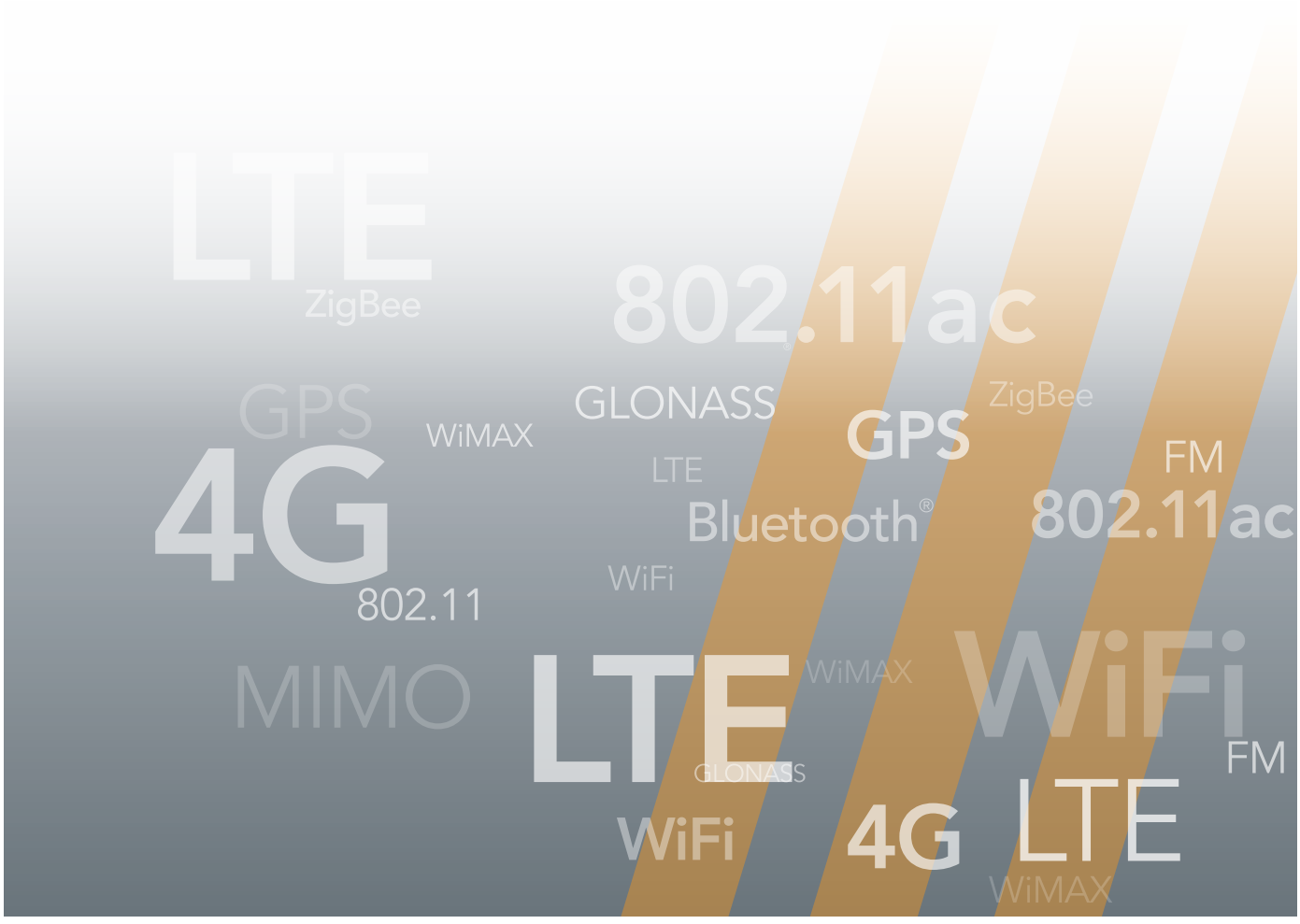
z471 SMU

TECHNICAL SPECIFICATIONS

z471
Floating Source/Measure Unit (SMU)
PXI Express



LITEPOINT

Port Descriptions

Trigger: bi-directional external trigger port (BNC)

Analog output:

GUARD	HIGH side driven current guard (see manual for proper operation)
SH	Sense High input
FH	Force High output
SL	Sense Low input
FL	Force Low output

LED	Description
ERR	ON when internal temperature is more than 75°C or Phase-locked loop (PLL) fails to lock
ACT	Blink when instrument is active
PWR	ON when instrument is powered ON

Electrical Specifications

General

Specification	Value
Channels	1
Operation	2 quadrant
Remote sensing	5-wire with Guard
Maximum voltage / current	+10 V, ±3 A (DC)
Isolation (Channel to Earth Ground)	60 V maximum
Voltage ranges	1, 10 V_{FS}
Voltage resolution	down to 20 µV
Current ranges	1 µA, 10 µA, 100 µA, 1 mA, 10 mA, 100 mA, 1 A, 3 A_{FS}
Current resolution	down to 10 pA
Programmable bandwidth	Custom, Slow, Normal, Fast
Line integration	Programmable 50/60 Hz

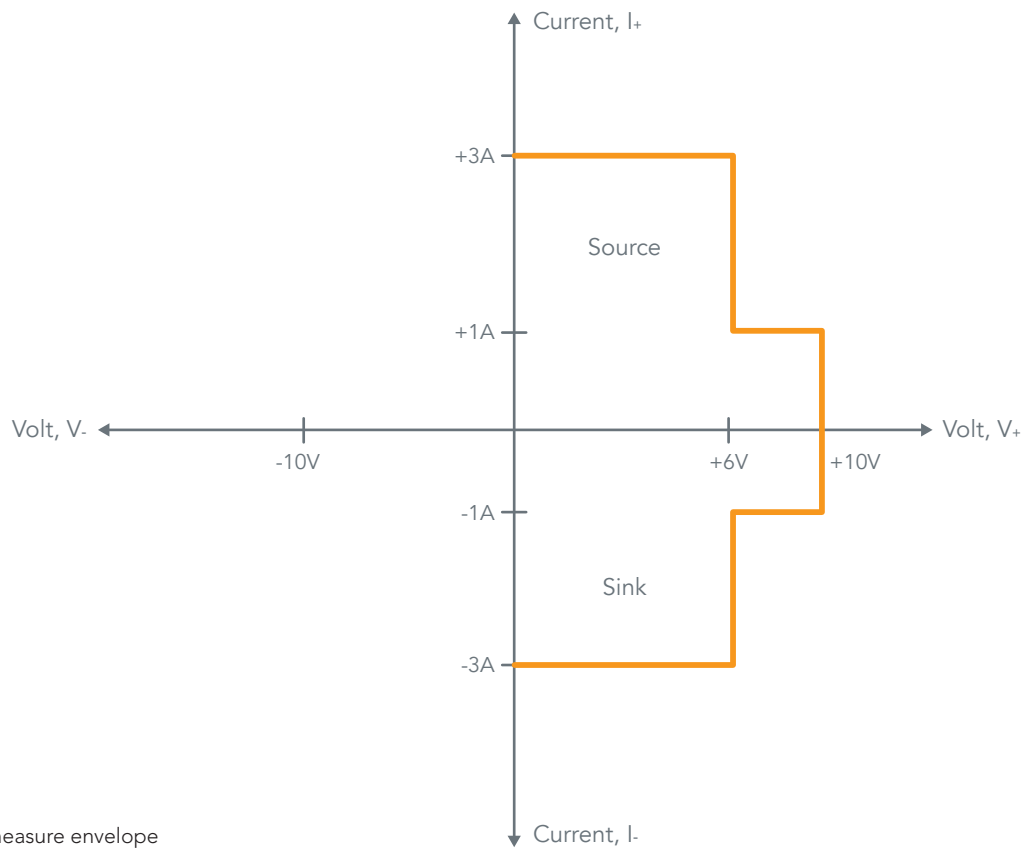


Figure 1: Source/measure envelope

Voltage Source/Measure Accuracy

Range (+V)	Accuracy (V), ± (% of voltage + offset), Tcal ±5 °C	Temp. Coefficient, ± (ppm of Voltage + ppm of Range)/°C, 13 °C – 33 °C	Resolution
10	600 µ + 0.015%	25 + 6	80 µ
1	1 m + 0.1%	25 + 21	20 µ

Current Source/Measure Accuracy

Range (±A)	Accuracy (A), ± (% of current + offset), Tcal ±5 °C	Temp. Coefficient, ± (ppm of current + ppm of Range)/°C, 13 °C – 33 °C	Resolution
3	3 m + 0.12%	27 + 6	400 µ
1	1 m + 0.12%	28 + 5	15 µ
100 m	15 µ + 0.03%	28 + 8	1 µ
10 m	1.5 µ + 0.03%	25 + 5	20 n
1 m	150 n + 0.03%	15 + 5	2 n
100 µ	15 n + 0.03%	28 + 5	200 p
10 µ	1.5 n + 0.03%	10 + 10	20 p
1 µ	1 n + 0.1%	11 + 120	10 p

Notes:

1. Tcal is the temperature recorded at calibration completion
2. Resolution is noise-limited. Specifications valid for aperture time of 2 power line cycles (PLC). See z471 Noise/Resolution vs. Measure Speed (see Figure 2) for typical performance at higher sample rates.

Noise and Resolution vs. Measurement Aperture

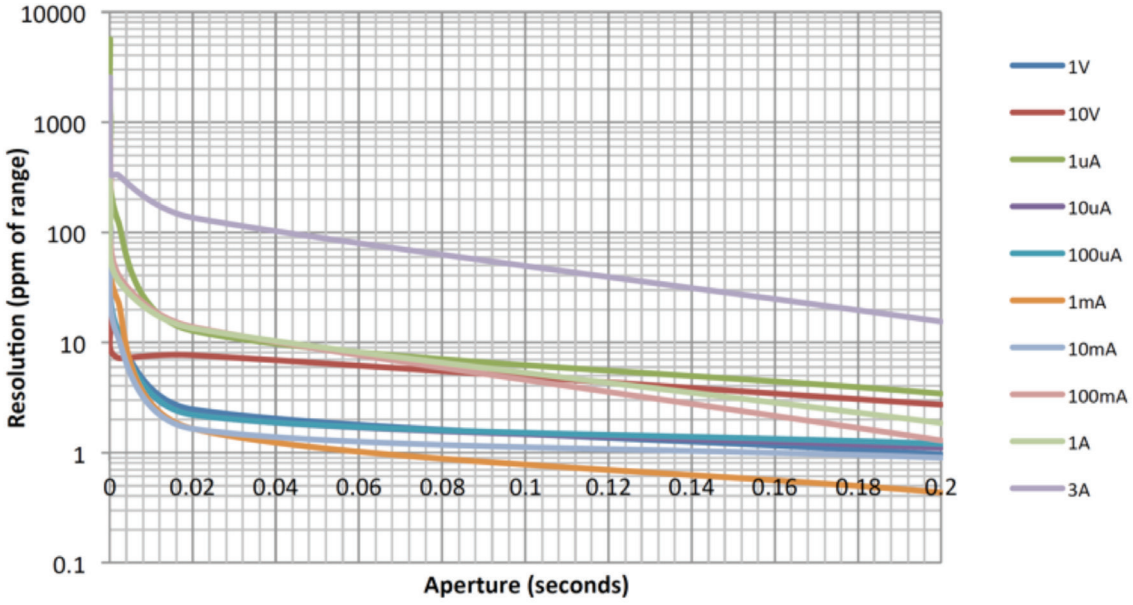


Figure 2: Typical noise/resolution as a function of measurement aperture

To derive a resolution in absolute units, complete the following:

- select a voltage or current range.
- for a given aperture time, find the corresponding resolution.
- multiply resolution in ppm of range by the selected range.

For example, the z471 resolution is ~10 ppm at 50 ms aperture. For the 100 mA measure range, multiply 100 mA by 10 ppm:

100 mA * 10 ppm = 0.1A * 10 * $1x10^{-6}$ = 1 µA

Similarly, for the 10 V range @ 50 ms:

10 V * 8 ppm = 10 V * 8 * $1x10^{-6}$ = 80 µV

Voltage settling time (no load)

1. Settling time, typical:
   < 100 µs to settle to 0.1% of voltage step, fast transient response
   (Note: Current limit set to ≥ 1mA)
2. Cable guard output impedance, typical: 1kΩ
3. The following figures show transient response setting for different loads

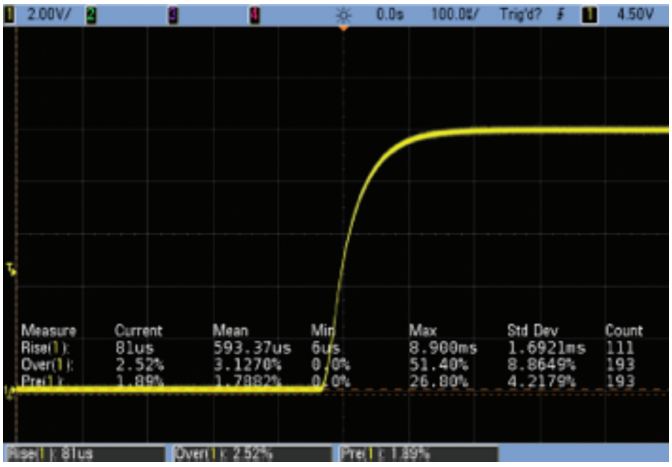


Figure 3: 10V step response, 10 mA range, typical, no load, *Fast* – <100 µs to 0.1%

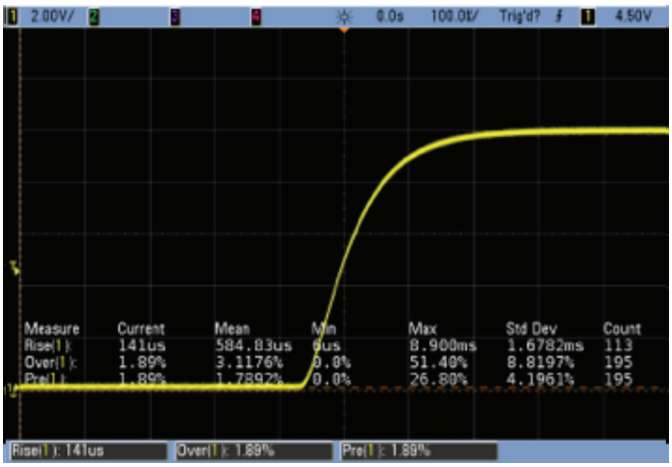


Figure 4: 10V step response, 10 mA range, typical, no load, *Normal* – <200 µs to 0.1%

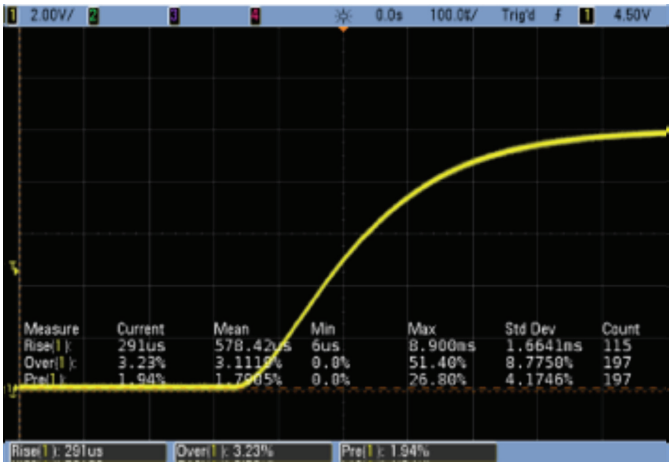


Figure 5: 10V step response, 10 mA range, typical, no load, *Slow* – <500 µs to 0.1%

Voltage settling time (100 nF load)

1. Settling time, typical:
   < 100 µs to settle to 0.1% of voltage step, fast transient response
   (Note: Current limit set to ≥ 1mA)
2. Cable guard output impedance, typical: 1kΩ
3. The following figures show transient response setting for different loads

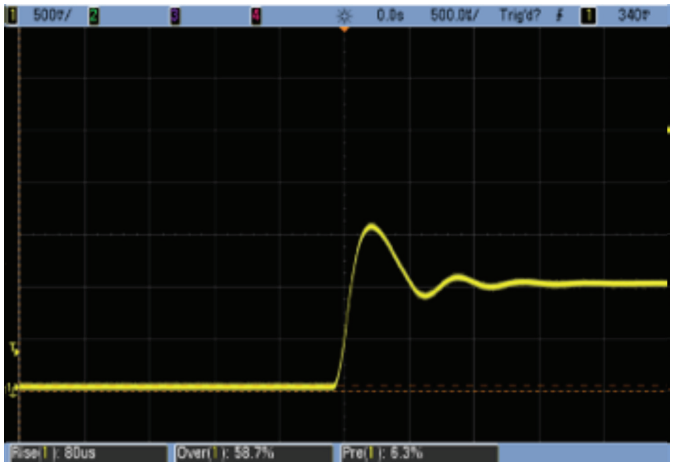


Figure 6: 10V step response, 10 mA range, typical, 100 nF load, *Fast*

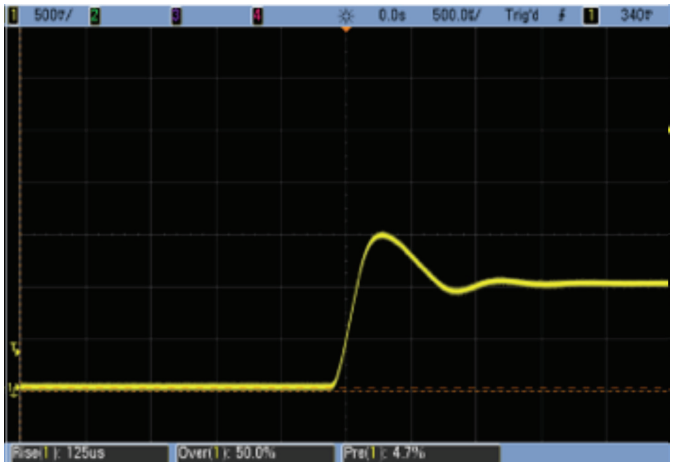


Figure 7: 10V step response, 10 mA range, typical, 100 nF load, *Normal*

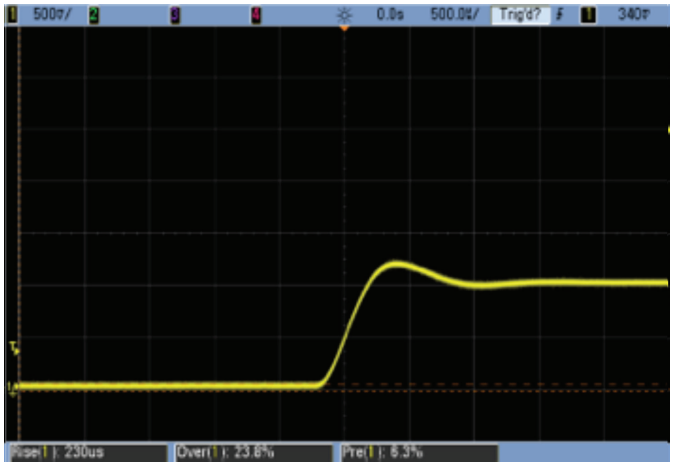


Figure 8: 10V step response, 10 mA range, typical, 100 nF load, *Slow*

Supplemental Electrical

Specification	Value
Remote sense Maximum lead drop	Add 2 µV error to voltage accuracy specification per mV of lead drop Up to 1V drop per force lead
Sampling speed Measure maximum Source update rate maximum	 1 MS/s 100 kS/s
Connectors/output	Phoenix Contact, MOBICON, 6-position, male 5-wires (Force High, Force Low, Sense High, Sense Low, Guard) BNC socket
Input triggers Types Sources Polarity Pulse width Destination Polarity Pulse width	 Measure, measure array PXI trigger lines 0-7, external, software Configurable (high, low rising, falling) ≥ 200 ns PXI trigger lines 0-7, external Configurable (high, low rising, falling) ≥ 200 ns
Output trigger Types Destination Polarity Pulse width	 Source complete, measure complete, enter compliance, exit compliance, during source, software PXI trigger lines 0-7, external Active High Configurable between 1 µs and 50 ms

Physical & Environmental

Size & Weight

Specification	Value
Physical size z471 SMU	 1 slot 3U PXI Express Instrument
Operating temperature range	23° C ± 10° C
Calibration interval	1 year

Terminology

Numeric Prefixes

When referring to numeric values, this document will use SI (International System of Units) and IEC (International Electrotechnical Commission) standard prefixes. Prefix definitions are in the following table.

Prefix	Multiplier
n (nano)	1/(1000x1000x1000)
µ (micro)	1/(1000x1000)
m (milli)	1/1000
k/K (kilo)	1000
M (Mega)	1000x1000
G (Giga)	1000x1000x1000
Ki (Kibi)	1024
Mi (Mebi)	1024x1024
Gi (Gibi)	1024x1024x1024

Differential Outputs

Single-Ended is used to refer to the output on either the + or – output pin

Differential is used to refer to the output between the + and- output pins

Vd indicates Volts differential

Vppd indicates Volts peak-to-peak differential

Safety

This product is designed to meet the requirements of the following standard of safety for electrical equipment for measurement, control and laboratory use: EN 61010-1

Electromagnetic Compatibility

CE Marking EN 61326-1:1997 with A1:1998 and A2:2001 Compliant

FCC Part 15 (Class A) Compliant

Emissions

EN 55011	Radiated Emissions, ISM Group 1, Class A, distance 10 m, emissions < 1 GHz
EN 55011	Conducted Emissions, Class A, emissions < 30 MHz Immunity
EN 61000-4-2	Electrostatic Discharge (ESD), 4 kV by Contact, 8 kV by Air
EN 61000-4-3	RF Radiated Susceptibility, 10 V/m
EN 61000-4-4	Electrical Fast Transient Burst (EFTB), 2 kV AC Power Lines
EN 61000-4-5	Surge
EN 61000-4-6	Conducted Immunity
EN 61000-4-8	Power Frequency Magnetic Field, 30 A/m
EN 61000-4-11	Voltage Dips and Interrupts

CE Compliance

This product meets the necessary requirements of applicable European Directives for CE Marking as follows:

73/23/EEC Low Voltage Directive (Safety)
89/336/EEC Electromagnetic Compatibility Directive (EMC)

See Declaration of Conformity for this product for additional regulatory compliance information.

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