

J2100A 1Hz-5MHz Injection Transformer



J2101A 10Hz-45MHz Injection Transformer



Product specifications are subject to change without notice.

Picotest offers two different injection transformers specially optimized for different applications. Both are constructed with materials that are superior to most other injection transformers, resulting in greatly improved bandwidth, durability, and overall performance. The usable bandwidth of the Picotest injection transformers is greater than the 3dB frequency limits.

An injection transformer is a special transformer that is connected between a network analyzer and a DC-DC converter or voltage regulator in order to inject a perturbing signal into the control loop and is primarily used for control loop stability measurements. In order to accomplish this with a high degree of fidelity, the transformer is isolated and, therefore, capable of floating on a high voltage line seen in many circuits such as a Power Factor Corrector (PFC), which can be on the order of 400VDC.

The injection transformer is employed in the following manner: The output of a network analyzer, an oscillating signal of small amplitude and varying frequency, stimulates the voltage regulator's control loop via the transformer. The circuit response is monitored on either side of the transformer via the CH1 and CH2 connections. This effectively breaks the regulator's control loop allowing the analyzer to generate the magnitude and phase of the loop, i.e. V_{out}/V_{in} . The undistorted transmission of these signals, their levels and the proper setup and connection of the circuit are paramount to a successful and valid result.

Many incorrectly believe that the transformer is a non-critical element and that the bandwidth is unimportant since the transformer is outside of the measurement. This could not be farther from the truth. A quality injection transformer is a vital part of your stability test setup.

KEY FEATURES:

J2100A 1Hz-5MHz Injection Transformer

- 1Hz - supports PFC regulators
- 5MHz - high enough for most power supplies and regulators
- 23 Octave range
- Low distortion for superior precision
- 5 ohm termination for minimum impact to the loop
- Includes attenuation to assure small signal measurement

KEY FEATURES:

J2101A 10Hz-45MHz Injection Transformer

- 10Hz - supports off-line power supplies
- 45MHz - high enough for even state of the art regulators
- 23 Octave range
- Low distortion for superior precision
- 5 ohm termination for minimum impact to the loop
- Includes attenuation to assure small signal measurement

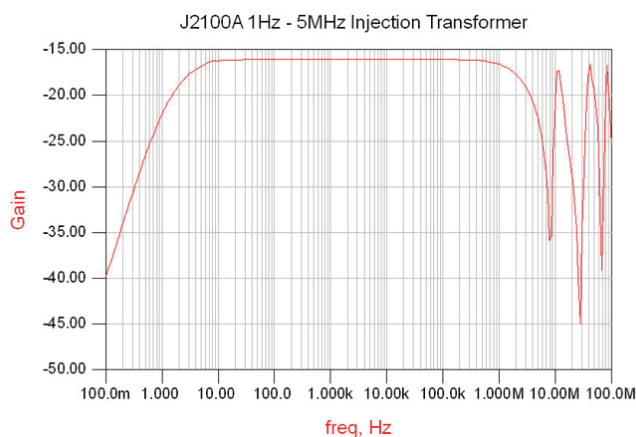
J2100A 1Hz-5MHz Injection Transformer



Performance at -10dBm input level		
Characteristics:	Rating:	Conditions:
DCR		25 degC
Ratio	1:1	
Termination Impedance	5 Ohms	
Nominal 3dB Bandwidth	1Hz-5 MHz	10mHz~100Hz, 10Hz~100MHz
Isolation Voltage	600V / CATII	3kVrms/1min
Isolation Capacitance	390pF	1kHz
DC Current	10mA	DC current at which inductance (@1kHz) drops 10% (typ) from its value without current
Temperature Range	0 - 50C	
Maximum Altitude	6000 Ft	

Mechanical characteristics	
Dimensions	109.22 x 89.66 x 50.80 mm 4.30" x 3.53" x 2.00"
Weight	0.225 kg / 0.496 lbs

Connectors	
Input	BNC socket
Output	Banana



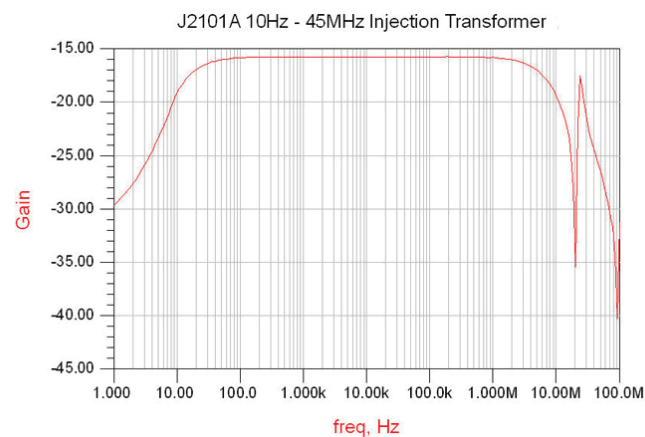
J2101A 10Hz-45MHz Injection Transformer



Performance at -10dBm input level		
Characteristics:	Rating:	Conditions:
DCR		25 degC
Ratio	1:1	
Termination Impedance	5 Ohms	
Nominal 3dB Bandwidth	10Hz-45 MHz	100mHz~100Hz, 10Hz~500MHz
Isolation Voltage	600V / CATII	3kVrms/1min
Isolation Capacitance	150pF	1kHz
DC Current	10mA	DC current at which inductance (@1kHz) drops 10% (typ) from its value without current
Temperature Range	0 - 50C	
Maximum Altitude	6000 Ft	

Mechanical characteristics	
Dimensions	109.22 x 89.66 x 50.80 mm 4.30" x 3.53" x 2.00"
Weight	0.225 kg / 0.496 lbs

Connectors	
Input	BNC socket
Output	Banana



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J2111A Current Injector



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The J2111A Current Injector is the most versatile tool in the Picotest Signal Injector product line. Coupled with the G5100A AWG, or other equivalent function generator, it is capable of performing small-signal load steps up to 40MHz, with up to 20ns rise/fall times. Rise and fall times can be controlled and arbitrary waveforms can be used to drive the injector producing load current profiles of virtually any characteristic pattern. This is ideal for emulating all types of load conditions, including high speed digital circuit loading, battery discharge profiles, or spontaneous current spikes.

When coupled with a network analyzer, the Current Injector can be used to measure the output impedance of all types of circuits and systems including power supplies, voltage regulators, power buses, and batteries. It can be used to **non-invasively** measure the stability of a combined input filter /negative resistance of a switching power supply or the phase margin of a linear or switching regulator WITHOUT the need to break the control loop.

It also supports applications in the measurement and extraction of transistor data, including small signal current gain, Ft, and many other dynamic performance parameters. In RF and instrumentation circuits it can be used to provide constant current biasing for class A amplifiers and buffers.

The Ultimate Controllable Current Source

The Current Injector has two connections for the output current flow. The controlling input is an arbitrary user controlled DC+AC signal that can be taken from either a signal generator or network analyzer. A built-in bidirectional

bias current enables Class A operation for use with network analyzers.

The output current is reduced 40dB from the input signal, resulting in 10mA/V scaling. The current monitor output port is designed to be terminated into 50 Ohms and can be used with the network analyzer, an oscilloscope or a DMM to monitor the output current of the injector on a 1A/V scale.

KEY FEATURES: J2111A Current Injector

- The versatile current source you can't be without; enables high fidelity load step, impedance, and stability measurements
- Enables non-invasive phase margin testing
- High speed load stepping current source – 20nSec edges
- DC-40MHz usable range
- Bi-Lateral operation works with positive or negative source
- Built in current offset for use with a network analyzer
- Precision current monitor with 50 Ohm output
- Works with any manufacturer's oscilloscope or network analyzer
- Current output easily controlled by any AWG or function generator
- Can be used to measure battery impedance
- Includes high PSRR low noise regulator with universal input
- Can be used to measure input filter stability

J2111A Current Injector



Specifications

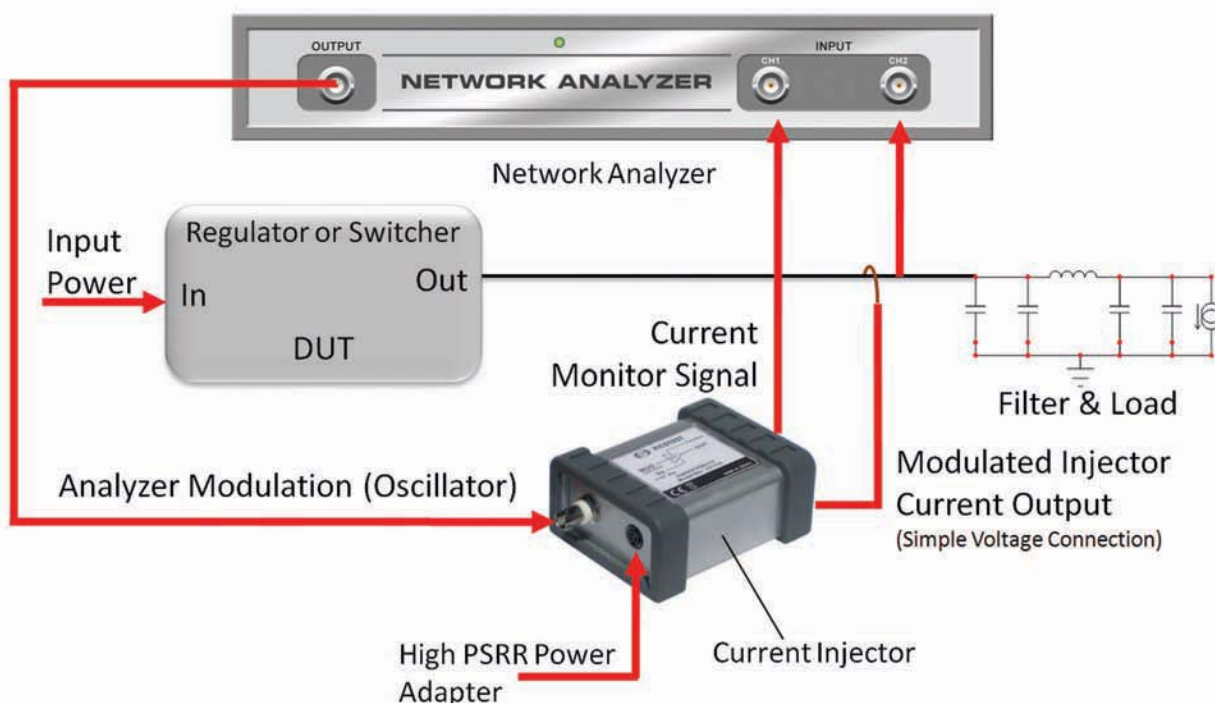
Characteristic	Typical	Units
Max input voltage DC+AC	+/-5	A / V
Output voltage	40	V
Current Monitor	1	V / A
Modulator Gain	10m	A / V
Offset Current (typical)	+24m/0/-24m	A
Usable Bandwidth	DC-40M	Hz
Temperature Range	0 - 50	C
Maximum Altitude	6000	Ft

Mechanical characteristics

Dimensions (box only)	109.22 mm x 89.66 mm x 50.80 mm 4.30" x 3.53" x 2.00"
(box + connectors)	122.68 mm x 89.66 mm x 50.80 mm 4.83" x 3.53" x 2.00"
Weight	0.210 kg / 0.463 lbs

Connectors

Input	BNC, MOD - BNC
Output	Banana



The J2111A Current Injector supports Non-invasive phase margin measurements. You can actually use it to measure the stability of your power supplies WITHOUT having to break the control loop. Simply connect the Current injector output (+ and - leads) to the signal of interest and you can measure the impedance, stability, or step load response.

J2110A Solid State Injector



Product specifications are subject to change without notice.

The Solid State Voltage Injector or “Bode box” is employed in a similar way as the injection transformer. It is used for stability and low current injection as well as signal combining without mixing, as in IMD distortion measurements.

While it is possible to obtain high quality injection transformers with bandwidths down to 1Hz and up to 45MHz, in some cases, this is still insufficient. For example a typical heater control loop might have a bandwidth of less than 1Hz while some linear regulators and opamp circuits can have bandwidths of exceeding 100MHz. For these applications, a solid state injector can provide the necessary bandwidth. The Picotest solid state injector has a wider bandwidth than most passive injection transformers with a performance range of DC-45MHz.

The resulting plots are often much cleaner when using a solid state injector as compared with an injection transformer.

The selection of a valid injection point in the circuit is more critical when using a solid state injector than with the transformer injector. The solid state injector presents an infinite impedance between the points of injection. In order to provide correct results one side of the measurement must present a much higher impedance than the other side. In a typical power supply control loop, the voltage sense divider is generally a good injection point, since the output impedance of the power supply is very low compared with the impedance of the voltage sense divider.

The solid state injector has a limitation in the operating voltage due to the common mode limits of the operational amplifiers.

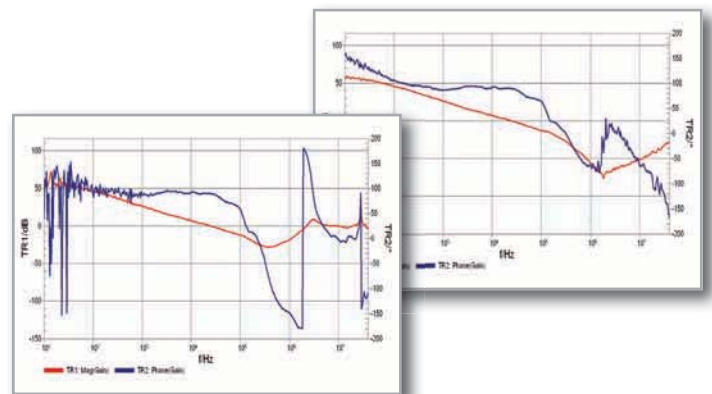
The Picotest J2110A accepts -10.5V to +10.5V inputs. This is the peak value (positive or negative AC+DC) of the operating voltage at the injector input and output.

KEY FEATURES:

J2110A Solid State Injector

- DC-45MHz; supports thermal and mechanical controls and highest performance regulators and amplifiers
- Low distortion for superior precision
- 25 Ohm insertion resistance
- 50 Ohm oscillator input
- < 3uA typical bias current
- >2 MΩ typical Input Resistance
- High PSRR low noise regulator with universal input

Picotest J2110A Solid State Injector



Picotest J2100A Injection Transformer

J2110A Solid State



Specifications		
Characteristic	Typical	Units
max Vcc	+/-12	V
max Icc	20	mA
Max input voltage DC+AC	+/-10.5	Vcc
Output voltage	+/-10.5	Vcc
Offset voltage	3	mV
Bias Current	8	uA
-3dB Bandwidth (-10dBm)	DC-40M	Hz
Temperature Range	0 - 50	C
Maximum Altitude	6000	Ft

Mechanical characteristics	
Dimensions (box only)	109.22 mm x 89.66 mm x 50.80 mm 4.30" x 3.53" x 2.00"
(box + connectors)	122.68 mm x 89.66 mm x 50.80 mm 4.83" x 3.53" x 2.00"
Weight	0.210 kg / 0.463 lbs

Connectors	
Input	BNC, MOD - BNC
Output	Banana

J2140A Attenuator



There are two common uses for attenuators when used in conjunction with a network analyzer. One is to attenuate the oscillator source signal. While this may seem odd, one of the most common errors in frequency domain measurements is using a source signal that is too large. Even though analyzers allow setting of the signal output amplitude, the lowest setting is often too high to allow an accurate small-signal measurement to be made. The correct amplitude is the smallest amplitude that exceeds the noise floor. Picotest's attenuators are also useful for improving the dynamic range of the measurement. In some cases, as in the measurement of the open loop gain of an opamp, the low frequency loop

gain will be extremely large (100dB or more is not uncommon). Attenuating the output signal increases the effective range of the measurement.

KEY FEATURES:

J2140A Attenuator

- Integrated unit includes 40dB, 20dB and 10dB ports
- Cascadable for greater attenuation
- Improve noise floor and assures small signal measurement

Specifications		
Characteristic	Typical	Units
Maximum input level	+20	dBm
3dB Frequency Range	DC-50M	Hz
Maximum VSWR	1.3	
Attenuation accuracy	0.2	dB

Mechanical characteristics	
Dimensions (box only)	109.22 mm x 89.66 mm x 50.80 mm 4.30" x 3.53" x 2.00"
(box + connectors)	135.38 mm x 89.66 mm x 50.80 mm 5.33" x 3.53" x 2.00"
Weight	0.238 kg / 0.525 lbs

Connectors	
Input	BNC
Output	BNC

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J2120A Line Injector



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Measuring PSRR

While the injection transformer is a very wideband adapter, it is not useful for measuring the power supply rejection ratio (PSRR) of a power supply or even an opamp. This is because the attributes that make the injection transformer perform so well also result in a transformer that is intolerant of DC current. Even very small DC currents (5mA or less) can greatly reduce the signal capacity or even totally saturate the transformer. For this reason, the Picotest J2120A Line Injector is another essential test adapter.

The Line Injector allows the input DC supply voltage to be modulated by the network analyzer source signal, as in the case of a PSRR measurement. The J2120A allows the DC supply voltage to be modulated over a wide range of frequency, from below the minimum AC line frequency to above the bandwidth of most, if not all linear regulators.

The Line Injector is only capable of sourcing current, so that the output amplitude can be significantly impacted by the operating current and the total storage capacitance at the load. The OMICRON-Lab Bode 100 network analyzer has a very high selectivity so distortion at the output of the Line Injector generally does not influence the measurement. Again, this is a small signal measurement, so the oscillator signals should be kept as small as possible above the noise floor. In some cases you may need to attenuate the source signal even further using the Picotest J2140A attenuators. Some analyzers, such as the Bode 100 allow shaping of the injection amplitude as a function of frequency, which helps optimize the signal level.

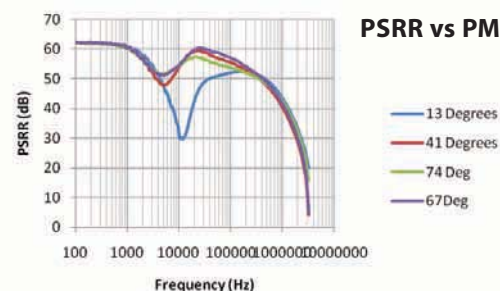
Measuring Input Impedance

The Line Injector can also be used in conjunction with a current probe to measure the input impedance of a power supply. The input impedance of a switching power supply or regulator is negative, which is a stability concern when combined with an EMI filter, making the Line Injector and the measurement an important part of the power supply design, analysis, and verification process.

KEY FEATURES:

J2120A Line Injector

- Enable PSRR measurement
- 10Hz-10MHz usable bandwidth
- Low loss design
- 5 Amps maximum current
- 50VDC maximum input
- Easily measure input filter Impedance, Q, transfer function
- Other Applications: PSRR clock sensitivity, LNA sensitivity and more



J2120A Line Injector

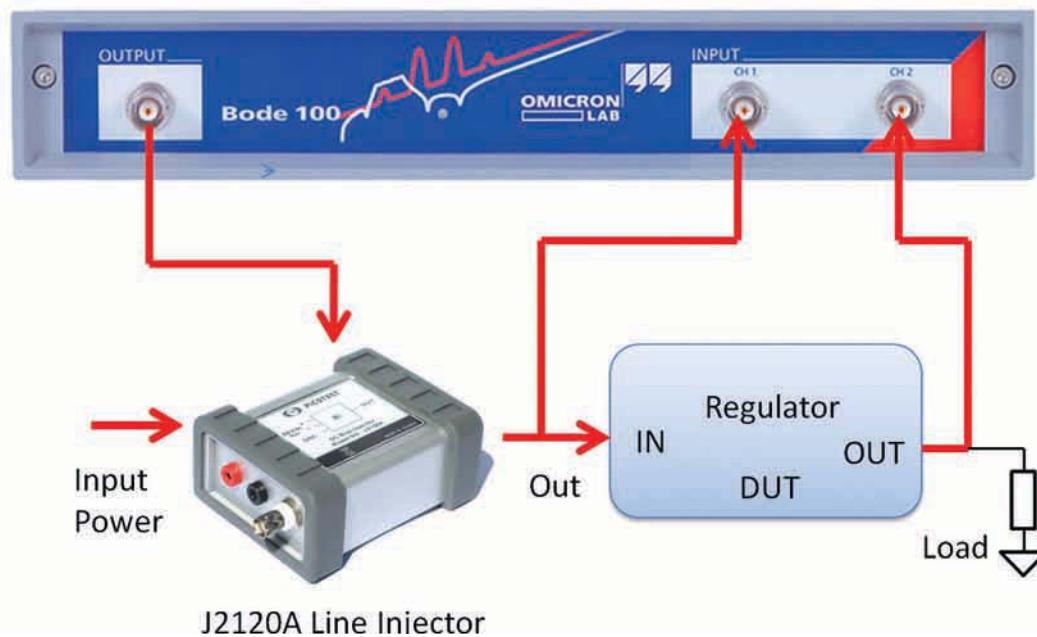


Specifications		
Characteristic	Typical	Units
Max DC input voltage	50	VDC
Max Continuous Current	5	A
Max Voltage Drop	3.25	VDC
3dB Frequency Response	15-5M	Hz
Useable Frequency Response	10-10M	Hz
Recommended Injection Signal	-20 -10	dBm
Temperature Range	0 - 50	C
Maximum Altitude	6000	Ft

Mechanical characteristics	
Dimensions (box only)	109.22 mm x 89.66 mm x 50.80 mm 4.30" x 3.53" x 2.00"
(box + connectors)	122.68 mm x 89.66 mm x 50.80 mm 4.83" x 3.53" x 2.00"
Weight	0.225 kg / 0.463 lbs

Connectors	
Input	Banana, MOD - BNC
Output	Banana

PSSR Measurement Test Setup



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