

Report on the FCC and IC Testing of:

DETNET SOUTH AFRICA (PTY) LTD
Handheld Electronic Detonator Tester,
Model: CE4 Tagger

In accordance with FCC 47 CFR Part 15 (Simultaneous Transmission)

Prepared for: DETNET SOUTH AFRICA (PTY) LTD
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Product Service

Choose certainty.
Add value.

FCC ID: 2ARNH-16541610 IC: 24476-16541610

COMMERCIAL-IN-CONFIDENCE

Document Number: 75943624-02 | Issue: 02

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Simon Bennett	Chief Engineer	Authorised Signatory	05 February 2019

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 15. The sample tested was found to comply with the requirements defined in the applied rules.

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Graeme Lawler	Senior Engineer	Testing	05 February 2019

FCC Accreditation Industry Canada Accreditation
90987 Octagon House, Fareham Test Laboratory IC2932B-1 Octagon House, Fareham Test Laboratory

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with FCC 47 CFR Parts 15: 2017.



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Contents

1	Report Summary	2
1.1	Report Modification Record.....	2
1.2	Introduction.....	2
1.3	Brief Summary of Results	3
1.4	Application Form	4
1.5	Product Information	6
1.6	Deviations from the Standard.....	6
1.7	EUT Modification Record	6
1.8	Test Location	6
2	Test Details	7
2.1	Radiated Spurious Emissions (Simultaneous Transmission)	7
3	Measurement Uncertainty	19



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	21 November 2018
2	To amend the FCC and IC ID's	05 February 2019

Table 1

1.2 Introduction

Applicant	DETNET SOUTH AFRICA (PTY) LTD
Manufacturer	DETNET SOUTH AFRICA (PTY) LTD
Model Number(s)	CE4 Tagger
Serial Number(s)	Not Serialised (75943624- TSR0005)
Hardware Version(s)	V4
Software Version(s)	36230B
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Parts 15
Order Number	4500348610
Date	23-August-2018
Date of Receipt of EUT	07-September-2018
Start of Test	19-September-2018
Finish of Test	19-September-2018
Name of Engineer(s)	Graeme Lawler
Related Document(s)	ANSI C63.10: 2013



Product Service

1.3 Brief Summary of Results

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

Section	Specification Clause	Test Description	Result	Comments/Base Standard
Configuration and Mode: CoTX (13.56MHz + 2.4GHz WLAN)				
2.1	15.247 (d), 15.225 and 15.209	Radiated Spurious Emissions (Simultaneous Transmission)	Pass	

Table 2



1.4 Application Form

EQUIPMENT DESCRIPTION	
Model Name/Number	CE4 Tagger
Part Number	
Hardware Version	V4
Software Version	36230B
FCC ID (if applicable)	2ARNH-16541610
Industry Canada ID (if applicable)	24476-16541610
Technical Description (Please provide a brief description of the intended use of the equipment)	Hand held electronic tester for use us with electronic detonators in the mining and blasting industry.

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
WiFi	2400	18		2.412 – 2.457GHz			2412	2437	2457
NFC	13.56	6		13.56				13.56	

UN-INTENTIONAL RADIATOR	
Highest frequency generated or used in the device or on which the device operates or tunes	3 177.2 MHz
Lowest frequency generated or used in the device or on which the device operates or tunes	32.768 kHz
Class A Digital Device (Use in commercial, industrial or business environment) <input checked="" type="checkbox"/>	
Class B Digital Device (Use in residential environment only) <input type="checkbox"/>	

Power Source			
AC	Single Phase	Three Phase	Nominal Voltage
External DC	Nominal Voltage		Maximum Current
Battery	Nominal Voltage		Battery Operating End Point Voltage
	3.7		3.3
Can EUT transmit whilst being charged?			Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>



EXTREME CONDITIONS					
Maximum temperature	+60	°C	Minimum temperature	-30	°C

Ancillaries
Please list all ancillaries which will be used with the device.

ANTENNA CHARACTERISTICS					
<input checked="" type="checkbox"/>	Antenna connector		State impedance	50	Ohm
<input type="checkbox"/>	Temporary antenna connector		State impedance		Ohm
<input checked="" type="checkbox"/>	Integral antenna	Type	PCB Trace Antenna		
<input type="checkbox"/>	External antenna	Type			

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

Name: H van der Walt

Position held: Quality and Compliance Manager

Date: 2018-09-12



1.5 Product Information

1.5.1 Technical Description

Tagger - Hand held electronic tester for use us with electronic detonators in the mining and blasting industry.

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
CE4 Tagger, Serial Number: Not Serialised (75943624- TSR0005)			
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: CoTX (13.56MHz + 2.4GHz WLAN)		
Radiated Spurious Emissions (Simultaneous Transmission)	Graeme Lawler	UKAS

Table 4

Office Address:

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



2 Test Details

2.1 Radiated Spurious Emissions (Simultaneous Transmission)

2.1.1 Specification Reference

FCC 47 CFR Parts 15, Clause 15.247 (d), 15.225 (d) and 15.209

2.1.2 Equipment Under Test and Modification State

CE4 Tagger, S/N: Not Serialised (75943624- TSR0005) - Modification State 0

2.1.3 Date of Test

19-September-2018

2.1.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 6.3, 6.5 and 6.6. For frequencies > 1 GHz, plots for average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.3 to characterize the EUT. Where emissions were detected, final average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.2.

If emissions were found to be pulsed, final average measurements were taken in accordance with ANSI C63.10 clause 7.5. A peak measurement is performed. A duty cycle correction factor is then determined by the expression $\text{duty (dB)} = 20 \log (\text{On Time} / (\text{On Time} + \text{Off Time}))$. This factor is then subtracted from the peak value to determine the final average value.

The plots shown are the characterization of the EUT. The limits on the plots represent the most stringent case for restricted bands, (74/54 dBuV/m) when compared to 20 dBc outside restricted bands. The limits shown have been used as a threshold to determine where further measurements are necessary. Where results are within 10 dB of the limits shown on the plots, further investigation was carried out and reported in results tables.

For frequencies > 18 GHz, the measurement distance was reduced to 1 meter and the limit line was increased by $20 * \text{LOG}(3/1) = 9.54 \text{ dB}$.

The following conversion can be applied to convert from dB μ V/m to μ V/m:
 $10^{(\text{Field Strength in dB}\mu\text{V/m}/20)}$.

2.1.5 Environmental Conditions

Ambient Temperature	21.0 °C
Relative Humidity	52.0 %



2.1.6 Test Results

CoTX (13.56MHz + 2.4GHz WLAN)

The EUT was configured for simultaneous transmission in the following mode of operation:

Technology	Frequency Band (MHz)	Channel Frequency (MHz)
802.11b	2400 MHz to 2483.5 MHz	2437 MHz
RFID	13.11 to 14.01 MHz	13.56 MHz

Table 5 - Modes of Operation

Frequency (MHz)	QP Level (dBuV/m)	QP Limit (dBuV/m)	QP Margin (dBuV/m)	Angle(Deg)	Height(m)	Polarity
267.036	36.0	46.0	-10.0	357	1.00	Horizontal
274.480	38.5	46.0	-7.5	196	1.00	Horizontal
276.945	39.7	46.0	-6.3	196	1.00	Horizontal
281.848	38.2	46.0	-7.8	231	1.00	Horizontal
284.344	40.3	46.0	-5.7	24	1.00	Horizontal
324.003	38.5	46.0	-7.5	169	1.00	Horizontal

Table 6 - 30 MHz to 1 GHz - X Orientation Emissions Results

No other emissions were detected within 6 dB of the limit.

Frequency (MHz)	QP Level (dBuV/m)	QP Limit (dBuV/m)	QP Margin (dBuV/m)	Angle(Deg)	Height(m)	Polarity
279.415	36.0	46.0	-10.0	52	1.89	Vertical
281.812	35.8	46.0	-10.2	113	1.85	Vertical
324.009	36.9	46.0	-9.1	24	1.46	Vertical
520.333	37.5	46.0	-8.5	293	1.00	Vertical

Table 7 - 30 MHz to 1 GHz - Y Orientation Emissions Results

No other emissions were detected within 6 dB of the limit.

Frequency (MHz)	QP Level (dBuV/m)	QP Limit (dBuV/m)	QP Margin (dBuV/m)	Angle(Deg)	Height(m)	Polarity
271.852	36.3	46.0	-9.7	237	1.00	Horizontal
274.369	39.2	46.0	-6.8	211	1.00	Horizontal
276.812	40.2	46.0	-5.8	203	1.00	Horizontal
281.786	41.5	46.0	-4.5	13	1.00	Horizontal
284.220	41.0	46.0	-5.0	6	1.00	Horizontal
324.016	37.0	46.0	-9.0	10	1.20	Horizontal

Table 8 - 30 MHz to 1 GHz - Z Orientation Emissions Results

No other emissions were detected within 6 dB of the limit.

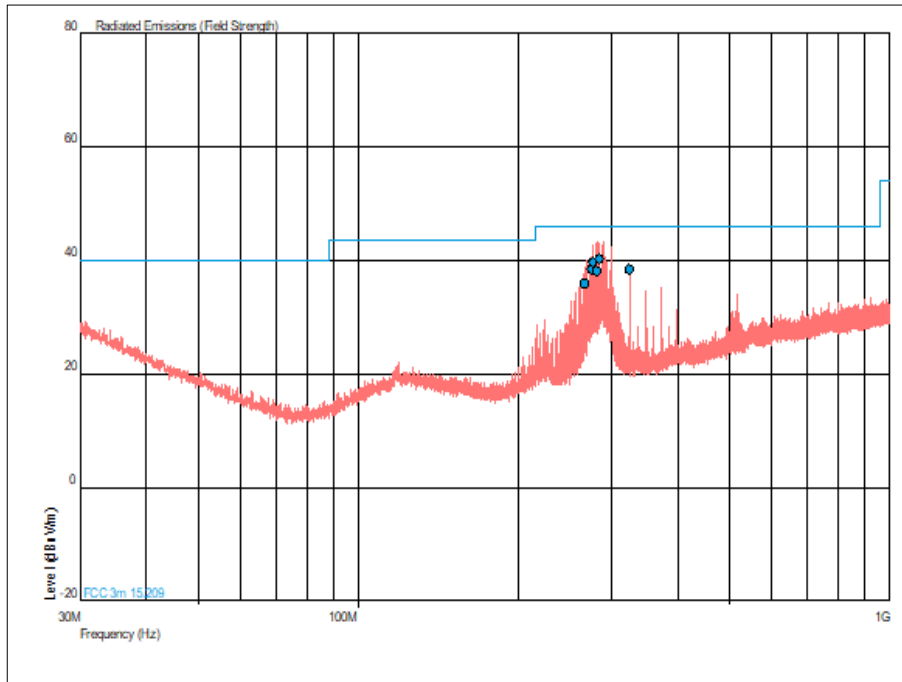


Figure 1 - 30 MHz to 1 GHz - X Orientation - Horizontal and Vertical

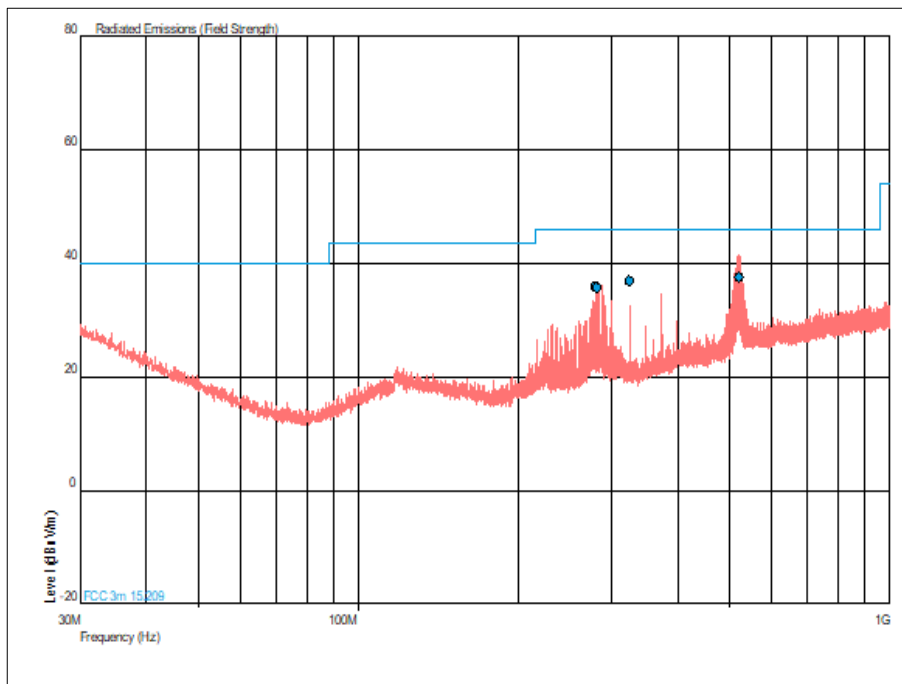


Figure 2 - 30 MHz to 1 GHz - Y Orientation - Horizontal and Vertical

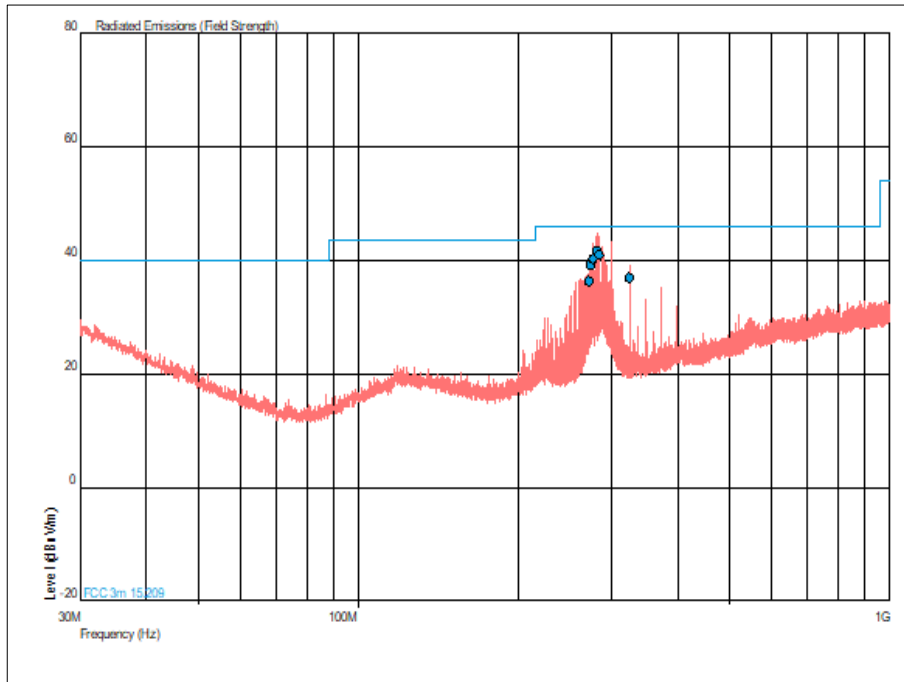


Figure 3 - 30 MHz to 1 GHz - Z Orientation - Horizontal and Vertical



Frequency (GHz)	Result ($\mu\text{V}/\text{m}$)		Limit ($\mu\text{V}/\text{m}$)		Margin ($\mu\text{V}/\text{m}$)	
	Peak	Average	Peak	Average	Peak	Average
*						

Table 9 - 1 GHz to 25 GHz Emissions Results

*No emissions were detected within 6 dB of the limit.

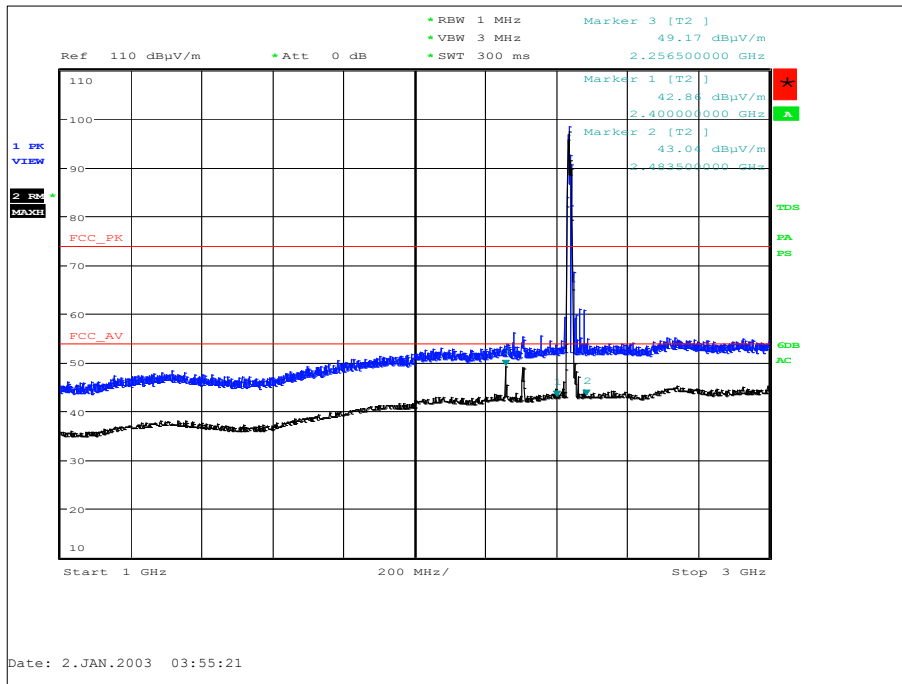


Figure 4 - 1 GHz to 3 GHz - X Orientation - Horizontal and Vertical

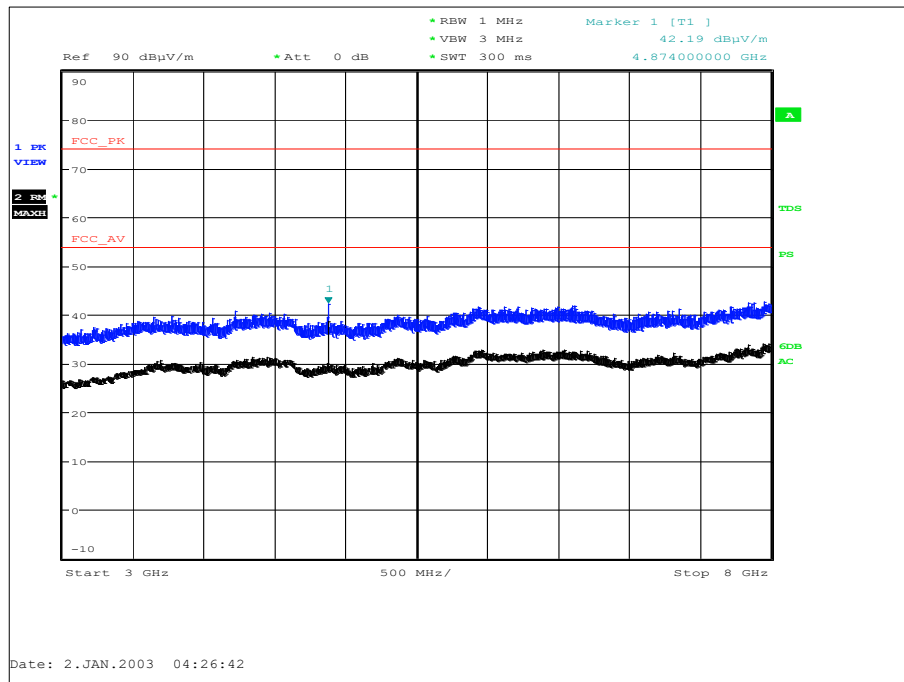


Figure 5 - 3 GHz to 8 GHz - X Orientation - Horizontal and Vertical

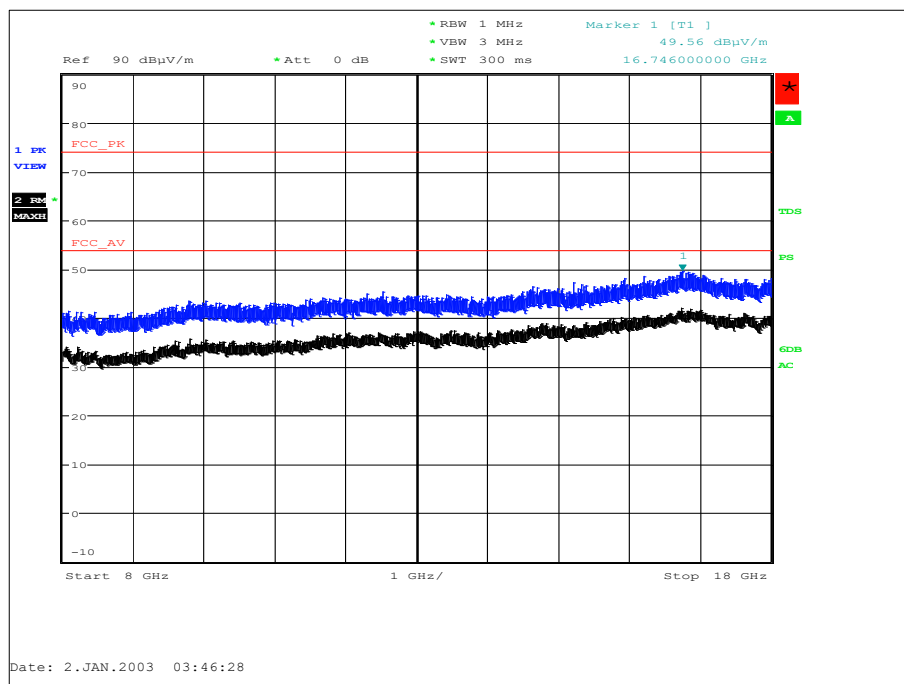


Figure 6 - 8 GHz to 18 GHz - X Orientation - Horizontal and Vertical

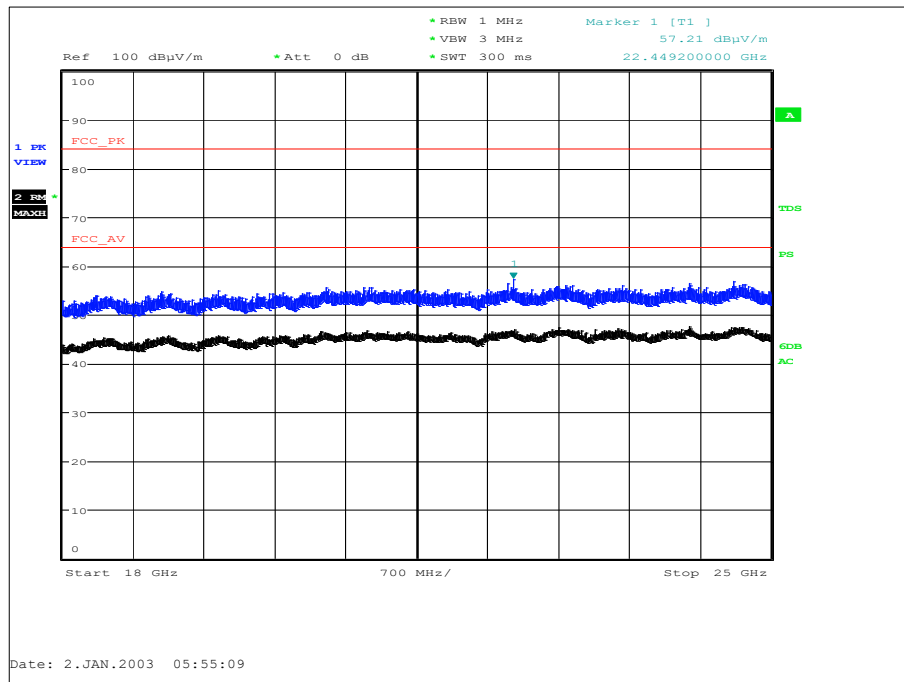


Figure 7 - 18 GHz to 25 GHz - X Orientation - Horizontal and Vertical

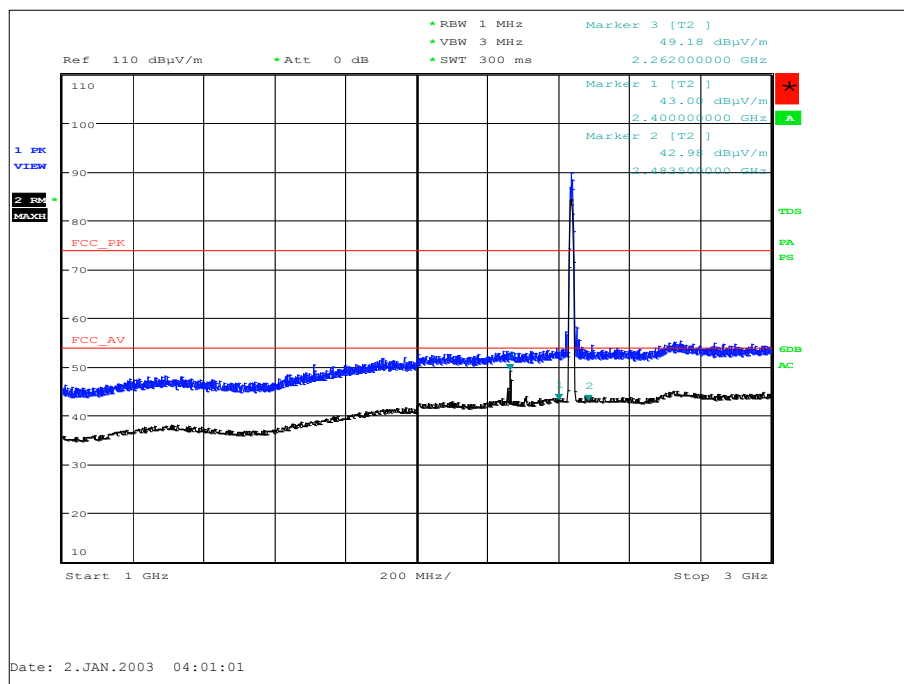


Figure 8 - 1 GHz to 3 GHz - Y Orientation - Horizontal and Vertical

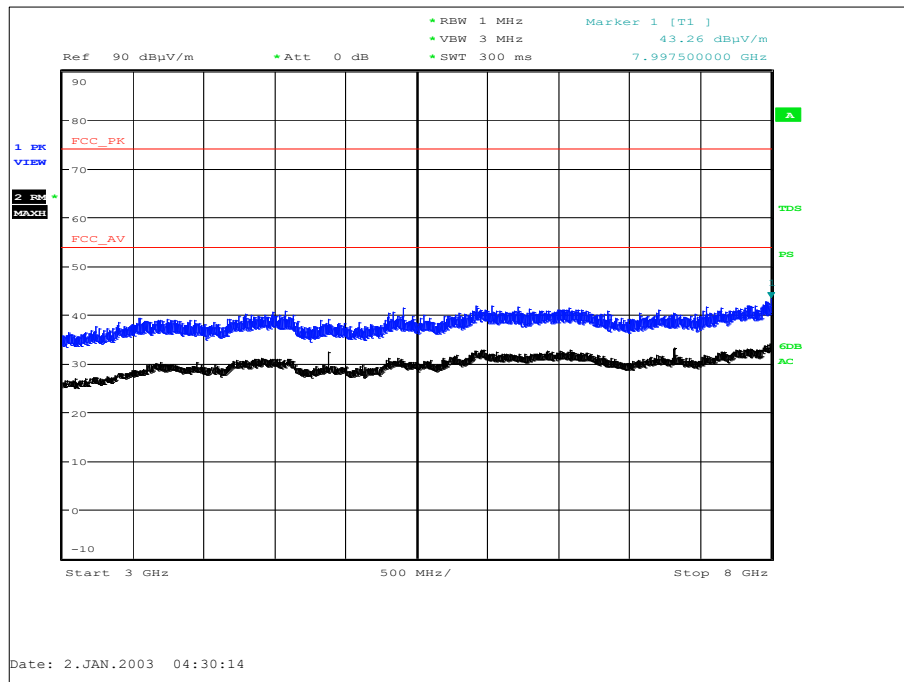


Figure 9 - 3 GHz to 8 GHz - Y Orientation - Horizontal and Vertical

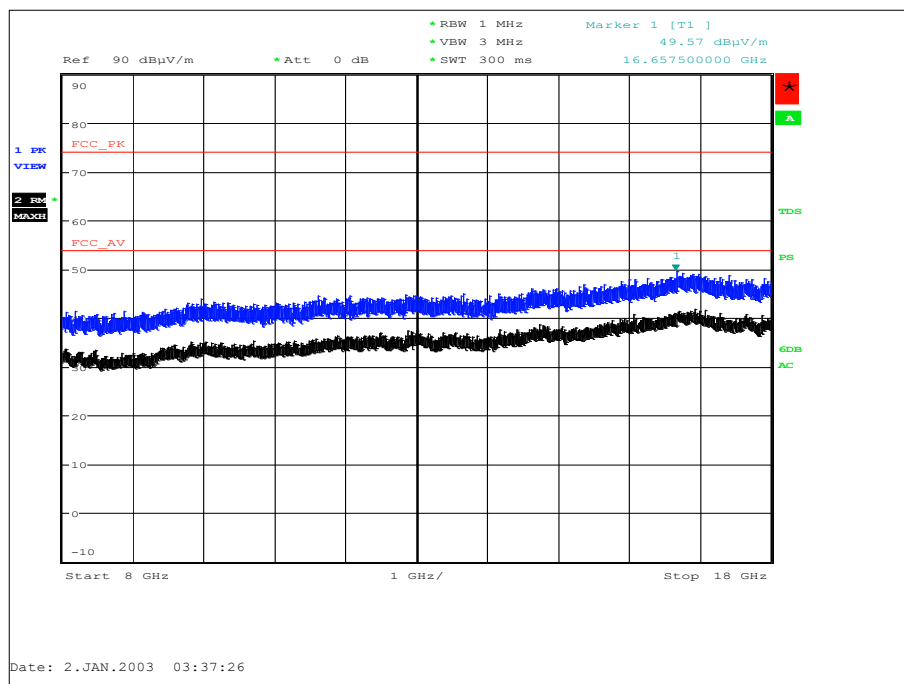


Figure 10 - 8 GHz to 18 GHz - Y Orientation - Horizontal and Vertical

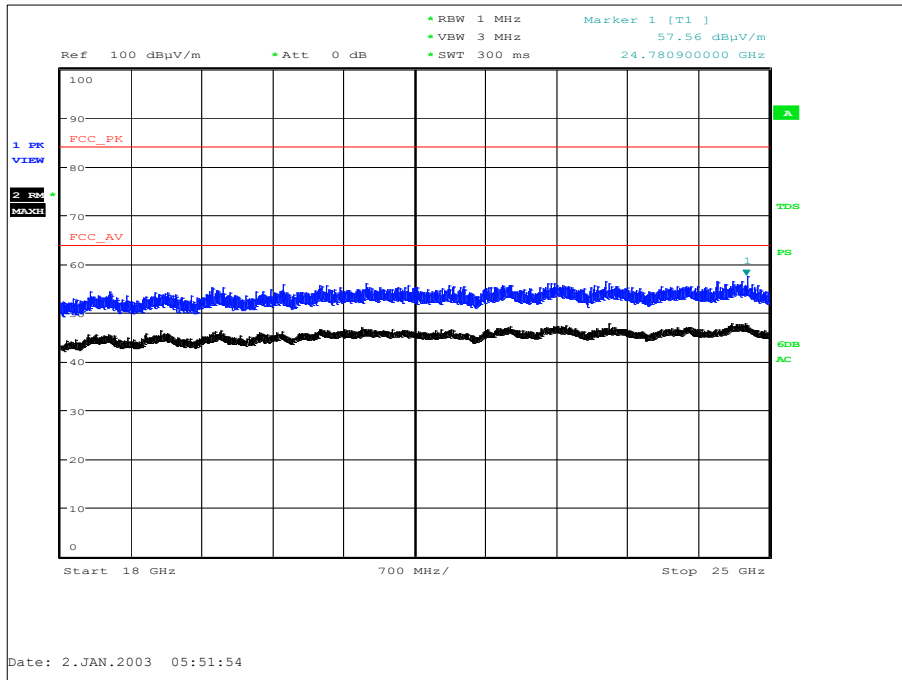


Figure 11 - 18 GHz to 25 GHz - Y Orientation - Horizontal and Vertical

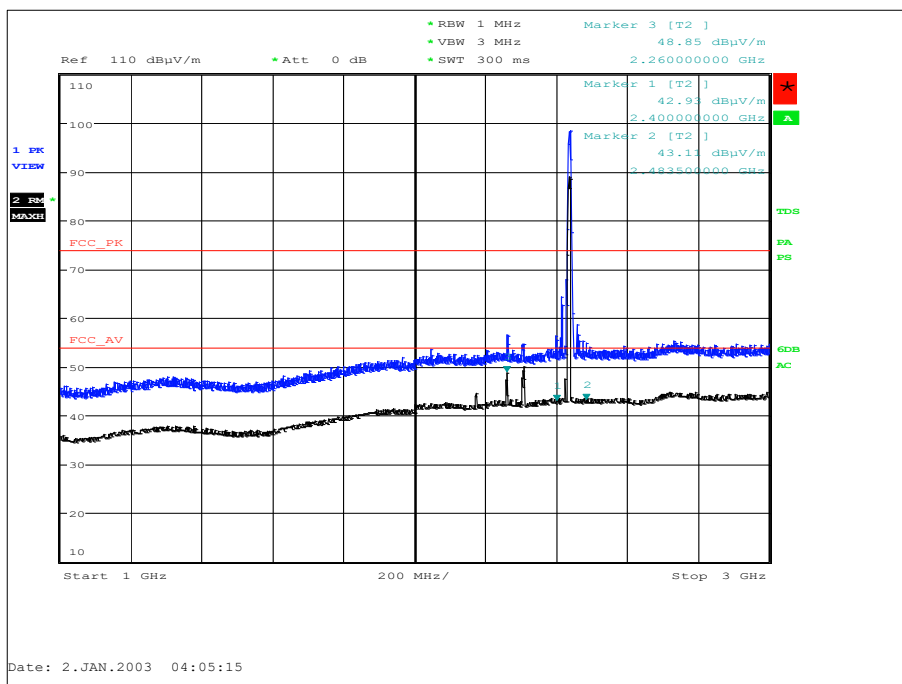


Figure 12 - 1 GHz to 3 GHz - Z Orientation - Horizontal and Vertical

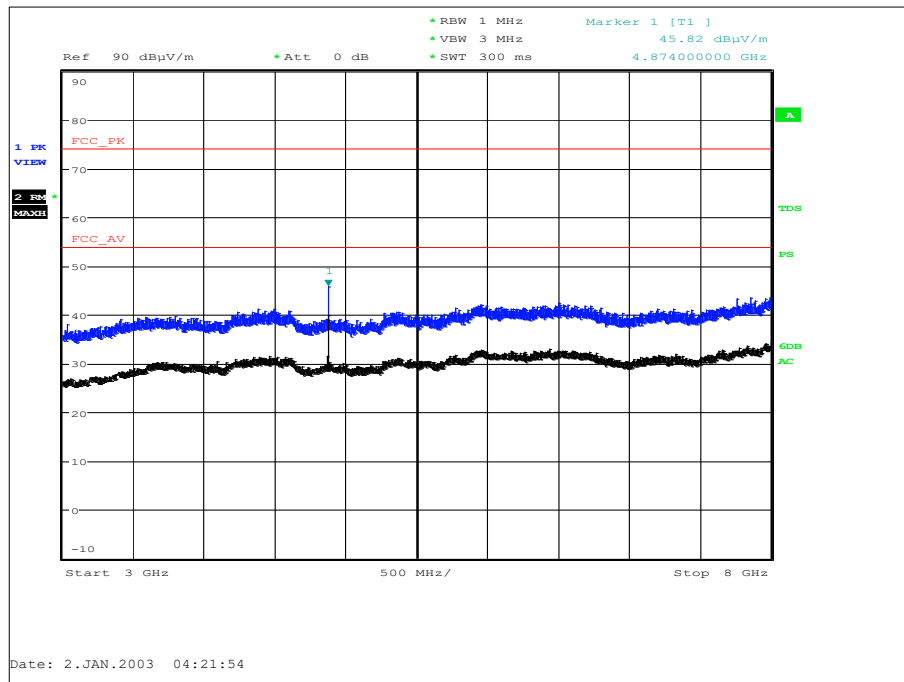


Figure 13 - 3 GHz to 8 GHz - Z Orientation - Horizontal and Vertical

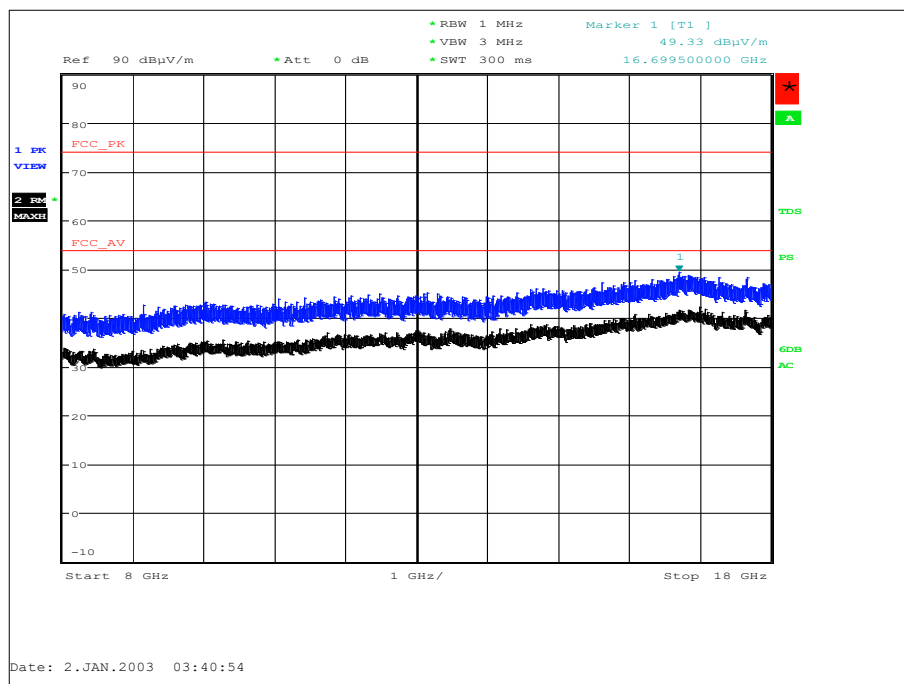


Figure 14 - 8 GHz to 18 GHz - Z Orientation - Horizontal and Vertical

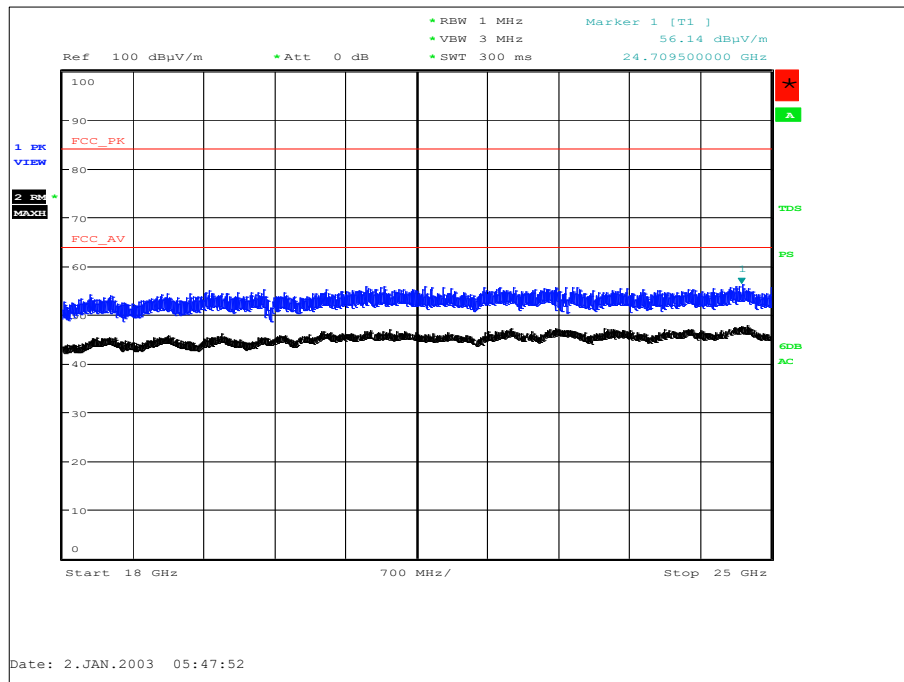


Figure 15 - 18 GHz to 25 GHz - Z Orientation - Horizontal and Vertical

FCC 47 CFR Parts 15.247 (d), 15.225 (d) and 15.209

The least stringent limit from the applicable rule parts was used to determine compliance for Radiated Emissions testing of multiple transmission sources.

The least stringent applicable limit was:

Rule Part	Limit
Part 15.247 (d)	-20 dBc
Part 15.209 (Applies within restricted bands of operation listed in 15.205).	30-88 MHz: 40 dBμV/m at 3m 88-216 MHz: 43.5 dBμV/m at 3m 216-916 MHz: 46 dBμV/m at 3m Above 960 MHz: Peak: 74 dBμV/m at 3m, Average 54 dBμV/m at 3m

Table 10 - Limit Table



2.1.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 7.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Hewlett Packard	ESG4000A	38	12	05-Jun-2019
Antenna 18-40GHz (Double Ridge Guide)	Link Microtek Ltd	AM180HA-K-TU2	230	24	02-May-2020
Turntable Controller	Heinrich Diesel	HD 050	280	-	TU
Antenna with permanent attenuator (Bilog)	Schaffner	CBL6143	287	24	15-May-2020
Filter (Tuneable Bandreject)	K&L Microwave	5TNF-500/1000-N/N	439	-	O/P Mon
Pre-Amplifier	Phase One	PS04-0086	1533	12	12-Jan-2019
18GHz - 40GHz Pre-Amplifier	Phase One	PSO4-0087	1534	12	02-Feb-2019
Screened Room (7)	Siemens	S M	1547	36	21-Jan-2021
Low Pass Filter	Mini-Circuits	NLP-300	1636	12	25-Oct-2018
Hygromer	Rotronic	A1	2138	12	21-Feb-2019
Comb Generator	Schaffner	RSG1000	3034	-	TU
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
1GHz to 8GHz Low Noise Amplifier	Wright Technologies	APS04-0085	4365	12	18-Oct-2018
Suspended Substrate Highpass Filter	Advance Power Components	11SH10-3000/X18000-O/O	4412	12	15-Jun-2019
1 metre K-Type Cable	Florida Labs	KMS-180SP-39.4-KMS	4520	12	13-Feb-2019
Double Ridged Waveguide Horn Antenna	ETS-Lindgren	3117	4722	12	01-Mar-2019
N to N cable, 4m	Rhophase	2303-002-TUVS	4849	12	18-Dec-2018
N to N cable, 4m	Rhophase	2303-002-TUVS	4850	12	18-Dec-2018
Cable (26.5GHz)	Rosenberger	LU7-133-5000	5019	-	O/P Mon
Cable (18GHz)	Rosenberger	LU7-036-1000	5030	-	O/P Mon

Table 11

TU - Traceability Unscheduled
 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
Radiated Spurious Emissions (Simultaneous Transmission)	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB

Table 12