E8396
Abicom International Limited
Vibtech CAN II
March 2008
FCC CFR 47 Part 15 Subparts B & C

1 Test Information

The results contained within this Test Report only apply to this specific Equipment Under Test.

Test	Emissions
Standards	CFR 47: 2007 PART 15 SUBPART B: Class B CFR 47: 2007 PART 15 SUBPART C Section 15.247

Equipment Under Test (EUT)

Description	802.11b Central Access Node
Manufacturer	Vibration Technology Limited
Model Name	Vibtech CAN II
Serial Number	Production Sample

EUT comprising of:

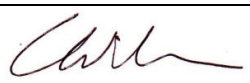
Description	Motherboard
Manufacturer	Vibration Technology Limited
Model Name	VIB-700-0007A0603
Part Reference	VIBTECH CAN II PCB
Serial Number	4371

Description	Transceiver
Manufacturer	Vibration Technology Limited
Model Name	Freecom CPE
Part Number	AP48-ABICOM-03-REV04
Serial Number	4371

Description	Transceiver
Manufacturer	Vibration Technology Limited
Model Name	Freecom CPE
Part Number	AP48-ABICOM-03-REV04
Serial Number	4381

Description	Transceiver
Manufacturer	Vibration Technology Limited
Model Name	Freecom CPE
Part Number	AP48-ABICOM-03-REV04
Serial Number	4344

Manufacturer	Vibration Technology Limited 5 Central Boulevard Central Park Larbert Stirlingshire FK5 4RU United Kingdom
Representative	Dave Edwards
Purchase Order	1658
Test Started	29th October 2007
Test Finished	15th February 2008

Test Engineer	Carl Wilson		02/04/08
Technical Manager	Mark Richens		02/04/08
Technical Director	Keith Richens		02/04/08

2 Equipment Under Test

2.1 General

The Vibtech CAN II Central Access Node contains 3 radio transceivers. Each transceiver is connected to individual antenna's from the associated MAXRAD All Terrain Sectorised Omnidirectional Antenna.

The radio technology employed by the Vibtech CAN II is Digital Sequence Spread Spectrum. For the purposes of this report testing has been performed only in the 802.11b mode of operation, which operates in the frequency band of 2412 MHz - 2462 MHz.

The Vibtech CAN II Central Access Node does not employ frequency hopping and is used for point to multipoint communications.

The EUT would typically be configured to transmit/receive data with lower channels on one transceiver, middle channels on the second transceiver and high channels on the third transceiver incorporated in the unit.

However, for the purposes of testing, each transceiver has been tested individually with low channel, middle channel and high channel operation. It must be noted that throughout testing the RF level selected by the software was set to 17 dB. This was to ensure that the conducted output power requirements were met, therefore this value **cannot** be more than 17 dB.

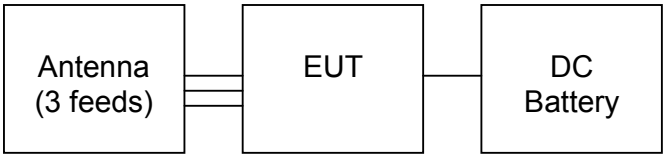
The EUT is classed as an intentional radiator incorporating a digital device.

The EUT has 11 channels for data transmission. According to Part 15 Section 15.31(m), the channels 1, 6 and 11 of each transceiver were chosen for evaluation.

Operating Mode	Operating Channel	Operating Frequency (MHz)
802.11b	**1**	**2412**
	2	2417
	3	2422
	4	2427
	5	2432
	6	**2437**
	7	2442
	8	2447
	9	2452
	10	2457
	11	**2462**

Photographs of the Equipment Under Test (EUT) can be found in Appendix 1.

Throughout testing the EUT was configured as shown in the diagram below.



2.2 Peripheral Equipment

Description	2.4GHz ISM All Terrain Sectorized Omnidirectional Antenna
Manufacturer	MAXRAD
Model Name	XtremeWaveTM
Model Number	MSO24014PTNF
Serial Number	-
Antenna Gain	+14 dBi
Description	12V DC Battery (fitted in housing incorporating connector which fits to the EUT)
Description	Laptop inc. 2.4/5 GHz Tri-Mode Dualband Wireless Cardbus Adapter*
Manufacturer	Toshiba (Laptop) & D-Link (Wireless Adapter)
Model Name	Satellite & AirXpert
Model Number	S1700-400 & DWL-AG650
Serial Number	71850302G & BN3Y134000597

The laptop was used for setting up the power level & frequency of the CAN II unit only and was not used in the testing.

2.3 Cables

3 x 7 m Times Microwave Systems ultraflex coaxial cables (N-Type connectors).

2.4 EMC Modifications

Wurth ferrite (part number 742-711 42) fitted internally to fan cable at an equal distance of 130 mm. This ferrite was fitted to meet the requirements of Radiated emissions below 1 GHz.

2.5 Antenna Requirement

Section 15.203 of CFR 47 states:

'An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section'.

The above requirement does not apply to intentional radiators that must be professionally installed, which in accordance with 15.31(d) have been measured on a properly calibrated test site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

3 Test Result Summary

The EUT and it's associated devices have been tested in accordance with CFR 47 Part 15, Subpart B and Subpart C Section 15.247.

PARAGRAPH	TEST REQUIREMENTS	COMPLIANCE (Yes/No)
15.247(a)(2)	6 dB Bandwidth Requirement	Yes
15.247(b)	Maximum Peak Output Power	Yes
15.247(b)(5)	Maximum Permissible Exposure	Yes
15.247(d)	Conducted Spurious Emissions	Yes
15.247(d)	Restricted Band Radiated Emissions	Yes
15.247(e)	Power Spectral Density	Yes
-	Occupied Bandwidth Measurements	Note 1
15.109	Radiated Emissions Unintentional Radiators	Yes

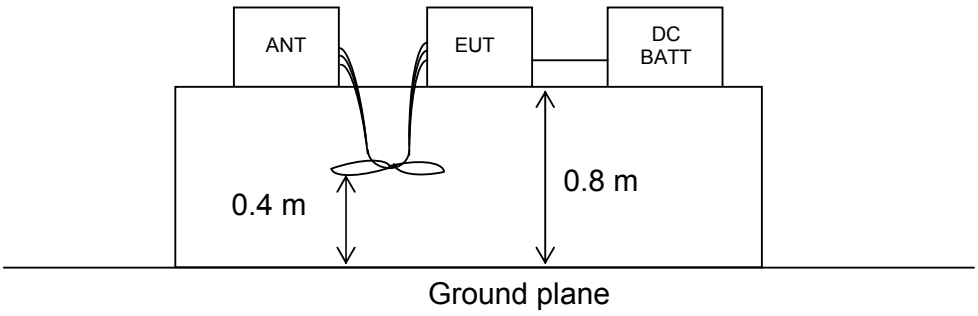
Note 1: Measurements performed at customer's request.

4 Test Set-Up

4.1 Radiated Emissions 30 MHz - 1000 MHz

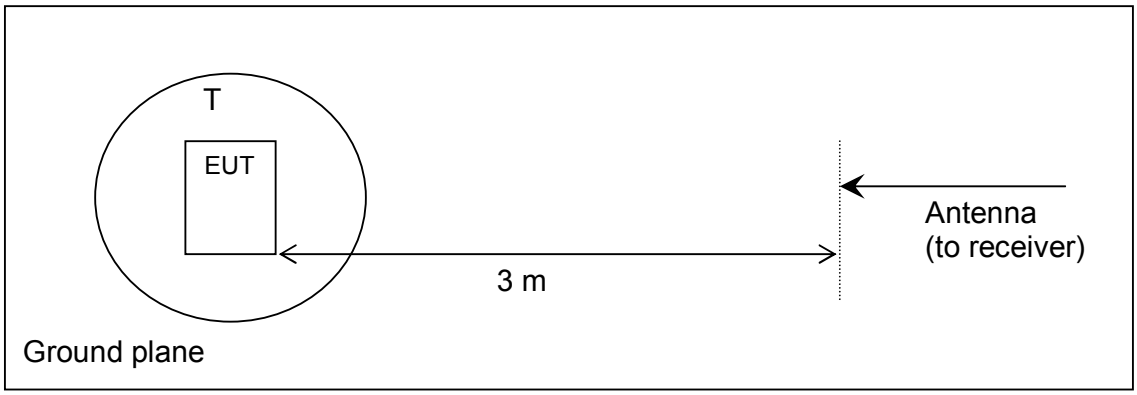
4.1.1 Physical Set-Up

The EUT was set up in accordance with ANSI C63.4: 2003 and as shown in the diagram below.



ANT 2.4GHz ISM Antenna
DC BATT Housed 12V DC Battery
EUT Equipment under test

The EUT and peripheral equipment were placed on a non-conducting table, 0.8 m above a ground plane. Excess cables were bundled and kept at a distance of 0.4 m from the ground plane. The measuring antenna was positioned at a distance of 3 m. Each piece of equipment was placed 0.1 m apart. The rear of the EUT was positioned flush with the edge of the non-conducting table.



T Turntable
EUT Equipment under test

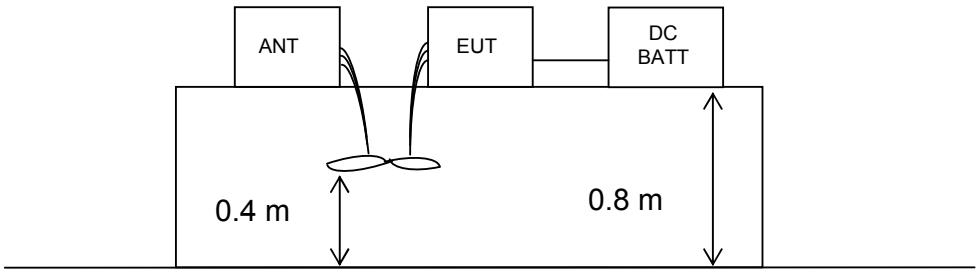
4.1.2 Equipment Used

Description	Make and Model	Serial Number	Calibration Date	Calibration Period
Receiver	R&S ESVS10	845165/023	01/10/07	Annually
Pre-amp	Minicircuits 15542	ND091698	03/01/08	Annually
Antenna	AH Systems SAS-200/544	161	13/02/04	4 Years
Antenna	AH Systems SAS-200/510	709	13/02/04	4 Years
Cable	Cranage	478	18/01/08	Bi-annually
Cable	Cranage	891	18/01/08	Bi-annually
Cable	Cranage	892	18/01/08	Bi-annually

4.2 Radiated Emissions 1 GHz - 26.5 GHz

4.2.1 Physical Set-Up

The EUT was set up within a semi-anechoic chamber as shown in the diagram below.



The EUT and peripheral equipment were placed on a non-conducting table, 0.8 m above a ground plane. Excess cables were bundled and kept at a distance of 0.4 m from the ground plane. Each piece of equipment was positioned 0.1 m apart, with the rear of the equipment positioned flush with the edge of the non-conducting table. To identify frequencies of interest the measuring antenna was moved over the surfaces of the EUT and peripheral equipment.

4.2.2 Equipment Used

Description	Make and Model	Serial Number	Calibration Date	Calibration Period
Spectrum Analyser	R&S FSEM30	830151/012	17/01/2007	Annually
Antenna	EMCO	2103	24/09/07	Annually
Antenna	EMCO	9605-4793	11/10/06	Annually
Cable	Sucoflex	N/A	29/10/07	Annually
Cable	Unknown	N/A	20/07/07	Annually

4.3 6dB Bandwidth Test – Section 15.247(a)(2).

The EUT uses digital modulation techniques and operates in the 2400 MHz – 2483.5 MHz band and therefore must meet the requirements of CFR 47 Part 15 Subpart C Section 15.247(a)(2). The requirement states that the minimum bandwidth measured shall be at least 500 kHz.

Each transceiver of the EUT was investigated in turn whilst transmitting on Channels 1, 6 & 11 respectively, by directly connecting the transceiver at board level to a spectrum analyser.

4.3.1 Equipment Used

Description	Make and Model	Serial Number	Calibration Date	Calibration Period
Spectrum Analyser	R&S FSEM30	830151/012	17/01/2007	Annually

4.4 Maximum Peak Output Power – Section 15.247(b)(3).

The EUT uses digital modulation techniques and operates in the 2400 MHz – 2483.5 MHz band and therefore must meet the requirements of CFR 47 Part 15 Subpart C Section 15.247(b)(3). The requirement states that the maximum peak conducted output power shall not exceed 1 Watt.

This is based on antennae with directional gains that do not exceed 6 dBi. The directional antenna gain of the antenna used (fed individually) is 14 dBi.

The EUT does not employ frequency hopping and is classed as both a point to multipoint system and an omnidirectional application.

In accordance with CFR 47 Part 15 Subpart C, Section 15.247(b)(4) *'the conducted output power from the intentional radiator shall be reduced below the stated value of 1 Watt as given in Section 15.247(b)(3), by the amount in dB that the directional gain of the antenna exceeds 6 dBi'.*

1 Watt limit = +30 dBm
Directional gain of antenna (fed individually) is 14 dBi, exceeding 6 dBi by 8 dB.
Therefore the maximum conducted output power shall be reduced to +22 dBm (equivalent to 0.15849 W).

CFR 47 Part 15 Subpart C, Section 15.247(c)(iii) excludes the use of point to multipoint systems and omnidirectional applications. It also states that *'the operator of the spread spectrum or digitally modulated intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point to point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility'.*

Each transceiver of the EUT was investigated whilst transmitting on Channels 1, 6 & 11 respectively, by directly connecting the transceiver at board level to a spectrum analyser with inbuilt functionality to perform power measurements.

4.4.1 Equipment Used

Description	Make and Model	Serial Number	Calibration Date	Calibration Period
Spectrum Analyser	R&S FSEM30	830151/012	17/01/2007	Annually

4.5 Maximum Permissible Exposure - Section 15.247(i).

The data from the following table, together with the maximum peak output power measurements shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in Section 1.1307(b)(1).

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)
(Specified in CFR 47 Volume 1 Section 1.1310)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time (minutes)
Limits for Occupational / Control Exposures				
300-1500	---	---	F/300	6
1500-100,000	---	---	5	6
Limits for General Population / Uncontrolled Exposure				
300-1500	---	---	F/1500	6
1500-100,000	---	---	1.0	30

F = Frequency in MHz

4.6 Conducted Spurious Emissions - Section 15.247(d).

CFR 47 Part 15 Subpart C, Section 15.247(d) states that *'In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. Attenuation below the general limits specified in Section 15.209(a) is not required'.*

Conducted Spurious Emission measurements were performed on each transceiver of the EUT, whilst transmitting on Channel 1, Channel 6 and Channel 11 respectively.
The spectrum analyser was connected to each transceiver in turn using the connector at board level.

4.6.1 Equipment Used

Description	Make and Model	Serial Number	Calibration Date	Calibration Period
Spectrum Analyser	R&S FSEM30	830151/012	17/01/2007	Annually

4.7 Power Spectral Density Test – Section 15.247(e).

In accordance with CFR 47 Part 15 Subpart C, Section 15.247(e), *'for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission'.*

Power Spectral Density measurements were performed at board connector level for each transceiver in turn, whilst operating on Channels 1, 6 and 11 respectively. Peak Power Spectral Density measurements were taken using the in-built functions of the R&S spectrum analyser.

4.7.1 Equipment Used

Description	Make and Model	Serial Number	Calibration Date	Calibration Period
Spectrum Analyser	R&S FSEM30	830151/012	17/01/2007	Annually

4.8 Occupied Bandwidth Measurements.

Occupied Bandwidth measurements were performed as requested by the customer.
The measurements were performed at board connector level for each transceiver in turn, whilst operating on Channels 1, 6 and 11 respectively.

Occupied Bandwidth measurements were performed using the in-built functionality of the R&S spectrum analyser.

4.8.1 Equipment Used

Description	Make and Model	Serial Number	Calibration Date	Calibration Period
Spectrum Analyser	R&S FSEM30	830151/012	17/01/2007	Annually

5 Results

5.1 Radiated Emissions 30 MHz - 1000 MHz

5.1.1 Radiated Emissions Digital Device 30 MHz - 1000 MHz

This test took place on the 21st January, 2008. The EUT was set up as described in 2.1.

Temperature: 9 °C – 12 °C (Open Area Test Site)
Humidity: 73 % rh – 78 % rh (Open Area Test Site)

The EUT was powered and remained connected to it's associated antenna throughout the test. No transmissions from the unit were initiated.

The modification as detailed in Section 2.4 of this report was in place for this test.

The EUT's radiated emissions were measured to the limits specified in CFR 47 Part 15 Subpart B, Section 15.109 for a Class B digital device and the highest emissions relative to the limit are tabulated below.

Polarization (V/H)	Frequency (MHz)	Amplitude (dB(μVm^{-1}))	Limit (dB(μVm^{-1}))	Margin (dB)
H	86.250	35.6	40.0	4.4
H	86.800	35.9	40.0	4.1
H	100.000	41.3	43.5	2.2
H	109.950	38.2	43.5	5.3
V	109.979	39.1	43.5	4.4
H	110.000	41.9	43.5	5.4
V	125.000	39.6	43.5	3.9
H	225.000	40.5	46.0	5.5
H	330.000	44.3	46.0	1.7
H	500.000	44.7	46.0	1.3

The 95 % confidence measurement uncertainty for this test is 5.4 dB.

The EUT with the modification as detailed in Section 2.4 of this report, met the limits as specified in CFR 47 Part 15 Subpart B, Section 15.109 for a Class B digital device.

5.1.2 Restricted Band Radiated Emissions 30 MHz - 1000 MHz.

This test took place between 17th – 21st January, 2008. The EUT was set up as described in 2.1.

Temperature varied between: 9 °C – 12 °C (Open Area Test Site)
Humidity varied between: 73 % rh – 78 % rh (Open Area Test Site)

Radiated Emission measurements were performed in turn with each transceiver operating in 802.11b mode on Channels 1, 6 & 11 respectively.

The modification as detailed in Section 2.4 of this report was in place for this test.

CFR 47 Part 15 Subpart C, Section 15.247(d), states that *'radiated emissions which fall in the restricted bands, as defined in 15.205(a), must also comply with the radiated emission limits specified in 15.209(a)'.*

The EUT's radiated emissions were measured to the limits specified in CFR 47 Part 15 Subpart C, Section 15.209(a) and the highest restricted band emissions relative to the limit are tabulated below.

Polarization (V/H)	Frequency (MHz)	Amplitude (dB(μVm^{-1}))	Limit (dB(μVm^{-1}))	Margin (dB)
H	73.500	25.9	40.0	14.1
H	109.950	38.2	43.5	5.3
V	109.979	39.1	43.5	4.4
V	109.992	38.1	43.5	5.4
H	110.000	41.9	43.5	1.6
H	112.100	33.4	43.5	10.1
H	112.400	32.2	43.5	11.3
V	125.000	39.6	43.5	3.9
H	250.000	35.2	46.0	10.8
H	266.600	39.1	46.0	6.9
H	266.700	38.6	46.0	7.4
H	330.000	44.3	46.0	1.7

The 95 % confidence measurement uncertainty for this test is 5.4 dB.

The EUT with the modification as detailed in Section 2.4 of this report, met the limits as specified in CFR 47 Part 15 Subpart C, Section 15.209 for radiated emissions in the restricted bands as defined in Section 15.205(a).

5.2 Radiated Emissions 1 GHz – 26.5 GHz.

This test took place between 30th – 31st October, 2007. The EUT was set up as described in 2.1.

Temperature varied between: 11 °C – 16 °C
Humidity varied between: 44 % rh – 47 % rh

5.2.1 Radiated Emissions Digital Device

No emissions were found to be emanating from the EUT in the frequency range of 1 GHz to 26.5 GHz. Plots were captured using a spectrum analyser and are shown in Section 5.2.4 of this report.

Note: Plots included in Section 5.2.4 of this report were from preliminary radiated emission investigations to identify frequencies of interest. The bandwidth was reduced to aid in identifying frequencies of interest by reducing the noise floor. No frequencies of interest were found and therefore measurements were not performed with the required RBW and VBW settings.

The EUT meets the requirements as specified in CFR 47 Part 15 Subpart B, Section 15.109 for a Class B digital device.

5.2.2 Radiated Emissions Intentional Radiator

No emissions, other than the fundamental were found emanating from the EUT. Plots were captured using a spectrum analyser and are shown in Section 5.2.3 of this report.

Note: Plots included in Section 5.2.4 of this report were from preliminary radiated emission investigations to identify frequencies of interest. The bandwidth was reduced to aid in identifying frequencies of interest by reducing the noise floor. No frequencies of interest were found and therefore measurements were not performed with the required RBW and VBW settings.

The EUT meets the requirements as specified in CFR 47 Part 15 Subpart C, Section 15.209 for radiated emissions in the restricted bands as defined in Section 15.205(a).

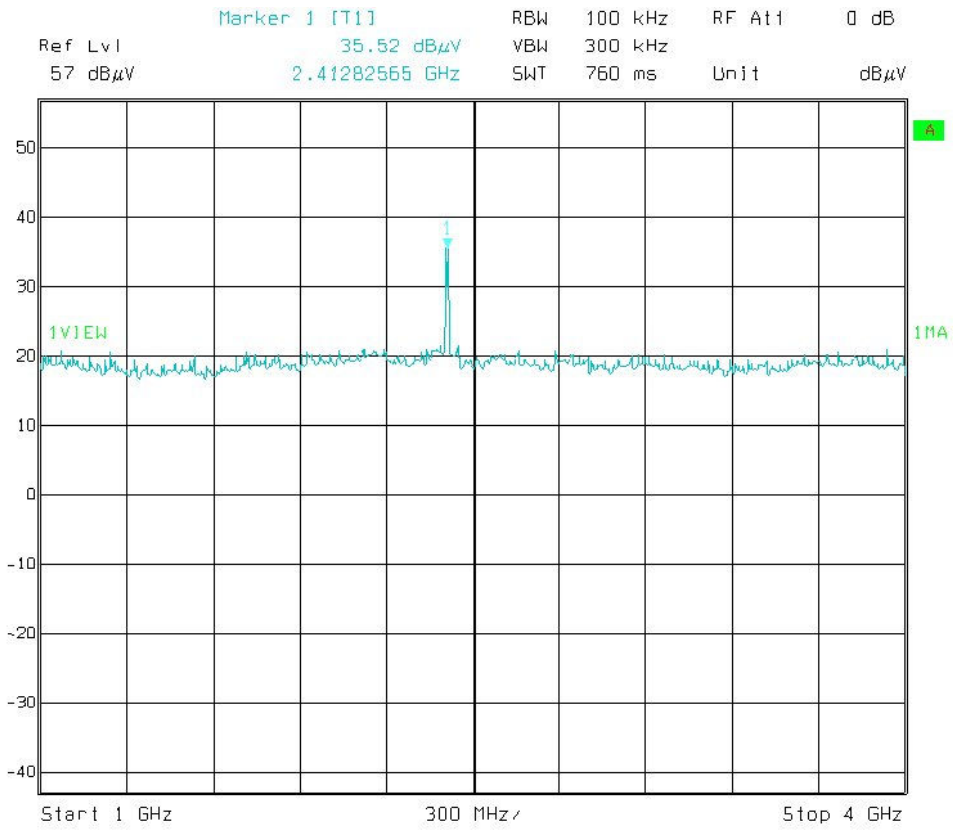
5.2.3 Band-edge Radiated Emissions.

No emissions, other than the fundamental were found emanating from the EUT. Therefore band-edge radiated emissions were not required. Plots are shown in Section 5.2.4 of this report.

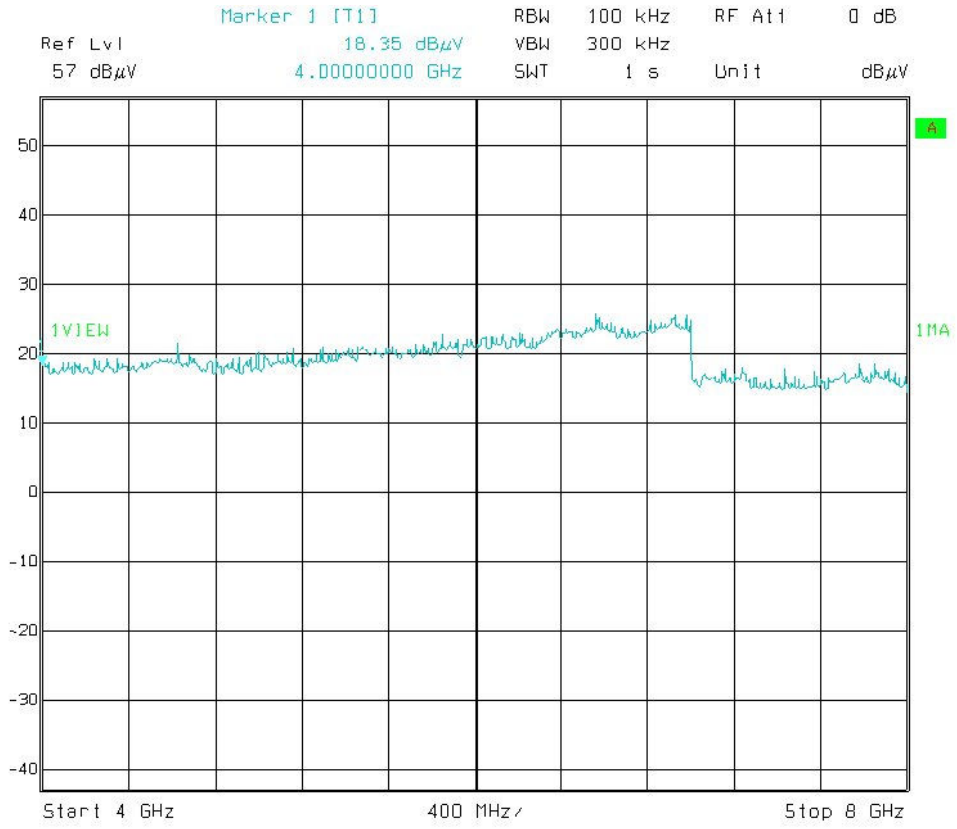
5.2.4 Radiated Emission Plots 1 GHz – 26.5 GHz

The following plots were obtained to identify frequencies of interest. The RBW and VBW settings were reduced to lower the noise floor of the measuring instrument and aid in identifying frequencies of interest. No final measurements were performed using the reduced RBW and VBW settings as no frequencies of interest were found apart from the fundamental which does not require measurement. As there were no frequencies found other than the fundamental no band-edge measurements were required.

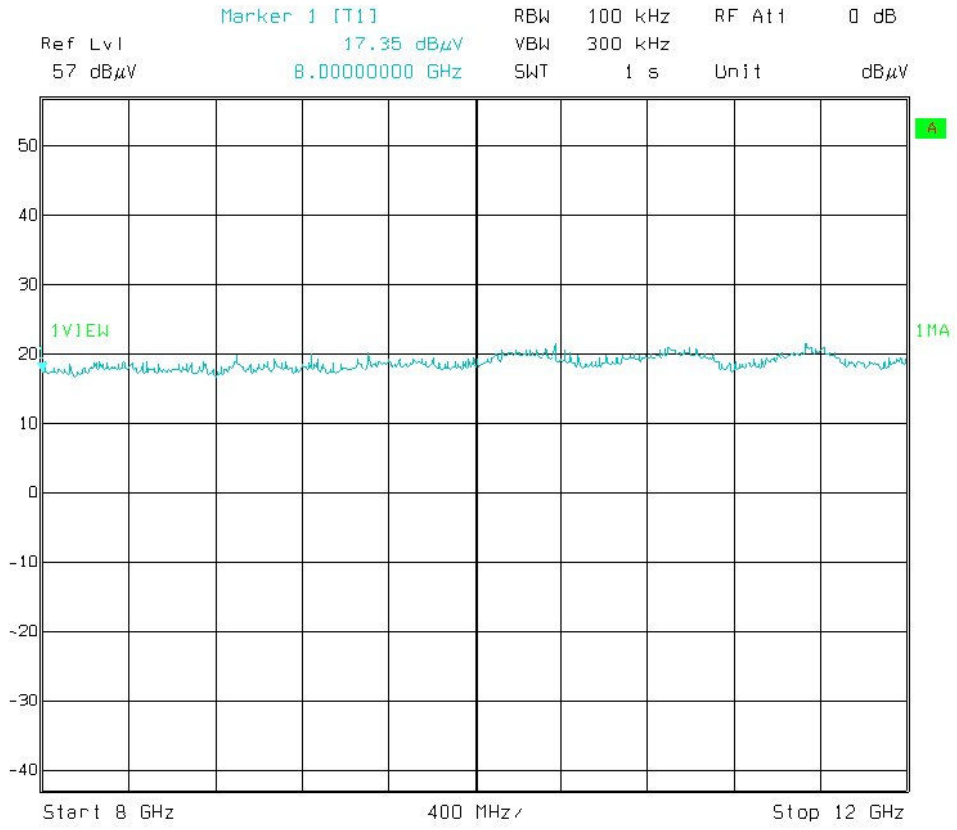
Transceiver A – Channel 1 Horizontal Polarisation



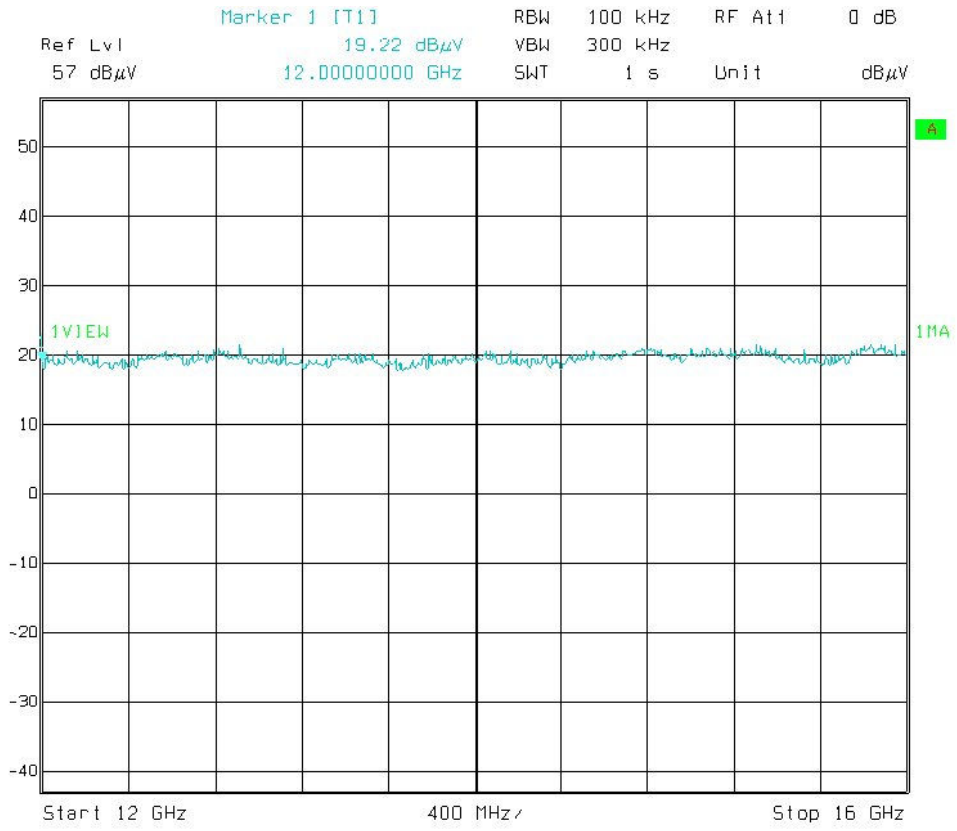
Transceiver A – Channel 1 Horizontal Polarisation



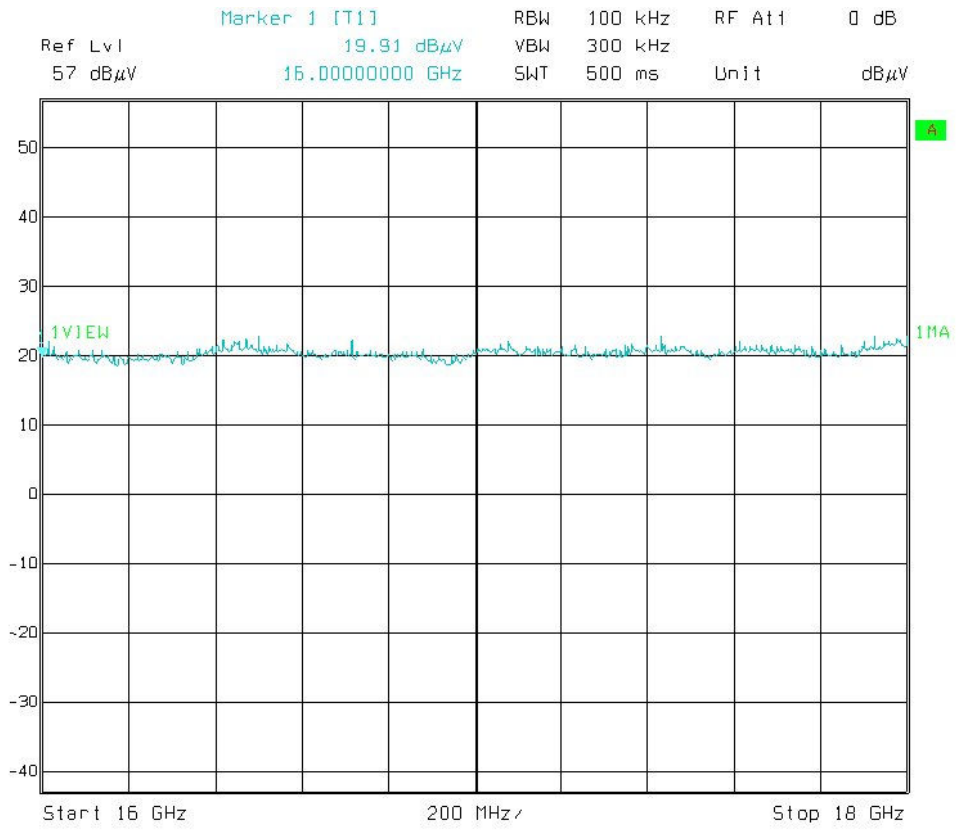
Transceiver A – Channel 1 Horizontal Polarisation



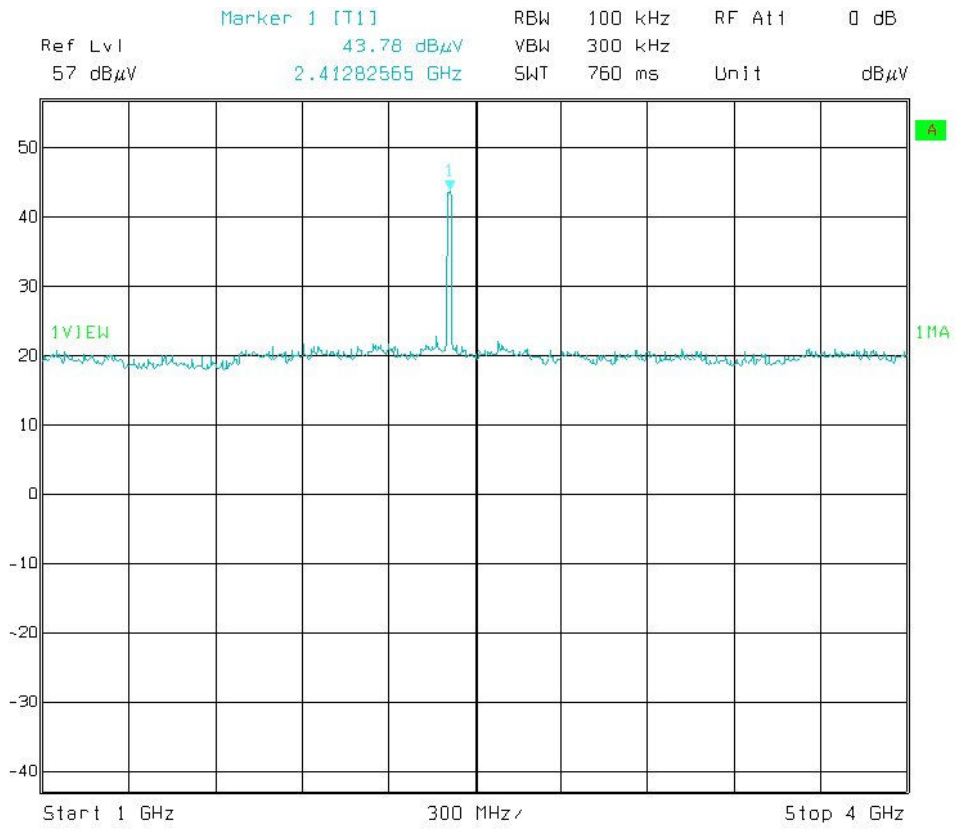
Transceiver A – Channel 1 Horizontal Polarisation



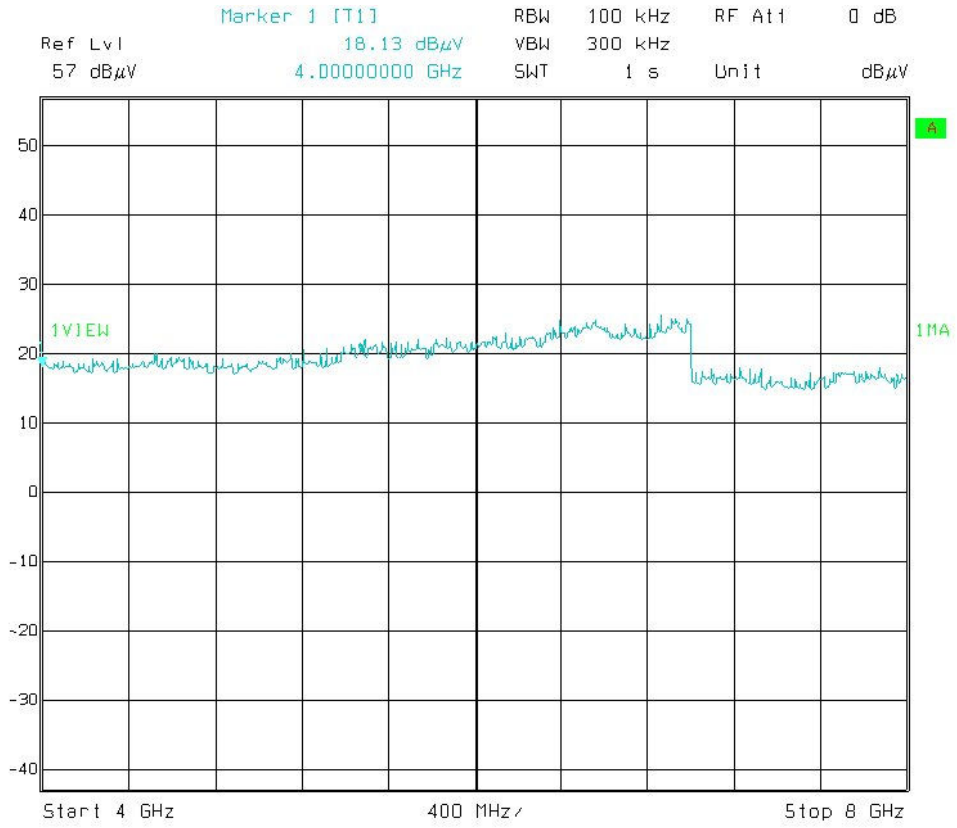
Transceiver A – Channel 1 Horizontal Polarisation



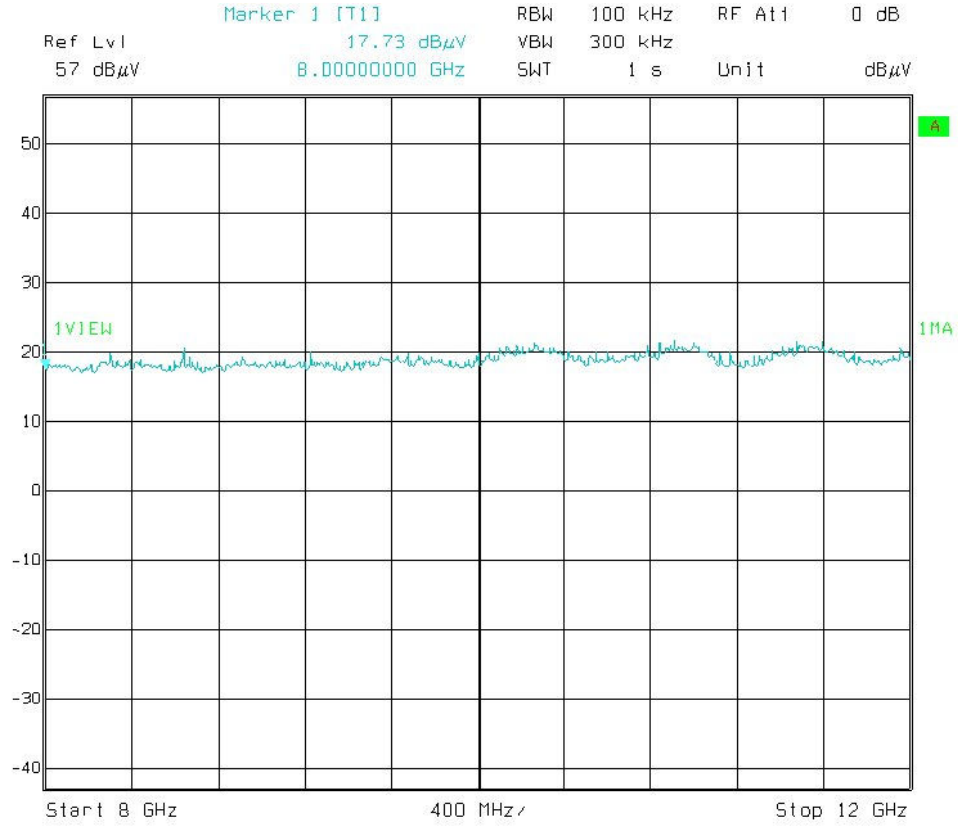
Transceiver A – Channel 1 Vertical Polarisation



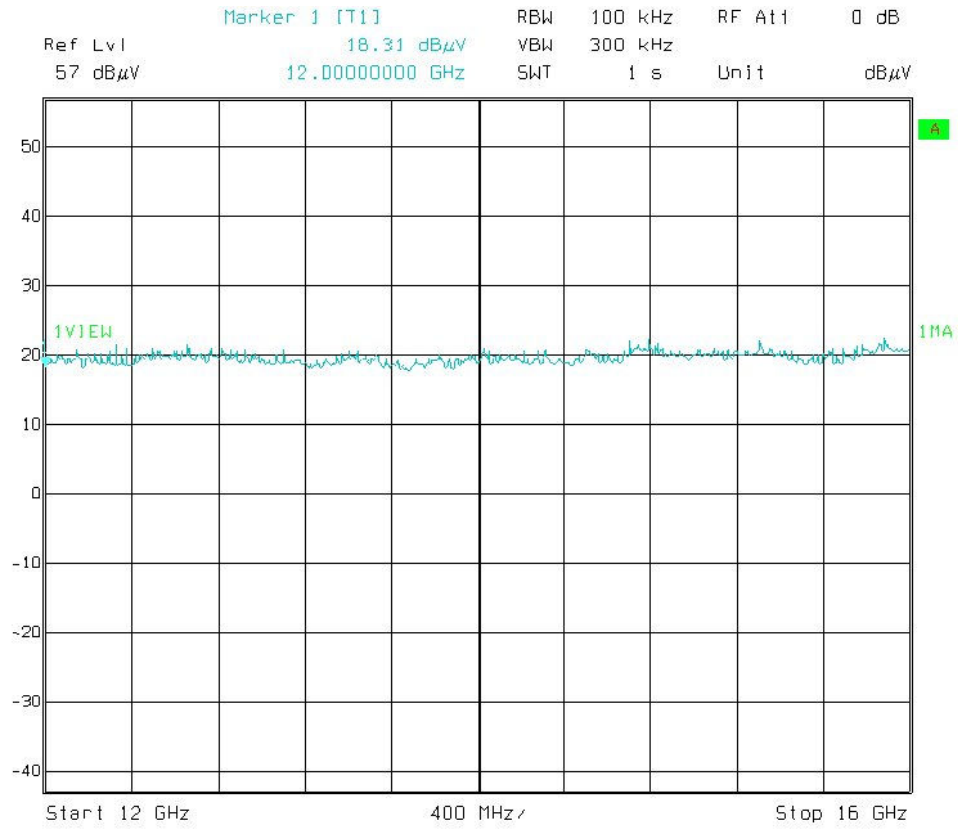
Transceiver A – Channel 1 Vertical Polarisation



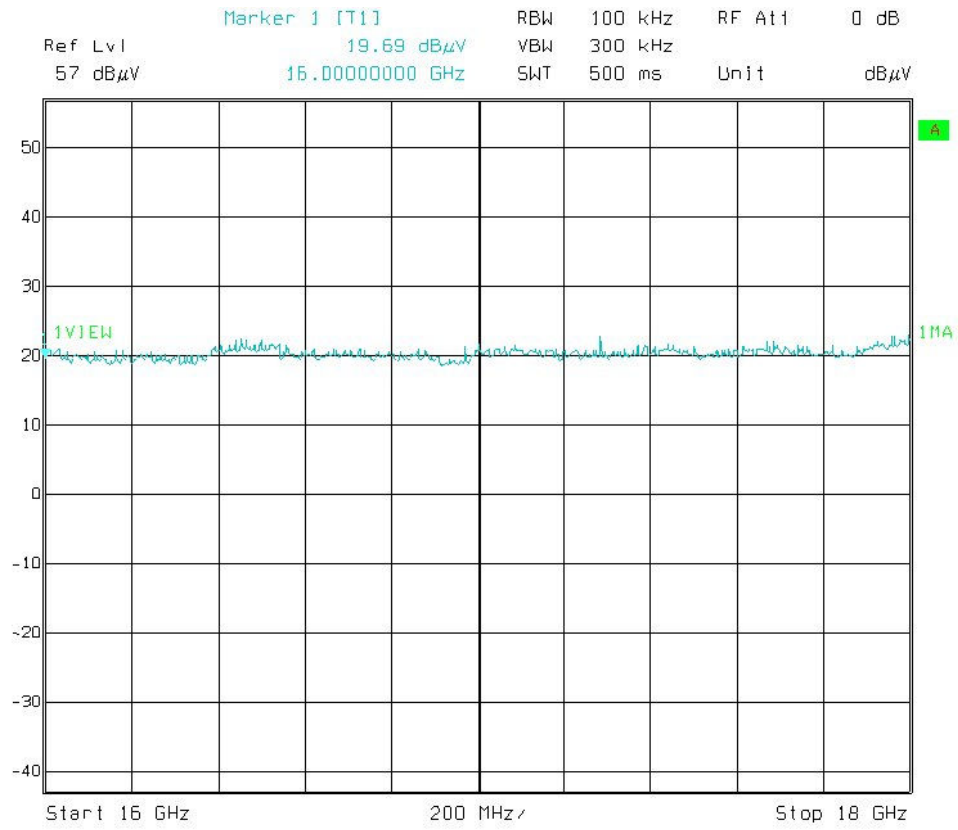
Transceiver A – Channel 1 Vertical Polarisation



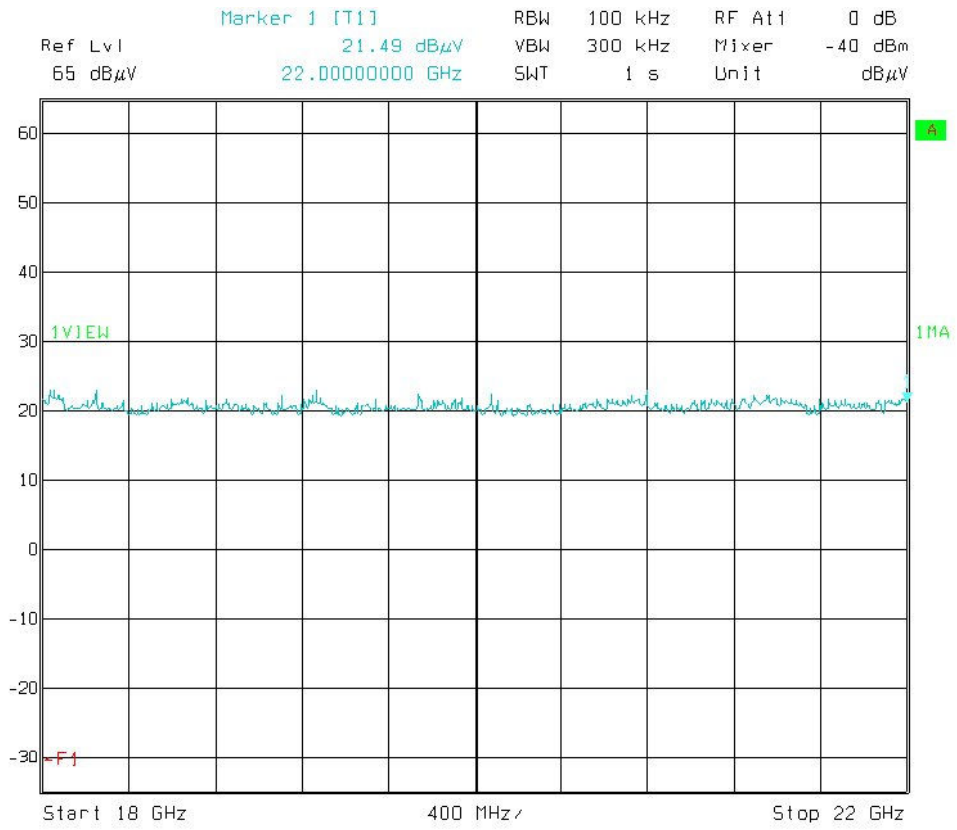
Transceiver A – Channel 1 Vertical Polarisation



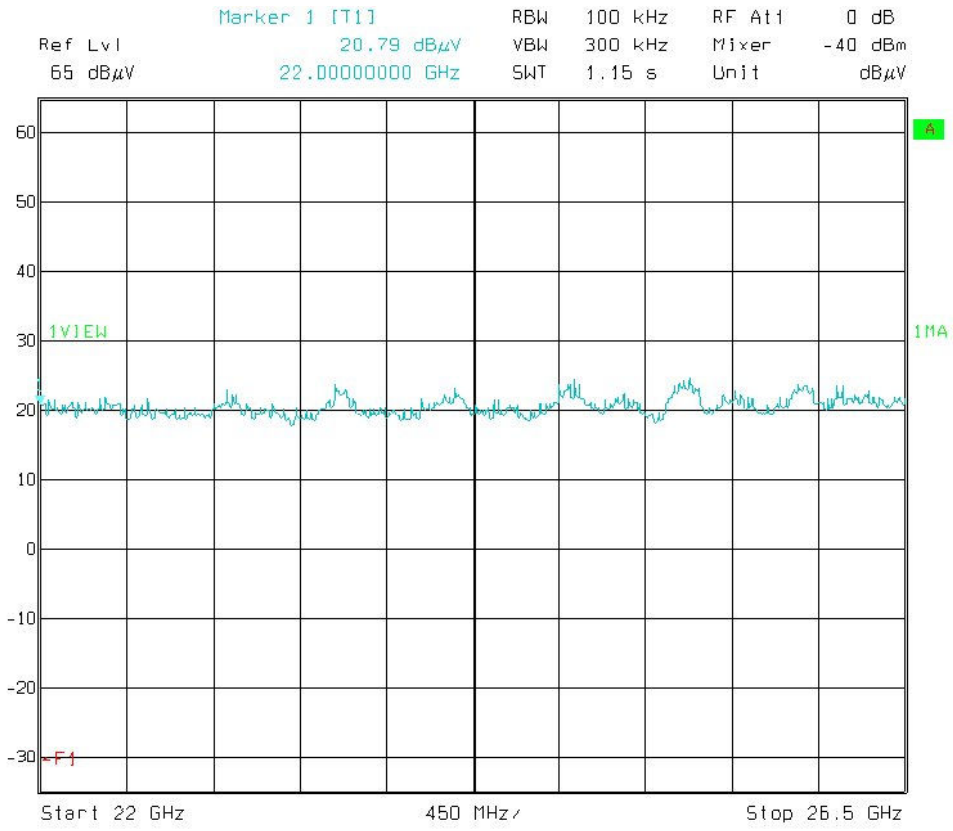
Transceiver A – Channel 1 Vertical Polarisation



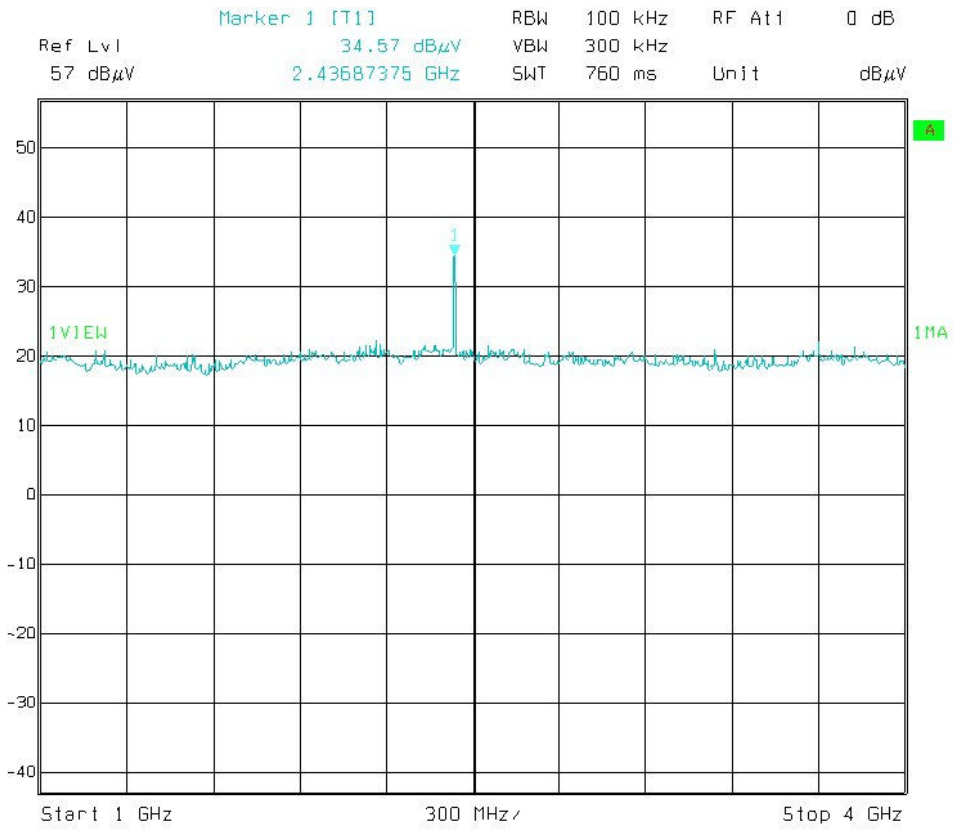
Transceiver A – Channel 1 Horizontal & Vertical Polarisation



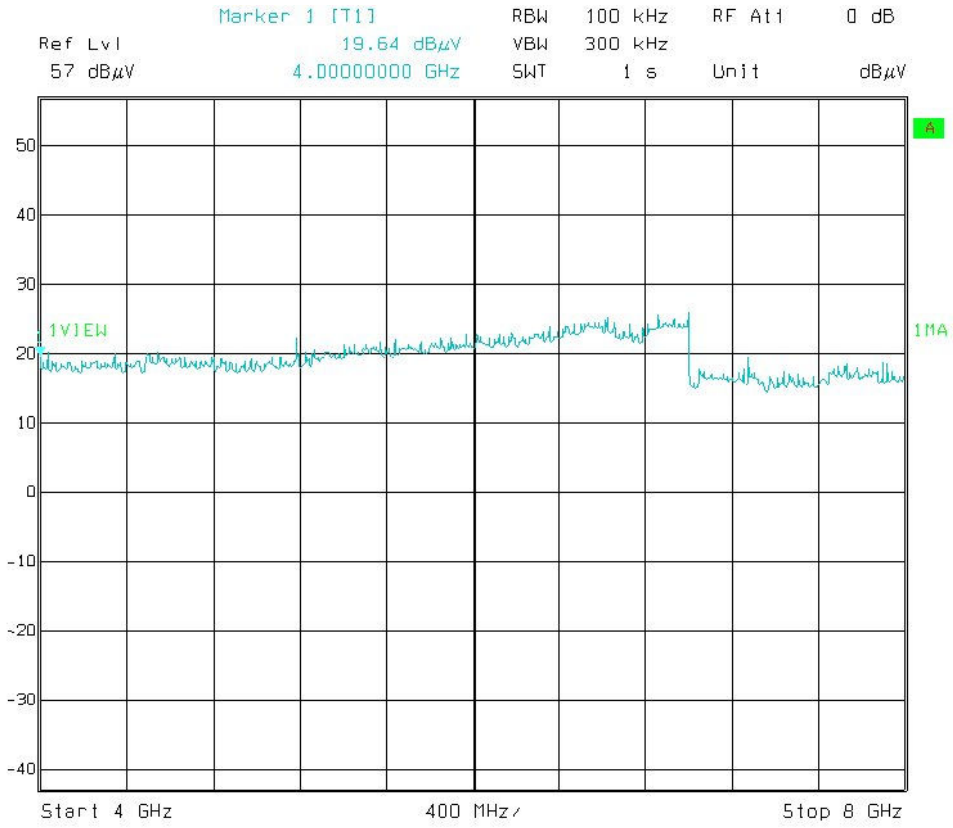
Transceiver A – Channel 1 Horizontal & Vertical Polarisation



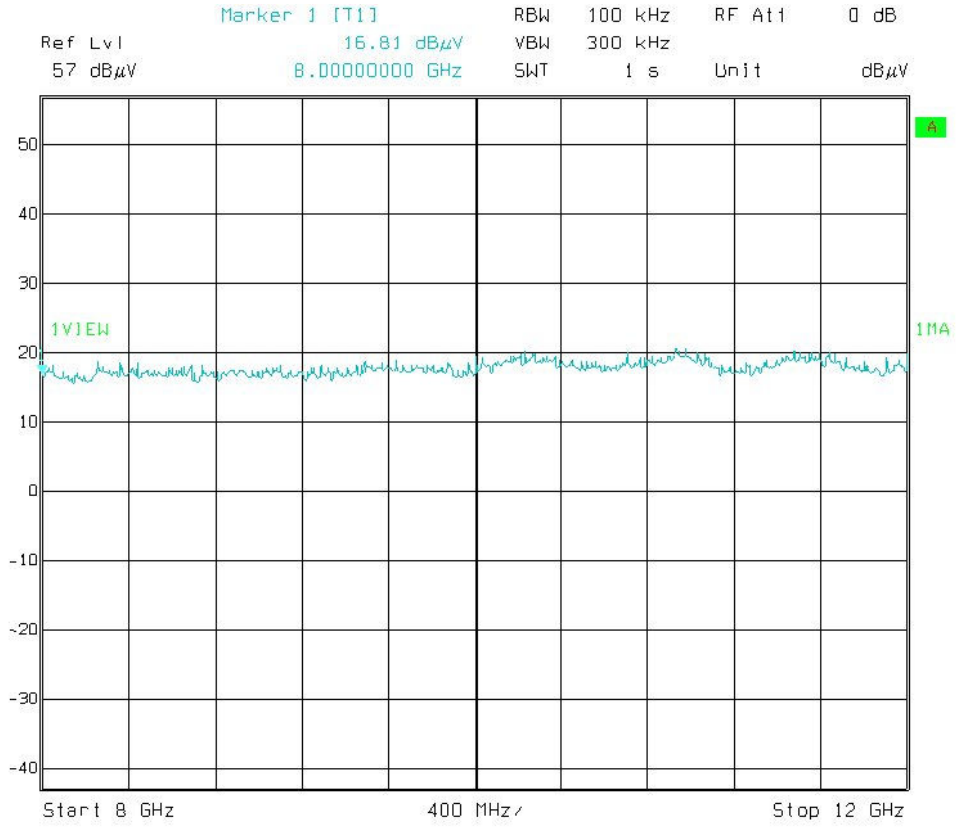
Transceiver A – Channel 6 Horizontal Polarisation



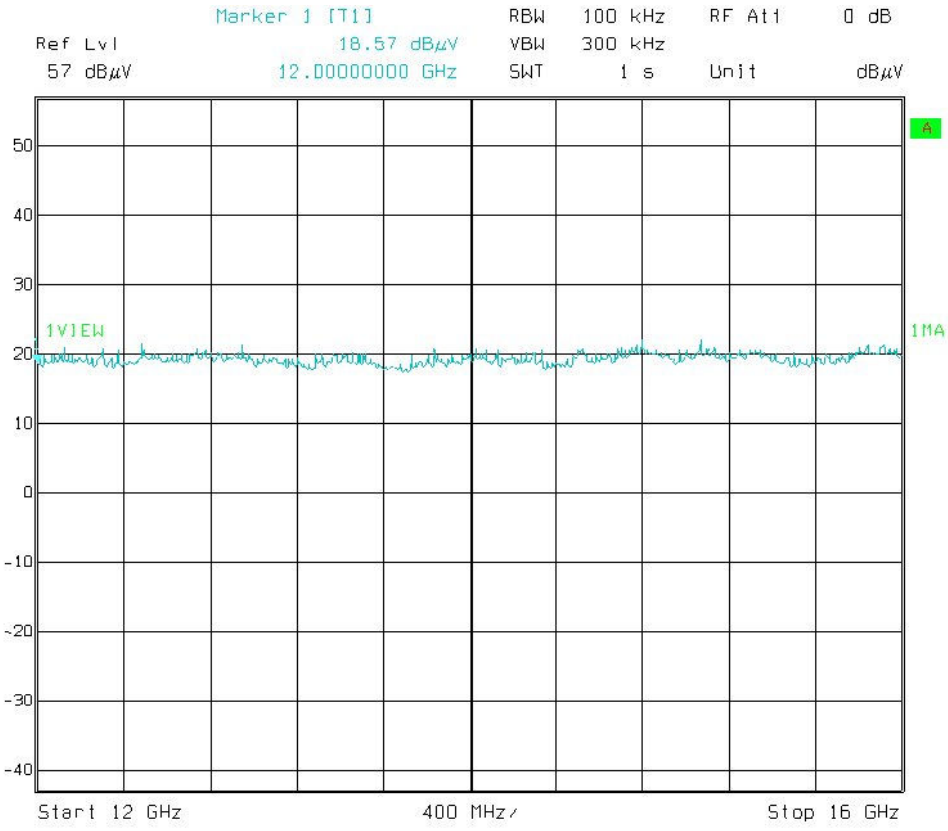
Transceiver A – Channel 6 Horizontal Polarisation



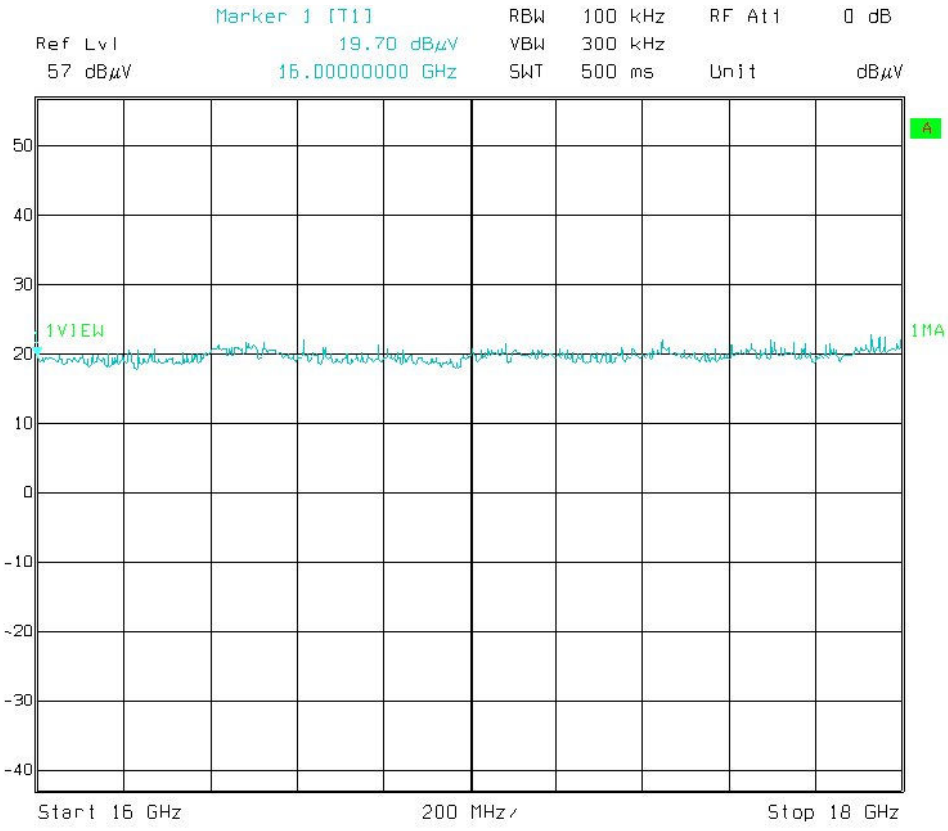
Transceiver A – Channel 6 Horizontal Polarisation



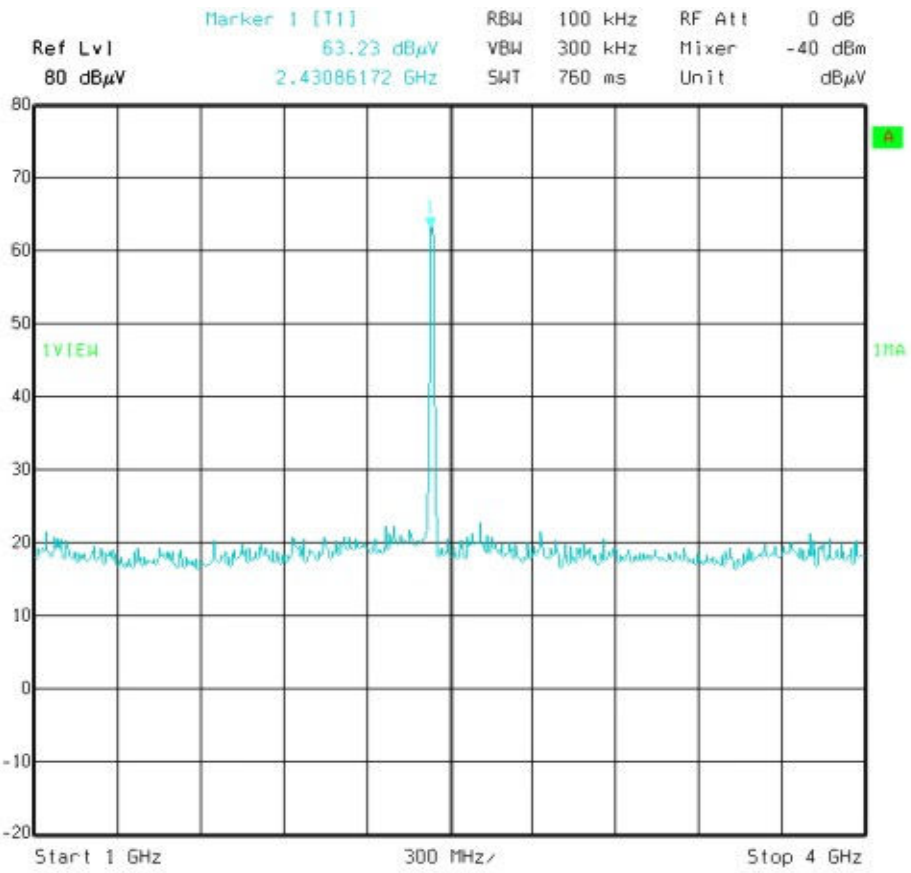
Transceiver A – Channel 6 Horizontal Polarisation



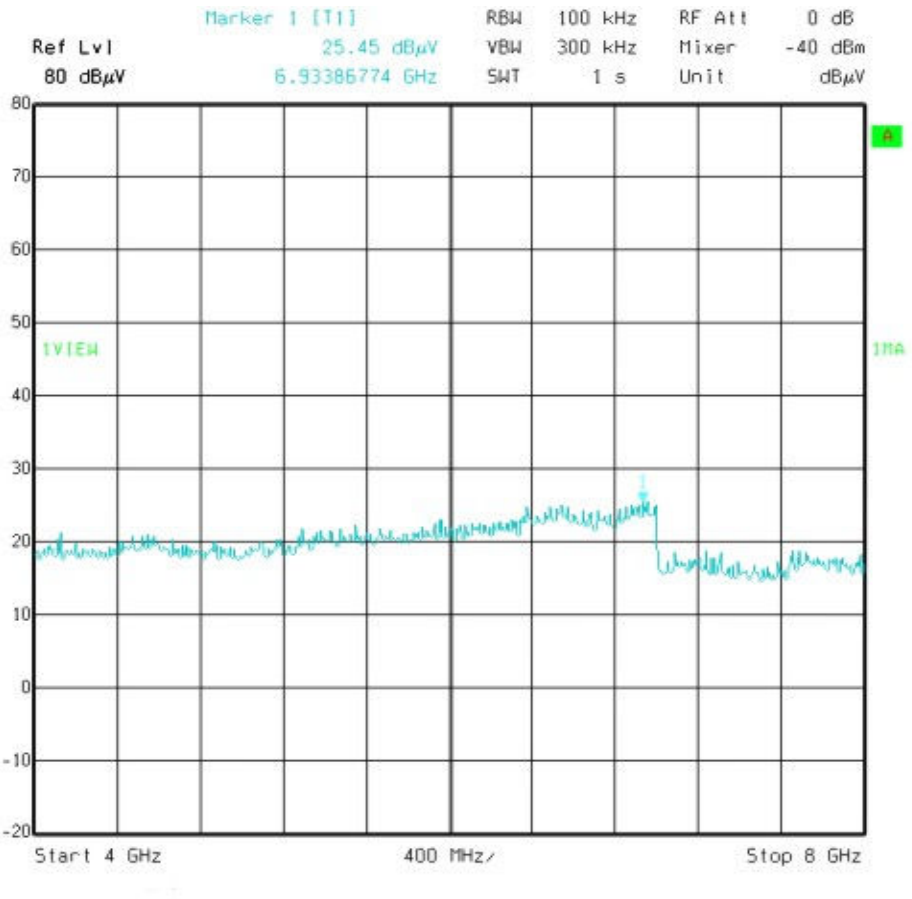
Transceiver A – Channel 6 Horizontal Polarisation



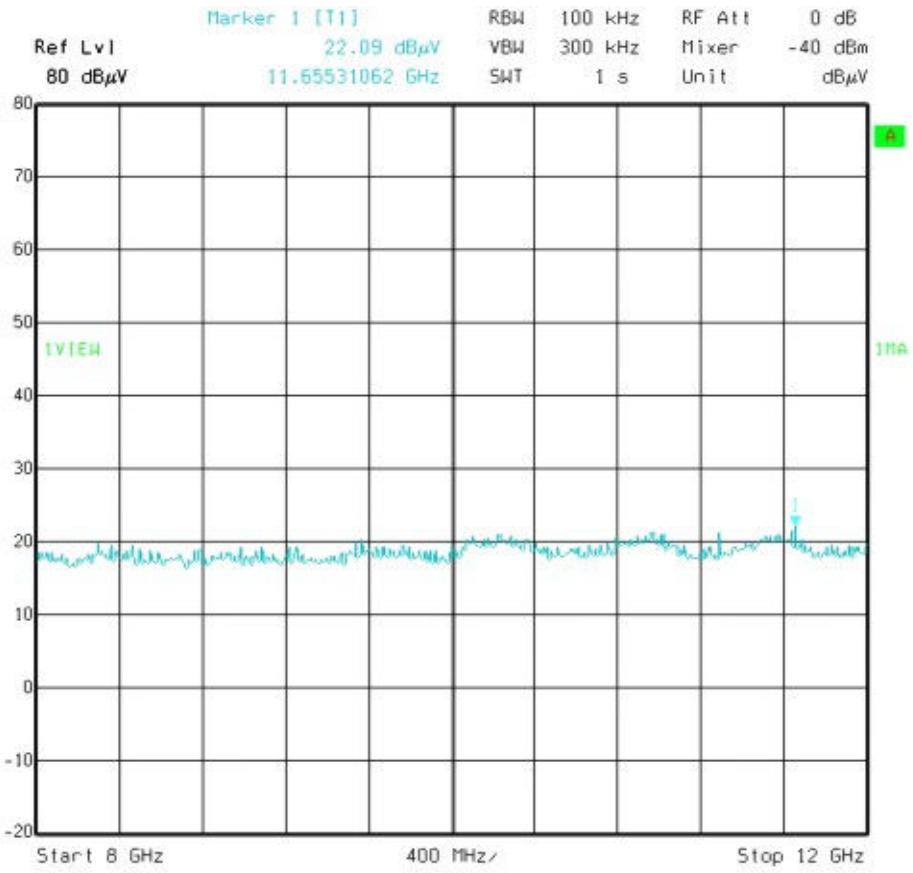
Transceiver A – Channel 6 Vertical Polarisation



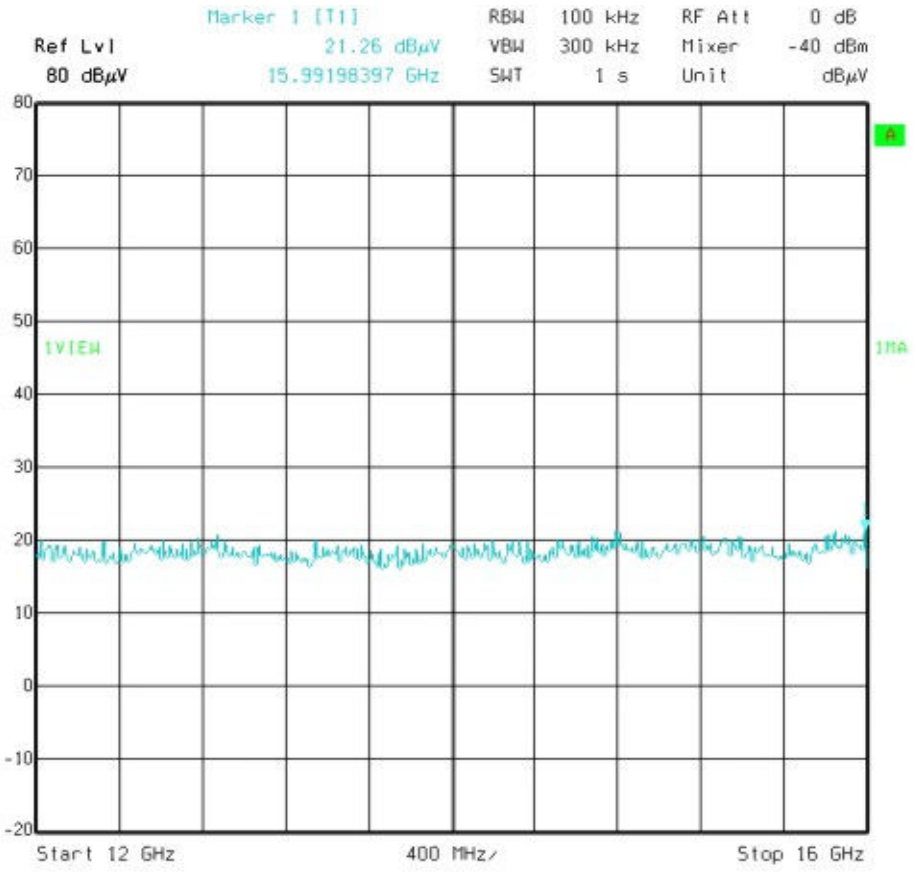
Transceiver A – Channel 6 Vertical Polarisation



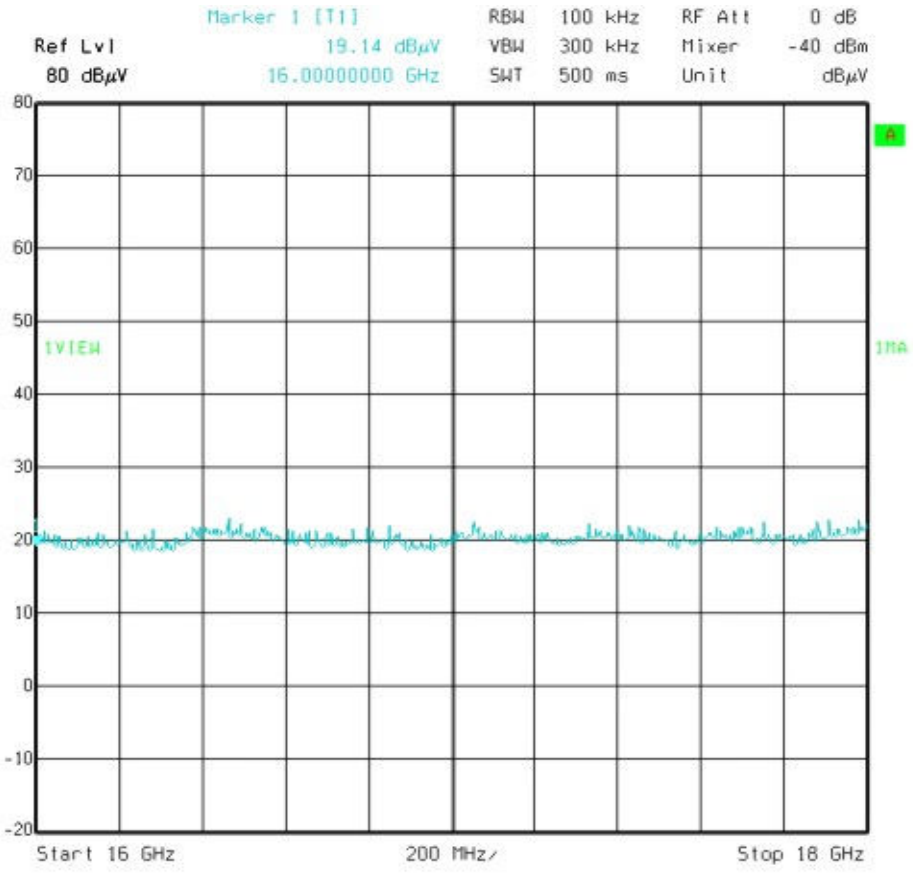
Transceiver A – Channel 6 Vertical Polarisation



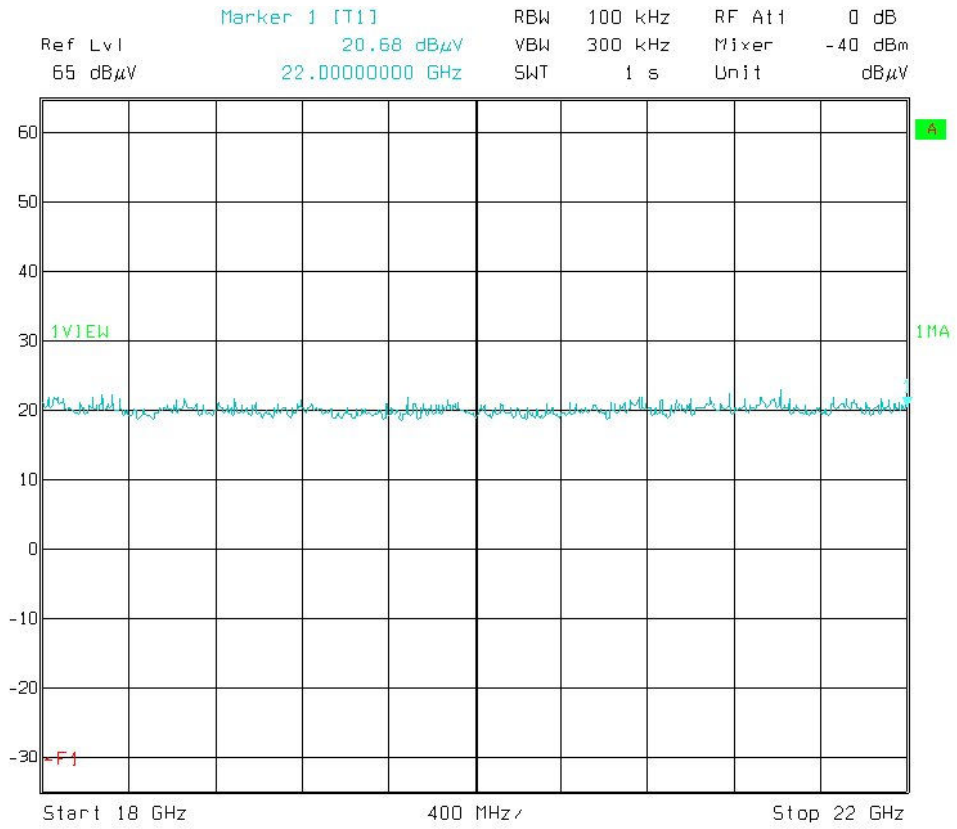
Transceiver A – Channel 6 Vertical Polarisation



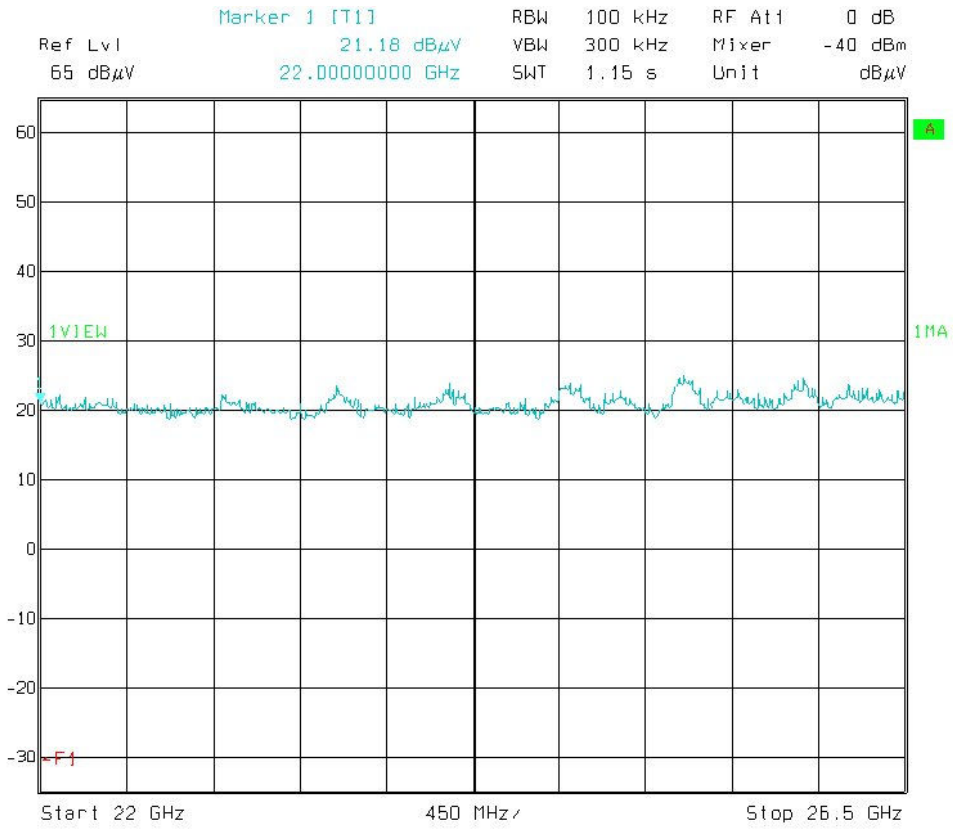
Transceiver A – Channel 6 Vertical Polarisation



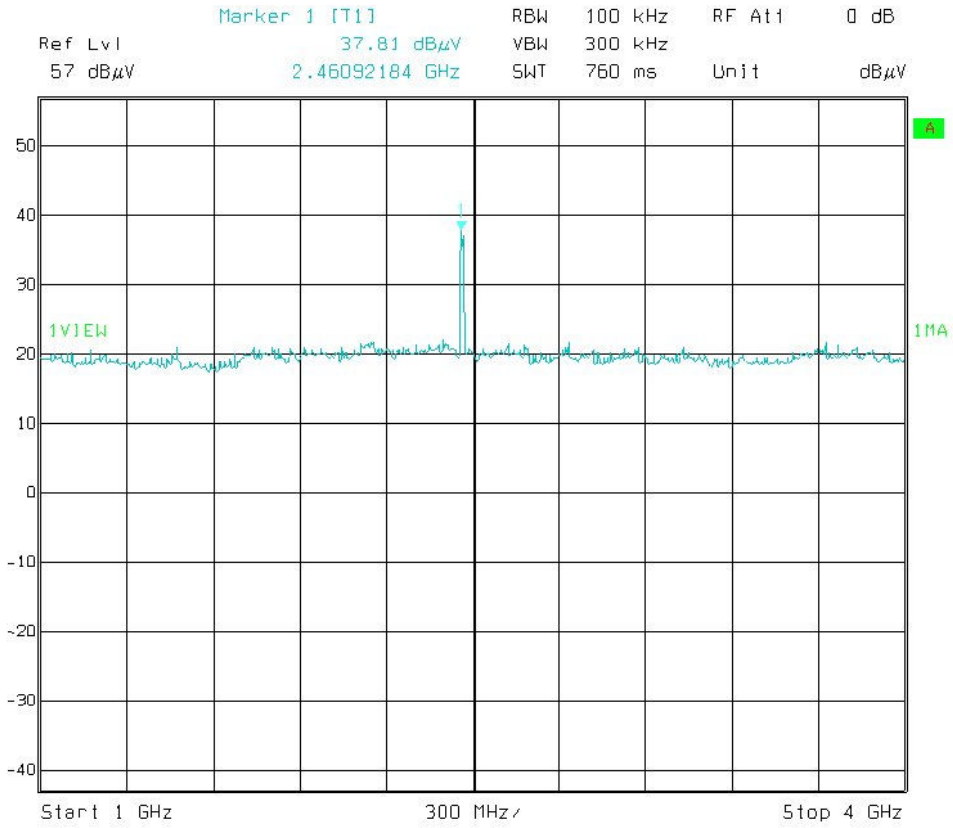
Transceiver A – Channel 6 Horizontal & Vertical Polarisation



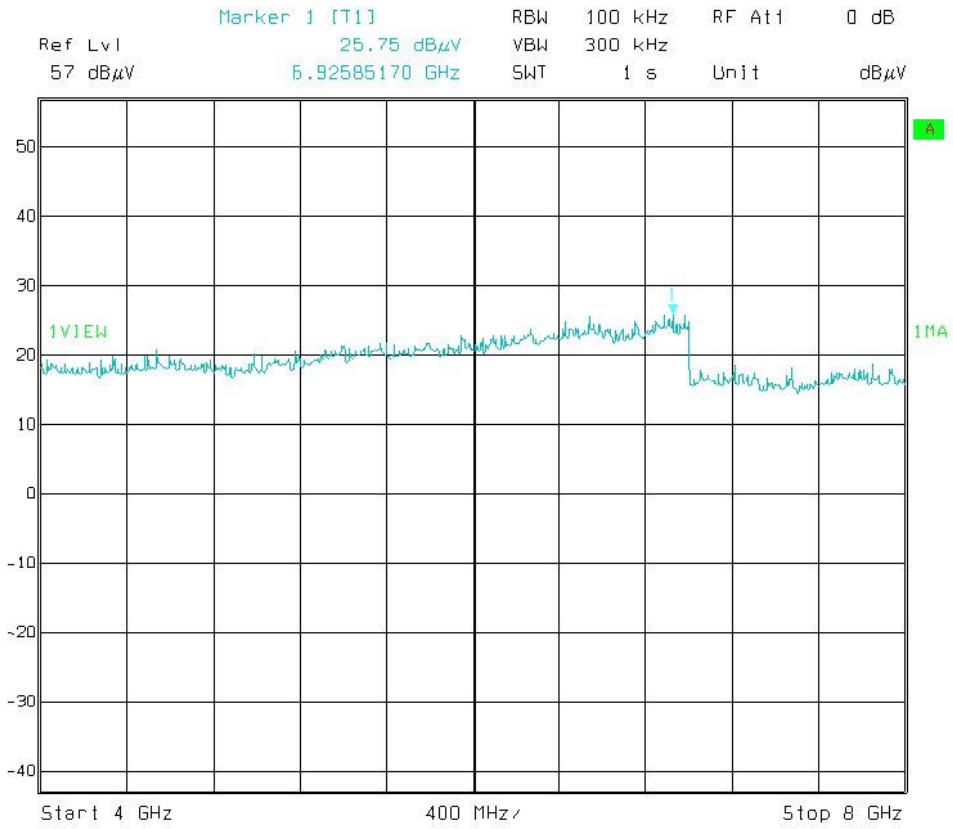
Transceiver A – Channel 6 Horizontal & Vertical Polarisation



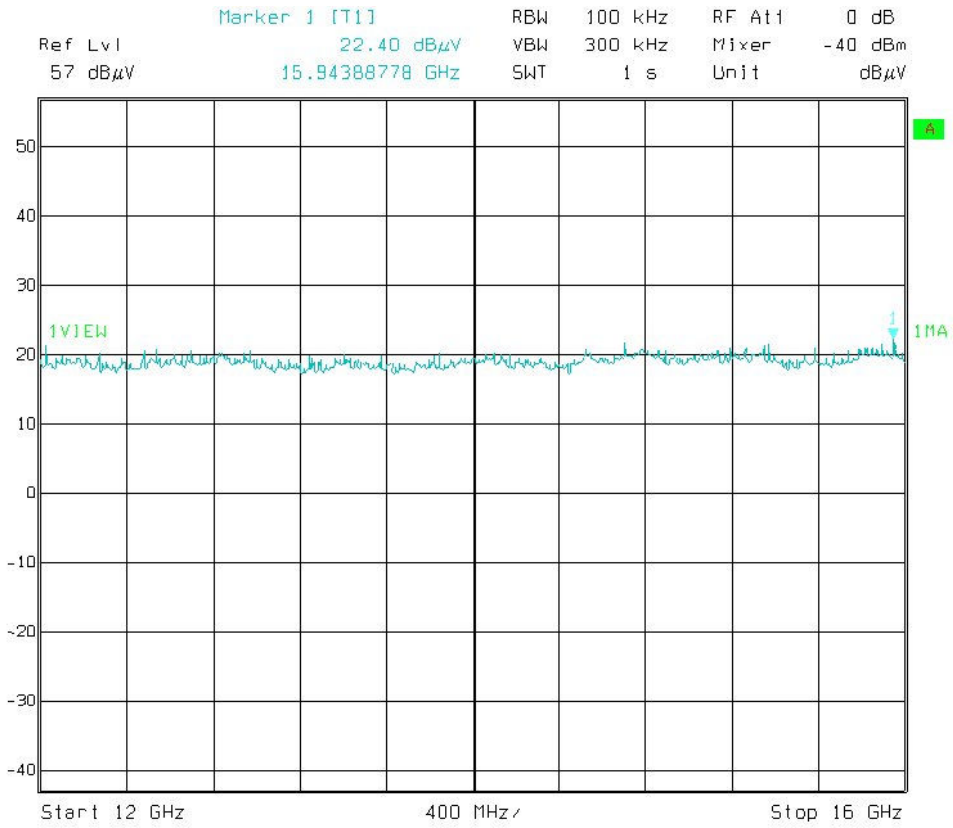
Transceiver A – Channel 11 Horizontal Polarisation



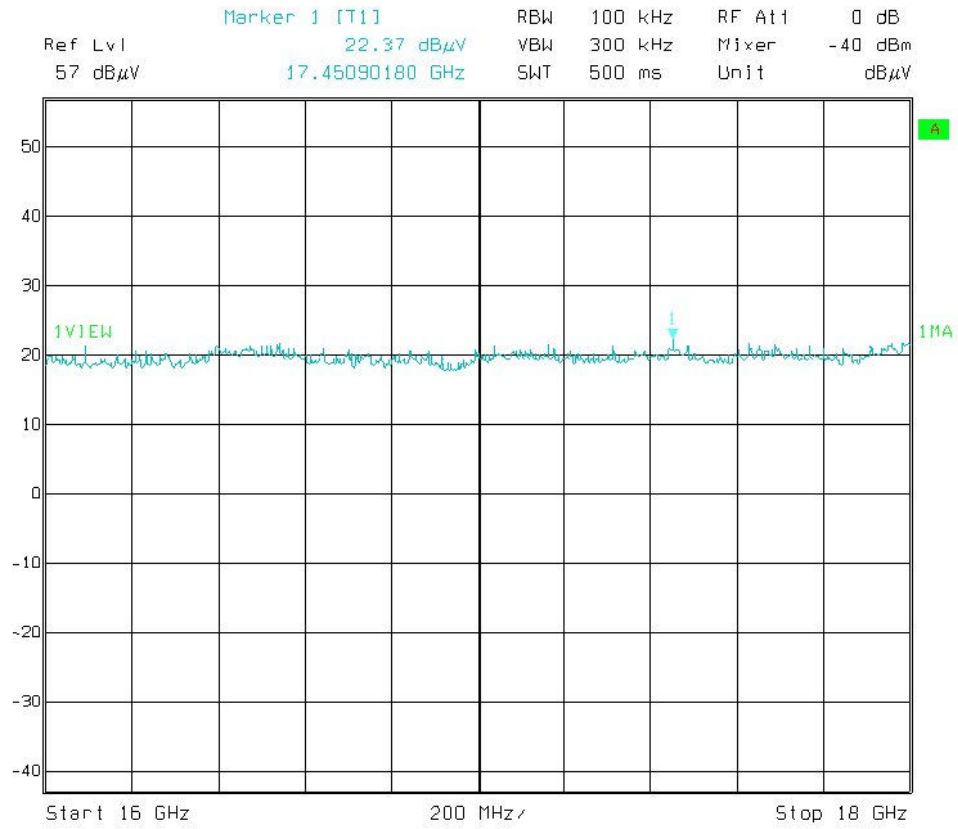
Transceiver A – Channel 11 Horizontal Polarisation



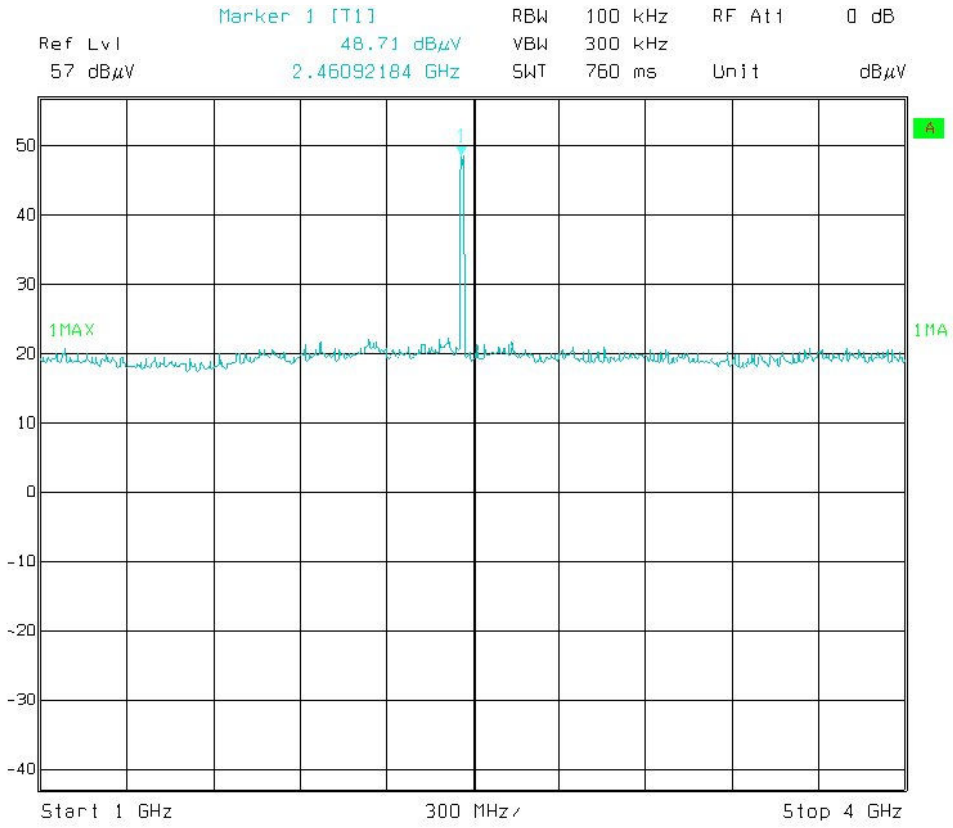
Transceiver A – Channel 11 Horizontal Polarisation



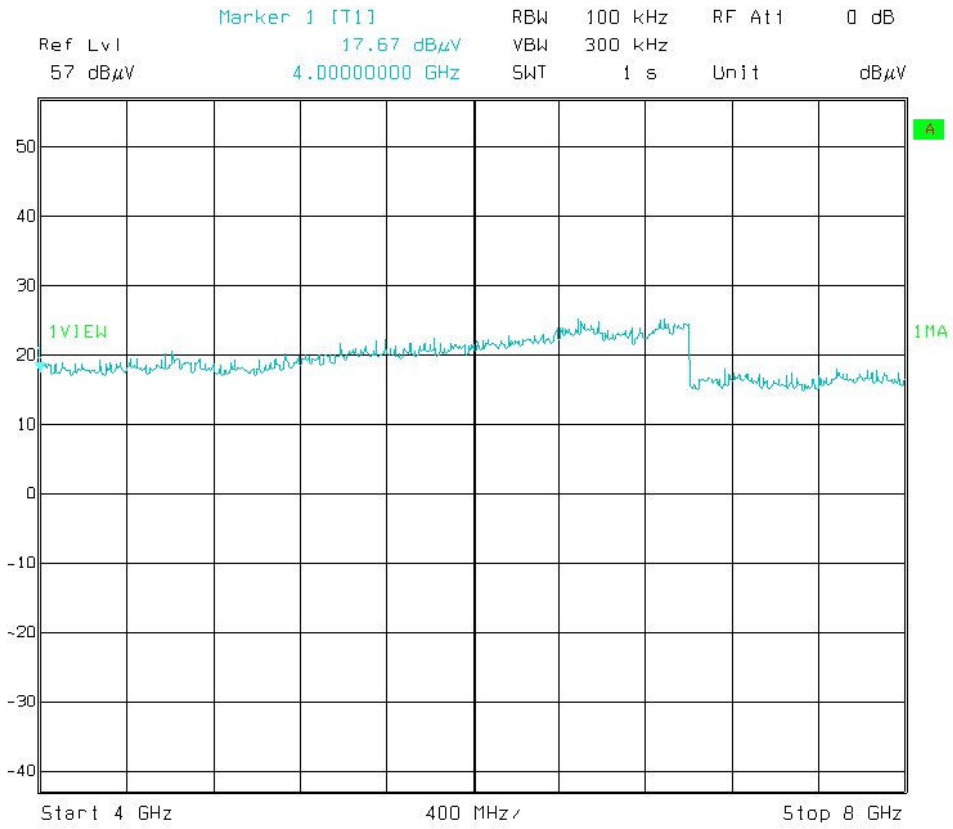
Transceiver A – Channel 11 Horizontal Polarisation



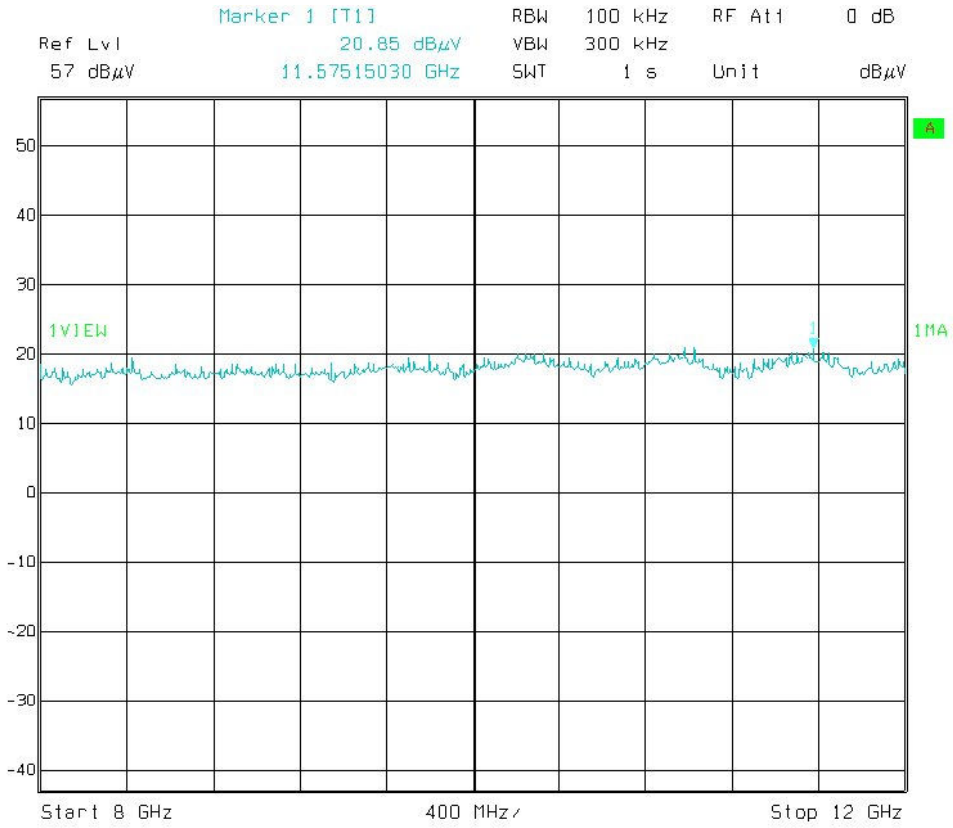
Transceiver A – Channel 11 Vertical Polarisation



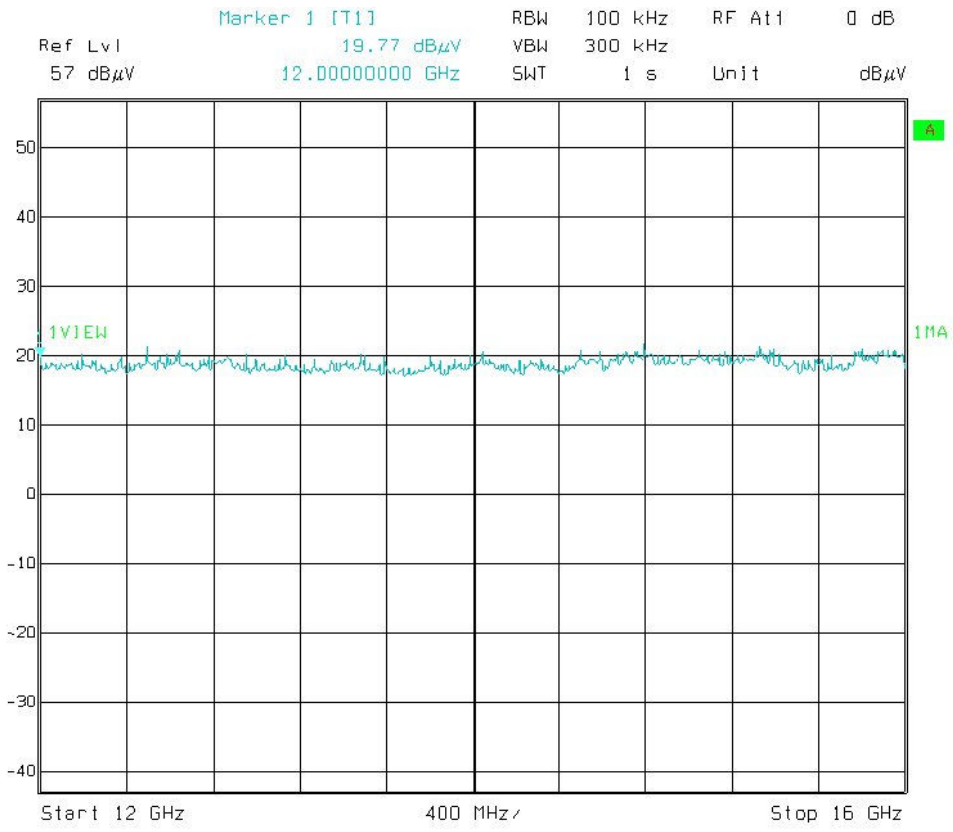
Transceiver A – Channel 11 Vertical Polarisation



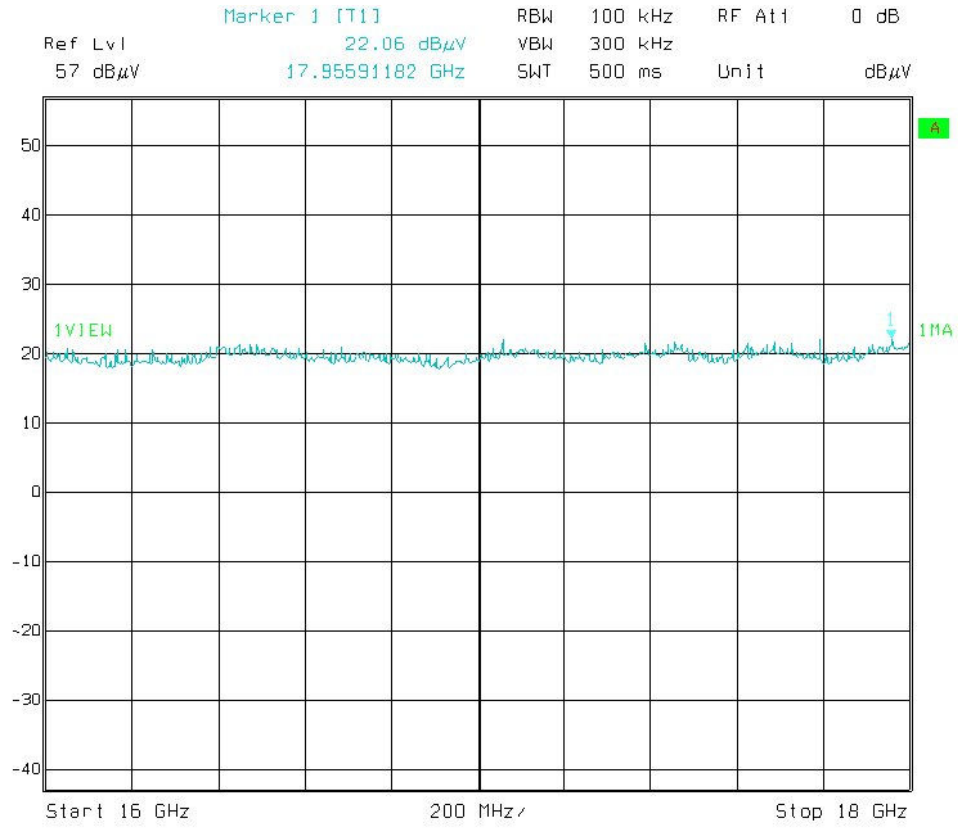
Transceiver A – Channel 11 Vertical Polarisation



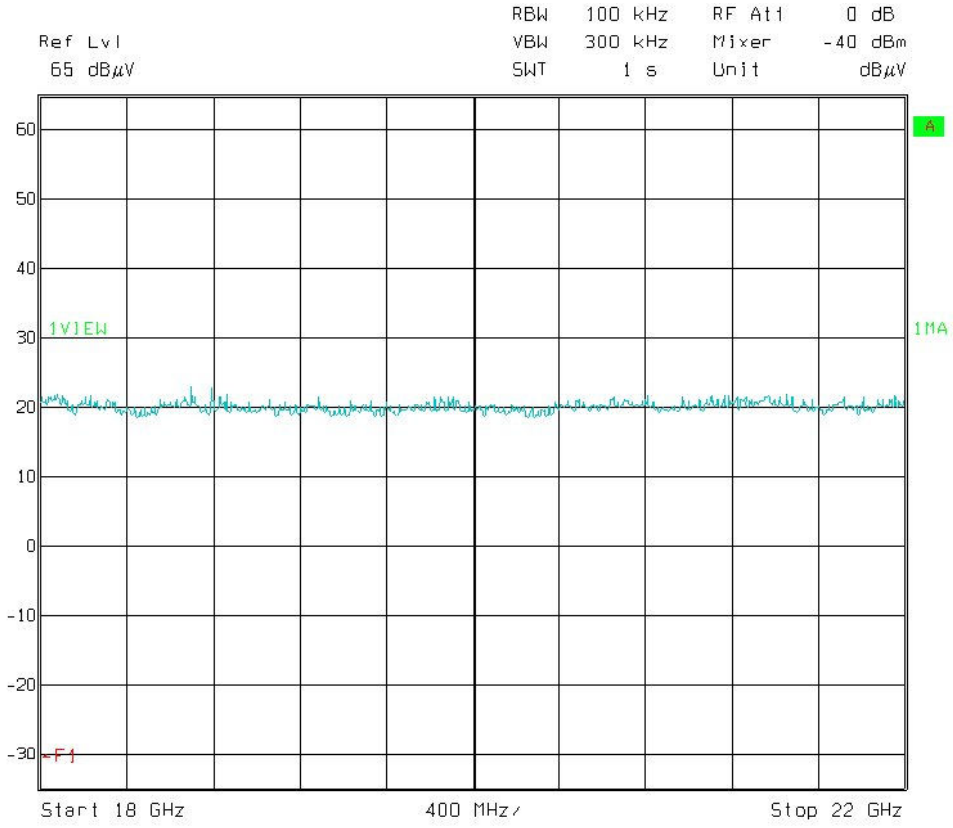
Transceiver A – Channel 11 Vertical Polarisation



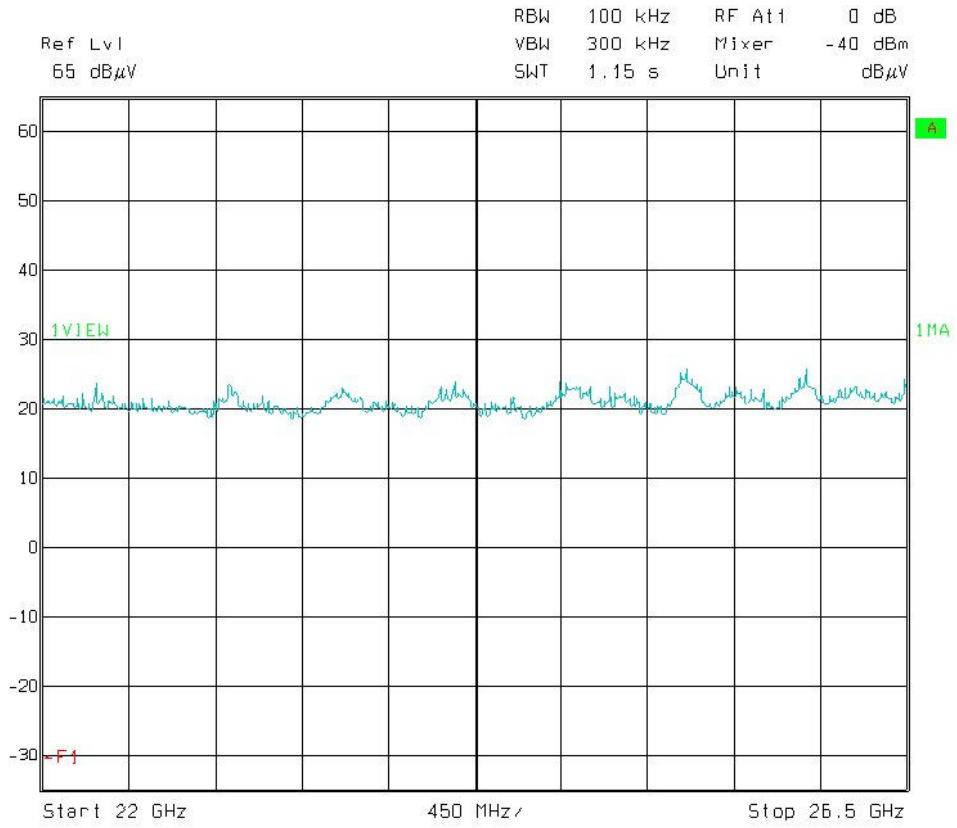
Transceiver A – Channel 11 Vertical Polarisation



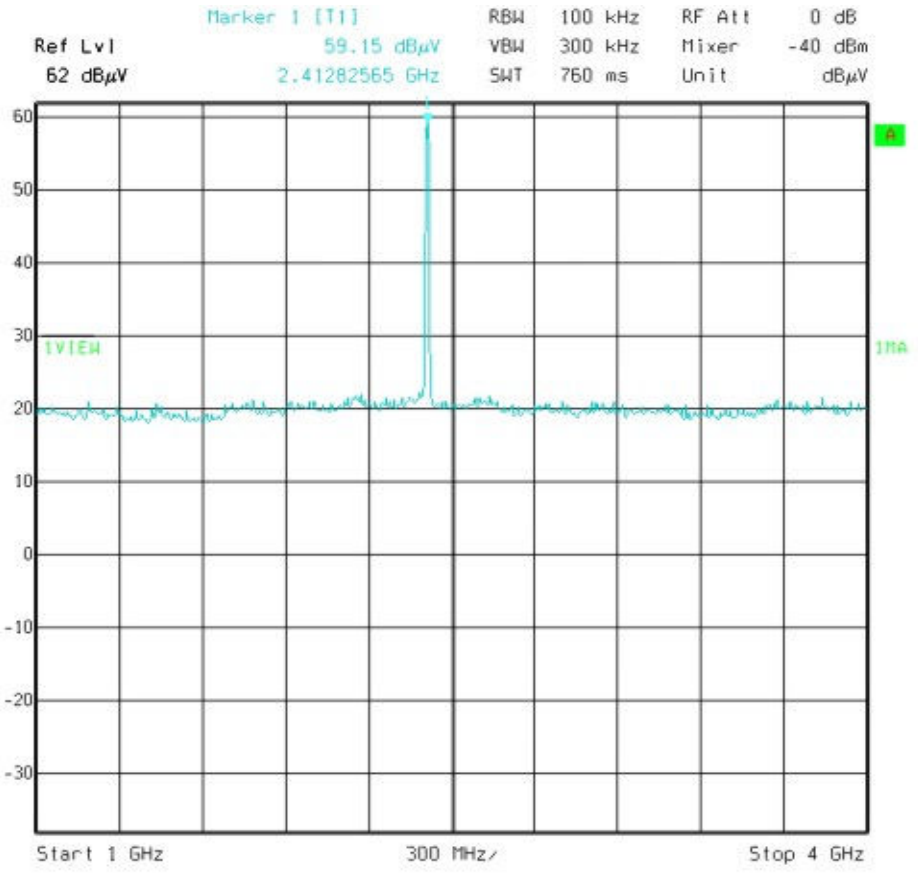
Transceiver A – Channel 11 Horizontal & Vertical Polarisation



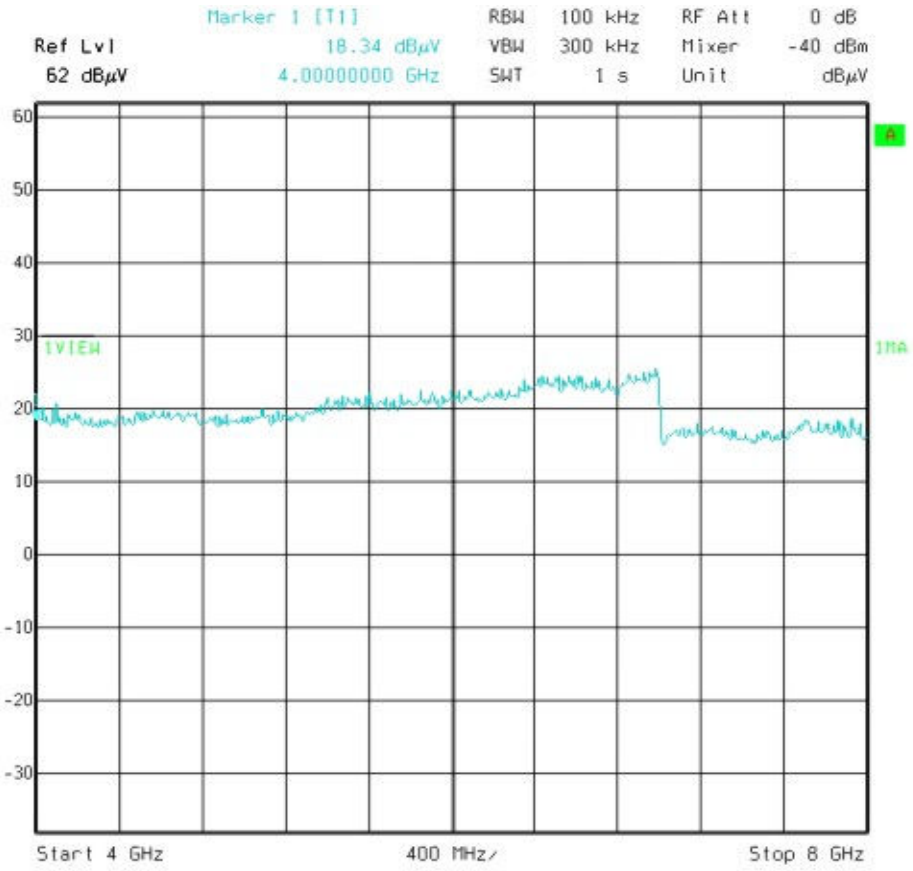
Transceiver A – Channel 11 Horizontal & Vertical Polarisation



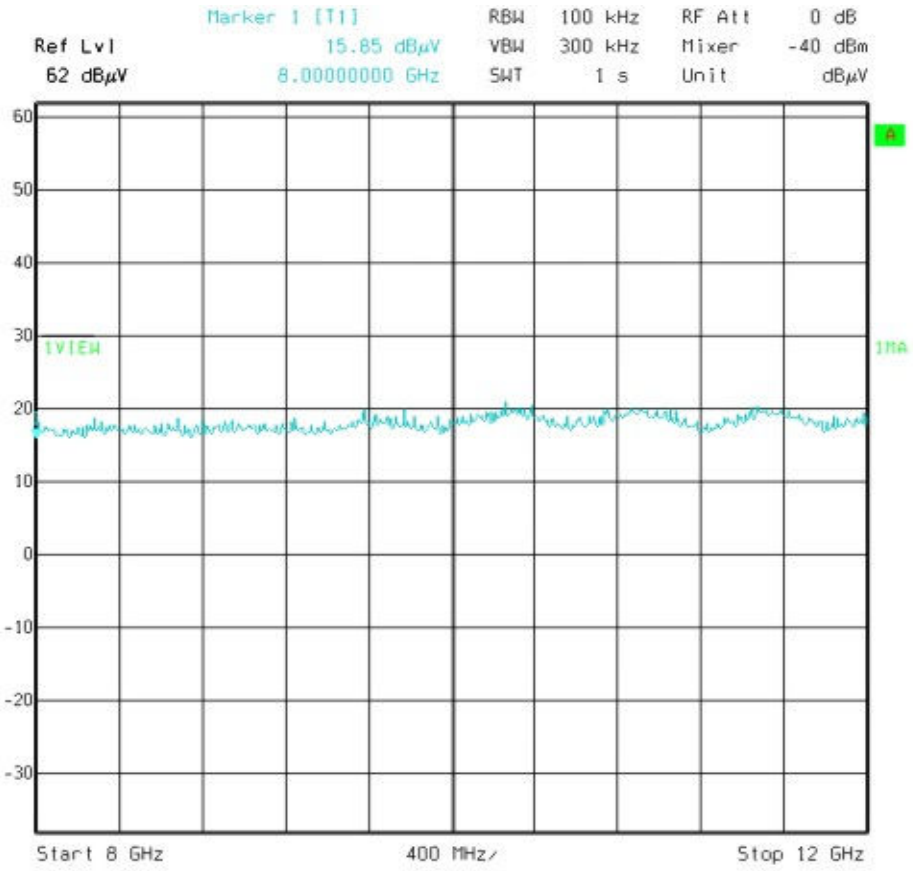
Transceiver B – Channel 1 Horizontal Polarisation



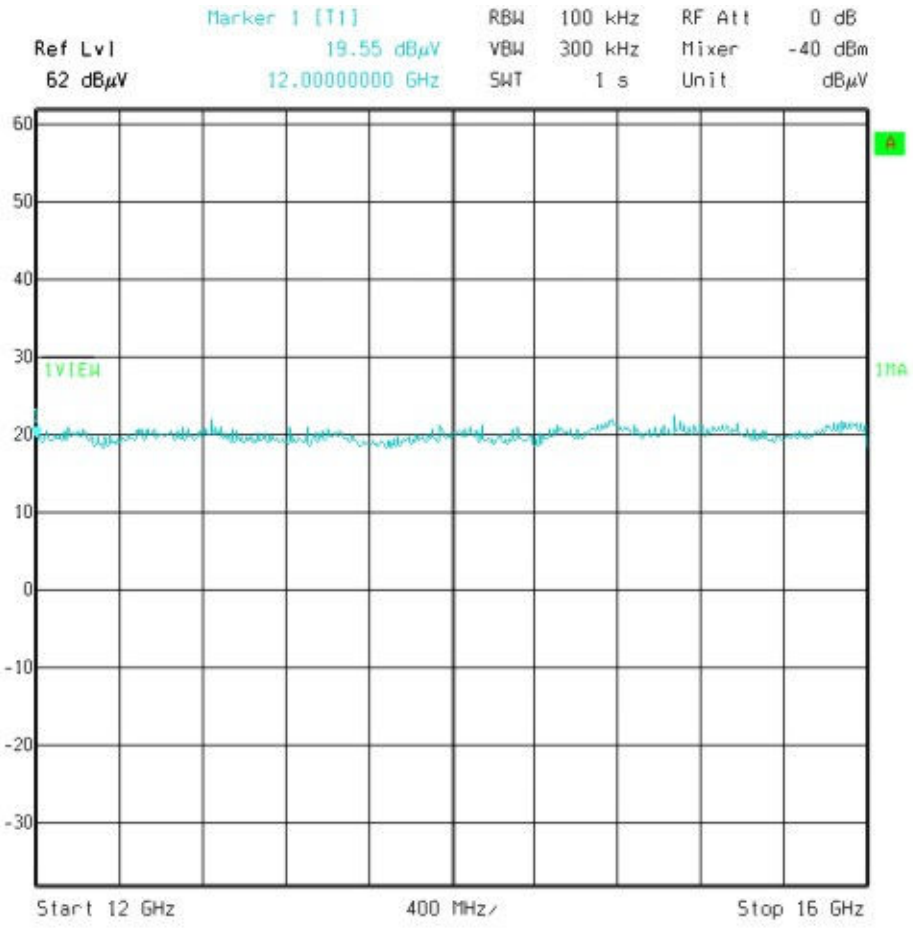
Transceiver B – Channel 1 Horizontal Polarisation



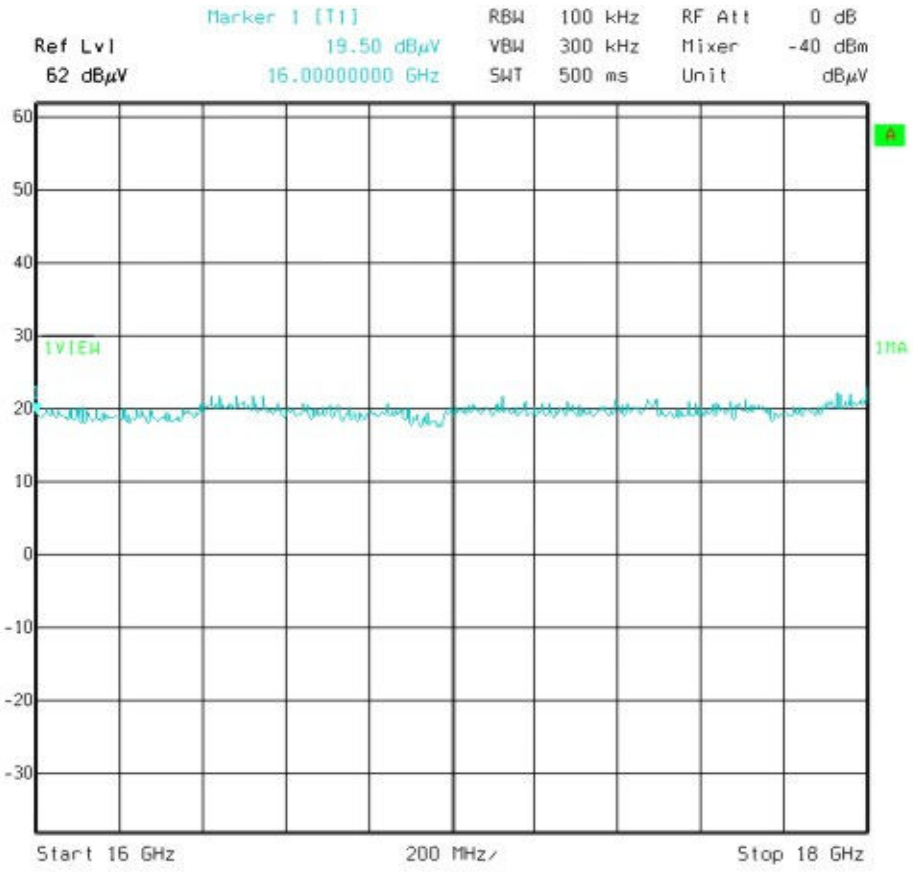
Transceiver B – Channel 1 Horizontal Polarisation



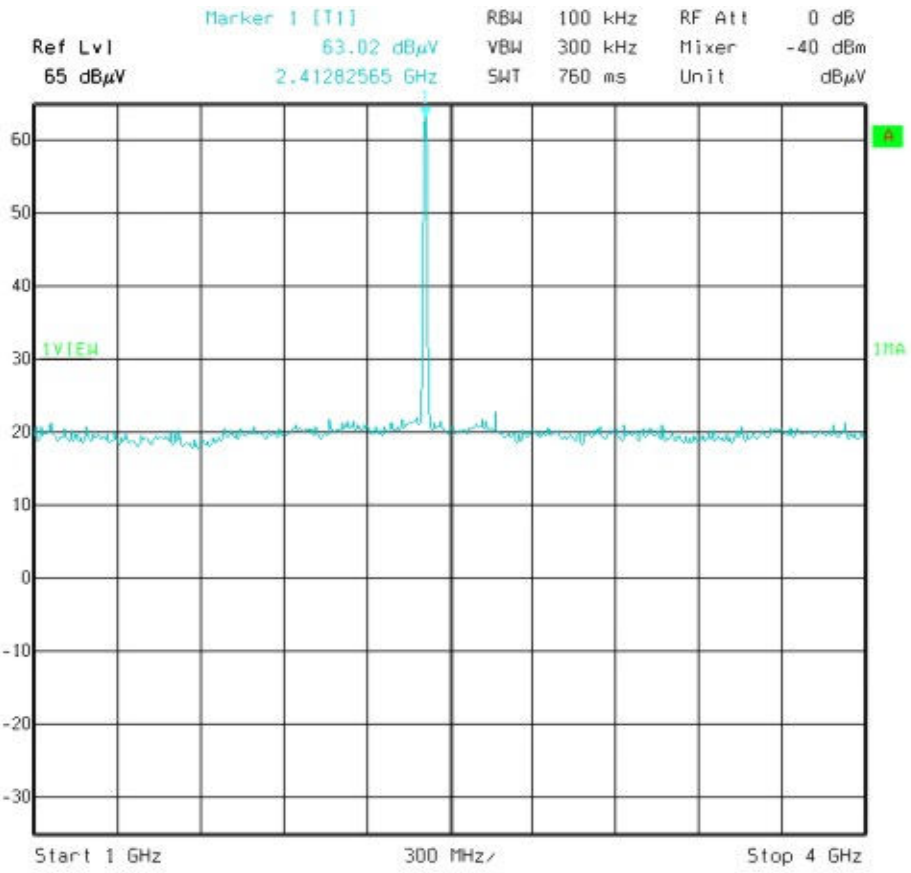
Transceiver B – Channel 1 Horizontal Polarisation



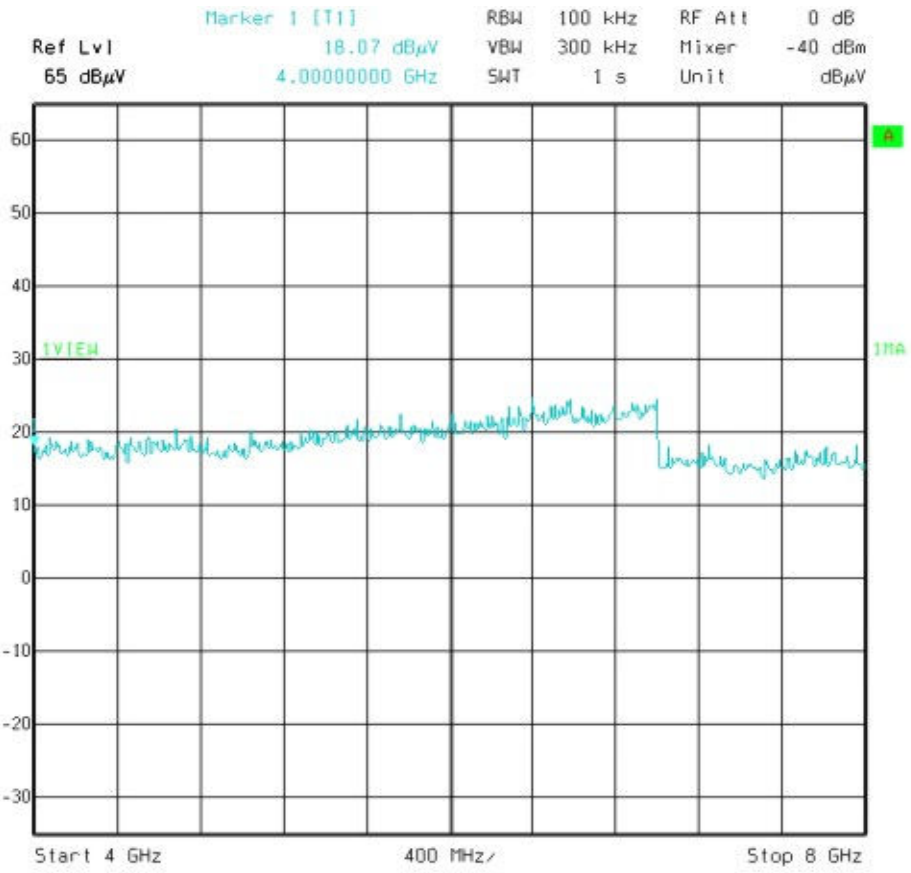
Transceiver B – Channel 1 Horizontal Polarisation



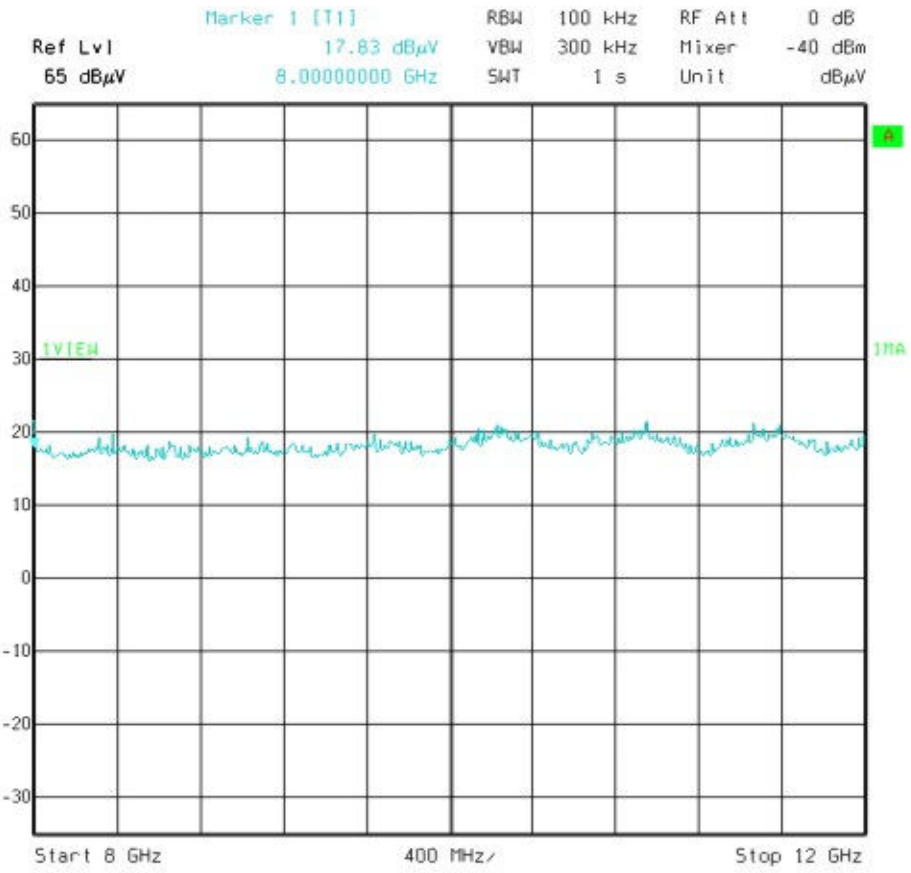
Transceiver B – Channel 1 Vertical Polarisation



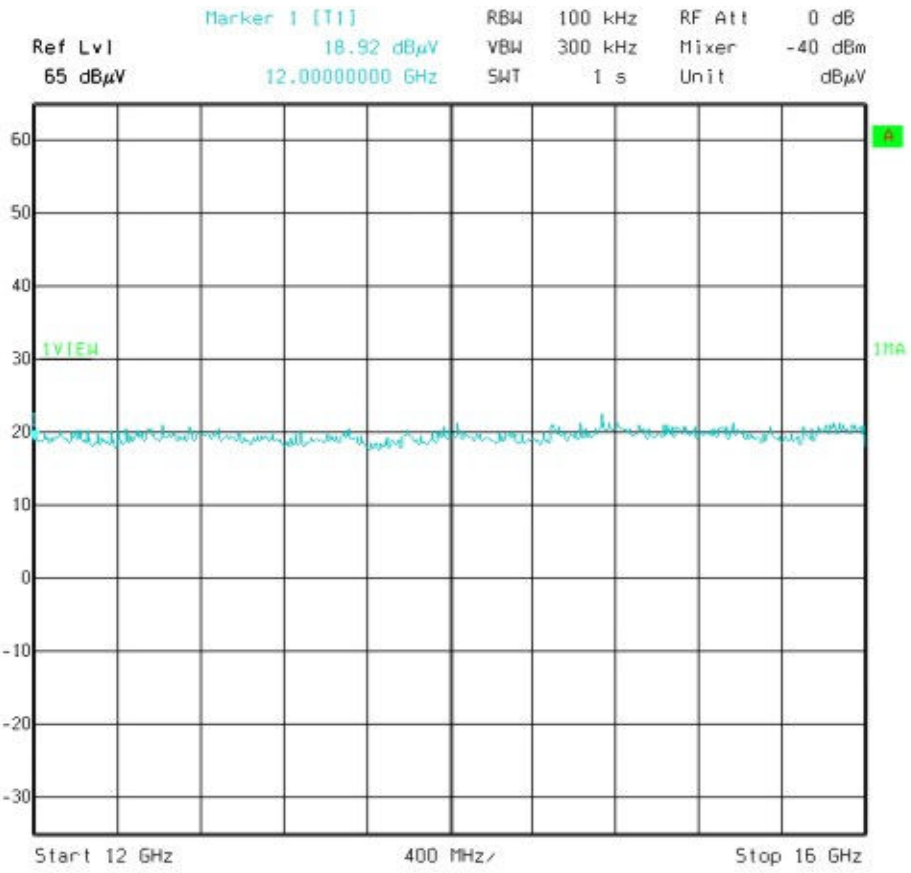
Transceiver B – Channel 1 Vertical Polarisation



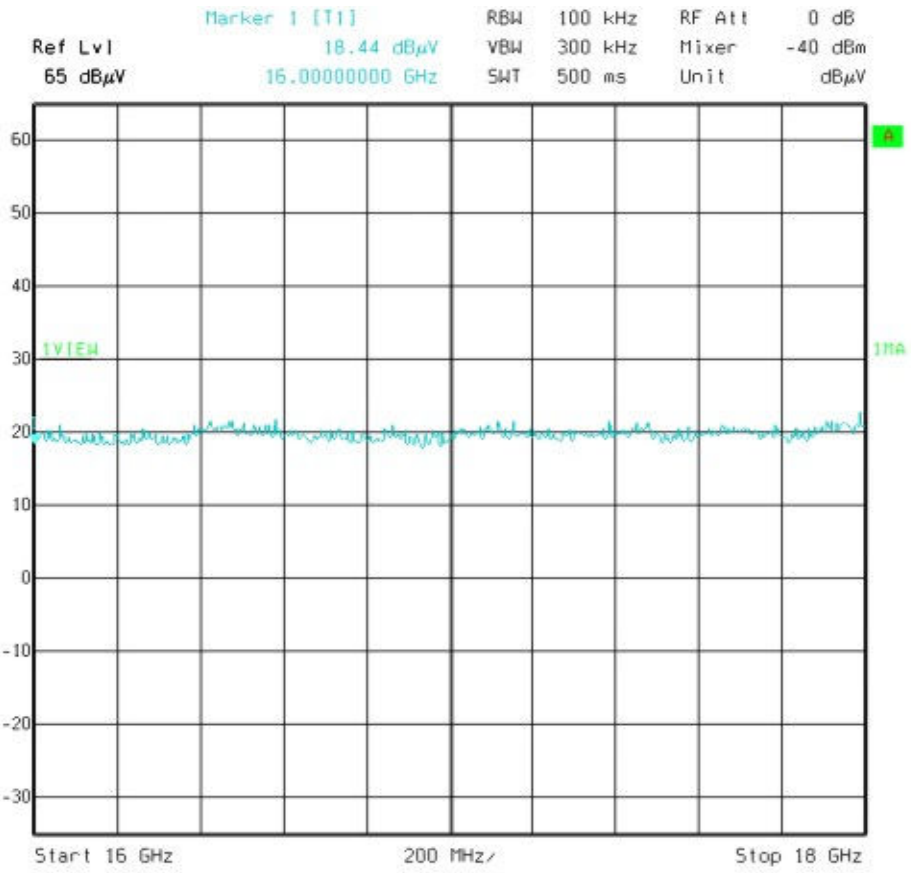
Transceiver B – Channel 1 Vertical Polarisation



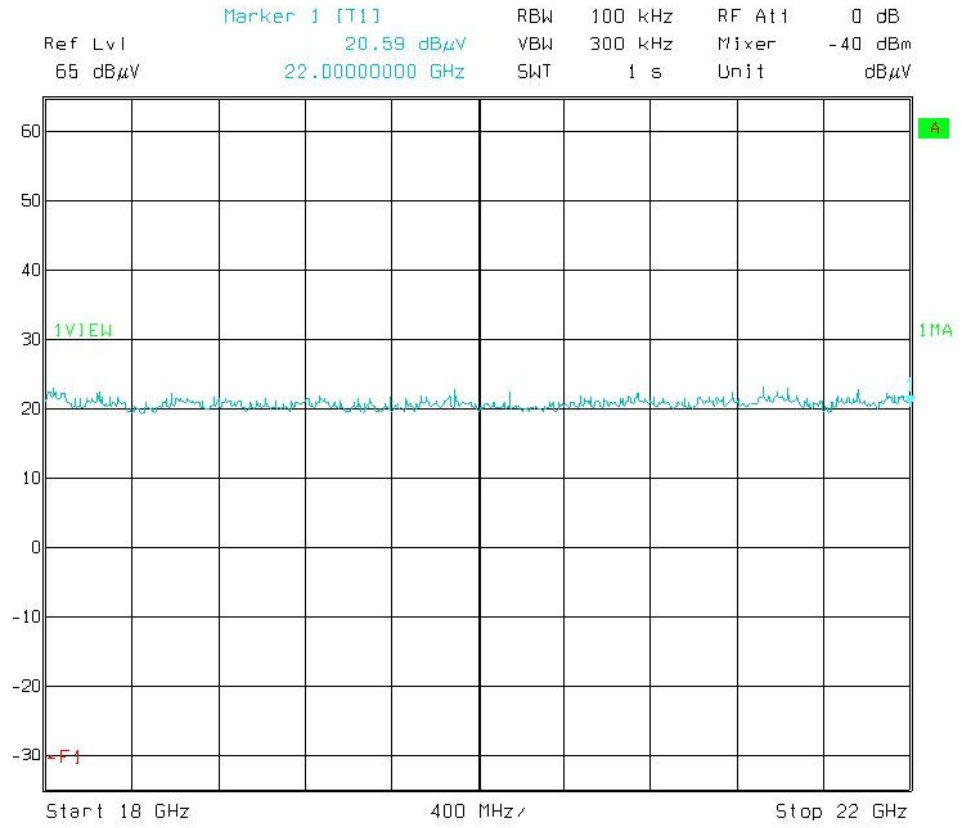
Transceiver B – Channel 1 Vertical Polarisation



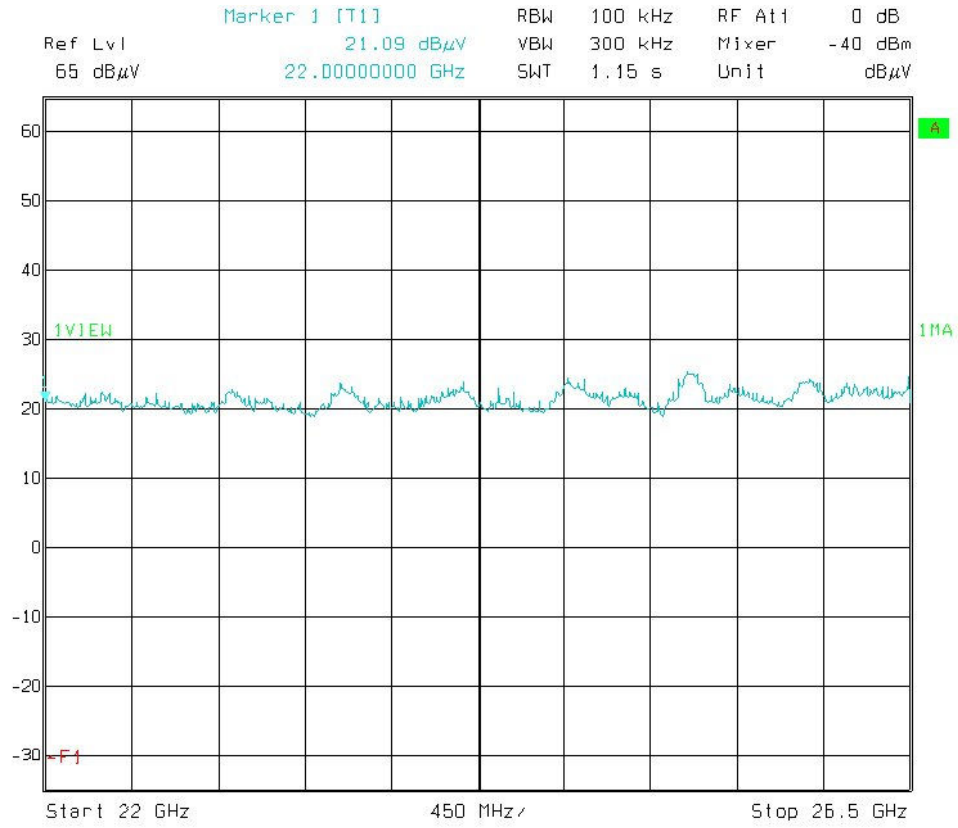
Transceiver B – Channel 1 Vertical Polarisation



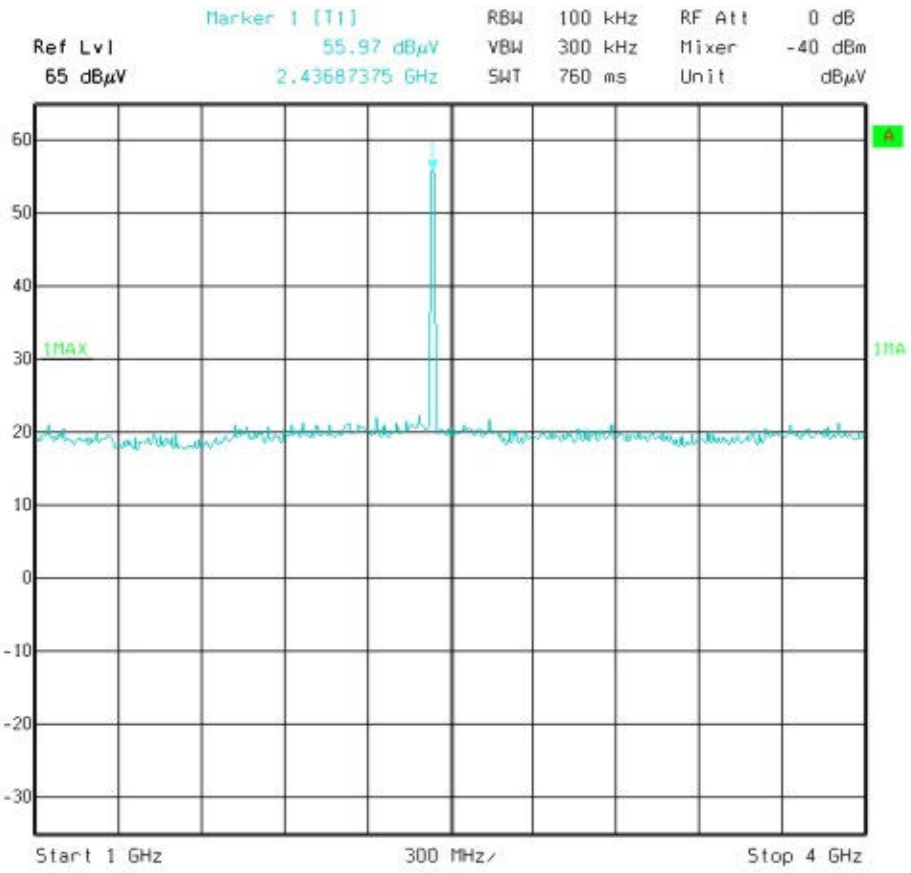
Transceiver B – Channel 1 Horizontal & Vertical Polarisation



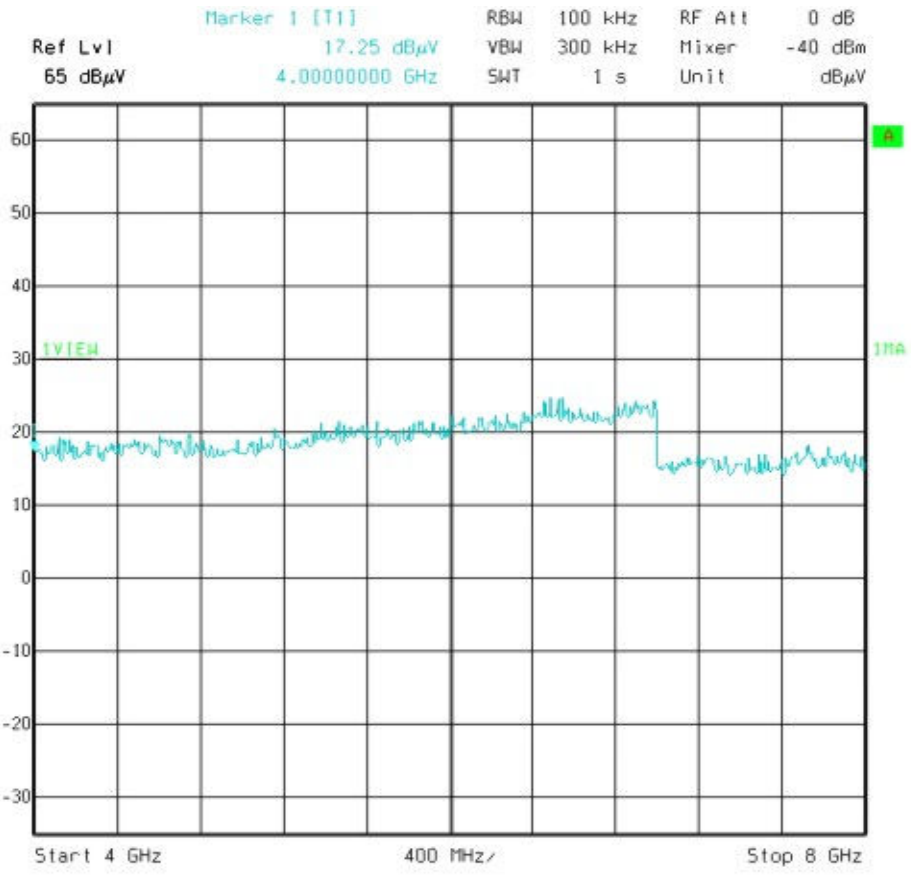
Transceiver B – Channel 1 Horizontal & Vertical Polarisation



Transceiver B – Channel 6 Horizontal Polarisation



Transceiver B – Channel 6 Horizontal Polarisation



Transceiver B – Channel 6 Horizontal Polarisation