

Lightning Tests

EMC -
PARTNER



MIG-System

Military Testers

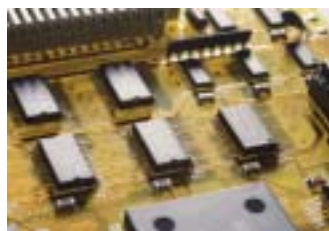


I MIL-STD-461E CS115

II MIL-STD-461E CS116

III Customised Plug-ins

IV Customised System



General Information about MIL-STD-461, -462, -464 Wave Shapes and Coupling

Lightning

Lightning strikes the earth once every two minutes. A recent study by the Federal Aviation Administration reveals that the average commercial aircraft is likely to be struck once a year. Needless to say, it is imperative that all aircraft must be tested against lightning. Lightning flashes differ mainly in current amplitude, in the transferred charge and in the impulse shapes of the lightning current. Two lightning simulations can be accomplished:

- the simulation of the direct current (MIL-STD-464)
- the simulation of the indirect current (MIL-STD-461)

The current waveform and the generator impedance values specified for simulation of indirect lightning (internal environment during lightning) are the results of applied lightning current to the system. The idealized transient waveforms can be accomplished for the internal lightning simulation:

- damped sinusoidal waveform in the frequency range 10 kHz up to 100 MHz, conducted susceptibility (CS116)
- Rectangular waveform 30 ns, conducted susceptibility (CS115)

For civilian aircraft testing multiple stroke and multiple burst waveforms sequences are used.

MIL-STD-461E

MIL-STD-461E published 20 August 1999 by the Department of Defence Interface Standard: Requirements of the control of electro-magnetic interference characteristics of subsystems and equipment.

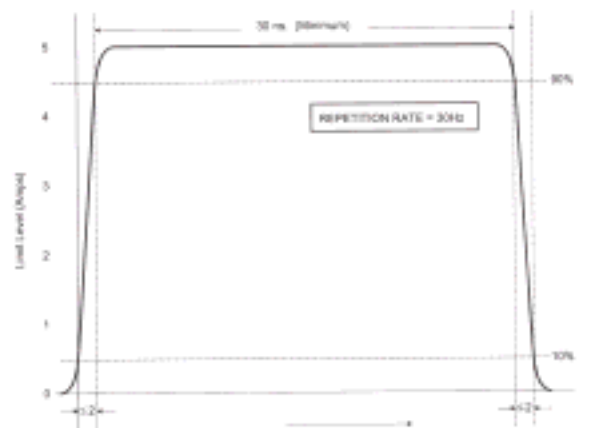
The MIL-STD-461E supersedes the 461D and 462 standards.

CS115: Conducted Susceptibility, bulk cable injection, impulse excitation

CS116: Conducted susceptibility, damped sinusoidal transients, cables and power leads, 10 kHz to 100 MHz

CS115

This requirement is applicable to all aircraft, space, and ground system interconnecting cables, including power cables. The requirement is also applicable for surface ship and submarine subsystem and equipment when specified by the procuring activity.



CS116

This requirement is applicable to all interconnecting cables, including power cables, and individual high power leads. Power returns and neutral need not to be tested individually.



NOTES: 1. Normalized waveform: $e^{-(\pi f t)/Q} \sin(2\pi f t)$

Where:

f = Frequency (Hz)

t = Time (sec)

Q = Damping factor, 15 ±5

Other applications

The MIG2000-6 system can be used for the generation of other waveforms up to 30 Hz pulse repetition.

MIG2000-6 System

MIG2000-6 test system

The system consists of different parts such as:

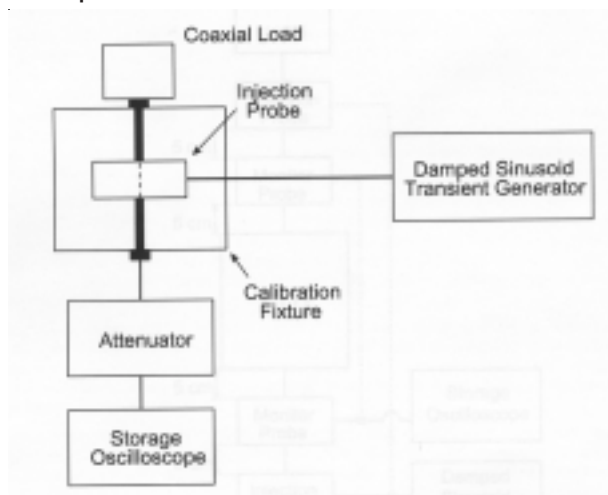
- mainframe with control, display and high voltage supply variable up to 6 kV
- different frequency plug-ins in accordance with different standards
- injection coupler CN-MIG-BT for the frequency range 10 kHz up to 10 MHz
- injection coupler CN-MIG-BT2 for the frequency range 10 MHz up to 100 MHz
- calibration set up VERI-MIL in accordance with MIL-STD-461E

Customised frequency plug-ins (e.g. platform resonance) can be ordered separately.



Calibration fixture

All waveforms must be measured and calibrated in the calibration fixture as shown in the picture above. The coupler and the 1 m transmission line which is on both sides terminated with 50 Ohm shape the calibration set-up.



MIL-STD-461E plug-ins

For the time being three plug-ins exist for MIL -STD-461E requirements:

CS115 with rectangular 30 ns wave

CS116-10k10M with sinusoidal waveform and frequencies 10 kHz, 100 kHz, 1 MHz and 10 MHz

The frequency range fits to the low frequency coupler CN-MIG-BT in a optimum way. The four frequencies can be programmed and linked together with different test parameters (test levels, polarity, test time, etc.). The plug-in has only one output.



CS116-30M+100M with sinusoidal waveform and frequencies 30 and 100 MHz

Also this plug-in fits to the high frequency coupler CN-MIG-BT2 in an optimum way. This plug-in has for each frequency a separate output.



Couplers

Two couplers are necessary for the frequency range from 10 KHz up to 100 MHz.



CN-MIG-BT

Plug-ins for Conducted Susceptibility CS115, CS116

Technical data of the plug-ins CS116-10k10M and CS116-30M100M

With these two plug-ins adapted to the frequency range of the two couplers the whole current range specified in MIL-STD-461E can be selected. Currents of up to 10 A for Army and Navy procurements and of up to 5 A for Airforce are required in the frequency range of 1 to 10 MHz.

Waveform at the calibration set-up:	VERI-MIL (1m)		
Oscillation frequency	10, 100 kHz, 1, 10, 30 100 MHz		± 10%
Q - Damping	15		± 5
Current range into 100 Ohm - Plug-in CS116-10k10M with injection probe CN-MIG-BT			
Plug-in CS116-10k10M „one output“	0.02 A up to 0.20 A	10 kHz	Z ≈ 0,5 Ohm
	0.20 A up to 2.00 A	100 kHz	Z ≈ 5 Ohm
	1.00 A up to 15.0 A	1 MHz	Z ≈ 50 Ohm
	1.00 A up to 11.0 A	10 MHz	Z ≈ 50 Ohm
Current range into 100 Ohm with injection probe CN-MIG-BT2 - Plug-in CS116-30M100M			
Plug-in CS116-30M100M „two outputs“	1.00 A up to 11.0 A	30 MHz	Z ≈ 50 Ohm
	0.40 A up to 4.00 A	100 MHz	Z ≈ 50 Ohm

Time between two pulses	0.5 up to 999 s
Polarity	positive and negative programmable
Test time	1 up to 30000 seconds
CS116-10k10M	parameter programmable: waveshape, lp, polarity, test time, repetition, etc.

Technical data of the plug-in CS115

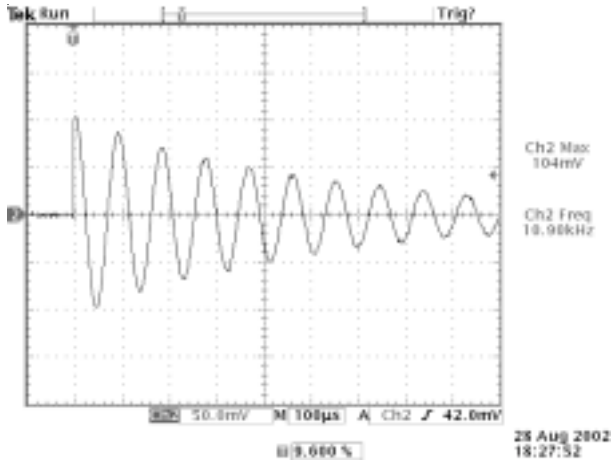
With this plug-in the high frequency coupler CN-MIG-BT2 must be used. For all applications — Army, Navy and Airforce procurements — a current of up to 5 A is required with a pulse repetition rate of 30 Hz and a test time of one minute.

Waveform at the calibration set-up:		
Rise time	< 2ns	± 10%
Fall time	< 2 ns	
Duration	> 30 ns	
current range into 100 Ohm with injection probe (coupler)	1.00 A up to 15.0 A	(nominal 5 A CS115)

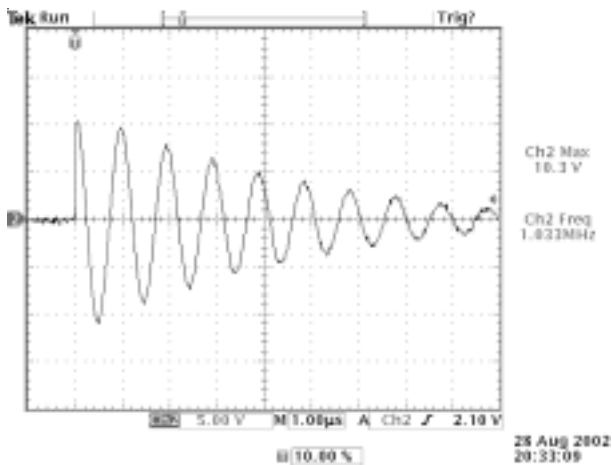
Repetition rate	max. 30 Hz (0.033s)	+10% -0%
Polarity	pos. / neg.	
Source Impedance	50 Ohm	
Test time	1 up to 30000 s	

Calibration Waveform Results

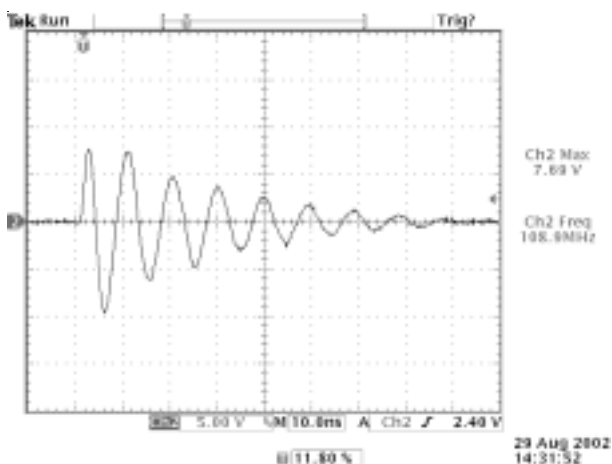
Examples of oscillograms measured in the calibration fixture



Probe factor: 0.05 A per division



Probe factor: 5 A per division



Probe factor: 2 A per division

Corresponding generator displays

10 kHz

```
MIG2000-6 Version: 1.34 SIN: 200
- MIL-461E 10kHz - MIL-461E 10MHz
- MIL-461E 100kHz
- MIL-461E 1MHz
choose a shape and press enter
[SETUP] [MAIN]
Main 1 MIL-461E 10kHz
I-peak : .100A
Polarity : pos
Test-Time: 600s Repetition : 1.00s
[SETUP] [SHAPE] [MAIN] [Menu] [More]
```

1 MHz

```
MIG2000-6 Version: 1.35 SIN: 200
- MIL-461E 10kHz - MIL-461E 10MHz
- MIL-461E 100kHz - Test
- MIL-461E 1MHz
choose a shape and press enter
[SETUP] [MAIN]
Main 1 MIL-461E 1MHz
I-peak : 10.0A
Polarity : pos
Test-Time: 300s Repetition : 1.00s
[SETUP] [SHAPE] [MAIN] [Menu] [More]
```

100 MHz

```
MIG2000-6 Version: 1.35 SIN: 200
- MIL-461E 30MHz
- MIL-461E 100MHz
choose a shape and press enter
[SETUP] [MAIN]
Main 1 MIL-461E 100MHz
I-peak : 3.00A
Polarity : pos
Test-Time: 600s Repetition : 1.00s
[SETUP] [SHAPE] [MAIN] [Menu] [More]
```

Customised Surge Test System

Plug-ins for DO-160 "Single Impulse"
 The MIG2000-6 mainframe can be equipped with plug-ins for civilian aircraft testing in accordance with DO-160. The MIG2000-6 can only be used for single pulse generation and not for multiple stroke or multiple burst.



Basic data

Dimensions: 550 x 450 x 190 mm (l x w x h)
 Weight: 20 kg without plug-in
 Power supply: 230 / 115 V selected automatically, power < 400 VA

Control

Trigger: auto or manual
 Polarity: positive or negative

Some examples of plug-ins

Waveshape and ranges ABD0013:

40/95 μ s

V_{range} : 200 up to 2000 V
 I_{range} : 42 A up to 420 A
 Max. repetition rate: 6 per minute

5 MHz source impedance 12 Ohm

V_{range} : 150 up to 1500 V
 I_{range} : 12.5 A up to 125 A
 Max. repetition rate: 2 per second

1/10 μ s source impedance 12 Ohm

V_{range} : 160 up to 3200 V
 I_{range} : 6.4 A up to 128 A
 Max. repetition rate: 2 per second

Waveshape and ranges DO-160:

1 MHz

V_{range} : 160 up to 3200 V
 I_{range} : 6.4 A up to 128 A
 Voltage range: min. 160/6,4 up to max. 3200/128

1 MHz

V_{range} : 160 up to 3200 V
 I_{range} : 6.4 A up to 128 A
 Voltage range: min. 160/6,4 up to max. 3200/128

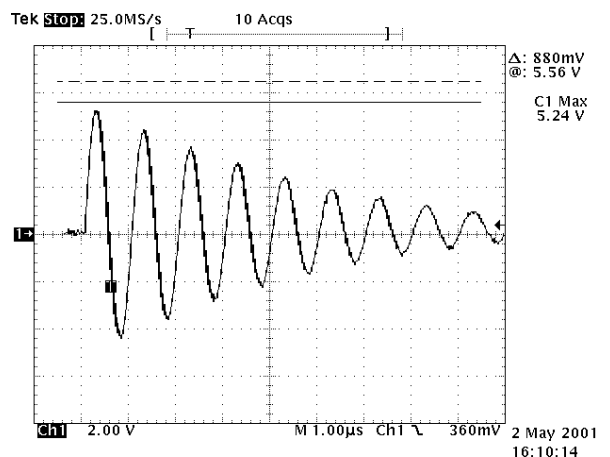
0.1/6.4 μ s

V_{range} : 125 V up to 1600 V
 I_{range} : 25 A up to 320 A

Other plug-ins are available on demand.

Coupling of the waveform 1 MHz, 10 MHz and 0.1/6.4 μ s

All waveforms can be coupled onto cable bundles with the transformer CN-MIG-BT1.



Example: coupling 3'200 V

EMC PARTNER's Product Range

Immunity Tests



The TRA2000 performs all of the following transient tests on electronic equipment that are required for the CE-mark up to full levels: **ESD, EFT, surge, dips, a.c. magnetic field, surge magnetic field and common mode tests**. A large range of accessories for different applications is available: MF antennas, three phase couplers, verification sets, coupling kits, etc. The TRA2000 complies with IEC 61000-4-2, -4, -5, -8, -9, -11, -12p, -16, -29p.



The Modular Impulse Generator (MIG) performs **damped oscillatory tests**: 100 kHz, 1 MHz, voltage and magnetic field tests. The MIG complies with IEC 61000-4-8, -9, -10, -12 as well as with IEC 60255-4, -5, -22.



The HAR1000 with the Immunity software performs the following tests: **harmonics, voltage variation and ripple on d.c.** The HARMONICS-1000 complies with IEC 61000-4-13, -14, -17, -29p.

Lightning Tests

EMC PARTNER offers a wide range of testers in accordance with FCC 68 part D, ITU K.44, ETS 300 046, Bellcore and RTCA DO-160D, etc. for telecom, aircraft and military electronic equipment testing.



Component Tests



EMC PARTNER offers a wide range of modular impulse generators (MIG) for transient component testing on: varistors, arresters, surge protective devices (SPD), capacitors, circuit breakers, watt-hour meters, protection relays, insulation material, suppressor diodes, connectors, chokes, fuses, resistors, emc-gaskets, cables, etc.

EMC PARTNER has the largest range of impulse generators in the range up to 100 kV and 100 kA. Below is an example for an insulation tester up to 24 kV.



Emission Measurements



One unit performs all measurements on the power supplies of electronic equipment and products for the CE-Mark. The HAR1000 includes an amplifier for a clean power source, a line impedance network, the measurement systems Harmonics and Flicker. Accessories: three phase extension, "Immunity" and "ANASIM" software. Complies with IEC 61000-3-2 and -3.

We look forward to working with you

For more detailed information please contact our representative in your area or EMC PARTNER in Switzerland. For information on further products please visit also our website.

The headquarters:



EMC PARTNER AG
Baselstrasse 160
CH - 4242 Laufen
Switzerland

Phone: ++ 41 61 763 01 11
Fax: ++ 41 61 763 01 15
Email: sales@emc-partner.ch
Web-Site: www.emc-partner.com

We have representatives in:

America: Canada, Mexico, USA, ...

Asia: China, Hong Kong, Israel, Japan, Malaysia, South Korea, Taiwan, ...

Australia: Australia, New Zealand

Europe: Austria, Belgium, France, Germany, Great Britain, Hungary, Ireland, Italy, Netherlands, Scandinavia, Spain, ...

You will find contact information for all representatives at EMC PARTNER's website www.emc-partner.com.

Your local representative:

EMC PARTNER offers the largest range of impulse test equipment up to 100 kA and 100 kV in the areas of:

Immunity Tests

Lightning Tests

Component Tests

Emission Measurements