CE EMC Test Report

Equipment	:	**Sentrius™ IG60 Serial, Wi-Fi, & LTE Cat 1 Gateway**
Model No.	:	**Sentrius™ IG60-SERIAL-LTE**
Brand Name	:	**Laird Connectivity**
Applicant	:	**Laird Connectivity, Inc.**
Address	:	**W66N220 Commerce Court, Cedarburg, Wisconsin 53012, USA**
Standard	:	**EN 301 489-1 V2.2.3 (2019-11)** **Draft EN 301 489-17 V3.2.2 (2019-12)** **Draft EN 301 489-52 V1.1.0 (2016-11)**
Received Date	:	**Aug. 19, 2019**
Tested Date	:	**Oct. 02, 2019 ~ Jan. 20, 2020**

We, International Certification Corp., would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by:

Peter Lin / Supervisor

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Approved by:

Kent Chen / Assistant Manager

Testing Laboratory 2732

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Release Record

Report No.	Version	Description	Issued Date
EW8N2101-01	Rev. 01	Initial issue	Apr. 24, 2020
EW8N2101-01	Rev. 02	Updated brand name	May 25, 2020

Summary of Test Results

Emission Tests				
Ref. Std. Clause	**Test Standard**	**Test Items**	**Measured**	**Result**
8.3/8.4	EN 55032:2015/AC:2016, Class A	Conducted Emissions from the AC mains power ports	-25.99dB AV@ 6.557MHz.	Pass
8.7	EN 55032:2015/AC:2016, Class A	Asymmetric Mode Conducted Emissions	-15.09dB AV@ 0.189MHz.	Pass
8.2	EN 55032:2015/AC:2016, Class A	Radiated Emissions	-3.18dB PK@ 47.46MHz.	Pass
8.5	EN 61000-3-2:2014, Class A	Harmonic Current Emissions	Note	Pass
8.6	EN 61000-3-3:2013	Voltage Fluctuations and Flicker	Meet the requirement of limit.	Pass
Note: Equipment with a rated power is less than 75W than exempted harmonic current emissions test. For equipment intended to be used in an industrial environment or a telecommunication centre				

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Immunity Tests					
Ref. Std. Clause	**Test Standard**	**Description of Test**		**Pass Criterion**	**Result**
9.3	EN 61000-4-2:2009	Electrostatic Discharge (ESD)		TT/TR(B)	Pass
9.2	EN 61000-4-3:2006/A1:2008/ A2:2010	Radio Frequency Electromagnetic Field (RS)		CT/CR(A)	Pass*
9.4	EN 61000-4-4:2012	Electrical Fast Transient/Burst (EFT)		CT/CR(A)	Pass
9.8	EN 61000-4-5:2014+A1:2017	Surge		CT/CR(A)	Pass
9.5	EN 61000-4-6:2014	Conducted Disturbances (CS)		CT/CR(A)	Pass
9.7	EN 61000-4-11:2004	Voltage Dips	0% residual for 0.5 cycle	CT/CR(A)	Pass
			0% residual for 1 cycle	CT/CR(A)	Pass
			70% residual for 25 cycle	CT/CR(A)	Pass
			30% reduction for 0.5 cycle	CT/CR(A)	Pass
		Voltage Interruption	0% residual for 250 cycle (w/o battery back-up)	(C)	Pass
"*": Test method reported herein was performed according to the method specified by applicant.					

Comments and Explanations:
The declared performance criteria of immunity test for EUT presented in the report are provided by manufacturer, and the manufacturer takes all the responsibilities for the judgement of the test result.

1 General Description

1.1 Information

This report is issued as a supplementary report to original ICC report no. EH8N2101. The modification is concerned with following item:

- A WWAN module (Brand: Laird, Model: IGUP-CAT1) is added
- New model name, brand name, producrt name and applicant.
- Additional one adapter.
- Updating EN 301 489-1 standard version from V2.2.0 to V2.2.3.
- Updating EN 301 489-17 standard version from V3.2.0 to V3.2.2.

Therefore, all test items had been re-tested and was recorded in the following sections.

1.1.1 Specification of the Equipment under Test (EUT)

HW Version	2.0
SW Version	R2.0
WLAN	
Operating Frequency	802.11b/g/n: 2412 MHz ~ 2472 MHz 802.11a/n/ac: 5180 MHz ~ 5240 MHz; 5260 MHz ~ 5320 MHz; 5500 MHz ~ 5700 MHz
Antenna Type	Dipole antenna
Modulation Type	802.11b: DSSS (DBPSK / DQPSK / CCK) 802.11a/g/n/ac: OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM)
LTE	
Operating Frequency	LTE Band 1: 1920 MHz ~ 1980 MHz LTE Band 3: 1710 MHz ~ 1785 MHz LTE Band 7: 2500 MHz ~ 2570 MHz LTE Band 8: 880 MHz ~ 915 MHz LTE Band 20: 832 MHz ~ 862 MHz LTE Band 28: 703 MHz ~ 748 MHz
Antenna Type	Dipole antenna
Modulation Type	QPSK, 16QAM, 64QAM
WWAN	
Operating Bandwidth & Frequency	P-GSM 900: 880.2 MHz ~ 914.8 MHz DCS 1800: 1710.2 MHz ~ 1784.8 MHz WCDMA Band VIII: 880 MHz ~ 915 MHz
Antenna Type	Dipole antenna
Modulation Type	WCDMA: BPSK, QPSK GPRS: GMSK EDGE: 8PSK
BT	
Operating Frequency	2402 MHz ~ 2480 MHz
Antenna Type	Dipole antenna
Modulation Type	Bluetooth 4.2 LE: GFSK Bluetooth BR(1Mbps): GFSK Bluetooth EDR (2Mbps): π/4-DQPSK Bluetooth EDR (3Mbps): 8-DPSK

1.1.2 Power Supply Type of the Equipment under Test (EUT)

Power Supply Type	12Vdc from adapter 9Vdc ~ 36Vdc from DC Power Supply

1.1.3 Accessories (New addition is marked in boldface)

Accessories		
No.	**Equipment**	**Description**
1	AC adapter	Brand: FRECOM Model: F30L2-120250SPACP Power Rating: I/P: 100-240Vac, 50/60Hz, 0.8A O/P: 12Vdc, 2.5A Power Line: 1.5m non-shielded without core
2	**AC adapter**	**Brand: FRECOM** **Model: F48L-120400SPAV** **Power Rating:** **I/P: 100-240Vac, 50/60Hz, 1.4A** **O/P: 12Vdc, 4A** **Power Line: 1.5m non-shielded with one core**
3	**DC cable**	**3m non-shielded without core**
4	**Serial loopback adapter**	**Model : DB9 female** **Brand : Kingmate**

1.2 Test Equipment and Calibration Data

For Adapter: F30L2-120250SPACP

Test Item	Conducted Emission				
Test Site	Conduction room 1 / (CO01-WS)				
Test Date	Jan. 08, 2020				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Receiver	R&S	ESR3	101658	Dec. 12, 2019	Dec. 11, 2020
LISN	R&S	ENV216	101579	Mar. 08, 2019	Mar. 07, 2020
LISN (Support Unit)	SCHWARZBECK	Schwarzbeck 8127	8127-666	Dec. 20, 2019	Dec. 19, 2020
ISN	TESEQ	ISN T800	34406	Apr. 25, 2019	Apr. 24, 2020
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Oct. 22, 2019	Oct. 21, 2020
50 ohm terminal	NA	50	01	Apr. 19, 2019	Apr. 18, 2020
50 ohm terminal (Support Unit)	NA	50	04	May 28, 2019	May 27, 2020
Measurement Software	AUDIX	e3	6.120210k	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emission below 1GHz				
Test Site	966 chamber 2 / (03CH02-WS)				
Test Date	Oct. 22, 2019				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Receiver	Agilent	N9038A	MY53290044	Sep. 17, 2019	Sep. 16, 2020
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 09, 2018	Nov. 08, 2019
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-523	Dec. 03, 2018	Dec. 02, 2019
Preamplifier	EMC	EMC02325	980194	Sep. 18, 2019	Sep. 17, 2020
LF cable 1M	EMC	EMCCFD400-NM-NM-1000	160501	Oct. 18, 2019	Oct. 17, 2020
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-003	Oct. 18, 2019	Oct. 17, 2020
LF cable 10M	EMCC	CFD400-E	CFD400-001	Oct. 18, 2019	Oct. 17, 2020
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emission above 1GHz				
Test Site	966 chamber 2 / (03CH02-WS)				
Test Date	Oct. 22, 2019				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	Agilent	N9010A	MY53400091	Nov. 07, 2018	Nov. 06, 2019
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1095	Sep. 26, 2019	Sep. 25, 2020
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Nov. 15, 2018	Nov. 14, 2019
Preamplifier	Agilent	83017A	MY39501309	Sep. 24, 2019	Sep. 23, 2020
Preamplifier	EMC	EMC184045B	980192	Aug. 01, 2019	Jul. 31, 2020
RF Cable	EMC	EMC105-SM-SM-8000	180512	Oct. 18, 2019	Oct. 17, 2020
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16018/4	Oct. 18, 2019	Oct. 17, 2020
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	ESD				
Test Site	ESD room 1 / (ES01-WS)				
Tested Date	Oct. 15, 2019				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
ESD Generator	EMTest	Dito	V1248114239	Aug. 17, 2019	Aug. 16, 2020
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Immunity (80 MHz - 6 GHz)				
Test Site	RS room 1 / (RS01-WS)				
Tested Date	Oct. 11, 2019				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Signal Generator	R&S	SMB100A	103924HA	Oct. 23, 2018	Oct. 22, 2019
Power Sensor	R&S	NRP-Z91	101094-UL	Oct. 16, 2018	Oct. 15, 2019
Power Sensor	R&S	NRP-Z91	101095-KY	Oct. 16, 2018	Oct. 15, 2019
Power Amplifier	BONN	BLWA 0810-160/100D	107972A	N/A	N/A
Power Amplifier	BONN	BLMA 1060-100D	107972B	N/A	N/A
Antenna	SCHWARZBECK MESS-ELEKTRONIK	STLP 9149	9149-073	N/A	N/A
Antenna	R&S	HL046E	100076-Cd	N/A	N/A
Note: Calibration Interval of instruments listed above is one year.					

Test Item	SURGE				
Test Site	EFT/SURGE room 1 / (SE01-WS)				
Tested Date	Oct. 14, 2019				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Surge Generator	TESEQ	NSG 3060	1527	Apr. 17, 2019	Apr. 16, 2020
Automated 1-Phase CDN	TESEQ	CDN 3061	1441	Apr. 17, 2019	Apr. 16, 2020
Telecom Surge Module	TESEQ	NSG 3060	1537	Apr. 17, 2019	Apr. 16, 2020
CDN for unshielded symmetrical high speed communication lines	TESEQ	CDN HSS-2	34284	Jan. 14, 2019	Jan. 13, 2020
CDN for unshielded symmetrical signal & data lines	TESEQ	CDN118,INA175	35347,N/A	Apr. 17, 2019	Apr. 16, 2020
CDN for unshielded symmetrical signal & data lines	TESEQ	CDN118,INA181	35347/35348/35907/ 35908	Apr. 17, 2019	Apr. 16, 2020
CDN for unshielded symmetrical signal & data lines	TESEQ	CDN118,INA183	35347/35926	Apr. 17, 2019	Apr. 16, 2020
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Conducted Immunity				
Test Site	CS room 1 / (CS01-WS)				
Tested Date	Oct. 14, 2019				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Signal Generator	R&S	SMB-100A	107025	Dec. 21, 2018	Dec. 20, 2019
Conducted Immunity Test System Amplifier	A.R	75A250A	338329	N/A	N/A
Attenuator	BIRD	75-A-FFN-06	0128	N/A	N/A
AVG Power Sensor	R&S	NRP-Z91	101951	Jan. 07, 2019	Jan. 06, 2020
Coupling and Decoupling Network	TESEQ	CDN M016	25099	Dec. 27, 2018	Dec. 26, 2019
Coupling and Decoupling Network	TESEQ	CDN M016	25102	Dec. 22, 2018	Dec. 21, 2019
Coupling and Decoupling Network	TESEQ	CDN-T400A	28570	Feb. 11, 2019	Feb. 10, 2020
Coupling and Decoupling Network	TESEQ	CDN T8-10	40372	May 14, 2019	May 13, 2020
Note: Calibration Interval of instruments listed above is one year.					

Test Item	EFT				
Test Site	EFT/SURGE room 1 / (SE01-WS)				
Tested Date	Oct. 14, 2019				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
EFT Generator	TESEQ	NSG 3060	1527	Apr. 17, 2019	Apr. 16, 2020
Automated 1-Phase CDN	TESEQ	CDN 3061	1441	Apr. 17, 2019	Apr. 16, 2020
Burst/EFT Data line Coupling Clamp	TESEQ	CDN 3425	1775	Jan. 14, 2019	Jan. 13, 2020
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Harmonic , Flicker , DIP				
Test Site	EMS room 1 / (EX01-WS)				
Tested Date	Oct. 02, 2019				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
AC Power Source	TESEQ	NSG 1007	1301A00159	Mar. 08, 2019	Mar. 07, 2020
Signal Conditioning Unit	TESEQ	CCN 1000-1	1301A00159	Mar. 08, 2019	Mar. 07, 2020
Note: Calibration Interval of instruments listed above is one year.					

For Adapter: F48L-120400SPAV

Test Item	Conducted Emission				
Test Site	Conduction room 1 / (CO01-WS)				
Test Date	Jan. 08, 2020				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Receiver	R&S	ESR3	101658	Dec. 12, 2019	Dec. 11, 2020
LISN	R&S	ENV216	101579	Mar. 08, 2019	Mar. 07, 2020
LISN (Support Unit)	SCHWARZBECK	Schwarzbeck 8127	8127-666	Dec. 20, 2019	Dec. 19, 2020
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Oct. 22, 2019	Oct. 21, 2020
50 ohm terminal (Support Unit)	NA	50	04	May. 28, 2019	May. 27, 2020
Measurement Software	AUDIX	e3	6.120210k	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	ESD				
Test Site	ESD room 1 / (ES01-WS)				
Tested Date	Jan. 20, 2020				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
ESD Generator	EMTest	Dito	V1248114239	Aug. 17, 2019	Aug. 16, 2020
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Immunity (80 MHz - 6 GHz)				
Test Site	RS room 1 / (RS01-WS)				
Tested Date	Jan. 17, 2020				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Signal Generator	R&S	SMB100A	103924HA	Oct. 18, 2019	Oct. 17, 2020
Power Sensor	R&S	NRP-Z91	101094-UL	Oct. 16, 2019	Oct. 15, 2020
Power Sensor	R&S	NRP-Z91	101095-KY	Oct. 16, 2019	Oct. 15, 2020
Power Amplifier	BONN	BLWA 0810-160/100D	107972A	N/A	N/A
Power Amplifier	BONN	BLMA 1060-100D	107972B	N/A	N/A
Antenna	SCHWARZBECK MESS-ELEKTRONIK	STLP 9149	9149-073	N/A	N/A
Antenna	R&S	HL046E	100076-Cd	N/A	N/A
Note: Calibration Interval of instruments listed above is one year.					

Test Item	SURGE				
Test Site	EFT/SURGE room 1 / (SE01-WS)				
Tested Date	Jan. 20, 2020				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Surge Generator	TESEQ	NSG 3060	1527	Apr. 17, 2019	Apr. 16, 2020
Automated 1-Phase CDN	TESEQ	CDN 3061	1441	Apr. 17, 2019	Apr. 16, 2020
Telecom Surge Module	TESEQ	NSG 3060	1537	Apr. 17, 2019	Apr. 16, 2020
CDN for unshielded symmetrical high speed communication lines	TESEQ	CDN HSS-2	34284	Jan. 10, 2020	Jan. 09, 2021
CDN for unshielded symmetrical signal & data lines	TESEQ	CDN118,INA175	35347,N/A	Apr. 17, 2019	Apr. 16, 2020
CDN for unshielded symmetrical signal & data lines	TESEQ	CDN118,INA181	35347/35348/35907/35908	Apr. 17, 2019	Apr. 16, 2020
CDN for unshielded symmetrical signal & data lines	TESEQ	CDN118,INA183	35347/35926	Apr. 17, 2019	Apr. 16, 2020
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Conducted Immunity				
Test Site	CS room 1 / (CS01-WS)				
Tested Date	Jan. 20, 2020				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Signal Generator	R&S	SMB-100A	107025	Dec. 18, 2019	Dec. 17, 2020
Conducted Immunity Test System Amplifier	A.R	75A250A	338329	N/A	N/A
Attenuator	BIRD	75-A-FFN-06	0128	N/A	N/A
Power Sensor	R&S	NRP-Z91	101094-UL	Oct. 16, 2019	Oct. 15, 2020
Coupling and Decoupling Network	TESEQ	CDN M016	25099	Jan. 02, 2020	Jan. 01, 2021
Coupling and Decoupling Network	TESEQ	CDN M016	25102	Dec. 18, 2019	Dec. 17, 2020
Coupling and Decoupling Network	TESEQ	CDN-T200A	26969	Feb. 11, 2019	Feb. 10, 2020
Coupling and Decoupling Network	TESEQ	CDN-T400A	28570	Feb. 11, 2019	Feb. 10, 2020
Coupling and Decoupling Network	TESEQ	CDN T8-10	40372	May 14, 2019	May 13, 2020
Note: Calibration Interval of instruments listed above is one year.					

Test Item	EFT				
Test Site	EFT/SURGE room 1 / (SE01-WS)				
Tested Date	Jan. 20, 2020				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
EFT Generator	TESEQ	NSG 3060	1527	Apr. 17, 2019	Apr. 16, 2020
Automated 1-Phase CDN	TESEQ	CDN 3061	1441	Apr. 17, 2019	Apr. 16, 2020
Burst/EFT Data line Coupling Clamp	TESEQ	CDN 3425	1775	Jan. 10, 2020	Jan. 09, 2021
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Harmonic , Flicker , DIP				
Test Site	EMS room 1 / (EX01-WS)				
Tested Date	Jan. 17, 2020				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
AC Power Source	TESEQ	NSG 1007	1301A00159	Mar. 08, 2019	Mar. 07, 2020
Signal Conditioning Unit	TESEQ	CCN 1000-1	1301A00159	Mar. 08, 2019	Mar. 07, 2020
Note: Calibration Interval of instruments listed above is one year.					

1.3 Testing Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

EN 301 489-1 V2.2.3 (2019-11)
Draft EN 301 489-17 V3.2.2 (2019-12)
Draft EN 301 489-52 V1.1.0 (2016-11)

1.4 Deviation from Test Standard and Measurement Procedure

None

1.5 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2).

Measurement Uncertainty		
Test Item	**Frequency**	**Uncertainty**
Conducted Emissions from the AC mains power ports	150kHz ~ 30MHz	±2.92 dB
Asymmetric Mode Conducted Emissions	150kHz ~ 30MHz	±3.26 dB
Radiated Emissions	30MHz ~ 1GHz	±4.32 dB
	Above 1GHz	±4.57 dB

Note: The results of measurements of emissions shall reference the measurement uncertainty considerations contained in CISPR 16-4-2.

2 Test Configuration

2.1 Testing Condition

For Adapter: F30L2-120250SPACP

Test Item	Test Site	Ambient Condition	Tested By
Conducted Emissions from the AC mains power ports	CO01-WS	20°C/60%	Alex Tsai
Asymmetric Mode Conducted Emissions	CO01-WS	20°C/60%	Alex Tsai
Radiated Emissions	03CH02-WS	24°C/64%	Alex Tsai
Harmonic / Flicker	EX01-WS	25°C/60%/102kPa	Zoe Yu
ESD	ES01-WS	23°C/51%/102kPa	Zoe Yu
RS	RS01-WS	22°C/60%/103kPa	Zoe Yu
EFT	SE01-WS	23°C/58%/103kPa	Zoe Yu
Surge	SE01-WS	23°C/58%/103kPa	Zoe Yu
CS	CS01-WS	23°C/58%/103kPa	Zoe Yu
DIP	EX01-WS	25°C/60%/102kPa	Zoe Yu

For Adapter: F48L-120400SPAV

Test Item	Test Site	Ambient Condition	Tested By
Conducted Emissions from the AC mains power ports	CO01-WS	20°C/60%	Alex Tsai
Harmonic / Flicker	EX01-WS	17°C/60%/101kPa	Zoe Yu
ESD	ES01-WS	20°C/45%/102kPa	Zoe Yu
RS	RS01-WS	21°C/58%/101kPa	Zoe Yu
EFT	SE01-WS	21°C/53%/102kPa	Zoe Yu
Surge	SE01-WS	21°C/53%/102kPa	Zoe Yu
CS	CS01-WS	21°C/52%/102kPa	Zoe Yu
DIP	EX01-WS	17°C/60%/101kPa	Zoe Yu

2.2 The Worst Case Measurement Configuration

Pretested Mode	
Pretest Mode	**Operating Description**
1	LAN Speed 1G+100Mbps, Ping WiFi 5G, LTE Link, SD R/W, EUT orientation: X-axis, DC 9V
2	LAN Speed 1G+100Mbps, Ping WiFi 2.4G, LTE Link, SD R/W, EUT orientation: X-axis, DC 36V
3	LAN Speed 1G+100Mbps, Ping WiFi 2.4G, 3G Link, SD R/W, EUT orientation: X-axis, with adapter: F30L2-120250SPACP, 230V/50Hz
4	LAN Speed 1G+100Mbps, Ping WiFi 5G, LTE Link, SD R/W, EUT orientation: Y-axis, with adapter: F30L2-120250SPACP, 230V/50Hz
5	LAN Speed 1G+100Mbps, BT Link, 2G Link, SD R/W, EUT orientation: Z-axis, with adapter: F30L2-120250SPACP
6	LAN Speed 1G+100Mbps, Ping WiFi 2.4G, 2G Link, SD R/W, EUT orientation: Z-axis, with adapter: F30L2-120250SPACP, 230V/50Hz
7	LAN Speed 1G+100Mbps, Ping WiFi 5G, LTE Link, SD R/W, EUT orientation: Y-axis, with adapter: F30L2-120250SPACP, 110V/60Hz
8	LAN Speed 1G+100Mbps, Standby Mode, EUT orientation: Y-axis, with adapter : F30L2-120250SPACP, 230V/50Hz
9	LAN Speed 1G+100Mbps, Ping WiFi 5G, LTE Link, SD R/W, EUT orientation: Y-axis, with adapter: F48L-120400SPAV, 230V/50Hz
For **Pretest Mode 4** is the worst case and only its data was record in this test report.	

The Worst Test Configurations	
Conducted Emissions from the AC mains power ports	
Test Mode	**Operating Description**
1	LAN Speed 1G+100Mbps, Ping WiFi 5G, LTE Link, SD R/W, EUT orientation: Y-axis, with adapter: F30L2-120250SPACP, 230V/50Hz
2	LAN Speed 1G+100Mbps, Ping WiFi 5G, LTE Link, SD R/W, EUT orientation: Y-axis, with adapter: F30L2-120250SPACP, 110V/60Hz
3	LAN Speed 1G+100Mbps, Ping WiFi 5G, LTE Link, SD R/W, EUT orientation: Y-axis, with adapter: F48L-120400SPAV, 230V/50Hz
4	LAN Speed 1G+100Mbps, Ping WiFi 5G, LTE Link, SD R/W, EUT orientation: Y-axis, with adapter: F48L-120400SPAV, 110V/60Hz
Asymmetric Mode Conducted Emissions	
Test Mode	**Operating Description**
1	LAN1 Speed 100Mbps, Ping WiFi 5G, LTE Link, SD R/W, EUT orientation: Y-axis, with adapter: F30L2-120250SPACP, 230V/50Hz
2	LAN2 Speed 1Gbps, Ping WiFi 5G, LTE Link, SD R/W, EUT orientation: Y-axis, with adapter: F30L2-120250SPACP, 230V/50Hz
Note: The determined worst condition of telecom ports test is under the worst case of conducted emission test.	
Radiated Emissions	
Test Mode ≤1GHz	**Operating Description**
1	LAN Speed 1G+100Mbps, Ping WiFi 5G, LTE Link, SD R/W, EUT orientation: Y-axis, with adapter: F30L2-120250SPACP, 230V/50Hz
Test Mode >1GHz	**Operating Description**
1	LAN Speed 1G+100Mbps, Ping WiFi 5G, LTE Link, SD R/W, EUT orientation: Y-axis, with adapter: F30L2-120250SPACP, 230V/50Hz

Harmonic Current Emissions / Voltage Fluctuation and Flicker	
Test Mode	**Operating Description**
1	LTE Band1 Link, Run LAN & WiFi 2.4G ping test, SD R/W, Adapter: F30L2-120250SPACP
2	LTE Band7 Link, Run LAN & WiFi 5G ping test, SD R/W, Adapter: F30L2-120250SPACP
3	LTE Band28 Link, Run LAN & WiFi 2.4G ping test, SD R/W, Adapter: F30L2-120250SPACP
4	WCDMA Band8 link, Run LAN & WiFi 5G ping test, SD R/W, Adapter: F30L2-120250SPACP
5	GSM900 link, Run LAN & WiFi 2.4G ping test, SD R/W, Adapter: F30L2-120250SPACP
6	LTE Band3 idle, Run LAN & WiFi 5G ping test, SD R/W, Adapter: F30L2-120250SPACP
7	LTE Band8 idle ,Run LAN & WiFi 2.4G ping test, SD R/W, Adapter: F30L2-120250SPACP
8	LTE Band20 idle, Run LAN & WiFi 5G ping test, SD R/W, Adapter: F30L2-120250SPACP
9	WCDMA Band8 idle, Run LAN & WiFi 2.4G ping test, SD R/W, Adapter: F30L2-120250SPACP
10	GSM1800 idle ,Run LAN & WiFi 5G ping test, SD R/W, Adapter: F30L2-120250SPACP
11	BT on, Observe the BT function status, Adapter: F30L2-120250SPACP
12	LTE Band1 Link, Run LAN & WiFi 2.4G ping test, SD R/W, Adapter: F48L-120400SPAV

For Adapter: F30L2-120250SPACP

Immunity Tests (ESD test only)	
Test Mode	**Operating Description**
1	LTE Band1 Link, Run LAN & WiFi 2.4G ping test, USB & SD R/W, Adapter: F30L2-120250SPACP
2	LTE Band7 Link, Run LAN & WiFi 5G ping test, USB & SD R/W, Adapter: F30L2-120250SPACP
3	LTE Band28 Link, Run LAN & WiFi 2.4G ping test, USB & SD R/W, Adapter: F30L2-120250SPACP
4	WCDMA Band8 link, Run LAN & WiFi 5G ping test, USB & SD R/W, Adapter: F30L2-120250SPACP
5	GSM900 link, Run LAN & WiFi 2.4G ping test, USB & SD R/W, Adapter: F30L2-120250SPACP
6	LTE Band3 idle, Run LAN & WiFi 5G ping test, USB & SD R/W, Adapter: F30L2-120250SPACP
7	LTE Band8 idle ,Run LAN & WiFi 2.4G ping test, USB & SD R/W, Adapter: F30L2-120250SPACP
8	LTE Band20 idle, Run LAN & WiFi 5G ping test, USB & SD R/W, Adapter: F30L2-120250SPACP
9	WCDMA Band8 idle, Run LAN & WiFi 2.4G ping test, USB & SD R/W, Adapter: F30L2-120250SPACP
10	GSM1800 idle ,Run LAN & WiFi 5G ping test, USB & SD R/W, Adapter: F30L2-120250SPACP
11	BT on, Observe the BT function status, Adapter: F30L2-120250SPACP

Immunity Tests (All test except ESD)	
Test Mode	**Operating Description**
1	LTE Band1 Link, Run LAN & WiFi 2.4G ping test, SD R/W, Adapter: F30L2-120250SPACP
2	LTE Band7 Link, Run LAN & WiFi 5G ping test, SD R/W, Adapter: F30L2-120250SPACP
3	LTE Band28 Link, Run LAN & WiFi 2.4G ping test, SD R/W, Adapter: F30L2-120250SPACP
4	WCDMA Band8 link, Run LAN & WiFi 5G ping test, SD R/W, Adapter: F30L2-120250SPACP
5	GSM900 link, Run LAN & WiFi 2.4G ping test, SD R/W, Adapter: F30L2-120250SPACP
6	LTE Band3 idle, Run LAN & WiFi 5G ping test, SD R/W, Adapter: F30L2-120250SPACP
7	LTE Band8 idle ,Run LAN & WiFi 2.4G ping test, SD R/W, Adapter: F30L2-120250SPACP
8	LTE Band20 idle, Run LAN & WiFi 5G ping test, SD R/W, Adapter: F30L2-120250SPACP
9	WCDMA Band8 idle, Run LAN & WiFi 2.4G ping test, SD R/W, Adapter: F30L2-120250SPACP
10	GSM1800 idle ,Run LAN & WiFi 5G ping test, SD R/W, Adapter: F30L2-120250SPACP
11	BT on, Observe the BT function status, Adapter: F30L2-120250SPACP

For Adapter: F48L-120400SPAV

Immunity Tests (All test)	
Test Mode	**Operating Description**
12	LTE Band1 Link, Run LAN & WiFi 2.4G ping test, SD R/W, Adapter: F48L-120400SPAV

2.3 Local Support Equipment List

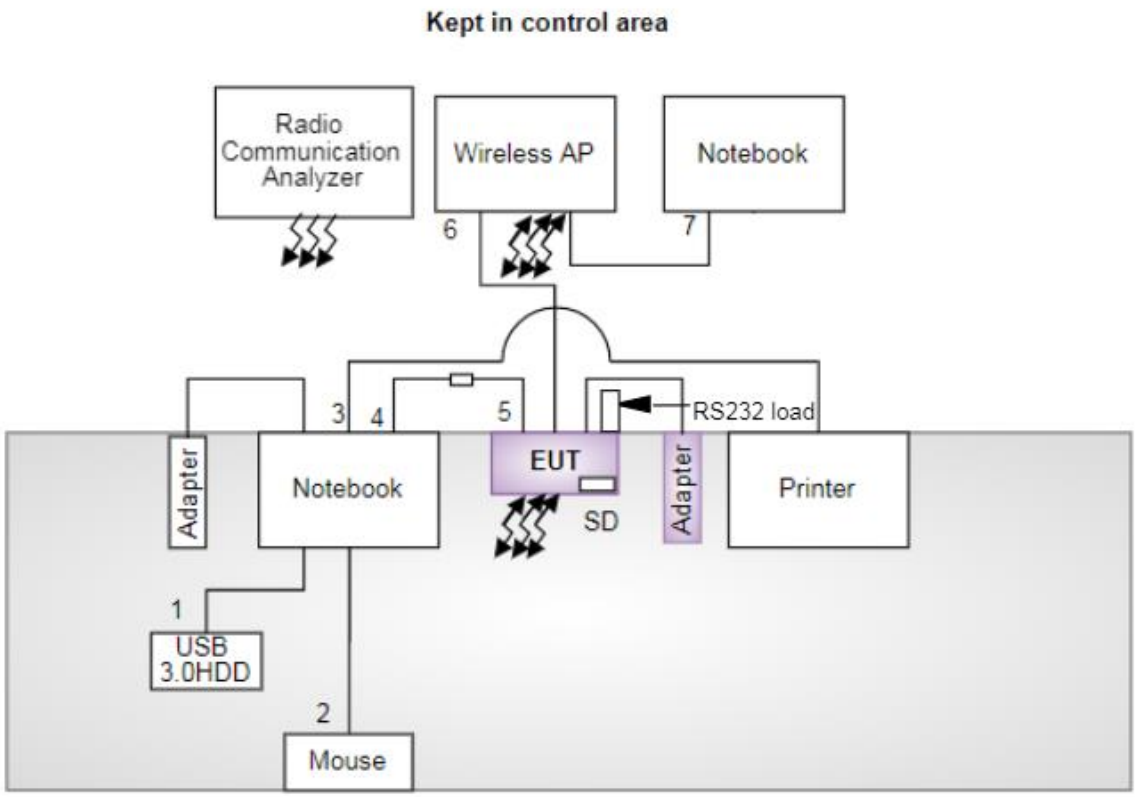
Support Equipment List (EMI)					
No.	**Equipment**	**Brand**	**Model**	**S/N**	**Remarks**
1	Notebook	DELL	Latitude E6440	8VXMD12	---
2	Notebook	DELL	Latitude E6440	FNXMD12	---
3	Wireless AP	D-LINK	DIR-850L	RZ1Q4G6000261	---
4	Printer	EPSON	XP-30	QSDK002410	---
5	Mouse	DELL	MS111-L	2C3-00N9	---
6	SD Card	SanDisk	Micro SDHC 8GB	---	---
7	Radio Communication Analyzer	ANRITSU	MT8820C	6201240341	---

Support Equipment List (EMS)					
No.	**Equipment**	**Brand**	**Model**	**S/N**	**Remarks**
1	Notebook	DELL	Latitude E5430	6R4RWW1	---
2	Notebook	DELL	Latitude E5430	264RWW1	---
3	Wireless AP	D-LINK	DIR-850L	RZ1Q4G6000261	---
4	USB 3.0 Flash	Kingston	D43254	NXVA3	---
5	SD card	SP	16G	---	---
6	Radio Communication Analyzer	ANRITSU	MT8820C	6201240341	---

Support Equipment List (EMS, BT only)					
No.	**Equipment**	**Brand**	**Model**	**S/N**	**Remarks**
1	Notebook	DELL	Latitude E5430	6R4RWW1	---
2	Notebook	DELL	Latitude E5430	264RWW1	---
3	AP	D-LINK	DIR-815	3000228	---
4	USB Flash	Kingston	DTSE9	NXPAB	---
5	SD card	SONY	SR-32UY3	---	Provided by applicant.
6	BT Fixture	---	---	---	Provided by applicant.

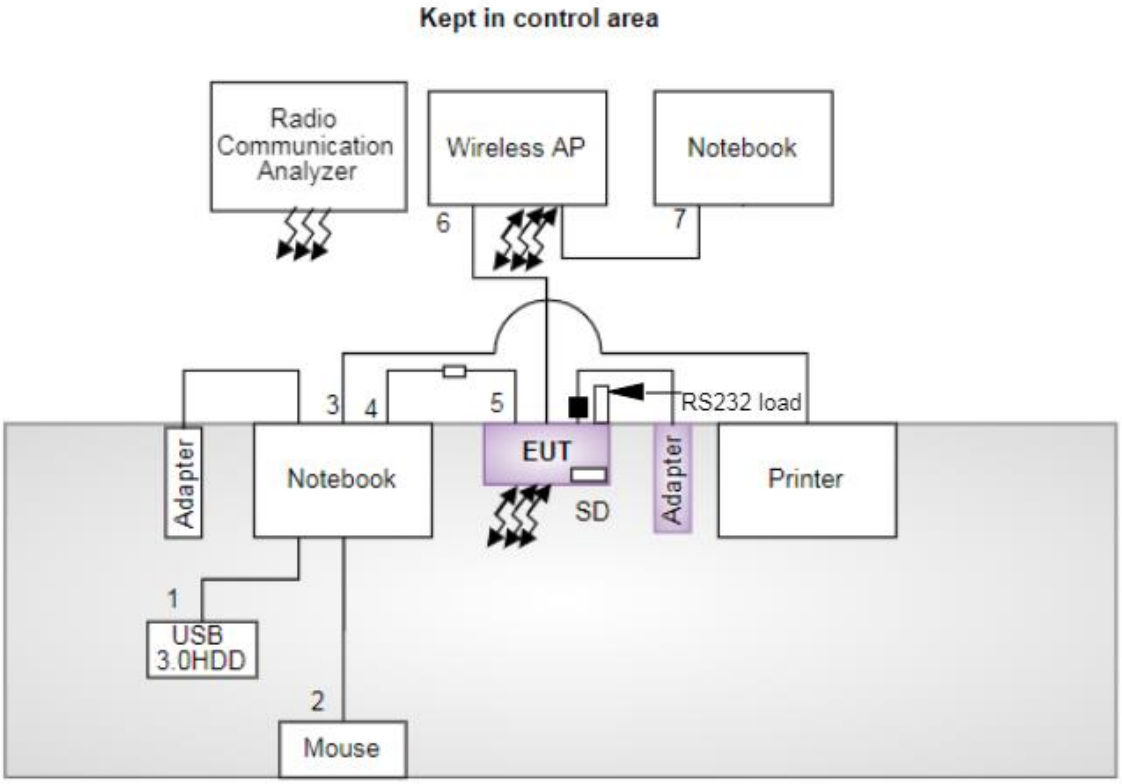
2.4 Test Setup Chart

Test Setup Diagram (EMI, Adapter: F30L2-120250SPACP)



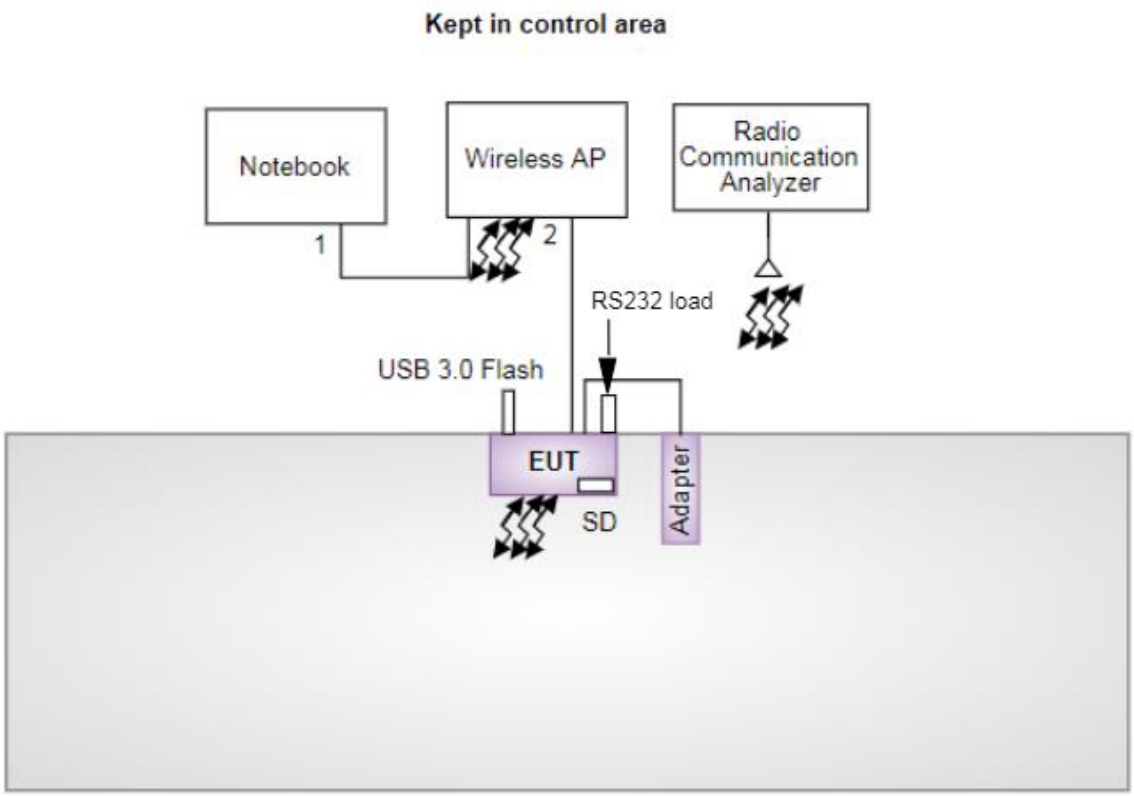
No.	Signal cable / Length (m)
1	USB, 0.5m shielded.
2-3	USB, 1.8m shielded.
4-5	USB to RS232, 2m shielded.
6	RJ45, 10m(x2) non-shielded.
7	RJ45, 3m non-shielded.

Test Setup Diagram (EMI, Adapter: F48L-120400SPAV)



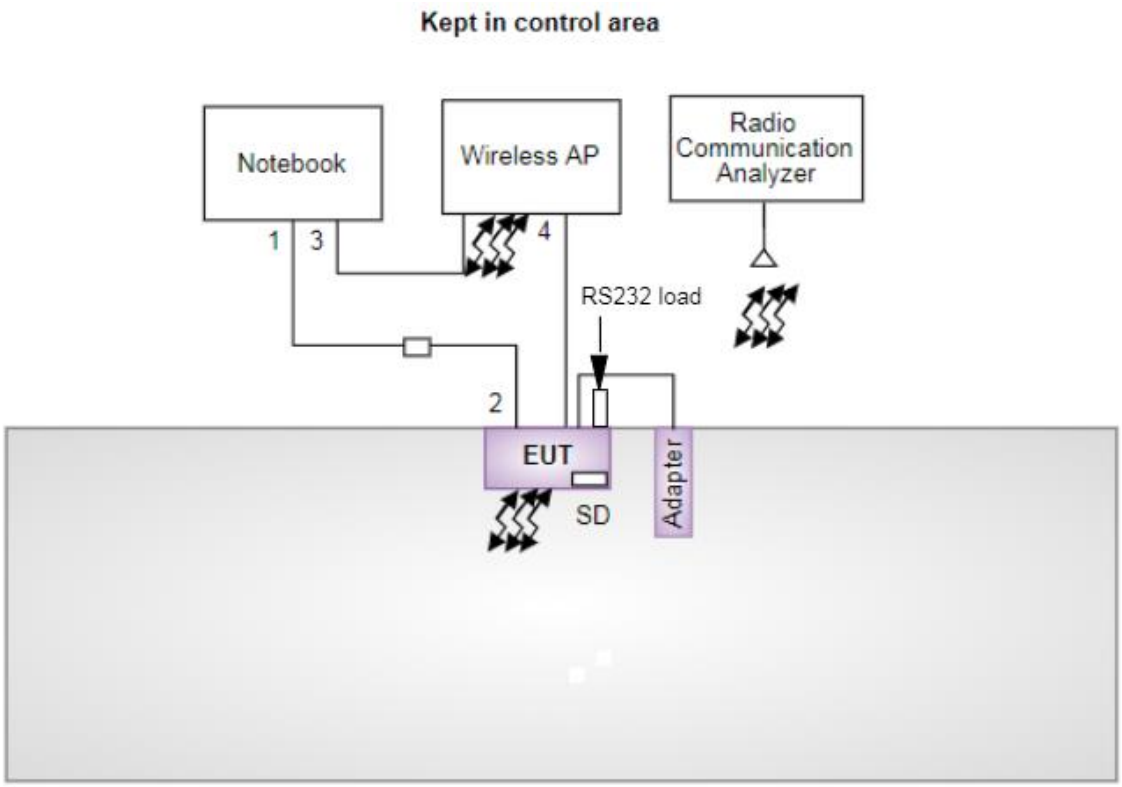
No.	Signal cable / Length (m)
1	USB, 0.5m shielded.
2-3	USB, 1.8m shielded.
4-5	USB to RS232, 2m shielded.
6	RJ45, 10m(x2) non-shielded.
7	RJ45, 3m non-shielded.

Test Setup Diagram (EMS, ESD test only, Adapter: F30L2-120250SPACP)



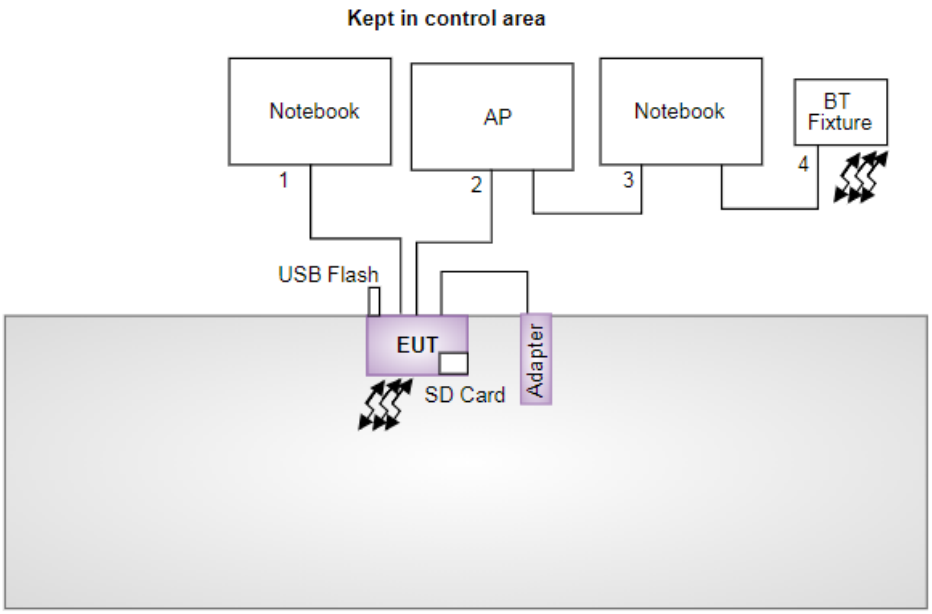
No.	Signal cable / Length (m)
1	RJ45, 1m non-shielded.
2	RJ45, 3m(x2) non-shielded.

Test Setup Diagram (EMS, all test except ESD, Adapter: F30L2-120250SPACP)



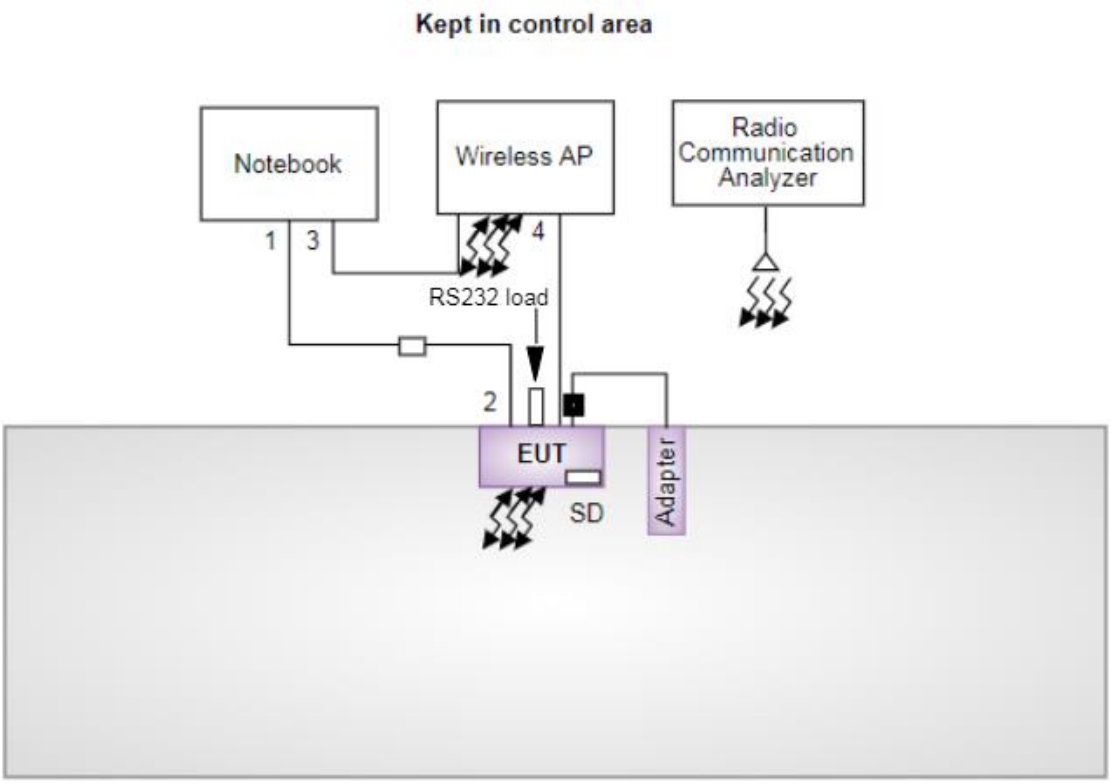
No.	Signal cable / Length (m)
1-2	USB to RS232, 1.8m shielded.
3	RJ45, 1m non-shielded.
4	RJ45, 3m(x2) non-shielded.

Test Setup Diagram (EMS, BT only , Adapter: F30L2-120250SPACP)



No.	Signal cable / Length (m)
1-3	RJ45, 3m non-shielded.
4	USB 1.8m shielded.

Test Setup Diagram (EMS, all test, Adapter: F48L-120400SPAV)



No.	Signal cable / Length (m)
1-2	USB to RS232, 1.8m shielded.
3	RJ45, 1m non-shielded.
4	RJ45, 3m(x2) non-shielded.

2.5 Test Software and Operating Condition

a. Enabled all function of test system.
b. Plugged the SD card into EUT to turn on the WiFi function.
c. The notebook executed “KM player.exe” to play colorbar video.
d. The support notebook executed “WinEMC.exe” to send “H” patterns to the printer.
e. The support notebooks communicated with support AP via EUT by using ping command to receive and transmit data by LAN & WLAN
f. The support notebook executed “teraterm.exe” to read and write data from SD card via console cable.
g. The LTE radio function is linked between EUT and the Radio Communication Analyzer
h. During testing, the support notebook executed "TfGen.exe" to traffic packet data generated software and LAN utilization in excess of 950Mbps to link with the EUT by RJ45 cable.(for 10/100Mbps)
i. During testing, the support notebook executed "TfGen.exe" to traffic packet data generated software and LAN utilization in excess of 750Mbps to link with the EUT by RJ45 cable. (for 1000Mbps)

EMS

All test except ESD (Adapter: F30L2-120250SPACP) & All test (Adapter: F48L-120400SPAV)

a. Enabled all function of test system.
b. The support notebooks communicated with support AP via EUT by using ping command to receive and transmit data by LAN & WLAN
c. The support notebook executed “teraterm.exe” to read and write data from SD card via console cable.
d. The LTE radio function is linked between EUT and the Radio Communication Analyzer

ESD test only (Adapter: F30L2-120250SPACP)

a. Enabled all function of test system.
b. The support notebooks communicated with support AP via EUT by using ping command to receive and transmit data by LAN & WLAN
c. The support notebook executed “teraterm.exe” to read and write data from USB Flash and SD card via console cable, and was disconnected from EUT and removed from test table after sending command.
d. The LTE radio function is linked between EUT and the Radio Communication Analyzer

BT only (Adapter: F30L2-120250SPACP)

a. Enabled all function of test system.
b. Plugged the SD card (SONY) into EUT to turn on the BT function.
c. The support notebook executed "teraterm.exe" to monitor the status of BT connection between support notebook and EUT.
d. The support notebook executed “teraterm.exe” to read and write data from USB Flash and SD card via console cable, and was disconnected from EUT and removed from test table after sending command.

3 Emission Test Results

3.1 Conducted Emissions from the AC mains power ports

3.1.1 Limits of Conducted Emissions from the AC mains power ports

Frequency range (MHz)	Limits values (dBµV)			
	Class A		Class B	
	Quasi-peak	Average	Quasi-peak	Average
0,15 to 0,5	79	66	66 to 56 *	56 to 46 *
0,5 to 5	73	60	56	46
5 to 30	73	60	60	50

Note 1: "*" Decreasing linearly with the logarithm of the frequency.
Note 2: If the limits for the average detector are met when using the quasi-peak detector, then the limits for the measurements with the average detector are considered to be met.
Note 3: The higher value measured with and without the outer conductor screen of the antenna terminal connected to earth is considered.

3.1.2 Test Procedures

a. The EUT was placed on a desk 0.8 meters height from the metal ground plane and 0.4 meter from the conducting wall of the shielding room and it was kept at least 0.8 meters from any other grounded conducting surface.

b. A thickness of ≤ 0.15m insulation should be placed between local AE and associated cabling and the RGP.

c. Connect EUT to the power mains through a line impedance stabilization network (LISN).

d. All the support units are connecting to the other LISN.

e. The LISN provides 50 ohm coupling impedance for the measuring instrument.

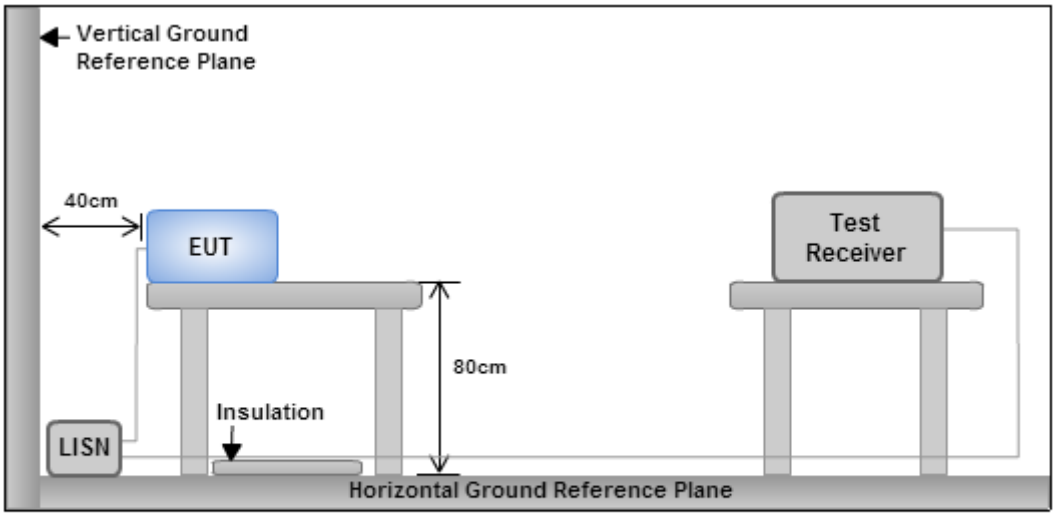
f. The CISPR states that a 50 ohm, 50 microhenry LISN should be used.

g. Both sides of AC line were checked for maximum conducted interference.

h. The frequency range from 150 kHz to 30 MHz was searched.

i. Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

3.1.3 Test Setup

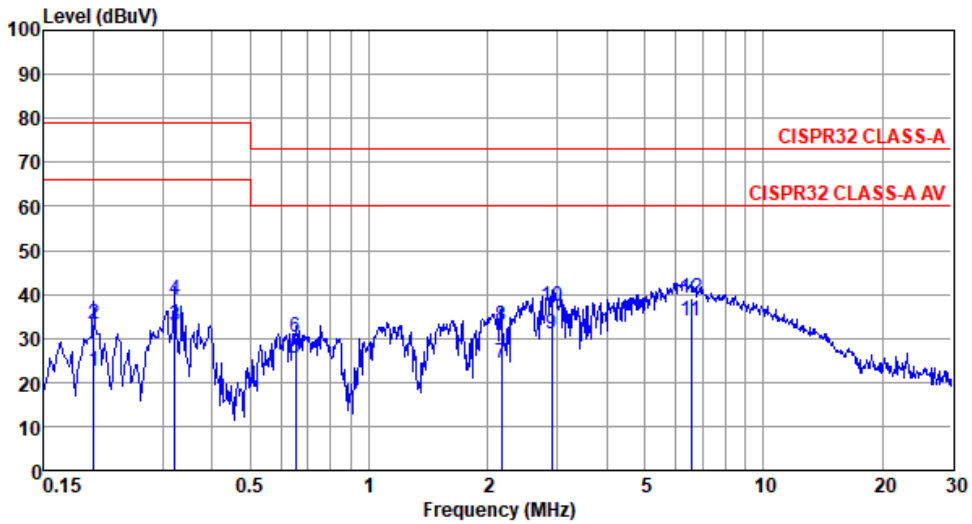


Note: 1. Support units were connected to second LISN.

2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

3.1.4 Test Result of Conducted Emissions from the AC mains power ports

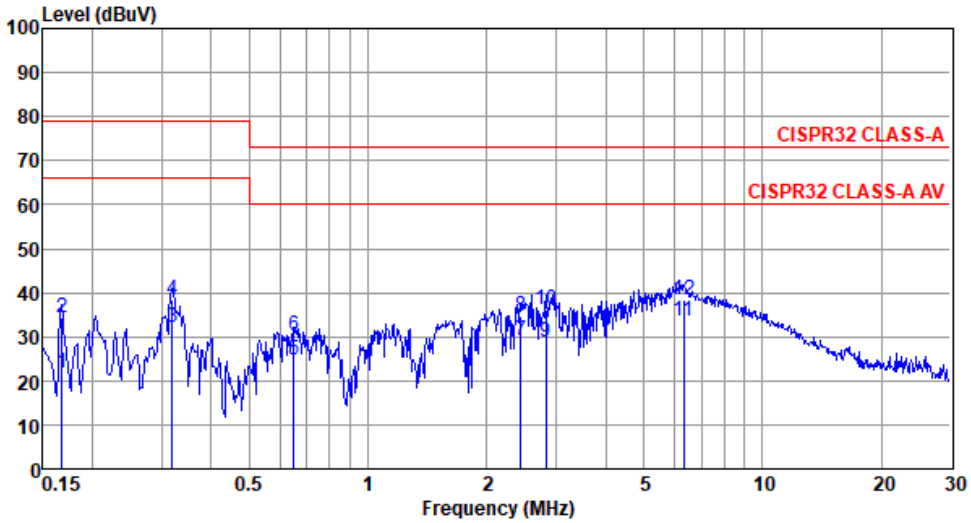
Power Phase	Line	Test Mode	1



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.201	22.56	66.00	-43.44	12.77	9.54	0.06	Average
2	0.201	33.21	79.00	-45.79	23.42	9.54	0.06	QP
3	0.322	32.70	66.00	-33.30	22.84	9.56	0.07	Average
4	0.322	38.82	79.00	-40.18	28.96	9.56	0.07	QP
5	0.651	25.37	60.00	-34.63	15.39	9.59	0.10	Average
6	0.651	30.39	73.00	-42.61	20.41	9.59	0.10	QP
7	2.167	24.51	60.00	-35.49	14.38	9.60	0.19	Average
8	2.167	32.73	73.00	-40.27	22.60	9.60	0.19	QP
9	2.900	30.95	60.00	-29.05	20.74	9.61	0.24	Average
10	2.900	37.45	73.00	-35.55	27.24	9.61	0.24	QP
11*	6.557	34.01	60.00	-25.99	23.65	9.63	0.34	Average
12	6.557	38.96	73.00	-34.04	28.60	9.63	0.34	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Limit Line (dBuV) – Level (dBuV).

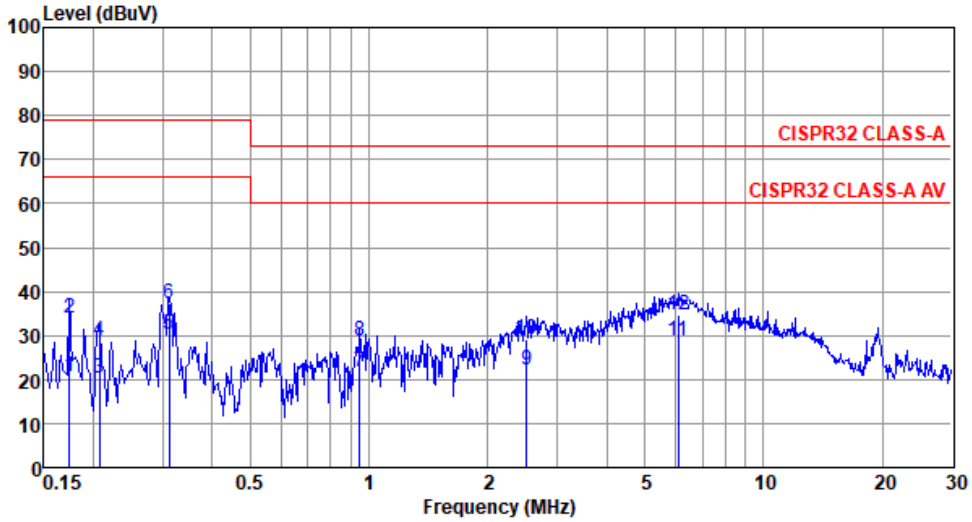
Power Phase	Neutral	Test Mode	1



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.168	21.67	66.00	-44.33	11.92	9.57	0.05	Average
2	0.168	34.20	79.00	-44.80	24.45	9.57	0.05	QP
3	0.318	32.27	66.00	-33.73	22.44	9.60	0.07	Average
4	0.318	38.35	79.00	-40.65	28.52	9.60	0.07	QP
5	0.647	24.66	60.00	-35.34	14.74	9.63	0.10	Average
6	0.647	30.31	73.00	-42.69	20.39	9.63	0.10	QP
7	2.435	29.13	60.00	-30.87	19.01	9.65	0.21	Average
8	2.435	34.76	73.00	-38.24	24.64	9.65	0.21	QP
9	2.824	28.69	60.00	-31.31	18.55	9.65	0.23	Average
10	2.824	36.00	73.00	-37.00	25.86	9.65	0.23	QP
11*	6.319	33.74	60.00	-26.26	23.42	9.68	0.34	Average
12	6.319	38.49	73.00	-34.51	28.17	9.68	0.34	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Limit Line (dBuV) – Level (dBuV).

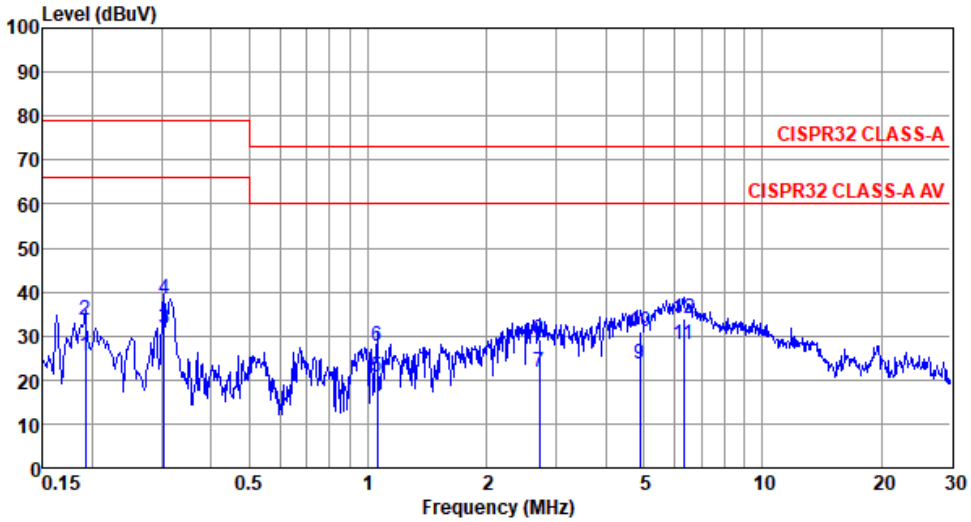
Power Phase	Line	Test Mode	2



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.174	20.77	66.00	-45.23	10.99	9.54	0.06	Average
2	0.174	33.82	79.00	-45.18	24.04	9.54	0.06	QP
3	0.207	20.47	66.00	-45.53	10.68	9.54	0.06	Average
4	0.207	28.73	79.00	-50.27	18.94	9.54	0.06	QP
5	0.312	30.08	66.00	-35.92	20.22	9.56	0.07	Average
6	0.312	37.16	79.00	-41.84	27.30	9.56	0.07	QP
7	0.948	21.69	60.00	-38.31	11.65	9.60	0.12	Average
8	0.948	28.89	73.00	-44.11	18.85	9.60	0.12	QP
9	2.513	22.12	60.00	-37.88	11.95	9.60	0.22	Average
10	2.513	29.12	73.00	-43.88	18.95	9.60	0.22	QP
11*	6.089	28.76	60.00	-31.24	18.41	9.63	0.34	Average
12	6.089	34.58	73.00	-38.42	24.23	9.63	0.34	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Limit Line (dBuV) – Level (dBuV).

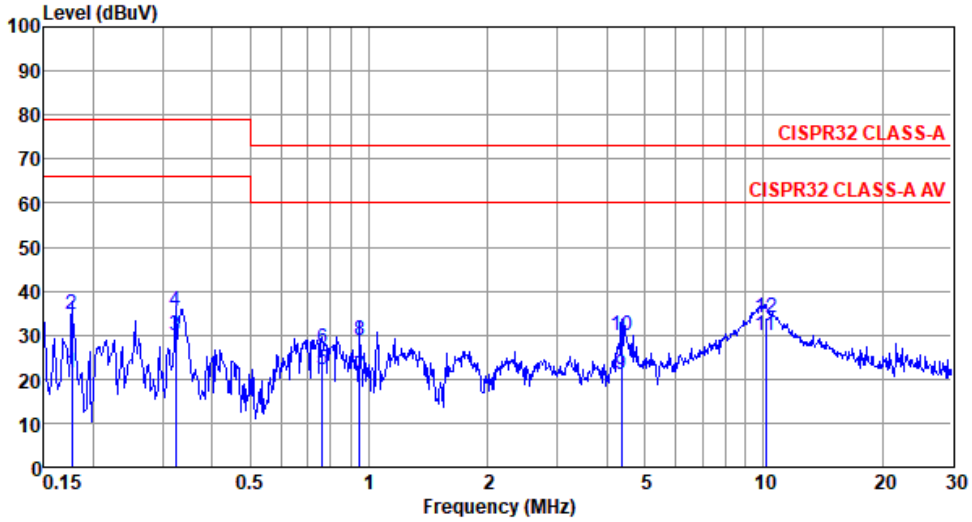
Power Phase	Neutral	Test Mode	2



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.192	25.30	66.00	-40.70	15.51	9.58	0.06	Average
2	0.192	33.40	79.00	-45.60	23.61	9.58	0.06	QP
3	0.303	31.70	66.00	-34.30	21.87	9.60	0.07	Average
4	0.303	38.41	79.00	-40.59	28.58	9.60	0.07	QP
5	1.054	20.75	60.00	-39.25	10.79	9.64	0.12	Average
6	1.054	27.69	73.00	-45.31	17.73	9.64	0.12	QP
7	2.721	21.94	60.00	-38.06	11.80	9.65	0.23	Average
8	2.721	29.05	73.00	-43.95	18.91	9.65	0.23	QP
9	4.900	23.49	60.00	-36.51	13.23	9.67	0.31	Average
10	4.900	31.13	73.00	-41.87	20.87	9.67	0.31	QP
11*	6.319	28.13	60.00	-31.87	17.81	9.68	0.34	Average
12	6.319	33.82	73.00	-39.18	23.50	9.68	0.34	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Limit Line (dBuV) – Level (dBuV).

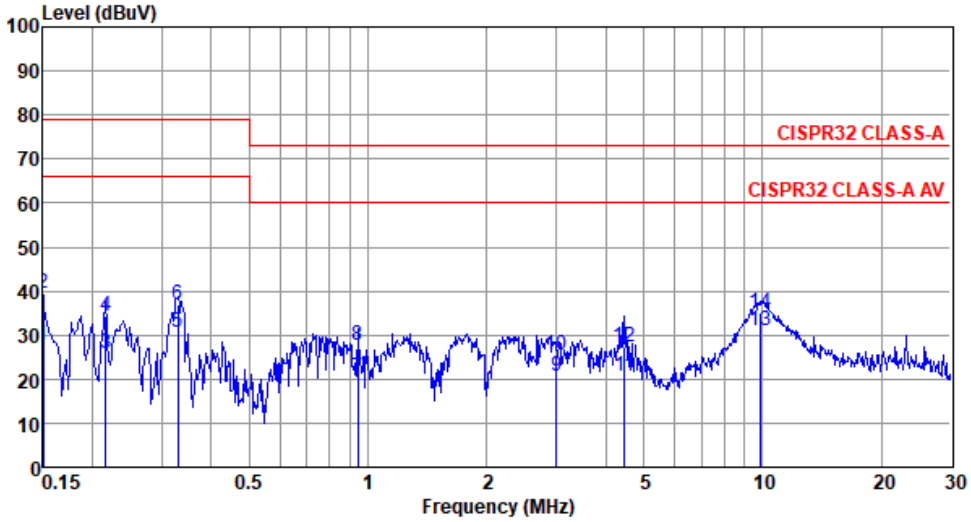
Power Phase	Line	Test Mode	3



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.177	21.36	66.00	-44.64	11.58	9.54	0.06	Average
2	0.177	34.77	79.00	-44.23	24.99	9.54	0.06	QP
3	0.323	29.81	66.00	-36.19	19.95	9.56	0.07	Average
4	0.323	35.50	79.00	-43.50	25.64	9.56	0.07	QP
5	0.763	21.98	60.00	-38.02	11.98	9.59	0.11	Average
6	0.763	26.86	73.00	-46.14	16.86	9.59	0.11	QP
7	0.948	20.56	60.00	-39.44	10.52	9.60	0.12	Average
8	0.948	28.73	73.00	-44.27	18.69	9.60	0.12	QP
9	4.361	20.96	60.00	-39.04	10.68	9.61	0.30	Average
10	4.361	29.71	73.00	-43.29	19.43	9.61	0.30	QP
11*	10.125	29.90	60.00	-30.10	19.46	9.65	0.39	Average
12	10.125	34.02	73.00	-38.98	23.58	9.65	0.39	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Limit Line (dBuV) – Level (dBuV).

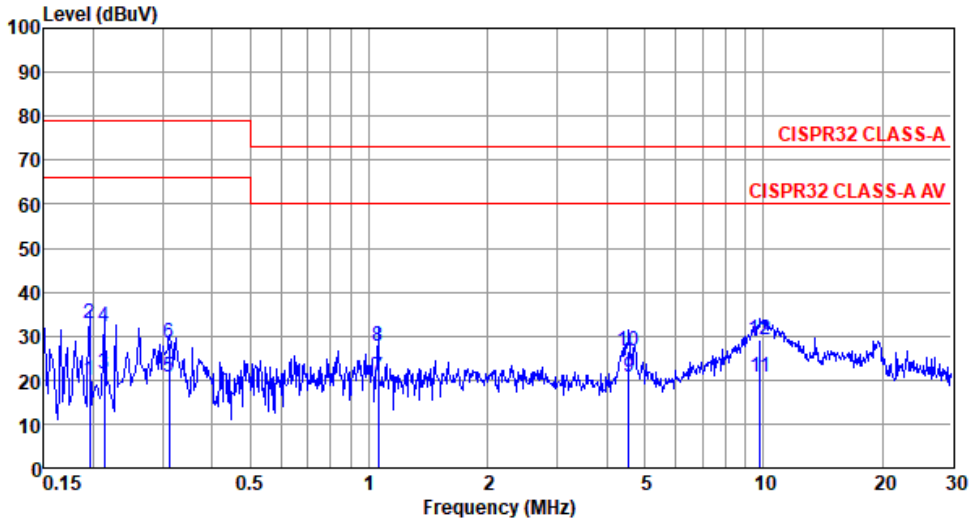
Power Phase	Neutral	Test Mode	3



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.150	27.58	66.00	-38.42	17.84	9.57	0.05	Average
2	0.150	39.65	79.00	-39.35	29.91	9.57	0.05	QP
3	0.216	25.97	66.00	-40.03	16.18	9.58	0.06	Average
4	0.216	34.40	79.00	-44.60	24.61	9.58	0.06	QP
5	0.330	30.73	66.00	-35.27	20.90	9.60	0.07	Average
6	0.330	37.07	79.00	-41.93	27.24	9.60	0.07	QP
7	0.943	20.27	60.00	-39.73	10.31	9.64	0.12	Average
8	0.943	27.66	73.00	-45.34	17.70	9.64	0.12	QP
9	3.000	20.59	60.00	-39.41	10.43	9.66	0.24	Average
10	3.000	25.30	73.00	-47.70	15.14	9.66	0.24	QP
11	4.478	20.57	60.00	-39.43	10.33	9.67	0.30	Average
12	4.478	27.23	73.00	-45.77	16.99	9.67	0.30	QP
13*	9.913	30.90	60.00	-29.10	20.47	9.71	0.39	Average
14	9.913	35.18	73.00	-37.82	24.75	9.71	0.39	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Limit Line (dBuV) – Level (dBuV).

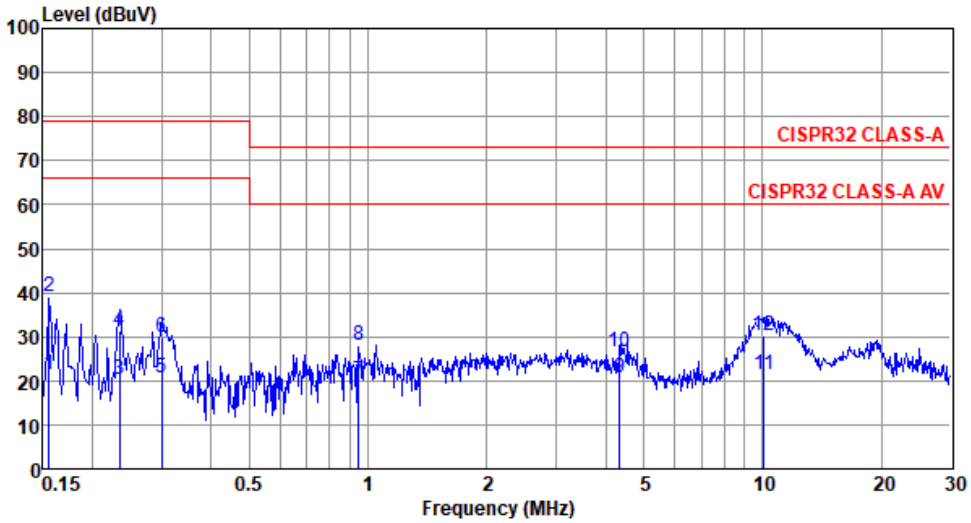
Power Phase	Line	Test Mode	4



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.195	19.98	66.00	-46.02	10.19	9.54	0.06	Average
2	0.195	32.72	79.00	-46.28	22.93	9.54	0.06	QP
3	0.213	21.47	66.00	-44.53	11.68	9.54	0.06	Average
4	0.213	32.13	79.00	-46.87	22.34	9.54	0.06	QP
5	0.312	20.52	66.00	-45.48	10.66	9.56	0.07	Average
6	0.312	28.59	79.00	-50.41	18.73	9.56	0.07	QP
7	1.054	20.52	60.00	-39.48	10.48	9.60	0.12	Average
8	1.054	27.63	73.00	-45.37	17.59	9.60	0.12	QP
9*	4.549	20.84	60.00	-39.16	10.55	9.62	0.30	Average
10	4.549	26.66	73.00	-46.34	16.37	9.62	0.30	QP
11	9.809	20.81	60.00	-39.19	10.37	9.65	0.39	Average
12	9.809	29.00	73.00	-44.00	18.56	9.65	0.39	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Limit Line (dBuV) – Level (dBuV).

Power Phase	Neutral	Test Mode	4



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1	0.156	21.31	66.00	-44.69	11.57	9.57	0.05	Average
2	0.156	39.28	79.00	-39.72	29.54	9.57	0.05	QP
3	0.234	20.28	66.00	-45.72	10.48	9.59	0.06	Average
4	0.234	31.27	79.00	-47.73	21.47	9.59	0.06	QP
5	0.300	20.55	66.00	-45.45	10.72	9.60	0.07	Average
6	0.300	29.99	79.00	-49.01	20.16	9.60	0.07	QP
7	0.948	20.03	60.00	-39.97	10.07	9.64	0.12	Average
8	0.948	27.86	73.00	-45.14	17.90	9.64	0.12	QP
9	4.338	20.51	60.00	-39.49	10.28	9.66	0.30	Average
10	4.338	26.45	73.00	-46.55	16.22	9.66	0.30	QP
11*	10.072	21.25	60.00	-38.75	10.82	9.71	0.39	Average
12	10.072	30.08	73.00	-42.92	19.65	9.71	0.39	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Limit Line (dBuV) – Level (dBuV).

3.2 Asymmetric Mode Conducted Emissions

3.2.1 Limit of Asymmetric Mode Conducted Emissions

Asymmetric Mode Conducted Emissions Class A limits				
Frequency Range (MHz)	Voltage Limits (dBuV)		Current Limits (dBµA)	
	Quasi-peak	Average	Quasi-peak	Average
0,15 to 0,5	97 to 87	84 to 74	53 to 43	40 to 30
0,5 to 30	87	74	43	30
Note: The limit decreases linearly with the logarithm of the frequency in the range 0,15 MHz to 0,5 MHz.				

Asymmetric Mode Conducted Emissions Class B limits				
Frequency Range (MHz)	Voltage Limits (dBuV)		Current Limits (dBµA)	
	Quasi-peak	Average	Quasi-peak	Average
0,15 to 0,5	84 to 74	74 to 64	40 to 30	30 to 20
0,5 to 30	74	64	30	20
Note: The limit decreases linearly with the logarithm of the frequency in the range 0,15 MHz to 0,5 MHz.				

3.2.2 Test Procedures

Using ISN

a. Connect CDN/ISN directly to reference ground plane.

b. If voltage measurement is used, measure voltage at the measurement port of the ISN, correct the reading by adding the ISN voltage division factor, and compare to the voltage limit.

c. If current measurement is used, measure current with the current probe and compare to the current limit.

d. The disturbance levels and the frequencies of at least six highest disturbances are recorded from be measured each telecommunication port, which comprises the EUT.

e. It is not necessary to apply the voltage and the current limit if the ISN is used. A 50 ohm load has to be connected to the measurement port of the ISN during the current measurement.

Using a 150 ohm load to the outside surface of the shield ("in situ CDN/ISN")

a. Break the insulation and connect a 150 ohm resistor from the outside surface of the shield cable to ground.

b. Apply a ferrite tube or clamp between 150 ohm connection and AE.

f. Connect to AE with shield cable.

c. The disturbance levels and the frequencies of at least six highest disturbances are recorded from be measured each telecommunication port, which comprises the EUT.

d. Measure current with a current probe and compare to the current limit. The common mode impedance towards the right of the 150 ohm resistor shall be sufficiently large as not to affect the measurement. Use Clause C.2 to measure this impedance which should be much greater than 150 ohm so as not to affect the measurement for frequencies emitted by the EUT.

Using a combination of current probe and capacitive voltage probe with a table top EUT

a. Connect to AE with a cable. The cable contains more than four balanced pairs or to unbalanced cable.

b. Measure current with a current probe and compare to the current limit.

c. Measure voltage with a capacitive probe and adjust the measured voltage as follows:
   - current margin ≤ 6 dB – subtract the actual current margin from measured voltage;
   - current margin > 6 dB – subtract 6 dB from measured voltage.

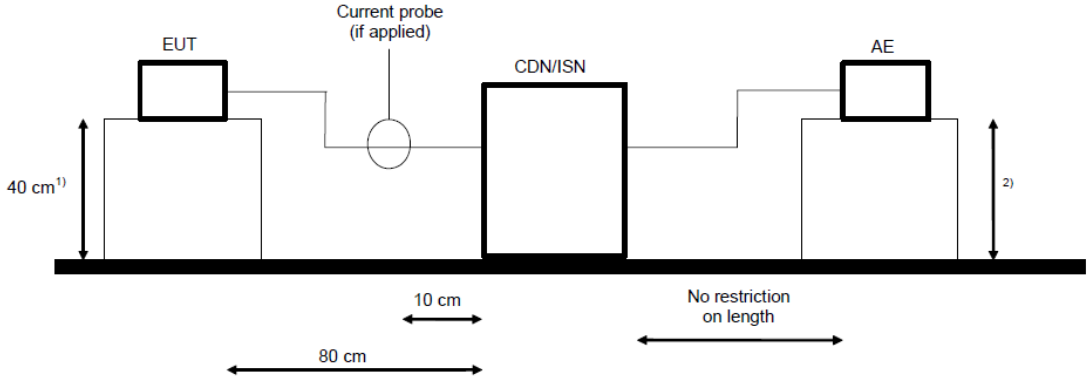
   Compare adjusted voltage with the applicable voltage limit.

d. Both the measured current and the adjusted voltage shall be below the applicable current and voltage limits.

e. The disturbance levels and the frequencies of at least six highest disturbances are recorded from be measured each telecommunication port, which comprises the EUT.

3.2.3 Test Setup

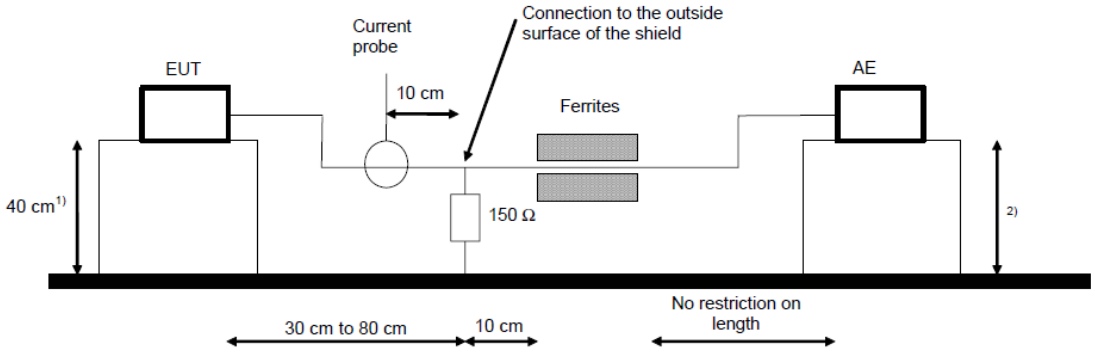
Using ISN



AE = Associated equipment
EUT = Equipment under test

1) Distance to the reference groundplane (vertical or horizontal).
2) Distance to the reference groundplane is not critical.

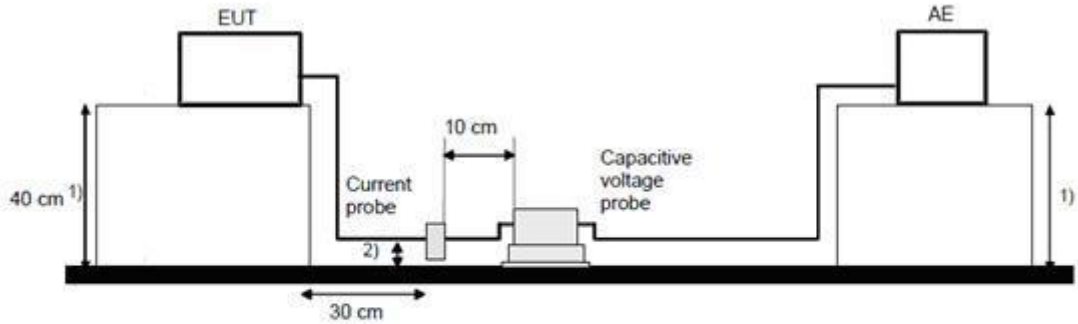
Using a 150 ohm load to the outside surface of the shield cable



AE = Associated equipment
EUT = Equipment under test

1) Distance to the reference groundplane (vertical or horizontal).
2) Distance to the reference groundplane is not critical.

Using a combination of current probe and capacitive voltage probe

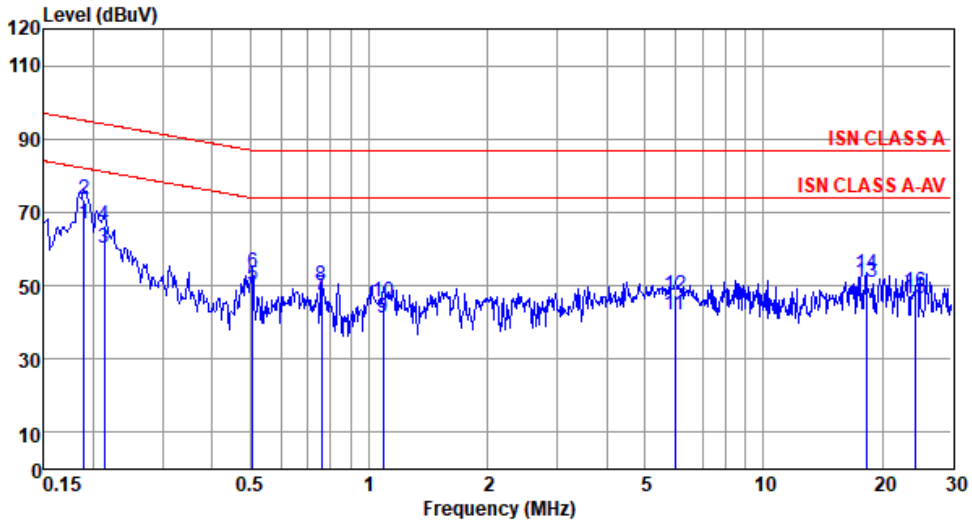


AE = Associated equipment
EUT = Equipment under test

1) Distance to the reference groundplane (vertical or horizontal)
2) Distance 4± 1 cm from the reference groundplane.

3.2.4 Test Result of Asymmetric Mode Conducted Emissions

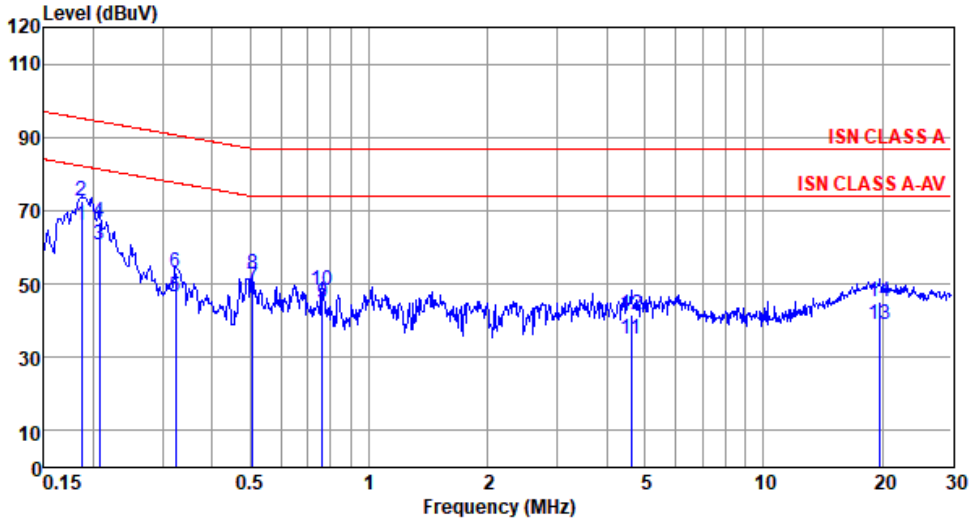
Test Mode	1. LAN1 Speed 100Mbps, Ping WiFi 5G, LTE Link, SD R/W, EUT orientation: Y-axis, with adapter: F30L2-120250SPACP, 230V/50Hz



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1*	0.189	66.97	82.06	-15.09	56.97	9.94	0.06	Average
2	0.189	73.67	95.06	-21.39	63.67	9.94	0.06	QP
3	0.213	60.22	81.10	-20.88	50.27	9.89	0.06	Average
4	0.213	66.60	94.10	-27.50	56.65	9.89	0.06	QP
5	0.507	50.09	74.00	-23.91	40.35	9.65	0.09	Average
6	0.507	53.50	87.00	-33.50	43.76	9.65	0.09	QP
7	0.759	47.32	74.00	-26.68	37.62	9.59	0.11	Average
8	0.759	50.25	87.00	-36.75	40.55	9.59	0.11	QP
9	1.088	41.32	74.00	-32.68	31.64	9.55	0.13	Average
10	1.088	45.76	87.00	-41.24	36.08	9.55	0.13	QP
11	5.961	41.97	74.00	-32.03	32.20	9.44	0.33	Average
12	5.961	47.34	87.00	-39.66	37.57	9.44	0.33	QP
13	18.245	50.87	74.00	-23.13	40.71	9.52	0.64	Average
14	18.245	53.01	87.00	-33.99	42.85	9.52	0.64	QP
15	24.349	46.45	74.00	-27.55	36.13	9.62	0.70	Average
16	24.349	48.14	87.00	-38.86	37.82	9.62	0.70	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

Test Mode	2. LAN2 Speed 1Gbps, Ping WiFi 5G, LTE Link, SD R/W, EUT orientation: Y-axis, with adapter: F30L2-120250SPACP, 230V/50Hz



	Freq MHz	Level dBuV	Limit Line dBuV	Over Limit dB	Read Level dBuV	LISN factor dB	cable loss dB	Remark
1*	0.186	66.10	82.20	-16.10	56.09	9.95	0.06	Average
2	0.186	72.69	95.20	-22.51	62.68	9.95	0.06	QP
3	0.207	60.47	81.32	-20.85	50.51	9.90	0.06	Average
4	0.207	66.96	94.32	-27.36	57.00	9.90	0.06	QP
5	0.323	46.29	77.62	-31.33	36.47	9.75	0.07	Average
6	0.323	52.99	90.62	-37.63	43.17	9.75	0.07	QP
7	0.507	49.01	74.00	-24.99	39.27	9.65	0.09	Average
8	0.507	52.57	87.00	-34.43	42.83	9.65	0.09	QP
9	0.763	44.87	74.00	-29.13	35.17	9.59	0.11	Average
10	0.763	48.25	87.00	-38.75	38.55	9.59	0.11	QP
11	4.622	34.84	74.00	-39.16	25.08	9.45	0.31	Average
12	4.622	41.55	87.00	-45.45	31.79	9.45	0.31	QP
13	19.740	39.08	74.00	-34.92	28.89	9.53	0.66	Average
14	19.740	44.96	87.00	-42.04	34.77	9.53	0.66	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

3.3 Radiated Emissions

3.3.1 Limit of Radiated Emissions

Frequency Range (MHz)	Class A		Class B	
	10m	3m	10m	3m
	Quasi-peak limits (dBμV/m)			
30 to 230	40	50	30	40
230 to 1000	47	57	37	47
Note 1: The lower limit shall apply at the transition frequency. Note 2: Additional provisions may be required for cases where interference occurs.				

Frequency range (GHz)	Class A (3 m)		Class B (3 m)	
	Average limit (dBμV/m)	Peak limit (dBμV/m)	Average limit (dBμV/m)	Peak limit (dBμV/m)
1 to 3	56	76	50	70
3 to 6	60	80	54	74
Note 1: The lower limit shall apply at the transition frequency. Note 2: Additional provisions may be required for cases where interference occurs.				

For an unintentional radiator is shown in the table below.

The highest internal source of an EUT is defined as the highest frequency generated or used within the EUT or on which the EUT operates or tunes.	Upper frequency of measurement range
Below 108 MHz	1 GHz
108 MHz to 500 MHz	2 GHz
500 MHz to 1 GHz	5 GHz
Above 1 GHz	5 times the highest frequency or 6 GHz, whichever is less.

3.3.2 Test Procedures

a. The EUT was placed on a rotatable table top with a height of 0.8 meters which is placed on the ground plane.

b. A thickness of ≤ 0.15m insulation should be placed between local AE and associated cabling and the RGP.

c. The EUT received DC power source from the outlet socket under the turntable. All support equipment power received from another socket under the turntable.

d. The EUT and local AE shall be arranged in the most compact practical arrangement within the test volume. The central point of the arrangement shall be positioned at the centre of the turntable. The measurement distance is the shortest horizontal distance between an imaginary circular periphery just encompassing this arrangement and calibration point of the antenna.

e. The table was rotated 360 degrees to determine the position of the highest radiation.

f. The antenna is a half wave dipole and its height is varied between one meter and four meters above ground to find the maximum value of the field strength both horizontal polarization and vertical polarization of the antenna are set to make the measurement.

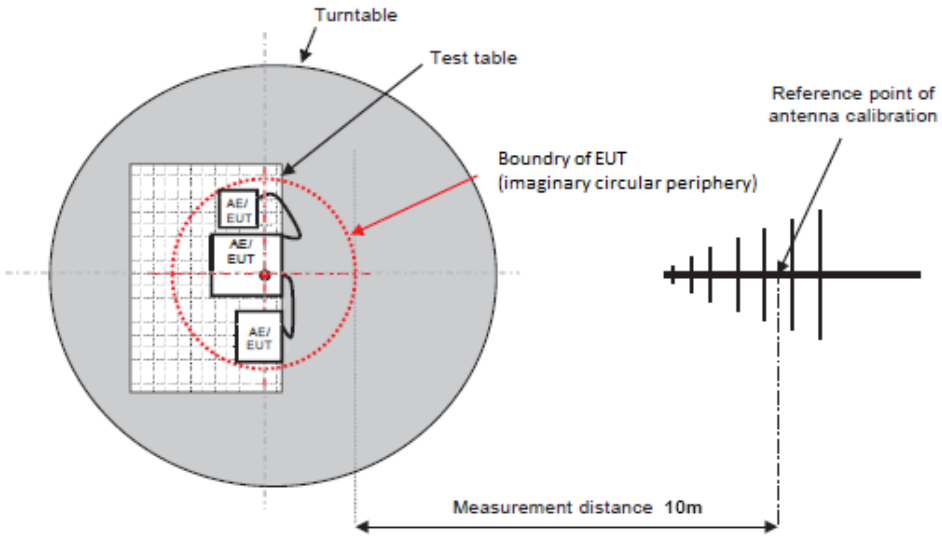
g. For each suspected emission the EUT was arranged to its worst case and then tune the antenna tower (from 1 to 4 meters) and turn table (from 0 to 360 degrees) to find the maximum reading.

h. Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode.

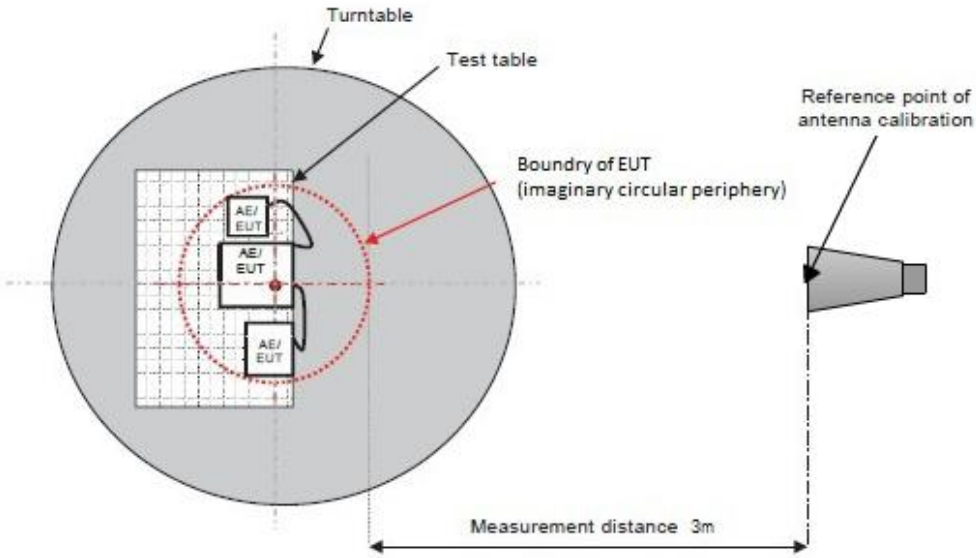
i. If the emission level of the EUT in peak mode was 2 dB lower than the limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 2 dB margin will be repeated one by one using the quasi-peak method and reported.

3.3.3 Test Setup

Radiated Emissions below 1GHz

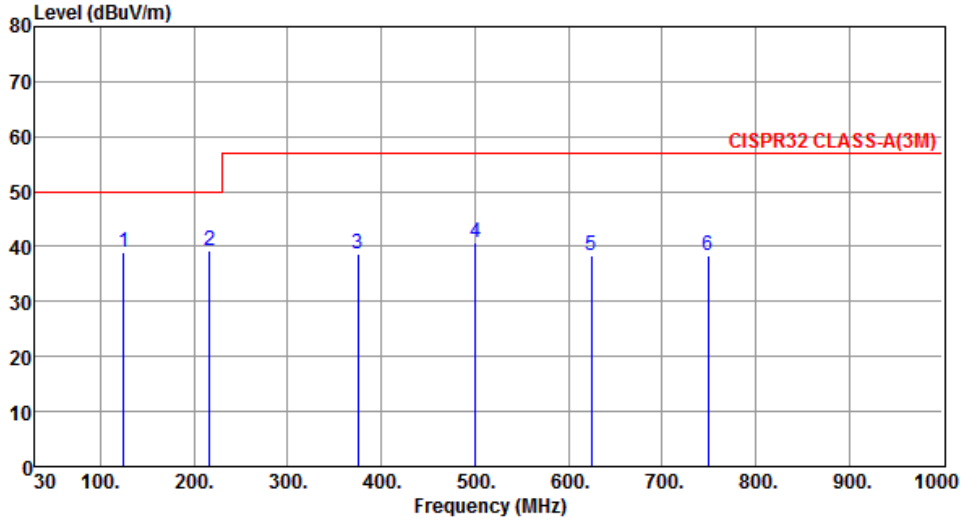


Radiated Emissions above 1GHz



3.3.4 Radiated Emissions (Below 1GHz)

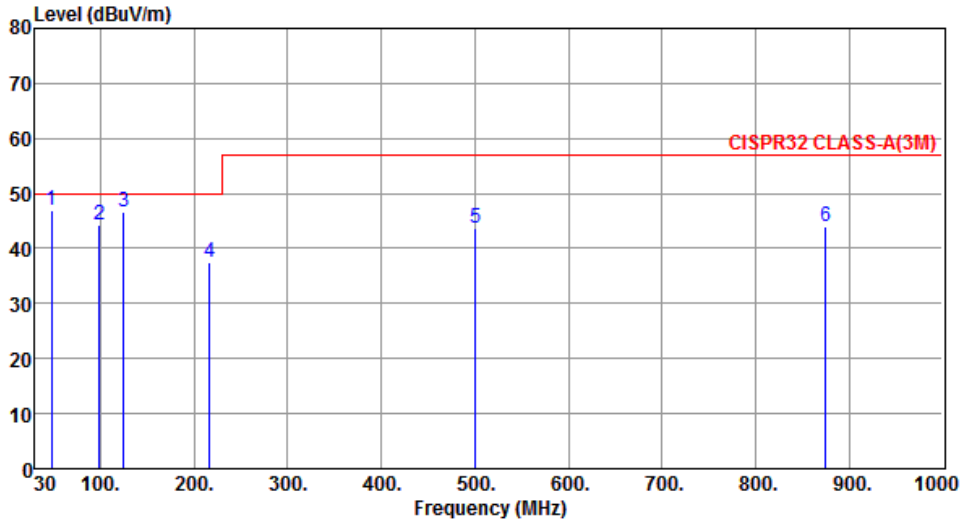
Polarization	Horizontal	Test Mode	1



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	125.06	39.11	50.00	-10.89	48.85	-9.74	Peak	---	---
2	216.24	39.39	50.00	-10.61	49.09	-9.70	Peak	---	---
3	375.32	38.55	57.00	-18.45	43.50	-4.95	Peak	---	---
4	500.45	40.79	57.00	-16.21	42.99	-2.20	Peak	---	---
5	624.61	38.27	57.00	-18.73	37.66	0.61	Peak	---	---
6	749.74	38.51	57.00	-18.49	35.68	2.83	Peak	---	---

Note 1: Emission level (dBuV/m) = SA reading (dBuV) + Factor (dB).
2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Polarization	Vertical	Test Mode	1

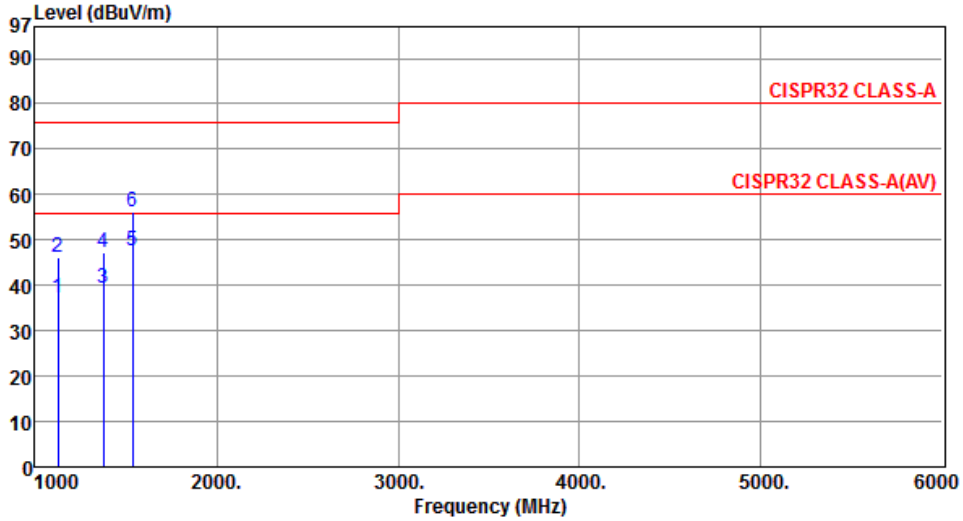


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	47.46	46.82	50.00	-3.18	54.60	-7.78	Peak	---	---
2	98.87	44.24	50.00	-5.76	57.43	-13.19	Peak	---	---
3	125.06	46.68	50.00	-3.32	56.42	-9.74	Peak	---	---
4	216.24	37.39	50.00	-12.61	47.09	-9.70	Peak	---	---
5	500.45	43.66	57.00	-13.34	45.86	-2.20	Peak	---	---
6	874.87	43.87	57.00	-13.13	39.10	4.77	Peak	---	---

Note 1: Emission level (dBuV/m) = SA reading (dBuV) + Factor (dB).
2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

3.3.5 Radiated Emissions (Above 1GHz)

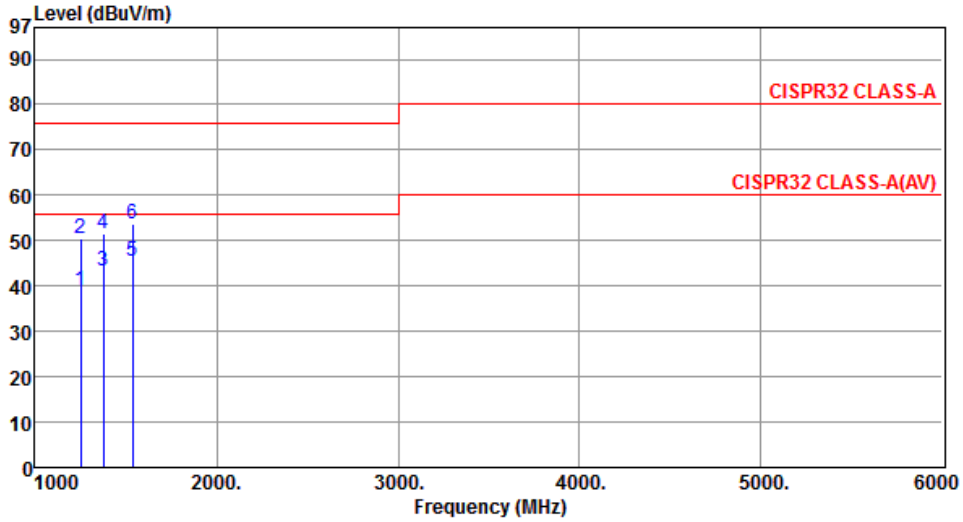
Polarization	Horizontal	Test Mode	1



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1125.02	37.30	56.00	-18.70	46.24	-8.94	Average	100	204
2	1125.02	46.01	76.00	-29.99	54.95	-8.94	Peak	100	204
3	1374.92	39.53	56.00	-16.47	45.85	-6.32	Average	100	157
4	1374.92	47.09	76.00	-28.91	53.41	-6.32	Peak	100	157
5	1538.09	47.67	56.00	-8.33	54.01	-6.34	Average	100	57
6	1538.09	56.29	76.00	-19.71	62.63	-6.34	Peak	100	57

Note 1: Emission level (dBuV/m) = SA reading (dBuV) + Factor (dB).
2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Polarization	Vertical	Test Mode	1



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1249.84	38.91	56.00	-17.09	46.26	-7.35	Average	100	113
2	1249.84	50.62	76.00	-25.38	57.97	-7.35	Peak	100	113
3	1375.09	43.31	56.00	-12.69	49.63	-6.32	Average	100	141
4	1375.09	51.67	76.00	-24.33	57.99	-6.32	Peak	100	141
5	1538.03	45.36	56.00	-10.64	51.70	-6.34	Average	100	189
6	1538.03	53.65	76.00	-22.35	59.99	-6.34	Peak	100	189

Note 1: Emission level (dBuV/m) = SA reading (dBuV) + Factor (dB).
2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

3.4 Harmonic Current Emissions

3.4.1 Limit of Harmonic Current Emissions

Harmonics [n]	Class A [A]	Class D [mA/W]
Odd harmonics		
3	2.30	3.4
5	1.14	1.9
7	0.77	1.0
9	0.40	0.5
11	0.33	0.35
13	0.21	0.30
15 ≤ n ≤ 39	0.15 x 15/n	3.85/n
Even harmonics		
2	1.08	-
4	0.43	-
6	0.30	-
8 ≤ n ≤ 40	0.23 x 8/n	-

Note:
1) According to EN 61000-3-2, the above limits for all equipment except for lighting equipment having an active input power > 75W and no limits apply for equipment with an active input power up to and including 75W.

3.4.2 Test Procedures

a. The EUT was placed on the top of a wooden table with a height of 0.8 meters above the ground and operated to produce the maximum harmonic components under normal operating conditions for each successive harmonic component in turn.

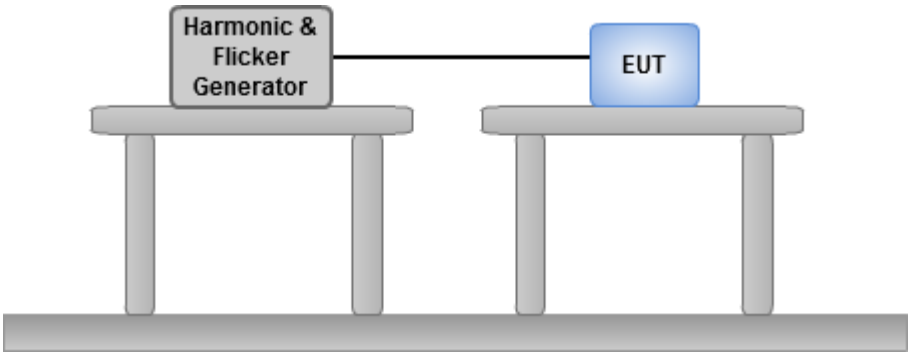
b. The classification of EUT is according to EN 61000-3-2.

The EUT is classified as follows:

- Class A: Balanced three-phase equipment, Household appliances excluding equipment as Class D, Tools excluding portable tools, Dimmers for incandescent lamps, audio equipment, equipment not specified in one of the three other classes.
- Class B: Portable tools. Arc welding equipment which is not professional equipment.
- Class C: Lighting equipment.
- Class D: Equipment having a specified power less than or equal to 600 W of the following types: Personal computers, personal computer monitors and TV receivers.

c. The correspondent test program of test instrument to measure the current harmonics emanated from EUT is chosen. The measure time shall be not less than the time necessary for the EUT to be exercised.

3.4.3 Test Setup



3.4.4 Test Result of Harmonic Current Emissions

Test Mode	1				
Fundamental Voltage (Vrms)	Ampere (Amps)	Power Frequency (Hz)	Rated Power Consumption (W)	Power Factor	Observation Period (Tp)
229.93	0.027	50	2.8	0.279	3 mins

Note: The EUT is not required to meet the limits as its power consumption is less than 75W.

Test Mode	2				
Fundamental Voltage (Vrms)	Ampere (Amps)	Power Frequency (Hz)	Rated Power Consumption (W)	Power Factor	Observation Period (Tp)
229.93	0.027	50	2.9	0.275	3 mins

Note: The EUT is not required to meet the limits as its power consumption is less than 75W.

Test Mode	3				
Fundamental Voltage (Vrms)	Ampere (Amps)	Power Frequency (Hz)	Rated Power Consumption (W)	Power Factor	Observation Period (Tp)
229.92	0.027	50	2.8	0.274	3 mins

Note: The EUT is not required to meet the limits as its power consumption is less than 75W.

Test Mode	4				
Fundamental Voltage (Vrms)	Ampere (Amps)	Power Frequency (Hz)	Rated Power Consumption (W)	Power Factor	Observation Period (Tp)
229.92	0.027	50	2.9	0.276	3 mins

Note: The EUT is not required to meet the limits as its power consumption is less than 75W.

Test Mode	5				
Fundamental Voltage (Vrms)	Ampere (Amps)	Power Frequency (Hz)	Rated Power Consumption (W)	Power Factor	Observation Period (Tp)
229.93	0.027	50	2.9	0.276	3 mins

Note: The EUT is not required to meet the limits as its power consumption is less than 75W.

Test Mode	6				
Fundamental Voltage (Vrms)	Ampere (Amps)	Power Frequency (Hz)	Rated Power Consumption (W)	Power Factor	Observation Period (Tp)
229.93	0.027	50	2.7	0.269	3 mins

Note: The EUT is not required to meet the limits as its power consumption is less than 75W.

Test Mode	7				
Fundamental Voltage (Vrms)	Ampere (Amps)	Power Frequency (Hz)	Rated Power Consumption (W)	Power Factor	Observation Period (Tp)
229.93	0.027	50	2.9	0.275	3 mins

Note: The EUT is not required to meet the limits as its power consumption is less than 75W.

Test Mode	8				
Fundamental Voltage (Vrms)	Ampere (Amps)	Power Frequency (Hz)	Rated Power Consumption (W)	Power Factor	Observation Period (Tp)
229.93	0.027	50	2.9	0.276	3 mins

Note: The EUT is not required to meet the limits as its power consumption is less than 75W.

Test Mode	9				
Fundamental Voltage (Vrms)	Ampere (Amps)	Power Frequency (Hz)	Rated Power Consumption (W)	Power Factor	Observation Period (Tp)
229.93	0.027	50	2.7	0.269	3 mins

Note: The EUT is not required to meet the limits as its power consumption is less than 75W.

Test Mode	10				
Fundamental Voltage (Vrms)	Ampere (Amps)	Power Frequency (Hz)	Rated Power Consumption (W)	Power Factor	Observation Period (Tp)
229.92	0.027	50	2.9	0.276	3 mins

Note: The EUT is not required to meet the limits as its power consumption is less than 75W.

Test Mode	11				
Fundamental Voltage (Vrms)	**Ampere (Amps)**	**Power Frequency (Hz)**	**Rated Power Consumption (W)**	**Power Factor**	**Observation Period (Tp)**
229.9	0.027	50	3.1	0.291	3 mins

Note: The EUT is not required to meet the limits as its power consumption is less than 75W.

Test Mode	12				
Fundamental Voltage (Vrms)	**Ampere (Amps)**	**Power Frequency (Hz)**	**Rated Power Consumption (W)**	**Power Factor**	**Observation Period (Tp)**
229.87	0.028	50	3.6	0.288	3 mins

Note: The EUT is not required to meet the limits as its power consumption is less than 75W.

3.5 Voltage Fluctuation and Flicker

3.5.1 Limit of Voltage Fluctuation and Flicker

- ✧ The value of P_{st} shall not be greater than 1.0.
- ✧ The value of P_{lt} shall not be greater than 0.65.
- ✧ The value of Tdt during a voltage change shall not exceed 3.3 % for more than 500 ms.
- ✧ The relative steady-state voltage change, dc, shall not exceed 3.3 %.
- ✧ The maximum relative voltage change, dmax, shall not exceed 4.0 %.

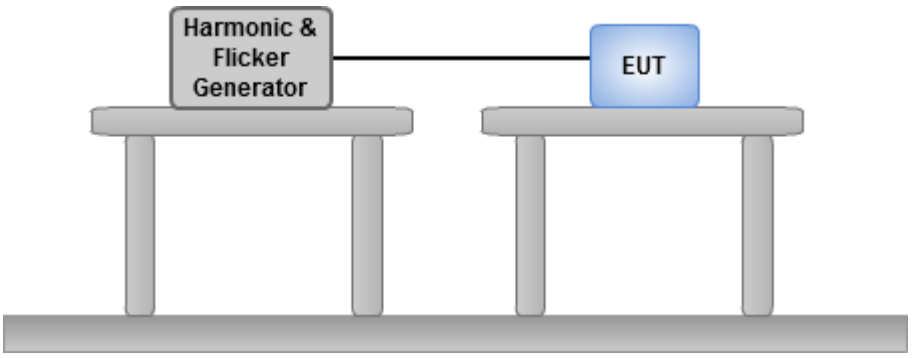
Note:
1) P_{st} means short-term flicker indicator.
2) P_{lt} means long-term flicker indicator.
3) Tdt means maximum time that dt exceeds 3.3 %.
4) dc means relative steady-state voltage change.
5) dmax means maximum relative voltage change.

3.5.2 Test Procedures

a. The EUT was placed on the top of a wooden table with a height of 0.8 meters above the ground and operated to produce the most unfavorable sequence of voltage changes under normal operating conditions.

b. During the flick measurement, the measure time shall include that part of whole operation cycle in which the EUT produce the most unfavorable sequence of voltage changes. The observation period for short-term flicker indicator is 10 minutes and the observation period for long-term flicker indicator is 2 hours.

3.5.3 Test Setup



3.5.4 Test Result of Voltage Fluctuation and Flicker

Test Mode	1			
Fundamental Voltage (Vrms)	Fundamental Ampere (Amps)	Power Frequency (Hz)	Observation Period (Tp)	Power Factor
229.85	0.027	50	10 mins	0.279
Measurement Value				
P_{st}	P_{lt}	T_{dt} (ms)	d_{max} (%)	dc (%)
0.064	0.028	0	0	0

Test Mode	2			
Fundamental Voltage (Vrms)	Fundamental Ampere (Amps)	Power Frequency (Hz)	Observation Period (Tp)	Power Factor
229.86	0.027	50	10 mins	0.275
Measurement Value				
P_{st}	P_{lt}	T_{dt} (ms)	d_{max} (%)	dc (%)
0.064	0.028	0	0	0

Test Mode	3			
Fundamental Voltage (Vrms)	Fundamental Ampere (Amps)	Power Frequency (Hz)	Observation Period (Tp)	Power Factor
229.89	0.027	50	10 mins	0.274
Measurement Value				
P_{st}	P_{lt}	T_{dt} (ms)	d_{max} (%)	dc (%)
0.064	0.028	0	0	0

Test Mode	4			
Fundamental Voltage (Vrms)	Fundamental Ampere (Amps)	Power Frequency (Hz)	Observation Period (Tp)	Power Factor
229.82	0.027	50	10 mins	0.276
Measurement Value				
P_{st}	P_{lt}	T_{dt} (ms)	d_{max} (%)	dc (%)
0.064	0.028	0	0	0

Test Mode	5			
Fundamental Voltage (Vrms)	Fundamental Ampere (Amps)	Power Frequency (Hz)	Observation Period (Tp)	Power Factor
229.89	0.027	50	10 mins	0.276
Measurement Value				
P_{st}	P_{lt}	T_{dt} (ms)	d_{max} (%)	dc (%)
0.064	0.028	0	0	0

Test Mode	6			
Fundamental Voltage (Vrms)	Fundamental Ampere (Amps)	Power Frequency (Hz)	Observation Period (Tp)	Power Factor
229.85	0.027	50	10 mins	0.269
Measurement Value				
P_{st}	P_{lt}	T_{dt} (ms)	d_{max} (%)	dc (%)
0.064	0.028	0	0	0

Test Mode	7			
Fundamental Voltage (Vrms)	Fundamental Ampere (Amps)	Power Frequency (Hz)	Observation Period (Tp)	Power Factor
229.9	0.027	50	10 mins	0.275
Measurement Value				
P_{st}	P_{lt}	T_{dt} (ms)	d_{max} (%)	dc (%)
0.064	0.028	0	0	0

Test Mode	8			
Fundamental Voltage (Vrms)	Fundamental Ampere (Amps)	Power Frequency (Hz)	Observation Period (Tp)	Power Factor
229.88	0.027	50	10 mins	0.276
Measurement Value				
P_{st}	P_{lt}	T_{dt} (ms)	d_{max} (%)	dc (%)
0.064	0.028	0	0	0

Test Mode	9			
Fundamental Voltage (Vrms)	Fundamental Ampere (Amps)	Power Frequency (Hz)	Observation Period (Tp)	Power Factor
229.91	0.027	50	10 mins	0.269
Measurement Value				
P_{st}	P_{lt}	T_{dt} (ms)	d_{max} (%)	dc (%)
0.064	0.028	0	0	0

Test Mode	10			
Fundamental Voltage (Vrms)	Fundamental Ampere (Amps)	Power Frequency (Hz)	Observation Period (Tp)	Power Factor
229.86	0.027	50	10 mins	0.276
Measurement Value				
P_{st}	P_{lt}	T_{dt} (ms)	d_{max} (%)	dc (%)
0.064	0.028	0	0	0

Test Mode	11			
Fundamental Voltage (Vrms)	Fundamental Ampere (Amps)	Power Frequency (Hz)	Observation Period (Tp)	Power Factor
229.82	0.027	50	10 mins	0.291
Measurement Value				
P_{st}	P_{lt}	T_{dt} (ms)	d_{max} (%)	dc (%)
0.064	0.028	0	0	0

Test Mode	12			
Fundamental Voltage (Vrms)	Fundamental Ampere (Amps)	Power Frequency (Hz)	Observation Period (Tp)	Power Factor
229.75	0.028	50	10 mins	0.288
Measurement Value				
P_{st}	P_{lt}	T_{dt} (ms)	d_{max} (%)	dc (%)
0.064	0.028	0	0	0

4 Immunity Tests

4.1 General Description

Product Standard: EN 301 489-1, Draft EN 301 489-17, Draft EN 301 489-52		
Basic Standard	**Spec. Requirement**	**Performance Criteria**
EN 61000-4-2 (ESD)	Contact Discharge: ± 4 kV Air Discharge: ± 8 kV	TT/TR (B)
EN 61000-4-3 (RS)	80 MHz to 6000 MHz 3 V/m, 1 kHz Sine Wave 80%, AM Modulation	CT/CR (A)
EN 61000-4-4 (EFT)	AC power ports: ± 1 kV DC power ports: ± 0.5 kV Signal ports: ± 0.5 kV	TT/TR (B)
EN 61000-4-5 (Surge)	In telecom centers: Power ports: line to line ± 0.5 kV, line to ground ± 1 kV Signal ports: line to ground: outdoor: ± 0.5 kV	TT/TR (B)
	Other than telecom centers: Power ports: line to line ± 1 kV, line to ground ± 2 kV Signal ports: line to ground: outdoor: ± 1 kV, indoor: ± 0.5 kV	TT/TR (B)
EN 61000-4-6 (CS)	150 kHz to 80 MHz, 3 V_{rms}, 1 kHz Sine Wave 80%, AM Modulation	CT/CR (A)
EN 61000-4-11 (Dip)	Voltage Dips: 0% residual for 0.5 cycle	TT/TR (B)
	Voltage Dips: 0% residual for 1 cycle	TT/TR (B)
	Voltage Dips: 70% residual for 25 cycle	(C)
	Voltage Dips: 30% reduction for 0.5 cycle	TT (B) / CR (A)
	Voltage Interruptions: 0% residual for 250 cycle - with battery back-up	TT/TR (B)
	Voltage Interruptions: 0% residual for 250 cycle - without battery back-up	(C)

4.2 Performance Criteria Description

Draft EN 301 489-17		
Criteria	**During test**	**After test (i.e. as a result of the application of the test)**
A	Shall operate as intended. (see note). Shall be no loss of function. Shall be no unintentional transmissions.	Shall operate as intended. Shall be no degradation of performance Shall be no loss of function. Shall be no loss of critical stored data.
B	May be loss of function.	Functions shall be self-recoverable. Shall operate as intended after recovering. Shall be no loss of critical stored data.
C	May be loss of function.	Functions shall be recoverable by the operator. Shall operate as intended after recovering. Shall be no loss of critical stored data.
Note: Operate as intended during the test allows a level of degradation in accordance with clause 6.2.2. ***Clause 6.2.2 Minimum performance level*** *For equipment that supports a PER or FER, the minimum performance level shall be a PER or FER less than or equal to 10%.* *For equipment that does not support a PER or FER, the minimum performance level shall be no loss of wireless transmission function needed for the intended use of the equipment.*		

Draft EN 301 489-17 Performance Criteria	
CT	The performance criteria A shall apply. Tests shall be repeated with the EUT in standby mode (if applicable) to ensure that unintentional transmission does not occur. In systems using acknowledgement signals, it is recognized that an ACKnowledgement (ACK) or Not ACKnowledgement (NACK) transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.
TT	The performance criteria B shall apply, except for voltage dips of 100 ms and voltage interruptions of 5 000 ms duration, for which performance criteria C shall apply. Tests shall be repeated with the EUT in standby mode (if applicable) to ensure that unintentional transmission does not occur. In systems using acknowledgement signals, it is recognized that an acknowledgement (ACK) or not-acknowledgement (NACK) transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.
CR	The performance criteria A shall apply. Where the EUT is a transceiver, under no circumstances, shall the transmitter operate unintentionally during the test. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.
TR	The performance criteria B shall apply, except for voltage dips of 100 ms and voltage interruptions of 5 000 ms duration for which performance criteria C shall apply. Where the EUT is a transceiver, under no circumstances, shall the transmitter operate unintentionally during the test. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

Draft EN 301 489-52 GSM and DCS Performance Criteria	
CT	A communication link shall be established at the start of the test, and maintained during the test During the test, the uplink speech output level shall be at least 35 dB less than the previously recorded reference levels, when measured through an audio band pass filter of width 200 Hz, centred on 1 kHz (audio breakthrough check). NOTE: When there is a high level of background audio noise present, the filter bandwidth can be reduced down to a minimum of 40 Hz. At the conclusion of the test, the EUT shall operate as intended with no loss of user control functions or stored data, and the communication link shall have been maintained. In addition to confirming the above performance during a call, the test shall also be performed in idle mode, and the transmitter shall not unintentionally operate.
TT	A communications link shall be established at the start of the test. At the conclusion of each exposure the EUT shall operate with no user noticeable loss of the communication link. At the conclusion of the total test comprising the series of individual exposures, the EUT shall operate as intended with no loss of user control functions or stored data, as declared by the manufacturer, and the communication link shall have been maintained. In addition to confirming the above performance during a call, the test shall also be performed in idle mode, and the transmitter shall not unintentionally operate.
CR	A communications link shall be established at the start of the test. During the test, the RXQUAL of the downlink shall not exceed the value of three, measured during each individual exposure in the test sequence. During the test, the downlink speech output level shall be at least 35 dB less than the previously recorded reference levels, when measured through an audio band pass filter of width 200 Hz, centred on 1 kHz (audio breakthrough check). NOTE: When there is a high level background noise present the filter bandwidth can be reduced down to a minimum of 40 Hz. At the conclusion of the test, the EUT shall operate as intended with no loss of user control functions or stored data, and the communication link shall have been maintained.
TR	A communications link shall be established at the start of the test. At the conclusion of each exposure the EUT shall operate with no user noticeable loss of the communication link. At the conclusion of the total test comprising the series of individual exposures, the EUT shall operate as intended with no loss of user control functions or stored data, as declared by the manufacturer, and the communication link shall have been maintained.

Draft EN 301 489-52 CDMA Direct Spread (UTRA and E-UTRA) Performance Criteria	
Criteria	**During test / After test**
CT/CR	A communication link shall be established at the start of the test, and maintained during the test. In the speech mode, the performance criteria shall be that the Up Link and Down Link speech output levels shall be at least 35 dB less than the recorded reference levels, when measured through an audio band pass filter of width 200 Hz, centred on 1 kHz (annex B). NOTE: When there is a high level of background audio noise present, the filter bandwidth can be reduced down to a minimum of 40 Hz. At the conclusion of the test, the EUT shall operate as intended with no loss of user control functions or stored data, and the communication link shall have been maintained. In addition to confirming the above performance in traffic mode, the test shall be performed in idle mode, and the transmitter shall not unintentionally operate. - UTRA In the data transfer mode, the performance criteria can be one of the following: ● if the BER (as referred in ETSI TS 134 109 [4]) is used, it shall not exceed 0,001 during the test sequence; ● if the BLER (as referred in ETSI TS 134 109 [4]) is used, it shall not exceed 0,01 during the test sequence. The BLER calculation shall be based on evaluating the CRC on each transport block. - E-UTRA In the data transfer mode, the performance criteria shall be that the throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channel as specified in annex C in ETSI TS 136 101 [9] with parameters specified in tables 7.3.1-1 and 7.3.1-2 in ETSI TS 136 101 [9] during the test sequence.
TT/TR	A communications link shall be established at the start of the test. At the conclusion of each exposure the EUT shall operate with no user noticeable loss of the communication link. At the conclusion of the total test comprising the series of individual exposures, the EUT shall operate as intended with no loss of user control functions or stored data, as declared by the manufacturer, and the communication link shall have been maintained. In addition to confirming the above performance in traffic mode, the test shall also be performed in idle mode, and the transmitter shall not unintentionally operate.

4.3 Special Conditions for EMC Measurements

4.3.1 Special Conditions for Emission Measurements

Draft EN 301 489-52 GSM and DCS

Reference to clauses in EN 301 489-1 [1]	Special product-related conditions, additional to or modifying the test conditions in EN 301 489-1 [1], clause 8
8.2 Enclosure of ancillary equipment measured on a stand alone basis	At the manufacturer's discretion, ancillary equipment can also be measured in combination with the radio equipment under test. When the ancillary equipment is measured in combination with the radio equipment, radiated emissions from the transmitter/transceiver shall be ignored, but recorded in the test report.

Draft EN 301 489-17 / Draft EN 301 489-52 CDMA Direct Spread (UTRA and E-UTRA)

No special conditions.

4.3.2 Special Conditions for Immunity Measurements

Draft EN 301 489-52 GSM and DCS

Reference to clauses in EN 301 489-1 [1]	Special product-related conditions, additional to or modifying the test conditions in EN 301 489-1 [1], clause 9
9.2 Radio frequency electromagnetic field 9.2.2 Test method	When using the max hold detector method (see annex B) at each test frequency step initially an unmodulated test signal shall be applied. Then the test modulation shall be applied. The test shall be repeated with the equipment in the idle mode of operation and the exclusion band shall not be used during this test.
9.5 Radio frequency, common mode	When using the max hold detector method (see annex B) at each test frequency step initially an unmodulated test signal shall be applied. Then the test modulation shall be applied.
9.5.2 Test method	The stepped frequency increments may be 50 kHz increment of the momentary frequency in the frequency range 150 kHz to 5 MHz. When using the max hold detector method, initially at each test frequency step an unmodulated immunity test signal shall be applied. Then the modulation of the immunity RF test signal (1 kHz tone) shall be applied as specified in the EN 301 489-1 [1].
9.6.3 Performance criteria	During tests with pulses 3a and 3b, the performance criteria TT shall apply, see clause 6.2.
9.7.3 Performance criteria; Voltage dips and interruptions	For a voltage dip corresponding to a reduction of the supply voltage of 30 % for 10 ms the performance criteria TT or CR specified in clauses 6.2 or 6.3 shall apply as appropriate.

Draft EN 301 489-52 CDMA Direct Spread (UTRA and E-UTRA)

Reference to clauses in EN 301 489-1 [1]	Special product-related conditions, additional to or modifying the test conditions in EN 301 489-1 [1], clause 9
9.2 Radio frequency electromagnetic field 9.2.2 Test method	When using the max hold detector method (see annex B) at each test frequency step initially an unmodulated test signal shall be applied. Then the test modulation shall be applied.
9.5 Radio frequency, common mode 9.5.2 Test method	There is no exclusion band for the equipment in the scope of the present document. When using the max hold detector method (see annex B) at each test frequency step initially an unmodulated test signal shall be applied. Then the test modulation shall be applied. The procedure used for identifying narrowband responses does not apply to conducted immunity tests in the frequency range 150 kHz to 80 MHz (see clause 4.4).
9.6.3 Performance criteria	During tests with pulses 3a and 3b, the performance criteria TT shall apply, see clause 6.2.

Draft EN 301 489-17

No special conditions.

4.4 Electrostatic Discharge (ESD)

4.4.1 Test Specification of Electrostatic Discharge (ESD)

Basic Standard	EN 61000-4-2
Discharge Voltage	Contact Discharge: ± 2 kV / ± 4 kV Air Discharge: ± 2 kV / ± 4 kV / ± 8 kV
Discharge Impedance	330 ohm / 150 pF
Number of Discharge	Air Discharge: minimum 20 times at each test point Contact Discharge: minimum 20 times at each test point
Discharge Mode	Single Discharge
Discharge Period	1 second minimum

4.4.2 Test Procedures

a. In the case of air discharge testing the climatic conditions shall be within the following ranges:
- ambient temperature: 15°C to 35°C;
- relative humidity : 30% to 60%;
- atmospheric pressure : 86 kPa (860 mbar) to 106 kPa (1060 mbar).

b. Test programs and software shall be chosen so as to exercise all normal modes of operation of the EUT. The use of special exercising software is encouraged, but permitted only where it can be shown that the EUT is being comprehensively exercised.

c. The test voltage shall be increased from the minimum to the selected test severity level, in order to determine any threshold of failure. The final severity level should not exceed the product specification value in order to avoid damage to the equipment.

d. The test shall be performed with both air discharge and contact discharge. On preselected points at least 10 single discharges (in the most sensitive polarity) shall be applied on air discharge. On preselected points at least 10 single discharges (in the most sensitive polarity) shall be applied on contact discharge.

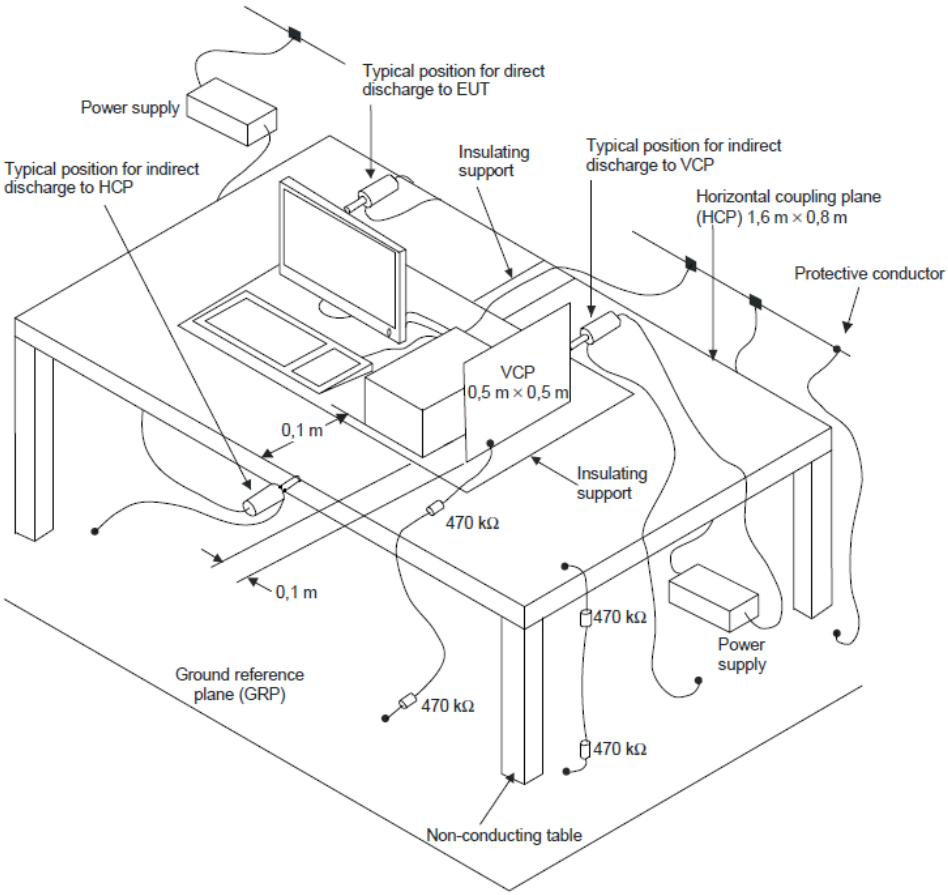
e. For the time interval between successive single discharges an initial value of one second is recommended. Longer intervals may be determined whether a system failure has occurred.

f. In the case of contact discharges, the tip of the discharge electrode shall touch the EUT before the discharge switch is operated.

g. In the case of painted surface covering a conducting substrate, the following procedure shall be adopted:
- If the coating is not declared to be an insulating coating by the equipment manufacturer, then the pointed tip of the generator shall penetrate the coating so as to make contact with the conducting substrate.
- Coating declared as insulating by the manufacturer shall only be submitted to the air discharge.
- The contact discharge test shall not be applied to such surfaces.

h. In the case of air discharges, the round discharge tip of the discharge electrode shall be approached as fast as possible (without causing mechanical damage) to touch the EUT. After each discharge, the ESD generator (discharge electrode) shall be removed from the EUT. The generator is then retriggered for a new single discharge. This procedure shall be repeated until the discharges are completed. In the case of an air discharge test, the discharge switch, which is used for contact discharge, shall be closed.

4.4.3 Test Setup



The test setup shall consist of a non-conductive table, (0.8 ± 0.08) m high, standing on the ground reference plane.

A horizontal coupling plane (HCP), (1.6 ± 0.02) m × (0.8 ± 0.02) m, shall be placed on the table. The EUT and its cables shall be isolated from the coupling plane by an insulating support (0.5 ± 0.05) mm in thickness.

4.4.4 Test Result of Electrostatic Discharge (ESD)

Test Mode	1 ~ 11				
Direct Application					
Test Voltage (kV)	**Polarity**	**Test Point**	**Contact Discharge**	**Air Discharge**	**Performance Criteria**
2, 4, 8	+/-	1 ~ 4	N/A	Note1	A
2, 4	+/-	5 ~ 6	N/A	Note1	A
8	+/-	5 ~ 6	N/A	Note2	B
2	+/-	7 ~ 9	Note1	N/A	A
4	+/-	7 ~ 9	Note2	N/A	B
Indirect Application					
Test Voltage (kV)	**Polarity**	**Test Point**	**Horizontal Coupling Plane (HCP)**	**Vertical Coupling Plane (VCP)**	**Performance Criteria**
2, 4	+/-	At front, rear, left and right side	Note1	Note1	A

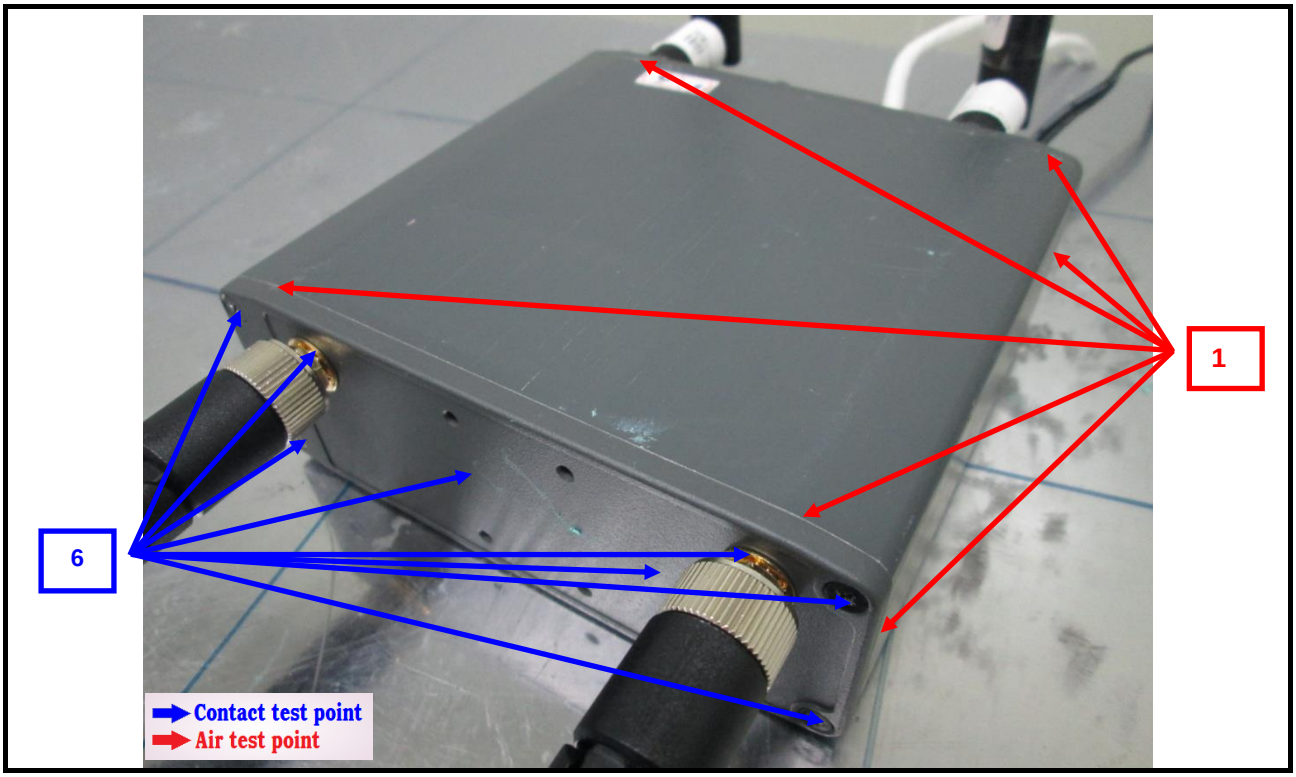
Note1: There was no abnormal situation during the test compared with initial operation.
Note2: The EUT had ping lost during the test, but could be self-recoverable after the test.

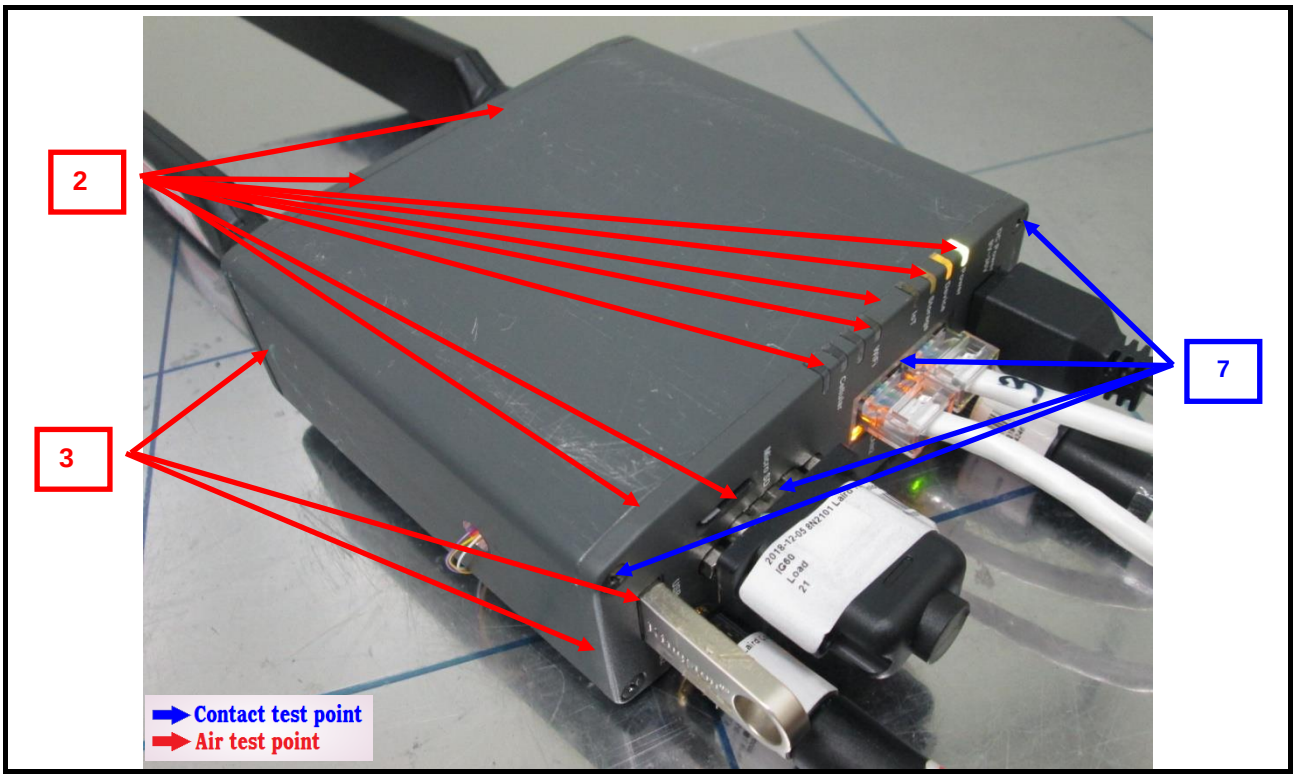
Test Mode	12				
Direct Application					
Test Voltage (kV)	**Polarity**	**Test Point**	**Contact Discharge**	**Air Discharge**	**Performance Criteria**
2, 4, 8	+/-	1 ~ 4	N/A	Note1	A
2, 4	+/-	5	N/A	Note1	A
8	+/-	5	N/A	Note2	B
2	+/-	6 ~ 8	Note1	N/A	A
4	+/-	6 ~ 8	Note2	N/A	B
Indirect Application					
Test Voltage (kV)	**Polarity**	**Test Point**	**Horizontal Coupling Plane (HCP)**	**Vertical Coupling Plane (VCP)**	**Performance Criteria**
2, 4	+/-	At front, rear, left and right side	Note1	Note1	A

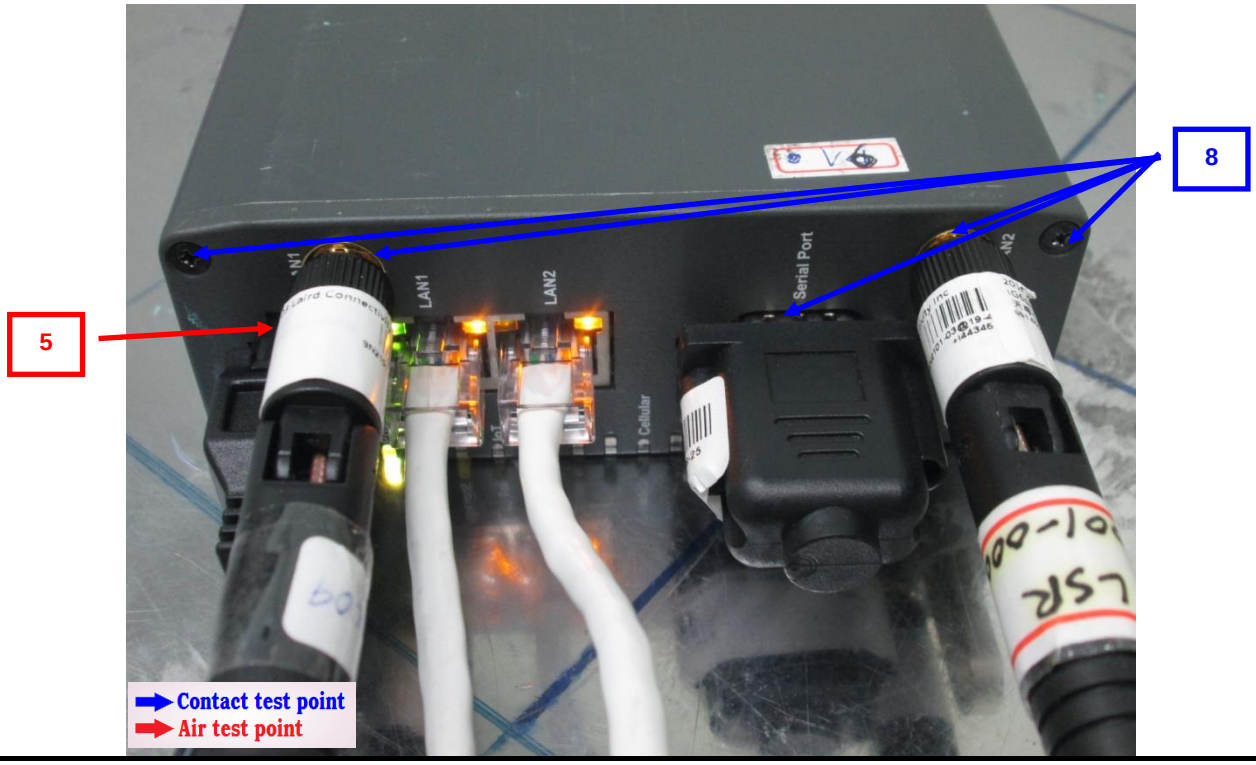
Note1: There was no abnormal situation during the test compared with initial operation.
Note2: The EUT had ping lost during the test, but could be self-recoverable after the test.

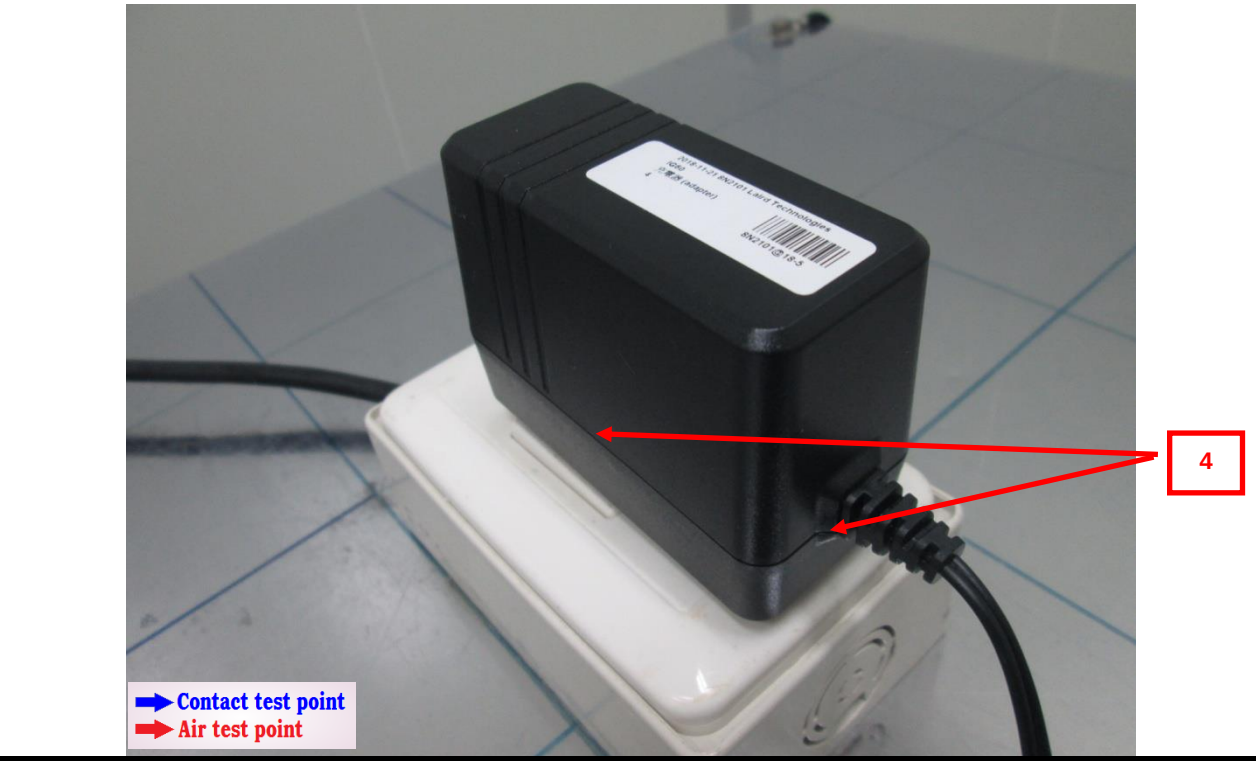
4.4.5 Test Point Photo

Test Mode 1 ~ 11

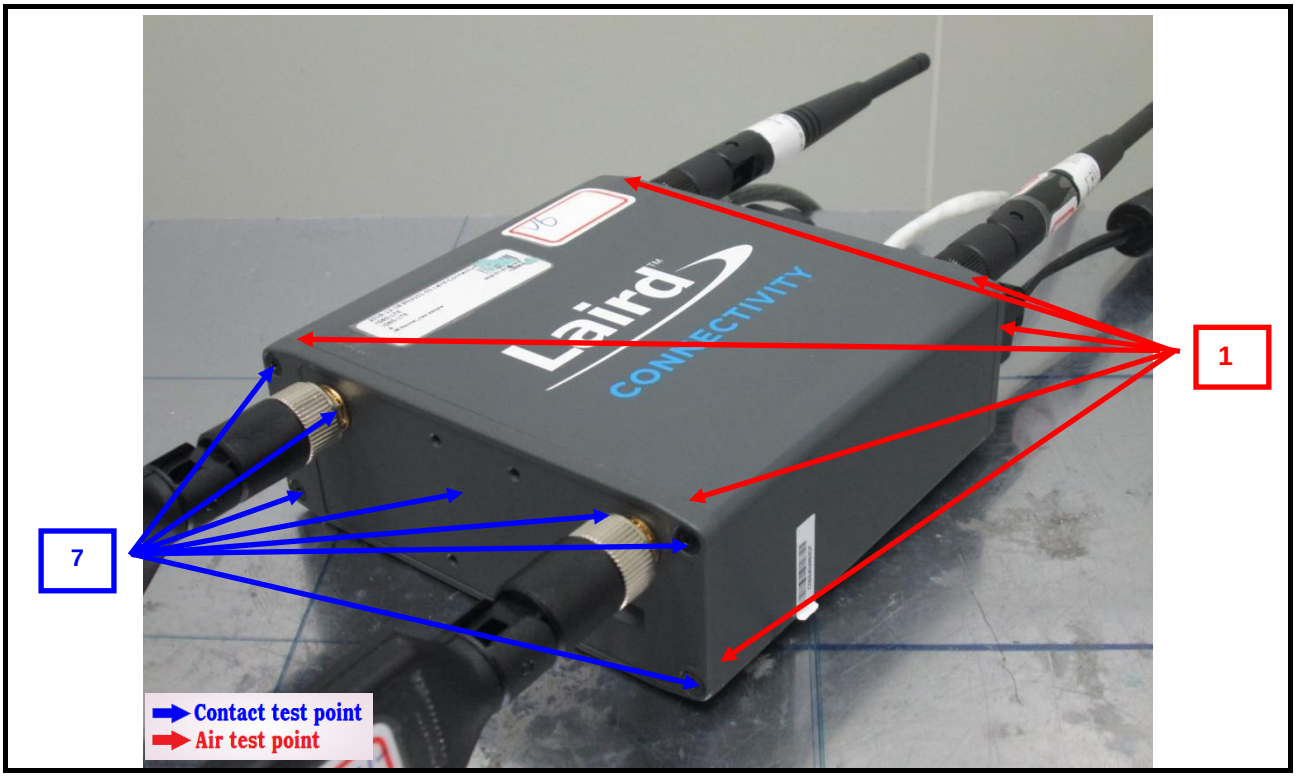


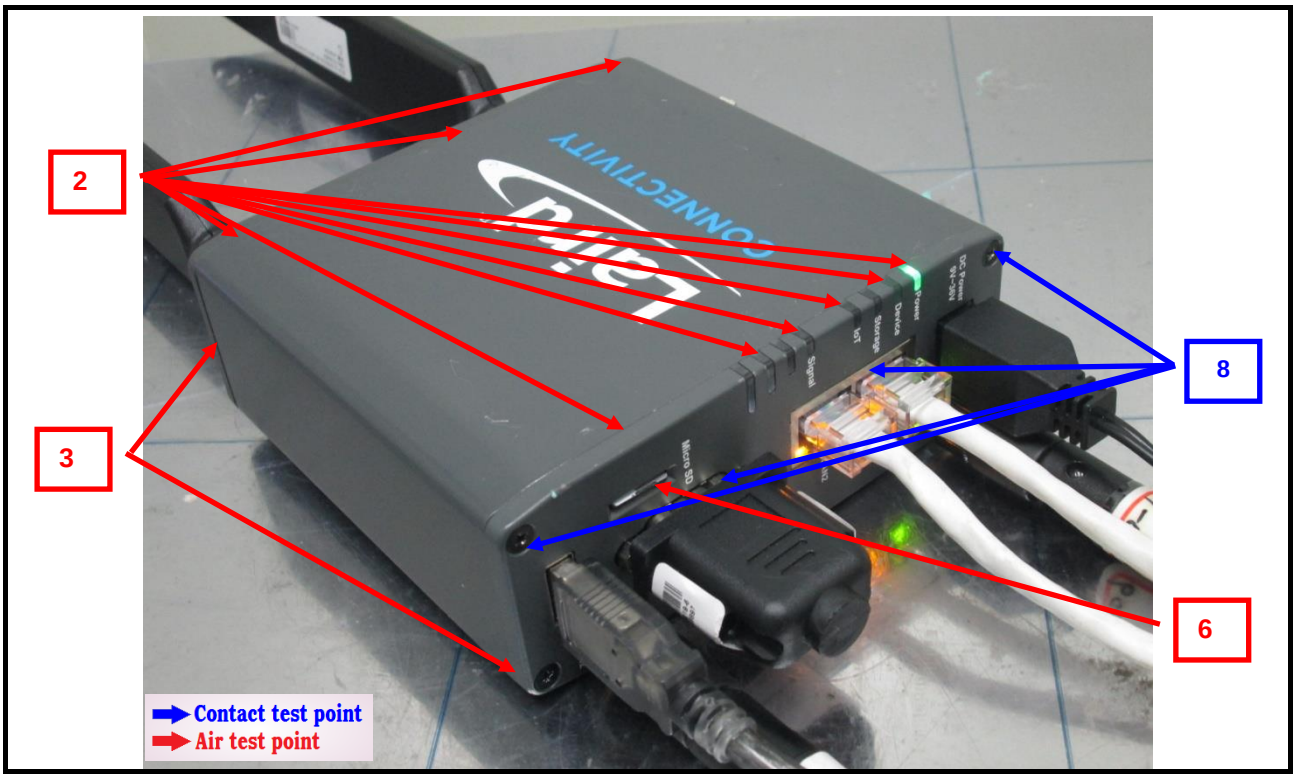


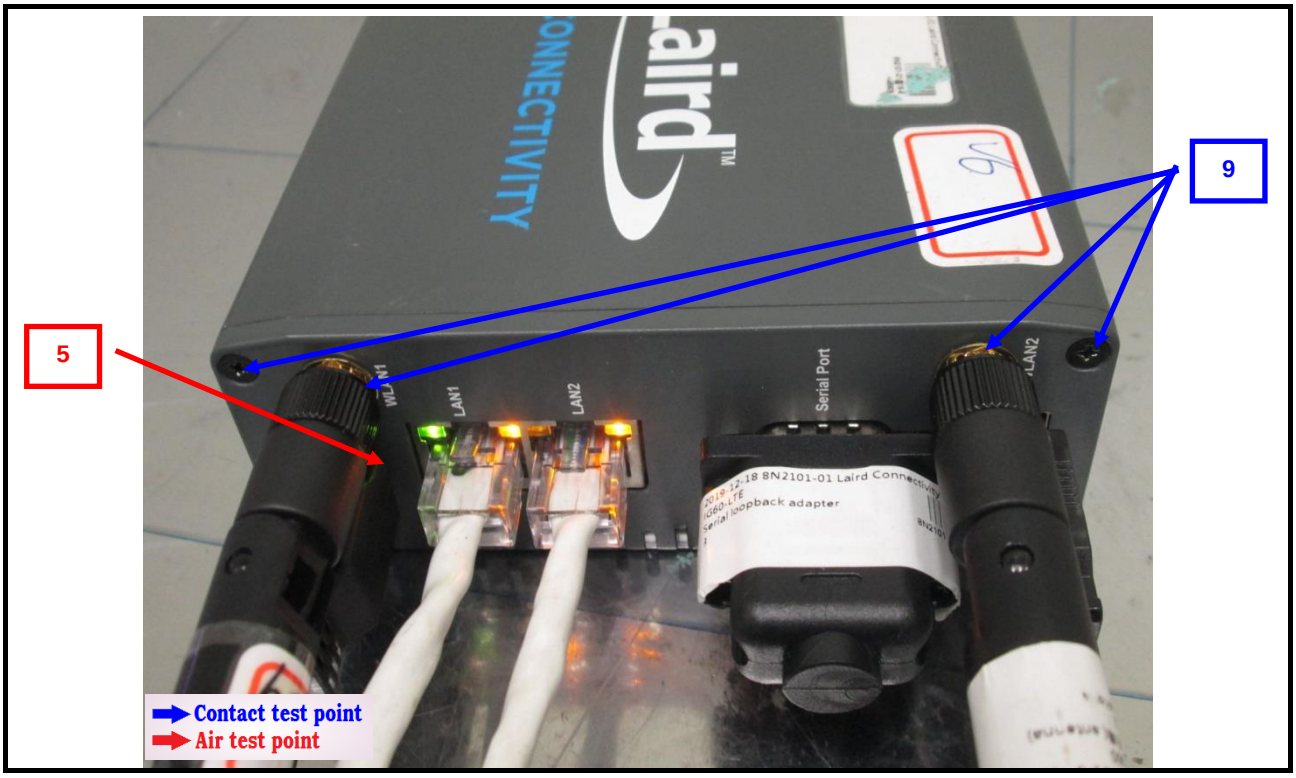

8
5
LAN1
LAN2
Serial Port
Contact test point
Air test point

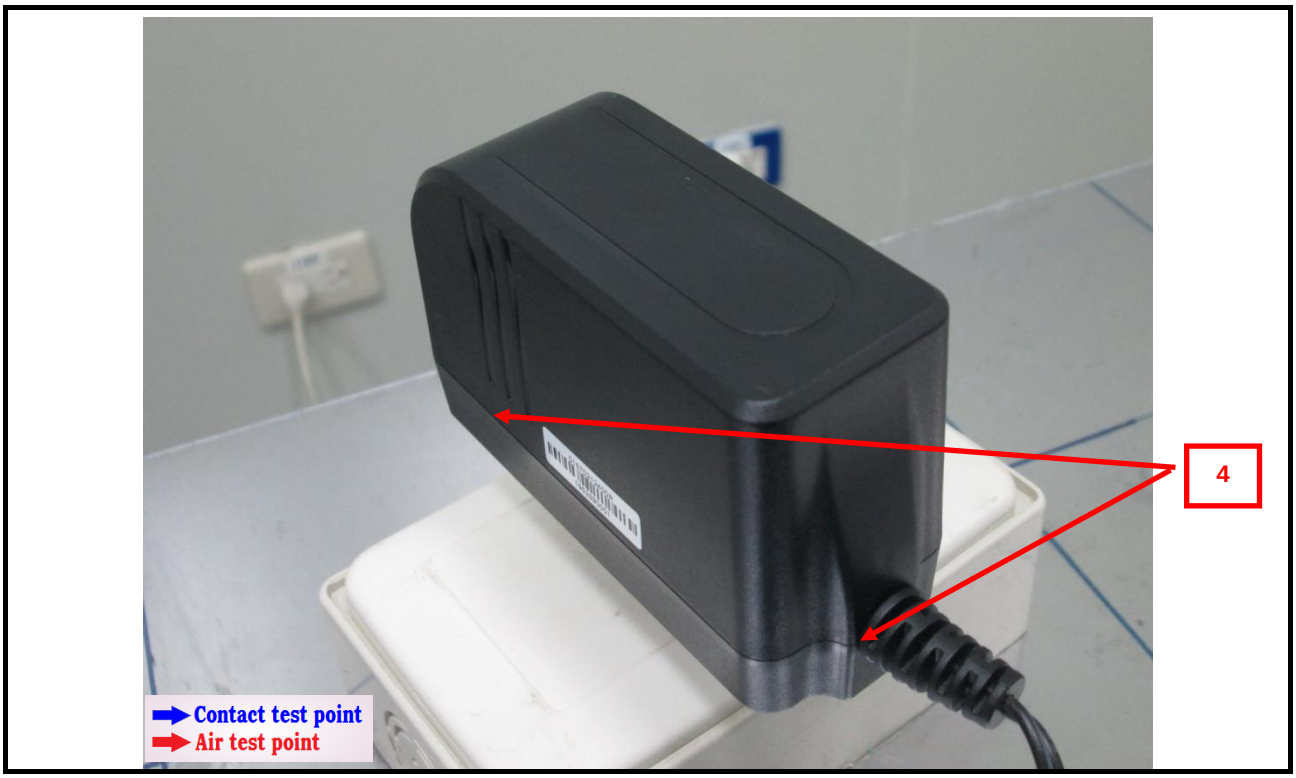

4
Contact test point
Air test point

Test Mode 12


1
7
Contact test point
Air test point


2
3
8
6
Contact test point
Air test point


9
5
LAN1
LAN2
Serial Port
Contact test point
Air test point


4
Contact test point
Air test point

4.5 Radio Frequency Electromagnetic Field (RS)

4.5.1 Test Specification of Radio Frequency Electromagnetic Field (RS)

Basic Standard	EN 61000-4-3
Frequency Range	80 MHz ~ 6000 MHz
Field Strength	10 V/m
Modulation	1 kHz Sine Wave, 80%, AM Modulation
Frequency Step	1 % of preceding frequency value
Polarity of Antenna	Horizontal and Vertical
Antenna Height	1.5 m
Antenna Distance	80 MHz ~ 1000 MHz: 3 m 1000 MHz ~ 6000 MHz: 1 m
Dwell Time	3 seconds

4.5.2 Test Procedures

a. The test level shall be 10 V/m (measured unmodulated). The test signal shall be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1000 Hz. If the wanted signal is modulated at 1000 Hz, then an audio signal of 400 Hz shall be used.

b. The test shall be performed over the frequency range 80 MHz to 6000 MHz with the exception of the exclusion band for transmitters, receivers and duplex transceivers, as appropriate.

c. For receivers and transmitters the stepped frequency increments shall be 1 % frequency increment of the momentary used frequency, unless specified otherwise in the part of EN 301 489 series [i.13] dealing with the relevant type of radio equipment.

d. Further product related spot frequency tests may be specified in the relevant part of EN 301 489 series [i.13] dealing with the particular type of radio equipment.

e. Responses on receivers occurring at discrete frequencies, which are narrow band responses, shall be disregarded from the test.

f. The frequencies selected and used during the test shall be recorded in the test report.

g. When testing at frequencies above 1 GHz, the test distance shall be 1 m when using the independent windows method. Compliance with the field uniformity requirement shall be verified for the selected test distance.

h. The alternative method for frequencies above 1 GHz divides the calibration area into a suitable array of 0,5 m × 0,5 m windows such that the whole area to be occupied by the face of the EUT is covered. The field uniformity shall be independently calibrated over each window.

i. During the test, at each frequency the forward power shall be applied to the field-generating antenna. The test shall be repeated with the field-generating antenna repositioned to illuminate each of the required windows in turn.

4.5.3 Exclusion bands

Draft EN 301 489-17

The frequencies on which the transmitter part of the EUT is intended to operate shall be excluded from radiated emission measurements when performed in transmit mode of operation.

There shall be no frequency exclusion band applied to emission measurements of the receiver part of transceivers or the stand alone receiver under test, and/or associated ancillary equipment.

The exclusion band for immunity testing of equipment operating in the 2,4 GHz band shall be:

- lower limit of exclusion band = lowest allocated band edge frequency -120 MHz, i.e. 2 280 MHz;
- upper limit of exclusion band = highest allocated band edge frequency +120 MHz, i.e. 2 603,5MHz.

The exclusion band for immunity testing of equipment operating in the 5 GHz Wi-Fi band shall be:

- lower limit of exclusion band = lowest allocated band edge frequency -270 MHz, i.e. 4 880 MHz;
- upper limit of exclusion band = highest allocated band edge frequency +270 MHz, i.e. 5 995 MHz.

The exclusion band for immunity testing of equipment operating in the 5,8 GHz band shall be:

- lower limit of exclusion band = lowest allocated band edge frequency -270 MHz, i.e. 5 455 MHz;
- as the immunity requirements have an upper frequency range of 6 GHz and any upper edge exclusion band would be greater than this for the 5,8 GHz band. The above frequency shall also be regarded as the upper end of the test range.

NOTE: These receiver exclusion band ranges align with the relevant blocking test ranges.

Draft EN 301 489-52

GSM and DCS Receiver and receivers of duplex transceivers exclusion band

- The exclusion band for receivers and receiver sections of transceivers is the band of frequencies over which no immunity tests with radiated RF are made.
- As defined in clause 4.3.3 of ETSI EN 301 489-1 where n=1 and Channel Width is 200 kHz.

GSM and DCS Transmitter exclusion band

- The exclusion band for transmitters and transmitter sections of transceivers is the band of frequencies over which no immunity tests with radiated RF are made.
- The exclusion band for transmitters is as defined in clause 4.3.2.2 of ETSI EN 301 489-1 250 % of the channel width either side of the nominal operating frequency of the transmitter.

CDMA Direct Spread (UTRA and E-UTRA) Transmitter exclusion band

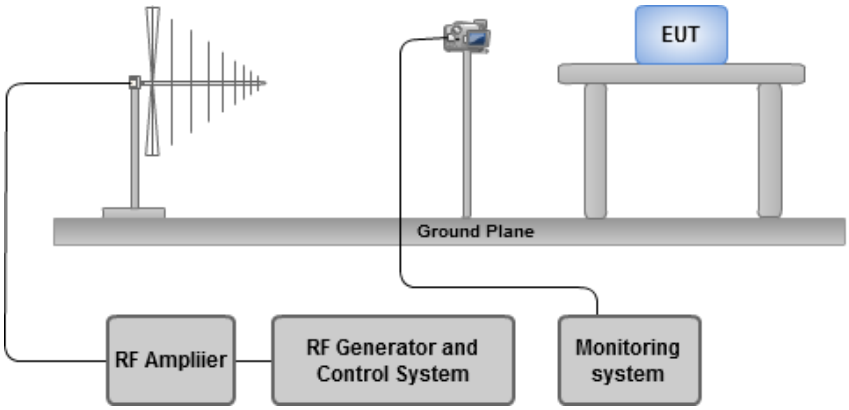
- UTRA
  - In the frequency bands including in band emissions and out of band emissions are covered by the RF spectral mask specification and need no further consideration.
  - For the purpose of EMC specifications the transmitter exclusion band this shall be as defined in clause 4.3.2.2 of ETSI EN 301 489-1.
- E-UTRA
  - For the purpose of EMC specifications there shall be a transmitter exclusion band as defined in clause 4.3.2.2 of ETSI EN 301 489-1 where BWChannel is the channel bandwidth as defined in ETSI TS 136 101.

CDMA Direct Spread (UTRA and E-UTRA) Receiver exclusion band

As defined in clause 4.3.3 of ETSI EN 301 489-1 where n=1 and Channel Width is as follows:

- UTRA Channel Width 5 MHz.
- E-UTRA Channel Width 20 MHz.

4.5.4 Test Setup



Note: The procedure defined in this part requires the generation of electromagnetic fields within which the test sample is placed and its operation observed. To generate fields that are useful for simulation of actual (field) conditions may require significant antenna drive power and the resultant high field strength levels. To comply with local regulations and to prevent biological hazards to the testing personnel, it is recommended that these tests be carried out in a shielded enclosure or semi-anechoic chamber.

4.5.5 Test Result of Radio Frequency Electromagnetic Field (RS)

Test Mode	1 ~ 3, 12					
Frequency Range (MHz)	**Azimuth**	**Polarity**	**Test Field Strength (V/m)**	**Obser--vation**	**Performance Criteria**	**Remarks**
80 - 6000	0, 90, 180, 270	V&H	10	Note 1, 3	CT/CR (A)	---
80 - 6000	0, 90, 180, 270	V&H	10	Note 2, 3	CT/CR (A)	Throughput shall be ≥ 95%

Note:
1) There was no abnormal situation during the test compared with initial operation.
2) The throughput of LTE data transfer measurement: During the test, the measured throughput was found no less than 95% of the maximum throughput of the reference measurement channel.
3) Test method reported herein was performed according to the method specified by applicant.

Test Mode	4 ~11				
Frequency Range (MHz)	**Azimuth**	**Polarity**	**Test Field Strength (V/m)**	**Observation**	**Performance Criteria**
80 - 6000	0, 90, 180, 270	V&H	10	Note1, 2	CT/CR (A)

Note:
1) There was no abnormal situation during the test compared with initial operation.
2) Test method reported herein was performed according to the method specified by applicant.

4.6 Electrical Fast Transient/Burst (EFT)

4.6.1 Test Specification of Electrical Fast Transient/Burst (EFT)

Basic Standard	EN 61000-4-4
Test Voltage	AC mains power: ± 1 kV Signal ports: ± 0.5 kV
Impulse Frequency	100 kHz: only for signal lines of xDSL equipment 5 kHz: except for xDSL equipment
Impulse Waveshape	5/50 ns
Burst Duration	0.75 ms: only for signal lines of xDSL equipment 15 ms: except for xDSL equipment
Burst Period	300 ms
Test Duration	1 min.

4.6.2 Test Procedures

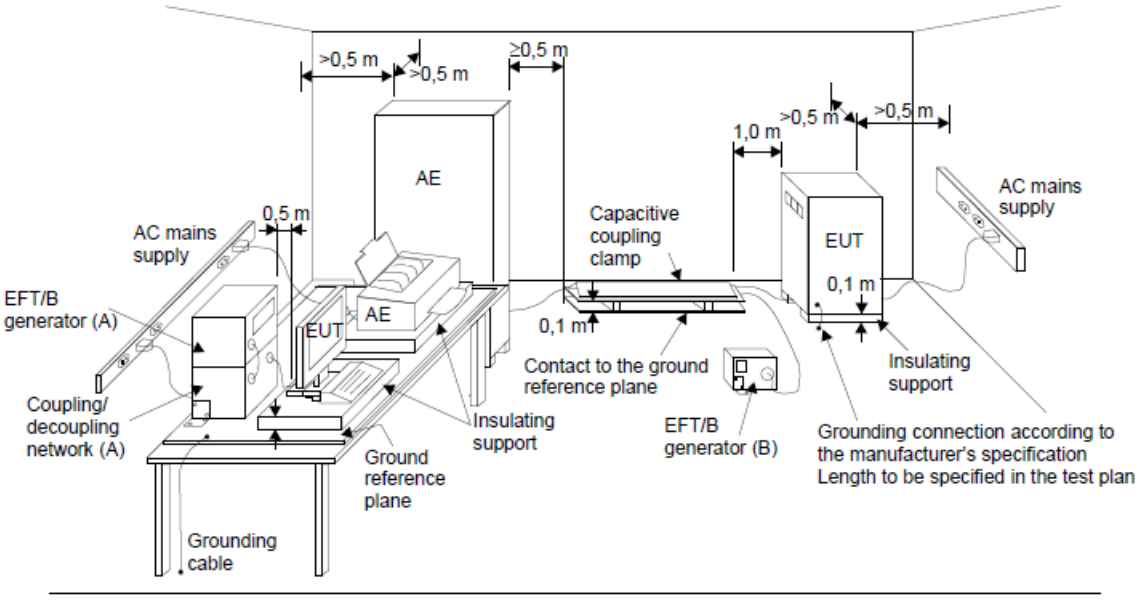
a. In order to minimize the effect of environmental parameters on test results, the electromagnetic environment of the laboratory shall not influence the test results.

b. Test shall not be performed if the relative humidity is so high as to cause condensation on the EUT or the test equipment.

c. The variety and diversity of equipment and systems to be tested make it difficult to establish general criteria for the evaluation of the effects of fast transients/bursts on equipment and systems.

d. The test results may be classified on the basic of the operating conditions and the functional specification of the equipment under test, according to the following performance criteria:
   - Normal performance within the specification limits.
   - Temporary degradation or loss of function or performance which is self-recoverable.
   - Temporary degradation or loss of function or performance which requires operator intervention or system reset.
   - Degradation or loss of function which is not recoverable due to damage of equipment (components).

4.6.3 Test Setup



(A) location for supply line coupling

(B) location for signal lines coupling

Table-top equipment and equipment normally mounted on ceilings or walls as well as built-in equipment shall be tested with the EUT located (0.1 ± 0.01) m above the ground reference plane (GRP)

Testing of large table-top equipment or multiple systems can be performed on the floor; maintaining the same distances as for the test setup of table-top equipment.

The test generator and the coupling/decoupling network shall be bonded to the GRP.

The GRP shall be a metallic sheet of 0.25 mm, minimum thickness; other metallic may be used but they shall have at least 0.65 mm thickness.

The minimum size of the GRP is 0.8 m × 1 m. The actual size depends on the dimensions of the EUT.

The GRP shall project beyond the EUT by at least 0.1m on all sides.

The GRP shall be connected to protective earth (PE) for safety reasons.

The EUT shall be arranged and connected to satisfy its functional requirements, according to the equipment installation specifications.

The minimum distance between the EUT and all other conductive structures (including the generator, AE and the walls of a shielded room), except the ground reference plane, shall be more than 0.5 m.

All cables to the EUT shall be placed on the insulation support 0.1 m above the GRP. Cables not subject to electrical fast transients shall be routed as far as possible from the cable under test to minimize the coupling between the cables.

4.6.4 Test Result of Electrical Fast Transient/Burst (EFT)

Test Mode	1			
Test Port	**Polarity**	**Test Voltage (kV)**	**Observation**	**Performance Criteria**
For power ports				
L1	+/-	1	Note	CT/CR (A)
L2	+/-	1	Note	CT/CR (A)
L1, L2	+/-	1	Note	CT/CR (A)
For telecom & signal ports				
LAN 1 100 Mbps	+/-	0.5	Note	CT/CR (A)

Note: There was no abnormal situation during the test compared with initial operation.

Test Mode	2 ~ 11			
Test Port	**Polarity**	**Test Voltage (kV)**	**Observation**	**Performance Criteria**
For power ports				
L1	+/-	1	Note	CT/CR (A)
L2	+/-	1	Note	CT/CR (A)
L1, L2	+/-	1	Note	CT/CR (A)

Note: There was no abnormal situation during the test compared with initial operation.

Test Mode	12			
Test Port	**Polarity**	**Test Voltage (kV)**	**Observation**	**Performance Criteria**
For power ports				
L1	+/-	1	Note	CT/CR (A)
L2	+/-	1	Note	CT/CR (A)
L1, L2	+/-	1	Note	CT/CR (A)
For telecom & signal ports				
LAN 1 10/100 Mbps	+/-	0.5	Note	CT/CR (A)
LAN 2 1000 Mbps	+/-	0.5	Note	CT/CR (A)

Note: There was no abnormal situation during the test compared with initial operation.

4.7 Surge

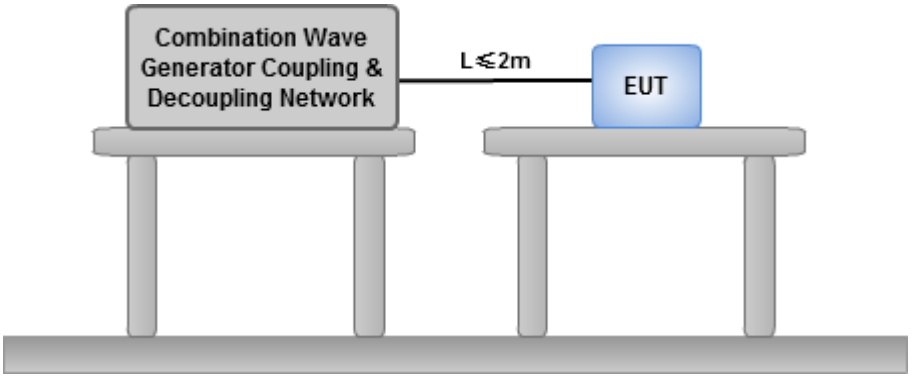
4.7.1 Test Specification of Surge

Basic Standard	EN 61000-4-5
Wave-Shape	☒ Combination Wave Generator for power lines 1.2/50 µs Open Circuit Voltage 8/20 µs Short Circuit Current
	☐ Combination Wave Generator for signal lines (direct to outdoor cables) 10/700 µs Open Circuit Voltage
	☒ Combination Wave Generator for shielded telecom, telecom & signal lines (direct to indoor cables) 1.2/50 µs Open Circuit Voltage 8/20 µs Short Circuit Current
Test Voltage	Power port: ± 0.5 kV, ± 1 kV Signal port: ± 0.5 kV
Generator Source Impedance	2 ohm between networks 42 ohm between signal line and ground
Phase Angle	0°/90°/180°/270°
Pulse Repetition Rate	60 sec.
Number of Tests	5 positive and 5 negative at selected points

4.7.2 Test Procedures

a. Electromagnetic conditions, the electromagnetic environment of the laboratory shall not influence the test results.
b. Test shall not be performed if the relative humidity is so high as to cause condensation on the EUT or the test equipment.
c. The test shall be performed according the test plan that shall specify the test set-up with
   -- generator and other equipment utilized;
   -- test level (voltage/current);
   -- generator source impedance;
   -- internal or external generator trigger;
   -- number of tests: at least five positive and five negative at the selected points;
   -- repetition rate: maximum 1/min.
   -- inputs and outputs to be tested;
   -- representative operating conditions of the EUT;
   -- sequence of application of the surge to the circuit;
   -- phase angle in the case of AC power supply;
   -- actual installation conditions, for example :
      AC : neutral earthed,
      DC : (+) or (-) earthed to simulated the actual earth conditions.
d. If not otherwise specified the surges have to be applied synchronized to the voltage phase at the zero crossing and the peak value of the a.c. voltage wave (positive and negative).
e. The surges have to be applied line to line and line(s) and earth. When testing line to earth, the test voltage has to be applied successively between each of the lines and earth, if there is no other specification.
f. The test procedure shall also consider the non-linear current-voltage characteristics of the equipment under test. Therefore the test voltage has to be increased by steps up to the test level specified in the product standard or test plan.
g. All lower levels including the selected test level shall be satisfied. For testing the secondary protection, the output voltage of the generator shall be increased up to the worst-case voltage breakdown level (let-through level) of the primary protection.
h. If the actual operating signal sources are not available, the may be simulated. Under no circumstances may the test level exceed the product specification. The test shall be carried out according to the test plan.
i. To find all critical points of the duty cycle of the equipment, a sufficient number of positive and negative test pulses shall be applied. For acceptance test previously unstressed equipment shall be used to the protection devices shall be replaced.

4.7.3 Test Setup



4.7.4 Test Result of Surge

Test Mode	1				
Test Port	**Polarity**	**Test Voltage (kV)**	**Phase Angle**	**Observation**	**Performance Criteria**
For power ports					
L1-L2	+/-	0.5, 1	0°/90°/180°/270°	Note	CT/CR (A)
For telecom & signal ports					
LAN 1 100 Mbps	+/-	0.5	-	Note	CT/CR (A)

Note: There was no abnormal situation during the test compared with initial operation.

Test Mode	2 ~ 11				
Test Port	**Polarity**	**Test Voltage (kV)**	**Phase Angle**	**Observation**	**Performance Criteria**
For power ports					
L1-L2	+/-	0.5, 1	0°/90°/180°/270°	Note	CT/CR (A)

Note: There was no abnormal situation during the test compared with initial operation.

Test Mode	12				
Test Port	**Polarity**	**Test Voltage (kV)**	**Phase Angle**	**Observation**	**Performance Criteria**
For power ports					
L1-L2	+/-	0.5, 1	0°/90°/180°/270°	Note	CT/CR (A)
For telecom & signal ports					
LAN1 10/100 Mbps	+/-	0.5	-	Note	CT/CR (A)
LAN2 1000 Mbps	+/-	0.5	-	Note	CT/CR (A)

Note: There was no abnormal situation during the test compared with initial operation.

4.8 Conducted Disturbances (CS)

4.8.1 Test Specification of Conducted Disturbances (CS)

Basic Standard	EN 61000-4-6
Frequency Range	150 kHz ~ 80 MHz
Induced by RF fields	3 V_{rms}
Modulation	1 kHz Sine Wave, 80%, AM Modulation
Frequency Step	1 % of preceding frequency value
Coupling Device	CDN-M2, CDN-T400A, CDN-T8-10
Dwell Time	3 seconds

4.8.2 Test Procedures

a. The EUT shall be tested within its intended operating and climatic conditions.

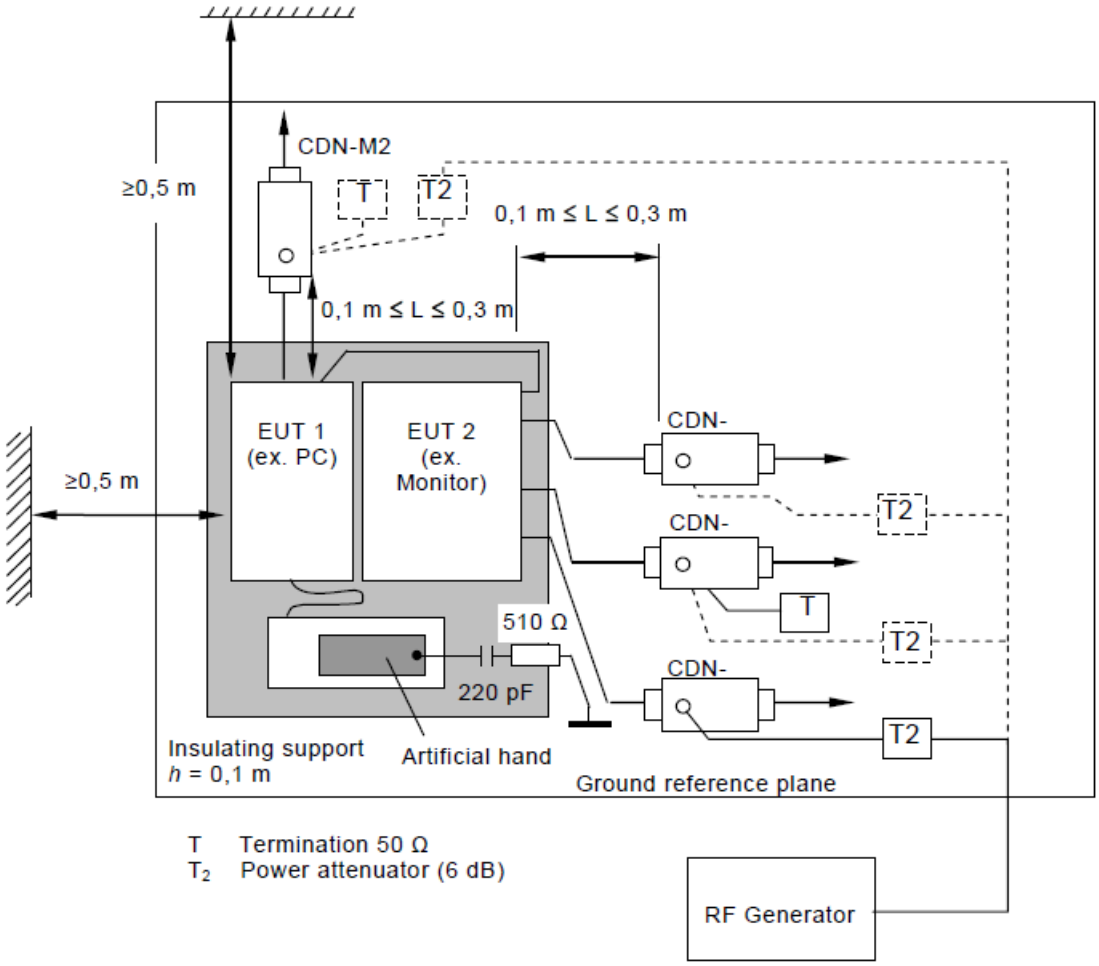
b. The frequency range is swept from 150 kHz to 80 MHz, using the signal levels established during the setting process, and with the disturbance signal 80 % amplitude modulated with a 1 kHz sine wave, pausing to adjust the RF signal level or to change coupling devices as necessary. Where the frequency is swept incrementally, the step size shall not exceed 1 % of the preceding frequency value.

c. The dwell time of the amplitude modulated carrier at each frequency shall not be less than the time necessary for the EUT to be exercised and to respond, but shall in no case be less than 0,5 s.

d. The sensitive frequencies (e.g. clock frequencies) shall be analyzed separately.

e. Attempts should be made to fully exercise the EUT during testing, and to fully interrogate all exercise modes selected for susceptibility.

4.8.3 Test Setup



The EUT shall be placed on an insulating support 0.1 m above the ground reference plane (GRP).

On all cables to be tested, coupling and decoupling devices shall be inserted. The coupling and decoupling devices shall be placed on the GRP, making direct contact with it at a distance of 0.1 m to 0.3 m from the EUT.

4.8.4 Test Result of Conducted Disturbances (CS)

Test Mode	1					
Frequency Band (MHz)	**Induced by RF fields (V_{rms})**	**Test Port**	**Injection Method**	**Return Path**	**Observation**	**Performance Criteria**
0.15-80	3	Power line	CDN-M2	CDN-T8-10	Note 1, 2	CT/CR (A)
0.15-80	3	LAN1 100 Mbps	CDN-T400A	CDN-M2	Note 1	CT/CR (A)

Note:
1) There was no abnormal situation during the test compared with initial operation.
2) The throughput of LTE data transfer measurement: During the test, the measured throughput was found no less than 95% of the maximum throughput of the reference measurement channel.

Test Mode	2 ~ 3					
Frequency Band (MHz)	**Induced by RF fields (V_{rms})**	**Test Port**	**Injection Method**	**Return Path**	**Observation**	**Performance Criteria**
0.15-80	3	Power line	CDN-M2	CDN-T8-10	Note 1, 2	CT/CR (A)

Note:
1) There was no abnormal situation during the test compared with initial operation.
2) The throughput of LTE data transfer measurement: During the test, the measured throughput was found no less than 95% of the maximum throughput of the reference measurement channel.

Test Mode	4 ~ 11					
Frequency Band (MHz)	**Induced by RF fields (V_{rms})**	**Test Port**	**Injection Method**	**Return Path**	**Observation**	**Performance Criteria**
0.15-80	3	Power line	CDN-M2	CDN-T8-10	Note	CT/CR (A)

Note: There was no abnormal situation during the test compared with initial operation.

Test Mode	12					
Frequency Band (MHz)	**Induced by RF fields (V_{rms})**	**Test Port**	**Injection Method**	**Return Path**	**Observation**	**Performance Criteria**
0.15-80	3	Power line	CDN-M2	CDN-T8-10	Note 1, 2	CT/CR (A)
0.15-80	3	LAN1 10/100 Mbps	CDN-T400A	CDN-M2	Note1,2	CT/CR (A)
0.15-80	3	LAN2 1000 Mbps	CDN-T8-10	CDN-M2	Note1,2	CT/CR (A)

Note:
1) There was no abnormal situation during the test compared with initial operation.
2) The throughput of LTE data transfer measurement: During the test, the measured throughput was found no less than 95% of the maximum throughput of the reference measurement channel.

4.9 Voltage Dips and Voltage Interruption

4.9.1 Test Specification of Voltage Dips and Voltage Interruption

Basic Standard	EN 61000-4-11
Test Levels:	Voltage Dips: 0 % residual voltage for 0.5 cycle 0 % residual voltage for 1 cycle 70 % residual voltage for 25 cycles 30 % reduction voltage for 0.5 cycle Voltage Interruptions: 0 % residual voltage for 250 cycles
Test Duration Time:	3 test events in sequence
Interval between Event:	10 seconds
Phase Angle:	0°/180°

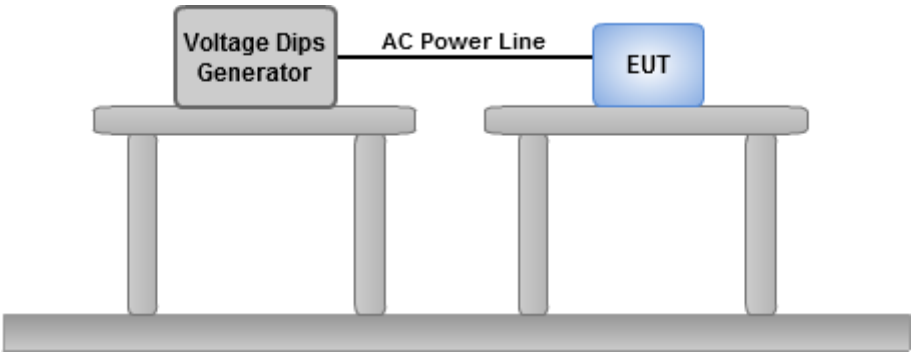
4.9.2 Test Procedures

a. Electromagnetic conditions, the electromagnetic environment of the laboratory shall not influence the test results.

b. Test shall not be performed if the relative humidity is so high as to cause condensation on the EUT or the test equipment.

c. The EUT is powered up to a nominal voltage of 240VAC/50Hz and 100VAC/50Hz and 230VAC/50Hz, and then software-controlled voltage dips and interruptions are introduced.

4.9.3 Test Setup



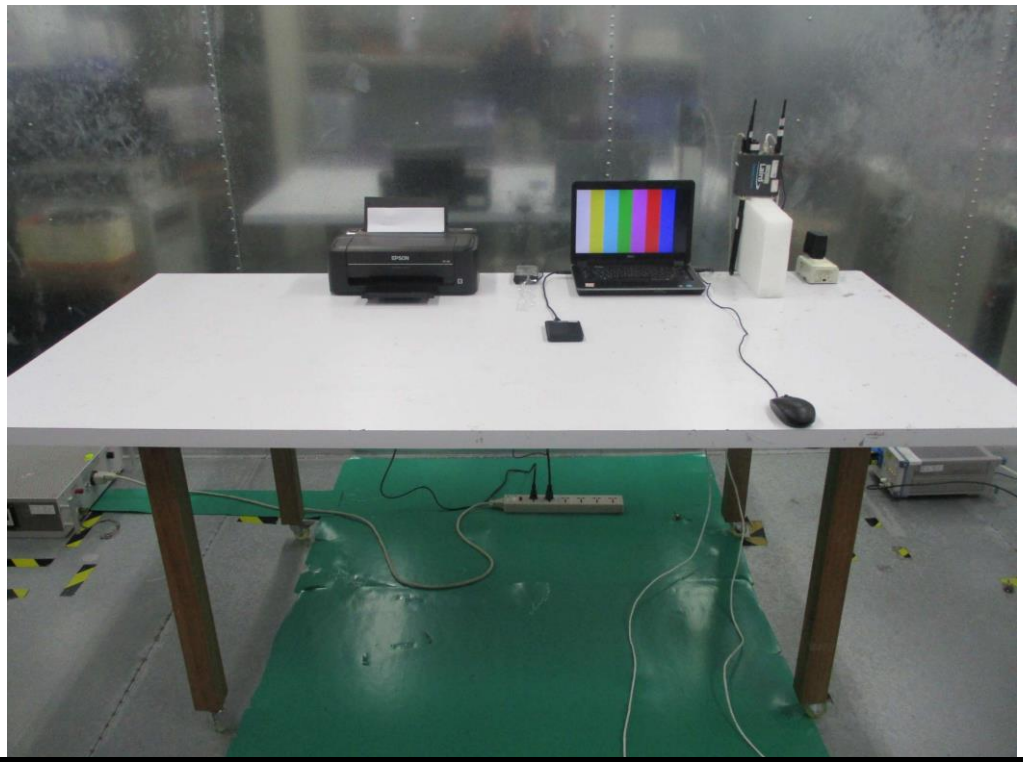
4.9.4 Test Result of Voltage Dips and Voltage Interruption

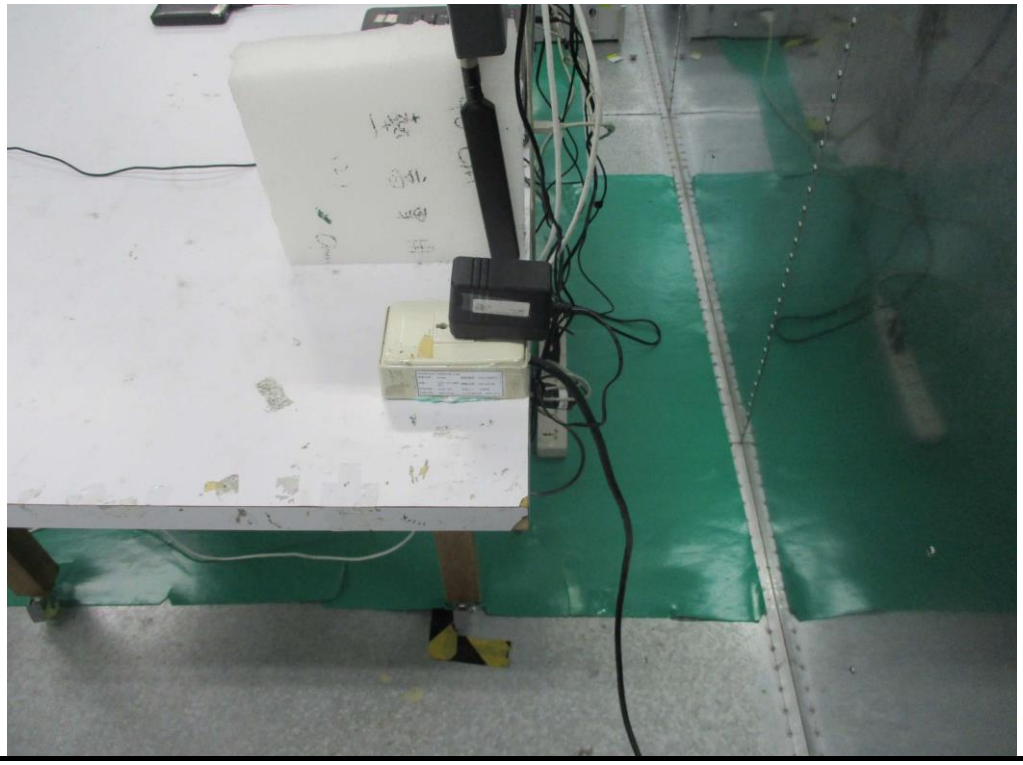
Test Mode	1 ~ 12					
Test Voltage	230V/50Hz					
Item	Residual Voltage (%)	Reduction Voltage (%)	Residual Voltage Cycle	Reduction Voltage Cycle	Observation	Performance Criteria
Voltage Dip	0	---	0.5	---	Note 1	CT/CR (A)
Voltage Dip	0	---	1	---	Note 1	CT/CR (A)
Voltage Dip	70	---	25	---	Note 1	CT/CR (A)
Voltage Dip	---	30	---	0.5	Note 1	CT/CR (A)
Voltage Interruption	0	---	250	---	Note 2	(C)
Test Voltage	240V/50Hz					
Item	Residual Voltage (%)	Reduction Voltage (%)	Residual Voltage Cycle	Reduction Voltage Cycle	Observation	Performance Criteria
Voltage Dip	0	---	0.5	---	Note 1	CT/CR (A)
Voltage Dip	0	---	1	---	Note 1	CT/CR (A)
Voltage Dip	70	---	25	---	Note 1	CT/CR (A)
Voltage Dip	---	30	---	0.5	Note 1	CT/CR (A)
Voltage Interruption	0	---	250	---	Note 2	(C)
Test Voltage	100V/50Hz					
Item	Residual Voltage (%)	Reduction Voltage (%)	Residual Voltage Cycle	Reduction Voltage Cycle	Observation	Performance Criteria
Voltage Dip	0	---	0.5	---	Note 1	CT/CR (A)
Voltage Dip	0	---	1	---	Note 1	CT/CR (A)
Voltage Dip	70	---	25	---	Note 1	CT/CR (A)
Voltage Dip	---	30	---	0.5	Note 1	CT/CR (A)
Voltage Interruption	0	---	250	---	Note 2	(C)

Note:
1) There was no abnormal situation during the test compared with initial operation.
2) The EUT lost power during the test, and must be recovered manually.

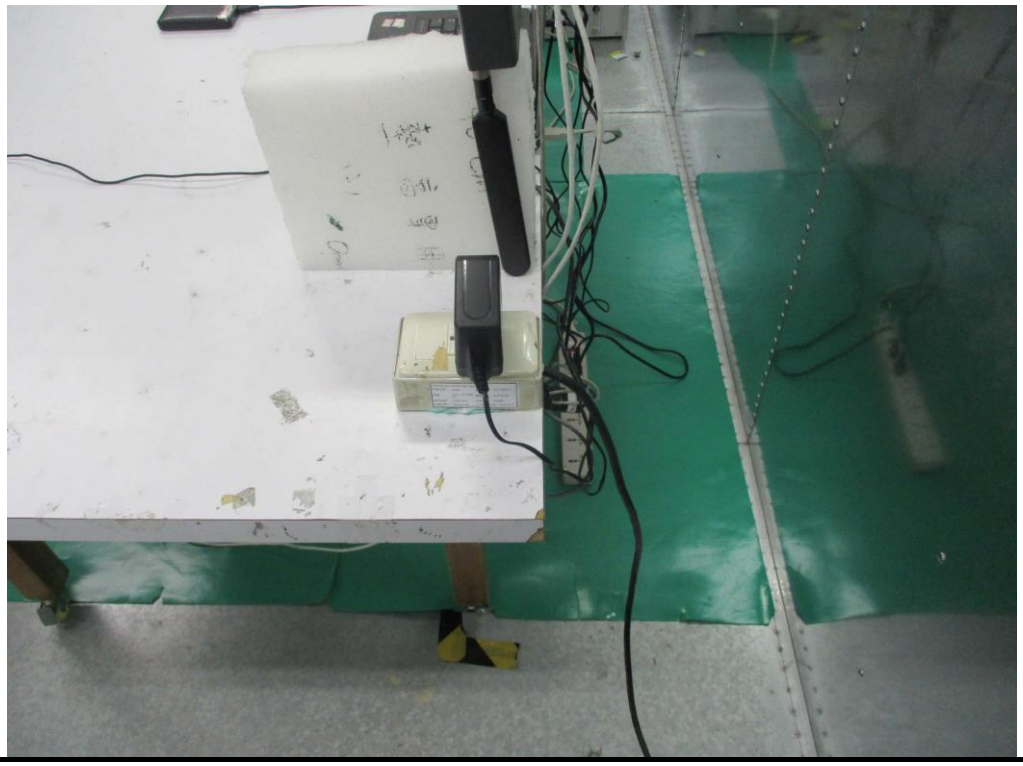
5 Photographs of the Test Configuration

Conducted Emissions from the AC mains power ports (Adapter: F30L2-120250SPACP)

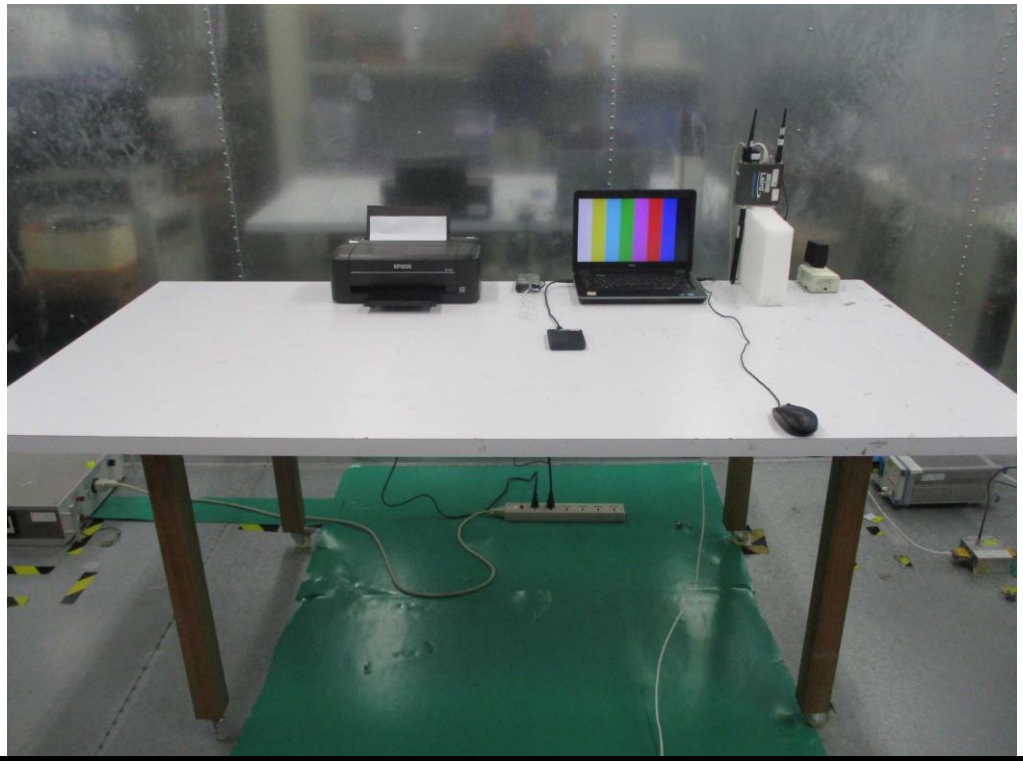


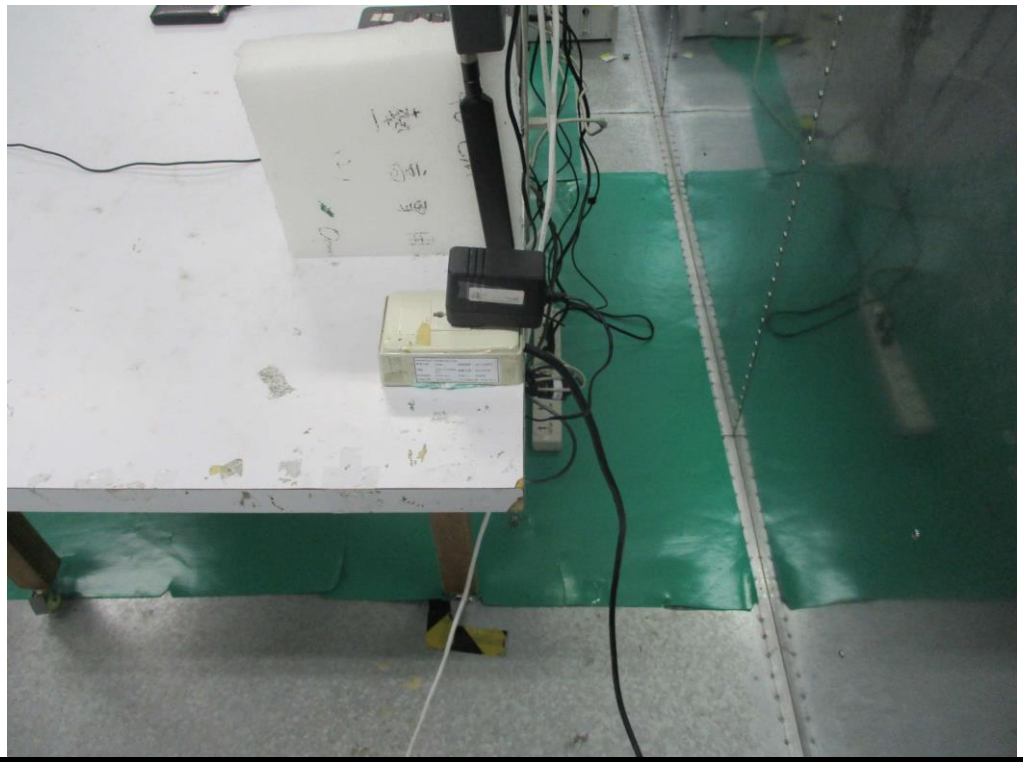


Conducted Emissions from the AC mains power ports (Adapter: F48L-120400SPAV)

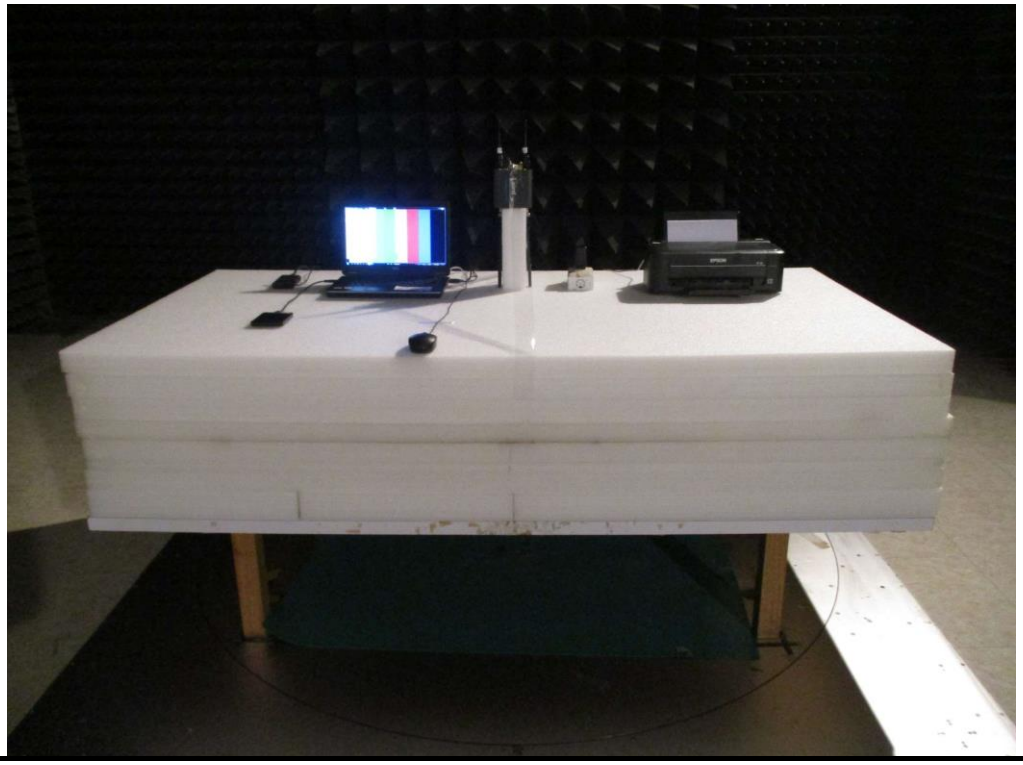


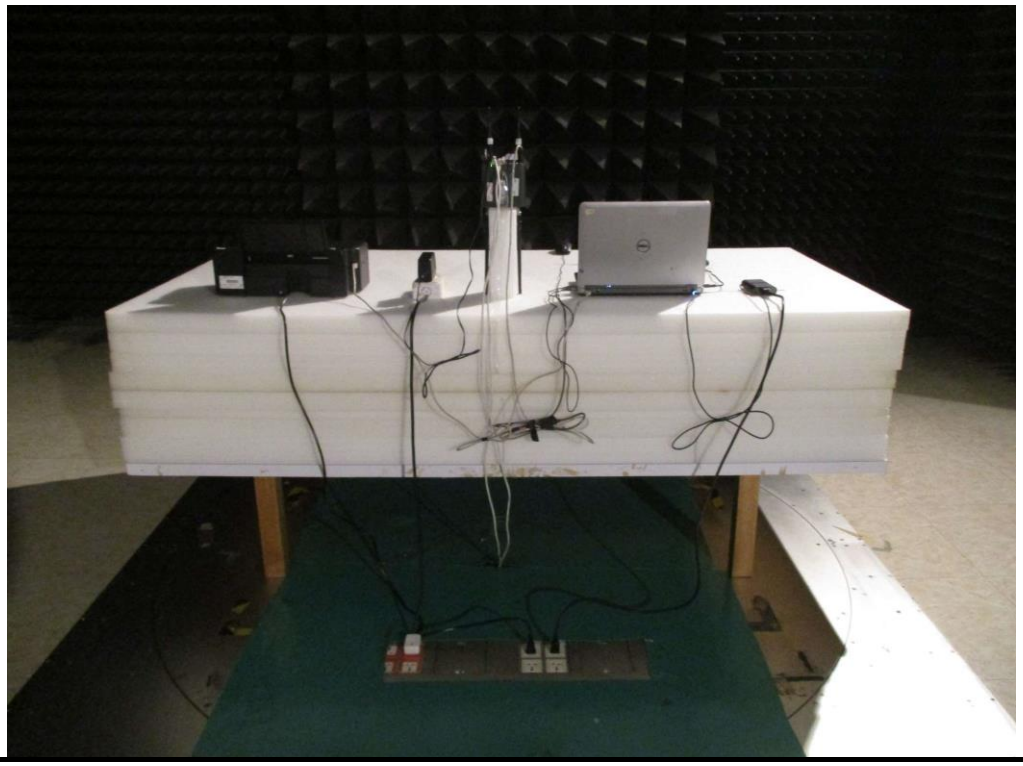
Asymmetric Mode Conducted Emissions (Adapter: F30L2-120250SPACP)



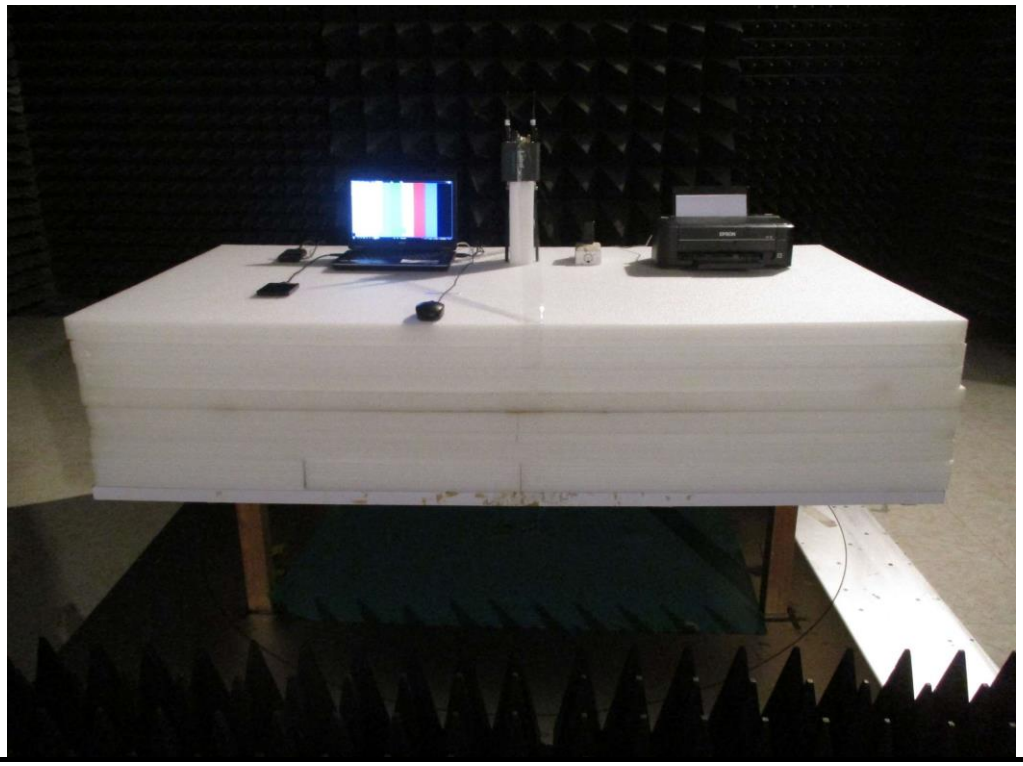


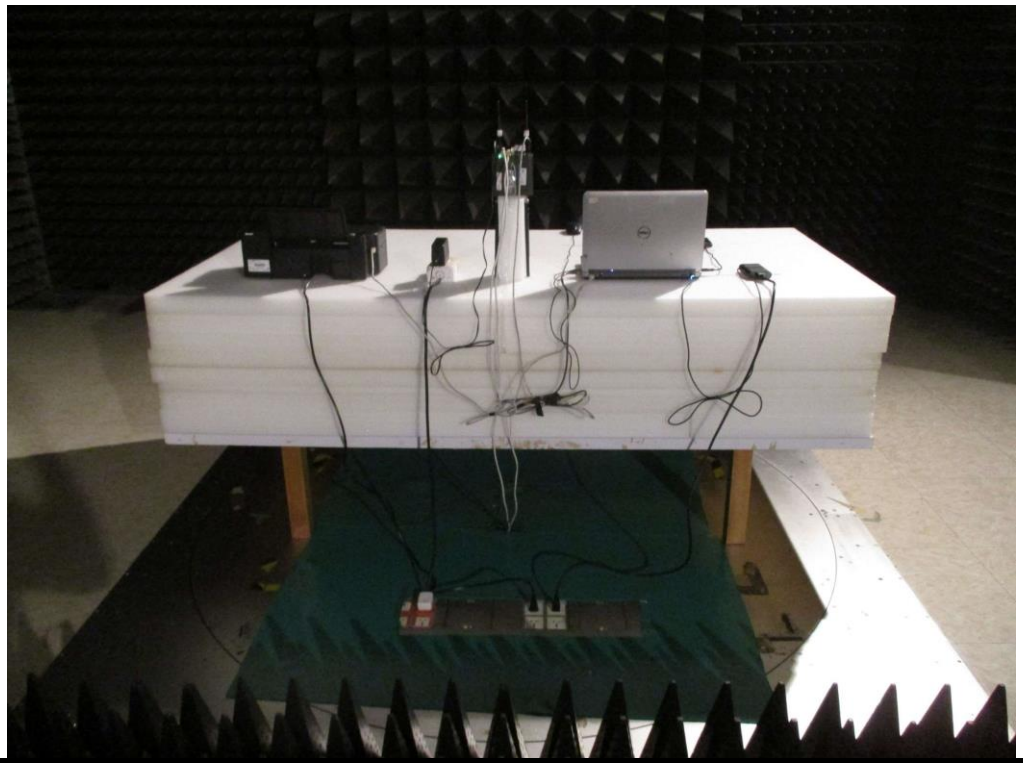
Radiated Emission Below 1GHz Test (Adapter: F30L2-120250SPACP)



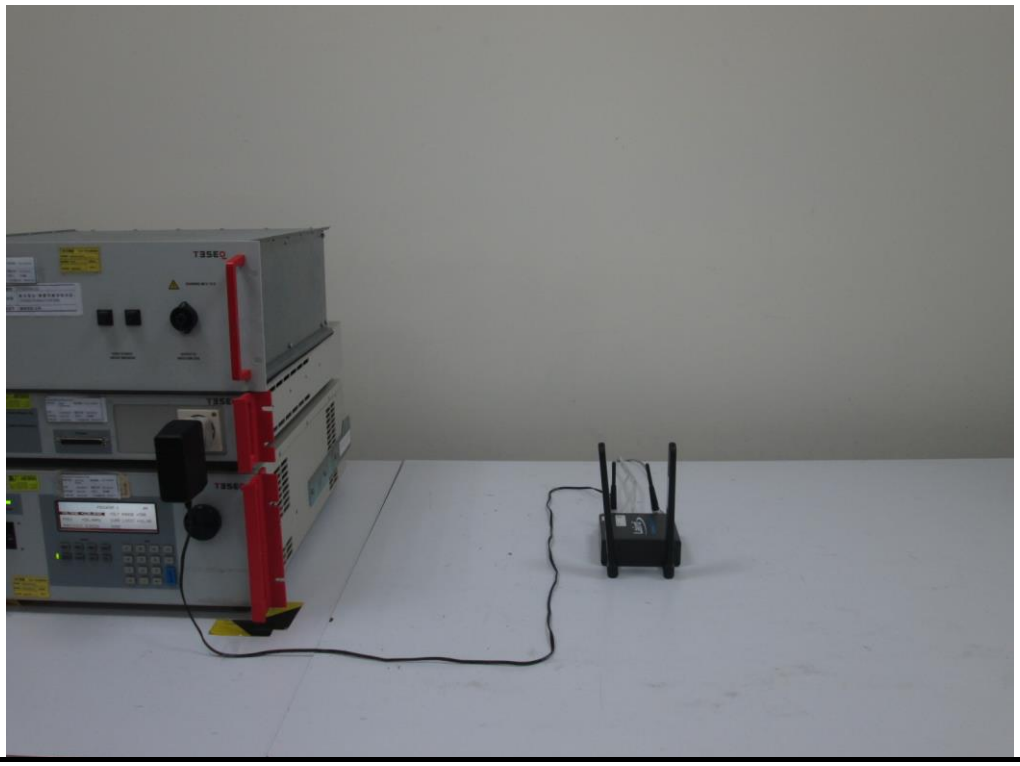


Radiated Emission Above 1GHz Test (Adapter: F30L2-120250SPACP)

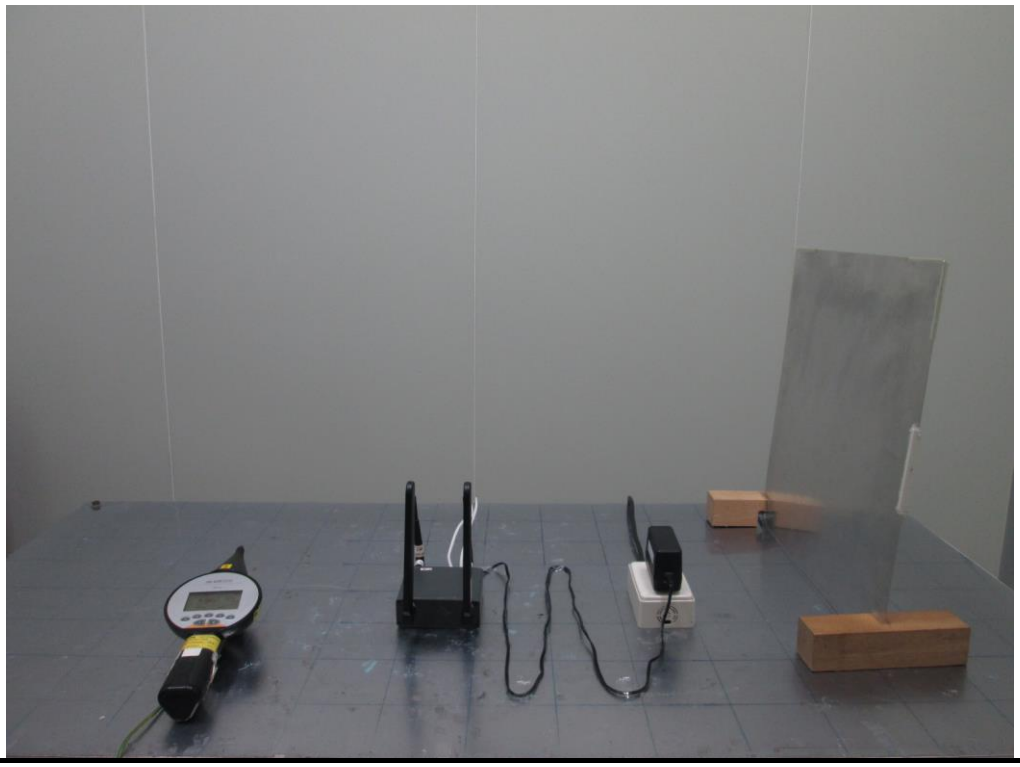




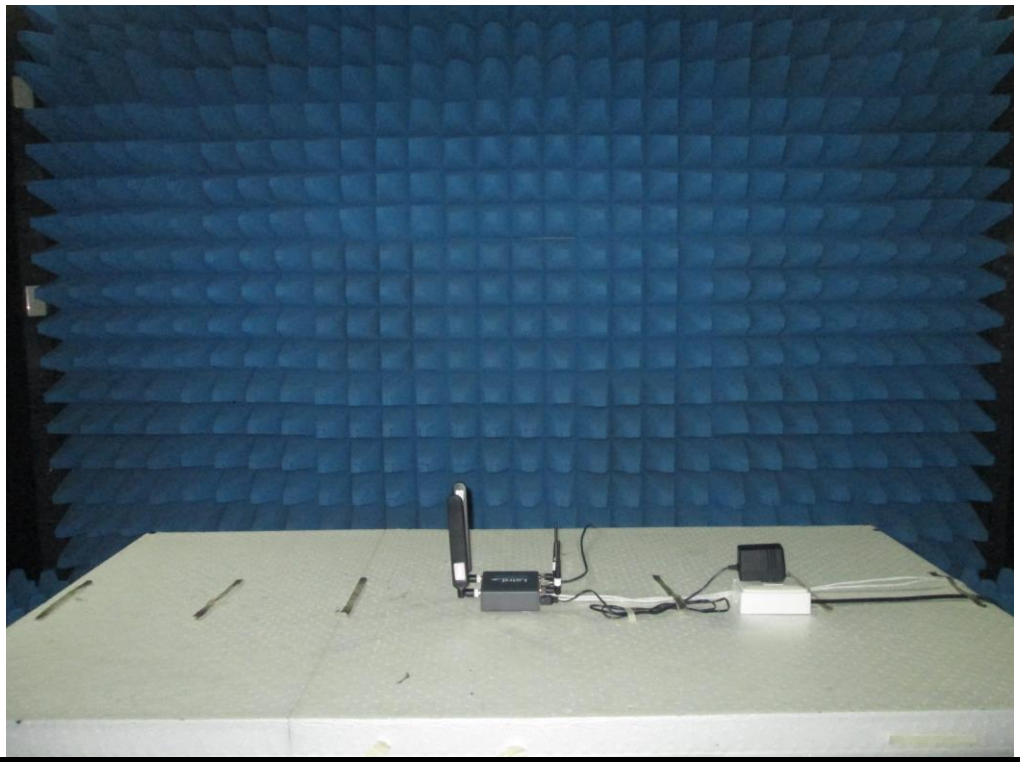
Harmonic & Flicker Test (Adapter: F30L2-120250SPACP)



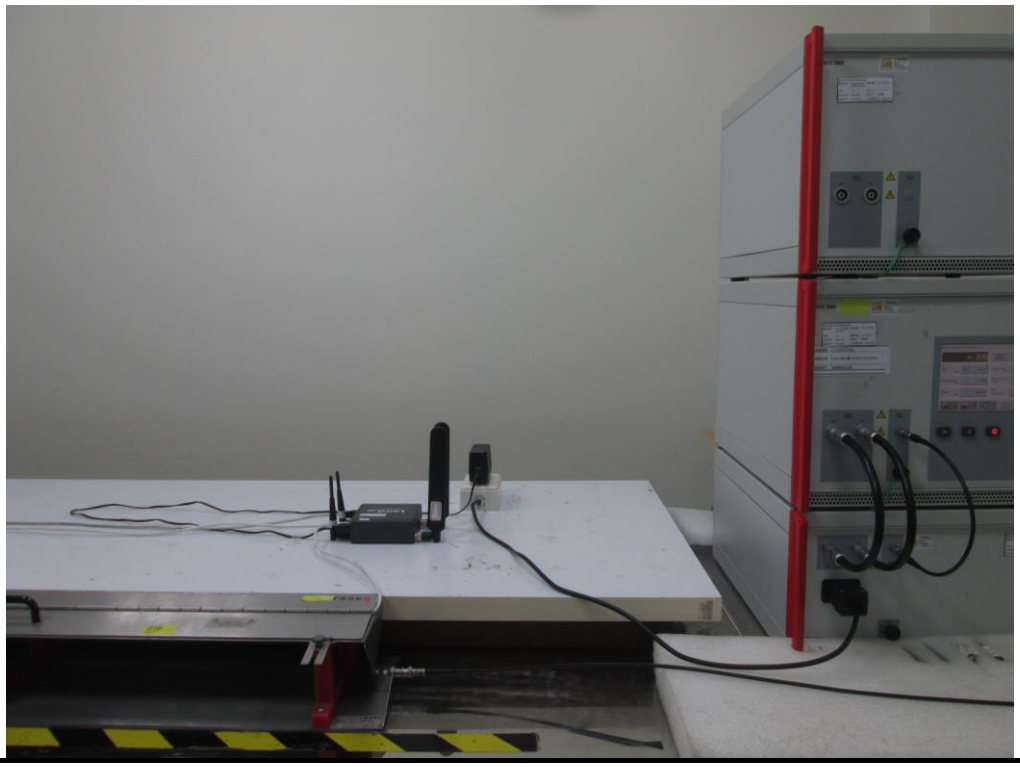
ESD Test (Adapter: F30L2-120250SPACP)



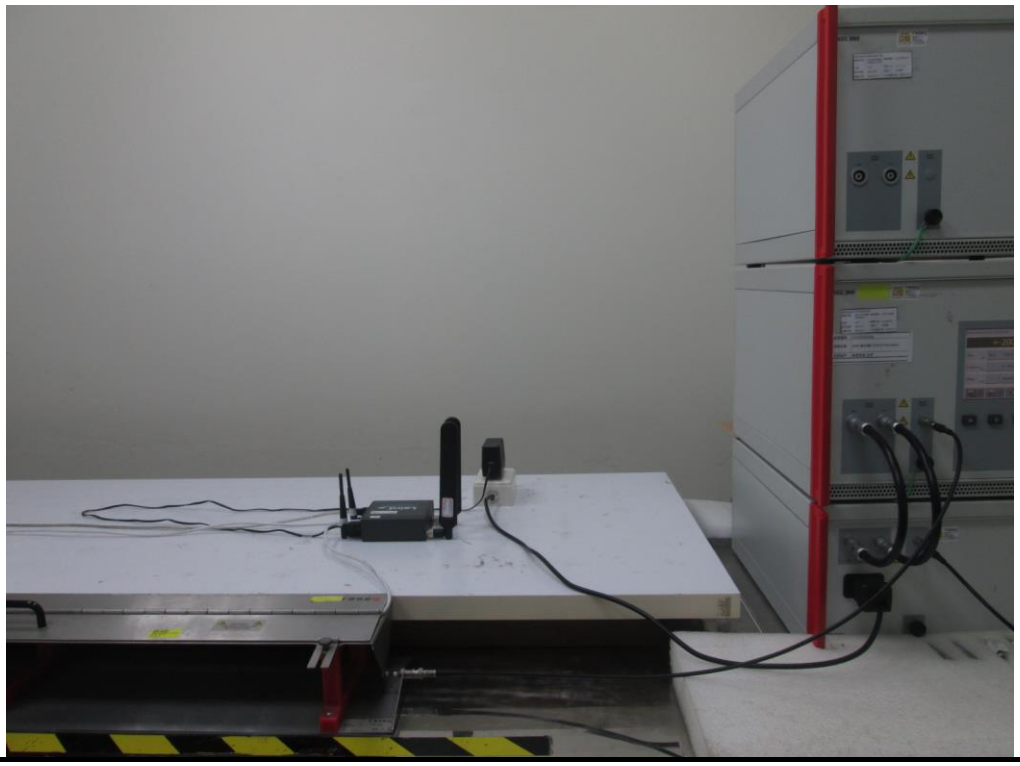
RS Test (Adapter: F30L2-120250SPACP)



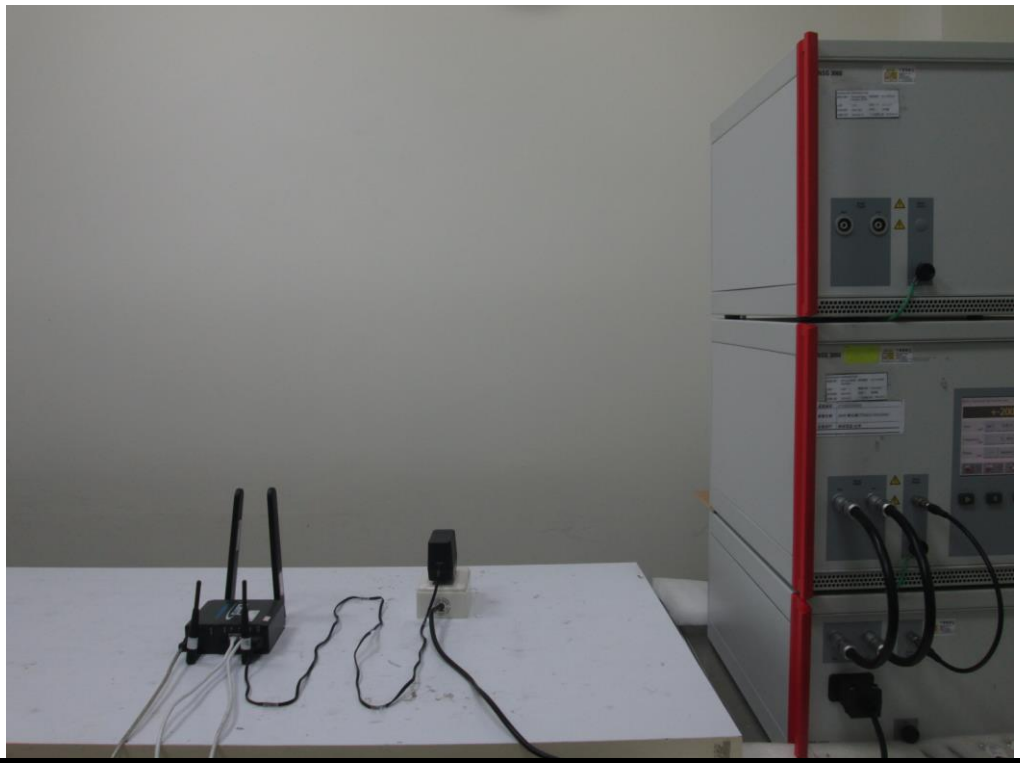
EFT Test (Power) (Adapter: F30L2-120250SPACP)



EFT Test (LAN1 100 Mbps) (Adapter: F30L2-120250SPACP)



Surge Test (Power) (Adapter: F30L2-120250SPACP)

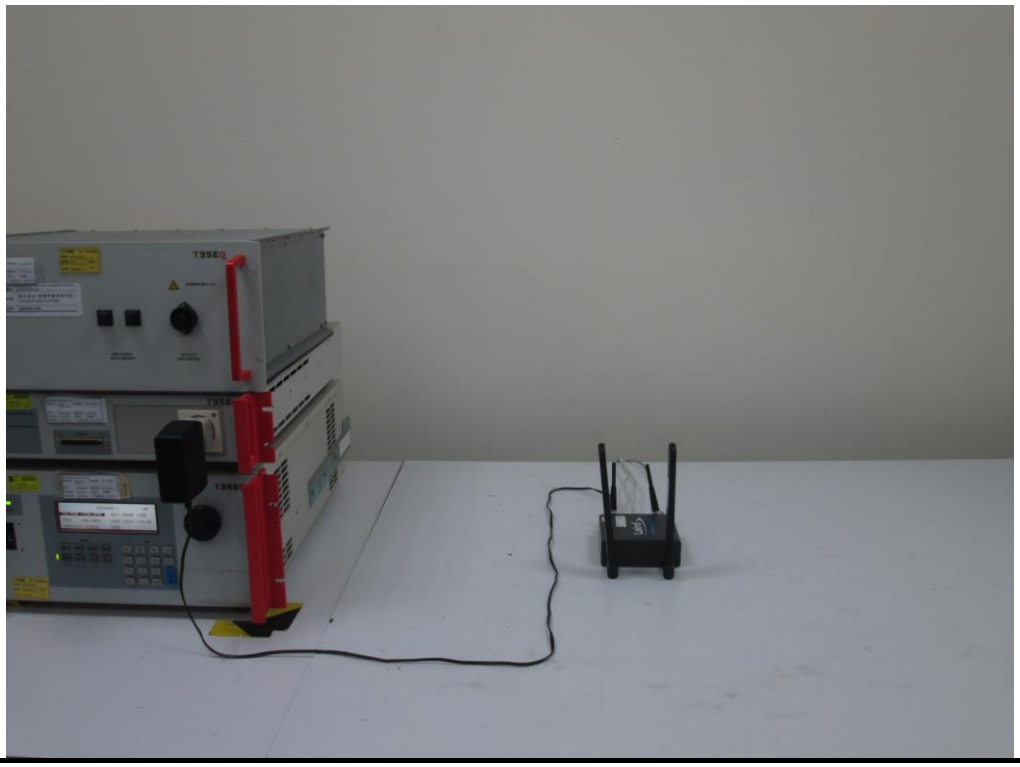


Surge Test (LAN1 100 Mbps) (Adapter: F30L2-120250SPACP)

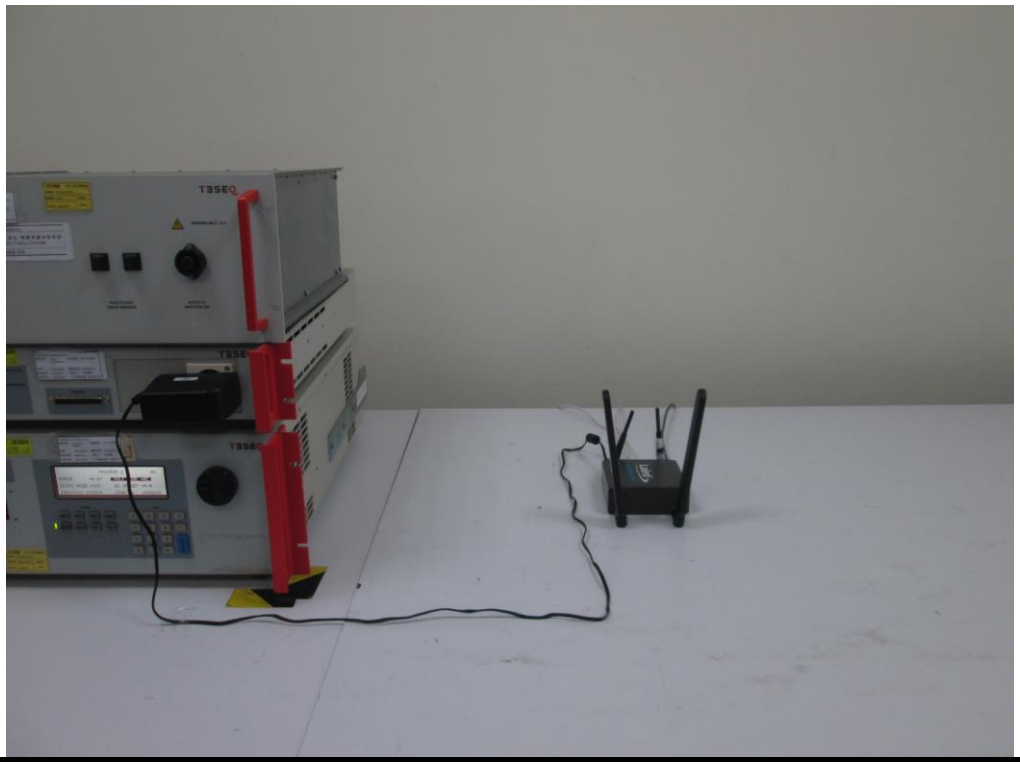
CS Test (Power) (Adapter: F30L2-120250SPACP)

CS Test (LAN1 100 Mbps) (Adapter: F30L2-120250SPACP)

DIP Test (Adapter: F30L2-120250SPACP)

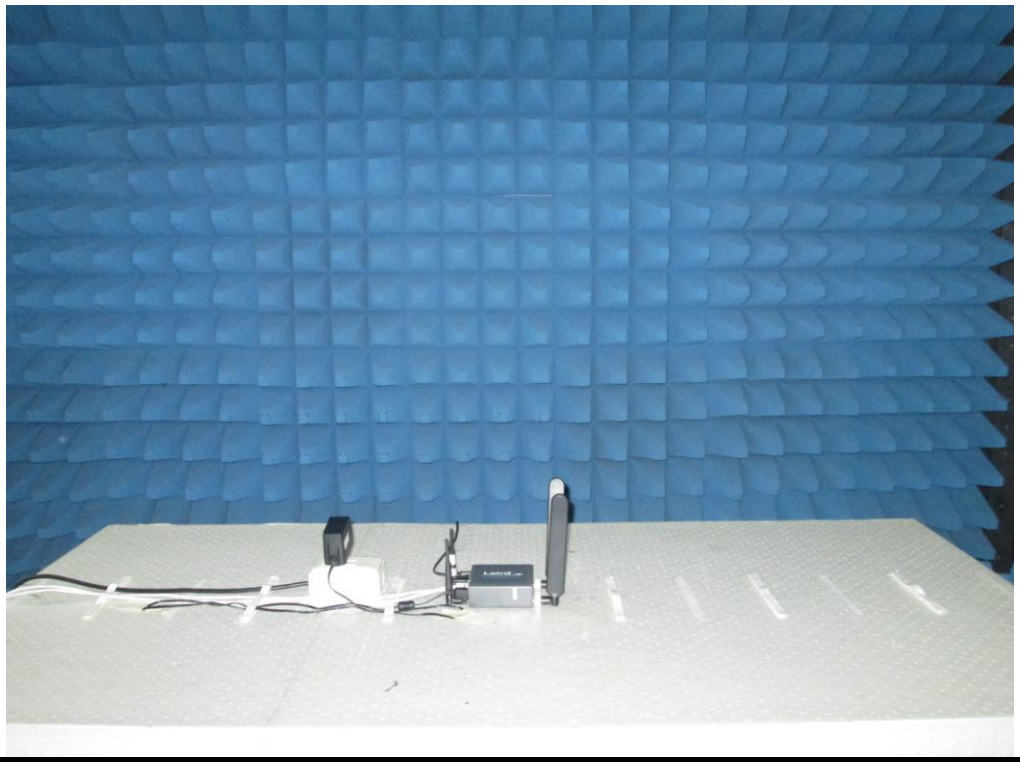


Harmonic & Flicker Test (Adapter: F48L-120400SPAV)

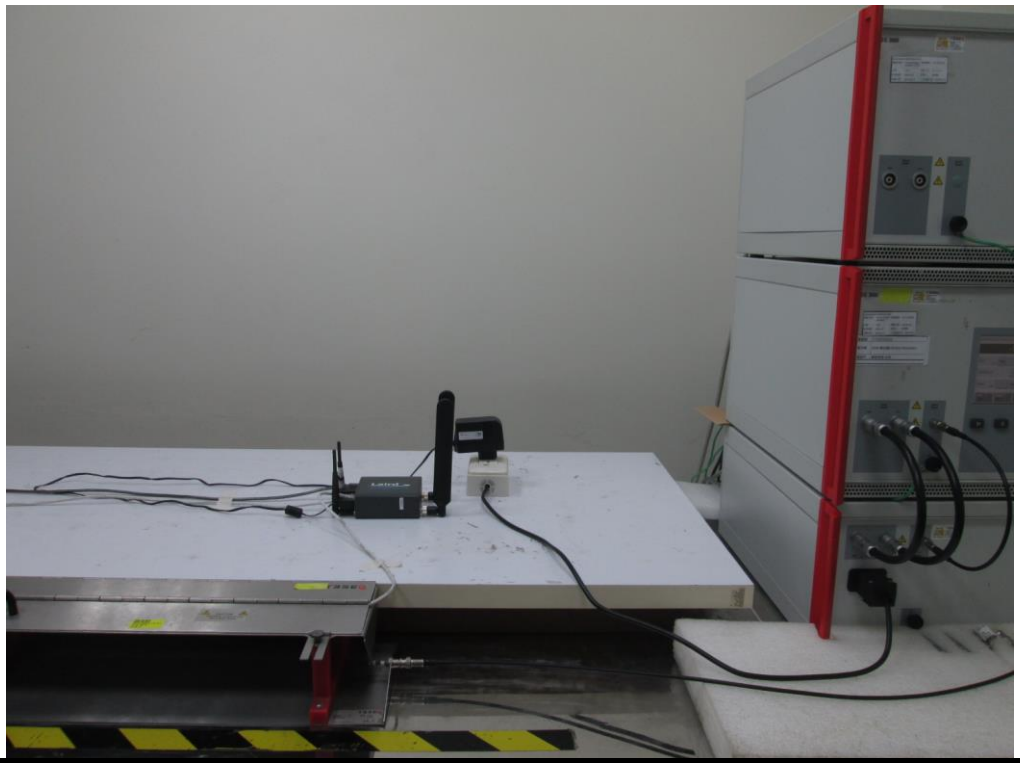


ESD Test (Adapter: F48L-120400SPAV)

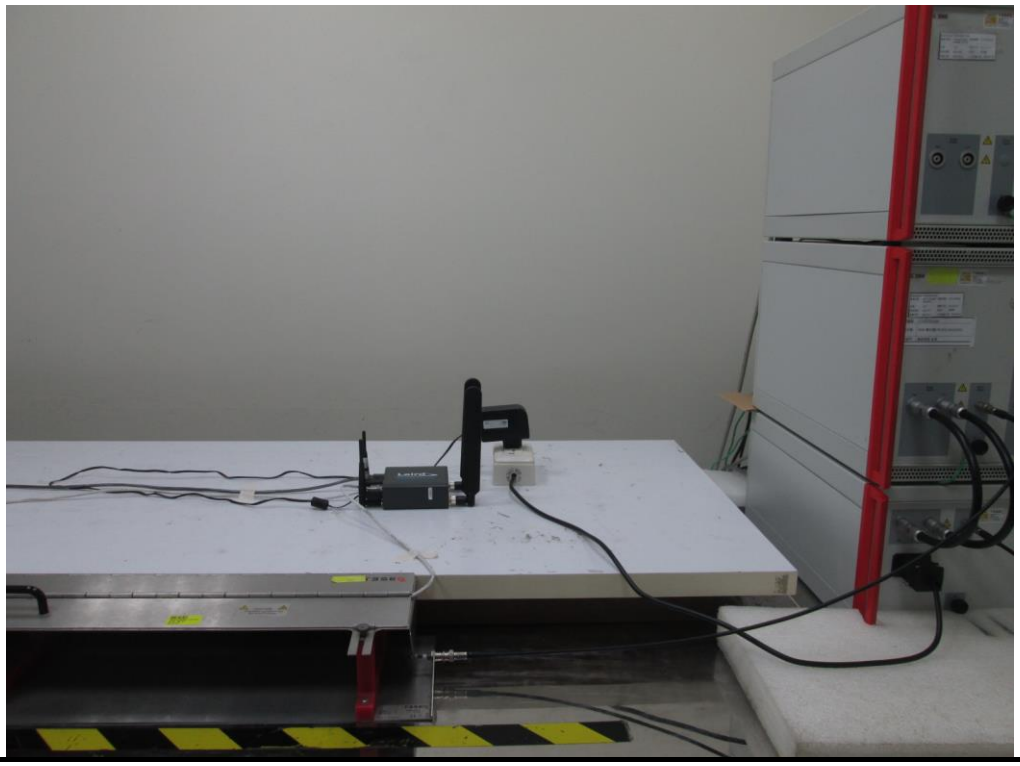
RS Test (Adapter: F48L-120400SPAV)



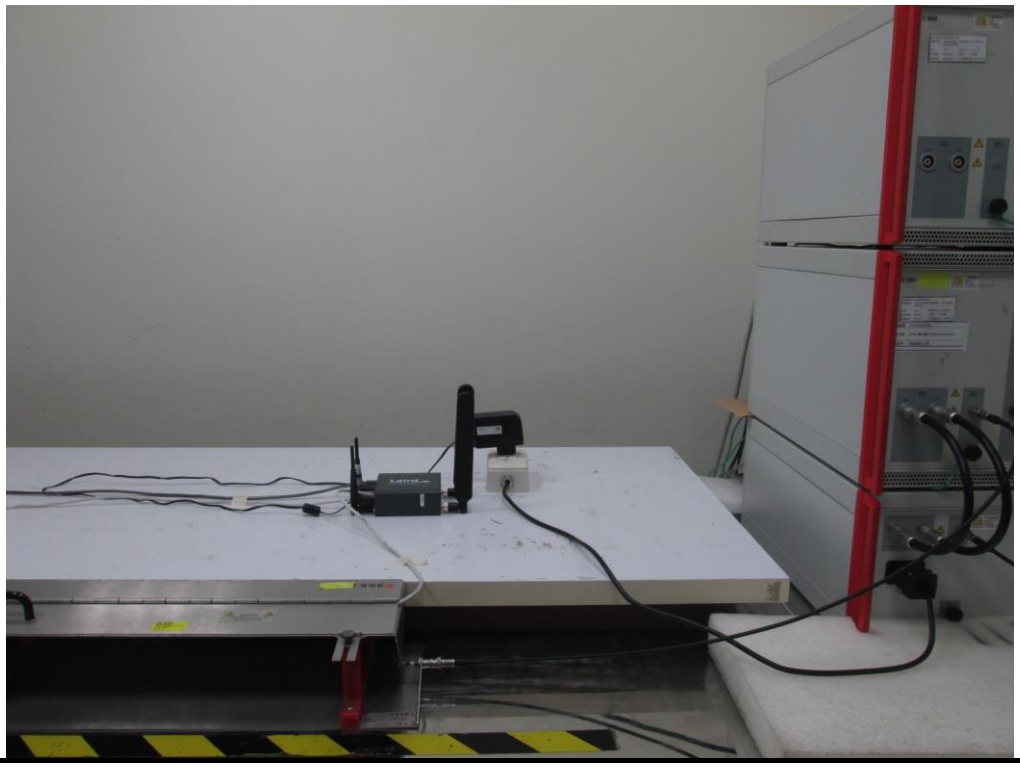
EFT Test (Power) (Adapter: F48L-120400SPAV)



EFT Test (LAN1 10/100 Mbps) (Adapter: F48L-120400SPAV)

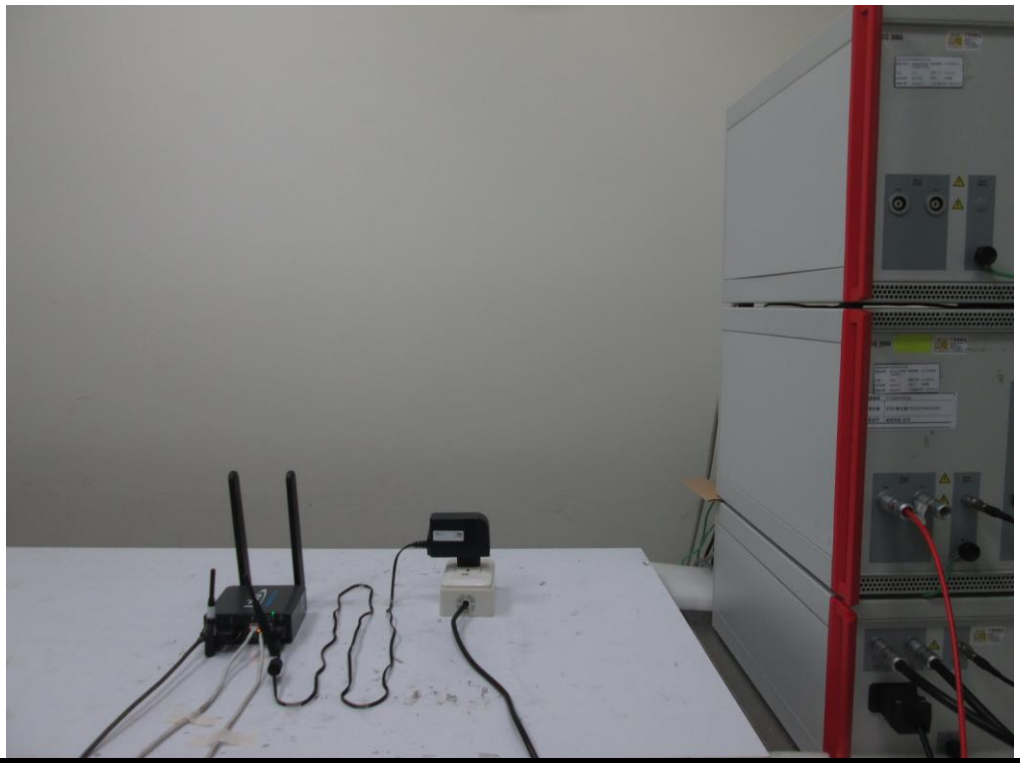


EFT Test (LAN2 1000 Mbps) (Adapter: F48L-120400SPAV)



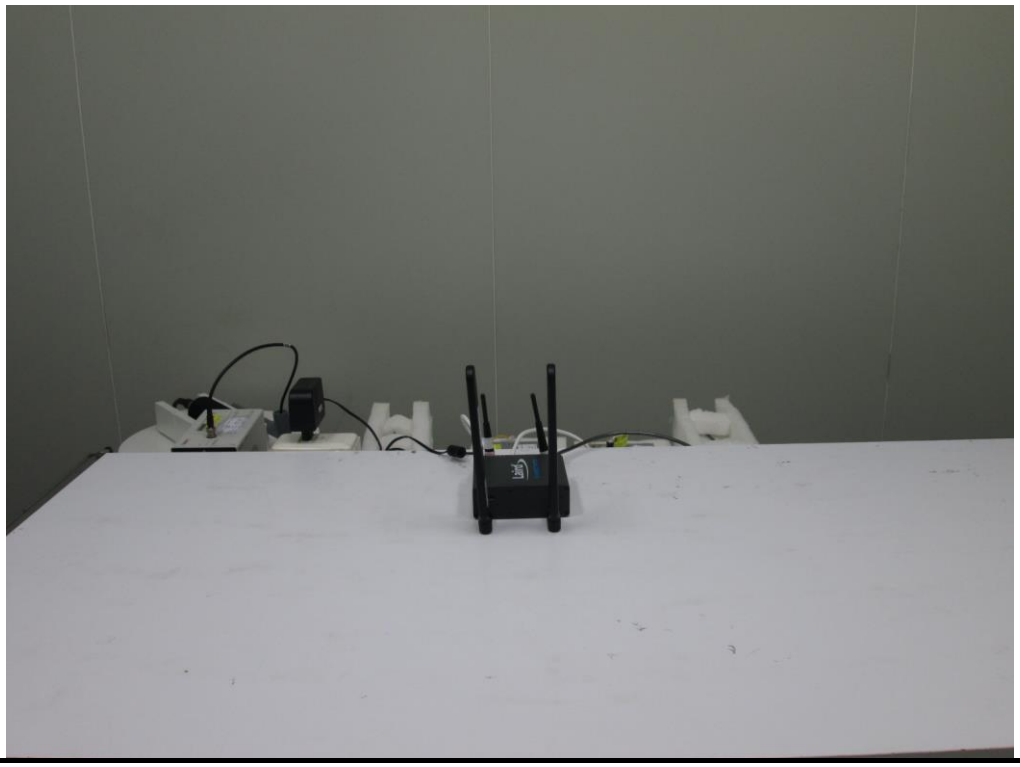
Surge Test (Power) (Adapter: F48L-120400SPAV)

Surge Test (LAN1 10/100 Mbps) (Adapter: F48L-120400SPAV)

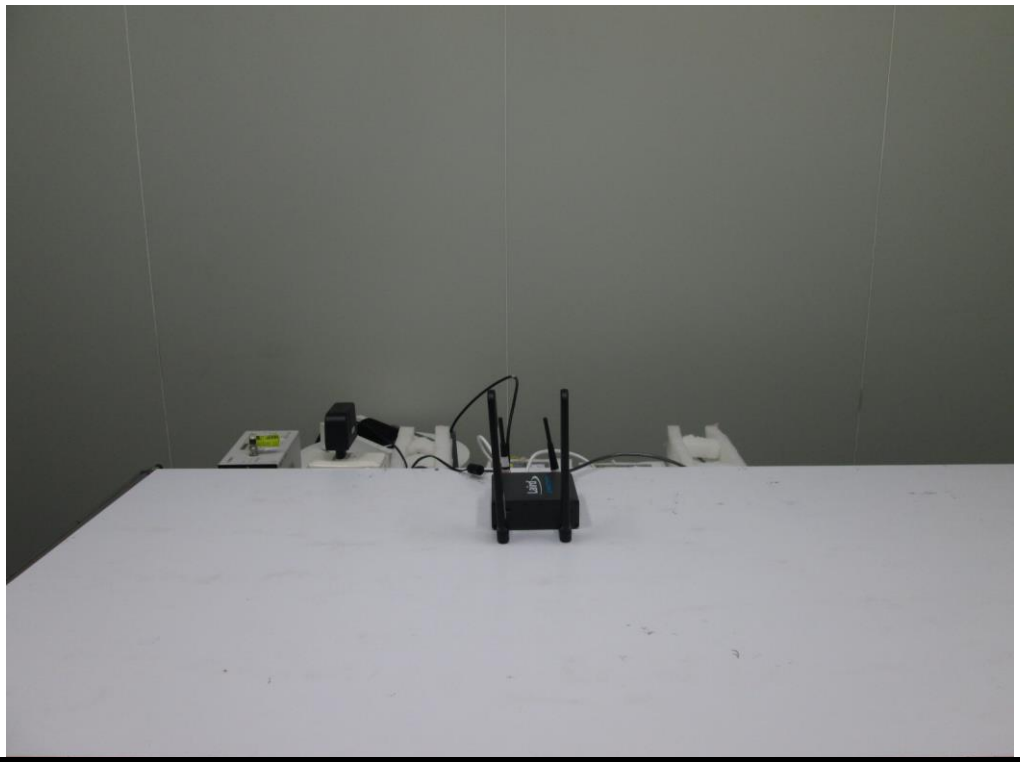


Surge Test (LAN2 1000 Mbps) (Adapter: F48L-120400SPAV)

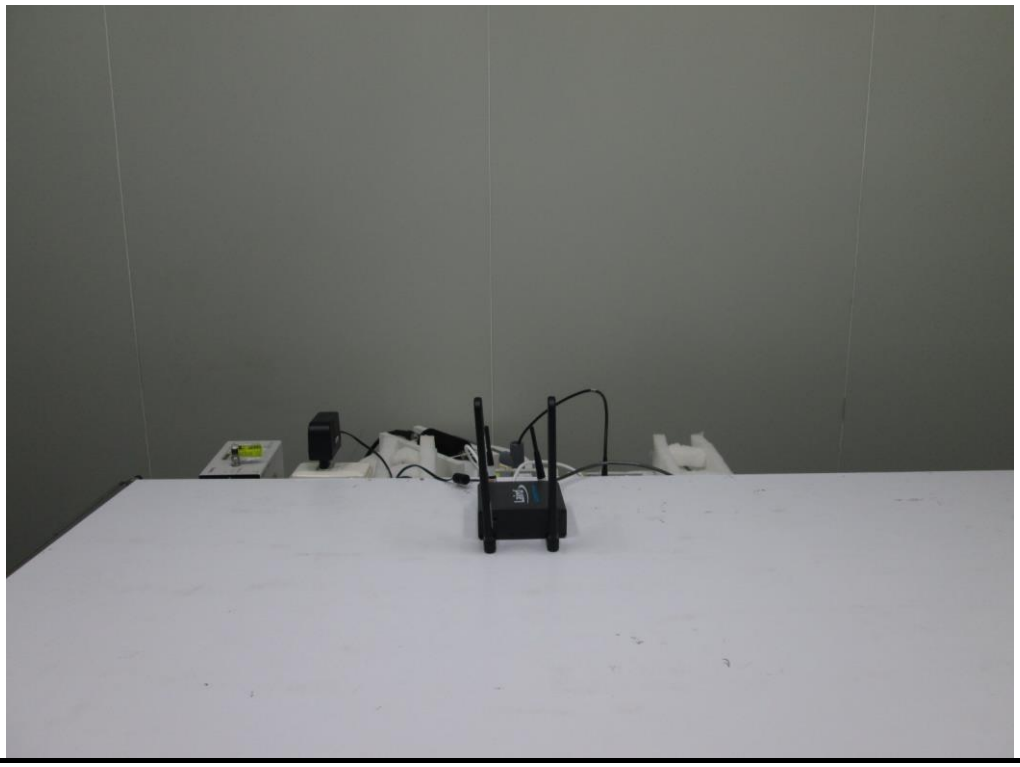
CS Test (Power) (Adapter: F48L-120400SPAV)



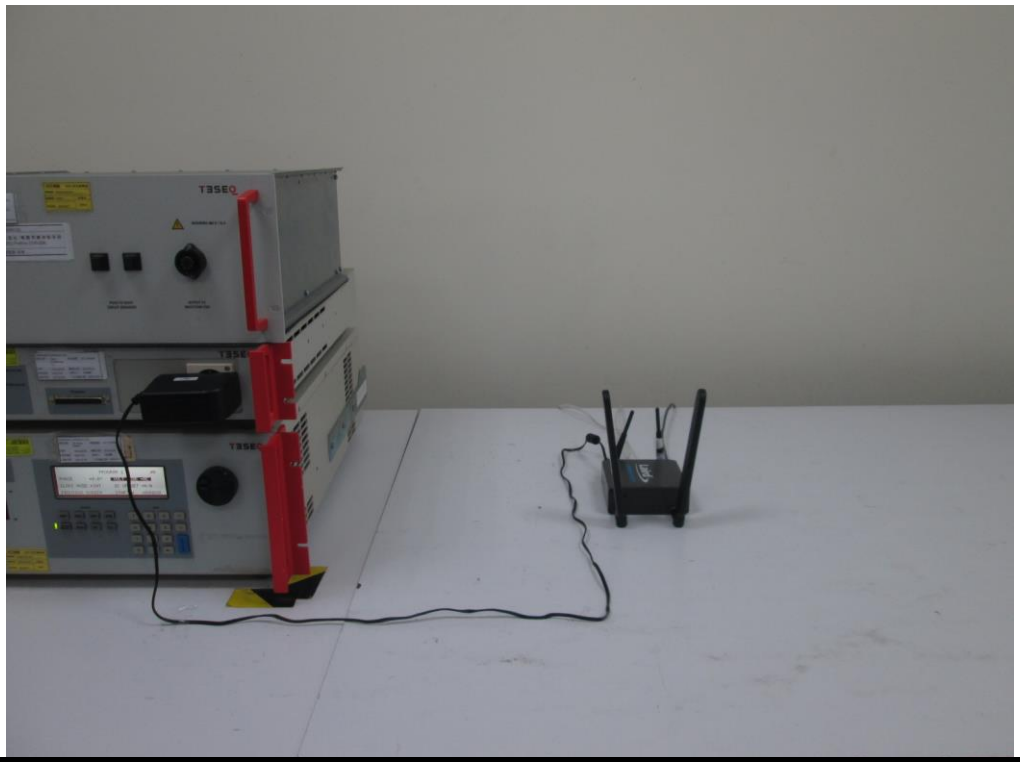
CS Test (LAN1 10/100 Mbps) (Adapter: F48L-120400SPAV)



CS Test (LAN2 1000 Mbps) (Adapter: F48L-120400SPAV)



DIP Test (Adapter: F48L-120400SPAV)



6 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corp (EMC and Wireless Communication Laboratory), it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan District. Location map can be found on our website http://www.icertifi.com.tw.

Linkou	**Kwei Shan**	**Kwei Shan Site II**
Tel: 886-2-2601-1640	Tel: 886-3-271-8666	Tel: 886-3-271-8640
No. 30-2, Ding Fwu Tsuen, Lin Kou District, New Taipei City, Taiwan, R.O.C.	No. 3-1, Lane 6, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C.	No. 14-1, Lane 19, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C.

If you have any suggestion, please feel free to contact us as below information

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Fax: 886-3-318-0155
Email: ICC_Service@icertifi.com.tw

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