PRODUCED BY THE OPERATIONS DIRECTORATE OF ENERGY NETWORKS ASSOCIATION

Engineering Recommendation G5

Issue 5 2018

Interpretation of EMC Test Report

www.energynetworks.org

PUBLISHING AND COPYRIGHT INFORMATION

© 2018 Energy Networks Association

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior written consent of Energy Networks Association. Specific enquiries concerning this document should be addressed to:

Operations Directorate
Energy Networks Association
6th Floor, Dean Bradley House
52 Horseferry Rd
London
SW1P 2AF

This document has been prepared for use by members of the Energy Networks Association to take account of the conditions which apply to them. Advice should be taken from an appropriately qualified engineer on the suitability of this document for any other purpose.

First published, August 2018

Amendments since publication

Issue	Date	Amendment
Issue 1	August, 2018	Initial publication Details of all other technical, general and editorial amendments are included in the associated Document Amendment Summary for this Issue (available on request from the Operations Directorate of ENA)

Contents

Figures

Tables

Introduction

This document provides an annotated interpretation of the EMC Test Report to aid the Network Operator in identifying the required information for an assessment against Stage 1B using data supplied by the manufacturer in an IEC 61000-3-12 compliance test report.

1 Interpretation of the EMC Test Report

Figure 1 in this document is an extract from an EMC Test Report, testing against IEC 61000‑3-12 for a three-phase item of plant or equipment.

The following can be identified from the data presented:

- Label a) identifies the maximum RMS current drawn for this set of test data, which was found to be 74.693 A.
- Label b) identifies the total harmonic current distortion, THD_I, at maximum RMS current to be 30.99%; this is consistent with a six-pulse converter.[1]
- Label c) shows that the highest harmonic current emissions are at the 5th and 7th harmonics; this is consistent with a six-pulse converter.[2]
- Label d) highlights that I_{ref} has been set equal to I_{equ} at 68 A. It also shows the IEC 61000-3-12 limits, which have been taken from Table 2 of IEC 61000-3-12:2011 for $R_{sce} \geq 350$ – see Table 1 of this document – and are given as a percentage of I_{ref}.

  In Figure 1, the column 4 values have been calculated with I_{ref} = 68 A.

  For example, for I_5, the limit I_h / I_{ref} (in %) for $R_{sce} \geq 350$ is 24%; which, in Amperes, equals $I_{ref} \times 24/100 = 68\text{ A} \times 0.24 = 16.32\text{ A}$.
- Label e) shows that the equipment passes the assessment with R_{sce} = 350. As it does not pass with R_{sce} = 33, with the required R_{sce} to pass IEC 61000-3-12 being 350, then the manufacturer would have to make the statement “equipment complying with IEC 61000-3-12 subject to $S_{SC\ Min} \geq$ X kVA” rather than “equipment complying with IEC 61000-3-12” and so, Stage 1B-2 will apply. As the equipment is unbalanced three-phase equipment, IEC 61000-3-12 gives:

  $S_{equ} = \sqrt{3} \times 400\text{ V} \times I_{equ} = \sqrt{3} \times 400\text{ V} \times 68\text{ A} = 47{,}111.782\text{ VA}$.

  Thus, $S_{SC\ Min} = S_{equ} \times R_{sce} = 47{,}111.782\text{ VA} \times 350 = 16.489\text{ MVA}$. This result shows that a very high short-circuit power is required at the LV PCC to connect this piece of equipment.

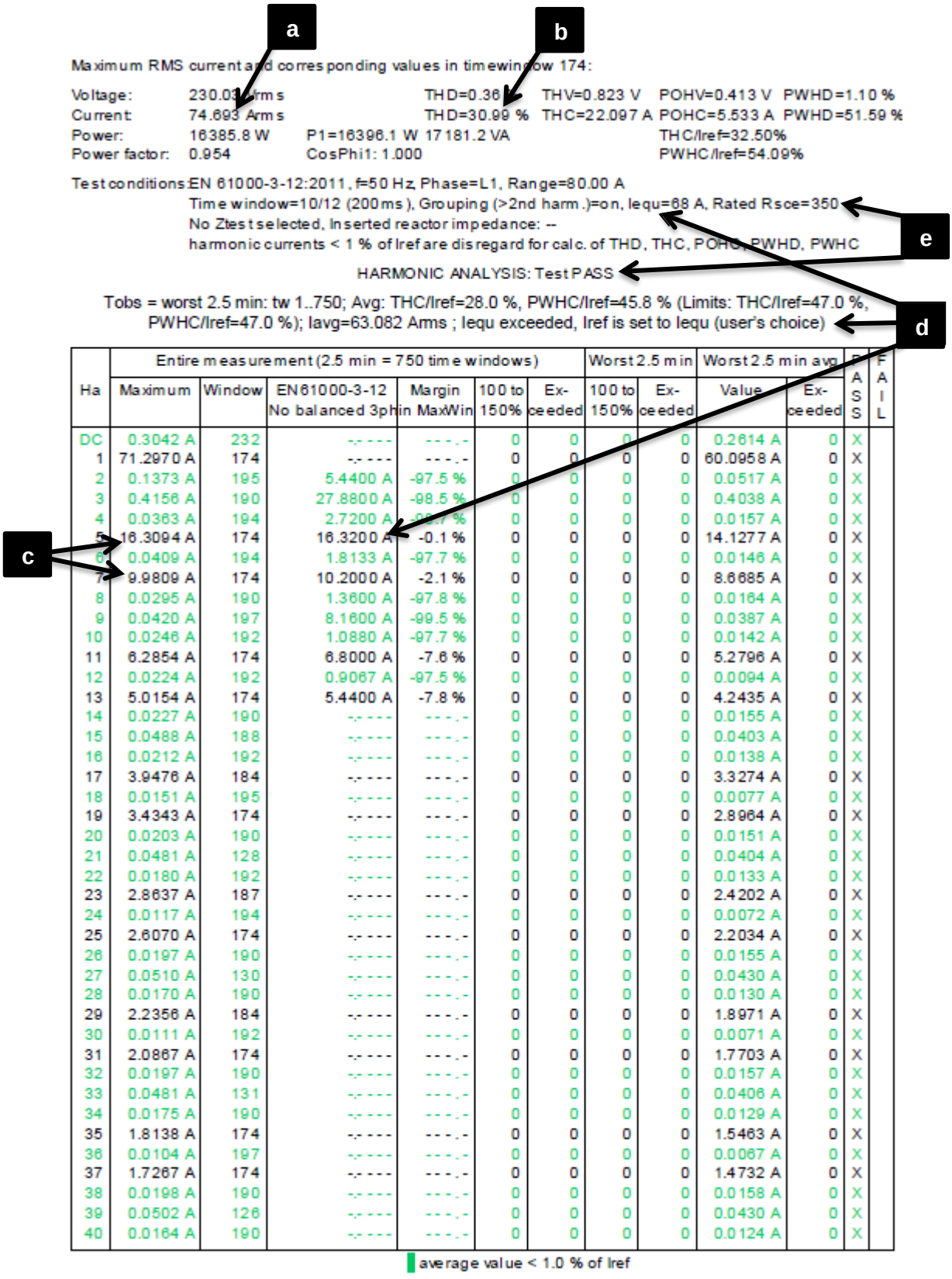
NOTE 1: R_{sce} is defined in IEC 610003-12 as the ratio of short-circuit power to equipment rating.

NOTE 2: To fully understand the use of R_{sce}, its relationship to the required statements that a manufacturer should make and the associated implications, it may help to consult IEC 61000-3-12 directly.

---

[1] A value of ~30% is typical for a six-pulse converter. For a twelve-pulse converter, a value of ~6–18% is typical; for active front-end converter a value of ~3–4% is typical.

[2] For a twelve-pulse converter the 11th and 13th harmonics would be highest.



Maximum RMS current and corresponding values in timewindow 174:

Voltage:	230.03 Vrms		THD=0.36 %	THV=0.823 V	POHV=0.413 V PWHD=1.10 %
Current:	74.693 Arms		THD=30.99 %	THC=22.097 A	POHC=5.533 A PWHD=51.59 %
Power:	16385.8 W	P1=16396.1 W	17181.2 VA		THC/Iref=32.50%
Power factor:	0.954	CosPhi1: 1.000			PWHC/Iref=54.09%

Test conditions: EN 61000-3-12:2011, f=50 Hz, Phase=L1, Range=80.00 A
Time window=10/12 (200ms), Grouping (>2nd harm.)=on, Iequ=68 A, Rated Rsce=350
No Ztest selected, Inserted reactor impedance: --
harmonic currents < 1 % of Iref are disregard for calc. of THD, THC, POHC, PWHD, PWHC

HARMONIC ANALYSIS: Test PASS

Tobs = worst 2.5 min: tw 1..750; Avg: THC/Iref=28.0 %, PWHC/Iref=45.8 % (Limits: THC/Iref=47.0 %, PWHC/Iref=47.0 %); Iavg=63.082 Arms ; Iequ exceeded, Iref is set to Iequ (user's choice)

Ha	Entire measurement (2.5 min = 750 time windows)						Worst 2.5 min		Worst 2.5 min avg		PASS	FAIL
	Maximum	Window	EN61000-3-12 No balanced 3phase	Margin MaxWin	100 to 150%	Exceeded	100 to 150%	Exceeded	Value	Exceeded		
DC	0.3042 A	232	-.- ---	---.-	0	0	0	0	0.2614 A	0	X	
1	71.2970 A	174	-.- ---	---.-	0	0	0	0	60.0958 A	0	X	
2	0.1373 A	195	5.4400 A	-97.5 %	0	0	0	0	0.0517 A	0	X	
3	0.4156 A	190	27.8800 A	-98.5 %	0	0	0	0	0.4038 A	0	X	
4	0.0363 A	194	2.7200 A	-98.7 %	0	0	0	0	0.0157 A	0	X	
5	16.3094 A	174	16.3200 A	-0.1 %	0	0	0	0	14.1277 A	0	X	
6	0.0409 A	194	1.8133 A	-97.7 %	0	0	0	0	0.0146 A	0	X	
7	9.9809 A	174	10.2000 A	-2.1 %	0	0	0	0	8.6685 A	0	X	
8	0.0295 A	190	1.3600 A	-97.8 %	0	0	0	0	0.0164 A	0	X	
9	0.0420 A	197	8.1600 A	-99.5 %	0	0	0	0	0.0387 A	0	X	
10	0.0246 A	192	1.0880 A	-97.7 %	0	0	0	0	0.0142 A	0	X	
11	6.2854 A	174	6.8000 A	-7.6 %	0	0	0	0	5.2796 A	0	X	
12	0.0224 A	192	0.9067 A	-97.5 %	0	0	0	0	0.0094 A	0	X	
13	5.0154 A	174	5.4400 A	-7.8 %	0	0	0	0	4.2435 A	0	X	
14	0.0227 A	190	-.- ---	---.-	0	0	0	0	0.0155 A	0	X	
15	0.0488 A	188	-.- ---	---.-	0	0	0	0	0.0403 A	0	X	
16	0.0212 A	192	-.- ---	---.-	0	0	0	0	0.0138 A	0	X	
17	3.9476 A	184	-.- ---	---.-	0	0	0	0	3.3274 A	0	X	
18	0.0151 A	195	-.- ---	---.-	0	0	0	0	0.0077 A	0	X	
19	3.4343 A	174	-.- ---	---.-	0	0	0	0	2.8964 A	0	X	
20	0.0203 A	190	-.- ---	---.-	0	0	0	0	0.0151 A	0	X	
21	0.0481 A	128	-.- ---	---.-	0	0	0	0	0.0404 A	0	X	
22	0.0180 A	192	-.- ---	---.-	0	0	0	0	0.0133 A	0	X	
23	2.8637 A	187	-.- ---	---.-	0	0	0	0	2.4202 A	0	X	
24	0.0117 A	194	-.- ---	---.-	0	0	0	0	0.0072 A	0	X	
25	2.6070 A	174	-.- ---	---.-	0	0	0	0	2.2034 A	0	X	
26	0.0197 A	190	-.- ---	---.-	0	0	0	0	0.0155 A	0	X	
27	0.0510 A	130	-.- ---	---.-	0	0	0	0	0.0430 A	0	X	
28	0.0170 A	190	-.- ---	---.-	0	0	0	0	0.0130 A	0	X	
29	2.2356 A	184	-.- ---	---.-	0	0	0	0	1.8971 A	0	X	
30	0.0111 A	192	-.- ---	---.-	0	0	0	0	0.0071 A	0	X	
31	2.0867 A	174	-.- ---	---.-	0	0	0	0	1.7703 A	0	X	
32	0.0197 A	190	-.- ---	---.-	0	0	0	0	0.0157 A	0	X	
33	0.0481 A	131	-.- ---	---.-	0	0	0	0	0.0406 A	0	X	
34	0.0175 A	190	-.- ---	---.-	0	0	0	0	0.0129 A	0	X	
35	1.8138 A	174	-.- ---	---.-	0	0	0	0	1.5463 A	0	X	
36	0.0104 A	197	-.- ---	---.-	0	0	0	0	0.0067 A	0	X	
37	1.7267 A	174	-.- ---	---.-	0	0	0	0	1.4732 A	0	X	
38	0.0198 A	190	-.- ---	---.-	0	0	0	0	0.0158 A	0	X	
39	0.0502 A	126	-.- ---	---.-	0	0	0	0	0.0430 A	0	X	
40	0.0164 A	190	-.- ---	---.-	0	0	0	0	0.0124 A	0	X	

average value < 1.0 % of Iref

Figure 1 — Annotated EMC Test Report

Table 1 — Current emission limits for equipment other than balanced three-phase equipment; Taken from IEC 61000-3-12

Minimum R_{sce}	**Admissible individual harmonic current I_h / I_{ref} [a] %**						**Admissible harmonic parameters %**	
	I_3	I_5	I_7	I_9	I_{11}	I_{13}	THC / I_{ref}	$PWHC$ / I_{ref}
33	21.6	10.7	7.2	3.8	3.1	2	23	23
66	24	13	8	5	4	3	26	26
120	27	15	10	6	5	4	30	30
250	35	20	13	9	8	6	40	40
≥ 350	41	24	15	12	10	8	47	47

The relative values of even harmonics up to 12 shall not exceed 16 / h %. Even harmonics above order 12 are taken in into account in *THC* and *PWHC* in the same way as odd-order harmonics.

Linear interpolation between successive R_{sce} values is permitted.

NOTE: *THC* and *PWHC* are as defined in IEC 61000-3-12.

[a] I_{ref} = reference current; I_h = harmonic current component.