Radio Test Report

Entel UK Ltd

Entel DX485 & DX482

47 CFR Part 90I Effective Date 1st October 2021
↳ 47CFR part 2J 2021
TNF: Licensed Non-Broadcast Transmitter Held to Face
Test Date: 8th June 2022 to 29th November 2022
Report Number: 11-12754-1-22 Issue 02
Supersedes report: 07-12754-1-22 Issue 01

R.N. Electronics Ltd.
Arnolds Court
Arnolds Farm Lane
Mountnessing
Essex
CM13 1UT
U.K.

www.RNelectronics.com

Telephone: +44 (0) 1277 352219
Email: sales@RNelectronics.com

Arnolds Court, Arnolds Farm Lane, Mountnessing, Brentwood Essex, CM13 1UT

Certificate of Test 12754-1

The equipment noted below has been fully tested by R.N. Electronics Limited and, where appropriate, conforms to the relevant subpart of FCC Part 90I. This is a certificate of test only and should not be confused with an equipment authorisation. Other standards may also apply.

Equipment:	Entel DX485 & DX482
Model Number:	DX485, DX482
Unique Serial Number:	DPAK00025 (Display) DPDG02469 (Non-Display)
Applicant:	Entel UK Ltd 320 Centennial Avenue, Centennial Park Elstree, Hertfordshire WD6 3TJ
Full measurement results are detailed in Report Number:	11-12754-1-22 Issue 02
Test Standards:	47 CFR Part 90I Effective Date 1st October 2021 ↳ 47CFR part 2J 2021 TNF: Licensed Non-Broadcast Transmitter Held to Face

NOTE:
Certain tests were not performed based upon manufacturer's declarations. Certain other requirements are subject to manufacturer declaration only and have not been tested/verified. For details refer to section 3 of this report.

DEVIATIONS:
No deviations have been applied.

This certificate relates only to the unit tested as identified by a unique serial number and in the condition at the time it was tested. It does not relate to any other similar equipment and performance of the product before or after the test cannot be guaranteed. Whilst every effort is made to assure quality of testing, type tests are not exhaustive and although no non-conformances may be found, this doesn't exclude the possibility of unit not meeting the intentions of the standard or the requirements of the Federal Regulations, particularly under different conditions to those during testing. Any compliance statements are made reliant on (a) the application of the product and use of the assigned band being acceptable to the FCC and (b) the modes of operation as instructed to us by the Customer based on their specific knowledge of the application and functionality of the EUT. Statements of compliance, where measurements were made, do not include the measurement uncertainty. The measurement uncertainty, where stated, is the expanded uncertainty based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

Date Of Test:	8th June 2022 to 29th November 2022
Test Engineer:	Graham Blake Digitally signed by: Graham Blake DN: CN = Graham Blake email = graham.blake@rnelectronics.com C = AD O = RN Electronics OU = Engineer Date: 2023.01.19 16:34:06 Z
Approved By: Radio Manager	Digitally signed by: Daniel Sims DN: CN = Daniel Sims C = GB O = RN Electronics Ltd Date: 2023.01.19 15:56:04 Z
Customer Representative:	

0 Revision History

Issue Number	Revision History	Page Reference(s)
01	First Issue	-
02	Note added to section 2.1 stating that additional testing has been performed on an Entel DX482 (non-display model) Additional test results for the DX482 model added to Radiated Emissions section 5.1 Additional test results for the DX482 model added to Conducted Power section 5.3 Additional test results for the DX482 model added to Emission Mask section 5.6. Plots added to section 6.3 I.D. photographs of the DX482 model added to photograph section 7.1 All photographs removed from report due to confidentiality request under the certification request.	5 14, 15 21 29, 54, 55, 56 66 65-76

1 Contents

2 Equipment under test (EUT)

2.1 Equipment specification

Applicant	Entel UK Ltd 320 Centennial Avenue Centennial Park Elstree Hertfordshire WD6 3TJ	
Manufacturer of EUT	Entel UK Ltd	
Full Name of EUT	Entel DX485, & Entel DX482	
Model Number of EUT	DX485 (Display version), DX482 (Non-Display version)	
Serial Number of EUT	DPAK00025 (Display) DPDG02469 (Non-Display)	
Date Received	7th April 2021	
Date of Test:	8th June 2022 to 29th November 2022	
Purpose of Test	To demonstrate design compliance to the relevant rules of Chapter 47 of the Code of Federal Regulations.	
Date Report Issued	15th December 2022	
Main Function	Radio communication	
Information Specification	Height	130 mm
	Width	95.5 mm
	Depth	37 mm
	Weight	0.277 kg
	Voltage	6 - 7.4 V DC
	Current	2 Amp maximum

Note: Full testing has been performed with an Entel DX485 Serial Number DPAK00025 Display version model. Additional Radiated Emissions, Conducted Power and Emission Mask tests have been performed with an Entel DX482 (non-display model) serial number DPDG02469, along with a conducted emissions check.

Alternative references
Entel UK Ltd confirm that the Entel DX485 model and DX482 model share identical Radio hardware, and are also identical with their intrinsically safe enclosure versions, model numbers listed below:

DX585-IS Intrinsically safe, Display model approved to UL913.

DX582-IS Intrinsically safe, Non display model approved to UL913.

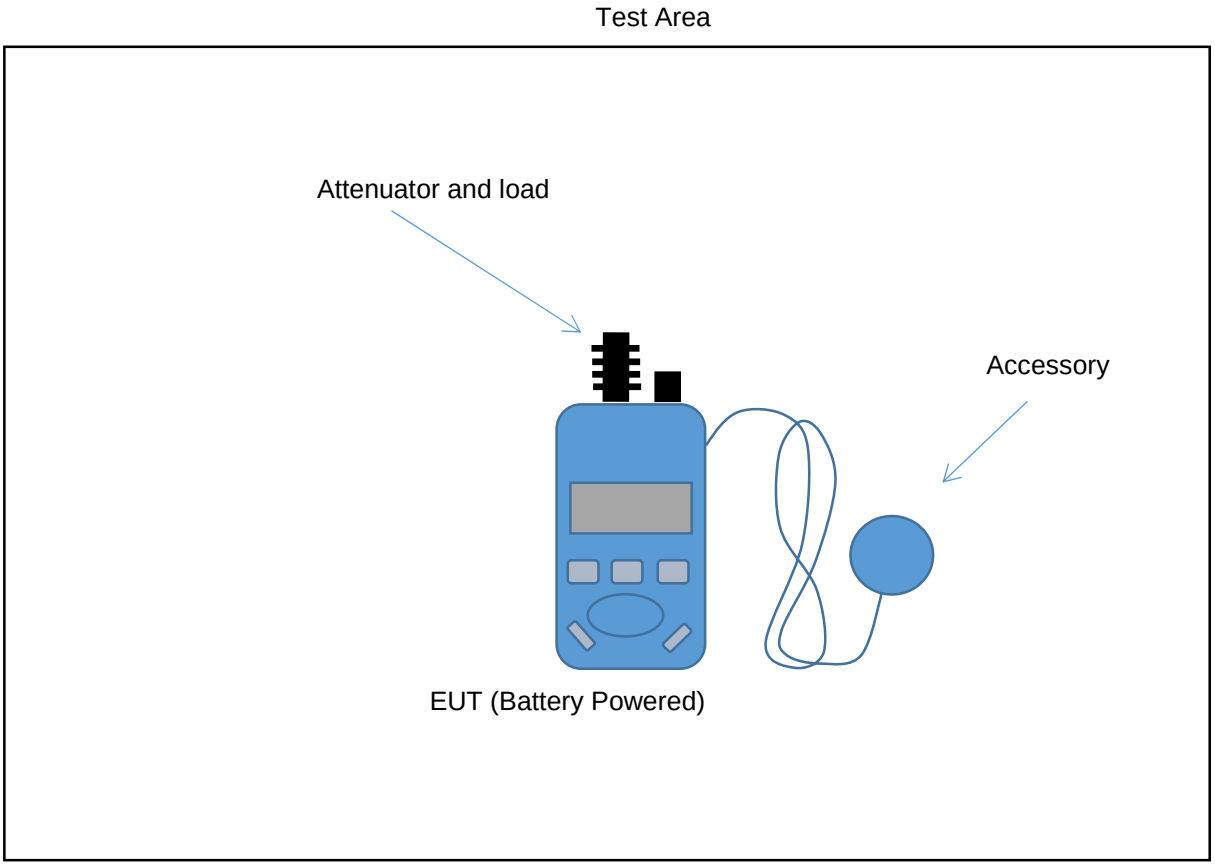
2.3 Functional description

Industrial grade portable radio with detachable antenna and battery pack. Channels and volume are programmable and can be assigned to either top rotary controls or front keypad. Side mounted press to talk button activates the transmitter, release to receive. Both loud speaker and microphone are mounted on the front panel.

2.4 Modes of operation

Mode Reference	Description	Used for testing
FM LOW	Transmitting continuously at 400.025 MHz with FM modulation.	Yes
FM MID	Transmitting continuously at 435.0 MHz with FM modulation.	Yes
FM HIGH	Transmitting continuously at 469.975 MHz with FM modulation.	Yes
CW LOW	Transmitting continuously at 400.025 MHz without modulation.	Yes
CW MID	Transmitting continuously at 435.0 MHz without modulation.	Yes
CW HIGH	Transmitting continuously at 469.975 MHz without modulation.	Yes
DIGITAL LOW	Transmitting continuously at 400.025 MHz with DIGITAL modulation.	Yes
DIGITAL MID	Transmitting continuously at 435.0 MHz with DIGITAL modulation.	Yes
DIGITAL HIGH	Transmitting continuously at 469.975 MHz with DIGITAL modulation.	Yes

2.5 Emissions configuration

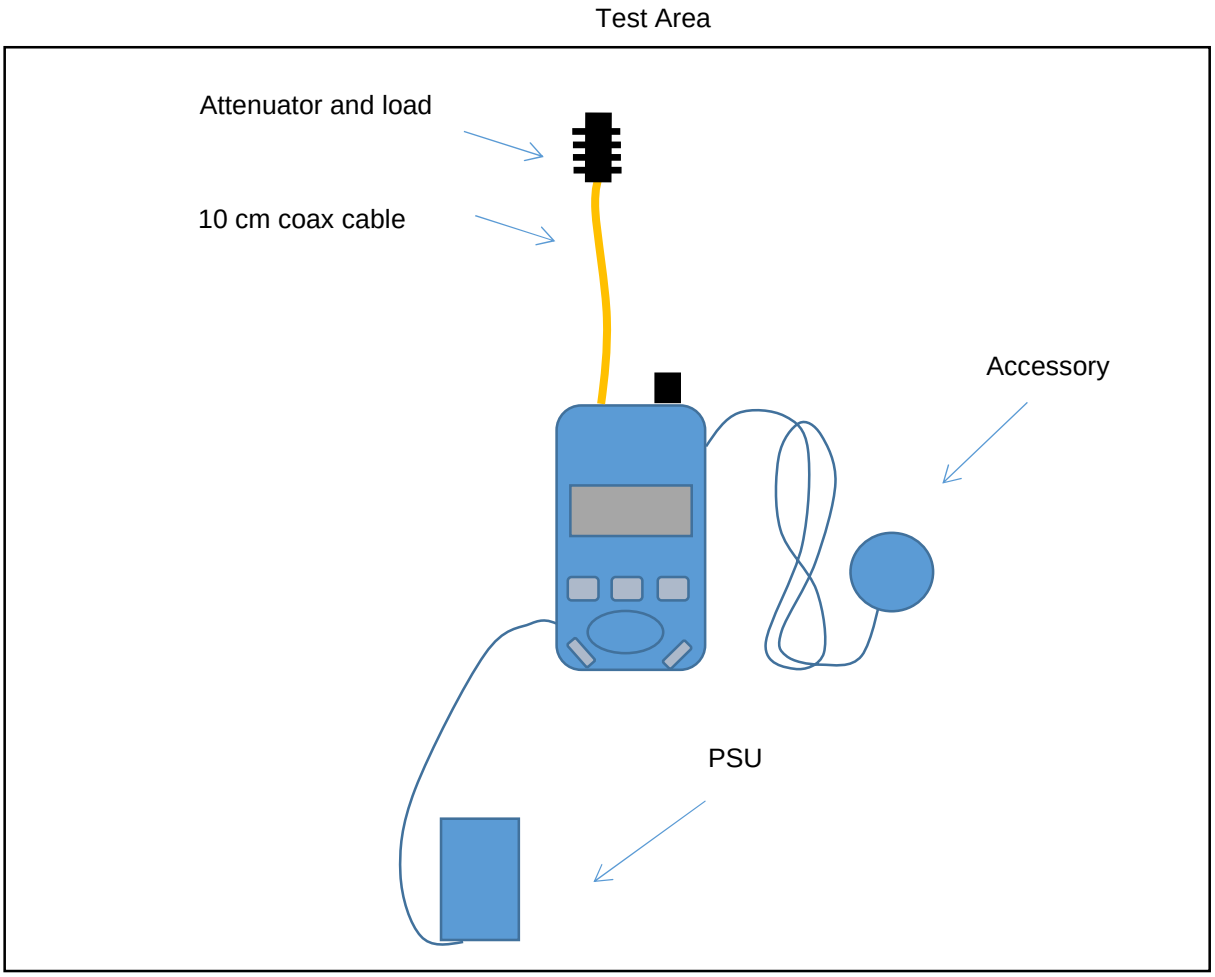


The units were powered from a fully charged battery. The EUT's antenna was removed and an attenuator and 50 ohm load were connected directly to the EUT's RF port. During a pre-scan a selection of accessories were connected to the EUT in turn and an assessment was made to establish which accessory produced the worst-case emissions. This accessory was used for full-test and is listed in section 9.1. The accessories excess wiring was bundled.

For conducted tests measurements were made at the antenna port. The EUTs operating modes were set using the EUT controls. For testing at voltage extremes a modified battery pack was used to allow connection of an external DC power supply. This allowed control of the supply voltage to the end-points as stated in section 4.3.

A test jig was supplied for the purposes of test to allow control of the transceiver, and as a means of applying audio to and obtaining audio from the transceiver when required.

2nd Configuration



At the request of the applicant, the EUT was also assessed in a second configuration as the radio is also intended to be integrated permanently into other equipment. A 10 cm coax cable was provided for test which was connected to the EUT's RF port and then terminated with an attenuator and a 50 ohm load. The EUT was also powered using a bench power supply, rather than its battery. In order to provide the EUT with power, a modified battery pack was used. This provided the DC power directly to the battery terminals on leads. The same worst case accessory was used.

2.5.1 Signal leads

Port Name	Cable Type	Connected
Antenna	SMA	Yes
Accessory	Custom connector	Yes
USB	Micro USB	No

Note: The USB is used for programming the device at manufacture and for engineering use only.

3 Summary of test results

The Entel DX485 and DX482 was tested for compliance to the following standard:

47 CFR Part 90I Effective Date 1st October 2021
↳ 47CFR part 2J 2021
TNF: Licensed Non-Broadcast Transmitter Held to Face

Any compliance statements are made reliant on (a) the application of the product and use of the assigned band being acceptable to the FCC and (b) the modes of operation as instructed to us by the Customer based on their specific knowledge of the application and functionality of the EUT. Whilst every effort is made to assure quality of testing, type tests are not exhaustive and although no non-conformances may be found, this doesn't exclude the possibility of equipment not meeting the intentions of the standard or the essential requirements of the directive, particularly under different conditions to those during testing. Statements of compliance, where measurements were made, do not include the measurement uncertainty. The measurement uncertainty, where stated, is the expanded uncertainty based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

Title	References	Results
Transmitter Tests		
1. Radiated emissions	FCC Part 90I Clause 90.210(d), 47CFR part 2J Clause 2.1053	PASSED[1]
2. Conducted emissions	FCC Part 90I Clause 90.210(d), 47CFR part 2J Clause 2.1051	PASSED[1]
3. Conducted power	FCC Part 90I Clause 90.205(g)(h), FCC Part 90I Clause 2.1046	PERFORMED[2]
4. Frequency stability	FCC Part 90I Clause 90.213(a), 47CFR part 2J Clause 2.1055	PASSED
5. Occupied bandwidth	FCC Part 90I Clause 90.209(b)(5), 47CFR part 2J Clause 2.1049	PASSED[3]
6. Emission mask	FCC Part 90I Clause 90.210(d)	PASSED
7. Modulation limiting	47CFR part 2J Clause 2.1047(b)	PERFORMED[4]
8. Modulation frequency response	47CFR part 2J Clause 2.1047(a)	PERFORMED[5]
9. Transient frequency behaviour	FCC Part 90I Clause 90.214	PASSED
10. Adjacent channel power	FCC Part 90I Clause 90.221	NOT APPLICABLE[6]

[1] Spectrum investigated up to a frequency of 5 GHz based on 10 times the highest channel/ signal generated in equipment of 470 MHz.
[2] Per FCC 2.1046 and 90.205(g)(h): Maximum ERP is dependent on the stations HAAT and required service area.
[3] Part 90.209(b)(5) Operations using equipment designed to operate with a 12.5 kHz channel bandwidth will be authorized a 11.25 kHz bandwidth. Please also see emissions mask results.
[4] Part 2J Clause 2.1047(b): The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.
[5] No limits specified, for information.
[6] EUT does not employ 25 kHz channels

4 Specifications

The tests were performed and operated in accordance with R.N. Electronics Ltd procedures and the relevant standards listed below.

4.1 Relevant standards

Ref.	Standard Number	Version	Description
4.1.1	FCC Part 90I	2021	Part 90 - Private Land Mobile Radio Services - Subpart I - General Technical standards
4.1.2	47CFR part 2J	2021	Part 2 – Frequency Allocations and radio treaty matters; General rules and regulations
4.1.3	ANSI C63.26	2015	American National Standard for Compliance testing of transmitters used in Licensed radio services

4.2 Deviations

No deviations were applied

4.3 Tests at extremes of temperature & voltage

The following test conditions were used to simulate testing at nominal or extremes.

Temperature Test Conditions		Voltage Test Conditions	
T nominal	20 °C	V nominal	7.4V DC
T minimum	-30 °C	V minimum	6V DC
T maximum	50 °C	V maximum	7.4V DC

Extremes of voltage are based on manufacturer's declaration.

Extremes of temperature are based upon the requirements of 47 CFR 2.1055.
The ambient test conditions of humidity and pressure in the laboratory were as specified in each specific test section within this report

4.4 Test fixtures

In order to measure RF parameters at temperature extremes, the EUT was tested in a temperature controlled chamber as follows:

A permanent internal RF port was used for testing.

5 Tests, methods and results

5.1 Radiated emissions

5.1.1 Test methods

Test Requirements:	FCC Part 90I Clause 90.210(d) [Reference 4.1.1 of this report], 47CFR part 2J Clause 2.1053 [Reference 4.1.2 of this report]
Test Method:	ANSI C63.26 Clause 5.5 [Reference 4.1.3 of this report]
Limits:	FCC Part 90I Clause 90.210(d)(3) [Reference 4.1.1 of this report]

5.1.2 Configuration of EUT

The EUT's were tested in an ALSE, and ambient conditions were monitored. Three orthogonal planes were examined. The EUT's were operated in CW LOW, CW MID, CW HIGH, DIGITAL LOW, DIGITAL MID and DIGITAL HIGH modes for this test. Both EUT's were operated in the 2 set-up configurations.

5.1.3 Test procedure

Tests were made in accordance with the Test Method noted above using the measuring equipment noted in the 'Test Equipment' Section at Sites B and M. Peak field strength from the EUT was maximised by rotating it 360 degrees. An RMS detector was used for final measurements.

25 MHz – 1 GHz.
The measuring antenna was scanned 1 - 4m in both Horizontal and Vertical polarisations. Substitution method was performed using tuned dipoles / a calibrated bi-conical antenna.

1 GHz – 4.7 GHz
The measuring antenna was used in both Horizontal and Vertical polarisations. Substitution method was performed using standard gain horn antennas.

5.1.4 Test equipment

E136, E236, E268, E289, E411, E428, E433, E467, E624, E743, E755, LPE364, TMS82, TMS812

See Section 8 for more details

5.1.5 Test results

Temperature of test environment	20°C
Humidity of test environment	50%
Pressure of test environment	101kPa

Configuration 1.

Setup Table

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	FM
Low channel	400.025 MHz
Mid channel	435.0 MHz
High channel	469.975 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No emissions within 20 dB of the limit were observed.				

Setup Table

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	Digital (TDMA)
Low channel	400.025 MHz
Mid channel	435.0 MHz
High channel	469.975 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No emissions within 20 dB of the limit were observed.				

Note: At the request of the applicant, the EUT (Display version) was also assessed as a radio module (minimum 10cm leads) which is intended to be integrated permanently into other equipment. Configuration 2.

Setup Table

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	FM
Low channel	400.025 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No emissions within 20 dB of the limit were observed.				

Setup Table

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	FM
Mid channel	435.0 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
4785.1	-38.7	-18.7	Horizontal	Upright

Setup Table

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	FM
High channel	469.975 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
4699.75	-43.3	-13.3	Vertical	Upright

4699.75	-31.0	-11.0	Horizontal	Upright

Setup Table

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	Digital (TDMA)
Low channel	400.025 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No emissions within 20 dB of the limit were observed.				

Setup Table

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	Digital (TDMA)
Mid channel	435.0 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
4785.1	-38.7	-18.7	Horizontal	Upright

Setup Table

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	Digital (TDMA)
High channel	469.975 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
4699.75	-43.3	-13.3	Vertical	Upright
4699.75	-31.0	-11.0	Horizontal	Upright

Additional test results for Entel DX482 (non-display model)
Configuration 1.

Setup Table

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	FM
Low channel	400.025 MHz
Mid channel	435.0 MHz
High channel	469.975 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No emissions within 20 dB of the limit were observed.				

Setup Table

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	Digital (TDMA)
Low channel	400.025 MHz
Mid channel	435.0 MHz
High channel	469.975 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No emissions within 20 dB of the limit were observed.				

Note: At the request of the applicant, the EUT (Non display) version was also assessed as a radio module (minimum 10cm leads) which is intended to be integrated permanently into other equipment.
Configuration 2.

Setup Table

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	TDMA
Low channel	400.025 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No emissions within 20 dB of the limit were observed.				

Setup Table

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	TDMA
Mid channel	435.0 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No emissions within 20 dB of the limit were observed.				

Setup Table

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	TDMA
High channel	469.975 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
4699.75	-34.0	-14.0	Vertical	Flat
4699.75	-35.0	-15.0	Horizontal	Upright

Setup Table

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	FM
Low channel	400.025 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No emissions within 20 dB of the limit were observed.				

Setup Table

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	FM
Mid channel	435.0 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No emissions within 20 dB of the limit were observed.				

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	FM
High channel	469.975 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation

4699.75	-34.0	-14.0	Vertical	Flat
4699.75	-35.0	-15.0	Horizontal	Upright

LIMITS:
Part 90.210(d)(3), On any frequency removed from the centre of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation. For 1 W and 4 W gives a limit of -20 dBm.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
30MHz – 1000MHz ±6.1dB, 1 – 5 GHz ±3.5dB

5.2 Conducted emissions

5.2.1 Test methods

Test Requirements:	FCC Part 90I Clause 90.210(d) [Reference 4.1.1 of this report], 47CFR part 2J Clause 2.1051 [Reference 4.1.2 of this report]
Test Method:	ANSI C63.26 Clause 5.7 [Reference 4.1.3 of this report]
Limits:	FCC Part 90I Clause 90.210(d)(3) [Reference 4.1.1 of this report]

5.2.2 Configuration of EUT

The EUT was operated on a test bench. Measurements were made at the RF port. The EUT was operated in FM LOW, FM MID, FM HIGH, DIGITAL LOW, DIGITAL MID and DIGITAL HIGH modes for this test.

5.2.3 Test procedure

Tests were made in accordance with the Test Method noted above using the measuring equipment noted in the 'Test Equipment' Section at Site A. A complete scan of emissions from the lowest frequency used within the equipment up to 10 times the highest frequency generated was made, to identify any signals within 20dB of the limits. Any identified spurious signals were measured in the required bandwidths.

5.2.4 Test equipment

E236, E266, E412, E463, E478, E558, E967

See Section 8 for more details

5.2.5 Test results

Temperature of test environment	20°C
Humidity of test environment	50%
Pressure of test environment	101kPa

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	FM
Low channel	400.025 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
No emissions observed within 20 dB of the limit.		

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	FM
Mid channel	435.0 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
No emissions observed within 20 dB of the limit.		

Plots
12754-1 TX Conducted Emissions FM 435 MHz channel, 9 – 150 kHz
12754-1 TX Conducted Emissions FM 435 MHz channel, 150 kHz – 30 MHz
12754-1 TX Conducted Emissions FM 435 MHz channel, 30 – 500 MHz
12754-1 TX Conducted Emissions FM 435 MHz channel, 500 – 1000 MHz
12754-1 TX Conducted Emissions FM 435 MHz channel, 1 – 3 GHz
12754-1 TX Conducted Emissions FM 435 MHz channel, 3 – 4 GHz
12754-1 TX Conducted Emissions FM 435 MHz channel, 4 – 5 GHz

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	FM
High channel	469.975 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
No emissions observed within 20 dB of the limit.		

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	Digital (TDMA)
Low channel	400.025 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
No emissions observed within 20 dB of the limit.		

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	Digital (TDMA)
Mid channel	435.0 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
No emissions observed within 20 dB of the limit.		

Plots
12754-1 TX Conducted Emissions DIGITAL 435 MHz channel, 9 – 150 kHz
12754-1 TX Conducted Emissions DIGITAL 435 MHz channel, 150 kHz – 30 MHz
12754-1 TX Conducted Emissions DIGITAL 435 MHz channel, 30 – 500 MHz
12754-1 TX Conducted Emissions DIGITAL 435 MHz channel, 500 – 1000 MHz
12754-1 TX Conducted Emissions DIGITAL 435 MHz channel, 1 – 3 GHz
12754-1 TX Conducted Emissions DIGITAL 435 MHz channel, 3 – 4 GHz
12754-1 TX Conducted Emissions DIGITAL 435 MHz channel, 4 – 5 GHz

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	Digital (TDMA)
High channel	469.975 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
No emissions observed within 20 dB of the limit.		

Note: The Non-Display EUT model was also checked and no spurious emissions within 20dB of limits were observed, no plots were taken. Configuration 1 (10cm RF lead not fitted) was used for full tests as worst case.

Any analyser plots can be found in Section 6 of this report.

Note: Whilst Low, Mid and High channels were tested, plots are for illustrative purposes only and only Mid channel plots are shown in this report.

LIMITS:
Part 90.210(d)(3), On any frequency removed from the centre of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.
For 1 W and 4 W gives a limit of -20 dBm.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
± 2.8 dB up to 5 GHz

5.3 Conducted power

5.3.1 Test methods

Test Requirements:	FCC Part 90I Clause 90.205(g)(h) [Reference 4.1.1 of this report], FCC Part 90I Clause 2.1046 [Reference 4.1.1 of this report]
Test Method:	ANSI C63.26 Clause 5.2 [Reference 4.1.3 of this report]
Limits:	FCC Part 90I Clause 90.205(g)(h) [Reference 4.1.1 of this report]

5.3.2 Configuration of EUT

The EUT was measured on a bench using a spectrum analyser connected to the RF port. The EUT was operated in CW LOW, CW MID, CW HIGH, DIGITAL LOW, DIGITAL MID and DIGITAL HIGH modes for this test. The EUT was set to each mode and test signal in turn (see section 2.4) and highest power levels recorded.

5.3.3 Test procedure

Tests were made in accordance with the Test Method noted above using the measuring equipment listed in the 'Test Equipment' Section. Power meter reading stated is maximum power observed using a spectrum analyser. The test was repeated using the EUT's low power setting. Measurements were made in site A.

5.3.4 Test equipment

E266, E558, H072

See Section 8 for more details

5.3.5 Test results

Temperature of test environment	20°C
Humidity of test environment	50%
Pressure of test environment	101kPa

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	FM
Low channel	400.025 MHz
Mid channel	435 MHz
High channel	469.975 MHz

Test conditions		Carrier Power (dBm)	Carrier Power (dBm)	Carrier Power (dBm)
		Low channel	Mid channel	High channel
Temp Ambient	Volts Nominal	35.8	35.8	35.6

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	Digital (TDMA)
Low channel	400.025 MHz
Mid channel	435 MHz
High channel	469.975 MHz

Test conditions		Carrier Power (dBm)	Carrier Power (dBm)	Carrier Power (dBm)
		Low channel	Mid channel	High channel
Temp Ambient	Volts Nominal	36.2	36.2	36.1

Band	400-470 MHz
Power Level	1 Watt
Channel Spacing	12.5 kHz
Mod Scheme	FM
Low channel	400.025 MHz
Mid channel	435 MHz
High channel	469.975 MHz

Test conditions		Carrier Power (dBm)	Carrier Power (dBm)	Carrier Power (dBm)
		Low channel	Mid channel	High channel
Temp Ambient	Volts Nominal	29.7	29.7	29.6

Band	400-470 MHz
Power Level	1 Watt
Channel Spacing	12.5 kHz
Mod Scheme	Digital (TDMA)
Low channel	400.025 MHz
Mid channel	435 MHz
High channel	469.975 MHz

Test conditions		Carrier Power (dBm)	Carrier Power (dBm)	Carrier Power (dBm)
		Low channel	Mid channel	High channel
Temp Ambient	Volts Nominal	29.9	29.9	29.7

Additional test results for Entel DX482 (non-display model)

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	FM
Low channel	400.025 MHz
Mid channel	435 MHz
High channel	469.975 MHz

Test conditions		Carrier Power (dBm)	Carrier Power (dBm)	Carrier Power (dBm)
		Low channel	Mid channel	High channel
Temp Ambient	Volts Nominal	36.2	36.0	35.5

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	Digital (TDMA)
Low channel	400.025 MHz
Mid channel	435 MHz
High channel	469.975 MHz

Test conditions		Carrier Power (dBm)	Carrier Power (dBm)	Carrier Power (dBm)
		Low channel	Mid channel	High channel
Temp Ambient	Volts Nominal	36.2	36.0	35.5

Band	400-470 MHz
Power Level	1 Watt
Channel Spacing	12.5 kHz
Mod Scheme	FM
Low channel	400.025 MHz
Mid channel	435 MHz
High channel	469.975 MHz

Test conditions		Carrier Power (dBm)	Carrier Power (dBm)	Carrier Power (dBm)
		Low channel	Mid channel	High channel
Temp Ambient	Volts Nominal	30.6	30.4	30.4

Band	400-470 MHz
Power Level	1 Watt
Channel Spacing	12.5 kHz
Mod Scheme	Digital (TDMA)
Low channel	400.025 MHz
Mid channel	435 MHz
High channel	469.975 MHz

Test conditions		Carrier Power (dBm)	Carrier Power (dBm)	Carrier Power (dBm)
		Low channel	Mid channel	High channel
Temp Ambient	Volts Nominal	30.6	30.4	30.1

LIMITS:
Per FCC 2.1046 and 90.205(g)(h): Maximum ERP is dependent on the stations HAAT and required service area.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
<± 1.0 dB

5.4 Frequency stability

5.4.1 Test methods

Test Requirements: FCC Part 90I Clause 90.213(a) [Reference 4.1.1 of this report], 47CFR part 2J Clause 2.1055 [Reference 4.1.2 of this report]
Test Method: ANSI C63.26 Clause 5.6 [Reference 4.1.3 of this report]
Limits: FCC Part 90I Clause 90.213(a) [Reference 4.1.1 of this report]

5.4.2 Configuration of EUT

The EUT was placed in a temperature controlled chamber and thermal balance was achieved before tests began. Measurements were made at the EUT 50 ohm port using a spectrum analyser. The EUT was operated in CW LOW, CW MID and CW HIGH mode for this test.

5.4.3 Test procedure

Tests were made in accordance with the Test Method noted above, using the measuring equipment listed in the 'Test Equipment' Section.
Temperature stability was achieved at each test level before taking measurements. The measurement was performed on a CW signal. Tests were performed using Test Site B.

5.4.4 Test equipment

E227, E309, E434, E755, L264, N579, TMS38

See Section 8 for more details

5.4.5 Test results

Temperature of test environment	20°C
Humidity of test environment	50%
Pressure of test environment	101kPa

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	FM
Low channel	400.025 MHz
Mid channel	435 MHz
High channel	469.975 MHz

Test conditions		Frequency Error (MHz) Low channel	Frequency Error (MHz) Mid channel	Frequency Error (MHz) High channel
-30°C	Volts Nominal (7.4)	400.025014	435.000037	469.975048
-20°C	Volts Nominal (7.4)	400.025044	435.000056	469.975056
-10°C	Volts Nominal (7.4)	400.025056	435.000081	469.975092
0°C	Volts Nominal (7.4)	400.025073	435.000086	469.975083
10°C	Volts Nominal (7.4)	400.025081	435.000116	469.975131
20°C	Volts Minimum (6)	400.024985	435.000001	469.975005
	Volts Nominal (7.4)	400.024987	434.999997	469.975003
	Volts Maximum (7.4)	400.024987	434.999997	469.975003
30°C	Volts Nominal (7.4)	400.025088	435.000113	469.975128
40°C	Volts Nominal (7.4)	400.025073	435.000091	469.975102
50°C	Volts Nominal (7.4)	400.025076	435.000097	469.975110
Max Frequency Error per chan (Hz)		+88 / -15	+116 / -3	+131 / -0
Max Frequency Error observed (MHz)		0.000088	0.000116	0.000131
Max frequency error (ppm)		0.279	0.313	0.3

LIMITS:
Part 90.213 (a): In the 421-512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
<± 0.7 ppm

5.5 Occupied bandwidth

5.5.1 Test methods

Test Requirements:	FCC Part 90I Clause 90.209(b)(5) [Reference 4.1.1 of this report], 47CFR part 2J Clause 2.1049 [Reference 4.1.2 of this report]
Test Method:	ANSI C63.26 Clause 5.4 [Reference 4.1.3 of this report]
Limits:	FCC Part 90I Clause 90.209(b)(5) [Reference 4.1.1 of this report]

5.5.2 Configuration of EUT

The EUT was operated on a test bench. Measurements were made at the RF port. For FM mode of operation the EUT was modulated with a 2.5 kHz audio tone. The EUT was operated in FM LOW, FM MID, FM HIGH, DIGITAL LOW, DIGITAL MID and DIGITAL HIGH modes.

5.5.3 Test procedure

Tests were performed using Test Site A. Tests were made in accordance with the Test Method noted above using the measuring equipment noted in the 'Test Equipment' Section. A 390 Hz RBW, 3x VBW, auto sweep time and max hold settings were used for the 99% bandwidth.
The EUT was set to each Bandwidth/mod scheme in turn (see section 2.4) and 99% bandwidth recorded.

5.5.4 Test equipment

E266, E412, E558, TMS48, TMS55

See Section 8 for more details

5.5.5 Test results

Temperature of test environment	20°C
Humidity of test environment	50%
Pressure of test environment	101kPa

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	FM
Low channel	400.025 MHz
Mid channel	435 MHz
High channel	469.975 MHz

	Low channel	Mid channel	High channel
99 % Bandwidth (kHz) Nominal Temp & Volts	5.91	5.92	5.89
Plot for 99 % Bandwidth Nominal Temp & Volts	12754-1 FM LOW	12754-1 FM MID	12754-1 FM HIGH

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	Digital (TDMA)
Low channel	400.025 MHz
Mid channel	435 MHz
High channel	469.975 MHz

	Low channel	Mid channel	High channel
99 % Bandwidth (kHz) Nominal Temp & Volts	7.68	7.75	8.15
Plot for 99 % Bandwidth Nominal Temp & Volts	12754-1 DIGITAL LOW	12754-1 DIGITAL MID	12754-1 DIGITAL HIGH

Any analyser plots can be found in Section 6 of this report.

LIMITS:
Part 90.209(b)(5) Operations using equipment designed to operate with a 12.5 kHz channel bandwidth will be authorized a 11.25 kHz bandwidth.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
<± 1.9 %

5.6 Emission mask

5.6.1 Test methods

Test Requirements:	FCC Part 90I Clause 90.210(d) [Reference 4.1.1 of this report]
Test Method:	ANSI C63.26 Clause 5.7 [Reference 4.1.3 of this report]
Limits:	FCC Part 90I Clause 90.210(d) [Reference 4.1.1 of this report]

5.6.2 Configuration of EUT

The EUT was operated on a test bench. Measurements were made at the RF port. For FM mode of operation the EUT was modulated with a 2.5 kHz audio tone. The EUT was operated in FM LOW, FM MID, FM HIGH, DIGITAL LOW, DIGITAL MID and DIGITAL HIGH modes.

5.6.3 Test procedure

Tests were made in accordance with the Test Method noted above using the measuring equipment listed in the 'Test equipment used' Section. The analyser was tuned to the nominal centre frequency and the spectrum analyser was set using a suitable span. The max-hold function of the analyser was used and was allowed to sweep enough times to capture the entire power envelope. Plots were taken referenced to the applicable spectrum mask.

Tests were performed is test site A.

5.6.4 Test equipment

E309, H071

See Section 8 for more details

5.6.5 Test results

Temperature of test environment	20°C
Humidity of test environment	50%
Pressure of test environment	102kPa

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	FM
Low channel	400.025 MHz
Mid channel	435 MHz
High channel	469.975 MHz

	Low channel	Mid channel	High channel
Nominal plot reference	12754-1 Emission mask D (12.5kHz) – FM LOW CHANNEL	12754-1 Emission mask D (12.5kHz) – FM MID CHANNEL	12754-1 Emission mask D (12.5kHz) – FM HIGH CHANNEL

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	Digital (TDMA)
Low channel	400.025 MHz
Mid channel	435 MHz
High channel	469.975 MHz

	Low channel	Mid channel	High channel
Nominal plot reference	12754-1 Emission mask D (12.5kHz) – DIGITAL LOW CHANNEL	12754-1 Emission mask D (12.5kHz) – DIGITAL MID CHANNEL	12754-1 Emission mask D (12.5kHz) – DIGITAL HIGH CHANNEL

Additional test results for Entel DX482 (non-display model)

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	FM
Low channel	400.025 MHz
Mid channel	435 MHz
High channel	469.975 MHz

	Low channel	Mid channel	High channel
Nominal plot reference	12754-4 Emission mask D (12.5kHz) – FM LOW CHANNEL	12754-4 Emission mask D (12.5kHz) – FM MID CHANNEL	12754-4 Emission mask D (12.5kHz) – FM HIGH CHANNEL

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	Digital (TDMA)
Low channel	400.025 MHz
Mid channel	435 MHz
High channel	469.975 MHz

	Low channel	Mid channel	High channel
Nominal plot reference	12754-4 Emission mask D (12.5kHz) – DIGITAL LOW CHANNEL	12754-4 Emission mask D (12.5kHz) – DIGITAL MID CHANNEL	12754-4 Emission mask D (12.5kHz) – DIGITAL HIGH CHANNEL

Analyser plots can be found in Section 6 of this report.

LIMITS:
Part 90.210(d)

(d) Emission Mask D – 12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(24) On any frequency from the centre of the authorized bandwidth f0 to 5.625 kHz removed from f0: Zero dB.

(2) On any frequency removed from the centre of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27(fd−2.88 kHz) dB.

(3) On any frequency removed from the centre 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.

(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the

emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows: ± 2.8 dB

5.7 Modulation limiting

5.7.1 Test methods

Test Requirements:	47CFR part 2J Clause 2.1047(b) [Reference 4.1.2 of this report]
Test Method:	ANSI C63.26 Clause 5.3.2 [Reference 4.1.3 of this report]
Limits:	47CFR part 2J Clause 2.1047(b) [Reference 4.1.2 of this report]

5.7.2 Configuration of EUT

The EUT was operated on a test bench. Measurements were made at the RF port. The EUT was operated in FM LOW, FM MID and FM HIGH modes for this test.

5.7.3 Test procedure

Tests were made in accordance with FCC Part 2 using the measuring equipment noted below.
A family of curves were produced using an audio input frequency of 300Hz, 1000Hz, 2500Hz and 3000Hz in turn, showing the percentage of modulation (deviation) versus the modulation input voltage.
Tests were performed using Test Site A.

5.7.4 Test equipment

E482, E558, TMS48, TMS55

See Section 8 for more details

5.7.5 Test results

Temperature of test environment	20°C
Humidity of test environment	50%
Pressure of test environment	101kPa

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	FM
Low channel	400.025 MHz

Plot Ref	Mod Lim Low

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	FM
Mid channel	435.0 MHz

Plot Ref	Mod Lim Mid

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	FM
High channel	469.975 MHz

Plot Ref	Mod Lim High

LIMITS:
Part 2J Clause 2.1047(b): The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
<± 1%

5.8 Modulation frequency response

5.8.1 Test methods

Test Requirements: 47CFR part 2J Clause 2.1047(a) [Reference 4.1.2 of this report]
Test Method: ANSI C63.26 Clause 5.3.3 [Reference 4.1.3 of this report]
Limits: No limits specified

5.8.2 Configuration of EUT

The EUT was operated on a test bench. Measurements were made at the RF port using a modulation analyser. The audio signals were applied directly to the audio input via a test fixture. The EUT was operated in FM LOW, FM MID and FM HIGH modes for this test.

5.8.3 Test procedure

Tests were made in accordance with the Test Methods noted above using the measuring equipment noted in the 'Test Equipment' Section.

An audio frequency response of the EUT was plotted for each tested channel.
Tests were performed using Test Site A.

5.8.4 Test equipment

E482, E558, TMS48, TMS55

See Section 8 for more details

5.8.5 Test results

Temperature of test environment	20°C
Humidity of test environment	50%
Pressure of test environment	101kPa

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	FM
Low channel	400.025 MHz

Plot ref	Low

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	FM
Mid channel	435.0 MHz

Plot ref	Mid

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	FM
High channel	469.975 MHz

Plot ref	High

LIMITS:
No limits specified.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
<± 1%

5.9 Transient frequency behaviour

5.9.1 Test methods

Test Requirements: FCC Part 90I Clause 90.214 [Reference 4.1.1 of this report]
Test Method: ANSI C63.26 Clause 6.5.2.2 [Reference 4.1.3 of this report]
Limits: FCC Part 90I Clause 90.214 [Reference 4.1.1 of this report]

5.9.2 Configuration of EUT

The EUT was operated on a test bench. Measurements were made at the RF port. The EUT was operated in CW LOW, CW MID and CW HIGH modes for this test.

5.9.3 Test procedure

Tests were made in accordance with the Test Method noted above using the measuring equipment noted in the 'Test Equipment' Section at Site A. Tests were made in accordance with the Test Method noted above using the measuring equipment noted in the 'Test Equipment' Section at Site A. The EUT was repeatedly keyed up and down and the frequency vs. time curve observed from the discriminator output of a modulation meter was recorded using a storage oscilloscope.

5.9.4 Test equipment

E309, E412, E479, E482, E517, E532, E557, E699, F136, TMS205, TMS30

See Section 8 for more details

5.9.5 Test results

Temperature of test environment 20°C
Humidity of test environment 50%
Pressure of test environment 101kPa

Band	400-470 MHz
Power Level	4 Watts
Channel Spacing	12.5 kHz
Mod Scheme	FM
Low channel	400.025 MHz
Mid channel	435 MHz
High channel	469.975 MHz

	Low channel	Mid channel	High channel
TX ON Result	PASSED	PASSED	PASSED
TX ON Plot Reference	12754-1 Transient frequency behaviour, Low Channel – Turn On	12754-1 Transient frequency behaviour, Mid Channel – Turn On	12754-1 Transient frequency behaviour, High Channel - Turn On
TX OFF Result	PASSED	PASSED	PASSED
TX OFF Plot Reference	12754-1 Transient frequency behaviour, Low Channel - Turn Off	12754-1 Transient frequency behaviour, Mid Channel - Turn Off	12754-1 Transient frequency behaviour, High Channel - Turn Off

LIMITS:

Channel Separation	Time Period[1,2]	Transient Period	Maximum frequency difference[3]
12.5 kHz	t_1[4]	10 ms	±12.5 kHz
	t_2	25 ms	±6.25 kHz
	t_3[4]	10 ms	±12.5 kHz

[1] t_{on} is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.
t_1 is the time period immediately following t_{on}.
T_2 is the time period immediately following t1.
T_3 is the time period from the instant when the transmitter is turned off until toff.
t_{off} is the instant when the 1 kHz test signal starts to rise.
[2] During the time from the end of t_2 to the beginning of t_3, the frequency difference must not exceed the limits specified in § 90.213.
[3] Difference between the actual transmitter frequency and the assigned transmitter frequency.
[4] If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
<± 185 Hz

5.10 Adjacent channel power

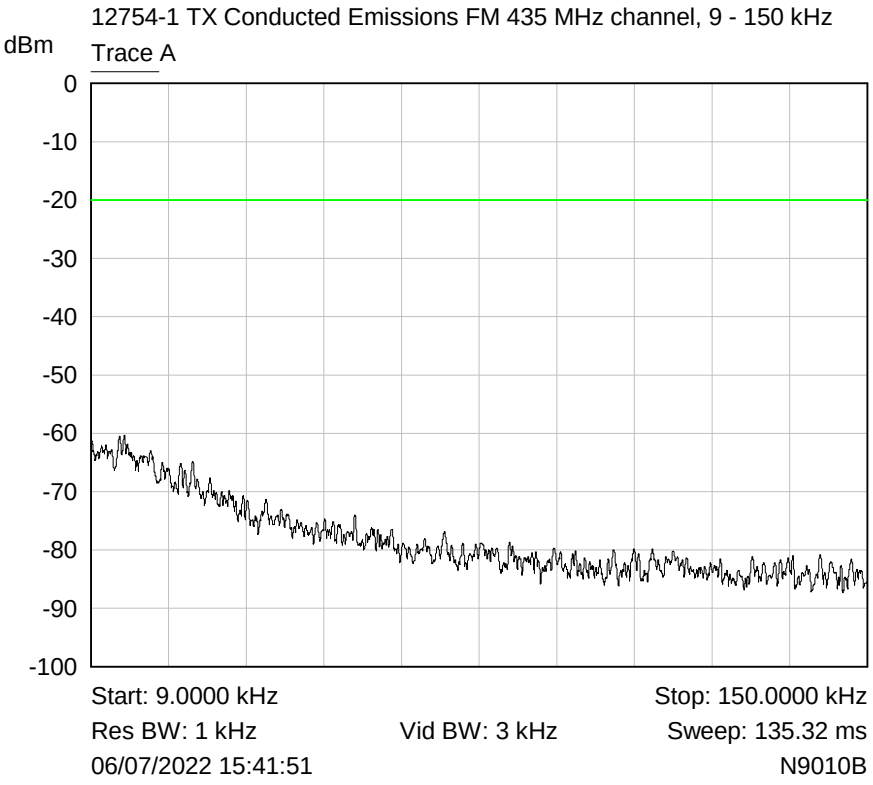
NOT APPLICABLE: EUT does not employ 25 kHz channels.

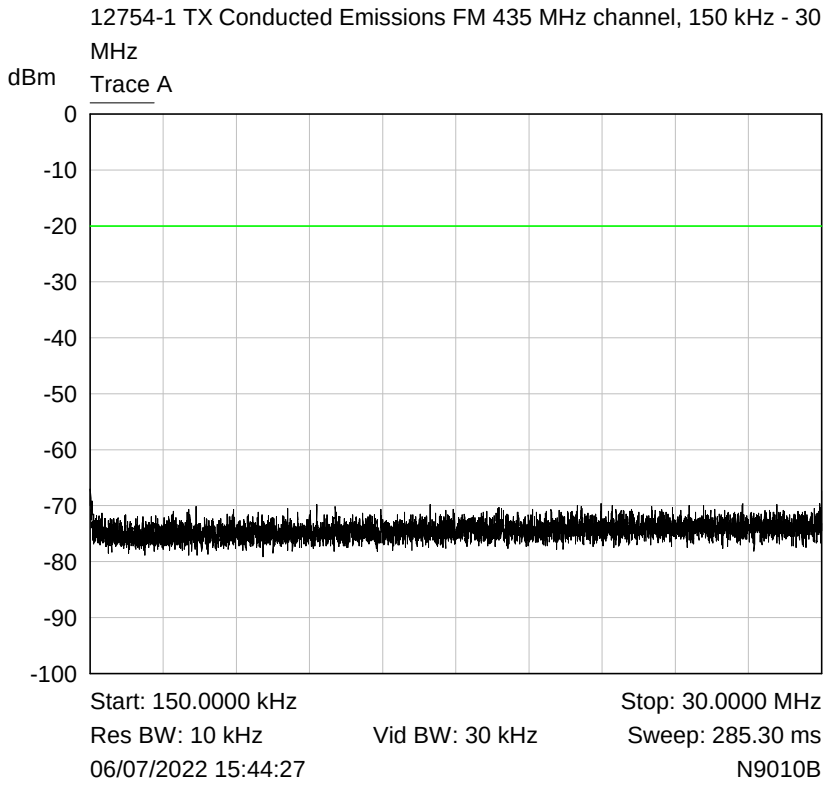
6 Plots/Graphical results

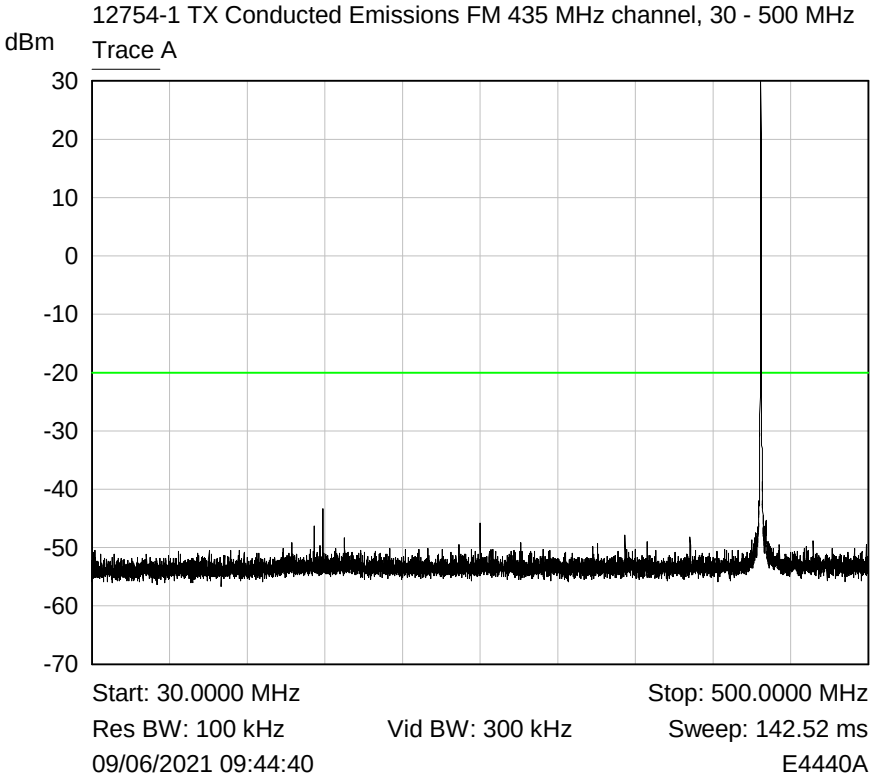
6.1 Conducted emissions

Note: Whilst Low, Mid and High channels have been measured, only middle channel plots are shown to minimise report size.

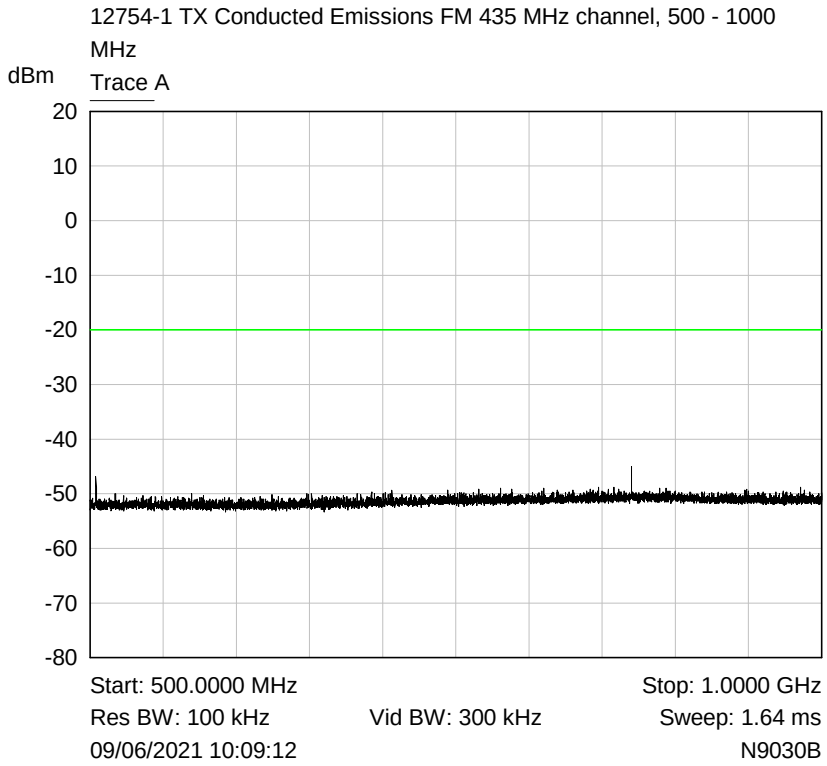
RF Parameters: Band 400-470 MHz, Power 4 Watts, Mid channel, Channel Spacing 12.5 kHz, Modulation FM

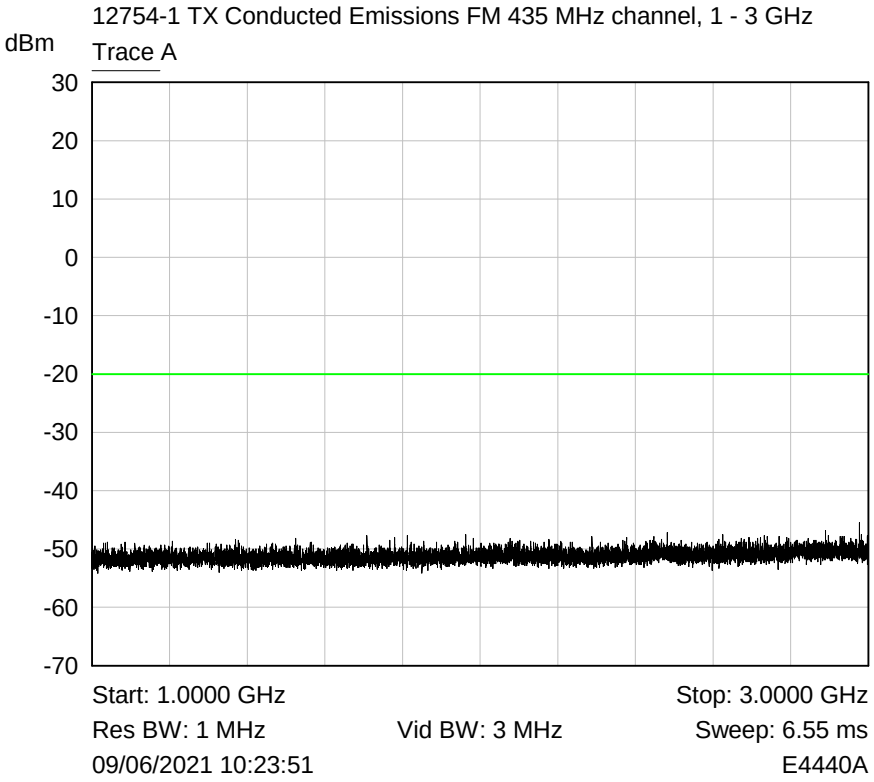


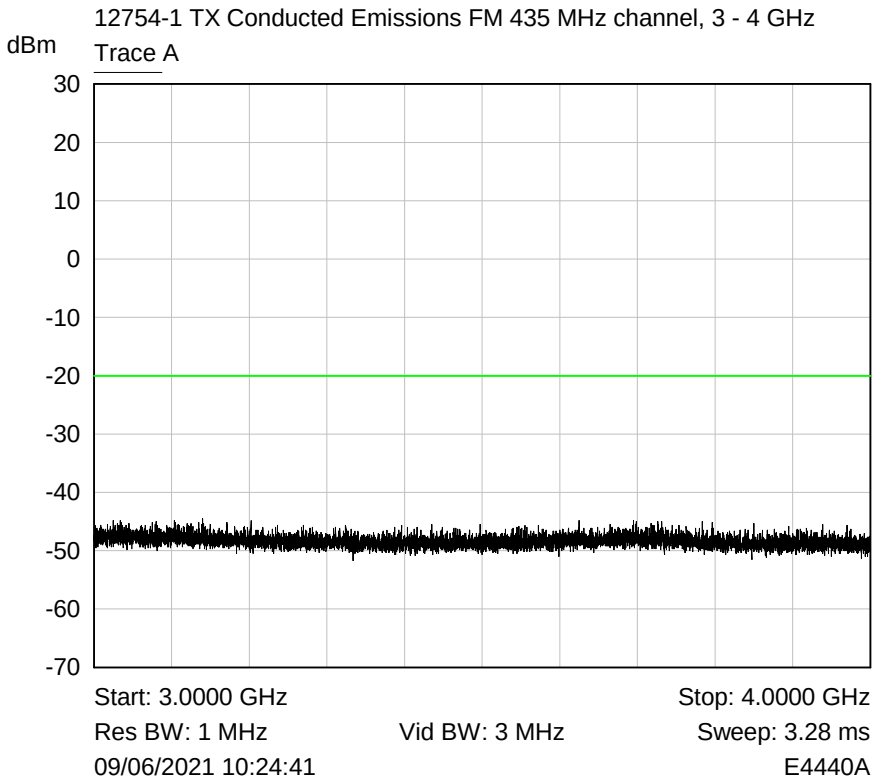


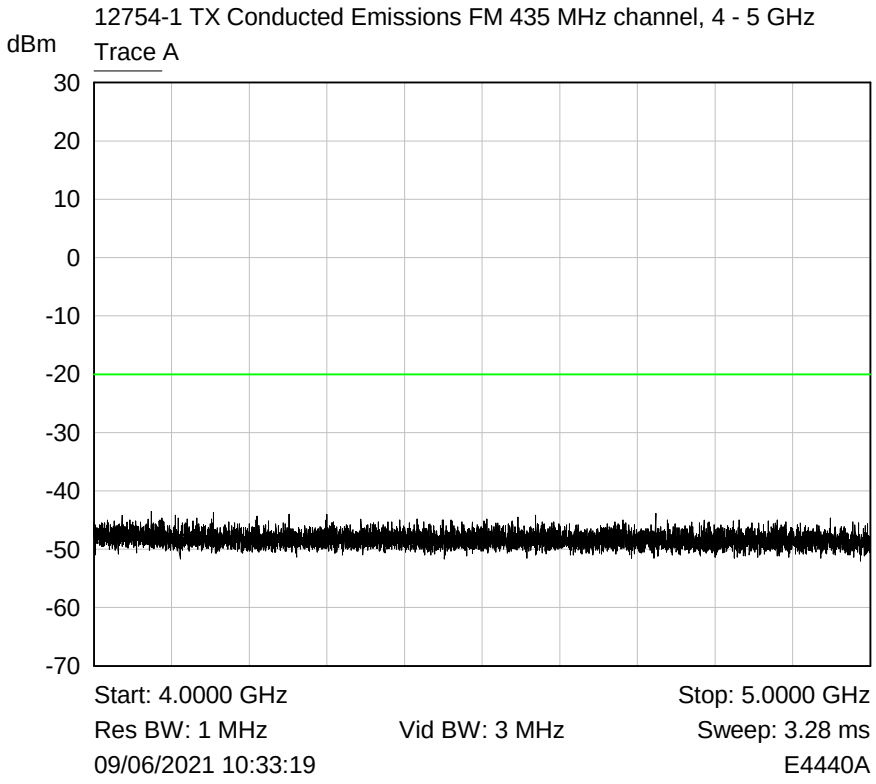


Plot includes the fundamental transmit carrier at 435 MHz


12754-1 TX Conducted Emissions FM 435 MHz channel, 500 - 1000 MHz
dBm
Trace A
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
Start: 500.0000 MHz
Stop: 1.0000 GHz
Res BW: 100 kHz
Vid BW: 300 kHz
Sweep: 1.64 ms
09/06/2021 10:09:12
N9030B


12754-1 TX Conducted Emissions FM 435 MHz channel, 1 - 3 GHz
dBm
Trace A
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
Start: 1.0000 GHz
Stop: 3.0000 GHz
Res BW: 1 MHz
Vid BW: 3 MHz
Sweep: 6.55 ms
09/06/2021 10:23:51
E4440A

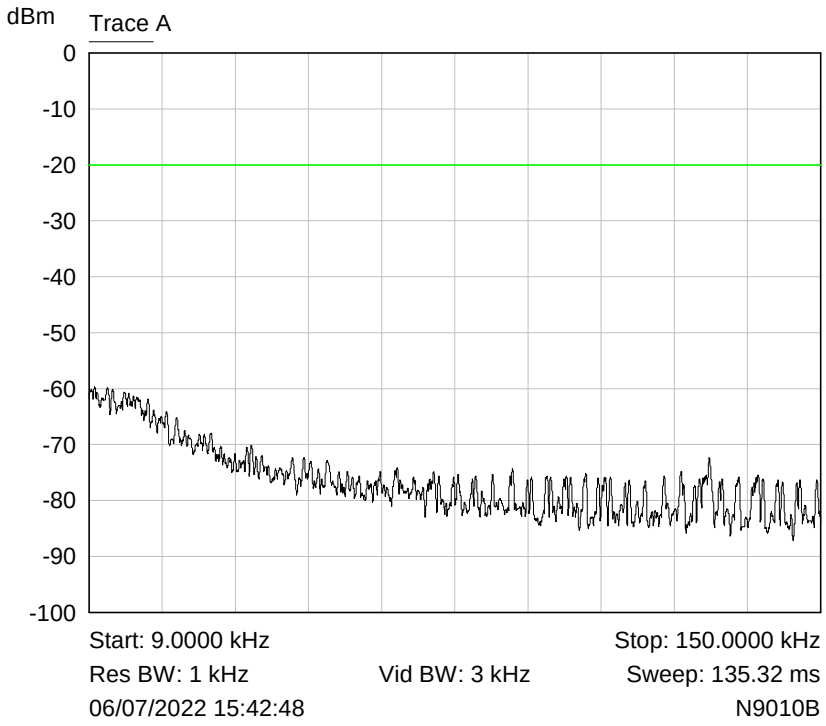

12754-1 TX Conducted Emissions FM 435 MHz channel, 3 - 4 GHz
dBm
Trace A
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
Start: 3.0000 GHz
Stop: 4.0000 GHz
Res BW: 1 MHz
Vid BW: 3 MHz
Sweep: 3.28 ms
09/06/2021 10:24:41
E4440A


12754-1 TX Conducted Emissions FM 435 MHz channel, 4 - 5 GHz
dBm
Trace A
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
Start: 4.0000 GHz
Stop: 5.0000 GHz
Res BW: 1 MHz
Vid BW: 3 MHz
Sweep: 3.28 ms
09/06/2021 10:33:19
E4440A

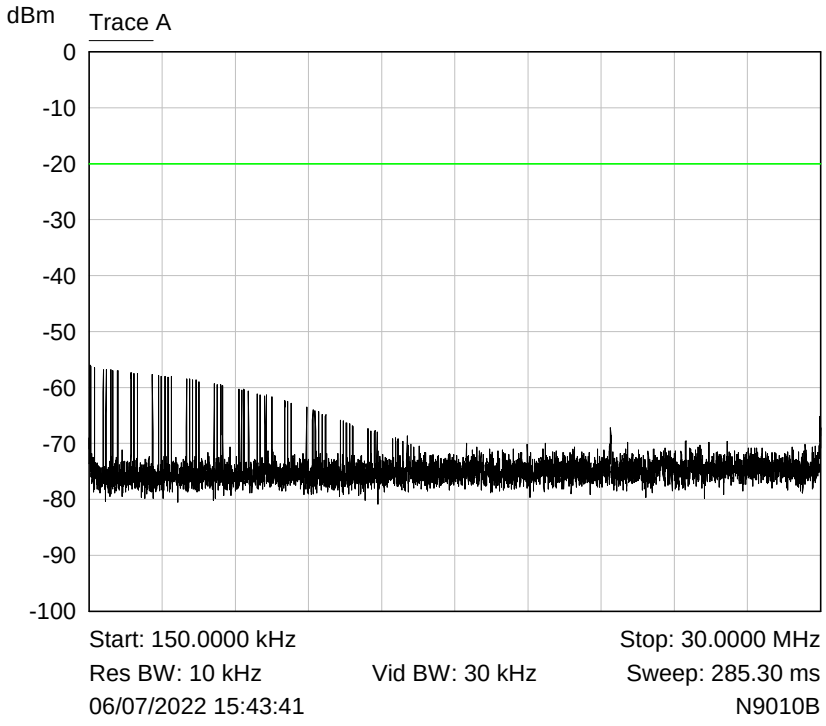
Note: Whilst Low, Mid and High channels have been measured, only middle channel plots are shown to minimise report size.

RF Parameters: Band 400-470 MHz, Power 4 Watts, Mid channel, Channel Spacing 12.5 kHz, Modulation Digital (TDMA)

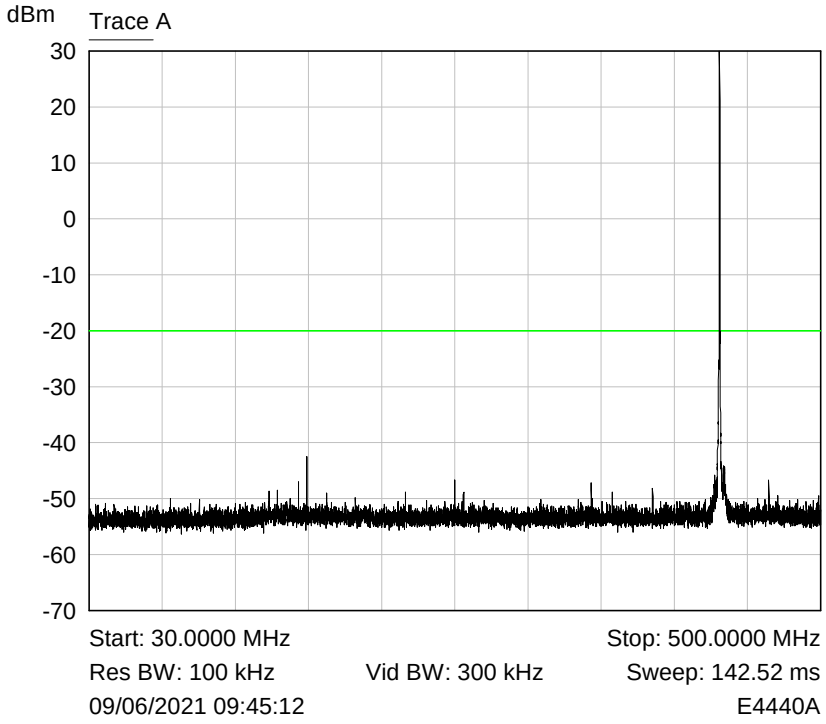
12754-1 TX Conducted Emissions DIGITAL 435 MHz channel, 9 - 150 kHz



12754-1 TX Conducted Emissions DIGITAL 435 MHz channel, 150 kHz - 30 MHz

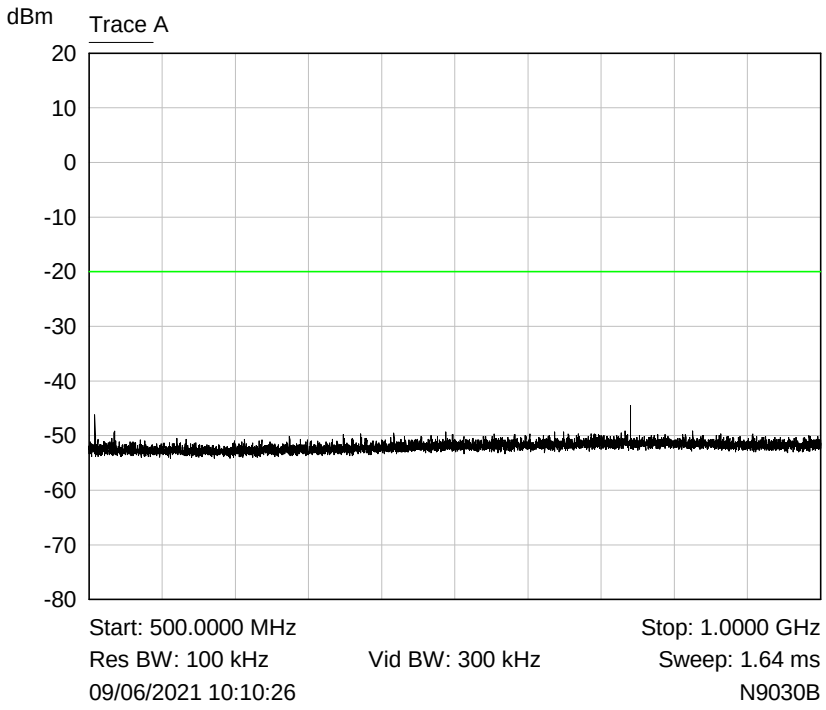


12754-1 TX Conducted Emissions DIGITAL 435 MHz channel, 30 - 500 MHz

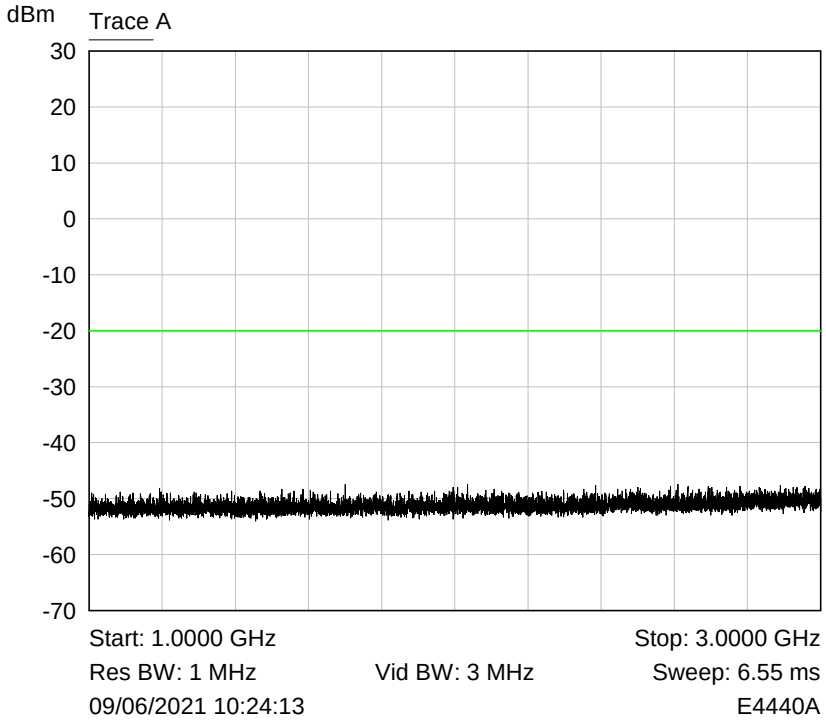


Plot includes the fundamental transmit carrier at 435 MHz

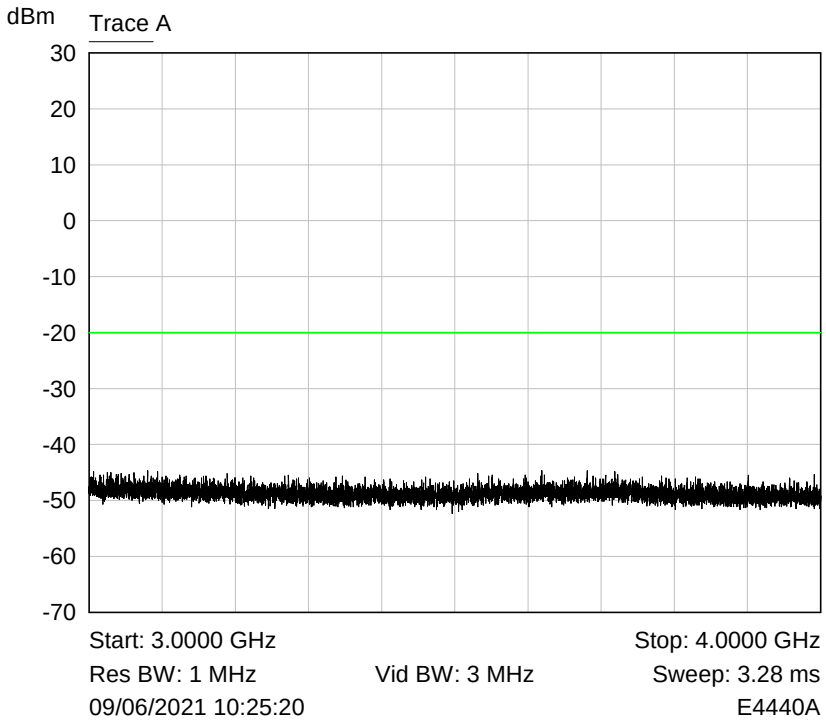
12754-1 TX Conducted Emissions DIGITAL 435 MHz channel, 500 - 1000 MHz

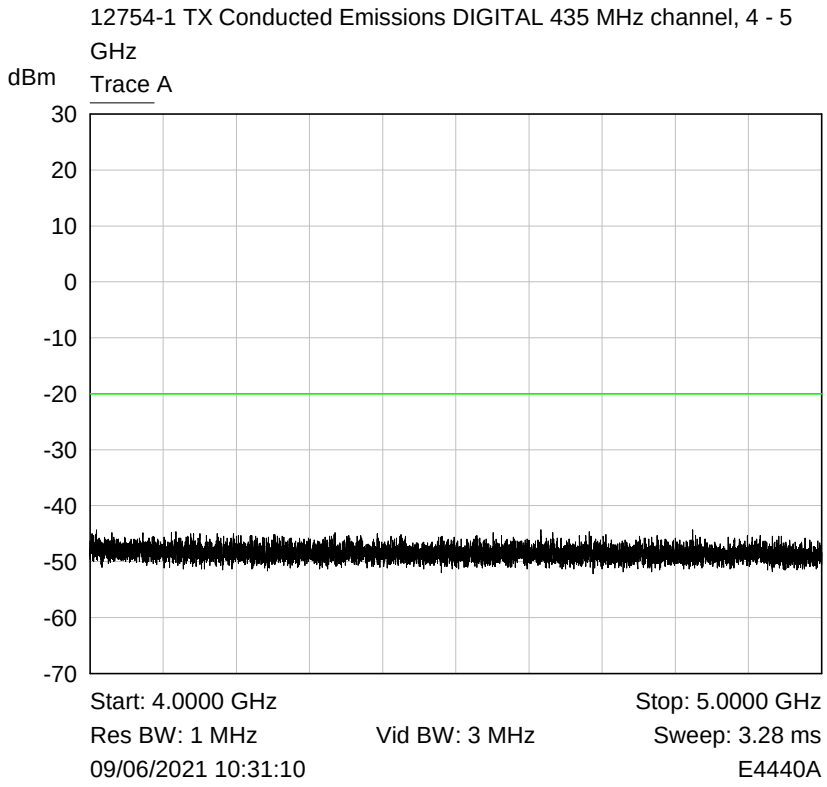


12754-1 TX Conducted Emissions DIGITAL 435 MHz channel, 1 - 3 GHz



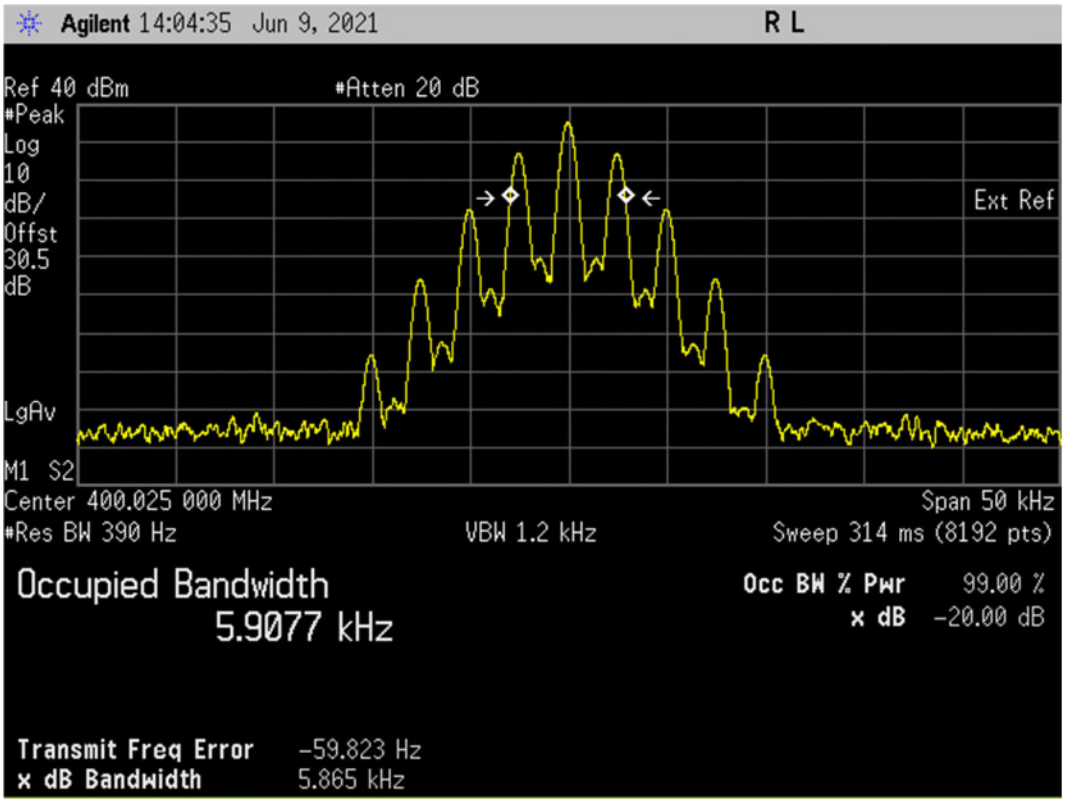
12754-1 TX Conducted Emissions DIGITAL 435 MHz channel, 3 - 4 GHz





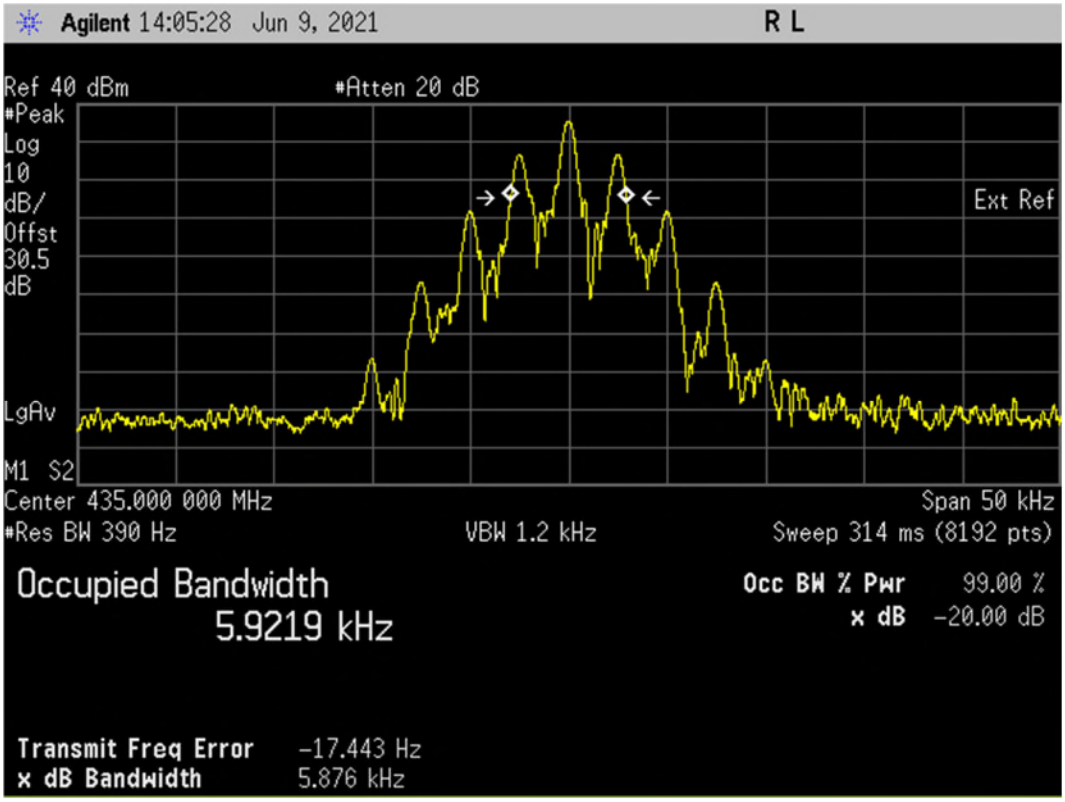
6.2 Occupied bandwidth

RF Parameters: Band 400-470 MHz, Power 4 Watts, Channel Spacing 12.5 kHz, Modulation FM, Channel 400.025 MHz



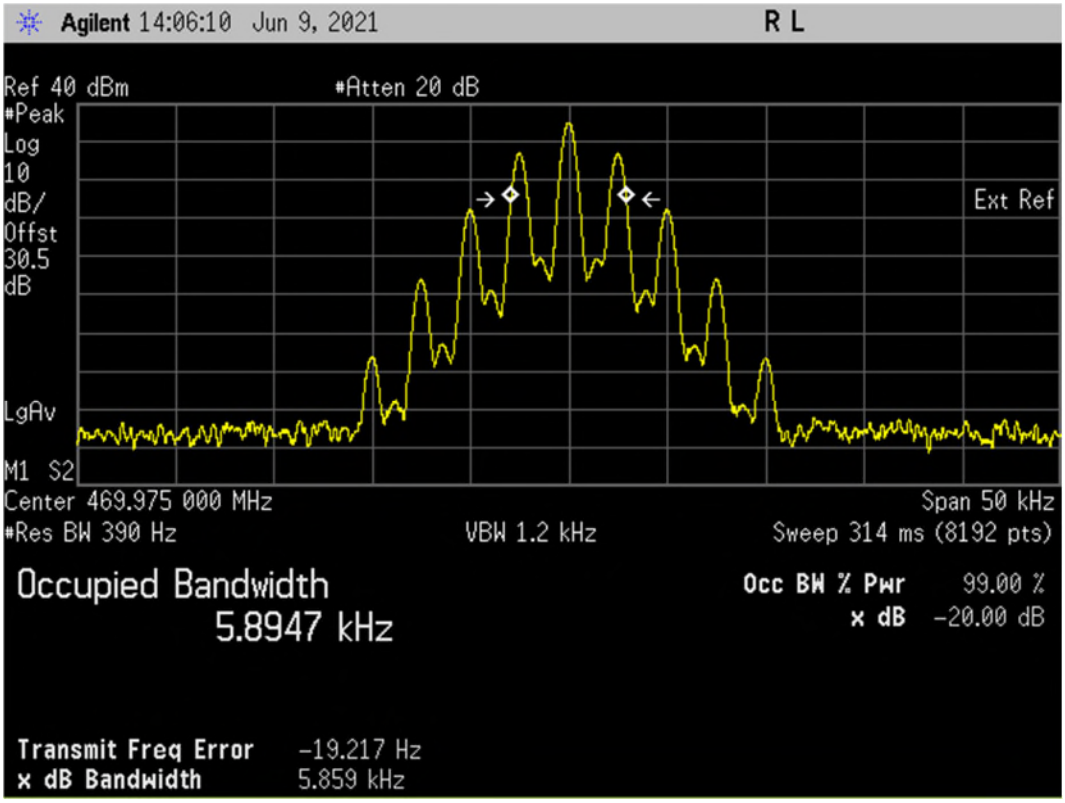
Plot for 99 % Bandwidth Nominal Temp & Volts

RF Parameters: Band 400-470 MHz, Power 4 Watts, Channel Spacing 12.5 kHz, Modulation FM, Channel 435 MHz



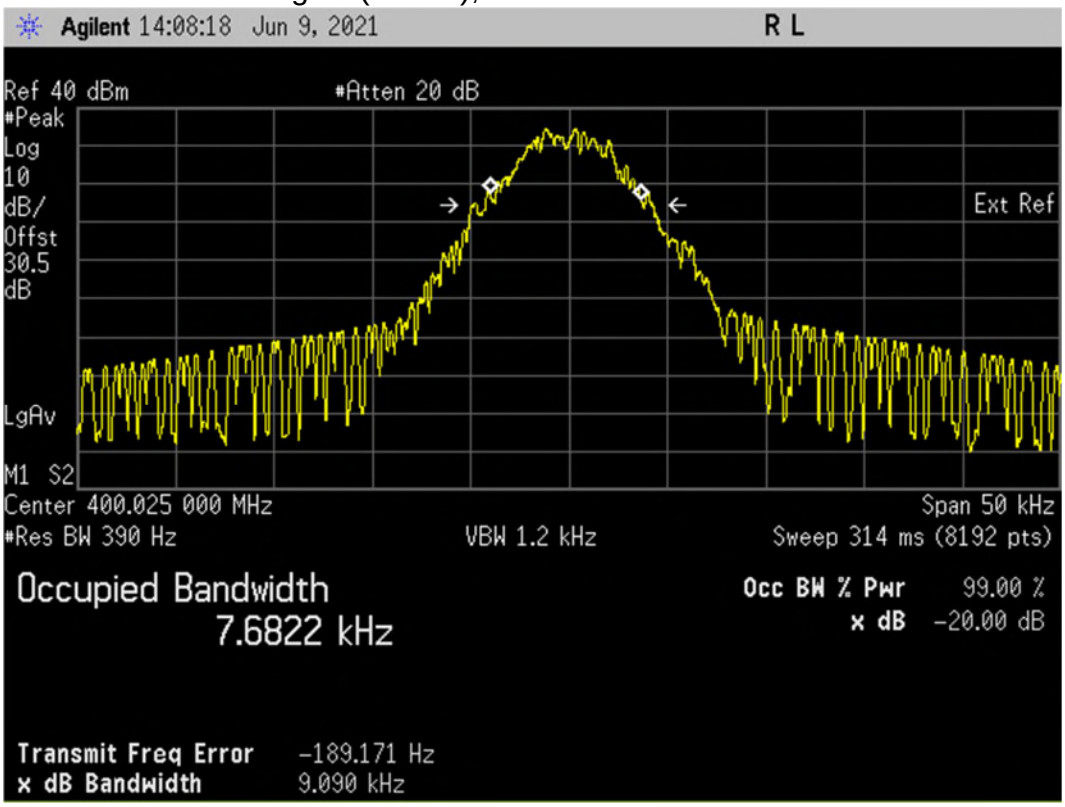
Plot for 99 % Bandwidth Nominal Temp & Volts

RF Parameters: Band 400-470 MHz, Power 4 Watts, Channel Spacing 12.5 kHz, Modulation FM, Channel 469.975 MHz



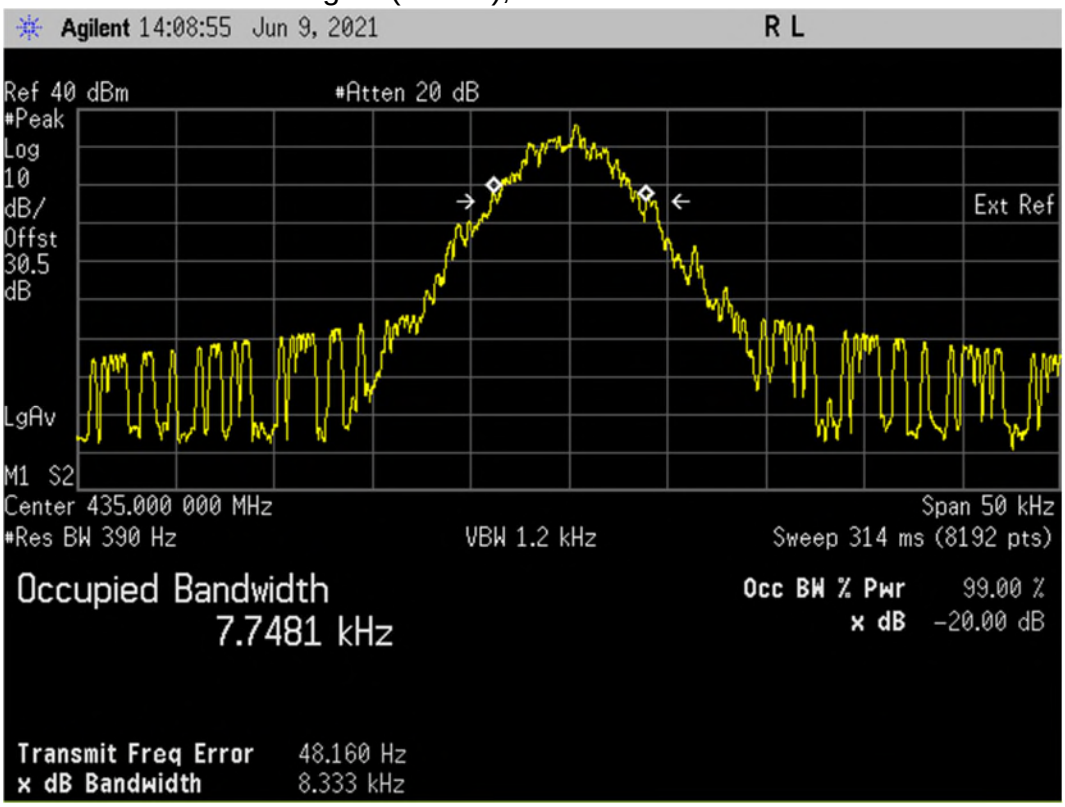
Plot for 99 % Bandwidth Nominal Temp & Volts

RF Parameters: Band 400-470 MHz, Power 4 Watts, Channel Spacing 12.5 kHz, Modulation Digital (TDMA), Channel 400.025 MHz



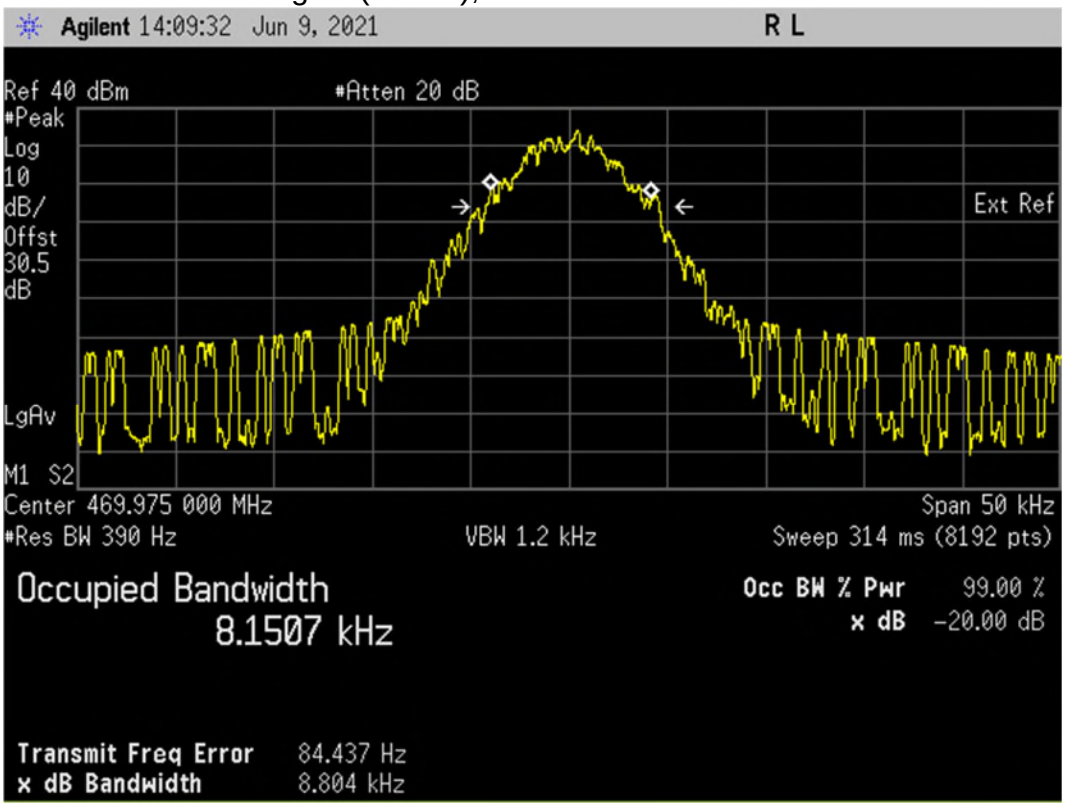
Plot for 99 % Bandwidth Nominal Temp & Volts

RF Parameters: Band 400-470 MHz, Power 4 Watts, Channel Spacing 12.5 kHz, Modulation Digital (TDMA), Channel 435 MHz



Plot for 99 % Bandwidth Nominal Temp & Volts

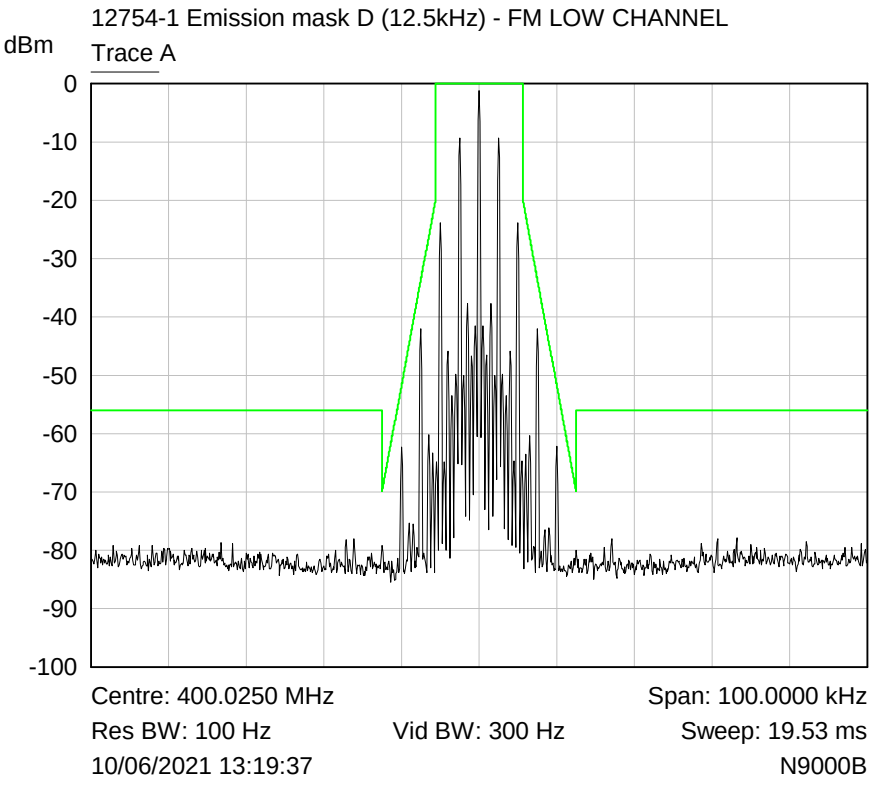
RF Parameters: Band 400-470 MHz, Power 4 Watts, Channel Spacing 12.5 kHz, Modulation Digital (TDMA), Channel 469.975 MHz



Plot for 99 % Bandwidth Nominal Temp & Volts

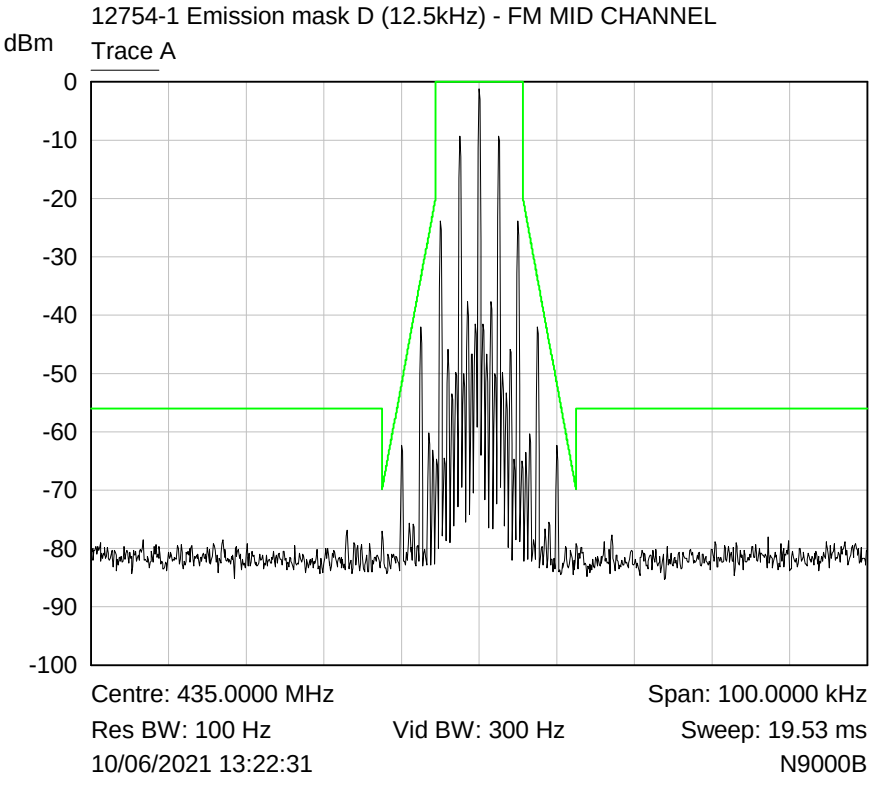
6.3 Emission mask

RF Parameters: Band 400-470 MHz, Power 4 Watts, Channel Spacing 12.5 kHz, Modulation FM, Channel 400.025 MHz



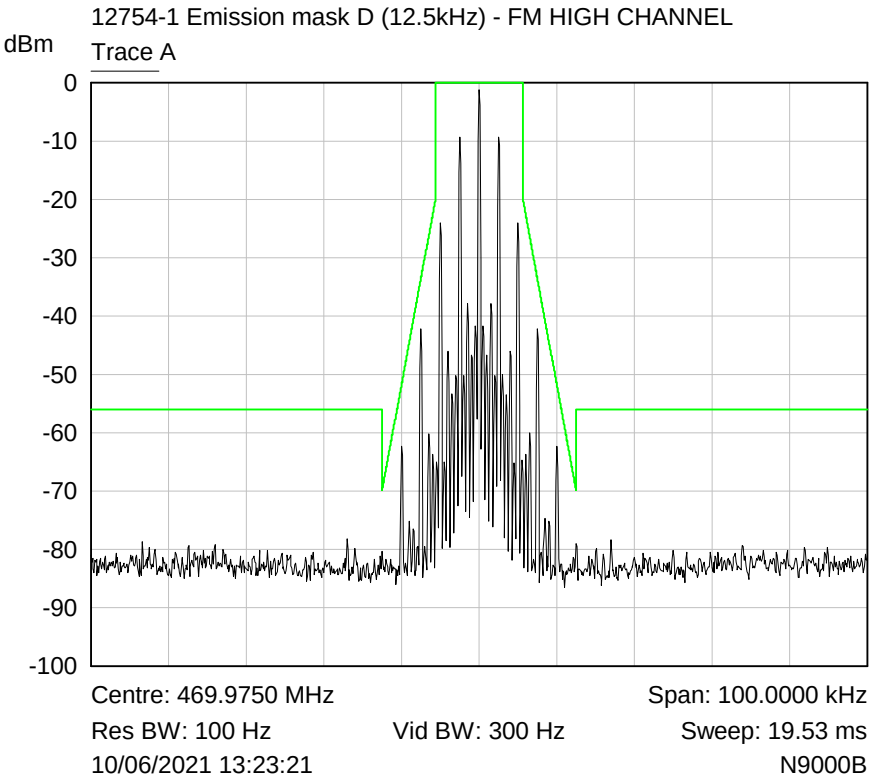
Nominal Temperature, Nominal Voltage

RF Parameters: Band 400-470 MHz, Power 4 Watts, Channel Spacing 12.5 kHz, Modulation FM, Channel 435 MHz



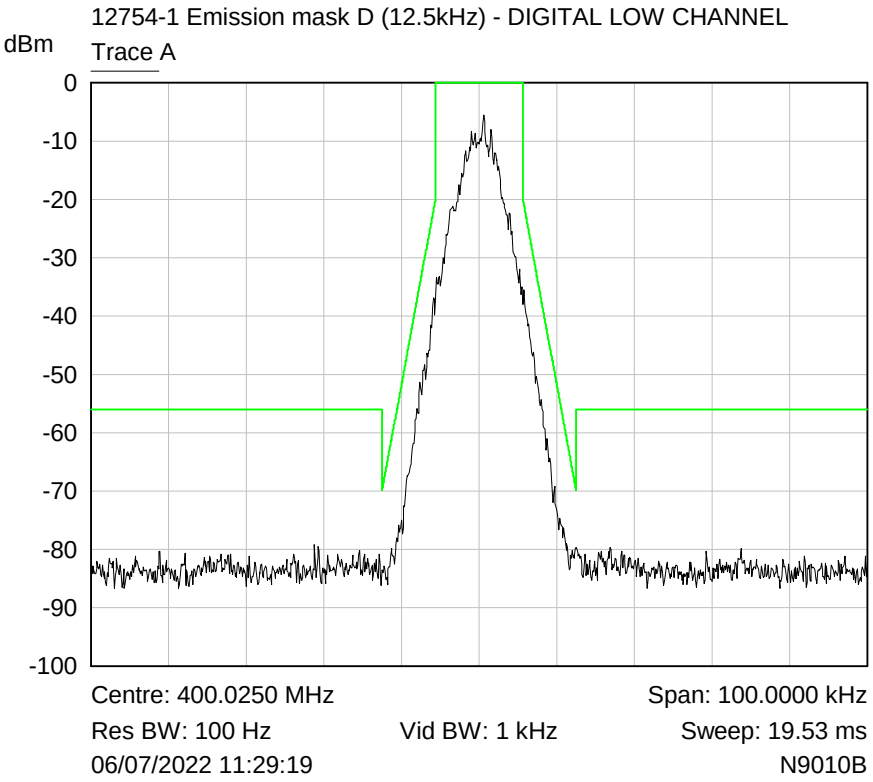
Nominal Temperature, Nominal Voltage

RF Parameters: Band 400-470 MHz, Power 4 Watts, Channel Spacing 12.5 kHz, Modulation FM, Channel 469.975 MHz



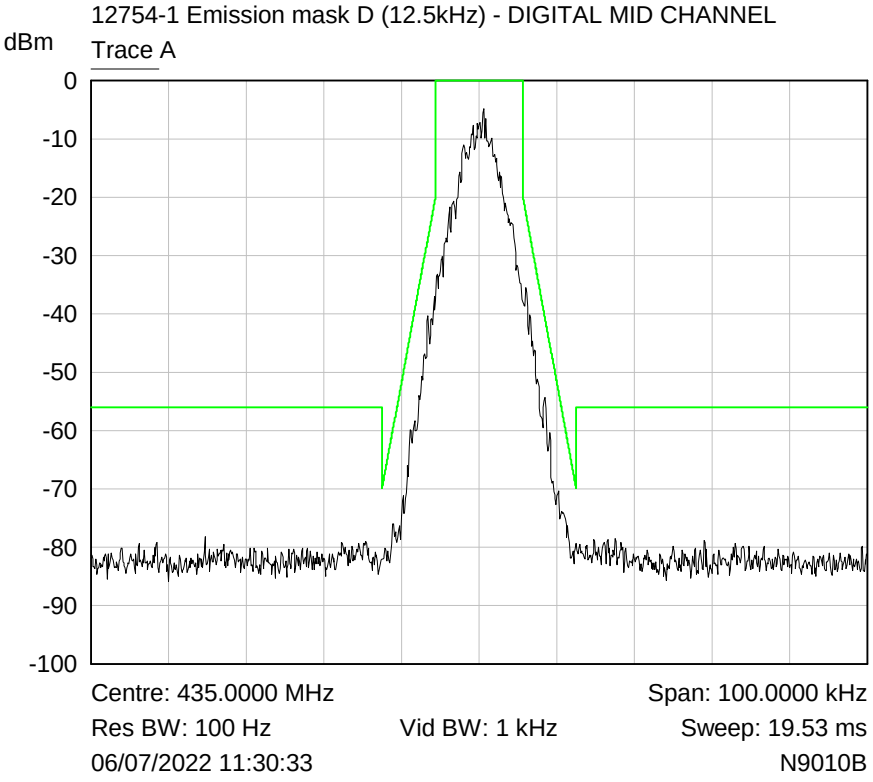
Nominal Temperature, Nominal Voltage

RF Parameters: Band 400-470 MHz, Power 4 Watts, Channel Spacing 12.5 kHz, Modulation Digital (TDMA), Channel 400.025 MHz



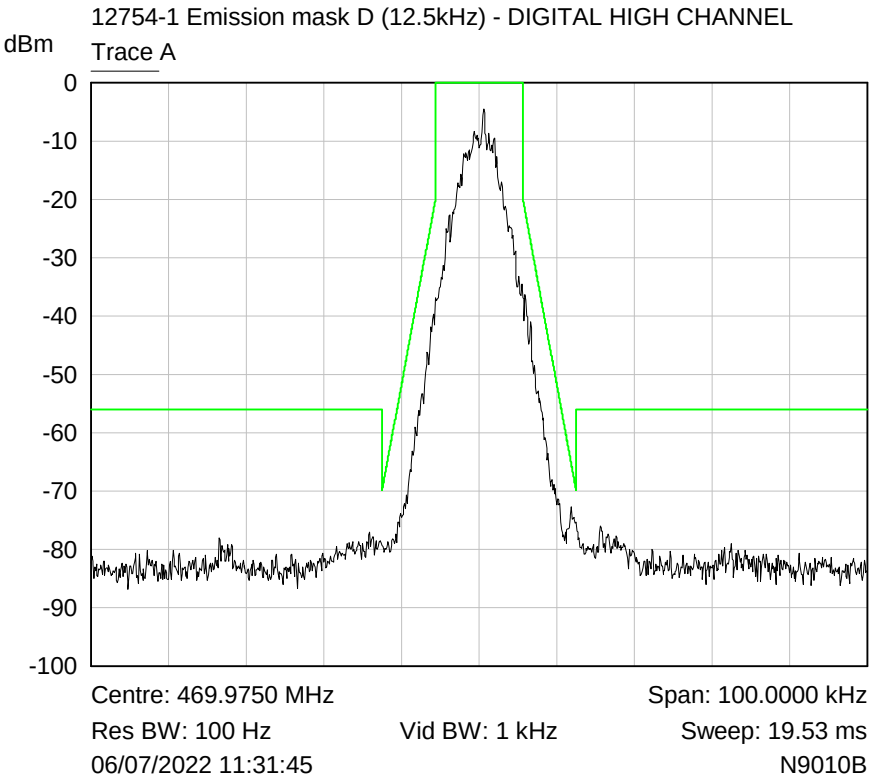
Nominal Temperature, Nominal Voltage

RF Parameters: Band 400-470 MHz, Power 4 Watts, Channel Spacing 12.5 kHz, Modulation Digital (TDMA), Channel 435 MHz



Nominal Temperature, Nominal Voltage

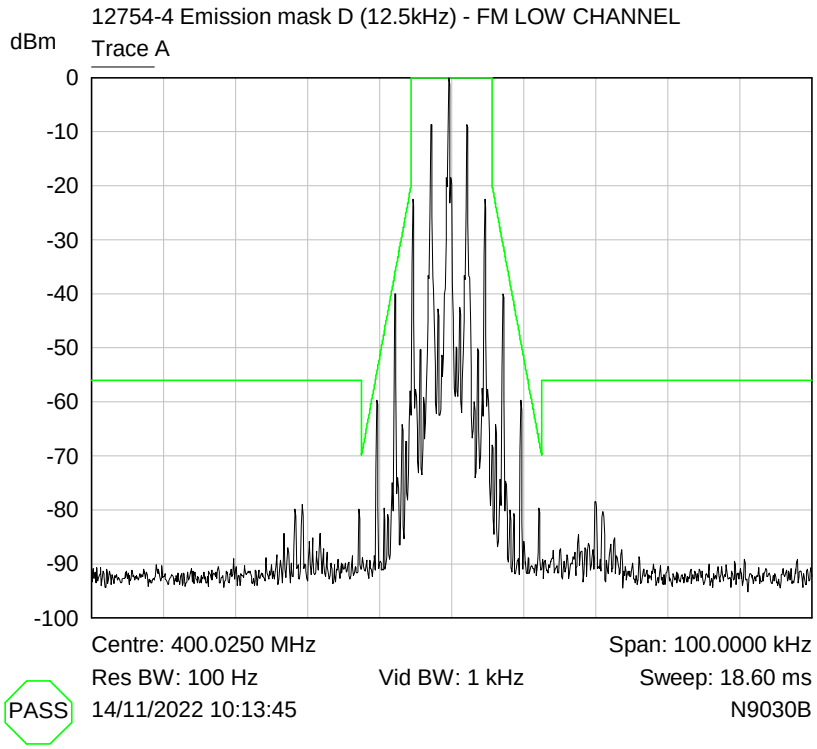
RF Parameters: Band 400-470 MHz, Power 4 Watts, Channel Spacing 12.5 kHz, Modulation Digital (TDMA), Channel 469.975 MHz



Nominal Temperature, Nominal Voltage

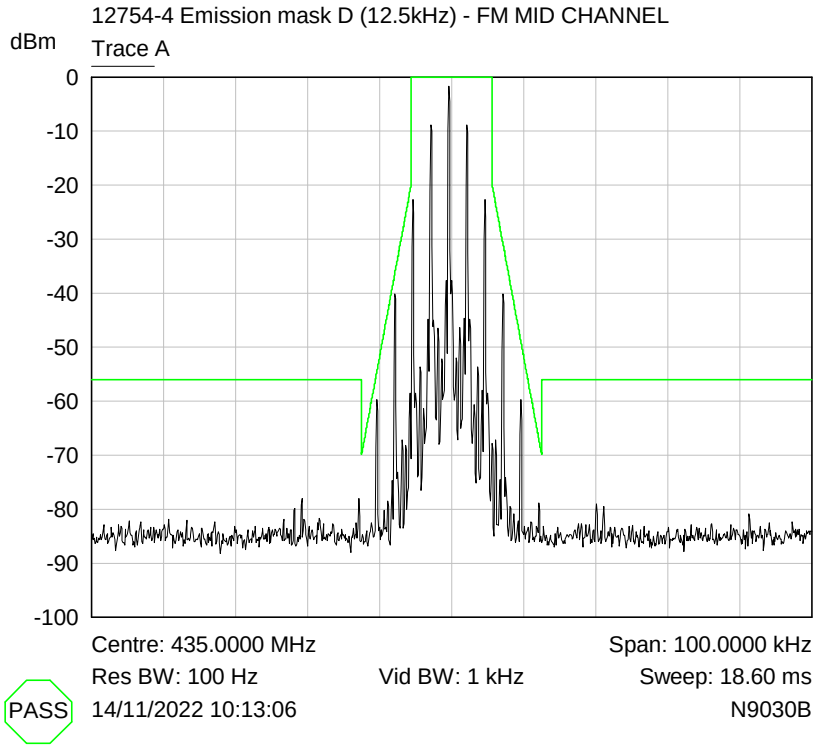
Additional test results for Entel DX482 (non-display model)

RF Parameters: Band 400-470 MHz, Power 4 Watts, Channel Spacing 12.5 kHz, Modulation FM, Channel 400.025 MHz



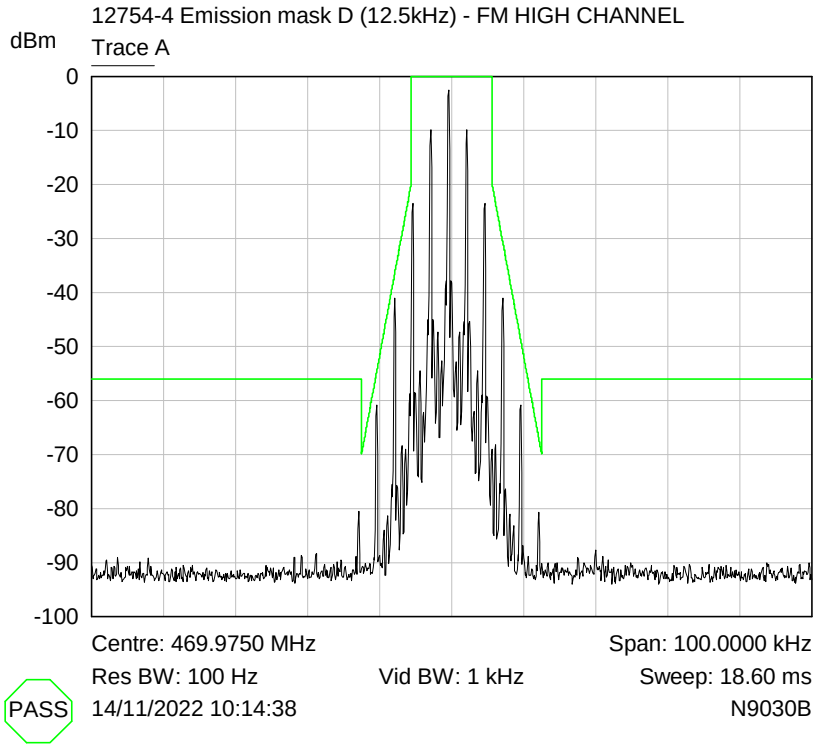
Nominal Temperature, Nominal Voltage

RF Parameters: Band 400-470 MHz, Power 4 Watts, Channel Spacing 12.5 kHz, Modulation FM, Channel 435 MHz



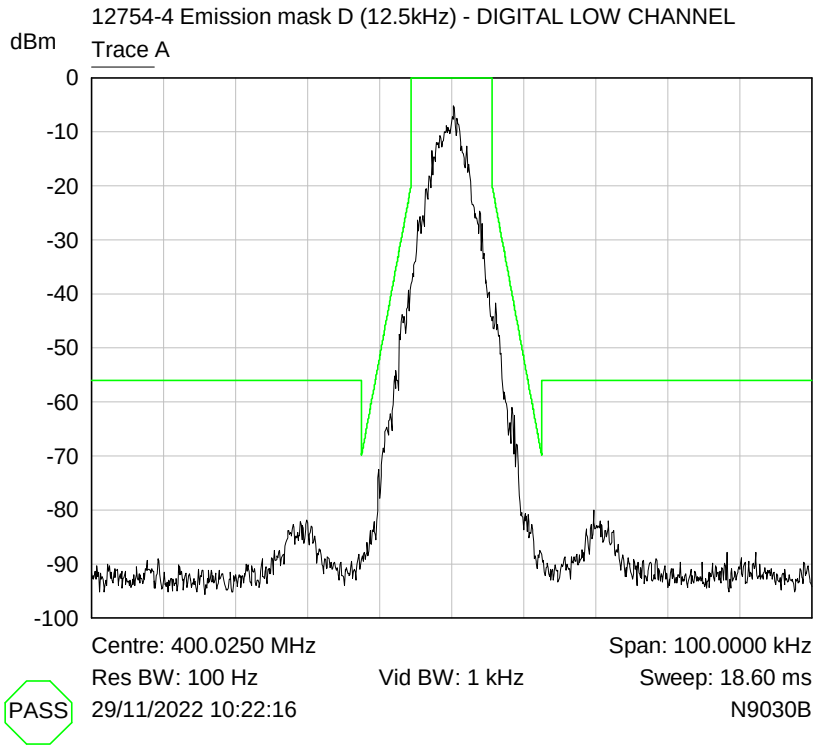
Nominal Temperature, Nominal Voltage

RF Parameters: Band 400-470 MHz, Power 4 Watts, Channel Spacing 12.5 kHz, Modulation FM, Channel 469.975 MHz



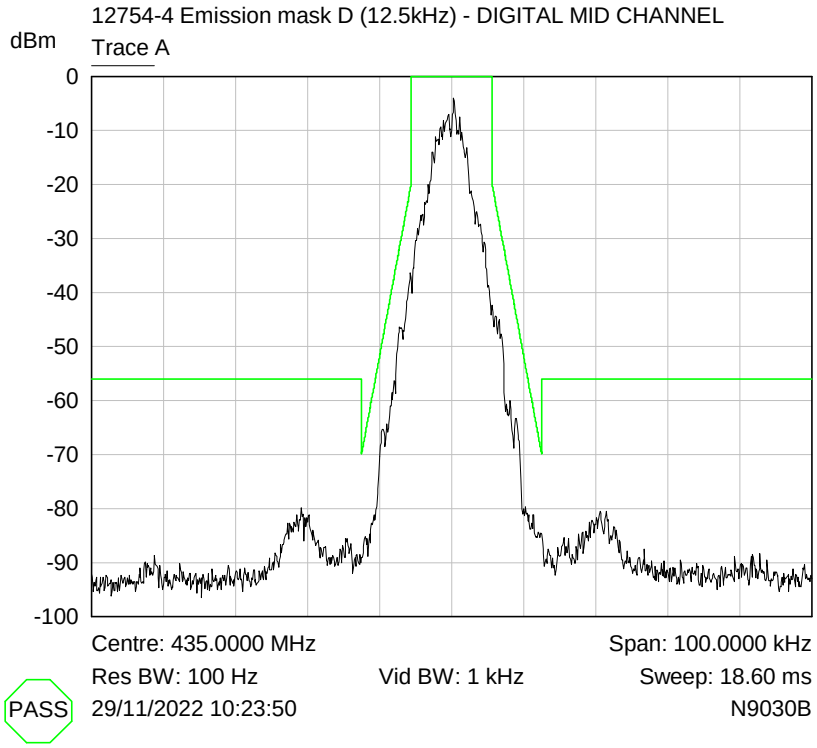
Nominal Temperature, Nominal Voltage

RF Parameters: Band 400-470 MHz, Power 4 Watts, Channel Spacing 12.5 kHz, Modulation Digital (TDMA), Channel 400.025 MHz



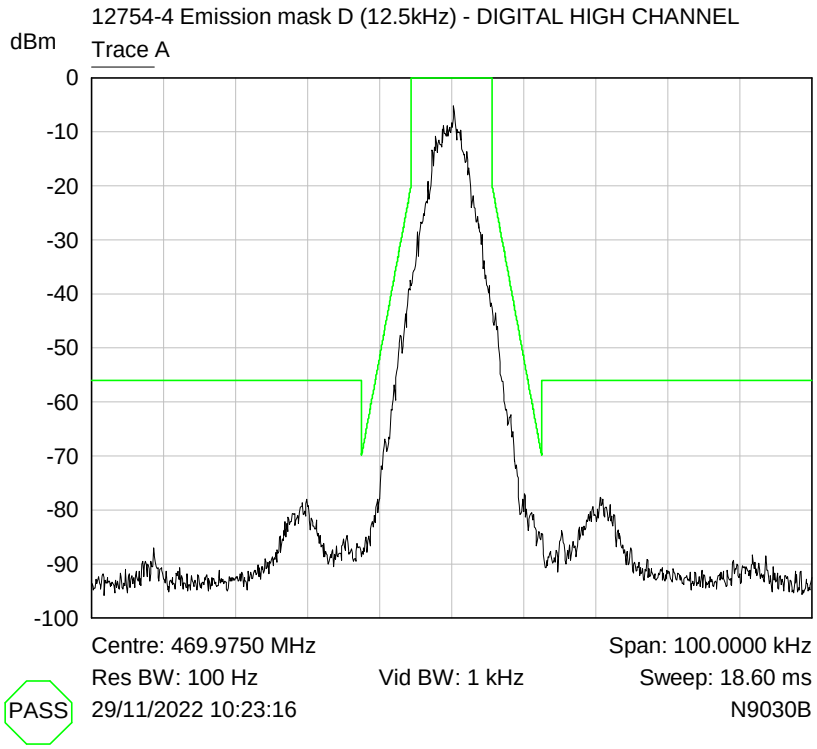
Nominal Temperature, Nominal Voltage

RF Parameters: Band 400-470 MHz, Power 4 Watts, Channel Spacing 12.5 kHz, Modulation Digital (TDMA), Channel 435 MHz



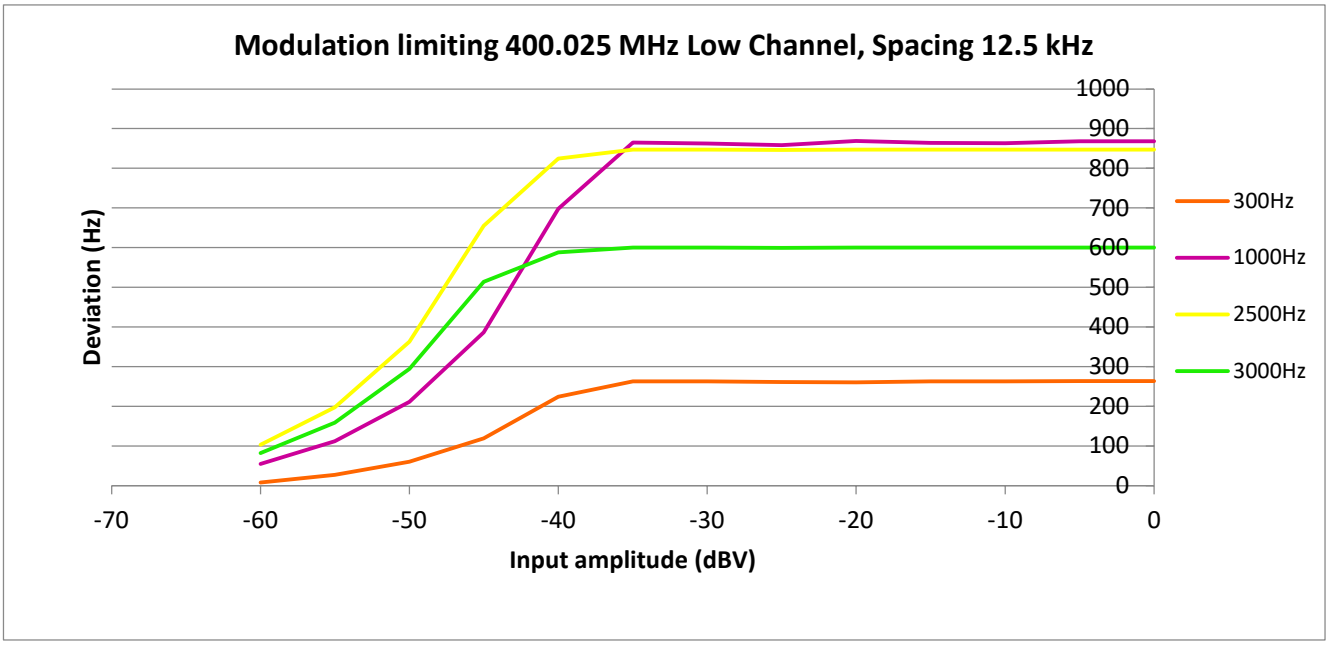
Nominal Temperature, Nominal Voltage

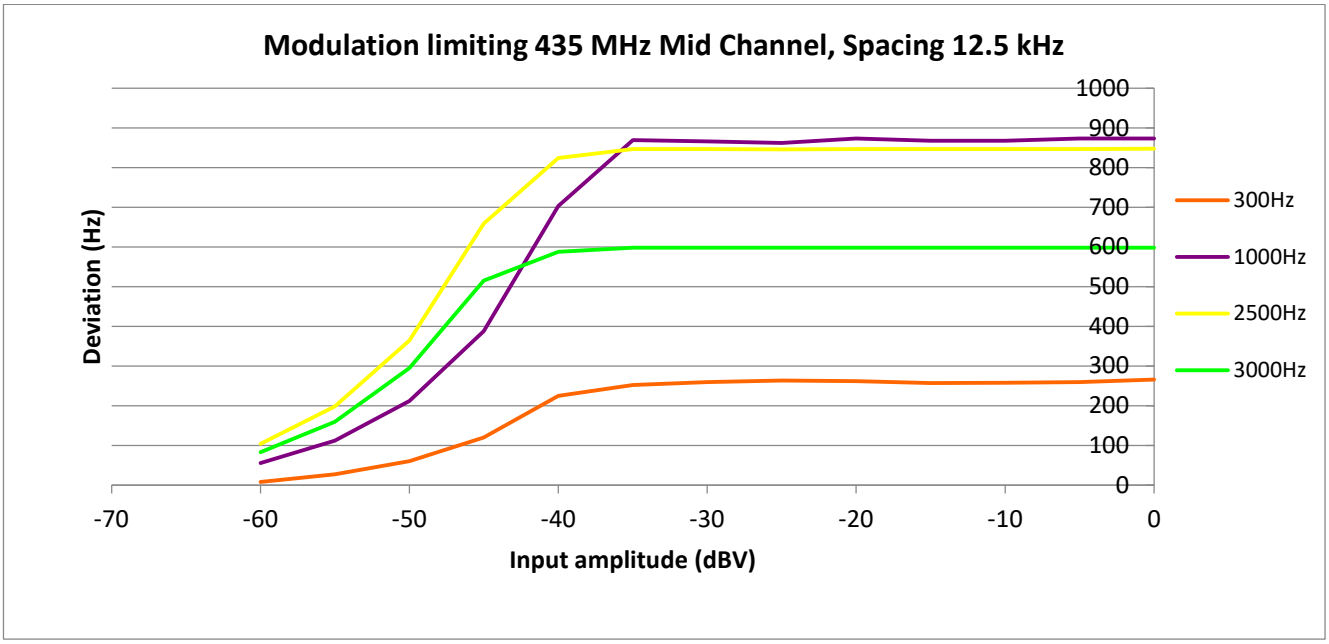
RF Parameters: Band 400-470 MHz, Power 4 Watts, Channel Spacing 12.5 kHz, Modulation Digital (TDMA), Channel 469.975 MHz

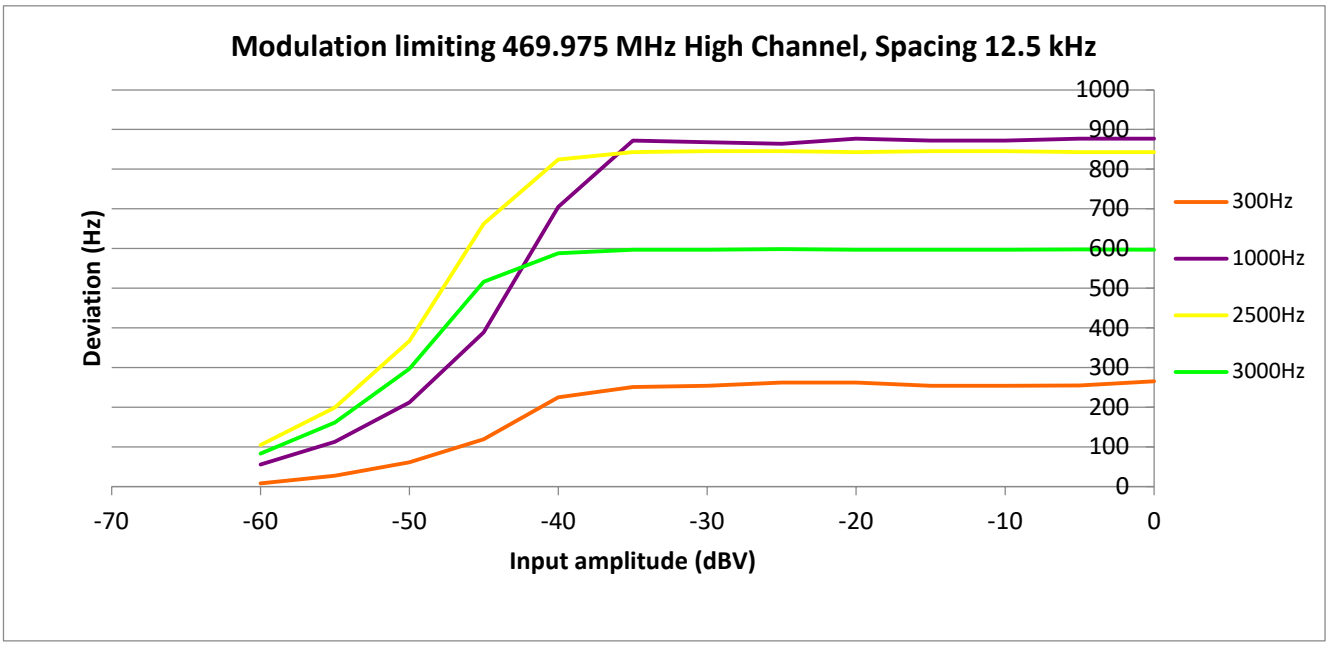


Nominal Temperature, Nominal Voltage

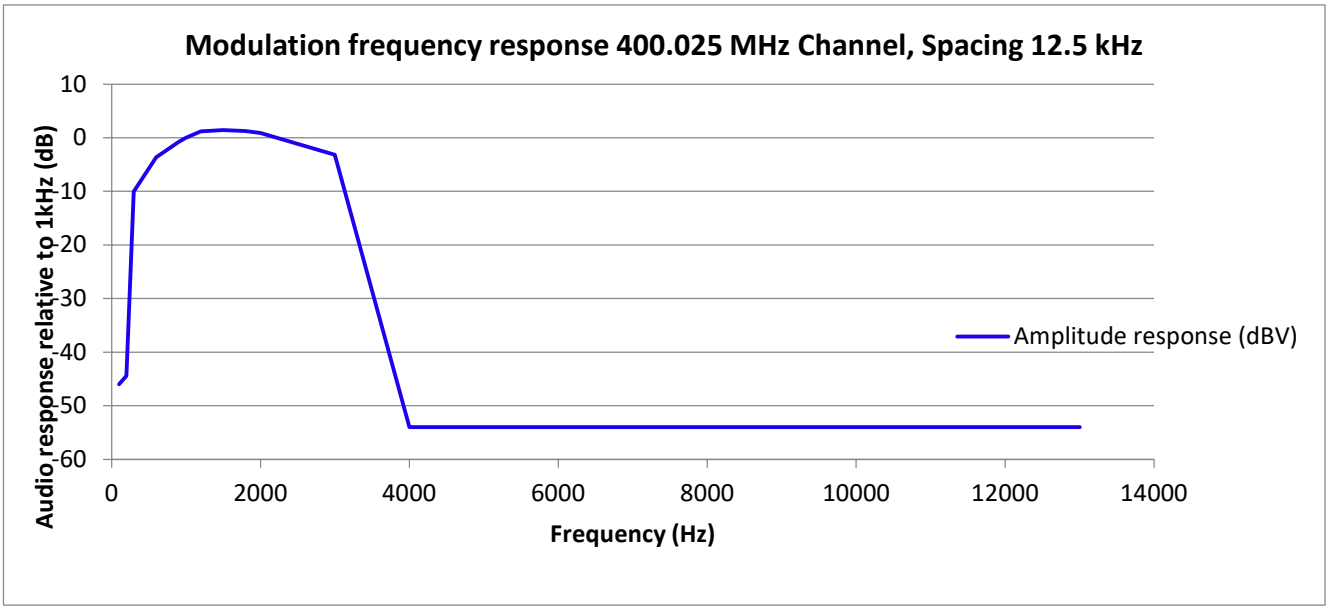
6.4 Modulation limiting

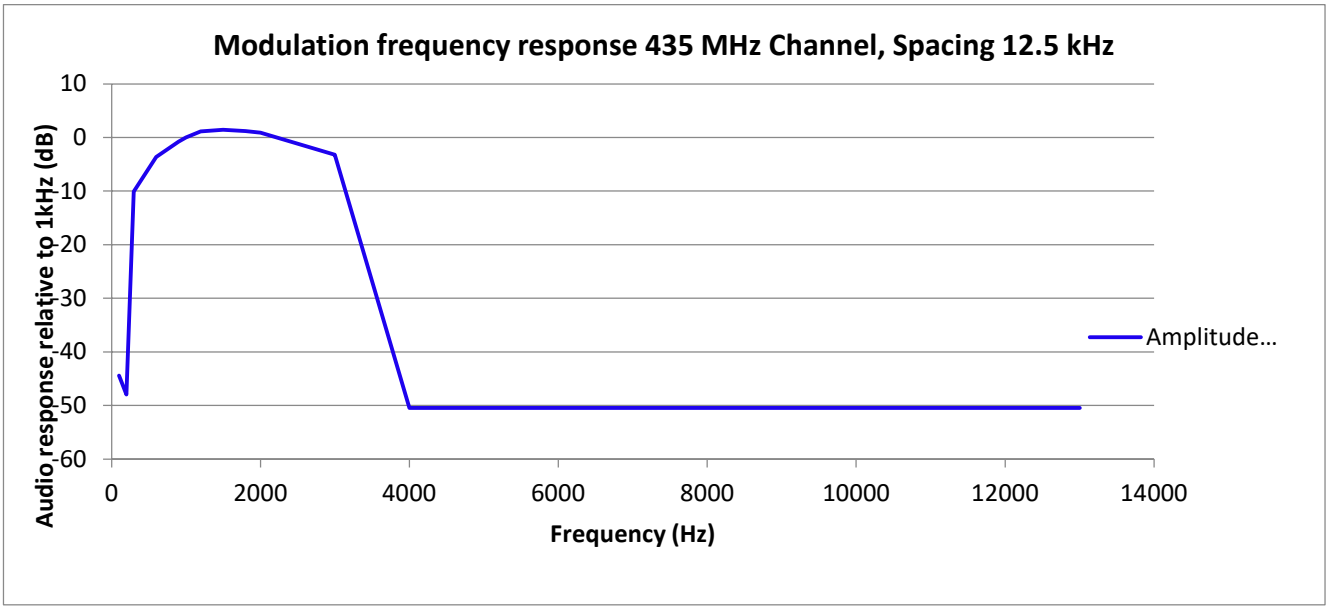


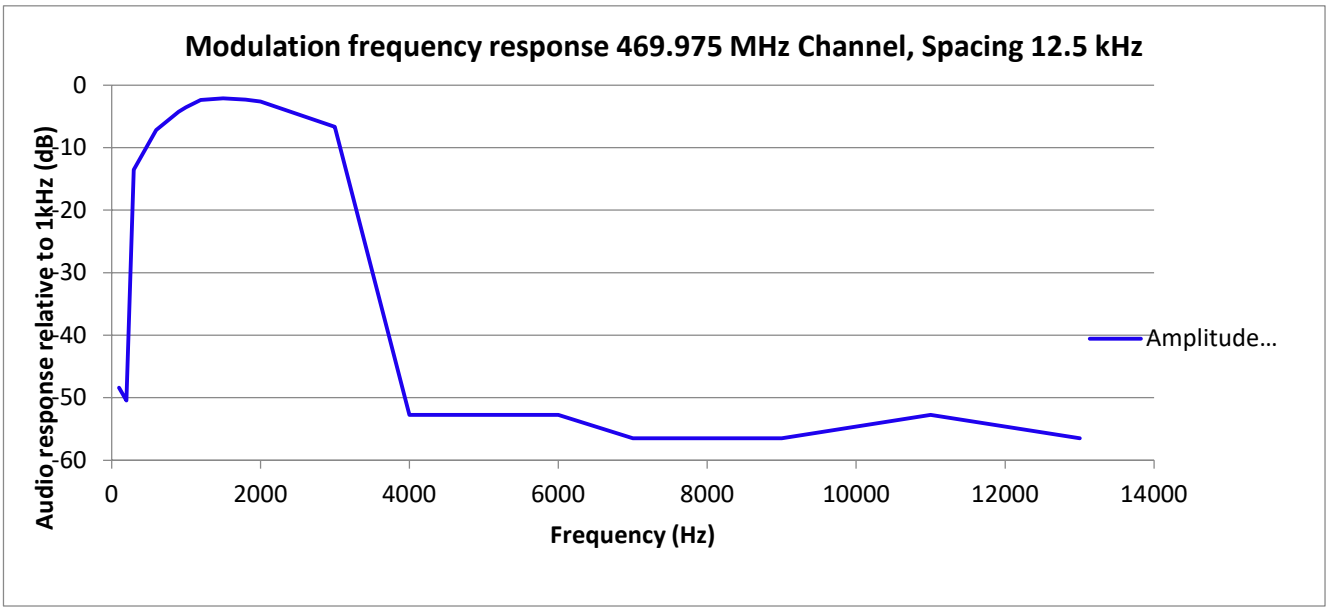



Modulation limiting 469.975 MHz High Channel, Spacing 12.5 kHz
Deviation (Hz)
1000
900
800
700
600
500
400
300
200
100
0
-70
-60
-50
-40
-30
-20
-10
0
Input amplitude (dBV)
300Hz
1000Hz
2500Hz
3000Hz

6.5 Modulation frequency response

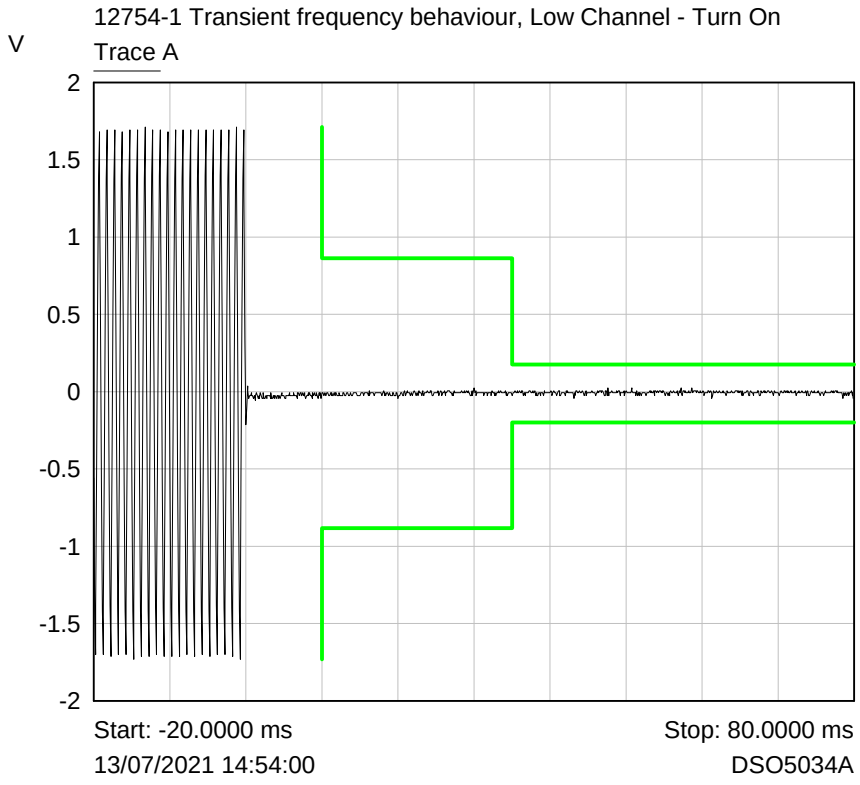




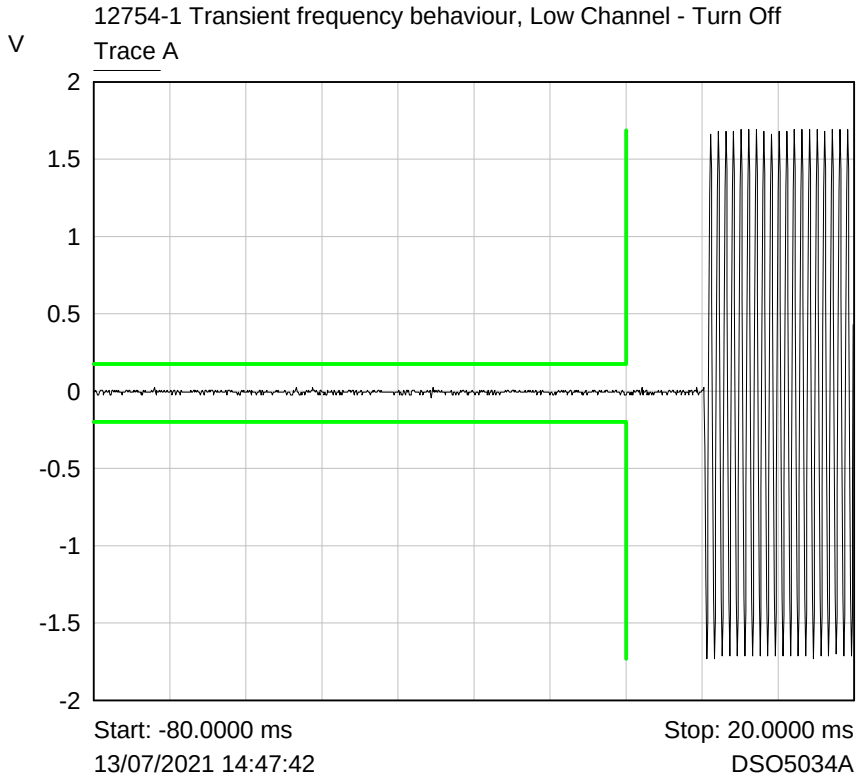

Modulation frequency response 469.975 MHz Channel, Spacing 12.5 kHz
Audio response relative to 1kHz (dB)
0
-10
-20
-30
-40
-50
-60
0
2000
4000
6000
8000
10000
12000
14000
Frequency (Hz)
Amplitude...

6.6 Transient frequency behaviour

RF Parameters: Band 400-470 MHz, Power 4 Watts, Channel Spacing 12.5 kHz, Modulation FM, Channel 400.025 MHz

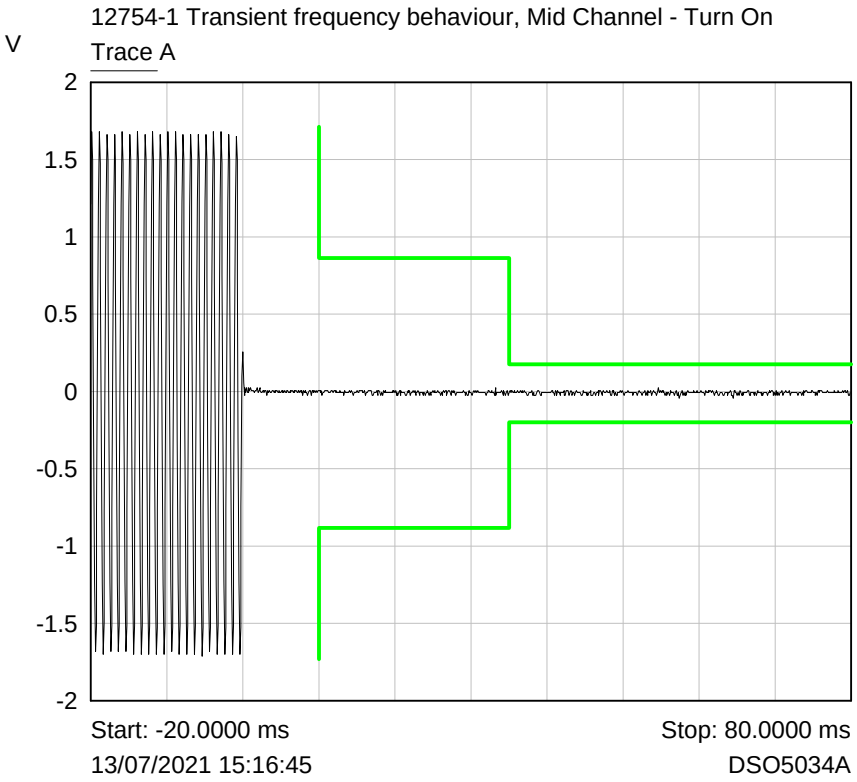


TX ON Result

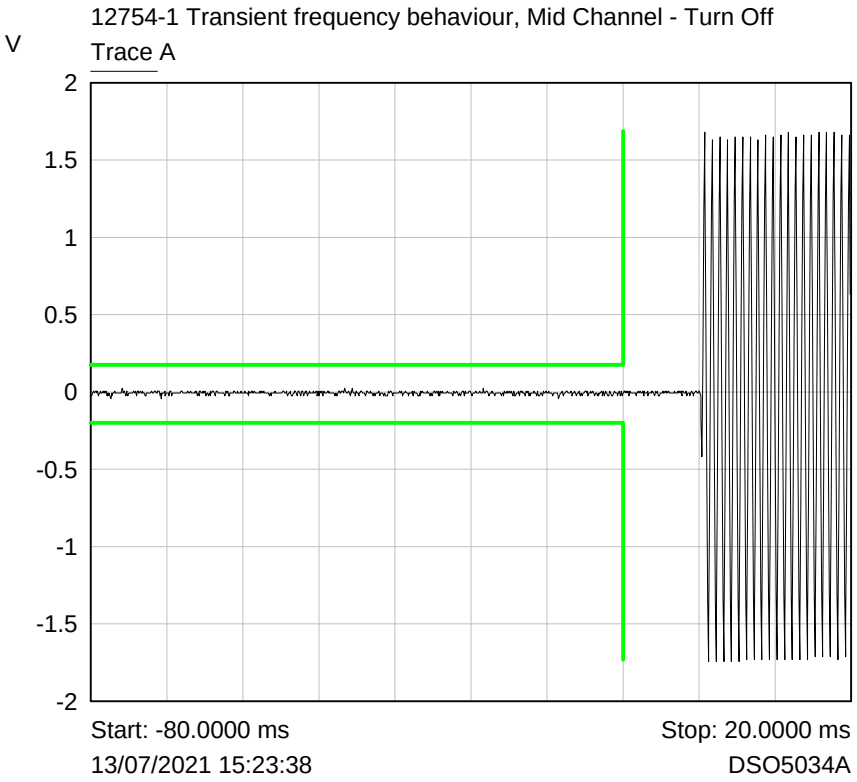


TX OFF Result

RF Parameters: Band 400-470 MHz, Power 4 Watts, Channel Spacing 12.5 kHz, Modulation FM, Channel 435 MHz

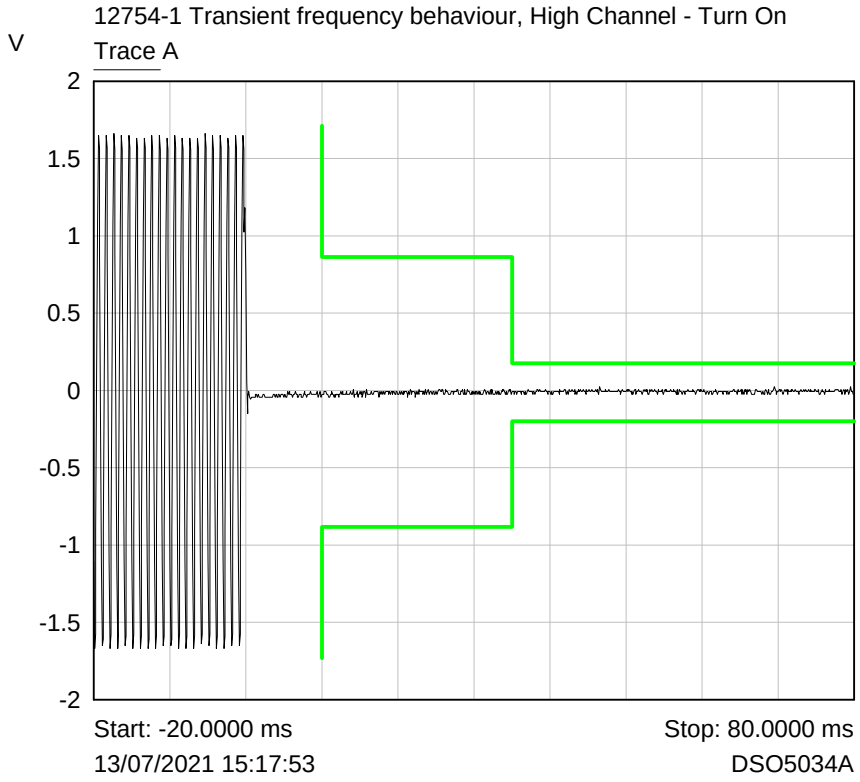


TX ON Result

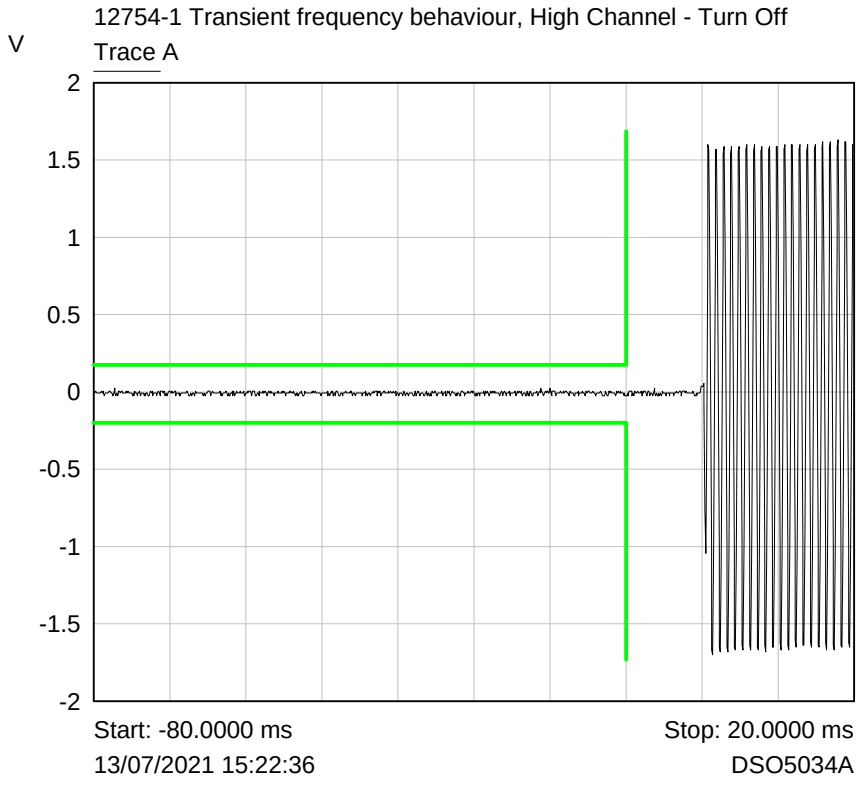


TX OFF Result

RF Parameters: Band 400-470 MHz, Power 4 Watts, Channel Spacing 12.5 kHz, Modulation FM, Channel 469.975 MHz



TX ON Result



TX OFF Result

7 Photographs

No photographs included in report due to confidentiality requested under the certification.

7.1 Radiated emission diagrams

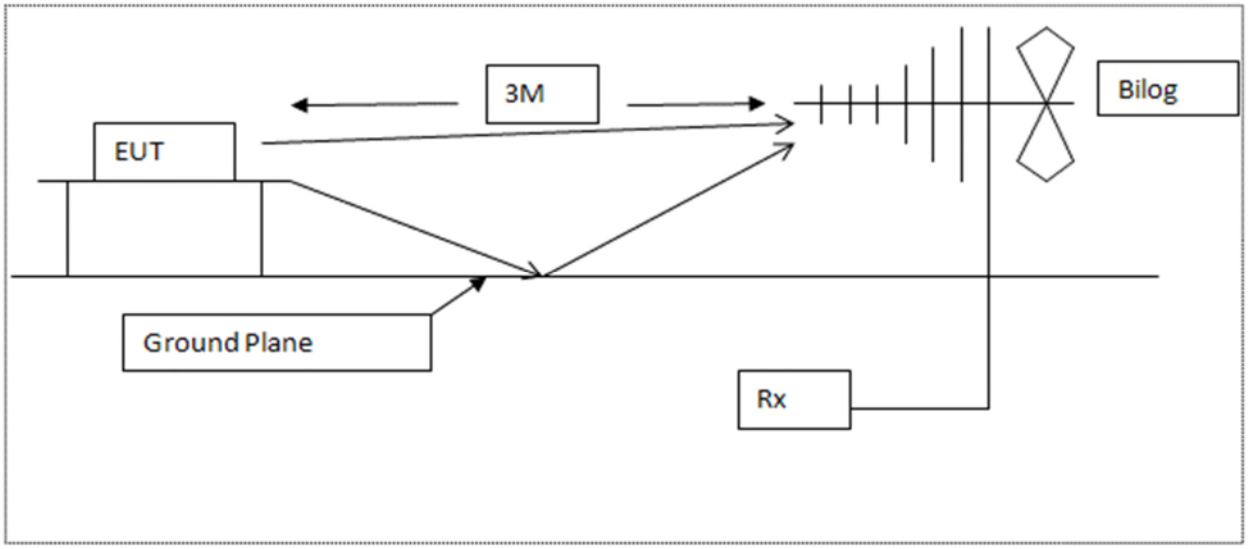


Diagram of the radiated emissions test setup 30 - 1000 MHz

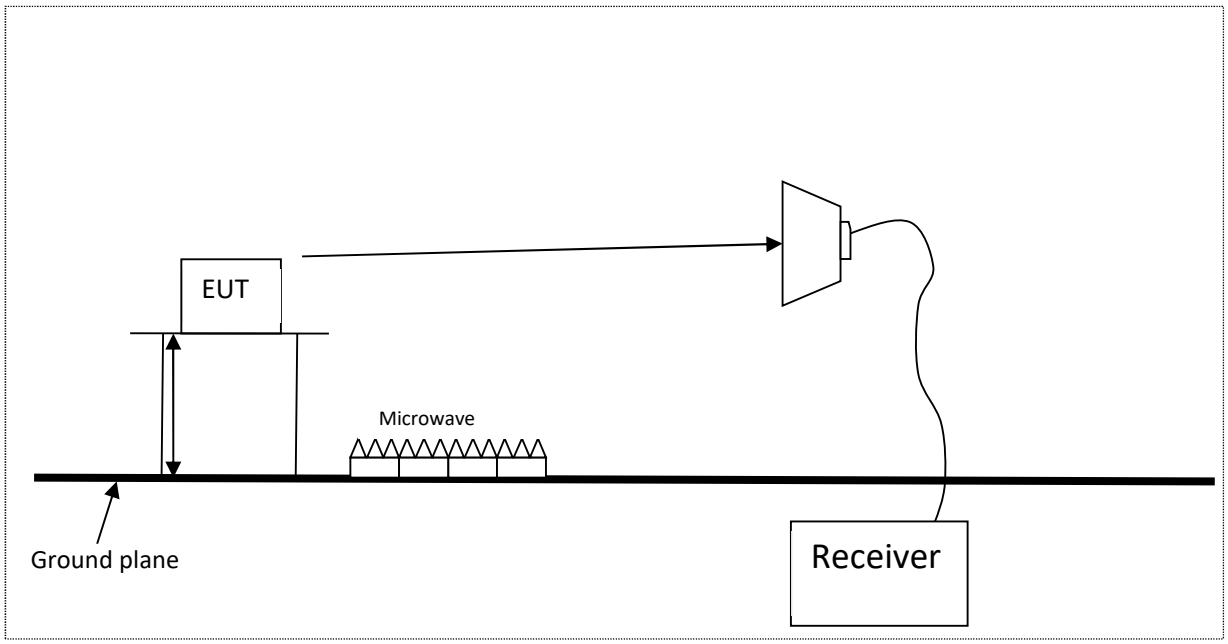


Diagram of the radiated emissions test setup above 1GHz

8 Test equipment calibration list

The following is a list of the test equipment used by R.N. Electronics Ltd to test the unit detailed within this report. In line with our procedures, the equipment was within calibration for the period during which testing was carried out.

RN No.	Model No.	Description	Manufacturer	Calibration date	Cal period
E136	3105	Horn Antenna 1 - 12.5 GHz	EMCO	02-Apr-2022	12 months
E227	6632A	PSU System DC Power Supply	Hewlett Packard	21-Mar-2022	12 months
E236	MP526D	Filter HPF 590 MHz	Anritsu	Not applicable	
E266	2032	Signal Generator 10kHz - 5.4GHz	Marconi Instruments	24-Jan-2022	12 months
E268	BHA 9118	Horn Antenna 1 - 18 GHz	Schaffner	02-Apr-2022	12 months
E289	8449B	Pre-Amplifier 1GHz - 26.5GHz	Hewlett Packard	#24-Jun-2022	12 months
E309	392	Attenuator 30dB 12.4GHz 10W	Midwest Microwave	#15-Dec-2022	12 months
E411	N9039A	9 kHz - 1 GHz RF Filter Section	Agilent Technologies	#07-Jul-2022	12 months
E412	E4440A	PSA 3 Hz - 26.5 GHz	Agilent Technologies	#21-Jun-2022	24 months
E428	HF906	Horn Antenna 1 - 18 GHz	Rohde & Schwarz	02-Apr-2022	12 months
E433	MG3693A	Signal Generator 2 GHz - 30 GHz	Anritsu	#03-Oct-2022	12 months
E434	G3RUH	10 MHz GPS Disciplined Oscillator	G3RUH - James Miller	23-Feb-2022	12 months
E463	8431A	Filter Band pass 2-4 GHz	Hewlett Packard	#24-Oct-2022	12 months
E467	8447F	Pre-Amplifier 0.1MHz to 1300MHz	Hewlett Packard	04-May-2022	12 months
E478	LQ2992/H	Filter Band pass 1-3GHz	RACAL-MESL	11-Mar-2022	12 months
E479	3750	Variable Electronic Filter	Krohn-Hite	21-Mar-2022	12 months
E482	26-6-34	Attenuator 6dB 18GHz	Weinschel Corp	30-Mar-2022	12 months
E517	E4421B	Signal Generator 250 kHz - 3 GHz	Hewlett Packard	08-Sep-2021	24 months
E532	-	Power Combiner 75-225MHz 3dB	AFL	Not applicable	
E534	E4440A	PSA 3 Hz - 26.5 GHz	Agilent Technologies	24-Jan-2022	24 months
E535	N9039A	9 kHz - 1 GHz RF Filter Section	Agilent Technologies	25-Jan-2022	12 months
E557	46-10-34	Attenuator 10dB	Weinschel Corp	17-Mar-2022	12 months
E558	18N20W-30dB	Attenuator 30dB 20W	Inmet	17-Mar-2022	12 months
E624	E4440A	PSA 3 Hz - 26.5 GHz	Agilent Technologies	#06-Jul-2022	24 months
E699	2305	Modulation Meter	Marconi Instruments	08-Dec-2021	12 months
E743	2017 4/2dB	Attenuator 4/2dB 30-1000MHz	RN Electronics	10-Mar-2022	12 months
E745	2017 4/2dB	Attenuator 4/2dB 30-1000MHz	RN Electronics	04-Feb-2022	12 months
E755	N9030B	PXA Signal Analyser 3 Hz to 50 GHz	Keysight Technologies	#03-Aug-2022	12 months
E914	VULB 9163	Antenna BiLog 30MHz to 3GHz	Schwarzbeck	23-Apr-2022	12 months
E967	F-336/UPM-84	Filter Band Pass 3.5 to 6.9GHz	Polarad Electronics	Not applicable	
F136	DSO5034A	Oscilloscope 300MHz 4CH	Agilent Technologies	#03-Oct-2022	12 months
H071	N9010B	EXA Signal Analyser 10 Hz to 44 GHz	Keysight Technologies	#09-Nov-2022	3 months
H072	N9000B	CXA Signal Analyser 9 kHz to 26.5 GHz	Keysight Technologies	09-Feb-2021	24 months
L264	DT75	Digital Thermometer	Instrotech Ltd	#20-Nov-2022	24 months
LPE261	3115	Horn Antenna 1 - 18 GHz	EMCO	02-Apr-2022	12 months
LPE333	8449B	Pre-Amplifier 1GHz - 26.5GHz	Hewlett Packard	27-May-2022	12 months
N579	71043	Frequency Standard Distribution amp	-	N/A	N/A
TMS205	4901.01B	Power Divider 50Ω 6dB 1W DC-2GHz	Suhner	#28-Nov-2022	12 months
TMS30	778D	Dual Directional Coupler 100MHz to 2GHz	Hewlett Packard	#09-Aug-2022	12 months

TMS38	VMT04/140	Environmental Oven	Heraeus Votsch	Not applicable	
TMS48	8901B	Modulation Analyser	Hewlett Packard	24-Mar-2021	24 months
TMS55	8903B	Audio Analyser	Hewlett Packard	22-Apr-2021	24 months
TMS812	MP534A MP651A	Dipole Set 200 - 1700 MHz	Anritsu	#16-Jun-2022	12 months
TMS82	8449B	Pre-Amplifier 1GHz - 26.5GHz	Agilent Technologies	16-Dec-2021	12 months

Equipment was within calibration dates for tests and has been re-calibrated since/during date of tests.

9 Auxiliary and peripheral equipment

9 .1 Customer supplied equipment

Item No.	Model No.	Description	Manufacturer	Serial No.
1	CNB450E	Battery	Entel	DPAD04061B1
2	CSAHX	Battery charger	Entel	41AA1804
3	EA12/DX	D-shaped earpiece with tie clip mic / PTT	Entel	Not stated
4	not applicable	10 cm SMA coax cable	Not stated	not applicable

9 .2 RN Electronics supplied equipment

No RN Electronics Ltd supplied equipment was used.

10 Condition of the equipment tested

In order for the EUT to produce the results shown within this report the following modifications, if any, were implemented.

10.1 Modifications before test

Test	Modification	Time of modification
Emission mask	Software modification to modify transmit on/off ramp characteristics.	Before testing

10.2 Modifications during test

No modifications were made during test by RN Electronics Ltd.

11 Description of test sites

Site A Radio Laboratory and Anechoic Chamber

Site B Semi-Anechoic Chamber and Control Room
FCC Registration No. 293246, ISED Registration No. 5612A-4

Site C Transient Laboratory

Site D Screened Room (Conducted Immunity)

Site E Screened Room (Control Room for Site D)

Site F Screened Room (Conducted Emissions)

Site G Screened Room (Control Room for Site H)

Site H 3m Semi-Anechoic Chamber (indoor OATS)
FCC Registration No. 293246, ISED Registration No. 5612A-2, VCCI Registration No. 4065

Site J Transient Laboratory

Site K Screened Room (Control Room for Site M)

Site M 3m Semi-Anechoic Chamber (indoor OATS)
FCC Registration No. 293246, ISED Registration No. 5612A-3

Site N Radio Laboratory

Site Q Fully-Anechoic Chamber

Site OATS 3m and 10m Open Area Test Site
FCC Registration No. 293246, ISED Registration No. 5612A-1

Site R Screened Room (Conducted Immunity)

Site S Safety Laboratory

Site T Transient Laboratory

RN Electronics CAB identifier as issued by Innovation, Science and Economic Development Canada is UK0002
RN Electronics CAB identifier as issued by FCC is UK0015

12 Abbreviations and units

%	Percent
µA/m	microAmps per metre
µV	microVolts
µW	microWatts
AC	Alternating Current
ALSE	Absorber Lined Screened Enclosure
AM	Amplitude Modulation
Amb	Ambient
ATPC	Automatic Transmit Power Control
BER	Bit Error Rate
ºC	Degrees Celsius
C/I	Carrier / Interferer
CEPT	European Conference of Postal and Telecommunications Administrations
COFDM	Coherent OFDM
CS	Channel Spacing
CW	Continuous Wave
dB	deciBels
dBµA/m	deciBels relative to 1µA/m
dBµV	deciBels relative to 1µV
dBc	deciBels relative to Carrier
dBm	deciBels relative to 1mW
DC	Direct Current
DTA	Digital Transmission Analyser
EIRP	Equivalent Isotropic Radiated Power
ERP	Effective Radiated Power
EU	European Union
EUT	Equipment Under Test
FM	Frequency Modulation
FSK	Frequency Shift Keying
g	Grams
GHz	GigaHertz
Hz	Hertz
IF	Intermediate Frequency
kHz	kiloHertz
LBT	Listen Before Talk
LO	Local Oscillator
mA	milliAmps
max	maximum
kPa	Kilopascal
Mbit/s	MegaBits per second
MHz	MegaHertz
mic	Microphone
min	minimum
mm	milliMetres
ms	milliSeconds
mW	milliWatts
NA	Not Applicable
nom	Nominal
nW	nanoWatt
OATS	Open Area Test Site
OFDM	Orthogonal Frequency Division Multiplexing
ppm	Parts per million
PRBS	Pseudo Random Bit Sequence
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
R&TTE	Radio and Telecommunication Terminal Equipment
Ref	Reference
RF	Radio Frequency
RFC	Remote Frequency Control
RSL	Received Signal Level
RTP	Room Temperature and Pressure
RTPC	Remote Transmit Power Control
Rx	Receiver
s	Seconds
SINAD	Signal to Noise And Distortion
Tx	Transmitter
V	Volts