Test Report

for

Electromagnetic Interference

of

Product： **Substation Gateway**

Trade Name： N/A

Model Number： G100

Prepared for

GE MULTILIN

650 MARKLAND STREET MARKHAM ON L6C OM1 CA

Prepared by

Interocean EMC Technology Corp.
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Remark:

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The test result in this report is only subjected to the test sample.

Table of Contents

Statement of Compliance

Applicant:	GE MULTILIN
Manufacturer:	GE MULTILIN
Product:	Substation Gateway
Model No.:	G100
Tested Power Voltage:	DC 12 V; DC 24 V; DC 48 V
Date of Final Test:	Jun. 21, 2021
Revision of Report:	Rev. 03

Reference Standards:

IEC 61850-3: 2013
IEEE 1613: 2009

Measurement Procedures and Standards Used:

Emission:

- ☒ CISPR 11: 2015+A1: 2016
- ☒ CISPR 32: 2015

Immunity:

- ☒ IEC 61000-4-2: 2008
- ☒ IEC 61000-4-3: 2020
- ☒ IEC 61000-4-4: 2012
- ☒ IEC 61000-4-5: 2014+A1: 2017
- ☒ IEC 61000-4-6: 2013+COR1: 2015
- ☒ IEC 61000-4-8: 2009
- ☒ IEC 61000-4-16: 2015
- ☒ IEC 61000-4-17: 1999+A1: 2001+A2: 2008
- ☒ IEC 61000-4-18: 2006+A1: 2010
- ☒ IEC 61000-4-29: 2000

The measurement results in this test report were performed at Interocean EMC Technology Corp. the responsibility of measurement result is only subjected to the tested sample. This report shows the EUT is technically compliance with the above official standards. This report shall not be partial reproduced without written approval by Interocean EMC Technology Corporation. Statement of Conformity: Judgment of conformity is based on test result, regardless of measurement uncertainty.

Report Issued: 2021/06/28

Prepared by: Albert Zeng

Approved: Edison Lee

1 General Information

1.1 Description of Equipment Under Test

Product : Substation Gateway

Model Number : G100

Applicant : **GE MULTILIN**
650 MARKLAND STREET MARKHAM ON L6C OM1 CA

Power Supply : DC 12/24/48V

Operational Highest Frequency : 1.3 GHz

Receipt Date of EUT : Mar. 08, 2021

Date of Test : Mar. 16 ~ May 26, 2021

Additional Description : 1.) The test model is "**G100**" and included in this report.
2.) For more detailed specification about EUT, please refer to the user's manual.

Inside Description of EUT :

Product	Description
CPU	1.3 GHz

1.2 Details of Tested Supporting System

1.2.1 Link PC

PC51

Model Number	:	ASUS BM6620
CPU Speed	:	Dual Core Intel Core i3 3240 3.4GHz
RAM	:	4GB DDR3 1600MHz
EMC Compliance	:	CE, BSMI
Serial Number	:	DBPFAG00073F
Hard Disk Drive	:	500GB Serial ATA3
Manufacturer	:	ASUS
Power Cord	:	Non-shielded, Detachable, 1.8m, w/o core

PC52

Model Number	:	M51AC
CPU Speed	:	Dual Core Intel Core i5 4570 3.2GHz
RAM	:	8GB DDR3 1600MHz
EMC Compliance	:	BSMI R31018
Serial Number	:	E2PDAG000FCF
Hard Disk Drive	:	1TBGB Serial ATA3
Manufacturer	:	ASUS
Switching Power Supply	:	HBA008
Power Cord	:	Non-shielded, Detachable, 1.8m, w/o core

1.2.2 Peripheral Device * 2

Manufacturer	:	GE MULTILIN

1.2.3 Monitor

MT56

Model Number	:	276E8V
Serial Number	:	UKC1919001532
EMC Compliance	:	FCC, CE
Manufacturer	:	PHILIPS
Power Cord	:	Non-shielded, Detachable, 1.8 m, w/o core

1.2.4 Keyboard

KB33 (USB)

Model Number	:	Y-U0011
Serial Number	:	N/A
EMC Compliance	:	CE, FCC, C-Tick, BSMI T51160, VCCI
Manufacturer	:	LOGITECH
Data Cable	:	Non-Shielded, Un-detachable, 1.5m

1.2.5 Mouse

USB67

Model Number	:	M-U0028
Serial Number	:	N/A
EMC Compliance	:	FCC, CE, BSMI T41126, VCCI
Manufacturer	:	LOGITECH
Data Cable	:	Non-shielded, Un-detachable, 1.8m

1.2.6 HDD

ED19

3.5”USB Hard Disk Drive	:	Buffalo 3.5” DriveStation USB 3.0 HDD Storage
Model Number	:	HX-1.0TU3.0
Serial Number	:	45564801002487
EMC Compliance	:	CE, FCC Doc, IC, C-TICK, BSMI D33093
Manufacturer	:	Buffalo
Data Cable	:	USB 3.0 Cable: Shielded, Detachable, 1.0m, w/o core
Hard Disk	:	BUFFALO 1T HD

ED47

3.5”USB Hard Disk Drive	:	WD 3.5” DriveStation USB 2.0 HDD Storage
Model Number	:	WD Elements Desktop 1T USB2.0
Serial Number	:	WCAZAA781945
EMC Compliance	:	CE, FCC Doc, BSMI D33015
Manufacturer	:	WD
Data Cable	:	USB 2.0 Cable: Shielded, Detachable, 1.0m, w/o core
Hard Disk	:	WD 1T HD

1.2.7 Test Cable

A. Power Cable *1	:	Non-shielded, Detachable, 1.5 m, w/o core
B. Ethernet copper *2	:	Non-shielded, Detachable, 1.8 m, w/o core
C. Display Cable *1	:	Shielded, Detachable, 1.8 m, with core
D. Di Do Cable *1	:	Non-shielded, Detachable, 1.5 m, w/o core
E. Ai Cable *1	:	Non-shielded, Detachable, 1.5 m, w/o core
F. IRIG-B Cable *1	:	Shielded, Detachable, 1.5 m, w/o core
G. Fiber Cable *1	:	Shielded, Detachable, 1.0 m, w/o core

1.3 Test Facility

Site Description : ☒Conducted 1 ☒OATS 1 ☒Chamber 3 ☒EMS Room

Name of Firm : Interocean EMC Technology Corp.

Company web : http://www.ietc.com.tw

Location : No. 5-2, Lin 1, Tin-Fu, Lin-Kou Dist., New Taipei City, Taiwan 244, R.O.C.

Site Filing :

- Federal Communication Commissions – USA
  Designation No.: TW1020 (Test Firm Registration #: 651092)
  Designation No.: TW1113 (Test Firm Registration #: 959554)
- Innovation, Science and Economic Development Canada (ISED)
  CAB identifier: TW1113 (Ref. No 14962756)
- Voluntary Control Council for Interference by Information Technology Equipment (VCCI) – Japan
  Member No.: 1349
  Registration No. (Conducted Room): C-11094
  Registration No. (Conducted Room): T-11562
  Registration No. (OATS 1): R-11040
  Registration No. (Chamber 3): G-20080

Site Accreditation :

- Bureau of Standards and Metrology and Inspection (BSMI) – Taiwan, R.O.C.
  Accreditation No.:
  SL2-IN-E-0026 for CNS 13438 / CISPR 22
  SL2-R1-E-0026 for CNS 13439 / CISPR 13
  SL2-R2-E-0026 for CNS 13439 / CISPR 13
  SL2-L1-E-0026 for CNS 14115 / CISPR 15
- Taiwan Accreditation Foundation (TAF)
  Accreditation No.: 1113
- American Association for Laboratory Accreditation (A2LA)
  Certificate Number: 4891.01
- Vehicle Safety Certification Center (VSCC)
  Approval No.: TW16-11

1.4 Summary of Test Results

Report Clause	Phenomenon	Reference Standard	Result	Location of Test
2	Power Line Conducted Emission	CISPR 11 / CISPR 32	PASS	IETC LAB
3	Asymmetric Mode Conducted Emissions	CISPR 32	PASS	IETC LAB
4	Radiated Emission (Below 1GHz)	CISPR 11 / CISPR 32	PASS	IETC LAB
5	Radiated Emission (Above 1GHz)	CISPR 32	PASS	IETC LAB
6	Electrostatic Discharge Test	IEC 61850-3 / IEC 61000-4-2 IEEE 1613 / IEEE 37.90.3	PASS	IETC LAB
7	Radiated, Radio-Frequency Electromagnetic Field	IEC 61850-3 / IEC 61000-4-3 IEEE 1613 / IEEE 37.90.2	PASS	IETC LAB
8	Fast Transient/Burst Test	IEC 61850-3 / IEC 61000-4-4 IEEE 1613 / IEEE 37.90.1	PASS	IETC LAB
9	Surge 1.2/50us	IEC 61850-3 / IEC 61000-4-5	PASS	IETC LAB
10	Radio-frequency, Conducted Disturbances Immunity	IEC 61850-3 / IEC 61000-4-6	PASS	IETC LAB
11	Power Frequency Magnetic Field	IEC 61850-3 / IEC 61000-4-8	PASS	IETC LAB
12	Conducted Common Mode Disturbances	IEC 61850-3 / IEC 61000-4-16	PASS	IETC LAB
13	Ripple on d.c. Power Supply	IEC 61850-3 / IEC 61000-4-17	PASS	IETC LAB
14	Damped Oscillatory Wave	IEC 61850-3 / IEC 61000-4-18 IEEE 1613 / IEEE 37.90.1	PASS	IETC LAB
15	DC Voltage Dips & Voltage Interruptions	IEC 61850-3 / IEC 61000-4-29	PASS	IETC LAB

1.5 Measurement Uncertainty

Item	Value
Conduction 1:	
Conducted Emission - AMN (9 kHz to 30 MHz)	3.0 dB
Conducted Emission - AAN (ISN T800) (150 kHz to 30 MHz)	3.3 dB
Conducted Emission - CP (9 kHz to 30 MHz)	3.1 dB
Radiated Emission - LAS (2 m Loop) (9 kHz to 30 MHz)	3.3 dB
Antenna Power (30 MHz to 2150 MHz)	2.1 dB
Conduction 2:	
Conducted Emission - VP (9 kHz to 30 MHz)	2.5 dB
Disturbance Power (30 MHz to 300 MHz)	4.1 dB
OATS 1:	
Radiated Emission Test (30 MHz to 200 MHz)	4.6 dB
Radiated Emission Test (200 MHz to 1 GHz)	4.8 dB
OATS 3:	
Radiated Emission Test (30 MHz to 200 MHz)	4.8 dB
Radiated Emission Test (200 MHz to 1 GHz)	4.8 dB
Chamber 3:	
Radiated Emission Test (9 kHz to 30 MHz)	3.2 dB
Radiated Emission Test (30 MHz to 200 MHz)	4.6 dB
Radiated Emission Test (200 MHz to 1 GHz) (Antenna: without tilting)	5.9 dB
Radiated Emission Test (1 GHz to 6 GHz)	4.9 dB
Induced Current Density (20 kHz to 10 MHz)	1.9 dB
The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%	

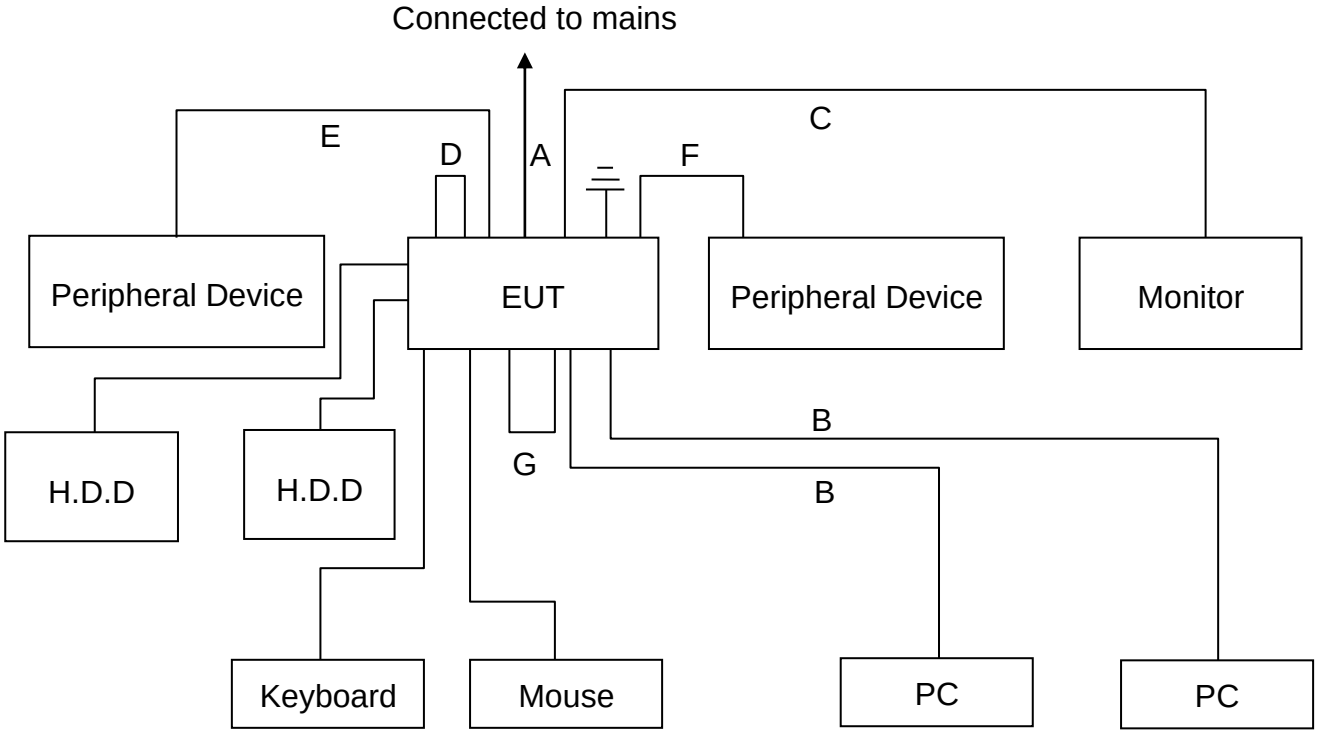
1.6 Measured Mode

1.6.1 The test modes for final test are as following:

- Mode 1: Working Mode (DC 12 V)
- Mode 2: Working Mode (DC 24 V)
- Mode 3: Working Mode (DC 48 V)

1.6.2 For signal port test: Ethernet copper (LAN 1); Ethernet copper (LAN 2)

1.7 Configuration of EUT Setup



A. Power Cable
B. Ethernet copper
C. Display Cable
D. DiDo Cable
E. Ai Cable
F. IRIG-B Cable
G. Fiber Cable

1.8 Test Step of EUT

1.8.1 Set the EUT and peripheral as above.

1.8.2 Turn on the power of all equipments.

1.8.3 An executive program, EMC software under Windows OS

1.8.4 Test programs exercising various part of EUT are used. The programs are executed as follows:

(Only For CISPR 32)

a. The PC sends data to another remotely controlled PC.
b. The PC sends Color bar patterns to the monitor.
c. The PC sends data to the hard disk, and the hard disk reads and writes.
d. Repeat the above steps.

(For Other tests)

a. The PC sends data to another remotely controlled PC.
b. The PC sends "H" patterns to the monitor.
c. The PC sends data to the hard disk, and the hard disk reads and writes.
e. Repeat the above steps.

2 Conducted Emission Measurement (CISPR 11 / CISPR 32)

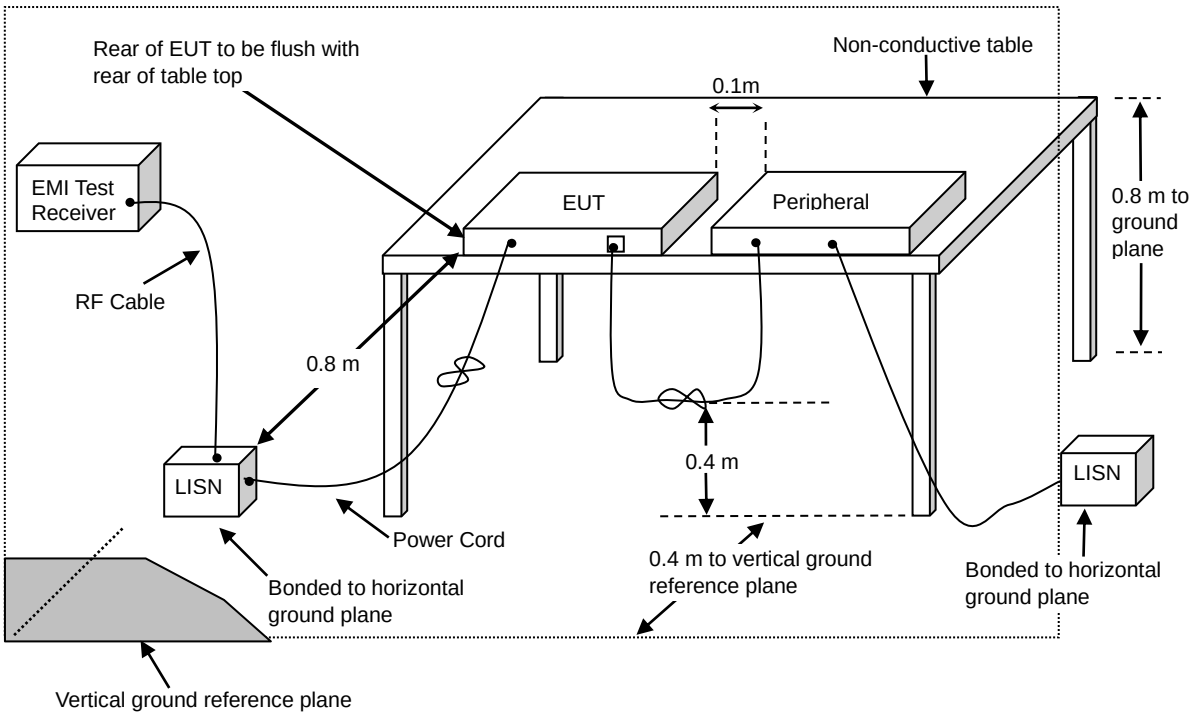
2.1 Instrument

Instrument	Manufacturer	Model	Serial No.	Next Cal. Date
EMI Test Receiver	Rohde & Schwarz	ESCS 30	100127	2021/11/17
RF Cable	IETC	CBL68	CBL68	2022/01/22
Pulse Limiter	R&S	ESH3-Z2	8360836/026	2022/01/22
L.I.S.N.	Schwarzbeck	NNLK8121	8121417	2022/03/08
L.I.S.N.	Schaffner	MN2050D	1598	2021/08/04
Measurement Software	AUDIX-e3			

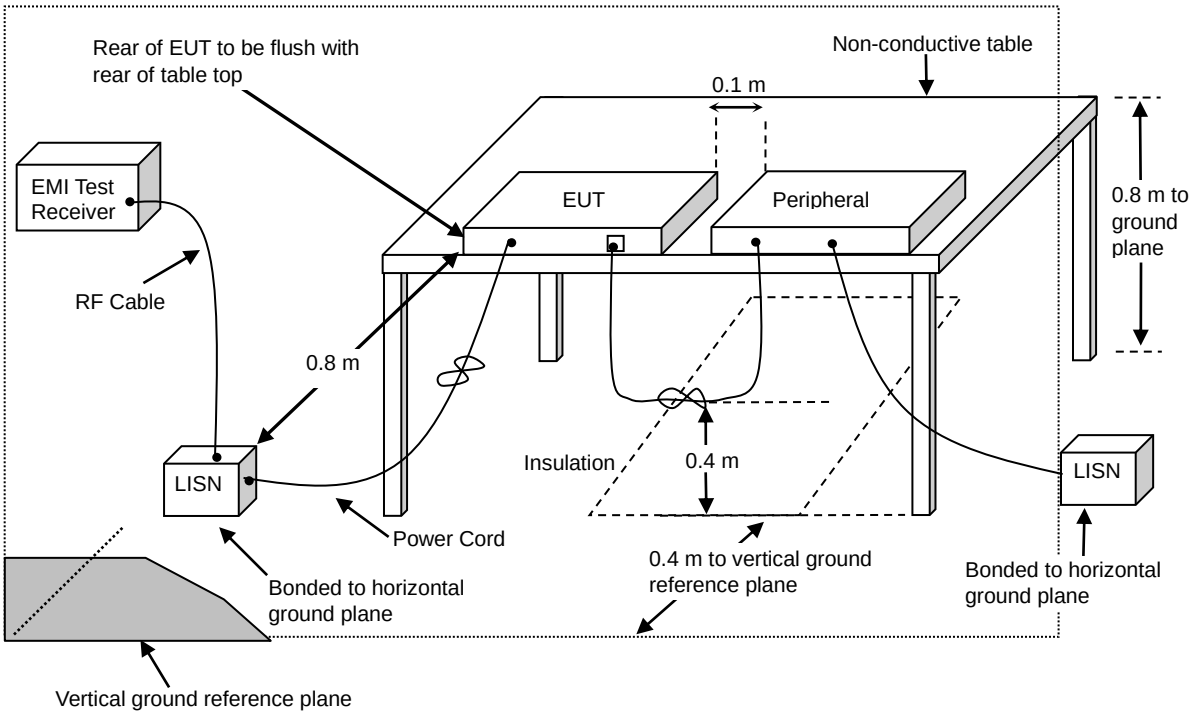
Note: The above equipments are within the valid calibration period.

2.2 Block Diagram of Test Configuration

For CISPR 11



For CISPR 32



2.3 Conducted Limits

CISPR 11

☒ Group 1, Class A

Frequency (MHz)	☒ Rated input power of ≤ 20 kVA (dBμV)		☐ Rated input power of > 20 kVA (dBμV)	
	Q.P. (Quasi-Peak)	A.V. (Average)	Q.P. (Quasi-Peak)	A.V. (Average)
0.15 ~ 0.50	79	66	100	90
0.50 ~ 5.0	73	60	86	76
5.0 ~ 30	73	60	90 to 73	80 to 60

☐ Group 1, Class B

Frequency (MHz)	Group 1, Class B (dBμV)	
	Q.P. (Quasi-Peak)	A.V. (Average)
0.15 ~ 0.50	66 to 56	56 to 46
0.50 ~ 5.0	56	46
5.0 ~ 30	60	50

CISPR 32

Frequency (MHz)	☒ Class A (dBμV)		☐ Class B (dBμV)	
	Q.P. (Quasi-Peak)	A.V. (Average)	Q.P. (Quasi-Peak)	A.V. (Average)
0.15 ~ 0.50	79	66	66 to 56	56 to 46
0.50 ~ 5.0	73	60	56	46
5.0 ~ 30	73	60	60	50

2.4 Instrument Configuration

2.4.1 Set the EMI test receiver frequency range from 150 kHz to 30 MHz.

2.4.2 Set the EMI test receiver bandwidth at 9 kHz.

2.4.3 Set the EMI test receiver detector as Quasi-Peak (Q.P.) and Average (AV).

2.5 Configuration of Measurement

2.5.1 The EUT was placed on a non-conductive table whose total height equaled 80 cm and vertical conducting plane located 40 cm to the rear of the EUT.

2.5.2 The EUT was connected to the main power through Line Impedance Stabilization Networks (LISN). This setup provided a 50 ohm / 50 μH coupling impedance for the measuring equipment. The auxiliary equipment was also connected to the main power through a LISN that provided a 50 ohm/50 μH coupling impedance with 50 ohm termination. (Refer to the block diagram of the test setup and photographs.)

2.5.3 The conducted disturbance was measured between the phase lead and the reference ground, and between the neutral lead and reference ground. The initial testing identified the frequency that has the highest disturbance relative to the limit while operating the EUT in typical modes of operation and cable positions in a test setup representative of typical system configuration.

2.5.4 The identification of the frequency of highest disturbance with respect to the limit was found by investigating disturbances at a number of significant frequencies. The probable frequency of maximum disturbance had been found and that the associated cable and EUT configuration and mode of operation had been identified.

2.6 Test Result

PASS.

The final test data is shown as following pages.

Factor = Insertion Loss + Cable Loss

Level = Reading + Factor

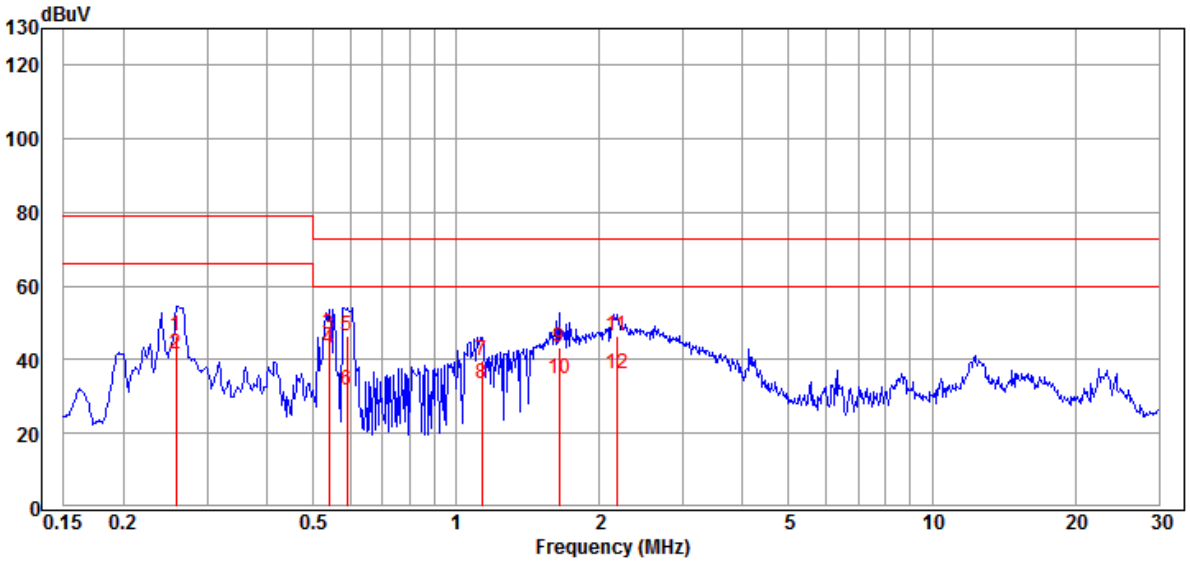
Margin = Level - Limit

CLIENT: GE MULTILIN
EUT: Substation Gateway
MODEL: G100
RATING: DC 12 V
COMMENT: Test Mode: Mode 1: Working Mode (DC 12 V)

OPERATOR: Albert
TEST SITE: Conducted 1
POLARIZATION: Line
TEMP/HUM: 22.5°C / 43%

Data:15

2021-03-16

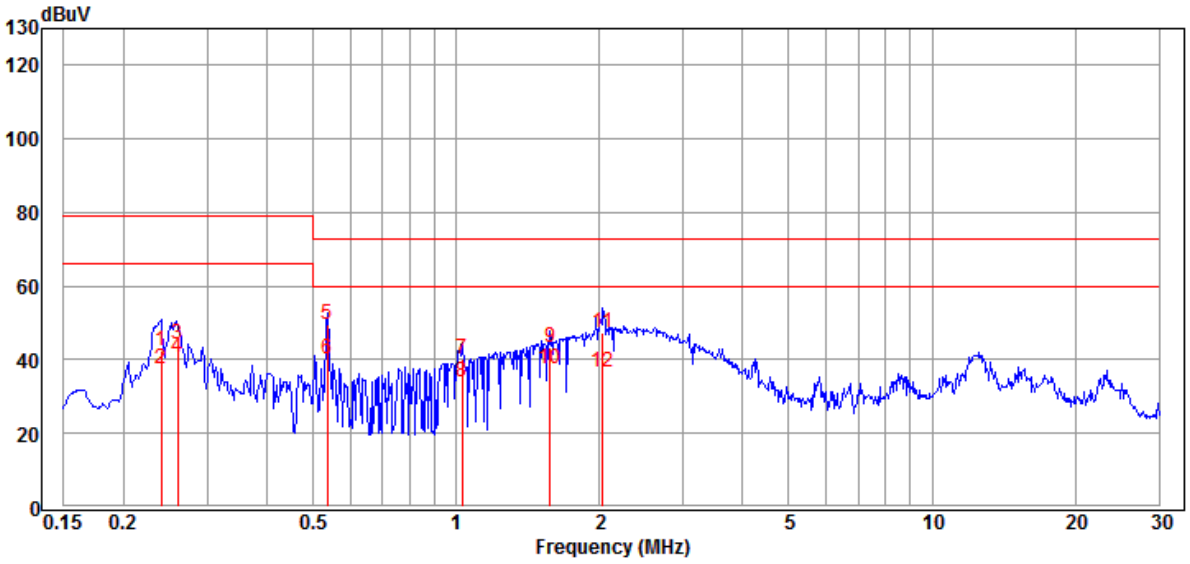


Item Mark	Freq. MHz	Reading dBuV	Factor dB	Level dBuV	Limit dBuV	Margin dB	Remark
1	0.2589	36.52	9.91	46.43	79.00	-32.57	QP
2	0.2589	31.65	9.91	41.56	66.00	-24.44	Average
3	0.5407	37.23	9.88	47.11	73.00	-25.89	QP
4	0.5407	32.91	9.88	42.79	60.00	-17.21	Average
5	0.5916	36.69	9.88	46.57	73.00	-26.43	QP
6	0.5916	21.99	9.88	31.87	60.00	-28.13	Average
7	1.1350	30.01	9.91	39.92	73.00	-33.08	QP
8	1.1350	23.44	9.91	33.35	60.00	-26.65	Average
9	1.6450	33.27	9.93	43.20	73.00	-29.80	QP
10	1.6450	24.81	9.93	34.74	60.00	-25.26	Average
11	2.1780	36.60	9.94	46.54	73.00	-26.46	QP
12	2.1780	26.35	9.94	36.29	60.00	-23.71	Average

CLIENT: GE MULTILIN
EUT: Substation Gateway
MODEL: G100
RATING: DC 12 V
COMMENT: Test Mode: Mode 1: Working Mode (DC 12 V)

OPERATOR: Albert
TEST SITE: Conducted 1
POLARIZATION: Neutral
TEMP/HUM: 22.5°C / 43%

Data:16 2021-03-16

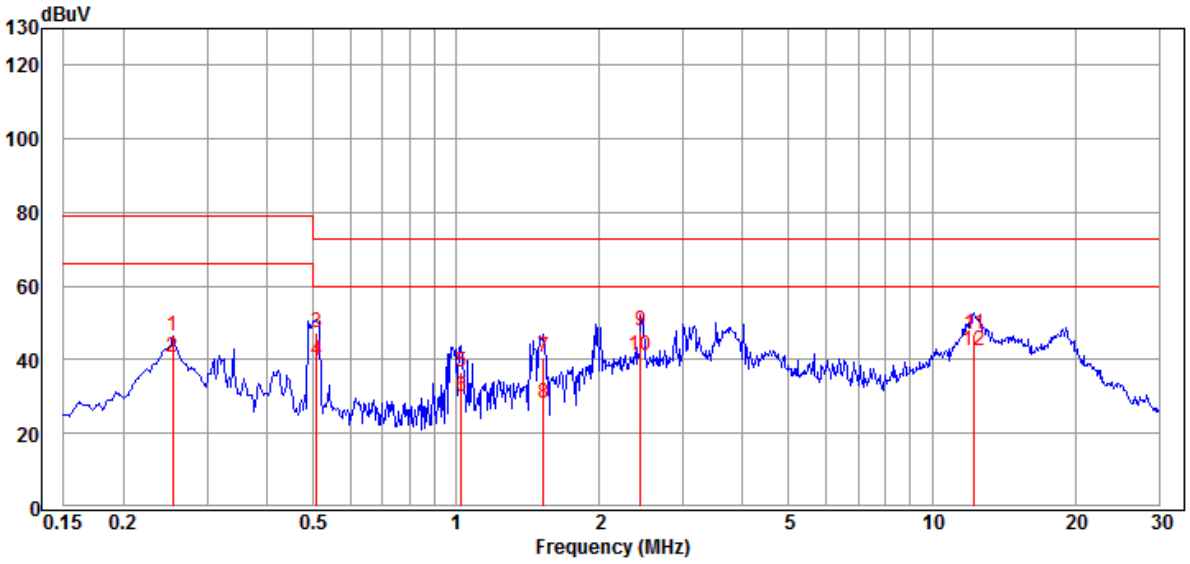


Item Mark	Freq. MHz	Reading dBuV	Factor dB	Level dBuV	Limit dBuV	Margin dB	Remark
1	0.2404	32.41	9.89	42.30	79.00	-36.70	QP
2	0.2404	27.75	9.89	37.64	66.00	-28.36	Average
3	0.2603	34.33	9.90	44.23	79.00	-34.77	QP
4	0.2603	30.58	9.90	40.48	66.00	-25.52	Average
5	0.5378	39.61	9.86	49.47	73.00	-23.53	QP
6	0.5378	30.54	9.86	40.40	60.00	-19.60	Average
7	1.0320	30.49	9.88	40.37	73.00	-32.63	QP
8	1.0320	23.93	9.88	33.81	60.00	-26.19	Average
9	1.5770	33.43	9.89	43.32	73.00	-29.68	QP
10	1.5770	27.46	9.89	37.35	60.00	-22.65	Average
11	2.0330	37.28	9.89	47.17	73.00	-25.83	QP
12	2.0330	26.71	9.89	36.60	60.00	-23.40	Average

CLIENT: GE MULTILIN
EUT: Substation Gateway
MODEL: G100
RATING: DC 24 V
COMMENT: Test Mode: Mode 2: Working Mode (DC 24 V)

OPERATOR: Albert
TEST SITE: Conducted 1
POLARIZATION: Line
TEMP/HUM: 22.5°C / 43%

Data:17 2021-03-16

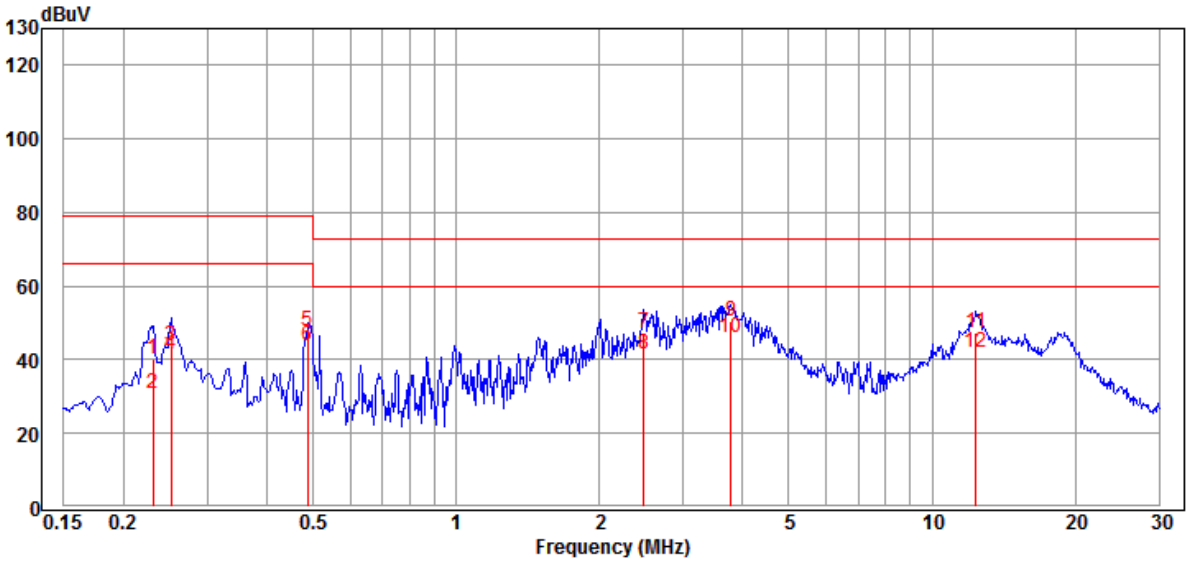


Item Mark	Freq. MHz	Reading dBuV	Factor dB	Level dBuV	Limit dBuV	Margin dB	Remark
1	0.2548	36.50	9.91	46.41	79.00	-32.59	QP
2	0.2548	30.88	9.91	40.79	66.00	-25.21	Average
3	0.5101	37.38	9.88	47.26	73.00	-25.74	QP
4	0.5101	29.79	9.88	39.67	60.00	-20.33	Average
5	1.0270	26.81	9.91	36.72	73.00	-36.28	QP
6	1.0270	20.22	9.91	30.13	60.00	-29.87	Average
7	1.5270	30.59	9.93	40.52	73.00	-32.48	QP
8	1.5270	18.40	9.93	28.33	60.00	-31.67	Average
9	2.4480	37.96	9.96	47.92	73.00	-25.08	QP
10	2.4480	31.34	9.96	41.30	60.00	-18.70	Average
11	12.2530	36.47	10.44	46.91	73.00	-26.09	QP
12	12.2530	32.02	10.44	42.46	60.00	-17.54	Average

CLIENT: GE MULTILIN
EUT: Substation Gateway
MODEL: G100
RATING: DC 24 V
COMMENT: Test Mode: Mode 2: Working Mode (DC 24 V)

OPERATOR: Albert
TEST SITE: Conducted 1
POLARIZATION: Neutral
TEMP/HUM: 22.5°C / 43%

Data:18 2021-03-16

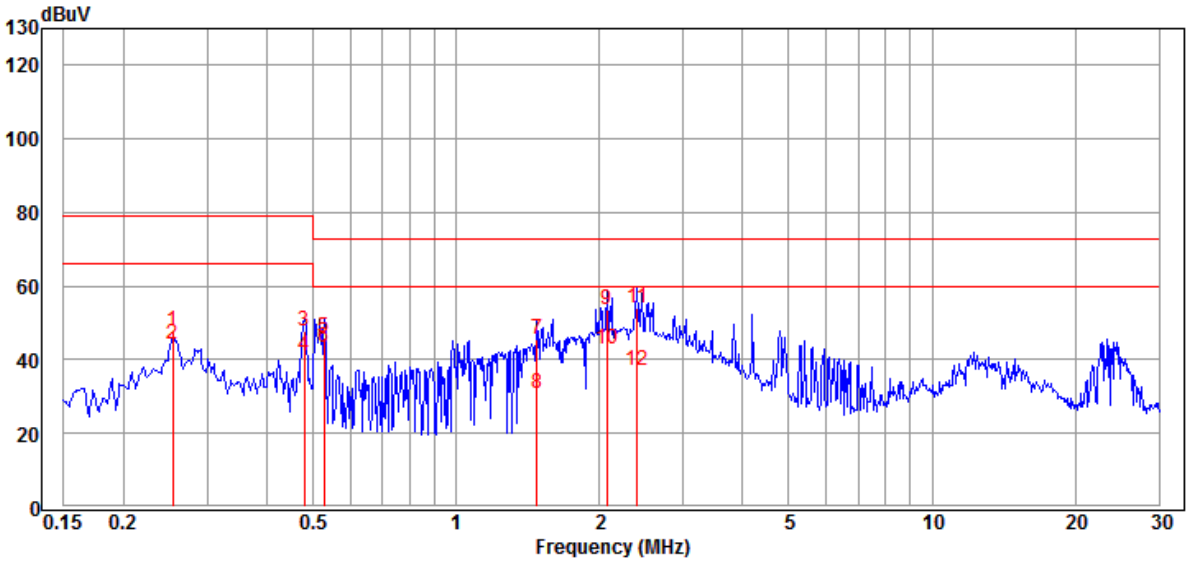


Item Mark	Freq. MHz	Reading dBuV	Factor dB	Level dBuV	Limit dBuV	Margin dB	Remark
1	0.2316	30.22	9.89	40.11	79.00	-38.89	QP
2	0.2316	20.98	9.89	30.87	66.00	-35.13	Average
3	0.2521	34.05	9.89	43.94	79.00	-35.06	QP
4	0.2521	31.56	9.89	41.45	66.00	-24.55	Average
5	0.4889	37.78	9.86	47.64	79.00	-31.36	QP
6	0.4889	33.71	9.86	43.57	66.00	-22.43	Average
7	2.4870	37.34	9.91	47.25	73.00	-25.75	QP
8	2.4870	31.76	9.91	41.67	60.00	-18.33	Average
9	3.7790	40.39	9.95	50.34	73.00	-22.66	QP
10	3.7790	35.99	9.95	45.94	60.00	-14.06	Average
11	12.3840	37.27	10.14	47.41	73.00	-25.59	QP
12	12.3840	31.76	10.14	41.90	60.00	-18.10	Average

CLIENT: GE MULTILIN
EUT: Substation Gateway
MODEL: G100
RATING: DC 48 V
COMMENT: Test Mode: Mode 3: Working Mode (DC48 V)

OPERATOR: Albert
TEST SITE: Conducted 1
POLARIZATION: Line
TEMP/HUM: 22.5°C / 43%

Data:19 2021-03-16

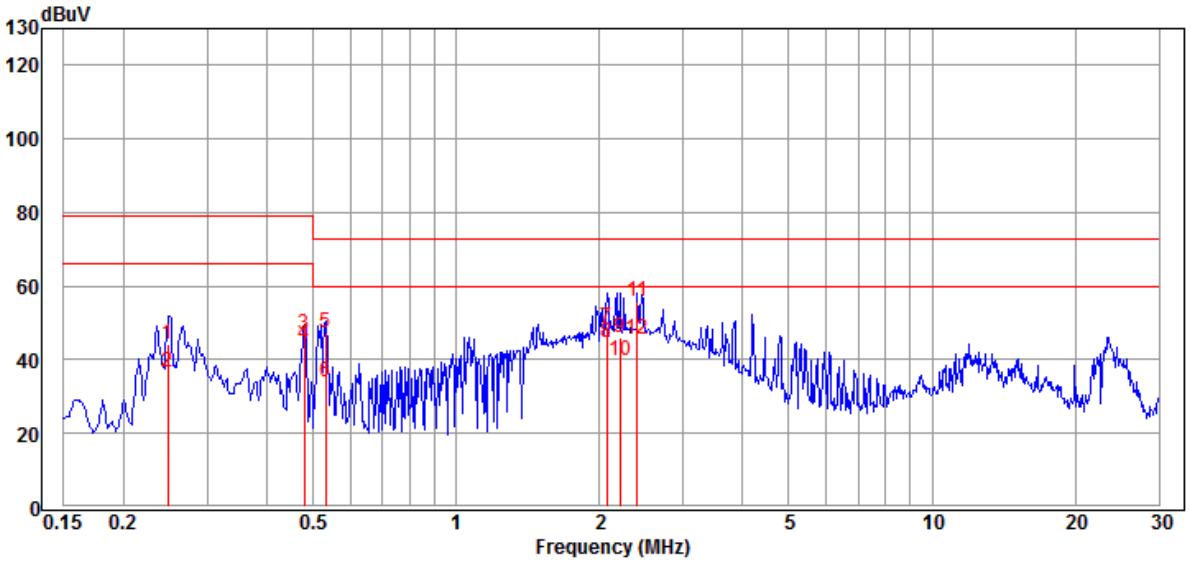


Item Mark	Freq. MHz	Reading dBuV	Factor dB	Level dBuV	Limit dBuV	Margin dB	Remark
1	0.2548	37.95	9.91	47.86	79.00	-31.14	QP
2	0.2548	34.15	9.91	44.06	66.00	-21.94	Average
3	0.4812	37.90	9.88	47.78	79.00	-31.22	QP
4	0.4812	31.42	9.88	41.30	66.00	-24.70	Average
5	0.5293	36.17	9.88	46.05	73.00	-26.95	QP
6	0.5293	33.59	9.88	43.47	60.00	-16.53	Average
7	1.4800	35.69	9.93	45.62	73.00	-27.38	QP
8	1.4800	21.04	9.93	30.97	60.00	-29.03	Average
9	2.0770	43.64	9.93	53.57	73.00	-19.43	QP
10	2.0770	32.78	9.93	42.71	60.00	-17.29	Average
11	2.4090	44.14	9.96	54.10	73.00	-18.90	QP
12	2.4090	27.03	9.96	36.99	60.00	-23.01	Average

CLIENT: GE MULTILIN
EUT: Substation Gateway
MODEL: G100
RATING: DC 48 V
COMMENT: Test Mode: Mode 3: Working Mode (DC48 V)

OPERATOR: Albert
TEST SITE: Conducted 1
POLARIZATION: Neutral
TEMP/HUM: 22.5°C / 43%

Data:20 2021-03-16



Item Mark	Freq. MHz	Reading dBuV	Factor dB	Level dBuV	Limit dBuV	Margin dB	Remark
1	0.2481	34.18	9.89	44.07	79.00	-34.93	QP
2	0.2481	26.79	9.89	36.68	66.00	-29.32	Average
3	0.4812	37.22	9.86	47.08	79.00	-31.92	QP
4	0.4812	34.52	9.86	44.38	66.00	-21.62	Average
5	0.5322	37.66	9.86	47.52	73.00	-25.48	QP
6	0.5322	24.21	9.86	34.07	60.00	-25.93	Average
7	2.0770	38.78	9.89	48.67	73.00	-24.33	QP
8	2.0770	34.70	9.89	44.59	60.00	-15.41	Average
9	2.2130	35.98	9.90	45.88	73.00	-27.12	QP
10	2.2130	29.80	9.90	39.70	60.00	-20.30	Average
11	2.4090	45.91	9.91	55.82	73.00	-17.18	QP
12	2.4090	35.71	9.91	45.62	60.00	-14.38	Average

Front View (For CISPR 11)

Rear View (For CISPR 11)

Front View (For CISPR 32)

Rear View (For CISPR 32)

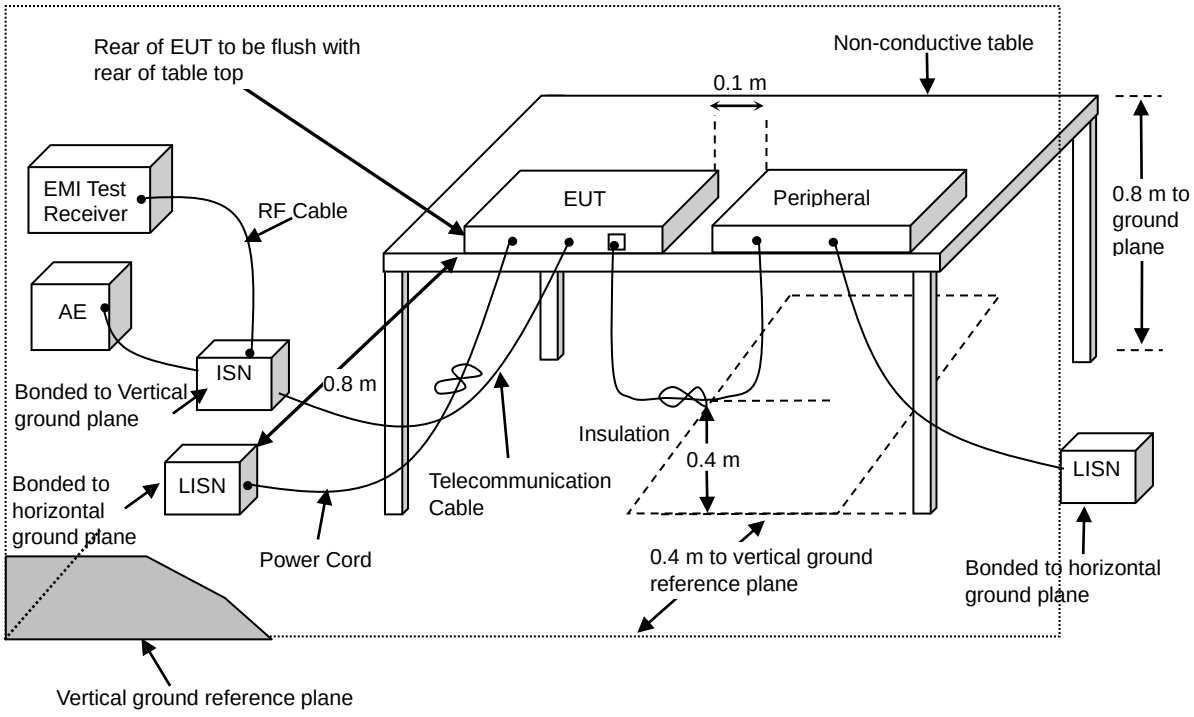
3 Asymmetric Mode Conducted Emission (Wired Network Ports) (CISPR 32)

3.1 Instrument

Instrument	Manufacturer	Model	Serial No.	Next Cal. Date
EMI Test Receiver	Rohde & Schwarz	ESCS 30	100127	2021/11/17
RF Cable	IETC	CBL68	CBL68	2022/01/22
Pulse Limiter	R&S	ESH3-Z2	8360836/026	2022/01/22
L.I.S.N.	Schwarzbeck	NNLK8121	8121417	2022/03/08
L.I.S.N.	Schaffner	MN2050D	1598	2021/08/04
ISN	TESEQ GmbH	ISN T800	39144	2022/03/14
Measurement Software	AUDIX-e3			

Note: The above equipments are within the valid calibration period.

3.2 Block Diagram of Test Configuration



3.3 Conducted Limit

☒ For Class A equipment

Coupling Device		Frequency Range (MHz)	Voltage Limits dB(μV)		Current Limits dB(μA)	
			Q.P. (Quasi-Peak)	A.V. (Average)	Q.P. (Quasi-Peak)	A.V. (Average)
☒	AAN	0.15 – 0.5	97 – 87	84 – 74	N/A	N/A
		0.5 – 30	87	74		
☐	Current Probe	0.15 – 0.5	N/A	N/A	53 – 43	40 – 30
		0.5 – 30			43	30

☐ For Class B equipment

Coupling Device		Frequency Range (MHz)	Voltage Limits dB(μV)		Current Limits dB(μA)	
			Q.P. (Quasi-Peak)	A.V. (Average)	Q.P. (Quasi-Peak)	A.V. (Average)
☐	AAN	0.15 – 0.5	84 – 74	74 – 64	N/A	N/A
		0.5 – 30	74	64		
☐	Current Probe	0.15 – 0.5	N/A	N/A	40 – 30	30 – 20
		0.5 – 30			30	20

3.4 Instrument Configuration

3.4.1 Set the EMI test receiver frequency range from 150 kHz to 30 MHz.

3.4.2 Set the EMI test receiver bandwidth at 9 kHz.

3.4.3 Set the EMI test receiver detector as Quasi-Peak (Q.P.) and Average (AV).

3.5 Configuration of Measurement

Measurement procedure using an AAN:

3.5.1 Measurement is made at wired network ports using AANs with longitudinal conversion losses as defined in EN 55032 Table C.2. The AAN for the cable category specified by the equipment documentation provided to the user shall be used. The level of emissions from the EUT shall not exceed the applicable limits of EN 55032 Annex A.

3.5.2 When emission voltage measurements are performed, the AAN shall provide a voltage measurement port suitable for connection to a measuring receiver while simultaneously satisfying the analogue/digital data port common mode termination impedance requirements.

3.5.3 For unscreened cables containing balanced pairs, an AAN conforming to EN 55032 C.4.1.2 shall be used. The LCL values of the AAN shall be within the tolerance given in EN 55032 Table C.2 for an AAN appropriate to the cable category connected to the EUT. The procedure shall be as follows:

a) Arrange the EUT, local AE and associated cabling (examples are given EN 55032 Annex D);

b) Measure the voltage at the measurement port of the AAN;

c) Correct the measured voltage by adding the AAN voltage division factor (V_{vdf}) defined in EN 55032 C.4.1.2 e);

d) Compare the corrected voltage with the limit.

Measurement procedure using a combination of current probe:

3.5.4 Arrange the EUT, local AE and associated cabling, generally as shown in EN 55032 Figure D.4 or EN 55032 Figure D.5, replacing the CVP in EN 55032 Figure D.4 by a 150 Ω adaptor. The current probe to EUT horizontal distance may be increased to 0.8 m. Alternatively in EN 55032 Figure D.5, the AAN shall be replaced by the 150 Ω adaptor/current probe combination.

3.5.5 Break the external protective insulation (exposing the shield) and connect a 150 Ω resistor with a physical connection between the cable screen and the RGP. The 150 Ω resistor shall be ≤0.3 m from the outside surface of the screen to ground. For further information refer to EN 55032 G.2.5.

3.5.6 Insert a ferrite tube or clamp between the 150 Ω connection and the AE.

3.5.7 Measure the current with a current probe and compare to the current limit. Use the procedure given in EN 55032 C.4.1.7 to measure the asymmetric common mode impedance from the 150 Ω resistor towards the AE, which should be much greater than 150 Ω so as not to affect the measurement at frequencies emitted by the EUT.

3.5.8 The separation distance between the AE and the ground plane is not critical if the impedance of the ferrite is higher than that given in EN 55032 G.2.5. If this cannot be achieved, then the AE shall be placed at 0.4 m from a vertical or horizontal RGP, as defined for the EUT in Table EN 55032 D.2.

3.6 Test Result

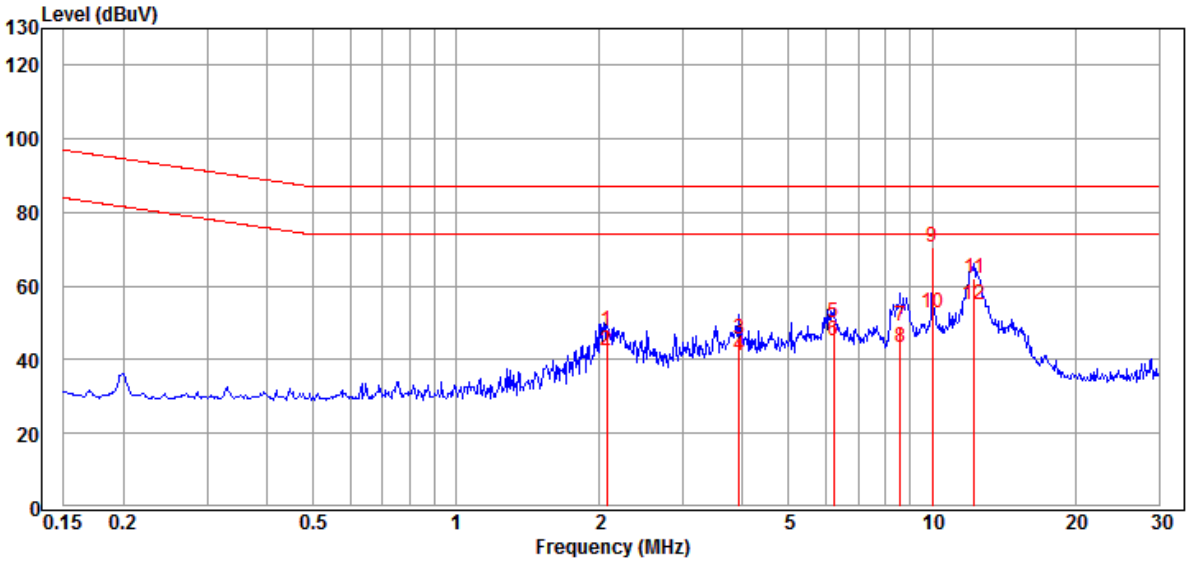
PASS.

The final test data is shown as following pages.

Factor = Insertion Loss + Cable Loss
Level = Reading + Factor
Margin = Level - Limit

CLIENT: GE MULTILIN
EUT: Substation Gateway
MODEL: G100
RATING: DC 24 V
OPERATOR: Albert
TEST SITE: Conducted 1
POLARIZATION: ISN
TEMP/HUM: 22.5°C / 43%
COMMENT: Test Mode: Mode 2: Working Mode (DC 24 V) (Ethernet copper (LAN 1) Speed: 10 Mbps)

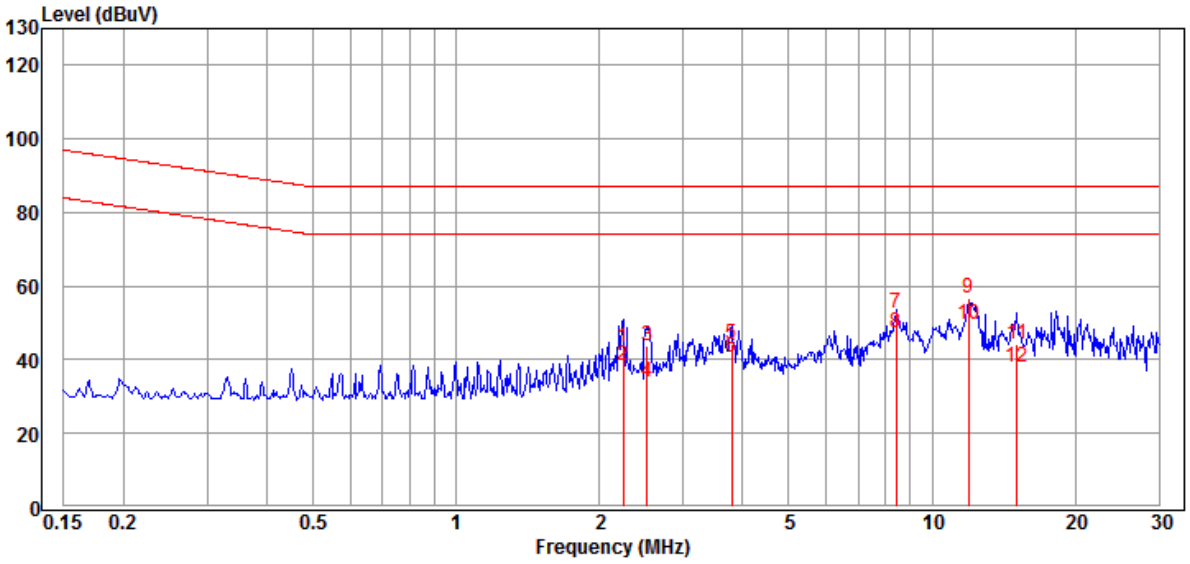
Data:36
2021-05-26



Item Mark	Freq. MHz	Reading dBuV	Factor dB	Level dBuV	Limit dBuV	Margin dB	Remark
1	2.0770	28.24	19.41	47.65	87.00	-39.35	QP
2	2.0770	23.09	19.41	42.50	74.00	-31.50	Average
3	3.9430	26.11	19.43	45.54	87.00	-41.46	QP
4	3.9430	21.69	19.43	41.12	74.00	-32.88	Average
5	6.2190	30.35	19.49	49.84	87.00	-37.16	QP
6	6.2190	25.67	19.49	45.16	74.00	-28.84	Average
7	8.5920	29.49	19.55	49.04	87.00	-37.96	QP
8	8.5920	23.68	19.55	43.23	74.00	-30.77	Average
9	10.0190	50.97	19.58	70.55	87.00	-16.45	QP
10	10.0190	33.03	19.58	52.61	74.00	-21.39	Average
11	12.2530	42.66	19.64	62.30	87.00	-24.70	QP
12	12.2530	35.33	19.64	54.97	74.00	-19.03	Average

CLIENT: GE MULTILIN
EUT: Substation Gateway
MODEL: G100
RATING: DC 24 V
OPERATOR: Albert
TEST SITE: Conducted 1
POLARIZATION: ISN
TEMP/HUM: 22.5°C / 43%
COMMENT: Test Mode: Mode 2: Working Mode (DC 24 V) (Ethernet copper (LAN 1) Speed: 100 Mbps)

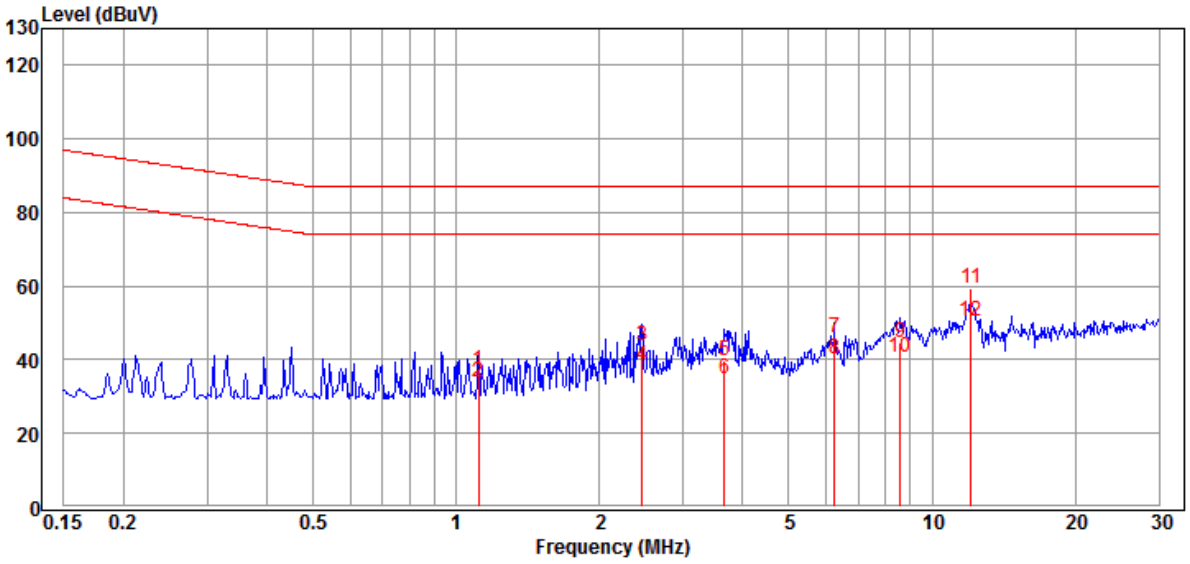
Data:35 2021-05-26



Item Mark	Freq. MHz	Reading dBuV	Factor dB	Level dBuV	Limit dBuV	Margin dB	Remark
1	2.2490	23.96	19.41	43.37	87.00	-43.63	QP
2	2.2490	18.95	19.41	38.36	74.00	-35.64	Average
3	2.5270	24.29	19.42	43.71	87.00	-43.29	QP
4	2.5270	14.66	19.42	34.08	74.00	-39.92	Average
5	3.7990	24.75	19.43	44.18	87.00	-42.82	QP
6	3.7990	21.01	19.43	40.44	74.00	-33.56	Average
7	8.4120	33.13	19.54	52.67	87.00	-34.33	QP
8	8.4120	27.62	19.54	47.16	74.00	-26.84	Average
9	11.9330	37.06	19.63	56.69	87.00	-30.31	QP
10	11.9330	30.05	19.63	49.68	74.00	-24.32	Average
11	15.0660	24.66	19.69	44.35	87.00	-42.65	QP
12	15.0660	18.27	19.69	37.96	74.00	-36.04	Average

CLIENT: GE MULTILIN
EUT: Substation Gateway
MODEL: G100
RATING: DC 24 V
OPERATOR: Albert
TEST SITE: Conducted 1
POLARIZATION: ISN
TEMP/HUM: 22.5°C / 43%
COMMENT: Test Mode: Mode 2: Working Mode (DC 24 V) (Ethernet copper (LAN 1) Speed: 1 Gbps)

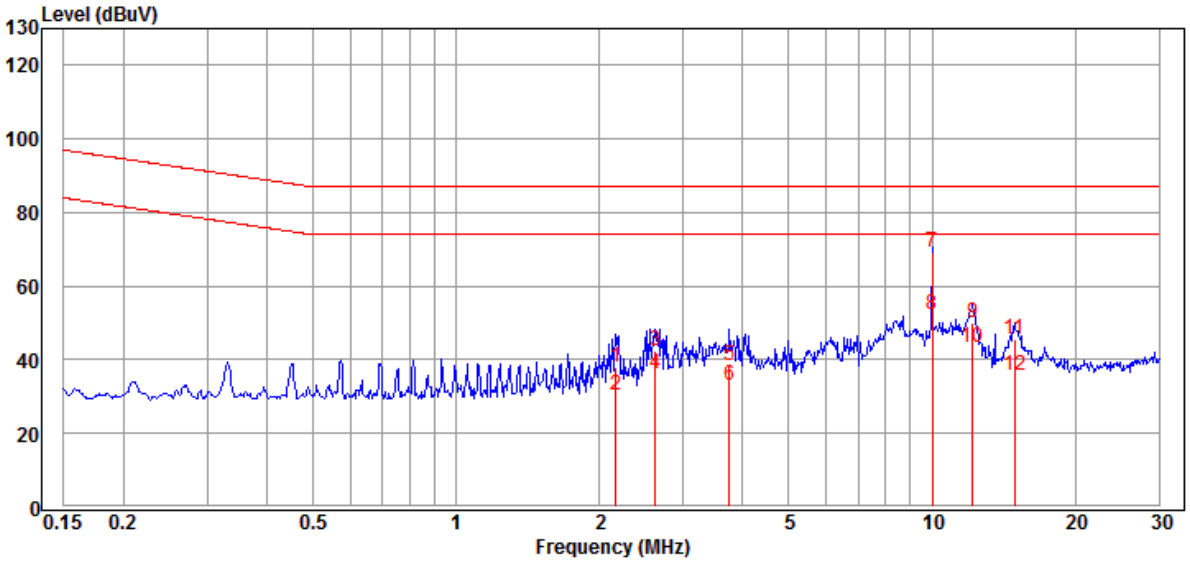
Data:34 2021-05-26



Item Mark	Freq. MHz	Reading dBuV	Factor dB	Level dBuV	Limit dBuV	Margin dB	Remark
1	1.1170	17.73	19.45	37.18	87.00	-49.82	QP
2	1.1170	14.64	19.45	34.09	74.00	-39.91	Average
3	2.4610	24.40	19.42	43.82	87.00	-43.18	QP
4	2.4610	18.99	19.42	38.41	74.00	-35.59	Average
5	3.6610	20.12	19.43	39.55	87.00	-47.45	QP
6	3.6610	15.37	19.43	34.80	74.00	-39.20	Average
7	6.2520	26.58	19.49	46.07	87.00	-40.93	QP
8	6.2520	20.90	19.49	40.39	74.00	-33.61	Average
9	8.5920	25.05	19.55	44.60	87.00	-42.40	QP
10	8.5920	21.19	19.55	40.74	74.00	-33.26	Average
11	12.0600	39.68	19.63	59.31	87.00	-27.69	QP
12	12.0600	30.79	19.63	50.42	74.00	-23.58	Average

CLIENT: GE MULTILIN
EUT: Substation Gateway
MODEL: G100
RATING: DC 24 V
OPERATOR: Albert
TEST SITE: Conducted 1
POLARIZATION: ISN
TEMP/HUM: 22.5°C / 43%
COMMENT: Test Mode: Mode 2: Working Mode (DC 24 V) (Ethernet copper (LAN 2) Speed: 10 Mbps)

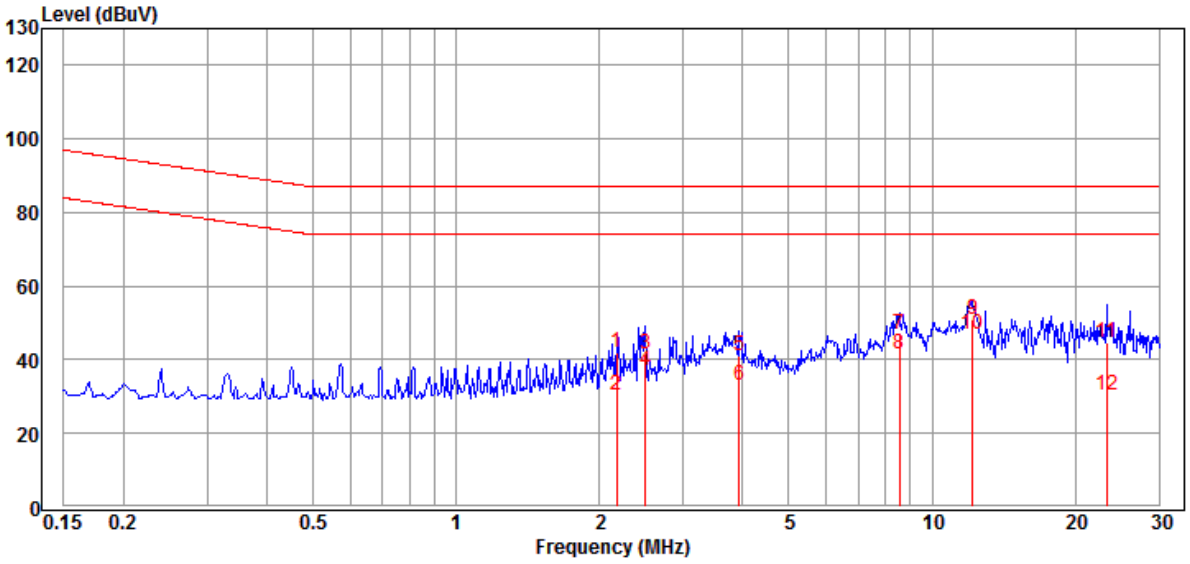
Data:39 2021-05-26



Item Mark	Freq. MHz	Reading dBuV	Factor dB	Level dBuV	Limit dBuV	Margin dB	Remark
1	2.1670	18.33	19.42	37.75	87.00	-49.25	QP
2	2.1670	10.75	19.42	30.17	74.00	-43.83	Average
3	2.6220	23.20	19.42	42.62	87.00	-44.38	QP
4	2.6220	16.58	19.42	36.00	74.00	-38.00	Average
5	3.7590	19.13	19.43	38.56	87.00	-48.44	QP
6	3.7590	13.52	19.43	32.95	74.00	-41.05	Average
7	10.0190	49.85	19.58	69.43	87.00	-17.57	QP
8	10.0190	32.84	19.58	52.42	74.00	-21.58	Average
9	12.1880	30.30	19.63	49.93	87.00	-37.07	QP
10	12.1880	23.58	19.63	43.21	74.00	-30.79	Average
11	14.9070	25.94	19.68	45.62	87.00	-41.38	QP
12	14.9070	16.21	19.68	35.89	74.00	-38.11	Average

CLIENT: GE MULTILIN
EUT: Substation Gateway
MODEL: G100
RATING: DC 24 V
OPERATOR: Albert
TEST SITE: Conducted 1
POLARIZATION: ISN
TEMP/HUM: 22.5°C / 43%
COMMENT: Test Mode: Mode 2: Working Mode (DC 24 V) (Ethernet copper (LAN 2) Speed: 100 Mbps)

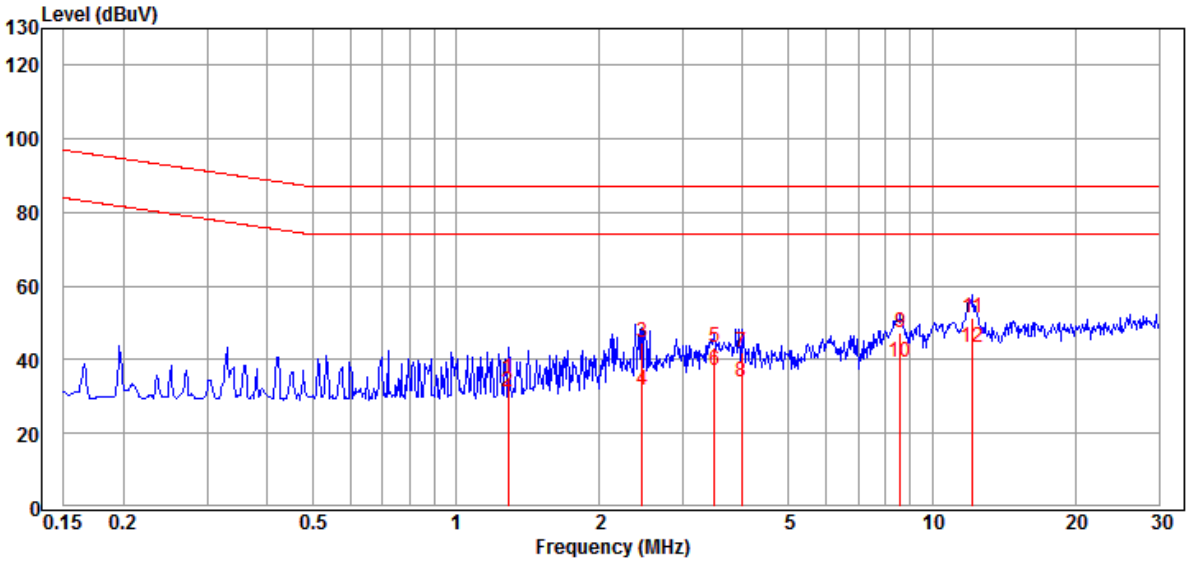
Data:38 2021-05-26



Item Mark	Freq. MHz	Reading dBuV	Factor dB	Level dBuV	Limit dBuV	Margin dB	Remark
1	2.1780	22.62	19.42	42.04	87.00	-44.96	QP
2	2.1780	10.76	19.42	30.18	74.00	-43.82	Average
3	2.5000	22.22	19.42	41.64	87.00	-45.36	QP
4	2.5000	17.60	19.42	37.02	74.00	-36.98	Average
5	3.9430	21.50	19.43	40.93	87.00	-46.07	QP
6	3.9430	13.76	19.43	33.19	74.00	-40.81	Average
7	8.5460	27.56	19.55	47.11	87.00	-39.89	QP
8	8.5460	22.17	19.55	41.72	74.00	-32.28	Average
9	12.1880	31.28	19.63	50.91	87.00	-36.09	QP
10	12.1880	27.30	19.63	46.93	74.00	-27.07	Average
11	23.2630	24.70	19.91	44.61	87.00	-42.39	QP
12	23.2630	10.40	19.91	30.31	74.00	-43.69	Average

CLIENT: GE MULTILIN
EUT: Substation Gateway
MODEL: G100
RATING: DC 24 V
OPERATOR: Albert
TEST SITE: Conducted 1
POLARIZATION: ISN
TEMP/HUM: 22.5°C / 43%
COMMENT: Test Mode: Mode 2: Working Mode (DC 24 V) (Ethernet copper (LAN 2) Speed: 1 Gbps)

Data:37 2021-05-26



Item Mark	Freq. MHz	Reading dBuV	Factor dB	Level dBuV	Limit dBuV	Margin dB	Remark
1	1.2890	15.61	19.44	35.05	87.00	-51.95	QP
2	1.2890	11.94	19.44	31.38	74.00	-42.62	Average
3	2.4610	25.14	19.42	44.56	87.00	-42.44	QP
4	2.4610	12.51	19.42	31.93	74.00	-42.07	Average
5	3.4910	23.81	19.43	43.24	87.00	-43.76	QP
6	3.4910	17.67	19.43	37.10	74.00	-36.90	Average
7	3.9850	22.56	19.43	41.99	87.00	-45.01	QP
8	3.9850	14.66	19.43	34.09	74.00	-39.91	Average
9	8.5920	27.71	19.55	47.26	87.00	-39.74	QP
10	8.5920	19.82	19.55	39.37	74.00	-34.63	Average
11	12.1880	31.64	19.63	51.27	87.00	-35.73	QP
12	12.1880	23.70	19.63	43.33	74.00	-30.67	Average

4 Radiated Emission (Below 1 GHz) (CISPR 11 / CISPR 32)

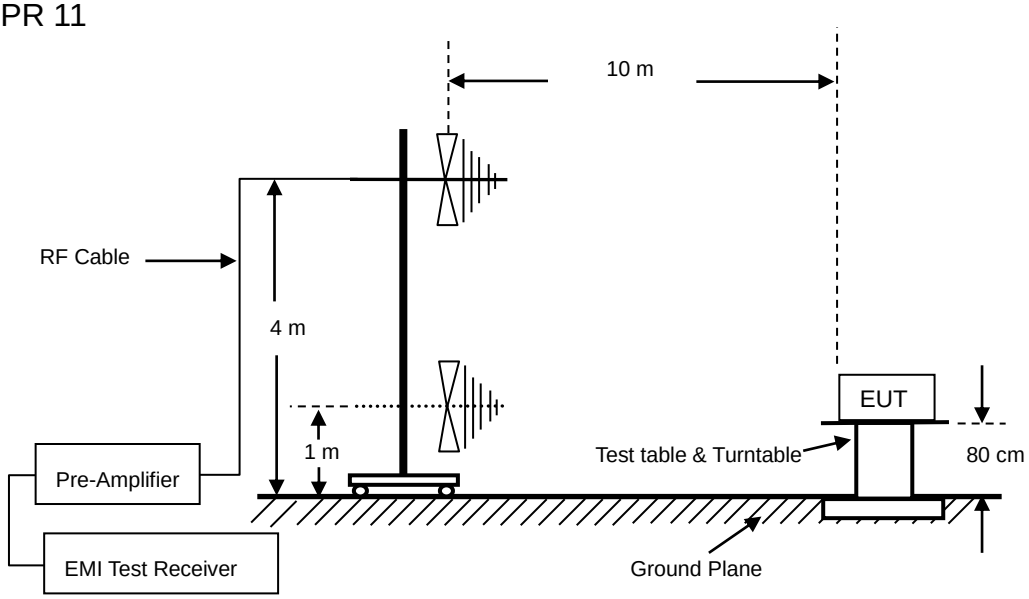
4.1 Instrument

Instrument	Manufacturer	Model	Serial No.	Next Cal. Date
EMI Test Receiver	Rohde & Schwarz	ESCS30	830245/027	2021/06/03
Biconical Antenna	Schwarzbeck	VHA 9103 & BBA 9106	VHA 9103-2418	2021/08/09
Log Antenna	Schwarzbeck	UHALP 9108-A	9108-A 0739	2021/08/09
Pre-Amplifier	Agilent	8447D	2944A09703	2022/01/22
RF Cable	EMCI	EMC8D-NM-NM-25000	140105	2022/01/22
RF Cable	Mini-Circuits	CBL-3FL-NMNM	CBL56	2022/01/22
Measurement Software	AUDIX-e3			

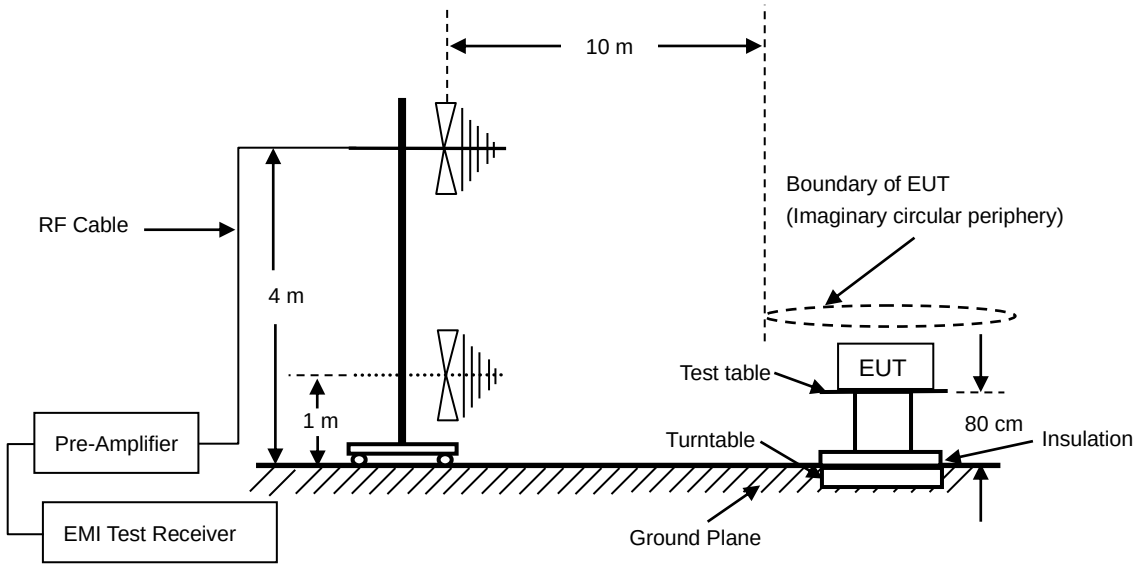
Note: The above equipments are within the valid calibration period.

4.2 Block Diagram of Test Configuration

For CISPR 11



For CISPR 32



4.3 Radiated Limits

CISPR 11

Frequency (MHz)	☒ Group 1, Class A		☐ Group 1, Class B
	☒ Rated input power of ≤ 20 kVA	☐ Rated input power of > 20 kVA	
	Quasi-Peak dB(μV/m)	Quasi-Peak dB(μV/m)	Quasi-Peak dB(μV/m)
30 ~ 230	40.0	50.0	30.0
230 ~ 1000	47.0	50.0	37.0

CISPR 32

Frequency (MHz)	☒ Class A	☐ Class B
	Quasi-Peak dB(μV/m)	Quasi-Peak dB(μV/m)
30 to 230	40.0	30.0
230 to 1000	47.0	37.0

4.4 Instrument Configuration

4.4.1 Set the EMI test receiver frequency range from 30 MHz to 1000 MHz.

4.4.2 Set the EMI test receiver bandwidth at 120 kHz.

4.4.3 Set the EMI test receiver detector as Quasi-Peak (Q.P.).

4.5 Configuration of Measurement

4.5.1 The EUT was placed on a non-conductive table whose total height equaled 80 cm. The turntable can rotate 360 degree to determine the position of the maximum emission level.

4.5.2 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 the calibration point of the antenna. The antenna can move up and down between 1 to 4 meters to find out the maximum emission level.

4.5.3 The initial testing identified the frequency that has the highest disturbance relative to the limit while operating the EUT in typical modes of operation and cable positions in a test setup representative of typical system configuration.

4.5.4 The identification of the frequency of highest emission with respect to the limit was found by investigating emissions at a number of significant frequencies. The probable frequency of maximum emission had been found and that the associated cable and EUT configuration and mode of operation had been identified.

4.6 Test Result

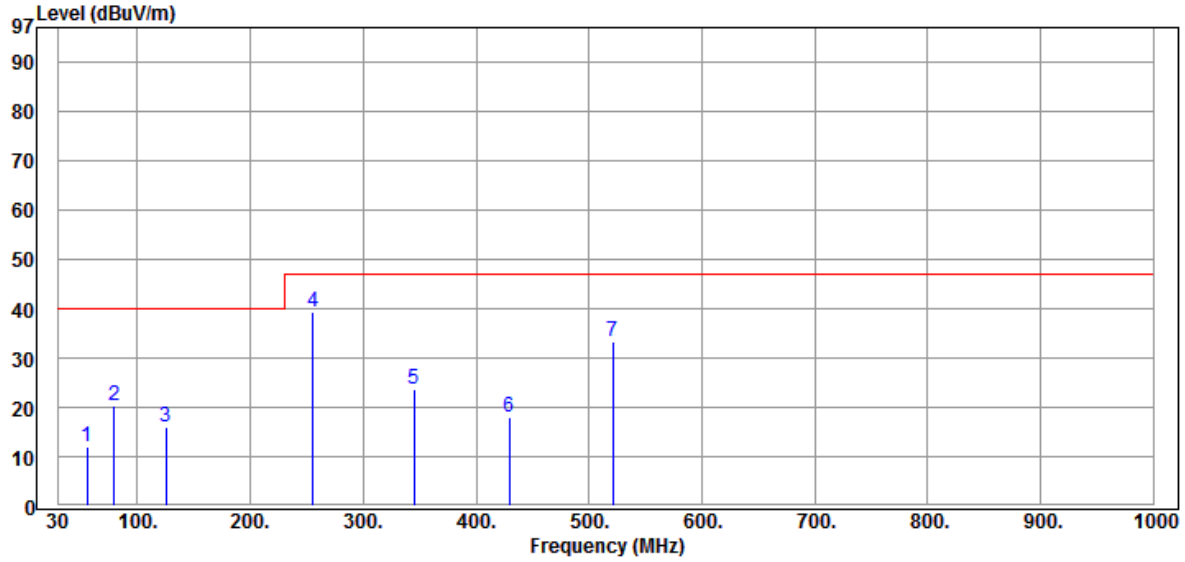
PASS.

The final test data is shown as following pages.

Factor = Antenna Factor + Cable Loss - Preamplifier Gain
Level = Reading + Factor
Margin = Level - Limit

CLIENT: GE MULTILIN	OPERATOR : Albert
EUT: Substation Gateway	TEST SITE : OATS 1
MODEL: G100	TEST DISTANCE : 10 m
RATING: DC 12 V	POLARIZATION : HORIZONTAL
COMMENT: Test Mode: Mode 1: Working Mode (DC 12 V) (For CISPR 11)	TEMP/HUM : 23.3℃/ 57%

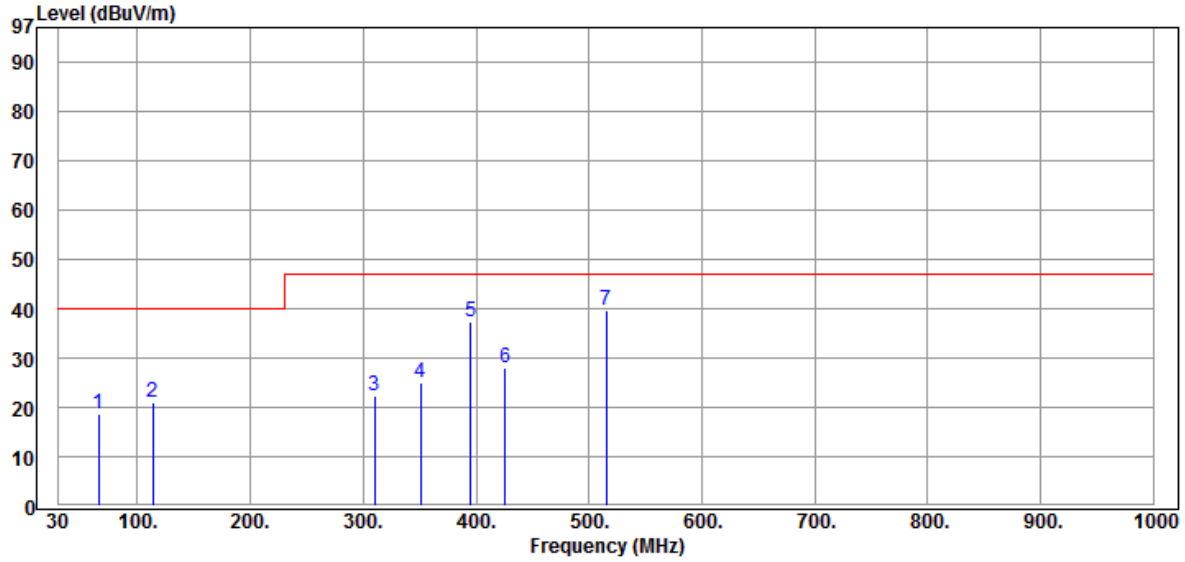
Data:20 2021-03-19



Item Mark	Freq. MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark
1	55.626	32.41	-20.34	12.07	40.00	-27.93	QP
2	79.415	42.79	-22.53	20.26	40.00	-19.74	QP
3	125.215	31.49	-15.39	16.10	40.00	-23.90	QP
4	255.278	48.76	-9.55	39.21	47.00	-7.79	QP
5	345.169	36.29	-12.67	23.62	47.00	-23.38	QP
6	429.574	27.61	-9.53	18.08	47.00	-28.92	QP
7	521.190	41.28	-8.03	33.25	47.00	-13.75	QP

CLIENT: GE MULTILIN	OPERATOR : Albert
EUT: Substation Gateway	TEST SITE : OATS 1
MODEL: G100	TEST DISTANCE : 10 m
RATING: DC 12 V	POLARIZATION : VERTICAL
COMMENT: Test Mode: Mode 1: Working Mode (DC 12 V) (For CISPR 11)	TEMP/HUM : 23.3℃/ 57%

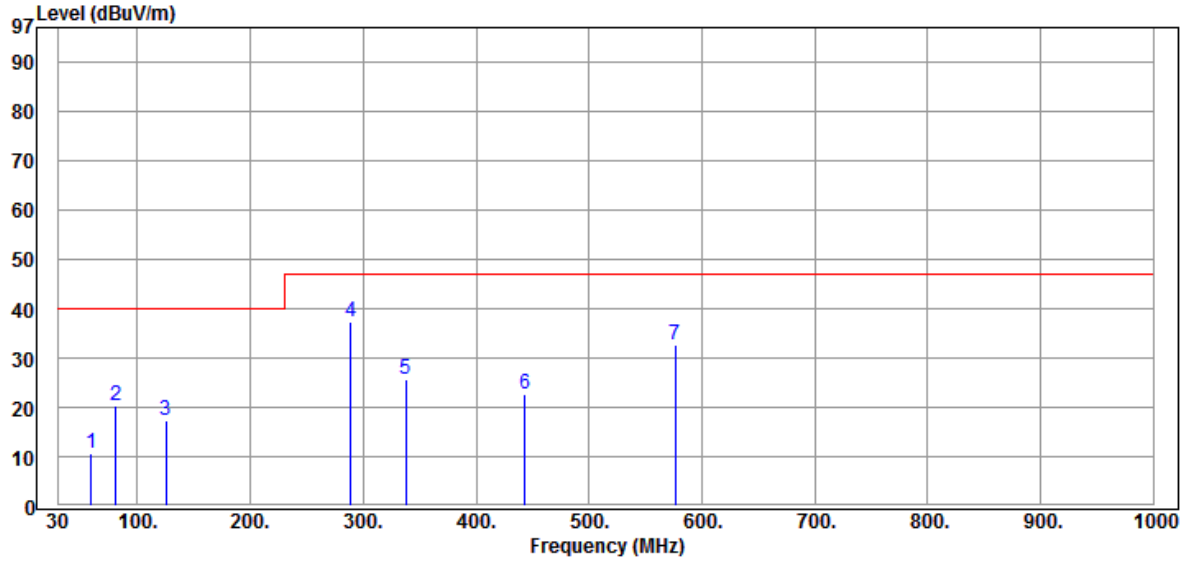
Data:19 2021-03-19



Item Mark	Freq. MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark
1	65.350	40.84	-22.17	18.67	40.00	-21.33	QP
2	113.684	37.55	-16.59	20.96	40.00	-19.04	QP
3	310.148	35.34	-13.04	22.30	47.00	-24.70	QP
4	351.164	37.66	-12.52	25.14	47.00	-21.86	QP
5	395.359	48.27	-10.82	37.45	47.00	-9.55	QP
6	425.523	37.51	-9.56	27.95	47.00	-19.05	QP
7	515.652	47.66	-8.13	39.53	47.00	-7.47	QP

CLIENT: GE MULTILIN	OPERATOR : Albert
EUT: Substation Gateway	TEST SITE : OATS 1
MODEL: G100	TEST DISTANCE : 10 m
RATING: DC 24 V	POLARIZATION : HORIZONTAL
COMMENT: Test Mode: Mode 2: Working Mode (DC 24 V) (For CISPR 11)	TEMP/HUM : 23.3℃/ 57%

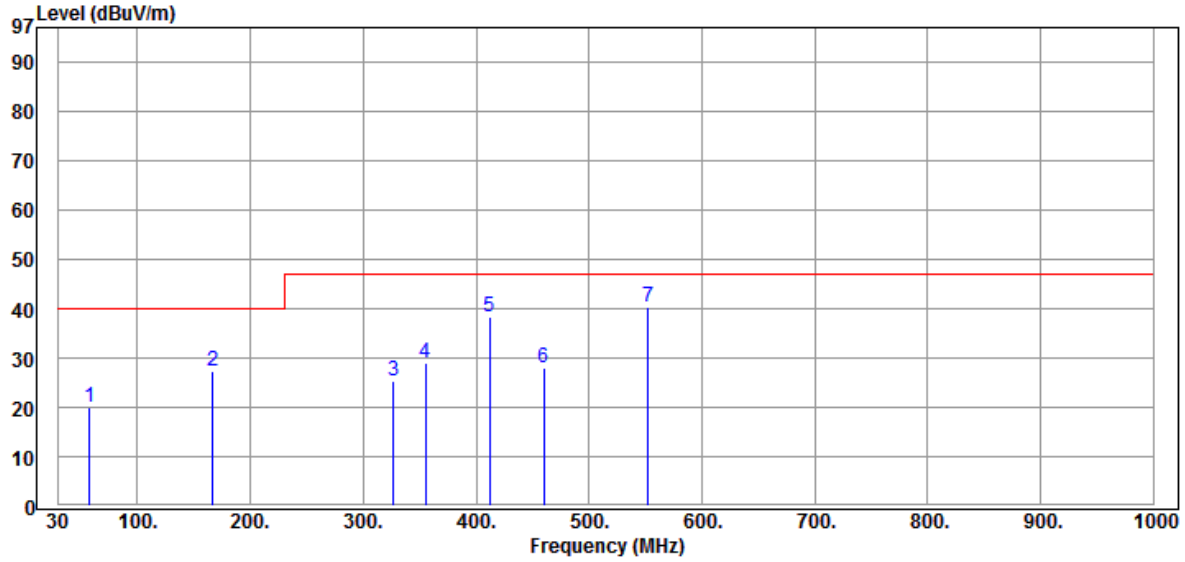
Data:21 2021-03-19



Item Mark	Freq. MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark
1	59.362	32.04	-21.30	10.74	40.00	-29.26	QP
2	81.060	42.70	-22.38	20.32	40.00	-19.68	QP
3	125.178	32.84	-15.39	17.45	40.00	-22.55	QP
4	288.741	45.24	-7.75	37.49	47.00	-9.51	QP
5	337.792	38.35	-12.84	25.51	47.00	-21.49	QP
6	443.521	31.98	-9.41	22.57	47.00	-24.43	QP
7	576.485	39.07	-6.37	32.70	47.00	-14.30	QP

CLIENT: GE MULTILIN	OPERATOR : Albert
EUT: Substation Gateway	TEST SITE : OATS 1
MODEL: G100	TEST DISTANCE : 10 m
RATING: DC 24 V	POLARIZATION : VERTICAL
COMMENT: Test Mode: Mode 2: Working Mode (DC 24 V) (For CISPR 11)	TEMP/HUM : 23.3℃/ 57%

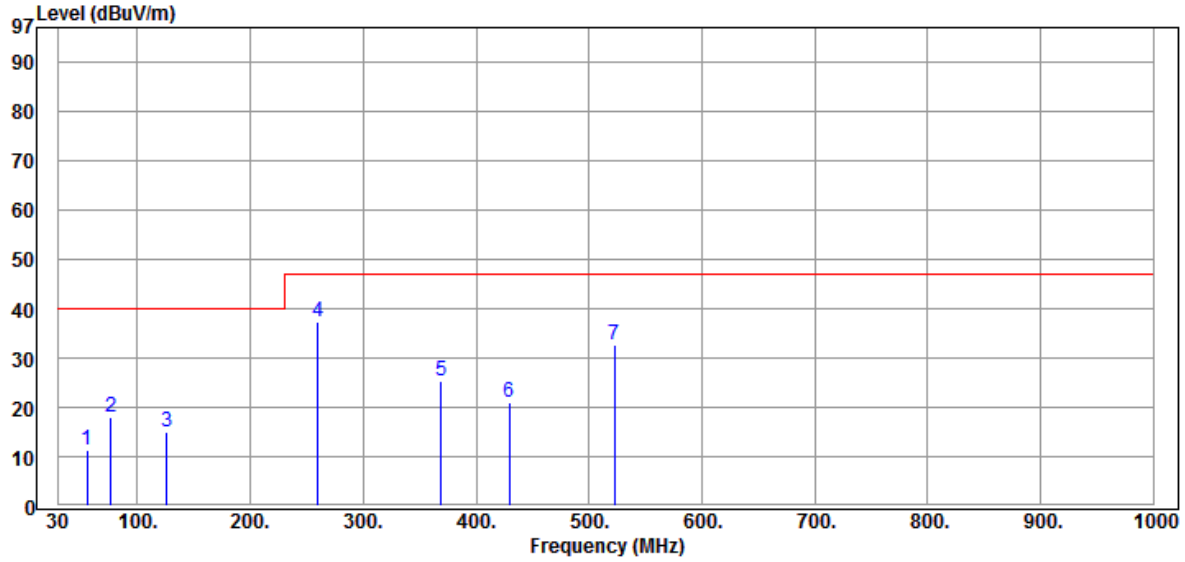
Data:22 2021-03-19



Item Mark	Freq. MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark
1	57.621	41.02	-20.86	20.16	40.00	-19.84	QP
2	167.065	40.36	-13.18	27.18	40.00	-12.82	QP
3	327.042	38.42	-13.11	25.31	47.00	-21.69	QP
4	355.175	41.25	-12.37	28.88	47.00	-18.12	QP
5	411.742	48.35	-10.13	38.22	47.00	-8.78	QP
6	459.743	37.18	-9.27	27.91	47.00	-19.09	QP
7	552.497	47.74	-7.28	40.46	47.00	-6.54	QP

CLIENT: GE MULTILIN	OPERATOR : Albert
EUT: Substation Gateway	TEST SITE : OATS 1
MODEL: G100	TEST DISTANCE : 10 m
RATING: DC 48 V	POLARIZATION : HORIZONTAL
COMMENT: Test Mode: Mode 3: Working Mode (DC 48 V) (For CISPR 11)	TEMP/HUM : 23.3℃/ 57%

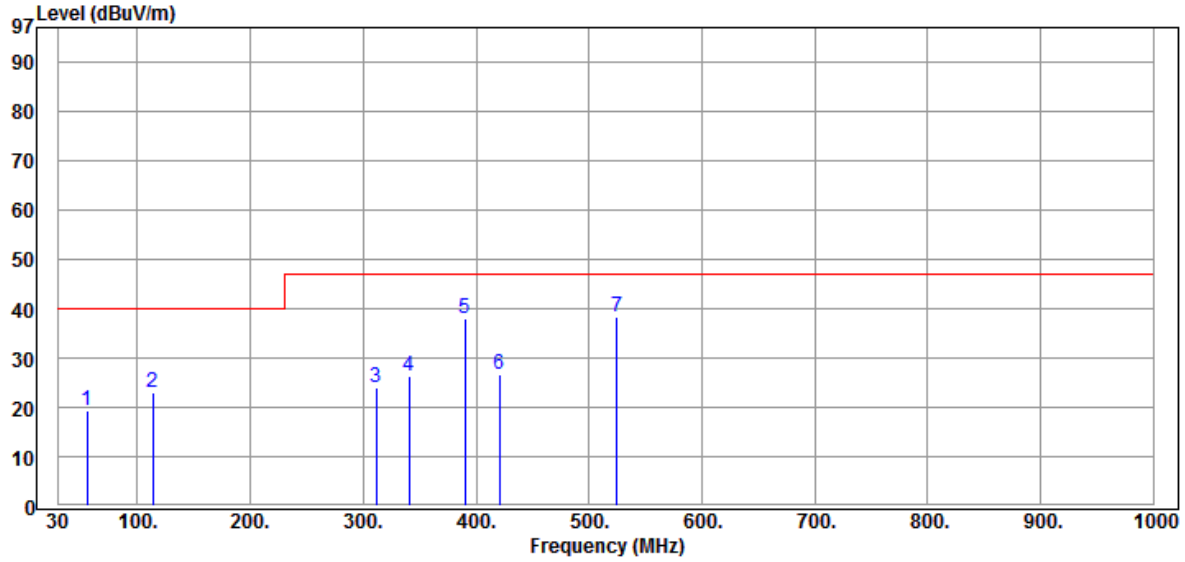
Data:23 2021-03-19



Item Mark	Freq. MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark
1	55.042	31.45	-20.19	11.26	40.00	-28.74	QP
2	76.165	40.64	-22.61	18.03	40.00	-21.97	QP
3	125.759	30.32	-15.35	14.97	40.00	-25.03	QP
4	259.651	47.01	-9.52	37.49	47.00	-9.51	QP
5	369.417	37.14	-11.89	25.25	47.00	-21.75	QP
6	429.612	30.65	-9.53	21.12	47.00	-25.88	QP
7	522.742	40.59	-8.01	32.58	47.00	-14.42	QP

CLIENT: GE MULTILIN	OPERATOR : Albert
EUT: Substation Gateway	TEST SITE : OATS 1
MODEL: G100	TEST DISTANCE : 10 m
RATING: DC 48 V	POLARIZATION : VERTICAL
COMMENT: Test Mode: Mode 3: Working Mode (DC 48 V) (For CISPR 11)	TEMP/HUM : 23.3℃/ 57%

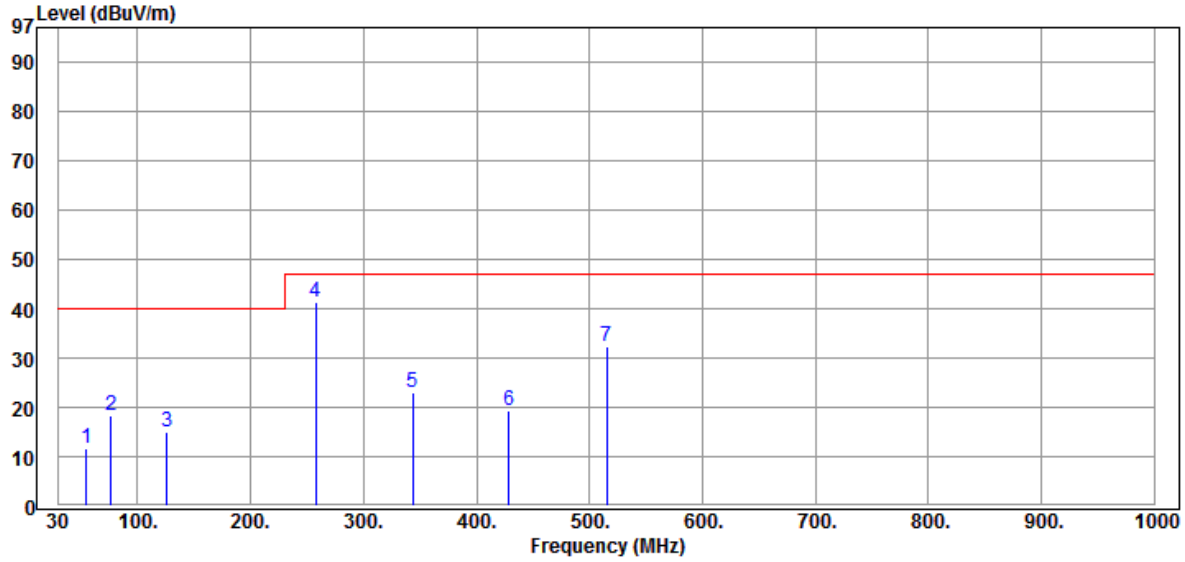
Data:24 2021-03-19



Item Mark	Freq. MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark
1	55.425	39.76	-20.29	19.47	40.00	-20.53	QP
2	113.758	39.43	-16.58	22.85	40.00	-17.15	QP
3	311.598	37.06	-13.04	24.02	47.00	-22.98	QP
4	340.598	39.16	-12.77	26.39	47.00	-20.61	QP
5	390.258	49.07	-11.04	38.03	47.00	-8.97	QP
6	420.896	36.35	-9.74	26.61	47.00	-20.39	QP
7	525.135	46.22	-7.97	38.25	47.00	-8.75	QP

CLIENT: GE MULTILIN	OPERATOR : Albert
EUT: Substation Gateway	TEST SITE : OATS 1
MODEL: G100	TEST DISTANCE : 10 m
RATING: DC 12 V	POLARIZATION : HORIZONTAL
COMMENT: Test Mode: Mode 1: Working Mode (DC 12 V) (For CISPR 32)	TEMP/HUM : 23.3℃/ 57%

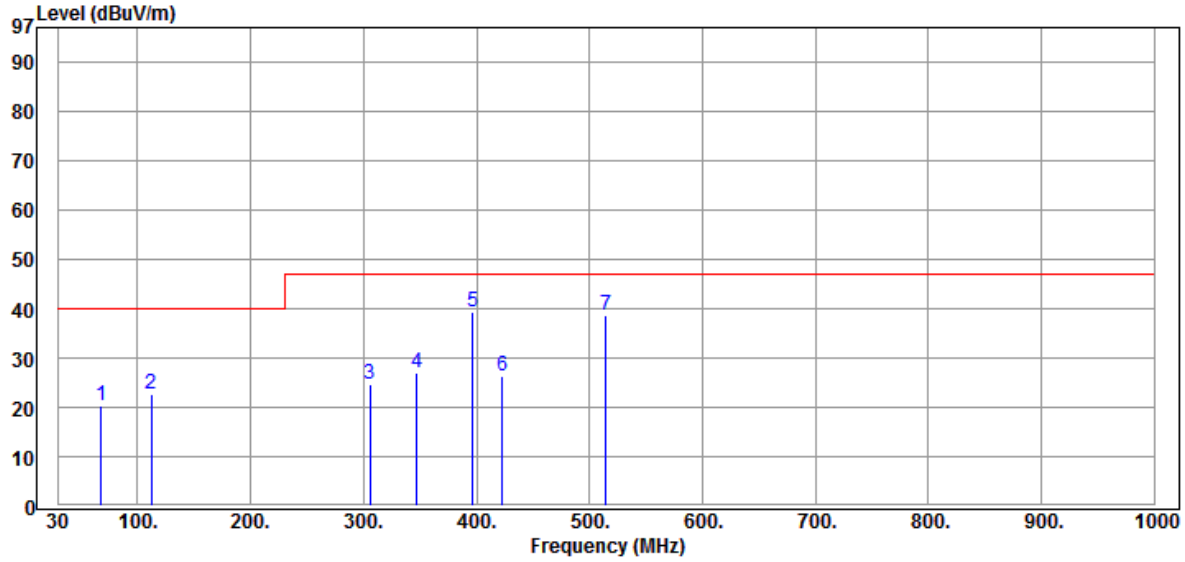
Data:4 2021-03-18



Item Mark	Freq. MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark
1	54.450	31.60	-20.04	11.56	40.00	-28.44	QP
2	76.250	40.90	-22.61	18.29	40.00	-21.71	QP
3	126.250	30.30	-15.32	14.98	40.00	-25.02	QP
4	257.750	50.79	-9.53	41.26	47.00	-5.74	QP
5	343.630	35.60	-12.70	22.90	47.00	-24.10	QP
6	428.730	28.90	-9.54	19.36	47.00	-27.64	QP
7	515.030	40.60	-8.14	32.46	47.00	-14.54	QP

CLIENT: GE MULTILIN	OPERATOR : Albert
EUT: Substation Gateway	TEST SITE : OATS 1
MODEL: G100	TEST DISTANCE : 10 m
RATING: DC 12 V	POLARIZATION : VERTICAL
COMMENT: Test Mode: Mode 1: Working Mode (DC12 V) (For CISPR 32)	TEMP/HUM : 23.3℃/ 57%

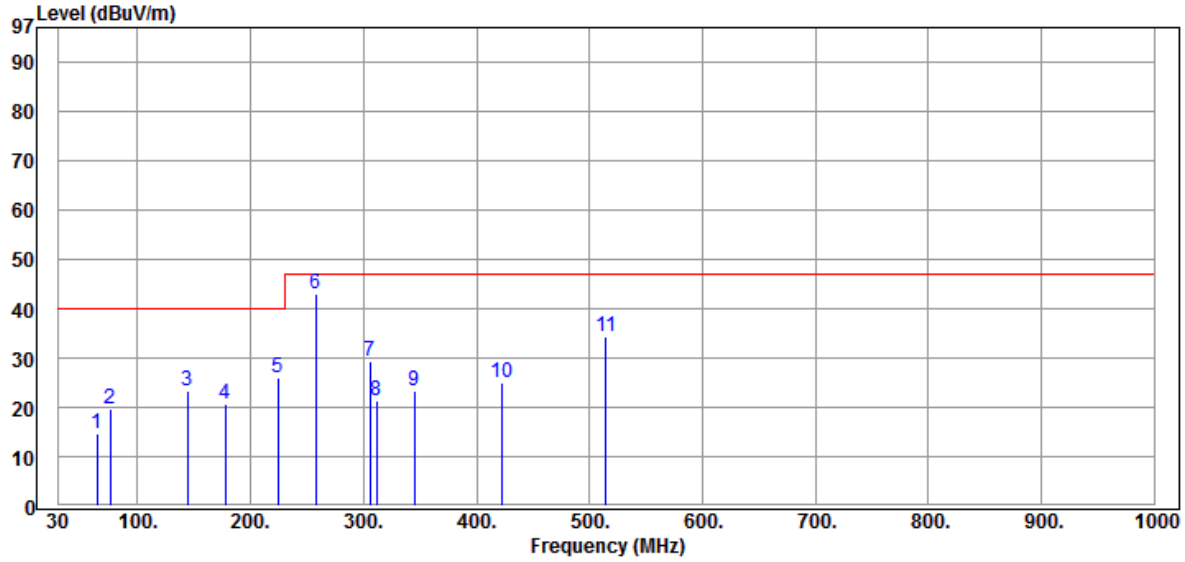
Data:3 2021-03-18



Item Mark	Freq. MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark
1	67.450	42.80	-22.45	20.35	40.00	-19.65	QP
2	112.450	39.40	-16.76	22.64	40.00	-17.36	QP
3	306.000	37.69	-13.00	24.69	47.00	-22.31	QP
4	347.300	39.51	-12.62	26.89	47.00	-20.11	QP
5	397.046	50.10	-10.75	39.35	47.00	-7.65	QP
6	423.000	36.00	-9.65	26.35	47.00	-20.65	QP
7	514.480	46.70	-8.15	38.55	47.00	-8.45	QP

CLIENT: GE MULTILIN	OPERATOR : Albert
EUT: Substation Gateway	TEST SITE : OATS 1
MODEL: G100	TEST DISTANCE : 10 m
RATING: DC 24 V	POLARIZATION : HORIZONTAL
COMMENT: Test Mode: Mode 2: Working Mode (DC 24 V) (For CISPR 32)	TEMP/HUM : 23.3℃/ 57%

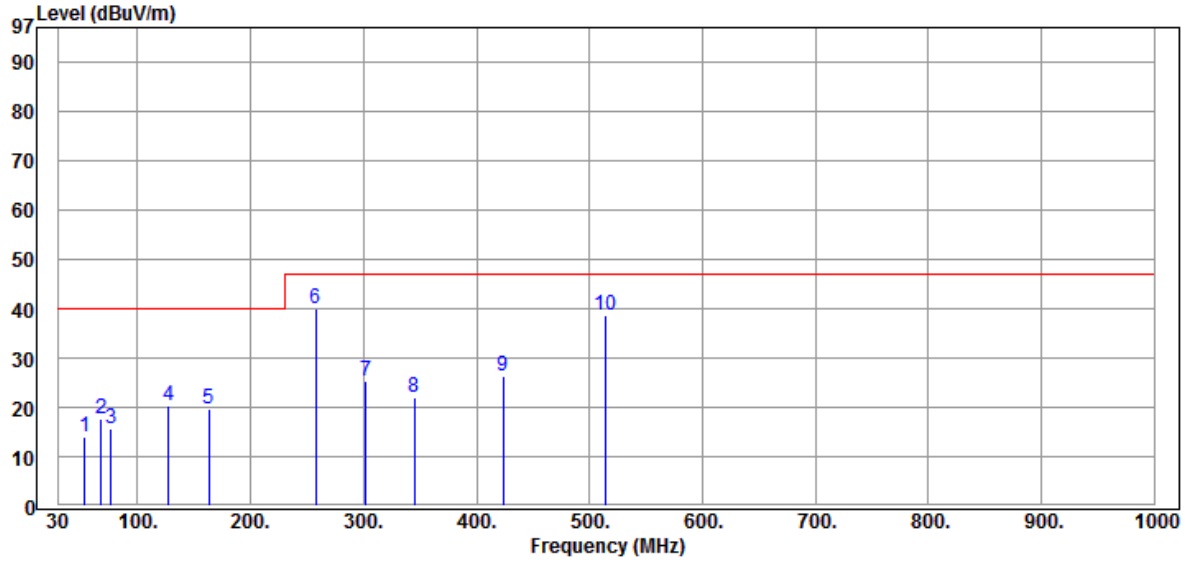
Data:2 2021-03-18



Item Mark	Freq. MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark
1	63.880	36.49	-21.97	14.52	40.00	-25.48	QP
2	75.730	42.20	-22.63	19.57	40.00	-20.43	QP
3	143.930	37.60	-14.33	23.27	40.00	-16.73	QP
4	177.430	33.21	-12.64	20.57	40.00	-19.43	QP
5	224.330	36.30	-10.22	26.08	40.00	-13.92	QP
6	257.560	52.39	-9.53	42.86	47.00	-4.14	QP
7	305.400	42.20	-13.00	29.20	47.00	-17.80	QP
8	311.380	34.30	-13.05	21.25	47.00	-25.75	QP
9	344.800	36.10	-12.67	23.43	47.00	-23.57	QP
10	422.000	34.79	-9.69	25.10	47.00	-21.90	QP
11	514.900	42.50	-8.14	34.36	47.00	-12.64	QP

CLIENT: GE MULTILIN	OPERATOR : Albert
EUT: Substation Gateway	TEST SITE : OATS 1
MODEL: G100	TEST DISTANCE : 10 m
RATING: DC 24 V	POLARIZATION : VERTICAL
COMMENT: Test Mode: Mode 2: Working Mode (DC 24 V) (For CISPR 32)	TEMP/HUM : 23.3℃/ 57%

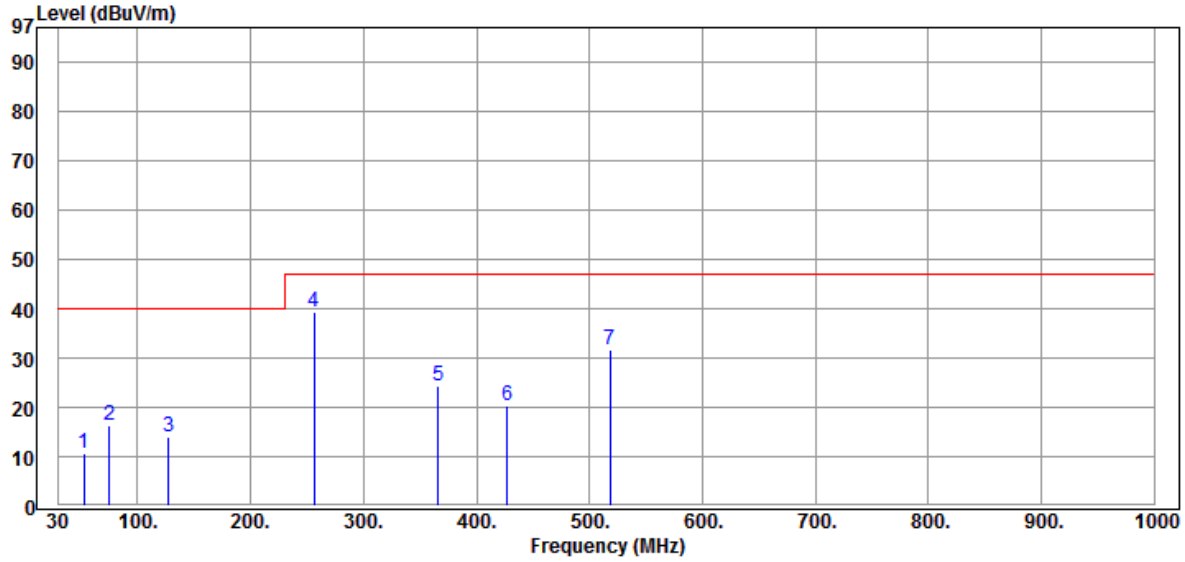
Data:1 2021-03-18



Item Mark	Freq. MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark
1	53.100	33.60	-19.70	13.90	40.00	-26.10	QP
2	67.980	40.19	-22.51	17.68	40.00	-22.32	QP
3	76.680	38.10	-22.60	15.50	40.00	-24.50	QP
4	127.530	35.50	-15.23	20.27	40.00	-19.73	QP
5	162.800	33.00	-13.36	19.64	40.00	-20.36	QP
6	257.430	49.71	-9.55	40.16	47.00	-6.84	QP
7	302.000	38.29	-12.97	25.32	47.00	-21.68	QP
8	345.000	34.70	-12.67	22.03	47.00	-24.97	QP
9	424.000	36.00	-9.61	26.39	47.00	-20.61	QP
10	514.900	46.80	-8.14	38.66	47.00	-8.34	QP

CLIENT: GE MULTILIN	OPERATOR : Albert
EUT: Substation Gateway	TEST SITE : OATS 1
MODEL: G100	TEST DISTANCE : 10 m
RATING: DC 48 V	POLARIZATION : HORIZONTAL
COMMENT: Test Mode: Mode 3: Working Mode (DC 48 V) (For CISPR 32)	TEMP/HUM : 23.3℃/ 57%

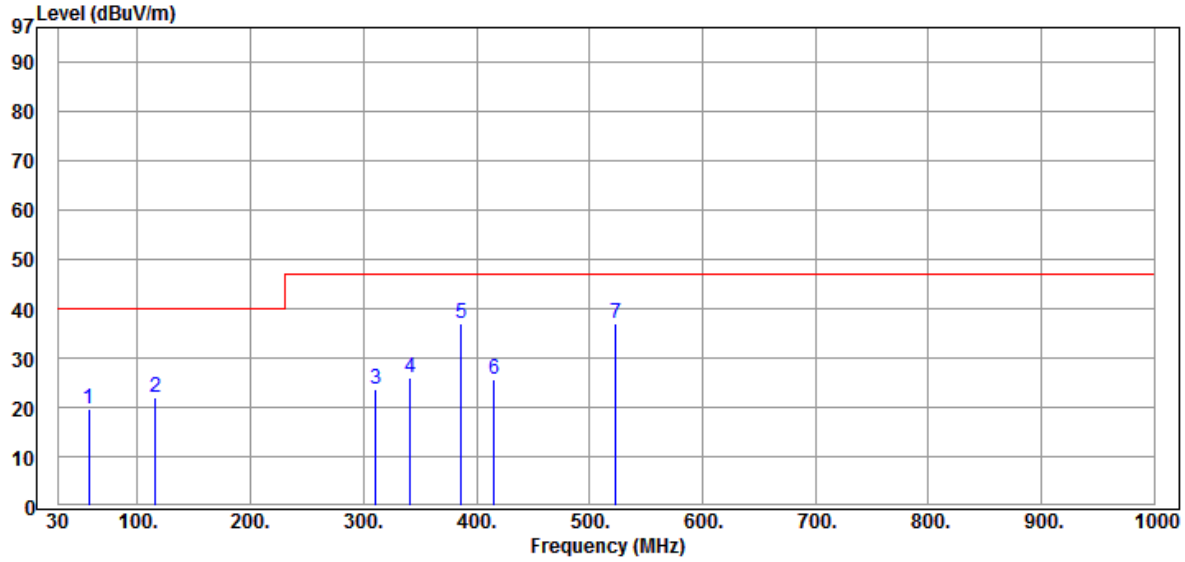
Data:5 2021-03-18



Item Mark	Freq. MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark
1	52.489	30.28	-19.54	10.74	40.00	-29.26	QP
2	75.050	39.02	-22.65	16.37	40.00	-23.63	QP
3	127.528	29.32	-15.23	14.09	40.00	-25.91	QP
4	256.250	48.75	-9.54	39.21	47.00	-7.79	QP
5	366.485	36.42	-11.98	24.44	47.00	-22.56	QP
6	427.059	29.76	-9.55	20.21	47.00	-26.79	QP
7	518.280	39.71	-8.08	31.63	47.00	-15.37	QP

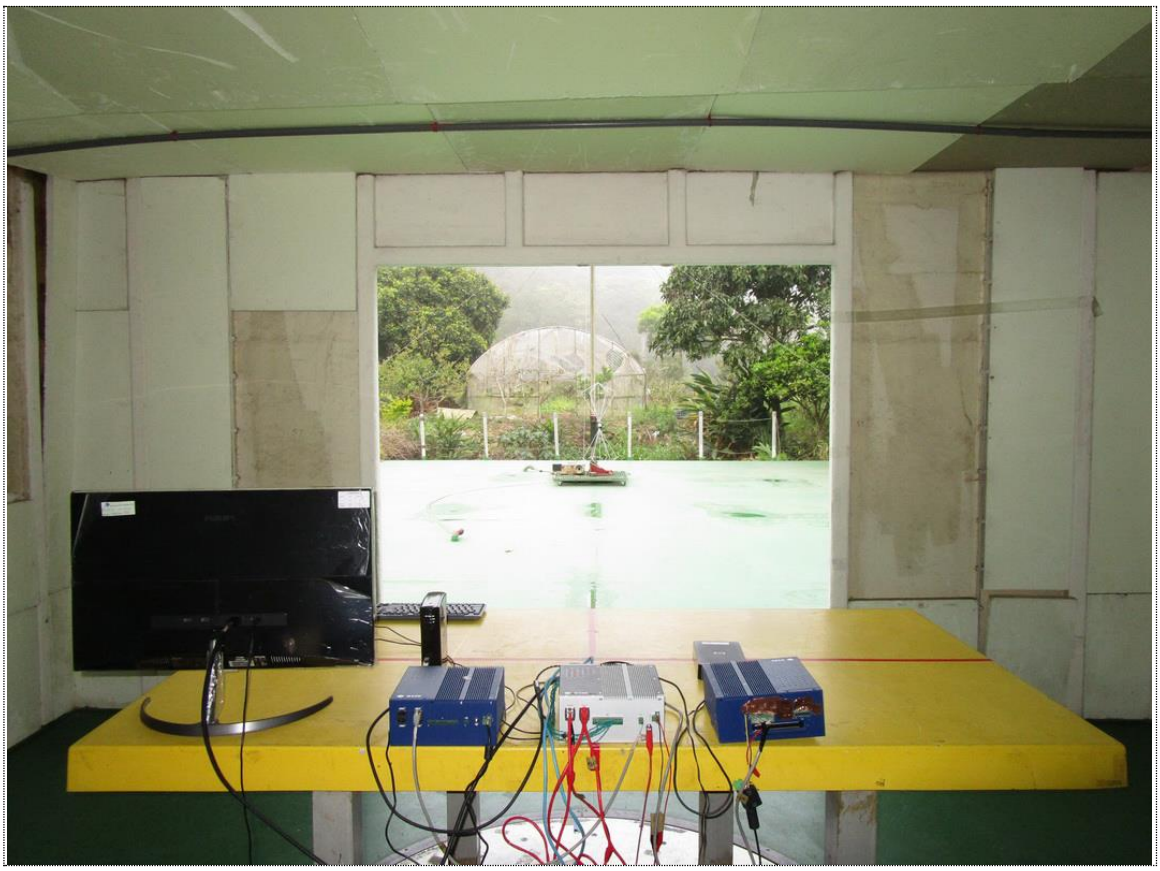
CLIENT: GE MULTILIN	OPERATOR : Albert
EUT: Substation Gateway	TEST SITE : OATS 1
MODEL: G100	TEST DISTANCE : 10 m
RATING: DC 48 V	POLARIZATION : VERTICAL
COMMENT: Test Mode: Mode 3: Working Mode (DC 48 V) (For CISPR 32)	TEMP/HUM : 23.3℃/ 57%

Data:6 2021-03-18

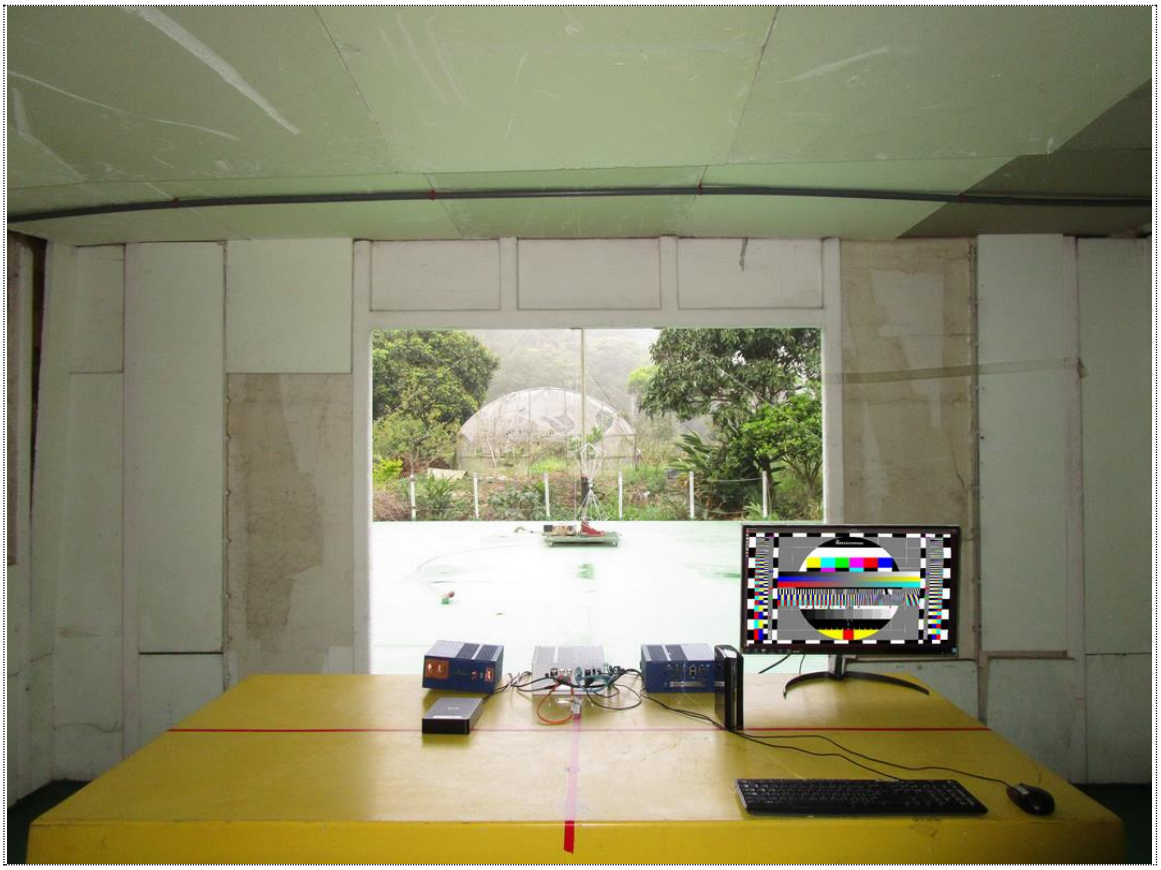


Item Mark	Freq. MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark
1	56.750	40.31	-20.64	19.67	40.00	-20.33	QP
2	115.625	38.31	-16.33	21.98	40.00	-18.02	QP
3	310.575	36.70	-13.04	23.66	47.00	-23.34	QP
4	341.650	38.75	-12.74	26.01	47.00	-20.99	QP
5	386.266	48.25	-11.20	37.05	47.00	-9.95	QP
6	415.497	35.62	-9.96	25.66	47.00	-21.34	QP
7	523.625	45.03	-7.99	37.04	47.00	-9.96	QP

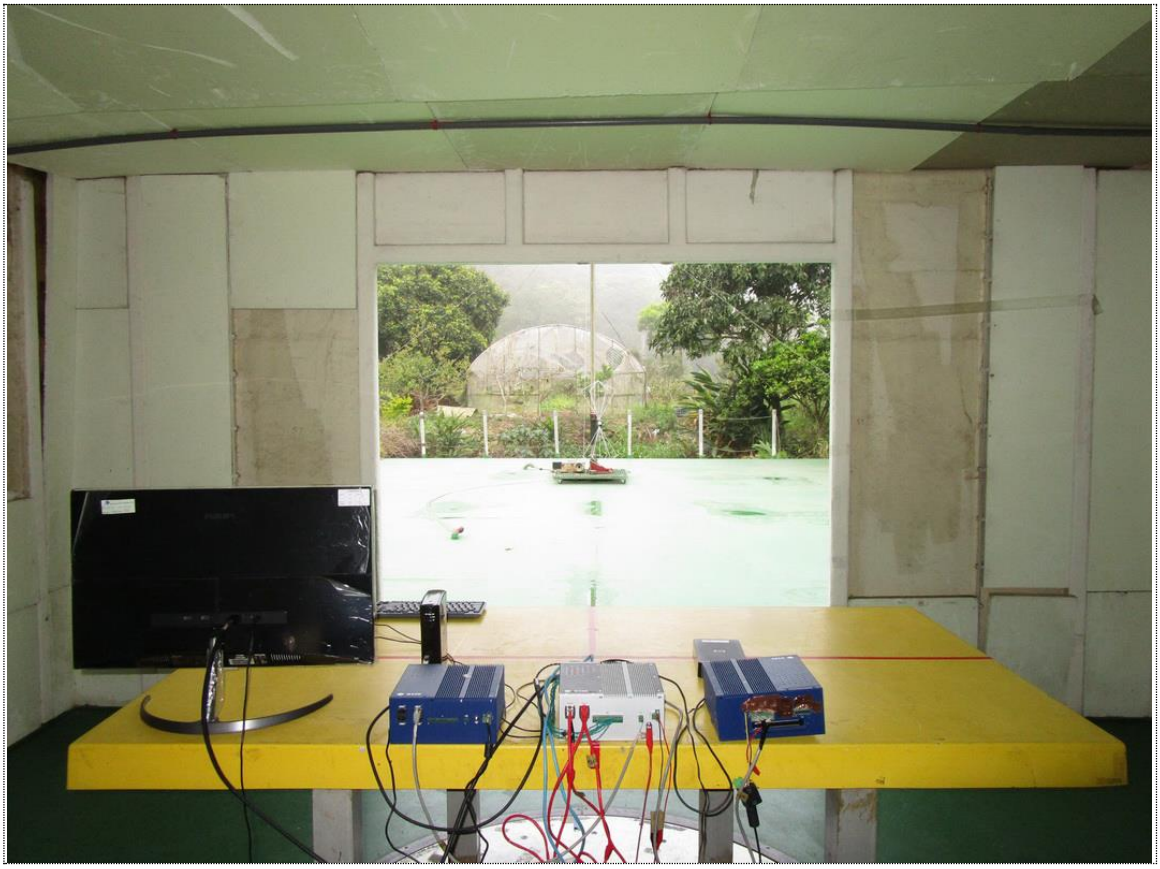
Front View (For CISPR 11)



Rear View (For CISPR 11)



Front View (For CISPR 32)



Rear View (For CISPR 32)

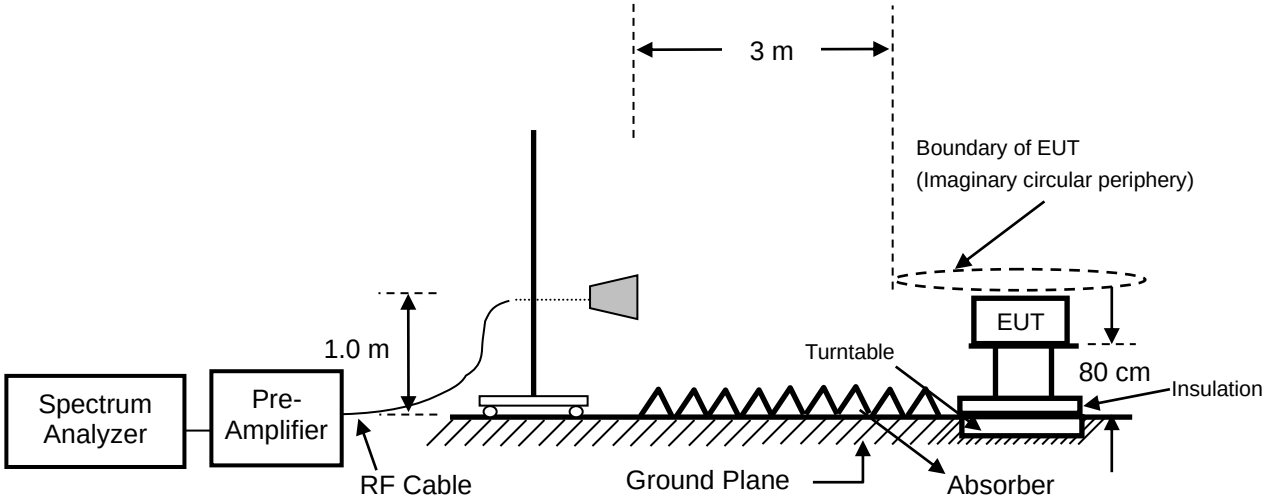
5 Radiated Emission (Above 1 GHz) (CISPR 32)

5.1 Instrument

Instrument	Manufacturer	Model	Serial No.	Next Cal. Date
Spectrum Analyzer	R&S	FSP30	100002	2021/05/12
Horn Antenna	Schwarzbeck	BBHA9120	9120D-1051	2021/08/03
Pre-Amplifier	EMCI	EMC 051845	980110	2021/07/02
RF Cable	HARBOUR	27478LL142	CBL65	2022/01/22
RF Cable	Marvelous Microwave	MCBL-LL266.50	CBL70	2022/01/22
Measurement Software	AUDIX-e3			

Note: The above equipments are within the valid calibration period.

5.2 Block Diagram of Test Configuration



5.3 Radiated Limit

CISPR 32

Frequency (GHz)	☒ Class A		☐ Class B	
	Peak dB(μV/m)	Average dB(μV/m)	Peak dB(μV/m)	Average dB(μV/m)
1 to 3	76	56	70	50
3 to 6	80	60	74	54

5.4 Instrument Configuration

5.4.1 Set the EMI test Spectrum frequency range above 1 GHz.

5.4.2 Set the EMI test Spectrum bandwidths above 1 GHz are at 1 MHz for peak value and average value.

5.4.3 All readings of the test Spectrum detector above 1 GHz are average value.

5.5 Configuration of Measurement

5.5.1 The EUT was set 3 meters for measuring frequency above 1 GHz away from the receiving antenna that was mounted on a non-conductive mast.

5.5.2 The antenna set at 1 meter height and EUT was placed on a non-conductive table whose total height equaled 80cm. The turntable can rotate 360 degree to determine the position of the maximum emission level.

5.5.3 The initial testing identified the frequency that has the highest disturbance relative to the limit while operating the EUT in typical modes of operation and cable positions in a test setup representative of typical system configuration.

5.5.4 The identification of the frequency of highest emission with respect to the limit was found by investigating emissions at a number of significant frequencies. The probable frequency of maximum emission had been found and that the associated cable and EUT configuration and mode of operation had been identified.

5.6 Test Result

PASS.

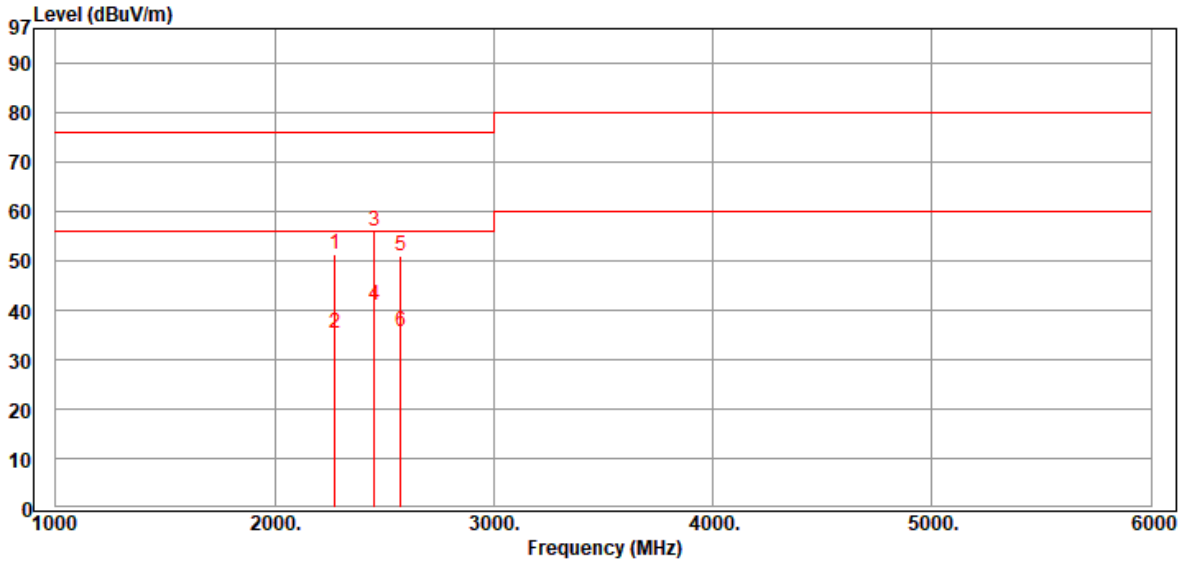
The final test data is shown as following pages.

Factor = Antenna Factor + Cable Loss - Preamplifier Gain
Level = Reading + Factor
Margin = Level - Limit

CLIENT: GE MULTILIN
EUT: Substation Gateway
MODEL: G100
RATING: DC 12 V
COMMENT: Test Mode: Mode 1: Working Mode (DC12 V)

OPERATOR : Scott
TEST SITE : Chamber 3
TEST DISTANCE : 3 m
POLARIZATION : HORIZONTAL
TEMP/HUM : 20℃/ 51%

Data:3 2021-03-25

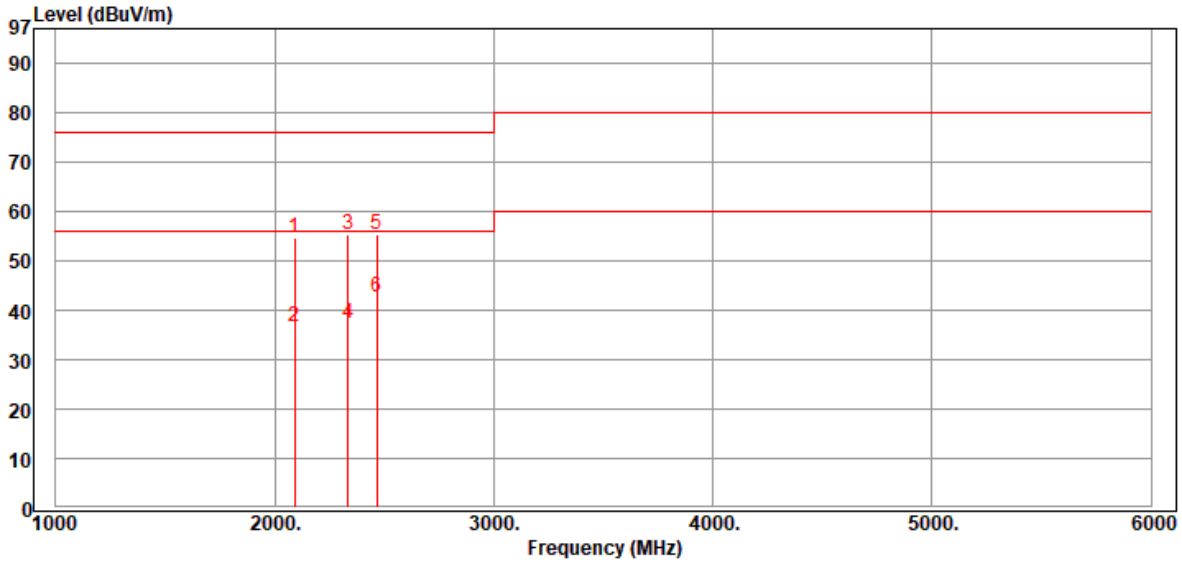


Item Mark	Freq. MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark
1	2275.000	67.34	-15.96	51.38	76.00	-24.62	Peak
2	2275.000	51.30	-15.96	35.34	56.00	-20.66	Average
3	2455.000	72.02	-16.10	55.92	76.00	-20.08	Peak
4	2455.000	57.20	-16.10	41.10	56.00	-14.90	Average
5	2575.000	66.83	-15.91	50.92	76.00	-25.08	Peak
6	2575.000	51.60	-15.91	35.69	56.00	-20.31	Average

CLIENT: GE MULTILIN
EUT: Substation Gateway
MODEL: G100
RATING: DC 12 V
COMMENT: Test Mode: Mode 1: Working Mode (DC12 V)

OPERATOR : Scott
TEST SITE : Chamber 3
TEST DISTANCE : 3 m
POLARIZATION : VERTICAL
TEMP/HUM : 20℃/ 51%

Data:4 2021-03-25

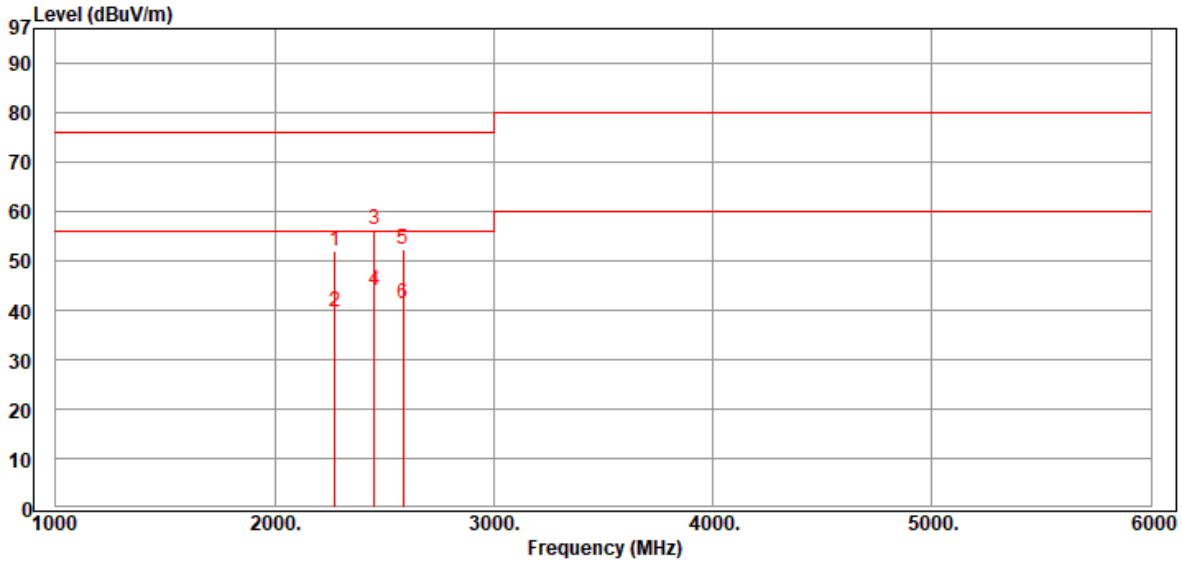


Item Mark	Freq. MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark
1	2090.000	72.17	-17.38	54.79	76.00	-21.21	Peak
2	2090.000	54.20	-17.38	36.82	56.00	-19.18	Average
3	2335.000	71.46	-16.00	55.46	76.00	-20.54	Peak
4	2335.000	53.20	-16.00	37.20	56.00	-18.80	Average
5	2465.000	71.51	-16.10	55.41	76.00	-20.59	Peak
6	2465.000	58.80	-16.10	42.70	56.00	-13.30	Average

CLIENT: GE MULTILIN
EUT: Substation Gateway
MODEL: G100
RATING: DC 24 V
COMMENT: Test Mode: Mode 2: Working Mode (DC 24 V)

OPERATOR : Scott
TEST SITE : Chamber 3
TEST DISTANCE : 3 m
POLARIZATION : HORIZONTAL
TEMP/HUM : 20℃/ 51%

Data:1 2021-03-25

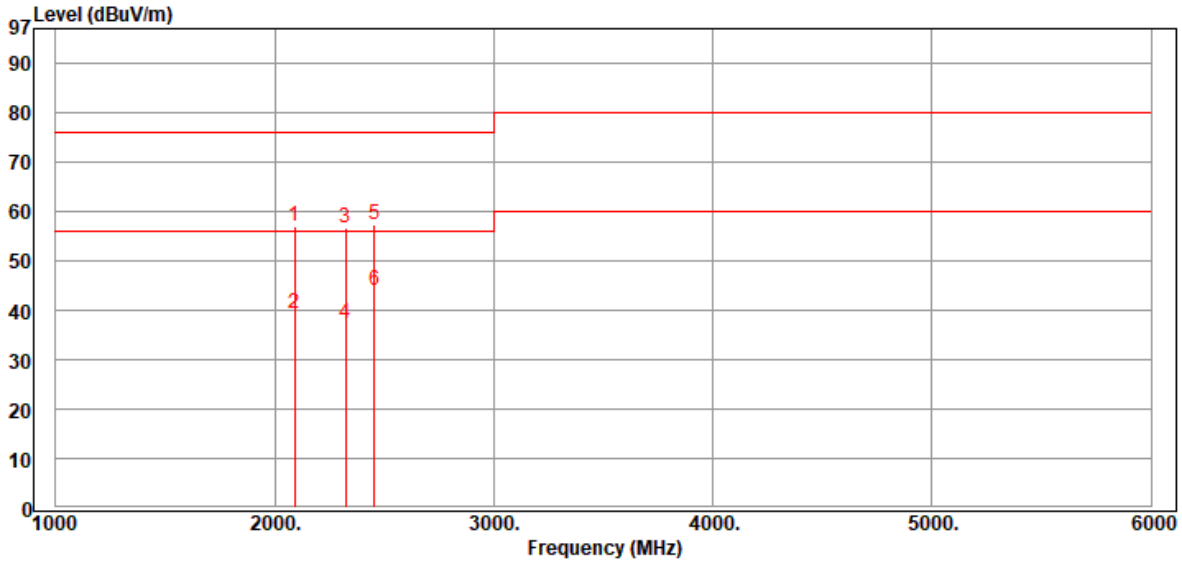


Item Mark	Freq. MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark
1	2275.000	68.05	-15.96	52.09	76.00	-23.91	Peak
2	2275.000	55.60	-15.96	39.64	56.00	-16.36	Average
3	2455.000	72.52	-16.10	56.42	76.00	-19.58	Peak
4	2455.000	60.10	-16.10	44.00	56.00	-12.00	Average
5	2585.000	68.17	-15.88	52.29	76.00	-23.71	Peak
6	2585.000	57.21	-15.88	41.33	56.00	-14.67	Average

CLIENT: GE MULTILIN
EUT: Substation Gateway
MODEL: G100
RATING: DC 24 V
COMMENT: Test Mode: Mode 2: Working Mode (DC 24 V)

OPERATOR : Scott
TEST SITE : Chamber 3
TEST DISTANCE : 3 m
POLARIZATION : VERTICAL
TEMP/HUM : 20℃/ 51%

Data:2 2021-03-25

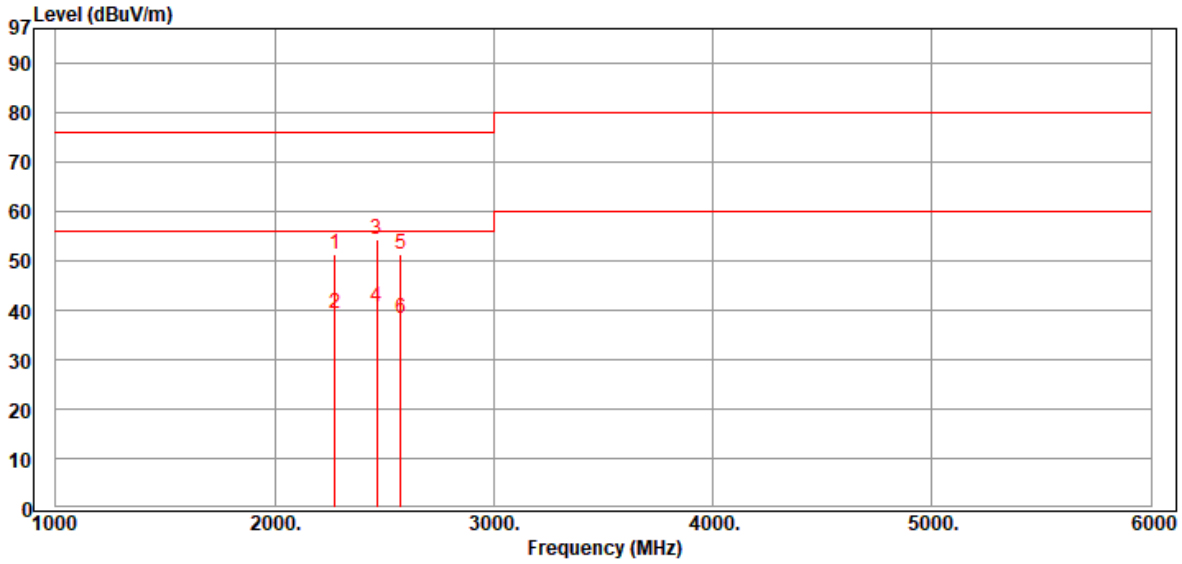


Item Mark	Freq. MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark
1	2090.000	74.43	-17.38	57.05	76.00	-18.95	Peak
2	2090.000	56.80	-17.38	39.42	56.00	-16.58	Average
3	2325.000	72.56	-16.00	56.56	76.00	-19.44	Peak
4	2325.000	53.30	-16.00	37.30	56.00	-18.70	Average
5	2455.000	73.46	-16.10	57.36	76.00	-18.64	Peak
6	2455.000	60.00	-16.10	43.90	56.00	-12.10	Average

CLIENT: GE MULTILIN
EUT: Substation Gateway
MODEL: G100
RATING: DC 48 V
COMMENT: Test Mode: Mode 3: Working Mode (DC 48 V)

OPERATOR : Scott
TEST SITE : Chamber 3
TEST DISTANCE : 3 m
POLARIZATION : HORIZONTAL
TEMP/HUM : 20℃/ 51%

Data:5 2021-03-25

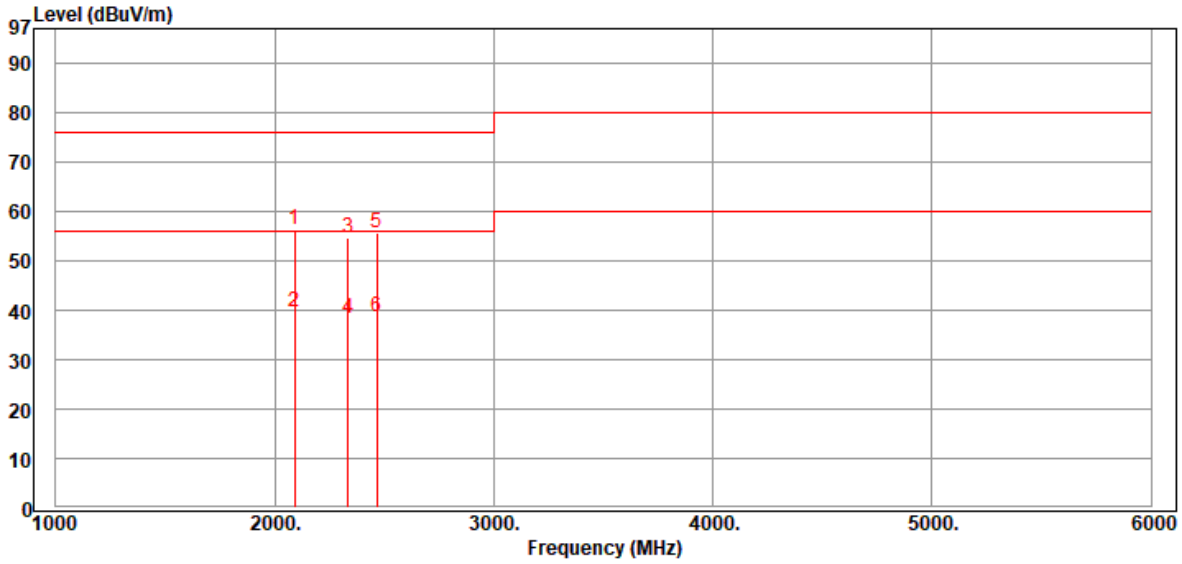


Item Mark	Freq. MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark
1	2275.000	67.15	-15.96	51.19	76.00	-24.81	Peak
2	2275.000	55.20	-15.96	39.24	56.00	-16.76	Average
3	2465.000	70.32	-16.10	54.22	76.00	-21.78	Peak
4	2465.000	56.60	-16.10	40.50	56.00	-15.50	Average
5	2575.000	67.41	-15.91	51.50	76.00	-24.50	Peak
6	2575.000	54.30	-15.91	38.39	56.00	-17.61	Average

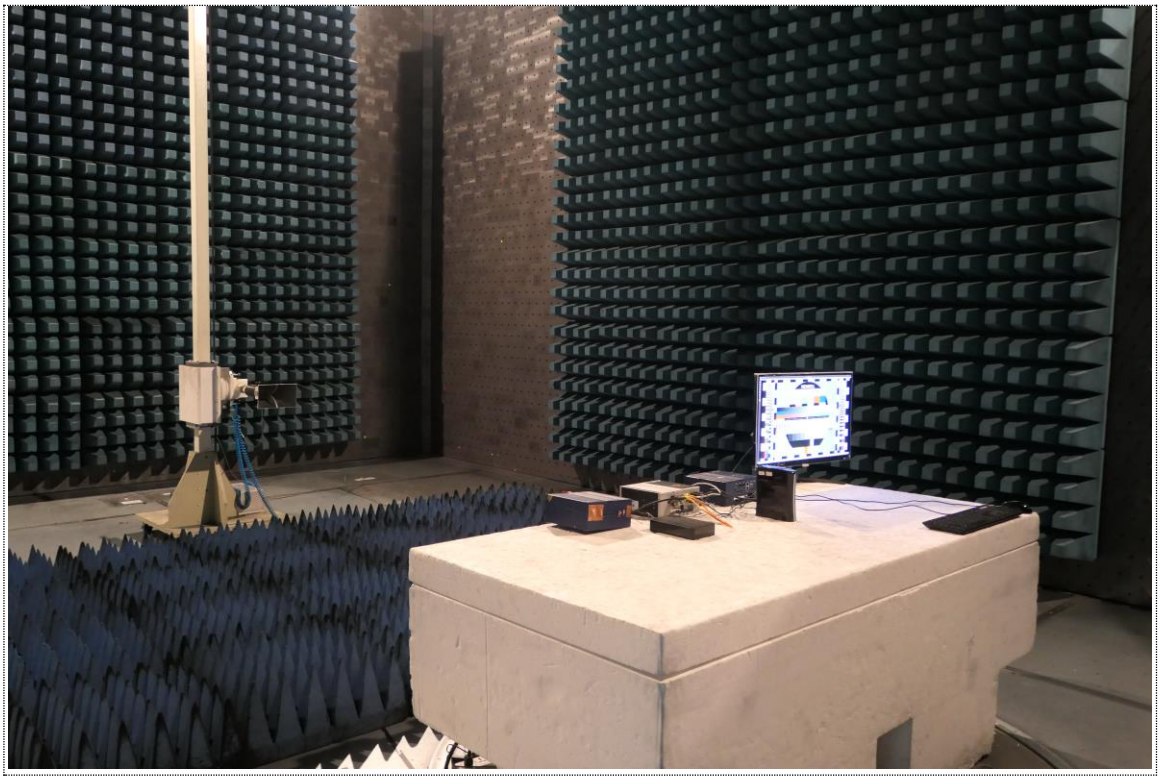
CLIENT: GE MULTILIN
EUT: Substation Gateway
MODEL: G100
RATING: DC 48 V
COMMENT: Test Mode: Mode 3: Working Mode (DC 48 V)

OPERATOR : Scott
TEST SITE : Chamber 3
TEST DISTANCE : 3 m
POLARIZATION : VERTICAL
TEMP/HUM : 20℃/ 51%

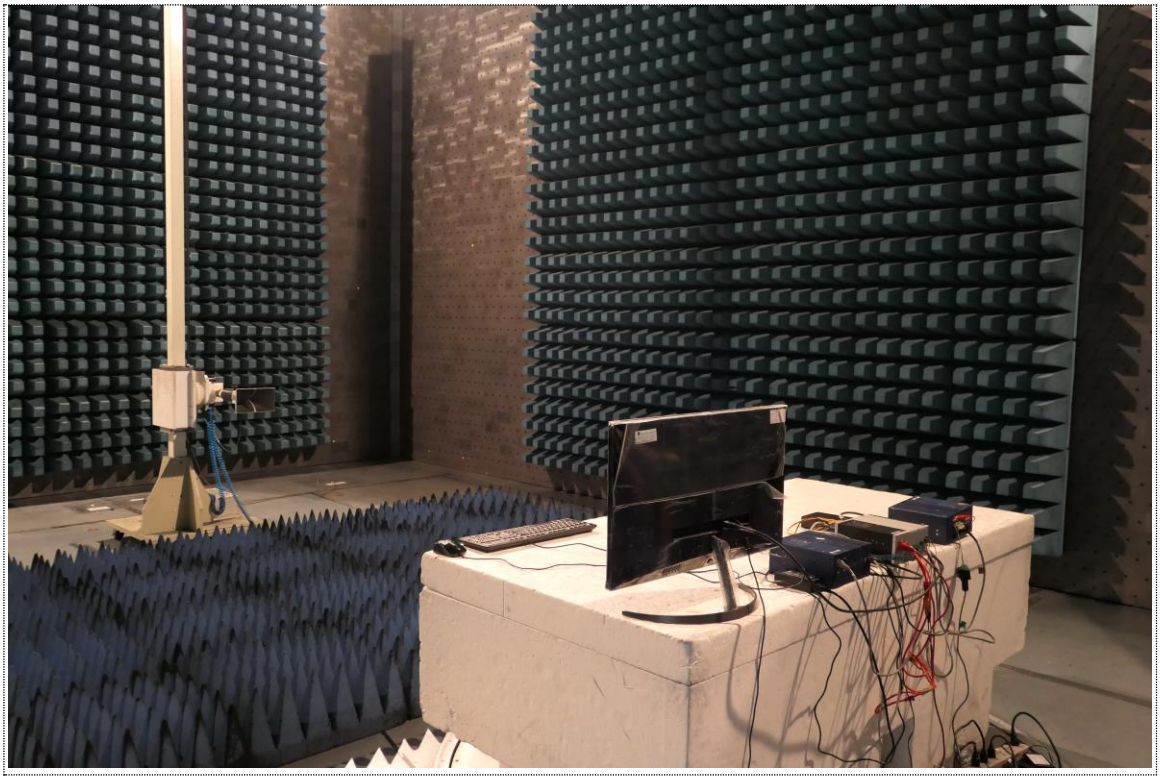
Data:6 2021-03-25



Item Mark	Freq. MHz	Reading dBuV	Factor dB/m	Level dBuV/m	Limit dBuV/m	Margin dB	Remark
1	2090.000	73.74	-17.38	56.36	76.00	-19.64	Peak
2	2090.000	57.20	-17.38	39.82	56.00	-16.18	Average
3	2335.000	70.55	-16.00	54.55	76.00	-21.45	Peak
4	2335.000	54.40	-16.00	38.40	56.00	-17.60	Average
5	2465.000	71.91	-16.10	55.81	76.00	-20.19	Peak
6	2465.000	54.60	-16.10	38.50	56.00	-17.50	Average



Front View



Rear View

6 Electrostatic Discharge Test

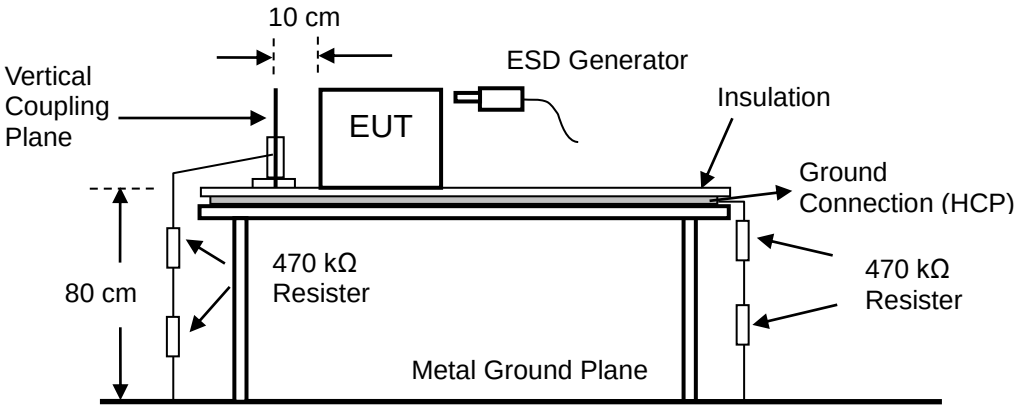
6.1 Instrument

Instrument	Manufacturer	Model	Serial No.	Next Cal. Date
ESD Simulator	EMC PARTNER	ESD3000	276	2022/03/02

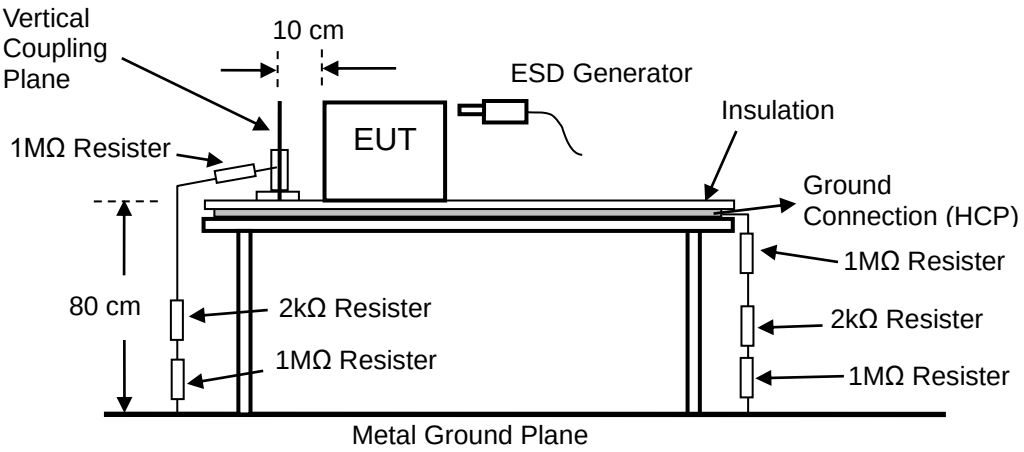
Note: The above equipments are within the valid calibration period.

6.2 Block Diagram of Test Configuration

For IEC 61850-3 & IEC 61000-4-2



For IEEE 1613 & IEEE 37.90.3



6.3 Test Requirement for Client

6.3.1 According to IEC 61850-3 & IEC 61000-4-2;

470 kΩ Resister:

Air discharge: ± 8 kV

Contact discharge: ± 6 kV

6.3.2 According to IEEE 1613 & IEEE 37.90.3;

1 MΩ + 2 kΩ Resister:

Air discharge: ± 8 kV

Contact discharge: ± 15 kV

6.4 Configuration of Measurement

6.4.1 The test setup consists of the test generator, EUT and auxiliary instrumentation necessary to perform direct and indirect application of discharges to the EUT in the following manner:

a) Contact discharge to the conductive surfaces and to coupling planes;

b) Air discharge at insulating surfaces.

6.4.2 The EUT shall be arranged in accordance with the manufacturer's instructions for installation.

6.5 Test Result

PASS.

According to IEC 61850-3 & IEC 61000-4-2 requirement:

Temperature: 24.3 ℃； Humidity: 46 %； Atmospheric: 989 hPa； Test Engineer: Albert

470 kΩ Resister

Mode 1: Working Mode (DC 12 V)

Air discharge ± 2 kV, ± 4 kV, ± 8 kV:	☒ **A**	☐ **B**	☐ **C**
Contact discharge ± 2 kV, ± 4 kV, ± 6 kV:	☒ **A**	☐ **B**	☐ **C**
Indirect discharge (HCP) ± 2 kV, ± 4 kV, ± 6 kV:	☒ **A**	☐ **B**	☐ **C**
Indirect discharge (VCP) ± 2 kV, ± 4 kV, ± 6 kV:	☒ **A**	☐ **B**	☐ **C**

Mode 2: Working Mode (DC 24 V)

Air discharge ± 2 kV, ± 4 kV, ± 8 kV:	☒ **A**	☐ **B**	☐ **C**
Contact discharge ± 2 kV, ± 4 kV, ± 6 kV:	☒ **A**	☐ **B**	☐ **C**
Indirect discharge (HCP) ± 2 kV, ± 4 kV, ± 6 kV:	☒ **A**	☐ **B**	☐ **C**
Indirect discharge (VCP) ± 2 kV, ± 4 kV, ± 6 kV:	☒ **A**	☐ **B**	☐ **C**

Mode 3: Working Mode (DC 48 V)

Air discharge ± 2 kV, ± 4 kV, ± 8 kV:	☒ **A**	☐ **B**	☐ **C**
Contact discharge ± 2 kV, ± 4 kV, ± 6 kV:	☒ **A**	☐ **B**	☐ **C**
Indirect discharge (HCP) ± 2 kV, ± 4 kV, ± 6 kV:	☒ **A**	☐ **B**	☐ **C**
Indirect discharge (VCP) ± 2 kV, ± 4 kV, ± 6 kV:	☒ **A**	☐ **B**	☐ **C**

According to IEEE 1613 & IEEE 37.90.3 requirement:

Temperature: 24.3 ℃； Humidity: 46 %； Atmospheric: 989 hPa； Test Engineer: Albert

1 MΩ + 2 kΩ Resister

Mode 1: Working Mode (DC 12 V)

Air discharge ± 2 KV, ± 4 kV, ± 8 kV, ± 15 kV:	☒ **A**	☐ **B**	☐ **C**
Contact discharge ± 2 kV, ± 4 kV, ± 6 kV, ± 8 kV:	☒ **A**	☐ **B**	☐ **C**
Indirect discharge (HCP) ± 2 kV, ± 4 kV, ± 6 kV, ± 8 kV:	☒ **A**	☐ **B**	☐ **C**
Indirect discharge (VCP) ± 2 kV, ± 4 kV, ± 6 kV, ± 8 kV:	☒ **A**	☐ **B**	☐ **C**

Mode 2: Working Mode (DC 24 V)

Air discharge ± 2 KV, ± 4 kV, ± 8 kV, ± 15 kV:	☒ **A**	☐ **B**	☐ **C**
Contact discharge ± 2 kV, ± 4 kV, ± 6 kV, ± 8 kV:	☒ **A**	☐ **B**	☐ **C**
Indirect discharge (HCP) ± 2 kV, ± 4 kV, ± 6 kV, ± 8 kV:	☒ **A**	☐ **B**	☐ **C**
Indirect discharge (VCP) ± 2 kV, ± 4 kV, ± 6 kV, ± 8 kV:	☒ **A**	☐ **B**	☐ **C**

Mode 3: Working Mode (DC 48 V)

Air discharge ± 2 KV, ± 4 kV, ± 8 kV, ± 15 kV:	☒ **A**	☐ **B**	☐ **C**
Contact discharge ± 2 kV, ± 4 kV, ± 6 kV, ± 8 kV:	☒ **A**	☐ **B**	☐ **C**
Indirect discharge (HCP) ± 2 kV, ± 4 kV, ± 6 kV, ± 8 kV:	☒ **A**	☐ **B**	☐ **C**
Indirect discharge (VCP) ± 2 kV, ± 4 kV, ± 6 kV, ± 8 kV:	☒ **A**	☐ **B**	☐ **C**

Note:

Criteria A : No damage, no reset, no loss or corruption of stored memory or data, no maloperation and no communications/network errors.

LAN: Communications normally no errors;

DI: Show 0xFF and 0x00 no errors;

DO: Show 0xFF and 0x00 no errors;

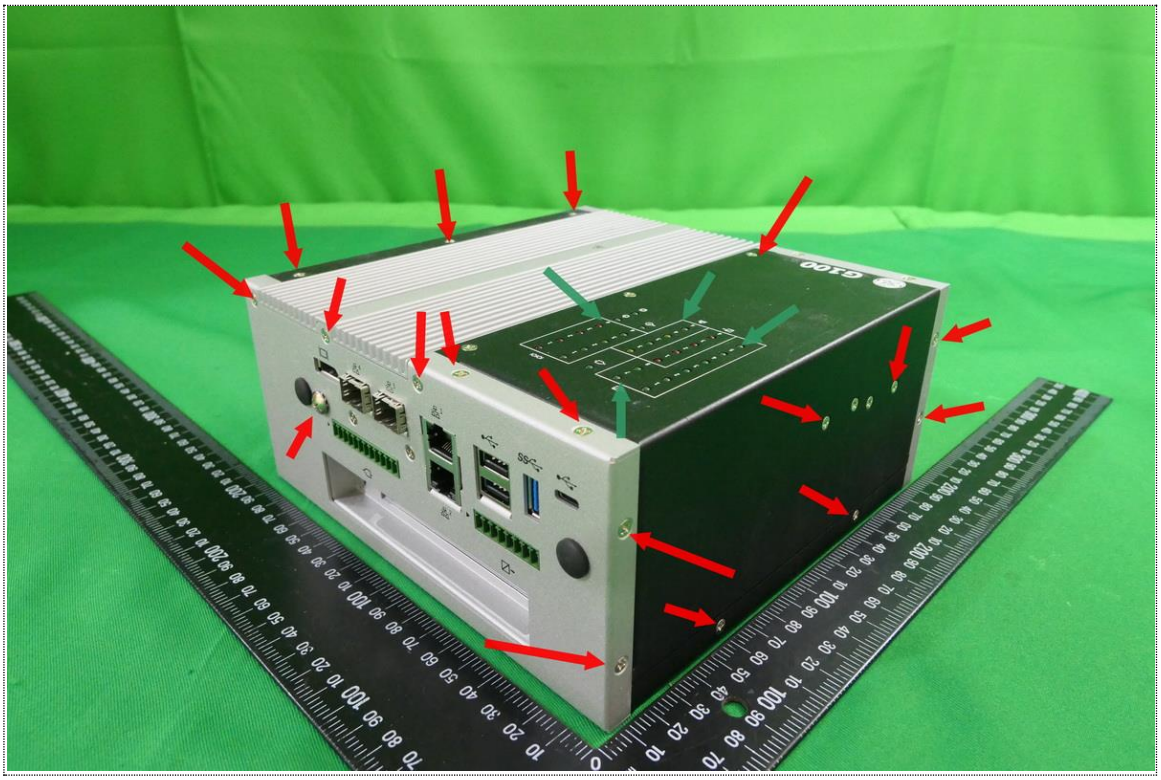
AI: ±FS accuracy(1.6V), no errors;

Display: Monitor show normaly, no errors;

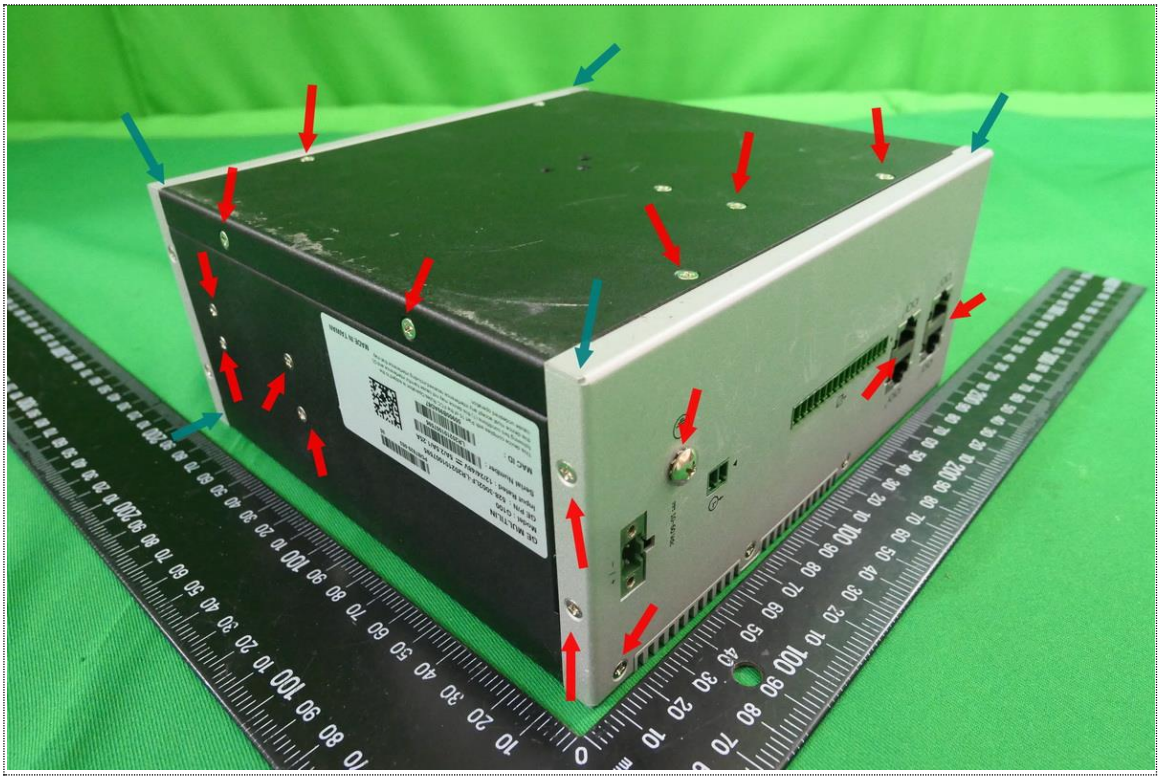
Serial Com: LED flashes normally no errors;

IRIG-B: Communications normally no errors.

Photographs of Test



View of Discharge Point-1 (Green: Air Discharge; Red: Contact Discharge)



View of Discharge Point-2 (Green: Air Discharge; Red: Contact Discharge)

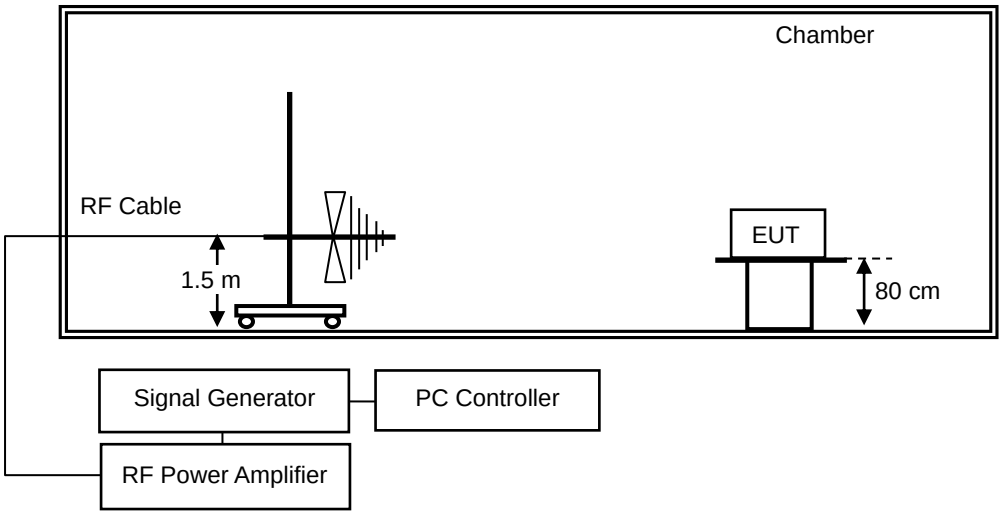
7 Radio-frequency, Electromagnetic field Test

7.1 Instrument

Instrument	Manufacturer	Model	Serial No.	Next Cal. Date
Signal Generator	KEYSIGHT	N5171B	MY53051802	2022/03/09
Power Amplifier	R&K	A080M102-5555R	B30850	2021/04/18
Power Amplifier	R&K	A701M402-4747R	B35850	2021/04/18
Log Antenna	Schwarzbeck	VULP 9118 G Special	9118GS912	2021/04/18
Horn Antenna	Schwarzbeck	BBHA 9120 E	BBHA9120E 586	2021/04/18

Note: The above equipments are within the valid calibration period.

7.2 Block Diagram of Test Configuration



7.3 Test Requirement for Client

7.3.1 According to IEC 61850-3 & IEC 61000-4-3;
Frequency range: **80** to **3000** MHz, Field strength: **10** V/m, 80 % AM (1 kHz)

7.3.2 According to IEEE 1613 & IEEE 37.90.2;
Frequency range: **80** to **1000** MHz, Field strength: **20** V/m, 80 % AM (1 kHz),
Frequency range: **80** to **1000** MHz, Field strength: **20** V/m, 80 % PM (2 Hz),
Frequency: **80**, **160**, **450**, **900** MHz, Field strength: **20** V/m, 80 % AM (1 kHz),
Frequency: **900** MHz, Field strength: **20** V/m, 80 % PM (200 Hz)

7.4 Configuration of Measurement

7.4.1 Before testing, the intensity of the established field strength was checked by placing the field sensor at a calibration grid point, and with the field generating antenna and cables in the same positions as used for the calibration, the forward and reverse power were measured. The forward power needed to give the calibrated field was evaluated.

7.4.2 The EUT was placed on a non-metallic table 0.8 m above the reference ground plane (RGP) and was operated according to its specified operating mode.

7.4.3 Ferrite tiles/ absorbers were placed on the RGP between the EUT and the antenna to reduce the reflections from the RGP.

7.4.4 The distance between antenna and EUT is 1 meter.

7.5 Test Result

PASS.

According to IEC 61850-3 & IEC 61000-4-3 requirement:

Temperature: 26.4 ℃； Humidity: 57 %； Atmospheric: 996 hPa； Test Engineer: Scott

Mode 1: Working Mode (DC 12 V)

Frequency Range (MHz)	E.U.T. Position (Angle)	Ant. Polarity (Hor. or Ver.)	Modulate	Field Strength (Modulated)		Results
80 to 3000	0°,90°, 180°, 270°	H、V	AM	10	(V/m)	**A**

Mode 2: Working Mode (DC 24 V)

Frequency Range (MHz)	E.U.T. Position (Angle)	Ant. Polarity (Hor. or Ver.)	Modulate	Field Strength (Modulated)		Results
80 to 3000	0°,90°, 180°, 270°	H、V	AM	10	(V/m)	**A**

Mode 3: Working Mode (DC 48 V)

Frequency Range (MHz)	E.U.T. Position (Angle)	Ant. Polarity (Hor. or Ver.)	Modulate	Field Strength (Modulated)		Results
80 to 3000	0°,90°, 180°, 270°	H、V	AM	10	(V/m)	**A**

According to IEEE 1613 & IEEE 37.90.2 requirement:

Temperature: 26.4 ℃； Humidity: 57 %； Atmospheric: 996 hPa； Test Engineer: Scott

Mode 1: Working Mode (DC 12 V)

Frequency Range (MHz)	E.U.T. Position (Angle)	Ant. Polarity (Hor. or Ver.)	Modulate	Field Strength (Modulated)		Results
80 to 1000	0°,90°, 180°, 270°	H、V	AM	20	(V/m)	**A**
80 to 1000	0°,90°, 180°, 270°	H、V	PM (2)	20	(V/m)	**A**
80 (± 0.5 %)	0°,90°, 180°, 270°	H、V	AM	20	(V/m)	**A**
160 (± 0.5 %)	0°,90°, 180°, 270°	H、V	AM	20	(V/m)	**A**
450 (± 0.5 %)	0°,90°, 180°, 270°	H、V	AM	20	(V/m)	**A**

900 (± 5)	0°,90°, 180°, 270°	H、V	AM	20	(V/m)	**A**
900 (± 5)	0°,90°, 180°, 270°	H、V	PM (1)	20	(V/m)	**A**

Note: AM: 80 % 1 kHz
PM (1): Duty Cycle 50 % 200 Hz
PM (2): Duty Cycle 50 % 2 Hz

Mode 2: Working Mode (DC 24 V)

Frequency Range (MHz)	E.U.T. Position (Angle)	Ant. Polarity (Hor. or Ver.)	Modulate	Field Strength (Modulated)		Results
80 to 1000	0°,90°, 180°, 270°	H、V	AM	20	(V/m)	**A**
80 to 1000	0°,90°, 180°, 270°	H、V	PM (2)	20	(V/m)	**A**
80 (± 0.5 %)	0°,90°, 180°, 270°	H、V	AM	20	(V/m)	**A**
160 (± 0.5 %)	0°,90°, 180°, 270°	H、V	AM	20	(V/m)	**A**
450 (± 0.5 %)	0°,90°, 180°, 270°	H、V	AM	20	(V/m)	**A**
900 (± 5)	0°,90°, 180°, 270°	H、V	AM	20	(V/m)	**A**
900 (± 5)	0°,90°, 180°, 270°	H、V	PM (1)	20	(V/m)	**A**

Note: AM: 80 % 1 kHz
PM (1): Duty Cycle 50 % 200 Hz
PM (2): Duty Cycle 50 % 2 Hz

Mode 3: Working Mode (DC 48 V)

Frequency Range (MHz)	E.U.T. Position (Angle)	Ant. Polarity (Hor. or Ver.)	Modulate	Field Strength (Modulated)		Results
80 to 1000	0°,90°, 180°, 270°	H、V	AM	20	(V/m)	**A**
80 to 1000	0°,90°, 180°, 270°	H、V	PM (2)	20	(V/m)	**A**
80 (± 0.5 %)	0°,90°, 180°, 270°	H、V	AM	20	(V/m)	**A**
160 (± 0.5 %)	0°,90°, 180°, 270°	H、V	AM	20	(V/m)	**A**
450 (± 0.5 %)	0°,90°, 180°, 270°	H、V	AM	20	(V/m)	**A**
900 (± 5)	0°,90°, 180°, 270°	H、V	AM	20	(V/m)	**A**
900 (± 5)	0°,90°, 180°, 270°	H、V	PM (1)	20	(V/m)	**A**

Note: AM: 80 % 1 kHz
PM (1): Duty Cycle 50 % 200 Hz
PM (2): Duty Cycle 50 % 2 Hz

Note:

Criteria A : No damage, no reset, no loss or corruption of stored memory or data, no maloperation and no communications/network errors.

LAN: Communications normally no errors;

DI: Show 0xFF and 0x00 no errors;

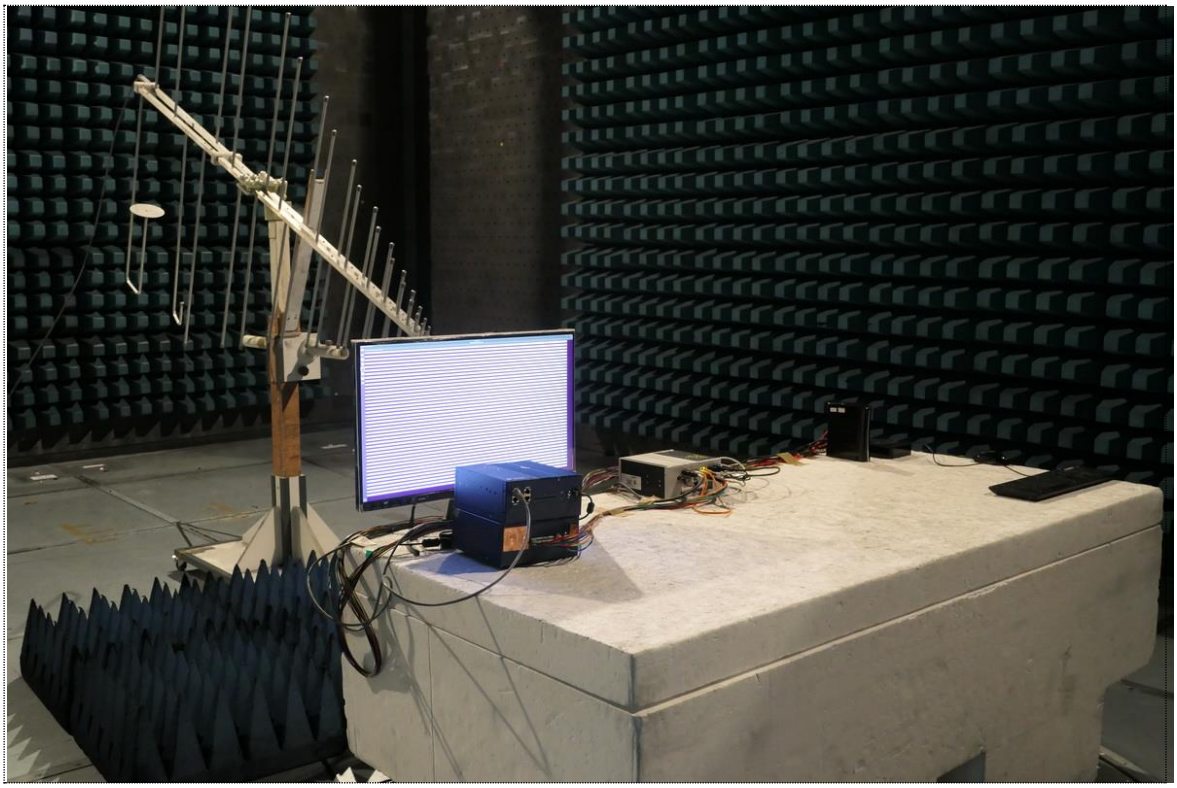
DO: Show 0xFF and 0x00 no errors;

AI: ±FS accuracy(1.6V), no errors;

Display: Monitor show normaly, no errors;

Serial Com: LED flashes normally no errors;

IRIG-B: Communications normally no errors.



Photographs of Test

8 Fast Transient/Burst Test

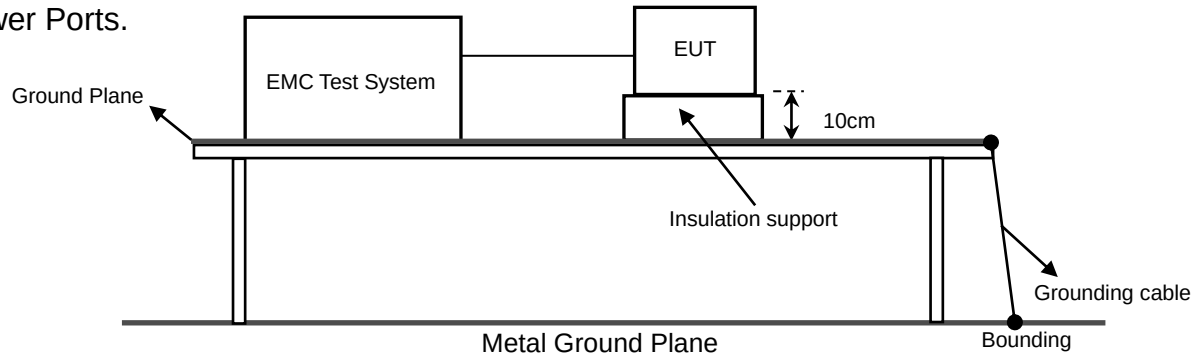
8.1 Instrument

Instrument	Manufacturer	Model	Serial No.	Next Cal. Date
EMC Test System	EMC PARTNER	TRANSIENT-2000	812	2022/01/12
Injection Clamp	EMC PARTNER	CN-EFT1000	497	2022/01/12

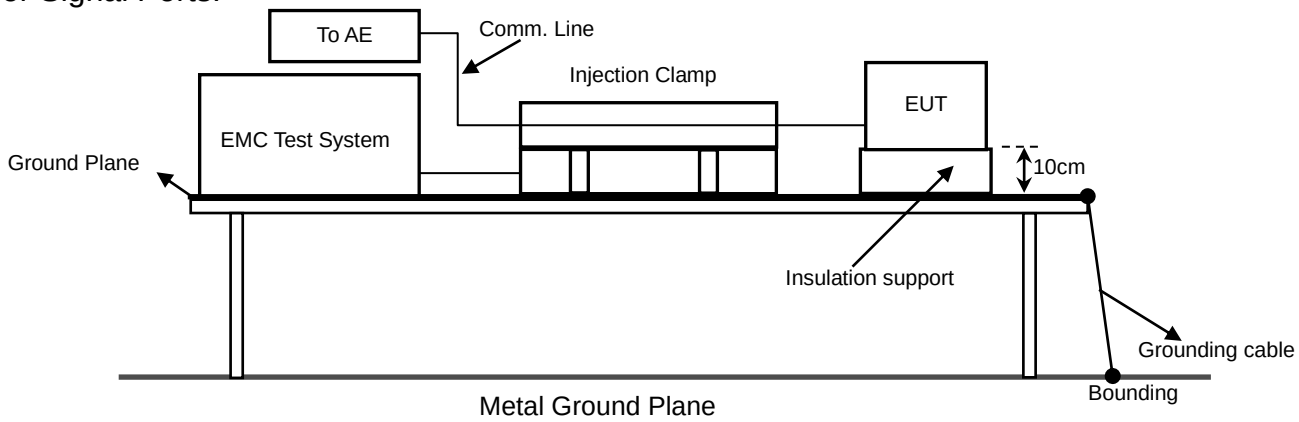
Note: The above equipments are within the valid calibration period.

8.2 Block Diagram of Test Configuration

For Power Ports.



For Signal Ports.



8.3 Test Requirement for Client

According to IEC 61850-3, IEC 61000-4-4, IEEE 1613 & IEEE 37.90.1;

5 kHz Repetition frequency

☒ ± 4.0 kV input DC power ports.

☒ ± 4.0 kV for Signal ports.

8.4 Configuration of Measurement

8.4.1 The EUT and the auxiliary equipment were placed on a wooden table of 0.8 meters height. The size of ground plane is greater than 1 m×1 m and project beyond the EUT by at least 0.1 m on all sides. The ground plane is connected to the protective earth.

8.4.2 The EUT was connected to the power mains through a coupling device that directly couples the EFT interference signal. Each of the Line, Neutral and Protective Earth (PE) conductors was impressed with burst noise for 1 minute. Both the voltage polarities were applied for each test level. The length of the signal and power lines between the coupling device and the EUT shall be 0.5 m ± 0.05 m.

8.5 Test Result

PASS.

Temperature: 23.5 ℃； Humidity: 47 %； Atmospheric: 989 hPa； Test Engineer: Albert

Mode 1: Working Mode (DC 12 V)

Test Port		Level	Measured (Sec.)	Repetition Rate (kHz)	Result
Power Port	L	± 4 kV	60	5	**A**
	N	± 4 kV	60	5	**A**
	PE	± 4 kV	60	5	**A**
	L+N	± 4 kV	60	5	**A**
	L+PE	± 4 kV	60	5	**A**
	N+PE	± 4 kV	60	5	**A**
	L+N+PE	± 4 kV	60	5	**A**
I/O Port	Ethernet copper (LAN 1)	± 4 kV	60	5	**A**
	Ethernet copper (LAN 2)	± 4 kV	60	5	**A**
	IRIG-B	± 4 kV	60	5	**A**
	Relay contact outputs (AI Port)	± 4 kV	60	5	**A**
	Relay contact outputs (DI port)	± 4 kV	60	5	**A**
	Relay contact outputs (DO port)	± 4 kV	60	5	**A**
	Serial Com 1	± 4 kV	60	5	**A**
	Serial Com 2	± 4 kV	60	5	**A**
	Serial Com 3	± 4 kV	60	5	**A**
	Serial Com 4	± 4 kV	60	5	**A**
	SFP 1	± 4 kV	60	5	**A**
	SFP 2	± 4 kV	60	5	**A**

Mode 2: Working Mode (DC 24 V)

Test Port		Level	Measured (Sec.)	Repetition Rate (kHz)	Result
Power Port	L	± 4 kV	60	5	**A**
	N	± 4 kV	60	5	**A**
	PE	± 4 kV	60	5	**A**
	L+N	± 4 kV	60	5	**A**
	L+PE	± 4 kV	60	5	**A**
	N+PE	± 4 kV	60	5	**A**
	L+N+PE	± 4 kV	60	5	**A**
I/O Port	Ethernet copper (LAN 1)	± 4 kV	60	5	**A**
	Ethernet copper (LAN 2)	± 4 kV	60	5	**A**
	IRIG-B	± 4 kV	60	5	**A**
	Relay contact outputs (AI Port)	± 4 kV	60	5	**A**
	Relay contact outputs (DI port)	± 4 kV	60	5	**A**
	Relay contact outputs (DO port)	± 4 kV	60	5	**A**
	Serial Com 1	± 4 kV	60	5	**A**
	Serial Com 2	± 4 kV	60	5	**A**
	Serial Com 3	± 4 kV	60	5	**A**
	Serial Com 4	± 4 kV	60	5	**A**
	SFP 1	± 4 kV	60	5	**A**
	SFP 2	± 4 kV	60	5	**A**

Mode 3: Working Mode (DC 48 V)

Test Port		Level	Measured (Sec.)	Repetition Rate (kHz)	Result
Power Port	L	± 4 kV	60	5	**A**
	N	± 4 kV	60	5	**A**
	PE	± 4 kV	60	5	**A**
	L+N	± 4 kV	60	5	**A**
	L+PE	± 4 kV	60	5	**A**
	N+PE	± 4 kV	60	5	**A**
	L+N+PE	± 4 kV	60	5	**A**
I/O Port	Ethernet copper (LAN 1)	± 4 kV	60	5	**A**
	Ethernet copper (LAN 2)	± 4 kV	60	5	**A**
	IRIG-B	± 4 kV	60	5	**A**
	Relay contact outputs (AI Port)	± 4 kV	60	5	**A**
	Relay contact outputs (DI port)	± 4 kV	60	5	**A**

I/O Port	Relay contact outputs (DO port)	± 4 kV	60	5	**A**
	Serial Com 1	± 4 kV	60	5	**A**
	Serial Com 2	± 4 kV	60	5	**A**
	Serial Com 3	± 4 kV	60	5	**A**
	Serial Com 4	± 4 kV	60	5	**A**
	SFP 1	± 4 kV	60	5	**A**
	SFP 2	± 4 kV	60	5	**A**

Note:

The SFP 1 & SFP 2 during measurement , DAC Cable used.

Criteria A : No damage, no reset, no loss or corruption of stored memory or data, no maloperation and no communications/network errors.

LAN: Communications normally no errors;

DI: Show 0xFF and 0x00 no errors;

DO: Show 0xFF and 0x00 no errors;

AI: ±FS accuracy(1.6V), no errors;

Display: Monitor show normaly, no errors;

Serial Com: LED flashes normally no errors;

IRIG-B: Communications normally no errors.

Photographs of Test

9 Surge 1.2/50us

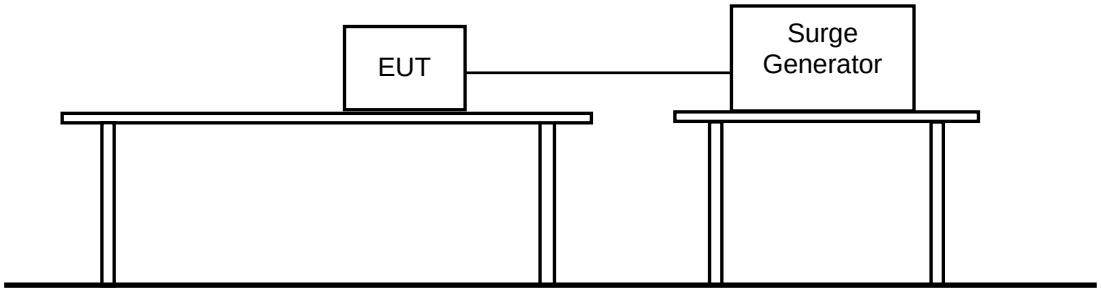
9.1 Instrument

Instrument	Manufacturer	Model	Serial No.	Next Cal. Date
Surge Generator	KeyTek	EMC Pro	0003234	2022/01/11
C.D.N	Sheng Xuan	HSX-1G3A	HSX-20150002	2022/01/11

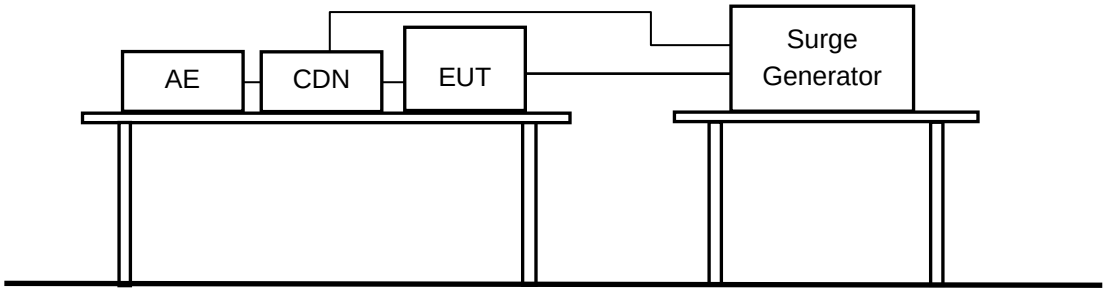
Note: The above equipments are within the valid calibration period.

9.2 Block Diagram of Test Configuration

For Power Ports.



For Signal Ports.



9.3 Test Requirement for Client

According to IEC 61850-3 & IEC 61000-4-5;

Power ports: ☒ Common Mode: ± 2.0 kV (12 Ω), 1.2/50 (8/20) Tr/Th μs

☒ Differential Mode: ± 2.0 kV (2 Ω), 1.2/50 (8/20) Tr/Th μs

Signal ports: ☒ Common Mode: ± 4.0 kV (42 Ω), 1.2/50 (8/20) Tr/Th μs

☒ Common Mode: ± 1.0 kV (162 Ω), 1.2/50 (8/20) Tr/Th μs

☒ Differential Mode: ± 2.5 kV (42 Ω), 1.2/50 (8/20) Tr/Th μs

9.4 Configuration of Measurement

9.4.1 The EUT and support units were located on a wooden table 0.8 m away from ground floor.

9.4.2 The EUT was connected to the power mains through a coupling device that directly couples the Surge interference signal.

9.4.3 The surges were applied line to line and line(s) to earth. When testing line to earth the test voltage was applied successively between each of the lines and earth. Steps up to the test level specified increased the test voltage. All lower levels including the selected test level were tested. The polarity of each surge level included positive and negative test pulses.

9.5 Test Result

PASS.

Temperature: 25.1 ℃； Humidity: 46 %； Atmospheric: 989 hPa； Test Engineer: Albert

Mode 1: Working Mode (DC 12 V)

Input Power Ports					
Test Point	Voltage (+-) (kV)	Test mode	ohm	Result	Description
Power	0.5	Common	12 Ω	**A**	1.2μs/ 50μs
Power	1	Common	12 Ω	**A**	1.2μs/ 50μs
Power	2	Common	12 Ω	**A**	1.2μs/ 50μs
Power	0.5	Differential	2 Ω	**A**	1.2μs/ 50μs
Power	1	Differential	2 Ω	**A**	1.2μs/ 50μs
Power	2	Differential	2 Ω	**A**	1.2μs/ 50μs
Signal Ports					
Test Point	Voltage (+-) (kV)	Test mode	ohm	Result	Description
Ethernet copper (LAN 1)	0.5	Common	42 Ω	**B**	1.2μs /50μs
	1	Common	42 Ω	**B**	1.2μs /50μs
	2	Common	42 Ω	**B**	1.2μs /50μs
	4	Common	42 Ω	**B**	1.2μs /50μs
Ethernet copper (LAN 2)	0.5	Common	42 Ω	**B**	1.2μs /50μs
	1	Common	42 Ω	**B**	1.2μs /50μs
	2	Common	42 Ω	**B**	1.2μs /50μs
	4	Common	42 Ω	**B**	1.2μs /50μs
Ethernet copper (LAN 1)	0.5	Common	162 Ω	**A**	1.2μs /50μs
	1	Common	162 Ω	**A**	1.2μs /50μs
Ethernet copper (LAN 2)	0.5	Common	162 Ω	**A**	1.2μs /50μs
	1	Common	162 Ω	**A**	1.2μs /50μs

IRIG-B	0.5	Common	42 Ω	**A**	1.2μs /50μs
	1	Common	42 Ω	**A**	1.2μs /50μs
	2	Common	42 Ω	**A**	1.2μs /50μs
	4	Common	42 Ω	**A**	1.2μs /50μs
	0.5	Differential	42 Ω	**A-1**	1.2μs /50μs
	1	Differential	42 Ω	**A-1**	1.2μs /50μs
	2	Differential	42 Ω	**A-1**	1.2μs /50μs
Relay contact outputs (AI Port)	0.5	Common	42 Ω	**A-1**	1.2μs /50μs
	1	Common	42 Ω	**A-1**	1.2μs /50μs
	2	Common	42 Ω	**A-1**	1.2μs /50μs
	4	Common	42 Ω	**A-1**	1.2μs /50μs
	0.5	Differential	42 Ω	**A-1**	1.2μs /50μs
	1	Differential	42 Ω	**A-1**	1.2μs /50μs
	2.5	Differential	42 Ω	**A-1**	1.2μs /50μs
Relay contact outputs (DI port)	0.5	Common	42 Ω	**A-1**	1.2μs /50μs
	1	Common	42 Ω	**A-1**	1.2μs /50μs
	2	Common	42 Ω	**A-1**	1.2μs /50μs
	4	Common	42 Ω	**A-1**	1.2μs /50μs
	0.5	Differential	42 Ω	**A-1**	1.2μs /50μs
	1	Differential	42 Ω	**A-1**	1.2μs /50μs
	2.5	Differential	42 Ω	**A-1**	1.2μs /50μs
Relay contact outputs (Do port)	0.5	Common	42 Ω	**A-1**	1.2μs /50μs
	1	Common	42 Ω	**A-1**	1.2μs /50μs
	2	Common	42 Ω	**A-1**	1.2μs /50μs
	4	Common	42 Ω	**A-1**	1.2μs /50μs
	0.5	Differential	42 Ω	**A-1**	1.2μs /50μs
	1	Differential	42 Ω	**A-1**	1.2μs /50μs
	2.5	Differential	42 Ω	**A-1**	1.2μs /50μs
Serial Com 1	0.5	Common	42 Ω	**A-1**	1.2μs /50μs
	1	Common	42 Ω	**A-1**	1.2μs /50μs
	2	Common	42 Ω	**A-1**	1.2μs /50μs
	4	Common	42 Ω	**A-1**	1.2μs /50μs
Serial Com 2	0.5	Common	42 Ω	**A-1**	1.2μs /50μs
	1	Common	42 Ω	**A-1**	1.2μs /50μs
	2	Common	42 Ω	**A-1**	1.2μs /50μs
	4	Common	42 Ω	**A-1**	1.2μs /50μs
Serial Com 3	0.5	Common	42 Ω	**A-1**	1.2μs /50μs
	1	Common	42 Ω	**A-1**	1.2μs /50μs
	2	Common	42 Ω	**A-1**	1.2μs /50μs
	4	Common	42 Ω	**A-1**	1.2μs /50μs

Serial Com 4	0.5	Common	42 Ω	**A-1**	1.2μs /50μs
	1	Common	42 Ω	**A-1**	1.2μs /50μs
	2	Common	42 Ω	**A-1**	1.2μs /50μs
	4	Common	42 Ω	**A-1**	1.2μs /50μs
SFP 1	0.5	Common	162 Ω	**A**	1.2μs /50μs
	1	Common	162 Ω	**A**	1.2μs /50μs
SFP 2	0.5	Common	162 Ω	**A**	1.2μs /50μs
	1	Common	162 Ω	**A**	1.2μs /50μs

Mode 2: Working Mode (DC 24 V)

Input Power Ports					
Test Point	Voltage (+-) (kV)	Test mode	ohm	Result	Description
Power	0.5	Common	12 Ω	**A**	1.2μs/ 50μs
Power	1	Common	12 Ω	**A**	1.2μs/ 50μs
Power	2	Common	12 Ω	**A**	1.2μs/ 50μs
Power	0.5	Differential	2 Ω	**A**	1.2μs/ 50μs
Power	1	Differential	2 Ω	**A**	1.2μs/ 50μs
Power	2	Differential	2 Ω	**A**	1.2μs/ 50μs
Signal Ports					
Test Point	Voltage (+-) (kV)	Test mode	ohm	Result	Description
Ethernet copper (LAN 1)	0.5	Common	42 Ω	**B**	1.2μs /50μs
	1	Common	42 Ω	**B**	1.2μs /50μs
	2	Common	42 Ω	**B**	1.2μs /50μs
	4	Common	42 Ω	**B**	1.2μs /50μs
Ethernet copper (LAN 2)	0.5	Common	42 Ω	**B**	1.2μs /50μs
	1	Common	42 Ω	**B**	1.2μs /50μs
	2	Common	42 Ω	**B**	1.2μs /50μs
	4	Common	42 Ω	**B**	1.2μs /50μs
Ethernet copper (LAN 1)	0.5	Common	162 Ω	**A**	1.2μs /50μs
	1	Common	162 Ω	**A**	1.2μs /50μs
Ethernet copper (LAN 2)	0.5	Common	162 Ω	**A**	1.2μs /50μs
	1	Common	162 Ω	**A**	1.2μs /50μs

IRIG-B	0.5	Common	42 Ω	**A**	1.2μs /50μs
	1	Common	42 Ω	**A**	1.2μs /50μs
	2	Common	42 Ω	**A**	1.2μs /50μs
	4	Common	42 Ω	**A**	1.2μs /50μs
	0.5	Differential	42 Ω	**A-1**	1.2μs /50μs
	1	Differential	42 Ω	**A-1**	1.2μs /50μs
	2	Differential	42 Ω	**A-1**	1.2μs /50μs
Relay contact outputs (AI Port)	0.5	Common	42 Ω	**A-1**	1.2μs /50μs
	1	Common	42 Ω	**A-1**	1.2μs /50μs
	2	Common	42 Ω	**A-1**	1.2μs /50μs
	4	Common	42 Ω	**A-1**	1.2μs /50μs
	0.5	Differential	42 Ω	**A-1**	1.2μs /50μs
	1	Differential	42 Ω	**A-1**	1.2μs /50μs
	2.5	Differential	42 Ω	**A-1**	1.2μs /50μs
Relay contact outputs (DI port)	0.5	Common	42 Ω	**A-1**	1.2μs /50μs
	1	Common	42 Ω	**A-1**	1.2μs /50μs
	2	Common	42 Ω	**A-1**	1.2μs /50μs
	4	Common	42 Ω	**A-1**	1.2μs /50μs
	0.5	Differential	42 Ω	**A-1**	1.2μs /50μs
	1	Differential	42 Ω	**A-1**	1.2μs /50μs
	2.5	Differential	42 Ω	**A-1**	1.2μs /50μs
Relay contact outputs (Do port)	0.5	Common	42 Ω	**A-1**	1.2μs /50μs
	1	Common	42 Ω	**A-1**	1.2μs /50μs
	2	Common	42 Ω	**A-1**	1.2μs /50μs
	4	Common	42 Ω	**A-1**	1.2μs /50μs
	0.5	Differential	42 Ω	**A-1**	1.2μs /50μs
	1	Differential	42 Ω	**A-1**	1.2μs /50μs
	2.5	Differential	42 Ω	**A-1**	1.2μs /50μs
Serial Com 1	0.5	Common	42 Ω	**A-1**	1.2μs /50μs
	1	Common	42 Ω	**A-1**	1.2μs /50μs
	2	Common	42 Ω	**A-1**	1.2μs /50μs
	4	Common	42 Ω	**A-1**	1.2μs /50μs
Serial Com 2	0.5	Common	42 Ω	**A-1**	1.2μs /50μs
	1	Common	42 Ω	**A-1**	1.2μs /50μs
	2	Common	42 Ω	**A-1**	1.2μs /50μs
	4	Common	42 Ω	**A-1**	1.2μs /50μs
Serial Com 3	0.5	Common	42 Ω	**A-1**	1.2μs /50μs
	1	Common	42 Ω	**A-1**	1.2μs /50μs
	2	Common	42 Ω	**A-1**	1.2μs /50μs
	4	Common	42 Ω	**A-1**	1.2μs /50μs

Serial Com 4	0.5	Common	42 Ω	**A-1**	1.2μs /50μs
	1	Common	42 Ω	**A-1**	1.2μs /50μs
	2	Common	42 Ω	**A-1**	1.2μs /50μs
	4	Common	42 Ω	**A-1**	1.2μs /50μs
SFP 1	0.5	Common	162 Ω	**A**	1.2μs /50μs
	1	Common	162 Ω	**A**	1.2μs /50μs
SFP 2	0.5	Common	162 Ω	**A**	1.2μs /50μs
	1	Common	162 Ω	**A**	1.2μs /50μs

Mode 3: Working Mode (DC 48 V)

Input Power Ports					
Test Point	Voltage (+-) (kV)	Test mode	ohm	Result	Description
Power	0.5	Common	12 Ω	**A**	1.2μs/ 50μs
Power	1	Common	12 Ω	**A**	1.2μs/ 50μs
Power	2	Common	12 Ω	**A**	1.2μs/ 50μs
Power	0.5	Differential	2 Ω	**A**	1.2μs/ 50μs
Power	1	Differential	2 Ω	**A**	1.2μs/ 50μs
Power	2	Differential	2 Ω	**A**	1.2μs/ 50μs
Signal Ports					
Test Point	Voltage (+-) (kV)	Test mode	ohm	Result	Description
Ethernet copper (LAN 1)	0.5	Common	42 Ω	**B**	1.2μs /50μs
	1	Common	42 Ω	**B**	1.2μs /50μs
	2	Common	42 Ω	**B**	1.2μs /50μs
	4	Common	42 Ω	**B**	1.2μs /50μs
Ethernet copper (LAN 2)	0.5	Common	42 Ω	**B**	1.2μs /50μs
	1	Common	42 Ω	**B**	1.2μs /50μs
	2	Common	42 Ω	**B**	1.2μs /50μs
	4	Common	42 Ω	**B**	1.2μs /50μs
Ethernet copper (LAN 1)	0.5	Common	162 Ω	**A**	1.2μs /50μs
	1	Common	162 Ω	**A**	1.2μs /50μs
Ethernet copper (LAN 2)	0.5	Common	162 Ω	**A**	1.2μs /50μs
	1	Common	162 Ω	**A**	1.2μs /50μs

IRIG-B	0.5	Common	42 Ω	**A**	1.2μs /50μs
	1	Common	42 Ω	**A**	1.2μs /50μs
	2	Common	42 Ω	**A**	1.2μs /50μs
	4	Common	42 Ω	**A**	1.2μs /50μs
	0.5	Differential	42 Ω	**A-1**	1.2μs /50μs
	1	Differential	42 Ω	**A-1**	1.2μs /50μs
	2	Differential	42 Ω	**A-1**	1.2μs /50μs
Relay contact outputs (AI Port)	0.5	Common	42 Ω	**A-1**	1.2μs /50μs
	1	Common	42 Ω	**A-1**	1.2μs /50μs
	2	Common	42 Ω	**A-1**	1.2μs /50μs
	4	Common	42 Ω	**A-1**	1.2μs /50μs
	0.5	Differential	42 Ω	**A-1**	1.2μs /50μs
	1	Differential	42 Ω	**A-1**	1.2μs /50μs
	2.5	Differential	42 Ω	**A-1**	1.2μs /50μs
Relay contact outputs (DI port)	0.5	Common	42 Ω	**A-1**	1.2μs /50μs
	1	Common	42 Ω	**A-1**	1.2μs /50μs
	2	Common	42 Ω	**A-1**	1.2μs /50μs
	4	Common	42 Ω	**A-1**	1.2μs /50μs
	0.5	Differential	42 Ω	**A-1**	1.2μs /50μs
	1	Differential	42 Ω	**A-1**	1.2μs /50μs
	2.5	Differential	42 Ω	**A-1**	1.2μs /50μs
Relay contact outputs (Do port)	0.5	Common	42 Ω	**A-1**	1.2μs /50μs
	1	Common	42 Ω	**A-1**	1.2μs /50μs
	2	Common	42 Ω	**A-1**	1.2μs /50μs
	4	Common	42 Ω	**A-1**	1.2μs /50μs
	0.5	Differential	42 Ω	**A-1**	1.2μs /50μs
	1	Differential	42 Ω	**A-1**	1.2μs /50μs
	2.5	Differential	42 Ω	**A-1**	1.2μs /50μs
Serial Com 1	0.5	Common	42 Ω	**A-1**	1.2μs /50μs
	1	Common	42 Ω	**A-1**	1.2μs /50μs
	2	Common	42 Ω	**A-1**	1.2μs /50μs
	4	Common	42 Ω	**A-1**	1.2μs /50μs
Serial Com 2	0.5	Common	42 Ω	**A-1**	1.2μs /50μs
	1	Common	42 Ω	**A-1**	1.2μs /50μs
	2	Common	42 Ω	**A-1**	1.2μs /50μs
	4	Common	42 Ω	**A-1**	1.2μs /50μs
Serial Com 3	0.5	Common	42 Ω	**A-1**	1.2μs /50μs
	1	Common	42 Ω	**A-1**	1.2μs /50μs
	2	Common	42 Ω	**A-1**	1.2μs /50μs
	4	Common	42 Ω	**A-1**	1.2μs /50μs

Serial Com 4	0.5	Common	42 Ω	**A-1**	1.2μs /50μs
	1	Common	42 Ω	**A-1**	1.2μs /50μs
	2	Common	42 Ω	**A-1**	1.2μs /50μs
	4	Common	42 Ω	**A-1**	1.2μs /50μs
SFP 1	0.5	Common	162 Ω	**A**	1.2μs /50μs
	1	Common	162 Ω	**A**	1.2μs /50μs
SFP 2	0.5	Common	162 Ω	**A**	1.2μs /50μs
	1	Common	162 Ω	**A**	1.2μs /50μs

Note:

The SFP 1 & SFP 2 during measurement , DAC Cable used

Criteria A : No damage, no reset, no loss or corruption of stored memory or data, no maloperation and no communications/network errors.

Criteria A-1= Use off-line during the test. After the test is completed, the EUT no damage, no reset, no loss or corruption of stored memory or data, no maloperation and no communications/network errors.

Criteria B: The Serial Com LED flashes abnormally during the test, and EUT no damage, no reset, no loss or corruption of stored memory or data, no maloperation and no communications/network errors after the test.

LAN: Communications normally no errors;

DI: Show 0xFF and 0x00 no errors;

DO: Show 0xFF and 0x00 no errors;

AI: ±FS accuracy(1.6V), no errors;

Display: Monitor show normaly, no errors;

Serial Com: LED flashes normally no errors;

IRIG-B: Communications normally no errors.

Photographs of Test

10 Radio-frequency, Conducted Disturbances Immunity Test

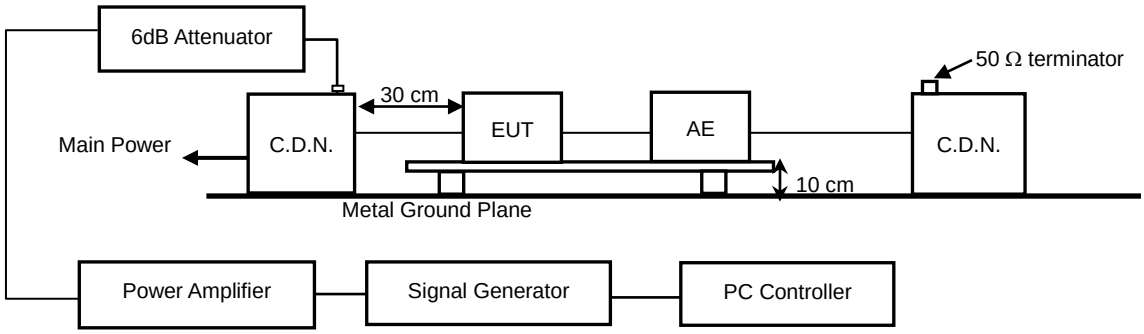
10.1 Instrument

Instrument	Manufacturer	Model	Serial No.	Next Cal. Date
Signal Generator	Marconi Instruments	2024	112246/087	2022/03/09
RF Power Amplifier	R&K	A009K101-5050R	B30850	2022/03/13
Attenuator	Microwave Device Inc.	MA-5250/6N	001052	2022/03/13
C.D.N	FCC	FCC-801-M3-25A	01030	2022/03/10
C.D.N	FCC	FCC-801-16A	2045	N.C.R.
EM Injection Clamp	SCHAFFNER	KEMZ 801	17037	2022/03/10

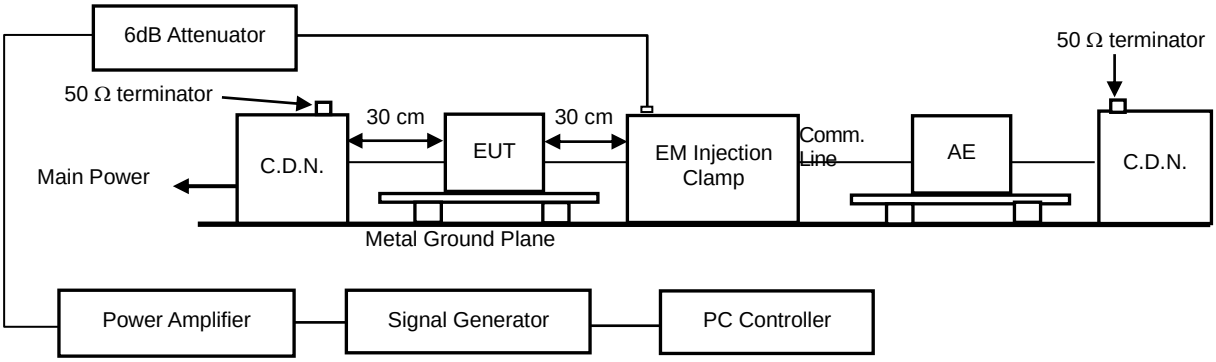
Note: The above equipments are within the valid calibration period.

10.2 Block Diagram of Test Configuration

For Power Ports.



For Signal Ports.



10.3 Test Requirement for Client

According to IEC 61850-3 & IEC 61000-4-6;

Frequency Range is from 0.15 to 80 MHz.

Spot: 27, 68 MHz

Field strength: **10** V, 80 % AM (1 kHz)

☒ Input DC power ports.

☒ Signal ports.

10.4 Configuration of Measurement

10.4.1 The EUT was placed on a table of is 0.1 m height. In Semi-Anechoic chamber A Ground reference plane was placed on the table and a 0.1 meter insulating support was inserted between the EUT and Ground reference plane.

10.4.2 The EUT was connected to the power mains through a Coupling and Decoupling Networks (CDN).

10.4.3 The test was performed with the test generator connected to each of the coupling and decoupling devices in turn while the other non-excited RF input ports of the coupling devices were terminated by a 50 Ω terminator.

10.4.4 The frequency range was swept from 150 kHz to 80 MHz. Using the signal levels established during the setting process, and without the disturbance signal 80 % amplitude modulated with a 1 kHz sine wave, pausing to adjust the RF signal level or to switch coupling devices as necessary. The rate of sweep was less than 1.5×10^{-3} decades/s. And the step size of the frequency sweep was also less than 1 % of the start and thereafter

1 % of the preceding frequency value. The dwell time at each frequency was more than the time necessary for the EUT to be excited, and able to respond.

10.4.5 The EUT was fully excised during the testing and all the selected excise modes were fully interrogated for susceptibility.

10.5 Test Result

Temperature: 22.1 ℃； Humidity: 45 %； Atmospheric: 989 hPa； Test Engineer: Albert

Mode 1: Working Mode (DC 12 V)

Appliance Item	Frequency Range	Level (V)	Result
Power Port	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Ethernet copper (LAN 1)	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Ethernet copper (LAN 2)	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
IRIG-B	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Relay contact outputs (AI Port)	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Relay contact outputs (DI port)	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Relay contact outputs (DO port)	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Serial Com 1	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Serial Com 2	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**

Serial Com 3	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Serial Com 4	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
SFP 1	0.15 MHz to 80 MHz	10	**A**
SFP 2	0.15 MHz to 80 MHz	10	**A**

Mode 2: Working Mode (DC 24 V)

Appliance Item	Frequency Range	Level (V)	Result
Power Port	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Ethernet copper (LAN 1)	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Ethernet copper (LAN 2)	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
IRIG-B	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Relay contact outputs (AI Port)	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Relay contact outputs (DI port)	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Relay contact outputs (DO port)	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Serial Com 1	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Serial Com 2	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Serial Com 3	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Serial Com 4	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
SFP 1	0.15 MHz to 80 MHz	10	**A**
SFP 2	0.15 MHz to 80 MHz	10	**A**

Mode 3: Working Mode (DC 48 V)

Appliance Item	Frequency Range	Level (V)	Result
Power Port	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Ethernet copper (LAN 1)	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Ethernet copper (LAN 2)	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
IRIG-B	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**

Relay contact outputs (AI Port)	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Relay contact outputs (DI port)	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Relay contact outputs (DO port)	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Serial Com 1	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Serial Com 2	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Serial Com 3	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
Serial Com 4	0.15 MHz to 80 MHz Spot: 27, 68 MHz	10	**A**
SFP 1	0.15 MHz to 80 MHz	10	**A**
SFP 2	0.15 MHz to 80 MHz	10	**A**

Note:

The SFP 1 & SFP 2 during measurement , DAC Cable used .

Criteria A : No damage, no reset, no loss or corruption of stored memory or data, no maloperation and no communications/network errors.

LAN: Communications normally no errors;

DI: Show 0xFF and 0x00 no errors;

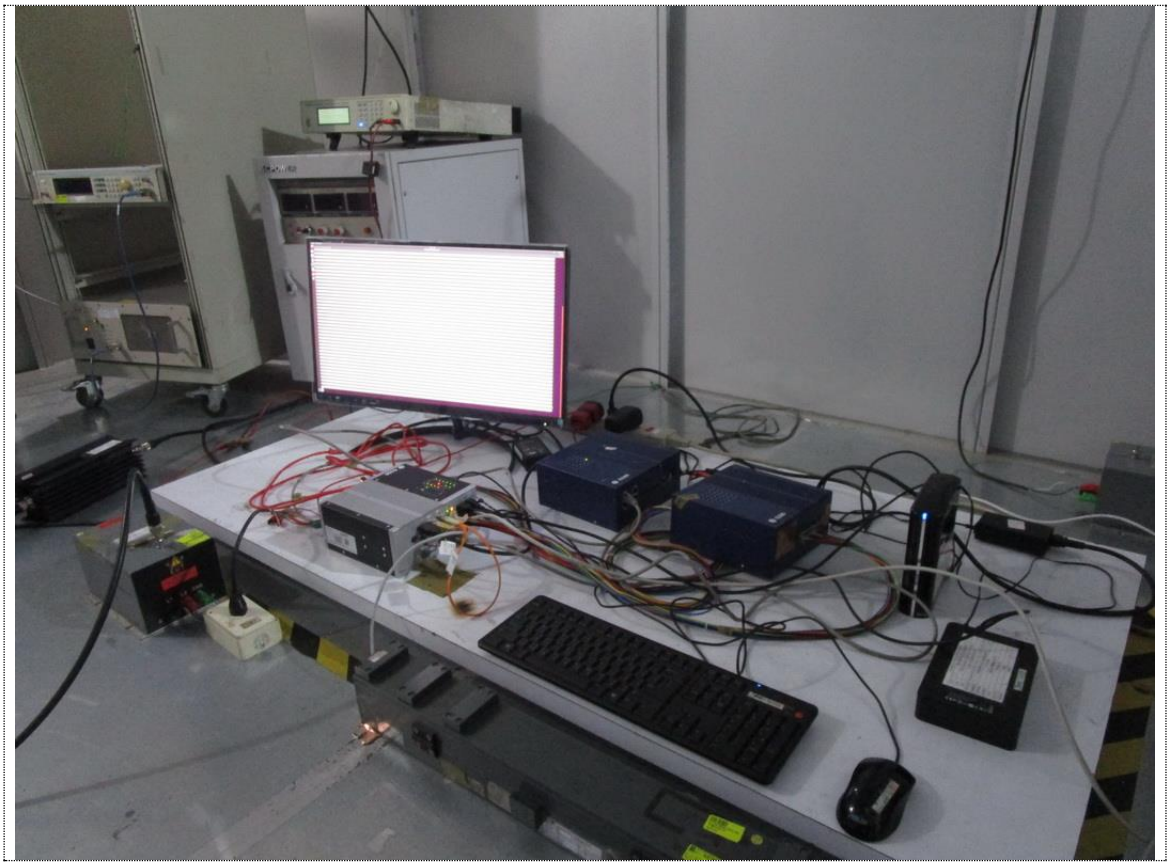
DO: Show 0xFF and 0x00 no errors;

AI: ±FS accuracy(1.6V), no errors;

Display: Monitor show normaly, no error;

Serial Com:LED flashes normally no errors;

IRIG-B: Communications normally no errors.



Photographs of Test

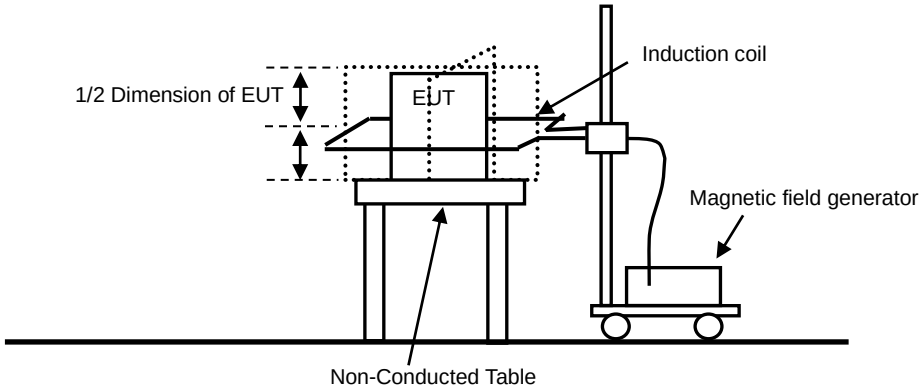
11 Power Frequency Magnetic Field Test

11.1 Instrument

Instrument	Manufacturer	Model	Serial No.	Next Cal. Date
Magnetic field generator	PMM	PMM1008	0000J00301	2021/04/29

Note: The above equipments are within the valid calibration period.

11.2 Block Diagram of Test Configuration



11.3 Test Requirement for Client

According to IEC 61850-3 & IEC 61000-4-8;

Power Frequency is 50 Hz.

Magnetic field strength:

30 A/m (60 Sec.); **100** A/m (180 Sec.); **300** A/m (3 Sec.); **1000** A/m (1 Sec.).

11.4 Configuration of Measurement

11.4.1 The equipment is configured and connected to satisfy its functional requirements.

11.4.2 All cables shall be exposed to the magnetic field for 1 m of their length.

11.4.3 Different induction coils may be selected for testing in the different orthogonal directions.

11.5 Test Result

PASS.

Temperature: 24.3 ℃； Humidity: 43 %； Atmospheric: 989 hPa； Test Engineer: Albert

Mode 1: Working Mode (DC 12 V)

Level (A/m)	Axis	Hz	Sec.	Result
30	X, Y, Z	50	60	**A**
100	X, Y, Z	50	180	**A**
300	X, Y, Z	50	3	**A**
1000	X, Y, Z	50	1	**A**

Mode 2: Working Mode (DC 24 V)

Level (A/m)	Axis	Hz	Sec.	Result
30	X, Y, Z	50	60	**A**
100	X, Y, Z	50	180	**A**
300	X, Y, Z	50	3	**A**
1000	X, Y, Z	50	1	**A**

Mode 3: Working Mode (DC 48 V)

Level (A/m)	Axis	Hz	Sec.	Result
30	X, Y, Z	50	60	**A**
100	X, Y, Z	50	180	**A**
300	X, Y, Z	50	3	**A**
1000	X, Y, Z	50	1	**A**

Note:

Criteria A : No damage, no reset, no loss or corruption of stored memory or data, no maloperation and no communications/network errors.

LAN: Communications normally no errors;

DI: Show 0xFF and 0x00 no errors;

DO: Show 0xFF and 0x00 no errors;

AI: ±FS accuracy(1.6V), no errors;

Display: Monitor show normaly, no errors;

Serial Com: LED flashes normally no errors;

IRIG-B: Communications normally no errors.

Photographs of Test

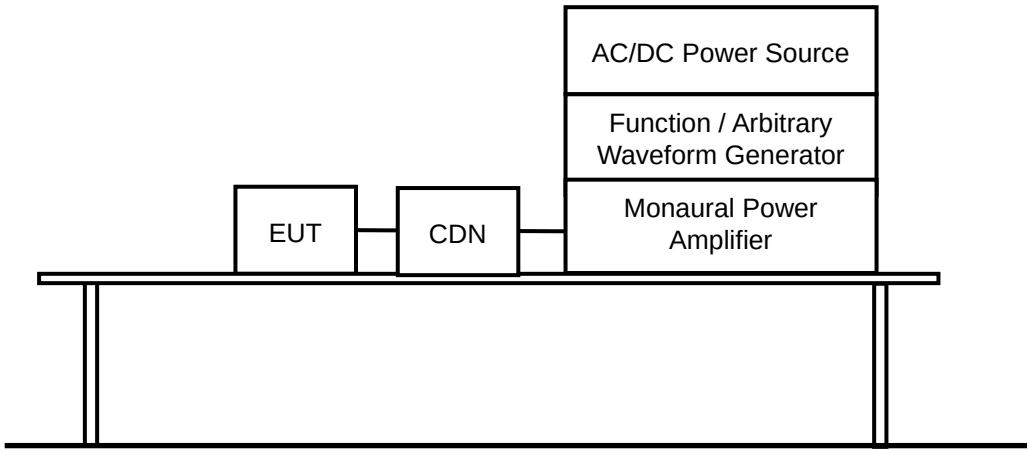
12 Conducted Common Mode Disturbances

12.1 Instrument

Instrument	Manufacturer	Model	Serial No.	Next Cal. Date
Oscilloscope	Tektronix	TDS 1012B	C062509	2021/11/17
AC/DC Power Source	N4L	N4A03-M	91J-11832	2022/03/30
CDN	IETC	CDN-416	416-2	N.C.R.
CDN	Frankonia	CN-T8	B6100003/2017	2021/10/14
CDN	Frankonia	CN-T4	B6050007/2017	2021/10/14

Note: The above equipments are within the valid calibration period.

12.2 Block Diagram of Test Configuration



12.3 Test Requirement for Client

According to IEC 61850-3 & IEC 61000-4-16:

D.C. Input ports: **30** V continuous; **300** V 1 Sec.

Telecommunication ports: **30** V continuous; **300** V 1 Sec.

12.4 Configuration of Measurement

12.4.1 The test voltage shall be applied in common mode to power supply, control, signal and communication ports.

12.4.2 Place the EUT on the GRP and connect EUT to the ground.

12.4.3 The CM voltage via the CDN coupling to the power supply, input/output and communication ports.

12.5 Test Result

PASS.

Temperature: 22.3℃； Humidity: 48 %； Atmospheric: 987 hPa； Test Engineer: Albert

Mode 1: Working Mode (DC 12 V)

Appliance Item	Test Voltage	Disturbance Time		Result
DC Power port	30 V	60	Sec.	**A**
DC Power port	300 V	1	Sec.	**A**
Ethernet copper (LAN 1)	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
Ethernet copper (LAN 2)	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
IRIG-B	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
Relay contact outputs (AI Port)	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
Relay contact outputs (DI port)	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
Relay contact outputs (Do port)	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
Serial Com 1	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
Serial Com 2	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
Serial Com 3	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
Serial Com 4	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
SFP 1	30 V	60	Sec.	**A**
	300 V	1	Sec.	**A**
SFP 2	30 V	60	Sec.	**A**
	300 V	1	Sec.	**A**

Mode 2: Working Mode (DC 24 V)

Appliance Item	Test Voltage	Disturbance Time		Result
DC Power port	30 V	60	Sec.	**A**
DC Power port	300 V	1	Sec.	**A**
Ethernet copper (LAN 1)	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**

Ethernet copper (LAN 2)	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
IRIG-B	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
Relay contact outputs (AI Port)	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
Relay contact outputs (DI port)	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
Relay contact outputs (Do port)	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
Serial Com 1	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
Serial Com 2	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
Serial Com 3	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
Serial Com 4	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
SFP 1	30 V	60	Sec.	**A**
	300 V	1	Sec.	**A**
SFP 2	30 V	60	Sec.	**A**
	300 V	1	Sec.	**A**

Mode 3: Working Mode (DC 48 V)

Appliance Item	Test Voltage	Disturbance Time		Result
DC Power port	30 V	60	Sec.	**A**
DC Power port	300 V	1	Sec.	**A**
Ethernet copper (LAN 1)	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
Ethernet copper (LAN 2)	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
IRIG-B	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
Relay contact outputs (AI Port)	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
Relay contact outputs (DI port)	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**

Relay contact outputs (Do port)	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
Serial Com 1	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
Serial Com 2	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
Serial Com 3	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
Serial Com 4	30 V	60	Sec.	**A-1**
	300 V	1	Sec.	**A-1**
SFP 1	30 V	60	Sec.	**A**
	300 V	1	Sec.	**A**
SFP 2	30 V	60	Sec.	**A**
	300 V	1	Sec.	**A**

Note:

The SFP 1 & SFP 2 during measurement , DAC Cable used .

Criteria A : No damage, no reset, no loss or corruption of stored memory or data, no maloperation and no communications/network errors.

Criteria A-1= Use off-line during the test. After the test is completed, the EUT no damage, no reset, no loss or corruption of stored memory or data, no maloperation and no communications/network errors.

LAN: Communications normally no errors;

DI: Show 0xFF and 0x00 no errors;

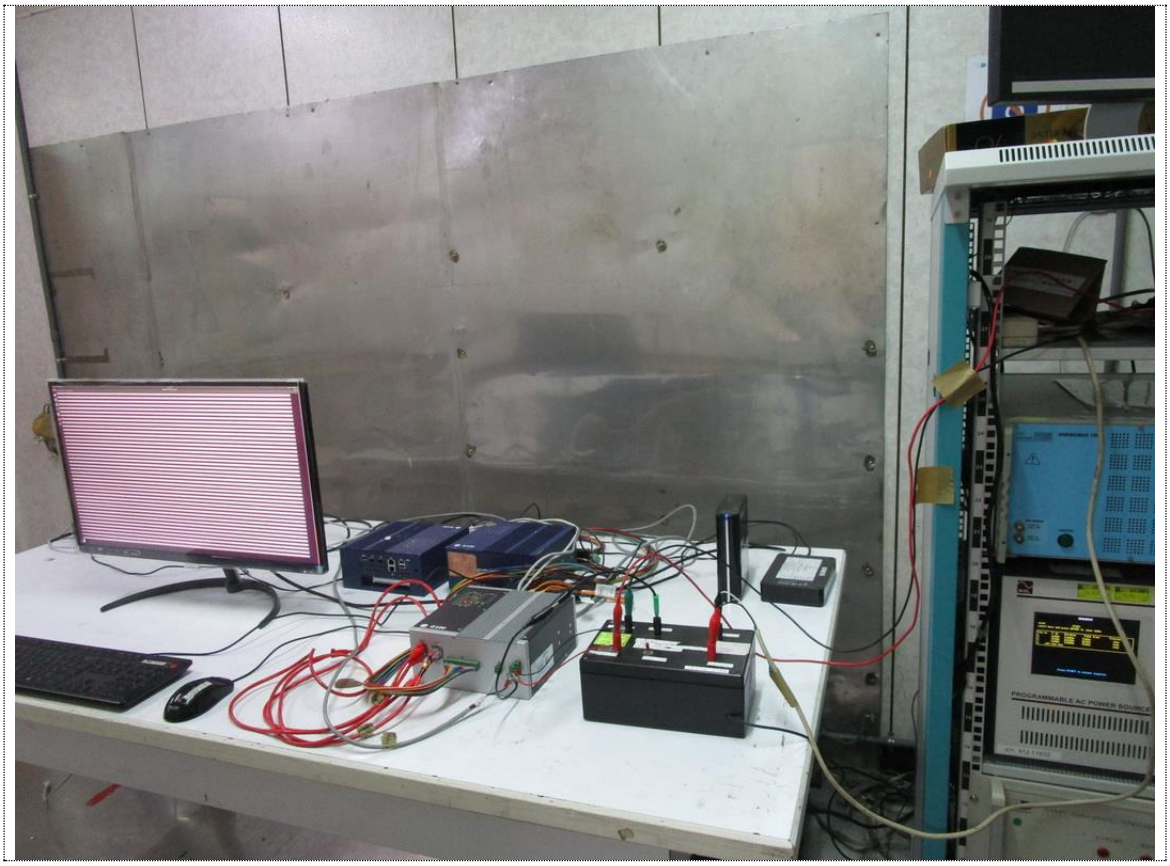
DO: Show 0xFF and 0x00 no errors;

AI: ±FS accuracy(1.6V), no errors;

Display: Monitor show normaly, no errors;

Serial Com: LED flashes normally no errors;

IRIG-B: Communications normally no errors.



Photographs of Test

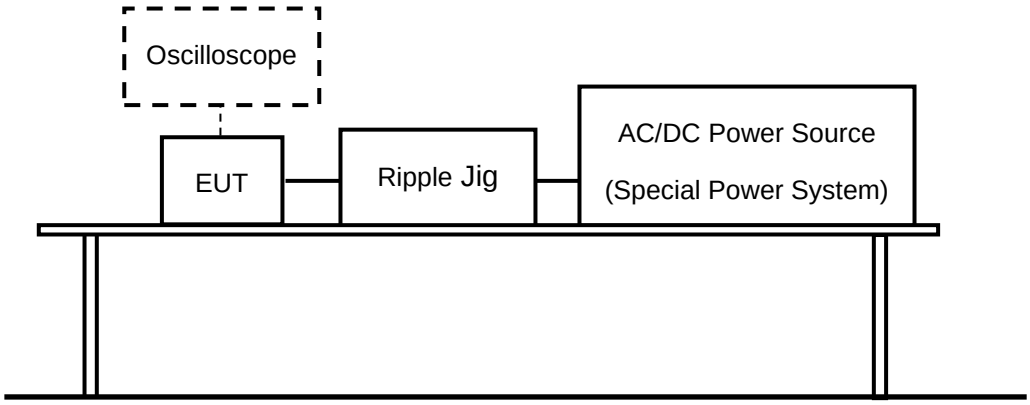
13 Ripple on d.c. Power Supply

13.1 Instrument

Instrument	Manufacturer	Model	Serial No.	Next Cal. Date
Oscilloscope	Tektronix	TDS 1012B	C062509	2021/11/17
AC/DC Power Source	N4L	N4A03-M	91J-11832	2022/03/30
Ripple Jig	IETC	Ripple-01	IETC01	N.C.R.

Note: The above equipments are within the valid calibration period.

13.2 Block Diagram of Test Configuration



13.3 Test Requirement for Client

According to IEC 61850-3 & IEC 61000-4-17;
D.C. Input or Output ports: 10 % of Un.

13.4 Configuration of Measurement

13.4.1 The test shall be performed with the EUT connected to the test generator with the shortest power supply cable as specified by the manufacturer. If no cable length is specified, it shall be the shortest practical length suitable for the connection of the EUT.

13.4.2 Place the EUT on 80cm table above RGP connect to DC power supply and confirm EUT operate function normally.

13.4.3 According by regulation and setup value as standard require, through to Power Amplifier and Function Generator connect to ripple simulate then start test.

13.4.4 During the test confirm EUT operate function normally.

13.5 Test Result

PASS.

Temperature: 22.3℃； Humidity: 48 %； Atmospheric: 987 hPa； Test Engineer: Albert

Mode 1: Working Mode (DC 12 V)

Percentage of the nominal d.c.	Frequency	Result
10 %	100 Hz	**A**

Mode 2: Working Mode (DC 24 V)

Percentage of the nominal d.c.	Frequency	Result
10 %	100 Hz	**A**

Mode 3: Working Mode (DC 48 V)

Percentage of the nominal d.c.	Frequency	Result
10 %	100 Hz	**A**

Note:

Criteria A : No damage, no reset, no loss or corruption of stored memory or data, no maloperation and no communications/network errors.

LAN: Communications normally no errors;

DI: Show 0xFF and 0x00 no errors;

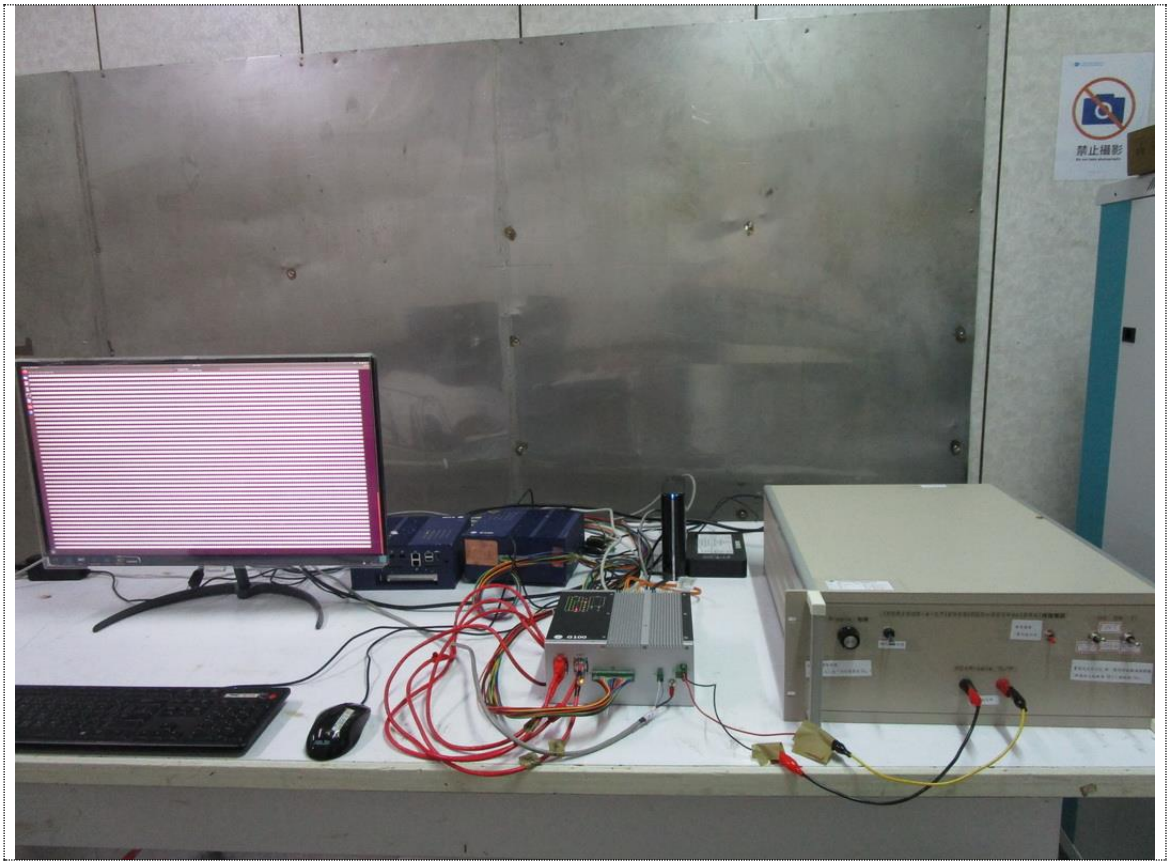
DO: Show 0xFF and 0x00 no errors;

AI: ±FS accuracy(1.6V), no errors;

Display: Monitor show normaly, no errors;

Serial Com: LED flashes normally no errors;

IRIG-B: Communications normally no errors.



Photographs of Test

14 Damped Oscillatory Wave

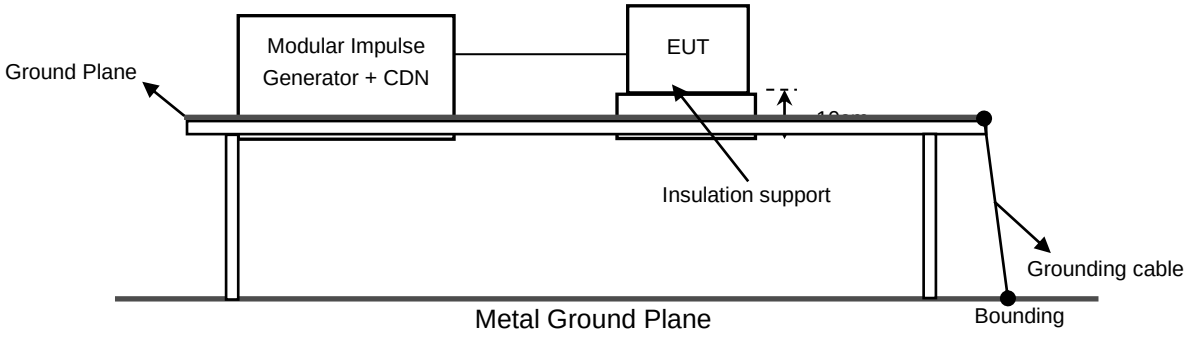
14.1 Instrument

Instrument	Manufacturer	Model	Serial No.	Next Cal. Date
Modular Impulse Generator	EMC PARTNER	MIG0603OS1	819	2021/11/18
CDN	EMC PARTNER	CDN2000-06-25	069	2021/11/18
Injection Clamp	EMC PARTNER	CN-EFT1000	497	2022/01/12

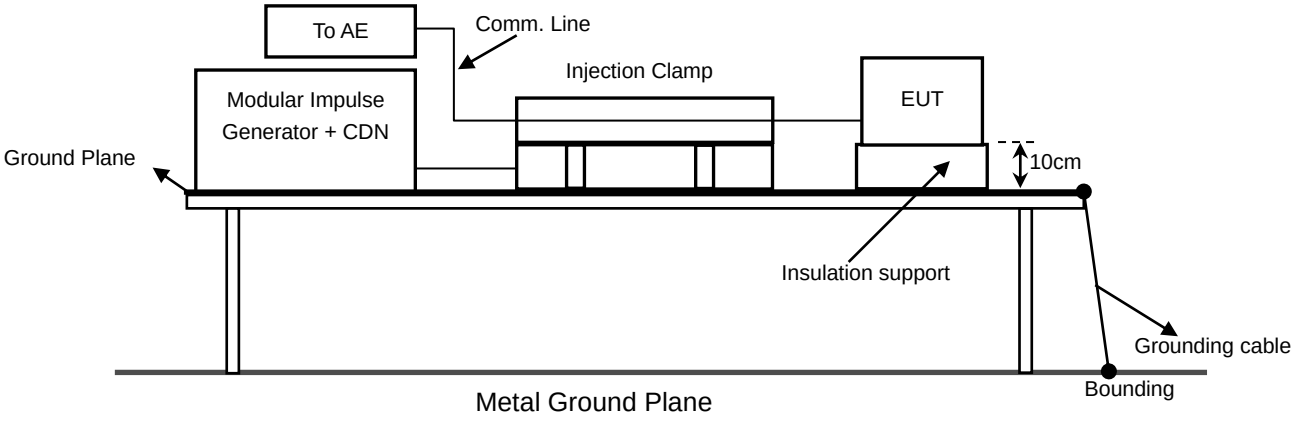
Note: The above equipments are within the valid calibration period.

14.2 Block Diagram of Test Configuration

For Power Ports.



For Signal Ports.



14.3 Test Requirement for Client

According to IEC 61850-3, IEC 61000-4-18, IEEE 1613 & IEEE 37.90.1;

☒Input DC power ports: ☒ ± 2.5 kV differential mode, 1 MHz Oscillator

☒ ± 2.5 kV common mode, 1 MHz Oscillator

☒Telecommunication ports: ☒ ± 2.5 kV differential mode, 1 MHz Oscillator

☒ ± 2.5 kV common mode, 1 MHz Oscillator

14.4 Configuration of Measurement

14.4.1 The EUT were place on a wood table of 0.1 m heights above GRP only. The size of ground plane is greater than 1 m×1 m and project beyond the EUT by at least 0.1 m on all sides. The ground plane is connected to the protective earth. The length of power cord between the coupling device and the EUT was at less long than 1 meter long.

14.4.2 The EUT was connected to the power mains through a coupling device that directly couples test generator interference signal. The noise was applied to the voltage phase at the peak value of the AC voltage wave (positive and negative).

14.4.3 The generator was applied line to line and line(s) to earth for main power. Oscillatory waves except data communications and signal circuits shall be tested in common mode.

14.5 Test Result

PASS.

Temperature: 25.2 ℃； Humidity: 45 %； Atmospheric: 987 hPa； Test Engineer: Albert

Mode 1: Working Mode (DC 12 V)

Test Item		Level	Sec.	Oscillator	Results
DC Power input port	Common mode	± 2.5 kV	60	1 MHz	**A**
DC Power input port	Differential mode	± 2.5 kV	60	1 MHz	**A**
LAN Port	Common mode	± 2.5 kV	60	1 MHz	**A**
LAN Port	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Ethernet copper (LAN 1)	Common mode	± 2.5 kV	60	1 MHz	**A**
Ethernet copper (LAN 1)	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Ethernet copper (LAN 2)	Common mode	± 2.5 kV	60	1 MHz	**A**
Ethernet copper (LAN 2)	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
IRIG-B	Common mode	± 2.5 kV	60	1 MHz	**A**
IRIG-B	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Relay contact outputs (AI Port)	Common mode	± 2.5 kV	60	1 MHz	**A**
Relay contact outputs (AI Port)	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Relay contact outputs (DI port)	Common mode	± 2.5 kV	60	1 MHz	**A**
Relay contact outputs (DI port)	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Relay contact outputs(DO port)	Common mode	± 2.5 kV	60	1 MHz	**A**

Relay contact outputs(DO port)	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Serial Com 1	Common mode	± 2.5 kV	60	1 MHz	**A**
Serial Com 1	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Serial Com 2	Common mode	± 2.5 kV	60	1 MHz	**A**
Serial Com 2	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Serial Com 3	Common mode	± 2.5 kV	60	1 MHz	**A**
Serial Com 3	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Serial Com 4	Common mode	± 2.5 kV	60	1 MHz	**A**
Serial Com 4	Differential mode	± 2.5 kV	60	1 MHz	**A**
SFP 1	Common mode	± 2.5 kV	60	1 MHz	**A**
SFP 2	Common mode	± 2.5 kV	60	1 MHz	**A**

Mode 2: Working Mode (DC 24 V)

Test Item		Level	Sec.	Oscillator	Results
DC Power input port	Common mode	± 2.5 kV	60	1 MHz	**A**
DC Power input port	Differential mode	± 2.5 kV	60	1 MHz	**A**
LAN Port	Common mode	± 2.5 kV	60	1 MHz	**A**
LAN Port	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Ethernet copper (LAN 1)	Common mode	± 2.5 kV	60	1 MHz	**A**
Ethernet copper (LAN 1)	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Ethernet copper (LAN 2)	Common mode	± 2.5 kV	60	1 MHz	**A**
Ethernet copper (LAN 2)	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
IRIG-B	Common mode	± 2.5 kV	60	1 MHz	**A**
IRIG-B	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Relay contact outputs (AI Port)	Common mode	± 2.5 kV	60	1 MHz	**A**
Relay contact outputs (AI Port)	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Relay contact outputs (DI port)	Common mode	± 2.5 kV	60	1 MHz	**A**
Relay contact outputs (DI port)	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Relay contact outputs(DO port)	Common mode	± 2.5 kV	60	1 MHz	**A**
Relay contact outputs(DO port)	Differential mode	± 2.5 kV	60	1 MHz	**A-1**

Serial Com 1	Common mode	± 2.5 kV	60	1 MHz	**A**
Serial Com 1	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Serial Com 2	Common mode	± 2.5 kV	60	1 MHz	**A**
Serial Com 2	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Serial Com 3	Common mode	± 2.5 kV	60	1 MHz	**A**
Serial Com 3	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Serial Com 4	Common mode	± 2.5 kV	60	1 MHz	**A**
Serial Com 4	Differential mode	± 2.5 kV	60	1 MHz	**A**
SFP 1	Common mode	± 2.5 kV	60	1 MHz	**A**
SFP 2	Common mode	± 2.5 kV	60	1 MHz	**A**

Mode 3: Working Mode (DC 48 V)

Test Item		Level	Sec.	Oscillator	Results
DC Power input port	Common mode	± 2.5 kV	60	1 MHz	**A**
DC Power input port	Differential mode	± 2.5 kV	60	1 MHz	**A**
LAN Port	Common mode	± 2.5 kV	60	1 MHz	**A**
LAN Port	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Ethernet copper (LAN 1)	Common mode	± 2.5 kV	60	1 MHz	**A**
Ethernet copper (LAN 1)	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Ethernet copper (LAN 2)	Common mode	± 2.5 kV	60	1 MHz	**A**
Ethernet copper (LAN 2)	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
IRIG-B	Common mode	± 2.5 kV	60	1 MHz	**A**
IRIG-B	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Relay contact outputs (AI Port)	Common mode	± 2.5 kV	60	1 MHz	**A**
Relay contact outputs (AI Port)	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Relay contact outputs (DI port)	Common mode	± 2.5 kV	60	1 MHz	**A**
Relay contact outputs (DI port)	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Relay contact outputs(DO port)	Common mode	± 2.5 kV	60	1 MHz	**A**
Relay contact outputs(DO port)	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Serial Com 1	Common mode	± 2.5 kV	60	1 MHz	**A**

Serial Com 1	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Serial Com 2	Common mode	± 2.5 kV	60	1 MHz	**A**
Serial Com 2	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Serial Com 3	Common mode	± 2.5 kV	60	1 MHz	**A**
Serial Com 3	Differential mode	± 2.5 kV	60	1 MHz	**A-1**
Serial Com 4	Common mode	± 2.5 kV	60	1 MHz	**A**
Serial Com 4	Differential mode	± 2.5 kV	60	1 MHz	**A**
SFP 1	Common mode	± 2.5 kV	60	1 MHz	**A**
SFP 2	Common mode	± 2.5 kV	60	1 MHz	**A**

Note:

The SFP 1 & SFP 2 during measurement , DAC Cable used .

Criteria A : No damage, no reset, no loss or corruption of stored memory or data, no maloperation and no communications/network errors.

Criteria A-1= Use off-line during the test. After the test is completed, the EUT no damage, no reset, no loss or corruption of stored memory or data, no maloperation and no communications/network errors.

LAN: Communications normally no errors;

DI: Show 0xFF and 0x00 no errors;

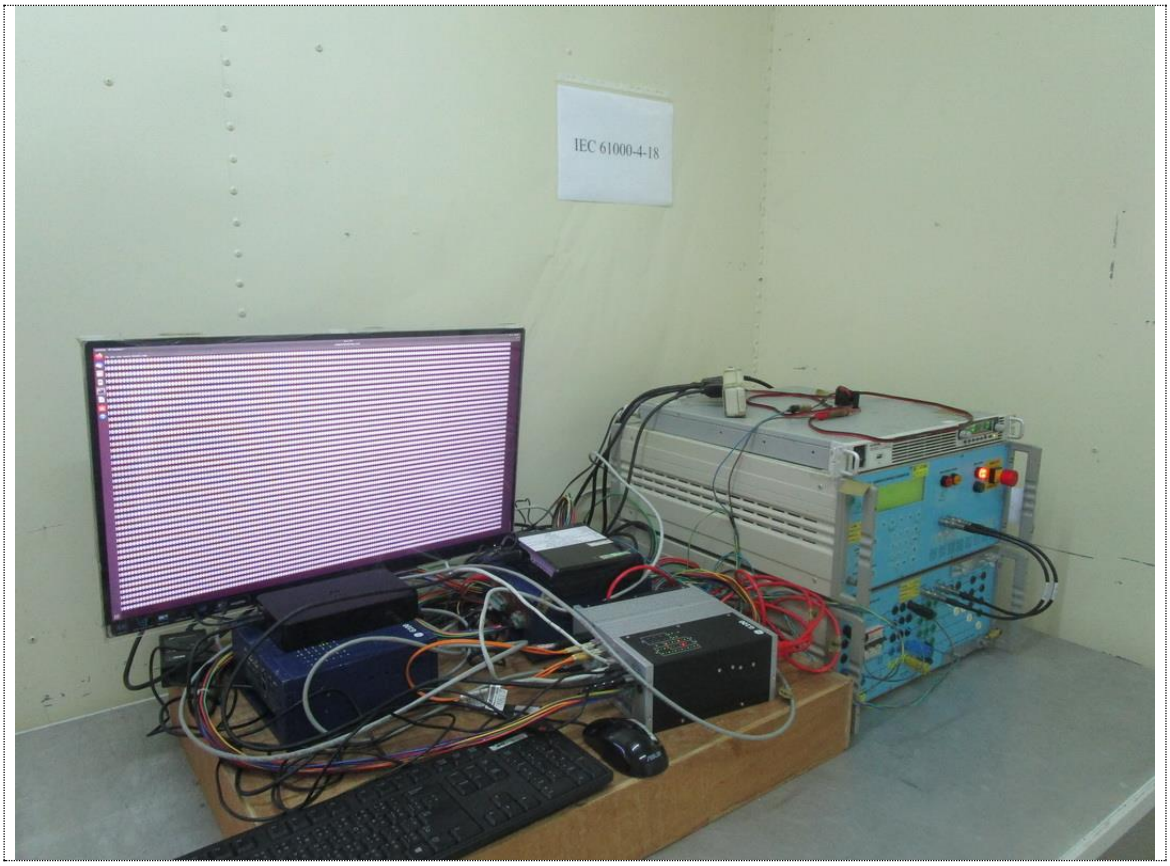
DO: Show 0xFF and 0x00 no error;

AI: ±FS accuracy(1.6V), no errors;

Display: Monitor show normaly, no errors;

Serial Com: LED flashes normally no error;

IRIG-B: Communications normally no errors.



Photographs of Test

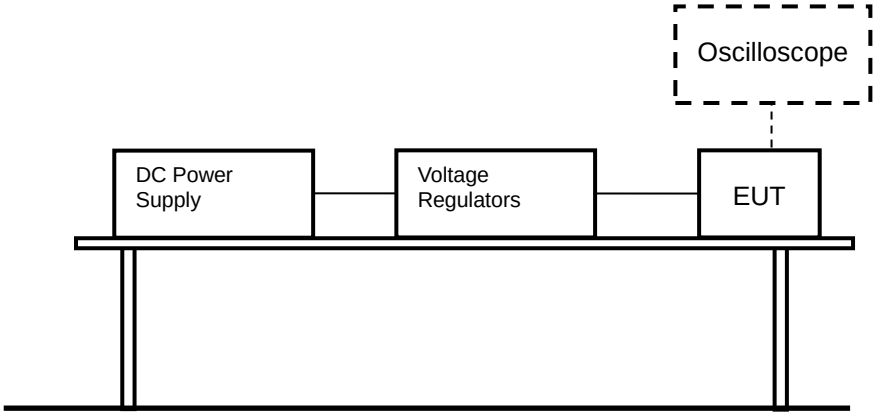
15 DC Voltage Dips & Voltage Interruptions

15.1 Instrument

Instrument	Manufacturer	Model	Serial No.	Next Cal. Date
Oscilloscope	Tektronix	TDS 1012B	C062509	2021/11/17
AC/DC Power Supply	Chroma	61604	616040003004	2022/03/30
AC/DC Power Supply	N4L	N4A03-M	91J-11832	2022/03/30
Voltage Regulators	IETC	IETC-VR	IETC-VR-001	N.C.R.

Note: The above equipments are within the valid calibration period.

15.2 Block Diagram of Test Configuration



15.3 Test Requirement for Client

According to IEC 61850-3, IEC 61000-4-29;
D.C. Input ports: 30 % reduction (Voltage Dips), 0.1 Sec.
D.C. Input ports: 60 % reduction (Voltage Dips), 0.1 Sec.
D.C. Input ports: 100 % reduction (Voltage Interruptions), 0.05 Sec.

15.4 Configuration of Measurement

15.4.1 The power cord was used as supplied by the manufacturer. The EUT was connected to the line output of the Voltage Dips and Interruption Generator.

15.4.2 The EUT was tested for (I) 30 % voltage dip of supplied voltage with duration of 0.1 sec., (II) 60 % voltage dip of supplied voltage and duration 0.1 sec. Both of the dip tests were carried out for a sequence of three voltage dips with intervals of 10 seconds. (III) 100 % voltage interruption of supplied voltage with duration of 0.05 sec was followed, which was a sequence of three voltage interruptions with intervals of 10 seconds.

15.5 Test Result

PASS.

Temperature: 25.3℃； Humidity: 43 %； Atmospheric: 989 hPa； Test Engineer: Albert

Mode 1: Working Mode (DC 12 V)

Voltage Dips	Test Time	Result
30 %	0.1 Sec.	**A**
60 %	0.1 Sec.	**A**
100 %	0.05 Sec.	**A**

Mode 2: Working Mode (DC 24 V)

Voltage Dips	Test Time	Result
30 %	0.1 Sec.	**A**
60 %	0.1 Sec.	**A**
100 %	0.05 Sec.	**A**

Mode 3: Working Mode (DC 48 V)

Voltage Dips	Test Time	Result
30 %	0.1 Sec.	**A**
60 %	0.1 Sec.	**A**
100 %	0.05 Sec.	**A**

Note:

Criteria A : No damage, no reset, no loss or corruption of stored memory or data, no maloperation and no communications/network errors.

LAN: Communications normally no errors;

DI: Show 0xFF and 0x00 no errors;

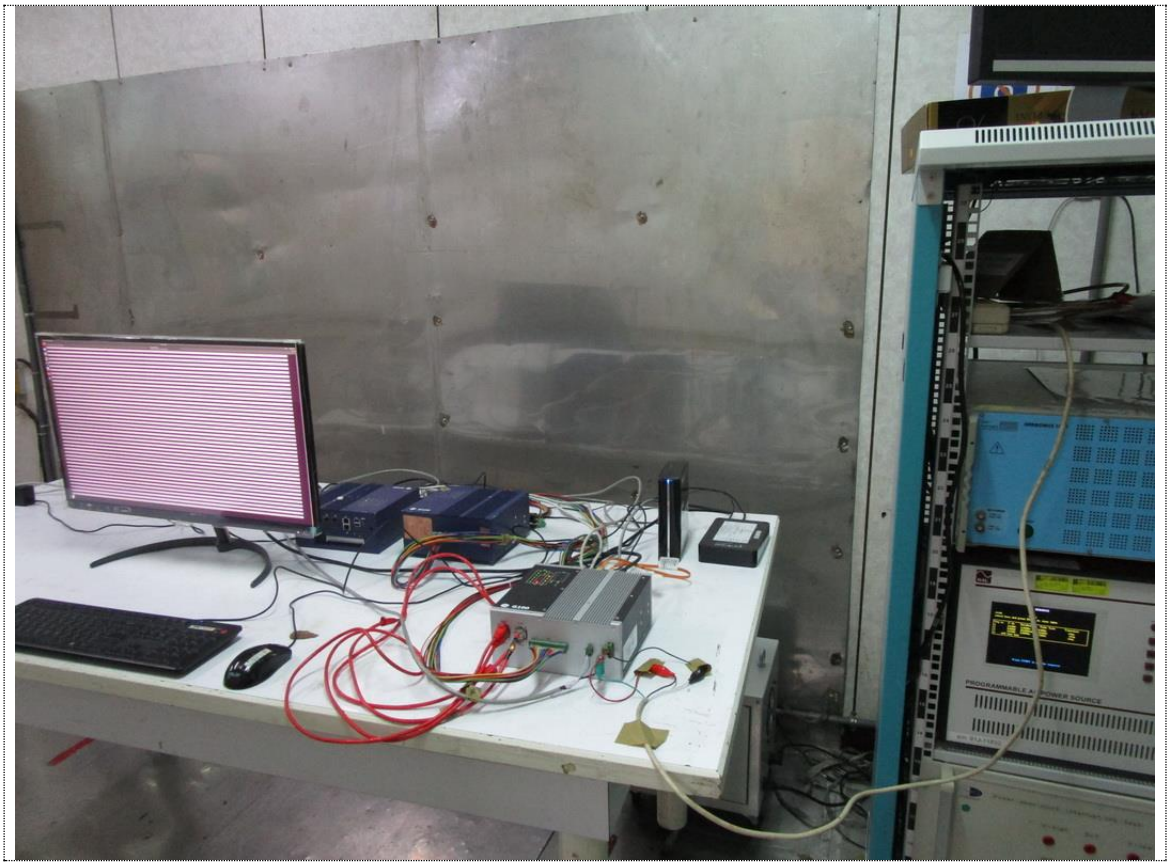
DO: Show 0xFF and 0x00 no errors;

AI: ±FS accuracy(1.6V), no errors;

Display: Monitor show normaly, no errors;

Serial Com: LED flashes normally no errors;

IRIG-B: Communications normally no errors.



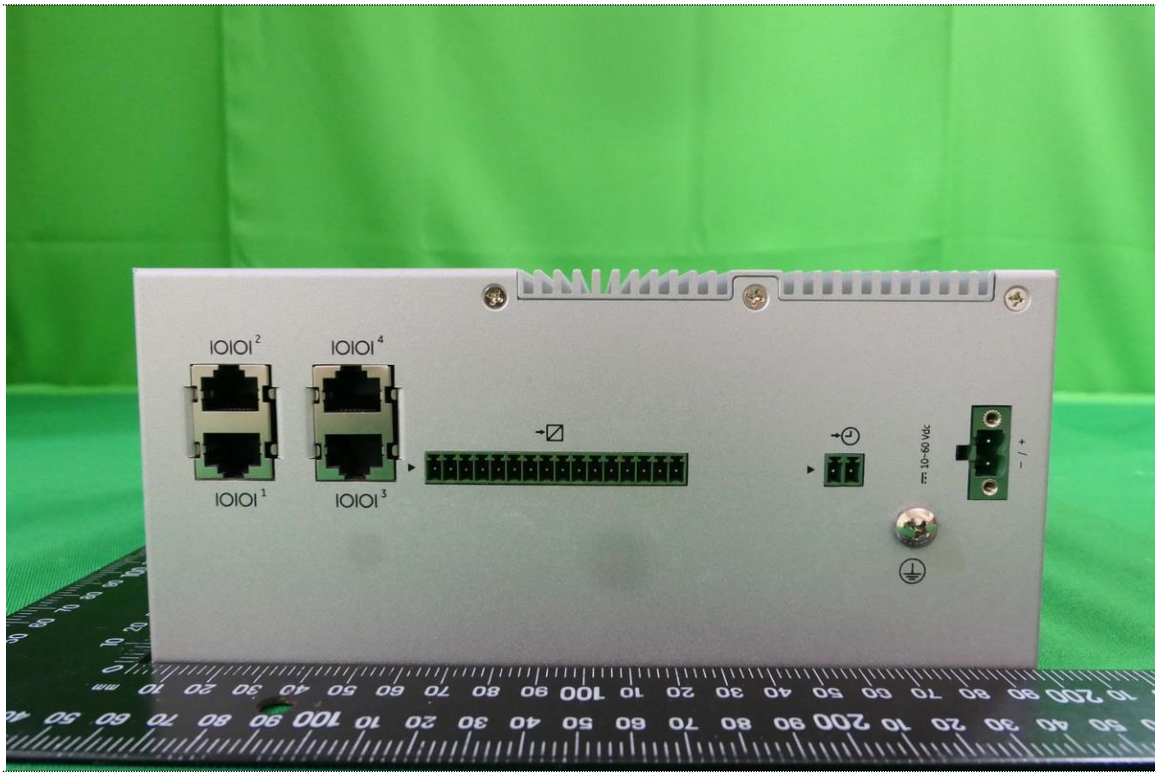
Photographs of Test

16 Photographs of EUT

Front View of EUT

Rear View of EUT

View of I/O Port-1



View of I/O Port-2