



Insights and best practice

EMC COMPLIANCE KNOW-HOW



TECHNICAL NOTE 0120

emtest / TESEQ / AMETEK

IEC 61000-4-6 ED 5

EDITION 5 - CHANGES TO THE STANDARD

This technical note, delves into the important updates encapsulated in the latest iteration, IEC 61000-4-6:2023. This international standard outlines meticulous testing procedures aimed at safeguarding electrical equipment against potential disruptions induced by conducted disturbances originating from nearby radio frequency fields. These disturbances, often provoked when cables or leads act as inadvertent antennas, pose a critical consideration in the realm of electromagnetic compatibility (EMC) testing.

Within this document, we navigate through key modifications in the standard and explore their implications on EMC test equipment.

Significant technical changes with respect to the previous edition:

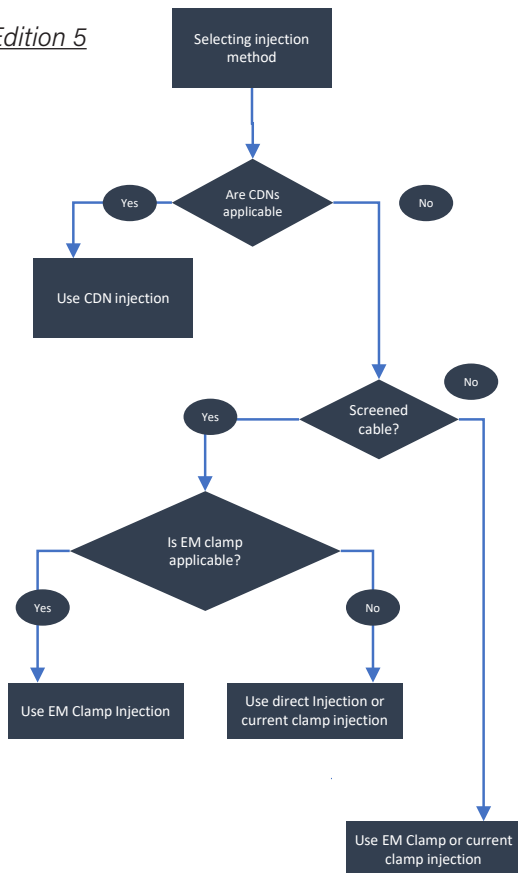
- a. Selection of injection devices revised
- b. Level-setting only with feedback loop
- c. Saturation check revised
- d. Decoupling specifications
- e. Need of AE impedance check for clamp injection removed and Annex H deleted
- f. New Annex H on testing with multiple signals

IMPORTANT NOTE : This document aims to emphasize significant changes between editions 4 and 5 of the IEC 61000-4-6:2023 standard. It is the reader's responsibility to thoroughly review and apply the complete text of edition 5 based on their individual circumstances.

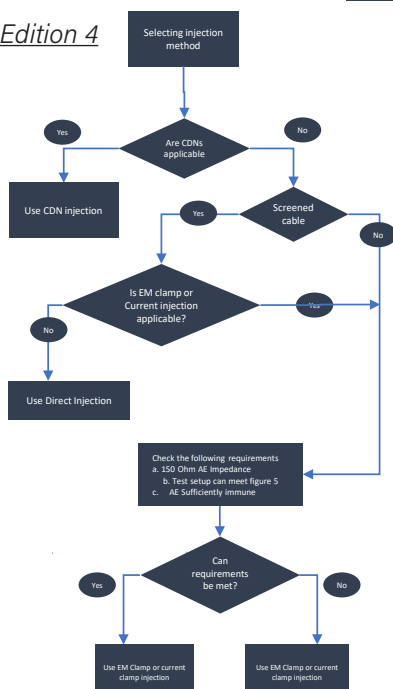


a. SELECTION OF INJECTION DEVICES
(revised)

Edition 5



Edition 4



You can choose the injection device by referring to the Edition 5 selection diagram on the left. For comparison, diagram 2 displays the selection chart for the standard's previous Edition

UPDATE

1. If CDN is applicable → then use it

Ed. 4: This is similar to edition 4

UPDATE

2. If EM clamp can accommodate the cable & the cable is screened → use it without testing the AE side impedance and if AE immune. Please read carefully the conditions needed to be verified to apply this test, specifically concerning common-mode impedance and the monitoring of current probes.

Ed. 4: The condition is comparable, with the additional consideration of whether the current clamp can also accommodate the cable. In this instance will need to check the AE impedance and also check if AE sufficiently immune. If these requirements are met then use either EM clamp or current clamp. If the requirements are not met then you can still use either EM clamp or current clamp but with more steps written in section 7.7.

UPDATE

3. If EM clamp cannot accommodate the cable & the cable is screened → use either current clamp or direct injection.

Ed. 4: The condition is similar, but with the added consideration that if the current clamp cannot accommodate the cable, the only viable option is to utilize direct injection in this scenario.

UPDATE

4. If the cable is not screened → use either EM clamp or current clamp injection

Ed. 4: If this condition is met then you should use the same requirement check as in condition 2 in Edition 4.

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UPDATE

b. TEST LEVEL IN ED. 5 HAS TWO MODIFICATION COMPARED TO ED. 4 *(revised)*

1. The customer is required to assess the forward power output specifically from the power amplifier, without the necessity to measure power generated by the generator.
2. The test level must consistently incorporate the stop frequency.

UPDATE

c. AMPLIFIER SATURATION CHECK *(revised)*

Compared to Edition 4 of IEC 61000-4-6, Edition 5 requires you to specifically repeat the saturation check for each frequency at the highest level. In Edition 4 the frequency requirements are not mentioned.

Power measurement before and after adding the 5.1 dB is enough in Ed. 5 and there is no need to measure the voltage for the linearity check.

UPDATE

d. DECOUPLING SPECIFICATIONS *(revised)*

The decoupling clamp specifications are clearly outlined in Edition 5, contrasting with Edition 4. These specifications include:

- Operating frequency 0.15 MHz to 80 MHz
- Decoupling factor for frequencies above 1 MHz should be better than 5 dB (measured using ABCD transformation) which corresponds to better than 14 dB measured in 50 Ω system
- Height of the center of the clamp opening above the ground plane: 35 mm to 70mm
- Clamp reference point (distance from outer dimension to first core): <30 mm

UPDATE

e. AE IMPEDANCE CHECK FOR CLAMP INJECTION *(removed and Annex H deleted)*

Since there is no requirement for the impedance check when using EM clamp, the whole section in Ed. 5 is deleted.

UPDATE

f. MULTIPLE SIGNAL TESTING *(new optional requirement)*

The testing of multiple signals within a single dwell cycle is a new optional step in Edition 5 of IEC 61000-4-6. This option proves advantageous for customers as it effectively cuts testing time in half if two signals are used. Nevertheless, there are several points that need to be addressed:

Intermodulation

When utilizing two or more signals to drive the power amplifier, various combinations, such as the sum or difference of several multiples of the original signal, can be generated. If the amplifier lacks linearity or is driven at high power levels, near saturation, it may exhibit visible intermodulation signals. These signals can impact the overall power, resulting in a failure to test the EUT with the specified power or potentially degrading its performance."

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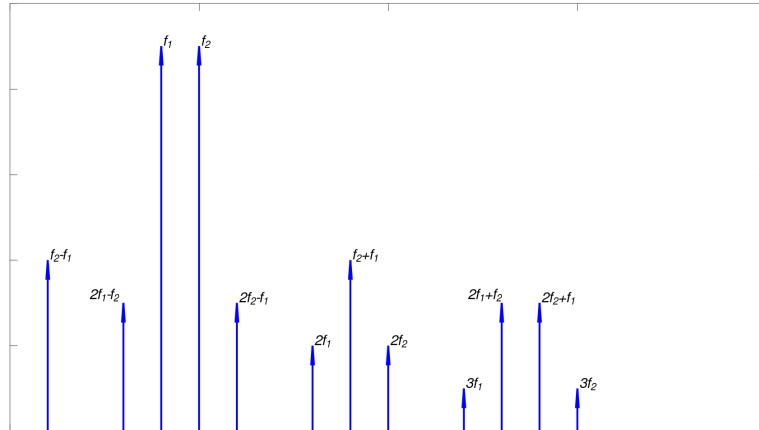


MULTIPLE SIGNAL TESTING *continued...*

The intermodulation signals are the sum or difference of multiple of the multisignal frequency (e.g. f_1 and f_2) as following:

$$m*f_1 \pm n*f_2$$

where m and n are integer number and $m+n$ is the order of IMD products.



Power requirements

The power for multiple signal will increase compared to a single frequency according to:

$$10*\log(N)$$

Where N is number of signals. So, for two signal testing we need 3 dB more power for CW and 8.1 dB for modulated signals.

Level setting

A selective power measurement device should be used in addition to the normal calibration testing for each signal.

The saturation check can also be used for each additional signal to find the total number of possible test signals for the amplifier.

Linearity testing

Saturation testing should be applied on each test signal as an aggregate. When all test signals are present the generator should increase the power by 5.1dBm. Each signal should be measured and checked if it is within 3.1 dB to 7.1 dB range.

For linearity check, the power of all non-fundamental signals should be measured and should be less than 6 dB to the main test signals.

EUT Performance criteria with multiple signals

Performance criteria for the Equipment Under Test (EUT) with multiple signals involve a retesting procedure in case of failure. It is necessary to conduct individual testing for each signal if the EUT fails during the multiple-signal test. The EUT is considered to have failed the overall testing only if it fails during retesting with a single frequency.

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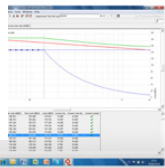
CONDUCTED RF IMMUNITY TEST SOLUTIONS - IEC/EN 61000-4-6



HIGH FREQUENCY GENERATORS RF IMMUNITY TEST SYSTEMS



AMETEK CTS offers RF Immunity test systems covering applications with frequency range from 4 kHz to 6 GHz. Depending upon the mode, the test systems can be ordered integrated with different options such as amplifiers, power meters, switch and EUT monitoring.



SOFTWARE RF IMMUNITY TEST SYSTEMS



Software for the remote operation of AMETEK CTS signal generators used for EMC testing. The software can be used in simulation mode and test mode, where simulation mode allows user to get familiarized with the software for testing in EMC environment. It is easy to make your first tests quickly with the Standard Test. The Vector Test is structured so it stands to your highest requirements on the most variable test-procedures.



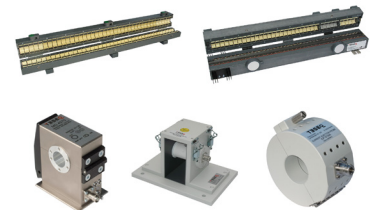
RF CDN-COMMON MODE



A comprehensive selection of coupling/decoupling networks (CDNs) encompassing the M, AF, S, T, and CAN series. These CDNs adhere entirely to the guidelines set forth by IEC/EN 61000-4-6.



RF PROBES AND CLAMPS



Absorbing Clamps are used for measuring interference signals on power supply cables. Decoupling clamps and ferrite tube are available for a variety of different EMC applications. The current sensing probes are used for current monitoring applications, such as those required by the standard IEC/EN 61000-4-6