

EM-FI Transient Probe

Quick Start Guide



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What is in the box

The box contains the EM-FI Transient Probe and all standard accessories and cables to connect it to a glitch generator.



Box content checklist

Qty [1]	Description	Photo	Identifier [2]
1	EM-FI Transient Probe, with bracket		
5	Probe tips: - flat head tip, red: $\varnothing$ 1.5 and 4 mm - flat head tip, black: $\varnothing$ 1.5 and 4 mm - crescent tip		
1	24 V DC Power supply unit: input 100 V .. 240 V AC, 50 .. 60 Hz Power cable (country specific)		PSU
2	Signal cable: SMB – SMB, 50 Ω , coax, 6 ft		SMB2SMB

Qty [1]	Description	Photo	Identifier [2]
1	Signal cable: SMB – BNC, 50 Ω , coax, 6 ft		SMB2BNC
1	Low-pass filter: BNC, 50 Ω , cut-off frequency 90 MHz		LPF90M
1	Digital glitch input transformer with label 'Adapter EMFI' on back side		Adapter EMFI
-	This "EM-FI Transient Probe- Quick Start Guide"		

[1] The amount of registered items (quantity, Qty).

[2] Identifier used in this document to refer to the item.

Safety instructions

Electrical safety



HIGH VOLTAGE ON THE PROBE TIP

DO NOT touch the probe tip when it is actively firing pulses.



LIFE-THRETHENING INTERNAL VOLTAGE AND CURRENT

DO NOT open the product casing.



What does it do

The EM-FI Transient Probe is an electromagnetic (EM) perturbation device used in Fault Injection (FI) attacks.

The probe is capable of delivering fast, precise and powerful electromagnetic pulses, used for inducing currents in metal layers and causing voltage glitches in CMOS logic gates.

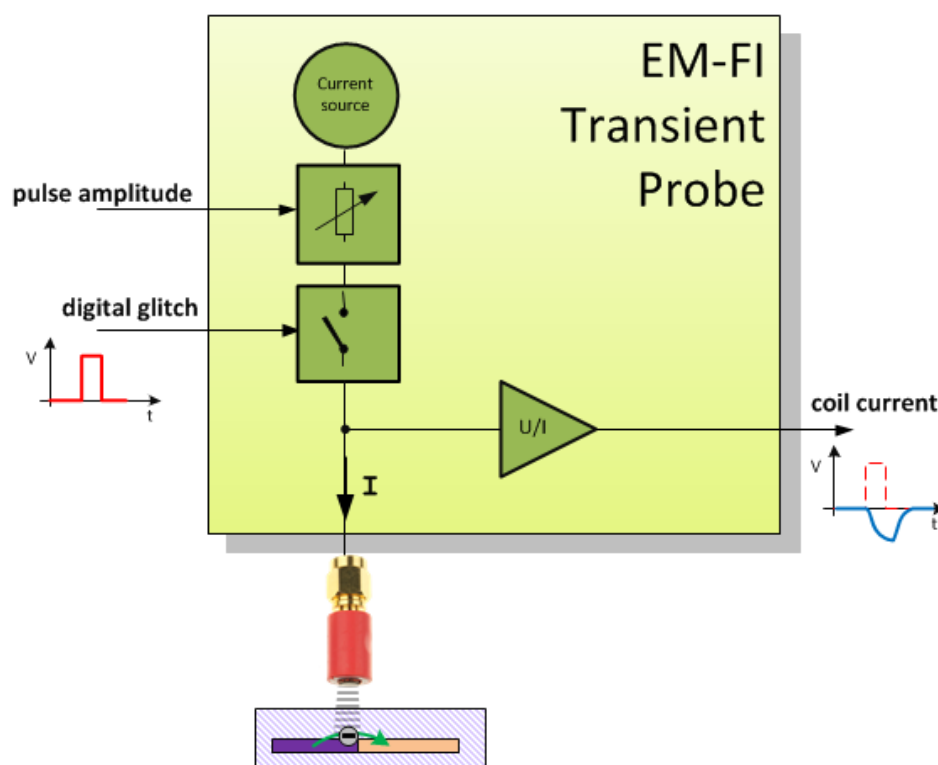


Figure 1 Functional overview of the EM-FI Transient Probe.

The EM-FI Transient Probe uses amplitude and timing signals from an external glitch generator, and is typically used in a Probe Station in combination with a VC Glitcher.

Connecting a Spider

Connecting Spider to EMFI

The following connections need to be made between Spider and EM-FI transient probe:

1. To trigger generation of an EM pulse, a connection needs to be made between Spider, SMB-SMB cable, digital glitch input transformer and EM-FI transient probe in the following order:

- Connect SMB-SMB cable to 'glitch out 1' of Spider,
- Connect SMB-SMB cable to digital glitch input transformer with label 'adapter EMFI'. The digital glitch input transformer performs pulse shaping to enable reliable triggering.



Digital glitch input transformer is required.

Digital glitch input transformer is required to prevent damaging the EM-FI Transient Probe.

- Connect digital glitch input transformer to 'digital glitch' input of EM-FI transient probe.
2. To set EM pulse strength, a connection needs to be made between Spider, SMB-SMB cable and EM-FI transient probe in the following order:
 - Connect SMB-SMB cable to 'voltage out 1' of Spider,
 - Connect SMB-SMB cable to 'pulse amplitude' input of EM-FI transient probe.



Figure 2 Digital glitch input transformer with label 'Adapter EMFI' connected to the EM-FI transient probe.

How to build a setup

Setup for EM glitching of a smart card

This setup uses the VC Glitcher as smart card reader and as producer of the glitch triggers. The EM-FI Transient Probe is placed above the non-contact side of the smart card.

Figure 3 also shows the temporary connection of the **coil current** output with an oscilloscope, to verify if the setup is correctly configured and the probe tip is activated.

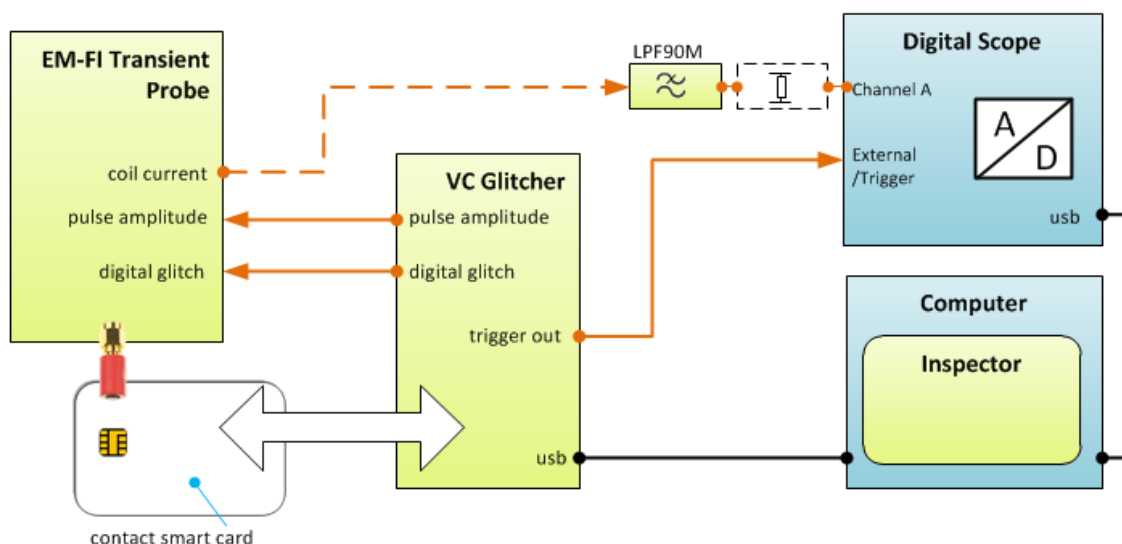


Figure 3 Basic setup for EM fault injection of a smart card.

Setup for EM glitching of an embedded target

This setup uses the VC Glitcher as producer of the glitch triggers.

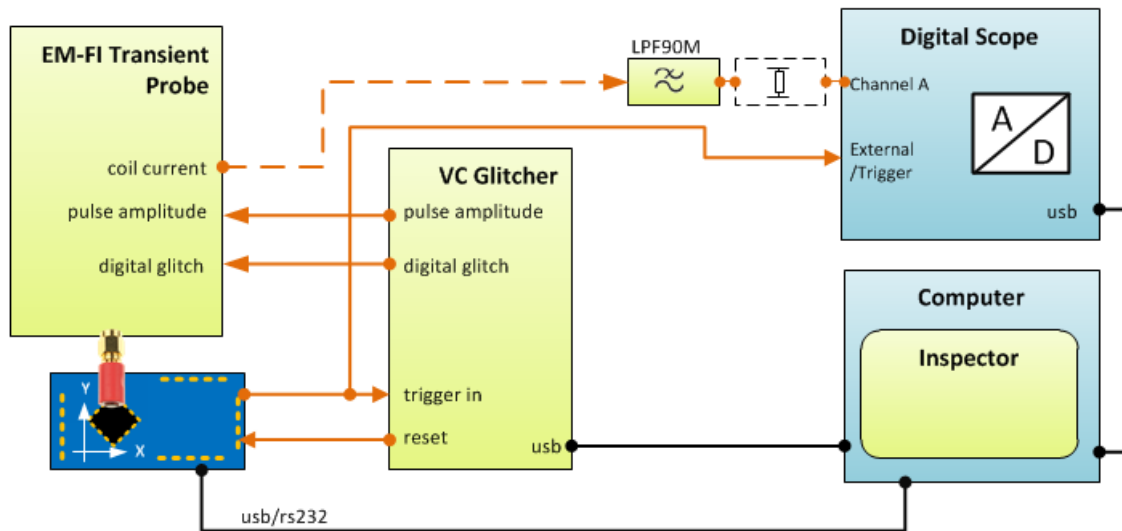


Figure 4 Basic setup for EM fault injection of an embedded target.

Attaching the bracket

The EM-FI Transient Probe comes with a disassembled bracket.

Fit the bracket to the back panel with the 2 screws supplied. There are 3 different fitting positions to meet your need for a height above the baseplate.

With the bracket fitted, the probe fits into the probe clamp of the Probe Station as well as the Diode Laser Station (Figure 5).

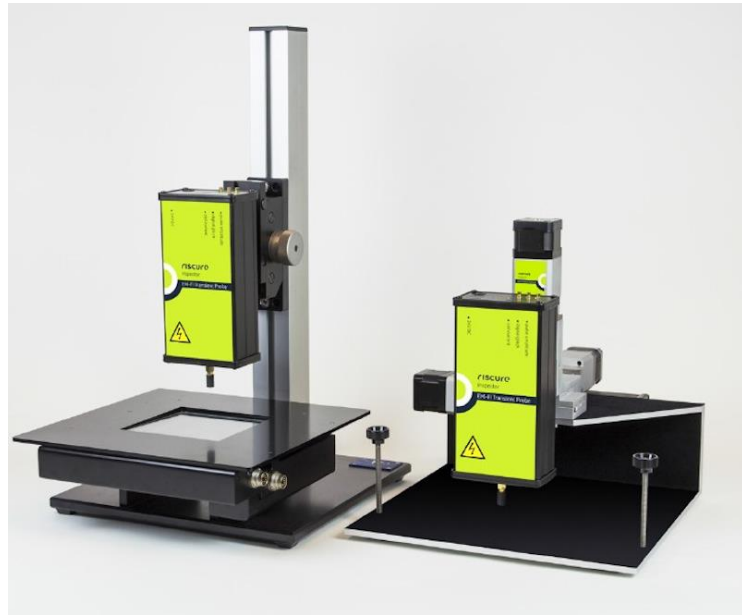


Figure 5 The backside bracket enables the EM-FI Transient Probe to be fitted on the Diode Laser Station and the Probe Station.

Selecting the probe tip

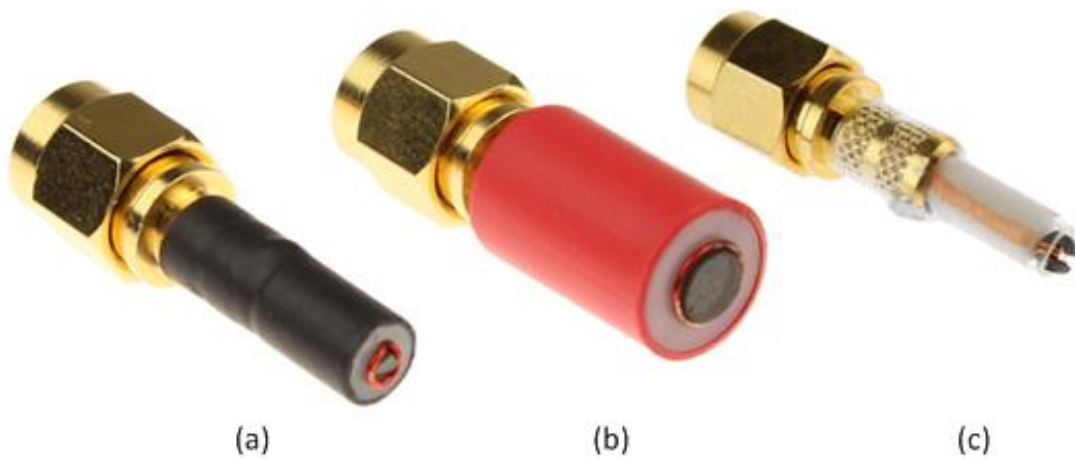


Figure 6 Different probe tips for EM fault injection.

The EM-FI Transient Probe is supplied with flat head probe tips (Figure 6 a,b) and a crescent probe tip (Figure 6 c).

The flat head probe tip produces a magnetic field which is perpendicular to the surface and is applied to induce currents in a circuit loop between adjacent gates (Figure 7a).

The crescent probe tip produces a magnetic field along the surface and is applied to induce directed currents in tracks and junctions (Figure 7b).

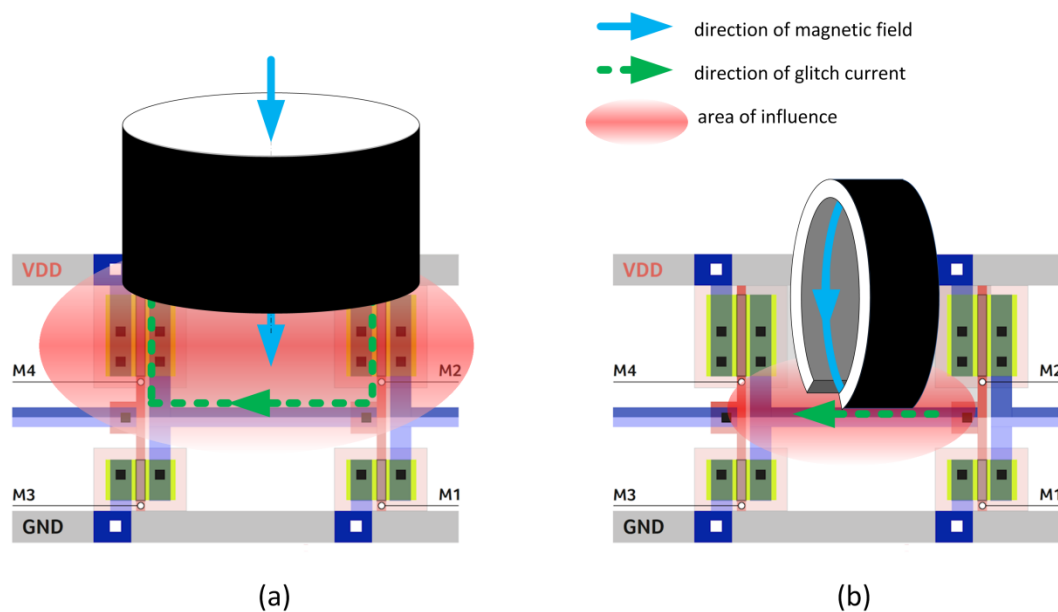


Figure 7 The concepts of glitching with a flat head tip (a) and a crescent tip (b).

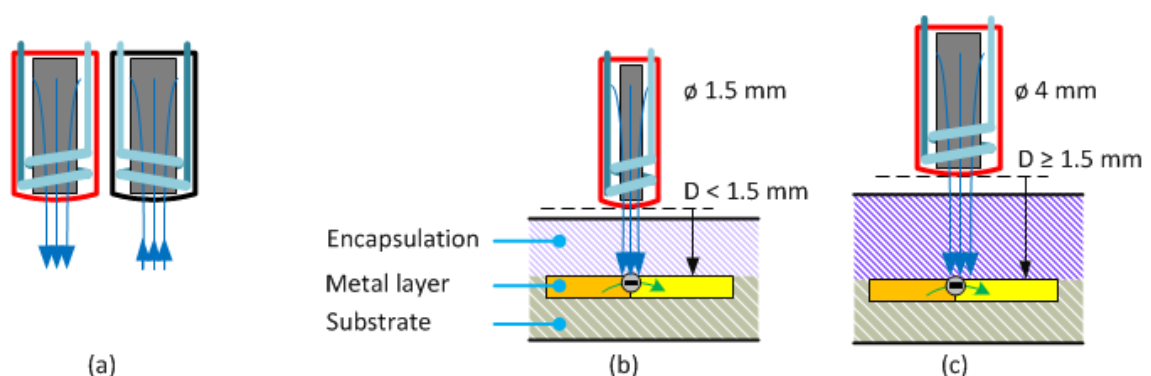


Figure 8 Choice of polarity (a) and diameter (b,c) for the flat head probe tip

The flat head tips come with different color and diameter. The colors red and black only differ in coil winding direction (Figure 8a). Use the **red tip** first, then the **black**

tip, and compare your perturbation results to select the probe tip best suited for your target.

Choose the appropriate diameter of the flat head tip after considering the thickness (and material density) of the encapsulation and the depth of the metal layer (Figure 8b,c). Use the **small tip** (Figure 8b) if the penetration depth **D** is less than 1.5 mm, or when acquiring a detailed scan of a surface region. Use the **wide tip** (Figure 8c) if the penetration depth needs to be more than 1.5 mm, or when globally scanning for regions susceptible to faults (hotspots).

Connecting the probe

Connect the **pulse amplitude** port and **digital glitch** port of the EM-FI Transient Probe with cable SMB2SMB to an external, trigger generating device e.g. the VC Glitcher.

Moving the probe

The operator must obey to the following warnings when using the EM-FI Transient Probe, especially when used in combination with the Probe Station.



Do not apply any pushing force on the probe tip.

Pay attention when lowering the probe under control of a XYZ-platform.



Do not apply any sideways force on the probe tip.

Pay attention when moving the probe through a hole (as in the older models of the PowerTracer and the VC Glitcher) by control of a XYZ-platform.



Do not apply any grinding force on the probe tip.

Pay attention when the target surface is not parallel with XY-motion plane of the tip.



Use the Inspector XYZ-plane calibration function where applicable, to accommodate for a slanted target surface.

How to verify your setup

Follow the next checks to verify a correct setup:

3. Is the EM-FI Transient Probe powered?
4. Is the EM-FI Transient Probe responding to triggers?

Please ensure that each check is successful, before proceeding to the next one. If not successful, refer to page 15 for solutions.

Is the probe powered?

There are no visible or audible signs of the EM-FI Transient Probe being powered.

Verify that the EM-FI Transient Probe is using the supplied 24 V PSU, and that the PSU is connected to mains supply.

Is the probe responding to triggers?

Follow the next steps to verify the control behavior of the EM-FI Transient Probe:

1. Connect the **coil current** output of the probe to an **input channel** of an oscilloscope.
2. Set input channel range to -2 V .. +2 V.
3. Verify that the **pulse amplitude** and **digital glitch** connections with the VC Glitcher are not mixed up.
4. Execute a perturbation program in Inspector.
Configure the pulse amplitude to 3.3 V.
5. For each active-high trigger pulse received on port **digital glitch** of the EM-FI Transient Probe, the oscilloscope must display a negative pulse. This is evidence that the probe tip coil emits EM pulses.

Help and troubleshooting

Common problems

Probe does not work.

CAUSE: Probe not powered.

SOLUTION: Verify the connection of the power cable to the probe and to the PSU.

CAUSE: The probe's **digital glitch** port has a static value because it is connected to **pulse amplitude** of the VC Glitcher.

SOLUTION: Reconnect the mixed up cables to the correct ports of the VC Glitcher.

CAUSE: At least one of the cables is not connected.

SOLUTION: Guide all cables from input to output, and reseal its connectors.

CAUSE: Probe tip is not properly fitted.

SOLUTION: Screw the probe tip.

Interoperability issues

Cable length

Use the provided 6 ft. cables. Shorter cables may disturb the shape of the glitch input signal, and prevent the probe from triggering.

Still have questions?

Visit the Riscure Support Portal: <http://support.riscure.com>.

Technical specifications

Operational conditions

- Room temperature 20 .. 30 °C, (68 .. 86 °F), preferred.



Do not block the ventilation holes of the EM-FI Transient Probe. A blocked air flow may cause malfunction or break down.



Maintain a stable and identical environment in order to reliably repeat tests.



Turning OFF the EM-FI Transient Probe is not required but recommended when not used for an extended period.

Power supply input

- 24 V DC.
- Center-positive plug, inner-Ø 2.5 mm, outer-Ø 5.5 mm.



Use of a PSU other than supplied by Riscure is not supported. Power spikes may cause internal damage and loss of accuracy.

Probe characteristics

- Max. voltage over coil: 475 V $\pm$ 10%
- Max. internal current: 64 A
- EM pulse power control: 5 .. 100%
- Digital glitch pulse width for full power: $\geq$ 50 ns
- Max. switching frequency for constant power: 1 MHz
- Red and black tip have opposite polarity (coil winding direction).

Characteristic	Tip ø 1.5 mm	Tip ø 4 mm
Electromagnetic propagation delay (10% edge of digital glitch to 10% edge of magnetic/EM field change)	40 ns $\pm$ 10%	42 ns $\pm$ 10%
Electric propagation delay (10% edge of digital glitch to 10% edge of coil current signal)	50 ns $\pm$ 10%	50 ns $\pm$ 10%
Max. current through coil	56 A $\pm$ 10%	48 A $\pm$ 10%
Max. voltage at coil current port	-1.4 V $\pm$ 10%	-1.2 V $\pm$ 10%
Pulse width of waveform at coil current port	17 ns $\pm$ 10%	20 ns $\pm$ 10%
Operating distance tip to target layer	$\leq$ 1.5 mm	$\leq$ 4 mm

Probe attachment

- Outer diameter of bracket: ø 25 mm
- Weight: 650 g

Product case

- Dimensions: 181 x 92 x 50 [mm], 7.23 x 3,62 x 1,97 [inch] (L x W x H)



Port	Label	Description
A1	-	Probe tip.
B1	pulse amplitude	SMB, 50 Ω . Analog input, 0 .. 3.3 V. Defines proportional EM power level 0 V= 5%, 3.3 V = 100%.
B2	digital glitch	SMB. Binary active high input. A probe fires a single EM pulse if the voltage gets over 2.4 V.
B3	coil current	SMB. Analog output -1.5 V .. +1.5 V. A voltage proportional to the current through the coil for monitoring purposes. Usually connected to an oscilloscope.
C1	24VDC	24 V DC Power supply input.