

Report on the Radio Testing  
For  
Rentokil Initial 1927 plc  
on  
Dual AutoGate Connect  
Report no. TRA-039867-45-01A  
22 June 2018

RF915 5.0



Report Number: TRA-039867-45-01A  
Issue: A

REPORT ON THE RADIO TESTING OF A  
Rentokil Initial 1927 plc  
Dual AutoGate Connect  
WITH RESPECT TO SPECIFICATION  
FCC 47CFR 15.247

TEST DATE: 2018-04-20 to 2018-05-23

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Date: 22 June 2018

Disclaimers:

- [1] THIS DOCUMENT MAY BE REPRODUCED ONLY IN ITS ENTIRETY AND WITHOUT CHANGE  
[2] THE RESULTS CONTAINED IN THIS DOCUMENT RELATE ONLY TO THE ITEM(S) TESTED

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RF915 5.0

## 1 Revision Record

<i>Issue Number</i>	<i>Issue Date</i>	<i>Revision History</i>
A	22 June 2018	Original

## 2 Summary

TEST REPORT NUMBER:	TRA-039867-45-01A
WORKS ORDER NUMBER:	TRA-039867-01
PURPOSE OF TEST:	USA: Testing of radio frequency equipment per the relevant authorization procedure of chapter 47 of CFR (code of federal regulations) Part 2, subpart J.
TEST SPECIFICATION(S):	47CFR15.247
EQUIPMENT UNDER TEST (EUT):	Dual AutoGate Connect
FCC IDENTIFIER:	2AK3PGSD-500349
EUT SERIAL NUMBER:	not available
MANUFACTURER/AGENT:	Rentokil Initial 1927 plc
ADDRESS:	Marketing and Innovation Riverbank Meadows Business Park Camberley GU17 9AB United Kingdom
CLIENT CONTACT:	Ning Pan ☎ 01276536676 ✉ <a href="mailto:ning.pan@rentokil-initial.com">ning.pan@rentokil-initial.com</a>
ORDER NUMBER:	PO-G017612
TEST DATE:	2018-04-20 to 2018-05-23
TESTED BY:	I Broadwell Element

## 2.1 Test Summary

Test Method and Description		Requirement Clause	Applicable to this equipment	Result / Note
		47CFR15		
Radiated spurious emissions (restricted bands of operation and cabinet radiation)		15.205	<input checked="" type="checkbox"/>	Pass
AC power line conducted emissions		15.207	<input type="checkbox"/>	Note 1
Occupied bandwidth		15.247(a)(2)	<input type="checkbox"/>	Note 1
Conducted carrier power	Peak	15.247(b)(3)	<input checked="" type="checkbox"/>	Pass
	Max.		<input type="checkbox"/>	
Conducted / radiated RF power out-of-band		15.247(d)	<input checked="" type="checkbox"/>	Pass
Power spectral density, conducted		15.247(e)	<input type="checkbox"/>	Note 1
Calculation of duty correction		15.35(c)	<input type="checkbox"/>	N/A

### Notes:

Note 1: The results in this report cover radiated tests only and are intended to support the use of a previously tested module in a new product. See also Element test report TRA-033559-45-00B.

The results contained in this report relate only to the items tested, in the condition at time of test, and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

The apparatus was set up and exercised using the configurations, modes of operation and arrangements defined in this report only. Any modifications made are identified in Section 8 of this report.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except where identified in Section 5.2 of this test report (Deviations from Test Standards).

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## 4 Introduction

This report TRA-039867-45-01A presents the results of the Radio testing on a Rentokil Initial 1927 plc, Dual AutoGate Connect to specification 47CFR15 Radio Frequency Devices.

The testing was carried out for Rentokil Initial 1927 plc by Element, at the address detailed below.

<input checked="" type="checkbox"/>	Element Hull Unit E South Orbital Trading Park Hedon Road Hull HU9 1NJ UK	<input type="checkbox"/>	Element Skelmersdale Unit 1 Pendle Place Skelmersdale West Lancashire WN8 9PN UK
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This report details the configuration of the equipment, the test methods used and any relevant modifications where appropriate.

All test and measurement equipment under the control of the laboratory and requiring calibration is subject to an established programme and procedures to control and maintain measurement standards. The quality management system meets the principles of ISO 9001, and has quality control procedures for monitoring the validity of tests undertaken. Records and sufficient detail are retained to establish an audit trail of calibration records relating to its test results for a defined period. Under control of the established calibration programme, key quantities or values of the test & measurement instrumentation are within specification and comply with the relevant traceable internationally recognised and appropriate standard specifications, which are UKAS calibrated as such where these properties have a significant effect on results. Participation in inter-laboratory comparisons and proficiency testing ensures satisfactory correlation of results conform to Elements own procedures, as well as statistical techniques for analysis of test data providing the appropriate confidence in measurements.

Throughout this report EUT denotes equipment under test.

FCC Site Listing:

Element is accredited for the above sites under the US-EU MRA, Designation number UK0007.

The test site requirements of ANSI C63.4-2014 are met up to 1GHz.

The test site SVSWR requirements of CISPR 16-1-4:2010 are met over the frequency range 1 GHz to 18 GHz.

## **5 Test Specifications**

### **5.1 Normative References**

- FCC 47 CFR Ch. I – Part 15 – Radio Frequency Devices.
- ANSI C63.10-2013 – American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
- ANSI C63.4-2014 – American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

### **5.2 Deviations from Test Standards**

There were no deviations from the test standard.

The results in this report cover radiated tests only and are intended to support the use of a previously tested module in a new product. See also Element test report TRA-033559-45-00B.



## 6 Glossary of Terms

<b>§</b>	denotes a section reference from the standard, not this document
<b>AC</b>	Alternating Current
<b>ANSI</b>	American National Standards Institute
<b>BW</b>	bandwidth
<b>C</b>	Celsius
<b>CFR</b>	Code of Federal Regulations
<b>CW</b>	Continuous Wave
<b>dB</b>	decibel
<b>dBm</b>	dB relative to 1 milliwatt
<b>DC</b>	Direct Current
<b>DSSS</b>	Direct Sequence Spread Spectrum
<b>EIRP</b>	Equivalent Isotropically Radiated Power
<b>ERP</b>	Effective Radiated Power
<b>EUT</b>	Equipment Under Test
<b>FCC</b>	Federal Communications Commission
<b>FHSS</b>	Frequency Hopping Spread Spectrum
<b>Hz</b>	hertz
<b>IC</b>	Industry Canada
<b>ITU</b>	International Telecommunication Union
<b>LBT</b>	Listen Before Talk
<b>m</b>	metre
<b>max</b>	maximum
<b>MIMO</b>	Multiple Input and Multiple Output
<b>min</b>	minimum
<b>MRA</b>	Mutual Recognition Agreement
<b>N/A</b>	Not Applicable
<b>PCB</b>	Printed Circuit Board
<b>PDF</b>	Portable Document Format
<b>Pt-mpt</b>	Point-to-multipoint
<b>Pt-pt</b>	Point-to-point
<b>RF</b>	Radio Frequency
<b>RH</b>	Relative Humidity
<b>RMS</b>	Root Mean Square
<b>Rx</b>	receiver
<b>s</b>	second
<b>SVSWR</b>	Site Voltage Standing Wave Ratio
<b>Tx</b>	transmitter
<b>UKAS</b>	United Kingdom Accreditation Service
<b>V</b>	volt
<b>W</b>	watt
<b>Ω</b>	ohm

## **7 Equipment Under Test**

### **7.1 EUT Identification**

- Name: Dual AutoGate Connect
- Serial Number: not available
- Model Number: 304854
- Software Revision: Not Applicable
- Build Level / Revision Number: Not Applicable

### **7.2 System Equipment**

Equipment listed below forms part of the overall test setup and is required for equipment functionality and/or monitoring during testing. The compliance levels achieved in this report relate only to the EUT and not items given in the following list.

*Laptop PC (required to change operating mode, not connected during testing).*

### **7.3 EUT Mode of Operation**

#### **7.3.1 Transmission**

The mode of operation for Transmitter tests was as follows:  
Continuous transmit mode with modulation.

#### **7.3.2 Reception**

The mode of operation for Receiver tests was as follows:  
No receiver testing is detailed in this report.

## 7.4 EUT Radio Parameters

### 7.4.1 General

<b>Frequency of operation:</b>	915 MHz to 928 MHz
<b>Modulation type(s):</b>	FSK chirp (LoRa)
<b>Occupied channel bandwidth(s):</b>	200 kHz
<b>Channel spacing:</b>	200 kHz
<b>ITU emission designator(s):</b>	125K1DEX
<b>Declared output power(s):</b>	10 dBm
<b>Warning against use of alternative antennas in user manual (yes/no):</b>	Yes
<b>Nominal Supply Voltage:</b>	6 Vdc
<b>Location of notice for license exempt use:</b>	Label / user manual / both.
<b>Method of prevention of use on non-US / non-Canadian frequencies:</b>	Software Locked
<b>Duty cycle:</b>	< 10 % in normal operation

### 7.4.2 Antennas

<b>Type:</b>	Fixed
<b>Frequency range:</b>	915 MHz to 928 MHz
<b>Impedance:</b>	50Ω
<b>SWR:</b>	Unknown
<b>Gain:</b>	-0.6 dBi
<b>Polarisation:</b>	Linear
<b>Beam width:</b>	Unknown
<b>Connector type:</b>	Soldered to PCB

### 7.4.3 Product specific declarations

<b>Multiple antenna configuration(s), e.g. MIMO:</b>	Single antenna only
<b>Fixed pt-pt operations (yes/no):</b>	No
<b>Installation manual advice on pt-pt operational restrictions (yes/no):</b>	N/A
<b>Fixed pt-mpt operations (yes/no):</b>	No
<b>Simultaneous tx (yes/no):</b>	No

### 7.5 EUT Description

The EUT is a rodent trap fitted with a LoRa radio module.

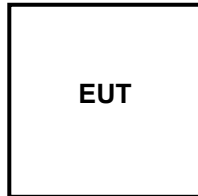
## **8 Modifications**

No modifications were performed during this assessment.

## 9 EUT Test Setup

### 9.1 *Block Diagram*

The following diagram shows basic EUT setup, the EUT is a standalone battery powered device:



## 9.2 General Set-up Photograph

The following photograph shows basic EUT set-up:



## **10 General Technical Parameters**

### ***10.1 Normal Conditions***

The E U T was tested under the normal environmental conditions of the test laboratory, except where otherwise stated. The normal power source applied was 6 V dc from alkaline batteries.



## 11 Radiated emissions

### 11.1 Definitions

#### *Spurious emissions*

Emissions on a frequency or frequencies, which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

#### *Restricted bands*

A frequency band in which intentional radiators are permitted to radiate only spurious emissions but not fundamental signals.

### 11.2 Test Parameters

Test Location:	Element Hull (UK0007)
Test Chamber:	Wireless Laboratory 2
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.5 and 6.6
EUT Channels Measured:	Low Channel 06 / Mid Channel 29 / High Channel 55
Deviations From Standard:	None
Measurement BW:	30 MHz to 1 GHz: 120 kHz Above 1 GHz: 1 MHz
Measurement Detector:	Up to 1 GHz: quasi-peak Above 1 GHz: RMS average and Peak

### Environmental Conditions (Normal Environment)

Temperature: 17 °C	+15 °C to +35 °C (as declared)
Humidity: 31 % RH	20 % RH to 75 % RH (as declared)
Supply: 3 V dc	(as declared)

### 11.3 Test Limit

Unwanted emissions that fall within the restricted frequency bands shall comply with the limits specified:

#### General Field Strength Limits for License-Exempt Transmitters at Frequencies above 30 MHz

<i>Frequency (MHz)</i>	<i>Field Strength (<math>\mu</math>V/m at 3 m)</i>
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500

## 11.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure i, the emissions from the EUT were measured on a spectrum analyzer / EMI receiver.

Radiated electromagnetic emissions from the EUT are checked first by preview scans. Preview scans for all spectrum and modulation characteristics are checked, using a peak detector and where applicable worst-case determined for function, operation, orientation, etc. for both vertical and horizontal polarisations. Pre-scan plots are shown with a peak detector and 100 kHz RBW.

If the EUT connects to auxiliary equipment and is table or floor standing, the configurations prescribed in ANSI C63.10 are followed. Alternatively, a layout closest to normal use (as declared by the provider) is employed, (see EUT setup photographs for more detail).

Emissions between 30 MHz and 1 GHz are measured using calibrated broadband antennas. Emissions above 1 GHz are characterized using standard gain horn antennas. Pre-amplifiers and filters are used where required. Care is taken to ensure that test receiver resolution bandwidth, video bandwidth and detector type(s) meet the regulatory requirements.

For both horizontal and vertical polarizations, the EUT is then rotated through 360 degrees in azimuth until the highest emission is detected. At the previously determined azimuth the test antenna is raised and lowered from 1 to 4 m in height until a maximum emission level is detected, this maximum value is recorded.

Power values measured on the test receiver / analyzer are converted to field strength, FS, in dBμV/m at the regulatory distance, using:

$$FS = PR + CL + AF - PA + DC - CF$$

Where,

PR is the power recorded on the receiver / spectrum analyzer in dBμV;

CL is the cable loss in dB;

AF is the test antenna factor in dB/m;

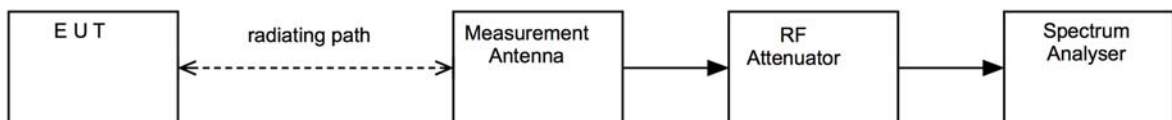
PA is the pre-amplifier gain in dB (where used);

DC is the duty correction factor in dB (where used, e.g. harmonics of pulsed fundamental);

CF is the distance factor in dB (where measurement distance different to limit distance);

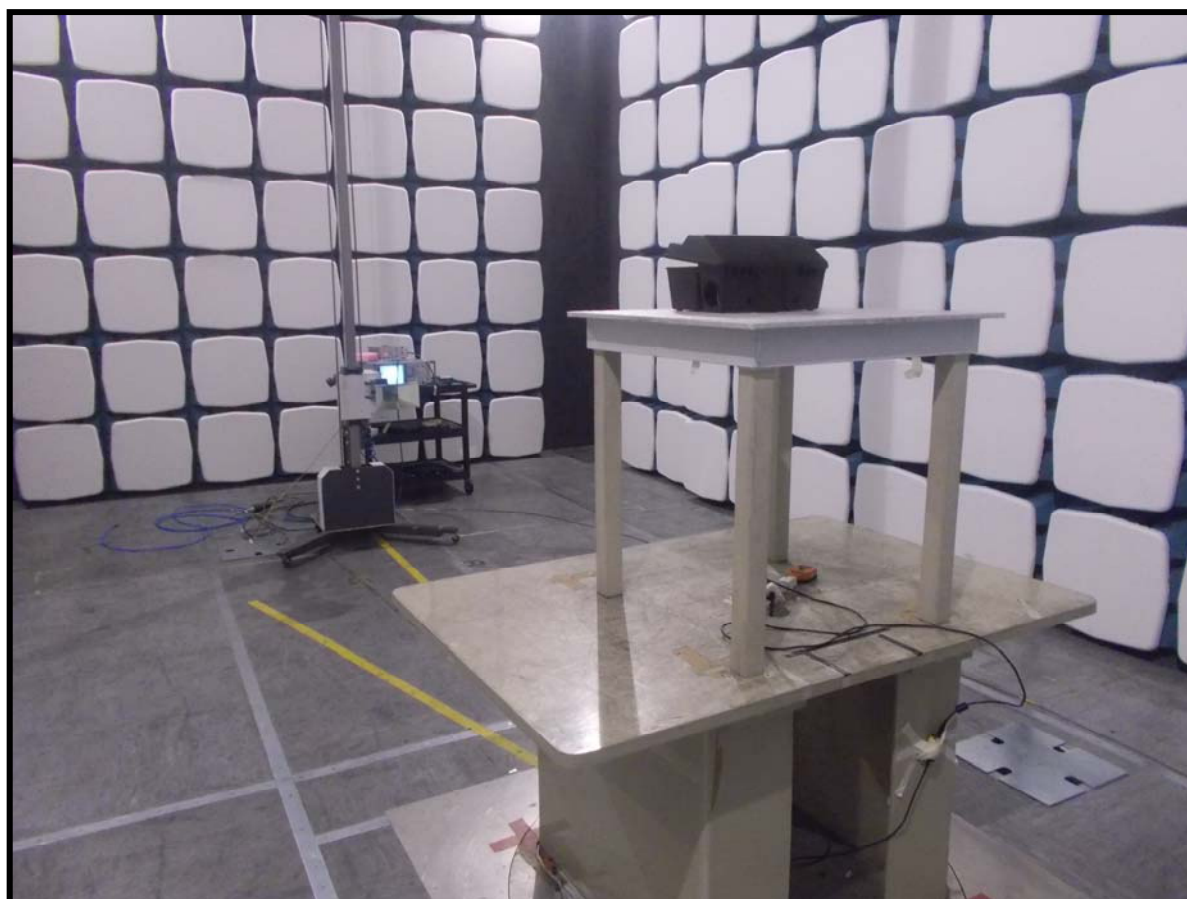
This field strength value is then compared with the regulatory limit.

**Figure i Test Setup**



### 11.5 Test Set-up Photograph



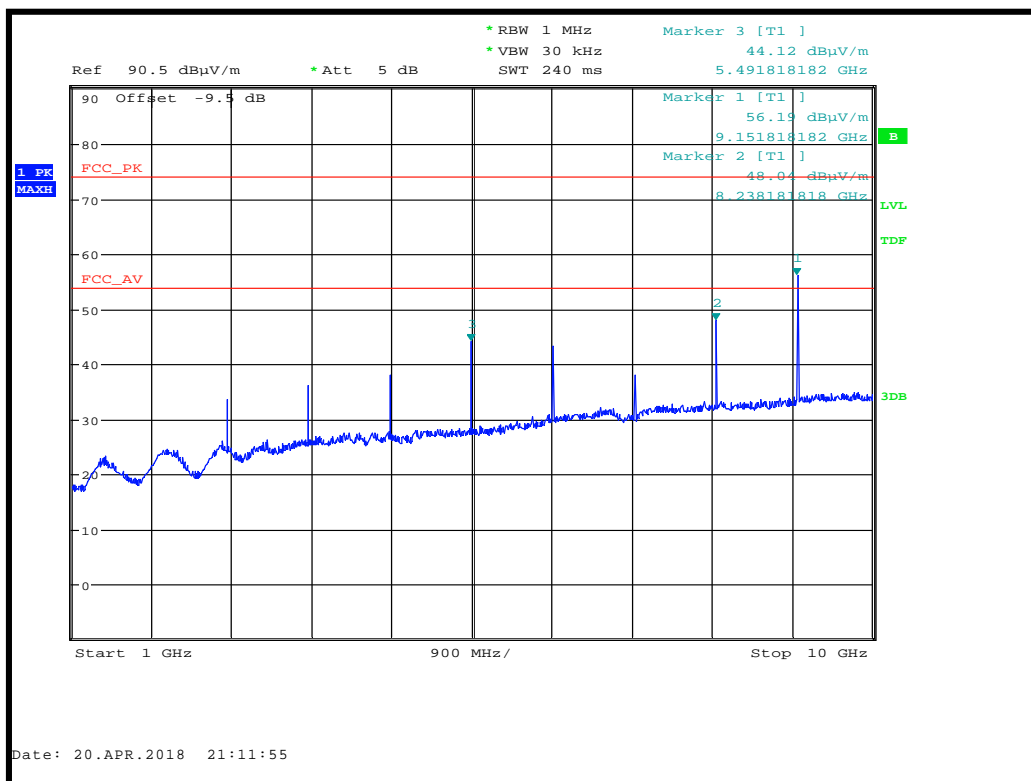
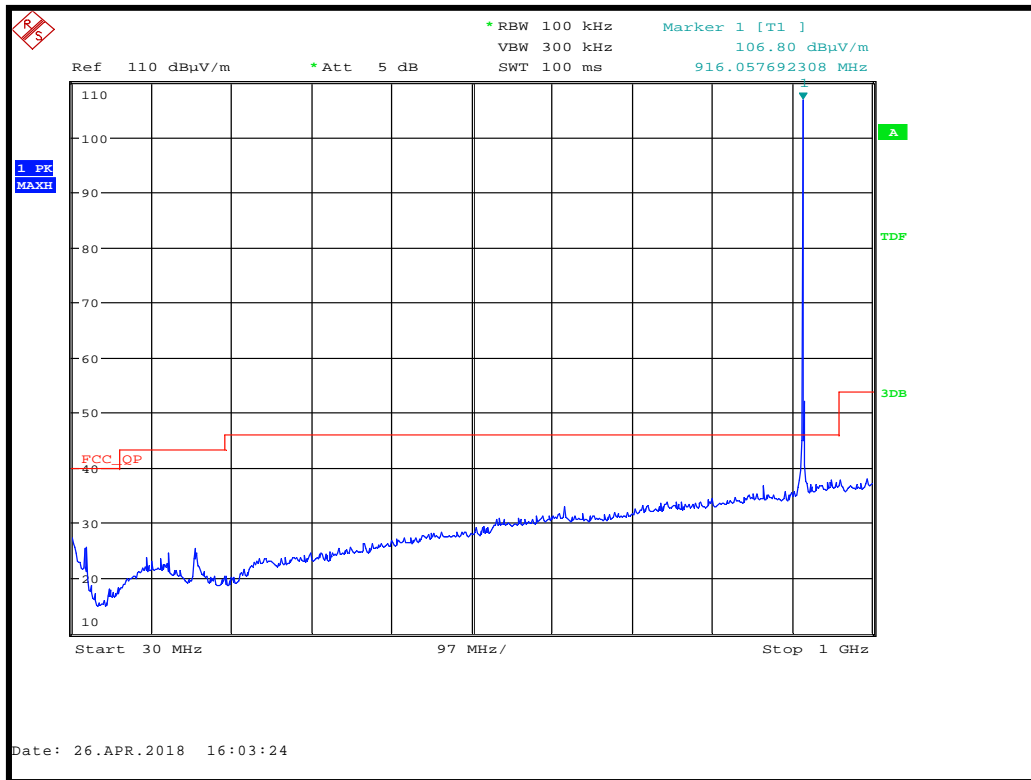


### 11.6 Test Equipment

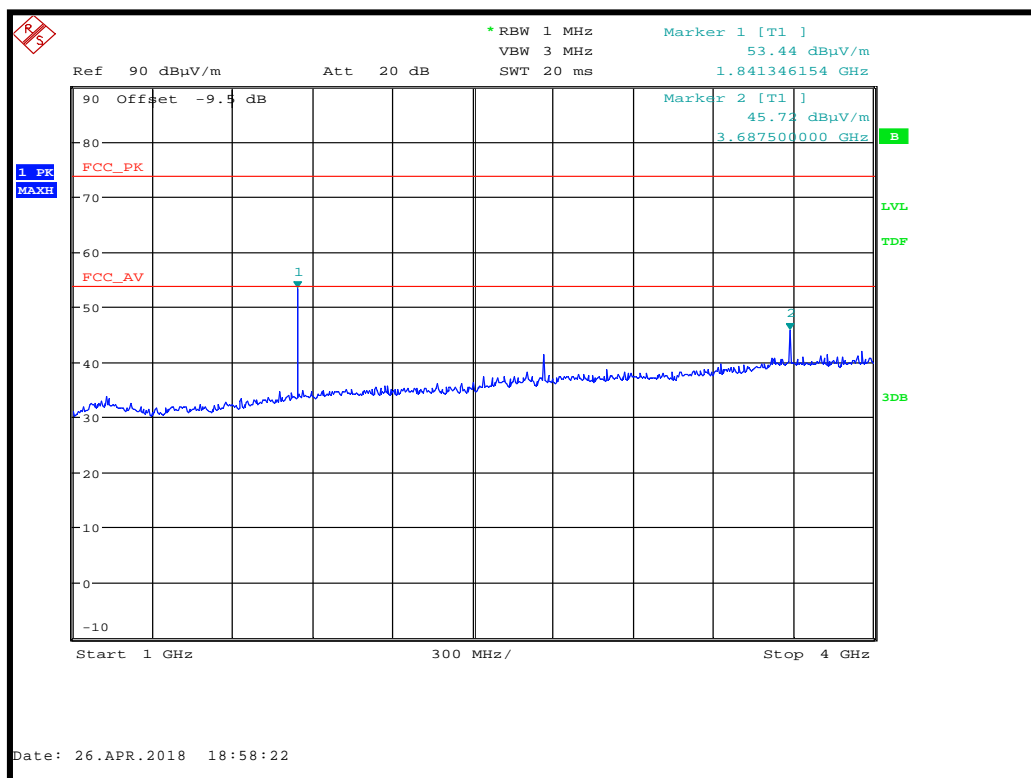
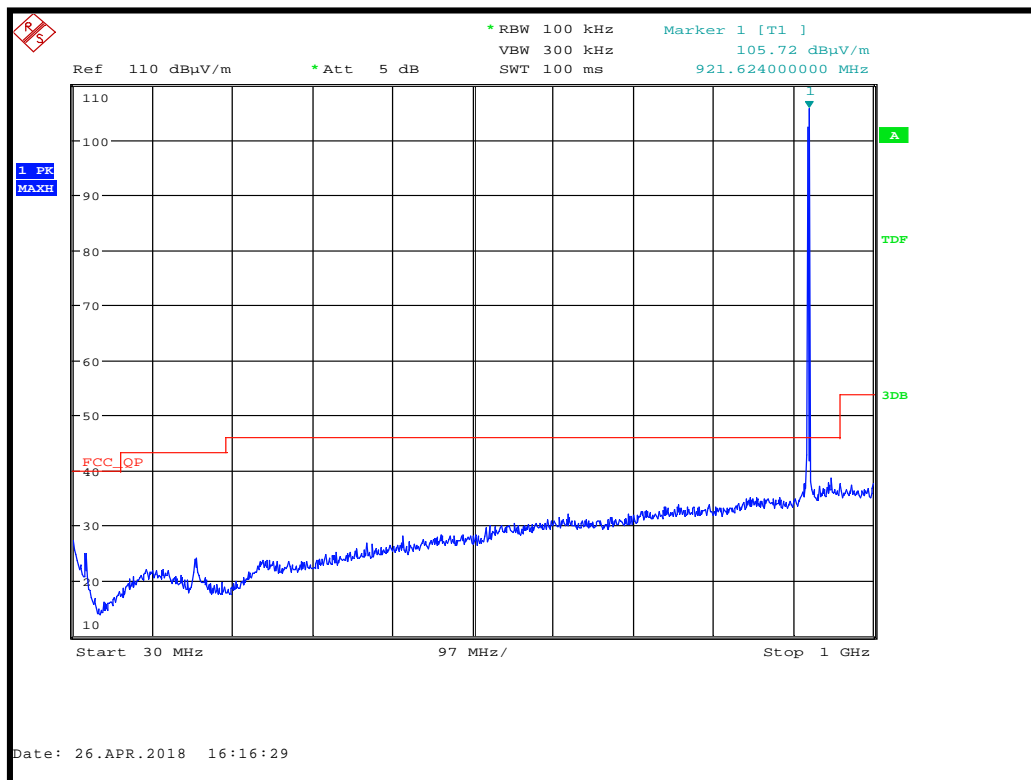
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
ATS	Rainford	Ferrite Lined Chamber	REF886	2018-07-24
FSU46	R&S	Spectrum Analyser	U281	2018-06-19
CBL6111B	Chase	Bilog Antenna	REF2218	2019-11-06
VUBA9117	Schwarzbeck	Biconical Antenna	REF859	2018-09-14
310	Sonoma	Pre-Amp (9kHz – 1GHz)	REF927	2018-06-30
8449B	Agilent	Pre-Amp (1 – 26.5GHz)	REF913	2019-02-07
3115	EMCO	Horn Antenna	RFG129	2020-02-12
3TNF-500/1000-N/N	K & L	Tuneable Notch Filter	REF827	Cal in use
VHF-1300+	Mini Circuits	High Pass Filter	REF2227	2019-02-27
VHF-3100+	Mini Circuits	High Pass Filter	REF688	2019-02-27

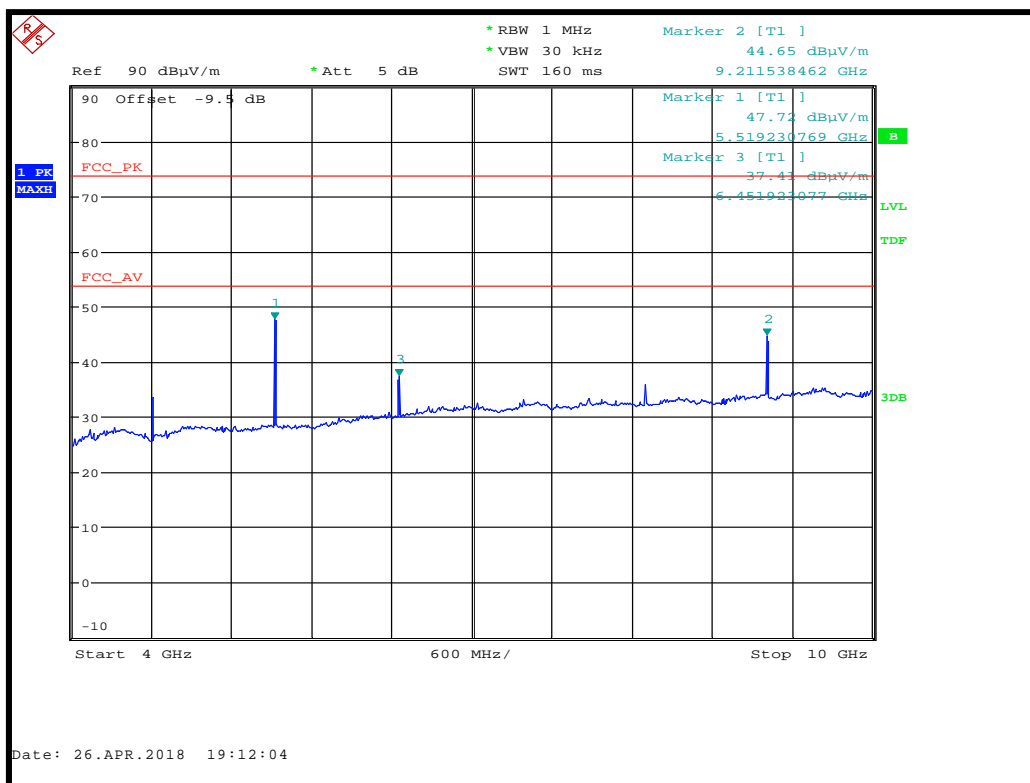
## 11.7 Test Results

### Channel 6 (Bottom Channel)

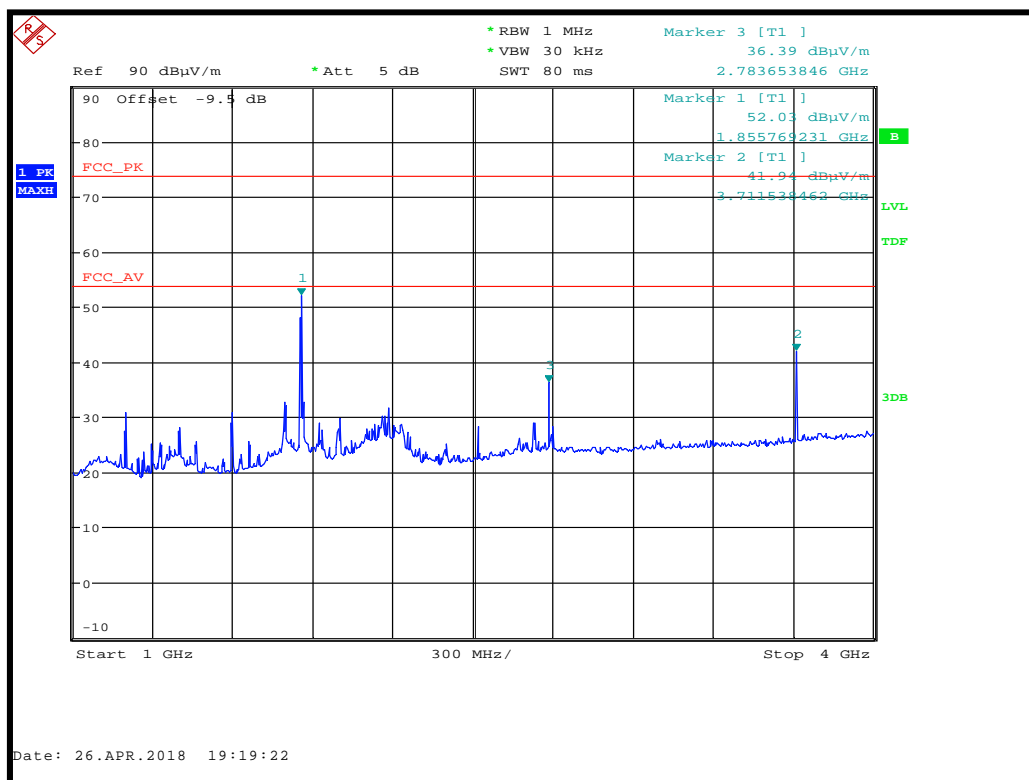
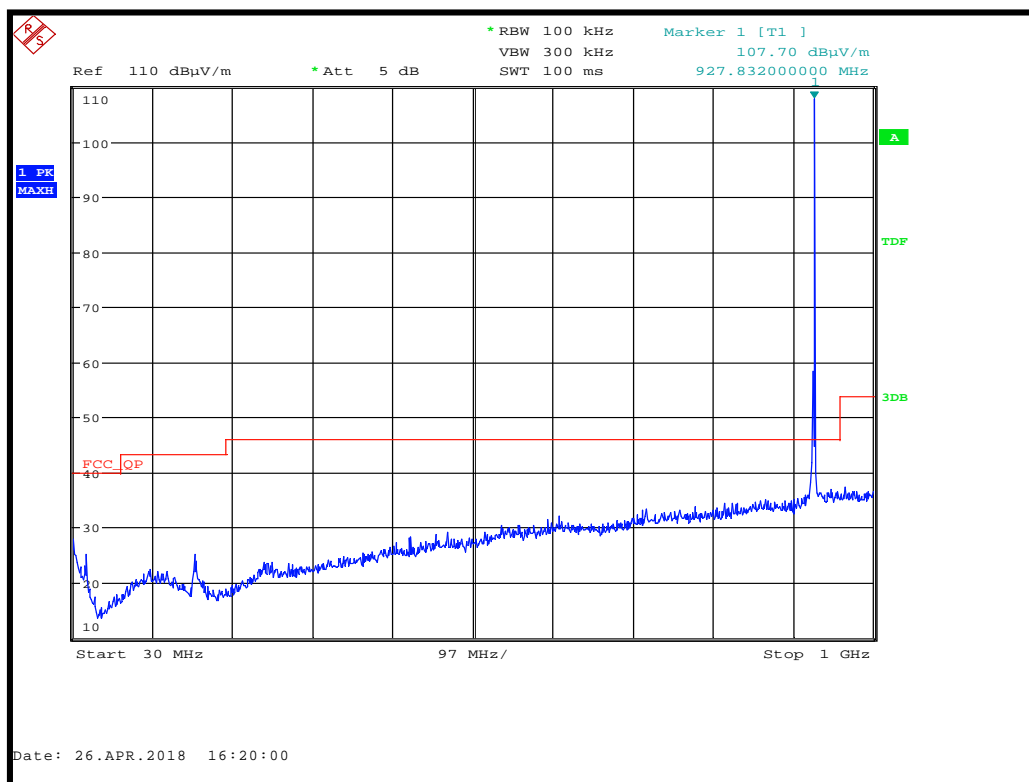


## Channel 29 (Middle Channel)

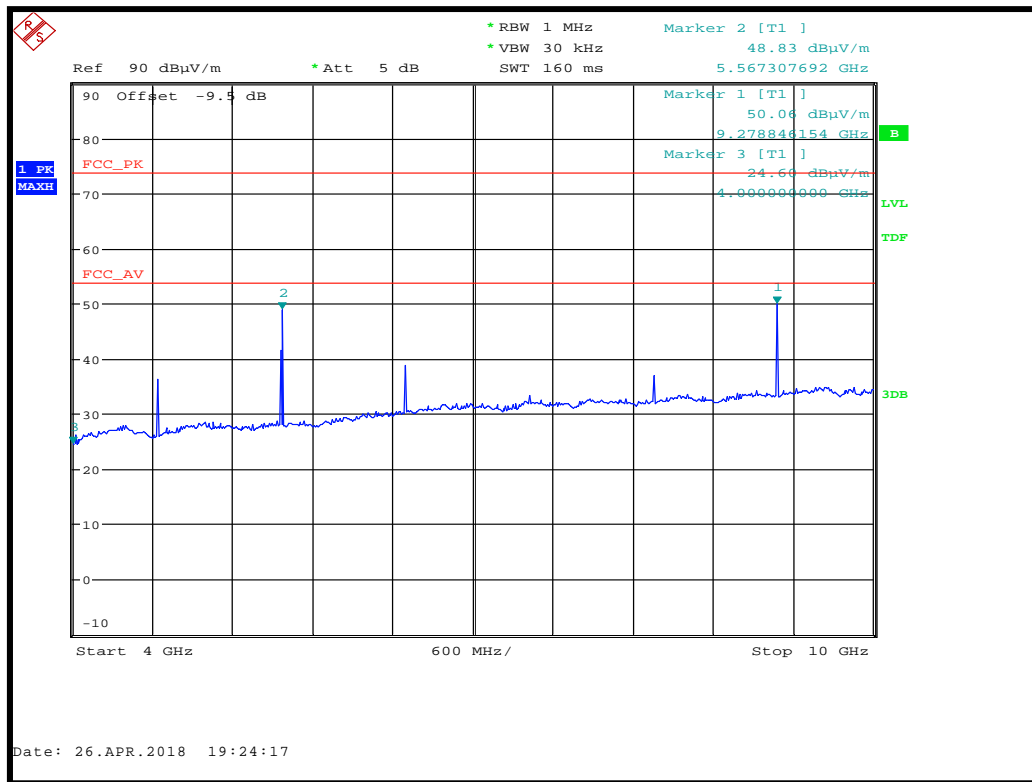




## Channel 55 (Top Channel)







Power 0x0C; Channel: 06										
Detector	Freq. (MHz)	Meas'd Emission (dBμV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	Filter loss (dB)	Distance Extrap'n Factor (dB)	Field Strength (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
P	2745.75	56.66	3.4	29.3	35.6	0.5	0.0	54.3	519.4	5000.0
A	2745.75	55.14	3.4	29.3	35.6	0.5	0.0	52.8	436.0	500.0
P	2762.87	51.99	3.4	29.4	35.6	0.5	0.0	49.7	306.5	5000.0
A	2762.87	50.41	3.4	29.4	35.6	0.5	0.0	48.2	255.6	500.0
P	2782.50	55.19	3.4	29.5	35.6	0.4	0.0	52.9	442.6	5000.0
A	2782.50	53.39	3.4	29.5	35.6	0.4	0.0	51.1	359.7	500.0
P	3661.00	47.46	3.9	31.6	35.5	0.4	0.0	47.8	246.6	5000.0
A	3661.00	42.72	3.9	31.6	35.5	0.4	0.0	43.1	142.9	500.0
P	3684.00	46.60	4.0	31.7	35.5	0.4	0.0	47.2	228.8	5000.0
A	3684.00	42.34	4.0	31.7	35.5	0.4	0.0	42.9	140.1	500.0
P	3710.00	46.29	4.0	31.8	35.5	0.4	0.0	47.0	223.4	5000.0
A	3710.00	41.37	4.0	31.8	35.5	0.4	0.0	42.0	126.8	500.0
P	9152.50	47.98	6.4	37.8	36.2	1.1	0.0	57.0	711.2	5000.0
A	9152.50	43.58	6.4	37.8	36.2	1.1	0.0	52.6	428.5	500.0

Power 0x0C; Channel: 29										
Detector	Freq. (MHz)	Meas'd Emission (dBμV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-amp Gain (dB)	Filter loss (dB)	Distance Extrap'n Factor (dB)	Field Strength (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
P	1841.00	67.05	2.8	27.7	35.3	0.6	9.5	53.2	457.5	5000.0
A	1841.00	66.46	2.8	27.7	35.3	0.6	9.5	52.6	427.4	500.0
P	3684.00	54.18	4.0	31.7	35.5	0.4	9.5	45.2	182.5	5000.0
A	3684.00	51.55	4.0	31.7	35.5	0.4	9.5	42.6	134.9	500.0
P	5526.00	59.58	4.9	34.2	35.6	0.4	9.5	54.0	499.3	5000.0
A	5526.00	57.58	4.9	34.2	35.6	0.4	9.5	52.0	396.6	500.0
P	9201.00	53.94	6.4	37.9	36.3	1.1	9.5	53.5	475.2	5000.0
A	9201.00	49.19	6.4	37.9	36.3	1.1	9.5	48.8	275.0	500.0

<i>Power 0x0C; Channel: 55</i>										
<i>Detector</i>	<i>Freq. (MHz)</i>	<i>Meas'd Emission (dBμV)</i>	<i>Cable Loss (dB)</i>	<i>Antenna Factor (dB/m)</i>	<i>Pre-amp Gain (dB)</i>	<i>Duty Filter loss (dB)</i>	<i>Distance Extrap'n Factor (dB)</i>	<i>Field Strength (dBμV/m)</i>	<i>Field Strength (μV/m)</i>	<i>Limit (μV/m)</i>
P	1855.00	66.28	2.8	27.7	35.3	0.6	9.5	52.5	423.5	5000.0
A	1855.00	65.61	2.8	27.7	35.3	0.6	9.5	51.9	392.1	500.0
P	3709.00	52.87	4.0	31.8	35.5	0.4	9.5	44.0	158.8	5000.0
A	3709.00	50.31	4.0	31.8	35.5	0.4	9.5	41.5	118.3	500.0
P	5565.00	59.53	4.9	34.3	35.6	0.4	9.5	54.0	502.2	5000.0
A	5565.00	57.46	4.9	34.3	35.6	0.4	9.5	52.0	395.7	500.0
P	9275.00	57.81	6.4	37.9	36.3	1.1	9.5	57.4	739.4	5000.0
A	9275.00	53.79	6.4	37.9	36.3	1.1	9.5	53.4	465.5	500.0

## 12 Maximum peak conducted output power

### 12.1 Definition

The maximum peak conducted output power is defined as the maximum power level measured with a peak detector using a filter with width and shape of which is sufficient to accept the signal bandwidth.

The maximum conducted output power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level.

### 12.2 Test Parameters

Test Location:	Element Hull (UK0007)
Test Chamber:	Lab 16
Test Standard and Clause:	ANSI C63.10-2013, Clause 7.8.5
EUT Channels / Frequencies Measured:	Low Channel 06 / Mid Channel 29 / High Channel 55 - Hopping disabled
EUT Channel Bandwidths:	200 kHz
Deviations From Standard:	None
Measurement BW:	3 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	10 kHz
Measurement Detector:	Peak
Voltage Extreme Environment Test Range:	Battery Power = new battery.

### Environmental Conditions (Normal Environment)

Temperature: 21 °C	+15 °C to +35 °C (as declared)
Humidity: 41 % RH	20 % RH to 75 % RH (as declared)

### 12.3 Test Limit

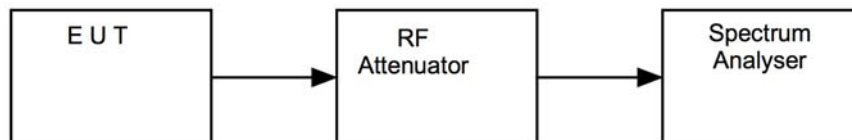
- For frequency hopping systems operating in the band 902 to 928 MHz, the maximum peak conducted output power shall not exceed 1 W, and the e.i.r.p. shall not exceed 4 W, if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W, and the e.i.r.p. shall not exceed 1 W, if the hopset uses less than 50 hopping channels.
- For frequency hopping systems operating in the band 2400 to 2483.5 MHz and employing at least 75 hopping channels, the maximum peak conducted output power shall not exceed 1 W; for all other frequency hopping systems in the band, the maximum peak conducted output power shall not exceed 0.125 W. The e.i.r.p. shall not exceed 4 W.
- For frequency hopping systems operating in the band 5725 to 5850 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W.
- Point-to-point systems in the bands 2400-2483.5 MHz and 5725 to 5850 MHz are permitted to have an e.i.r.p. higher than 4 W provided that the higher e.i.r.p. is achieved by employing higher gain directional antennas and not higher transmitter output powers.

## 12.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure iv, the resolution bandwidth of the spectrum analyser was increased above the EUT occupied bandwidth and the peak emission data noted.

The measurements were performed with EUT set at its maximum duty. All modulation schemes, data rates and power settings were used to observe the worst-case configuration in each bandwidth.

**Figure iv Test Setup**



## 12.5 Test Equipment

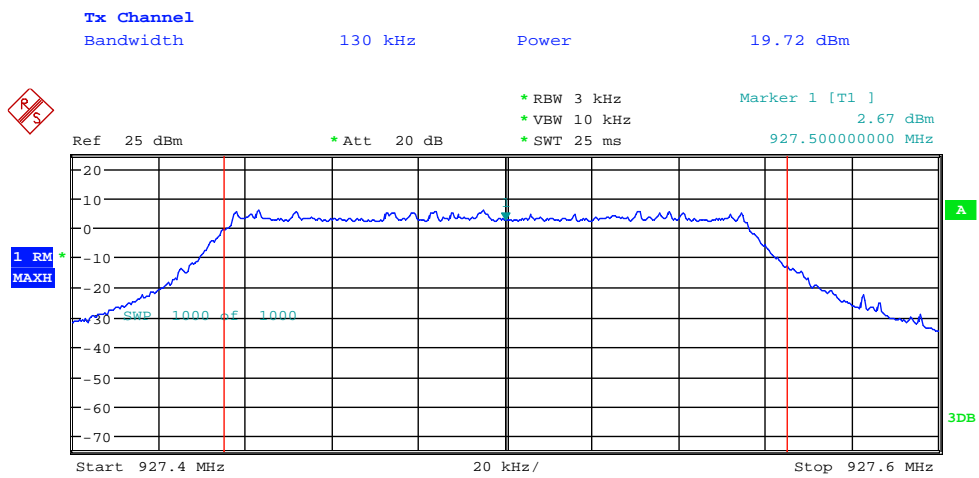
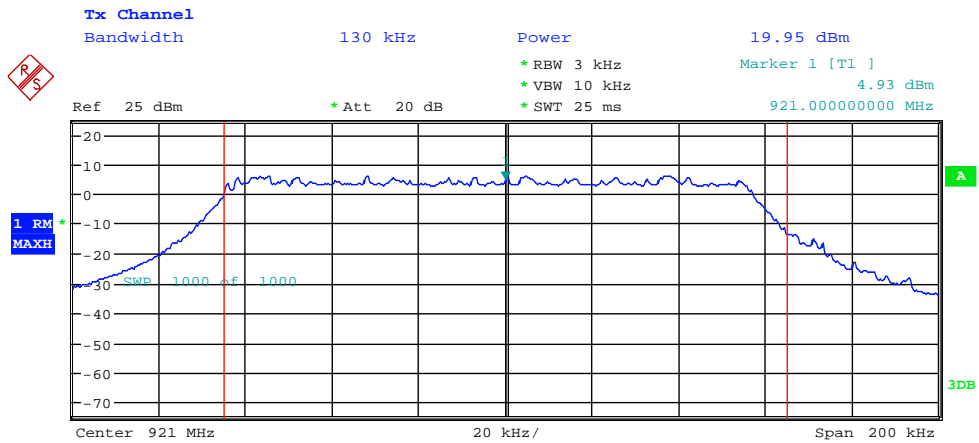
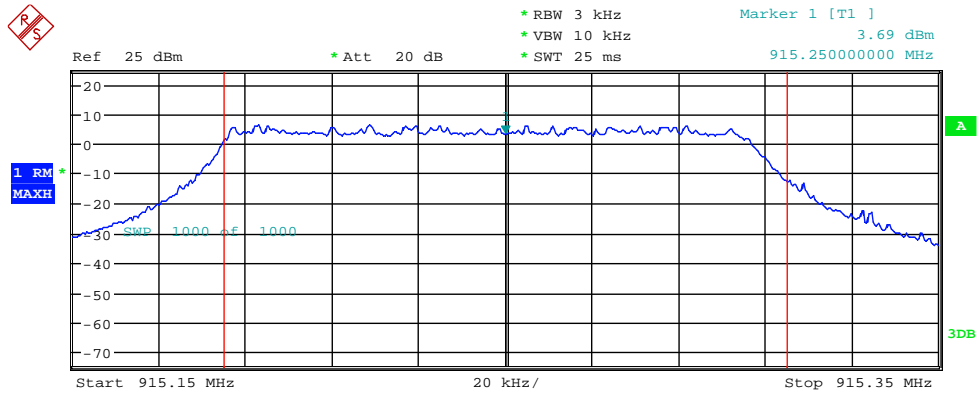
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU46	R&S	Spectrum Analyser	U281	2018-06-19

## 12.6 Test Results

Power setting: 0x0C				
Channel Frequency (MHz)	Analyzer Level (dBm)	Cable loss (dB)	Power (mW)	Result
915.25	19.95	0	98.86	PASS
921.00	19.72	0	93.76	PASS
927.50	19.12	0	81.66	PASS

Antennas used by all three products covered by this report were < 6 dBi gain, 6 dBi was used as a worst case to cover all products.

Measurements were made using the AVGSA-1 method detailed in 558074 D01 DTS Meas Guidance v04



## 13 Out-of-band and conducted spurious emissions

### 13.1 Definition

#### *Out-of-band emission.*

Emission on a frequency or frequencies immediately outside the necessary bandwidth that results from the modulation process but excluding spurious emissions.

#### *Spurious emission.*

Emission on a frequency or frequencies that are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products, and frequency conversion products, but exclude out-of-band emissions.

### 13.2 Test Parameters

Test Location:	Element Hull (UK0007)
Test Chamber:	Wireless Laboratory 1
Test Standard and Clause:	ANSI C63.10-2013, Clause 11.11
EUT Channels Measured:	Low Channel 06 / Mid Channel 29 / High Channel 55
EUT Channel Bandwidths:	200 kHz
Deviations From Standard:	None
Measurement BW:	100 kHz
Spectrum Analyzer Video BW: (requirement at least 3x RBW)	300 kHz
Measurement Detector:	Peak
Measurement Range:	30 MHz to 10 GHz

### Environmental Conditions (Normal Environment)

Temperature: 21 °C	+15 °C to +35 °C (as declared)
Humidity: 41 % RH	20 % RH to 75 % RH (as declared)
Supply: 6 Vdc	(as declared)

### 13.3 Test Limit

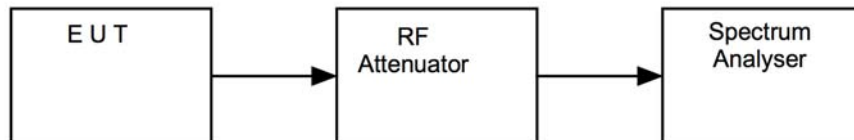
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in FCC 47CFR15.209(a) / RSS-Gen is not required.

### 13.4 Test Method

With the EUT setup as per section 9 of this report and connected as per Figure v, the emissions from the EUT were measured on a spectrum analyser.

The measurements were performed with EUT set at its maximum duty. All modulation schemes, data rates and power settings were used to observe the worst case configuration in each bandwidth.

**Figure v Test Setup**



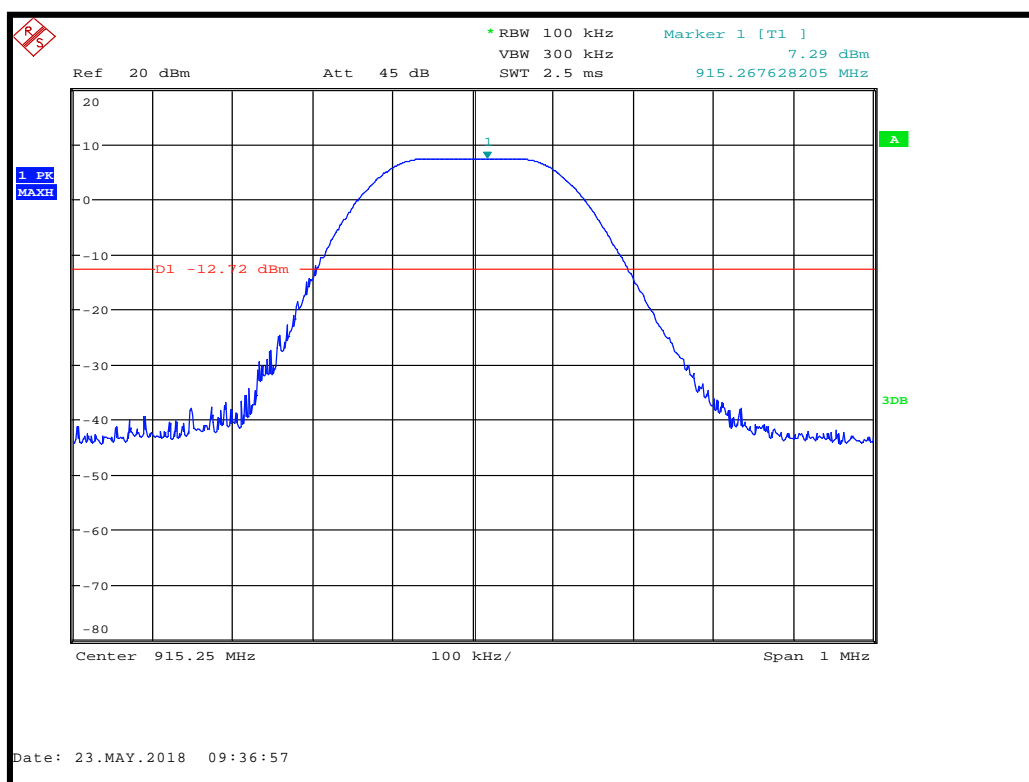
### 13.5 Test Equipment

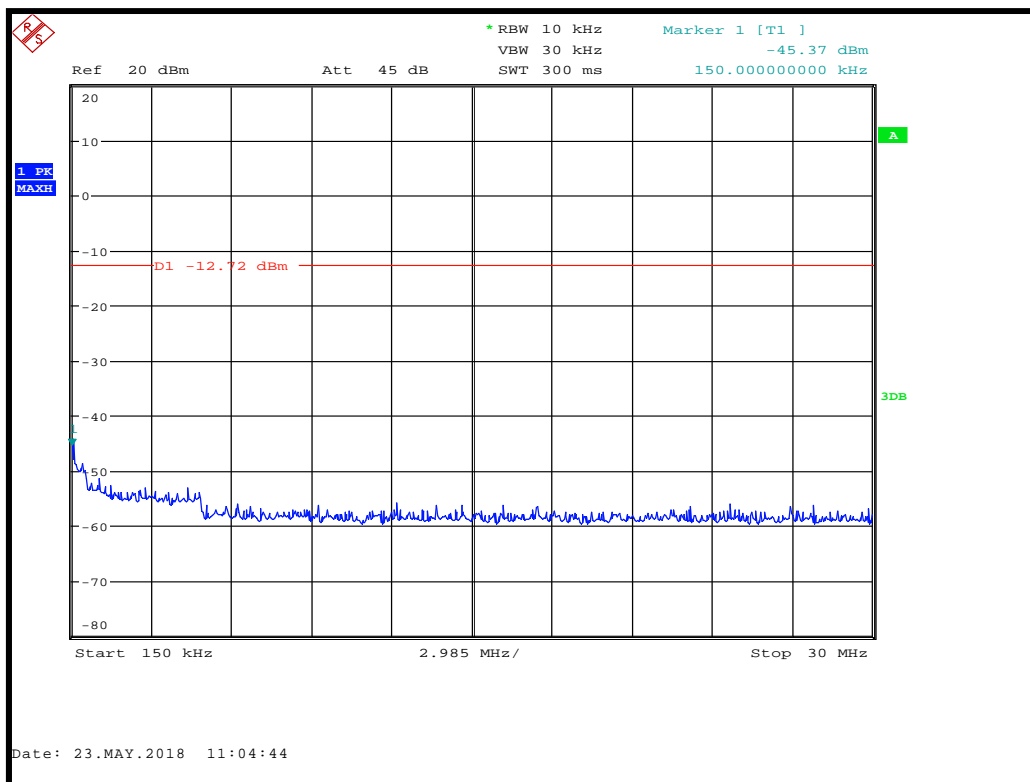
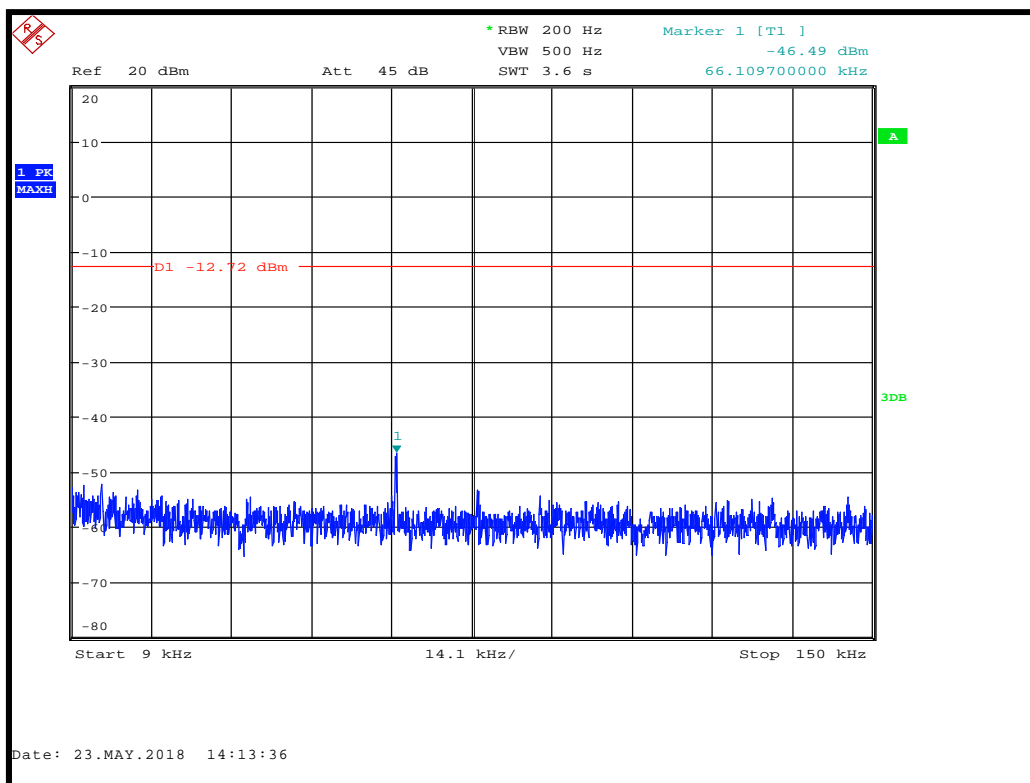
Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
FSU46	R&S	Spectrum Analyser	U281	2018-06-19

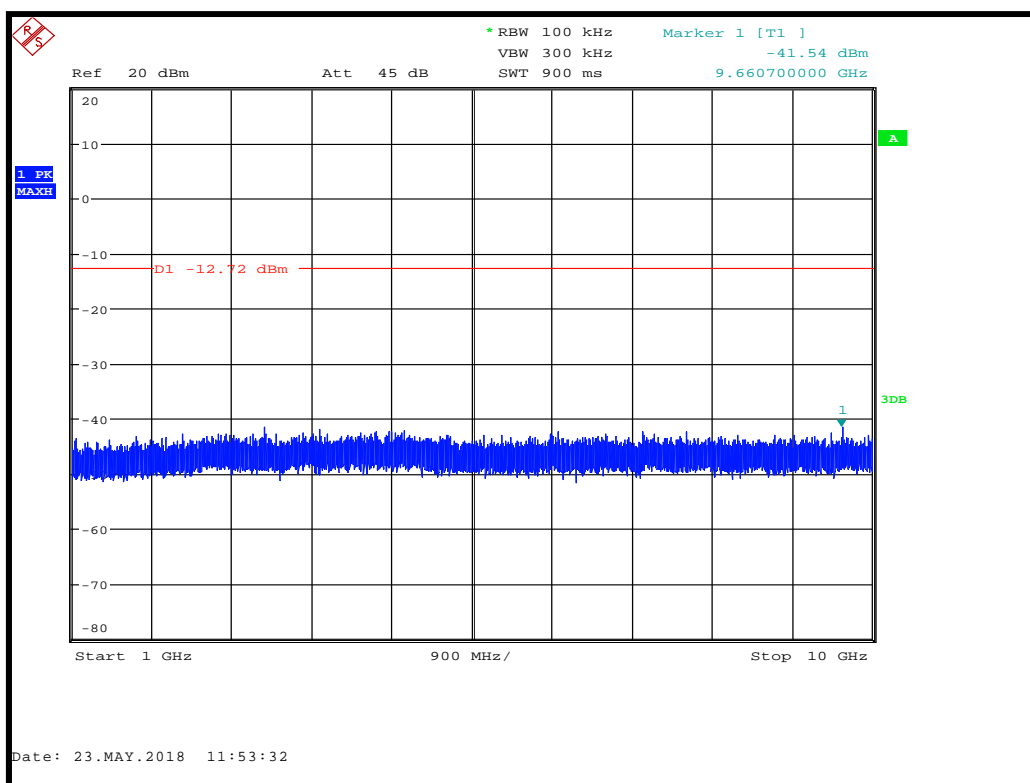
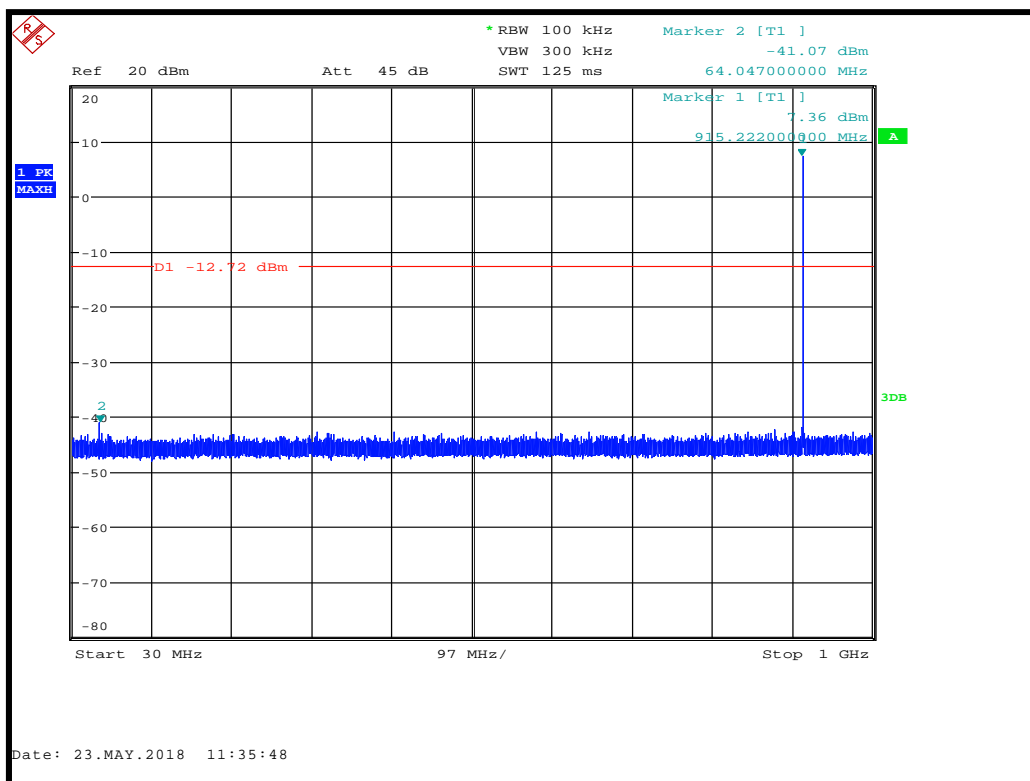


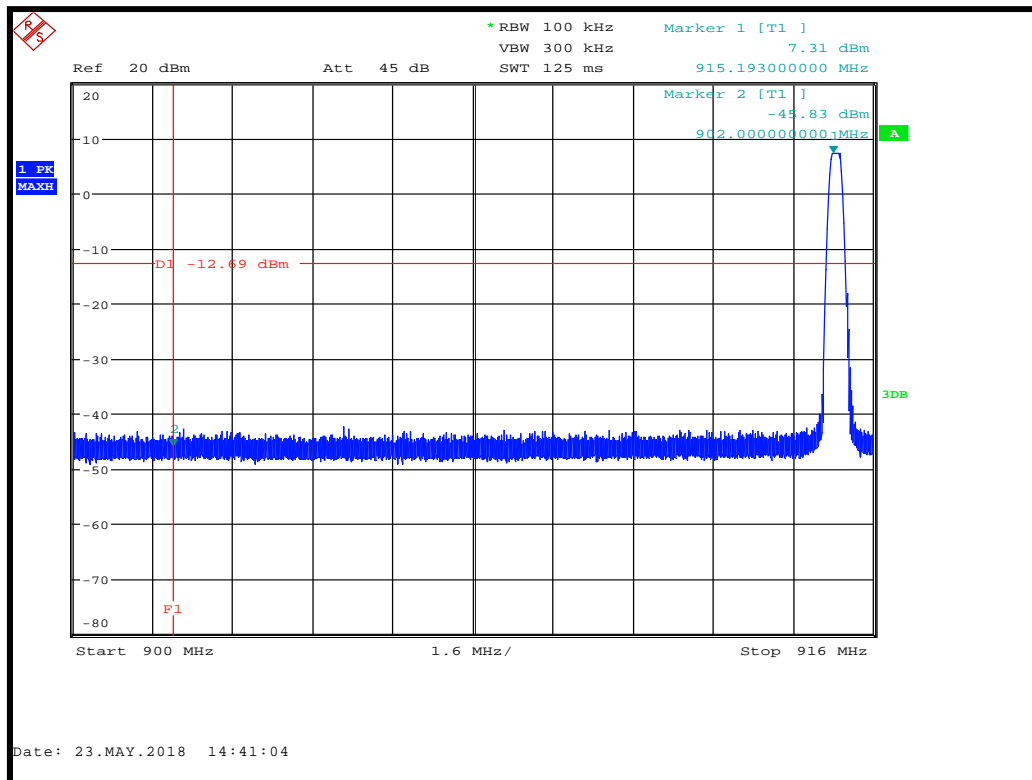
### 13.6 Test Results

Power setting: 0x0C						
Channel Frequency (MHz)	Emission Frequency (MHz)	Analyzer Level (dBm)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
Low	915.2500	7.29	7.29	N/A	N/A	PASS
	0.0661	-46.49	-46.49	-12.71	-33.78	PASS
	0.1500	-45.37	-45.37	-12.71	-32.66	PASS
	64.0470	-41.07	-41.07	-12.71	-28.36	PASS
	9660.7000	-41.54	-41.54	-12.71	-28.83	PASS

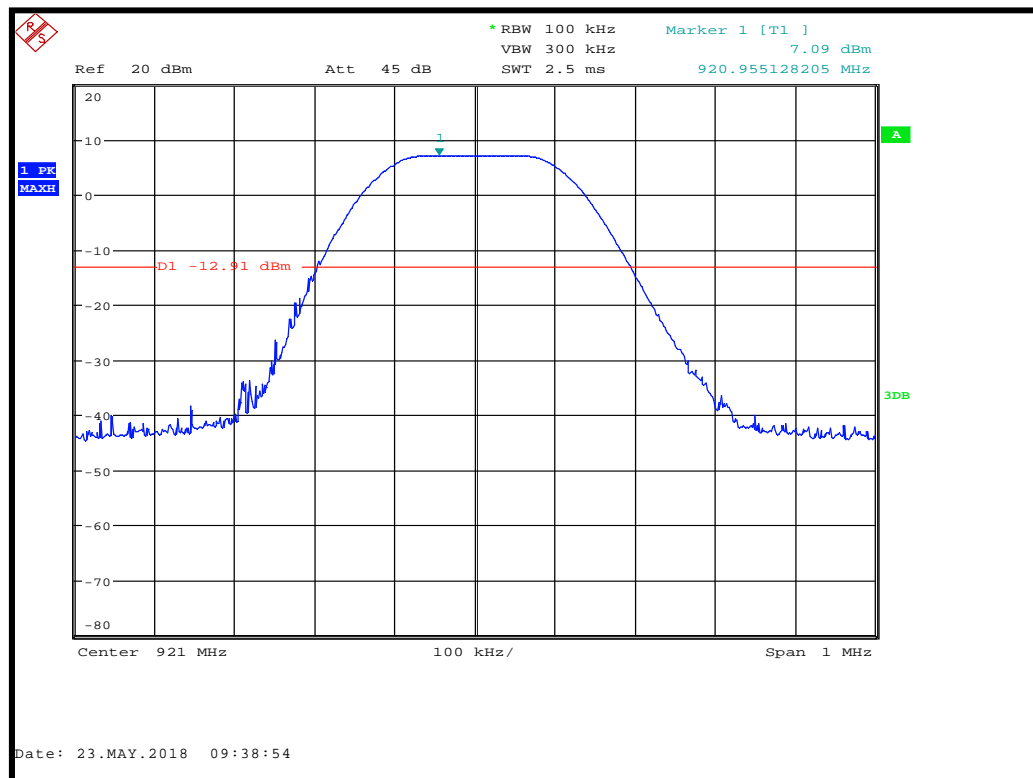


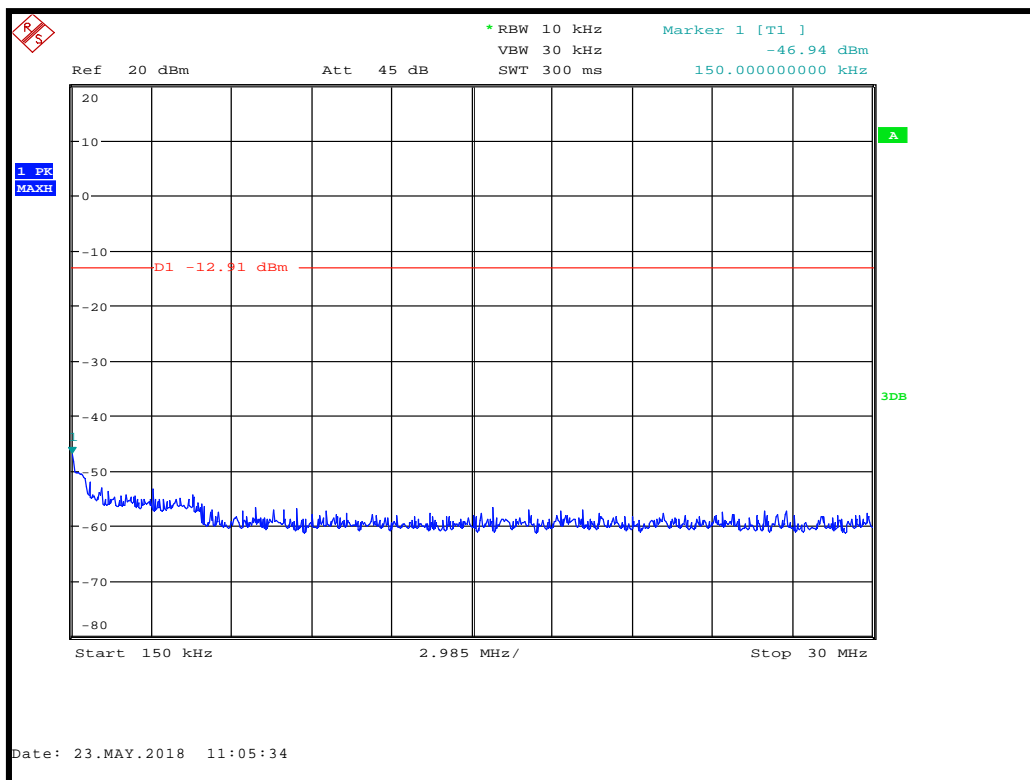
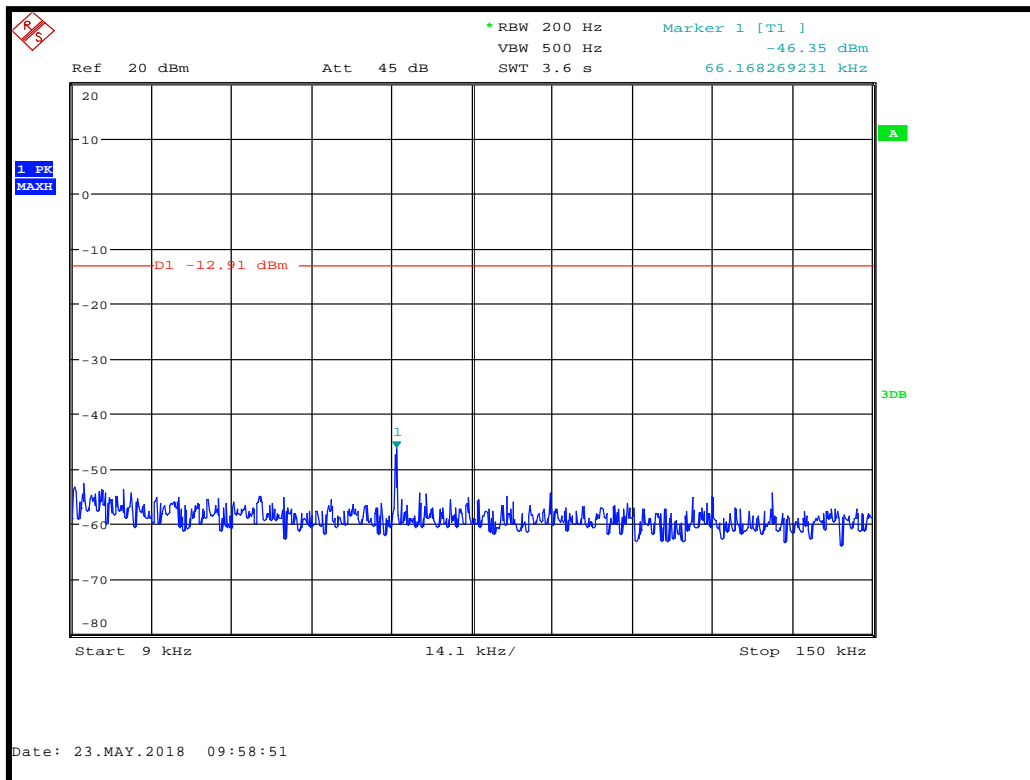


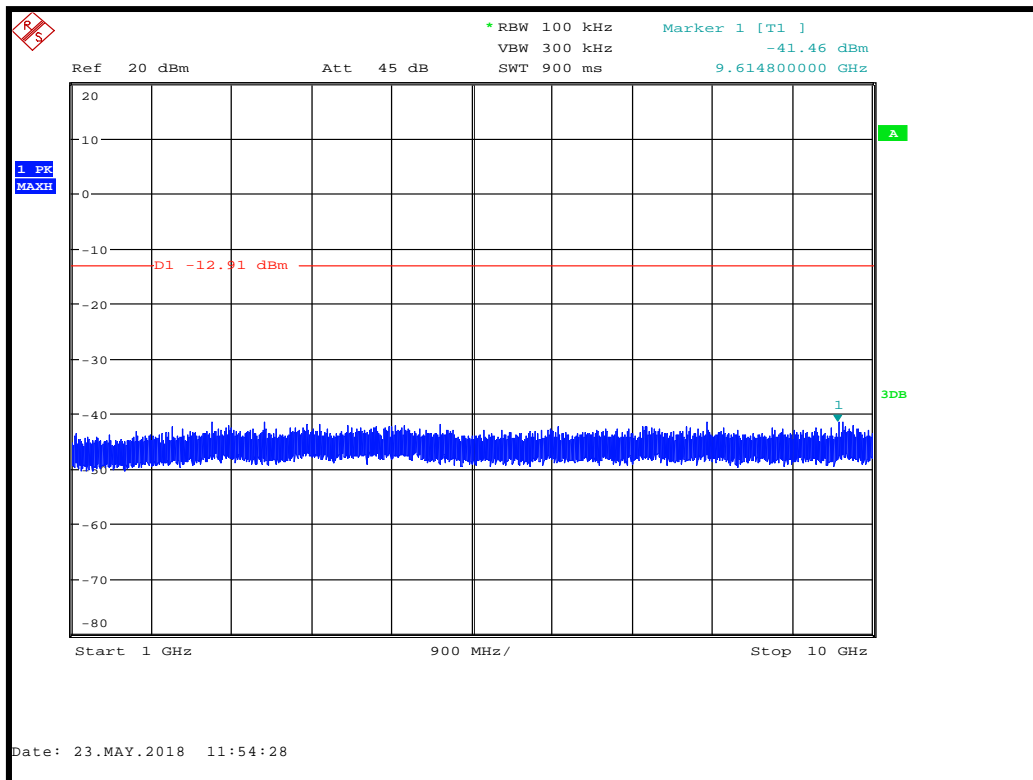
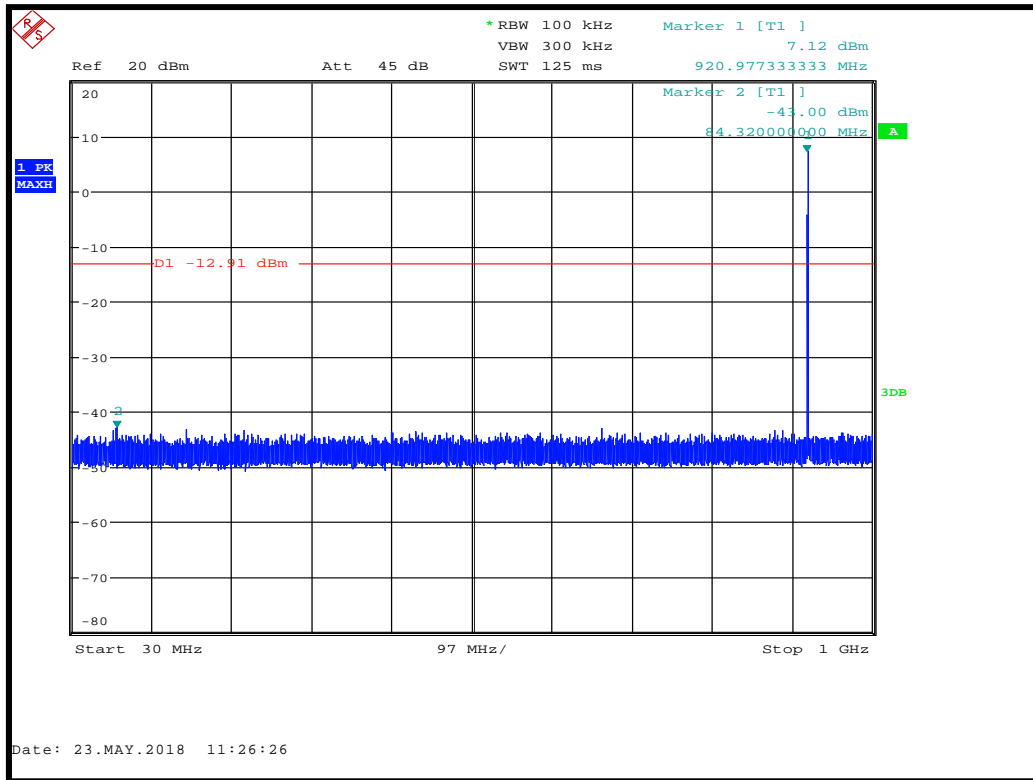




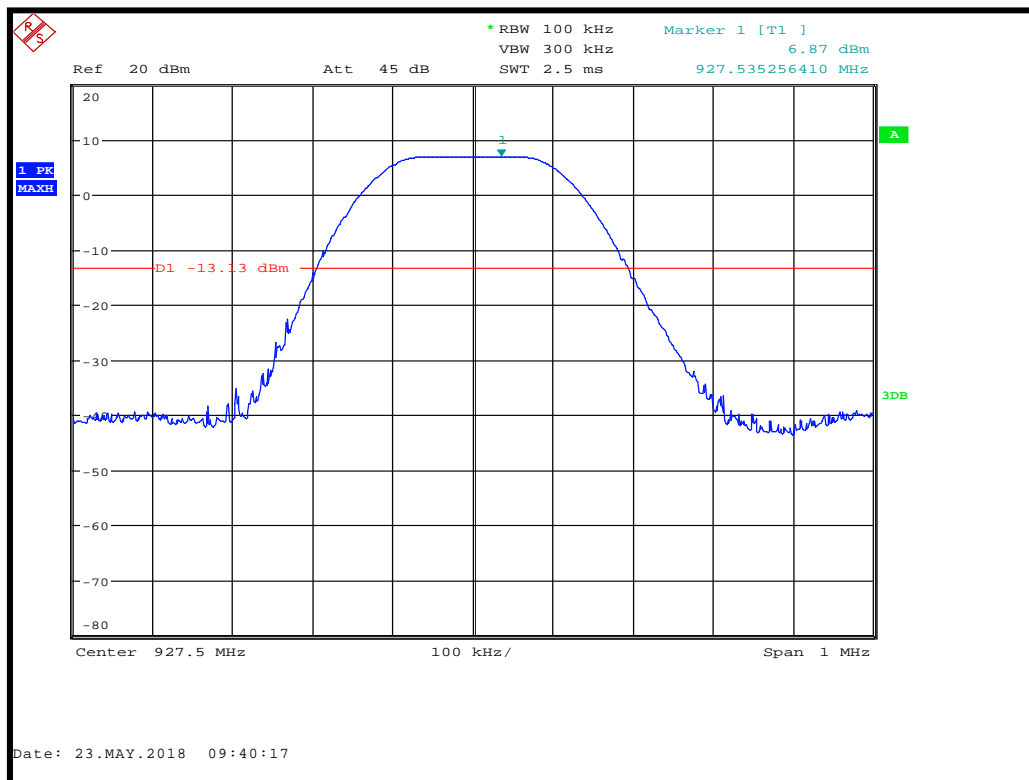
Power setting: 0x0C						
Channel Frequency (MHz)	Emission Frequency (MHz)	Analyzer Level (dBm)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
Mid	921.0000	7.09	7.09	N/A	N/A	PASS
	0.0662	-46.35	-46.35	-12.91	-33.44	PASS
	0.1500	-46.94	-46.94	-12.91	-34.03	PASS
	84.3200	-43.00	-43.00	-12.91	-30.09	PASS
	9614.8000	-41.46	-41.46	-12.91	-28.55	PASS



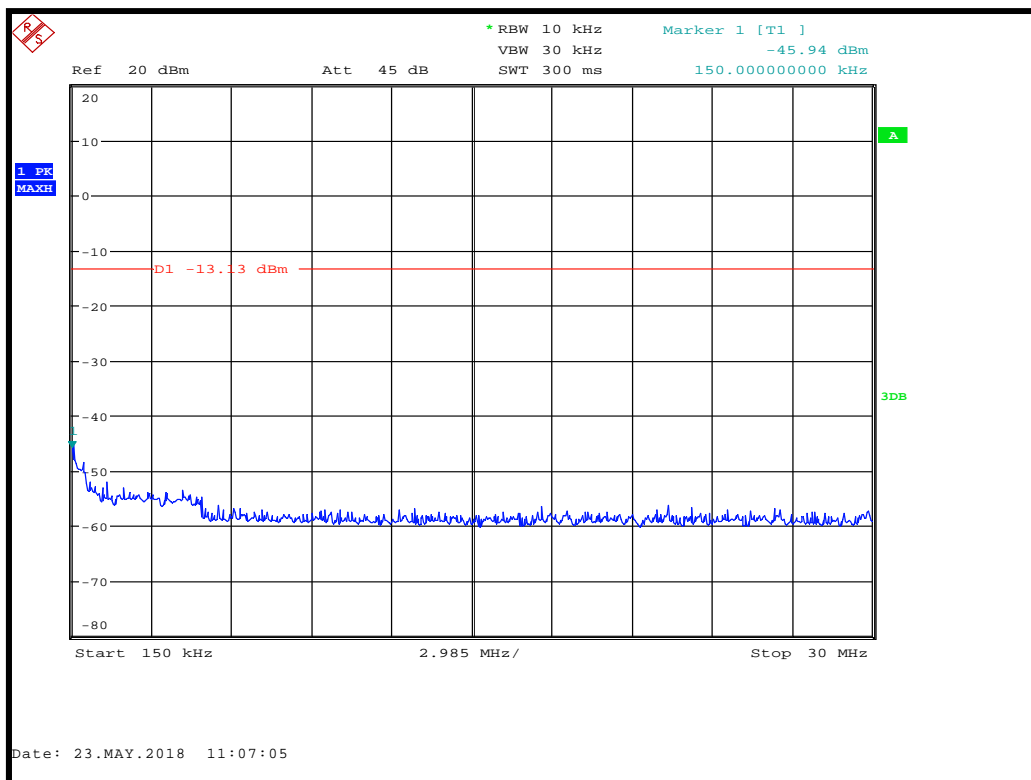
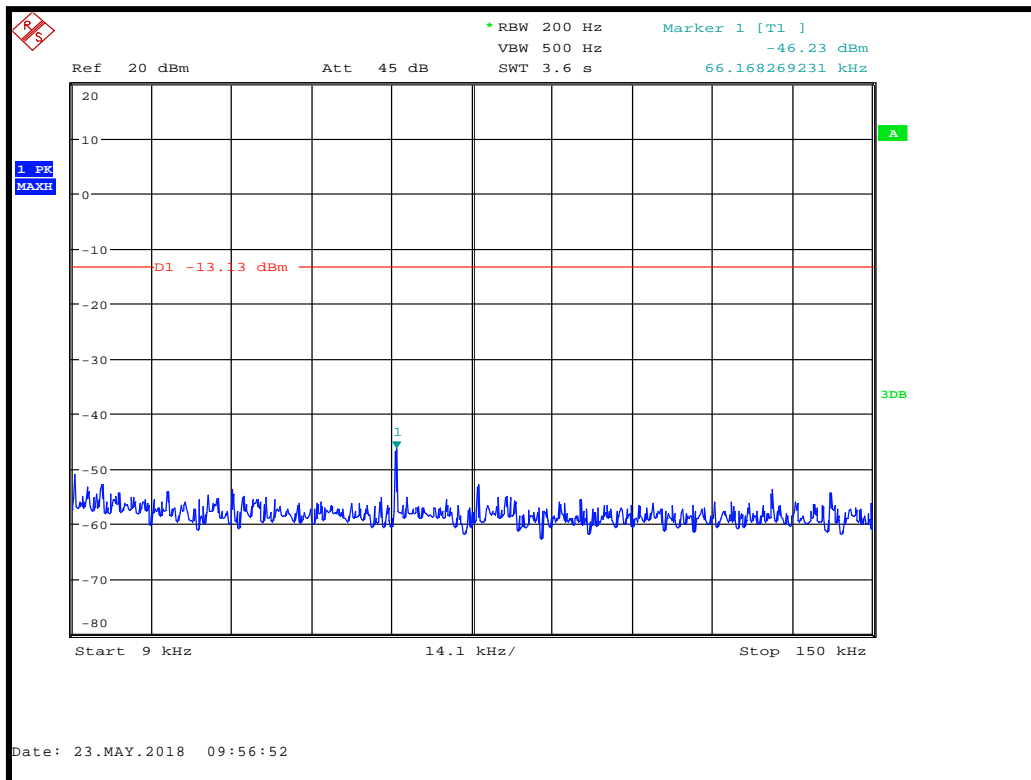


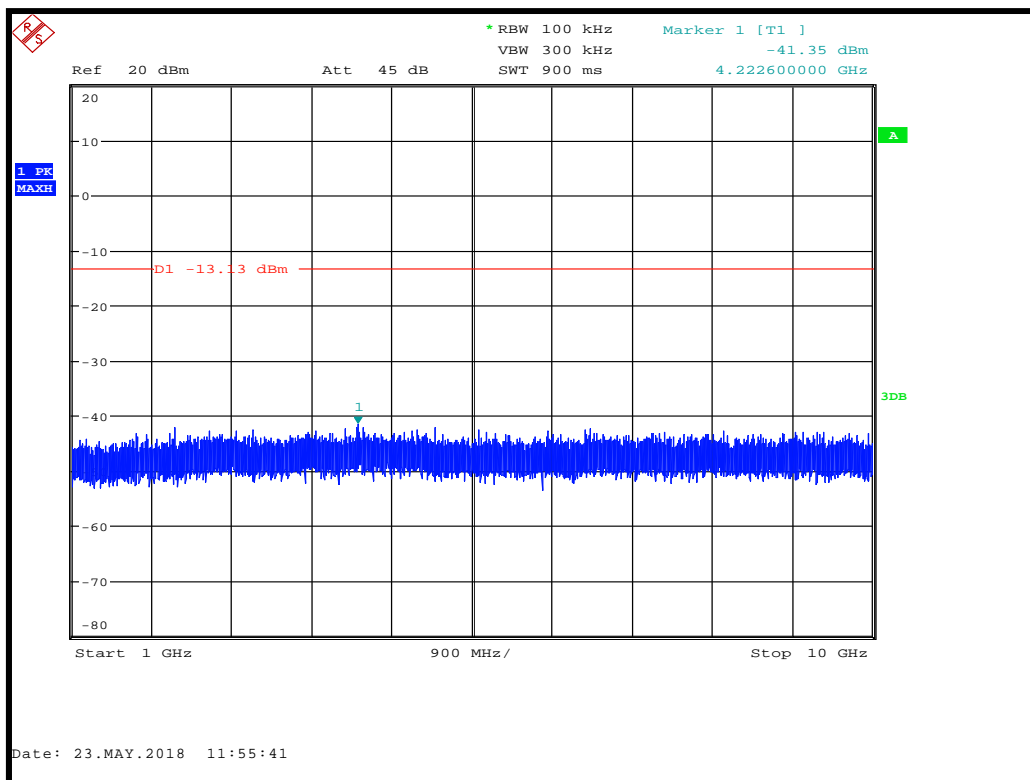
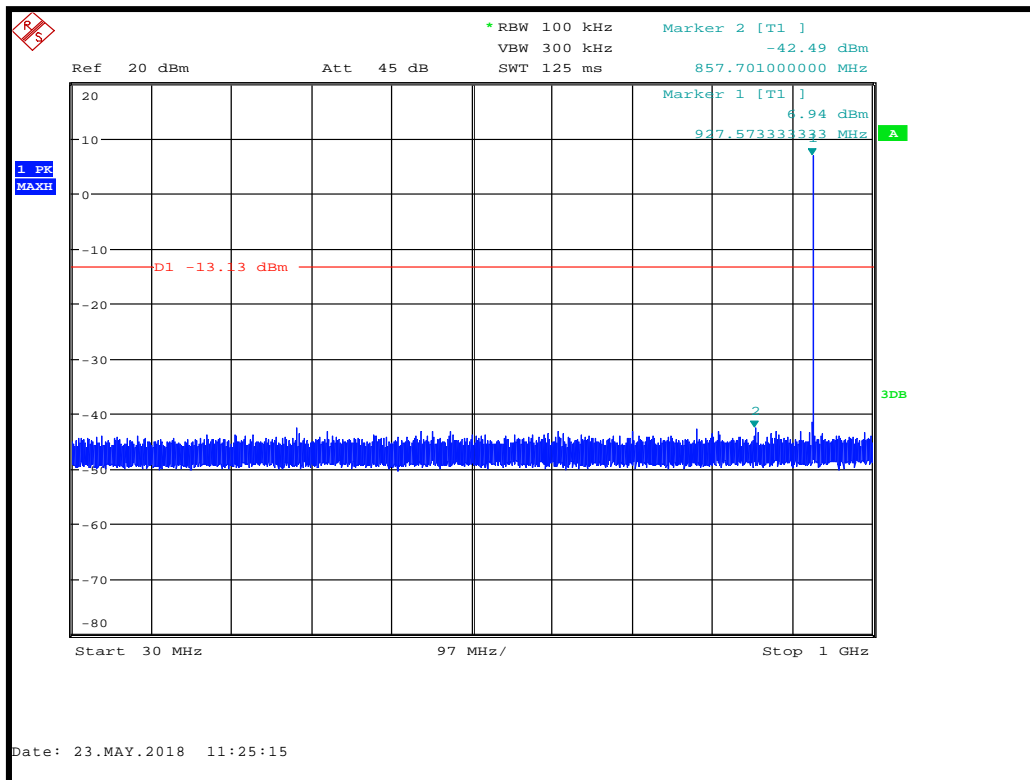


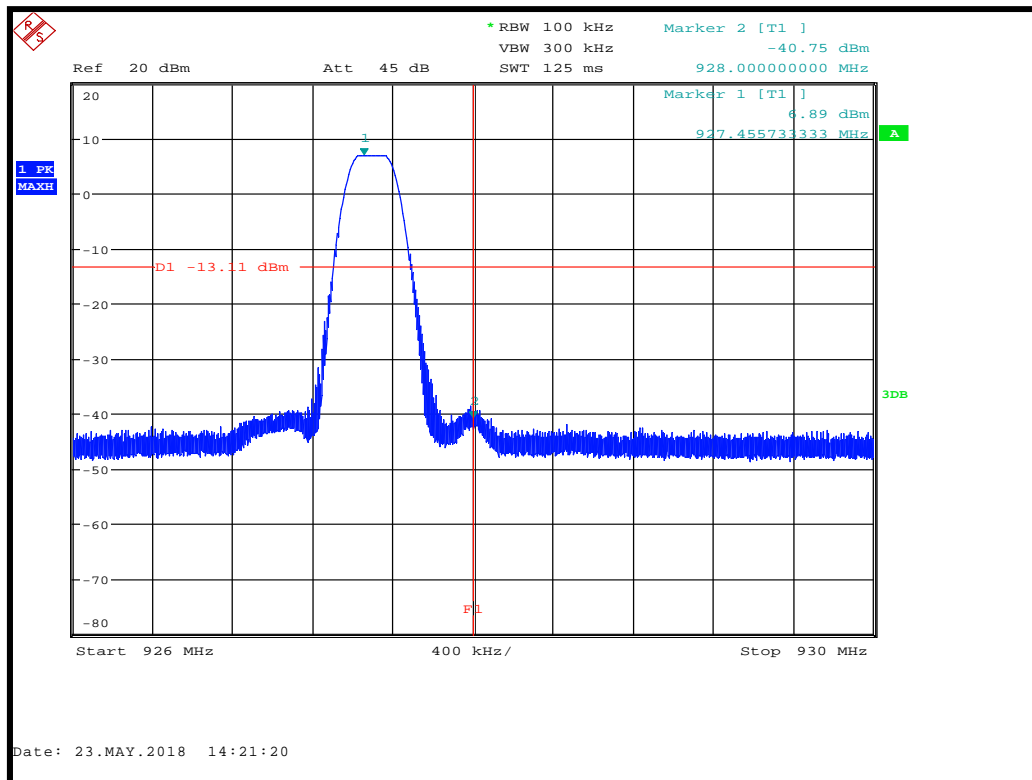
Power setting: 0x0C						
Channel Frequency (MHz)	Emission Frequency (MHz)	Analyzer Level (dBm)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
High	927.5	6.87	6.87	N/A	N/A	PASS
	0.0662	-46.23	-46.23	-13.13	-33.10	PASS
	0.1500	-45.94	-45.94	-13.13	-32.81	PASS
	857.7010	-42.49	-42.49	-13.13	-29.36	PASS
	4222.6000	-41.35	-41.35	-13.13	-28.22	PASS











## 14 Measurement Uncertainty

### Calculated Measurement Uncertainties

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95 % confidence:

#### [1] Radiated spurious emissions

Uncertainty in test result (30 MHz to 1 GHz) = **4.6 dB**

Uncertainty in test result (1 GHz to 18 GHz) = **4.7 dB**

#### [2] AC power line conducted emissions

Uncertainty in test result = **3.4 dB**

#### [3] Occupied bandwidth

Uncertainty in test result = **15.5 %**

#### [4] Conducted carrier power

Uncertainty in test result (Power Meter) = **1.08 dB**

#### [5] Conducted / radiated RF power out-of-band

Uncertainty in test result – up to 8.1 GHz = **3.31 dB**

Uncertainty in test result – 8.1 GHz to 15.3 GHz = **4.43 dB**

Uncertainty in test result (30 MHz to 1 GHz) = **4.6 dB**

Uncertainty in test result (1 GHz to 18 GHz) = **4.7 dB**

#### [6] Power spectral density

Uncertainty in test result (Spectrum Analyser) = **2.48 dB**

## 15 RF Exposure

### MPE Calculation

#### As per KDB 447498

47 CFR §§1.1307 and 2.1091

2.1091 Radio frequency radiation exposure evaluation: Portable devices.

For purposes of these requirements mobile devices are defined by the FCC as transmitters designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimetres is normally maintained between radiating structures and the body of the user or nearby persons. These devices are normally evaluated for exposure potential with relation to the MPE limits. As the 20cm separation specified under FCC rules may not be achievable under normal operation of the EUT, an RF exposure calculation is needed to show the minimum distance required to be less than 0.6mW/cm<sup>2</sup> power density limit, as required under FCC rules

#### Prediction of MPE limit at a given distance

Equation from KDB 447498 D01

$$S = \frac{1.64 \text{ ERP}}{4 \pi R^2} \quad \text{re - arranged} \quad R = \sqrt{\frac{1.64 \text{ ERP}}{S 4 \pi}}$$

where:

S = power density

R = distance to the centre of radiation of the antenna

ERP = EUT Maximum power

Result:

Prediction Frequency (MHz)	Maximum ERP (mW)	Power density limit (S) (mW/cm <sup>2</sup> )	Distance (R) cm required to be less than 0.6mW/cm <sup>2</sup> (cm)
915.25	239.88	0.6	7.22

Prediction Frequency (MHz)	Maximum Conducted power (mW)	Power density limit (S) (mW/cm <sup>2</sup> )	Distance (R) cm required to be less than 0.6mW/cm <sup>2</sup> (cm)
915.25	98.86	0.6	4.64