

# Harmonic Comb Injector

Broadband EMI Signal Generator

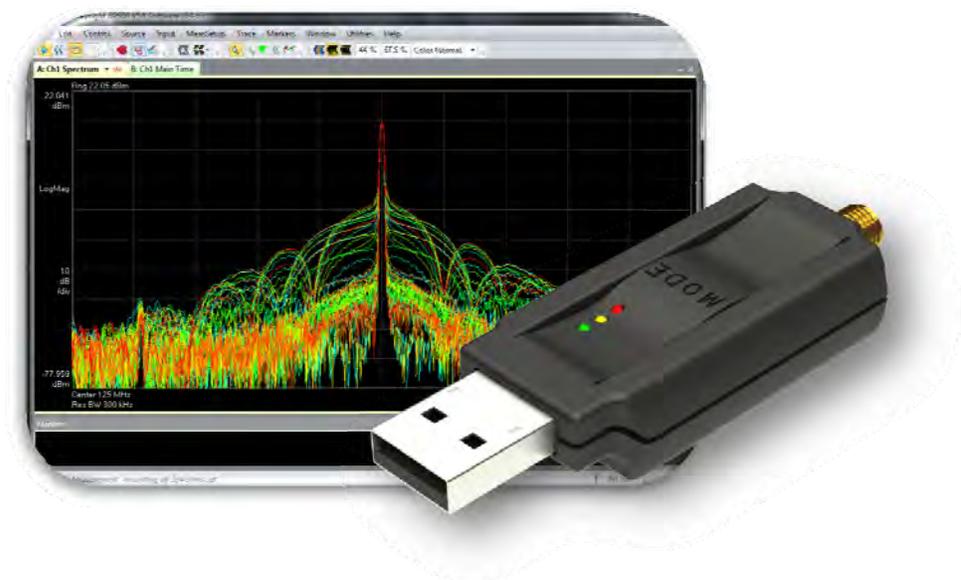
power integrity

pdn interrogation

EMI/EMC

cable/chamber testing

troubleshooting



# Harmonic Comb Injector

## Multi-Mode Signal Generator

The Harmonic Comb Injector is a simple-to-use signal generator designed to support Power Integrity and EMC/EMI testing applications.

A comb signal generator is simply a device that produces a set of harmonically related signals whose spacing is based on a fundamental oscillator frequency. The automatically stepped and manually-controllable frequencies of 1 kHz, 100 kHz, and 8 MHz help separate this comb generator from other generators.

### KEY COMB CHARACTERISTICS

The J2150A is the perfect troubleshooting tool to help reveal resonances in power bus and power supply circuitry. It's also very useful as an EMC/EMI troubleshooting tool. The generator has five different frequency modes, from 1kHz to 8MHz. Several of the modes are "dithered" in pulse width and frequency, so as to help fill in the gaps between harmonic combs. Useful harmonic content can easily cover up to 1.5 GHz. No external software is required for operation and the key is USB powered so its ultraportable. It can even be powered from a battery.

### KEY COMB APPLICATIONS

The J2150A has many uses including EMI, power supply and clock jitter testing, cable testing, EMC chamber characterization (for measurement consistency day-to-day, and comparing one chamber to another), a general purpose source for characterizing semi-anechoic chambers and as an AWG substitute for transient step load testing.

The Comb is especially useful in helping to reveal resonances in power supply and voltage bus designs, as well as troubleshooting hard to find sources of EMC/EMI emissions.

The Comb supports Power Integrity applications including Power Distribution Network ('PDN') interrogation and resonance assessment.

### FEATURES:

#### J2150A Harmonic Comb

- Wideband harmonic comb generator spans 1kHz-1GHz+
- Ultraportable USB stick design, Powers from any USB port
- Versatile – Multiple Signal Modes in One Tool
- Modes include time and frequency jitter
- Easily change modes via pushbutton
- USB powered; replaces bulky AWGs
- Impulse and Square Wave Outputs

### HIGHLIGHTS:

- Quickly identify power supply related issues
- Interrogate your Power Distribution Network for resonances
- Test and Calibrate Cables and EMC Chambers



### OPERATION

The J2150A has five (5) modes of operation. Mode 1 steps through three different impulse modes (1 kHz, 100 kHz and 8 MHz). It provides a broadband spectrum which allows you to easily find circuit resonances. These modes include frequency and pulse width dithering

The mode can be selected by pressing the MODE push button on the top of the key.

Once resonant frequencies are identified in Mode 1, Modes 2, 3 and 4 (fundamental frequencies of 1kHz, 100kHz, and 8MHz) may be used to zero in on specific resonances. Modes 2 and 3 are high enough resolution to accurately identify circuit resonances. However, the 8MHz mode is useful in determining higher-frequency resonances for EMI troubleshooting.

Three LEDs indicate the mode the key is in.

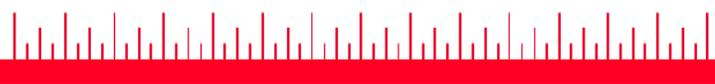
Mode	Description	Red	Yellow	Green	Notes
1	Stepped (through modes 2-4)	x	x	x	300ms per mode
2	1kHz Impulse	x			Freq and Width Dither
3	100kHz Impulse		x		Freq and Width Dither
4	8MHz Impulse			x	Freq and Width Dither
5	10kHz Square wave	x	x		

Mode 5 is an exception and is a simple 50% duty cycle square wave running at 10kHz. This is often handy for probe calibration and for simple transient load step testing when coupled with the J2111A Current Injector.

The output of the Comb can be connected to a probe or other cable connection via the SMA output connector. The output is DC-coupled, so the signal may be used to modulate other Picotest voltage and current injectors. The output voltage is 5V into a high impedance termination, 2.5V into 50 ohms. In order to AC-couple the output, a Picotest P2130A DC Blocker (shown below) may be used.



Specifications		
Characteristic	Typical	Units
-13dBm typical 1kHz and 100kHz	50	mA
-17dBm typical 8MHz	74	mA
10kHz square wave 13dBm, typical duty cycle 50% typical	+/-5	A / V
DC coupled 0 to +2.5V pulse into 50Ohms	40	V
Typical rise/fall time 470ps/270ps	1	V / A

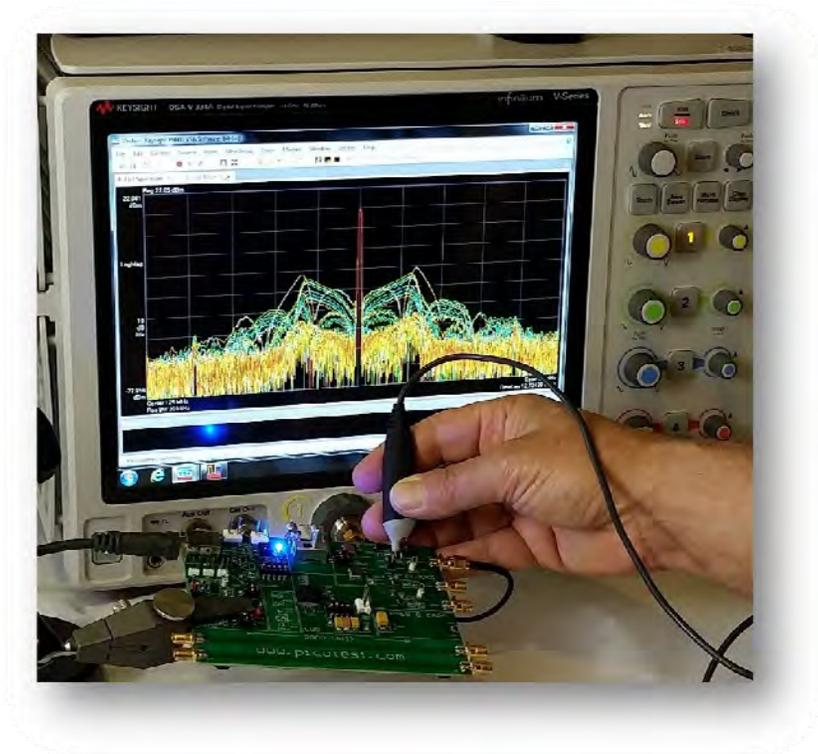


## SAMPLE APPLICATION – LOCATE AND CORRECT POWER RAIL ISSUES

**Problem:** Investigate and discover the source of excessive power supply noise

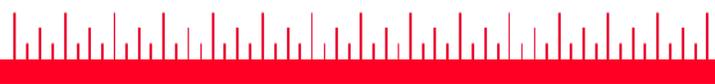
**Instruments Used:** Picotest J2150A Harmonic Comb, Picotest P2100A 1-Port PDN Probe, Keysight Oscilloscope

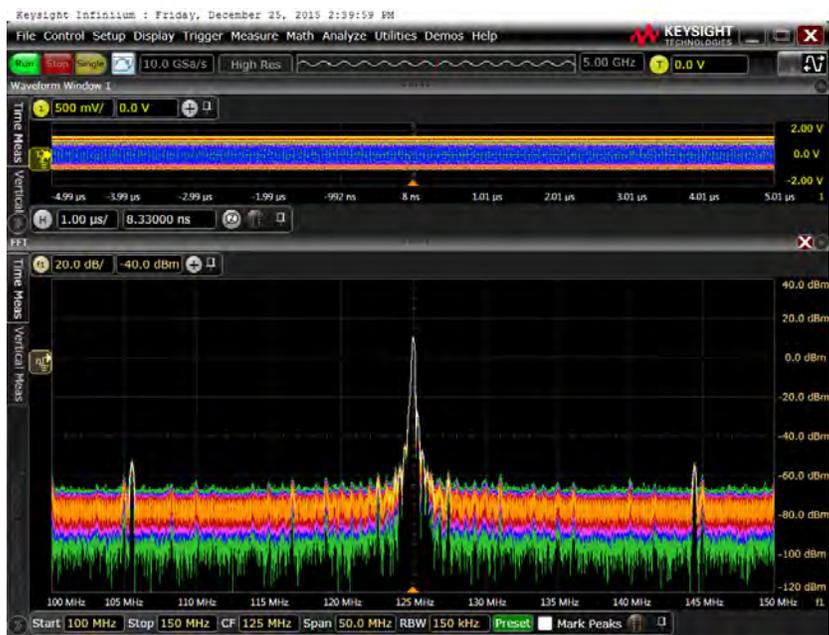
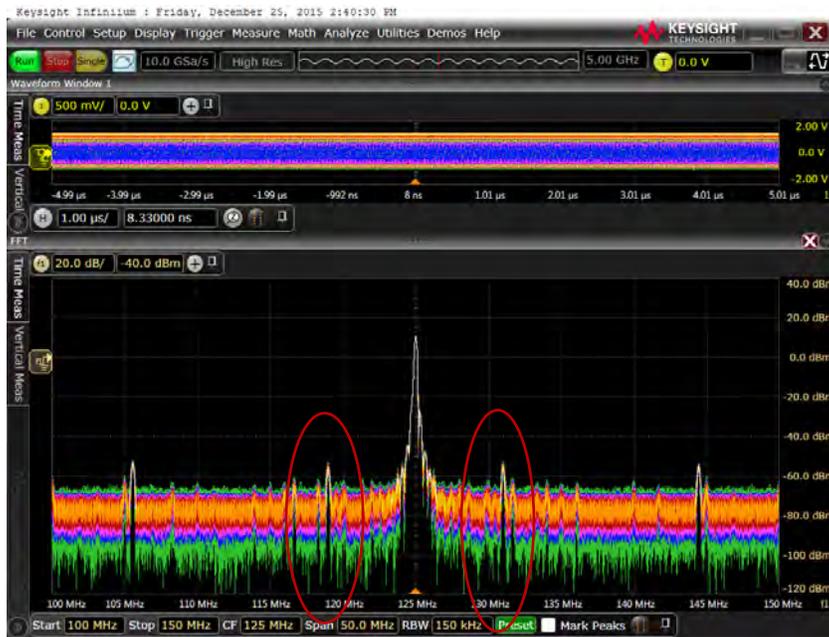
**Total Time:** Just a few minutes!



The output signal of the J2150A is connected to the Picotest 1-Port probe. The probe is used to INJECT a signal at the power supply for a clock oscillator. In the picture above the Comb is set to frequency step in order to best find PCB resonances.

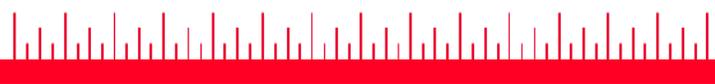
The Comb is switched to 100kHz in order to better detail the spectrum in the area about the 125MHz clock frequency. Two spurs, approximately 7.5MHz from the fundamental, are circled below in the next image.





The spur is removed by adding a 2.40hm resistor to the circuit and/or using an inexpensive high ESR capacitor in order to reduce the impedance resonance causing the spur.

**Solution:** We quickly identified a sensitivity – located and isolated it – determined its source and characteristic impedance and showed that the resonance can be tamed by flattening the impedance. We did this all in just a few minutes using a scope, 1-Port probe and the Comb.



## COMPATIBILITY

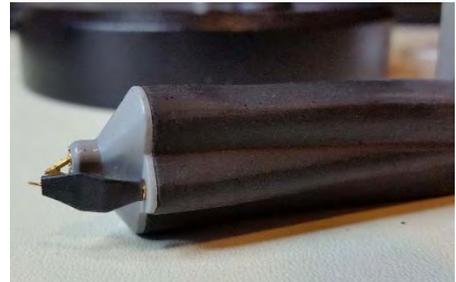
The Harmonic Comb is compatible with all spectrum analyzers, oscilloscopes, and signal source analyzers.

## RECOMMENDED ACCESSORIES

Both the Picotest 1-Port and 2-Port PDN Probes (P2100A and P2101A) and the P2130A DC blocker are highly recommended. The probes are bi-directional and can be used to inject the signal from the Comb into your circuit. Since they are 50ohm passive probes, with ultralow loading, they, along with the DC blocker, will allow you to inject signals without impacting or loading the circuit you are testing.



**P2100A – 1-Port PDN Probe**



**P2101A – 2-Port PDN Probe**



**P2130A – DC Blocker**

**For more information on Picotest products, applications, or services, please contact Picotest at [info@picotest.com](mailto:info@picotest.com) or call 1-877-914-7426.**

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