4500B Power Meter and the Built-In Precision Calibrator

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Introduction

The Boonton 4500B power meter is the instrument of choice for capturing, displaying, analyzing and characterizing RF power in both the time and statistical domains. The 4500B power meter has two basic measurement modes – pulse power and modulated power. In pulse power mode, the 4500B functions as an enhanced peak power analyzer with the ability of viewing the RF envelope of signal frequencies up to 40 GHz. The RF frequency range and detection bandwidth are naturally sensor model dependent. The Boonton 4500B has a built-in 1 GHz step calibrator which enhances the measurement accuracy by performing an automatic routine calibration to the connected Boonton sensor model. The calibration process can be performed by connecting a peak power sensor to the calibrator output terminal of the Boonton 4500B peak power meter. This application note describes various uses and applications of the internal calibrator of the Boonton 4500B power meter.

Built-In Calibrator

The internal step calibrator of Boonton 4500B is traceable to NIST (National Institute for Standards and Technology) and it enhances the measurement accuracy. The output of the built-in programmable calibrator is available from a Type-N connector located on the front of the instrument. This calibrator is used to automatically calibrate sensor offset and linearity, and can also be used as an internal signal source. In order to maintain measurement accuracy, it is always recommended to calibrate the 4500B instrument once in a year.

Specifications of the Internal Calibration Source

Below is a brief specification of the internal calibrator of the Boonton 4500B power meter.

Operating Modes	CW, internal or external pulse
Frequency	1.024 GHz ± 0.01%
Level Range	-50 to +20 dBm
Resolution	0.1 dB
Output VSWR	1.20 maximum
Absolute Accuracy	±0.065 dB (±1.5%) at 0 dBm
Accuracy vs Level	add ±0.03 dB per 5 dB increment from 0 dBm
Preset Internal Pulse Period	0.1 or 1 or 10 msec
Preset Internal Pulse Duty Cycle	10% to 90% in 10% increments
Variable Pulse On Time	7 usec to 65.535 msec in 1 usec steps
Variable Pulse Period	28 usec to 131.072 msec in 2 usec steps Off-time limits - within 7 usec to 65.535 msec
Pulse Polarity	+ or –
RF Connector	Precision type N
External Pulse Input	Rear panel BNC, TTL level compatible

Auto-Calibration

   The calibrator is used to automatically generate linearity calibration data for peak power sensors.

Auto-Calibration

The built-in 1 GHz internal calibrator provides a convenient means for calibrating the sensor. The internal calibrator is used to automatically generate linearity calibration data for peak power sensors. Before starting any measurement by using the 4500B power meter, the sensor must be connected to the built-in calibrator and need to be calibrated. The internal calibrator has a dynamic range from -50 dBm to +20 dBm. The user-selectable automatic calibration routine has a group of commands which is used to control automatic zero offset and linearity adjustment to the RF power sensor in steps over its full dynamic range.
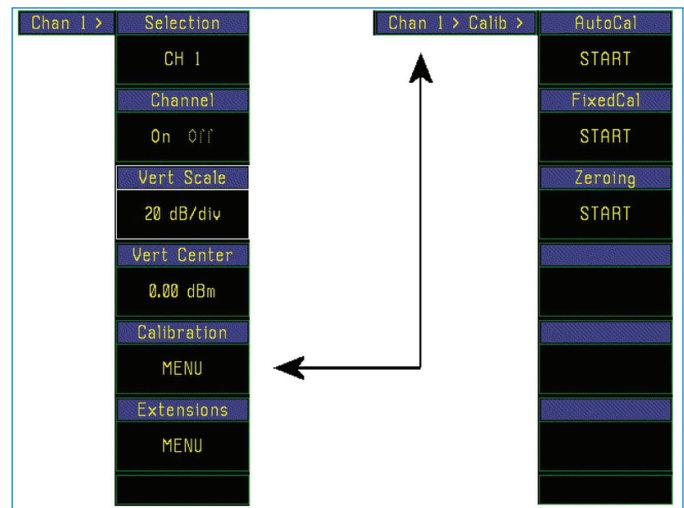

Fig. 1: Screenshot of the automatic calibration menu selection for channel 1 on Boonton 4500B

Calibrator Report Information

There is a report information available about the installed calibrator in the Boonton 4500B power meter. The calibrator information can be retrieved by pressing ''Calibrator'' > ''Extensions'' > ''Calibrator'' menu keys. The report includes: Status, Serial Number, Software Version, Calibration Date and Internal Temperature.

Calibrator Output Modes

The internal calibrator of Boonton 4500B power meter has two selectable output modes – CW and Pulse. The calibrator output mode can be set as CW by selecting buttons ''Spcl'' > ''Calibrator'' > ''Cal Mode'' > ''CW''. For Pulse mode, the button selection should be as ''Spcl'' > ''Calibrator'' > ''Cal Mode'' > ''Pulse''. For each output mode, the calibrator output need to be enabled by selecting ''Calibrator'' > ''Cal'' > ''Output'' > ''ON''.

Calibrator as an Internal Pulse Generator

The internal calibrator of Boonton 4500B peak power analyzer can be configured as a programmable pulse signal generator in pulse mode, with the options for modulation rate and duty cycle. The preset internal pulse period can be adjusted as 0.1, 1 or 10 msec and the internal pulse duty cycle can be adjusted from 10% to 90% in 10% increments. The pulse measurement can be started by pressing "Esc" button, and then selecting "Measurement" > "Run", "Measurement Mode" > "Pulse" and finally "Auto-Setup" > "START". The highlighted automatic measurement parameters in pulse mode are: Pulse width, Risetime, Falltime Period, Duty cycle, Pulse Period, Overshoot. The screenshot of pulse measurements by using the internal calibrator as a internal signal source is shown in Fig. 2
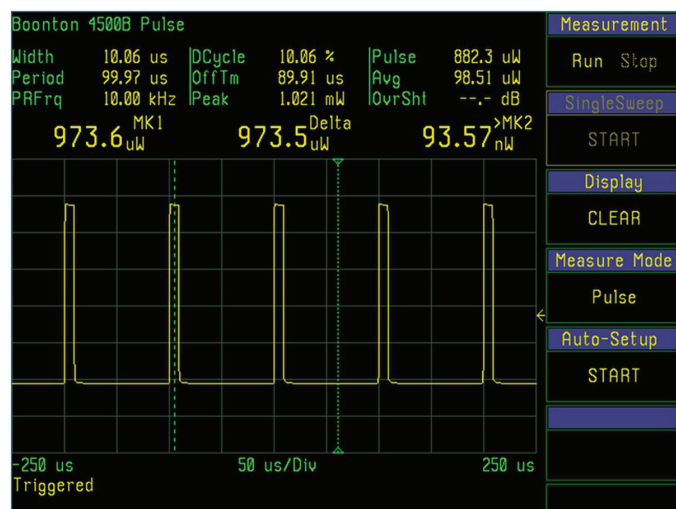

Fig 2: Example of pulse signals by using the internal 1 GHz calibrator source as a signal generator

Calibrator Driven by an External Pulse Generator

The 1 GHz internal calibrator can also be driven by an external modulation source. An external pulse generator with TTL compatible output must be connected to the rear mounted BNC connector of the 4500B power meter labeled as "EXT PULSE". The source for the calibrator output pulse modulation can be selected by pressing the "Calibrator" > "Pulse" > "Source" > "Ext" menu key to specify the calibrator output pulse is to be externally generated. Now if the internal calibrator is selected as a "Pulse" mode, the output will be pulse modulated by the external source. Here is the example screenshot of the pulse measurement by using an external TTL compatible pulse signal generator (Fig. 3).
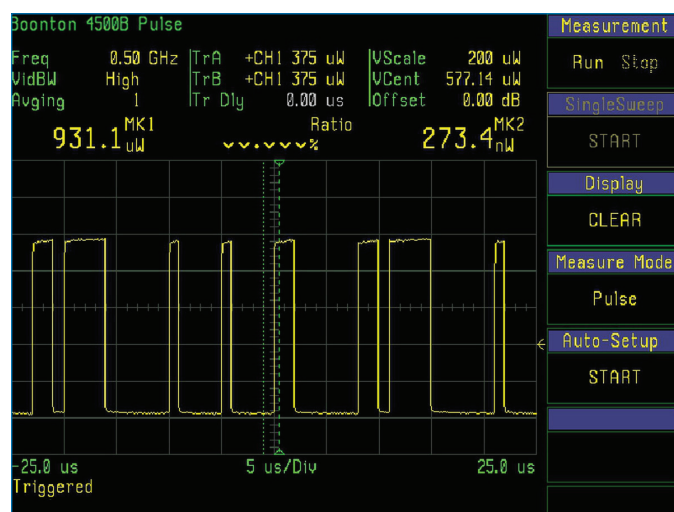

Fig 3: Example of a pulse train by using an external TTL compatible signal generator and modulated by the internal calibrator

References:

[1] Boonton 4500B Peak Power Analyzer (http://boonton.com/products/power-meters/4500b-peak-power-meter)

[2] Boonton 4500B Data Sheet (http://boonton.com/~/media/Boonton/Datasheets/4500B_Datasheet_WEB.ashx)

[3] Boonton 4500B Instruction Manual (http://boonton.com/~/media/Boonton/Manuals%20and%20Software/4500B_Instruction_Manual.ashx)

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