FIELD STRENGTH OF SPURIOUS EMISSIONS

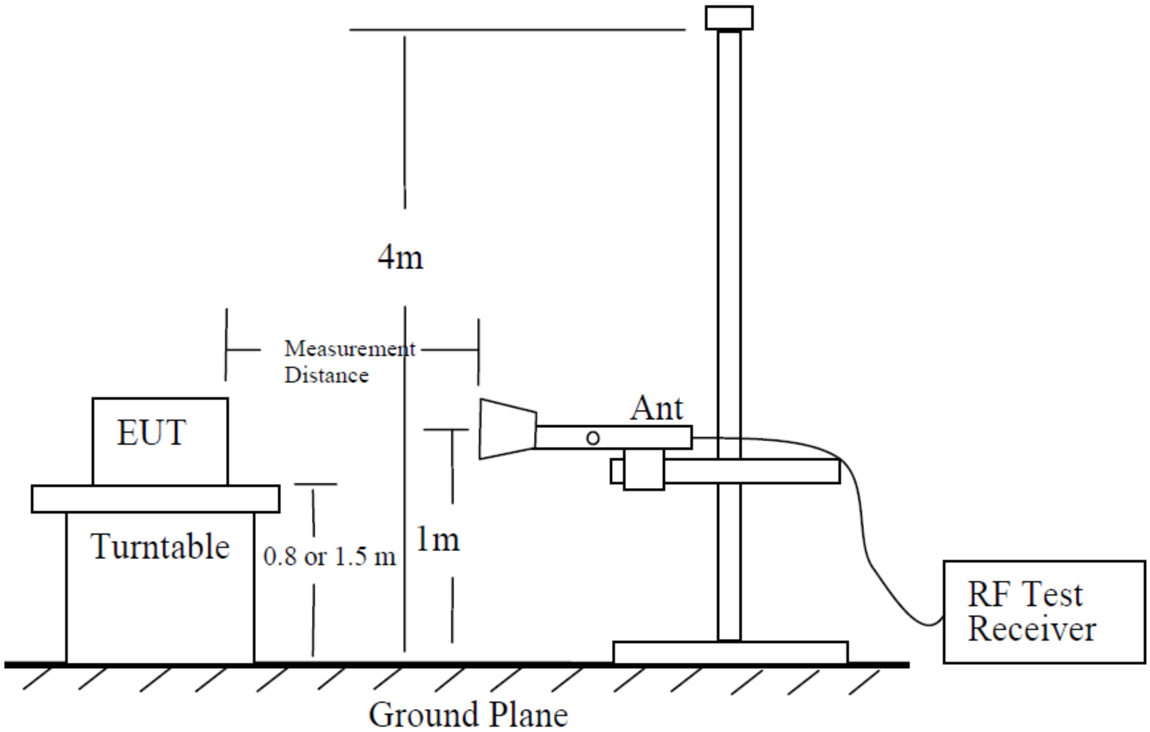

Figure 4 —Test set-up for radiated spurious measurements

Radiated unwanted emissions measurements shall be made over the frequency range specified in 5.1, dependent upon the relevant operational frequency band. These radiated measurements shall be made around the EUT (or alternatively, with the EUT rotated on a turntable), while varying the measurement antenna height and examining both horizontal and vertical polarization of the measurement antenna, as described above. Ordinarily, this will require the use of a turntable and an antenna positioner.

The EUT shall be set up in its typical configuration and arrangement and operated in its various modes of operation. Unless the EUT uses an integral antenna, the EUT shall be terminated with a non-radiating transmitter load. In cases where the EUT uses an adjustable antenna, the antenna shall be adjusted through typical positions and lengths to maximize emissions levels. EUTs with integral antennas shall be evaluated in their normal orientation. Where EUTs are designed to be installed in one of two distinct orientations, they shall be tested in both of their possible orientations. EUTs that can be operated in one of multiple orientations (e.g., handheld, portable, or modular devices) shall be tested in a minimum of three orientations. See Figure 5. When large antennas (e.g., high gain) or antennas not structurally supported by the EUT are utilized, a RF transparent supporting structure shall be used to facilitate the compliance testing. In all cases, the EUT, including the transmit antenna, shall be orientated such that the measurement of the emission is maximized.

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FIELD STRENGTH OF SPURIOUS EMISSIONS

Cables or wires inclusive to the EUT shall be configured so as to maximize the measured emission levels. The EUT controls shall also be adjusted to maximize the emission according to the manufacturer's specifications. The modulation applied shall be based on the guidance provided in the manufacturer's specifications. When necessary, field strength measurements shall be converted to ERP or EIRP for comparison to the applicable regulatory limits. See 5.2.7 for additional guidance.

5.5.2.3.2 Test arrangements for floor-standing EUTs

The floor standing EUT should be installed and tested as described in the manufactures instruction manual. If the installation methods are described for indoor and outdoor installations, one of the more typically used installation methods shall be tested. If the installation method provided in the manufacturer's instruction is not practical for testing, then EUT installation method provided in the latest edition of ANSI C63.4 may be used. The grounding of EUT must be achieved in accordance with manufacturer's instructions. However, if grounding studs are provided only at the top of EUT, grounding(s) of EUT may be achieved within 20 cm from the bottom of the EUT cabinet. Grounding of the EUT arbitrarily at middle of the cabinet is not allowed. The grounding material and size should be in accordance with manufacturer's instructions. Electromagnetically shielded ground wires shall not be used. If installation requires use of metal conduits for data, RF, and power cables, then typical or equivalent conduits may be used during the tests. The conduits should be elevated at least 1 cm above the ground plane and can be grounded only at the end of the conduit. All exposed cables shall be routed in accordance with latest edition of ANSI C63.4. The body of the loads connected to the RF ports should be electrically isolated from the cabinet or ground-plane. RF loads can be located outside the measurement area. Leakage radiation from the loads shall not overload the measurement receiver/analyzer.

5.5.2.4 Operational configurations

The EUT shall be tested while operating on the frequency per manufacturer specification. For EUTs that can operate on more than one frequency, unless otherwise specified, measurements shall be performed with the EUT transmitting on a frequency or frequencies as specified in 5.1 for each frequency band of operation.

a) Set the transmitter to operate in continuous transmit mode. For transmitters unable to be configured for ≥98% duty cycle even in a test mode, configure the system to transmit at the maximum duty cycle supported.

b) Compliance testing shall be performed with the minimum number of channels specified in 5.1 for each supported frequency band. A compliance test shall be performed on all channel sets supported by the EUT and permitted under the applicable regulatory requirements.

c) Compliance testing shall be performed for each supported frequency/channel using every available modulation supported by the transmitter, and at minimum and maximum data rate, in an effort to examine all possible combinations with the potential for producing the maximum emission amplitude. The test report shall clearly indicate how the various combinations were examined and a technical justification for any applied streamlining of test requirements. See 5.1.2.2 for guidance with regards to potential streamlined test requirement guidance.

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FIELD STRENGTH OF SPURIOUS EMISSIONS

5.5.2.5 Pre-scan testing

Exploratory radiated measurements (pre-scans) may be performed to determine the general EUT radiated emissions characteristics and, when necessary, the EUT-to-measurement antenna orientation that produces the maximum emission amplitude. Pre-scans shall only be used to determine the emission frequencies (i.e., not amplitude levels). The information garnered from a pre-scan can then be used to perform final compliance measurements using either the substitution or direct field strength method.

Pre-scan tests shall be performed following the test procedures provided in 5.5.2.3 and 5.5.2.4. When maximizing the emissions from the EUT for measurement, the EUT and its transmitting antenna(s) shall be rotated through 360°. For each mode of operation to be tested, the frequency spectrum (based on findings from exploratory measurements) shall be monitored.

5.5.4 Radiated measurement using the field strength method

5.5.4.1 General

Using the test configuration shown in Figure 6, measure the radiated emissions directly from the EUT and convert the measured field strength or received power to ERP or EIRP, as required, for comparison to the applicable limits. As stated in 5.5.1, the field strength measurement method using a test site validated to the requirements of ANSI C63.4 is an alternative to the substitution measurement method described in 5.5.3.

The test site shall satisfy the requirements in 4.6.3. The measurements shall be performed using the instrumentation specified in Clause 4, and using the common procedures in 5.5.2.

5.5.4.2 Radiated measurements for acquiring final compliance data

Final compliance data (i.e., data to be reported to the regulatory agency in support of an application for an equipment authorization) shall be collected in accordance with the procedures provided in 5.5.2, with the EUT transmitting for each frequency specified in 5.1.2. The emission characteristics of the EUT can be identified from the pre-scan measurement information obtained as specified in 5.5.2.5. Final measurements shall be performed for the worst case combination(s) of variable technical parameters that result in the maximum measured emission amplitude as per the guidelines provided in 5.1.2. For each mode selected, record the frequency and amplitude of the highest fundamental emission (if applicable), and the frequency and amplitude data for the six highest-amplitude spurious emissions.

When reduced measurement distances or higher gain antennas are used in the measurement, a far-field measurement distance relationship and measurement antenna beamwidth coverage of the EUT must be maintained. When preamplifiers are used to improve the measurement system noise floor, overload protection shall be ensured (see guidance in 4.2). Any deviations from the specific measurement conditions or requirements shall be fully described in the test report.

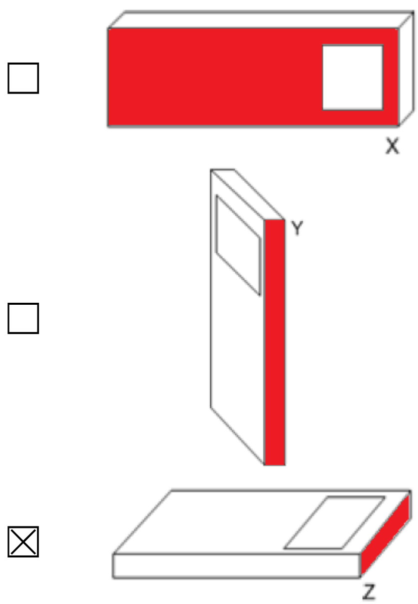
See 5.5.2.5 and/or Annex C for guidance on converting measured field strength or received power data to ERP or EIRP, as applicable, for comparison with the applicable regulatory limits.

FIELD STRENGTH OF SPURIOUS EMISSIONS

5.5.5 Recording test results

A minimum of six data points representing the highest identified unwanted emission amplitude levels revelant to the limit and associated frequencies must be included in the test report. This information shall be reported in a combination of both plots and tabular data as necessary to demonstrate compliance to the applicable technical requirement(s). When multiple operating modes are evaluated, only the "worst case" plots for each mode in each operating band need to be provided in the test report, along with an explanation and technical rationale supporting the identification of the "worst case." Test set-up photos shall be included and shall be of a sufficient quantity and detail as to allow for replication of the tests (i.e., a single photograph made from several meters away from the EUT is typically not sufficient). Data content and format shall conform to the requirements specified in Clause 8. While it is recognized that a graphical format is not applicable to final tests that utilize the traditional two-stage substitution measurement for every emission, graph(s) of preliminary swept measurement(s) that identify the emissions to be measured during final testing shall be presented in the report.

Worst-Case EUT Orientation



KDB 935210 4.9 SPURIOUS EMISSION RADIATED MEASUREMENTS

This measurement is intended to produce test data necessary to demonstrate compliance to the radiated spurious emission requirements specified in Section 2.1053 of the FCC rules. This test is intended to capture any emissions that radiate directly from the case, cabinet, control circuits, etc., instead of via the antenna output port, and thus would not be captured in conducted spurious emission measurements. See KDB Publication 971168 [R8] for measurement procedure guidance.

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2.1055 FREQUENCY STABILITY

§2.1055 Measurements required: Frequency stability.

(a) The frequency stability shall be measured with variation of ambient temperature as follows:

☐ (1) From −30° to + 50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.

☐ (2) From −20° to + 50° centigrade for equipment to be licensed for use in the Maritime Services under part 80 of this chapter, except for Class A, B, and S Emergency Position Indicating Radiobeacons (EPIRBS), and equipment to be licensed for use above 952 MHz at operational fixed stations in all services, stations in the Local Television Transmission Service and Point-to-Point Microwave Radio Service under part 21 of this chapter, equipment licensed for use aboard aircraft in the Aviation Services under part 87 of this chapter, and equipment authorized for use in the Family Radio Service under part 95 of this chapter.

☐ (3) From 0° to + 50° centigrade for equipment to be licensed for use in the Radio Broadcast Services under part 73 of this chapter.

(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

☐ (c) In addition to all other requirements of this section, the following information is required for equipment incorporating heater type crystal oscillators to be used in mobile stations, for which type acceptance is first requested after March 25, 1974, except for battery powered, hand carried, portable equipment having less than 3 watts mean output power.

(1) Measurement data showing variation in transmitter output frequency from a cold start and the elapsed time necessary for the frequency to stabilize within the applicable tolerance. Tests shall be made after temperature stabilization at each of the ambient temperature levels; the lower temperature limit, 0° centigrade and + 30° centigrade with no primary power applied.

(2) Beginning at each temperature level specified in paragraph (c)(1) of this section, the frequency shall be measured within one minute after application of primary power to the transmitter and at intervals of no more than one minute thereafter until ten minutes have elapsed or until sufficient measurements are obtained to indicate clearly that the frequency has stabilized within the applicable tolerance, whichever time period is greater. During each test, the ambient temperature shall not be allowed to rise more than 10° centigrade above the respective beginning ambient temperature level.

(3) The elapsed time necessary for the frequency to stabilize within the applicable tolerance from each beginning ambient temperature level as determined from the tests specified in this paragraph shall be specified in the instruction book for the transmitter furnished to the user.

(4) When it is impracticable to subject the complete transmitter to this test because of its physical dimensions or power rating, only its frequency determining and stabilizing portions need be tested.

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FREQUENCY STABILITY

(d) The frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

(e) When deemed necessary, the Commission may require tests of frequency stability under conditions in addition to those specifically set out in paragraphs (a), (b), (c), and (d) of this section. (For example measurements showing the effect of proximity to large metal objects, or of various types of antennas, may be required for portable equipment.)

KDB 935210 4.8 FREQUENCY STABILITY

Section 90.219(e)(4)(i) requires that a signal being retransmitted by an amplifier, repeater, or industrial booster meets the frequency stability requirements of Section 90.213. However, this requirement presumes that the EUT processes an input signal in ways that can influence the output signal frequency/frequencies; however, most signal boosters do not incorporate an oscillator). If the amplifier, booster, or repeater does not alter the input signal in any way, then a frequency stability test may not be required.

When performing frequency stability measurements on these types of devices, the instability associated with the EUT must be isolated from any frequency instability associated with the measurement instrumentation. One method for realizing such isolation is to connect the reference clock input of the signal generator to the reference output of the frequency counter, to confirm that any frequency instability is associated with the EUT, and is not due to differences between the reference oscillators internal to the measurement instrumentation.

90.213 FREQUENCY STABILITY

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

(b) For the purpose of determining the frequency stability limits, the power of a transmitter is considered to be the maximum rated output power as specified by the manufacturer.

Applies to EUT	Frequency range (MHz)	Fixed and base stations (ppm)	Mobile stations > 2 watts output power (ppm)	Mobile stations ≤ 2 watts output power (ppm)
☐	150 - 174	[5 11] 1 / 2.5 / 5	[6] 2 / 5	[4 6] 2 / 5 / 50

[4]Stations operating in the 154.45 to 154.49 MHz or the 173.2 to 173.4 MHz bands must have a frequency stability of 5 ppm.

[5]In the 150-174 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.

[6]In the 150-174 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth or designed to operate on a frequency specifically designated for itinerant use or designed for low-power operation of two watts or less, must have a frequency stability of 5.0 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 2.0 ppm.

[11]Paging transmitters operating on paging-only frequencies must operate with frequency stability of 5 ppm in the 150-174 MHz band and 2.5 ppm in the 421-512 MHz band.

FREQUENCY STABILITY

22.355 FREQUENCY TOLERANCE

Except as otherwise provided in this part, the carrier frequency of each transmitter in the Public Mobile Services must be maintained within the tolerances given in Table C-1 of this section.

TABLE C-1—FREQUENCY TOLERANCE FOR TRANSMITTERS IN THE PUBLIC MOBILE SERVICES

Applies to EUT	Frequency range (MHz)	Fixed and base stations (ppm)	Mobile stations > 3 watts output power (ppm)	Mobile stations ≤ 3 watts output power (ppm)
☐	50 450	5	5	50

FREQUENCY STABILITY

Test Procedure: ANSI C63.26 S 5.6.3

5.6.3 Procedure for frequency stability testing

Frequency stability is a measure of the frequency drift due to temperature and supply voltage variations, with reference to the frequency measured at +20 °C and rated supply voltage.

The operating carrier frequency shall be set up in accordance with the manufacturer's published operation and instruction manual prior to the commencement of these tests. No adjustment of any frequency determining circuit element shall be made subsequent to this initial set-up. Frequency stability is tested:

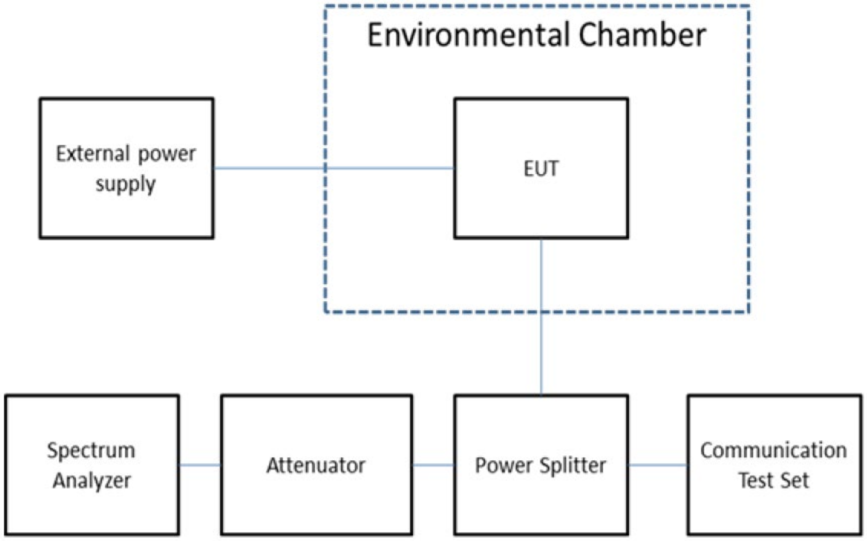
a) At 10 °C intervals of temperatures between −30 °C and +50 °C at the manufacturer's rated supply voltage, and

b) At +20 °C temperature and ±15% supply voltage variations. If a product is specified to operate over a range of input voltage then the −15% variation is applied to the lowermost voltage and the +15% is applied to the uppermost voltage.

During the test all necessary settings, adjustments and control of the EUT have to be performed without disturbing the test environment, i.e., without opening the environmental chamber. The frequency stabilities can be maintained to a lesser temperature range provided that the transmitter is automatically inhibited from operating outside the lesser temperature range. For handheld equipment that is only capable of operating from internal batteries and the supply voltage cannot be varied, the frequency stability tests shall be performed at the nominal battery voltage and the battery end point voltage specified by the manufacturer. An external supply voltage can be used and set at the internal battery nominal voltage, and again at the battery operating end point voltage which shall be specified by the equipment manufacturer.

If an unmodulated carrier is not available, the mean frequency of a modulated carrier can be obtained by using a frequency counter with gating time set to an appropriately large multiple of bit periods (gating time depending on the required accuracy). Full details on the choice of values shall be included in the test report.

Test Setup Block Diagram:



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90.214 TRANSIENT FREQUENCY RESPONSE

§90.214 Transient frequency behavior.

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:

150 - 174 MHz, 25 kHz Channel, 12.5 kHz Channel, & 6.25 kHz Channel			
Time intervals [1] [2]	t_1[4]	t_2	t_3[4]
Length (ms)	5 ms	20 ms	5 ms
Maximum Frequency Difference [3]	±1 Ch.	±0.5 Ch.	±1 Ch.

[1] $_{on}$ 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.

STATEMENT OF MEASUREMENT UNCERTAINTY

The data and results referenced in this document are true and accurate. The measurement uncertainty was calculated for all measurements listed in this test report according To CISPR 16–4 or EN TR 100-028 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: "Uncertainty in EMC Measurements" and is documented in the Timco Engineering, Inc. quality system according to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Timco Engineering, Inc. is reported:

Test Items	Measurement Uncertainty	Notes
TR 100 028 PARAGRAPH 7.1.1 – FREQUENCY ERROR < 30 MHz	± 0.063 ppm	(1)
TR 100 028 PARAGRAPH 7.1.1 - FREQUENCY ERROR < 200 MHz	± 0.051 ppm	(1)
TR 100 028 PARAGRAPH 7.1.1 - FREQUENCY ERROR < 1 GHz	± 0.051 ppm	(1)
TR 100 028 PARAGRAPH 7.1.1 - FREQUENCY ERROR ≤ 18 GHz	± 0.051 ppm	(1)
TR 100 028 PARAGRAPH 7.1.1 - FREQUENCY ERROR ≤ 40 GHz	± 0.051 ppm	(1)
TR 100 028 PARAGRAPH 7.1.2 - CONDUCTED POWER MEASUREMENT	±0.643 dB	(1)
TR 100 028 PARAGRAPH 7.1.4.1 - CONDUCTED SPURIOUS EMISSIONS 9 kHz – 150 kHz	± 3.14 dB	(1)
TR 100 028 PARAGRAPH 7.1.4.1 - CONDUCTED SPURIOUS EMISSIONS 150 kHz – 30 MHz	± 3.08 dB	(1)
TR 100 028 PARAGRAPH 7.2 – RADIATED EMISSIONS < 200 MHz	± 2.16 dB	(1)
TR 100 028 PARAGRAPH 7.2 – RADIATED EMISSIONS < 1 GHz	± 2.15 dB	(1)
TR 100 028 PARAGRAPH 7.2 – RADIATED EMISSIONS < 18 GHz	± 2.14 dB	(1)
TR 100 028 PARAGRAPH 7.2 – RADIATED EMISSIONS ≤ 40 GHz	± 2.31 dB	(1)
FLUKE Multimeter AC Voltage Uncertainty	± 2.263 %	(1)
FLUKE Multimeter DC Voltage Uncertainty	± 0.453 %	(1)
Temperature (C°)	± 0.81 C°	

Notes: (1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=1.96.

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EMC EQUIPMENT LIST

Device	Manufacturer	Model	SN	Calibration Date	Cal Due Date
Function Generator	Standford	DS340	25200	02/21/18	02/21/20
Modulation Analyzer	HP	8901A	3050A05856	04/13/17	04/13/20
Audio Analyzer	HP	8903B	3011A13084	02/20/18	02/20/20
EMI Test Receiver R & S ESIB 40 firmware v 4.34.3 BIOS v3.3	Rohde & Schwarz	ESIB 40	100274	07/22/19	07/22/21
EMI Test Receiver R & S ESU 40 firmware v 4.43 SP 3 BIOS v5.1-24-3	Rohde & Schwarz	ESU 40	100320	08/28/18	08/28/20
Software: Field Strength Program	Timco	N/A	Version 4.10.7.0	N/A	N/A
Coaxial Cable - Chamber 3 cable set (backup)	Micro-Coax	Chamber 3 cable set (backup)	KMKM-0244-02 KMKM-0670-01 KFKF-0197-00	02/27/19	02/27/21
CHAMBER	Panashield	3M	N/A	03/15/19	03/15/21
Antenna: Active Loop	ETS-Lindgren	6502	00062529	12/11/17	12/11/19
Antenna: Biconical 1096	Eaton	94455-1	1096	08/01/17	08/01/19
Antenna: Log-Periodic 1122	Electro-Metrics	LPA-25	1122	07/26/17	07/26/19
Ant: Double-Ridged Horn/ETS Horn 1	ETS-Lindgren	3117	00035923	01/30/17	01/30/19
Temperature Chamber LARGE	Tenney Engineering	TTRC	11717-7	N/A	N/A
Type K J Thermometer	Martel	303	080504494	11/06/17	11/06/20
Oscilloscope	LeCroy	LT364	00414	03/28/19	03/28/21

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ANNEX I – MANUFACTURER-PROVIDED INFORMATION

Note: The accuracy and precision of the following information provided by the manufacturer of the equipment under test has not been verified using test methods, cannot be verified, or is not necessary to verify.

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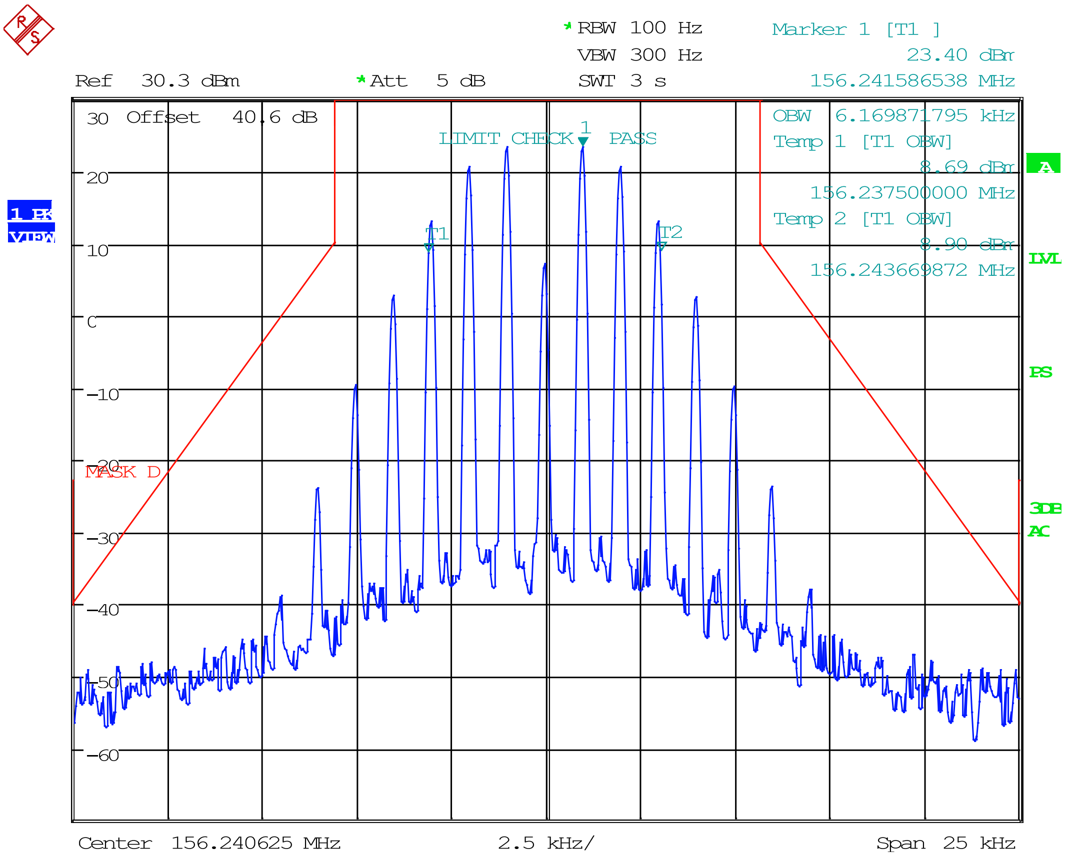
ANNEX II – MEASUREMENT DATA

KDB 935210 4.1 INPUT SIGNALS

FM INPUT SIGNAL

OBW = 6.170 kHz

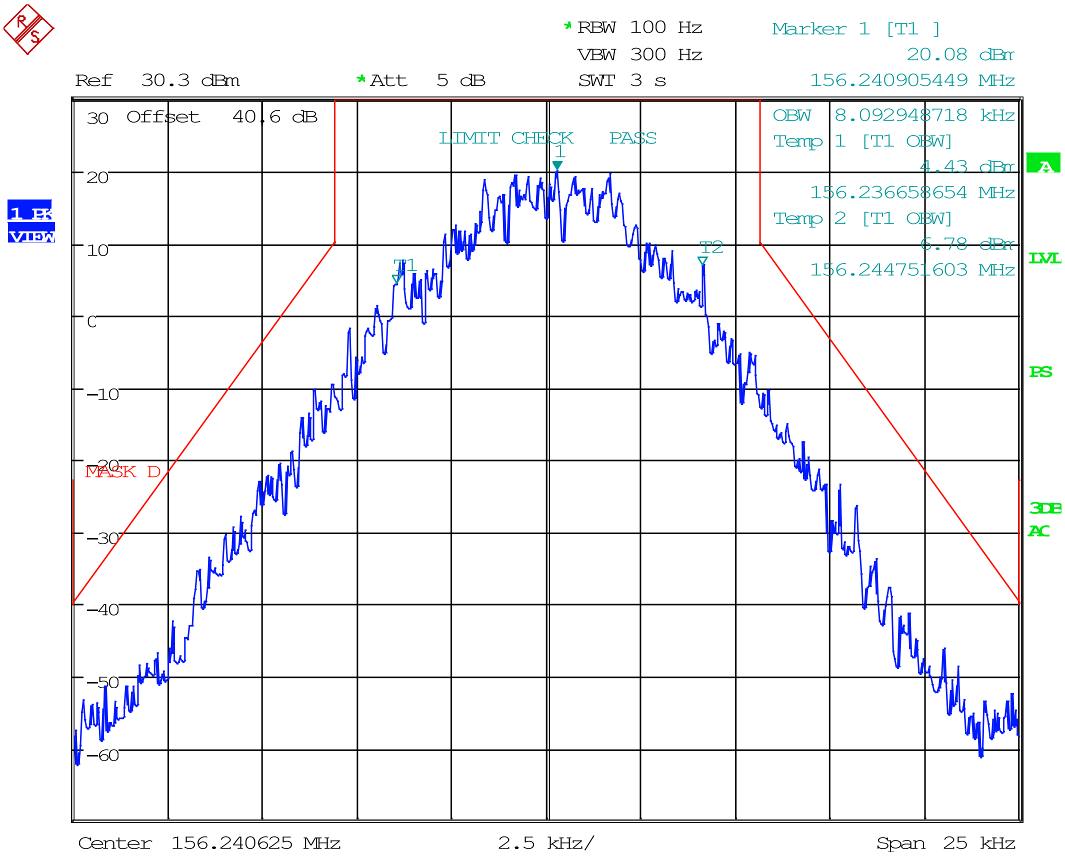


Date: 13.MAY.2019 15:34:04

KDB 935210 4.1 INPUT SIGNALS

C4FM INPUT SIGNAL

OBW = 8.093 kHz



Date: 13.MAY.2019 15:36:15

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ANNEX I – MANUFACTURER-PROVIDED INFORMATION

Note: The accuracy and precision of the following information provided by the manufacturer of the equipment under test has not been verified using test methods, cannot be verified, or is not necessary to verify.

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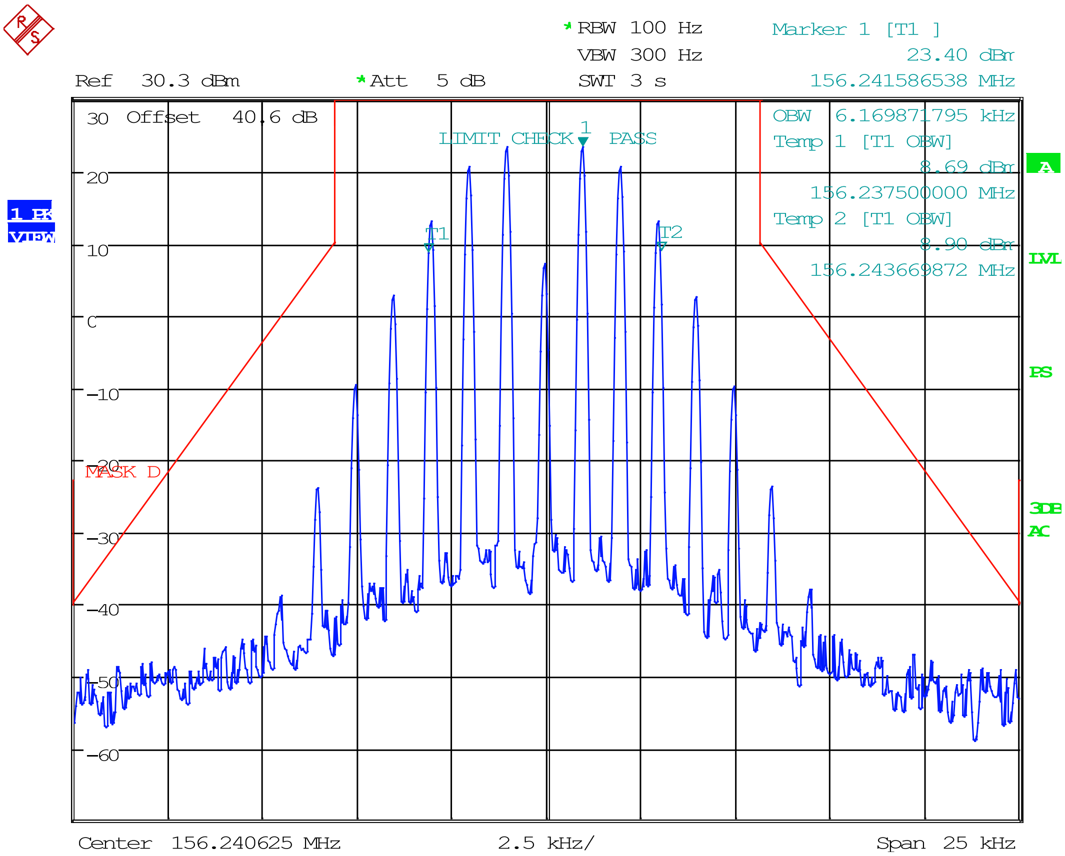
ANNEX II – MEASUREMENT DATA

KDB 935210 4.1 INPUT SIGNALS

FM INPUT SIGNAL

OBW = 6.170 kHz

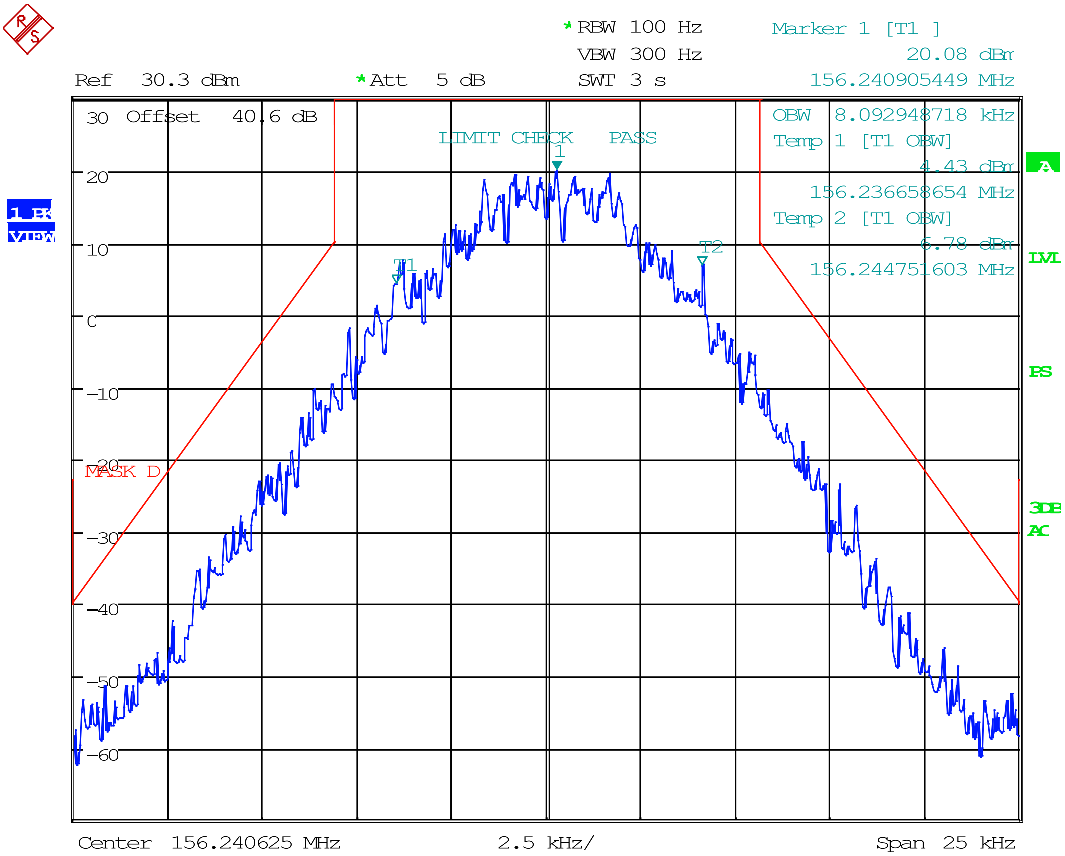


Date: 13.MAY.2019 15:34:04

KDB 935210 4.1 INPUT SIGNALS

C4FM INPUT SIGNAL

OBW = 8.093 kHz

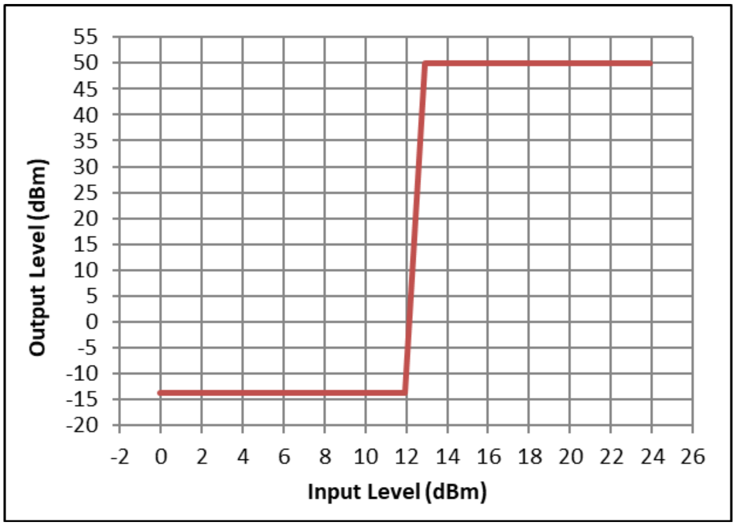


Date: 13.MAY.2019 15:36:15

KDB 935210 4.2 AGC THRESHOLD

Test Engineer: FR
Test Date: NOV 13 2019

INPUT (dBm)	CORRECTED INPUT (dBm)	CORRECTED OUTPUT (dBm)	GAIN (dB)	
0	-0.07	-13.84	-13.8	
1	0.93	-13.84	-14.8	
2	1.93	-13.84	-15.8	
3	2.93	-13.84	-16.8	
4	3.93	-13.84	-17.8	
5	4.93	-13.84	-18.8	
6	5.93	-13.84	-19.8	
7	6.93	-13.84	-20.8	
8	7.93	-13.84	-21.8	
9	8.93	-13.84	-22.8	
10	9.93	-13.84	-23.8	AGC -3 Level
11	10.93	-13.84	-24.8	
12	11.93	-13.84	-25.8	
13	12.93	49.89	37.0	AGC Level
14	13.93	50.03	36.1	
15	14.93	50.03	35.1	
16	15.93	50.03	34.1	AGC +3 Level
17	16.93	50.03	33.1	
18	17.93	50.03	32.1	
19	18.93	50.03	31.1	
20	19.93	50.03	30.1	
21	20.93	50.03	29.1	
22	21.93	50.03	28.1	
23	22.93	50.03	27.1	
24	23.93	50.03	26.1	Saturation



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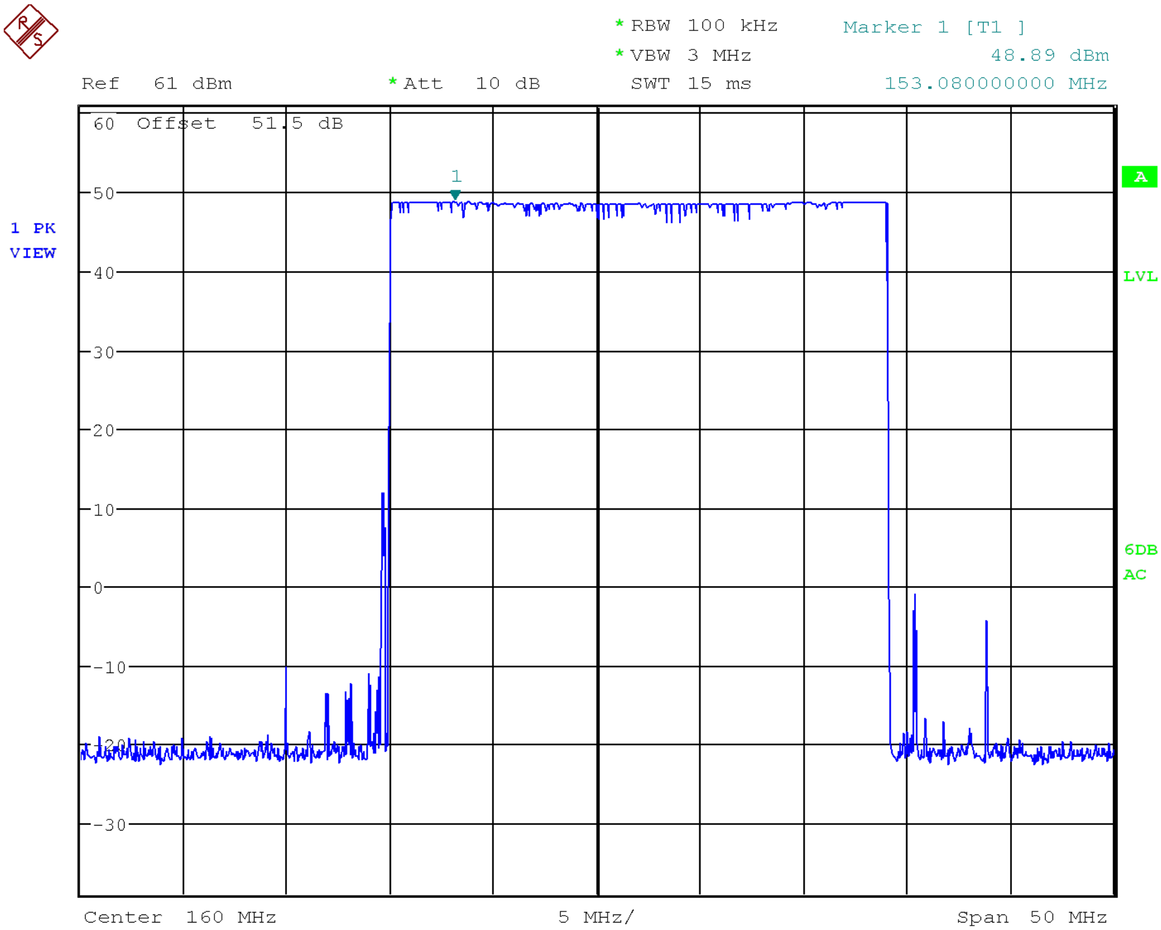
KDB 935210 4.3 OUT OF BAND REJECTION

Test Engineer: FR
Test Date: NOV 13 2019



Date: 13.NOV.2019 15:23:23

2.1046 RF POWER OUTPUT

KDB 935210 4.5 RF POWER OUTPUT & GAIN

Test Engineer: FR
Test Date: NOV 13 2019

Max Power Output = 50.03 dBm (100.69 W)

Max Gain = 37 dB

Frequency	AGC Level	Input (dBm)	Output (dBm)	Antenna Gain (dBi)	Cable Loss (dB)	Gain (dB)
150.82	AGC	12.93	48.83	0.00	0.00	35.9
150.82	AGC +3	15.93	50.03	0.00	0.00	34.1
150.82	Saturation	24.00	50.03	0.00	0.00	26.0
159.0	AGC	12.93	49.89	0.00	0.00	37.0
159.0	AGC +3	15.93	50.03	0.00	0.00	34.1
159.0	Saturation	24.00	50.03	0.00	0.00	26.0
173.38	AGC	12.93	48.83	0.00	0.00	35.9
173.38	AGC +3	15.93	50.03	0.00	0.00	34.1
173.38	Saturation	24.00	50.03	0.00	0.00	26.0

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KDB 935210 4.6 NOISE FIGURE

Test Engineer: TR
Test Date: NOV 25 2019

FCC KDB 935210 S. 4.6, ISED RSS-131 S. 6.4 - NOISE FIGURE	
Measurement Freq. (MHz)	**159**
Noise Source ENR (dB)	15.1428
Noise Source T_s^{OFF}, T_O (K)	290
Noise Source T_s^{ON} (K)	9767.1311
Noise Source Cal N_2^{off} (dB)	**-117.29**
Noise Source Cal N_2^{off} (pW)	0.00187
Noise Source Cal N_2^{on} (dB)	**-109.58**
Noise Source Cal N_2^{on} (pW)	0.01102
Calibration Ratio Y_2	5.9020
Calibration T_2	1643.3150
Noise + EUT N_{12}^{off} (dB)	**-69.82**
Noise + EUT N_{12}^{off} (pW)	104.23
Noise + EUT N_{12}^{on} (dB)	**-57.82**
Noise + EUT N_{12}^{on} (pW)	1651.96
Noise + EUT Ratio Y_{12}	15.8489
Noise + EUT T_{12}	348.2365
Gain (Ratio)	169169.0663
Gain (dB)	52.2832
2nd Stage Correction T_1	348.226834764242
Noise Factor F	2.20078
Noise Figure (dB)	3.43
Limit (dB)	9.00
Margin (dB)	**5.57**

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2.1047 AUDIO FREQUENCY RESPONSE

2.1047 LOW PASS FILTER RESPONSE

Test Engineer:___________
Test Date:_________

N/A. Device does not accept audio input.

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2.1047 MODULATION LIMITING

Test Engineer:___________
Test Date:_________

N/A. Device does not have means to limit modulation.

90.209 OCCUPIED BANDWIDTH

90.210 EMISSION MASKS

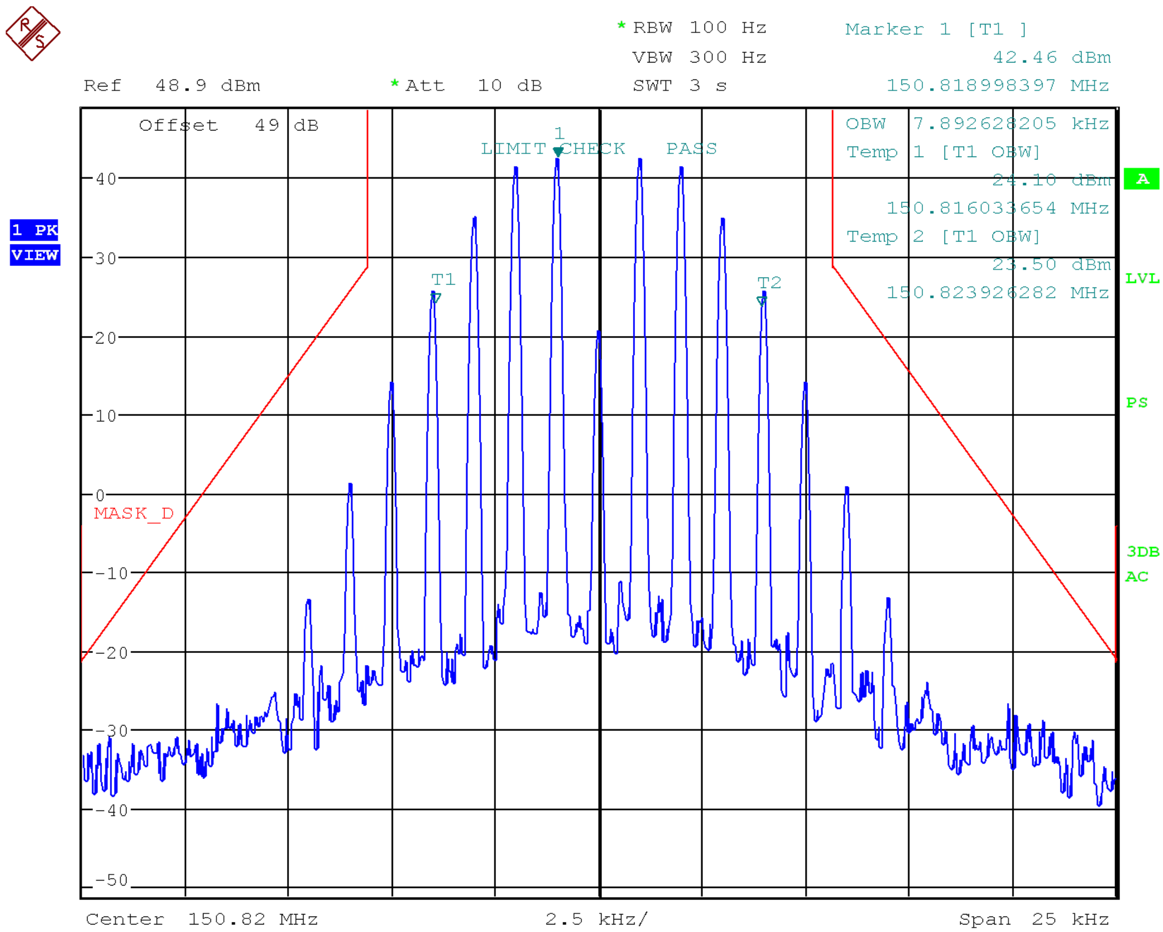
KDB 935210 4.4 INPUT VS OUTPUT COMPARISON

Test Engineer: FR
Test Date: NOV 15 2019

NOTE: All tests for Occupied Bandwidth, Emission Mask, and Input VS Output have been combined, below.

150.82 MHz, FM, at AGC

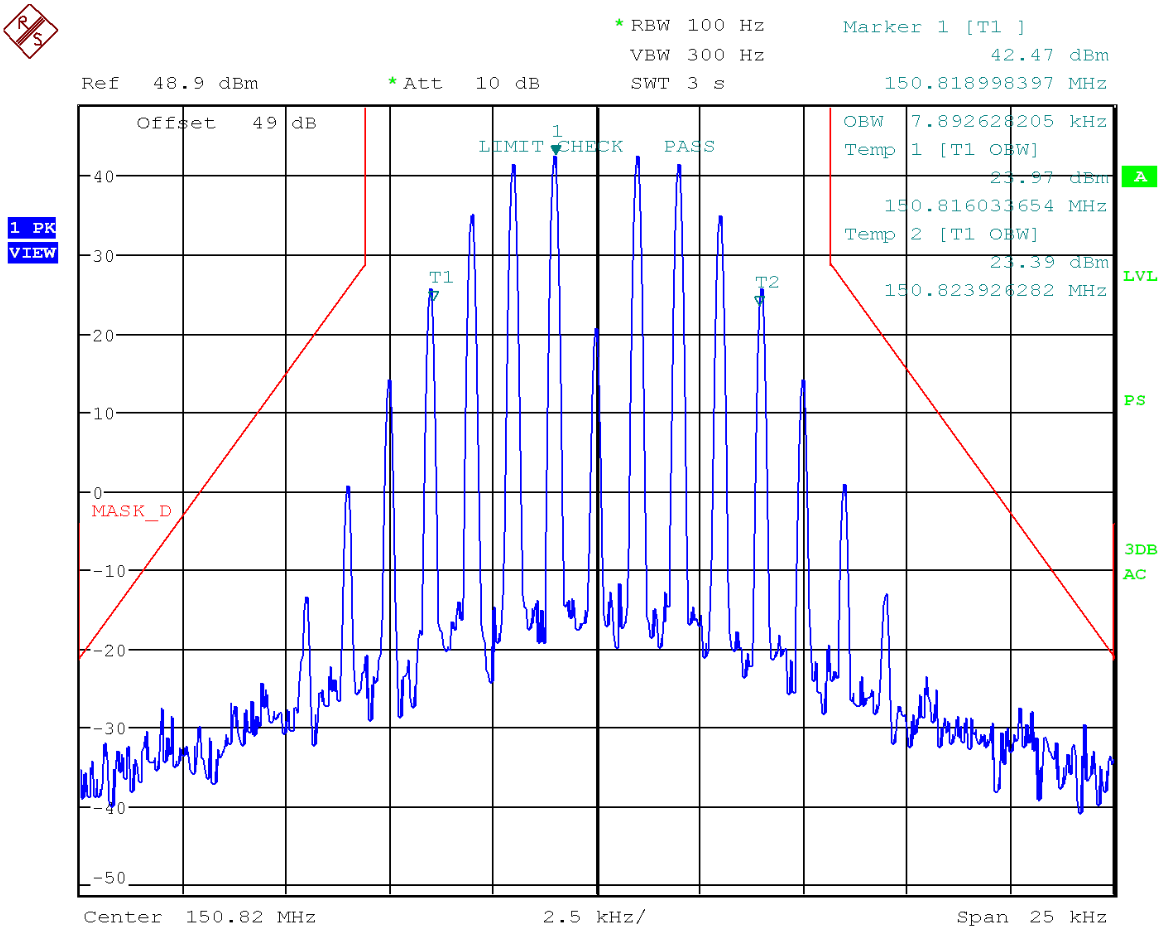
OBW: 7.893 MHz



Date: 15.NOV.2019 17:54:48

150.82 MHz, FM, at AGC +3 dB

OBW: 7.893 MHz



Date: 15.NOV.2019 17:54:02

ANNEX I – MANUFACTURER-PROVIDED INFORMATION

Note: The accuracy and precision of the following information provided by the manufacturer of the equipment under test has not been verified using test methods, cannot be verified, or is not necessary to verify.

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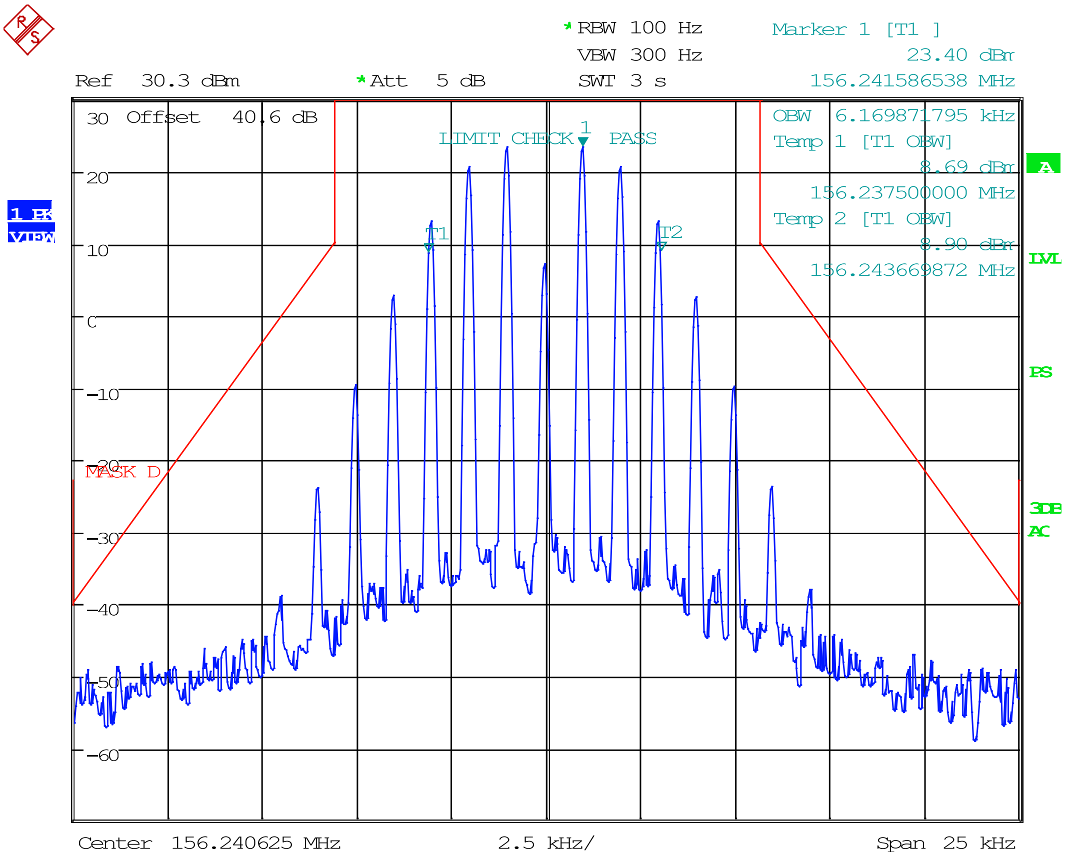
ANNEX II – MEASUREMENT DATA

KDB 935210 4.1 INPUT SIGNALS

FM INPUT SIGNAL

OBW = 6.170 kHz

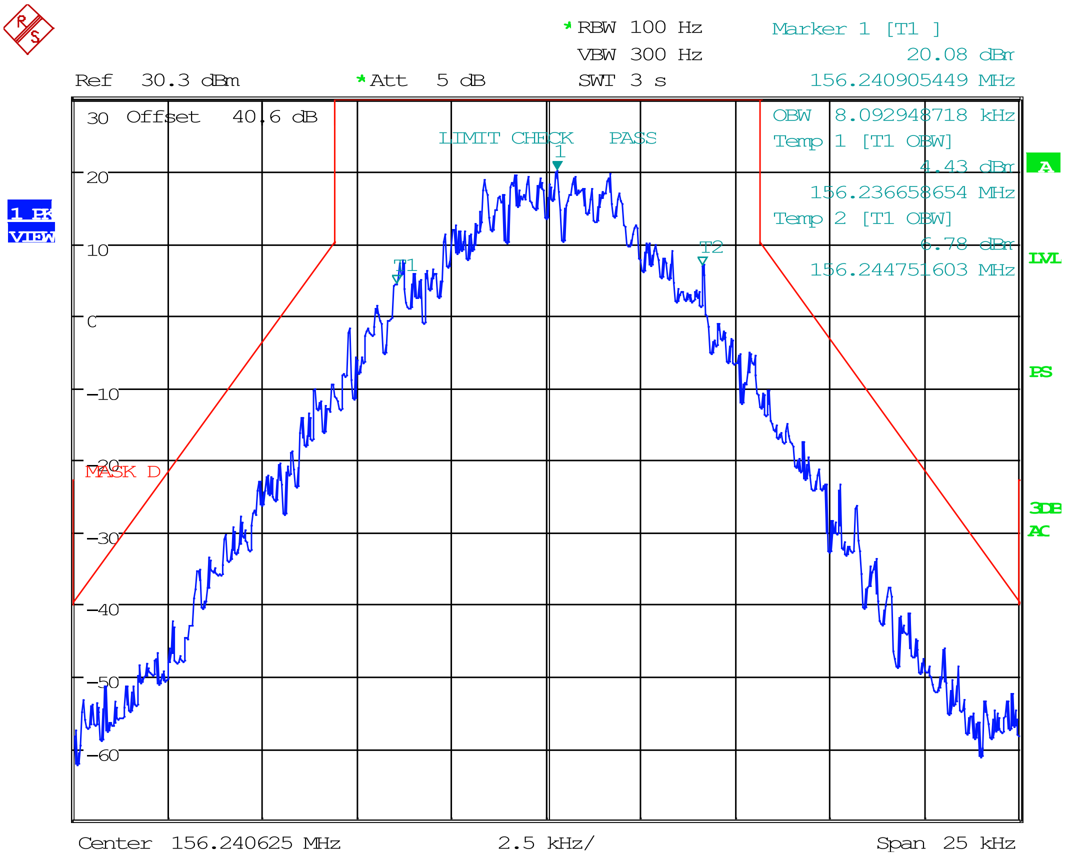


Date: 13.MAY.2019 15:34:04

KDB 935210 4.1 INPUT SIGNALS

C4FM INPUT SIGNAL

OBW = 8.093 kHz



Date: 13.MAY.2019 15:36:15

ANNEX I – MANUFACTURER-PROVIDED INFORMATION

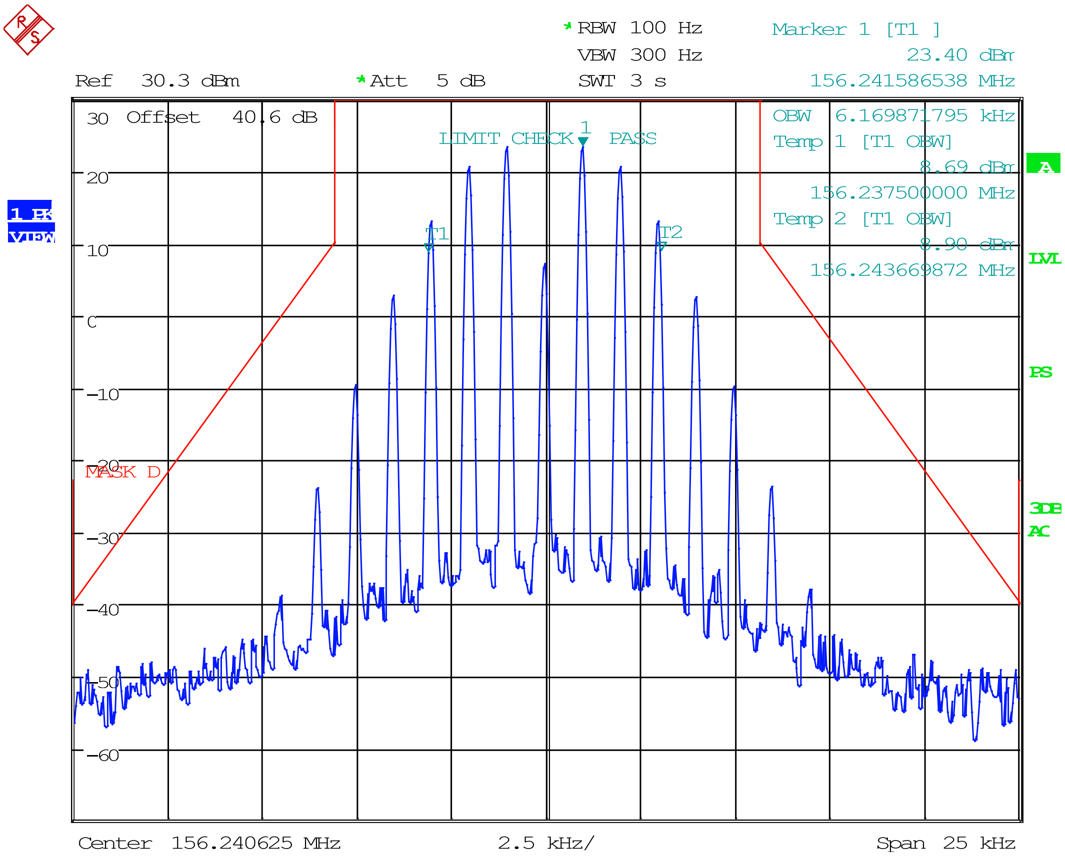
Note: The accuracy and precision of the following information provided by the manufacturer of the equipment under test has not been verified using test methods, cannot be verified, or is not necessary to verify.

ANNEX II – MEASUREMENT DATA

KDB 935210 4.1 INPUT SIGNALS

FM INPUT SIGNAL

OBW = 6.170 kHz

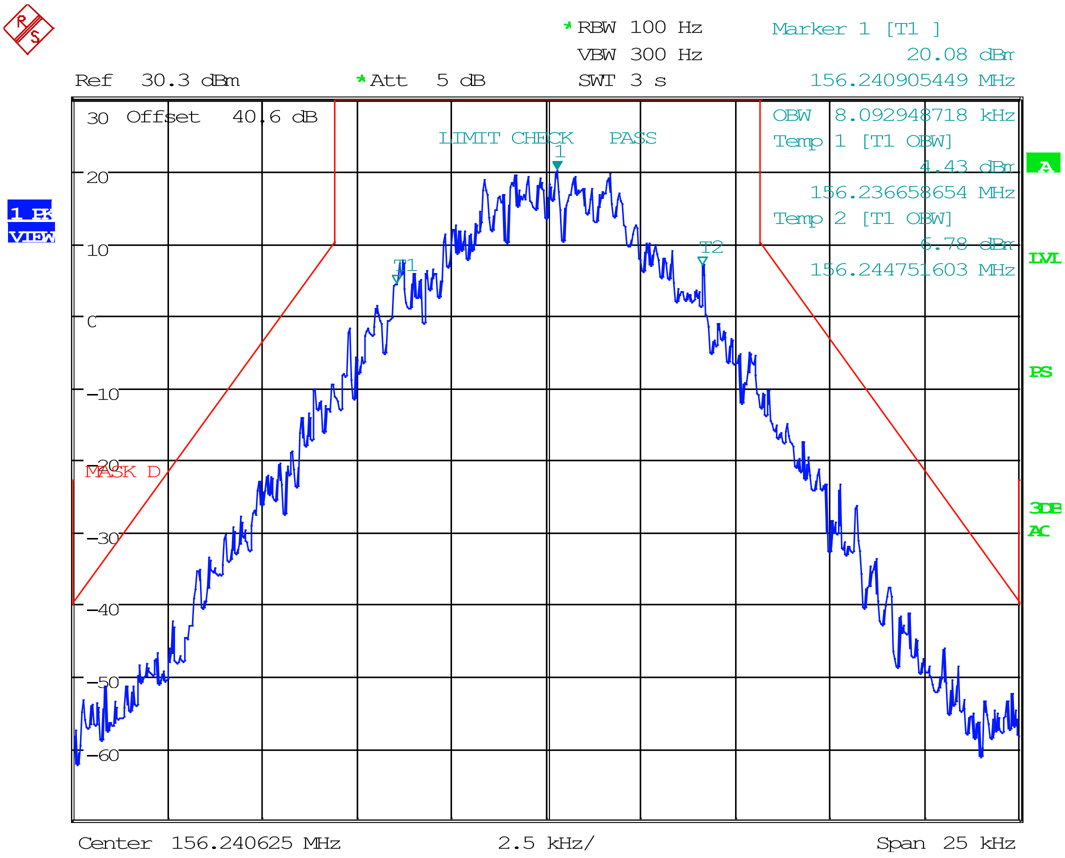


Date: 13.MAY.2019 15:34:04

KDB 935210 4.1 INPUT SIGNALS

C4FM INPUT SIGNAL

OBW = 8.093 kHz

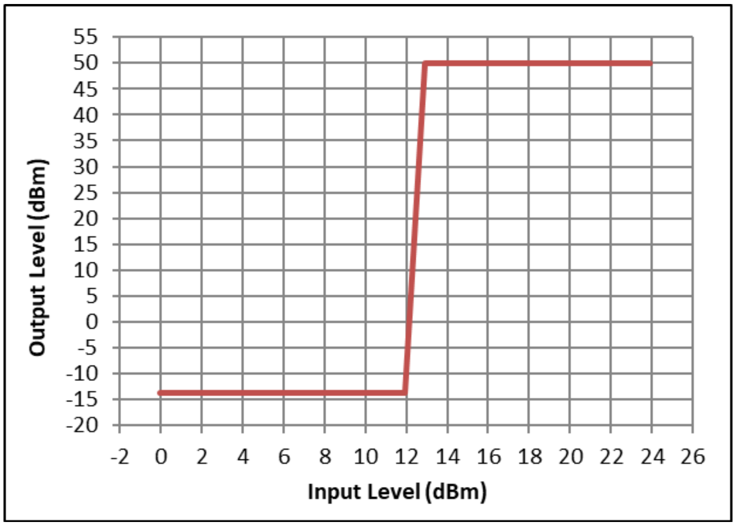


Date: 13.MAY.2019 15:36:15

KDB 935210 4.2 AGC THRESHOLD

Test Engineer: FR
Test Date: NOV 13 2019

INPUT (dBm)	CORRECTED INPUT (dBm)	CORRECTED OUTPUT (dBm)	GAIN (dB)	
0	-0.07	-13.84	-13.8	
1	0.93	-13.84	-14.8	
2	1.93	-13.84	-15.8	
3	2.93	-13.84	-16.8	
4	3.93	-13.84	-17.8	
5	4.93	-13.84	-18.8	
6	5.93	-13.84	-19.8	
7	6.93	-13.84	-20.8	
8	7.93	-13.84	-21.8	
9	8.93	-13.84	-22.8	
10	9.93	-13.84	-23.8	AGC -3 Level
11	10.93	-13.84	-24.8	
12	11.93	-13.84	-25.8	
13	12.93	49.89	37.0	AGC Level
14	13.93	50.03	36.1	
15	14.93	50.03	35.1	
16	15.93	50.03	34.1	AGC +3 Level
17	16.93	50.03	33.1	
18	17.93	50.03	32.1	
19	18.93	50.03	31.1	
20	19.93	50.03	30.1	
21	20.93	50.03	29.1	
22	21.93	50.03	28.1	
23	22.93	50.03	27.1	
24	23.93	50.03	26.1	Saturation



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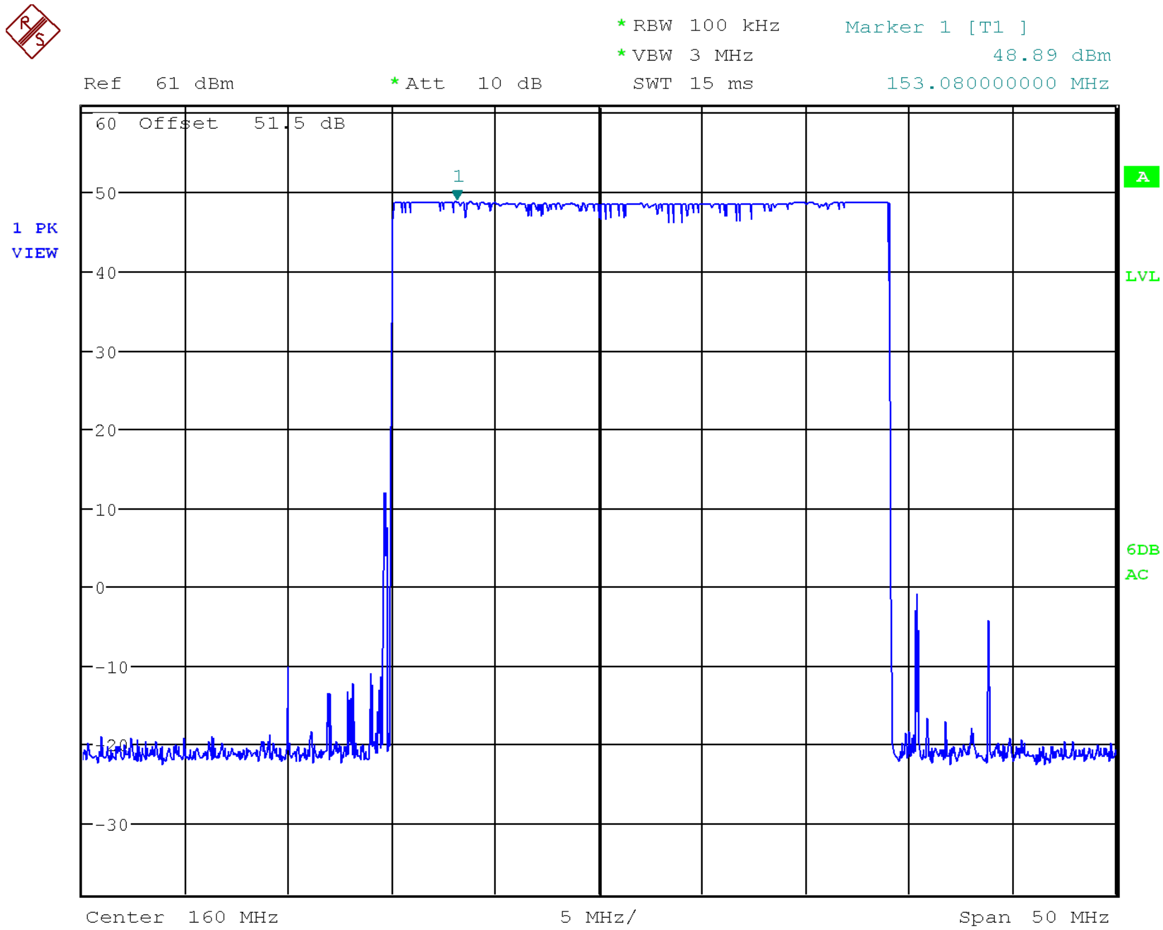
KDB 935210 4.3 OUT OF BAND REJECTION

Test Engineer: FR
Test Date: NOV 13 2019



Date: 13.NOV.2019 15:23:23

2.1046 RF POWER OUTPUT

KDB 935210 4.5 RF POWER OUTPUT & GAIN

Test Engineer: FR
Test Date: NOV 13 2019

Max Power Output = 50.03 dBm (100.69 W)

Max Gain = 37 dB

Frequency	AGC Level	Input (dBm)	Output (dBm)	Antenna Gain (dBi)	Cable Loss (dB)	Gain (dB)
150.82	AGC	12.93	48.83	0.00	0.00	35.9
150.82	AGC +3	15.93	50.03	0.00	0.00	34.1
150.82	Saturation	24.00	50.03	0.00	0.00	26.0
159.0	AGC	12.93	49.89	0.00	0.00	37.0
159.0	AGC +3	15.93	50.03	0.00	0.00	34.1
159.0	Saturation	24.00	50.03	0.00	0.00	26.0
173.38	AGC	12.93	48.83	0.00	0.00	35.9
173.38	AGC +3	15.93	50.03	0.00	0.00	34.1
173.38	Saturation	24.00	50.03	0.00	0.00	26.0

KDB 935210 4.6 NOISE FIGURE

Test Engineer: TR
Test Date: NOV 25 2019

FCC KDB 935210 S. 4.6, ISED RSS-131 S. 6.4 - NOISE FIGURE	
Measurement Freq. (MHz)	**159**
Noise Source ENR (dB)	15.1428
Noise Source T_s^{OFF}, T_O (K)	290
Noise Source T_s^{ON} (K)	9767.1311
Noise Source Cal N_2^{off} (dB)	**-117.29**
Noise Source Cal N_2^{off} (pW)	0.00187
Noise Source Cal N_2^{on} (dB)	**-109.58**
Noise Source Cal N_2^{on} (pW)	0.01102
Calibration Ratio Y_2	5.9020
Calibration T_2	1643.3150
Noise + EUT N_{12}^{off} (dB)	**-69.82**
Noise + EUT N_{12}^{off} (pW)	104.23
Noise + EUT N_{12}^{on} (dB)	**-57.82**
Noise + EUT N_{12}^{on} (pW)	1651.96
Noise + EUT Ratio Y_{12}	15.8489
Noise + EUT T_{12}	348.2365
Gain (Ratio)	169169.0663
Gain (dB)	52.2832
2nd Stage Correction T_1	348.226834764242
Noise Factor F	2.20078
Noise Figure (dB)	3.43
Limit (dB)	9.00
Margin (dB)	**5.57**

2.1047 AUDIO FREQUENCY RESPONSE

2.1047 LOW PASS FILTER RESPONSE

Test Engineer:___________
Test Date:_________

N/A. Device does not accept audio input.

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2.1047 MODULATION LIMITING

Test Engineer:___________
Test Date:_________

N/A. Device does not have means to limit modulation.

90.209 OCCUPIED BANDWIDTH

90.210 EMISSION MASKS

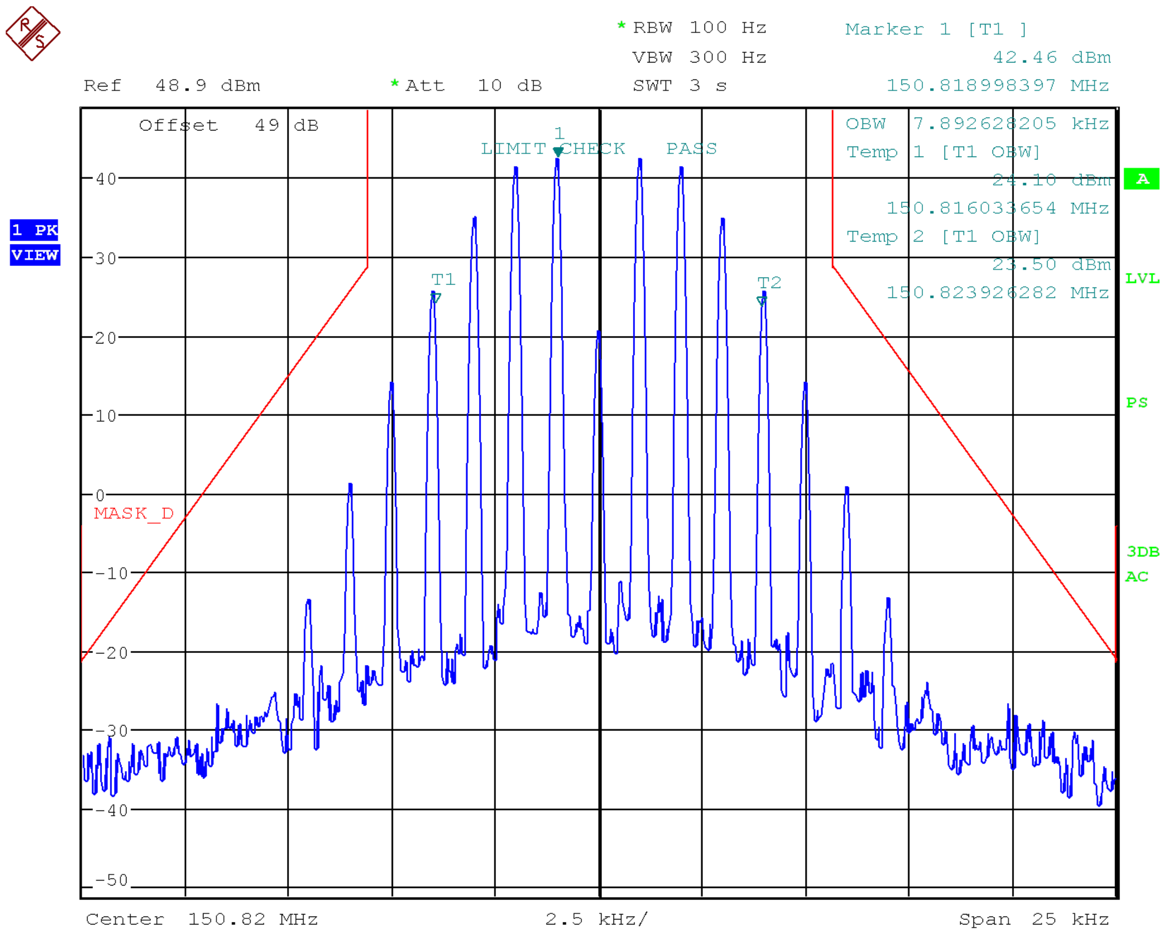
KDB 935210 4.4 INPUT VS OUTPUT COMPARISON

Test Engineer: FR
Test Date: NOV 15 2019

NOTE: All tests for Occupied Bandwidth, Emission Mask, and Input VS Output have been combined, below.

150.82 MHz, FM, at AGC

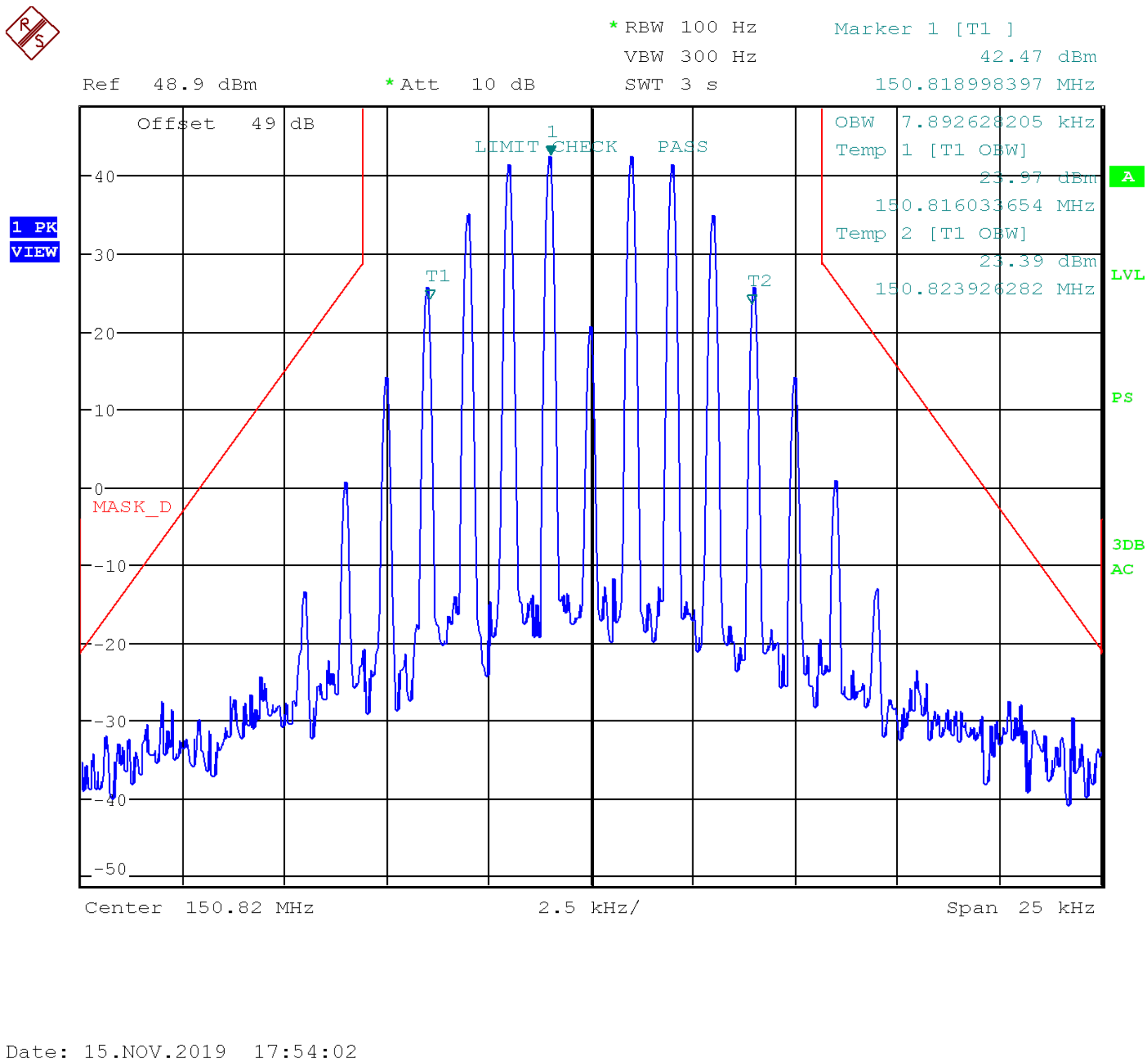
OBW: 7.893 MHz



Date: 15.NOV.2019 17:54:48

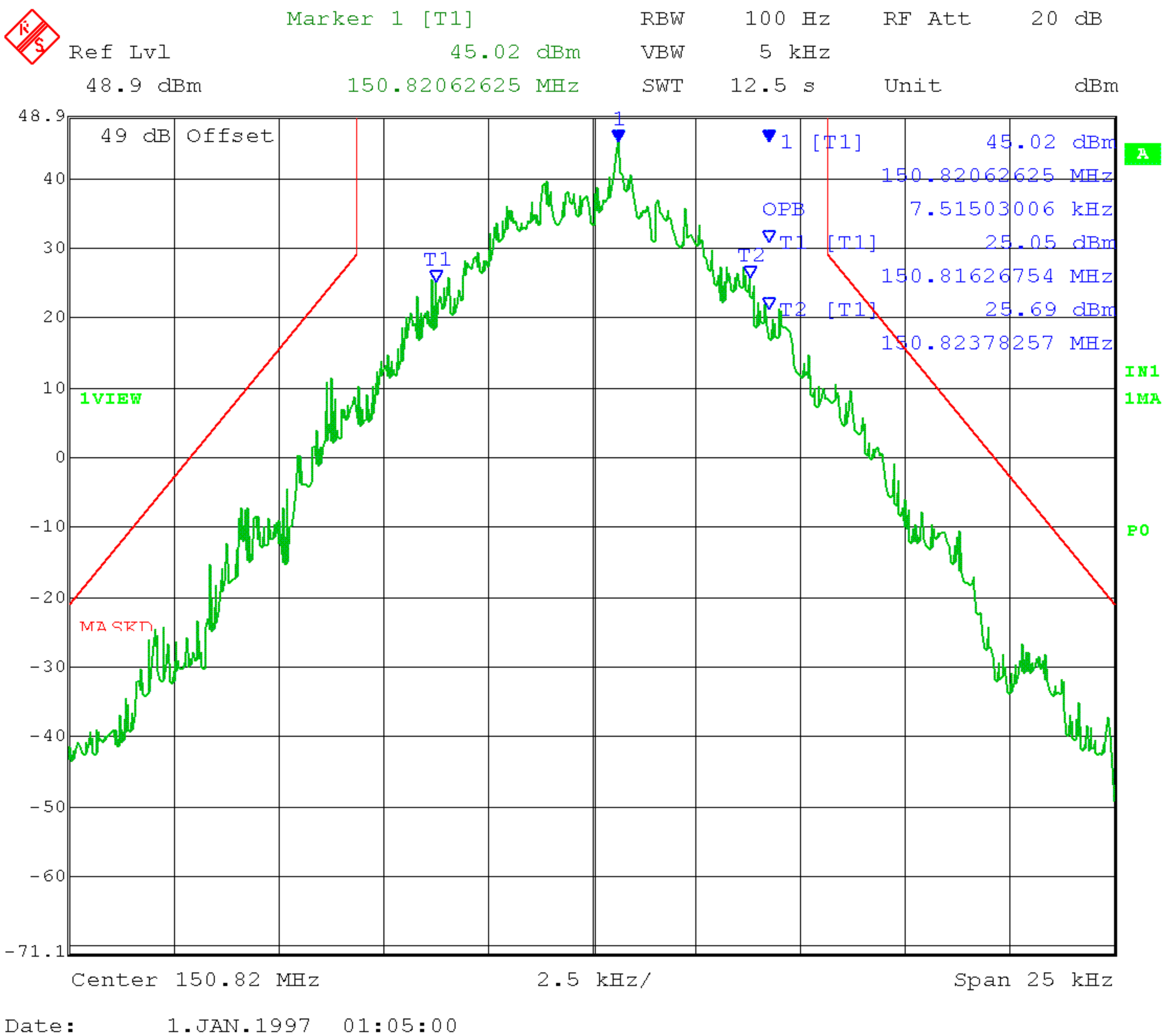
150.82 MHz, FM, at AGC +3 dB

OBW: 7.893 MHz



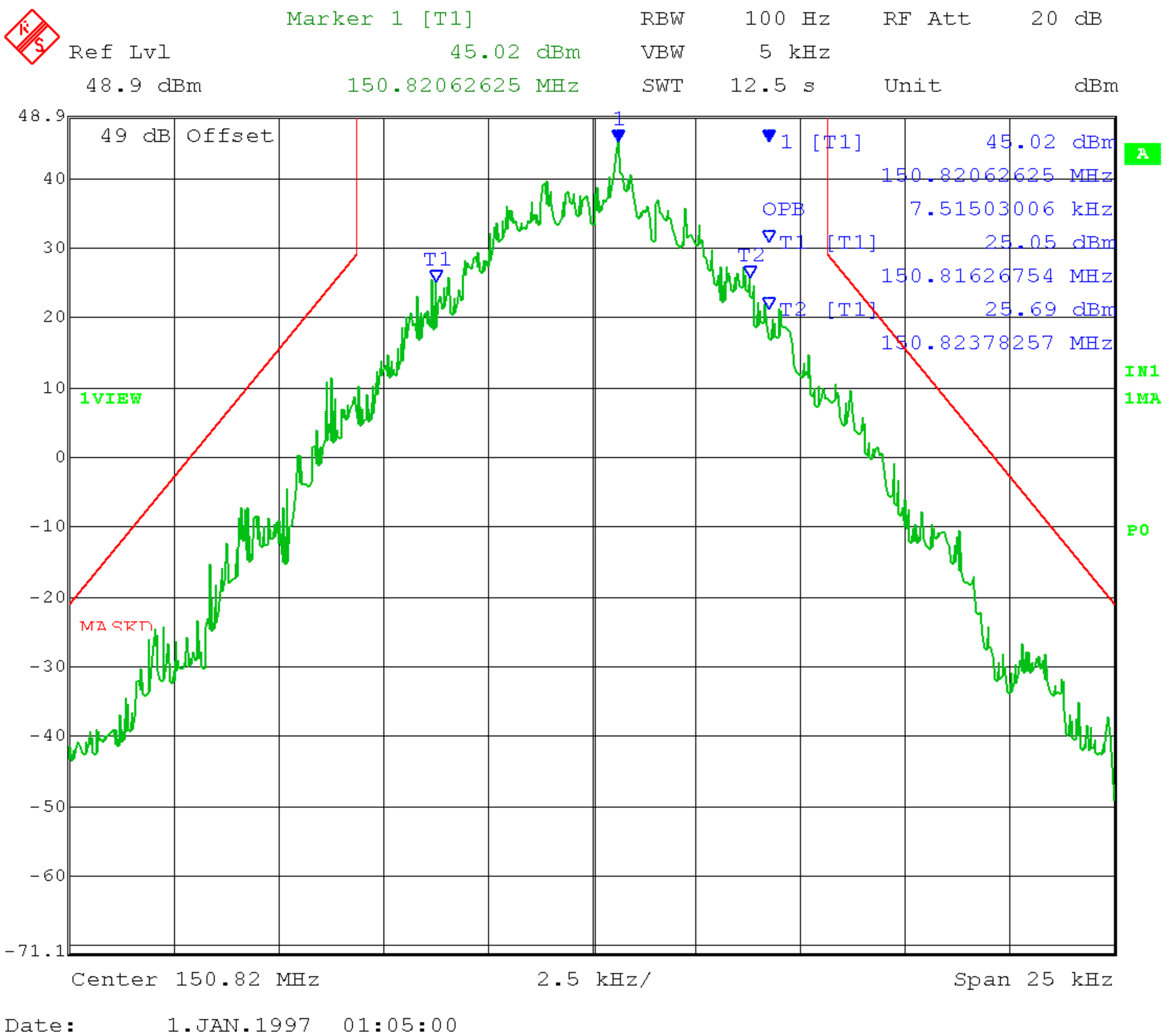
150.82 MHz, C4FM, at AGC

OBW: 7.515 MHz



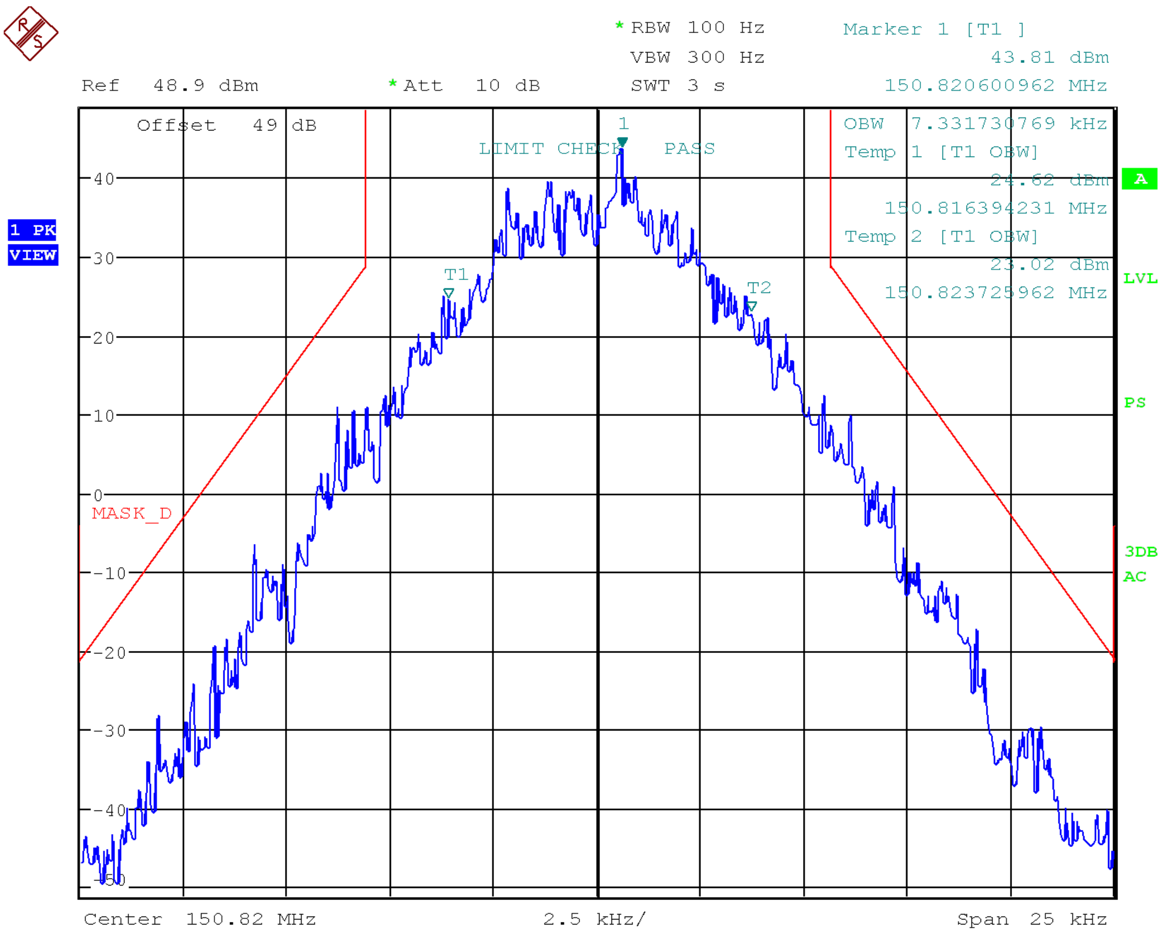
150.82 MHz, C4FM, at AGC

OBW: 7.515 MHz



150.82 MHz, C4FM, at AGC +3 dB

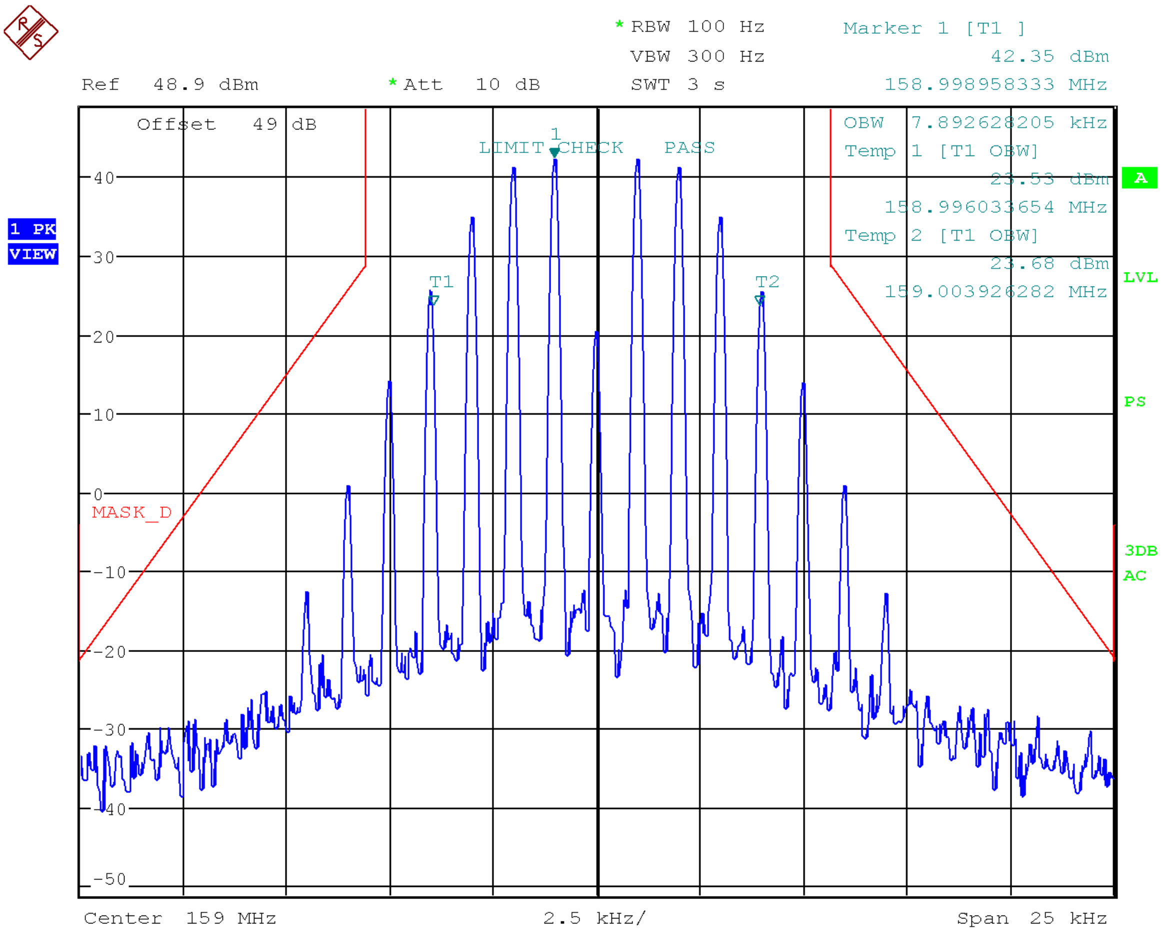
OBW: 7.332 MHz



Date: 15.NOV.2019 17:52:44

159.00 MHz, FM, at AGC

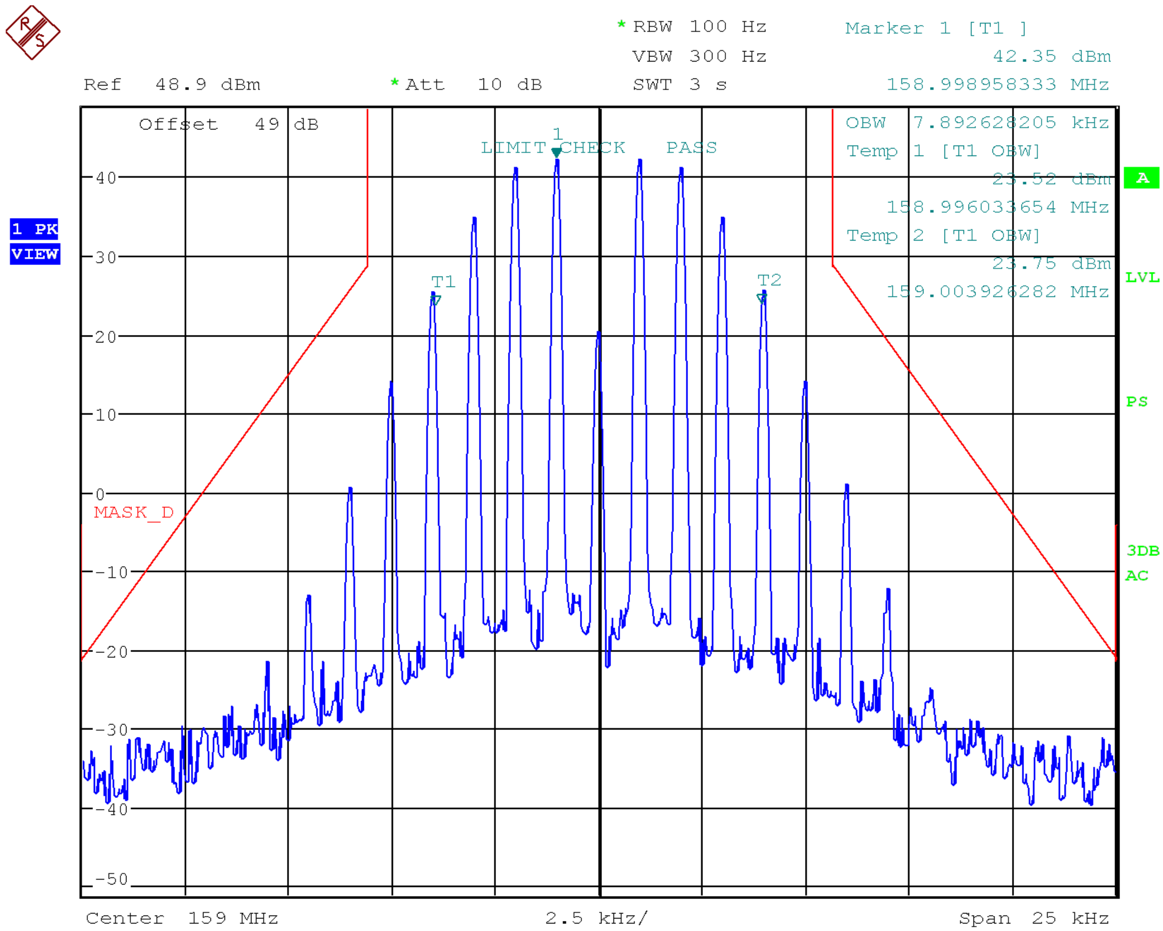
OBW: 7.893 MHz



Date: 15.NOV.2019 17:55:57

159.00 MHz, FM, at AGC +3 dB

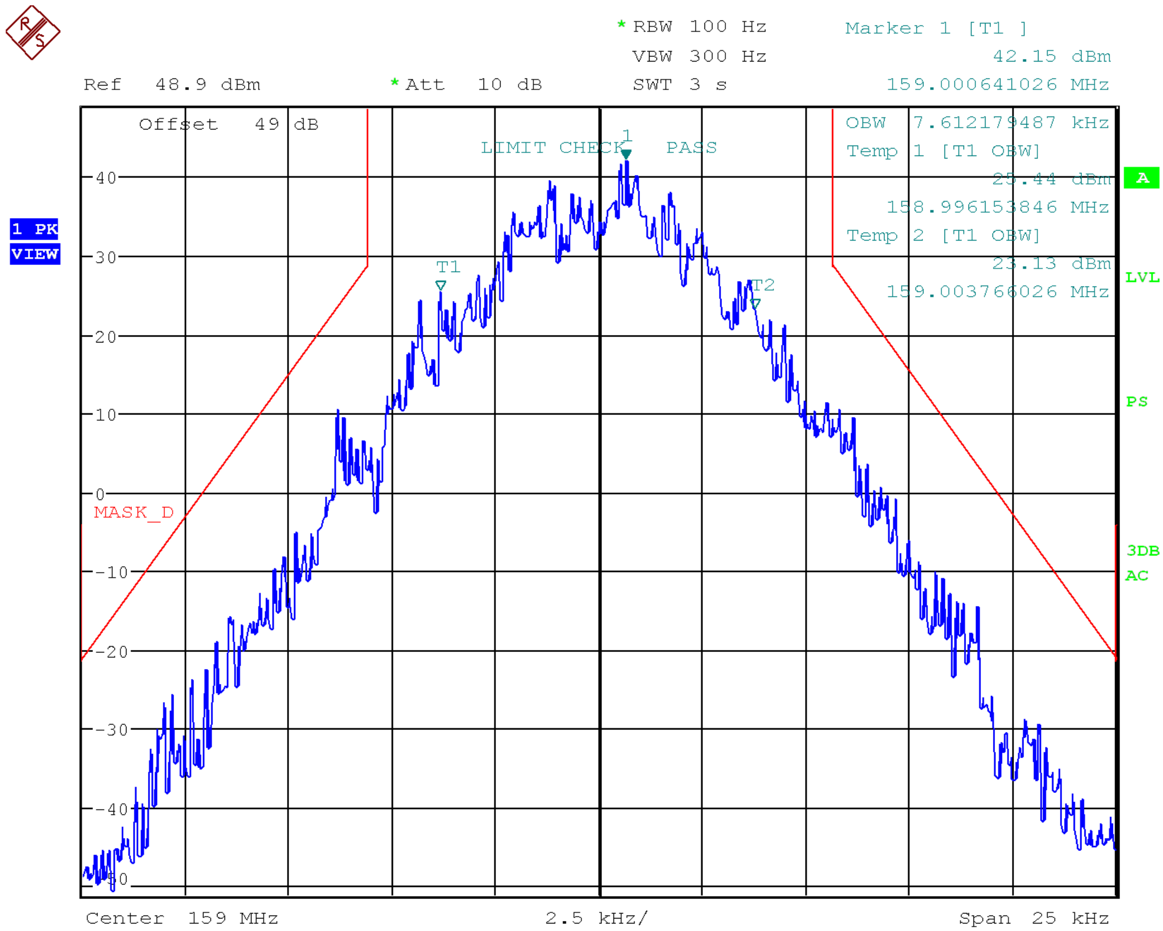
OBW: 7.893 MHz



Date: 15.NOV.2019 17:56:43

159.00 MHz, C4FM, at AGC

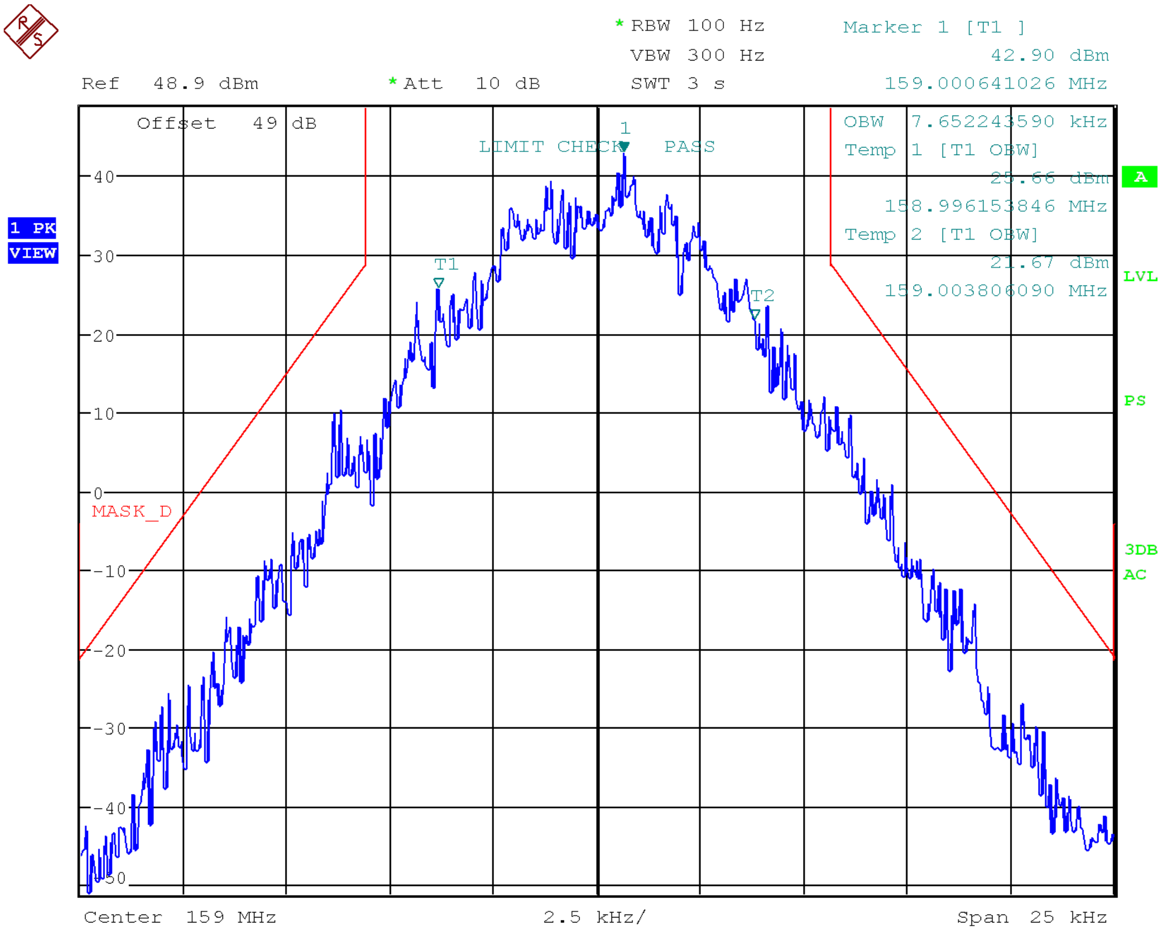
OBW: 7.612 MHz



Date: 15.NOV.2019 17:57:34

159.00 MHz, C4FM, at AGC +3 dB

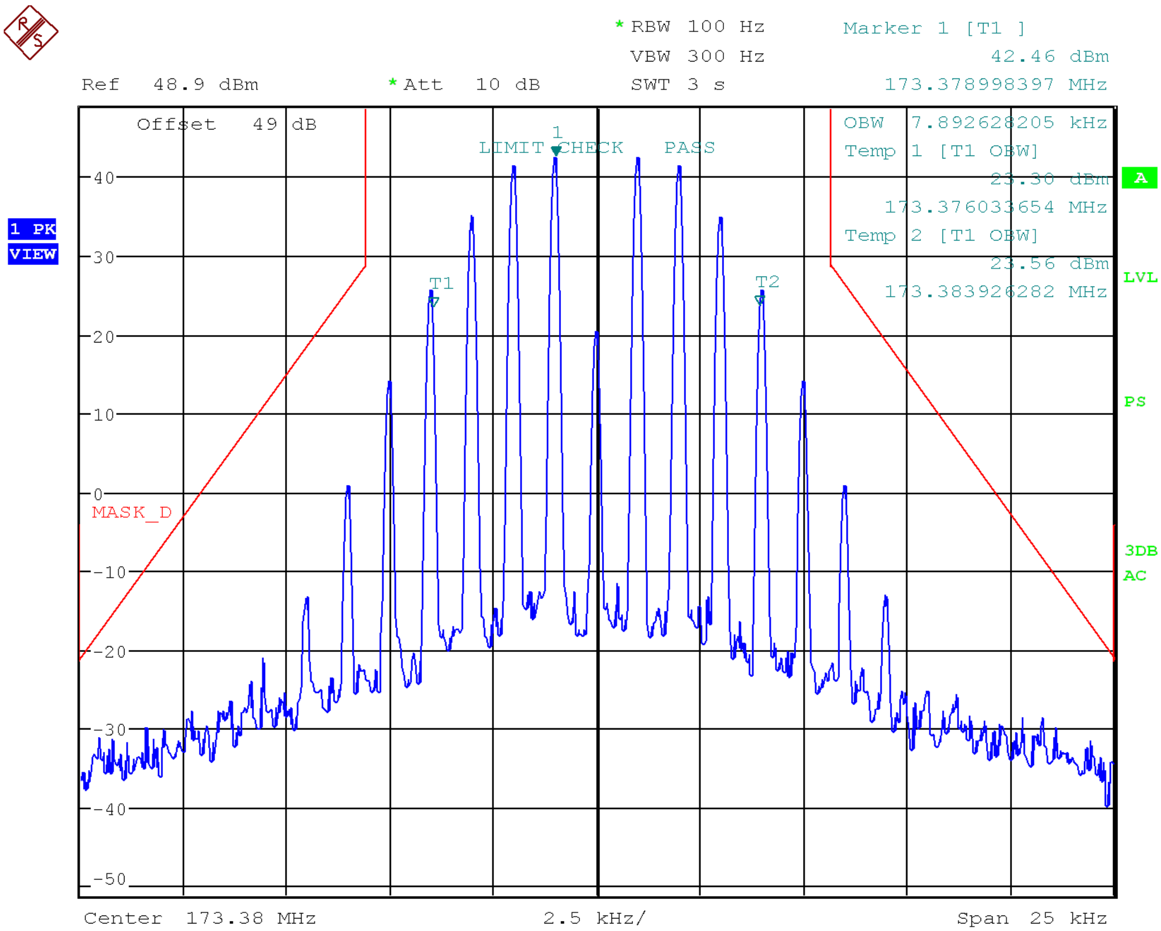
OBW: 7.652 MHz



Date: 15.NOV.2019 17:58:20

173.38 MHz, FM, at AGC

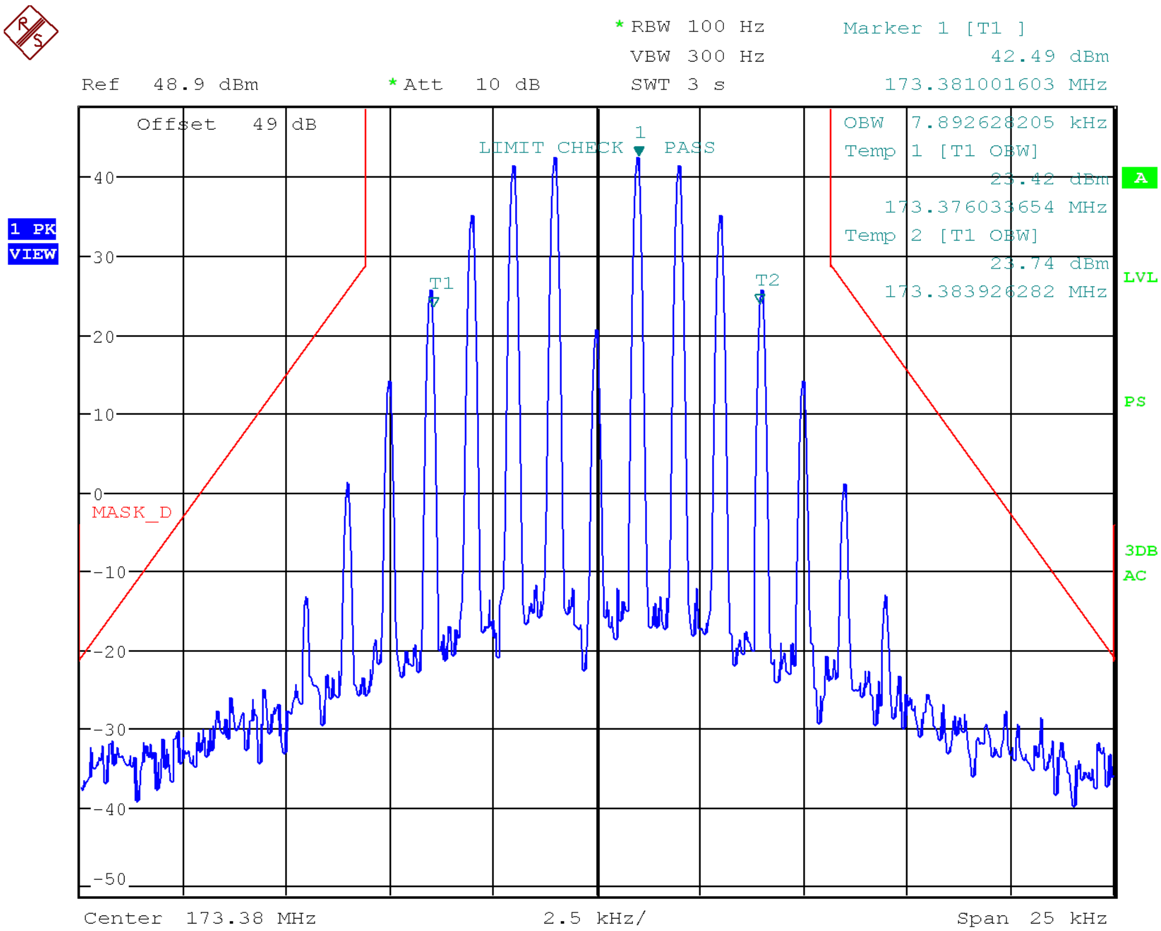
OBW: 7.893 MHz



Date: 15.NOV.2019 18:03:04

173.38 MHz, FM, at AGC +3 dB

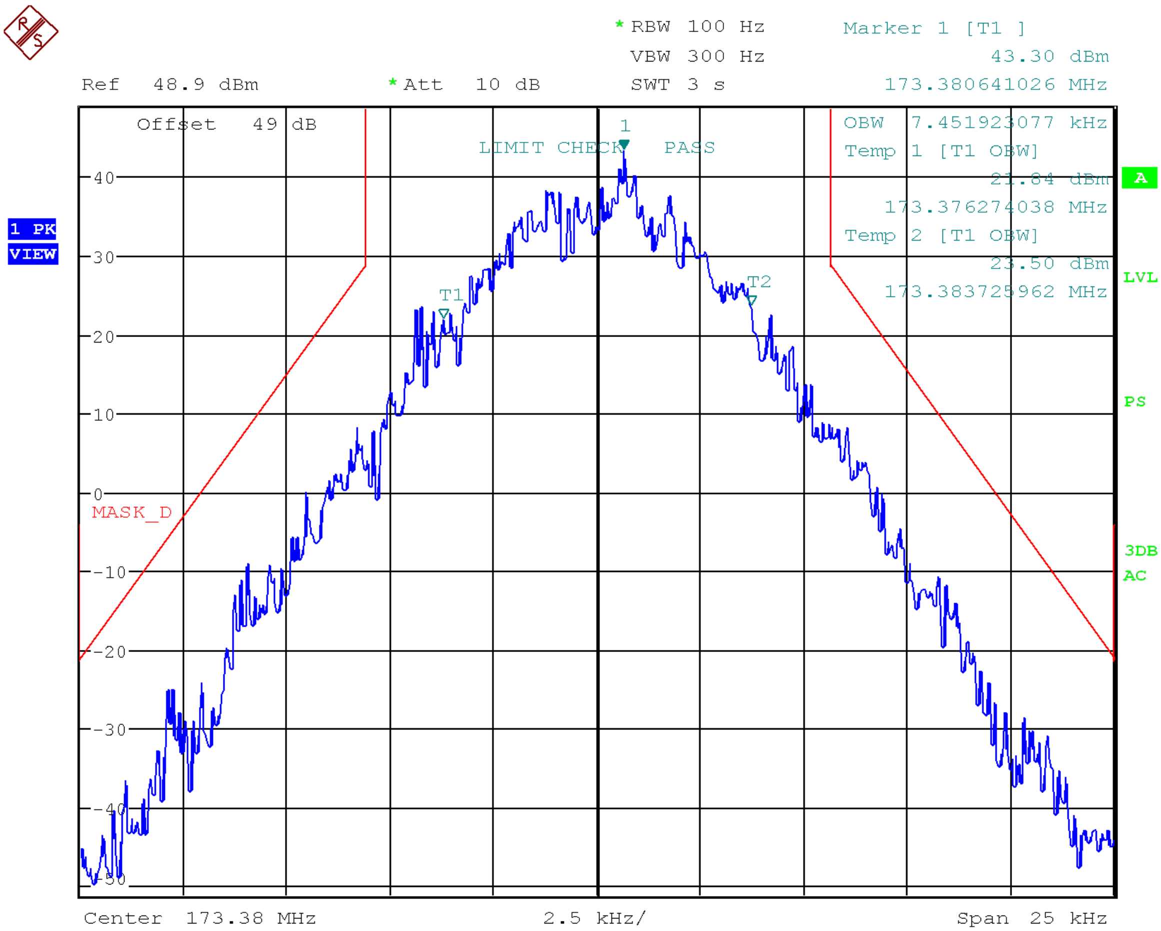
OBW: 7.893 MHz



Date: 15.NOV.2019 18:02:15

173.38 MHz, C4FM, at AGC

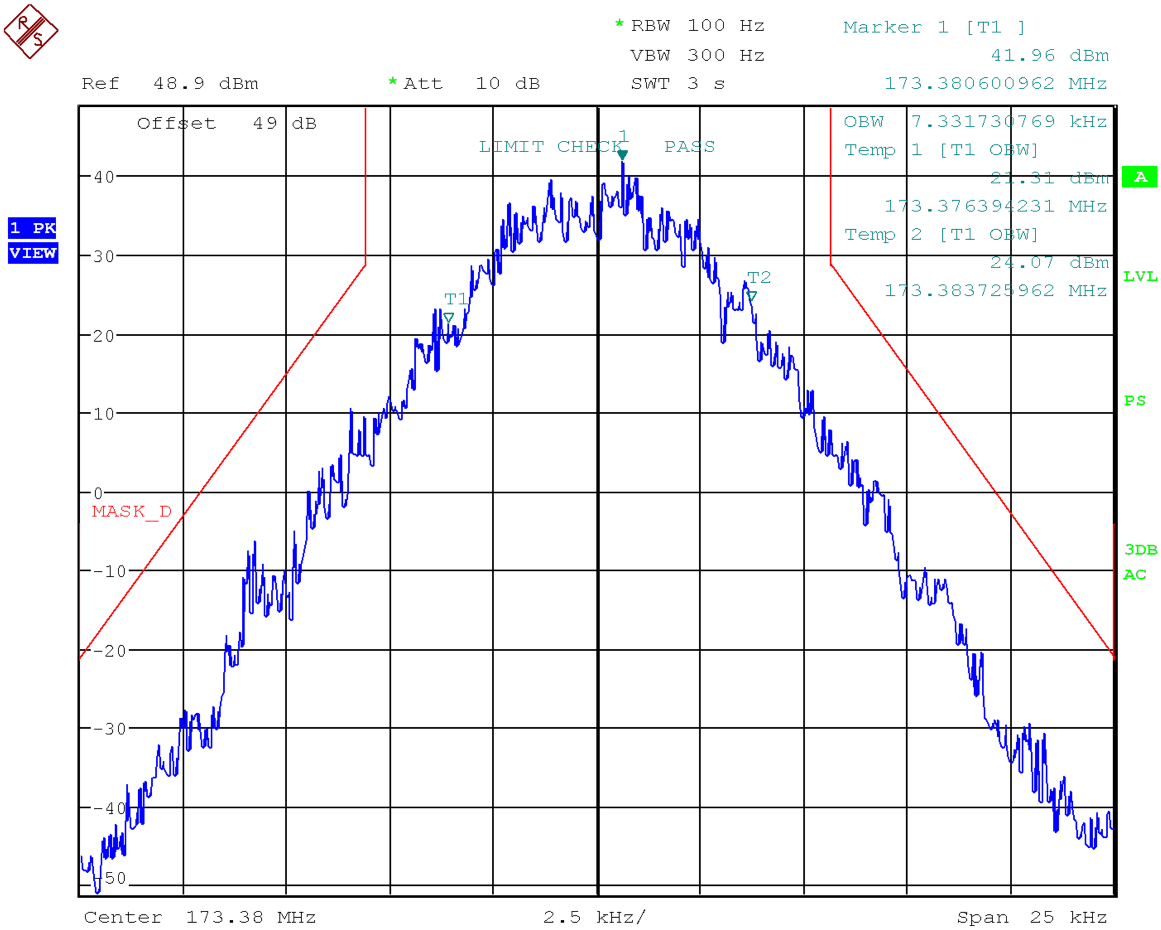
OBW: 7.452 MHz



Date: 15.NOV.2019 18:00:23

173.38 MHz, C4FM, at AGC +3 dB

OBW: 7.332 MHz



Date: 15.NOV.2019 17:59:34

KDB 935210 4.7.2 INTERMODULATION

Test Engineer:___________
Test Date:_________

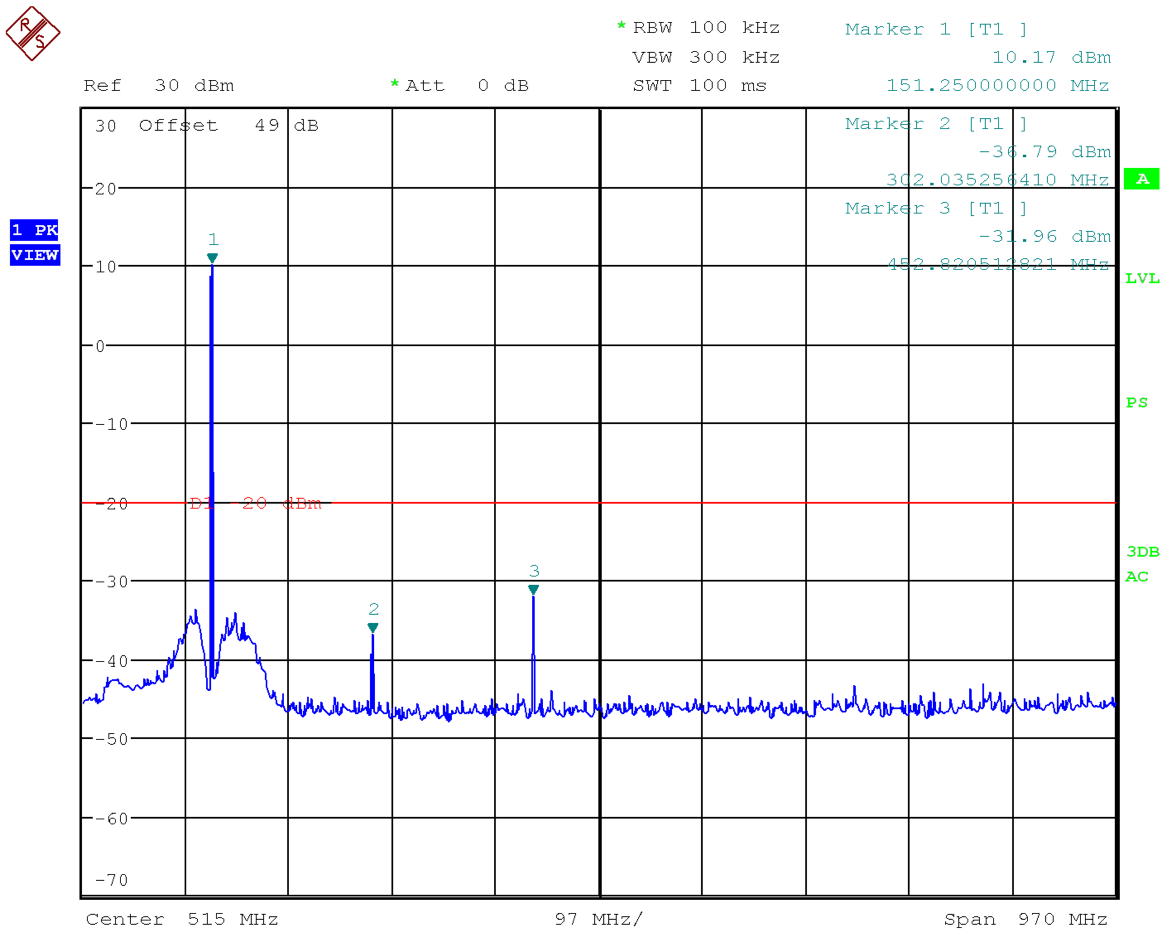
N/A. Device does not pass multiple signals simultaneously.

2.1051 CONDUCTED SPURIOUS EMISSIONS

KDB 935210 4.7.3 CONDUCTED SPURIOUS EMISSIONS

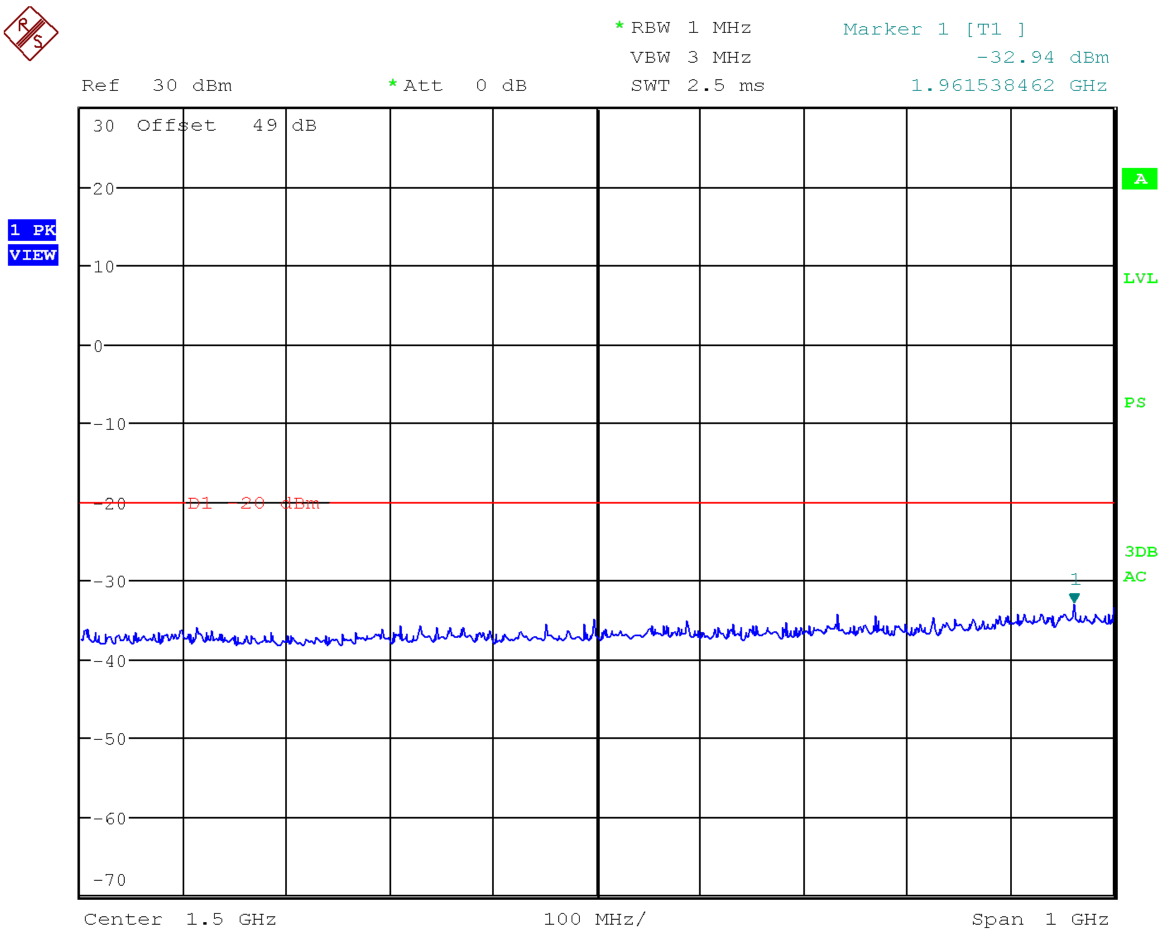
Test Engineer: FR
Test Date: NOV 18 2019

150.82 MHz, BELOW 1 GHz



Date: 18.NOV.2019 11:42:42

150.82 MHz, ABOVE 1 GHz



Date: 18.NOV.2019 11:54:58

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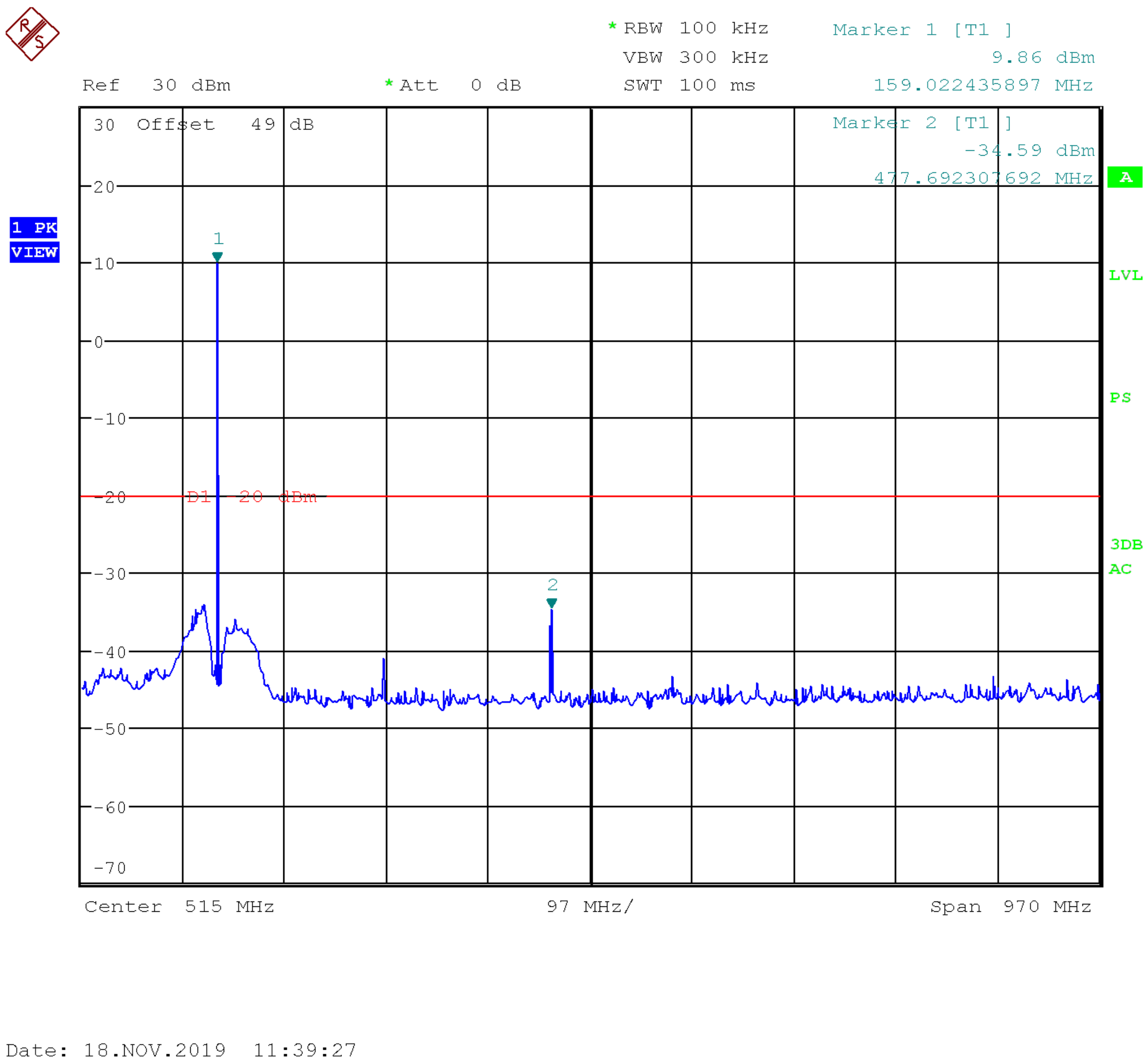
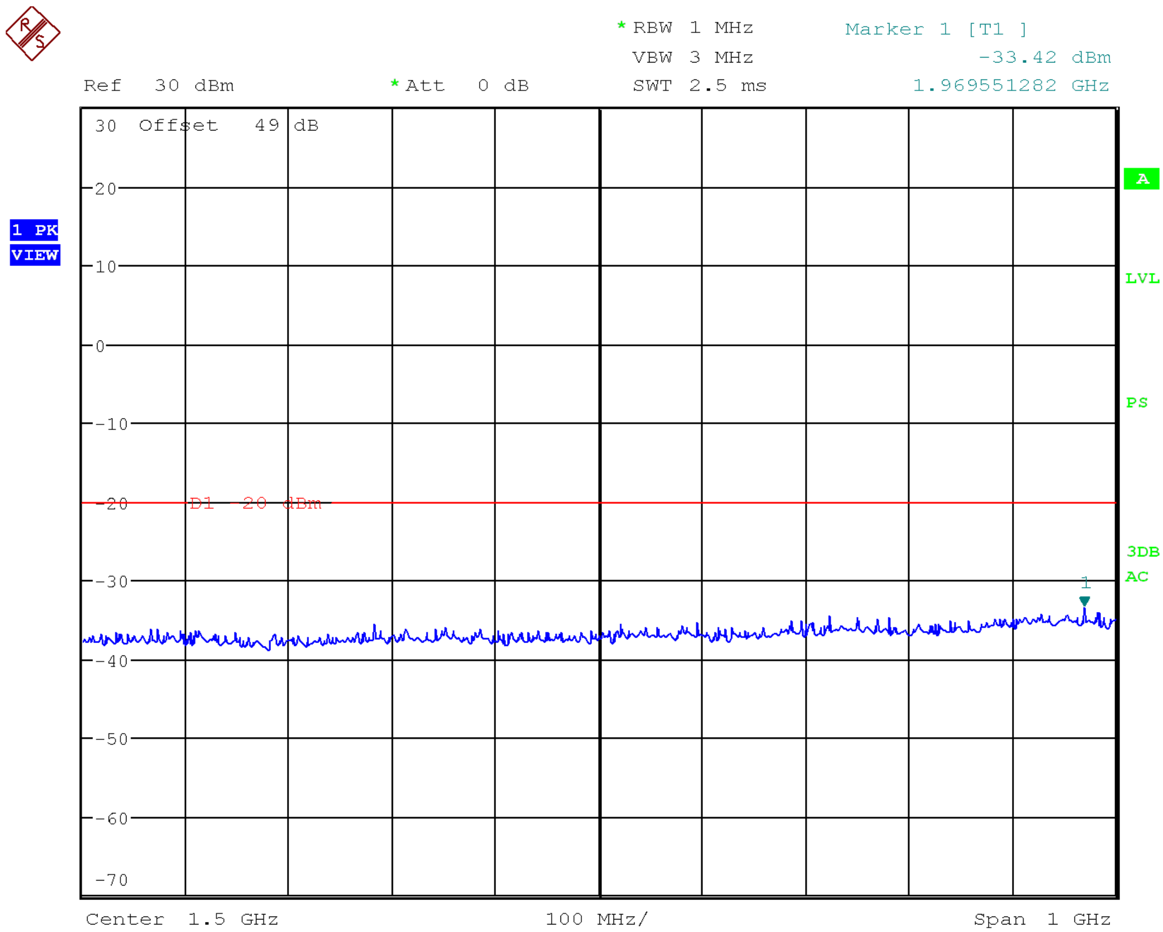
159.00 MHz, BELOW 1 GHz



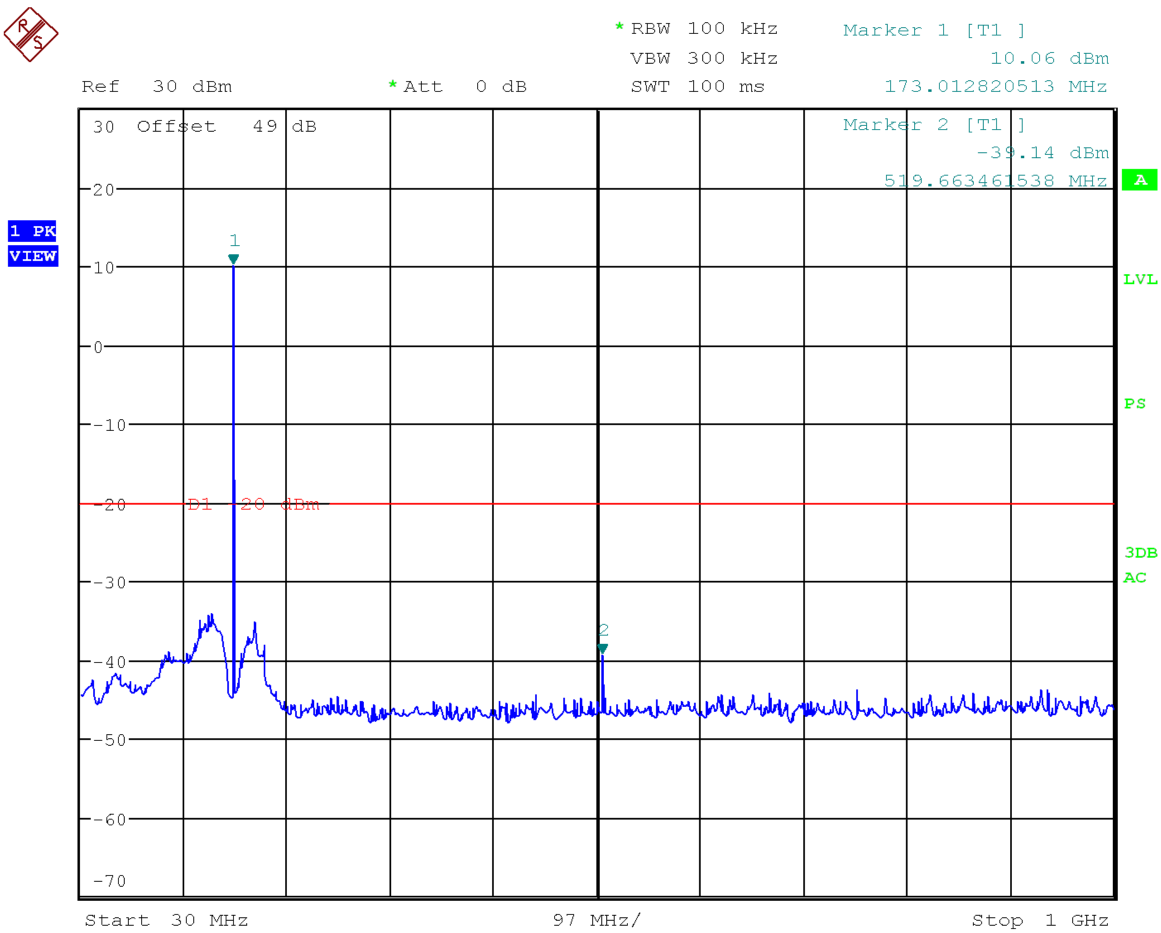
159.00 MHz, ABOVE 1 GHz



Date: 15.NOV.2019 18:19:49

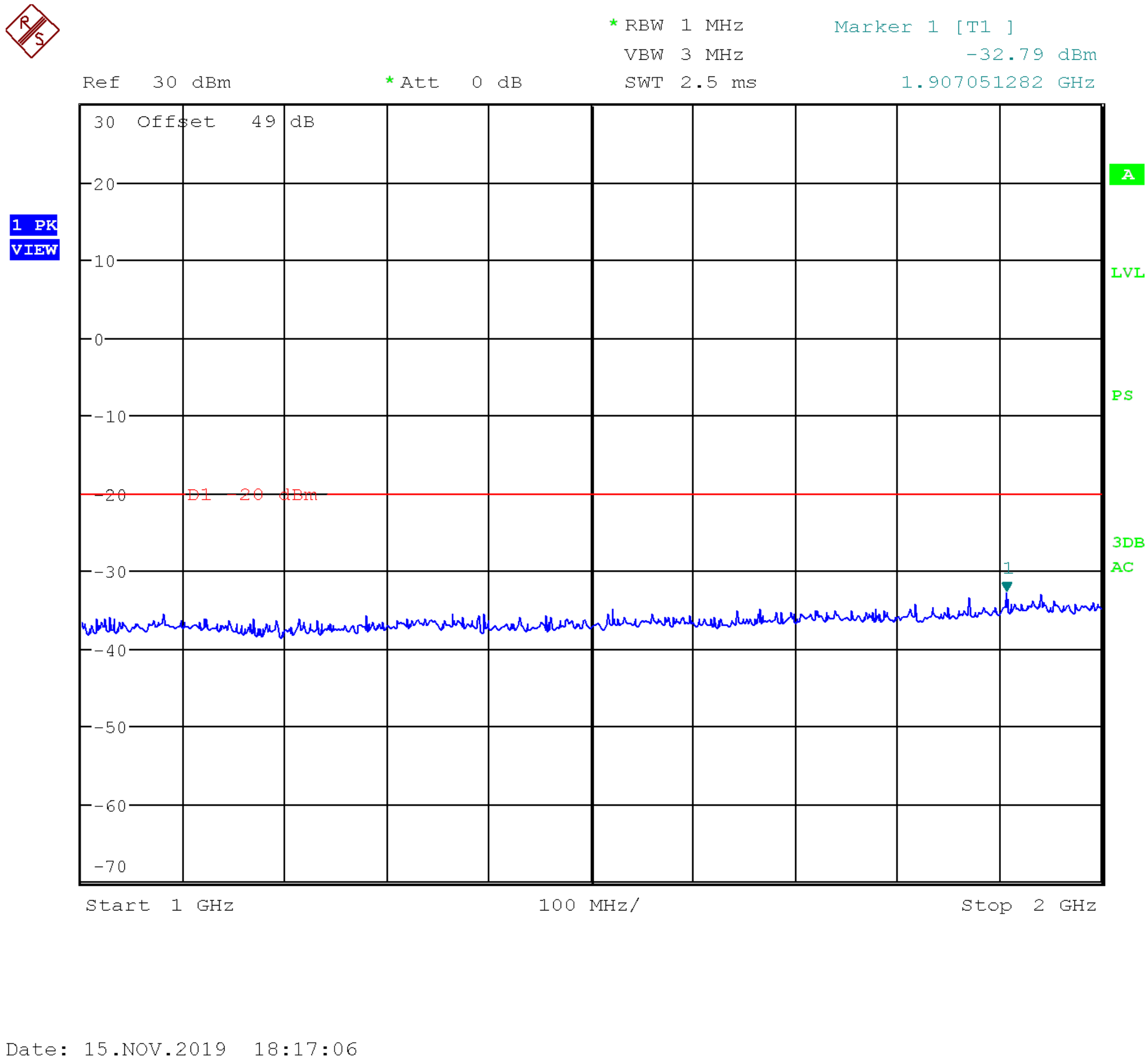
849 NW STATE ROAD 45 NEWBERRY, FL 32669 USA | PHONE: 888.472.2424 | EMAIL: INFO@TIMCOENGR.COM | WEB: HTTP://WWW.TIMCOENGR.COM

173.38 MHz, BELOW 1 GHz



Date: 15.NOV.2019 18:15:24

173.38 MHz, ABOVE 1 GHz



2.1053 FIELD STRENGTH OF SPURIOUS EMISSIONS

KDB 935210 4.9 FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Engineer: TR
Test Date: NOV 18 2019

150.82 MHz

Tuned Freq MHz	Emission Frequency MHz	Meter Reading dBu V	Antenna Polarity	Coax Loss Db	Correction Factor dB/M	Distance (m)	Field Strength dBu V/M	ERP (dBm)	LIMIT (dBm)	Margin
150.08	300.20	9.70	H	2.08	13.44	3.00	25.22	-72.16	-13.00	59.16
150.08	300.20	0.00	V	2.08	13.44	3.00	15.52	-81.86	-13.00	68.86
150.08	450.20	4.30	V	2.46	15.99	3.00	22.75	-74.63	-13.00	61.63
150.08	450.20	0.10	H	2.46	15.99	3.00	18.55	-78.83	-13.00	65.83
150.08	600.30	-1.21	H	2.86	18.41	3.00	20.06	-77.32	-13.00	64.32
150.08	600.30	-2.43	V	2.86	18.41	3.00	18.84	-78.54	-13.00	65.54
150.08	750.40	1.77	V	3.22	20.91	3.00	25.90	-71.48	-13.00	58.48
150.08	750.40	7.14	H	3.22	20.91	3.00	31.27	-66.11	-13.00	53.11
150.08	900.50	-0.48	H	3.54	21.75	3.00	24.81	-72.57	-13.00	59.57
150.08	900.50	-1.71	V	3.54	21.75	3.00	23.58	-73.80	-13.00	60.80
150.82	1055.70	10.79	H	3.78	26.80	3.00	41.37	-56.01	-13.00	43.01
150.82	1055.70	12.25	H	3.78	26.80	3.00	42.83	-54.55	-13.00	41.55
150.82	1206.60	11.74	H	3.95	28.10	3.00	43.79	-53.58	-13.00	40.58
150.82	1206.60	10.63	H	3.95	28.10	3.00	42.68	-54.69	-13.00	41.69
150.82	1357.40	10.97	H	4.26	28.71	3.00	43.94	-53.44	-13.00	40.44
150.82	1357.40	11.32	V	4.26	28.71	3.00	44.29	-53.09	-13.00	40.09
150.82	1508.20	11.13	V	4.50	27.76	3.00	43.39	-53.98	-13.00	40.98
150.82	1508.20	10.67	H	4.50	27.76	3.00	42.93	-54.44	-13.00	41.44

159.00 MHz

Tuned Freq MHz	Emission Frequency MHz	Meter Reading dBu V	Antenna Polarity	Coax Loss Db	Correction Factor dB/M	Distance (m)	Field Strength dBu V/M	ERP (dBm)	LIMIT (dBm)	Margin
159.00	318.00	3.15	V	2.09	14.18	3.00	19.42	-77.96	-13.00	64.96
159.00	318.00	6.02	H	2.09	14.18	3.00	22.29	-75.09	-13.00	62.09
159.00	477.00	3.11	H	2.57	16.96	3.00	22.64	-74.74	-13.00	61.74
159.00	477.00	1.91	V	2.57	16.96	3.00	21.44	-75.94	-13.00	62.94
159.00	636.00	1.43	V	2.94	19.26	3.00	23.63	-73.74	-13.00	60.74
159.00	636.00	-0.33	H	2.94	19.26	3.00	21.87	-75.50	-13.00	62.50
159.00	795.00	-0.52	H	3.33	20.50	3.00	23.31	-74.07	-13.00	61.07
159.00	795.00	4.15	V	3.33	20.50	3.00	27.98	-69.40	-13.00	56.40
159.00	954.00	2.16	V	3.62	23.04	3.00	28.82	-68.56	-13.00	55.56
159.00	954.00	-3.28	H	3.62	23.04	3.00	23.38	-74.00	-13.00	61.00
159.00	1113.00	12.08	H	3.85	27.21	3.00	43.14	-54.23	-13.00	41.23
159.00	1113.00	10.58	V	3.85	27.21	3.00	41.64	-55.73	-13.00	42.73
159.00	1272.00	10.10	V	4.05	28.53	3.00	42.68	-54.69	-13.00	41.69
159.00	1272.00	11.30	H	4.05	28.53	3.00	43.88	-53.49	-13.00	40.49
159.00	1431.00	10.75	H	4.39	28.23	3.00	43.37	-54.01	-13.00	41.01
159.00	1431.00	11.34	V	4.39	28.23	3.00	43.96	-53.42	-13.00	40.42
159.00	1590.00	10.34	V	4.64	28.01	3.00	42.99	-54.39	-13.00	41.39
159.00	1590.00	11.15	H	4.64	28.01	3.00	43.80	-53.58	-13.00	40.58

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173.38 MHz

Tuned Freq MHz	Emission Frequency MHz	Meter Reading dBu V	Antenna Polarity	Coax Loss Db	Correction Factor dB/M	Distance (m)	Field Strength dBu V/M	ERP (dBm)	LIMIT (dBm)	Margin
173.38	346.80	2.60	H	2.11	13.81	3.00	18.52	-78.85	-13.00	65.85
173.38	346.80	3.13	V	2.11	13.81	3.00	19.05	-78.32	-13.00	65.32
173.38	520.10	3.70	V	2.73	17.20	3.00	23.63	-73.75	-13.00	60.75
173.38	520.10	3.15	H	2.73	17.20	3.00	23.08	-74.30	-13.00	61.30
173.38	693.50	3.26	H	3.08	20.40	3.00	26.74	-70.64	-13.00	57.64
173.38	693.50	-0.39	V	3.08	20.40	3.00	23.09	-74.29	-13.00	61.29
173.38	866.90	3.98	V	3.51	22.51	3.00	30.00	-67.38	-13.00	54.38
173.38	866.90	7.60	H	3.51	22.51	3.00	33.62	-63.76	-13.00	50.76
173.38	1040.30	12.84	H	3.75	26.82	3.00	43.41	-53.96	-13.00	40.96
173.38	1040.30	10.79	V	3.75	26.82	3.00	41.36	-56.01	-13.00	43.01
173.38	1213.70	10.70	V	3.96	28.15	3.00	42.81	-54.56	-13.00	41.56
173.38	1213.70	9.54	H	3.96	28.15	3.00	41.65	-55.72	-13.00	42.72
173.38	1387.00	10.75	H	4.32	28.54	3.00	43.61	-53.77	-13.00	40.77
173.38	1387.00	12.43	V	4.32	28.54	3.00	45.29	-52.09	-13.00	39.09
173.38	1560.40	12.08	V	4.59	27.82	3.00	44.49	-52.89	-13.00	39.89
173.38	1560.40	12.72	V	4.59	27.82	3.00	45.13	-52.25	-13.00	39.25
173.38	1733.80	11.79	V	4.82	29.51	3.00	46.12	-51.26	-13.00	38.26
173.38	1733.80	9.93	H	4.82	29.51	3.00	44.26	-53.12	-13.00	40.12

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2.1055 FREQUENCY STABILITY

KDB 935210 4.8 FREQUENCY STABILITY

90.213 FREQUENCY STABILITY

22.355 FREQUENCY TOLERANCE

Test Engineer:___________
Test Date:_________

N/A. Device does not use a frequency determining element and is exempt.

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90.214 TRANSIENT FREQUENCY RESPONSE

Test Engineer:___________
Test Date:_________

N/A. Device does not key up, and does not utilize a frequency determining element.

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END OF TEST REPORT

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