

**FCC LISTED, REGISTRATION
 NUMBER: 720267**

Test report No:

**ISED LISTED REGISTRATION
 NUMBER IC 4621A-2**

NIE: 54533RRF.001A1

Test report (Modification 1) REFERENCE STANDARD: USA FCC Part 90 CANADA IC RSS-119

| | |
|---|--|
| Identificación del objeto ensayado.....: Identification of item tested | RF Transceiver / Mast-Mounted Base Station |
| Marca Trade | PowerTrunk |
| Modelo y/o referencia tipo Model and /or type reference | MBS Unit –N |
| Other identification of the product | D148N01PT FCC ID: WT7PTMBS800B IC: 8624A-PTMBS800B |
| HW version | CCP: 00.13.14.12 |
| SW version | CCP: 00.13.14.12 |
| Características Features | <u>Power supply:</u> MBS Unit –N with DC power supply: <ul style="list-style-type: none"> • Nominal voltage: 24 VDC. • Operational range: [21.6 – 31.2 VDC] MBS Unit –N with AC power supply: <ul style="list-style-type: none"> • Nominal voltage: 110/220 VAC. 50/60 Hz • Operational range: [90 – 264 VAC] <u>Frequency band:</u> <ul style="list-style-type: none"> • TX: 851-870 MHz / RX: 806-825 MHz <u>RF output power (nominal):</u> <ul style="list-style-type: none"> • TETRA: 40 dBm (10 W) / TI D-LMR: 40 dBm (10 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. ANSI/TIA-603-E: 2016 |
| Resultado.....: Summary | IN COMPLIANCE |
| Aprobado por (nombre / cargo y firma) Approved by (name / position & signature) | A. Llamas RF Lab. Manager |

| | |
|-------------------------------------|------------|
| Fecha de realización | 2018-01-11 |
| Date of issue | |
| Formato de informe No. | FDT11_20 |
| Report template No | |

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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 conjunction 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.

DEKRA Testing and Certification guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA Testing and Certification at the time of performance of the test.

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The results presented in this Test Report apply only to the particular item under test established in this document.

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General conditions

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4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Testing and Certification and the Accreditation Bodies.

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 N° | Description | Model | Serial number | Reception date |
|------------|---|-------------|---------------|----------------|
| 54533/001 | MBS Unit 806-870 MHz (D148N01PT) Option VAC (O148017PT) | MBS Unit -N | 3265963 | 2017-09-01 |
| 54533/002 | MBS Unit 806-870 MHz (D148N01PT) Option VDC (O148018PT) | MBS Unit -N | 3265962 | 2017-09-01 |
| 54008B/003 | Ethernet cable | --- | --- | 2017-09-01 |
| 54008B/004 | POE/ETH cable | --- | --- | 2017-09-01 |
| 54008B/005 | POE cable | --- | --- | 2017-09-01 |
| 54008B/006 | SYNC cable | --- | --- | 2017-09-01 |
| 54008B/007 | DIV cable | --- | --- | 2017-09-01 |
| 54008B/008 | Power cable | --- | --- | 2017-09-01 |

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

All tests indicated in appendix A.

Test sample description

The MBS Unit is a TETRA and TI D-LMR single-carrier module (digital RF transceiver) designed for indoor or outdoor installation in different locations such as walls, towers or masts. Up to two MBS Units can be interconnected to deploy a full-featured Mast-mounted Base Station (MBS). It can be either DC or AC power-supplied. The MBS Unit -N operates in the frequency band 806-870 MHz and provides an RF output power of 10 W in the subband 851-870 MHz.

Features:

Power Supply:

MBS Unit -N with DC power supply:

- Nominal voltage: 24 VDC.
- Operational range: [21.6 – 31.2 VDC]

MBS Unit -N with AC power supply:

- Nominal voltage: 110/220 VAC. 50/60 Hz
- Operational range: [90 – 264 VAC]

Access scheme:

TDMA with 4 physical channels (time slots) per RF channel.

Modulation scheme:

$\pi/4$ -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: 851-870 MHz
- RX: 806-825 MHz

RF output power (nominal):

- TETRA: 40 dBm (10 W)
- TI D-LMR: 40 dBm (10 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 (root-raised cosine filter).

Options:

| EQUIPMENT | CODE+OPTIONS | S/N |
|-----------|--|---------|
| MBS DC | D148N01PT O148018PT O148019PT O148057PT | 3265962 |
| MBS AC | D148N01PT O148017PT O148019PT O148057PT | 3265963 |

D148N01PT: MBS UNIT 806-870 MHz POWERTRUNK
O148018PT: OPTION VDC (Power Supply: 24 VDC)
O148017PT: OPTION VAC (Power Supply: 110/220 VAC)
O148019PT: OPTION MBS SUBBAND TX851/RX806/BW19
O148057PT: OPTION LITE

Identification of the client

TELTRONIC, S.A.U.

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

Testing period

The performed test started on 2017-10-27 and finished on 2017-12-04.

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 °C Max. = 35 °C |
| Relative humidity | Min. = 20 % Max. = 75 % |
| Shielding effectiveness | > 100 dB |
| Electric insulation | > 10 k Ω |
| Reference resistance to earth | < 1 Ω |

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

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

Modifications to the reference test report

It was introduced the following modifications in respect to the test report number 54533RRF.001 related with the same samples, in the next clauses and sub-clauses:

| Clauses / Sub-clauses | Modification | Justification |
|---|---|---|
| Cover sheet / Other identification of the product | The reference "D148N01-11" is replaced by the correct reference "D148N01PT" | Applicant's request. Change of product coding |
| Usage of samples / Description in table | The reference "D148N01-11" is replaced by the correct reference "D148N01PT" | Applicant's request. Change of product coding |
| Test sample description / Options | The reference "D148N01-11" is replaced by the correct reference "D148N01PT" | Applicant's request. Change of product coding |

This modification test report cancels and replaces the test report 54533RRF.001.

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. Spectrum analyser Agilent PSA E4440A | 2017/10 | 2019/10 |
| 2. Climatic chamber CTS C-70/600 | 2017/05 | 2018/05 |
| 3. DC power supply R&S NGPE 40/40 | 2014/11 | 2017/11 |
| 4. Radiocommunication analyzer HP 8920A | 2017/04 | 2020/04 |
| 5. Power sensor R&S NRP-Z91 | 2016/04 | 2018/04 |
| 6. Spectrum analyser R&S FSV40 | 2017/07 | 2019/07 |
| 7. AC power supply ELGAR CS-AC35(351SL) | 2016/05 | 2019/05 |

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 |

- 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, 90.635 / RSS-119 Clause 5.4: RF output power | | P | | |
| Clause 90.210, 90.691 / RSS-119 Clause 5.5, 5.8: Emission mask | | P | | |
| Clause 90.221: Adjacent channel power | | P | | |
| Clause 90.213 / RSS-119 Clause 5.3: Frequency stability | | P | | |
| Clause 90.210, 90.221, 90.691 / RSS-119 Clause 5.8: Spurious emissions at antenna terminals | | P | | |
| Clause 90.210, 90.221, 90.691 / RSS-119 Clause 5.8: Radiated emissions | | P | | |

3: see point "Remarks and comments".

Appendix A – Test results

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| Occupied Bandwidth | 18 |
| RF Output Power | 24 |
| Emission Mask | 26 |
| Adjacent channel power | 35 |
| Frequency Stability | 38 |
| Spurious emissions at antenna terminals | 40 |
| Radiated emissions | 50 |

TEST CONDITIONS

Power supply (V):

AC voltage

$$V_{\text{nom}} = 110.0 \text{ Vac}$$

$$V_{\text{max}} = 126.5 \text{ Vac}$$

$$V_{\text{min}} = 93.5 \text{ Vac}$$

DC voltage

$$V_{\text{nom}} = 24.0 \text{ Vdc}$$

$$V_{\text{max}} = 31.2 \text{ Vdc}$$

$$V_{\text{min}} = 20.4 \text{ Vdc}$$

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

Type of power supply = AC or DC Voltage from external power supply

Type of antenna = external connectable antenna

Rated RF Output Power:

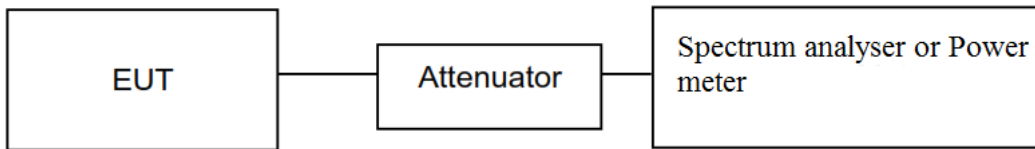
- Mode TETRA (22 kHz bandwidth): 40 dBm (10 W)
- Mode TI D-LMR (20 kHz bandwidth): 40 dBm (10 W)

TEST FREQUENCIES:

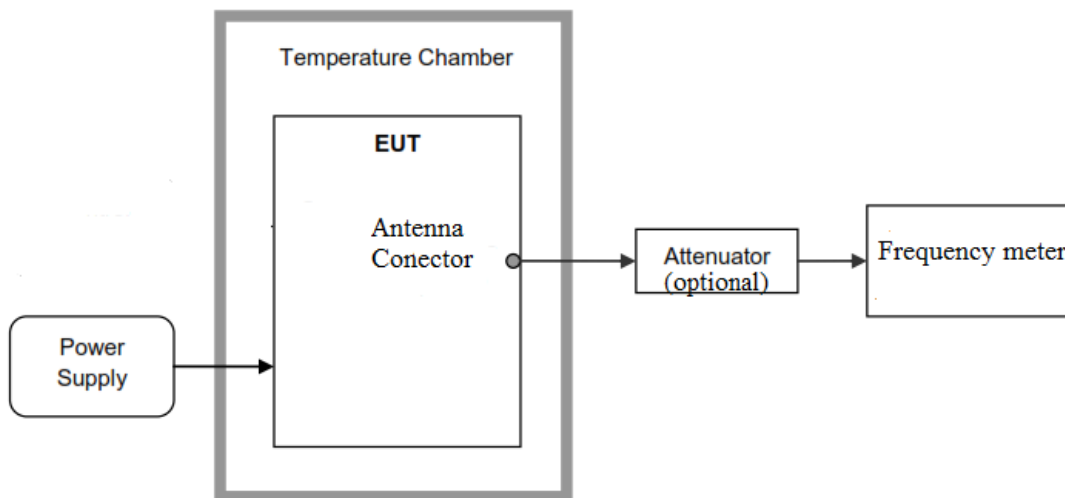
| | 851-869 MHz band |
|------------------------|-------------------------|
| Lowest channel RSS-119 | 851.0125 MHz |
| Lowest channel FCC 90 | 854.0125 MHz |
| Middle channel | 861.5 MHz |
| Highest channel | 868.9875 MHz |

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 and AC 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 10000 MHz.

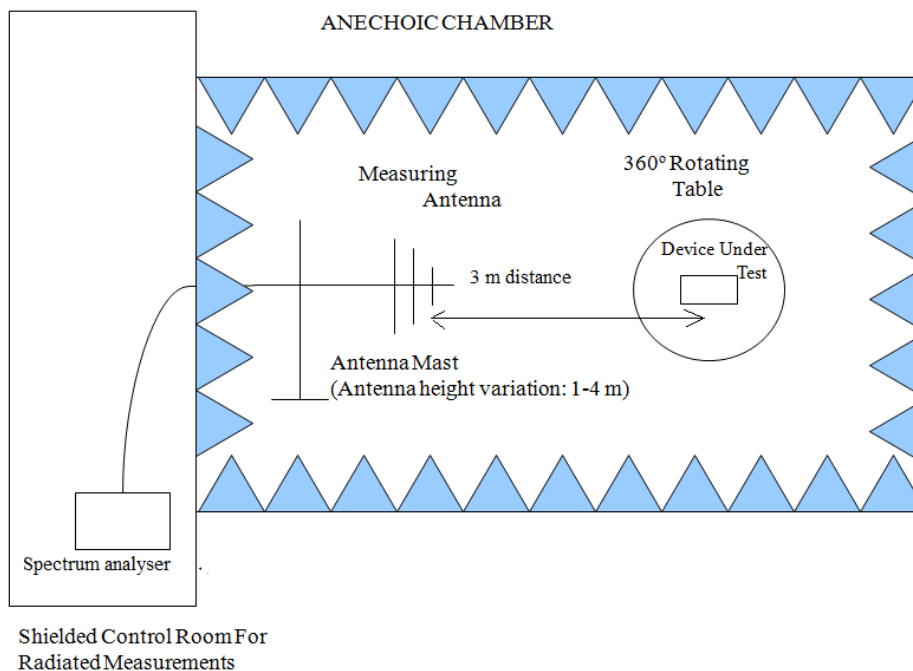
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30 MHz-1000 MHz (30 MHz-1000 MHz Bilog antenna) and at a distance of 1m for the frequency range 1 GHz-10 GHz (1 GHz-18 GHz Double ridge horn antenna).

For radiated emissions in the range 1 GHz-10 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

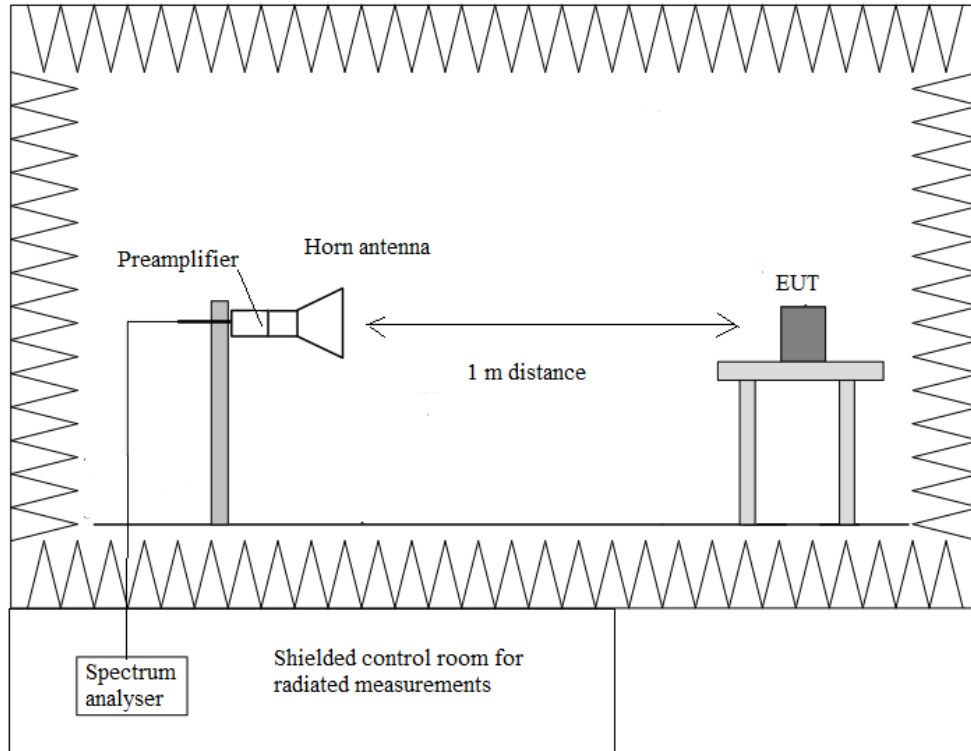
The equipment under test was set up on a non-conductive platform and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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)

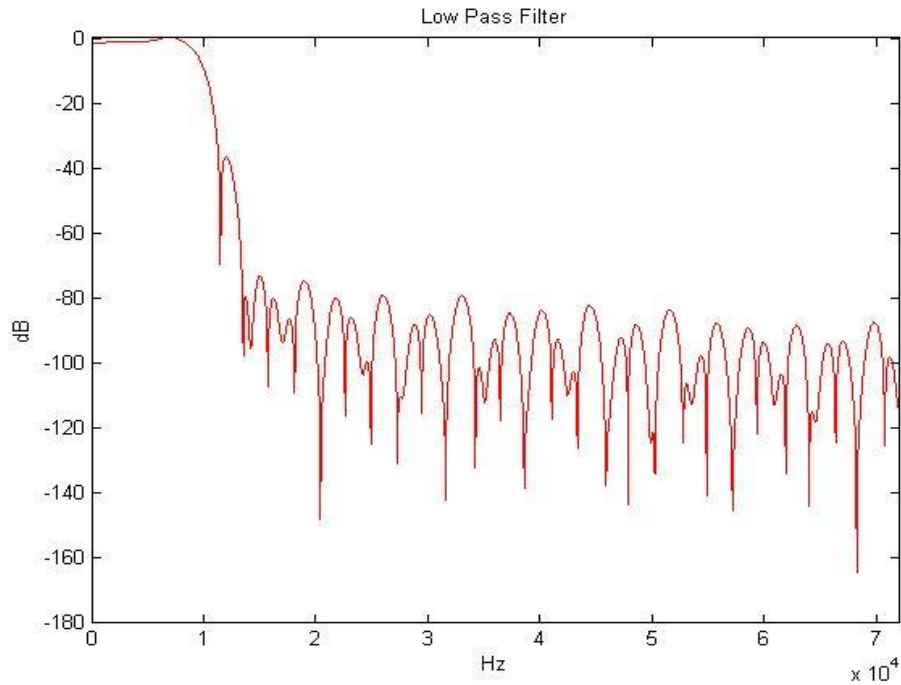
The EUT operates with $\pi/4$ -shifted Differential Quaternary Phase Shift Keying ($\pi/4$ -DQPSK) in both TI D-LMR and TETRA, featuring a modulation rate of 18 ksym/s (36 kbits/s).

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

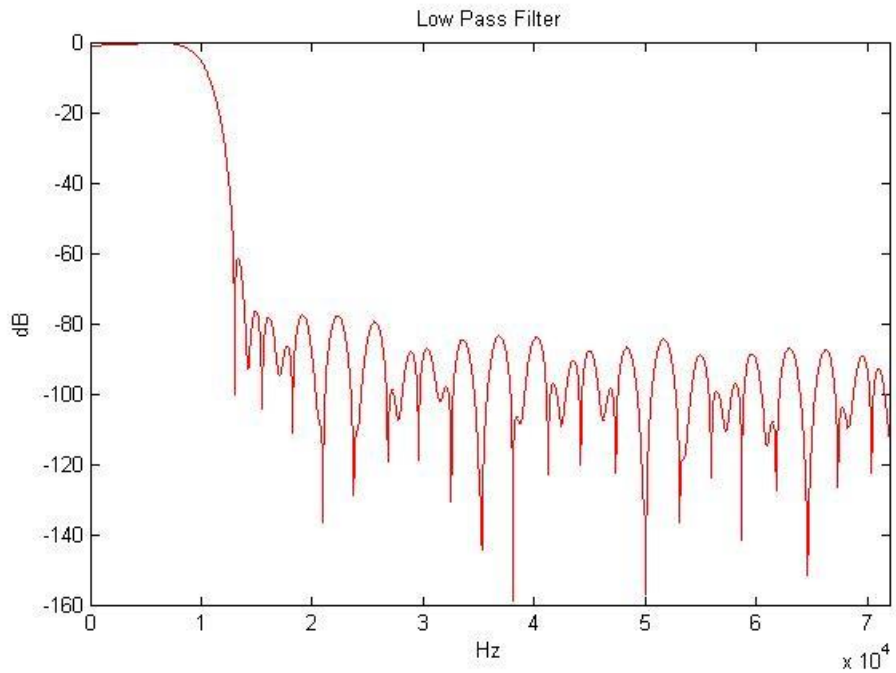
A root-raised-cosine filter (RRC) is used as a transmitting and receiving filter in both digital communication systems to perform matched filtering. The combined response of such two filters is that of the raised-cosine filter. The raised-cosine filter is often used for pulse-shaping in digital modulation,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

MBS Unit Transmitter low pass filter for TI D-LMR (20 KHz authorized bandwidth):



MBS Unit Transmitter low pass filter for TETRA (22 KHz modulation bandwidth):



Occupied Bandwidth

SPECIFICATION

FCC §2.1049, §90.209.

| Frequency band (MHz) | Channel spacing (kHz) | Authorized bandwidth (kHz) |
|----------------------|-----------------------|----------------------------|
| 854-869 | 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) |
|----------------------|--|-----------------------|----------------------------|
| 851-866 and 866-869 | SRSP-502 | 6.25 12.5 25 | 6 11.25 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 analyser E4440A.

RESULTS (see next plots)

TI D-LMR 20 kHz.

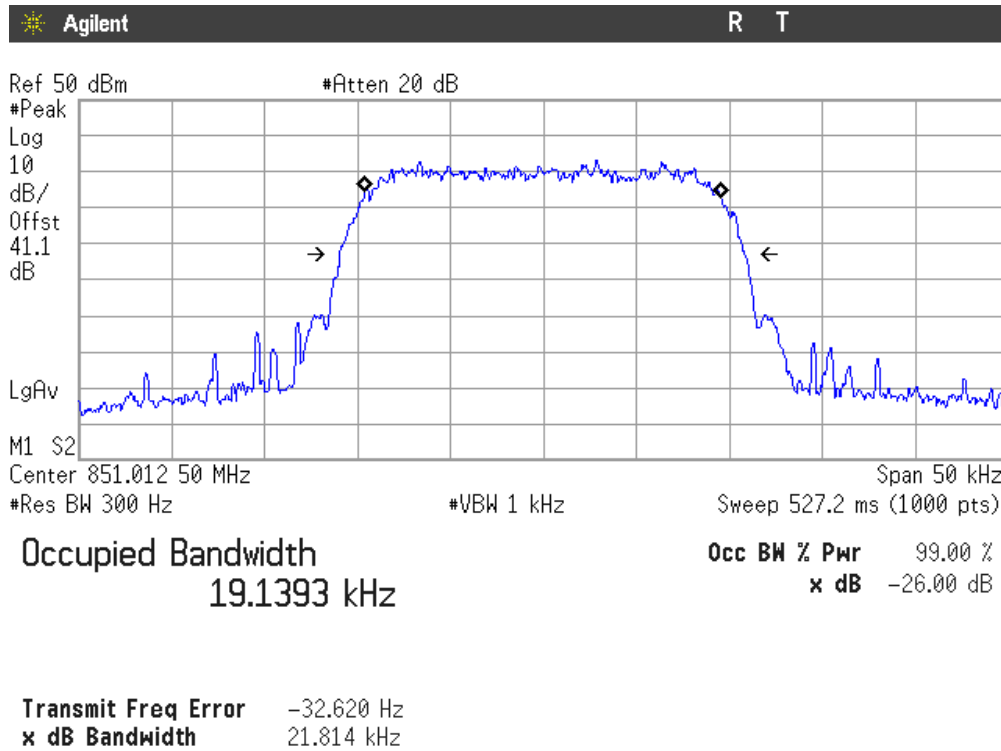
| Channel | 99% Occupied bandwidth (kHz) | -26 dBc bandwidth (kHz) |
|-------------------------------|------------------------------|-------------------------|
| 851.0125 MHz | 19.1393 | 21.814 |
| 854.0125 MHz | 19.2315 | 21.737 |
| 861.5 MHz | 19.1349 | 21.820 |
| 868.9875 MHz | 19.0651 | 21.879 |
| Measurement uncertainty (kHz) | <±0.17 | |

TETRA 22 kHz.

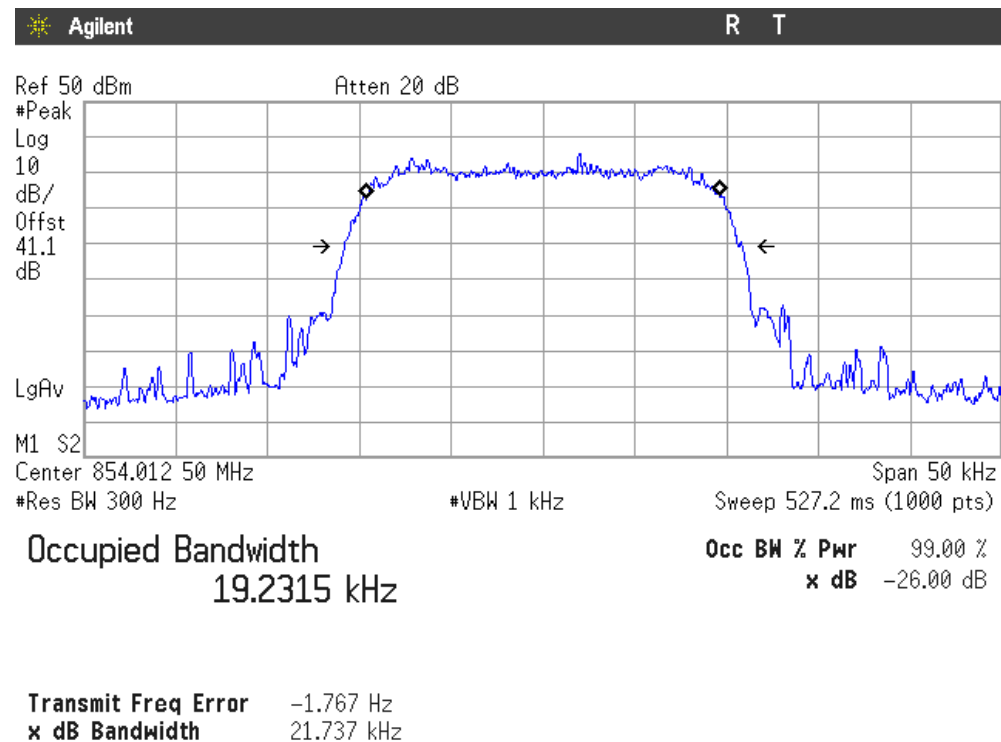
| Channel | 99% Occupied bandwidth (kHz) | -26 dBc bandwidth (kHz) |
|-------------------------------|------------------------------|-------------------------|
| 851.0125 MHz | 20.2504 | 22.835 |
| 854.0125 MHz | 20.3673 | 23.394 |
| 861.5 MHz | 20.2592 | 23.385 |
| 868.9875 MHz | 20.2407 | 23.055 |
| Measurement uncertainty (kHz) | <±0.17 | |

TI D-LMR 20 kHz.

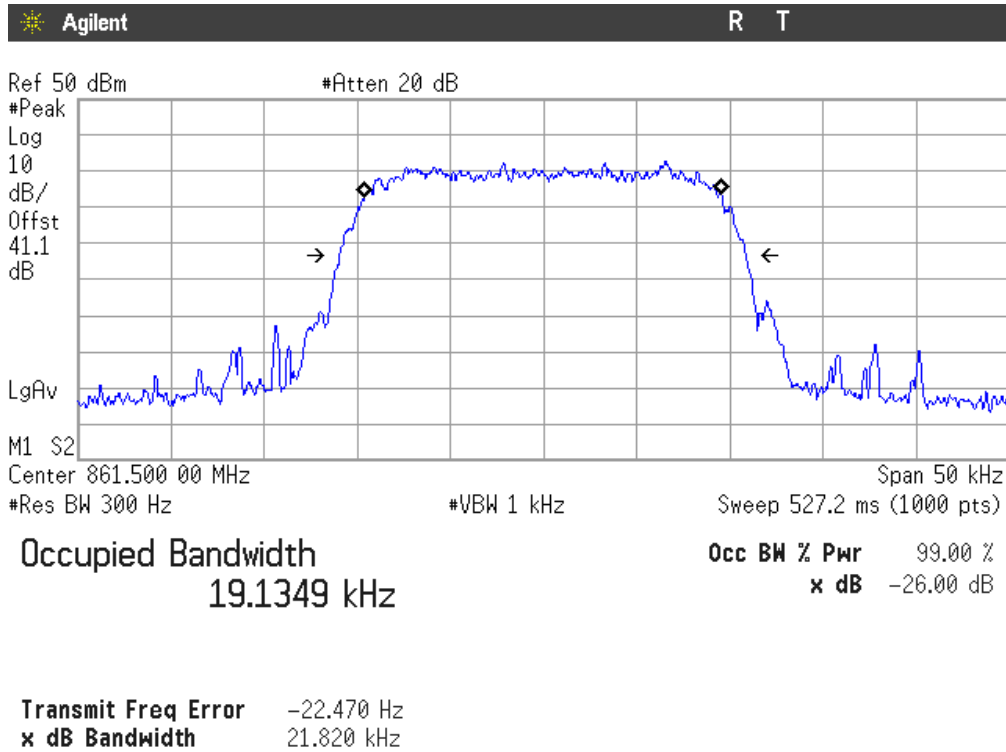
RSS-119 Lowest Channel 851.0125 MHz



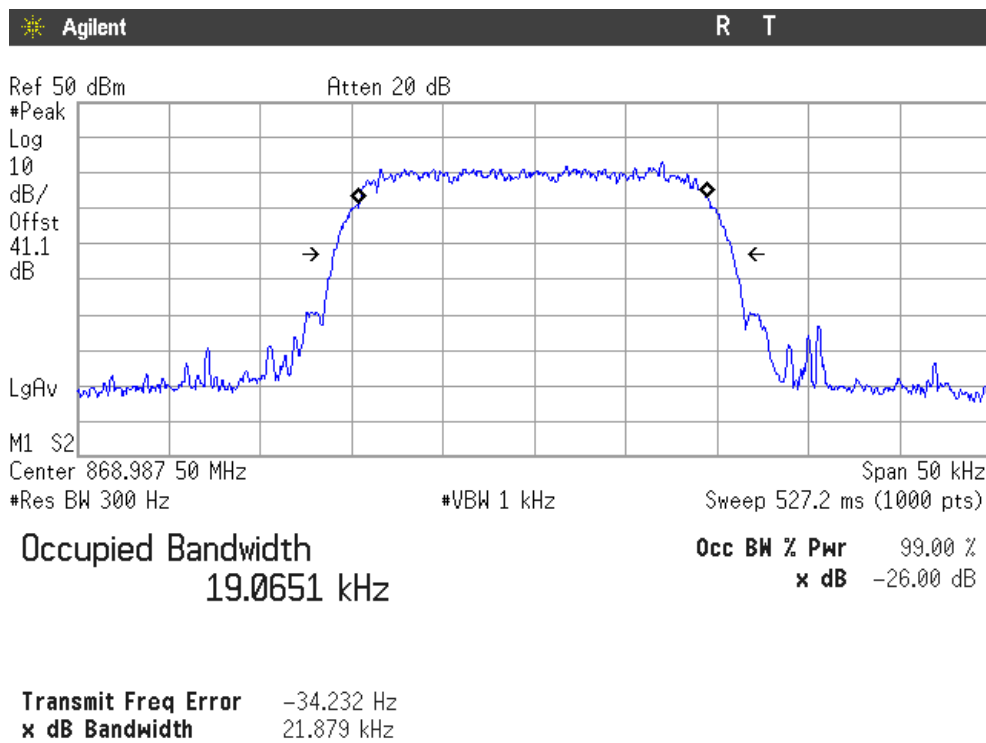
FCC 90 Lowest Channel 854.0125 MHz



Middle Channel

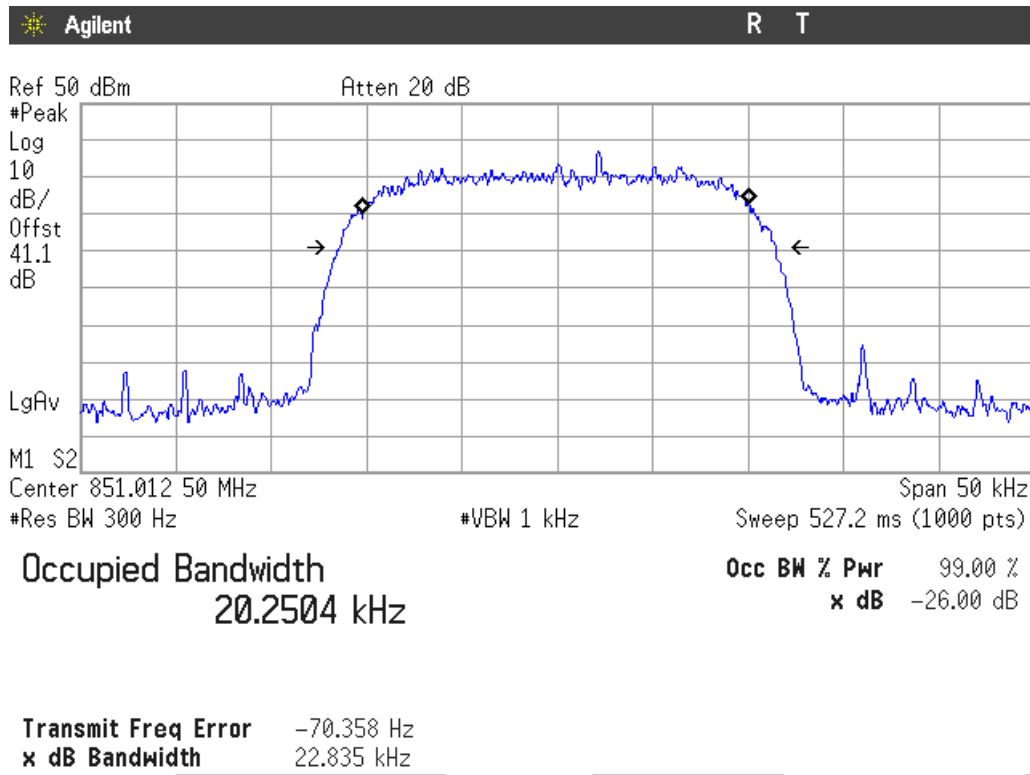


Highest Channel

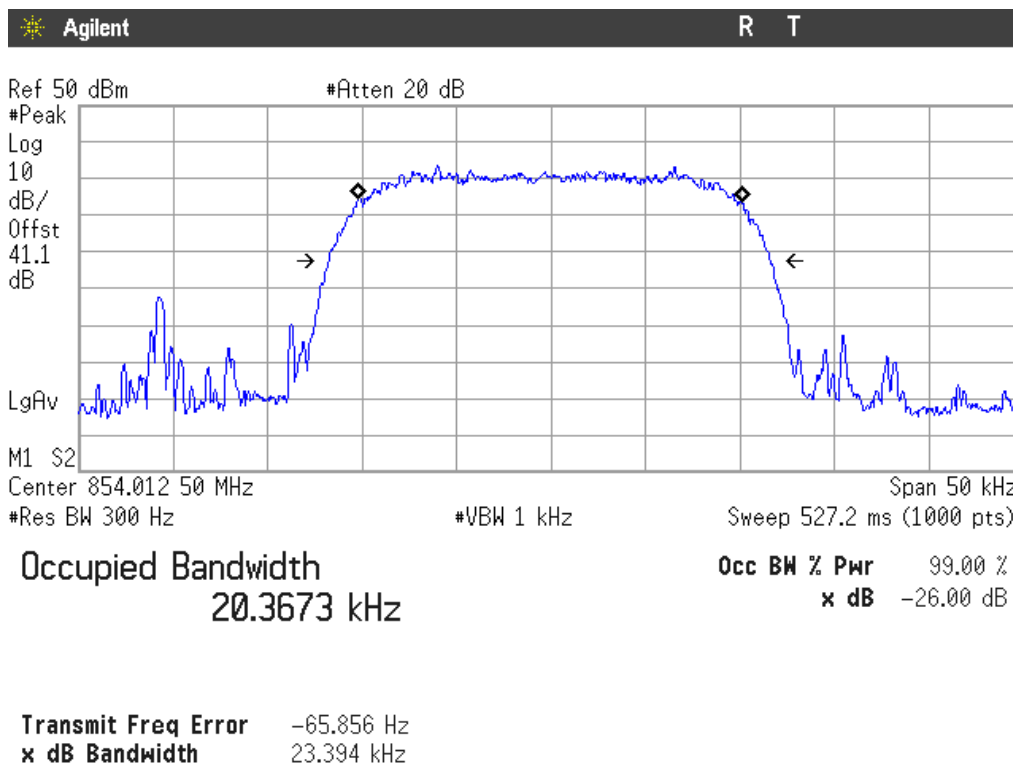


TETRA 22 kHz.

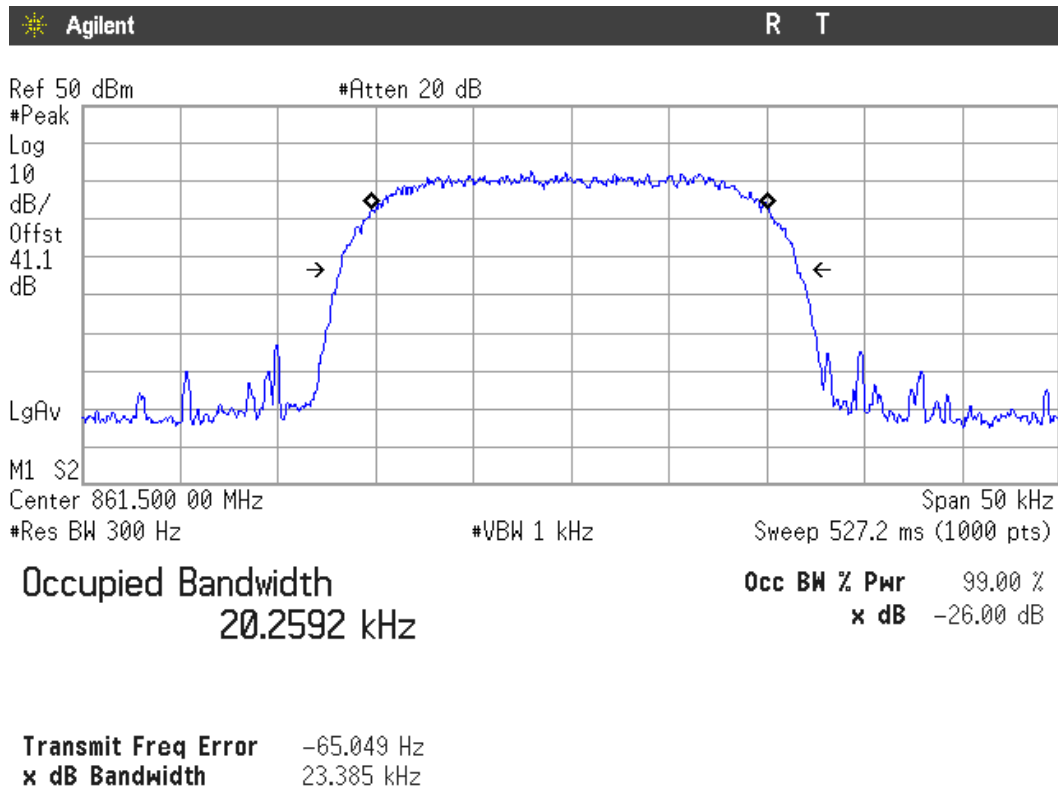
RSS-119 Lowest Channel 851.0125 MHz



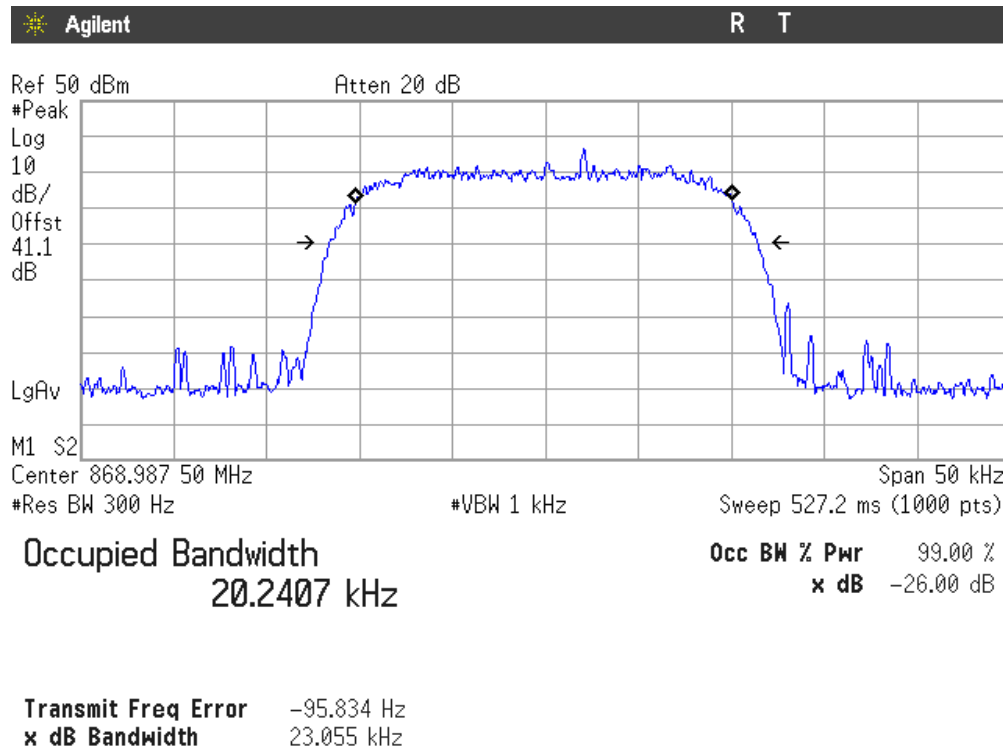
FCC 90 Lowest Channel 854.0125 MHz



Middle Channel



Highest Channel



RF Output Power

SPECIFICATION

FCC §90.205 and §90.635. 809-824 MHz and 854-869 MHz bands.

The effective radiated power and antenna height for base stations may not exceed 1 kilowatt (30 dBw / 60 dBm) and 304 m.

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 |
| 851-866 and 866-869 | 110 | 30 |

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

Manufacturer's rated power: 10 W (40 dBm).

| TI D-LMR. 20 kHz Bandwidth | Frequency (MHz) | Maximum average power (dBm) | Maximum deviation (dB) |
|------------------------------|-----------------|-----------------------------|------------------------|
| | 851.0125 | 39.57 | -0.43 |
| | 854.0125 | 39.82 | -0.18 |
| | 861.5 | 39.61 | -0.39 |
| | 868.9875 | 39.70 | -0.30 |
| Measurement uncertainty (dB) | | $<\pm 0.33$ | |

| TETRA. 22 kHz Bandwidth | Frequency (MHz) | Maximum average power (dBm) | Maximum deviation (dB) |
|------------------------------|-----------------|-----------------------------|------------------------|
| | 851.0125 | 39.68 | -0.32 |
| | 854.0125 | 39.80 | -0.20 |
| | 861.5 | 39.61 | -0.39 |
| | 868.9875 | 39.55 | -0.45 |
| Measurement uncertainty (dB) | | <±0.33 | |

The sum of the system loss (dB) and antenna gain (dBd) for the worst case of conducted power (39.82 dBm) shall be such that the Effective Radiated Power (E.R.P.) shall not exceed the limit indicated above.

Verdict: PASS

Emission Mask

SPECIFICATION

FCC §90.210, FCC §90.691:

| Frequency band (MHz) | Mask for equipment with audio low pass filter | Mask for equipment without audio low pass filter |
|--------------------------------|---|--|
| 809-824/854-869 ^{3,5} | B | G |

3: Equipment used in this licensed to EA or non-EA systems shall comply with the emission mask provisions of §90.691.

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.

FCC §90.691. Emission mask requirements for EA-based systems. Out-of-band emission requirement shall apply only to the “outer” channels included in an EA license and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:

- (1) For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $116 \log_{10}(f/6.1)$ decibels or $50 + 10 \log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.
- (2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

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 |
|----------------------|--|-----------------------|----------------------------|--|---|
| 851-866 and 866-869 | SRSP-502 | 25 | 20 | B | G |
| | | | 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 10 - Emission Mask G

| Displacement Frequency, f_d (kHz) | Minimum Attenuation (dB) | Resolution Bandwidth (Hz) |
|-------------------------------------|---|----------------------------|
| $10 < f_d \leq 50$ | whichever is the lesser attenuation: 70 or $116 \log_{10}(f_d/6.11)$ or $50 + 10 \log_{10}(p)$ | 300 |
| $f_d > 50$ | $43 + 10 \log_{10}(p)$ | Specified in Section 4.2.1 |

Table 17 - Emission Mask Y

| Displacement Frequency, f_d (kHz) | Minimum Attenuation (dB) | Resolution Bandwidth (Hz) |
|-------------------------------------|---|----------------------------|
| $12.375 < f_d \leq 13.975$ | whichever is the lesser attenuation: $30 + 16.67(f_d - 12.375)$ or $55 + 10 \log_{10}(p)$ | Specified in Section 4.2.2 |
| $f_d > 13.975$ | whichever is the lesser attenuation: 57 or $55 + 10 \log_{10}(p)$ | 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)

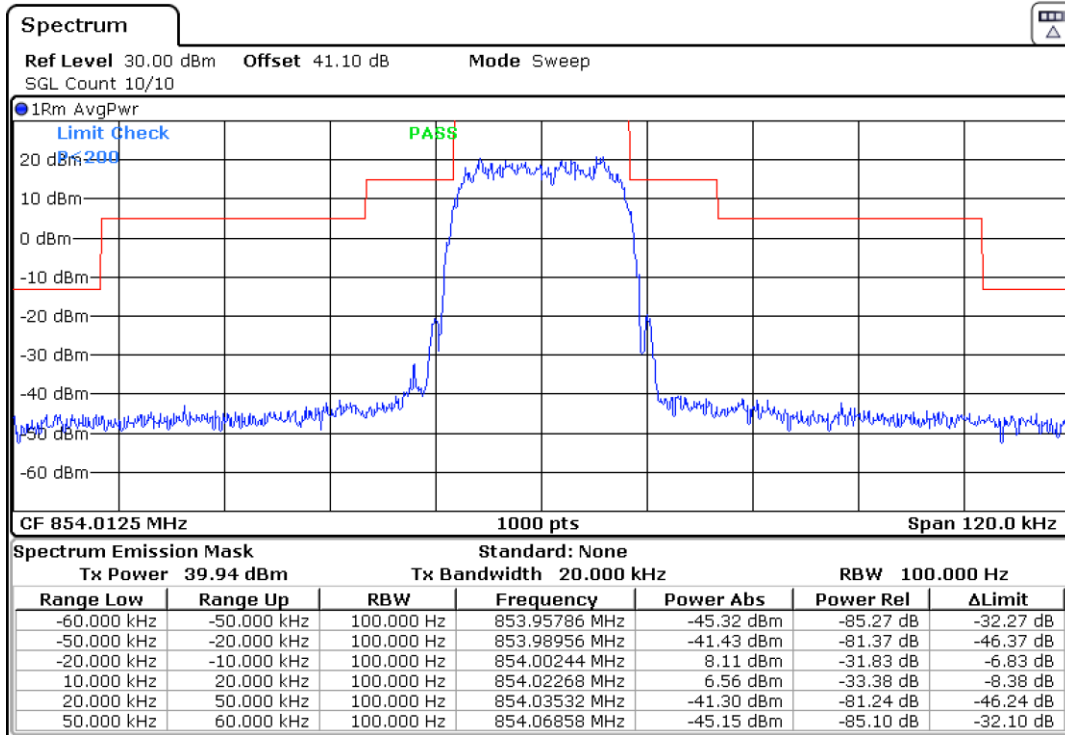
| | |
|------------------------------|--------|
| Measurement uncertainty (dB) | <±0.33 |
|------------------------------|--------|

Verdict: PASS

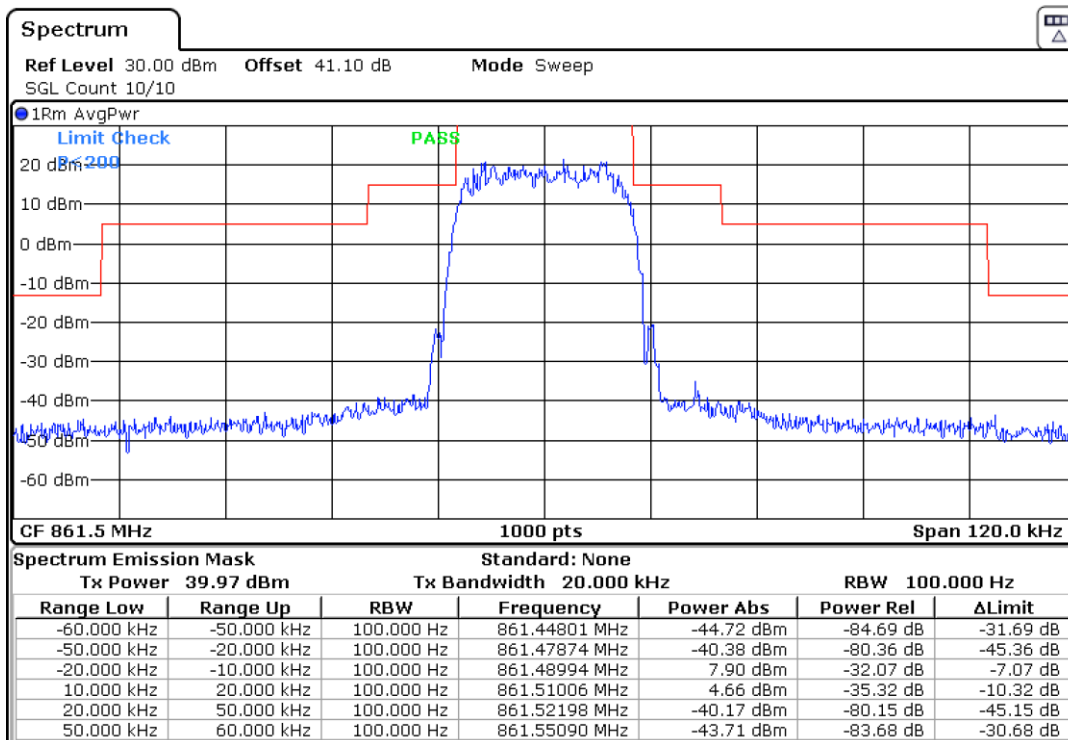
FCC 90 Emission Mask B.

TI D-LMR 20 kHz Bandwidth.

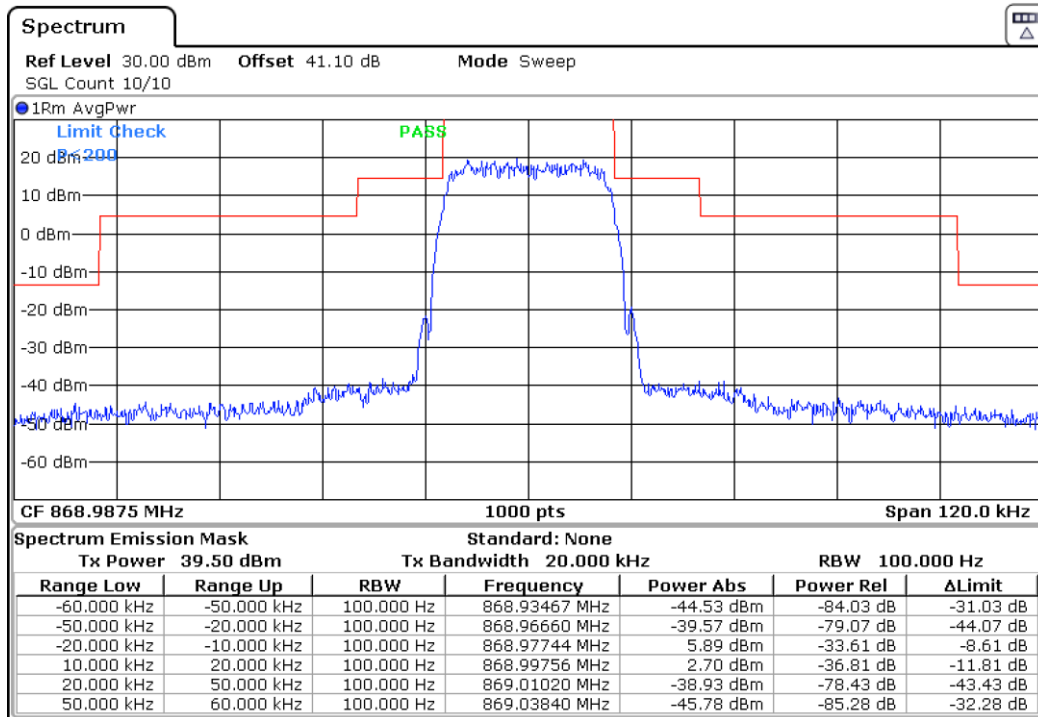
FCC 90 Lowest Channel 854.0125 MHz



Middle Channel



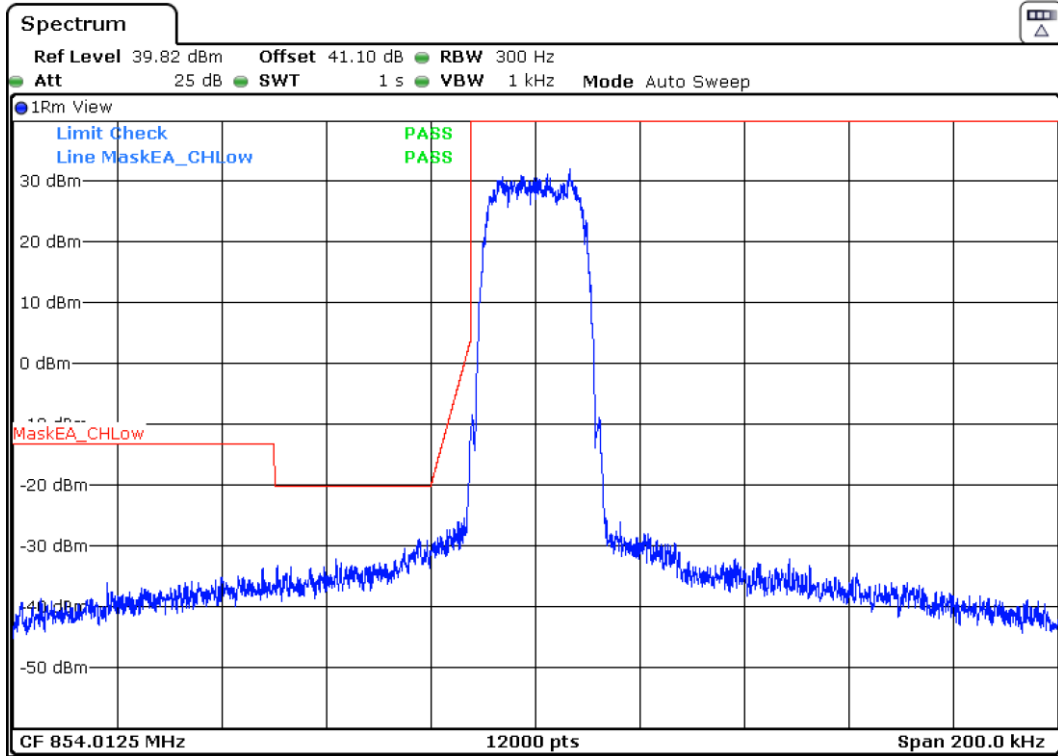
Highest Channel



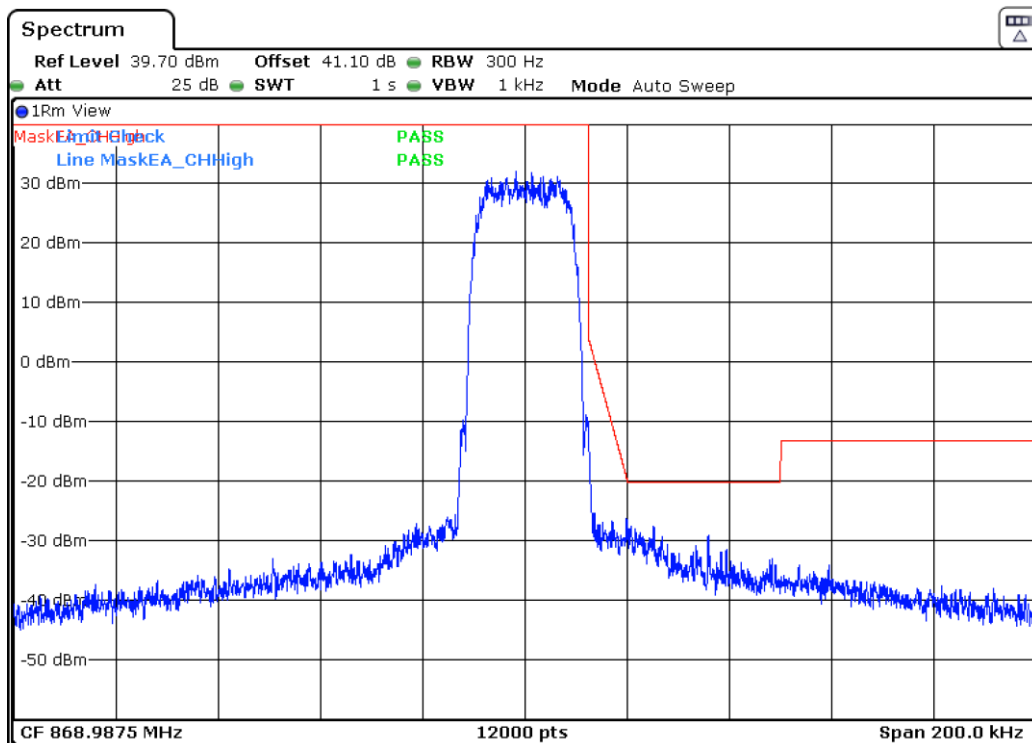
FCC 90 Emission Mask EA.

TI D-LMR 20 kHz Bandwidth.

FCC 90 Lowest Channel 854.0125 MHz



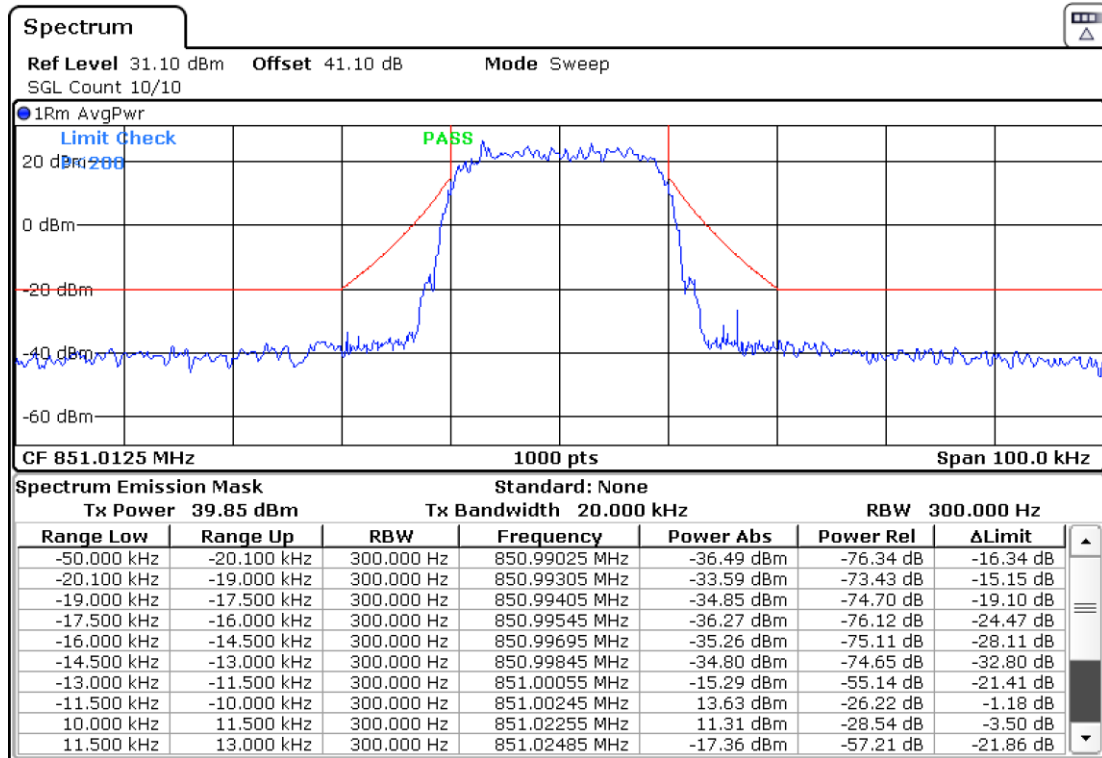
Highest Channel



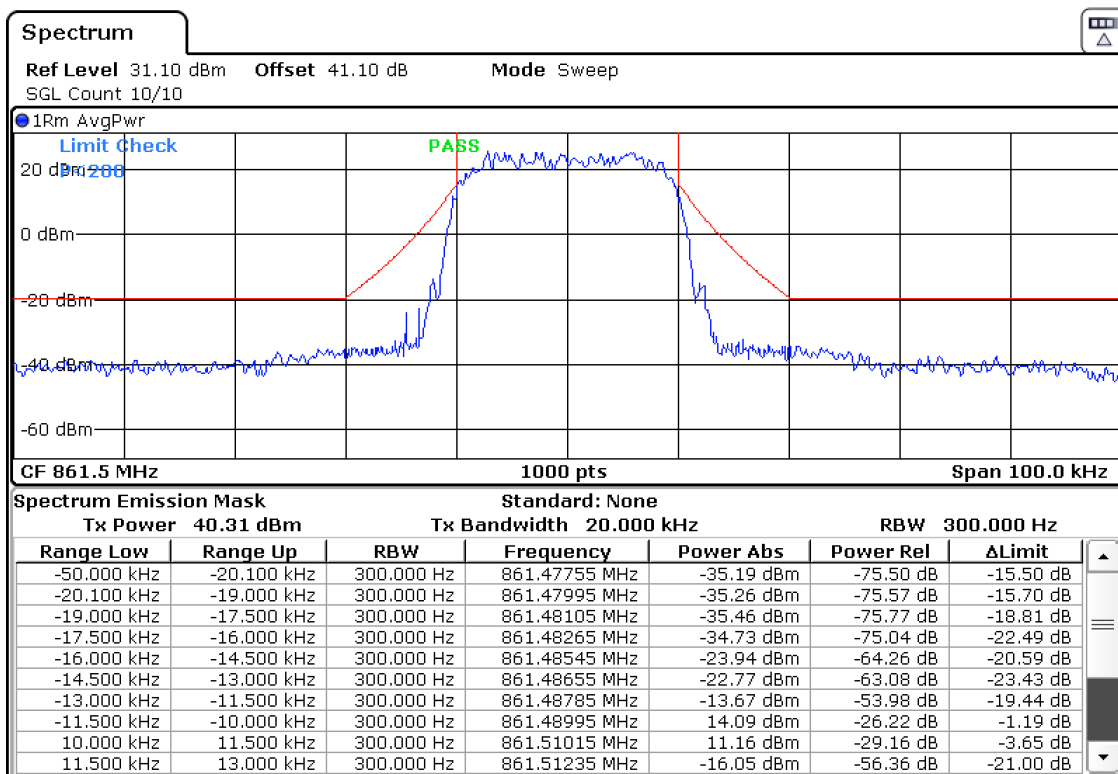
RSS-119 Emission Mask G.

TI D-LMR 20 kHz Bandwidth.

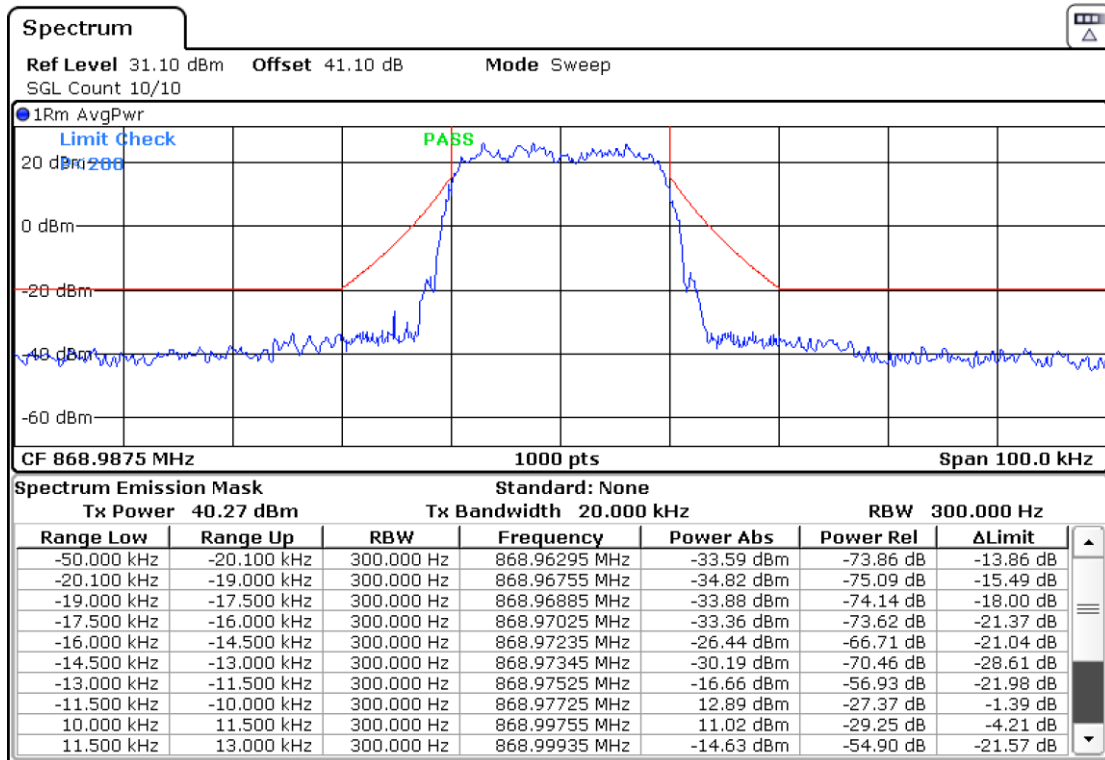
RSS-119 Lowest Channel 851.0125 MHz



Middle Channel



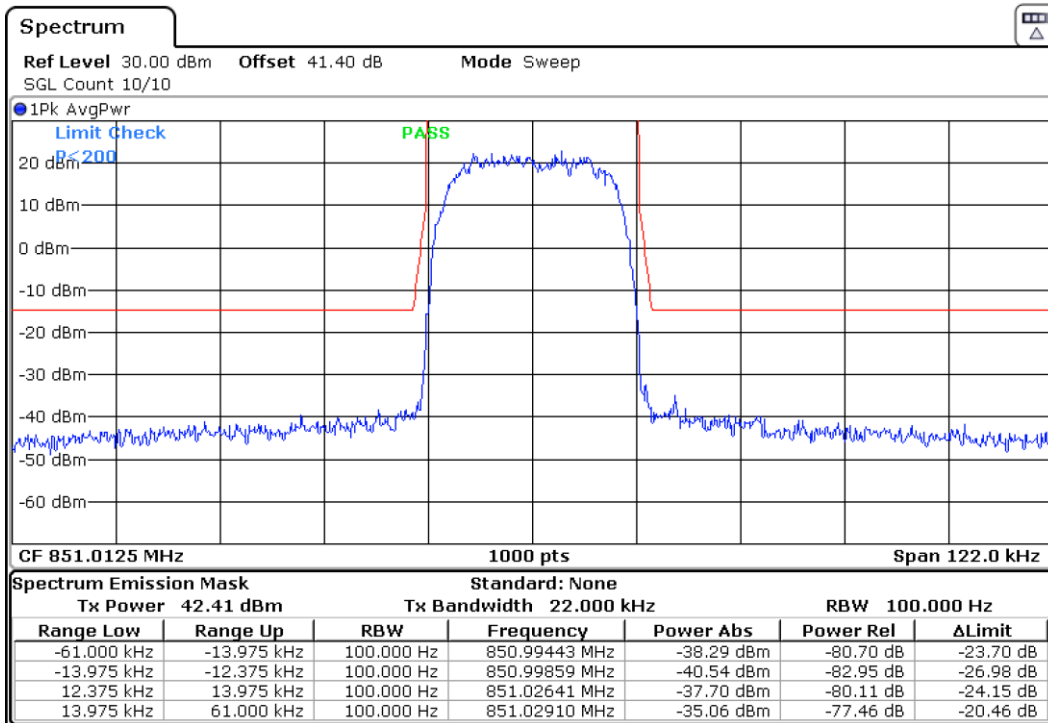
Highest Channel



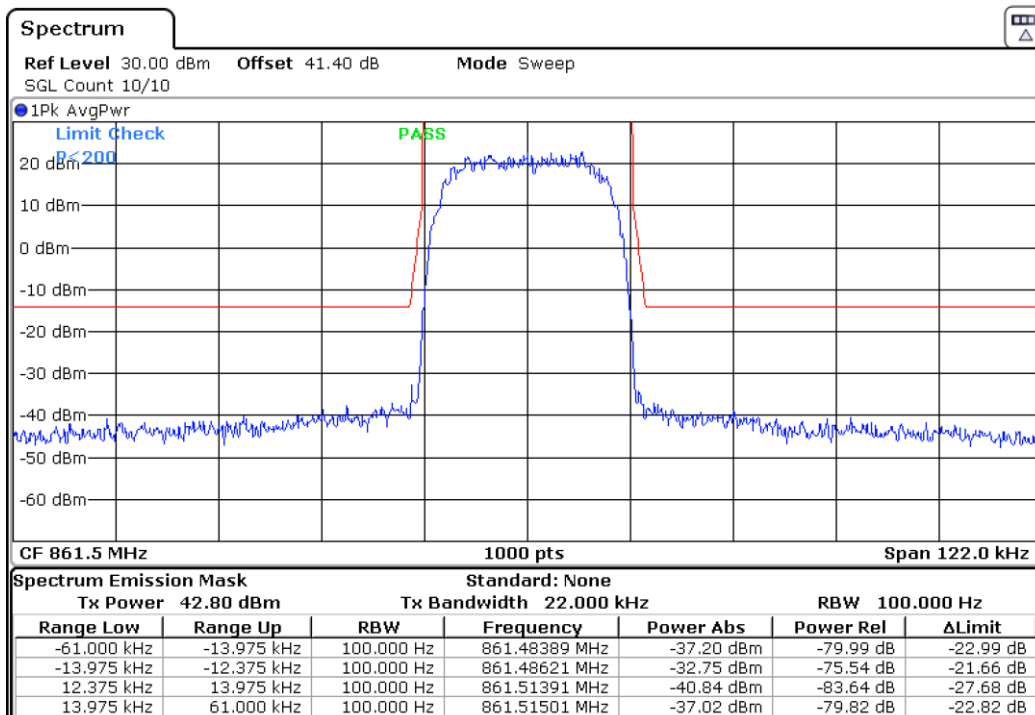
RSS-119 Emission Mask Y.

TETRA 22 kHz Bandwidth.

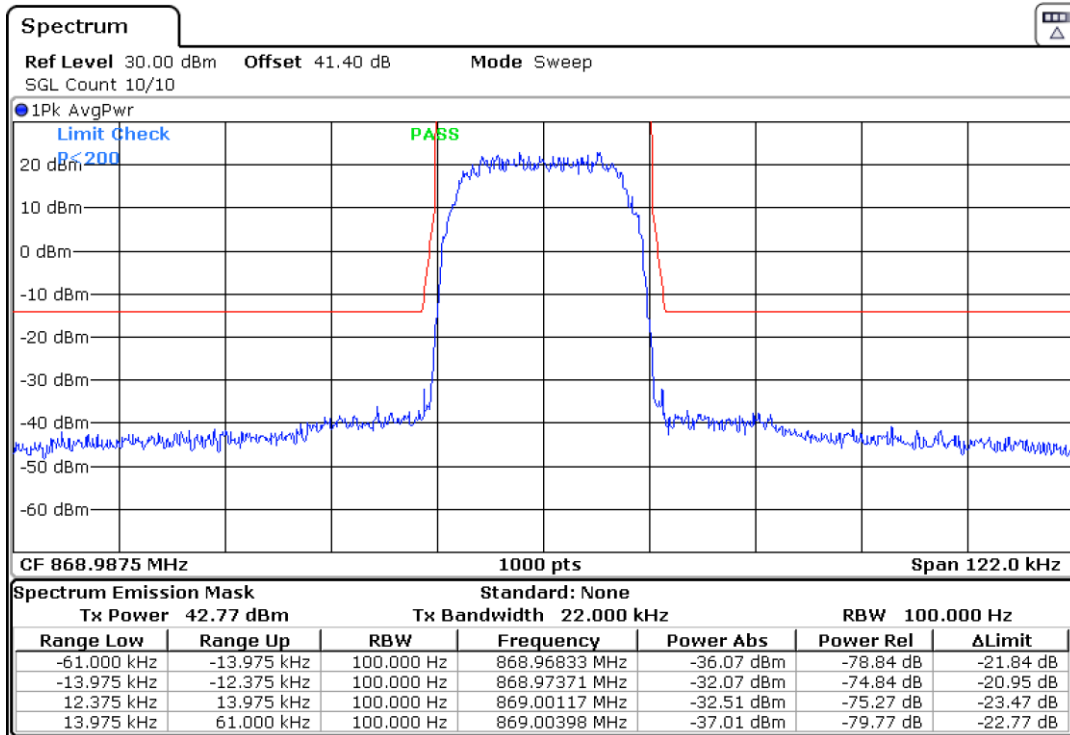
RSS-119 Lowest Channel 851.0125 MHz



Middle Channel



Highest Channel



Adjacent channel power

SPECIFICATION

FCC §90.221. 854–869 MHz band.

(a) For the frequency bands indicated below, 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 (ACP) limits below. The table specifies a value for the ACP as a function of the displacement from the channel center frequency and a measurement bandwidth of 18 kHz.

(c)(1) Maximum adjacent power levels for frequencies in the 809–824/854–869 MHz band:

| Frequency offset | Maximum ACP (dBc) for devices less than 15 watts | Maximum ACP (dBc) for devices 15 watts and above |
|------------------|--|--|
| 25 kHz | -55 dBc | -55 dBc |
| 50 kHz | -65 dBc | -65 dBc |
| 75 kHz | -65 dBc | -70 dBc |

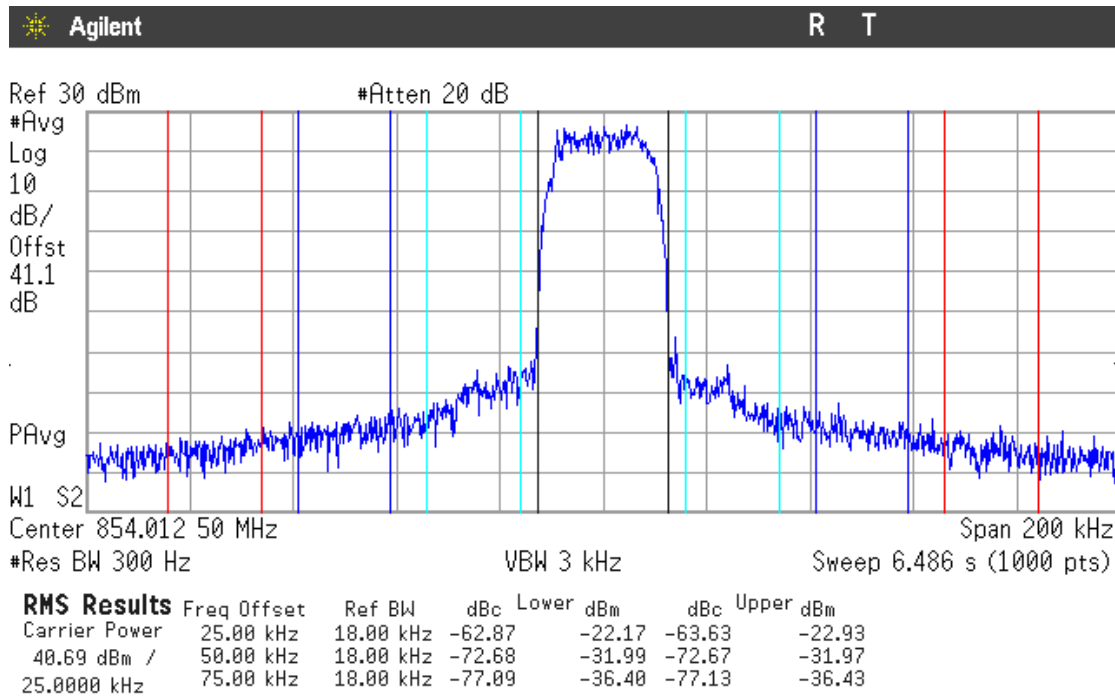
(2) In any case, no requirement in excess of -36 dBm shall apply.

(d) On any frequency removed from the assigned frequency by more than 75 kHz, the attenuation of any emission must be at least $43 + 10 \log (P_{\text{watts}})$ dB.

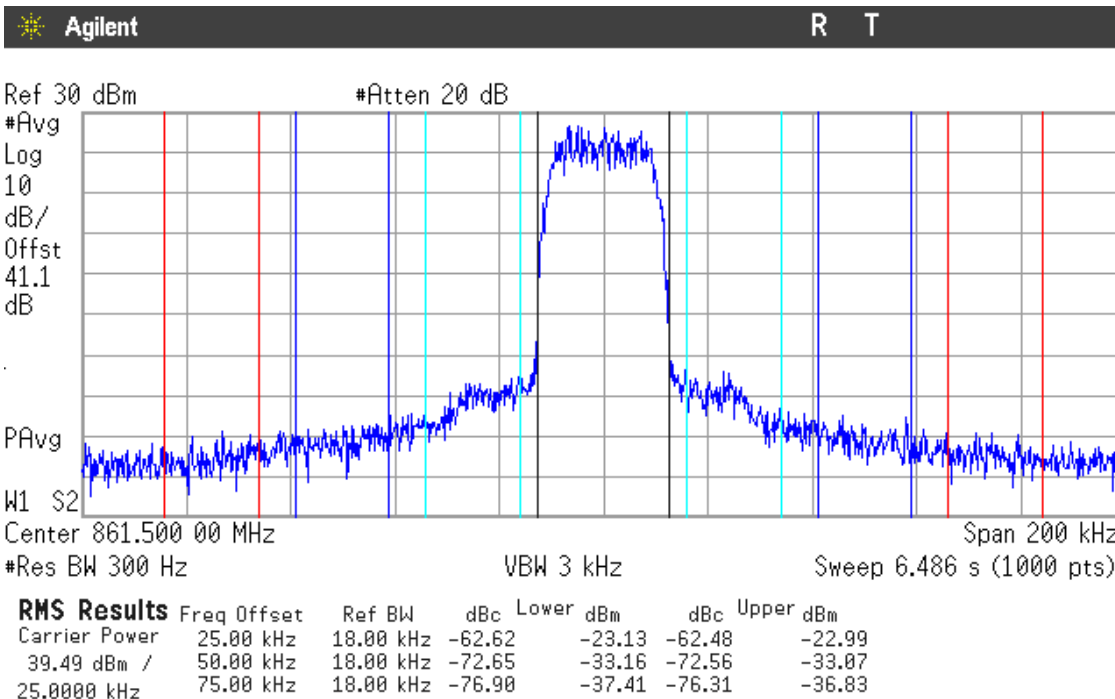
| | |
|------------------------------|--------|
| Measurement uncertainty (dB) | <±0.64 |
|------------------------------|--------|

TETRA 22 kHz.

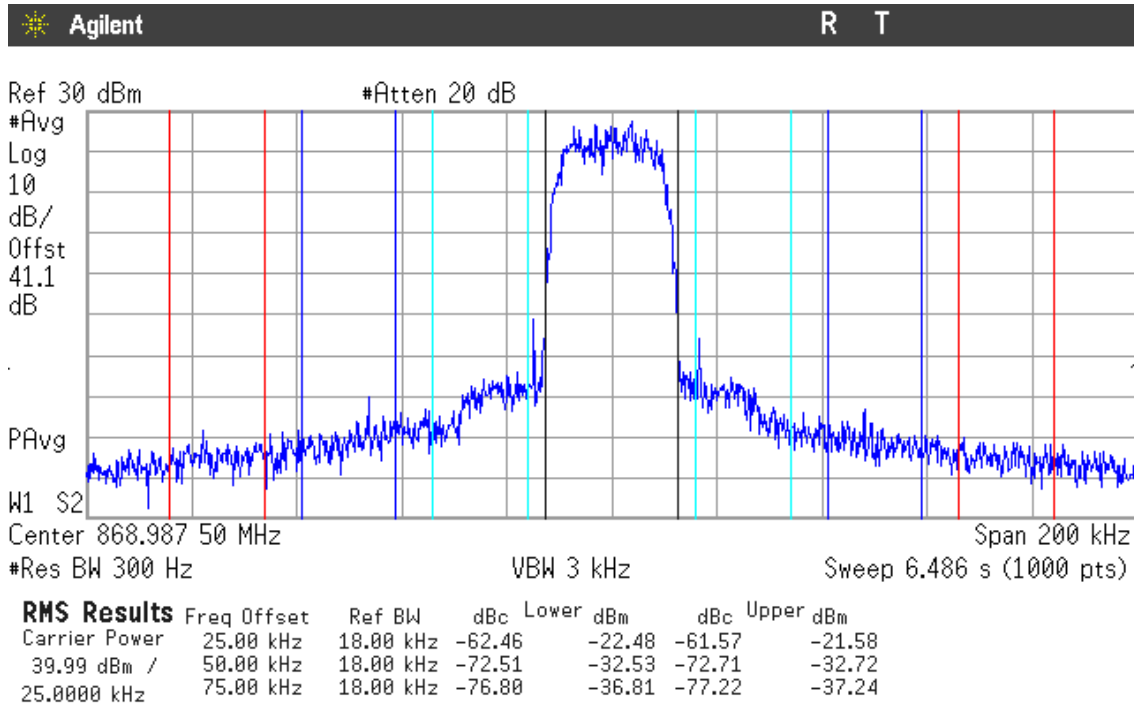
FCC 90 Lowest Channel 854.0125 MHz



Middle Channel



Highest Channel



Frequency Stability

SPECIFICATION

FCC §2.1055, §90.213. 854–869 MHz bands

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) | Fixed and base stations |
|-----------------------|-------------------------|
| 854–869 | 1.5 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 Spacing (kHz) | Frequency Stability (ppm) |
|----------------------|-----------------------|---------------------------|
| | | Base/Fixed |
| 851-866 and 866-869 | 25 (Note) | 0.1 |
| | 25 | 1.5 |
| | 12.5 | 1 |
| | 6.25 | 0.1 |

Note: This provision is for digital equipment with a channel bandwidth of 25 kHz and an occupied bandwidth greater than 20 kHz.

METHOD

The frequency tolerance measurements over temperature variations were made over the temperature range of -30°C to $+50^{\circ}\text{C}$. The EUT was placed inside a climatic chamber and the temperature was raised hourly in 10°C steps from -30°C up to $+50^{\circ}\text{C}$.

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

Middle Channel.

| Voltage (Vdc) | Temperature (°C) | Frequency Error (Hz) | Frequency Error (ppm) |
|---|------------------|----------------------|-----------------------|
| Frequency stability with Temperature | | | |
| 24 | +50 | 3 | 0.00348 |
| | +40 | 3 | 0.00348 |
| | +30 | 3 | 0.00348 |
| | +20 | 3 | 0.00348 |
| | +10 | 3 | 0.00348 |
| | 0 | 3 | 0.00348 |
| | -10 | 4 | 0.00464 |
| | -20 | 4 | 0.00464 |
| | -30 | 4 | 0.00464 |
| Frequency stability with Supply Voltage | | | |
| 20.4 | 20 | 3 | 0.00348 |
| 31.2 | 20 | 3 | 0.00348 |

| Voltage (Vac) | Temperature (°C) | Frequency Error (Hz) | Frequency Error (ppm) |
|---|------------------|----------------------|-----------------------|
| Frequency stability with Supply Voltage | | | |
| 93.5 | 20 | 4 | 0.00464 |
| 126.5 | 20 | 5 | 0.00580 |

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

Verdict: PASS

Spurious emissions at antenna terminals

SPECIFICATION

FCC §2.1051, §90.210, §90.221, §90.691. 854–869 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.

Emission mask requirements for EA-based systems.

For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

Adjacent channel power limits.

On any frequency removed from the assigned frequency by more than 75 kHz, the attenuation of any emission must be at least $43 + 10 \log (P_{\text{watts}})$ dB.

RSS-119 Clause 5.8.

Table 10 - Emission Mask G

| Displacement Frequency, f_d (kHz) | Minimum Attenuation (dB) | Resolution Bandwidth (Hz) |
|-------------------------------------|---|----------------------------|
| $10 < f_d \leq 50$ | whichever is the lesser attenuation: 70 or $116 \log_{10}(f_d/6.11)$ or $50 + 10 \log_{10}(p)$ | 300 |
| $f_d > 50$ | $43 + 10 \log_{10}(p)$ | Specified in Section 4.2.1 |

Table 17 - Emission Mask Y

| Displacement Frequency, f_d (kHz) | Minimum Attenuation (dB) | Resolution Bandwidth (Hz) |
|-------------------------------------|---|----------------------------|
| $12.375 < f_d \leq 13.975$ | whichever is the lesser attenuation: $30 + 16.67(f_d - 12.375)$ or $55 + 10 \log_{10}(p)$ | Specified in Section 4.2.2 |
| $f_d > 13.975$ | whichever is the lesser attenuation: 57 or $55 + 10 \log_{10}(p)$ | 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 > 1GHz. The spectrum was investigated from 10 kHz to 10 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.

A preliminary scan determined the DC power supply configuration as the worst case.

RESULTS (see plots in next pages)

TI D-LMR 20 kHz bandwidth.

RSS-119 LOWEST CHANNEL: 851.0125 MHz

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

FCC 90 LOWEST CHANNEL: 854.0125 MHz

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

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

TETRA 22 kHz bandwidth.

RSS-119 LOWEST CHANNEL: 851.0125 MHz

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

FCC 90 LOWEST CHANNEL: 854.0125 MHz

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

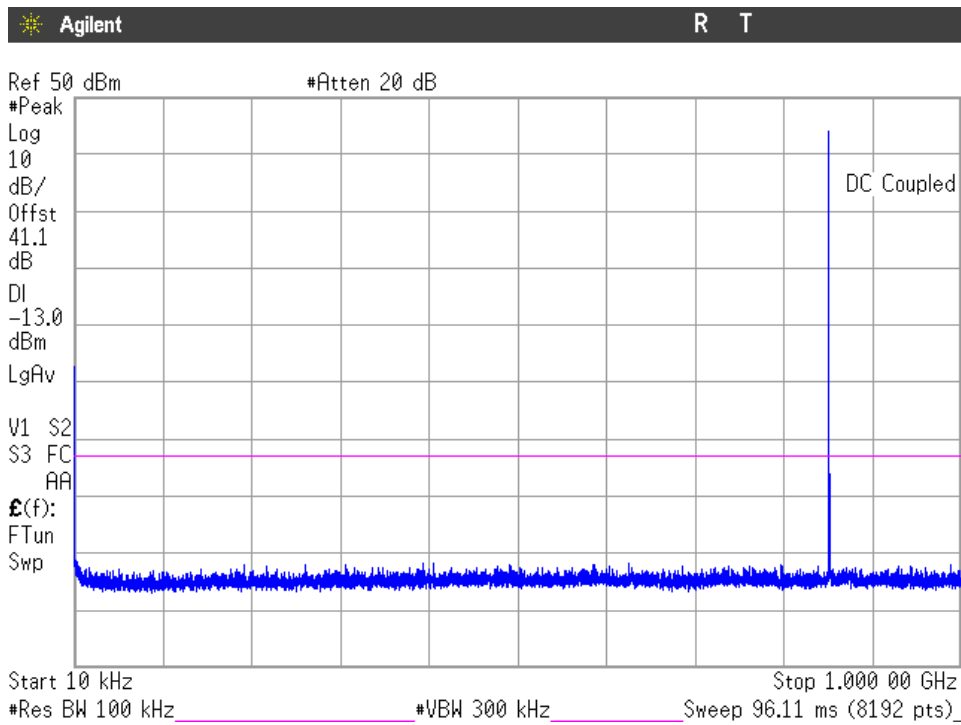
All peaks found are more than 20 dB below the limit.

| | |
|------------------------------|--------|
| Measurement uncertainty (dB) | <±2.03 |
|------------------------------|--------|

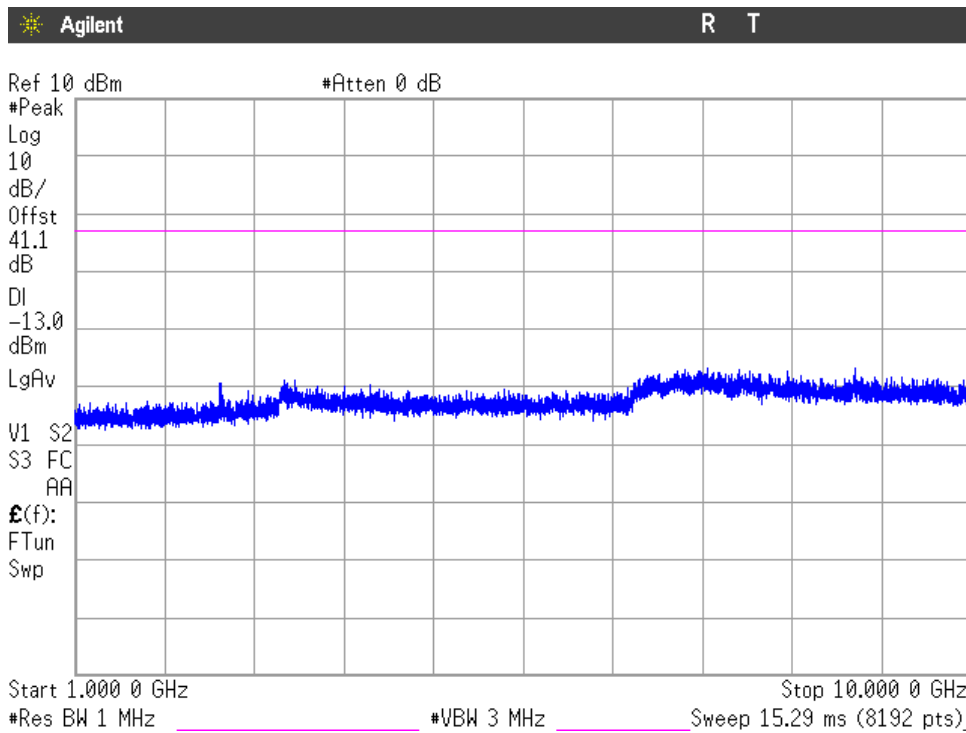
Verdict: PASS

TI D-LMR 20 kHz bandwidth.

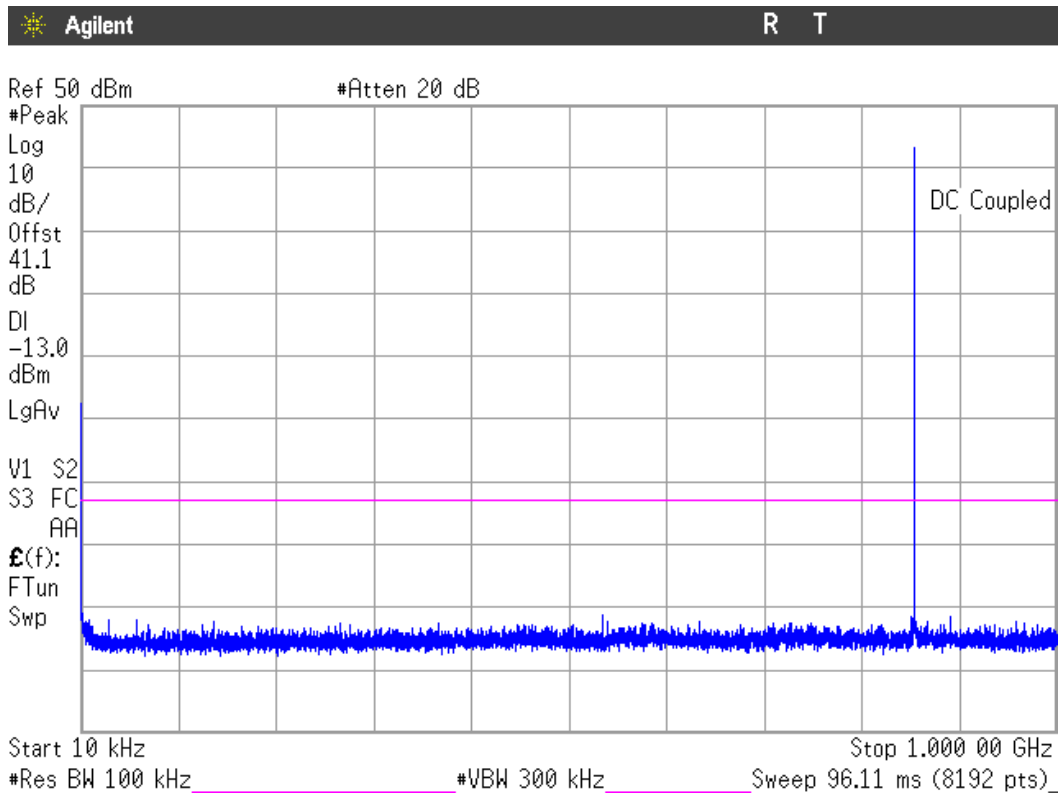
RSS-119 LOWEST CHANNEL: 851.0125 MHz



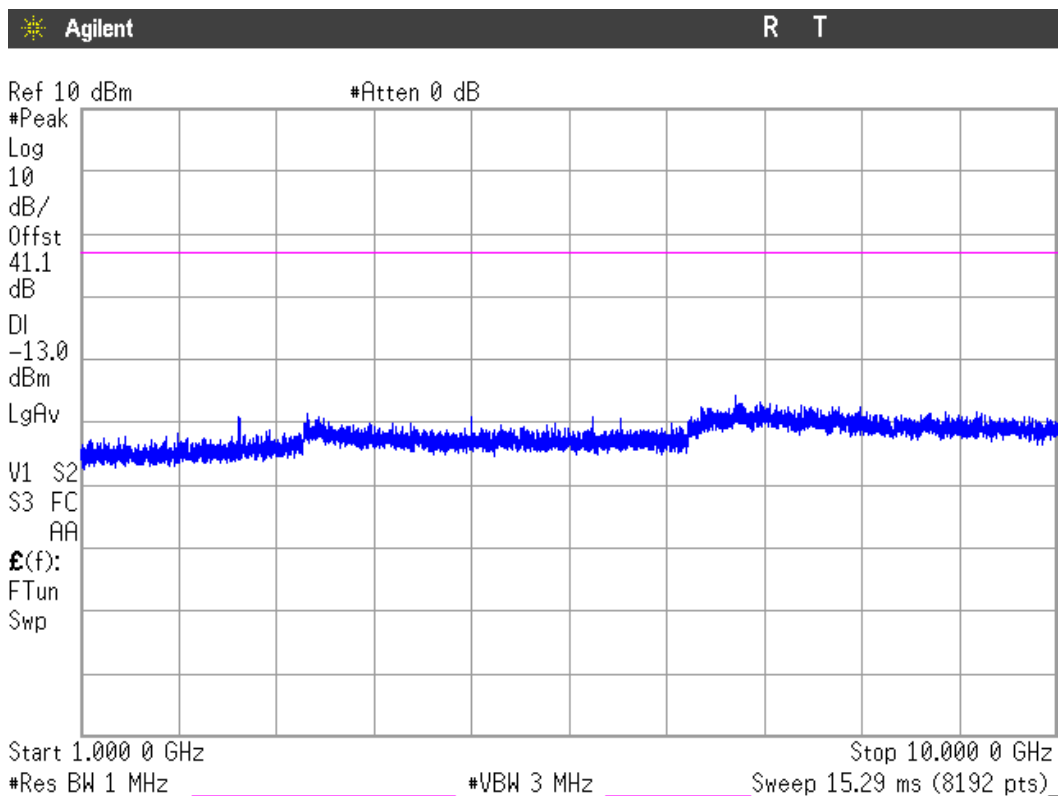
Note: The peak above the limit is the carrier frequency.



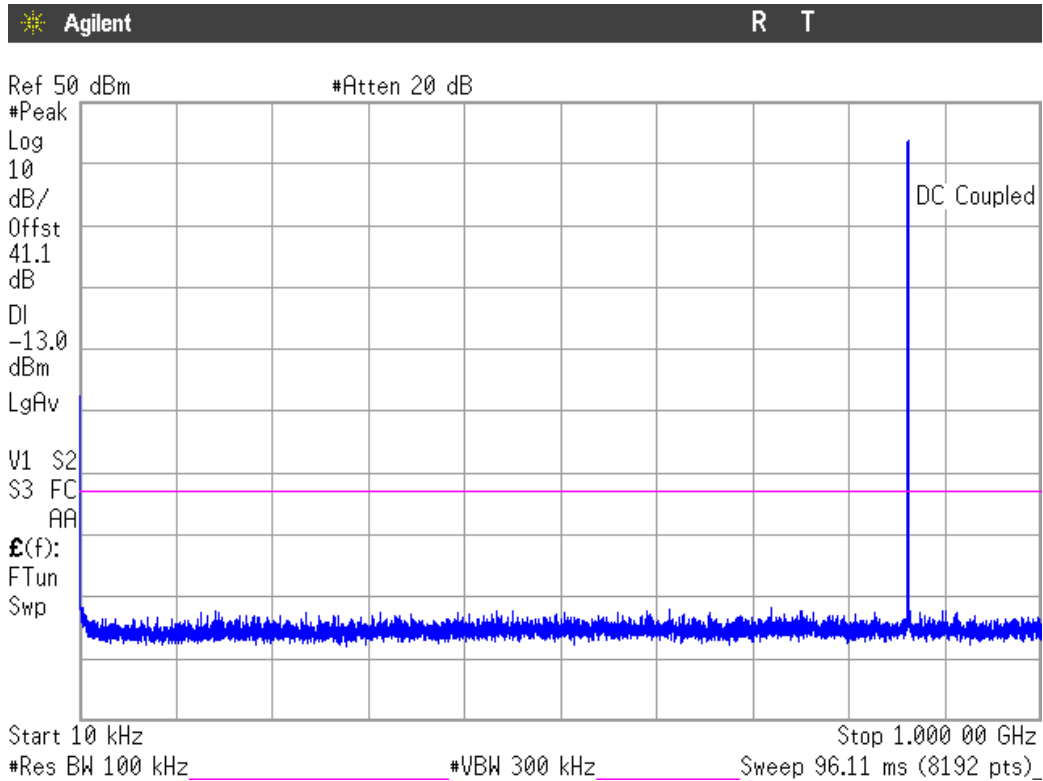
FCC 90 LOWEST CHANNEL: 854.0125 MHz



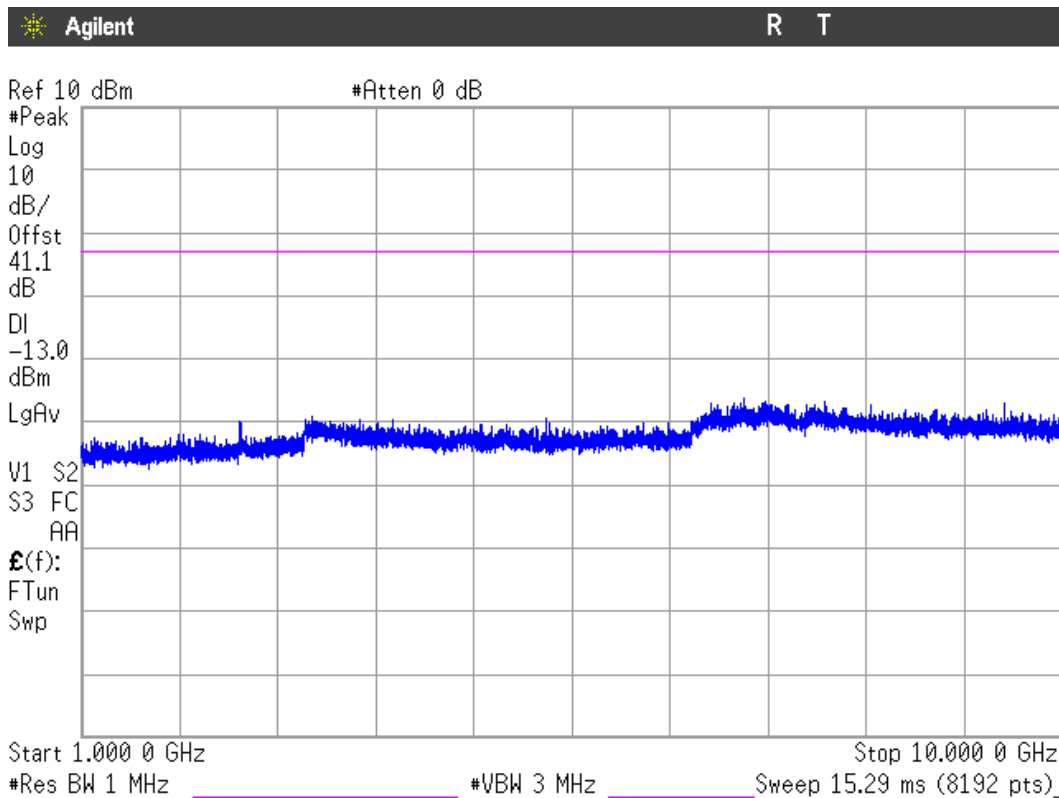
Note: The peak above the limit is the carrier frequency.



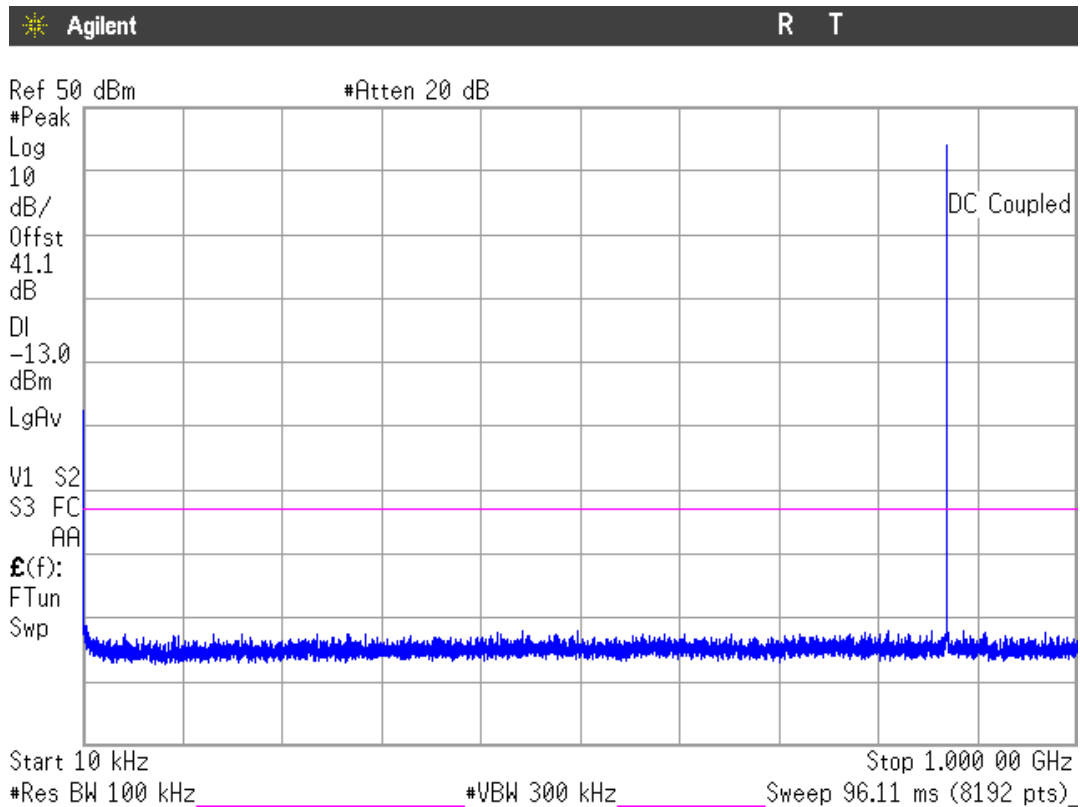
CHANNEL: MIDDLE



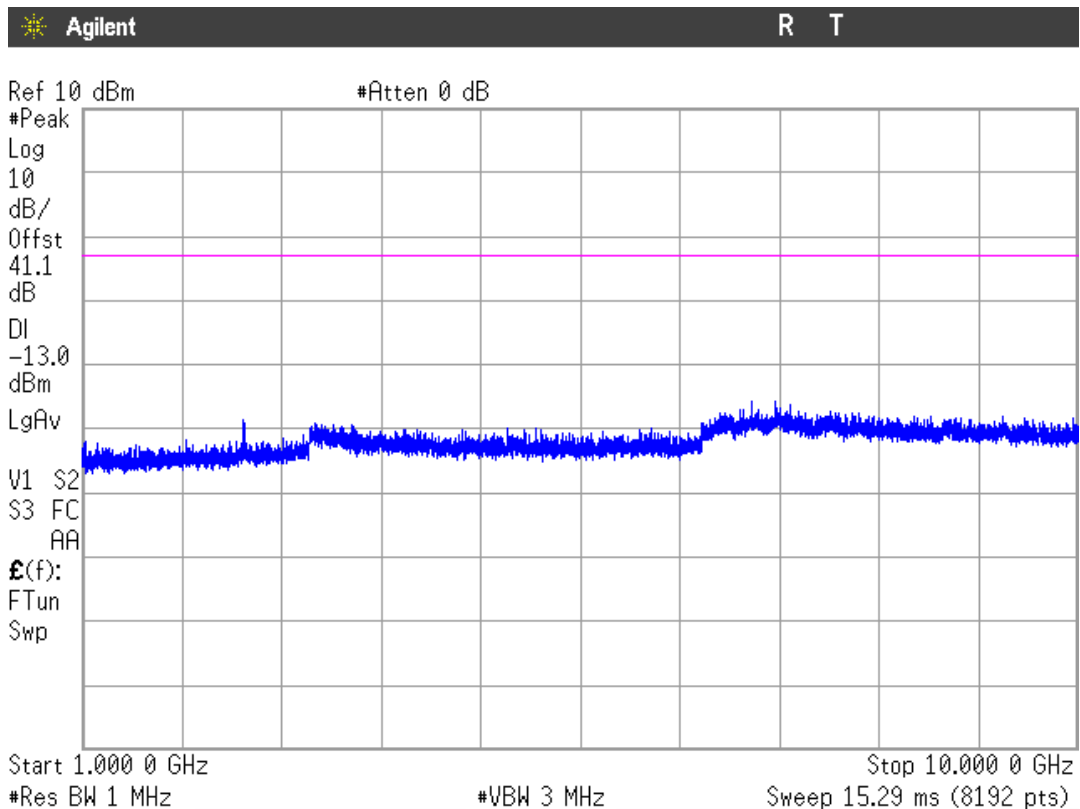
Note: The peak above the limit is the carrier frequency.



CHANNEL: HIGHEST

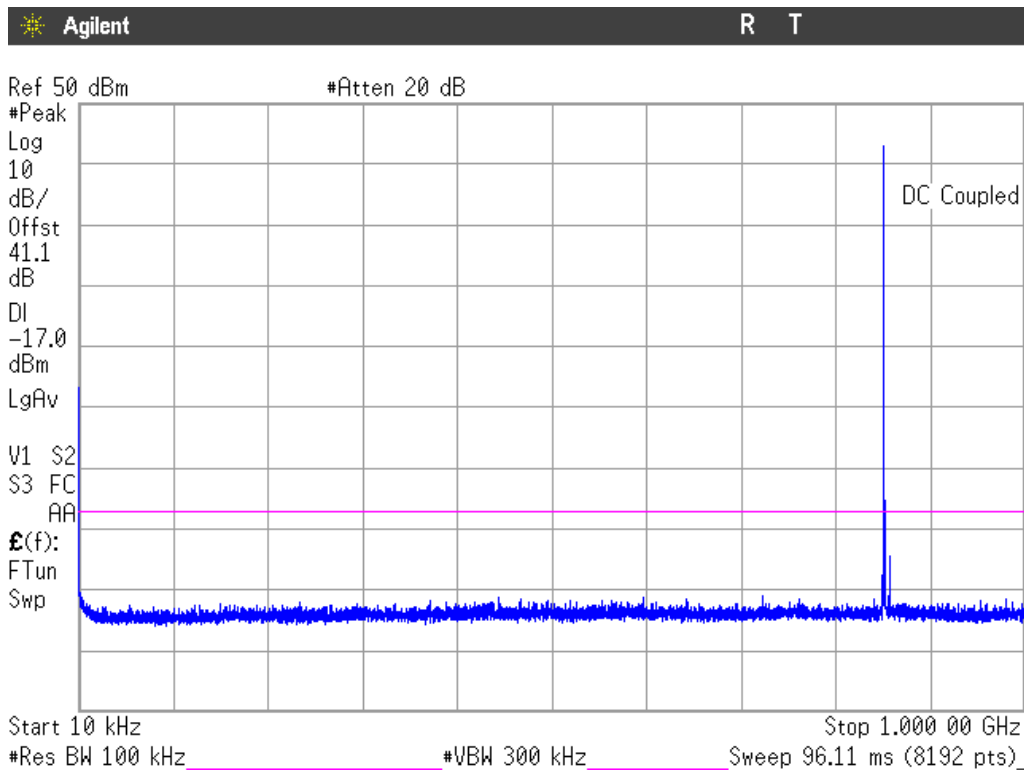


Note: The peak above the limit is the carrier frequency.

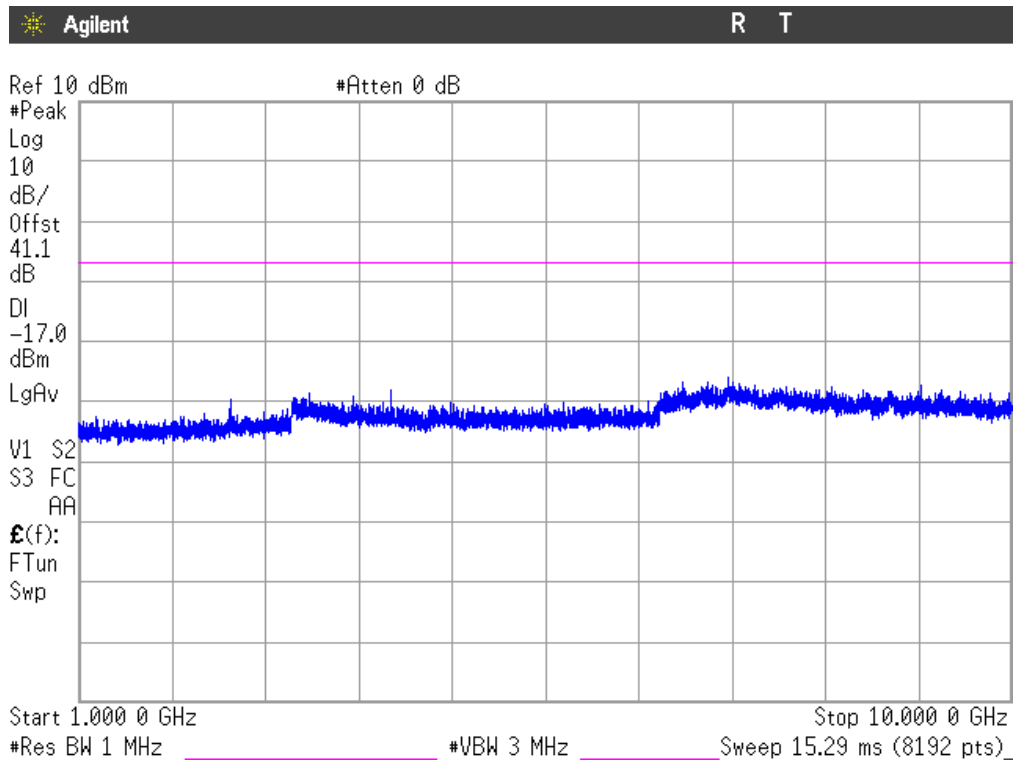


TETRA 22 kHz bandwidth.

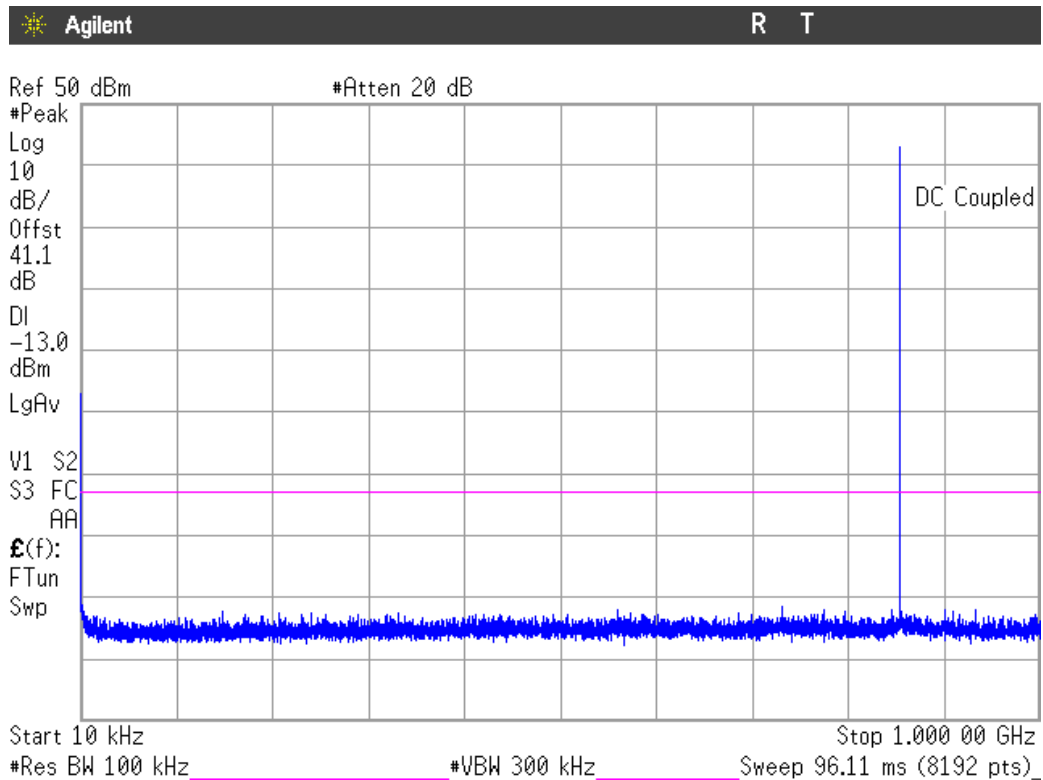
RSS-119 LOWEST CHANNEL: 851.0125 MHz



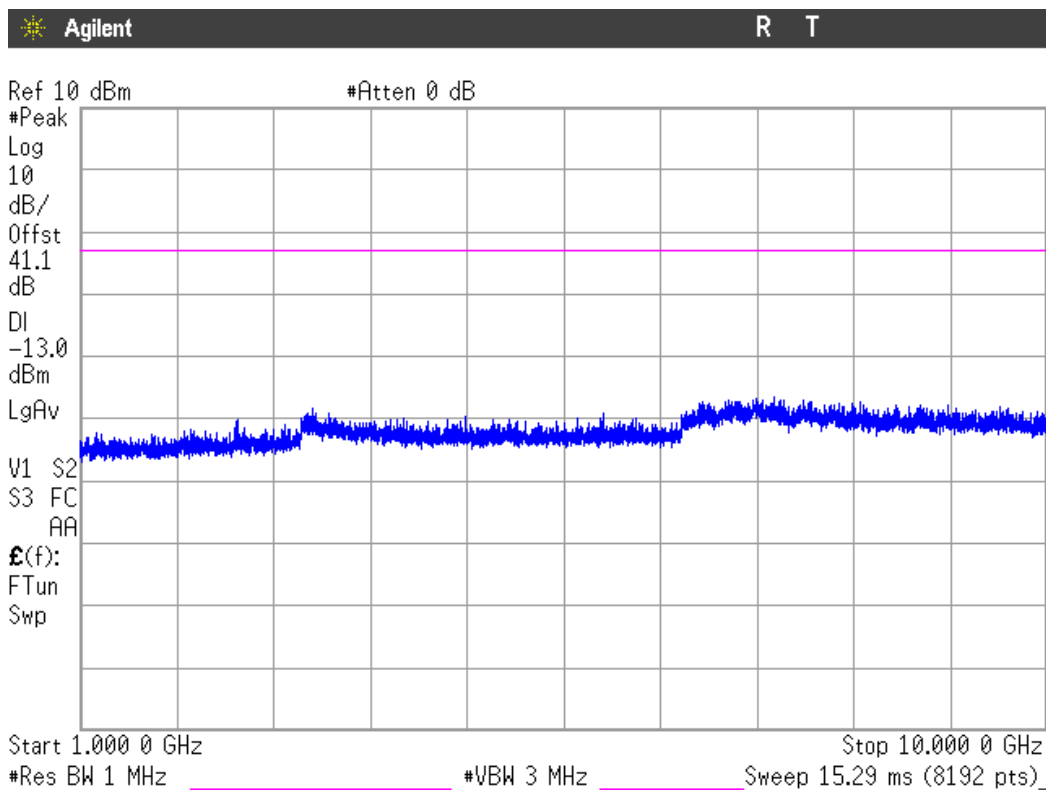
Note: The peak above the limit is the carrier frequency.



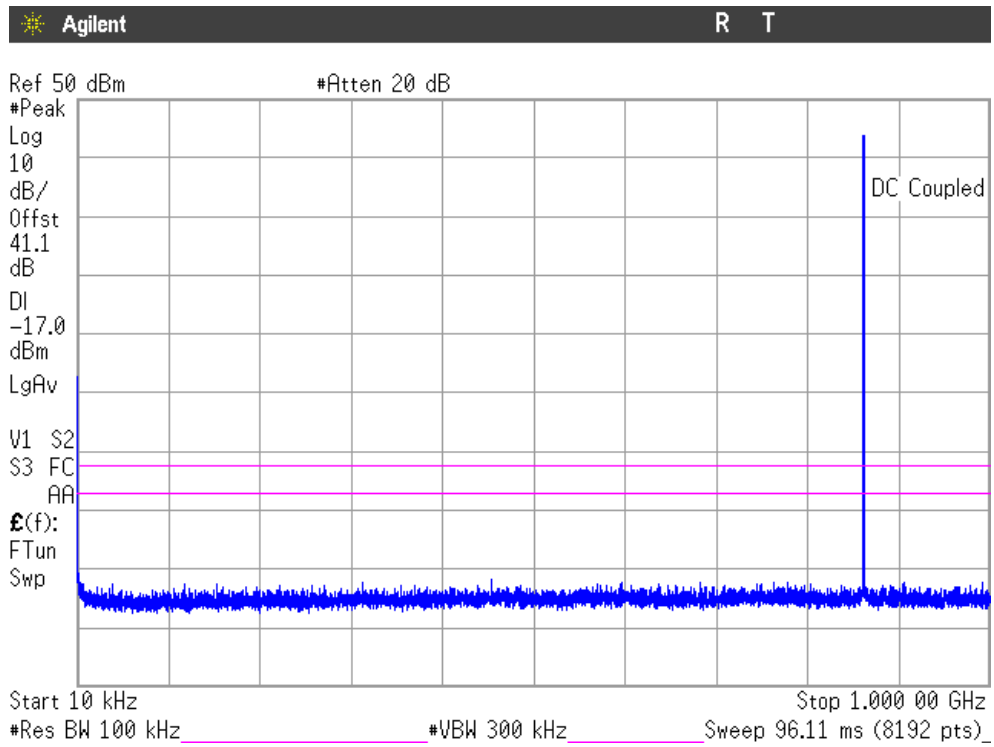
FCC 90 LOWEST CHANNEL: 854.0125 MHz



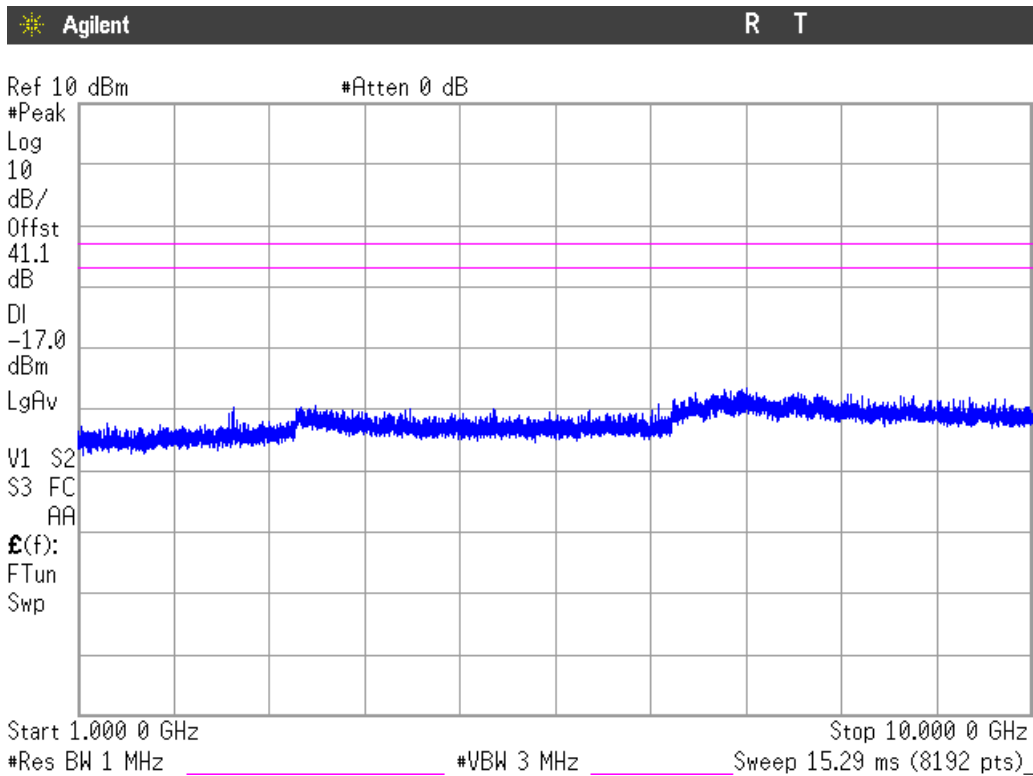
Note: The peak above the limit is the carrier frequency.



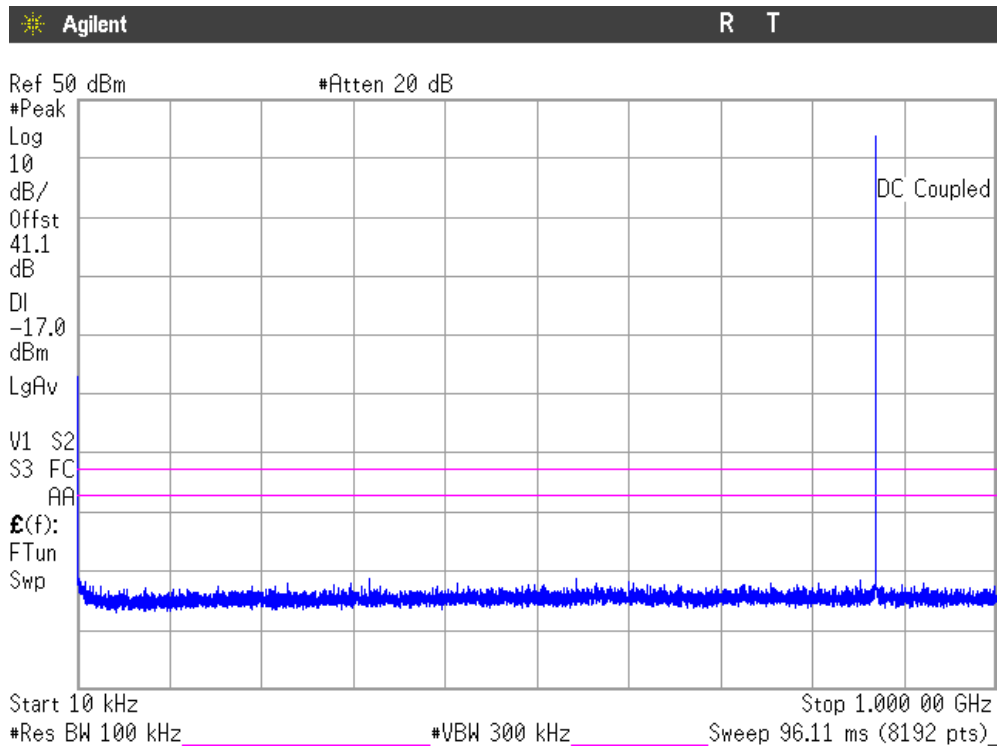
CHANNEL: MIDDLE



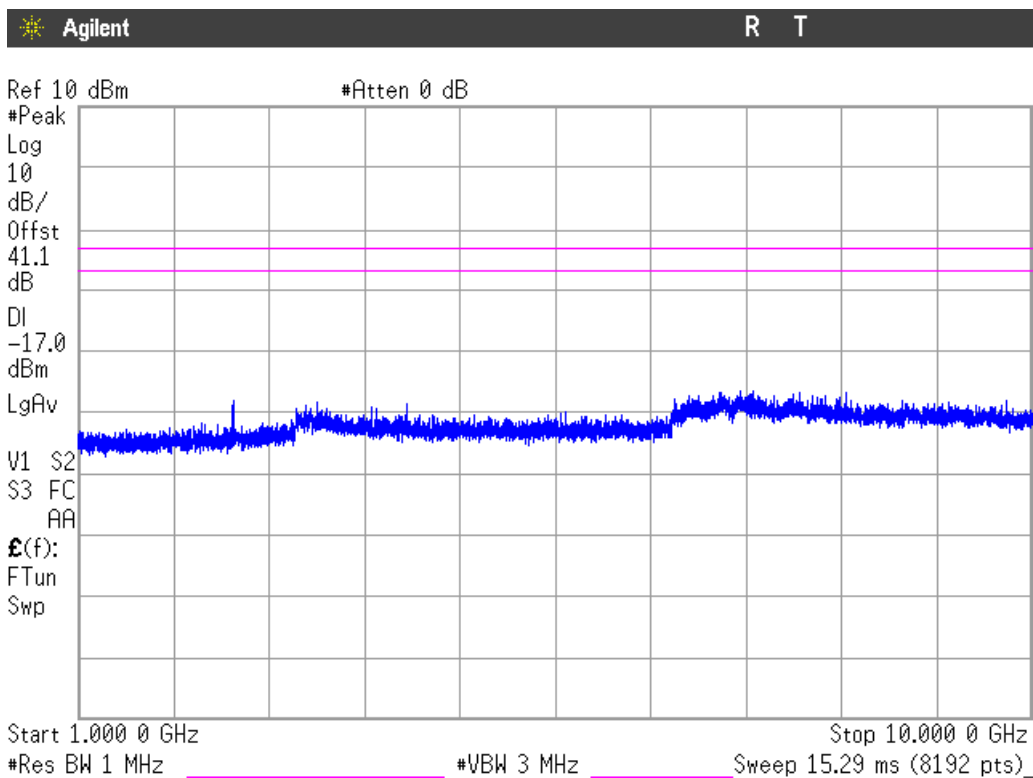
Note: The peak above the limit is the carrier frequency.



CHANNEL: HIGHEST



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



Radiated emissions

SPECIFICATION

FCC §2.1051, §90.210, §90.221, §90.691. 854–869 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.

Emission mask requirements for EA-based systems.

For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $43 + 10\text{Log}_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

Adjacent channel power limits.

On any frequency removed from the assigned frequency by more than 75 kHz, the attenuation of any emission must be at least $43 + 10 \log (P_{\text{watts}})$ dB.

RSS-119 Clause 5.8.

Table 10 - Emission Mask G

| Displacement Frequency, fd (kHz) | Minimum Attenuation (dB) | Resolution Bandwidth (Hz) |
|----------------------------------|--|----------------------------|
| $10 < fd \leq 50$ | whichever is the lesser attenuation: 70 or $116 \log_{10}(fd/6.11)$ or $50 + 10 \log_{10}(p)$ | 300 |
| $fd > 50$ | $43 + 10 \log_{10}(p)$ | Specified in Section 4.2.1 |

Table 17 - Emission Mask Y

| Displacement Frequency, fd (kHz) | Minimum Attenuation (dB) | Resolution Bandwidth (Hz) |
|----------------------------------|--|----------------------------|
| $12.375 < fd \leq 13.975$ | whichever is the lesser attenuation: $30 + 16.67(fd-12.375)$ or $55 + 10 \log_{10}(p)$ | Specified in Section 4.2.2 |
| $fd > 13.975$ | whichever is the lesser attenuation: 57 or $55 + 10 \log_{10}(p)$ | 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 power supply configuration and modulation mode.

Each detected emission is substituted by the Substitution method in accordance with the ANSI/TIA-603.

RESULTS

A preliminary scan determined the DC power supply and TI D-LMR 20 kHz mode as the worst case. The following tables and plots show the results for this configuration.

RSS-119 LOWEST CHANNEL: 851.0125 MHz

Highest spurious signals.

Substitution method data

| Frequency (GHz) | Instrument reading (dBm) | RBW (kHz) | Detector | Polarization | (1) Generator output (dBm) | (2) Cable loss (dB) | (3) Substitution antenna gain G_i (respect to isotropic radiator) (dB) | E.I.R.P. (dBm) = (1) – (2) + (3) |
|-----------------|--------------------------|-----------|----------|--------------|----------------------------|---------------------|--|----------------------------------|
| 2.55295 | -55.20 | 1000 | Peak | Vertical | -64.71 | 2.10 | 10.78 | -56.03 |

FCC 90 LOWEST CHANNEL: 854.0125 MHz

Highest spurious signals.

Substitution method data

| Frequency (GHz) | Instrument reading (dBm) | RBW (kHz) | Detector | Polarization | (1) Generator output (dBm) | (2) Cable loss (dB) | (3) Substitution antenna gain G_i (respect to isotropic radiator) (dB) | E.I.R.P. (dBm) = (1) – (2) + (3) |
|-----------------|--------------------------|-----------|----------|--------------|----------------------------|---------------------|--|----------------------------------|
| 1.70785 | -56.66 | 1000 | Peak | Vertical | -67.47 | 2.02 | 8.85 | -60.64 |
| 2.56195 | -56.61 | 1000 | Peak | Vertical | -66.10 | 2.10 | 10.80 | -57.40 |

2. CHANNEL: MIDDLE.

Highest spurious signals.

Substitution method data

| Frequency (GHz) | Instrument reading (dBm) | RBW (kHz) | Detector | Polarization | (1) Generator output (dBm) | (2) Cable loss (dB) | (3) Substitution antenna gain G_i (respect to isotropic radiator) (dB) | E.I.R.P. (dBm) = (1) – (2) + (3) |
|-----------------|--------------------------|-----------|----------|--------------|----------------------------|---------------------|--|----------------------------------|
| 1.10035 | -59.55 | 1000 | Peak | Vertical | -71.14 | 0.80 | 6.66 | -65.28 |
| 1.72315 | -56.55 | 1000 | Peak | Vertical | -67.34 | 2.05 | 8.90 | -60.48 |

3. CHANNEL: HIGHEST.

Highest spurious signals.

Substitution method data

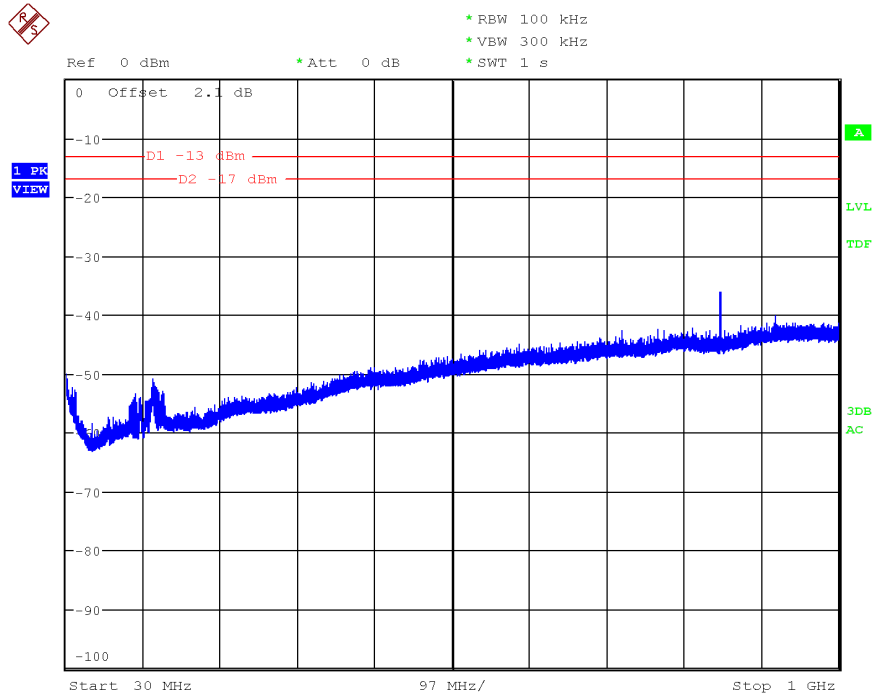
| Frequency (GHz) | Instrument reading (dBm) | RBW (kHz) | Detector | Polarization | (1) Generator output (dBm) | (2) Cable loss (dB) | (3) Substitution antenna gain G_i (respect to isotropic radiator) (dB) | E.I.R.P. (dBm) = (1) - (2) + (3) |
|-----------------|--------------------------|-----------|----------|--------------|----------------------------|---------------------|--|----------------------------------|
| 1.73815 | -57.63 | 1000 | Peak | Vertical | -68.40 | 2.08 | 8.96 | -61.52 |

| | |
|------------------------------|--|
| Measurement uncertainty (dB) | $< \pm 3.88$ for $f < 1$ GHz $< \pm 4.87$ for $f \geq 1$ GHz up to 18 GHz |
|------------------------------|--|

Verdict: PASS

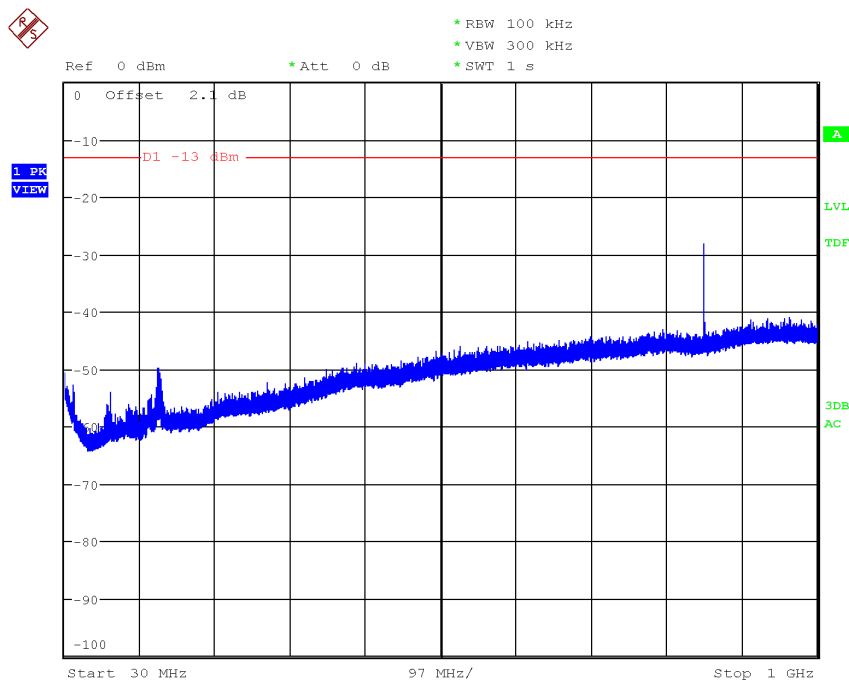
FREQUENCY RANGE 30 MHz-1000 MHz.

RSS-119 LOWEST CHANNEL: 851.0125 MHz



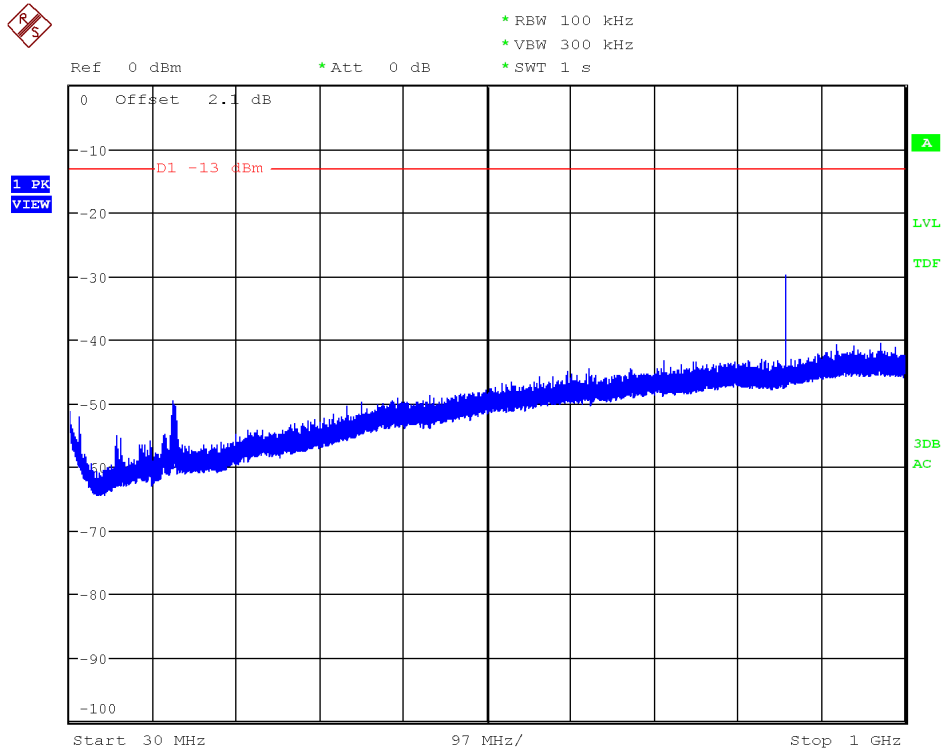
Note: The highest peak shown in the plot is the carrier frequency.

FCC 90 LOWEST CHANNEL: 854.0125 MHz



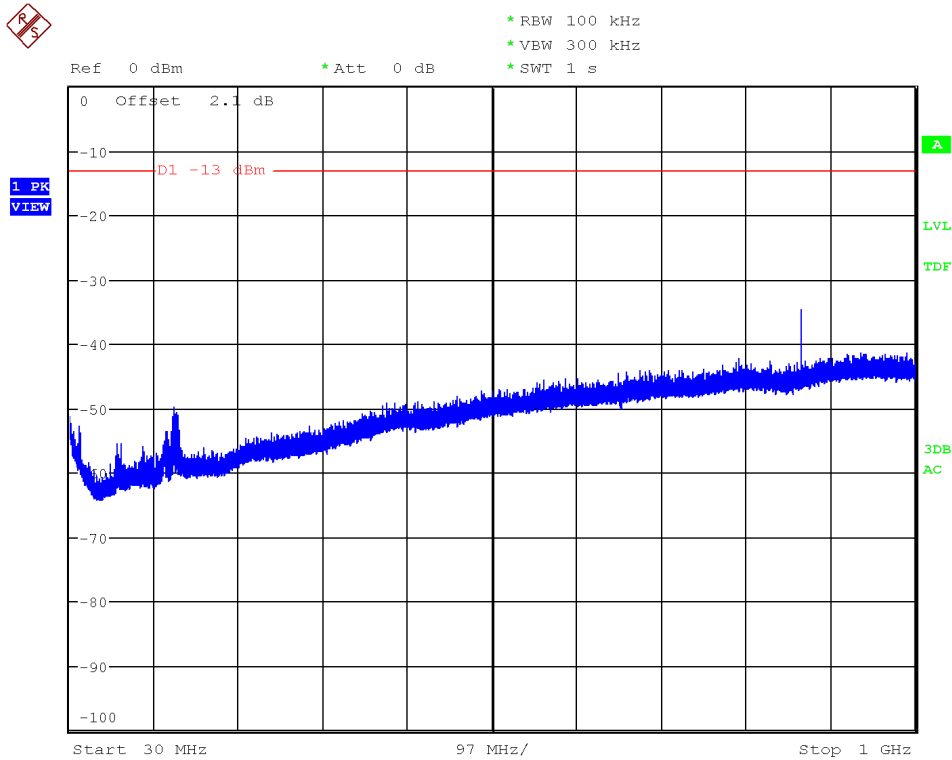
Note: The highest peak shown in the plot is the carrier frequency.

CHANNEL: MIDDLE.



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

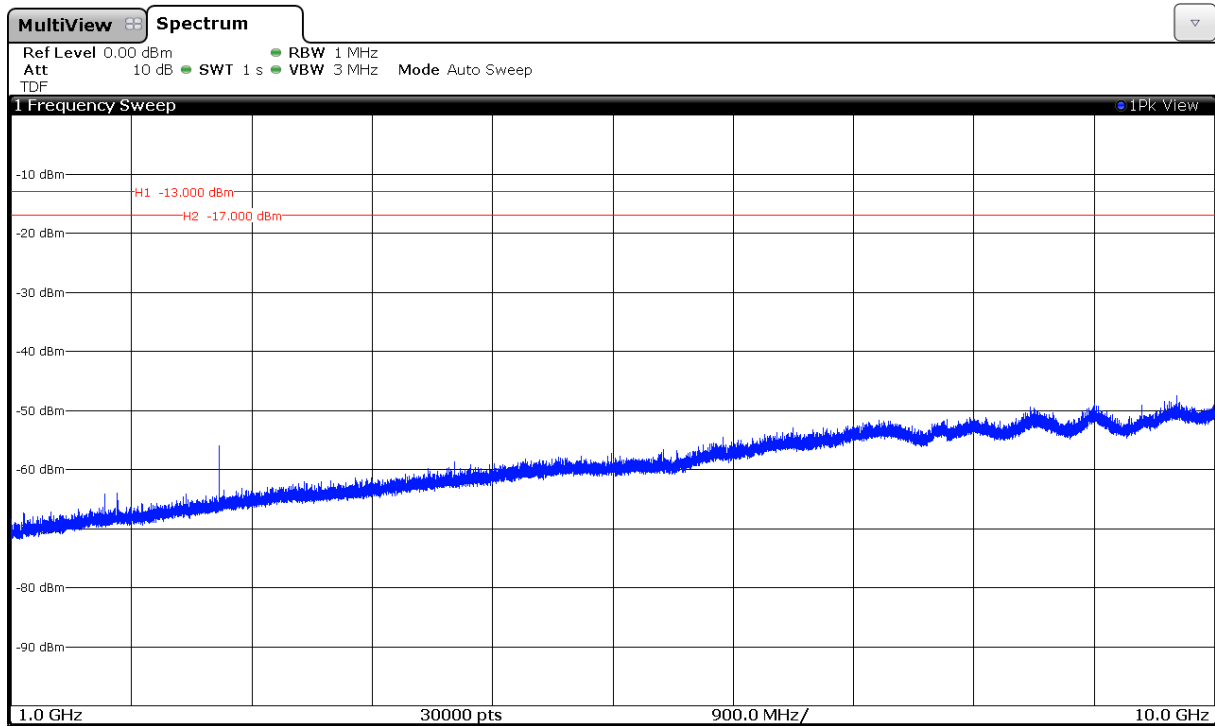
CHANNEL: HIGHEST.



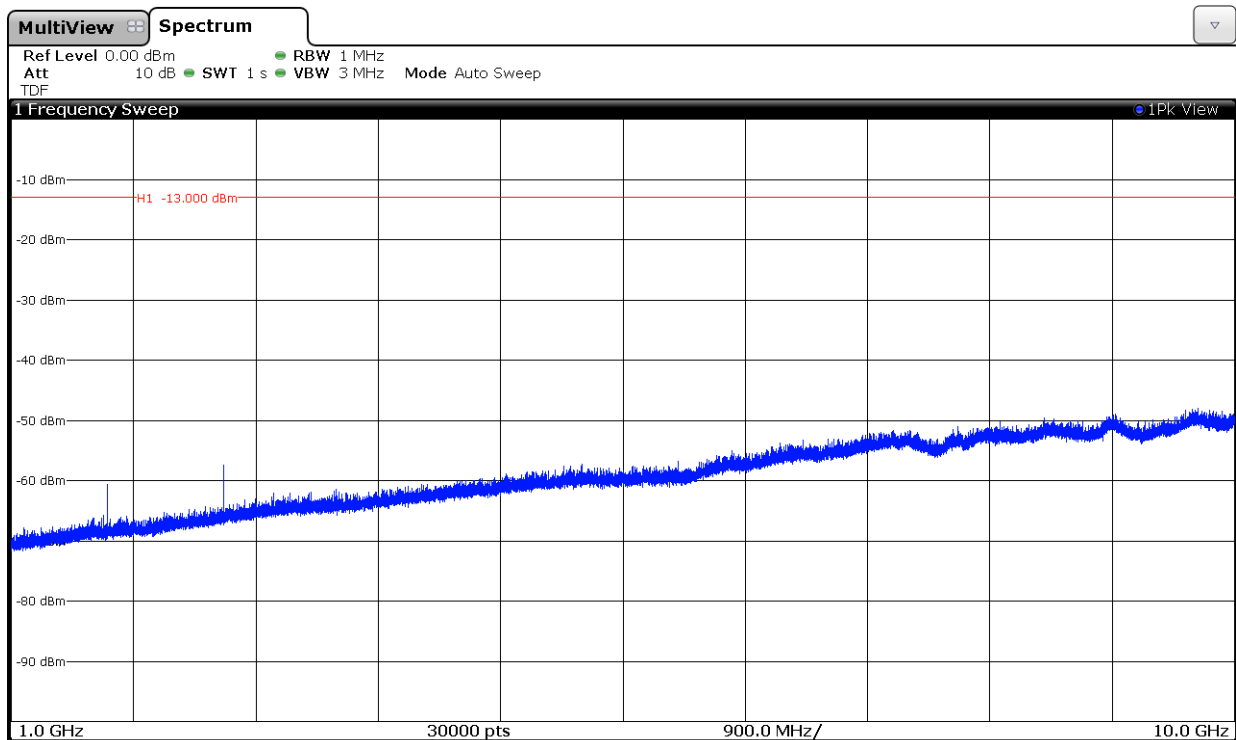
Note: The highest peak shown in the plot is the carrier frequency.

FREQUENCY RANGE 1 GHz to 10 GHz.

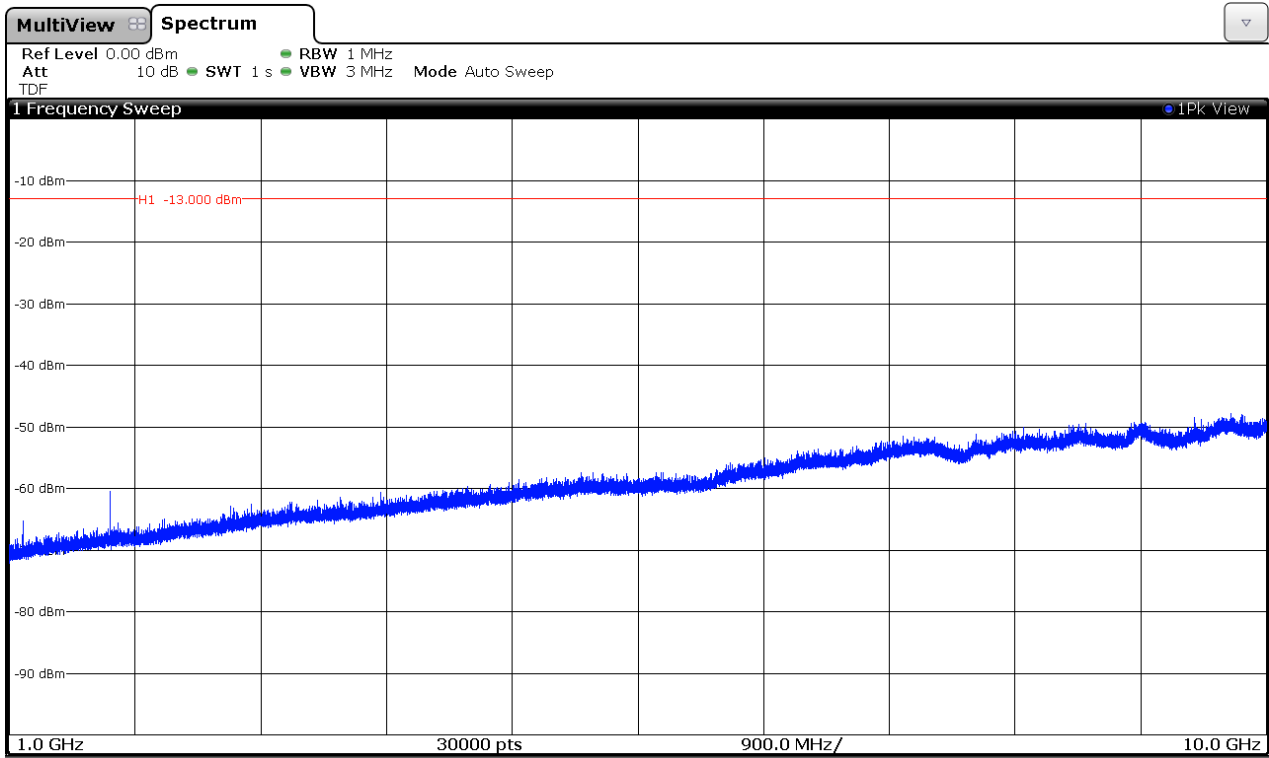
RSS-119 LOWEST CHANNEL: 851.0125 MHz



FCC 90 LOWEST CHANNEL: 854.0125 MHz



CHANNEL: MIDDLE.



CHANNEL: HIGHEST.

