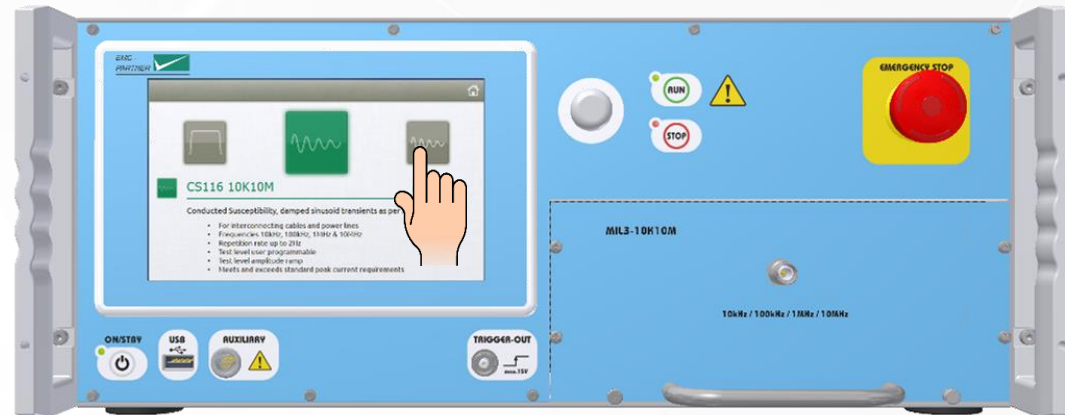


# MIL Standard 461 G

final release December 11<sup>th</sup>, 2015





## EMC PARTNER AG

- ✓ Founded in 1994
- ✓ Swiss private company, headquarters in Laufen (CH)
- ✓ Largest choice of impulse generators
- ✓ Market leader, reputed worldwide
- ✓ Development, production and testing in house
- ✓ Global representative network



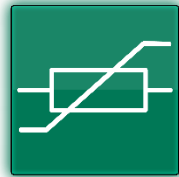
**Largest range of impulse test equipment up to 100 kV and 100 kA**

## Introduction

EMC Partner provides conducted immunity test solutions for a broad range of sectors:



Industry &  
Household



Components



Renewable  
energy



Avionics



Military



Telecom



# Military domain

Equipment categories:



| Equipment and Subsystems       |
|--------------------------------|
| Surface Ships                  |
| Submarines                     |
| Aircraft, Army, Flight Line    |
| Aircraft, Navy                 |
| Aircraft, Air Force            |
| Space systems, Launch Vehicles |
| Ground, Army                   |
| Ground, Navy                   |
| Ground, Air Force              |



## Index

EMC Partner provides test solutions for current MIL Std 461:

| Test   | Version F | Version G |
|--------|-----------|-----------|
| CS 106 | yes       | -         |
| CS 115 | yes       | yes       |
| CS 116 | yes       | yes       |
| CS 117 | -         | yes, new  |
| CS 118 | -         | yes, new  |



## Index

CE, RE, RS: same structure of standard

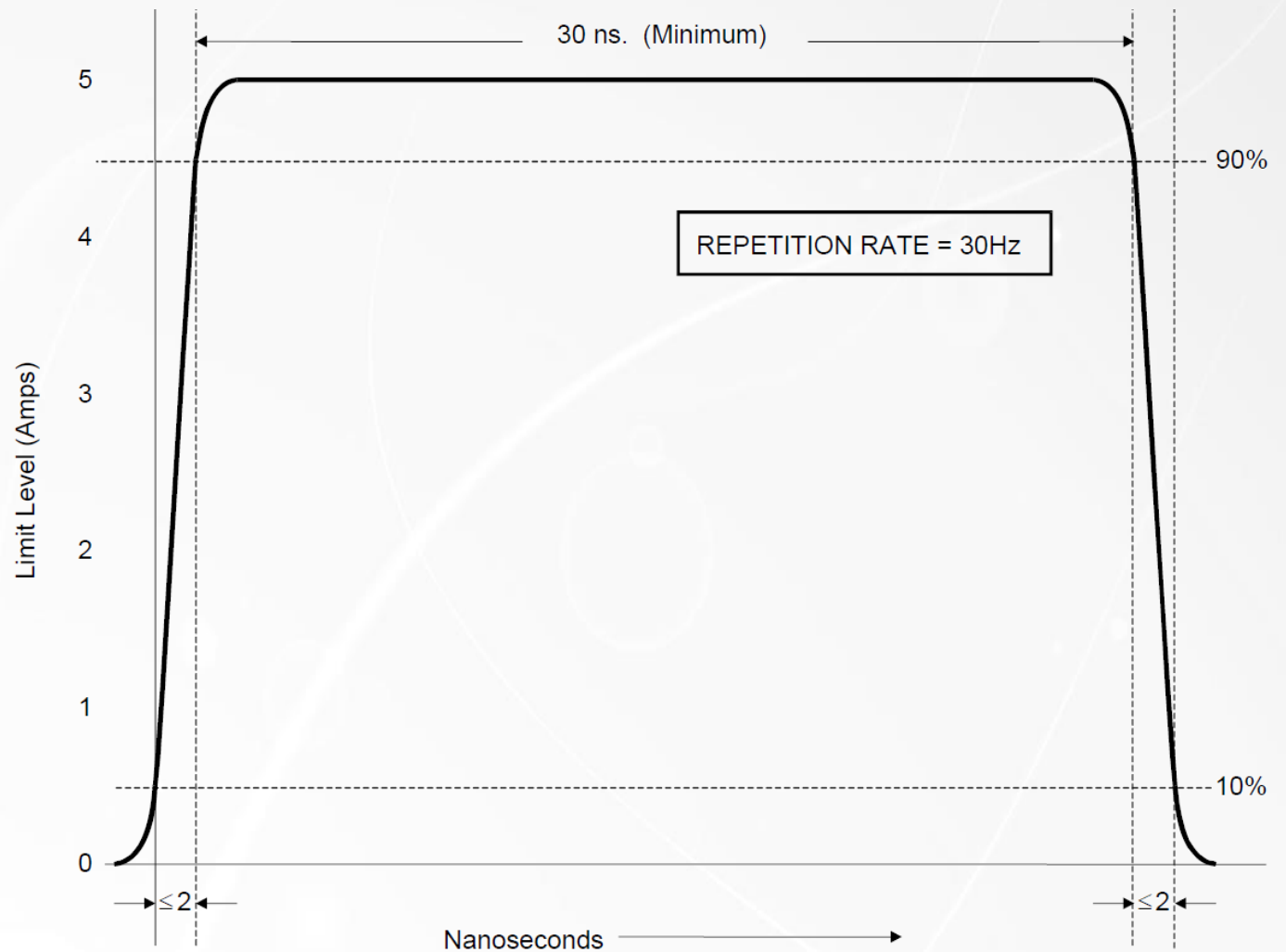
| Test   | Version F   | Version G |
|--------|-------------|-----------|
| CS101  | yes         | yes       |
| CS 103 | yes         | yes       |
| CS104  | yes         | yes       |
| CS 105 | yes         | yes       |
| CS 106 | yes         | deleted   |
| CS 109 | yes         | yes       |
| CS 114 | yes         | yes       |
| CS 115 | yes         | yes       |
| CS 116 | yes         | yes       |
| CS 117 | not defined | yes, new  |
| CS 118 | not defined | yes, new  |

- ⊘ CS 106: transients, power leads – deleted
- ✓ CS 117: lightning induced transients - new
- ✓ CS 118: personnel borne Electrostatic Discharge - new

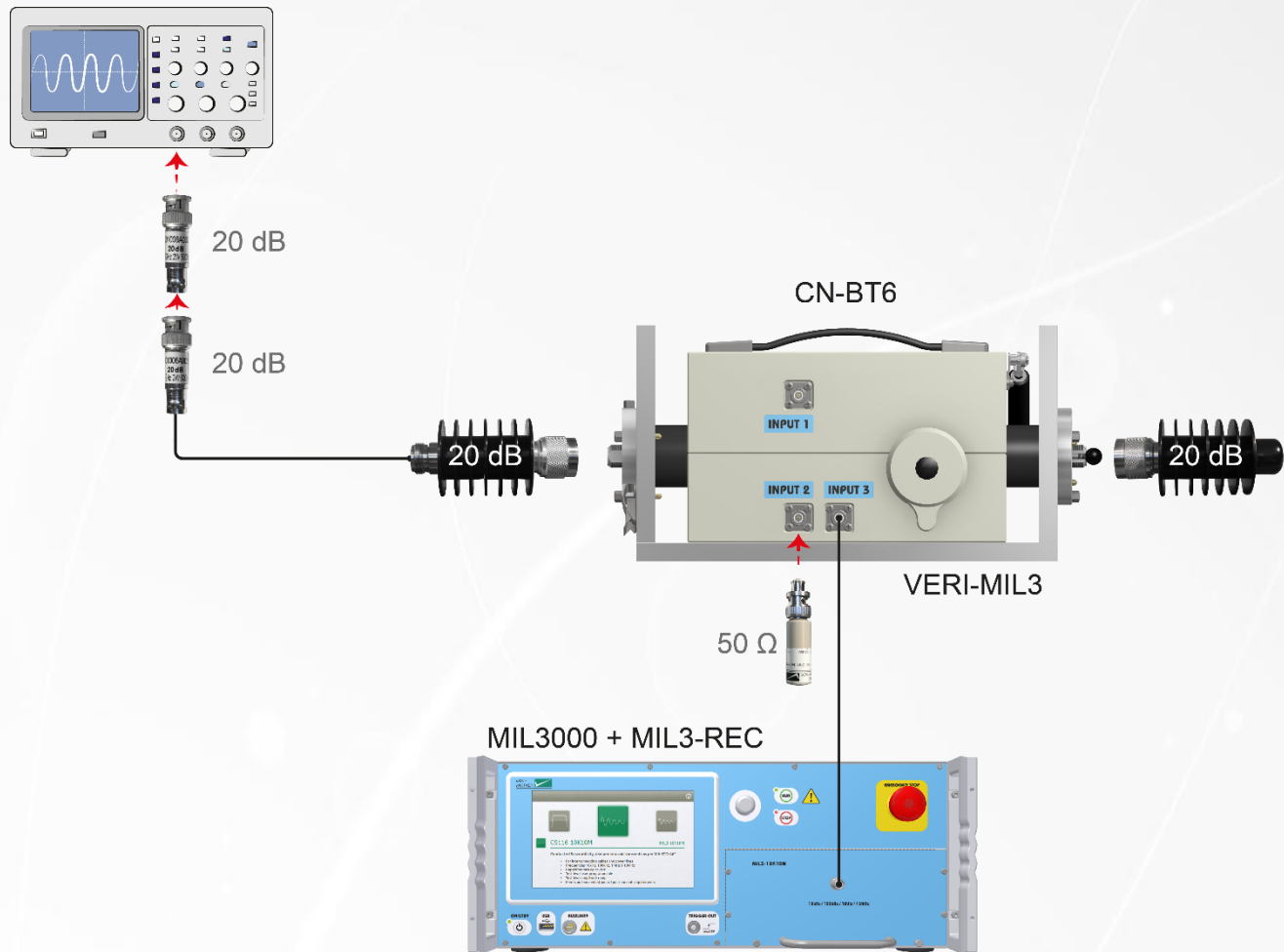


# CS 115 – bulk cable injection, impulse excitation

## Waveform and test levels



## CS 115 Calibration setup



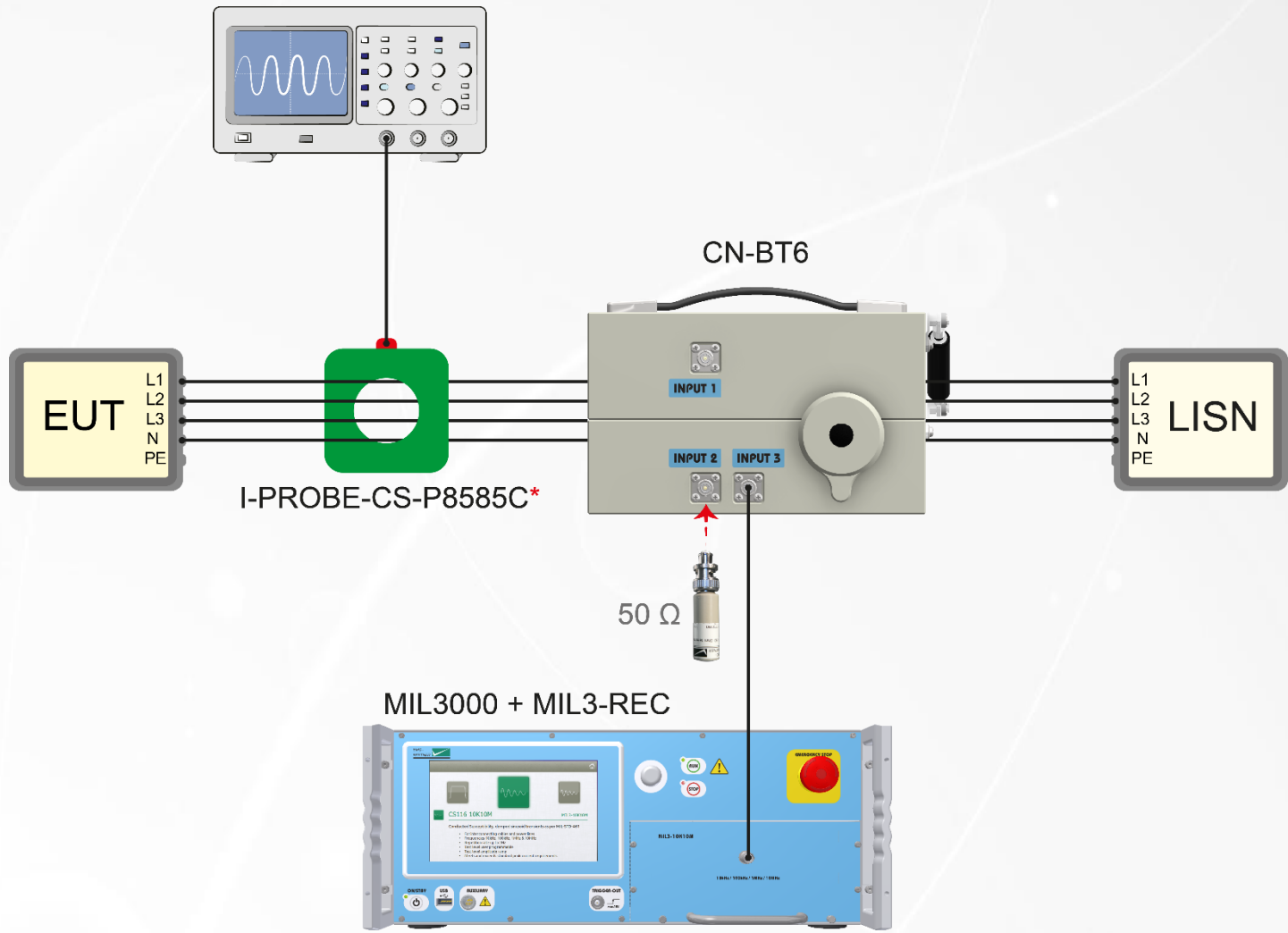
50  $\Omega$  termination is included in CN-BT6

2 x 20dB/50 $\Omega$ , N-BNC cable and 20 dB att. Are included in VERI-MIL3



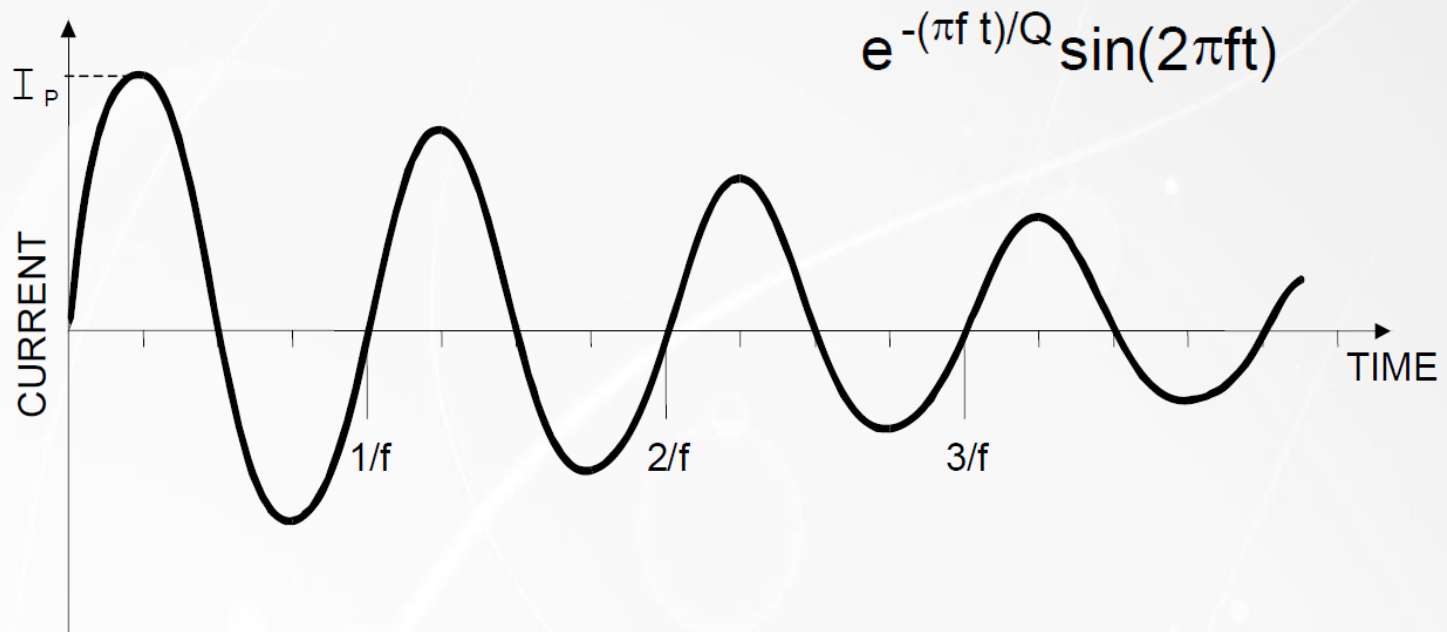


# CS 115 Test setup



# CS 116 – damped sinusoidal transients, cables and power leads, 10 kHz – 100 MHz

Waveform



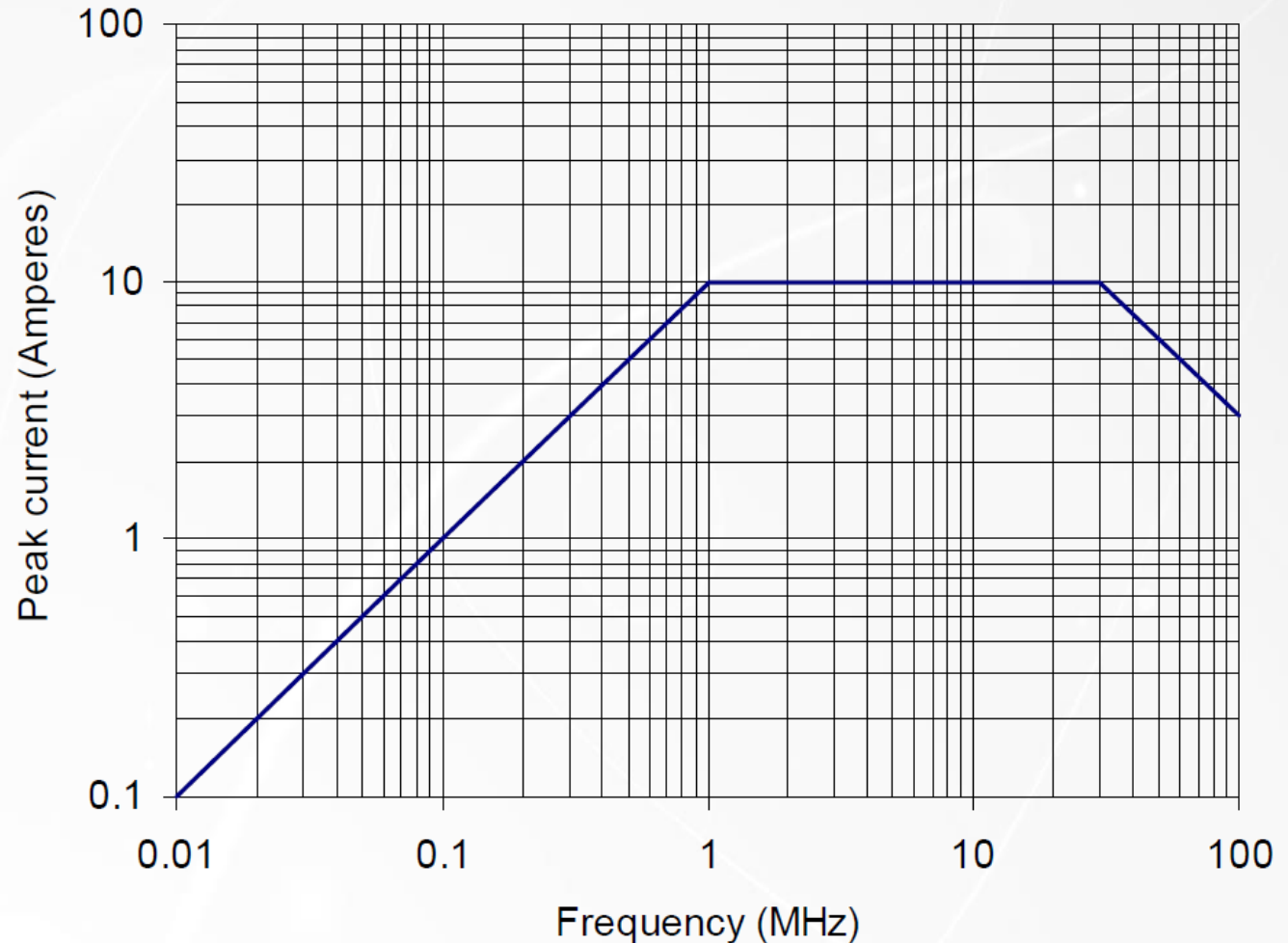
- f – frequency
- t – time
- Q – damping factor  $15 \pm 5$

$$Q = \frac{\pi(N - 1)}{\ln(I_P/I_N)}$$

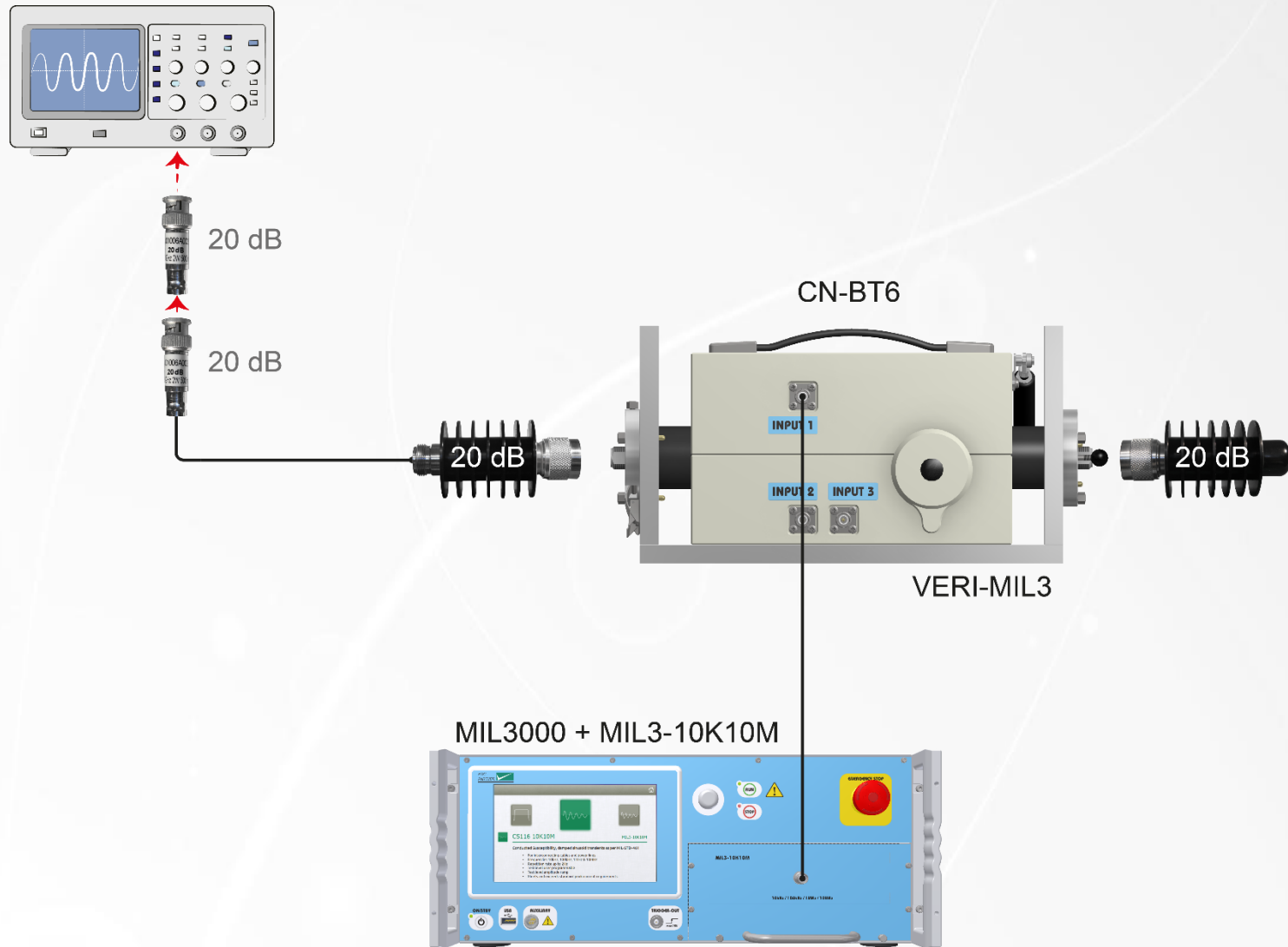


# CS 116 – damped sinusoidal transients, cables and power leads, 10 kHz – 100 MHz

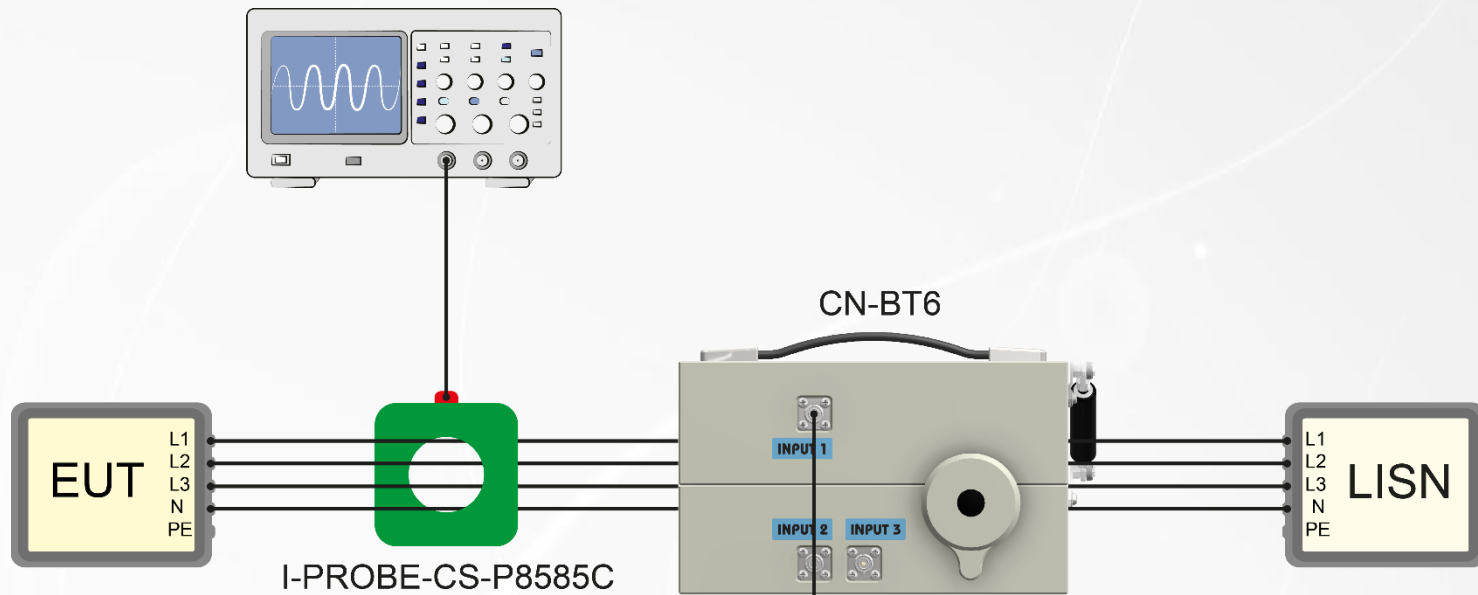
Test levels



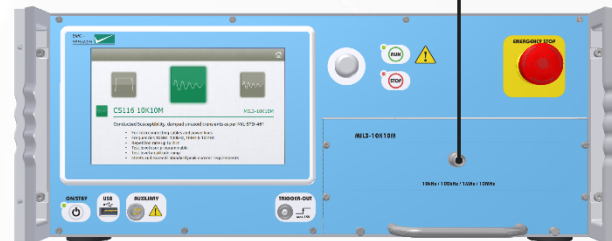
## CS 116 Calibration setup 10 kHz – 10 MHz



# CS 116 Test setup 10 kHz – 10 MHz

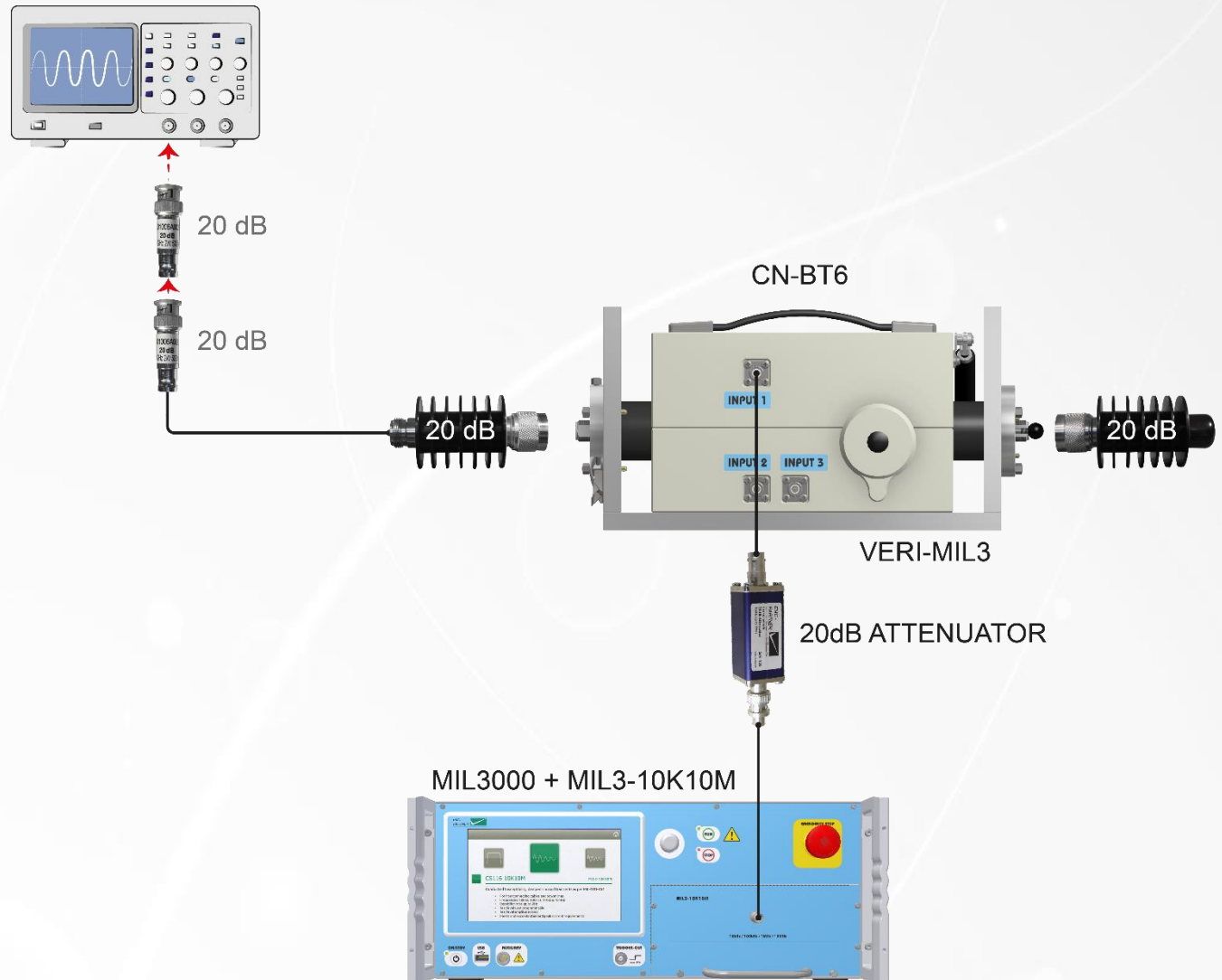


MIL3000 + MIL3-10K10M



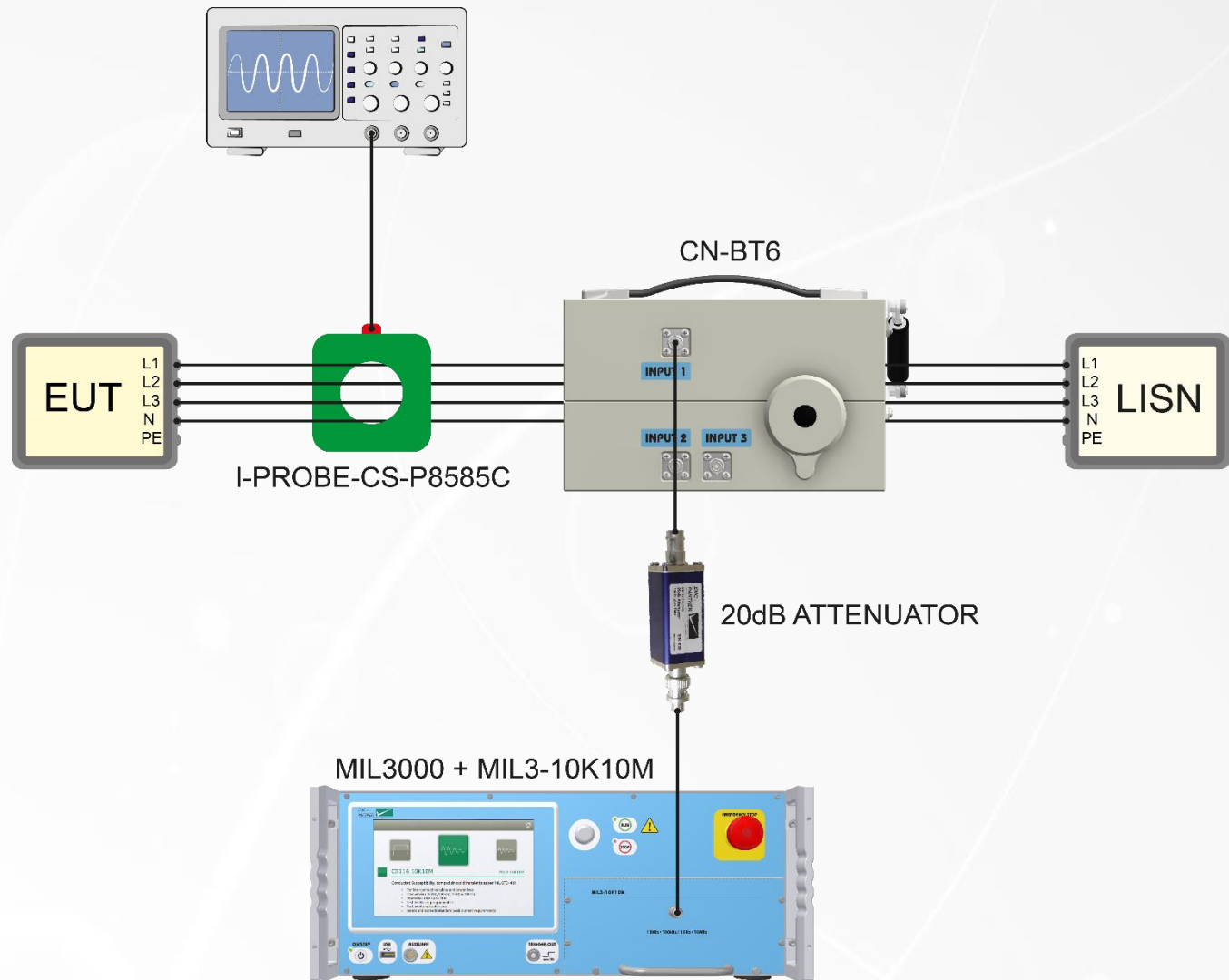
# CS 116

Special EMCP calibration setup 10 kHz – 10 MHz – reduced level



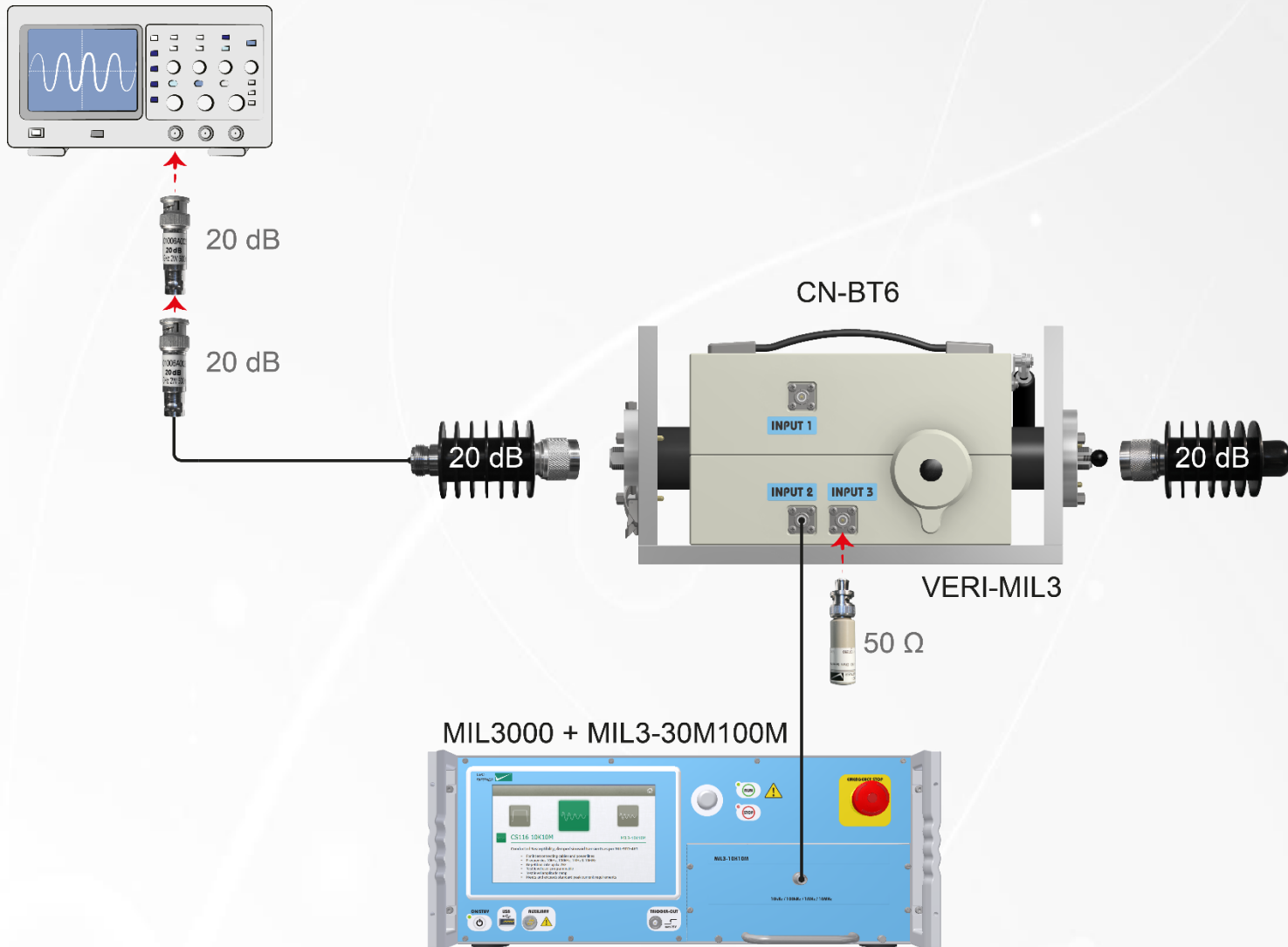
# CS 116

Special EMCP test setup 10 kHz – 10 MHz – reduced level



# CS 116

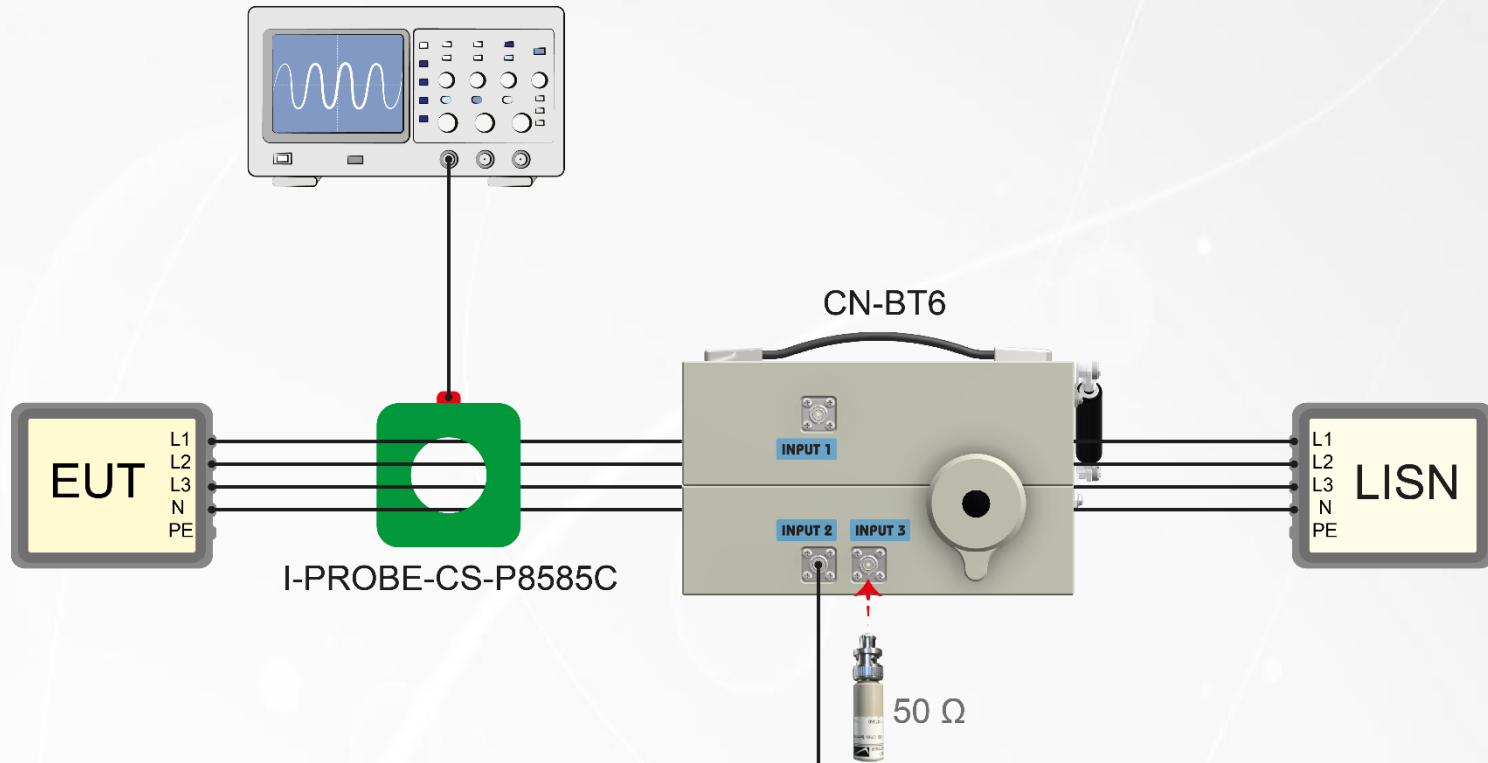
## Calibration setup 30 MHz – 100 MHz



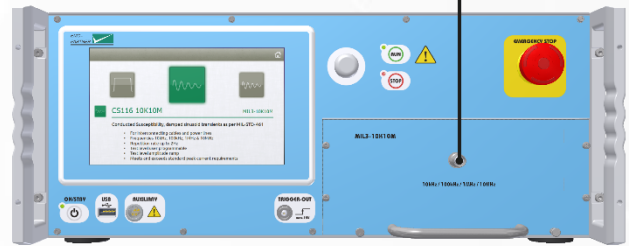


# CS 116

Test setup 30 MHz – 100 MHz



MIL3000 + MIL3-10M100M



## CS 117 – Lightning induced transients

Tests derived from RTCA DO160 G, Section 22



**RTCA** 

DO-160G – Environmental Conditions and Test Procedures for Airborne Equipment – Section 22

## CS 117 – Lightning induced transients

Tests derived from RTCA DO160 G, Section 22

Lightning stroke (click to play)

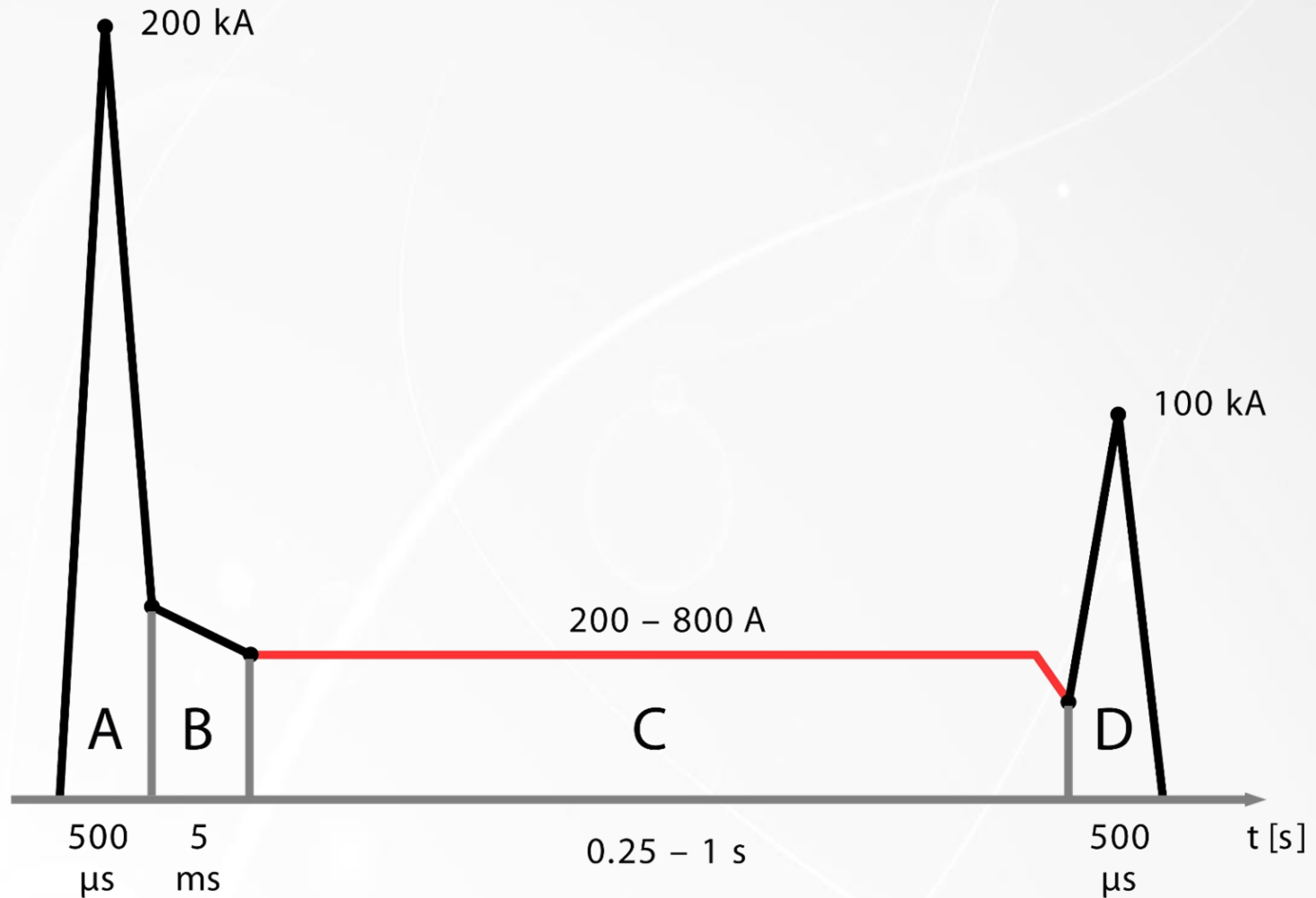


Slow replay (click to play)



## CS 117 – Lightning induced transients

Tests derived from RTCA DO160 G, Section 22



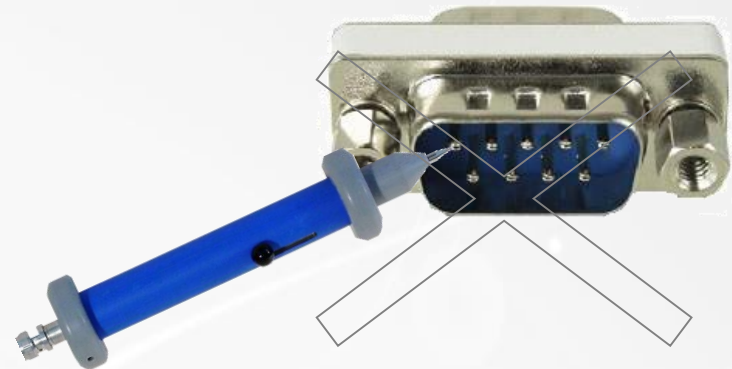
## CS 117 – tests derived from RTCA DO160G, S. 22

Test types from DO160G:

~~Damage tolerance test~~

~~┌ Lightning damage test~~

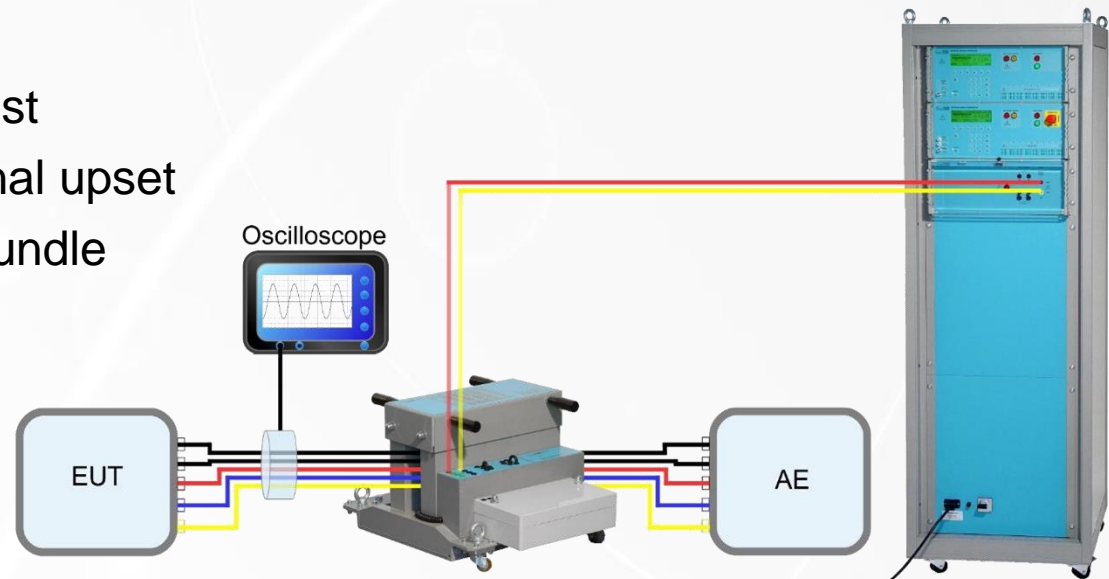
~~┌ Pin injection~~



Immunity test

✓ Functional upset

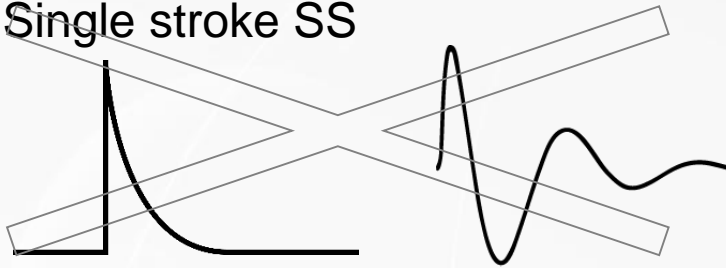
✓ Cable bundle



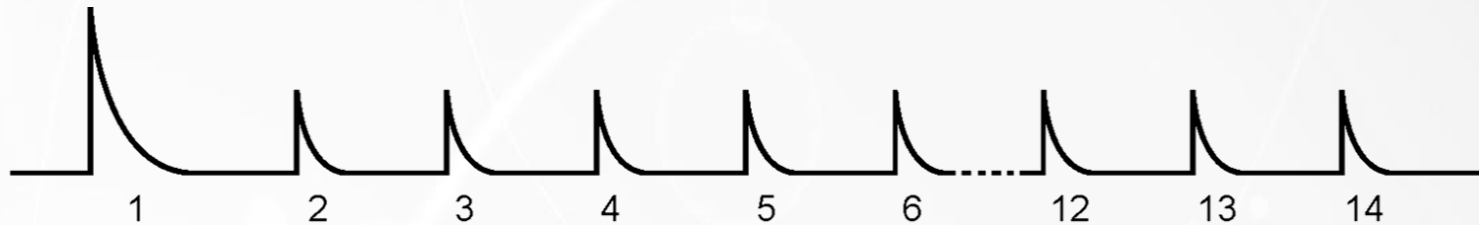
## CS 117 – tests derived from RTCA DO160G, S. 22

Signal types from DO160G:

Single stroke SS



✓ Multiple stroke MS

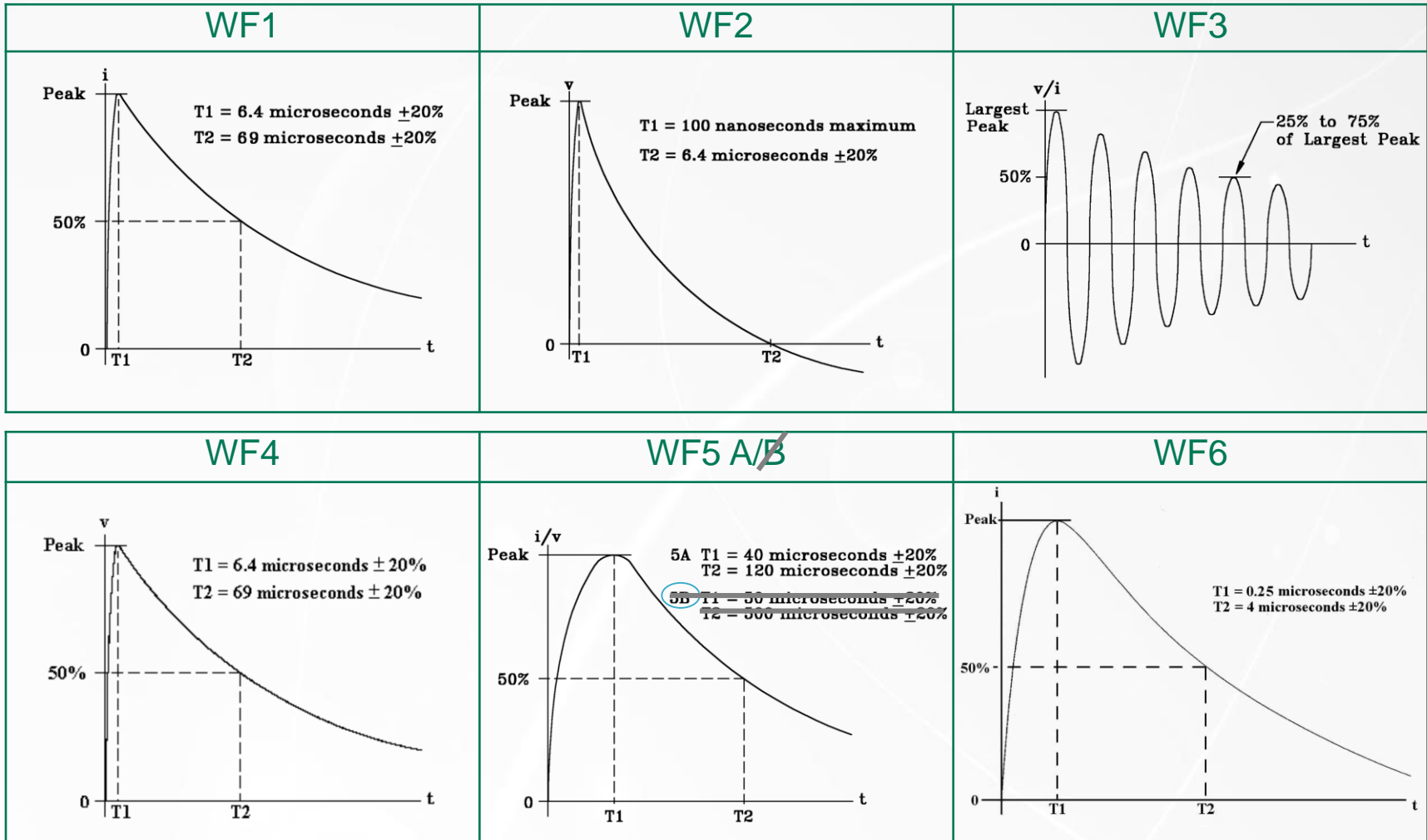


✓ Multiple Burst MB



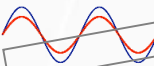
# CS 117 – tests derived from RTCA DO160G, S. 22

Waveforms from DO160G:



## CS 117 – tests derived from RTCA DO160G, S. 22

Waveforms and associated test types from DO160G:

| Test type  | Signal | WF1            | WF2 | WF3 | WF4 | WF5A/B | WF6 |
|--|--------|----------------|-----|-----|-----|--------|-----|
| Pin injection<br> | SS     | no             | no  | yes | yes | WF5A   | no  |
|  | MS     | no requirement |     |     |     |        |     |
|  | MB     |                |     |     |     |        |     |
| Cable bundle   | SS     | yes            | yes | yes | yes | yes    | no  |
|  | MS     | yes            | yes | yes | yes | yes    | no  |
|  | MB     | no             | no  | yes | no  | no     | yes |

Pin injection tests and Cable Bundle SS not required in MIL 461G





## CS 117 – tests derived from RTCA DO160G, S. 22

Multiple stroke: test levels in MIL 461 G

Level 1: internal equipment

Level 2: external equipment

Multiple Stroke: First stroke [-0%;+20%]

Subsequent strokes: [-0%;+50%]

|            |      | Waveforms                                |  |  |  |
|------------|------|--|--|--|--|
|            |      | 2 / 1                                    | 3 / 3                                    | 4 / 1                                    | 4 / 5A                                   |
| Test level |      | V <sub>L</sub> / I <sub>T</sub><br>[V/A] | V <sub>T</sub> / I <sub>L</sub><br>[V/A] | V <sub>T</sub> / I <sub>L</sub><br>[V/A] | V <sub>L</sub> / I <sub>T</sub><br>[V/A] |
| 1          | FS   | 300 / 600                                | 600 / 120                                | 25 / 50                                  | 300 / 1000                               |
|            | Sub. | 150 / 150                                | 300 / 60                                 | 12.5 / 25                                | 75 / 200                                 |
| 2          | FS   | 750 / 1500                               | 1500 / 300                               | 62.5 / 125                               | 750 / 2000                               |
|            | Sub. | 375 / 375                                | 750 / 150                                | 31.25 / 62.5                             | 187.5 / 400                              |

Levels between L3 and L5 from DO 160G

Possibility to reduce test level as function of line number



## CS 117 – tests derived from RTCA DO160G, S. 22

Multiple burst: test levels in MIL 461 G

Level 1: internal equipment

Level 2: external equipment

|            | Waveforms                          |                                    |
|------------|------------------------------------|------------------------------------|
| Test level | 3 / 3                              | 6 / 6 *                            |
|            | $V_T / I_L$<br>[-0%;+20%]<br>[V/A] | $V_L / I_T$<br>[-0%;+20%]<br>[V/A] |
| 1          | 360 / 6                            | 600 / 30                           |
| 2          | 900 / 15                           | 1500 / 75                          |

Levels L3 and L4 from DO 160G

Possibility to reduce test level in function of individual power leads



## CS 117 – tests derived from RTCA DO160G, S. 22

Test equipment (chapter 5.15.3.2):

- ✓ Lightning transient generator(s)
- ✓ Injection transformers
- ✓ Oscilloscope
- ✓ Attenuators, 50Ω
- ✓ Voltage and current probes
- ✓ Calibration loop, low Z
- ✓ Capacitor >28'000 μF for DC inputs
- ✓ LISNs



DN-LISN160-32  
*EUT supply*



Decouplers, loads, shunt for cal.



## CS 117 – tests derived from RTCA DO160G, S. 22

Test duration ?

Up to 3 tests in parallel due to real modularity and flexibility



MIG 0600MS



MIG 0618SS



MIG OS-MB +EXT



## CS 117 – tests derived from RTCA DO160G, S. 22

Couplers:



CN-GI-CI-V



CN-GI-CI



CN-MIG-BT5



CN-MIG-BT3

- ✓ Test levels guaranteed at output of coupler
- ✓ Only one coupler needed for one test level as per DO 160
- ✓ Easy to use, easy to transport
- ✓ Same coupler for WF2, WF3, WF6



## CS 117 – tests derived from RTCA DO160G, S. 22

High performance probes:



I-PROBE-MS

*WF 1,4, 5A*



V-PROBE-PHV

*WF 1,4, 5A*



I-PROBE-MB-P1

*WF 2, 3, 6*



V-PROBE-SI

*WF 2, 3, 6*



## CS 117 – tests derived from RTCA DO160G, S. 22

EMC Partner is # 1 worldwide in indirect lightning tests:

20 years of experience and continuous improvement

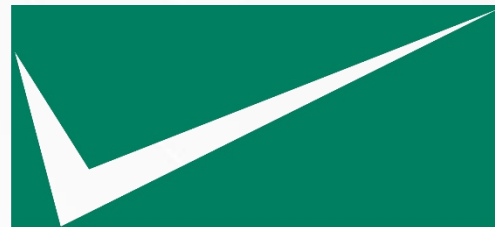
Unique technology, highly appreciated

Compliant and worldwide recognized tests

Accurate, reproducible and reliable results



**EMC -  
PARTNER**



## CS 118 – Personnel born electrostatic discharge

Test requirements similar to IEC 61000-4-2



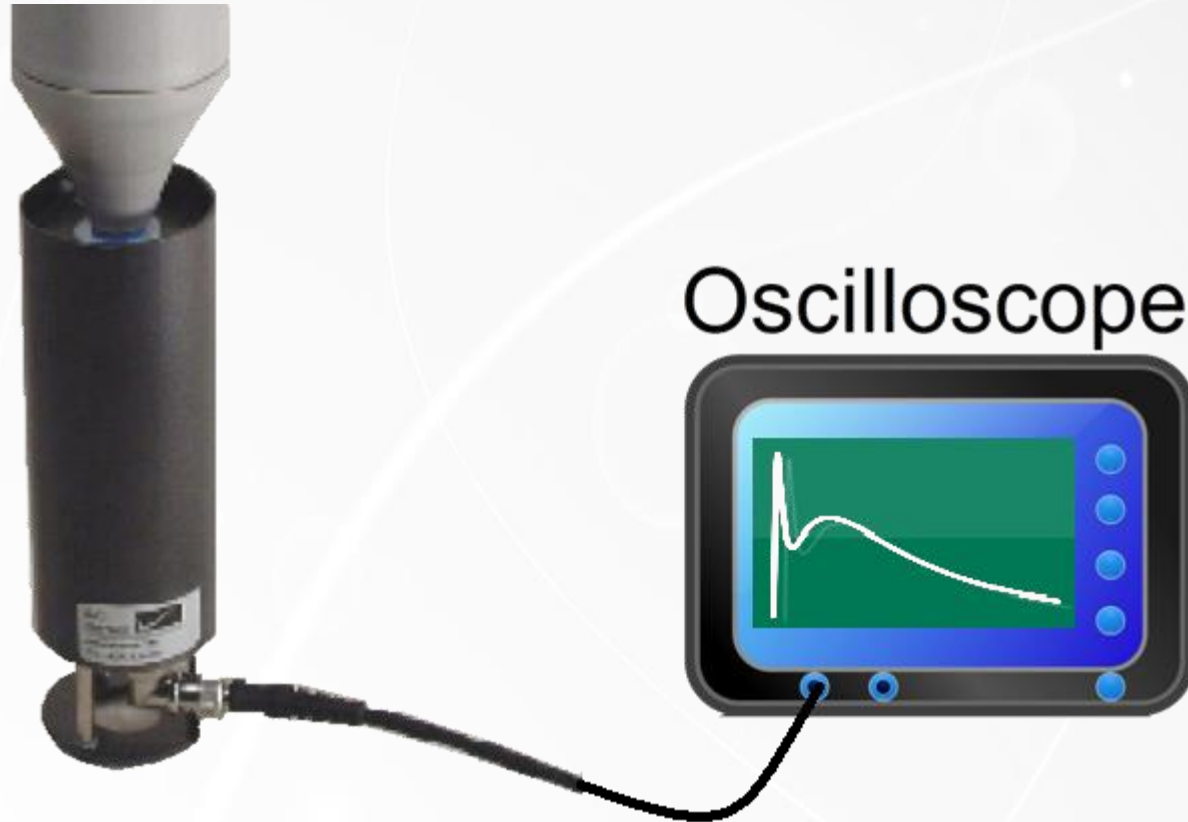
| Parameter               | Value                     |
|-------------------------|---------------------------|
| Discharge module        | 150 pF, 330 $\Omega$      |
| Max. voltage            | 8 kV CD, 15 kV AD         |
| Current verification at | $\pm 2$ kV and $\pm 8$ kV |
| Indirect discharge      | Not required              |



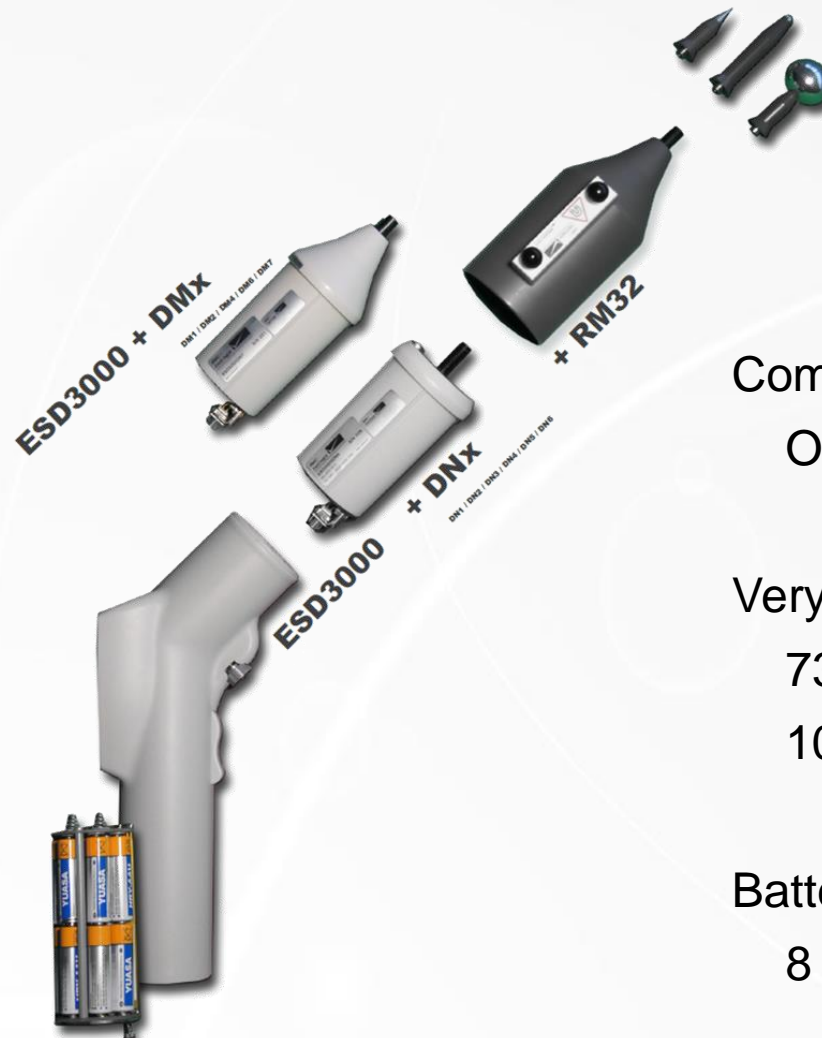


## CS 118 – Personnel born electrostatic discharge

Verification of ESD voltage required: 20 G $\Omega$  divider, connected directly to oscilloscope, ratio: 1:20'000



## CS 118 – Personnel born electrostatic discharge



Compact: no base unit  
Optimal weight distribution

Very light:  
730 g without batteries  
1050 g with batteries

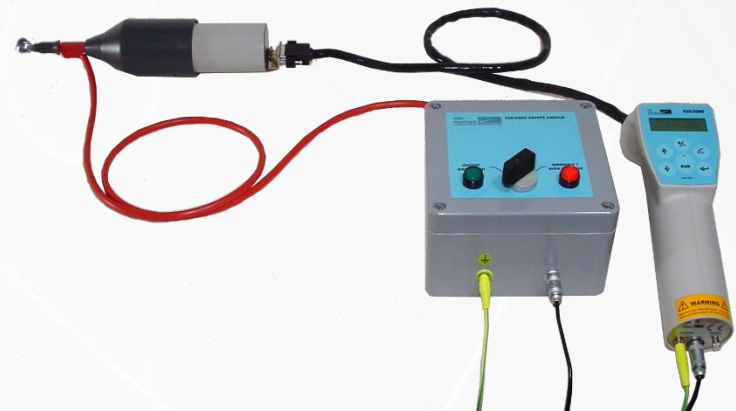
Batteries: 10 AA type,  
8 hours: 1 Hz @ 30 kV



## CS 118 – Personnel born electrostatic discharge

ESD target as per IEC  
61000-4-2 ed. 2.0, special  
calibration targets available: 2  
 $\Omega$ , 50  $\Omega$ , 500  $\Omega$

Safety switch to short circuit  
generator's output, necessary  
when testing explosive devices



## CS 118 – Personnel born electrostatic discharge

Test cabinet for explosive  
EUT devices and module  
remote connection

Optical link connection cable (10m  
long) and remote control software



## Conclusions

- ✓ New requirements are planned in MIL STD 461G
- ✓ EMC Partner is already prepared to provide suitable equipment





Thank you,  
[www.emc-partner.com](http://www.emc-partner.com)

