

DS1115A / DS1116A Single Mode Diode Fault Injection Lasers

An ALPhANOV and Keysight product



Why We Developed Them

Observations

We developed the DS1115A and DS1116A single mode diode fault injection lasers to address user challenges such as:

1. “I know my chip is sensitive to fault injection, but I’m having difficulty finding which part of the die is sensitive at which moment in time due to a lack of resolution in fault injection.”
2. “I want to inject a small specific fault, but always trigger too many changes because the fault spreads over a wide area.”
3. “Sometimes it is difficult to avoid triggering a countermeasure such as a light sensor due to a large spot size.”
4. “Sometimes I do not get a fault at all due to lack of power.”

Alternatives	Limitations
General purpose, single-mode fiber diode lasers	Insufficient power to inject faults
Multimode diode lasers	Spot size on chip too large
DPSS lasers	Very limited pulse duration control. Laser needs to recharge over a long period for the next pulse



In partnership with ALPhANOV, the world leader in single-mode fiber diode lasers, Keysight company Riscure developed a dedicated laser source comprising the following:

1. **Single mode lasers** can achieve the smallest spot size given a certain wavelength.
2. **Diode lasers** feature a small, tunable pulse duration with high tunable repetition frequency, providing maximum timing control.
3. **Fibers** allow maximum flexibility in your laser fault injection setup.

Challenges Single Mode Lasers Solve

1. Understanding a fault's cause

"I want to be more precise to understand what caused a fault. I want to affect a smaller chip area during a smaller time interval, so that I can better understand exactly what part of the chip is sensitive at which moment."

2. Gaining precise control over fault injection

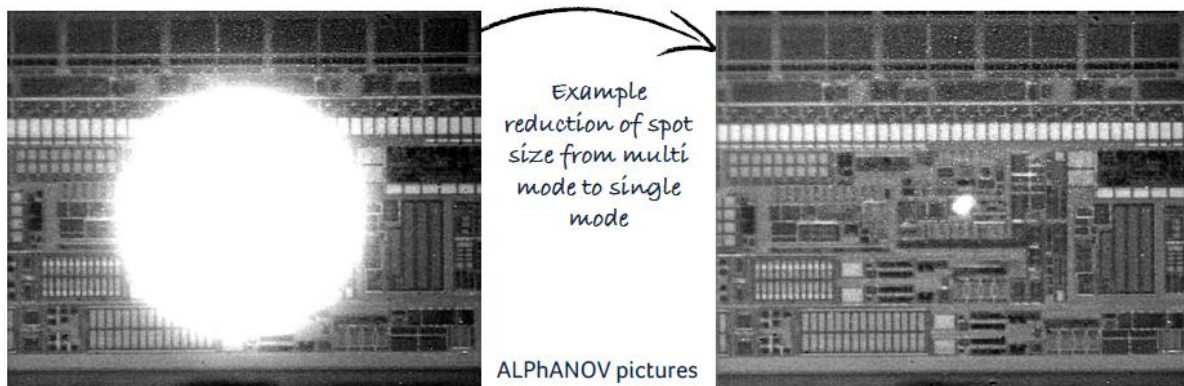
"I want to have better control over fault injection. I need to inject a small fault in a specific part of the chip and at a specific moment during the process. The light pulse needs to be as small and short as possible with sufficient power."

3. Avoiding on-chip countermeasures

"The fault needs to be small area- and time-wise to avoid triggering on-chip countermeasures. For example, I need to shoot between light sensors, because illuminating light sensors will trigger undesired behavior."

4. Getting through the substrate and having an effect

"The front side of the chip is too densely covered with metal, and I need to go through the back side. To inject a fault, I need the optimal wavelength to get through the substrate and generate free electrons."



Unique Features

1. **Small spot size by single mode** as well as the highest power for single mode, a short pulse duration, and high-repetition frequency.
2. **Flexible, robust setup** due to fiber coupling between laser source and laser microscope.
3. **Wide-ranging power control** through two independent diode lasers in one box that can be combined for maximum power.
4. **Runs independently** and with Inspector. Our single mode diode lasers come with their own software and can be controlled via analog and trigger signals. The interface to Inspector and Keysight hardware such as the Smartcard Voltage and Clock Glitcher and Glitch Pattern Generator is seamless.
5. **Two different wavelengths** for a back-side attack: 980 nm for thinner substrates (e.g., smartcards) and 1,064 nm for thicker substrates (e.g., flip-chip embedded processors).
6. **Adapter kit** to interface with fiber and laser microscopes.

Small spot size diameter: down to 1.0 μm

Short pulse duration: down to 4 ns

Low jitter for precise timing: below 8 ps

High-repetition frequency: up to 250 MHz

High optical output power: up to 5,2 W

Two wavelengths: 980 or 1064 nm

Technical Specifications

Inputs

- Trigger input for pulse control: 0 – 3,3 V, 50 Ohm
- Analog input for power control: 0 – 5 V, high impedance
- Manual switch: switches between pulse and continuous wave
- USB: for software control
- Power supply: 12 – 15 Vdc or 110 – 220 Vac via included power adapter
- Interlock: for safe operation

Outputs

- Spot size diameter: 1.0 μm / 1.5 μm for 100x / 50x objective at Fault Injection Laser Station.
Measured FWHM via knife edge technique at wavelength 1,064 nm, $M^2 = 1.3$, Mitutoyo near-infrared (NIR) long working distance objectives, without the Spot Size Reducer
- Optical pulse duration: down to 2 ns
- Jitter electrical to optical pulse: below 8 ps
- Optical pulse repetition rate: up to 250 MHz
- Optical power out of fiber: up to 5,2 W for 980 nm; up to 4,6 W for 1,064 nm
- Wavelength: 980 nm or 1,064 nm

Package

Quantity	Description	Photo
1	930 nm DS1115A or 1064 nm DS1116A single mode diode fault injection laser	
1	110 – 220 V power adapter	
1	Adapter kit for laser injection	

Keysight enables innovators to push the boundaries of engineering by quickly solving design, emulation, and test challenges to create the best product experiences. Start your innovation journey at www.keysight.com.



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