Solid State Noise Source Calibration

using cryogenically cooled thermal noise generators

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SETUP USED TO COOL A 50 OHM LOAD TO 9.4K AND CALIBRATE THE DOLID STATE NOISE SOURCE

Keithley 2400
Precision power supply

ZVL3
Spectrum Analyzer

Batteries used to Power the noise source

Noise source Under test

Amplifier and switches

FLUKE 8845A Micro ammeter

Vacuum pump Hose used to evacuate the chamber

PC running Python
Used to control the setup
And take data

Vacuum Chamber

Labjack DAQ
Used to control switching
View of the Cold Load inside the Vacuum chamber

Temperature of the Cold load: 9.4K Measured very close To the load

Output Cable

Cable heat sink

Cold plate of the cryostat 9.4K

Short used for calibration (done at room temperature)

Temperature Sensor: LAKESHORE DT 470 SILICON DIODE SENSOR

Indium foil used To improve heat Sinking of the load

30dB Attenuator + 50 Ohm Load
DEGRADATION OF THE RETURN LOSS OF THE 50 Ohm load when cooled from 300K to 9.4K

A better 50 ohm load needs to be used
Capacitive DC feed through connectors Soldered hermetically to the package

Precision temperature sensor Soldered next to noise diode

Precision constant current Source Attached to the package for heat sinking Input voltage from Battery

Custom designed RFI tight, compact Package made of Aluminum

Precision 2.9mm Connector (air Dielectric) Field replaceable with Hermetic 50 Ohm glass Bead

Matching network To improve the S11 Of the noise source

Thin film attenuator Chips with good Power match and low temperature coefficient used here to set the level and improve the impedance match

Wideband, Low loss DC blocking capacitor With smooth freq response Mounted on an Alumina 50 ohm microstrip line

Wideband RF choke Conical inductor with Smooth freq response

Ultra low noise voltage Regulator in Die form soldered to the package for better heat sinking. Gold bond wires are used to connect it to the circuit
Type;ZVL-3;
Version;3.20;
Date;30.Jan 13;
Mode;ANALYZER;
Center Freq;115000000.000000;Hz
Freq Offset;0.000000;Hz
Span;170000000.000000;Hz
x-Axis;LIN;
Start;300000000.000000;Hz
Stop;200000000.000000;Hz
Ref Level;20.000000;dBpW
Level Offset;0.000000;dB
Ref Position;100.000000;%
y-Axis;LOG;
Level Range;20.000000;dB
Rf Att;0.000000;dB
RBW;100000.000000;Hz
VBW;300.000000;Hz
SWT;11.500000;s
Trace Mode;AVERAGE;
Detector;AVERAGE;
Sweep Count;0;
Trace 1;;
x-Unit;Hz;
y-Unit;dBpW;
Preamplifier;OFF;
Transducer;OFF;
Values;1701;
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Version;3.20;
Date;30.Jan 13;
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Freq Offset;0.000000;Hz
Span;170000000.000000;Hz
x-Axis;LIN;
Start;30000000.000000;Hz
Stop;200000000.000000;Hz
Ref Level;20.000000;dB
Level Offset;0.000000;dB
Ref Position;100.000000;%
y-Axis;LOG;
Level Range;20.000000;dB
Rf Att;0.000000;dB
RBW;100000.000000;Hz
VBW;300.000000;Hz
SWT;11.500000;s
Trace Mode;AVERAGE;
Detector;AVERAGE;
Sweep Count;0;
Trace 1:;
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y-Unit;dBpW;
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Transducer;OFF;
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Freq Offset;0.00000;Hz
Span;40000000.00000;Hz
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Start;40000000.00000;Hz
Stop;80000000.00000;Hz
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Level Offset;0.000000;dB
Ref Position;100.000000;%
Y-Axis;LOG;
Level Range;15.000000;dB
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VBW;1.000000;Hz
SWT;80.000000;s
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Detector;AVERAGE;
Sweep Count;0;
Trace 1;;
x-Unit;Hz;
y-Unit;dBpW;
Preamplifier;OFF;
Transducer;OFF;
Values;4001;
Raw Spectra in the 3 Positions
Uncalibrated Averaged

Equivalent Noise Spectra in the 3 Positions
BW = 100KHz Uncalibrated

Spectra STD DEV for 3 positions

Spectra STD DEV for 3 positions