ENGINEERING TEST REPORT

UHF P25 Transceiver
Model No.: IC-F7040T/S
FCC ID: AFJ399000

Applicant:
ICOM Incorporated
1-1-32, Kamiminami, Hirano-ku
Osaka, Japan, 547-0003

Tested in Accordance With
Federal Communications Commission (FCC)
47 CFR, Parts 2, 22, 74, 80 and 90 (Subpart I)
And
Industry Canada, RSS-119, Issue 12
Land Mobile and Fixed Equipment
Operating in the Frequency Range 27.41-960 MHz

UltraTech's File No.: 22ICOM580_FCC90

This Test report is Issued under the Authority of Tri M. Luu, BASc, Vice President of Engineering UltraTech Group of Labs Date: May 3, 2022	
Report Prepared by: Santhosh Fernandez Issued Date: May 3, 2022	Tested by: Nimisha Desai Test Dates: April 14-May 3, 2022

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91038 1309 46390-2049 AT-1945 SL2-IN-E-1119R Korea KCC-RRA CA2049

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Parts 2, 22, 74,and 90 (Subpart I), RSS-119
Title:	Code of Federal Regulations (CFR), Title 47 Telecommunication – Parts 2, 22, 74, 80 and 90 (Subpart I) Land Mobile and Fixed Equipment Operating in the Frequency range 27.41-960 MHz
Purpose of Test:	To obtain FCC Certification Authorization and RSS-119
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with TIA/EIA Standard TIA/EIA-603-E – Land Mobile FM or PM Communications Equipment Measurement and performance Standards.

1.2. REVISION HISTORY

Document	Issue Date	Description
22ICOM580_FCC90	May 2, 2022	Original Report

1.3. RELATED SUBMITTAL(S)/GRANT(S)

None

1.4. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19, 80-End	2022	Code of Federal Regulations – Telecommunication
ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI/TIA-603-E	2016	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
ANSI C63.26	2015	American National Standard for Compliance Testing of Transmitters used in Licensed Radio Services
RSS-119, Issue 12	2015	Land Mobile and Fixed Equipment Operating in the Frequency range 27.41-960 MHz
RSS-Gen, Issue 5	2018	General Requirements for Compliance of Radio Apparatus
ICES-003, ISSUE 7	2020	Information Technology Equipment (Including Digital Apparatus) — Limits and Methods of Measurement

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	Icom Incorporated
Address:	1-1-32, Kamiminami Hirano-ku, Osaka Japan, 547-0003
Contact Person:	Mr. Atsushi Tomiyama Phone #: +81 6 6793 5302 Fax #: +81 6 6793 0013 Email Address: world_support@icom.co.jp

MANUFACTURER	
Name:	Icom Incorporated
Address:	1-1-32, Kamiminami Hirano-ku, Osaka Japan, 547-0003
Contact Person:	Mr. Atsushi Tomiyama Phone #: +81 6 6793 5302 Fax #: +81 6 6793 0013 Email Address: world_support@icom.co.jp

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The applicant has supplied the following information (with the exception of the Date of Receipt).

Brand Name:	ICOM Incorporated
Product Name:	UHF P25 Transceiver
Model Name or Number:	IC-F7040T
Serial Number:	41000203
Type of Equipment:	Licensed Non-Broadcast Station Transmitter
Power Supply Requirement:	7.5 VDC nominal
Transmitting/Receiving Antenna Type:	Non-integral
Primary User Functions of EUT:	2-Way Wireless Voice & Data Communication

2.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	Portable
Intended Operating Environment:	Restricted to Occupational Use only
Power Supply Requirement:	7.5 VDC Nominal
RF Output Power Rating:	3 Watts(High) / 1 Watts (Low)
Operating Frequency Range:	769-775 MHz, 799-805 MHz & 806-824 MHz and 851-869 MHz
RF Output Impedance:	50 Ω
Channel Spacing:	25 kHz, 20 kHz, 12.5 kHz
Occupied Bandwidth (99%):	15.82 kHz (25 kHz Analog) F3E 10.385 kHz (20 kHz Analog) F3E 5.689 kHz (12.5 kHz Analog) F3E 7.93 kHz (12.5 kHz Digital) F1D/F1E 8.09 kHz (12.5 kHz Digital) F1W
Emission Designation*:	Analog: 16K0F3E**, 14K0F3E, 11K0F3E, Digital: 8K10F1E, 8K10F1D, 8K10F1W

* For an average case of commercial telephony, the Necessary Bandwidth is calculated as follows:
For FM Voice Modulation:
Channel Spacing = 25 KHz, D = 5 KHz max, K = 1, M = 3 KHz
B_n = 2M + 2DK = 2(3) + 2(5)(1) = **16 KHz**
Emission designation: 16K0F3E

Channel Spacing = 20 KHz, D = 4 KHz max, K = 1, M = 3 KHz
B_n = 2M + 2DK = 2(3) + 2(4)(1) = **14 KHz**
Emission designation: 14K0F3E

Channel Spacing = 12.5 KHz, D = 2.5 KHz max, K = 1, M = 3 KHz
B_n = 2M + 2DK = 2(3) + 2(2.5)(1) = **11 KHz**
Emission designation: 11K0F3E
****Note:** The emission designation 16K0F3E with 25 KHz Channel bandwidth is only applied to the device operated in FCC Rules Part 22, 74 & 80 frequencies. The operation of 16K0F3E emission will be disabled in the firmware by the manufacturer for device that operates in FCC Rules Part 90 frequencies (Private Land Mobile) as declared by the applicant.

2.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Terminated with
1	Speaker-Microphone Connector	1	ICOM Multi-connector Jack	Speaker-Microphone
2	Antenna Connector	1	SMA	50 Ohm Load/Antenna
3.	USB	1	Micro USB connector	Micro USB Cable

2.5. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

Ancillary Equipment # 1	
Description:	Speaker Microphone
Brand name:	ICOM
Model Name or Number:	HM-222
Connected to EUT's Port:	Speaker-Microphone Connector

EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C - 24°C
Humidity:	45% to 58%
Pressure:	102 kPa
Power Input Source:	7.5 VDC Nominal

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TEST SIGNALS

Operating Modes:	The transmitter was operated in a continuous transmission mode with the carrier modulated as specified in the Test Data.
Special Test Software:	N/A
Special Hardware Used:	N/A
Transmitter Test Antenna:	The EUT is tested with the antenna port terminated to a 50 Ohm RF Load.

Transmitter Test Signals	
Frequency Band(s):	769-775 MHz, 799-805 MHz & 806-824 MHz and 851-869 MHz
Test Frequencies: (Near lowest, near middle & near highest frequencies in the frequency range of operation of applicable band)	769.1 MHz, 774.9 MHz, 799.1 MHz, 804.9 MHz, 806.1 MHz, 815.1 MHz, 823.9 MHz, 851.1 MHz, 860.1 MHz, 868.9 MHz
Transmitter Wanted Output Test Signals: Transmitter Power (measured maximum output power): Normal Test Modulation: Modulating signal source:	 3.12 W High FM Voice/Digital External

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with ANAB File No.: AT-1945.

4.2. APPLICABILITY & SUMMARY OF EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Applicability (Yes/No)
1.1307, 1.1310, 2.1091 & 2.1093 RSS-Gen, §3.4 & RSS-102	RF Exposure Limit	Yes, Refer to SAR Report
2.1046, 22.565, 90.205, 90.541 (d) RSS-119 § 5.4	RF Power Output	Yes
90.543(f)	GNSS (EIRP)	Yes for 769-805MHz Band
2.1047(a), & 90.242(b)(8)	Audio Frequency Response	N/A
2.1047(b) & 90.210	Modulation Limiting	N/A for this C2PC
2.1049 90.209, 90.210, 90.691 RSS-Gen § 6.7 RSS-119 § 5.5	Emission Limitation & Emission Mask	N/A for this C2PC
2.1051, 2.1057, 90.210, 90.543 RSS-119 § 5.8	Emission Limits - Spurious Emissions at Antenna Terminal	Yes
2.1053, 2.1057, 22.359, 90.210, 90.543 RSS-119 § 5.8	Emission Limits - Field Strength of Spurious Emissions	Yes
90.543 RSS-119 § 5.8.9.1	Adjacent Channel Power	N/A for this C2PC
2.1055, 22.355, 90.213 & 90.539 RSS-119 § 5.3	Frequency Stability	Yes
90.214 RSS-119 § 5.9	Transient Frequency Behavior	N/A
ICES-003	Radiated Emissions from Digital Apparatus – Radiated	Yes
RSS-Gen § 8.8 ICES-003	Power Line Conducted Emissions from Digital Apparatus	N/A- battery operated.
RSS-Gen, Section 7.3	Receiver Spurious Emissions (Radiated)	Yes
RSS-Gen, Section 7.4	Receiver Spurious Emissions (Antenna Conducted)	Yes

UHF P25 Transceiver, Model No.: IC-F7040T, by ICOM Incorporated has also been tested and found to comply with FCC Part 15, Subpart B - Radio Receivers Digital Devices.

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None

4.3.1. DEVIATION OF STANDARD TEST PROCEDURES

None

EXHIBIT 5. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

5.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in EXHIBIT 8 of this report.

5.2. MEASUREMENT UNCERTAINTIES

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.
Refer to Exhibit 7 for Measurement Uncertainties.

5.3. MEASUREMENT EQUIPMENT USED

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C63.4 and CISPR 16-1-1.

5.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUFACTURER

The essential function of the EUT is to communicate to and from radios over RF link.

5.5. RF POWER OUTPUT [§§ 2.1046, 22.565, 90.205, 90.541& 90.543] [RSS-119 § 5.4]

5.5.1. Limits

Please refer to FCC 47 CFR 90.205, 90.541, 90.543 & 22.565 for specification details.

[RSS-119 § 5.4]
The output power shall be within ± 1.0 dB of the manufacturer's rated power

Frequency Bands (MHz)	Transmitter Output Power (W)	
	Base/Fixed Equipment	Mobile Equipment
768-776 and 798-806	As per SRSP-511 for ERP limit	30 **3 W ERP** for portable equipment
806-821/851-866 and 821-824/866-869	110	30
896-901/935-940	110	60

5.5.2. Method of Measurements

Refer to Section 8.1 (Conducted) and 8.2 (Radiated) of this report for measurement details

5.5.3. Test Data

769-805 MHz band Conducted power

Frequencies MHz	Actual Power dBm	Actual Power Watts	Power Rating Watts
769.100	34.53	2.84	3.0
774.900	34.52	2.83	3.0
799.100	34.60	2.88	3.0
804.900	34.61	2.89	3.0
769.100	29.91	0.98	1.0
774.900	29.95	0.99	1.0
799.100	30.08	1.02	1.0
804.900	30.12	1.03	1.0

769-805 MHz band Radiated power ERP with Antenna @ 90.541(d)

Frequency (MHz)	Antenna Polatrization	Measured (dBuV)	ERP (dBm)	ERP Limit (dBm)	Margin
769.1	V	133.94	32.55	34.77	-2.2
769.1	H	120.16	24.75	34.77	-10.0
774.9	V	131.24	32.95	34.77	-1.8
774.9	H	121.65	21.15	34.77	-13.6
799.1	V	131.4	32.95	34.77	-1.8
799.1	H	119.48	19.05	34.77	-15.7
804.9	V	130.15	31.35	34.77	-3.4
804.9	H	122.13	17.65	34.77	-17.1

806-869MHz Band Conducted power

Channel	Frequencies MHz	Wide/ Narrow	Actual Power dBm	Actual Power Watts	Power Rating Watts
7	806.100	Narrow	34.68	2.94	3.0
8	815.100	Narrow	34.74	2.98	3.0
9	823.900	Narrow	34.79	3.01	3.0
10	851.100	Narrow	34.94	3.12	3.0
11	860.100	Narrow	34.92	3.10	3.0
12	868.900	Narrow	34.91	3.10	3.0
19	806.100	Narrow	30.11	1.03	1.0
20	815.100	Narrow	30.10	1.02	1.0
21	823.900	Narrow	30.09	1.02	1.0
22	851.100	Narrow	30.04	1.01	1.0
23	860.100	Narrow	30.05	1.01	1.0
24	868.900	Narrow	30.08	1.02	1.0
25	806.100	Mid	34.59	2.88	3.0
26	851.100	Mid	34.88	3.08	3.0
27	806.100	Mid	30.07	1.02	1.0
28	851.100	Mid	30.01	1.00	1.0

5.6. TRANSMITTER ANTENNA POWER SPURIOUS/HARMONIC CONDUCTED EMISSIONS [§ 2.1051, 2.1057, 22.359, & 90.210] [RSS-119 § 5.5 & 5.8]

5.6.1. Limits

Emissions shall be attenuated below the mean output power of the transmitter as follows:

FCC Rules	Attenuation Limit (dBc)
§ 90.210(b)	At least 43 + 10 log (P) dB.
§ 90.210(d)	At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.
§ 90.543(b)	At least 43 + 10 log (P) dB

RSS -119
The maximum permissible occupied bandwidth shall not exceed the authorized bandwidth specified in Table 3 for the equipment's frequency band.

Table 3 - Channel Spacing, Authorized Bandwidths and Applicable Spectrum Masks

Frequency Band (MHz)	Related SRSP for Channelling Plan and ERP	Channel Spacing (kHz)	Authorized Bandwidth (kHz)	Spectrum Masks with Audio Filter	Spectrum Masks Without Audio Filter
764-776 and 794-806	SRSP-511	6.25, 12.5, 25, 50	Note 2	Section 5.8.9	Section 5.8.9
806-821-/851-866 and 821-824/866-869	SRSP-502	25	20	B	G
		12.5	11.25	D	D
896-901/ 935-940	SRSP-506	12.5	13.6	I	J (G, Note 3)

Note 2: Provided that the ACP requirements in Section 5.8.9.1 are met, any authorized bandwidth that does not exceed the channel bandwidth can be used.

Note 3: Mask G applies if two 12.5 kHz channels are aggregated. Alternatively, a mask may be used which does not produce more adjacent channel interference than narrowband (12.5 kHz) channel equipment.

RSS-119, Issue 12 Tables 6 & 7	Frequency Range	Attenuation Limit (dBc)
Mask D	30 MHz or lowest radio frequency signal generated in the device to the tenth harmonic of the highest fundamental frequency.	At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.
Mask E	30 MHz or lowest radio frequency signal generated in the device to the tenth harmonic of the highest fundamental frequency.	At least 55 + 10 log (P) or 65 dB, whichever is the lesser attenuation.
Mask B	30 MHz or lowest radio frequency signal generated in the device to the tenth harmonic of the highest fundamental frequency.	At least 43 + 10 log (P).

5.6.2. Method of Measurements

Refer to Section 8.5 of this report for measurement details

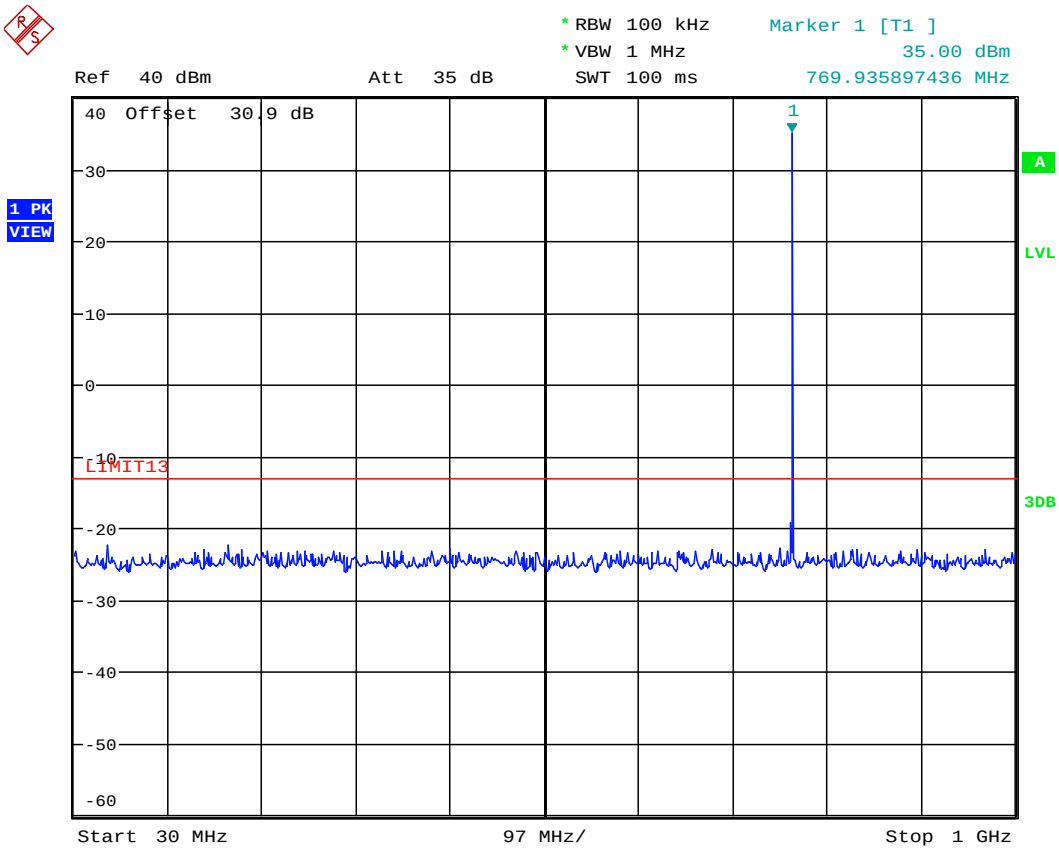
5.6.3. Test Data

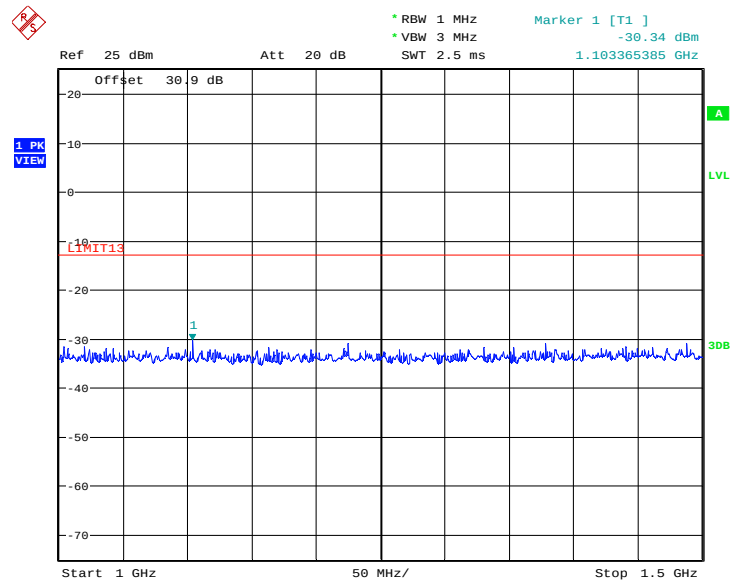
Note: There was no difference in spurious/harmonic emissions on the pre-scans for different channel spacing and modulation types. Therefore, the RF spurious/harmonic emissions in this section would be performed for Digital modulation with 12.5 kHz channel spacing F1W Digital. The frequencies were investigated from 30 MHz- 9 GHz.

Band 1: 769-775 MHz

High Power

5.6.3.1. Configuration: Tx Conducted Emission, Band 1: 769-775MHz, 769.1MHz, F1W, Digital, High power





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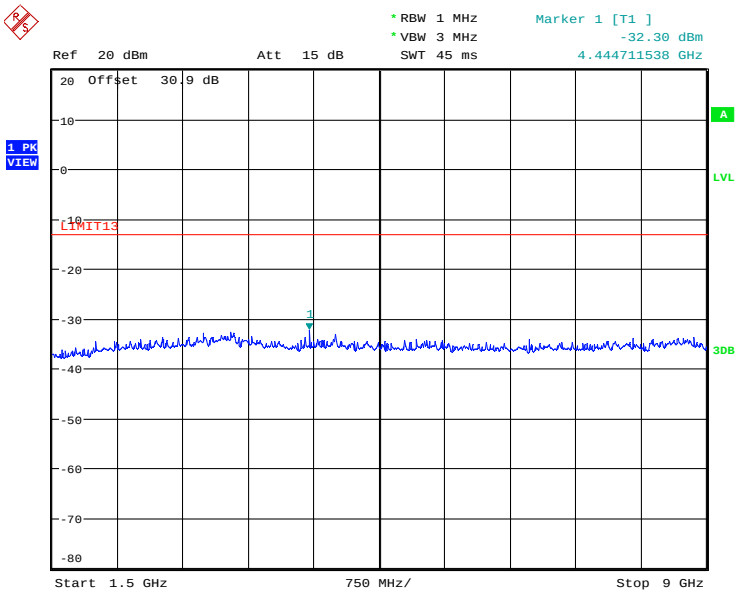

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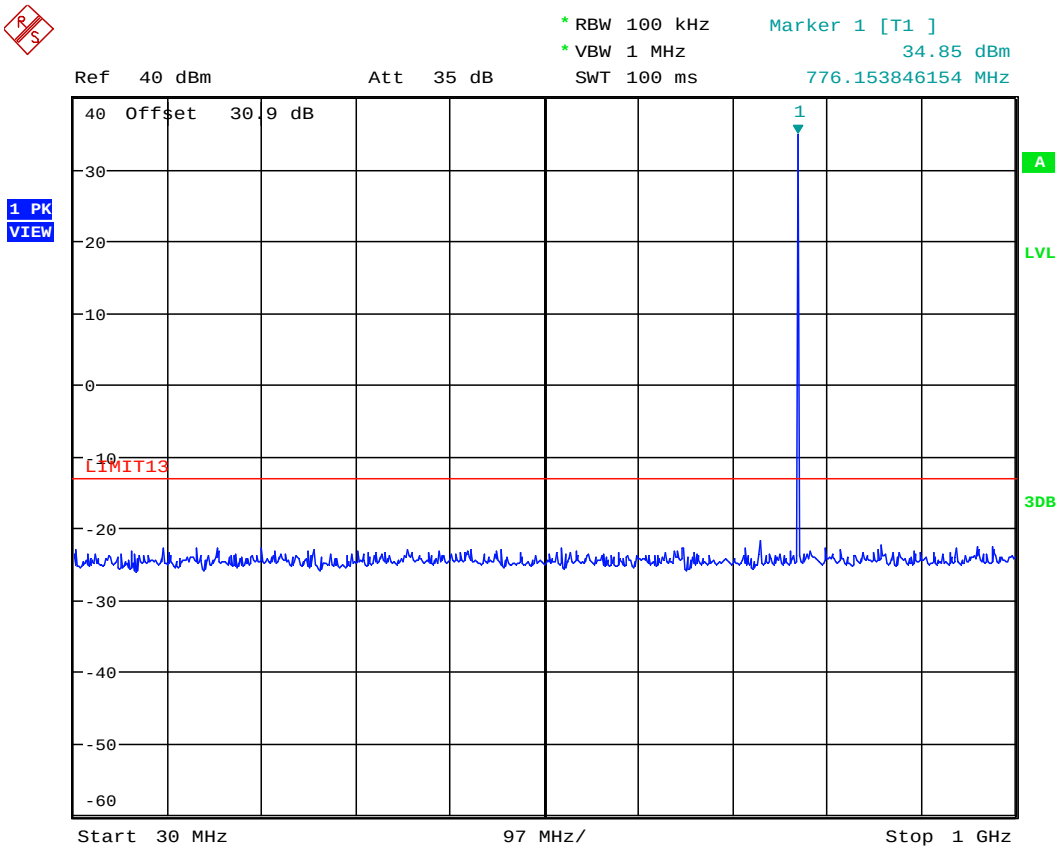
5.6.3.2. Configuration: Tx Conducted Emission, Band 1: 769-775MHz, 774.9MHz, F1W, Digital, High power



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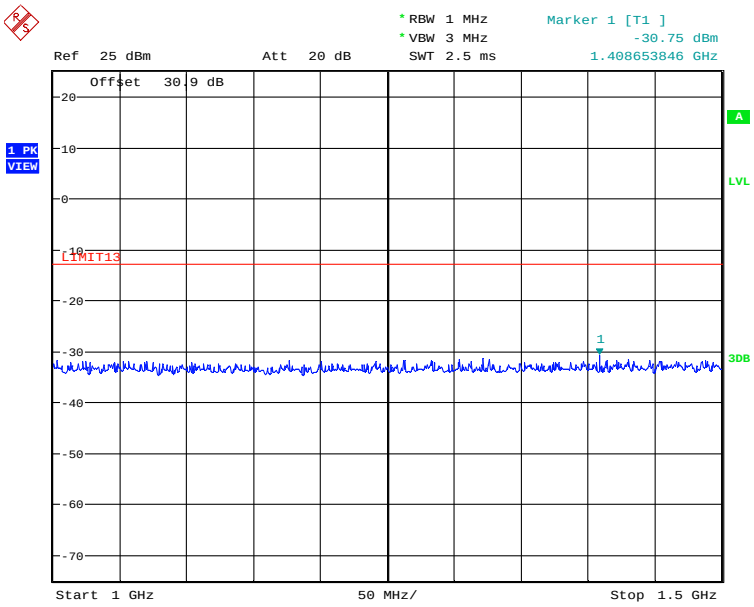

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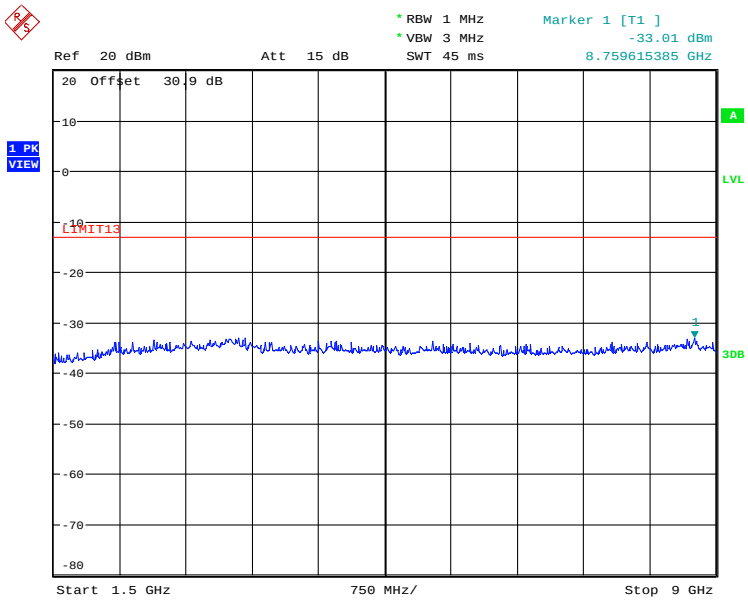

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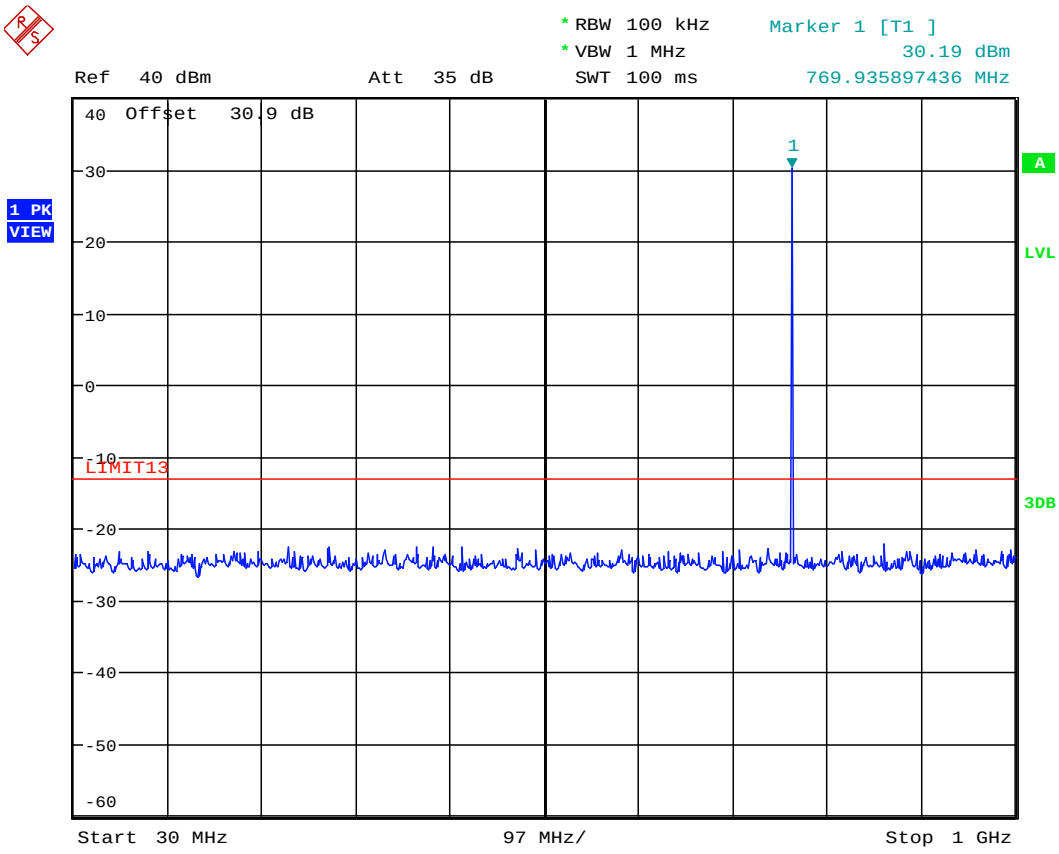
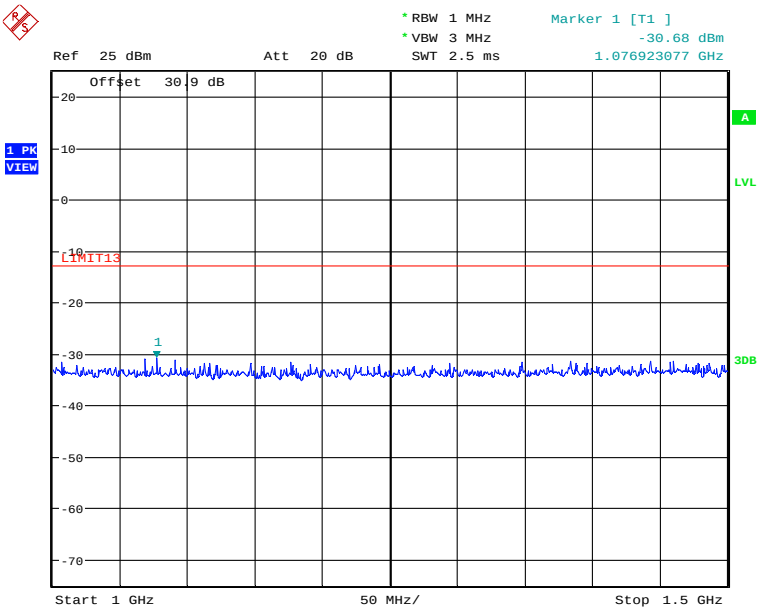
Low Power

5.6.3.3. Configuration: Tx Conducted Emission, Band 1: 769-775MHz, 769.1MHz, F1W, Digital, Low power





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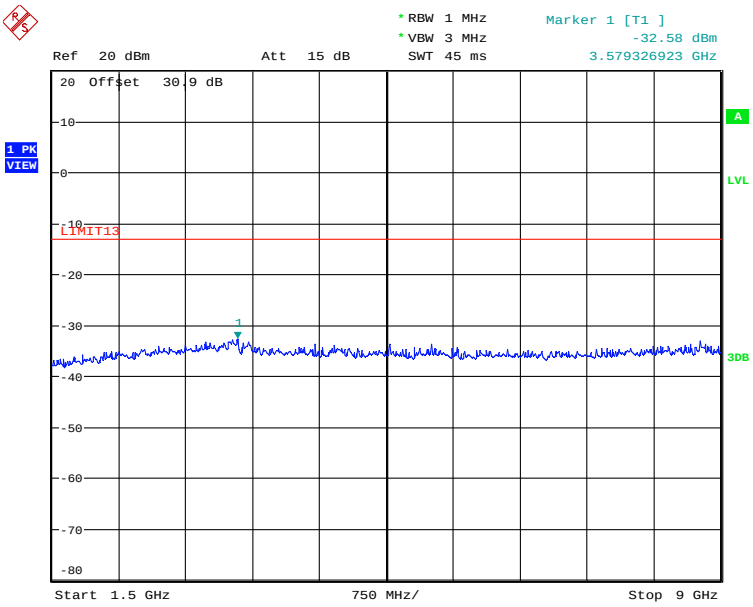

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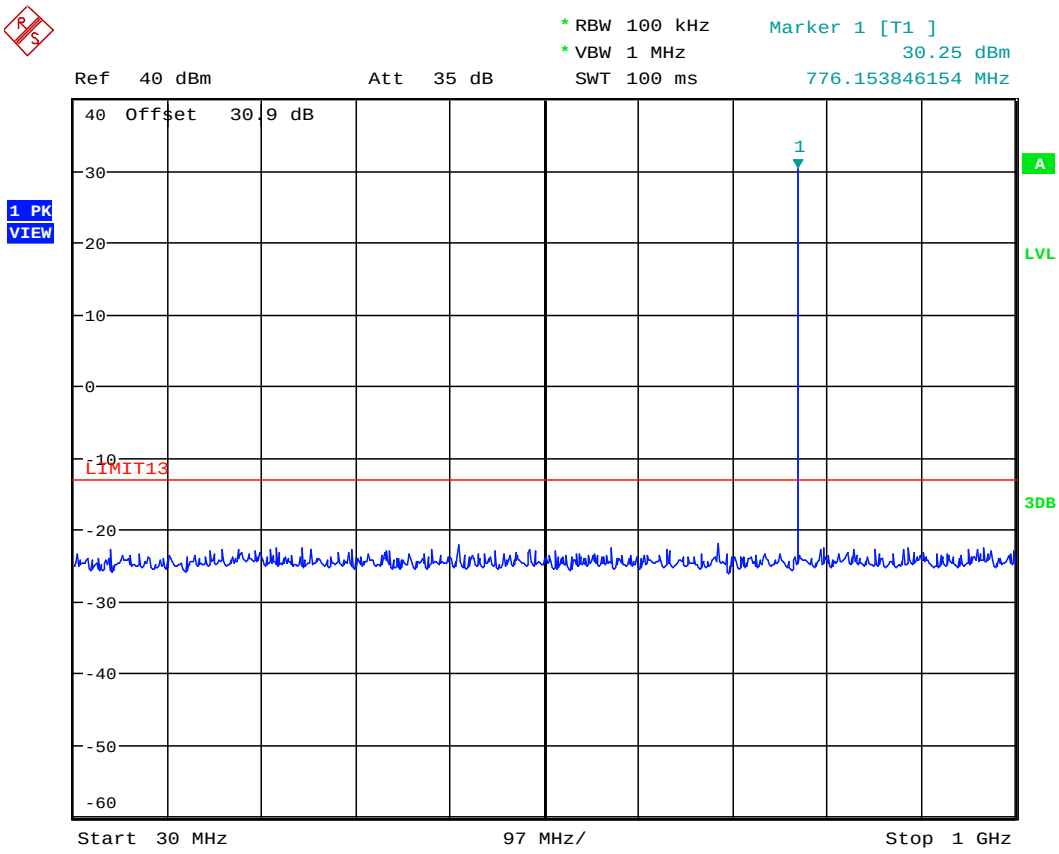
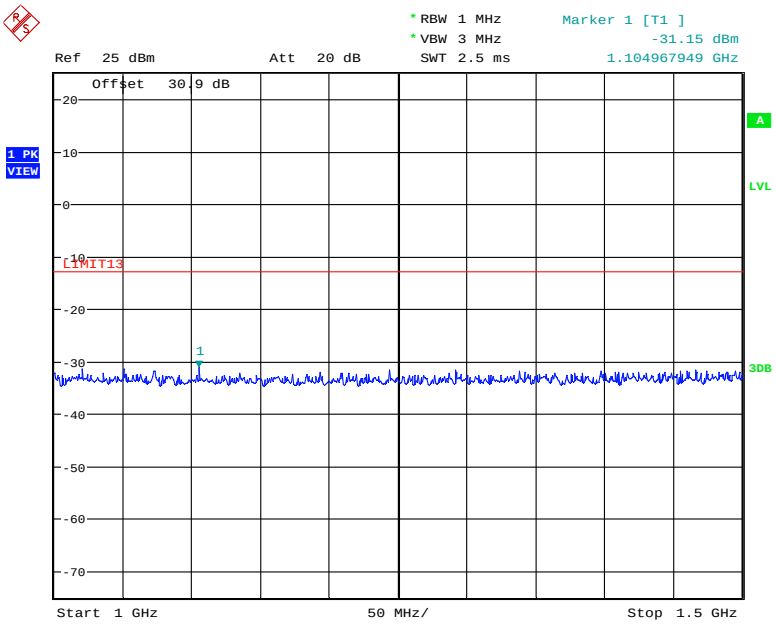
5.6.3.4. Configuration: Tx Conducted Emission, Band 1: 769-775MHz, 774.9MHz, F1W, Digital, Low power





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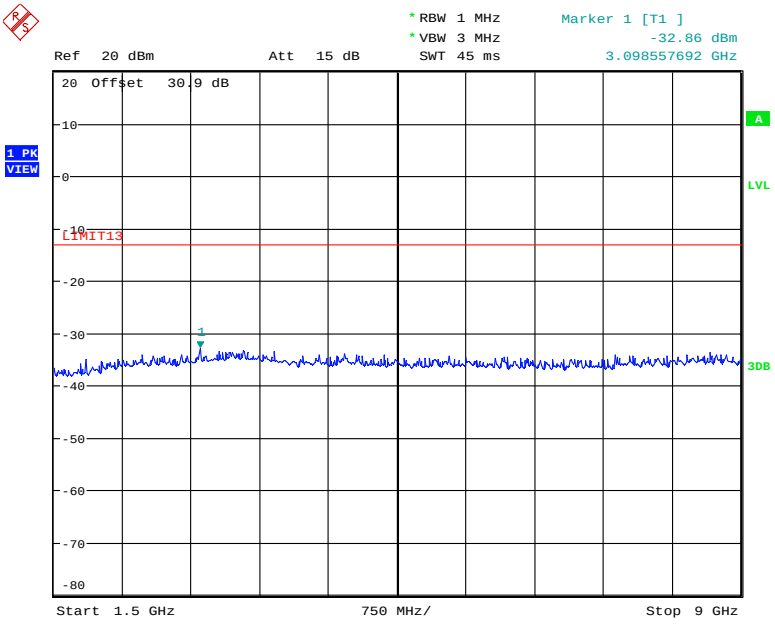

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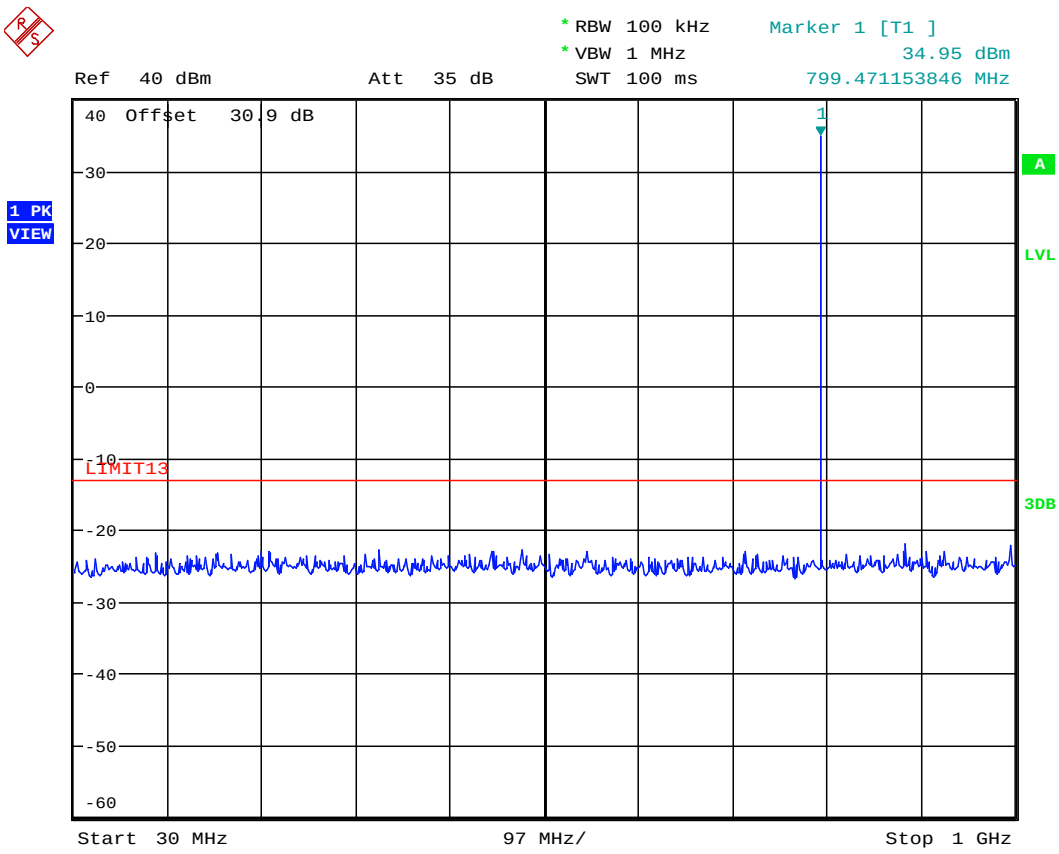
Band 2: 799-805 MHz

High Power

5.6.3.5. Configuration: Tx Conducted Emission, Band 2: 799-805MHz, 799.1MHz, F1W, Digital, High power



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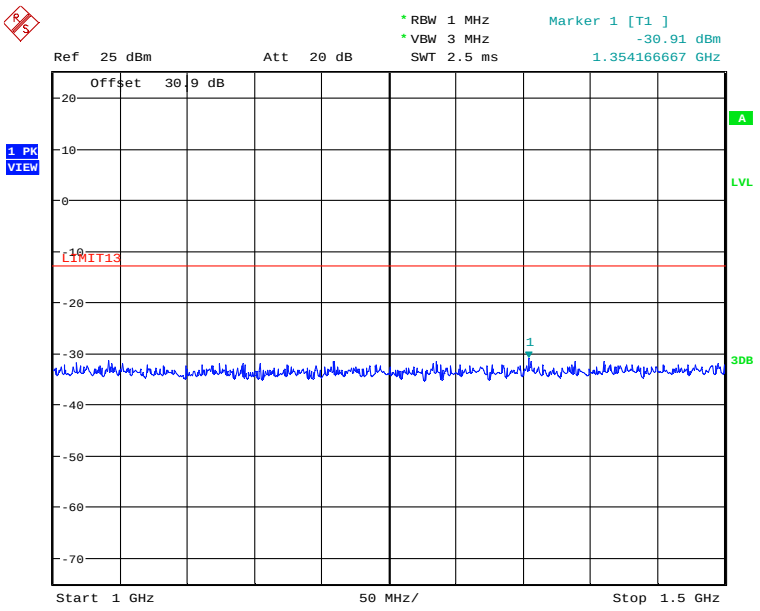

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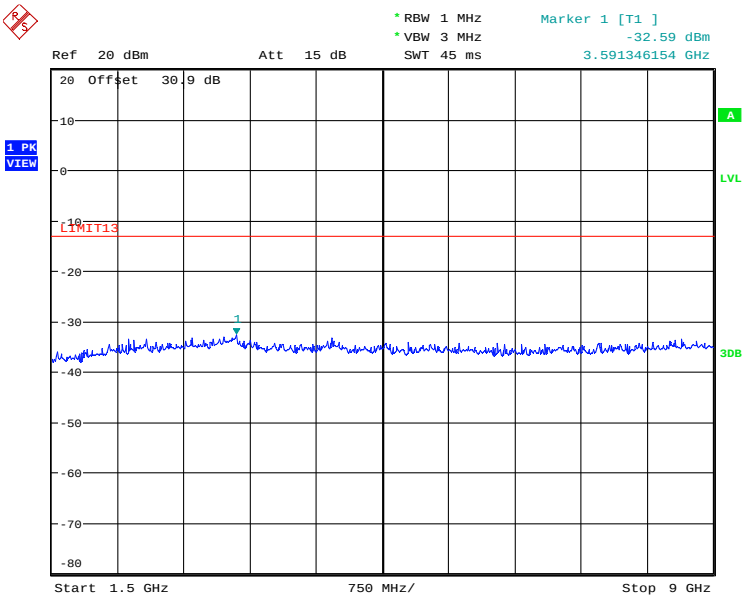

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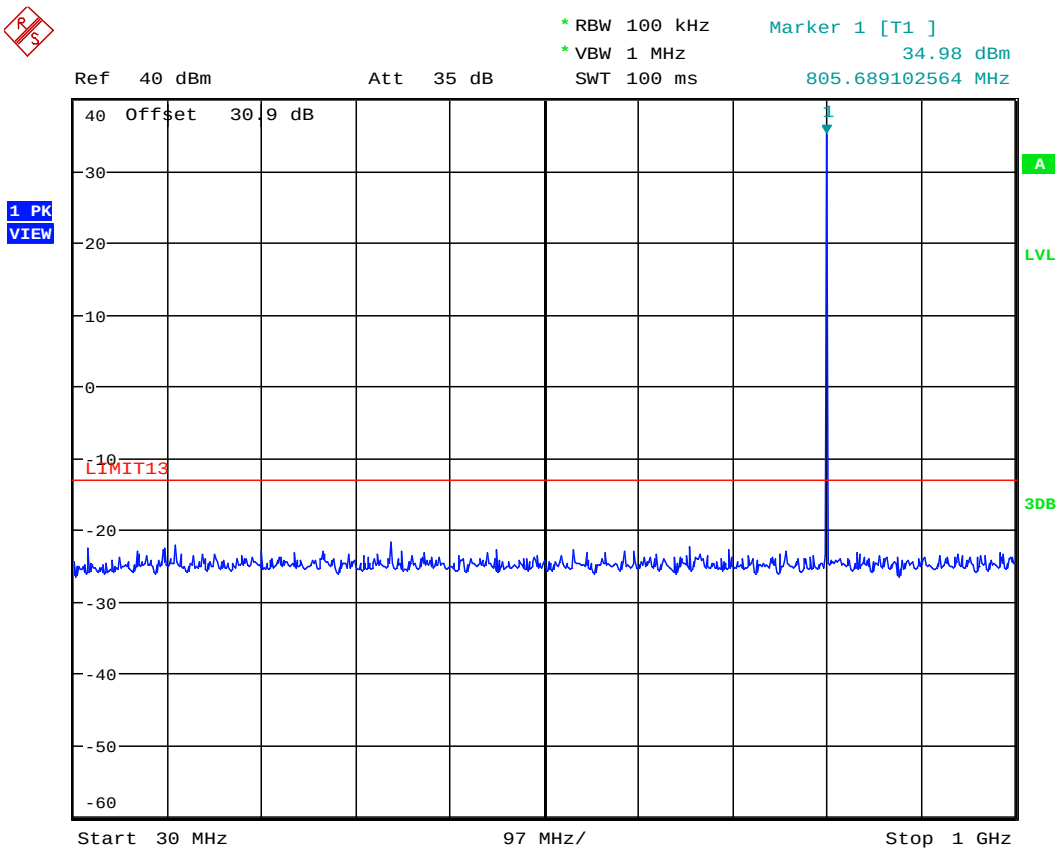
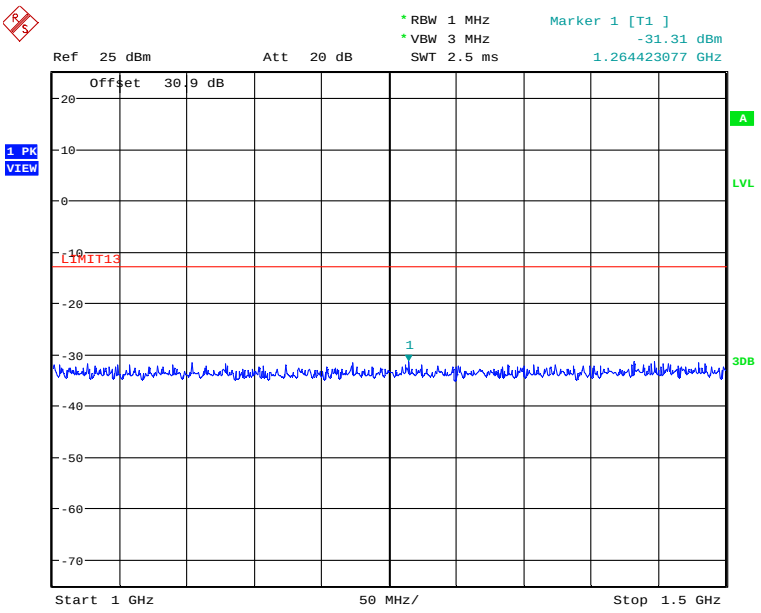
5.6.3.6. Configuration: Tx Conducted Emission, Band 2: 799-805MHz, 804.9MHz, F1W, Digital, High power





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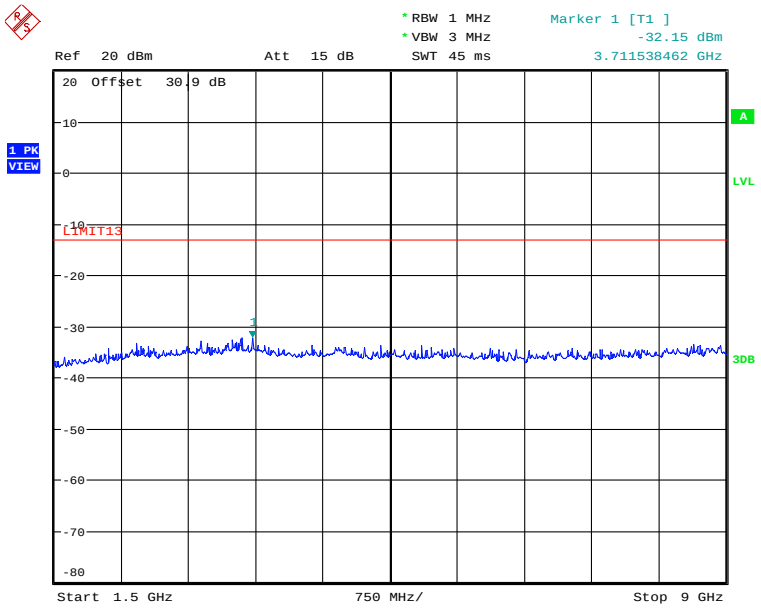

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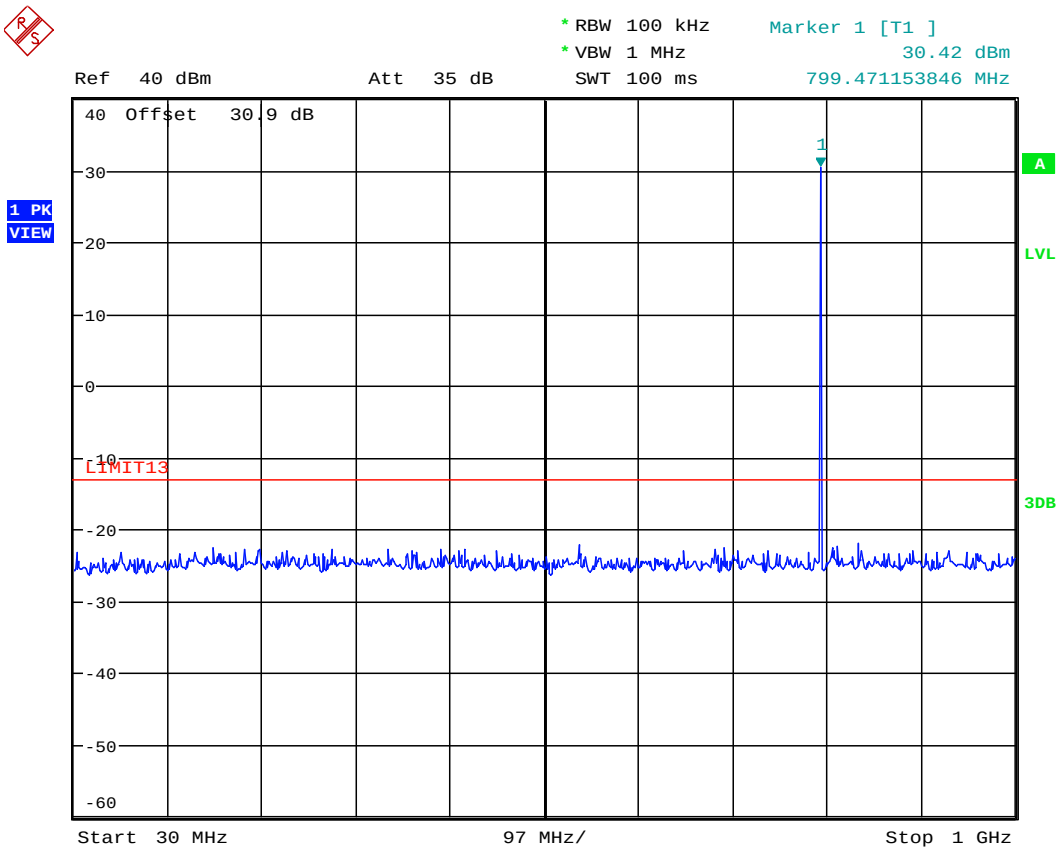
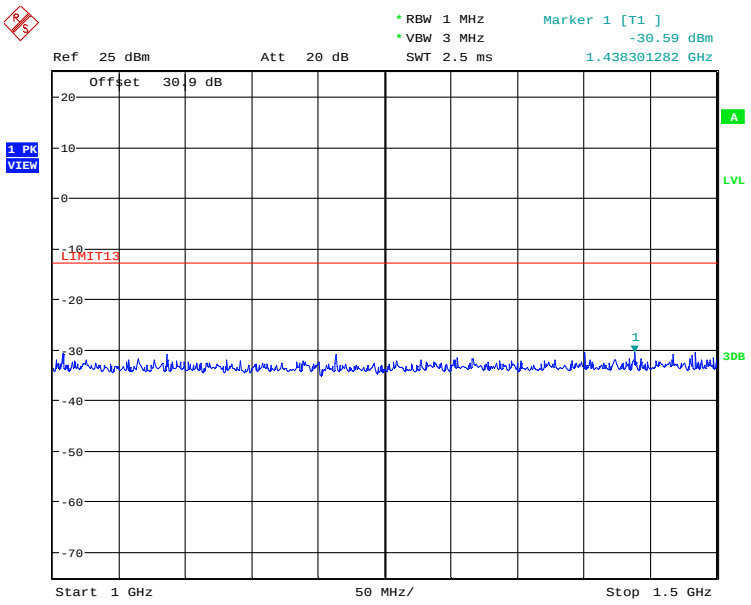
Low Power

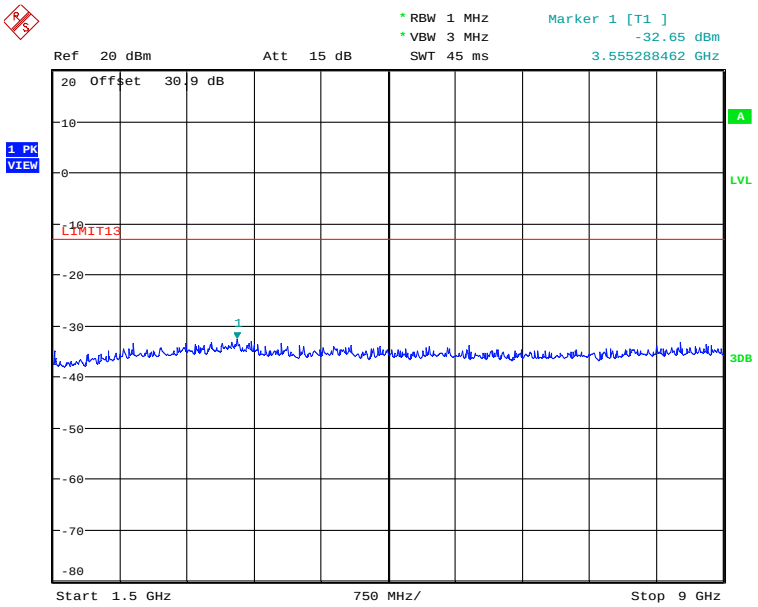
5.6.3.7. Configuration: Tx Conducted Emission, Band 2: 799-805MHz, 799.1MHz, F1W, Digital, Low power



Date: 14.APR.2022 14:43:42

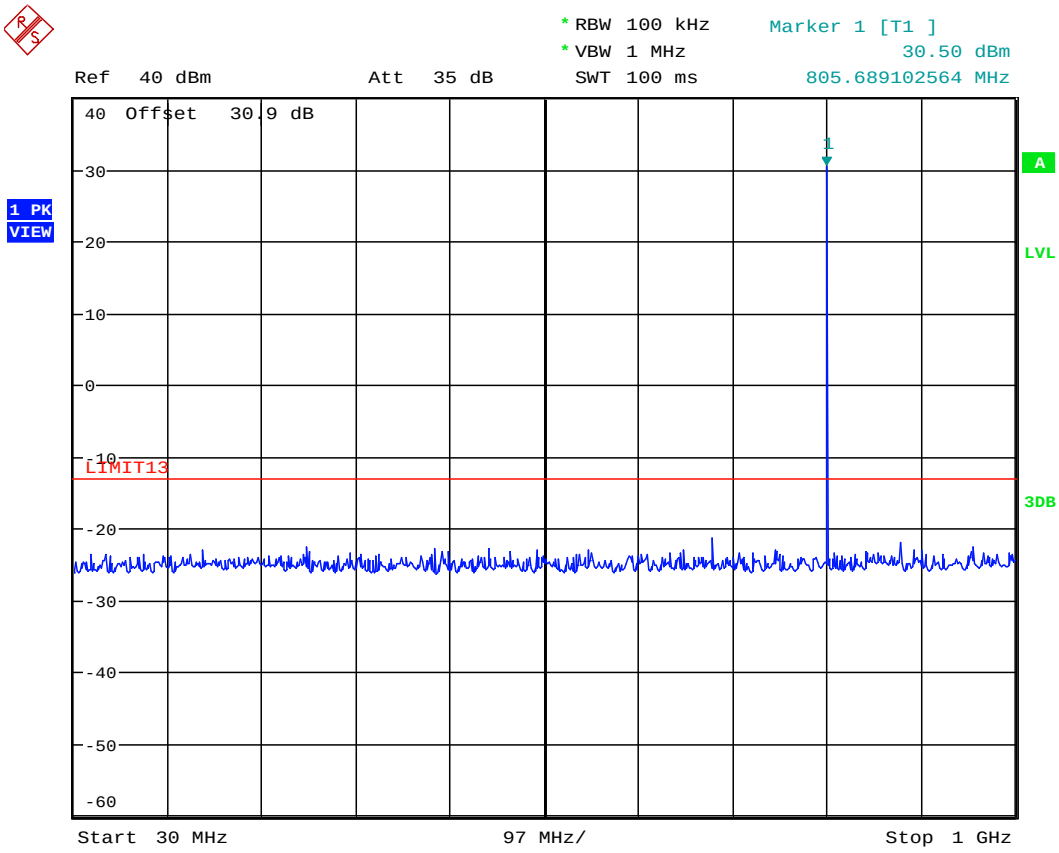


Date: 14.APR.2022 15:12:28

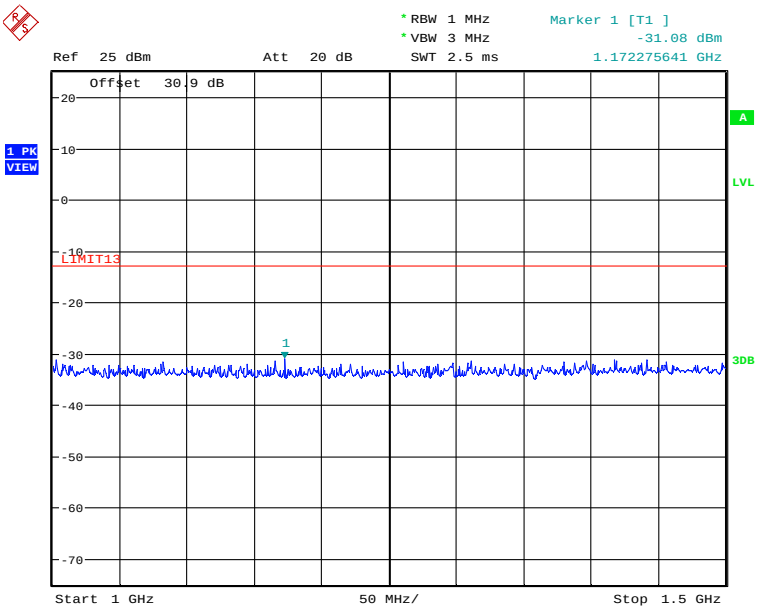


Date: 14.APR.2022 15:21:40

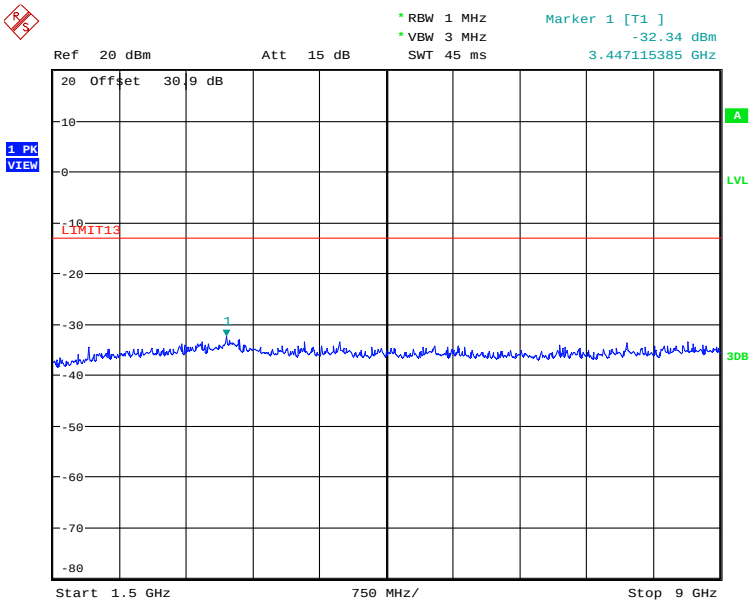
5.6.3.8. Configuration: Tx Conducted Emission, Band 2: 799-805MHz, 804.9MHz, F1W, Digital, Low power



Date: 14.APR.2022 14:52:28



Date: 14.APR.2022 15:13:07

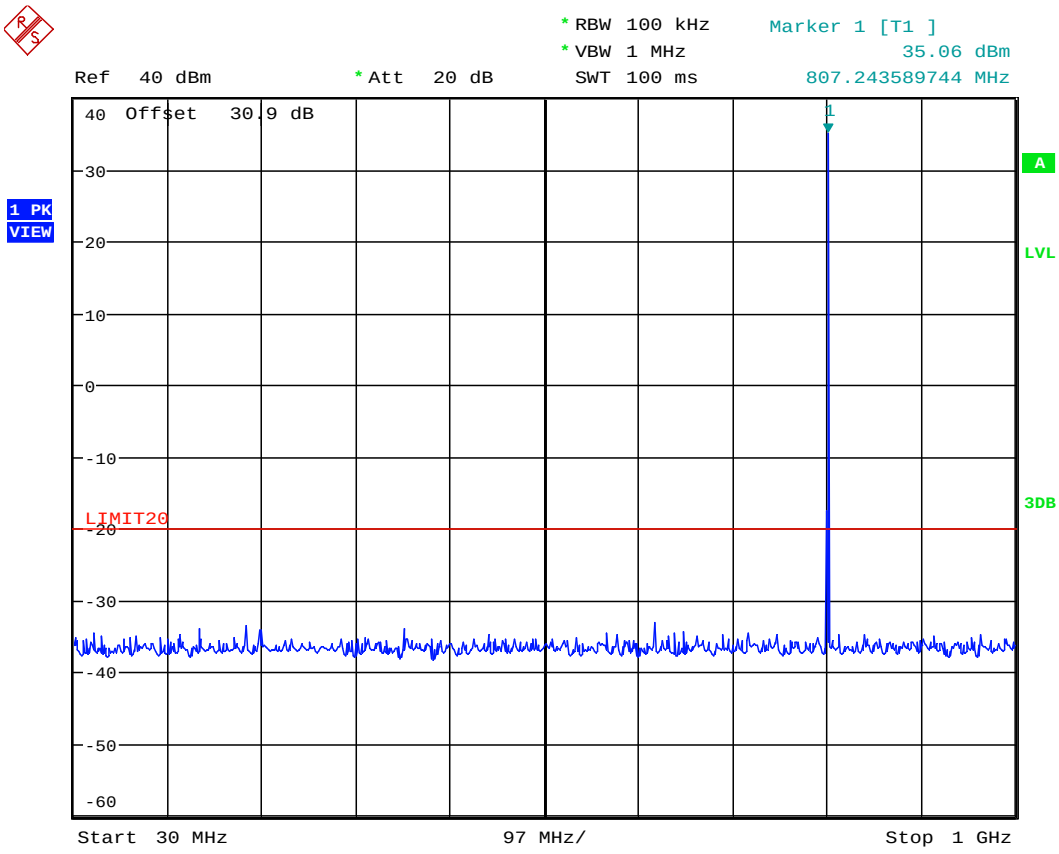


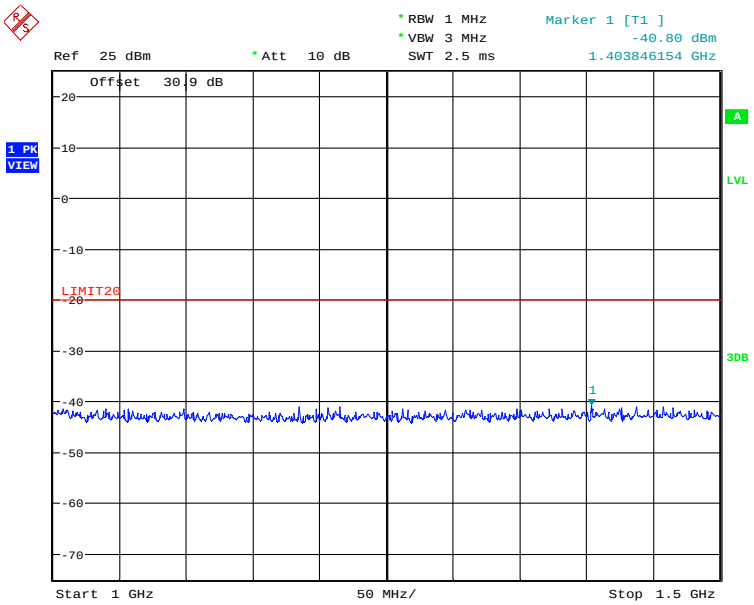
Date: 14.APR.2022 15:22:26

Band 3: 806-824 MHz

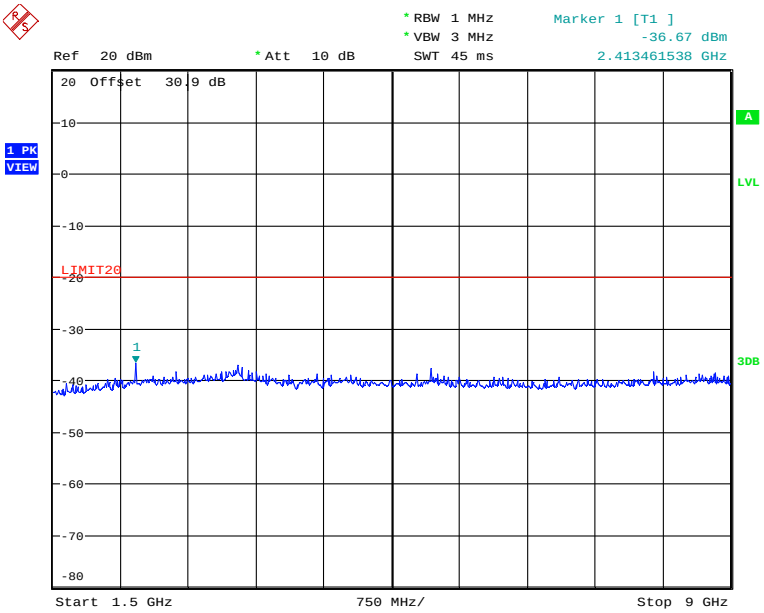
High Power

5.6.3.9. Configuration: Tx Conducted Emission, Band 3: 806-824MHz, 806.1MHz, F1W, Digital, High power



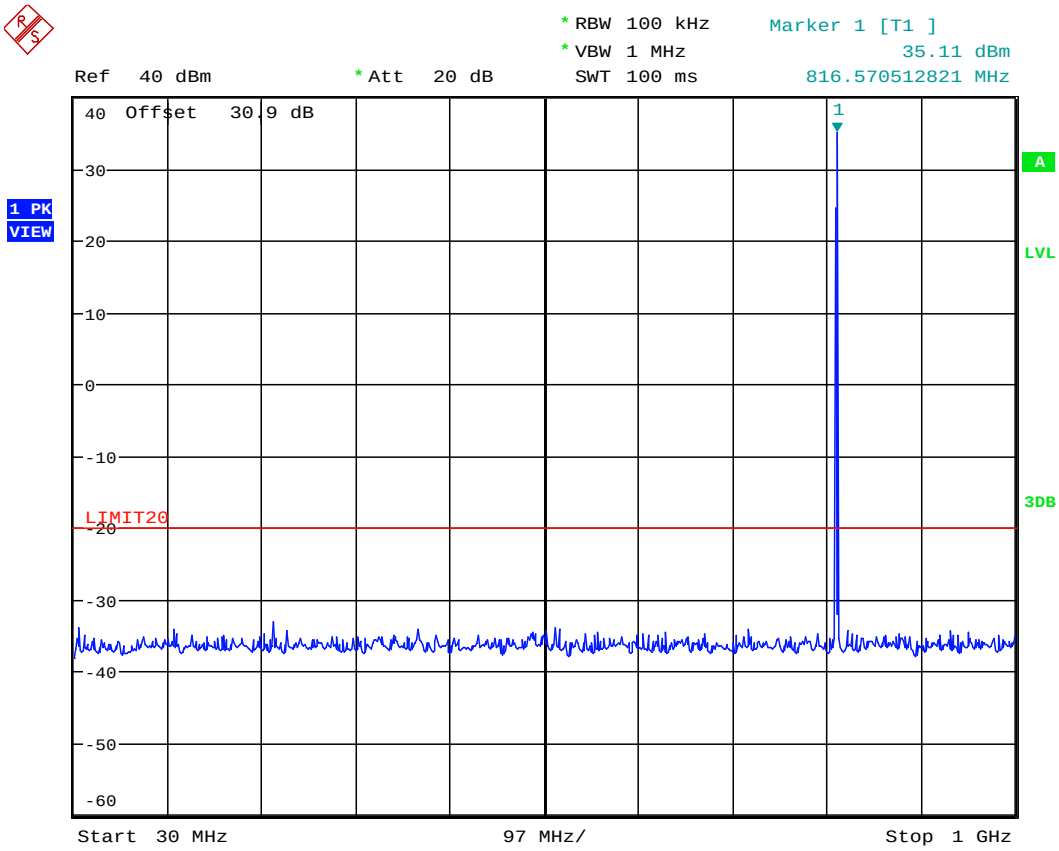


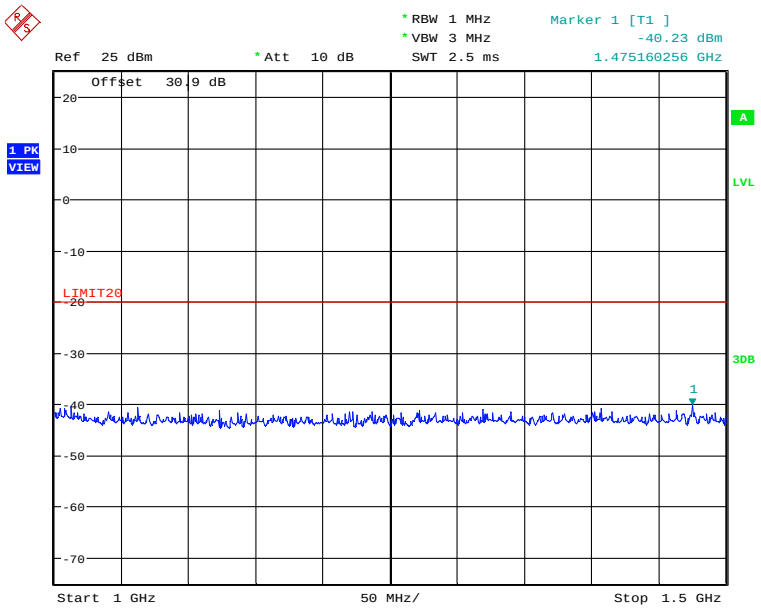
Date: 14.APR.2022 15:52:21



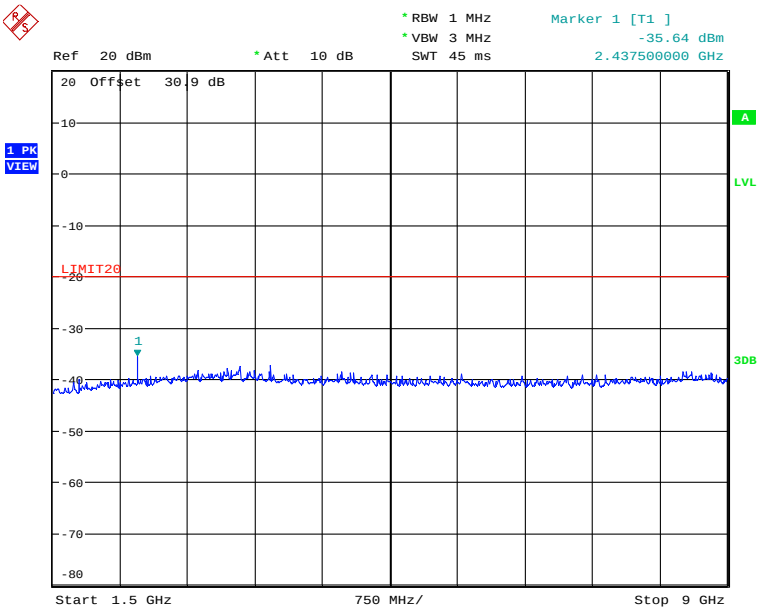
Date: 14.APR.2022 16:04:03

5.6.3.10. Configuration: Tx Conducted Emission, Band 3: 806-824MHz, 815.1MHz, F1W, Digital, High power



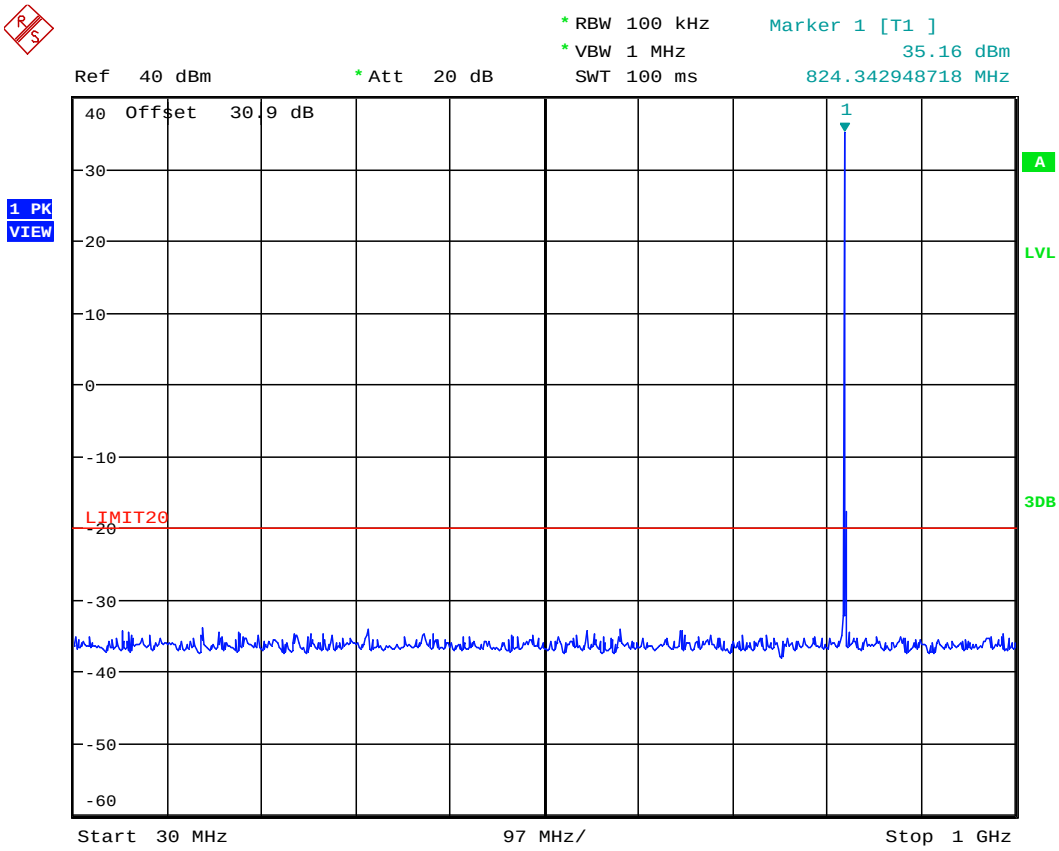


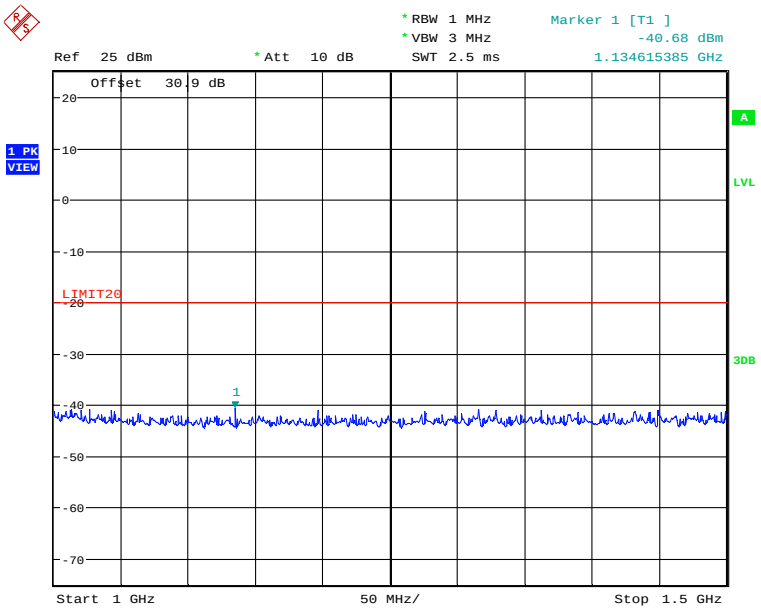
Date: 14.APR.2022 15:53:01



Date: 14.APR.2022 16:05:05

5.6.3.11. Configuration: Tx Conducted Emission, Band 3: 806-824MHz, 823.9MHz, F1W, Digital, High power





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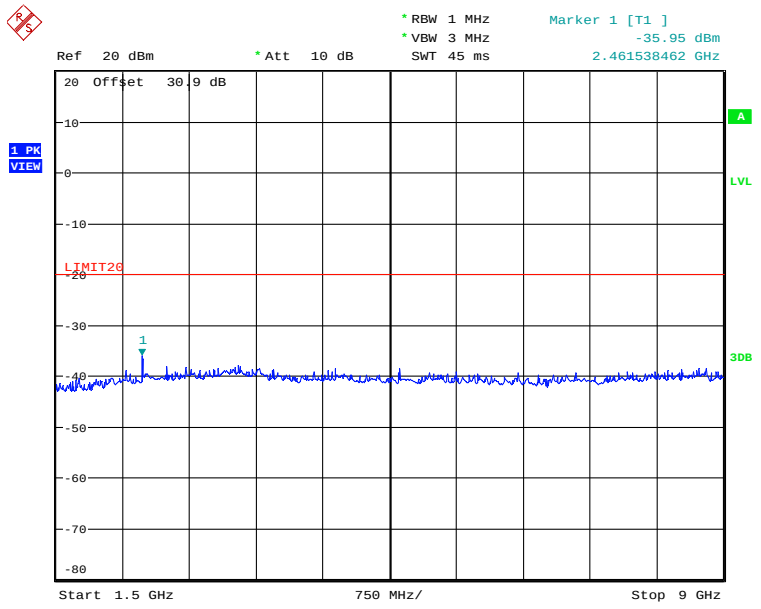
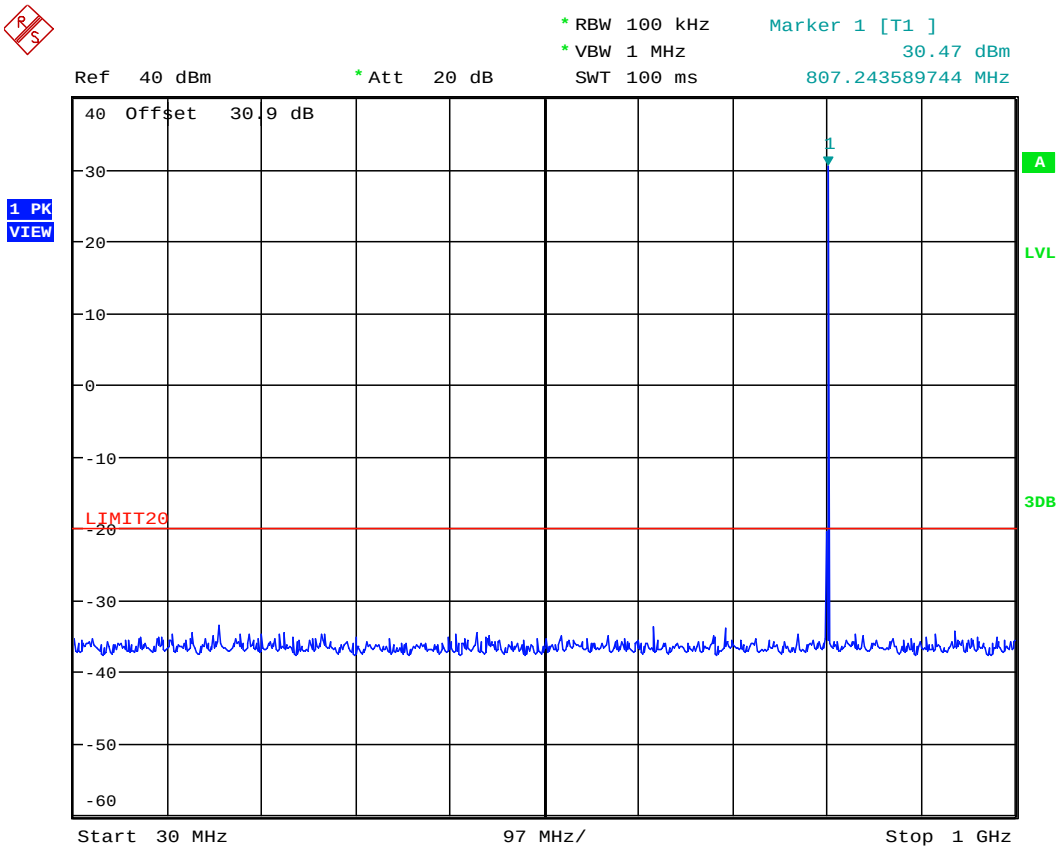


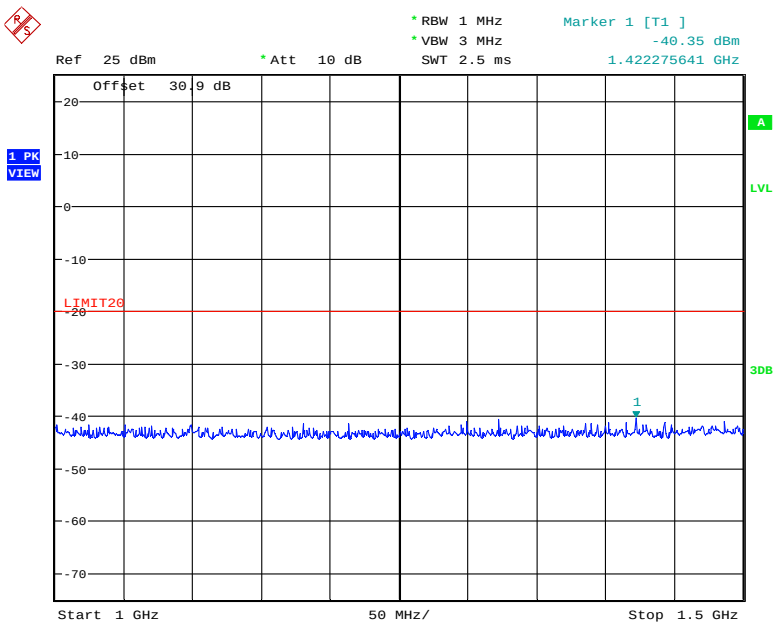
Date: 14.APR.2022 16:05:56

Low Power

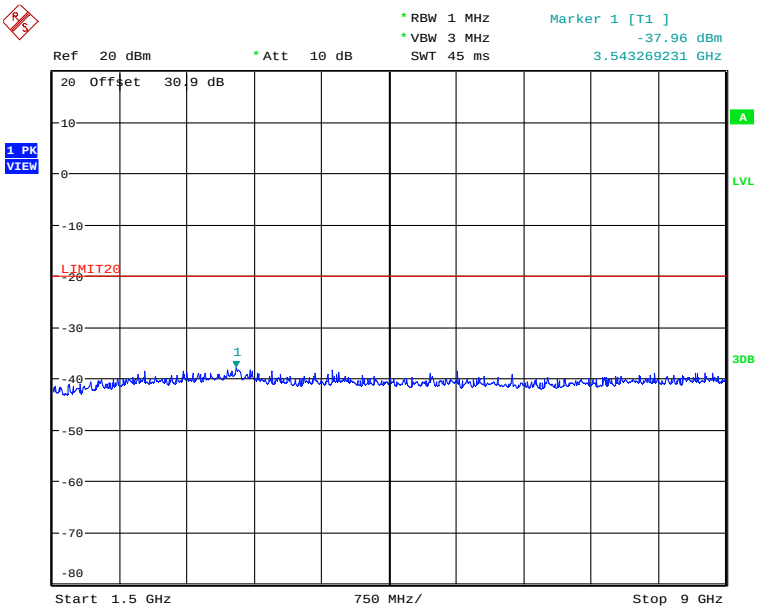
5.6.3.12. Configuration: Tx Conducted Emission, Band 3: 806-824MHz, 806.1MHz, F1W, Digital, Low power



Date: 14.APR.2022 15:46:42

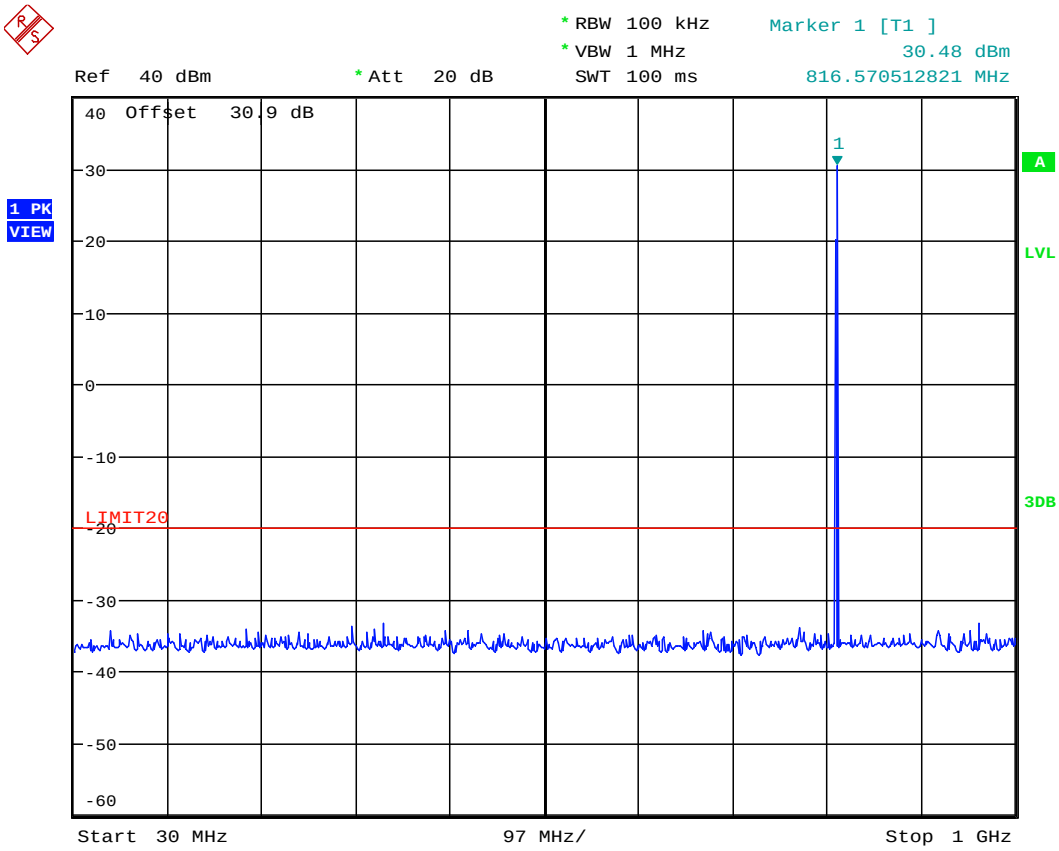


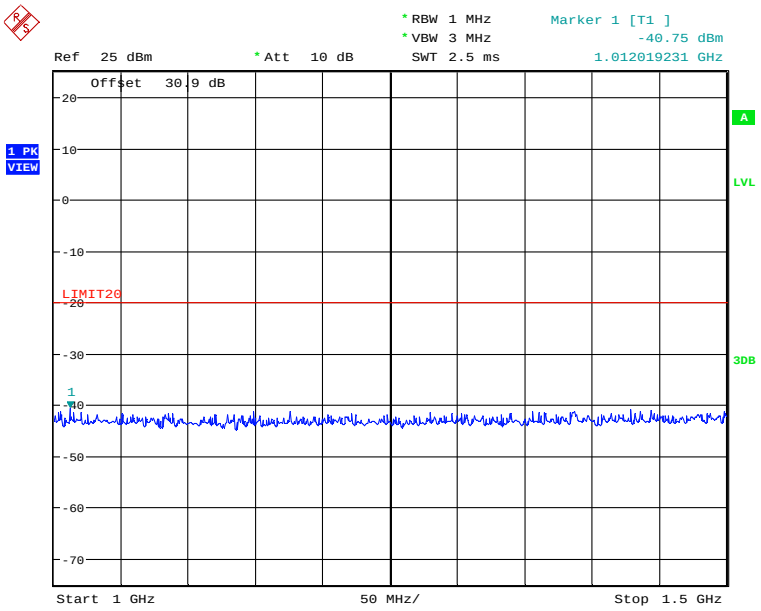
Date: 14.APR.2022 15:57:32



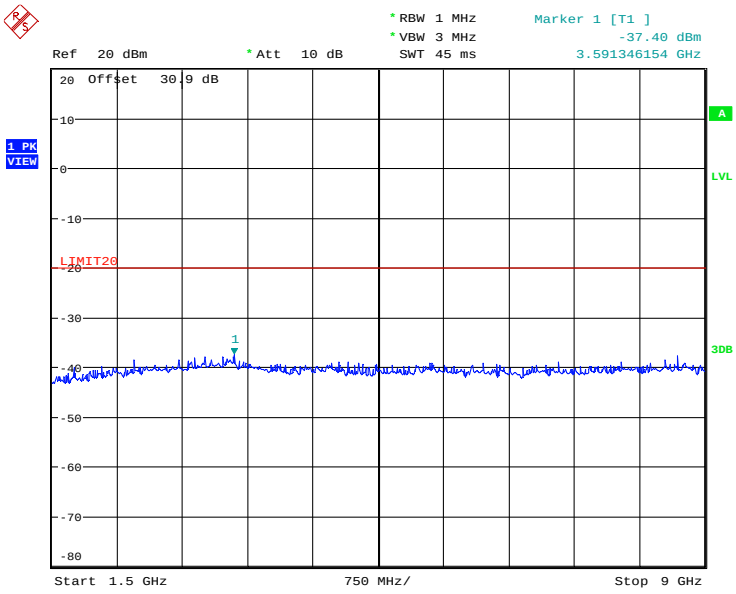
Date: 14.APR.2022 16:10:30

5.6.3.13. Configuration: Tx Conducted Emission, Band 3: 806-824MHz, 815.1MHz, F1W, Digital, Low power



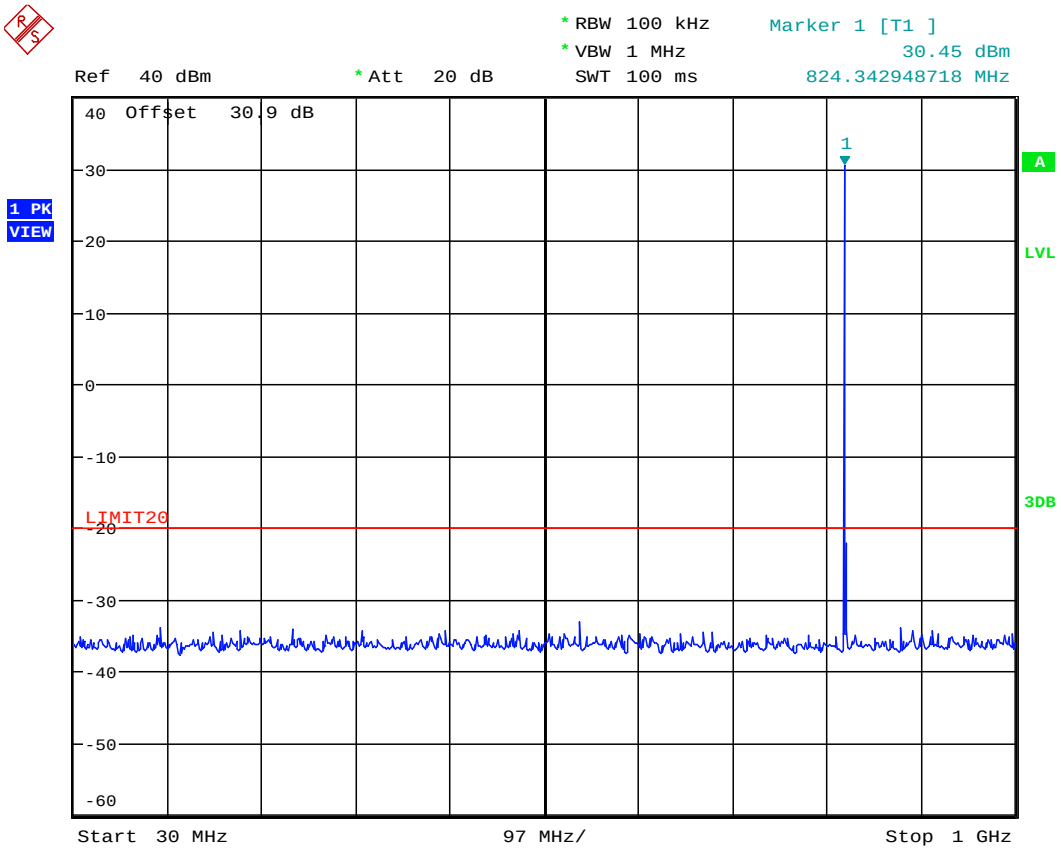


Date: 14.APR.2022 15:58:11

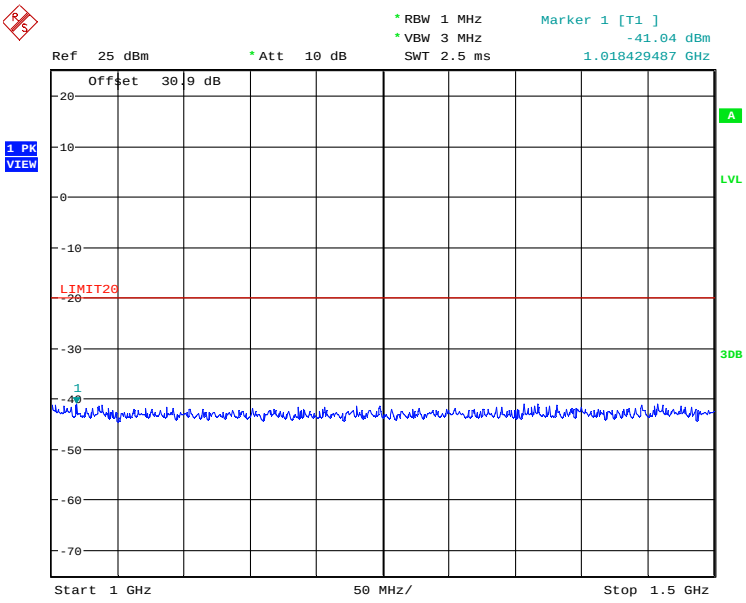


Date: 14.APR.2022 16:11:17

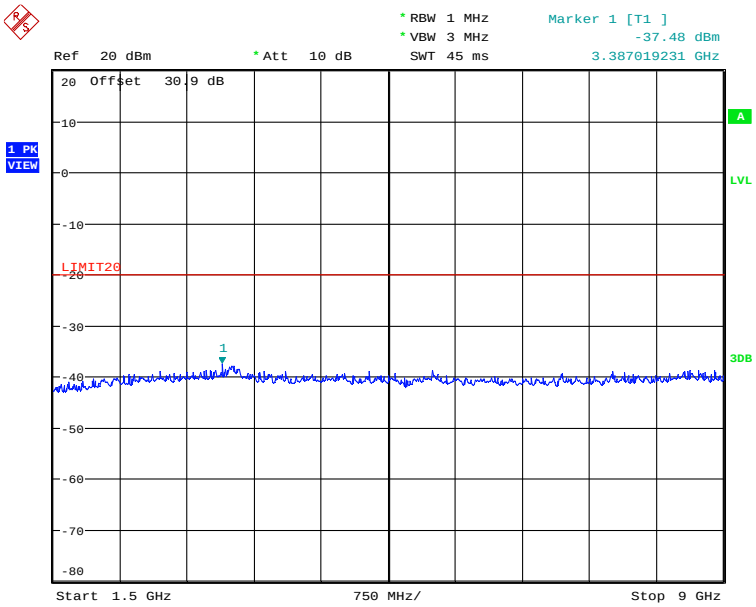
5.6.3.14. Configuration: Tx Conducted Emission, Band 3: 806-824MHz, 823.9MHz, F1W, Digital, Low power



Date: 14.APR.2022 15:47:46



Date: 14.APR.2022 15:59:05

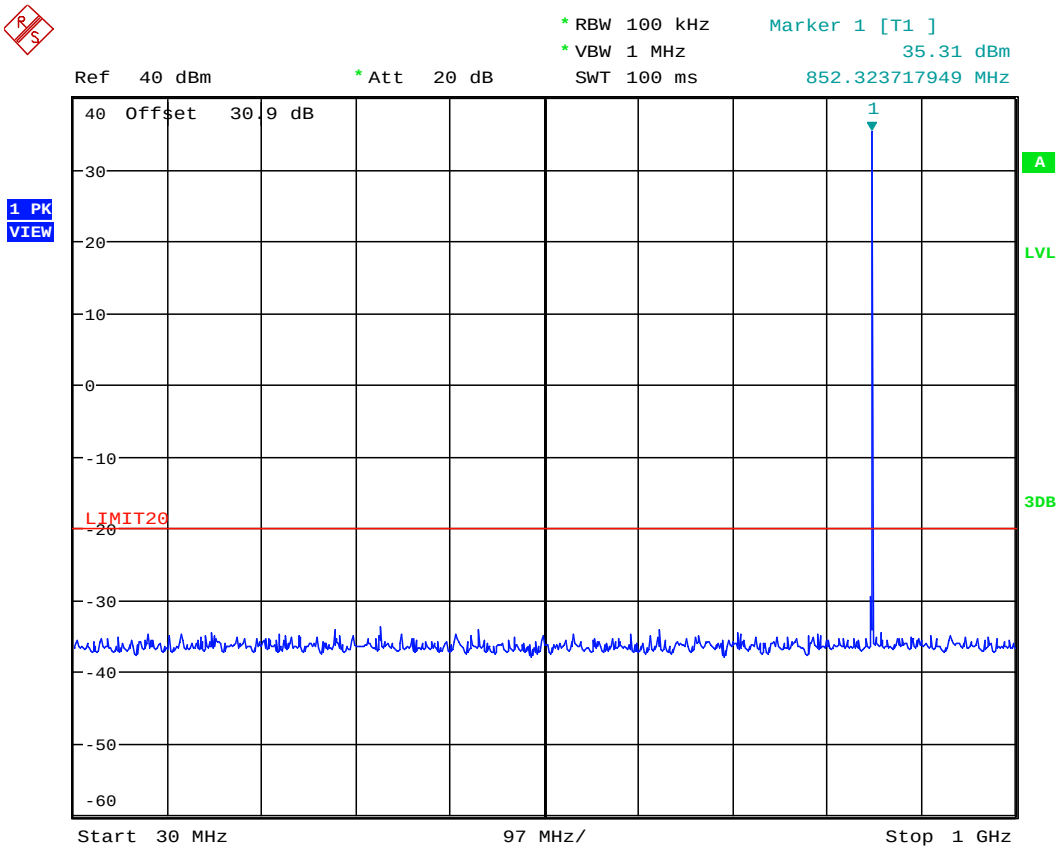


Date: 14.APR.2022 16:11:58

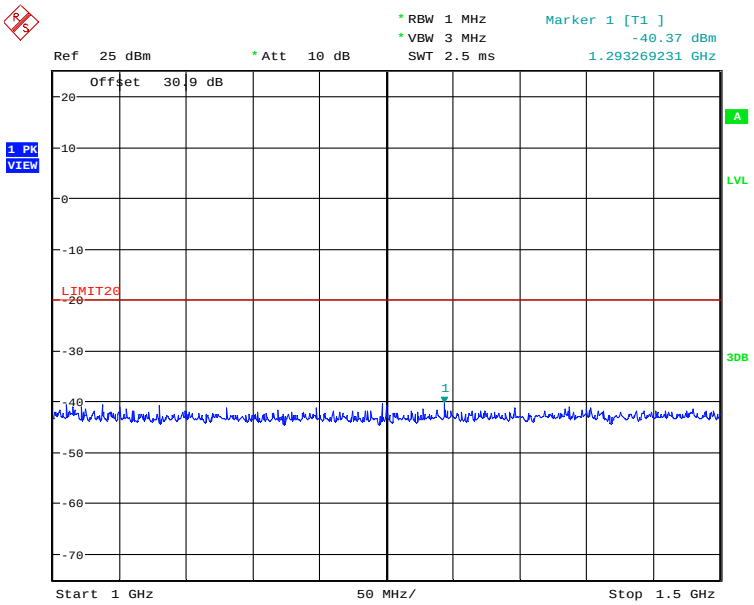
Band 4: 851-869 MHz

High Power

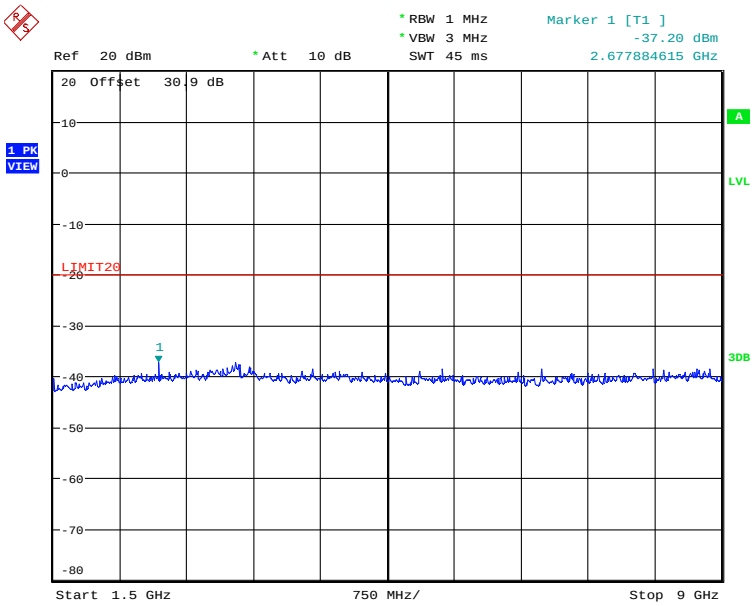
5.6.3.15. Configuration: Tx Conducted Emission, Band 4: 851-869MHz, 851.1MHz, F1W, Digital, High power



Date: 14.APR.2022 15:40:49

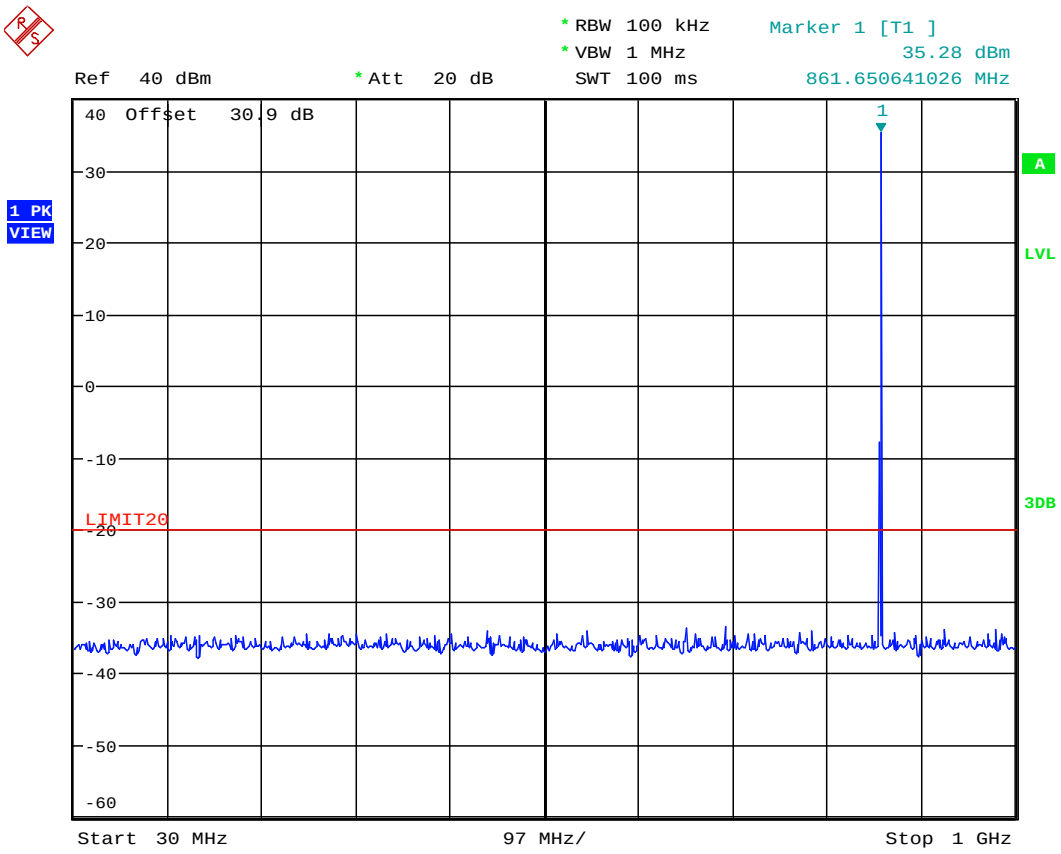


Date: 14.APR.2022 15:54:27

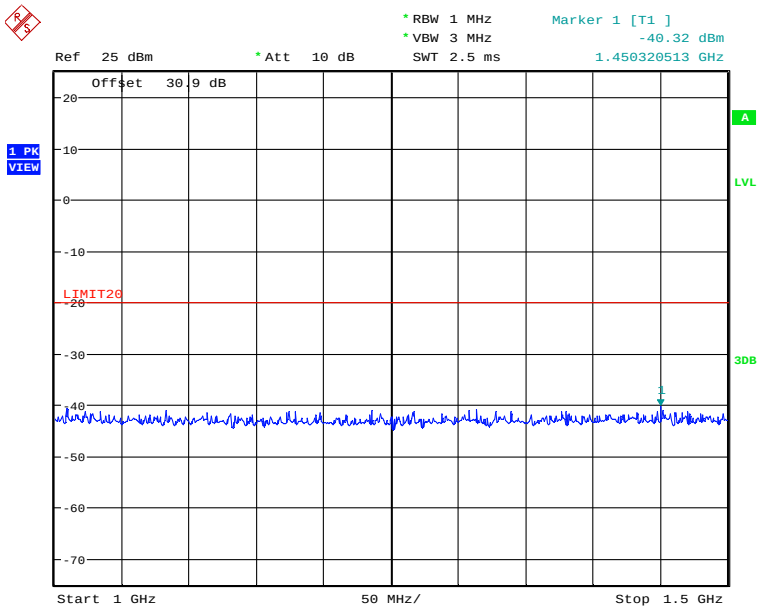


Date: 14.APR.2022 16:06:45

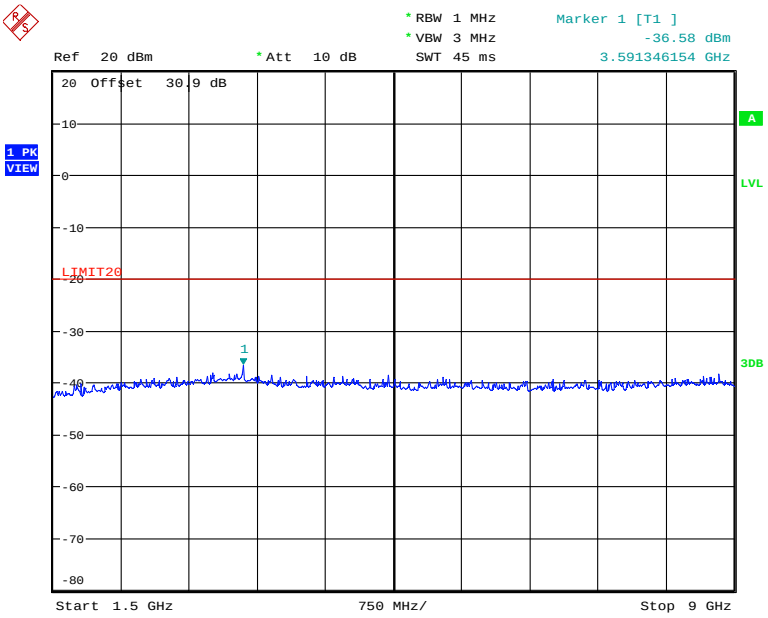
5.6.3.16. Configuration: Tx Conducted Emission, Band 4: 851-869MHz, 860.1MHz, F1W, Digital, High power



Date: 14.APR.2022 15:41:23

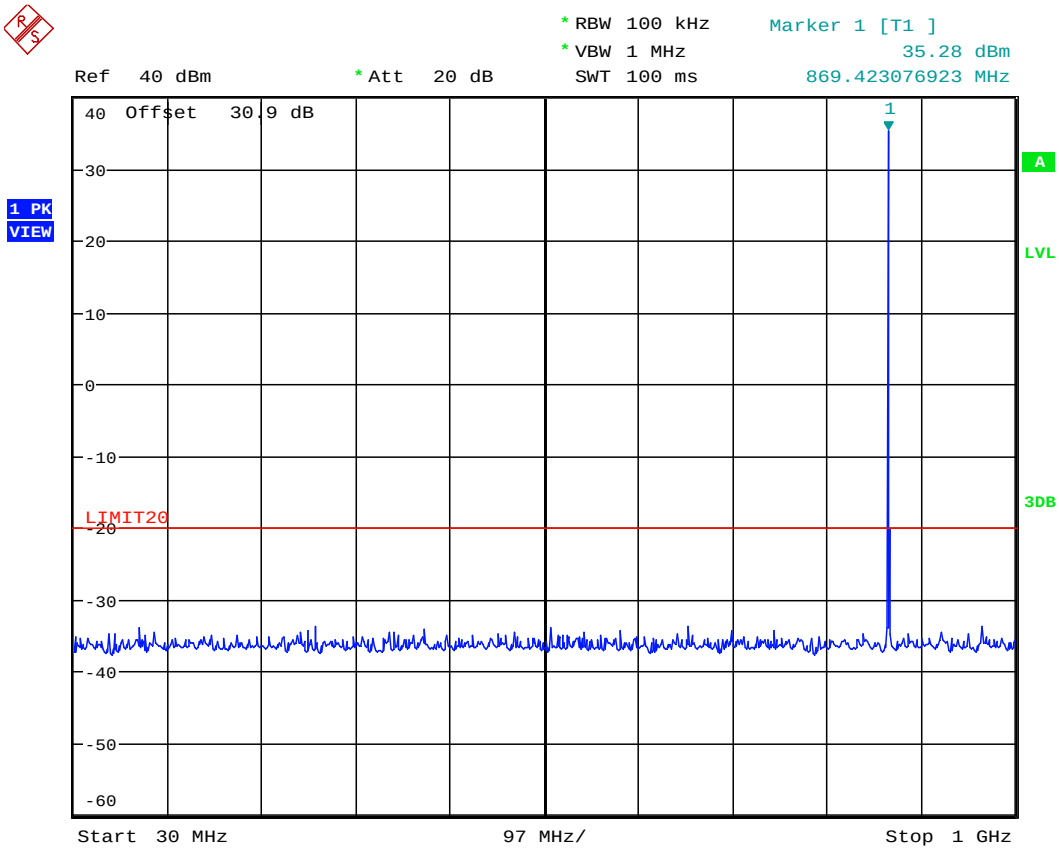


Date: 14.APR.2022 15:55:53

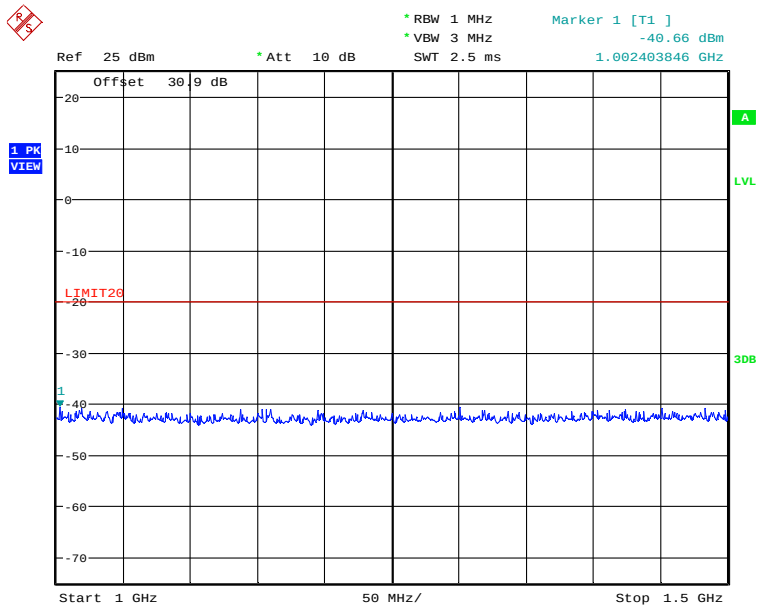


Date: 14.APR.2022 16:08:26

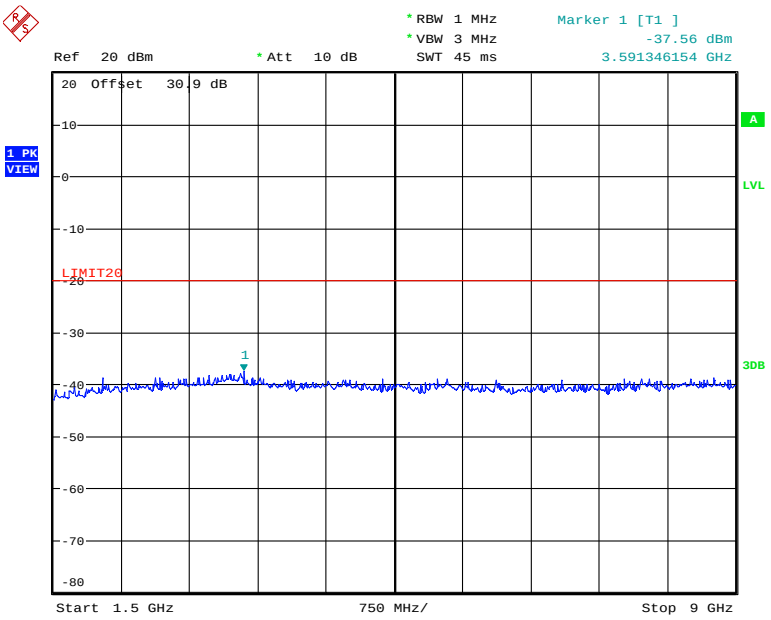
5.6.3.17. Configuration: Tx Conducted Emission, Band 4: 851-869MHz, 868.9MHz, F1W, Digital, High power



Date: 14.APR.2022 15:41:59



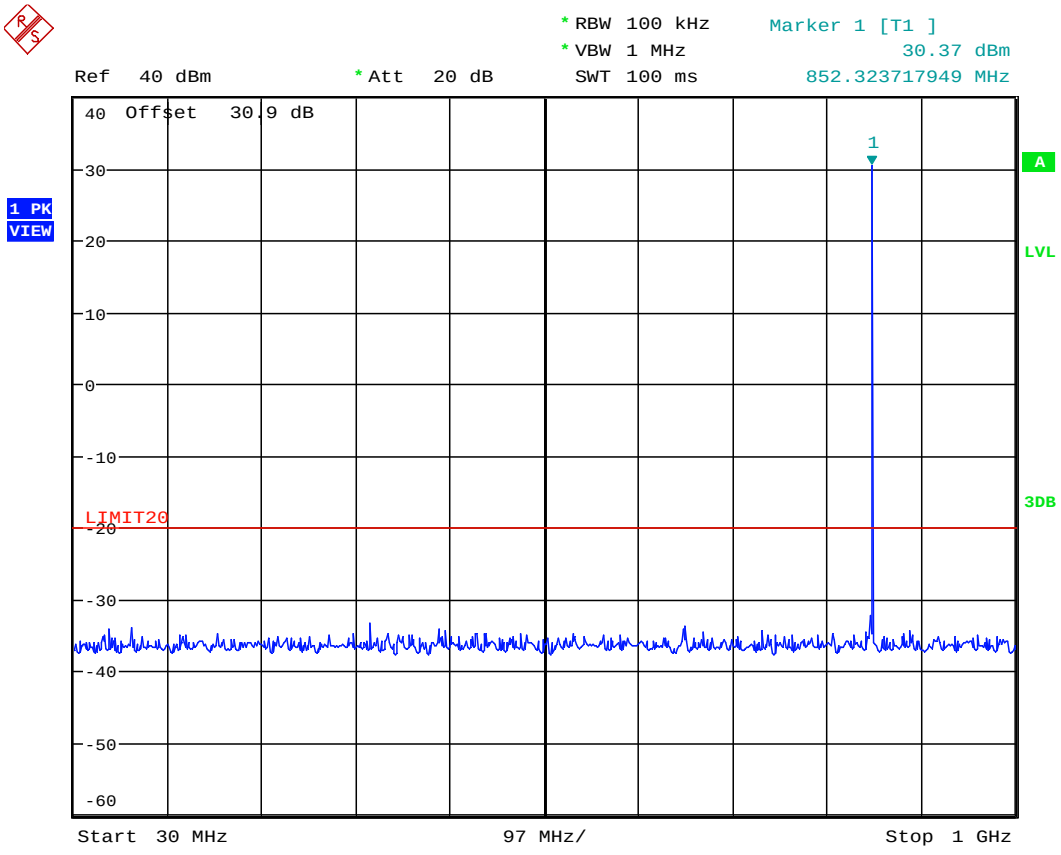
Date: 14.APR.2022 15:56:41



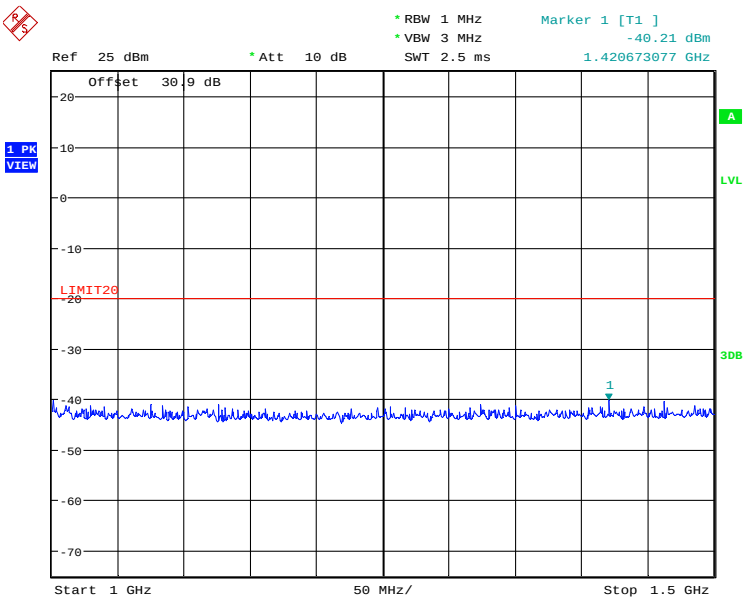
Date: 14.APR.2022 16:09:21

Low Power

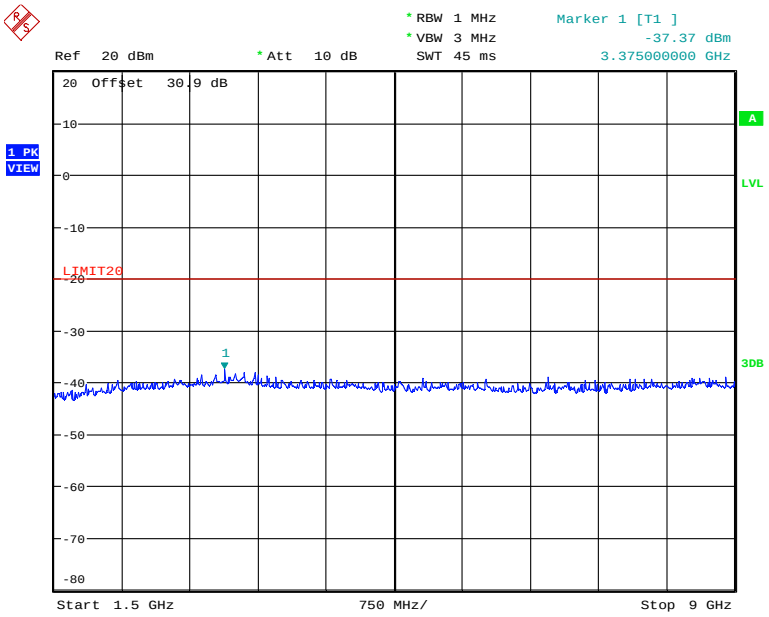
5.6.3.18. Configuration: Tx Conducted Emission, Band 4: 851-869MHz, 851.1MHz, F1W, Digital, Low power



Date: 14.APR.2022 15:48:23

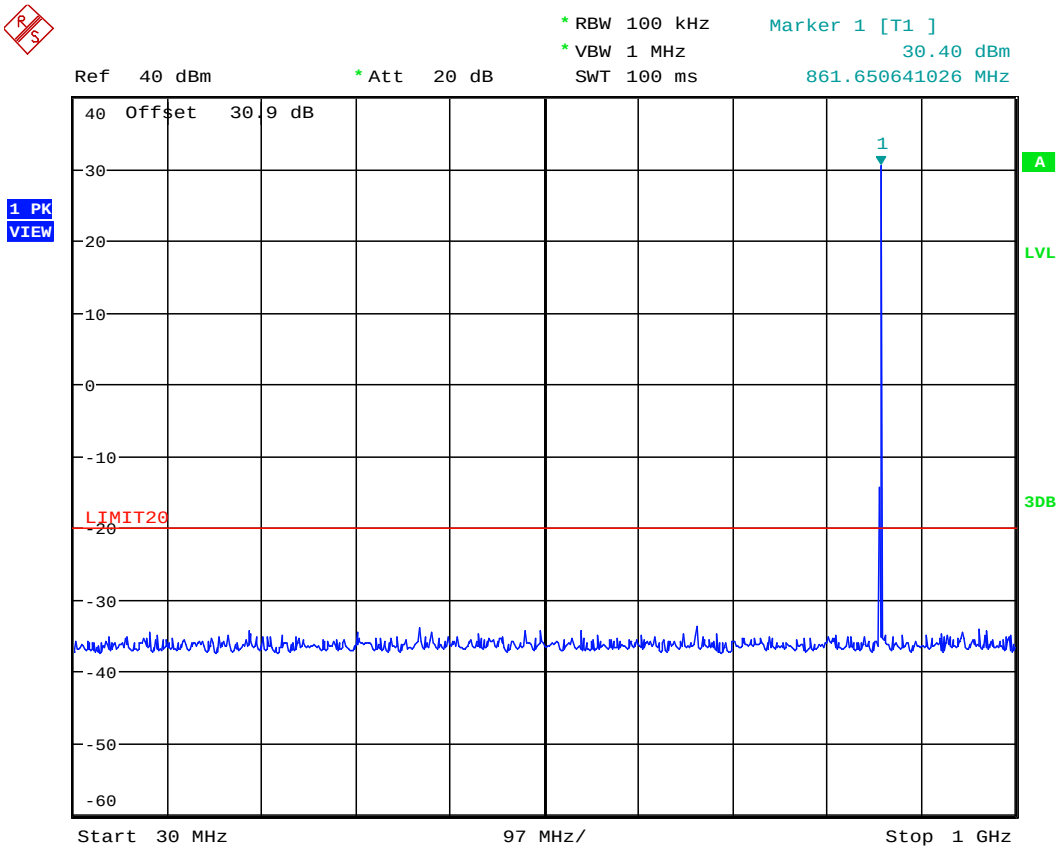


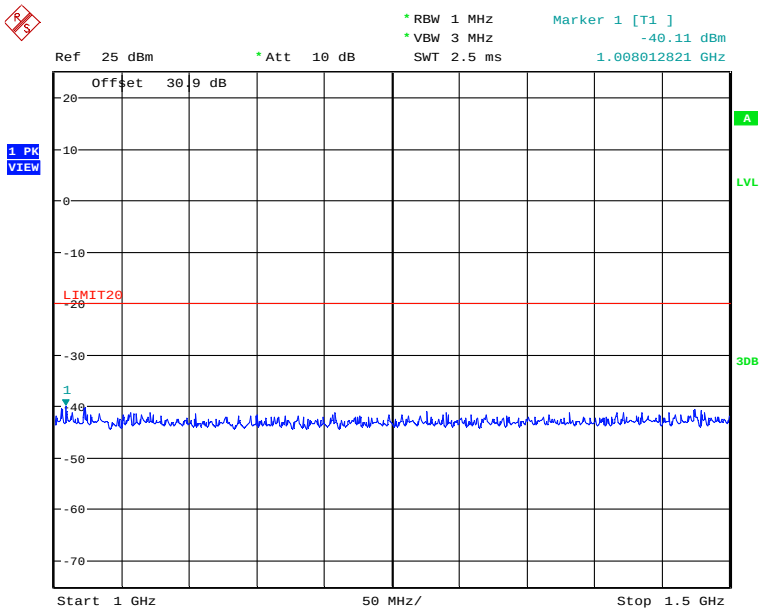
Date: 14.APR.2022 16:00:01



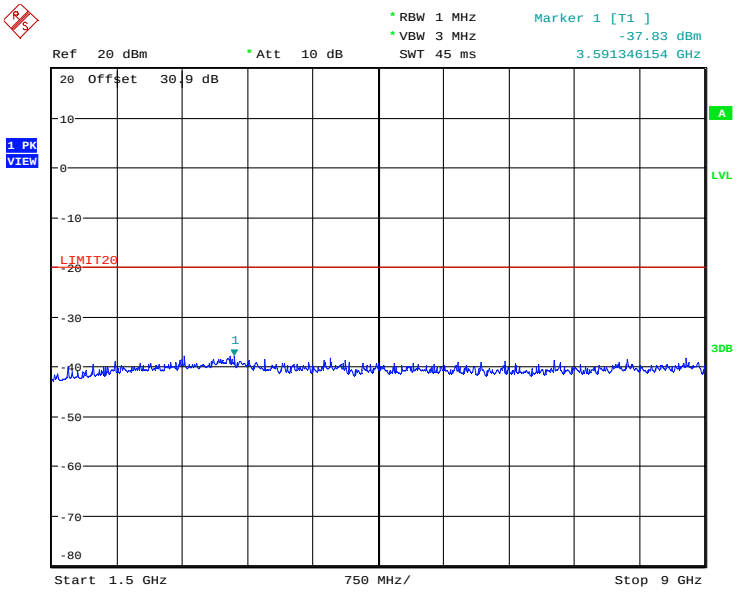
Date: 14.APR.2022 16:12:55

5.6.3.19. Configuration: Tx Conducted Emission, Band 4: 851-869MHz, 860.1MHz, F1W, Digital, Low power



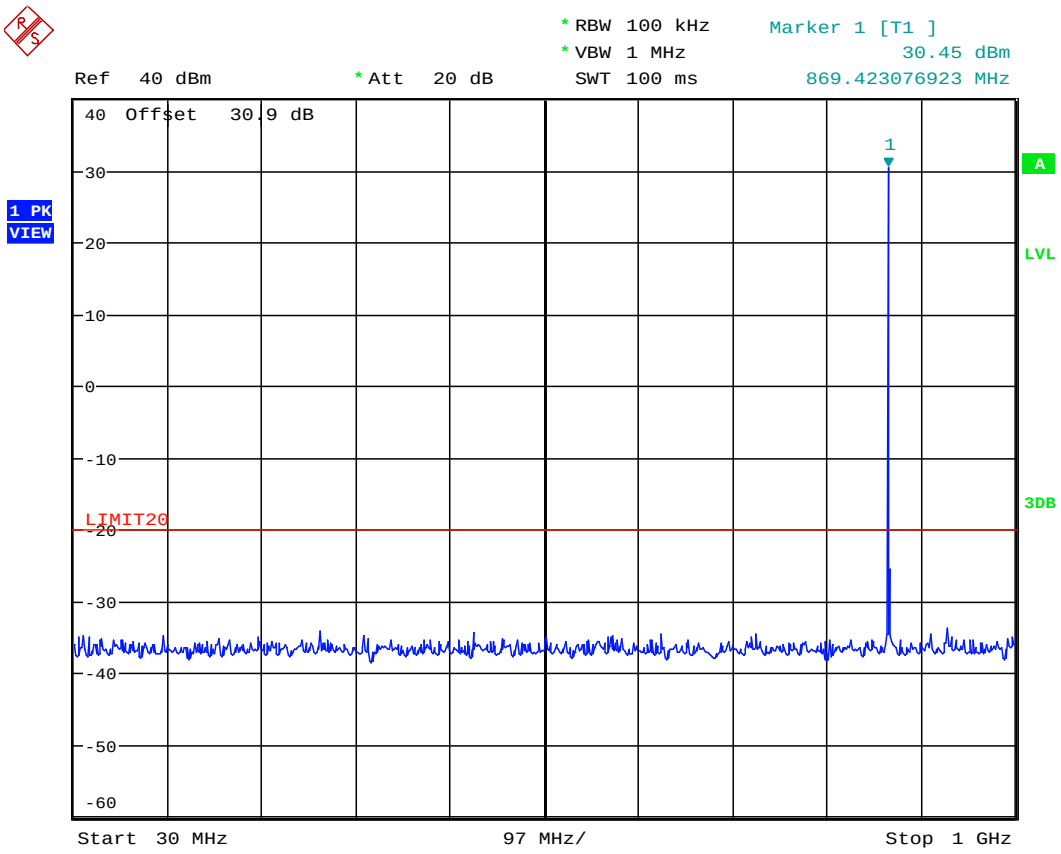


Date: 14.APR.2022 16:00:42

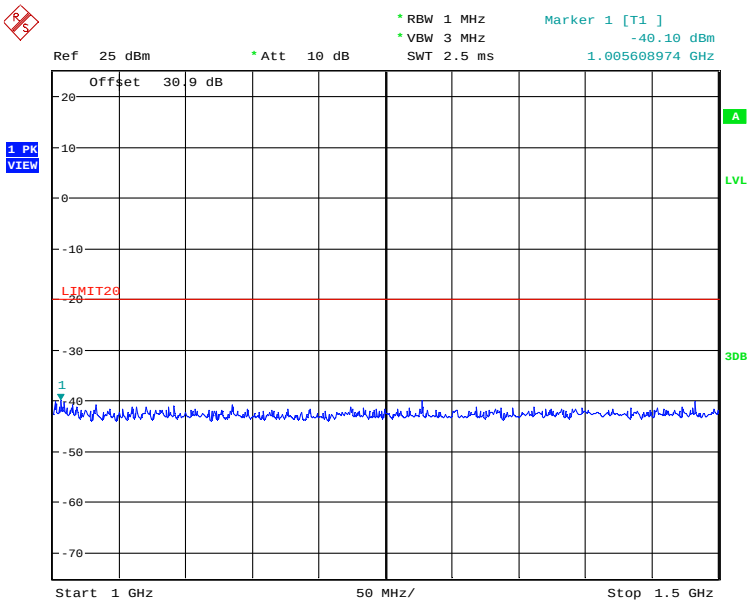


Date: 14.APR.2022 16:13:37

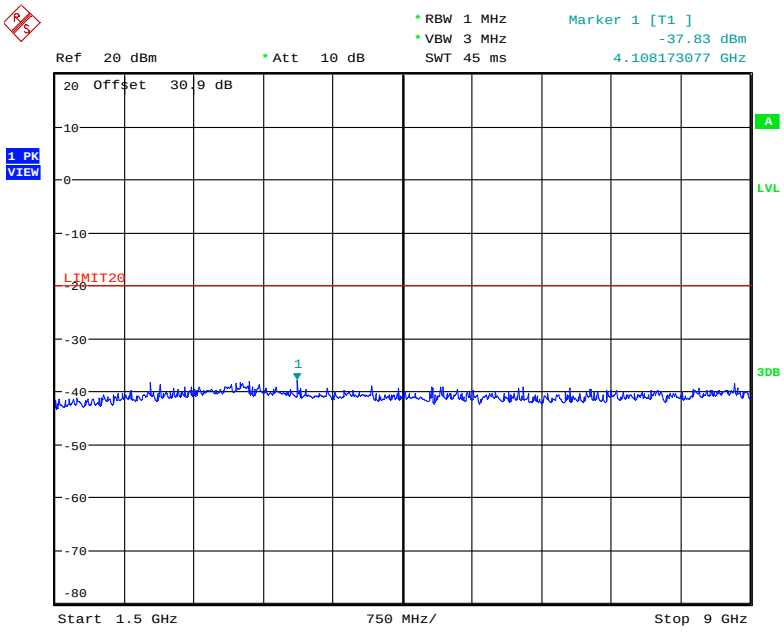
5.6.3.20. Configuration: Tx Conducted Emission, Band 4: 851-869MHz, 868.9MHz, F1W, Digital, Low power



Date: 14.APR.2022 15:49:36



Date: 14.APR.2022 16:01:28



Date: 14.APR.2022 16:14:24

5.7. EIRP measurement in the GNSS band 1559-1610MHz [90.543(f)] RSS 119[5.8.9.2]

5.7.1. Limits

For operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

RSS 119[5.8.9.2]
For operations in the bands 768-776 MHz and 798-806 MHz, all emissions (including harmonics in the band 1559-1610 MHz), shall not exceed:
−70 dBW/MHz equivalent isotropically radiated power (e.i.r.p.) for wideband emissions, and
−80 dBW/kHz e.i.r.p. for discrete emissions of less than 700 Hz bandwidth.

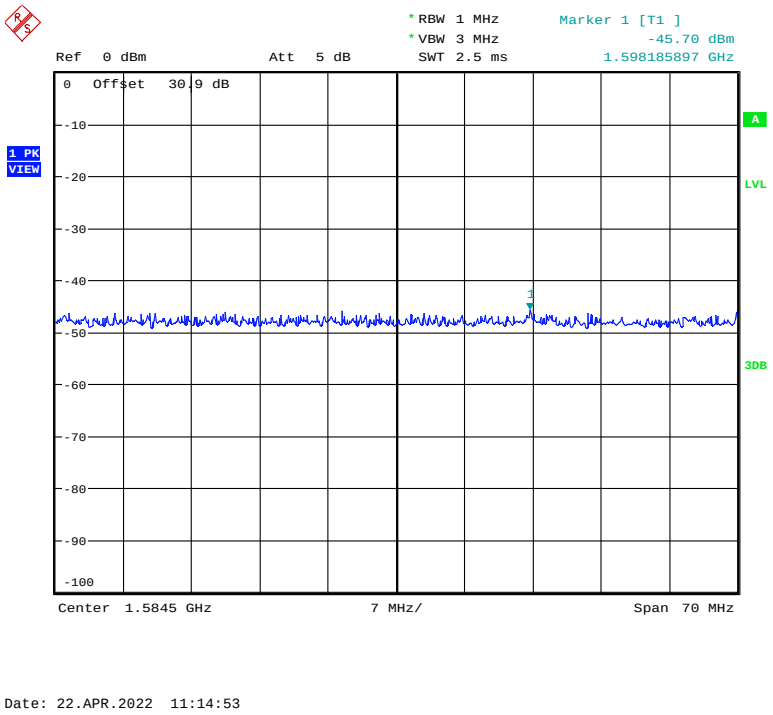
5.7.2. Method of Measurements

ANSI 63.26(6.5.2.7) & TIA-603-E (2.2.12.4)

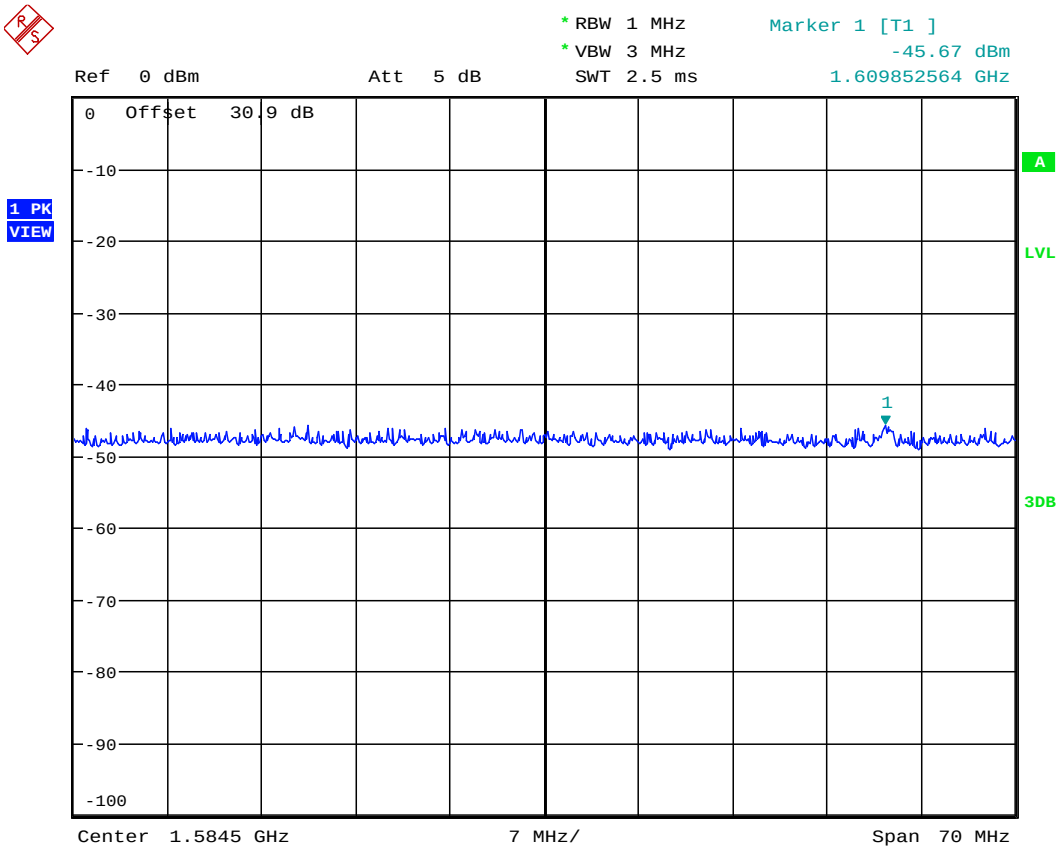
5.7.3. Test Data

Signal is Broadband so 1MHz Resolution BW used

5.7.3.1. Configuration: Tx Conducted Emission, Band 2: 799-805MHz, 799.1MHz, Digital, F1W, High power



5.7.3.2. Configuration: Tx Conducted Emission, Band 2: 799-805MHz, 804.9MHz, Digital, F1W, High power



Date: 22.APR.2022 11:12:04

PSD(dBm/z)= Power(dBm)-10log(RBW)

Tx Frequency (MHz)	Measured Frequency (MHz)	Measured Level (dBm)	PSD (dBm/Hz)	PSD (dBW/MHz)	EIRP (dBW/MHz)	EIRP Limit (dBW/MHz)
799.1	1598.2	-45.70	-105.7	-75.7	-73.10	-70
804.9	1609.8	-45.67	-105.67	-75.67	-73.07	-70

5.8. TRANSMITTER SPURIOUS/HARMONIC RADIATED EMISSIONS [§§ 2.1053, 2.1057, 22.359, 80.211(f)(3) & 90.210] [RSS-119 § 5.5 & 5.8]

5.8.1. Limits

Emissions shall be attenuated below the mean output power of the transmitter as follows:

FCC Rules	Attenuation Limit (dBc)
§ 90.210(b)	At least 43 + 10 log (P) dB.
§ 90.210(d)	At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.
§ 90.543(b)	At least 43 + 10 log (P) dB

RSS -119
The maximum permissible occupied bandwidth shall not exceed the authorized bandwidth specified in Table 3 for the equipment's frequency band.

Table 3 - Channel Spacing, Authorized Bandwidths and Applicable Spectrum Masks

Frequency Band (MHz)	Related SRSP for Channelling Plan and ERP	Channel Spacing (kHz)	Authorized Bandwidth (kHz)	Spectrum Masks with Audio Filter	Spectrum Masks Without Audio Filter
764-776 and 794-806	SRSP-511	6.25, 12.5, 25, 50	Note 2	Section 5.8.9	Section 5.8.9
806-821-/851-866 and 821-824/866-869	SRSP-502	25	20	B	G
		12.5	11.25	D	D
896-901/ 935-940	SRSP-506	12.5	13.6	I	J (G, Note 3)

Note 2: Provided that the ACP requirements in Section 5.8.9.1 are met, any authorized bandwidth that does not exceed the channel bandwidth can be used.

Note 3: Mask G applies if two 12.5 kHz channels are aggregated. Alternatively, a mask may be used which does not produce more adjacent channel interference than narrowband (12.5 kHz) channel equipment.

RSS-119, Issue 12 Tables 6 & 7	Frequency Range	Attenuation Limit (dBc)
Mask D	30 MHz or lowest radio frequency signal generated in the device to the tenth harmonic of the highest fundamental frequency.	At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.
Mask E	30 MHz or lowest radio frequency signal generated in the device to the tenth harmonic of the highest fundamental frequency.	At least 55 + 10 log (P) or 65 dB, whichever is the lesser attenuation.
Mask B	30 MHz or lowest radio frequency signal generated in the device to the tenth harmonic of the highest fundamental frequency.	At least 43 + 10 log (P).

5.9. Method of Measurements

The spurious/harmonic ERP measurements are using substitution method specified in Section 8.2 of this report.

5.9.1. Test Data

Remarks:

- The RF spurious/harmonic emission characteristics for different channel spacing are indistinguishable. Therefore, the following radiated emissions were performed at 12.5 kHz channel spacing Digital F1W operation,
- The radiated emissions were performed with high power setting at 3 m distance to represents the worst-case test configuration.
- The emissions were scanned from 30 MHz to 10th harmonics; all spurious emissions that are in excess of 20dB below the specified limit shall be recorded.

5.9.1.1. Near Lowest Frequency (769.1MHz) –Band 1

Test Frequency (MHz):		**769.1**				
Power $_{setting}$:		High				
Limit (dBm):		-13.0				
Frequency (MHz)	**E-Field (dBµV/m)**	**EMI Detector (Peak/QP)**	**Antenna Polarization (H/V)**	**ERP Measured (dBm)**	**Limit (dBm)**	**Margin (dB)**
1538.2	67.37	PEAK	V	-29.84	-13.0	-16.81
All other emissions are more than 20 dB below the limit line.						

5.9.1.2. Near Highest Frequency (774.9MHz) –Band 1

Test Frequency (MHz):		**774.9**				
Power $_{setting}$:		High				
Limit (dBm):		-13.0				
Frequency (MHz)	**E-Field (dBµV/m)**	**EMI Detector (Peak/QP)**	**Antenna Polarization (H/V)**	**ERP Measured (dBm)**	**Limit (dBm)**	**Margin (dB)**
1549.8	65.86	PEAK	V	-31.27	-13.0	-18.27
All other emissions are more than 20 dB below the limit line.						

5.9.1.3. Near Lowest Frequency (799.1 MHz) –Band 2

Test Frequency (MHz):	**799.1**
Power $_{setting}$:	High
Limit (dBm):	-13.0
All emissions are more than 20 dB below the limit line.	

5.9.1.4. Near Highest Frequency (804.9MHz) –Band 2

Test Frequency (MHz):	**804.9**
Power $_{setting}$:	High
Limit (dBm):	-13.0
All emissions are more than 20 dB below the limit line.	

5.9.1.5. Near Lowest Frequency (806.1MHz) –Band 3

Test Frequency (MHz):		806.1				
Power setting:		High				
Limit (dBm):		-20				
Frequency (MHz)	**E-Field (dBµV/m)**	**EMI Detector (Peak/QP)**	**Antenna Polarization (H/V)**	**ERP Measured (dBm)**	**Limit (dBm)**	**Margin (dB)**
1612.2	67.83	PEAK	V	-31.05	-20.00	-11.05
1612.2	61.97	PEAK	H	-37.25	-20.00	-17.25
All other emissions are more than 20 dB below the limit line.						

5.9.1.6. Near Middle Frequency (815.1 MHz) –Band 3

Test Frequency (MHz):		815.1				
Power setting:		High				
Limit (dBm):		-20				
Frequency (MHz)	**E-Field (dBµV/m)**	**EMI Detector (Peak/QP)**	**Antenna Polarization (H/V)**	**ERP Measured (dBm)**	**Limit (dBm)**	**Margin (dB)**
1630.200	64.74	PEAK	V	-34.01	-20.00	-14.01
1630.200	62.91	PEAK	H	-35.51	-20.00	-15.51
All other emissions are more than 20 dB below the limit line.						

5.9.1.7. Near Highest Frequency (823.9MHz) –Band 3

Test Frequency (MHz):		823.9				
Power setting:		High				
Limit (dBm):		-20				
Frequency (MHz)	**E-Field (dBµV/m)**	**EMI Detector (Peak/QP)**	**Antenna Polarization (H/V)**	**ERP Measured (dBm)**	**Limit (dBm)**	**Margin (dB)**
1647.8	65.53	PEAK	V	-33.17	-20.00	-13.17
1647.8	59.59	PEAK	H	-38.17	-20.00	-18.17
All other emissions are more than 20 dB below the limit line.						

5.9.1.8. Near Lowest Frequency (851.1MHz) –Band 4

Test Frequency (MHz):		851.1				
Power conducted (dBm):		34.87				
Limit (dBm):		-20				
Frequency (MHz)	**E-Field (dBµV/m)**	**EMI Detector (Peak/QP)**	**Antenna Polarization (H/V)**	**ERP Measured (dBm)**	**Limit (dBm)**	**Margin (dB)**
1702.200	65.63	**PEAK**	**V**	-31.25	-20.00	-11.25
All other emissions are more than 20 dB below the limit line.						

5.9.1.9. Near Middle Frequency (860.1 MHz) –Band 4

Test Frequency (MHz):		860.1				
Power conducted (dBm):		34.88				
Limit (dBm):		-20				
Frequency (MHz)	**E-Field (dBµV/m)**	**EMI Detector (Peak/QP)**	**Antenna Polarization (H/V)**	**ERP Measured (dBm)**	**Limit (dBm)**	**Margin (dB)**
1720.200	62.07	**PEAK**	**V**	-34.36	-20.00	-14.36
All other emissions are more than 20 dB below the limit line.						

5.9.1.10. Near Highest Frequency (868.9 MHz) –Band 4

Test Frequency (MHz):		868.9				
Power conducted (dBm):		34.87				
Limit (dBm):		-20				
Frequency (MHz)	**E-Field (dBµV/m)**	**EMI Detector (Peak/QP)**	**Antenna Polarization (H/V)**	**ERP Measured (dBm)**	**Limit (dBm)**	**Margin (dB)**
1737.800	64.58	**PEAK**	**V**	-32.34	-20.00	-12.34
1737.800	57.60	**PEAK**	**H**	-38.54	-20.00	-18.54
All other emissions are more than 20 dB below the limit line.						

5.10. FREQUENCY STABILITY [§§ 2.1055, 22.355, 90.213& 90.539] [RSS-119 § 5.3]

5.10.1. Limits

§ 90.213 Transmitters used must have minimum frequency stability as specified in the following table.

Frequency Range (MHz)	Channel Bandwidth (KHz)	Frequency Tolerance (ppm)		
		Fixed and Base Stations	Mobile Stations	
			> 2 W	≤ 2 W
150-174 MHz	6.25 12.5 25	1.0 2.5 5.0	2.0 5.0 5.0	2.0 5.0 50.0*
421-512 MHz	6.25 12.5 25	0.5 1.5 2.5	1.0 2.5 5.0	1.0 2.5 5.0

- 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.
- 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.

§ 22.355 Transmitters used must have minimum frequency stability as specified in the following table.

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

Frequency range (MHz)	Base, fixed (ppm)	Mobile ≤3 watts (ppm)	Mobile ≤3 watts (ppm)
25 to 50	20.0	20.0	50.0
50 to 450	5.0	5.0	50.0
450 to 512	2.5	5.0	5.0
821 to 896	1.5	2.5	2.5
928 to 929	5.0	n/a	n/a
929 to 960	1.5	n/a	n/a
2110 to 2220	10.0	n/a	n/a

§ 90.539 Transmitters designed to operate in 769–775 MHz and 799–805 MHz frequency bands must meet the frequency stability requirements in this section.
(a) Mobile, portable and control transmitters must normally use automatic frequency control (AFC) to lock on to the base station signal.
(b) The frequency stability of base transmitters operating in the narrowband segment must be 100 parts per billion or better.
(c) The frequency stability of mobile, portable, and control transmitters operating in the narrowband segment must be 400 parts per billion or better when AFC is locked to the base station. When AFC is not locked to the base station, the frequency stability must be at least 1.0 ppm for 6.25 kHz, 1.5 ppm for 12.5 kHz (2 channel aggregate), and 2.5 ppm for 25 kHz (4 channel aggregate).
(d) The frequency stability of base transmitters operating in the wideband segment must be 1 part per million or better.
(e) The frequency stability of mobile, portable and control transmitters operating in the wideband segment must be 1.25 parts per million or better when AFC is locked to a base station, and 5 parts per million or better when AFC is not locked.

Note: For 90.539 band the EUT was tested while AFC was not locked and hence the limit is 1.5ppm. For this unit a limit of 1 ppm is specified by manufacturer.
[RSS-119 § 5.3]
he carrier frequency shall not depart from the reference frequency in excess of the values given in Table 1.

Table 1 - Transmitter Frequency Stability

Frequency Band (MHz)	Authorized Bandwidth (kHz)	Frequency Stability (ppm)		
		Base/Fixed	Mobile Station	
			>2 watts	≤ 2 watts
764-776 and 794-806 (Note 3)	6.25 12.5 25	0.1	0.4 (Note 4)	0.4 (Note 4)
	50	1	1.25 (Note 5)	1.25 (Note 5)
806-821/851-866 and 821-824/866-869 (Note 5)	25 (Note 2)	0.1	0.1	0.1
	25	1.5	2.5	2.5
	12.5	1	1.5	1.5
896-901/935-940 (Note 6)	12.5	0.1	1.5	1.5
929-930/931-932	25	1.5	N/A	N/A
928-929/952-953 and 932-932.5/941-941.5	25	1.5	N/A	N/A
	12.5	1	3 for remote station	N/A
932.5-935/941.5-944	25	2.5	N/A	N/A
	12.5	2.5	N/A	N/A

Note 1: Mobile units may utilize synchronizing signals from associated base stations to achieve the specified carrier stability.
Note 2: This provision is for digital equipment with a channel spacing of 25 kHz and an occupied bandwidth greater than 20kHz.
Note 2: Mobile, portable and control transmitters operating in the 764-776 MHz and 794-806 MHz must normally use automatic frequency control (AFC) to lock onto the base station signal. The mobile station's frequency stability values given in Table 1 are for mobile stations operating under this condition.
Note 3: Mobile, portable and control transmitters operating in the bands 768-776 MHz and 798-806 MHz must normally use AFC to lock onto the base station signal. The mobile station's frequency stability values given in Table 1 are for mobile stations operating under this condition.
Note 4: When the mobile, portable and control transmitters are operating in the 764-776 MHz narrowband segment and the AFC is not locked to the base station, the frequency stability must be at least 1.0 ppm for 6.25 kHz, 1.5 ppm for 12.5 kHz (2-channel aggregate), and 2.5 ppm for 25 kHz (4-channel aggregate).
Note 6: Control stations may operate with the frequency tolerance specified for associated mobile frequencies.

Note: For 764-776 and 794-806 band the EUT was tested while AFC was not locked and hence the limit is 1.5ppm. For this unit a limit of 1 ppm is specified by manufacturer.

5.10.2. Method of Measurements

Refer to Section 8.3 of this report for measurement details

5.10.3. Test Data

Test Frequency:	**769.1 MHz**
Full Power Level:	2.84 W
Frequency Tolerance Limit:	± 1.0 ppm or ± 769.1 Hz
Max. Frequency Tolerance Measured:	-283 Hz or -0.37 ppm
Input Voltage Rating:	7.5 VDC (nominal)

Ambient Temperature (°C)	**Frequency Drift (Hz)**		
	Supply Voltage (Nominal) 7.5 VDC	**Supply Voltage (Battery end point) 5.9 Vdc**	**Supply Voltage(+15%) 8.62 Vdc**
-30	161	--	--
-20	117	--	--
-10	-223	--	--
0	-249	--	--
10	-269	--	--
20	-162	-283	-283
30	-188	--	--
40	-108	--	--
50	154	--	--
60	164	--	--

5.11. RADIATED EMISSIONS FROM UNINTENTIONAL RADIATORS [ICES-003]

5.11.1. Limits

The equipment shall meet the limits of the following table:

Frequency of emission (MHz)	Class B Limits	
	(dBμV/m at 3 m)	(dBμV/m at 10 m)
30 – 88	40.0	29.5
88 – 216	43.5	33.1
216 – 960	46.0	35.6
Above 960	54.0	43.5

5.11.2. Method of Measurements

Refer to Ultratech Test Procedures ULTR-P001-2004 & ANSI C63.4 for method of measurements.

5.11.3. Test Data

The emissions were scanned from 30 MHz to 18.0 GHz at 3m. All emissions found above than 20 dB below the permissible limits were recorded

Frequency	Peak Measurement (dBuV/m)		QP/Avg Measurement (dBuV/m)		Limit (dBuV/m)	Margin	(dB)
(MHz)	Vertical	Horizontal	Vertical	Horizontal	QP/AVG	Vertical	Horizontal
51.76	24.48	25.03	--	--	40	-15.52	-14.97
107.72	30.54	24.26	--	--	43.5	-12.96	-19.24
115.49	28.13	28.54	--	--	43.5	-15.37	-14.96
132.59	23.02		--	--	43.5	-20.48	--
145.03		23.45	--	--	43.5	--	-20.05
162.13	32.26	23	--	--	43.5	-11.24	-20.5
193.22		26.19	--	--	43.5	--	-17.31
214.98	23.19		--	--	43.5	-20.31	--
283.38		31.27	--	--	46	--	-14.73

5.12. RECEIVER SPURIOUS EMISSIONS (RADIATED) [RSS-Gen §§ 7.3]

5.12.1. Limits

The equipment shall meet the limits of the following table:

Spurious Frequency (MHz)	Field Strength at 3 meters	
	(μV/m)	(dBμV/m)
30 – 88	100	40.0
88 – 216	150	43.5
216 – 960	200	46.0
Above 960	500	54.0

5.12.2. Method of Measurements

RSS-Gen and ANSI C63.4

5.12.3. Test Data

The emissions were scanned from 30 MHz to 6.0 GHz at 3 Meters distance and all emissions less than 20 dB below the limits were recorded.

(IF=57.15 MHz)

Test Frequency (MHz)	Frequency (MHz)	Peak Measurement (dBuV/m)		QP/Avg Measurement (dBuV/m)		Limit (dBuV/m)	Margin (dB)	
		Vertical	Horizontal	Vertical	Horizontal	QP/AVG	Vertical	Horizontal
769.1	711.95	34.3	30.19	--	--	46	-11.7	-15.81
774.9	717.75	33.83	31.62	--	--	46	-12.17	-14.38
851.1	793.95	34.07	30.13	--	--	46	-11.93	-15.87
860.1	802.95	35.54	30.91	--	--	46	-10.46	-15.09
868.9	811.75	35.48	31.76	--	--	46	-10.52	-14.24

5.13. RECEIVER ANTENNA POWER SPURIOUS/HARMONIC CONDUCTED EMISSIONS [RSS-Gen §§ 7.4]

5.13.1. Limits

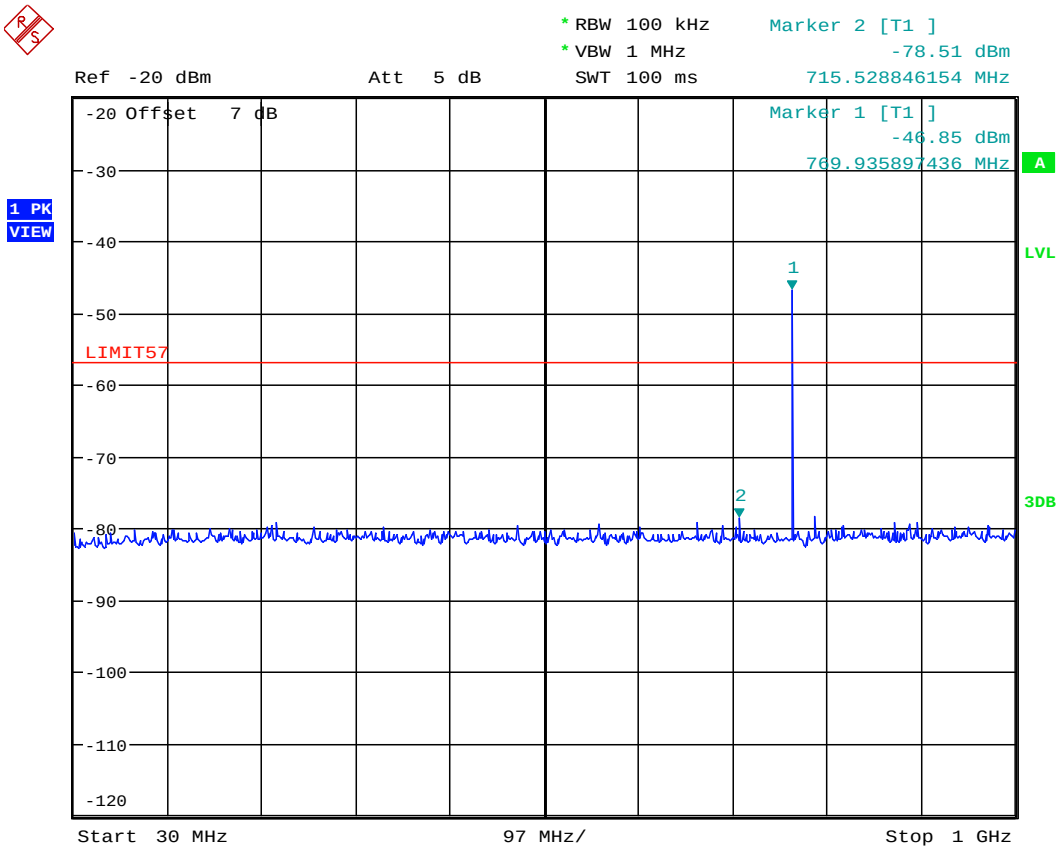
No spurious output signals appearing at the antenna terminals shall exceed 2 nanowatts per any 4 kHz spurious frequency in the band 30-1000 MHz, or 5 nanowatts above 1 GHz.

5.13.2. Method of Measurements

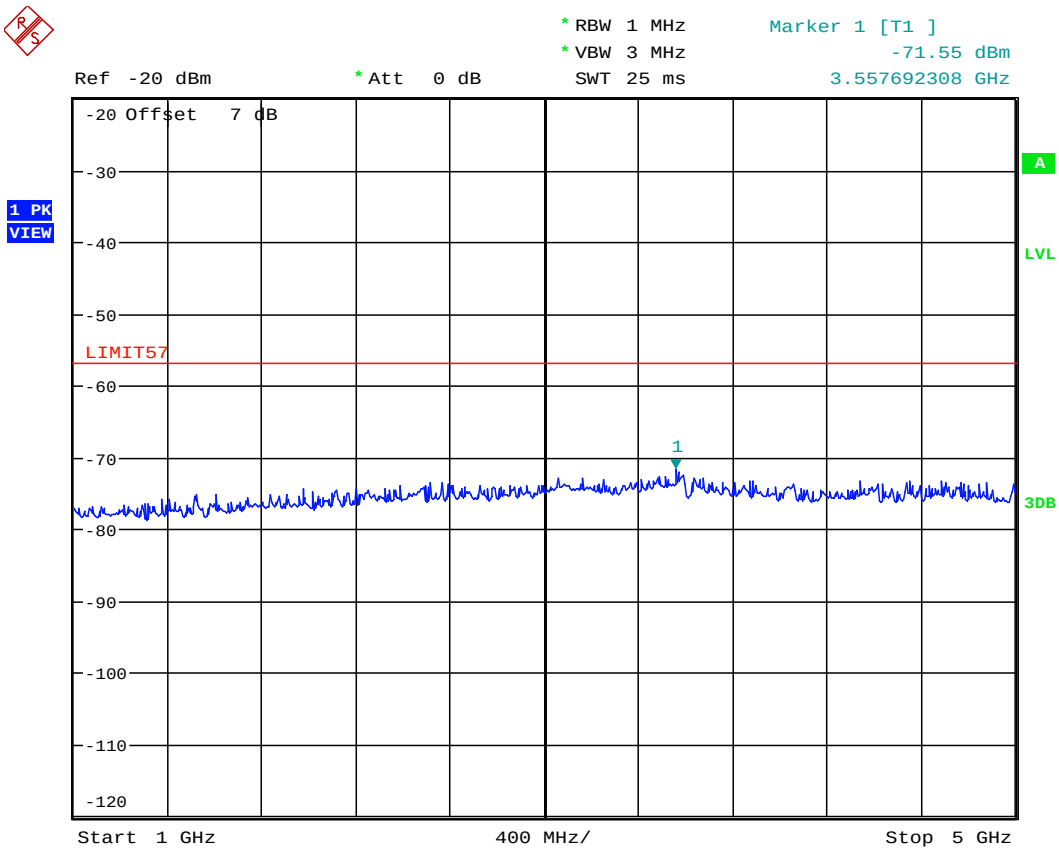
Refer to Industry Canada RSS-119, Issue 9 and ANSI C63.4.

5.13.3. Test Data

5.13.3.1. Configuration: Rx Conducted Emission, Band 1: 769-775MHz, 769.1MHz

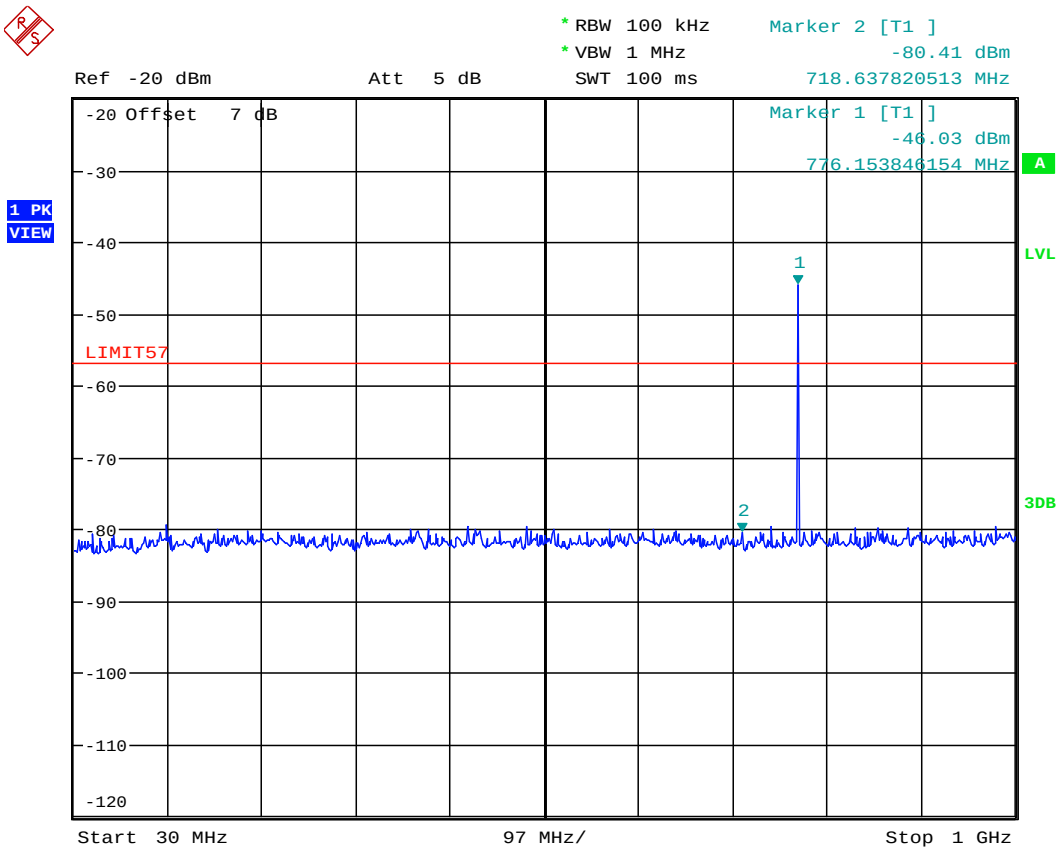


Highest peak is Rx Signal input (1mV rms)



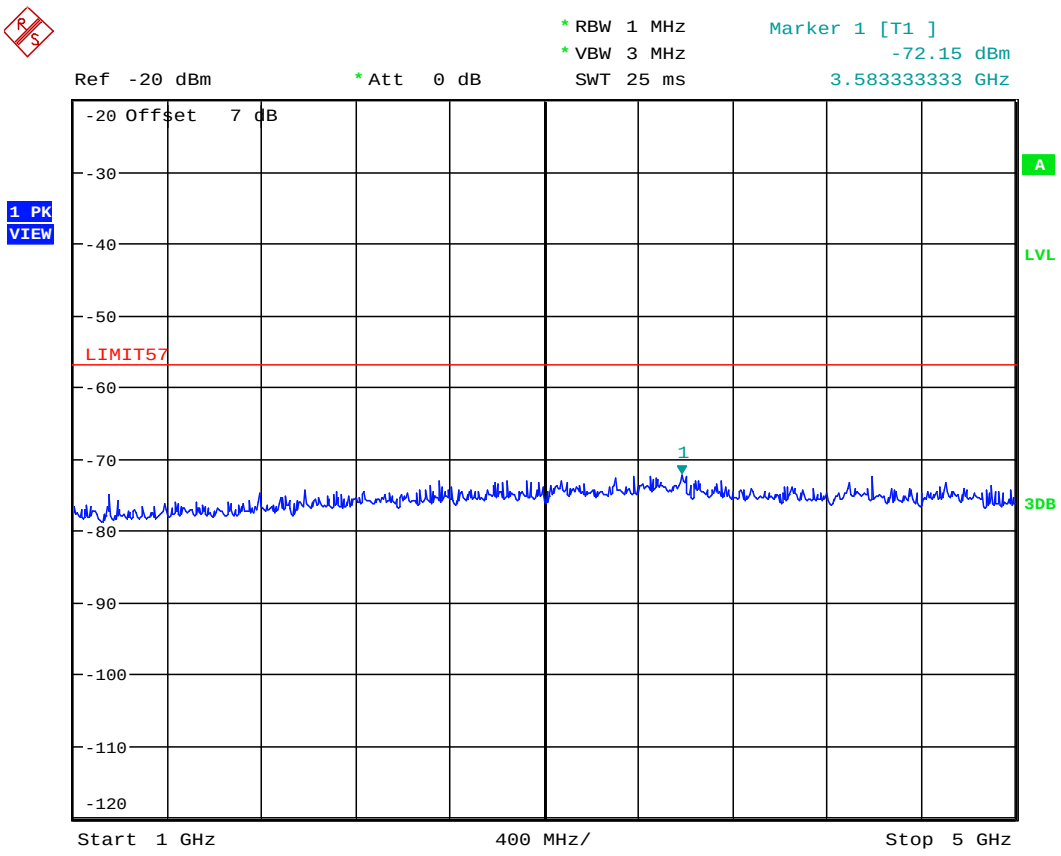
Date: 3.MAY.2022 13:54:26

5.13.3.2. Configuration: Rx Conducted Emission, Band 1: 769-775MHz, 774.9MHz

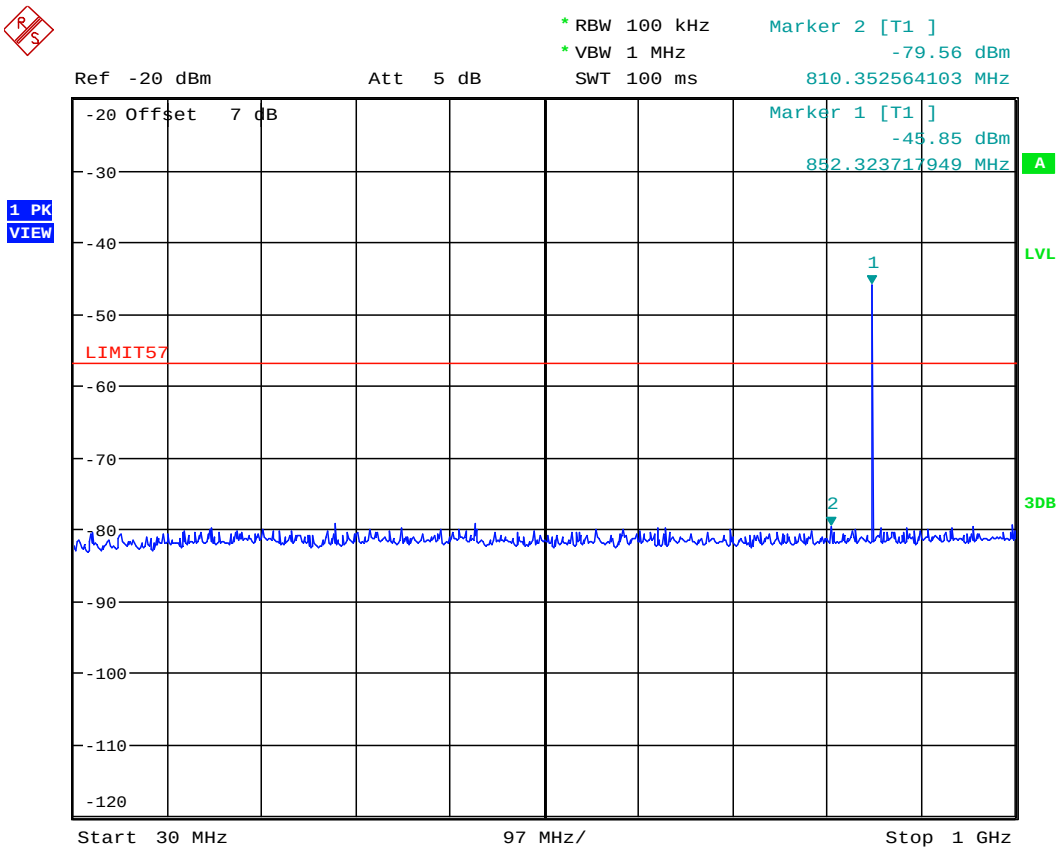


Date: 3.MAY.2022 13:51:29

Highest peak is Rx Signal input (1mV rms)

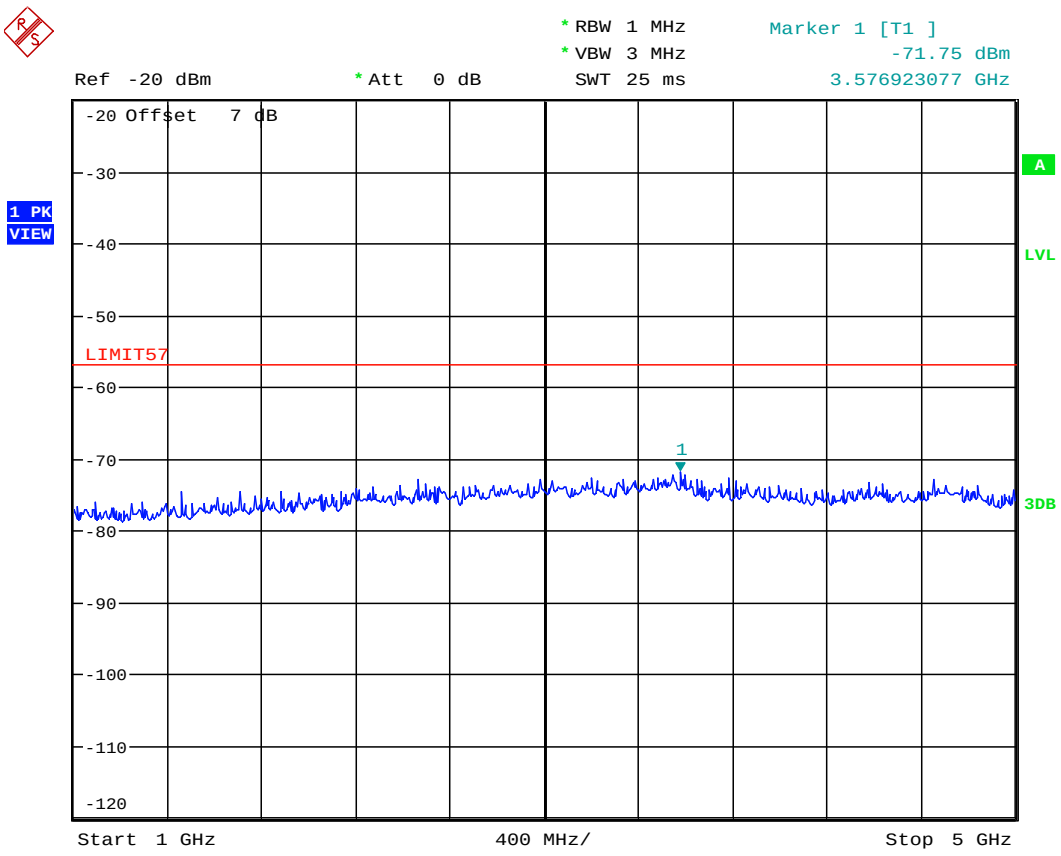

RBW 1 MHz
VBW 3 MHz
SWT 25 ms
Marker 1 [T1]
-72.15 dBm
3.583333333 GHz
Ref -20 dBm
Att 0 dB
Offset 7 dB
1 PK
VIEW
A
LVL
3DB
LIMIT57
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
Start 1 GHz
400 MHz/
Stop 5 GHz
Date: 3.MAY.2022 13:53:43

5.13.3.3. Configuration: Rx Conducted Emission, Band 4: 851-869MHz, 851.1MHz

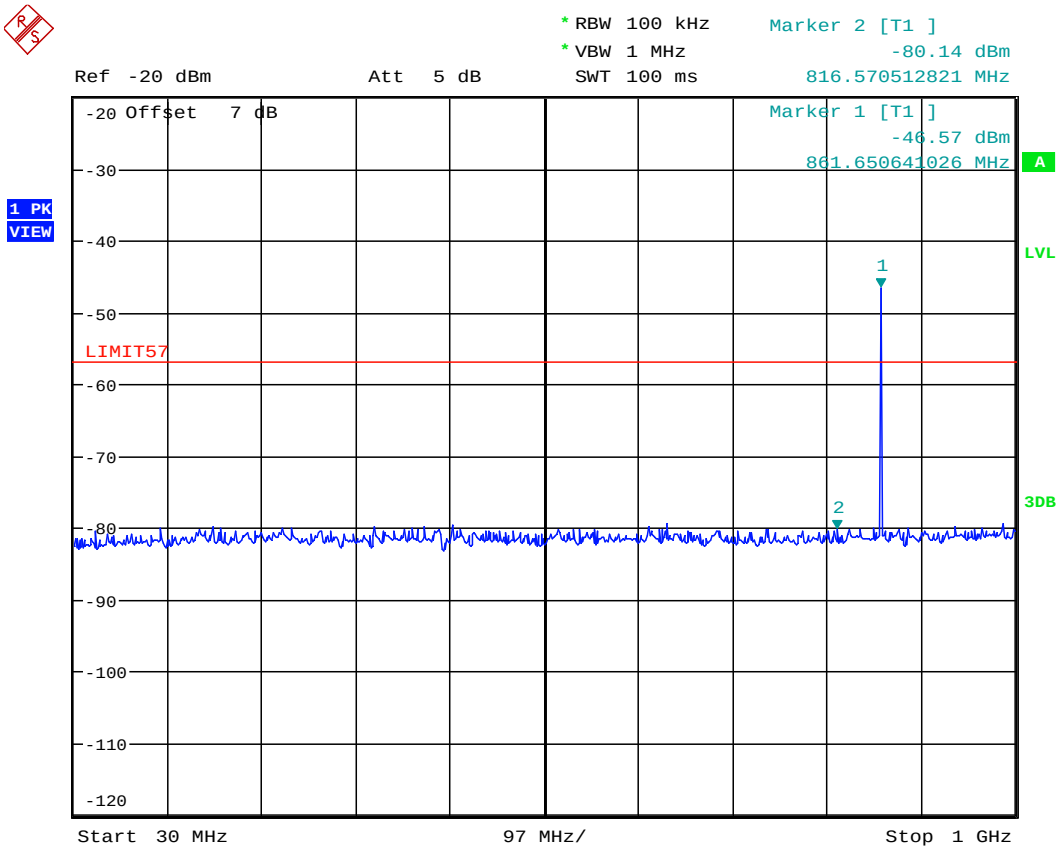


Date: 3.MAY.2022 14:00:24

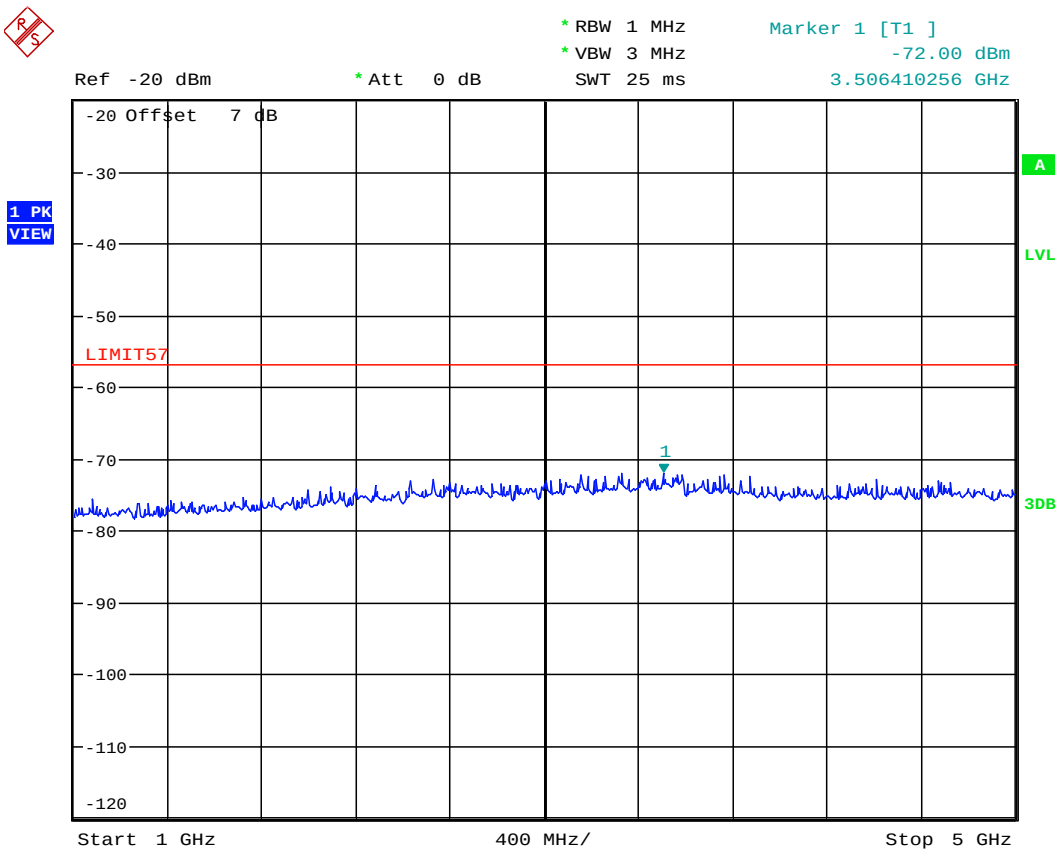
Highest peak is Rx Signal input (1mV rms)


RBW 1 MHz
VBW 3 MHz
SWT 25 ms
Marker 1 [T1]
-71.75 dBm
3.576923077 GHz
Ref -20 dBm
Att 0 dB
Offset 7 dB
1 PK
VIEW
A
LVL
3DB
LIMIT57
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
Start 1 GHz
400 MHz/
Stop 5 GHz
Date: 3.MAY.2022 13:56:16

5.13.3.4. Configuration: Rx Conducted Emission, Band 4: 851-869MHz, 860.1MHz

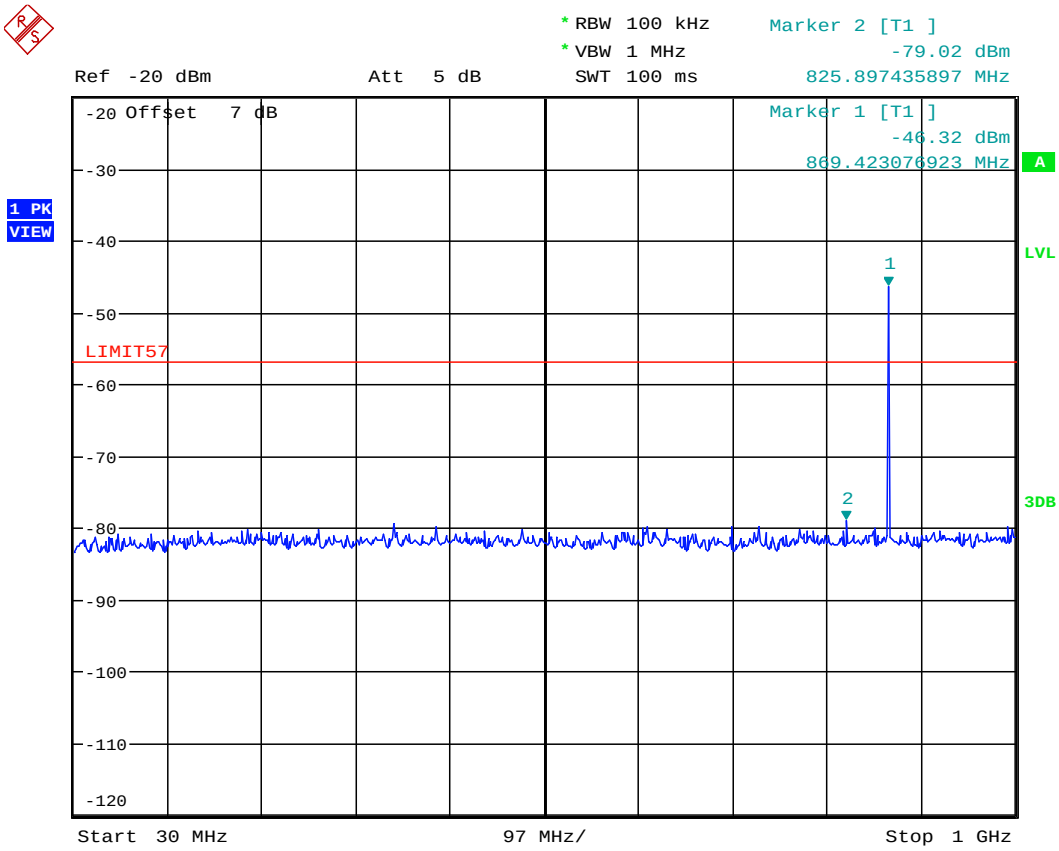


Highest peak is Rx Signal input (1mV rms)



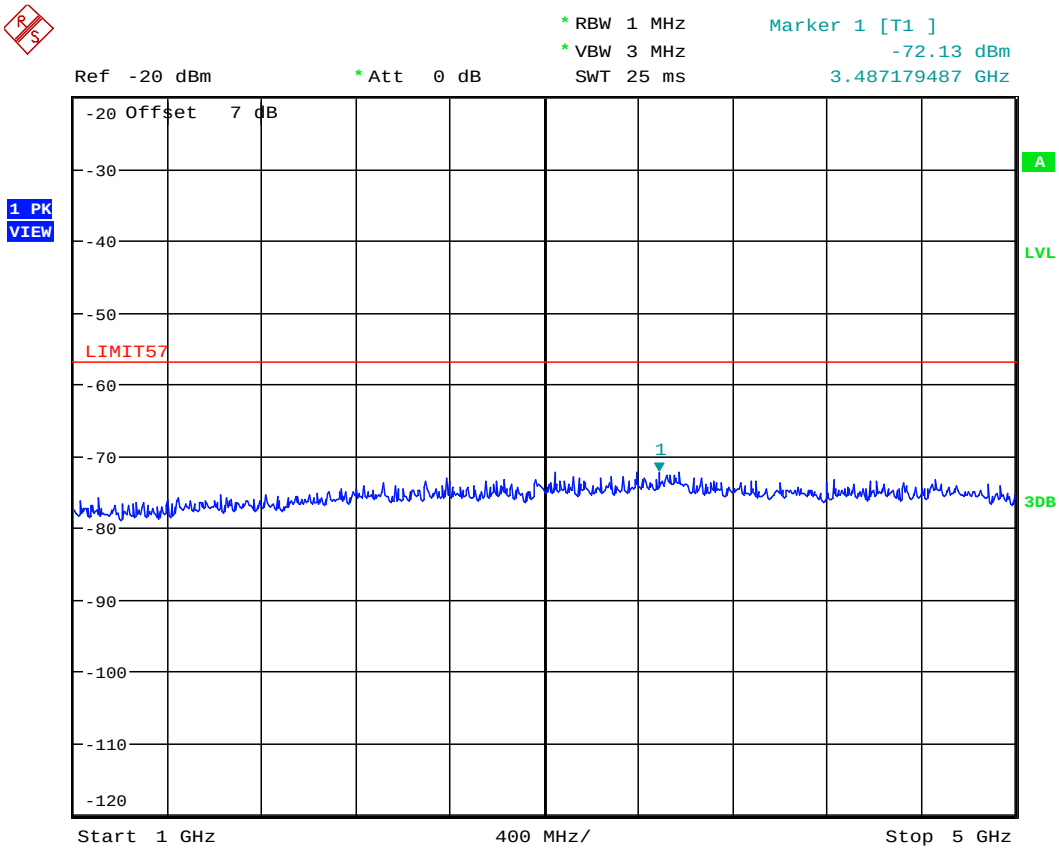
Date: 3.MAY.2022 13:56:57

5.13.3.5. Configuration: Rx Conducted Emission, Band 4: 851-869MHz, 868.9MHz



Date: 3.MAY.2022 13:58:36

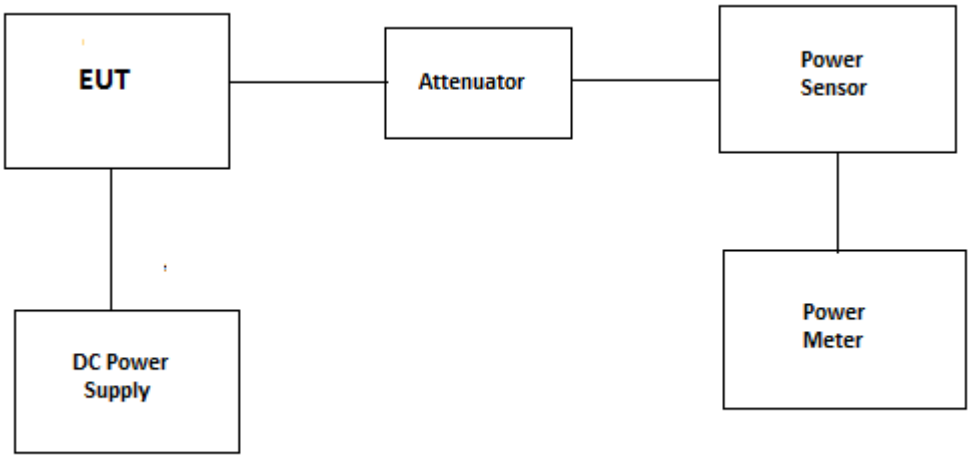
Highest peak is Rx Signal input (1mV rms)



Date: 3.MAY.2022 13:57:51

EXHIBIT 6. TEST EQUIPMENT LIST AND SETUP

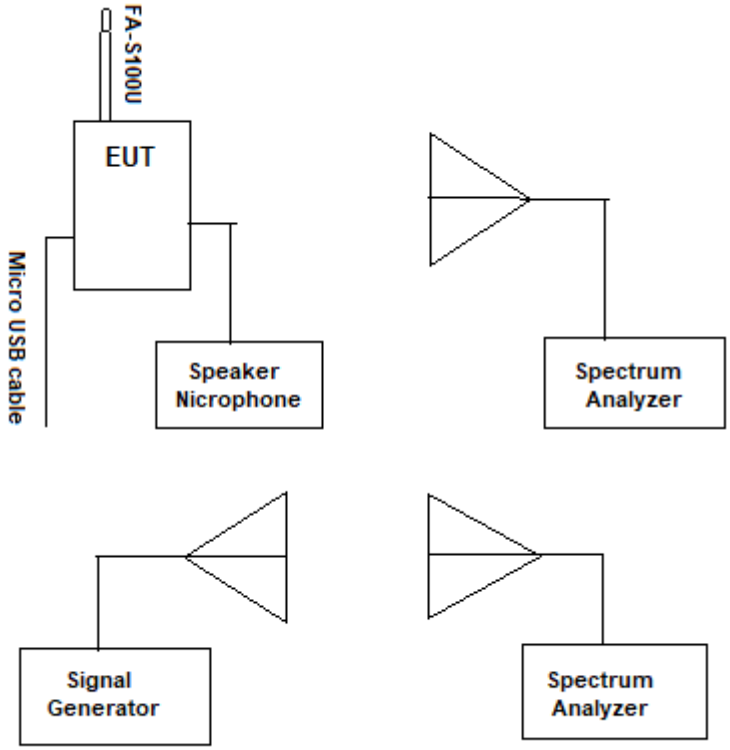
6.1. Conducted Power



Test Date: Apr 14, 2022

Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Power Meter	HP	436A	2709A27515	100KHz-sensor dependant	17 Jul 2022
Power Sensor	HP	8482A	US37295943	0.1MHz-4.2GHz	28 Mar 2023
Attenuator	Aeroflex\Weinschel	46-30-34	BR9127	DC-18GHz	Cal on use
Power Supply	Tenma	72-6153	-	1-18V, DC 10A	----
Multimeter	Fluke	8842A	4142058	---	01 Oct 2022

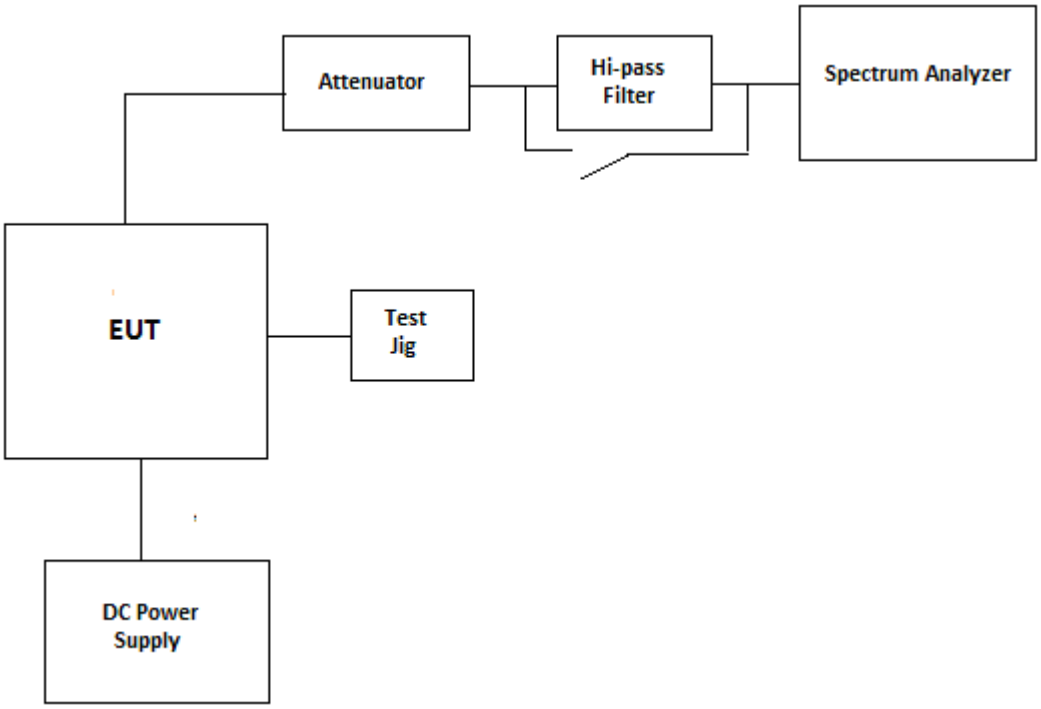
6.2. Effective Radiated Power



Test Date: Apr 22, 2022

Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Spectrum Analyzer	Rohde & Schwarz	FSU	100398	20Hz-26.5GHz	20 Sep 2023
Dipole	ETS-Lindgren	3121C-DB1	434	400-1000	13 Apr 2023
Attenuator	Pasternack	PE7024-10	4	DC-18GHz	Cal on use
Log Periodic Antenna	ETS-Lindgren	3148	00023845	200-2000MHz	14 Apr 2023
Signal Generator	IFR	2025	202304/141	9KHz-2.51GHz	02 Dec 2023

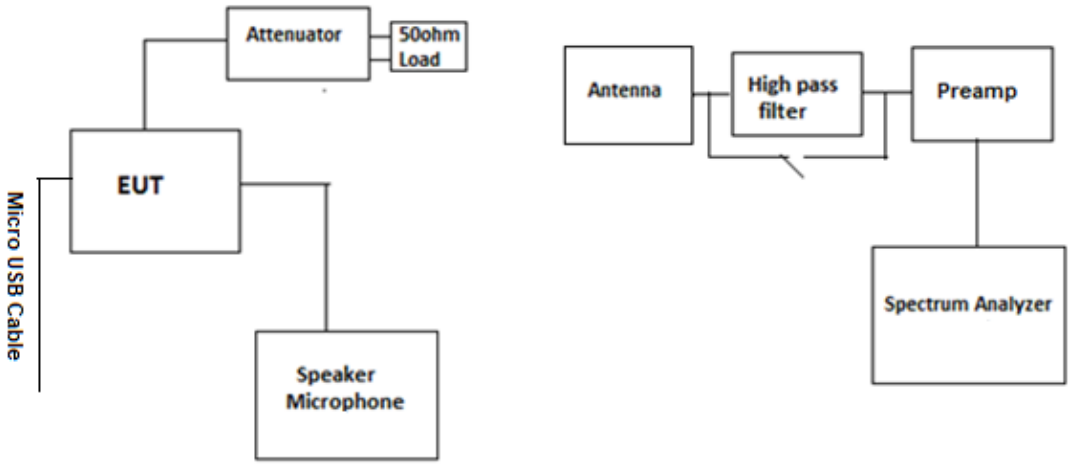
6.3. Tx Conducted Emission, EIRP for GNSS Band



Test Date: Apr 14, 2022

Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Spectrum Analyzer	Rohde & Schwarz	FSU	100398	20Hz-26.5GHz	20 Sep 2023
AF Signal Generator	HP	HP-8920B	US39064699	30MHz-1GHz	29 Mar 2024
Hi-pass filter	K&L	11SH10-1500/T8000-0/0	2	Cut off 1500MHz	Cal on use
Attenuator(30dB)	Aeroflex\Weinschel	46-30-34	BR9127	DC-18GHz	Cal on use
Power Supply	Tenma	72-6153	-	1-18V, DC 10A	----
Multimeter	Fluke	8842A	4142058	---	01 Oct 2022

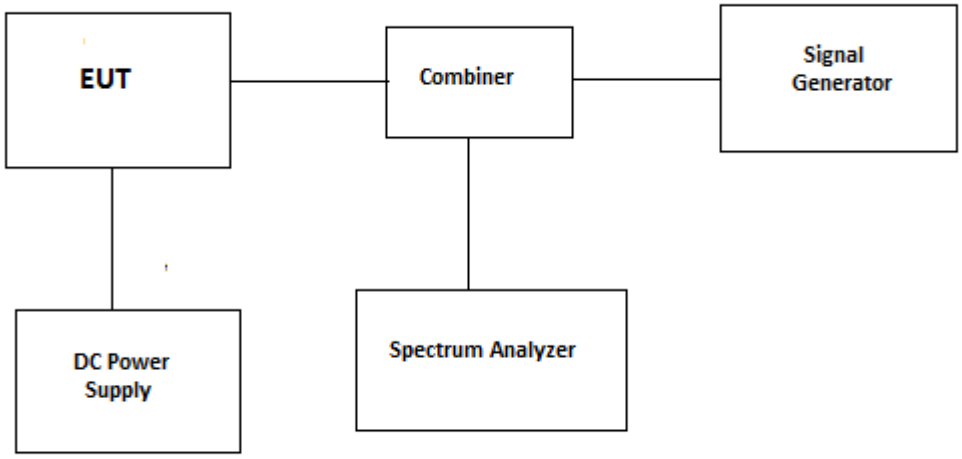
6.4. TX Radiated



Test Date: Apr 26, 2022

Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Spectrum Analyzer	Rohde & Schwarz	FSU	100398	20Hz-26.5GHz	20 Sep 2023
Spectrum Analyzer	Rohde & Schwarz	ESU40	100037	20Hz-40GHz	01 Sep 2022
Biconilog Antenna	EMCO	3142C	00034792	26-2000MHz	16 May 2022
Horn Antenna	ETS	3115	5955	1-18GHz	12 Oct 2022
Horn Antenna	ETS	3117	00119425	1-18GHz	20 Jan 2024
Preamplifier	Com-Power	PAM-118A	551016	500MHz-18GHz	04 Mar 2023
Preamplifier	Com-Power	PA-103	161040	1-1000MHz	04 Mar 2023
Hi-pass filter	K&L	11SH10-1500/T8000-0/0	2	Cut off 1500MHz	Cal on use
Attenuator(30dB)	Aeroflex\Weinschel	46-30-34	BR9127	DC-18GHz	Cal on use
Load(50ohm)	Mini-Circuits	KARN-50+	--	DC-18GHz	Cal on use

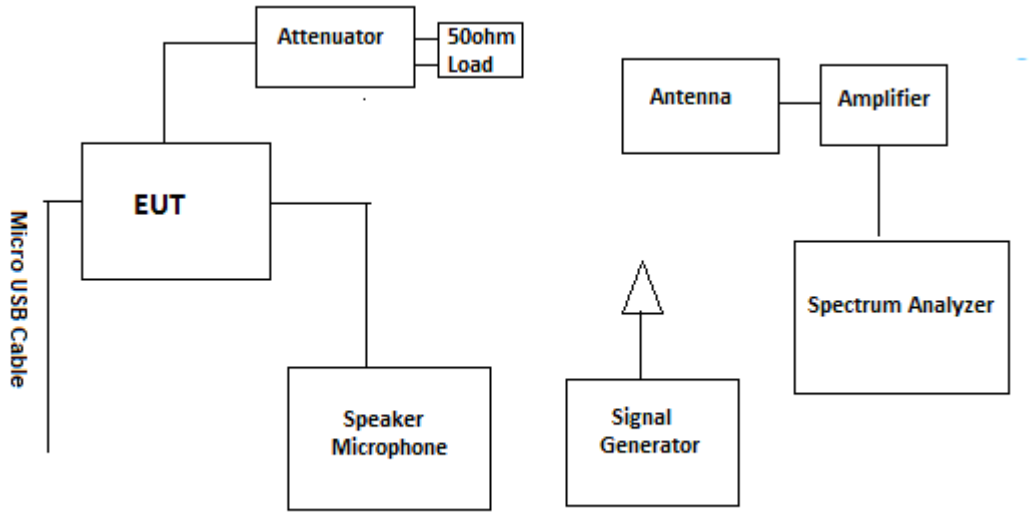
6.5. Rx Conducted Emission



Test Date: May 03, 2022

Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Spectrum Analyzer	Rohde & Schwarz	FSU	100398	20Hz-26.5GHz	20 Sep 2023
Signal Generator	IFR	2025	202304/141	9KHz-2.5GHz	02 Dec 2023
Combiner	Weinschel	1515	PS119	DC-18GHz	Cal before use
Power Supply	Tenma	72-6153	-	1-18V, DC 10A	----
Multimeter	Fluke	8842A	4142058	---	01 Oct 2022

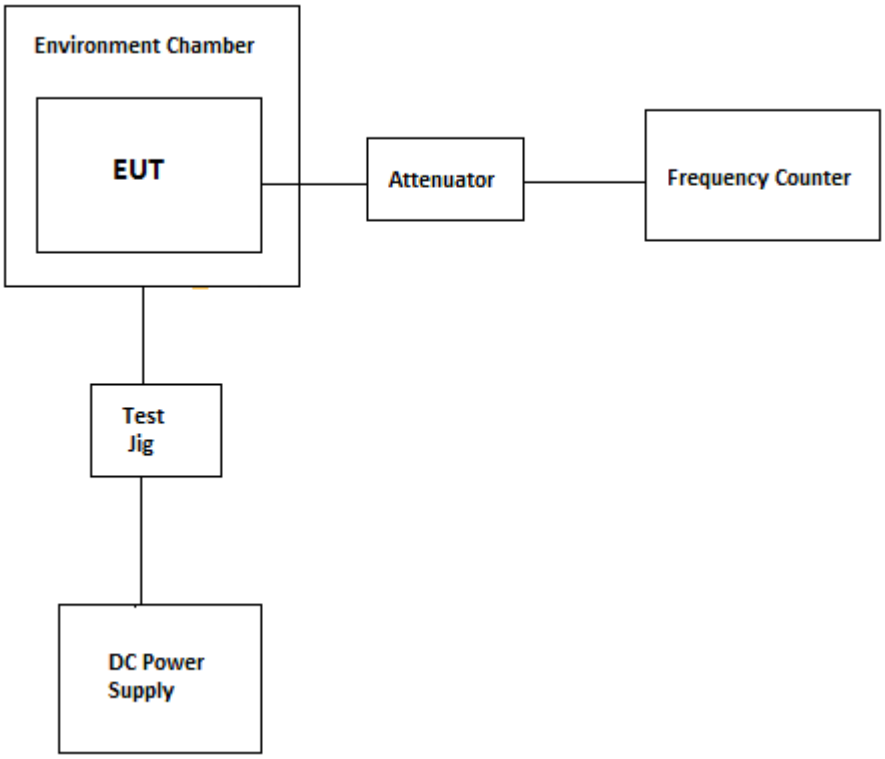
6.6. Unintentional Radiated & Rx Radiated



Test Date: Apr 20, 2022,

Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Spectrum Analyzer	Rohde & Schwarz	ESU40	100037	20Hz-40GHz	01 Sep 2022
Biconilog Antenna	EMCO	3142C	00034792	26-2000MHz	16 May 2022
Horn Antenna	ETS	3115	5955	1-18GHz	12 Oct 2022
Preamplifier	Com-Power	PAM-118A	551052	500MHz-18GHz	11 Sep 2022
Attenuator(30dB)	Aeroflex\Weinschel	46-30-34	BR9127	DC-18GHz	Cal on use
Load(50ohm)	Mini-Circuits	KARN-50+	--	DC-18GHz	Cal on use

6.7. Frequency Stability



Test Date: Apr 27~28, 2022

Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Environmental Chamber	Envirotronics	SSH32C	11994847-S-11059	-60 to 177° C	25 Aug 2023
Frequency Counter	EIP	545A	2683	10MHz-1GHz	08 Sep 2022
Attenuator(20dB)	Aeroflex\Weinschel	34-20-34	BP6023	DC-18GHz	Cal on use
Attenuator(20dB)	Narda	26298	A577	DC-1GHz	Cal on use
Power Supply	Tenma	72-6153	-	1-18V, DC 10A	----
Multimeter	Fluke	8842A	4142058	---	01 Oct 2022

EXHIBIT 7. MEASUREMENT UNCERTAINTY

Test description		Uncertainty
Conducted Output Power		+/- 0.62 dB
Occupied bandwidth		+/-0.2Hz
Emission Mask	Amplitude	+/- 0.63 dB
	Frequency	+/-0.2Hz
Conducted Out of Band/Spurious Emissions		+/- 0.72 dB
Radiated Out of Band/Spurious Emissions	<30 MHz	+/-2.69dB
	30-1000 MHz	+/-4.20dB
	>1 GHz	+/-2.70dB
Frequency Stability		+/-1.2 Hz
Power Line Conducted Emission		+ 2.62dB

All uncertainty values are expanded standard uncertainty to give a confidence level of 95%, based on coverage factor k=2

EXHIBIT 8. MEASUREMENT METHODS

8.1. CONDUCTED POWER MEASUREMENTS

- The following shall be applied to the combination(s) of the radio device and its intended antenna(e).
- I f the RF level is user adjustable, all measurements shall be made with the highest power level available to the user for that combination.
- The following method of measurement shall apply to both conducted and radiated measurements.
- The radiated measurements are performed at the Ultratech Calibrated Open Field Test Site.
- The measurement shall be performed using normal operation of the equipment with modulation.

Test procedure shall be as follows:

Step 1: Duty Cycle measurements if the transmitter's transmission is transient

- Using a EMI Receiver with the frequency span set to 0 Hz and the sweep time set at a suitable value to capture the envelope peaks and the duty cycle of the transmitter output signal;
- The duty cycle of the transmitter, x = Tx on / (Tx on + Tx off) with 0<x<1, is measure and recorded in the test report. For the purpose of testing, the equipment shall be operated with a duty cycle that is equal or more than 0.1.

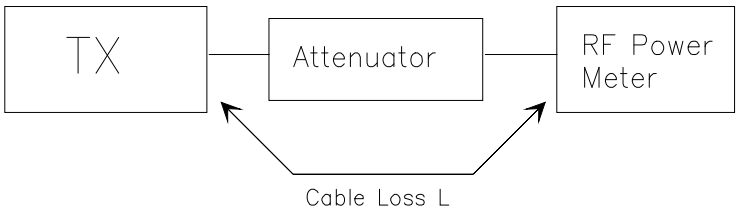
Step 2: Calculation of Average EIRP. See Figure 1

- The average output power of the transmitter shall be determined using a wideband, calibrated RF average power meter with the power sensor with an integration period that exceeds the repetition period of the transmitter by a factor 5 or more. The observed value shall be recorded as "A" (in dBm);
- The e.i.r.p. shall be calculated from the above measured power output "A", the observed duty cycle x, and the applicable antenna assembly gain "G" in dBi, according to the formula:

EIRP = A + G + 10log(1/x)

{X = 1 for continuous transmission => 10log(1/x) = 0 dB}

Figure 1.



8.2. RADIATED POWER MEASUREMENTS (ERP & EIRP) USING SUBSTITUTION METHOD

8.2.1. MAXIMIZING RF EMISSION LEVEL (E-FIELD)

(a) The measurements were performed with full rf output power and modulation.
(b) Test was performed at listed 3m open area test site (listed with FCC, IC, ITI, NVLAP, ACA & VCCI).
(c) The transmitter under test was placed at the specified height on a non-conducting turntable (80 cm height)
(d) The BICONILOG antenna (20 MHz to 1 GHz) or HORN antenna (1 GHz to 18 GHz) was used for measuring.
(e) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
E (dBμV/m) = Reading (dBμV) + Total Correction Factor (dB/m)

(f) Set the EMI Receiver and #2 as follows:

Center Frequency:	test frequency
Resolution BW:	100 KHz
Video BW:	same
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

(g) The test antenna was lowered or raised from 1 to 4 meters until the maximum signal level was detected.
(h) The transmitter was rotated through 360^{o} about a vertical axis until a higher maximum signal was received.
(i) The test antenna was lowered or raised again from 1 to 4 meters until a maximum was obtained. This level was recorded.
(j) The recorded reading was corrected to the true field strength level by adding the antenna factor, cable loss and subtracting the pre-amplifier gain.
(k) The above steps were repeated with both transmitters' antenna and test receiving antenna placed in vertical and horizontal polarization. Both readings with the antennas placed in vertical and horizontal polarization shall be recorded.
(l) Repeat for all different test signal frequencies.

8.2.2. Measuring the EIRP of Spurious/Harmonic Emissions using Substitution Method

(a) Set the EMI Receiver (for measuring E-Field) and Receiver #2 (for measuring EIRP) as follows:

Center Frequency:	equal to the signal source
Resolution BW:	100 KHz
Video BW:	VBW > RBW
Detector Mode:	positive
Average:	off
Span:	3 x the signal bandwidth

(b) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
E (dBuV/m) = Reading (dBuV) + Total Correction Factor (dB/m)

(c) Select the frequency and E-field levels obtained in the Section 8.2.1 for ERP/EIRP measurements.
(d) Substitute the EUT by a signal generator and one of the following transmitting antenna (substitution antenna):
- DIPOLE antenna for frequency from 30-1000 MHz or
- HORN antenna for frequency above 1 GHz }.

(e) Mount the transmitting antenna at 1.5 meter high from the ground plane.
(f) Use one of the following antenna as a receiving antenna:
- DIPOLE antenna for frequency from 30-1000 MHz or
- HORN antenna for frequency above 1 GHz }.

(g) If the DIPOLE antenna is used, tune it's elements to the frequency as specified in the calibration manual.
(h) Adjust both transmitting and receiving antenna in a VERTICAL polarization.
(i) Tune the EMI Receivers to the test frequency.
(j) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(k) The transmitter was rotated through 360^{o} about a vertical axis until a higher maximum signal was received.
(l) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(m) Adjust input signal to the substitution antenna until an equal or a known related level to that detected from the transmitter was obtained in the test receiver.
(n) Record the power level read from the Average Power Meter and calculate the ERP/EIRP as follows:

P = P1 - L1 = (P2 + L2) – L1 = P3 + A + L2 - L1
EIRP = P + G1 = P3 + L2 - L1 + A + G1
ERP = EIRP – 2.15 dB
Total Correction factor in EMI Receiver # 2 = L2 – L1 + G1

Where:	P:	Actual RF Power fed into the substitution antenna port after corrected.
	P1:	Power output from the signal generator
	P2:	Power measured at attenuator A input
	P3:	Power reading on the Average Power Meter
	EIRP:	EIRP after correction
	ERP:	ERP after correction

(o) Adjust both transmitting and receiving antenna in a HORIZONTAL polarization, then repeat step (k) to (o)
(p) Repeat step (d) to (o) for different test frequency
(q) Repeat steps (c) to (j) with the substitution antenna oriented in horizontal polarization.
(r) Actual gain of the EUT's antenna is the difference of the measured EIRP and measured RF power at the RF port. Correct the antenna gain if necessary.

Figure 2

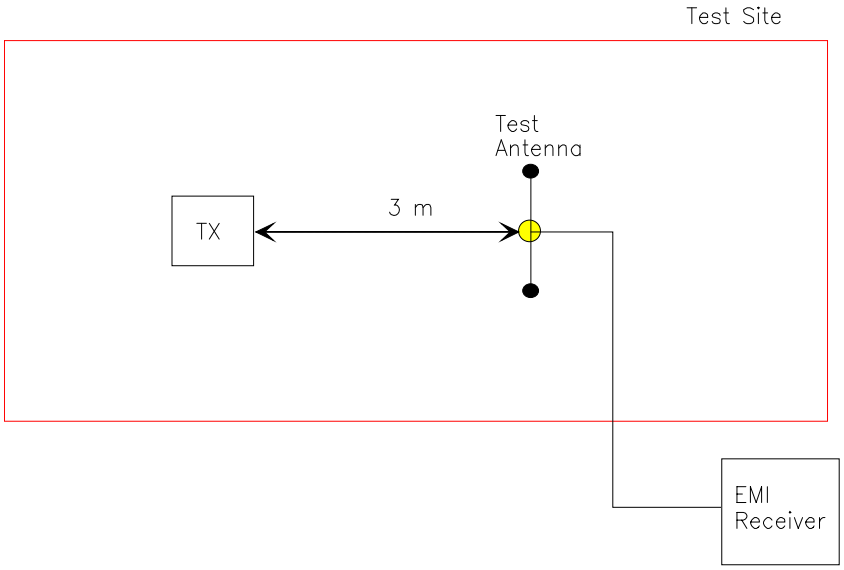
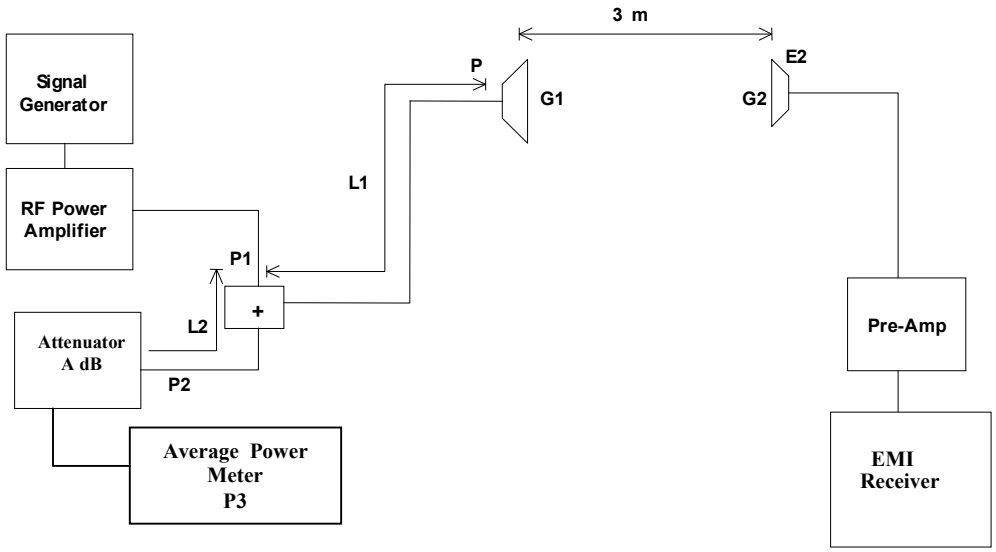


Figure 3



8.3. FREQUENCY STABILITY

Refer to FCC @ 2.1055.

(a) The frequency stability shall be measured with variation of ambient temperature as follows: From -30 to +50 centigrade except that specified in subparagraph (2) & (3) of this paragraph.

(b) Frequency measurements shall be made at 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 stability circuitry need be subjected to the temperature variation test.

(d) The frequency stability supply 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 provide 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).

8.4. EMISSION MASK

Voice or Digital Modulation Through a Voice Input Port @ 2.1049(c)(i):- The transmitter was modulated by a 2.5 KHz tone signal at an input level 16 dB greater than that required to produce 50% modulation (e.g.: ±2.5 KHz peak deviation at 1 KHz modulating frequency). The input level was established at the frequency of maximum response of the audio modulating circuit.

Digital Modulation Through a Data Input Port @ 2.1049(h):- Transmitters employing digital modulation techniques - when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the Emission Masks shall be shown for operation with any devices used for modifying the spectrum when such devices are operational at the discretion of the user.

The following EMI Receiver bandwidth shall be used for measurement of Emission Mask/Out-of-Band Emission Measurements:

(1) For 25 KHz Channel Spacing: RBW = 300 Hz
(2) For 12.5 KHz or 6.25 KHz Channel Spacings: RBW = 100 Hz

The all cases the Video Bandwidth shall be equal or greater than the measuring bandwidth.

8.5. SPURIOUS EMISSIONS (CONDUCTED)

With transmitter modulation characteristics described in Out-of-Band Emissions measurements @ 2.1049, the transmitter spurious and harmonic emissions were scanned. The spurious and harmonic emissions were measured with the EMI Receiver controls set as RBW = 30 KHz minimum , VBW ≥ RBW and SWEEP TIME = AUTO). The transmitter was operated at a full rated power output, and modulated as follows:

FCC 47 CFR 2.1057 - Frequency spectrum to be investigated: The spectrum was investigated from the lowest radio generated in the equipment up to at least the 10^{th} harmonic of the carrier frequency or to the highest frequency practicable in the present state of the art of measuring techniques, whichever is lower. Particular attention should be paid to harmonics and subharmonics of the carrier frequency. Radiation at the frequencies of multiplier stages should be checked. The
amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

FCC 47 CFR 2.1051 - Spurious Emissions at Antenna Terminal: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of the harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in 2.1049 as appropriate. The magnitude of spurious emissions, which are attenuated more than 20 dB below the permissible value, need not be specified.

8.6. TRANSIENT FREQUENCY BEHAVIOR

1. Connect the transmitter under tests as shown in the above block diagram
2. Set the signal generator to the assigned frequency and modulate with a 1 KHz tone at ±12.5 KHz deviation and its output level to be 50 dB below the transmitter rf output at the test receiver end.
3. Set the horizontal sweep rate on the storage scope to 10 milliseconds per division and adjust the display to continuously view the 1000 Hz tone from the Demodulator Output Port (DOP) of the Test Receiver. Adjust the vertical scale amplitude control of the scope to display the 1000 Hz at ±4 divisions vertical Center at the display.
4. Adjust the scope so it will trigger on an increasing magnitude from the RF trigger signal of the transmitter under test when the transmitter was turned on. Set the controls to store the display.
5. The output at the DOP, due to the change in the ratio of the power between the signal generator input power and transmitter output power will, because of the capture effect of the test receiver, produce a change in display: For the first part of the sweep it will show the 1 KHz test signal. Then once the receiver's demodulator has been captured by the transmitter power, the display will show the frequency difference from the assigned frequency to the actual transmitter frequency versus time. The instant when the 1 KHz test signal is completely suppressed (including any capture time due to phasing) is considered to be t_{on}. The trace should be maintained within the allowed divisions during the period t_1 and t_2.
6. During the time from the end of t_2 to the beginning of t_3 the frequency difference should not exceed the limits set by the FCC in Part 90.214 and the outlined in the Carrier Frequency Stability sections. The allowed limit is equal to FCC frequency tolerance limits specified in FCC 90.213.
7. Repeat the above steps when the transmitter was turned off for measuring t_3.

END OF REPORT