

DS1120A Unidirectional Fault Injection Probe / DS1121A Bidirectional Fault Injection Probe

Introduction

Modern chips have become faster, stronger, and safer. Since their safety depends on security analyses and testing, the equipment used for testing must keep up with the latest developments. To improve the chips' testing accuracy and allow the security tester or analyst more flexibility, we created the new DS1121A Bidirectional Fault Injection Probe.



Figure 1. DS1121A Bidirectional Fault Injection Probe

Description

EM-FI (Electro-Magnetic Fault Injections) is a method that hackers use to compromise the security of devices. The new Bidirectional Fault Injection Probe will be your perfect match to test countermeasures against these types of attacks.

The traditional approach requires different devices to first find the location on the chip where faults need to be injected and then switch to the device that can generate the EM glitches. The Bidirectional Fault Injection **allows us to do both glitching and measuring simultaneously through the same tip**. This is not only more efficient but will also improve the effectiveness of your tests. Next, the Bidirectional Fault Injection will give the user more flexibility to experiment because of the configurable pulse width.

Testing becomes straightforward with Keysight Inspector and other Keysight test devices like DS1180A Glitch Pattern Generator. Inspector helps you to communicate to the device under test and controls your hardware test setup. The user will find that Inspector gives you much freedom to design your test scenario and will automate as much as possible. You can be creative and design tests while the Inspector handles the heavy lifting.

Integrated with Inspector or Standalone

Inspector integration: Keysight Glitch Pattern Generator controls the timing and power settings of the EM pulses. The Bidirectional Fault Injection can be mounted on a Keysight DS1010A Precision XYZ stage in combination with Inspector FI software used for navigation and automated surface scanning. For embedded devices and smartcards, Inspector supports a multitude of protocols to communicate to the device under test.

The setup can be extended with Keysight DS1002A Pattern Based Trigger Generator if triggering based on the recognition of power or EM signals is needed for the exact timing of the glitches.

Standalone: The Unidirectional Fault Injection Probe can be integrated with any fault injection test set up with third party products (software and hardware). Next, the Precision XYZ stage and other devices mentioned can also be controlled through an SDK from third party software.

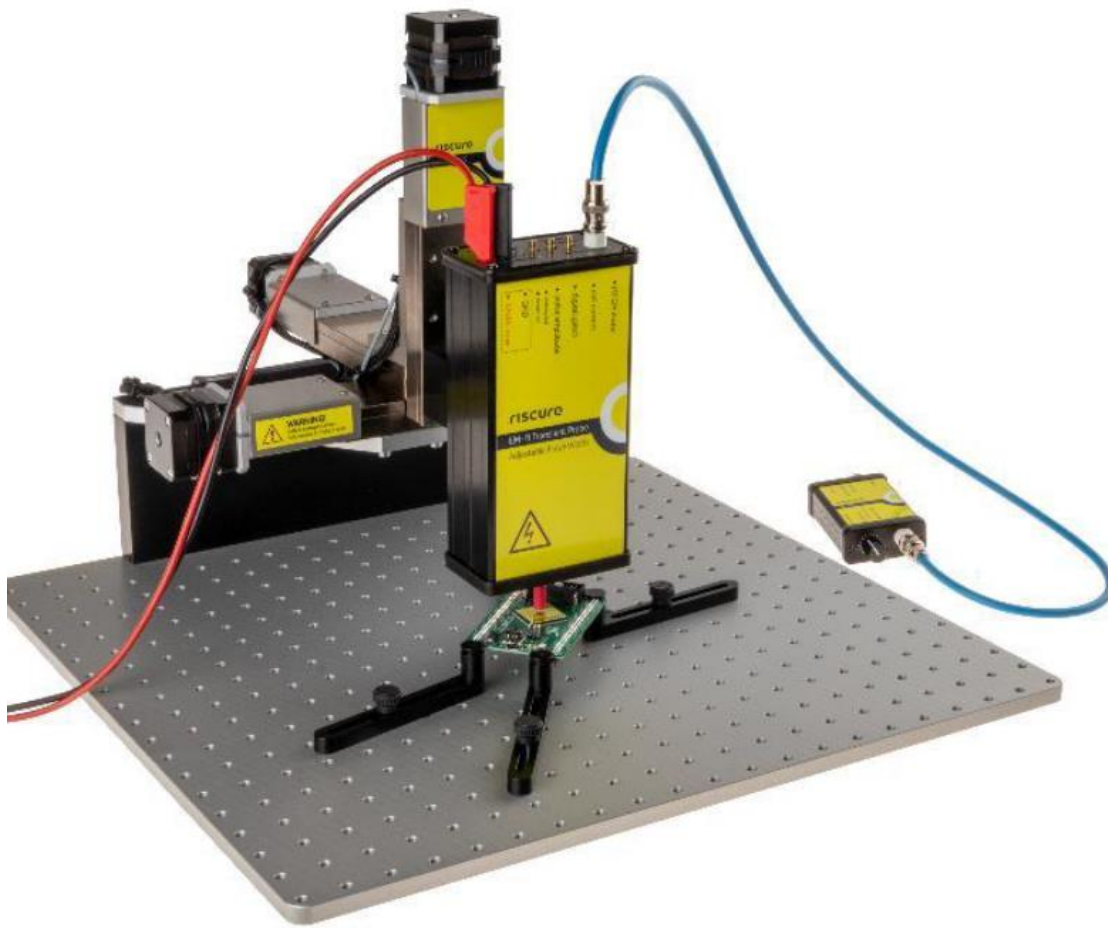


Figure 2. Bidirectional Fault Injection mounted on a Keysight DS1010A Precision XYZ stage

Why This New Device?

The first Unidirectional Fault Injection Probe was created eight years ago. It induced fast, high-power EM pulses on a user-defined chip location so that the user could test the robustness of a chip or the effectiveness of countermeasures. The tested devices changed over time, so new features and improvements were necessary to get better, more efficient results. With this in mind, we created the Bidirectional Fault Injection Probe, which can glitch and measure simultaneously through the same tip at the same location.

Key Features

Measuring EM emission while glitching

You can measure EM emission while glitching the device under test with EM pulses.

This will enable you to use EM signals to decide on the perfect timing for the FI attack (IC Waves or a similar device required for pattern recognition) and verify if the pulses are injected at the correct time.

Controlling the pulse width

You can now control the pulse width to be more flexible in creating the EM field over a chip.



Figure 3. New parameter glitch length

Other Features

- Adjustable pulses (Glitch power, timing).
- Multiple probe tips included.
- Shorter pulses than before, starting as small as 4ns configurable from software.
- Fast and predictable response to a trigger.
- Connects to a stable, clean power supply for optimal results.
- Low setup costs for chip preparation.
- When using the bigger tips, testing does not require de-packaging the chip.
- Lower chance of permanent chip damage compared to other Fault Injection methods.
- Fits Keysight Precision XYZ stage for surface automated scanning.

New Bidirectional Fault Injection Probe

The Bidirectional Fault Injection Probe is a **new product with new features**. It is not a replacement for the Unidirectional Fault Injection Probe. The Bidirectional Fault Injection Probe will be added to the Keysight portfolio and will allow users to:

- Perform glitching and measuring simultaneously through the same tip to enable triggering an EM signal.
- Have more options to experiment with the configurable pulse width.
- Increase efficiency as measurement and glitching options are combined in one device.



Figure 4. DS1121A Bidirectional Fault Injection Probe

Unidirectional Fault Injection Probe

The Unidirectional Fault Injection Probe is still a standard in the market. It can generate stronger pulses, which is important for some devices that need to be tested for resistance against very powerful pulses.



Figure 5. Unidirectional Fault Injection Probe

Technical Parameter Comparison

Unidirectional Fault
Injection Probe



Bidirectional Fault
Injection Probe



Max. voltage over coil	450 V (+/-10%)	100V ± 10%
Max. internal current	64A	92A ± 10%
EM pulse power control	5 – 100%	1..100%
Digital glitch pulse width for full power	50 ns	Adjustable, 4–200ns ± 10%
Max. switching frequency for constant power	1 MHz	1 MHz
Pulse frequency	1 MHz	50 MHz
Power	24V-450V ± 10%	3V-100V ± 10%
Propagation delay: Digital glitch to Coil Current	50ns (+/-10%) / 51ns (+/-10%)	18ns ± 10% (4mm tip 5 windings)
Propagation delay: Digital glitch to EM-Tip	40ns (+/-10%) / 42ns (+/-10%)	20ns ± 10% (4mm tip 5 windings)
Max current through coil of probe tip	56 A (+/-10%) / 48 A (+/-10%)	69 A ± 10% (4mm tip 5 windings)
Max voltage at current monitor	–1.4 V (+/-10%) / -1.2 V (+/-10%)	-2V ± 10%
Pulse width of the waveform at Current Monitor	17ns (+/-10%) / 20ns (+/-10%)	Adjustable, 4–200ns ± 10%
Probe coils (tips)	1.5mm tip / 4mm tip (positive/negative); Crescent tip High precision tips	1.5mm, 3 windings 1.5mm, 5 windings 4mm, 3 windings 4mm, 5 windings
Measurement circuit	No	The device can both inject and measure EM at the same time
LED	No	Power and Activity

Application

The Unidirectional Fault Injection Probe is designed to test devices of the latest generations. Used daily in the Keysight Device Security Research Lab, we make sure it meets the highest demands of the industry and security analysts. This way, we ensure the device is effective in testing both embedded devices and smart cards.

We have repeatedly proven that hardware and software countermeasures available in up-market devices can be challenged successfully with state-of-the-art test equipment. Fine control over all parameters used to execute a Fault Injection test with our test devices and software will ensure a high degree of security for your product.



Figure 6. Bidirectional Fault Injection Probe

Use Cases

The new Bidirectional Fault Injection gives the user more efficiency and flexibility and can be more effective than before. It is best suitable in the following use cases:

- For the teams that need **accurate EM measurements** during FI testing to determine the best trigger point.
- For the teams that work on **sensitive targets** and want to control the parameters of the glitch more accurately.
- For the teams who are **short on time** and want to take the most from a device which combines essential steps for effective Electro-Magnetic Fault Injection testing.



Figure 7. Bidirectional Fault Injection Probe

Bidirectional Fault Injection Technical Parameters

- Power over coil: 3V-100V (+/-10%).
- Maximum internal current: 92A \pm 10%.
- EM pulse power control: 1 – 100%.
- Pulse width at digital glitch input for full power: Adjustable, 4–200ns \pm 10%.
- Pulse frequency: 50 MHz.
- Measurement circle: The device can both inject and measure EM at the same time.

Bidirectional Fault Injection Probe Coils

- 4mm / 1.5mm, 5 windings.
- 4mm / 1.5mm, 3 windings.



Figure 8. Bidirectional Fault Injection Probe Coils

Bidirectional Fault Injection Probe Data Sheet

Parameter	Value
Max. voltage over coil	100V \pm 10%
Max. internal current	92A \pm 10%
EM pulse power control	1..100%
Digital glitch pulse width for full power	Adjustable, 4–200ns \pm 10%
Max. switching frequency for constant power	1 MHz
Pulse frequency	50 MHz
Power	3V-100V \pm 10%
Working Voltage	12VDC
Operating Temperature	0-70°C
Propagation delay: Digital glitch to Coil Current	18ns \pm 10% (4mm tip 5windings)
Propagation delay: Digital glitch to EM-Tip	20ns \pm 10% (4mm tip 5windings)
Max current through coil of probe tip	69 A \pm 10% (4mm tip 5windings)
Max voltage at current monitor	-2V \pm 10%
Pulse width of the waveform at current monitor	Adjustable, 4–200ns \pm 10%
Measurement circle	The device can both inject and measure EM at the same time
LED	Power and Activity

Bidirectional Fault Injection Probe Coils

Quantity	Diameter	Circuit
1	4mm	5 windings
2	1.5mm	5 windings
3	4mm	3 windings
4	1.5mm	3 windings

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.



This information is subject to change without notice. © Keysight Technologies, 2024, Published in USA, November 8, 2024, 3124-1801.EN