

Report on the FCC and IC Testing of the  
Guardhat Inc.  
Model: GHP2470  
In accordance with FCC 47 CFR Part C

Prepared for: Guardhat Inc.  
1520 Woodward Ave 3rd Floor  
Detroit, MI 48226  
USA

FCC ID: 2AR6OGHP2470

COMMERCIAL-IN-CONFIDENCE

Date: 2019-05-27  
TR-03867-42960-03 | Issue 4



Product Service

Choose certainty.  
Add value.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Project Management	Matthias Stumpe	2019-06-11	
Authorised Signatory	Martin Steindl	2019-06-11	

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service document control rules.

ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Part 15C. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Matthias Stumpe	2019-06-11	

Laboratory Accreditation

DAkkS Reg. No. D-PL-11321-11-02

Laboratory recognition

Registration No. BNetzA-CAB-16/21-15

ISED Canada test site registration

3050A-2

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with FCC 47 CFR Part 15C:2016.

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Trade Register Munich  
HRB 85742  
VAT ID No. DE129484267  
Information pursuant to Section 2(1)  
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## 1 Report Summary

### 1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	2018-11-21
2	Chapter "2.8 RF Exposure Assessment" corrected	2019-05-07
3	Chapter "2.8 RF Exposure Assessment" corrected	2019-05-27
4	Chapter "2.8 RF Exposure Assessment" removed	2019-06-11

**Table 1**

### 1.2 Introduction

Applicant	Guardhat Inc.
Manufacturer	Guardhat Inc.
Model Number(s)	GHP2470
Serial Number(s)	A49124
Hardware Version(s)	10554
Software Version(s)	0.0.8
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 15C:2016
Test Plan/Issue/Date	NA
Order Number	B18-09018
Date	2018-09-05
Date of Receipt of EUT	2018-09-20
Start of Test	2018-10-29
Finish of Test	2019-05-27
Name of Engineer(s)	Matthias Stumpe
Related Document(s)	KDB 558074 D01 15.247 Meas Guidance v05 ANSI C63.10 (2013)



### 1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15C is shown below.

Section	Specification Clause	Test Description	Result	Comments/Base Standard
Configuration and Mode: Continuously transmitting				
2.1	15.205	Restricted Band Edges	Pass	ANSI C63.10 (2013)
2.2	15.247 (e)	Power Spectral Density	Pass	ANSI C63.10 (2013)
2.3	15.207	AC Power Line Conducted Emissions	Pass	ANSI C63.10 (2013)
2.4	15.247 (a)(2)	Emission Bandwidth	Pass	ANSI C63.10 (2013)
2.5	15.247 (d) and 15.205	Spurious Radiated Emissions	Pass	ANSI C63.10 (2013)
2.6	15.247 (b)	Maximum Conducted Output Power	Pass	ANSI C63.10 (2013)
2.7	15.247 (d)	Authorised Band Edges	Pass	ANSI C63.10 (2013)

**Table 2**



## 1.4 Product Information

### 1.4.1 Technical Description

GHP2470 is a radio device using UWB technology in range 30 MHz to 10.6 GHz and Wideband transmission in the range 2.4 to 2.4835 GHz.

## 1.5 Deviations from the Standard

none

## 1.6 EUT Modification Record

The table below details modifications made to the EUT during the test programme.  
The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
0	As supplied by the customer	Not Applicable	Not Applicable

**Table 3**

## 1.7 Test Location

TÜV SÜD Product Service conducted the following tests at our Straubing Test Laboratory.

Test Name	Name of Engineer(s)
Configuration and Mode: Continuously transmitting	
Restricted Band Edges	Matthias Stumpe
Power Spectral Density	Matthias Stumpe
AC Power Line Conducted Emissions	Matthias Stumpe
Emission Bandwidth	Matthias Stumpe
Spurious Radiated Emissions	Matthias Stumpe
Maximum Conducted Output Power	Matthias Stumpe
Authorised Band Edges	Matthias Stumpe

**Table 4**

Office Address:

Äußere Frühlingstraße 45  
94315 Straubing  
Germany



## 2 Test Details

### 2.1 Restricted Band Edges

#### 2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.205

#### 2.1.2 Equipment Under Test and Modification State

GHP2470, S/N: A49124 - Modification State 0

#### 2.1.3 Date of Test

2018-10-30

#### 2.1.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 11.12.2.

#### 2.1.5 Environmental Conditions

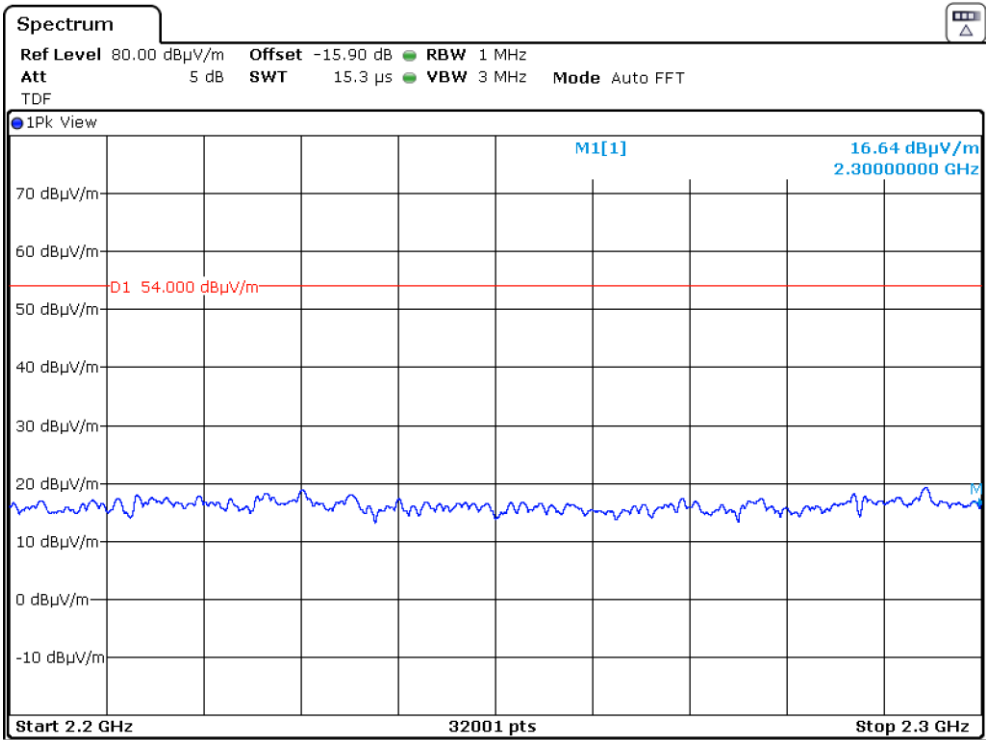
Ambient Temperature	24,0 °C
Relative Humidity	40,0 %



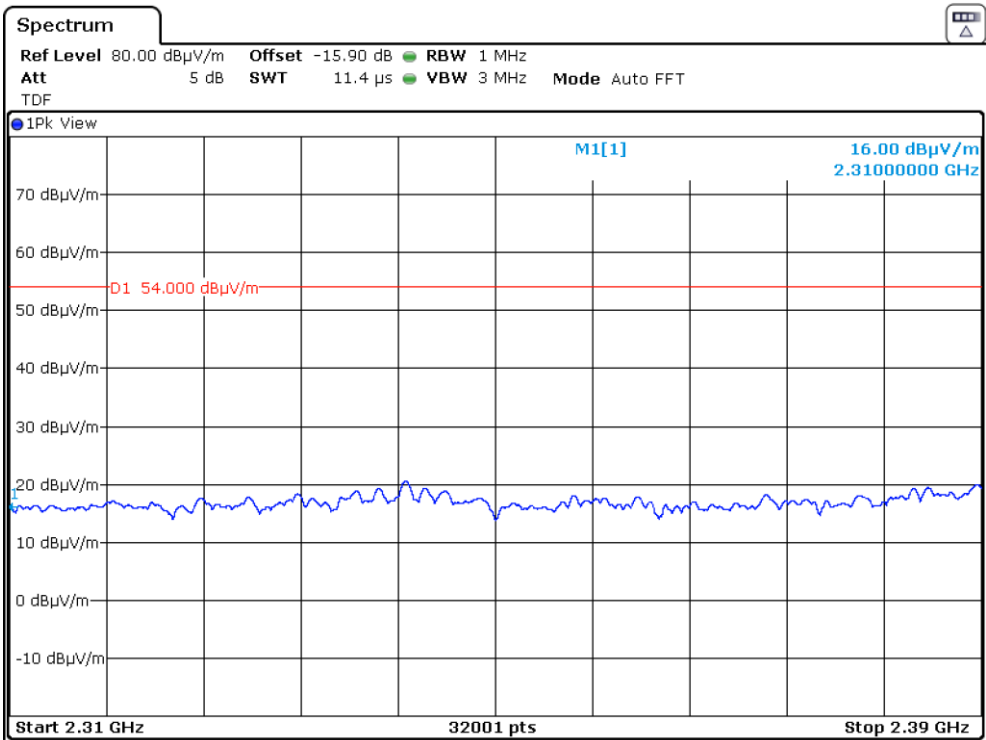
Product Service

2.1.6 Test Results

Continuous Transmission with modulation on Lower Channel (Ch 12):



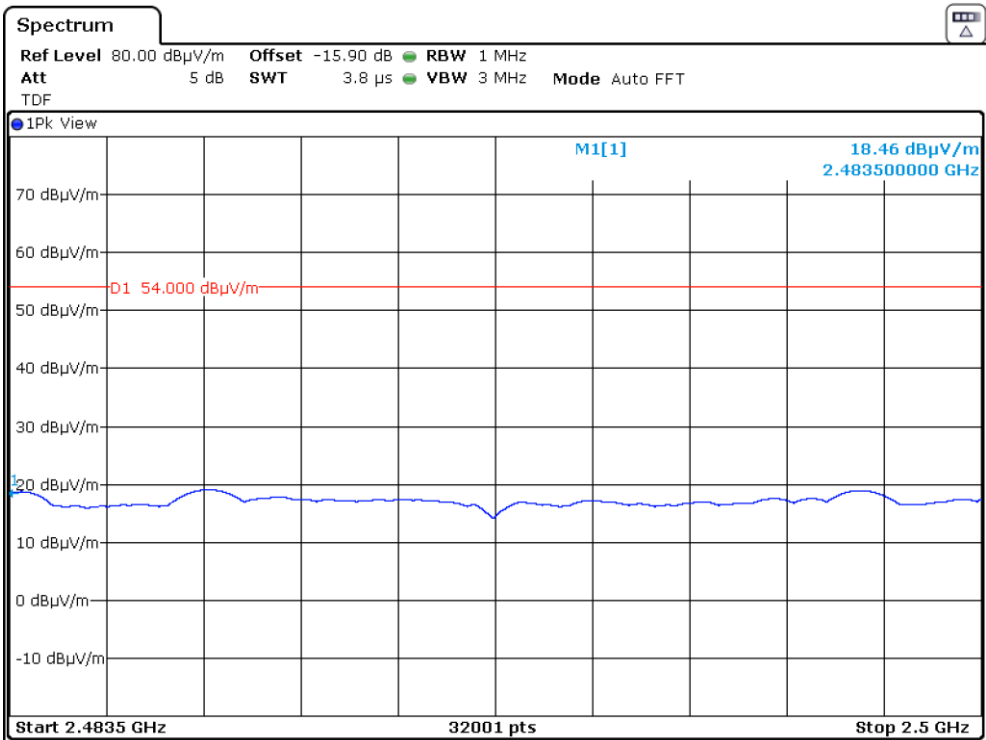
Date: 30.OCT.2018 11:39:10



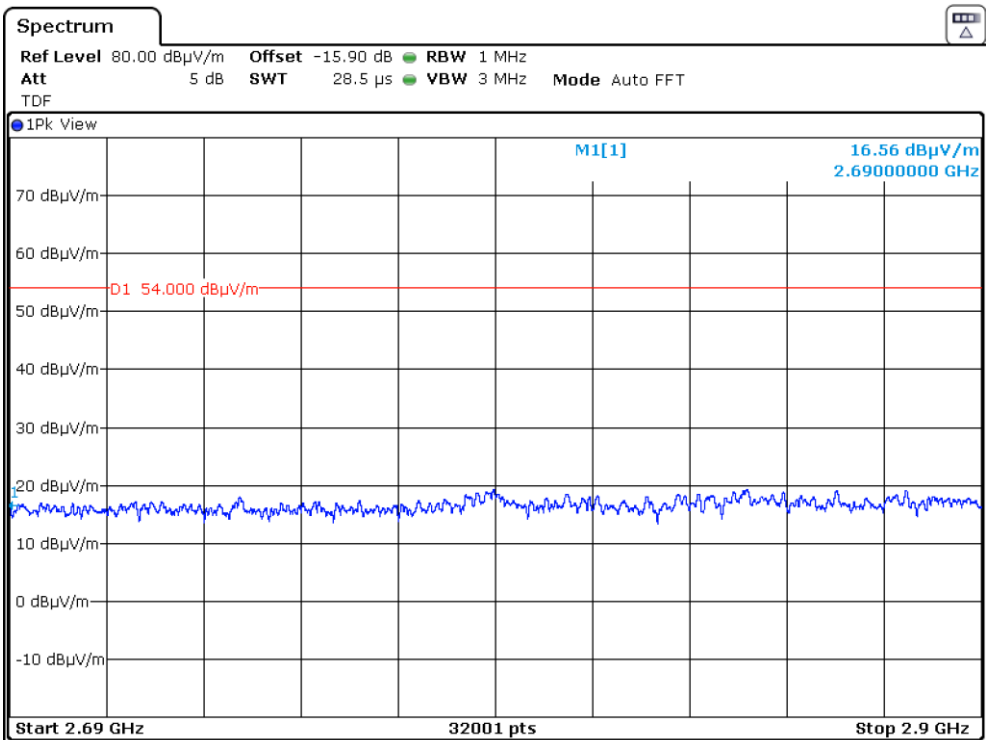
Date: 30.OCT.2018 11:40:37



Product Service



Date: 30.OCT.2018 11:41:35

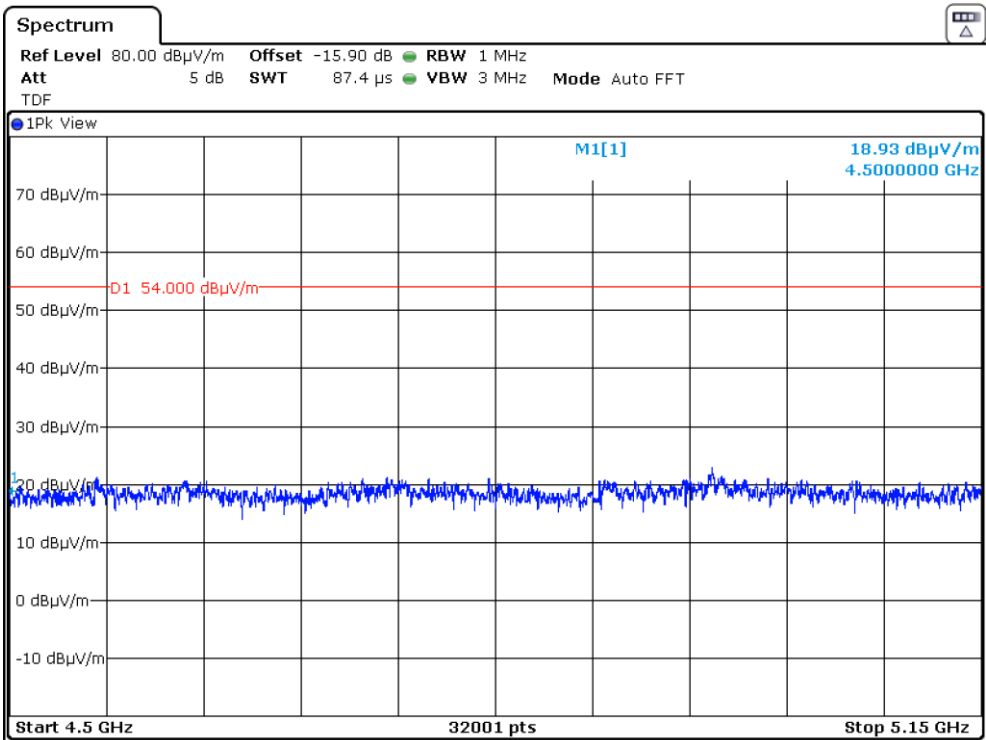


Date: 30.OCT.2018 11:42:39



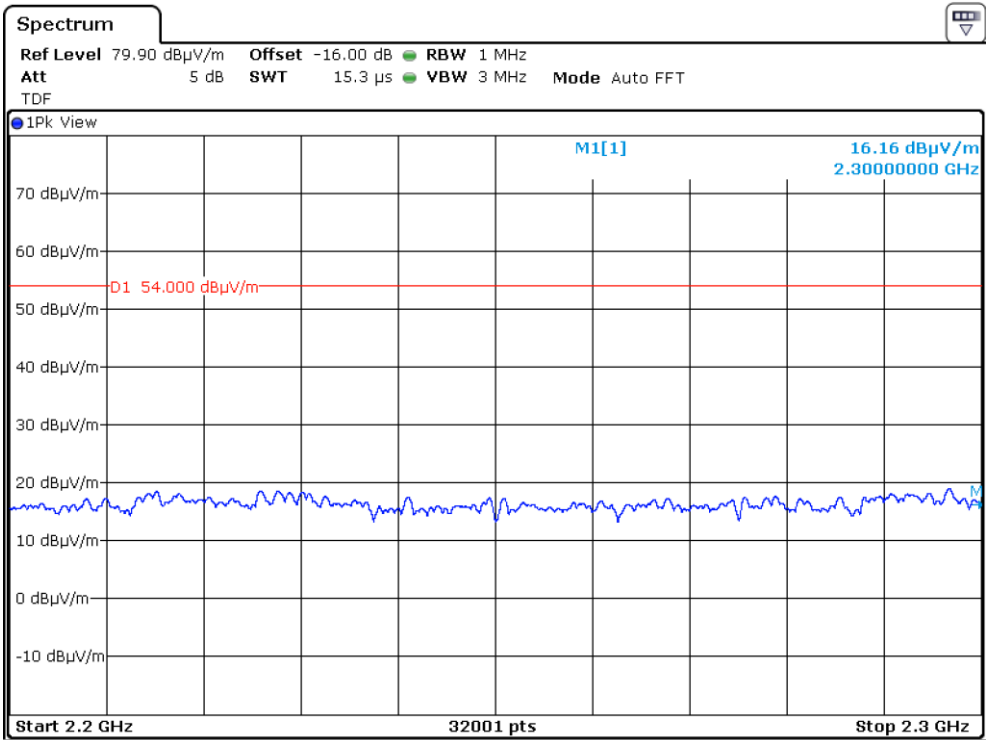


Product Service



Date: 30.OCT.2018 11:43:46

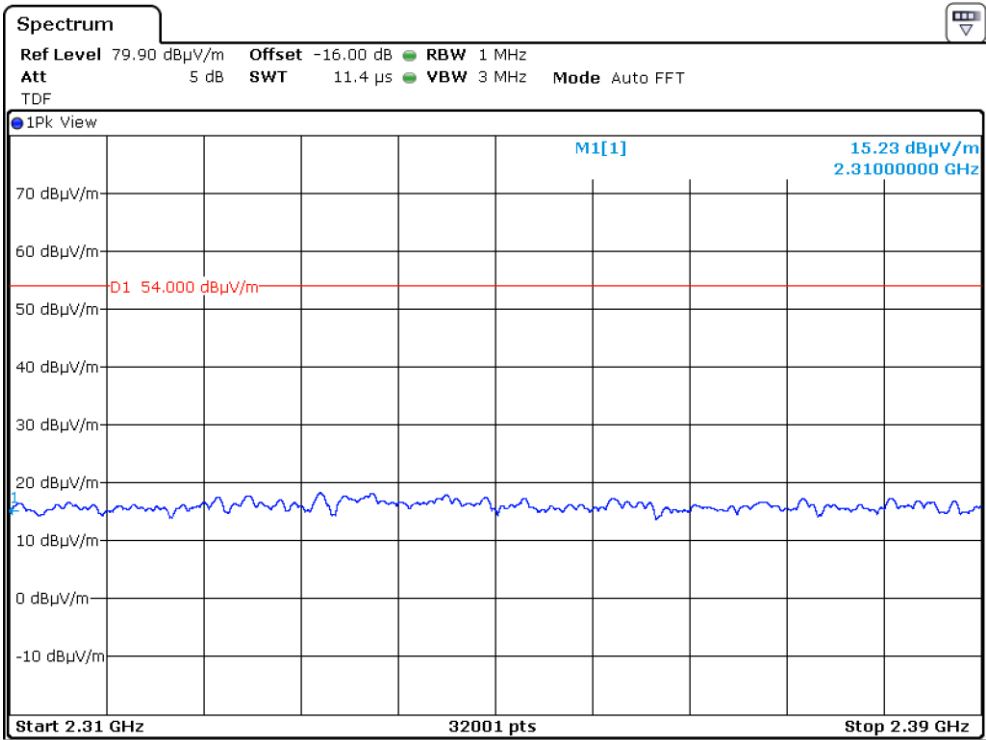
Continuous Transmission with modulation on Upper Channel (Ch 26):



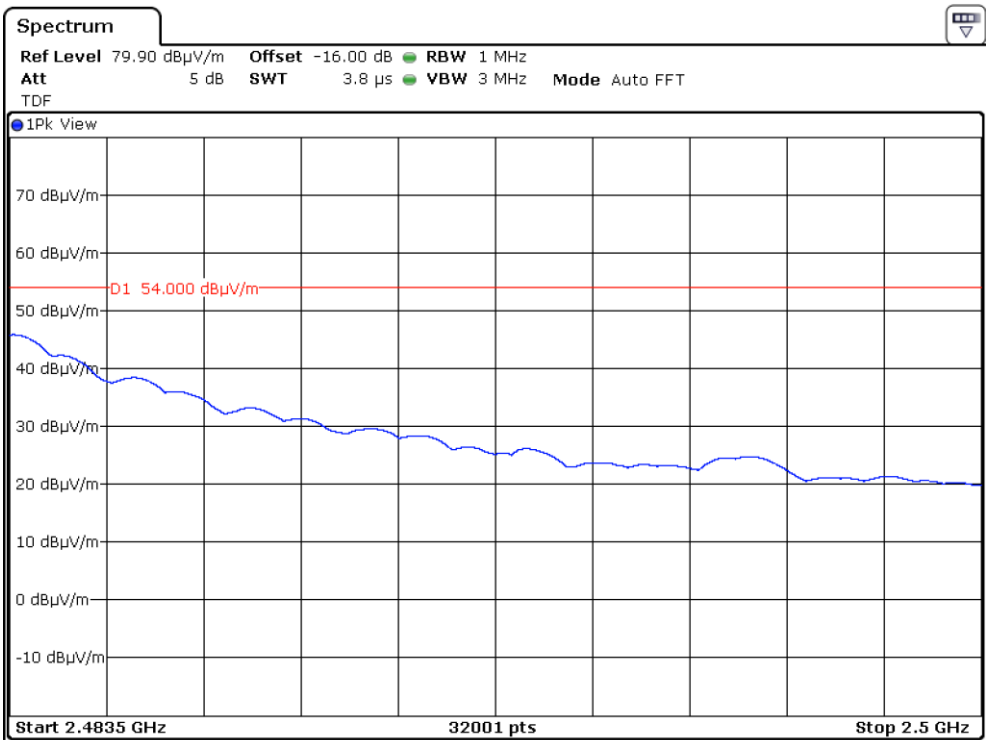
Date: 30.OCT.2018 13:25:42



Product Service



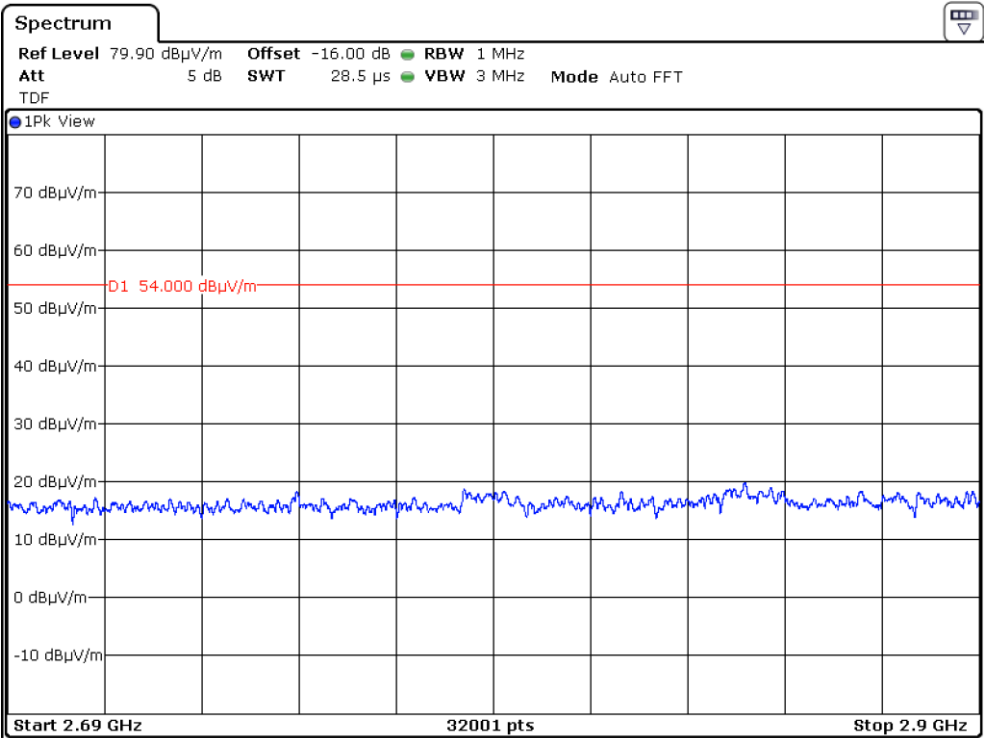
Date: 30.OCT.2018 13:26:48



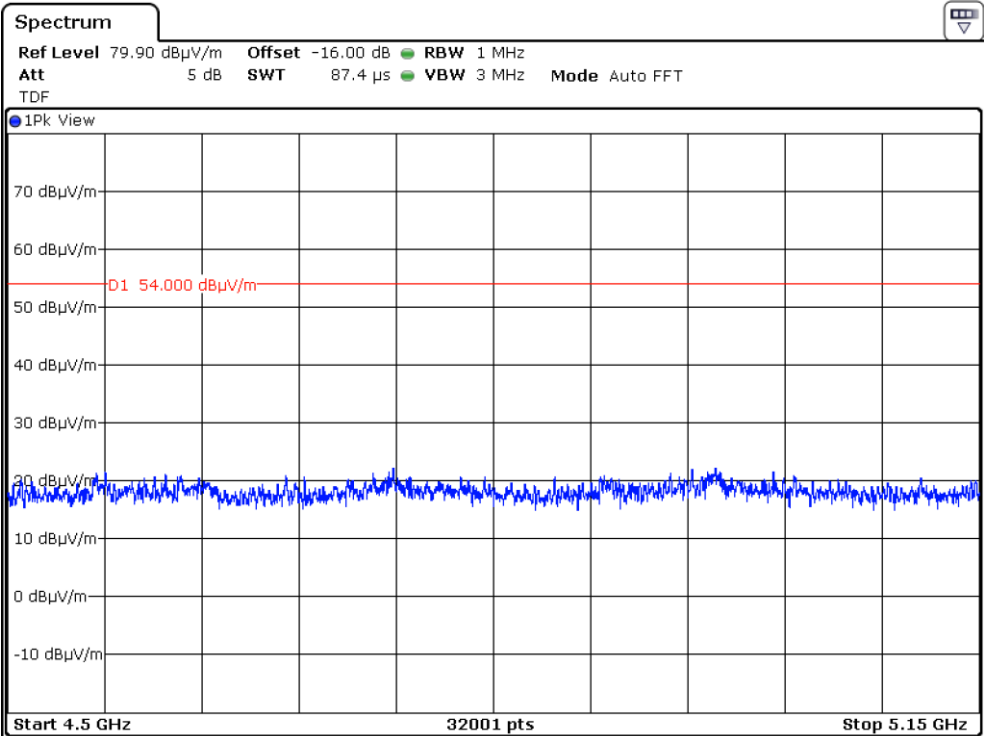
Date: 30.OCT.2018 13:27:55



Product Service



Date: 30.OCT.2018 13:29:14



Date: 30.OCT.2018 13:30:26



Product Service

### 2.1.7 Test Location and Test Equipment Used

This test was carried out in Non shielded room.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSV40	20219	12	2019-01-31

**Table 5**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment

N/A - Not Applicable



## **2.2 Power Spectral Density**

### **2.2.1 Specification Reference**

FCC 47 CFR Part 15C, Clause 15.247 (e)

### **2.2.2 Equipment Under Test and Modification State**

GHP2470, S/N: A49124 - Modification State 0

### **2.2.3 Date of Test**

2018-10-30

### **2.2.4 Test Method**

This test was performed in accordance with ANSI C63.10, clause 11.10.2.

### **2.2.5 Environmental Conditions**

Ambient Temperature    24,0 °C  
Relative Humidity        40,0 %

### **2.2.6 Test Results**

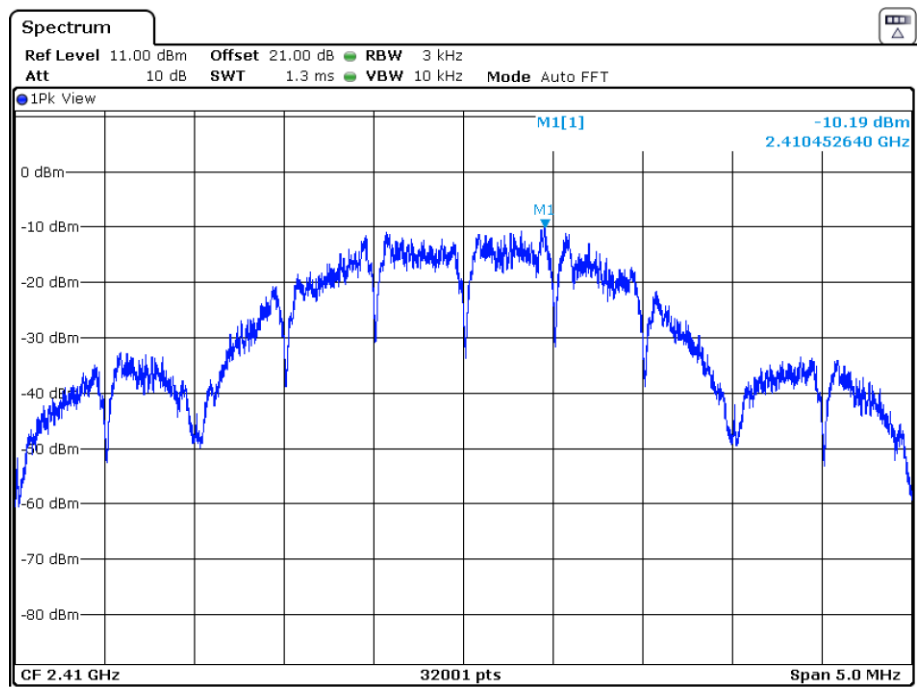
Continuous Transmission with modulation on Lower Channel (Ch 12):

Channel	Power Spectral Density [dBm/3kHz]
12 (Lower)	-10.19
19 (Middle)	-9.27
26 (Upper)	-10.22



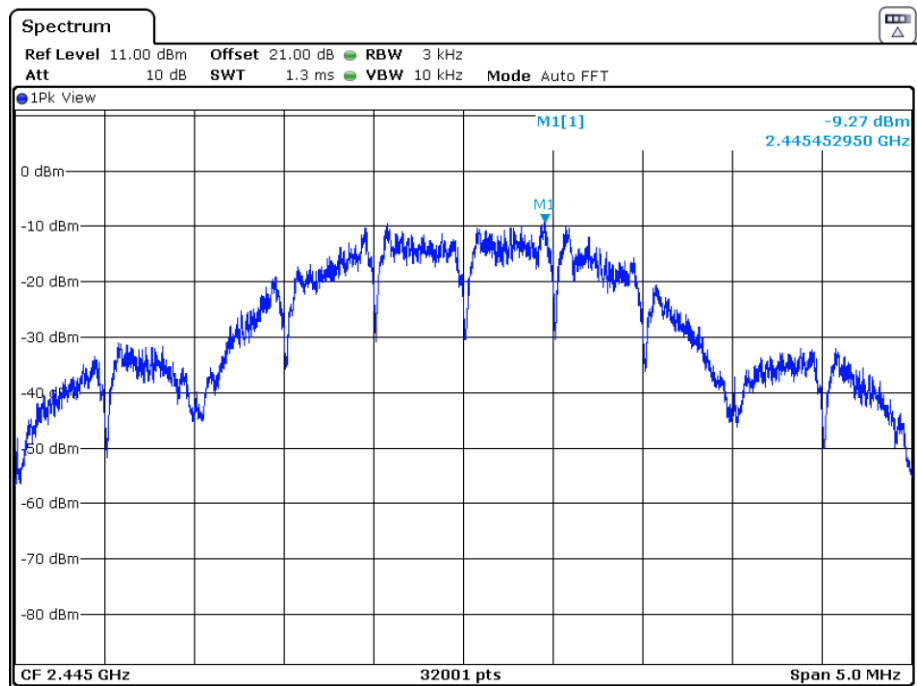
Product Service

PSD Test on Lower Channel (Ch 12):



Date: 30.OCT.2018 10:41:56

PSD Test on Middle Channel (Ch 19):

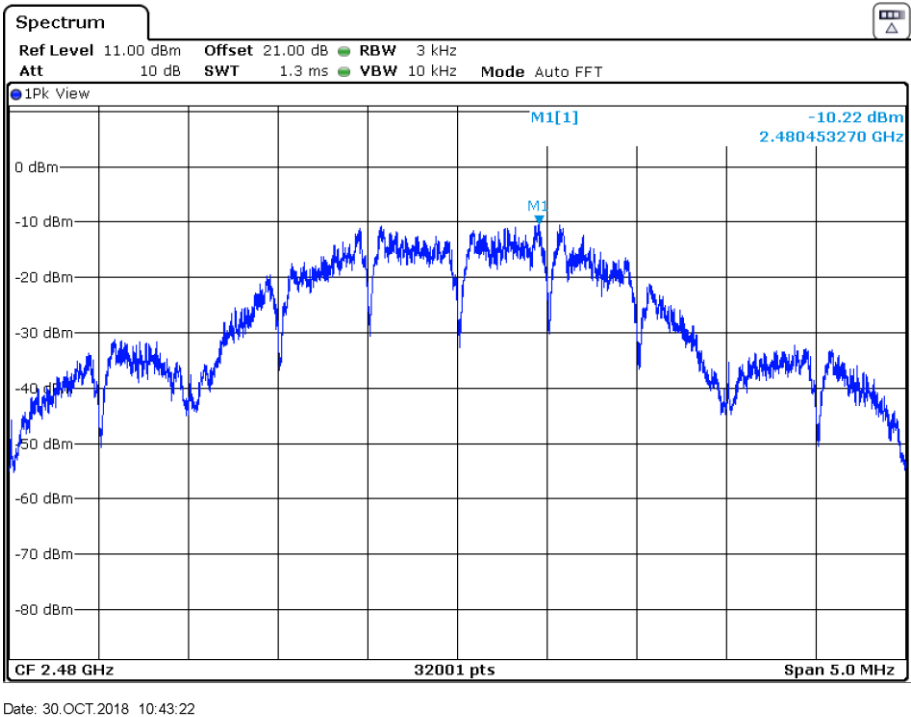


Date: 30.OCT.2018 10:40:24

PSD Test on Upper Channel (Ch 26):



Product Service



2.2.7 Test Location and Test Equipment Used

This test was carried out in Non shielded room.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSV40	20219	12	2019-01-31

Table 6

TU - Traceability Unscheduled  
O/P Mon – Output Monitored using calibrated equipment  
N/A - Not Applicable



Product Service

## **2.3 AC Power Line Conducted Emissions**

### **2.3.1 Specification Reference**

FCC 47 CFR Part 15C, Clause 15.207

### **2.3.2 Equipment Under Test and Modification State**

GHP2470, S/N: A49124 - Modification State 0

### **2.3.3 Date of Test**

2018-11-05

### **2.3.4 Environmental Conditions**

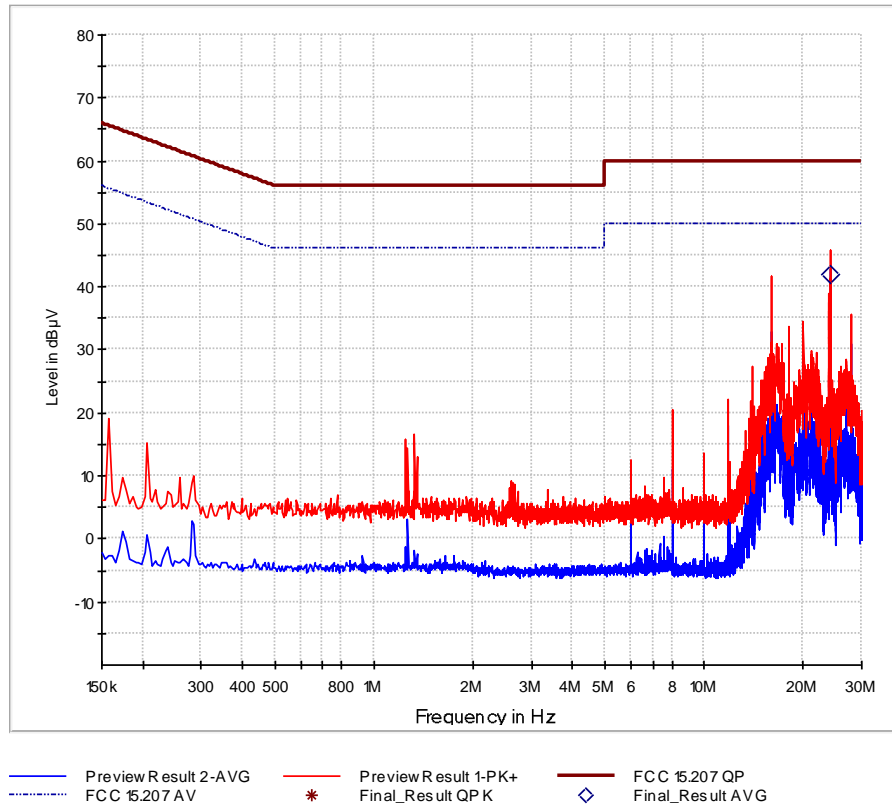
Ambient Temperature	24,0 °C
Relative Humidity	40,0 %





### 2.3.5 Test Result

#### Test Result Live and Neutral Line



#### Final Result:

Frequency MHz	QuasiPeak dBμV	Average dBμV	Limit dBμV	Margin dB	Meas. Time ms	Bandwidth kHz	Line	PE	Corr. dB
24.002000	---	42.07	50.00	7.93	1000.0	9.000	L1	GND	0.4

### 2.3.6 Test Location and Test Equipment Used

This test was carried out in Shielded room - cabin no. 4.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
EMI Test Receiver	Rohde&Schwarz	ESC13	19730	18	2019-04-30
V-Network	Rohde&Schwarz	ESH3-Z5	19078	36	2019-10-31
Test Software	Rohde&Schwarz	EMC32, V9.26.01	20090	---	---

Table 7

TU - Traceability Unscheduled  
O/P Mon – Output Monitored using calibrated equipment  
N/A - Not Applicable



Product Service

## **2.4 Emission Bandwidth**

### **2.4.1 Specification Reference**

FCC 47 CFR Part 15C, Clause 15.247 (a)(2)

### **2.4.2 Equipment Under Test and Modification State**

GHP2470, S/N: A49124 - Modification State 0

### **2.4.3 Date of Test**

2018-10-30

### **2.4.4 Test Method**

The test was performed in accordance with ANSI C63.10 clause 11.8.1.

### **2.4.5 Environmental Conditions**

Ambient Temperature    24,0 °C  
Relative Humidity        40,0 %

### **2.4.6 Test Results**

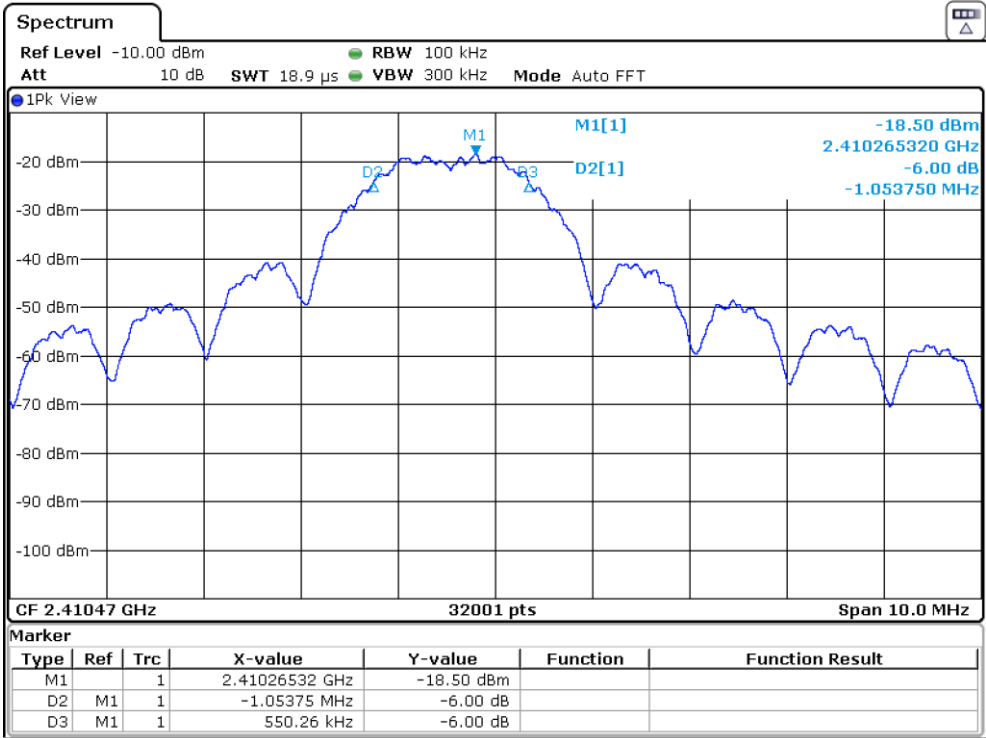
Continuous Transmission with modulation on Lower Channel (Ch 12):

Channel	Emission Bandwidth [kHz]
12 (Lower)	1604
26 (Upper)	1746



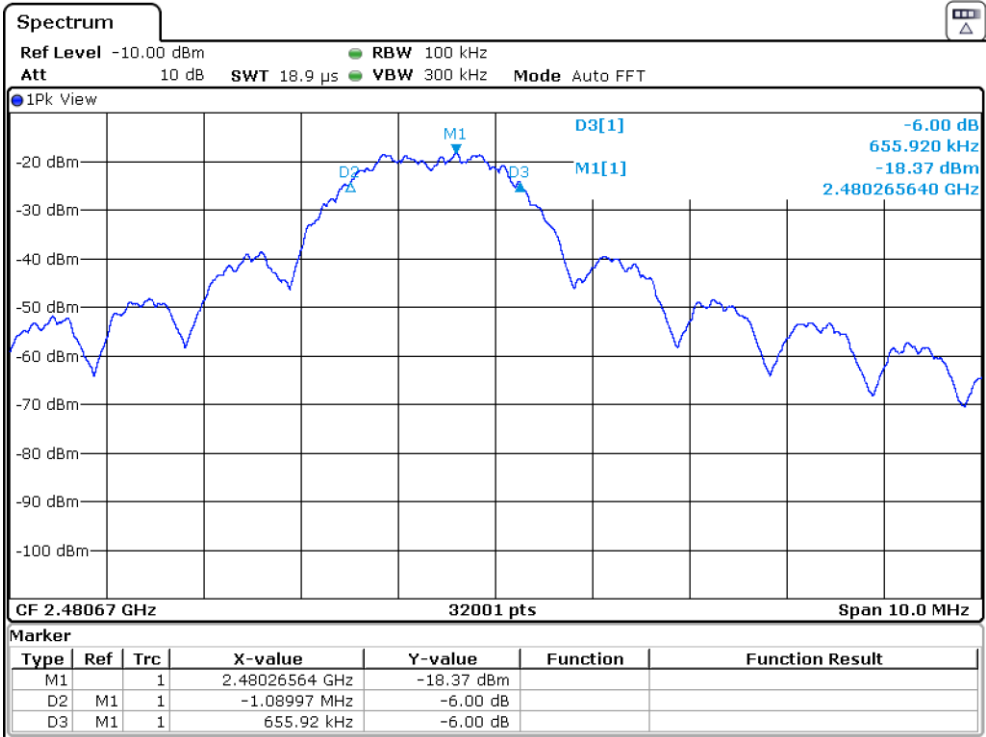
Product Service

Emission Bandwidth Test on Lower Channel (Ch 12):



Date: 30.OCT.2018 10:19:21

Emission Bandwidth Test on Upper Channel (Ch 26):



Date: 30.OCT.2018 10:15:48



Product Service

#### 2.4.7 Test Location and Test Equipment Used

This test was carried out in Non shielded room.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSV40	20219	12	2019-01-31

**Table 8**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment

N/A - Not Applicable



## **2.5 Spurious Emissions**

### **2.5.1 Specification Reference**

FCC 47 CFR Part 15C, Clause 15.247 (d) and 15.205

### **2.5.2 Equipment Under Test and Modification State**

GHP2470, S/N: A49124 - Modification State 0

### **2.5.3 Date of Test**

2018-10-29

### **2.5.4 Test Method**

This test was performed in accordance with ANSI C63.10-2013 clause 11.11.

### **2.5.5 Environmental Conditions**

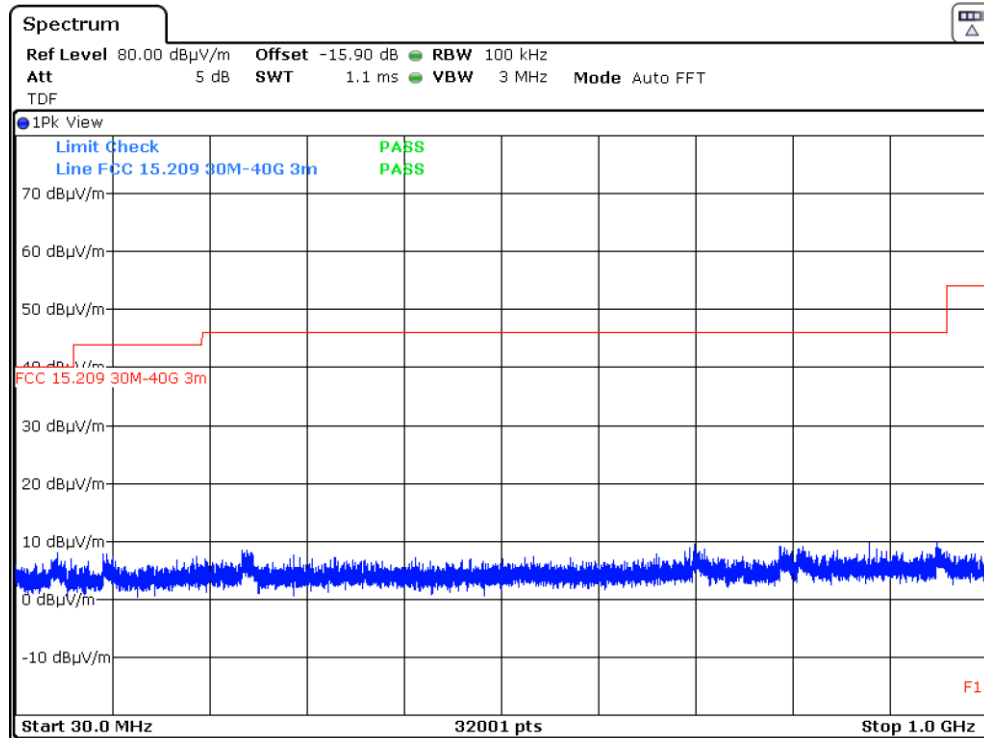
Ambient Temperature	22,0 °C
Relative Humidity	41,0 %



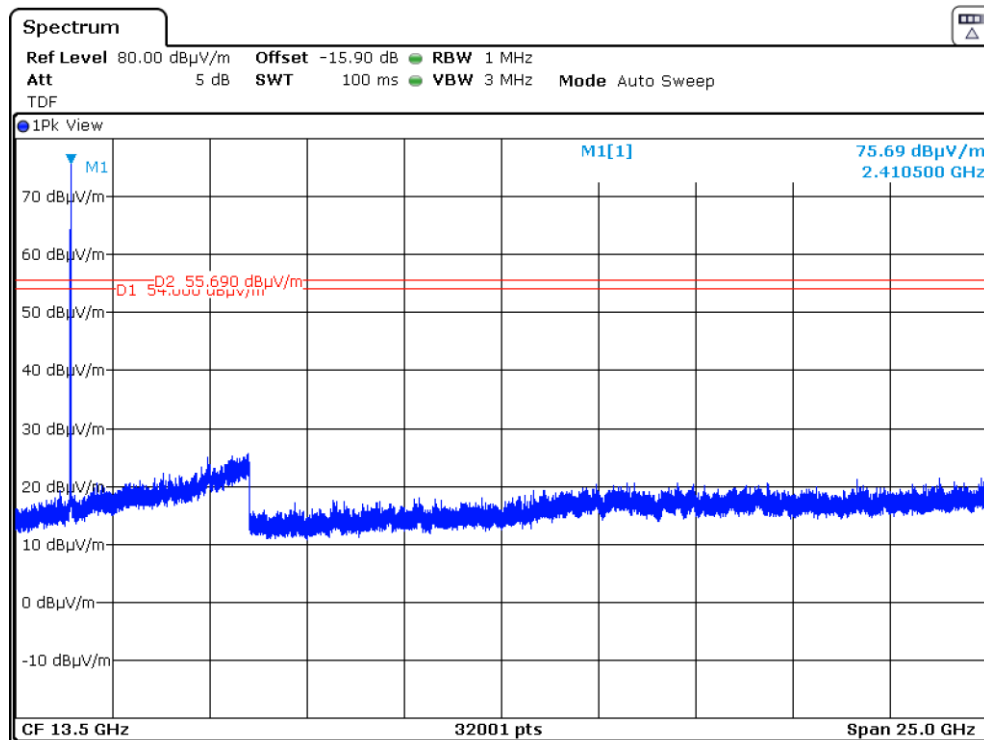
Product Service

## 2.5.6 Test Results

### Spurious Emissions Lower Channel (Ch 12):



Date: 30.OCT.2018 13:13:44

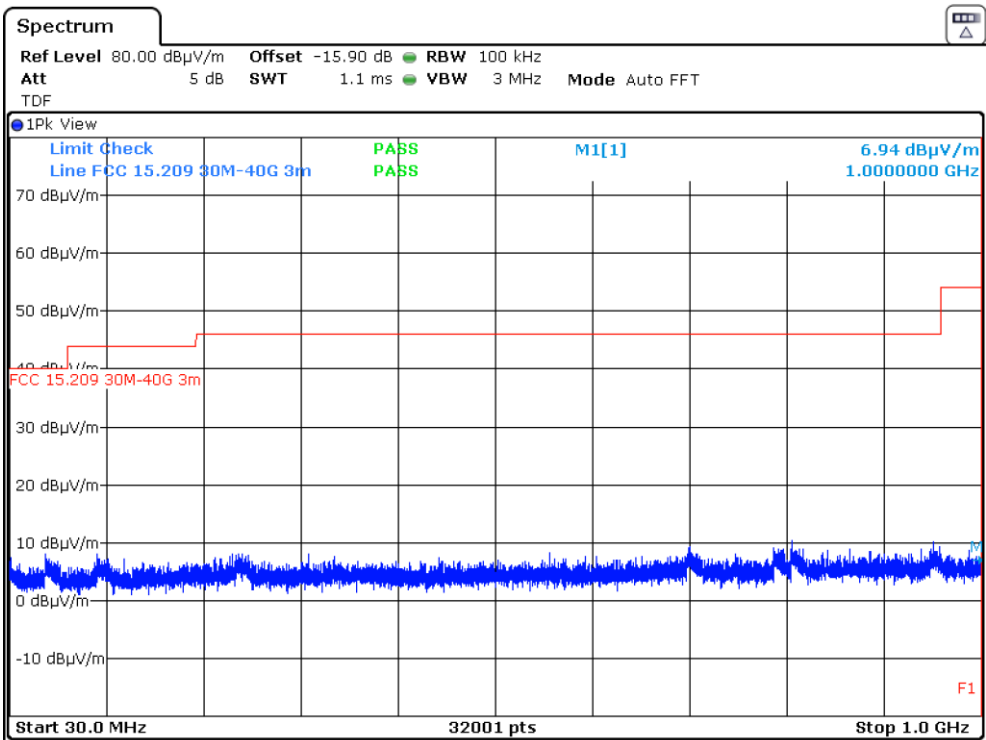


Date: 30.OCT.2018 11:35:29

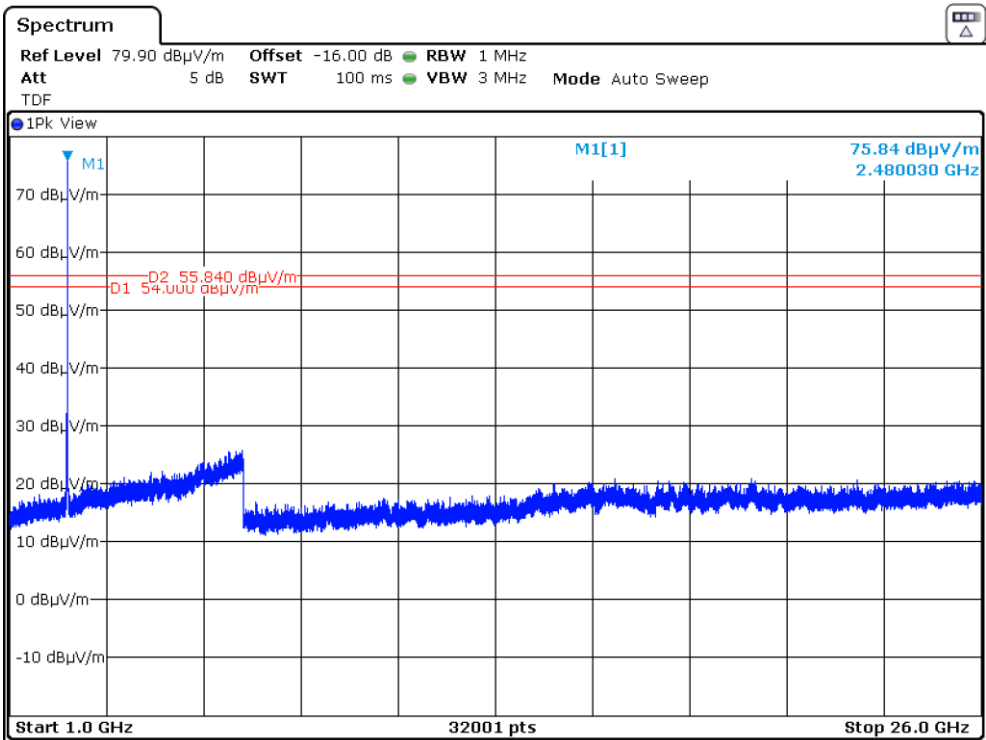


Product Service

Spurious Emissions Upper Channel (Ch 26):



Date: 30.OCT.2018 13:18:20



Date: 30.OCT.2018 13:22:49



Product Service

### 2.5.7 Test Location and Test Equipment Used

This test was carried out in Non shielded room.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSV40	20219	12	2019-01-31

**Table 9**

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment

N/A - Not Applicable





## **2.6 Maximum Conducted Output Power**

### **2.6.1 Specification Reference**

FCC 47 CFR Part 15C, Clause 15.247 (b)

### **2.6.2 Equipment Under Test and Modification State**

GHP2470, S/N: A49124 - Modification State 0

### **2.6.3 Date of Test**

2018-10-30

### **2.6.4 Test Method**

The test was performed in accordance with ANSI C63.10, clause 11.9.1.1.

### **2.6.5 Environmental Conditions**

Ambient Temperature    24,0 °C  
Relative Humidity        40,0 %

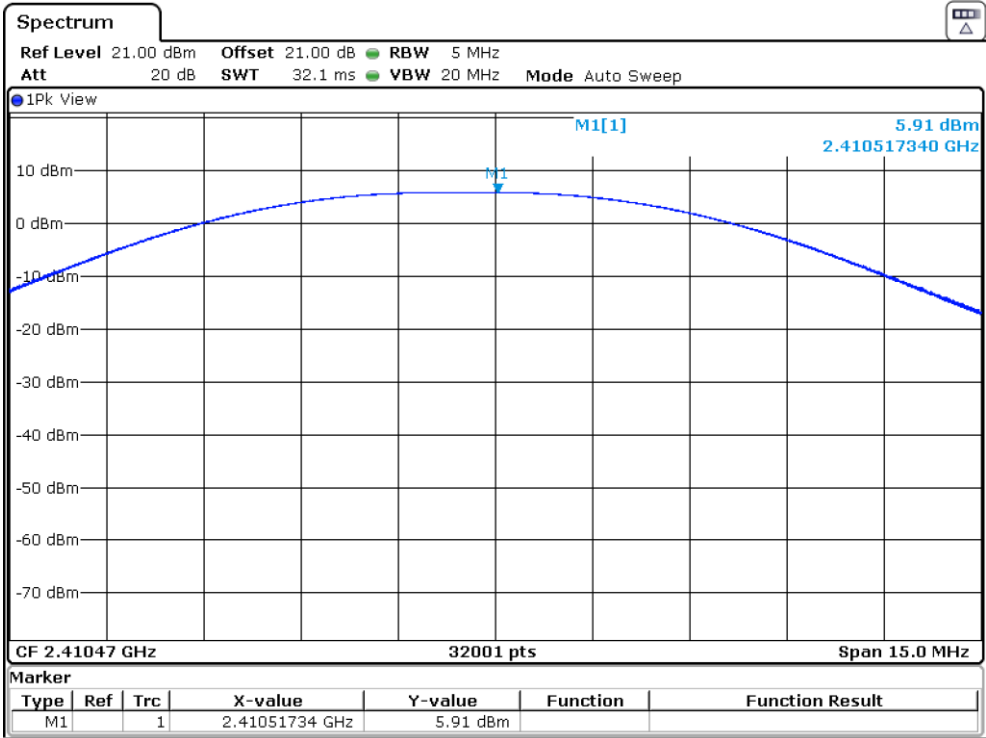
### **2.6.6 Test Results**

Channel	Maximum Conducted Output Power [mW]	Maximum Conducted Output Power [dBm]
12 (Lower)	390	5.91
19 (Middle)	474	6.76
26 (Upper)	400	6.02



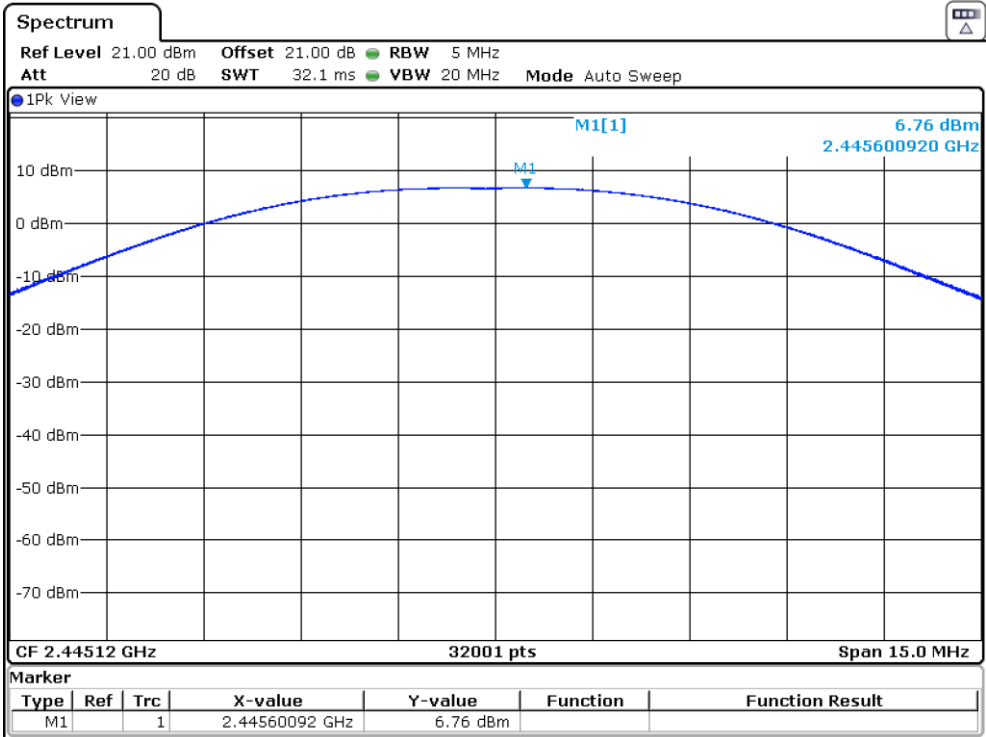
Product Service

Continuous Transmission with modulation on Lower Channel (Ch 12):



Date: 30.OCT.2018 10:22:24

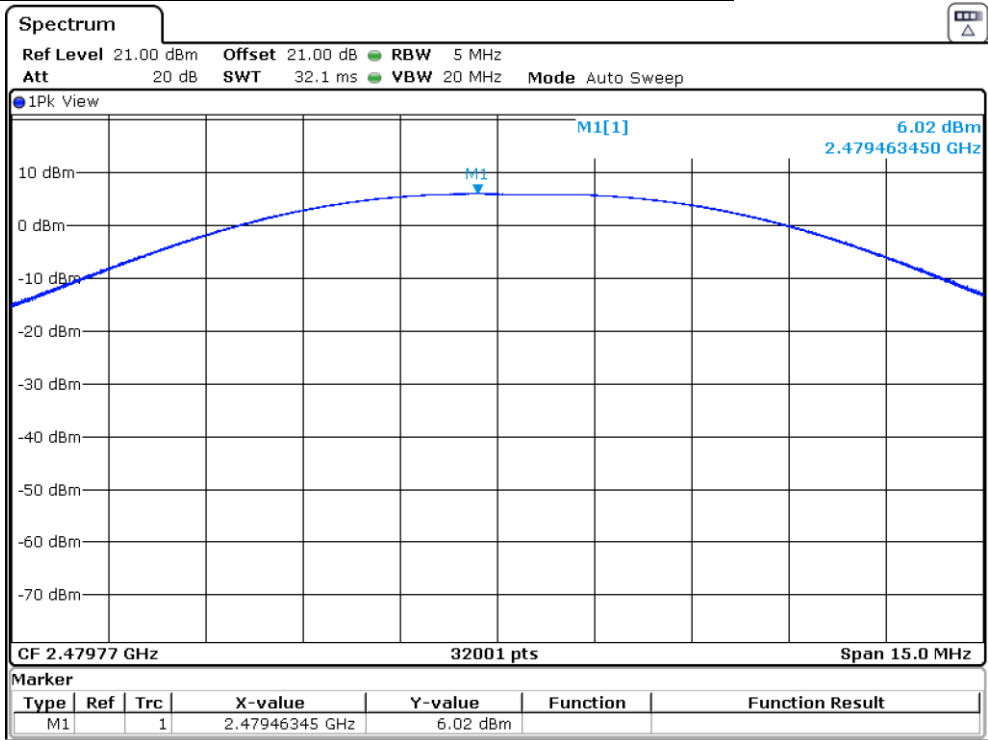
Continuous Transmission with modulation on Center Channel (Ch 19):



Date: 30.OCT.2018 10:25:14



Continuous Transmission with modulation on Upper Channel (Ch 26):



Date: 30.OCT.2018 10:24:03

2.6.7 Test Location and Test Equipment Used

This test was carried out in Non shielded room.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSV40	20219	12	2019-01-31

Table 10

TU - Traceability Unscheduled  
O/P Mon – Output Monitored using calibrated equipment  
N/A - Not Applicable



Product Service

## **2.7 Authorised Band Edges**

### **2.7.1 Specification Reference**

FCC 47 CFR Part 15C, Clause 15.247 (d)

### **2.7.2 Equipment Under Test and Modification State**

GHP2470, S/N: A49124 - Modification State 0

### **2.7.3 Date of Test**

2018-10-30

### **2.7.4 Test Method**

The test was performed in accordance with ANSI C63.10, clause 11.11.

### **2.7.5 Environmental Conditions**

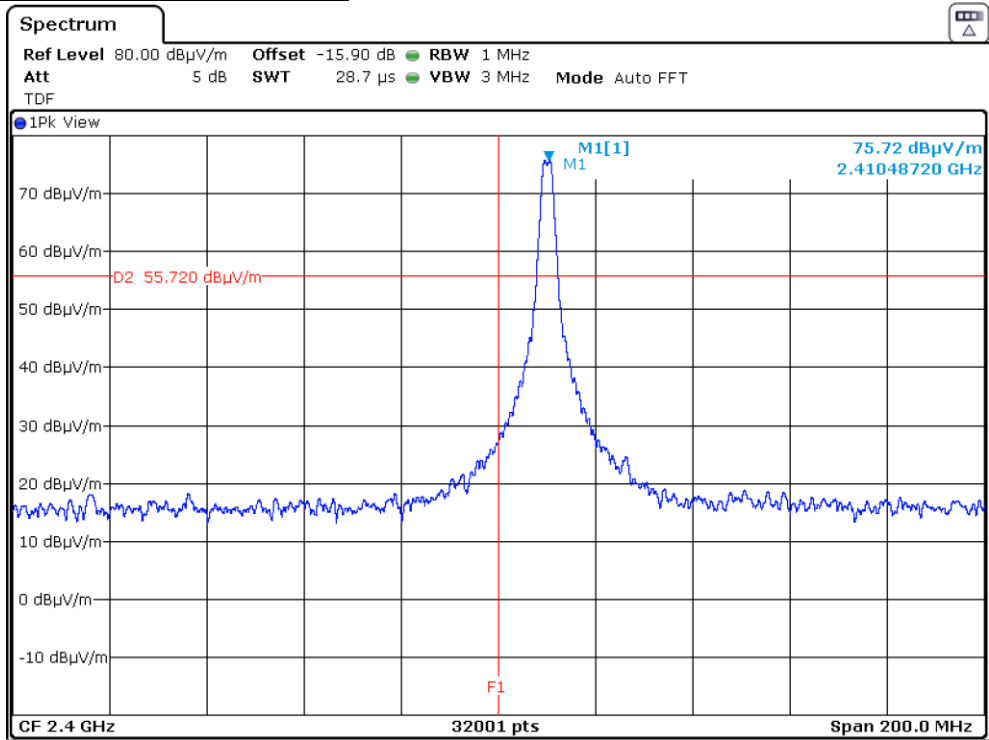
Ambient Temperature	24,0 °C
Relative Humidity	40,0 %



Product Service

2.7.6 Test Results

Continuous Transmission with modulation  
Lower Channel, Lower Band Edge:

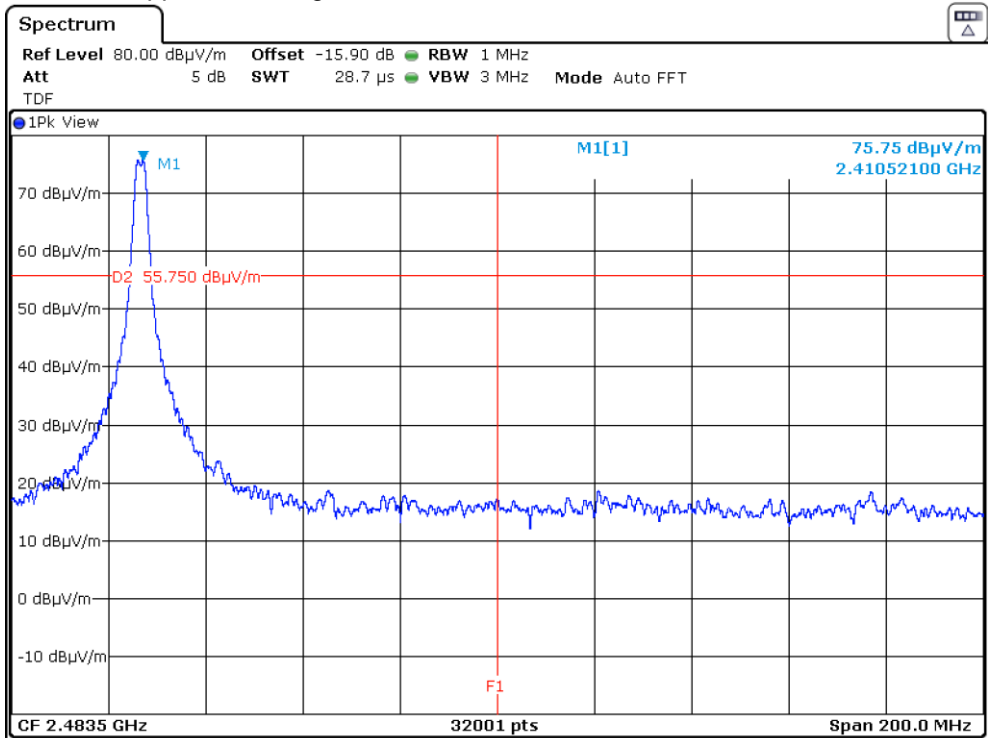


Date: 30.OCT.2018 11:59:11



Product Service

Continuous Transmission with modulation  
Lower Channel, Upper Band Edge:

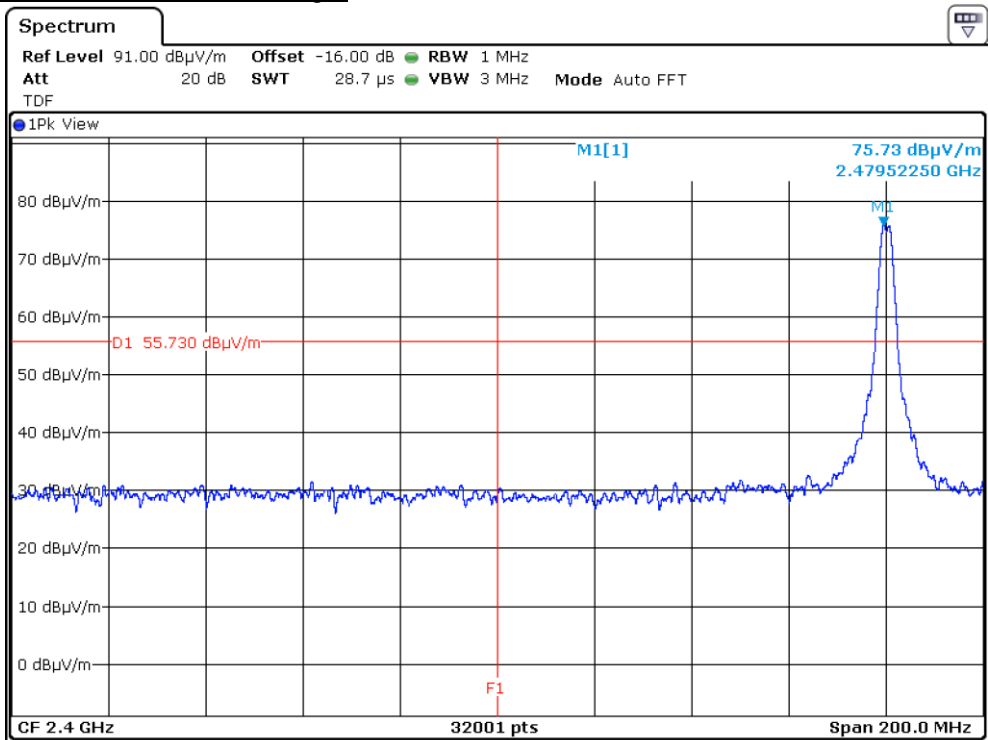


Date: 30.OCT.2018 12:05:40



Product Service

Continuous Transmission with modulation  
Upper Channel, Lower Band Edge:

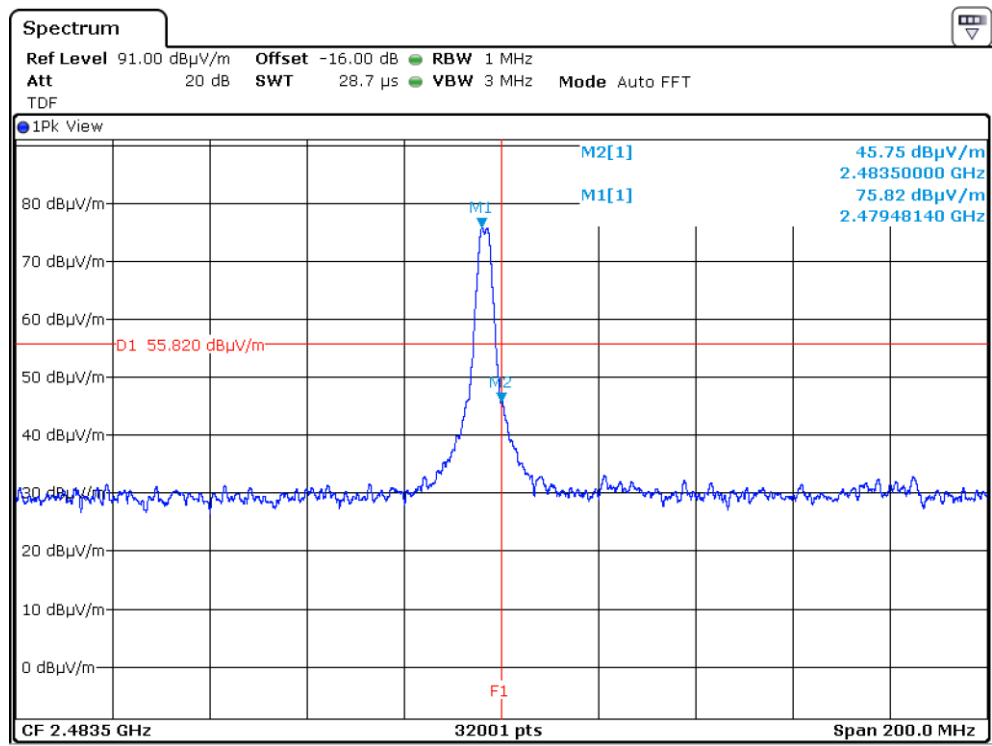


Date: 30.OCT.2018 13:33:22



Product Service

Continuous Transmission with modulation  
Upper Channel, Upper Band Edge:



FCC 47 CFR Part 15, Limit Clause 15.247 (d)

20 dB below the fundamental measured in a 100 kHz bandwidth using a peak detector. If the transmitter complies with the conducted power limits, based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB below the fundamental instead of 20 dB.

2.7.7 Test Location and Test Equipment Used

This test was carried out in Non shielded room.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSV40	20219	12	2019-01-31

Table 11

TU - Traceability Unscheduled  
O/P Mon – Output Monitored using calibrated equipment  
N/A - Not Applicable



### 3 Photographs

#### 3.1 Equipment Under Test (EUT)

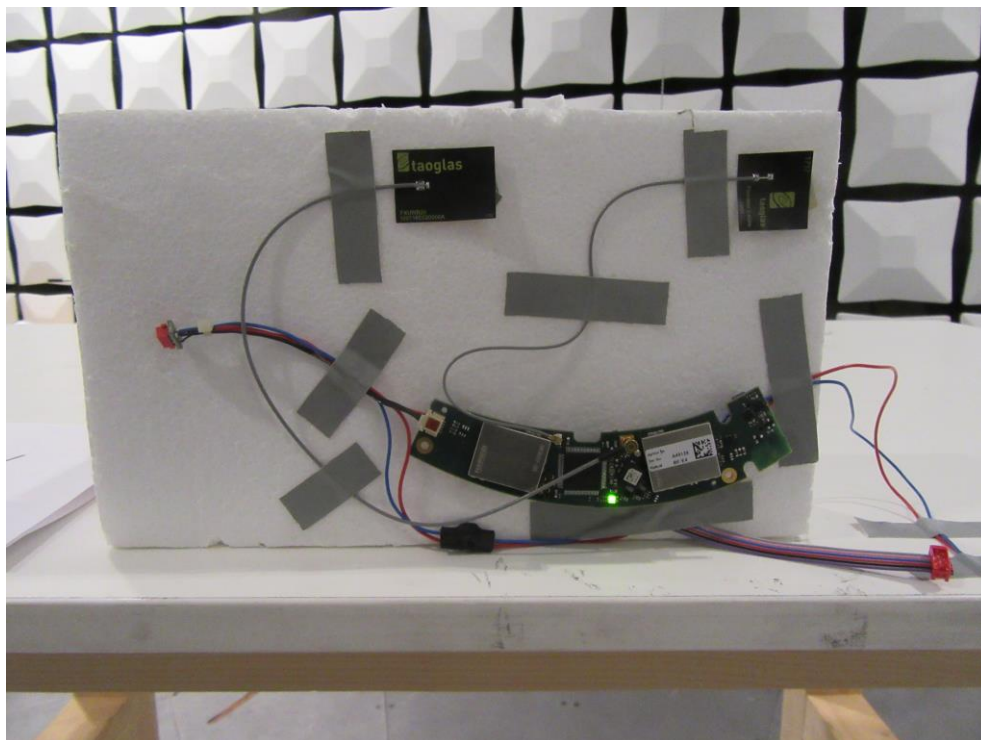


Figure 1



Figure 2

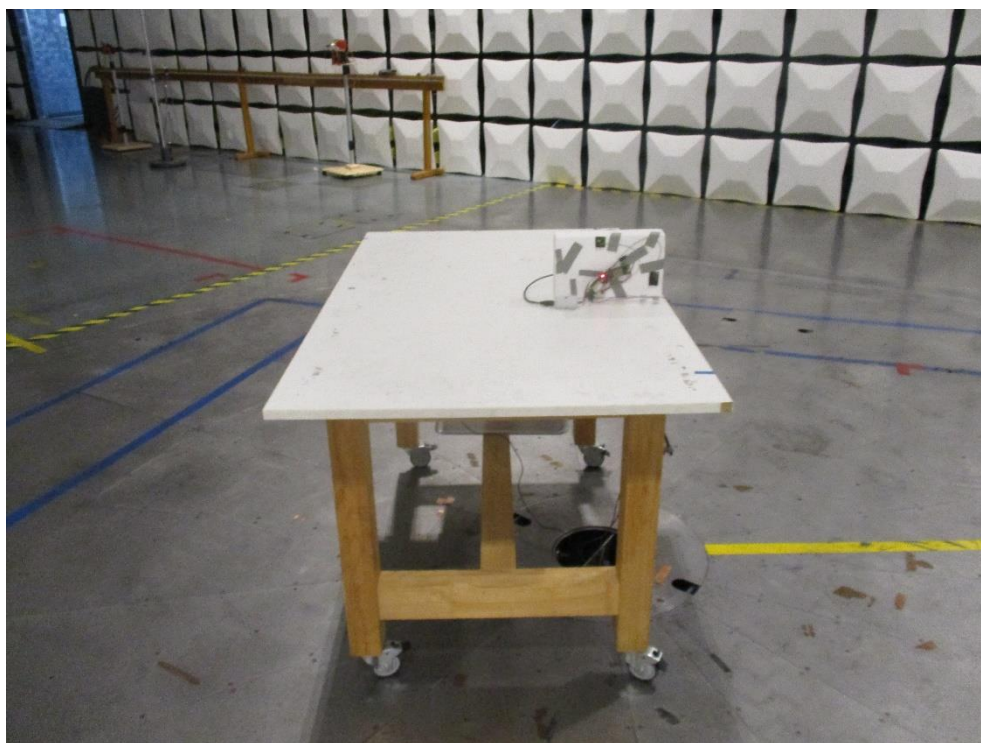
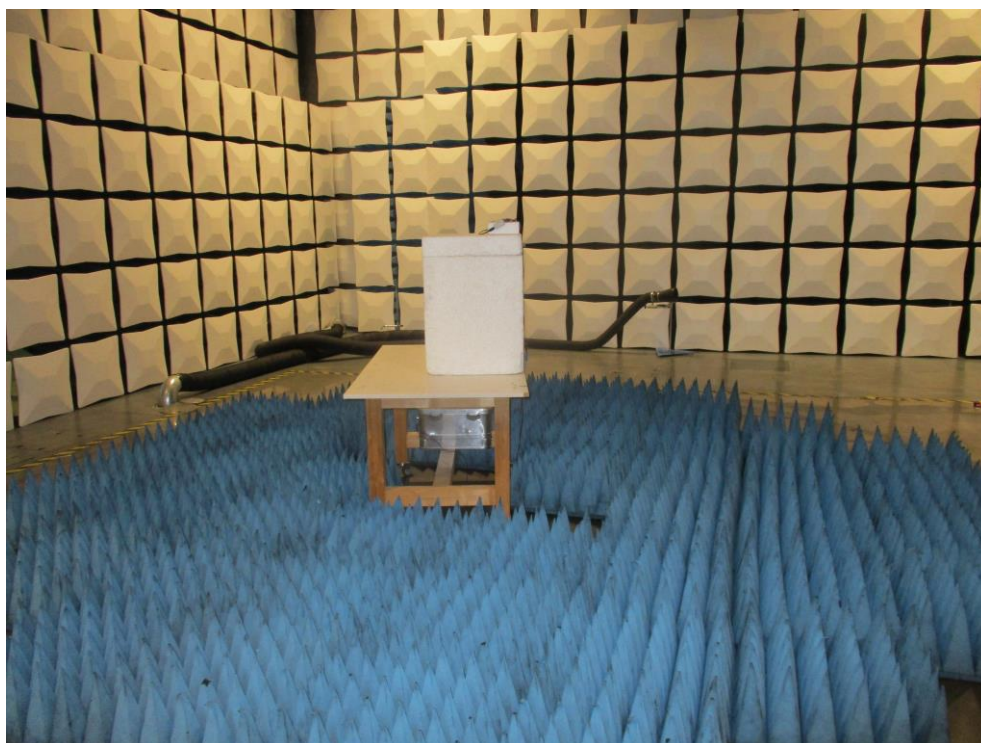


Figure 3



Figure 4





**Figure 5**



## 4 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

Radio Testing			
Test Name	kp	Expanded Uncertainty	Note
Occupied Bandwidth	2.0	$\pm 1.14 \%$	2
RF-Frequency error	1.96	$\pm 1 \cdot 10^{-7}$	7
RF-Power, conducted carrier	2	$\pm 0.079 \text{ dB}$	2
RF-Power uncertainty for given BER	1.96	$+0.94 \text{ dB} / -1.05$	7
RF power, conducted, spurious emissions	1.96	$+1.4 \text{ dB} / -1.6 \text{ dB}$	7
RF power, radiated			
25 MHz – 4 GHz	1.96	$+3.6 \text{ dB} / -5.2 \text{ dB}$	8
1 GHz – 18 GHz	1.96	$+3.8 \text{ dB} / -5.6 \text{ dB}$	8
18 GHz – 26.5 GHz	1.96	$+3.4 \text{ dB} / -4.5 \text{ dB}$	8
40 GHz – 170 GHz	1.96	$+4.2 \text{ dB} / -7.1 \text{ dB}$	8
Spectral Power Density, conducted	2.0	$\pm 0.53 \text{ dB}$	2
Maximum frequency deviation			
300 Hz – 6 kHz	2	$\pm 2.89 \%$	2
6 kHz – 25 kHz	2	$\pm 0.2 \text{ dB}$	2
Maximum frequency deviation for FM	2	$\pm 2.89 \%$	2
Adjacent channel power 25 MHz – 1 GHz	2	$\pm 2.31 \%$	2
Temperature	2	$\pm 0.39 \text{ K}$	4
(Relative) Humidity	2	$\pm 2.28 \%$	2
DC- and low frequency AC voltage			
DC voltage	2	$\pm 0.01 \%$	2
AC voltage up to 1 kHz	2	$\pm 1.2 \%$	2
Time	2	$\pm 0.6 \%$	2

Table 12



Radio Interference Emission Testing			
Test Name	kp	Expanded Uncertainty	Note
Conducted Voltage Emission			
9 kHz to 150 kHz (50Ω/50μH AMN)	2	± 3.8 dB	1
150 kHz to 30 MHz (50Ω/50μH AMN)	2	± 3.4 dB	1
100 kHz to 200 MHz (50Ω/5μH AMN)	2	± 3.6 dB	1
Discontinuous Conducted Emission			
9 kHz to 150 kHz (50Ω/50μH AMN)	2	± 3.8 dB	1
150 kHz to 30 MHz (50Ω/50μH AMN)	2	± 3.4 dB	1
Conducted Current Emission			
9 kHz to 200 MHz	2	± 3.5 dB	1
Magnetic Fieldstrength			
9 kHz to 30 MHz (with loop antenna)	2	± 3.9 dB	1
9 kHz to 30 MHz (large-loop antenna 2 m)	2	± 3.5 dB	1
Radiated Emission			
Test distance 1 m (ALSE)			
9 kHz to 150 kHz	2	± 4.6 dB	1
150 kHz to 30 MHz	2	± 4.1 dB	1
30 MHz to 200 MHz	2	± 5.2 dB	1
200 MHz to 2 GHz	2	± 4.4 dB	1
2 GHz to 3 GHz	2	± 4.6 dB	1
Test distance 3 m			
30 MHz to 300 MHz	2	± 4.9 dB	1
300 MHz to 1 GHz	2	± 5.0 dB	1
1 GHz to 6 GHz	2	± 4.6 dB	1
Test distance 10 m			
30 MHz to 300 MHz	2	± 4.9 dB	1
300 MHz to 1 GHz	2	± 4.9 dB	1
Radio Interference Power			
30 MHz to 300 MHz	2	± 3.5 dB	1
Harmonic Current Emissions			4
Voltage Changes, Voltage Fluctuations and Flicker			4

Table 13



Immunity Testing			
Test Name	kp	Expanded Uncertainty	Note
Electrostatic Discharges			4
Radiated RF-Field			
Pre-calibrated field level	2	+32.2 / -24.3 %	5
Dynamic feedback field level	2.05	+21.2 / -17.5 %	3
Electrical Fast Transients (EFT) / Bursts			4
Surges			4
Conducted Disturbances, induced by RF-Fields			
via CDN	2	+15.1 / -13.1 %	6
via EM clamp	2	+42.6 / -29.9 %	6
via current clamp	2	+43.9 / -30.5 %	6
Power Frequency Magnetic Field	2	+20.7 / -17.1 %	2
Pulse Magnetic Field			4
Voltage Dips, Short Interruptions and Voltage Variations			4
Oscillatory Waves			4
Conducted Low Frequency Disturbances			
Voltage setting	2	± 0.9 %	2
Frequency setting	2	± 0.1 %	2
Electrical Transient Transmission in Road Vehicles			4

**Table 14**

Note 1:

The expanded uncertainty reported according to CISPR 16-4-2:2003-11 is based on a standard uncertainty multiplied by a coverage factor of  $k_p = 2$ , providing a level of confidence of  $p = 95.45\%$

Note 2:

The expanded uncertainty reported according to UKAS Lab 34 (Edition 1, 2002-08) is based on a standard uncertainty multiplied by a coverage factor of  $k_p = 2$ , providing a level of confidence of  $p = 95.45\%$

Note 3:

The expanded uncertainty reported according to UKAS Lab 34 (Edition 1, 2002-08) is based on a standard uncertainty multiplied by a coverage factor of  $k_p = 2.05$ , providing a level of confidence of  $p = 95.45\%$

Note 4:

It has been demonstrated that the used test equipment meets the specified requirements in the standard with at least a 95% confidence.

Note 5:

The expanded uncertainty reported according to IEC 61000-4-3 is based on a standard uncertainty multiplied by a coverage factor of  $k_p = 2$ , providing a level of confidence of  $p = 95.45\%$

Note 6:

The expanded uncertainty reported according to IEC 61000-4-6 is based on a standard uncertainty multiplied by a coverage factor of  $k_p = 2$ , providing a level of confidence of  $p = 95.45\%$

Note 7:

The expanded uncertainty reported according to ETSI TR 100 028 V1.4.1 (all parts) is based on a standard uncertainty multiplied by a coverage factor of  $k_p = 1.96$ , providing a level of confidence of  $p = 95.45\%$

Note 8:



Product Service

The expanded uncertainty reported according to ETSI TR 102 273 V1.2.1 (all parts) is based on a standard uncertainty multiplied by a coverage factor of  $k_p = 1.96$ , providing a level of confidence of  $p = 95.45\%$