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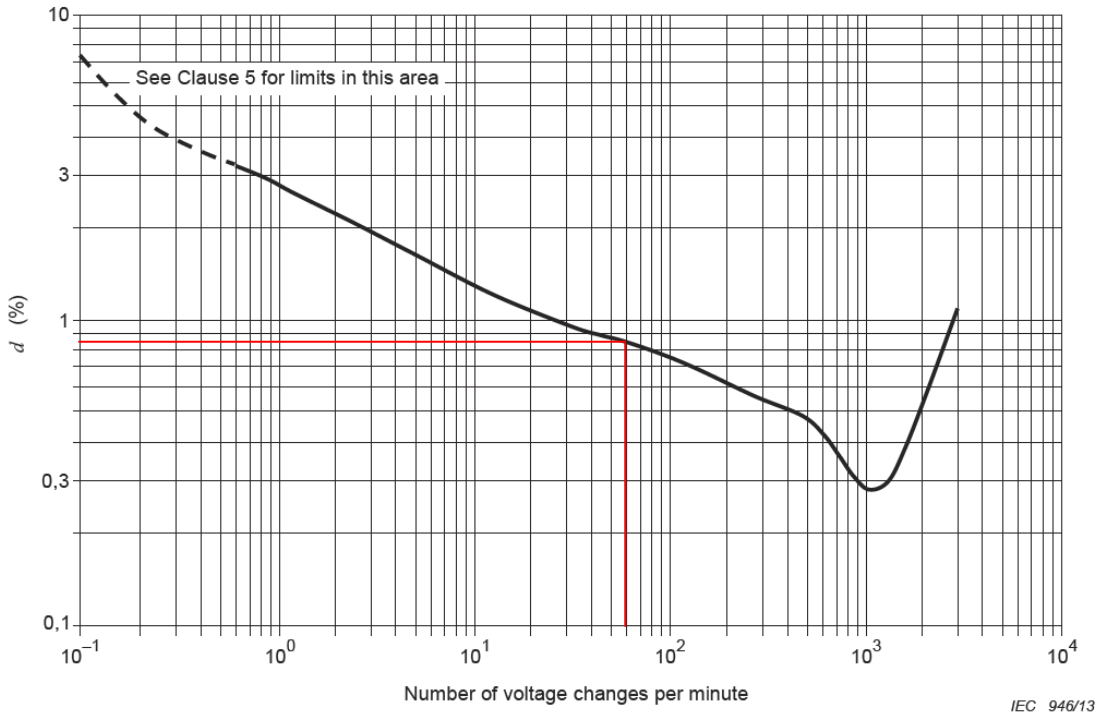
APPLICATION NOTE 34

Flicker Simulation with the Newtons4th N4Axx Power Sources

Flicker simulation may be required for a number of reasons, these include calibration of flicker meters or to verify the operation of a product within an environment that is exhibiting flicker itself. Flicker simulation with the Newtons4th N4A power sources allows R&D engineers to create a supply signal for a DUT(device under test) which exhibits flicker characteristics. This simulation is performed by modulating the amplitude of the applied signal (in this case 230Vrms, 50Hz) in the time domain. IEC61000-3-3 provides a number of tables and graphs which can be used to determine the modulation depth and changes/min that equate to a PST of 1. A wide variety of PST values can also be simulated by altering the modulation depth and the frequency at which the amplitude change occurs, this frequency is commonly referred to as the "changes/min" modulation rate.

Flicker simulation can be programmed via the "SEQUENCE" mode within the standard firmware of the N4A. Referring to the PST=1 curve in the IEC61000-3-3 international test standard, voltage modulation depth (d%) and voltage changes per minute can be derived.

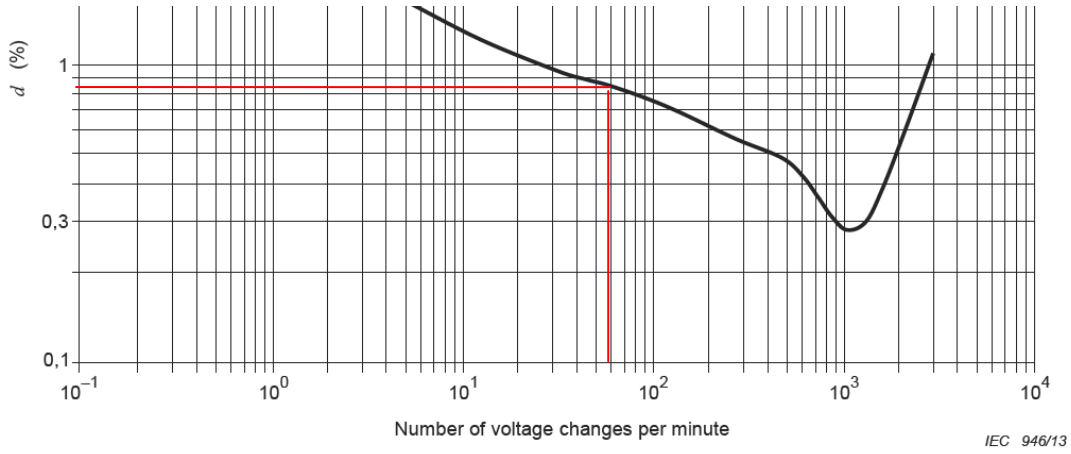


[1] IEC61000-3-3:2013

The N4A power sources feature the ability to provide magnitude modulation with a half cycle resolution, this flexibility results in a wide variety of flicker waveforms to be produced.

Example 1:

Vnom: 230V, Frequency: 50Hz, 60 Changes per minute = 1Hz modulation



[2]

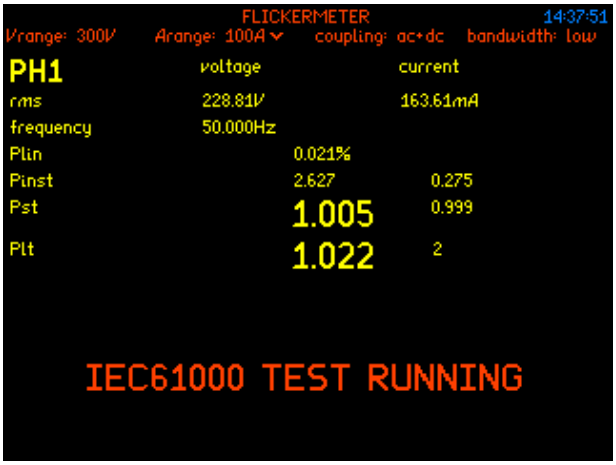
"Sequence mode" within the PPA is utilised to create the required amplitude depth and modulation frequency. Referring to figure [2], the modulation depth for the example 1Hz modulation (60/min) is 0.83%.

Sequence mode is configured as follows;

Sequence no	Voltage	Frequency	No. Half cycles
1	230	50	100
2	228.1	50	100

This signal is then generated by the AC power source (N4A06 in this example), which is able to supply a DUT with up to 6kVA.

PST Results (PPA5511 Precision Power Analyzer):



[3] PPA55x1, PST = 1.005

A PST result of 1.005 equates to a signal generation uncertainty of 0.5% (plus instrument measurement uncertainty of 3%), this is well within the 8% uncertainty limit of the IEC61000-3-3 standard.

Example 2:

Referring to Annex D of the IEC61000-3-3 standard, a PST = 1 simulation waveform can be created.

Annex D
(informative)

Input relative voltage fluctuation ΔV/V for P_{st} = 1,0 at output [IEC/TR 61000-3-7:2008]

Table D.1 – Input relative voltage fluctuation ΔV/V for P_{st} = 1,0 at output

Fluctuation rate (r) changes/min	Voltage fluctuation %		Fluctuation rate (r) changes/min	Voltage fluctuation %	
	120 V lamp 60 Hz system	230 V lamp 50 Hz System		120 V lamp 60 Hz system	230 V lamp 50 Hz system
0,1	8,202	7,4	176	0,739	0,64
0,2	5,232	4,58	273	0,65	0,56
0,4	4,062	3,54	375	0,594	0,5
0,6	3,645	3,2	480	0,559	0,48
1	3,166	2,724	585	0,501	0,42
2	2,568	2,211	682	0,445	0,37
3	2,25	1,95	796	0,393	0,32
5	1,899	1,64	1 020	0,35	0,28
7	1,695	1,459	1 055	0,351	0,28
10	1,499	1,29	1 200	0,371	0,29
22	1,186	1,02	1 390	0,438	0,34
39	1,044	0,906	1 620	0,547	0,402
48	1	0,87	2 400	1,051	0,77
68	0,939	0,81	2 875	1,498	1,04
110	0,841	0,725			

NOTE 1 Two consecutive voltage changes (one positive and one negative) constitute one "cycle", i.e. two voltage changes per second correspond to a 1 Hz fluctuation.

NOTE 2 These curves are based on 60 W incandescent lighting. While other lighting equipment can give different results, these curves are adopted as reference to allow consistent evaluations across a wide variety of situations.

NOTE 3 Different versions of this table exist in the literature with very minor differences.

[4] IEC61000-3-3:2013

The Fluctuation rate highlighted in red indicates 110 changes/min, or a 1.83Hz modulation rate. This is equivalent to a level change every 54 cycles (@50Hz), the following sequence settings are entered into the N4A in order to create this waveform:

Sequence no	Voltage	Frequency	No. Half cycles
1	230.00	50	54
2	228.32	50	54

PST Results (PPA5511 Precision Power Analyzer):

[5] PPA5511, PST = 1.010

A PST of 1.010 was recorded with an N4L PPA5511, calibrated to UKAS ISO17025 - IEC61000-3-3 in the N4L UKAS calibration laboratory.

It is preferable to utilise a PPA55x1 in conjunction with the N4Axx power sources in order to traceably verify the PST value being supplied to the DUT.

This application note has demonstrated how the N4Axx AC Power Sources can be utilised to generate a wide range of PST values, effectively simulating typical mains modulation events. This is useful to the engineer as it equips them with the ability to test their DUT under a wide range of conditions, ensuring system stability in a range of modulation events.

References

[1] IEC61000-3-3:2013, Electromagnetic compatibility (EMC) Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current <=16A per phase and not subject to conditional connection