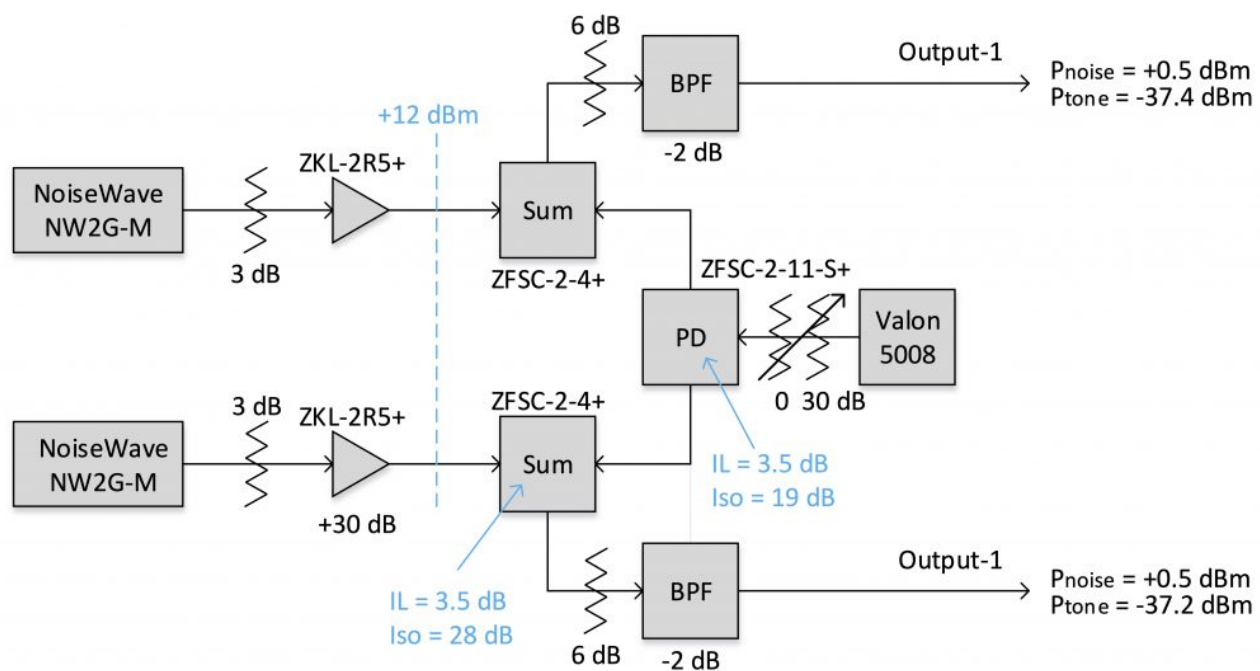


# Noise/Tone Source Design

The block diagram and photo of the noise + tone source is shown below. The assembly consists of two independent noise sources (NoiseWave) followed by amplification (ZKL-2R5+) then a power combiner. A Valon synthesizer is used to produce 600.000 MHz (Output A) and 677.500 MHz (Output B) followed by a manual step attenuator. This tone is power divided and fed the pair of power combiners to sum with the noise. And finally a Mini-Circuits band-pass filter, ZABP-598-S+, is used to provide a passband of 400-800 MHz to the ADC inputs of the ICE chassis.



Block diagram for Noise/Tone source

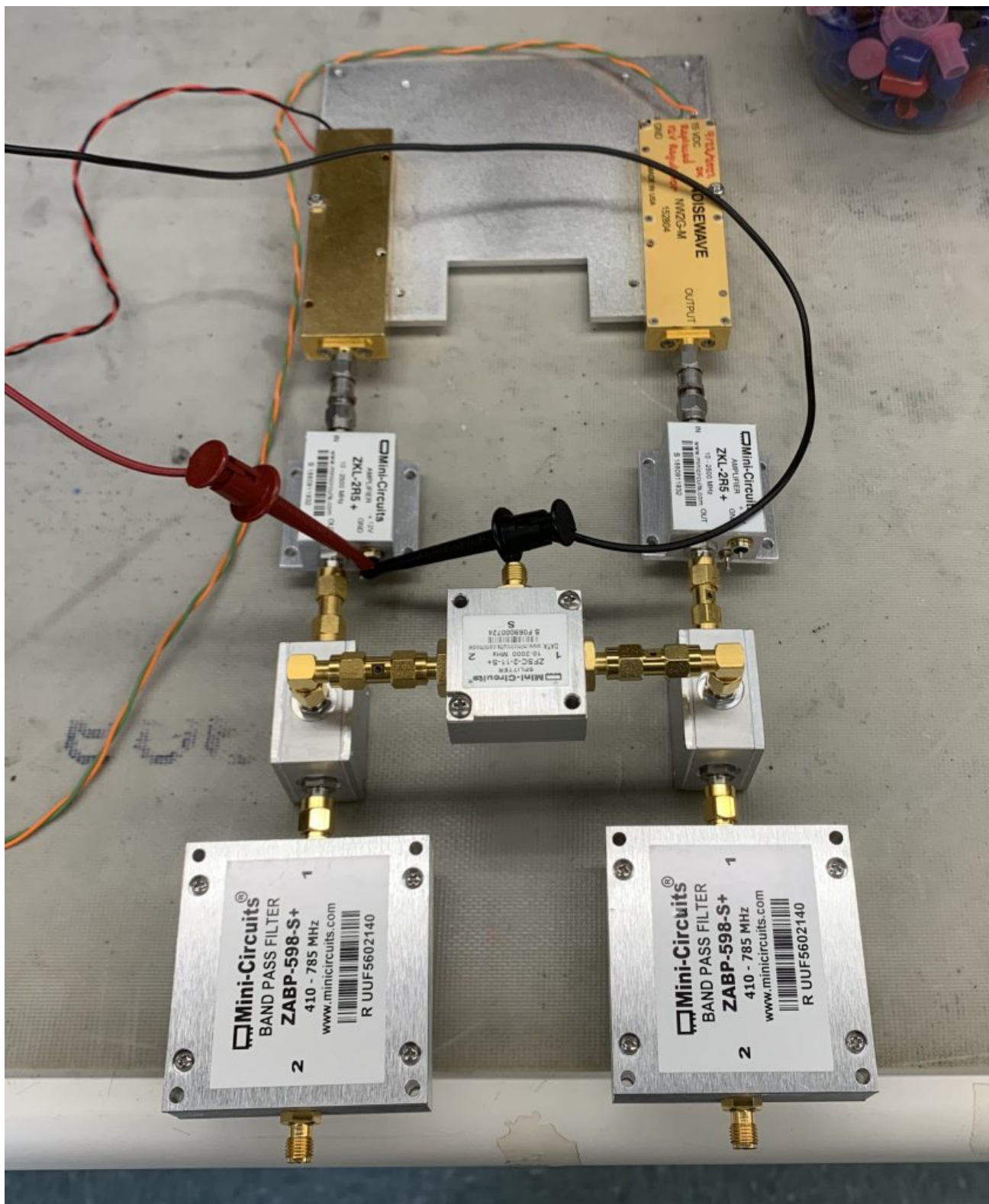


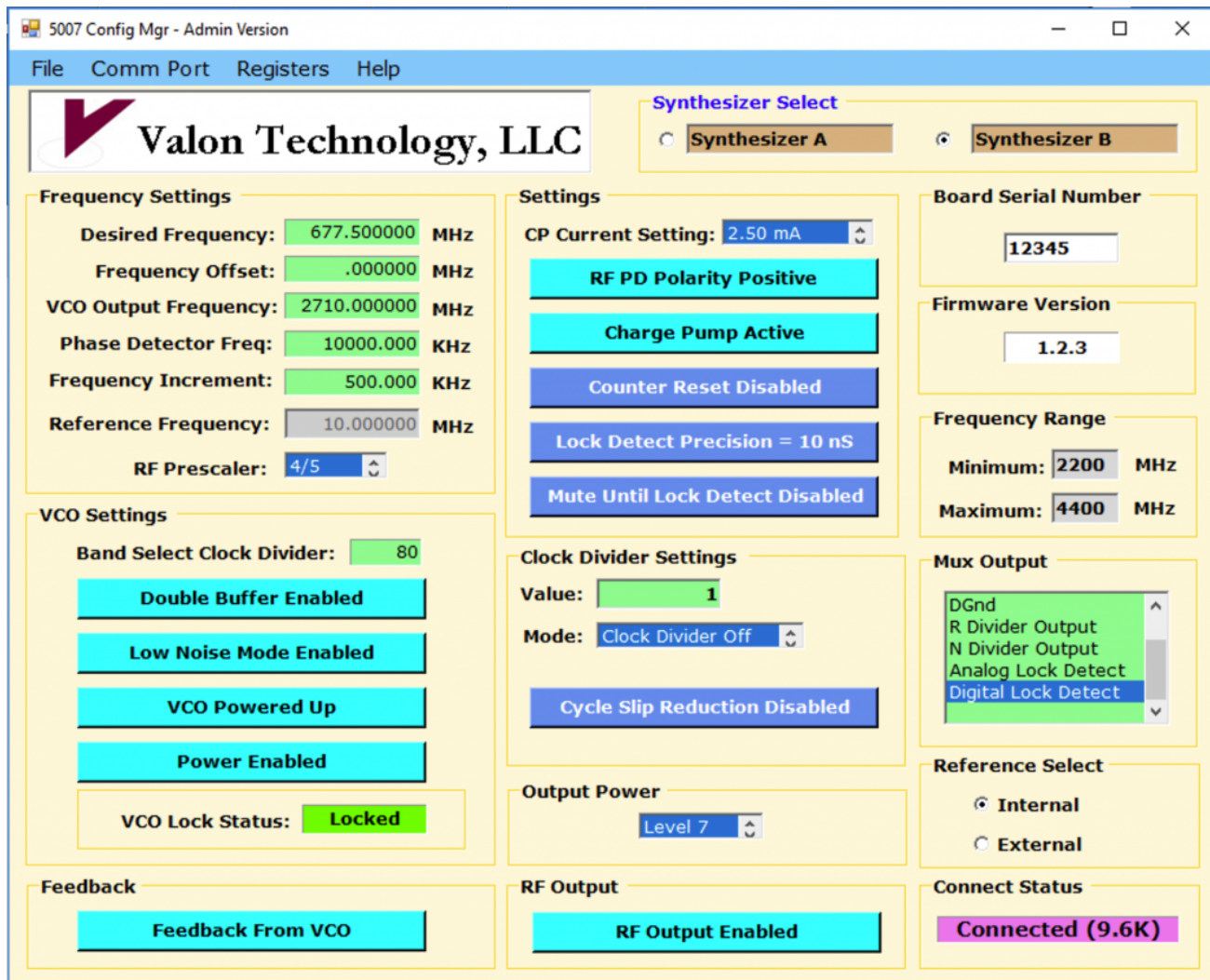
Photo of the noise + tone assembly prior to adding the Valon 5008 and step attenuator

The Valon 5008 synthesizer was setup using the Valon utility (Windows only) and screenshots are shown below:

The screenshot displays the Valon Technology, LLC 5007 Config Mgr - Admin Version software interface. The window title is "5007 Config Mgr - Admin Version" and the menu bar includes "File", "Comm Port", "Registers", and "Help". The main interface is divided into several sections:

- Synthesizer Select:** Two radio buttons are present, with "Synthesizer A" selected.
- Frequency Settings:** Includes fields for Desired Frequency (600.000000 MHz), Frequency Offset (.000000 MHz), VCO Output Frequency (2400.000000 MHz), Phase Detector Freq (10000.000 KHz), Frequency Increment (1000.000 KHz), Reference Frequency (10.000000 MHz), and RF Prescaler (8/9).
- Settings:** Includes CP Current Setting (2.19 mA) and several status buttons: "RF PD Polarity Positive", "Charge Pump Active", "Counter Reset Disabled", "Lock Detect Precision = 6 nS", and "Mute Until Lock Detect Enabled".
- Board Serial Number:** A text field containing "12345".
- Firmware Version:** A text field containing "1.2.3".
- Frequency Range:** Minimum: 2200 MHz, Maximum: 4400 MHz.
- VCO Settings:** Band Select Clock Divider (80) and several status buttons: "Double Buffer Enabled", "Low Noise Mode Enabled", "VCO Powered Up", "Power Enabled", and "VCO Lock Status: Locked".
- Clock Divider Settings:** Value (1) and Mode (Fast-Lock Enable), with a "Cycle Slip Reduction Enabled" button.
- Mux Output:** A dropdown menu with options: DGnd, R Divider Output, N Divider Output, Analog Lock Detect, and Digital Lock Detect.
- Output Power:** A dropdown menu set to "Level 7".
- Reference Select:** Two radio buttons, with "Internal" selected.
- Feedback:** A "Feedback From VCO" button.
- RF Output:** An "RF Output Enabled" button.
- Connect Status:** A status indicator showing "Connected (9.6K)".

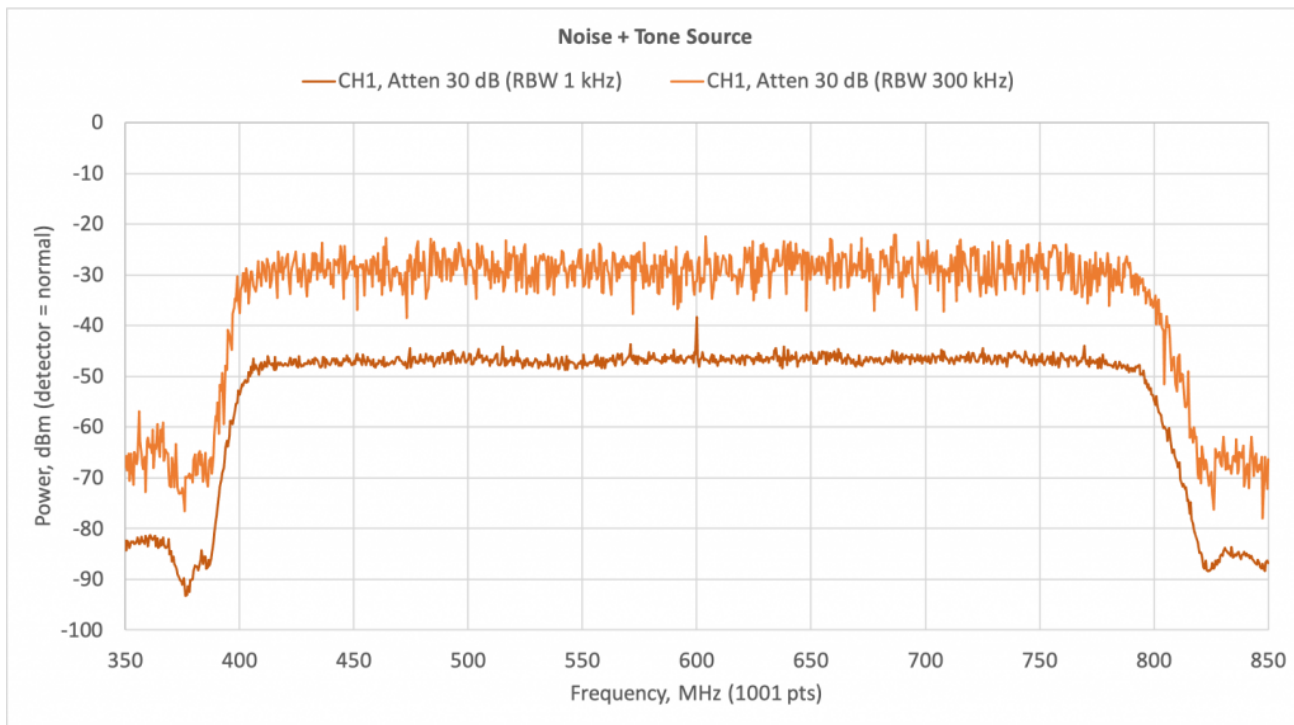
Valon 5008 synthesizer output-A configuration for 600 MHz tone



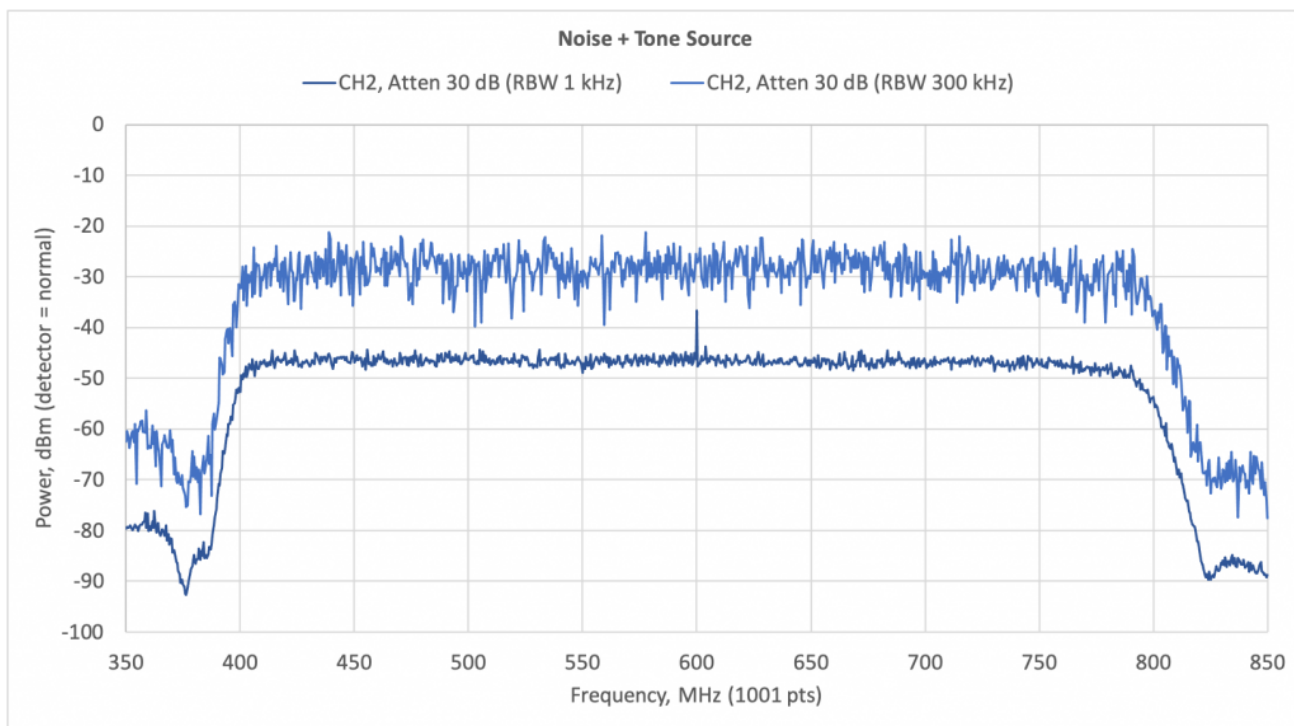
Valon 5008 synthesizer output-B for 677.5 MHz tone

Spectral output plots are shown below for spectrum analyzer resolution bandwidth settings of 1 kHz and 300 kHz. The step attenuator that controls the tone output power was set to 30 dB and produced -37.4 and -37.2 dBm for output channels 1 and 2, respectively (measured using power meter with noise-1 and noise-2 turned off). The total noise output power for both channels were measured to be +0.5 dBm. Note that the FFT process performed within the ICE board produces 1024 channels across the 400-800 MHz spectrum resulting in a channel bandwidth of 390.625 kHz (30% wider than the 300 kHz RBW). Thus we don't expect to see the tone in the realtime waterfall plots from the ICE board system unless there is some integration taking place.





Channel-1 output spectra for RBW of 1 kHz (lower trace) and 300 kHz (upper trace)



Channel-2 output spectra for RBW of 1 kHz (lower trace) and 300 kHz (upper trace)

Calculation of channel-1 to channel-2 noise isolation: The undesired leakage path consists of "Sum" → "PD" → "Sum" or  $28 + 19 + 28 \text{ dB} = 75 \text{ dB}$ . In other words, the Ch-1 noise output level of +0.5 dBm also consists of -74.5 dBm of noise-2, and visa versa. Because the reverse isolation of the power dividers is a parasitic effect its response versus frequency is probably not flat.

-Derek

September 28, 2022

Derek Kubo

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## FRB containers painted

Here are some pictures of the the containers that were recently painted with infared reflective paint. The color is called polo green. The inside of the containers should be