CURRENT Technologies, LLC
Interference Mitigation and Avoidance
CT Bridge® URD 5010mvx

1. General

CT Bridge® URD 5010mvx comes in three different versions, and each version uses a distinct frequency set. The CT OTP™ URD 5000 can utilize all three frequency sets in order to communicate with CT Bridges on each frequency set. An overview is shown in Figure 1 below.

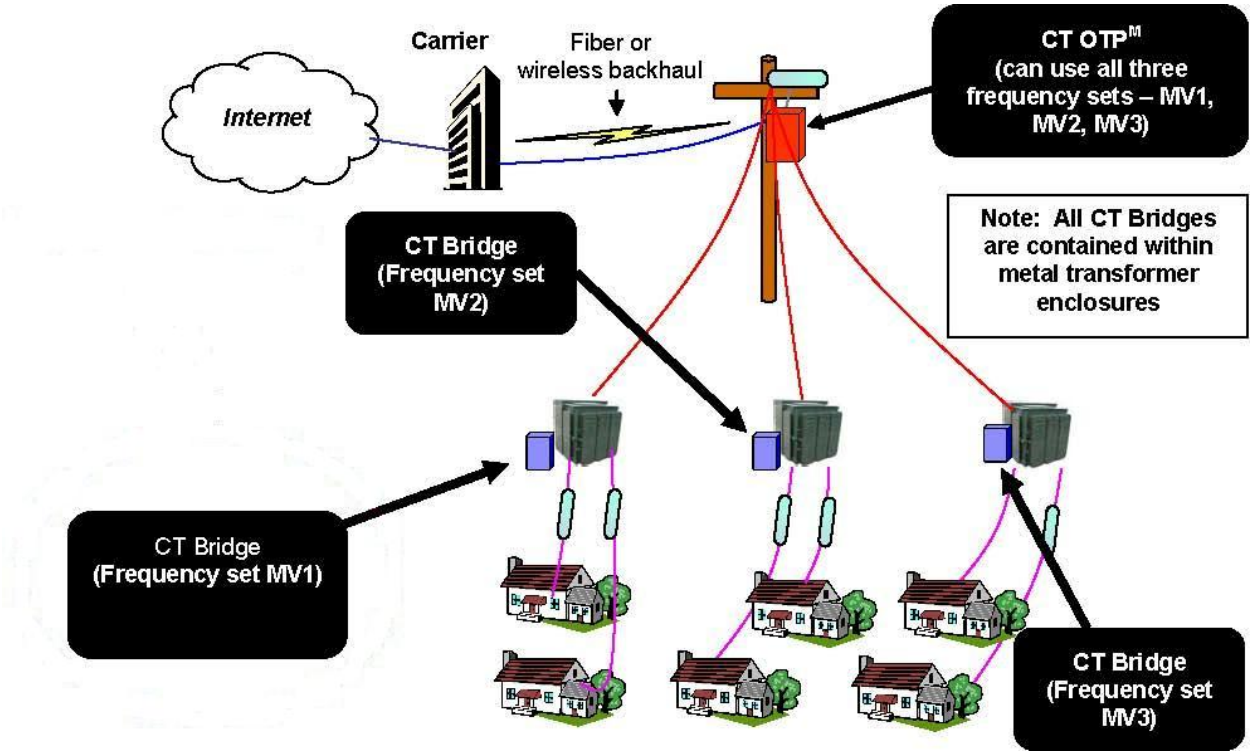


Figure 1: Overall CT Bridge® URD 5010mvx System Diagram

The frequency plan is shown in Figure 2 below.

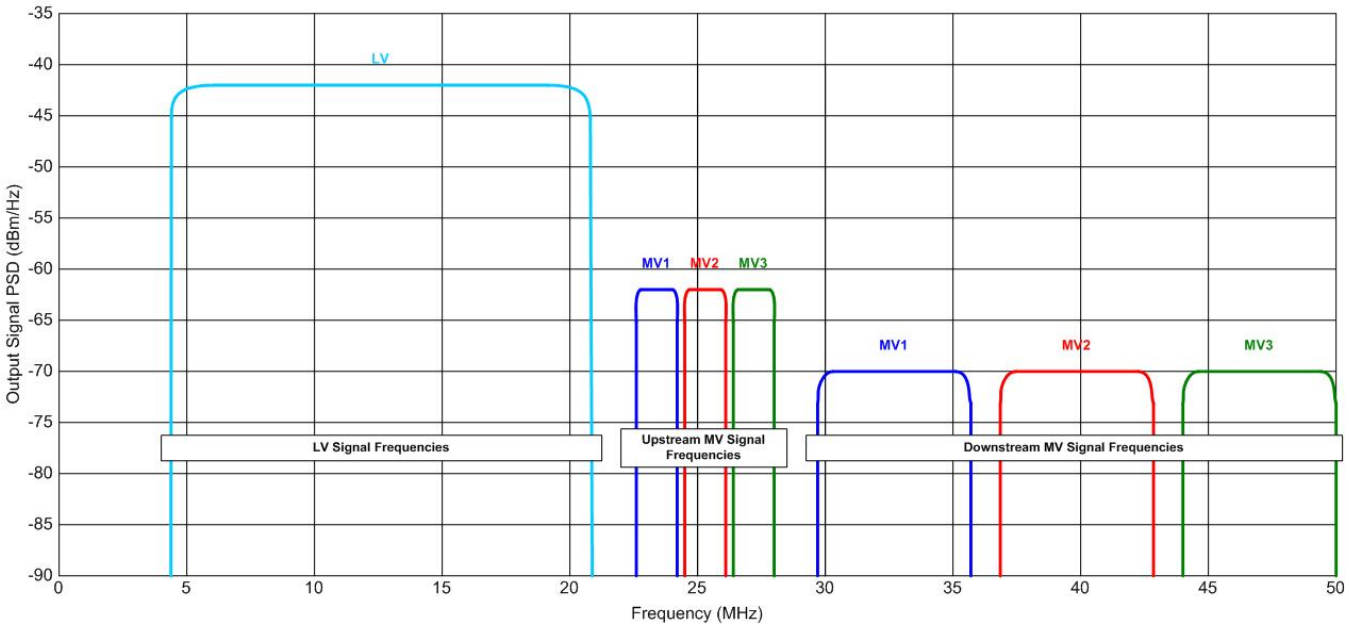


Figure 2: CT Bridge® URD 5010mvx Frequency Plan

The CT Bridge® installs at the distribution transformer, where it bridges between the low voltage and medium voltage lines. The CT Bridge® is always installed inside a distribution transformer case. The CT OTP device can be installed on a riser pole, where an overhead line goes underground. Note that typically 15 CT Bridges are installed for every CT OTP device.

1.1. Low-Voltage (LV) Signal

The LV-signal operates only on the public utility's low-voltage wiring. It is based on the HomePlug 1.0 standard and operates at frequencies from 4.4 MHz to 20.8 MHz using OFDM signals with carriers spaced approximately 195 kHz apart. The LV signal does not place carriers in the frequency bands specified for amateur radio use. Additional frequency notching of the LV-signal spectrum can be performed as required. Interference mitigation is accomplished by removing specified OFDM carriers from the Bridge's LV-signal via a software download performed remotely over the power line network. A simple user interface allows the system operator to specify which carriers will be removed. If required, the signal can also be shut down remotely.

1.2. Upstream Medium-Voltage (MV) Signal

The upstream MV-signals operate only on the public utility's medium-voltage wiring. There are three possible upstream channels, each 1.6 MHz wide, centered on 23.4, 25.3, and 27.2 MHz. The occupied bandwidth for each channel is adjustable to 1600, 800, 400, or 200 kHz. An occupied bandwidth below 1600 kHz can be shifted remotely to anywhere in the original channel. It is thus possible to avoid transmitting on any frequency while maintaining service to BPL customers. Frequencies on all three available channels are pre-chosen to avoid amateur radio frequencies and the excluded frequency bands of FCC Rules, Section 15.615(f)(1). The channel can be changed among the three possibilities by replacing the CT Bridge® at the transformer. This requires changing every CT Bridge® on a run, which only takes a few minutes at each site.

Each individual CT Bridge® can be separately addressed and its power separately controlled. Each unit can also be turned off remotely. Power can be reduced remotely across the entire 1600 kHz channel in small increments up to 20 dB.

1.3. Downstream Medium-Voltage (MV) Signal:

The downstream MV-signals operate only on the public utility's medium-voltage wiring. The entire system has 3 possible downstream channels, each 6 MHz wide, centered at 32.7, 39.85, 47.0. MHz. Frequencies on all three available channels are pre-chosen to avoid amateur radio frequencies and the excluded frequency bands of FCC Rules, Section 15.615(f)(1). The channel can be changed among the three possibilities by replacing the CT Bridge® at the transformer. This requires changing every CT Bridge® on a run, which only takes a few minutes at each site.

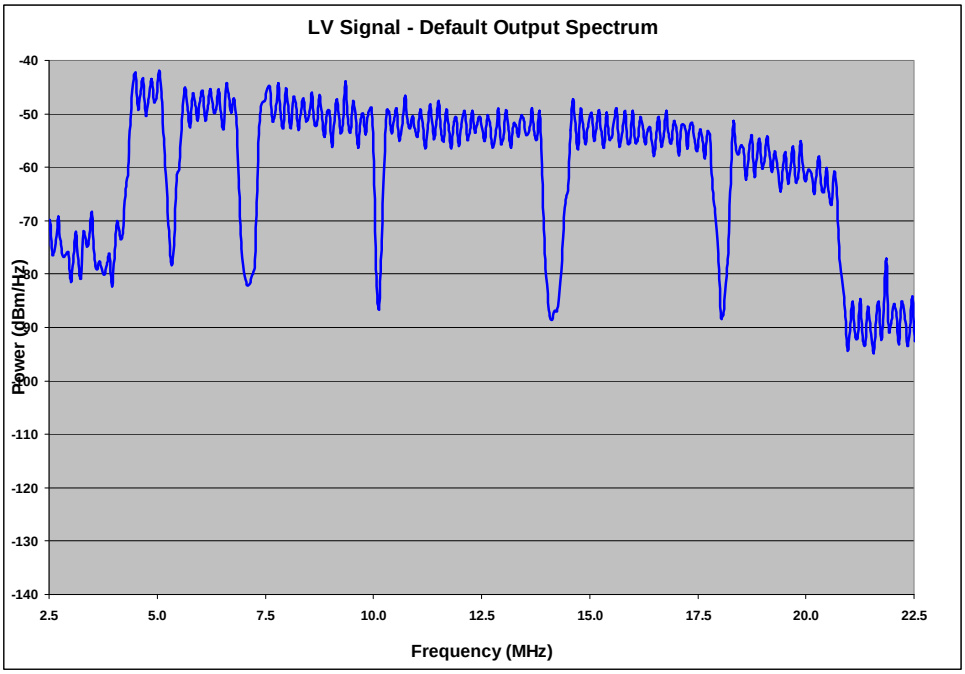
Each individual CT Bridge® can be separately addressed and its power separately controlled. Each unit can also be turned off remotely. Power can be reduced remotely across the entire 6 MHz channel in small increments up to 10 dB.

2. Output Spectrum Shaping Overview

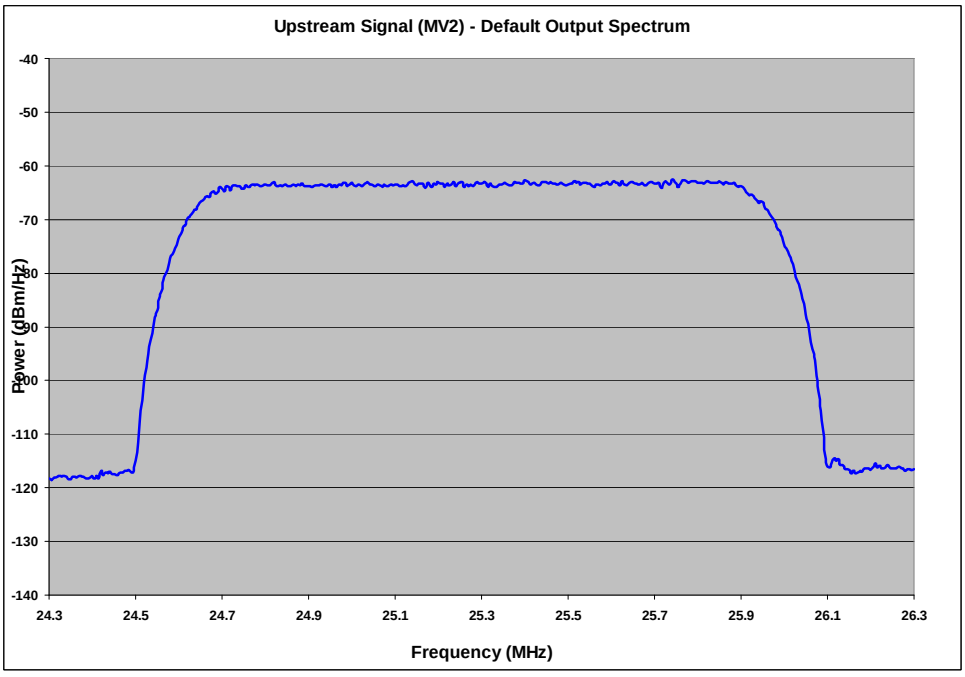
The charts below demonstrate compliance with FCC Rules, Section 15.611(c).

2.1. Default Output Spectrums

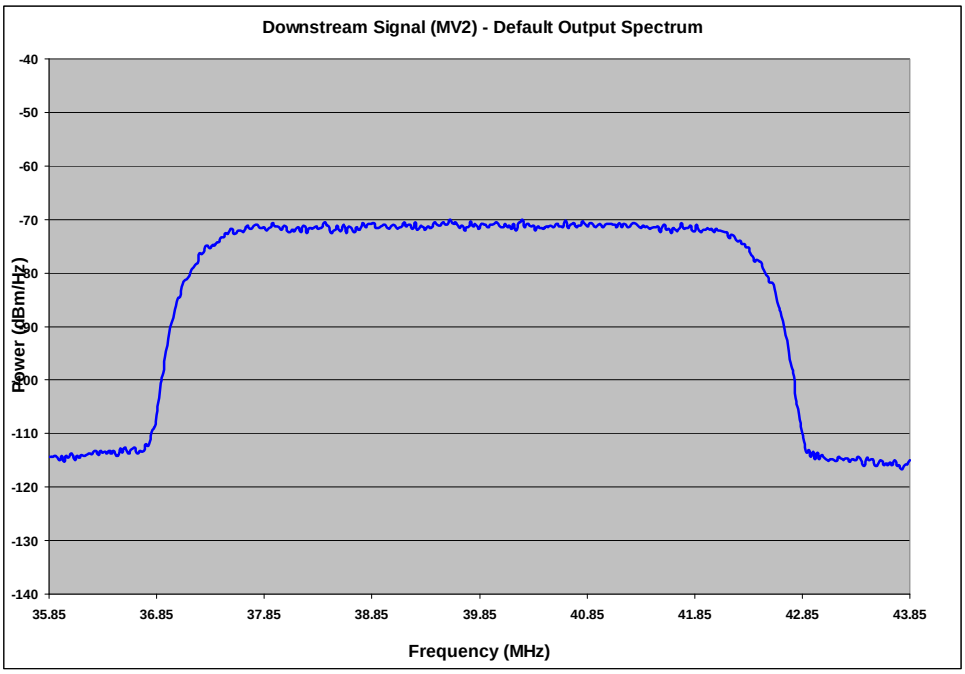
The following chart shows the default output spectrum of the LV signal, as-shipped from the factory.



The following chart shows the default output spectrum of the Upstream signal (MV2), as-shipped from the factory.

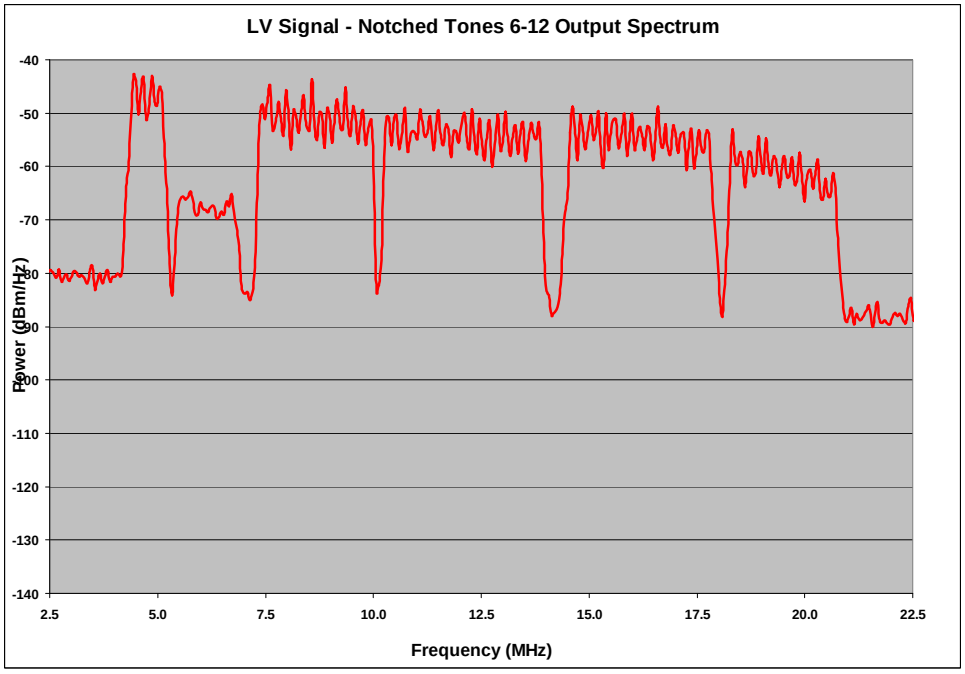


The following chart shows the default output spectrum of the Downstream signal (MV2), as-shipped from the factory.



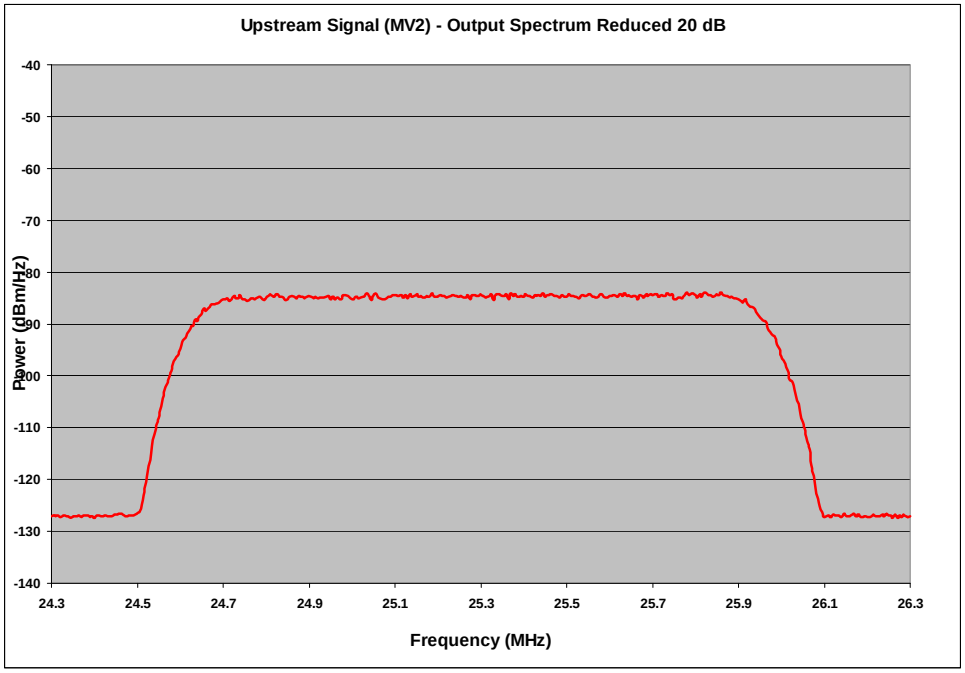
2.2. Notched LV-Signal Output Spectrum

The following chart shows the output spectrum of the LV signal following a remote software change which removes carriers 6 through 12. The notch shows the required 20 dB suppression.

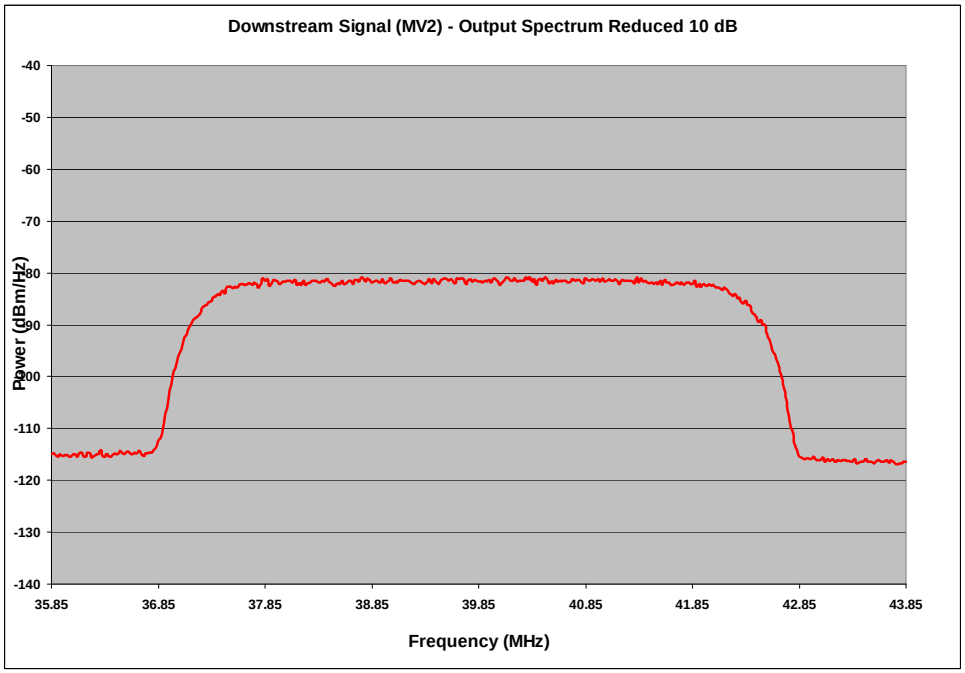


2.3. Reduced Power MV-Signal Output Spectrum

The following chart shows the output spectrum of the Upstream signal (MV2) after a 20 dB reduction in power, made by a software change from a remote location. The measured signal reduction is 21.2 dB.

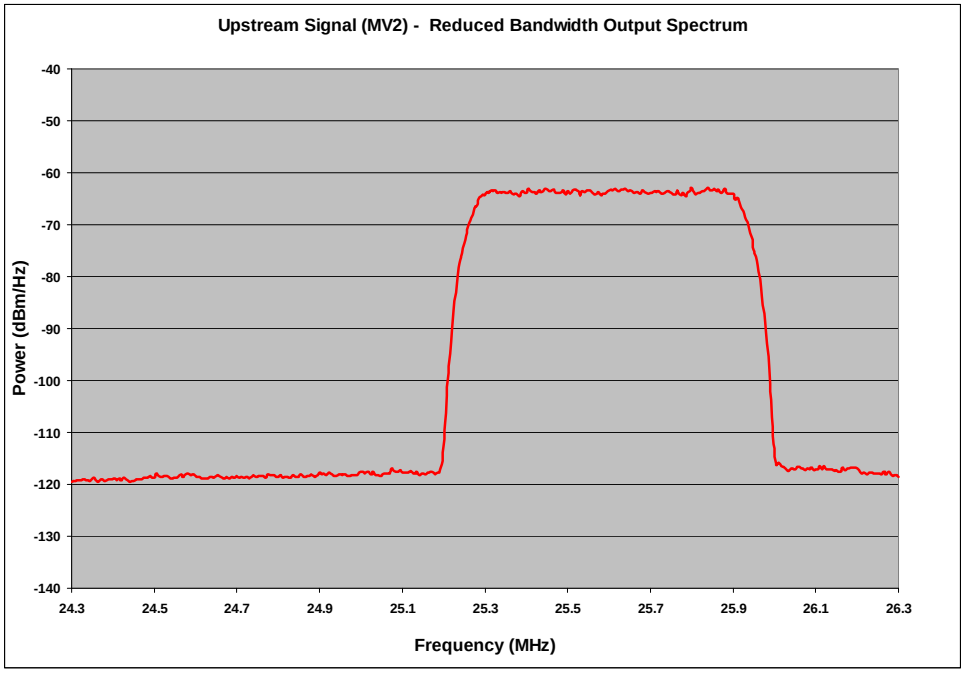


The following chart shows the output spectrum of the Downstream signal (MV2) after a 10 dB reduction in power, made by a software change from a remote location. The measured signal reduction is 10.1 dB.



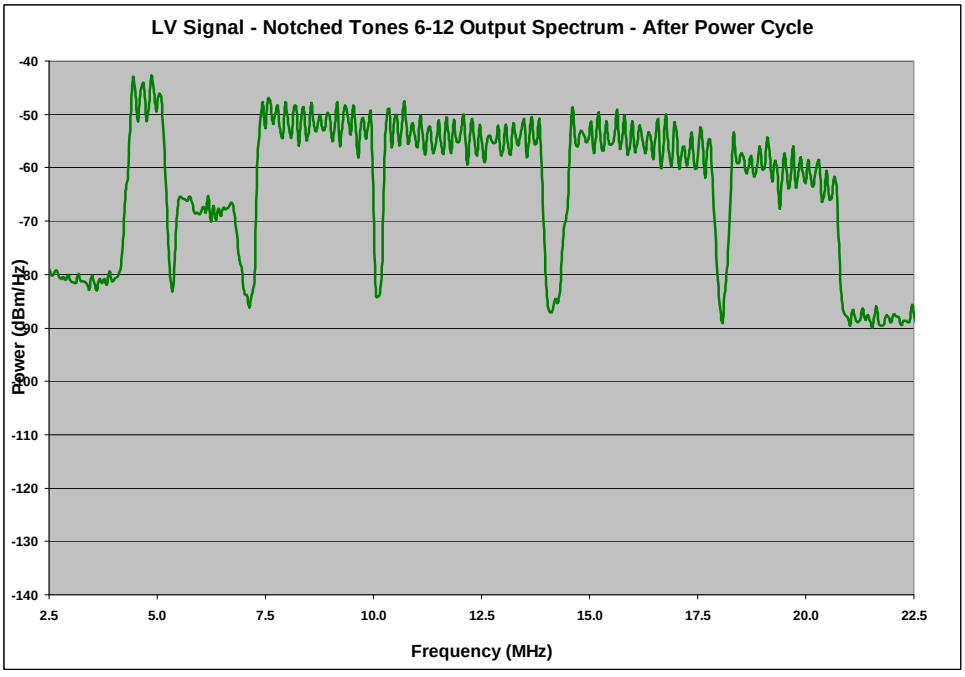
2.4. Reduced Bandwidth MV-Signal Output Spectrum

The following chart shows the output spectrum of the Upstream signal (MV2) after a software change made from a remote location that reduces the bandwidth of the output spectrum.



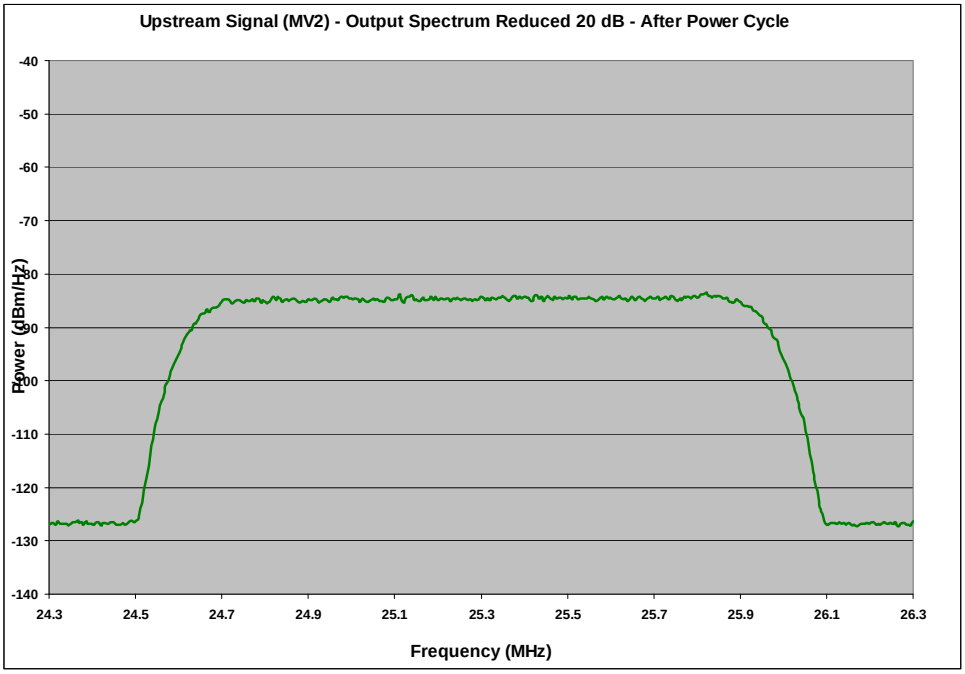
2.5. Notched LV-Signal Output Spectrum After Power Cycling

The following chart shows the output spectrum of the LV signal with carriers 6 through 12 removed and power cycled. No additional output spectral shaping commands were sent from the remote location.

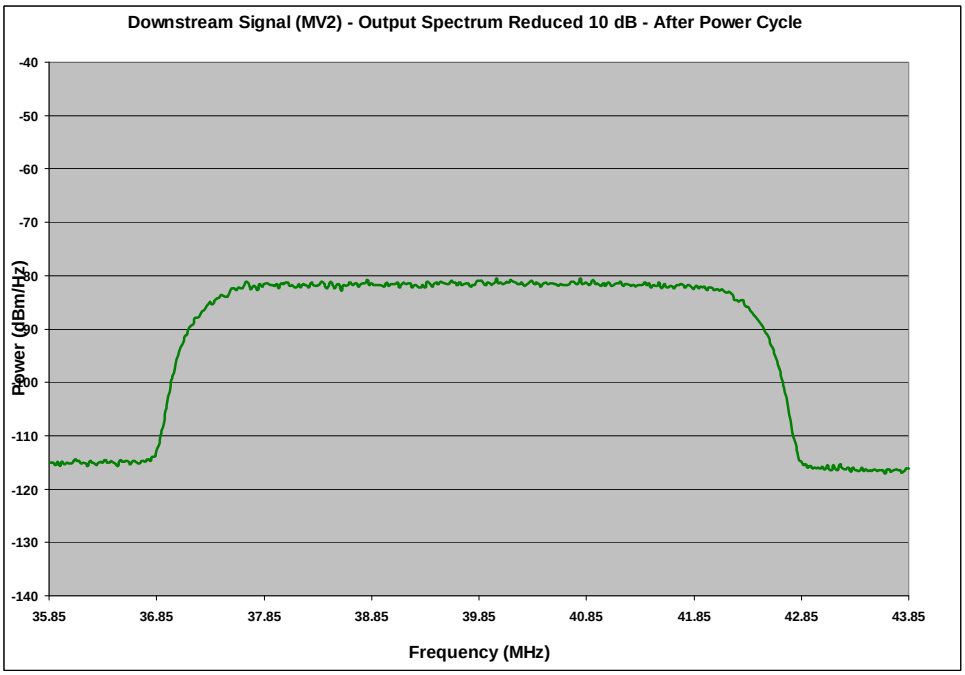


2.6. Reduced Power MV-Signal Output Spectrum After Power Cycling

The following chart shows the output spectrum of the Upstream signal (MV2) with reduced power after power cycling. No additional output spectral shaping commands were sent from the remote location.

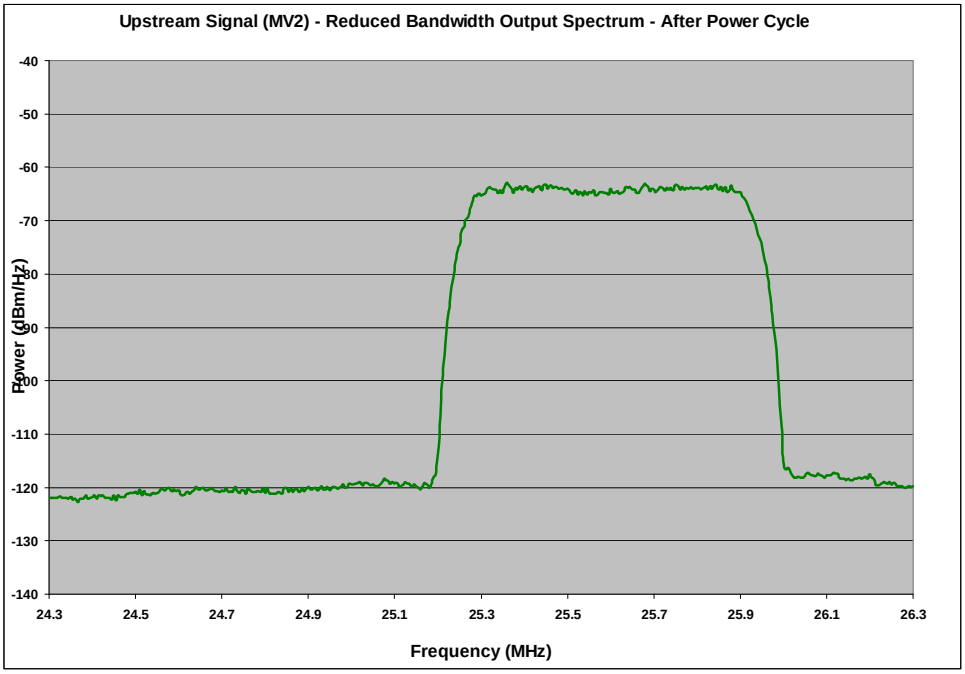


The following chart shows the output spectrum of the Downstream signal (MV2) with reduced power after power cycling. No additional output spectral shaping commands were sent from the remote location.



2.7. Reduced Bandwidth MV-Signal Output Spectrum After Power Cycling

The following chart shows the output spectrum of the Downstream signal (MV2) with reduced bandwidth after power cycling. No additional output spectral shaping commands were sent from the remote location.



3. Compliance With FCC Rules

The LV signal does not place carriers in the frequency bands specified for amateur radio use. Additional frequency notching of the LV-signal spectrum can be performed as required. LV-signals can be attenuated at least 20 dB below the applicable Part 15 limits.

The upstream signal frequency bands have been specifically chosen to avoid the excluded frequency bands of FCC Rules, Section 15.615(f)(1). Also, the upstream signals can be attenuated at least 20 dB below the applicable Part 15 limits, and can be shifted in frequency to avoid site-specific local interference.

The downstream signal frequency bands have been specifically chosen to avoid the excluded frequency bands of FCC Rules, Section 15.615(f)(1). Also, the downstream signals can be attenuated at least 10 dB below the applicable Part 15 limits.

All of these changes can be made remotely, and are stored in non-volatile memory so that they are immediately restored upon power-up following a fault condition. In addition, the CT Bridge® URD 5010mvx can be shut down remotely, if needed.