



Test Report - FCC Part 90 Booster Class A (B9A)

Applicant: Fiplex Communications Inc.

Approved for Release By:

Signature: Bruno Clavier

Name & Title: Bruno Clavier, General Manager

Date of Signature 4/3/2023

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1. Customer Information

Applicant: Fiplex Communications Inc.
Address: 2101 NW 79th Avenue,
Miami, Florida, 33122, United States

1.1 Test Result Summary

The following test procedure and guidance were used for measuring FCC PART 90 (PRIVATE LAND MOBILE RADIO SERVICES) known as Licensed Land Mobile; ANSI C63.26-2015 and FCC KDB 935210 D05 v01r04 Industrial Signal Boosters. Full test results are available in this report.

No additions to the test methods were needed. There were no deviations, or exclusions from the test methods. No test results are from external providers or from the customer. The test results relate only to the items tested. Timco does not offer opinions and interpretations, only a pass/fail statement.

Applicable Clauses from Part 2		
FCC Part 2 Clauses	Description of the requirements	Result: (Pass, Fail, N/A)
2.202	Bandwidth & Emission	Pass
2.1033 (c)(8)	Power at the Final Amplifier	Pass
2.1046 (a)	RF Output Power	Pass
2.1047	Modulation characteristics	n/a
2.1049	Occupied Bandwidth	Pass
2.1051	Spurious emissions at antenna terminals	Pass
2.1053	Field strength of spurious radiation	Pass
2.1055	Frequency stability	n/a

Applicable Clauses from Part 90 Subpart I		
FCC Part 90 Clauses	Description of the requirements	Result: (Pass, Fail, N/A)
90.205	Transmitter Power	Pass
90.207	Types of Emissions	Pass
90.209	Bandwidth limitations	Pass
90.210	Emission masks, In-band	Pass
90.210	Emission masks, Out-of-band	Pass
90.213	Frequency stability	n/a
90.214	Transient Frequency Behavior	n/a
90.219 (d)(6)(i)	ERP of intermodulation products	n/a ¹
90.219 (d)(6)(ii)	ERP of noise within the passband	n/a ¹
90.219 (d)(6)(iii)	ERP of noise on spectrum < 1 MHz outside of the passband	n/a ¹
90.219 (d)(3)(i), (e)(1)	ERP of Radiated Power	n/a ¹
90.219 (e)(2)	Noise figure	Pass
90.219 (e)(3)	Spurious emissions	Pass
90.219 (e)(4)(i)(ii)(iii)	Retransmitted Signals	n/a
90.221	Adjacent channel power limits	n/a

Note 1: Requirements in Part 90.219 (d) apply at deployment of this EUT, therefore are not applicable at certification.

KDB 935210 D05 v01r04		
FCC KDB 935210 D05 Clauses	Description of the requirements	Result: (Pass, Fail, N/A)
4.1	Test Signals for PLMRS (Input Signals)	Pass
4.2	AGC Threshold	Reported
4.3	Out-of-Band Rejection	Reported
4.4	Input-versus-Output Signal Comparison	Pass
4.5	Output Power	Pass
4.5	Amplifier/Booster Gain (optional)	Reported
4.6	Noise Figure	Pass
4.7.2	Out-of-band/Out-of-block Conducted Emissions (Intermodulation Products)	Reported
4.7.3	EUT Spurious Conducted Emissions	Pass
4.8	Frequency Stability	n/a
4.9	Spurious Radiated Emissions	Pass



KDB 484596 D01 v01		
FCC KDB 935210 D05 Clauses	Description of the requirements	Result: (Pass, Fail, N/A)
3 a	Introduction	Reported
3 b	Explain the Differences	Reported
3 c	Spot-check Verification Data	Pass
3 d	Reference Section	Reported

Introduction

Equipment classes B9A and B9B are not allowed to be filed under the same FCC ID. However, FCC ID P3TDH14-10A is electrically identical to FCC ID P3TDH14-10B. The EUT uses software to limit the passband, converting the EUT from a Class B Industrial Signal Booster into a Class A Industrial Signal Booster. The test data is valid to be re-used due to the Class B operation of the EUT being worst-case in all aspects. The Class A operation represented in this filing was equal or more compliant with FCC Part 90 in all respects. Therefore all testing is to be considered identical, and has been re-used following the guidelines of KDB 484596.

Explain the Differences

FCC ID P3TDH14-10A is electrically identical to FCC ID P3TDH14-10B and has no difference in hardware. The EUT uses software to limit the passband from widths equal to or greater than 75 kHz to widths less than 75 kHz.

Spot-Check Verification Data

Please see sections Out-of-Band Rejection and Spurious Radiated Emissions in this report for Spot-Check data.

Reference Section

All original test data is from FCC ID P3TDH14-10B, test report "TR_6428-23_FCC_PT90_Booster Class B_1.docx".



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2. Location of Testing

2.1 Test Laboratory

Timco Engineering Inc. is a subsidiary of Industrial Inspection & Analysis, Inc. ("IIA").

Testing was performed at Timco's permanent laboratory located at 849 NW State Road 45, Newberry, Florida 32669

FCC test firm # 578780

FCC Designation # US1070

FCC site registration is under A2LA certificate # 0955.01

ISED Canada test site registration # 2056A

EU Notified Body # 1177

For all designations see A2LA scope # 0955.01

2.2 Testing was performed, reviewed by

Dates of Testing: 2/9/2023- 2/13/2023

Signature:

Sr. EMC Engineer
EMC-003838-NE



Name & Title:

Tim Royer, EMC Engineer

Date of Signature

4/3/2023

Signature:

Name & Title:

Kristoffer Costa, EMC Technician

Date of Signature

4/3/2023



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3. Test Sample(s) (EUT/DUT)

The test sample was received: 2/7/2023

3.1 Definitions

Signal booster: A device or system that automatically receives, amplifies, and retransmits signals from wireless stations into and out of building interiors, tunnels, shielded outdoor areas and other locations where these signals would otherwise be too weak for reliable communications. Signal booster systems may contain both Class A and Class B signal boosters as components.

Class A signal booster: A signal booster designed to retransmit signals on one or more specific channels. A signal booster is deemed to be a Class A signal booster if none of its passbands exceed 75 kHz.

Class B signal booster: A signal booster designed to retransmit any signals within a wide frequency band. A signal booster is deemed to be a Class B signal booster if it has a passband that exceeds 75 kHz.



3.2 Description of the EUT

A description as well as unambiguous identification of the EUT(s) tested. Where more than one sample is required for technical reasons (such as the use of connected units for the purpose of conducted output power testing where the product units will have integral antennas), each specific test shall identify which unit was tested.

Identification	
FCC ID:	P3TDH14-10A
Brief Description	UHF LOW BAND DIGITAL SIGNAL BOOSTER BDA
Model(s) #	HONBDA-A-L
Firmware version	N/A
Software version	N/A
Serial Number	N/A

Technical Characteristics	
Frequency Range	Unit 1: UL: 406.1 MHz – 411 MHz DL: 411 MHz – 416 MHz Unit 2: UL: 425 MHz – 430 MHz DL: 420 MHz – 425 MHz
RF O/P Power (Max.)	Downlink: 36.85 dBm/ 4.84 W Uplink: 25.03 dBm/ 0.32W
Modulation	FM
Bandwidth & Emission Class	4K04F3E, 7K86F3E, 12K3F3E, 8K06F1D, 8K06F1E, 8K02F1W, 9K63F1D, 9K63F1E, 9K63D7W
Duty Cycle	100%
Antenna Connector	N Type
Voltage Rating (AC or Batt.)	110 VAC/ 24VDC

Antenna Characteristics			
Antenna	Frequency Range	Mode / BW	Antenna Gain
1	n/a	n/a	0 dBi

- Note: Information such as antenna gain, firmware/software numbers are provided by manufacturer and cannot be validated by the test lab.



3.3 Configuration of EUT

Test Modes			
Unit	Band (MHz)	Link Direction	Test Frequencies (MHz)
1	406.1- 411 MHz	Uplink	409 MHz
	411- 416 MHz	Downlink	413.5 MHz
2	425- 430 MHz	Uplink	428 MHz
	420- 425 MHz	Downlink	423 MHz

Operating conditions during Testing:

No other modifications of the device under test (including firmware, specific software settings, and input/output signal levels to the EUT) were made.

Peripherals used during Testing:

A laptop was used to program the EUT.

3.4 Test Setup of EUT

Equipment, antenna, and cable arrangement. The setup of the equipment and cable or wire placement on the test site that produces the highest radiated and the highest ac power line conducted emissions shall be shown clearly and described. Information on the orientation of portable equipment during testing shall be included. Drawings or photographs may be used for this purpose.

Test Setups are included in the test report.



4. Test methods & Applicable Regulatory Limits

4.1 Test methods/Standards/Guidance:

Test procedures and guidance for measuring Licensed Part 90 Licensed device:

- 1) ANSI C63.26-2015
- 2) FCC KDB 935210 D05 v01r04 Industrial Signal Boosters

4.2 Applied Limits and Regulatory Limits:

- 1) FCC CFR 47 Part 90 Subpart I, 90.219

5. Measurement Uncertainty

Parameter	Uncertainty (dB)
Conducted Emissions	± 3.14 dB
Radiated Emissions (9kHz – 30 MHz)	± 3.08 dB
Radiated Emissions (30 – 200 MHz)	± 2.16 dB
Radiated Emissions (200 – 1000 MHz)	± 2.15 dB
Radiated Emissions (1 GHz – 18 GHz)	± 2.14 dB
Radiated Emissions (18 GHz – 40 GHz)	± 2.31 dB
Note: The uncertainties provided in this table represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of K=2.	

6. Environmental Conditions

6.1 Temperature & Humidity

Measurements performed at the test site did not exceed the following:

Parameter	Measurement
Temperature	23 C +/- 5%
Humidity	55% +/- 5%
Barometric Pressure	30.05 in Hg
Note: Specific environmental conditions that are applicable to a specific test are available in the test result section.	



7. List of Test Equipment and Test Facility

The test equipment used identified by type, manufacturer, serial number, or other identification and the date on which the next calibration or service check is due.

Description of the firmware or software used to operate EUT for testing purposes.

A complete list of all test equipment used shall be included with the test report. The manufacturer's model and serial numbers, and date of last calibration, and calibration interval shall be included. Measurement cable loss, measuring instrument bandwidth and detector function, video bandwidth, if appropriate, and antenna factors shall also be included where applicable.

7.1 List of Test Equipment

Test Equipment						
Type	Device	Manufacturer	Model	SN#	Current Cal	Cal Due
Antenna, NSA	Log-Periodic 1243	Eaton	96005	1243	5/4/21	5/3/2024
Antenna	Double-Ridged Horn/ETS Horn 1	ETS-Lindgren	3117	00035923	2/25/20	2/24/2023
CHAMBER	CHAMBER	Panashield	3M	N/A	3/12/19	12/21/2023
Pre-amp	Pre-amp	RF-LAMBDA	RLNA00M45GA	NA	2/27/19	7/26/2025
Receiver	EMI Test Receiver R&S ESU 40	Rohde & Schwarz	ESU 40	100320	5/27/21	5/26/2024
Receiver	EMI Test Receiver R&S ESW44	Rohde & Schwarz	ESW44	103049	10/13/21	10/12/2024
Function Generator	Function Generator	Standford	DS340	25200	1/13/21	1/13/2024
Signal Generator	Signal Generator HP 8648C	HP	8648C	35537A01679	3/29/19	8/03/2025

Software			
Software	Author	Version	Validation on
ESU Firmware	Rohde & Schwarz	4.43 SP3; BIOS v5.1-24-3	2018
RSCCommander	Rohde & Schwarz	1.6.4	2014
ScopeExplorer	LeCroy	v2.25.0.0	2009
Field Strength	Timco	v4.10.7.0	2016



8. Test Results

The results of the test are usually indicated in the form of tables, spectrum analyzer plots, charts, sample calculations, as appropriate for each test procedure.

A description and/or a block diagram of the test setup is usually provided.

The measurement results, along with the appropriate limits for comparison, may be presented in tabular or graphical form. In addition, any variation in the measurement environment may be reported if applicable (e.g., a significant change of temperature that could affect the cable loss and amplifier response).

Unless noted otherwise in the referenced standard, the measurements of **ac power-line conducted emissions and conducted power output** will be reported in units of dB μ V. Unless noted otherwise in the referenced standard, the measurements of **radiated emissions** will be reported in units of decibels, referenced to one microvolt per meter (dB μ V/m) for electric fields, or to one ampere per meter (dBA/m) for magnetic fields, at the distance specified in the appropriate standards or requirements. The measurements of antenna-conducted power for receivers may be reported in units of dB μ V if the impedance of the measuring instrument is also reported. Otherwise, antenna-conducted power will be reported in units of decibels referenced to one milliwatt (dBm). All formulas for data conversions and conversion factors, if used, will be included in this measurement report.

Example:

Freq (MHz)	Meter Reading	+ ACF	+CL	= FS
33	20 dB μ V	+ 10.36 dB/m	+0.40 dB	=30.36 dB μ V/m @ 3m

$EIRP = P_{cond} \text{ (dBm)} + dBi$



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8.1 Power at the Final Amplifier

Referenced from test report "TR_6428-23_FCC_PT90_Booster Class B_1.docx".

Limits from FCC Part 2.1033 (c)(8).

No method of measurement is specified. The result has been calculated based on all available information.

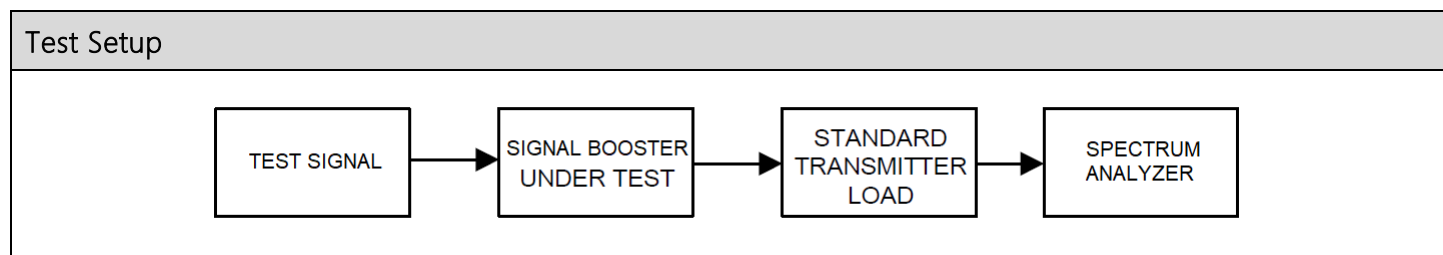
Test Results		
EUT Operating Voltage (V)	EUT Current (A)	Power at the Final Amplifier (W)
24	3.33	79.92



8.2 RF Output Power & Gain

Referenced from test report "TR_6428-23_FCC_PT90_Booster Class B_1.docx".

Limits from FCC Parts 2.1046(a), and 90.205 and test procedure from ANSI C63.26-2015 and FCC KDB 935210 D05 v01r04 Industrial Signal Boosters.



Test Results, Power Output			
Unit	Link Direction	Max Power Output (dBm)	Max Power Output (W)
1	Uplink	25.03	0.32
	Downlink	36.85	4.84
2	Uplink	24.19	0.26
	Downlink	36.21	4.18



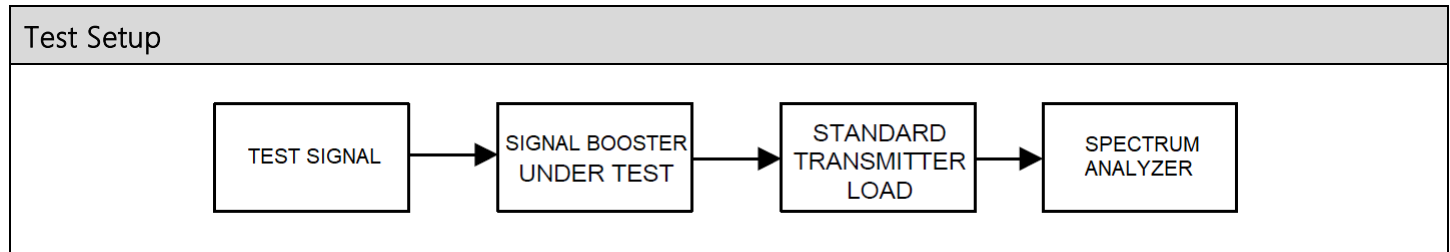
Unit 1: Test Results, Gain					
Link Direction	Tuned Frequency (MHz)	Input Level	Power Input (dBm)	Power Output (dBm)	Gain (dB)
Uplink	409	AGC	-55.5	24.58	80.08
		AGC+3	-52.5	25.03	77.53
Downlink	413.5	AGC	-43.5	36.43	79.93
		AGC+3	-40.5	36.85	77.35

Unit 2: Test Results, Gain					
Link Direction	Tuned Frequency (MHz)	Input Level	Power Input (dBm)	Power Output (dBm)	Gain (dB)
Uplink	428	AGC	-56	24.19	80.19
		AGC+3	-53	23.93	76.93
Downlink	423	AGC	-42.5	36.21	78.71
		AGC+3	-39.5	36.12	75.62



8.3 Out-of-band Rejection

Limits and test method from FCC KDB 935210 D05 v01r04 Industrial Signal Boosters.

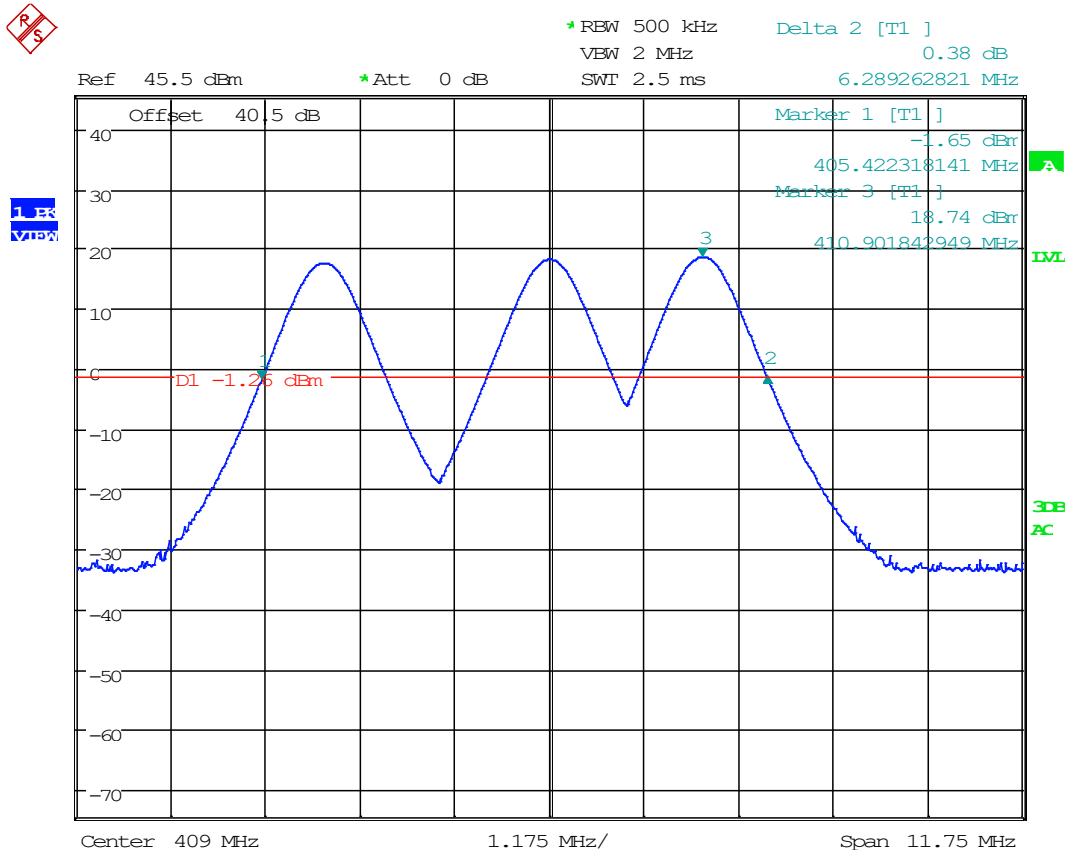


Test Results, Out-of-band Rejection and Class of Operation				
Unit	Operating Band (MHz)	Link Direction	Passband (kHz)	Class of Operation
1	406.1- 411 MHz	Uplink	< 75 kHz	Class A
	411- 416 MHz	Downlink	< 75 kHz	Class A
2	425- 430 MHz	Uplink	< 75 kHz	Class A
	420- 425 MHz	Downlink	< 75 kHz	Class A



Out-of-band Rejection, Spectrum Plots

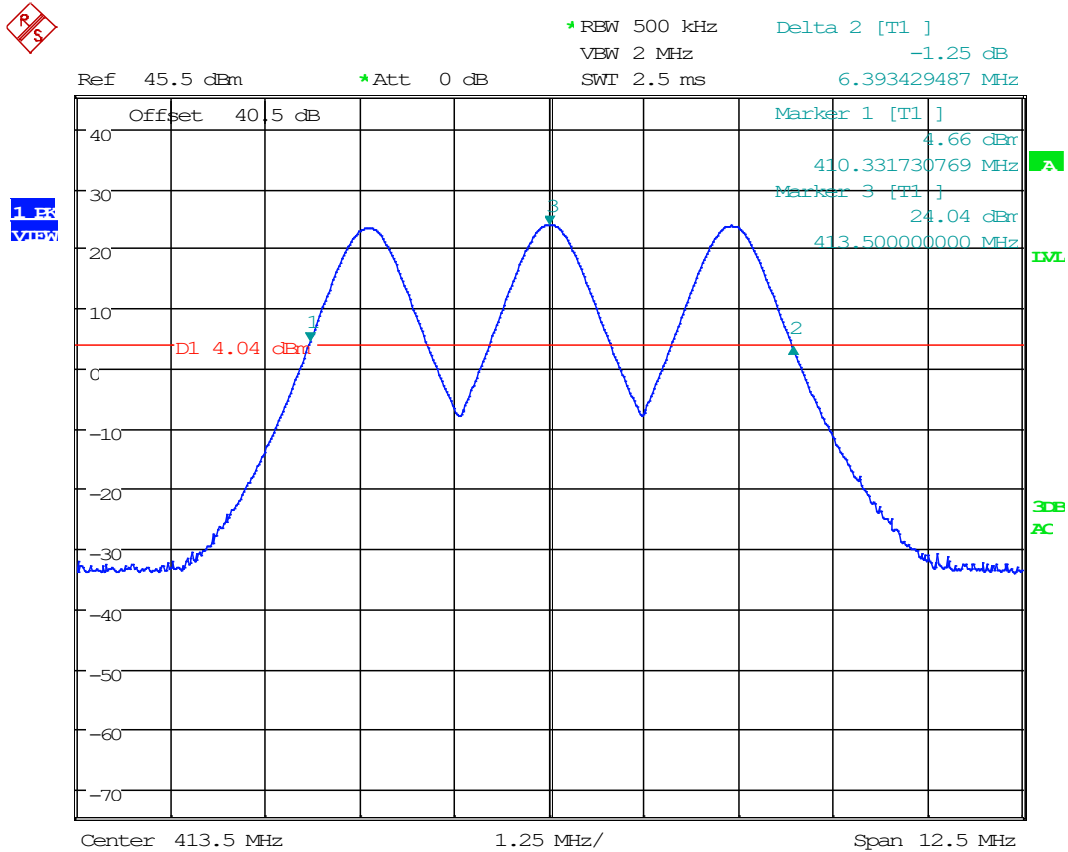
8.3.1 Unit 1, Uplink



Date: 9.FEB.2023 15:25:23



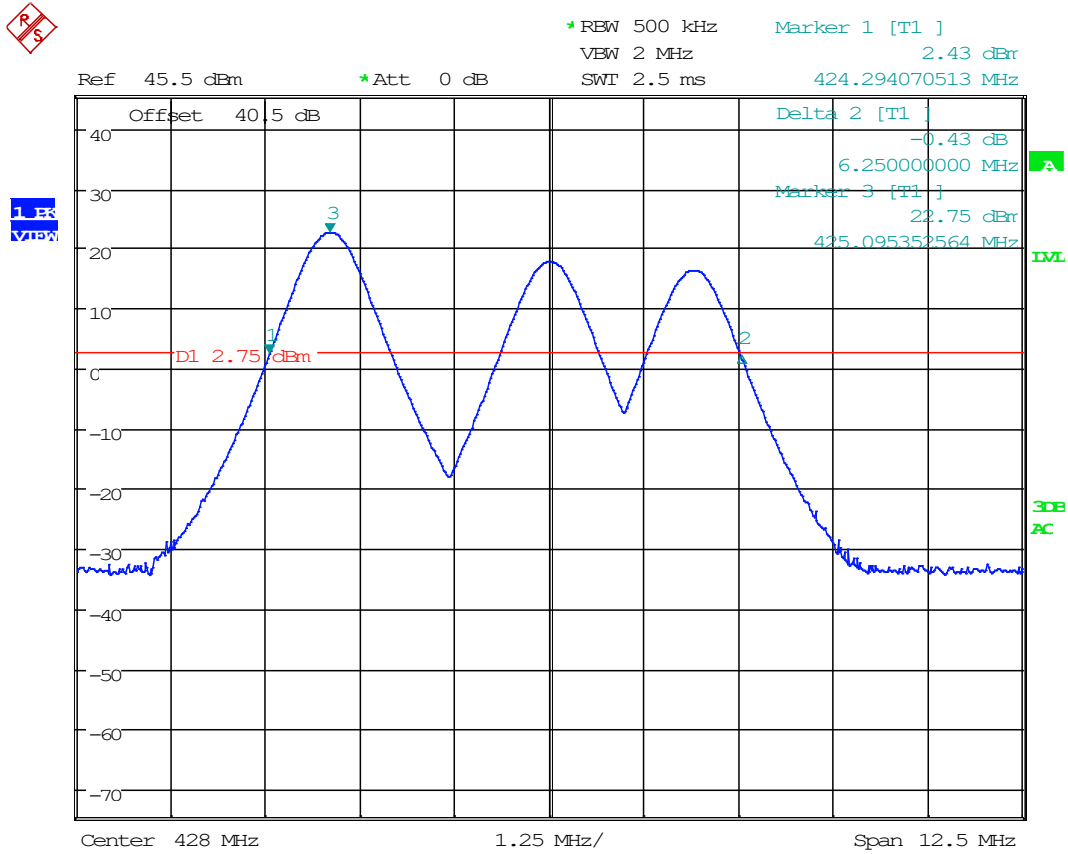
8.3.2 Unit 1, Downlink



Date: 9.FEB.2023 15:47:40



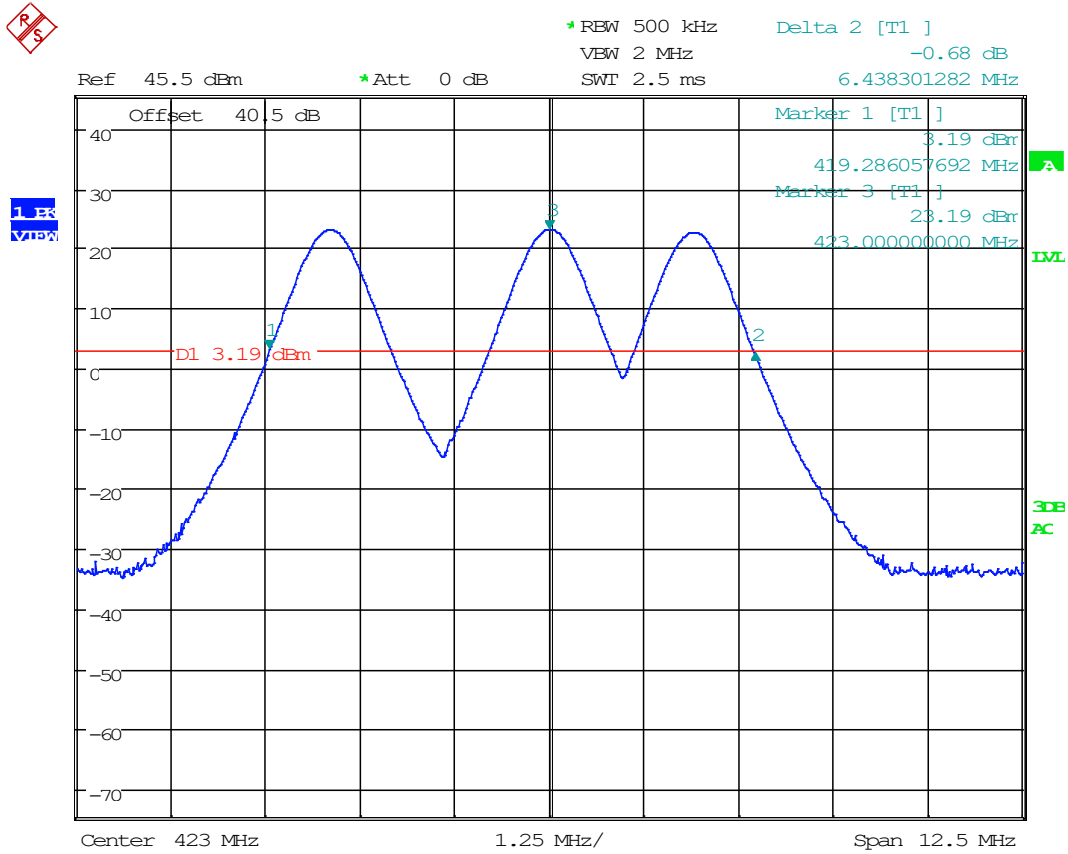
8.3.3 Unit 2, Uplink



Date: 9.FEB.2023 15:40:34



8.3.4 Unit 2, Downlink



Date: 9.FEB.2023 15:43:50



8.4 Bandwidth & Emission

Referenced from test report "TR_6428-23_FCC_PT90_Booster Class B_1.docx".

Limits from FCC Parts 90.209 and FCC KDB 935210 D05 v01r04 Industrial Signal Boosters.

Authorized Bandwidth		
Rule Part	Operating Range (MHz)	Authorized Bandwidth (kHz)
Part 90	406 439MHz	6/11.25/20

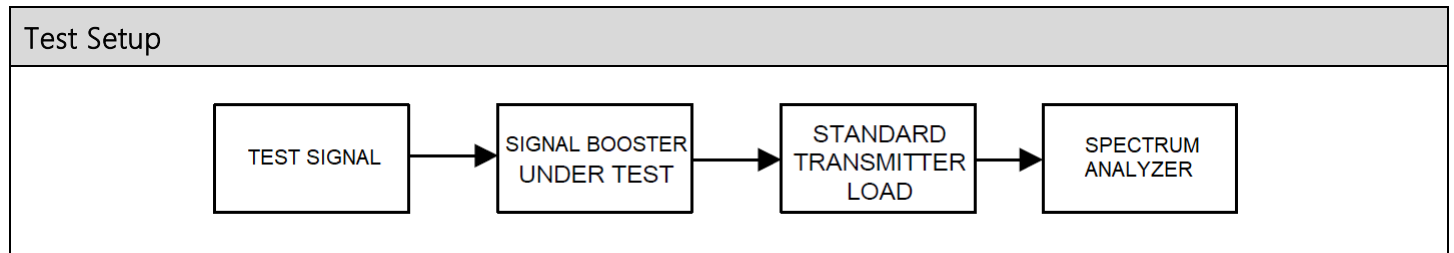
Applicable Input Signals		
Signal	Occupied Bandwidth (kHz)	Representative Emission Designator(s)
CW	N/A	N/A
6.25 kHz FM	4.04	4K04F3E
12.5 kHz FM	7.86	7K86F3E
25 kHz FM	12.3	12K3F3E
C4FM (P25 Phase I)	8.06	8K06F1D, 8K06F1E
HCPM (P25 Phase II SU)	8.2	8K02F1W
HDQPSK (P25 Phase II BS)	9.63	9K63F1D, 9K63F1E, 9K63D7W



8.5 Input VS Output Signal Comparison

Referenced from test report "TR_6428-23_FCC_PT90_Booster Class B_1.docx".

Limits from FCC Parts 90.210 and test procedure from ANSI C63.26-2015 and FCC KDB 935210 D05 v01r04 Industrial Signal Boosters.





Unit 1 Input VS Output Comparison

Test Results, Input VS Output Comparison						
Link Direction	Tuned Frequency (MHz)	Input Signal	AGC Level	99% OBW of Input (kHz)	99% OBW of Output (kHz)	Change (%)
Unit 1 Uplink	409	6.25 kHz FM	@ AGC	4.038	4.03	0.008
		12.5 kHz FM	@ AGC	6.21	7.85	1.64
		25 kHz FM	@ AGC	10.21	12.29	2.08
		C4FM	@ AGC	7.71	8.06	0.35
		HCPM	@ AGC	7.71	8.19	0.48
		HDQPSK	@ AGC	9.91	9.63	0.28
Unit 1 Downlink	413.5	6.25 kHz FM	@ AGC	4.038	4.02	0.018
		12.5 kHz FM	@ AGC	6.21	7.84	1.63
		25 kHz FM	@ AGC	10.21	12.34	2.13
		C4FM	@ AGC	7.71	8.02	0.31
		HCPM	@ AGC	7.71	8.18	0.47
		HDQPSK	@ AGC	9.91	9.85	0.06



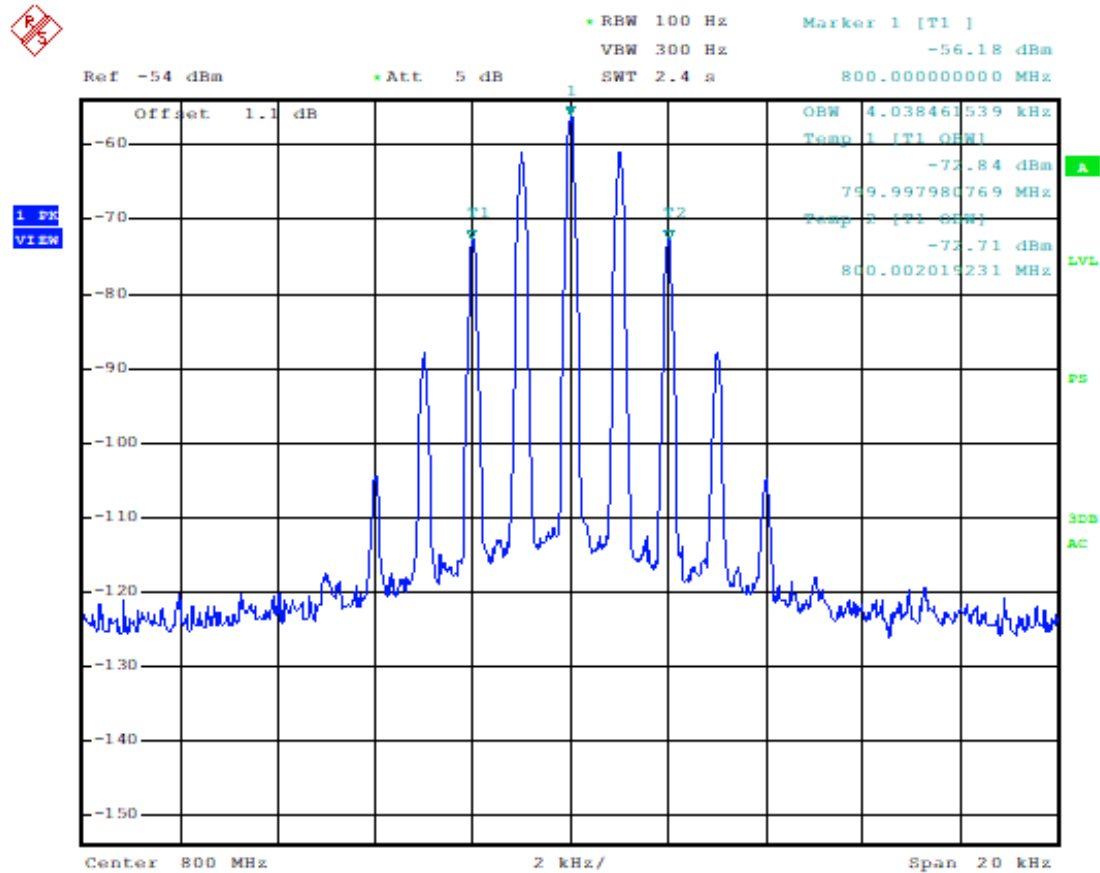
Unit 2 Input VS Output Comparison

Test Results, Input VS Output Comparison						
Link Direction	Tuned Frequency (MHz)	Input Signal	AGC Level	99% OBW of Input (kHz)	99% OBW of Output (kHz)	Change (%)
Unit 2 Uplink	428	6.25 kHz FM	@ AGC	4.038	4.05	0.012
		12.5 kHz FM	@ AGC	6.21	7.81	1.6
		25 kHz FM	@ AGC	10.21	12.24	2.03
		C4FM	@ AGC	7.71	8.11	0.4
		HCPM	@ AGC	7.71	8.09	0.38
		HDQPSK	@ AGC	9.91	9.91	0
Unit 2 Downlink	423	6.25 kHz FM	@ AGC	4.038	4.03	0.008
		12.5 kHz FM	@ AGC	6.21	7.84	1.63
		25 kHz FM	@ AGC	10.21	12.21	2.0
		C4FM	@ AGC	7.71	8.21	0.5
		HCPM	@ AGC	7.71	8.06	0.35
		HDQPSK	@ AGC	9.91	9.86	0.05



Input VS Output, Input Spectrum Plots

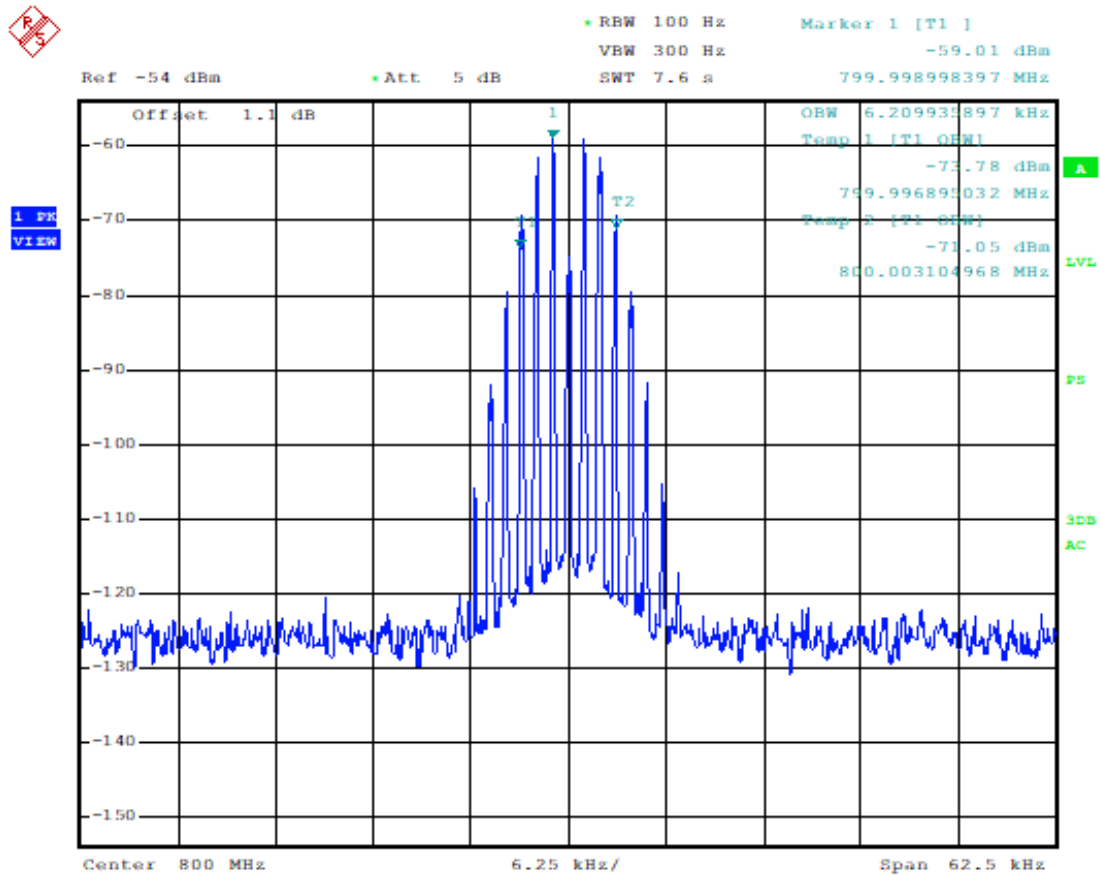
8.5.1 6.25 kHz FM, Input Signal



Date: 30.JAN.2019 13:10:11



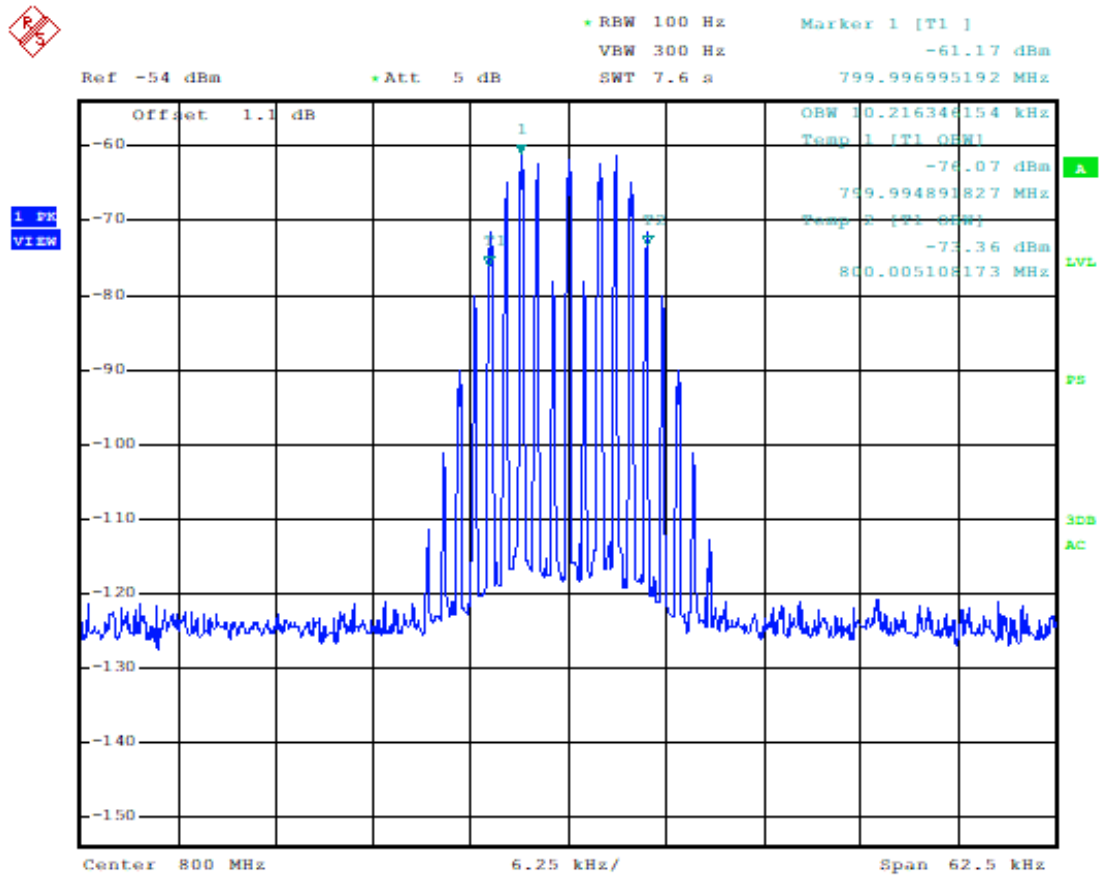
8.5.2 12.5 kHz FM, Input Signal



Date: 30.JAN.2019 14:19:45



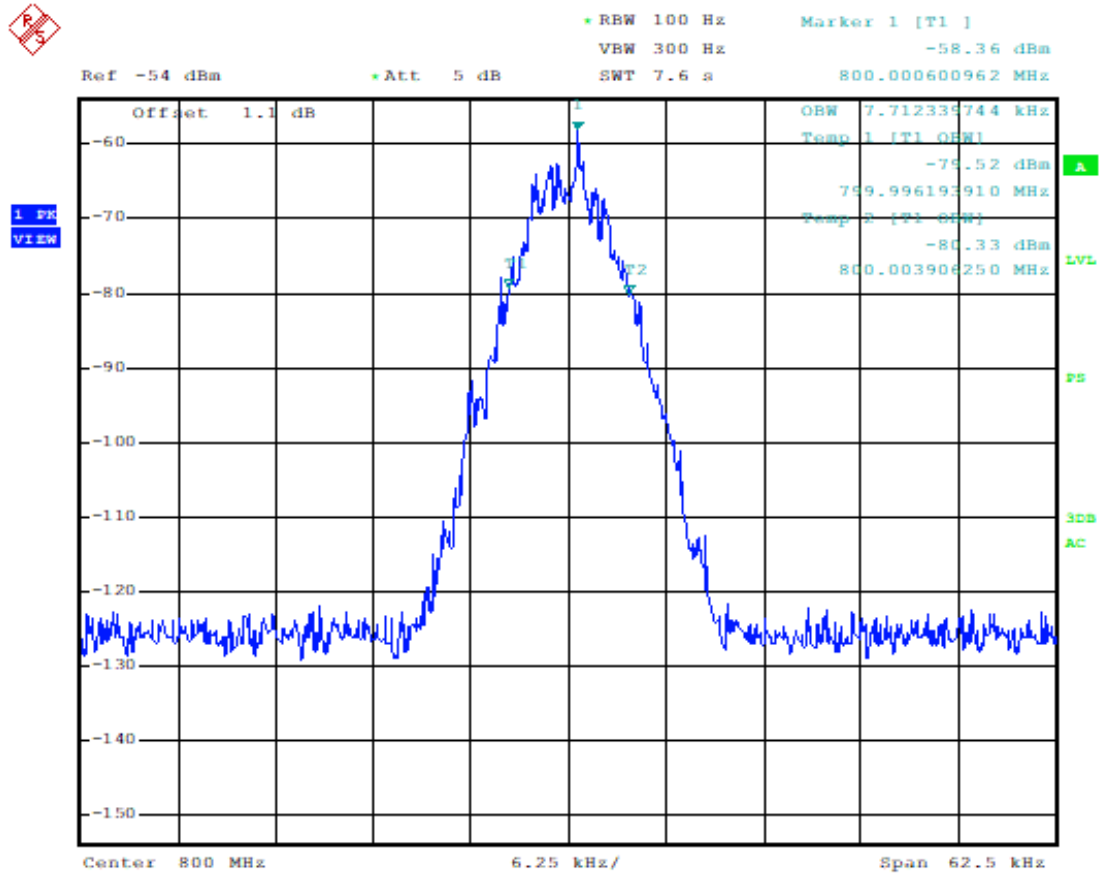
8.5.3 25 kHz FM, Input Signal



Date: 30.JAN.2019 14:23:14



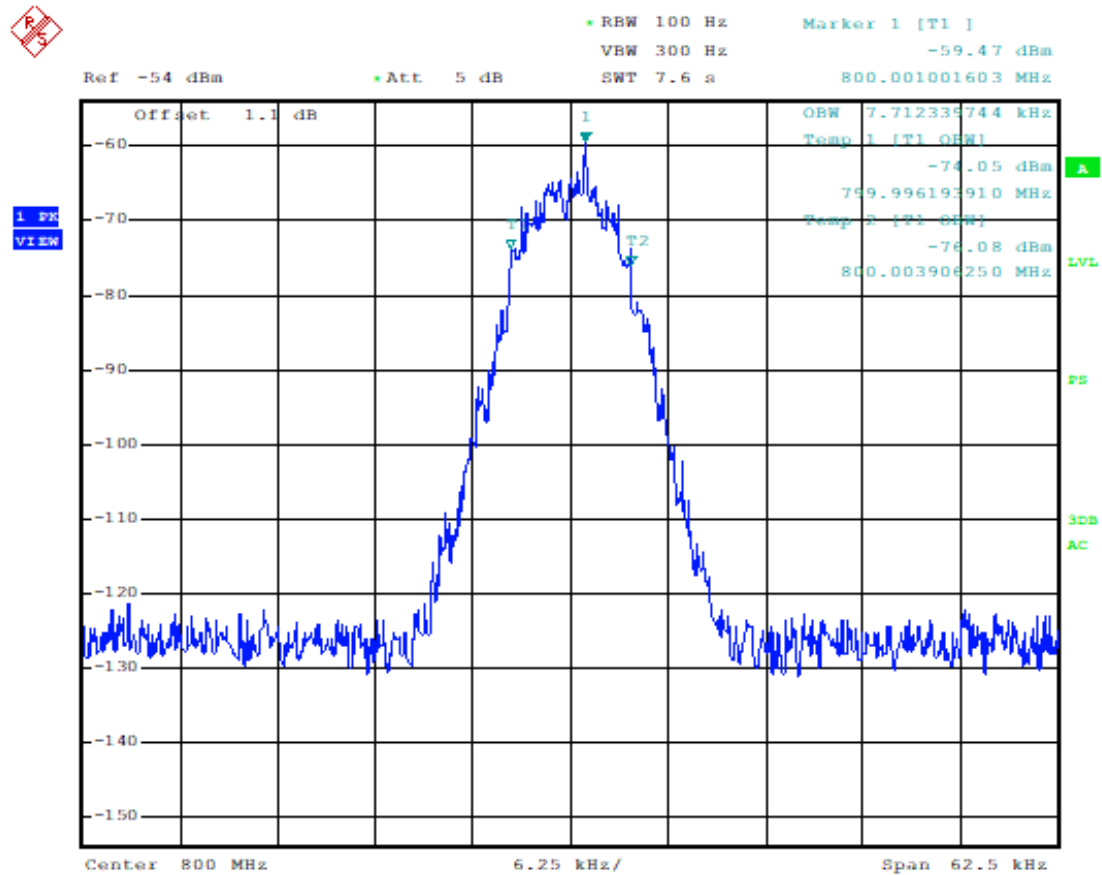
8.5.4 C4FM, Input Signal



Date: 30.JAN.2019 14:28:58



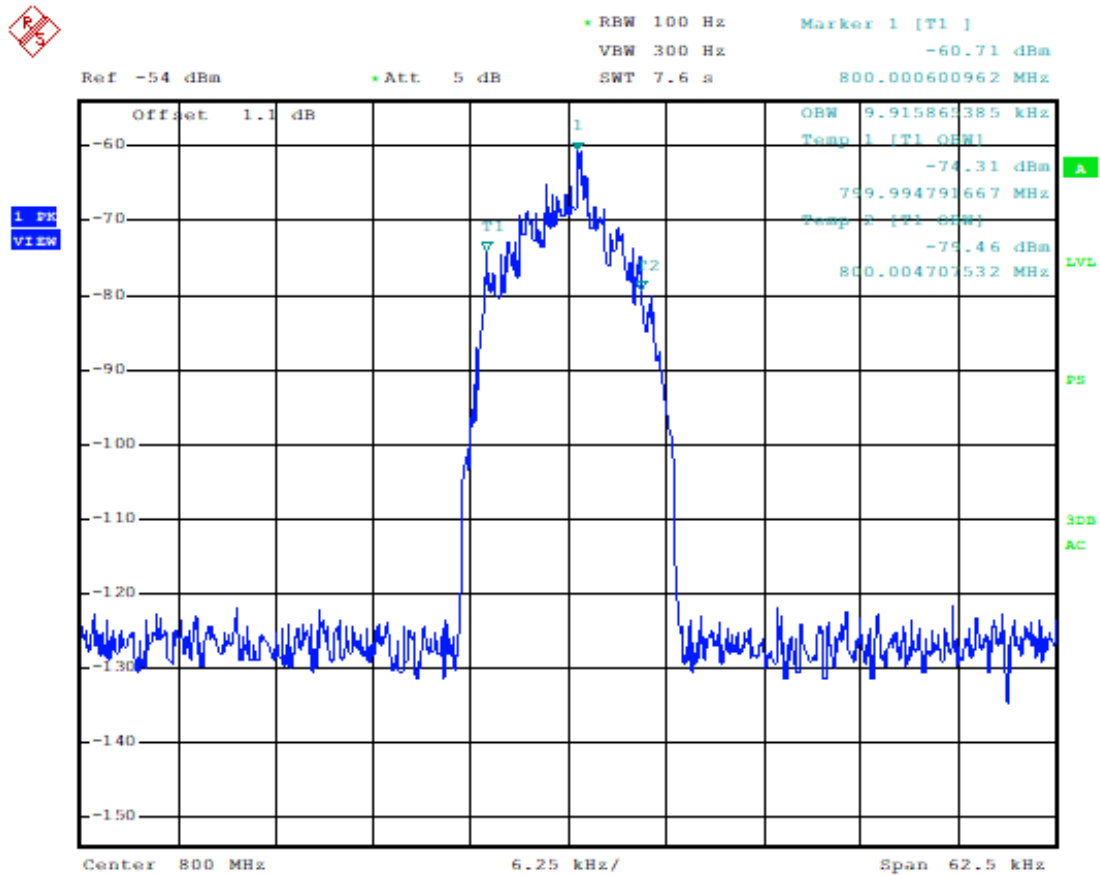
8.5.5 H-CPM, Input Signal



Date: 30.JAN.2019 14:30:47



8.5.6 H-DQPSK, Input Signal

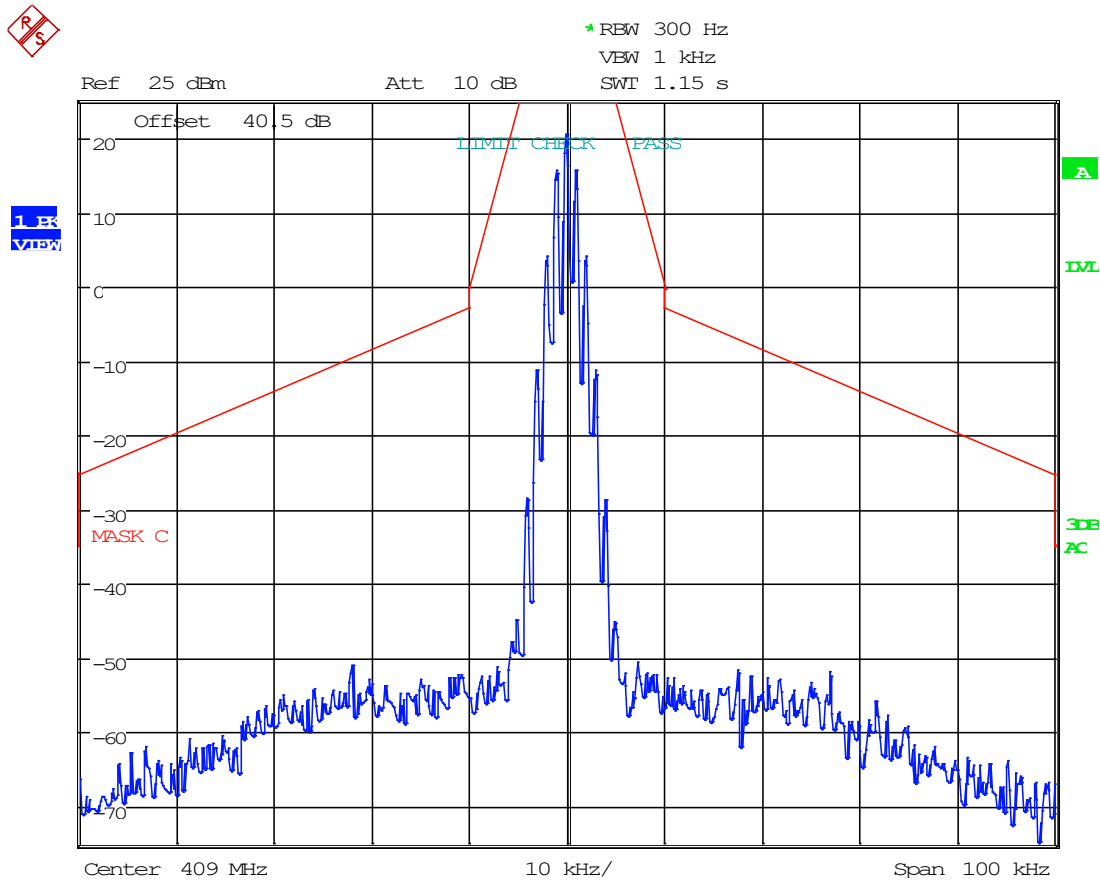


Date: 30.JAN.2019 14:32:35



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8.5.7 Unit 1, 6.25 kHz, FM, UL Mask C, AGC, 409 MHz

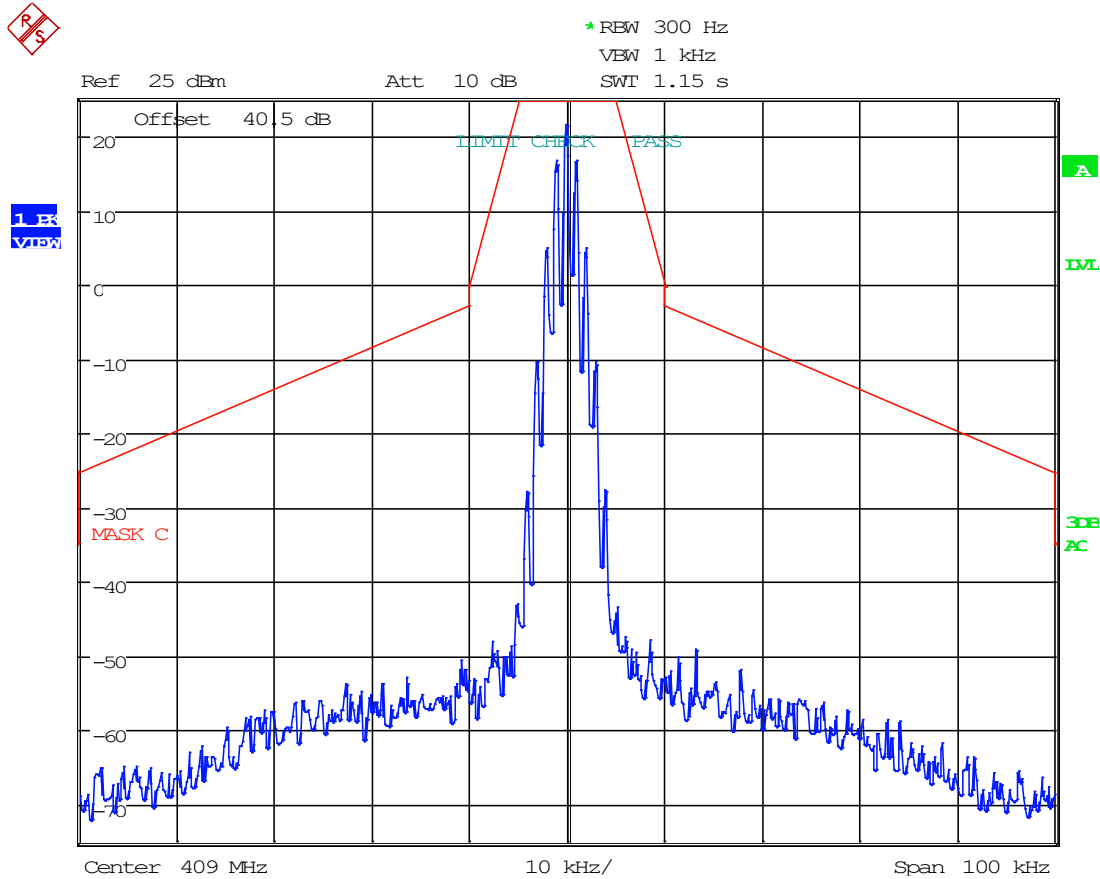


Date: 10.FEB.2023 09:59:37



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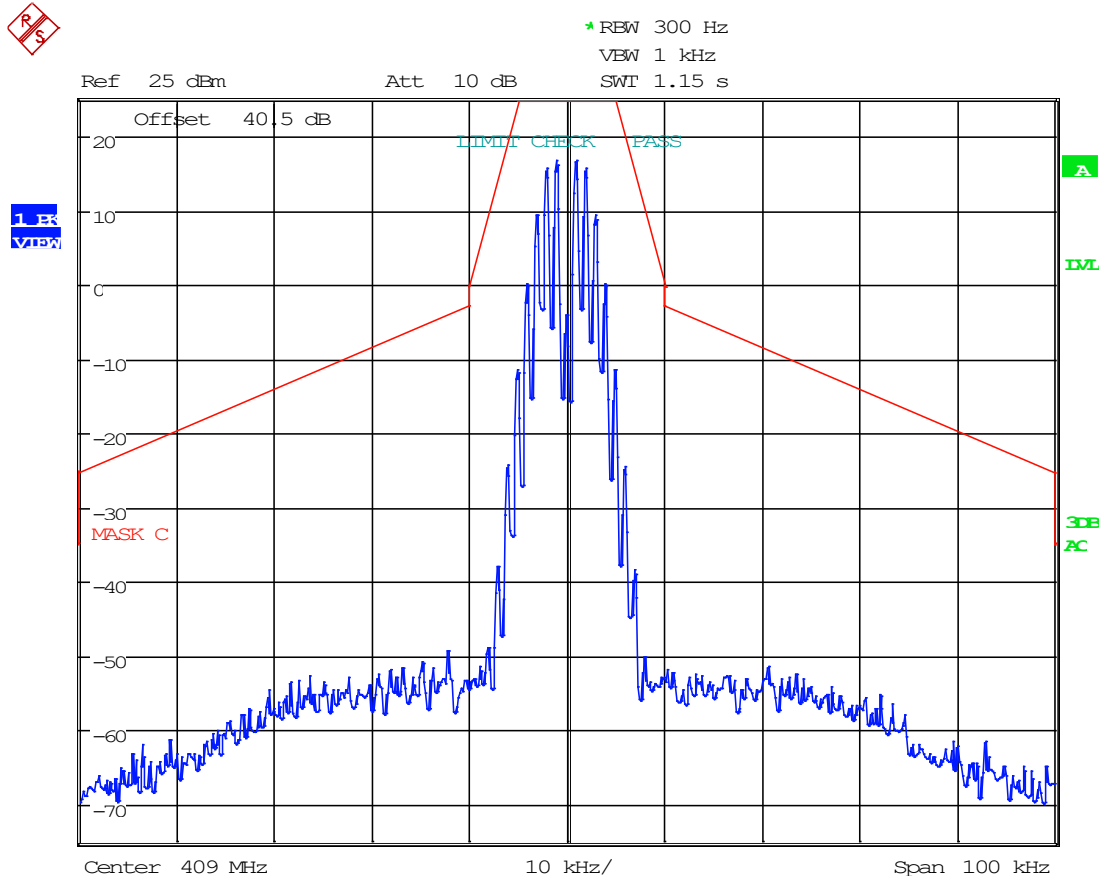
8.5.8 Unit 1, 6.25 kHz, FM, UL Mask C, AGC +3, 409 MHz



Date: 10.FEB.2023 10:01:35

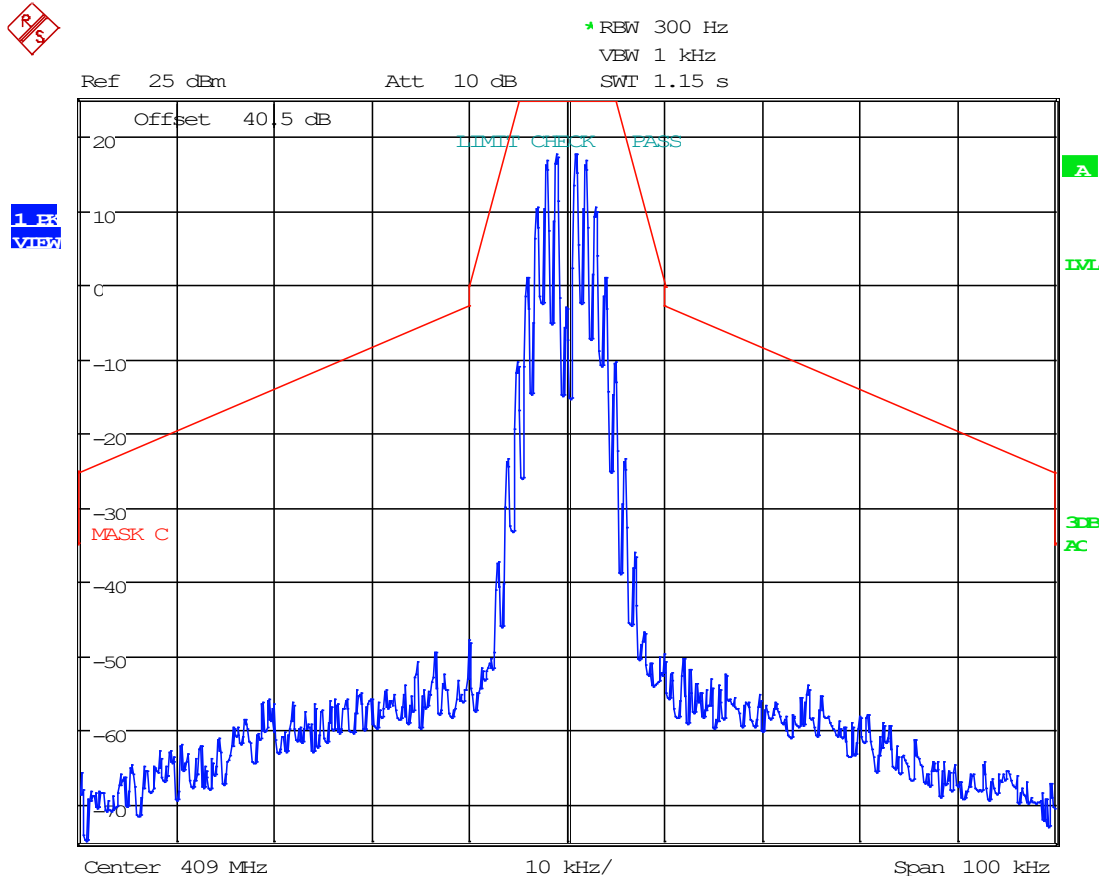


8.5.9 Unit 1, 12.5 kHz, FM, UL Mask C, AGC, 409 MHz



Date: 10.FEB.2023 10:02:25

8.5.10 Unit 1, 12.5 kHz, FM, UL Mask C, AGC+3, 409 MHz

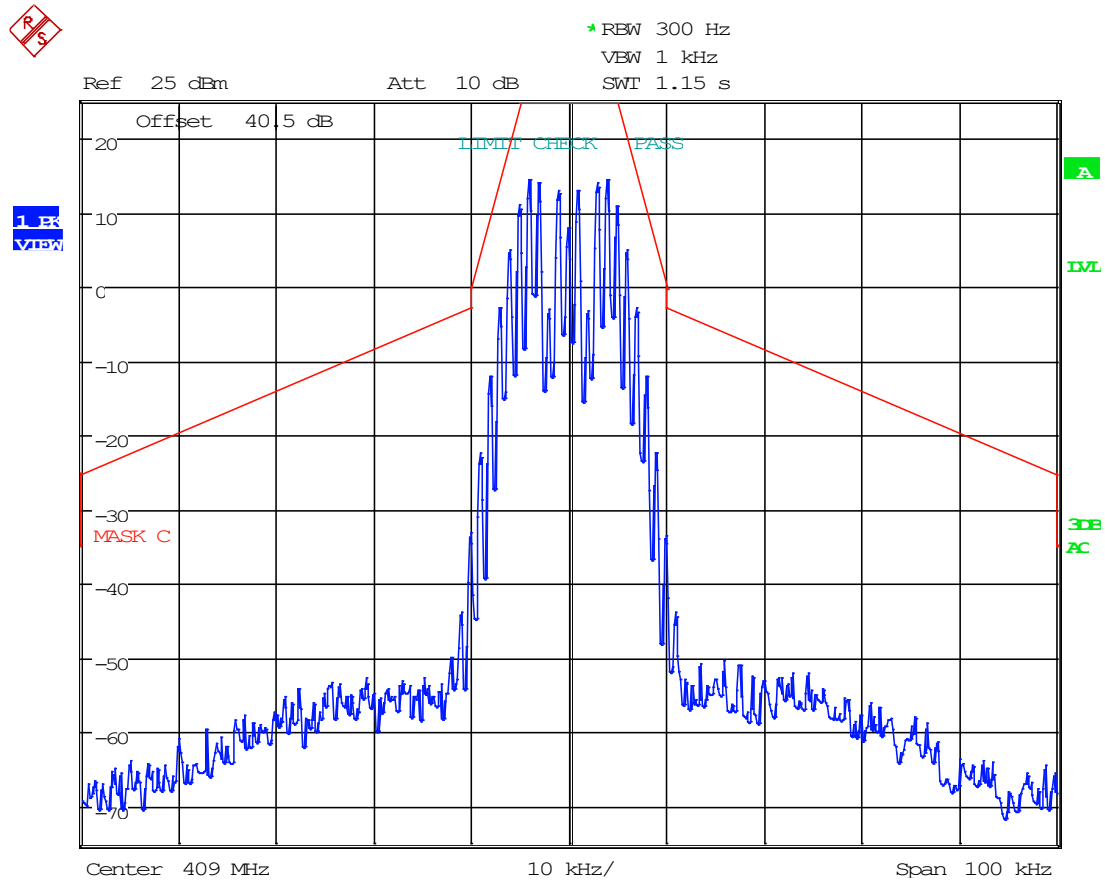


Date: 10.FEB.2023 10:03:05



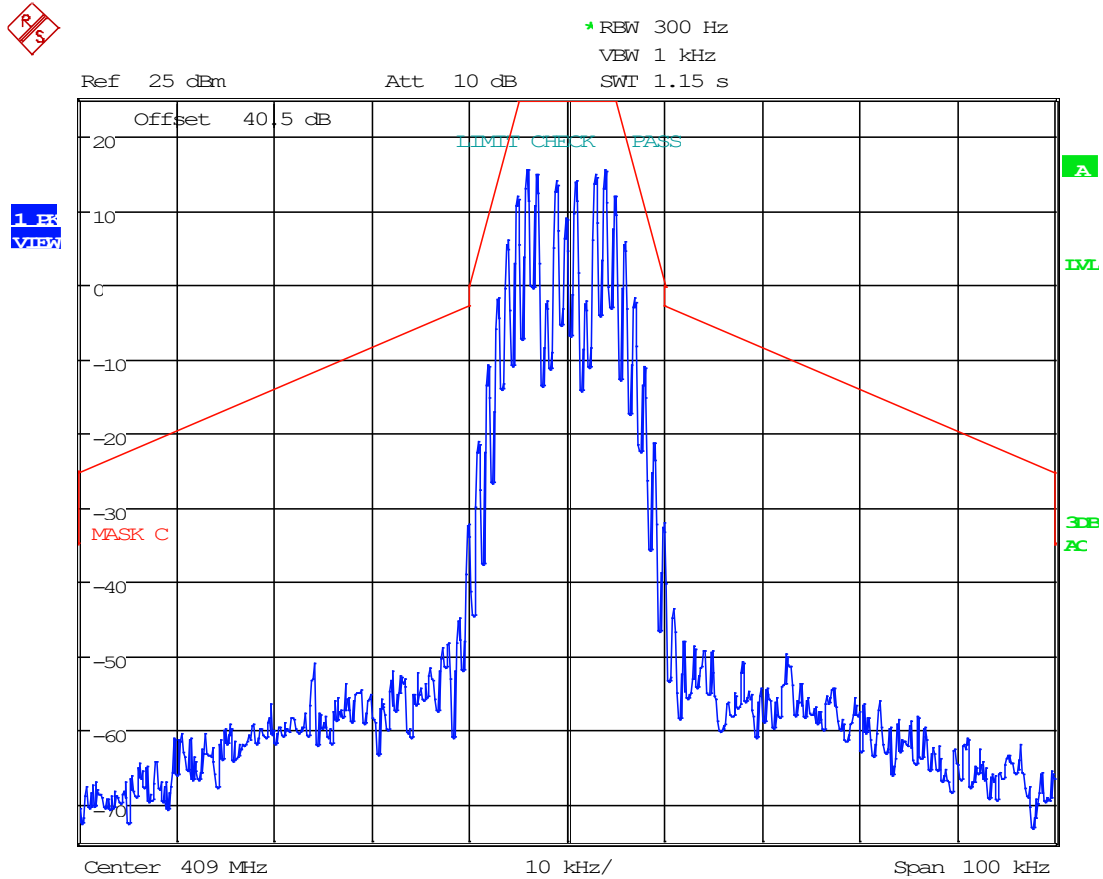
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8.5.11 Unit 1, 25 kHz FM, UL Mask C, AGC, 409 MHz



Date: 10.FEB.2023 10:03:44

8.5.12 Unit 1, 25 kHz FM, UL Mask C, AGC+3, 409 MHz

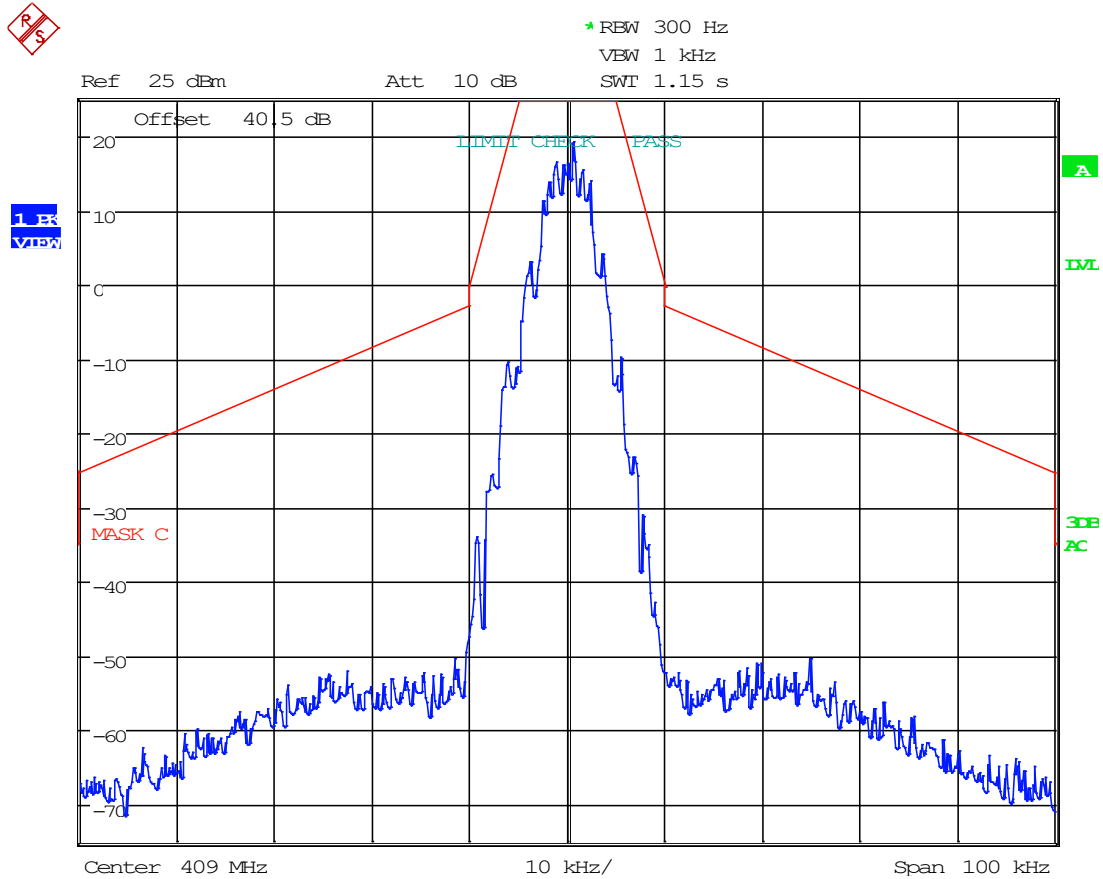


Date: 10.FEB.2023 10:05:29



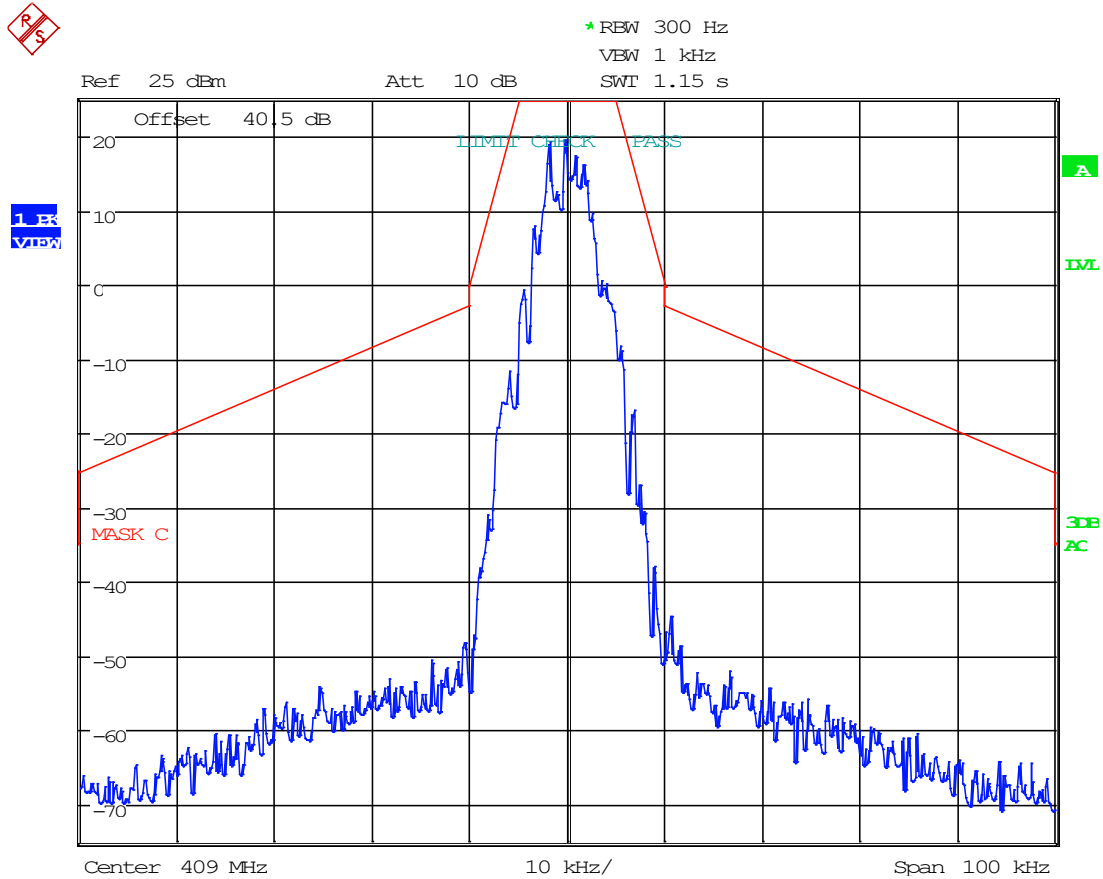
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8.5.13 Unit 1, C4FM, UL Mask C, AGC, 409 MHz



Date: 10.FEB.2023 10:08:47

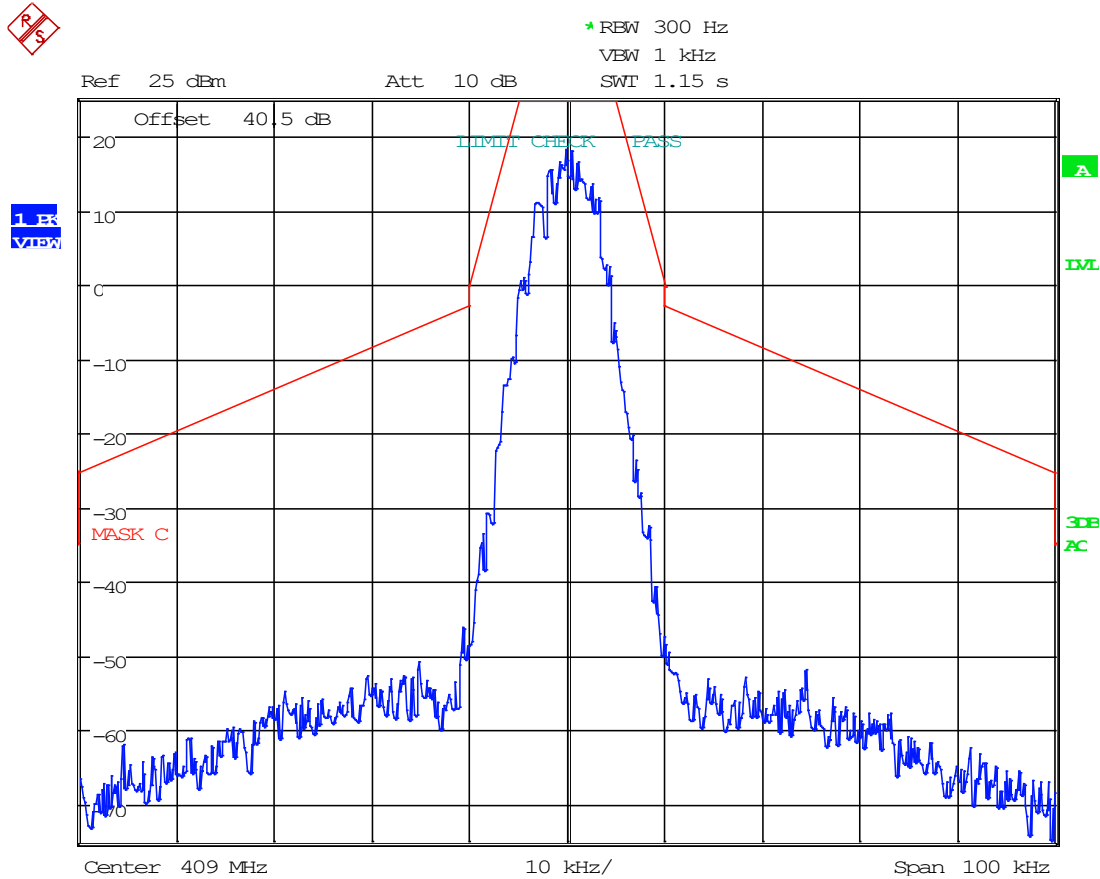
8.5.14 Unit 1, C4FM, UL Mask C, AGC+3, 409 MHz



Date: 10.FEB.2023 10:09:27

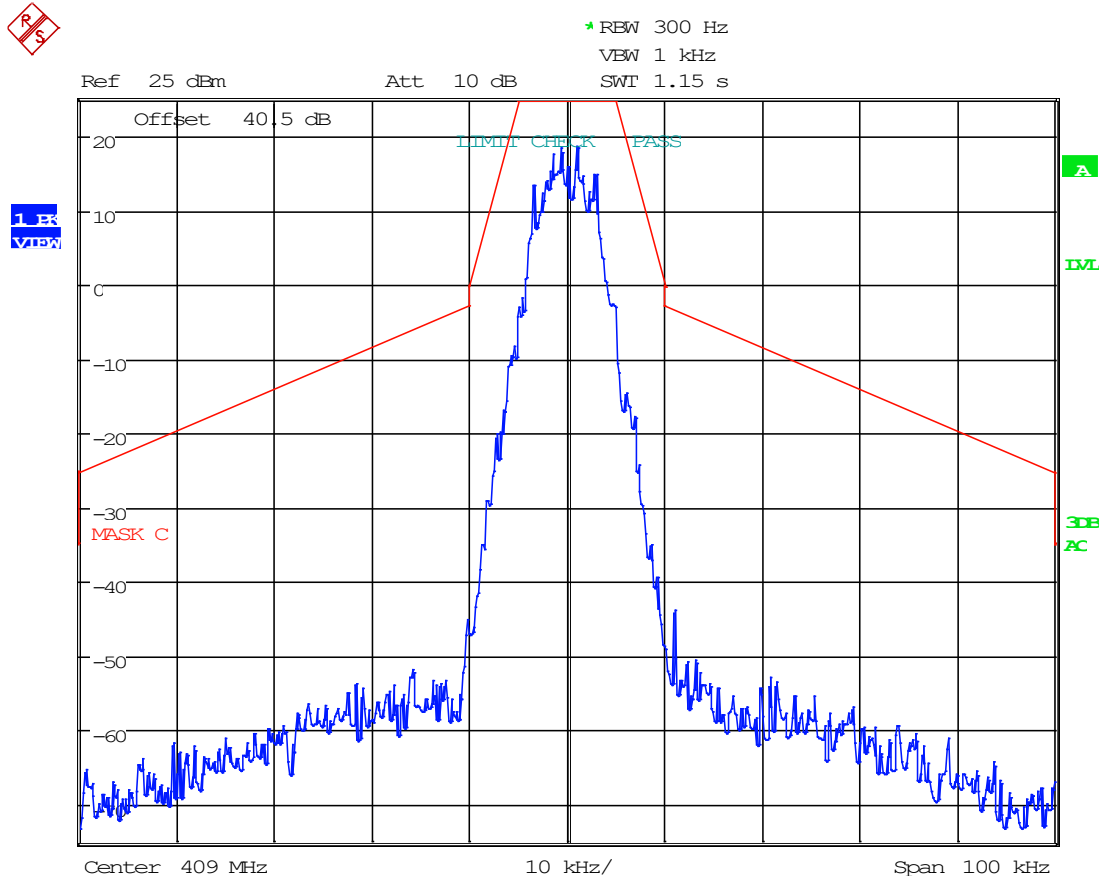


8.5.15 Unit 1, H-CPM, UL Mask C, AGC, 409 MHz



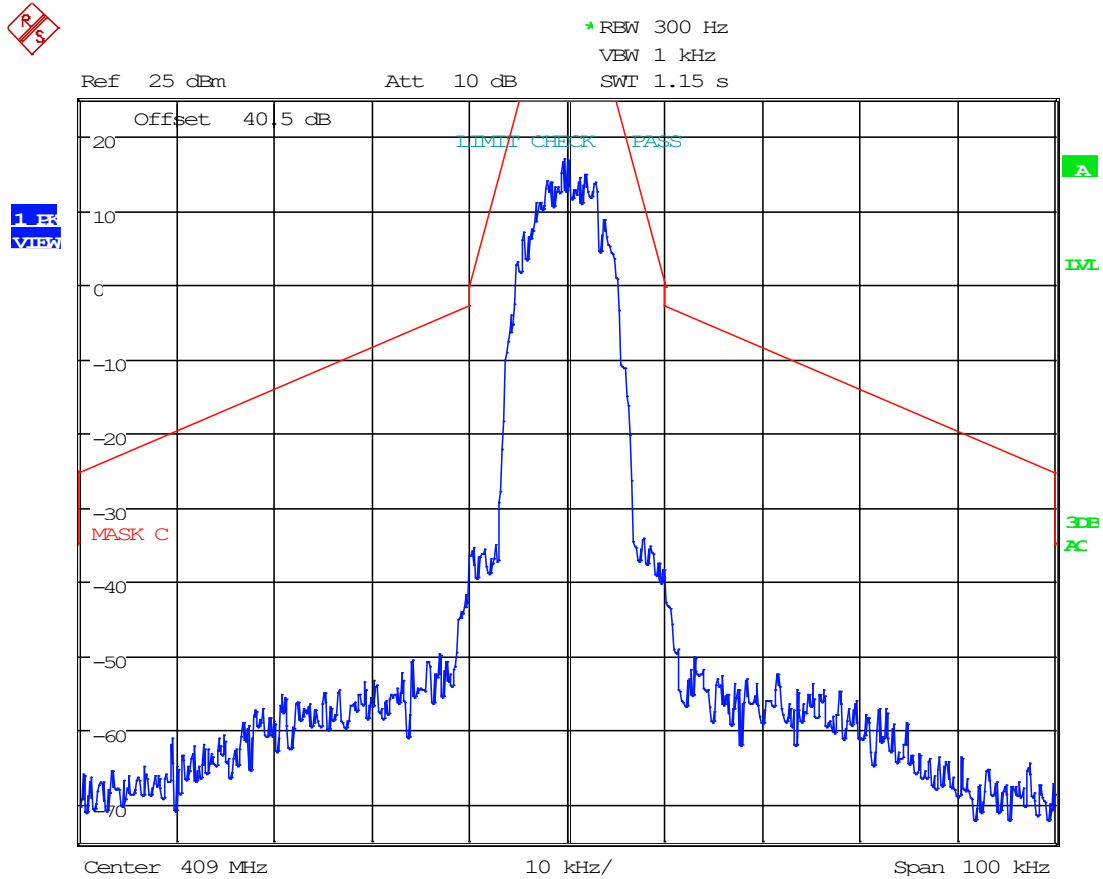
Date: 10.FEB.2023 10:10:32

8.5.16 Unit 1, H-CPM, UL Mask C, AGC+3, 409 MHz



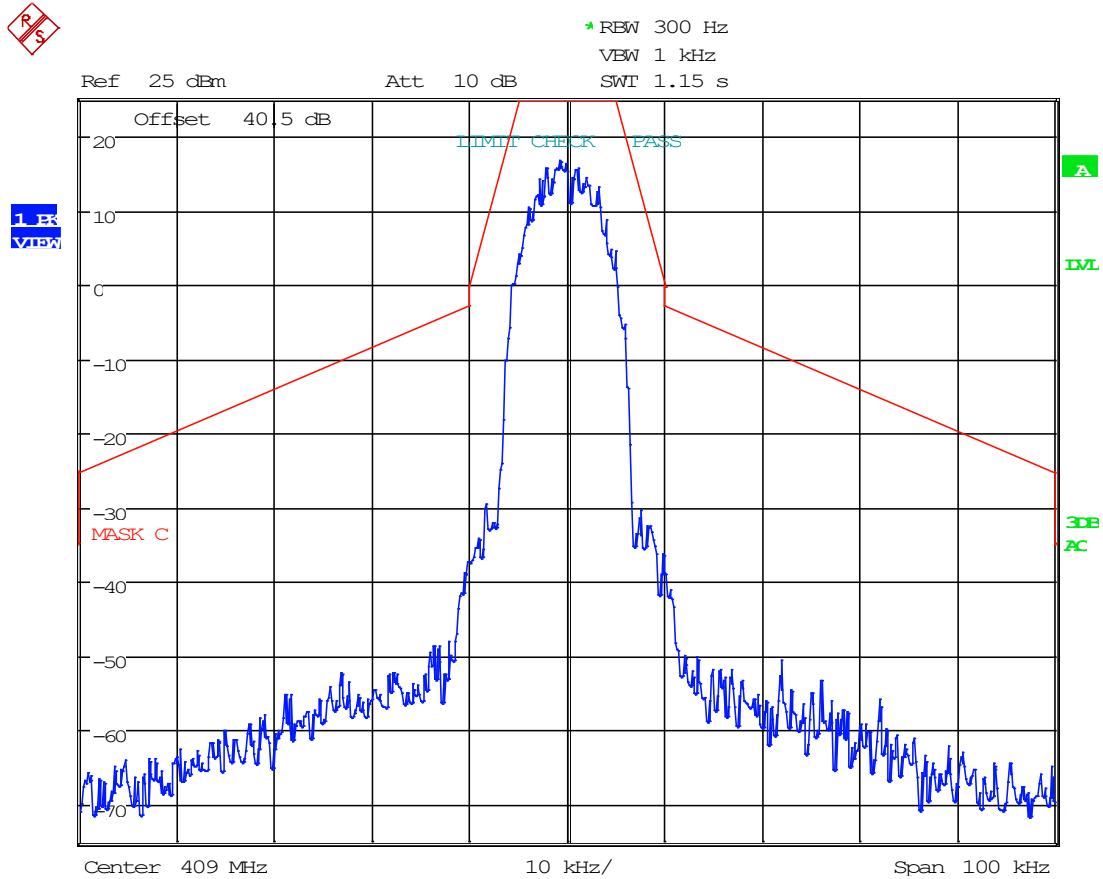
Date: 10.FEB.2023 10:10:59

8.5.17 Unit 1, H-DQPSK, UL Mask C, AGC, 409 MHz



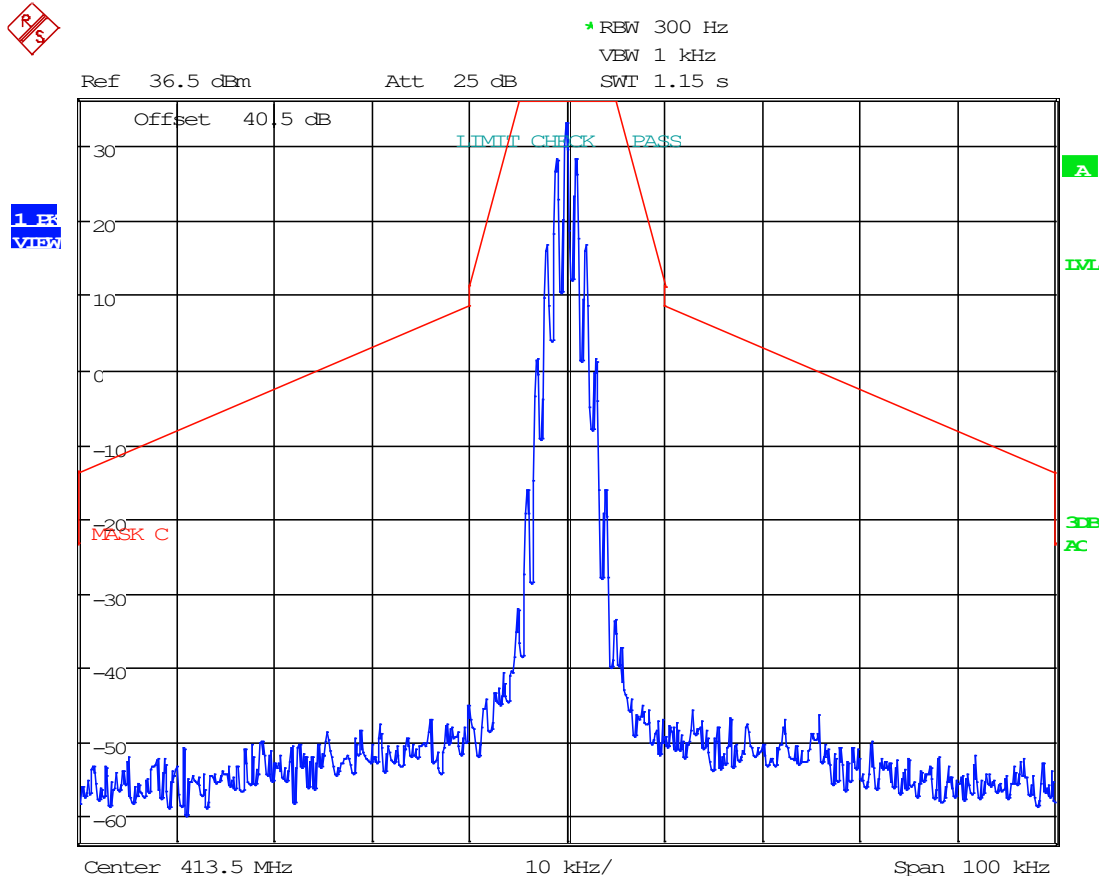
Date: 10.FEB.2023 10:11:35

8.5.18 Unit 1, H-DQPSK, UL Mask C, AGC+3, 409 MHz



Date: 10.FEB.2023 10:12:03

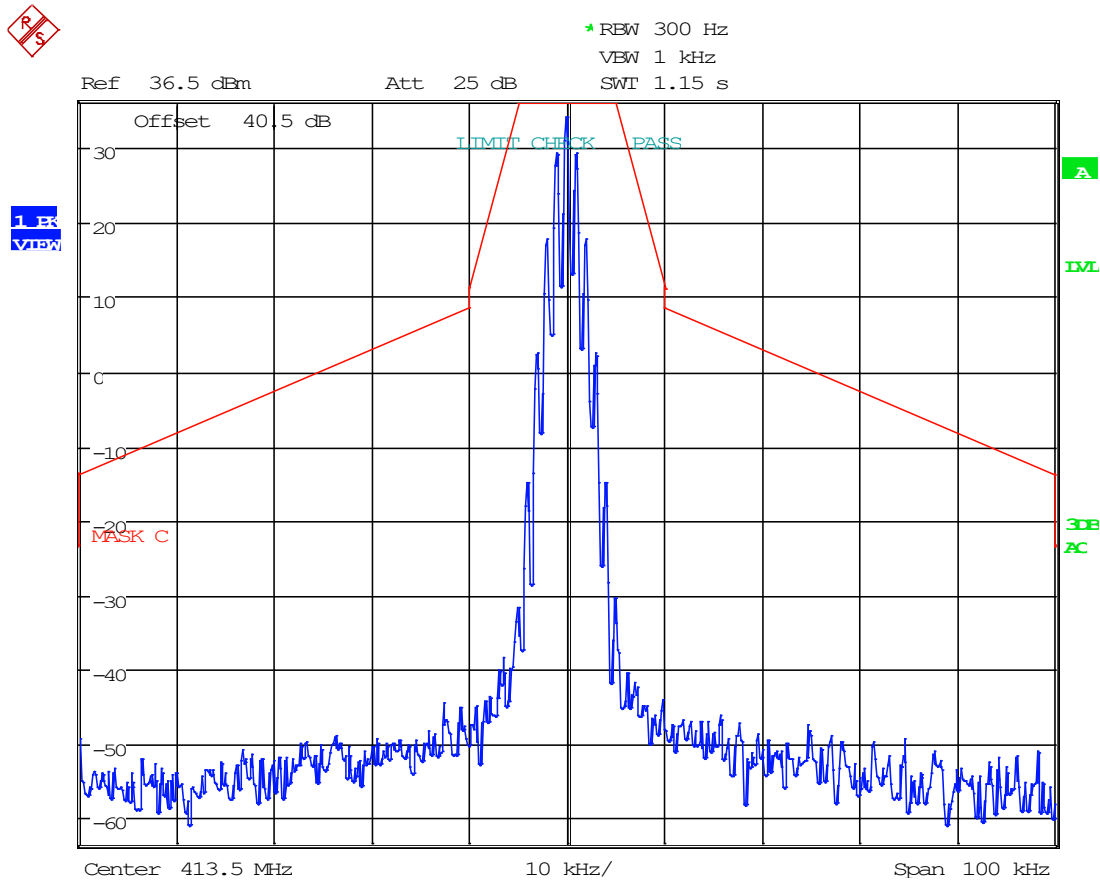
8.5.19 Unit 1, 6.25 kHz, FM, DL Mask C, AGC, 413.5 MHz



Date: 10.FEB.2023 10:32:46



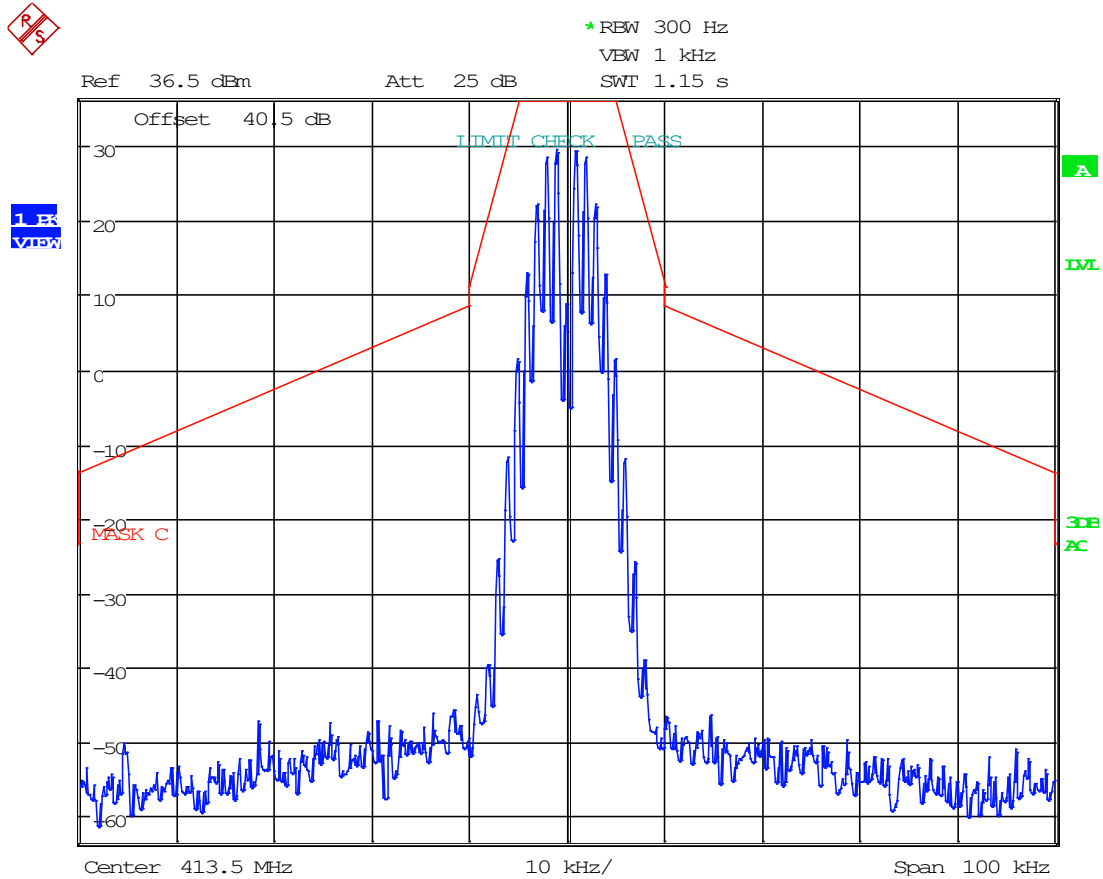
8.5.20 Unit 1, 6.25 kHz, FM, DL Mask C, AGC+3, 413.5 MHz



Date: 10.FEB.2023 10:33:16



8.5.21 Unit 1, 12.5 kHz, FM, DL Mask C, AGC, 413.5 MHz

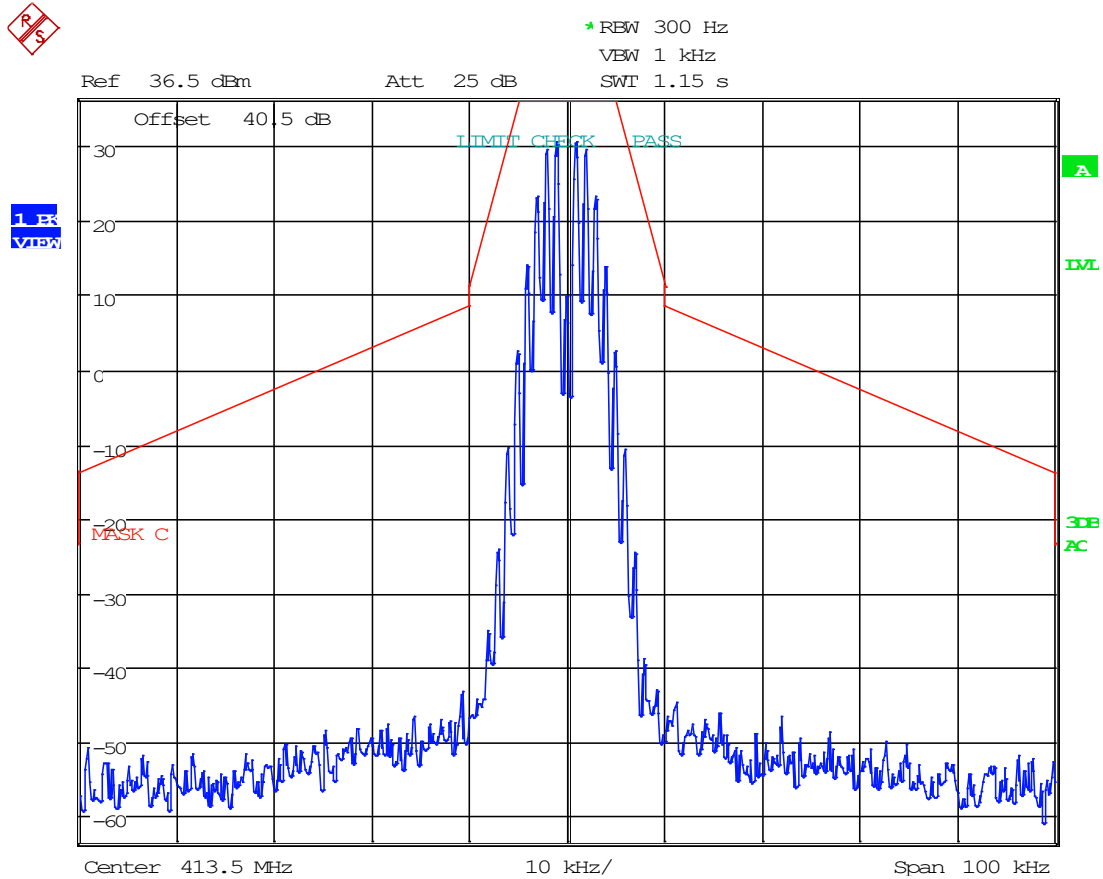


Date: 10.FEB.2023 10:31:22



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8.5.22 Unit 1, 12.5 kHz, FM, DL Mask C, AGC+3, 413.5 MHz

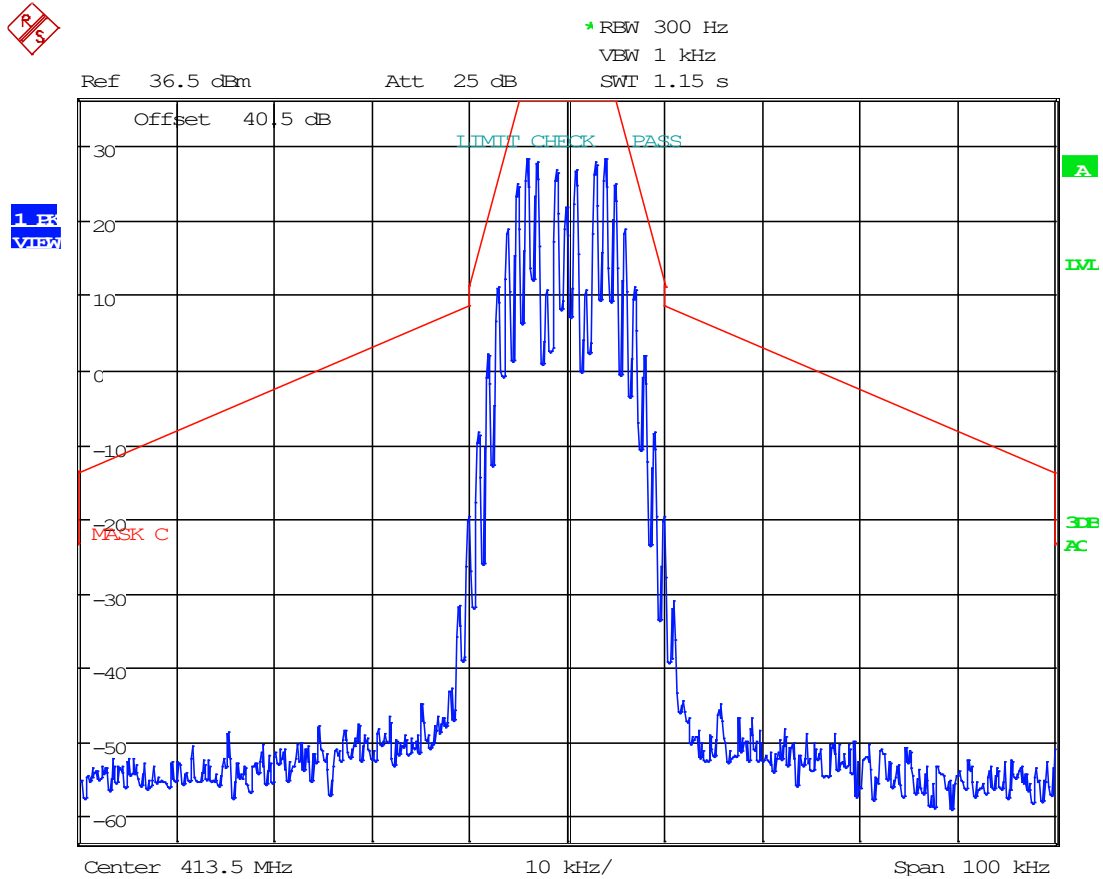


Date: 10.FEB.2023 10:31:59





8.5.24 Unit 1, 25 kHz FM, DL Mask C, AGC+3, 413.5 MHz

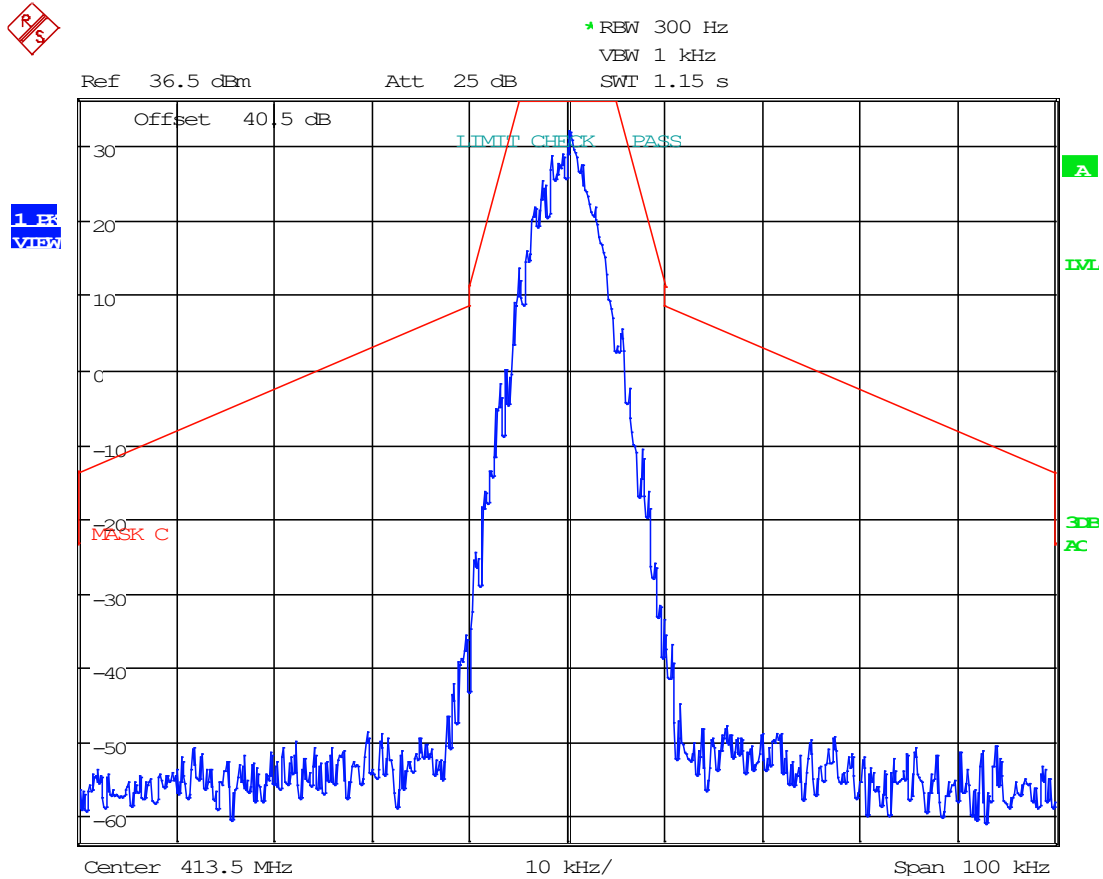


Date: 10.FEB.2023 10:29:55



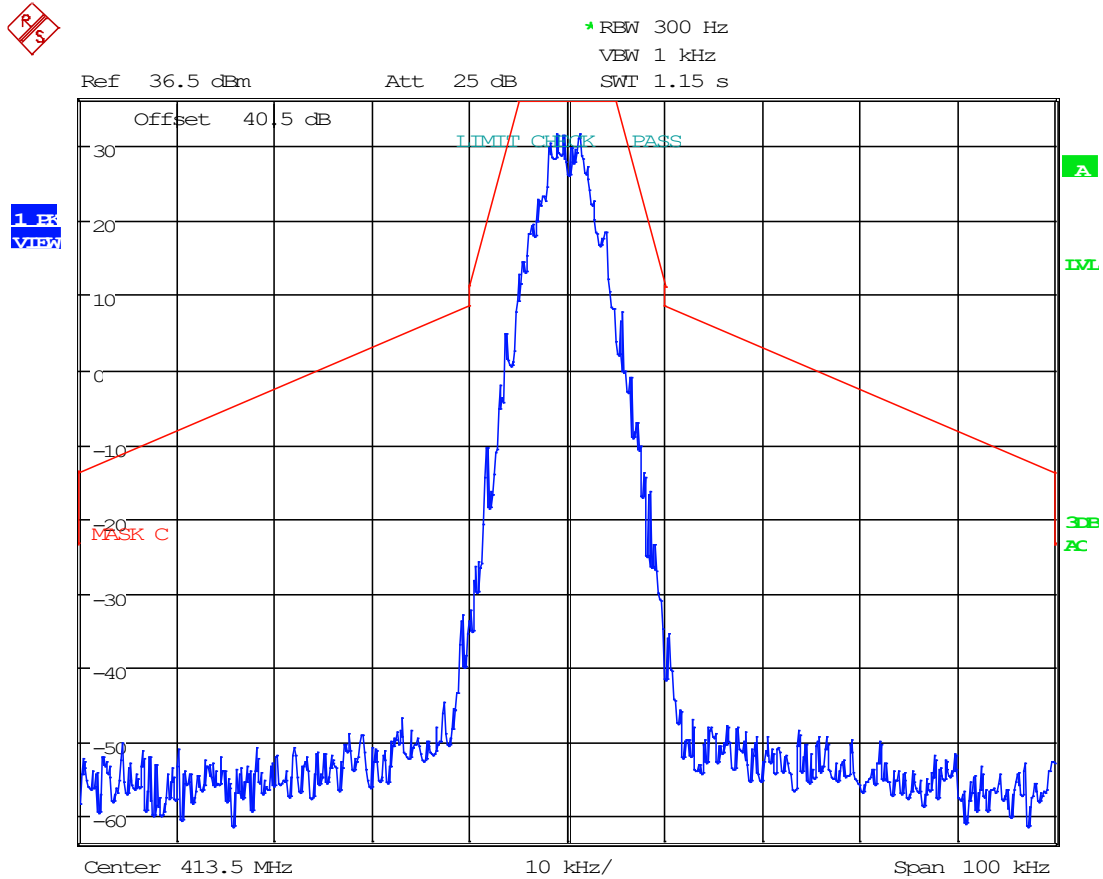
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8.5.25 Unit 1, C4FM, DL Mask C, AGC, 413.5 MHz



Date: 10.FEB.2023 10:34:15

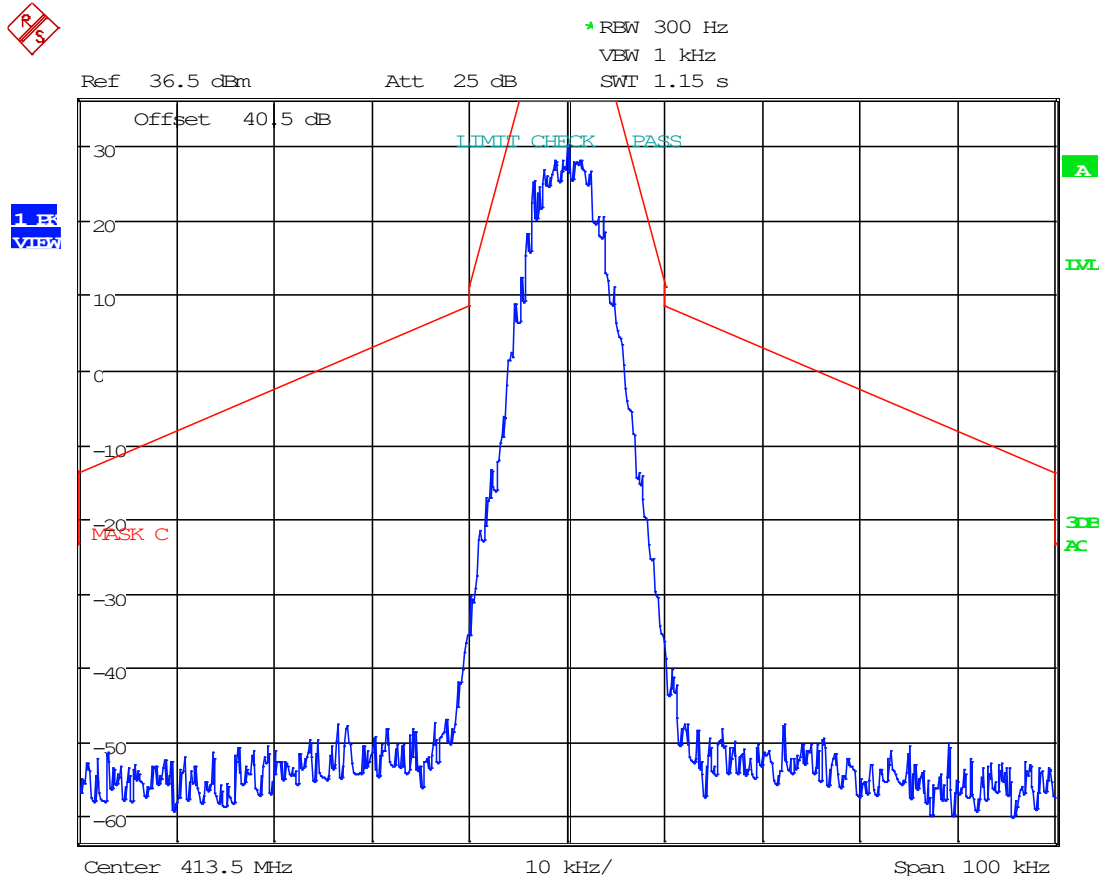
8.5.26 Unit 1, C4FM, DL Mask C, AGC+3, 413.5 MHz



Date: 10.FEB.2023 10:34:44



8.5.27 Unit 1, H-CPM, DL Mask C, AGC, 413.5 MHz

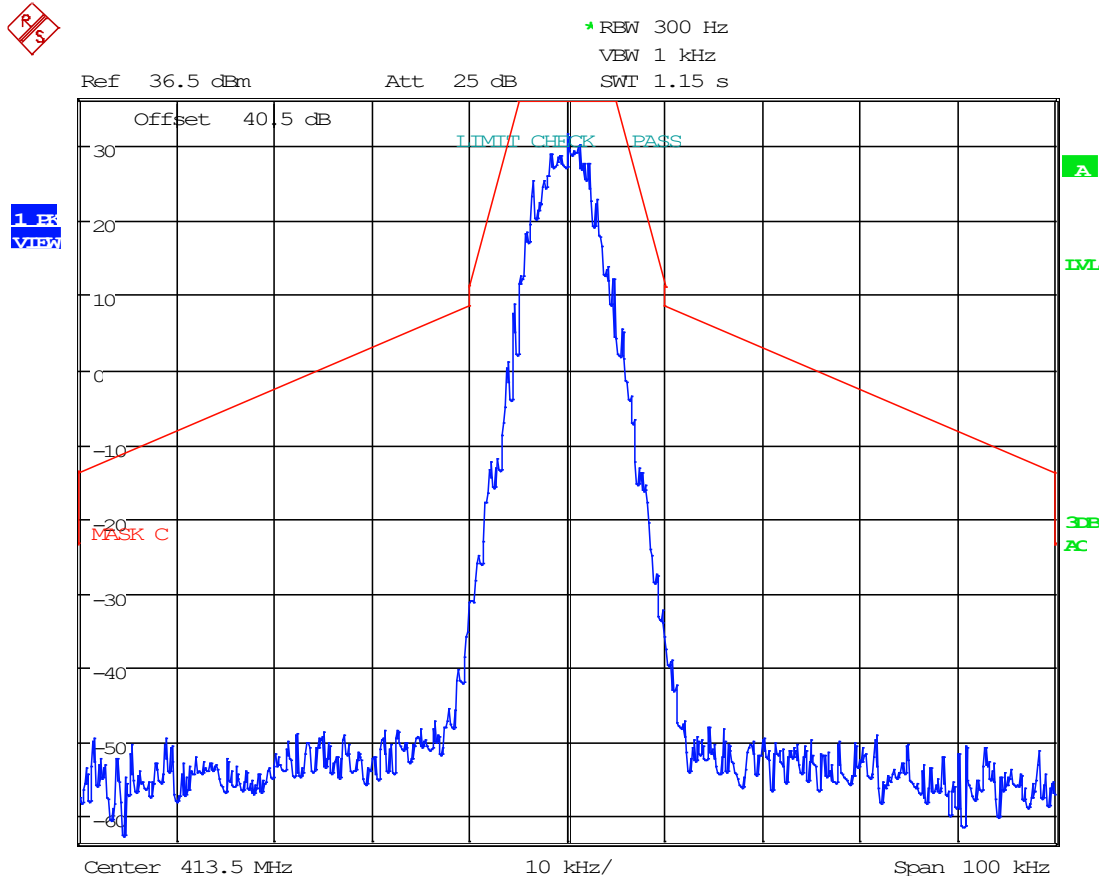


Date: 10.FEB.2023 10:35:30



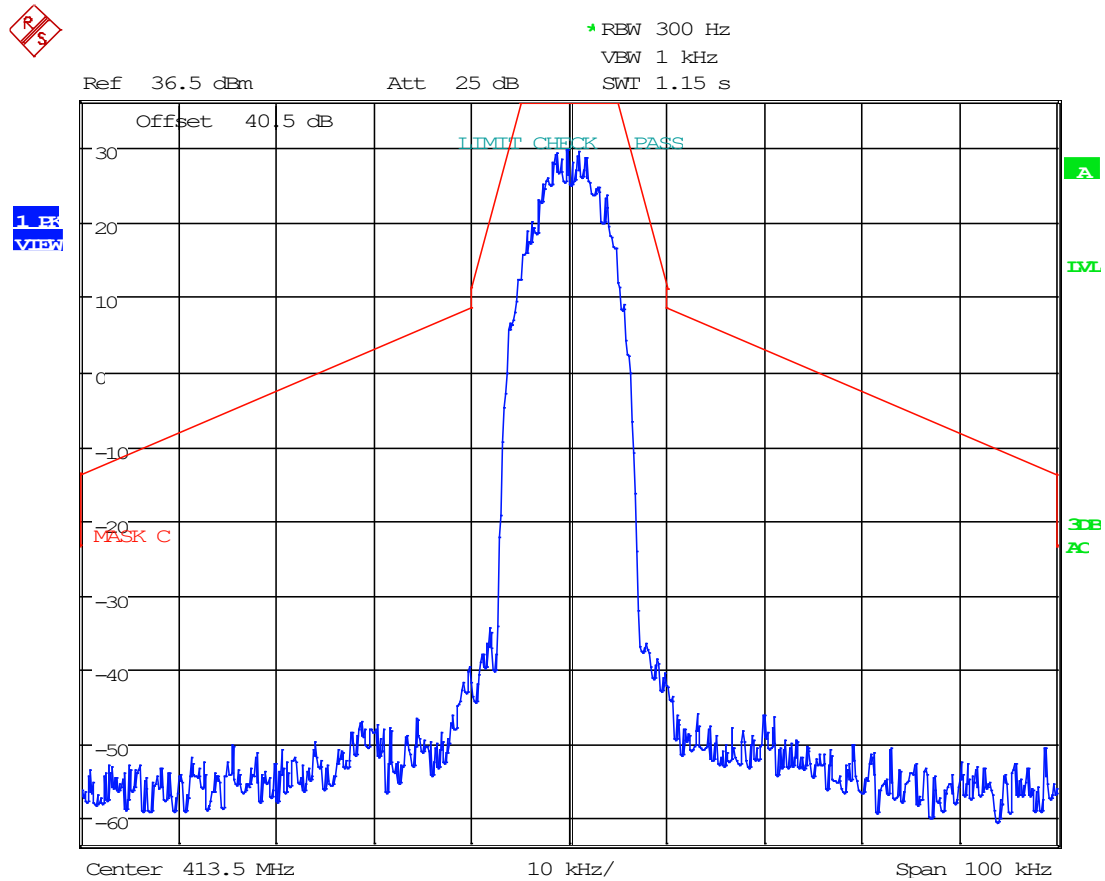
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8.5.28 Unit 1, H-CPM, DL Mask C, AGC+3, 413.5 MHz



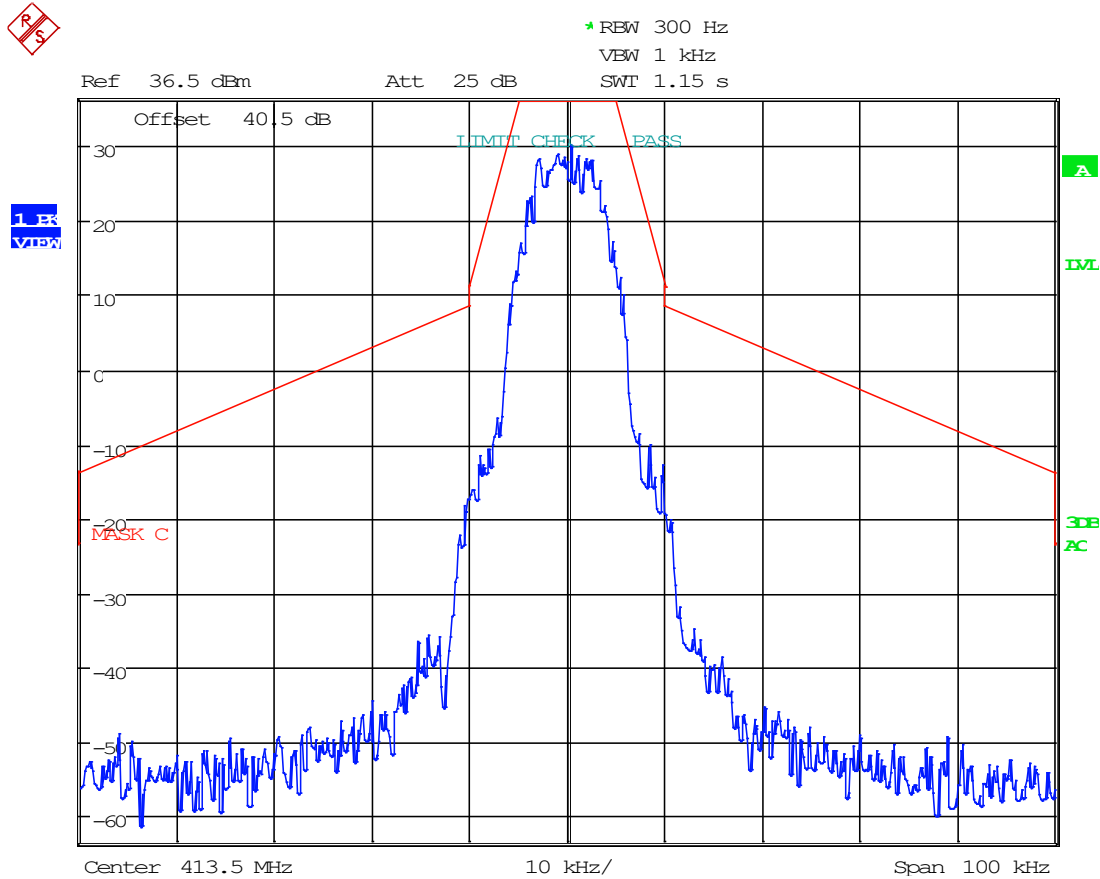
Date: 10.FEB.2023 10:36:15

8.5.29 Unit 1, H-DQPSK, DL Mask C, AGC, 413.5 MHz



Date: 10.FEB.2023 10:36:54

8.5.30 Unit 1, H-DQPSK, DL Mask C, AGC+3, 413.5 MHz

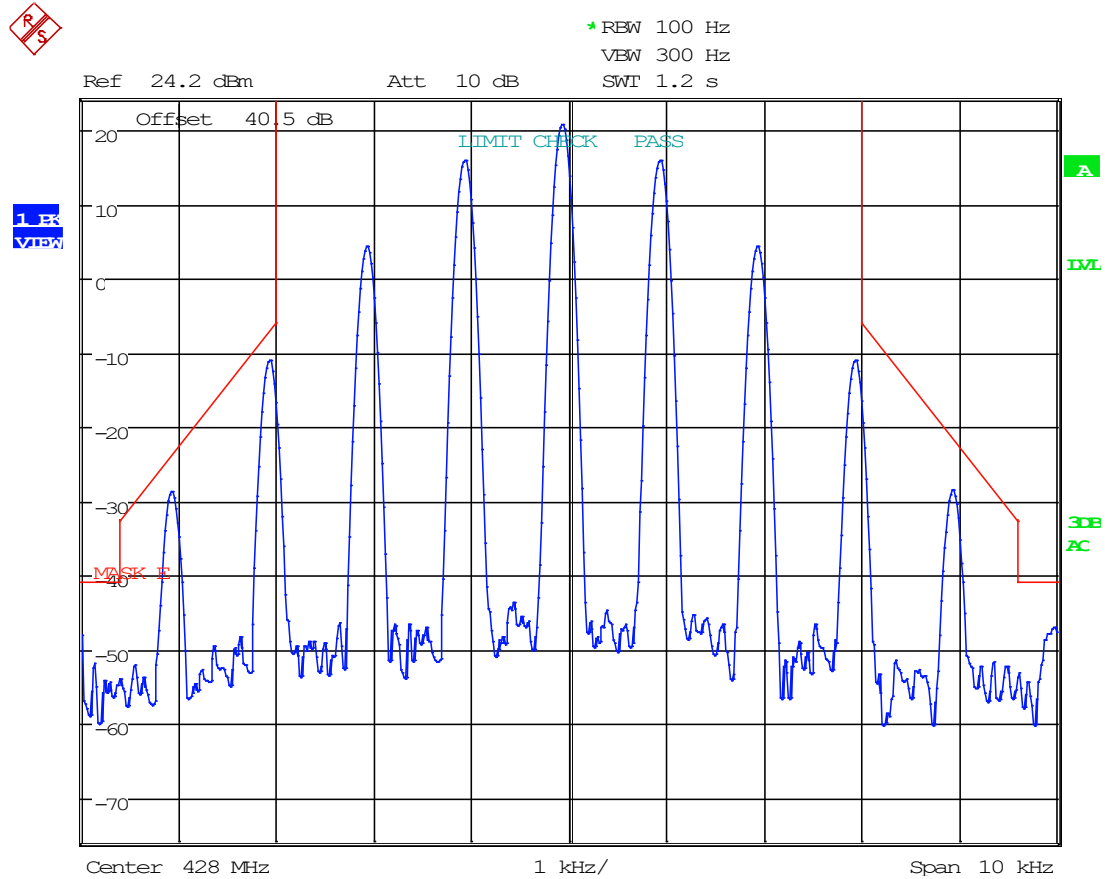


Date: 10.FEB.2023 10:37:19



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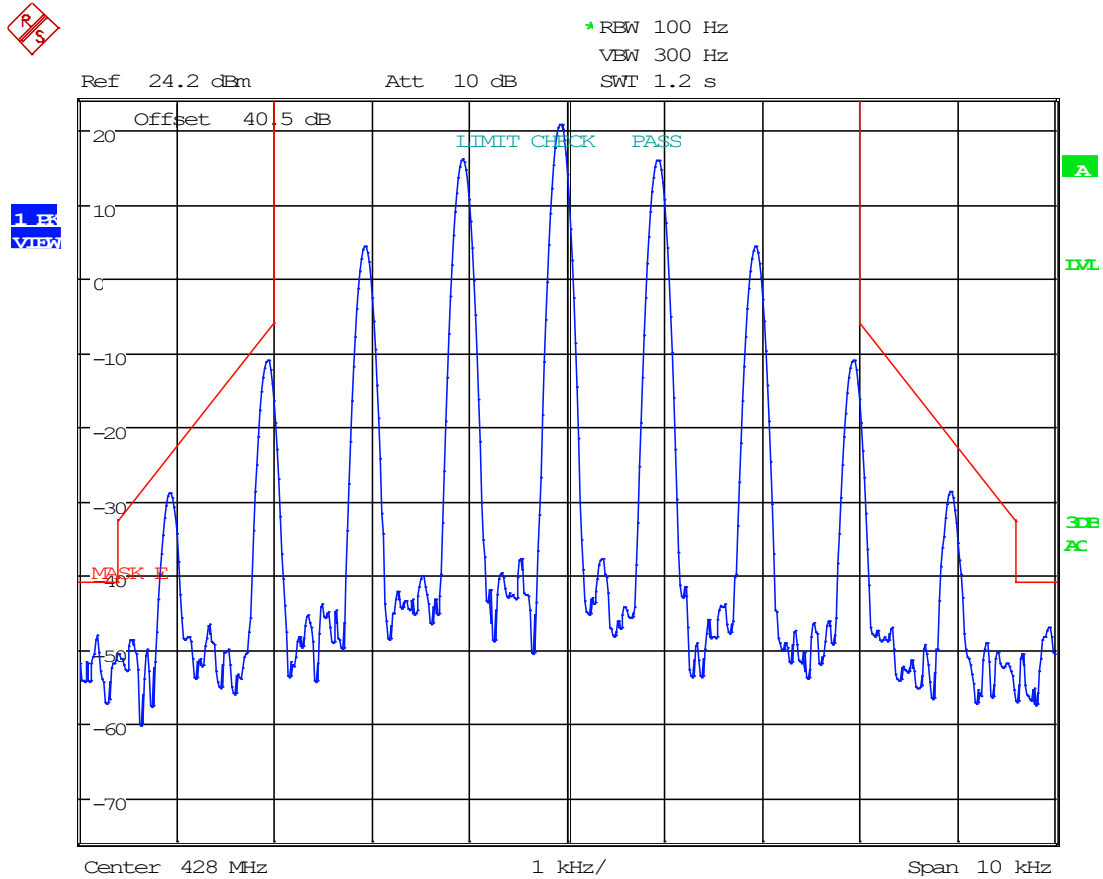
8.5.31 Unit 2, 6.25 kHz, FM, UL Mask E, AGC, 428 MHz



Date: 10.FEB.2023 11:14:11



8.5.32 Unit 2, 6.25 kHz, FM, UL Mask E, AGC+3, 428 MHz

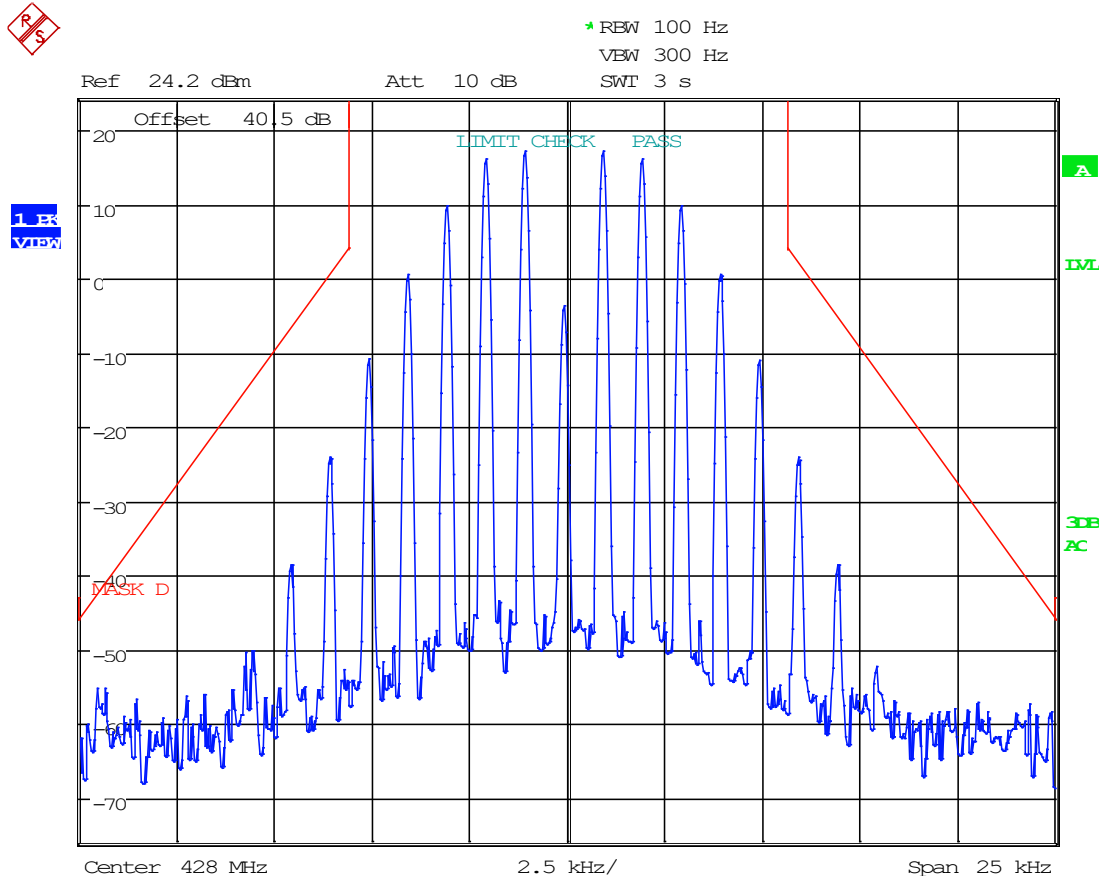


Date: 10.FEB.2023 11:15:23



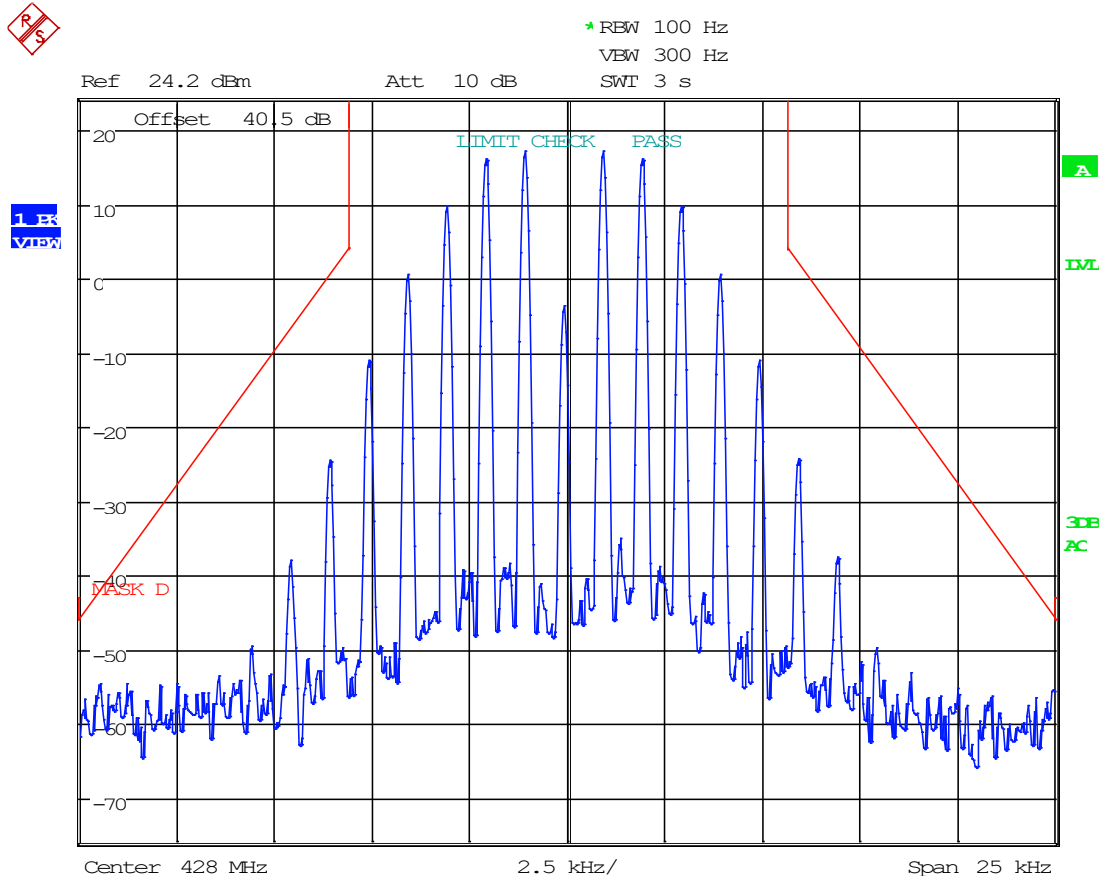
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8.5.33 Unit 2, 12.5 kHz, FM, UL Mask D, AGC, 428 MHz



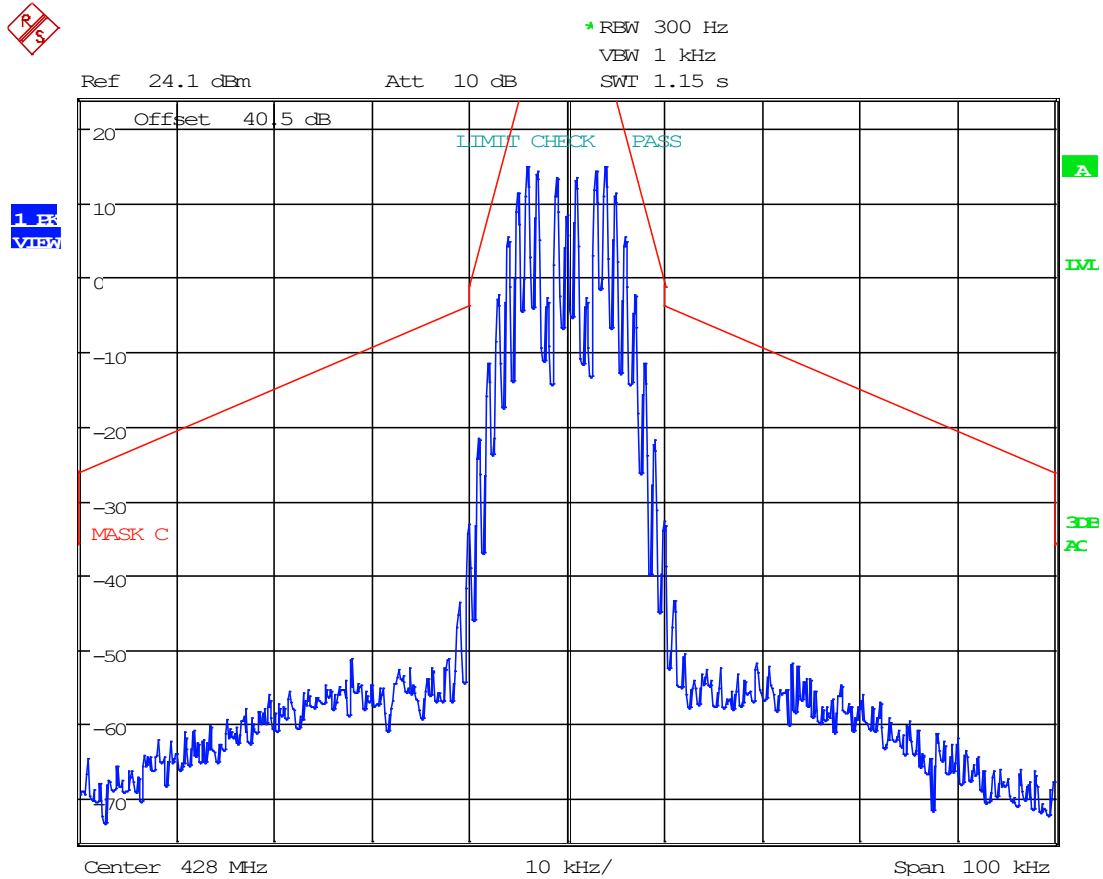
Date: 10.FEB.2023 11:00:32

8.5.34 Unit 2, 12.5 kHz, FM, UL Mask D, AGC+3, 428 MHz



Date: 10.FEB.2023 11:03:11

8.5.35 Unit 2, 25 kHz FM, UL Mask C, AGC, 428 MHz

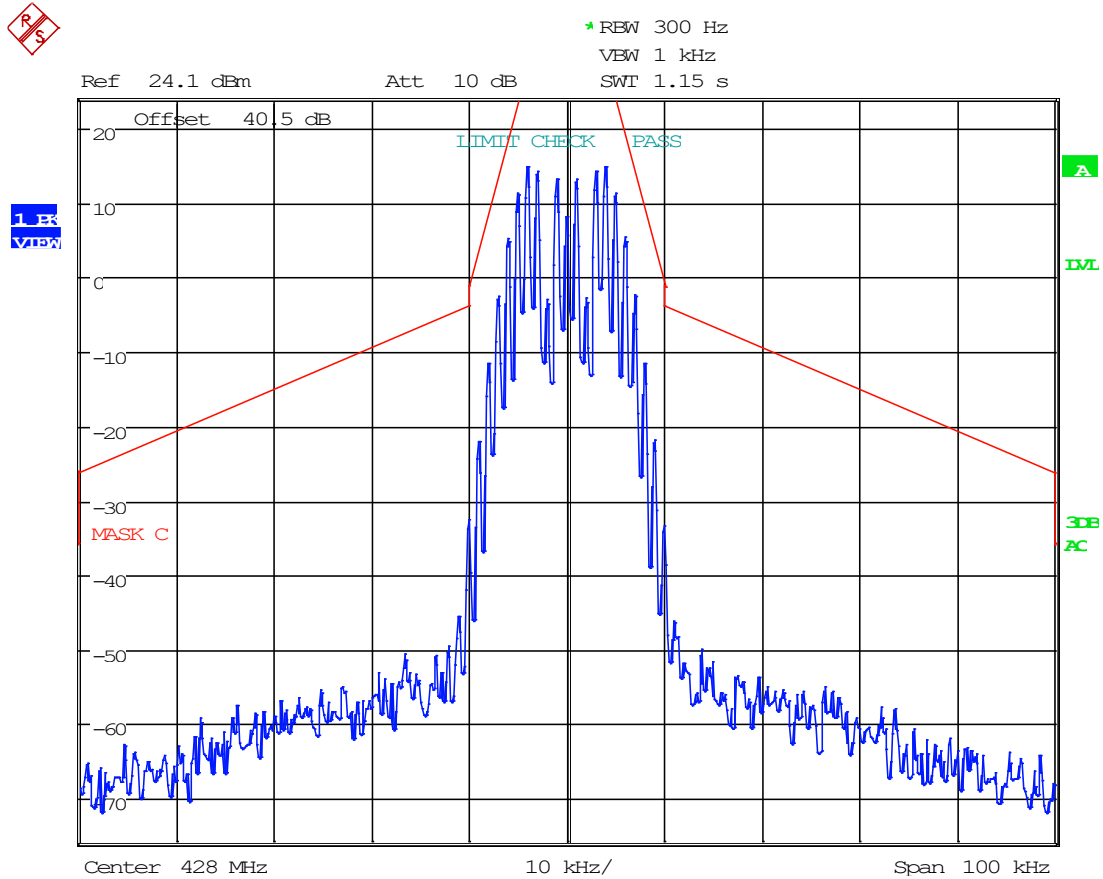


Date: 10.FEB.2023 11:19:04



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8.5.36 Unit 2, 25 kHz FM, UL Mask C, AGC+3, 428 MHz

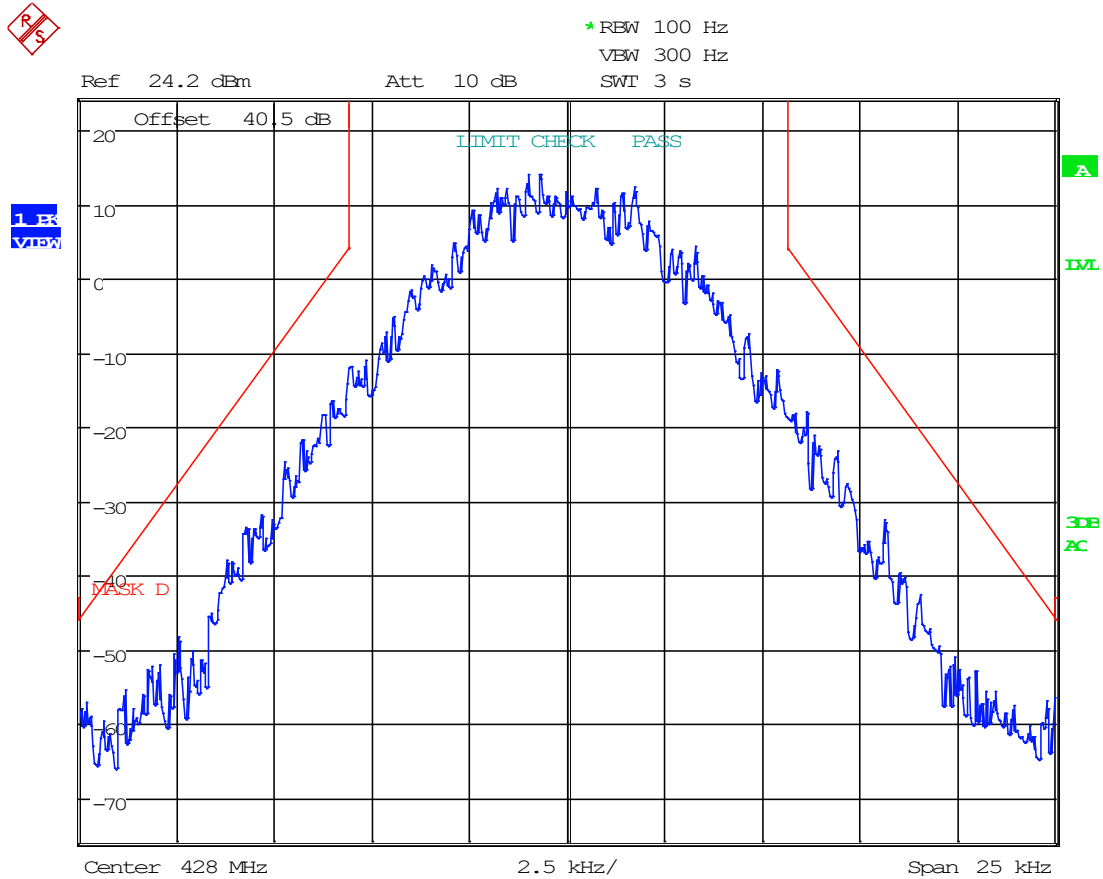


Date: 10.FEB.2023 11:19:52



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8.5.37 Unit 2, C4FM, UL Mask D, AGC, 428 MHz

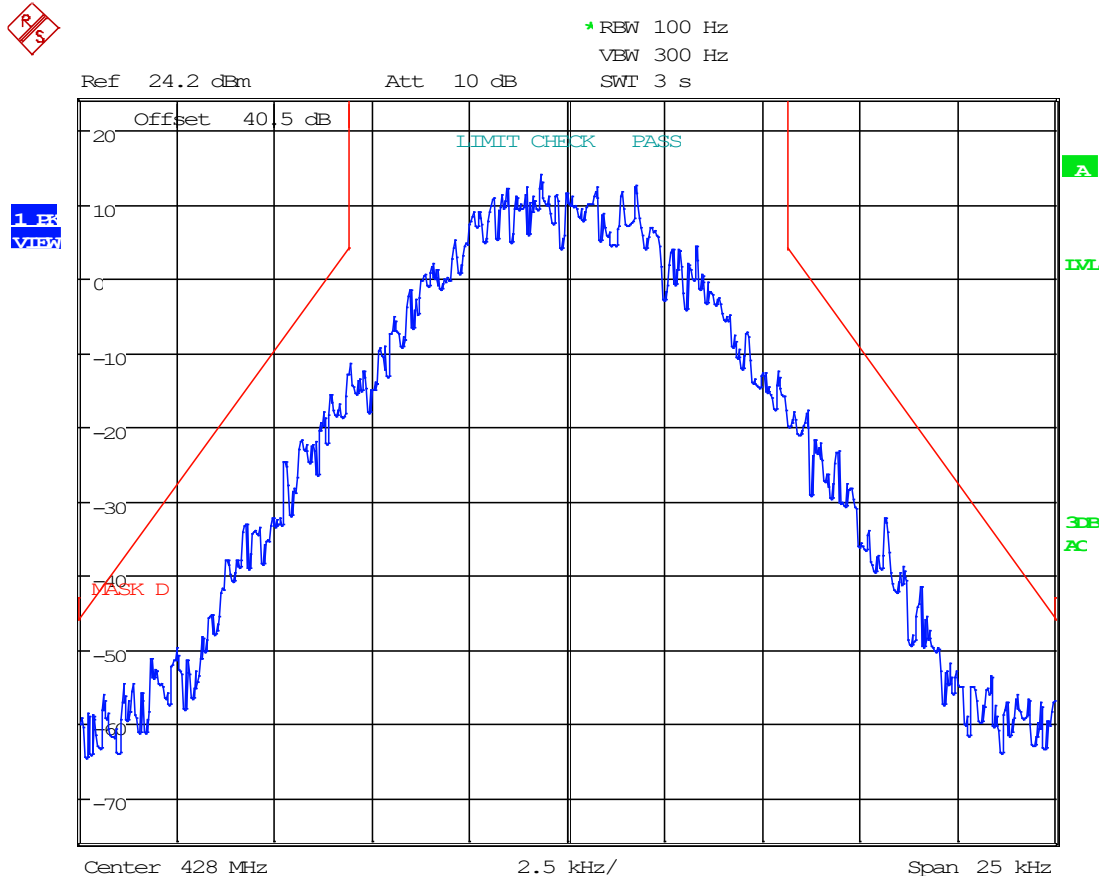


Date: 10.FEB.2023 11:05:06

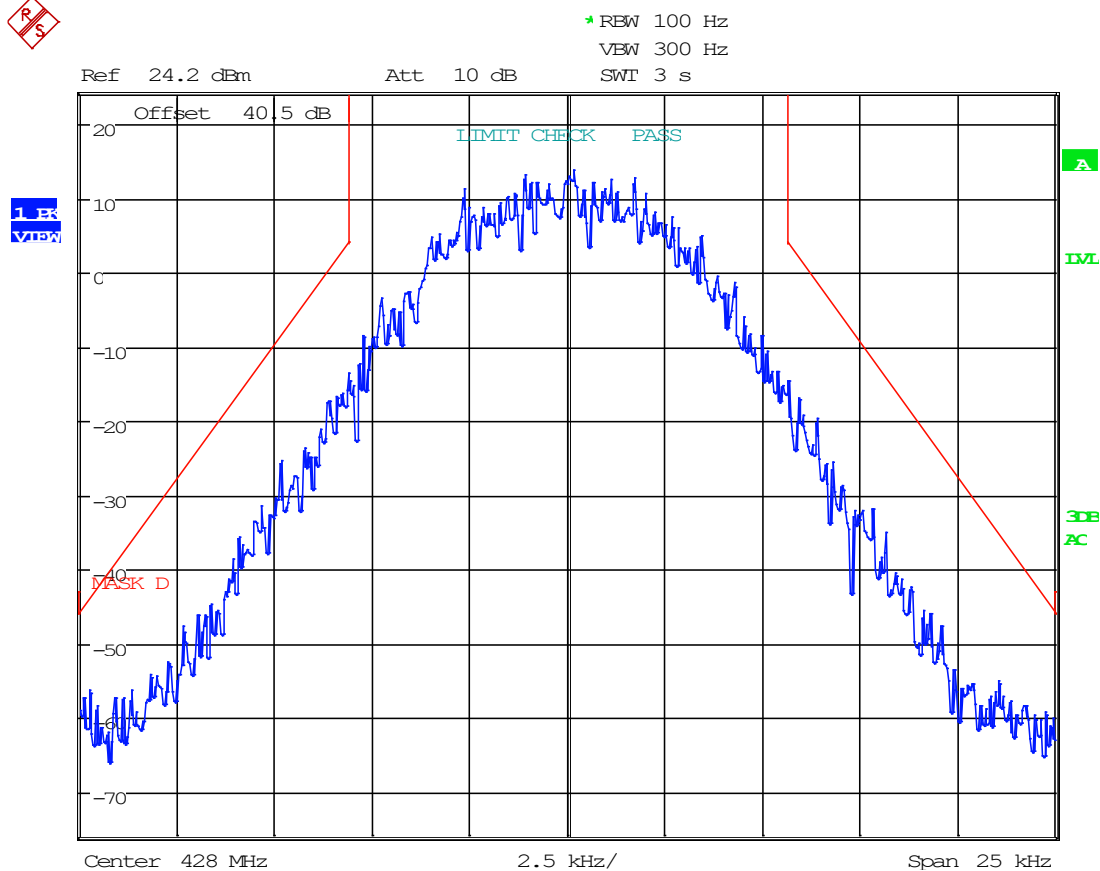
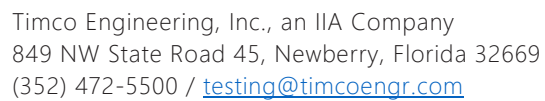


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8.5.38 Unit 2, C4FM, UL Mask D, AGC+3, 428 MHz



Date: 10.FEB.2023 11:06:00

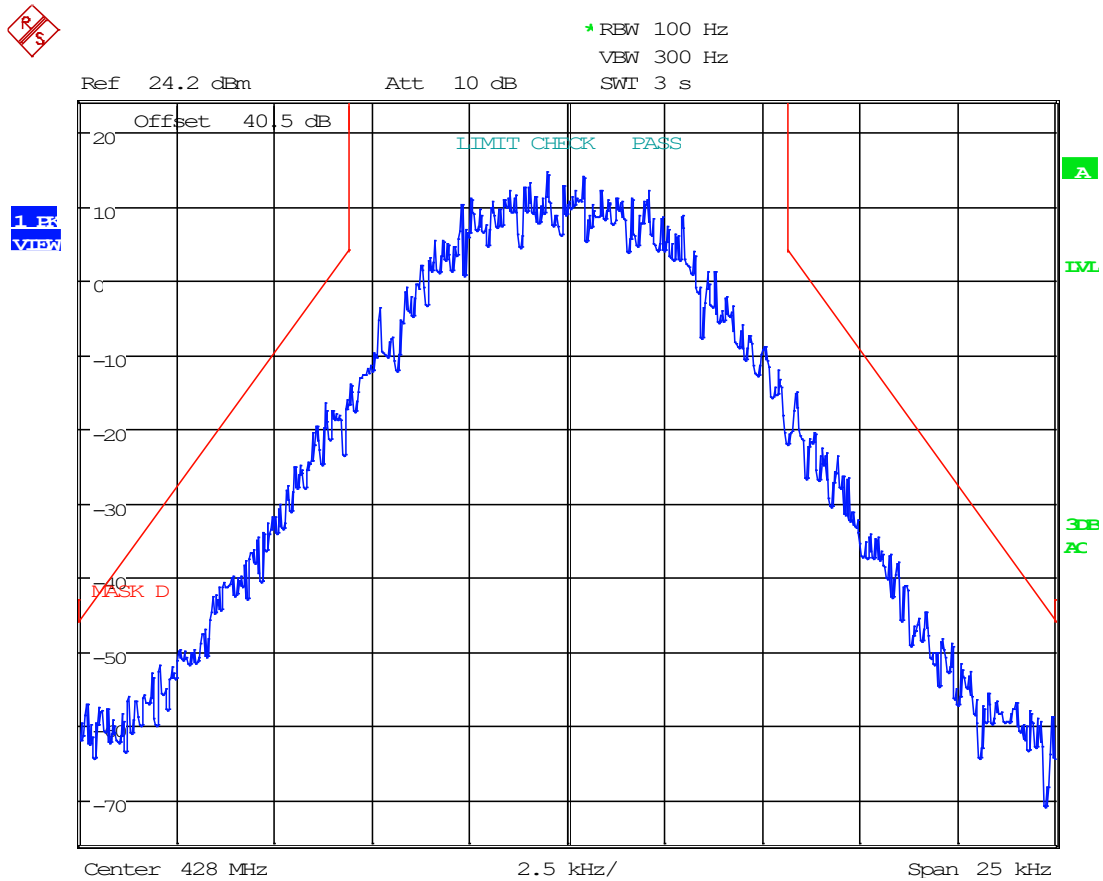


Date: 10.FEB.2023 11:06:59



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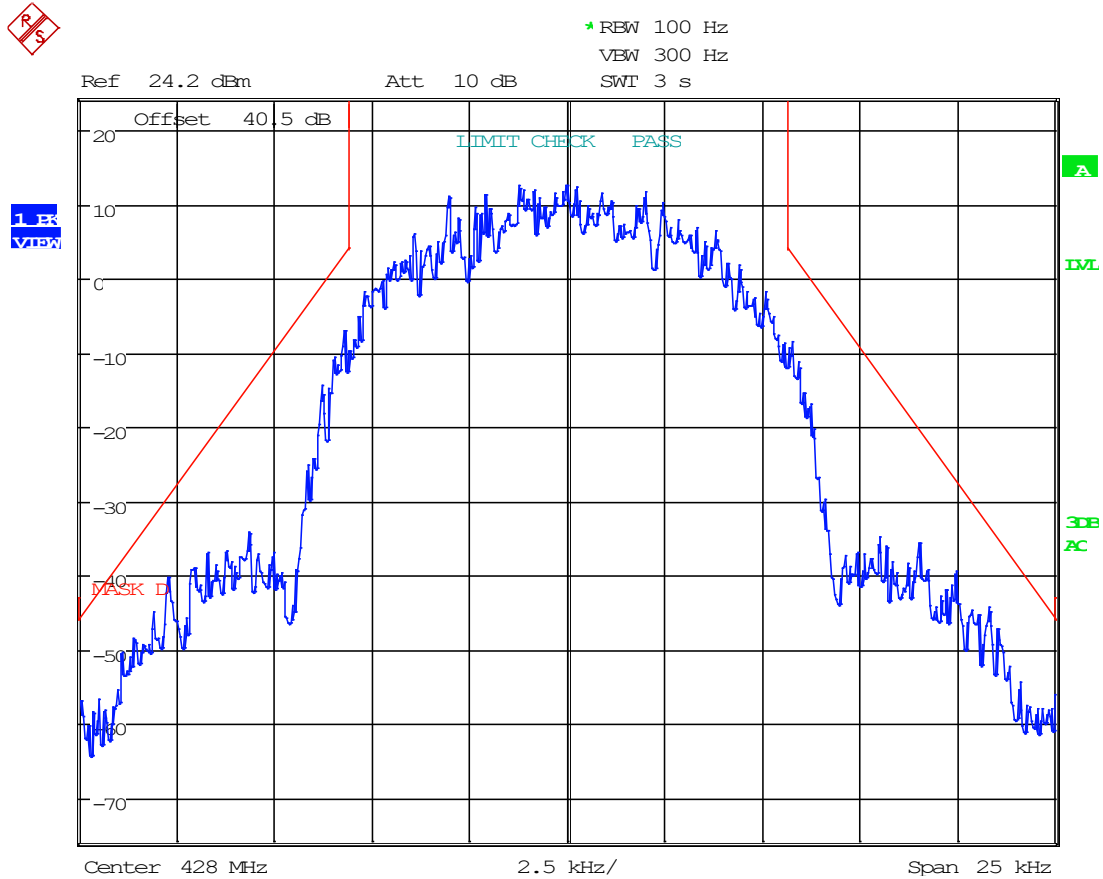
8.5.40 Unit 2, H-CPM, UL Mask D, AGC+3, 428 MHz



Date: 10.FEB.2023 11:07:55



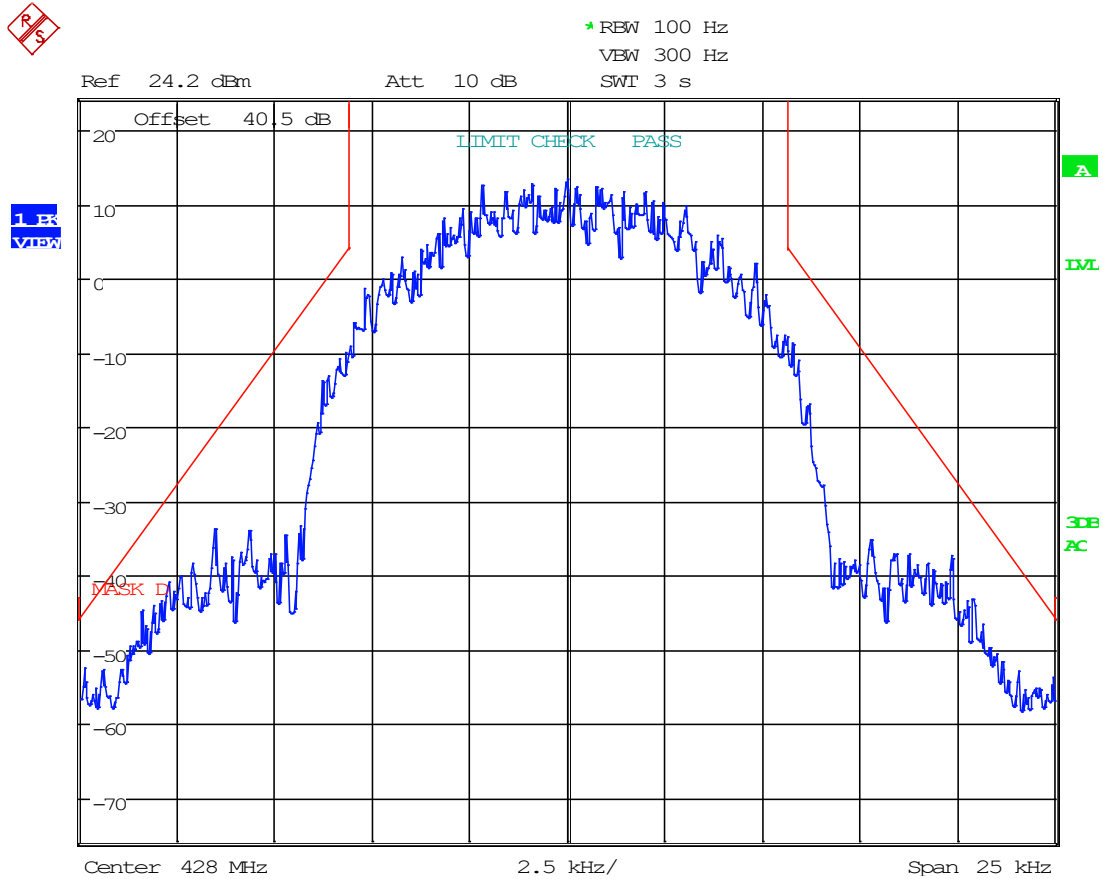
8.5.41 Unit 2, H-DQPSK, UL Mask D, AGC, 428 MHz



Date: 10.FEB.2023 11:08:51



8.5.42 Unit 2, H-DQPSK, UL Mask D, AGC+3, 428 MHz

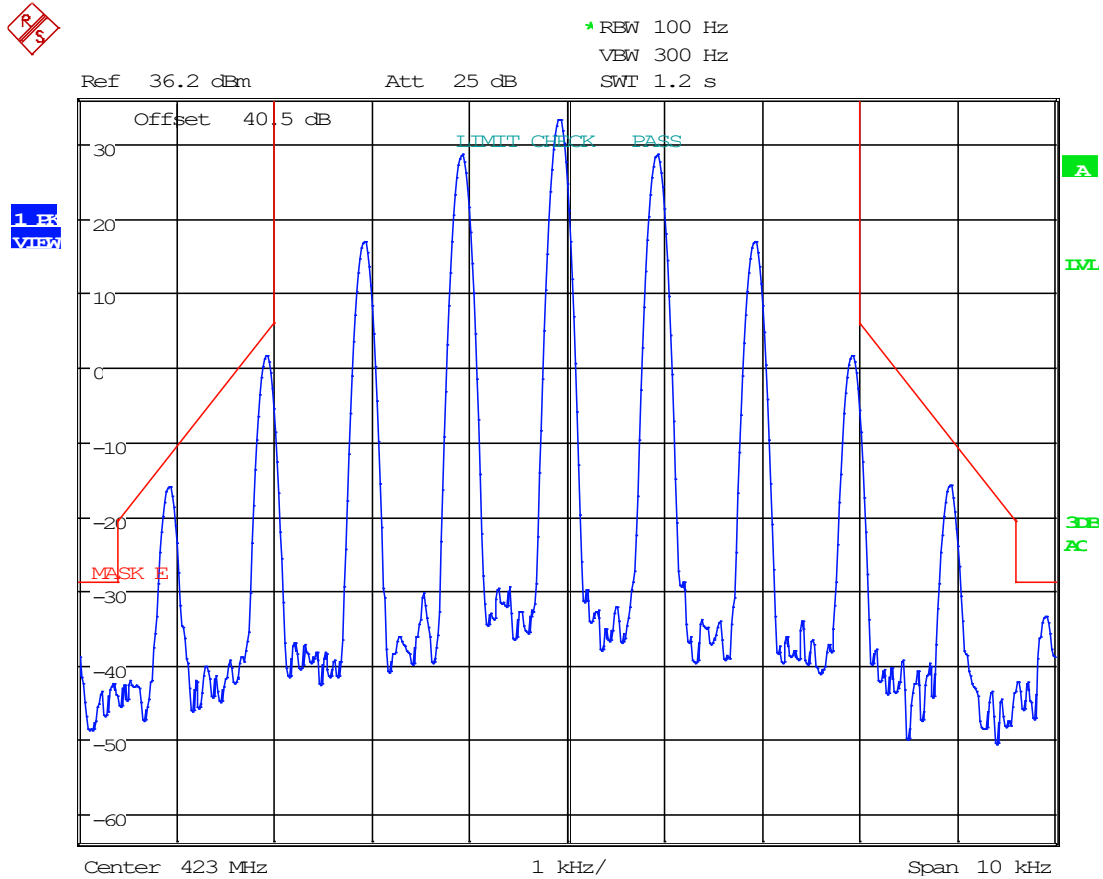


Date: 10.FEB.2023 11:09:43



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8.5.43 Unit 2, 6.25 kHz, FM, DL Mask E, AGC, 423 MHz

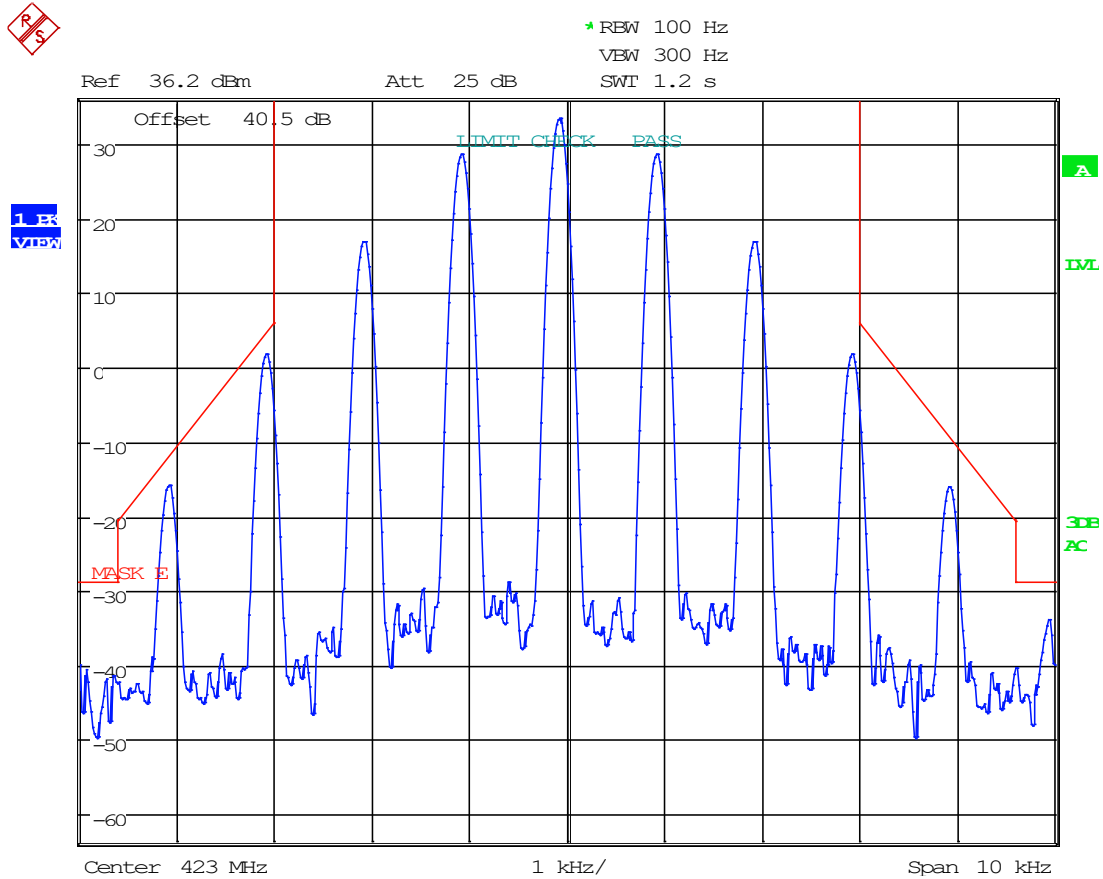


Date: 10.FEB.2023 11:24:59



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8.5.44 Unit 2, 6.25 kHz, FM, DL Mask E, AGC+3, 423 MHz

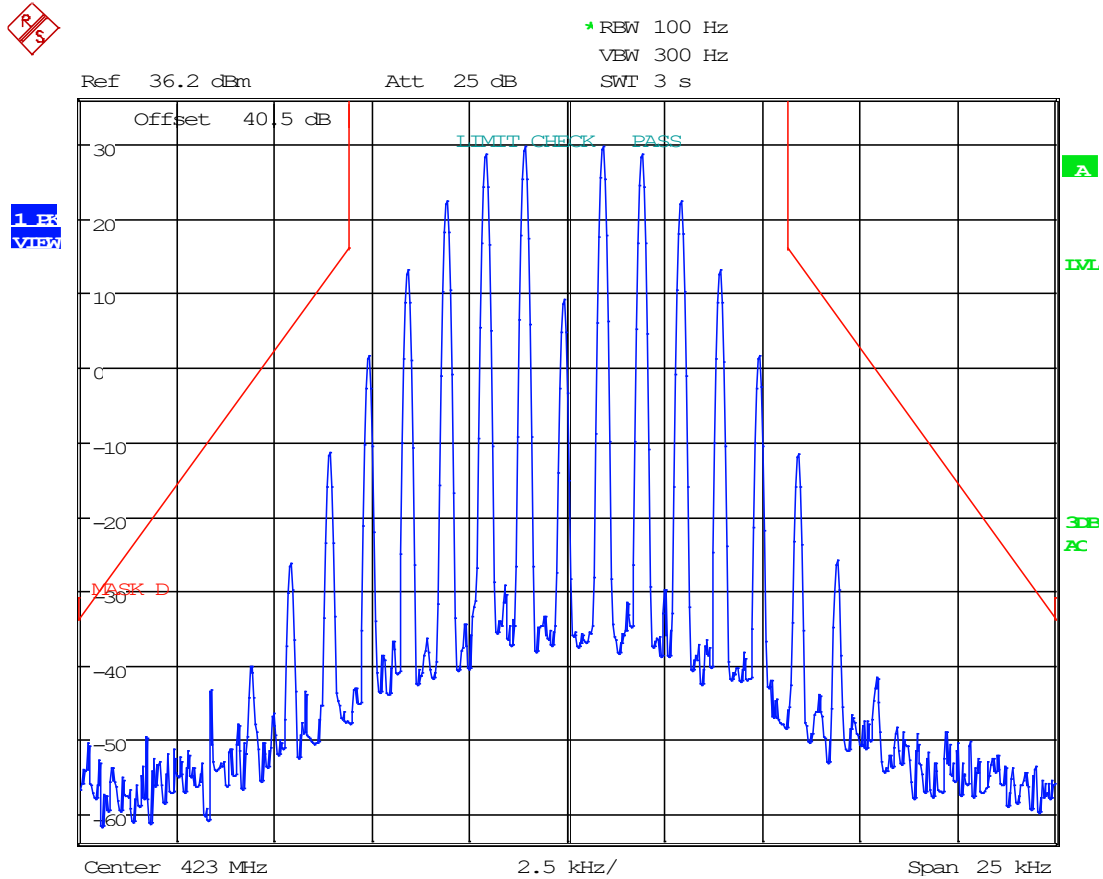


Date: 10.FEB.2023 11:25:51



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8.5.45 Unit 2, 12.5 kHz, FM, DL Mask D, AGC, 423 MHz

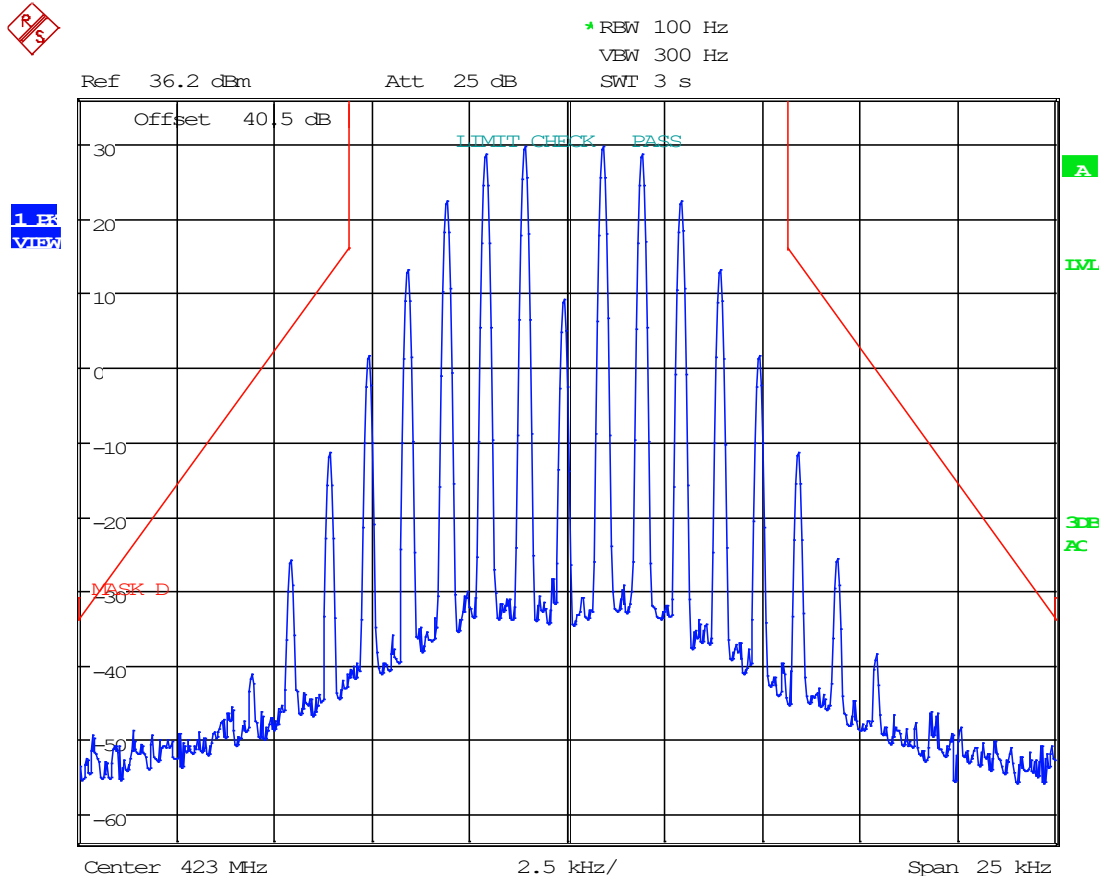


Date: 10.FEB.2023 11:27:36



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8.5.46 Unit 2, 12.5 kHz, FM, DL Mask D, AGC+3, 423 MHz

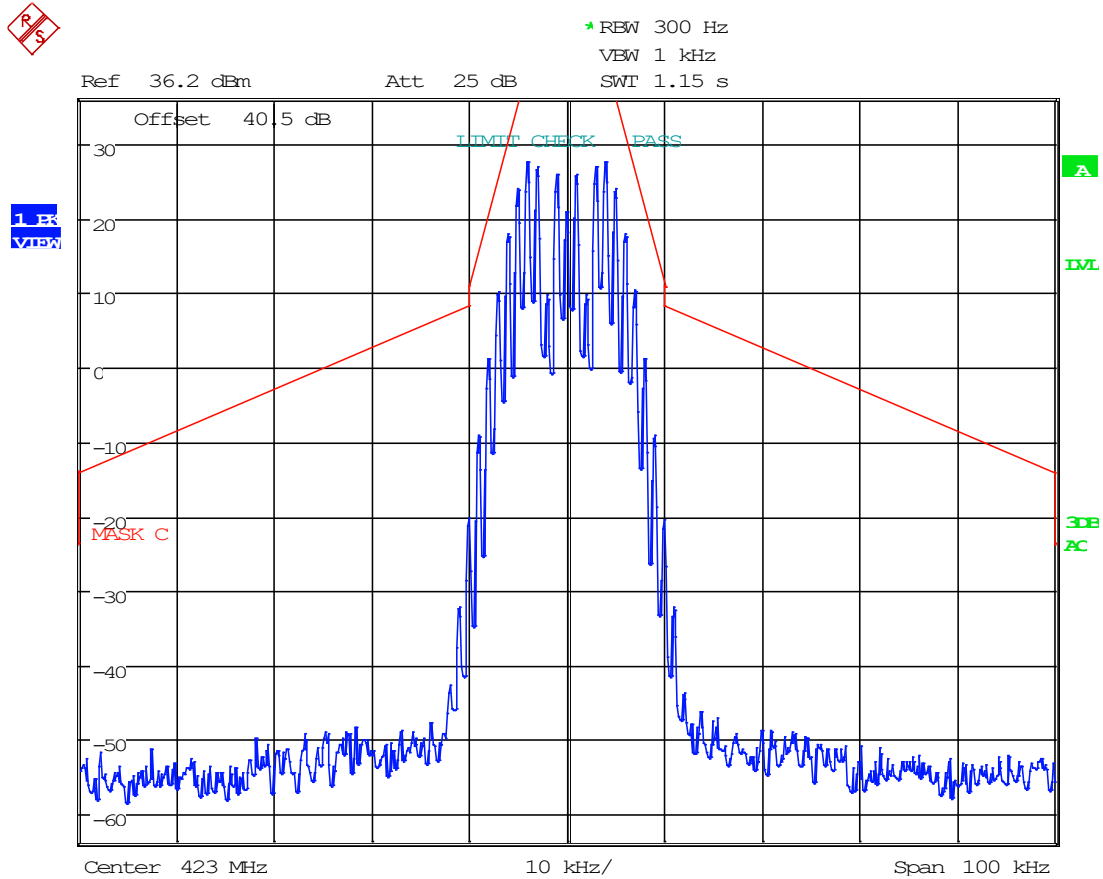


Date: 10.FEB.2023 11:30:07



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8.5.47 Unit 2, 25 kHz FM, DL Mask C, AGC, 423 MHz

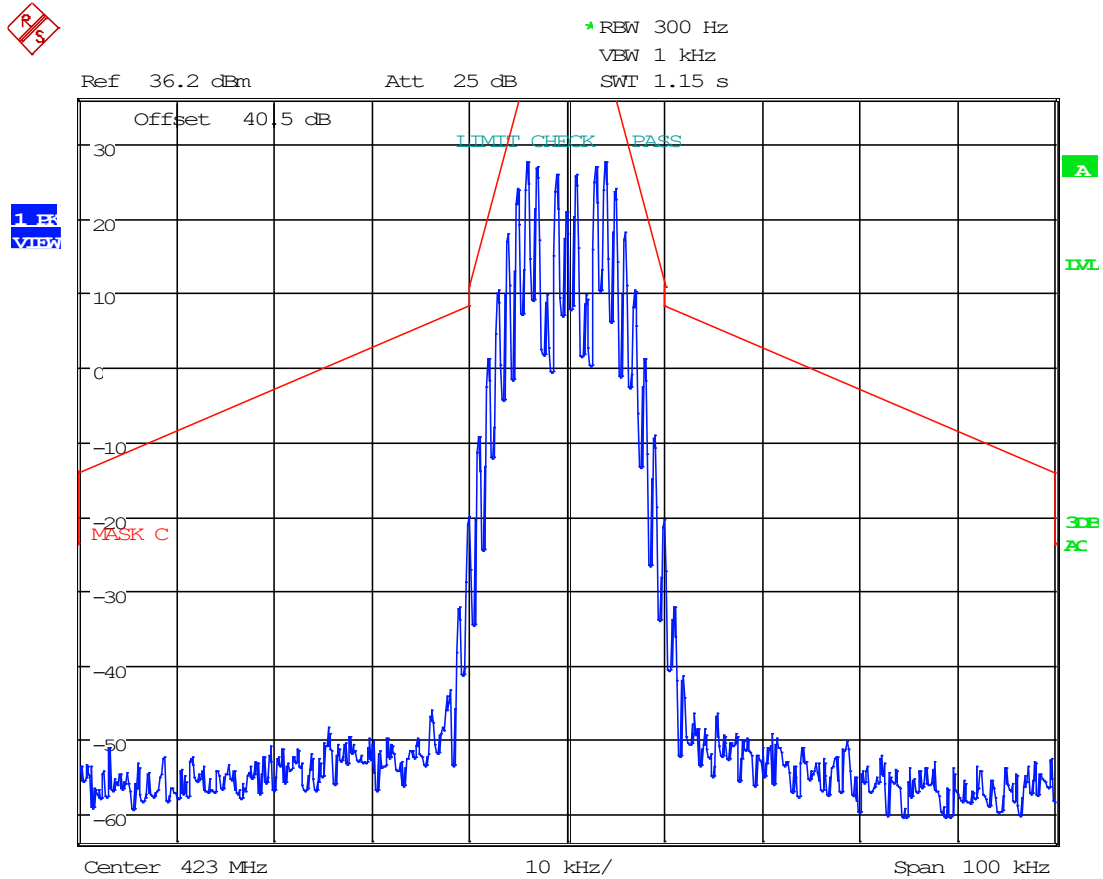


Date: 10.FEB.2023 11:22:03



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8.5.48 Unit 2, 25 kHz FM, DL Mask C, AGC+3, 423 MHz

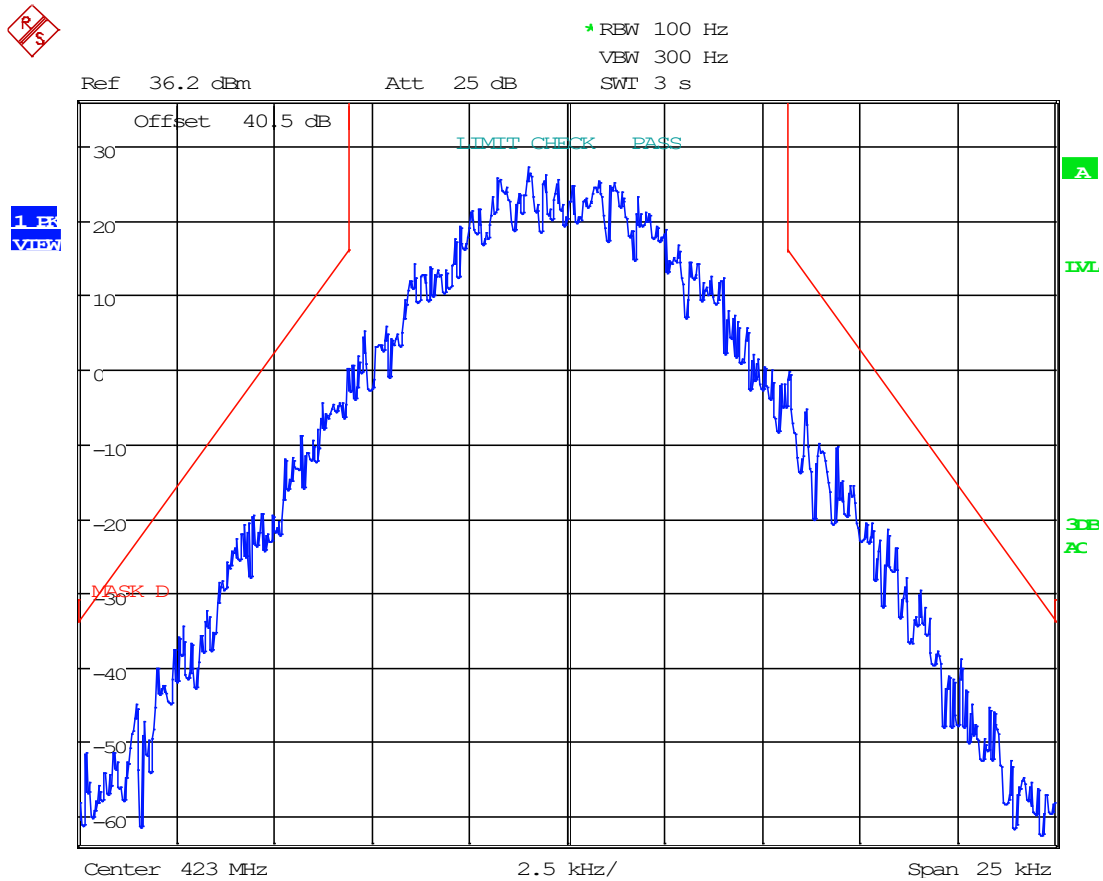


Date: 10.FEB.2023 11:23:16



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(352) 472-5500 / testing@timcoengr.com

8.5.49 Unit 2, C4FM, DL Mask D, AGC, 423 MHz

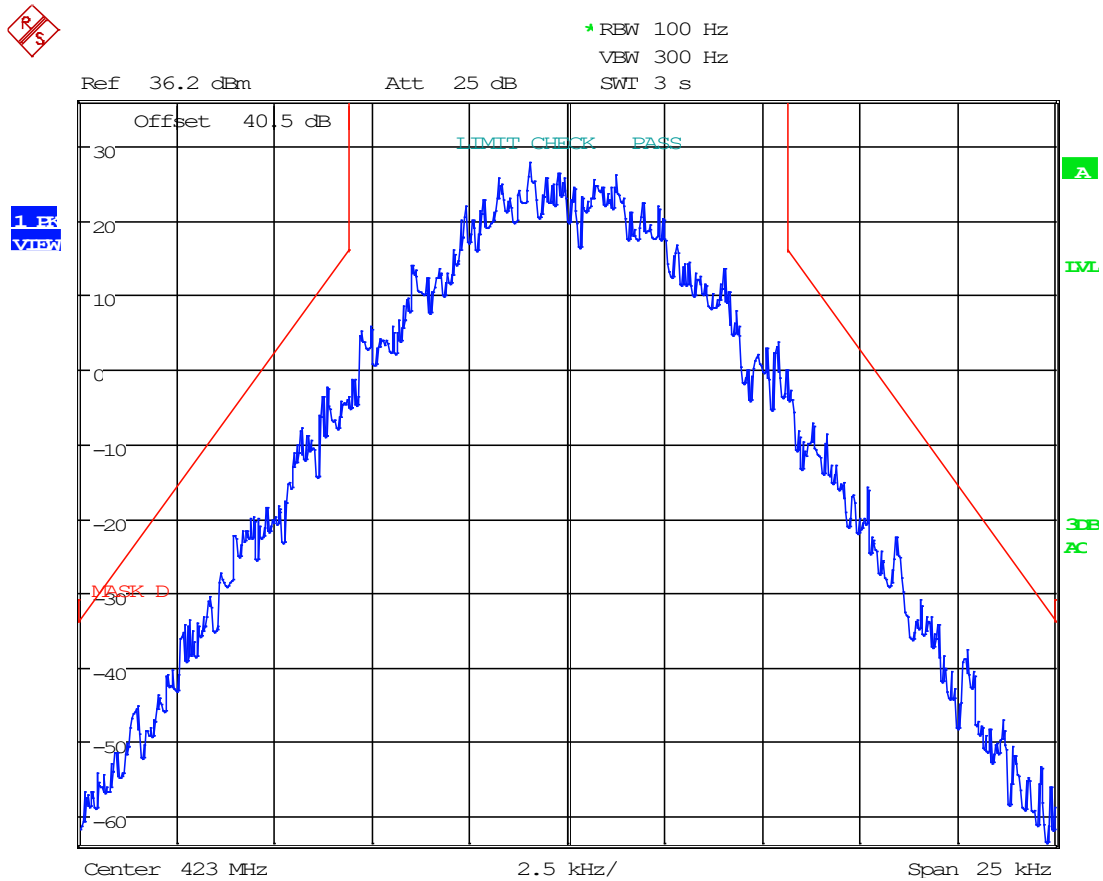


Date: 10.FEB.2023 11:32:26



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(352) 472-5500 / testing@timcoengr.com

8.5.50 Unit 2, C4FM, DL Mask D, AGC+3, 423 MHz

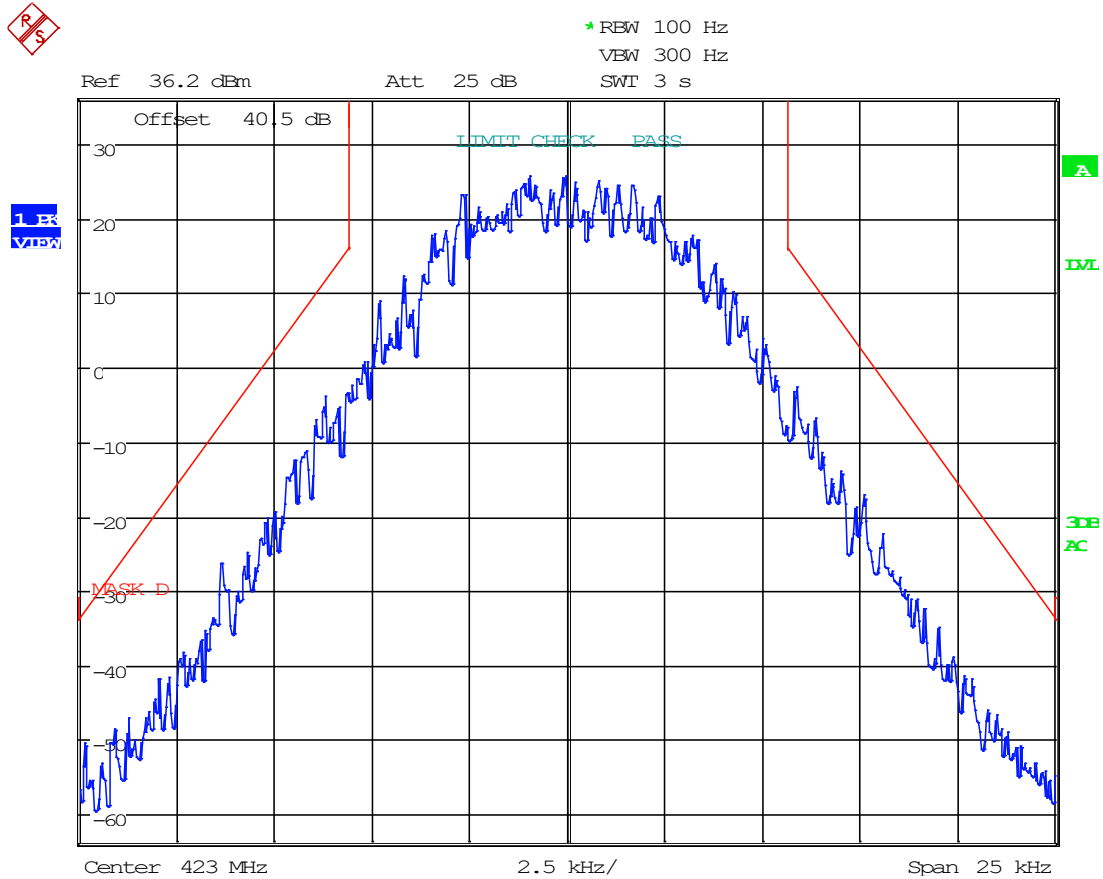


Date: 10.FEB.2023 11:33:42



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8.5.51 Unit 2, H-CPM, DL Mask D, AGC, 423 MHz

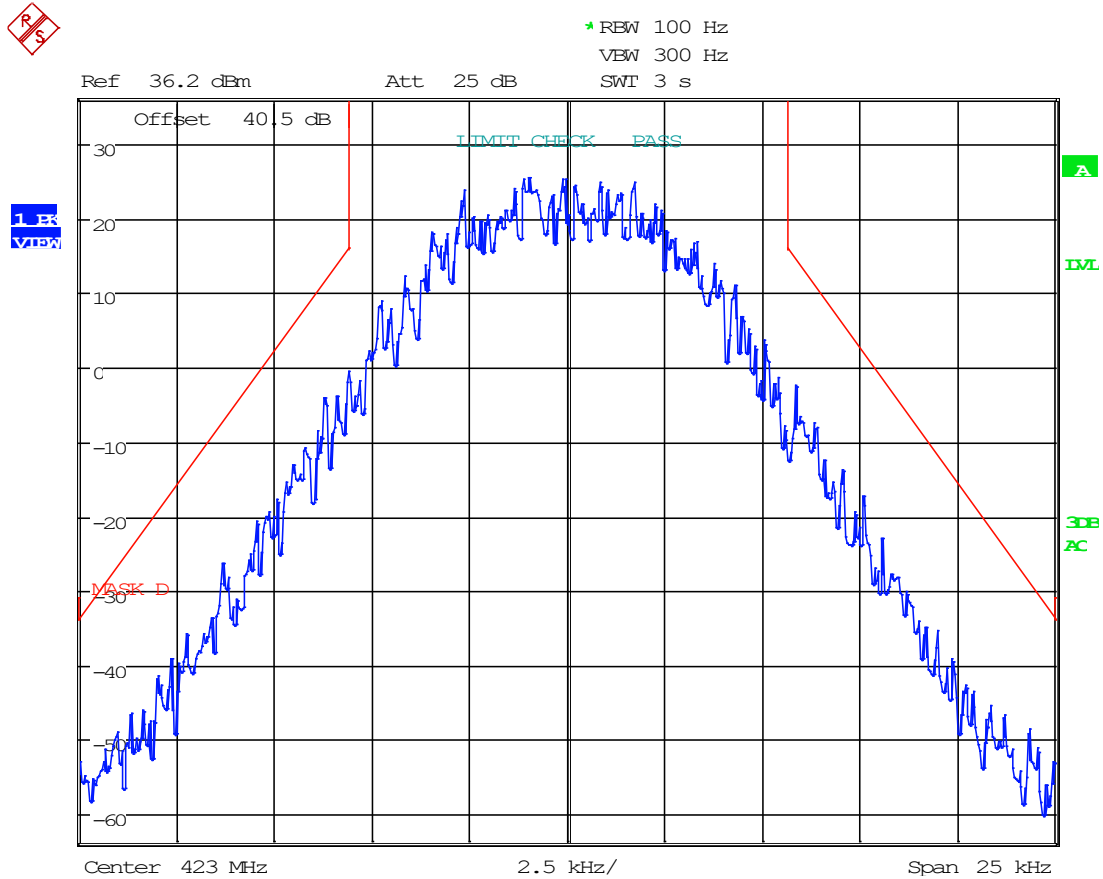


Date: 10.FEB.2023 11:34:41



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8.5.52 Unit 2, H-CPM, DL Mask D, AGC+3, 423 MHz

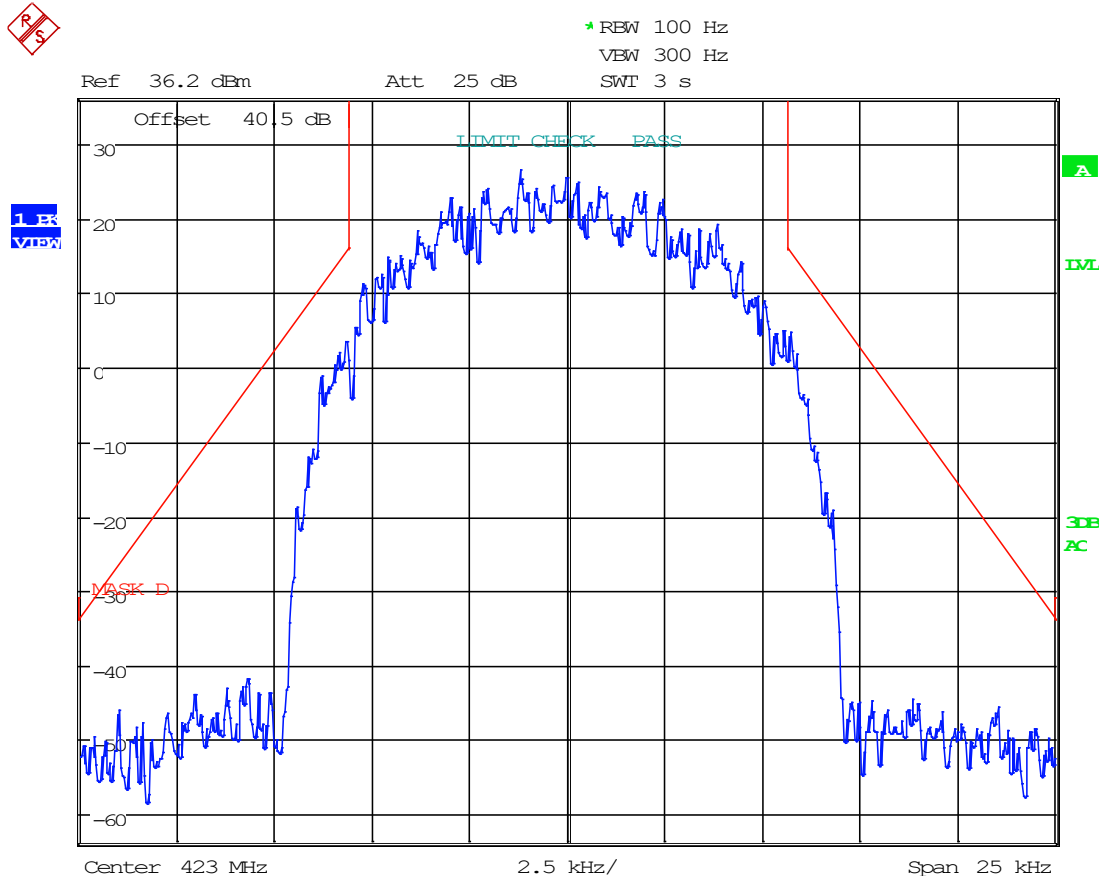


Date: 10.FEB.2023 11:35:27



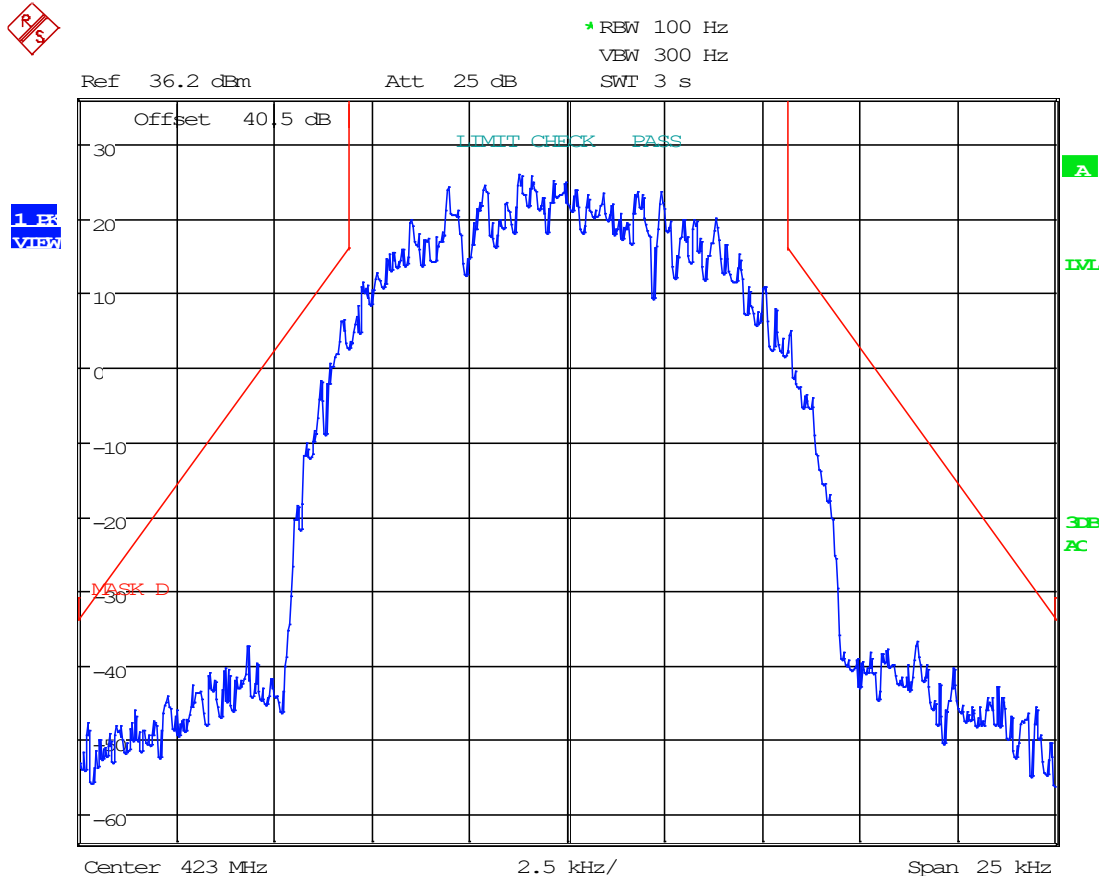
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8.5.53 Unit 2, H-DQPSK, DL Mask D, AGC, 423 MHz



Date: 10.FEB.2023 11:36:30

8.5.54 Unit 2, H-DQPSK, DL Mask D, AGC+3, 423 MHz



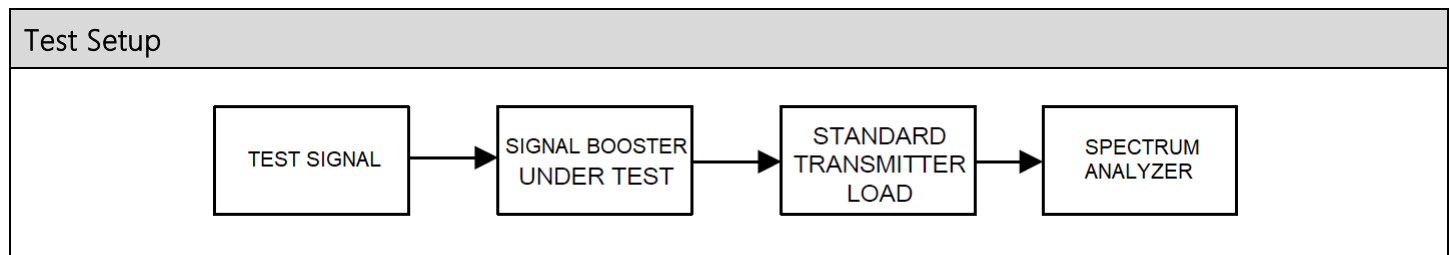
Date: 10.FEB.2023 11:37:40



8.6 Noise Figure

Referenced from test report "TR_6428-23_FCC_PT90_Booster Class B_1.docx".

Limits from FCC KDB 935210 D05 v01r04 Industrial Signal Boosters. Test method from "Noise Figure Measurement Accuracy: The Y-Factor Method" by Keysight Technologies.



Test Results, Out-of-band Rejection and Class of Operation				
Unit	Operating Band (MHz)	Link Direction	Noise Figure (dB)	Limit (dB)
1	406.1- 411 MHz	Uplink	5.16	< 9 dB
	411- 416 MHz	Downlink	2.55	< 9 dB
2	425- 430 MHz	Uplink	3.76	< 9 dB
	420-425 MHz	Downlink	6.54	< 9 dB



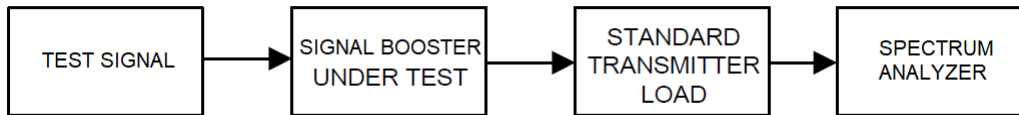
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8.7 Out-of-Band/Out-of-Block Emissions (Intermodulation Products)

Referenced from test report "TR_6428-23_FCC_PT90_Booster Class B_1.docx".

Limits from FCC Parts 2.1051, FCC Pt. 90.219(d)(6)(i), FCC Pt. 90.219(e)(3) and test procedure from ANSI C63.26-2015 and FCC KDB 935210 D05 v01r04 Industrial Signal Boosters.

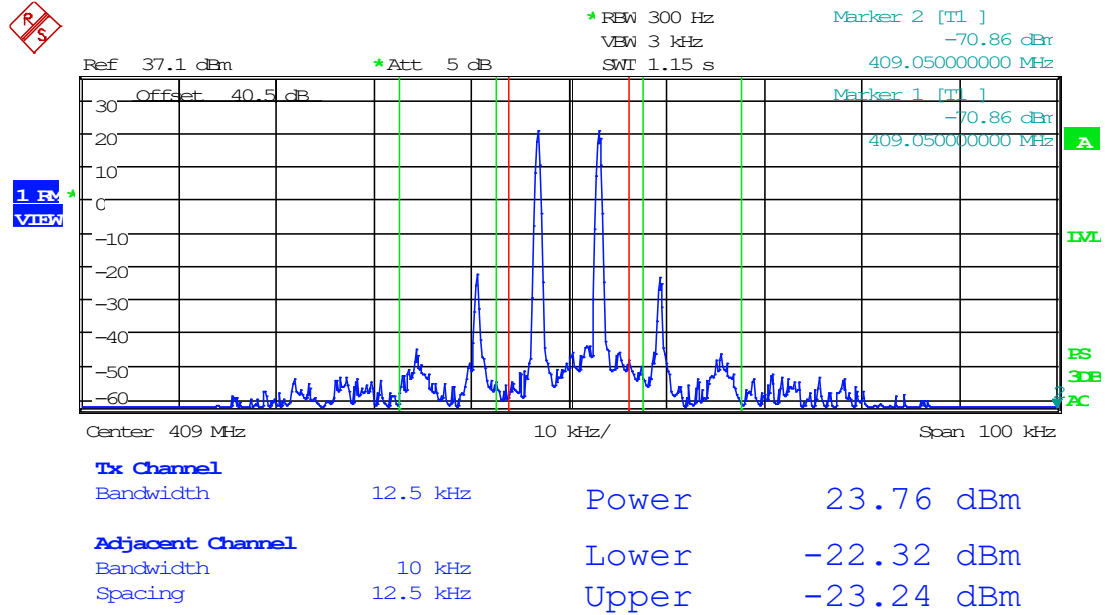
Test Setup





Intermodulation Products Spectrum Plots

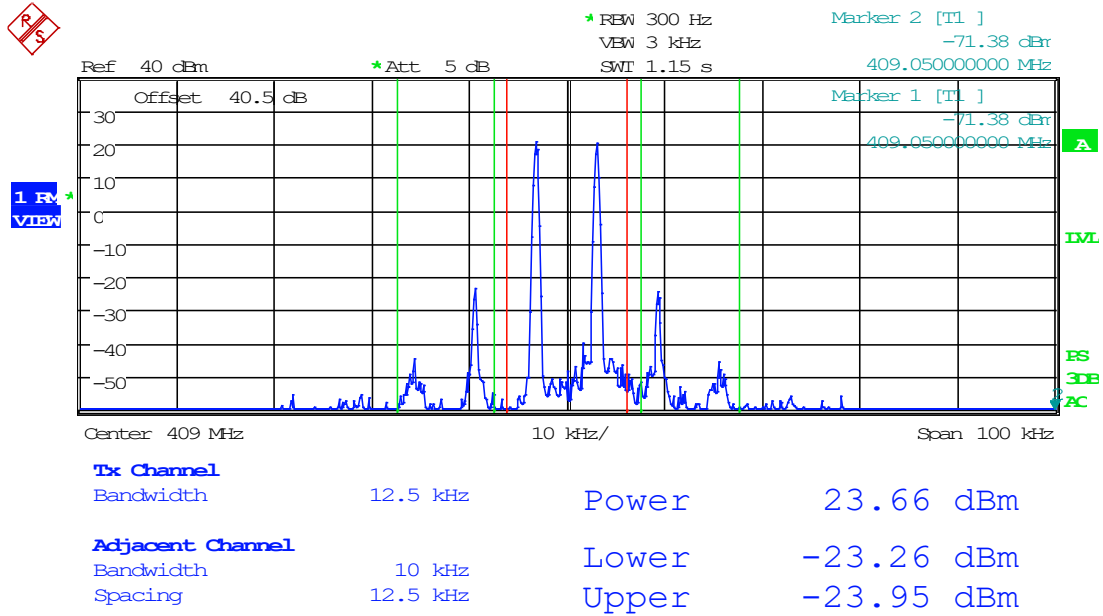
8.7.1 Unit 1, 6.25 kHz Signal, Uplink, AGC, 409 MHz



Date: 9.FEB.2023 14:03:30



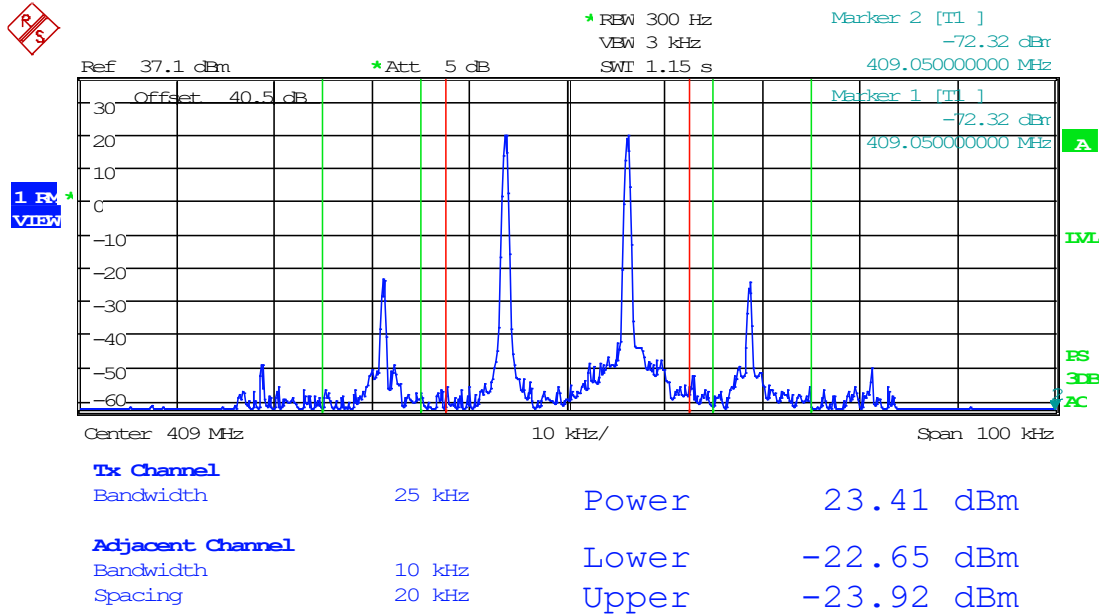
8.7.2 Unit 1, 6.25 kHz Signal, Uplink, AGC+3dB, 409 MHz



Date: 9.FEB.2023 14:06:14



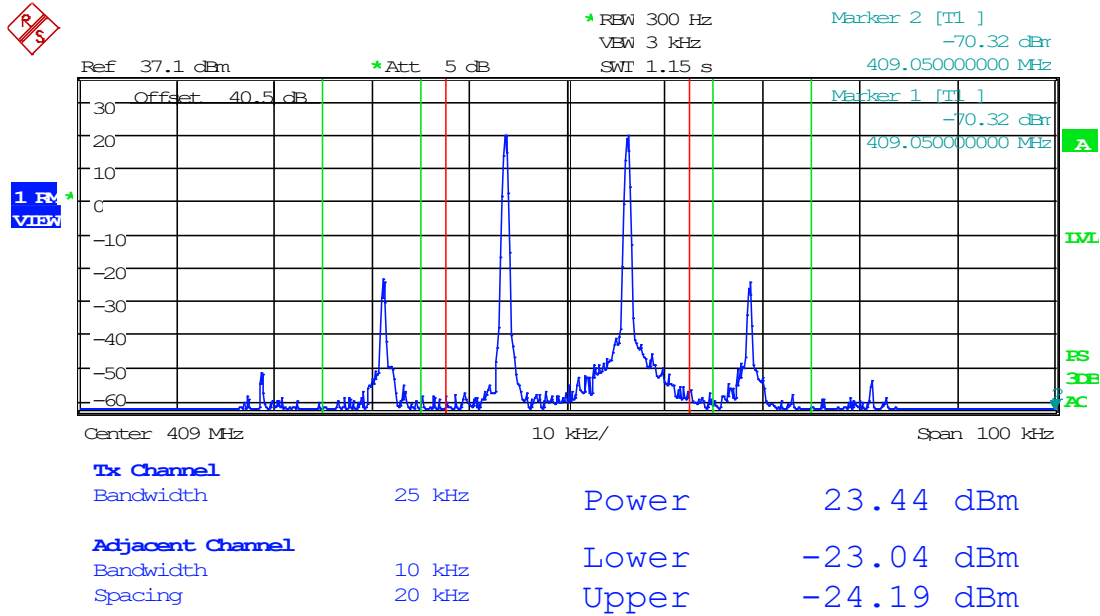
8.7.3 Unit 1, 12.5 kHz Signal, Uplink, AGC, 409 MHz



Date: 9.FEB.2023 14:08:22



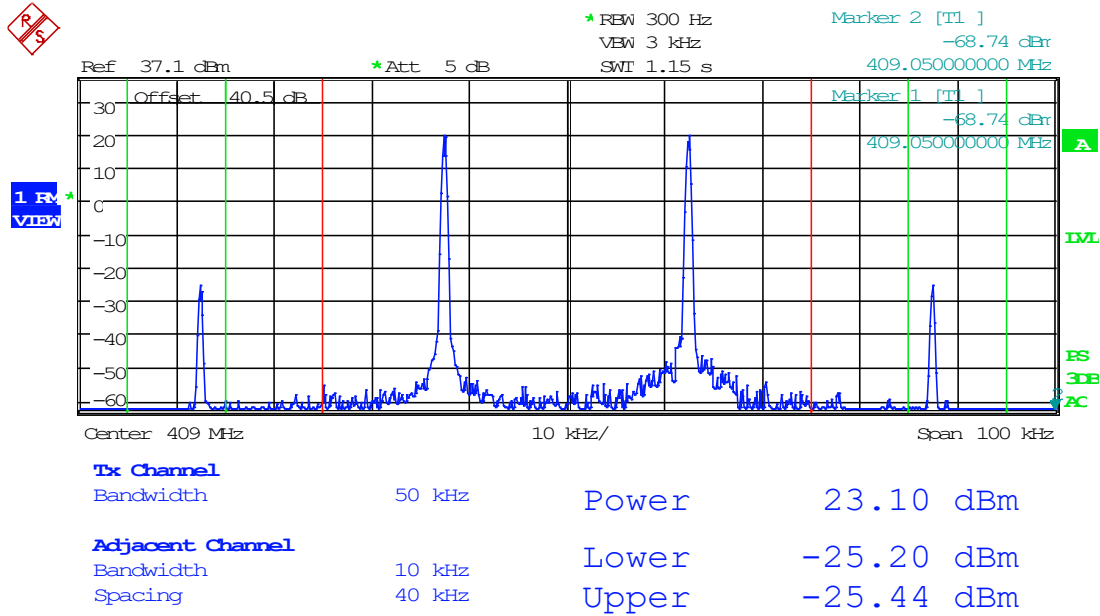
8.7.4 Unit 1, 12.5 kHz Signal, Uplink, AGC+3dB, 409 MHz



Date: 9.FEB.2023 14:09:21



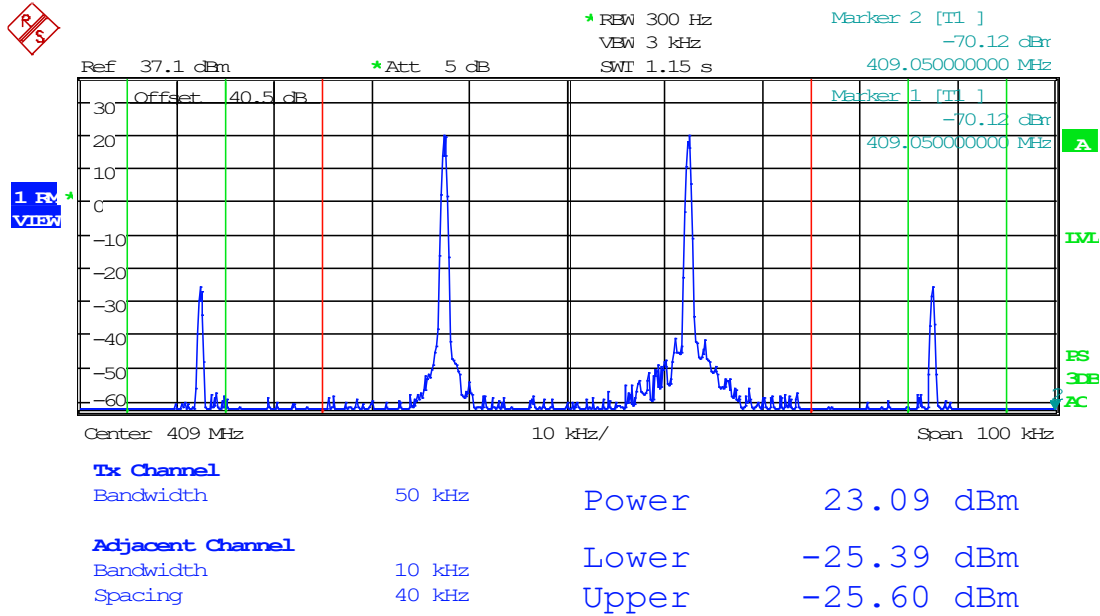
8.7.5 Unit 1, 25 kHz Signal, Uplink, AGC, 409 MHz



Date: 9.FEB.2023 14:11:20



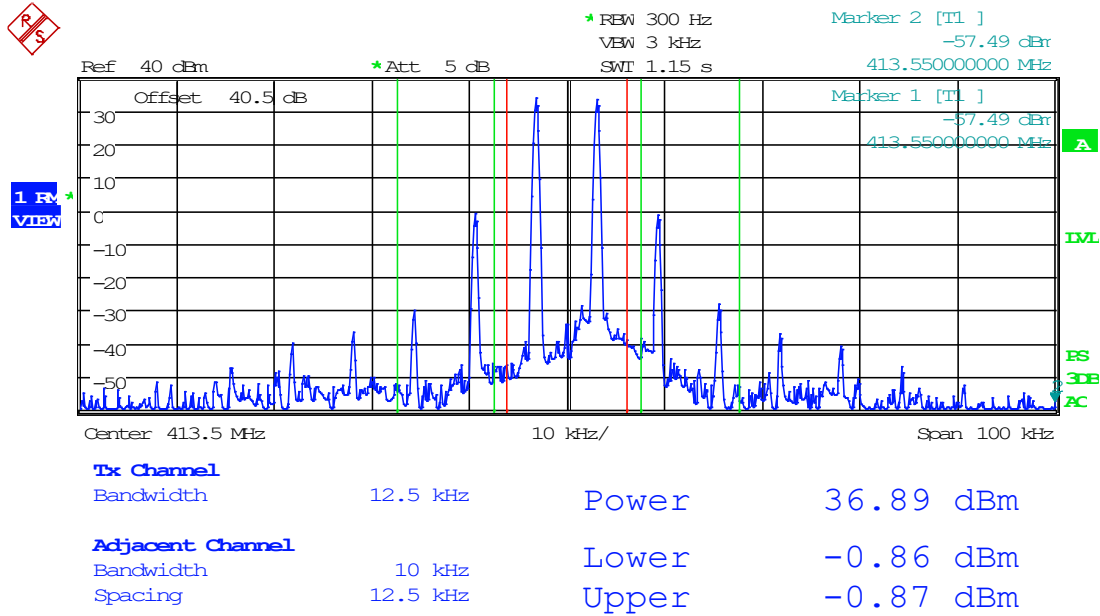
8.7.6 Unit 1, 25 kHz Signal, Uplink, AGC+3dB, 409 MHz



Date: 9.FEB.2023 14:12:04



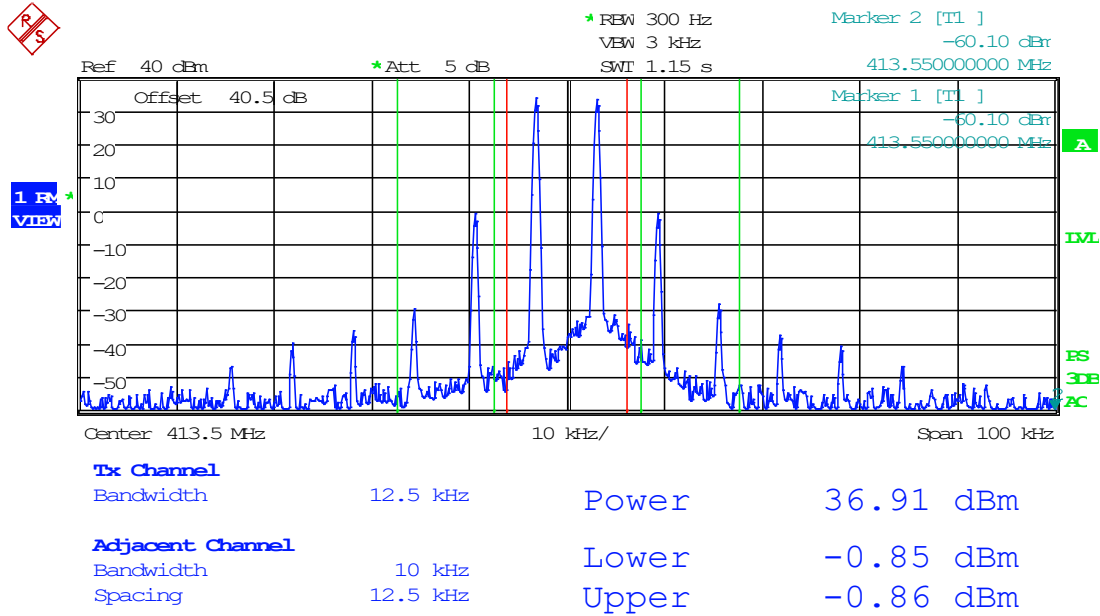
8.7.7 Unit 1, 6.25 kHz Signal, Downlink, AGC, 413.5 MHz



Date: 9.FEB.2023 14:28:48



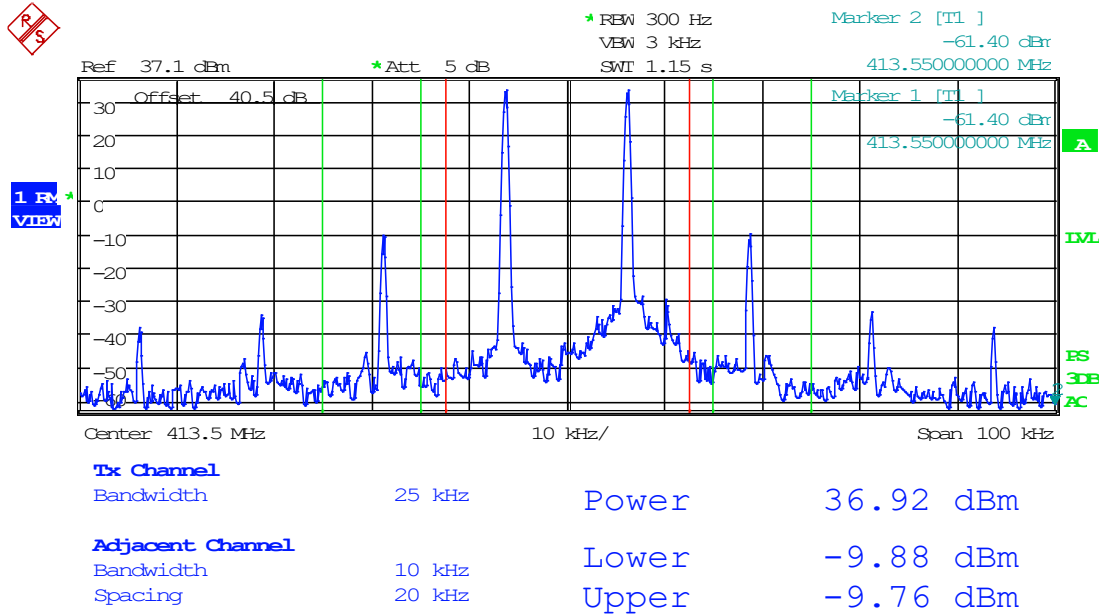
8.7.8 Unit 1, 6.25 kHz Signal, Downlink, AGC+3dB, 413.5 MHz



Date: 9.FEB.2023 14:29:46



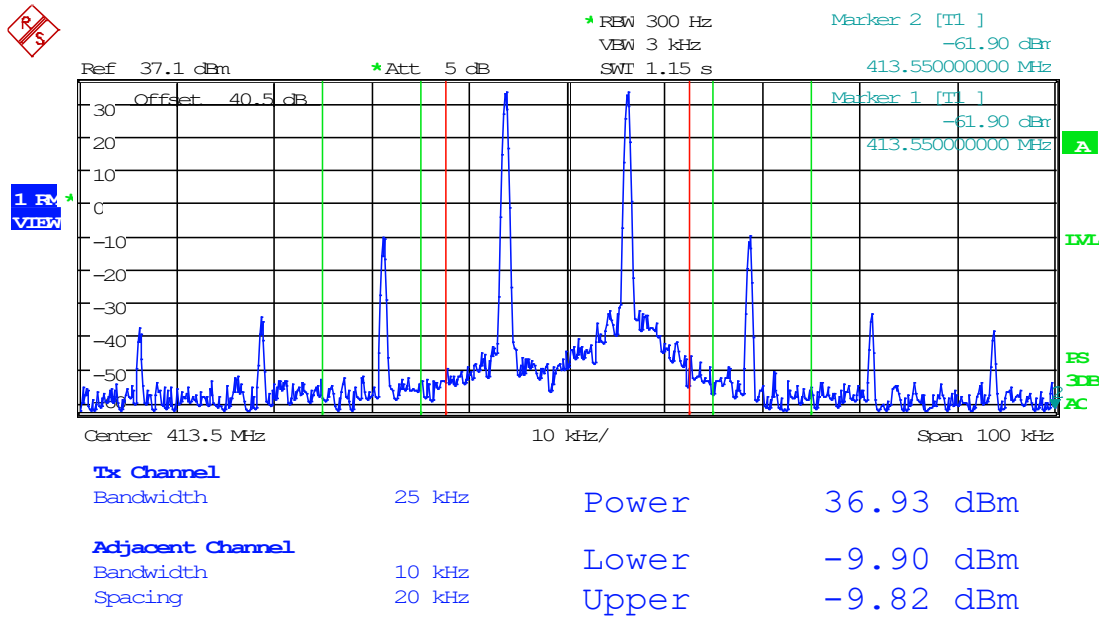
8.7.9 Unit 1, 12.5 kHz Signal, Downlink, AGC, 413.5 MHz



Date: 9.FEB.2023 14:32:47



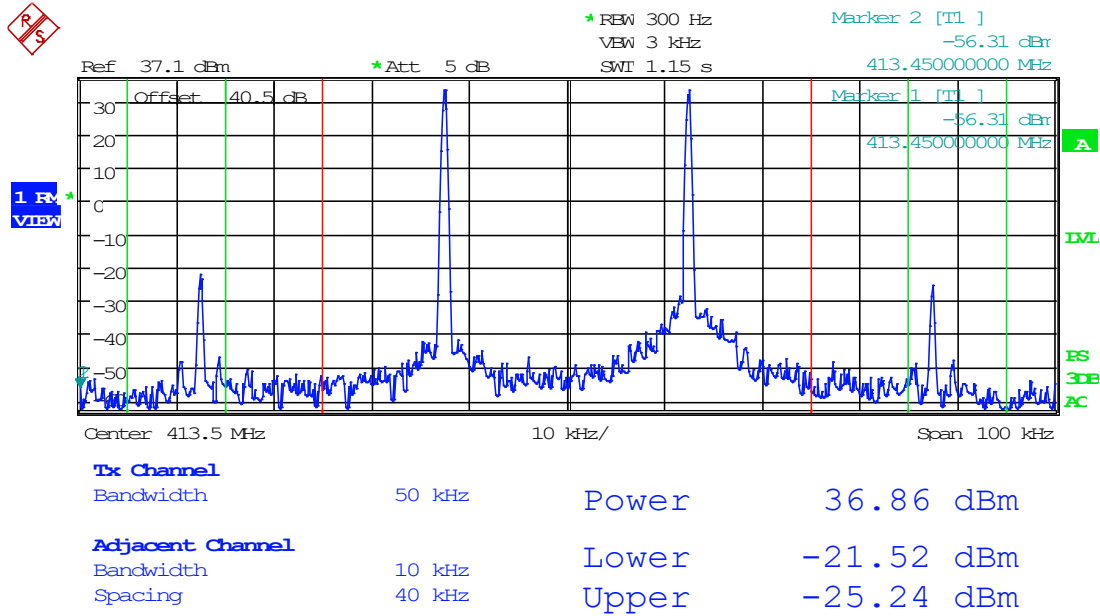
8.7.10 Unit 1, 12.5 kHz Signal, Downlink, AGC+3dB, 413.5 MHz



Date: 9.FEB.2023 14:33:56



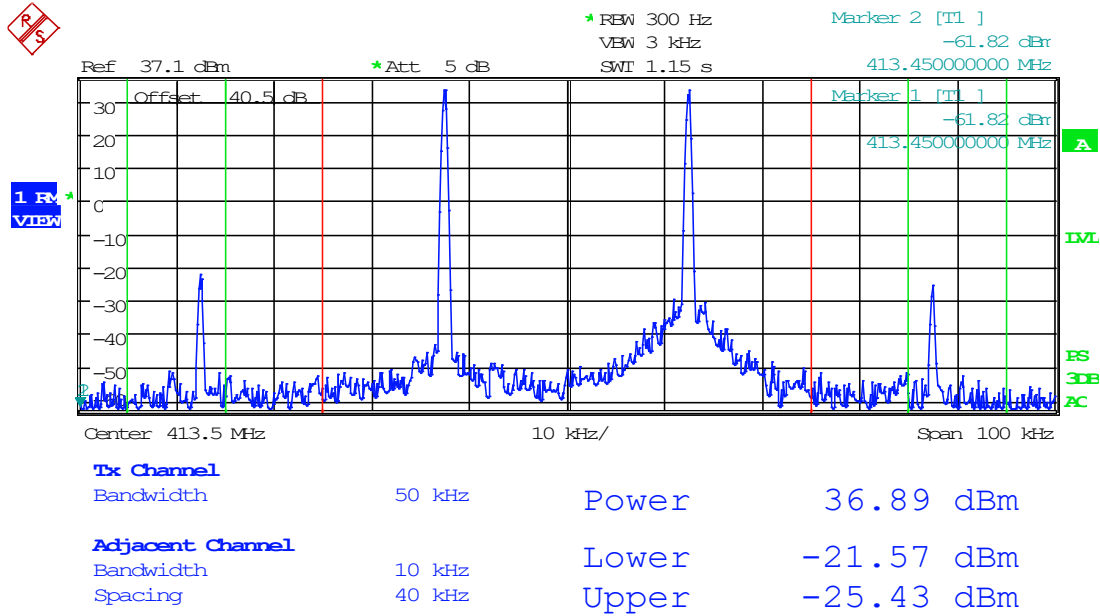
8.7.11 Unit 1, 25 kHz Signal, Downlink, AGC, 413.5 MHz



Date: 9.FEB.2023 14:14:06



8.7.12 Unit 1, 25 kHz Signal, Downlink, AGC+3dB, 413.5 MHz

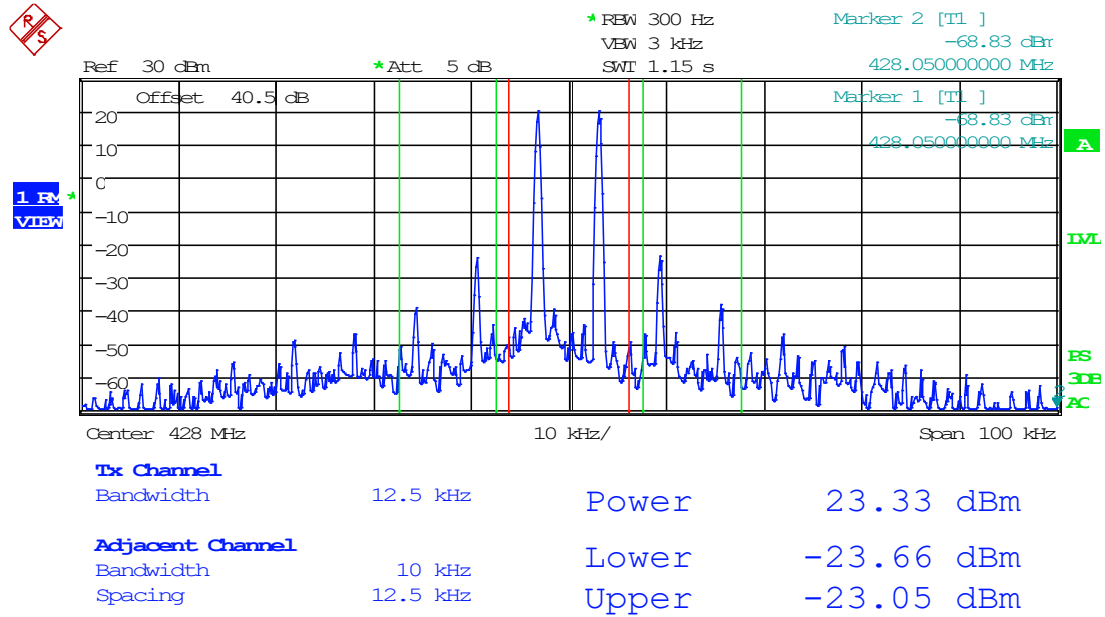


Date: 9.FEB.2023 14:15:02



Intermodulation Products Spectrum Plots

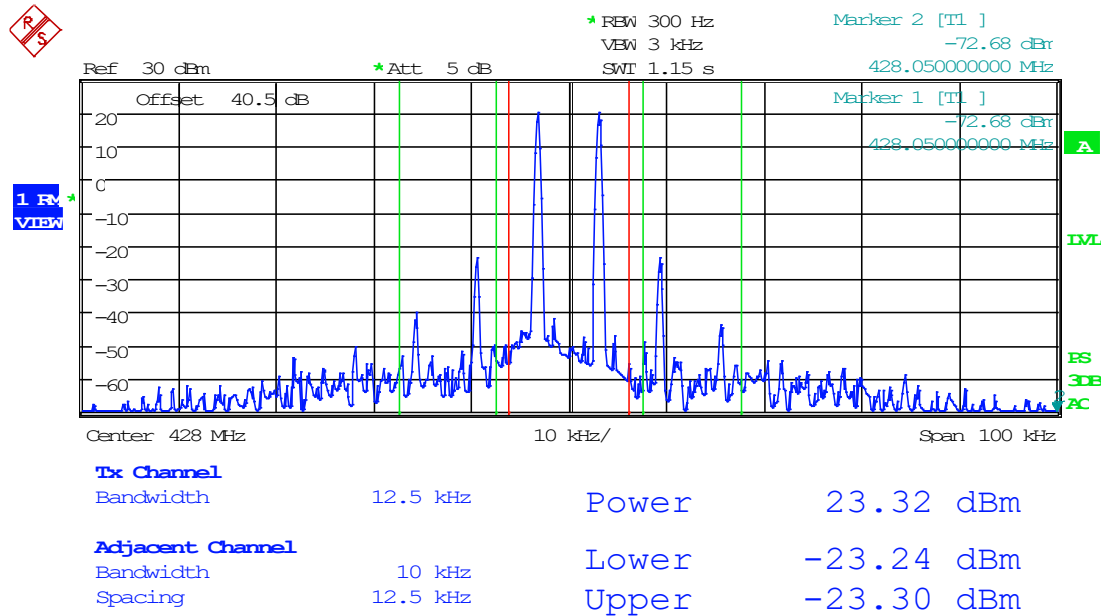
8.7.13 Unit 2, 6.25 kHz Signal, Uplink, AGC, 428 MHz



Date: 9.FEB.2023 13:28:28



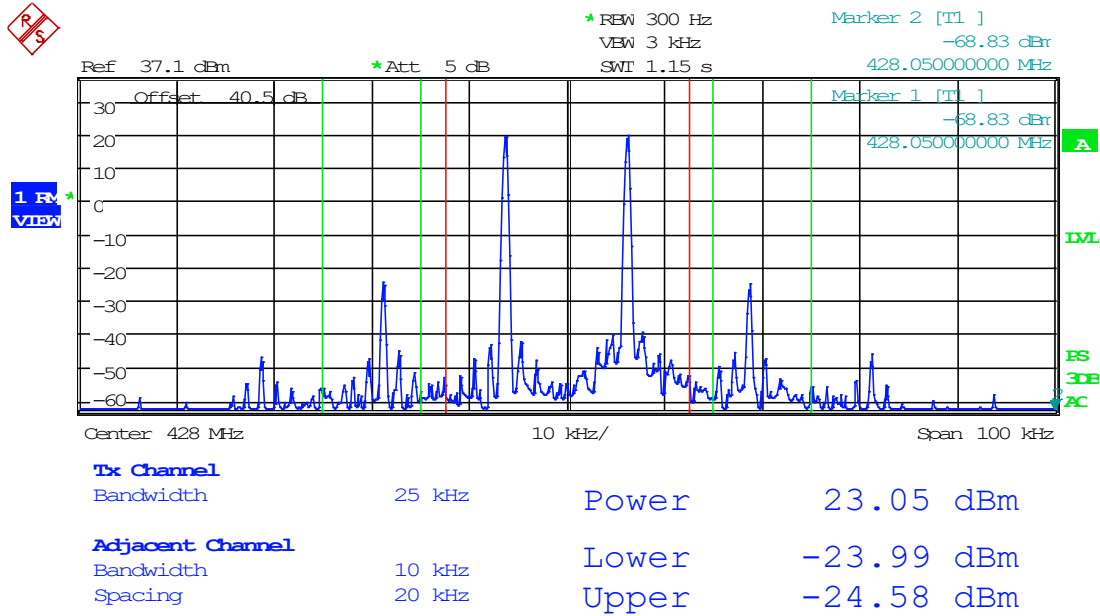
8.7.14 Unit 2, 6.25 kHz Signal, Uplink, AGC+3dB, 428 MHz



Date: 9.FEB.2023 13:29:15



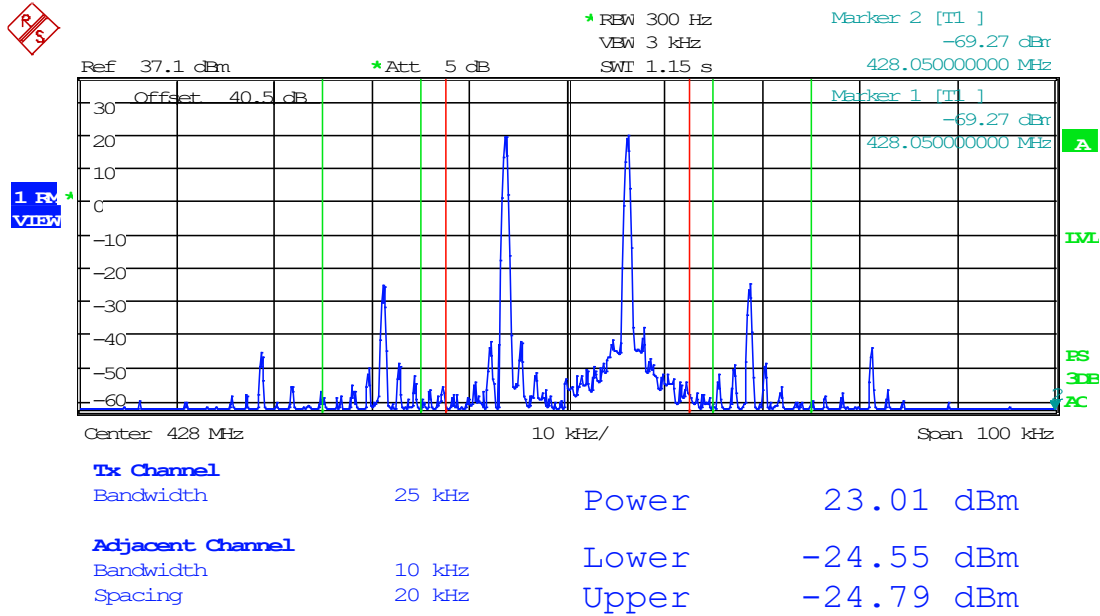
8.7.15 Unit 2, 12.5 kHz Signal, Uplink, AGC, 428 MHz



Date: 9.FEB.2023 13:40:23



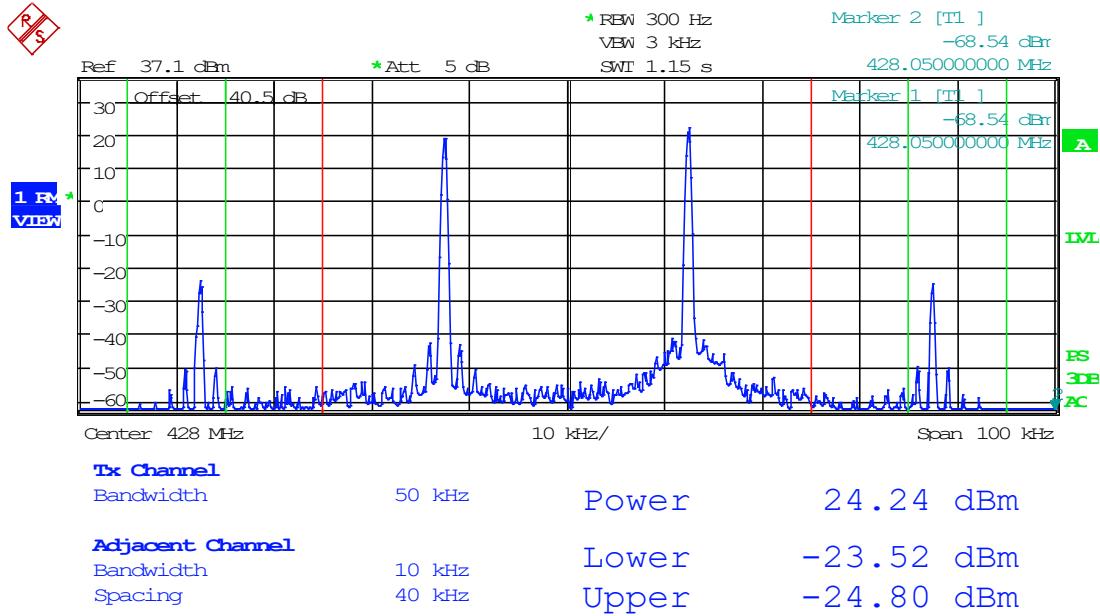
8.7.16 Unit 2, 12.5 kHz Signal, Uplink, AGC+3dB, 428 MHz



Date: 9.FEB.2023 13:41:12



8.7.17 Unit 2, 25 kHz Signal, Uplink, AGC, 428 MHz



Date: 9.FEB.2023 13:44:06



Ref 37.1 dBm *Att 5 dB SWI 1.15 s 428.05000000 MHz

Offset 40.5 dB Marker 1 [T1] -68.21 dBm 428.05000000 MHz

Center 428 MHz 10 kHz/ Span 100 kHz

Tx Channel
 Bandwidth 50 kHz Power 22.68 dBm

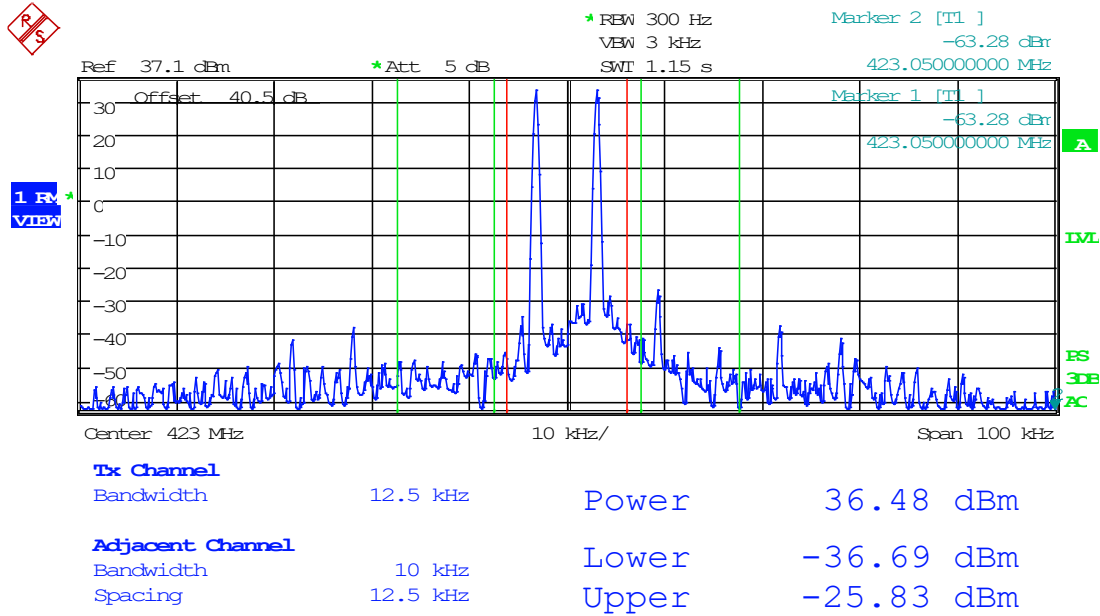
Adjacent Channel
 Bandwidth 10 kHz Lower -26.45 dBm
 Spacing 40 kHz Upper -24.86 dBm

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8.7.19 Unit 2, 6.25 kHz Signal, Downlink, AGC, 423 MHz

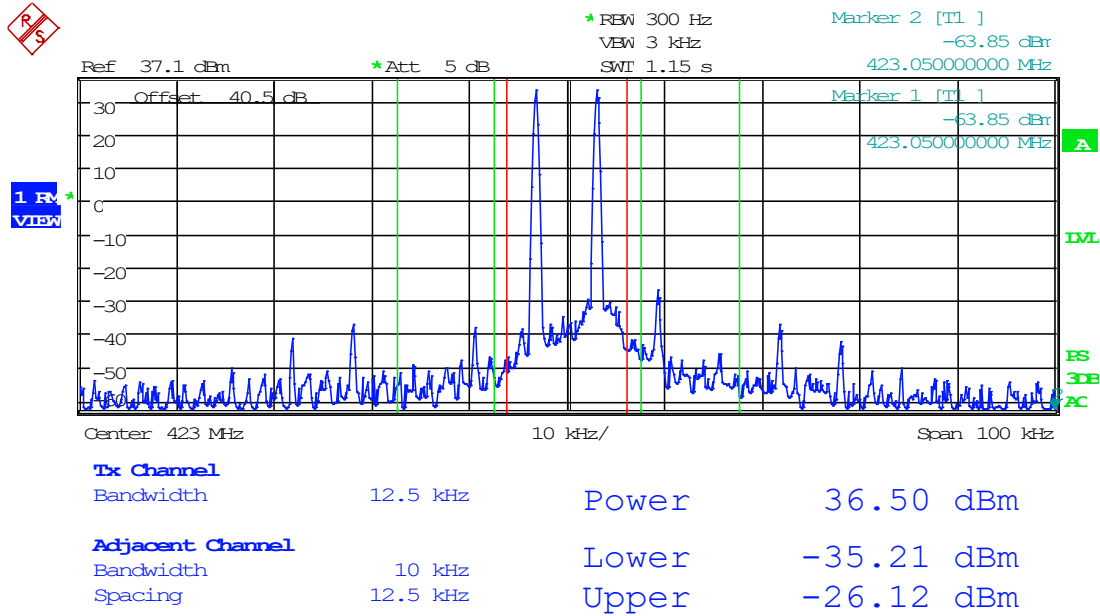


Date: 9.FEB.2023 14:00:14



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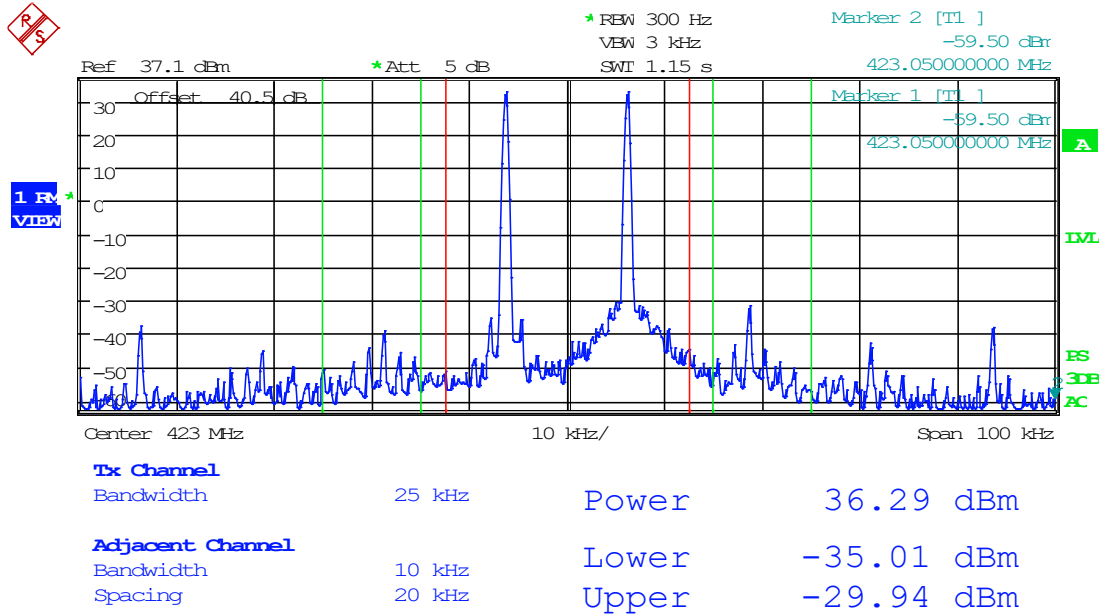
8.7.20 Unit 2, 6.25 kHz Signal, Downlink, AGC+3dB, 423 MHz



Date: 9.FEB.2023 14:00:56



8.7.21 Unit 2, 12.5 kHz Signal, Downlink, AGC, 423 MHz

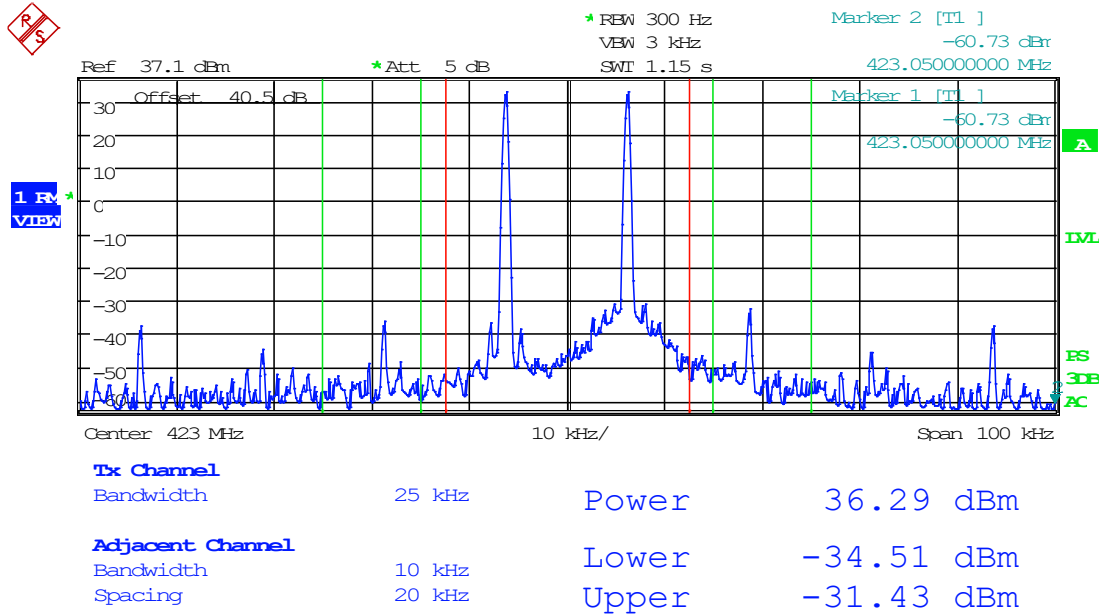


Date: 9.FEB.2023 13:56:01



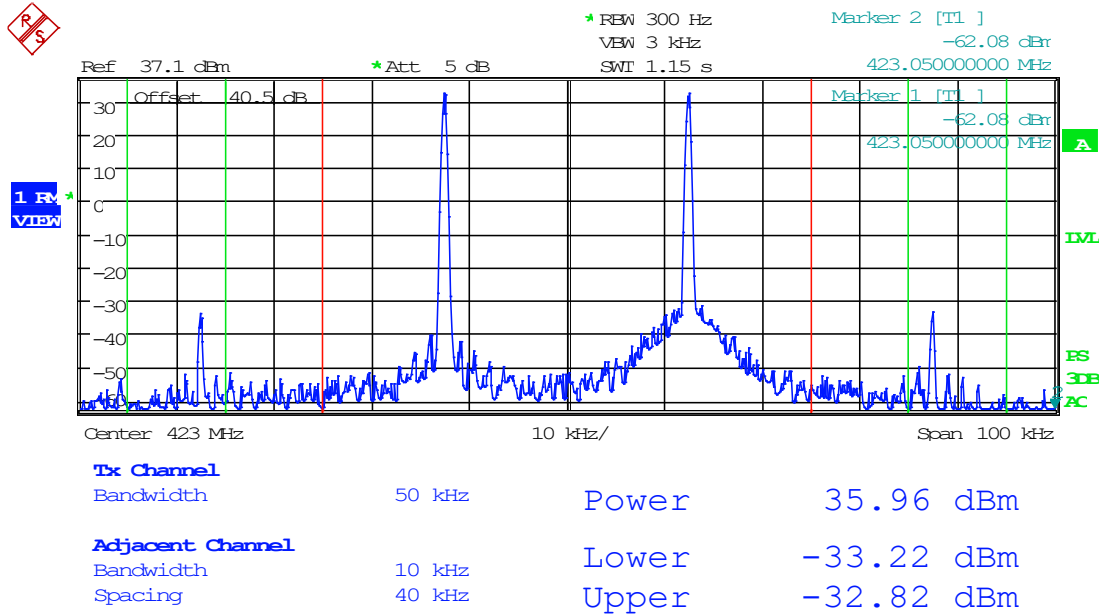
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8.7.22 Unit 2, 12.5 kHz Signal, Downlink, AGC+3dB, 423 MHz



Date: 9.FEB.2023 13:57:06

8.7.23 Unit 2, 25 kHz Signal, Downlink, AGC, 423 MHz

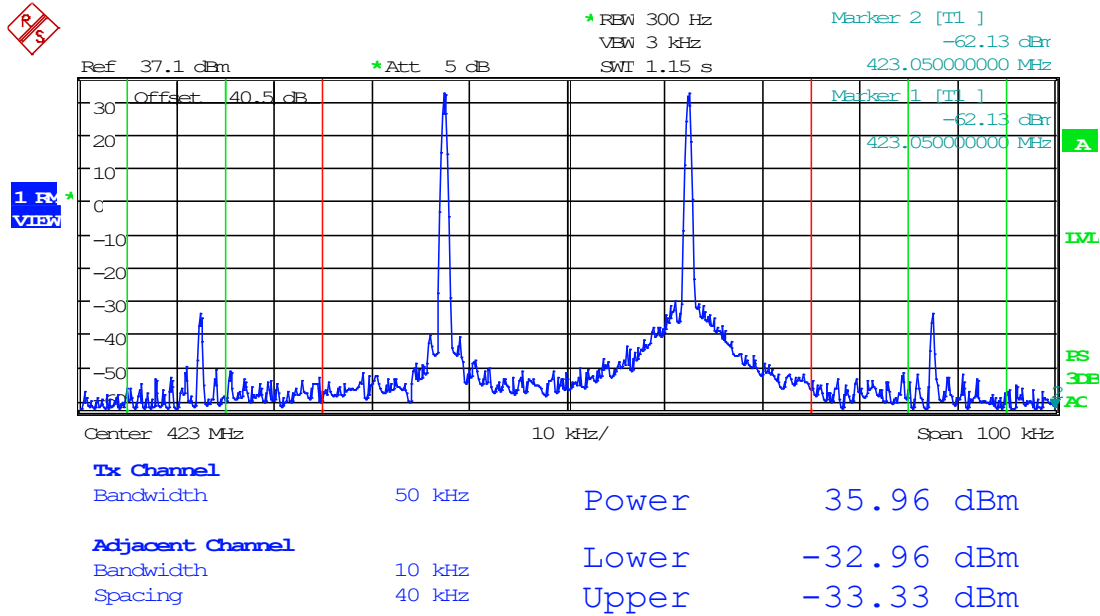


Date: 9.FEB.2023 13:49:37



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8.7.24 Unit 2, 25 kHz Signal, Downlink, AGC+3dB, 423 MHz



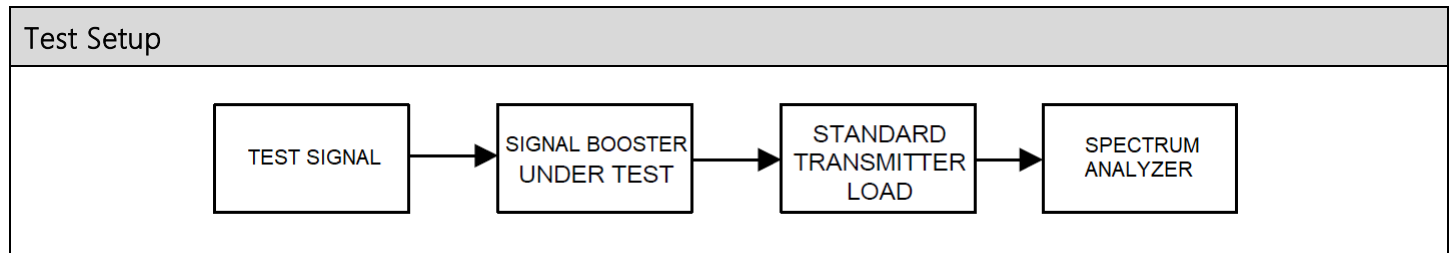
Date: 9.FEB.2023 13:51:37



8.8 Emission Mask, Out-of-Band

Referenced from test report "TR_6428-23_FCC_PT90_Booster Class B_1.docx".

Limits from FCC Parts 2.1051, 90.210 and test procedure from ANSI C63.26-2015 and FCC KDB 935210 D05 v01r04 Industrial Signal Boosters.

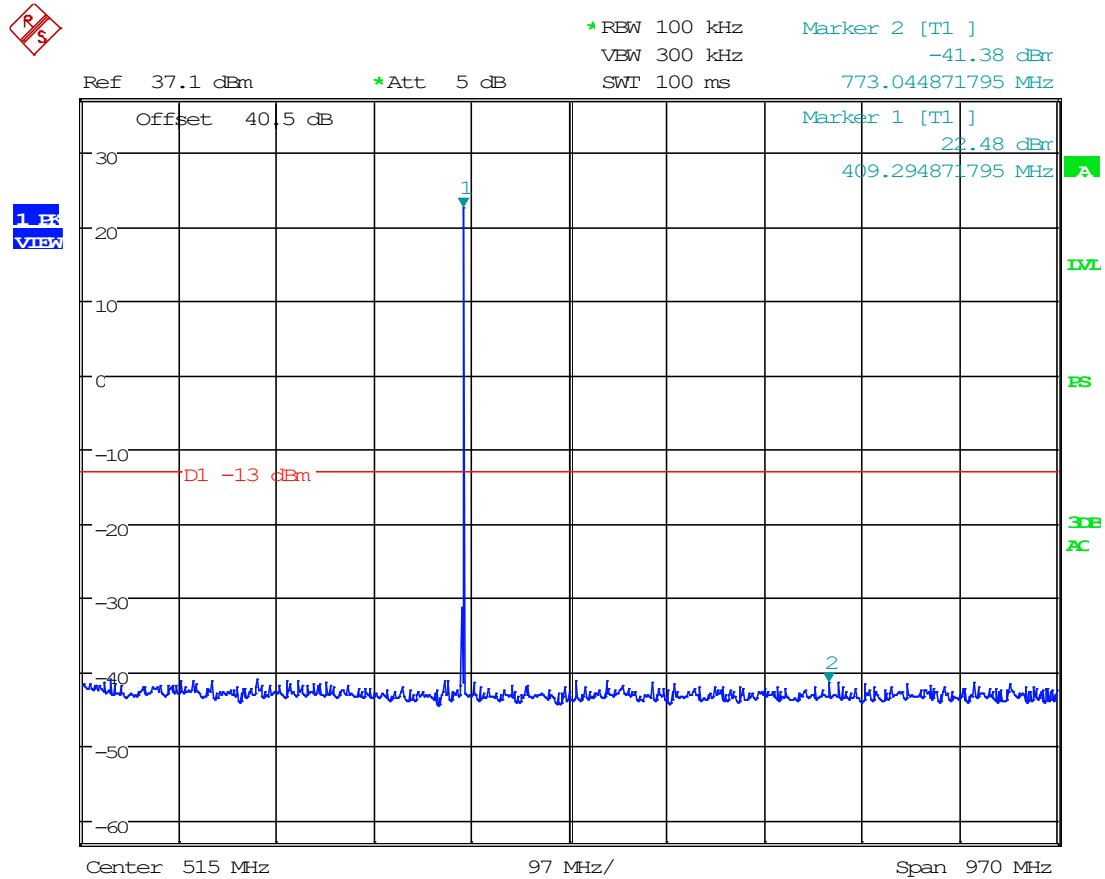


Note: Testing was done simultaneously on all combinations of Uplinks and Downlinks to address co-location of signals.



Conducted Emissions Spectrum Plots

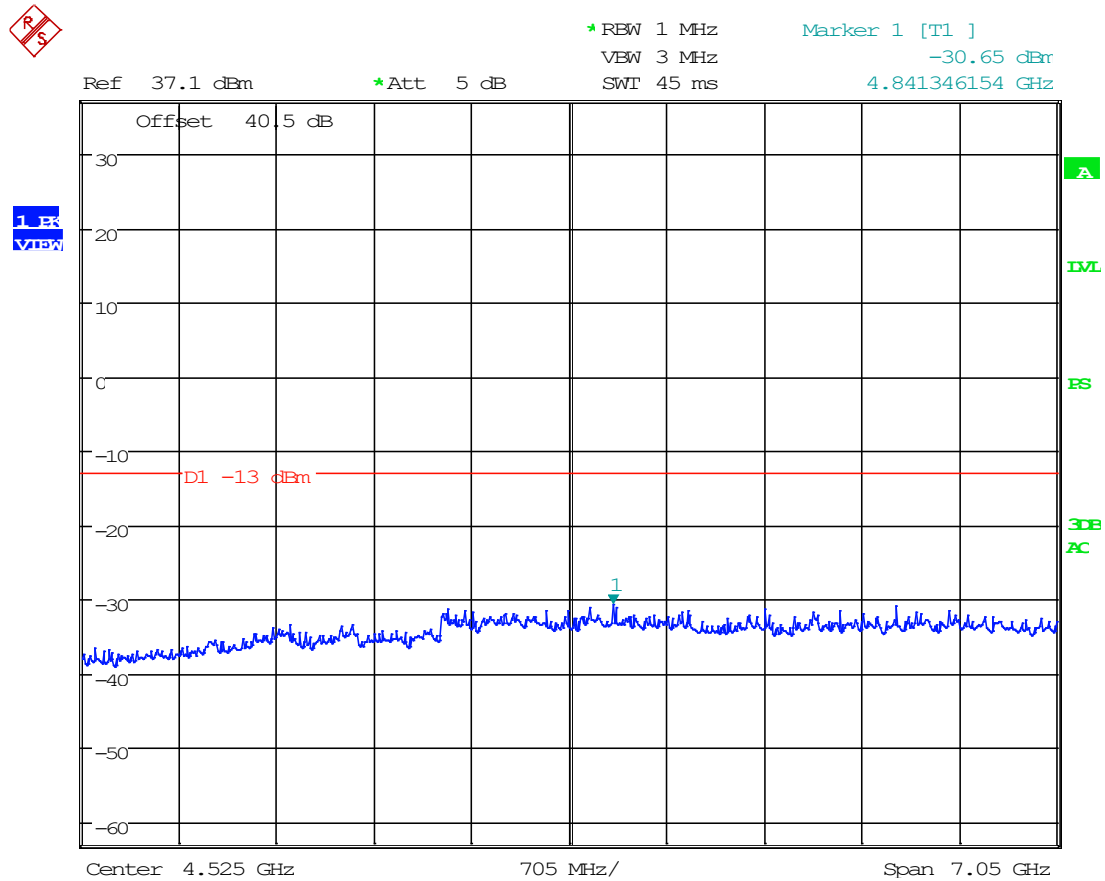
8.8.1 Unit 1, 30 MHz to 1 GHz, UL, 409 MHz



Date: 9.FEB.2023 16:07:54



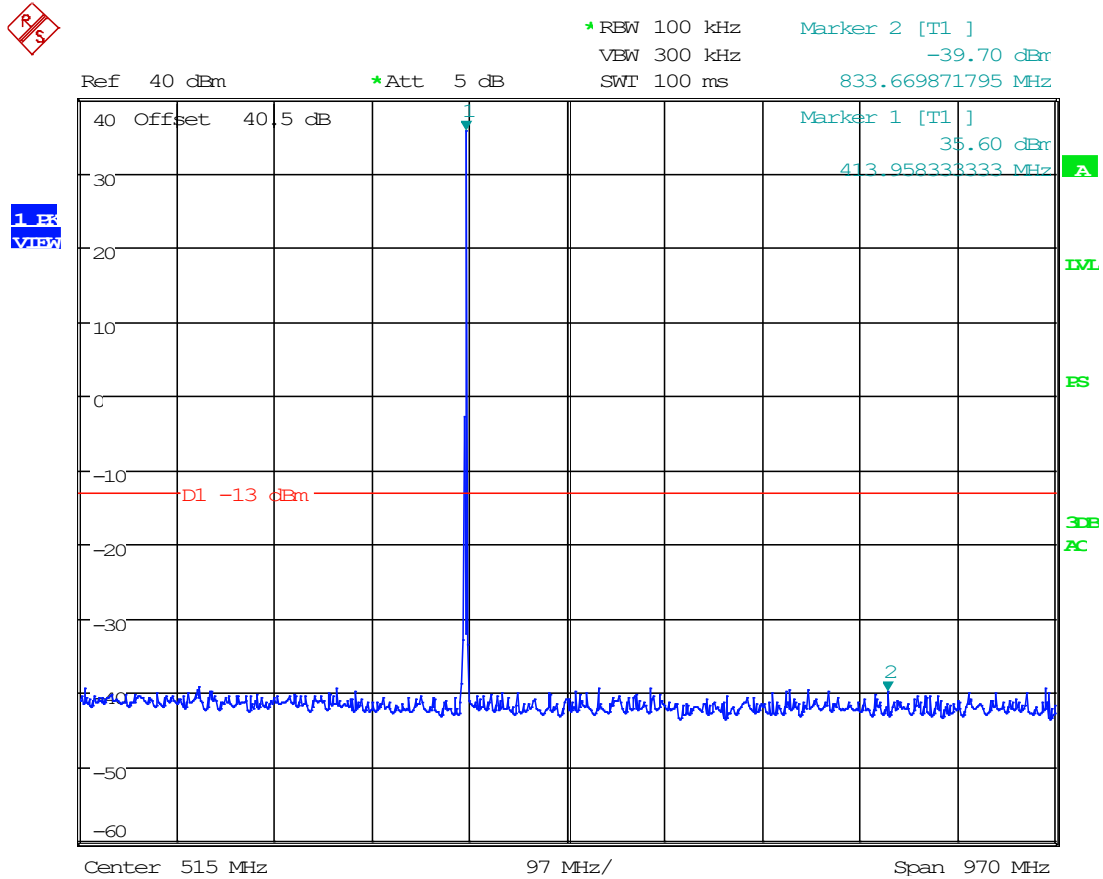
8.8.2 Unit 1, 1 GHz to 10th Harmonic, UL, 409 MHz



Date: 9.FEB.2023 16:09:01



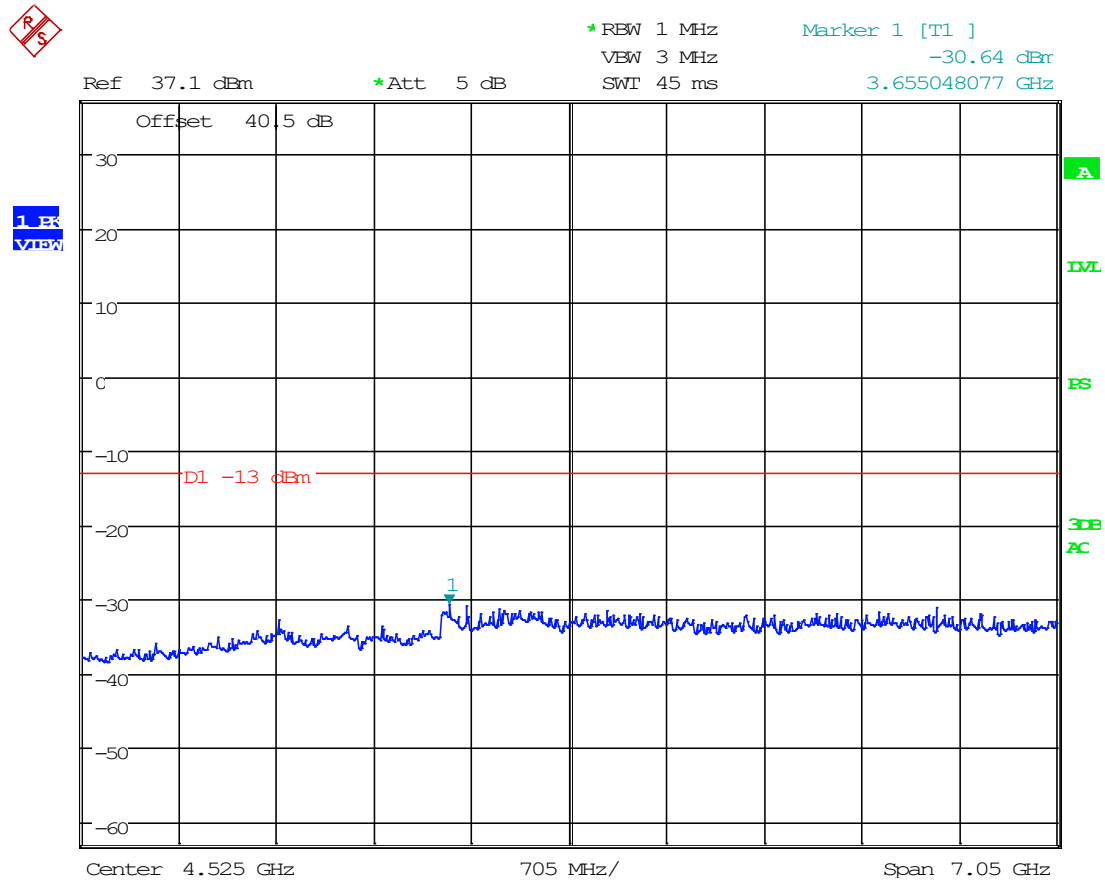
8.8.3 Unit 1, 30 MHz to 1 GHz, DL, 413.5 MHz



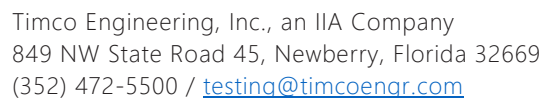
Date: 9.FEB.2023 16:00:11



8.8.4 Unit 1, 1 GHz to 10th Harmonic, DL, 413.5 MHz



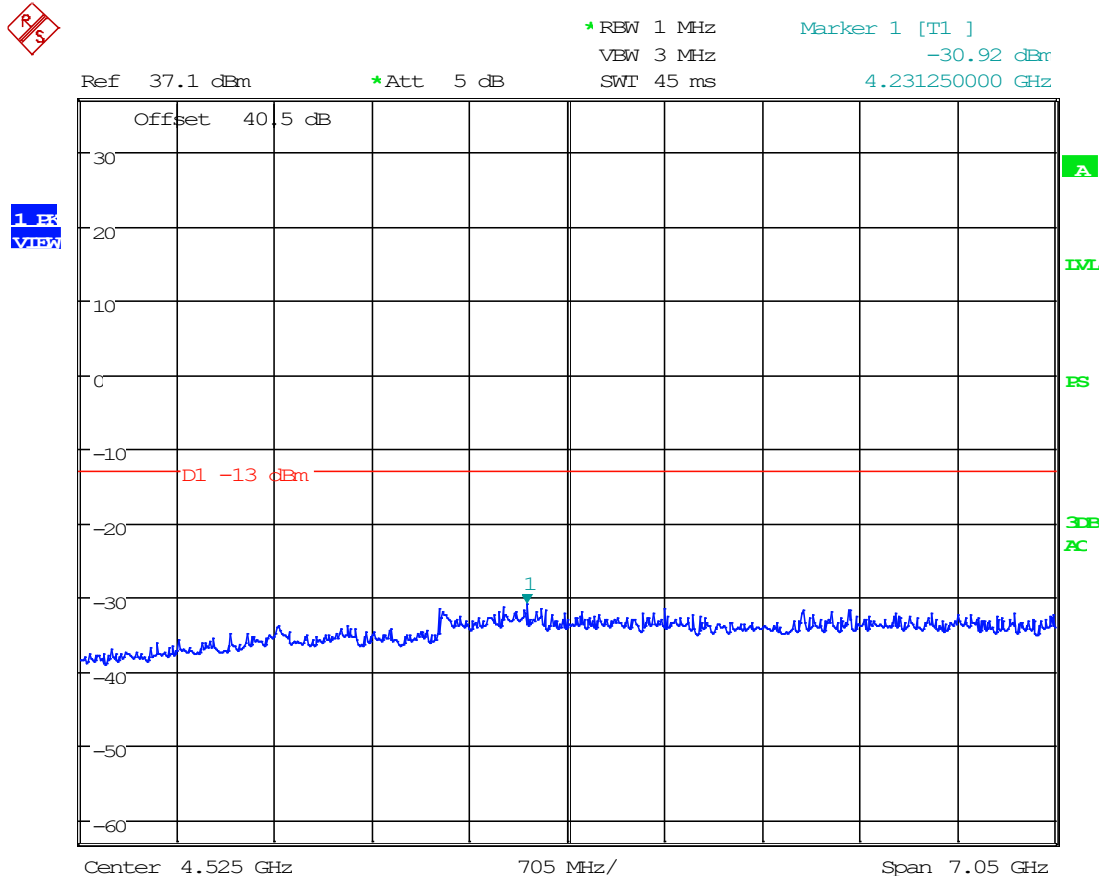
Date: 9.FEB.2023 16:04:36



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8.8.6 Unit 2, 1 GHz to 10th Harmonic, UL, 428 MHz

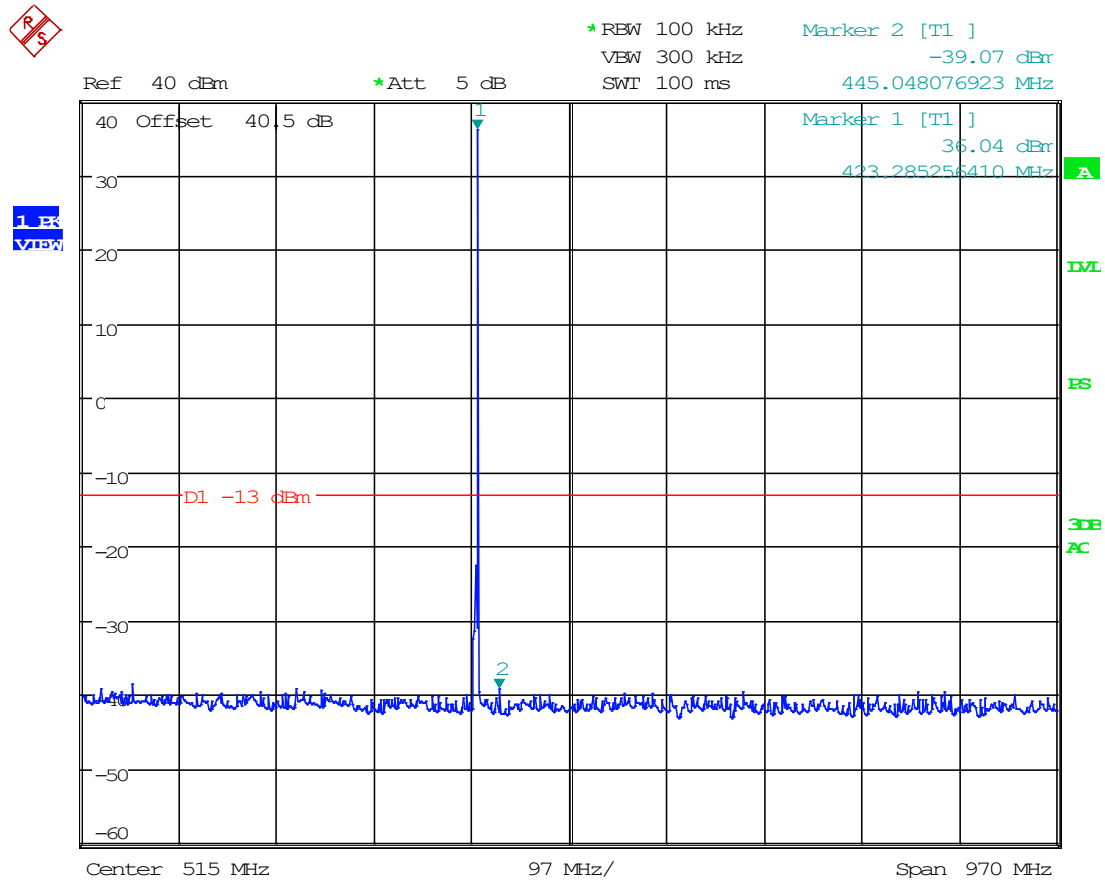


Date: 9.FEB.2023 16:10:35



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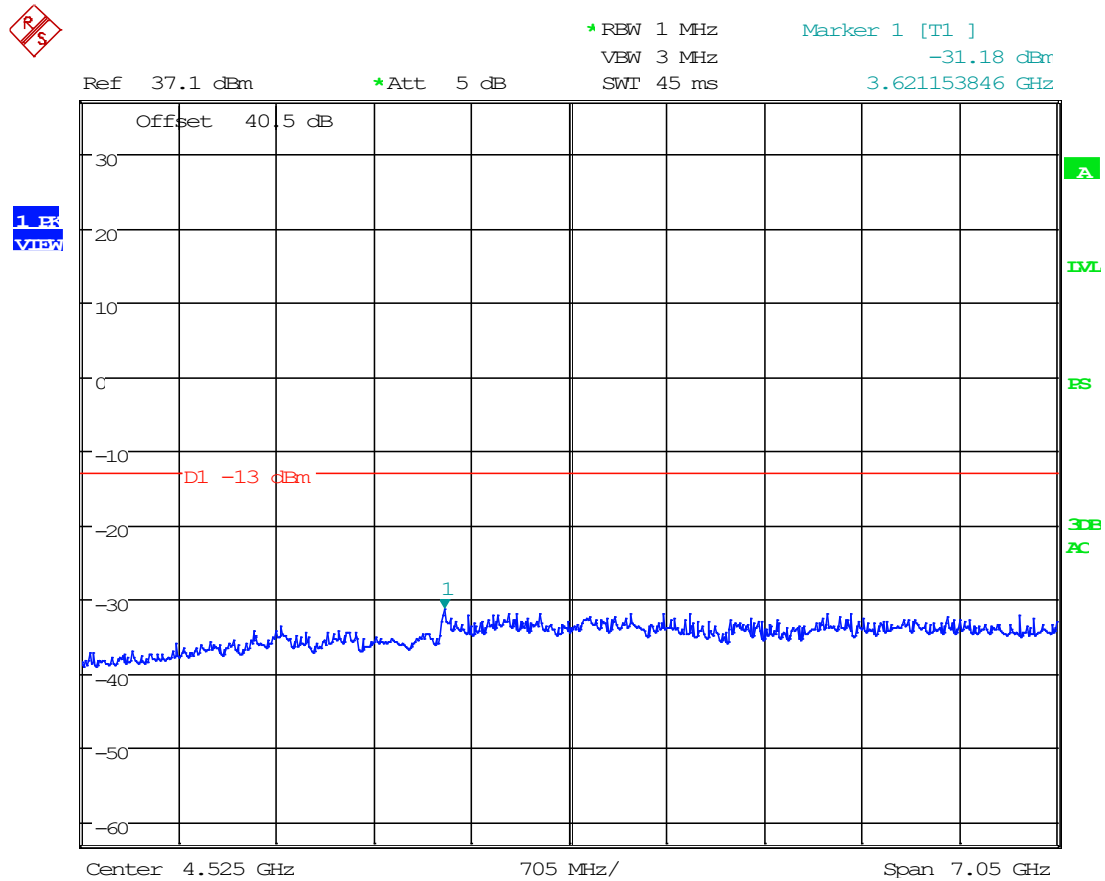
8.8.7 Unit 2, 30 MHz to 1 GHz, DL, 423 MHz



Date: 9.FEB.2023 16:14:17



8.8.8 Unit 2, 1 GHz to 10th Harmonic, DL, 423 MHz

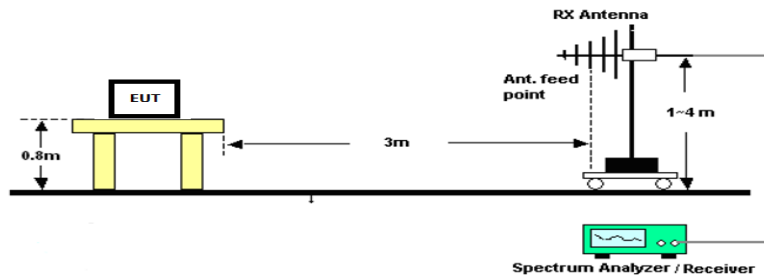


Date: 9.FEB.2023 16:18:29

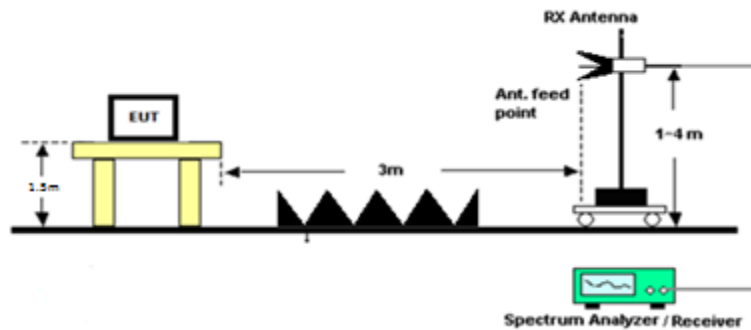
8.9 Spurious Radiated Emissions

Limits from FCC Parts 2.1053, 90.210 and test procedure from ANSI C63.26-2015 and FCC KDB 935210 D05 v01r04 Industrial Signal Boosters.

Radiated Test Setup, 30 – 1000 MHz



Radiated Test Setup, Above 1000 MHz





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Radiated Emissions, Tabular Data

8.9.1 Unit 1, Uplink, 409 MHz

Tuned Frequency (MHz)	Emission Frequency (MHz)	Detector	Meter Reading (dBuV)	Antenna Polarity	Coax Loss (dB)	Antenna Correction Factor (dB/m)	Distance (m)	Field Strength (dBuV/m)	ERP (dBm)	Spurious Limit (dBm)	Margin (dB)
409.00	818.00	PK	9.90	H	3.40	20.68	3.00	33.98	-63.40	-13.00	50.40
409.00	818.00	PK	9.80	V	3.40	20.68	3.00	33.88	-63.50	-13.00	50.50
409.00	1227.00	PK	9.70	H	4.04	28.25	3.00	41.99	-55.39	-13.00	42.39
409.00	1227.00	PK	9.20	V	4.04	28.25	3.00	41.49	-55.89	-13.00	42.89
409.00	1636.00	PK	10.60	H	4.71	28.46	3.00	43.77	-53.61	-13.00	40.61
409.00	1636.00	PK	10.70	V	4.71	28.46	3.00	43.87	-53.51	-13.00	40.51
409.00	2045.00	PK	11.00	H	5.27	31.01	3.00	47.28	-50.10	-13.00	37.10
409.00	2045.00	PK	11.10	V	5.27	31.01	3.00	47.38	-50.00	-13.00	37.00
409.00	2454.00	PK	12.00	H	5.61	31.87	3.00	49.49	-47.89	-13.00	34.89
409.00	2454.00	PK	11.90	V	5.61	31.87	3.00	49.39	-47.99	-13.00	34.99
409.00	2863.00	PK	12.10	H	6.20	32.29	3.00	50.59	-46.79	-13.00	33.79
409.00	2863.00	PK	13.00	V	6.20	32.29	3.00	51.49	-45.89	-13.00	32.89
409.00	3272.00	PK	13.90	H	6.68	32.66	3.00	53.23	-44.15	-13.00	31.15
409.00	3272.00	PK	14.30	V	6.68	32.66	3.00	53.63	-43.75	-13.00	30.75
409.00	3681.00	PK	13.70	H	6.62	33.19	3.00	53.52	-43.86	-13.00	30.86
409.00	3681.00	PK	14.10	V	6.62	33.19	3.00	53.92	-43.46	-13.00	30.46
409.00	4090.00	PK	13.70	H	7.13	33.40	3.00	54.23	-43.15	-13.00	30.15
409.00	4090.00	PK	13.20	V	7.13	33.40	3.00	53.73	-43.65	-13.00	30.65



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8.9.2 Unit 1, Downlink, 413.5 MHz

Tuned Frequency (MHz)	Emission Frequency (MHz)	Detector	Meter Reading (dBuV)	Antenna Polarity	Coax Loss (dB)	Antenna Correction Factor (dB/m)	Distance (m)	Field Strength (dBuV/m)	ERP (dBm)	Spurious Limit (dBm)	Margin (dB)
413.50	827.00	PK	10.00	H	3.40	20.98	3.00	34.38	-63.00	-13.00	50.00
413.50	827.00	PK	9.70	V	3.40	20.98	3.00	34.08	-63.30	-13.00	50.30
413.50	1240.50	PK	9.90	H	4.06	28.35	3.00	42.30	-55.07	-13.00	42.07
413.50	1240.50	PK	10.10	V	4.06	28.35	3.00	42.50	-54.87	-13.00	41.87
413.50	1654.00	PK	10.20	H	4.73	28.64	3.00	43.57	-53.80	-13.00	40.80
413.50	1654.00	PK	10.40	V	4.73	28.64	3.00	43.77	-53.60	-13.00	40.60
413.50	2067.50	PK	11.50	H	5.31	31.00	3.00	47.81	-49.57	-13.00	36.57
413.50	2067.50	PK	10.80	V	5.31	31.00	3.00	47.11	-50.27	-13.00	37.27
413.50	2481.00	PK	11.80	H	5.62	32.11	3.00	49.53	-47.85	-13.00	34.85
413.50	2481.00	PK	12.30	V	5.62	32.11	3.00	50.03	-47.35	-13.00	34.35
413.50	2894.50	PK	12.70	H	6.23	32.22	3.00	51.15	-46.23	-13.00	33.23
413.50	2894.50	PK	12.60	V	6.23	32.22	3.00	51.05	-46.33	-13.00	33.33
413.50	3308.00	PK	13.60	H	6.72	32.63	3.00	52.94	-44.44	-13.00	31.44
413.50	3308.00	PK	14.40	V	6.72	32.63	3.00	53.74	-43.64	-13.00	30.64
413.50	3721.50	PK	14.10	H	6.54	33.16	3.00	53.80	-43.58	-13.00	30.58
413.50	3721.50	PK	14.40	V	6.54	33.16	3.00	54.10	-43.28	-13.00	30.28
413.50	4135.00	PK	13.70	H	7.05	33.41	3.00	54.17	-43.21	-13.00	30.21
413.50	4135.00	PK	13.80	V	7.05	33.41	3.00	54.27	-43.11	-13.00	30.11



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Radiated Emissions, Tabular Data

8.9.3 Unit 2, Uplink, 428 MHz

Tuned Frequency (MHz)	Emission Frequency (MHz)	Detector	Meter Reading (dBuV)	Antenna Polarity	Coax Loss (dB)	Antenna Correction Factor (dB/m)	Distance (m)	Field Strength (dBuV/m)	ERP (dBm)	Spurious Limit (dBm)	Margin (dB)
428.00	856.00	PK	9.60	H	3.49	22.20	3.00	35.29	-62.09	-13.00	49.09
428.00	856.00	PK	9.70	V	3.49	22.20	3.00	35.39	-61.99	-13.00	48.99
428.00	1284.00	PK	10.30	H	4.14	28.59	3.00	43.04	-54.34	-13.00	41.34
428.00	1284.00	PK	10.60	V	4.14	28.59	3.00	43.34	-54.04	-13.00	41.04
428.00	1712.00	PK	10.40	H	4.80	29.23	3.00	44.43	-52.95	-13.00	39.95
428.00	1712.00	PK	10.30	V	4.80	29.23	3.00	44.33	-53.05	-13.00	40.05
428.00	2140.00	PK	11.60	H	5.36	31.20	3.00	48.16	-49.22	-13.00	36.22
428.00	2140.00	PK	11.50	V	5.36	31.20	3.00	48.06	-49.32	-13.00	36.32
428.00	2568.00	PK	12.10	H	5.72	32.54	3.00	50.36	-47.02	-13.00	34.02
428.00	2568.00	PK	12.00	V	5.72	32.54	3.00	50.26	-47.12	-13.00	34.12
428.00	2996.00	PK	13.20	H	6.32	32.51	3.00	52.03	-45.34	-13.00	32.34
428.00	2996.00	PK	13.00	V	6.32	32.51	3.00	51.83	-45.54	-13.00	32.54
428.00	3424.00	PK	13.10	H	6.84	32.62	3.00	52.57	-44.81	-13.00	31.81
428.00	3424.00	PK	13.50	V	6.84	32.62	3.00	52.97	-44.41	-13.00	31.41
428.00	3852.00	PK	15.60	H	6.60	33.20	3.00	55.40	-41.97	-13.00	28.97
428.00	3852.00	PK	15.90	V	6.60	33.20	3.00	55.70	-41.67	-13.00	28.67
428.00	4280.00	PK	14.20	H	7.36	33.41	3.00	54.97	-42.40	-13.00	29.40
428.00	4280.00	PK	14.10	V	7.36	33.41	3.00	54.87	-42.50	-13.00	29.50



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8.9.4 Unit 2, Downlink, 423 MHz

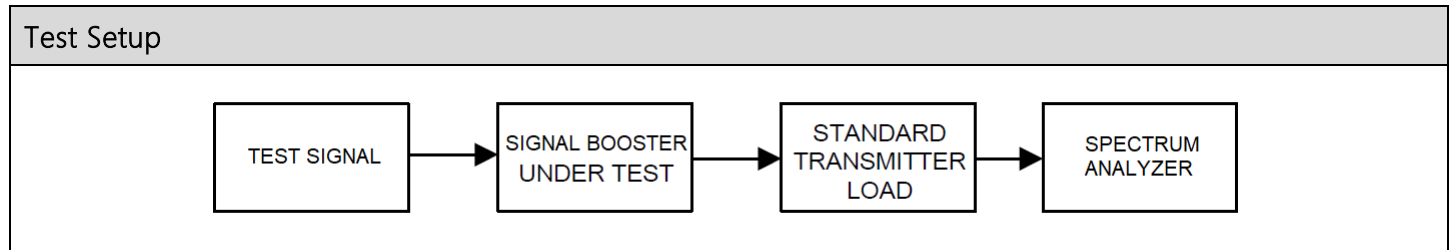
Tuned Frequency (MHz)	Emission Frequency (MHz)	Detector	Meter Reading (dBuV)	Antenna Polarity	Coax Loss (dB)	Antenna Correction Factor (dB/m)	Distance (m)	Field Strength (dBuV/m)	ERP (dBm)	Spurious Limit (dBm)	Margin (dB)
423.00	846.00	PK	9.30	H	3.47	22.10	3.00	34.87	-62.50	-13.00	49.50
423.00	846.00	PK	9.20	V	3.47	22.10	3.00	34.77	-62.60	-13.00	49.60
423.00	1269.00	PK	10.20	H	4.11	28.52	3.00	42.83	-54.55	-13.00	41.55
423.00	1269.00	PK	9.60	V	4.11	28.52	3.00	42.23	-55.15	-13.00	42.15
423.00	1692.00	PK	11.20	H	4.77	29.00	3.00	44.97	-52.41	-13.00	39.41
423.00	1692.00	PK	11.10	V	4.77	29.00	3.00	44.87	-52.51	-13.00	39.51
423.00	2115.00	PK	11.30	H	5.35	31.10	3.00	47.75	-49.63	-13.00	36.63
423.00	2115.00	PK	11.70	V	5.35	31.10	3.00	48.15	-49.23	-13.00	36.23
423.00	2538.00	PK	12.20	H	5.68	32.53	3.00	50.41	-46.97	-13.00	33.97
423.00	2538.00	PK	12.30	V	5.68	32.53	3.00	50.51	-46.87	-13.00	33.87
423.00	2961.00	PK	12.90	H	6.30	32.38	3.00	51.57	-45.80	-13.00	32.80
423.00	2961.00	PK	13.30	V	6.30	32.38	3.00	51.97	-45.40	-13.00	32.40
423.00	3384.00	PK	13.70	H	6.75	32.65	3.00	53.10	-44.28	-13.00	31.28
423.00	3384.00	PK	14.00	V	6.75	32.65	3.00	53.40	-43.98	-13.00	30.98
423.00	3807.00	PK	15.10	H	6.38	33.15	3.00	54.63	-42.75	-13.00	29.75
423.00	3807.00	PK	15.30	V	6.38	33.15	3.00	54.83	-42.55	-13.00	29.55
423.00	4230.00	PK	14.00	H	7.10	33.33	3.00	54.43	-42.95	-13.00	29.95
423.00	4230.00	PK	13.90	V	7.10	33.33	3.00	54.33	-43.05	-13.00	30.05



8.10 Modulation Characteristics

Referenced from test report "TR_6428-23_FCC_PT90_Booster Class B_1.docx".

Limits from FCC Parts 2.1047, and test procedure from ANSI C63.26-2015.

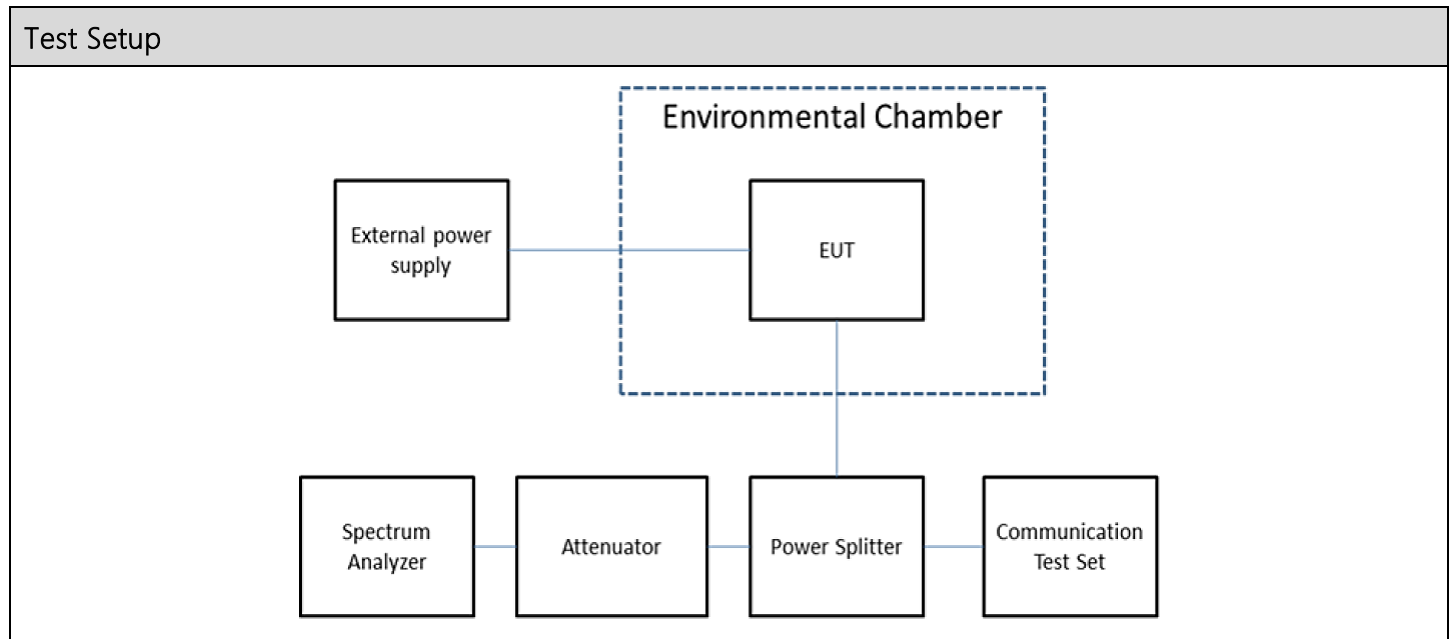


N/A. The EUT does not have any means to modulate the incoming signal.

8.11 Frequency Stability

Referenced from test report "TR_6428-23_FCC_PT90_Booster Class B_1.docx".

Limits from FCC Parts 2.1055, 90.213 (a); and test procedure from ANSI C63.26-2015 and FCC KDB 935210 D05 v01r04 Industrial Signal Boosters.



Test Results, Mode 1		
Tuned Frequency (MHz)	Max Deviation (kHz)	Limit (ppm)
n/a	n/a	n/a

N/A. The EUT does not alter the input signal in any way.



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8.12 Transient Frequency Behavior

Referenced from test report "TR_6428-23_FCC_PT90_Booster Class B_1.docx".

Limits from FCC Part 90.214; and test procedure from ANSI C63.26-2015.

N/A. The EUT does not "key-on" or "key off", and instead transmits indefinitely.



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8.13 Adjacent channel power limits

Referenced from test report "TR_6428-23_FCC_PT90_Booster Class B_1.docx".

Limits from FCC Part 90.221, and test procedure from ANSI C63.26-2015.

N/A. Device does not operate in a band requiring ACP measurement.



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9. ANNEX-A - Photographs of the EUT

Photographs of the EUT and any manufacturer supplied accessories to be used with the EUT are in separate supplementary documents labelled EXTERNAL PHOTOS and INTERNAL PHOTOS.

10. ANNEX-B – Test Setup Photographs

Test setup photographs are located in a separate supplementary ANNEX-B document.

11. History of Test Report Changes

Test Report #	Revision #	Description	Date of Issue
TR_6432-23_FCC 90_Booster Class A_	1	Initial release	2/14/2023



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END OF TEST REPORT
