# Qualification Test Plan

## MIL-STD-461

## AVR800-54L4


| Product Manager | H/W Leader | System Engineer | Testing Engineer |
|---|---|---|---|
| Vinnie Yuan | | | |

| Version History | | | |
|---|---|---|---|
| **Document Release** | **Date** | **Change Item** | **Remarks** |
| V1.0 | 07/28/2025 | Preliminary release | |
| | | | |
| | | | |

| System Configuration | |
|---|---|
| **Motherboard** | Supermicro X13SEW-TF |
| **CPU** | Intel® Xeon SP Gold 5411N (1.9Ghz, 165W, 45MB) |
| **PCH** | Intel C741 Chipset |
| **RAM1** | Samsung DDR5 5600 64GB RDIMM ECC |
| **RAM2** | Samsung DDR5 5600 64GB RDIMM ECC |
| **RAM3** | Samsung DDR5 5600 64GB RDIMM ECC |
| **RAM4** | Samsung DDR5 5600 64GB RDIMM ECC |
| **RAM5** | Samsung DDR5 5600 64GB RDIMM ECC |
| **RAM6** | Samsung DDR5 5600 64GB RDIMM ECC |
| **RAM7** | Samsung DDR5 5600 64GB RDIMM ECC |
| **RAM8** | Samsung DDR5 5600 64GB RDIMM ECC |
| **GPU** | Nvidia Tesla L4 24GB GDDR6 7680 CUDA Cores |
| **SATA 1** | 2.5” U.2 NVMe 8TB SSD PCIe Gen III x 4 |
| **SATA 2** | 2.5” U.2 NVMe 8TB SSD PCIe Gen III x 4 |
| **LAN 1** | Intel® 10 Gigabit X550 Ethernet |
| **LAN 2** | Intel® 10 Gigabit X550 Ethernet |
| **LAN3** | Intel® 1 Gigabit i350 Ethernet |
| **IPMI** | 1 GbE Dedicated IPMI LAN port |
| **USB** | 4 x USB 2.0 |
| **VGA** | VGA D-Sub Connector port (Aspeed AST2600 BMC) |
| **POWER** | DC-DC 18V to 36V (500W Max) MIL-STD-461 |
| **Dimension** | 450(D) x 316 (W) x 154 (H) mm |
| **Weight** | 18Kg(39.68lbs) |
| **Chassis** | Aluminum Alloy, Corrosion Resistant |
| **Finish** | Anodic aluminum oxide |
| **Cooling** | Natural Passive convection/Conduction with IP65 Active Smart Fans |
| **Ingress Protection** | IP65 |

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# 1 AVR800-S4L4 D38999 Connectors and ICD

INDEX

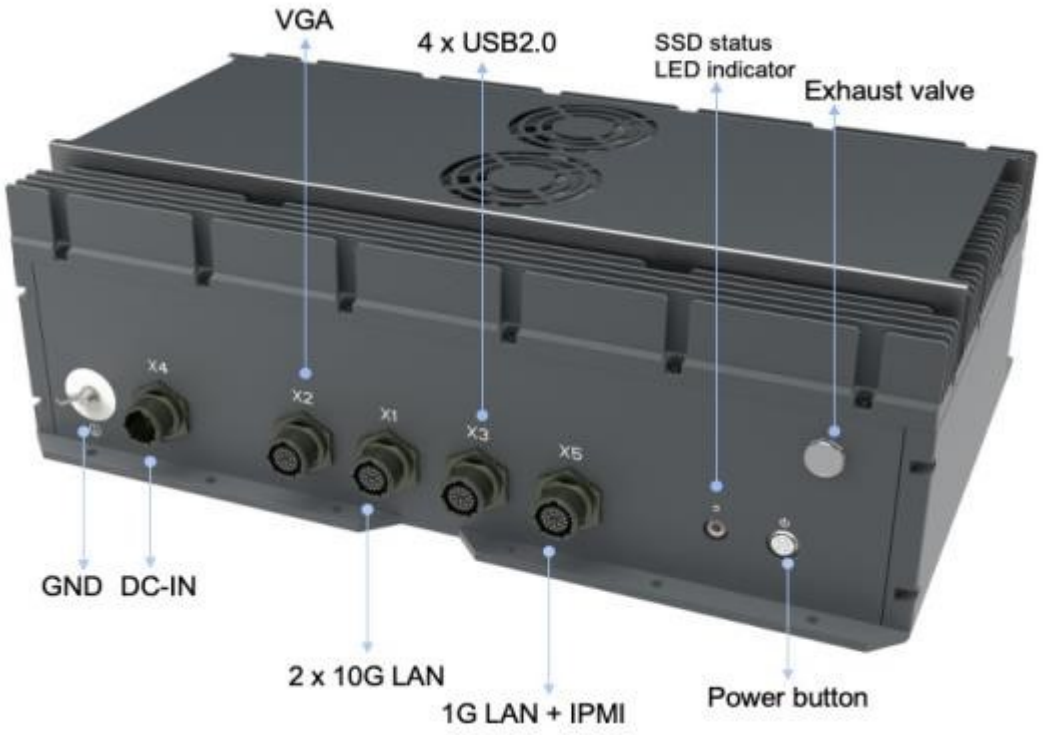
A) X1 2 x 10G LAN (AMPHENOL TV07RW13-35SN)

B) X2 VGA (AMPHENOL TV07RW-13-98S)

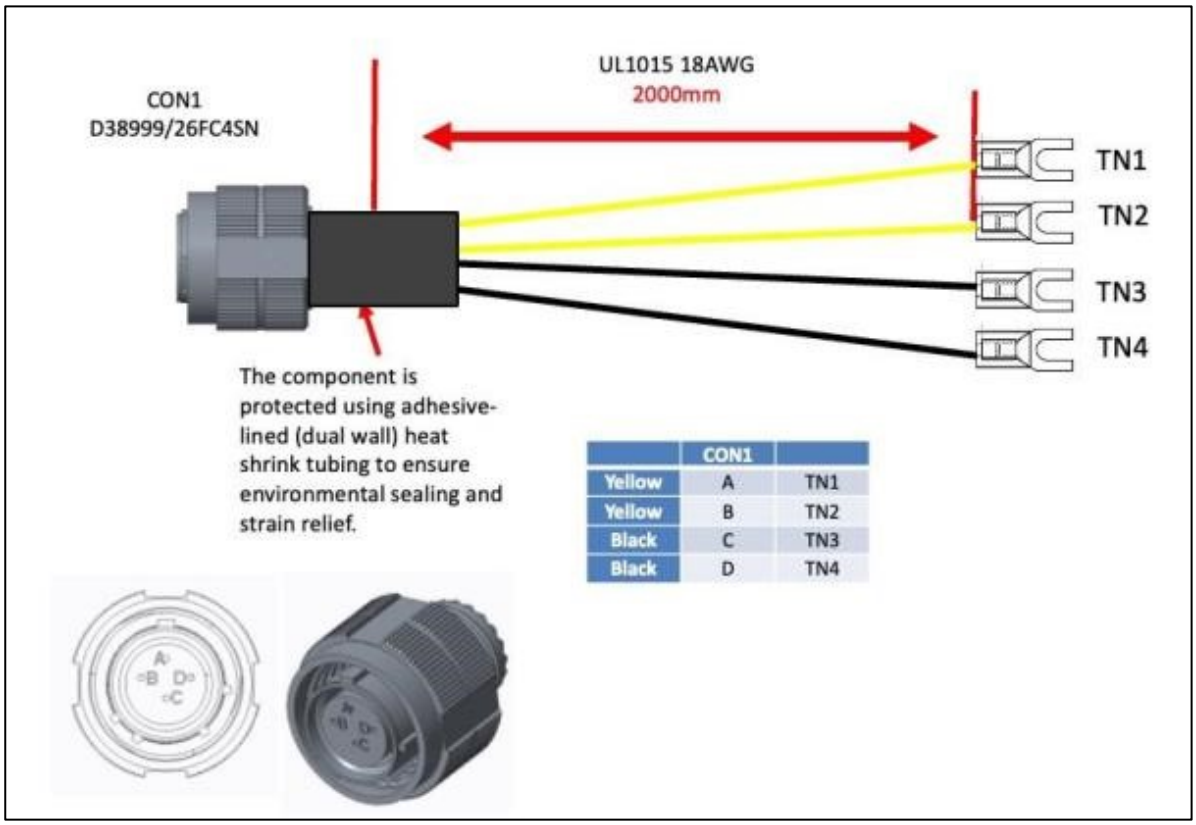
C) X3 4 x USB 2.0 (AMPHENOL TV07RW13-35SB)

D) X4 DC-IN (AMPHENOL TV07RW-13-04P)

E) X5 1G LAN + IPMI (AMPHENOL TV07RW13-35SN)



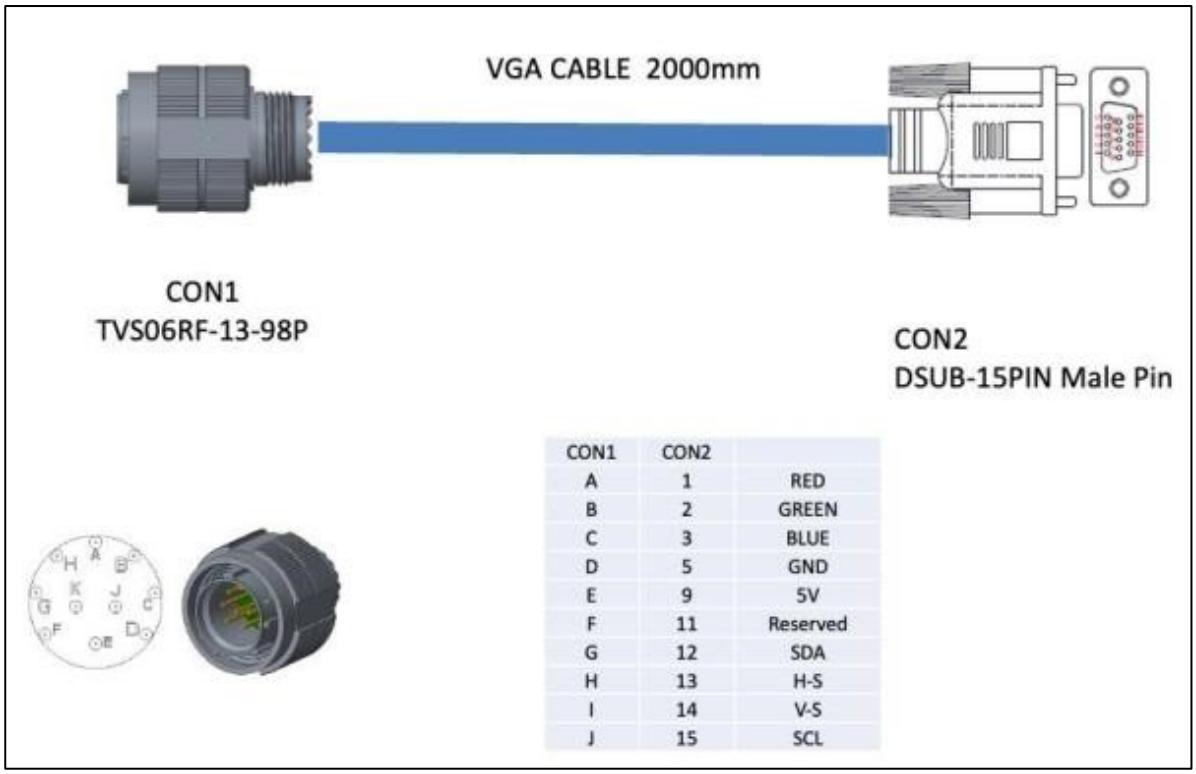
**AV800-S4L4_1 EXT-DC-IN CABLE**




| | CON1 | |
|---|---|---|
| Yellow | A | TN1 |
| Yellow | B | TN2 |
| Black | C | TN3 |
| Black | D | TN4 |

*Note: The DC In cable is unshielded*

**AV800-S4L4_11 EXT VGA CABLE**




| CON1 | CON2 | |
|---|---|---|
| A | 1 | RED |
| B | 2 | GREEN |
| C | 3 | BLUE |
| D | 5 | GND |
| E | 9 | 5V |
| F | 11 | Reserved |
| G | 12 | SDA |
| H | 13 | H-S |
| I | 14 | V-S |
| J | 15 | SCL |

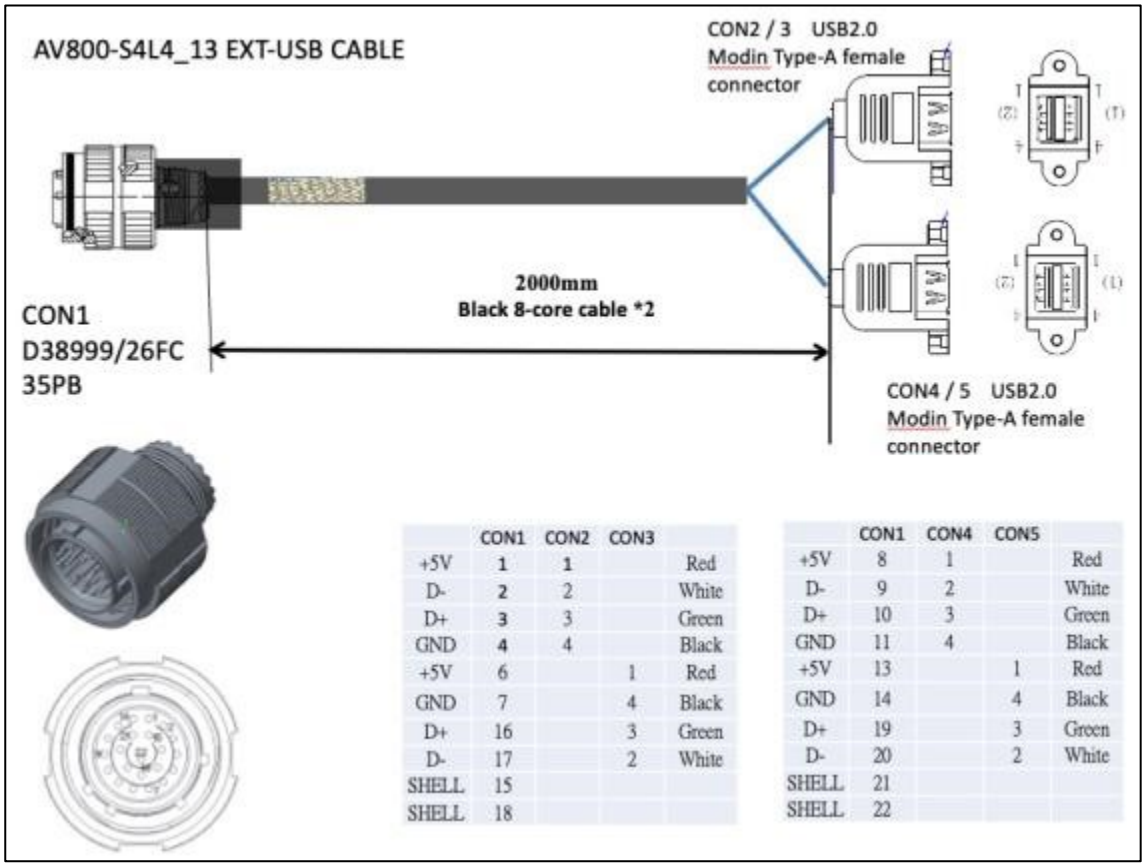
*Note: The VGA cable is shielded*

**AV800-S4L4_15 EXT-10G LAN CABLE**

| CON1 | CON2 | | CON1 | CON3 |
|---|---|---|---|---|
| 1 | 1 | WHITE / ORANGE | 8 | 1 |
| 2 | 2 | ORANG | 9 | 2 |
| 3 | 3 | WHITE / GREEN | 10 | 3 |
| 4 | 6 | GREEN | 11 | 6 |
| 5 | 4 | WHITE / BLUE | 12 | 4 |
| 6 | 5 | BLUE | 13 | 5 |
| 15 | 7 | WHITE / BROWN | 19 | 7 |
| 16 | 8 | BROWN | 20 | 8 |

*Note: The 10G LAN cable is shielded*

**AV800-S4L4_13 EXT-USB CABLE**




| | CON1 | CON2 | CON3 | |
|---|---|---|---|---|
| +5V | 1 | 1 | | Red |
| D- | 2 | 2 | | White |
| D+ | 3 | 3 | | Green |
| GND | 4 | 4 | | Black |
| +5V | 6 | | 1 | Red |
| GND | 7 | | 4 | Black |
| D+ | 16 | | 3 | Green |
| D- | 17 | | 2 | White |
| SHELL | 15 | | | |
| SHELL | 18 | | | |

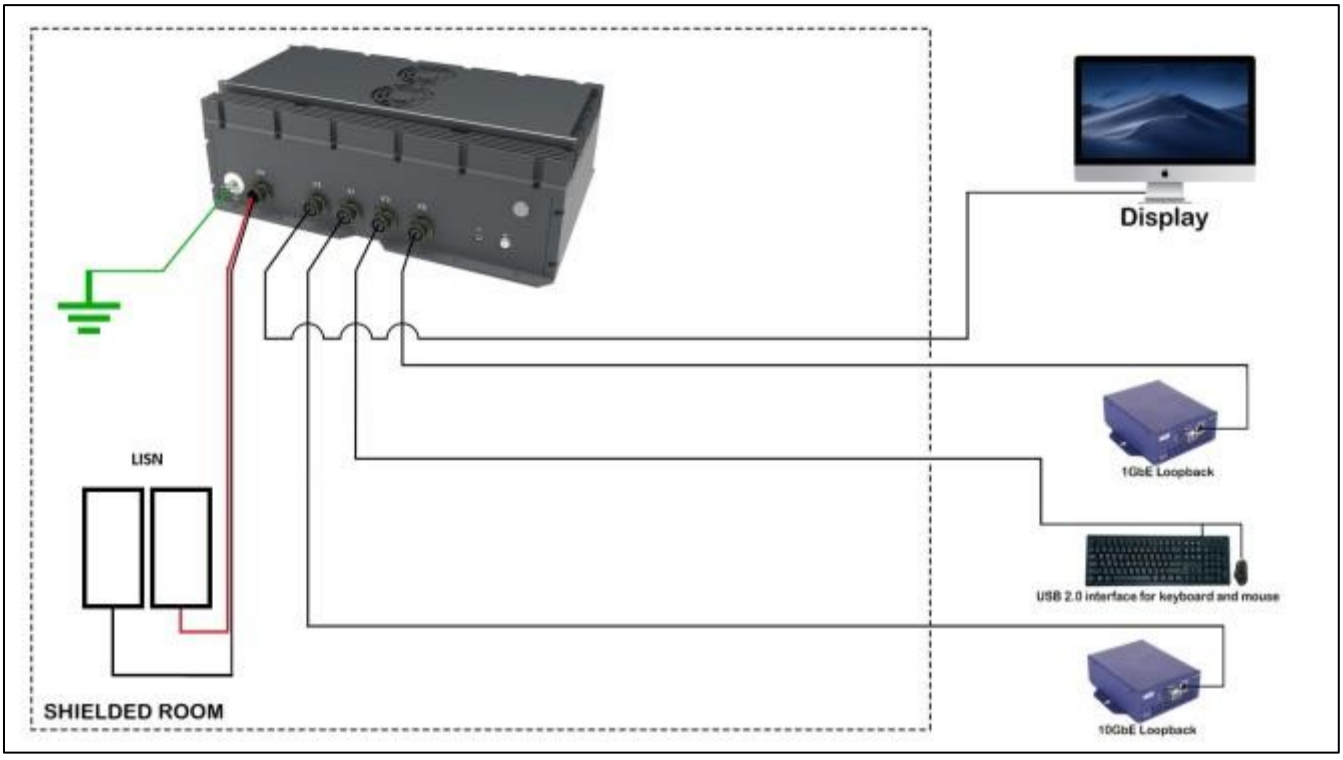
| | CON1 | CON4 | CON5 | |
|---|---|---|---|---|
| +5V | 8 | 1 | | Red |
| D- | 9 | 2 | | White |
| D+ | 10 | 3 | | Green |
| GND | 11 | 4 | | Black |
| +5V | 13 | | 1 | Red |
| GND | 14 | | 4 | Black |
| D+ | 19 | | 3 | Green |
| D- | 20 | | 2 | White |
| SHELL | 21 | | | |
| SHELL | 22 | | | |

*Note: The USB cable is shielded*

**AV800-S4L4_17 EXT-1G LAN CABLE**

| CON1 | CON2 | | CON1 | CON3 |
|---|---|---|---|---|
| 1 | 1 | WHITE / ORANGE | 8 | 1 |
| 2 | 2 | ORANG | 9 | 2 |
| 3 | 3 | WHITE / GREEN | 10 | 3 |
| 4 | 6 | GREEN | 11 | 6 |
| 5 | 4 | WHITE / BLUE | 12 | 4 |
| 6 | 5 | BLUE | 13 | 5 |
| 15 | 7 | WHITE / BROWN | 19 | 7 |
| 16 | 8 | BROWN | 20 | 8 |

***Note: The 1G LAN cable is shielded***



# 2 I/O Functional Tests

### A) Power Button & LED/ X4 (DC-In)


**Test Method:**

Testing the motherboard after pressing the power button.

Make sure the System switches ON and the LED lights up. When the system is correctly connected to the DC input and receives a valid operating voltage within the 18–36V range. that nominal input voltage is 28VDC.

**X1/X5 (1GbE / Dual 10GbE LAN)**

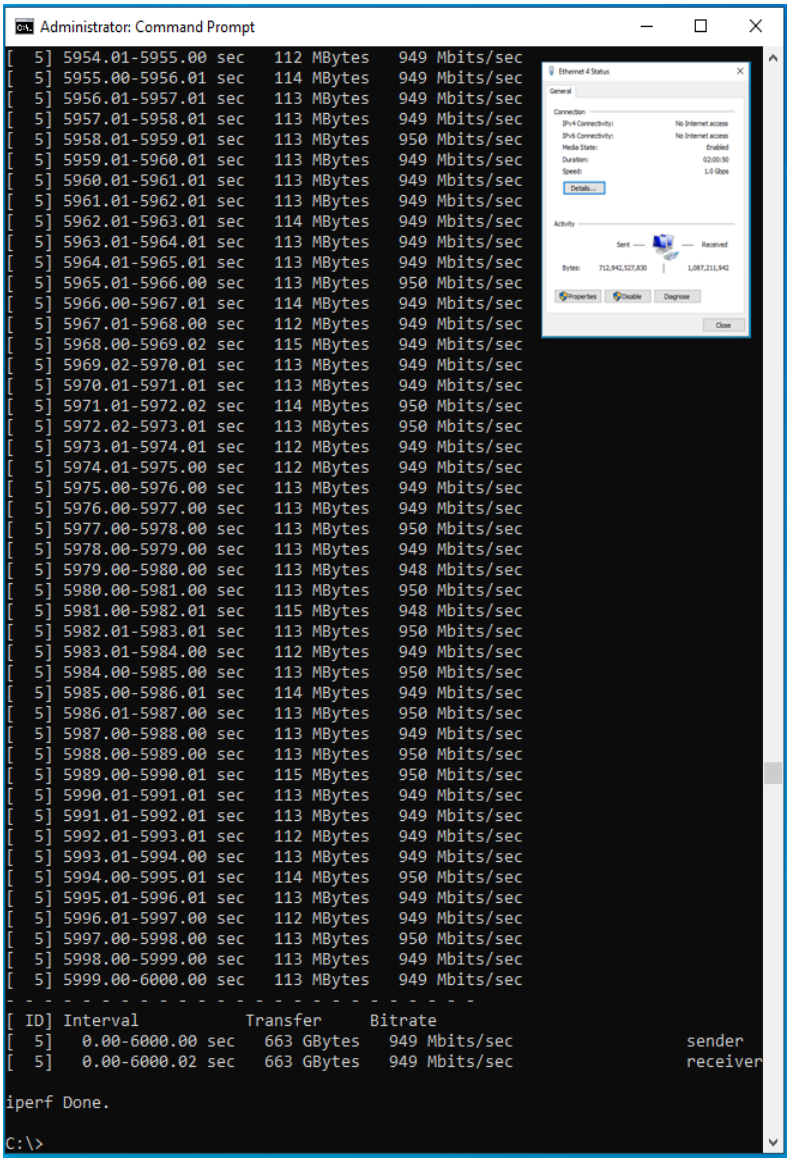
**Test Method:**

Loopback the dual channels one to the other using external cable.

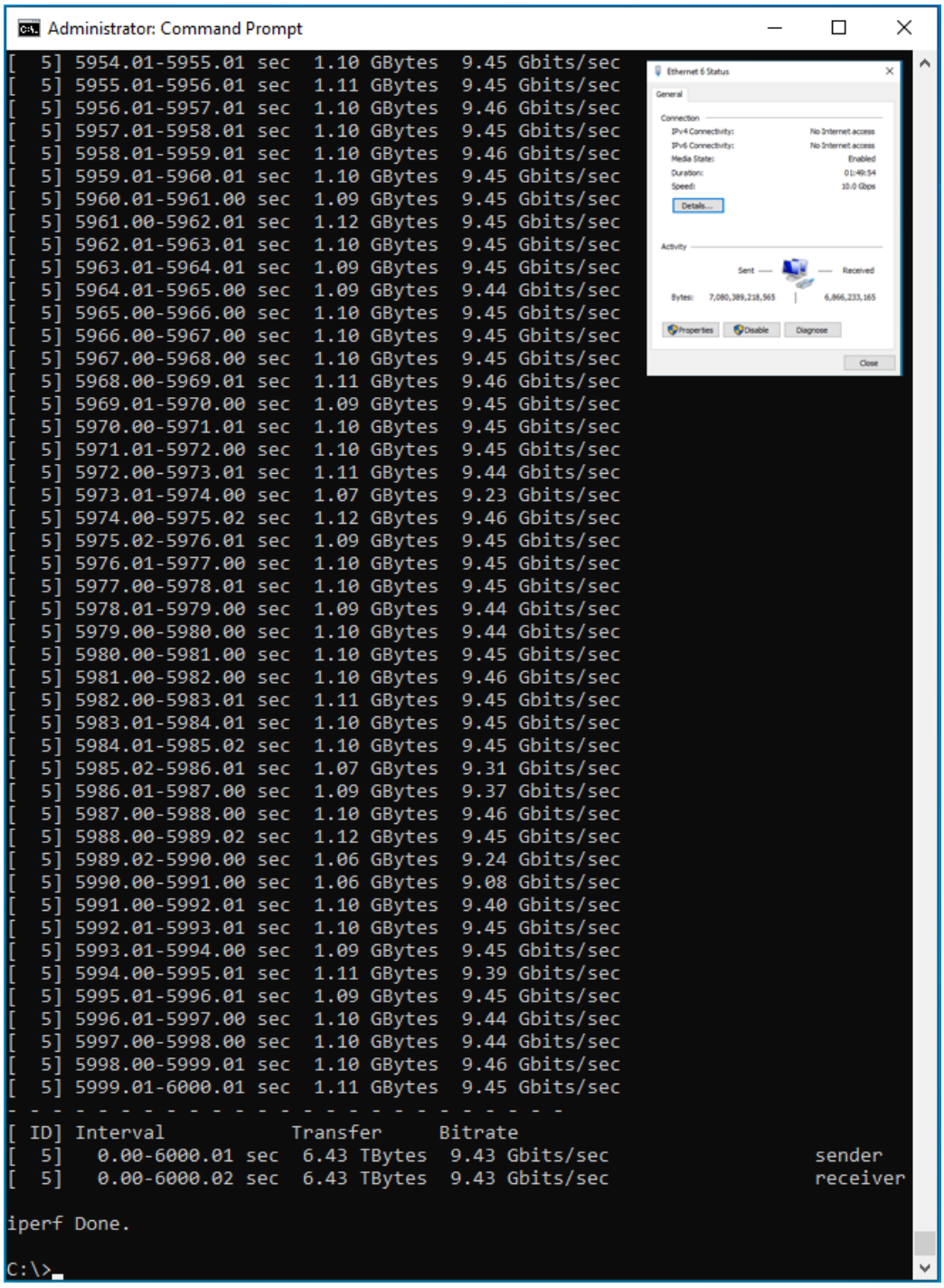
Check the LAN MAC ADDRESS on the MB, LAN SPEED and setup iPerf to test at 10GbE and 1GbE speeds.

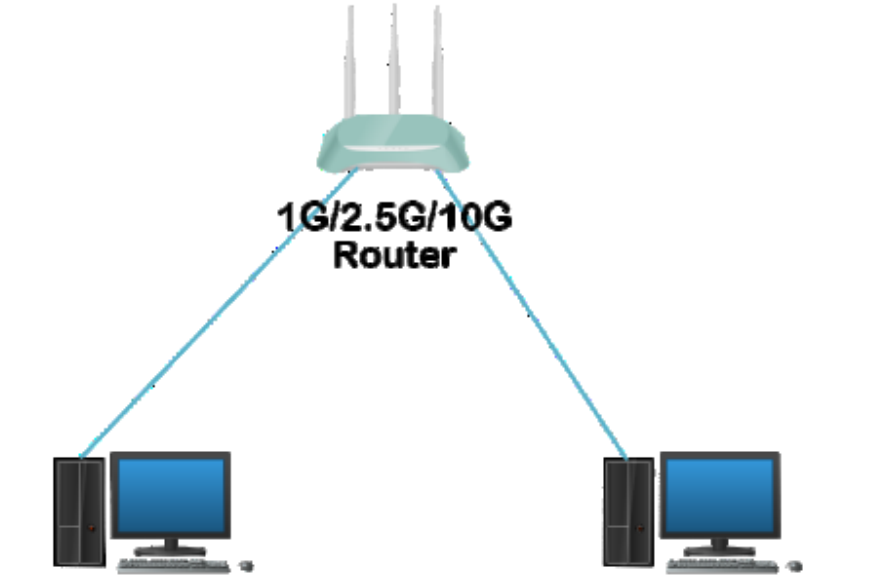
| X550 / i350 LAN |
| --- |
| i350 1GE Connect them directly with a CAT5e/CAT6 cable or via a Gigabit switch. Ensure both NICs are set to 1 Gbps full-duplex and have valid IP addresses. |
| X550 10GE: NICs: Both endpoints must have 10GE adapters (SFP+, RJ45 10GBase-T, or QSFP breakout). Connect them directly with a CAT6A/CAT7 cable or via a Gigabit switch. Ensure both NICs are set to 10 Gbps full-duplex and have valid IP addresses. |

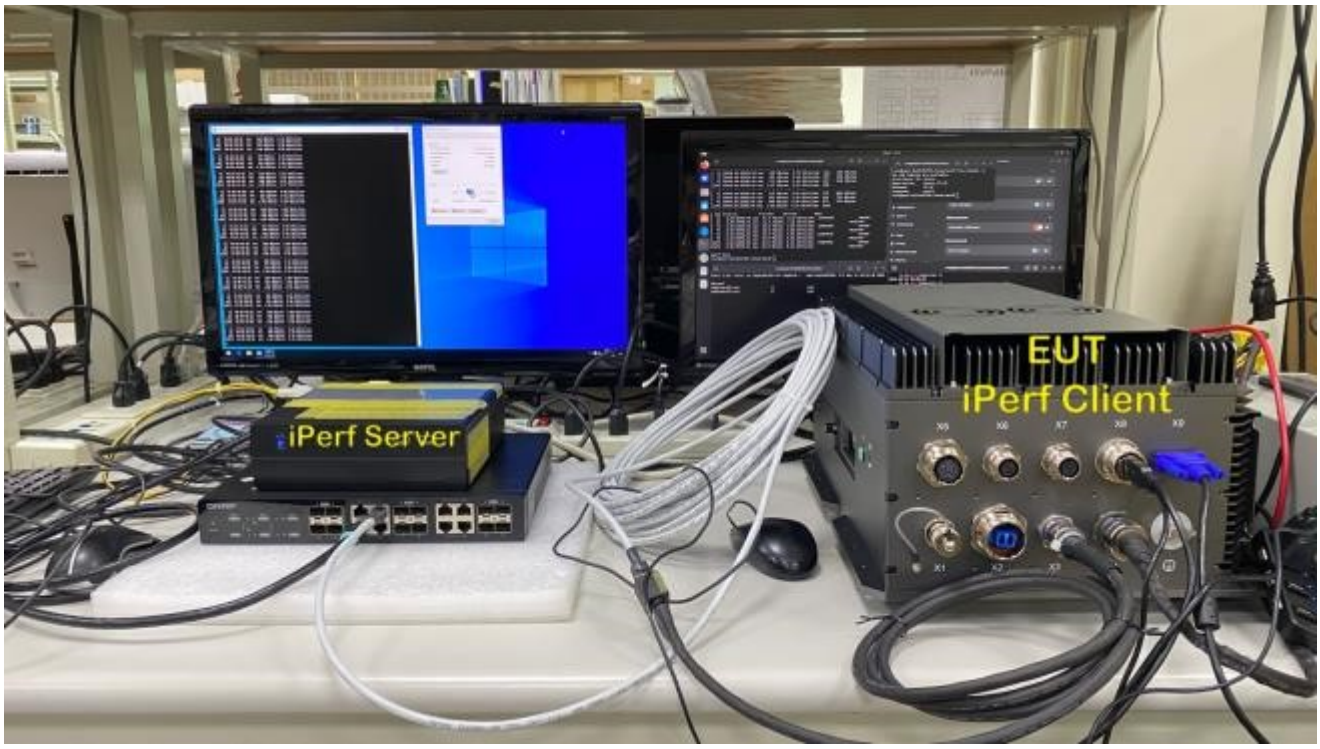
iPerf 1GbE test speed




iPerf 10GbE test speed


Administrator: Command Prompt
[ 5] 5954.01-5955.01 sec 1.10 GBytes 9.45 Gbits/sec
[ 5] 5955.01-5956.01 sec 1.11 GBytes 9.45 Gbits/sec
[ 5] 5956.01-5957.01 sec 1.10 GBytes 9.46 Gbits/sec
[ 5] 5957.01-5958.01 sec 1.10 GBytes 9.45 Gbits/sec
[ 5] 5958.01-5959.01 sec 1.10 GBytes 9.46 Gbits/sec
[ 5] 5959.01-5960.01 sec 1.10 GBytes 9.45 Gbits/sec
[ 5] 5960.01-5961.00 sec 1.09 GBytes 9.45 Gbits/sec
[ 5] 5961.00-5962.01 sec 1.12 GBytes 9.45 Gbits/sec
[ 5] 5962.01-5963.01 sec 1.10 GBytes 9.45 Gbits/sec
[ 5] 5963.01-5964.01 sec 1.09 GBytes 9.45 Gbits/sec
[ 5] 5964.01-5965.00 sec 1.09 GBytes 9.44 Gbits/sec
[ 5] 5965.00-5966.00 sec 1.10 GBytes 9.45 Gbits/sec
[ 5] 5966.00-5967.00 sec 1.10 GBytes 9.45 Gbits/sec
[ 5] 5967.00-5968.00 sec 1.10 GBytes 9.45 Gbits/sec
[ 5] 5968.00-5969.01 sec 1.11 GBytes 9.46 Gbits/sec
[ 5] 5969.01-5970.00 sec 1.09 GBytes 9.45 Gbits/sec
[ 5] 5970.00-5971.01 sec 1.10 GBytes 9.45 Gbits/sec
[ 5] 5971.01-5972.00 sec 1.10 GBytes 9.45 Gbits/sec
[ 5] 5972.00-5973.01 sec 1.11 GBytes 9.44 Gbits/sec
[ 5] 5973.01-5974.00 sec 1.07 GBytes 9.23 Gbits/sec
[ 5] 5974.00-5975.02 sec 1.12 GBytes 9.46 Gbits/sec
[ 5] 5975.02-5976.01 sec 1.09 GBytes 9.45 Gbits/sec
[ 5] 5976.01-5977.00 sec 1.10 GBytes 9.45 Gbits/sec
[ 5] 5977.00-5978.01 sec 1.10 GBytes 9.45 Gbits/sec
[ 5] 5978.01-5979.00 sec 1.09 GBytes 9.44 Gbits/sec
[ 5] 5979.00-5980.00 sec 1.10 GBytes 9.44 Gbits/sec
[ 5] 5980.00-5981.00 sec 1.10 GBytes 9.45 Gbits/sec
[ 5] 5981.00-5982.00 sec 1.10 GBytes 9.46 Gbits/sec
[ 5] 5982.00-5983.01 sec 1.11 GBytes 9.45 Gbits/sec
[ 5] 5983.01-5984.01 sec 1.10 GBytes 9.45 Gbits/sec
[ 5] 5984.01-5985.02 sec 1.10 GBytes 9.45 Gbits/sec
[ 5] 5985.02-5986.01 sec 1.07 GBytes 9.31 Gbits/sec
[ 5] 5986.01-5987.00 sec 1.09 GBytes 9.37 Gbits/sec
[ 5] 5987.00-5988.00 sec 1.10 GBytes 9.46 Gbits/sec
[ 5] 5988.00-5989.02 sec 1.12 GBytes 9.45 Gbits/sec
[ 5] 5989.02-5990.00 sec 1.06 GBytes 9.24 Gbits/sec
[ 5] 5990.00-5991.00 sec 1.06 GBytes 9.08 Gbits/sec
[ 5] 5991.00-5992.01 sec 1.10 GBytes 9.40 Gbits/sec
[ 5] 5992.01-5993.01 sec 1.10 GBytes 9.45 Gbits/sec
[ 5] 5993.01-5994.00 sec 1.09 GBytes 9.45 Gbits/sec
[ 5] 5994.00-5995.01 sec 1.11 GBytes 9.39 Gbits/sec
[ 5] 5995.01-5996.01 sec 1.09 GBytes 9.45 Gbits/sec
[ 5] 5996.01-5997.00 sec 1.10 GBytes 9.44 Gbits/sec
[ 5] 5997.00-5998.00 sec 1.10 GBytes 9.44 Gbits/sec
[ 5] 5998.00-5999.01 sec 1.10 GBytes 9.46 Gbits/sec
[ 5] 5999.01-6000.01 sec 1.11 GBytes 9.45 Gbits/sec
[ ID] Interval Transfer Bitrate
[ 5] 0.00-6000.01 sec 6.43 TBytes 9.43 Gbits/sec sender
[ 5] 0.00-6000.02 sec 6.43 TBytes 9.43 Gbits/sec receiver
iperf Done.
C:\>
Ethernet 6 Status
General
Connection
IPv4 Connectivity: No Internet access
IPv6 Connectivity: No Internet access
Media State: Enabled
Duration: 01:49:54
Speed: 10.0 Gbps
Details...
Activity
Sent
Received
Bytes: 7,080,389,218,565 6,866,233,165
Properties
Disable
Diagnose
Close


1G/2.5G/10G
Router
PC: A (iperf Server)
IP: 192.168.1.4
Mask: 255.255.255.0
Gateway :192.168.1.1
OS: Windows 10 64bits
PC: B (iperf Client)
IP: 192.168.1.103
Mask: 255.255.255.0
Gateway :192.168.1.1
OS: Windows 10 64bits


iPerf Server
EUT
iPerf Client

B) X2 (VGA)


**Test Method:**

Connect the VGA cable and make sure the screen will be displayed and the color is normal. functional. VGA is connected to an external screen for monitoring. Pass = clear picture. Fail= noise, flickering or loss of signal.

Pass = clear picture.

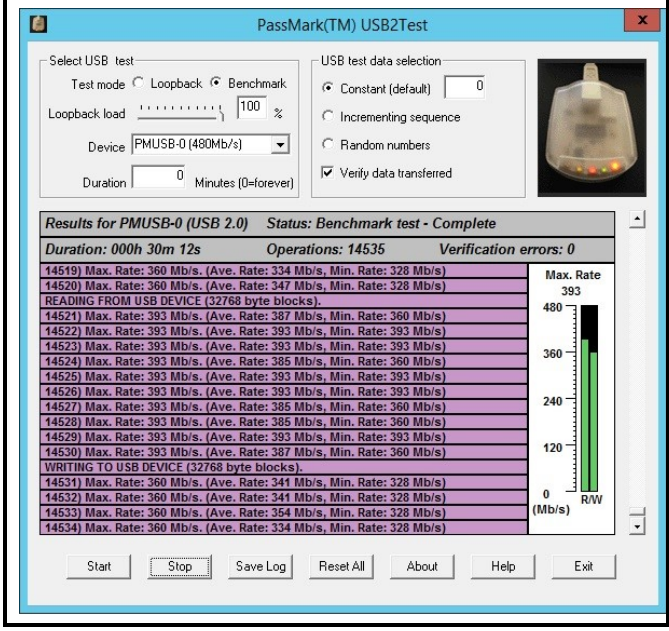
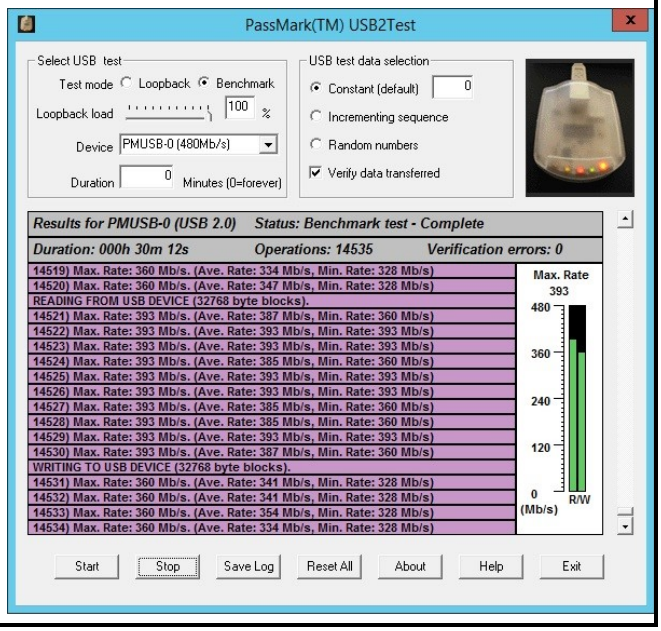
Fail= noise, flickering or loss of signal

### C) X3 (USB)


**Test Method:**

Check if we can detect the USB2.0 x4 with USB DEVICE TEST PLUG

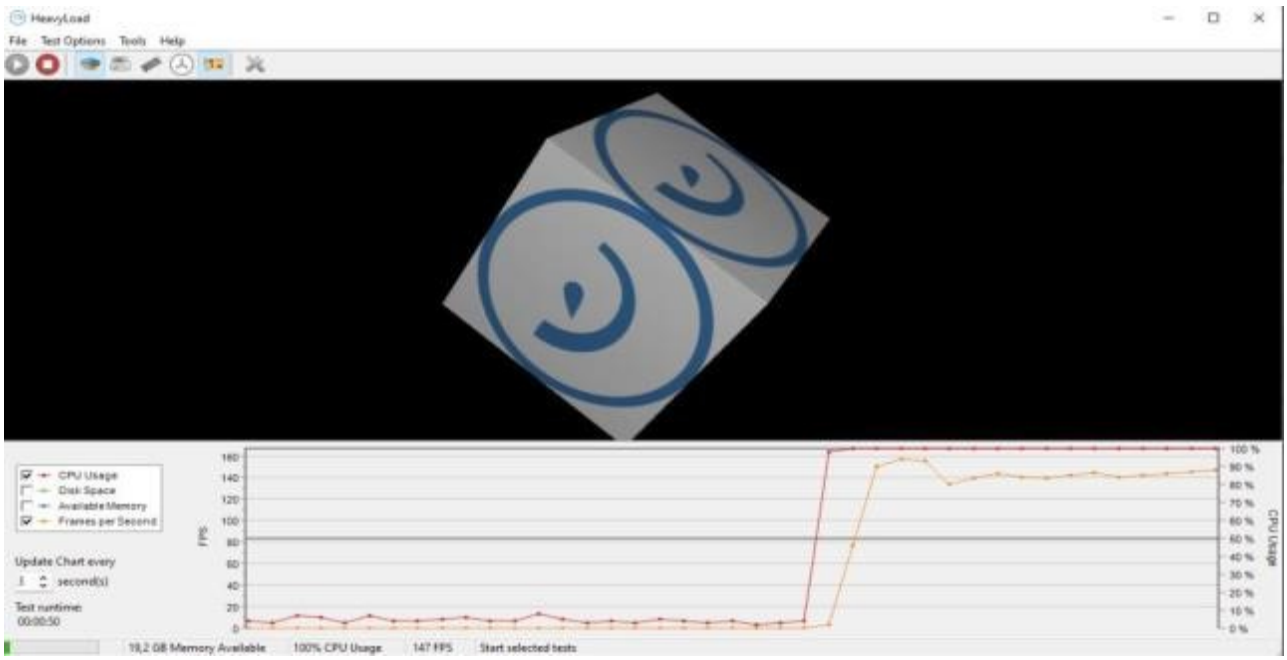
| Loopback Plugs for USB 3.0 &USB2.0 | | | | | |
|---|---|---|---|---|---|
| **Software** | **Comment / (unit)** | **connector** | **Read / Write** (Mb/s) | **Result** | **Note** |
| | PassMark USB2.0 test plug | USB2.0-1<br>USB2.0-2<br>USB2.0-3<br>USB2.0-4 | 393/360 (Mb/s) | | |

| USB2.0-1, USB2.0-2 | USB2.0-3, USB2.0-4 |
|---|---|
|  |  |

# 3 Stress CPU/GPU Test

HeavyLoad is intended to stress all resources of a PC (CPU, GPU, RAM, hard disk, network, operating system etc.) in order to test if it will run reliably under heavy load. This is useful for assessing important file or database servers before using them productively, or simply to ensure your new PC will not overheat or crash when used intensively.

The program also allows testing the behavior of systems under fading system resources (memory, disk space).




- **Stress CPU**

Use your processor or even a specific number of processor cores to full capacity. HeavyLoad performs complex calculations to simulate the load on your processor. 0~100%

CPU Options

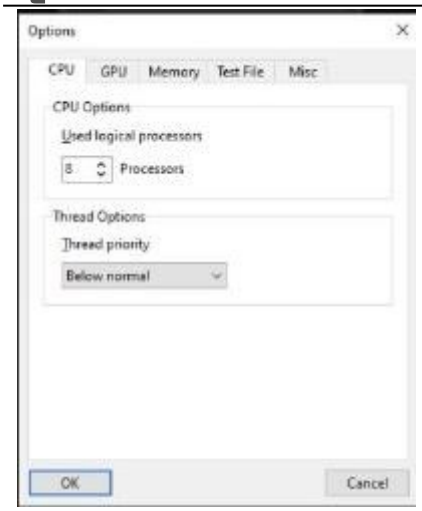
**Used logical processors**

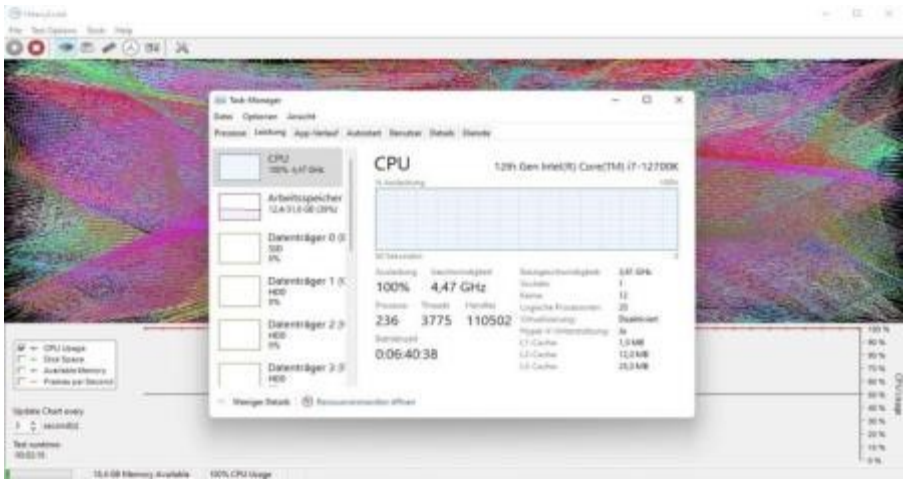
Allows to set the number of used logical processors for the CPU stress test if the system has more than one. The default number is set to the maximum amount of available processors (physical and virtual cores) on your system.

Thread Options

**Thread priority**

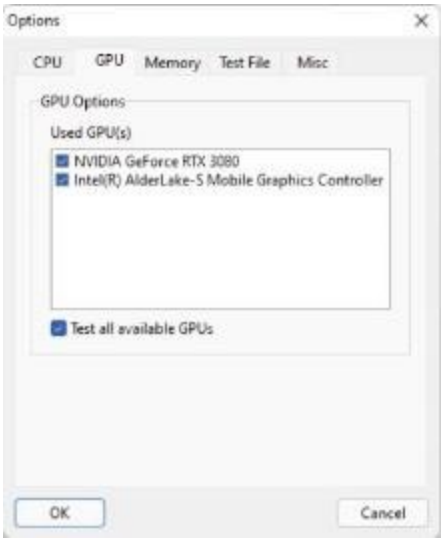
Allows to define the priority at which the threads are running. This can be used to precisely control the system utilization of HeavyLoad. "Idle" means the CPU will only be used if no other threads are using it. Choosing a higher priority will result in the stress threads having a higher priority than the thread of the user interface, which may result in the user interface being unresponsive during the tests.




- **Stress GPU**

HeavyLoad you can utilize your graphics card processor to capacity. HeavyLoad employs a 3D rendered graphic to simulate a high load on the GPU.




**These tests will be run with StressCPU and StressGPU to load the AVR800-S4L4 to approximately 70% load on both the CPU and the GPU.**

# 4 Order of tests and usage of test units

## 4-1 Test units

Two test units will be allocated for parallel testing activities: one unit for MIL-STD-461 compliance verification and the second unit for MIL-STD-810 environmental qualification testing.

## 4-2 ESS and bonding

Bonding will be tested on both units (less than 2.5 milliohm should be measured between X1/2/3/4/5 and the GND stud).

Both units should then undergo ESS, and have their bonding measured again.

Record the results.

## 4-3 Order of Tests

The tests will be carried out on the single unit in the following order

a) ESS/bonding.

b) MIL-STD-461

# 5 MIL-STD-461 TESTS

REQUIREMENTS FOR THE CONTROL OF ELECTROMAGNETIC INTERFERENCE CHARACTERISTICS OF SUBSYSTEMS AND EQUIPMENT

The AVR800-S4L4 shall be tested under the ELECTROMAGNETIC INTERFERENCE CHARACTERISTICS as defined by MIL-STD-461G category: Ground, Army, as detailed according to the order in Table 1

Table 1: Order of Tests

| # | Test | |
|---|---|---|
| | | **Spec' as Equipment Conditions** |
| 1 | RE102 | Radiated emissions, electric filed, 2MHz to 18GHz (Figure RE102-4) |
| 2 | RS103 | Radiated susceptibility, electric filed, 2Mhz to 18GHz, 50V/m (2MHz to 100MHz: 50V/m<br>100MHz to 18GHz: 50V/m) |
| 3 | CE102 | Conducted emissions, power leads, 10KHz to 10MHz (Figure CE102-1) |
| 4 | CS101 | Conducted susceptibility, power leads, 30Hz to 150KHz (Figure CS101-1: Curve #2) |
| 5 | CS114 | Conducted susceptibility, bulk cable injection, 10KHz to 200MHz, curves 3&4 (10KHz to 2MHz, curves 3& 2MHz to 200MHz: Curve #4) |
| 6 | CS115 | Conducted susceptibility, bulk cable injection, impulse excitation (5A) |
| 7 | CS116 | Conducted susceptibility, damped sinusoidal transients, cables and power leads, 10KHz to 100MHz (10A) |
| 8 | CS118 | Personnel borne electrostatic discharge (Added upon the change from 461F to 461G) |

## 5-1 RE102 TEST

### 5-1.1 Requirements

Perform the Radiated emissions, electric field test in accordance with MIL-STD-461G the following parameters:**2MHz to 18GHz**

### 5-1.2 Test Procedure

**Limit**

Electric field emissions shall not be radiated in excess of those shown in Figures RE102-4. Above 30 MHz, the limits shall be met for both horizontally and vertically polarized fields according to Ground, Army curve.

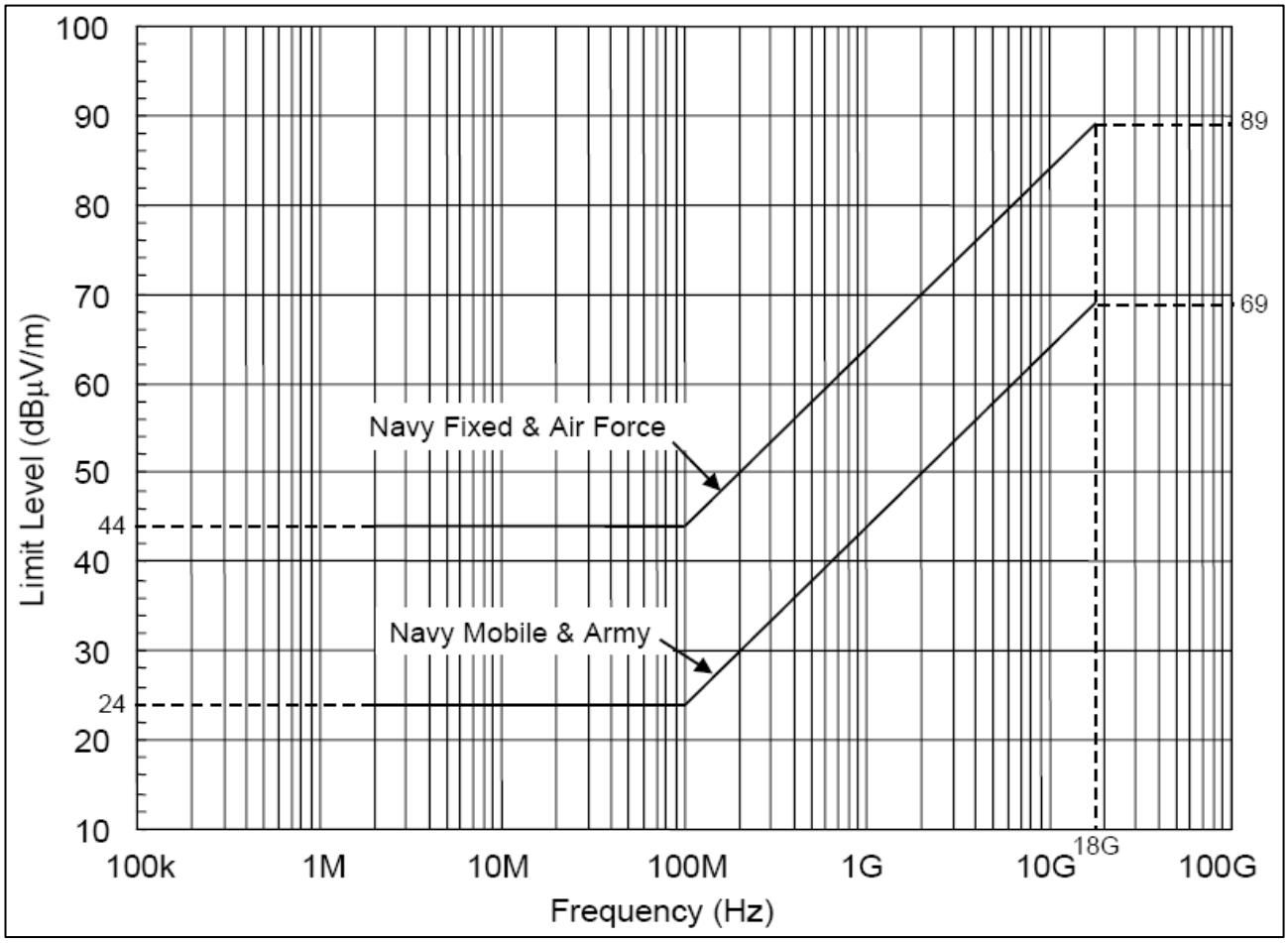
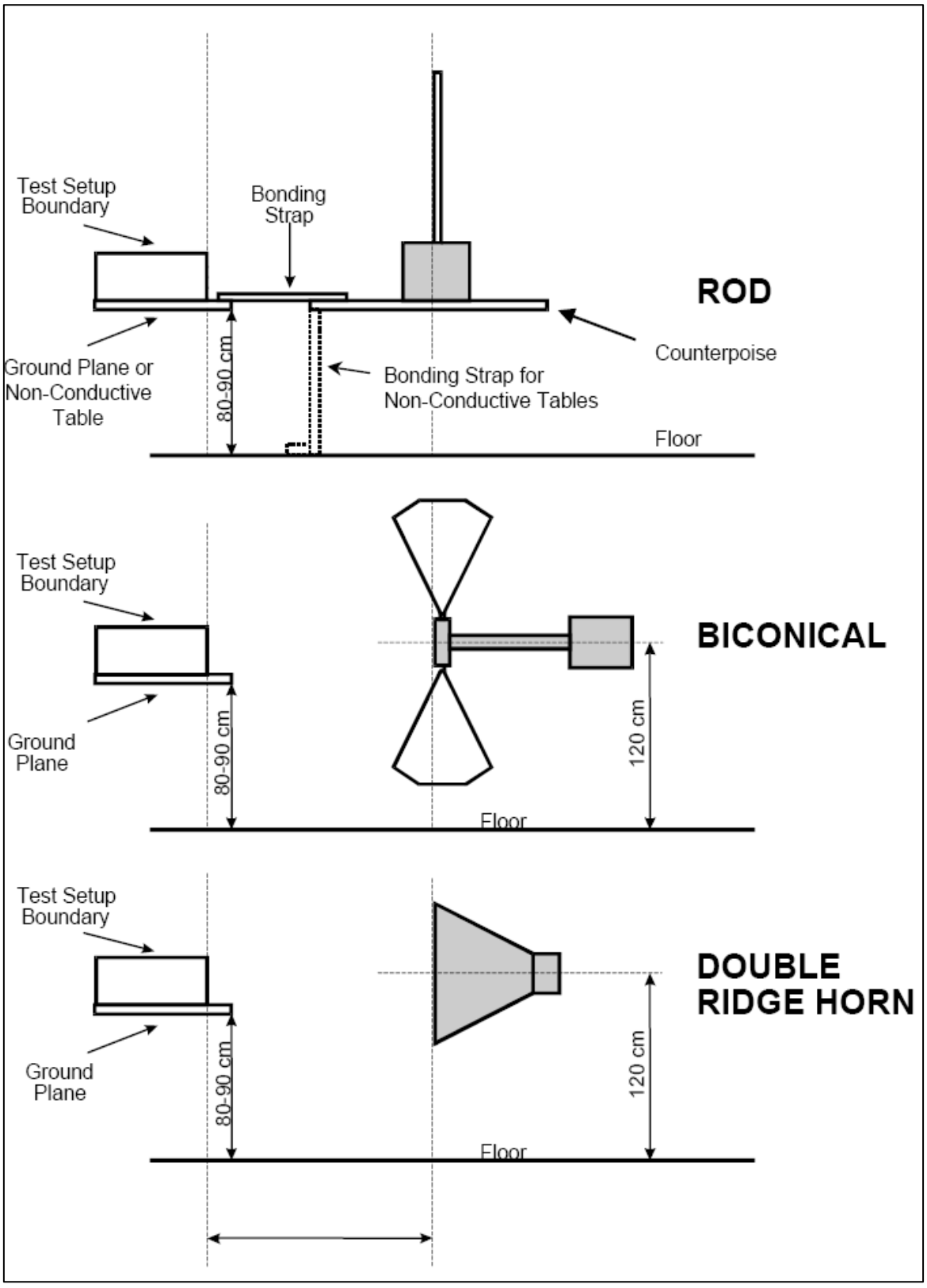
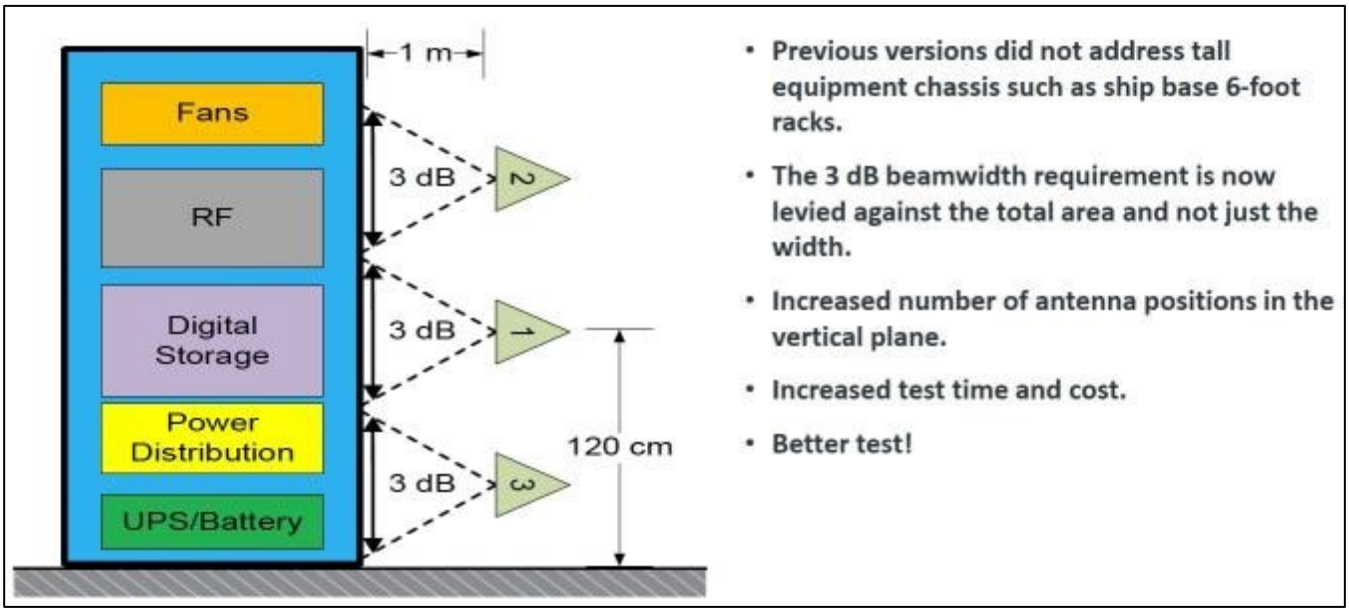



**FIGURE RE102-4. RE102 limit for ground applications.**

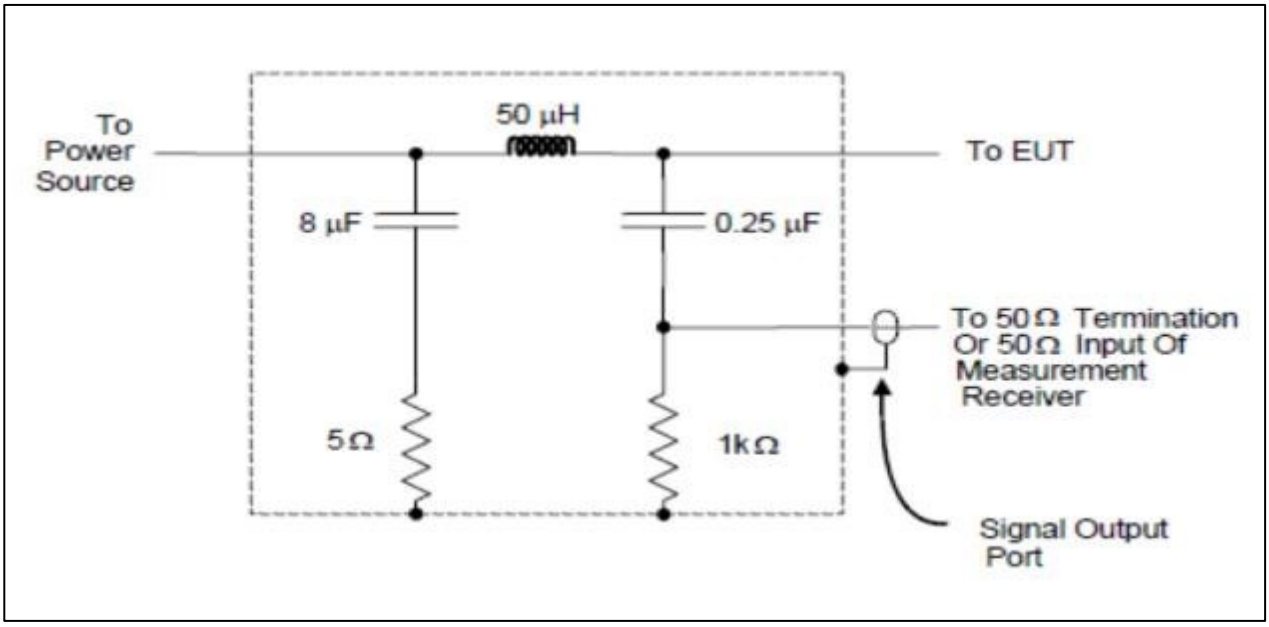
### 5-1.3 Test Configuration






The impedance of power sources providing input power to the EUT shall be controlled by Line Impedance Stabilization Networks (LISNs) for all measurement procedures of this document unless otherwise stated in a particular test procedure. LISNs shall not be used on output power leads. The LISNs shall be located at the power source end of the exposed length of power leads specified in 4.3.8.6.2.

• LISNs shall be electrically bonded to the test ground plane or facility ground as required and the bond resistance shall not exceed 2.5 milliohms.



## 5-2 RS103 TEST

### 5-2.1 Requirements

Perform the Radiated susceptibility, electric field test in accordance with MIL-STD-461G the following parameters:**2Mhz to 18GHz, 50V/m**

### 5-2.2 Test Procedure

**Limit**

The EUT shall not exhibit any malfunction, degradation of performance, or deviation from. specified indications, beyond the tolerances indicated in the individual equipment or subsystem specification, when subjected to the radiated electric fields listed in Table VII and modulated as specified below. Up to 30 MHz, the requirement shall be met for vertically polarized fields. Above 30 MHz, the requirement shall be met for both horizontally and vertically polarized fields. Circular polarized fields are not acceptable.

| | | LIMIT LEVEL (VOLTS/METER) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| PLATFORM / FREQ. RANGE | | AIRCRAFT (EXTERNAL OR SAFETY CRITICAL) | AIRCRAFT INTERNAL | ALL SHIPS (ABOVE DECKS) AND SUBMARINES (EXTERNAL)* | SHIPS (METALLIC) (BELOW DECKS) | SHIPS (NON-METALLIC) (BELOW DECKS) | SUBMARINES (INTERNAL) | GROUND | SPACE |
| 2 MHz | A | 200 | 200 | 200 | 10 | 50 | 5 | 50 | 20 |
| ↓ | N | 200 | 200 | 200 | 10 | 50 | 5 | 10 | 20 |
| 30 MHz | AF | 200 | 20 | - | - | - | - | 10 | 20 |
| 30 MHz | A | 200 | 200 | 200 | 10 | 10 | 10 | 50 | 20 |
| ↓ | N | 200 | 200 | 200 | 10 | 10 | 10 | 10 | 20 |
| 1 GHz | AF | 200 | 20 | - | - | - | - | 10 | 20 |
| 1 GHz | A | 200 | 200 | 200 | 10 | 10 | 10 | 50 | 20 |
| ↓ | N | 200 | 200 | 200 | 10 | 10 | 10 | 50 | 20 |
| 18 GHz | AF | 200 | 60 | - | - | - | - | 50 | 20 |
| 18 GHz | A | 200 | 200 | 200 | 10 | 10 | 10 | 50 | 20 |
| ↓ | N | 200 | 60 | 200 | 10 | 10 | 10 | 50 | 20 |
| 40 GHz | AF | 200 | 60 | - | - | - | - | 50 | 20 |

KEY: A = Army
N = Navy
AF = Air Force

* For equipment located external to the pressure hull of a submarine but within the superstructure, use SHIPS (METALLIC)(BELOW DECKS)

**Classification Of Functional Status**

All classifications are for the total device/system functional status.
**Class A:** all functions of a device/system perform as designed during and after exposure to disturbance.
**Class B:** all functions of a device/system perform as designed during exposure. However, one or more of them can go beyond specified tolerance. All functions return automatically to within normal limits after exposure is removed.
**Class C:** one or more functions of a device/system do not perform as designed during exposure but return automatically to normal operation after exposure is removed.
**Class D:** one or more functions of a device/system do not perform as designed during exposure and do not return to normal operation until exposure is removed and the device/system is reset by simple “operator/use” action.
**Class E:** one or more functions of a device/system do not perform as designed during and after exposure and cannot be returned to proper operation without repairing or replacing the device/system.

### 5-2.3 Test Configuration

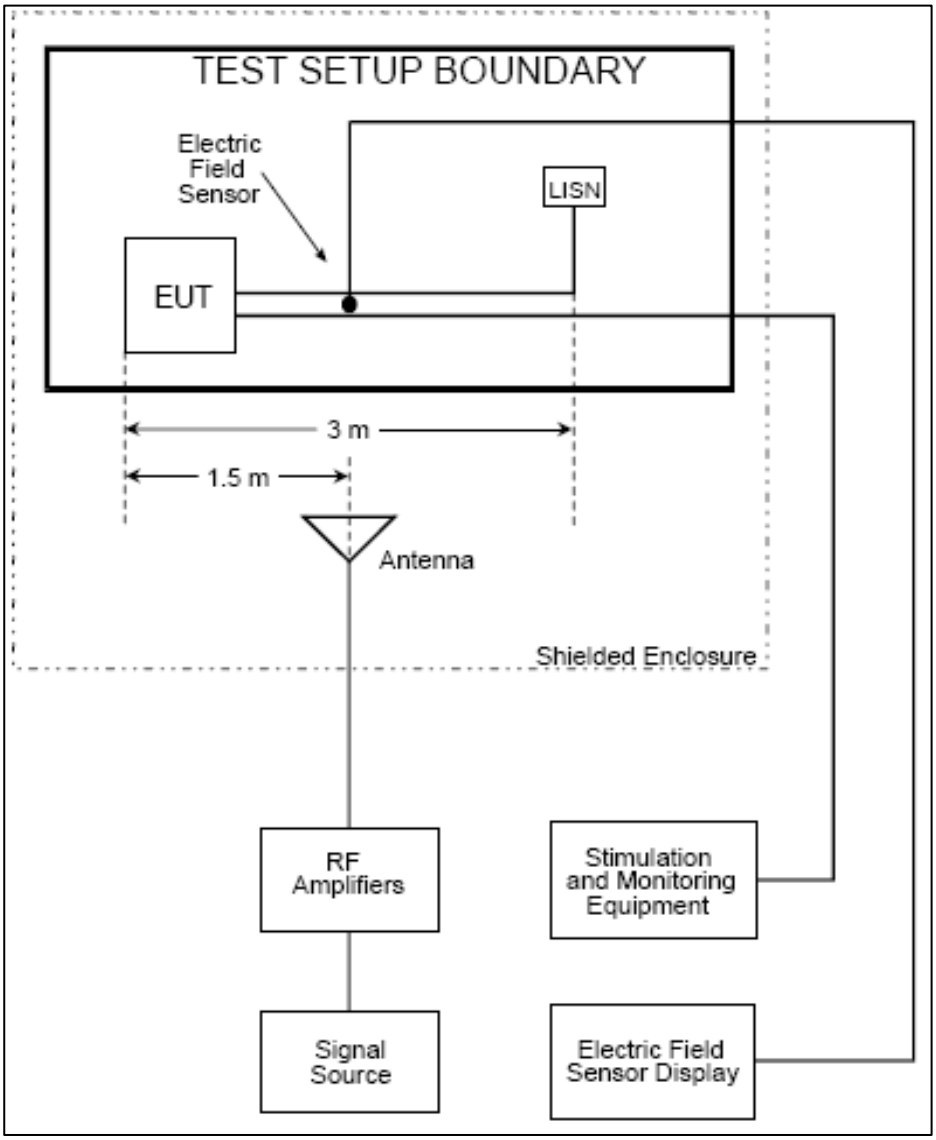



**FIGURE RS103-1. Test equipment configuration.**

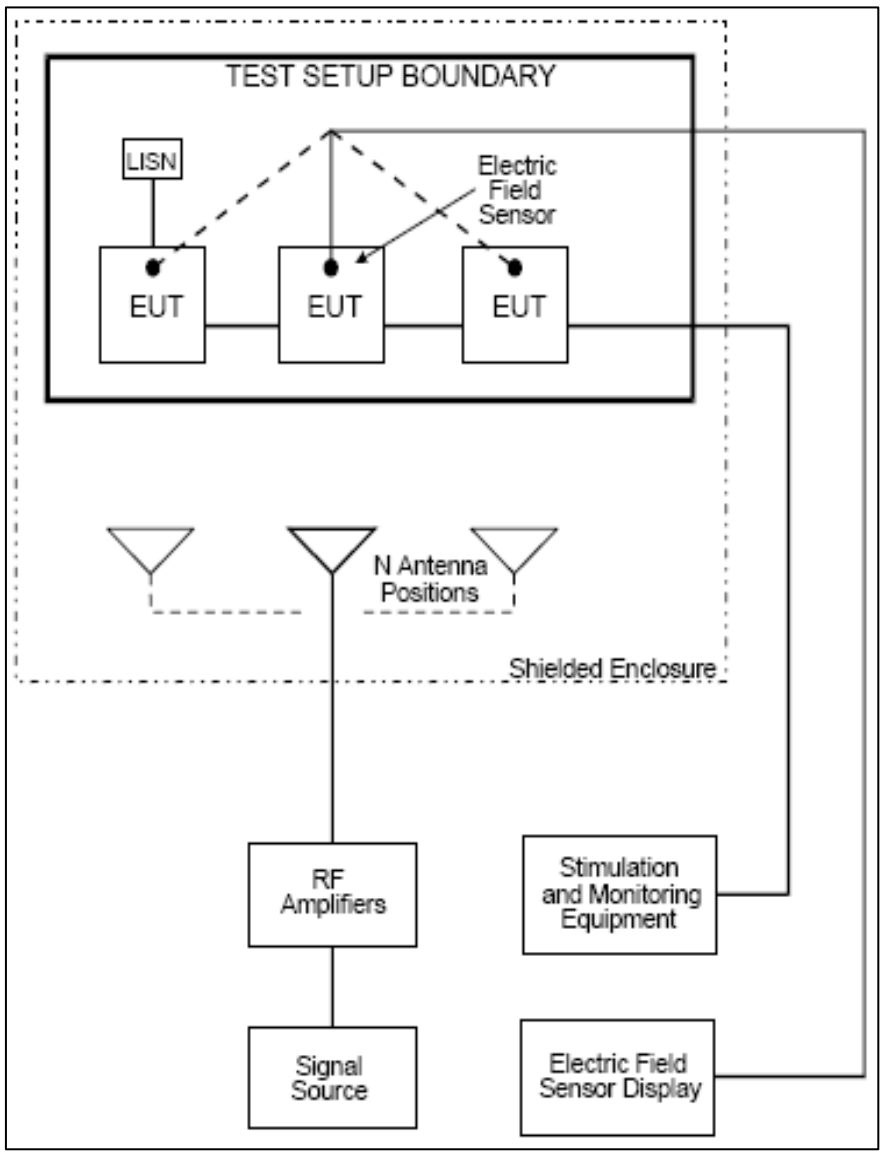



**FIGURE RS103-2. Multiple test antenna locations for frequency > 200 MHz**

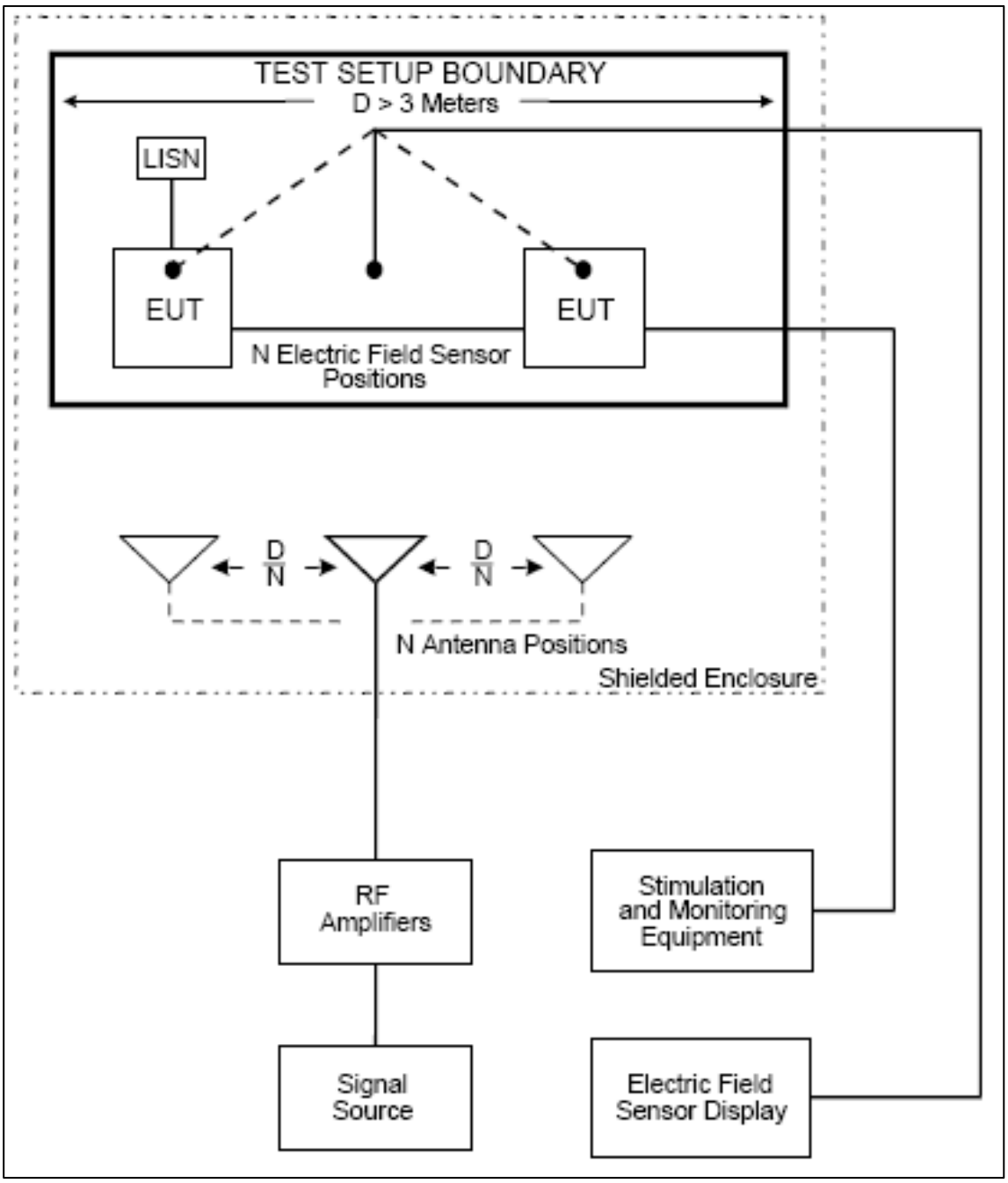



**FIGURE RS103-3. Multiple test antenna locations for N positions, D > 3 meters**

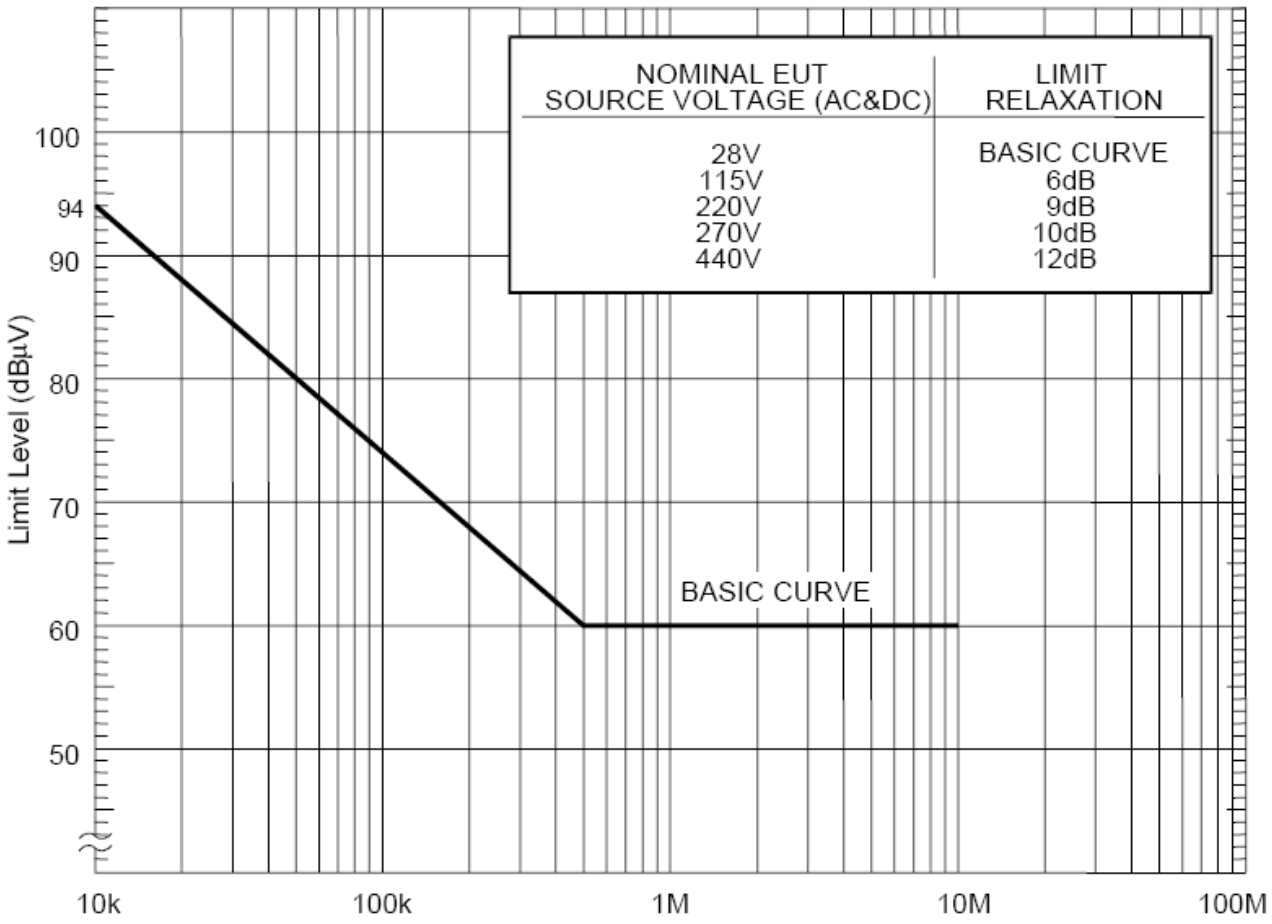
## 5-3 CE102 TEST

### 5-3.1 Requirements

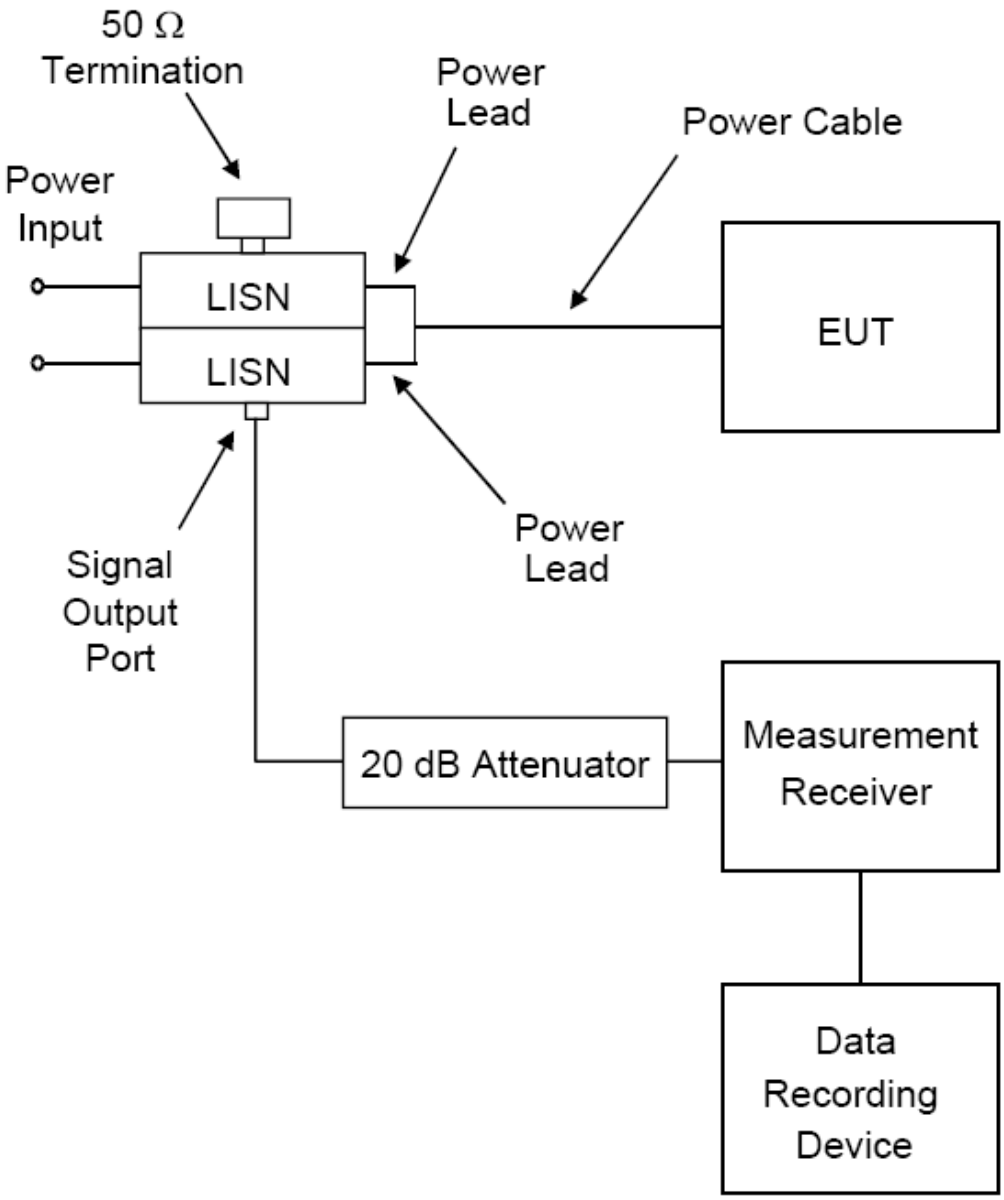
Perform the Conducted emissions, power leads test in accordance with MIL-STD-461G the following parameters:**10KHz to 10MHz**

### 5-3.2 Test Procedure

Conducted emissions on power leads shall not exceed the applicable values shown on Figure CE102-1.




### 5-3.3 Test Configuration


50 Ω
Termination
Power
Lead
Power Cable
Power
Input
LISN
LISN
EUT
Signal
Output
Port
Power
Lead
20 dB Attenuator
Measurement
Receiver
Data
Recording
Device

## 5-4 CS101 TEST

### 5-4.1 Requirements

Perform the Conducted susceptibility, power leads test in accordance with MIL-STD-461G the following parameters:**30Hz to 150KHz**

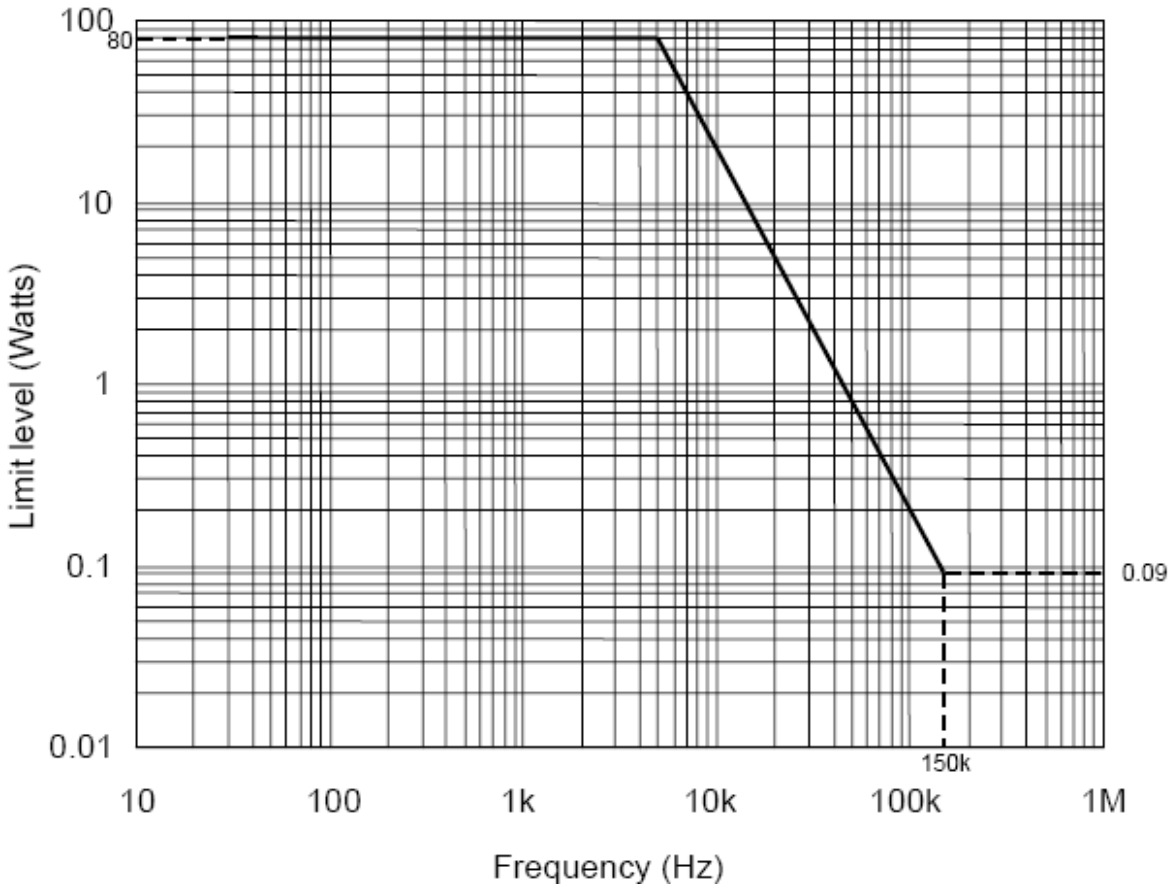



FIGURE CS101-2. CS101 power limit for all applications.

### 5-4.2 Test Procedure

**Limit**

The EUT shall not exhibit any malfunction, degradation of performance, or deviation from specified indications, beyond the tolerances indicated in the individual equipment or subsystem specification, when subjected to a test signal with voltage levels as specified in Figure CS101-1. The requirement is also met when the power source is adjusted to dissipate the power level shown in Figure CS101-2 in a 0.5 ohm load and the EUT is not susceptible.

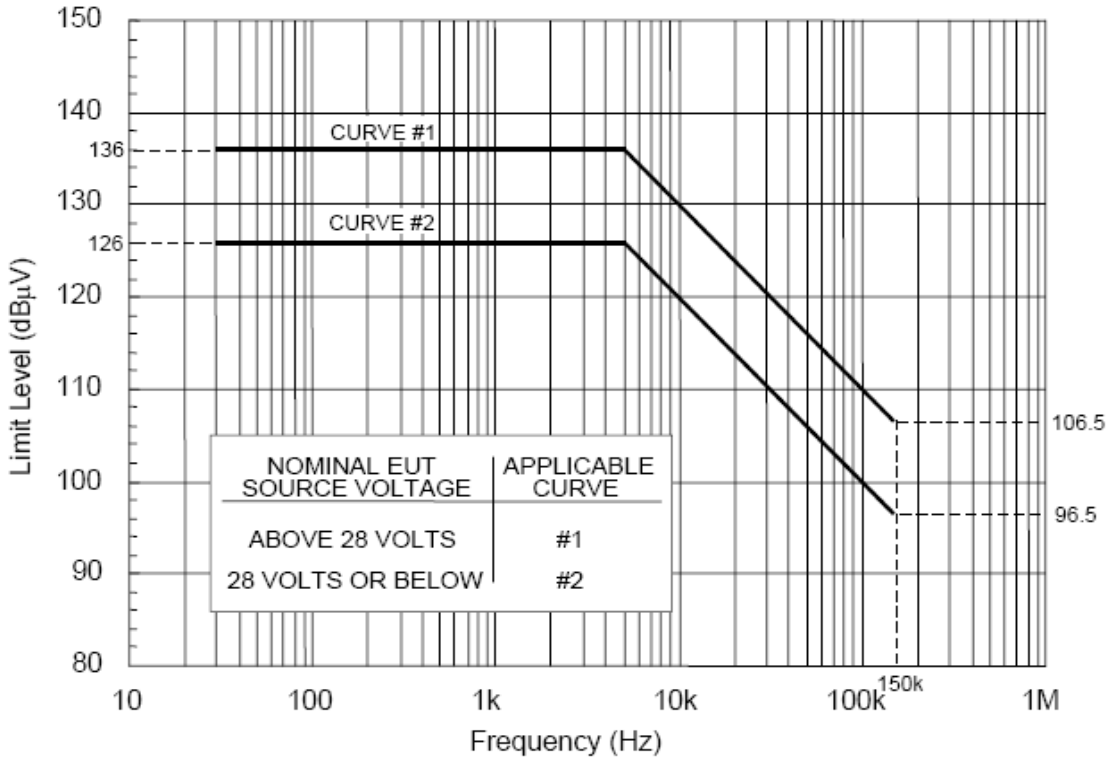



FIGURE CS101-1. CS101 voltage limit for all applications.

**Classification Of Functional Status**

All classifications are for the total device/system functional status.

**Class A:** all functions of a device/system perform as designed during and after exposure to disturbance.

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**Class D:** one or more functions of a device/system do not perform as designed during exposure and do not return to normal operation until exposure is removed and the device/system is reset by simple “operator/use” action.

**Class E:** one or more functions of a device/system do not perform as designed during and after exposure and cannot be returned to proper operation without repairing or replacing the device/system.

### 5-4.3 Test Configuration

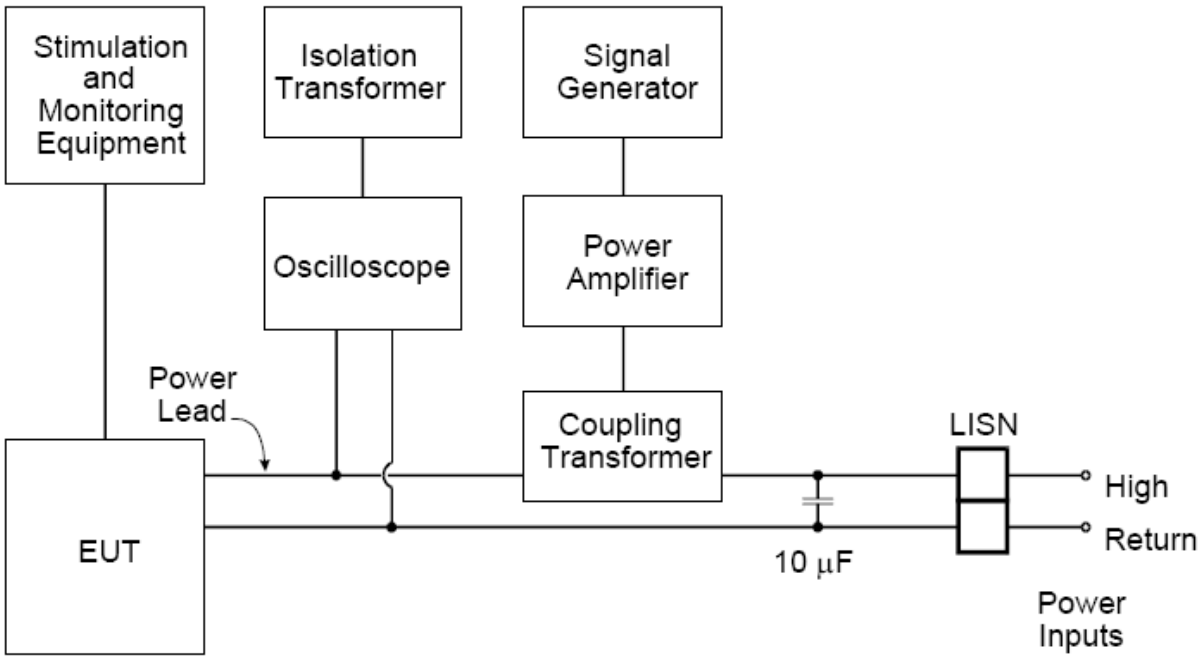



FIGURE CS101-4. Signal injection, DC or single phase AC

## 5-5 CS114 TEST

### 5-5.1 Requirements

Perform the Conducted susceptibility, bulk cable injection test in accordance with MIL-STD-461G the following parameters: **10 kHz to 2 MHz: Curve #3 ; 2MHz to 200MHz: Curve #4**

**Limit**

The EUT shall not exhibit any malfunction, degradation of performance, or deviation from specified indications, beyond the tolerances indicated in the individual equipment or subsystem specification, when subjected to a test signal with voltage levels as specified in Figure CS114. The requirement is also met when the power source is adjusted to dissipate the power level shown in Figure CS114 and the EUT is not susceptible.

### 5-5.2 Test Procedure

The CS114 test is used to verify the ability of the EUT to withstand RF signals coupled onto EUT associated cabling

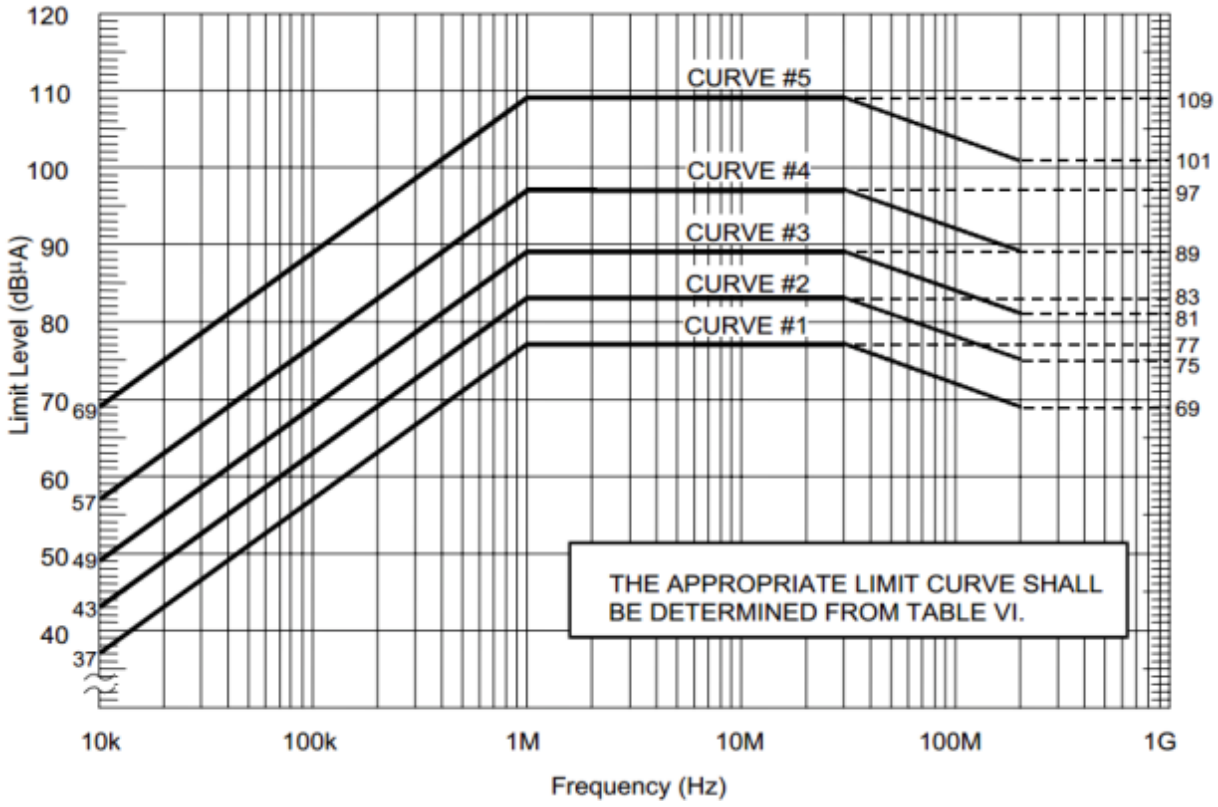
**Frequency Range**: 10KHz(4 KHz) – 200MHz

**Dwell Time:** The greater of 3 seconds or EUT response time per frequency

**Frequency Step:** max 5% (4KHz-1MHz), max 1% (1MHz-30MHz), max 0.1% (30MHz-200MHz)

**Unit:** Current (dBuA)

**Modulation:** 1KHz, 50% Duty Cycle, Pulse Modulation




**Classification Of Functional Status**

All classifications are for the total device/system functional status.

**Class A:** all functions of a device/system perform as designed during and after exposure to disturbance.

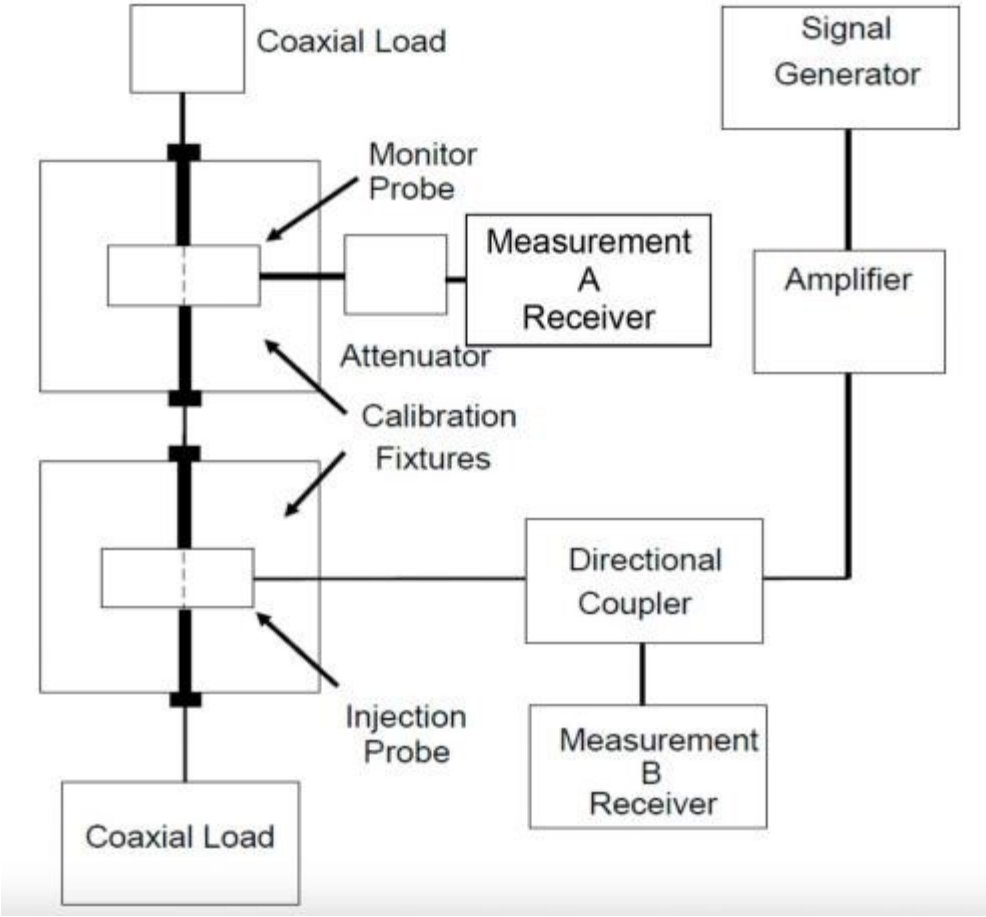
**Class B:** all functions of a device/system perform as designed during exposure. However, one or more of them can go beyond specified tolerance. All functions return automatically to within normal limits after exposure is removed.

**Class C:** one or more functions of a device/system do not perform as designed during exposure but return automatically to normal operation after exposure is removed.

**Class D:** one or more functions of a device/system do not perform as designed during exposure and do not return to normal operation until exposure is removed and the device/system is reset by simple "operator/use" action.

**Class E:** one or more functions of a device/system do not perform as designed during and after exposure and cannot be returned to proper operation without repairing or replacing the device/system.

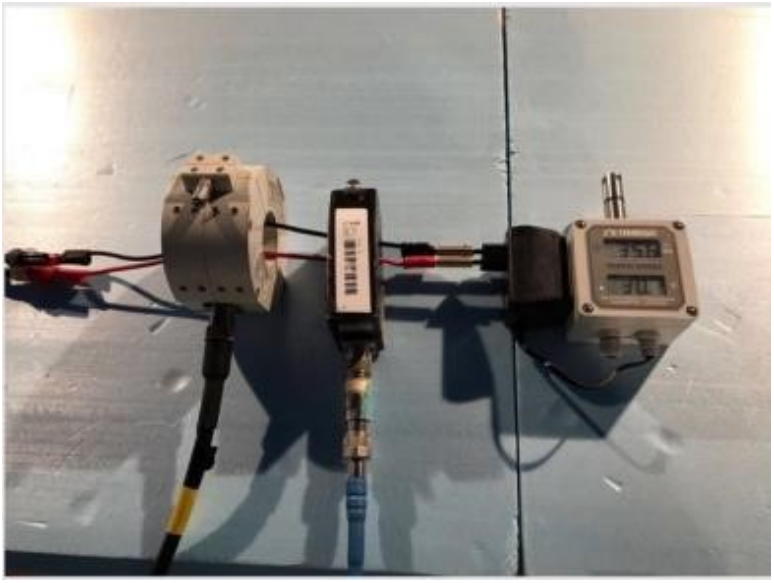
### 5-5.3 Test Configuration

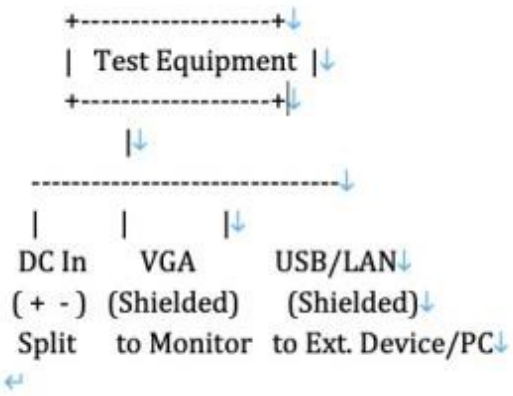


### 5-5.4 Test Setup of wires in the DC In cable:

All I/O cables are tested whole. The Power cable is tested as a bundle (i.e. all wires) and ◦ also with just the + line.

The following diagram illustrates the test setup and the separation of wires in the DC In cable:





## 5-6 CS115 TEST

### 5-6.1 Requirements

Perform the Conducted susceptibility, bulk cable injection test in accordance with MIL-STD-461G the following parameters: **impulse excitation**

**Limit**

The EUT shall not exhibit any malfunction, degradation of performance, or deviation from specified indications, beyond the tolerances indicated in the individual equipment or subsystem specification, when subjected to a test signal with voltage levels as specified in Figure CS115. The requirement is also met when the power source is adjusted to dissipate the power level shown in Figure CS115 and the EUT is not susceptible.

### 5-6.2 Test Procedure

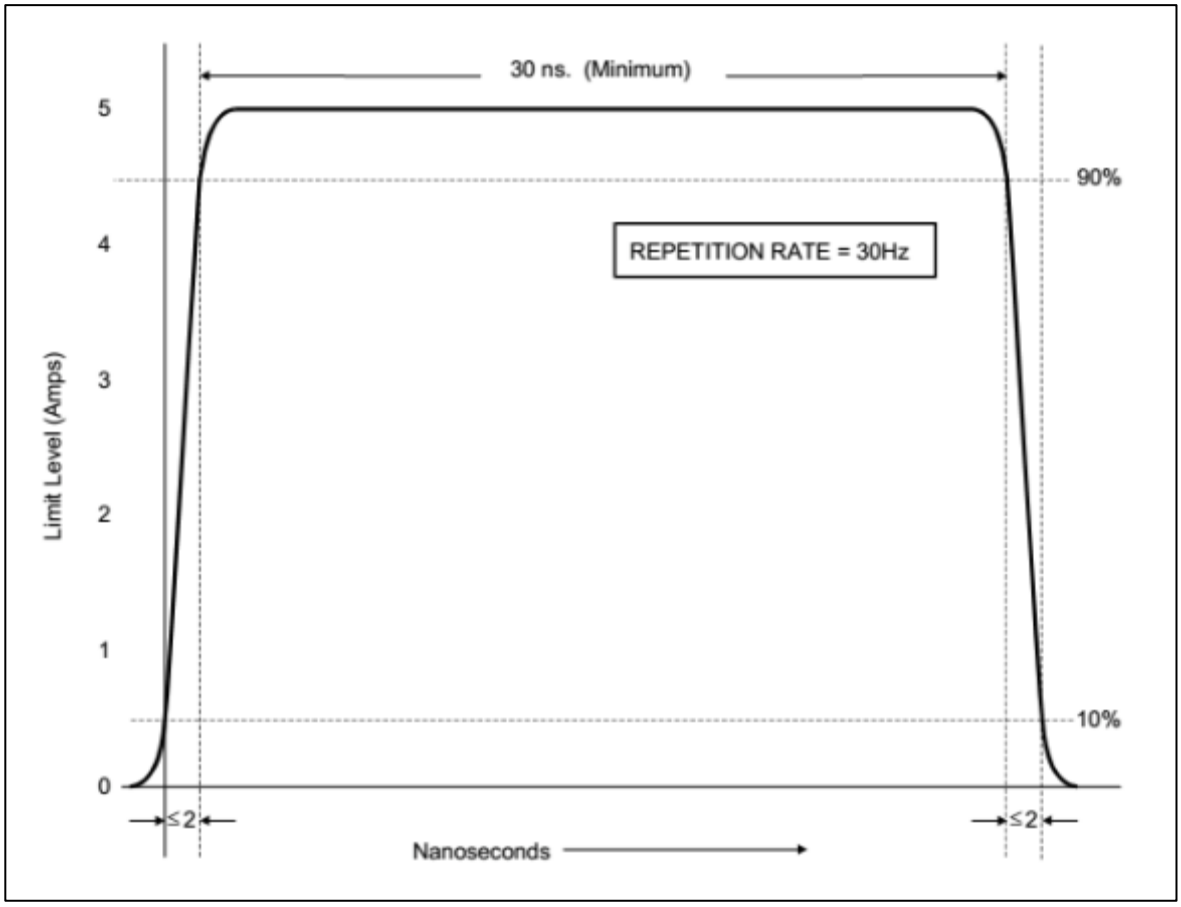
The CS115 test is used to verify the ability of the EUT to withstand impulse signals coupled onto EUT associated cabling

**Frequency Range:** Broadband

**Unit:** Current (A)

**Signal:** Impulse

**Test duration:** 1 minute per application




**Classification Of Functional Status**

All classifications are for the total device/system functional status.

**Class A:** all functions of a device/system perform as designed during and after exposure to disturbance.

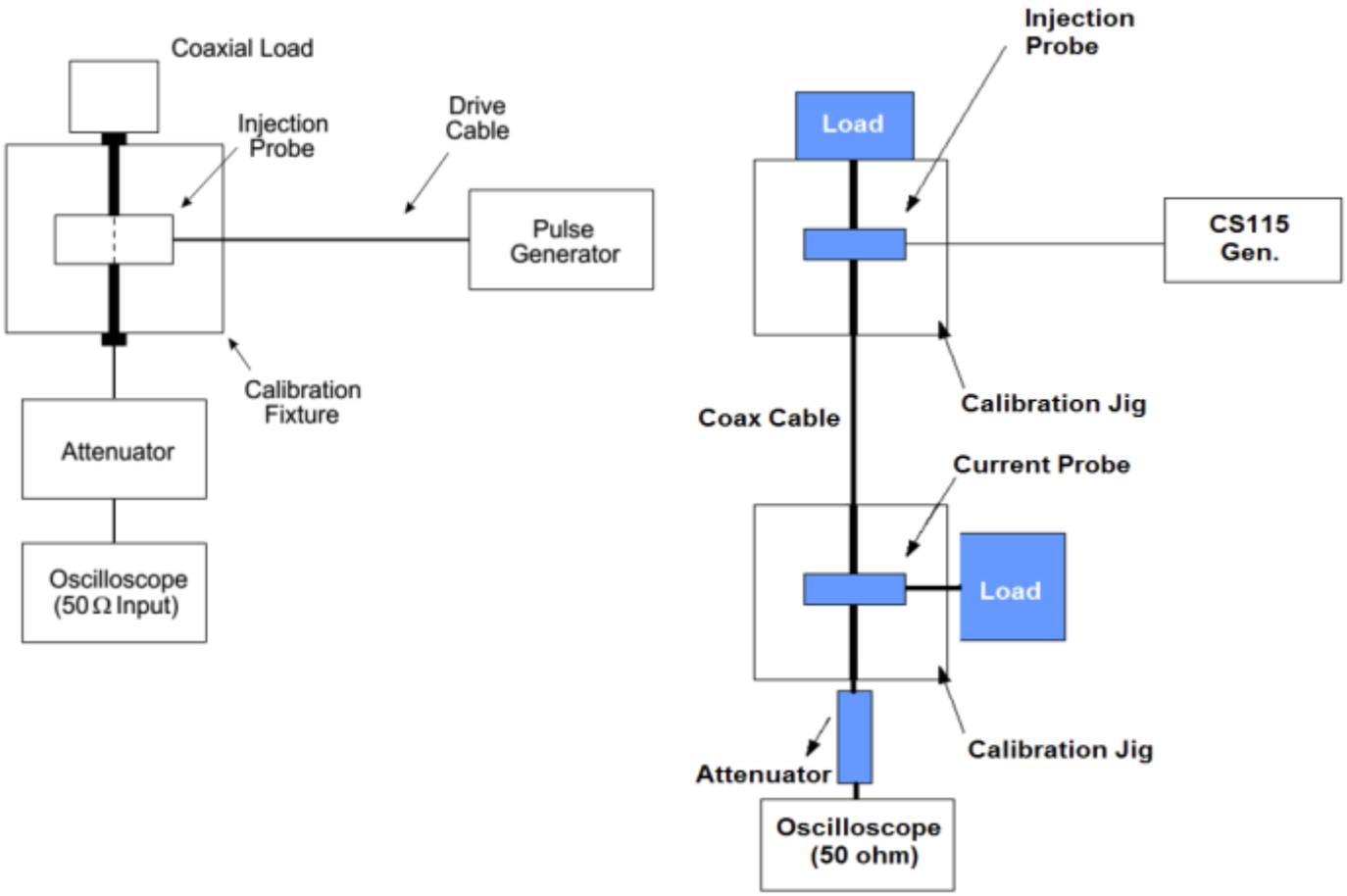
**Class B:** all functions of a device/system perform as designed during exposure. However, one or more of them can go beyond specified tolerance. All functions return automatically to within normal limits after exposure is removed.

**Class C:** one or more functions of a device/system do not perform as designed during exposure but return automatically to normal operation after exposure is removed.

**Class D:** one or more functions of a device/system do not perform as designed during exposure and do not return to normal operation until exposure is removed and the device/system is reset by simple "operator/use" action.

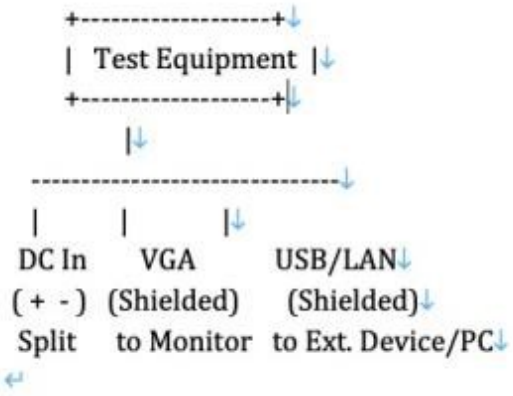
**Class E:** one or more functions of a device/system do not perform as designed during and after exposure and cannot be returned to proper operation without repairing or replacing the device/system.

### 5-6.3 Test Configuration



### 5-6.4 Test Setup of wires in the DC In cable:

The following diagram illustrates the test setup and the separation of wires in the DC In cable:




All I/O cables are tested whole. The Power cable is tested as a bundle (i.e. all wires) and also with just the + line.

## 5-7 CS116 TEST

### 5-7.1 Requirements

Perform the Conducted susceptibility, damped sinusoidal transients, cables and power leads test in accordance with MIL-STD-461G the following parameters:**10KHz to 100MHz**

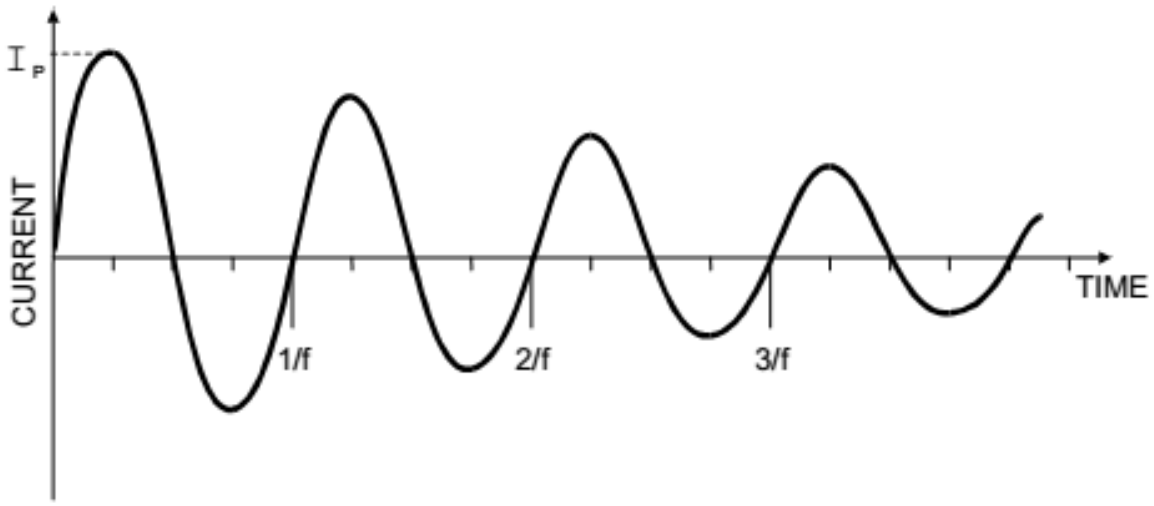
**Limit**

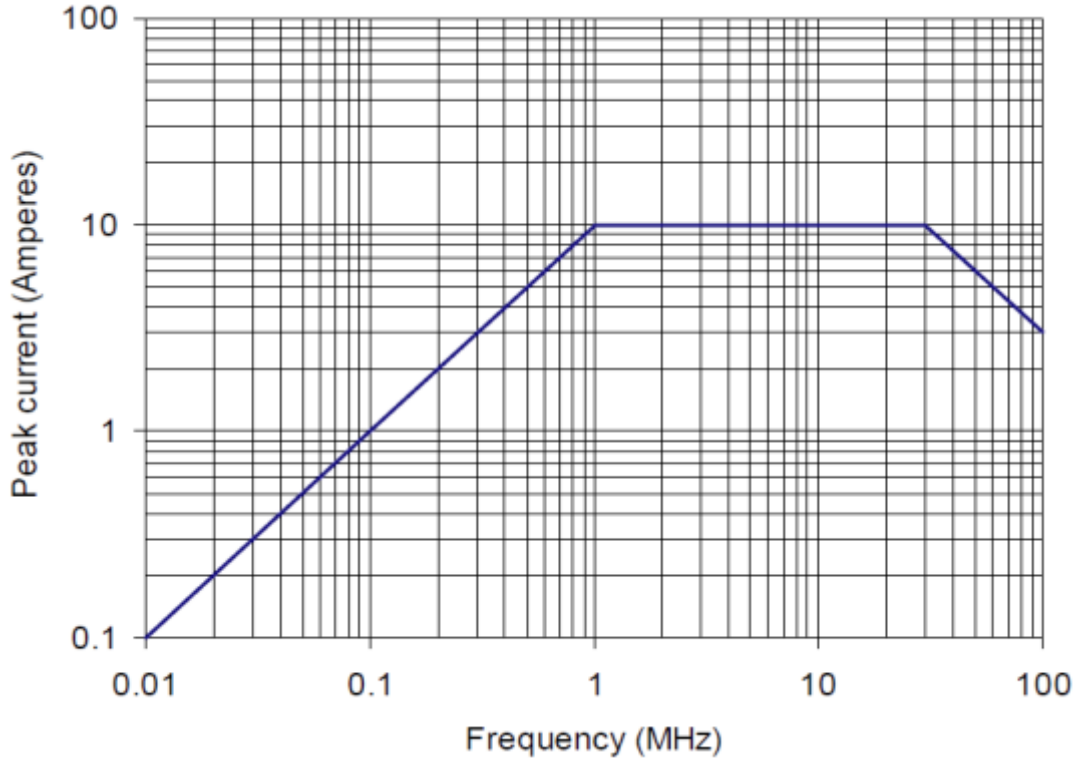
The EUT shall not exhibit any malfunction, degradation of performance, or deviation from specified indications, beyond the tolerances indicated in the individual equipment or subsystem specification, when subjected to a test signal with voltage levels as specified in Figure CS116. The requirement is also met when the power source is adjusted to dissipate the power level shown in Figure CS116 and the EUT is not susceptible.

### 5-7.2 Test Procedure

The CS116 test is used to verify the ability of the EUT to withstand damped sinusoidal transients coupled onto EUT associated cables and power leads.

**Frequency Range:** 10KHz-100MHz
**Unit:** Current (A)
**Interference Signal**: Damped Sinusoidal Transients
**Test Duration:** 5 minutes per applcation






Test Frequencies: 10 kHz, 100 kHz, 1 MHz, 10 MHz, 30 MHz, 100 MHz as a minimum

## Classification Of Functional Status

All classifications are for the total device/system functional status.

**Class A:** all functions of a device/system perform as designed during and after exposure to disturbance.

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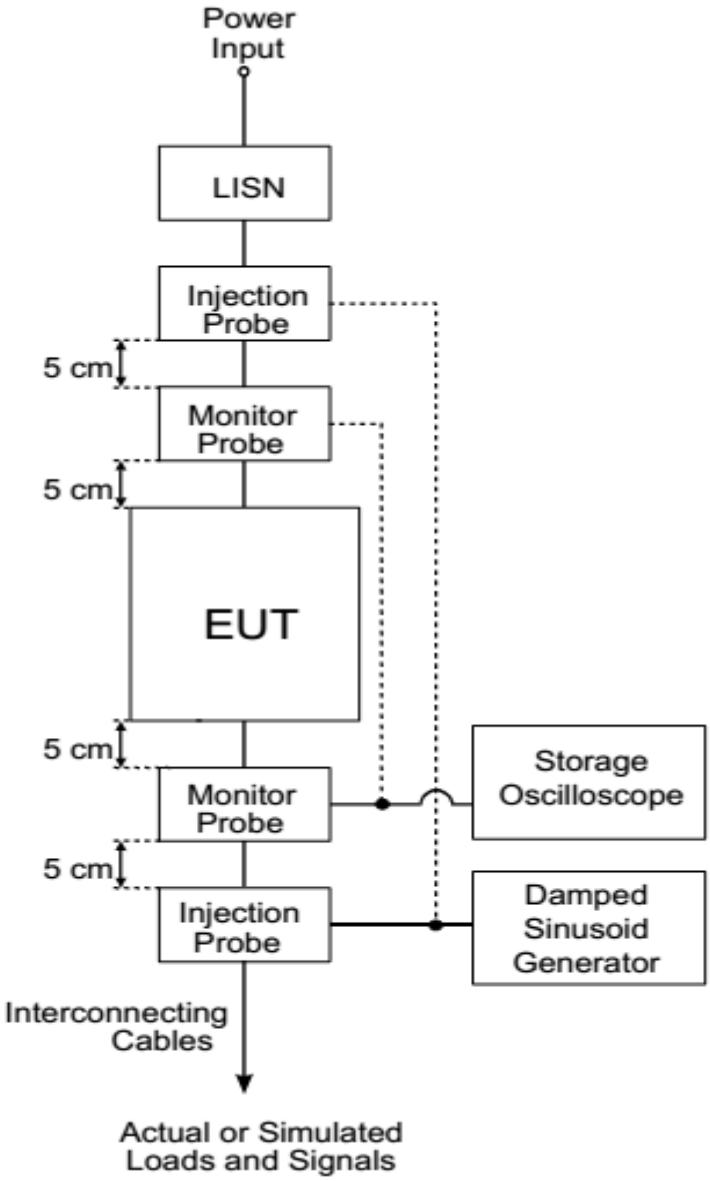
**Class C:** one or more functions of a device/system do not perform as designed during exposure but return automatically to normal operation after exposure is removed.

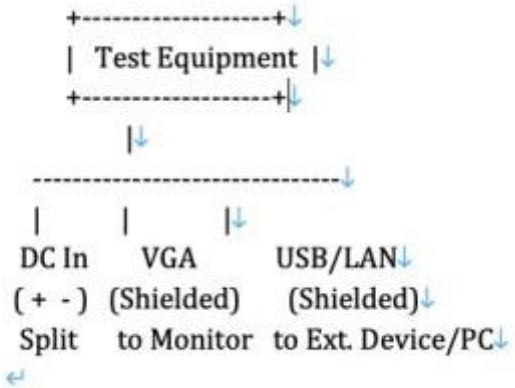
**Class D:** one or more functions of a device/system do not perform as designed during exposure and do not return to normal operation until exposure is removed and the device/system is reset by simple “operator/use” action.

**Class E:** one or more functions of a device/system do not perform as designed during and after exposure and cannot be returned to proper operation without repairing or replacing the device/system.

### 5-7.3 Test Configuration




The following diagram illustrates the test setup and the separation of wires in the DC In Cable:




All I/O cables are tested whole including the Power cable.

## 5-8 CS118 TEST

### 5-8.1 Requirements

This requirement is applicable to electrical, electronic, and electromechanical subsystems and equipment that have a man-machine interface.

**Limit**

The EUT shall not exhibit any malfunction, degradation of performance, or deviation from specified indications, beyond the tolerances indicated in the individual equipment or subsystem specification, when subjected to the values shown in Table while discharging from a 150 picofarads capacitor through a 330 ohm resistor with a circuit inductance not to exceed 5 microhenry. Contact discharge at 8kV is required for conductive surfaces. Air discharge is only required where contact discharge cannot be applied

### 5-8.2 Test Procedure

The test equipment shall be as follows:

a. ESD Generator, adjustable from ±2kV to ±15kV (minimum range), for simplified ESD generator characteristics.
b. ESD network, 150 picofarads (pF) capacitance, 330 ohm discharge resistance.
c. Contact discharge tip Figure CS118-2
d. Air discharge tip Figure CS118-2
e. Electrostatic voltmeter.
f. Oscilloscope, single event bandwidth ≥ 1 GHz.
g. ESD current target, input resistance 2 ±5% ohms Figure CS118-3.
h. Attenuator, 20 dB.
i. Coaxial cable, 50 ohm impedance, ≤ 1 meter.
j. Metallic ground plane.
k. Ionizer or one (1) megohm resistor (1MΩ±10%).

| Level | Test Voltage (kV) | Discharge Method |
|---|---|---|
| 1 | ± 2 | Air |
| 2 | ± 4 | Air |
| 3 | ± 8 | Contact/Air |
| 4 | ± 15 | Air |

| Display Voltage (kV) | First Peak Current, ± 15% (A) | Rise Time (ns) | Current $I_1$, ± 30% (A) at $t_1$ = 30 ns | Current $I_2$, ± 30% (A) at $t_2$ = 60 ns |
|---|---|---|---|---|
| ± 8 | 30 | $0.6 \le t_r \le 1.0$ | 16 | 8 |
| Rise time is defined as the time from 10% to 90% of the peak value of the current waveform. | | | | |

**Typical test consists of 5 positive discharges and 5 negative discharges per test point.**

**TABLE X. ESD generator general specifications.**

| Parameters | Values |
|---|---|
| Output voltage, contact discharge mode (see NOTE 1) | At least 2 kV to 8 kV, nominal |
| Output voltage, air discharge mode (see NOTE 1) | At least 2 kV to 15 kV, nominal |
| Tolerance of output voltage | ±5 % |
| Polarity of output voltage | Positive and negative |
| Holding time | ≥5 s |
| Discharge mode of operation | Single discharge (see NOTE 2) |
| NOTE 1: Open circuit voltage measured at the discharge electrode of the ESD generator.<br>NOTE 2: The generator should be able to generate at the repetition rate of at least 20 discharges per second for exploratory purposes. | |

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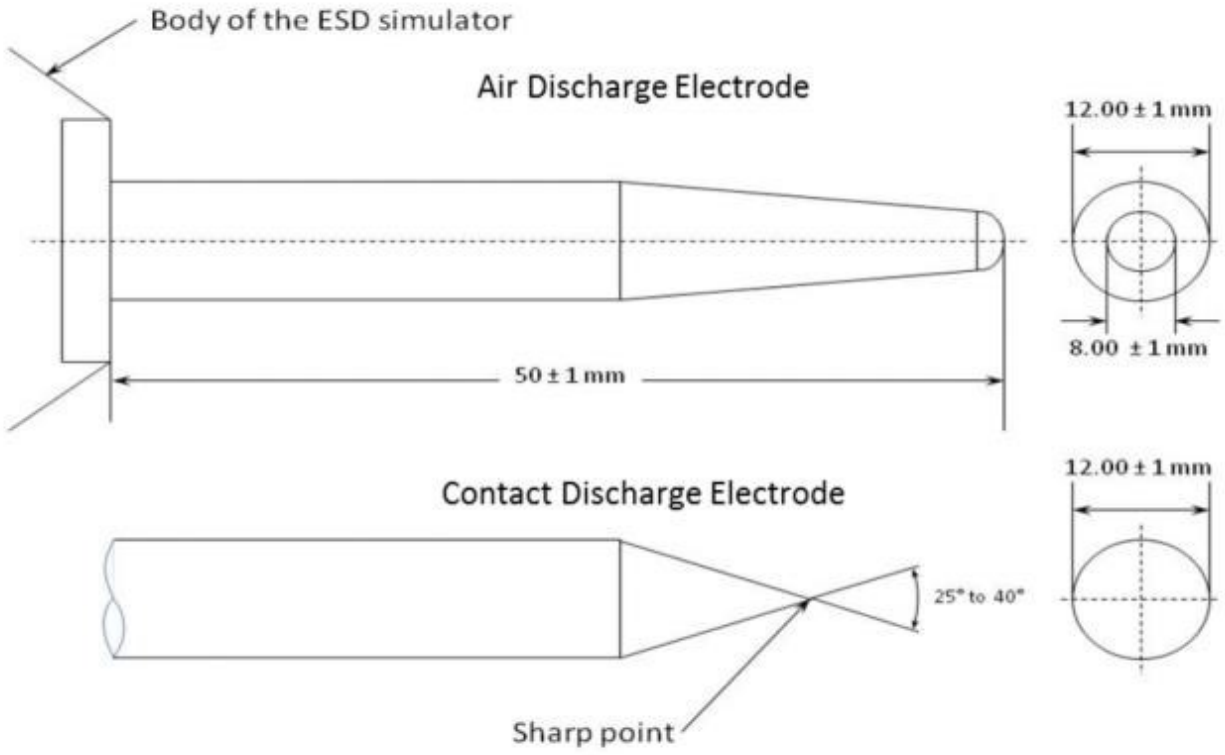


**FIGURE CS118-2. Discharge electrodes of the ESD generator.**

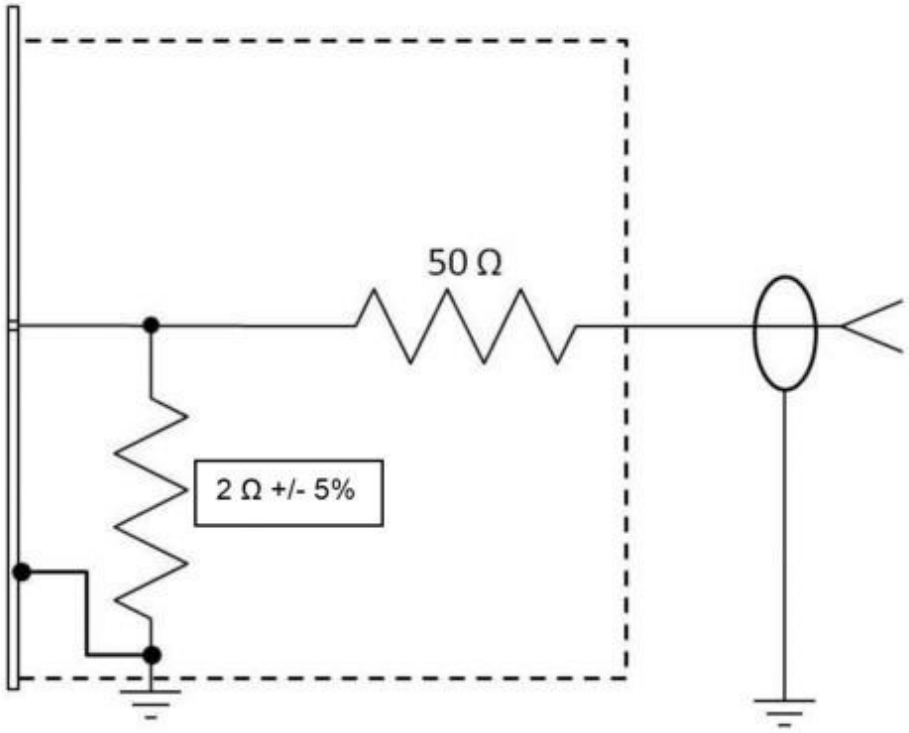


FIGURE CS118-3. Sample ESD current target schematic representation.

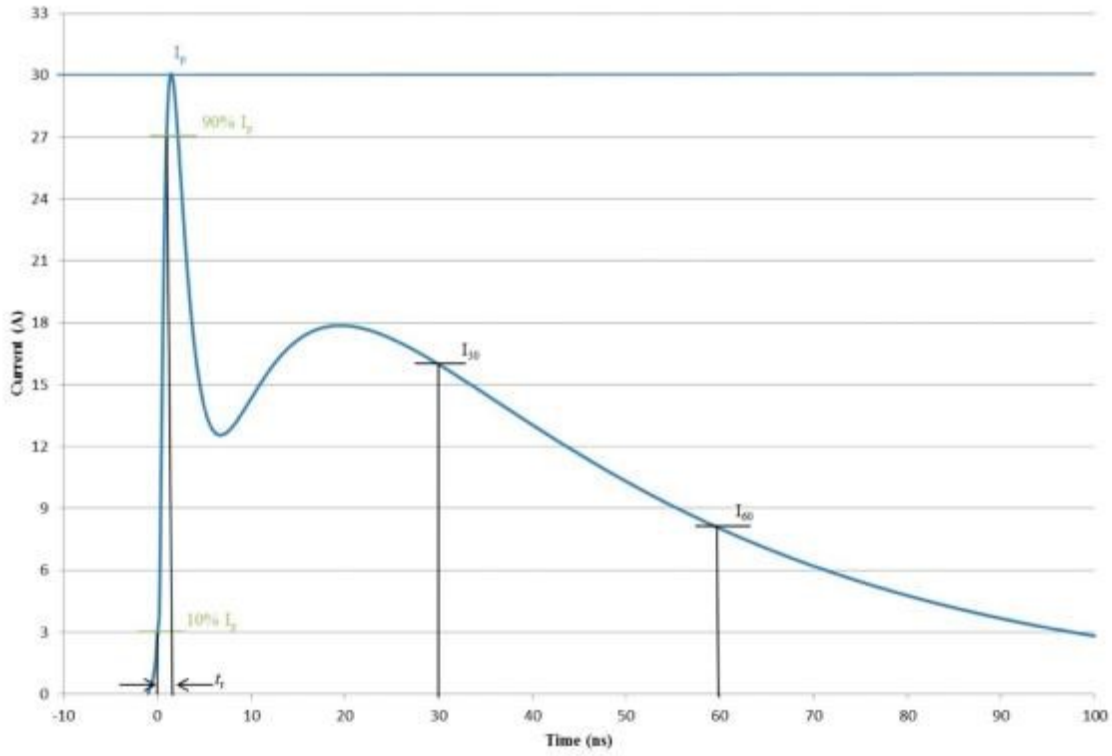


FIGURE CS118-4. Ideal contact discharge current waveform at 8 kV.


Apply five (5) positive discharges and five (5) negative discharges to each EUT test point as discussed in test point selection in 5.16.3.3 (b). (Test Point Selection. The electrostatic discharges shall be applied to those points and surfaces of the EUT which are accessible to the operator/installer during normal use. Test points to be considered shall include the following locations as applicable: any conductive or non-conductive points in the control or keyboard area and any other point of human contact such as switches, knobs, buttons, indicators LEDs, seams slots, grilles, connector shells and other accessible areas. As a minimum, each face shall be included.)