

Line Noise Reduction, Rcvr Mute & AGC ASP



Problems

Air Traffic Controllers have identified four significant noise, audio level and equipment safety related problems with many current voice switches:

- High Idle Channel Noise even when no radio receiver is active, specially when using HF radios.
- Noise burst coupled from a transmitter to its co-located receiver when the transmitter is un-keyed.
- Improper balancing of the volume of incoming calls or radio audio (inadequate or no Automatic Gain Control)
- Transmitter lockup due to a failure in the voice switch radio interface or a PTT switch lockup in the On state

The consequences of these problems are significant and may result in serious accident or equipment damage.

- High Idle Channel Noise in the operator headset results in unnecessary controller fatigue and could become a safety issue during peak busy times.
- Transmitter to Receiver coupling results in controller hearing a burst of white noise every time PTT is released. It becomes a nuisance and may even interfere with other active calls at the operator position.
- The improper balancing of the volume from airplanes and various callers causes controllers to constantly readjust volume settings for ground-to-ground (G/G) and air-to-ground (A/G) calls and increases the probability that a critical message could be missed. This increases controller's workload and induces a significant safety hazard.
- In case of a failure in the voice switch (Locked-up PTT switch or a failure in the Radio Control Equipment) a transmitter may be constantly keyed. This prevents other operators from using the same radio (s) and may even result in a damage to transmitters.

Solution

Digital Signal Products (DSP), Inc. has developed an Audio Signal Processor (ASP) that simultaneously solves all of these problems.

The ASP measures the strength of all incoming voice signals and adjusts the volume of all calls to the level selected by the AGC range selection. A total of 32 dB AGC (+/- 16 dB) can be incorporated. The AGC function is performed without reduction in quality of normal voice signals or amplification of low level noise.

When multiple radios are selected by an operator, idle channel noise from all selected receivers adds up, and becomes significantly loud and disturbing. For removing this idle channel noise, the ASP monitors line audio levels and opens up the channel for signals as low as -40dBm, and shuts it off at -43dBm (3 dB of hysteresis is provided). A fast attack time (5-10 msec) and a slow release time (50-60 msec) insures that no part of a conversation is lost, while interfering channel noise is removed gently when a call is de-activated.

If a transmitter and receiver are co-located a strong RF coupling results in overdrive and saturation of receiver front end. Consequently, when the PTT is released, the receiver outputs a burst of white noise while this extra energy is being discharged. If an operator keys multiple such co-located transmitters, the noise level becomes very significant and disturbing. For removing such coupled white noise, the ASP monitors the incoming PTT signal and shuts off the incoming receive channel when PTT transitions from On to Off state. Duration of this shut-off (receiver muting) can be selected from 0-300 mses in 20 msec steps. In response to incoming PTT, the ASP generates a PTT output signal toward the radio transmitter. A PTT timeout circuit (when enabled by the front panel switch) shuts off the PTT output after 1 minute timeout.

All functions are independently selectable from the front panel DIP switch.

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Configuration

The Noise Reduction and AGC ASPs are housed in a 5.25-inch high, 19-inch rack mountable chassis. The ASP employs a state of the art Texas Instrument digital signal processor running at 160 MIPS. Each card has necessary circuitry for interfacing to four audio channels. Front panel located DIP switches select functions and features to be performed by the ASP. Each card works in an independent manner. The chassis has 12 card slots and is powered by an external 110/220 VAC brick power supply, provided with the chassis. All inputs and outputs to the ASP are done using transformers, opto-isolators and relay contacts, thus preventing ground noise and hum from one system to get into another. Continuous health check, combined with a high reliability design, insures a trouble free operation in critical communication systems. For ease in maintenance, front panel located VOX and PTT LEDs provide constant channel status. Open-Collector alarm outputs from ASPs are available on I/O connectors located in the backplane. All connections to the ASP chassis are made through 25-pair telephone type I/O connectors located in the backplane. Mating cables to suit your requirements are available from DSP.

Specifications:

Input/Output Impedance: 600 Ohms, Balanced

Frequency Response: +/- 1.0 dB (300-3000 Hz) with respect to 1 KHz

Input/Output Signal Range: +7.0 dBm to -50 dBm (no adjustment required)

Fail Safe Operation: Automatic bypass in case of DSP or power failure within 3-5 seconds.

Open-Collector Alarm output (20 ma max current @ 30 VDC) and a red LED are provided to announce a card failure

Power Consumption: Typical: 5 watts, Maximum: 7 watts

Inter-channel Crosstalk Attenuation: 65 dB minimum

Total Harmonic Distortion: Less than 2%

Idle Channel Noise: Less than 6 dBm (with VOX feature enabled)

VOX Attack Time: 5-10 msec, VOX Release Time: 50-60 msec (other times can be provided to suit your application)

AGC Attack Time: 5-10 msec, AGC Release Time: 400-800 msec

AGC Range: +/- 8 dB (Referenced to 0dBm line level) or +/-16dB (Referenced to -8dBm line level) or +8/-24dB (Referenced to 0 dBm)

Radio Receive Mute Timing: 0-300 mses, switch selectable in 20 msec steps

Forced PTT Release Time: 1minute, when enabled (other times can be provided to suit your application)

Card Size: 5.25" x 8.66"

PTT Input: Contact Closure, Ground or +12V, 5ma typical, 10 ma max

PTT Output: Contact Closure, Ground or Externally supplied voltage (+/-12V, +/-24V or +/-48V)

PTT Contact Rating: 1 Amp @ 30V or 250 ma max at 48V (Protection provided on all PTT contacts)

Function/Feature Selection: Front Panel DIP switch

Other DSP Products

Voice Clipping – In some communication switches, there are call types where a caller will start speaking before the connection to the receiving position is complete. The Audio Clipping ASP prevents the loss of the initial portions of an incoming call when the connection times within the switch are too slow and up to 1 second of the message is lost.

Best Signal Selection (BSS) – In some radio communication systems, there are more than one receiver for a given frequency. This occurs for reasons such as too great a distance or terrain interference with only one receiver. Under some circumstances, multiple receivers will have a signal that exceeds an audible threshold, but the strength and quality may be significantly different. The Best Signal Selection ASP monitors all receivers and within 70 msec routes the call using the highest quality signal.

Radio Control Equipment (RCE) – DSP has developed an RCE that provides full duplex voice and data communications between a control site and a remote site over unconditioned telephone lines and satellite links. The control end modem trains the remote end modem to achieve the highest possible data transmission rate. The operator voice bandwidth is 300-3000 Hz end-to-end. The design employs speech encoding at 8 Kbits/s.

Digital Signal Products, Inc.

Digital Signal Products, Inc. provides both high quality products for communication systems as well as services for developing solutions for specific customer problems. DSP can help establish requirements, provide both a high level design and a detailed design that satisfy a set of requirements and, if desired, actually build and test products that conform to the design.

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