Global No.1 Testing Laboratory Universal Certification Solution

EMC TEST REPORT

Product name:	Power Filter Module
Models:	U-1500, U-1000, U-700, U-500, U-300, UC-200, UC-150, UC-100, UC-70, UC-50
Standards:	EN 61000-6-2:2005/AC:2005 EN 61000-6-4:2007/A1:2011
Applicant:	KESECO CO., LTD.
Test Report No.:	UCSCE-1512-131

UCS Co., Ltd.

#702, AnyangMegavalley, 268 Hagui-ro, Dongan-gu, Anyang-si, Gyeonggi-do, 14056 Korea.
Tel: +82-31-420-5680 / Fax: +82-31-420-5685 / Open Site: +82-31-355-2666
Online: http://www.ucs.co.kr

EMC TEST REPORT

Report Number		UCSCE-1512-131		
Applicant	Company Name	KESECO CO., LTD.		
	Address	Namyoung Digital Tower 8F, Seongsuil-ro 84, Seongdong-gu, Seoul, South Korea		
Product	Product Name	Power Filter Module		
	Model Name	U-1500		
	Family Model Name	U-1000, U-700, U-500, U-300, UC-200, UC-150, UC-100, UC-70, UC-50		
	Manufacturer	KESECO CO., LTD.		
	Serial No.	I11511162K001N CE		
Other	Receipt Date	2015.11.26	Receipt Number	UCS-R-2015-936
	Issued Date	2015.12.07	Tested Date	2015.11.30 ~ 2015.12.04
Standard		EN 61000-6-2:2005/AC:2005 EN 61000-6-4:2007/A1:2011		
Tested by		J. H. Park (Sign)		
Approved by		Y. M. Choi (Sign)		

UCS Co., Ltd.

#702, AnyangMegavally, 268 Hagui-ro, Dongan-gu, Anyang-si, Gyeonggi-do, 14056 KOREA
Tel : +82-31-420-5680, Fax : +82-31-420-5685

Contents

Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
UCSCE-1512-131	07-Dec-2015	Initial Issue	All

1. Applicant Information

Applicant Name : KESECO CO., LTD.

Address : Namyoung Digital Tower 8F, Seongsuil-ro 84, Seongdong-gu, Seoul, South Korea

Manufacturer : KESECO CO., LTD.

Address : Namyoung Digital Tower 8F, Seongsuil-ro 84, Seongdong-gu, Seoul, South Korea

Country of Origin : Korea

2. EUT (Equipment under test) Information

Product Name : Power Filter Module

Basic Model Name : U-1500

Family Model Name : U-1000, U-700, U-500, U-300, UC-200, UC-150, UC-100, UC-70, UC-50

Model difference

Model	Capacity	Size (W x L x H)	Tested
U-1500	1500	40 cm x 60 cm x 25 cm	■
U-1000	1000	40 cm x 60 cm x 20 cm	□
U-700	700	35 cm x 52 cm x 15 cm	□
U-500	500	35 cm x 45 cm x 15 cm	□
U-300	300	30 cm x 40 cm x 10 cm	□
UC-200	200	25 cm x 35 cm x 8 cm	□
UC-150	150	24 cm x 32 cm x 8 cm	□
UC-100	100	22 cm x 30 cm x 8 cm	□
UC-70	70	20 cm x 27 cm x 7 cm	□
UC-50	30	18 cm x 25 cm x 6 cm	□

* Applicant consigns only basic model to test. Therefore this test report just guarantees the units, which have been tested.

* The Applicant/manufacturer is responsible for the compliance of all variants.

Input Rating : 3 Phase, 380 V~, 50 Hz

* Product specification information described herein was obtained from product data sheet or user's manual.

3. Laboratory Information

Laboratory Name : UCS Co., Ltd.

Location : 35-13, Hwalcho-gil, 109beon-gil, Namyang-eup, Hwaseong-si, Gyeonggi-do, 18278 Korea

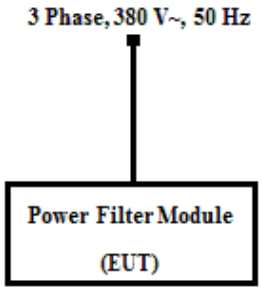
4. Test Configuration and Condition

4.1 EUT operating condition

- The EUT was operated continuously during the test.

- Input power condition during the measurements was 3 Phase, 380 V~, 50 Hz

4.2 EUT test configuration diagram



4.3 Peripheral equipments list for test

Equipment Name	Model	Serial Number	Manufacturer
Power Filter Module (EUT)	U-1500	I11511162K001N CE	KESECO CO., LTD.

4.4 EUT modifications

- None

5. Summary of Test Results

5.1 Summary of test results

Standard	Test Item	Results
EN 61000-6-4:2007 + A1:2011	Conducted disturbance at the mains ports	Met / Pass
	Radiated disturbance	Met / Pass
EN 61000-6-2:2005 + AC:2005	Electrostatic discharge	Met Criterion A / Pass
	Radiated RF electromagnetic field immunity	Met Criterion A / Pass
	Electrical fast transient/burst immunity	Met Criterion A / Pass
	Surge immunity	Met Criterion A / Pass
	Conducted disturbance induced by RF fields immunity	Met Criterion A / Pass

* Were tested in the applicant's requested standards.

5.2 Performance of criteria

Performance criterion A

The apparatus shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

Performance criterion B

The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is however allowed. No change of actual operating state or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

Performance criterion C

Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls.

6. Test Results

6.1 Conducted disturbance

Test Standard	EN 61000-6-4:2007/A1:2011		
Tested Date	2015.11.30		
Input Ratings	3 Phase, 380 V~, 50 Hz		
Temperature	24.1 °C	**Humidity**	(30.45 ± 0.05) % R.H.
Test result	Met / Pass		

6.1.1 Limit

Mains ports

Frequency [MHz]	Quasi-Peak [dBµV]	Average [dBµV]
0.15 ~ 0.5	79	66
0.5 ~ 30	73	60

* The limit decreases linearly with the logarithm of frequency.

Telecommunication ports

Frequency [MHz]	Quasi-Peak [dBµV]	Average [dBµV]	Quasi-Peak [dBµA]	Average [dBµA]
0.15 ~ 0.5	97 ~ 87*	84 ~ 74*	53 ~ 43*	40 ~ 30*
0.5 ~ 30	87	74	43	30

* The limit decreases linearly with the logarithm of frequency.

6.1.2 Test set-up and procedure

The mains terminal disturbance voltage was measured with the equipment under test (EUT) in a shield room.
The EUT was connected to an artificial mains network (LISN) placed on the floor.
The EUT was placed on non-metallic table 0.8 m above the metallic, grounded floor.
Amplitude measurements were performed with a quasi-peak detector and an average detector.

6.1.3 Used test equipments

Equipment	Model	Serial No.	Vendor	Next Cal. Date	Use
Test Receiver	ESPI3	101171	ROHDE & SCHWARZ	2016.08.04	□
Test Receiver	ESR7	101120	ROHDE & SCHWARZ	2016.08.04	■
LISN	NSLK 8127	8127518	SCHWARZBECK	2016.08.05	□
Two-Line V-Netwoek	NV216	3560.6550.12-101874-Rq	ROHDE & SCHWARZ	2016.08.04	□
LISN	L3-32	1220X20311	PMM	2016.08.05	■
ISN	ISN T800	30813	TESEQ	2016.02.12	□
ISN	ISN T8-Cat6	29709	TESEQ	2016.02.10	□
PULSE LIMITER	ESH3-Z2	100059	ROHDE & SCHWARZ	2016.04.16	■

6.1.4 Test set-up photos (Mains ports)

[Front view]

[Rear view]

6.1.5 Test data (Mains ports)

- Test Frequency rang : 150 kHz ~ 30 MHz
- Bandwidth : 9 kHz

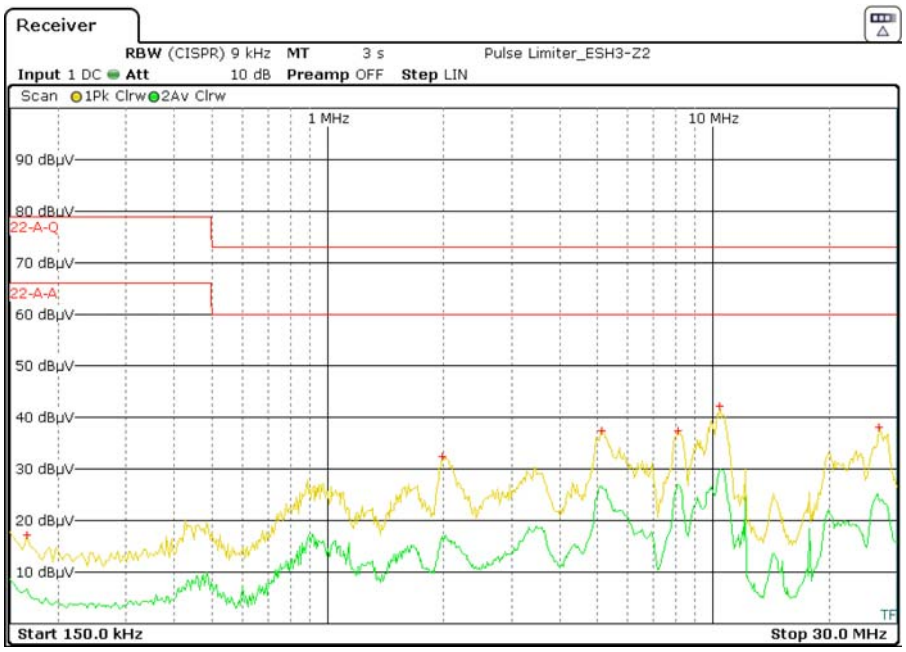
Frequency [MHz]	Lisn Factor [dB]	Pulse Limiter [dB]	Cable Loss [dB]	Line	Quasi-Peak			Average		
					Limit [dBµV]	Reading [dBµV]	Results [dBµV]	Limit [dBµV]	Reading [dBµV]	Results [dBµV]
0.44	0.09	9.84	0.03	L3	79.00	9.45	19.41	66.00	-	-
1.97	0.12	9.85	0.07	L2	73.00	23.37	33.41	60.00	-	-
5.64	0.19	9.85	0.16	L3	73.00	27.79	37.99	60.00	-	-
8.05	0.25	9.85	0.20	L3	73.00	29.30	39.60	60.00	-	-
10.56	0.30	9.86	0.24	L2	73.00	35.32	45.72	60.00	-	-
26.69	0.57	9.96	0.36	L3	73.00	29.54	40.43	60.00	-	-

* Average mode was not recorded, because Quasi-Peak values were under the Average limit.

* **Results [dBµV]** = Reading [dBµV] + LISN [dB] + Pulse Limiter [dB] + Cable [dB]

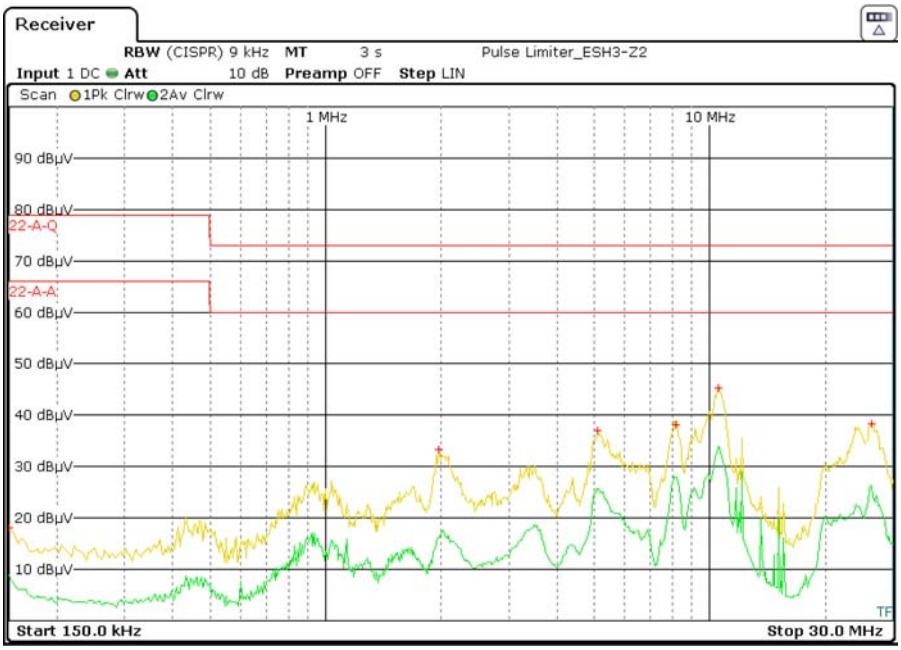
6.1.6 Test graph (Mains ports)

[L1 Line]



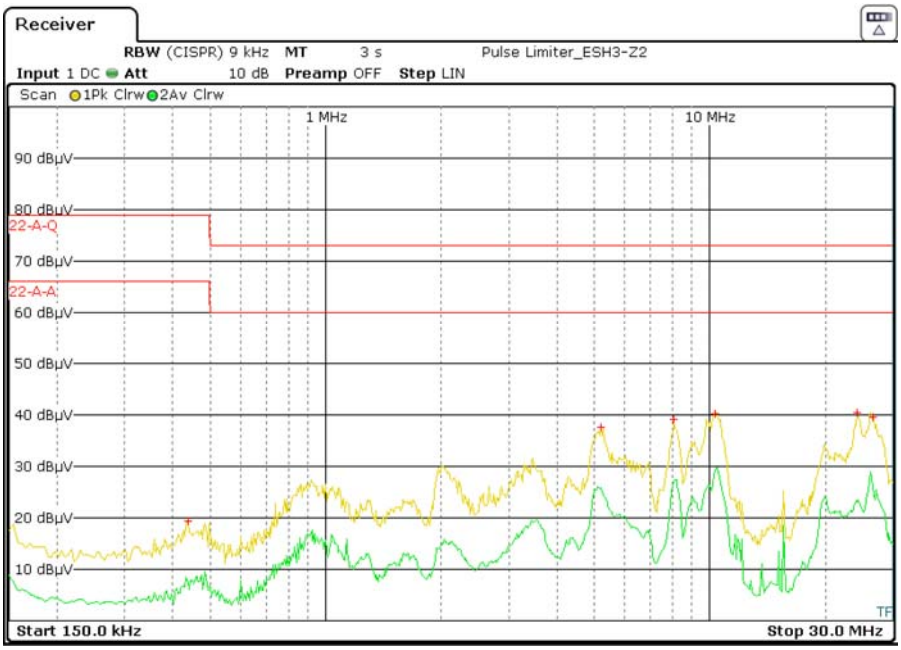
* : Quasi-Peak, : Average

[L2 Line]



* : Quasi-Peak, : Average

[L3 Line]



* : Quasi-Peak, : Average

6.2 Radiated disturbance

Test Standard	EN 61000-6-4:2007/A1:2011		
Tested Date	2015.11.30		
Input Ratings	3 Phase, 380 V~, 50 Hz		
Temperature	(10.65 ± 0.05) °C	**Humidity**	(46.25 ± 0.25) % R.H.
Test result	Met / Pass		

6.2.1 Limit

Frequency [MHz]	Quasi-peak [dBµV/m] @ 10 m
30 ~ 230	40
230 ~ 1 000	47

Frequency [GHz]	Peak [dBµV/m] @ 3 m	Average [dBµV/m] @ 3 m
1 ~ 3	76	56
3 ~ 6	80	60

6.2.2 Test set-up and procedure

A pretest was performed at 3 m distance in a semi-anechoic chamber for searching correct frequency.
The final test was done at a 10 m open area test site with a quasi-peak detector. (Below 1 GHz)
The final test was done at a 3 m SVSWR chamber with a peak and average detector. (Above 1 GHz)
EUT was placed on a non-metallic table height of 0.8 m above the reference ground plane. Cables were folded back and forth forming a bundle 0.3 m to 0.4 m long and were hanged at a 0.4 m height to the ground plane.
Cables connected to EUT were fixed to cause maximum emission.
Test was made with the antenna positioned in both the horizontal and vertical planes of polarization.

6.2.3 Used test equipments

Equipment	Model	Serial No.	Vendor	Next Cal. Date	Use
Test Receiver	ESPI3	101171	ROHDE & SCHWARZ	2016.08.04	■
Test Receiver	ESR7	101120	ROHDE & SCHWARZ	2016.08.04	□
Spectrum Analyzer	FSP13	100640	ROHDE & SCHWARZ	2016.08.04	□
BI-LOG ANT	VULB 9163	691	SCHWARZBECK	2016.02.28	■
Antenna Master	act-a400	20090812002	Audix Coporation	-	■
Turn Table	act-t450	2009814072	Audix Coporation	-	■
Controller	act	CT-0131	Audix Coporation	-	■
HORN ANTENNA	BBHA 9120D	768	Schwarzbeck	2015.12.11	□
AMPLIFIER	310N	291723	SONOMA	2016.08.04	■
10 m OATS	-	-	Semitec	-	■

6.2.4 Test set-up photos

[Front view]

[Rear view]

6.2.5 Test data

- Frequency Range : 30 MHz ~ 1 000 MHz
- Bandwidth : 120 kHz
- Distance : 10 m

Freq. [MHz]	Reading [dBμV]	Antenna Polarity [H/V]	Height [m]	Antenna Factor [dB/m]	Cable Loss [dB]	Amp. Gain [dB]	Results [dBμV/m]	Limit [dBμV/m]	Margin [dB]
30.63	37.45	H	4.00	10.15	0.86	31.67	16.79	40.00	-23.21
41.51	35.59	H	3.10	12.52	1.50	31.66	17.95	40.00	-22.05
141.79	39.13	V	1.00	7.77	3.87	31.64	19.13	40.00	-20.87
225.46	33.79	V	1.00	11.61	5.29	31.59	19.10	40.00	-20.90
245.70	29.94	V	1.00	12.42	5.59	31.59	16.36	47.00	-30.64
321.30	28.52	V	1.00	14.08	6.55	31.62	17.53	47.00	-29.47
Other frequencies up to 1 GHz were not observed during the test.									

* Remark: “H”: Horizontal, “V”: Vertical

* **Results [dBμV/m]** = Reading [dBμV] + Antenna Factor [dB/m] + Cable Loss [dB] – Amp. Gain [dB]
* **Margin [dB]** = Results [dBμV/m] – Limit [dBμV/m]

6.3 Electrostatic discharge

Test Standard	EN 61000-4-2:2009, Criteria: B		
Test Level	Contact/HCP/VCP: ± 4 kV		
Discharge Impedance	330 Ω / 150 pF		
Test Time	at least 10 times for each adapting point		
Tested Date	2015.12.01		
Input Ratings	3 Phase, 380 V~, 50 Hz		
Temperature	18.7 °C	**Humidity**	(36.95 ± 0.05) % R.H.
Atmospheric pressure	102.4 kPa		
Test Result	Met criterion A / Pass		

6.3.1 Test set-up and procedure

A ground reference plane was located on the floor, and connected to earth via a low Impedance connection.

The return cable of the ESD generator was connected to the reference plane.

In case of floor standing equipment, EUT was placed on the reference plane on 0.1 m of insulating Support.

In case of table top equipment, EUT was placed on a wooden table 0.8 m above the reference grounded floor.

A horizontal coupling plane (HCP) was placed on the table, and Connected to the reference plane via a 470 kohm resistor located in each end (0.5 mm insulating support between EUT and HCP).

In both cases a vertical coupling plane (VCP) of 0.5 m x 0.5 m was located 0.1 m from the EUT's sides.

The VCP was connected to the reference plane in the same matter as the HCP.

6.3.2 Used test equipments

Equipment	Model	Serial No.	Vendor	Next Cal. Date	Use
ESD Simulator	ESS-2000	4010C63927	NoiseKen	2016.08.10	■
HAEFELY TEST AG	ONYX 16	177897	HAEFELY TECHNOLOGY	2016.02.10	□
HCP	-	-	-	-	■
VCP	-	-	-	-	■

6.3.3 Test set-up photos

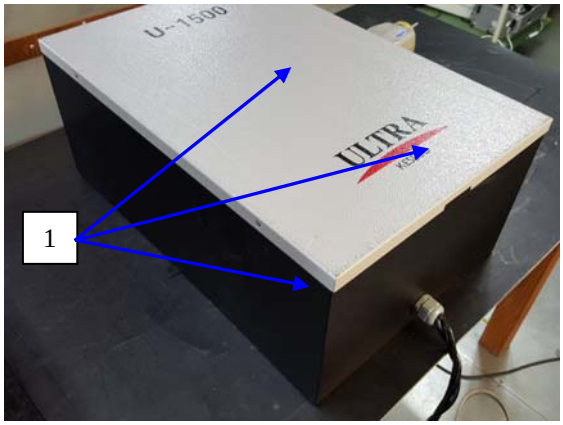
6.3.4 Test data

Location	Applied Level (±)	Criteria	Results
VCP	4 kV	B	A
HCP	4 kV	B	A

* There was no deviation from normal operation condition.

Location (EUT)	Applied Level (±)	Method	Criteria	Results
(1) Cover Part	4 kV	Contact	B	A

* There was no deviation from normal operation condition.



6.4 Radiated RF electromagnetic field immunity

Test Standard	EN 61000-4-3:2006/A2:2010, Criteria: A		
Tested Frequency	80 MHz ~ 2.7 GHz		
Test Level/Modulation	80 MHz ~ 1.0 GHz: 10 V/m (AM 80 %, 1 kHz) 1.4 GHz ~ 2.0 GHz: 3 V/m (AM 80 %, 1 kHz) 2.0 GHz ~ 2.7 GHz: 1 V/m (AM 80 %, 1 kHz)		
Distance	80 MHz ~ 1.0 GHz : 3 m, 1.4 GHz ~ 2.7 GHz : 1 m		
Dwell Time	1 s		
Step Size	log 1 % step		
Tested Date	2015.12.04		
Input Ratings	3 Phase, 380 V~, 50 Hz		
Temperature	(17.5 ± 2.0) °C	**Humidity**	(32.7 ± 1.5) % R.H.
Atmospheric pressure	102.0 kPa		
Test Result	Met criterion A / Pass		

6.4.1 Test set-up and procedure

The test was performed at 3 m full anechoic chamber.

For floor standing equipment, the EUT was standing on the floor.

For tabletop equipment, the EUT was located on a wooden table 0.8 m above the floor.

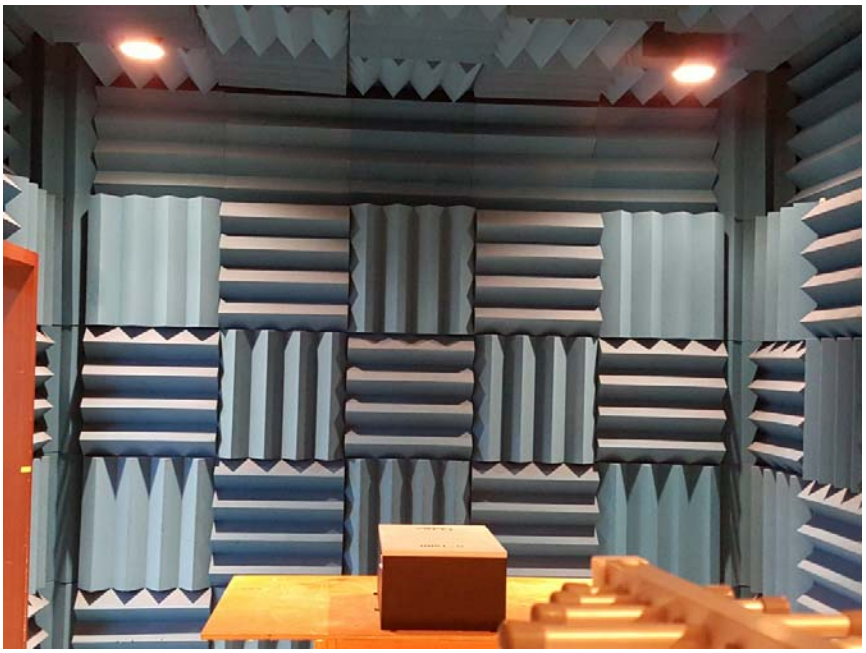
The EUT was tested all sides, horizontal and vertical polarization.

6.4.2 Used test equipments

Equipment	Model	Serial No.	Vendor	Next Cal. Date	Use
SIGNAL GENERATOR	SMC100A	101441	ROHDE & SCHWARZ	2016.08.04	■
EMP Series Power Meter	E4419B	MY45104421	Agilent	2016.08.04	■
E-SERIES AVG POWER SENSOR	E9304A	MY41499023	Agilent	2016.08.04	■
RF AMPLIFIER	25A250AM1	0331227	AMPLIFRER RESEARCH	-	□
RF AMPLIFIER	30S1G3M1	0331152	AMPLIFRER RESEARCH	-	■
RF AMPLIFIER	150W1000M1	0331746	AMPLIFRER RESEARCH	-	■
Horn Antenna	AT4002A	0330909	AMPLIFRER RESEARCH	-	■
LOG-PER ANTENNA	VULP 9118 E	855	SCHWARZBECK	-	■

6.4.3 Test set-up photos

[80 MHz ~ 1 GHz]



[1.4 GHz ~ 2.7 GHz]

6.4.4 Test data

Location (EUT)	Antenna Polarization	Criteria	Results
Front Side	Horizontal	A	A
	Vertical	A	A
Rear Side	Horizontal	A	A
	Vertical	A	A
Left Side	Horizontal	A	A
	Vertical	A	A
Right Side	Horizontal	A	A
	Vertical	A	A

* There was no deviation from normal operation condition.

6.5 Electric fast transient/burst immunity

Test Standard	EN 61000-4-4:2012, Criteria: B		
Coupling	Mains port - Coupling Decoupling Network		
Test Level	AC Mains: ± 2 kV		
Repetition Freq.	5 kHz, Tr / Th = 5 / 50 ns		
Coupling Time	60 s		
Tested Date	2015.12.04		
Input Ratings	3 Phase, 380 V~, 50 Hz		
Temperature	(22.6 ± 0.1) °C	**Humidity**	(30.55 ± 0.05) % R.H.
Atmospheric pressure	102.1 kPa		
Test Result	Met criterion A / Pass		

6.5.1 Test set-up and procedure

A ground reference plane was located on the floor.

EFT generator was connected to reference ground plane via low impedance connection.

For floor standing equipment, EUT was placed on a 0.1 m wooden table.

For tabletop equipment, EUT was placed on a 0.1 m above the ground reference plane.

Test generator and coupling/decoupling network was placed on, and bounded to, the ground reference plane.

When using the coupling clamp, the minimum distance between the coupling plates and all other conductive surfaces, except the ground reference plane beneath the coupling clamp, Shall be 0.5 m.

6.5.2 Used test equipments

Equipment	Model	Serial No.	Vendor	Next Cal. Date	Use
EMC IMMUNITY TEST	EMCPRO PLUS	0906221	ThermoFisher Scientific	2016.08.28	□
Capacitive Clamp	CCL	0904227	ThermoFisher Scientific	2016.08.04	□
COMPACT IMMUNITY TEST SYSTEM	AXOS5	180998	HAEFELY EMC TECHNOLOGY	2016.03.19	■
THREE PHASES EXTERNAL CDN	FP-COMB32	181211	HAEFELY EMC TECHNOLOGY	2016.03.19	■
Capacitive Coupling Clamp	IP4B	181514	HAEFELY EMC TECHNOLOGY	2016.03.19	□

6.5.3 Test set-up photos

6.5.4 Test data

EFT Coupling Point	Level (±)	Criteria	Results
L1	2 kV	B	A
L2	2 kV	B	A
L3	2 kV	B	A
L1 - L2	2 kV	B	A
L1 - L3	2 kV	B	A
L2 - L3	2 kV	B	A
L1 - L2 - L3	2 kV	B	A

* There was no deviation from normal operation condition.
* The EUT does not have a port of signal and DC.

6.6 Surge immunity

Test Standard	EN 61000-4-5:2014, Criteria: B		
Coupling	Coupling Decoupling Network		
Test Level	AC Mains (Line to Line): ± 0.5 kV, ± 1 kV		
Number of surge/time	1 time / 1 min, total 5 times		
Repetition rate	60 s		
Tested Date	2015.12.04		
Input Ratings	3 Phase, 380 V~, 50 Hz		
Temperature	(22.8 ± 0.1) °C	**Humidity**	(31.0 ± 0.4) % R.H.
Atmospheric pressure	102.1 kPa		
Test Result	Met criterion A / Pass		

6.6.1 Test set-up and procedure

A ground reference plane was located on the floor. SURGE generator was connected to reference ground plane via low impedance connection. For floor standing equipment, EUT was placed on a 0.1 m wooden table.

For tabletop equipment, EUT was placed on a wooden table (0.1 m) above the reference plane.

6.6.2 Used test equipments

Equipment	Model	Serial No.	Vendor	Next Cal. Date	Use
EMC IMMUNITY TEST	EMCPRO PLUS	0906221	ThermoFisher Scientific	2016.08.28	□
I/O Lin Coupler/Decoupler	CM-I/OCD	0906226	ThermoFisher Scientific	-	□
Telecom coupler/Decoupler	CM-TELCD	0905226	ThermoFisher Scientific	-	□
COMPACT IMMUNITY TEST SYSTEM	AXOS5	180998	HAEFELY EMC TECHNOLOGY	2016.03.19	■
THREE PHASES EXTERNAL CDN	FP-COMB32	181211	HAEFELY EMC TECHNOLOGY	2016.03.19	■

6.6.3 Test set-up photos

6.6.4 Test data

Coupling Point	Level (±)	Criteria	Results
L1 – L2	0.5 kV, 1 kV	B	A
L1 – L3	0.5 kV, 1 kV	B	A
L2 – L3	0.5 kV, 1 kV	B	A

* There was no deviation from normal operation condition.
* The EUT does not have a port of signal and DC.

6.7 Conducted disturbance induced by RF fields immunity

Test Standard	EN 61000-4-6:2014, Criteria: A		
Tested Frequency	150 kHz ~ 80 MHz		
Test Level/Modulation	10 V (AM 80 %, 1 kHz)		
Coupling Method	AC Mains: M4		
Dwell Time	1 s		
Step Size	log 1 % step		
Tested Date	2015.12.01		
Input Ratings	3 Phase, 380 V~, 50 Hz		
Temperature	(21.8 ± 0.1) °C	**Humidity**	(34.1 ± 0.1) % R.H.
Atmospheric pressure	102.3 kPa		
Test Result	Met criterion A / Pass		

6.7.1 Test set-up and procedure

A ground reference plane was located on the floor.

The test was performed on a ground reference plane on a 0.1 m wooden table.

This test were performed using CDN for mains, clamp for signal and injection probe.

The frequency range was swept from 150 kHz to 80 MHz. This frequency range was modulated with 1 kHz sine wave at 80 %.

The signal generators provided the modulated frequency at a 1 % step size.

The power and all network cable, I/O cables longer than 3 m length were tested.

6.7.2 Used test equipments

Equipment	Model	Serial No.	Vendor	Next Cal. Date	Use
CDN M2	FCC-801-M2-16A	091165	FCC	2016.08.04	□
CDN M3	FCC-801-M3-16A	091994	FCC	2016.08.04	□
Coupling & Decoupling Network	CDN M4 PE	P1317118037	EM Test	2016.02.11	■
EM INJECTION CLAMP	F-203I-23mm	091199	FCC	2016.08.04	□
Continuous Wave Simulator	CWS 500N1	P1247105423	EM Test	2016.02.11	■
Coaxial Fixed Attenuator	ATT6/75	P1306112966	EM Test	2016.02.11	■
COUPLING & DECOUPLING NETWORK	CDN M4 PE	P1317118037	EM Test	2016.02.11	□

6.7.3 Test set-up photos

6.7.4 Test data

Coupling Point	Coupling Method	Criteria	Results
AC Mains	CDN (M4)	A	A

* There was no deviation from normal operation condition.
* The EUT does not have a port of signal and DC.

7. EUT Photos

7.1 External view

[Front view]

[Rear view]

7.2 Internal view