



Voice Security

Voice Inversion

Rolling Code

Hopping Code

Frequency Domain

Double Inversion

Voice Scramblers

Voice Inversion with ANI

Split-band

Radio Encryption

Rolling Double Inversion

Frequently Asked Questions

This Voice Security Selection Guide is designed to help answer common questions about voice scramblers, their applications & which level of security is appropriate.

Do I need digital voice encryption?

Most likely not! Digital voice encryption tends to be very costly and the benefits for many systems do not outweigh this high cost. Most users only need their conversations secured for a number of minutes or hours or days. Once this time period has passed the information is no longer important. Examples of this would be a military commander directing troop movements during a battle, police SWAT or Narcotics operations, a taxi or towing company picking up a fare, etc. Once the troops have moved, the SWAT operation is over or the fare is picked up the information transmitted is no longer important to an eavesdropper, therefore most systems only need a tactical level of voice security such as Midian's TVS-2 or VS-1200. Digital voice encryption is typically only needed to secure conversations for a strategic time period (i.e. months or years).

Is voice inversion scrambling secure?

Voice inversion scramblers will protect conversations from a casual listener. Many radio manufacturers are building voice inversion scramblers into the firmware of the radio and they tend to use the same or very similar inversion frequencies. If you buy a radio with the built in inversion scrambler, someone with a radio with a built in inversion scrambler could eavesdrop on your conversation if on the same channel. Adding a Midian voice inversion scrambler, such as the VPU-12A or VS-1000, on an inversion frequency away from what the radio manufacturers have built in can provide additional privacy.

Is it difficult to install a voice scrambler?

Midian supports plug in modules for many popular radio manufacturers and models including Motorola, Kenwood, Vertex, Icom, Tait and HYT. Midian also offers voice scramblers in a speaker microphone configuration. For radios not supported with a plug in module, Midian offers many application notes which are instructions on how to wire in a wired module. Many of the plug in installations can be done in just a matter of minutes. Wire in installations vary in their difficulty depending on the radio, some being very easy for a radio technician and others requiring a highly skilled radio technician.

Which kinds of systems can scramblers be used in?

Midian has installed voice scramblers in simplex radio systems, as well as repeater systems, trunking systems and voted systems.

Scramblers can also be used with signaling such as CTCSS, DCS, DTMF, 5-Tone and MDC-1200. On the transmit side the scrambler scrambles the audio prior to the signaling being encoded and on the receive side the scrambler descrambles the audio after the signaling has been decoded.

Do the number of security codes matter?

Only up to a point. Midian's TVS-2 offers 4.29 billion user-programmable codes plus 10,000 Midian controlled system ID's for a total of 42.9 trillion codes. Midian's VS-1200 offers approximately 4 billion user programmable codes from 6.2×10^{23} total codes. To put this in perspective, it would take more than 30 years to test one billion codes at a rate of one code per minute. Some manufacturers claim to offer more codes alluding to higher security, but that is just marketing hype. It is no more practical to try and break a scrambler with a billion codes than a scrambler with a trillion codes.

	VPU-12A	VS-1000	VS-1050	VPU-15	VS-1100	VS-110
Level of Analog Security (Scale 1-6 (6 = highest))	1	1	1	1	2	3
Type of Security	Inversion				Double Inversion	Rolling Double Inversion
# of Selectable Codes	up to 16	up to 16	up to 16	up to 4	up to 16	up to 16
# of total codes	Inversion Range: 2100-4100 Hz			37	32	1020
Exportability*	Easiest	Easiest	Easiest	Easiest	Easiest	Easiest
Power Consumption	Very Low	Very Low	Very Low	Very Low	Low	Low
Voice Quality	Best	Best	Best	Best	Better	Better
Automatic Number ID*	None	None	M, F, G, D, 5	K	None	None
Over-The-Air-Reprogramming	No	No	No	Yes	No	No
Radio Kill	No	No	No	Yes	No	No

* Exportability: Midian's TVS-2 and VS-1200 are controlled by the US Department of Commerce. For export Midian's End User Form must be completed and submitted to Midian when the order is placed. The ECCN for the TVS-2 and VS-1200 is 5A992 subject to AT1 controls.

**ANI Formats: K = Midian's Kryptic, M = Motorola's MDC-1200, F = Kenwood's FleetSync, G = Harris' G-Star, D = DTMF, 5 = 5-Tone

Frequently Asked Questions

Why choose Midian:

Customer Support: Midian believes in creating lasting relationships with its customers and our support does not end once the order is placed. Our sales and technical support staff are dedicated to ensuring that you are completely satisfied with your experience.

Product Quality: Midian takes the utmost care to make certain that you receive only the highest quality products. To demonstrate our commitment to quality Midian offers a 3 year product warranty on parts and labor. Midian performs its engineering and production in-house, so that we can tightly control our quality.

Experience: Midian Electronics has been in business since 1975. Its engineers, technicians and sales staff have over 100 years of combined experience in the two-way radio industry. This experience enables Midian's staff to understand your applications and find the best product to fit the applications.

Ease of Installation: Midian offers the largest selection of plug-in modules. For radios that we don't offer a plug-in module Midian has a very large database of application notes. We also have an applications engineer on staff to assist with installations.

Cost Effective: Midian strives to offer the most cost effective prices for its products. If it's not the lowest-cost, Midian will meet or beat a competitor's price on a comparable product.

Common applications for voice scramblers include:

Military: Maintain tactical level classified information and the secrecy of planned tactical operations (Midian's TVS-2 and VS-1200).

Police: Keep criminals & news media from listening in on police communications. Criminals often eavesdrop on communications using radio scanners. Criminals then use the knowledge gained from police communications to avoid detection by police & plot activities. Protect sensitive information from being used by the news media or crime scenes from being interfered with prior to a police arrival.

Ambulance: Secure communications maintain the integrity of patients' information (HIPAA) from being intercepted when transmitted over the air.

Fleets: Taxi, towing and fishing competitors often use information intercepted over the air to take business from one another.

Industry: Some extreme activists eavesdrop on chemical and mining companies' communications. These activities can cause unnecessary harassment and litigation and may cost the companies financially.

Utilities: In an effort to protect a country's infrastructure, utilities are encrypting communications to prevent outsiders from learning information that could expose weaknesses in construction, operations, etc. that could make the site a more susceptible target.

	TVS-2 L1	TVS-2 L2	TVS-2 L3	TVS-2 L4	VS-1200 L1	VS-1200 L2	VS-1200 L3
Level of Analog Security (Scale 1-6 (6 = highest))	3	4	5	6	4	5	6
Type of Security	Hopping Code				Frequency Domain		
# of Selectable Codes	up to 4	up to 4	up to 4	up to 4	up to 3	up to 3	up to 3
# of Total Codes	42.9 Trillion Codes				Total: $\sim 6.2 \times 10^{23}$ Actual: ~ 4 Billion		
Exportability*	Easy	Easy	Easy	Easy	Easy	Easy	Easy
Power Consumption	Very Low	Very Low	Very Low	Very Low	Low	Low	Low
Voice Quality	Better	Better	Good	Good	Better	Good	Good
Automatic Number ID**	K	K	K	K	M, F, G, D, 5	M, F, G, D, 5	M, F, G, D, 5
Over-The-Air-Reprogramming	Yes	Yes	Yes	Yes	No	No	No
Radio Kill	Yes	Yes	Yes	Yes	No	No	No

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Frequency Domain Voice Scramblers



VS-1200 Frequency Domain Scrambler

Midian's VS-1200 series is a new Digital Signal Processor (DSP) based Frequency Domain voice scrambler offering a high level of voice privacy. This new technology is comparable in security to rolling code scrambling, yet does not require synchronization.

The DSP converts the analog signal into quantized digital data. It then converts the "Time Domain" signal into the "Frequency Domain". This results in an audio "frequency spectrum", which is then partitioned into bins that are encrypted by the non-linear key generator. The digitized data is converted back to the analog realm using a digital to analog converter.

The above technique and the lack of synchronization result in excellent audio quality, high security and enables the VS-1200 to be used in virtually any type of radio system. These systems include HF SSB, Conventional two-way, Trunking, and Voting.

The VS-1200 series has the following features:

- Total code combinations: $\sim 6.2 \times 10^{23}$
- Actual code combinations: ~ 4 billion
- Number of selectable keys: 3
- 4 user-programmable levels of security including voice inversion
- Multi-Format ANI including Motorola's MDC-1200, Kenwood's FleetSync, Harris' G-Star (aka GE-Star), DTMF and 5-Tone
- Automatic detection of scramble
- Programmable audio levels
- Dimensions: 1.59" L x 0.83" W x 0.21" H
- Plug-in modules are available for Icom, Kenwood, Motorola and Vertex. Plug-in modules for HYT and Tait are in development.

VS-1xxx-SM1 Secure Speaker Microphone

Midian's offers a secure speaker microphone for use with handheld two-way radios. This is ideal for radios with no space or options connector available or just for ease of installation.

The secure microphone is available in the following versions:

- VS-1200-SM1 - Frequency Domain Scrambler with Multi-Format ANI
- VS-110-SM1 - Rolling Double Inversion Scrambler
- VS-1100-SM1 - Double Inversion Scrambler
- VS-1050-SM1 - Inversion Scrambler with Multi-Format ANI
- VS-1100-SM1 - Inversion Scrambler

Pre-made cables are available for the following radio manufacturers:

- Icom
- Kenwood
- Motorola
- Vertex





Hopping Code Voice Scramblers

TVS-2

Hopping Code Scrambler

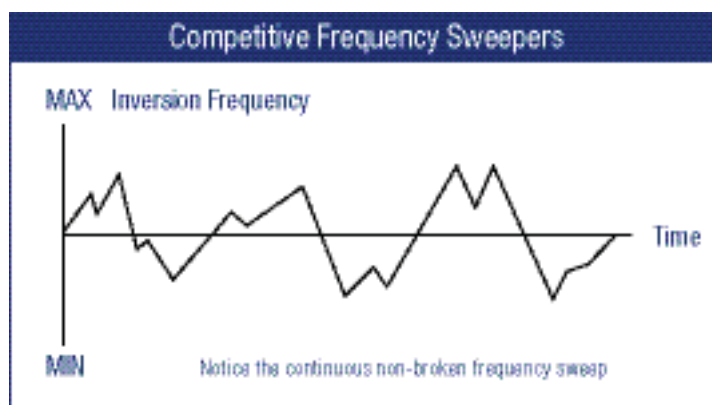
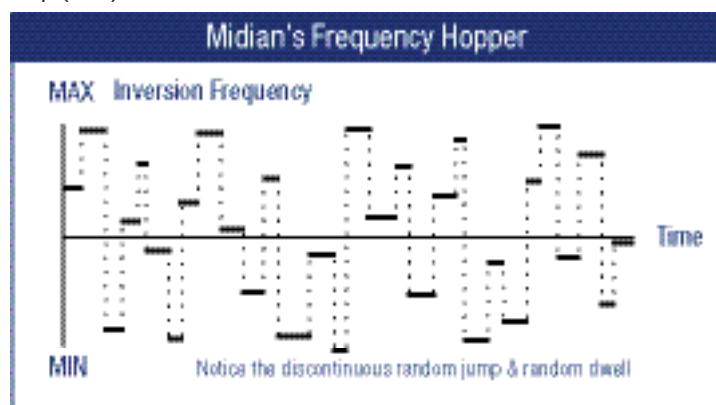
Midian's TVS-2 offers a high-level of voice security for two-way radio communications. By using the hopping code type of rolling code scrambling, Midian's TVS-2 offers a higher level of security versus other rolling code scramblers (see comparison below). The TVS-2 incorporates Midian's Kryptic signaling format which allows for greater control of fleet communications (see below) and the automatic detection of scrambled/clear audio. A Dual Mode option is available upon request for systems that require both rolling code and voice inversion scrambling for interoperability.



The TVS-2 series has the following features:

- Number of possible codes: ~ 40 Trillion
- Number of selectable keys: 4
- 5 user-programmable levels of security
 - Level L4: 12-25 hops per second
 - Level L3: 6-12 hops per second
 - Level L2: 1.2-2.4 hops per second
 - Level L1: 0.8-1.2 hops per second
 - Voice Inversion
- Midian's Kryptic signaling format for:
 - ANI & Emergency ANI
 - Selective Calling
 - Radio Kill
 - Spy
 - Radio Check
 - Over-The-Air-Reprogramming (OTAR) of the security keys
- Dimensions: 1.64" L x 0.84" W x 0.2" H
- Plug-in modules are available for HYT, Icom, Kenwood, Motorola, Tait and Vertex.

Hopping versus Sweeping Rolling Code Scramblers: Midian's TVS-2 uses the hopping type of rolling code scrambling, instead of the sweeping type, for higher security. Both types of scramblers claim a certain number of hops per second. Sweepers (aka Hybrid Sweeper/Hopper) imply a higher level of security because they "hop" hundreds of times per second. However, it is the length of the hop that is important rather than the number of hops per second. Each "hop" of a sweeper is approximately 1 Hz in length whereas each hop of a true hopping scrambler is at least 300 Hz. Therefore it would take ~300 hops of a sweeper to equal the change of a true hopper in one hop. Because of the negligible frequency change of a sweeper, sweepers are susceptible to attack by tracking the sweeping with a phase lock loop (PLL) circuit.



Voice Inversion Scramblers

Voice inversion scramblers protect two-way radio communications from eavesdropping by casual listeners. For more sensitive communications Midian recommends using the VS-1200 or TVS-2.

VPU-12A

Voice Inversion Scrambler



The VPU-12A is a user-programmable voice inversion scrambler with 16 different inversion frequencies that are selectable using 4-line binary. The VPU-12A offers the same features as the VPU-12 except the VPU-12A has mode indications.

The VPU-12A series has the following features:

- Number of Programmable Inversion Codes: 16
- Inversion Frequency Range: 2100 to 4100 Hz

A plug-in version of the VPU-12 is available for Tait.

VPU-15

Voice Inversion Scrambler with Kryptic Signaling

Midian's VPU-15 incorporates voice inversion scrambling with Midian's Kryptic signaling format. These signaling features allow for greater control of fleet communications and the automatic detection of scrambled/clear audio. (See below for Kryptic features)



The VPU-15 series has the following features:

- Total Inversion Codes Available: 37
- Number of Selectable Inversion Codes: 4
- Midian's Kryptic Signaling Format using Midian's CAD-300 for:
 - ANI & Emergency ANI
 - Selective Calling
 - Radio Kill
 - Spy
 - Radio Check
 - Over-The-Air-Reprogramming (OTAR) of the Security Keys

Plug-in modules of the VPU-15 are available for HYT, Icom, Kenwood, Motorola, Tait and Vertex.

VS-1000

Voice Inversion Scrambler

Midian's VS-1000 is a 16-code voice inversion scrambler that is programmable to any inversion frequency between 2100 Hz and 4096 Hz.

VS-1050

Voice Inversion Scrambler with Multi-Format ANI

Midian's VS-1050 offers the same security features as the VS-1000, but offers ANI and Emergency ANI in the following signaling formats:

- Motorola's MDC-1200
- Harris' G-Star (aka GE-Star)
- 5-Tone (all formats)
- Kenwood's FleetSync
- DTMF

Plug-in modules of the VS-1000 & VS-1050 are available for Icom, Kenwood, Motorola & Vertex. Plug ins for HYT & Tait are in development. A speaker microphone version is also available.



VS-1100

Double Inversion Scrambler

Midian's VS-1100 series is a double inversion voice scrambler (aka split-band scrambler) that is compatible with Midian's VPU-6, Icom's UT-109 and Inysa's XPTO (Señalización y Telecontrol).

- The VS-1100 can be programmed to match any of the 32 double inversion codes used by Midian's VPU-6, Icom's UT-109 and Inysa's XPTO.
- Programmable for up to 16 different codes (some versions may only support up to 4 codes).
- Plug-in modules available for Icom, Kenwood, Motorola and Vertex.



VS-110

Rolling Double Inversion Scrambler

Midian's VS-110 series is a rolling double inversion voice scrambler that is compatible with Icom's UT-110. The VS-110 matches the Icom UT-110 group and code numbers. The VS-110's codes can also be programmed for fixed double inversion voice scrambling (aka split-band voice scrambling) that is compatible with Midian's VS-1100 and VPU-6, Icom's UT-109 and Inysa's XPTO (Señalización y Telecontrol).

- In rolling double inversion mode (Icom UT-110 mode) the unit can be programmed to match the 1020 codes of the UT-110 (4 groups with 255 codes per group).
- In fixed double inversion mode the unit can be programmed to match any of the 32 double inversion codes used by Midian's VS-1100 and VPU-6, Icom's UT-109 and Inysa's XPTO.
- Programmable for up to 16 different codes (some versions may only support up to 4 codes).
- Plug-in modules available for Icom, Kenwood, Motorola and Vertex.



CAD-300

Midian's Kryptic Controller

Midian's CAD-300 is a PC-based controller for Midian's Kryptic signaling format used in Midian's TVS-2 and VPU-15 series voice scramblers. The CAD-300 offers the following controls:

- **Over-The-Air-Reprogramming (OTAR):** OTAR enables the system administrator to change the security codes of the TVS-2 or VPU-15 over-the-air.
- **Radio Kill:** If a field unit becomes lost or stolen, the system administrator can remotely disable the TVS-2 or VPU-15. The Radio Kill feature can also erase the security keys of the scrambler.
- **ANI/ENI:** The scramblers can be programmed with a unique ID to identify to the dispatcher who is transmitting. The scrambler can also transmit an Emergency ANI to quickly and accurately identify users in distress.
- **Selective Call:** The dispatcher can selectively call field units, while other units remain muted.
- **Remote Monitor:** Allows the dispatcher to remotely monitor a radio for a predetermined amount of time to eavesdrop or triangulate on a particular field unit.
- **Radio Check:** Informs the dispatcher if a field unit is turned on/off or is decoding properly.



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