DEKRA Testing and Certification, S.A.U.
Parque Tecnológico de Andalucía,
c/ Severo Ochoa nº 2 · 29590 Campanillas · Málaga · España

FCC LISTED, REGISTRATION NUMBER: 720267

ISED LISTED REGISTRATION NUMBER IC 4621A-2

Test report No:

NIE: 53314RRF.001

Test report
REFERENCE STANDARD:
USA FCC Part 90
CANADA IC RSS-119

Identificación del objeto ensayado.....: Identification of item tested	Mobile Radiotelephone
Marca .....: Trade	PowerTrunk
Modelo y/o referencia tipo .....: Model and /or type reference	MDT-400 409-430 MHz
Other identification of the product .....:	D262Z28PT FCC ID: WT7PTMDT410B IC: 8624A-PTMDT410B
HW version .....:	CCP 1.14.26.01.08
SW version .....:	v26.02b00
Características .....: Features	Power supply: MDT-400 409-430 MHz: o Nominal voltage: 13.2 VDC o Operational voltage range: [10.8 - 15.6 VDC] Frequency band: TX: 409-430 MHz RX: 409-430 MHz RF output power (nominal): TETRA: 40 dBm (10 W) TI D-LMR: 37.78 dBm (6 W) See full details on pages 5 and 6
Solicitante.....: Applicant	TELTRONIC, S.A.U. Polígono Malpica, Calle C/F-Oeste (50016). Zaragoza (SPAIN).
Método de ensayo solicitado, norma.....: Test method requested, standard	USA FCC Part 90 10-01-16 Edition. CANADA IC RSS-119 Issue 12, May 2015. ANSI C63.26-2015.
Resultado.....: Summary	IN COMPLIANCE
Aprobado por (nombre / cargo y firma) .....: Approved by (name / position & signature)	A. Llamas RF Lab. Manager Firmado digitalmente por ALEJANDRO LLAMAS RODRIGUEZ Fecha: 2018.02.07 10:01:27 +01'00'
Fecha de realización .....: Date of issue	2018-02-07

Formato de informe No. .....: Report template No	FDT08_20

Index

Competences and guarantees....4
General conditions....4
Uncertainty....4
Usage of samples....5
Test sample description....5
Identification of the client....6
Testing period....6
Environmental conditions....6
Remarks and comments....7
Testing verdicts....8
Appendix A – Test results....9

Competences and guarantees

DEKRA Testing and Certification is a laboratory with a measurement facility in compliance with the requirements of Section 2.948 of the FCC rules and has been added to the list of facilities whose measurements data will be accepted in conjuction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Registration Number: 720267.

DEKRA Testing and Certification is a laboratory with a measurement site in compliance with the requirements of RSS 212, Issue 1 (Provisional) and has been added to the list of filed sites of the Canadian Certification and Engineering Bureau. Reference File Number: ISED 4621A-2.

In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification has a calibration and maintenance program for its measurement equipment.

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Uncertainty

Uncertainty (factor k=2) was calculated according to the DEKRA Testing and Certification internal document PODT000.

Usage of samples

Samples undergoing test have been selected by: **the client**.

Sample S/01 is composed of the following elements:

Control Nº	Description	Model	Code	Serial number	Reception date
53314/045	MDT-400 in-vehicle & PEI connection kit	---	D026521PT	---	2017-10-24
53314/051	Front panel	F-400	ME261020APT	9765924	2017-10-24
53314/053	GPS antenna	---	11779	024428	2017-10-24
53314/054	GPS Antenna cable	---	---	---	2017-10-24
53314/055	Fist microphone	MP-400	D026608PT	---	2017-10-24
53314/057	MDT-400 radio unit	MDT-400 409-430 MHz	D262Z28PT	TEI: 000003032659510	2017-10-24
53314/060	Button PTT	---	D026000PT	---	2017-10-24
53314/061	Standard loudspeaker	2 1/4" 5W	D026620PT	---	2017-10-24
53314/062	Directional microphone	---	D026600PT	---	2017-10-24
53314/064	DC power supply cable	---	D026502PT	---	2017-10-24
53314/065	Remote front panel cable	---	208748	---	2017-10-24

1. Sample S/01 has undergone the test(s).

   All tests indicated in appendix A.

Test sample description

The MDT-400 mobile radio is a TETRA and TI D-LMR digital RF transceiver that can operate in the following modes:

- TMO mode (Trunked Mode of Operation) on the network infrastructure supported by a service provider.
- DMO mode (Direct Mode of Operation), by communicating directly with another radio (antenna to antenna)

A GPS receiver can optionally be fitted inside the MDT-400.
The DT-410 is an accessory of the MDT-400 mobile radio. Being conceived for desktop operation, it is made up of an AC-DC power supply, an internal speaker, a fan and an MDT-400 unit itself, all of them being integrated in an enclosure.

Features:

Power Supply:
MDT-400 409-430 MHz:

- Nominal voltage: 13.2 VDC
- Operational voltage range: [10.8 - 15.6 VDC]

DT-410 409-430 MHz:

- Nominal voltage: 110/220 VAC. 50/60 Hz
- Range: [100 - 240 VAC] , [47-63 Hz]

Access scheme:
TDMA with 4 physical channels (time slots) per RF channel.
Modulation scheme:
π/4-DQPSK with a modulation rate of 18 Ksym/s, equivalent to 36 Kbits/s. Based upon it, two digital communication systems are supported:

- TETRA:

Modulation low-pass filter: Square-root raised cosine filter with a roll-off factor of 0.35.

- TI D-LMR:

Modulation low-pass filter: Square-root raised cosine filter with a roll-off factor of 0.2.
RF channel bandwidth (channel spacing):
25 KHz

Spectral efficiency:
One voice & data physical channel with a rate of 9 Kbits/s is allocated a 6.25 KHz equivalent channel bandwidth.
Frequency band:
TX: 409-430 MHz
RX: 409-430 MHz
RF output power (nominal):
TETRA: 40 dBm (10 W)
TI D-LMR: 37.78 dBm (6 W)
RF authorized bandwidth:
TETRA: 22 KHz
TI D-LMR: 20 KHz
Emission designators:
TETRA: 22K0D7D, 22K0D7E, 22K0D7W
TI D-LMR: 20K0D7D, 20K0D7E, 20K0D7W
Additional features:
Audio low-pass filter.

Options:
MDT-400 409-430 MHz (TEI 000003032659510):
- O000: GPS receiver option.

MDT-400 409-430 MHz (TEI 000003032659500) fitted inside the DT-410 (S/N 9845330):
- O000: GPS receiver option.
- O610: Dispatcher option

Identification of the client

TELTRONIC, S.A.U.

Polígono Malpica, Calle C/F-Oeste (50016). Zaragoza (SPAIN).

Testing period

The radiated measurements started on 2017-11-30 and finished on the same day.

The conducted measurements started on 2018-01-11 and finished on 2018-01-31.

The tests have been performed at DEKRA Testing and Certification.

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω

In the semianechoic chamber, the following limits were not exceeded during the test.

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω
Normal site attenuation (NSA)	< ±4 dB at 10 m distance between item under test and receiver antenna, (30 MHz to 1000 MHz)
Field homogeneity	More than 75% of illuminated surface is between 0 and 6 dB (26 MHz to 1000 MHz).

In the chamber for conducted measurements, the following limits were not exceeded during the test:

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω

Remarks and comments

1: The tests have been performed by the technical personnel: Pedro Parada and Carolina Postigo.

2: Used instrumentation.

Conducted Measurements

		Last Cal. date	Cal. due date
1.	Climatic chamber HERAEUS VM 04/35	2016/03	2018/03
2.	DC power supply R&S NGPE 40/40	---	---
3.	Digital multimeter FLUKE 113	2017/05	2019/05
4.	Radiocommunication analyser R&S CMTA84	2015/07	2018/07
5.	Power sensor R&S NRP-Z81	2016/04	2018/04
6.	Spectrum analyser R&S FSV40	2017/07	2019/07
7.	RF generator R&S SMB100A	2017/07	2019/07
8.	Storage oscilloscope Tektronix DPO4104B	2017/09	2018/09
9.	Radiocommunication analyser HP 8920A	2017/04	2019/04

Radiated Measurements

		Last Cal. date	Cal. due date
1.	Semianechoic Absorber Lined Chamber ETS FACT3 200STP	N.A.	N.A.
2.	BiconicalLog antenna ETS LINDGREN 3142E	2015/06	2018/06
3.	Multi Device Controller EMCO 2090	N.A.	N.A.
4.	Double-ridge Guide Horn antenna 1-18 GHz SCHWARZBECK BBHA 9120 D	2016/11	2019/11
5.	Spectrum analyser Rohde & Schwarz FSW50	2015/12	2017/12
6.	EMI Test Receiver R&S ESU 26	2015/11	2017/11
7.	RF pre-amplifier 20 MHz-7 GHz A. H. SYSTEMS PAM-0207	2017/09	2018/09
8.	RF pre-amplifier 1-18 GHz Bonn Elektronik BLMA 0118-1M	2016/02	2018/02
9.	DC power supply KEYSIGHT TECHNOLOGIES	---	---
10.	Digital multimeter FLUKE 113	2017/05	2019/05

3: This information has been provided by the applicant.

Testing verdicts

Not applicable ..... :	N/A
Pass ..... :	P
Fail ..... :	F
Not measured ..... :	N/M

FCC PART 90 / RSS-119 PARAGRAPH	VERDICT			
	NA	P	F	NM
Clause 2.1047, 90.207. Modulation characteristics				NM[3]
Clause 90.209 / RSS-119 Clause 5.5: Occupied Bandwidth		P		
Clause 90.205, 90.279 / RSS-119 Clause 5.4: RF output power		P		
Clause 90.210 / RSS-119 Clause 5.5, 5.8: Emission mask		P		
Clause 90.213 / RSS-119 Clause 5.3: Frequency stability		P		
Clause 90.210 / RSS-119 Clause 5.8: Spurious emissions at antenna terminals		P		
Clause 90.210 / RSS-119 Clause 5.8: Radiated emissions		P		
Clause 90.214 / RSS-119 Clause 5.9: Transient frequency behaviour		P		

3: see point “Remarks and comments”.

Appendix A – Test results

INDEX

TEST CONDITIONS 11

Modulation Characteristics 15

Occupied Bandwidth 18

RF Output Power 24

Emission Mask 26

Frequency Stability 33

Spurious emissions at antenna terminals 35

Radiated emissions 43

Transient Frequency Behaviour 50

TEST CONDITIONS

Power supply (V):

DC voltage

V_{nom} = 13.2 Vdc

V_{max} = 15.6 Vdc

V_{min} = 10.8 Vdc

The subscripts nom, min and max indicate voltage test conditions (nominal, minimum and maximum respectively, as declared by the applicant).

Type of power supply = DC Voltage from external power supply

Type of antenna = external connectable antenna

Rated RF Output Power:

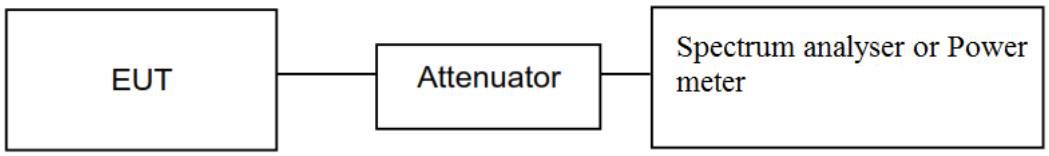
- Mode TETRA (22 kHz bandwidth): 40 dBm (10 W)
- Mode TI D-LMR (20 kHz bandwidth): 37.78 dBm (6 W)

TEST FREQUENCIES:

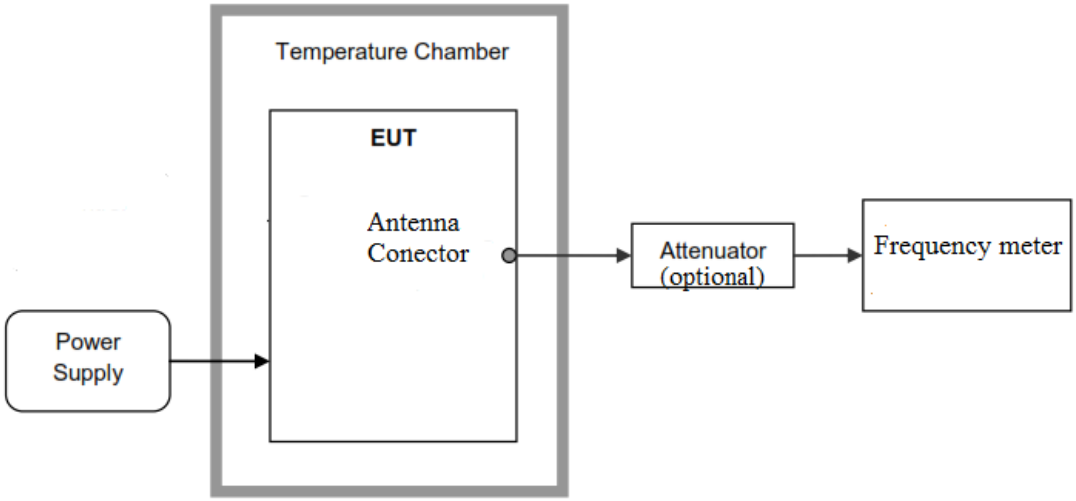
FCC 90 TI D-LMR 20 kHz bandwidth	
Lowest channel	421 MHz
Highest channel	430 MHz
RSS-119 TI D-LMR 20 kHz bandwidth & TETRA 22 kHz bandwidth	
Lowest channel	409 MHz
Middle channel	421 MHz
Highest channel	430 MHz

CONDUCTED MEASUREMENTS

The equipment under test (EUT) was set up in a shielded room and it is connected to the spectrum analyzer or power meter through a calibrated attenuator and a low loss RF cable. The reading of the instrument is corrected taking into account the attenuator and cable loss.



For frequency stability test the EUT was placed inside a climatic chamber and connected to a frequency meter using a low loss cable. An external DC power supply was connected to the EUT for voltage variation test.



RADIATED MEASUREMENTS

The equipment under test was scanned for spurious emissions in the frequency range 30 to 5000 MHz.

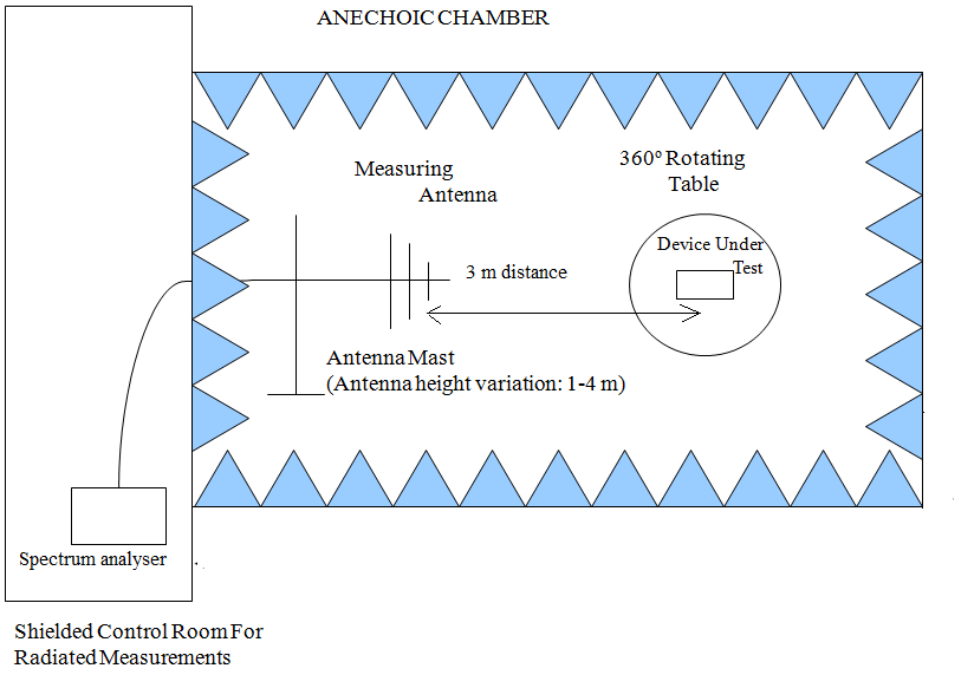
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30 MHz-1000 MHz (30 MHz-1000 MHz Bilog antenna) and at a distance of 1m for the frequency range 1 GHz-5 GHz (1 GHz-18 GHz Double ridge horn antenna).

For radiated emissions in the range 1 GHz-5 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance. The sample is prepared so that transmits continuously when the batteries are connected

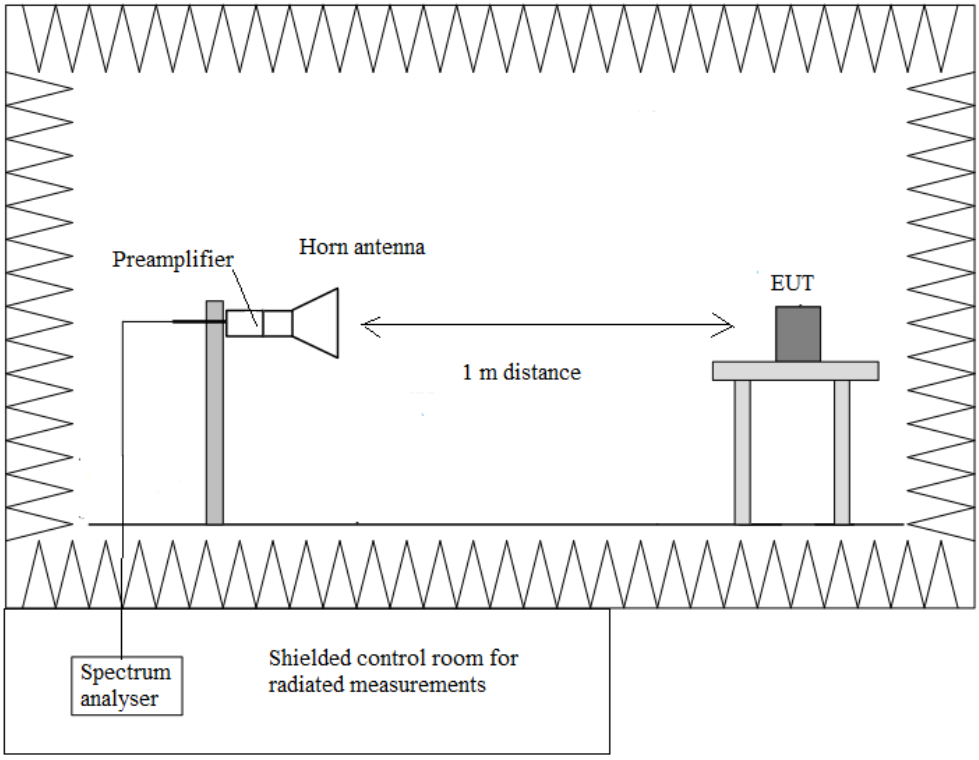
The equipment under test was set up on a non-conductive platform and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

Radiated measurements setup f < 1 GHz



Radiated measurements setup f > 1 GHz



Modulation Characteristics

SPECIFICATION

FCC §2.1047 and §90.207

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

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

(c) Single sideband and independent sideband radiotelephone transmitters which employ a device or circuit to limit peak envelope power. A curve showing the peak envelope power output versus the modulation input voltage shall be supplied. The modulating signals shall be the same in frequency as specified in paragraph (c) of § 2.1049 for the occupied bandwidth tests.

(d) Other types of equipment. A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

RESULTS (The following information has been provided by the applicant)

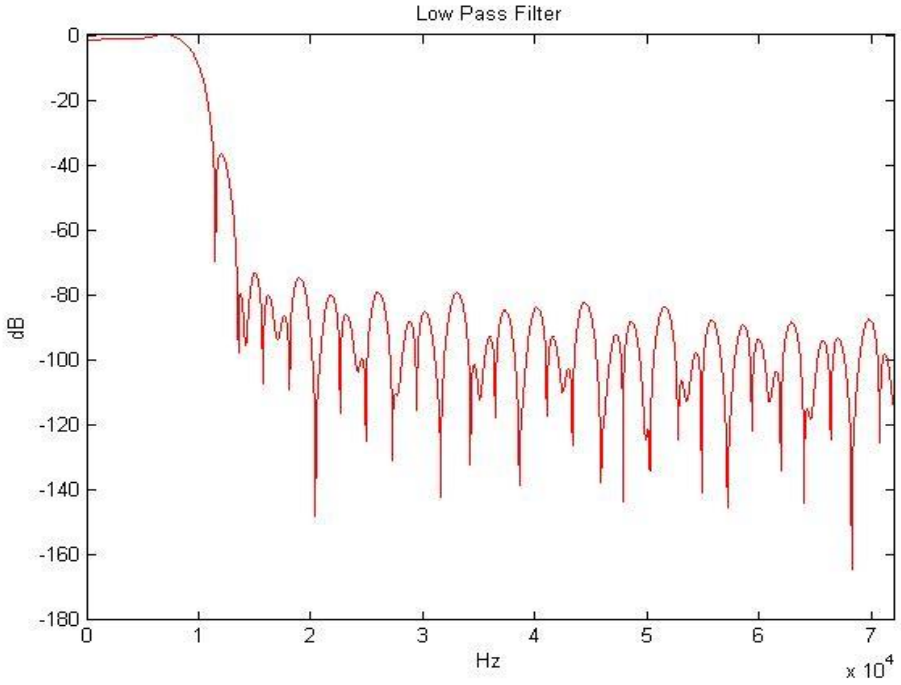
The EUT operates with π/4-shifted Differential Quaternary Phase Shift Keying (π/4-DQPSK) in both TI D-LMR and TETRA, featuring a modulation rate of 18 ksym/s (36 kbits/s).

The access scheme is TDMA with 4 physical channels per carrier.

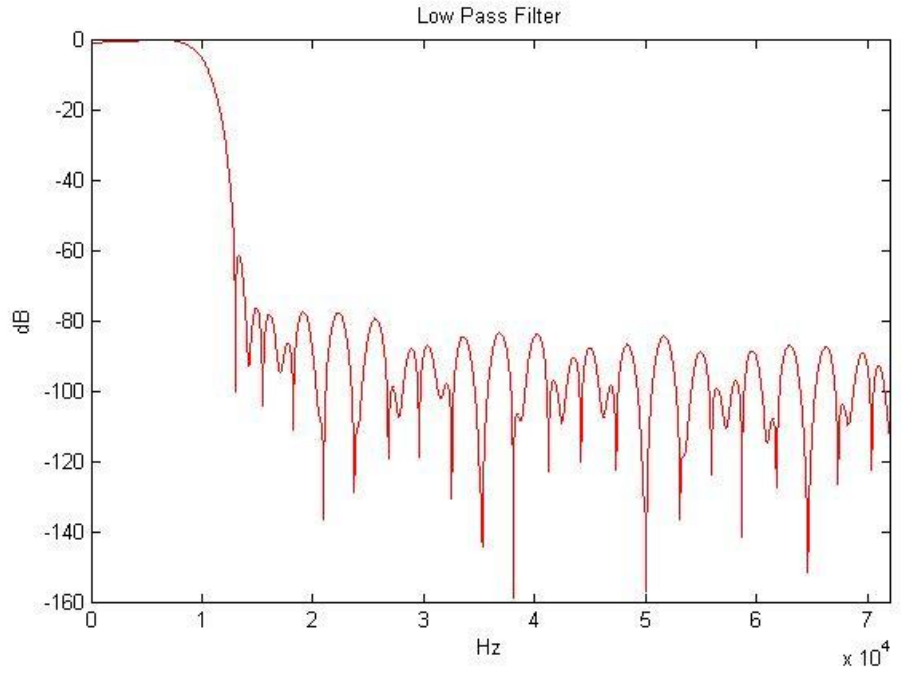
A root-raised-cosine filter (RRC) is used as a transmitting and receiving filter in both digital communication systems to perform matched filtering. The combined response of such two filters is that of the raised-cosine filter. The raised-cosine filter is often used for pulse-shaping in digital modulation, known for its ability to minimize intersymbol interference (ISI).

The graphs below show the transfer function of the aforementioned filter when the authorized modulation bandwidth is 20 KHz and 22 KHz, respectively.

MDT-400 409-430 MHz transmitter low pass filter for TI D-LMR (20 KHz authorized bandwidth):

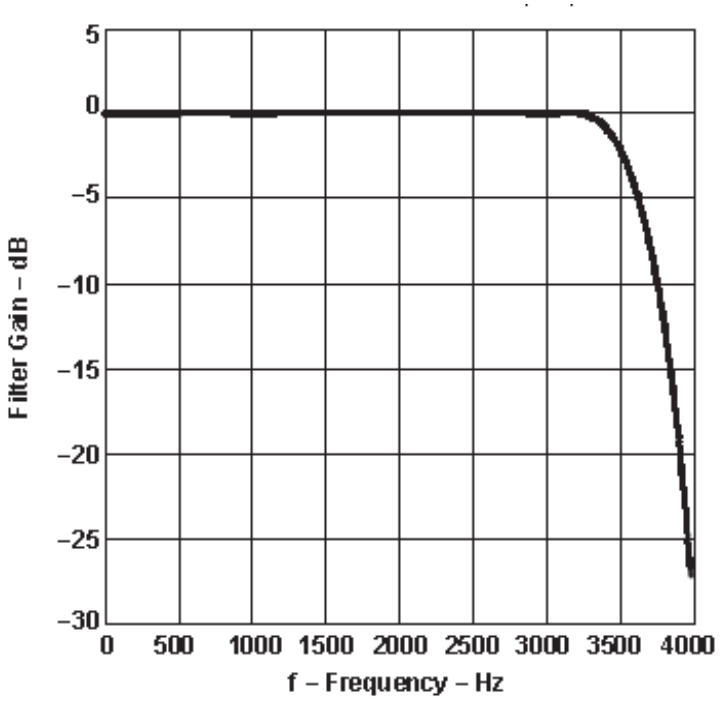


MDT-400 409-430 MHz transmitter low pass filter for TETRA (22 KHz modulation bandwidth):



AUDIO LOW-PASS FILTER:

The transmitter and receiver audio functionalities are supported by an audio CODEC integrated circuit that bears an internal low-pass filter with the frequency response shown below:



Occupied Bandwidth

SPECIFICATION

FCC §2.1049, §90.209.

Frequency band (MHz)	Channel spacing (kHz)	Authorized bandwidth (kHz)
406-512	25	20

Note: Operations using equipment designed to operate with a 25 kHz channel bandwidth may be authorized up to a 22 kHz bandwidth if the equipment meets the Adjacent Channel Power limits of § 90.221.

RSS-119 Clause 5.5.

Frequency Band (MHz)	**Related SRSP for Channelling Plan and e.r.p.**	**Channel Spacing (kHz)**	**Authorized Bandwidth (kHz)**
406.1-430 and 450-470	SRSP-501	25	20 22

METHOD

The EUT was configured to transmit a modulated carrier signal. The 99% occupied bandwidth and the -26 dBc bandwidths were measured directly using the built-in bandwidth measuring option of spectrum analyzer.

RESULTS (see next plots)

TI D-LMR 20 kHz.

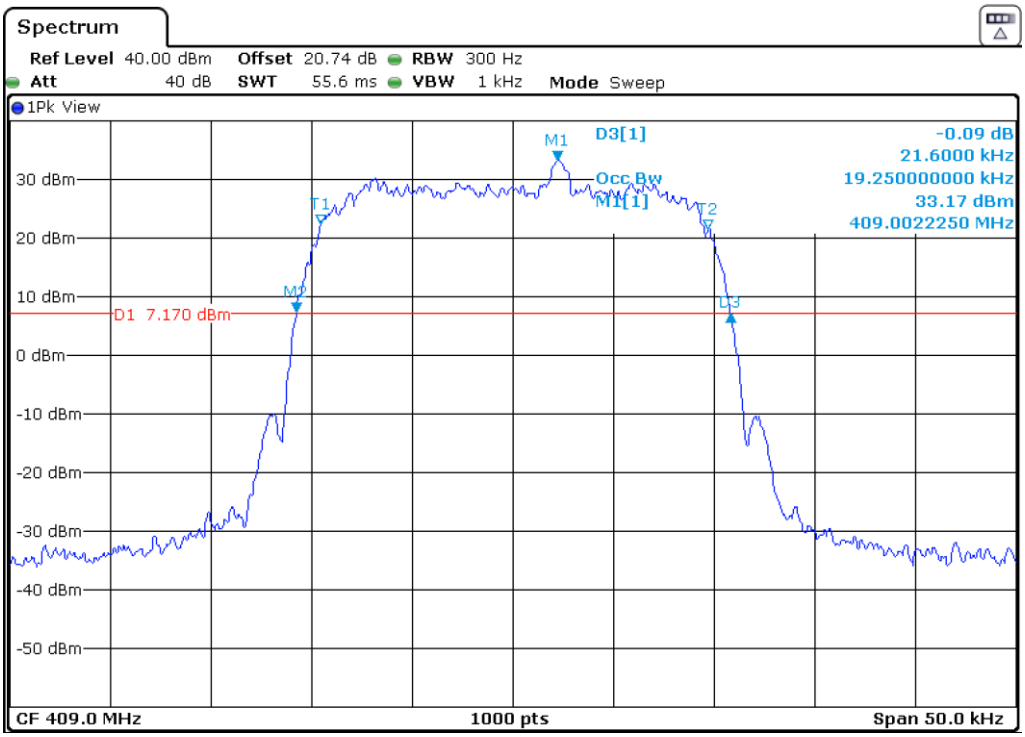
Channel	99% Occupied bandwidth (kHz)	-26 dBc bandwidth (kHz)
409 MHz	19.25	21.60
421 MHz	19.20	21.60
430 MHz	19.15	21.65
Measurement uncertainty (kHz)	<±0.03	

TETRA 22 kHz.

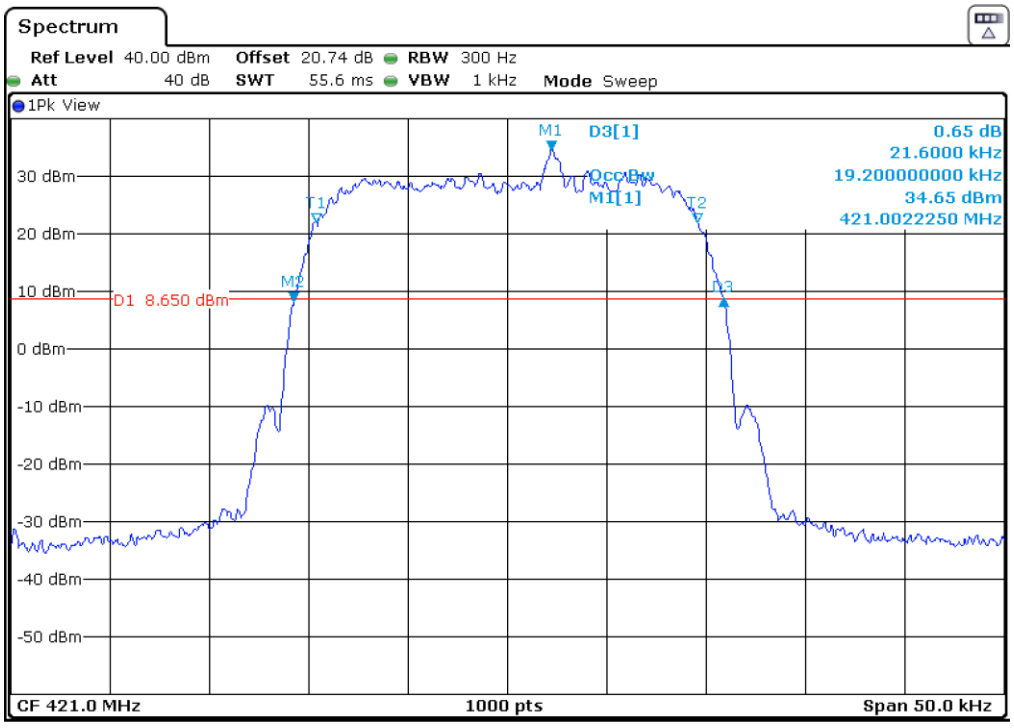
Channel	99% Occupied bandwidth (kHz)	-26 dBc bandwidth (kHz)
409 MHz	20.20	23.15
421 MHz	20.20	23.05
430 MHz	20.40	23.00
Measurement uncertainty (kHz)	<±0.03	

TI D-LMR 20 kHz.

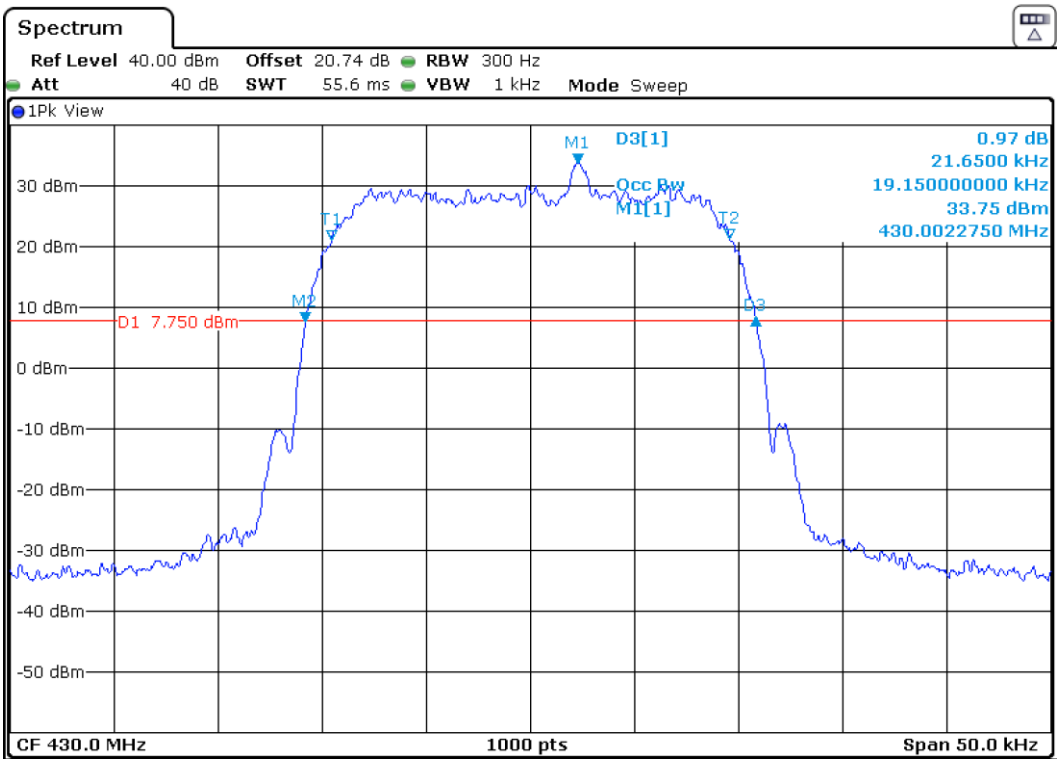
Lowest Channel



Middle Channel

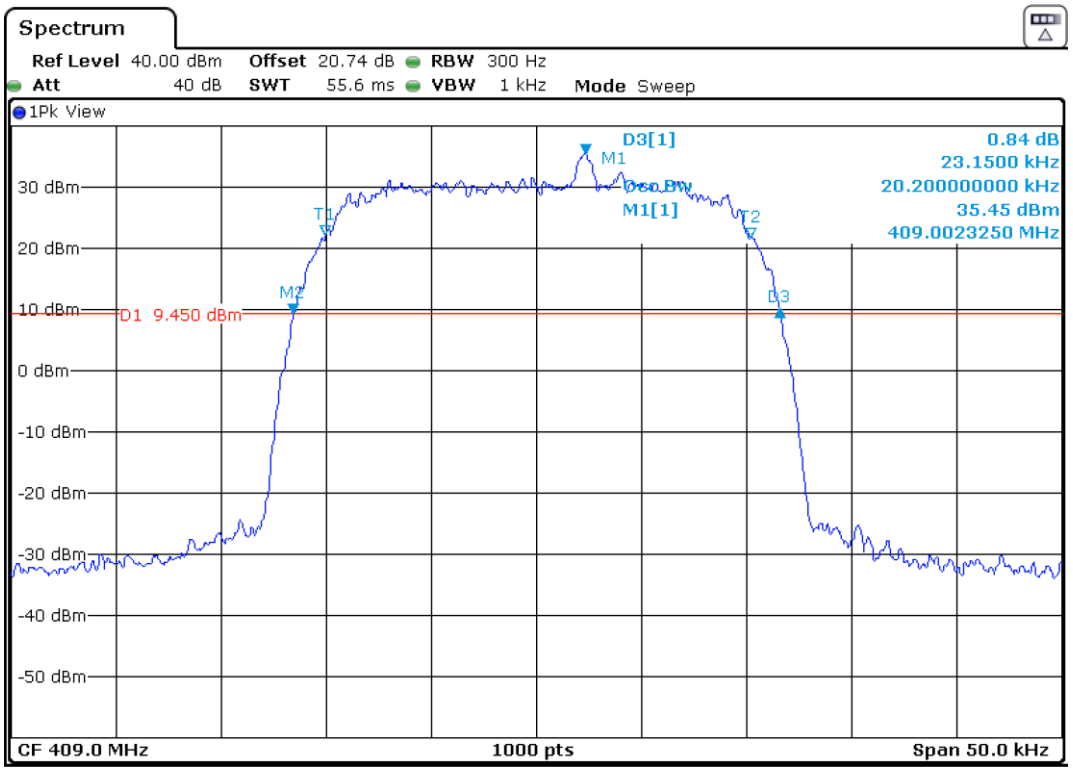


Highest Channel

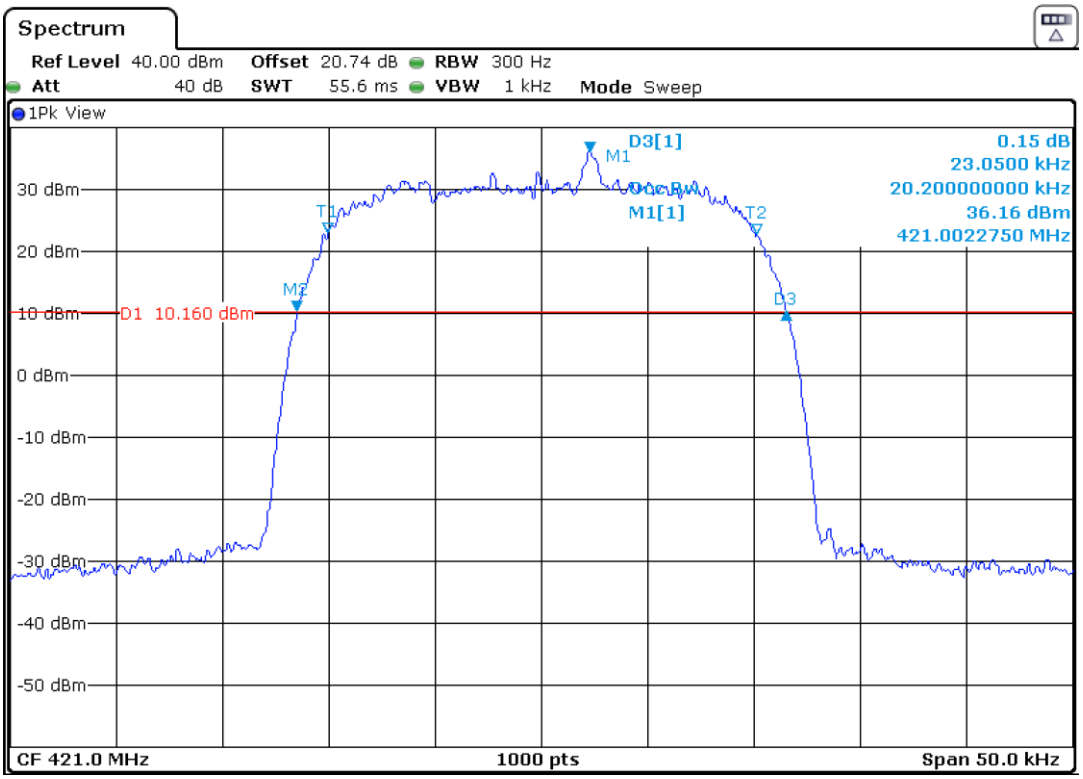


TETRA 22 kHz.

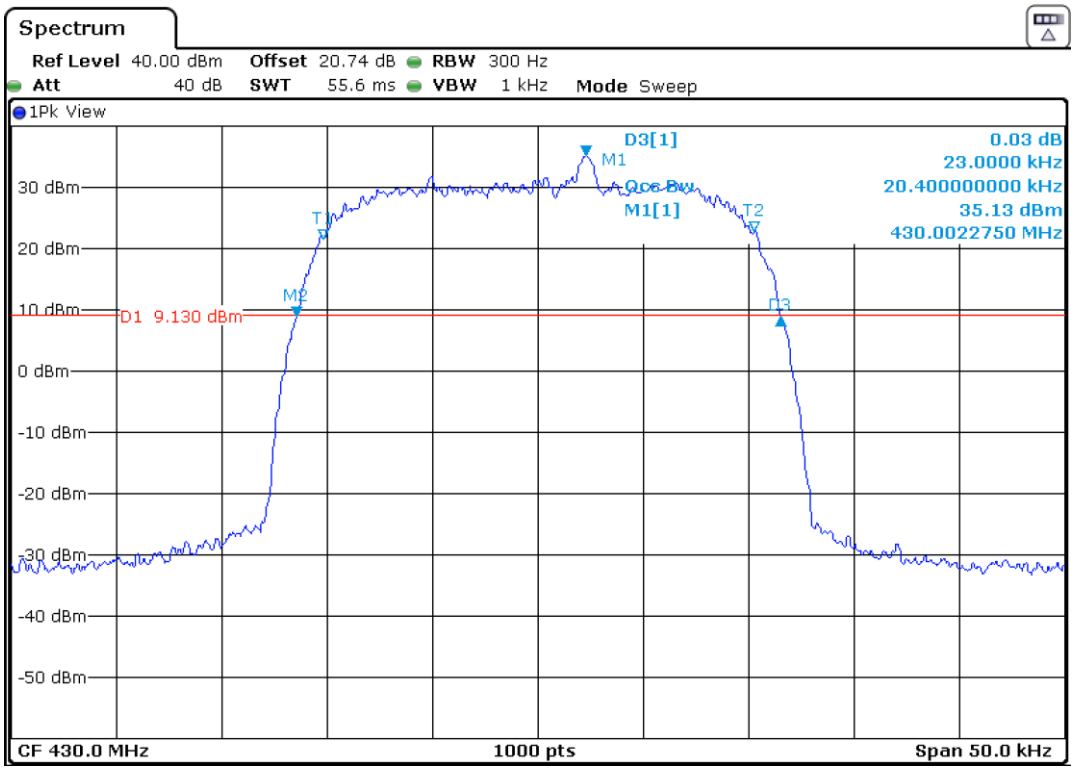
Lowest Channel



Middle Channel



Highest Channel



RF Output Power

SPECIFICATION

FCC §90.205 and §90.279. 421-430 MHz band.

(a) Base station authorizations in the 421-430 MHz band will be subject to Effective Radiated Power (ERP) and Effective Antenna Height (EAH) limitations as shown in the table below. ERP is defined as the product of the power supplied to the antenna and its gain relative to a half-wave dipole in a given direction. EAH is calculated by subtracting the Assumed Average Terrain Elevation (AATE) as listed in table 7 of §90.619 from the antenna height above mean sea level.

Limits of Effective Radiated Power (ERP) Corresponding to Effective Antenna Heights (EAH) of Base Stations in the 421-430 MHz Band

Effective antenna height (EAH) in meters (feet)	**Maximum effective radiated power (ERP) (watts)**
0-152 (0-500)	250
Above 152-305 (above 500-1000)	150
Above 305-457 (above 1000-1500)	75
Above 457-610 (above 1500-2000)	40
Above 610-762 (above 2000-2500)	20
Above 762-914 (above 2500-3000)	15
Above 914-1219 (above 3000-4000)	10
Above 1219 (above 4000)	5

(b) The maximum transmitter power output that will be authorized for control stations is 20 watts.

RSS-119 Clause 5.4.

The output power shall be within ±1 dB of the manufacturer's rated power listed in the equipment specifications.

The transmitter output power limits set forth in the following table will come into force upon the publication of Issue 12 of this standard and will apply to newly certified equipment.

Frequency Band (MHz)	Transmitter Output Power (W)	
	Base/Fixed Equipment	Mobile Equipment
406.1-430 and 450-470	110	60

METHOD

The conducted RF output power measurements were made at the RF output terminals of the EUT using an attenuator and a calibrated power sensor.

RESULTS

Type of equipment: Mobile equipment or control station.

TI D-LMR. 20 kHz Bandwidth	Frequency (MHz)	Maximum average power (dBm)	Maximum deviation (dB)
Manufacturer's rated power: 6 W (37.78dBm).	409	38.52	0.74
	421	38.31	0.53
	430	38.16	0.38
Measurement uncertainty (dB)		<±0.33	

TETRA. 22 kHz Bandwidth	Frequency (MHz)	Maximum average power (dBm)	Maximum deviation (dB)
Manufacturer's rated power: 10 W (40 dBm).	409	40.12	0.12
	421	39.94	-0.06
	430	39.77	-0.23
Measurement uncertainty (dB)		<±0.33	

Verdict: PASS

Emission Mask

SPECIFICATION

FCC §90.210:

Frequency band (MHz)	Mask for equipment with audio low pass filter	Mask for equipment without audio low pass filter
421-512[2.5]	B	C

2: Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C. as applicable.

5: Equipment may alternatively meet the Adjacent Channel Power limits of §90.221.

Emission Mask B. For transmitters that are equipped with an audio low-pass filter. the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the assigned frequency by more than 50 percent. but not more than 100 percent of the authorized bandwidth: At least 25 dB.

(2) On any frequency removed from the assigned frequency by more than 100 percent. but not more than 250 percent of the authorized bandwidth: At least 35 dB.

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

RSS-119 Clauses 5.5 and 5.8.

Frequency Band (MHz)	**Related SRSP for Channelling Plan and e.r.p.**	**Channel Spacing (kHz)**	**Authorized Bandwidth (kHz)**	**Spectrum Masks for equipment with Audio Filter**	**Spectrum Masks for equipment Without Audio Filter**
406.1-430 and 450-470	SRSP-501	25	20	B	C
			22	Y	Y

FM transmitters with voice input may use the spectrum mask for equipment with an audio filter if they are equipped with suitable filters to be used for the audio signal only and not for other purposes. Equipment employing other modulations shall comply with the spectrum masks for equipment without an audio filter.

Table 6 - Emission Mask C

Displacement Frequency. fd (kHz)	Minimum Attenuation (dB)	Resolution Bandwidth (Hz)
5 < fd ≤ 10	83 log10(fd/5)	300
10 < fd ≤ 50	whichever is the lesser: 50 or 29 log10(fd^2/11)	300
fd > 50	43 + 10 log10(p)	Specified in Section 4.2.1

Table 17 - Emission Mask Y

Displacement Frequency. fd (kHz)	Minimum Attenuation (dB)	Resolution Bandwidth (Hz)
12.375 < fd ≤ 13.975	whichever is the lesser attenuation: 30 + 16.67(fd–12.375) or 55 + 10 log10(p)	Specified in Section 4.2.2
fd > 13.975	whichever is the lesser attenuation: 57 or 55 + 10 log10(p)	Specified in Section 4.2.2

METHOD

The emission masks were measured at the RF output terminals of the EUT using an attenuator and a spectrum analyser with a built-in spectrum mask measurement function.

RESULTS (see next plots)

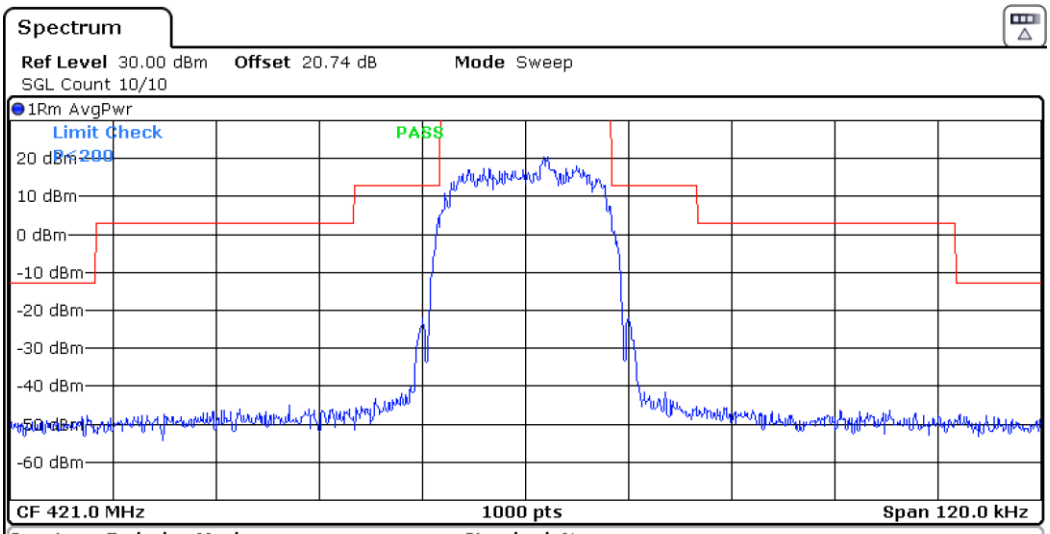
Measurement uncertainty (dB)	<±0.34

Verdict: PASS

FCC 90 Emission Mask B.

TI D-LMR 20 kHz Bandwidth.

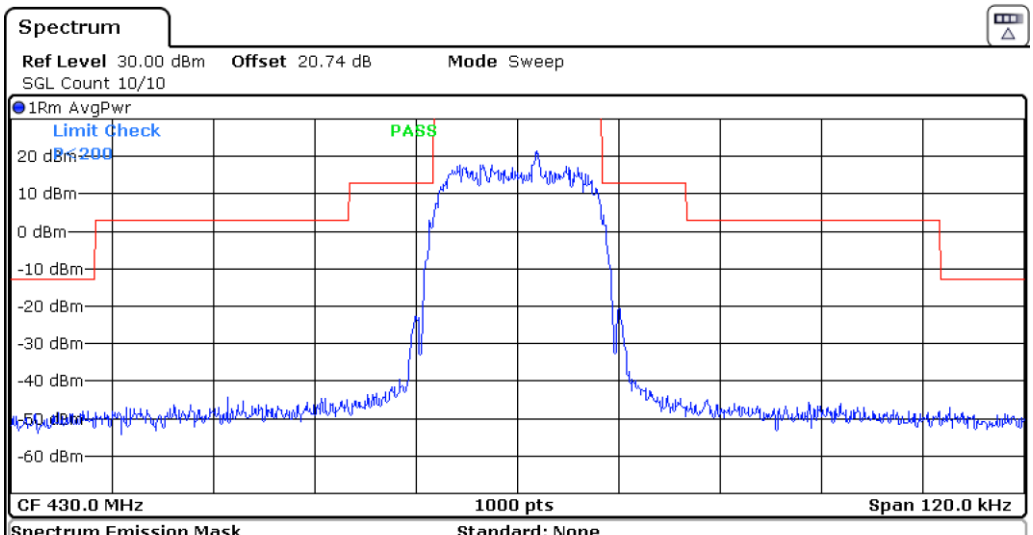
FCC 90 Lowest Channel 421 MHz



Spectrum Emission Mask — Standard: None
Tx Power 37.90 dBm — Tx Bandwidth 20.000 kHz — RBW 100.000 Hz

Range Low	Range Up	RBW	Frequency	Power Abs	Power Rel	ΔLimit
-60.000 kHz	-50.000 kHz	100.000 Hz	420.94898 MHz	-47.90 dBm	-85.80 dB	-35.00 dB
-50.000 kHz	-20.000 kHz	100.000 Hz	420.97250 MHz	-44.86 dBm	-82.76 dB	-47.76 dB
-20.000 kHz	-10.000 kHz	100.000 Hz	420.98982 MHz	4.16 dBm	-33.74 dB	-8.74 dB
10.000 kHz	20.000 kHz	100.000 Hz	421.01006 MHz	3.08 dBm	-34.82 dB	-9.82 dB
20.000 kHz	50.000 kHz	100.000 Hz	421.02078 MHz	-45.57 dBm	-83.47 dB	-48.47 dB
50.000 kHz	60.000 kHz	100.000 Hz	421.05054 MHz	-47.48 dBm	-85.38 dB	-34.58 dB

FCC 90 Highest Channel 430 MHz



Spectrum Emission Mask — Standard: None
Tx Power 37.84 dBm — Tx Bandwidth 20.000 kHz — RBW 100.000 Hz

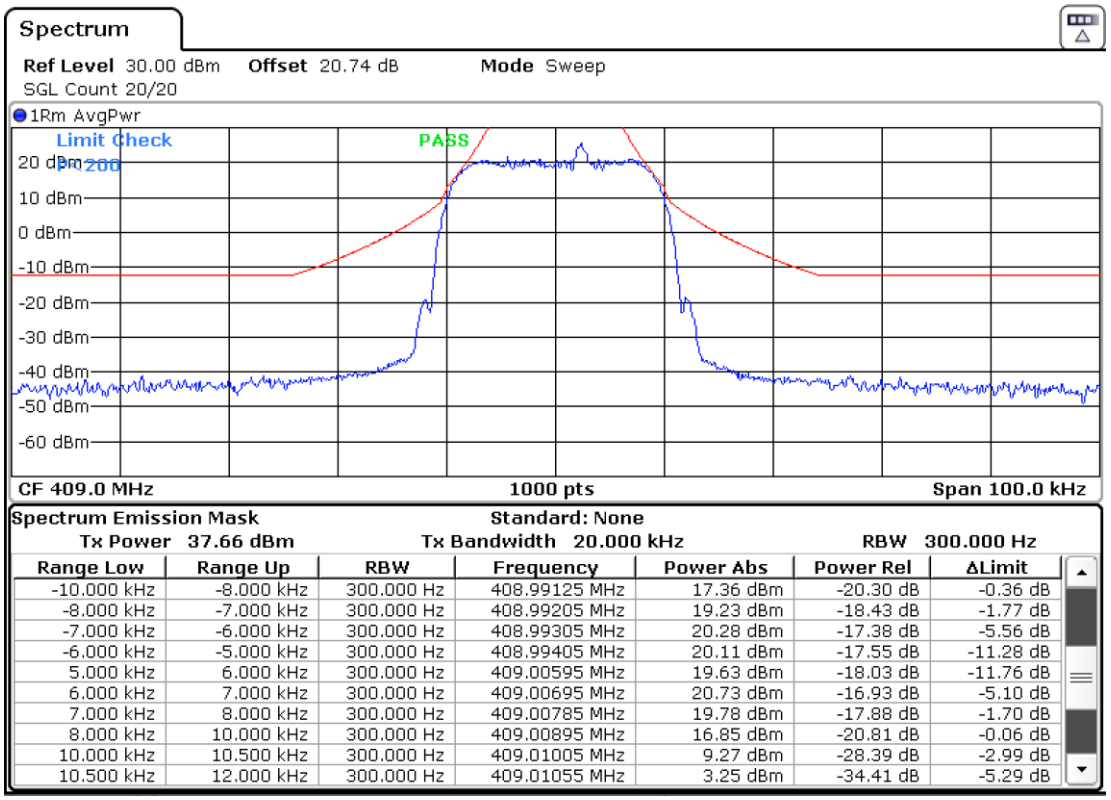
Range Low	Range Up	RBW	Frequency	Power Abs	Power Rel	ΔLimit
-60.000 kHz	-50.000 kHz	100.000 Hz	429.94861 MHz	-47.96 dBm	-85.80 dB	-35.00 dB
-50.000 kHz	-20.000 kHz	100.000 Hz	429.96566 MHz	-44.19 dBm	-82.03 dB	-47.03 dB
-20.000 kHz	-10.000 kHz	100.000 Hz	429.98958 MHz	2.98 dBm	-34.86 dB	-9.86 dB
10.000 kHz	20.000 kHz	100.000 Hz	430.01018 MHz	4.30 dBm	-33.54 dB	-8.54 dB
20.000 kHz	50.000 kHz	100.000 Hz	430.02246 MHz	-45.08 dBm	-82.92 dB	-47.92 dB
50.000 kHz	60.000 kHz	100.000 Hz	430.05114 MHz	-47.22 dBm	-85.06 dB	-34.26 dB

Verdict: PASS

RSS-119 Emission Mask C.

TI D-LMR 20 kHz Bandwidth.

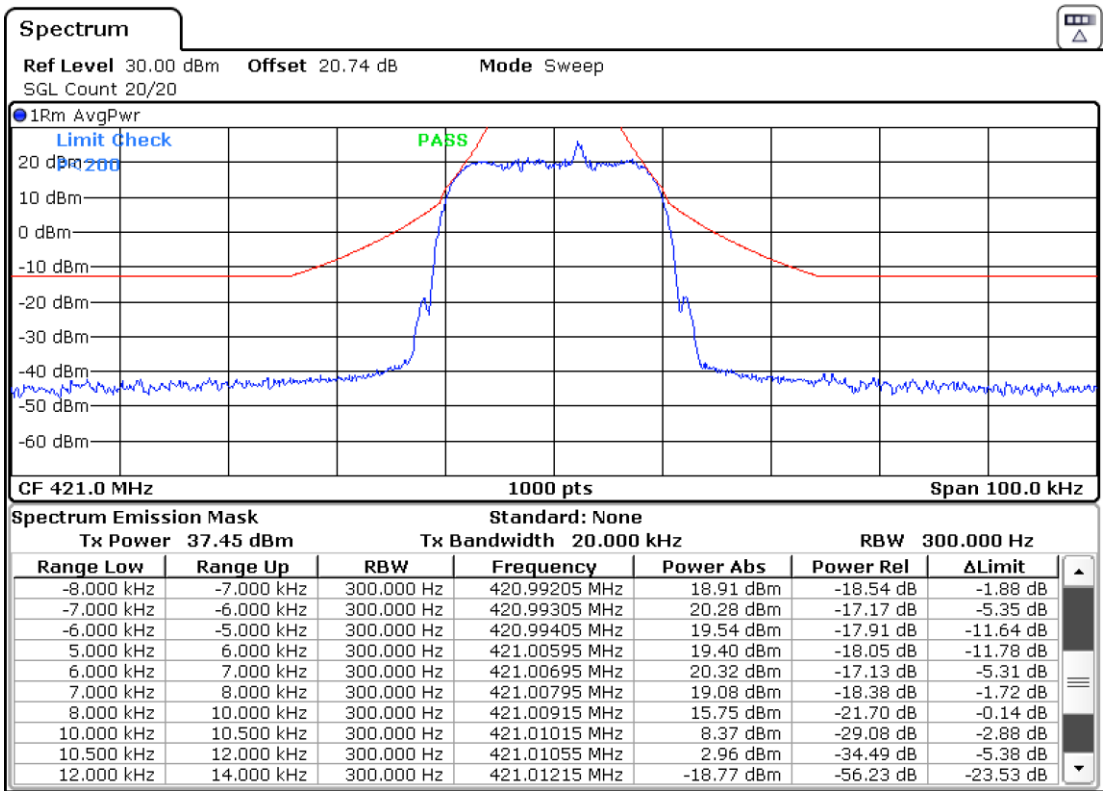
RSS-119 Lowest Channel 409 MHz



Spectrum Emission Mask — Standard: None
Tx Power 37.66 dBm — Tx Bandwidth 20.000 kHz — RBW 300.000 Hz

Range Low	Range Up	RBW	Frequency	Power Abs	Power Rel	ΔLimit
-10.000 kHz	-8.000 kHz	300.000 Hz	408.99125 MHz	17.36 dBm	-20.30 dB	-0.36 dB
-8.000 kHz	-7.000 kHz	300.000 Hz	408.99205 MHz	19.23 dBm	-18.43 dB	-1.77 dB
-7.000 kHz	-6.000 kHz	300.000 Hz	408.99305 MHz	20.28 dBm	-17.38 dB	-5.56 dB
-6.000 kHz	-5.000 kHz	300.000 Hz	408.99405 MHz	20.11 dBm	-17.55 dB	-11.28 dB
5.000 kHz	6.000 kHz	300.000 Hz	409.00595 MHz	19.63 dBm	-18.03 dB	-11.76 dB
6.000 kHz	7.000 kHz	300.000 Hz	409.00695 MHz	20.73 dBm	-16.93 dB	-5.10 dB
7.000 kHz	8.000 kHz	300.000 Hz	409.00785 MHz	19.78 dBm	-17.88 dB	-1.70 dB
8.000 kHz	10.000 kHz	300.000 Hz	409.00895 MHz	16.85 dBm	-20.81 dB	-0.06 dB
10.000 kHz	10.500 kHz	300.000 Hz	409.01005 MHz	9.27 dBm	-28.39 dB	-2.99 dB
10.500 kHz	12.000 kHz	300.000 Hz	409.01055 MHz	3.25 dBm	-34.41 dB	-5.29 dB

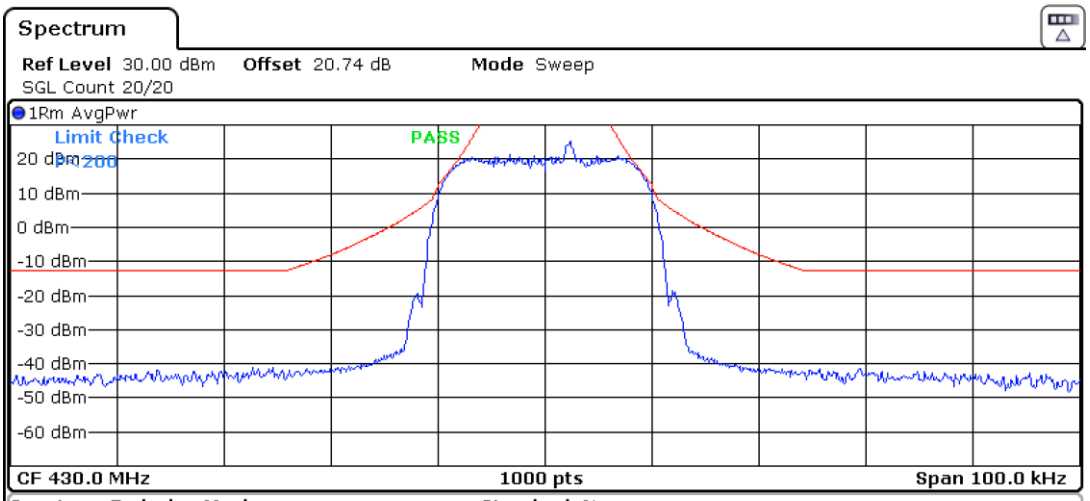
RSS-119 Middle Channel 421 MHz



Spectrum Emission Mask — Standard: None
Tx Power 37.45 dBm — Tx Bandwidth 20.000 kHz — RBW 300.000 Hz

Range Low	Range Up	RBW	Frequency	Power Abs	Power Rel	ΔLimit
-8.000 kHz	-7.000 kHz	300.000 Hz	420.99205 MHz	18.91 dBm	-18.54 dB	-1.88 dB
-7.000 kHz	-6.000 kHz	300.000 Hz	420.99305 MHz	20.28 dBm	-17.17 dB	-5.35 dB
-6.000 kHz	-5.000 kHz	300.000 Hz	420.99405 MHz	19.54 dBm	-17.91 dB	-11.64 dB
5.000 kHz	6.000 kHz	300.000 Hz	421.00595 MHz	19.40 dBm	-18.05 dB	-11.78 dB
6.000 kHz	7.000 kHz	300.000 Hz	421.00695 MHz	20.32 dBm	-17.13 dB	-5.31 dB
7.000 kHz	8.000 kHz	300.000 Hz	421.00795 MHz	19.08 dBm	-18.38 dB	-1.72 dB
8.000 kHz	10.000 kHz	300.000 Hz	421.00915 MHz	15.75 dBm	-21.70 dB	-0.14 dB
10.000 kHz	10.500 kHz	300.000 Hz	421.01015 MHz	8.37 dBm	-29.08 dB	-2.88 dB
10.500 kHz	12.000 kHz	300.000 Hz	421.01055 MHz	2.96 dBm	-34.49 dB	-5.38 dB
12.000 kHz	14.000 kHz	300.000 Hz	421.01215 MHz	-18.77 dBm	-56.23 dB	-23.53 dB

RSS-119 Highest Channel 430 MHz



Spectrum Emission Mask — Standard: None
Tx Power 37.29 dBm — Tx Bandwidth 20.000 kHz — RBW 300.000 Hz

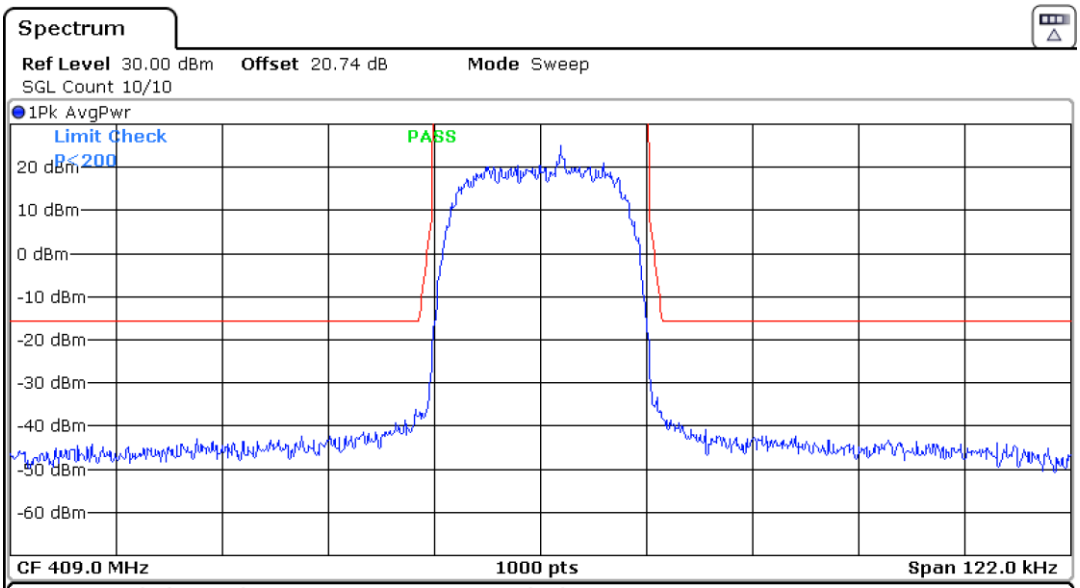
Range Low	Range Up	RBW	Frequency	Power Abs	Power Rel	ΔLimit
-50.000 kHz	-24.200 kHz	300.000 Hz	429.97455 MHz	-41.16 dBm	-78.45 dB	-28.45 dB
-24.200 kHz	-22.000 kHz	300.000 Hz	429.97615 MHz	-41.95 dBm	-79.24 dB	-29.60 dB
-22.000 kHz	-20.000 kHz	300.000 Hz	429.97805 MHz	-42.27 dBm	-79.56 dB	-31.92 dB
-20.000 kHz	-18.000 kHz	300.000 Hz	429.98005 MHz	-41.78 dBm	-79.07 dB	-33.84 dB
-18.000 kHz	-16.000 kHz	300.000 Hz	429.98245 MHz	-40.66 dBm	-77.95 dB	-36.02 dB
-16.000 kHz	-14.000 kHz	300.000 Hz	429.98415 MHz	-38.70 dBm	-75.99 dB	-36.63 dB
-14.000 kHz	-12.000 kHz	300.000 Hz	429.98795 MHz	-19.86 dBm	-57.16 dB	-24.66 dB
-12.000 kHz	-10.500 kHz	300.000 Hz	429.98945 MHz	2.79 dBm	-34.50 dB	-5.38 dB
-10.500 kHz	-10.000 kHz	300.000 Hz	429.98995 MHz	8.49 dBm	-28.80 dB	-3.40 dB
-10.000 kHz	-8.000 kHz	300.000 Hz	429.99095 MHz	15.97 dBm	-21.32 dB	-0.17 dB

Verdict: PASS

RSS-119 Emission Mask Y.

TETRA 22 kHz Bandwidth.

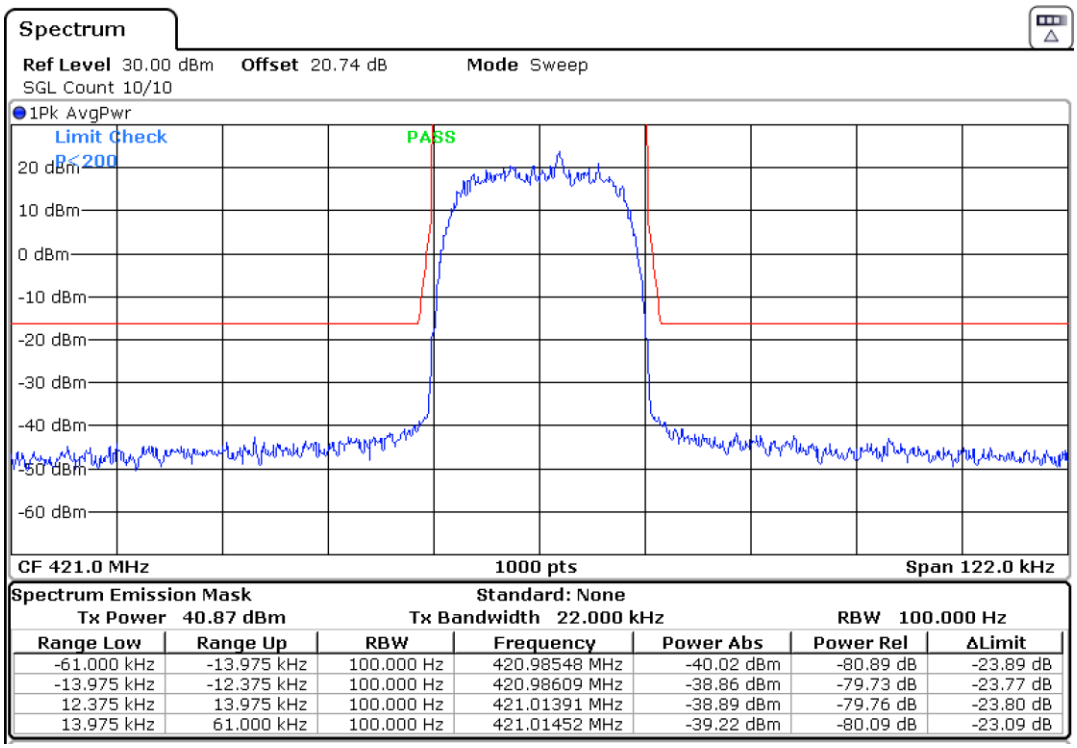
RSS-119 Lowest Channel 409 MHz



Spectrum Emission Mask — Standard: None
Tx Power 41.40 dBm — Tx Bandwidth 22.000 kHz — RBW 100.000 Hz

Range Low	Range Up	RBW	Frequency	Power Abs	Power Rel	ΔLimit
-61.000 kHz	-13.975 kHz	100.000 Hz	408.98560 MHz	-36.18 dBm	-77.58 dB	-20.58 dB
-13.975 kHz	-12.375 kHz	100.000 Hz	408.98609 MHz	-36.68 dBm	-78.08 dB	-22.12 dB
12.375 kHz	13.975 kHz	100.000 Hz	409.01391 MHz	-36.79 dBm	-78.19 dB	-22.23 dB
13.975 kHz	61.000 kHz	100.000 Hz	409.01404 MHz	-38.25 dBm	-79.66 dB	-22.66 dB

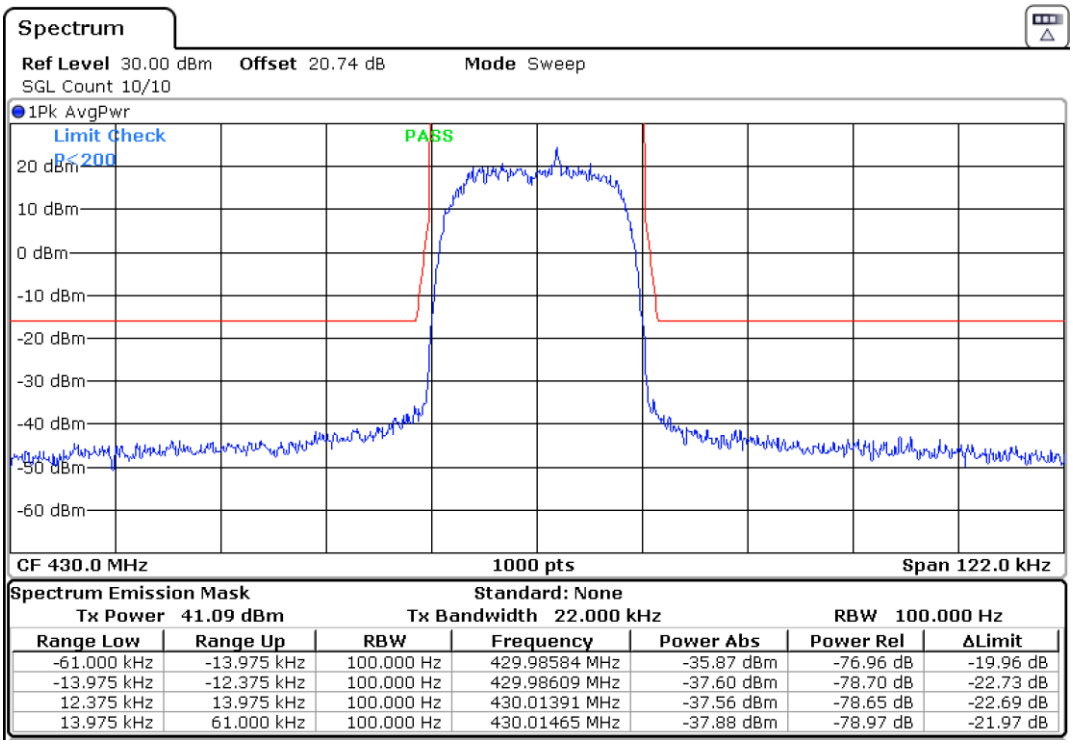
RSS-119 Middle Channel 421 MHz



Spectrum Emission Mask — Standard: None
Tx Power 40.87 dBm — Tx Bandwidth 22.000 kHz — RBW 100.000 Hz

Range Low	Range Up	RBW	Frequency	Power Abs	Power Rel	ΔLimit
-61.000 kHz	-13.975 kHz	100.000 Hz	420.98548 MHz	-40.02 dBm	-80.89 dB	-23.89 dB
-13.975 kHz	-12.375 kHz	100.000 Hz	420.98609 MHz	-38.86 dBm	-79.73 dB	-23.77 dB
12.375 kHz	13.975 kHz	100.000 Hz	421.01391 MHz	-38.89 dBm	-79.76 dB	-23.80 dB
13.975 kHz	61.000 kHz	100.000 Hz	421.01452 MHz	-39.22 dBm	-80.09 dB	-23.09 dB

RSS-119 Highest Channel 430 MHz



Range Low	Range Up	RBW	Frequency	Power Abs	Power Rel	ΔLimit
-61.000 kHz	-13.975 kHz	100.000 Hz	429.98584 MHz	-35.87 dBm	-76.96 dB	-19.96 dB
-13.975 kHz	-12.375 kHz	100.000 Hz	429.98609 MHz	-37.60 dBm	-78.70 dB	-22.73 dB
12.375 kHz	13.975 kHz	100.000 Hz	430.01391 MHz	-37.56 dBm	-78.65 dB	-22.69 dB
13.975 kHz	61.000 kHz	100.000 Hz	430.01465 MHz	-37.88 dBm	-78.97 dB	-21.97 dB

Verdict: PASS

Frequency Stability

SPECIFICATION

FCC §2.1055. §90.213. 421–512 MHz band

Unless noted elsewhere. transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table.

Frequency range (MHz)	Mobile stations	
	Over 2 watts output power	2 watts or less output power
421-512	[8]5 ppm	[8]5 ppm

Note 8: 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. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.

RSS-119 Clause 5.3.

The carrier frequency shall not depart from the reference frequency in excess of the values given in the following table:

Frequency Band (MHz)	Channel Bandwidth (kHz)	Frequency Stability (ppm)	
		Mobile stations	
		Output power > 2 watts	Output power ≤ 2 watts
406.1-430 and 450-470 (Note 6)	25 (Note 2)	1	1
	25	5	5

Note 2: This provision is for digital equipment with a channel spacing of 25 kHz and an occupied bandwidth greater than 20 kHz. The mobile station's frequency stability values given in Table 1 are for mobile. portable and control transmitters using automatic frequency control (AFC) to lock onto the base station signal. When the mobile. portable and control transmitters are operating without using AFC to lock onto the base station signal. the frequency stability limit shall be better than 1 kHz and the equipment's unwanted emissions measured with maximum frequency shift shall still comply with emission mask Y (Section 5.8.10) at nominal carrier frequency.

Note 6: Control stations may operate with the frequency tolerance specified for associated mobile frequencies.

METHOD

The frequency tolerance measurements over temperature variations were made over the temperature range of –30ºC to +50ºC. The EUT was placed inside a climatic chamber and the temperature was raised hourly in 10ºC steps from –30ºC up to +50ºC.

Frequency Stability vs Voltage: Vary primary supply voltage between the extreme voltage values declared.

The EUT is set in continuous transmission without modulation (only carrier) and the frequency is measured with the frequency meter of Radiocommunication analyzer HP 8920A.

RESULTS

Channel 421 MHz.

Voltage (Vdc)	Temperature (ºC)	Frequency Error (Hz)	Frequency Error (ppm)
Frequency stability with Temperature			
13.2	+50	61	0.144893112
	+40	47	0.111638955
	+30	43	0.102137767
	+20	-3	-0.007125891
	+10	-36	-0.085510689
	0	-67	-0.159144893
	-10	-97	-0.230403800
	-20	-96	-0.228028504
	-30	-209	-0.496437055
Frequency stability with Supply Voltage			
10.8	20	-6	-0.014251781
15.6	20	-4	-0.009501188

Measurement uncertainty	$<\pm 1 \times 10^{-6}$

Verdict: PASS

Spurious emissions at antenna terminals

SPECIFICATION

FCC §2.1051. §90.210. 421–512 MHz band.

Emission Mask B.

On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

RSS-119 Clause 5.8.

Table 6 - Emission Mask C

Displacement Frequency. fd (kHz)	Minimum Attenuation (dB)	Resolution Bandwidth (Hz)
5 < fd ≤ 10	83 log10(fd/5)	300
10 < fd ≤ 50	whichever is the lesser: 50 or 29 log10(fd^2/11)	300
fd > 50	43 + 10 log10(p)	Specified in Section 4.2.1

Table 17 - Emission Mask Y

Displacement Frequency. fd (kHz)	Minimum Attenuation (dB)	Resolution Bandwidth (Hz)
12.375 < fd ≤ 13.975	whichever is the lesser attenuation: 30 + 16.67(fd–12.375) or 55 + 10 log10(p)	Specified in Section 4.2.2
fd > 13.975	whichever is the lesser attenuation: 57 or 55 + 10 log10(p)	Specified in Section 4.2.2

METHOD

The EUT RF output connector was connected to a spectrum analyser using a 50 ohm attenuator and the resolution bandwidth of the spectrum analyser was set to 100 kHz for frequencies < 1GHz and 1 MHz for frequencies > 1 GHz. The spectrum was investigated from 9 kHz to 5 GHz.

The reading of the spectrum analyser is corrected with the attenuation loss of connection between output terminal of EUT and input of the spectrum analyzer.

RESULTS (see plots in next pages)

TI D-LMR 20 kHz bandwidth.

CHANNEL: LOWEST

All peaks found are more than 20 dB below the limit.

CHANNEL: MIDDLE

All peaks found are more than 20 dB below the limit.

CHANNEL: HIGHEST

Spurious Frequency (MHz)	Level (dBm)	Uncertainty (dB)
1290.07	-30.45	<±0.46

TETRA 22 kHz bandwidth.

CHANNEL: LOWEST

Spurious Frequency (MHz)	Level (dBm)	Uncertainty (dB)
1227.13	-32.82	<±0.46

CHANNEL: MIDDLE

Spurious Frequency (MHz)	Level (dBm)	Uncertainty (dB)
1263.13	-32.32	<±0.46

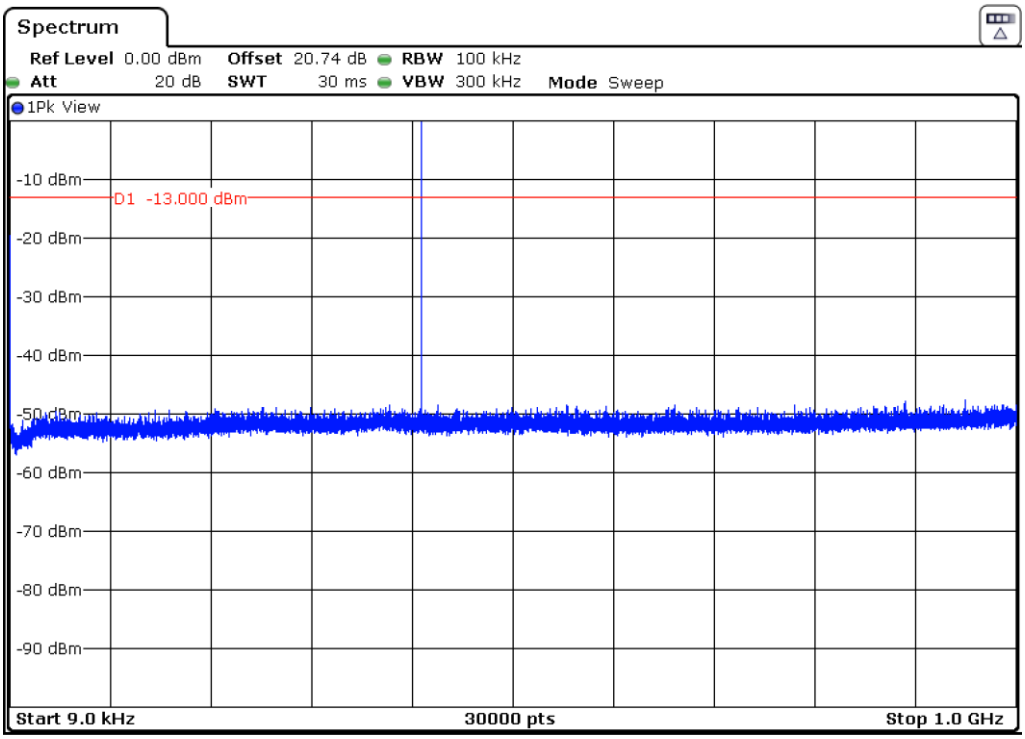
CHANNEL: HIGHEST

Spurious Frequency (MHz)	Level (dBm)	Uncertainty (dB)
1290.07	-34.37	<±0.46
4157.80	-34.02	<±0.46

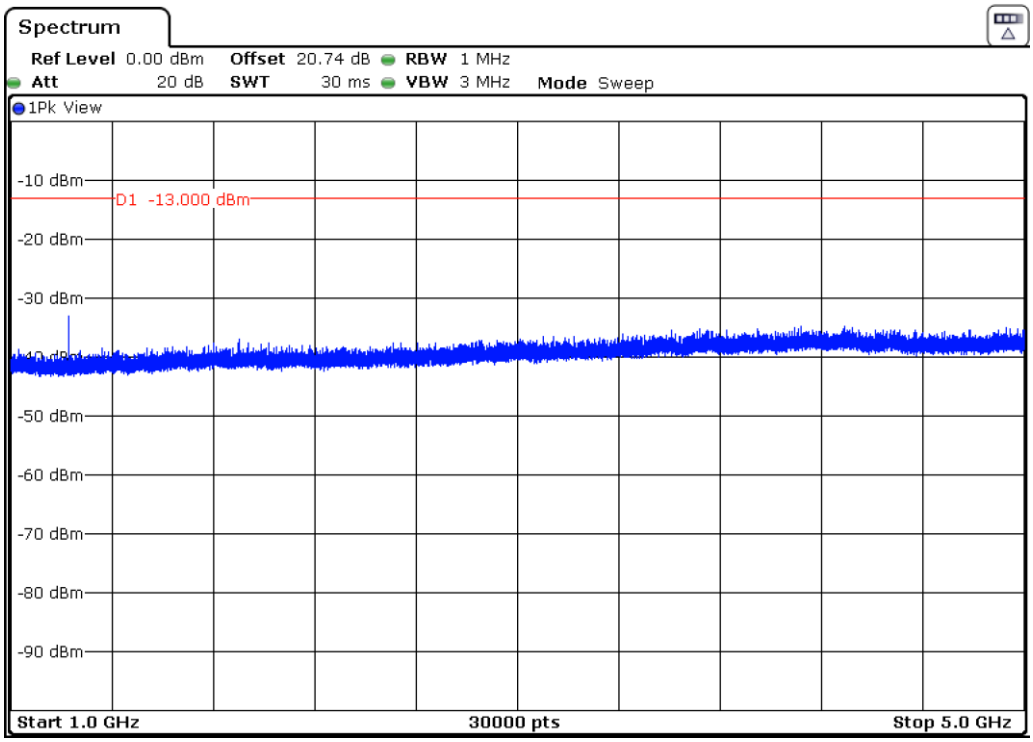
Verdict: PASS

TI D-LMR 20 kHz bandwidth.

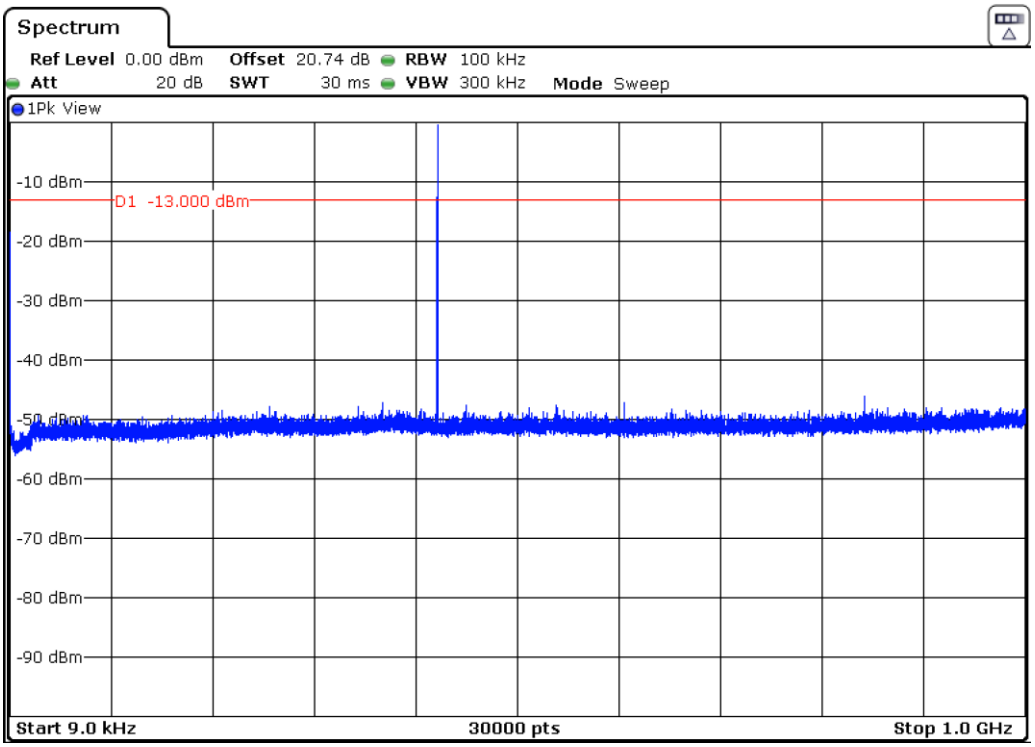
CHANNEL: LOWEST



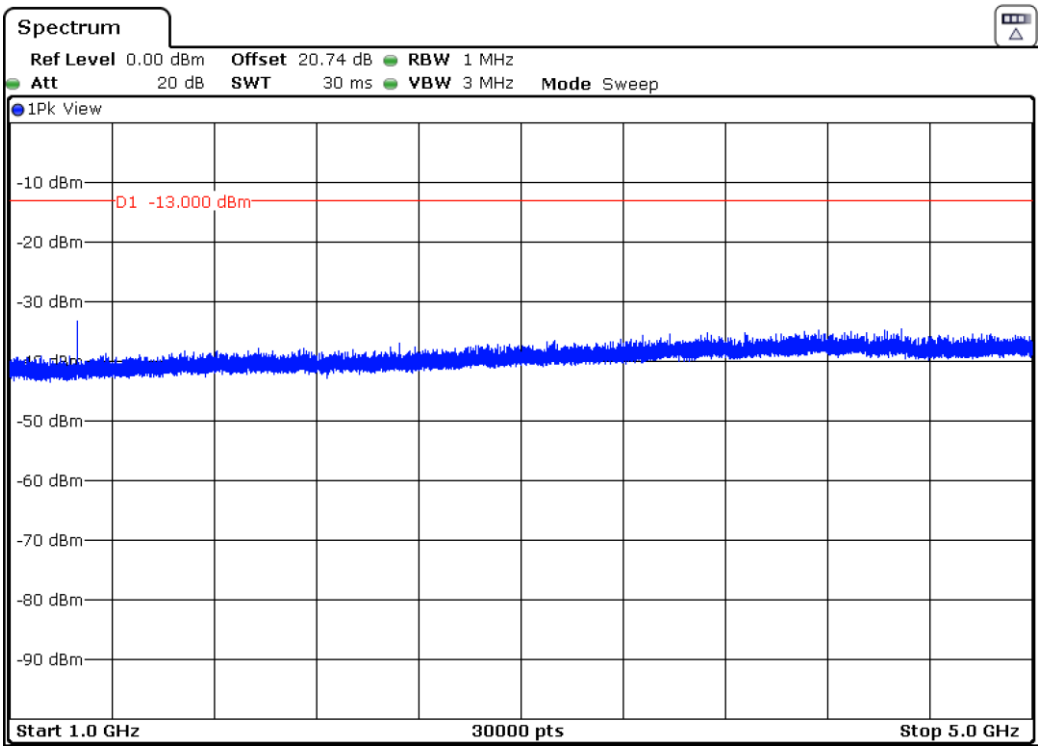
Note: The peak above the limit is the carrier frequency.



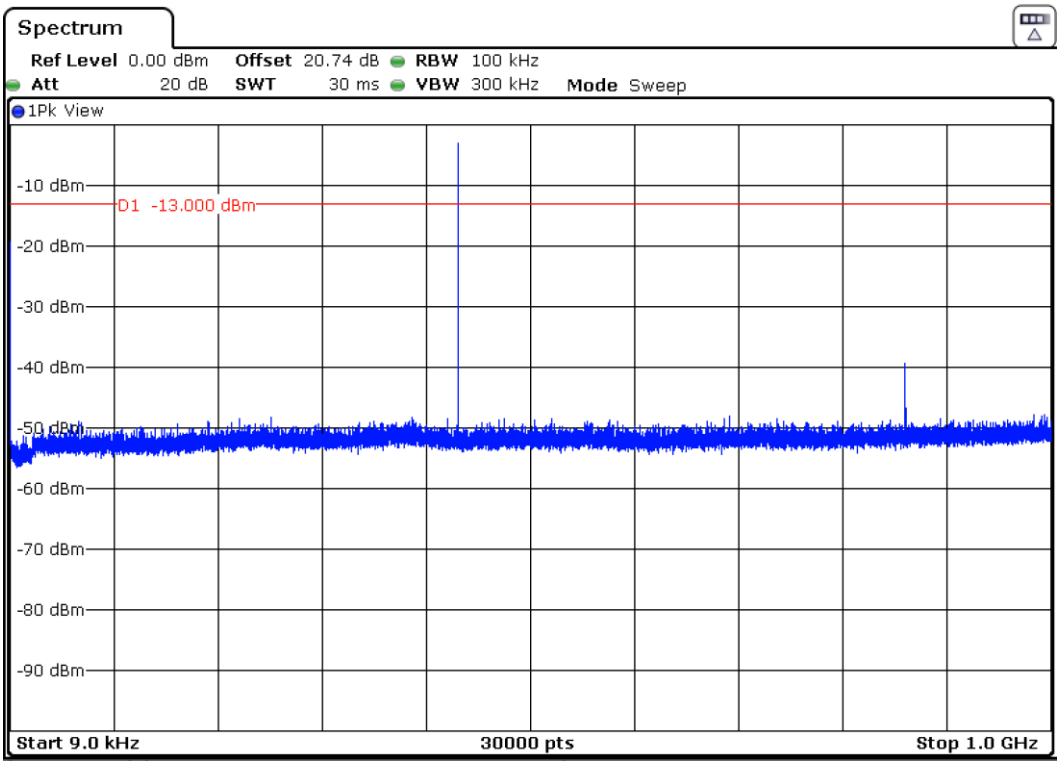
CHANNEL: MIDDLE



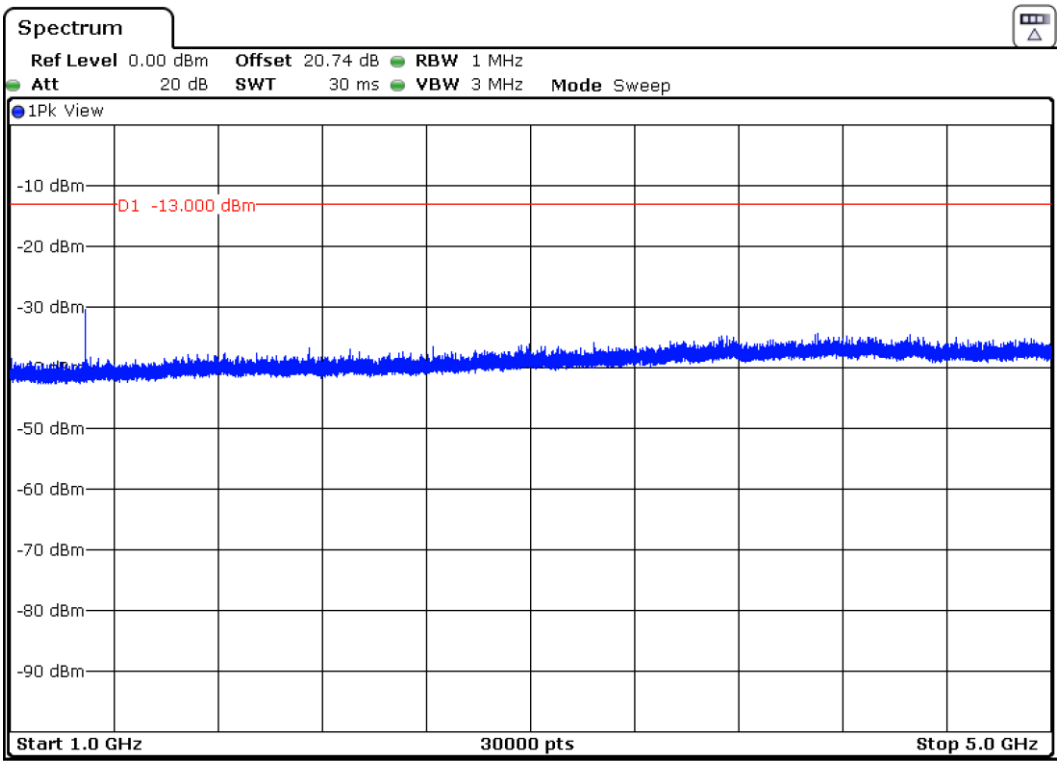
Note: The peak above the limit is the carrier frequency.



CHANNEL: HIGHEST

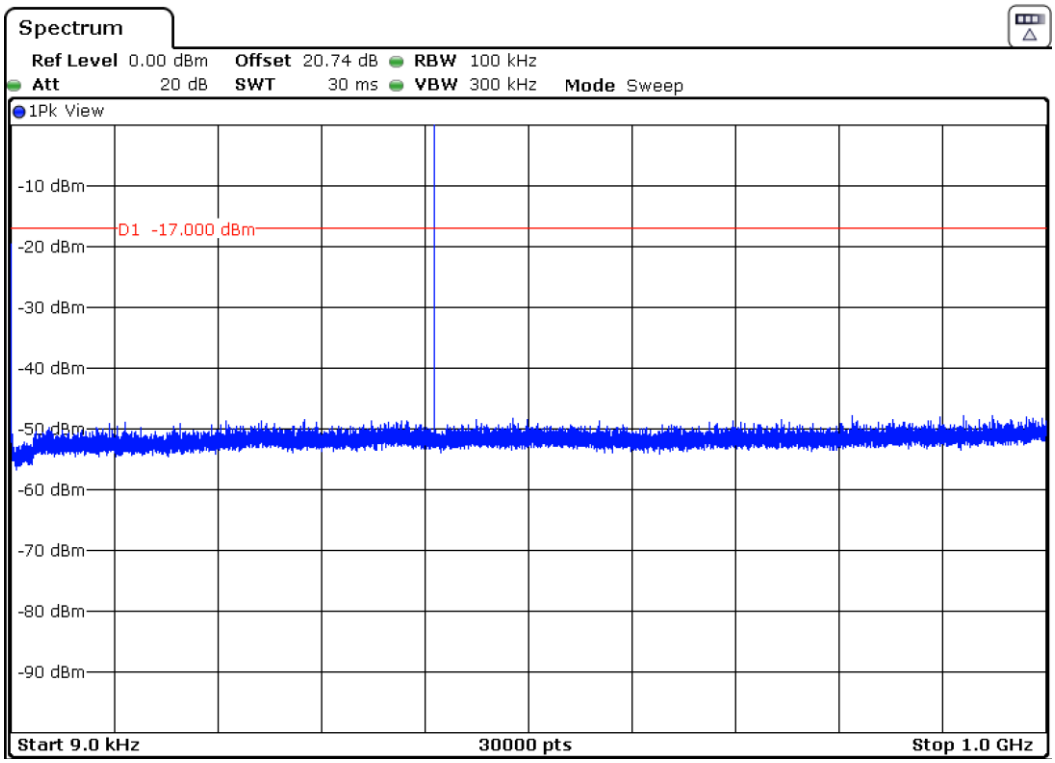


Note: The peak above the limit is the carrier frequency.

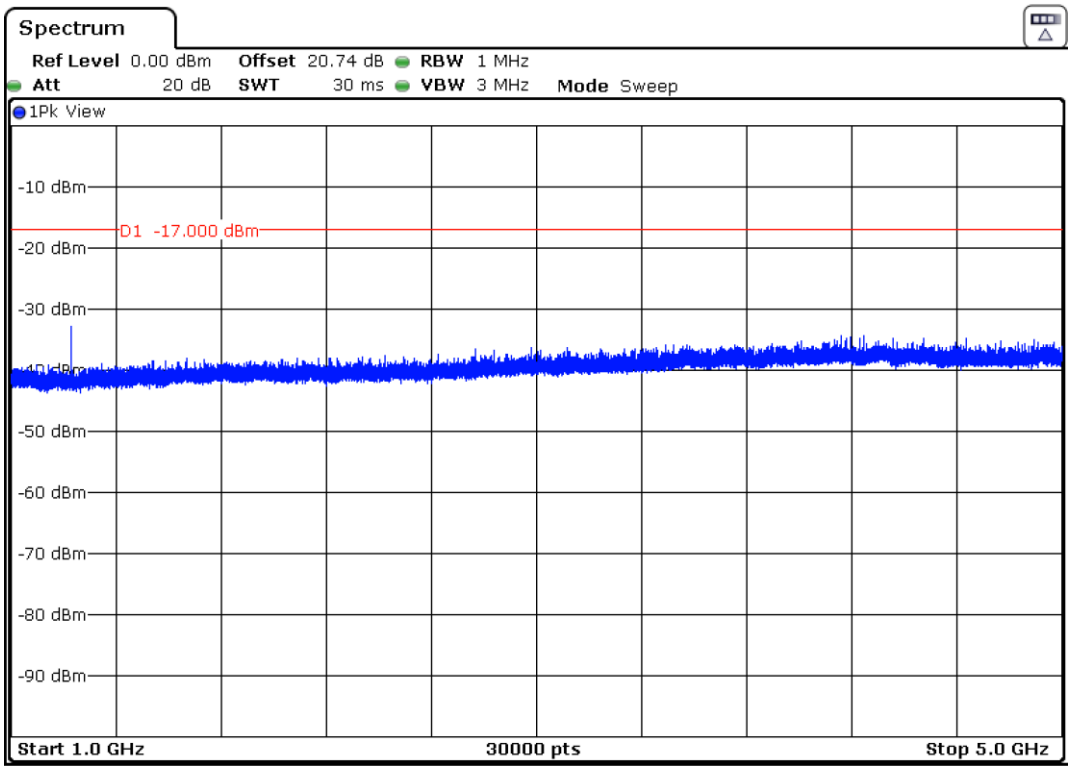


TETRA 22 kHz bandwidth.

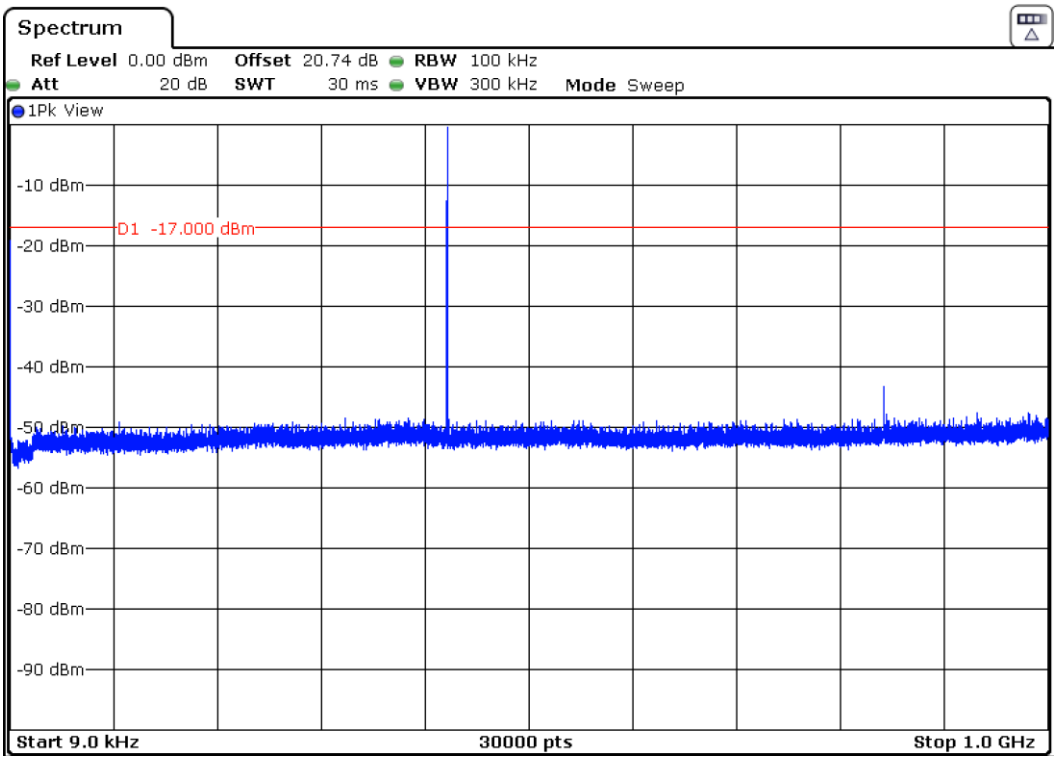
CHANNEL: LOWEST



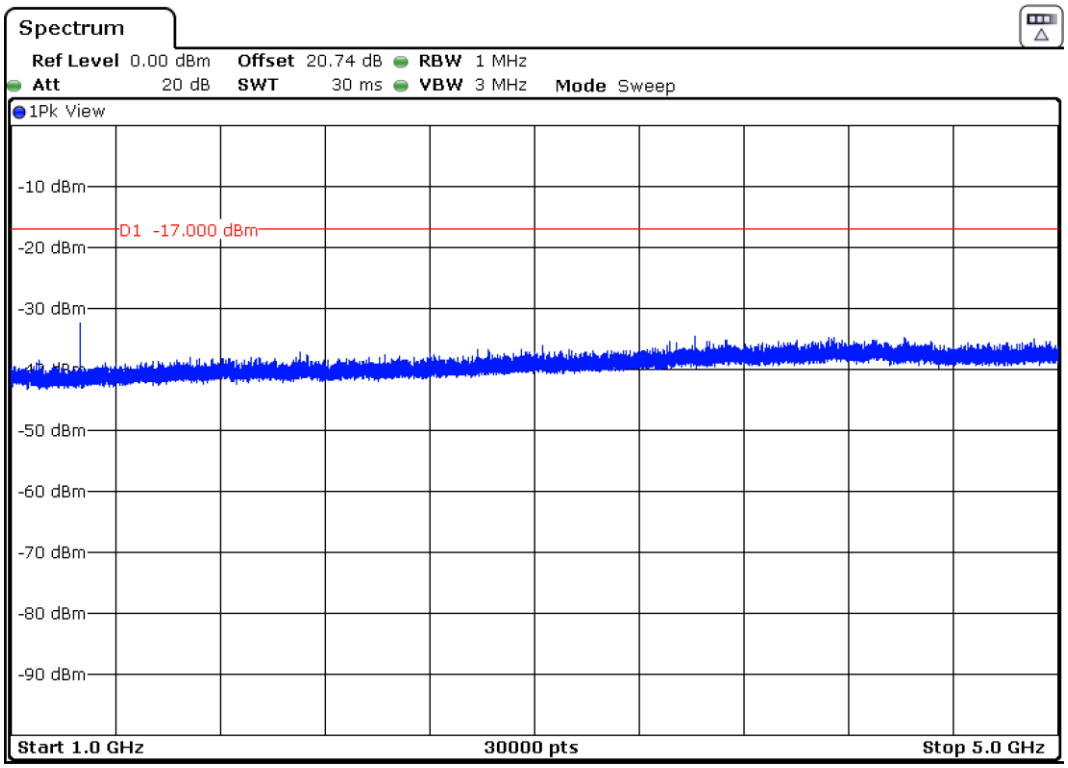
Note: The peak above the limit is the carrier frequency.



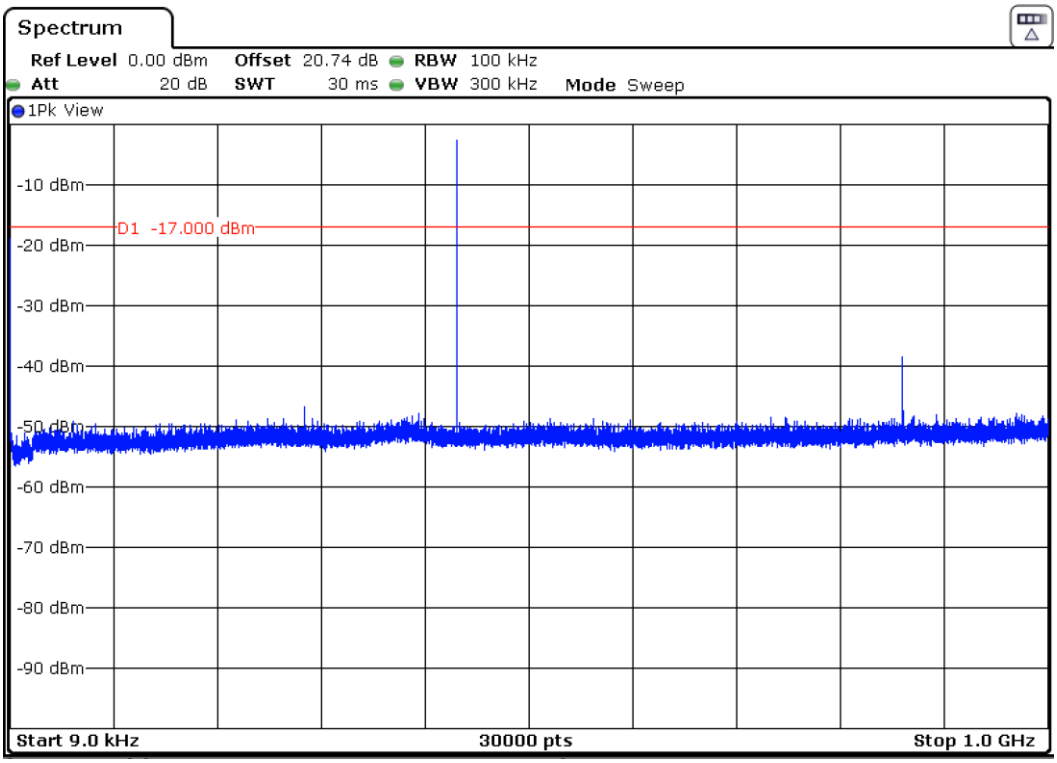
CHANNEL: MIDDLE



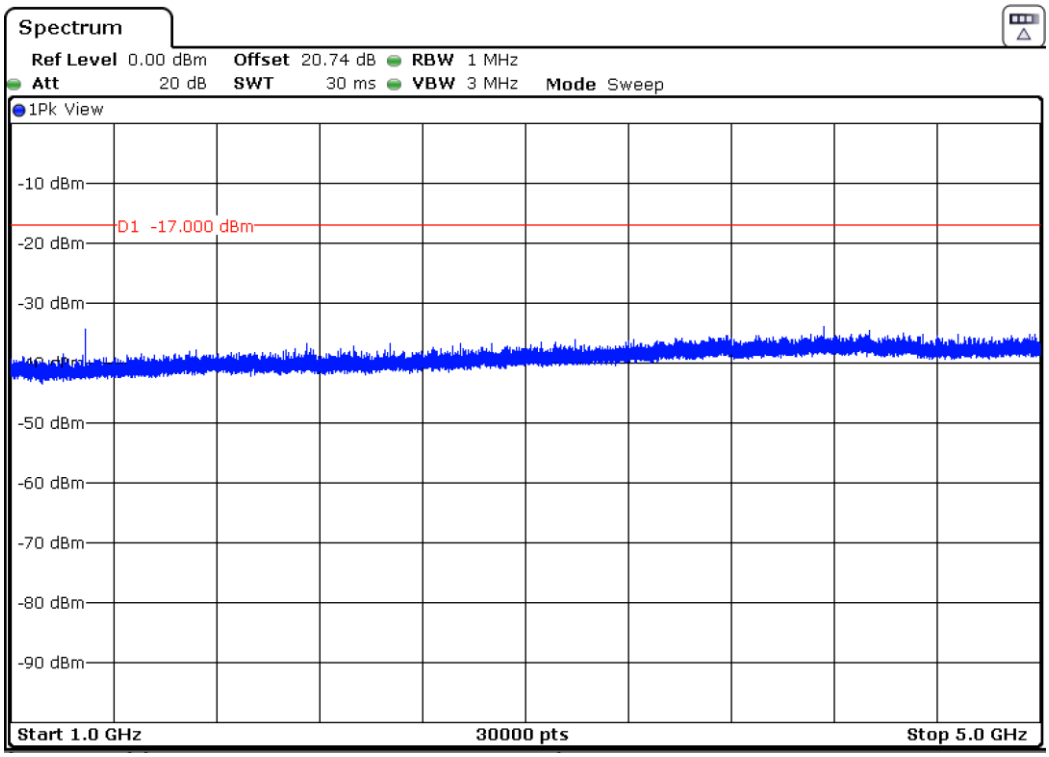
Note: The peak above the limit is the carrier frequency.



CHANNEL: HIGHEST



Note: The peak above the limit is the carrier frequency.



Radiated emissions

SPECIFICATION

FCC §2.1053. §90.210. 421–512 MHz band.

Emission Mask B.

On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

RSS-119 Clause 5.8.

Table 6 - Emission Mask C

Displacement Frequency. fd (kHz)	Minimum Attenuation (dB)	Resolution Bandwidth (Hz)
5 < fd ≤ 10	83 log10(fd/5)	300
10 < fd ≤ 50	whichever is the lesser: 50 or 29 log10(fd^2/11)	300
fd > 50	43 + 10 log10(p)	Specified in Section 4.2.1

Table 17 - Emission Mask Y

Displacement Frequency. fd (kHz)	Minimum Attenuation (dB)	Resolution Bandwidth (Hz)
12.375 < fd ≤ 13.975	whichever is the lesser attenuation: 30 + 16.67(fd–12.375) or 55 + 10 log10(p)	Specified in Section 4.2.2
fd > 13.975	whichever is the lesser attenuation: 57 or 55 + 10 log10(p)	Specified in Section 4.2.2

METHOD

The measurement was performed with the EUT inside an anechoic chamber with the accessories connected. The RF output connector of the EUT is terminated with an attenuator and a 50 ohm load.

The spectrum was scanned from 30 MHz to at least the 10th harmonic of the highest frequency generated within the equipment.
The EUT was placed on a non-conductive stand at a 3 meter distance from the measuring antenna for measurements below 1 GHz and at 1 m distance for measurements above 1 GHz.
Detected emissions were maximized at each frequency by rotating the EUT and adjusting the measuring antenna height and polarization. The maximum meter reading was recorded.
A preliminary scan was performed to determine the worst case of modulation mode.
Each detected emission is substituted by the Substitution method.

RESULTS

A preliminary scan determined the TETRA 22 kHz mode as the worst case. The following tables and plots show the results for this configuration.

CHANNEL: LOWEST.

Highest spurious signals.

Substitution method data

Frequency (MHz)	Instrument reading (dBm)	RBW (kHz)	Detector	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain Gi (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
95.960	-45.07	100	Peak	Vertical	-52.24	0.30	1.05	-51.49
818.028	-56.59	100	Peak	Horizontal	-52.48	1.23	6.72	-46.99
1226.870	-40.36	1000	Peak	Horizontal	-50.98	1.40	6.63	-45.75
1636.070	-37.86	1000	Peak	Vertical	-48.77	1.87	8.59	-42.05
2044.870	-47.91	1000	Peak	Vertical	-58.93	1.90	9.97	-50.86
2454.070	-47.61	1000	Peak	Horizontal	-57.38	2.10	10.63	-48.85

2. CHANNEL: MIDDLE.

Highest spurious signals.

Substitution method data

Frequency (MHz)	Instrument reading (dBm)	RBW (kHz)	Detector	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain Gi (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
95.960	-46.62	100	Peak	Vertical	-53.79	0.30	1.05	-53.04
842.036	-55.59	100	Peak	Horizontal	-51.57	1.25	6.63	-46.19
1263.000	-41.97	1000	Peak	Horizontal	-52.67	1.40	6.82	-47.25
1683.930	-38.42	1000	Peak	Vertical	-49.26	1.90	8.76	-42.40
2104.870	-48.24	1000	Peak	Vertical	-59.11	1.97	10.07	-50.01
2525.800	-45.62	1000	Peak	Horizontal	-55.16	2.13	10.71	-46.58

3. CHANNEL: HIGHEST.

Highest spurious signals.

Substitution method data

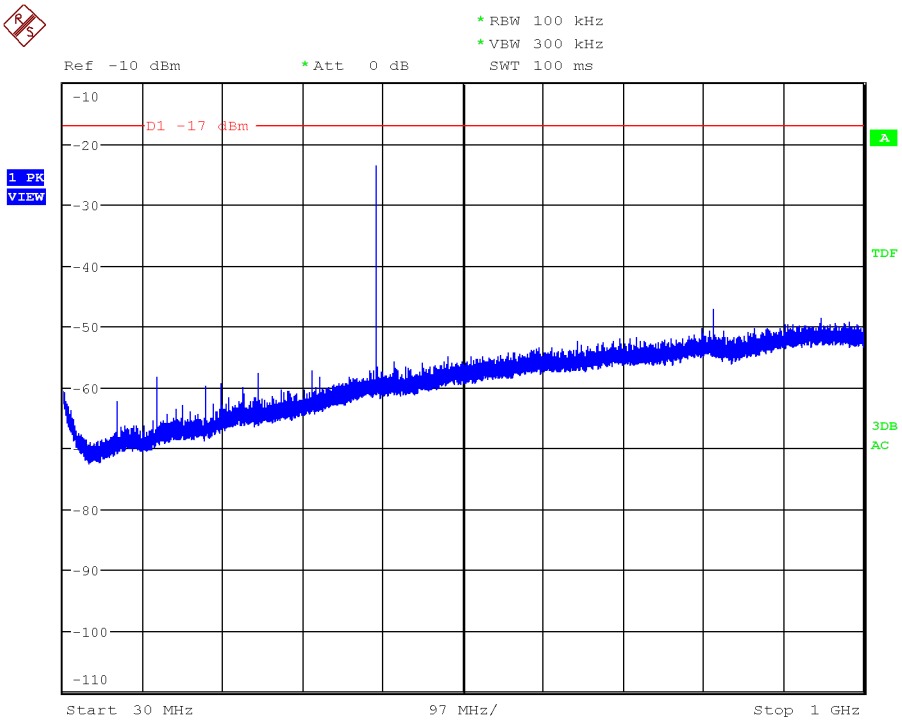
Frequency (MHz)	Instrument reading (dBm)	RBW (kHz)	Detector	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain Gi (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
95.960	-46.15	100	Peak	Vertical	-53.32	0.30	1.05	-52.57
860.029	-52.43	100	Peak	Horizontal	-48.34	1.23	6.64	-42.93
1289.930	-39.68	1000	Peak	Horizontal	-50.45	1.40	6.97	-44.88
1720.070	-39.91	1000	Peak	Vertical	-42.80	1.90	8.89	-35.81
2149.930	-49.59	1000	Peak	Vertical	-60.34	1.94	10.14	-52.14
2580.070	-48.79	1000	Peak	Horizontal	-58.12	2.18	10.73	-49.57

Measurement uncertainty (dB)	<±3.88 for f < 1GHz <±4.87 for f ≥ 1 GHz up to 18 GHz

Verdict: PASS

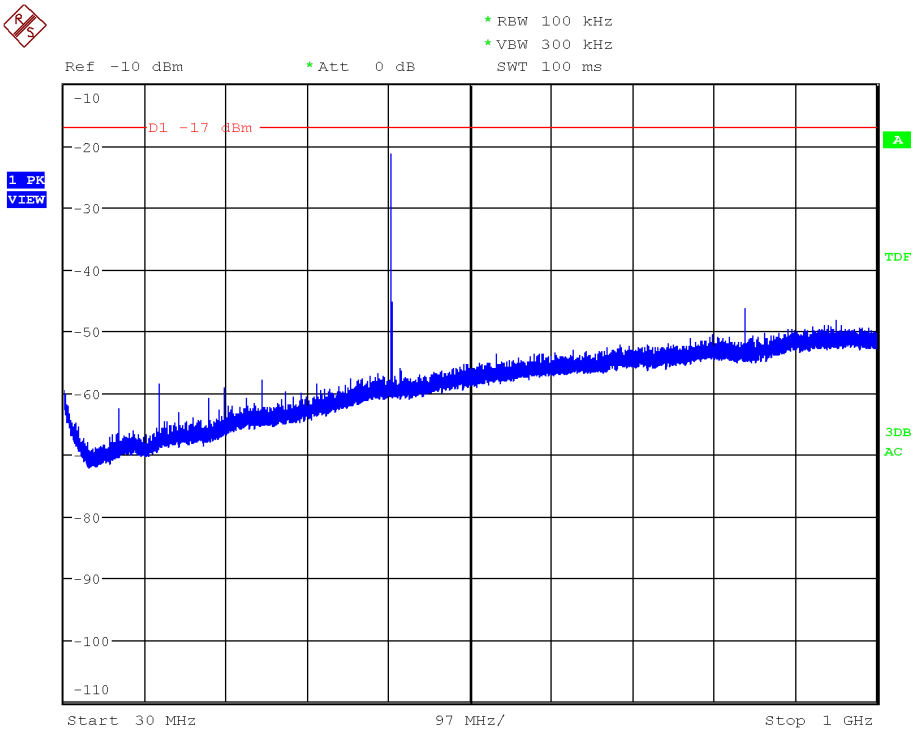
FREQUENCY RANGE 30 MHz-1000 MHz.

CHANNEL: LOWEST



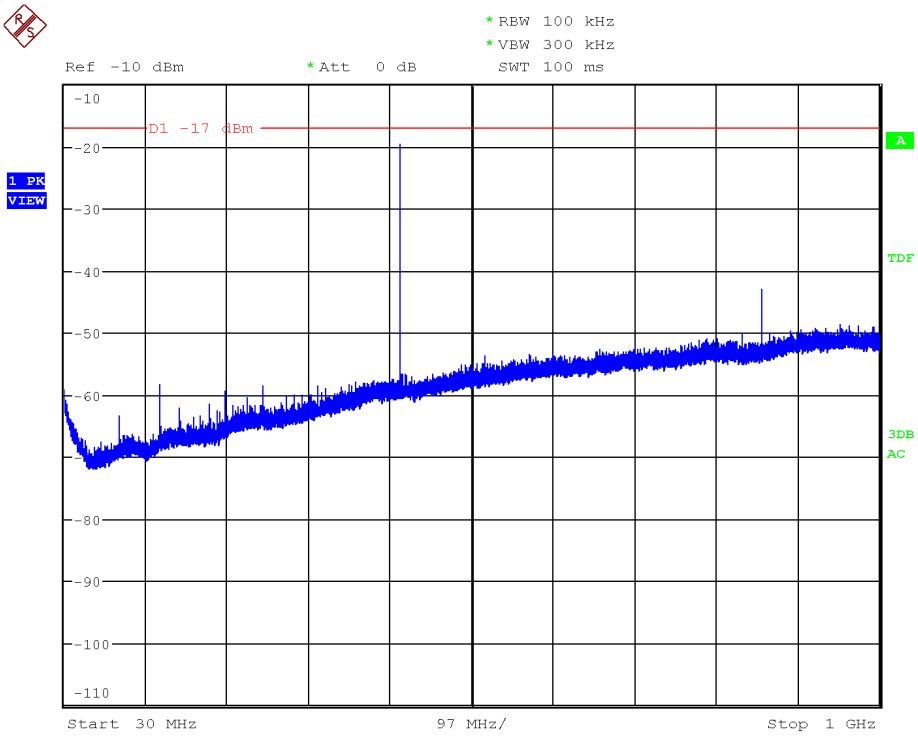
Note: The highest peak shown in the plot is the carrier frequency.

CHANNEL: MIDDLE.



Note: The highest peak shown in the plot is the carrier frequency.

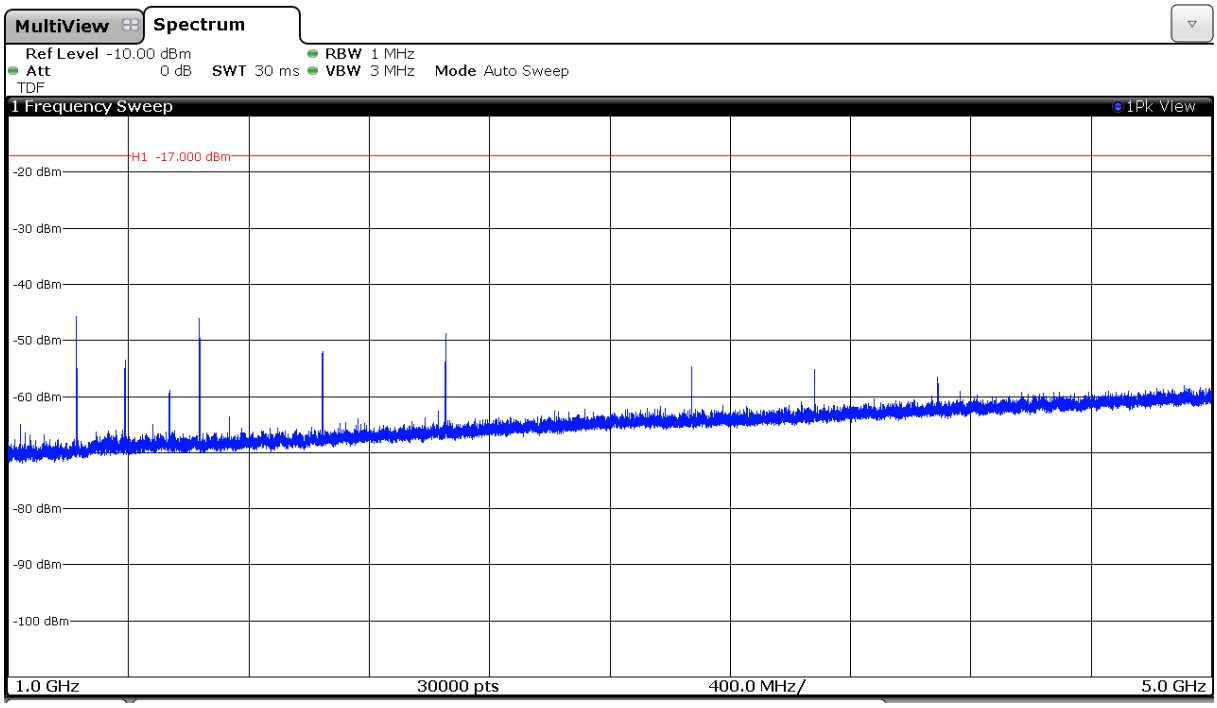
CHANNEL: HIGHEST.



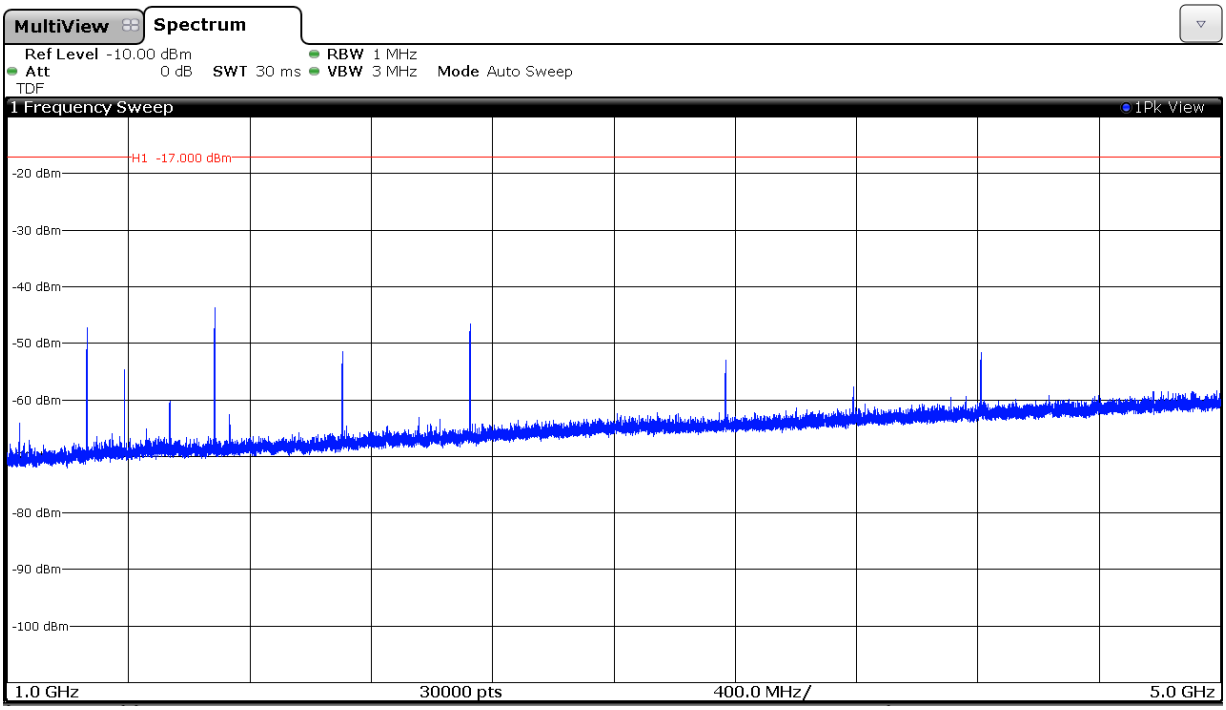
Note: The highest peak shown in the plot is the carrier frequency.

FREQUENCY RANGE 1 GHz to 10 GHz.

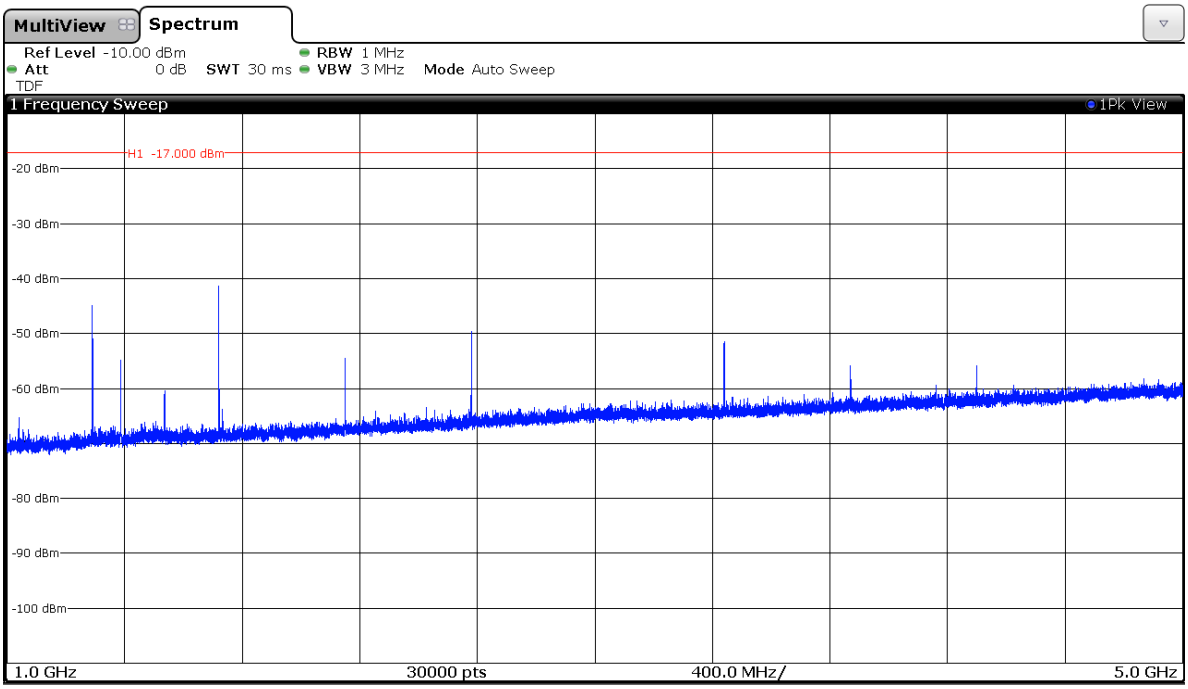
CHANNEL: LOWEST



CHANNEL: MIDDLE.



CHANNEL: HIGHEST.



Transient Frequency Behaviour

SPECIFICATION

FCC §90.214

Transmitters designed to operate in the 150-174 MHz and 421-512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

Time intervals[1 2]	Maximum frequency difference[3]	All equipment	
		150 to 174 MHz	421 to 512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels			
t_1[4]	±25.0 kHz	5.0 ms	10.0 ms
t_2	±12.5 kHz	20.0 ms	25.0 ms
t_3[4]	±25.0 kHz	5.0 ms	10.0 ms

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 t_1.

t_3 is the time period from the instant when the transmitter is turned off until t_{off}.

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.

RSS-119 §5.9.

When a transmitter is turned on. the radio frequency may take some time to stabilize. During this initial period. the frequency error or frequency difference (i.e.. between the instantaneous and the steady state frequencies) shall not exceed the limits specified in Table 18.

Table 18 – Transient Frequency Behaviour

Channel Bandwidth (kHz)	**Time intervals (Notes 1. 2)**	**Maximum Frequency Difference (kHz)**	**Transient Duration Limit (ms)**	
			138 to 174 MHz	**406.1 to 512 MHz**
25	t_1	±25.0 kHz	5.0	10.0
	t_2	±12.5 kHz	20.0	25.0
	t_3	±25.0 kHz	5.0	10.0

Notes:

1. t_{on}: 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 t_1.

t_3 is the time period from the instant when the transmitter is turned off until t_{off}.

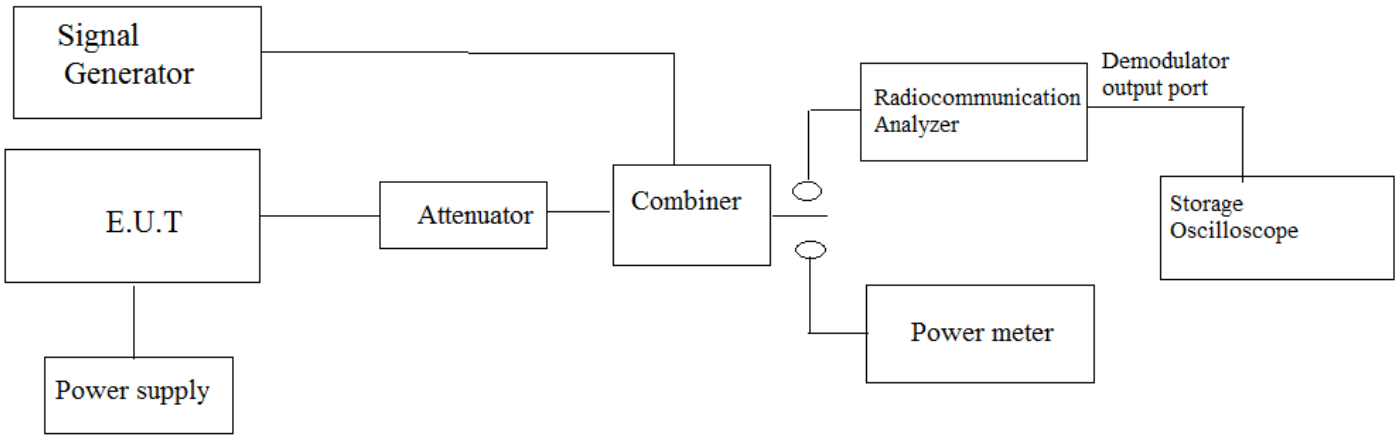
t_{off} is the instant when the 1 kHz test signal starts to rise.

2. If the transmitter carrier output power rating is 6 watts or less. the frequency difference during the time periods t_1 and t_3 may exceed the maximum frequency difference for theses time periods.

METHOD

The method used was according to ANSI C63.26-2015 6.5.2.3. “Transient frequency behaviour alternative method using a test receiver”.

An attenuator and a calibrated wideband power sensor were used to measure the power levels.



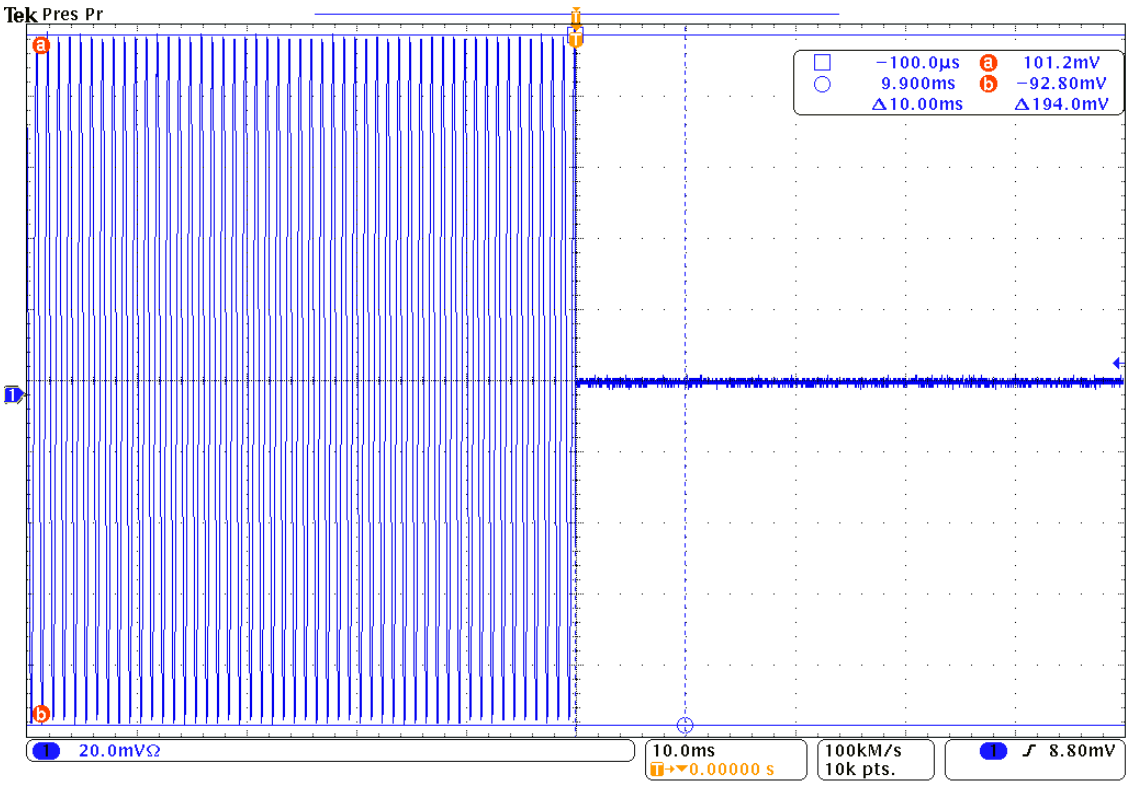
RESULTS (see next plots).

CHANNEL: 421 MHz.

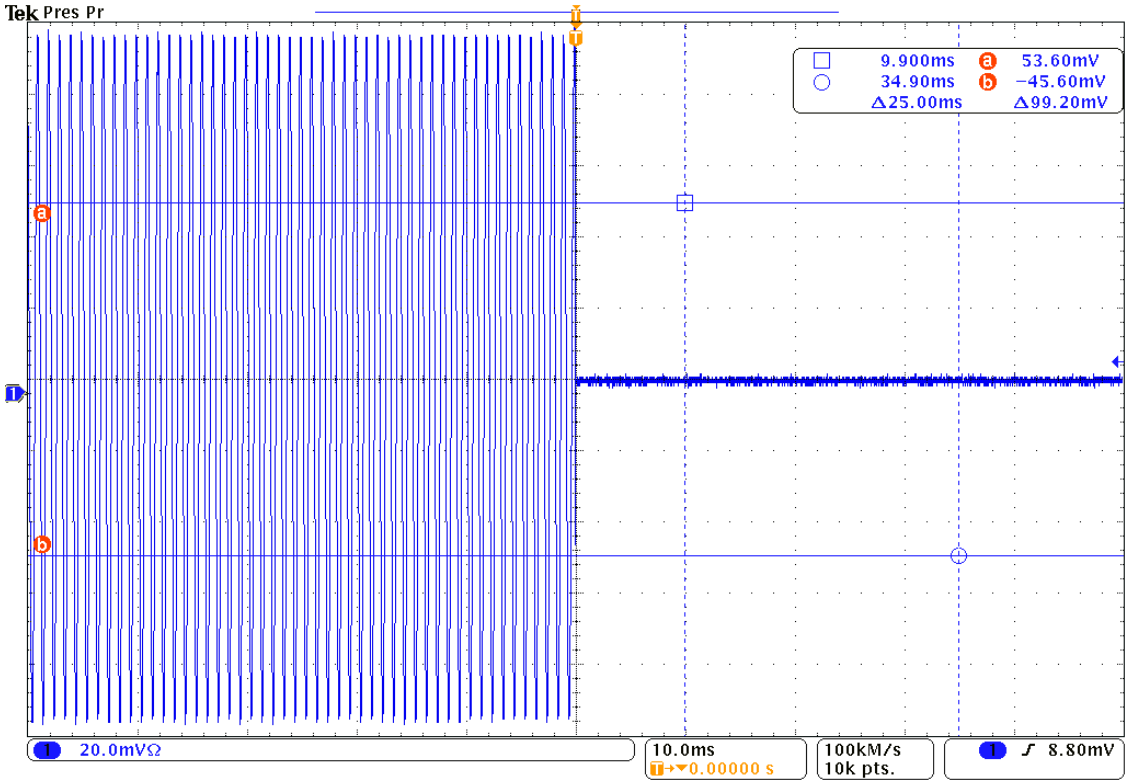
Time intervals	**Maximum Frequency Difference (kHz)**
t_1	< 12.0
t_2	< 0.421
t_3	< 21.0
Measurement uncertainty (kHz)	< ± 0.75

Verdict: PASS

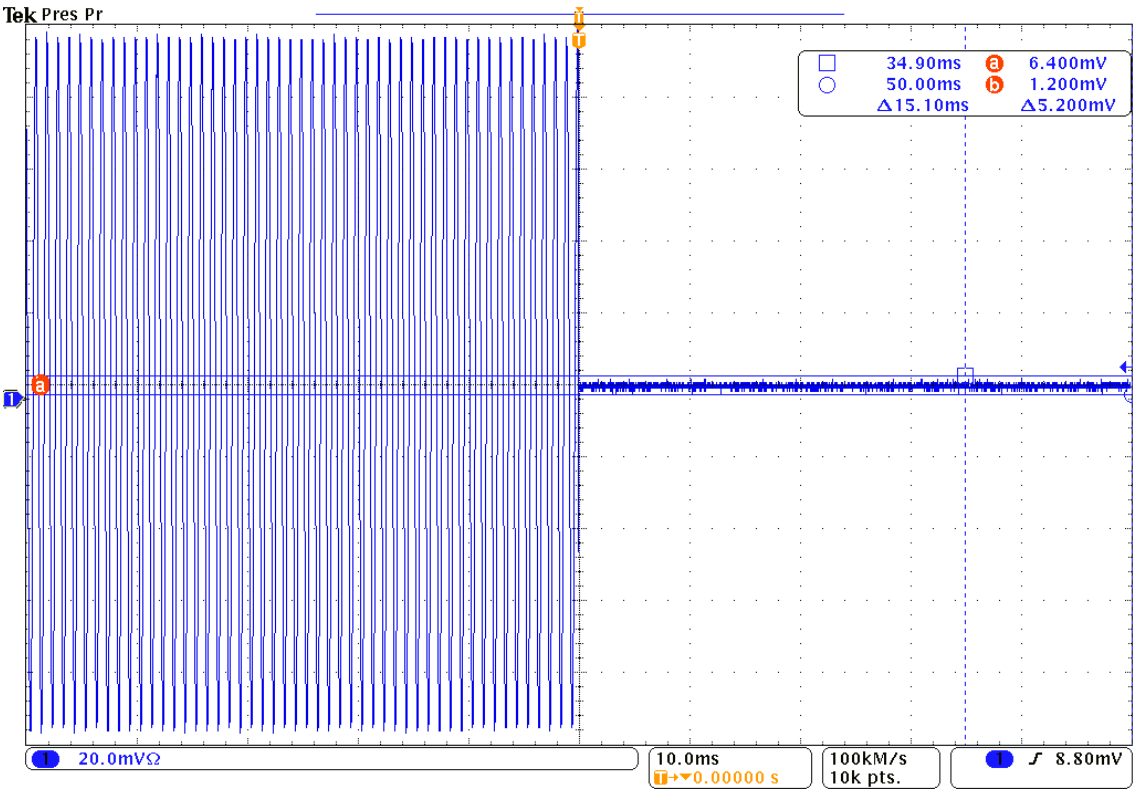
Transient Frequency Behaviour t_{on} to t_1.



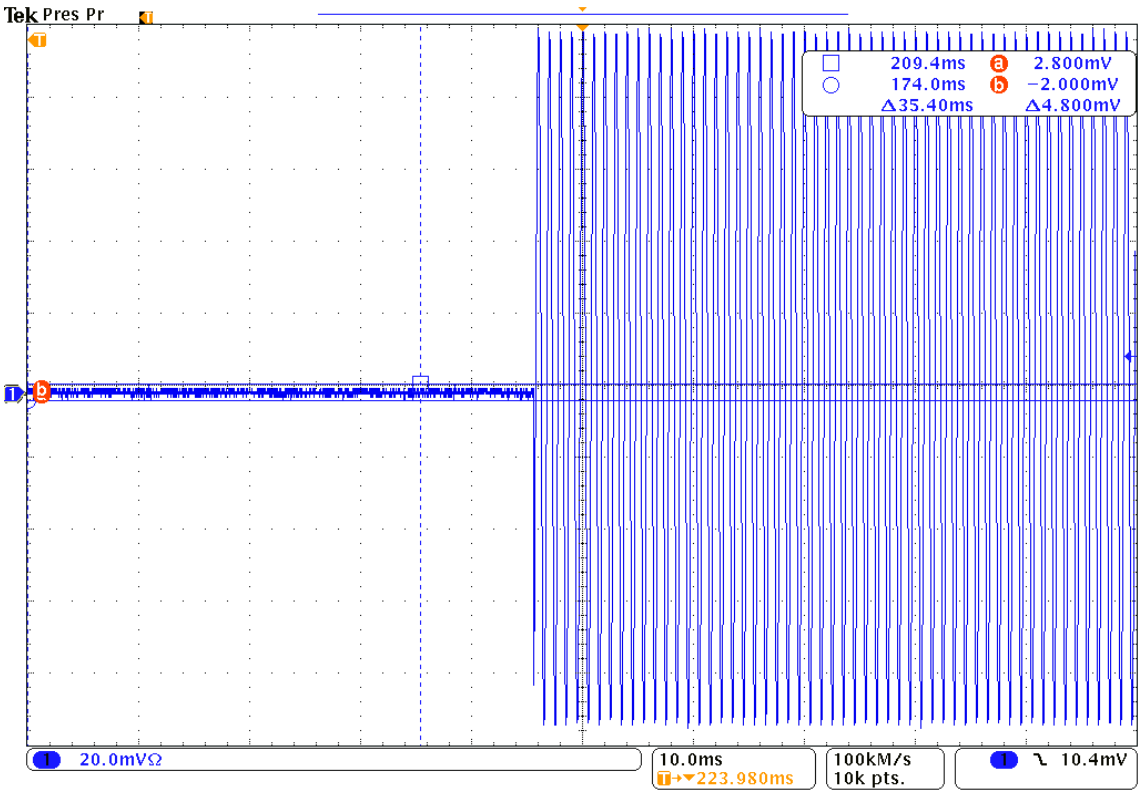
Transient Frequency Behaviour t_1 to t_2.



Transient Frequency Behaviour following t_2.



Transient Frequency Behaviour before .t_3.



Transient Frequency Behaviour t_3 to t_{off}.