SNV-12 Signal-And-Noise Voter
Land Mobile

**Introduction**
The SNV-12 voter comparator from Raytheon JPS Communications solves radio system talk-in problems. It monitors multiple remote receivers on a radio channel, and selects the best signal. The incoming signal with the lowest noise is selected; this is usually from the receive site closest to the transmitting portable or mobile. The SNV-12 monitors up to twelve receiver audio inputs per chassis and sends the best signal to the dispatcher and/or repeats it over the air.

One of the most common receiver voting application is for a single duplex repeater and multiple auxiliary receivers. The voter can also be utilized in simplex applications. Additionally, the SNV-12 can be configured to handle complex applications controlling multiple repeaters or transmitters.

The SNV-12 works on 2175Hz pilot tone, 1950Hz pilot tone, or E-lead COR (Carrier Operated Relay contact closures) to detect when a receiver has unsquelched. It generates both EIA keytones and M-Lead PTT (Push To Talk) outputs for keying transmitters. Examples are shown of the following typical voter voting system configurations:

- **Figure 1**: Pilot tone internally generated in receiver, EIA keying
- **Figure 2**: Pilot tone externally generated, EIA keying
- **Figure 3**: E-Lead squelch indication, PTT keying
- **Figure 4**: Pilot tone internally generated, RF linked, hardwired PTT

The SNV-12 voter software resides in the central processing module and is flashed down into all other modules. Customers can enable/disable all voter functions via dip switches.

An SNV-12 voter chassis holds up to 12 site modules. Each site module is interfaced to an individual receiver. Up to three chassis can be connected together, allowing up to 36 sites to be voted.

This application note illustrates the use of the SNV-12 in conventional (non-trunked) radio systems.

**Voting Remote Receivers which have Internal Pilot Tone Generators**
The most common installation of the SNV-12 voter is illustrated in Figure 1. In this interconnection drawing, a duplex system with a single transmitter and multiple receivers is shown. The additional receivers assist the field units in reaching dispatch and other field units. Since this is a duplex system, portables or mobiles transmit on f1 and receive on f2. The remote receivers shown are tuned to f1 and are located throughout the region for maximum coverage. Transmissions from the field can be routed to dispatch and/or repeated over the same high-powered base station transmitter (TX1), that is used for dispatch transmissions. This transmitter should be capable of being heard by portables and mobiles throughout the desired coverage area.

Most voting receivers produce pilot tones when not receiving audio or carrier from a field unit. Each remote receiver shown in Figure 1 generates a 2175 Hz pilot tone. The pilot tone remains on until the receiver senses a carrier with the correct CTCSS tone, it then removes the pilot tone and sends the received signal to the voter. This audio/pilot tone signal can be sent back to the SNV-12 from the remote site over a wide variety of transmission paths. Audio can be sent via a dedicated twisted pair, a telco 4-wire circuit, a microwave link, or an RF link. Audio reaches a DSP (Digital Signal Processor) in each site voter module (SVM). The DSPs sample the incoming RX audio sig-
nals and use sophisticated proprietary algorithms to calculate a signal quality number for each SVM. The signal quality number is fed to the micro-controller in the CPM-1 module, which selects the best of these signals and routes it to the console and the repeater.

Refer again to the voting system depicted in Figure 1. The presence of a pilot tone on the incoming audio pair signals that the receiver is squelched; the SNV-12 votes the best quality RX signal from among all sites that do not have pilot tones. This voted signal is sent on to the dispatch console, and if the “Repeat Mode” feature is enabled in the SNV-12, the voted audio is mixed with the EIA keying tone sequence and sent to the system transmitter.

The pilot tones also provide a means for the voter to detect a failed receiver or broken link to the receiver. If the voter does not receive a pilot tone from a receiver, it assumes that the receiver is unsquelched; therefore a voice signal should be forthcoming. If the voice signal doesn’t show up after a set time period, it is clear that the receiver or the line to the receiver has failed and that site is removed from voting consideration. The failed site is indicated by the illumination of the FAULT light on the Site Voter Module’s front panel. The use of identical voting receivers in all locations is recommended so that the received audio sounds similar whichever site is voted. This creates a better audio signal to the dispatcher as the voter switches between receiver sites.

Input audio delay is available in each Site Voter Module to compensate all incoming audio paths – for example, if one circuit is coming in on a very compressed microwave link with an additional 120 milliseconds of modulate / demodulate time, then all other channels should be delayed by the same amount so switching occurs on the same syllable. Potential variations on Figure 1 include the use of a 1950 Hz pilot tone instead of 2175; the use of PTT keying instead of EIA keytones; or to operate without the Repeat Mode enabled (in other words, field communications are not retransmitted and are heard only by the dispatcher.).
**Voting Remote Receivers which require External Pilot Tone Generators**

Another typical configuration for the SNV-12 voter is illustrated in Figure 2. This is basically identical to Figure 1, except that the voting receivers did not have the capability to generate pilot tone internally. The Raytheon JPS Model PTG-10 is shown installed at each remote receiver site. The PTG-10 injects pilot tone onto the RX audio pair whenever the receiver is squelched. This allows low cost base stations (or even mobile receivers) to be used instead of expensive voting receivers. Variations on Figure 2 again include the use of a 1950 Hz pilot tone instead of 2175; the use of PTT (E&M) keying instead of EIA keytones; or to operate without the Repeat Mode enabled.

**Voting Remote Receivers and using COR (E-Lead) Inputs**

In Figure 3, the SNV-12 uses an E-lead input from each remote receiver to determine when that receiver is unsquelched. This configuration is typically utilized in microwave or telco T1 configurations where a customer controlled multiplexer or channel bank passes E&M signaling. The E-lead can be either high going or low going at multiple voltage levels from remote receivers, in other words, signaling types I, II, III, or V. In this Figure, the COR from the remote receiver feeds an input on the multiplexer in the remote site, causing an E-lead output at the local site to feed the SNV-12. As in Figures 1 and 2, if the Repeat Mode is enabled, the voted audio is retransmitted by the system repeater at site #1.
Voting Remote Receivers using RF links

In Figure 4, an RF link brings the receive audio (or pilot tone) from the voting receiver site back to the SNV-12. RF links of this type are useful when difficult terrain or other problems make it hard to bring a direct line back the voter. The system shows a single transmitter at the voter location. This transmitter sends out signals from the dispatch console, and if the SNV-12 has the Repeat Mode enabled, it also retransmits the voted audio. Pilot tones are recommended on systems interconnected by RF links. This requires a link transmitter with a 100% duty cycle to eliminate the delays required for the link transmitter to key and the link receiver to unsquelch.

Summary

To discuss how the SNV-12 voter comparator can help solve your specific radio system talk-in problem, contact your local Raytheon JPS Communications representative. Alternatively you can email our application staff in Raleigh, North Carolina at jps@jps.com