



Radio Test Report	
For:	Displaydata Limited
Product:	Electronic Shelf Label
Model:	Chroma 29L (DD29-3A)
FCC ID:	VC7-A001463
IC:	8910A-A001463
	
Project Engineer:	Richard Pennell
	
Approval Signatory:	Andy Coombes

Document Reference:	4153C FR
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1.0 OVERVIEW

1.1 Introduction

The equipment under test (EUT) as described within this document was submitted for testing as agreed with the customer.

1.2 Objective

The purpose of the test was to measure and report the EUT against limits and methods of the requested standards as listed in section 2.0 Test Summary.

1.3 Product Modifications

None to sample submitted.

1.4 Conclusion

The EUT met the emission requirements of the tests defined in section 2.0 Test Summary.

This report relates to the sample tested and may not represent the entire population. It is valid only for the product identified, either in part or in full, to the standards and/or tests covered in this document.

1.5 EMC Test Lab Reference

Eurofins E&E Hursley File: 4153C

1.6 Test Deviations

None.

2.0 TEST SUMMARY

2.1 Summary

The EUT, as described and reported within this document, complies with the applied requested sections of the standards listed below.

The EUT met the emissions test requirements of the following standards:		
Description	Referenced Standard	Status
Radiated Emissions	FCC CFR 47 Part 15 (15.109, 15.209, 15.249) ANSI C63.4: 2013 + 4a:2017 ANSI C63.10: 2013 RSS-210 issue 10: 2019 RSS-GEN issue 5:2018 (Amendment 2: February 2021)	Pass
Occupied Bandwidth	FCC CFR 47 Part 15 (15.215) ANSI C63.10: 2013 RSS-GEN issue 5:2018 (Amendment 2: February 2021) AS/NZ 4268 Section 8.3.2	Pass

3.0 EQUIPMENT AND TEST DETAILS

3.1 General

Product (EUT):	Electronic Shelf Label		
Model:	Chroma 29L (DD29-3A)	Serial Number:	TG10000039C
Sample Build:	Production Sample		
EUT Power:	Battery Power		
Customer Test Plan:	Not Applicable		
Alternate Models:	Not Applicable		
EUT Manufacturer:	Displaydata Limited		
Customer Name:	Displaydata Limited		
Customer Address:	Headley Park 10		
	Headley Road East		
	Woodley		
	Reading		
	Berkshire		
	RG5 4SW		
	United Kingdom		
Test Commissioned By:	Dave Jones		
Date EUT Received:	5 th October 2022		
Test Date(s):	5 th to 13 th October 2022		
EMC Measurement Site:	Eurofins E&E Hursley Limited		
	Trafalgar Close, Chandlers Ford, Hampshire, United Kingdom		
Product Category:	IT and Multimedia Electrical Equipment,		

3.2 EUT Description

The EUT is an Electronic Shelf Label using radio technology which operates in the 902 to 928MHz band.

3.3 Support Equipment

Description	Manufacturer	Model	Serial Number
Dynamic Communicator	Displaydata Limited	E2	ZC00018022

3.4 EUT Test Exerciser

In normal operation the ESL has an extremely low duty cycle. Therefore, to facilitate emissions testing, the ESL is loaded with special RF test software.

By default, when running the RF test software, the ESL is idle, waiting for a test command to be sent from the laptop via the Dynamic Communicator.

Displaydata's 1.3.0 release of RF test software was used during the testing of the ESL

Radiated Emissions testing:

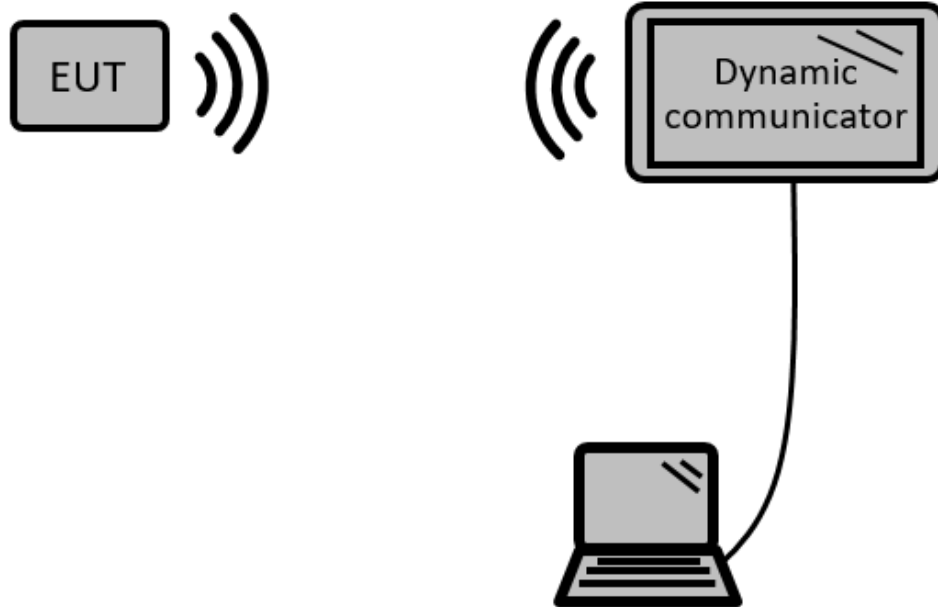
The Dynamic Communicator / Laptop are used to send a command to the ESL which causes the ESL to continuously transmit a continuous (100% duty cycle) modulated carrier, using data rate of 100 kbps. The duration of the continuous modulated transmission is programmable. The duration of transmission is chosen to ensure that the modulated transmission continues for the length of each emissions scan.

Radiated emissions testing was carried out on bottom, middle and top channels, 902.5MHz, 913.5MHz and 927.5 MHz respectively.

Idle Emissions testing:

During Idle Emissions testing of the ESL, running the RF test software, is left in its idle state, there is no active transmission.

3.5 EUT Test Configuration #1



4.0 TEST RESULTS

4.1 Radiated Emissions; Top Landscape

4.1.1 Test Parameters

A profile scan was taken using an EMI receiver at a distance of three metres on eight azimuths of the EUT in both the vertical and horizontal polarisation of the field in a semi-anechoic chamber.

Using the pre-scan results as a guide, each emission from the EUT was maximised. Measurements were carried out at a distance of three metres using the specified detector in a CISPR 16-1-4 compliant semi-anechoic chamber. Cable positions were then finally adjusted to produce the maximum emission levels. The worst-case results are reported below.

Test Equipment						
#ID	CP	Manufacturer	Type	Serial Number	Description	Calibration Due Date
053	1	HP	8449B	3008A01394	Pre-amplifier (1.0-26.5GHz) (with #516)	19/10/2022
073	3	Schwarzbeck	BBHA9120B	237	Horn Antenna (1-10GHz)	20/05/2024
750	1	Global	CISPR16	1	11 x 7 x 6.2m, chamber	14/12/2022
762	3	Schwarzbeck	VULB9162	129	30-7000MHz	04/03/2024
762a	3	Schwarzbeck	DGA 9552N	0	Attenuator (6dB) for #762	04/03/2024
788	1	Rohde & Schwarz	ESW 44	101799	EMI test receiver (44GHz)	09/08/2023
877	1	Huber & Suhner	SUCOTEST_18A	602608/18A	ST_18A/Nm/Nm/3m	19/04/2023
Test Equipment Software						
#ID	CP	Manufacturer	Type		Description	Calibration Due Date
856	0	Rohde & Schwarz	Software	0	EMC32 v10.50.10	Not required

Environmental Test Conditions		
Frequency	Below 1GHz	Above 1GHz
Temperature	21.2° Celsius	19.2° Celsius
Relative Humidity	62%	53%
Atmospheric Pressure	1011.6 millibars	1031.9 millibars
Test Date:	5 th October 2022	6 th October 2022
Test Engineer:	Richard Pennell	Richard Pennell

Note: "Calibration due date" means the instrument is certified within UKAS or traceable calibration certificate. "Internal" means the instrument is calibrated using Eurofins Hursley procedures. "Not required" means the asset does not require calibration. "CP" is the interval period [year] prescribed for external calibration.

4.1.2 Test Configuration

Please refer to EUT Test Configuration #1.

4.1.3 Set-up Photos; Below 1GHz

Radiated Emissions; Below 1GHz



4.1.4 Set-up Photos; Above 1GHz

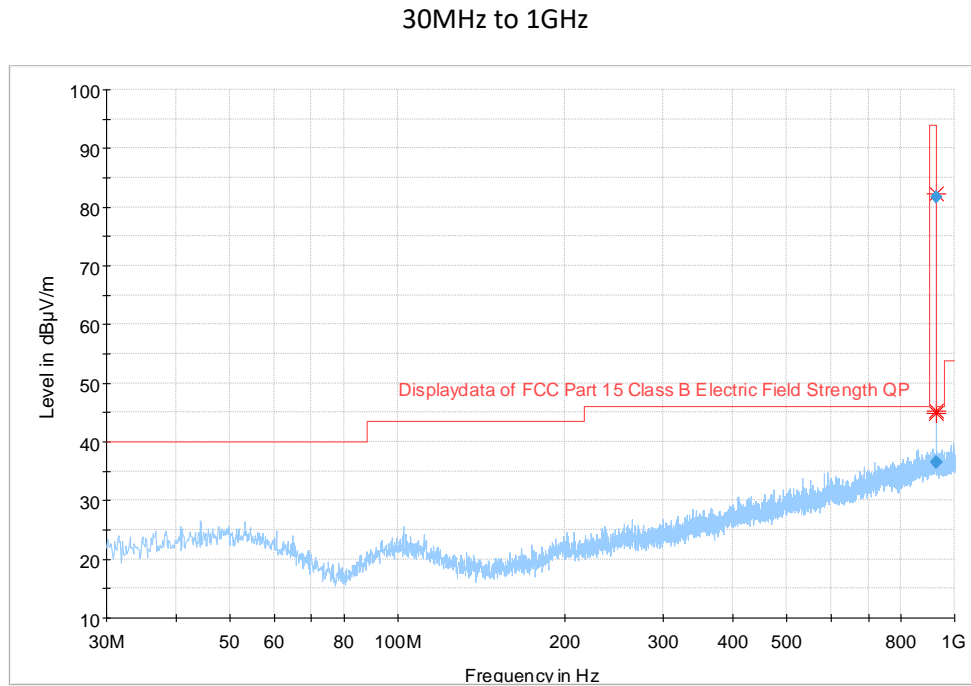
Radiated Emissions; Above 1GHz



4.1.5 Profile; 30MHz to 1GHz, Top Landscape

Maximum peak hold trace with quasi-peak values (◆)

Peak measurements (✱)



4.1.6 Data; 30MHz to 1GHz, Top Landscape

Emission Frequency	Measured Quasi-Peak Value	FCC Specified Quasi-Peak Limit	Pass Margin	Antenna Polarisation	Antenna Height	Turntable Azimuth	
MHz	dBµV/m	dBµV/m	dB	H/V	cm	deg	Status
927.500000	81.95	94.00	12.05	V	128.0	121.0	Pass
928.000000	36.93	94.00	57.07	V	239.0	106.0	Pass
928.050000	36.49	46.00	9.51	V	271.0	34.0	Pass

V = Vertical / H = Horizontal

The measurements reported are the highest emissions relative to the FCC limits and take into account the correction factor*. Measurements made according to the CISPR test standard and Eurofins Hursley test procedure RAD-01.

*Correction factor (dB) = cable and antenna losses as summed positive values (dB) – pre-amp gain where applicable (dB).

The recorded measured value (dB) = measured receiver value (dB) + correction factor (dB).

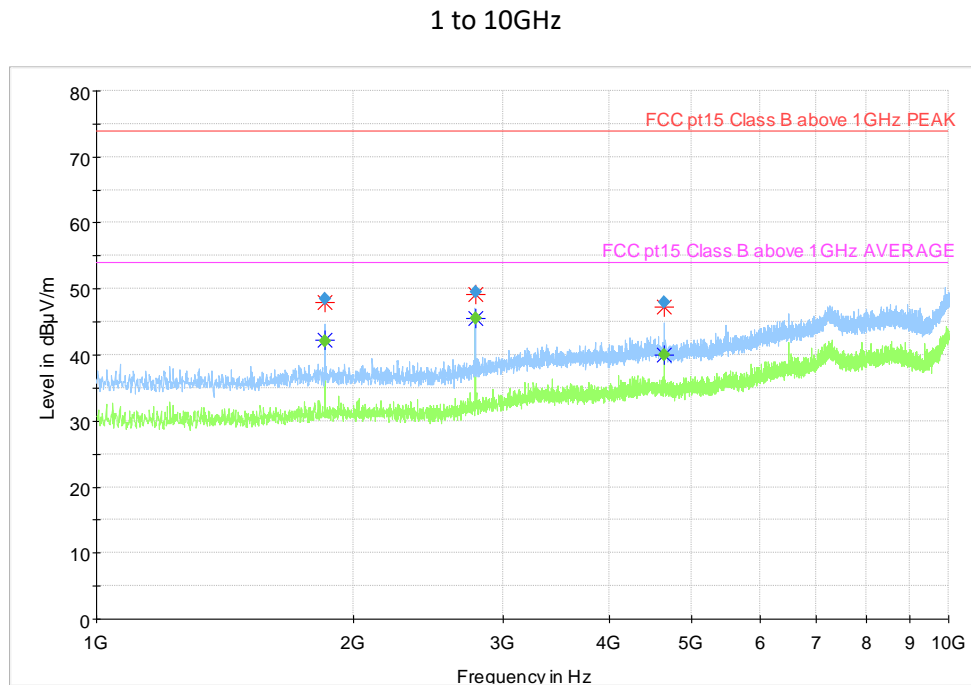
Note: Path losses are factored into the limit value, and given by the test standard. Chamber calibration data contributes to the measurement uncertainty figure.

4.1.7 Profile; 1 to 10GHz, Top Landscape

Maximum hold trace with peak values (◆)

Peak measurements (✱)

Average measurements (◆)



4.1.8 Data; 1 to 10GHz, Top Landscape

Frequency	Peak	CISPR Average	FCC Limit	Margin	Height	Pol	Azimuth	Corr.	
MHz	dBµV/m	dBµV/m	dBµV/m	dB	cm	H/V	Deg	dB/m	Status
1854.942031	---	42.00	54.00	12.00	160.0	V	180.0	-7.3	Pass
1855.057969	48.53	---	74.00	25.47	128.0	H	18.0	-7.3	Pass
2782.434688	---	45.55	54.00	8.46	109.0	H	41.0	-5.4	Pass
2782.747663	49.58	---	74.00	24.42	100.0	H	42.0	-5.4	Pass
4637.351341	48.00	---	74.00	26.00	118.0	V	165.0	-1.4	Pass
4637.414820	---	40.00	54.00	14.00	100.0	V	174.0	-1.4	Pass

V = Vertical / H = Horizontal

The measurements reported are the highest emissions relative to the FCC limits and take into account the correction factor*. Measurements made according to the CISPR test standard and Eurofins Hursley test procedure RAD-01.

*Correction factor (dB) = cable and antenna losses as summed positive values (dB) – pre-amp gain where applicable (dB).

The recorded measured value (dB) = measured receiver value (dB) + correction factor (dB).

Note: path losses are factored into the limit value, and given by the test standard. Chamber calibration data contributes to the measurement uncertainty figure.

4.2 Radiated Emissions; Middle Landscape

4.2.1 Test Parameters

A profile scan was taken using an EMI receiver at a distance of three metres on eight azimuths of the EUT in both the vertical and horizontal polarisation of the field in a semi-anechoic chamber.

Using the pre-scan results as a guide, each emission from the EUT was maximised. Measurements were carried out at a distance of three metres using the specified detector in a CISPR 16-1-4 compliant semi-anechoic chamber. Cable positions were then finally adjusted to produce the maximum emission levels. The worst-case results are reported below.

Test Equipment						
#ID	CP	Manufacturer	Type	Serial Number	Description	Calibration Due Date
053	1	HP	8449B	3008A01394	Pre-amplifier (1.0-26.5GHz) (with #516)	19/10/2022
073	3	Schwarzbeck	BBHA9120B	237	Horn Antenna (1-10GHz)	20/05/2024
750	1	Global	CISPR16	1	11 x 7 x 6.2m, chamber	14/12/2022
762	3	Schwarzbeck	VULB9162	129	30-7000MHz	04/03/2024
762a	3	Schwarzbeck	DGA 9552N	0	Attenuator (6dB) for #762	04/03/2024
788	1	Rohde & Schwarz	ESW 44	101799	EMI test receiver (44GHz)	09/08/2023
877	1	Huber & Suhner	SUCOTEST_18A	602608/18A	ST_18A/Nm/Nm/3m	19/04/2023
Test Equipment Software						
#ID	CP	Manufacturer	Type		Description	Calibration Due Date
856	0	Rohde & Schwarz	Software	0	EMC32 v10.50.10	Not required

Environmental Test Conditions		
Frequency	Below 1GHz	Above 1GHz
Temperature	21.2° Celsius	19.2° Celsius
Relative Humidity	62%	53%
Atmospheric Pressure	1011.6 millibars	1031.9 millibars
Test Date:	5 th October 2022	6 th October 2022
Test Engineer:	Richard Pennell	Richard Pennell

Note: "Calibration due date" means the instrument is certified within UKAS or traceable calibration certificate. "Internal" means the instrument is calibrated using Eurofins Hursley procedures. "Not required" means the asset does not require calibration. "CP" is the interval period [year] prescribed for external calibration.

4.2.2 Test Configuration

Please refer to EUT Test Configuration #1.

4.2.3 Set-up Photos; Below 1GHz

Radiated Emissions; Below 1GHz



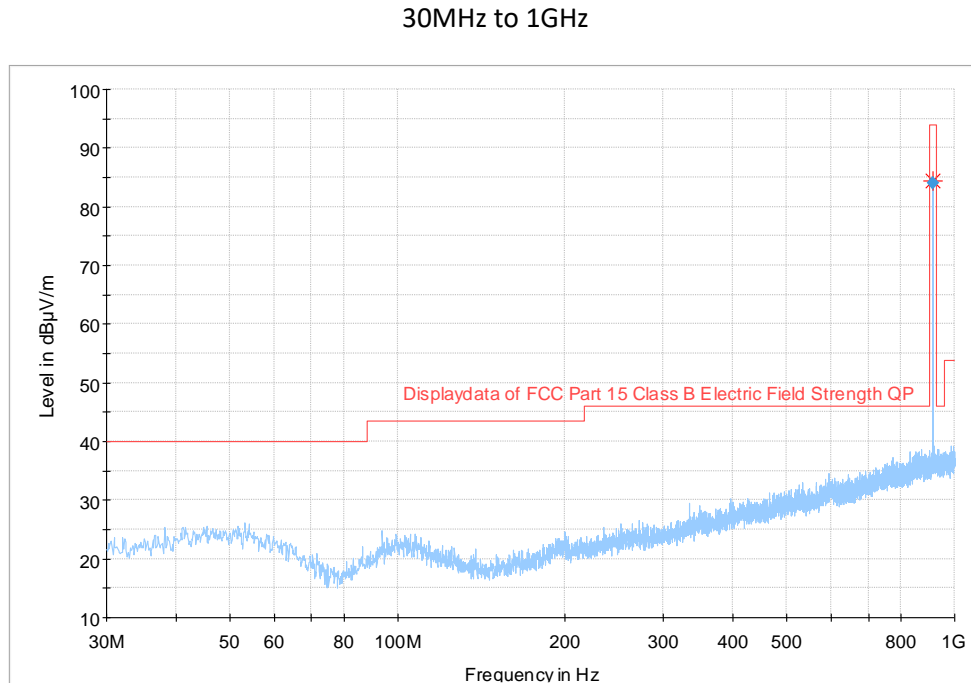
4.2.4 Set-up Photos; Above 1GHz

Radiated Emissions; Above 1GHz



4.2.5 Profile; 30MHz to 1GHz, Middle Landscape

Maximum peak hold trace with quasi-peak values (◆)
 Peak measurements (✱)



4.2.6 Data; 30MHz to 1GHz, Middle Landscape

Emission Frequency	Measured Quasi-Peak Value	FCC Specified Quasi-Peak Limit	Pass Margin	Antenna Polarisation	Antenna Height	Turntable Azimuth	Status
MHz	dBµV/m	dBµV/m	dB	H/V	cm	deg	
913.500000	83.90	94.00	10.10	V	128.0	118.0	Pass

V = Vertical / H = Horizontal

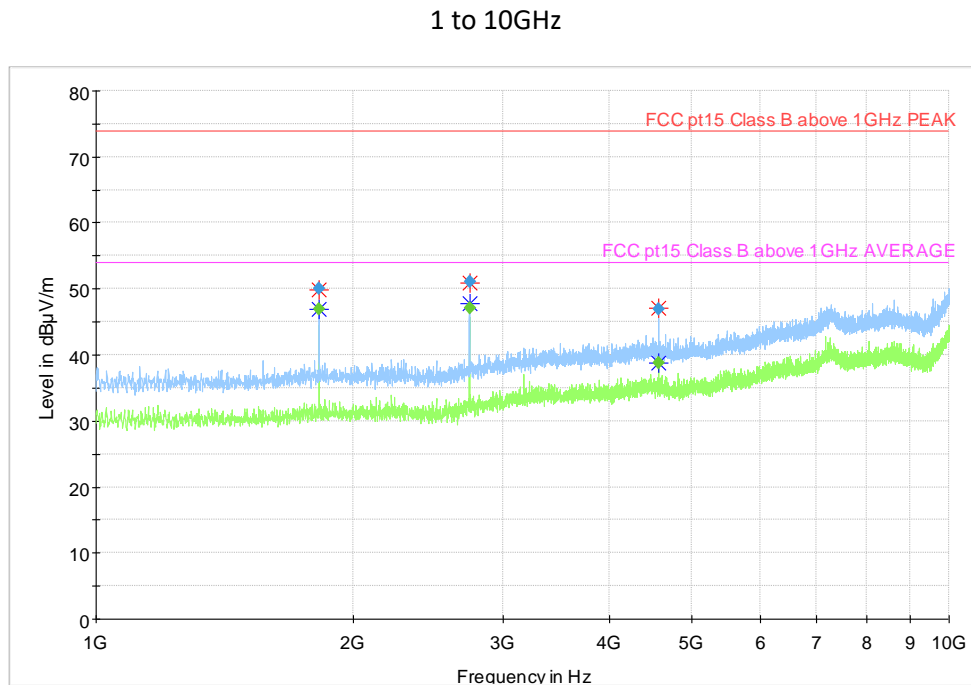
The measurements reported are the highest emissions relative to the FCC limits and take into account the correction factor*. Measurements made according to the CISPR test standard and Eurofins Hursley test procedure RAD-01.
 *Correction factor (dB) = cable and antenna losses as summed positive values (dB) – pre-amp gain where applicable (dB).
 The recorded measured value (dB) = measured receiver value (dB) + correction factor (dB).
 Note: Path losses are factored into the limit value, and given by the test standard. Chamber calibration data contributes to the measurement uncertainty figure.

4.2.7 Profile; 1 to 10GHz, Middle Landscape

Maximum hold trace with peak values (◆)

Peak measurements (✱)

Average measurements (◆)



4.2.8 Data; 1 to 10GHz, Middle Landscape

Frequency	Peak	CISPR Average	FCC Limit	Margin	Height	Pol	Azimuth	Corr.	Status
MHz	dBµV/m	dBµV/m	dBµV/m	dB	cm	H/V	Deg	dB/m	
1827.034852	---	46.89	54.00	7.11	149.0	H	187.0	-7.3	Pass
1827.320302	50.02	---	74.00	23.98	140.0	H	9.0	-7.3	Pass
2740.443510	---	47.05	54.00	6.95	109.0	H	41.0	-5.6	Pass
2740.717548	51.09	---	74.00	22.91	100.0	H	41.0	-5.6	Pass
4567.375000	---	38.79	54.00	15.21	129.0	V	181.0	-1.3	Pass
4567.717554	46.88	---	74.00	27.12	180.0	V	199.0	-1.3	Pass

V = Vertical / H = Horizontal

The measurements reported are the highest emissions relative to the FCC limits and take into account the correction factor*. Measurements made according to the CISPR test standard and Eurofins Hursley test procedure RAD-01.

*Correction factor (dB) = cable and antenna losses as summed positive values (dB) – pre-amp gain where applicable (dB).

The recorded measured value (dB) = measured receiver value (dB) + correction factor (dB).

Note: path losses are factored into the limit value, and given by the test standard. Chamber calibration data contributes to the measurement uncertainty figure.

4.3 Radiated Emissions; Bottom Landscape

4.3.1 Test Parameters

A profile scan was taken using an EMI receiver at a distance of three metres on eight azimuths of the EUT in both the vertical and horizontal polarisation of the field in a semi-anechoic chamber.

Using the pre-scan results as a guide, each emission from the EUT was maximised. Measurements were carried out at a distance of three metres using the specified detector in a CISPR 16-1-4 compliant semi-anechoic chamber. Cable positions were then finally adjusted to produce the maximum emission levels. The worst-case results are reported below.

Test Equipment						
#ID	CP	Manufacturer	Type	Serial Number	Description	Calibration Due Date
053	1	HP	8449B	3008A01394	Pre-amplifier (1.0-26.5GHz) (with #516)	19/10/2022
073	3	Schwarzbeck	BBHA9120B	237	Horn Antenna (1-10GHz)	20/05/2024
750	1	Global	CISPR16	1	11 x 7 x 6.2m, chamber	14/12/2022
762	3	Schwarzbeck	VULB9162	129	30-7000MHz	04/03/2024
762a	3	Schwarzbeck	DGA 9552N	0	Attenuator (6dB) for #762	04/03/2024
788	1	Rohde & Schwarz	ESW 44	101799	EMI test receiver (44GHz)	09/08/2023
877	1	Huber & Suhner	SUCOTEST_18A	602608/18A	ST_18A/Nm/Nm/3m	19/04/2023
Test Equipment Software						
#ID	CP	Manufacturer	Type		Description	Calibration Due Date
856	0	Rohde & Schwarz	Software	0	EMC32 v10.50.10	Not required

Environmental Test Conditions		
Frequency	Below 1GHz	Above 1GHz
Temperature	21.2° Celsius	19.2° Celsius
Relative Humidity	62%	53%
Atmospheric Pressure	1011.6 millibars	1031.9 millibars
Test Date:	5 th October 2022	6 th October 2022
Test Engineer:	Richard Pennell	Richard Pennell

Note: "Calibration due date" means the instrument is certified within UKAS or traceable calibration certificate. "Internal" means the instrument is calibrated using Eurofins Hursley procedures. "Not required" means the asset does not require calibration. "CP" is the interval period [year] prescribed for external calibration.

4.3.2 Test Configuration

Please refer to EUT Test Configuration #1.

4.3.3 Set-up Photos; Below 1GHz

Radiated Emissions; Below 1GHz



4.3.4 Set-up Photos; Above 1GHz

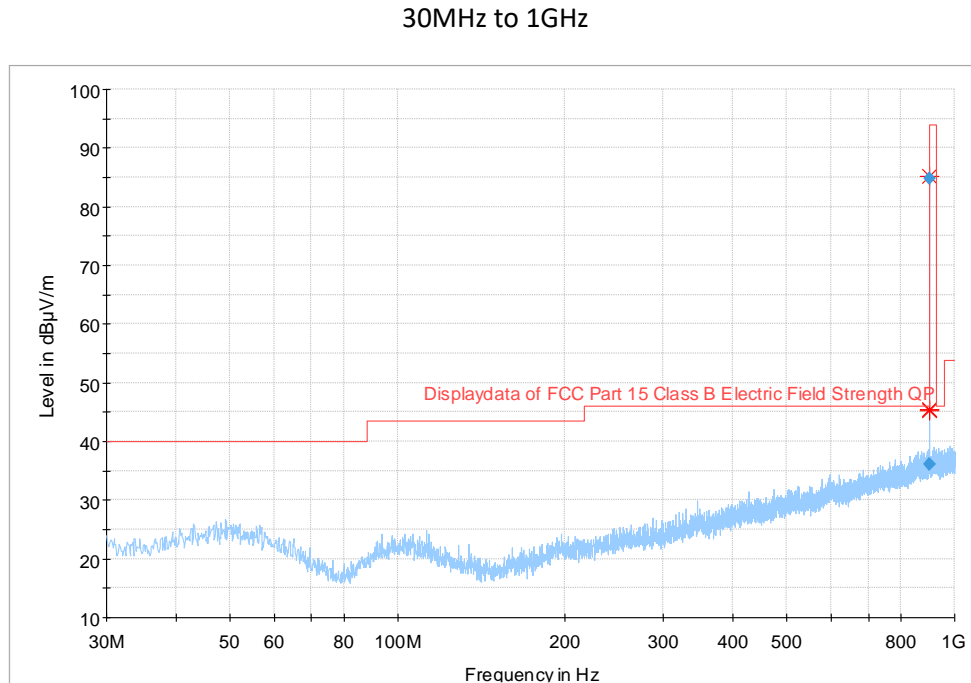
Radiated Emissions; Above 1GHz



4.3.5 Profile; 30MHz to 1GHz, Bottom Landscape

Maximum peak hold trace with quasi-peak values (◆)

Peak measurements (✱)



4.3.6 Data; 30MHz to 1GHz, Bottom Landscape

Emission Frequency	Measured Quasi-Peak Value	FCC Specified Quasi-Peak Limit	Pass Margin	Antenna Polarisation	Antenna Height	Turntable Azimuth	
MHz	dBµV/m	dBµV/m	dB	H/V	cm	deg	Status
901.950000	36.50	46.00	9.50	V	129.0	326.0	Pass
902.000000	36.20	94.00	57.80	H	282.0	111.0	Pass
902.500000	84.75	94.00	9.25	V	128.0	113.0	Pass

V = Vertical / H = Horizontal

The measurements reported are the highest emissions relative to the FCC limits and take into account the correction factor*. Measurements made according to the CISPR test standard and Eurofins Hursley test procedure RAD-01.

*Correction factor (dB) = cable and antenna losses as summed positive values (dB) – pre-amp gain where applicable (dB).

The recorded measured value (dB) = measured receiver value (dB) + correction factor (dB).

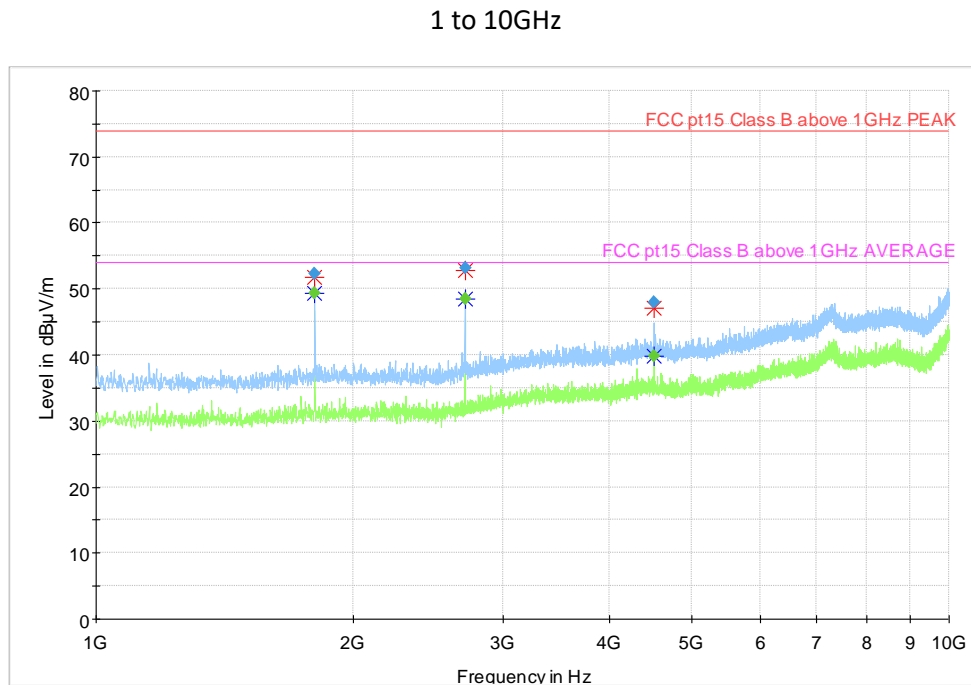
Note: Path losses are factored into the limit value, and given by the test standard. Chamber calibration data contributes to the measurement uncertainty figure.

4.3.7 Profile; 1 to 10GHz, Bottom Landscape

Maximum hold trace with peak values (◆)

Peak measurements (✱)

Average measurements (◆)



4.3.8 Data; 1 to 10GHz, Bottom Landscape

Frequency	Peak	CISPR Average	FCC Limit	Margin	Height	Pol	Azimuth	Corr.	Status
MHz	dBµV/m	dBµV/m	dBµV/m	dB	cm	H/V	Deg	dB/m	
1804.995256	---	49.35	54.00	4.65	190.0	H	190.0	-7.3	Pass
1805.040365	52.32	---	74.00	21.68	191.0	H	179.0	-7.3	Pass
2707.445377	53.15	---	74.00	20.85	118.0	H	210.0	-5.7	Pass
2707.665383	---	48.45	54.00	5.55	149.0	V	161.0	-5.7	Pass
4512.503814	47.95	---	74.00	26.05	100.0	V	177.0	-1.3	Pass
4512.560217	---	39.75	54.00	14.25	100.0	V	178.0	-1.3	Pass

V = Vertical / H = Horizontal

The measurements reported are the highest emissions relative to the FCC limits and take into account the correction factor*. Measurements made according to the CISPR test standard and Eurofins Hursley test procedure RAD-01.

*Correction factor (dB) = cable and antenna losses as summed positive values (dB) – pre-amp gain where applicable (dB).

The recorded measured value (dB) = measured receiver value (dB) + correction factor (dB).

Note: path losses are factored into the limit value, and given by the test standard. Chamber calibration data contributes to the measurement uncertainty figure.

4.4 Radiated Emissions; Idle Landscape

4.4.1 Test Parameters

A profile scan was taken using an EMI receiver at a distance of three metres on eight azimuths of the EUT in both the vertical and horizontal polarisation of the field in a semi-anechoic chamber.

Using the pre-scan results as a guide, each emission from the EUT was maximised. Measurements were carried out at a distance of three metres using the specified detector in a CISPR 16-1-4 compliant semi-anechoic chamber. Cable positions were then finally adjusted to produce the maximum emission levels. The worst-case results are reported below.

Test Equipment						
#ID	CP	Manufacturer	Type	Serial Number	Description	Calibration Due Date
053	1	HP	8449B	3008A01394	Pre-amplifier (1.0-26.5GHz) (with #516)	19/10/2022
073	3	Schwarzbeck	BBHA9120B	237	Horn Antenna (1-10GHz)	20/05/2024
750	1	Global	CISPR16	1	11 x 7 x 6.2m, chamber	14/12/2022
762	3	Schwarzbeck	VULB9162	129	30-7000MHz	04/03/2024
762a	3	Schwarzbeck	DGA 9552N	0	Attenuator (6dB) for #762	04/03/2024
788	1	Rohde & Schwarz	ESW 44	101799	EMI test receiver (44GHz)	09/08/2023
877	1	Huber & Suhner	SUCOTEST_18A	602608/18A	ST_18A/Nm/Nm/3m	19/04/2023
Test Equipment Software						
#ID	CP	Manufacturer	Type		Description	Calibration Due Date
856	0	Rohde & Schwarz	Software	0	EMC32 v10.50.10	Not required

Environmental Test Conditions		
Frequency	Below 1GHz	Above 1GHz
Temperature	21.2° Celsius	19.2° Celsius
Relative Humidity	62%	53%
Atmospheric Pressure	1011.6 millibars	1031.9 millibars
Test Date:	5 th October 2022	6 th October 2022
Test Engineer:	Richard Pennell	Richard Pennell

Note: "Calibration due date" means the instrument is certified within UKAS or traceable calibration certificate. "Internal" means the instrument is calibrated using Eurofins Hursley procedures. "Not required" means the asset does not require calibration. "CP" is the interval period [year] prescribed for external calibration.

4.4.2 Test Configuration

Please refer to EUT Test Configuration #1.

4.4.3 Set-up Photos; Below 1GHz

Radiated Emissions; Below 1GHz



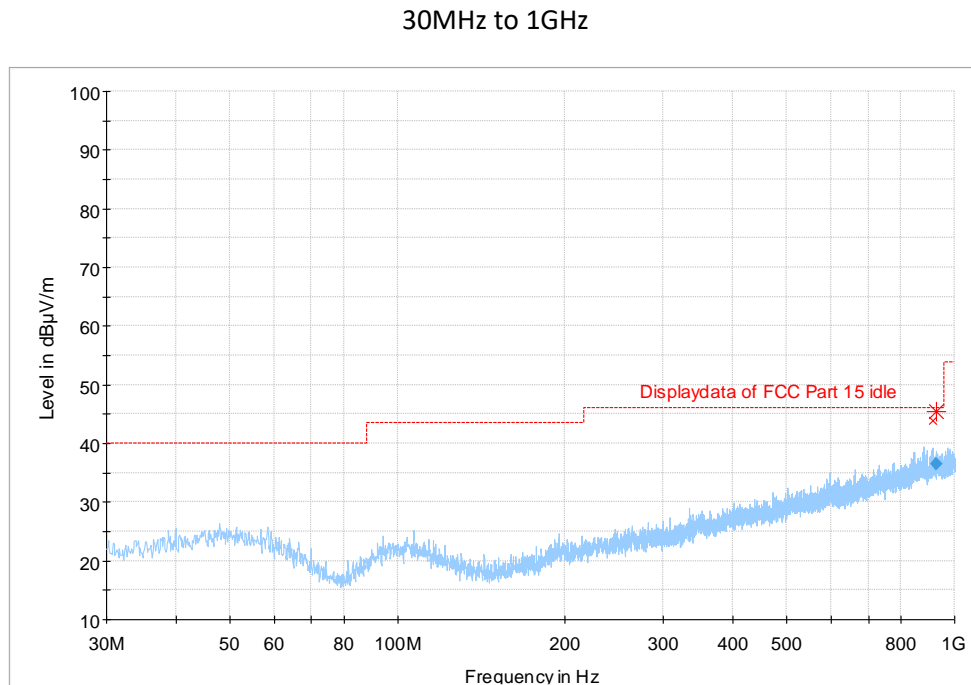
4.4.4 Set-up Photos; Above 1GHz

Radiated Emissions; Above 1GHz



4.4.5 Profile; 30MHz to 1GHz, Idle Landscape

Maximum peak hold trace with quasi-peak values (◆)
 Peak measurements (✱)



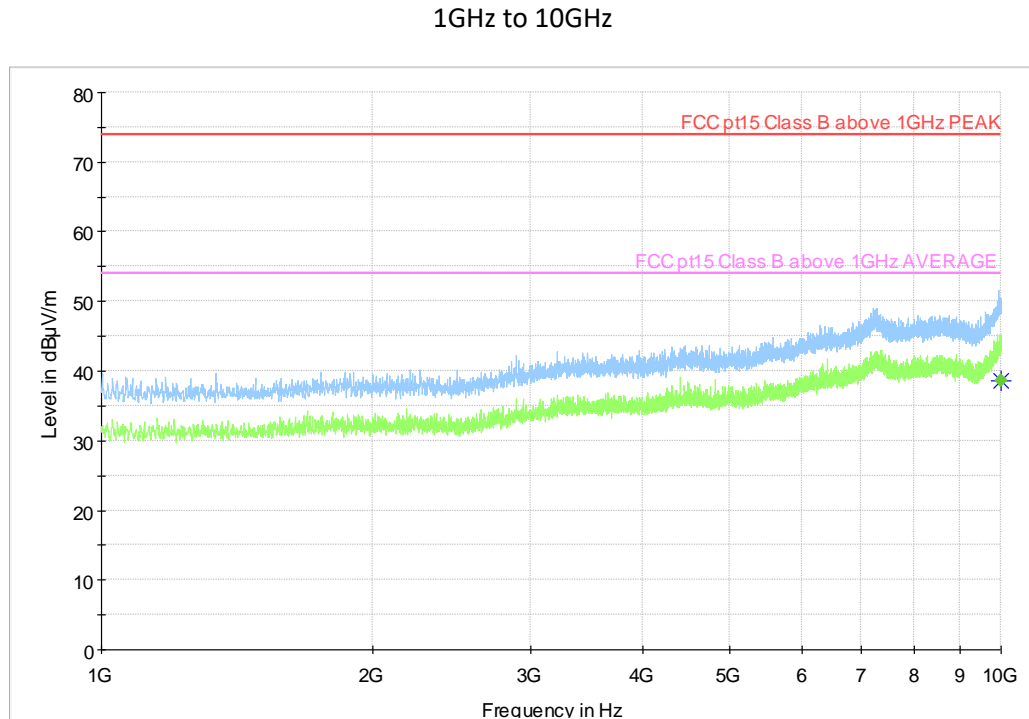
4.4.6 Data; 30MHz to 1GHz, Idle Landscape

Emission Frequency	Measured Quasi-Peak Value	FCC Specified Quasi-Peak Limit	Pass Margin	Antenna Polarisation	Antenna Height	Turntable Azimuth	Status
MHz	dBµV/m	dBµV/m	dB	H/V	cm	deg	
928.050000	36.43	46.00	9.57	H	197.0	5.0	Pass

V = Vertical / H = Horizontal

The measurements reported are the highest emissions relative to the FCC limits and take into account the correction factor*. Measurements made according to the CISPR test standard and Eurofins Hursley test procedure RAD-01.
 *Correction factor (dB) = cable and antenna losses as summed positive values (dB) – pre-amp gain where applicable (dB).
 The recorded measured value (dB) = measured receiver value (dB) + correction factor (dB).
 Note: Path losses are factored into the limit value, and given by the test standard. Chamber calibration data contributes to the measurement uncertainty figure.

4.4.7 Profile; 1GHz to 10GHz, Idle mode, Landscape orientation
 Maximum peak hold trace with quasi-peak values (◆)
 Peak measurements (✱)



4.4.8 Data; 1GHz to 10GHz, Idle mode, Landscape orientation

Emission Frequency	Measured Average Value	FCC Specified Average Limit	Pass Margin	Antenna Polarisation	Antenna Height	Turntable Azimuth	
MHz	dBµV/m	dBµV/m	dB	H/V	cm	deg	Status
9987.338206	38.64	54.00	15.36	H	224.0	7.0	Pass

V = Vertical / H = Horizontal

The measurements reported are the highest emissions relative to the FCC limits and take into account the correction factor*. Measurements made according to the CISPR test standard and Eurofins Hursley test procedure RAD-01.

*Correction factor (dB) = cable and antenna losses as summed positive values (dB) – pre-amp gain where applicable (dB).

The recorded measured value (dB) = measured receiver value (dB) + correction factor (dB).

Note: Path losses are factored into the limit value, and given by the test standard. Chamber calibration data contributes to the measurement uncertainty figure.

4.5 Occupied Bandwidth (IC)

4.5.1 Test Parameters

Test Equipment						
#ID	CP	Manufacturer	Type	Serial Number	Description	Calibration Due Date
289	1	Rohde & Schwarz	ESCI7	100765	CISPR 7GHz receiver	20/09/2023
751	1	ETS	CISPR16	1	10 x 6 x 6m, chamber	29/04/2023

Environmental Test Conditions	
Temperature	20.6° Celsius
Relative Humidity	50%
Atmospheric Pressure	1019.5 millibars
Test Date:	12 th October 2022
Test Engineer:	Richard Pennell

Note: "Calibration due date" means the instrument is certified within UKAS or traceable calibration certificate. "Internal" means the instrument is calibrated using Eurofins Hursley procedures. "Not required" means the asset does not require calibration. "CP" is the interval period [year] prescribed for external calibration.

4.5.2 Test Configuration

Please refer to EUT Test Configuration #1.

4.5.3 Occupied Bandwidth (IC)

RSS-GEN Section 6.6

The output from the measuring antenna was fed into the input of the ESCI7 spectrum analyser/receiver. The bandwidth of the transmitter was measured with an ESCI7 analyser set to 99% Occupied Bandwidth with a peak detector on max hold. The resolution bandwidth, span and video bandwidth are indicated on the occupied bandwidth plot (modulated) included with this report.

In TX mode with a 100kbps data rate the bandwidth of the modulated transmitter signal was measured.

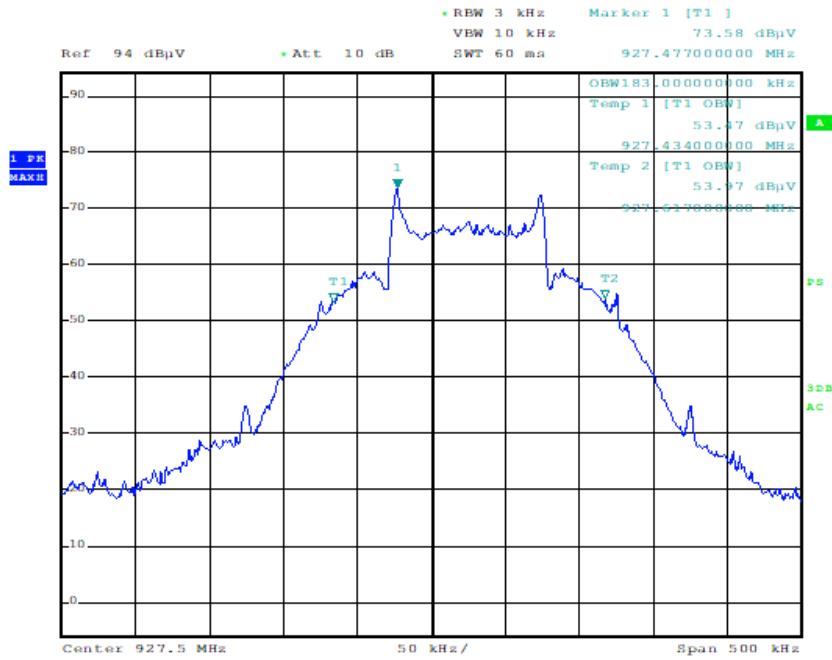
4.5.4 Set-up Photos

Occupied Bandwidth

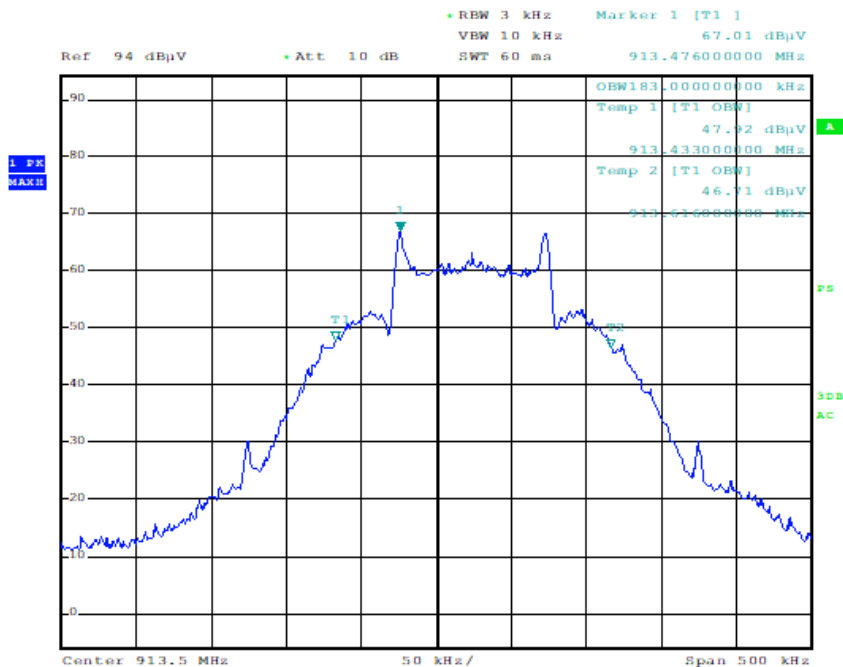


4.5.5 Profiles; IC

Top Landscape
 183kHz

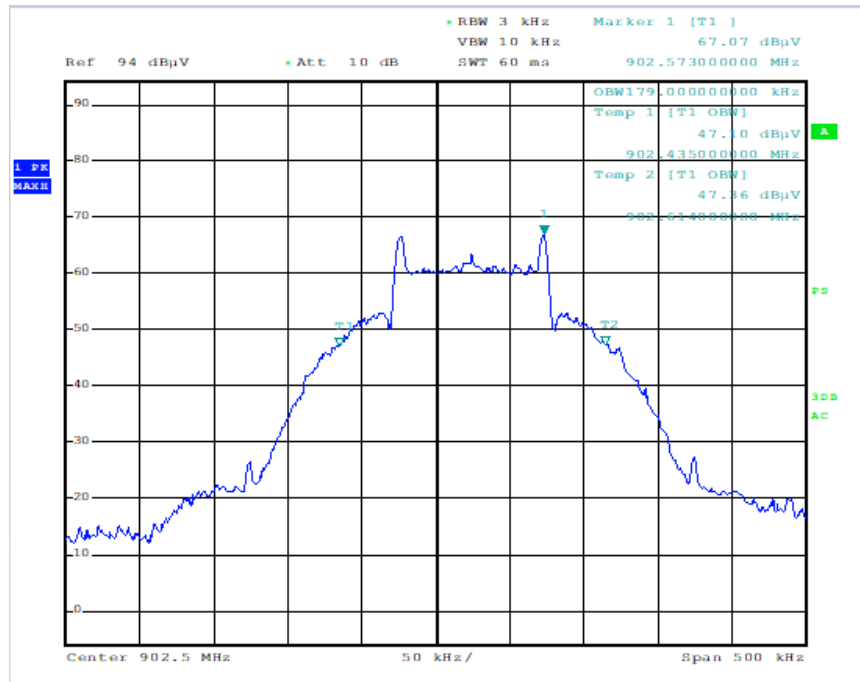


Middle Landscape
 183kHz



4.5.6 Profiles; IC (Continued)

Bottom Landscape
179kHz



4.6 Occupied Bandwidth (FCC)

4.6.1 Test Parameters

Test Equipment						
#ID	CP	Manufacturer	Type	Serial Number	Description	Calibration Due Date
289	1	Rohde & Schwarz	ESCI7	100765	CISPR 7GHz receiver	20/09/2023
751	1	ETS	CISPR16	1	10 x 6 x 6m, chamber	29/04/2023

Environmental Test Conditions	
Temperature	20.6° Celsius
Relative Humidity	50%
Atmospheric Pressure	1019.5 millibars
Test Date:	12 th October 2022
Test Engineer:	Richard Pennell

Note: "Calibration due date" means the instrument is certified within UKAS or traceable calibration certificate. "Internal" means the instrument is calibrated using Eurofins Hursley procedures. "Not required" means the asset does not require calibration. "CP" is the interval period [year] prescribed for external calibration.

4.6.2 Test Configuration

Please refer to EUT Test Configuration #1.

4.6.3 Occupied Bandwidth (FCC)

FCC 15.215 (c) / ANSI C63.10 Section 6.9

The output from the measuring antenna was fed into the input of the ESCI7 spectrum analyser/receiver. The bandwidth of the transmitter was measured 20dB down either side of the peak. The ESCI7 analyser was set to peak detector on max hold. The resolution bandwidth, span and video bandwidth are indicated on the occupied bandwidth plot (modulated) included with this report.

In TX mode with a 100kbps data rate the bandwidth of the modulated transmitter signal was measured.

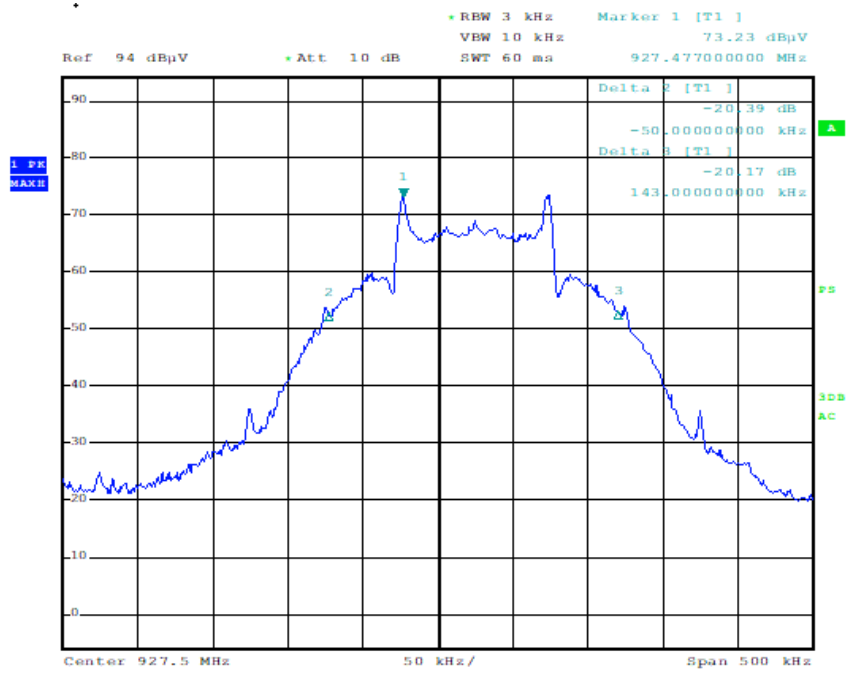
4.6.4 Set-up Photos

Occupied Bandwidth

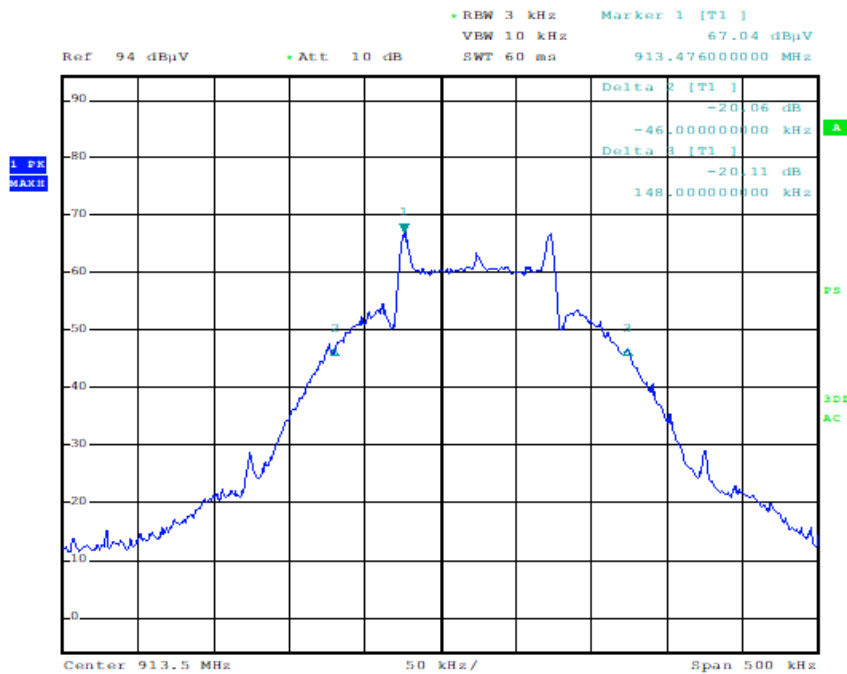


4.6.5 Profiles; FCC

Top Landscape
 193kHz

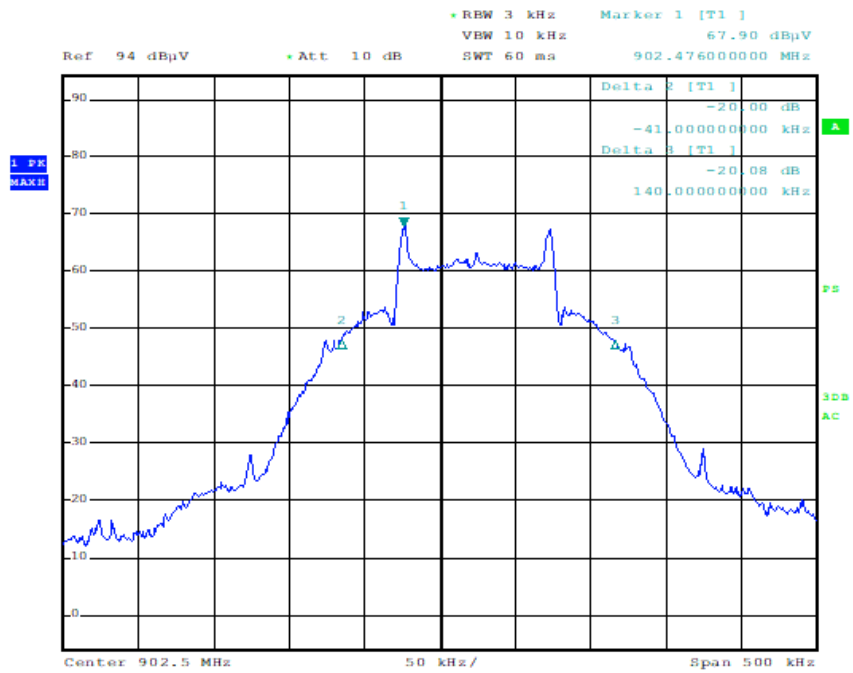


Middle Landscape
 194kHz



4.6.6 Profiles; FCC (Continued)

Bottom Landscape
181kHz



4.7 Occupied Bandwidth (AS/NZ)

4.7.1 Test Parameters

Test Equipment						
#ID	CP	Manufacturer	Type	Serial Number	Description	Calibration Due Date
289	1	Rohde & Schwarz	ESCI7	100765	CISPR 7GHz receiver	20/09/2023
751	1	ETS	CISPR16	1	10 x 6 x 6m, chamber	29/04/2023

Environmental Test Conditions	
Temperature	20.6° Celsius
Relative Humidity	50%
Atmospheric Pressure	1019.5 millibars
Test Date:	12 th October 2022
Test Engineer:	Richard Pennell

Note: "Calibration due date" means the instrument is certified within UKAS or traceable calibration certificate. "Internal" means the instrument is calibrated using Eurofins Hursley procedures. "Not required" means the asset does not require calibration. "CP" is the interval period [year] prescribed for external calibration.

4.7.2 Test Configuration

Please refer to EUT Test Configuration #1.

4.7.3 Occupied Bandwidth (AS/NZ)

AS/NZ 4268 Section 8.3.2

The output from the measuring antenna was fed into the input of the ESCI7 spectrum analyser/receiver. The bandwidth of the transmitter was measured with an ESCI7 analyser set to 99% Occupied Bandwidth with a peak detector on max hold. The resolution bandwidth, span and video bandwidth are indicated on the occupied bandwidth plot (modulated) included with this report.

In TX mode with a 100kbps data rate the bandwidth of the modulated transmitter signal was measured.

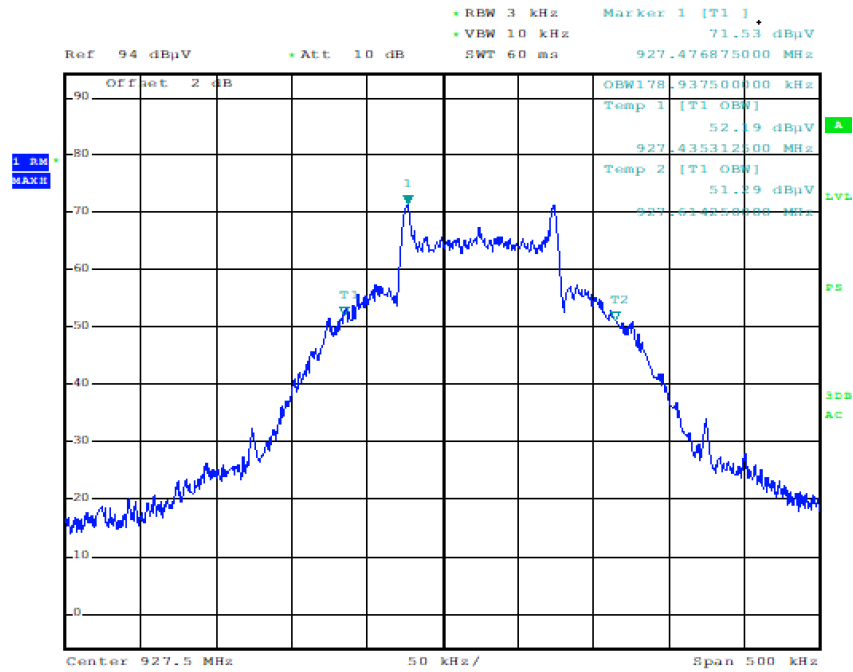
4.7.4 Set-up Photos

Occupied Bandwidth

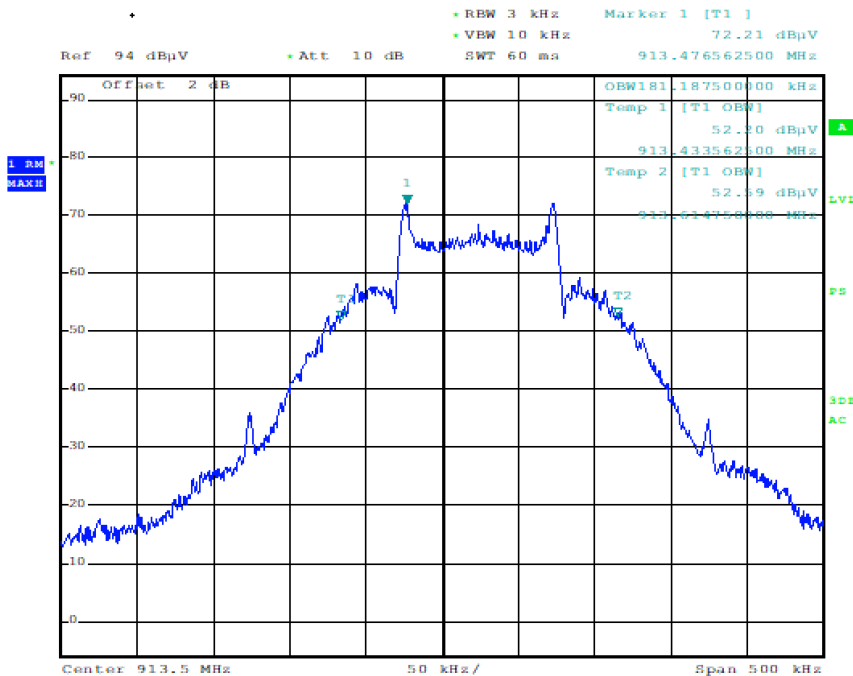


4.7.5 Profiles; AS/NZ

Top Landscape
 178.94kHz

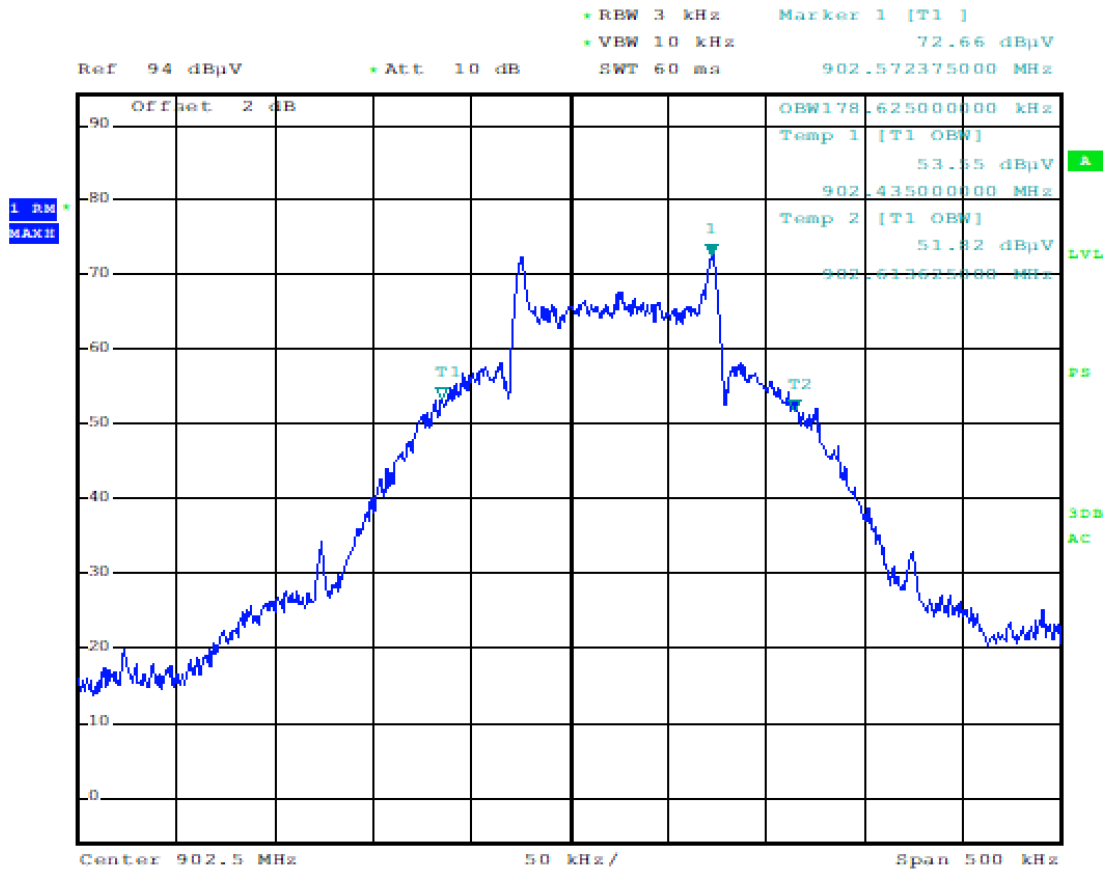


Middle Landscape
 181.19kHz



4.7.6 Profiles; AS/NZ (Continued)

Bottom Landscape
178.63kHz



5.0 MEASUREMENT UNCERTAINTIES

Emissions tests

For all emissions tests, measurement uncertainties have been calculated in line with the requirements of CISPR 16-4-2 to give a confidence level of greater than 95%. In all cases the laboratories calculated uncertainty values (known as U_{lab}) are equal to or are less than the expected uncertainty values contained in CISPR 16-4-2 (known as U_{cispr}). Below is a list of the laboratories calculated measurement uncertainties:

Conducted emissions:

Via AMN/LISN:	±3.27dB (9kHz – 150kHz), ±3.27dB (150kHz – 30MHz)
Via AAN/ISN:	±5.00dB (150kHz – 30MHz)
Via CVP:	±3.47dB (150kHz – 30MHz)
Via CP:	±2.69dB (150kHz – 30MHz)
Via 100 Ω:	±2.68dB (150kHz – 30MHz)
Clicks:	±2.83dB (150kHz – 30MHz)
Harmonics:	±1.42% (100Hz – 2kHz)
Flicker:	±1.76% (worst case for all parameters)

Radiated emissions:

H-Field:	±2.84dB (9kHz – 3MHz), ±2.92dB (3MHz – 30MHz)
D = 3.0 m (Horizontal):	±3.91dB (30MHz – 1GHz SAC), ±3.82dB (30MHz – 1GHz FAC)
D = 3.0 m (Vertical):	±5.22dB (30MHz – 1GHz SAC), ±3.82dB (30MHz – 1GHz FAC)
D = 3.0 m:	±5.13dB (1GHz – 6GHz SAC), ±5.15dB (1GHz – 10GHz SAC), ±3.64dB (10GHz – 18GHz SAC), ±3.10dB (18GHz – 40GHz SAC), ±3.05dB (1GHz – 6GHz FAC)

Radiated spurious emissions (RSE):

±1.71dB (30MHz – 1GHz), ±1.81dB (1 – 12.75GHz), ±2.07dB (12.75 – 18GHz)

Immunity tests

For IEC 61000-4-2, IEC 61000-4-4, IEC 61000-4-5, IEC 61000-4-8, IEC 61000-4-9, IEC 61000-4-11 tests, the following applies:

Measurement uncertainty has been calculated or calibrated for the various required parameters to provide a confidence level of 95% (k=2). These parameters have been compared to the basic standard tolerance requirements for each of the various parameters.

In all cases the calculated or calibrated uncertainty meets the basic standard requirements.

For IEC 61000-4-3, IEC 61000-4-6 tests, the following applies:

Measurement uncertainty has been calculated to provide a confidence level of 95%, or k=2, but this has not been applied to the applied test level, therefore the applied test level has an uncertainty of ±50%. This is in accordance with CENELEC and other international guidance.

In the case of Maritime equipment tested to EN/IEC 60945, there is a specific requirement that the applied test level be increased by the calculated measurement uncertainty. This is done by applying a coverage factor of k=1.64, which provides a 95% confidence that the applied test level has been achieved.

Test Results - Decision Rules

As the decision is generally inherent in the standard for Commercial EMC a simple acceptance rule can be applied. The following statement will be added to EMC quotes and reports. "The Decision Rule is applied on the basis of CISPR16-4-2 and/or EN61000-4-x (TR61000-1-6) These standards provide guidance on how to calculate and apply measurement uncertainty whilst providing maximum uncertainties allowance. Due consideration will also be given to JCGM 106:2012, ILAC-G8:09/2019 and LAB 48. This laboratory has demonstrated by calibrating its equipment and facilities, and calculating its own uncertainties, that it complies with the above requirements and therefore no allowance of uncertainties has been given to the tolerances." Where a result is considered marginal in respect of its proximity to the limit line, for example, the customer would be made aware of situation so that they can make an informed decision on how to proceed.

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