

Pulsed LIV Measurements

- Signal sources
- Impedance matching
- Hardware at UCSB

Current or Voltage Pulse Generator?

- **Current pulse would be preferred, but-**
 - stray inductance leads to large voltage spikes
 - min pulse width and max compliance voltage linked
 - inherently high impedance output- reflections circulate
- **Voltage pulse can be faster and larger**
 - requires independent measurement of current
 - limited current compliance
 - preferred method for widely varying experimental devices

Commercial Pulsed Current Sources

ILX Lightwave

PULSED CURRENT SOURCES			
Model	LDP-3840B	LDP-3811	LDX-36000 Series
Output Current	3000mA	200mA/500mA	Up to 220A
Pulse Width	100ns to 10ms	100ns to 1ms	40 μ to 600ms
Rise/Fall Time	≤ 50 ns	≤ 25 ns	≤ 10 μ s
Compliance Voltage	≥ 10 V	≥ 25 V	≤ 70 V
Overshoot	$< 5\%$	$< 5\%$	$< 5\%$
Pulse Repetition Interval	1 μ s to 100ms	1 μ s to 1ms	1ms to 1s
Duty Cycle	0 to 10%	0 to 100%	0.1 to 60%
GPIB Interface	Yes	Yes	Yes

- Hard to achieve high voltage with fast pulse

Commercial Voltage Pulse Sources



8114A High Power Pulse Generator, 100 V / 2 A

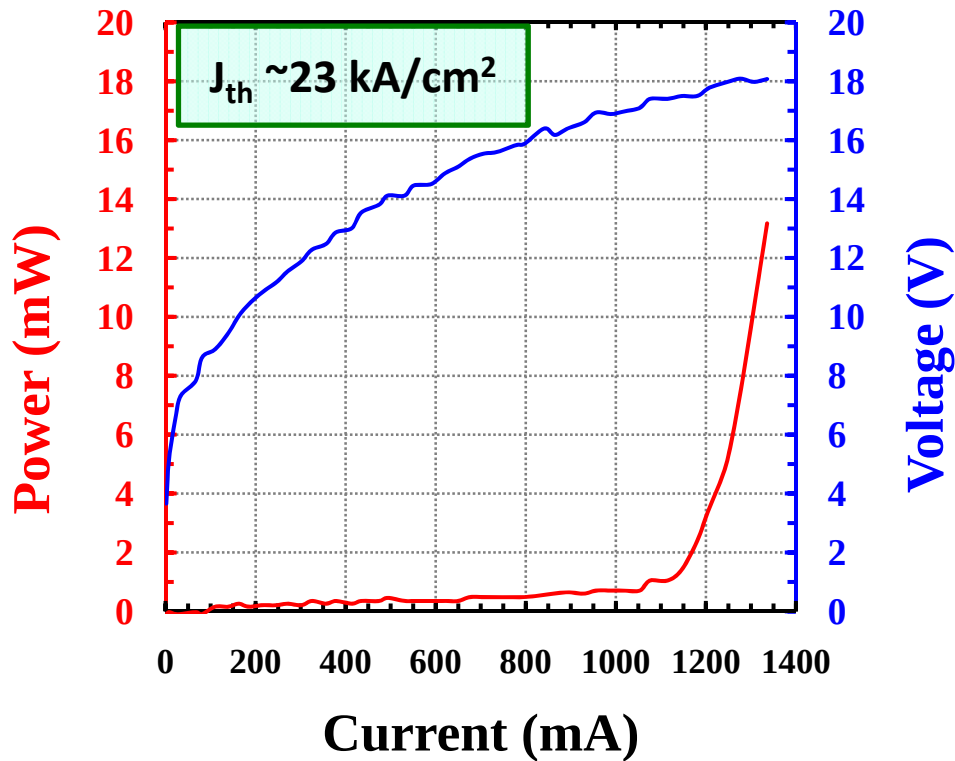
Product Status: Currently Orderable | Currently Supported

Sold By: ● Agilent ◆ Authorized Distributors ■ Authorized Tec

[-] Key Specifications

- Single-channel high power pulse generator
- 15 MHz
- 50 Vpp 50 Ω / 50 Ω ← This is important
- Max. amplitude 100 V (HI-Z/50 Ω)
- Max. current 2 A (HI-Z/50 Ω)
- Voltage, current, and duty cycle protection ← This is important
- Optional baseline shift of +/- 25 V

Typical Research Broad Area Laser



- What is the load impedance?

You-da Lin's 503nm InGaN laser

Impedance Matching

- Series resistor for low impedance lasers
- Impedance matching pulse transformer
- Attenuator at pulse gen output for isolation



- Difficult to match device capacitance
- Difficult to match probe inductance
- Difficult to match nonlinear IV of diode

Pulse Transformers

Model:	AVX-M4-S	AVX-M4	AVX-M3-S	AVX-M3	AVX-M1-S	AVX-M1	AVX-M2
Impedance match:	50Ω to 3Ω	50Ω to 3Ω	50Ω to 12.5Ω	50Ω to 12.5Ω	50Ω to 200Ω	50Ω to 200Ω	50Ω to 450Ω
Max. voltage in	30 V	350 V	30 V	350 V	30 V	350 V	50 V
Max. voltage out	7.5 V	87 V	15 V	175 V	60 V	700 V	450 V
Max. current out	2.5 A	28 A	1.2 A	14 A	0.3 A	3.5 A	1 A
Function:	current quadrupling	current quadrupling	current doubling	current doubling	voltage doubling	voltage doubling	voltage × 9
Max. pulse width:	250 ns	100 ns	10 ns	100 ns	10 ns	100 ns	100 ns
Rise time (20%-80%):	300 ps	1 ns	100 ps	1 ns	100 ps	1 ns	5 ns
Drop (max):	< 5%						
Dimensions: (H × W × D)	15×15×15mm 0.6×0.6×0.6"	38×28×23mm 1.5×1.1× 0.9"	15×15×15mm 0.6×0.6×0.6"	38×28×23mm 1.5×1.1× 0.9"	15×15×15mm 0.6×0.6×0.6"	38×28×23mm 1.5×1.1× 0.9"	38×28×23mm 1.5×1.1× 0.9"
Connectors:	In: Out:	SMA Microstrip line, with ground plane bordering the output center conductor					SMA solder terminal

Avtechpulse.com



Chassis for 1 & 5 ns rise times units,
38×28×23 mm, approx.



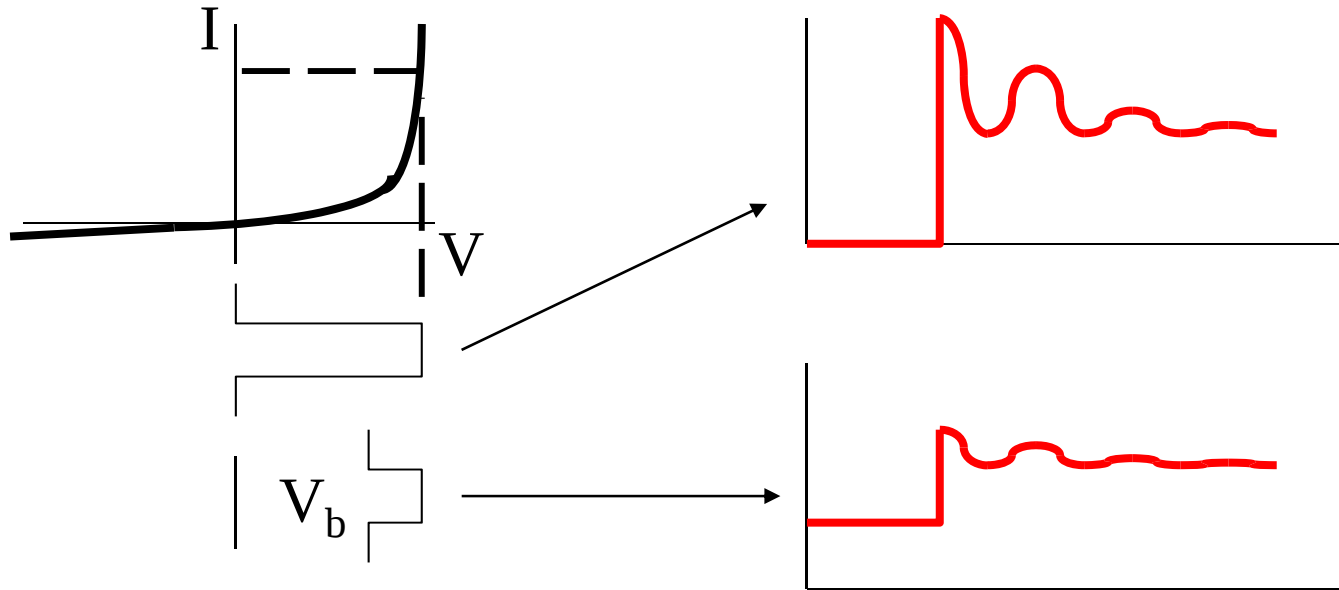
-S unit chassis
15×15×15 mm, approx.

- requires soldering device to circuit board

Some Tricks

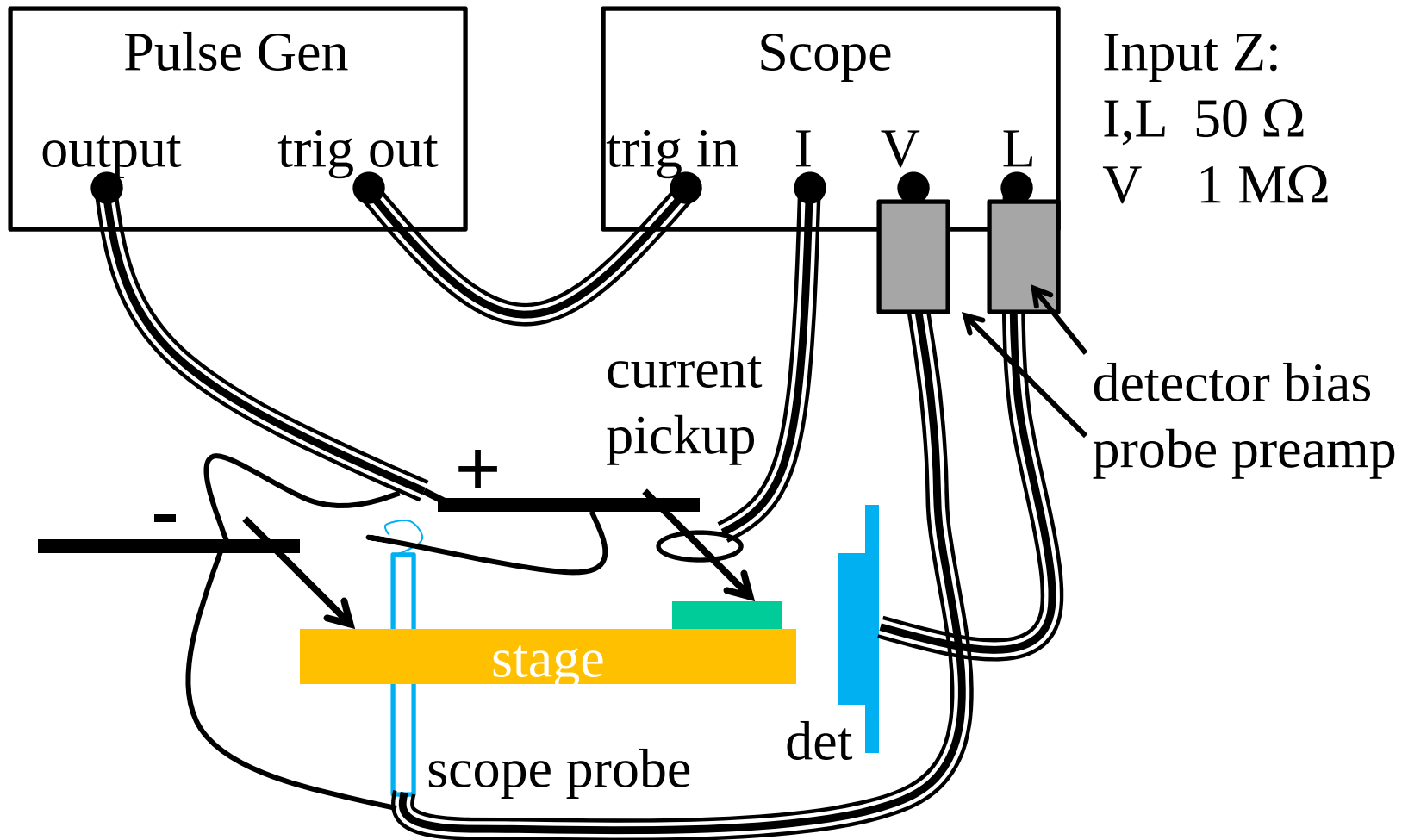
- Keep lines short, relative to c/f
- Insure signal source is well matched to T-line
- Use Z-matched attenuator (pad) in front of mismatched load
- Pre-bias device to lessen voltage step required

Bias Can Reduce Ringing



- Bias to point just below diode turn-on
- Some pulse generators have built-in bias

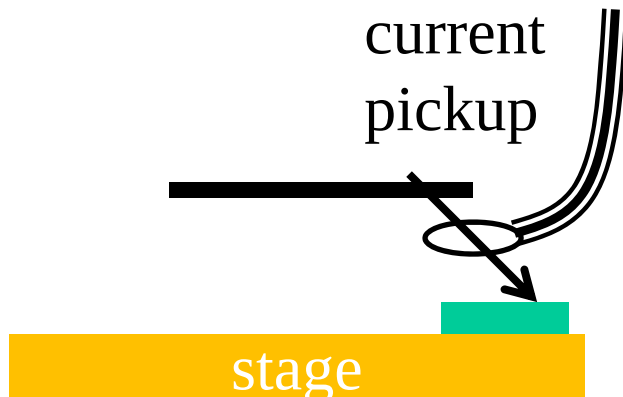
UCSB In-plane Laser Test Setup



Measuring Current

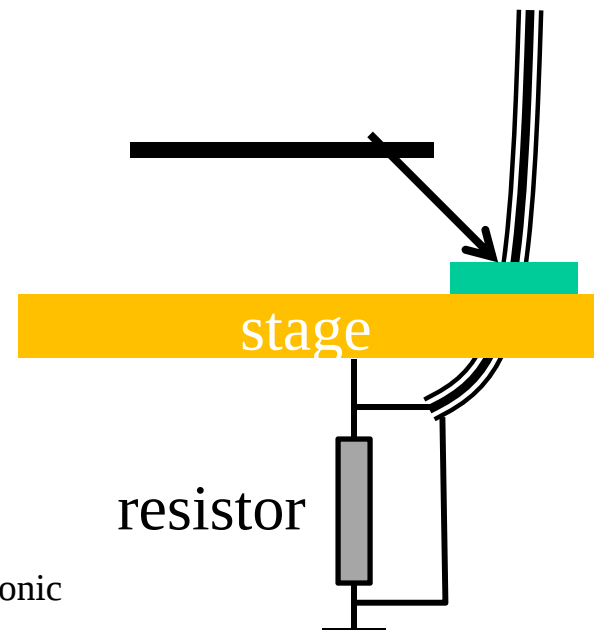
Current Pickup

- 50 Ohm impedance- no ringing
- 1 mV/mA: like 1 Ohm resistor
- No load on pulse gen
- Fast, but no DC response



Sensing resistor

- DC- GHz
- Must dissipate I^2R power
- Values convenient for sensing are badly mismatched to 50 Ohm



References

<http://www.ilxlightwave.com/appnotes>

<http://www.avtechpulse.com/appnote/current/>