



# TEST REPORT

**Test Report No. : UL-RPT-RP13551588-1616B**

**Applicant** : Raspberry Pi Ltd  
**Manufacturer** : Raspberry Pi Ltd  
**Model No.** : Raspberry Pi Compute Module 4  
**Technology** : BDR & EDR  
**Test Standard(s)** : Japan Radio Law Radio Equipment Regulations,  
Article 2, Paragraph 1, Item 19  
MIC notice 88 Appendix 43

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3. The sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. Version 1.0.

**Date of Issue:** 03 March 2022

**Checked by:**

Ben Mercer  
Lead Project Engineer, Radio Laboratory

**Company Signatory:**

Sarah Williams  
RF Operations Leader, Radio Laboratory

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**1 Customer Information**

<b>Company Name:</b>	Raspberry Pi Ltd
<b>Address:</b>	Maurice Wilkes Building Cowley Road Cambridge CB4 0DS United Kingdom

## 2 Summary of Testing

### 2.1 General Information

<b>Specification Reference:</b>	Japan Radio Law Radio Equipment Regulations Article 2, Paragraph 1, Item 19
<b>Specification Title:</b>	N/A
<b>Specification Reference:</b>	Ordinance Regulating Radio Equipment
<b>Specification Title:</b>	Radio Equipment Rules
<b>Location of Testing:</b>	Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
<b>Test Dates:</b>	22 September 2021 to 04 February 2022

### 2.2 Summary of Test Results

Measurement	Result
Frequency Tolerance	
Occupied Bandwidth and Spreading Bandwidth	
Unwanted Emission Strength	
Output Power, Power Tolerance and EIRP	
Secondary Radiated Emission Strength	
Dwell Time and Duty Cycle	
Interference Prevention function	
<b>Key to Results</b>	
 = Complied  = Did not comply	

### 2.3 Deviations from the Test Specification

For the measurements contained within this test report, there were no deviations from, additions to, or exclusions from the test specification identified above.

## **2.4 Test and Measurement Equipment**

### **Calibration Method**

A: Calibration conducted by the National Institute of Information and Communications Technology (NICT) or a designated calibration agency under Article 102-18 paragraph (1) of the Radio Law.

B: Calibration conducted pursuant to the provisions of Article 135 or Article 144 of the Measurement Law (Law No. 51 of 1992) Japan Calibration Service System.

C: Calibration conducted in foreign countries, which shall be equivalent to the calibration conducted by the NICT or a designated calibration agency under Article 102-18 paragraph (1).

D: Calibration conducted by using other equipment that listed above from a) to c).

### **Test Equipment Used for Frequency Tolerance, Occupied Bandwidth, Unwanted Emission Strength, Secondary Radiated Emissions Strength and Dwell Time & Duty Cycle**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Calibration Authority	Cal Method	Calibration Date	Cal. Interval
M2072	Thermohygrometer	Testo	608-H1	45257961	UL	D	08 Sep 2021	12
M2033	Signal Analyser	Rohde & Schwarz	FSV13	101667	Rohde & Schwarz	C	05 Aug 2021	12
M2036	Signal Analyser	Rohde & Schwarz	FSV30	101791	Rohde & Schwarz	C	21 May 2021	12
A3120	Attenuator	AtlanTecRF	AN18-10	237378#4	UL	D	Calibrated before use	-
G0614	Signal Generator	Rohde & Schwarz	SMB100A	177687	Rohde & Schwarz	C	19 May 2021	12

### **Test Equipment Used for Output Power, Power Tolerance and EIRP**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Calibration Authority	Cal Method	Calibration Date	Cal. Interval
M2072	Thermohygrometer	Testo	608-H1	45257961	UL	D	08 Sep 2021	12
M2036	Signal Analyser	Rohde & Schwarz	FSV30	101791	Rohde & Schwarz	C	21 May 2021	12
A3120	Attenuator	AtlanTecRF	AN18-10	237378#4	UL	D	Calibrated before use	-
G0614	Signal Generator	Rohde & Schwarz	SMB100A	177687	Rohde & Schwarz	C	19 May 2021	12
M1999	RF Power Sensor	Dare Instruments	RPR3006W	15I00041S NO79	Dare Calibrations	C	10 Jun 2021	12

### **Test Equipment Used for Interference Prevention Function**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Calibration Authority	Cal Method	Calibration Date	Cal. Interval
M2072	Thermohygrometer	Testo	608-H1	45257961	UL	D	08 Sep 2021	12
A3120	Attenuator	AtlanTecRF	AN18-10	237378#4	UL	D	Calibrated before use	-
M1758	Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	1201.0002 K50-117255-XP	Rohde & Schwarz	C	09 Apr 2021	12

### **3 Equipment Under Test (EUT)**

#### **3.1 Identification of Equipment Under Test (EUT)**

<b>Brand Name:</b>	Raspberry Pi Ltd
<b>Model Name or Number:</b>	Raspberry Pi Compute Module 4
<b>Test Sample Serial Number:</b>	0000011031015231 ( <i>Conducted sample #1</i> )
<b>Hardware Version:</b>	1.0
<b>Software Version:</b>	1.0

<b>Brand Name:</b>	Raspberry Pi Ltd
<b>Model Name or Number:</b>	Raspberry Pi Compute Module 4
<b>Test Sample Serial Number:</b>	0000011033775150 ( <i>Conducted sample #2</i> )
<b>Hardware Version:</b>	1.0
<b>Software Version:</b>	1.0

#### **3.2 Description of EUT**

The equipment under test was a a single board computer, containing a Bluetooth and WiFi radio module.

#### **3.3 Modifications Incorporated in the EUT**

No modifications were applied to the EUT during testing.

**3.4 Additional Information Related to Testing**

<b>Category of Equipment:</b>	<i>Bluetooth</i>		
<b>Type of Radio Wave:</b>	F1D / G1D		
<b>Power Supply Requirement(s):</b>	Nominal	5.0 VDC*	
<b>Max Antenna Gain:</b>	3.5 dBi		
<b>Channel Spacing:</b>	1 MHz		
<b>Mode:</b>	Basic Rate	Enhanced Data Rate	
<b>Modulation:</b>	GFSK	$\pi/4$ -DQPSK	8DPSK
<b>Packet Type (Maximum Payload):</b>	DH5	2DH5	3DH5
<b>Data Rate (Mbps):</b>	1	2	3
<b>Declared Output Power:</b>	0.03 mW/MHz	0.01 mW/MHz	0.01 mW/MHz
<b>Transmit Frequency Range:</b>	2402 MHz to 2480 MHz		
<b>Transmit Channels Tested:</b>	<b>Channel ID</b>	<b>Channel Number</b>	<b>Channel Frequency (MHz)</b>
	Bottom	0	2402
	Middle	39	2441
	Top	78	2480
<b>Receive Frequency Range:</b>	2400 MHz to 2483.5 MHz		
<b>Receive Channels Tested:</b>	<b>Channel ID</b>	<b>Channel Number</b>	<b>Channel Frequency (MHz)</b>
	Bottom	0	2402
	Middle	39	2441
	Top	78	2480

\*Note: The input voltage to the RF circuit varies by less than 1% when the input voltage from the external power supply to the receiver varies  $\pm 10\%$ . Tests were therefore performed at the rated input voltage only.

### **3.5 Support Equipment**

The following support equipment was used to exercise the EUT during testing:

<b>Description:</b>	Development board
<b>Brand Name:</b>	Raspberry Pi Ltd
<b>Model Name or Number:</b>	Compute Module 4 IO Board
<b>Serial Number:</b>	0000011032152810

<b>Description:</b>	Development board
<b>Brand Name:</b>	Raspberry Pi Ltd
<b>Model Name or Number:</b>	Compute Module 4 IO Board
<b>Serial Number:</b>	000001103152784

<b>Description:</b>	LCD Monitor
<b>Brand Name:</b>	Asus
<b>Model Name or Number:</b>	ProArt PA238
<b>Serial Number:</b>	D9LMTF114809

<b>Description:</b>	Keyboard
<b>Brand Name:</b>	Dell
<b>Model Name or Number:</b>	KB212-B
<b>Serial Number:</b>	0C643N

<b>Description:</b>	Mouse
<b>Brand Name:</b>	Microsoft
<b>Model Name or Number:</b>	1113
<b>Serial Number:</b>	X821908-002

<b>Description:</b>	HDMI Cable
<b>Brand Name:</b>	Raspberry Pi Ltd
<b>Model Name or Number:</b>	Not marked or stated
<b>Serial Number:</b>	Not marked or stated

<b>Description:</b>	Switching Adaptor
<b>Brand Name:</b>	PRO-ELEC
<b>Model Name or Number:</b>	PEL00848
<b>Serial Number:</b>	Not marked or stated

## **4 Operation and Monitoring of the EUT during Testing**

### **4.1 Operating Modes**

The EUT was tested in the following operating mode(s):

- The worst-case data rate for each mode has been determined based on preliminary testing of the chipset utilized in this radio. The worst case modes used for testing were:
  - Basic Rate DH5 packets of maximum supported length (1 Mbps).
  - Enhanced Data Rate 3DH5 packets of maximum supported length (3 Mbps).
- Transmitting in *Bluetooth* test mode at maximum power on bottom, middle or top channel as required.
- Receive Mode on bottom, middle or top channel as required.
- For Interference Prevention Function testing, the EUT was configured for normal operation.

### **4.2 Configuration and Peripherals**

The EUT was tested in the following configuration(s):

- Transmit tests: The EUT was controlled using the *Bluetooth* test commands run from within the terminal application on the EUT. The *Bluetooth* test commands were used to enable continuous transmission and to select the test channels & packet types as required.
- Receive tests: *Bluetooth* test mode was active but not transmitting. The receiver was sweeping across the operating band in the normal *Bluetooth* receive mode of operation.
- The EUT was powered from an AC/DC switch mode power supply.
- The customer supplied an RF cable to the EUT in order to perform conducted measurements. The respective path loss was measured and accounted for as an RF level offset.
- For Interference Prevention Function the EUT was connected with a companion device.

## **5 Measurements, Examinations and Derived Results**

### **5.1 General Comments**

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to Section 6 *Measurement Uncertainty* for details.

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

## 5.2 Test Results

### 5.2.1 Frequency Tolerance

#### Test Summary:

<b>Test Engineer:</b>	Raghavendra Katti	<b>Test Dates:</b>	22 September 2021 & 23 September 2021
<b>Test Sample Serial Number:</b>	0000011031015231		

<b>Reference:</b>	Ordinance Regulating Radio Equipment - Article 5 & Annex 1
<b>Test Method:</b>	Clause Notice 88 Annex 43 – Test Methods for Radio Equipment listed in Article 2, paragraph 1, Item (19), Section 3

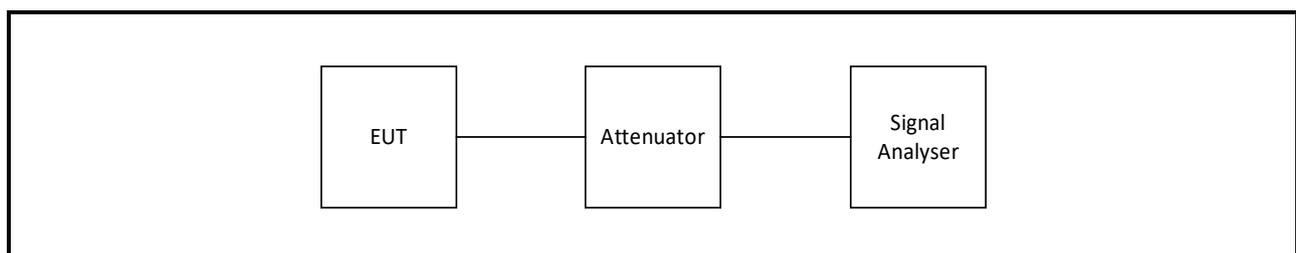
#### Environmental Conditions:

<b>Temperature (°C):</b>	22
<b>Relative Humidity (%):</b>	51 to 53

#### Note(s):

1. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable.
2. The signal analyser resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and the trace mode was Max Hold.
3. The frequency deviation was calculated by averaging  $f_L$  and  $f_H$ .
4. Lowest frequency of the power envelope ( $f_L$ ); the furthest frequency below the maximum power frequency at which the output power falls below the level of -10 dBc.
5. Highest frequency of the power envelope ( $f_H$ ); the furthest frequency above the maximum power frequency at which the output power falls below the level of -10 dBc.

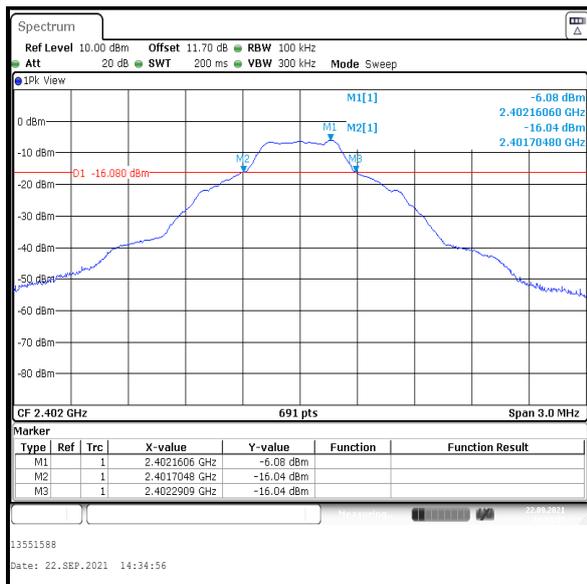
#### Test Setup Diagram:



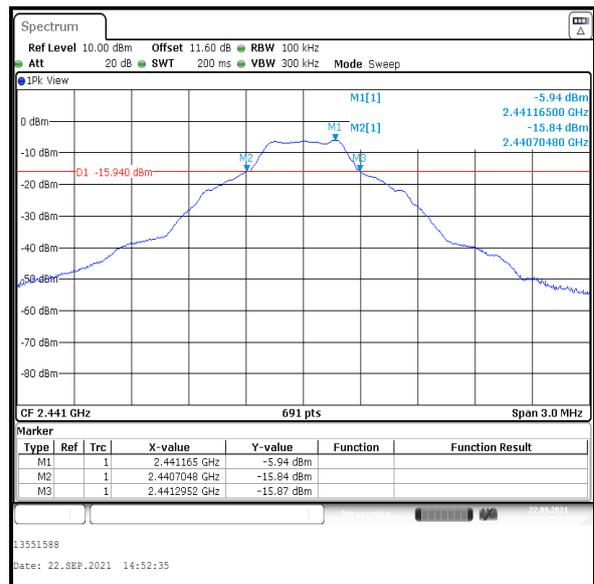
**Frequency Tolerance (continued)**

**Results: DH5**

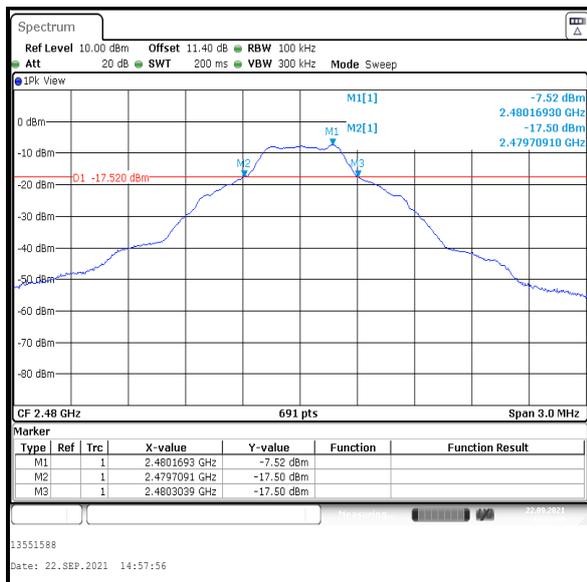
Channel	Channel Frequency (MHz)	Measured Frequency (MHz)	Tolerance (kHz)	Tolerance (ppm)	Limit (ppm)	Result
Bottom	2402	2401.997850	-2.15	-0.9	±50.0	Complied
Middle	2441	2441.000000	0.00	0.0	±50.0	Complied
Top	2480	2480.006500	6.50	2.6	±50.0	Complied



**Bottom Channel**



**Middle Channel**

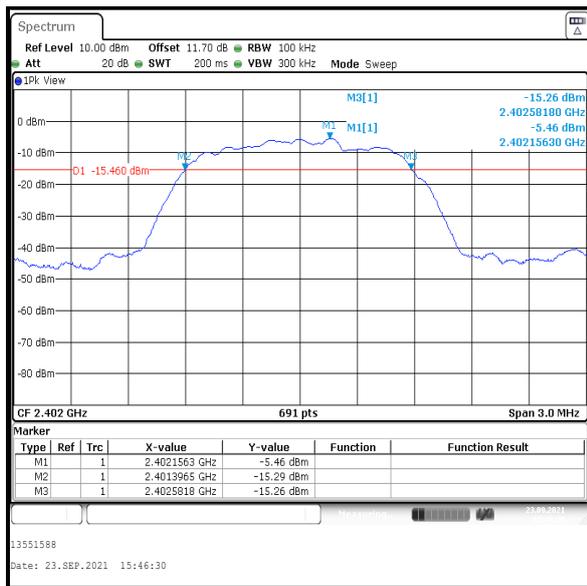


**Top Channel**

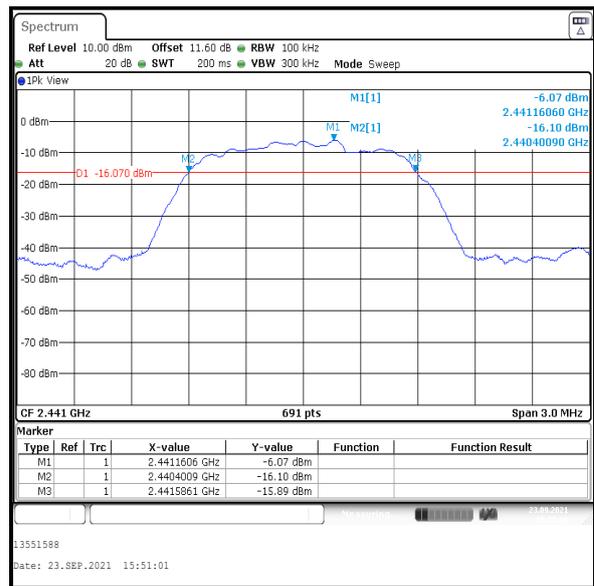
**Frequency Tolerance (continued)**

**Results: 3DH5**

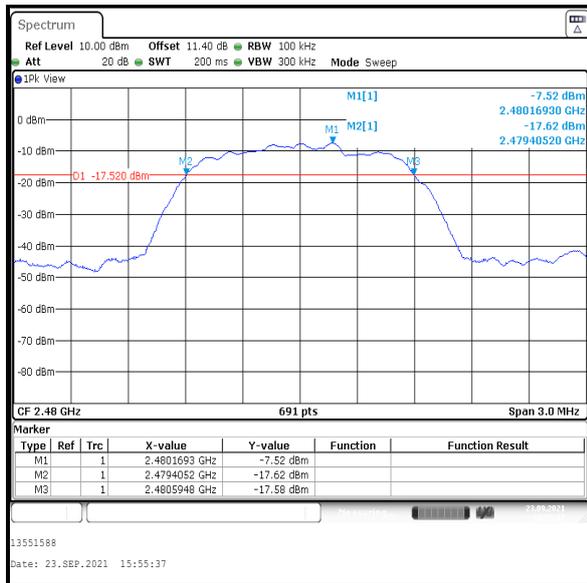
Channel	Channel Frequency (MHz)	Measured Frequency (MHz)	Tolerance (kHz)	Tolerance (ppm)	Limit (ppm)	Result
Bottom	2402	2401.989150	-10.85	-4.5	±50.0	Complied
Middle	2441	2440.993500	-6.50	-2.7	±50.0	Complied
Top	2480	2480.000000	0.00	0.0	±50.0	Complied



**Bottom Channel**



**Middle Channel**



**Top Channel**

**5.2.2 Occupied Bandwidth and Spreading Bandwidth****Test Summary:**

<b>Test Engineer:</b>	Raghavendra Katti	<b>Test Dates:</b>	22 September 2021 & 23 September 2021
<b>Test Sample Serial Number:</b>	0000011031015231		

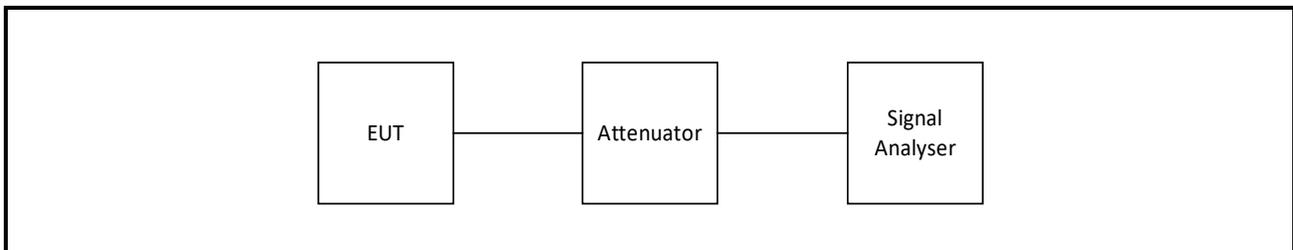
<b>Reference:</b>	Ordinance Regulating Radio Equipment - Article 6 & Article 49-20
<b>Test Method:</b>	Clause Notice 88 Annex 43 – Test Methods for Radio Equipment listed in Article 2, paragraph 1, Item (19), Section 4

**Environmental Conditions:**

<b>Temperature (°C):</b>	22
<b>Relative Humidity (%):</b>	51 to 53

**Note(s):**

1. Occupied Bandwidth was performed using the 99% Occupied Bandwidth function of a signal analyser.
2. Spreading Bandwidth was performed using the 90% Occupied Bandwidth function of a signal analyser.
3. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable.
4. The signal analyser resolution bandwidth was set to 300 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and the trace mode was Max Hold.

**Test Setup Diagram:**

**Occupied Bandwidth and Spreading Bandwidth (continued)**

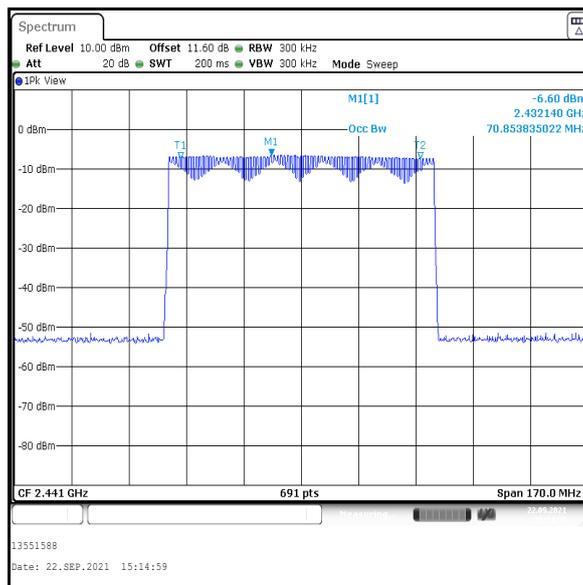
**Results: Occupied Bandwidth / DH5**

Occupied Bandwidth (MHz)	Limit (MHz)	Margin (MHz)	Result
78.234	83.5	5.266	Complied



**Results: Spreading Bandwidth / DH5**

Spreading Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
70853.835	≥500	70353.835	Complied



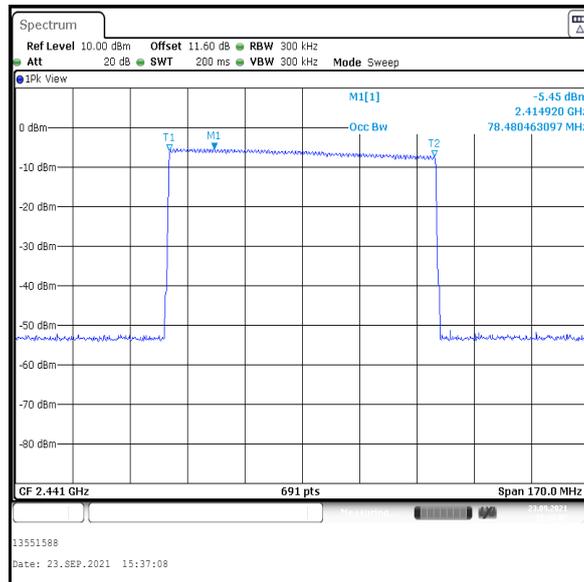
**Occupied Bandwidth and Spreading Bandwidth (continued)****Results: Spreading Factor / DH5**

<b>Spreading Bandwidth (MHz)</b>	<b>Symbol Rate (Msym/s)</b>	<b>Spreading Factor</b>	<b>Limit</b>	<b>Margin</b>	<b>Result</b>
70.854	1	70.854	≥5	65.854	Complied

**Occupied Bandwidth and Spreading Bandwidth (continued)**

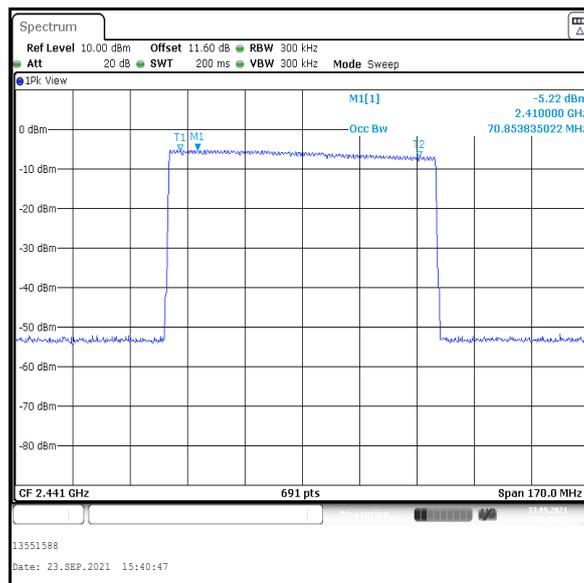
**Results: Occupied Bandwidth / 3DH5**

Occupied Bandwidth (MHz)	Limit (MHz)	Margin (MHz)	Result
78.480	83.5	5.020	Complied



**Results: Spreading Bandwidth / 3DH5**

Spreading Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
70853.835	≥500	70353.835	Complied



**Occupied Bandwidth and Spreading Bandwidth (continued)****Results: Spreading Factor / 3DH5**

<b>Spreading Bandwidth (MHz)</b>	<b>Symbol Rate (Msym/s)</b>	<b>Spreading Factor</b>	<b>Limit</b>	<b>Margin</b>	<b>Result</b>
70.854	1	70.854	$\geq 5$	65.854	Complied

### **5.2.3 Unwanted Emission Strength**

#### **Test Summary:**

<b>Test Engineer:</b>	Jose Bayona	<b>Test Date:</b>	01 February 2022
<b>Test Sample Serial Number:</b>	0000011033775150		

<b>Reference:</b>	Ordinance Regulating Radio Equipment - Article 7 & Annex 3-26
<b>Test Method:</b>	Clause Notice 88 Annex 43 – Test Methods for Radio Equipment listed in Article 2, paragraph 1, Item (19), Section 5

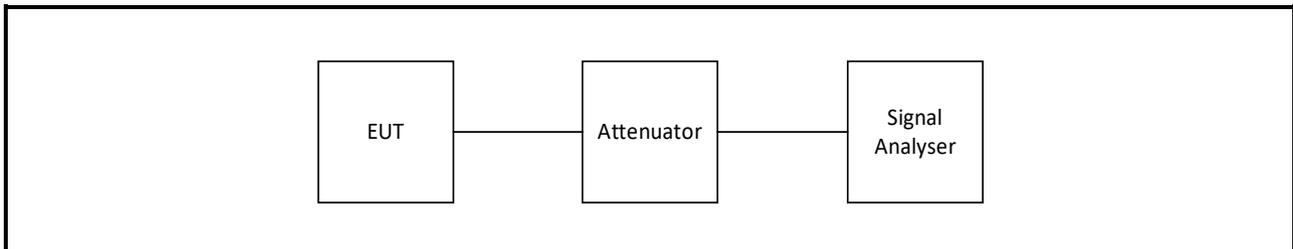
#### **Environmental Conditions:**

<b>Temperature (°C):</b>	22
<b>Relative Humidity (%):</b>	53

#### **Note(s):**

1. The signal analyser was connected to the EUT antenna port via suitable RF cables and attenuators. The RF path loss was included as a reference level offset.
2. The signal analyser resolution bandwidth was set to 1 MHz and video bandwidth 1 MHz. An RMS detector was used, sweep time was set to auto and the trace mode was Max Hold.

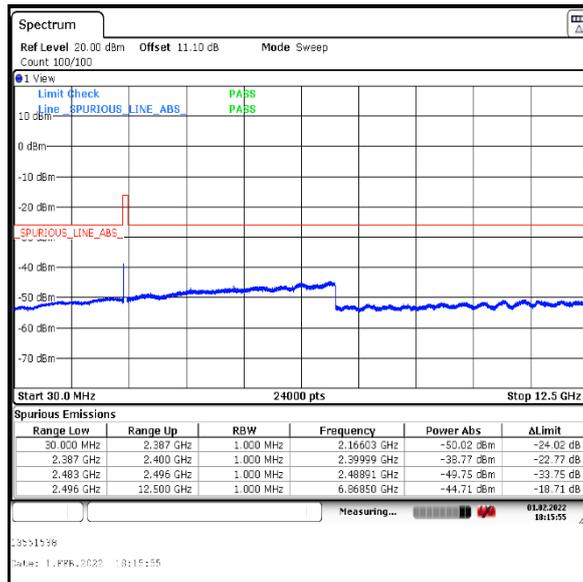
#### **Test Setup Diagram:**



**Unwanted Emission Strength (continued)**

**Results: DH5 / Bottom Channel**

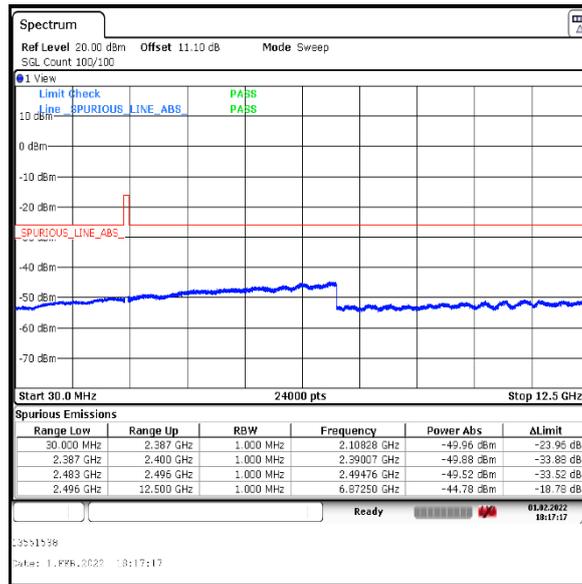
Frequency Range (MHz)	Frequency (MHz)	Peak Level (dBm)	Peak Level (µW)	Limit (µW)	Margin (µW)	Result
≥30 , ≤2387	2166.030	-50.0	0.010	2.5	2.490	Complied
≥2387 , ≤2400	2399.990	-38.8	0.133	25.0	24.867	Complied
≥2483.5 , ≤2496.5	2488.910	-49.7	0.011	25.0	24.989	Complied
≥2496.5 , ≤12500	6868.500	-44.7	0.034	2.5	2.466	Complied



**Unwanted Emission Strength (continued)**

**Results: DH5 / Middle Channel**

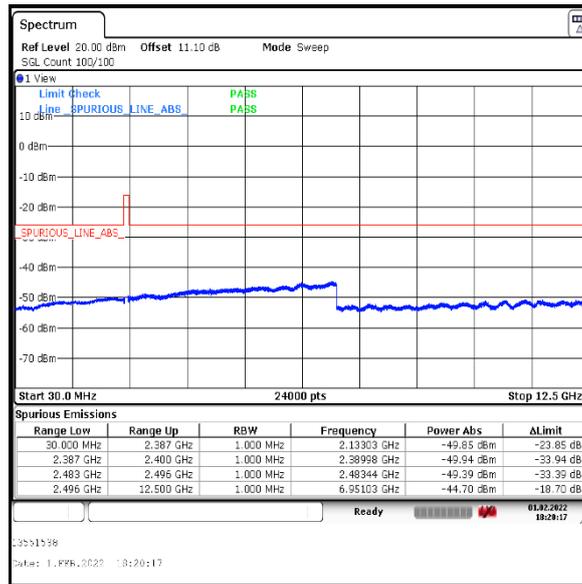
Frequency Range (MHz)	Frequency (MHz)	Peak Level (dBm)	Peak Level (µW)	Limit (µW)	Margin (µW)	Result
≥30 , ≤2387	2108.280	-50.0	0.010	2.5	2.490	Complied
≥2387 , ≤2400	2390.070	-49.9	0.010	25.0	24.990	Complied
≥2483.5 , ≤2496.5	2494.760	-49.5	0.011	25.0	24.989	Complied
≥2496.5 , ≤12500	6872.500	-44.8	0.033	2.5	2.467	Complied



**Unwanted Emission Strength (continued)**

**Results: DH5 / Top Channel**

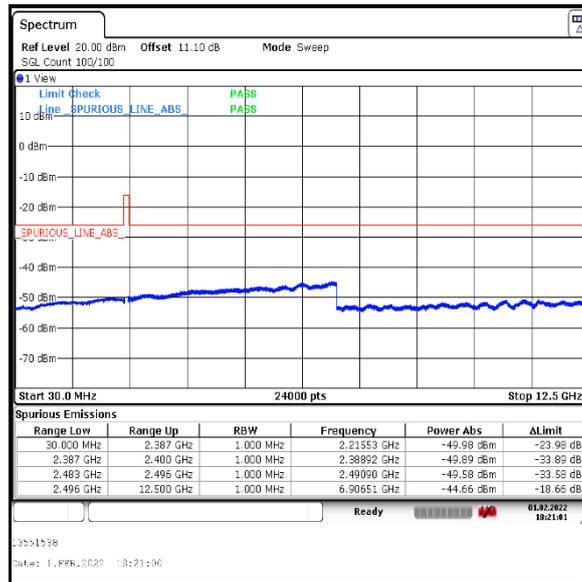
Frequency Range (MHz)	Frequency (MHz)	Peak Level (dBm)	Peak Level (µW)	Limit (µW)	Margin (µW)	Result
≥30 , ≤2387	2133.030	-49.8	0.010	2.5	2.490	Complied
≥2387 , ≤2400	2389.980	-49.9	0.010	25.0	24.990	Complied
≥2483.5 , ≤2496.5	2483.440	-49.4	0.012	25.0	24.988	Complied
≥2496.5 , ≤12500	6951.030	-44.7	0.034	2.5	2.466	Complied



**Unwanted Emission Strength (continued)**

**Results: 3DH5 / Bottom Channel**

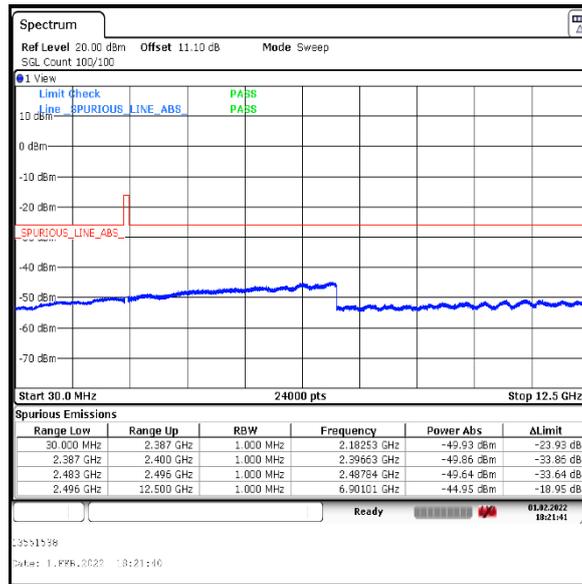
Frequency Range (MHz)	Frequency (MHz)	Peak Level (dBm)	Peak Level (µW)	Limit (µW)	Margin (µW)	Result
≥30 , ≤2387	2215.530	-50.0	0.010	2.5	2.490	Complied
≥2387 , ≤2400	2388.920	-49.9	0.010	25.0	24.990	Complied
≥2483.5 , ≤2496.5	2490.900	-49.6	0.011	25.0	24.989	Complied
≥2496.5 , ≤12500	6906.510	-44.7	0.034	2.5	2.466	Complied



**Unwanted Emission Strength (continued)**

**Results: 3DH5 / Middle Channel**

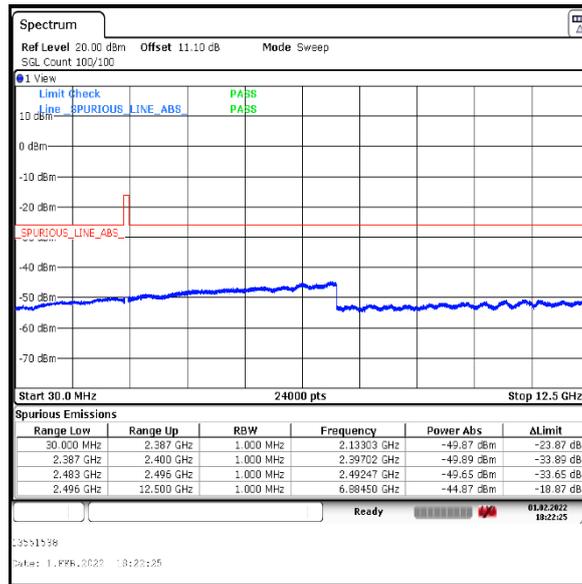
Frequency Range (MHz)	Frequency (MHz)	Peak Level (dBm)	Peak Level (µW)	Limit (µW)	Margin (µW)	Result
≥30 , ≤2387	2182.530	-49.9	0.010	2.5	2.490	Complied
≥2387 , ≤2400	2396.630	-49.9	0.010	25.0	24.990	Complied
≥2483.5 , ≤2496.5	2487.840	-49.6	0.011	25.0	24.989	Complied
≥2496.5 , ≤12500	6901.010	-44.9	0.032	2.5	2.468	Complied



**Unwanted Emission Strength (continued)**

**Results: 3DH5 / Top Channel**

Frequency Range (MHz)	Frequency (MHz)	Peak Level (dBm)	Peak Level (µW)	Limit (µW)	Margin (µW)	Result
≥30 , ≤2387	2133.030	-49.9	0.010	2.5	2.490	Complied
≥2387 , ≤2400	2397.020	-49.9	0.010	25.0	24.990	Complied
≥2483.5 , ≤2496.5	2492.470	-49.6	0.011	25.0	24.989	Complied
≥2496.5 , ≤12500	6884.500	-44.9	0.033	2.5	2.467	Complied



**5.2.4 Output Power, Power Tolerance and EIRP****Test Summary:**

<b>Test Engineer:</b>	Jose Bayona	<b>Test Date:</b>	04 February 2022
<b>Test Sample Serial Number:</b>	0000011033775150		

<b>Reference:</b>	Ordinance Regulating Radio Equipment - Article 49-20 & Article 14
<b>Test Method:</b>	Clause Notice 88 Annex 43 – Test Methods for Radio Equipment listed in Article 2, paragraph 1, Item (19), Section 6
<b>Peak Antenna Gain “G” (dBi):</b>	3.5

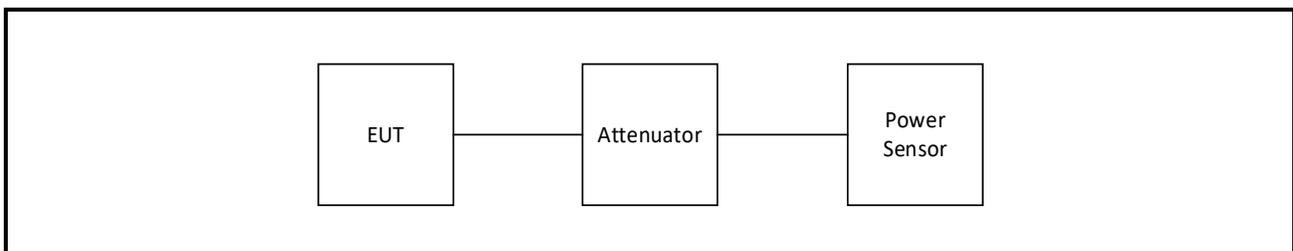
**Environmental Conditions:**

<b>Temperature (°C):</b>	24
<b>Relative Humidity (%):</b>	51

**Note(s):**

1. Measurements were performed with the EUT transmitting at maximum power in Basic Rate and EDR modes (DH5 and 3DH5) whilst hopping across the band of operation using a fast power sensor which automatically averaged across the bursts. Therefore no duty cycle correction calculations were required. The output power referred to 1 MHz was calculated by dividing the total power by spread bandwidth.
2. The peak antenna gain was added to the conducted output power measured to obtain the EIRP.
3. Tolerance was calculated by using the following calculation:

$$\text{Tolerance} = \text{Output Power} / \text{Declared Power} * 100 - 100$$

**Test Setup Diagram:**

**Output Power, Power Tolerance and EIRP (continued)****Results:DH5 / RF Output Power**

Measured Output Power (dBm)	Measured Output Power (mW)	Spreading Bandwidth (MHz)	Output Power (mW/MHz)	Limit (mW/MHz)	Margin (mW)	Result
3.3	2.138	70.850	0.030	3.0	2.970	Complied

**Results:DH5 / EIRP**

Output Power (mW/MHz)	Output Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)	Result
0.030	-15.2	3.5	-11.7	6.9	18.6	Complied

**Results:DH5 / RF Output Power Tolerance**

Output Power (mW/MHz)	Declared Output Power (mW/MHz)	Tolerance (%)	Limit (%)	Result
0.030	0.030	0.0	+20 to -80	Complied

**Results: 3DH5 / RF Output Power**

Measured Output Power (dBm)	Measured Output Power (mW)	Spreading Bandwidth (MHz)	Output Power (mW/MHz)	Limit (mW/MHz)	Margin (mW)	Result
-2.5	0.562	70.850	0.008	3.0	2.992	Complied

**Results: 3DH5 / EIRP**

Output Power (mW/MHz)	Output Power (dBm/MHz)	Antenna Gain (dBi)	EIRP (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)	Result
0.008	-21.0	3.5	-17.5	6.9	24.4	Complied

**Results: 3DH5 / RF Output Power Tolerance**

Output Power (mW/MHz)	Declared Output Power (mW/MHz)	Tolerance (%)	Limit (%)	Result
0.008	0.010	-20.0	+20 to -80	Complied

### **5.2.5 Secondary Radiated Emissions Strength**

#### **Test Summary:**

<b>Test Engineer:</b>	Jose Bayona	<b>Test Date:</b>	01 February 2022
<b>Test Sample Serial Number:</b>	0000011033775150		

<b>Reference:</b>	Ordinance Regulating Radio Equipment - Article 24
<b>Test Method:</b>	Clause Notice 88 Annex 43 – Test Methods for Radio Equipment listed in Article 2, paragraph 1, Item (19), Section 7

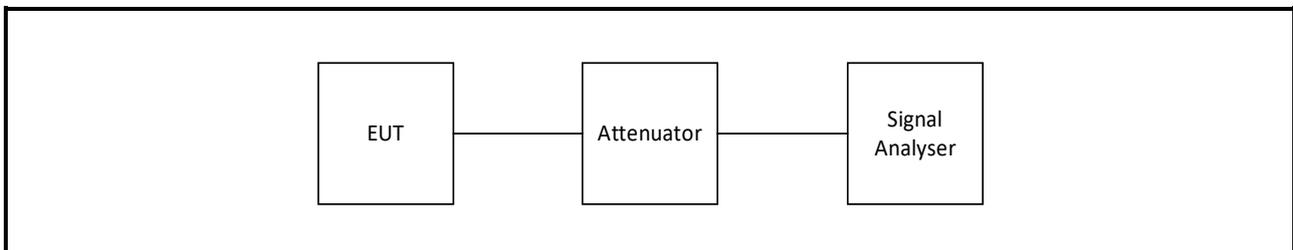
#### **Environmental Conditions:**

<b>Temperature (°C):</b>	22
<b>Relative Humidity (%):</b>	53

#### **Note(s):**

1. No spurious emissions were detected above the noise floor of the measuring receiver, therefore the highest peak noise floor reading of the measuring receiver was recorded in the table below.
2. The signal analyser was connected to the EUT antenna port via suitable RF cables and attenuators. The RF path loss was included as a reference level offset.
3. The resolution bandwidth of the signal analyser was set to 100 kHz for frequencies below 1 GHz and 1 MHz for frequencies above 1 GHz. The video bandwidth was set to the same value as the resolution bandwidth. A peak detector was used, sweep time was set to auto and the trace mode was Max Hold.

#### **Test Setup Diagram:**



**Secondary Radiated Emissions Strength (continued)****Results: DH5 / Bottom Channel**

Frequency Range (MHz)	Frequency (MHz)	Peak Level (dBm)	Peak Level (nW)	Limit (nW)	Margin (nW)	Result
30-1000	561.803	-79.3	0.011	4.0	3.989	Complied
1000-12500	6939.030	-64.7	0.336	20.0	19.664	Complied

**Results: DH5 / Middle Channel**

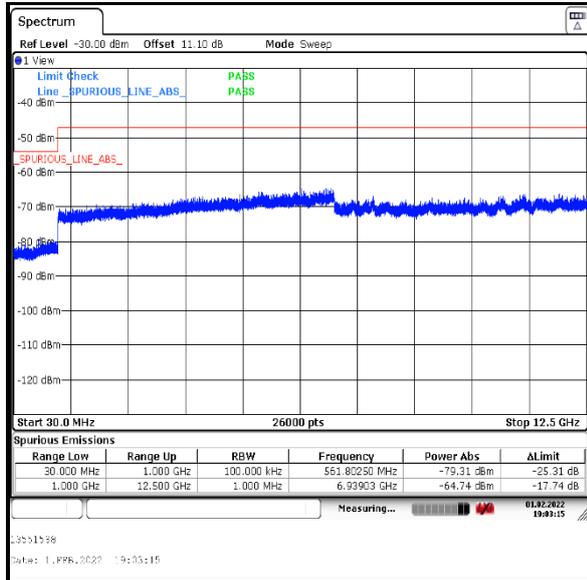
Frequency Range (MHz)	Frequency (MHz)	Peak Level (dBm)	Peak Level (nW)	Limit (nW)	Margin (nW)	Result
30-1000	878.508	-80.1	0.010	4.0	3.990	Complied
1000-12500	6910.280	-64.4	0.363	20.0	19.637	Complied

**Results: DH5 / Top Channel**

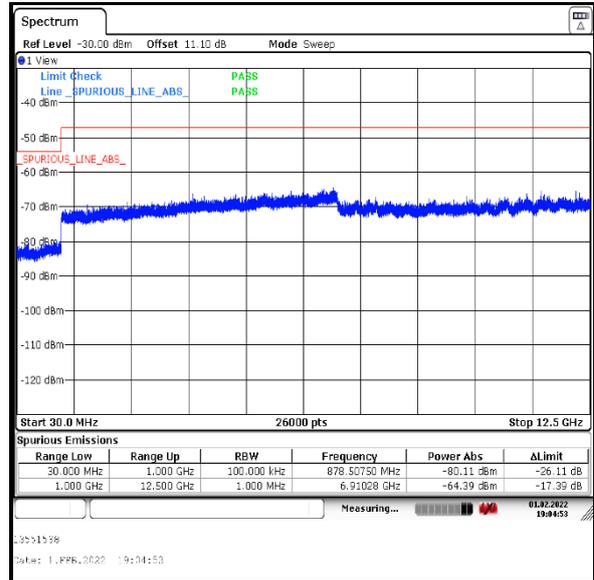
Frequency Range (MHz)	Frequency (MHz)	Peak Level (dBm)	Peak Level (nW)	Limit (nW)	Margin (nW)	Result
30-1000	941.558	-80.0	0.010	4.0	3.990	Complied
1000-12500	6894.470	-65.4	0.288	20.0	19.712	Complied

### Secondary Radiated Emissions Strength (continued)

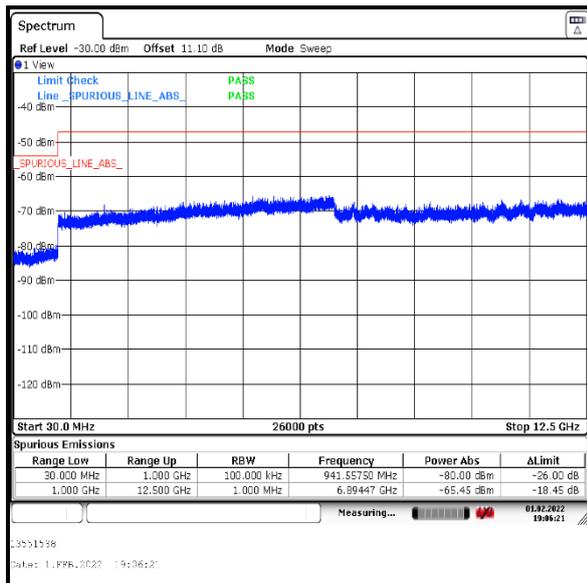
#### Results: DH5



Bottom Channel



Middle Channel



Top Channel

**Secondary Radiated Emissions Strength (continued)****Results: 3DH5 / Bottom Channel**

Frequency Range (MHz)	Frequency (MHz)	Peak Level (dBm)	Peak Level (nW)	Limit (nW)	Margin (nW)	Result
30-1000	749.983	-79.1	0.012	4.0	3.988	Complied
1000-12500	6681.720	-65.0	0.316	20.0	19.684	Complied

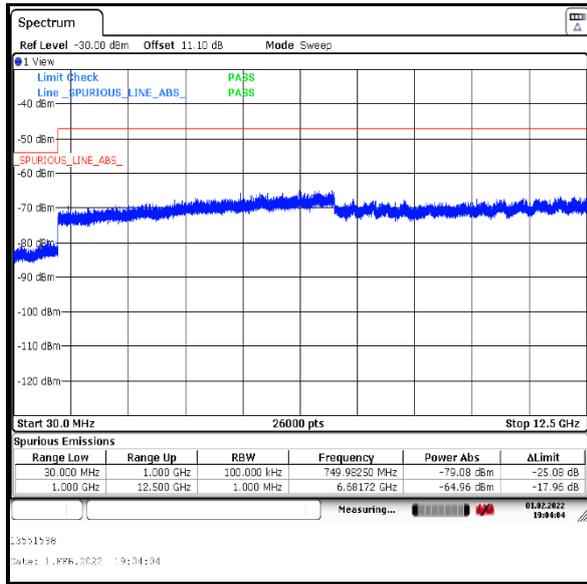
**Results: 3DH5 / Middle Channel**

Frequency Range (MHz)	Frequency (MHz)	Peak Level (dBm)	Peak Level (nW)	Limit (nW)	Margin (nW)	Result
30-1000	761.623	-79.8	0.010	4.0	3.990	Complied
1000-12500	6678.840	-65.3	0.295	20.0	19.705	Complied

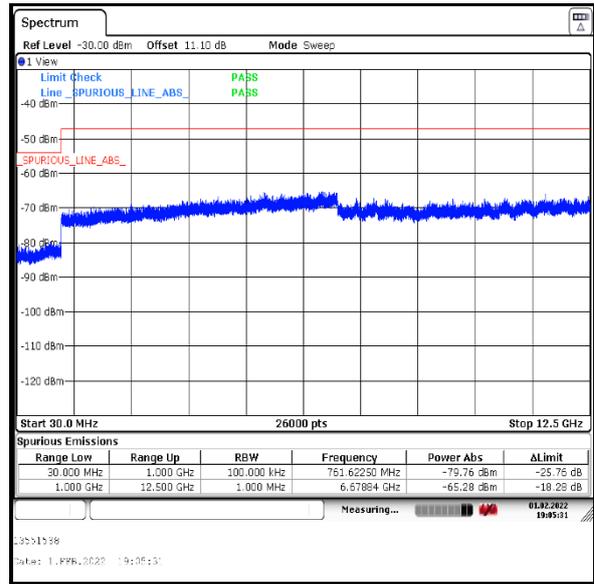
**Results: 3DH5 / Top Channel**

Frequency Range (MHz)	Frequency (MHz)	Peak Level (dBm)	Peak Level (nW)	Limit (nW)	Margin (nW)	Result
30-1000	777.628	-79.7	0.011	4.0	3.989	Complied
1000-12500	6942.860	-65.1	0.309	20.0	19.691	Complied

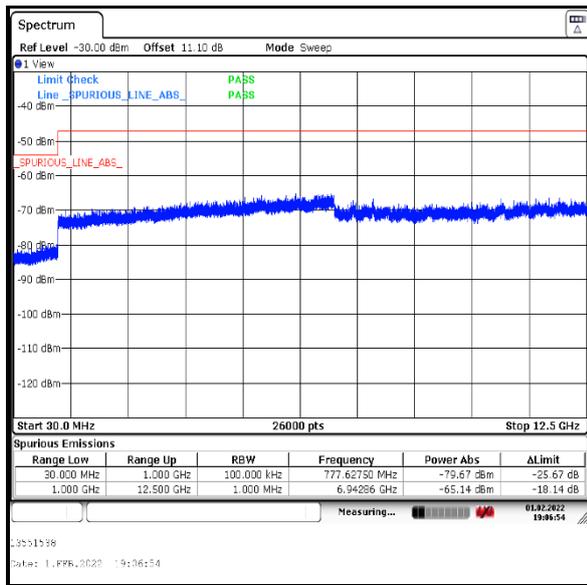
### Secondary Radiated Emissions Strength (continued)



Bottom Channel



Middle Channel



Top Channel

**5.2.6 Dwell Time and Duty Cycle****Test Summary:**

<b>Test Engineer:</b>	Raghavendra Katti	<b>Test Dates:</b>	22 September 2021 & 23 September 2021
<b>Test Sample Serial Number:</b>	0000011031015231		

<b>Reference:</b>	Ordinance Regulating Radio Equipment - Article 49-20
<b>Test Method:</b>	Clause Notice 88 Annex 43 – Test Methods for Radio Equipment listed in Article 2, paragraph 1, Item (19), Section 12

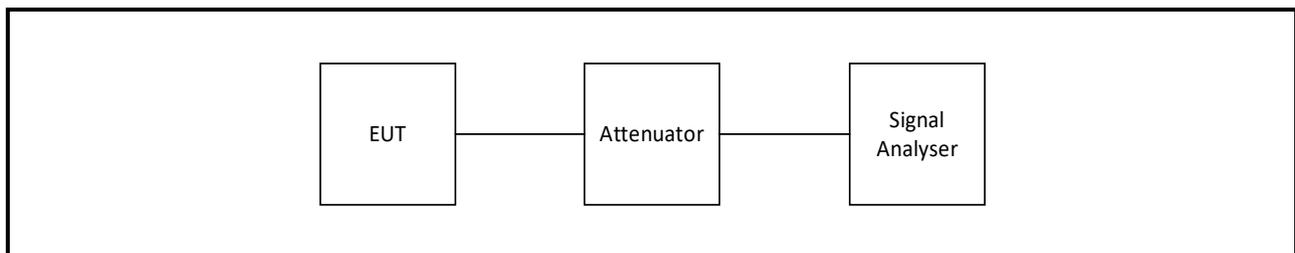
**Environmental Conditions:**

<b>Temperature (°C):</b>	22
<b>Relative Humidity (%):</b>	51 to 53

**Note(s):**

1. The signal analyser was connected to the RF port on the EUT using suitable attenuation and RF cable.
2. The signal analyser was set up as follows: the resolution bandwidth was set to 1 MHz and video bandwidth of 3 MHz. A peak detector was used. The EUT was set to transmit in a hopping frequency mode with zero span.
3. Dwell Time was measured using a signal analyser in the time domain and calculated by using the following calculation:

$$\text{Dwell Time} = (0.4 * \text{Spreading BW [MHz]} * \text{On Time / Symbol Rate [Mbps]}) / (\text{Period} * \text{Hopping Number})$$

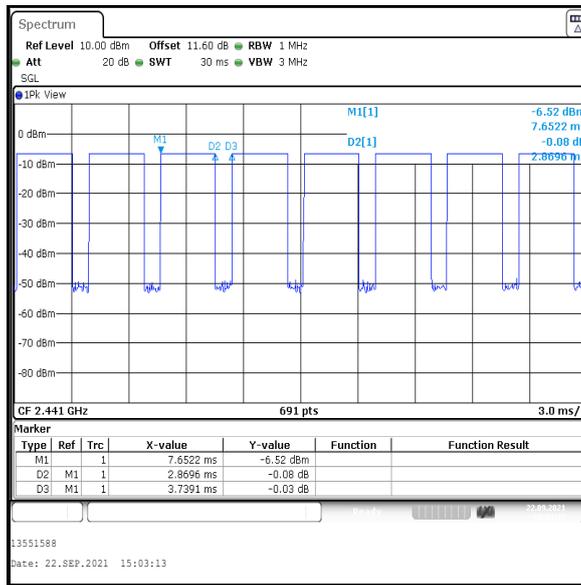
**Test Setup Diagram:**

**Dwell Time and Duty Cycle (continued)**

**Results: DH5**

On time (ms)	Period (ms)	Duty Cycle (%)
2.870	3.739	76.8

Spreading Bandwidth (MHz)	Transmission Rate (Mbps)	Number of Hops	Dwell Time	Limit (s)	Margin (s)	Result
70.854	1	79	0.275	0.4	0.125	Complied

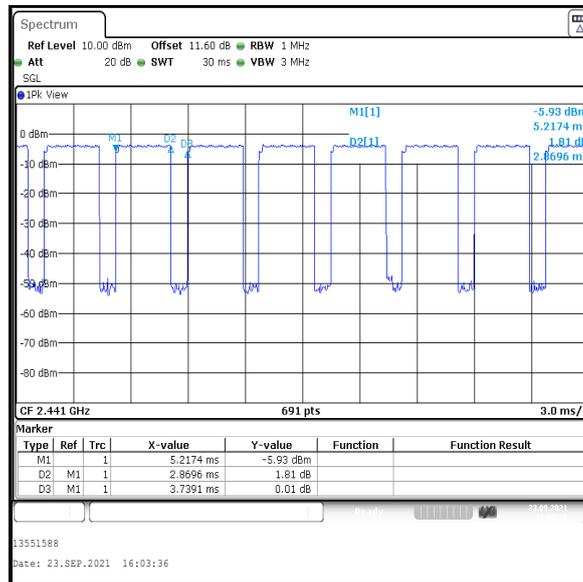


**Dwell Time and Duty Cycle (continued)**

**Results: 3DH5**

On time (ms)	Period (ms)	Duty Cycle (%)
2.870	3.739	76.8

Spreading Bandwidth (MHz)	Transmission Rate (Mbps)	Number of Hops	Dwell Time	Limit (s)	Margin (s)	Result
70.854	3	79	0.092	0.4	0.308	Complied



**5.2.7 Interference Prevention Function****Test Summary:**

<b>Test Engineer:</b>	Raghavendra Katti	<b>Test Date:</b>	30 September 2021
<b>Test Sample Serial Number:</b>	0000011031015231		

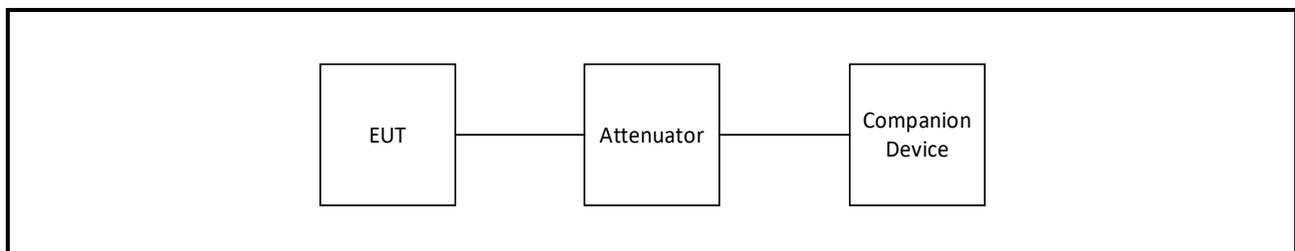
<b>Reference:</b>	Ordinance Regulating Radio Equipment - Article 9-4
<b>Test Method:</b>	Clause Notice 88 Annex 43 – Test Methods for Radio Equipment listed in Article 2, paragraph 1, Item (19), Section 11

**Environmental Conditions:**

<b>Temperature (°C):</b>	22
<b>Relative Humidity (%):</b>	53

**Note(s):**

1. The EUT was configured for normal operation and connected to a companion device.
2. The EUT has the function to transmit the identification code automatically. The identification code was verified via the companion device.
3. The EUT possesses function to receive identification code automatically. The identification code transmitted by the companion device was identified. The EUT stopped transmitting when the ID code was different.

**Test Setup Diagram:****Results:**

Function	Result
Transmit Identification Code	Complied
Receive Identification Code	Complied

## **6 Calibration and Uncertainty**

### **Measuring Instrument Calibration**

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

### **Measurement Uncertainty & Decision Rule**

#### **Overview**

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently the result of a measurement is only an approximation to the value measured (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

#### **Decision Rule**

The decision rule applied is based upon the accuracy method criteria. The measurement uncertainty is met and the result is considered in conformance with the requirement criteria if the observed value is within the prescribed limit.

#### **Measurement Uncertainty**

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

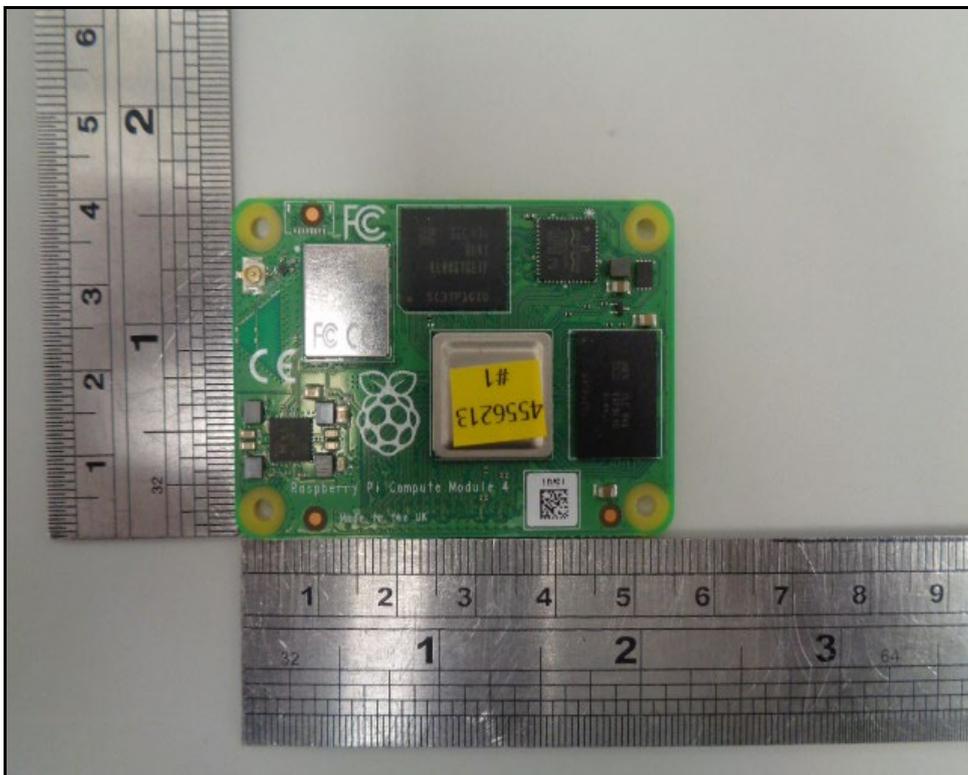
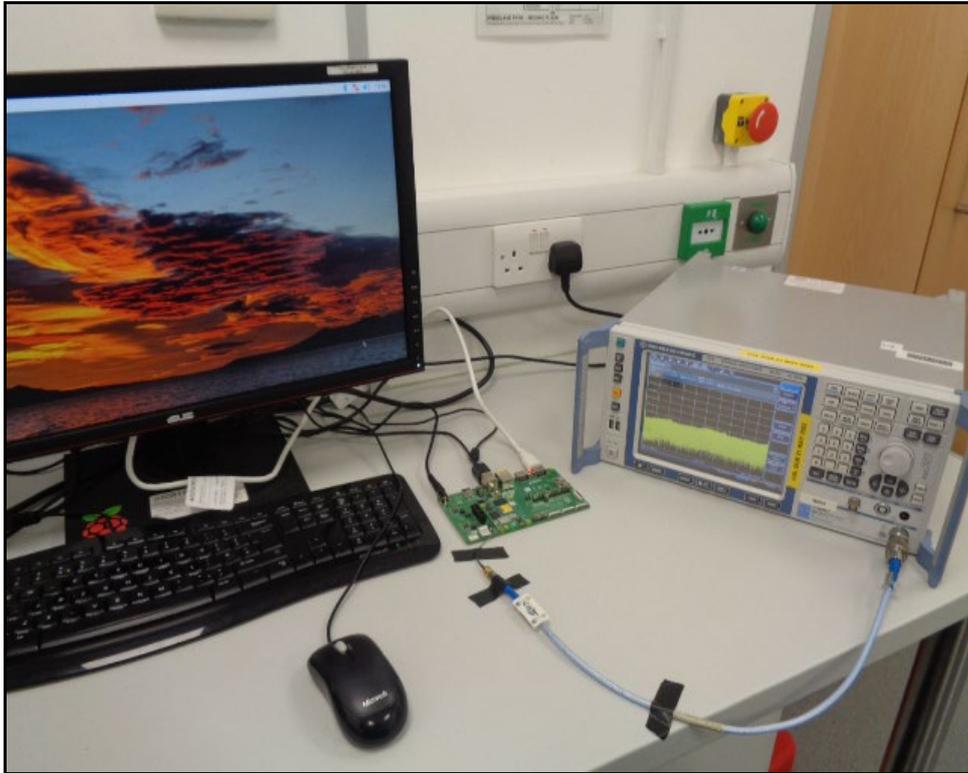
<b>Measurement Type</b>	<b>Confidence Level (%)</b>	<b>Calculated Uncertainty</b>
Frequency Tolerance	95%	±1.62 ppm
Occupied Bandwidth and Spreading Bandwidth	95%	±3.92 %
Unwanted Emission Strength	95%	±2.62 dB
Output Power, Power Tolerance and EIRP	95%	±1.13 dB
Secondary Radiated Emission Strength	95%	±2.62 dB
Dwell Time and Duty Cycle	95%	±1.14 %

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty the published guidance of the appropriate accreditation body is followed.

## **7 Report Revision History**

<b>Version Number</b>	<b>Revision Details</b>		
	<b>Page No(s)</b>	<b>Clause</b>	<b>Details</b>
1.0	-	-	Initial Version

## Appendix 1. Photographs of Test Setup



--- END OF REPORT ---