Raytheon-JPS SNV-12 voter – SRG manual

By Karl Shoemaker

Introduction:

Raytheon is a parent company for JPS interoperability that manufactures a radio system voter, SNV-12. A few manufactures have produced voter equipment such as Motorola, GE, Raven, Doug Hall and LDG Electronics. The last two being economy types for amateur repeaters and do not require a status tone from the remotes to work. However, they no longer are in production. Actually, only one is known to be current, which is this one by JPS. Current new price in 2018 is about $5,000. A used unit was donated to SRG in 2018

Raytheon now refers to company name of " JPS ". They are at 5800 Departure drive, Raleigh, NC 27616 with a number of (919) 790-1011 or emergency service of (800) 543-2540.

This manual:

The OEM manual is good information however, is over 200 pages and may be overwhelming for the newcomer. You may need to read through it a few times to make sense of everything you need to make the equipment "play nice" with a system. This (SRG version) manual supplement is a trimmed-down version; more geared towards an amateur radio repeater with a single site and some (extra) input receivers around the local area.

In order to provide a good System the technician needs to practice organization and discipline for installation, operations and technical specifications. The Author's honest observations may not be popular however, is needed for accuracy. For example, there's a little redundancy in the OEM manual, such as the setup chart after the section / page of 2.3 says "CPM Module" and "SVM Module", etc. instead of "CPM" and "SVM", respectively. Being that the last letter of the acronym stands for Module, this type of the language appears to be redundant. It's quite possible OEM wrote it that way to "blend in" with most readers that use redundancy, too. This supplement uses proper acronym and other language for clarification and understanding. Therefore, it's hoped this manual will help you with the install, maintenance and operation with this equipment. As a disclaimer, it's not the intent of the Author to circumvent or challenge the OEM specs, philosophy or design, as the Author supports the product manufacture and embraces their technology.

This supplement may be updated (without notice) with the effective date at the end of this manual, which supercedes previous versions. Some diagrams are rotated on pages therefore; this manual was intended to be (duplex) printed out as a hard copy with the pages in a 3-ring binder. It's best viewed and read in this manor.

Both the OEM and supplement manuals are kept in a 3-ring binder with tabs added on the page's edge to quickly find frequent used information. A physical manual (book) can be handy during times of a PC and screen not being available, along with the ability to add notes such as this document that may not be clear in the OEM manual or even overlooked. The Author spent several hours understanding the OEM manual. He hopes this document / supplement will make the setup and operation a better experience.

Acronyms:

JPSI JPS Interoperability Systems, Inc. (or just called "JPS")
SNV-12 Model of this voter by JPS
SVM Signal Voted Module
CPM Central Processor Module
CIM Console Interface Module
PM Power Supply Module
VI Vote Indicate
COR Carrier Operated Relay, AKA carrier operated squelch, COS, RUI, RUS, etc.
Rx PTT A receiver's PTT, from a buffered cor signal to produce an output.
Tx PTT A transmitter's circuit that sends out an RF signal on the air when keyed.
CTCSS Continuous Tone Coded Squelch System, AKA, tone, PL, CG, QC, etc.
TLP Test Level Point. This is a reference point.
TT Test tone normally 1 KHz at the TLP level.
SRG Spokane Repeater Group (organization this voter is being used).
MCP Master Control Point (where the voter, controller, timers, IDer, etc. are located.
PCB Printed Circuit Board.
LMR Land Mobile Radio, AKA, 2-way radio.
dbm logarithmic measurement of some AF test points on the unit.
SMD Surface Mounted Device (resistor, capacitor, transistor, etc.)

Overview:

The SNV-12 is a signal / noise voter mainly intended for LMR (FM) radios. It's also capable of HF / unsquelched use but will not be covered in this document. It has twelve (12) ports/channels. While SRG only needs 8 it's nice to have some expansion if needed. Their phone contact is (919) 790-1011. Immediate help is (800) 543-2540. They are located at 5800 Departure drive, Raleigh, NC, 27616. For service you need to contact them prior to shipping the unit with a "RMA".

The unit is made up of a shelf with "cards" (modules) to slide and push into a rear socket. The operational controls are on the front of each card while, the I/O and power connections are on the rear. It's made for standard rack mounting, taking up 3 RUs. It also has handles on the front panel for easy transport by hand. Fully loaded there are fifteen (15) cards on the shelf, (SRG only uses eight channels presently). Starting from left to right (front view):

- PSM, being the power supply module. It inputs either the 110v AC or 12v DC to convert a +12v and –12v-rail voltage for all the other modules.

You need to set the unit for the proper line voltage. Either the instructions are not in the OEM manual or the Author was unable to find them. Therefore this manual may help you.

There's a jumper on the older style unit as shown on the left in the "120" position. For clarification the right image shows this jumper pulled so you can see the choices.

Shown here is for the newer style unit with a flat blade adjustment, which is an improvement over the older style concerning easy selection. On the flip side (no pun) once the unit is set up this would be a one-time adjustment. SRG's is the later style.

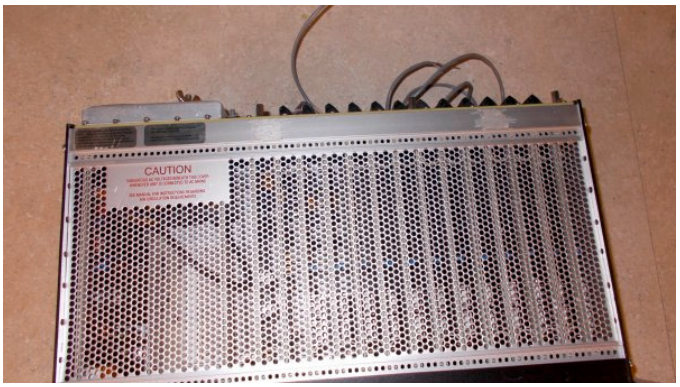
There are two indicators on the front that will light showing the +12 and –12 rails are active. . Also, two indictors on the front showing the power source (AC or DC). It's believed the front push-button power switch turns all power off for all the cards (except, of course, the early circuits of the PSM).

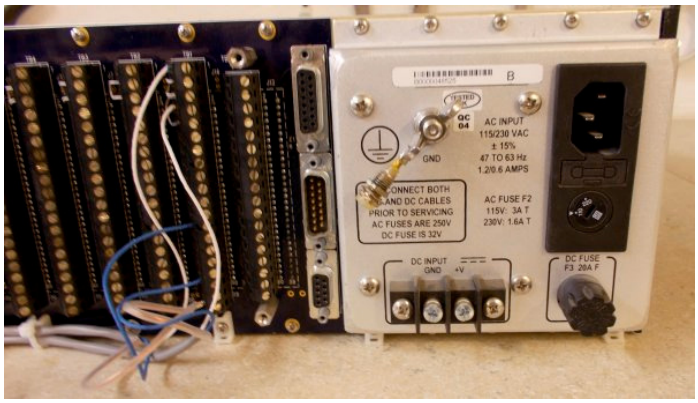
- CIM, being the console interface module. It interfaces a dispatcher console's audio and signaling, meaning transmit AF, receive AF, transmit PTT and possibly receive signaling (sometimes called "cor"). It's believed to also interface "normal" audio responses with a "flat" audio system such as SRG. Flat, meaning, remote receivers pick up the subscriber's emphasized transmit audio and de-emphasize it in the CIM for a natural sound the dispatcher person will hear. In return, the dispatcher transmit audio will be pre-emphasize going the remote system transmitter that the subscriber unit will hear in their speakers sounding natural as well.

- CPM, being the central processor module. This "talks" to the next set of modules by loading the pre-programmed parameters, such as any audio delay, S/N threshold, etc.

- SVM, being the site voter module. These 12 modules take in the (remove) received audio and signaling and report back to the CPM on the quality. As it's currently understood, the

SVMs use DSP with the effect of "AGC". Therefore, it's flexible on what audio level standard is used. This can be very useful for slight variances in the transport of such remote receiver levels. Variances can occur in the transport circuits, especially in TelCo. leased lines in the 1980's.





Showing below is the rear during bench testing. A handy ground pin jack as been added on both the front and rear for measurements.

Shown here is the unit in service at the MCP. Most of the SVM connections were made with wires following the resistor color code for easy tracing. Shown above the SNV-12 is an audio switcher (TDV) to facilitate a flat audio system to which the SNV-12 won't accommodate.

Quick start connections and set up:

The OEM manual lists 20 terminal points for outside wire connections. This manual will cover only the essential connections for amateur operations:

Pin 1 is the AF input from the remote receivers; used for SRG.
Pin 3 is ground (common ground for the AF); used for SRG.
Pin 4 is Tx AF output to go to the remote (or local) transmitter.
Pin 13 is the cor (Rx PTT) input from the remote receivers; used for SRG.
Pin 15 for VI (Vote Indicate); used for SRG.
Pin 18 is PTT output to the remote (or local) transmitter.

The manual talks about a lot of settings and options. For amateur use (SRG) most of the settings can be left on OEM (factory) default with the exceptions:

- Set for duplex mode via SW3-5, to "on".
- Set for repeat mode via SW3-7 to "on".
- Set Rx input for high impedance via JP1 to pins 2 & 3.
- Set Rx input for unbalance via JP2 to pins 2 & 3.
- Set "TX Hang-time Duration" (repeater tail.) to 0 sec via CIM's SW3-4 and SW3-5 to "off".
- Set PTT configuration to "PTT Only" via CIMs SW3-6 and SW3-7 to "off".

As a reminder it's also important to have the "Hardwired COR Input Configuration" is set to default via JP3 to pins 1 & 2. The idea is an active going low from your remote receiver signaling (cor).

The first SVM is used for any transmitter control. Therefore, at least one switch setting will be different from the other SVMs. This is assuming you have only one System transmitter and not using simulcasting or remote transmitter steering, (STARS) etc. This is described in detail in the OEM manual.

Alignment:

Adjust your levels per the OEM manual on page 3-79 (lower half of the page). Then normalize the system and test with users (subscribers). Voice average should light the yellow indicators and voice peaks should flash the red ones. This will happen only on the remote receiver paths the user is getting into on any RF strength.

Quick start connections and set up – you are done

Later, it was found and decided some of the DIP switch settings (above) does not affect SRG operation. This is because the only purpose the SNV-12 does is, vote, indicate that and provide PTT output to signal the MCP's controller. No audio appears to go through the SNV-12, which only signals the TDV (via VI). As mentioned on the previous page, the TDV performs all audio processing (along with the MCP's controller). This plan affects the alignment, described on the next page.

SRG:

This section is unique to SRG however, may provide some insight on how to set up your repeater. The SNV-12 signaling is compatible with SRG standards therefore, is used as part of the System, more specifically, the MCP operation. As mentioned earlier, the SNV-12 can run on either grid AC 110v or 12v battery DC power. All the equipment at the MCP is run on the 12v DC from a station battery, therefore never "sees" the (dirty) AC grid which is only used to operate the station's battery charger. This arraignment is similar to microwave radio mountain top sites. There is significant current draw of the unit at 12v so, the unused modules are pulled from the unit and stored in ESD bags as "cold" spares. Meaning, not powered; as opposed to "hot" spares that are 24/7 powered for readiness. The idea for cold is additional protection against a power surge (lighting, etc.).

SRG has (old school) technical standards when it comes to audio and signaling. Therefore, all SRG's MCP AF I/Os are medium to high impedance. All PTTs (Rx or Tx, etc). are active going low. All PTT outputs are derived from an open transistor collector to allow parallel operation. Power indicators are in green, Rx carrier indicate in yellow, signaling (decoding and encoding) in blue and Tx control (PTT) in red. There are more standards covered in other SRG manuals on the web site however, are not particularly relevant to this document so, are left out.

Some features of the SNC-12 are not compatible with SRG standards therefore, other arraignments and additional circuits have been built for the MCP. For example, the audio frequency response spec for SRG is about 20 Hz ~ 5 KHz for the MCP's voice circuits. Remote receiver transports also follow this spec. The SNV-12's audio frequency response is limited to the standard commercial voice channel of 300 Hz - 3 KHz. There is a low pass filter cutout option for the low end extending coverage only to about 100 Hz. At any rate, the transmit audio output on pin 4 of the first SVM is not used.

For voted audio control the VI (vote indicate) on pin 15 for each SVM drives an external 8-channel audio switch. It has full frequency range, excellent cross channel isolation and fast audio switching. This switch's PCB is located inside the original SRG's TDV from decades ago.

Connections: (wiring)

For audio, the eight remote receiver sources connect to each SVM, pin 1, with pin 2 jumpered to ground (single end). Then each AF source is "wyed" off to the TDV AF inputs, 1 ~ 8.

For signaling, the eight remote receiver sources go to the tone panel to produce a (controllable) "AND" squelch type of signal. From there, the eight signals go to the SNV-12's "cor" input on each SVM pin 13. The SVMs have an effective "squelch" controlled by it's "cor" input (good feature but not needed for SRG). In this case the input is an AND signal therefore, any RFI will be squelched out. (Some other voters have the audio path on carrier while only the signal path is AND, thus, causing RFI to be (annoyingly) heard on the System during the repeater's tail).

For signaling out, each of the SVM's VI go to the TDV's signaling (cor/Rx PTT) inputs. The SVM's VI outputs work quickly during a user transmission start-up (and voting/switching) therefore, is compatible with the MCP and has no delay / degradation to the System.

The TDV outputs provide audio mixing and PTT functions for the MCP's controller and finally the remote System transmitters and other cross-state links.

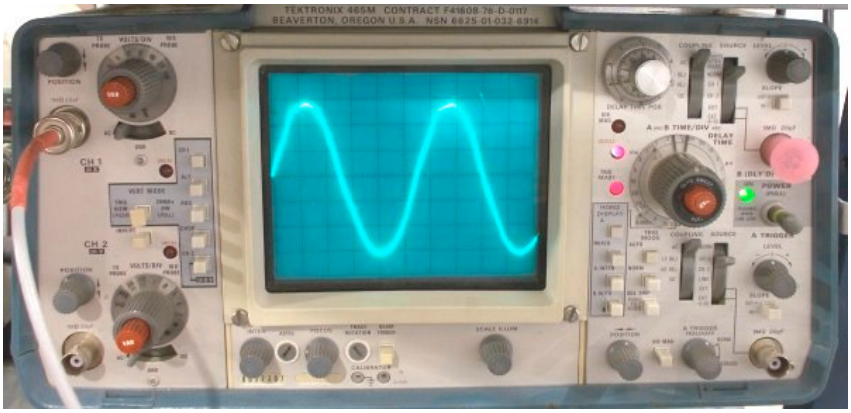
SRG alignment:

The OEM manual talks about alignment tone at 3 KHz full modulation. This may be based on commercial, narrow-band FM operation. Amateur / SRG is different in bandwidth.

Input an on-channel RF signal in each remote receiver with a level around –60 dbm, modulated at TLP, being 5 KHz deviation, with a 1 KHz test tone. Set each remote receiver audio level for a –5 dbm as read on a TIMM or AC meter, in bridge mode, on each SVM AF input on pin 1.

Keeping the RF signal generator on, set the level for +7 dbm as measured at TP3, which is the pin jack (and it's ground) on the front of each SVM. Adjustment is done with R45, which is a mult-turn pot on the front panel as well. This level should light the (nice) yellow indicator on each SVM. The red (peak) indicator starts lighting around +10 dbm at this point.

Shown here is the waveform on an oscilloscope; measured level about 6 v P-P which is roughly the same as the measurement in the previous paragraph of +9 dbm. The RMS equivalent is about 2.13 volts ac. TP3 is single ended so no isolation is needed for this measurement.



Research for different alignment levels will be performed as time permits. Speculation by the Author will be lowering the reference in 3 db steps possibly, finalizing with 0 dbm for the reference. As of Aug 24, 2018 the Author decided on the levels described on the previous page.

Since the SVM's audio output is not used, (for SRG only) the Tx level is not important. In the event the TDV audio output is not used, SVM # 1 output is set for a TLP of –5.

Theory of Operation:

Introduction:

A "voter" is a device used in a LMR base station, or (better yet) a repeater station. Several remote (input) receivers at various remote locations pick up a user's weak signal, and then are transported them back to a Master Control Point (MCP) by means of dedicated RF, wireline or IP channels for each of those remote receivers. At the MCP the SNV-12 voter "decides" which of the "best" (up to 12 channels) user signal will be heard by the control station, or (better yet) sent back out to the remoted (supported) system output transmitter for all to enjoy the best reception possible. Each channel is "weighted" with a micro-controller. Signaling is necessary to inform the voter when there is activity.

This can provide superior reception and user coverage over a conventional single Tx/Rx repeater station at one remote site. This comes with a price, starting with cost (equipment, sites, etc.) advanced experience, understanding and high maintenance discipline and standards by the supporting technicians. Voters come in two basic types; time domain or signal-to-noise quality (S/N). The latter is more popular and effective for best LMR communications. They also need some type of signaling to "tell" the voter a signal is there. This is accomplished either with a status tone (ST) or a carrier active indicator in the form of a buffered cor (cos) signal.

COR: AKA "Rx PTT"

Receiver signaling inputs each SVM (port) to "inform" the voter there is activity on a channel and to analyze it. This is assuming, of course, you have the unit set for "hardwired cor" since there are other modes this unit is capable of doing but not covered in this document.

Other notes:

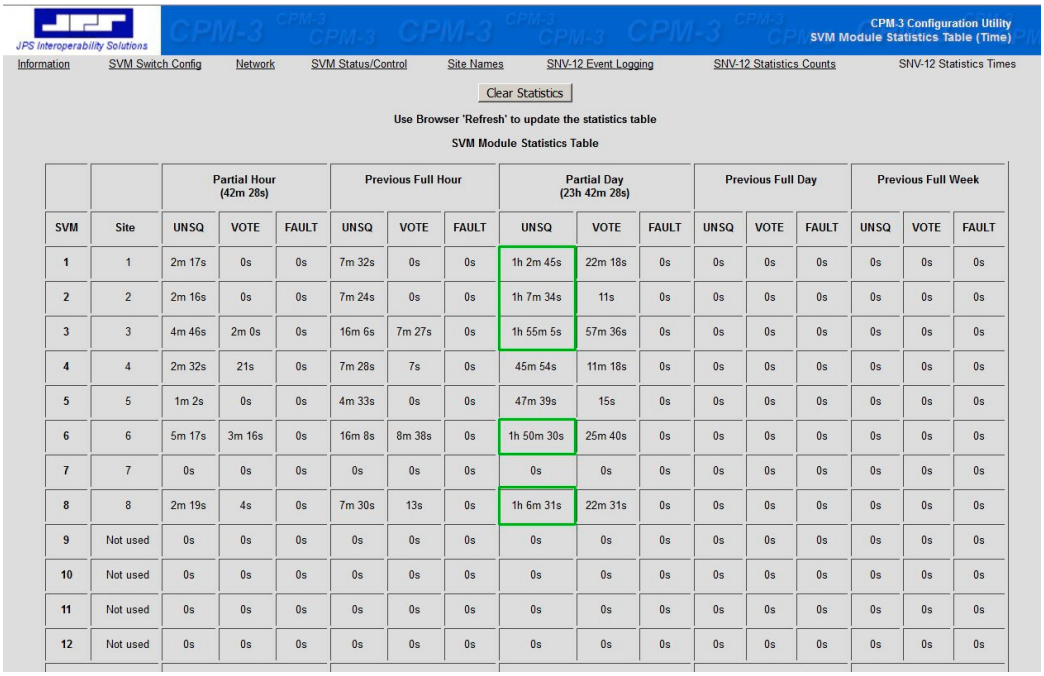
- If the voter is at a remote site, and you installed remote control (disable) of each port controlled on the repeater's input, then don't disable all 8 channels at the some time, preventing control access, requiring a trip to the site. That may be a reason to have an alternative control path to the voter site.

- As previously mentioned, there are audio level indicators on the front of each SVM for version 3 (SVM-3). This is handy as an alignment and general observations of a user input signal.

- The OEM manual says on page 3-27 the modules can be plugged in "hot". However, if you may need an extender card (for adjustments) you need to use the OEM type. In examining the module's card edge, some of the contacts are recessed from the others. That is believed to be a protection scheme by the DC power connections mating either before or after the other connections do. This was realized with an expensive mistake of using a non-standard extender card; thus, damaging (at least) the CPM.

- The unit can be remotely accessed either by serial or network. For network the default IP address is 192.168.1.200*. The default PW is "lightfoot". It's best to change the password when you get it running. The OEM manual details are discussed on page 6-14. The MAC address for the NIC is 00:0E:1A:00:7D:B4 and SNM is 255.255.255.0.

Statistics can help evaluating remote receiver placements. For example, the top screen reveals receiver 1, 2 3, 6, and 8 do most of the work (are voted) while the bottom shows lots of squelch breaks on 1, 5 and 8. 8 does a fair amount of the work, however 1, 3 and 6 are best for the area the test was performed.



JPS Interoperability Solutions

CPM-3 Configuration Utility
SVM Module Statistics Table (Time)

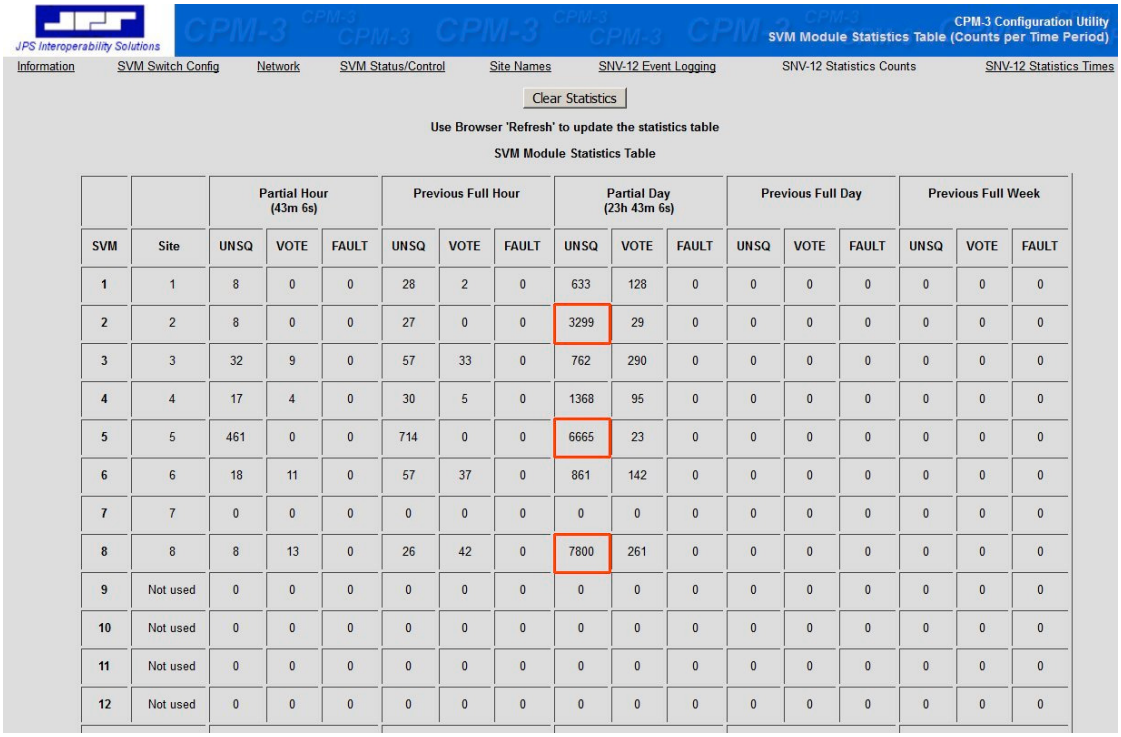
Information | SVM Switch Config | Network | SVM Status/Control | Site Names | SNV-12 Event Logging | SNV-12 Statistics Counts | SNV-12 Statistics Times

Clear Statistics

Use Browser 'Refresh' to update the statistics table

SVM Module Statistics Table

		Partial Hour (42m 28s)			Previous Full Hour			Partial Day (23h 42m 28s)			Previous Full Day			Previous Full Week		
SVM	Site	UNSQ	VOTE	FAULT	UNSQ	VOTE	FAULT	UNSQ	VOTE	FAULT	UNSQ	VOTE	FAULT	UNSQ	VOTE	FAULT
1	1	2m 17s	0s	0s	7m 32s	0s	0s	1h 2m 45s	22m 18s	0s	0s	0s	0s	0s	0s	0s
2	2	2m 16s	0s	0s	7m 24s	0s	0s	1h 7m 34s	11s	0s	0s	0s	0s	0s	0s	0s
3	3	4m 46s	2m 0s	0s	16m 6s	7m 27s	0s	1h 55m 5s	57m 36s	0s	0s	0s	0s	0s	0s	0s
4	4	2m 32s	21s	0s	7m 28s	7s	0s	45m 54s	11m 18s	0s	0s	0s	0s	0s	0s	0s
5	5	1m 2s	0s	0s	4m 33s	0s	0s	47m 39s	15s	0s	0s	0s	0s	0s	0s	0s
6	6	5m 17s	3m 16s	0s	16m 8s	8m 38s	0s	1h 50m 30s	25m 40s	0s	0s	0s	0s	0s	0s	0s
7	7	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s
8	8	2m 19s	4s	0s	7m 30s	13s	0s	1h 6m 31s	22m 31s	0s	0s	0s	0s	0s	0s	0s
9	Not used	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s
10	Not used	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s
11	Not used	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s
12	Not used	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s	0s



JPS Interoperability Solutions

CPM-3 Configuration Utility
SVM Module Statistics Table (Counts per Time Period)

Information | SVM Switch Config | Network | SVM Status/Control | Site Names | SNV-12 Event Logging | SNV-12 Statistics Counts | SNV-12 Statistics Times

Clear Statistics

Use Browser 'Refresh' to update the statistics table

SVM Module Statistics Table

		Partial Hour (43m 6s)			Previous Full Hour			Partial Day (23h 43m 6s)			Previous Full Day			Previous Full Week		
SVM	Site	UNSQ	VOTE	FAULT	UNSQ	VOTE	FAULT	UNSQ	VOTE	FAULT	UNSQ	VOTE	FAULT	UNSQ	VOTE	FAULT
1	1	8	0	0	28	2	0	633	128	0	0	0	0	0	0	0
2	2	8	0	0	27	0	0	3299	29	0	0	0	0	0	0	0
3	3	32	9	0	57	33	0	762	290	0	0	0	0	0	0	0
4	4	17	4	0	30	5	0	1368	95	0	0	0	0	0	0	0
5	5	461	0	0	714	0	0	6665	23	0	0	0	0	0	0	0
6	6	18	11	0	57	37	0	861	142	0	0	0	0	0	0	0
7	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	8	8	13	0	26	42	0	7800	261	0	0	0	0	0	0	0
9	Not used	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Not used	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	Not used	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Not used	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

To access these functions you need to connect the network jack (modular jack in the front of the CPM) to your network. If you don't know the IP address (default should be something like 192.168.1.200) you can find out by accessing the unit via the serial port.

To access the unit by the serial port power up a desktop or laptop PC with a comm. program. SRG normally uses a DOS PC/OS with Telix, a DOS program. The unit is normally set to accept communications at 9600 baud, 8, N and 1 stop. When the (straight through) 9-pin cable is connected to the PC, power up the SNV. The PC screen should show the IP and MAC addresses. The DIP switches on the CPM control the serial settings. It's done with switch one. Switch one positions 1~3 control the rate. It's normally set to the OEM default of 9600. You also must set switch on, position 4 to "ON" for this communication. When you are done (with serial access) be sure to turn position 4 back to "OFF" to avoid a distracting indicator on the front panel.

Once you find the IP address you can access the unit over any network.
As previously mentioned, the default password is " lightfoot ".

* The last address used with the LAN's RB750 in service. As of 2019 with the RB1100AH this no longer works.

Edition 1; July of 2018 by Karl Shoemaker; revised Nov 2018, Nov 2019, March 2023.