



TVS-2

High Level Hopping Code Scrambler

VPU-15

Voice Inversion Scrambler with Midian's Kryptic Signaling

Manual Revision: 2018-03-30 Rev G

Covers Software Revisions:

TVS-2: 4.97 & Higher

VPU-15: 4.97 & Higher

SPECIFICATIONS

Operating Voltage	5.5-15 VDC
Operating Current	9 mA
Operating Temperature	-30 - +60 C
Frequency Response	300-2600 Hz
Input Impedance	100 k Ω
Input Level (TX)	0.2-4.0 VPP
Input Level (RX)	0.3-4.0 VPP
Carrier Suppression	65 dB < Peak Voice
Audio Output Impedance	1K Ω (min)

Encryption Specifications

TVS-2: Encryption Sequences	+40 Trillion
TVS-2: Random Number Generator	64 bits
TVS-2: Sequence Length (est.)	84 billion years
VPU-15: Inversion Codes Available	37

INSTALLATION OVERVIEW

1. Test the radio for functionality.
2. Program the scrambler per the Product Programming Section of this manual.
3. Install the scrambler into the radio per the Hardware Installation Section of this manual.
4. Program the radio per any application note instructions.

*** Midian is not responsible for any damage/loss resulting from the use of Midian's products.

GENERAL INFORMATION

TVS-2 Series:

Midian's TVS-2 series is a high-level rolling code scrambler. The TVS-2 uses hopping type rolling code encryption for higher security rather than sweeping code type and offers 4 user-programmable hop rates and is down gradable to voice inversion. The scrambler is capable of features such as ANI, ENI, OTAR, Deadbeat Disable, Spy, and more when using Midian's Kryptic Signaling format with the CAD-300/DDU-300. For more information on Midian's TVS-2 please read the TVS-2 Technical Reference Manual.

VPU-15 Series:

Midian's VPU-15 series is an entry level voice inversion scrambler. The scrambler is capable of features such as ANI, ENI, OTAR, Deadbeat Disable, Spy, and more when using Midian's Kryptic Signaling format with the CAD-300/DDU-300.

Midian's TVS-2 and VPU-15 are programmed using Midian's KL-4F and MPS software. Please reference the KL-4 manual for setup instructions of the KL-4 hardware.

KL4-F USB PORT ASSIGNMENT and SOFTWARE INSTALLATION

Go to our website midians.com and under downloads> software download the latest MPS software version. If using the supplied CD-ROM insert it into the PC's CD-ROM drive. In the browser that will pop-up, install the MPS programming software. Be certain that the "Install KL-4 USB Driver" box is checked during the installation process.

Open Windows' Control Panel and go to Device Manager.

Open Ports (COM& LPT) to identify the port assignment issued by computer. Plug in the KL4 programmer to the USB port and the screen will flash and show the device location.

Open the software and choose product from product tree then set appropriate comport selection in the MPS software as needed, from the product selection screen on the programming software, select the appropriate product from the list and click OK. Set the parameters of the TVS-2\VPU-15 software to fit the application. If any clarifications on a feature are required, move the mouse cursor over the feature name until the question mark appears and right click, a definition of the feature will be shown.

After entering the parameters, save the file by going to File - Save As. Enter the file name in the File Name block and click Save. Saving the file will allow for quick and easy reprogramming of units.

The TVS-2 and VPU-15 require the following additional connections from the flea clips to the P2* connector of the module:

Green – Program In – Connect to the Midian product's Program In P2:8*.

Yellow – Program Out – Connect to the Midian product's Program Out P2:10*.

Please reference the pictorial at the end this manual for location of programming connections.

Important Note: Do not attempt to 'clone' the scrambler by reading one and then programming another. When the scrambler is read, the security codes will be read out as zeroes. If another scrambler is then cloned with this information, the scramblers will be incompatible because they have different security codes. To ensure scramblers communicate with each other, program them from a saved *file*.

HARDWARE INSTALLATION

Be certain to follow standard anti-static procedures when handling any of Midian's products. For installation instructions into a particular radio, please consult Midian's application notes for the TVS-2 and VPU-15 if available.

P1 – Connector Side

P1-1 – Green – PTT Input – Disconnect the line coming from the radio's PTT switch. Connect the PTT Input lead to the PTT switch. If you do not break the PTT line the unit must be programmed for common PTT. See P1-9.

P1-2 – Red – VIN +5.5-15 VDC – Connect to switched battery point in the radio. Connect to a regulated voltage point in a vehicular radio if engine noise is present on the battery line. Keep this lead as short as possible.

P1-3 – Brown – Mode/Code Select – Connect to a momentary or latching switch.

P1-4 – Black – Ground – Connect to the nearest ground plane in the radio.

P1-5 – Blue – TX Audio In – The scrambler must be installed in the TX audio path between the microphone and the insertion point of CTCSS or other tone signaling. Break the TX audio path and connect to the side nearest the microphone.

P1-6 – Orange – Emergency Input – When taken to ground the scrambler will send an ENI. This input is continually active.

P1-7 – Yellow – RX Audio In – The scrambler must be installed in the receive audio path after the CTCSS high pass filter and where any tone signaling is picked off. This point needs to be given a constant level; otherwise the trigger will not work. If possible connect to the high-side of the volume control where a constant level is available. Connect to the source of the audio at the break.

P1-8 – Green/White – Audio Enable Out - This output is active when the scrambler produces beeps such as when ringing or changing modes. This lead may be used in several different ways. Connect this lead to a point in the radio, which will turn on the radio's speaker power amp, allowing beep tones to be heard. This lead may also be used to supply a ground to one side of the speaker when used in conjunction with the Alert Tone Output (see P2-13). If used in this manner, make sure that the power amp output stage and Q2 will not be damaged (a resistor may be necessary). This lead may also be used to supply a ground to the cathode of an LED which will blink any time the TVS-2 beeps, providing a visual silent indicator. Be sure to use a current limiting resistor if connecting to an LED.

P1-9 – White – PTT Out – Connect to the wire removed from the switch mentioned above (see P1-1). PTT Output should be connected even when using common PTT mode. The PTT transistor is rated for 200 mA continuous.

P1-10 – Gray/White – RX Audio Out – Connect to side closest to the receiver's speaker driver amplifier at the above mentioned break point (see P1-7). In addition to outputting receive audio, this lead outputs beep tones whenever applicable, such as when the mode switch is pressed. Beep tones are also available on P2-13.

P1-11 – Gray - Mode LED Out – If desired, connect to the anode of an LED and the cathode to ground to indicate scramble or clear mode. This output will source up to 15 mA to drive the LED when in scramble mode.

P1-12 – Orange/White – TX Audio Out – Connect to the point nearest the modulator at the above-mentioned breakpoint (see P1-5).

P1-13 – Violet – COR Input – Connect to a point in the radio receiver squelch circuit that changes state when carrier is present. A radio whose squelch circuit gives a logic low (0V) or logic high (5V) should be used to drive the COR input. The COR input lead must be connected in order to use Advanced and Standard Mute functions.

P2 – Non-Connector Side

P2-1 – Keypad Column 3 Input

P2-2 – Keypad Column 2 Input. Can also be used with a binary switch to select security codes.

P2-3 – Keypad Column 1 Input

P2-4 – Keypad Row 4 Input

P2-5 – Keypad Row 3 Input

P2-6 – Keypad Row 2 Input. Can also be used with a binary switch to select security codes.

P2-7 – Keypad Row 1 Input

P2-8 – Program Input – Connect this lead to the green clip lead from the KL-3 programmer.

P2-9 – Squelch/Disable Output – When used as Squelch Output, this lead can be used to mute the radio's audio power amplifier by the scrambler. Using this lead to mute the radio is optional since the scrambler can mute internally. When programmed as Disable Output, this output will be active when the disable command is transmitted from the CAD-300/DDU-300 and will remain active until re-enabled from the CAD-300/DDU-300.

P2-10 – Program Output – Connect this lead to the yellow clip lead from the KL-3 programmer.

P2-11 – Trunking Delay Input – This input should be used in trunked radios with a channel acquisition strobe output. When used, the scrambler will wait up to 5 seconds for a channel to be acquired. After 5 seconds the PTT must be reset. If this input is not used, program the trunk delay polarity to positive and leave unconnected.

P2-12 – Keypad Ground

P2-13 – Alert Tone Output - This lead outputs beep tones whenever applicable, such as when the scrambler rings or the mode is changed. This lead should be used when the Audio Enable Output is insufficient for turning on the radio's audio amplifier. This lead should be connected directly to the high side of the radio's speaker. If neither side of the speaker is connected to ground, the Audio Enable Output may be used to supply a ground to the speaker when tones are being output. Be sure this will not damage the radio's audio amplifier or Q2.

HARDWARE ALIGNMENT

1. For level reference, take a signal measurement at the input and output of the RX audio path's breaking point component by modulating the receiver with a full quieting signal and at full modulation. That's 5 kHz for a wide band radio and 2.5 kHz for a narrow band radio of a 1 KHz tone.
2. For the TX signal level, speak normally into the microphone while monitoring the TX breaking point. For a higher level, say "FOUR" and document the levels. If it is possible to inject a 1 kHz tone into the microphone stage, set that as 3 kHz for wide band or 1.5 kHz for narrow band as a reference.
3. To set up the RX level correctly on the TVS-2 (after installation into the radio), modulate the radio receiver at full quieting with a 1250 Hz tone at .7 to .8 kHz for wide band or .35 to .4 kHz for narrow band.
4. To adjust the RX input pot, monitor with an oscilloscope at IC-6 Pin 7 until it triggers at the step 3 levels.
5. Adjust the RX output pot to match the reference level documented from step 1 output level. If the output level cannot be obtained call Midian for further details.
6. For the TX levels, set the TX input pot so that the level at IC-9 Pin 1 is just below clipping by speaking loudly into the microphone with the scrambler in scramble mode.
7. With the scrambler in the clear mode, adjust the TX output pot for the documented level from step 2 output level.
8. With the scrambler in scramble mode, key the radio with no audio and observe the TVS-2 sync-packets on a communications analyzer. Make sure the sync-packets are as close to full modulation as possible.

For further details for aligning the RX and TX lines, refer to the TVS-2 Technical Reference Manual.

Mode Select:

Momentary Switch: When using a momentary switch, pressing and then releasing the switch will cause the scrambler to switch modes. A medium tone followed by a high tone indicates the scrambler has been switched into scrambled mode. A medium tone followed by a low tone indicates the scrambler has been switched into clear mode.

Latched Switch: When using a latched switch, pressing the switch will toggle the mode. Depending on the programmed polarity will determine the mode. For example if the polarity is programmed as low, then the scrambler will be in scrambled mode when taken to ground. No mode indication tones are available.

Code Select:

Momentary Switch: When using a momentary switch, pressing and holding the switch will toggle the scrambler through the programmed codes (1-4 codes). The scrambler will emit a number of tones corresponding to the code that is being switched to. When the desired code is reached simply release the switch.

Latched Switch: Multi-code operation is not available when using a latched switch.

Communications: Once the desired mode has been selected, press and hold the PTT. The scrambler will generate a scrambled or clear synchronization packet to tell receiving radios whether to go to scramble or clear if Automatic Detection is enabled. Once the sync packet is transmitted a go-ahead beep is heard to indicate that it is okay to start the conversation.

Midian's Kryptic Signaling:

Midian's TVS-2 and VPU-15 offer the following signaling functions:

ANI: When the PTT button is pressed the scrambler will generate an ANI to be decoded by Midian's CAD-300 or DDU-300.

Emergency ANI (ENI): When the Emergency button on the radio is pressed and held for 1 second the scrambler will key the radio and transmit the ANI to be decoded by Midian's CAD-300 or DDU-300.

Selective Call: The scrambler can be selectively called from Midian's CAD-300 or DDU-300. When the scrambler is called it will generate ringing beeps out the radio's speaker.

Radio Kill: The scrambler can be disabled and re-enabled from Midian's CAD-300 or DDU-300. When the scrambler receives a disable command it will not allow any receive or transmit audio to pass through the scrambler or for a PTT command to be given to the radio if the PTT path is controlled by the scrambler. When the scrambler receives an enable command it will resume normal operation.

Spy: The scrambler can be sent a command from Midian's CAD-300 or DDU-300 to key the radio and transmit ambient noise from the microphone for 00-90 seconds in 10 second increments. This time is preprogrammed into the scrambler.

Query: This command sent from Midian's CAD-300 or DDU-300 will report to the CAD or DDU if the scrambler/radio is currently on or off.

Simplex:

It will be necessary to program the “Front Porch Time” on the TVS 2 long enough for the sync packet to open the repeaters’ CTCSS/DCS and let the repeater come up to full power and then to open the portable and mobile radios CTCSS/DCS so the sync is not blocked at the receiving radios. EIA spec states that a 100 Hz CTCSS tone should open in 250 msec. 67 Hz tone will take longer and a 250 Hz tone will be half the decode time.

Repeater:

If the repeater’s repeat audio levels are not properly aligned it is possible the synchronization packet could be distorted. Flat audio is preferred. Pre-emphasis and de-emphasis should be disabled via the repeaters internal programming. To correctly align the repeat audio levels of the repeater use the following procedure.

1. Connect a microphone to the repeater’s TX radio.
2. While monitoring the TX signal with a service monitor set the TX modulation for 4.8 – 5.0 kHz of deviation in a wide band system or 2.4 – 2.5 kHz in a narrow band system. This should be done while speaking loudly into the microphone with a constant voice.

NOTE: For military radio systems operating in the 36 -88 MHz range set the modulation to 13kHz out of a maximum of 15kHz

3. Adjust the RX repeat audio using 1.5 – 2.0 kHz deviation of a 1 kHz tone at the RX input with a strong RF signal and adjust the repeat level to the transmitter for the same level of 1.5 – 2.0 kHz while monitoring the TX signal with a service monitor. For a narrow band system use 0.75 – 1.0 kHz deviation.
4. Ensure that compression and expansion are turned off in the repeater. Do not enable de-emphasis or pre-emphasis.

It will be necessary to program the “Front Porch Time” on the TVS-2 long enough for the sync packet to be decoded by the receiving radio. Time should be given for CTCSS or DCS signaling to be decoded and for the repeater to rise prior to the synchronization being transmitted by the scrambler.

Trunking Systems:

Midian’s TVS-2 has a trunking delay input. Connect this input to a point in the radio that will give the scrambler a strobe upon acquisition of a channel. This can either be high or low. Program the “Trunking Delay Polarity” to the active state of the strobe. Upon indication that the channel has been acquired the TVS-2 will go through the programmed “Front Porch Time” and send the synchronization. If a channel is not acquired within 5 seconds the PTT will need to be reset.

Voted Systems:

When using the TVS-2 in a voted system please observe the following:

1. The voting receivers should be programmed to “Scan and Lock”, not “Scan and Re-Scan”.
2. Set the “Front Porch Type” on the TVS-2 to “Preamble”.

Some voting systems regard frequencies above a certain frequency (i.e. 2700 Hz) as noise. With inversion and rolling code scramblers the voting comparator may treat the inverted voice as noise.

Simulcast Systems:

Call for more information.

HF SSB:

Midian does not recommend the TVS-2 to be used on HF SSB systems for several reasons. Due to the nature of SSB modulation the signal fades in and out. Depending on the strength of the signal at the time the sync is received by the TVS-2 will determine whether or not the sync will be decoded. A radio 30 miles away might decode, but a radio 30 feet away might not. If the TVS-2 is used in an SSB system Midian recommends that either L1 or L2 hop rates are used for audio quality purposes.

For HF SSB systems Midian recommends using Midian's VS-1200 frequency domain scrambler.

TECHNICAL NOTES

Radio Compatibility: Midian has taken the utmost care to ensure the option board integrates into the radio with minimal impact to the features of the radio. However, some features may not be available in the radio when an option board is used. If a feature is not available, please contact Midian to see if the feature can be added.

MIDIAN CONTACT INFORMATION

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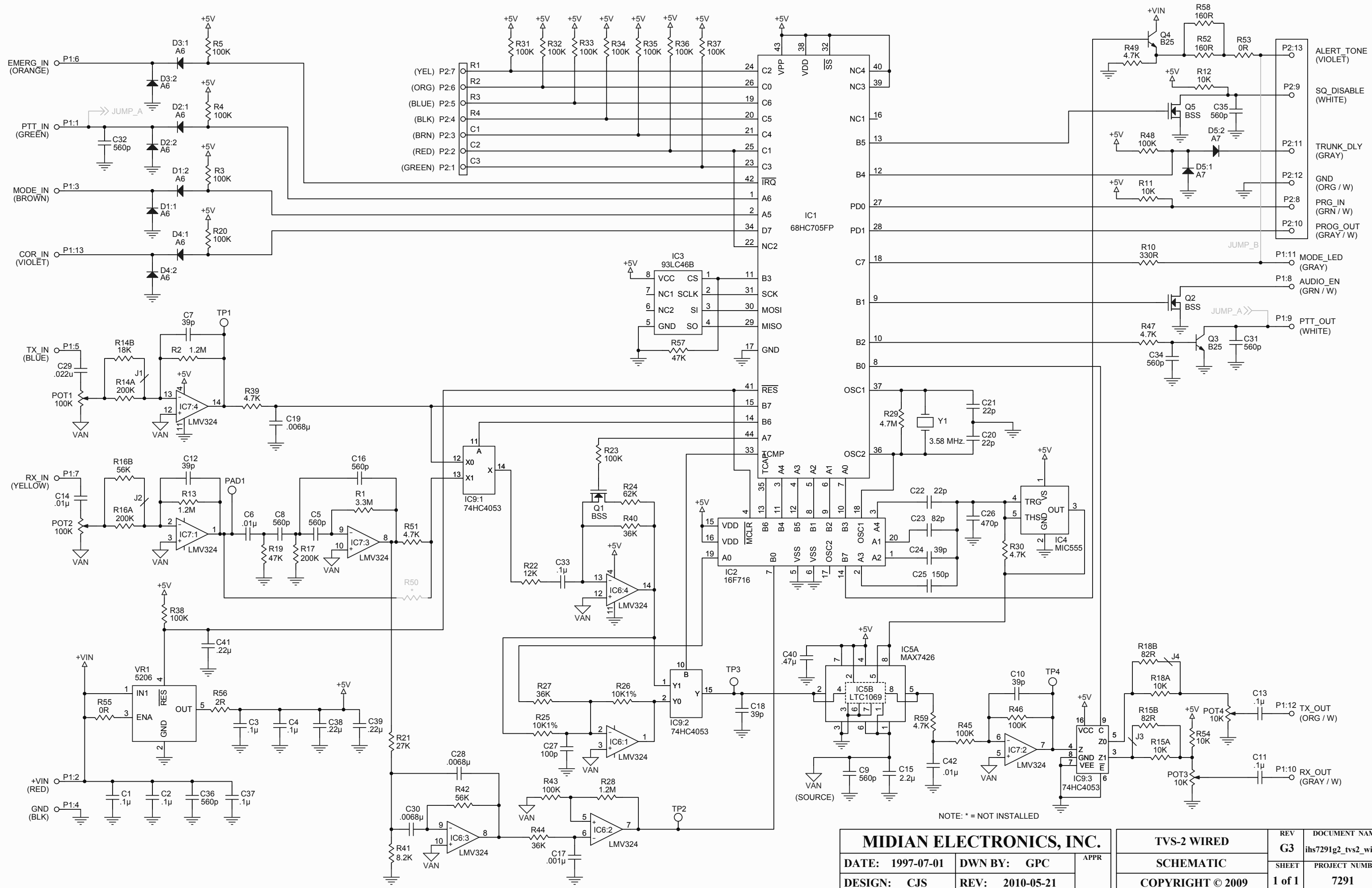
Orders: 1-800-MIDIANS

Phone: 520-884-7981

Fax: 520-884-0422

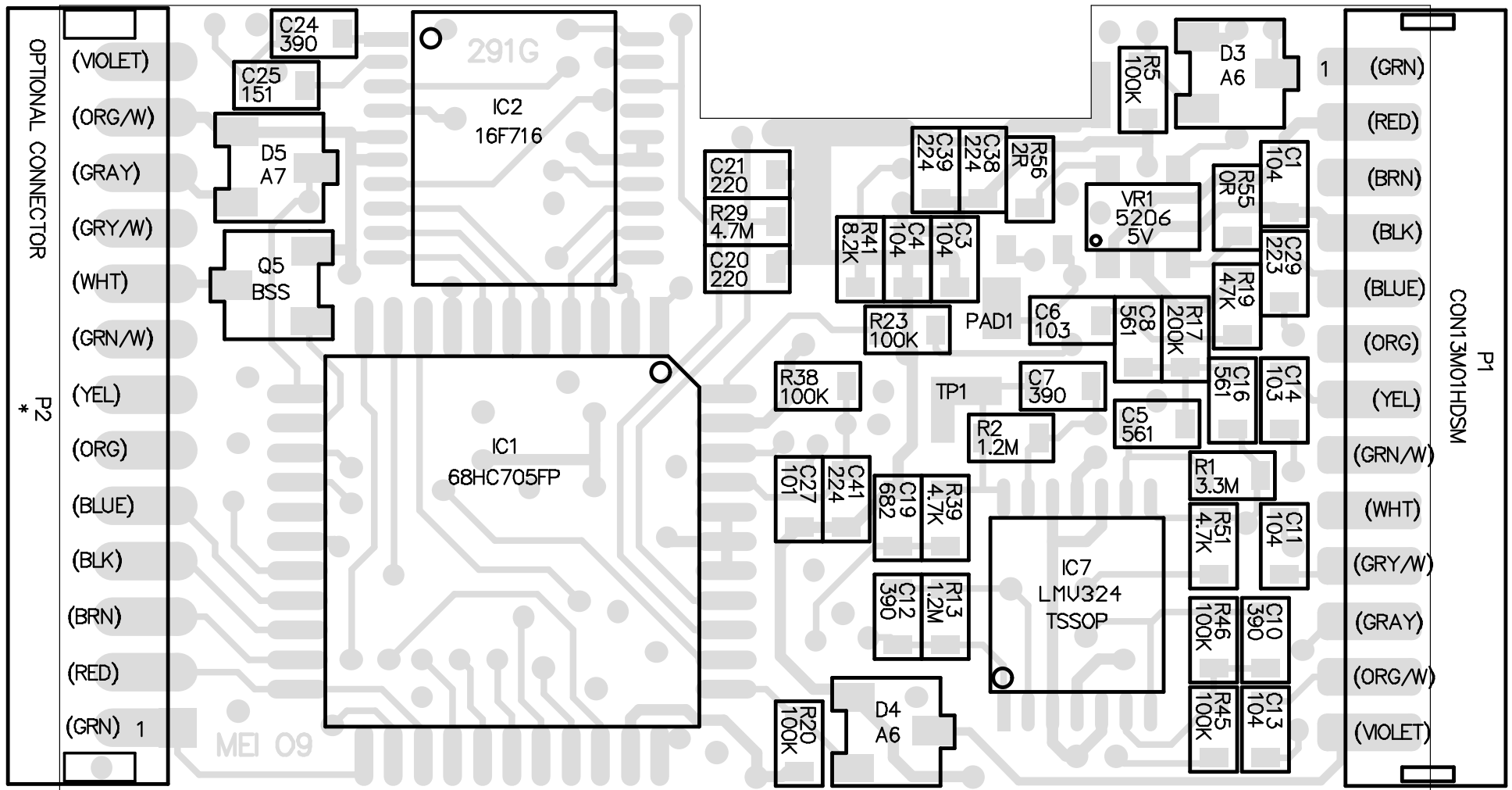
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DATE: 1997-07-01	DWN BY: GPC	APPR	COPYRIGHT © 2009		SHEET	PROJECT NUMBER
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* NOT INSTALLED

TVS2 COMP

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TVS-2 WIRED

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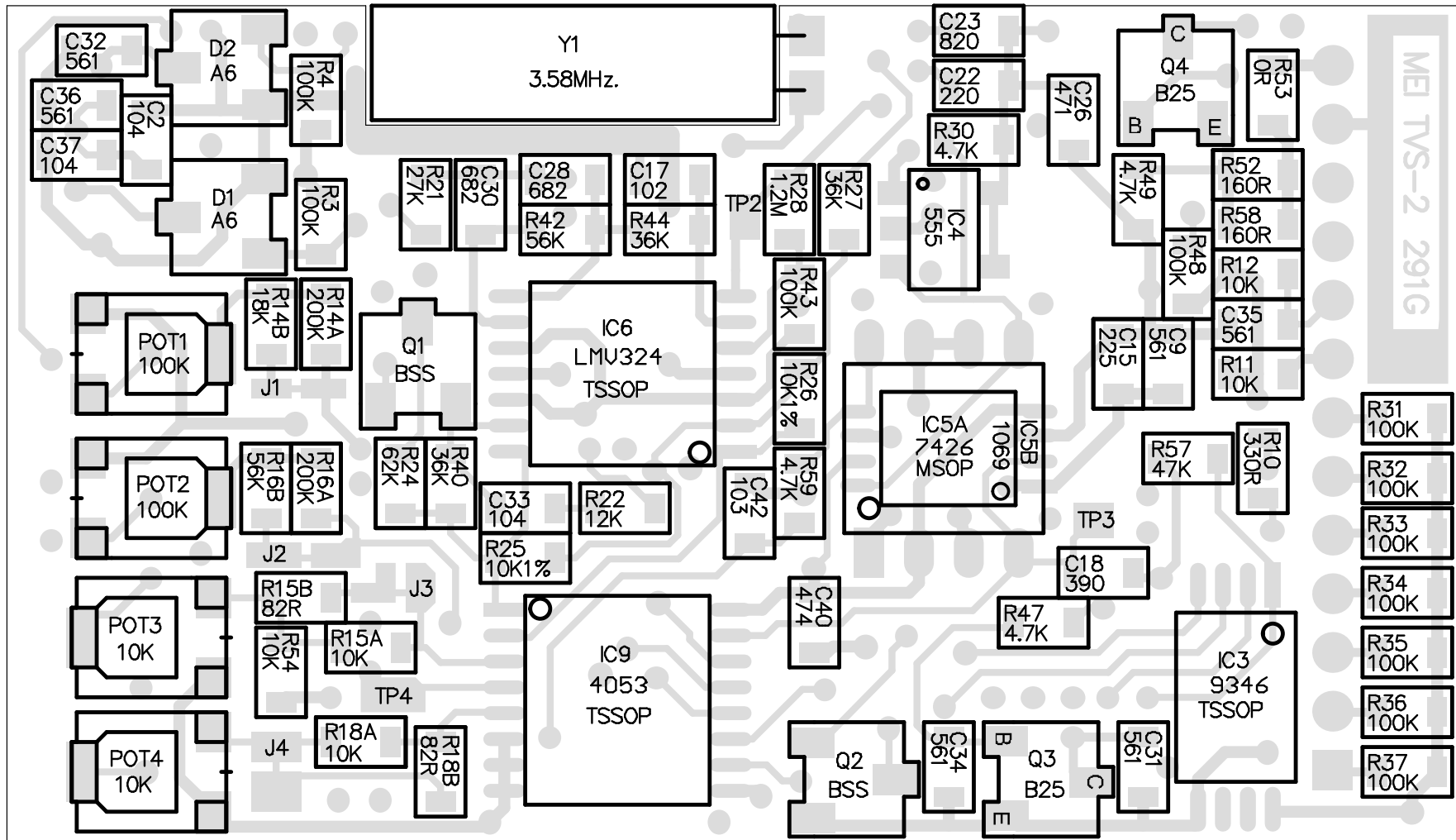
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DESIGN: CJS

REV: 2010-05-21



ME TVS-2 291G

NOTE:
IF IC5B IS
INSTALLED
R59 = OR
C42 = *

TVS2 SOLDER

* NOT INSTALLED

MIDIAN ELECTRONICS, INC.		
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