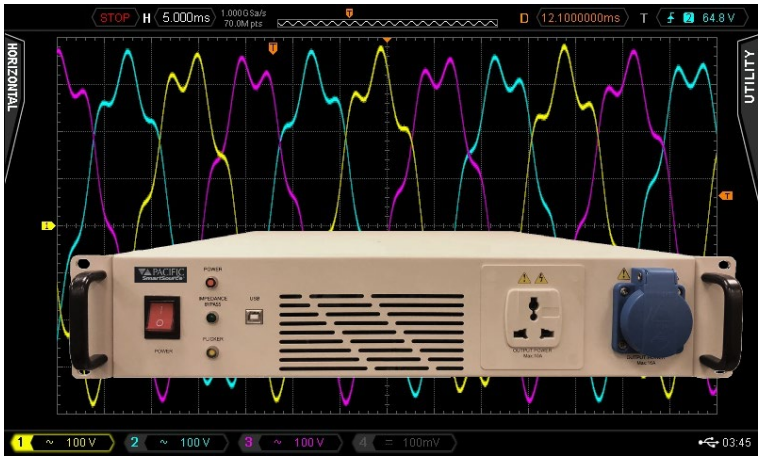
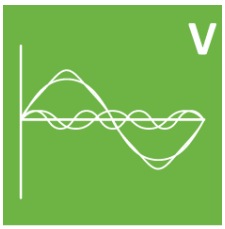
IEC 61000-4-13 Testing and Lumped Impedance Use



RELEVANT IEC STANDARDS

- IEC61000-4-13



HARM & INTERHARM

1 Preface

This application note explains the purpose of using a Lumped Impedance network as defined by IEC standard IEC TR 60725:2012. This impedance is normally used during voltage flicker emissions testing by Harmonics and Flicker test systems like the Pacific Power ECTS2 series but also has a purpose during IEC61000-4-13 Harmonics and Inter Harmonics testing. Often, EUTs that have to be tested for harmonics and flicker emissions also need to be tested for harmonics and inter harmonics immunity so the same EMC test system can be used.

2 Relevance

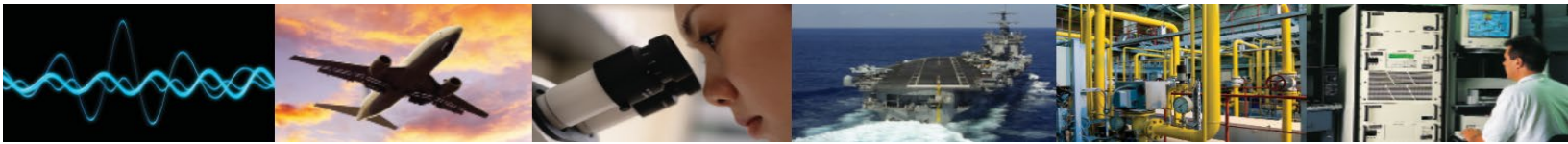
The detection of current resonance points may require the use of an additional impedance between the test generator and the Equipment Under Test (EUT) so EMC test systems used to verify compliance to IEC61000-4-13 Immunity must be equipped with such an impedance.

3 Pertinent Sections of the IEC61000-4-13 Standard

This section contains the relevant sections of the IEC61000-4-13 reference test standard.

3.1 6.1 Test Generator, Table 5, Note 5:

- An external series impedance network may be used, but only to find possible resonance excited by harmonics. The IEC 60725 impedance network is suggested. Annex A is included in this standard for guidance.



3.2 Section 6.2 Verification of the characteristics of the generator

The maximum harmonic voltage distortion of the generator shall be in accordance with IEC 61000-3-2 (when no harmonic/inter-harmonic is selected). The maximum distortion limits while delivering power to the EUT are given in table 6. (Note – Same as IEC 61000-3-2 standard V_{THD})

Harmonic number	% of U1
3	0,9
5	0,4
7	0,3
9	0,2
2 to 10 (even harmonics)	0,2
11-40	0,1

Table 6 – Maximum Harmonic Voltage Distortion

The characteristics of the generator specified in 6.1 lead to generators with low internal impedance. To simplify the procedure, the verification of the characteristics of the generator in accordance with 6.2 shall be performed **in the absence of** an external impedance network.

3.3 Annex A, Text:

The relevant Annex of the IEC61000-4-13 Test standard states the following:

Impedance network between voltage source and EUT

Most test generators have an extremely low, near zero, impedance which does not present a problem for testing. However, if it can be determined by a product committee that an impedance network is desired to find possible resonance between line and the EUT that could be excited by harmonics, the IEC 60725 impedance network is suggested.

As a result of LC resonant circuits formed by network line impedance and capacitor(s) inside an EUT, resonant phenomena excited by harmonic voltage sources can appear. These resonant phenomena can affect the proper operation of an EUT.

This leads to the necessity to place an impedance between the voltage fundamental and harmonics source and the EUT. Mains disturbance effects are likely to occur for high-level lower frequency harmonics when they excite these resonant circuits.

The IEC 60725 impedance network (phase Z = 0,24 + j 0,15 Ω, neutral Z = 0,16 + j 0,10 Ω at 50 Hz) is specified to be inserted in the test set-up between the source and EUT to detect possible damaging resonant phenomena excited by harmonics.

The representative impedance for 60 Hz networks is suggested as follows:

- for 120 / 208 V (phase Z = 0,10 + j 0,04 Ω, neutral Z = 0,10 + j 0,03 Ω)
- for 347 / 600 V (phase Z = 0,29 + j 0,07 Ω, neutral Z = 0,30 + j 0,04 Ω)

Product committees are free to realize additional tests with other impedance values considered to be of significant interest with regard to interactions with the EUT.

4 ECTS2 Lumped Impedances

All Pacific Power ECTS2 Harmonics and Flicker test systems are equipped with one or more IEC Flicker Impedances to support full compliance flicker test. These same impedances can be used to detect current resonance points in EUTs tested for IEC61000-4-13 immunity. The electrical schematic for this impedance and values for 230Vac, 50Hz test requirements are shown in the figure below.

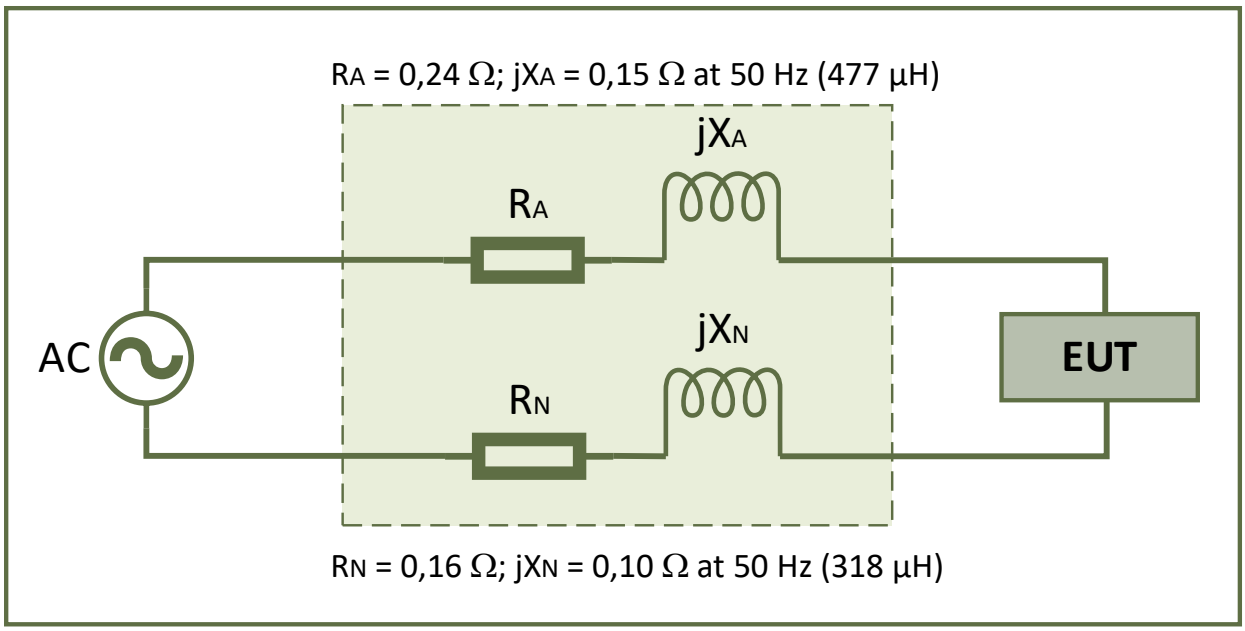


Figure 1: IEC TR 60725 Lumped Impedance Values for Single Phase

4.1 IEC TR 60725:2012 Abstract

IEC TR 60725:2012, which is a technical report, records the information that was available and the factors that were taken into account in arriving at the reference impedances that were incorporated in IEC 60555 and which are now incorporated in some parts of IEC 61000-3. In addition, information is given on the impedances of public supply networks associated with service current capacities $\leq$ 100 A per phase. The third edition includes brings two mainly significant technical changes with respect to the previous edition:

- A new survey and other data from countries with public supply networks operating at 60 Hz have been included; and
- Recommendations that were applicable to 50 Hz systems are now mirrored by new recommendations that are relevant to 60 Hz systems.

5 What does this mean?

As stated in the IEC standard, for compliance testing to IEC61000-4-13, the default position is that no Lumped Impedance is inserted between the AC generator and the EUT during compliance testing (Impedance is set to **BYPASS** mode).

However, **IF** the product committee for a class of products deems it necessary to do so, the impedance values called out in Annex A are to be used during compliance testing.

Since there are many product standards for all kinds of products, the EMC test equipment vendor cannot direct the end user as to whether to use a lumped impedance or not. The designer or manufacturer of the product to be tested **MUST** know what product standard applies to their products and if the call out the use of this impedance or not.

6 Resonance Point (Current)

What is a current resonance point?

Covered by Annex B of the standard:

> A resonance point for example may be assumed, if the harmonic or inter harmonic current at a constant harmonic voltage amplitude reaches a maximum value at a frequency f_{res}, and the current decreases by 3 dB in the frequency range f_{res} to 1,5 f_{res}. A resonance frequency can cause significant thermal disturbances. Thermal effects are not considered in this standard.
>
> In practice, resonances appear especially at higher frequencies.

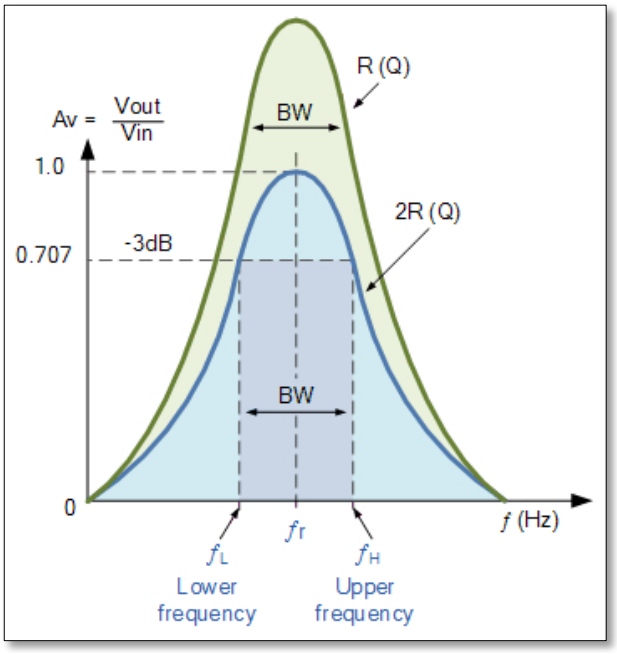


Figure 2: Current Resonance Point

Example:
A transformer is loaded by a capacitor. The capacitor causes a rising transformer current by increasing the frequency. If the leakage inductance of the transformer and the capacitor cause a resonance, a peak in the amplitude of current can occur. If the frequency is further increased, the transformer current decreases.

Note: Harmonic and inter harmonic currents can cause additional dissipation in transformers. This interaction can cause a degradation of the performance of an EUT. The heating effects due to this increased dissipation are not considered in this standard.

7 Summary

All Pacific Power ECTS2 EMC Test Systems have the required IEC TR 60725 Lumped Impedance available to find current resonance points on EUTs.

The Lumped Impedance can be selected from the Harmonics and Flicker test GUI (HFa) System Setup screen as shown in the figure below. Select "**Flicker from current**" to Bypass the lumped impedance.

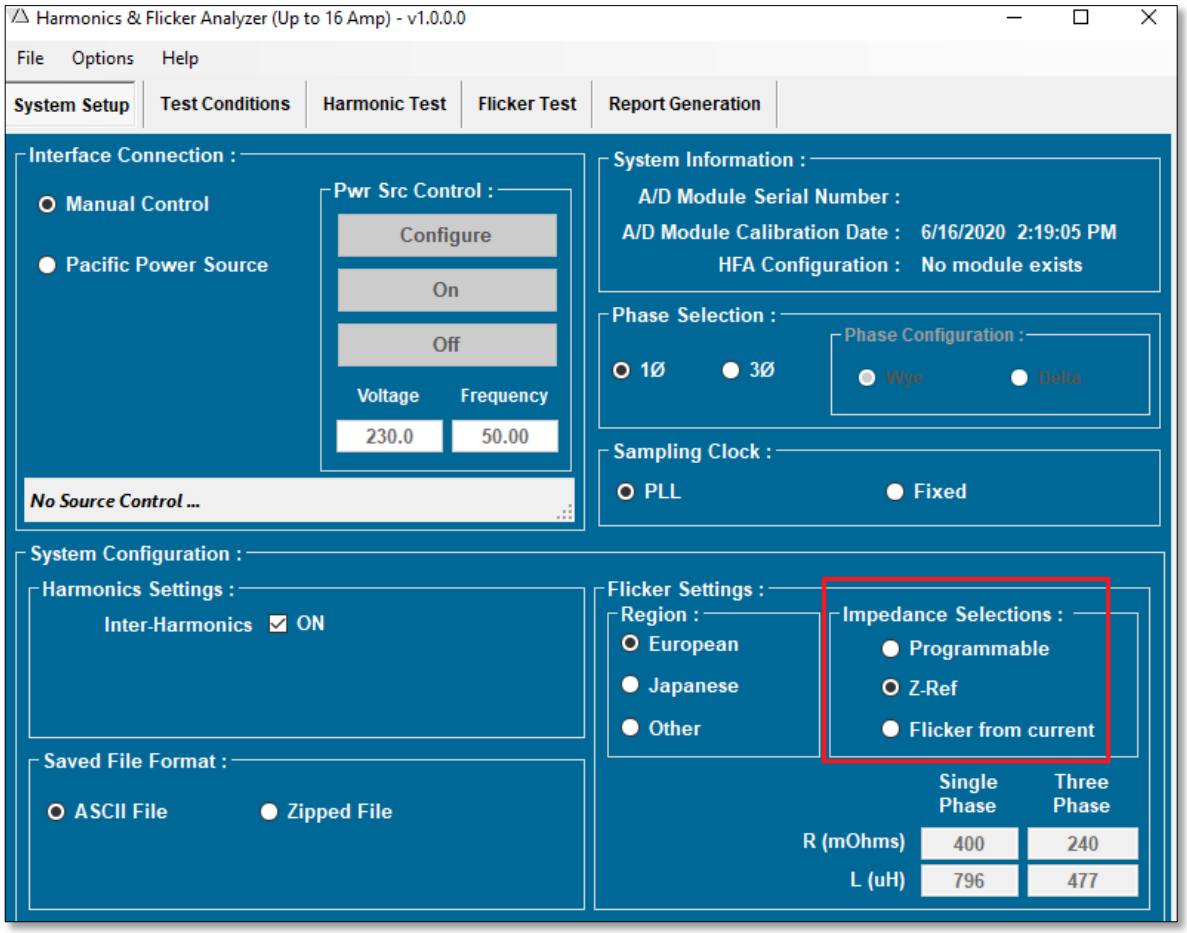


Figure 3: Lumped Impedance Selection Controls – Zref Lumped Impedance ENABLED

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