# CS114, CS115, CS116 Testing

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## **General Test Setup for Military Tests**

MIL-STD461F : Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems And Equipment



## CS114, Conducted Susceptibility, Bulk Cable Injection, 10 kHz-200MHz

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

- Frequency Range: 10 kHz (4 kHz) 200 MHz
- **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% (30 MHz-200 MHz)
- Unit: Current (dBuA)
- Modulation: 1 kHz, 50% Duty Cycle, Pulse Modulation
- Application: All power and interconnecting cables



#### **CS114 Limit Curves**





## **CS114 Applications**

			LIMIT CU	JRVE NUMBER	GURE CS-114-1 AND LIMITS				
PLATFORM FREQUENCY RANGE		AIRCRFAFT (EXTERNAL OR SAFETY CRITICAL)	AIRCRAFT INTERNAL	ALL SHIPS (ABOVE DECKS) AND SUBMARINES (EXTERNAL)*	SHIPS (METALLIC) (BELOW DECKS)	SHIPS (NON- METALLIC) (BELOW DECK)	SUBMARINE (INTERNAL)	GROUND	SPACE
4 kHz to 1MHz	N	-	-	77 dBµA	77 dBμA	77 dBμA	77 dBμA	-	-
10 kHz to 2 MHz	Α	5	5	2	2	2	1	3	3
	N	5	3	2	2	2	1	2	3
	AF	5	3	-	-	-	-	2	3
2 MHz to 30 MHz	Α	5	5	5	2	4	1	4	3
	N	5	5	5	2	4	1	2	3
	AF	5	3	-	-	-	-	2	3
30 MHz to 200 MHZ	Α	5	5	5	2	2	2	4	3
	N	5	5	5	2	2	2	2	3
	AF	5	3	-	-	-	-	2	3



## **CS114 Calibration**



#### **CS114 Verification**







#### CS114 Test



#### **CS114** Pulse Modulation











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PULSE MODULATION SHAPE FOR R\$103 AND C\$114 TESTS

 1 kHz - %50 Pulse Modulation (40 dB minimum from peak to baseline)

## **Different Levelling Methods in CS114 tests**

 During testing, reaching the target level by gradually increasing the signal generator level and simultaneously getting feedback from the receiver or power meter per test frequency, is called "Leveling"



## **CS114 Levelling Methods**

# Leveling Under CW Signal

(Commonly Practiced Method)

## Leveling Under Pulse Modulated Signal

(Required By Standard)



## **Leveling Under CW Signal**



- > No pulse correction factor for the receiver and power meter is required
- Standard test software used for commercial tests can be also employed easily for CS114 testing
- > The burden of measurement and use of pulse correction factors is eliminated.
- > Correct test verdict is tricky (EUT pass? or fail?) because EUT may fail under CW irreversibly
- This method is not stated in the standard !



## **Leveling Under Pulse Modulated Signal**

(Stipulated by standard)



> Measurement of pulse correction factors for the receiver and power meter may be required before the test as the peak detector is requested by the standard

- > Test software must be suitable specially for this leveling method
- The test verdict is easy and reliable
- > This is the actually required method by the standard



## **CS114 CW Levelling vs Pulse Levelling**



Probable differences in test results and also the indecision in the judgment of the EUT may occur due to the different effects of the two leveling methods.

Some EUTs may fail under the CW signal but may pass under the pulse modulated signal, therefore extra precautions should be taken to prove that the EUT fails really under the pulse modulated signal.

## CS115, Conducted Susceptibility, Bulk Cable Injection, Impulse Excitation

**Purpose:** 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
- Application: All power and interconnecting cables



#### **CS115 Signal Characteristics**



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#### **CS115** Calibration Setup





## **CS115 Broadband Current Probe Calibration**



#### **CS115 Test Setup**





Tested Ported	Polarity	C S115 Generator Value (A)	Injected Current Level (A)
Shielded Power Cable	Positive	5	4,10
Shieldeu Powei Cable	Negative	5	4,00
Shielded PCNET Cable	Positive	5	4,30
	Negative	5	4,37
Shielded DBDS Cable	Positive	5	5,37
Silleided DBDS Cable	Negative	5	5,45
Shielded ALLY Cable	Positive	5	6,70
	Negative	5	6,95





# CS116, Conducted Susceptibility, Damped Sinusoid Transients, 10 kHz to 100 MHz

**Purpose:** 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: 10 kHz 100 MHz
- Unit: Current (A)
- Interference Signal: Damped Sinusoidal Transients
- Test Duration: 5 minutes per application
- Application: All power cables, individual high-side power \_\_\_\_\_\_\_\_
   Ieads and interconnecting cables

## **CS116 damped sinusoidal waveform**



t = Time (sec) Q = Damping factor, 15±5

2. Damping factor (Q) shall be determined as follows:

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

Q = Damping factor N = Cycle number (i.e. N = 2, 3, 4, 5,...) $I_{\rm p}$  = Peak current at 1<sup>st</sup> cycle  $I_{N}$  = Peak current at cycle closest to 50% decay In = Natural log

The pulse repetition rate shall be no greater than one pulse per second and no less than one pulse every two seconds.

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

#### **CS116** Calibration





## CS116 Test





10 kHz, 100 kHz, 1 MHz and 10 MHz







Tested port	Polarity	Frequency (MHz)	Pulse Level (A)	Injected Current Level (A)
	Positive	0,01	0,1	35,3
	Positive	0,1	1	32,2
	Positive	1	10	53,3
	Positive	10	10	5,7
	Positive	30	10	6,7
Shielded Bower Cable	Positive	100	3	2,1
Silleided Fower Cable	Negative	0,01	0,1	35,8
	Negative	0,1	1	32,6
	Negative	1	10	53,8
	Negative	10	10	5,8
	Negative	30	10	6,6
	Negative	100	3	2,0

