary application.

NOTE: The SNV-12 must be mounted in a way that allows for sufficient air circulation or unacceptably high internal temperatures may result. There should be at least one inch of air space above and below the SNV-12 to allow air to flow through the perforated metal top and bottom covers. It should not be set on a flat surface without provisions made for air to flow through the voter.

A fully loaded SNV-12 (with twelve SVM modules installed) dissipates approximately 100 watts. Consider other heat sources installed along with the SNV-12 in a 19" rack or other type of cabinet. Do not install other heat generating devices below the SNV-12. Use forced air-cooling in the cabinet if necessary.

NOTE: If the SNV-12 is installed in a high RF environment such as repeater site, it is recommended that cable assemblies to each Site Voter Module should be individually shielded, with the shield grounded to the ground pin on the terminal block for that module. For all D-subminiature connector cable assemblies, cable shields should be connected to connector shells so that they make contact with the grounded D-subminiature connector shells on the backplane board.

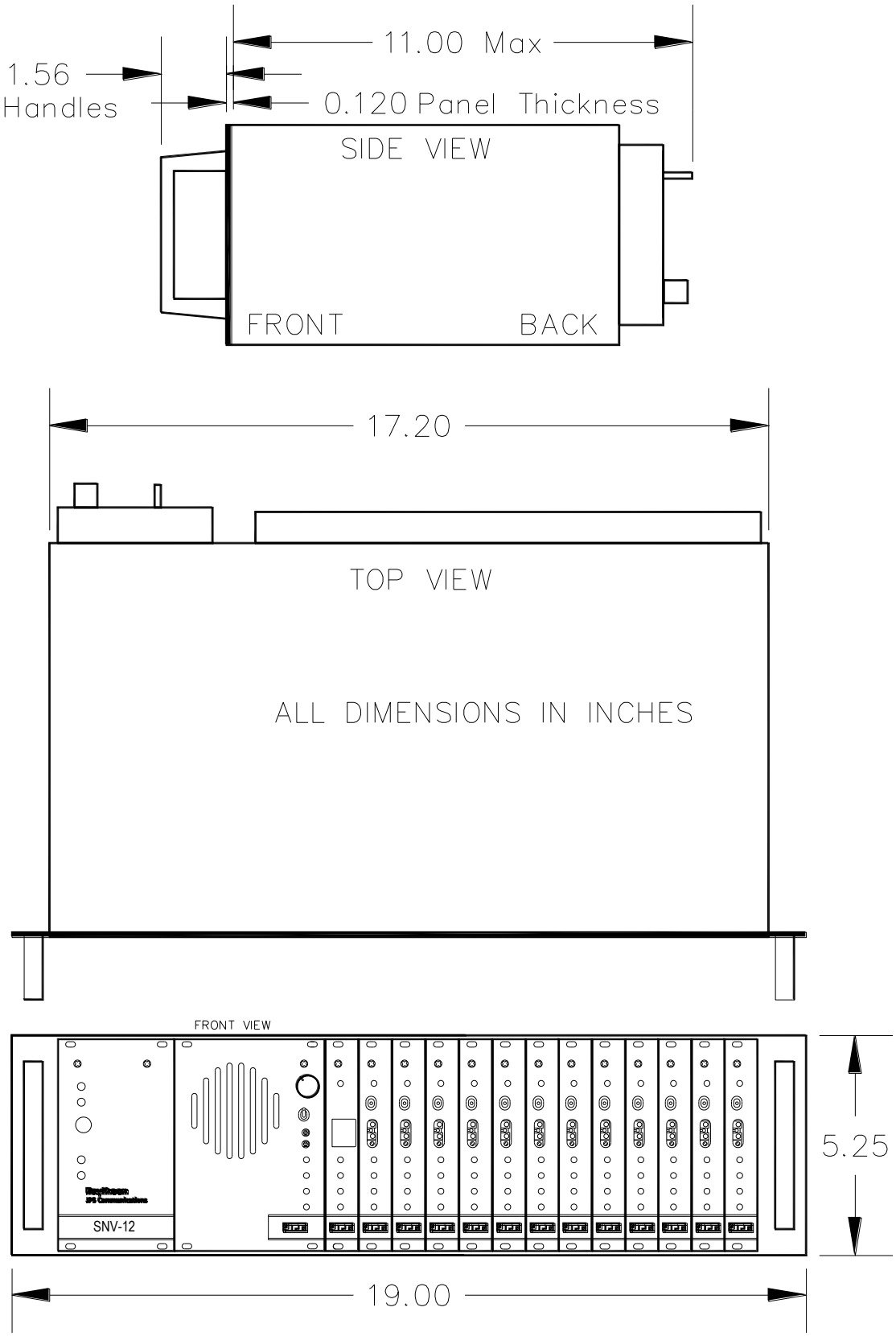

Figure 3-1 Outline Dimensions

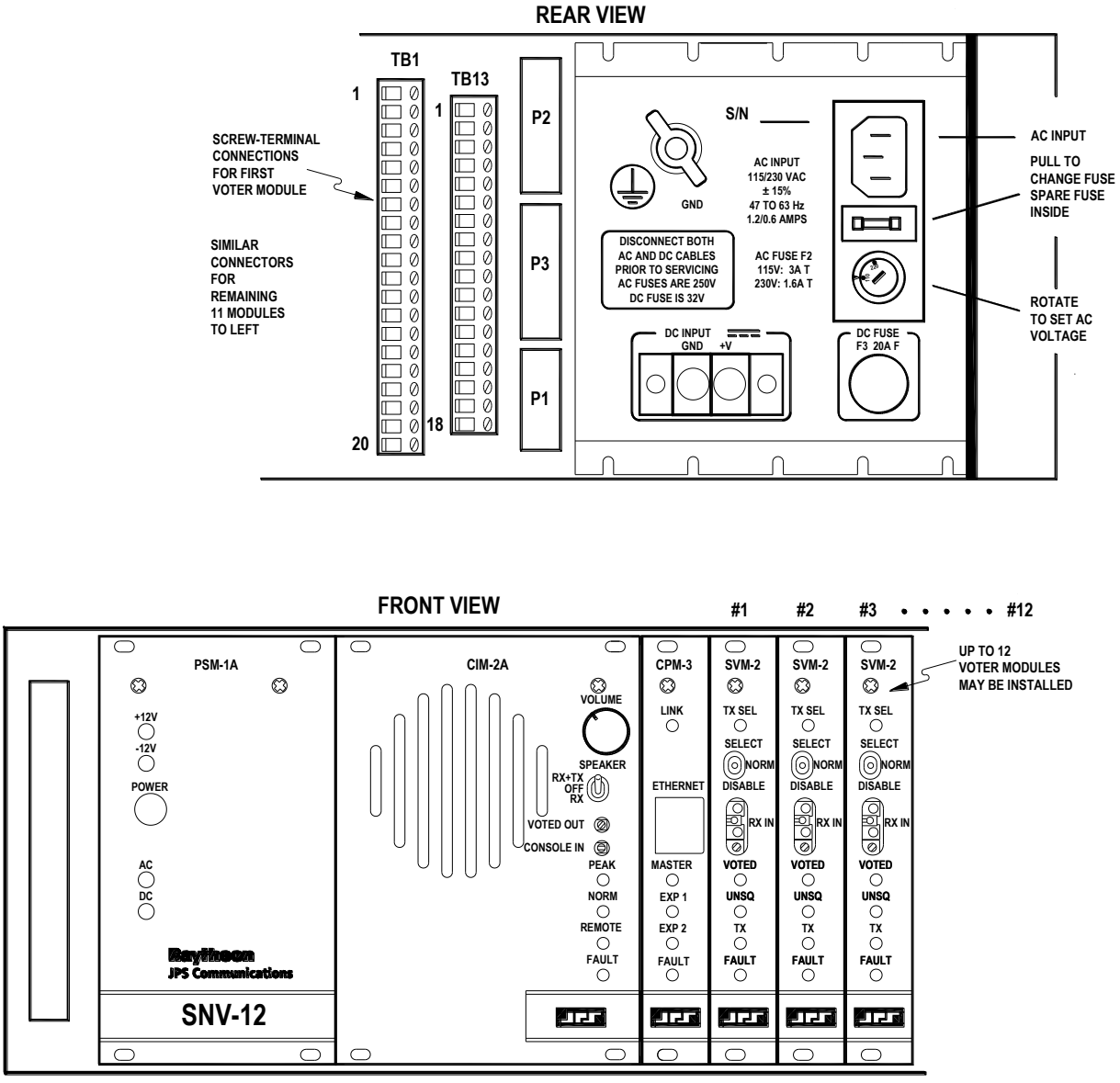

Figure 3-2 Control and Connector Locations

3.6 Power Requirements

The SNV-12 will accept either AC or DC power. If both are supplied simultaneously, the unit will draw DC power only if the AC line sags. The yellow LEDs on the PSM module's front panel will display the presence of AC and DC supply voltages. The LEDs do not indicate which power source the SNV-12 is currently using.

3.6.1 AC Voltage

The SNV-12 is designed to operate from 115V or 230V, 47 to 63 Hz, single-phase AC power source. The unit will meet all of its specifications over a voltage range of +/- 15% from nominal. The AC power consumption is 50 VA typical, 100 VA maximum.

The SNV-12 is a microprocessor-controlled device. As with any such equipment, a very short loss of AC Power can cause operational problems and/or cause the unit to reset. The voting system will be inoperable during the reset period. We recommend that the SNV-12 be connected to an AC power source that utilizes an uninterruptible power system (UPS). If the site does not have UPS capability, the SNV-12 should be plugged into a smaller UPS, such as those used for personal computer systems

3.6.1.1 AC Line Voltage Selection

> ***CAUTION*: To prevent damage to the unit, check the power line voltage selection before applying power. Also be certain that the unit is connected to a grounded outlet.**

As shipped from the factory, the SNV-12 is normally set for the correct 115 VAC unless otherwise stipulated on the Purchase Order, but the voltage selection should be checked before initial operation. The number visible at the bottom of the Power Interface Module (located on the rear panel – See Figure 3-2) indicates the nominal line voltage range in the following manner:

- 110 position: nominal 115V Operation
- 220 position: nominal 230V operation

Note that if the AC Voltage selection is changed, the AC fuse must also be changed. First remove the line power cord, and then use a small flat blade screwdriver to slide the fuse assembly out. A tab on the fuse assembly prevents its removal unless the power cord is disconnected, and the slot that's used when sliding the assembly out is only accessible when the cord is disconnected. Remove the fuse from the base of the assembly and replace with the correct fuse. Now use the screwdriver to push open the drawer in the fuse assembly and replace the spare fuse with a spare that corresponds with the AC line voltage. Slide the fuse assembly back into the Power Interface Module, making sure that it is fully seated.

Finally, use the screwdriver to switch the line voltage selection to the correct position and reconnect the AC power cord.

- Nominal 115V Operation- Use 250V, 3 amp, T (time delay)
- Nominal 230V Operation- Use 250V, 1.6 amp, T (time delay)

To replace a blown fuse, follow the same procedure using the spare fuse in the drawer.

3.6.2 DC Voltage

The SNV-12 will operate on +11 to +15 VDC, and the unit will automatically switch over to DC operation if the AC input voltage sags too low or disappears. Actual power consumption will depend on the number of SVM Modules installed. The DC power input characteristic is essentially constant power, i.e.; the input power requirement for any number of modules is constant so the input current varies with the input. A fully loaded chassis consumes 59 Watts when run at a nominal 12V DC.

To find the input current given the input voltage, divide the input power by the voltage:

- 59W / 12V = 4.92A at 12V input.

To find the power consumption for less than a fully loaded unit, use the following formula:

- Power Consumption (W) = 5.5W + (4.44W times # SVMs).

3.6.2.1 DC Voltage Operation

The PSM-1A will automatically switch over to DC operation if AC line voltages drop too low or disappears. The PSM-1A operates with a nominal +12 VDC input only; it does not contain any provisions for +24 VDC.

CAUTION: Always disconnect both the AC and DC input power cabling from the SNV-12 prior to servicing the unit.

NOTE: Any DC power supply connected to the SNV-12 DC input must be Safety Extra Low Voltage (SELV) certified.

3.6.2.2 Battery Power for the SNV-12

The SNV-12 may also be connected to a 12V battery to provide back-up power if the AC mains fail. When powered by a +12V battery at the DC input, the SNV-12 current consumption is the following: 0.46A + (0.37A * # SVM). In other words, the basic chassis with CPM module and CIM Module draws .46 Amps, and each Site Voter Module draws an additional 0.37 Amp. So the current consumption would be the following:

- Chassis with 3 SVMs = 1.57A x 8 hr = 12.56 AH
- Chassis with 4 SVMs = 1.94A x 8 hr = 15.52 AH
- Chassis with 8 SVMs = 3.42A x 8 hr = 27.36 AH

Most sealed Lead-Acid batteries are rated for a 10 hr discharge cycle, not an 8 hr cycle, so multiply each AH figure by 1.25 to arrive at the required battery capacity:

- 12.56 x 1.25 = 15.7 AH
- 15.52 x 1.25 = 19.4 AH
- 27.36 x 1.25 = 34.2 AH

Selecting the nearest larger capacity of a Panasonic battery:

- 18 AH Size: 7.3 x 4.9 x 6.5 inches LWH, Weight: 17 lb.
- 22 AH Size: 4.9 x 6.5 x 6.9 inches LWH, Weight: 19 lb.
- 35 AH Size: 7.8 x 6.5 x 6.9 inches LWH, Weight: 28 lb.

In addition, for batteries sized to provide more than one hour of backup, chargers will have to be provided, as the charger built into the SNV-12 can only supply 1 A, so it would take too long to recharge the batteries necessary for an 8 HR backup time.

*3.6.2.3 **Charge Switch***

The CHARGE Switch, SW3, should be set to CHARGE only if a back-up battery is being used.

CAUTION: Always disconnect both the AC and DC input power cabling from the SNV-12 prior to servicing the unit.

3.7 Fuse Information

This section identifies the three fuses used in the SNV-12 chassis. Be sure to remove all AC & DC input cabling prior to removing or servicing the PSM-1. F1 fuses the unfiltered low level DC bus voltage from the PSM-1 that powers the +5V DC switching supplies on each of the other chassis modules. It can only be replaced if the PSM-1 is removed from the chassis. F1 prevents damage to the PSM-1 if a short circuit or other unusual load is applied to this bus. If AC is applied and the AC LED is lit, the +12V and –12V LEDs should light when the PSM-1 front panel pushbutton power switch is pushed in. If they do not, this is an indication that Fuse F1 is blown or possibly another type of fault in the PSM-1. Similarly, if the unit is running off of a 12 VDC supply source and the DC LED is lit, the +12V and –12V LEDs should light when the main power pushbutton is pressed.

If AC is applied but the AC LED on the PSM-1 is not lit, then the AC Input Fuse, F2, is probably blown (or there is another fault in the PSM-1). If DC is applied but the DC LED on the PSM-1 is not lit, then the DC Input Fuse, F3, is probably blown (or less likely, there is another fault in the PSM-1). Both of these fuses may be accessed at the rear of the unit.

Table 1 SNV-12 Fuses

F1	10AF 250V, 3AG	DC Bus	Low voltage DC to each SNV-12 module
F2	3AT 250V, 5x20mm	AC Input	AC Line Fuse (115 VAC nominal)
	1.6AT 250V, 5x20mm	AC Input	AC Line Fuse (230 VAC nominal)
F3	20AF 32V, 3AG	DC Input	DC Power Input Fuse (12 VDC nominal)

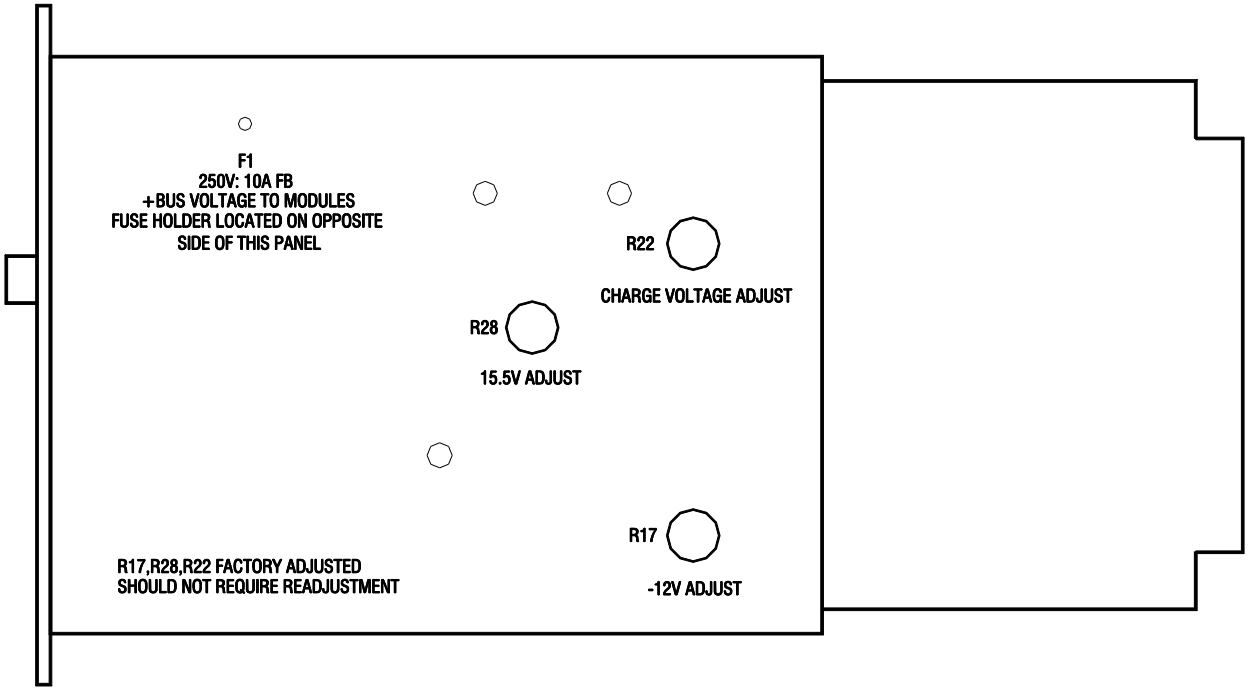

Figure 3-3 Side View of PSM-1A

This is a simplified side view of the PSM-1A. To replace Bus Voltage Fuse F1, first turn off the Main Power pushbutton and remove main power cabling from the unit. Loosen the four captive front panel screws and carefully slide the PSM-1A from the chassis. To completely remove the PSM-1A, the attached cable assembly must be disconnected (though this is not necessary to replace the fuse).

Fuse F1 is installed behind the heat sink panel as indicated above. Simply snap out the blown fuse and snap in a new one. Reverse disassembly procedures to reinstall the PSM-1A.

3.8 Grounding Considerations

When installing the SNV-12, industry standard grounding practices should be practiced in order to minimize chances of RF interference to audio and for lightning/surge protection. The following minimum steps should be taken:

- All equipment racks and/or cabinets should be properly grounded to a site ground system. Equipment inside the racks or cabinets should be properly bonded to the rack/cabinet.
- All wire line circuits (leased-line circuits, private circuits, etc.) should go through surge protection prior to connection to the SNV-12. This device should meet or exceed the specifications of a Polyphasor model IS-DPTL and should be connected to a site single-point ground system.
- AC Surge protection shall be provided by a device similar to and with specifications meeting or exceeding Polyphasor model ISPLDO12015A. This device shall be connected to a site single-point ground system.
- If the voter is co-located with transmitter and receiver equipment at a communications tower site, all transmission lines shall be protected by surge protectors similar to Polyphasor coaxial protectors. These devices shall be connected to a site single-point ground system. In addition, ground kits shall be properly installed on all feedlines.
- Communications tower sites should have a properly designed perimeter grounding system, including proper grounding of the communications shelter, tower structure, Telco and electrical services and site fence. Communications shelters should have a properly installed halo system.

The above steps cannot be guaranteed to prevent damage from lightning, but they will reduce the chances of severe equipment damage and improve system reliability. Keep in mind that most communications systems are more heavily utilized and relied upon during severe weather conditions, especially public safety and public utility communications systems. It is important that these systems be designed for high reliability during these conditions and proper grounding and surge protection is essential.

3.9 Installation Checklist

Table 3-1 Basic Installation Checklist	
Provide suitable Mounting and Cooling.	See Section 3.4
Check AC Line voltage selection.	See Section 3.6.1
DC Operation needed?	See Section 3.6.2
Battery Backup needed?	See Section 3.6.2
Make Interconnections.	See Sections 3.11 and 3.13 for External Interconnect Information.
Serial Remote Control needed?	Set Serial Remote control ON with CPM SW1-4. Set Baud Rate with CPM SW1-1, 2, and 3. Set SVM fault Reporting if needed by CPM SW2-4. RS-232 protocol provided in Section 6.
Do Audio Level adjustments need to be different from -10 dBm factory settings?	Console Interface Module- See Section 3.12.2.6 Site Voter Modules- See Section 3.12.6.6
Is system AM or HF rather than FM (default)? Note: All SVMs must have same setting.	Switch SVM SW3-5 on all SVMs to on for AM/HF mode. See 3.12.6.4 and 5.5.
Set Voting Parameters if need difference from factory settings.	Set Signal Quality difference on CPM SW2-1, 2, and 3. Set Voting Delay on CPM SW4. See 5.6.
Is Voting Lock needed?	Set CPM SW3-3 for Voting Lock on COR. Set CPM SW3-4 for Voting Detect & Lock on Data. See 3.12.5.3, 5.8, and 5.9.
Are Pilot Tones used on any SVM? (Default is 1950 Hz Pilot Tone Operation)	Enable pilot tones with SVM SW2-2, 3 Select Pilot tone frequency with SVM SW2-1. See 3.12.6.3 and 5.10.
COR type other than Pilot Tone required on any SVM?	Set for correct COR type for each SVM using SVM SW2-2, 3. See 3.12.6.3 and 5.10.
Active high Hardwired COR input rather than standard active low?	Set SVM for active high COR with SW2-7. See 3.12.6.3 and 5.10.
Are Guard Tones used on any SVM?	Enable Guard Tone Operation on each SVM where applicable with SVM SW2-4. See 3.12.6.3 and 5.12.
Is Line Fault Detection needed for Fault Reporting?	Set fault delay time with CPM SW2-5, 6. See 3.12.6.3 and 5.11.
Is RX Audio Delay needed on any SVM?	Set Audio Delay with SVM rotary switch SW1. See 3.12.6.2 and 5.7.

Table 3-1 Basic Installation Checklist	
Is Automatic TX Steering (STARS) needed?	Enable STARS on the CPM SW2-7. Set Holdover Timer with CPM SW3-1, 2. See 3.12.5.2, 3.12.5.3, 5.13, 5.17 and 5.19.
Should Console and Repeat Audio Transmissions be multicast to all sites rather than be sent to a single Home Site (when not TX steered)?	Change the Default TX Site selection to Multicast with CPM SW1-8. See 3.12.5.1 and 5.16.
Are RX Groups needed? If yes: Need Group Primary Site? Want Group Lockout with Primary Site Failure?	Set the appropriate RX Group on each SVM with Switch SW3-1, 2, and 3. Set Holdover Timer with CPM SW3-1, 2. Set Group Primary Sites if desired using SW3-4. Set Group Lockout with Primary Site Failure using CPM SW3-6. See 3.12.5.3 and 5.18.
Is Repeat Mode (retransmission of voted audio) needed?	Set Repeat mode ON with CPM SW3-7. See 3.12.5.3 and 5.15.
Is Tone Keying (rather than hardwired PTT) needed?	Set Tone Keying parameters with CIM SW2-1, 2,3,4, and 5. See 3.12.2.3 and 5.20.
Simplex or Duplex operation? If Simplex: Want to Disable Console PTT during receipt of message?	Set CPM SW3-5 as desired. See 3.12.5.3 and 5.21 Set CIM SW3-1. See 3.12.2.4.
Are more than 12 sites required? (Master/Expansion operation).	Connect two or three chassis together with a Master/Expansion Interconnect cable. There are no switches to set; the units configure themselves automatically. See 3.12.7 and 5.22.

3.10 Audio Links

The receive and transmit audio for each SVM must be linked to its associated receiver and/or transmitter. If the voter is co-located with the console and RF equipment, local wiring can be used. However, if the voter is separated from the other equipment geographically, other means of sending audio, COR and PTT must be considered. These include:

- Microwave
- Radio Links
- Leased wireline links
- Satellite Links

3.10.1 Microwave Links

Microwave systems provide good audio response between 300-3000 Hz and are typically more reliable than landline based links when properly designed, installed and maintained. E&M signaling is also available in some systems. Various microwave systems are used, including analog, digital, and unlicensed spread-spectrum microwave. Though initial system infrastructure costs are higher for microwave systems, there are no recurring monthly charges as opposed to leased line circuits or leased T1s.

3.10.2 Radio Links

Radio links may be used where microwave systems are not cost effective or may not work correctly. Typically the receiver's audio is relayed via a UHF radio link back to the voter site. At the voter, a UHF receiver passes the audio to the specific SVM. This type of system may be configured in one of the following ways:

3.10.2.1 Use Of Pilot Tone At The Voted Receiver Site

With this method, the link transmitter is constantly active, transmitting pilot tone to the voter when the voting receiver is squelched. The link receiver passes the pilot tone and audio to the voter. No COR signal is required from the link receiver by the voter.

Advantages:

- No delay in COR signal reaching the SVM.
- Fault detection feature in each SVM will detect the loss of pilot tone, providing an indication of loss-of-link condition.
- Presence of a constant signal on the link frequency reduces the chances of another potential co-channel user from selecting the frequency and possibly causing co-channel interference.

Disadvantages:

- Link transmitter is constantly keyed.

3.10.2.2 Use Of COR Signal From The Link Receiver

With this configuration, the link transmitter detects COR from the voted receiver, then keys up and retransmits the receiver's audio. The link receiver (co-located with the voter) unsquelches and provides a hardwired COR signal to the SVM.

Advantages:

- Does not require transmitter to be constantly keyed.

Disadvantages:

- Some delay in unsquelched condition detection at the voter. If too long, can result in missed initial syllables – unlike other path delays, this can't be fully rectified by adding digital RX audio delay in the SVM because the missed syllables don't reach the voter. If loss of initial syllables occurs, add some delay to the SVM (60 to 90 ms) to determine if some of the audio can be recovered.
- No Line Fault Detection possible.

3.10.2.3 RF Links Special Considerations

- To minimize co-channel interference, link transmitter/receiver antennas should be directional antennas with narrow beam width, placed higher than that required to ensure adequate link path. Link transmitter power should be reduced to the minimum required level. CTCSS tones should be used to protect link receivers from co-channel interference. (Lower frequency CTCSS tones are better attenuated by high pass filtering).
- The link transmitter should be rated for 100% duty cycle, especially when the link transmitter is always active sending pilot tone.
- Link receiver should utilize RF bandpass filtering, especially when mobile type radios are used for the link.
- The audio response of the link transmitter/receiver combination should be flat between 300-3000 Hz. Poor audio frequency response of the link will result in poor voting or poor voted audio quality.
- Whenever RF links are used, the link transmitter and receiver frequencies must be considered when performing site RF interference analysis.
- Consider the use of the Site Unsquelch Time Limiter feature enabled by a dipswitch on the CIM module. This feature faults any site that remains continuously unsquelched for more than 3 minutes. The purpose is to remove from consideration for voting sites that become unsquelched because the remote link transmitter has failed (so no pilot tone is being transmitted) while the local link receiver is always unsquelched (so the high noise volume prevents the SVM's speech detector from activating the Line Fault Detection feature).

3.10.3 Wireline Links

Wireline links include privately owned lines (such as in-building wiring), Leased circuits and leased T1 lines. Analog leased circuits for radio systems are often referred to as "radio tie lines" (RTLs). Wireline links are susceptible to outage due to broken cables, or failure of the leasing company's facilities.

If a standard voice grade line is requested, the following will normally result:

- Loss at 1000 Hz will be between 5 and 10 dB.
- Long term variation 4 dB.
- Frequency response referenced to 1000 Hz:
  300-3000 Hz: +3 to -12 dB.
  500-2500 Hz: +2 to -8 dB.
- Noise: 31 dBrnC maximum.
- Frequency translation error: 5 Hz.
- Normal impedance: 600 ohms.
- Maximum allowed signal into the line:
  -6dBm to –13 dBm in-band three second average.

Generally, standard voice grade lines are sufficient for voting systems. However the high frequency roll-off can cause voice quality to suffer. In addition, when a combination of leased lines and microwave and/or RF links are used, the loss of the high frequency components in the wireline line link can affect the voting process. Since the voter works by measuring noise above 2200 Hz, and the leased link will attenuate noise in this spectrum, the leased-line connected receiver may sometimes be voted even though the signal is actually noisier than other receivers linked by microwave or RF. *The ideal situation would have all receivers linked by the same medium back to the voter. If all are leased lines, all lines should be of the same type and specifications.*

If a combination of microwave and leased lines are used, it will be necessary to request tighter specifications on the leased lines in order to equalize performance.

By adding C-1 conditioning, the frequency response specifications change to:

- 300 to 2700 Hz: +2 to -6.
- 1000 to 2400 Hz: +1 to -3 dB.

C-1 conditioning will improve voice quality and improve performance when a mixture of leased lines and microwave/RF is used. There will still be high roll off above 2700 Hz.

Adding C-2 conditioning will further tighten the frequency response specifications to +2 to -6 dB from 300-3000 Hz. This further improves the spectrum between 2700-3000 Hz. When a mix of leased lines and microwave are used, C-2 conditioning is the best choice for optimal performance.

For a voting system using leased lines only, we recommend all lines have C-1 conditioning added.

Many systems are configured with a main site with a repeater/base station, co-located with the voter, and a number of remote receivers linked via leased lines. When these leased lines are standard voice-grade lines, the frequency response of those links will not be as good as the connection to the local site. This will cause a difference in audio quality (with the local site sounding better) and it may cause a remote site to vote even if the local site sounds better due to the attenuation of noise above 2200 Hz (where the voter measures the noise). This is the same problem that results when microwave and leased lines are used together. Conditioning of the leased lines will improve performance on such systems.

3.10.4 Satellite Links

When audio is linked via satellite, the same frequency response requirements apply as with leased lines. In addition, link path delays must be considered. SW1 on the SVMs may be used to equalize audio delay, and also turn on SW4-5 of the SVMs so that the COR signal is delayed along with the RX audio. Note that the terrestrial sites will need delay added to match the delay of the satellite-linked site. Proper voting may not be possible if delays are not consistent. Consider the use of COR Lock mode. See the Network Links section below for further information regarding the use of digitized audio.

3.10.5 Network Links

The use of the Internet Protocol (IP) to link remote voting receiver audio back to the SNV-12 is strongly discouraged and we will not attempt to assist installations that use IP links.

The main reason is that the purposes of IP and the needs of an analog voter are incompatible; this incompatibility creates a variety of problems that are difficult to resolve. It's important to keep in mind that the task of an analog voter is

> *To select the best signal from a group of signals that are essentially identical in all respects other than a variation in the amount of noise present.*

There are many problems to be overcome when using IP Links simply because IP and VoIP protocols were not designed with respect to the voter's requirements. What follows is a list of the problems that must be overcome in order to produce an analog voting system that works properly:

Frequency Response Problems: Some vocoders do a poor job of passing the noise content that's needed to discern the signal quality differentiation between voting sites, or they may do a poor job of passing tones required for signaling purposes.

Signal Level Variations: Some VoIP equipment includes an AGC function. Analog voters rely on a measurement of relative noise content between the unsquelched channels. This requires that signal levels be properly set and do not vary on a site-to-site basis.

Latency & Jitter: There are many timing problems that an IP & VoIP system can present to an analog voting system. The network terms for these timing issues are defined as:

> ***Latency*** is the difference in time between when information begins to enter a network and when it begins to leave the other end. Think "constant delay."
>
> ***Jitter*** is the variation in latency. If all information takes the same amount of time to traverse the network, there is no jitter. Unfortunately, this is never the case.

There are a wide variety of causes for latency and jitter. IP and VoIP protocol and equipment designers have come up with ways to deal with these delays. Unfortunately for analog voting systems, these remediation methods do not take into account the fact that voters need the signals from the various sites to all encounter identical delays.

Here is a quick list of potential causes of delays that will prevent proper voting.

Standard network latency and jitter as defined above. For the purposes of this discussion, these are the delays that would occur if VoIP equipment is not included. It can sometimes be reduced (but not eliminated) by proper network design, network loading, and QoS. True (consistent) latency is not the major problem as the SVM modules have variable delay settings. These settings don't help with jitter or with what's normally considered latency, but actually varies for any reason after the SVM delay settings are initially configured to compensate.

The addition of VoIP devices carries many additional timing problems. Again remember that an analog voter needs near-identical timing on all paths between voting receivers & the voter. Typical VoIP communications do not share this concern and hence do not have methods to maintain the relative timing between the various paths. The timing issues include:

Jitter buffer variations: If the jitter buffers are not identical in each path, audio begins streaming at different times to different sites (and as will be explained later, there are several ways that the timing of the buffers can be made to vary).

Lack of coincidence of control signals: Some VoIP devices allow a COR and or PTT signal to be embedded in the data packets. Unfortunately, the operating systems of the VoIP devices introduce an inherent granularity in how perfectly these signals are synchronized with the audio. These delay variations can be so great that one voting site may send a COR signal, and have the voter act on that COR indication and vote this site, before another site has even sent the active COR indication to the voter.

Variations in VoIP equipment clocks: All VoIP timing is dependant on internal clocks. These clocks are not precisely identical (there's no need for synchronization in typical VoIP communications). This means that that overall timing of packets varies between the sending unit (at the voting receiver) and the receiving unit (at the voter location), and eventually (typically within hours) this will add up to a sufficient total delay to cause the receiving unit's jitter buffer to either empty or overflow. This will occur, for example, if continually streaming audio is used to send pilot tone. At this time, the voter will experience either a gap in audio (if the jitter buffer had emptied and is being refilled) or a sudden jump ahead in the audio content (as the jitter buffer "dumps" excess packets). Both of these are problematic to throughput audio at the moment they occur, but this process also creates, during and afterwards, a constantly changing throughput delay variation that builds up to the duration of the jitter buffer before recycling. These potential delay variations are far too long to allow proper voting operation.

There are four main voting performance issues related to improper relative timing between the receipt of audio & control signals (COR) from the remote RX sites:

- The voter can only vote sites that are declared unsquelched – if COR or pilot tone arrives out of sync between the various sites, the voter may have already selected a poor quality site before a better site has declared itself unsquelched and eligible for voting.
- An unsquelched site with no audio (due to a gap in packet reception or during the filling of an empty jitter buffer) looks like clean, fully quieted signal and will be voted.
- Variations in audio timing between sites results in gaps and echoes if the voting process calls for a transition between sites during a field transmission.
- Variations in audio timing can result in improper voting because the voter is not comparing receiver signals at the same relative times. Analog voters use the quantity of total high frequency spectral content as a measurement of noise. There is some speech content included in these high frequency content measurements. This doesn't affect non-IP linked voting systems because the same speech content is found in all sites at the same time.

The site-to-site audio delay variations can be no greater than approximately 30 ms to insure proper voting performance. This degree of time-synchronization is extremely difficult to achieve between multiple IP/VoIP paths.

3.11 External Interconnect Information

This section details type and pin-out information for the SNV-12 external connectors. These connectors are mounted at the rear of the unit on the backplane.

3.11.1 DC Input Connector

This two-pin terminal block is mounted on the rear panel. The terminals for the ground (GND) and positive DC input voltage (+V) are clearly marked.

3.11.2 Site Voter Module Connections

Each of the SNV-12 Site Voter Modules has an associated 20-pin screw terminal block. The pin connections for each site are identical. The connectors are labeled J1-J12 on the terminal block backplane, for Site Voter Modules 1 through 12. Pin 1 is at the top of each connector. The terminal blocks are protected by an aluminum plate that is easily removed by taking off the 5 screws that secure it to the backplane. The plate should be reinstalled once all connections are made.

Interface information is supplied for the SVM-1 modules as well as the current SVM-2 module. The SNV-12 chassis can contain any combination of SVM-1 and SVM-2 modules in the same chassis.

Table 3-2 TB1-TB12 Site Voter Module Connections with SVM-2

PIN	Signal	Description
1	Site Audio In A	Balanced or unbalanced audio input from the site receiver. (See note 1 below)
2	Site Audio In B	Other half of balanced audio input pair from the site receiver.
3	Ground	Ground connection.
4	TX Audio Out A	Balanced audio output to the site transmitter. (See note 1 below)
5	TX Audio Out B	Balanced audio output to the site transmitter.
6	Line Audio Out	This module's throughput audio for monitoring (600 ohm, single-ended).
7	Ground	Ground connection.
8	TX Sel In	Low to select SVM for transmission of console audio. Site remains selected until input goes back high. (Compare to pin 14)
9	TX Sel Out	Low when this site selected for console TX. (See note 2 below)
10	E&M Return	E&M Relay normally-open contact (see pin 18). (See note 3 below)
11	Select In	Low to select (force-vote) this site.
12	Disable In	Low to disable this site (remove from voting).
13	COR In	Hardwired COR Input from receiver. Can be configured as E&M input.
14	MOM TX Sel In	Momentary low to select SVM for transmit. Reverts to default site when holdover timer expires. (Compare to pin 8).
15	Voted Out	Low when this site is voted (Or when selected by front panel SELECT switch or by pin 11).
16	Unsquelch Out -OR- TX SEL OUT	Configurable output. Normally indicates active COR (Unsquelched) when low. When SVM COR type is pilot tone or hardwired COR, the function of this output determined by SVM SW2-5. When OFF, output goes low when positive COR detected. When ON, output goes low when this site is selected for Console TX. .
17	Fault Out	Low while fault detected on this site.
18	Site PTT Out E&M relay out	Internally configurable; E&M relay common contact or active low PTT output to associated transmitter.
19	TX Inhibit -OR- UNSQ Inhibit	Configurable input. Active High or Low depending on SVM JP5. With SVM switch SW5-3 Off this is a TX Inhibit Input. When active, disables SVM transmit output (with 700 msec hangtime). When SVM SW5-3 is On, this input, when active, prevents the SVM from becoming unsquelched (no hangtime with this feature).
20	Ground	Ground connection.

Note 1: For unbalanced TX audio, ground "B" pin of audio pair; connect unbalanced audio to "A" pin. RX audio has jumper to set unbalanced or balanced configuration.

Note 2: Pin 9 TX Sel Out not available on some earlier versions. If JP6 is not on the module, there is no TX SEL Out on pin 9, but pin 16 can still be configured as a TX SEL Out.

Note 3: E&M return not available on some earlier-version SVM-2s. Relay common (pin 18) available on these versions and is shorted to ground internally when site PTT is active. Use jumper JP6 to select E&M return. If there is no JP6 on the module, there is no E&M Return.

Table 3-3 provides the TB1-TB12 interface description when the SVM-1 module is installed. The pins that have some differences are:

- 1 & 2 now have balanced / unbalanced jumper with SVM-2.
- 9 & 10 new functions with SVM-2
- 13 & 18 can now be configured for E&M via internal jumpers
- 19 now has dual function (configured by internal dipswitch) with SVM-2

Table 3-3 TB1-TB12 Site Voter Module Connections With SVM-1

PIN	Signal	Description
1	Site Audio In A	Balanced audio input from the site receiver.
2	Site Audio In B	Balanced audio input from the site receiver.
3	Ground	Ground connection.
4	TX Audio Out A	Balanced audio output to the site transmitter.
5	TX Audio Out B	Balanced audio output to the site transmitter.
6	Line Audio	This module's throughput audio for monitoring (600 ohm, single-ended).
7	Ground	Ground connection.
8	TX Sel In	Low to select SVM for transmission of console audio. Site remains selected until input goes back high. (Compare to pin 14)
9	Pilot Tone AGC	Low to enable Pilot Tone AGC function. System must be set correctly for proper operation. See 3.12.5.
10	Pilot Tone Notch Disable	Low to disable pilot tone notch filter except when pilot tone is detected. Note: See 3.12.5 regarding side effects.
11	Select In	Low to select (force-vote) this site.
12	Disable In	Low to disable this site (remove from voting).
13	COR In	Hardwired COR Input from receiver.
14	MOM TX Sel In	Momentary low to select SVM for transmit. Reverts to default site when holdover timer expires. (Compare to pin 8).
15	Voted Out	Low when this site is voted (Or Selected by front panel SELECT switch or by pin 11).
16	Unsquelch Out -OR- TX SEL OUT	Configurable output. Normally indicates positive COR (Unsquelched) when low. When SVM COR type is pilot tone or hardwired COR, the function of this output determined by SVM SW2-5. When OFF, output goes low when positive COR detected. When ON, output goes low when this site is selected for Console TX. (See 2.9).
17	Fault Out	Low while fault detected on this site.
18	Site PTT Out	Active low PTT output to associated transmitter.
19	TX Inhibit	When low, disables SVM transmit output (with 700 msec hangtime). The TX inhibit will prevent a site from being keyed, but it won't force another SVM to be voted in its place.
20	Ground	Ground connection.
Note: For unbalanced audio, ground "B" pin of audio pair; connect unbalanced audio to "A" pin.		

3.11.3 Serial Remote Connector

This female 9-pin D-sub connector provides a serial RS-232 interface. The connector is labeled P1 on the backplane. Standard DCE pinout is used:

Table 3-4 P1 – Serial Remote Connections

PIN	Signal
2	TX Data
3	RX Data
5	Ground

3.11.4 Console Interface Connections – P2

This connector carries control signals and audio between the console and the voter chassis. Most of the more important connections are also found on the 18 pin terminal block, TB13, (Not found on some earlier hardware versions). See Table 3-5. The P2 and TB13 connections are direct parallel connections, so only one or the other may be used for any particular signal without consideration for double-terminations. P2 is a 15-pin Female D-sub connector, so the mating connector must be D-15 male (included in the Accessory Kit).

In an expanded system, the P2 connector on the expansion shelf is cabled to the Expansion Connector on the next chassis up the daisy chain. See Figure 2-4 and Figure 2-5 for cable diagrams. Cables can be ordered from us, see Table 1-3.

Table 3-5 P2 - Console Interface Connections

PIN	Signal	Description
1	Voted Out A	Balanced voted receive audio output to the console.
2	Ground	Ground connection.
3	Console TX In B	Balanced transmit audio input from the console.
4	N/C	No Connection.
5	PTT/COR/Directed COR Out	Indicates if any site is keyed or when any SVM is unsquelched. (Internally configurable- active high or low, or with delay). Note: Transmitters should be connected to SVM TB1-TB12. See Table 3-2
6	Data Ground	Dedicated ground connection for ext. clock and data.
7	Ext Clock In	Serial clock input in an expanded system.
8	Ext Data Out	Serial data output in an expanded system.
9	Voted Out B	Balanced voted receive audio output to the console.
10	Console TX In A	Balanced transmit audio input from the console.
11	Misc In	EIA function tone select. (For SmarTrunk S/W only- Vote-lock enable instead)
12	Console PTT In	PTT input from the console; active low.
13	Speaker Out	Output to external monitor speaker.
14	Next Chassis Select In	Chassis select input in an expanded system.
15	Ext Data In	Serial data input in an expanded system.

- Notes: For unbalanced audio, ground the “B” pin of audio pair connections; connect the single-ended audio input to the “A” pin.
- Active high and directed COR output features not available with older version CIM-2s. If there is no jumper JP8 on the CIM-2 module, these features not available.

3.11.5 Console Interface Connections – TB13

This connector, like P2, carries control signals and audio between the console and the voter chassis. Some of these signals have direct parallel connections on P2, so only one or the other may be used for any particular signal without consideration for double-terminations.

Table 3-6 TB13 Console Interface Terminal Block Connections

PIN	Signal	Description
1	Console TX In B	Balanced transmit audio input from the console.
2	Console TX In A	Balanced transmit audio input from the console.
3	Audio Ground	Ground connection for audio cable shields.
4	Voted Out B	Balanced voted receive audio output to the console.
5	Voted Out A	Balanced voted receive audio output to the console.
6	Speaker Out	Output to external monitor speaker.
7	Console PTT In	PTT input from the console; active low.
8	PTT Out - COR Out - Directed COR Out	Indicates if any site is keyed or when any SVM is unsquelched. (Internally configurable- active high or low, or with delay).
9	Voted Line Out	Line Level Voted Audio (not muted by pin 17).
10	System Voted Out	Logic low if any SVM is voted.
11	System Fault Out	Logic low if any SVM is faulted.
12	COR Input -OR- STARS Enable	Low input activates Directed (Active High) COR Output. Alternate function is STARS Enable (CIM-2A SW4-6 = ON) [Alternate function CPM-3 only]
13	Relay N.C.	Follows configuration of PTT – COR – Directed COR Output.
14	Relay N.O.	Follows configuration of PTT – COR – Directed COR Output.
15	Relay Common	Relay common for pins 13, 14.
16	Relay-Ground	Follows configuration of PTT – COR – Directed COR Output.
17	VA Mute In -OR- Repeat Enable	Mutes Voted Audio Output when active. Jumper selectable (JP7) for either Active Low or Active High. Alternate function is Repeat Enable (CIM-2A SW4-5 = ON) [Alternate function CPM-3 only]
18	Ground	Ground connection.

Notes:

- For unbalanced audio, ground the "B" pin of audio pair connections; connect single-ended audio input to the "A" pin.
- COR Input (pin 12) and active high and delayed COR output features not available with older CIM-2s (not available if no JP8 on the module).
- Voted Line Out (pin 9) only operational when SVM-2 modules used; signal not available with SVM-1s.

3.11.6 Expansion Connector

In an expanded voter system consisting of more than one chassis, this connector is cabled to the Console Connector in the next chassis in the system. In the final voter (Expansion shelf 2 in a three chassis system, Expansion shelf 1 for two chassis) in a system, this connector is not used. This male 15 pin D-sub connector is labeled P3. See Figure 3-4 and Figure 3-5 for expansion cable diagram drawings. The expansion cables may be ordered from us (the cable lengths assume that all voters in an expanded system are located in the same rack, and separated by no more than 3U, or 5.25").

Table 3-7 P3 – Expansion Connector

PIN	Signal	Description
1	Exp. Voted A In	Balanced voted receive audio input from another chassis.
2	Ground	Ground connection.
3	Exp. TX B Out	Balanced transmit audio output to another chassis.
4	N/C	No connection.
5	N/C	No connection.
6	Data Ground	Dedicated ground connection for ext. clock and data.
7	Exp. Clock Out	Serial clock output in an expanded system.
8	RX Data Ext.	Serial data input in an expanded system.
9	Exp. Voted B In	Balanced voted receive audio input from another chassis.
10	Exp. TX A Out	Balanced transmit audio output to another chassis.
11	Misc. In	EIA function tone select.
12	Exp. PTT Out	PTT output from the next chassis in an expanded system.
13	N/C	No connection.
14	Next Chassis Select Out	Chassis select output in an expanded system.
15	Exp. TX Data	Serial data output in an expanded system.

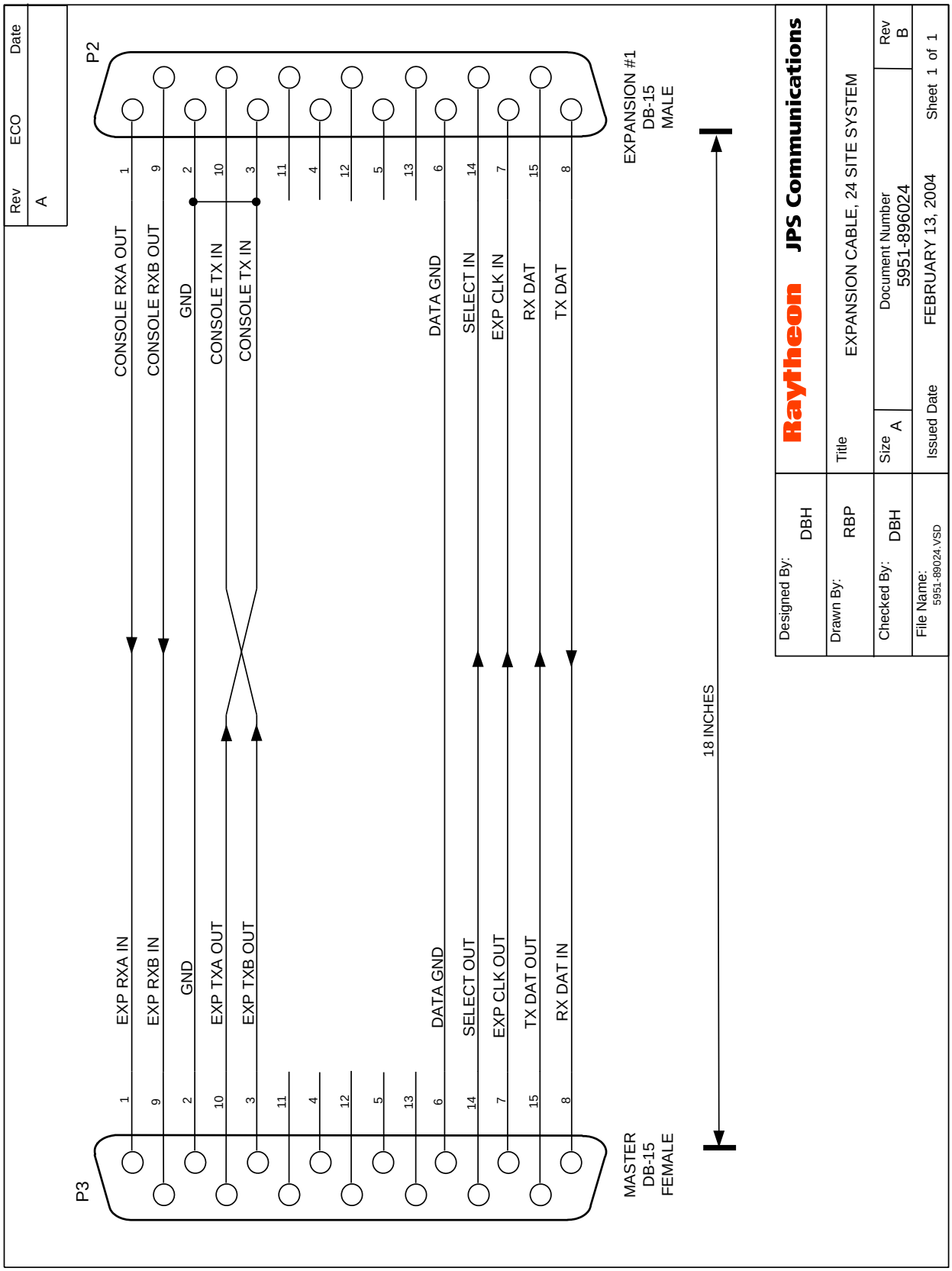

Figure 3-4 Expansion Cable, 24 Site System

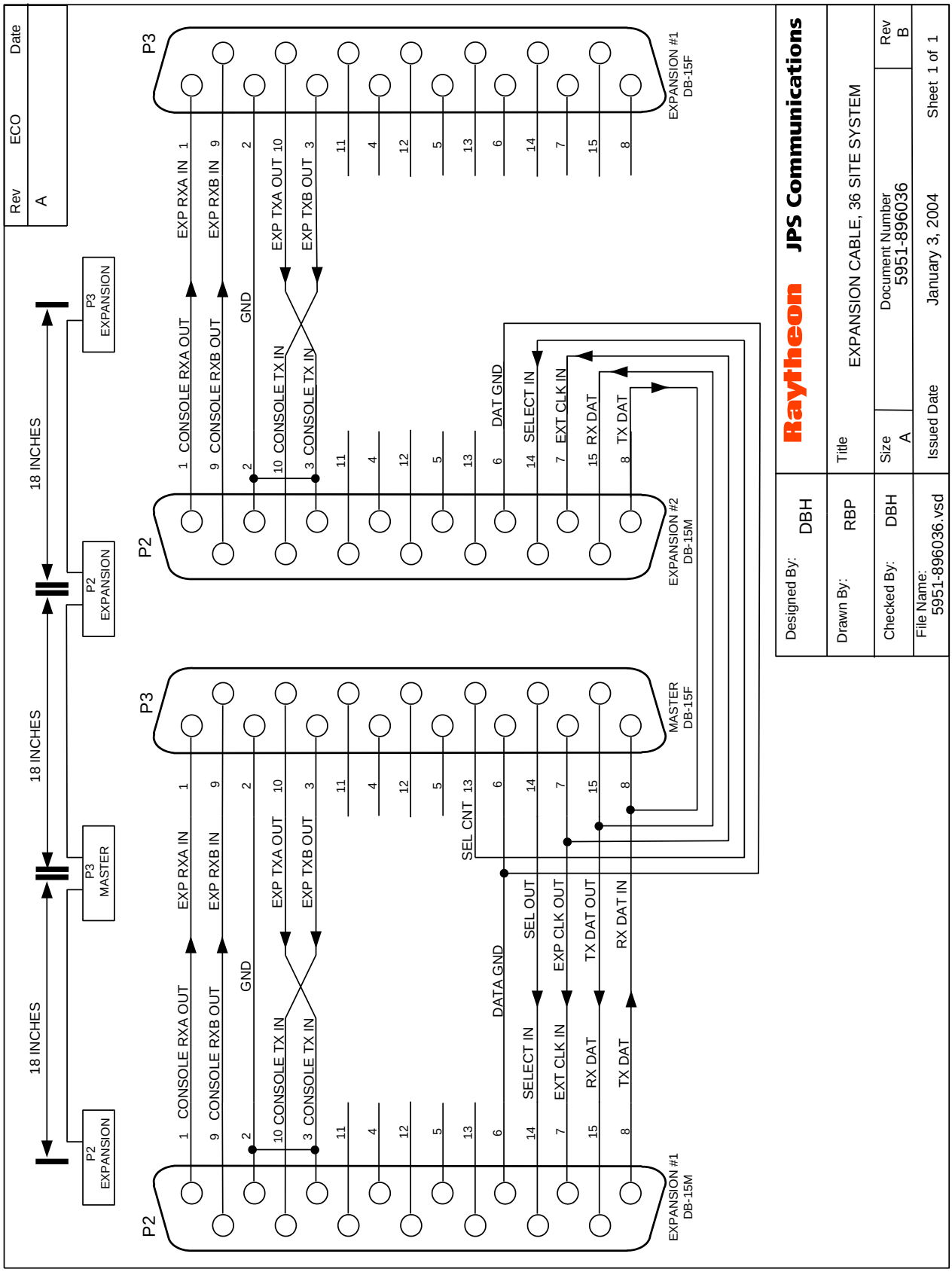

Figure 3-5 Expansion Cable, 36 Site System

3.12 Module Configuration Settings and Adjustments

This section explains the level adjustments and configuration switch settings for all SNV-12 modules. To access the potentiometers, jumpers and switches, use the Extender Card found in the Accessory Kit. Remove the module to be adjusted and install the extender card in its place. Insert the Extender Card with its connector on the right side of the card (the Extender Card connector must be on the same side of the extender card as the module components are). The Extender Card can't be plugged into the Power Supply Module slot. All modules except the power supply module can be "hot-plugged" (removed and re-inserted with the unit's power on) without damage, but interruptions to unit operation may occur (see Section 4.2).

3.12.1 PSM-1A Power Supply

Section 3.6 describes how to configure the PSM-1A for the input voltages and options used. Except for the Charge switch, the power supply module requires no field adjustments. The potentiometers on the PCB are adjusted for correct voltage levels at the factory. The Charge Switch should be left in the "OFF" position unless the PSM-1 is attached to a battery via the rear panel DC Supply terminals.

NOTE- Factory settings are marked *.

Table 3-8 PSM-1A Charge Switch

SW3	Trickle Charger
OFF	**No Battery Attached ***
ON	Trickle Charge Battery

3.12.2 CIM-2A Console Interface Module

The CIM-2A module interfaces Voted Audio Output to, & TX Audio Input from, a console.

A Digital Signal Processor on the module provides TX audio delay capability, detects keying tones in the Console TX input and adds keying tones to the TX output audio that's available at the SVM TX audio outputs. The CIM provides a variety of other features as explained in this section.

Table 3-9 CIM Switch Assignments

Switch SW1	**Console TX Input Audio Delay**
Switch SW2	**Function**
-1	Key Tone Type/Frequency
-2	Key Tone Type/Frequency
-3	Key Tone Type/Frequency
-4	Key Tone Attenuation
-5	Key Tone Attenuation
-6	EIA Function Tone Detection Enable
-7	Site Unsquelch Time Limiter
-8	Low Frequency Response (HPF Disable)
Switch SW3	**Function**
-1	Simplex Console Transmit Inhibit
-2	Simplex Voting Hold Off Timer
-3	Simplex Voting Hold Off Timer
-4	TX Hangtime (Repeat Mode Only Unless SW3-8 On)
-5	TX Hangtime (Repeat Mode Only Unless SW3-8 On)
-6	PTT / UNSQ Output
-7	PTT / UNSQ Output
-8	Console TX Hangtime Enable
Switch SW4	**Function (SW4 available on CIM-2A only)**
-1	Mix Repeat Audio With Console TX Audio
-2	Mix Repeat Audio With Console TX Audio
-3	Alternate EIA Key Tone Output Amplitudes
-4	Console PTT Input Active High Polarity
-5	TB13-17 Alternate function
-6	TB13-12 Alternate function
-7	Reserved for Future Use – Leave OFF
-8	Reserved for Future Use – Leave OFF

A side-view sketch of the CIM-2A is provided. The obsolete CIM-1 & CIM-2 modules are also shown for reference. If at all possible, all voter functions are compatible with all module versions. Exceptions are noted (for example, the features selected by SW4 which is available only on the CIM-2A).

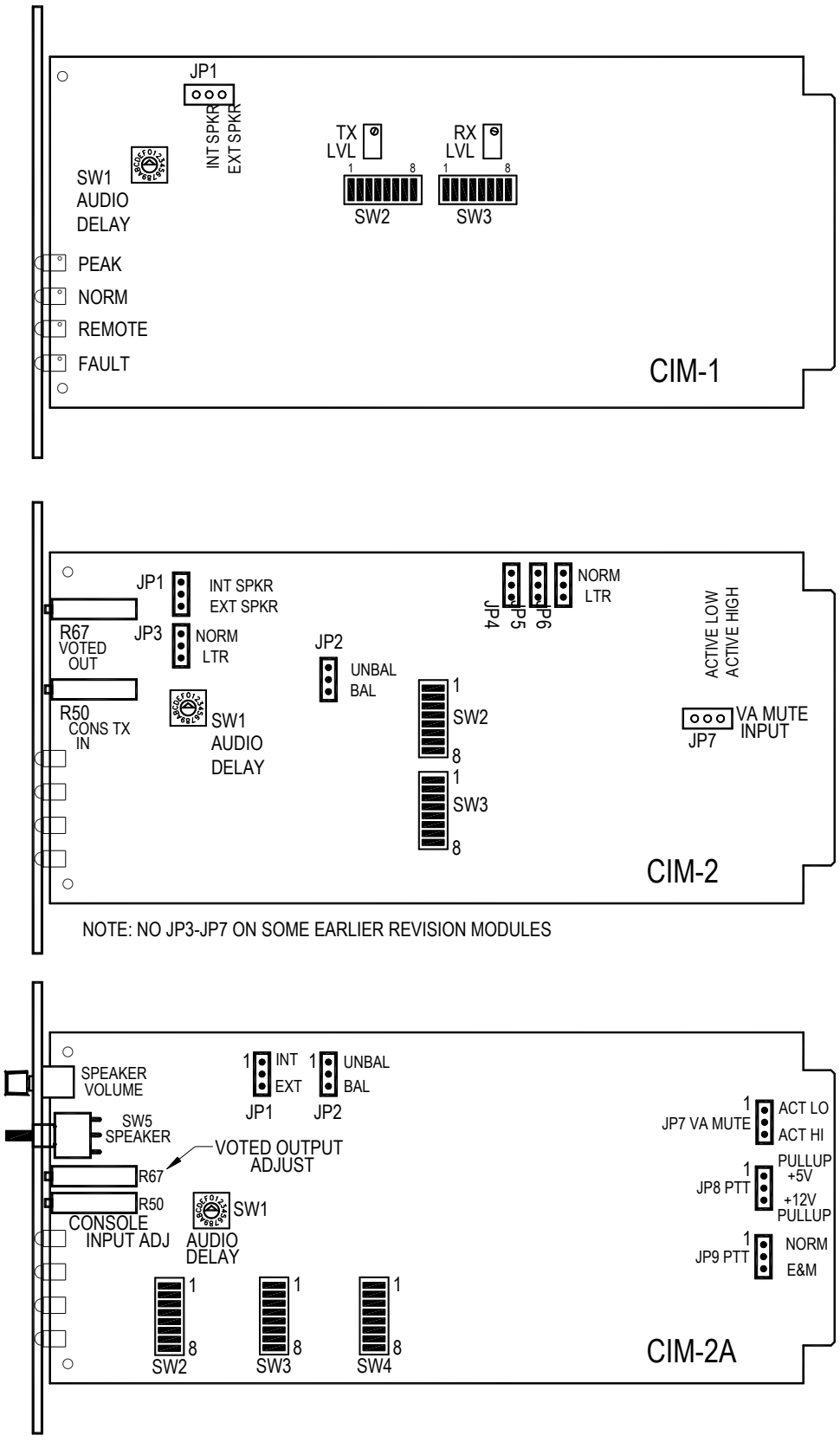

Figure 3-6 Console Interface Module Internal Adjustments Locations

3.12.2.1 CIM Jumper Configuration

The jumpers on the CIM module are listed on Table 3-10 and shown on Figure 2-6.

Table 3-10 CIM Jumper Settings

Jumper	Function	Pos 1&2	Pos 2&3
JP1	Speaker: Internal or External	**Internal ***	External
JP2	Console TX Input Configuration (Not present on CIM-1)	Single-ended 47k	**600 ohm balanced ***
JP3-6	Voted Audio Mode (CIM-2 only, not present on CIM-1 or CIM-2A)	**Normal ***	Do not use
JP7	Voted Audio Mute Input Config (Available on CIM-2A and some versions of CIM-2)	**Active Low ***	Active High
JP8	PTT/UNSQ Output Configuration (Available on CIM-2A and some versions of CIM-2)	**Active Low output** **47k pull-up to +5 VDC ***	Active Low output10k Pull-up to +12 VDC
JP9	Console PTT Input Configuration (available on CIM-2A only)	**Active Low Input** **10k pull-up to +5 VDC** **Threshold approx +2.5 VDC**	E&M input PTT Active for input below -10 VDC, inactive for open circuit or above 0 VDC.

Notes:

- Factory default jumper settings marked by *
- Pin #1 indicated by square pad.
- PTT input can be set to active high by CIM-2A switch SW4-4

JP1 Speaker

Set the jumper on positions 1&2 to listen to the internal speaker at the CIM front panel. To use an external speaker, move JP1 to positions 2&3 and wire the speaker to the speaker output terminal and ground terminal of either P2 or TB13. Note that when JP1 is set to External, there is no signal to the internal speaker. The driver circuitry on the CIM Module cannot run two speakers simultaneously.

JP2 Console TX Input Configuration

The Console TX input port can be set to either 47k ohms, single ended (JP2 on pos 1&2), or 600 ohms balanced (JP2 on pos 2&3).

JP3-JP6 Voted Output Mode

These jumpers were part of the CIM-2 module for an application that is now obsolete. Keep in Pos 1&2. No longer used.

JP7 Voted Audio Mute Input Configuration

The external input that mutes the voted audio output can be set to either active low or active high by JP7. Please note that there is a pull-up resistor on this input, so if the jumper is placed in the Active High position and no connection is made to the input terminal, the pull-up will hold the input active and the Voted Audio Output will remain muted.

JP8 PTT/UNSQ Output Configuration

This jumper provides a 10k pull-up to +12 VDC for proper operation of this output as the RECEIVING input when used as the conventional voter in an EDACS system. Note: The output must also be set as active high using the configuration dip-switches. The standard output is pulled up to +5 VDC as are most other SNV-12 outputs.

JP9 Console PTT Input Configuration

The standard configuration is a logic level, active low input with a pull-up resistor to +5 VDC. The alternate jumper setting provides an E&M input to the SNV-12 console PTT function. Threshold is approximately -5 VDC. Specification is PTT active for voltages equal to or below -10 VDC, PTT inactive for open-circuit or voltage 0 VDC or higher.

The Console PTT Input may also be configured as an active high input via CIM-2A dipswitch SW4-4. See Section 3.12.2.5. When set to active high via this switch, the keyed/unkeyed conditions for the E&M JP9 configuration are also reversed. That is, the standard specification of "PTT active for input below -10 VDC, inactive for open circuit or above 0 VDC" changes to "PTT inactive for input below -10 VDC, active for open circuit or above 0 VDC."

3.12.2.2 CIM Switch SW1; Console TX Audio Delay

SW1 is a BCD rotary switch used to add delay to the Console TX Input Audio. The Console TX Audio Delay feature allows communications system TX audio and PTT control paths to be set and stable before console audio is passed through.

The delay is adjustable from 0 to 450 ms in 30 ms steps. Actual total delay is the listed delay setting plus the inherent audio delay of under 10 ms. This inherent delay is the result of the A to D, DSP computations, then D to A processes.

Up to 50 ms delay is required to interpret all inputs for correct PTT and audio routing in a full 12 site single chassis SNV-12. This control signal delay is a result of the need for the CPM module, after it receives a request to key, to poll all of the SVMs to see if any TX Inhibit or Manual TX Steering inputs are currently active. The CPM must then direct the proper module(s) to transmit. The first two settings steps are below the typical TX control signal delay of approx 50ms, so a setting of 60 ms is recommended. Additional delay is required when expanding to a two or three chassis voting system.

The recommended delays ensure that the correct PTT output(s) and all required audio gates are set before console audio is sent to the selected SVM(s). Additional delay may be added to account for other delays in the rest of the system, or to hold up the console audio until EIA High Guard and Function Tones are transmitted.

If the voter is set to add EIA keying tones to the TX output, the tone sequence begins as soon as the voter invokes the TX mode, while the console audio input is delayed per the SW1 setting.

NOTE- Factory settings are marked *.

Table 3-11 Recommended Delay Settings Console TX Audio

No. Of Chassis	Delay Setting
1 (up to 12 SVMs)	**Pos 2 (60 ms)***
2 (up to 24 SVMs)	Pos 3 (90 ms)
3 (up to 36 SVMs)	Pos 3 (90 ms)

Table 3-12 Console TX Audio Delay Setting

Position	Delay (ms)	Position	Delay (ms)	Position	Delay (ms)	Position	Delay (ms)
0	0	4	120	8	240	C	360
1	30	5	150	9	270	D	390
2	**60 ***	6	180	A	300	E	420
3	90	7	210	B	330	F	450

3.12.2.3 CIM SW2 Settings

SW2-1, 2, and 3- Transmitter Control; Keying Tone Frequency & Type

The SNV-12 can generate various key tones and mix them with the SVM TX audio outputs. The voter can also detect the EIA key tone sequence in the Console TX Input audio. The available single-tone keying tones are 1950 Hz, 2175 Hz, 2600 Hz, and 2950 Hz. When selected, these single tones are continuously mixed with the transmit audio for the duration of the transmission. Refer to Section 5.20 for a full explanation of keying tone detection and generation.

The EIA tone key sequence consists of a 125 ms, 2175 Hz high guard tone (also called the *alert tone*), followed by a 40 ms function tone, followed by a low level 2175 Hz guard tone which is present for the duration of the transmission. The amplitude of the high guard tone is +10 dB relative to normal audio, the function tone level is the same as normal audio, and the low guard tone is 20 dB below the normal audio. The high guard and function tones replace TX audio, while TX audio is transmitted along with the low guard tone (also called the *hold tone*).

Standard EIA key tone detect operation is set to detect only the standard F1 1950 Hz tone for transmit, but the Function Tone Guided TX Steering feature allows 7 different function tones to be detected. The tone detected determines which SVMs are keyed. See Section 5.20 for additional information. When standard EIA key tone detection is enabled, the SNV-12 may be switched remotely in and out of the repeat mode by sending the proper function tone via the console TX audio input.

Standard EIA key tone generation also uses the standard F1 1950 Hz tone, but three other function tones may be generated and mixed with the TX audio output. These different function tones may be selected by grounding the Pin 11 inputs on the P2 and P3 backplane connectors as given in the EIA Function Tone Output Selection Table.

Refer to the four tables below for all key tone configuration settings.

NOTE- Factory settings are marked * on all switch tables.

Table 3-13 Transmitter Control; Key Tone Frequency & Type

SW2-1	SW2-2	SW2-3	Key Tone Frequency
OFF	**OFF**	**OFF**	**Key Tones Disabled ***
ON	OFF	OFF	1950 Hz
OFF	ON	OFF	2175 Hz
ON	ON	OFF	2600 Hz
OFF	OFF	ON	2950 Hz
ON	OFF	ON	Reserved- Do not use
OFF	ON	ON	Function Tone Guided TX Steering Also enable Key Tone Detection (SW2-6) Group selections must be made on SVMs
ON	ON	ON	EIA F1 (1950 Hz) Function Tone

Alternate EIA Function Tone Selection

The voter can generate any one of four different function tones. The standard function tone is F1, 1950 Hz. The alternate tones are selected via rear panel outputs (rather than internal dip switches) to allow them to be dynamically selected during operation.

Table 3-14 EIA Function Tone Output Selection

P2-11 (Console Connector)	P3-11 (Expand Connector)	Function Tone
Open	Open	1950 Hz F1 *
Grounded	Open	1850 Hz F2
Open	Grounded	1350 Hz Wild Card
Grounded	Grounded	1250 Hz Wild Card

SW2-4, 5 Key Tone Relative to Audio

Single keying tones generated in the voter may be adjusted in relationship to the transmit audio level by SW2-4, 5. This does not apply to the EIA tone sequence, as these relative levels must follow the EIA specification.

Table 3-15 Key Tone Level

SW2-4	SW2-5	Tone Attenuation
OFF	OFF	-20 dB
ON	OFF	-15 dB
OFF	ON	-10 dB
ON	**ON**	**- 5 dB ***

SW2-6 EIA Key Tone Detection in Console TX Audio

To enable EIA function tone detection in the Console TX Audio, Turn SW2-6 "ON". When enabled, the key tone detection functions in parallel with the Console PTT input at P2-12. Below Revision 4.0 software, only the F1 (1950 Hz) function tone can be detected, and will put the unit into TX mode as long as the low level guard tone (hold tone) is present. Beginning with Rev 4.0 SNV-12 software, the EIA Function Tone Enable feature will also allow the Repeat Mode to be turned off and on by sending the proper EIA sequence in the Console TX Audio (high guard followed by the proper function tone, no low guard tone).

To Key: High Guard, 1950 Hz Function Tone, Low Guard to hold.

Repeat Mode On: High Guard, 1550 Hz Function Tone

Repeat Mode Off: High Guard, 1450 Hz Function Tone.

The repeat mode control using EIA keying tones is only allowed when CPM SW1-5 is Enabled.

The dipswitch that sets Repeat Mode Off/On (CPM SW3-7) still functions when SW2-6 is set to On. With CPM SW1-5 On, SW2-6 determines the Repeat Mode function state at unit power-up; the state can then be changed by the proper EIA sequence. If power is again cycled, the voter will return to the Repeat Mode state set by dipswitch SW2-6.

Table 3-16 EIA Key Tone Detection, in Console TX Audio

SW2-6	Key Tone Detection
OFF	**Disabled ***
ON	Enabled

SW2-7 Site Unsquelch Time Limiter

This feature faults any site that remains continuously unsquelched for more than 3 minutes. This was intended to benefit systems where a continuous radio link brings the remote receiver audio to the voter. The purpose is to remove from consideration for voting sites that become unsquelched because the remote link transmitter has failed (so no pilot tone is being transmitted) while the local link receiver is always unsquelched (so the high noise volume prevents the SVM's speech detector from activating the Line Fault Detection feature). The fault will be removed as soon as the site again becomes squelched.

Table 3-17 Site Unsquelch Time Limiter Enable

SW2-7	Unsquelch Time Limiter
OFF	**Disabled ***
ON	Enabled

SW2-8 Low Frequency Response

The CIM DSP circuitry has a high pass filter that is designed to remove low frequency energy (such as 60 Hz AC hum) from the input audio passband. The high pass filter should be engaged for normal operation as only the audio above 300 Hz is used in most communications systems. This should be disabled only if it is necessary to pass low frequency data such as CTCSS, DCS, etc. If the filter is disabled, careful shielding, equipment grounding and site grounding are of increased importance. If SW2-8 is switched to On, the high-pass filter is removed, extending the pass band from a 100 Hz cutoff to below 50 Hz. The default setting leaves the filter in place. (The CIM's high pass filter only affects console-generated audio/tones; it has no effect on repeat audio.)

Table 3-18 CIM High-Pass Filter

SW2-8	High-Pass Filter
OFF	**Engaged ***
ON	Removed

3.12.2.4 CIM Switch SW3 Settings

SW3-1 TX Source Priority Selection

When in Duplex Repeat Mode, the voter can be set up so that either Console TX audio or voted audio (Field) will have priority when both are present. The selected priority audio will be sent to the transmitter. When the unit is in Simplex Mode (repeat or non-repeat) this priority determines whether the console will be able to break into a voted message coming in from the field. See Section 5.21 for more complete information.

In previous versions of the SNV-12 software, this feature was called "Simplex Mode Console TX Inhibit". This feature works exactly the same when the unit is in the Simplex Mode. New functionality was added to Duplex Mode operation only.

Table 3-19 TX Source Priority

SW3-1	TX Source Priority
OFF	**Console ***
ON	Field

SW3-2, 3 Simplex Mode Voting Hold Off After Console Transmission

This switch does not function unless the SNV-12 is set to the Simplex Mode. When set to simplex, the SNV-12 will not vote during console transmissions. This prevents the remote receivers from voting console audio, since the transmit frequency of the console TX signal is the same as the voting receiver RX frequency.

It's also important that the SNV-12 does not vote for a short time following the end of each console transmission, so that the unit does not vote a squelch tail that might be present following the transmission. Without this hold off, any TX steered console transmissions after the initial transmission will be routed to the site that votes on the squelch tail. Standard hold off time is one second. Alternate hold off durations can be selected using SW3-2 and SW3-3.

Table 3-20 Simplex Mode Voting Hold Off After Console Transmission

SW3-2	SW3-3	Voting Hold Off Duration
OFF	OFF	0.5 sec
ON	**OFF**	**1 sec***
OFF	ON	1.5 sec
ON	ON	2 sec

SW3-4, 5 TX Hangtime Duration

These switches set the TX hangtime duration. TX hangtime holds the voter's TX outputs active after the associated input is de-activated. For Repeat Mode retransmission of voted audio, the hangtime holds the voter's PTT output active after all voting receivers become squelched.

If CIM SW3-8 is also ON, the selected hangtime will also be applied to the end of console transmissions, holding the PTT outputs active after the CIM's PTT input is de-activated.

TX hangtime prevents transmitters from quickly shutting off and back on when system users momentarily deactivate their PTT inputs. TX hangtime is especially important when the EIA keying tone sequence is being used, due to the inherent delays in sending & decoding the EIA High Guard and Function tones.

Available selections are: No Hangtime (all key command outputs deactivated as soon as COR input de-activated), 0.5 seconds, 1 second, and 2 seconds. If the console is keyed during the Repeat Mode Hangtime duration (with the unit set for Console Priority), the transmitter will stay keyed, with the audio source switched from the Voted Audio to the Console TX Audio. Note that if the console is keyed via the EIA sequence, the 40 msec function tone will be transmitted, as the voter's notch filters remove only the 2175 Hz low and high guard tones.

These settings do not apply to console transmissions unless CIM SW3-8 is also switched ON. If so, console transmissions have hangtime of the specified duration, and other rules apply. See SW3-8 description.

Table 3-21 Transmit Hangtime

SW3-4	SW3-5	Hangtime Duration
OFF	OFF	0 (no Hangtime)
ON	OFF	0.5 seconds
OFF	**ON**	**1.0 seconds***
ON	ON	2.0 seconds

SW3-6, 7 PTT /COR Output Configuration

These switches configure the PTT/COR Relay and the output simultaneously available at both P2-5 and TB13-8. The output may be used as a PTT output or as an indication of a system wide active COR (unsquelched condition). The output available at P2-5 and TB13-8 can be configured by jumper JP8 on the CIM-2 module to have either a 47k pull-up to +5 VDC (factory default) or a 10k pull-up to +12 VDC. (Note: JP8 is installed only on CIM-2 rev D and higher. For earlier revisions, the modules have only the 47k, +5VDC pull-up.)

The relay and open-collector output can be configured to activate for one of the following:

- PTT Output. Low (and relay energized) if any SVM has been put into the TX mode (either due to console TX activity or by the retransmission of voted audio.)
- COR. Low (and relay energized) when any one of the SNV-12's sites is unsquelched. Please note that this indication occurs only following the CPM polling and computation process, and therefore is not instantaneous. For a quicker response, use the ***Directed COR Output*** configuration as explained below.

- Directed Active High COR. This output responds immediately to a low signal on TB13 COR input, Pin 12. The open-collector COR outputs from each SVM module are activated instantaneously upon detection of active COR, and may be all connected together and wired to the Directed COR input. The Directed Active High COR Output will go high as soon as any one of these system modules detects active COR by any method. NOTE: This input available on all revisions of the CIM-2A, and on the CIM-2 only if revision D or higher. The revision is stamped in ink on each CIM module.
- Delayed Directed Active High COR Output: In this configuration, the output responds 200 milliseconds after the Directed COR Input goes low. Again, this input available only for CIM-2A and CIM-2 modules rev D or higher.

Table 3-22 System PTT / COR Output Configuration

Applies to P2-5, TB13-8, and CIM-2 PTT / COR Relay K1

SW3-6	SW3-7	COR Output Configuration
OFF	**OFF**	**PTT Only***
ON	OFF	Active Low COR
OFF	ON	Directed Active High COR (Unsq.) (CIM-2A/CIM-2 only)
ON	ON	Directed Active High COR (Unsq.) Delayed 200ms (CIM-2A/CIM-2 only)

Note: The system transmitter or repeater should be connected to an SVM's TB1-TB12 output pins, not to P2. P2 provides voted audio, not TX audio, and has no TX audio delay or keying tones.

SW3-8 Console TX Hangtime

When SW3-8 is on, console TX transmissions will have the same hangtime duration as Repeat Mode transmissions (as set by CIM SW3-4, 5). If the SNV-12 is set to Console Priority rather than Field Priority (CIM SW3-1), the Console Priority status is overruled during the hangtime period, allowing repeat mode retransmission of voted audio to occur during this time.

Table 3-23 Console TX Hangtime

SW3-8	Console Hangtime
OFF	**Disabled ***
ON	Enabled

3.12.2.5 CIM Switch SW4 Settings

SW4-1, 2 Mix Repeat Audio With Console TX Audio

These switches allow audio from users in the field (Repeat Audio) to be mixed with the transmitted audio from the console operator. The system must be set so that console transmissions have precedence over field transmissions for this feature to be operational (CIM SW3-1 Off). The SNV-12 must also be in the Repeat Mode (CPM SW3-7).

The retransmitted field audio that's mixed with the console audio can be attenuated three different amounts: 6 dB lower, 3 dB lower, 0 dB.

Note: The mixed console/field audio will only be transmitted to sites that would key when this feature is not selected (CIM SW4-1, 2 both Off). That is, this feature affects only the audio that is being transmitted, not which sites are put into Transmit Mode.

Table 3-24 Mix Repeat Audio With Console TX Audio

SW4-1	SW4-2	Repeat Audio Attenuation
OFF	**OFF**	**Do Not Mix Repeat Audio ***
ON	OFF	Mix at -6 dB
OFF	ON	Mix at -3 dB
ON	ON	Mix at 0 dB (No Attenuation)

SW4-3 EIA Output Keying Tone Amplitudes, Alternate Levels

This switch sets the EIA Keying tones sent from the SVM modules to a transmitter to an alternate level set required by some transmitters/linking media. The EIA specified levels and the alternate levels (relative to the standard voice audio level) are provided in the following table:

Table 3-25 Output Keying Tone Amplitudes

Tone	Amplitude SW4-3 OFF	Amplitude SW4-3 ON
High Guard (Alert) Tone	**+10 dB ***	0 dB
Function Tone	**0 dB ***	-10 dB
Low Guard (Hold) Tone	**-20 dB ***	-20 dB

SW4-4 Console PTT Input Polarity

The Console PTT Input normally requires an active low input. If SW4-4 is set to ON, an active high input is required to put the voter into the TX mode. Note that, because of the pull-up resistors in the CIM module, the voter will be placed in a constantly keyed state if the PTT input line becomes an open-circuit.

When ON, this switch also affects the polarity of the E&M PTT input. That is, the conditions that would activate the PTT input cause the voter to be put into the TX mode (Open circuit or voltage higher than 0V) will now inactivate the PTT Input. Conditions that ensure that the PTT input is not activate (voltage lower than -10 VDC) will key the voter.

Table 3-26 PTT Input Polarity	
SW4-4	**PTT Input Polarity**
OFF	**Active Low ***
ON	Active High

SW4-5 TB13-17 Alternate Function – Repeat Enable Input

(For use with CPM-3 and CIM-2A Only)

Switching SW4-5 ON re-assigns the TB13-17 input to be Repeat Enable/Disable input rather than a VA Mute input. The CIM-2A JP7 jumper still determines the polarity of the input. When the input is asserted (as defined by JP7) the repeat function in the voter is enabled. Otherwise, the repeat function is disabled. Note that when this mode is used, the repeat mode setting (CPM-3 SW3-7) will be overridden by the TB13-17 hardware input state.

Table 3-27 TB13-17 Function	
SW4-5	**TB13-17 Function**
OFF	**VA Mute***
ON	Repeat Enable

SW4-6 TB13-12 Alternate Function – STARS Enable Input

(For use with CPM-3 and CIM-2A Only)

Switching SW4-6 ON re-assigns the TB13-12 input to be a STARS Enable/Disable input rather than Directed Unsquelch Input. The input is active low with a pull-up resistor. When the input is asserted (driven low), the STARS function in the voter is enabled. Otherwise, the STARS function is disabled. Note that when this mode is used, the STARS enable setting (CPM-3 SW2-7) will be overridden by the TB13-12 hardware input state.

Table 3-28 TB13-12 Function

SW4-6	TB13-12 Function
OFF	**Dir. Unsquelch Input***
ON	STARS Enable

SW4-7 to SW4-8 Reserved For Future

These switches must remain in the OFF position for proper operation unless and until software upgrades assign new features to them.

3.12.2.6 CIM Audio Level Adjustment

As shipped from the factory, the input and output levels of each Console Interface Module (CIM) module are set to -10 dBm. If level requirements differ, the Console TX Audio Input level may be adjusted via potentiometer R50, (available through an access hole in the front panel on the CIM-2, and on the CIM-1 near the top center of the board). Similarly, the Voted Audio Output can be adjusted using the Voted Output potentiometer (R67) located on the front panel (CIM-2) and internally near the top center of the board (CIM-1).

Console TX Audio input is conditioned by the DSP circuitry on the CIM module before being placed on a TX audio bus to be picked off by any site or sites chosen to transmit this audio. DSP functions include detection of EIA keying tones, addition of EIA tones, and digital audio delay. This input is set at the factory for -10 dBm average voice audio input. When Repeat Mode is enabled, the retransmitted voted audio does not pass through the CIM's DSP, but the DSP may be set to add keying tones to the voted audio as it is placed on the TX audio bus. To keep the Console TX audio and the retransmitted voted audio (repeat audio) signals at the same relative level, and to ensure that the DSP has sufficient headroom, it's important that the Console TX Audio input be correctly set.

When the voter is set to detect EIA keying tones in the console transmit audio, the tones should follow the EIA specification. The CIM detection algorithm is fairly forgiving, but if problems with detection occur, first check the input level adjustment as described below and then work with the console to bring the input key tones into alignment with the specification:

- The High Guard (Alert) Tone should be 125 millisecond long at 2175 Hz, 10 dB above average voice audio.
- The Function Tone should be 40 msec long at the average voice level.
- The Low Guard (Hold) Tone should be at 2175 Hz, 20 dB below the voice level.

Either of the two following methods may be used to set the input level in the CIM. Method 1 is the preferred approach, but method two will give satisfactory results in most installations:

Method 1:

- Using a tone box, generate a 1kHz tone into the console's microphone, at a level that will produce 100% modulation. (Some consoles produce a test tone that can be used during alignment.) The 1kHz test tone is used to simulate average voice.
- With the test tone still generated, set the console's output to the appropriate system level (normally -10dBm) for the connection medium that links it to the voter.
- Continue to generate the test tone and adjust the Console Input pot (R50) on the CIM so that the Norm LED just lights. Verify this adjustment by connecting a transmission test set to test point 3 (TP3) and ground. Verify a level of approximately 0dBM for the CIM.

Method 2:

The CIM front panel PEAK and NORM LEDs may be used to easily set the Console TX Audio input level without the need for any external equipment. When the Console TX Audio input control is adjusted properly, the NORM LED on the module will be lit during typical speech, and the PEAK LED will flash occasionally on peaks in speech input. If the NORM LED never lights, or if the PEAK LED lights frequently, then the RX audio level into the CIM is not correctly adjusted. Note that these LEDs assume a typical speaking voice at typical volume levels. There is room for variation if some console operators speak more loudly than others.

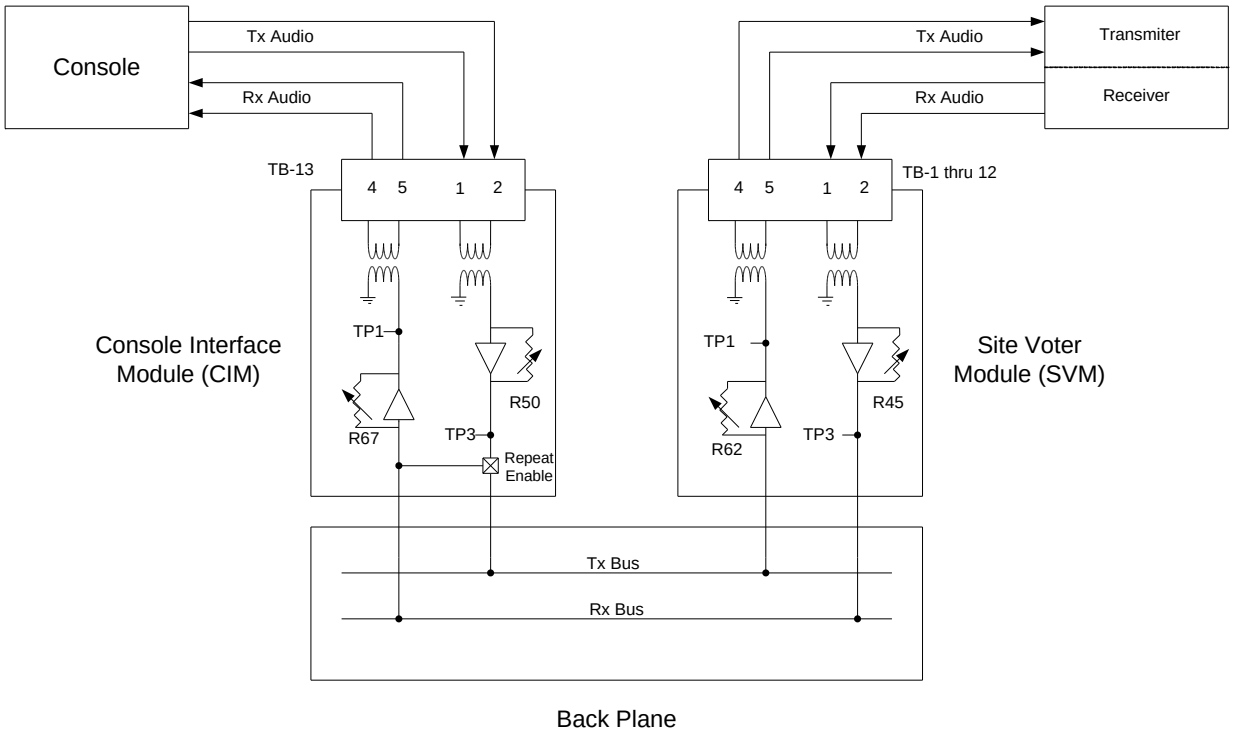

Figure 3-7 Audio Routing

The following procedure sets the level of the CIM's Voted Audio Output to the console.

The Voted Audio Output is set at the factory for -10 dBm out. It may be readjusted as desired to achieve levels from –20 dBm to +11 dBm.

Note: The Voted Audio Output adjustment should be done after the receiver adjustments, receiver-to-voter linking medium settings, and SVM RX input levels are properly set.

Connect a service monitor to a receiver's antenna port. On the receiver's frequency, generate a 1kHz tone at full deviation (FM; 3kHz normal, 2.4kHz NPSPAC. AM; 100% modulation). Apply enough signal strength to fully quiet the receiver, typically 12 dB. At the voter select the receiver site connected to the service monitor. Now connect a transmission test set to TP1 and ground on the CIM. Adjust the Voted Output pot (R67) on the CIM to the appropriate system level (typically -10dBm) for average voice to the console.

3.12.3 CPM-3 Control Processor Module

The SNV-12 CPM module uses 3 banks of 8-position dipswitches along with a 16-position rotary switch to set its operating parameters. These switches are read by the CPM only during unit power-up. To change any parameters, turn off the unit, remove the CPM-3 card and adjust the positions of SW1 through SW4 as desired, re-insert the module, and turn main power back on. If changes are made while the unit is on an extender card, the main power must be turned off and back on before the switches are read and any operational changes take place.

3.12.4 System Reset to Factory Defaults

The unit can be set to its Factory Default settings via jumper JP16 on the CPM-3 module. To return to Factory Defaults, set J16 to the Reset Position and cycle the power to On. Be sure to then return the jumper to the norm position or the factory defaults will be reset every time power is cycled.

These are the factory default options and settings:

Config Option	Default Setting
Module Name	CPM-3
Password	lightfoot
IP Address	192.168.1.200
Netmask	255.255.255.0

Also affected is the Boot Monitor Serial port configuration (affects Boot Monitor operation only, not standard serial port operation, which is still defined by CPM dipswitches SW1-4). Boot Monitor default settings are 115K, 8, N, 1.

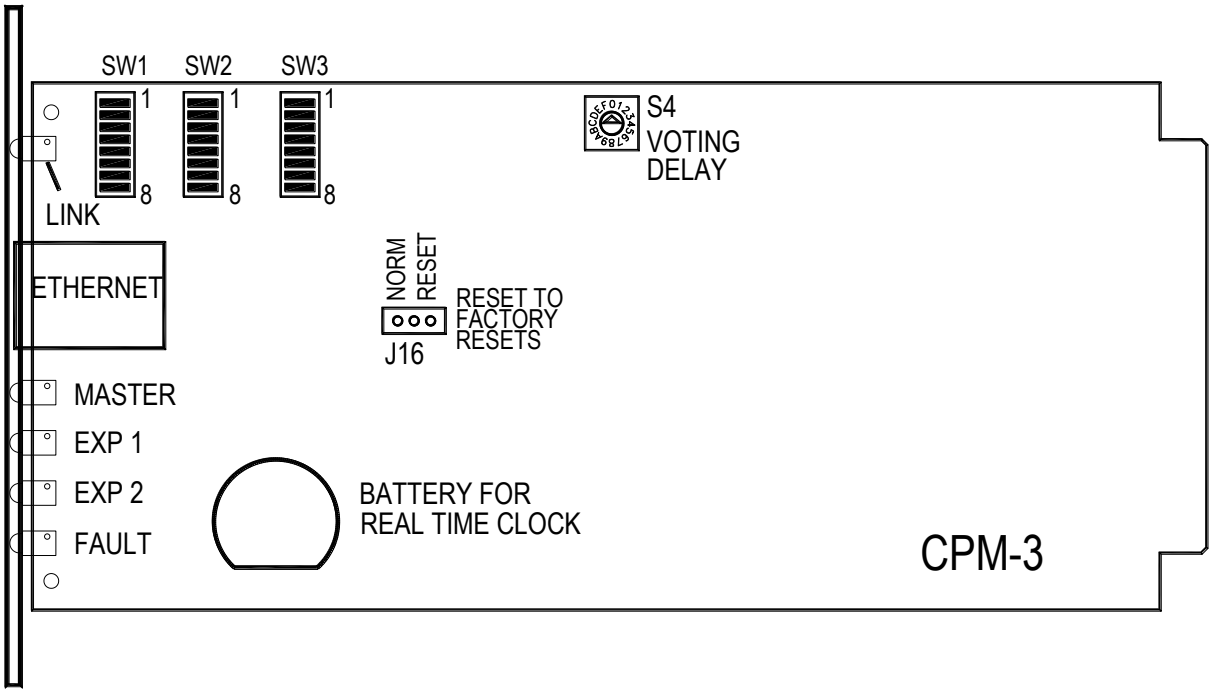

Figure 3-8 CPM-3 Internal Adjustments Locations

3.12.5 Real Time Clock (RTC)

The CPM-3's RTC clock will maintain the set time in the event of a power outage. The unit is not shipped with a battery. If RTC operation is desired, purchase and install a 3V CR2032 type lithium battery in the battery holder. Use the Event Log web page to set the time. See Section 6.5 for a more complete explanation.

Table 3-29 CPM Switch Assignments

Switch SW1	**Function**
-1	Baud Rate
-2	Baud Rate
-3	Baud Rate
-4	Enable/Disable Remote Control
-5	EIA Control of Repeat Mode
-6	Pilot Tone EOT Noise Cancellation
-7	Manufacturing Test
-8	TX Default Site – Multicast or Home Site
Switch SW2	**Function**
-1	SNR Difference
-2	SNR Difference
-3	SNR Difference
-4	SVM Fault Reporting
-5	Line Fault Detection
-6	Line Fault Detection
-7	STARS
-8	Normal/Update
Switch SW3	**Function**
-1	Holdover Time
-2	Holdover Time
-3	COR Voting Lock
-4	Data Voting Lock
-5	Simplex/Duplex
-6	RX Group Lockout
-7	Repeat Mode
-8	STARS Site Indication
Switch SW4	**Voting Delay/COR Lock Onset**

3.12.5.1 CPM Switch SW1 Settings

SW1-1,-2,-3 Serial Port Baud Rate

These are used to set the External Serial Port baud rate. The serial port uses 8 data bits, 1 stop bit, no parity and flow control none. The baud rate configuration is as follows:

Table 3-30 Serial Port Baud Rate Settings

SW1-1	SW1-2	SW1-3	Baud Rate
OFF	OFF	OFF	300
ON	OFF	OFF	1200
OFF	ON	OFF	2400
ON	ON	OFF	4800
OFF	**OFF**	**ON**	**9600***
ON	OFF	ON	19.2k
OFF	ON	ON	38.4k
ON	ON	ON	57.6k

SW1-4 Serial Remote Control

This switch enables the external serial port for remote control via RS-232. When the SNV-12 is configured for remote operation the REMOTE LED on the Console Interface Module will be on. In multiple chassis setup, only the Master unit can be (or needs to be) controlled remotely. The Remote Control Protocol is detailed in Section 6.

Table 3-31 Serial Port Control

SW1-4	Remote Control
OFF	**Disabled***
ON	Enabled

SW1- 5 Control of Repeat Mode Using EIA Keying Tones

The SNV-12 can use the detection of EIA keying tones in the Console TX audio (if CIM SW2-6 is On) to control transmitter keying and the current state of the Repeat Mode Feature. If there is no intention to turn Repeat Mode off and on using function tones, leave SW1-5 On.

Table 3-32 EIA Control of Repeat Mode

SW1-5	Repeat Mode Control
OFF	Enabled
ON	**Disabled***

SW1-6 Pilot Tone EOT Noise Cancellation

This switch is used to globally enable an end of transmission noise cancellation for all SVM-2 modules. Pilot tone operation can, with some radio equipment, cause an undesired noise burst at the end of a field transmission. This feature has the effect of removing the last 200ms of audio so that the noise burst is not heard. This is accomplished by delaying the audio output at the SVM-2 by 200ms (approximately equal to the time it takes for the SVM-2 to detect pilot tone, send that status to the CPM, and for the CPM to turn off the audio stream). This delay is applied equally to all SVM-2 modules in the system. Note that SVM-1 modules do not support this feature so enabling this for a system that has a mix of SVM-1 and SVM-2 modules will cause an audio synchronization issue.

Table 3-33 Pilot Tone EOT Noise Cancellation

SW1-6	Repeat Mode Control
OFF	**Disabled***
ON	Enabled

SW1-7 Manufacturing Test

This switch is used to enable Manufacturing Test Operation. This switch setting activates features used only by us during manufacturing test. Leaving this switch ON will interfere with normal SNV-12 operation.

NOTE: This switch must remain in the Off position for normal operation of the SNV-12.

Table 3-34 Manufacturing Test Selection

SW1-7	Manufacturing Test
OFF	**Disabled ***
ON	Enabled

SW1-8 Default Transmit Site Selection (Multicast or Home Site)

This switch determines which site or sites are keyed when the site selection is not controlled by automatic or manual TX steering. The choices are either the Home Site or Multicast. See Section 4.15. The factory default destination is to the Home Site.

Multicast refers to all ***TX eligible*** sites.

Home Site refers to one site only, the lowest-numbered ***TX eligible*** site.

See Section 5.13, SNV-12 Transmit Features, for more in-depth information.

Table 3-35 Default TX Site Selection	
SW1-8	**Default TX Destination**
OFF	**Home Site ***
ON	Multicast

3.12.5.2 CPM Switch SW2 Settings

NOTE- Factory settings are marked *.

SW2- 1, 2, and 3 Voting Criteria; Signal Quality

These switches determine the signal quality difference that must be exceeded before one SVM is voted over another. If site "A" is presently voted, site "B" must maintain a better signal than site "A" by the amount set by the dipswitches SW2-1, 2, 3 in order to be voted over site "A". In addition, this threshold must be maintained for a period of time determined by CPM SW4 before the CPM will vote the new site. A 1dB setting is the typical threshold for voting transitions. The 0dB setting should never be used; the voter may change sites based solely on the random fluctuations always present in noise levels. More detail is provided in Section 5.6

Table 3-36 Voting Criteria

SW2-1	SW2-2	SW2-3	Signal Quality Difference
OFF	OFF	OFF	0 (Test Mode ONLY)
ON	**OFF**	**OFF**	**1 dB ***
OFF	ON	OFF	2 dB
ON	ON	OFF	3 dB
OFF	OFF	ON	4 dB
ON	OFF	ON	5 dB
OFF	ON	ON	6 dB
ON	ON	ON	7 dB

SW2-4 SVM Fault Reporting

This switch determines if a fault is reported (on the RS-232 Remote Control port, the system fault output TB13-11, and the SVM fault output) when an SVM has been manually disabled at its front panel. Although disabling a unit is not actually a fault condition, this gives a remote console operator a way to know that someone set the SVM has been set to "DISABLE", thereby removing the site from service.

Table 3-37 SVM Fault Reporting

SW2-4	Setting
OFF	Front panel disable, not reported as Fault
ON	**Front panel disable is reported as Fault ***

SW2-5, and 6 Line Fault Delay Timer

These switches set the duration of the Line Fault timer. These timers apply to all SVMs in the system, to both Hardwire COR and Pilot Tone applications. See Section 5.11 for a complete explanation of the Line Fault Detection feature.

Table 3-38 Line Fault Timer Delay Selection		
SW2-5	**SW2-6**	**Line Fault Delay**
OFF	OFF	Off (No Line Fault)
ON	OFF	5 Seconds
OFF	ON	15 Seconds
ON	**ON**	**30 Seconds ***

SW2-7 STARS

This switch enables the STARS (Smart Transmit And Receive Steering) function. STARS is the SNV-12's automatic TX Steering feature; it allows the transmit site to be chosen based on which receive site was voted best during the last portion of the received transmission. This is not necessarily the site that was voted last. This setting will be overridden if the CIM-2A SW4-6 switch is set to ON. In this case STARS enabled/disabled state will be controlled by the TB13-12 hardware input.

Table 3-39 STARS Selection	
SW2-7	**Setting**
OFF	**STARS Disabled ***
ON	STARS Enabled

SW2-8 Normal/Update

This switch is used to force an update of the software in the Console Interface Module and all Site Voter Modules as well as the CPM-3 CPLD (programmable logic device) program after power up or module insertion. This is not normally needed as, at unit power-up, the CPM-3 checks the revisions of the software in all CIM and SVM modules and downloads software to them if they do not contain the current revision. The program update takes approximately 12 seconds for the CIM and approximately 20 seconds for each SVM. While the CPM is busy loading software it will alternately flash its EXP 1 and EXP 2 LEDs. The CPLD update is indicated by the EXP1 and EXP2 LEDs flashing simultaneously. The CPLD update is done before all other module updates. As with the CIM and SVM module updates, the CPLD update is normally not required because the revision number is evaluated when the system is powered up and an update is done automatically if the revision reported by the CPLD does not match the revision in software.

NOTE: Once the CPM has finished updating the CPLD and all of the modules, this dipswitch must be turned back to off, or the SNV-12 will again update all module software every time the power is cycled.

Table 3-40 Normal/Update Selection

SW2-8	Setting
OFF	**Normal operation ***
ON	CPM will update software at power up

3.12.5.3 CPM Switch SW3 Settings

NOTE- Factory settings are marked *.

SW3-1, 2 Transmit Steering; Holdover Timer

These switches determine the duration of the Holdover Timer. This timer sets the length of time that transmission routing will follow automatic or manual TX steering. When it expires, console and Repeat Mode transmissions revert to the Default TX Site. The "infinite" hold-over timer selection means that console transmissions will never be sent to the default site (except following initial power up – before any site is chosen for TX steering), but will always be set to the TX-steered site until a new site is voted or a different site is selected by the console operator. See Section 5.17 for complete information.

Table 3-41 Holdover Time Selection

SW3-1	SW3-2	Hold-Over Time
OFF	OFF	Infinite
ON	OFF	3 Secs
OFF	**ON**	**10 Secs ***
ON	ON	30 Secs

SW3-3 Voting Lock on COR (COR Lock)

This switch is used to set the SNV-12 to maintain a "lock" on a newly voted site. Some applications require that voting not occur during the reception of a transmission, and this switch supplies that feature. In this mode, starting with all sites squelched, the first-voted site will be locked in. As long as this site retains COR (whether a hard-wired COR input or the absence of pilot tone, it will be the voted site. When the voted and locked site loses COR, the SNV-12 is free to vote again. As soon as another site is voted, it will be locked as long as its COR signal remains active. See Section 5.8.

The minimum time from the onset of COR until the activation of COR Lock can be set by the CPM rotary switch SW4. See Section 3.12.5.4.

Table 3-42 Voting Lock on Active COR	
SW3-3	**Setting**
OFF	**Voting Lock Disabled (Normal Voting) ***
ON	Voting Lock Enabled

SW3-4 Voting Lock on Telemetry Data Detection

This switch is used to set the SNV-12 to maintain a "lock" on the voted site when the presence of **Telemetry Data** is detected. In this mode, as long as the voter continues to see data that conforms to the telemetry data specifications, it will remain locked on the voted site. When the data disappears, the normal voting process is re-established. Presently, only one data format is supported. This feature is supported in all SVM-2s, and in software Rev. 3.38 and earlier for SVM-1s. It is not supported in chassis that contain a mix of SVM-1s and SVM-2s. See Section 5.9 for details.

NOTE: In dual-chassis, Master/Expansion systems, this Voting Lock select switch must be set on each chassis where Voting Lock is desired. Most other switch selections only need to be made on the Master Chassis, and the setting on the Master CPM controls all sites in the system. The Voting Lock feature is individually set on each chassis.

Table 3-43 Voting Lock on Data Selection	
SW3-4	**Setting**
OFF	**Voting NOT locked on DATA***
ON	Voting locked on DATA

SW3-5 Duplex/Simplex Operation

This switch should be set to conform to the system's operational mode- either Duplex or Simplex (Half-Duplex). In a duplex system, transmit and receive frequencies are different. There are also separate paths for TX and RX audio between the SNV-12 and the station. When set to Duplex, the voter can simultaneous vote receive sites and transmit console TX audio.

When set to Simplex, voting is inhibited whenever console PTT is active and for a short time afterwards. The Simplex Mode ensures that receivers do not vote the transmitted console TX audio. See Section 5.21. Use the Simplex mode if the voting system is simplex (TX & RX frequencies are the same) or half-duplex (transceivers connected to the voters TX & RX ports have different TX and RX frequencies, but cannot receive while they are transmitting). Otherwise set to Duplex mode.

Table 3-44 Duplex/Simplex Operation	
SW3-5	**Setting**
OFF	Simplex operation
ON	**Duplex operation ***

SW3-6 Group Lockout with Primary Site Failure

When this feature is enabled, the CPM will fault all sites in an RX group whenever a failure is detected at the RX group's primary site. See Section 5.18.

NOTE: RX groups are set by dip-switches on the SVM modules. Selections are available for groups 1 through 7. If RX group #0 is selected, the SVM is "not associated with an RX group".

Table 3-45 Group Lockout Selection	
SW3-6	**Group Lockout Setting**
OFF	**RX Group Lockout Disabled***
ON	RX Group Lockout Enabled

SW3-7 Repeat Mode

This switch is used to enable Repeat Mode operation. When this feature is enabled, voted audio is both sent to the console and retransmitted to the field. See Sections 5.15 through 5.21 for a full explanation of the various voted audio retransmission modes and operational features available. This setting will be overridden if the CIM-2A SW4-5 switch is set to ON. In this case the Repeat Mode Enabled/Disabled state is controlled by the TB13-17 hardware input.

Table 3-46 Repeat Mode Enable	
SW3-7	**Setting**
OFF	Repeat Mode Disabled
ON	**Repeat Mode Enabled***

SW3-8 Vote Indication Hold After Squelch

When this switch is on, the module selected by the STARS TX steering algorithm will hold its "voted indicators" on after the voting sequence ends and all sites are squelched. This allows an operator to know which site any TX steered transmissions will be routed through. The voted indicators are the module's front panel VOTED light and its terminal block Voted Out output. The voted indicators will remain activated until the Holdover Timer expires or a new site is voted and chosen by STARS. When this feature is not enabled, all voted indicators are de-activated as soon as all sites become squelched. Any manual select input (front panel SELECT switch, rear panel Select In input, or RS-232 TXSEL command) will override the STARS site choice. See Section 4.12 for a full explanation of STARS TX steering and this STARS site indication feature. This feature was put in place prior to the implementation of flashing Front Panel LEDs to indicate TX-selected sites and prior to the implementation of the TX SEL OUT output at SVM terminal block pin 16.

Table 3-47 Vote Indication Hold After Squelch	
SW3-8	**Setting**
OFF	**Disabled ***
ON	Enabled

Note: The Select LED TX indication feature and the rear panel TX Select Output at pin 16 of the SVM terminal block provide an indication of all TX site selection modes and are usually a better way to determine which sites will transmit when the console PTT inputs are activated.

The Vote Indication Hold After Squelch feature is a holdover from the SVM-1 and has little utility with the SVM-2.

3.12.5.4 CPM Switch S4 Settings

NOTE: Factory settings are marked *.

NOTE: The function served by SW4 changes if the COR Lock feature is enabled. A full explanation follows.

S4 Voting Criteria; Transition Timer

S4 determines the time that one site must exhibit a better SNR or noise level than the presently voted site before the SNV-12 will change the voted site. If site "A" is presently voted, site "B" must maintain a better signal than site "A" by the amount set by the CPM switches SW2-1, 2, 3 for the entire duration of the time set by SW4 in order to be voted over site "A". The ideal position for this setting depends on the system requirements for voting speed and smoothness of voting operation. See Section 5.6.

Table 3-48 SW4 As Voting Transition Timer

Position	Delay	Position	Delay	Position	Delay	Position	Delay
0	Do not use	4	200ms	8	400ms	C	2 sec
1	50 ms	**5**	**250ms ***	9	500ms	D	2.5 sec
2	100ms	6	300ms	A	1 sec	E	3 sec
3	150ms	7	350ms	B	1.5 sec	F	5 sec

Position 0 is for testing purposes only.

The Voting Criteria default settings of 1 dB (set by SW2-1, 2, 3) and 250 msec will work well with most systems. Settings below 1 dB or 100 ms are likely to yield unsatisfactory results, as a change in the currently voted site could occur merely due to the random nature of noise, causing the voter to hop from site to site. Higher level and delay settings may be helpful in systems where less frequent voting transitions are desired; that is, in systems were it's preferred that the voter hold a particular site unless another site becomes much better.

S4 Adjustable COR Lock (Voting Lock); Onset Delay Timer

The rotary switch S4 on the CPM-3 module is changed from a "Voting Delay" control to a "Delay before COR Lock" whenever the COR Lock feature is enabled by CPM switch SW3-3. See Sections 3.12.5.3 and 5.8 for further information about COR Lock. Note that the "Voting Delay" adjustment is not needed when the COR LOCK feature is enabled, since the COR lock prevents all voting transitions. (The COR Lock feature is also called "Voting Lock.")

The "standard" delay setting (position 0) means simply that the voter performs its normal voting functions without regard to the SW4 setting. For the other positions, the voter will ensure that the lock does not occur until the set delay elapses. The delay timer starts the moment when the CPM is informed of an unsquelched SVM. The actual time between an unsquelch condition and the onset of the COR Lock may take a longer (but not shorter) period of time than the SW4 setting because of the polling operation of the SNV-12. The CPM communicates with each SVM in turn, so the precise timing depends on a module's order in the polling cycle and the number of SVMs in the system.

Table 3-49 SW4 As COR Lock Onset Delay Timer

Position	Delay	Position	Delay	Position	Delay	Position	Delay
0	Standard	4	175ms	8	275ms	C	450ms
1	100 ms	**5**	**200ms ***	9	300ms	D	500ms
2	125ms	6	225ms	A	350ms	E	550ms
3	150ms	7	250ms	B	400ms	F	600ms

200ms is set as default only because the default purpose of this switch is as Voting Transition Timer

3.12.6 SVM Site Voter Module

The SVM interfaces the SNV-12 with each voting site. The SVM's Digital Signal Processor performs a variety of functions including Signal Quality measurement, pilot tone detection and notching, speech detection, and RX audio delay. The configuration of these functions and others are explained in this section. The figures below give locations of adjustment pots, switches and jumpers for this module. The previous SVM-1 module is shown for reference.

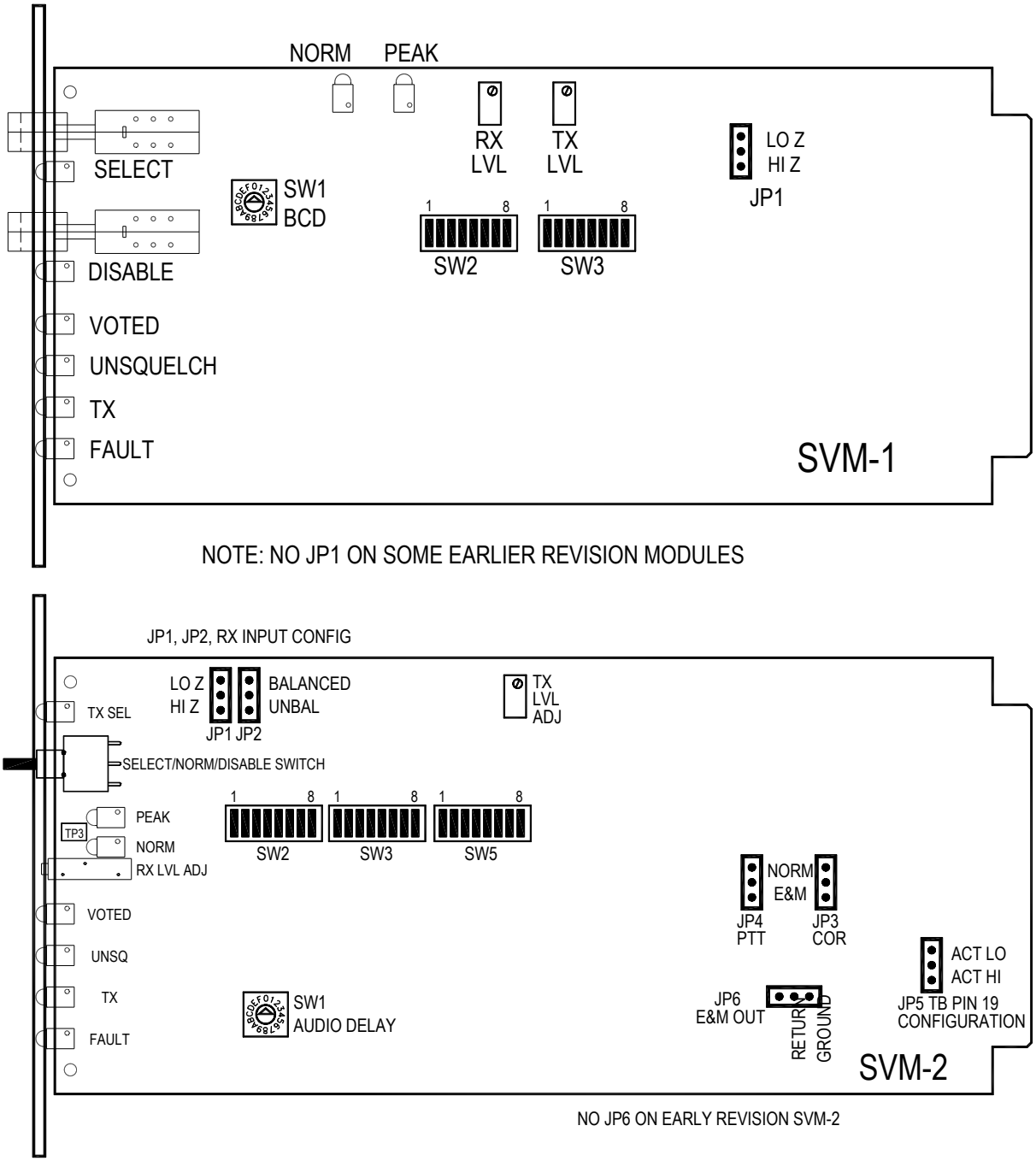

Figure 3-9 SVM Module Internal Adjustments Locations

Table 3-50 Site Voter Module Switch Assignments	
Switch SW1	**RX Audio Delay**
Switch SW2	**Function**
-1	Pilot Tone Frequency
-2	COR Type
-3	COR Type
-4	Guard Tone Enable
-5	COR Threshold -OR- Pin 16 Configuration TX Sel Out or Unsquelched Out
-6	COR Threshold -OR- RX-Only Site Configuration
-7	COR Polarity
-8	High Pass Filter
Switch SW3	**Function**
-1	RX Group
-2	RX Group
-3	RX Group
-4	Primary Site Designation
-5	FM Mode or AM/HF Mode Voting
-6	Simplex Repeat Enable
-7	AGC/Line Equalization
-8	AGC/Line Equalization
Switch SW5	**Function**
-1	Pilot Tone Guided AGC
-2	Pilot Tone Notch Disable
-3	Pin 19 Configuration PTT Inhibit or Unsquelch Inhibit
-4	COR Onset Delay
-5	Pilot Tone Sensitivity Reduction
-6 through -7	RX Audio Output Delay
-8	Reserved for Future Use

Special Notes Regarding SVM Dipswitch Assignments

The switches SW2-5 and SW2-6 set the audio derived COR threshold only if SW2-2 and SW2-3 are both on, configuring the SVM to the Audio Derived COR type. If SW2-2 and SW2-3 set the SVM for either Pilot Tone or Hardwired COR, SW2-5 and SW2-6 instead fill the other function listed in the table.

Switches SW3-7 and SW3-8 are used for AGC link equalization whenever the Pilot Tone AGC feature is enabled (SW5-1). This prevents the use of the Frequency Response Line Equalization feature.

There is no SW5 dipswitch on the SVM-1. SW5 was added with the new SNV-2. Some of the functions of the SW5 can be enabled with the SVM-1 by grounding the assigned rear panel terminal block pin. See SW5 text for details.

Table 3-51 SVM Jumper Settings

Jumper	Function	Pos 1&2	Pos 2&3
JP1	RX Audio Input Impedance	**Low (600 ohms) ***	High (10k ohms)
JP2	RX Audio Input – Balanced/Unbalanced	**Balanced ***	Single-Ended
JP3	COR Input	**Normal (logic level)***	E&M
JP4	PTT Output	**Normal (logic level)***	E&M
JP5	TX Inhibit; Terminal Block Pin 19 Configuration	**Active Low ***	Active High
JP6	E&M Return Configuration	**Internal Ground ***	Connected to Pin 10

Notes:

- Factory default jumper settings marked by *
- SVM-1 has JP1 only
- No JP6 on some early revision SVM-2 Modules. These early units were wired for internal ground.
- Pin #1 indicated by square pad. See Figure 3-9 for pictorial view of jumper settings.

3.12.6.1 SVM Jumper Configuration

The jumpers on the SVM module are listed on Table 3-51 and shown on Figure 3-9.

JP1 RX Audio Input Impedance

The RX Audio input port can be set to either 600 ohms (JP1 on pos 1&2) or 10k ohms (JP1 on pos 2&3).

JP2 RX Audio Input Configuration

The RX Audio input port can be set to either balanced (JP2 on pos 1&2) or unbalanced (JP2 on pos 2&3). The balanced configuration is highly recommended because of the superior noise immunity it provides. However, it can't be used unless the voting receiver and/or linking medium provide a balanced audio output.

JP3 COR Input Configuration

The options are NORM (JP3 on pos 1&2) or E&M (JP3 on pos 2&3). When set to NORM, the SVM expects a logic level signal to indicate the active COR (receiver unsquelched) condition. This logic level signal may be either active low (factory default) or active high, depending on the setting of SVM dipswitch SW2-7. When set to E&M, the SVM expects a negative input lower than –10 VDC to indicate active COR. An inactive COR requires an input of –0.5 VDC or higher. If dipswitch SW2-7 is set to Active Low, a signal below –10 VDC will indicate inactive COR.

Note: The SVM must also be set to the Hardwired COR mode for the E&M input to be used. See directions for SW2-1, 2, 3.

Note: Negative input signals can damage the SVM-2 if JP3 is not set to E&M.

JP4 PTT Output Configuration

The SVM PTT Output signal may be set as either an open-collector transistor that pulls low when PTT is activated (JP4 pos 1&2), or as an E&M output, with a relay contact closure (JP4 pos 2&3). The relay contact closure can either be to an internal ground, or the E&M signal can be looped back out to a rear panel terminal depending on the setting of JP6.

JP5 Pin 19 Configuration

JP5 determines whether the input terminal at Pin 19 is active low (JP5 pos 1&2) or active high (JP5 pos 2&3). Note that the function of Pin 19 is set by dipswitch SW5-3 and may be either TX Inhibit or Unsquelch Inhibit.

JP6 E&M Output Configuration

If JP6 is set to Ground (pos 1&2), the PTT output/E&M relay output pin 18 is internally grounded when the SVM is in the TX mode. When set to Return (pos 2&3), the signal is looped back to terminal block pin 10 whenever the SVM is in the TX mode.

3.12.6.2 SVM Switch SW1, Receive Site Audio Delay

NOTE- Factory settings are marked *.

SW1 is a BCD rotary switch used to set the desired amount of RX audio delay through the Site Voter Module. The amount of delay is adjustable from 0 to 450 milliseconds in 30 msec steps. See Section 5.7 for more details.

Table 3-52 Audio Delay Setting

Position	Delay	Position	Delay	Position	Delay	Position	Delay
0	**0ms***	4	120ms	8	240ms	C	360ms
1	30ms	5	150ms	9	270ms	D	390ms
2	60ms	6	180ms	A	300ms	E	420ms
3	90ms	7	210ms	B	330ms	F	450ms

3.12.6.3 SVM Switch SW2 Settings

NOTE- Factory settings are marked *.

SW2-1 Pilot Tone/Guard Tone Selection

When pilot tones are used in the system, the SVM may be configured for tones at either 1950 or 2175 Hz by SW2-1. If a guard tone is used, it will always be the frequency that is not used for pilot tones. This allows guard tones and pilot tones to be used simultaneously. See Sections 5.10 through 5.12.

Table 3-53 Pilot Tone/Guard Tone Selection

SW2-1	Pilot Tone Frequency	Guard Tone Frequency
OFF	2175 Hz	1950 Hz
ON	**1950 Hz ***	**2175 Hz ***

SW2-2, 3 COR Type

The type of COR (voting receiver unsquelched condition indication) selection in use by each SVM and its associated receiver is set by SW2-2 and SW2-3. See also Sections 5.10 and 5.11.

Table 3-54 COR Type Selection		
SW2-2	**SW2-3**	**COR Type**
OFF	OFF	None - Unsquelched receivers, COR always active
ON	OFF	Hardwired COR input
OFF	**ON**	**Pilot Tones used ***
ON	ON	Audio Level COR - use with squelched receivers

SW2-4 Guard Tones

When SW2-4 is ON the guard tone feature is enabled. The guard tone frequency used will be whichever tone is not selected as the pilot tone by SW2-1. For example, if the pilot tone is set to 1950 Hz, the guard tone is automatically set to 2175 Hz. When this feature is enabled and after guard tone has been acquired, failure of the SVM to detect the guard tone will result in that module being immediately removed from eligibility for voting until the guard tone is again acquired. The SVM FAULT LED will also be lit. The guard tone is considered acquired when it has been detected for two seconds without interruption. Compare this with the Line Fault function, wherein the voter can't immediately drop out a failed a site because it is relying on the absence of speech to indicate that the site has failed. For further information, see Section 5.12.

Table 3.39 Guard Tones Selection	
SW2-4	**Guard Tones**
OFF	**Disabled***
ON	Enabled

SW2-5, 6

NOTE: These two switch settings have different functionality depending on the COR type selection made by SW2-2, 3.

SW2-5, 6 When COR Type Selection Is "Hardwired" Or "Pilot Tone:"

SW2-5 Pin 16 Configuration – Unsquelched Output or TX Selected Site Output

Each SVM-2 can be set to use its terminal block pin 16 as either an indication that the SVM has detected an active COR (is unsquelched) or to indicate that the site is selected for console transmissions if the Console TX PTT input is activated.

Table 3-55 TB1-TB12, Pin 16 Configuration

SW2-5	Pin 16 Function
OFF	Unsquelched Indication
ON	**TX Selected Site Indication ***

SW2-6 RX-Only Site Designation

Each SVM-2 can be set as an RX-only site. If so designated, the site will not be eligible to transmit; its TX Select LED will not be lit and its TX outputs will not be enabled.

Table 3-56 Site Designation

SW2-6	RX-Only or RX & TX
OFF	RX-Only Site
ON	**RX & TX***

SW2-5, 6 When COR Type Selection Is "Audio Level COR:"

SW2-5, 6 Audio Level COR Threshold

The SNV-12 Site Voter Module can be set to generate its own internal COR based on the input receiver audio level. (See Section 5.10 and SW2-2, 3 COR Type above.) This feature is not for installations where either a hardwired COR line or a pilot tone is available; both provide a more reliable unsquelched condition indication.

When there is a detectable increase in noise in the receive audio between the squelched and unsquelched condition, the SVM can detect this noise and indicate that the receiver is unsquelched (COR active). First make sure the SVM's receive audio level potentiometer is correctly adjusted, as any change to this level will modify the Audio-Level COR Threshold setting. Then set the threshold via dipswitches SW2-5 and SW2-6 so that the SVM's UNSQ LED is off when the receiver is squelched, and on when it is unsquelched. Use the lowest threshold setting that will accomplish this. Minor adjustments to the RX LEVEL pot can be made if the correct threshold is right at the edge of one of the switch settings.

When there is not a sufficient increase in noise between the squelched and unsquelched receiver audio to operate as described above (usually due to a noisy line), the SVM can instead indicate an unsquelched condition when it detects actual speech in the receiver audio. Set the thresholds so that the UNSQ LED lights whenever there is speech in the received signal, but it's out when no speech is present.

For best performance the threshold should always be set to the lowest value that does not cause false unsquelched indication.

Table 3-57 COR Threshold Selection

SW2-5	SW2-6	Audio Level COR Threshold
OFF	OFF	Highest Threshold (lowest sensitivity)
ON	OFF	Medium-High
OFF	ON	Medium-Low
ON	**ON**	**Lowest Threshold (highest sensitivity) ***

NOTE: Audio Level COR should never be used in conjunction with Repeat Mode. When Repeat Mode is selected, every time a site is voted, the associated transmitter is keyed and retransmits the voted audio. When Audio Level COR is selected, any type of noise burst or momentary static on the receive audio lines to the voter will cause the associated SVM to unsquelch and voting will occur. This will create an unwanted transmission when in Repeat Mode. Since the threshold for detection of COR is the low level of broadband noise present when the receiver unsquelches, low-level noise or static will cause the voter to unsquelch and vote. This is not normally objectionable in non-Repeat Mode. However, the inadvertent keying of the transmitter that can result if Repeat Mode is used with this COR type usually requires that pilot tone generators be added.

SW2-7 COR Polarity

This switch allows the use of a non-standard "Active High" COR input**.**

NOTE: If an active high COR polarity is selected, but no connection is made to the SVM COR input, the SNV-12 will assume that COR is active. This is due to a pull-up resistor in the SVM module's COR Input circuit. This can result in the site (since it has no noise at its input) being voted.

Table 3-58 COR Polarity	
SW2-7	**COR Polarity**
OFF	**Active Low ***
ON	Active High

SW2-8 Low Frequency Response

The SVM DSP circuitry has a high pass filter that is designed to remove low frequency energy (such as 60 Hz ac hum) from the audio passband. The high pass filter should be engaged for normal operation as only the audio above 300 Hz is used in most communications systems. This should be disabled only if it is necessary to pass low frequency information such as sub audible data, CTCSS, DCS, etc. If the filter is disabled, careful shielding, equipment grounding and site grounding are of increased importance. Set SW2-8 On to remove this high-pass filter, extending the pass band from a 100 Hz cutoff to below 50 Hz. The default settings leave the filter in place.

Table 3-59 SVM High-Pass Filter	
SW2-8	**High-Pass Filter**
OFF	**Engaged ***
ON	Removed

3.12.6.4 SVM Switch SW3 Settings

NOTE- Factory settings are marked *.

SW3-1, 2, and 3 Receiver Groups

Each SNV-12 Site Voter Module can be set up to be associated with a receiver group. An SNV-12 can have up to 7 RX groups. A "Group 0" designation means the site is not part of any group. See Sections 5.13 through 5.20 for a complete discussion of RX groups and the various ways that they can be used.

Note- When the CIM module is set for Function Tone Guided Transmitter Steering (SW2-1, 2, 3), these switches select sets of SVMs that are keyed by each function tone, rather than the normal definition of RX Groups.

Table 3-60 RX Group Selection

SW3-1	SW3-2	SW3-3	Group
OFF	**OFF**	**OFF**	**Not a member of any RX group.***
ON	OFF	OFF	RX Group #1.
OFF	ON	OFF	RX Group #2.
ON	ON	OFF	RX Group #3.
OFF	OFF	ON	RX Group #4.
ON	OFF	ON	RX Group #5.
OFF	ON	ON	RX Group #6.
ON	ON	ON	RX Group #7.

SW3-1, 2, and 3 Function Tone Guided TX Steering Groups

The Function Tone Guided TX Steering feature allows console transmissions to be steered to a specific SVM or group of SVMs, based on:

- The function tone that precedes the console TX audio
- The group setting of each SVM

To enable this feature other settings must be made (besides the group setting switches described here). CIM module dipswitches must be set- CIM SW2-6 On (to enable function tone detection at the Console TX Audio Input), and CIM SW2-1 Off, SW2-2 On, and SW2-3 On (to enable the Function Tone Guided TX Steering function). See Section 5.20.

When the Function Tone Guided TX Steering Feature is enabled, the standard RX Group operation is disallowed. See Section 5.18.

Table 3-61 Function Tone Guided TX Steering Selection			
SW3-1	**SW3-2**	**SW3-3**	**Function Tone**
OFF	**OFF**	**OFF**	**Not Keyed by Any Function Tone ***
ON	OFF	OFF	Group 1 -1950 Hz
OFF	ON	OFF	Group 2 -1850 Hz.
ON	ON	OFF	Group 3 -1350 Hz.
OFF	OFF	ON	Group 4 -1250 Hz.
ON	OFF	ON	Group 5 -1150 Hz.
OFF	ON	ON	Group 6 -1050 Hz.
ON	ON	ON	Group 7 - 950 Hz.

SW3-4 Primary Site Designation

When RX group operation is used, one site can be designated as the primary site for the group. Audio routing varies depending on primary site selections. See Sections 5.13 through 5.18. If more than one site is designated by SW3-4 as the group's primary site, audio will be routed to all designated primary sites in the group. This designation relates only to standard RX group operation as described in Section 5.18. When the Function Tone Guided TX Steering feature is enabled, standard RX group operation is disallowed and this switch has no purpose.

Table 3-62 Primary Site	
SW3-4	**Primary Site Designation**
OFF	**Not a Primary Site ***
ON	Primary Site

SW3-5 Voting Mode: FM mode or AM/HF mode

Turn this switch on to set the SVM to use an SNR measurement as the basis for voting, rather than use the default noise-only voting mode. Use SNR voting mode for AM or HF systems. Use noise-only voting for FM systems, and for other voting systems using signaling tones (other than pilot tones) below 2200 Hz.

NOTE: If any SVM uses the AM/HF voting mode, all other SVMs must also be set to AM/HF mode or improper voting will result.

Table 3-63 SW3-5 Voting Mode

SW3-5	Voting Mode Selection
OFF	**FM mode ***
ON	AM/HF mode

SW3-6 Simplex Repeat To Currently Voted Site

When in the Simplex Mode and the Repeat Mode, the SNV-12 normally will not send repeat audio and keying commands to the voted site. This prevents the keying of a simplex transceiver at the voted site, as keying would take the unit out of its RX mode, making it ineligible for voting and setting up a feedback loop of voting, keying, un-voting, unkeying, voting, etc. Some Simplex installations with separate transmitters and receivers or repeaters require that the voted site receive repeat audio and keying signals. In these installations, Simplex Repeat When Voted can be enabled on a site-by-site basis by turning SW3-6 On.

Table 3-64 Simplex Repeat When Voted

SW3-6	Repeat of Voted Site
OFF	**Disabled ***
ON	Enabled

SW3-7, 8 Line Equalization

These switches may be used to compensate for frequency response differences between different sites. The SNV-12 votes based on the Signal Quality (high frequency noise measured) or SNR of received audio for the FM and AM/HF modes, respectively. Noise is measured above 2200 Hz, where relatively less speech energy is present. The Signal is measured from 300 to 800 Hz where a large percentage of speech is present. Pilot tones are used between 1900 and 2200 Hz. The frequencies between 800 and 1900 Hz, which contain varying amounts of both speech and noise energy, are excluded from the calculation.

Leased lines, particularly long ones, can act as Low Pass Filters, rolling off the frequency response in such a way that the Noise Measurement is reduced relative to the Signal Measurement. Equalization may be helpful for a site that uses a much longer line than the others, or in particular, when a combination of leased-line and microwave-linked sites are used. Microwave links may have better frequency response in the 2200 to 3000 Hz audio pass band than leased lines and less LPF effect, so more of the high-frequency noise reaches the SVM module to become part of the noise measurement. If a transmitter is picked up by a group of receivers that send the audio back to the SNV-12 by a mixture of these two methods, both microwave and actual wires, there may be a bias created in favor of voting the leased line sites (due to the lower amount of noise that reaches the SNV-12 from these receivers). The leased line site may have noticeably inferior audio quality but is still consistently voted due to its smaller total high frequency noise content (caused by the frequency response differences).

Equalization is likely to be required for installations that mix leased line and microwave links unless conditioning is added to the leased lines. We recommend that when leased line and microwave and/or RF links are used that the leased line circuits have C2 conditioning specified. This may eliminate the need for using the SVM equalization feature and will also ensure not only that the voting process functions properly, but also ensure the audio characteristics of all sites are more equal. See Section 3.10 for more information.

If C2 conditioning is either impossible or insufficient, an SVM module's DSP software can be used to modify the SNR measurement to account for the different frequency responses. SVM switches SW3-7 and SW3-8 add a multiplier to the noise portion of the SNR measurement. Three multiplier steps are available. Using the line equalization on an SVM biases the voting calculation against that SVM. It essentially restores the noise that was lost because of the roll-off in the frequency response. A higher setting pulls in a higher noise multiplier. (This effects only the Signal Quality calculation that takes place in the DSP and has no effect on actual voted audio quality).

If equalization is required, the best way to determine the correct setting is to key a transmitter that will provide a strong signal both to a site that requires equalization and a site that does not. The site requiring equalization is the site that is being voted but has poorer audio quality. The other site for the setup test is one that has the better sounding audio but is not being voted. (If necessary, use the SVM's front panel switch to disable other sites.) Start with the lowest equalization setting, and increase the setting until the non-equalized site is voted instead. The correct setting is either this setting or the next lower setting (the perfect equalization lies between the two settings). Remember to power the unit off and back on when changing the switch settings as the internal processors read the dipswitches only at power-up.

Equalization is likely to be required for installations that mix leased line and microwave links. In this case, the frequency response of either the leased line or one of the receivers may be the cause. It may also be useful to try the lower levels of equalization for leased line only installations where a site with poorer audio quality is being voted over a better-sounding site that is also unsquelched. The module SELECT and DISABLE selection on the SVM's front panel can be used to force vote individual sites for monitoring via the CIM's speaker for comparison purposes.

Table 3-65 Line Equalization

SW3-7	SW3-8	Equalization Level
OFF	**OFF**	**No Equalization***
ON	OFF	Minimal
OFF	ON	Medium
ON	ON	Highest

3.12.6.5 SVM-2 Switch SW5 Settings

Note: There is no SW5 on the SVM-1 module. It was added when the SVM-2 Module was designed. Some of the SW5 features are available on the SVM-1 by shorting rear panel terminals to ground. This is explained in the following sections.

NOTE- Factory settings are marked *.

SW5-1 Pilot Tone Regulated AGC

Each SVM can be set to run a DSP AGC algorithm to automatically adjust the levels of RX audio receptions. This AGC is intended to compensate for level changes in the link between each remote receiver site and the SNV-12. It is not intended to compensate the different volume levels of different system users. The AGC tracks the level of the pilot tone input; if it changes, the SVM's internal DSP gain is changed to compensate. This feature uses changes in the incoming pilot tone level as an indication of changes in the overall incoming RX signal level, which may result, for example, from gain changes in a microwave link. The AGC gain setting varies only when pilot tone is present and "freezes" when the pilot tone disappears. Thus, the gain applied to each individual transmission from a system user depends on the level of the pilot tone that preceded it at the SVM's RX audio input.

Table 3-66 Pilot Tone AGC

SW5-1	AGC Feature
OFF	**Disabled ***
ON	Enabled

In order for the AGC system to produce the correct receiver audio level in the SVM, the pilot tone must arrive at the SVM input in a known relationship to the receiver audio level (per the set-up procedure that follows), and this relationship must remain constant over time. For example, the AGC will perform well if the transmission medium between the receiver site and the SVM has a constant frequency response characteristic, such as is found in a microwave system. However, the AGC will not perform well if the transmission medium is a telephone line whose high frequency response varies over time. The AGC would then track these high frequency response changes even if the voice levels have not changed (since the pilot tone that regulates the AGC is at a higher frequency).

If the frequency response at the pilot tone frequency changes, the AGC will produce a gain error in the program audio. The system performance under these conditions will be much better if the Pilot Tone Regulated AGC feature is not used.

The DSP AGC algorithm was designed such that the pilot tone amplitude is expected to be equal to the amplitude of an average voice signal. Both should produce the same level at the receiver output as would an RF signal of sufficient strength to fully quiet the receiver, carrying a 1 kHz tone at 3 kHz deviation (or 1.5 kHz for narrowband). See the SVM audio input setting instructions in the next section of this manual and the AGC setup procedure below.

AGC and Pilot Tone Notch Filter

When the Pilot Tone Regulated AGC feature is enabled, the DSP pilot tone notch filter is not functional. This means that the pilot tone will be heard momentarily at the end of each voting sequence.

AGC Setup Procedure

The Line AGC level switches on each SVM are used to set a reference level for the pilot tone. If the Pilot tone varies in level from this reference point, the AGC circuit will compensate for changes within its limits (6dB of compression, and 12dB of gain). The following adjustment procedure is recommended. It describes how to set the pilot tone to the correct relationship to voice audio signals at the receiver output.

Ideally, the link between the remote receiver and the SNV-12 has a flat frequency response from 300 to 3k Hz. If the pilot tone and the received speech (simulated by a 1 kHz test tone) leave the receiver at the same level, high-frequency roll-off can cause the pilot tone to be at a relatively lower level when measured at the SVM audio input pins. The voter can compensate for some high frequency roll-off or other non-linear frequency response characteristic.

The procedure tells how to determine the link between the receiver and the voter is non-linear, and how to compensate if it is.

1. At the receiver site, connect a service monitor to the receiver's antenna port. On the receiver's frequency, generate a 1kHz tone at full deviation (FM; 3kHz normal, 2.4kHz NPSPAC. AM; 100% modulation). Apply enough signal strength to fully quiet the receiver, typically 12 dB. The 1kHz tone is used to simulate average voice (Test Tone).
2. Now bridge a transmission test set to the receiver's output audio pair. Set the receiver's "Line Out" adjustment to an appropriate system level for the transmission medium connection to the voter. If possible, set the receive output levels to 0dBm, -3dBm, -6dBm or -9dBm (these correspond to the center of one of the AGC ranges). Squelch the receiver and set the pilot tone output to as close as possible to the received 1 kHz tone. Write down these levels for comparisons in step 4.
3. At the voter, with the test tone still being generated at the receiver, verify the test tone level at the RX input (pins 1&2) of the corresponding terminal block, for the SVM being set up is the correct level for transmission medium connection. Write down the level for comparison in step 4. Set the SVM's RX audio level pot (R45) so that the 1kHz tone just lights the NORM LED (Yellow). Verify this adjustment by connecting a transmission test set between test point 3 (TP3) and ground. The SVM-2 should be measure for 5dBm and the SVM-1 should measure 0dBm.
4. Squelch the receiver so that pilot tone is produced. Note the pilot tone level as measured at the appropriate SVM RX input. If the transmission medium has a flat frequency response, the pilot tone and test tone measurements at the SVM will both vary by the same amount from their levels measured at the receiver. Note the difference between how much the pilot tone level changes as compared to the test tone level.

For example, if the RX level at the receiver is -10 dBm and the pilot tone is -13 dBm, and at the voter they measure -9 and -14 respectively, the relative pilot tone level is -2 dBm.

If the relative pilot tone level is above +1.5 dBm, not enough compensation is possible at the SVM; the pilot tone level must be reduced at the receiver site. If the pilot tone level is below -10.5 dBm, not enough compensation is possible at the SVM; the pilot tone level must be increased at the receiver site. (When adjusting levels, try to set the output at the receiver so the relative level will correspond to the center of one of the AGC ranges at the voter.) If it reads between +1.5 dBm and –10.5 dBm, set the equalization switches on the SVM as follows:

Table 3-67 AGC Link Equalization

Relative Pilot Tone Level	SW3-7	SW3-8	AGC Equalization Level
+1.5 to -1.5 dBm	**OFF**	**OFF**	**None- No Equalization**
-1.5 to -4.5 dBm	ON	OFF	Minimal
-4.5 to -7.5 dBm	OFF	ON	Medium
-7.5 to -10.5 dBm	ON	ON	Highest

Note: When Pilot Tone AGC is enabled, the normal Line Equalization feature also controlled by SW3-7 and SW3-8 is not available. However, the action of the AGC link equalization has a similar effect on the overall voting process.

Overall AGC Limits

The maximum AGC limits are 6 dBm of compression and 12 dBm of gain relative to the NORM voice setting. If the pilot tone amplitude is higher than +6 dB over the NORM threshold, a maximum of 6 dBm of compression will be applied. If the pilot tone is lower than 12 dBm relative to the NORM threshold, a maximum of 12 dBm of gain will be applied.

SW5-2 Pilot Tone Notch Filter Disable

It may be important in some special cases that there are no notch filters present in the normal RX audio passband. One instance is when encrypted audio is being voted, and part of this audio has been moved to the same part of the spectrum where the pilot tones reside*****. Each SVM can be individually set to run its pilot tone notch filter only when a pilot tone is detected in its RX audio input. (Note: Pilot tone notch filters are normally enabled only if an SVM is set to Pilot Tone COR, and only at the specified pilot tone frequency.)

When the filter is disabled, the SVM does not run its DSP notch filter algorithm even when set for Pilot Tone COR. The SVM cannot squelch until it detects a pilot tone, and some time is required to detect this tone, so it will be momentarily present in the voted audio output (and, when Repeat Mode is used, in the retransmitted voted audio). This momentary bit of pilot tone will be heard at the end of each voting sequence. As soon as the pilot tone is detected in all sites, the voting sequence is ended and the voted audio output is muted.

(***Note** that for the encrypted audio example given above: the SVM measures noise from 2300 to 3k Hz. The SVM expects that there is mostly noise only at these frequencies, with most speech components from 300 to 800 Hz. If the encryption mode inserts speech energy into the 2300 to 3k Hz range, the voting algorithm may be affected. If poor voting performance is noticed, it may be helpful to use COR Lock. In this mode, the voter makes a quick initial vote and holds it until all sites squelch. This initial vote usually occurs before speech is present in the RX input.)

Table 3-68 Pilot Tone Notch Filter	
SW5-2	**Pilot Tone Notch Filter**
OFF	**Enabled ***
ON	Disabled (no notch)

Note: To Disable with the SVM-1 Module, strap terminal block pin 10 to a ground pin for each SVM-1 that will use this feature. For SVM-2 modules, this rear panel terminal serves a different function so the dipswitch must be used.

SW5-3 Term Block Pin 19 Configuration – Unsquelch Inhibit

This switch enables an extra feature at the Rear Panel Terminal Block (TB1-12) Pin 19. Normally this pin provides a TX Inhibit input, which disables the TX outputs (TX audio and PTT signals) whenever it is pulled low. This is the only functionality that this pin has for the SVM-1. When SW5-3 is switched to on, for SVM-2 modules, pin 19 is configured as an Unsquelch Inhibit Input. This means that, whenever pin 19 is pulled low, the associated SVM will not declare itself unsquelched for any reason and therefore it will not become eligible for voting, line fault, etc.

Table 3-69 Pin 19 Configuration	
SW5-3	**Term Block Pin 19 Input**
OFF	**Transmit Inhibit ***
ON	Unsquelch Inhibit

SW5-4 COR Delayed with Receive Audio

When RX audio delay is added using an SVM's rotary switch SW1, the COR (unsquelched) indication can either be reported immediately or delayed along with the RX audio.

When not delayed, the audio delay is used to compensate for other system delays so that the site is voted and repeaters keyed, etc., before the audio is passed through the system.

By turning on dipswitch SW5-4, the reporting of active COR following its detection is delayed by the same amount as the RX audio. This can be useful when the voter is used to select from among signals arriving from very different media. For example if most sites are linked by microwave, but one site is linked via satellite, it's easier to ensure proper voting if the positive COR (unsquelched condition) is delayed along with the audio.

The ability to delay COR is not available with SVM-1 modules. See Section 5.7 for more information.

Table 3-70 COR Delayed with Rx Audio	
SW5-4	**COR Delay**
OFF	**COR Not Delayed ***
ON	COR Delayed

SW5-5 Pilot Tone Sensitivity Reduction

This switch allows the pilot tone sensitivity to be reduced by approx 7 dB. This may assist operation in environments where local environmental noise (or added noise, such as alternator whine) at the same frequency as the pilot tone sometimes causes falsing of the pilot tone detector. Falsing means that the RX audio at the pilot tone frequency causes the SVM to incorrectly determine (usually momentarily) that an SVM is squelched. If this feature is enabled, it's important that the pilot tone be generated at a high level (preferably at the same level as voice audio).

The Pilot Tone Sensitivity Reduction Feature is not available with SVM-1 modules.

Table 3-71 Pilot Tone Sensitivity Reduction	
SW5-5	**Pilot Tone Sensitivity**
OFF	**Not Reduced ***
ON	Reduced by approx 7 dB

SW5- 6, 7 – RX Output Audio Delay

These switches are used to configure a delay on the output audio from the SVM-2 to the voted audio bus. Essentially, this buffers the audio in the SVM-2 before it is output to the voted audio bus. This is useful, for example, when MDC telegrams are used at the beginning of a field transmission. In this case the time to detect receiver COR and perform the initial vote on the audio might be long enough that the initial portion of the MDC might be cut off. The RX output audio delay can be used to buffer the audio to give the system time to vote before the MDC telegram is received. This delay is independent of the RX site audio delay controlled by SW1.

NOTE: It is preferable to compensate for MDC telegrams arriving too close to the start of transmission by modifying the radio system to increase the "front porch" time for the transmissions. The RX output Audio Delay function is meant as a secondary option for the case when modifying the radio system is not possible.

NOTE: To properly configure the SNV-12 the RX Output Audio Delay should first be set to disabled. Next, the RX Site Audio Delay (SW1) should be used to compensate for line delays between the receiver and the SVM modules. Once the RX Site Audio Delay is set properly (so that audio is synchronized across all sites), the RX Output Audio Delay can be applied equally to all SVM-2 Modules to compensate for initial vote time. It is important that this delay is equal across all SVM modules to maintain audio synchronization.

Table 3-72 RX Output Audio Delay

SW5-6,7	RX Output Audio Delay
00	**Disabled ***
01	100ms
10	200ms
11	400ms

SW5-8 – Spare Switch

Reserved for future use.

NOTE: This switch must remain in the Off position for normal SNV-12 operation.

Table 3-73 Spare Switch

SW5-8	Spare
OFF	**Disabled ***
ON	Enabled

3.12.6.6 SVM Audio Level Settings

As shipped from the factory, the RX and TX levels for each SVM are set to -10 dBm. If level requirements differ, both the RX (input) level and TX (output for transmit audio) may be adjusted using the RX and TX level controls on the SVM PC board.

To check a module for correct audio levels, monitor the SVM's PEAK and NORM LEDs while a typical speech reception is coming in from the associated receiver. Press the module's SELECT pushbutton to force-vote the site so you can listen on the SNV-12 speaker. When the RX level control is adjusted properly, the NORM LED on the SVM will be lit on normal audio levels. The PEAK led should only come on during the highest audio peaks. If the NORM LED never lights, or if the PEAK LED lights frequently, then the audio level into the SVM is not correct and the RX level potentiometer should be adjusted.

It is important the audio levels be correctly adjusted, as they will affect the operation of the DSP algorithms for both voting and line fault detection.

There are three ways to set the input level to the SVM:

Method 1, the preferred method:

- Connect a service monitor to a receiver's antenna port. On the receiver's frequency, generate a 1kHz tone at full deviation (FM; 3kHz normal, 2.4kHz NPSPAC. AM; 100% modulation). Apply enough signal strength to fully quiet the receiver, typically 12 dB. The 1kHz tone is used to simulate average voice (Test Tone).
- Now connect a transmission test set to the receiver's output audio pair. Set the receiver's "Line Out" pot to the appropriate system level (normally -10dBm) for the linking medium to the voter (microwave link, etc.). Squelch the receiver and set the pilot tone output level for the appropriate level (typically same as average voice) and verify the pilot tone frequency.
- With the service monitor still producing a 1kHz signal at the receive site, verify the audio level measured at the SNV-12's terminal block (pins 2 & 1), for the site under setup, is between -30 and +10dBm.

- Set the SVM's receive audio level pot (R45) so that the average voice (1kHz tone) just lights the NORM LED (Yellow). Verify this adjustment by connecting a transmission test set to test points 3 (TP3) and ground. The SVM-2 should be set for 5dBm and the SVM-1 should be set for 0dBm.
- Now with a transmitter connected to the SVM, through the terminal block (pin 5&4), connect a transmission test set to TP1 and ground on the SVM under test. Adjust the transmit level pot (R62) to the appropriate system level (typically -10dBm) for average voice. (Note; repeat mode must be enable for this setting) ***When using EIA keying tones to key a transmitter, the function tone and the average voice levels are the same levels out of the voter. Both are set by R62.***
- Repeat setup for remaining receiver sites. Each SVM-1 or SVM-2 can be set to the same level at TP3 as measured on the initial SVM.

Method 2.

- Connect an AC Voltmeter between TP3 and ground (TP4).
- Remove the antenna from the receiver and open its squelch so that broadband noise is received at the SVM.
- Adjust the SVM audio level control R45 so that the AC Voltmeter reads +2 dBm (SVM-2) or -3 dBm (SVM-1). When properly adjusted on open squelch noise, the NORM indicator will be on solid and the PEAK indicator will be on most of the time. These indicators are peak-responding and cannot be used to accurately set the level using open squelch noise.

Method 3.

- Simply set R45 so that the NORM indicator flashes much of the time and the PEAK indicator flashes occasionally on normal voice audio. (As discussed above in method 1.)

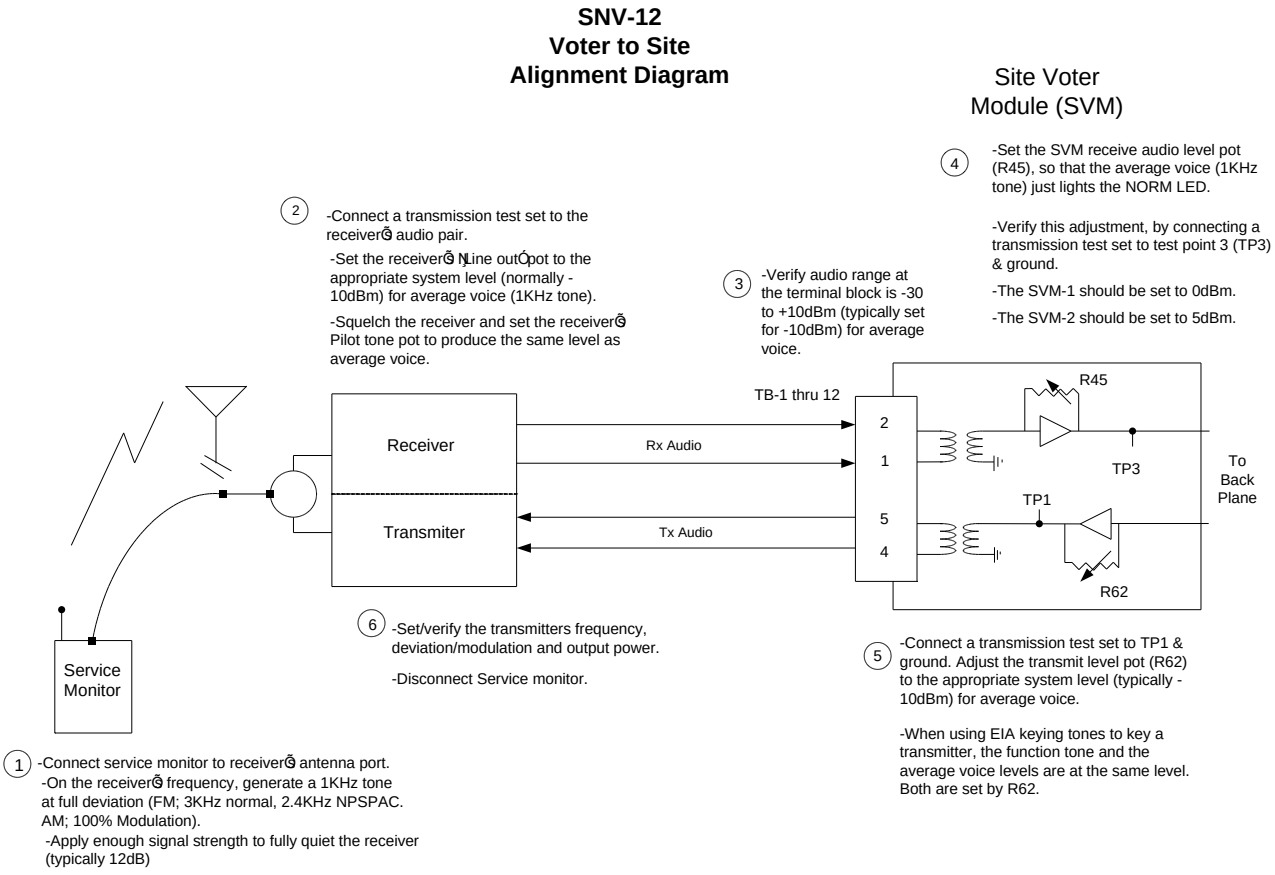

Figure 3-10 Alignment Setup

3.12.7 Expanded Voter System Alignment

In an expanded voter system consisting of more than one chassis, the following audio alignment procedure should be followed. This procedure sets both TX & RX levels. See Figure 3-4 and Figure 3-5 for expansion cable diagram drawings.

For a dual-chassis system, start with the Expansion Chassis. For a three-chassis system, start with the Expansion 2 chassis; this is the chassis furthest from the Master Chassis and has slots for SVMs #25 through #36.

1. Connect a service monitor to a receiver's antenna port. On the receiver's frequency, generate a 1kHz tone at full deviation (FM; 3kHz normal, 2.4kHz NPSPAC. AM; 100% modulation). Apply enough signal strength to fully quiet the receiver, typically 12 dB. The 1kHz tone is used to simulate average voice (Test Tone).
2. Now connect a transmission test set to the receiver's output audio pair. Set the receiver's "Line Out" adjustment to the appropriate system level (normally -10dBm) for the medium linking the receiver to the voter. Squelch the receiver and set its pilot tone level for the appropriate level (typically same as average voice) and verify the pilot tone frequency.
3. With the service monitor still producing a 1kHz signal at the receive site, verify the audio level measured at the associated SNV-12 terminal block (pins 2 & 1). It must measure between -30 to +10dBm.
4. Set the SVM's receive audio input potentiometer (R45) so that the 1kHz average voice test tone just lights the NORM LED (Yellow). Verify this adjustment by connecting a transmission test set to SVM test point 3 (TP3) and ground. The SVM-2 should be set for +5dBm and the SVM-1 should be set for 0dBm.
5. Use the SVM front panel switch to Select (force vote) the site being set up (note that a site must be unsquelched before it can be force-voted). Now place that chassis' CIM module on an extender card. Use a transmission test set to measure between TP1 and ground of the CIM and adjust R67 for 0dBm. This sets the proper level of the Voted Audio output to the next higher chassis (that is EXP 2 to EXP 1 or EXP 1 to the Master Chassis.
6. If there is only one expansion chassis skip this step, if two are in use, place the CIM module for expansion chassis 1 on an extender card. Monitor its TP1-to-ground voltage with a transmission test set and adjust its R67 for 0dBm.
7. Now place the CIM module of the Master SNV-12 Chassis on an extender card. Connect a transmission test set between its TP1 and ground and adjust the Master CIM Voted Output pot (R67) to the appropriate system level for average voice to the console (typically -10dBm)
8. If the voter will not transmit console audio, make sure that the Master Chassis is in Repeat Mode (CPM SW3-7 ON); steps 9-12 may be skipped.
9. On the CIM modules for each Expansion Chassis change jumper JP2 to 1-2. This sets them to input single-ended (unbalanced) TX audio from the next chassis in the system (that is, into the Expansion 1 chassis from the Master chassis, or into Expansion 2 from Expansion 1).

10. Using a tone box, generate a 1kHz tone into the console's microphone, at a level that will produce a 100% modulation. (Some consoles produce a test tone that can be used during alignment) The 1kHz tone is used to simulate average voice (Test Tone).
11. Continue to generate the test tone and set the console's output pot to the appropriate system level (normally -10dBm) for the connection medium linking the console to the voter.
12. Continue to generate the test tone and adjust the CIM Console TX Audio Input pot (R50) so that the Norm LED just lights. Verify this adjustment by connecting a transmission test set between CIM test point 3 (TP3) and ground. Verify a level of approximately 0dBM for the CIM-1 and CIM-2 modules.
13. Continue to generate the test tone at the console and adjust R50 on the CIM module in Expansion Chassis 1 until 0dBm is measured between TP3 and ground.
14. If there is only one Expansion Chassis, skip to Step 15. Otherwise adjust R50 on the CIM module of Expansion Chassis 2 until 0dBm is measured between TP3 and ground.
15. Now adjust the transmit levels for all system SVMs connected to transmitters through the SVM terminal block pins 5&4. Connect a transmission test set to TP1 and ground on the SVM under test. Adjust the SVM transmit level pot (R62) to the appropriate system level for average voice (typically -10dBm).

    When using EIA keying tones to key a transmitter, the function tone and the average voice levels are the same levels out of the voter. R62 adjusts the EIA tone/voice audio combination. Remember that the High Guard Tone is 10dB above the function tone and average voice levels. Be sure there is enough headroom to support this level.
16. Now repeat steps 1-4 for the remaining receiver sites. Each SVM can be set to the identical TP3 level at each SVM.
17. Disconnect all test equipment and remove modules from extender cards.

3.13 I/O DESCRIPTIONS

This section provides detailed explanations and schematics of the SNV-12's audio interfaces and its parallel control inputs and outputs.

3.13.1 Audio Inputs

The audio input of the CIM-1 Console Interface is 600 ohm balanced, and Site Voter Module input may either be 600 ohm or 10k ohm balanced. Either can be used as an unbalanced input by grounding one half of the balanced pair and connecting the single-ended input to the remaining half. The CIM-2A module has a jumper that allows the installer to select either 600 ohm balanced or 47k ohm unbalanced input. The use of balanced inputs and shielded cables is recommended for superior immunity to noise.

The audio inputs will accept signal levels from –30 to +11 dBm. Internal circuitry is used to amplify or attenuate this input as necessary to optimize the level to the DSP processors. The signal levels are adjusted by internal potentiometers, with PEAK and NORM lights to aid in adjusting and verifying levels. All inputs are set to 600 ohm, balanced, at -10 dBm when shipped. This means that the input potentiometers are adjusted so that an audio input of -10 dBm provides the correct level to the DSP circuitry, as can be verified by the NORM light coming on during all speech and the PEAK light flashing occasionally during voice peaks.

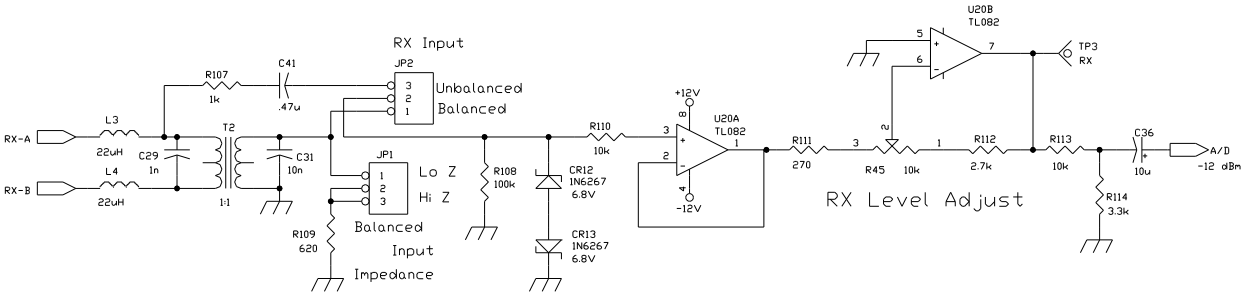

Figure 3-11 SVM-2 Remote Receiver Input

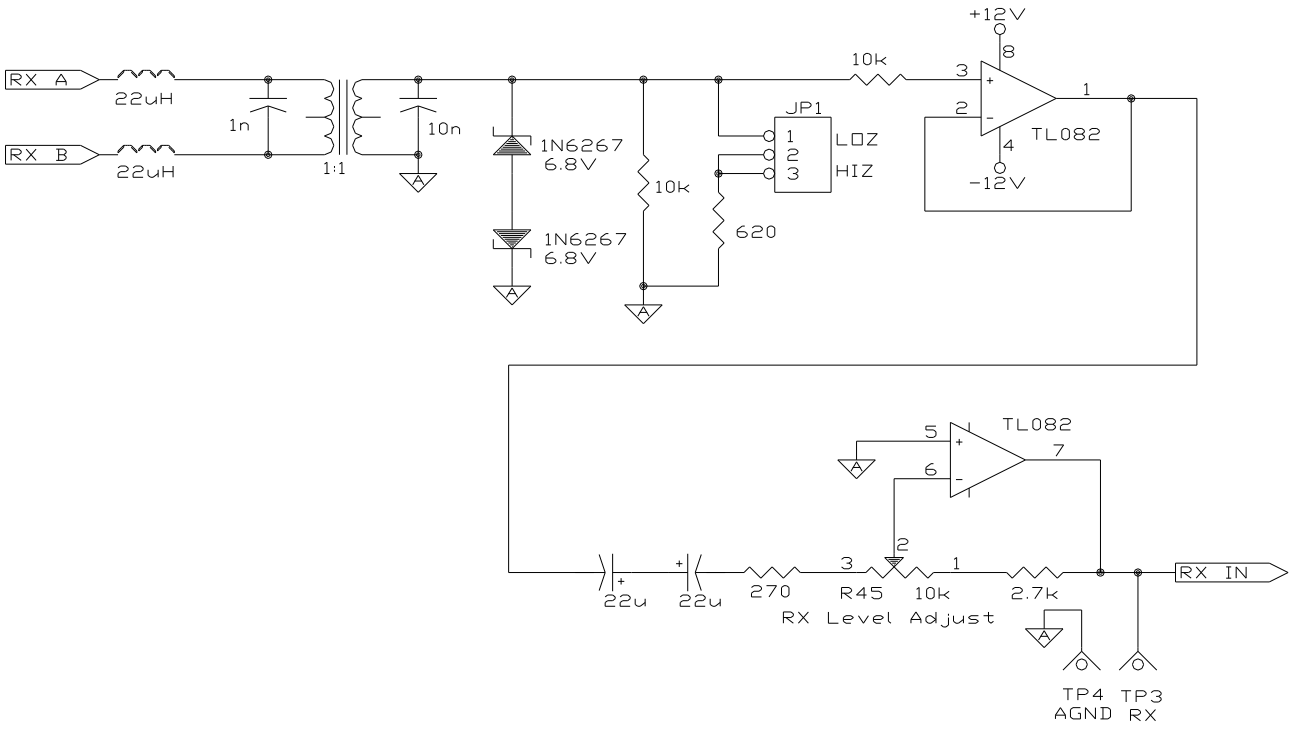

Figure 3-12 SVM-1 Remote Receiver Audio Input

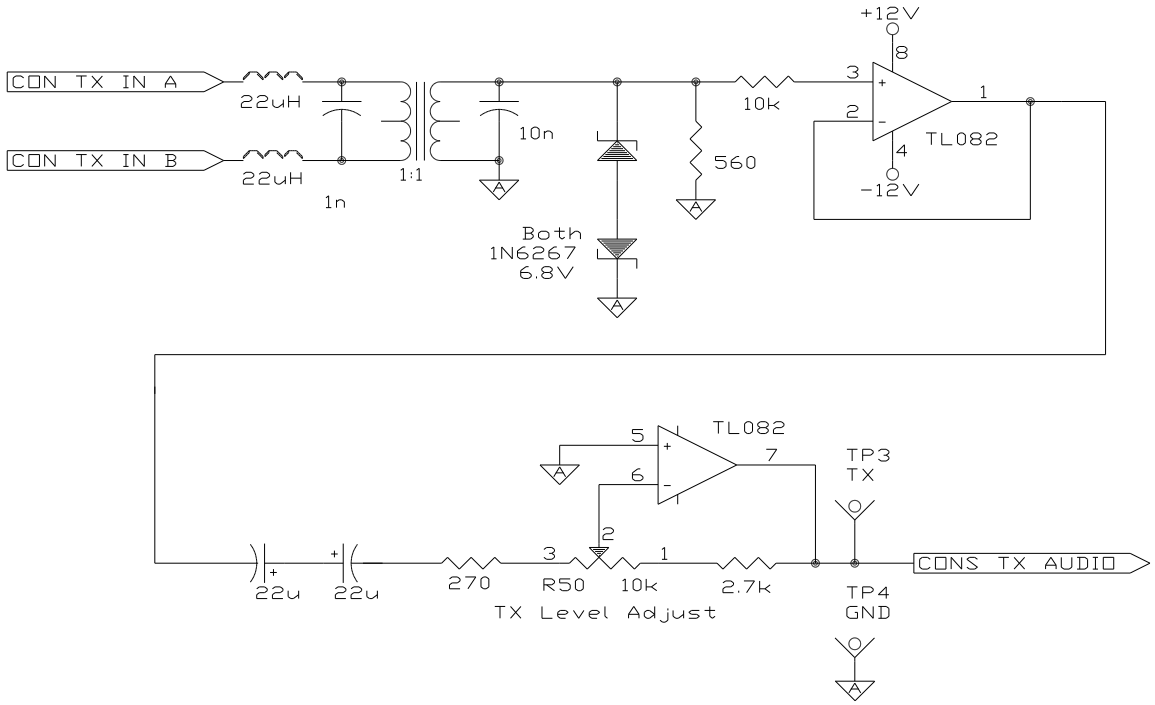

Figure 3-13 CIM-1 Console TX Audio Input

The CIM-1 input is 600 ohm, balanced. No jumper is supplied to create an unbalanced or high impedance input. To connect to an unbalance output, ground Console TX Input B, and wire the single-ended console audio input to Console TX Input A.

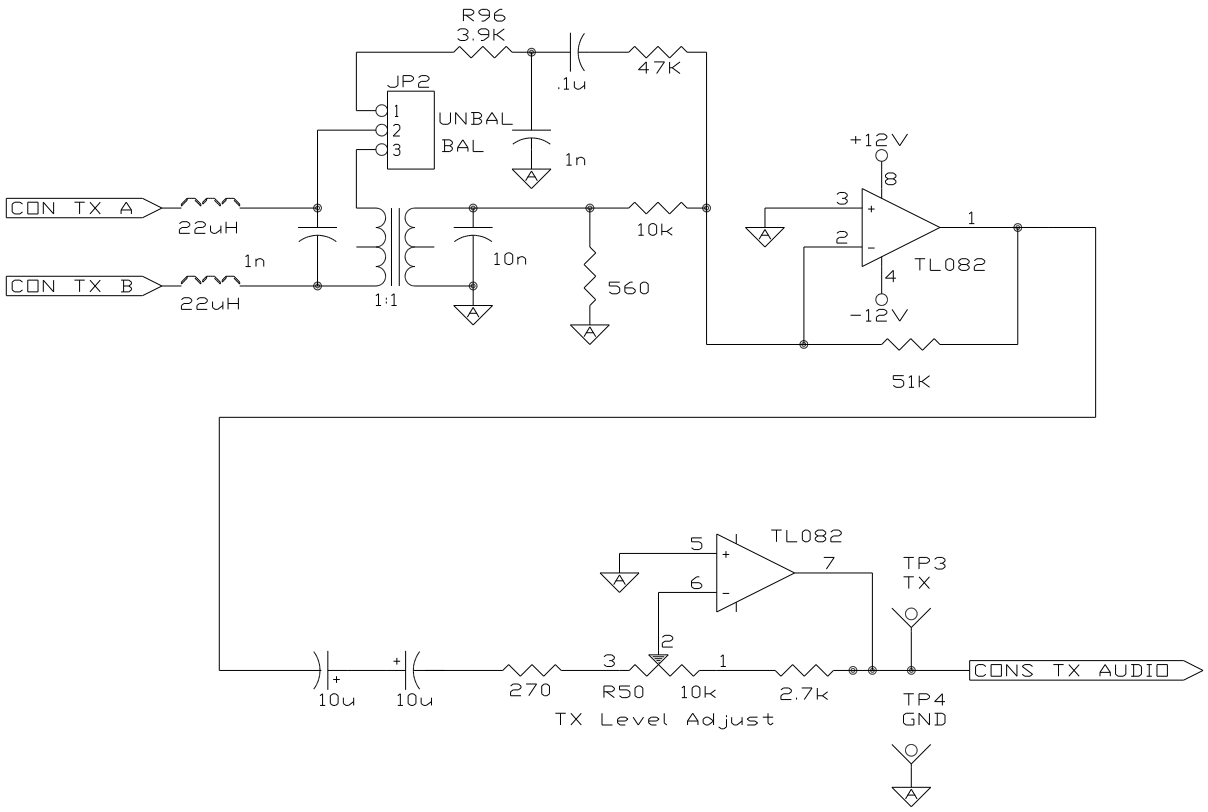

Figure 3-14 CIM-2 Console TX Audio Input

On the CIM-2 module, Jumper JP2 allows either a 600 ohm balanced input or a high impedance single-ended input.

3.13.2 Audio Outputs

All audio outputs are 600 ohm balanced, but may be set to 600 ohm unbalanced by grounding the unused output terminal. For 600 ohm unbalanced, ground the Audio Output B terminal to the Audio Ground Terminal and use the Audio Out A terminal as the signal source. The use of balanced outputs and shielded cables are recommended for superior immunity to noise.

The audio outputs will send out signal levels from –20 to +11 dBm. The internal signal level is set for optimum performance of the DSP processors. The circuitry shown below will amplify or attenuate to set the output to the level required by external equipment. All inputs and outputs are set to 600 ohm, balanced, at -10 dBm when shipped.

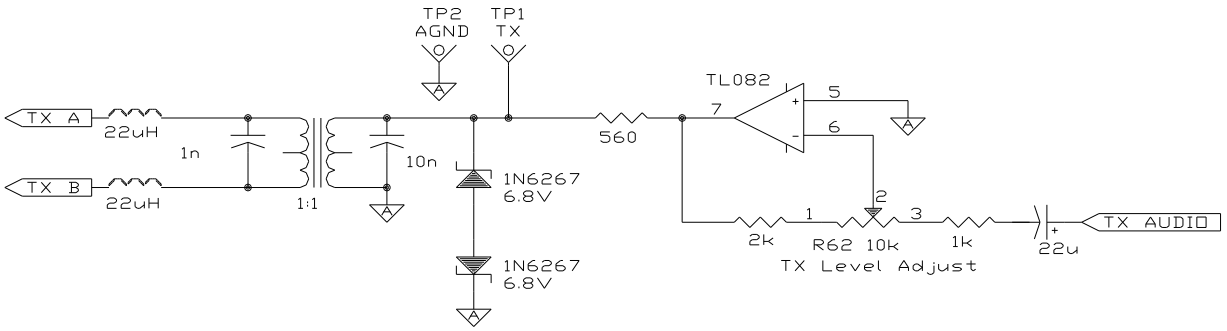

Figure 3-15 SVM TX Audio Output

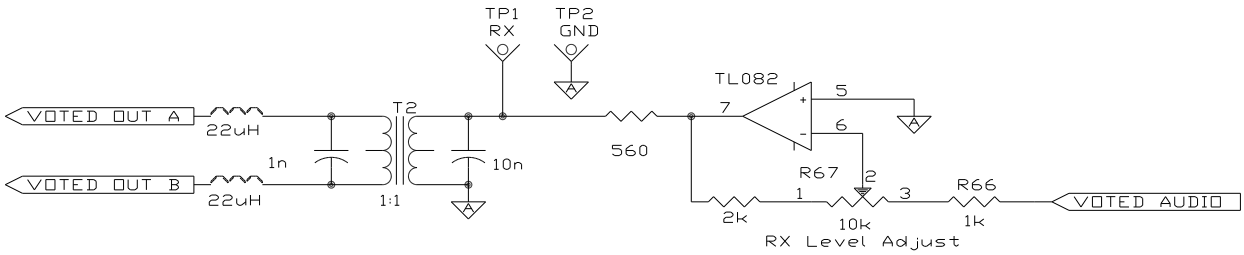

Figure 3-16 CIM Voted Audio Output

The CIM-2 module (since replaced by the CIM-2A) included jumpers JP3 through JP6. These were for an application that is no longer supported; these jumpers must be kept in the NORM position.

E&M Interfaces

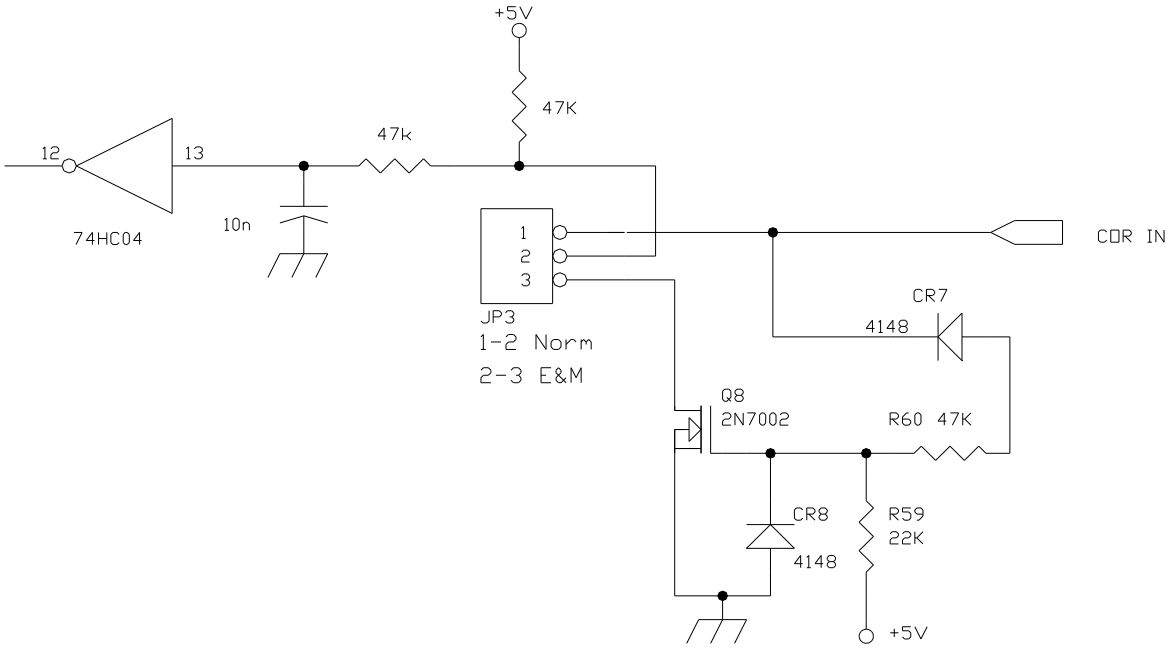

Figure 3-17 SVM-2 COR / E&M Input

When the jumper is in the "Norm" position, a 2.5 VDC (nominal) threshold signals active COR. Active low is standard; a dipswitch on the SVM module changes operation to active high. When the jumper is set to E&M, the threshold is approx –5 VDC nominal (use greater than –0.5 VDC and less than –10 VDC as the definite switchover thresholds). The standard setting is an indication of active COR for an input below –10 VDC, and inactive COR with an input above –0.5 VDC. Again, the COR Polarity dipswitch on each SVM can reverse this.

Note: An identical circuit is used on the CIM-2A to provide a PTT input that can be triggered by a negative voltage. The jumper on the CIM-2A is JP9. See Section 3.12.2.1.

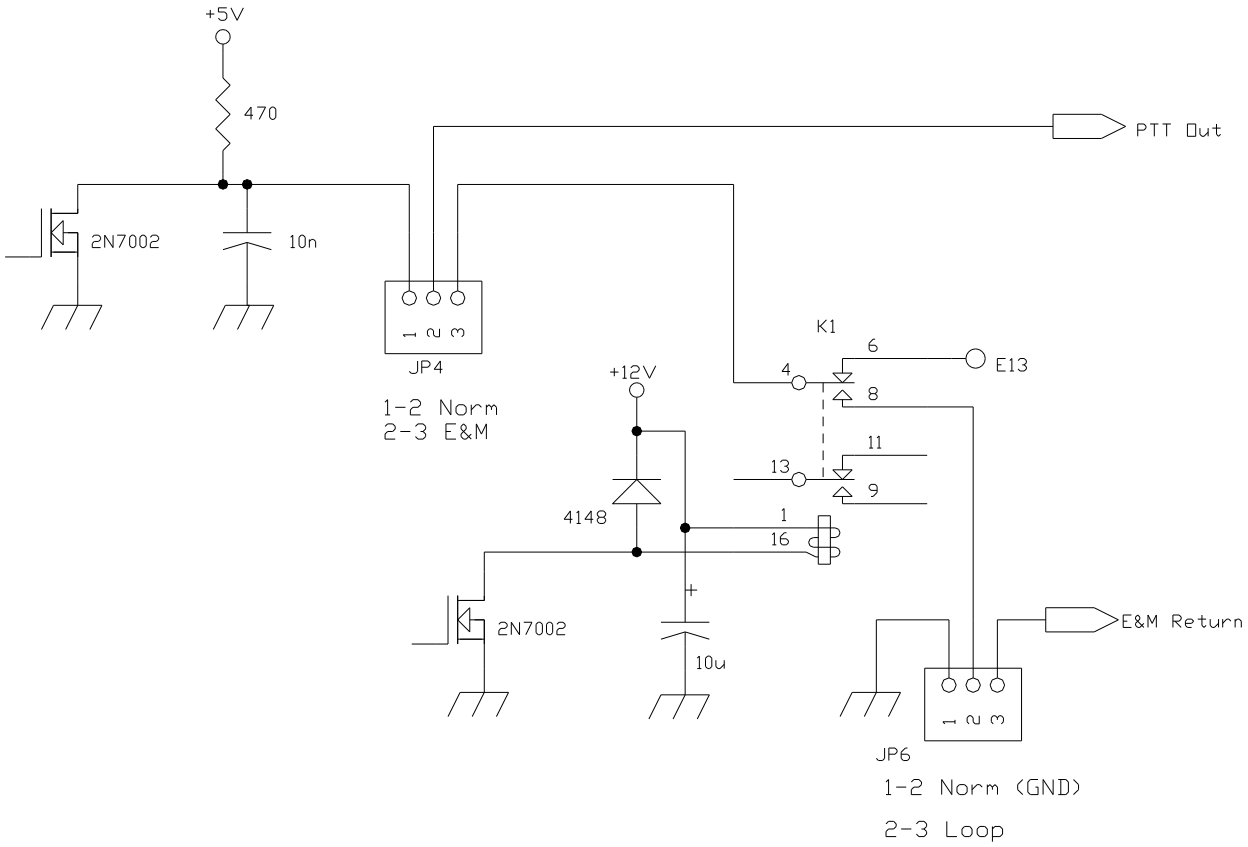

Figure 3-18 SVM-2 PTT / E&M Output

When JP4 is in the Norm position, the PTT output is an open-collector transistor with a 470 ohm pull-up resistor. When this jumper is moved to the E&M position, the PTT output is now connected to the common terminal of a relay. The relay is activated whenever the SVM-2 is put into the TX mode (when not in the TX mode, the output terminal is open-circuited). JP6 determines if, when the SVM is in the TX mode, the output is:

- Internally Grounded (JP6 on pins 1&2)
- Routed out to the E&M Return terminal on the rear panel terminal block.

Note: On some early revision SVM-2 modules do not have A JP6 jumper or an E&M return line. On these modules, the E&M active condition is always an internal ground.

Table 3-74 E & M Lead Chart				
	E Lead Idle	E Lead Busy	M Lead Idle	M Lead Busy
Type I	Open	Ground	Ground	Battery
Type II	Open	Signal Ground	Open	Signal Battery
Type III	Open	Ground	Signal Ground	Signal Battery
Type V	Open	Ground	Open	Ground

The diagrams on the following pages illustrate how to connect E & M leads to an SVM-2 module for type I, II, III and V signaling;

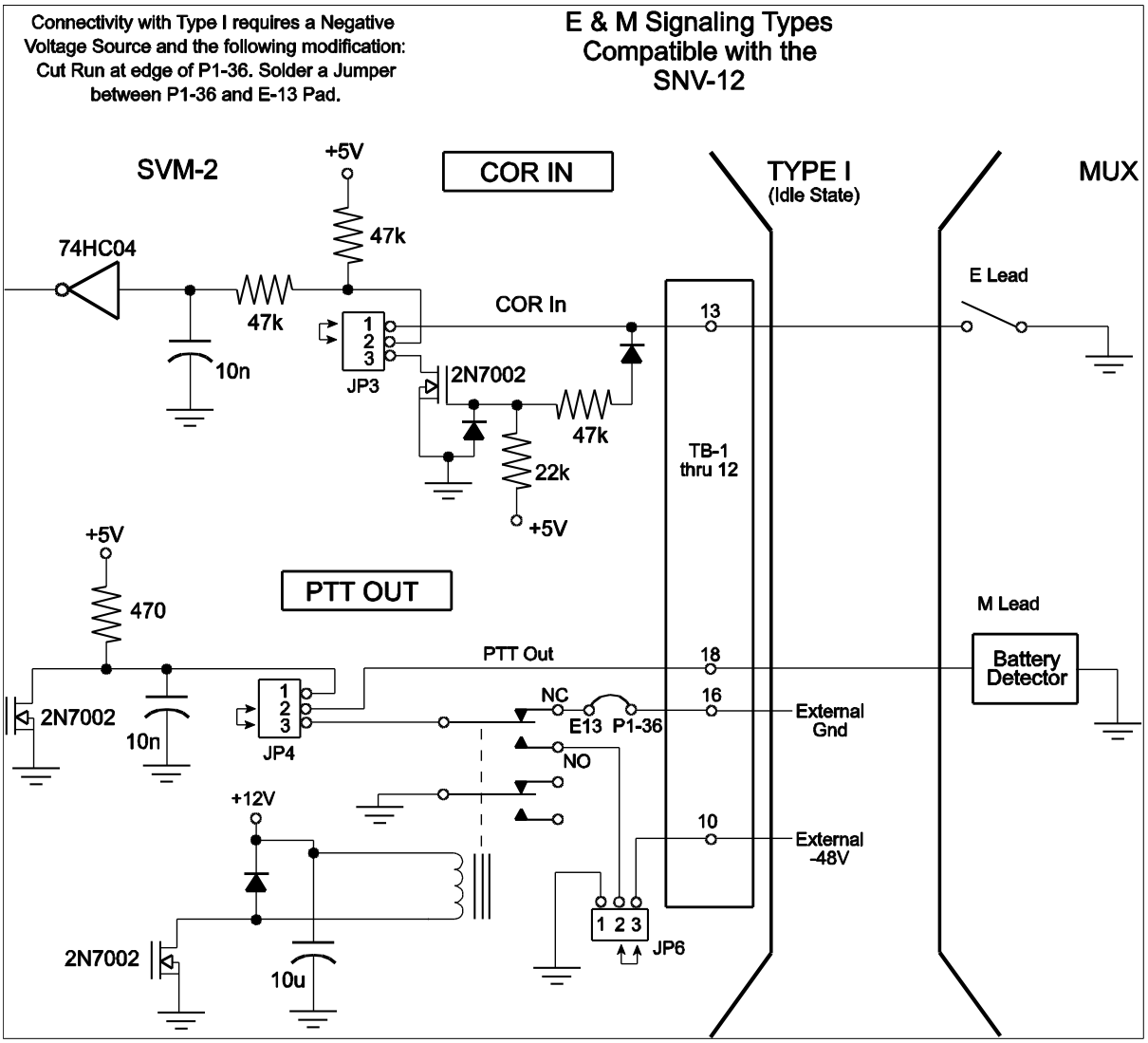

Figure 3-19 SVM-2 for Type I Signaling

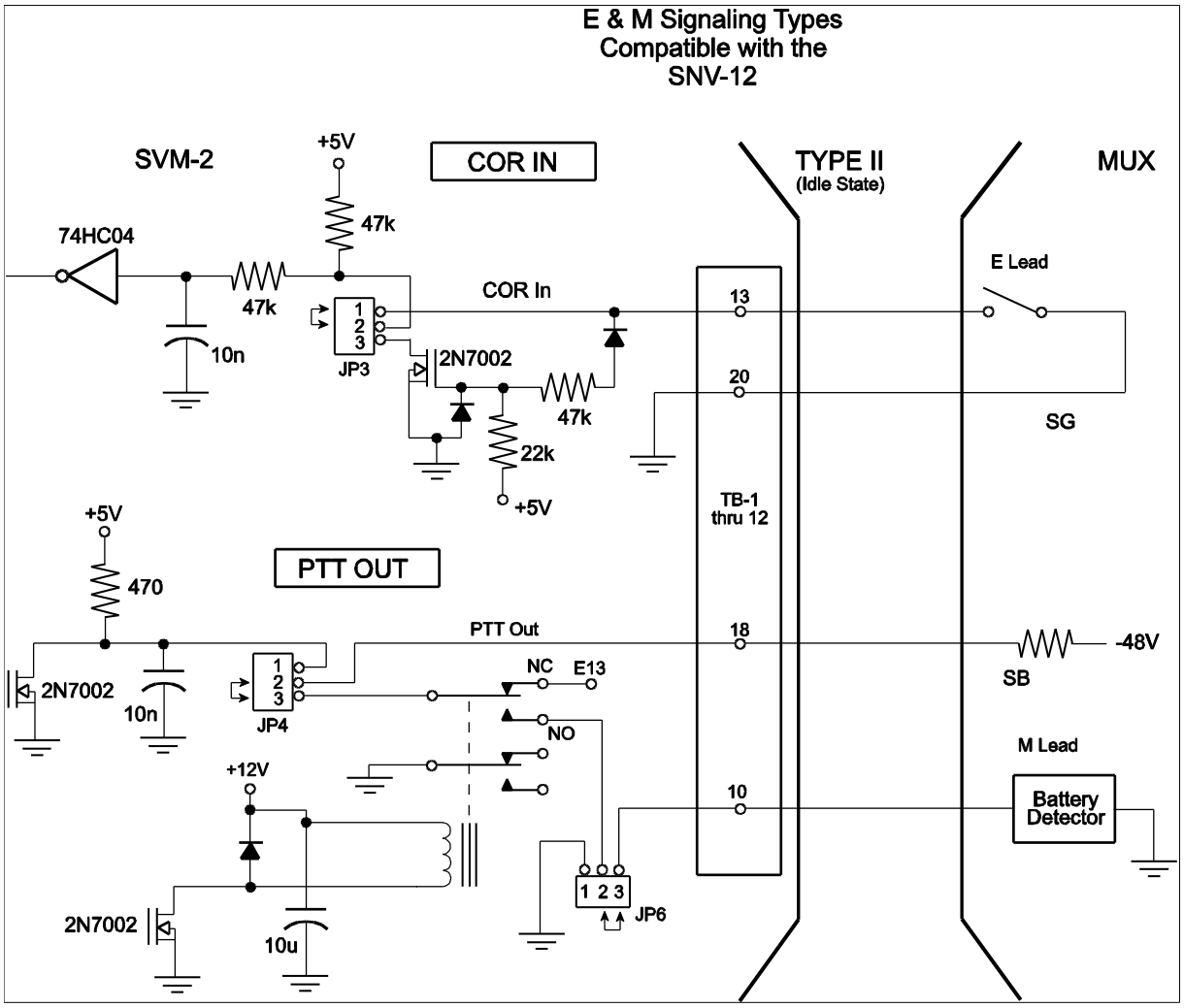

Figure 3-20 SVM-2 for Type II Signaling

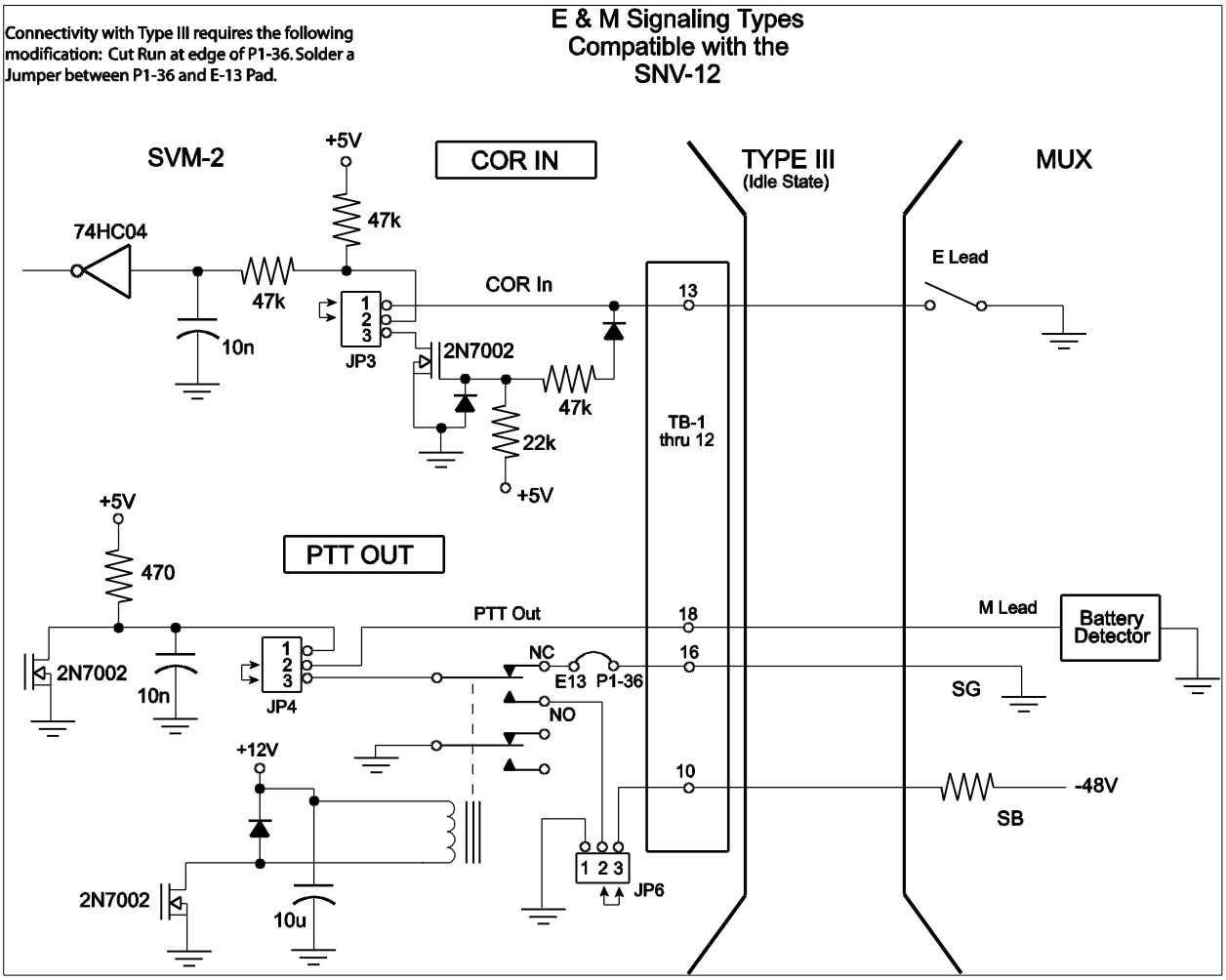

Figure 3-21 SVM-2 for Type III Signaling

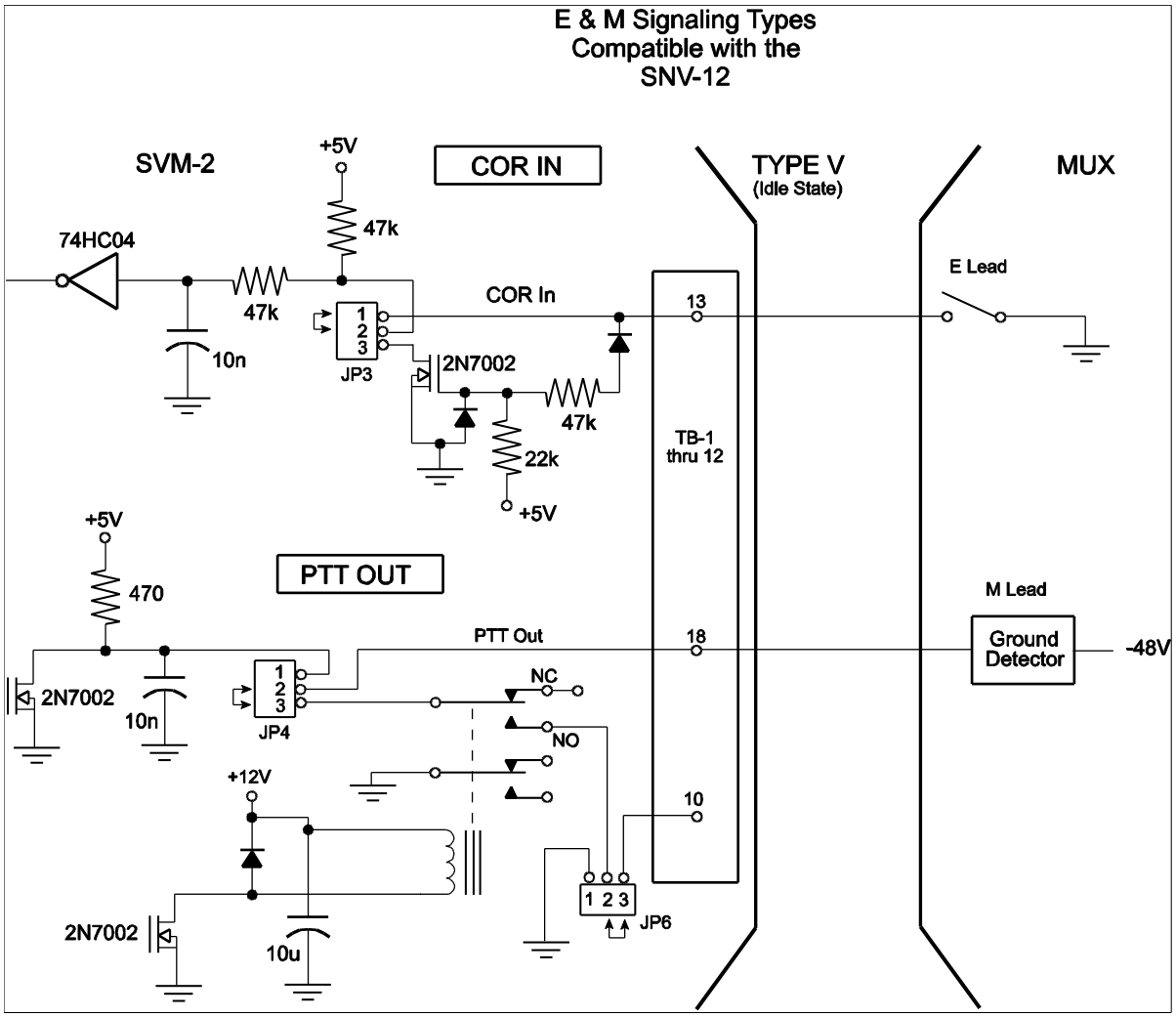

Figure 3-22 SVM-2 for Type V Signaling

The following diagrams illustrate how to connect E & M leads to a CIM-2 module for type I, II, III and V signaling:

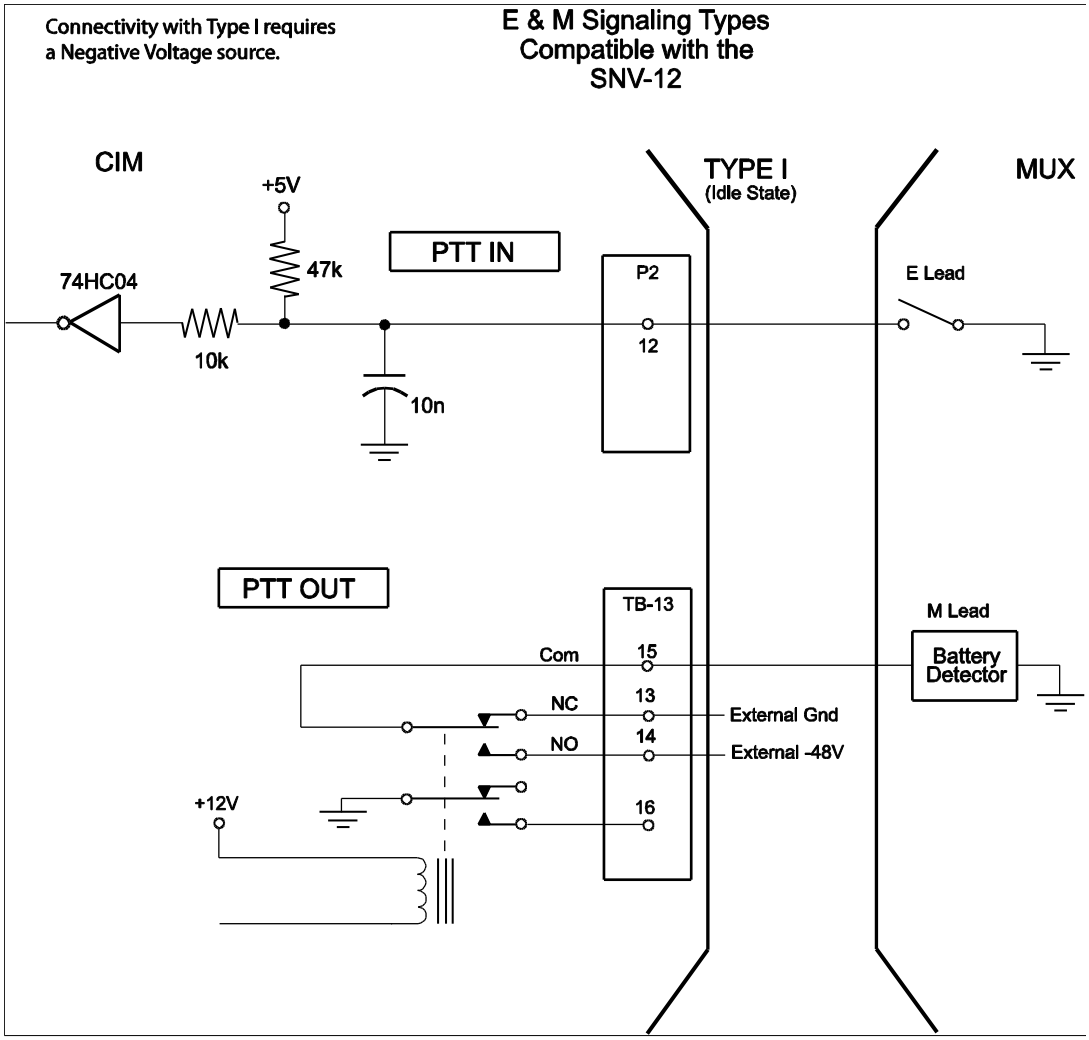

Figure 3-23 CIM-2 for Type I Signaling

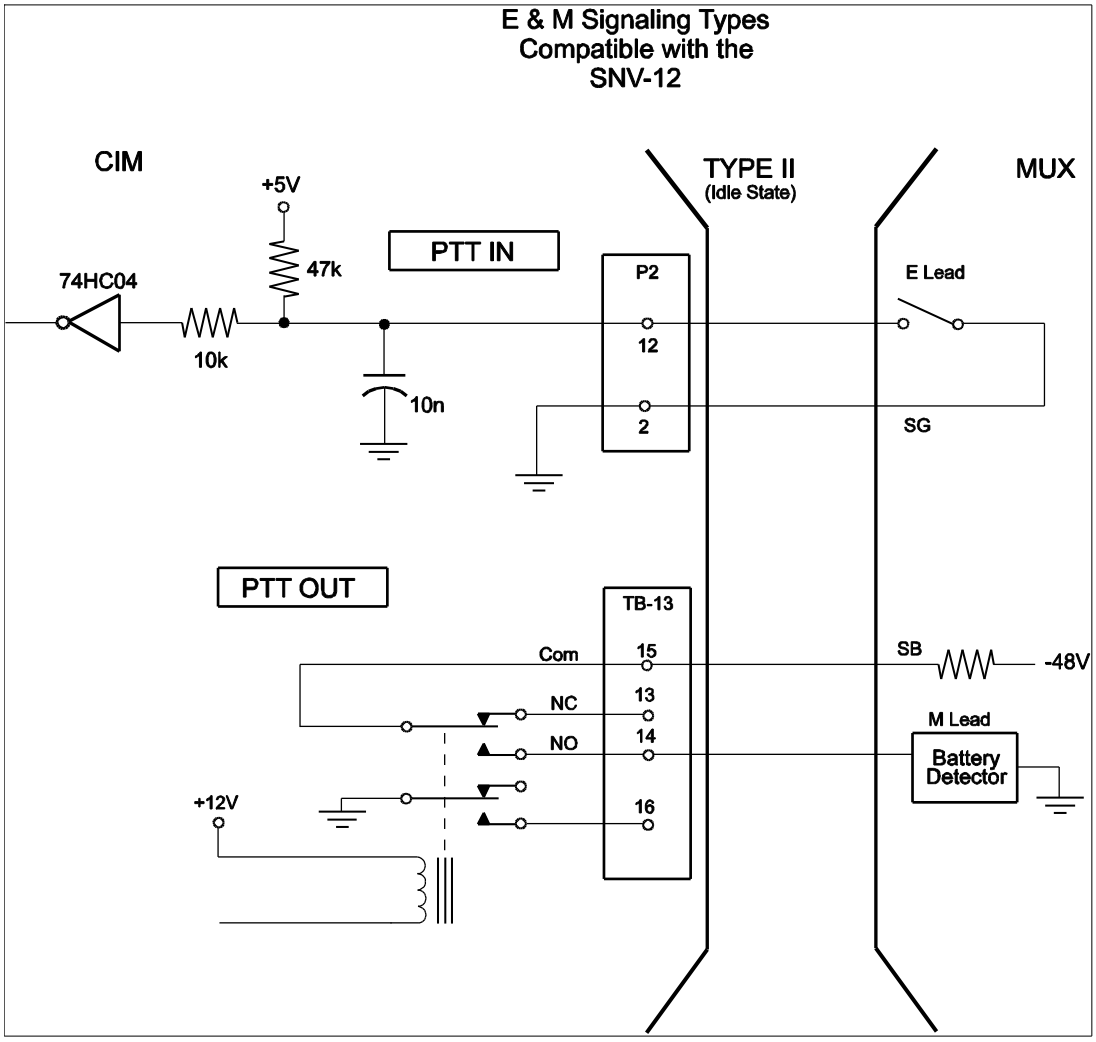

Figure 3-24 CIM-2 for Type II Signaling

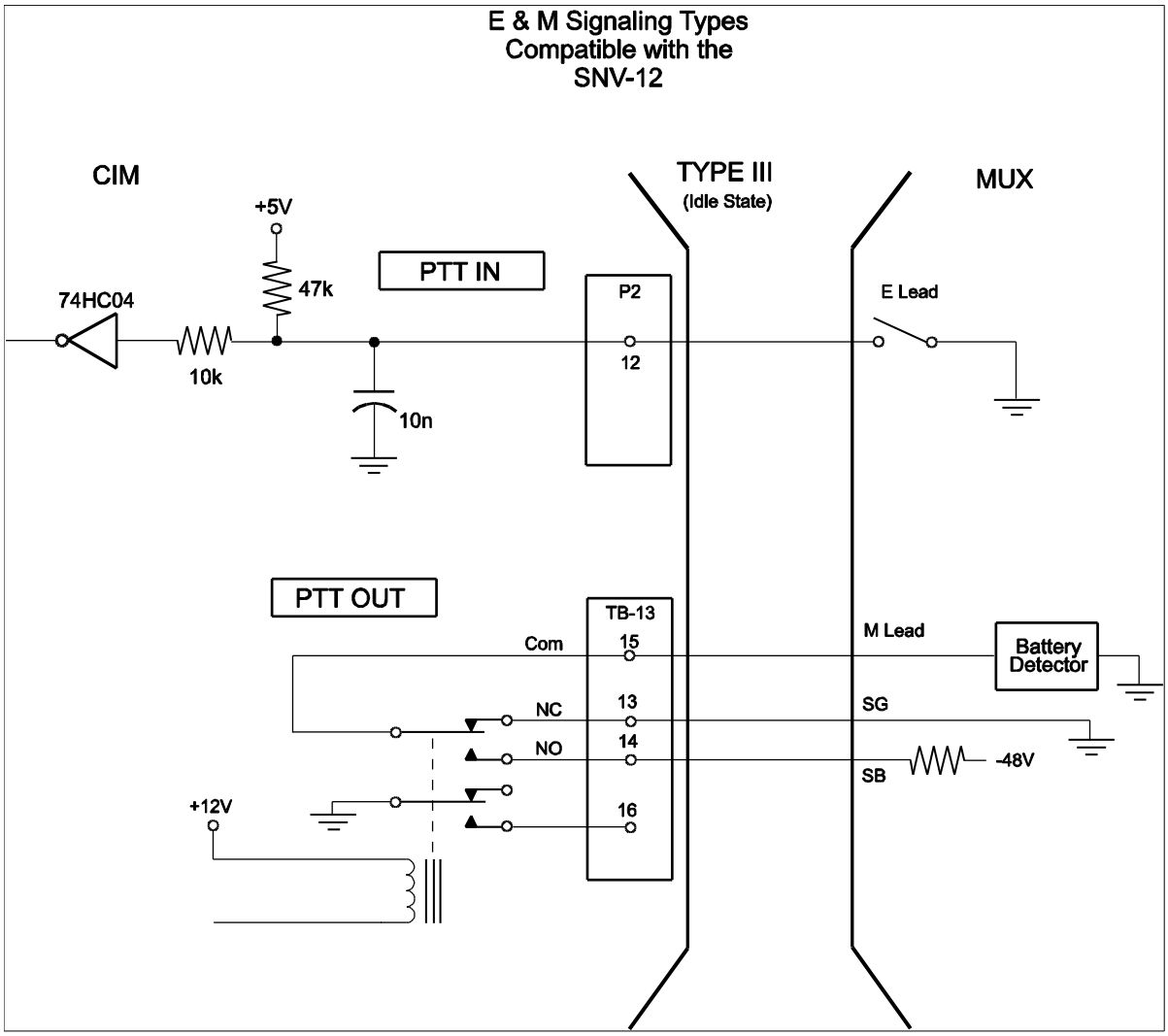

Figure 3-25 CIM-2 for Type III Signaling

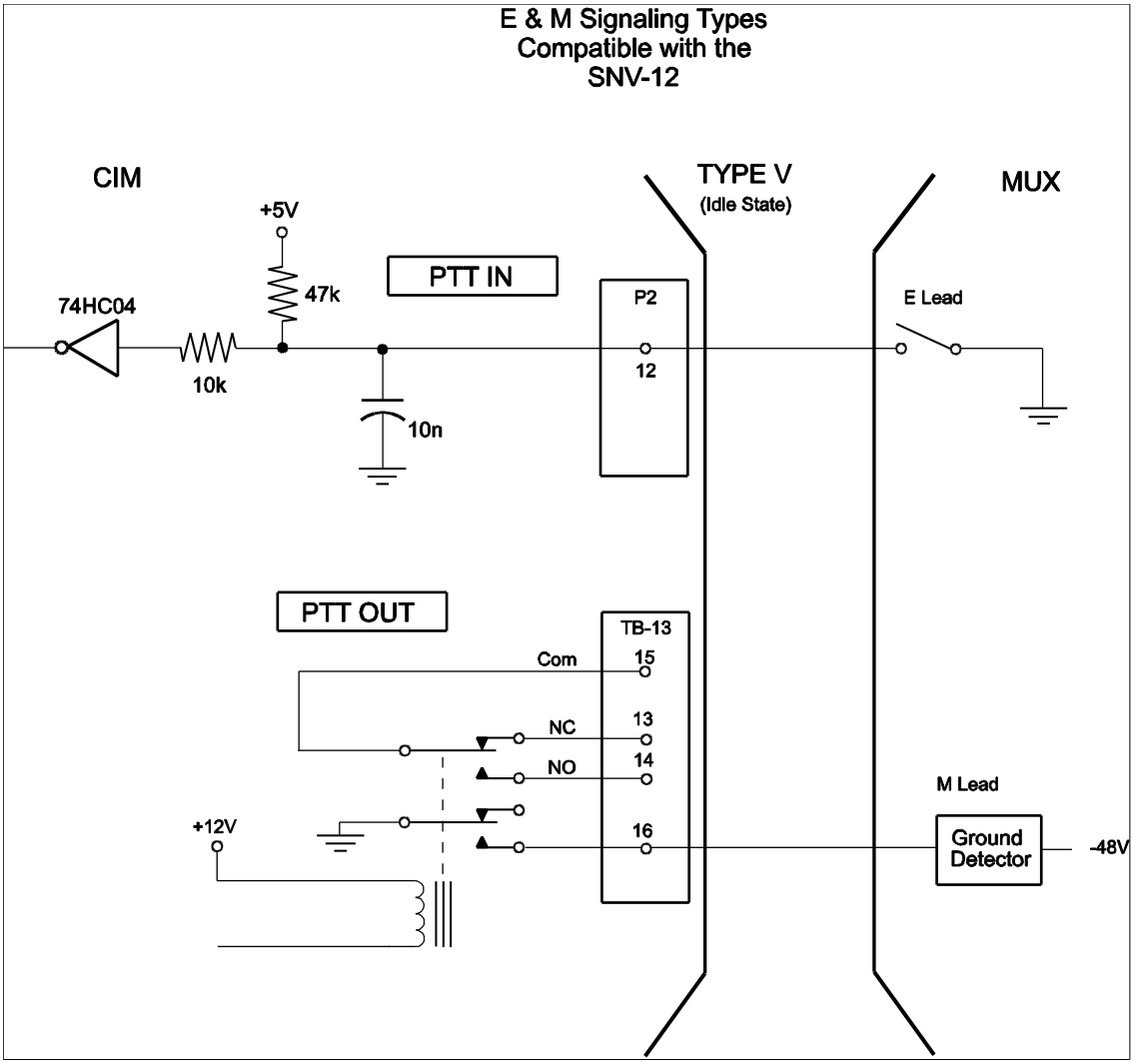

Figure 3-26 CIM-2 for Type V Signaling

3.13.3 Parallel Control Inputs

The following applies to all parallel control inputs of all SNV-12 modules. See the schematic representation below.

The inputs are held up to +5 VDC; when this input is pulled below an approximately +2.5 VDC threshold, the input is considered active, and the internal signal goes high. This input is protected from input signals to maximum amplitude of +/- 100V.

These digital inputs accommodate Contact Closure Sensing. The inputs connect to a 47k ohm pull-up resistor to +5 VDC, and a current limiting resistor to the input of a logic gate. A contact closure to ground will be sensed by the gate and indicate an active input.

Note: The COR Inputs on the SVM modules may be programmed to accept either Active High or Active Low COR signals. The circuit function does not change; instead the module is programmed to expect an input of the opposite sense. Note that if an Active High input is expected, and an open-circuit is present, positive COR (unsquelched condition) will be detected.

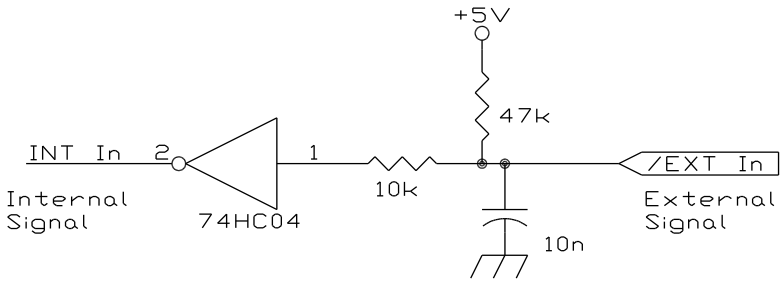

Figure 3-27 SVM-1, CIM-1, CIM-2 Control Inputs

3.13.4 Parallel Control Outputs

The following applies to all SNV-12 parallel control outputs. See the schematic representations below.

When an output becomes active, the open-drain transistor is turned on; current flows through the transistor drain to ground, pulling the output low. The maximum voltage that can be applied to the drain of the transistor at the output connection is +60 VDC. The maximum continuous current drain for the SVM-1 and CIM-1 is 100 mA, for the CIM-2's outputs, the maximum drain is 50 mA. These outputs are not intended for connection to negative voltages. The transistors include a parasitic diode; damage may occur if the applied voltage goes negative by a diode drop and is not current-limited to approx. 10 mA.

For Contact Closure Outputs: The digital outputs consist of an open-channel transistor and are pulled up to +5 VDC by an internal 47k ohm resistor. These outputs are capable of creating a "contact closure" indication for positive voltage inputs up to +60 VDC. Unless the internal pull-up resistor is removed, there will be some current draw through the 47k ohm pull-up for input logic level above +5 VDC. Alternatively, the output transistor can be used to control an external relay. Be sure to add a back-biased diode to prevent any reverse EMF problems when the relay is de-energized. The lower schematic shows the internal relay circuit of the CIM-2.

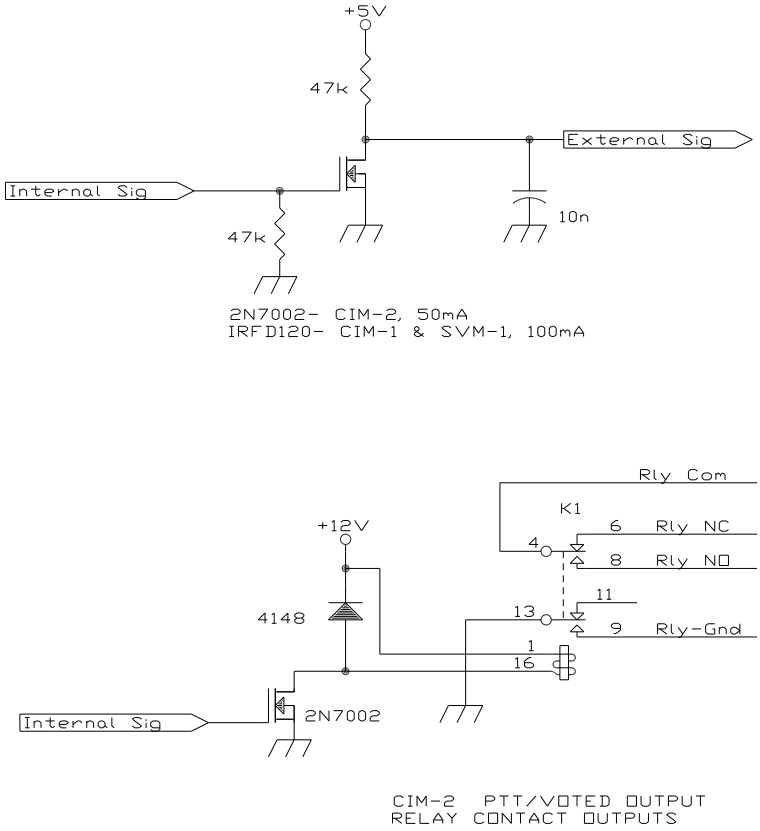

Figure 3-28 SNV-12 Control Output

4 SNV-12 Operation & Technical Description

4.1 General

This section contains information and instructions for proper operation as well as technical descriptions of the SNV-12 voter and its modules. Refer to Figure 4-1 for views of controls and connectors.

4.2 Modular Chassis and Backplane

4.2.1 General

The SNV-12 is packaged in a 19" wide EIA standard rack-mountable Eurocard cage equipped with a backplane board that the modules plug into. The module PC Boards are 100 x 220 mm. The card cage height is 5.25" (3RU); its depth is 11". Receiver signals are connected to the Site Voter Modules via rear panel terminal blocks. The SNV-12 consists of a Power Supply Module, a Console Interface Module, a CPM Module and up to twelve Site Voter Modules.

The SNV-12 chassis is completely modular; that is, each of its various modules can be removed and replaced with no tools other than a screwdriver. There are only three types of components: the chassis itself, the backplane board, and the plug-in modules. The modules all plug in to the backplane board through the front of the unit. Screws at the top and bottom of the module panels secure the modules in the chassis, and each module has a front panel handle for ease of handling. The backplane is attached to the rear of the chassis with screws along its top and bottom edges. A combination AC power connector, fuse holder, and line filter snaps permanently into a metal enclosure which mounts to the backplane board, and all dangerous AC voltage lines are covered by the enclosure. The backplane makes all electrical connections between the various plug-in modules so no discrete wiring between modules is required.

An extender card allows any modules except the power supply to be connected to the backplane with both sides of the module board exposed outside of the chassis for ease of adjustment, inspection, or repair. This same extender card can be used for all modules except the power supply. This means all modules except the power supply can be plugged into any slot except the power supply slot. The modules can only function correctly when plugged into the correct type of slot, but the SNV-12 is designed so that modules will not be harmed when plugged into incorrect slots. The Power Supply card edge connector is offset so no other modules can be plugged into it.

The Eurocard subrack accommodates 84 HP (horizontal pitch) increments of 0.2" each. The widths of the SNV-12 module panels are as follows:

- Power Supply Module- 14HP or 2.8"
- Control Processor Module- 4HP or 0.8"
- Console Interface Module- 18HP or 3.6"
- Site Voter Modules- 4HP or 0.8"

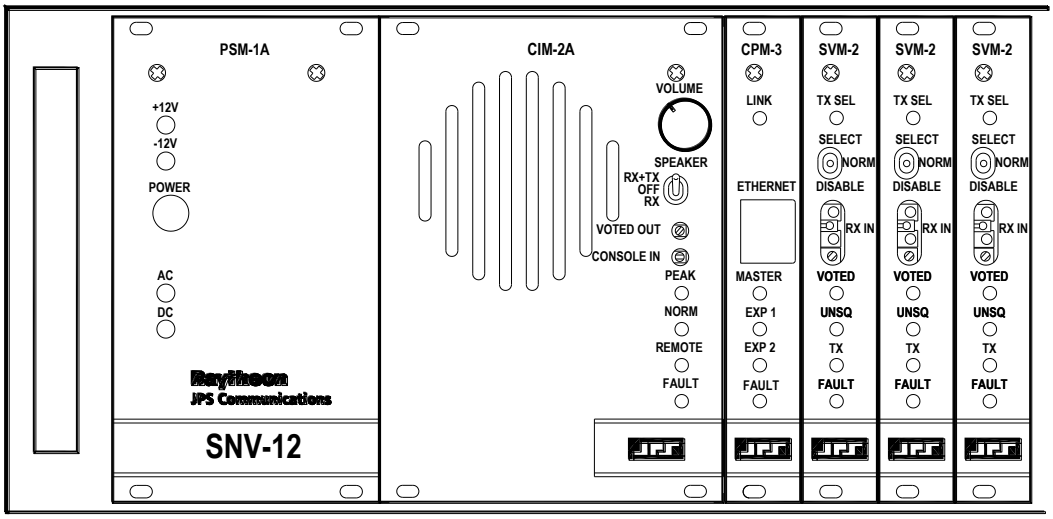

Figure 4-1 Front Panel Views

4.3 Power Supply Module

4.3.1 Features and Functions

- 115 VAC/230 VAC Input Selectable.
- Filtered AC Line Input.
- +12 VDC Operation with Auto Switch Over.
- 24 Hr. Charger for a One Hour +12V Backup Battery is Standard.

4.3.2 Functional Description

The Power Supply Module can operate from 115 VAC or 230 VAC, or from +11 VDC to +15 VDC. It furnishes the modules in the chassis with regulated +/- 12 VDC and filtered-but-unregulated +15 VDC. Each module produces its own +5V from the unregulated +15 VDC. A filtered line voltage selector module is used on the AC line input. If the AC voltage fails, the DC voltage automatically takes over. There is also provision to charge an optional 12 V gel cell backup battery sized to provide one hour of back-up operation. The charger is designed to recharge the battery in approximately twenty-four hours. The Power Supply Module front panel contains the power On/Off pushbutton switch, and yellow LEDs indicating AC or DC operation.

4.3.3 Power Switch (PSM-1)

The Power Switch controls the +15 VDC (nominal) Bus supply to the other modules in the unit and controls overall voter operation. It does not disconnect the AC or DC Mains.

4.3.4 AC and DC Indicators (PSM-1)

The AC and DC yellow LEDs, situated below the Power Switch, will be illuminated whenever the corresponding power is applied and the associated power supply circuitry is functioning correctly.

4.3.5 +12V and -12V Indicators (PSM-1)

These green LEDs are driven from the corresponding power supply output voltages and are illuminated whenever the unit's main power is on. A dark LED when the AC or DC indicators are on could indicate a failed power supply voltage.

4.4 Console Interface Module (CIM)

4.4.1 Features and Functions

- Monitor Console TX Input Audio With Speaker And Level LEDs.
- Monitor Voted Audio/Console TX Audio With Speaker.
- TX/RX Audio Interface To A Console.
- EIA Keying Tone Detection In Console TX Audio.
- Voted Audio & Console TX Audio Level Adjustments And Measurement Points.
- Adds Transmitter Keying Tones To Console Or Retransmitted Voted Audio.
- Variable Delay Of Console TX Audio Prior To Transmit.
- TX/RX Audio Interface With Expansion Chassis.

4.4.2 General

The Console Interface Module front panel provides a front panel speaker with volume control (to monitor voted audio or a voted audio/console TX audio combination), and two audio indicating levels LEDs (normal and peak) that monitor the Console TX Audio input level.

4.4.3 Speaker Switch

This switch has three selections: Off, Voted Audio, or Voted Audio plus Console TX Audio. It controls both the front panel speaker and the "external speaker driver audio signal" available at the rear panel. It dos not affect audio to the console or TX audio from an SVM.

4.4.4 Volume Control

This potentiometer adjusts the volume to the speaker and to the "external speaker driver audio signal" available at the rear panel.

4.4.5 Peak & Norm LEDs

These LEDs provide a level indication for the incoming Console TX Audio into the CIM's DSP and are an assist in setting the proper level via the input potentiometer R50.

4.4.6 Remote LED

The red Remote LED is illuminated when the Remote Serial Port is enabled.

4.4.7 Fault LED

The red Fault LEDs will be illuminated whenever the associated module's built-in-test circuitry detects a fault condition.

4.4.8 Console Audio Input & Voted Output Adjustments

These potentiometers are used to adjust the TX audio level into the voter from a console (R50) and the voted audio out to the console (R67).

4.5 Control Processor Module (CPM)

4.5.1 Features and Functions

- Votes On Signal Quality Information (Noise or SNR) From SVM Modules
- Control And Status Interface With SVM Modules
- Voting System Expansion Control
- RS-232 Remote Control/Programming
- 10/100 Ethernet Remote Control/Programming
- Voting Transition Control
- TX Steering And RX Group Control
- Master CPM Controls Expansion CPMs In Expanded Systems

4.5.2 General

The unit's CPM Module controls the entire SNV-12. Via an internal high-speed serial bus, it requests and receives SNR, Signal Quality, COR (signal present), speech present, and other information from each Site Voter Module and votes the SVM with the best signal. It instructs this SVM to output its audio to the voted audio bus. The CPM also provides an RS-232 serial port allowing control and monitor of SNV-12 functions via an external computer or serially interfaced console. The CPM-3 also provides a 10/100 Ethernet port for external control and monitor functions as well as for software upgrades. The front panel of the CPM Module contains a red Fault LED, along with three LEDs that indicate the Voting Status of an expanded system, and one green LED to indicate network link status. The voting status LEDs are labeled Master (Green), Expansion 1, and Expansion 2 (each yellow).

4.5.3 Hardware Description

The voter processors include a Freescale Coldfire based central control processor and up to 12 SVM modules. A synchronous serial bus supports inter-processor communications.

Each module has a unique "Select" line that is bi-directional. As far as the SVM module is concerned the Select line is strictly an input, but the control processor (CPM) can both read and write to these lines via a 74ACT16245 transceiver. If a module is not plugged in, the CPM will read the Select line as TTL high (via a weak pull-up resistor). If an SVM module is plugged in, it has a relatively strong pull-down resistor, and the CPM sees the input as TTL low. In this fashion the CPM can not only "select" an SVM module, it can also quickly detect its presence or absence.

The CPM interrogates each SVM module by first selecting the module, and then clocking out a 16 bit command word. While the command word is being clocked out, an SVM module status word is being clocked in. The command word is used to give various commands to the SVM module. One of the command word bits is used to "Vote" the SVM module. The status word, read from the SVM module, contains 5 bits of Signal Quality data. The other 11 bits provide SVM status information. See Table 6-1 for full details.

Once the CPM has polled each SVM module, it determines which module to "Vote" and signals that module to place its audio on the Voted Audio Bus on the next polling loop.

The system uses a similar scheme to share information between multiple chassis in a Master/Expansion system. If a voter is configured as an "Expansion Chassis", it will read all the Signal Quality information for each of its modules. It then calculates the "Best Signal Quality Available" for its chassis. This information is passed on to the Master unit, which compares this “Best SQ” with the SVMs in the Master Chassis. The Master then votes the best SVM in the system; one of its modules or one of the Expansion chassis modules.

4.5.4 Fault LED

The red Fault LED will be illuminated whenever the associated module's built-in-test circuitry detects a fault condition. The CPM-3 FAULT LED will flash during the unit power-up sequence until all internal setup is complete and the unit is fully operational. This LED will also light if the CPM-3 fails to establish communication with any of the Site Voter Modules installed.

4.5.5 Master/Expansion 1/Expansion 2 LEDs

These LEDs flash during system power-up and when software is being downloaded from the CPM-3 to other modules in the chassis. Otherwise, these LEDs are operational only when multiple SNV-12s are daisy-chained together. The LEDs indicate where each unit fits in the configuration. The MASTER unit is connected to the console and contains modules 1 through 12. The Expansion 1 chassis is connected to the MASTER chassis with SVMs 13 through 24. The Expansion 2 chassis is used if the full complement of 36 modules is required.

4.5.6 Link LED

The Link led will flash during the CPM-3 power-up sequence. When the LINK LED is lit it indicates that a network link to the CPM-3 is active.

4.6 Site Voter (SVM) Module

4.6.1 Features and Functions

- Accepts Audio From The Receiver
- Measures Various Parameters Of Incoming Signal
- Provides Delay To RX Audio If Selected
- Transmit Audio Output
- Internal RX/TX Audio Level Adjustments
- Audio Level Indicators And Measurement Points

4.6.2 General

The Site Voter Module interfaces with a receiver and measures its Noise Level or SNR, which it reports to the CPM-3 module as a Signal Quality Number. The SVM's front panel contains the following controls and indicators (detailed descriptions later in text):

- TX SEL LED (yellow); lit when this site is selected for transit by the TX Steering function.
- SELECT/NORM/DISABLE; toggle switch selects one of the three states.
- VOTED LED (green); lit when this site is voted best.
- UNSQ LED (yellow); lit when the site is receiving a valid (voting) signal.
  Also flashes to indicate that the module is in the Select Mode.
- TX LED (yellow); lit when this site's TX audio and TX control are enabled.
- FAULT LED (red); lit if this module has faulted. The SVM Fault LED will also be illuminated if a line fault is detected for the associated site. The SVM-2 will flash this LED when the module is in the Disable Mode.
- RX INPUT AUDIO adjustment potentiometer and level indication test point & LEDs

The SVM Module provides parallel status signals and inputs to interface with an external console. These I/O pins are protected from damage by high voltage transients.

When the voting system is first installed, the installer using the audio level test point & LEDs to set the proper internal input audio level of each SVM Module.

The SNV-12 SVM Modules are interfaced to a backplane voted audio bus that carries the currently voted signal to the Console Interface Module. A transmit audio bus feeds each SVM Module from the Console Interface Module. Transmit and receive audio are extended to additional SNV-12s when site expansion (past 12 SVMs) is required.

The SNV-12 votes audio, no matter what its source. The site receiver link to the SVM Modules may be leased lines, hard wire, or E&M pairs.

4.6.3 Hardware Description

The SVM-2 Module contains a Texas Instruments TMS320C5409 DSP with 32K words of internal RAM, and 128K words of non-volatile flash memory. A 14-bit Analog-to-Digital/Digital-to-Analog converter provides an analog interface. The module also contains various parallel I/O for reading control inputs, maintaining control outputs, and controlling the various audio gates. The SVM communicates with the CPM Module by using its MCBSP high-speed synchronous serial port.

4.6.4 Software Description

The Site Voter Module software is contained in flash memory and can be updated by the CPM module whenever software changes are necessary. The SVM Module Flash is partitioned into sectors. Bootloader code is programmed into one sector that is protected to prevent accidental erasure. The actual application code is stored in its own sector. When the SVM boots up it will look for valid application code in its Flash. If it finds application code it will copy it into internal RAM and execute it. During system boot-up the CPM module will query each SVM module to determine if the firmware is up to date. The CPM module contains the latest code for all voter modules. If the CPM determines that the SVM needs updating it will reset the SVM in bootloader mode and transfer new application code. The SVM updates its Flash with the new code. When the update is complete, the CPM will reset the SVM so that it can load and execute the new application code. The bootload step is performed only when the SVM Module code must be updated (the CPM module checks the revisions at power-up or module installation), and is skipped otherwise (see Section 8 regarding software updates).

The SVM Module software is responsible for all RX Audio-related signal-processing functions in the SNV-12. These include Signal-to-Noise measurement (HF/AM mode), Noise measurement (FM mode), pilot and guard tone detection, pilot and guard tone notching, and audio delay. Input samples from the A/D converter are passed to the various software routines for processing, and the resulting audio samples are sent back to the D/A converter.

Signal-to-Noise measurement is calculated based on the measured amplitude of the input signal in various frequency bands. Pilot tones are detected using a Discrete Fourier Transform specially adapted for tone detection, while notching of tones is performed using FIR digital bandstop filters. Running the output samples through a variable size circular buffer before sending them to the D/A converter provides audio delay.

4.6.5 Select/Norm/Disable Switch

This three-position toggle switch places the module in one of the SVM's three operating modes. The Norm position allows the usual voting processes to take place. The Select position causes a "forced vote" of the site as long as its COR state is currently active (as determined by any of the methods described in Section 5.10), while the Disable position excludes the site from voting. When the switch is set to Select (or the SVM-2 module is put into the Select Mode by other means), the Voted LED will flash as a reminder. Similarly, the Fault LED will flash if the SVM-2 is in the Disable Mode.

4.6.6 Transmit Select (TX SEL) LED

This yellow LED lights if the Voters Transmit Steering function has selected the site for transmit. This means that this site will key if the Console PTT Input is activated.

4.6.7 RX Input Level Indication LEDs, Test Point and Adjustment Potentiometer

Two RX level indication LEDs, along with the RX level adjustment potentiometer, are available through a window in the SVM-2 front panel. When the RX input is properly set, the green "normal" LED will be lit whenever a field radio is transmitting and its user is talking, while the red "peak" LED should only flash occasionally during voice peaks. If the normal LED never comes on or the peak LED never flashes, the RX input is set too low. If the peak LED stays on or flashes more than occasionally, the level is set too high. Note that there will be differences in LED activity between load talkers and quiet talkers. If the pilot tone level is set at standard voice level, the green LED may be on whenever the site receiver is squelched

The RX level test point is also available through the window. Besides its use during the initial setup, this test point can be used to check for degradation or changes in the link to the site's receiver. Simply measure the pilot tone level on a regular basis to ensure that the level doesn't change appreciably.

4.6.8 Voted LED

The green VOTED LED lights whenever the associated site has been selected as the site with the best signal quality. When STARS TX steering is enabled the VOTED LED (and the associated VOTE output) will remain active for the site selected until a new site is voted or the function times out. The SVM-2 will flash this LED when the module is in the Select Mode.

4.6.9 Unsquelch (UNSQ) LED

The yellow LED lights whenever a signal capable of being voted is present on the associated site. This indication will depend on the method of COR/pilot tone in use. In systems which use external COR inputs this occurs when the receiver is unsquelched, driving the receiver's COR output low. In sites using pilot tones, a signal is considered present when the pilot tone is absent from the input audio. When squelched receivers are used and no external COR line is available a signal is considered present when the audio input level rises above a preset threshold. In systems with unsquelched receivers and no COR input line or pilot tone, signal is considered present continuously, and the LED will always be on.

Regardless of the type of COR used, a site will never be voted if the associated SVM's UNSQ LED is not lit since the SVM will not vote a site unless it determines that there is a signal present on that site.

4.6.10 Transmit (TX) LED

This yellow LED is lit whenever the SVM's TX outputs are activated. This can be a discrete PTT output or the placement of keying tones on the site's TX audio signal, whichever is selected.

4.6.11 Fault LED

This red LED lights if the SVM fails its power-up test or if a line fault has been detected for the site. The LED also flashes as a reminder whenever the site has been placed in the Disable mode by the front panel switch or other means (remote control or rear panel input).

4.7 Rear Panel Connectors

Section 3.11 contains full explanations and pin-outs for all rear panel connectors. Figure 3-2 shows connector locations. Figure 3-4 and Figure 3-5 provide connector diagrams for expanded systems.

4.8 Voter Operation

Basic operation and control of the SNV-12 are discussed in the following paragraphs. These instructions assume that the SNV-12 has already been correctly configured per Section 3.

4.8.1 Unit Power-Up

Prior to initial power-up, ensure the SNV-12 is correctly configured for the AC or DC power source being used. If using 230 VAC, make sure the unit is not configured for 115 VAC, or damage may result. While the unit is turned off, the appropriate PSM-1A front panel AC or DC LED indicates the connection of a power source.

Depress the Main Power Switch on the PSM and the green +12V and -12V LEDs should also light. The SNV-12 will run internal start-up tests, ensure all connected modules have correct revision software installed, and then begin voting all eligible sites. (Eligible sites are all who's UNSQ LED is lit, but are not Disabled or Faulted.) Keying functions are last to be enabled at power-up. The CPM FAULT indicator will flash until the power-up sequence is complete.

NOTE: If the CPM-3 detects that any of the modules in the chassis do not have current revision software, it will download software to those modules at power-up. During this process, the Expansion 1 and Expansion 2 LEDs on the CPM will flash. If the CIM is receiving the download, its REMOTE LED will flash during the procedure, which takes approx. 15 seconds. If an SVM-1 is receiving the download, its SELECT LED will flash; an SVM-2 will flash its VOTED LED. Each SVM can take as long as 45 seconds to be updated. Be sure to wait until this procedure is complete, or it will have to be re-started the next time unit power is turned on.

If any SVM is unable to download the current software, the CPM will make three attempts to download, and then fault this SVM module. If this occurs, the rest of the voting system will continue to function; the CPM will treat that SVM as if it's not installed.

4.8.2 Voting Controls

Use the SELECT or DISABLE toggle switch selection on the individual Site Voter Modules if it is necessary to remove a site from consideration from voting (DISABLE) or cause a site to be voted without regard to its signal quality (SELECT). The SELECT mode will not take affect unless the site has active COR (is unsquelched). No other front panel operational control is required.

The SVM front panel LEDs will provide a constant indication of each site's status. The VOTED LED lights to indicate the site that's currently voted. The UNSQUELCH LED must be lit for any site to be eligible for voting. This LED lights to show active COR, which means that the associated receiver is unsquelched and is sending a valid signal. The evidence for this depends on the COR type used, it could be the presence of a hardwired COR input, the detection of audio in the RX signal, or the absence of a pilot tone. The TX LED will light to show that the Voter has been commanded to send transmit audio and keying commands to the associated transmitter. The FAULT LED flashes during the power-up sequence and lights to indicate the detection of a fault during power-up bit testing, or when a line fault is detected (COR signal with no audio presence, or absence of pilot tone with no audio presence, for a prolonged period). Faulted sites are removed from consideration for voting until the fault is cleared. The Peak and Normal LEDs are visible at the RX Input Monitor/Adjust access window in the SVM-2's front panel.

The voted audio or a voted audio/console TX audio combination may be monitored via the Console Interface Module, using its speaker or an external speaker. The volume knob on the CIM front panel controls the audio level to the speaker and the external speaker; the speaker switch may be used to turn off signal to either the internal or external speaker.

The Fault LED on the CPM will light if this module fails its own start-up test or if it cannot communicate with one of the Site Voter Modules. The CPM knows if an SVM is installed but not communicating; if it's not obvious which SVM has failed, simply remove SVMs one at a time until the CPM Fault LED clears. The CIM PEAK and NORM LEDs show the presence and level of the console TX Input Audio signal. The NORM LED is lit when audio is present at normal levels. If the levels are correctly set, the PEAK LED will flash during peaks in speech. If the console audio is too low, the PEAK LED will never light; if levels are too high, it will be lit for more than just brief flashes on voice peaks. The FAULT LED on the CIM is illuminated if it fails its start-up test.

4.9 Remote Control

The SNV-12 may be controlled and monitored remotely via its serial command interface (RS-232 or Telnet) or the web based user interface (see Sections 3.11.3 and 6). As many as three SNV-12s may be connected together to create a voting system of up to 36 sites. This type of expanded system has a Master and two Expansion units; the master unit controls both Expansion units, and only the master can be remotely controlled. The Master then controls each Expansion chassis.

4.10 Manual TX Selection

There are a variety of ways for a dispatcher to control which sites transmit console audio when the console PTT is activated. There are two "Momentary Manual TX Select" modes, one via RS-232 remote control, and the other requiring a momentary low at the rear panel inputs for the chosen site. If either is activated, it controls console TX and Repeat Mode transmissions until the Holdover Timer expires. Two "latched" Manual TX Select inputs similarly control console TX and Repeat Mode transmission routing until the inputs are changed, with no involvement by the Holdover Timer. These two "latched" TX Select versions instead remain in control until the commands are removed: for the rear panel input, until the TXSEL input is allowed to go high; for the RS-232 input, until another RS-232 command reverses the previous command.

4.11 Removal and Replacement of Modules

NOTE: The removal and replacement of system modules should be performed by a trained technician only and should not be performed by the communications system operator

All of the SNV-12 Modules, except the PSM power supply module, can be "Hot-Plugged"; that is, they can be removed and inserted while the unit's main power is on and the unit is operational without any damage resulting. Some temporary disruption of the voting process may result. Changing even an idle Site Voter Module may disrupt a currently voted path. It is best to wait until the entire system is idle before changing a module. Changing a Console Interface (CIM) or Control Processor (CPM) Module will certainly disrupt the operation temporarily, and changing the CPM Module will require the system to be re-initialized (power shut off and back on). If a CIM or SVM module is plugged in very slowly, the CPM may detect the presence of the module, but be unable to verify the revision of software currently residing on it. In this case (or if the replacement module does not have the current software), wait until the software download procedure is complete before proceeding. The power must be turned off and the power cord removed when installing or removing the PSM power supply module.

CAUTION

Turn Power OFF and disconnect the SNV-12 from its AC and DC sources before removing or replacing the PSM-1 Power Supply Module.

End of Section 4

5 Features and Capabilities

5.1 General

This section explains the features and capabilities of the SNV-12. See 8.2 for a list of features supported in various software versions, beginning with revision 2.50. The software or hardware installed in your SNV-12 may not support some features listed.

5.2 Hot Insertion of Modules

In the SNV-12 system any module (except the PSM-1 Power Supply) in the chassis may be inserted or removed with power applied without damage. This doesn't mean modules may be indiscriminately exchanged without temporarily disrupting system operation, so the following cautions apply: Changing even an idle Site Voter Module may disrupt a currently voted path. It is best to wait until the entire system is idle before changing a module. Changing a Console Interface (CIM) or Control Processor (CPM) Module will certainly disrupt the operation temporarily, and will require the system to be re-initialized (power shut off and back on).

5.3 Serial Port

All voter control functions and complete voter status can be accessed via the SNV-12's RS-232 serial port. The serial port connector, located at the rear of the unit, is a DB-9 (female) wired as a DCE interface. The word is fixed at 8 data bits, one stop bit, and no parity. Baud rates selectable on the CPM Module are 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, and 57600. CPM module dipswitch SW1 is used to set the baud rate. See Sections 3.11.3 and 3.12.5.1. The serial remote control protocol is listed in Section 6.

5.4 Serial Control via Telnet

The serial remote control protocol is available via the Ethernet interface using the Telnet protocol. The control protocol used for telnet is identical to the protocol used for the RS-232 serial port described in section 6. Section 6.4 provides details specific to the Telnet port.

5.5 SNR Voting and Noise-Only (FM Mode) Voting

Each Site Voter Module uses a Digital Signal Processor to continuously measure the signal and noise levels of the audio input from each receiver site. The signal measurement is made in the 300 to 800 Hz band by a Raytheon proprietary speech detection and measurement algorithm. The SNV-12 measures not only the energy in this range, but also the amount of syllabic activity. Speech syllables do not consist of continuous energy, but occur at predictable rates and with predictable harmonic content. Noise is measured in the frequency band above 2200 Hz, again using a spectral approach. The Signal to Noise Ratio (SNR) is calculated from the amplitude of calculated signal divided by the amplitude of the noise. The SNR measurement operates from -6 dB to +40 dB. FM systems work best if only the noise measurement is used for the selection of the best site, while the SNR measurement provides optimal voting performance in more noisy AM and HF systems.

The SNV-12 DSP algorithms are designed to vote speech and noise signals. For this reason the unit's voting capability can not be verified by injecting test tones into the receive audio inputs.

In order for a new site to be voted, one SVM must detect a (selectable) better noise level or SNR than the presently voted site, and maintain this difference for a selected voting transition time.

Factory defaults for these settings are 1 dB noise level/SNR difference and a 250 msec voting transition time. This means that if site A is presently voted, site B must maintain a 1 dB noise or SNR advantage over site A for at least 250 msec. in order to be voted in place of site A. Other "voting criteria" may be selected to fine-tune system performance.

Since the majority of voting systems use FM receivers, the factory default voting method is FM Mode. This voting mode is also recommended whenever low to mid-range tones (below 2.2 kHz) are introduced into the audio spectrum for signaling purposes.

To set the SNV-12 to vote based on SNR (AM/HF mode), a dipswitch must be set on each SVM. Note: All SVMs in a chassis must be set for the same mode; there cannot be a mixture of FM and AM/HF settings on the modules.

5.6 Voting Transition Criteria

The SNV-12 will react and vote immediately when signals appear on a previously inactive system (when the voter changes from all sites squelched to one or more sites unsquelched). An adjustable delay timer sets when a voting transition can occur within a system that is currently active (one site already voted). The voting delay settings are from 50 msec to 5 seconds. The purpose of longer delays is to restrict the number of voting transitions that occur when signal conditions vary rapidly. This voting delay time is set by CPM module switch SW4, a 16-position rotary switch.

In order to be voted over the presently voted site, a new site must also maintain a noise or SNR advantage over the presently voted site for the selected transition time. This signal quality level is adjustable, and set by CPM dipswitches SW2-1, 2, 3. See Section 3 for more information on the noise and SNR differences, and on voting delay settings.

5.7 Audio Delay

The Site Voter Modules can provide a variable amount of delay to each RX audio path to compensate for differences in the link delay between the satellite receiver sites and the voter or to compensate for delays elsewhere in the system. This delay is set on **each** Site Voter Module by switch SW1, a 16-position rotary switch. The delay range is 0 to 450 msec in 30 msec steps.

Similarly, the CIM module can add delay to the console transmit audio. This ensures that all audio and PTT signals are set and stable before transmit audio is sent through the voter and the rest of the communications system. The same range of audio delay settings is available.

See Figure 5-1 for a pictorial view of the delay options; descriptions of each follow.

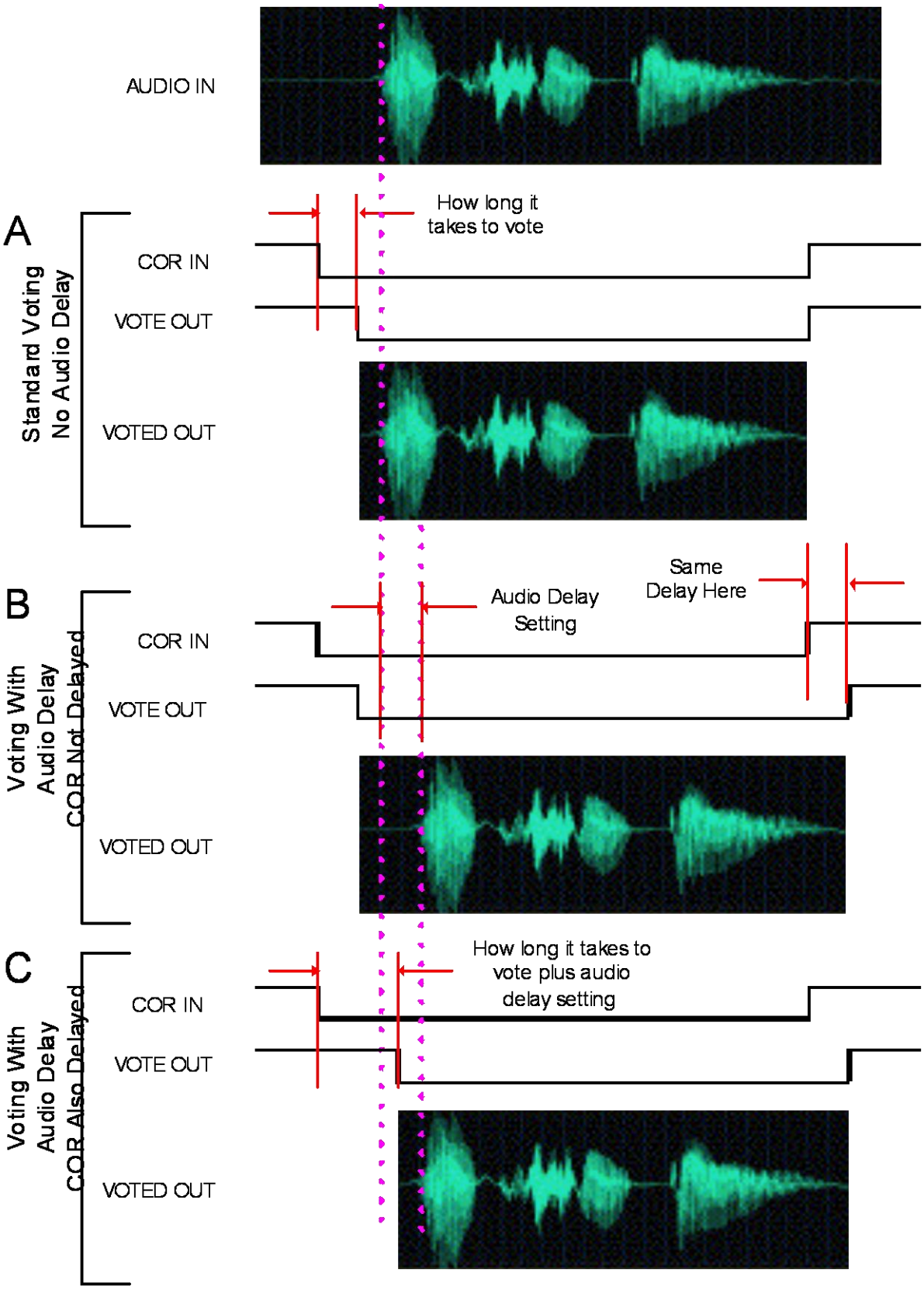

Figure 5-1 RX Audio Delay

Three different RX Audio throughput configurations exist:

5.7.1 A- Standard Voting With No Audio Delay.

The voter processes all signals as quickly as possible. Throughput delay is minimal, on the order of 6 milliseconds. This is simply the duration of the process of digitizing the input, analyzing it in the digital domain (includes measuring signal quality, notching pilot tone, etc.) and returning to analog format.

A longer period of time expires before the system votes and starts passing the voted audio signal. The CPM module must poll all SVM modules, and sufficient noise detector settling time is needed to ensure an accurate initial measurement. Note that a similar detector settling delay would be required if an analog detector, rather than DSP one, were used.

The end of the voting sequence does not have a similar processing delay; this reason is that while the SVM must be told by the CPM to place its audio on the voted audio bus, but it does not require CPM instruction to cut the audio off when its associated radio signals that it has become squelched.

Note that some of the initial RX audio that enters the voter before the voting sequence starts is clipped off. This is normally not noticed as there is typically no audio present this early in the field transmission. If there are other delays in the system (outside of the voter), this initial clipped audio can be problematic. This can be rectified by moving to configuration B.

5.7.2 B- RX Audio Delay; No Delay Added To The Onset Of Unsquelch Declaration

If audio delay is added, but no delay is added to the unsquelch declaration (factory default setting with SVM SW5-4 left Off), the audio is held in a buffer for the set delay time. The unsquelch declaration is not delayed, but the re-squelch declaration is held off for the set delay time so that the end of the RX Audio message is not clipped.

This delay can be set to equal the time it takes to vote plus other delays later in the signal path, thereby ensuring that all audio that reaches the voter while a site is unsquelched will reach the voted out port. When used for this purpose, the same delay should be set to all SVMs.

Note that the vote decision is being made on the undelayed audio.

5.7.3 C- RX Audio Delay; Unsquelch Declaration Also Delayed

If SVM dipswitch SW5-4 is set to On, the unsquelch declaration is delayed along with the RX audio. This is useful if the RX Audio Delay function is used to compensate for a slow to arrive signal by delaying all of the “quicker” SVMs to match up with the “slow” SVM (for example, if an SVM is getting its audio transferred via a network while the others are not). This lines up the entire sequence of a late-to-arrive signal with any SVMs that get an undelayed input. Note that, in this case, the signal quality reporting is delayed as much as the initial unsquelch declaration and RX audio are delayed. This can be thought to as what would happen if an external delay function slowed down the radio signals (audio and COR) coming into an SVM.

In Figure 5-1, the Audio Input signal at the top of the page is the input to an SVM module. For clarity, this is shown using a hardwired Unsquelch input; though the basic functions are the same if pilot tone is used. The UNSQ IN signal denotes the state of the COR input (or pilot tone detect function). The Vote Out control signal shows the time when audio is available at the SNV-12 Voted Audio Output port. Voted Out represents this audio signal.

5.8 Voting Lock (COR Lock)

The prevention of voting transitions in mid-sentence is sometimes desirable. Therefore the SNV-12 provides an optional mode of operation in which the SVM Modules make an initial audio quality decision. The vote occurs, and the SNV-12 locks onto that voted site until the voice transmission is complete and the voted site becomes squelched, at which time the SNV-12 is free to vote again. See Section 2.9.3.3.

CPM SW4 can be used to set the amount of time that SNV-12 will wait, following the initial detection of an unsquelched SVM, before the Voting Lock is put into place. See 3.12.5.4.

5.9 Data Detect & Lock

During the voting of speech signals, voting transitions in mid-syllable will not significantly harm the intelligibility of speech. However, transitions from one receiver site to another in the middle of a data stream may cause bit errors and possible resynchronization problems. The CPM module switch SW3-4 commands the voter to lock onto the voted site when data is detected, and remain locked until the voted site is squelched. See Section 2.9.3.3. The line fault timer is disabled when an SVM module is locked on data. The present standard data is defined as 1400 Hz radio telemetry data; ***this data detect & lock mode was removed from all software revisions above 3.38 in the SVM-1 module, to make room for more commonly requested features***. ***All versions of software with SVM-2 modules support this feature.*** All Data Detection algorithms and software are special order options to the SNV-12.

5.10 COR Types Accommodated

Each Site Voter Module is only eligible for voting only when it determines that its associated voting receiver is sending a valid signal. This determination can be based on an active COR (unsquelched) input from the receiver (pilot tone or hardwired COR line) or deduced by DSP signal measurement. The COR types can be set on a module-by module basis by dipswitches on each SVM. See Section 3.12.6.3. Each SVM can accommodate the following COR options:

- Pilot tones (also called “line-proving” tones).
- Hardwired COR input signal.
- Unsquelched receivers; COR always active. (Not recommended for FM systems.)
- Squelched receivers; Audio Level COR. (Not recommended for FM systems.)

5.10.1 Receiver with Pilot Tone

Most LMR voting systems transfer the remote receiver's COR signal to the voter using a pilot tone which is inserted on the receive audio lines whenever the receiver is squelched, and removed whenever the receiver is unsquelched. When the Site Voter Module detects the absence of the pilot tone, it knows its associated receiver is unsquelched and receiving a transmission. The Site Voter Module supports pilot tone frequencies of 1950 Hz and 2175 Hz. The DSP software positions a notch filter at the selected frequency so that the pilot tone is not heard in the received audio. This also ensures that when voted audio is repeated, the pilot tones are not retransmitted. The tone detect tolerance is +/-30 Hz with notch filter depth better than 40 dB. The selections of pilot tone frequency and Pilot Tone COR type are made by dipswitches on each SVM. See Section 3.12.6.3.

It's possible to reduce the sensitivity of the pilot tone detectors by approximately 7 dB. This may assist operation in environments where local environmental noise such as sirens (or added noise, such as alternator whine) at the same frequency as the pilot tone sometimes causes falsing of the pilot tone detector. Falsing means that the RX audio at the pilot tone frequency causes the SVM to incorrectly determine (usually momentarily) that an SVM is squelched. The pilot tone detector is acting properly based on the frequency content of the RX audio. Reduced sensitivity reduces the falsing without negatively affecting operation as long as the pilot tone is generated at a high level (preferably at the same level as voice audio).

Note: A PTG-10 pilot tone generator can be ordered from Raytheon and installed at a remote site for receivers without pilot tone capability. Its inputs are receiver audio and COR. Its output is two-wire balanced audio that has a pilot tone (when COR the signal is inactive, indicating that the receiver is squelched) or receive audio (when COR is active). The PTG-10 allows the connection of remote receivers to the SNV-12 using only a single pair of wires. See Section 7 for more information regarding the PTG-10. See Table 1-3, Optional Equipment, for ordering information.

5.10.2 Receiver with Hardwired COR Signal

Most FM receivers provide a COR output signal, and if the receiver is installed in close proximity with the voter chassis or linked via microwave this signal can be wired to Pin 13 of the associated SVM terminal block. This signal is expected to be active low (a logic level below 2.5V or a short to ground indicates COR, or signal received). A dipswitch on each SVM module accommodates receivers with active high COR outputs. Again, see Section 3.12.6.3. The SVM-2 Hardwired COR input may be configured by an internal jumper to accept an E&M level COR input. Please refer to Section 0 for E&M interface drawings.

5.10.3 Unsquelched Receiver

When this COR type is selected, the SVM assumes that there is a valid signal present at all times. Its Unsquelched LED will always be lit. If all SVMs use this COR type, all SVM Unsquelched LEDs are lit at all times, and the SNV-12 votes one of these sites based on the best signal quality measured among all sites, even when no receivers are unsquelched. Other SVMs in the system may be set for other COR types, and will be eligible for voting (UNSQ LED on) only if they detect a valid signal based on their COR type (for example, the absence of pilot tone for Pilot Tone COR sites, etc.). The SNV-12 will always select the voted audio signal based on the signal qualities of all eligible sites (UNSQ LED on). In FM Mode the voter selects based on noise only and could vote an Unsquelched COR site with no signal over a different type of COR with a real signal. The Unsquelched Receiver COR option is definitely not recommended for FM systems; it is more suited to AM or HF SSB use. If a COR signal is available from the receiver, either Hardwired COR or pilot tone generators should be used. The Line Fault Detection feature is not operative for SVMs that use this Unsquelch COR type (see Section 5.11). The Holdover Timer feature will also not function if any sites use this COR type because the Unsquelched Receiver COR sites are always unsquelched and the Holdover Timer starts when all sites become squelched. See Section 5.17.

5.10.4 Audio Level COR with a Squelched Receiver

If a COR output signal is available from the receiver, either Hardwired COR or pilot tone generators should be used. If it's impossible to attain a COR signal, the SNV-12 can use a sensitive level-detecting algorithm to allow operation with squelched receivers. This mode will not work well if there is a requirement for repeated voted audio and also may not function well for some systems due to variations in noise levels. If the receive signal when unsquelched is noisier than the squelched signal, the SNV-12 can use this increase in noise level as an indication that the radio is unsquelched.

If there is not a detectable difference in noise between the squelched and unsquelched condition, the SNV-12 can be set to indicate an unsquelched condition (COR active) whenever speech is present. COR is maintained while the increase in signal level is present and for a short Hangtime afterward. The receive audio signal level threshold is individually set on each SVM by switches SW2-5 and 6. Note that it may be difficult to set these thresholds to function correctly in a laboratory setting. The SNV-12 must detect the extra noise from the unsquelched receiver, and keying a handheld transmitter in close proximity to the receiver in a lab may result in a receiver that is so fully quieted that no detectable increase in noise occurs. A communications service monitor should be used when setting these thresholds. Note also that noisy lines may cause a site to become inappropriately unsquelched and voted. Because of noisy lines and/or insufficient unsquelched radio noise, it may sometimes be impossible to attain reliable performance using this COR method. If so, pilot tone generators must be added (see Section 7).

NOTE: Audio Level COR must not be used in conjunction with Repeat Mode. When Repeat Mode is selected, every time a site is voted, the associated transmitter is keyed and retransmits the voted audio. When Audio Level COR is selected, any type of noise burst or momentary static on the receive audio lines to the voter will cause the associated SVM to unsquelch and voting will occur. This will create an unwanted transmission when in Repeat Mode. Since the threshold for detection of COR is the low level of broadband noise present when the receiver unsquelches, low-level noise or static will cause the voter to unsquelch and vote. This is not normally objectionable in non-Repeat Mode. However, the inadvertent keying of the transmitter that can result if Repeat Mode is used with this COR type usually requires that pilot tone generators be added.

5.11 Line Fault (Pilot Tone Fault/COR Fault) Detection

The CPM Module provides continuous line fault detection by monitoring receiver site information from the SVM modules for proper operation. When a site is faulted, the SVM's front panel FAULT LED is lit and the site will not be voted until the fault is cleared.

In applications using pilot tones, the CPM will disable a Site Voter Module if a set Fault Delay time passes after the moment when the pilot tone disappears and before speech arrives. When either speech or pilot tone again appears on that site's audio the fault will be cleared and the CPM will automatically re-enable the failed site. The voter uses the absence of pilot tone as an indication of an unsquelched receiver that is eligible for voting. Line fault detection removes from voting consideration sites that have lost pilot tone due to a loss of link rather than because the receiver has become unsquelched.

In applications using Hardwired COR rather than pilot tones, a site will be disabled if it has continuous COR activity, but no speech is detected for the set time period. This prevents an unsquelched receiver with no voice activity from tying up the system. In COR systems, if voice activity is detected before the timer expires, the timer is reset to zero and starts running again. If the timer runs out, the site will be faulted, the fault will not be cleared until speech is again detected or COR is no longer present.

The fault delay time is the period between loss of COR and the non-appearance of speech. The timer can be programmed to OFF, 5, 15, or 30 seconds. This selection is made on the CPM module by switches SW2-5 and 6. This fault time will be the same for all modules in the system, regardless of COR type, except for SVMs set to the "Unsquelched Receiver" COR type, where COR is always active. The line fault timer will not be activated for these sites. For all other COR types, the timer will start for each module as soon as the SVM's UNSQuelched LED is lit (indicating COR or absence of Pilot Tone). The timer is also inactivated for any SVM when it is locked on data; this prevents line faults during the transmission of long data messages that do not contain speech (see Section 5.9).

5.12 Guard Tone Operation

Each SVM can also be set to use ***Guard Tones,*** alone or with pilot tones, for improved line fault detection. A pilot tone is present on the line whenever the associated receiver is squelched; the lack of a pilot tone should indicate the presence of a valid signal that could be voted on. In some systems, poor line conditions cause intermittent pilot tone loss (for example, a marginal microwave link). Guard tones can be used to remove these sites from consideration for voting immediately upon loss of link, rather than after waiting for the line fault timer to expire. When guard tone operation is enabled, a site is made ineligible for voting any time the guard tone is continuously not present for 100 milliseconds after being acquired (a guard tone is considered *acquired* when it has been detected, without interruption, for two seconds). The site becomes eligible again as soon as guard tone is again detected. The SNV-12 automatically notches the guard tone out of the received audio so it is neither heard by the console nor re-transmitted. There are two standard pilot tone/guard tone frequency options: 2175 Hz and 1950 Hz. If guard tones and pilot tones are both enabled, one will use the 1950 Hz tone and the other will use the 2175 Hz tone. The SVM will not begin guard tone operation until it first detects the guard tone. See Section 3.12.6.3 for settings details.

5.13 SNV-12 Transmit Features

The following is a quick overview of SNV-12 features related to the use of transmitters in a voting system. All features are discussed more fully in subsequent Sections. This overview introduces the basic concepts and definitions that follow and facilitates their understanding.

- Repeat Mode: Voted audio is retransmitted via the ***Default TX Site*** or Sites. Or, when ***RX Groups*** are enabled, the voted audio is retransmitted to all TX sites in the ***STARS*** selected group.
- Default TX Site Selection: The Default TX Site is the site (or sites) that will transmit if the default selection is not pre-empted by automatic (STARS or RX Groups) or manual TX Steering. Options are either a single ***Home Site*** (intended for use with a general coverage broadcast transmitter) or ***Multicast*** to all sites.
- Home Site: The lowest-number SVM (SVM modules in the shelf number from 1 to 12 starting at the left) that is ***TX-eligible***.
- TX-eligibility: All sites are TX-eligible unless they are set up as ***RX-Only Sites*** or are part of an ***RX Group*** that contains a ***Primary Site***, but the SVM is not the designated Primary Site. Primary sites loose TX-eligibility if the primary site experiences a ***Line Fault*** and Group Lockout with Primary Site Failure is enabled. A site may temporarily become unable to transmit if its rear panel PTT Inhibit input is activated; this does not affect TX-eligibility status.
- Multicast: To transmit via all TX-eligible sites.
- Console Priority: Console transmissions take precedence over retransmission of voted audio (when in ***Duplex Mode***) or the voting process itself (when in ***Simplex Mode***).
- Field Priority: Received messages from users in the field take precedence over console transmissions for retransmission of voted audio (Duplex Mode).
- Line Fault: A site is removed from consideration from voting if it is unsquelched but receives no RX audio for a selected time duration.
- STARS: Automatic steering of console transmissions to the "last-best" voted site. When STARS is enabled, all console transmissions are transmitted via only the STARS-chosen site until the ***Holdover Timer*** expires; afterwards they are sent to the Default Site.
- Holdover Timer: A user-adjustable timer that determines how long console transmissions will be steered to a STARS or ***Momentary Manual TX*** selected site.
- Latched Manual TX Selection: The use of RS-232 commands or SVM rear-panel inputs to select which site or sites will transmit Console TX audio. The selection remains valid until the RS-232 command is rescinded or the input is de-activated. Has precedence over ***STARS*** and ***Momentary Manual TX Selection***.
- Momentary Manual TX Selection: The use of a momentary low signal at SVM rear-panel inputs to select which site or sites will transmit Console TX audio. The selection remains valid until the Holdover Timer expires. Can also be commanded by an RS-232 remote control command. Has precedence over ***STARS***.

- RX-Only Site: Each SVM may be configured as an RX-only site; if so, the SVM's TX outputs and front panel TX LED are disabled.
- RX Groups: A number of SVMs may be tied together as an RX Group for transmit-steering purposes.
- Primary Site: if a primary site is designated for an ***RX Group***, the Primary Site handles all transmissions for that group.
- Duplex/Simplex Modes: Most voting systems should be set for Duplex Mode operation. If system receivers and transmitters share the same frequency, Simplex Mode is selected, and special provisions are added: Voting is delayed following console transmissions to prevent voting of console TX squelch tails, and, when the unit is in the Repeat Mode, voted audio is not retransmitted to the voted site.

5.14 Receive Only Sites

Each SVM that uses Hardwired COR or Pilot Tone COR (see Section 5.10) can be configured as an RX-Only Site. If so configured, the SVM is not eligible for transmit by any means. The front panel TX LED will not be lit and the SVM's TX outputs will not be enabled. This feature is not available for Audio Level COR sites. The RX-Only Site feature is enabled by a dipswitch on each SVM.

5.15 Repeat Mode

When in Repeat Mode, the voter will re-transmit voted audio via one or more SVMs. Whenever any site is voted, the Default TX Site's transmit audio outputs will be enabled and contain the receive audio from the currently voted module. There are two basic options available for the Default TX Sites: Home Site or Multicast (see Section 5.16).

Other SNV-12 configuration options affect the SVMs that will retransmit voted audio:

Duplex Mode/Simplex Mode: When the system is set to Simplex Mode, voted audio will not be retransmitted to the voted site. This exclusion can be overridden on a site-by-site basis by a dipswitch (SW3-6) on each SVM module.

RX Group Selection: If the voted SVM is part of an RX Group, its audio will be retransmitted only within its group.

Repeat Mode operation is also referred to as "Voted Site Talkthrough".

5.15.1 Repeat Mode Transmit Hangtime

Hangtime may be used to extend the duration of the voted audio retransmission PTT output beyond the duration of the positive COR indication input. Hangtime durations of 0 seconds, 0.5 seconds, 1 second, and 2 seconds are available. This Hangtime prevents repeaters from unkeying during short pauses in transmissions from remote mobile and portable radios. This is especially helpful when a lot of time is required for a transmitter to key (for example, when the EIA keying tone sequence is used). This Hangtime applies only to the retransmission of voted audio and does not extend console transmissions.

NOTE: Console transmissions have precedence over voted audio retransmission in most configurations. This means that any time the console PTT input is enabled at the same time that a site is voted, console audio will be transmitted instead of voted audio. Incoming messages may be given precedence by switching from "Console Priority" to "Field Priority" by means of a dipswitch on the CIM module. See Sections 5.19.4 and 3.12.2.4.

5.15.2 Repeat Mode and Automatic Transmit Steering

The SNV-12 has two automatic TX steering options: STARS and RX Groups. See details for each in their associated sections. STARS does not affect Repeat Mode TX steering. Retransmission of voted audio always takes place at the Default TX Site selected, regardless of whether or not STARS is enabled. If a voted site is part of an RX Group, voted audio will be retransmitted only to the TX eligible sites in the group, and not via any other sites.

5.15.3 Repeat Mode and Momentary Manual Transmit Steering

Manual transmit selections from the console will route both console and repeat transmissions. Prior to a transmit steering selection, if the Default TX Site selection is Multicast, console transmissions and voted audio retransmissions are both made via all TX eligible sites. If momentary manual TX steering is then used to select a particular site, console transmissions will be made only to that site until the Holdover Timer Expires. If Repeat Mode is also enabled, voted audio is heard at the console and is retransmitted only to the site selected by momentary TX steering until the sequence is ended (when the Holdover Timer expires). This allows the console operator to create a relatively private conversation with the radio users at the TX steered site (usually the voted site).

A possible drawback is that other system users will be unaware that this private conversation is taking place and may attempt to access the voting system. If a user causes a different site to be voted, his audio will be retransmitted only at the manually selected site, and this user will not hear console transmissions (as they are transmitted via the TX-steered site only).

5.15.4 Repeat Mode and "Latched" Manual Transmit Steering

Just as with momentary manual transmit selections, "latched" manual TX steering will route both console and repeat transmissions. Prior to a transmit steering selection, if the Default TX Site selection is Multicast, console transmissions and voted audio retransmissions are both made via all TX eligible sites. If latched manual TX steering is used to then select a particular site, console transmissions will be made to that site until the TX steering command is rescinded (the Holdover Timer is not used with the latched versions of TX steering). If Repeat Mode is also enabled, voted audio is heard at the console and, until the command is rescinded, is retransmitted only to the Latched TX steered site (usually the voted site).

A possible drawback is that other system users will be unaware that this private conversation is taking place and may attempt to access the voting system. If a user causes a different site to be voted, his audio will be retransmitted only at the manually selected site, and this user will not hear console transmissions (as they are transmitted via the TX-steered site only).

5.16 Default Transmit Site Selection

The Default TX Site is the site (or sites) that's normally keyed whenever console PTT is activated "Normally keyed" is when neither automatic nor manual TX steering is choosing the TX site. The two options are:

- Home Site
- Multicast

Home Site: Unless otherwise TX steered, when the Default TX Site selection is "Home Site", all console transmissions and Repeat Mode voted audio retransmissions are sent via the Home Site only. The Home Site is the lowest-numbered SVM in the SNV-12 voting system that is TX eligible. The Home Site transmitter is usually a general-coverage broadcast transmitter.

SVM numbering for a single chassis system starts with the SVM closest to the CPM-3 module (the left-most SVM) and continues to the right, for SVMs numbering 1 through 12. For multi-chassis systems, the Master SNV-12 contains SVM slots 1 through 12; the Expansion #1 chassis contains SVMs 13 through 24, and Expansion #3, SVMs 25 through 36. The Home Site remains the lowest numbered TX-eligible site. SVM numbering does not change if some SVM slots do not contain modules. For example, if there is no module in SVM slot #1 (the left-most slot), the SVM in slot #2 is still numbered as SVM #2. All SVM slots are TX eligible unless:

- No SVM is present.
- An SVM is configured as "RX-Only".
- An SVM is part of an RX Group, that group has a designated Primary Site (or Sites), and the SVM is not a Primary Site.

If the current Home Site loses its TX eligibility, the Home Site status moves to the next-highest numbered SVM that is TX eligible.

A site may be made temporarily unable to transmit if its PTT Inhibit input is activated on its rear panel terminal block. The PTT Inhibit input does not affect TX eligibility. This means that, if the TX Default site is the Home Site, and the PTT Inhibit input is activated on the Home Site, the Home Site Status does not move to the next-highest numbered site. Therefore, no site will be keyed unless TX Steering selects a TX eligible site other than the Home Site.

Note: A Line Fault indication does not cause a site to lose its TX eligible status unless the failed site is a designated primary site and the "Group Lockout With Primary Site Failure" option is selected. This means that, if the receiver at the Home Site fails, the SNV-12 will continue to key the Home Site transmitter.

Multicast: Unless otherwise TX steered, when the Default TX Site selection is "Multicast", all console transmissions and Repeat Mode voted audio retransmissions are sent via ***all*** TX eligible sites. The only exception is that when the SNV-12 is in the Simplex Mode, retransmitted voted audio is not sent to the voted site.

NOTE- When the Default Transmit Site Selection is the "Home Site", the home site should be a general coverage transmitter that will provide adequate RF coverage in the required service area. When multicast is used, attention should be paid to prevent the possibility of simulcast overlap problems.

5.17 Holdover Timer

For some forms of transmit steering, a ***Holdover Timer*** controls how long the console transmissions (and/or voted audio retransmissions) will remain steered to the chosen site. When the Holdover Timer expires, console transmissions revert to the Default TX Site selection. The Holdover Timer is programmable; selections range from 3 seconds to infinity (see Section 3.12.5.3).

It's important to note that the selected Holdover Timer duration setting does not set the overall length of time that console transmissions are sent to a TX steered site. Rather, it sets how long the console PTT must remain inactive before the most recent TX steering sequence is considered complete. That is, console transmissions will continue to be sent to the TX steered site as long as the console operator continues to communicate with the selected site(s).

The Holdover Timer is refreshed every time the Console PTT is activated, and starts running anew as soon as the Console PTT is de-activated. Therefore, console transmissions continue to be TX steered until the console operator maintains a PTT-inactive state for a time greater than the set Holdover Timer duration. Once the Holdover Timer expires, console transmissions revert to the Default TX Site selection.

One of the Holdover Timer options is "infinite", which basically disables the timer, so that all console transmissions are sent to the last TX steering chosen site until a TX steering chooses a new site, either by voting (STARS), or by manual TX steering.

The Holdover Timer feature does not function well if any modules use the "Unsquelched Receiver" COR type (see Section 5.10), as there will ***always*** be a voted site when this COR type is present.

5.17.1 Holdover Timer With STARS

Whenever STARS chooses a site (or RX Group) for TX steering, all console transmissions are routed to that site until the Holdover Timer expires. Note that if the console operator is having a discussion with the radio user at the TX steered site, the Holdover Timer is restarted both when the console transmits, and when the remote radio user transmits. This is because STARS will choose the voted site again, starting an entirely new sequence, after each vote. This means that console transmissions will continue to be steered by STARS until both the console operator, and the remote radio operator, fail to activate either of their PTT inputs for the entire duration of the timer.

If a different satellite receiver site becomes voted before the Holdover Timer expires, STARS will switch to the new site and subsequent transmissions will be sent there. This new site vote could be due to the original radio operator moving during the conversation with the console operator, or because an entirely different remote radio user has decided to access the voting system. An ongoing STARS-chosen TX-steered discussion can also be interrupted at any time by manual TX steering, which has precedence over STARS.

5.17.2 Holdover Timer With Momentary Manual TX Steering

The Holdover Timer is also active when TX steering selections are made via the MOM TX SEL input on the SVM's rear panel terminal block or by the RS-232 MOM_TXSEL command. Once a momentary transmit command is made, the Holdover Timer starts. Console transmissions and repeat transmissions will be steered to the chosen site until the holdover timer expires. The timer is refreshed every time the console PTT is activated and begins to run again as soon as the PTT is deactivated. Voted audio from the field does not reset the timer. Transmit selection remains with the chosen site until either the Holdover Timer expires or another site is manually selected (both manual TX steering modes have precedence over STARS).

5.17.3 Holdover Timer With Latched Manual TX Steering

The Holdover Timer does not come into play when non-momentary Manual TX Steering is used. For these "latched" versions, the console transmissions and repeated transmissions will be steered to the chosen site until the TX steering request is removed. When the rear panel "TX Sel In" input is pulled low, the site will be TX steered until the input is allowed to return high. If the RS-232 TXSEL command is issued, the specified site will remain TX steered until a subsequent RS-232 command removes this selection.

5.17.4 Holdover Timer Examples

STARS, single site:

Start with no activity. The TX SEL site is the Default TX Site.

- A site gets voted. TX SEL switches to the voted site.
- When the vote ends, the TX SEL stays with this voted site for the duration of the holdover timer, then returns to the Default TX Site.

STARS, multiple sites:

Start with no activity. TX SEL is the Default TX Site.

- A site gets voted. TX SEL switches to the voted site.
- A new site gets voted before all sites resquelch. Once the STARS weighting balance switches to the newly voted site, it becomes the TX SEL site. If it doesn't stay voted long enough (that is, more time in the previous 5 seconds than any other site) then it won't become the TX SEL site.
- When the vote sequence ends, the TX SEL stays with the site that last had this designation during the vote for the duration of the holdover timer, then returns to the Default TX Site.

Mom TX, single site:

Start with no activity. The TX SEL site is the Default TX Site.

1. A site is selected by Mom TX as the TX SEL site. The holdover timer starts running as soon as it's invoked. When it runs out, the TX SEL site designation returns to the Default TX site.
2. If the Mom TX is invoked again on the same site before the holdover timer expires, the timer is reset and starts anew.

Mom TX, multiple sites:
Start with no activity. The TX SEL site is the Default TX Site.

- A site is selected by Mom TX as the TX SEL site. The holdover timer starts running as soon as it's invoked. When it runs out, the TX SEL site designation returns to the Default TX site.
- If the Mom TX is invoked again on a different site before the holdover timer expires, this site immediately becomes the TX SEL site timer is reset and starts anew.

Mix STARS & Mom TX:
Start with no activity. The TX SEL site is the Default TX Site.

- A site gets voted. TX SEL switches to the voted site.
- While the site is voted (or afterwards, but before the holdover timer runs out), Mom TX is invoked. The TX SEL site switches immediately to this site, as it has precedence over STARS. The Mom TX holdover timer starts.
- When all sites resquelch, the site that would have been the TX SEL site chosen (as chosen by STARS) begins a STARS holdover timer.

Assuming no further activity, both holdover timers continue to run, but the timer associated with the Mom TX selection has precedence.

- If the Mom TX select timer runs out first, the TX SEL site will then switch over to the STARS chosen TX SEL site until the STARS holdover timer runs out. This condition will occur if any site [other than the Mom TX site or Default TX site] stayed voted after the last time the Mom TX selection was invoked, or a new site [again not the Mom TX or Default TX site] became voted and was voted long enough for it to become the new STARS site.
- If the Mom TX holdover timer runs out last the TX SEL site designation simply returns to the Default TX site.

5.18 Receiver / Transmitter Groups

The Voter can group multiple receivers around individual remote transmitters. ("RX Groups" are sometimes referred to as "TX Groups".) Each SVM Module has three switches (see section 2.9.4.4) that determine the group that its receiver is associated with. Each site has two basic options:

- Not belonging to any group (set for "group 0").
- Belonging to a group numbered 1 through 7.

When RX Groups are selected and STARS is enabled, console transmissions are routed to all transmitter sites in the group containing the "last-best" voted site. See 4.18 for an explanation of the STARS automatic TX steering algorithm.

An additional switch may be used to select a ***primary site*** for any group. If it's important that transmissions are routed to only one SVM in the voted group, or if "Group Lockout with Primary Site Failure" is desired, then a primary site must be designated. When a primary site is selected for a group, console transmissions will be routed only to the primary site SVM, rather than to all transmit-eligible SVMs in the voted group. If more than one site in a group is designated as a primary site, console transmissions will be routed to each of the group's primary sites.

As with some of the other available TX-steering formats, a Holdover Timer determines how long console transmissions are steered to the selected group. When the timer has expired, console transmissions are sent to the Default TX Site.

Note that a voting system may contain a combination of group and non-group sites. If a non-group site is voted, the system reacts as if there were no groups. This simply means that the unit does not treat sites that have no group selected as a collective "Group Zero"; these sites continue to be treated as individual sites. If STARS and Groups are enabled and a non-group site is voted, that single site is then selected for console transmissions as long as the Holdover Timer is running.

5.18.1 Group Operation and Repeat Mode

If Repeat Mode is enabled and an RX Group is voted, voted audio is retransmitted only to all TX eligible sites in that group (or only to the group's Primary Sites, if any are designated).

If a voting system has Repeat Mode enabled and contains sites that are grouped as well as sites that are not in groups, and a non-group site is voted, voted audio is retransmitted based solely on the Default TX Site selection, and not on which other sites may be group members.

5.18.2 Group Lockout With Primary Site Failure

When RX Group operation is enabled, the Group Lockout with Primary Site Failure feature may also be enabled. The purpose is to prevent voting any sites in a group with a faulty transmitter. This ensures that console transmissions will not be steered solely to a bad transmitter at the group primary site. Since the SNV-12 has no means to determine when a transmitter has failed, it can assume that if the receiver at the transmitter site has failed, the transmitter is also down. Any time this feature is selected, a line fault at a group primary site locks out the entire group, removing all member sites from consideration for voting until the fault is cleared. This feature is selected by dipswitch SW3-6 on the CPM module. Group Lockout can be overridden by Manual TX Steering.

5.19 Console Transmissions / Transmit Steering

Normally, console audio is transmitted via the Default TX Site (or sites) whenever the console PTT input is asserted. There are three methods to cause other sites to be keyed instead- Automatic TX steering, Manual TX Steering, or Function Tone Guided TX Steering.

5.19.1 STARS (Automatic Transmit Steering)

In many voting systems, a console operator must quickly respond to a message coming in from one of the satellite receiver sites; the operator's response must be routed to the transmitter closest to the receiver that best heard the incoming message. The SNV-12 can be set to provide automatic routing of console transmit audio and keying signals to the proper transmitter site. When automatic Transmit Steering is enabled, the CPM module selects a transmitter for the dispatcher's reply based on the history of which receiver site was voted best during the end of the voting sequence, not only on which receiver was voted last. This automatic TX Steering is called STARS, which stands for ***S**mart **T**ransmit **A**nd **R**eceive **S**teering*. It's enabled by CPM switch SW2-7.

The following scenario illustrates the importance of the STARS algorithm:

Assume a mobile operator transmits a request for vital information from the dispatcher. His transmission reaches three satellite receivers in the voting system, and all three receivers have associated transmitters. The SNV-12 detects the absence of pilot tone at these three receivers, making all three eligible for voting. The voter's signal quality measurements show that site #1 is a bit better than site #2, and site #3, which is far away, has a barely intelligible signal. Site # 1 is voted and the dispatcher hears the mobile operator's request. Now it's important that the dispatcher's response be relayed through the transmitter at site #1, but without the STARS system, it's possible that the dispatcher's reply will be routed to site #3.

This can easily happen if the pilot tone of the receiver at site #3 recovers more slowly than the pilot tones of the other two. This implies that following the end of the mobile transmission; site #3 will take longer to indicate it has become squelched. For this short time, Site #3 is the only unsquelched site, and as the only site then eligible for voting, the barely intelligible site #3 is momentarily voted. A standard, non-STARS, transmitter steering function would then route the dispatcher's message to the last voted site: the distant site #3. STARS, however, will correctly exclude site #3 as having been voted for only a short period of time at the end of the overall transmission from the mobile operator, and the dispatcher's reply will be correctly sent via the nearby transmitter at site #1.

The STARS chosen site is indicated by the TX SEL LED on an SVM's front panel. In addition, rear panel outputs are available that allow the Transmit Select status to be sent to external equipment.

When receiver group operation is enabled along with transmitter steering, the STARS algorithm will steer the dispatcher's reply to either the entire group that contained the best-voted receiver, or only to the group's selected primary site transmitter.

Console transmissions are sent to the STARS selected site or RX Group until the Holdover Timer expires. See Section 5.17.

5.19.2 Automatic TX Steering Related to RX Group Designations

See "Receiver / Transmitter Groups", Section 5.18. If STARS is enabled and group numbers for a collection of sites designated, whenever any site in a group is last/best voted, subsequent console transmissions are automatically steered to all transmit-eligible sites the group.

5.19.3 Manual Transmit Steering

The dispatcher can manually select which sites' transmitter(s) will be used for console and repeat transmissions. This manual selection will override the Default TX Site selection, RX Group designations, Group Lockout with Primary Site Failure, and STARS. It cannot be used to transmit from an SVM that has been designated as RX Only. A manual transmit steering selection can be made by any one of the following methods:

- Providing a constant logic low to the TX SEL IN input of the desired SVM
- Issuing a Transmit Select RS-232 command (TXSEL)
- Providing a momentary logic low to the MOM TX SEL IN of the desired SVM
- Issuing a Momentary Transmit Select RS-232 command (MOM_TXSEL)

When manual transmit steering is discontinued (all transmit select inputs allowed to return to normal and RS-232 transmit select commands turned off) console and repeat transmissions will revert to where they would have been sent if they had not been overridden. Manual Transmit Steering is not affected by RX group selections (including primary site designations). Manual TX steering commands do not take effect during a transmission. That is, if the voter is transmitting via site #3, and manual TX steering commands select site #8, the unit will continue to transmit via site #3 until the current transmission is complete. As soon as the voter unkeys, the manual TX selection takes effect, and the next transmission will be made via the manually selected site #8 (if this site selection is still in effect).

5.19.3.1 TX SEL IN input of SVM (Latched TX Selection)

If a logic low is provided to an SVM's TX SEL IN input at its rear panel terminal block, console and repeat transmissions will be routed to the selected site as long as the input remains low. If multiple TX SEL IN inputs are pulled low, all chosen sites will transmit. The terminal block TX SEL IN input works in parallel with the RS-232 TXSEL commands. This means that if the terminal block input is used to select site 5 and an RS-232 TXSEL command is used to select site 11, transmissions will be routed to both sites.

5.19.3.2 RS-232 Transmit Select (Latched TX Selection)

The RS-232 serial remote control TXSEL command provides a remote means to control which site or sites will transmit both console and repeat audio. This command will override both STARS and momentary transmitter selections. The specified site remains selected until deselected via RS-232. See Section 6.

5.19.3.3 Momentary TX SEL IN of SVM

If a momentary logic low is provided to the SVM's rear panel MOM TX SEL IN input, console and repeat transmissions will be routed to the selected site for the duration of the Holdover Timer or until another site is selected. The TX site changes when:

- The Holdover Timer (which starts when the input goes low) expires; this returns TX control back to the Default TX Site selection. The Holdover Timer is refreshed each time the console PTT is activated.
- Another momentary selection is made either by MOM TX SEL IN or RS-232 MOM_TXSEL. This switches transmitter selection to the newly selected site and resets the Holdover Timer.
- A logic low is applied to TX SEL IN or the RS-232 TXSEL command is issued.

5.19.3.4 RS-232 Momentary Transmit Select

Unlike the TXSEL RS-232 command, which must be rescinded to return keying to the Default TX Site selection, the MOM_TXSEL RS-232 command needs to be sent only once; afterwards, the specified site remains TX selected only until the Holdover Timer expires. The TX selected site will function and change under the same conditions as described for the MOM TX SEL IN logic input.

5.19.4 Console / Field Transmit Priority

The voter can be set up so that either the presence of an active Console PTT has priority, or the fact that any site is voted takes priority (field priority). When the voter is in the Duplex and Repeat Modes, this priority selection decides which audio source will be transmitted whenever these two conditions occur simultaneously. When the unit is in Simplex Mode (repeat or non-repeat) this priority determines whether the console will be able to break into a voted message coming in from the field. Each of the possible combinations of states is detailed below.

5.19.4.1 Console / Field Priority when in Simplex Non-Repeat

Console Priority (default): If a site is currently voted and console PTT is asserted, the voting sequence ends and the voter transmits the console audio.

Field Priority: While any site is voted, console PTT is ignored. This prevents the console operator from breaking in on an important message from a remote user (for instance, this may be used for a public safety system that has emergency units calling in). It is not possible for voting audio to break into a console transmission. When in simplex mode, voting cannot occur until a console transmission ends.

5.19.4.2 Console / Field Priority when in Simplex Repeat

Console Priority (default): If a site is currently voted and this voted audio is being retransmitted when console PTT is asserted, the voting sequence ends and the voter transmits the console audio.

Field Priority: While any site is voted and the voted audio retransmitted, console PTT is ignored. This prevents the console operator from breaking in on an important message from a remote user (for instance, this may be used for a public safety system that has emergency units calling in). It is not possible for voting audio to break into a console transmission. When in simplex mode, voting cannot occur until a console transmission ends.

5.19.4.3 Console / Field Priority when in Duplex Non-Repeat

Since duplex mode allows simultaneous voting and console transmissions, neither can take precedence over the other, so this feature has no affect unless the unit is also in the Repeat Mode.

5.19.4.4 Console / Field Priority when in Duplex Repeat

Console Priority (default): If console PTT is asserted while a site is voted (and this voted audio is being retransmitted), the voting sequence continues, but the voter transmits the console audio instead of the voted audio until the console PTT ends.

Field Priority: While any site is voted, console PTT is ignored. If a console transmission is under way while a site becomes voted, the console transmission ends and is replaced by retransmission of the voted audio.

5.19.4.5 Console Priority and Console Hangtime

When hangtime is added to the console transmissions, and console priority is selected, the console priority is not enforced during the hangtime period. This means that, after the console TX input is deactivated, but before the voter unkeys following the end of the hangtime duration, a voted site can take over the TX audio output.

5.19.5 Transmit Site Selection Indication

Each SVM-2 module has a TX Select LED on its front panel to indicate if that site is currently selected for transmit (this site will be keyed if the voter is put into the TX mode). Since there is no separate LED on the SVM-1 module, the SELECT LED on each SVM-1 has dual roles: If lit steadily, these LEDs indicate which sites have been "force voted", and when flashing they provide the TX Site Selection Indication.

5.19.5.1 Rear Panel TX Site Selection for SVM-2

The SVM-2 has a separate output pin (Term Block pin 9) that goes low to indicate when the site is TX-selected. This pin is not available on earlier-revision SVM-2s. If the SVM-2 does not have a JP6 jumper installed in the lower right corner, it's an early revision without this output. The dual-use output pin described in the next section for the SVM-1 may be used.

5.19.5.2 Rear Panel TX Site Selection for SVM-1

Rear panel terminal block pin 16 may either be "Unsquelch Out" or "TX SEL OUT". When set for "Unsquelch Out" this output goes low if the associated SVM detects an unsquelched indication from the connected receiver. When set for TX SEL OUT, the output goes low whenever the associated site is transmit selected. The function of pin 16 is determined by the position of SVM dipswitch SW2-5.

NOTE- The TX SEL OUT logic output at Term Block Pin 16 is not enabled unless either the hardwired COR or the pilot tone COR mode is used. If audio derived COR is used, the switch position sets the COR threshold and the TX SEL OUT terminal defaults to "Unsquelch Out".

It's important to note that the TX-selection indicators shows which SVMs would be placed in the transmit mode if the Console PTT inputs are activated, and are NOT an indication of sites that will be keyed to retransmit voted audio when the unit is in the Repeat Mode. The sites that would be keyed to retransmit voted audio are frequently the same sites, though this is not always true. For example, when the SNV-12 is set for Simplex Repeat operation, multicast console audio is transmitted via ***all sites***, while voted audio is retransmitted via ***all sites except the voted site.***

5.19.5.3 TX Site Selection Examples

- Start with the SNV-12 set per the following:

Repeat Mode off, STARS and RX Groups off, Default TX Site is Multicast.

When the SNV-12 is first powered up, TX Select LEDs of all SVM-2s will be lit (and the Select LEDs of all SVM-1s will flash… the remainder of this explanation will assume that SVM-2s are installed, but the SVM-1 would function identically with flashing Select LEDs instead of individual TX Select LEDs). If Console PTT is activated, the TX outputs of all SVMs will be activated and console audio will be sent via all SVM TX Audio Outputs. When any site is voted, all TX Select LEDs remain illuminated, as automatic TX Steering (STARS) is not enabled and repeated audio is sent to all SVM TX audio outputs. If manual TX Steering is employed, only the manually TX steered site will show the TX Select indication. If the "Momentary" versions of Manual TX Steering are used, the sites selected for TX will revert to multicast as soon as the Holdover Timer expires. If either of the non-momentary versions is used, the TX site selection will remain with the manually selected site until the manual selection is de-asserted.

- Now set SVMs #6 and #8 as RX-Only Sites.

Operation is identical, except that SVMs #6 and #8 will not transmit and their TX Select LEDs will not be illuminated. If either of these sites is manually TX selected, the SNV-12 will simply ignore the request, as they are RX-Only sites.

- Now turn on STARS, with the Holdover Timer set for 10 seconds

Initial operation will not change, as STARS has no effect until a site is voted. Assume that site #5 is voted; STARS now steers all console transmissions to site #5 only, until there is no communication from either the console or from site #5 for a continuous 10 seconds. Therefore, only site #5 will have a TX Select LED indication. When the 10 seconds elapse (the Holdover Timer has expired), the system will revert to sending all console transmissions to the Default Site. In this example, the Default Site Selection is Multicast; so all TX Select LEDs (except for the RX-Only sites #6 & #8) will be lit.

Now assume that one of the RX-Only sites is voted. Since this site cannot be keyed, the voter reverts to keying the Default TX Site, which in this example is still set to Multicast.

- Now set up an RX group, which includes the RX-Only sites #6 and #8.

Assume that there are several satellite receivers, but only one transmitter (at site #7), covering the area where sites 6, 7 and 8 10 are located. Set up sites 6 through 8 as an RX group. Now if any of the sites in the group is voted, STARS chooses the entire group for TX steering. Since site #7 is the only TX-eligible site in the group, only it will be keyed by a console transmission, and only it will have its TX Select LED lit.

If the SVMs for sites #6 and #8 had not been set up as RX-only sites, they would also be TX eligible, and, if any site in the group is voted, the TX Select LEDs for all three sites in the group would be lit until the Holdover Timer expires. Note that if site #7 were now designated as the Primary Site for the RX Group that includes sites 6 through 8, the system operation would be the same as for the group with no Primary Site and sites #6 and #8 configured as RX-Only sites.

- Go back to the fully factory-default voter, with one exception: The Default TX Site is changed from Multicast to Home Site.

When initially powered up, the SNV-12 will light the TX Select LED(s) of the Default TX site. Since the Default Site selection is now the Home Site, only the Home Site (the lowest-numbered TX-eligible site) will illuminate its TX Select LED. This will be the SVM in the left-most slot, alongside the CPM module.

- Now set SVM #1 as an RX-Only site.

Since SVM #1 is no longer TX-eligible, the Home Site is now site #2, and all console transmissions will be sent by SVM #2 only.

- Now turn on STARS

Since automatic TX steering is enabled, console transmissions will be sent via the STARS-chosen site until the Holdover Timer expires. When the unit is first powered up, the TX Select LED of the Home Site (now SVM #2) will be lit. If site #4 is voted and chosen by STARS, only the TX Select LED of SVM #4 will be lit, and console transmissions will be sent to site #4 until the Holdover Timer expires. At that time, they will revert to the default site, and only the TX Select LED of SVM #2 will be illuminated.

5.19.6 Vote Indication Hold After Squelch

Another method of indicating transmit selection is by use of the "Vote Indication Hold After Squelch" option. When this feature is enabled, the front panel VOTED LED will indicate the currently voted site during the normal voting sequence. When the voting sequence ends (because all sites become squelched) the VOTED LED will instead indicate the site picked by STARS. This will usually be the same site as the last voted site. The VOTED LED will stay lit until the Holdover Timer expires or a new site is voted and picked by STARS for TX steering. The terminal strip Voted Out output of the STARS site will also be active during this time. A dipswitch on the CPM-3 module enables this feature. STARS TX steering must also be enabled for this feature to be functional. Note also that the STARS site can always be identified via the RS-232 status information (see Section 6).

When the STARS site choice is over-ridden by a manual select input, the selected site replaces the STARS chosen site and the VOTED LED and rear panel Voted Output switch to this manually selected site. After the manual select input is re-asserted, the Voting Indicators will remain active on the manually selected site until that site is no longer the site chosen by STARS to steer TX audio.

The use of the flashing Select LEDs to indicate transmit site selection was added with software version 3.33 to replace this "Vote Indication Hold After Squelch" feature. The SVM-2 further improved TX Site Selection indication with separate LEDs and rear panel outputs, making the "Vote Indication Hold" feature much less useful. However, this feature has been retained in order to allow customers who use the feature to continue to do so.

5.19.7 Transmit Audio Delay

Transmit audio may be delayed to ensure all audio and PTT paths and signals of the communications system are set and stable before transmit audio is passed through the voter to the rest of the communications system. See Sections 3.12.2.2 and 5.7.

5.20 KEYING TONE DETECTION AND GENERATION

The SNV-12 can both detect and generate keying tones. Keying tone detection refers to monitoring the Console TX Input audio and activating the Console PTT Input when keying tones are present. Keying tone generation means the desired tone key format is mixed with the transmit audio output. The voter can detect and generate a variety of key tone standards. Keying tone detection and generation are accomplished by DSP algorithms in the CIM module. The voter can be set to generate keying tones but not detect them, detect but not generate, or detect and generate. If keying tone detection and generation are both selected, the input keying tones are not retransmitted; instead, the input tones are removed and new output keying tones are generated and added to the SVM TX audio outputs. The SNV-12 can also be set to steer console transmission based on the function tone detected in the Console TX Audio Input.

5.20.1 Simultaneity of Hardwired I/O

The Hardwired PTT inputs and outputs (Console PTT In at P2-12 and Site PTT out at pin 18 of each SVM terminal block) remain active and enabled when the keying tone functions are selected. This means that, when Keying Tone Detection is selected, the console PTT input can be activated either by the presence of a keying tone in the Console TX Input audio or by a logic low on the Console PTT Input. Also, when an SVM's TX Audio Out contains keying tones, that SVM's Site PTT Out output will be in an active low state.

5.20.2 Keying Tone Detection and Repeat Mode Control via EIA

The SNV-12 will detect the EIA Keying Tone sequence in the Console TX Input. This keying tone standard consists of a 125 msec long, 2175 Hz, "high guard tone", followed by one of a variety of "function tones" for a 40 msec duration, followed by a 2175 Hz "low guard tone" or "hold tone" that is present for the duration of the transmission sequence. The F1 single function tone mode detects only the F1 function tone (1950 Hz). Console PTT Input is considered active when the 1950 Hz function tone is replaced by the low guard tone, and remains active as long as the low guard tone is present (also called "hold tone"). A DSP notch filter removes the low guard tone from the audio passband so it will not be re-transmitted. If the EIA standard will also be used to key repeaters or transmitters attached to the voter, the voter will regenerate the key tones.

An EIA High Guard/Function Tone Sequence can also turn on the Repeat Mode (1550 Hz function tone) or turn it off (1450 Hz tone). The hold tone is not required. There have been incidences of inadvertent changes in the Repeat function. To prevent this, keep CPM SW1-5 ON unless the system will make use of EIA tones to control repeat mode. See Section 3.12.5.1.

NOTE: Keying Tone Detection requires updated software and hardware.

The software version installed in the CPM must 3.38 or higher, and if a CIM-1 module is used, it must be assembly revision "L" or higher. See Section 8 regarding software revision determination. The assembly revision of any CIM-1 can be found by examining the top right corner of the module's component side. The revision letter is stamped in the white oval that follows the assembly part number 5951-806000.
Consult Customer Service regarding upgrades.

5.20.3 Function Tone Guided TX Steering (Multiple Function Tone Detection)

When Function Tone Guided TX Steering is enabled, the SNV-12 steers console transmissions based on the function tone that's detected in the Console TX Audio Input. Seven different function tones can be detected. Each tone can cause any SVM or group of SVMs to be put into the transmit mode. The RX/TX Group switches are used to match up function tones to SVMs keyed. ***Because of this, RX/TX groups cannot be used when this feature is enabled.*** The table below shows the function tones that may be detected and which switches must be set on the individual SVMs to cause them to be put into transmit mode when that particular function tone is detected in the Console TX Audio Input. There are no restrictions as to which SVMs (or how many SVMs) are set to any particular Function Tone Group.

* Indicates the factory default switch setting.

Table 5-1 Function Tone Guided TX Steering Selection

SW3-1	SW3-2	SW3-3	Function Tone
OFF	**OFF**	**OFF**	**Not Keyed by Any Function Tone ***
ON	OFF	OFF	Group 1 -1950 Hz
OFF	ON	OFF	Group 2 -1850 Hz.
ON	ON	OFF	Group 3 -1350 Hz.
OFF	OFF	ON	Group 4 -1250 Hz.
ON	OFF	ON	Group 5 -1150 Hz.
OFF	ON	ON	Group 6 -1050 Hz.
ON	ON	ON	Group 7 - 950 Hz.

When this feature is enabled and the EIA sequence is detected with the 1850 Hz function tone (for example), all SVMs set to Group 2 will be keyed as long as the Low Guard Tone (hold tone) is detected in the Console TX Audio.

To enable the Function Tone Guided TX Steering feature, CIM module dipswitches must be set SW2-6 On (to enable function tone detection at the Console TX Audio Input), and SW2-1 Off, SW2-2 On, SW2-3 On (to enable the TX Steering function).

This feature affects EIA Keying Tone detection; it does not affect Keying Tone generation. The Keying Tone Generation feature as described below controls any keying tones generated by the SVMs. The standard output keying tone function tone is 1950 Hz, but three other function tones are available.

The following characteristics apply to Function Tone Guided TX Steering:

- The standard Console PTT logic-level input remains functional. The Default TX Site will be keyed when this input is active unless manual or automatic TX Steering (STARS) is used (similar to operation when Function Tone Guided TX Steering is not enabled).

  Note that the console PTT input should not be activated while the voter is keyed via function tone guided TX steering.
- All site keying is done by EIA keying with a 1950 Hz tone (or other as set by rear panel P2 and P3 inputs, see Sections 5.20.4 and 3.12.2.3.
- Standard TX/RX Group operation is not allowed when Function Tone Guided TX Steering is enabled. These switches only set each SVM's relationship to the function tone detected.

  Do not enable primary sites for TX/RX groups.
- In order for this feature to function properly, the CIM module must have two non-default settings: SW2-6 to enable Key Tone Detection, and SW2-1, -2, -3 set to enable Function Tone Guided TX Steering. Also, the individual SVM group switches must also be set to direct which SVMs are keyed by the different function tones (see above).
- If there is no SVM whose group switches correspond to the function tone detected in the CIM Console TX Audio input (or that site is set as RX-Only), no SVM will be keyed. There are no provisions to key the Default TX Site under this condition.

5.20.4 Keying Tone Generation

When configured to generate key tones, the SNV-12 will add the desired key tone format to the Console TX audio input before it is sent to the TX audio output bus. If the unit is set to the Repeat Mode, the tones are also added to repeated voted audio retransmissions.

Using an on-board DSP, the CIM module mixes the keying tones with the audio it sends to the selected transmitter or transmitters via the SVM TX Audio outputs. Available constant tones are 1950, 2175, 2600, and 2950 Hz. Alternatively, the EIA tone-keying standard may be selected, with 4 different function tone options. (See 3.12.2.3). This sequence uses a 125 msec high guard tone, followed by a 40 msec duration function tone, and then a constant low guard tone that is mixed with the transmit audio for the remainder of the transmission. Transmit audio is muted during the transmission of the high guard and function tones. Note that the High guard tone is set at 10 dBm above average voice audio. The maximum output capability of the SVM module TX ports is +10 dBm, so if the EIA keying sequence is used, regular program audio must not be set above 0 dBm.

The TX Hangtime settings also apply to tone keying operation. When single-tone keying is selected, the keying tone remains present for the set Hangtime after the repeat PTT input is no longer active. When the EIA tone sequence is used, the low guard tone (also called the hold tone) remains present for the set Hangtime following the de-activation of PTT.

5.21 Duplex and Simplex Modes

Duplex Mode should be used at all times unless the voting system has transmitters and receivers operating on the same frequency or uses half-duplex transceivers. In Duplex Mode, the voter continues the voting process while the console PTT is active. If automatic or manual TX steering is activated while the console is keyed, the voter will not switch to the newly selected TX sites until the console unkeys and keys again. The voter never switches transmit sites in the middle of a transmission.

When set to Simplex, voting is inhibited and voted audio is muted whenever console PTT is active. Since simplex systems transmit and receive on the same frequency, this voting inhibit during console transmissions ensures that receivers do not vote the console audio. The SNV-12 will also hold off voting for an adjustable time period following the completion of a console transmission. This guarantees the voter does not vote the squelch tail that follows that transmission. When a console operator is letting the STARS algorithm select a site for transmission, and sends several replies to the selected site; the voting hold off ensures the voter does not vote the squelch tail of one of these replies, which could cause the next console reply to be sent to the wrong site.

The voter can also be configured so that console transmissions are inhibited during Simplex Mode operation whenever any site is voted. This ensures that the console operator does not inadvertently cut off an important transmission from a remote site by transmitting at the same time on the same frequency. (Set to ***Field Priority*** rather than the default ***Console Priority***. See Section 5.19.4 for more information and Section 3.12.2.4 for switch settings).

When in the Repeat Mode, the SNV-12 also behaves differently depending on whether the SNV-12 is set to Duplex or to Simplex. When the unit is set to Duplex, voted audio is repeated (retransmitted) to the sites determined by the voter's configuration settings; ***this may include the voted site***. When set to Simplex, Voted audio is ***not retransmitted to the voted site***. This exclusion can be overridden on a site-by-site basis by a dipswitch on each SVM module. See Section 5.15 for more about the Repeat Mode and Section 3.12.6.4 for instructions to set the Voted Site Simplex Repeat Enable dipswitch.

5.22 System Expansion (Multiple Chassis)

Two or three SNV-12 chassis may be connected together, expanding the number of possible sites in a voting system from 12 to 24 or 36 sites. This expansion capability is implemented by daisy-chaining one SNV-12 to the next via rear panel Console and Expansion connectors. Signals between master and expansion units include a serial data bus, a Voted Audio bus, and a Transmit Audio bus.

Each expansion chassis must have a Control Processor Module and a Console Interface Module in addition to its SVM Modules. Three LEDs on the CPM front panels indicate the status of each chassis in the system: Master (SVMs 1-12), Expansion 1 (SVMs 13-24), or Expansion 2 (SVMs 25-36). There are no configuration switches to set Master/Expansion Mode; the units configure themselves automatically when the proper interconnections are made. Cables for making the interconnections may be purchased from us (see Table 3-1) or built per the cable drawings provided (see Figure 3-4 and Figure 3-5).

The expanded system is controlled by the CPM in the master unit, so most of the switch settings in the expansion CPM and CIM modules do not affect system performance. The exception is the Data Detect & Lock switch setting, CPM SW3-4. Data Detect & Lock can be set individually in each chassis to allow some system sites to be set with, and some without, the lock feature. Site-specific features are set individually on each SVM module.

NOTE: If you purchased a single-chassis SNV-12 in the past, and plan to expand to a dual or triple chassis system, please contact SNV-12 customer service so that we can help ensure that you have all you need and the upgrade transition goes quickly and smoothly. Some very-early version CPM modules do not support expansion.

NOTE: When using Master/Expansion configurations, any chassis that is kept powered down must be disconnected from the Master/Expansion cable. It is not possible to operate any chassis connected together in a Master/Expansion configuration unless all chassis in the system are functioning.

5.23 Pilot Tone AGC

Each SVM can be set to run a DSP AGC algorithm to automatically adjust the levels of RX audio receptions. This AGC is intended to compensate level changes in the link between each remote receiver site and the SNV-12. It is not intended to compensate the different volume levels of different system users. The AGC tracks the level of the pilot tone input; if it changes, the SVM's internal DSP gain is changed to compensate. This feature uses changes in the incoming pilot tone level as an indication of changes in the overall incoming RX signal level, which may result, for example, from gain changes in a microwave link. The AGC gain setting varies only when pilot tone is present and "freezes" when the pilot tone disappears. Thus, the gain applied to each individual transmission from a system user depends on the level of the pilot tone that preceded it at the SVM's RX audio input.

See Section 3.12.6.5 for full installation and operation instructions.

5.24 Pilot Tone Notch Filter Disable

It may be important in some special cases that there are no notch filters present in the normal RX audio passband. One instance is when encrypted audio is being voted, and part of this audio has been moved to the same part of the spectrum where the pilot tones reside*. Each SVM can be individually set to run its pilot tone notch filter only when a pilot tone is detected in its RX audio input. (Note: Pilot tone notch filters are normally enabled only if an SVM is set to Pilot Tone COR, and only at the specified pilot tone frequency.)

When this feature is enabled, the SVM does not run its DSP notch filter algorithm until it detects a pilot tone. Some time is required to detect this tone, so it will be present in the voted audio output (and, when Repeat Mode is used, in the retransmitted voted audio). This momentary bit of pilot tone will be heard at the end of each voting sequence. As soon as the pilot tone is detected in all sites, the voting sequence is ended and the voted audio output is muted.

(*Note that for the encrypted audio example given above: the SVM measures noise from 2300 to 3k Hz. The SVM expects that there is mostly noise only at these frequencies, with most speech components from 300 to 800 Hz. If the encryption mode inserts speech energy into the 2300 to 3k Hz range, the voting algorithm may be affected. If poor voting performance is noticed, it may be helpful to use Voting Lock on Active COR. In this mode, the voter makes a quick initial vote and holds it until all sites squelch. This initial vote usually occurs before speech is present in the RX input.)

See Section 3.12.6.5 for full installation and operation instructions.

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6 SNV-12 Remote Operation

6.1 General

This Section explains the RS-232 serial remote control capabilities of the SNV-12 and details all control commands to the voter and the corresponding responses from the voter. The web browser control and status interface is also covered.

6.2 Serial Port

All voter functions and complete voter status can be accessed via the SNV-12's RS-232 serial port. The serial port connector, located at the rear of the unit, is a DB-9 female connector wired as a DCE interface. The word is fixed at 8 data bits, one stop bit, no parity and Flow Control - none. Baud rates selectable on the CPM Module are 300, 1200, 2400, 4800, 9600, 19200, 38400, and 57600. Switch 1, positions 1,2,3 on the CPM module are used to set the baud rate. Switch 1, position 4 is used to enable the voter's Remote Mode, or it will ignore incoming commands. See section 2.9.3.1. Connections are made via backplane connector P1; a female 9-pin D-sub connector. Standard DCE pin out is used. See 2.8 and Table 3-4 for more details.

6.3 Remote Command Set

The following commands make up the SNV-12 Remote Command Set:

SEL	**Manually force a site or sites to be voted**
ENABLE	**Enable/disable a site from being voted**
TXSEL	**Select site or sites for console transmission –Stays active until disabled**
MOM_TXSEL	**Select site for console audio transmission –Stays active until Holdover Timer expires**
RPT	**Turn Repeat Mode on or off**
CFG	**Report CPM dipswitch configuration**
STAT	**Report site status (Signal Quality, Positive COR, speech present, voted, etc)**
VER	**Report software version number**
AS	**Enable/disable automatic status reporting**

The CPM-3 provides an extended serial command set to access the additional features available to the user. The extended command set is listed below:

RS	**Reset the CPM-3 (and the SNV-12 system)**
UPTIME	**Reports the time since the last system reset**
DATETIME	**Reports or sets the time for the real-time clock**
IPCONFIG	**Reports the IP Address and subnet mask for the CPM-3 Ethernet interface**
CPLDVER	**Reports the version number for the CPM-3 CPLD**
PASS	**Change the network access password**
TIMESTATS	**Returns the time voting statistics over the serial port in Comma Separated Values (CSV) format**
COUNTSTATS	**Reports the voting count statistics over the serial port in Comma Separated Values (CSV) format**
SYSCFG	**Reports the DIP switch values for all modules over the serial port in CSV format**

The following sections describe the operation of each of the SNV-12 remote control commands. In these examples the parameters delimited with < > are mandatory and those shown in braces "[ ]" are optional.

6.3.1 Manual Site Selection

SEL <SITE,ALL> <ON,OFF>

This command will manually select (force-vote) or de-select a given site. If a site is selected, voting is stopped. If the given site is out of range or previously disabled, an error message is issued. Site numbers range from 1 to 36. Sites may be de-selected individually or the command "SEL ALL OFF" can be given to de-select all available sites. If more than one site is selected, the voted audio will be the sum of the selected sites. Whenever no sites are selected, the SNV-12 begins polling each available SVM and normal SNR voting begins. A selected site functions similarly to a voted site except that, while a site becoming voted when the SNV-12 is in the Repeat Mode will initiate the retransmission of voted audio, the received audio of a manually selected site is not retransmitted unless the site also has positive COR.

Examples:

SEL 1 ON	**; Selects SVM number 1.**
SEL 1 OFF	**; De-selects SVM number 1.**
SEL ALL OFF	**; De-selects all SVMs.**

6.3.2 Site Enable

ENABLE <SITE,ALL> <ON,OFF>

This command is used to enable or disable a given SVM from being voted. If a given site is disabled, it may be manually selected by the SEL command. The site numbers range from 1 to 36. If a given site is not available, an error message is returned.

Examples:

```
ENABLE  1  ON        ; Enables site 1 to be voted.
ENABLE  1  OFF       ; Disables Site 1 (prevents it from voting).
ENABLE  ALL  OFF     ; Disables all sites from being voted.
ENABLE  ALL  ON      ; Allows all available sites to be voted.
```

6.3.3 Console Audio Transmission Select

TXSEL <SITE,ALL> <ON,OFF>

This command provides a means to send console audio to the selected site's associated transmitter. When a site is selected for console transmissions, its TX Audio Output will be enabled, and console audio present there, whenever the Console PTT input is activated. The TXSEL command overrides all other console audio and PTT steering modes (including STARS). If any sites are selected by TXSEL, then console audio will be transmitted from these sites and no others. The site numbers range from 1 to 36. If a given site is not available, an error message is returned. Multiple TXSEL commands can be used to send console transmissions to multiple sites.

If a site or sites are selected by the TXSEL command, and are then deselected by the command, console transmissions will return to where they would have been sent if the TXSEL command had not been issued.

RX group selections or primary site designations do not affect TXSEL commands.

If a SVM is configured as an RX-Only site, its TX output cannot be enabled by RS-232 or any other means.

Examples:

```
TXSEL  12  ON        ; Sends Console transmissions to site 12.
TXSEL  12  OFF       ; Removes TXSEL selection of site 12.
TXSEL  ALL  OFF      ; Removes TXSEL selection from all sites.
TXSEL  ALL  ON       ; Sends console transmissions to all sites.
```

6.3.4 Momentary TX Selection

MOM_TXSEL <SITE>

This command is used to select a given site for subsequent console and repeat audio transmissions. This is a "momentary" selection and is only valid for the duration of the Holdover Timer, unlike the TXSEL command, which is active until the chosen site is deselected. The Holdover Timer is refreshed whenever the console transmits.

If the voter is using the STARS automatic TX Steering mode, and any SVM becomes unsquelched, momentary TX takes precedence and the STARS selection is revoked. Likewise, a TXSEL command via RS-232 or an active low input at any SVM's rear panel TX SEL input overrides the Momentary TX Selection.

Only one site at a time may be selected for transmit by this method. If a new site is "Momentary TX Selected" before the previously selected site has dropped out because the Holdover Timer has expired, the new site takes precedence.

Example:

```
MOM_TXSEL 5      ; SVM # 5 is momentarily selected for transmit
```

6.3.5 Repeat Mode Control

This self-explanatory command can be used to put the voter in the Repeat Mode or remove it from the Repeat Mode. If the voter is already in the configuration requested, no change occurs.

RPT <ON, OFF>

Example:

```
RPT ON          ; Places the SNV-12 into the Repeat Mode.

RPT OFF         ; Removes the SNV-12 from Repeat Mode.
```

6.3.6 Configuration Information

CFG

This command takes no parameters, and returns a hexadecimal representation of the Dipswitches on the SNV-12 CPM-3 module. Switch SW1 is reported first, followed by SW2, followed by SW3, followed by SW4.

Example:

```
CFG

8B9A120F OK
```

This indicates that the value of switch SW1 is 8B (hexadecimal), the value of SW2 is 9A, the value of SW3 is 12, and the value of SW4 is 0F.

NOTE: The values for SW1, SW2, and SW3 will be inverted. Using the values in the example:

	8	7	6	5	4	3	2	1
SW1	OFF	ON	ON	ON	OFF	ON	OFF	OFF
SW2	OFF	ON	ON	OFF	OFF	ON	OFF	ON
SW3	ON	ON	ON	OFF	ON	ON	OFF	ON

6.3.7 Site Status

STAT [SITE,ALL]

This command is used to collect status from a selected SVM. The SITE parameter can be a single site in the range of 1 to 36, or by using the keyword "ALL" the status for all available SVMs is requested. If a specific site number is requested and that site is not available, an error message is returned. If no site number is given, status is reported for the site that is presently voted. If no site is given, and no site is presently voted, the command does not return any status. The return status gives the site number first (01-36) followed by a space and then by the status bytes. Each status byte is a 2 character hex representation of the following words. Note the bits that are marked "reserved for future use." The use of these bits may change at any time in upcoming revisions of software, so be sure to keep this in mind when doing any console program design

FIRST STATUS BYTE

bit 7: 1=voted site, 0=not voted site

bit 6: 1=unsquelched, 0=squelched

(For Hardwired COR site this bit is 1=COR present,

For pilot tone sites 1=absence of pilot tone.)

bit 5: 1=site fault detected, 0=no fault

bit 4: 1=site is enabled, 0=site is disabled

bit 3: 1=site is manually selected,

0=site is not manually selected

bit 2: 1=site is currently chosen by STARS,

0=site is not currently chosen by STARS

bit 1: Reserved for future use.

bit 0: Reserved for future use.

SECOND STATUS BYTE		
bit 7:	Reserved for future use.	
bit 6:	Reserved for future use.	
bit 5:	Reserved for future use.	
bit 4:	\	
bit 3:	\	A 5 bit value representing the signal quality
bit 2:	>	measured for this site. A higher number
bit 1:	/	corresponds to better signal quality.
bit 0:	/	

6.3.7.1 Status Byte Details

Table 6-1 lists the various combinations of the **first** status byte. The second status byte is the Signal Quality measurement.

Table 6-1 Status Byte Details

Status	Voted?	Unsq?	Faulted?	Enabled?	Man Sel?	STARS?
00	No	No	No	No	No	No
04	No	No	No	No	No	Yes
08	No	No	No	No	Yes	No
0C	No	No	No	No	Yes	Yes
10	No	No	No	Yes	No	No
14	No	No	No	Yes	No	Yes
18	No	No	No	Yes	Yes	No
1C	No	No	No	Yes	Yes	Yes
20	No	No	Yes	No	No	No
24	No	No	Yes	No	No	Yes
28	No	No	Yes	No	Yes	No
2C	No	No	Yes	No	Yes	Yes
30	No	No	Yes	Yes	No	No
34	No	No	Yes	Yes	No	Yes
38	No	No	Yes	Yes	Yes	No
3C	No	No	Yes	Yes	Yes	Yes
40	No	Yes	No	No	No	No
44	No	Yes	No	No	No	Yes
48	No	Yes	No	No	Yes	No
4C	No	Yes	No	No	Yes	Yes
50	No	Yes	No	Yes	No	No
54	No	Yes	No	Yes	No	Yes
58	No	Yes	No	Yes	Yes	No
5C	No	Yes	No	Yes	Yes	Yes
60	No	Yes	Yes	No	No	No
64	No	Yes	Yes	No	No	Yes
68	No	Yes	Yes	No	Yes	No
6C	No	Yes	Yes	No	Yes	Yes
70	No	Yes	Yes	Yes	No	No
74	No	Yes	Yes	Yes	No	Yes
78	No	Yes	Yes	Yes	Yes	No
7C	No	Yes	Yes	Yes	Yes	No
D0	Yes	Yes	No	Yes	No	No
D4	Yes	Yes	No	Yes	No	Yes

Examples:

STAT 1 ; Command sent to the SNV-12 to determine the status of site 1.

01 D4 05 OK ; Status returned.

This status indicates that site 1 is voted, is unsquelched, is not faulted, is enabled, is not manually selected, is the STARS site, and has a measured Signal Quality value of 5.

STAT 4 ; Command sent to the SNV-12 to determine the status of Site 4

04 14 01 OK ; Status returned

SVM 4 is not currently voted, but is the site currently selected by STARS for TX steering.

STAT ; Command sent to the SNV-12 to get the status of the presently voted SVM.

05 D0 07 OK ; Status returned.

SVM 5 is currently voted (note that SVM 5 has not been chosen by STARS; this is probably because the STARS feature is not enabled).

STAT ; Command to get the status of the currently voted SVM.

OK ; Status returned;

No SVMs currently voted.

STAT ALL ; Command to get status of all modules.

NOTE: the lower 2 bits of the first status word and the upper 5 bits of the second status word are not defined at this time and are always 0. Later versions of the SNV-12 software may make use of these bits. Be sure to take this possibility into account when writing applications software that uses the status words.

There are certain bit combinations that will never occur. For example, if the SVM is **not** enabled, it can not be voted. If the module is **manually selected** it can not be voted. If the module is **faulted** it can not be voted. If the module is not **unsquelched** (COR active, pilot tone absent, speech detected – see the unsquelch options (COR Types) available in Section 5.10) it will not be voted. Consequently a **voted** module will always have for its first status byte either **"D0" or "D4"**.

6.3.8 Software Version Number

VER

This command takes no parameters and returns the version number of the SNV-12 CPM board software. The software version number is in the form "X.YZ" where "X" is the release number, and "Y" and "Z" are major and minor revisions, respectively.

Example:

```
VER          ; Command sent to the SNV-12.

2.00 OK      ; Status returned from the SNV-12.
```

The status reply above indicates the CPM software version is 2.00.

6.3.9 Automatic Status Reporting

AS <ON,OFF>

This command is used to turn automatic status reporting on and off. The status reported depends on the last STAT command. If the STAT command was not previously given, the status for the currently voted site is given.

NOTE: reporting status at low baud rates or reporting status for multiple SVMs will affect the time between reports. Typically it is best to operate at baud rates of 9600 baud or higher. Once status has been given, new status will be sent approximately 500 msec later.

6.3.10 System Reset

RS

This command will cause the CPM-3 to reboot which in turn causes a reset of all of the modules in the SNV-12. This is functionally equivalent to cycling the unit's main power switch off and back on.

This is not the same as a full system reset to factory defaults as can be accomplished using Jumper J16 on the CPM-3 module.

6.3.11 System Uptime Query

UPTIME

This command returns the elapsed time since the CPM-3 was last reset.

Example:

```
UPTIME                                  ; Command sent to the SNV-12.

UP Time: 0 days, 0 hours, 46 mins, 15 secs      ; Status returned.
```

6.3.12 Return or Set Real-Time Clock

DATETIME

This command, with no arguments, returns the current date and time from the CPM-3 real-time clock. DATETIME can also be used to set the real-time clock from the serial command line. The argument for setting the date and time includes the day, month, date, year, hour, minute, and second in the form X:MM:DD:YY:HH:MM:SS where X is 1-7 for Monday-Sunday respectively.

Example:

```
DATETIME                                ; Command sent to the SNV-12.

Wednesday 02/14/2007 15:20:09           ; Status returned.

DATETIME 3:02:14:07:15:20:00            ; Command sent to the SNV-12.

OK                                      ; Status returned.
```

6.3.13 TCP/IP Configuration

IPCONFIG

The IPCONFIG command returns the IP address and subnet mask used for the CPM-3 Ethernet port.

Example:

IPCONFIG	**; Command sent to the SNV-12.**
IP Address : 192.168.1.200	**; Status returned.**
Subnet Mask: 255.255.0.0	**; Status returned.**

6.3.14 Report CPLD Version

CPLDVER

The CPLDVER command returns the version information contained in the CPM-3 CPLD. The Board Rev is read from the CPLD but is set by zero ohm jumpers on the PCB. The CPLD Rev is the revision of the CPLD code. This value is set by changing the value in the VHDL code for the CPLD.

Example:

CPLDVER	**; Command sent to the SNV-12.**
Board Rev : 1	**; Status returned.**
CPLD Rev : 2	**; Status returned.**

6.3.15 Return Time Statistics

TIMESTATS

The TIMESTATS command sends the time statistics table out the serial port in a comma separated values (CSV) format. This format can be imported into spreadsheet software such as Microsoft Excel. The user must configure the terminal software to capture the received data to a file.

Example:

TIMESTATS	**; Command sent to the SNV-12.**
[Returned CSV Data]	**; Status returned.**

6.3.16 Return Count Statistics

COUNTSTATS

The COUNTSTATS command sends the time statistics table out the serial port in a comma separated values (CSV) format. This format can be imported into spreadsheet software such as Microsoft Excel. The user must configure the terminal software to capture the received data to a file.

Example:

COUNTSTATS	**; Command sent to the SNV-12.**
[Returned CSV Data]	**; Status returned.**

6.3.17 Return System DIP Switch Configuration

SYSCFG

The SYSCFG command sends the DIP switch settings for all modules in the system out the serial port in a comma separated values (CSV) format. This format can be imported into spreadsheet software such as Microsoft Excel. The user must configure the terminal software to capture the received data to a file.

Example:

SYSCFG	**; Command sent to the SNV-12.**
[Returned CSV Data]	**; Status returned.**

6.3.18 Network Password Configuration

PASS <current_pw> <new_pw>

The network access password can be changed from the serial command line using the PASS command. The password is required for accessing any SNV-12 web pages that allow the user to change configuration. The user must know the current password in order to set the new password. The arguments to the PASS command are the current password followed by the new password. To keep the password secure, it is suggested that the serial terminal software be restarted after setting the password so that the serial buffer is cleared and the pass command cannot be recalled from the buffer.

NOTE: CPM-3 Software Version 1.04 and later enables SNV-12 system control via the Ethernet network port. It is HIGHLY recommended that the default factory password be changed before connecting to a network.

Example:

```
PASS B0wser! Sp0t?          ; Command sent to the SNV-12.
                            Change from the current password
                            "B0wser!" to new password "Sp0t?"

OK                          ; Status returned.
```

The default password is **lightfoot**. This is the password as shipped from the factory and also the password that is reset by Jumper J16. See Section 3.12.4 for instructions regarding the Reset to Factory Defaults operation.

The password must be less than 40 characters and does not require any specific combination of characters. Any character that is a capital or lower case letter, number, or symbol can be used. The password is case sensitive

Lost or Forgotten Passwords

There is a method for retrieving the current password if it's forgotten, but physical access to the unit is required. If the unit is set temporarily in the Manufacturing Test Mode (Set CPM-3 SW1-7 to on and cycle the main power), the PASS command, entered with no arguments, will cause the SNV-12 to respond with the current password.

Be sure to take the unit out of Manufacturing Test mode so that the unit can return to proper voting operation. Set CPM SW1-7 back to OFF and cycle unit power (the switches are only read at power up).

Alternatively, the unit can simply be set back to complete default settings via jumper J16.

6.3.19 Chassis Locate Function

LOCATE <ON,OFF>

The chassis locate function aids in finding the chassis that is being controlled via the network interface or serial port. When the function is enabled the Master, EXP1, EXP2, and Fault LEDs on the front panel of the CPM-3 blink simultaneously. The blinking will last for 2 minutes after which the LED functions will return to normal operation. The locate function can also be terminated before the timeout by sending the LOCATE OFF command.

Example:

LOCATE ON	**; LEDs on the CPM-3 Front Panel start blinking**
LOCATE OFF	**; LEDs on the CPM-3 Front Panel return to normal**

6.3.20 Remote Control Command Error Reports

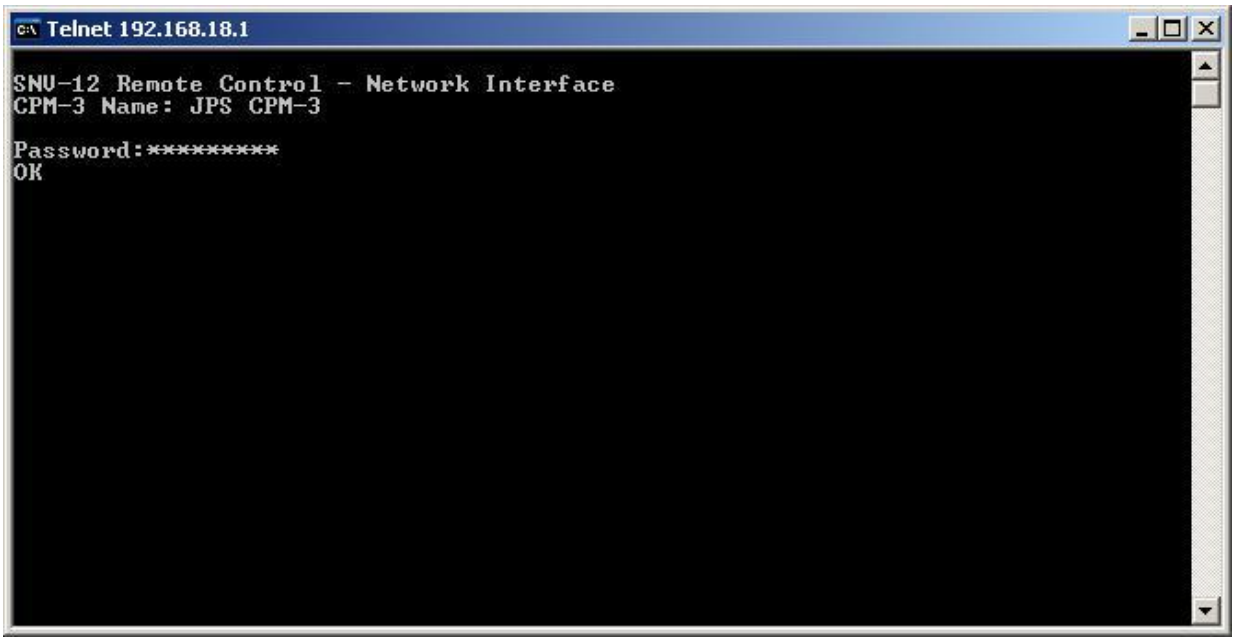
The normal status for a correctly received command in remote mode is <CR><LF>OK<CR><LF>. In cases where information is sent incorrectly or not received correctly, the SNV-12 will report error conditions as follows:

<CR><LF>E1<CR><LF>	**Unrecognized command**
<CR><LF>E2<CR><LF>	**Insufficient number of parameters**
<CR><LF>E3<CR><LF>	**Parameter out of range**
<CR><LF>E4<CR><LF>	**Too many parameters**
<CR><LF>E5<CR><LF>	**General status error**

6.4 Network (Telnet) Command Line Interface

The serial interface command set described in section 6.3 is also available over a network link. Using the telnet protocol a user can connect to the CPM-3 through its Ethernet interface and control the SNV-12 in the same way as is done on the serial port. The password for the telnet interface is the same as the password used for the web interface. The default password (as shipped from the factory) is **lightfoot**. This is also the password that the unit is reset to if J16 is used to perform a full factory reset (see section 3.12.4 for information on factory reset). An example of the telnet connect screen is shown below. The telnet connection is closed using the 'logout' command.

NOTE: CPM-3 Software Version 1.04 and later enables SNV-12 system control via the Ethernet network port. It is HIGHLY recommended that the default factory password be changed before connecting to a network. See section 6.3.18 for details on the serial command used for changing the network password.



6.5 Web Browser Interface

The CPM-3 includes a web browser interface that can be used to monitor and configure the SNV-12 voter. The interface is accessed by browsing to the IP address of the CPM-3. The default IP address (as shipped) is 192.168.1.200 and can be changed on the Network Configuration web page. The initial page that appears is an information page (shown below). The information page displays the CPM-3 and CIM configuration and DIP switch settings. The information page contains the web control for the chassis locate function as well. See section 6.3.19 for details on the chassis locate function. Links to other pages are located across the top

of the information page. The pages that allow a user to change configuration parameters or control the SNV-12 are password protected. The system password must be entered in the web browser login dialog box to gain access. A user name is not required. Refer to Section 6.3.18 for a description of how to change the system password. The default password (as shipped from the factory) is **lightfoot**. This is also the password that the unit is reset to if J16 is used to perform a full factory reset (see section 3.12.4 for information on factory reset).

NOTE: CPM-3 Software Version 1.04 and later enables SNV-12 system control via the Ethernet network port. It is HIGHLY recommended that the default factory password be changed before connecting to a network. See section 6.3.18 for details on the serial command used for changing the network password.

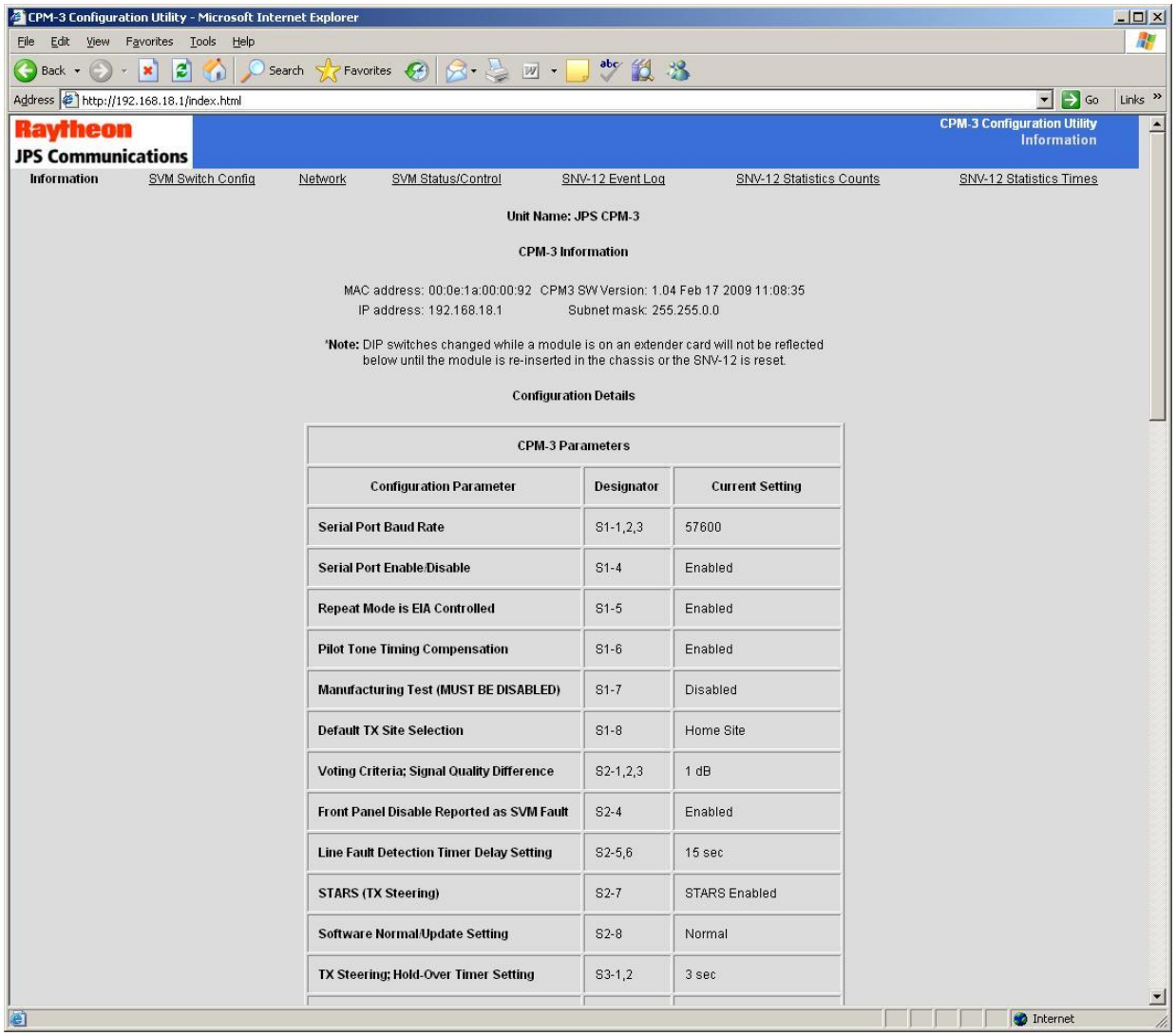
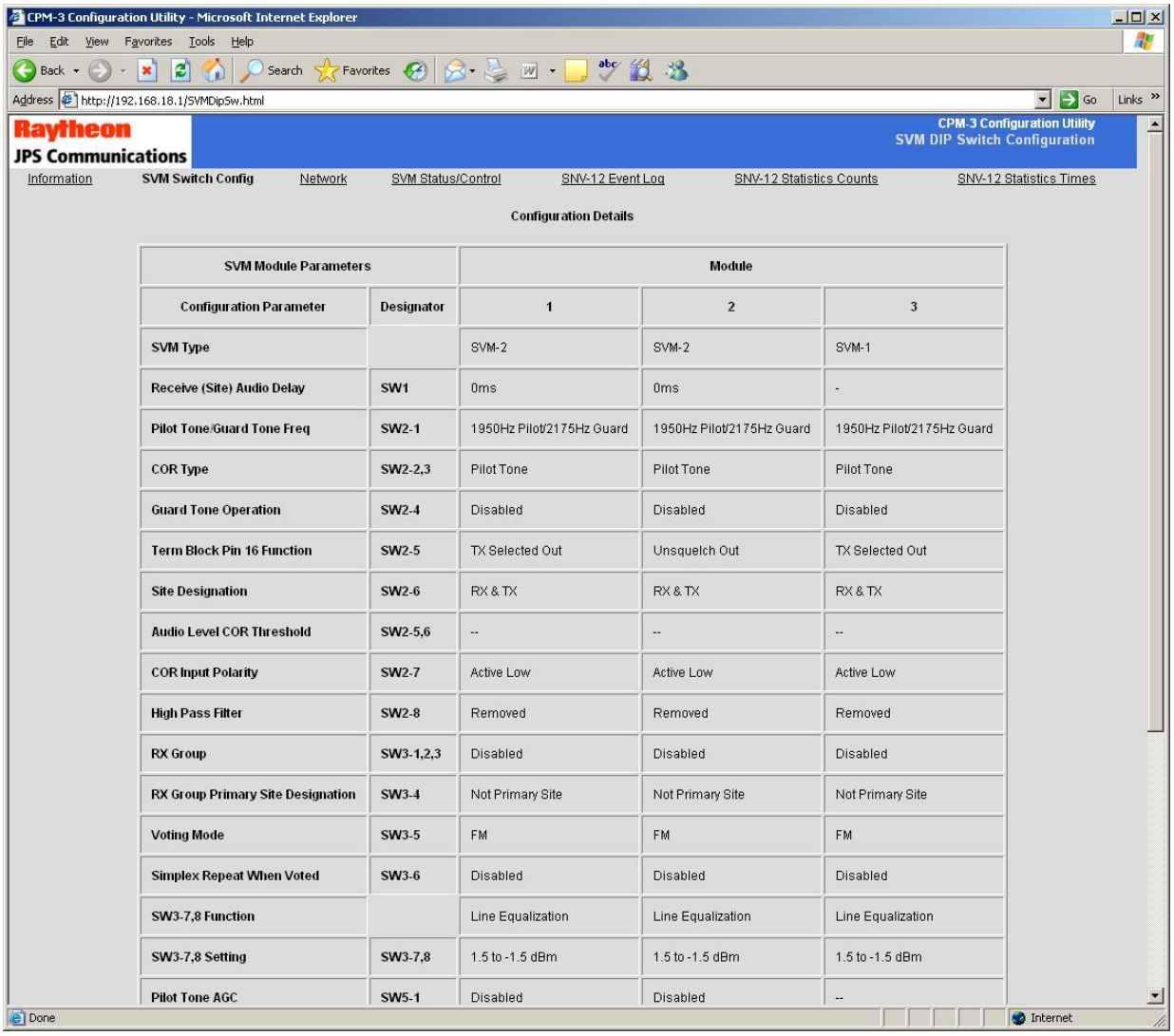


Figure 6-1 Information Page

6.5.1 SVM Configuration Details

The SVM Configuration Details page decodes the DIP switch values reported for all SVM modules in the SNV-12 system and reports the configuration parameters for each card in tabular form. Note that the configuration for SW1 will not be reported for SVM-1 modules because the SVM-1 does not return this information to the CPM-3. Similarly, SW5 parameters will not be reported for the SVM-1 because SW5 is only applicable to the SVM-2.



SVM Module Parameters		Module		
Configuration Parameter	Designator	1	2	3
SVM Type		SVM-2	SVM-2	SVM-1
Receive (Site) Audio Delay	SW1	0ms	0ms	-
Pilot Tone/Guard Tone Freq	SW2-1	1950Hz Pilot/2175Hz Guard	1950Hz Pilot/2175Hz Guard	1950Hz Pilot/2175Hz Guard
COR Type	SW2-2,3	Pilot Tone	Pilot Tone	Pilot Tone
Guard Tone Operation	SW2-4	Disabled	Disabled	Disabled
Term Block Pin 16 Function	SW2-5	TX Selected Out	Unsquelch Out	TX Selected Out
Site Designation	SW2-6	RX & TX	RX & TX	RX & TX
Audio Level COR Threshold	SW2-5,6	--	--	--
COR Input Polarity	SW2-7	Active Low	Active Low	Active Low
High Pass Filter	SW2-8	Removed	Removed	Removed
RX Group	SW3-1,2,3	Disabled	Disabled	Disabled
RX Group Primary Site Designation	SW3-4	Not Primary Site	Not Primary Site	Not Primary Site
Voting Mode	SW3-5	FM	FM	FM
Simplex Repeat When Voted	SW3-6	Disabled	Disabled	Disabled
SW3-7,8 Function		Line Equalization	Line Equalization	Line Equalization
SW3-7,8 Setting	SW3-7,8	1.5 to -1.5 dBm	1.5 to -1.5 dBm	1.5 to -1.5 dBm
Pilot Tone AGC	SW5-1	Disabled	Disabled	--

Figure 6-2 SVM Configuration Details Page

6.5.2 Network Configuration

The Network Configuration Page (below) displays and allows the user to change the network parameters for the CPM-3. The network parameters include the IP address, subnet mask, and gateway as well as an optional descriptive name for the module. The CPM-3 also has limited VoIP capability which can be used to remotely monitor system operation. Either the Voted audio, transmit audio or both can be configured to be sent to the VoIP port for monitoring. The

PCNXU application from Raytheon can be used with a PC to connect to the CPM-3 and receive the audio streams. Audio data cannot be sent to the CPM-3. Note that currently the CPM-3 can monitor audio only from the chassis where it is installed. The CPM-3 does not have access to audio buses going to or from expansion chassis. The CPM-3 uses only the GSM vocoder to send audio information so there is no configuration option to change the vocoder. The network configuration page is password protected.

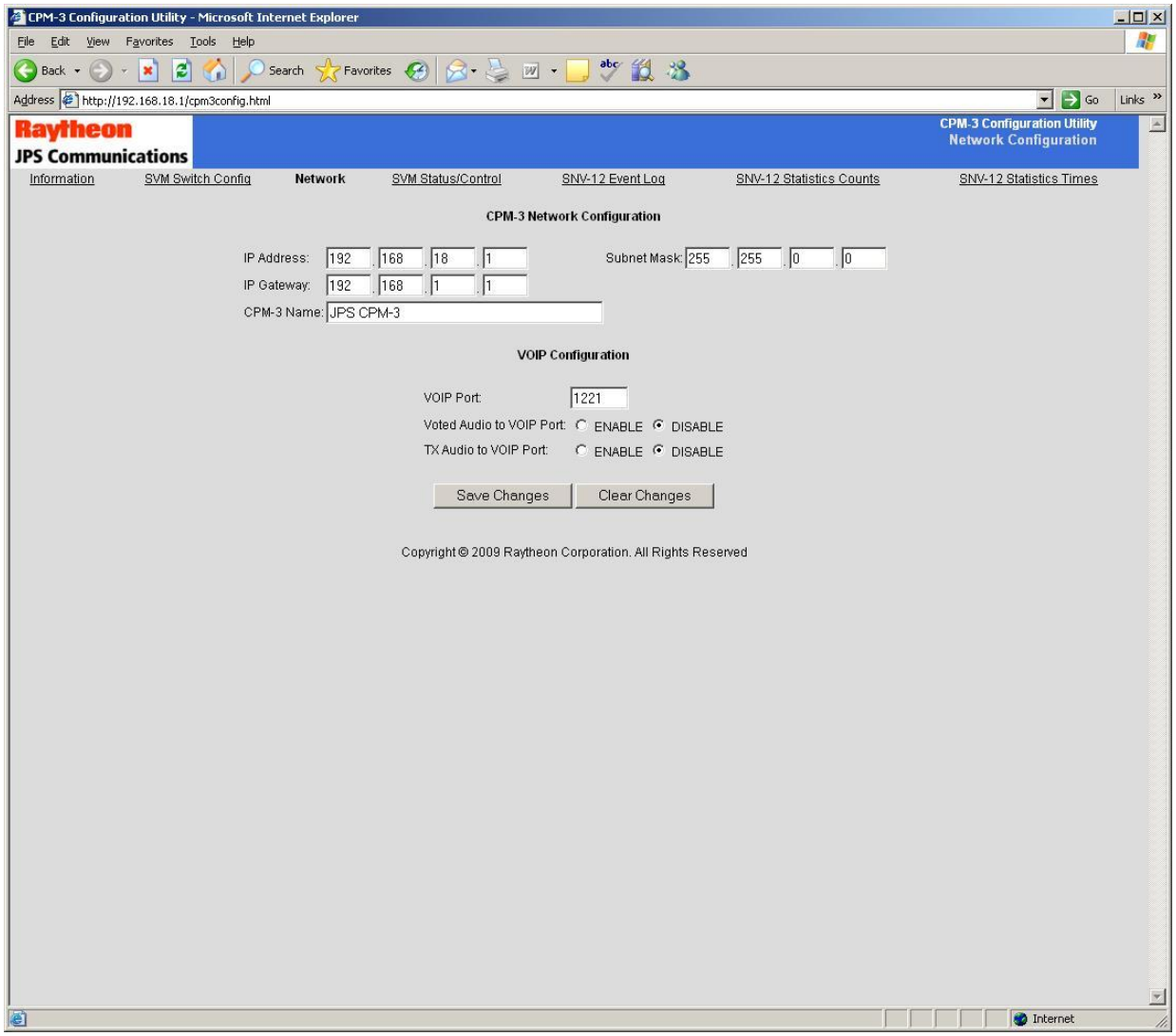


Figure 6-3 Network Configuration Page

6.5.3 SVM Status

The SVM Status Page (below) shows the general status of the SVM modules installed in the system. The unsquelch, voted, and fault status are shown as well as the status of the TX Select, RX select (force vote), and enabled status. In addition to the status, several software controls are provided to allow the user to remotely provision the SNV-12. The user may TX select or unselect an SVM module for console transmissions. This is equivalent to the TXSEL serial command described in section 6.3.3. The user may also RX select (force vote) an SVM. This is the same function as the SEL serial command detailed in section 6.3.1. Finally, the user can enable or disable an SVM as the ENABLE (section 6.3.2) serial command does. Global controls are also provided to allow the user to perform the control operations on every SVM in the SVN-12 system. This page is password protected.

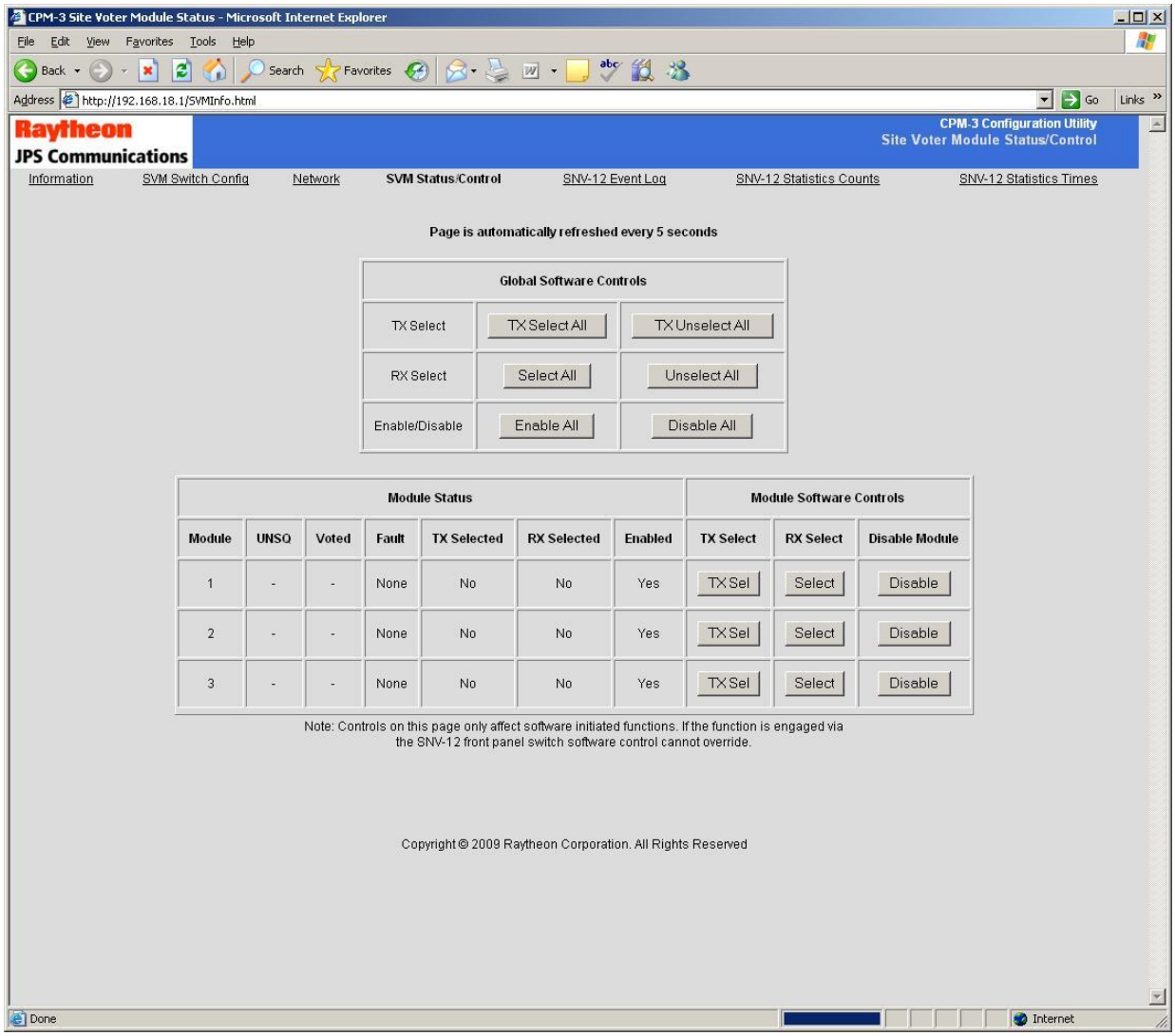


Figure 6-4 SVM Status Page

6.5.4 Event Log

The SNV-12 Event Log Page (below) presents logged system events with a time stamp from the real-time clock (RTC). This page also allows the user to configure which events to log. By default, all faults are logged but module vote and module unsquelch events can also be enabled for logging. To enable additional events, check the box corresponding to the event. Once all selections are made, click the "Submit Options" button and those events will be logged. To clear the event log, check the "Clear Event Log" button and then click "Submit Options."

In order to get a valid time stamp on the events, the real-time clock must be set. Use the link on the Event Log page to set the RTC. If the RTC backup battery is installed (BT1 on the CPM-3 board) the RTC time will be maintained across power-downs. If no RTC backup battery is installed, the RTC will be cleared at power-down and must be reset the next time the system is started. No battery is shipped with the CPM-3; it must be purchased separately (not from us). The RTC battery is a 3V CR2032 type lithium battery.

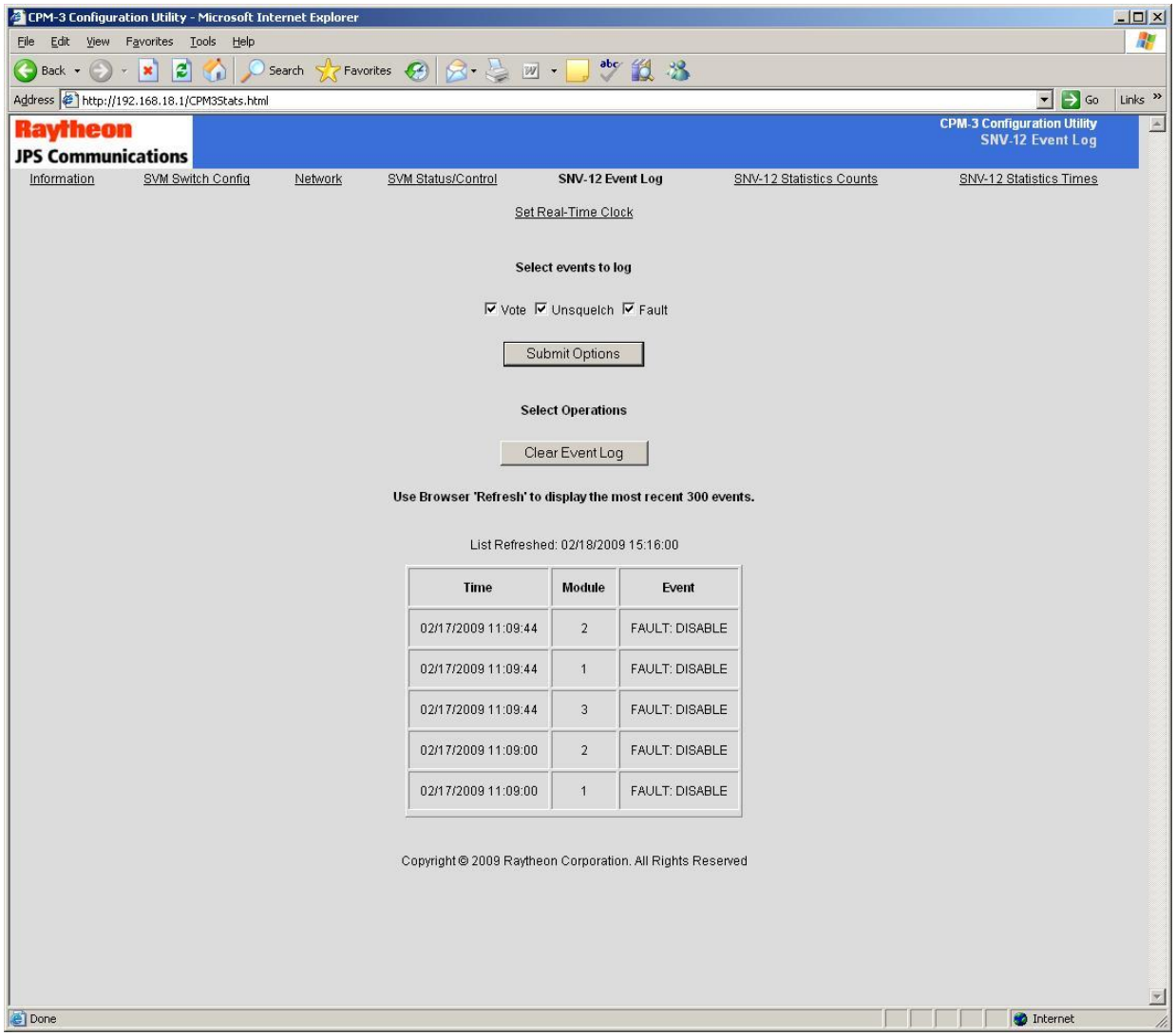
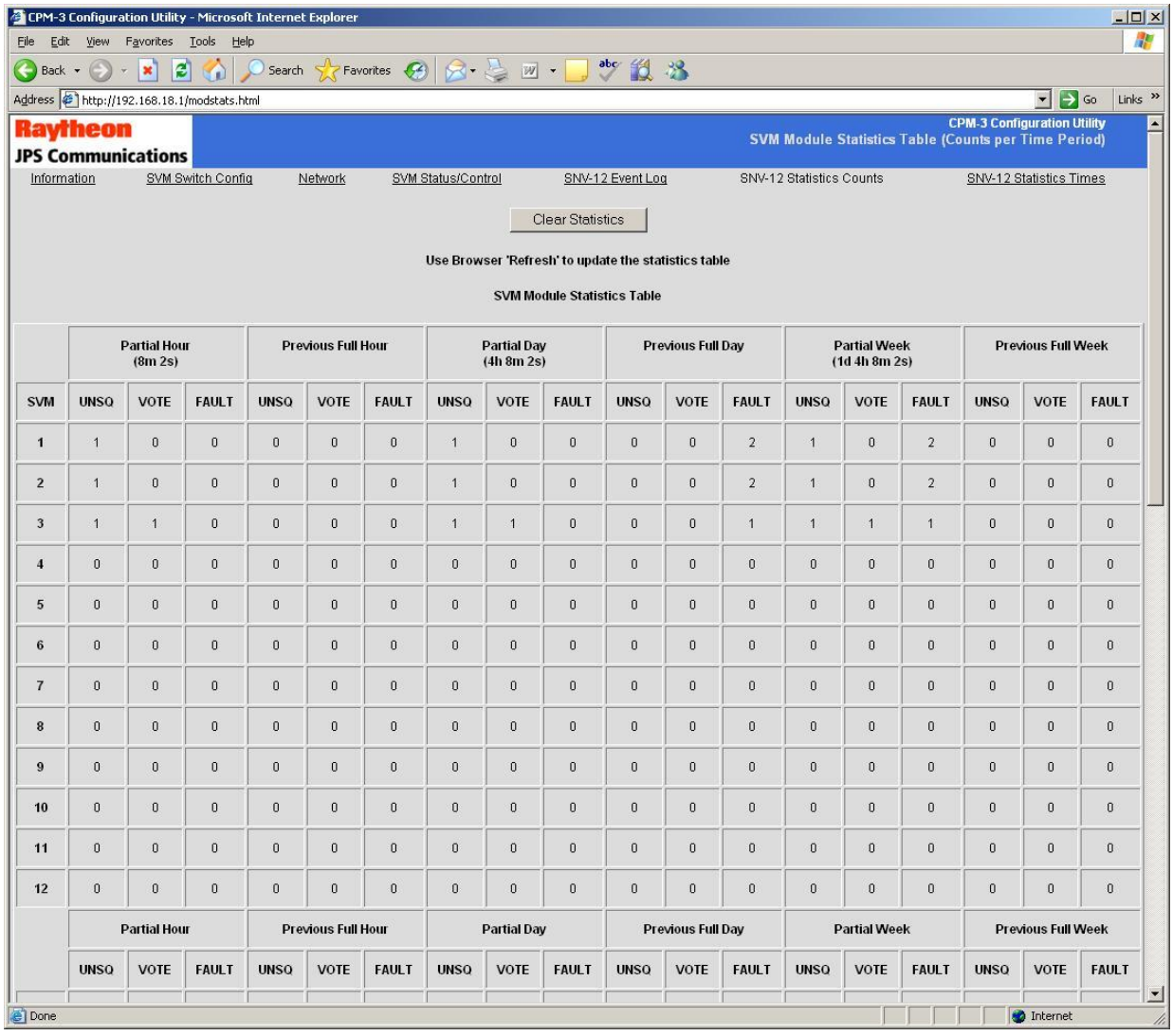


Figure 6-5 Event Log Page

6.5.5 SNV-12 Statistics (Counts)

The CPM-3 monitors the system and keeps counts for the number of times each SVM module is unsquelched, voted, and faulted. These counts are stored for the last full hour, day, and week as well as the partial hour, day, and week since the last full time increment. The Statistics counts page (below) is used to retrieve the counts. The data from the table can be cut and pasted into a spreadsheet, such as Microsoft Excel, where it can be manipulated and saved in a different format. The statistics counts page has a button to clear all statistics. Note that this clears all the count and time statistics. The information on this page is not affected by the Real Time Clock.



	Partial Hour (8m 2s)			Previous Full Hour			Partial Day (4h 8m 2s)			Previous Full Day			Partial Week (1d 4h 8m 2s)			Previous Full Week		
SVM	UNSQ	VOTE	FAULT	UNSQ	VOTE	FAULT	UNSQ	VOTE	FAULT	UNSQ	VOTE	FAULT	UNSQ	VOTE	FAULT	UNSQ	VOTE	FAULT
1	1	0	0	0	0	0	1	0	0	0	0	2	1	0	2	0	0	0
2	1	0	0	0	0	0	1	0	0	0	0	2	1	0	2	0	0	0
3	1	1	0	0	0	0	1	1	0	0	0	1	1	1	1	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Partial Hour			Previous Full Hour			Partial Day			Previous Full Day			Partial Week			Previous Full Week		
	UNSQ	VOTE	FAULT	UNSQ	VOTE	FAULT	UNSQ	VOTE	FAULT	UNSQ	VOTE	FAULT	UNSQ	VOTE	FAULT	UNSQ	VOTE	FAULT

Figure 6-6 Voter Statistics (Counts) Screen

6.5.6 SVN-12 Statistics (Time)

In addition to keeping counts of events, the CPM-3 stores the amount of time that the unsquelched, voted, and faulted conditions are met for each SVM module in the system. These time statistics are kept for the last full hour, day, and week as well as for the partial hour, day, and week since the last full time increment. The Statistics Times page (below) is used to retrieve the counts. The data from the table can be cut and pasted into a spreadsheet, such as Microsoft Excel, where it can be manipulated and saved in a different format. The statistics counts page has a button to clear all statistics. Note that this clears the count and time statistics. The information on this page is not affected by the Real Time Clock.

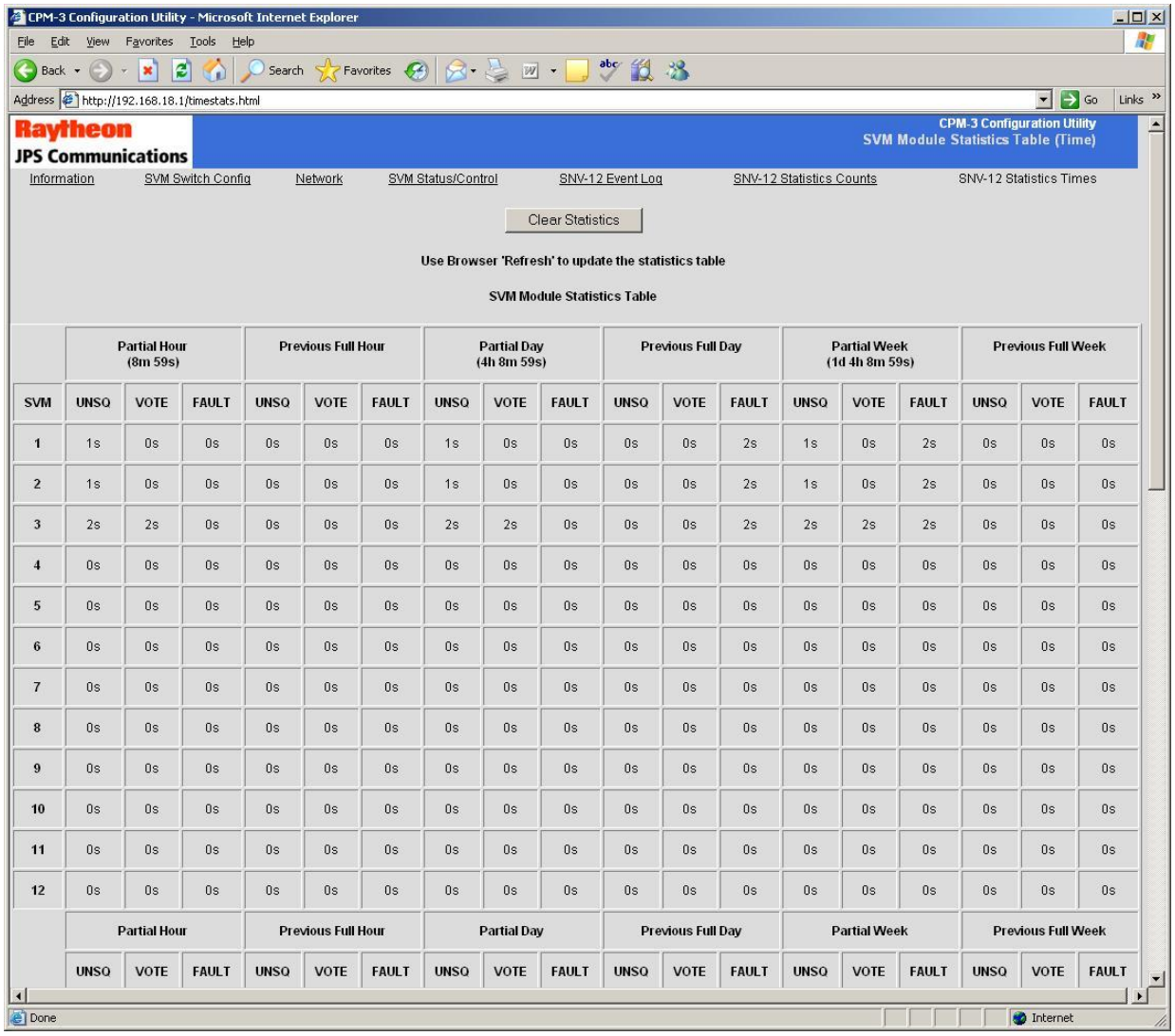


Figure 6-7 Voter Statistics (Time) Screen

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7 Options

There is one option presently available for use with the SNV-12 Voter:

7.1 PTG-10 Pilot Tone Generator

In an LMR voting system, receivers are strategically placed around a geographic area (at voting sites) to fill in dead spots where portable radios can't normally be heard by other portables, by the repeater, or by the dispatcher. The audio from each receiver is linked to the voter, which continuously compares the signal from all receivers while passing through the best quality signal to the dispatcher or to the local repeater. In this way, any portable in the voting area can be heard by the dispatcher, or by any other portable through the local repeater. In this system, it is necessary to transfer a receiver's COR or COS (Carrier Operated Relay or Carrier Operated Squelch) signal to the voter from a remote receiver site.

The PTG-10 Pilot Tone Generator Module produces a controlled pilot tone as a means of transferring this COR signal over the same path as the receive audio, eliminating the need for a second communications path for the COR signal. Audio output exits a receiver through one pair of wires and the COR (a DC logic signal) exits the receiver on another wire. The PTG-10 injects a pilot tone on the audio line whenever the associated receiver is squelched, and removes the tone whenever the receiver is unsquelched.

When a voting receiver detects a carrier (receives a signal), it unsquelches and issues a COR signal to the PTG-10. When the PTG-10 receives a COR signal the tone is removed from the audio link and the receiver audio is passed through the link to the voter.

The pilot tone also functions as a line proving tone: The removal of the pilot tone on the link notifies the voter to expect speech signals from the voting receiver. If the voter doesn't sense speech within a programmed time, it faults that particular voting site on the assumption that either the voting receiver is not functioning, or the link is broken between the voting site and the voter. The SNV-12 disallows use of that voting input until voice is received from the distant receiver or until the pilot tone returns.

The PTG-10 is capable of injecting one of two user selectable pilot tones: 1950Hz or 2175Hz. The module is 6.84" x 2.42" x 1.2" and is enclosed in a metal box suitable for mounting to flat surface or to a standard 19" rack. The mounting tabs are designed so that bolting three units together will span the standard 19" size rack. Wiring makes system interconnections to a screwdriver type terminal block. Audio input from the receiver is unbalanced, while audio output to the voter is configured for 600 Ohm balanced operation. The terminal block has provisions for a COR input (either positive or negative logic), power input (+11 to +15 VDC) and ground. Two LEDs are provided: One indicates the state of the receiver's COR signal and one is a power indicator. The overall audio level is adjustable with an independent adjustment to set the relative pilot tone level..

Table 7-1 PTG-10 Specifications	
Electrical	
DC Input Power	+12VDC (nominal) +11 to +15VDC @ 40mA
Input Impedance	50k ohms unbalanced
Output Impedance	600 ohms balanced
Frequency Response	Conservatively rated: 0 to 20kHz +/- 2dB
Tone Frequencies	1950 Hz or 2175 Hz, jumper selectable
Tone Stability	+/-2 Hz
The following are referenced to 0dBm output:	
Receiver Audio Input Range	-20 to +20dBm, variable.
Pilot Tone output Level	-20 to +3dBm, variable.
General	
Indicators	LED Power On, COR Active
Size	6.84 X 2.42 X 1.19; Designed to mount to EIA 19” rack
Weight	0.5 lbs.
Environmental	
Operating Temperature	-20° C to +55° C
Storage Temperature	-40° C to +85° C
Humidity	Up to 95% @ 55°C
Shock	MIL-STD-810D, method 516.3 procedure VI
Vibration	MIL-STD-810D, method 514.3 Category I

8 APPENDIX

8.1 Software Upgrades

This section contains information and instructions required to update the SNV-12 software to the latest revision. To determine the present firmware revision, use the RS-232 or telnet serial command VER. The revision can also be obtained by connecting to the CPM-3 via the web browser interface and viewing the version data on the Information Screen.

8.1.1 Upgrade Procedure

For the most part, SNV-12 users will not notice an initial difference in operation when updating software. This is because when we ship a unit, all currently undefined DIP switches are set to OFF. When new software adds features to these previously undefined switches, the features are usually enabled only when an associated DIP switch is turned on. Be sure to review Section 3 of this manual to be sure the updated voter is configured correctly.

Installing New Software in the CPM-3 Module

- Connect a Windows PC to the CPM-3 Ethernet port (using a crossover cable if connecting directly to the PC or with a standard cable when connecting into a switch or hub)
- Use the Netburner Auto-Update utility on the PC to program the new CPM-3 application image (.S19 file), provided by us, into the flash on the board. (Enter the IP Address of the CPM-3 and the filename of the firmware update file in the appropriate boxes. Check the "Reboot when Complete" box. Click the Update button.)

  Note: The Auto-Update utility, as well as the latest version of CPM-3 software, can be found on the website.
- Reboot the SNV-12 system (either select "Reboot when Complete" in the Auto-Update utility, use the RS serial command, or power cycle the chassis)
- After reboot the CPM-3 may reprogram its CPLD as well as the other modules in the system if required. Do not interrupt this programming process while it is running. CPLD programming is indicated by the EXP1 and EXP2 LEDs on the CPM-3 flashing simultaneously. CIM and SVM module programming is indicated by the EXP1 and EXP2 LEDs flashing alternately.
- **When all LEDs stop flashing, the update procedure is complete.**

8.2 CPM-3 Software Revision History

This section gives a list of software changes and the revision in which they were added. Use this section to determine any changes in system configuration will be required when changing from the currently installed revision of software to the latest released revision.

8.2.1 Version 1.0

CPM-3 Version 1.0 software was derived from CPM-1 software Revision 4.16. The CPM-1 did not have an Ethernet port and instead used plug in EPROM firmware. The CPM-3 software adds some additional features to the CPM-1 version 4.16. These additional features are described below:

- Support for hardware control of Repeat mode and STARS (Section 3.12.2.5 for CIM-2A SW4-5, 6)
- Event Logging and Statistics counts (Section 6.4)
- Web Browser interface (Section 6.4)

8.2.2 Version 1.01

- 1.01 22 August 2007 (CIM: 1.54, CIM2A: 1.05, SVM: 2.26, SVM2: 1.12)
- Corrected a bug where the default IP address was not set correctly when J16 was set to return CPM-3 to factory default configuration.
- Periodically refreshes SVM-2 configuration parameters to provide tolerance and error recovery for apparent serial communications corruption in high RF noise environments observed in the field.

8.2.3 Version 1.02

- 27 August 2007 (CIM: 1.54, CIM2A: 1.05, SVM: 2.26, SVM2: 1.12)
- Removed periodic refresh of SVM-2 parameters.

8.2.4 Version 1.03

- 04 June 2008 (CIM: 1.54, CIM2A: 1.06, SVM: 2.26, SVM2: 1.13)
- Includes SVM2 v1.13 with new SVM RX Output audio delay functionality
- Chassis locate function added. When enabled, this will flash all of the LEDs on the CPM-3 front panel to aid in locating the chassis being controlled. This feature is accessed from the Information web page or through a serial command (LOCATE [ON/OFF]).
- Fixed bug in the reporting of events in the event log where the display would not update after hitting the maximum number of events.
- Added an item to the web interface to enter a gateway.

- Changed serial port interface to ignore LF characters as the CPM-1 does.
- Fixed SVM and CIM back panel and LED fault indications for disabled modules (when "report SVM disabled SVMs as fault" option is enabled).

8.2.5 Version 1.04

- 1.04 13 March 2009 (CIM: 1.54, CIM2A: 1.06, SVM: 2.26, SVM2: 1.14)
- Fixed serial responses for certain commands which were causing issues when interfacing with some customers' equipment.
- Changed SVM2 to add a feature to eliminate noise burst at the end of receive from the field when using pilot tone COR. Assigned CPM-3 DIP Switch 1-6 to enable this feature globally for the voter system.
- Added additional control functionality to web interface. A user can now manual select (RX) or unselect a module, TX select or unselect a module, and enable or disable a module from the web interface.
- Enhanced the look of some of the web pages based on customer feedback.
- Enabled an option to pass the local chassis voted audio and transmit audio to the VoIP port on the CPM-3 Ethernet interface.
- Implemented password protection for the telnet command line interface.

9 Index