Report on the FCC Testing of the FCS, Outstation, Model: Tri-corr Touch Pro In accordance with FCC 47 CFR Part 90 and FCC 47 CFR Part 2

Product Service

Choose certainty.
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Prepared for: HWM-Water Ltd
Llantarnam Park Way
Cwmbran
NP44 3AW
United Kingdom

On Behalf of: Fluid Conservation Systems
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FCC ID: RUZ-068

COMMERCIAL-IN-CONFIDENCE

Date: January 2018
Document Number: 75940615-04 | Issue: 01

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Project Management	Natalie Bennett	16 January 2018	
Authorised Signatory	Simon Bennett	16 January 2018	

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 90 and FCC 47 CFR Part 2. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Mohamed Toubella	16 January 2018	
Testing	Graeme Lawler	16 January 2018	

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

EXECUTIVE SUMMARY
A sample of this product was tested and found to be compliant with FCC 47 CFR Part 90: 2016 and FCC 47 CFR Part 2: 2016.

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ACCREDITATION
Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation. Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).

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Product Service

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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	16 January 2018

Table 1

1.2 Introduction

Applicant	HWM Water Ltd
Manufacturer	Fluid Conservation Systems (FCS)
Model Number(s)	Tri-corr Touch Pro
Serial Number(s)	Not Serialised (75940615-TSR0001) Not Serialised (75940615-TSR0002)
Hardware Version(s)	B
Software Version(s)	105
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 90: 2016 FCC 47 CFR Part 2: 2016
Order Number Date	75593 18-October-2017
Date of Receipt of EUT	17-November-2017
Start of Test	17-November-2017
Finish of Test	05-January-2018
Name of Engineer(s)	Matthew Russell, Mohamed Toubella and Graeme Lawler
Related Document(s)	ANSI C63.26: 2015

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 90 and FCC 47 CFR Part 2 is shown below.

Section	Specification Clause		Test Description	Result	Comments/Base Standard
	Part 90	Part 2			
Configuration and Mode: MCT System – Transmit					
2.1	90.205	2.1046	Maximum Conducted Output Power	Pass	
2.2	90.207	2.1047	Types of Emissions	Pass	
2.3	90.209	2.1049	Bandwidth Limitations	Pass	
2.4	90.210	2.1051	Spurious Emissions at Antenna Terminals	Pass	
2.5	90.210	2.1053	Radiated Spurious Emissions	Pass	
2.6	90.214	-	Transient Frequency Behaviour	Pass	
2.7	90.210	2.1055	Frequency Stability	Pass	

Table 2

Product Service

1.4 Application Form

EQUIPMENT DESCRIPTION	
Model Name/Number	Tri-corr Touch Pro
Part Number	MCT-US-STD
Hardware Version	B
Software Version	105
FCC ID (if applicable)	RUZ-068
Industry Canada ID (if applicable)	10962A-068
Technical Description (Please provide a brief description of the intended use of the equipment)	Touch Pro is a high performance accoustic correlator for pinpointing leaks in a water network. It uses 2 outstation listening radio transmitters to send the leak sound to a central handheld receiver which calculates the location of the leak based on the time taken for the leak sound to reach each listening outstation. The 2 transmitters are fixed frequency with +/-1.5KHz stability.

INTENTIONAL RADIATORS									
Technology	Frequency Band (MHz)	Conducted Declared Output Power (dBm)	Antenna Gain (dBi)	Supported Bandwidth (s) (MHz)	Modulation Scheme(s)	ITU Emission Designator	Test Channels (MHz)		
							Bottom	Middle	Top
FSK	467.800	27	5	12.5 kHz	FSK	11K25F1D		467.800	
FSK	467.925	27	5	12.5 kHz	FSK	11K25F1D		467.925	

UN-INTENTIONAL RADIATOR	
Highest frequency generated or used in the device or on which the device operates or tunes	446.525MHz

Power Source			
AC	Single Phase	Three Phase	Nominal Voltage
	X		100-240v
External DC	Nominal Voltage		Maximum Current
	12v		5A
Battery	Nominal Voltage		Battery Operating End Point Voltage
	7.56V		~4v
Can EUT transmit whilst being charged?			Yes ☐ No ☒

EXTREME CONDITIONS					
Maximum temperature	-15	°C	Minimum temperature	50	°C

Product Service

Ancillaries
Please list all ancillaries which will be used with the device.
Stereo Headphones, magnetically coupled high sentivity microphones, battery charger, in case 3 device charger.

ANTENNA CHARACTERISTICS					
☒	Antenna connector		State impedance	50	Ohm
☐	Temporary antenna connector		State impedance		Ohm
☐	Integral antenna	Type			
☐	External antenna	Type			

I hereby declare that the information supplied is correct and complete.

Name: Andy Earp
Position held: Product Validation Manager Date: 3/11/2017

1.5 Product Information

1.5.1 Technical Description

Touch Pro is a high performance acoustic correlator for pinpointing leaks in a water network. It uses 2 outstation listening radio transmitters to send the leak sound to a central handheld receiver which calculates the location of the leak based on the time taken for the leak sound to reach each listening outstation. The 2 transmitters are fixed frequency with +/-1.5 kHz stability.

1.6 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

1.7 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
Serial Number: Not Serialised (75940615-TSR0001)			
0	As supplied by the customer	Not Applicable	Not Applicable
Serial Number: Not Serialised (75940615-TSR0002)			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 3

1.8 Test Location

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

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: MCT System - Transmit		
Maximum Conducted Output Power	Matthew Russell	UKAS
Types of Emissions	Mohamed Toubella	UKAS
Bandwidth Limitations	Matthew Russell	UKAS
Spurious Emissions at Antenna Terminals	Matthew Russell and Mohamed Toubella	UKAS
Radiated Spurious Emissions	Graeme Lawler	UKAS
Transient Frequency Behaviour	Matthew Russell	UKAS
Frequency Stability	Mohamed Toubella	UKAS

Table 4

Office Address:

Octagon House
Concorde Way
Segensworth North
Fareham
Hampshire
PO15 5RL
United Kingdom

2 Test Details

2.1 Maximum Conducted Output Power

2.1.1 Specification Reference

FCC 47 CFR Part 90, Clause 90.205
FCC 47 CFR Part 2, Clause 2.1046

2.1.2 Equipment Under Test and Modification State

Tri-corr Touch Pro, S/N: Not Serialised (75940615-TSR0001) - Modification State 0
Tri-corr Touch Pro, S/N: Not Serialised (75940615-TSR0002) - Modification State 0

2.1.3 Date of Test

04-January-2018

2.1.4 Test Method

This test was performed in accordance with ANSI C63.26, clause 5.2.3.3.

ERP = Maximum Conducted Output Power + Antenna Gain (dBi) – 2.15.

2.1.5 Environmental Conditions

Ambient Temperature	22.6 °C
Relative Humidity	29.2 %

2.1.6 Test Results

MCT System – Transmit

Maximum Rated Output Power = 500 mW (27 dBm)

Antenna Gain = 5 dBi

467.800 MHz		467.925 MHz	
Result (dBm)	Result (mW)	Result (dBm)	Result (mW)
26.35	431.52	26.19	415.91

Table 5 - Maximum Conducted Output Power

467.800 MHz		467.925 MHz	
Result (dBm)	Result (mW)	Result (dBm)	Result (mW)
29.20	831.76	29.04	801.68

Table 6 - ERP

FCC 47 CFR Part 90, Limit Clause 90.35 (c)(11)

Frequency (MHz)	Limit (erp W)
467.800	<2.0
467.925	<2.0

Table 7 - FCC Limits for Maximum ERP

The output power shall not exceed by more than 20 percent either the output power shown in the Radio Equipment List [available in accordance with § 90.203(a)(1)] for transmitters included in this list or when not so listed, the manufacturer's rated output power for the particular transmitter specifically listed on the authorization

2.1.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Multimeter	Fluke	79 Series III	498	12	9-Aug-2018
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	12	11-Jul-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
2 metre SMA Cable	Florida Labs	SMS-235SP-78.8-SMS	4517	12	19-Sep-2018
1 metre K-Type Cable	Florida Labs	KMS-180SP-39.4-KMS	4519	12	20-Dec-2018
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	12-Jan-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon
Vector Signal Generator	Rohde & Schwarz	SMBV100A	4886	12	11-May-2018

Table 8

O/P Mon – Output Monitored using calibrated equipment

2.2 Types of Emissions

2.2.1 Specification Reference

FCC 47 CFR Part 90, Clause 90.207
FCC 47 CFR Part 2, Clause 2.1047

2.2.2 Equipment Under Test and Modification State

Tri-corr Touch Pro, S/N: Not Serialised (75940615-TSR0001) - Modification State 0
Tri-corr Touch Pro, S/N: Not Serialised (75940615-TSR0002) - Modification State 0

2.2.3 Date of Test

21-November-2017

2.2.4 Test Method

The EUT was connected to a spectrum analyser via a cable and attenuator. The EUT was configured to transmit at maximum power. The audio input was initially set at a level of 50 mV and the audio frequency varied between 100 Hz and 5 kHz to show the audio frequency response.

At frequencies of 100 Hz, 1 kHz and 5 kHz, the audio input voltage was varied between 1 mV and 1000 mV to show the EUT's capability to limit the level of modulation for different input signal levels and frequencies. The results are shown on the graph below.

2.2.5 Environmental Conditions

Ambient Temperature	24.2 °C
Relative Humidity	45.5 %

2.2.6 Test Results

MCT System - Transmit

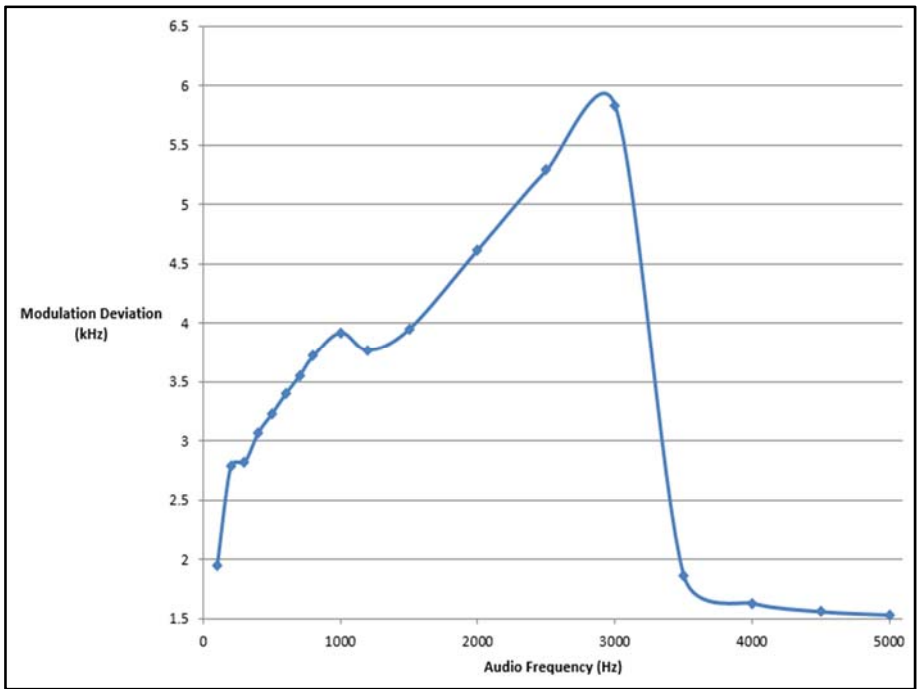

Figure 1 – Audio Frequency Response, 467.800 MHz

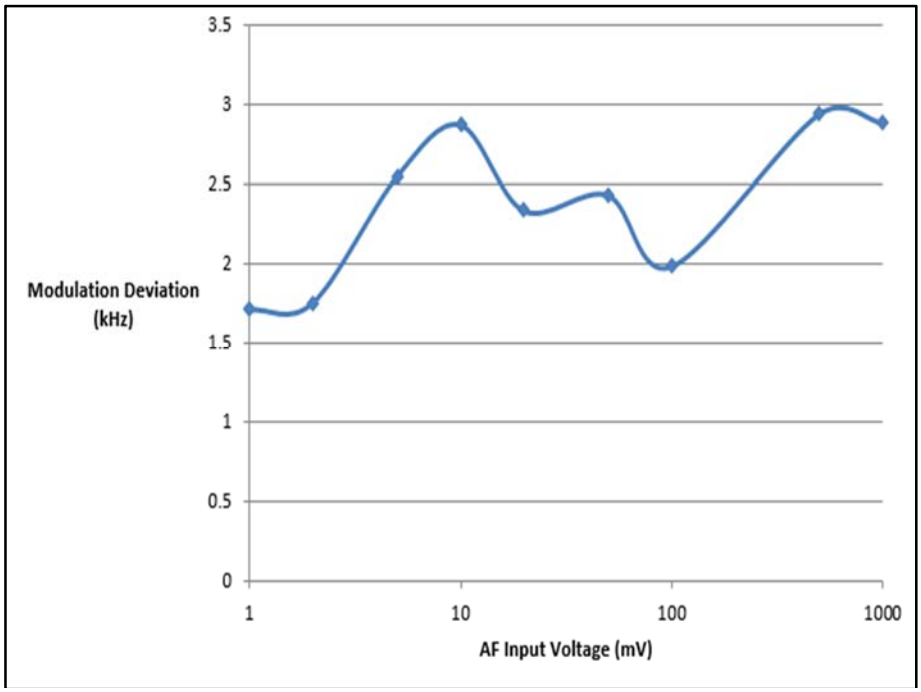

Figure 2 - Modulation Limiting Capability -100 Hz AF, 467.800 MHz

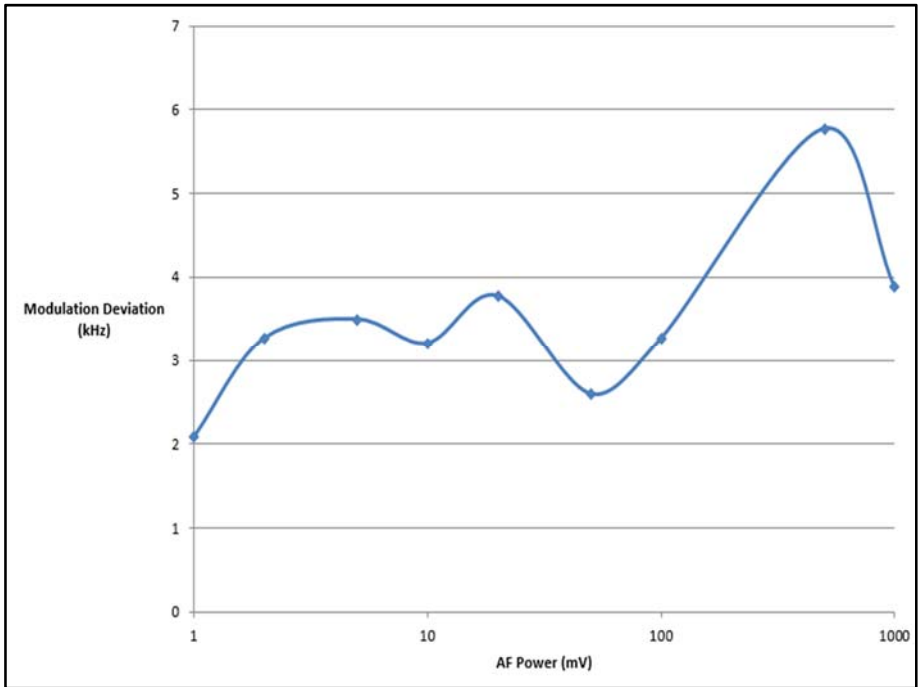

Figure 3 - Modulation Limiting Capability - 1 kHz AF, 467.800 MHz

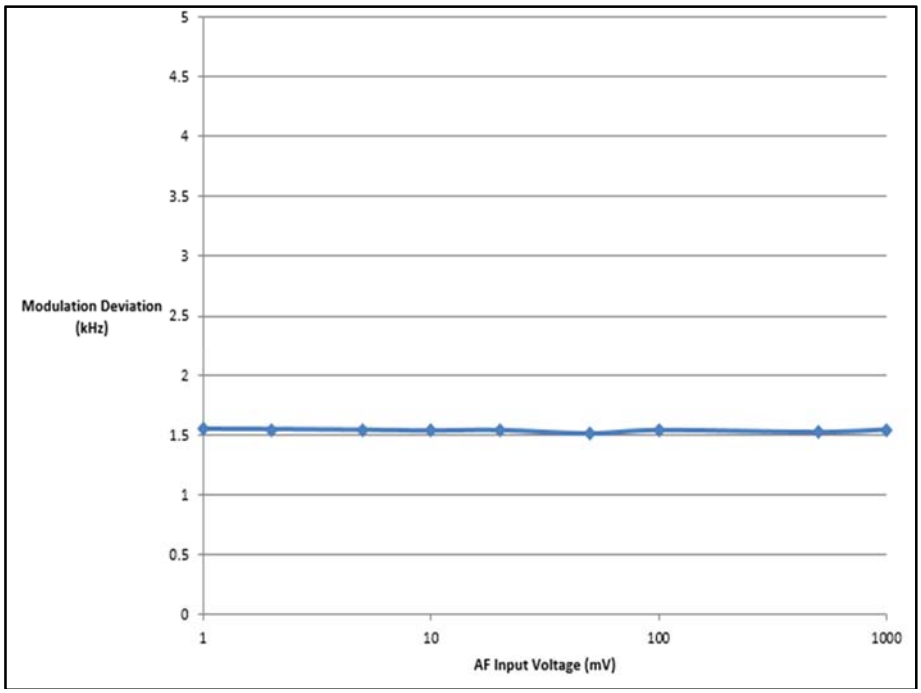

Figure 4 - Modulation Limiting Capability - 5 kHz AF, 467.800 MHz

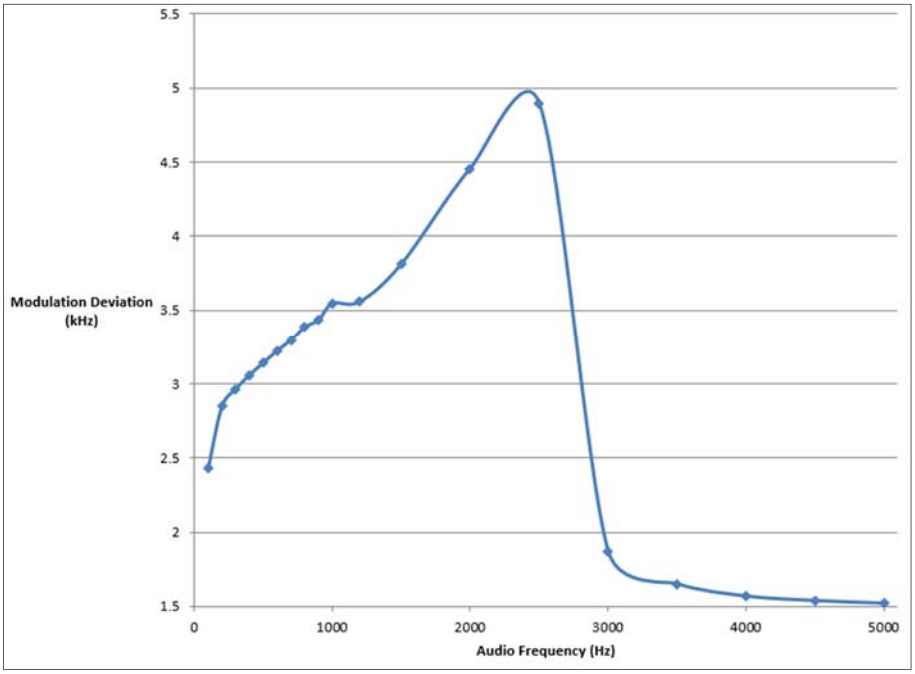

Figure 5 - Audio Frequency Response, 467.925 MHz

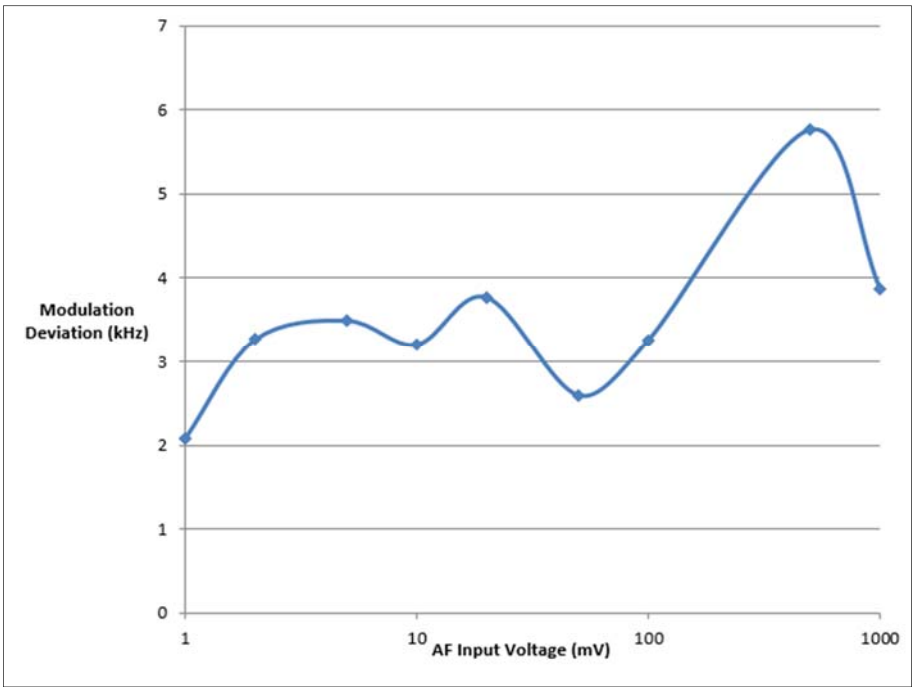

Figure 6 - Modulation Limiting Capability - 100 Hz AF, 467.925 MHz

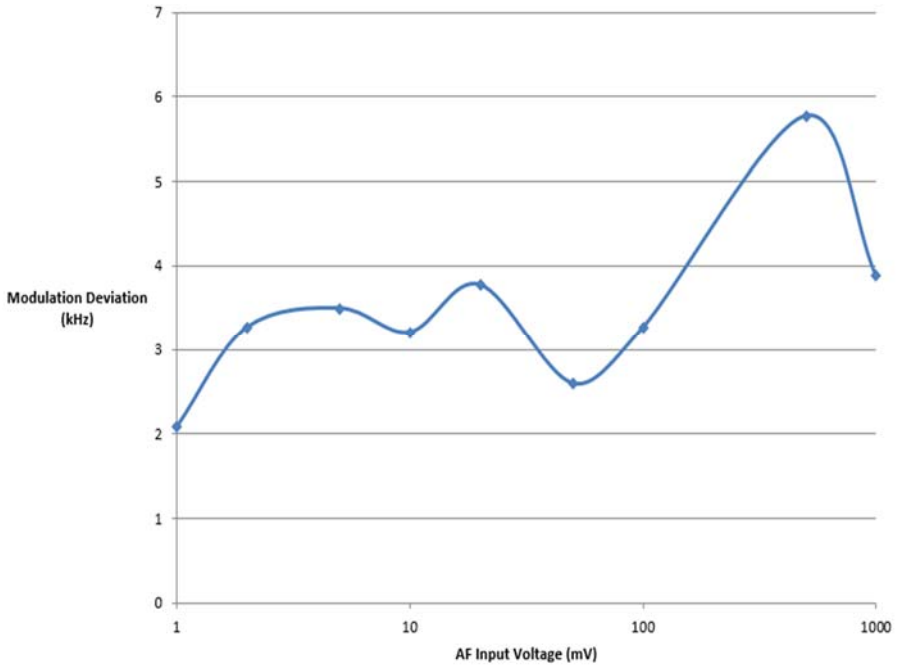

Figure 7 - Modulation Limiting Capability - 1 kHz AF, 467.925 MHz

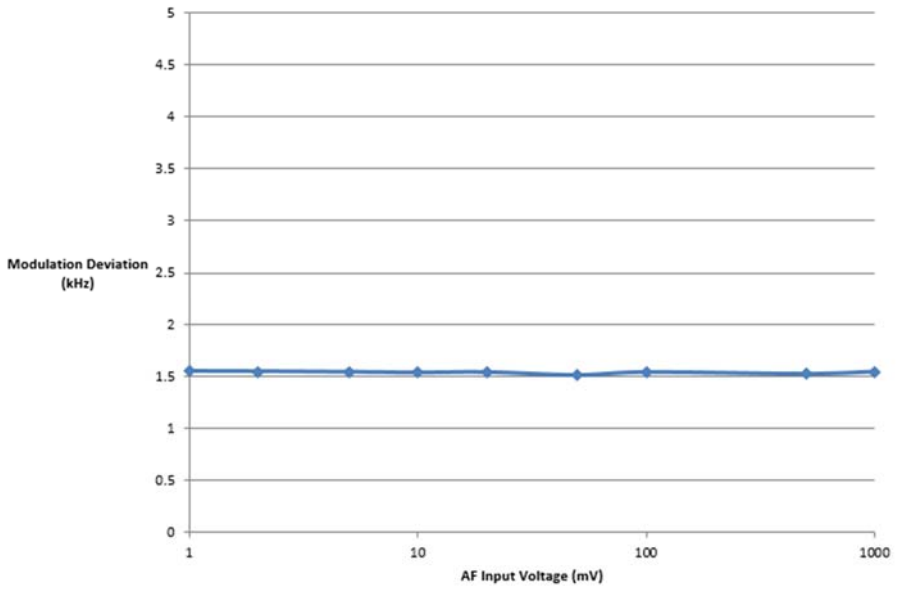

Figure 8 - Modulation Limiting Capability - 5 kHz, 467.925 MHz

FCC 47 CFR Part 90, Limit Clause 90.207

As per FCC Part 90.207 (n).

FCC 47 CFR Part 2, Limit Clause 2.1047

Voice modulated communication equipment. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.

Equipment which employs modulation limiting. A curve or family of curves showing the percentage of modulation versus the modulation input voltage shall be supplied. The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.

2.2.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Power Supply Unit	Hewlett Packard	6253A	441	-	O/P Mon
Multimeter	Iso-tech	IDM-101	466	12	02-Oct-2018
Audio Analyser	Hewlett Packard	8903B	576	12	03-Jan-2018
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3159	12	21-Jun-2018
Attenuator (10dB, 50W)	Aeroflex / Weinschel	47-10-34	3166	12	20-Oct-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	19-Sep-2018
2 metre N-Type Cable	Florida Labs	NMS-235SP-78.8-NMS	4508	12	02-Mar-2018
EMI Receiver	Keysight Technologies	N9038A MXE	4629	12	13-Sep-2018

Table 9

O/P Mon – Output Monitored using calibrated equipment

2.3 Bandwidth Limitations

2.3.1 Specification Reference

FCC 47 CFR Part 90, Clause 90.209
FCC 47 CFR Part 2, Clause 2.1049

2.3.2 Equipment Under Test and Modification State

Tri-corr Touch Pro, S/N: Not Serialised (75940615-TSR0001) - Modification State 0
Tri-corr Touch Pro, S/N: Not Serialised (75940615-TSR0002) - Modification State 0

2.3.3 Date of Test

05-January-2018

2.3.4 Test Method

This test was performed in accordance with ANSI C63.26, clause 5.4.4.

2.3.5 Environmental Conditions

Ambient Temperature	21.7 °C
Relative Humidity	35.1 %

2.3.6 Test Results

MCT System - Transmit

Occupied Bandwidth (kHz)	
467.800 MHz	467.925 MHz
5.533	5.482

Table 10 - Occupied Bandwidth Results

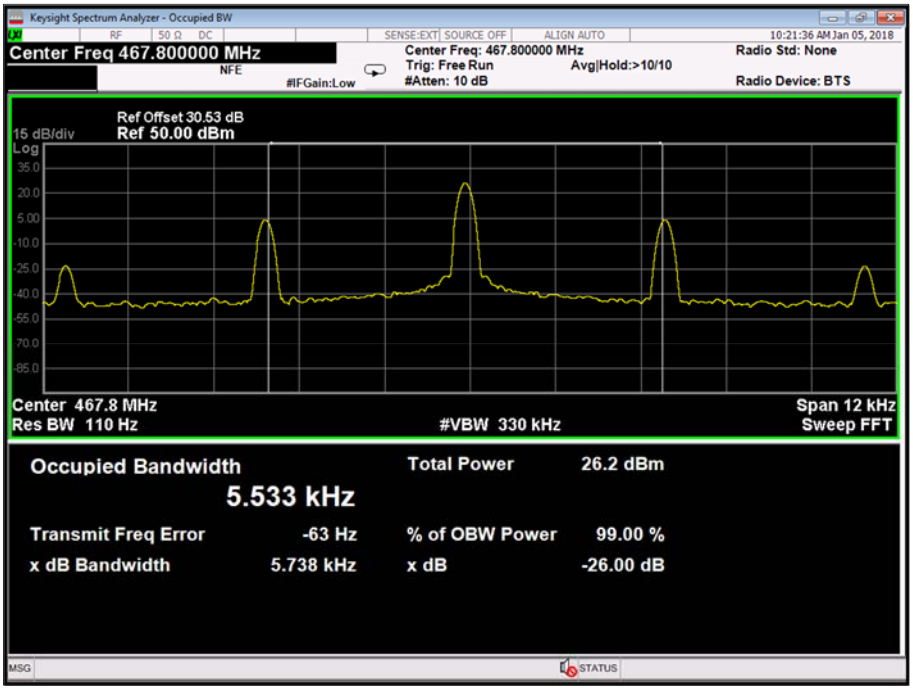

Figure 9 - 467.800 MHz Occupied Bandwidth

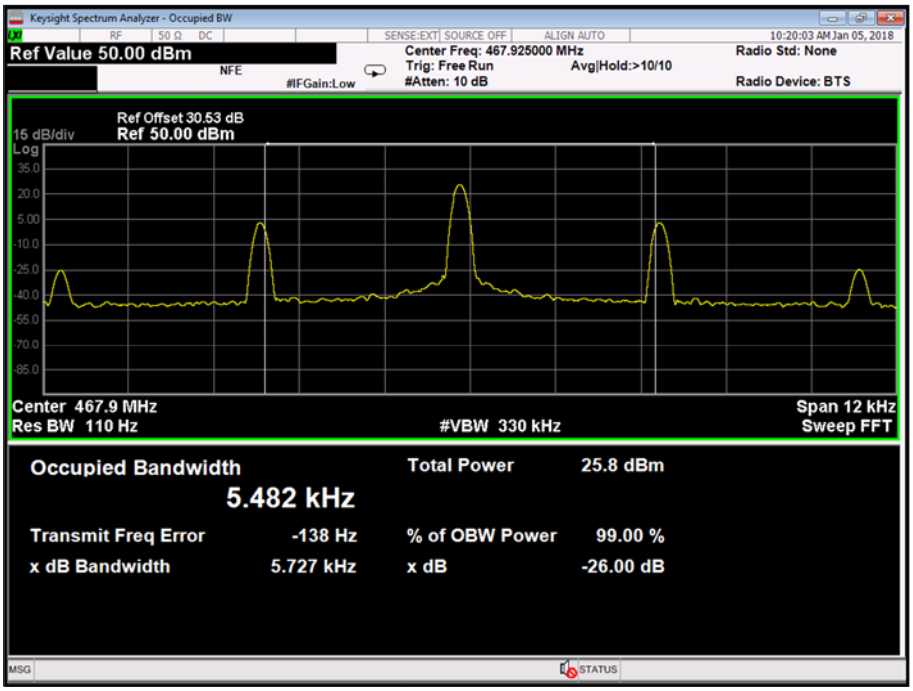

Figure 10 - 467.925 MHz Occupied Bandwidth

FCC 47 CFR Part 90, Limit Clause 90.209

< 11.25 kHz

2.3.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Multimeter	Fluke	79 Series III	498	12	9-Aug-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	12-Mar-2018
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2018
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	12	11-Jul-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	12-Mar-2018
2 metre SMA Cable	Florida Labs	SMS-235SP-78.8-SMS	4517	12	19-Sep-2018
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	12-Jan-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 11

O/P Mon – Output Monitored using calibrated equipment

2.4 Spurious Emissions at Antenna Terminals

2.4.1 Specification Reference

FCC 47 CFR Part 90, Clause 90.210
FCC 47 CFR Part 2, Clause 2.1051

2.4.2 Equipment Under Test and Modification State

Tri-corr Touch Pro, S/N: Not Serialised (75940615-TSR0001) - Modification State 0
Tri-corr Touch Pro, S/N: Not Serialised (75940615-TSR0002) - Modification State 0

2.4.3 Date of Test

21-November-2017 to 05-January-2018

2.4.4 Test Method

This test was performed in accordance with ANSI C63.26, clause 5.7.

2.4.5 Environmental Conditions

Ambient Temperature	21.7-24.2 °C
Relative Humidity	35.1-45.5 %

2.4.6 Test Results

MCT System – Transmit

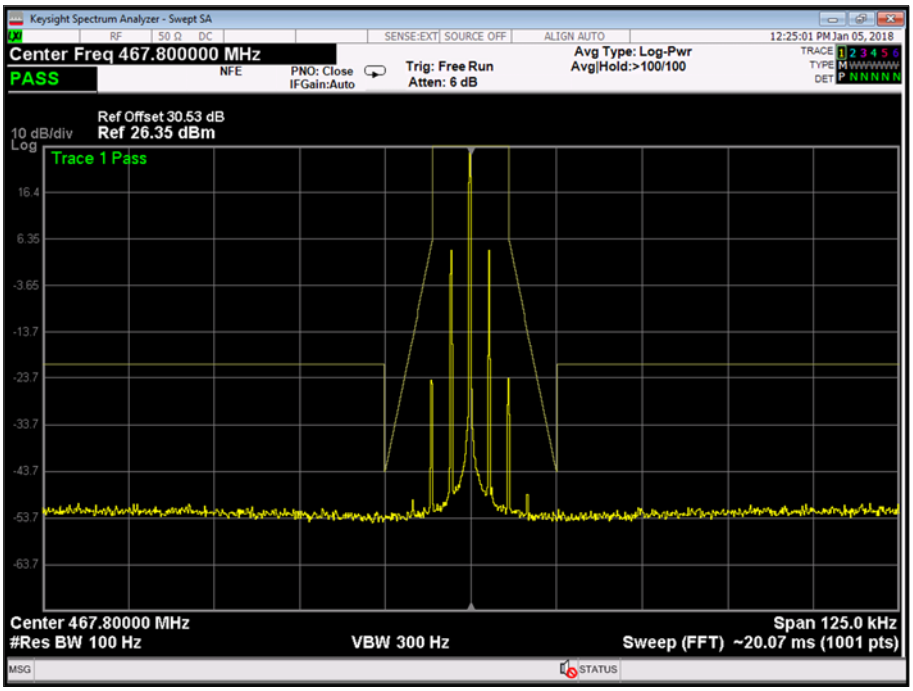

Figure 11 - 467.800 MHz - Transmitter Spectrum Mask

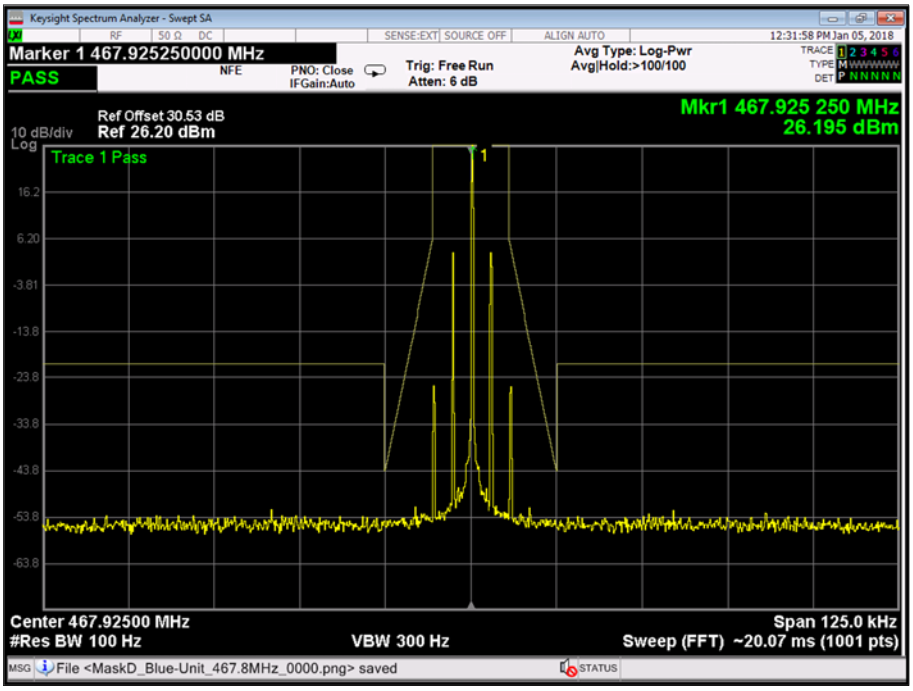

Figure 12 - 467.925 MHz - Transmitter Spectrum Mask

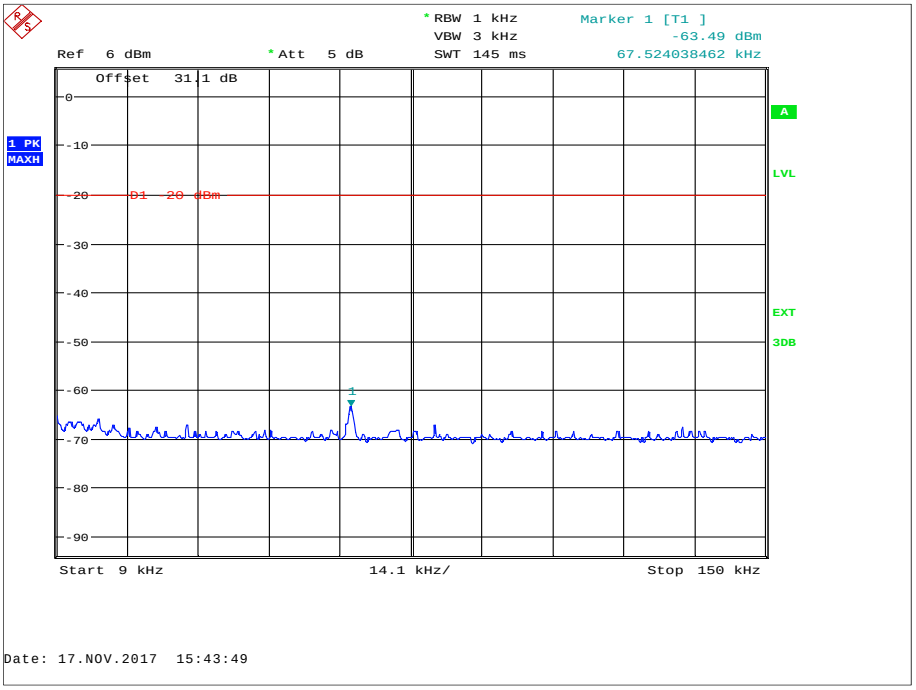

Figure 13 - 467.800 MHz - 9 kHz to 150 kHz

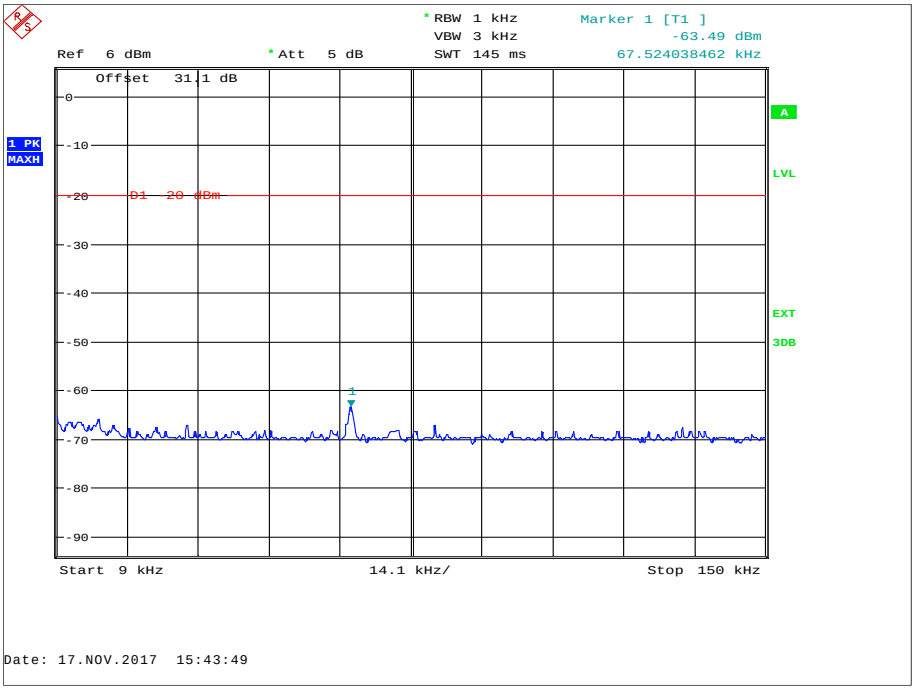

Figure 14 - 467.925 MHz - 9 kHz to 150 kHz

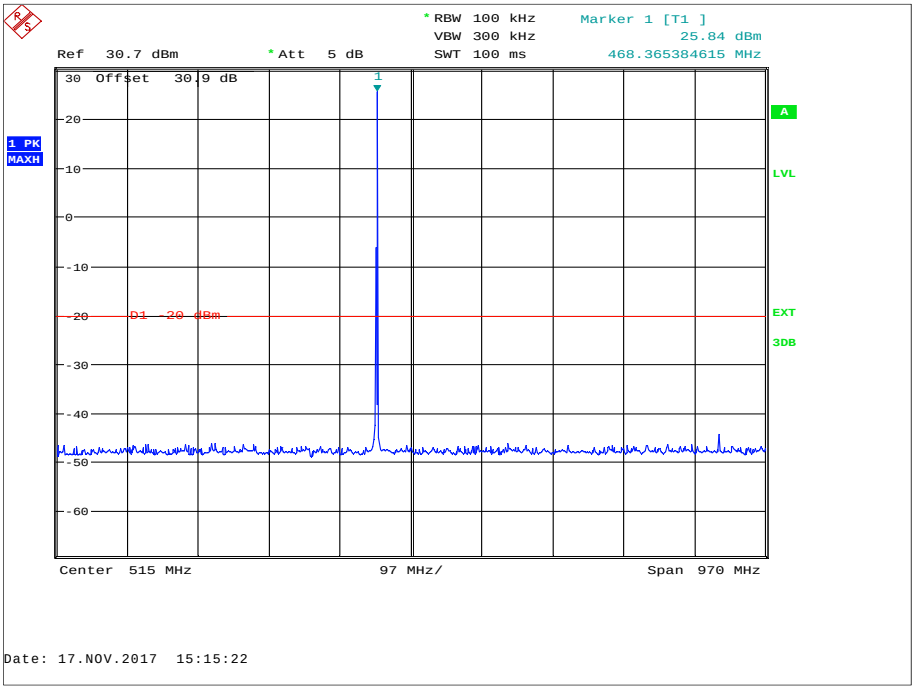

Figure 15 - 467.800 MHz - 30 MHz to 1 GHz

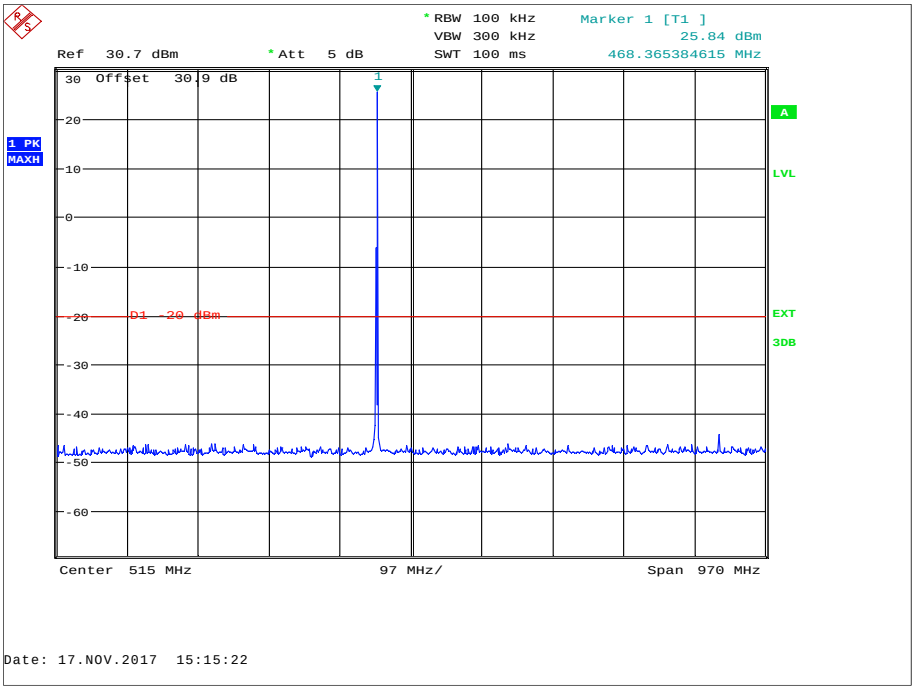

Figure 16 - 467.925 MHz - 30 MHz to 1 GHz

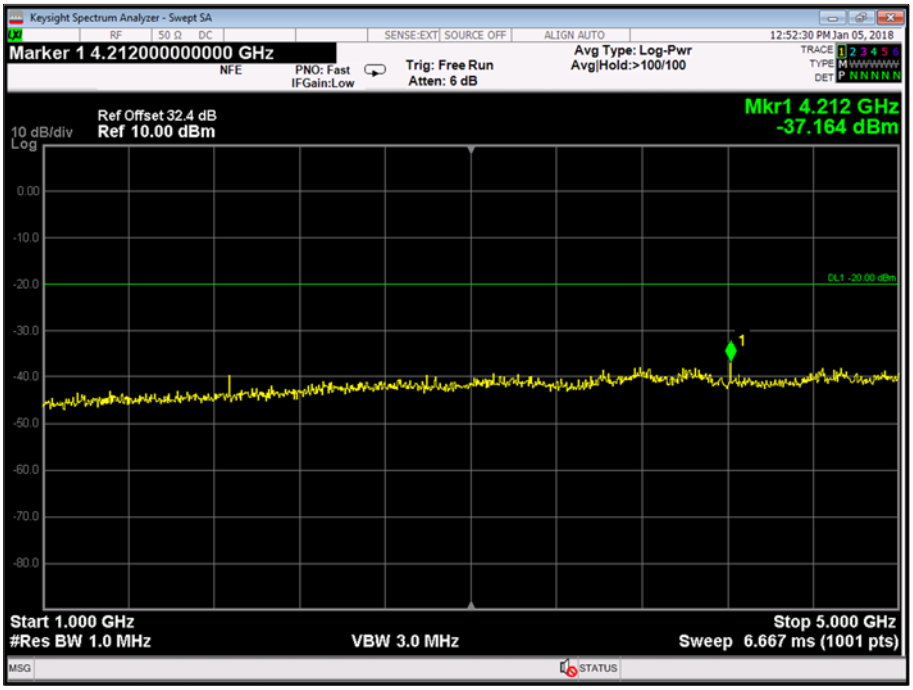

Figure 17 - 467.800 MHz - 1 GHz to 5 GHz

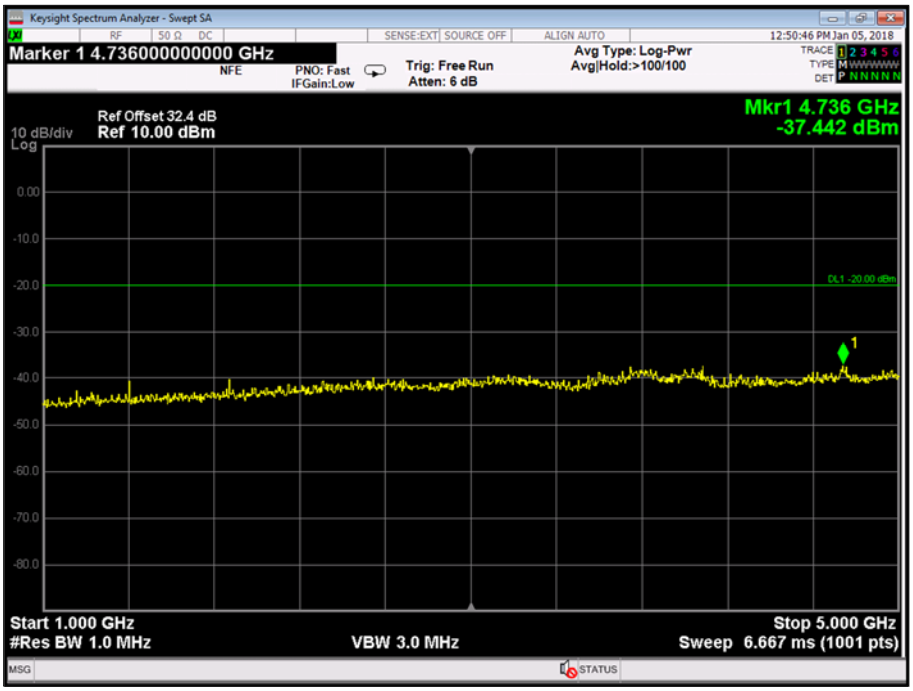

Figure 18 - 467.925 MHz - 1 GHz to 5 GHz

FCC 47 CFR Part 90, Limit Clause 90.210

The EUT shall comply with emission mask D as per FCC 47 CFR Part 90.210.

2.4.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Power Supply Unit	Hewlett Packard	6253A	441	-	O/P Mon
Multimeter	Iso-tech	IDM-101	466	12	02-Oct-2018
Multimeter	Fluke	79 Series III	498	12	9-Aug-2018
Audio Analyser	Hewlett Packard	8903B	576	12	03-Jan-2018
Audio Analyser	Hewlett Packard	8903B	1350	12	16-Nov-2018
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3159	12	21-Jun-2018
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	12	11-Jul-2018
Attenuator (10dB, 50W)	Aeroflex / Weinschel	47-10-34	3166	12	20-Oct-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	19-Sep-2018
2 metre N-Type Cable	Florida Labs	NMS-235SP-78.8-NMS	4508	12	02-Mar-2018
2 metre SMA Cable	Florida Labs	SMS-235SP-78.8-SMS	4517	12	19-Sep-2018
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	12-Jan-2018
EMI Receiver	Keysight Technologies	N9038A MXE	4629	12	13-Sep-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon

Table 12

O/P Mon – Output Monitored using calibrated equipment

2.5 Radiated Spurious Emissions

2.5.1 Specification Reference

FCC 47 CFR Part 90, Clause 90.210
FCC 47 CFR Part 2, Clause 2.1053

2.5.2 Equipment Under Test and Modification State

Tri-corr Touch Pro, S/N: Not Serialised (75940615-TSR0001) - Modification State 0
Tri-corr Touch Pro, S/N: Not Serialised (75940615-TSR0002) - Modification State 0

2.5.3 Date of Test

23-November-2017 to 28-November-2017

2.5.4 Test Method

Testing was performed in accordance with ANSI C63.26, Clause 5.5.

Prescans were performed using the direct field strength method. Any emissions found within 10 dB of the specification limit were formally measured using the substitution method.

The limit line on the prescan plots was calculated from equation c) in clause 5.2.7.

E (dBµV/m) = EIRP (dBm) – 20Log(D) + 104.8

Below 1 GHz: 75.2 = -20 – 20Log(3) +104.8

Above 1 GHz: 77.2 = -18 – 20Log(3) +104.8 (limit is specified as ERP but EIRP required above 1 GHz therefore 2 dB approx. added).

A 2500 Hz tone @ 50mV was applied to modulate the transmitter to achieve maximum power.

2.5.5 Environmental Conditions

Ambient Temperature	17.0 °C
Relative Humidity	38.0 %

2.5.6 Test Results

MCT System - Transmit

Frequency (MHz)	Level (dBm)
1403.881	-27.87
1871.168	-25.03
2338.998	-27.06

Table 13 - 467.800 MHz - Emissions Results

No other emissions were detected within 10 dB of the limit.

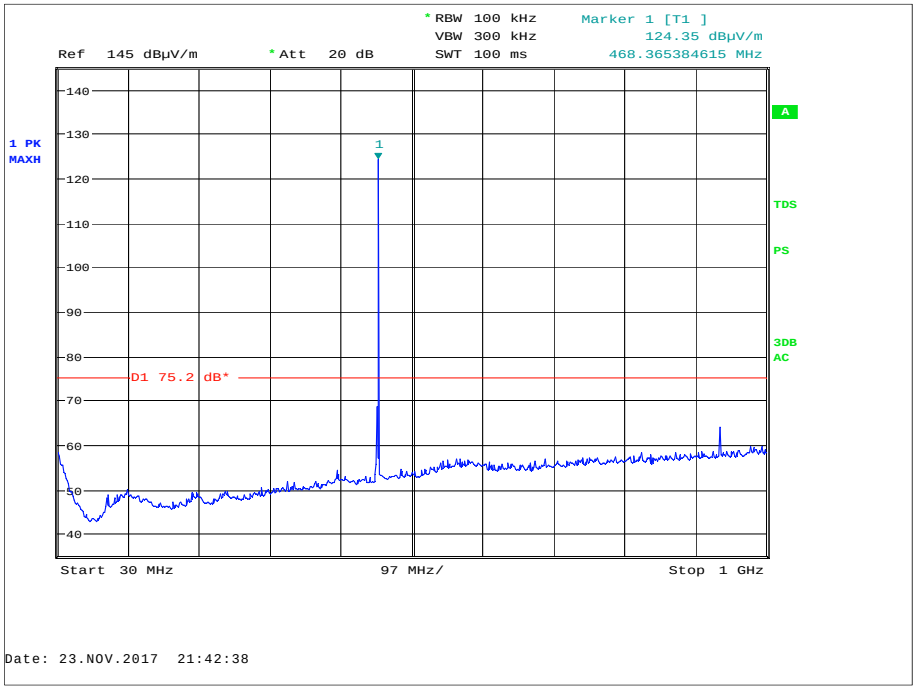

Figure 19 - 467.800 MHz - 30 MHz to 1 GHz

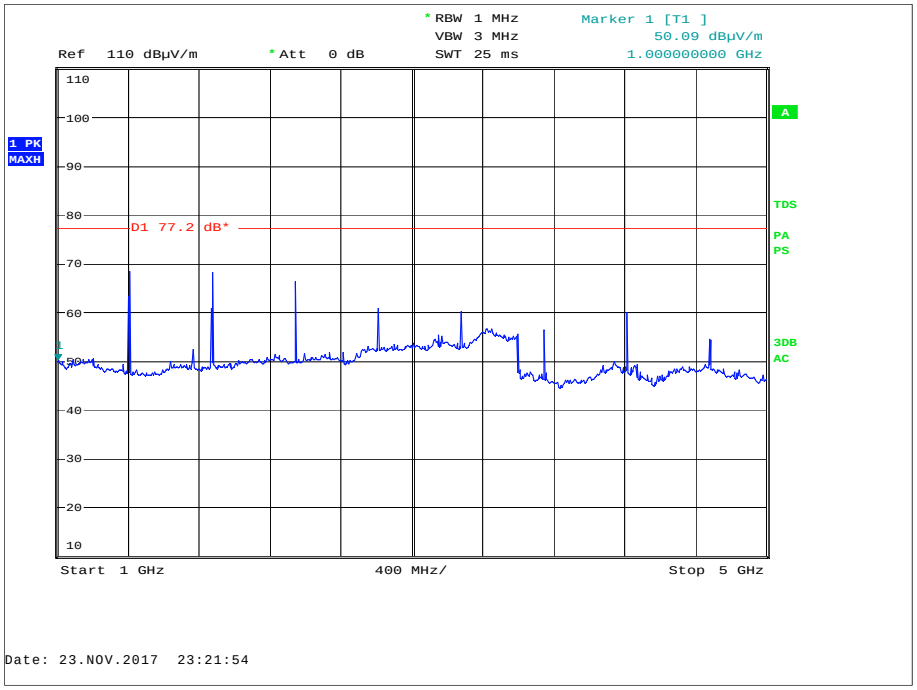

Figure 20 - 467.800 MHz - 1 GHz to 5 GHz

Frequency (MHz)	Level (dBm)
935.856	-29.67
1403.745	-22.89
1871.658	-29.21
2339.609	-28.73

Table 14 - 467.925 MHz - Emissions Results

No other emissions were detected within 10 dB of the limit.

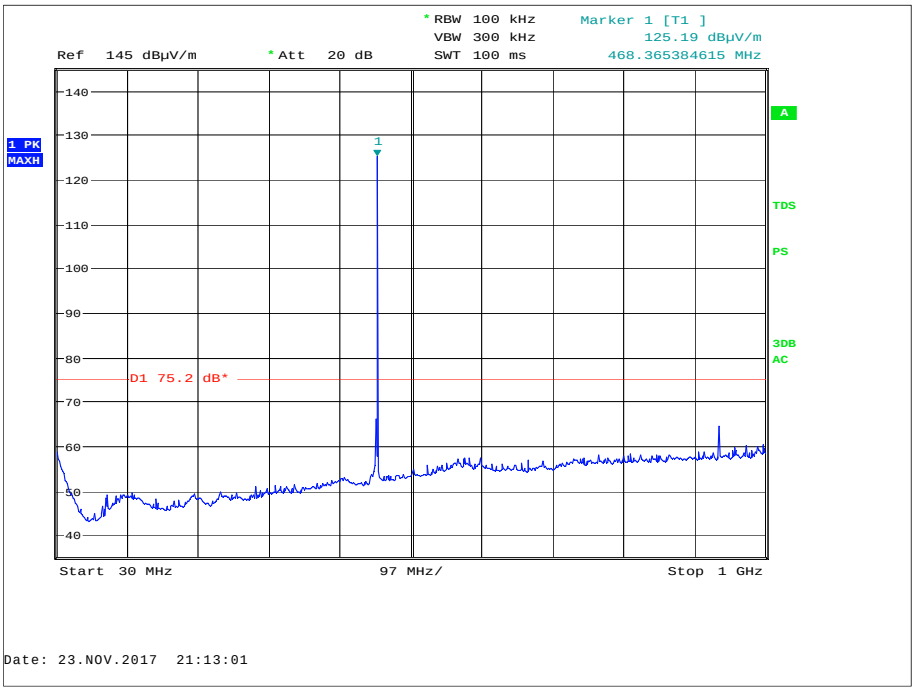

Figure 21 - 467.925 MHz - 30 MHz to 1 GHz

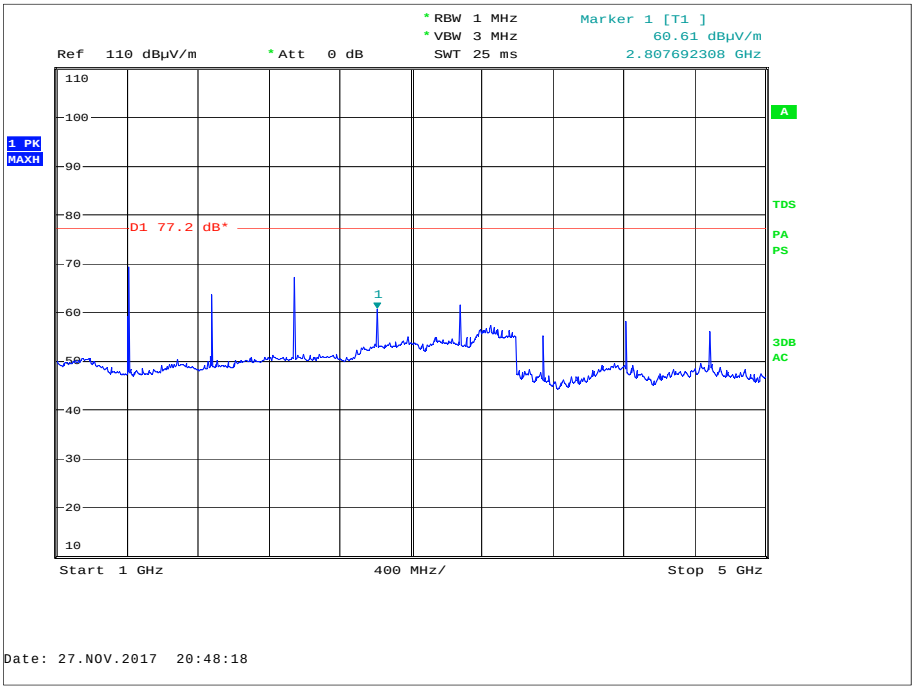

Figure 22 - 467.925 MHz - 1 GHz to 5 GHz

FCC 47 CFR Part 90, Limit Clause 90.210

On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

2.5.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Antenna (Bilog)	Schaffner	CBL6143	287	24	18-Apr-2018
Audio Analyser	Hewlett Packard	8903B	576	12	03-Jan-2018
Signal Generator (10MHz to 40GHz)	Rohde & Schwarz	SMR40	1002	12	20-Oct-2018
Screened Room (5)	Rainford	Rainford	1545	36	20-Dec-2017
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygrometer	Rotronic	HYGROPALM 1	2338	12	24-Oct-2018
Attenuator (20dB, 2W)	Pasternack	PE7004-20	2943	12	04-Apr-2018
Antenna (Log Periodic)	Schaffner	UPA6108	3108	12	16-Jun-2018
Antenna (DRG Horn)	ETS-Lindgren	3115	3125	12	21-Jul-2018
Cable (N-N, 8m)	Rhophase	NPS-2302-8000-NPS	3248	12	02-May-2018
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	22-Nov-2018
Tilt Antenna Mast	maturo Gmbh	TAM 4.0-P	3916	-	TU
Mast Controller	maturo Gmbh	NCD	3917	-	TU
Cable (Yellow, Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4527	6	04-Dec-2017
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	17-Feb-2018

Table 15

TU - Traceability Unscheduled

2.6 Transient Frequency Behaviour

2.6.1 Specification Reference

FCC 47 CFR Part 90, Clause 90.214

2.6.2 Equipment Under Test and Modification State

Tri-corr Touch Pro, S/N: Not Serialised (75940615-TSR0001) - Modification State 0
Tri-corr Touch Pro, S/N: Not Serialised (75940615-TSR0002) - Modification State 0

2.6.3 Date of Test

05-January-2018

2.6.4 Test Method

The EUT was connected to the spectrum analyser via an attenuator, combiner and cables. Connected to the other port of the combiner was a signal generator which was configured to the same frequency as the EUT using frequency modulation (1 kHz AF tone, 12.5 kHz deviation).

The FM demodulation mode of the spectrum analyser was used to determine whether the transient frequency behavior was within the required limits as shown in the plots below.

2.6.5 Environmental Conditions

Ambient Temperature	21.8°C
Relative Humidity	29.2 %

2.6.6 Test Results

MCT System – Transmit

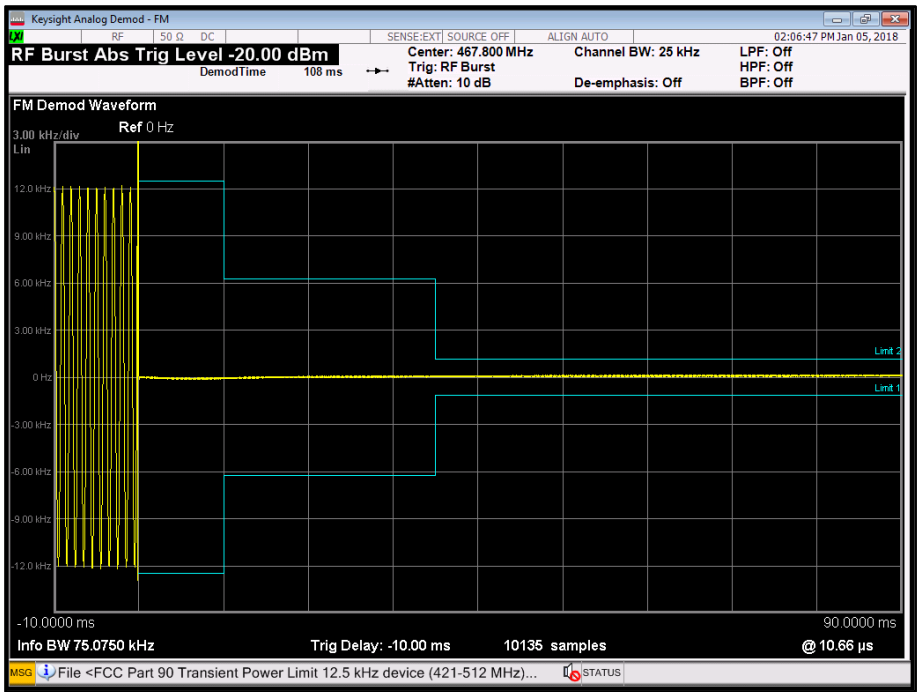

Figure 23 - 467.925 MHz - Switch On Transients

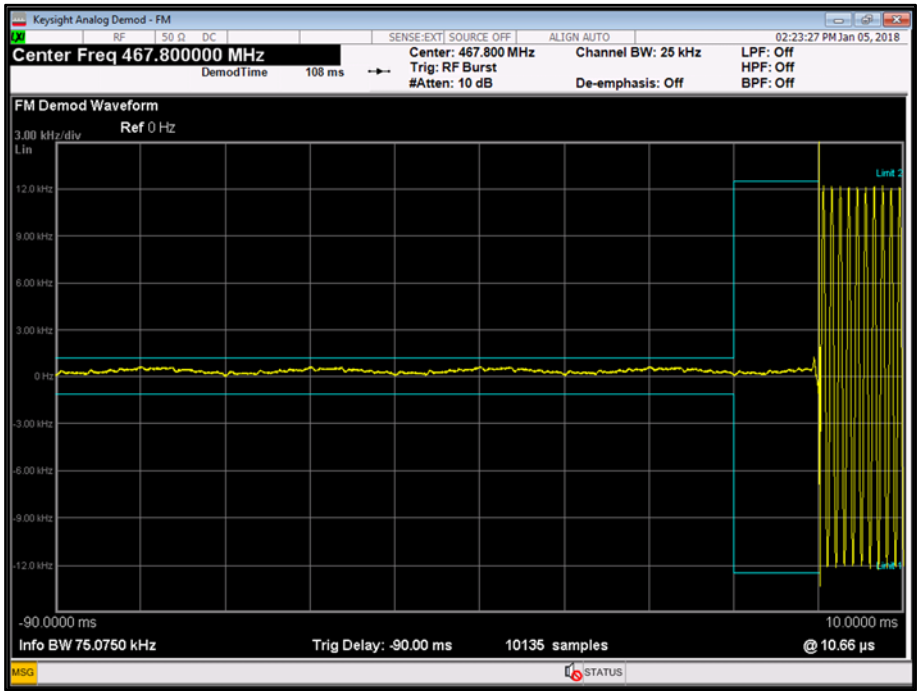

Figure 24 - 467.8 MHz - Switch Off Transients

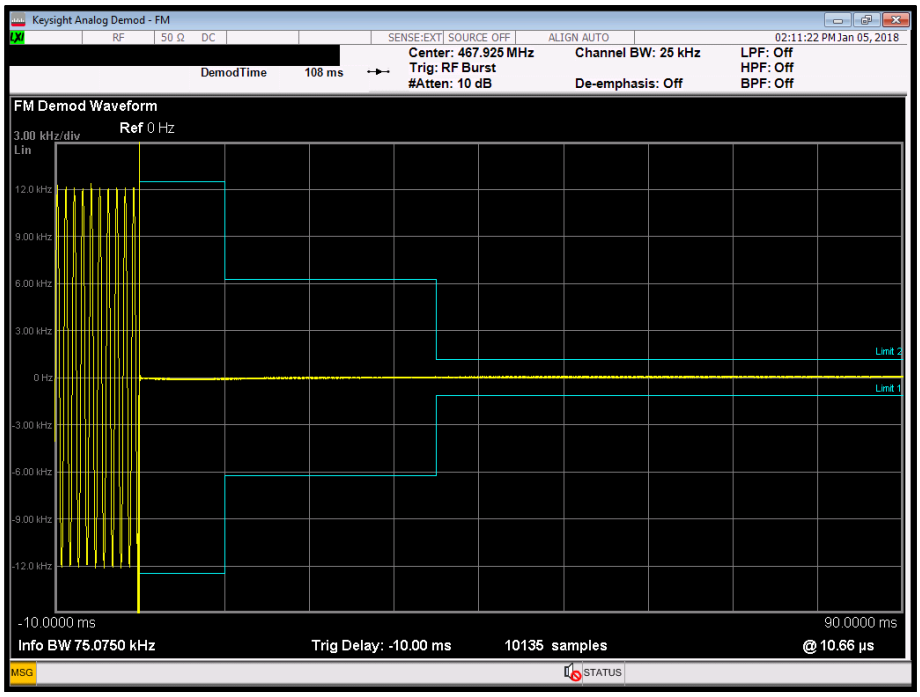

Figure 25 - 467.925 MHz - Switch On Transients

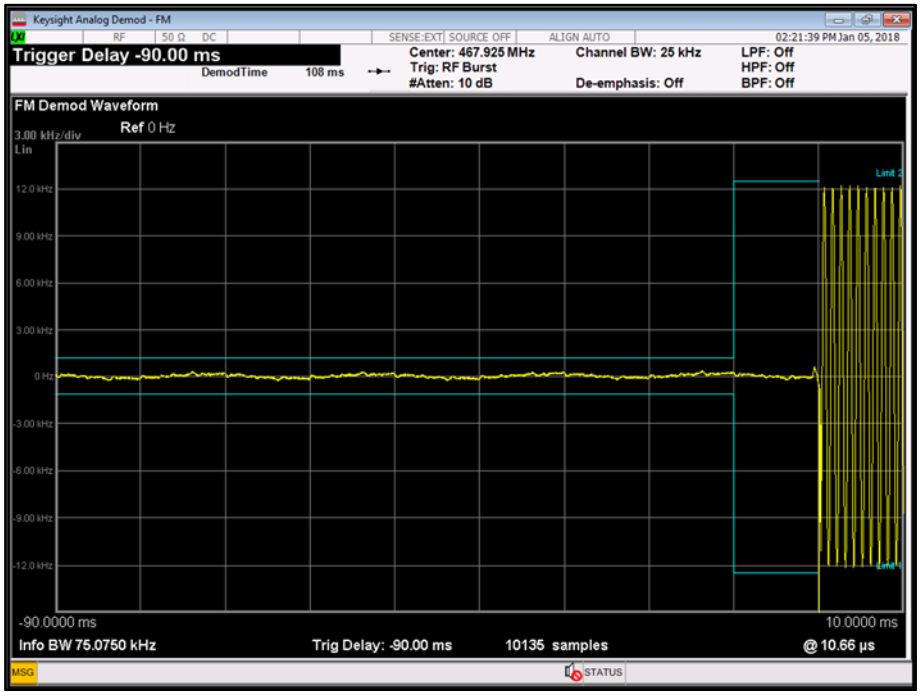

Figure 26 - 467.925 MHz – Switch Off Transients

FCC 47 CFR Part 90, Limit Clause 90.214

Time Interval	Maximum Frequency Difference	150 to 174 MHz	421 to 512 MHz
Transient Frequency Behaviour for Equipment Designed to Operate on 25 kHz Channels			
T_1	± 25.0 kHz	5.0 ms	10.0 ms
T_2	± 12.5 kHz	20.0 ms	25.0 ms
T_3	± 25.0 kHz	5.0 ms	10.0 ms
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz Channels			
T_1	± 12.5 kHz	5.0 ms	10.0 ms
T_2	± 6.25 kHz	20.0 ms	25.0 ms
T_3	± 12.5 kHz	5.0 ms	10.0 ms
Transient Frequency Behaviour for Equipment Designed to Operate on 6.25 kHz Channels			
T_1	± 6.25 kHz	5.0 ms	10.0 ms
T_2	± 3.125 kHz	20.0 ms	25.0 ms
T_3	± 6.25 kHz	5.0 ms	10.0 ms

Table 16 - FCC Limits for Transient Frequency Behaviour

2.6.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Multimeter	Fluke	79 Series III	498	12	9-Aug-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	12-Mar-2018
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	12	11-Jul-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Combiner/Splitter	Weinschel	1506A	3877	12	5-Apr-2018
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	12-Mar-2018
2 metre SMA Cable	Florida Labs	SMS-235SP-78.8-SMS	4517	12	19-Sep-2018
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	12-Jan-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon
Vector Signal Generator	Rohde & Schwarz	SMBV100A	4886	12	11-May-2018

Table 17

O/P Mon – Output Monitored using calibrated equipment

2.7 Frequency Stability

2.7.1 Specification Reference

FCC 47 CFR Part 90, Clause 90.210
FCC 47 CFR Part 2, Clause 2.1055

2.7.2 Equipment Under Test and Modification State

Tri-corr Touch Pro, S/N: Not Serialised (75940615-TSR0001) - Modification State 0
Tri-corr Touch Pro, S/N: Not Serialised (75940615-TSR0002) - Modification State 0

2.7.3 Date of Test

21-November-2017

2.7.4 Test Method

This test was performed in accordance with ANSI C63.26, clause 5.6. A frequency counter was used to measure the unmodulated carrier frequency.

2.7.5 Environmental Conditions

Ambient Temperature	24.2 °C
Relative Humidity	45.5 %

2.7.6 Test Results

MCT System - Transmit

Voltage	Frequency Error (ppm)	
	467.800 MHz	467.925 MHz
4.0 V DC	0.391	-0.016
7.56 V DC	-0.301	-0.016

Table 18 - Frequency Stability Under Voltage Variations

Temperature	Frequency Error (ppm)	
	467.800 MHz	467.925 MHz
50 °C	-0.010	-0.014
40 °C	-0.074	-0.018
30 °C	-0.097	-0.016
20 °C	-0.010	0.537
10 °C	-0.100	-0.051
0 °C	-0.024	0.318
-10 °C	0.391	0.579
-20 °C	-0.084	0.559
-30 °C	0.391	0.328

Table 19 - Frequency Stability Under Temperature Variations

FCC 47 CFR Part 90, Limit Clause 90.213

2.50 ppm

2.7.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Counter	Hewlett Packard	53181A	159	12	26-May-2018
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Power Supply Unit	Hewlett Packard	6253A	441	-	O/P Mon
Multimeter	Iso-tech	IDM-101	466	12	02-Oct-2018
Audio Analyser	Hewlett Packard	8903B	576	12	03-Jan-2018
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3159	12	21-Jun-2018
Attenuator (10dB, 50W)	Aeroflex / Weinschel	47-10-34	3166	12	20-Oct-2018
Thermocouple Thermometer	Fluke	51	3174	12	22-Dec-2017
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	19-Sep-2018
2 metre N-Type Cable	Florida Labs	NMS-235SP-78.8-NMS	4508	12	02-Mar-2018

Table 20

O/P Mon – Output Monitored using calibrated equipment

3 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Maximum Conducted Output Power	± 3.2 dB
Types of Emissions	-
Bandwidth Limitations	± 58.05 Hz
Spurious Emissions at Antenna Terminals	± 3.45 dB
Radiated Spurious Emissions	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 18 GHz: ± 6.3 dB
Transient Frequency Behaviour	± 0.2 Hz
Frequency Stability	± 11 Hz

Table 21