Tektronix®

Picotest J2131A

DC Bias Source for Power Inductor Testing

Demonstration Guide

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Overview

For simulation, modeling, component selection, counterfeit material detection and failure analysis, testing power inductor performance—up to and including saturation—is a key capability in the engineer's toolbox. Used with a stable, constant-current lab supply, the Picotest J2131A DC Bias Source creates stable, repeatable bias currents injected into an inductor Device Under Test (DUT).

Introduction

Technical Contacts

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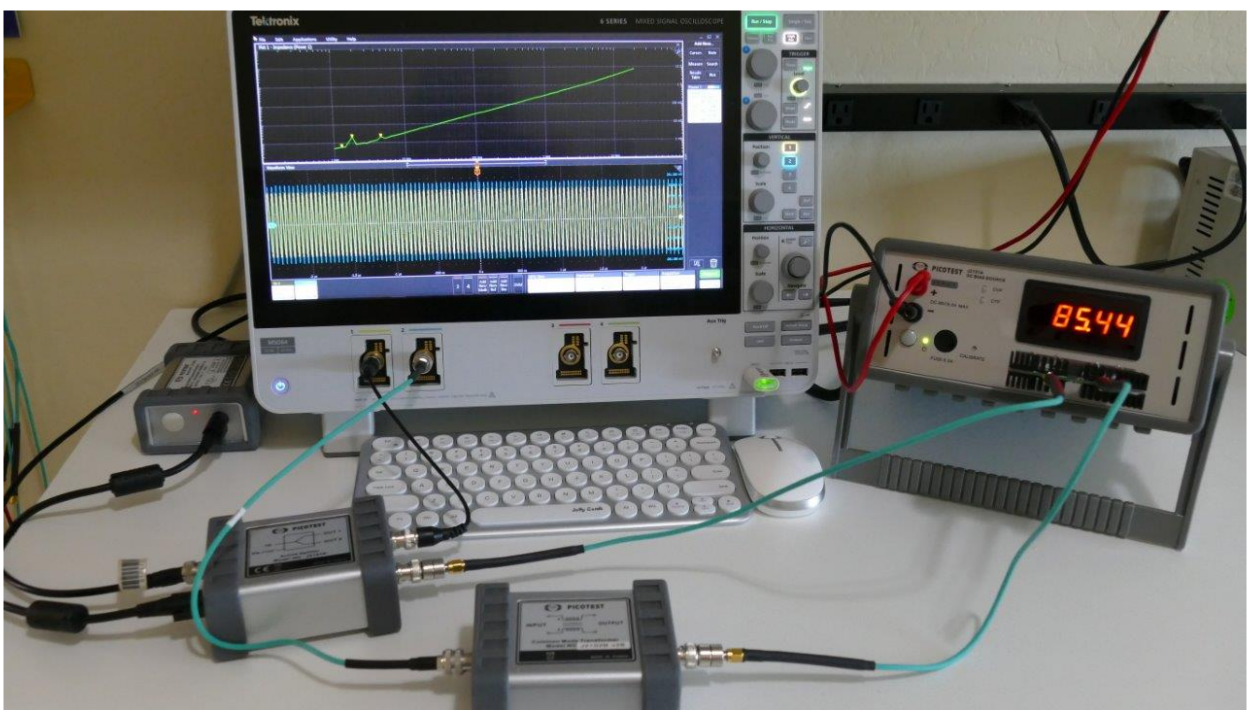
Key Differentiators

- Enables measurements of nano-henry up to 1 micro-henry power inductors with up to 125A of bias current.
- Accurate high-current produced with only a 5A input.
- Multiple levels of protection for inductor disconnects.
- Ideal performance when paired with the VNA features of a 5 or 6-series Tektronix oscilloscope.

Introduction



Example 1

Picotest J2131A DC Bias Source mixes a high current with a reference frequency to enable analyzing power inductor character in actual application conditions.

The DC Bias Source uses an internal 1:24 current multiplier to convert a stable 0-5Amp current source into a 0-125A current suitable for biasing power inductors. The Tektronix oscilloscope provides a variable frequency signal which is coupled with wide bandwidth cables (18Ghz PDN Cables, PDNCBL1M are recommended) to the Picotest J2161A Active Splitter (and accompanying J2170B High PSRR Regulated Adapter).

One of the split outputs is connected to an oscilloscope input and used as a reference. The other output is connected to the DC Bias Source where it is mixed with the DC bias current. The output of the Bias Source is connected to a Common Mode Transformer which reduces low frequency errors by breaking the ground loop.

The oscilloscope signal analysis functions are used to isolate and characterize the differences between the reference signal and the signal as modified by the inductor under bias.

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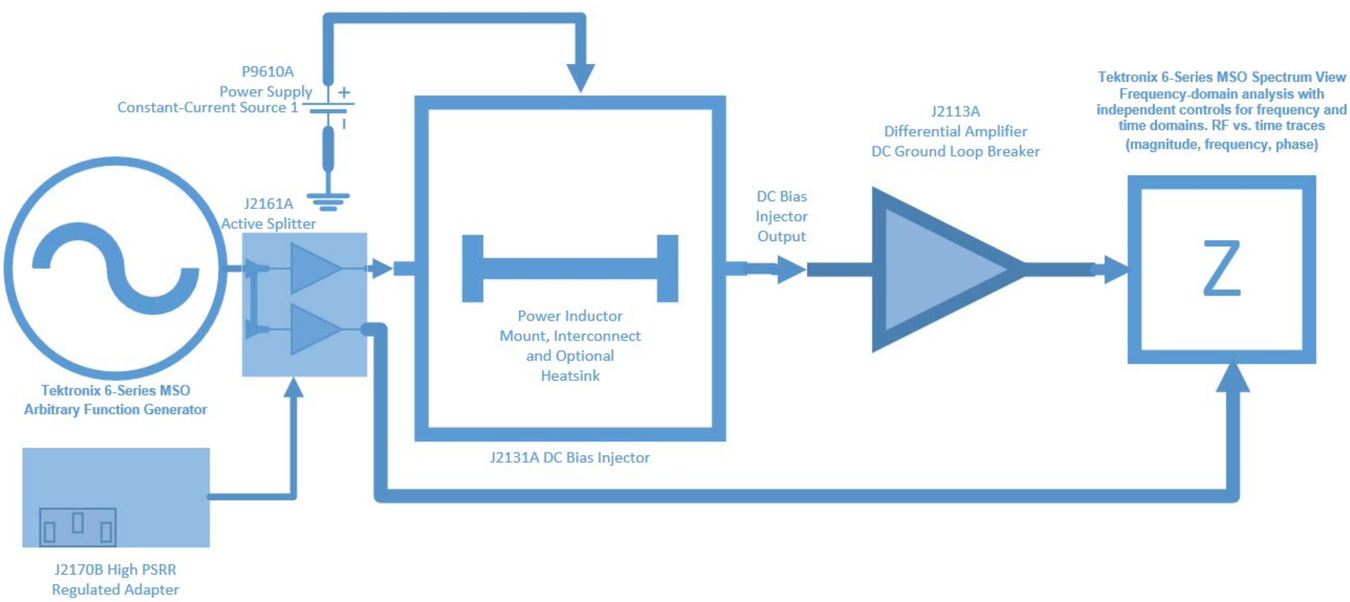
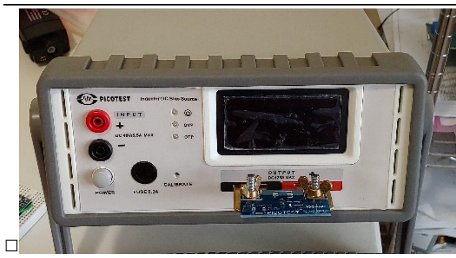
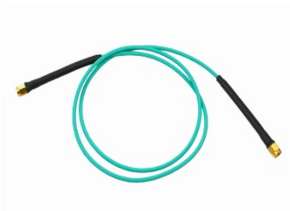


Figure 1: Test Setup Block Diagram


70.12
OUTPUT
DC125A MAX
PQ2007-0R4-70-G
STANDEX 37
R2
U2

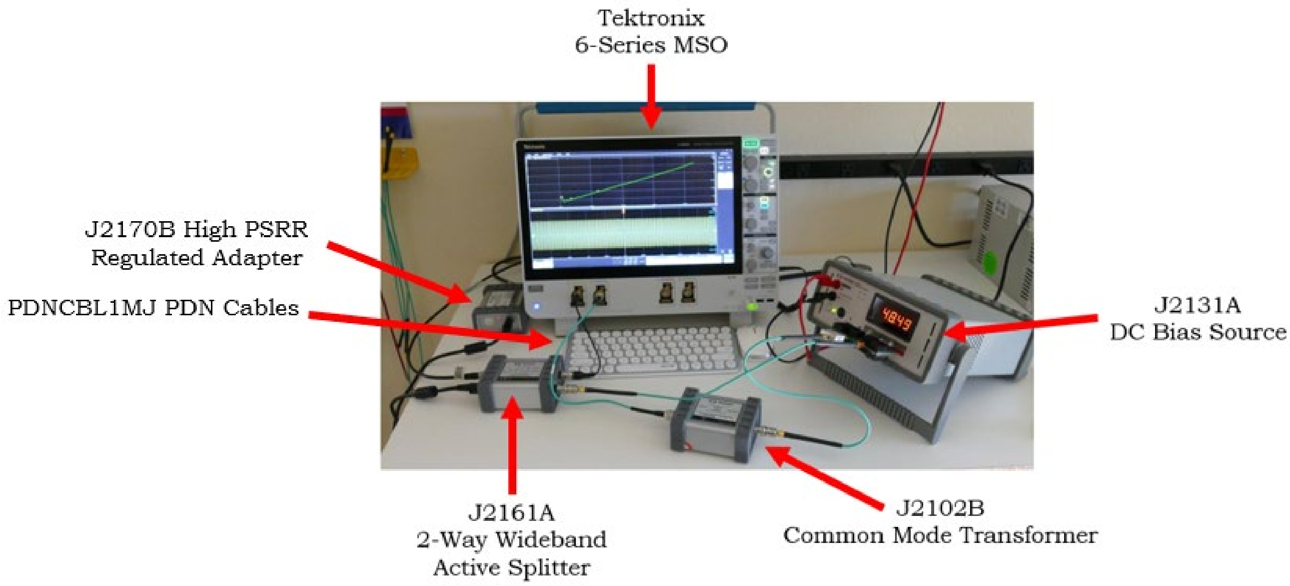
Equipment and Required Resources

	Description	Part Number
	6- or 7-series Oscilloscope	
□ 	Picotest DC Bias Source	J2131A
□ 	Picotest Active Splitter	J2161A
□ 	Picotest Regulated Adapter	J2170B
□ 	Picotest Transformer	J2102B

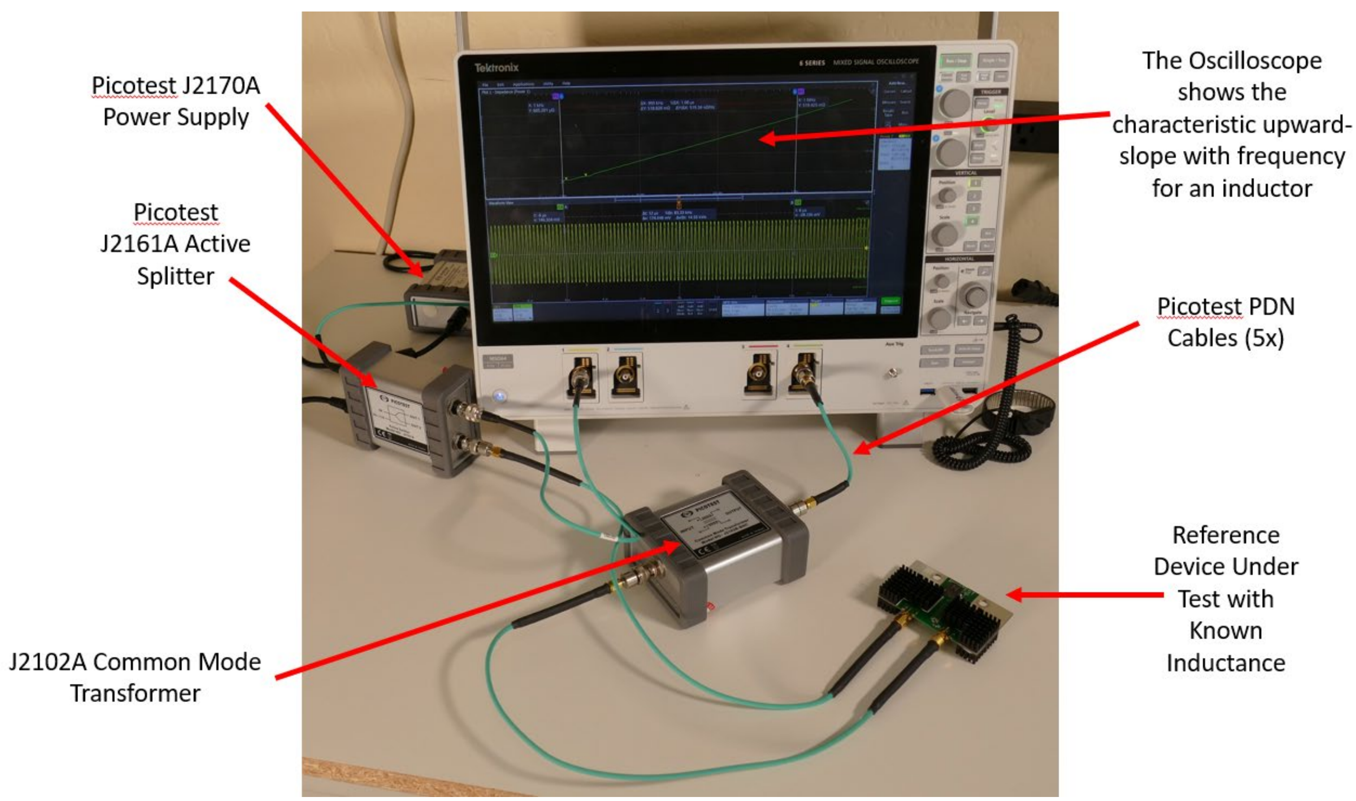
	Picotest PDN Cables (5x)	PDNCBL1M
	**Picotest Decoupling Test Board Kit**	**DTBK01**

□

Generic Connection Diagram



Reference Test Procedure



1. Connect the J2170A High PSRR Regulated Adapter to AC power and to the J2161A Active Splitter.

2. Connect one output channel of the J2170A to an input of the oscilloscope. This signal will be used as a reference. For this procedure, we use Channel 1.

3. Connect the other output of the J2161A Active Splitter to one side the DUT inductor. The DUT should be a known value. Using an inductor from the DTBK01 Decoupling Test Board Kit makes this connection convenient.

4. Connect the other end of the DUT inductor to the J2102B Common Mode Transformer input.

5. Connect the J2102B output to an input of the oscilloscope. For this procedure, we use Channel 4.

6. Setup the oscilloscope for a 2-port impedance measurement.

7. Start the oscilloscope configuration with the Default Setup.

8. From the input configuration menu, make sure the Channel 1 and Channel 4 inputs are terminated with 50 ohms.

9. From the default screen menu, select Measurement→Add Measurement→Impedance.

10. Configure Channel 1 for Frequency Response Analysis, Measure→Power→Frequency Response Analysis.

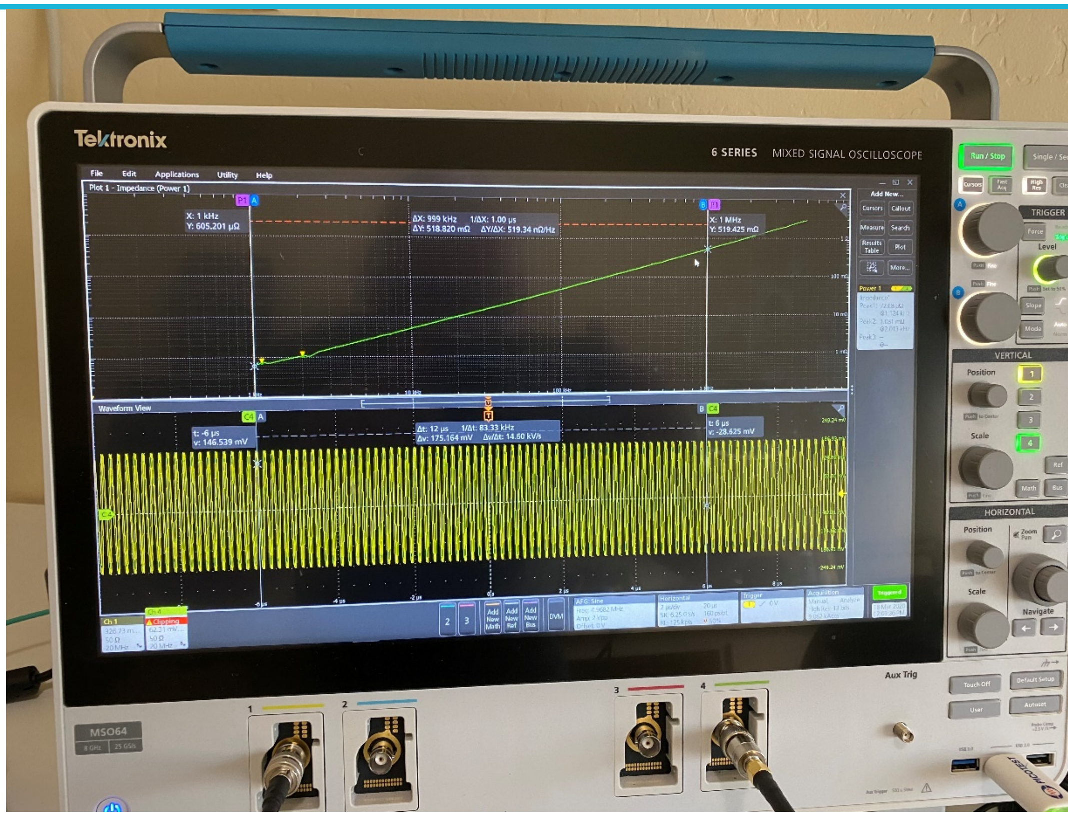
11. Because this inductor is only used at relatively low frequencies, select the 20Mhz bandwidth limit mode on both channels.

12. Double-click the Measurement Configuration Block. Select 20 points per division. Select 1Khz as a starting frequency. Select 5Mhz as the ending frequency. Set the signal amplitude to 500mV.

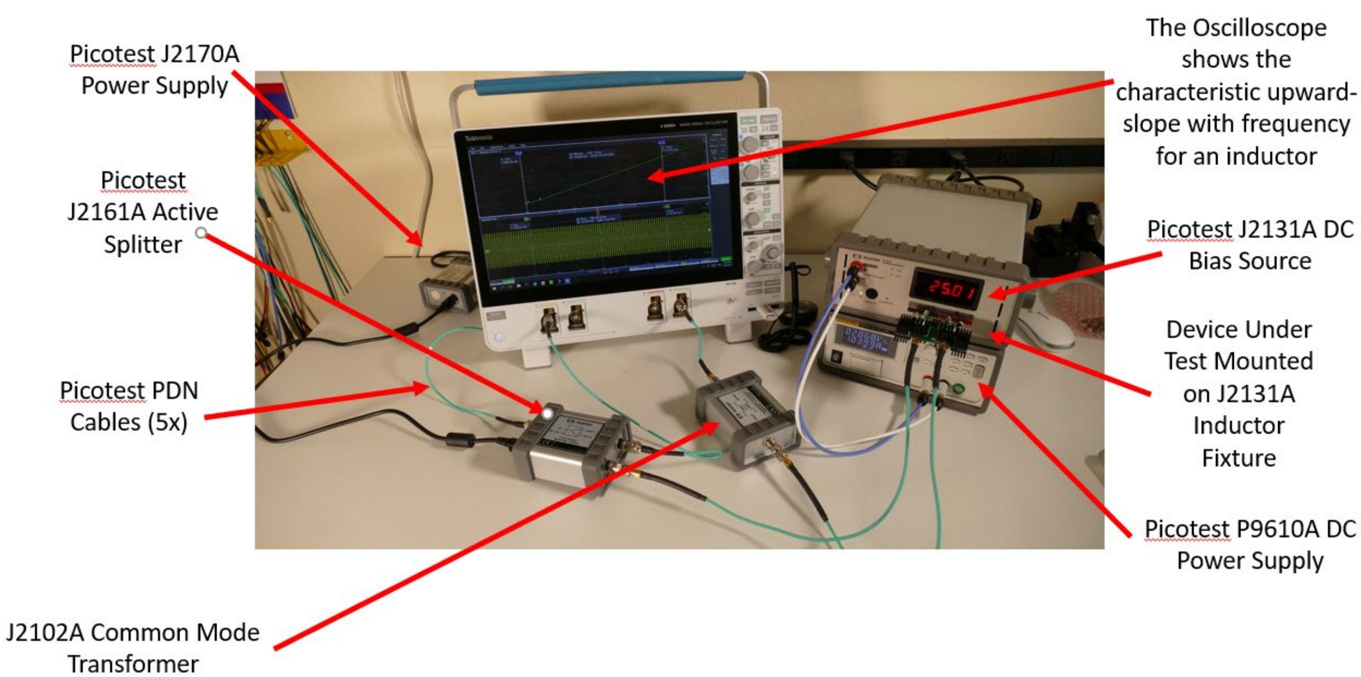
13. Press Power Preset. Wait for the test to complete and examine the impedance plot. To convert the impedance to inductance, use the formula:

$$L = \frac{Z_L}{2\pi f}$$

14. If the inductance is correct, we can move on to testing an unknown DUT.



Unknown DUT Test Procedure



1. Connect the J2170A High PSRR Regulated Adapter to AC power and to the J2161A Active Splitter.

2. Connect one output channel of the J2170A to an input of the oscilloscope.

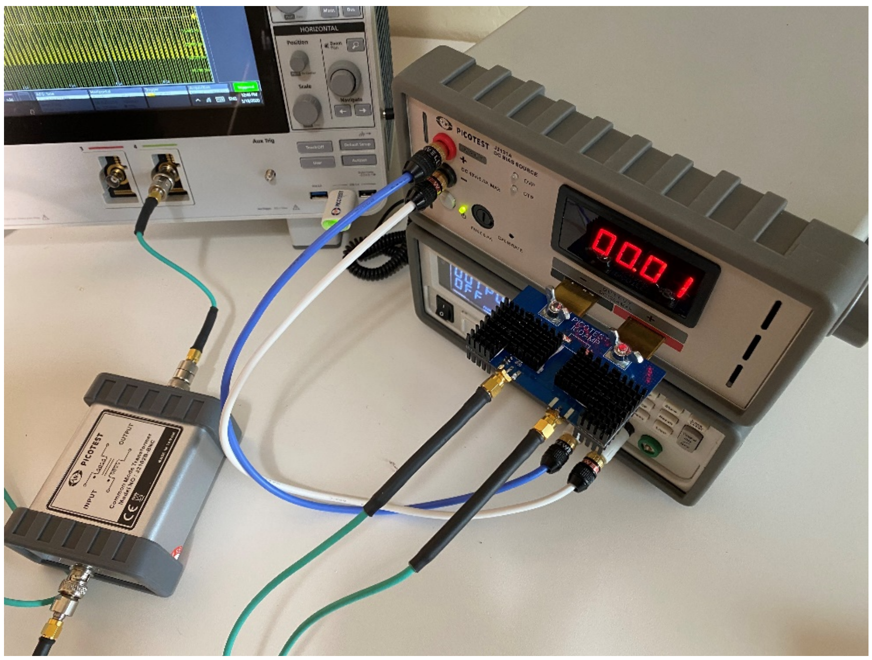
This signal will be used as a reference. For this procedure, we use Channel 1.

3. Set the P9610A Power Supply output to 0 and noting polarity, connect the it to the J2131A input power banana jacks. The P9610A is used in a constant-current mode.

Note: The J2131A takes in the current from the P9610A, multiplies it by 24 and sources it into the DUT.

4. Connect the other output of the J2161A Active Splitter to one side of the DUT inductor on the J2131A Inductor Fixture.

5. Connect the other end of the DUT inductor from the J2131A Inductor Fixture to the J2102B Common Mode Transformer input.



6. Connect the J2102B output to an input of the oscilloscope. For this procedure, we use Channel 4.

7. Setup the oscilloscope for a 2-port impedance measurement.

8. Start the oscilloscope configuration with the Default Setup.

9. From the input configuration menu, make sure the Channel 1 and Channel 4 inputs are terminated with 50 ohms.

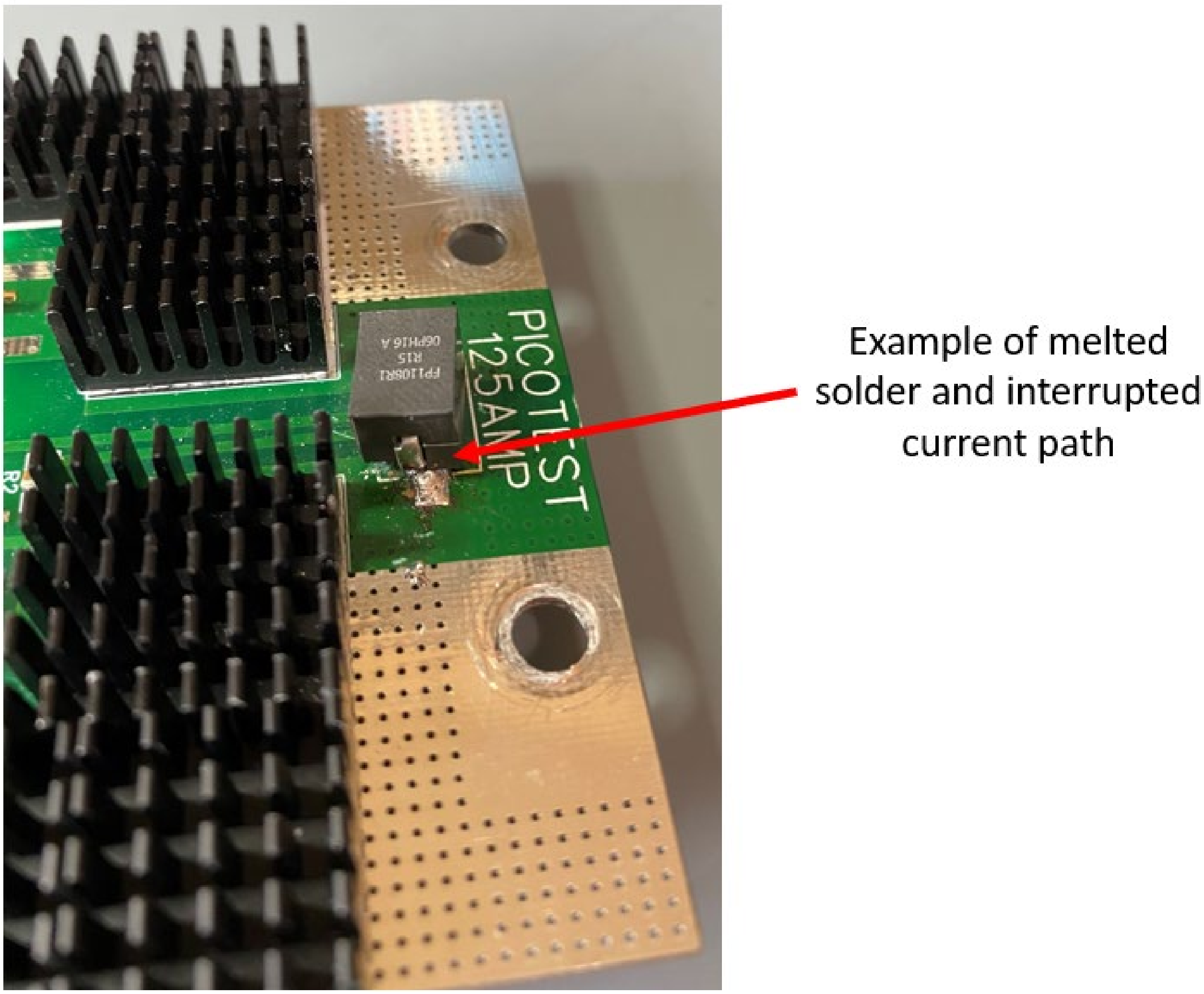
10. From the default screen menu, select Measurement→Add Measurement→Impedance.

11. Configure Channel 1 for Frequency Response Analysis, Measure→Power→Frequency Response Analysis.

12. Because this inductor is only used at relatively low frequencies, select the

20Mhz bandwidth limit mode on both channels.

Warning: For high bias currents, the inductor, internal J2131A circuitry, the mounting fixture and all solder joints in series with the bias current can get very hot. This might result in melting solder and instant disconnection of the power inductor (this could be at the DUT or an inductor internal to the J2131A). Rapid breaking of the current path can result in high voltages which might damage the test equipment (including the oscilloscope). During test, carefully monitor the DUT temperature and leave the high current flowing only for as long as the test takes to run.

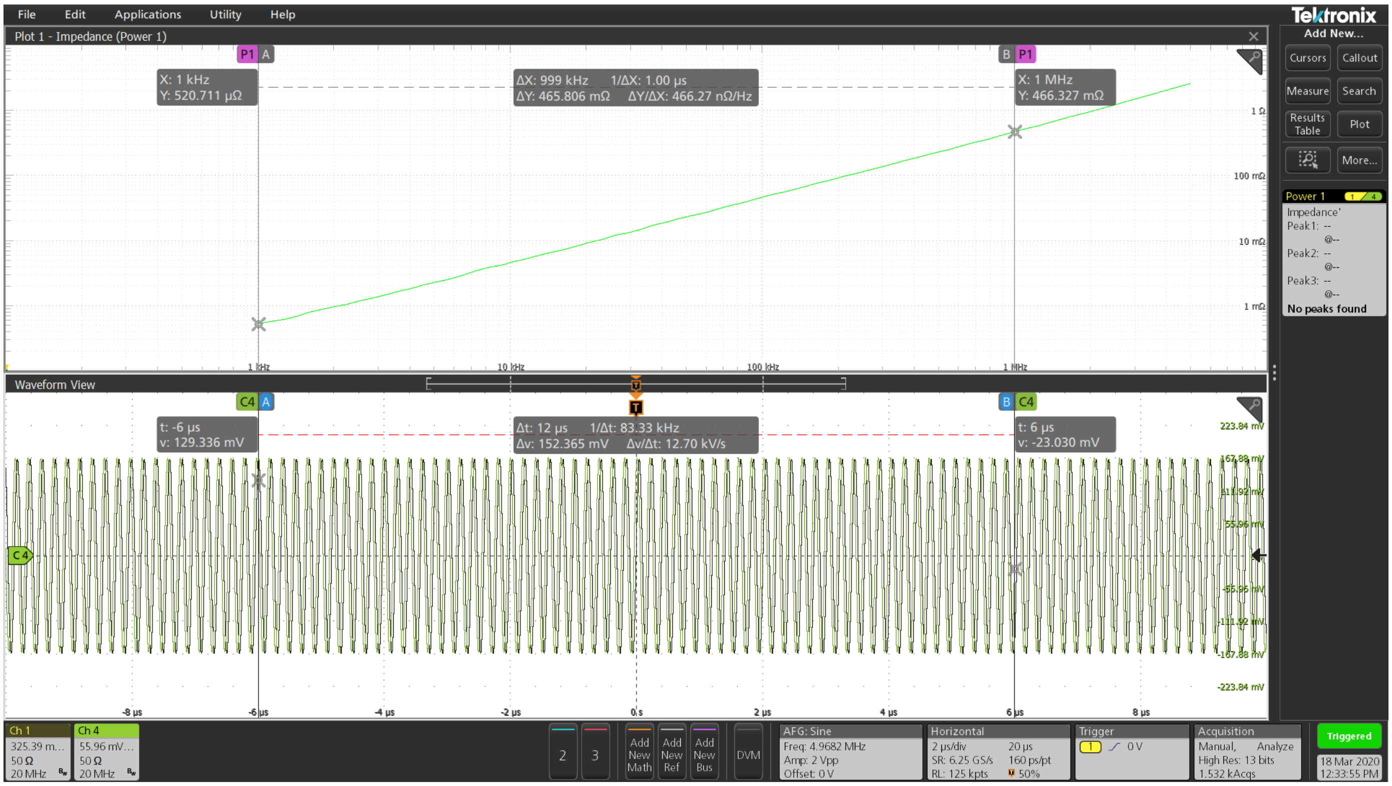


13. Double-click the Measurement Configuration Block. Select 20 points per division. Select 1Khz as a starting frequency. Select 5Mhz as the ending frequency. Set the signal amplitude to 500mV. These values can be adjusted to get the desired test result. Increasing the signal amplitude might increase the signal-to-noise ratio and provide a cleaner test result.

14. On the P9610A power supply, dial in the desired bias current.

15. Press Power Preset. Wait for the test to complete. Turn off the P9610A output to remove the bias current. Examine the impedance plot. To convert the impedance to inductance, use the formula:

$$L = \frac{Z_L}{2\pi f}$$



16. Note for the example above, we see an impedance of 466mOhm at 1Mhz. This gives an inductance of :

$$L = \frac{.466}{2\pi * 1M} = 74nH$$

Conclusion

Appendix

Things to add…

1. Calibration procedure
2. De-embed fixture procedure
3.