Excellence in Compliance Testing

Certification Test Report

FCC ID: SDBFLEXI210
IC: 2220A-FLEXI210
FCC Rule Part: CFR 47 Part 24 Subpart D, Part 101 Subpart C
IC Radio Standards Specification: RSS 119, RSS 134

ACS Report Number: 15-2011.W06.1A

Applicant: Sensus Metering Systems, Inc.
Model: FLEXI210

Test Begin Date: March 11, 2015
Test End Date: March 26, 2015

Report Issue Date: April 9, 2015

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

For The Scope of Accreditation Under Certificate Number AT-1533

This report must not be used by the client to claim product certification, approval, or endorsement by ANAB, ANSI, or any agency of the Federal Government.

Project Manager:

Thierry Jean-Charles
EMC Engineer
Advanced Compliance Solutions, Inc.

Reviewed by:

Kirby Munroe
Director, Wireless Certifications
Advanced Compliance Solutions, Inc.

This test report shall not be reproduced except in full. This report may be reproduced in part with prior written consent of ACS, Inc. The results contained in this report are representative of the sample(s) submitted for evaluation.

This report contains 69 pages

Table of Content

1.0 GENERAL ---- 3

1.1 PURPOSE ---- 3
1.2 PRODUCT DESCRIPTION ---- 3
1.3 TEST METHODOLOGY ---- 3
1.4 EMISSION DESIGNATORS ---- 5

2.0 TEST FACILITIES ---- 6

2.1 LOCATION ---- 6
2.2 LABORATORY ACCREDITATIONS/RECOGNITIONS/CERTIFICATIONS ---- 6
2.3 RADIATED & CONDUCTED EMISSIONS TEST SITE DESCRIPTION ---- 7

3.0 APPLICABLE STANDARD REFERENCES ---- 9

4.0 LIST OF TEST EQUIPMENT ---- 10

5.0 SUPPORT EQUIPMENT ---- 11

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM ---- 11

7.0 SUMMARY OF TESTS ---- 12

7.1 RF POWER OUTPUT ---- 12
7.2 OCCUPIED BANDWIDTH ---- 18
7.3 SPURIOUS EMISSIONS AT ANTENNA TERMINALS ---- 51
7.4 FIELD STRENGTH OF SPURIOUS EMISSIONS ---- 60
7.5 FREQUENCY STABILITY ---- 65

8.0 CONCLUSION ---- 69

1.0 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 2 Subpart J, Part 24 Subpart D and Part 101 Subpart C of the FCC's Code of Federal Regulations, and Industry Canada Radio Standards Specifications RSS-119 and RSS-134 for a modular approval.

1.2 Product Description

The FLEXI210 transceiver is a standard FlexNet protocol with FEM controlled output capable of 1W nominal conducted output power. The modular design enables GE and Sensus to locate the transceiver in several standard S form meters retailed to Utilities through GE and Sensus.

Manufacturer Information:
Sensus Metering Systems, Inc.
639 Davis Drive
Morrisville, NC 27560

Test Sample Serial Numbers: 1011 (RF Conducted Measurements), 1021 (Radiated Emission Measurements)

Test Sample Condition: The EUT was in good functional condition with no physical damages.

1.3 Test Methodology

1.3.1 Configurations and Justification

The EUT was evaluated for radiated and RF conducted measurements for all modulations formats. Where applicable, data is provided for the worst case.

The unit is designed to be integrated within specific hosts. The EUT was powered using an external power source providing 4 VDC for the basic operation of the radio and an additional 23 VDC for continuous transmission. The RF conducted measurements were performed for the EUT configured with a temporary SMA connector at the antenna port. The radiated emission evaluation was performed for the EUT set in the orientation of typical installation up to the 10^{th} harmonic of the fundamental frequency.

The evaluation for unintentional emission is documented separately in a verification report.

1.3.2 In-Band Testing Methodology

The EUT is designed to operate in multiple bands under the requirements of CFR 47 Parts 24 and 101. The following is a list of the frequency bands of operation sorted based on the FCC rule parts in which the band is associated.

CFR Title 47 Rule Part	Frequency Band of Operation (MHz)
24D	901.0 - 902.0
24D	930.0 - 931.0
24D	940.0 - 941.0
101	928.85 - 929.0
101	932.0 - 932.5
101	941.0 - 941.5
101	952.0 – 953.0
101	959.85 - 960.0

Based on the requirements set forth in accordance 47 CFR 2.1046-2.1057 as stated above, the methodology in selecting the places to test in the available bands of operation is outlined in the following table.

CFR Title 47 Rule Part	Frequency Band of Operation (MHz)	Location in the Range of Operation	Approx. Test Freq.
24D	901.0 - 902.0	Middle	901.5000
101	928.85 - 929.0	Middle	928.9250
24D	930.0 - 931.0	Middle	930.5000
101	932.0 - 932.5	Middle	932.2500
24D	940.0 - 941.0	1 near top and 1 near bottom	940.0125
101	941.0 - 941.5		941.4875
101	952.0 – 953.0	Middle	952.5000
101	959.85 – 960.0	Middle	959.9250

1.4 Emission Designators

The FLEXI210 transmitter produces six distinct modulation formats. The emission designators for the modulation types used by the FLEXI210 transmitter calculated using the baud rate defined in the Theory of Operation are as follows

EMISSIONS DESIGNATORS:

Normal Mode: 9K60F2D (7-FSK)
Double Density Mode: 9K60F2D (13-FSK)
C&I Mode (Half-Baud): 4K80F2D (7-FSK)
Priority Mode: 4K80F2D (13-FSK)
MPass Mode (5 kbps): 5K90F1D (2-GFSK)
MPass Mode (10 kbps): 11K8F1D (2-GFSK)

2.0 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions, Inc.
3998 FAU Blvd, Suite 310
Boca Raton, Florida 33431
Phone: (561) 961-5585
Fax: (561) 961-5587
www.acstestlab.com

FCC Test Firm Registration #: 475089
Industry Canada Lab Code: 4175C

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS, Boca Raton, Florida, is accredited to ISO/IEC 17025 by ANSI-ASQ National Accreditation Board under their ANAB program and has been issued certificate number AT-1533 in recognition of this accreditation.

2.3 Radiated & Conducted Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The EMC radiated test facility consists of an RF-shielded enclosure. The interior dimensions of the indoor semi-anechoic chamber are approximately 48 feet (14.6 m) long by 36 feet (10.8 m) wide by 24 feet (7.3 m) high and consist of rigid, 1/8 inch (0.32 cm) steel-clad, wood core modular panels with steel framing. In the shielded enclosure, the faces of the panels are galvanized and the chamber is self-supporting. 8-foot RF absorbing cones are installed on 4 walls and the ceiling. The steel-clad ground plane is covered with vinyl floor.

The turntable is driven by pneumatic motor, which is capable of supporting a 2000 lb. load. The turntable is flushed with the chamber floor which it is connected to, around its circumference, with metallic loaded springs. An EMCO Model 1051 Multi-device Controller controls the turntable position.

A pneumatic motor is used to control antenna polarizations and height relative to the ground. The height information is displayed on the control unit EMCO Model 1050.

The control room is an RF shielded enclosure attached to the semi-anechoic chamber with two bulkhead panels for connecting RF, and control cables. The dimension of the room is 7.3 m x 4.9 m x 3 m high and the entrance doors of both control and conducted rooms are 3 feet (0.91 m) by 7 feet (2.13 m).

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3.1-1 below:

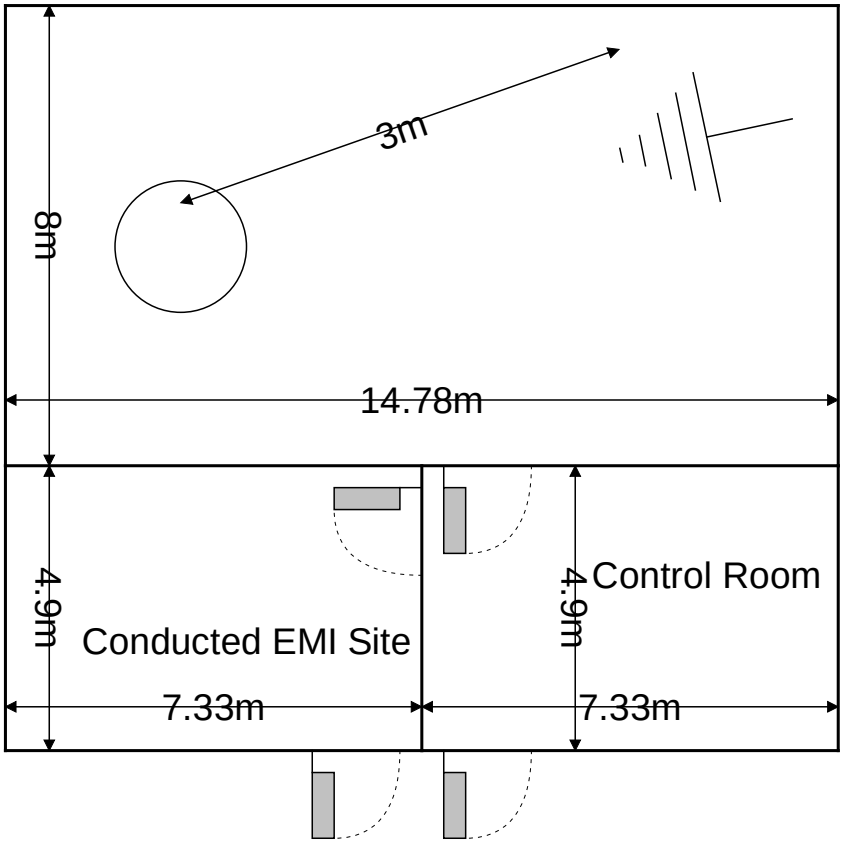


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

2.3.2 Conducted Emissions Test Site Description

The dimensions of the shielded conducted room are 7.3 x 4.9 x 3 m^3. As per ANSI C63.4 2003 requirements, the data were taken using two LISNs; a Solar Model 8028-50 50 Ω/50 µH and an EMCO Model 3825, which are installed as shown in Photograph 3. For evaluations requiring 220 V, 50 Hz, a Polarad LISN (S/N 879341/048) is used in conjunction with a 1 kVA, 50 Hz/220 V EDGAR variable frequency generator, Model 1001B, to filter conducted noise from the generator.

A diagram of the room is shown below in figure 2.3.2-1:

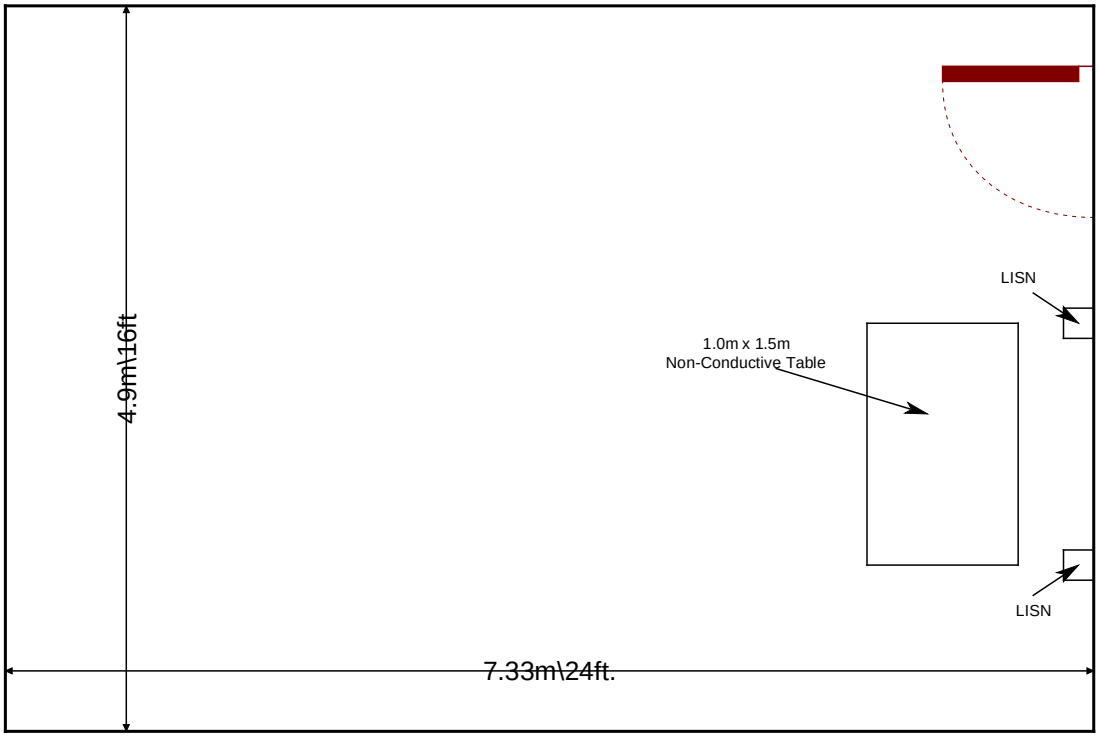


Figure 2.3.2-1: AC Mains Conducted EMI Site

3.0 APPLICABLE STANDARD REFERENCES

The following standards were used:

1 - ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9 kHz to 40GHz - 2003
2 - US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures - 2015
3 - US Code of Federal Regulations (CFR): Title 47, Part 24, Subpart D: Personal Communications Services – 2015
4 - US Code of Federal Regulations (CFR): Title 47, Part 101, Subpart C: Fixed Microwave Services - 2015
5 – TIA-603-C: Land Mobile FM or PM - Communications Equipment - Measurement and Performance Standards – 2004
6 – Industry Canada Radio Standards Specification: RSS-119 - Radio Transmitters and Receivers Operating in the Land Mobile and Fixed Services in the Frequency Range 27.41-960 MHz, Issue 11, June 2011
7 – Industry Canada Radio Standards Specification: RSS-134 - 900 MHz Narrow Band Personal Communication Service, Issue 1, March 2000
8 – Industry Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 4, November 2014.

4.0 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
430	RF Cables	SMS-290AW-480-SMS	Cables	N/A	3/20/2014	3/20/2015
430	RF Cables	SMS-290AW-480-SMS	Cables	N/A	3/18/2015	3/18/2016
523	Agilent	E7405	Spectrum Analyzers	MY45103293	12/26/2014	12/26/2016
2002	EMCO	3108	Antennas	2147	11/22/2013	11/22/2015
2004	EMCO	3146	Antennas	1385	11/22/2013	11/22/2015
2006	EMCO	3115	Antennas	2573	4/24/2013	4/24/2015
2007	EMCO	3115	Antennas	2419	1/27/2014	1/27/2016
2011	Hewlett-Packard	HP 8447D	Amplifiers	2443A03952	12/31/2014	12/31/2015
2037	ACS Boca	Chamber EMI Cable Set	Cable Set	2037	2/17/2015	2/17/2016
2071	Trilithic, Inc.	4HC1400-1-KK	Filter	9643263	12/31/2014	12/31/2015
2078	ACS Boca	Substitution Cable Set	Cable Set	2078	1/15/2015	1/15/2016
2089	Agilent Technologies, Inc.	83017A	Amplifiers	3123A00214	12/12/2014	12/12/2015
RE563	Hewlett Packard	8673D	Signal Generators	3034A01078	3/21/2013	3/21/2015
RE563	Hewlett Packard	8673D	Signal Generators	3034A01078	4/2/2015	4/2/2016
2075	Hewlett Packard	8495B	Attenuators	2626A11012	1/1/2015	1/1/2016
2102	Test Equity	115	Environmental Chamber	150892	3/28/2014	3/28/2015
2102	Test Equity	115	Environmental Chamber	150892	3/13/2015	3/13/2016
2108	Fluke	115	Digital MultiMeter	99211160	3/31/2014	3/31/2015
2112	Teledyne	921-0101-036	Cables	12-06-698	12/31/2014	12/31/2015
RE578	MPJA	HY5003	Power Supplies	3700278	NCR	NCR
RE597	BK Precision	1692	Power Supplies	S940035931	NCR	NCR
RE619	Rhode & Schwarz	ESU	Spectrum Analyzers	1302.6005K26 Ser. 100190	11/5/2014	11/5/2016

Notes:

- **NCR=No Calibration Required**
- **The assets calibration cycle information is provided to cover the entire test period.**
- **Asset RE563 was used only during the active period of the calibration cycle.**

5.0 SUPPORT EQUIPMENT

Table 5-1: EUT and Support Equipment

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Sensus Metering Systems, Inc.	GE-I210 (FLEXI210)	1011, 1021
2	DC Power Supply	Lambda	LPD-422A-FM	A82600

Table 5-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	2 Wire Power Leads	1.83m	No	DC power supply to EUT
B	2 Wire Power Leads	1.8 m	No	DC power supply to EUT
C	Power Cord	1.5 m	No	DC power supply to AC Mains

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

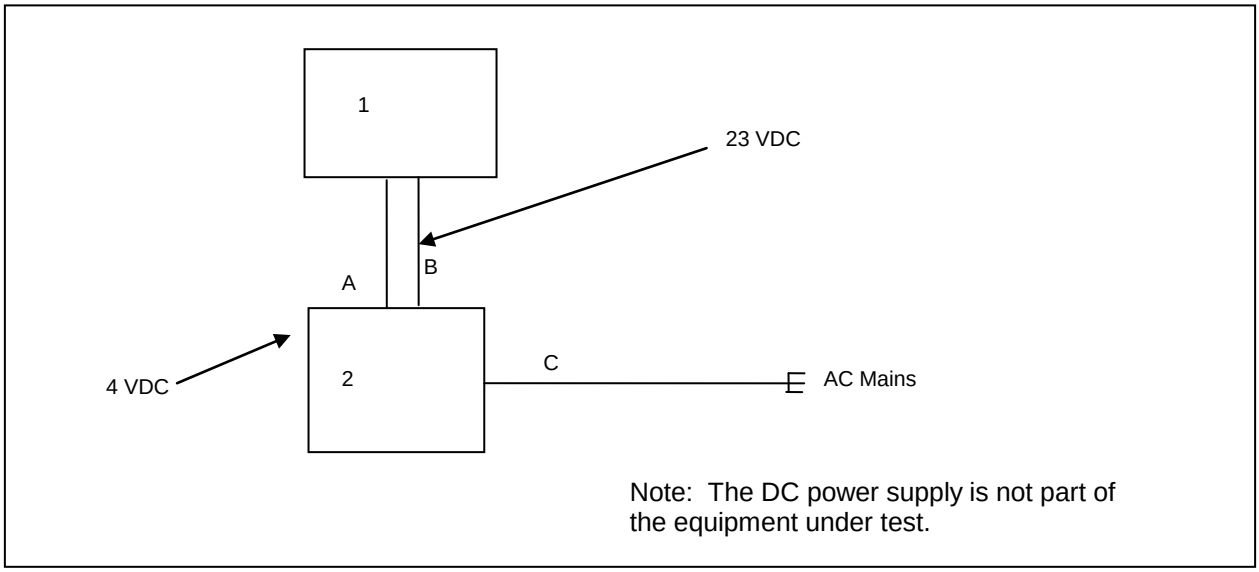


Figure 6-1: EUT Test Setup

7.0 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

Table 7-1: Test Results Summary

Test Parameter	Test Summary
RF Power Output	Pass
Occupied Bandwidth (Emissions Limits)	Pass
Spurious Emissions at Antenna Terminals	Pass
Field Strength of Spurious Emissions	Pass
Frequency Stability	Pass

7.1 RF Power Output

7.1.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer through a 30 dB passive attenuator. The resolution and video bandwidths of the spectrum analyzer were set at sufficient levels, >> signal bandwidth, to produce accurate results. The internal correction factors of the spectrum analyzer were employed to correct for any cable or attenuator losses. Results are shown below.

7.1.2 Measurement Results

Table 7.1.2-1: Peak Output Power

Frequency (MHz)	FCC Rule Part	Output Power (dBm)
901.5000	24D	31.21
930.5000	24D	30.87
940.0125	24D	30.70
928.9250	101	30.58
932.2500	101	30.77
941.4875	101	30.59
952.5000	101	30.48
959.9250	101	30.19

Part 24.132 / RSS-134 5.4(a)

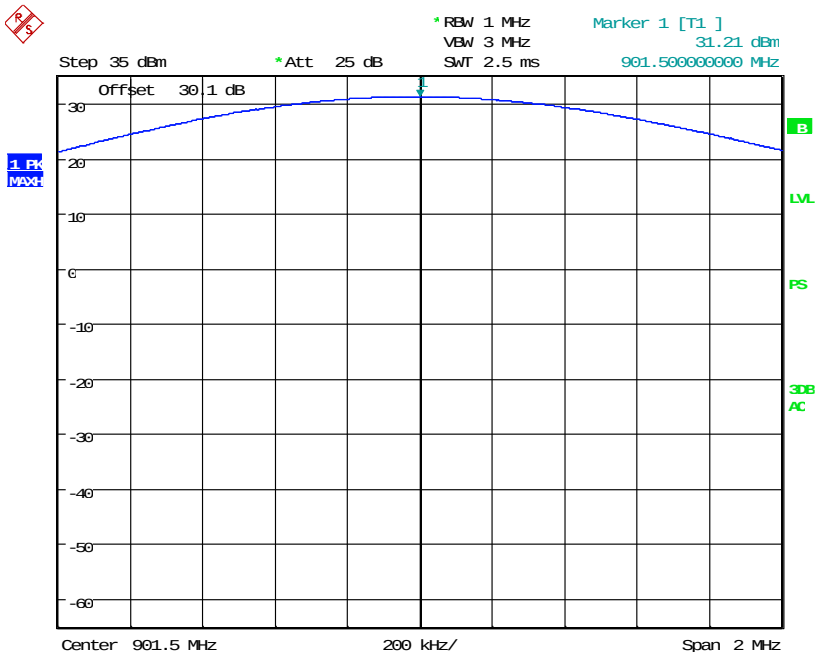


Figure 7.1.2-1: Peak Output Power 901.5 MHz

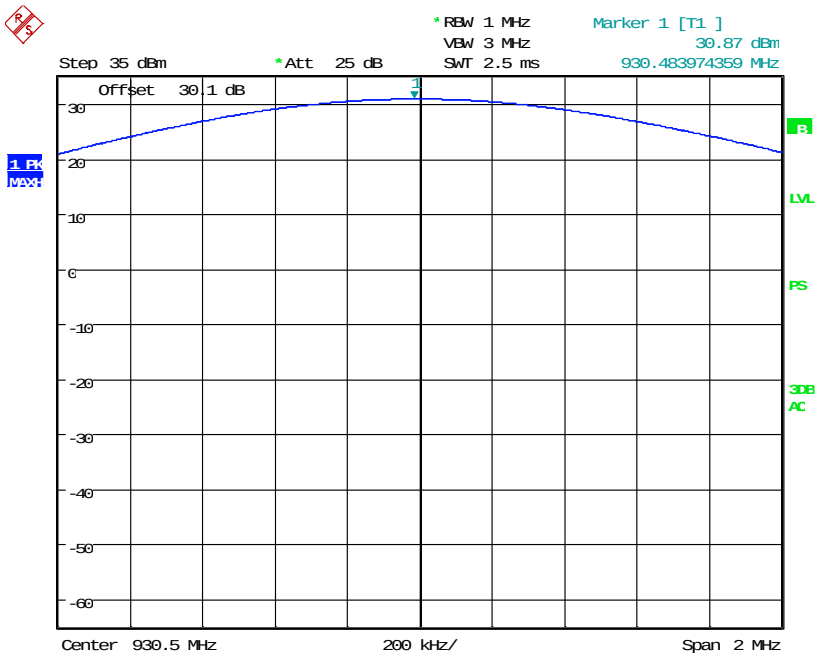


Figure 7.1.2-2: Peak Output Power 930.5 MHz

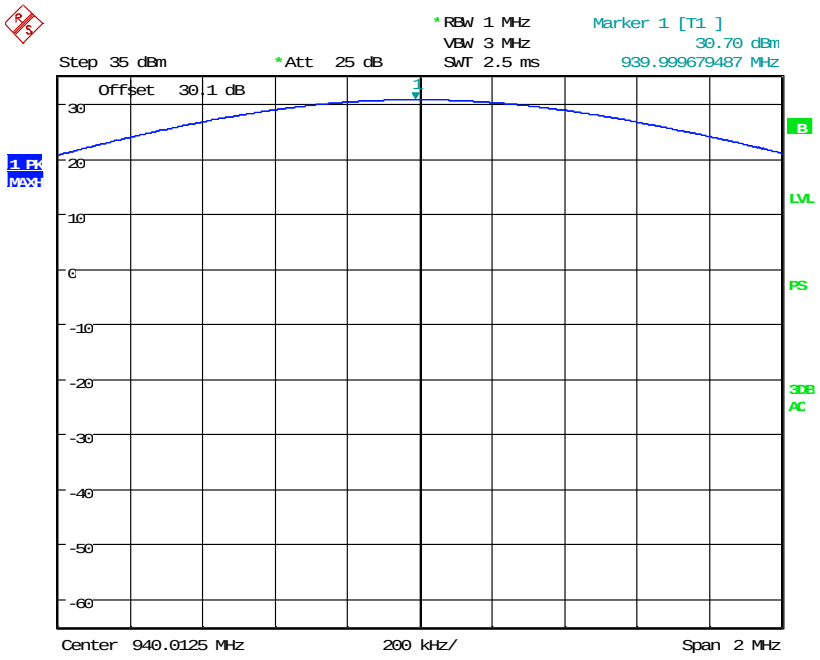


Figure 7.1.2-3: Peak Output Power 940.0125 MHz

Part 101.113(a) / RSS-119 5.41

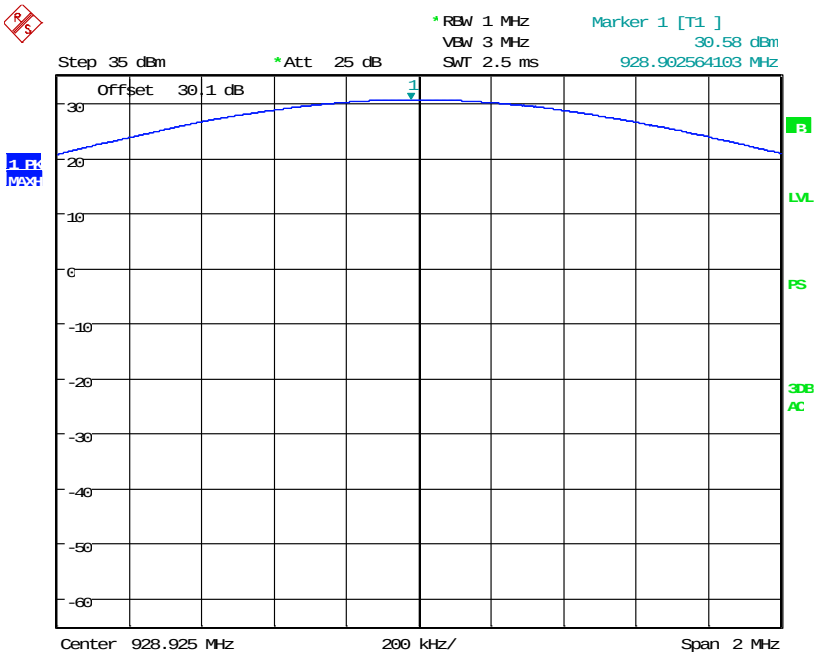


Figure 7.1.2-4: Peak Output Power 928.925 MHz

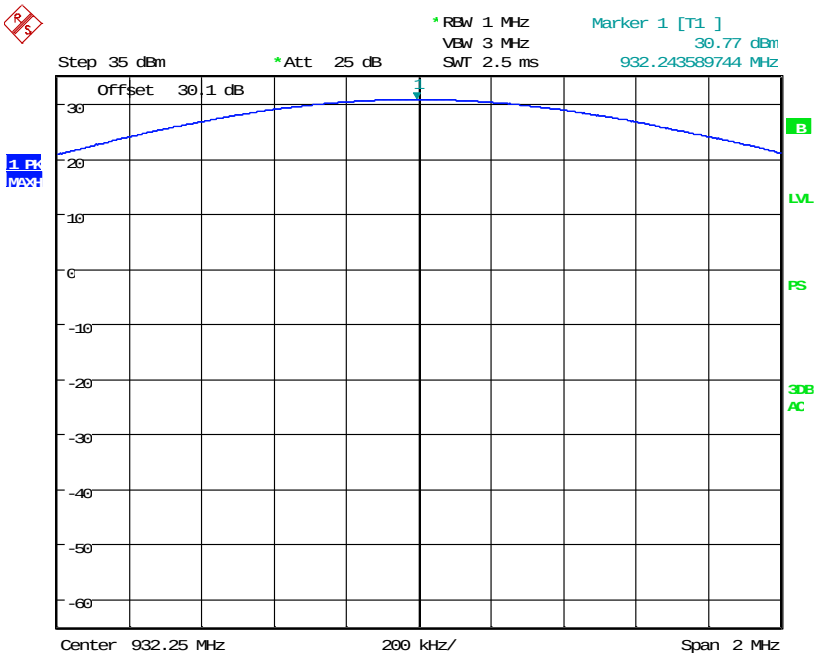
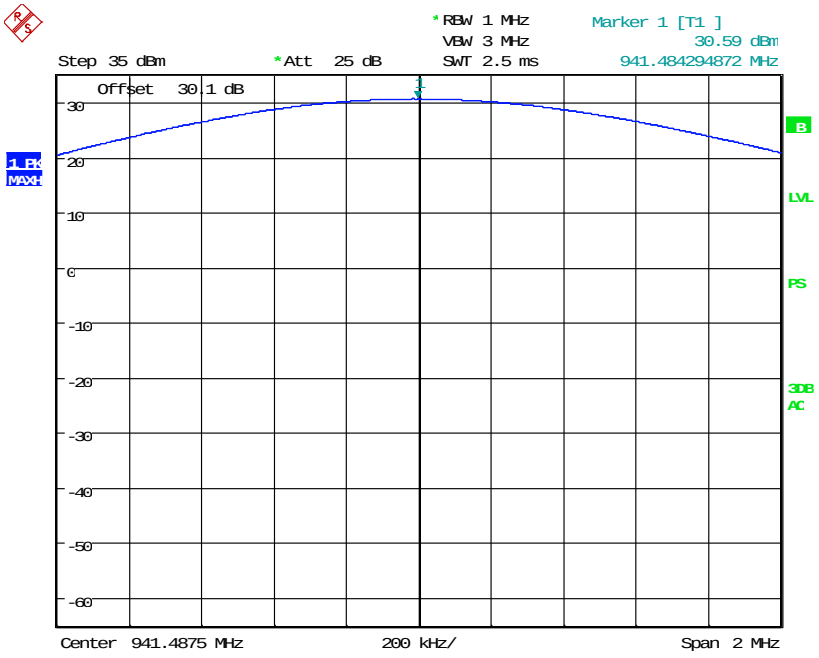
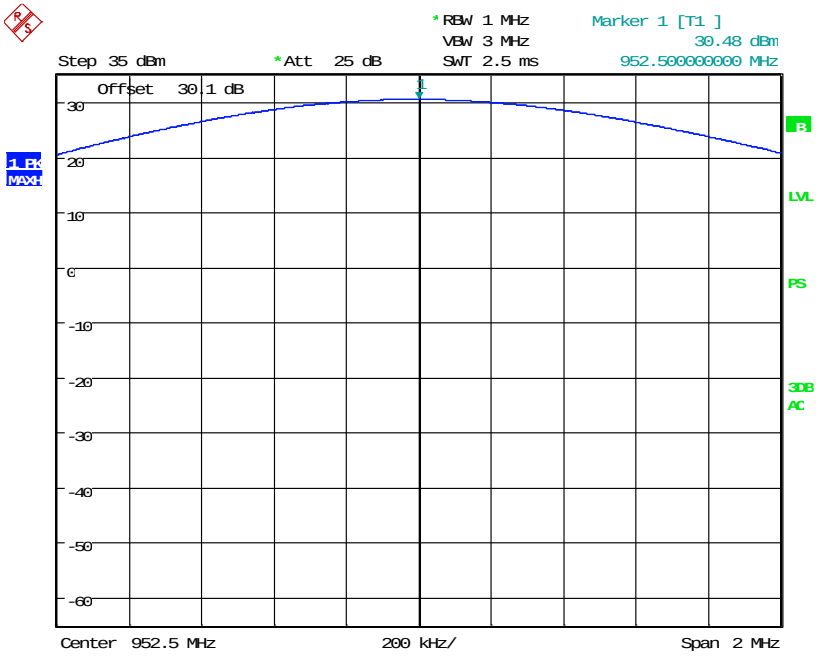


Figure 7.1.2-5: Peak Output Power 932.25 MHz



Date: 26.MAR.2015 19:06:15

Figure 7.1.2-6: Peak Output Power 941.4875 MHz



Date: 26.MAR.2015 19:07:53

Figure 7.1.2-7: Peak Output Power 952.5 MHz

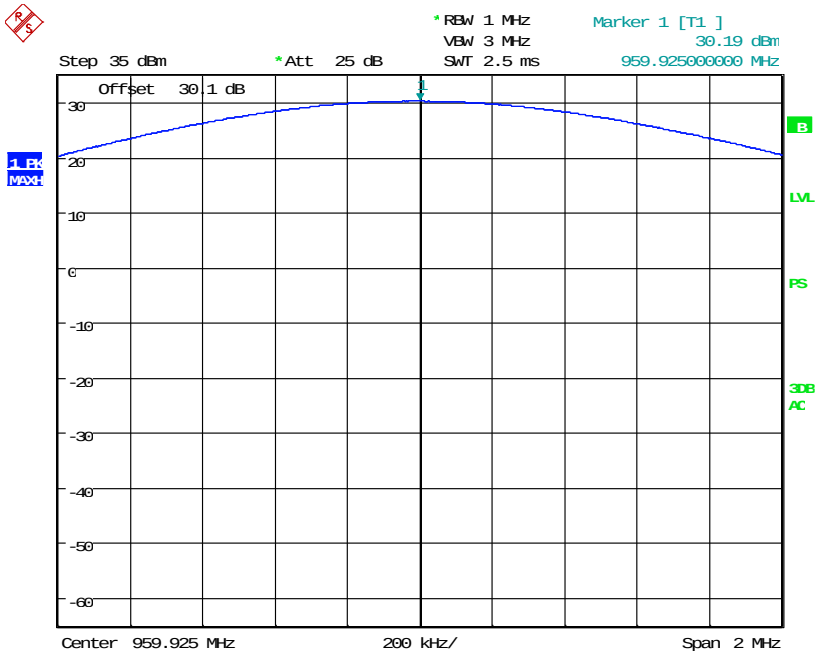


Figure 7.1.2-8: Peak Output Power 959.925 MHz

7.2 Occupied Bandwidth

7.2.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer through a 30 dB passive attenuator. The spectrum analyzer resolution and video bandwidths were set to 300 Hz and 3000 Hz respectively. The internal correction factors of the spectrum analyzer were employed to correct for any cable or attenuator losses. Results of the test are shown below for all modes of operation.

7.2.2 Measurement Results – Emission Masks

Part 24.133 a(1), a(2), IC RSS-134 6.3(i), (ii) – Emission Limits

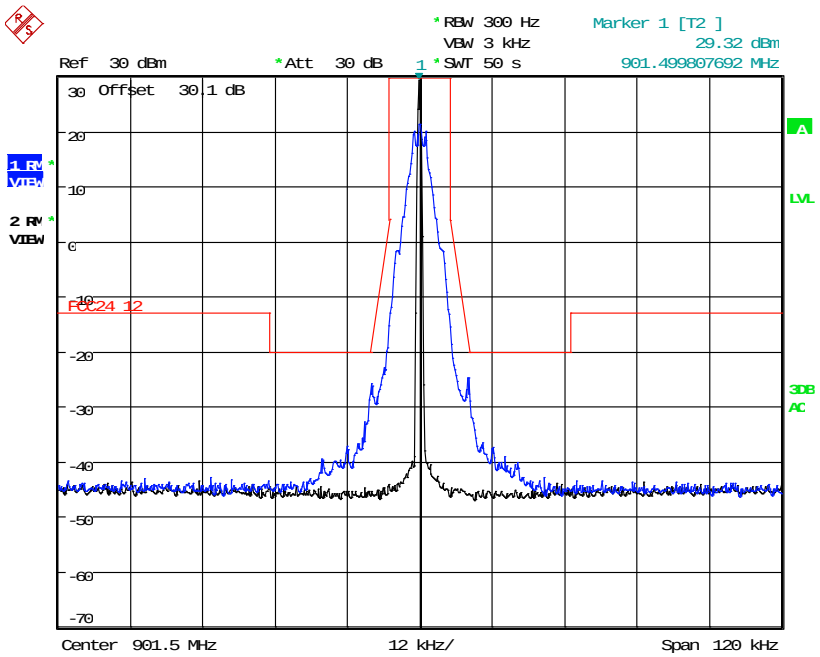


Figure 7.2.2-1: 901.5 MHz – 12.5 kHz Channel Spacing – C&I Mode

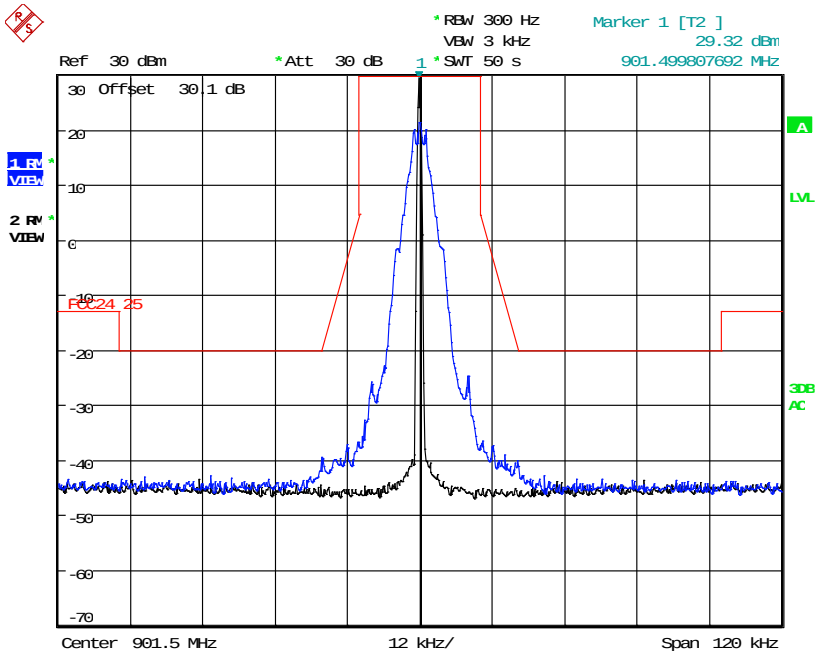


Figure 7.2.2-2: 901.5 MHz – 25 kHz Channel Spacing – C&I Mode

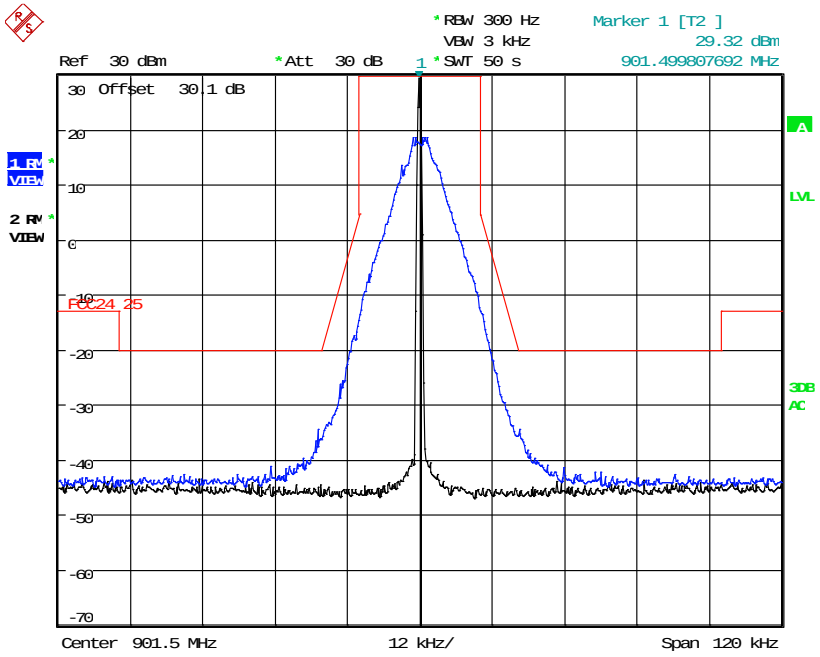


Figure 7.2.2-3: 901.5 MHz – 25 kHz Channel Spacing – Double Density Mode

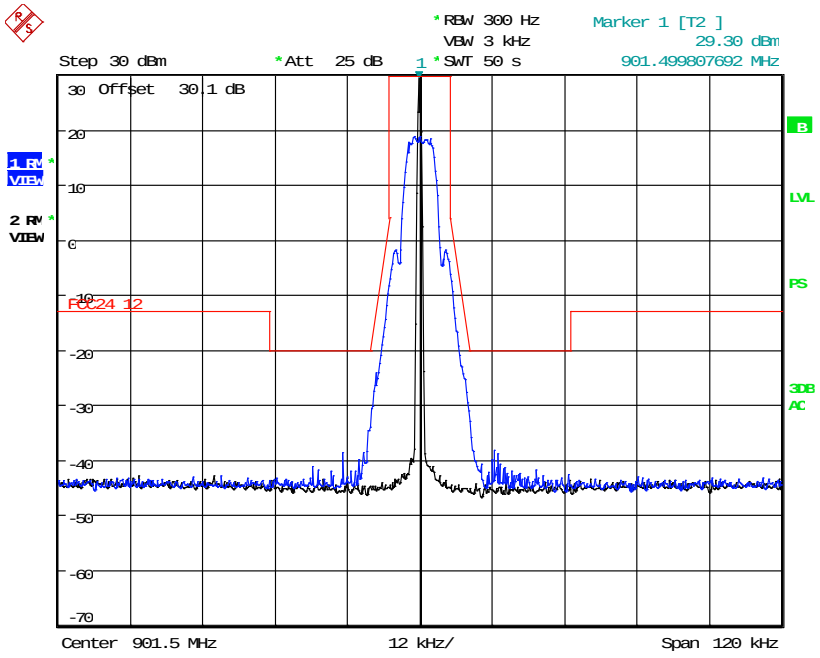


Figure 7.2.2-4: 901.5MHz – 12.5 kHz Channel Spacing – mPass 5k Mode

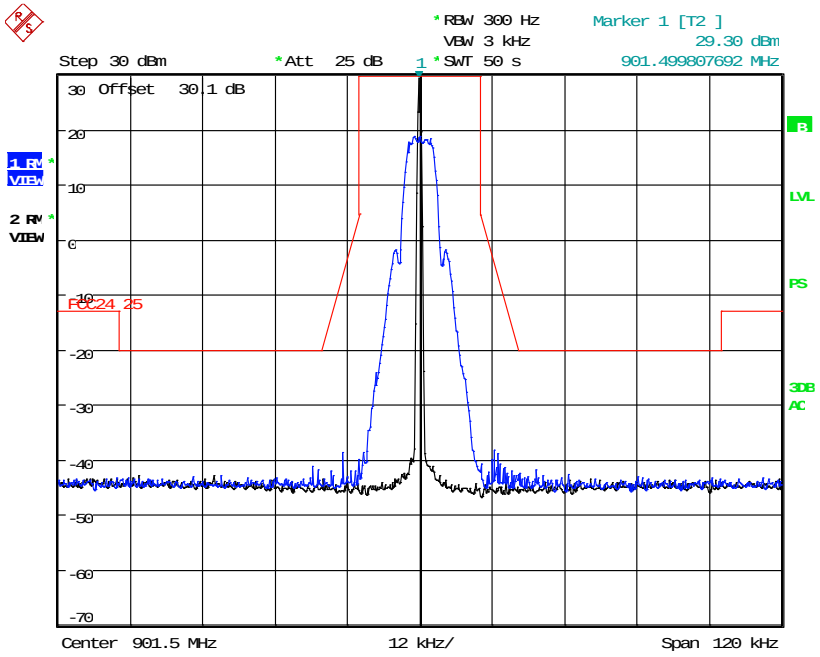


Figure 7.2.2-5: 901.5 MHz – 25 kHz Channel Spacing – mPass 5k Mode

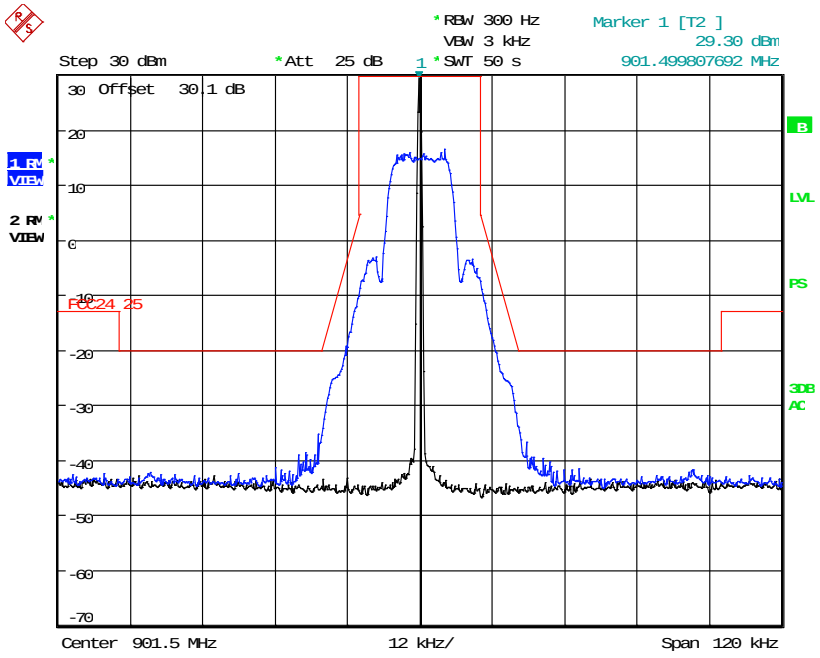


Figure 7.2.2-6: 901.5 MHz – 25 kHz Channel Spacing – mPass 10k Mode

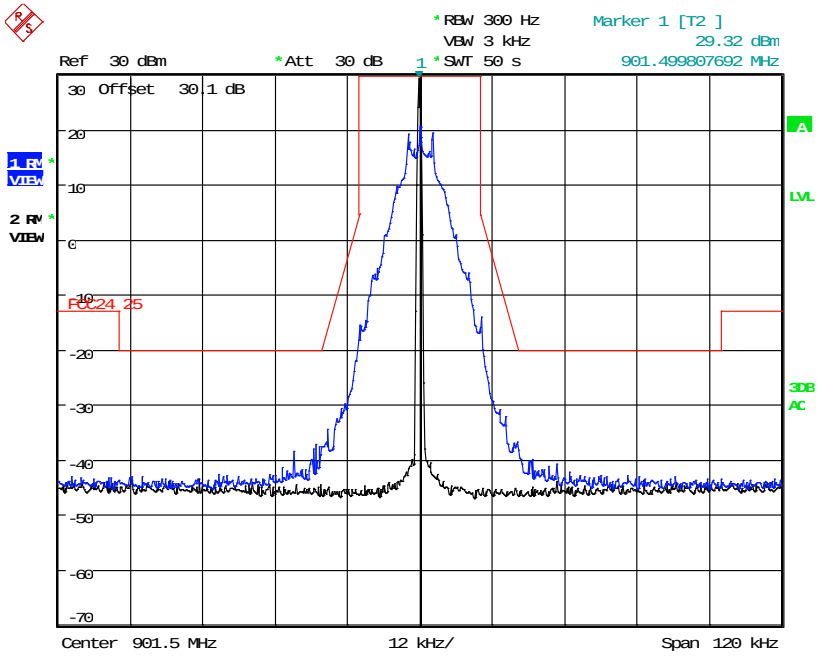


Figure 7.2.2-7: 901.5 MHz – 25 kHz Channel Spacing – Normal Mode

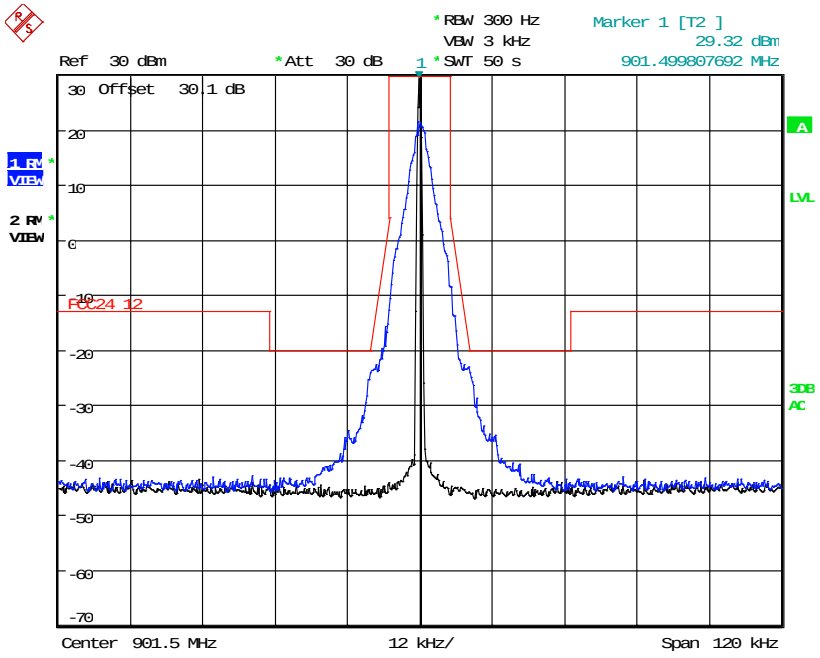


Figure 7.2.2-8: 901.5 MHz – 12.5 kHz Channel Spacing – Priority Mode

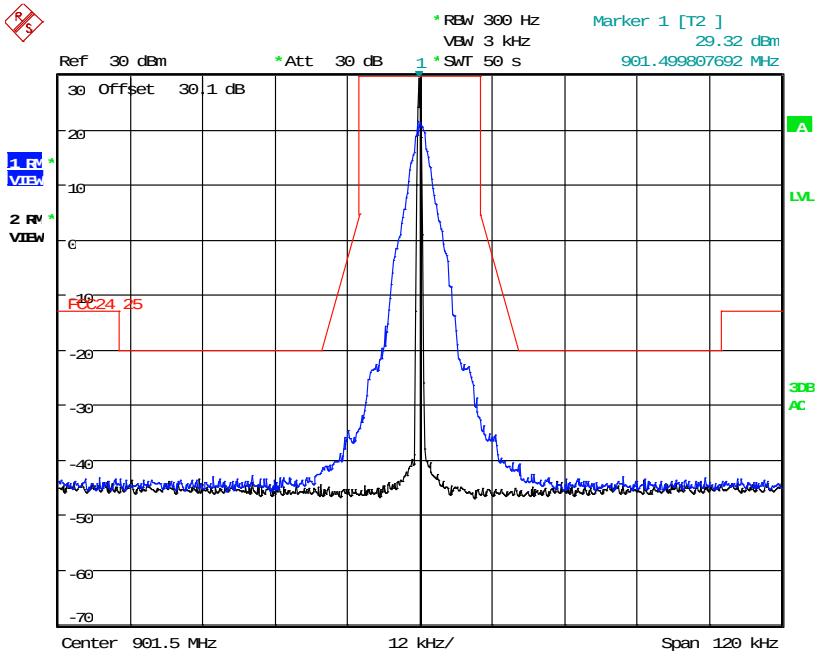
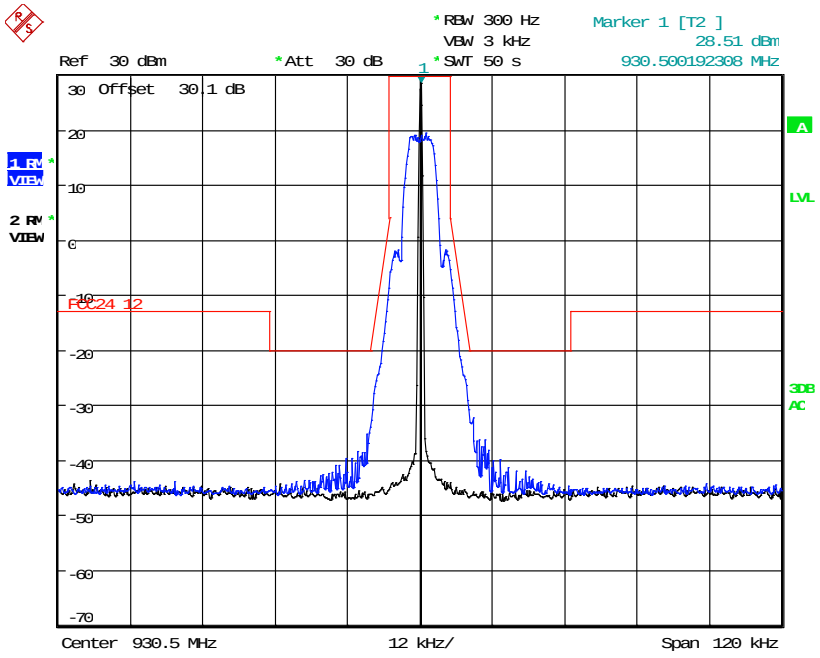
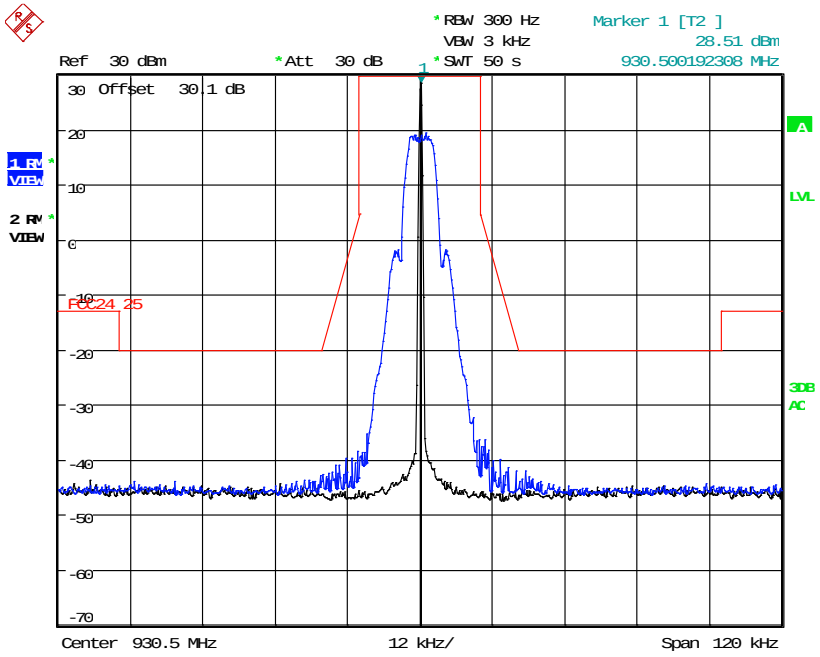


Figure 7.2.2-9: 901.5 MHz – 25 kHz Channel Spacing – Priority Mode



Date: 25.MAR.2015 15:19:08

Figure 7.2.2-10: 930.5 MHz – 12.5 kHz Channel Spacing – mPass 5k Mode



Date: 25.MAR.2015 15:18:08

Figure 7.2.2-11: 930.5 MHz – 25 kHz Channel Spacing – mPass 5k Mode

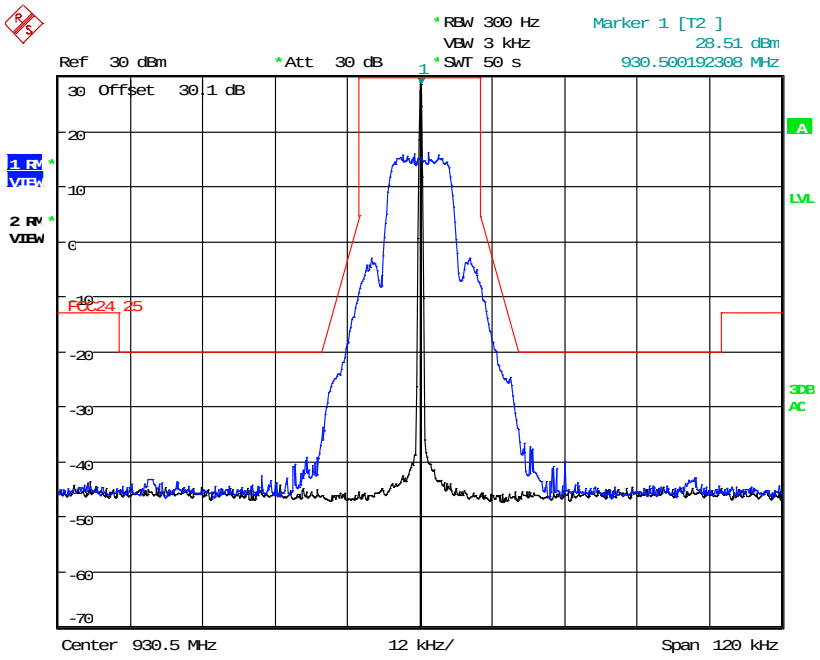


Figure 7.2.2-12: 930.5 MHz – 25 kHz Channel Spacing – mPass 10k Mode

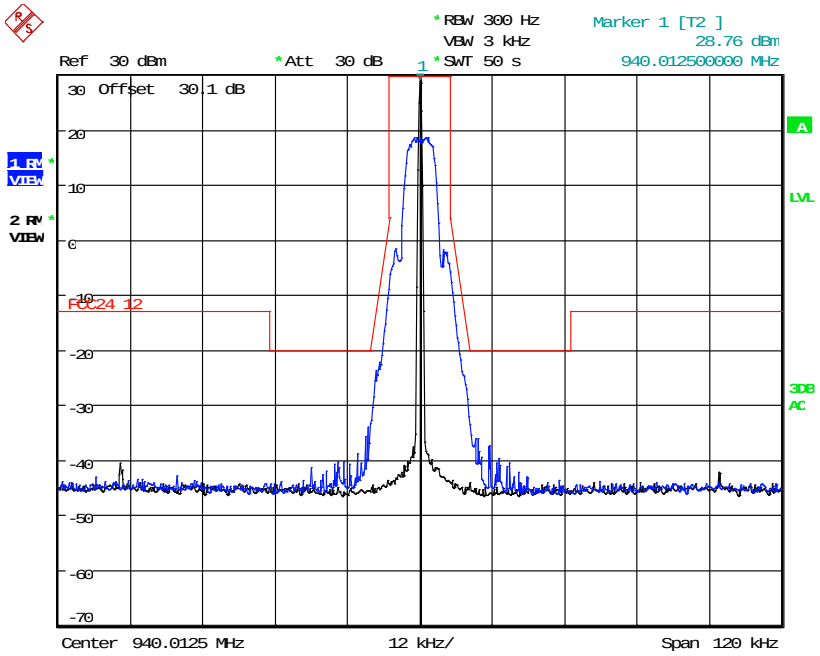


Figure 7.2.2-13: 940.0125 MHz – 12.5 kHz Channel Spacing – mPass 5k Mode

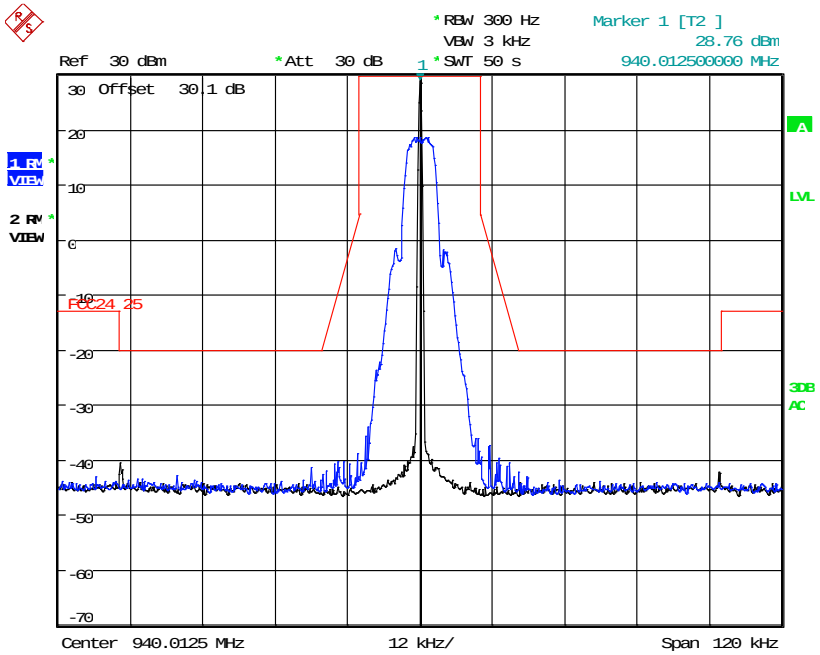


Figure 7.2.2-14: 940.0125 MHz – 25 kHz Channel Spacing – mPass 5k Mode

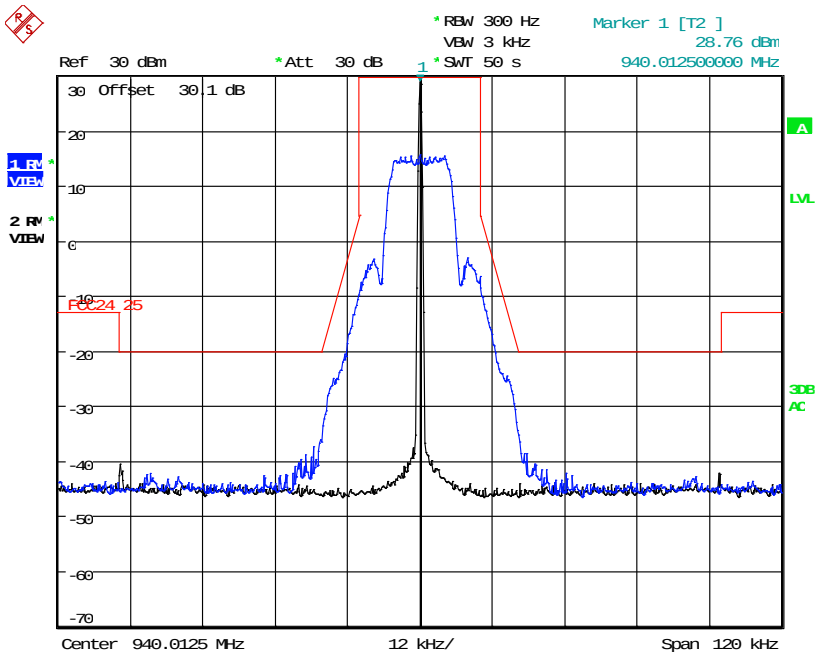


Figure 7.2.2-15: 940.0125 MHz – 25 kHz Channel Spacing – mPass 10k Mode

Part 101.111 a(6), RSS-119 5.8.6 (FCC Part 101.11a(6) provides worst case)

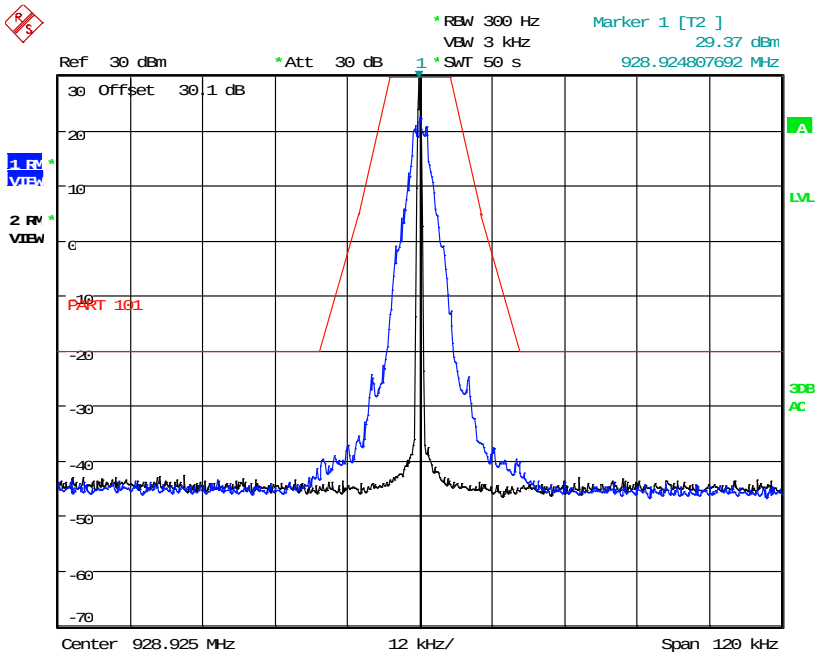


Figure 7.2.2-16: 928.925 MHz – C&I Mode

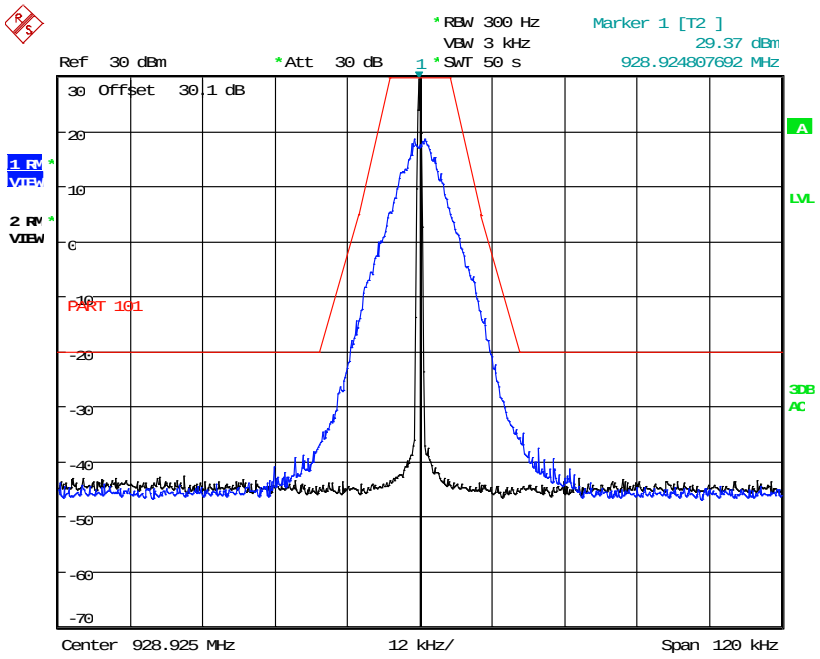


Figure 7.2.2-17: 928.925 MHz – Double Density Mode

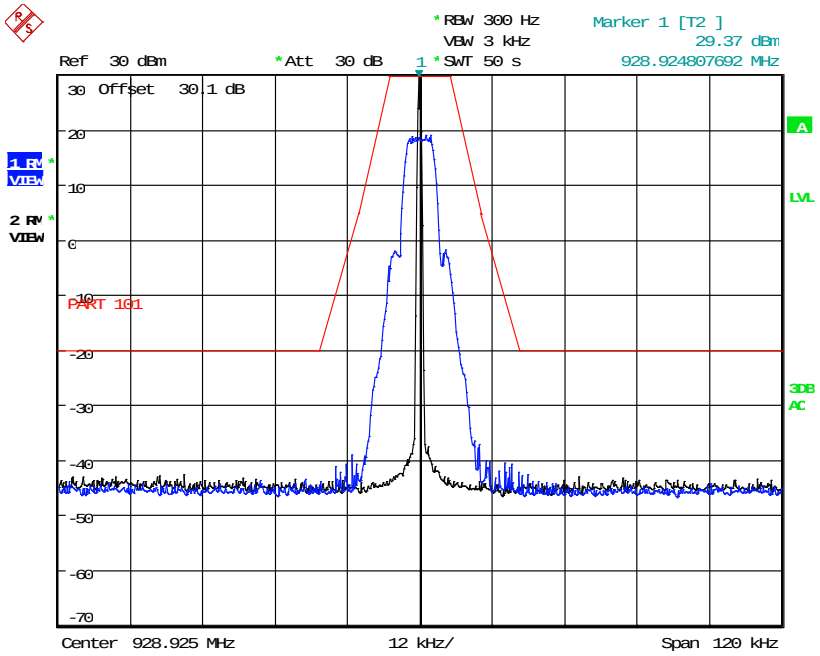


Figure 7.2.2-18: 928.925 MHz – MPass 5k Mode

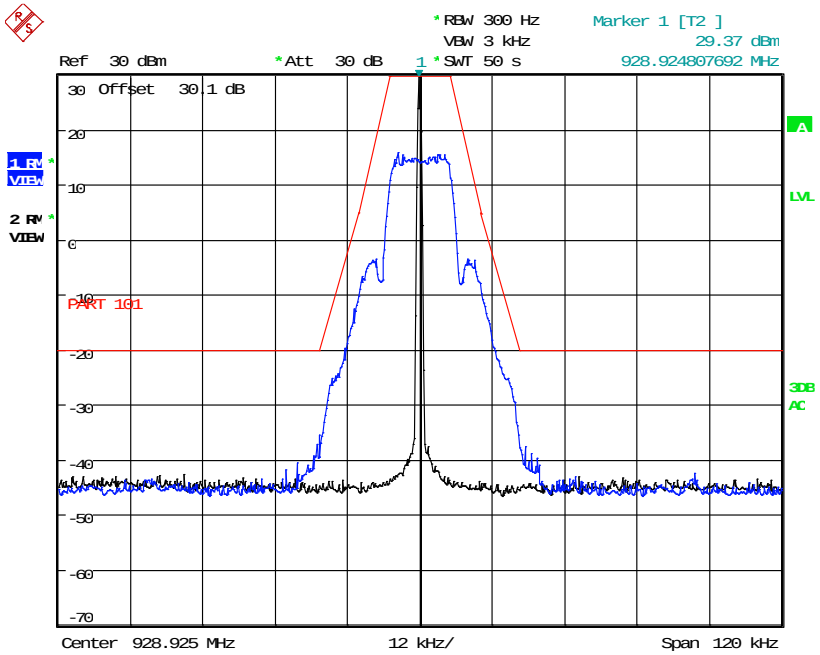


Figure 7.2.2-19: 928.925 MHz – MPass 10k Mode

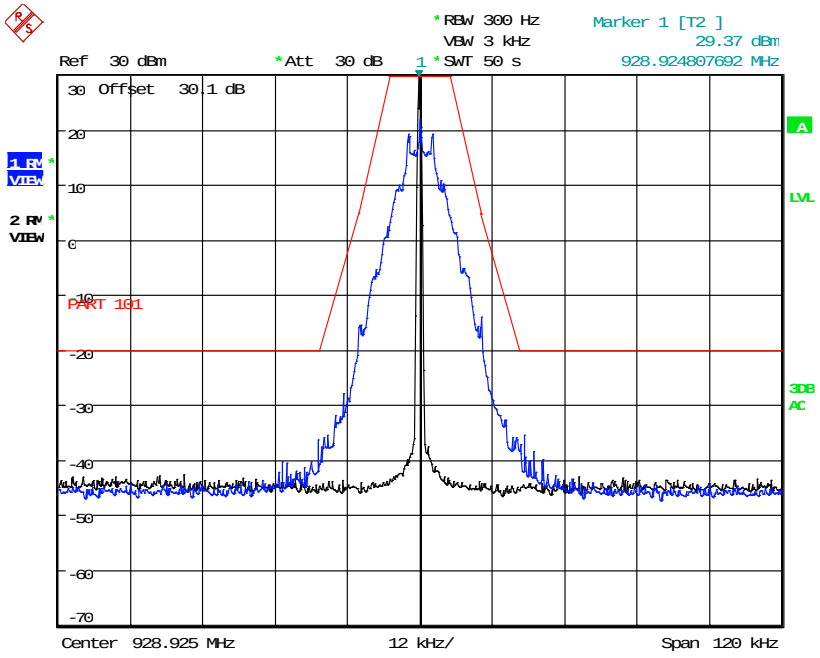


Figure 7.2.2-20: 928.925 MHz – Normal Mode

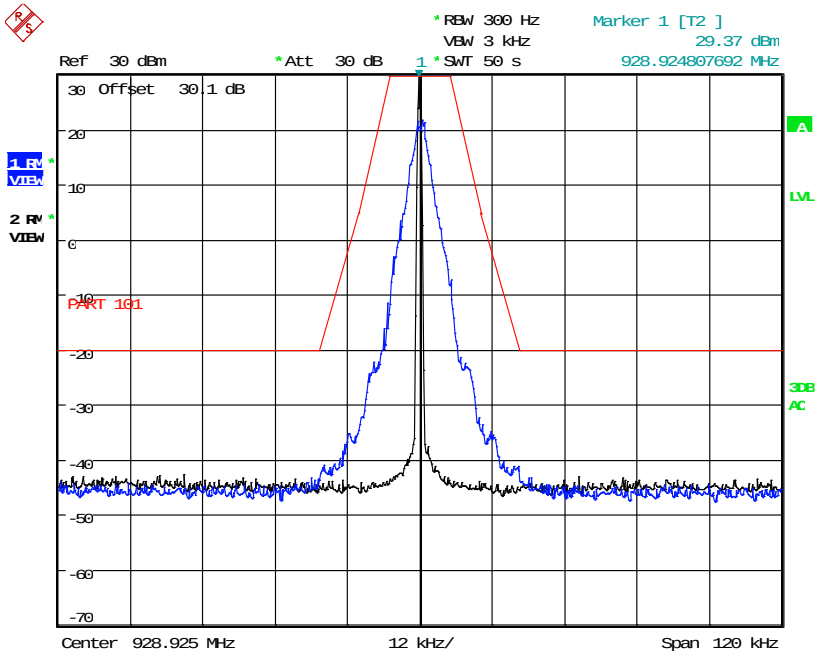


Figure 7.2.2-21: 928.925 MHz –– Priority Mode

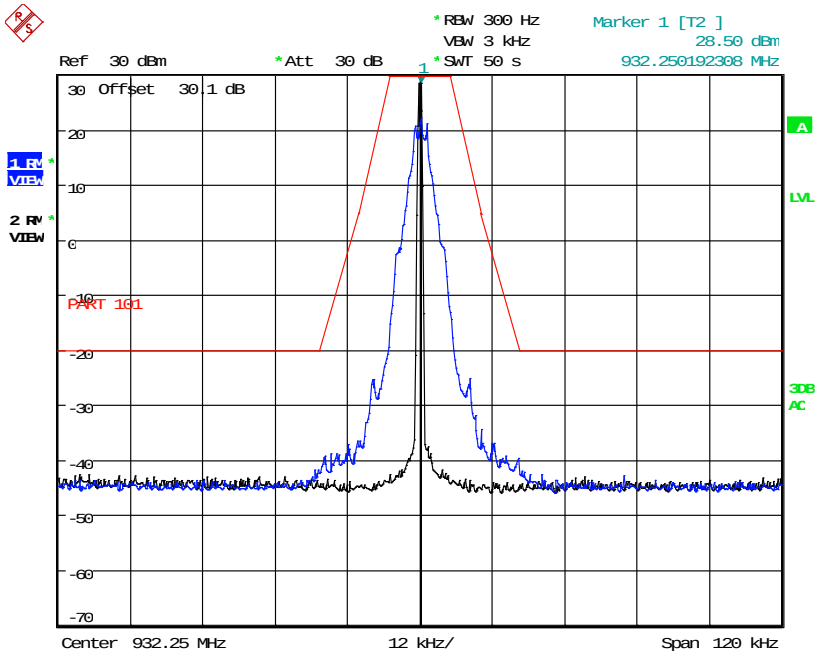


Figure 7.2.2-22: 932.25 MHz – C&I Mode

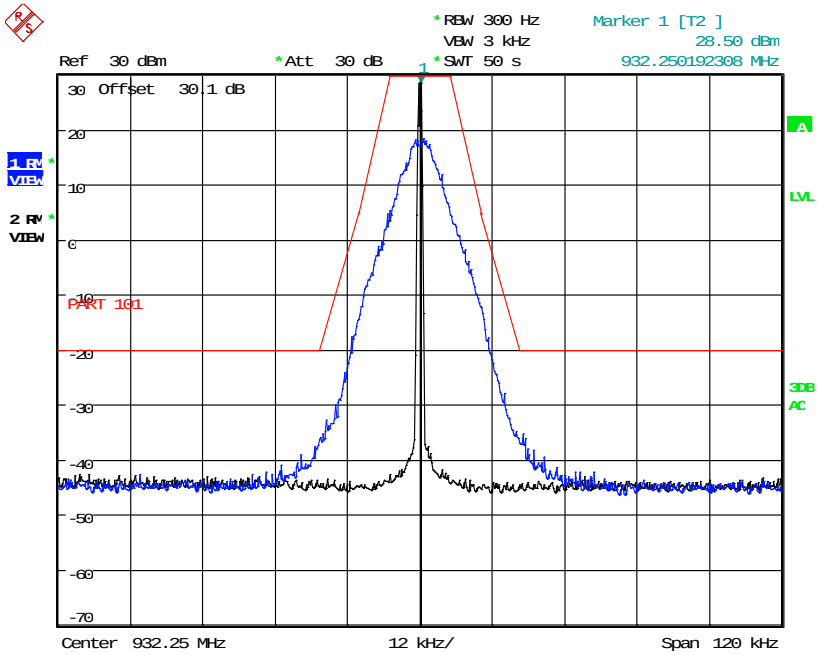


Figure 7.2.2-23: 932.25 MHz – Double Density Mode

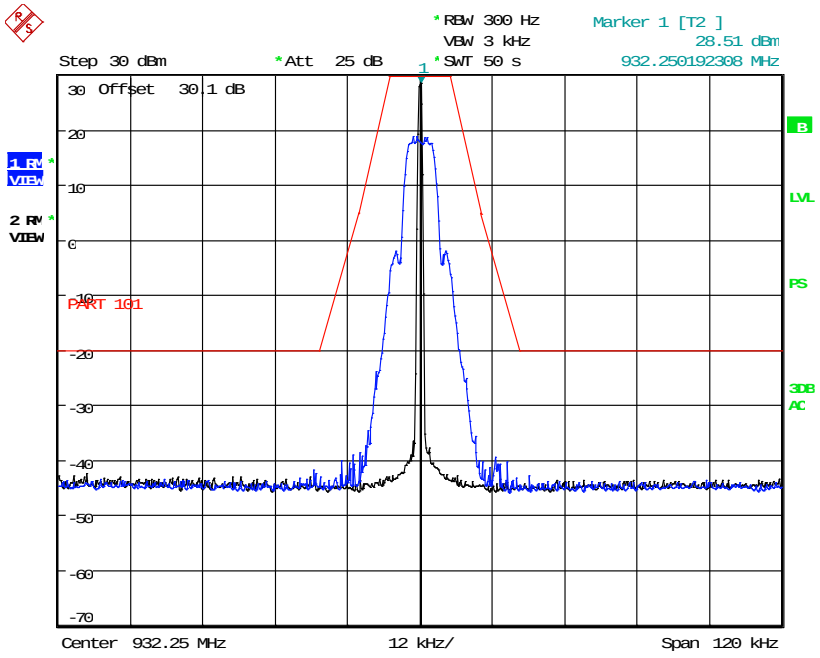


Figure 7.2.2-24: 932.25 MHz – MPass 5k Mode

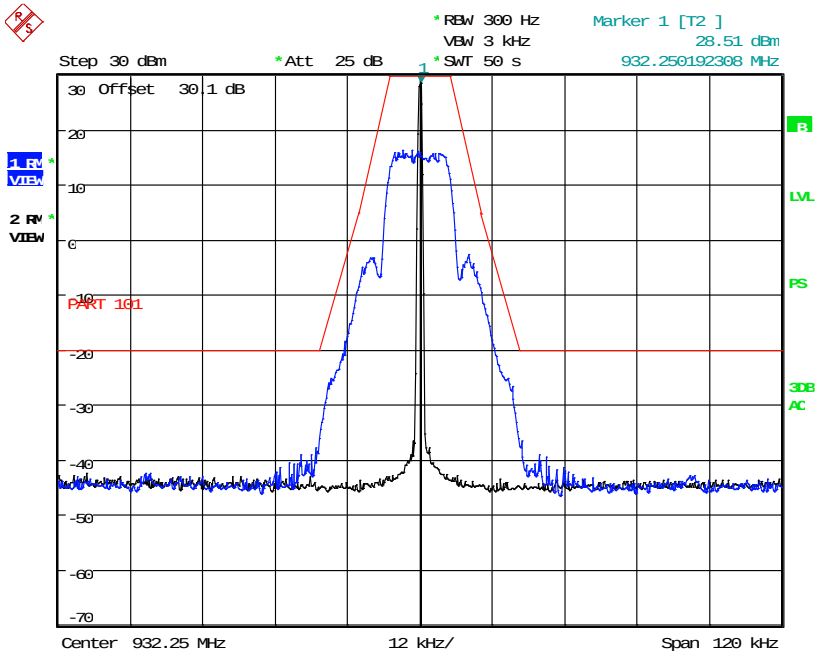


Figure 7.2.2-25: 932.25 MHz – MPass 10k Mode

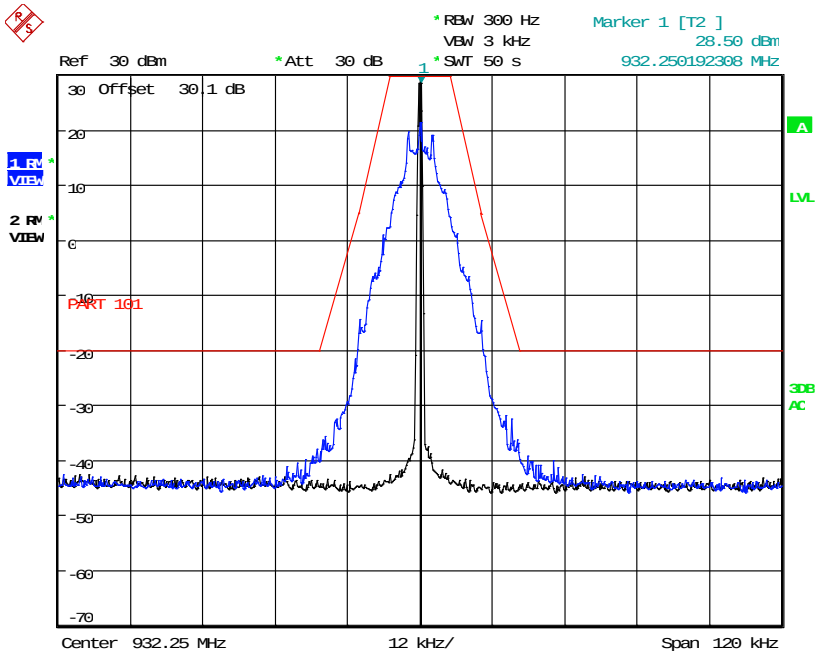


Figure 7.2.2-26: 932.25 MHz – Normal Mode

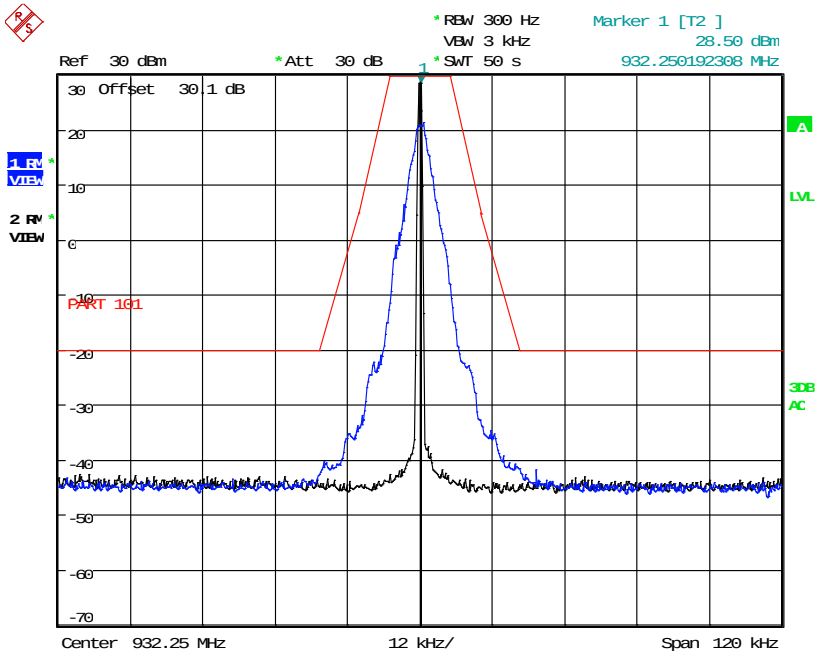


Figure 7.2.2-27: 932.25 MHz –– Priority Mode

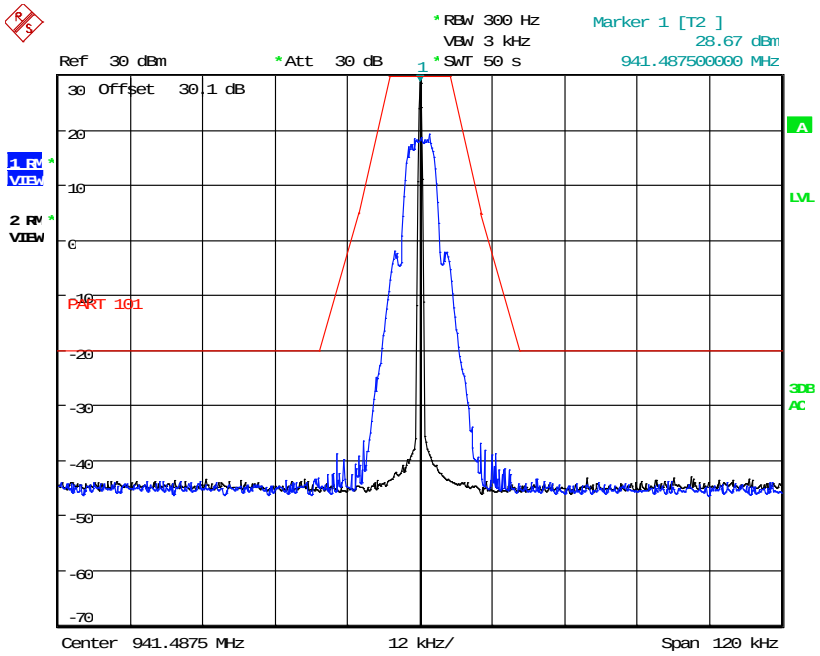


Figure 7.2.2-28: 941.4875 MHz – mPass 5k Mode

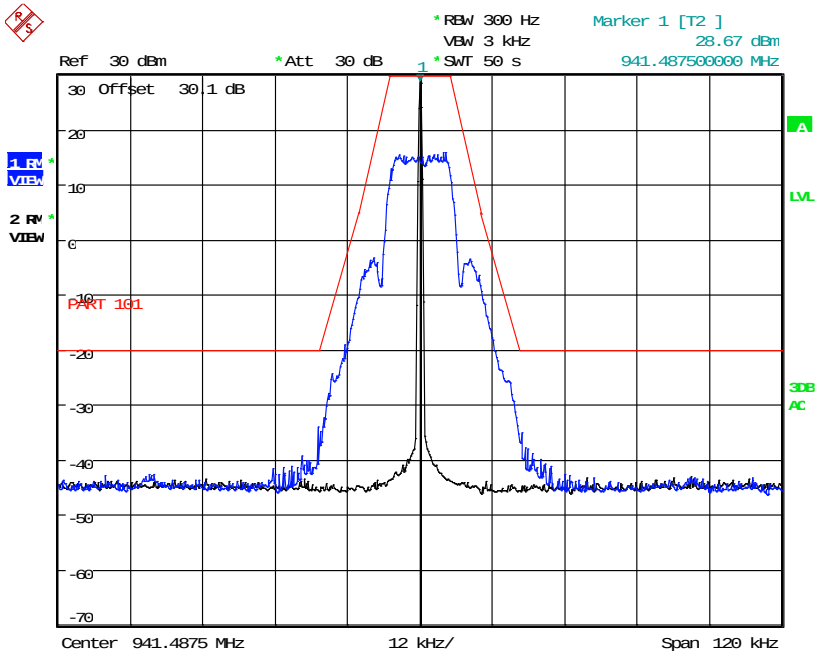


Figure 7.2.2-29: 941.4875 MHz – mPass 10k Mode

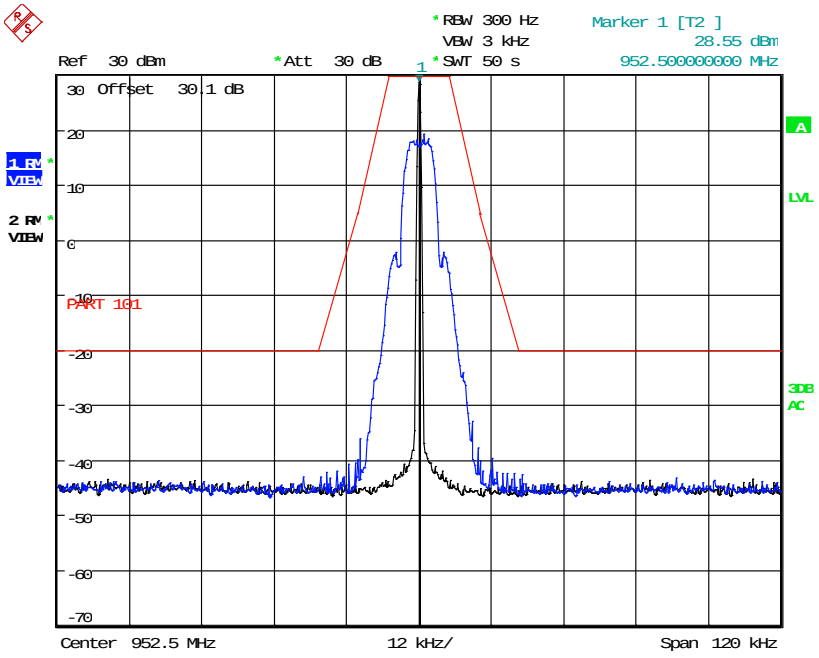


Figure 7.2.2-30: 952.5 MHz – mPass 5k Mode

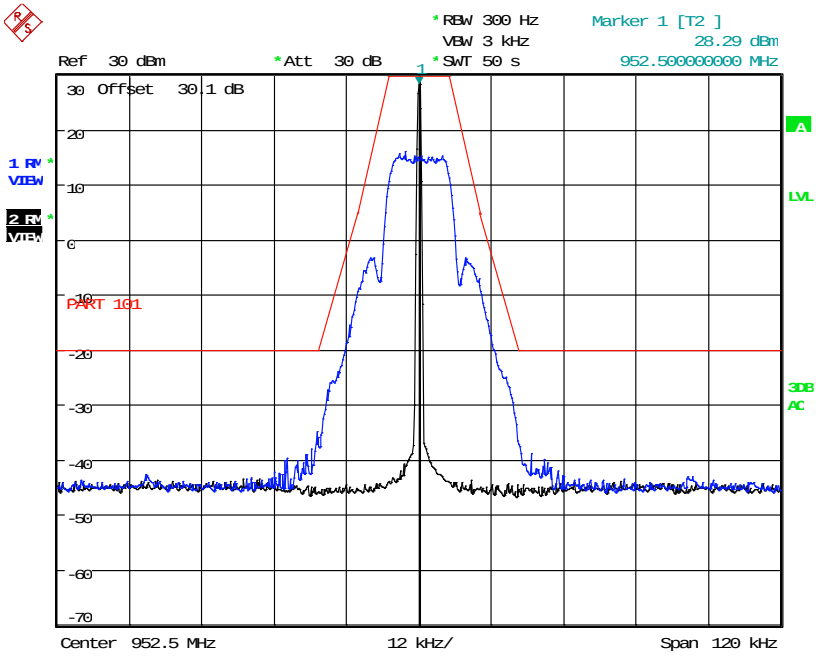


Figure 7.2.2-31: 952.5 MHz – mPass 10k Mode

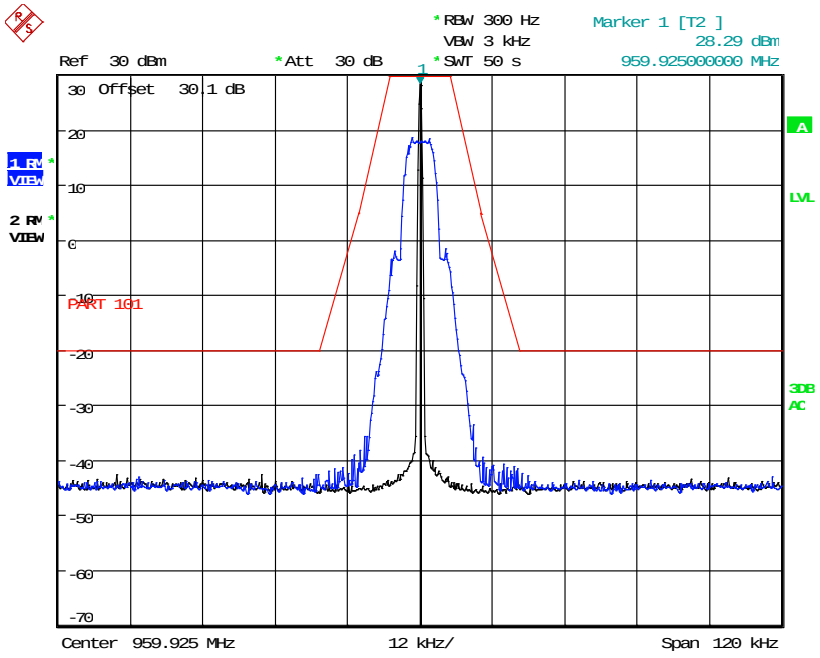


Figure 7.2.2-32: 959.925 MHz – mPass 5k Mode

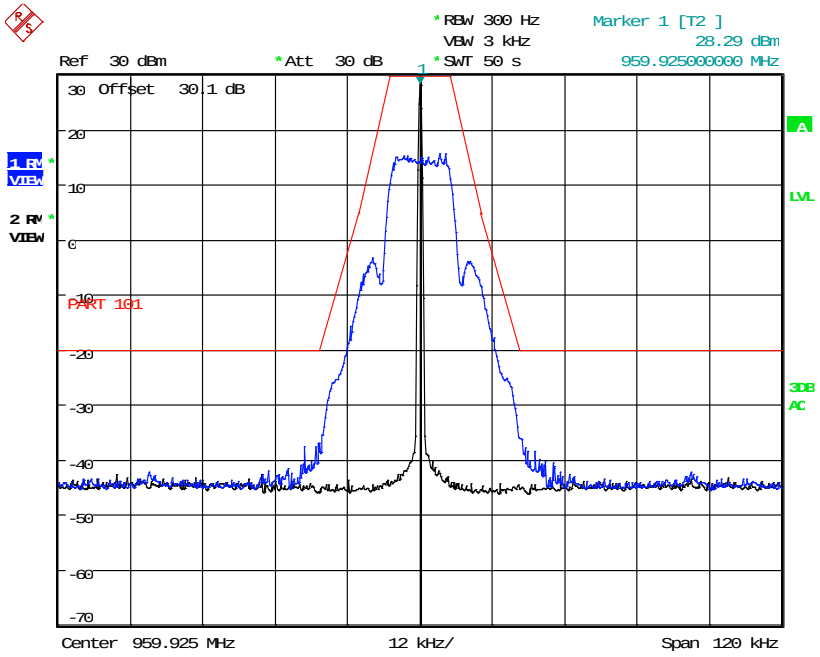


Figure 7.2.2-33: 959.925 MHz – mPass 10k Mode

7.2.3 Measurement Results – 99% Bandwidth

Frequency (MHz)	IC Rule Part	Mode of Operation	99% Bandwidth (kHz)
901.5000	RSS-134	C&I	6.0096
901.5000	RSS-134	Double Density	13.301
901.5000	RSS-134	mPass 5k	5.8974
901.5000	RSS-134	mPass 10k	11.859
901.5000	RSS-134	Normal	11.779
901.5000	RSS-134	Priority	6.7308
930.5000	RSS-134	mPass 5k	5.8333
930.5000	RSS-134	mPass 10k	11.859
940.0125	RSS-134	mPass 5k	5.8333
940.0125	RSS-134	mPass 10k	11.699
928.9250	RSS-119	C&I	5.7692
928.9250	RSS-119	Double Density	13.462
928.9250	RSS-119	mPass 5k	5.8654
928.9250	RSS-119	mPass 10k	11.779
928.9250	RSS-119	Normal	11.779
928.9250	RSS-119	Priority	6.7308
932.2500	RSS-119	C&I	5.8494
932.2500	RSS-119	Double Density	13.141
932.2500	RSS-119	mPass 5k	5.8013
932.2500	RSS-119	mPass 10k	11.699
932.2500	RSS-119	Normal	11.779
932.2500	RSS-119	Priority	6.4904
941.4875	RSS-119	mPass 5k	5.8333
941.4875	RSS-119	mPass 10k	11.779
952.5000	RSS-119	mPass 5k	5.8654
952.5000	RSS-119	mPass 10k	11.939
959.9250	RSS-119	mPass 5k	5.8333
959.9250	RSS-119	mPass 10k	11.779

IC RSS-GEN 6.6, IC RSS-134

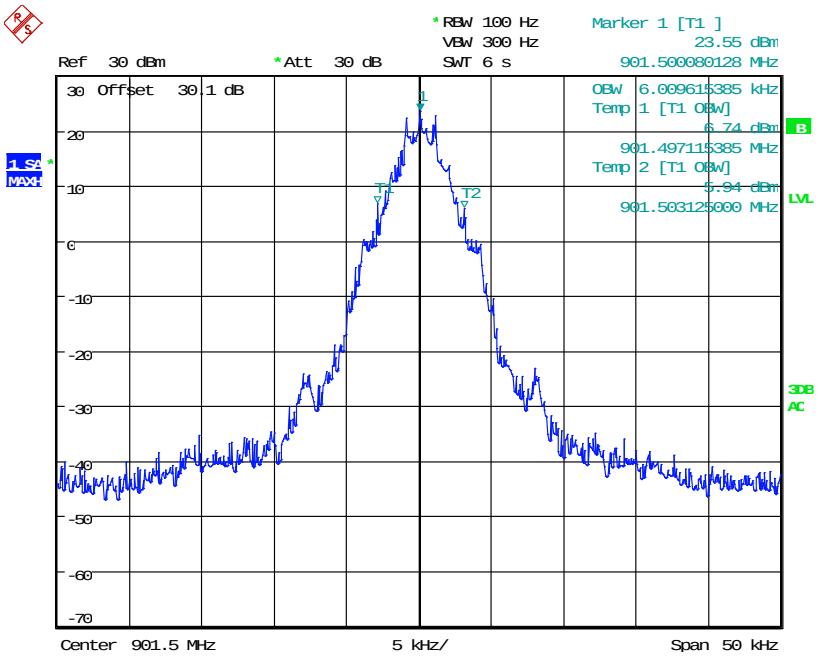


Figure 7.2.3-1: 901.5 MHz – C&I Mode

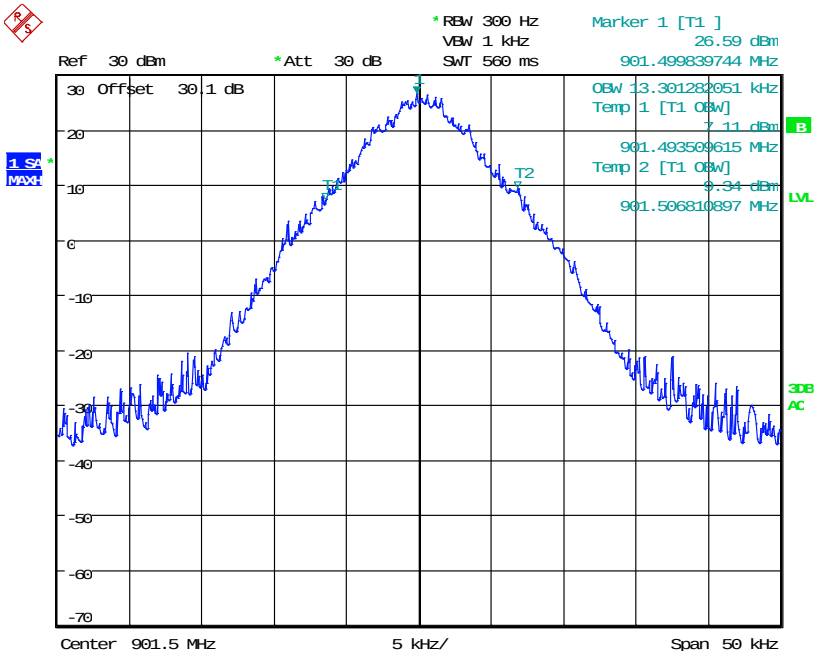


Figure 7.2.3-2: 901.5 MHz – Double Density Mode

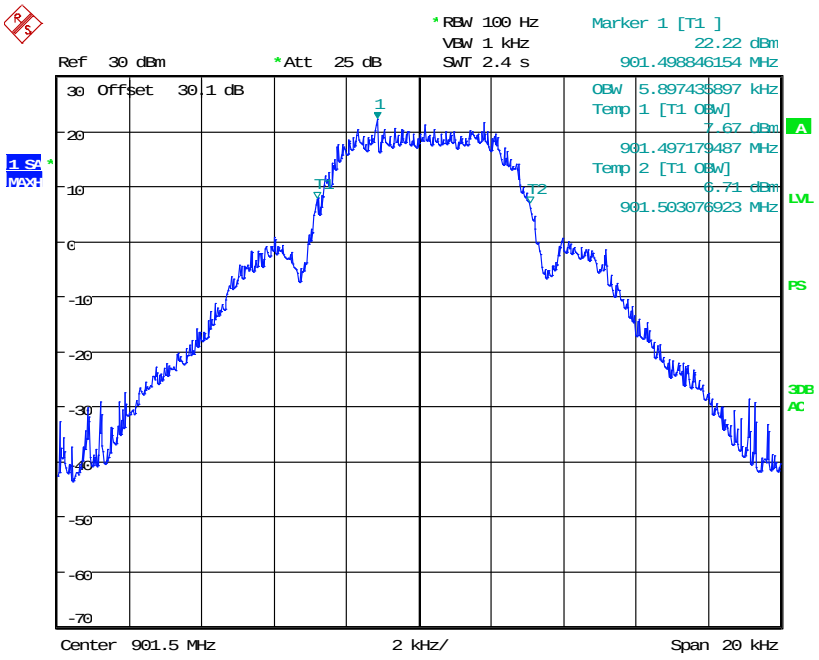


Figure 7.2.3-3: 901.5MHz – mPass 5k Mode

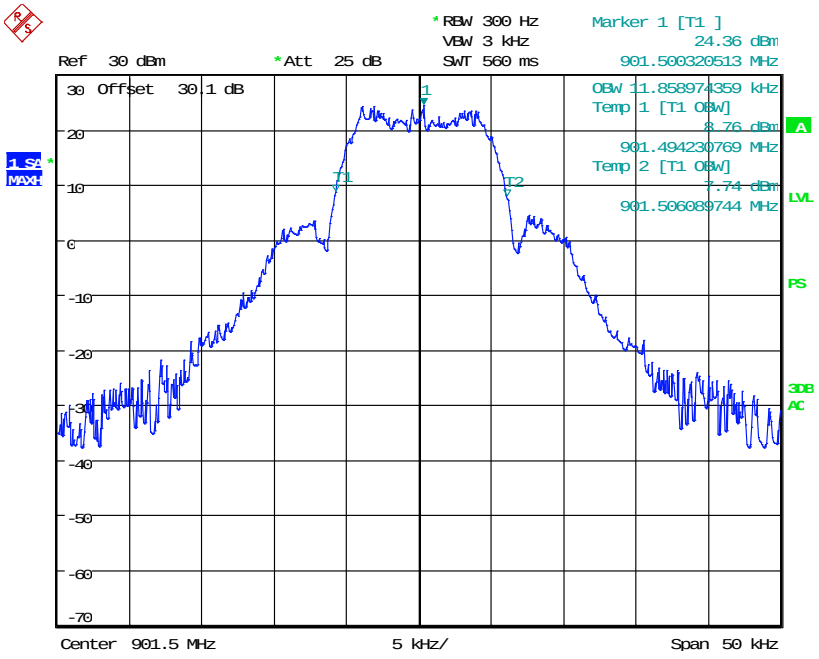
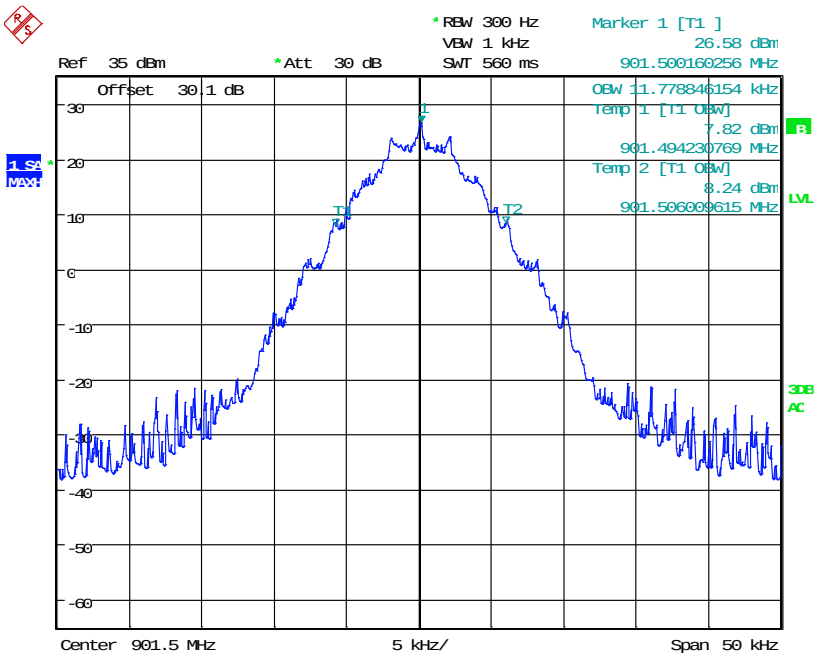
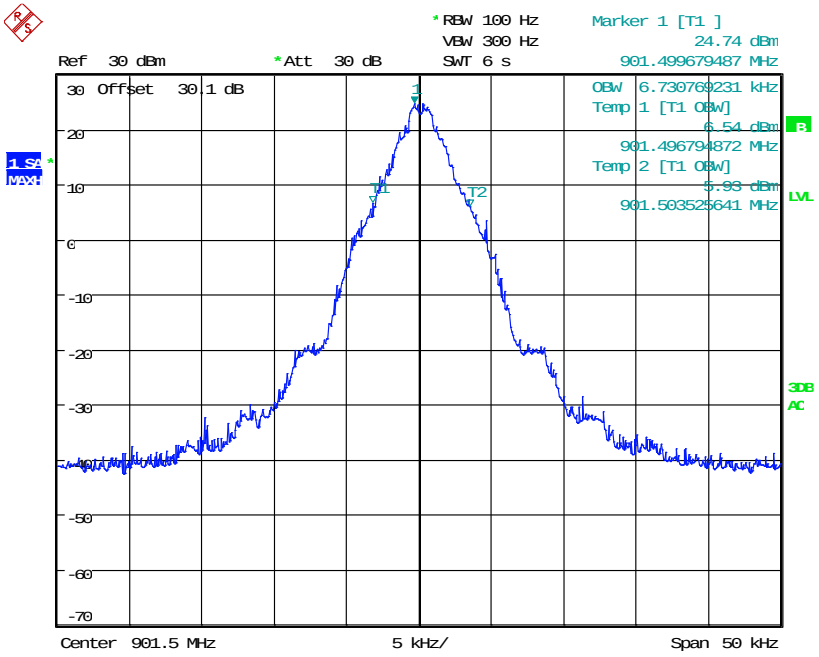


Figure 7.2.3-4: 901.5 MHz – mPass 10k Mode



Date: 24.MAR.2015 16:08:37

Figure 7.2.3-5: 901.5 MHz – Normal Mode



Date: 25.MAR.2015 14:34:25

Figure 7.2.3-6: 901.5 MHz – Priority Mode

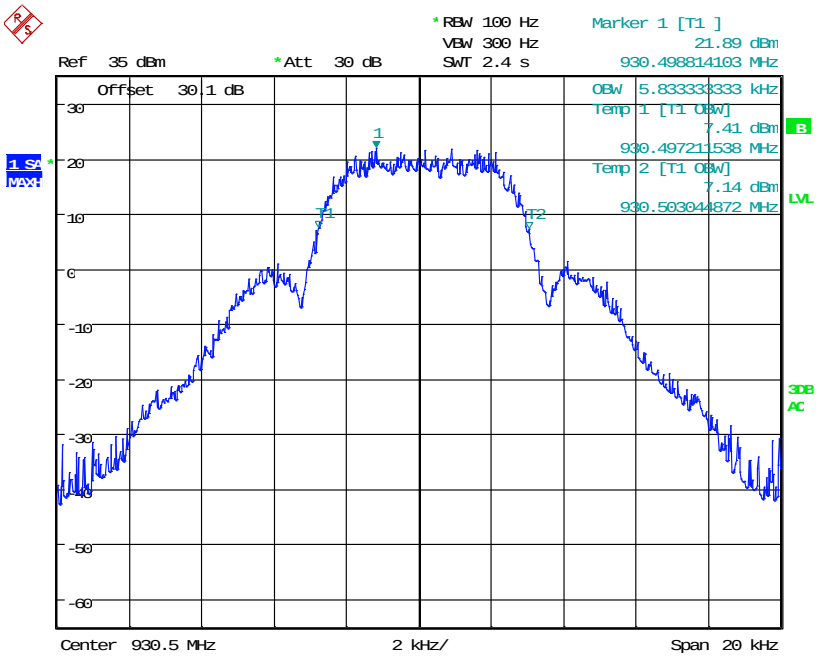


Figure 7.2.3-7: 930.5 MHz – mPass 5k Mode

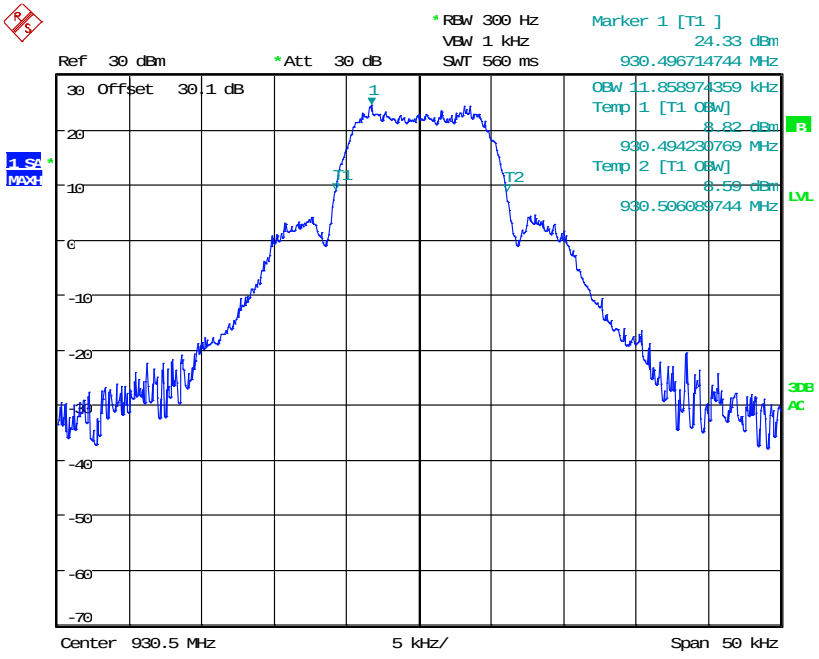
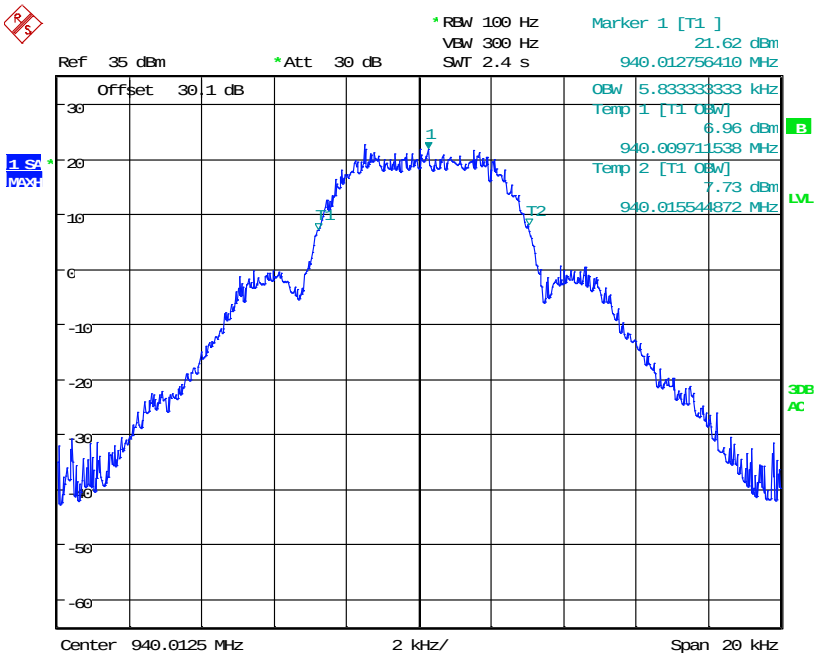
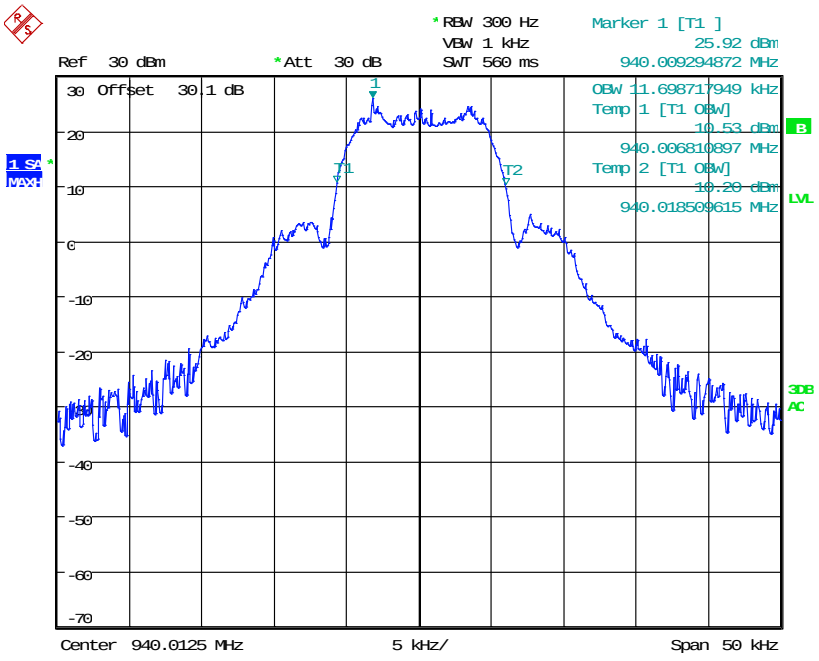


Figure 7.2.3-8: 930.5 MHz – mPass 10k Mode



Date: 24.MAR.2015 16:43:57

Figure 7.2.3-9: 940.0125 MHz – mPass 5k Mode



Date: 25.MAR.2015 15:59:37

Figure 7.2.3-10: 940.0125 MHz – mPass 10k Mode

IC RSS-GEN 6.6, IC RSS-119

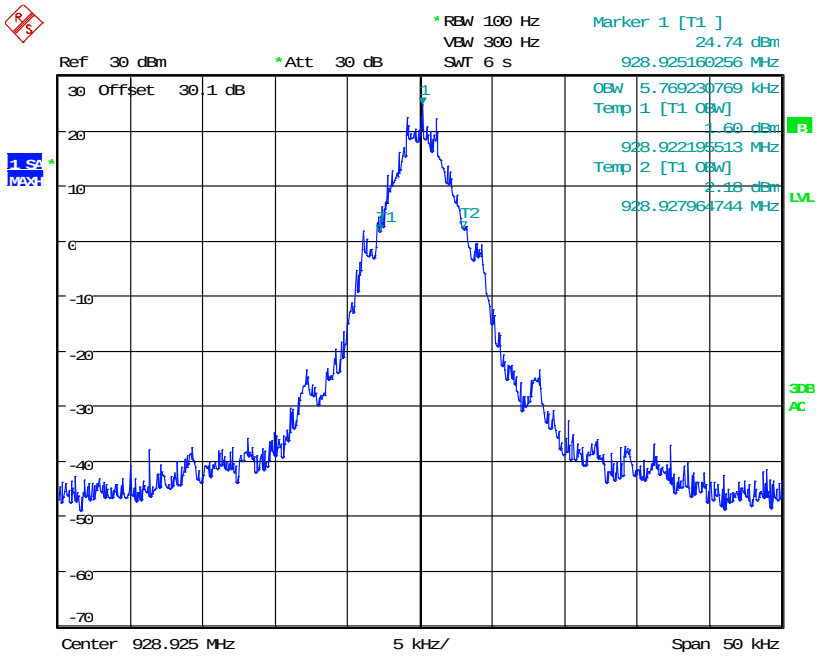


Figure 7.2.3-11: 928.925 MHz – C&I Mode

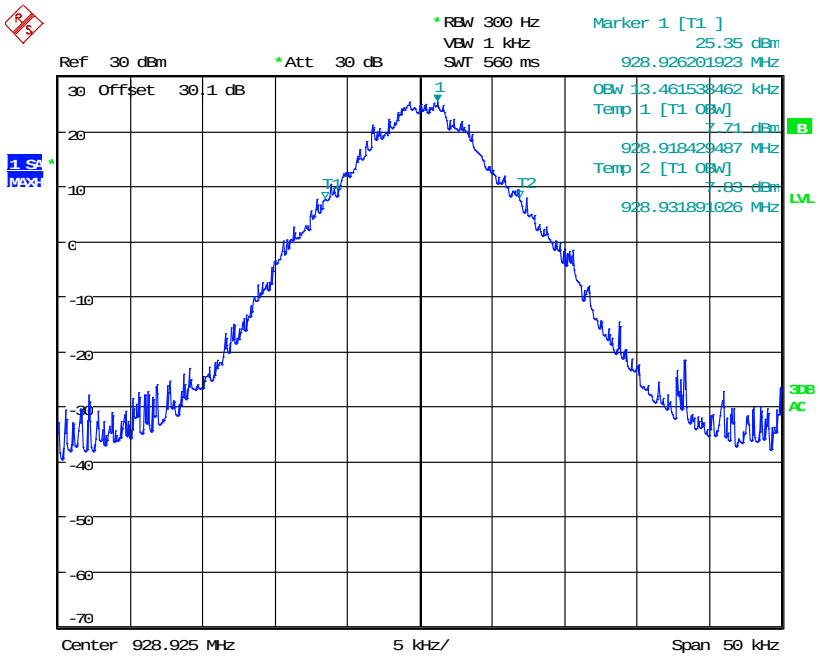


Figure 7.2.3-12: 928.925 MHz – Double Density Mode

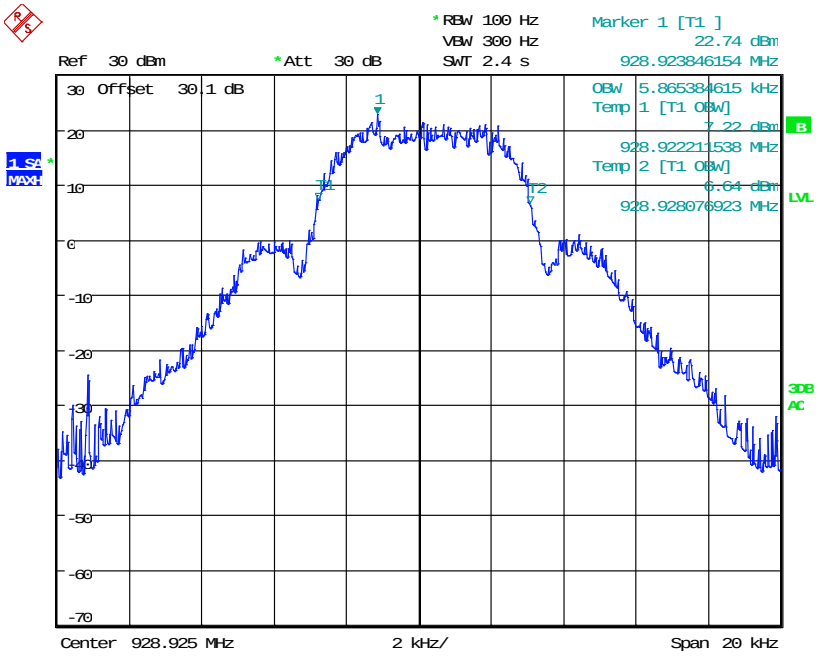


Figure 7.2.3-13: 928.925 MHz – MPass 5k Mode

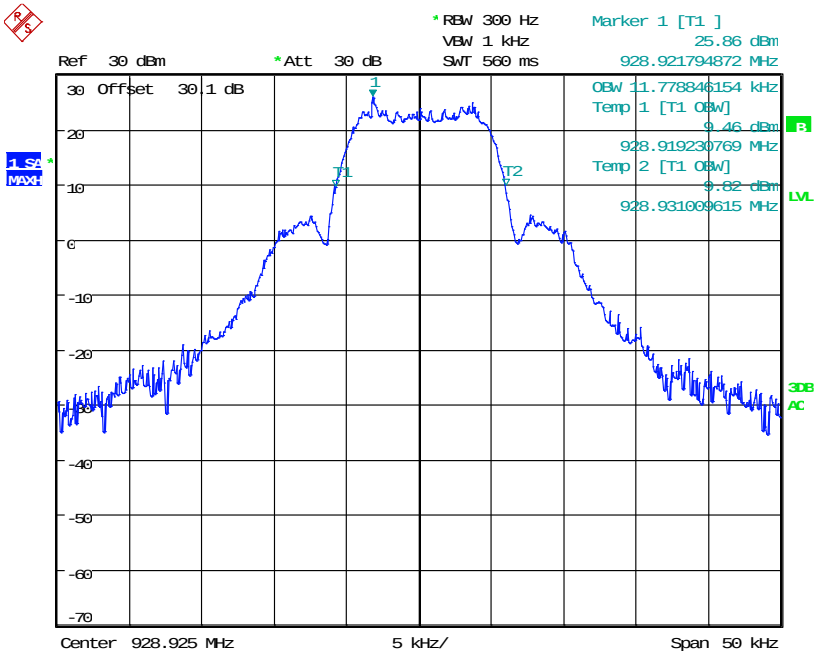


Figure 7.2.3-14: 928.925 MHz – MPass 10k Mode

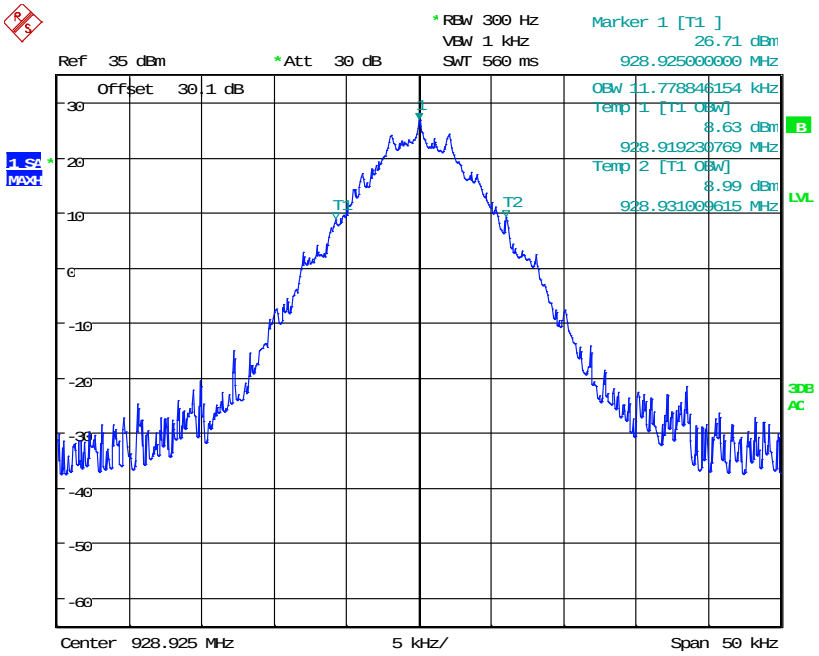


Figure 7.2.3-15: 928.925 MHz – Normal Mode

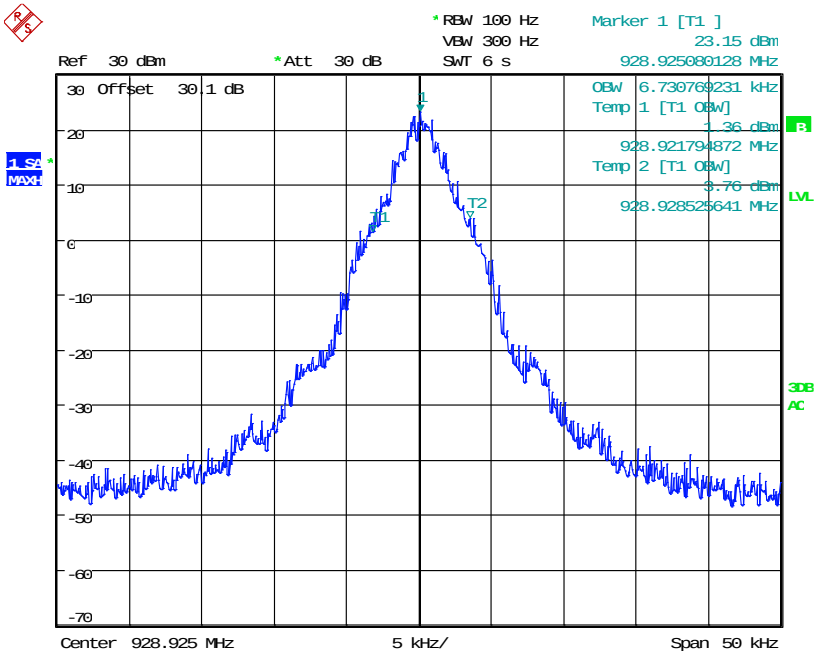


Figure 7.2.3-16: 928.925 MHz –– Priority Mode

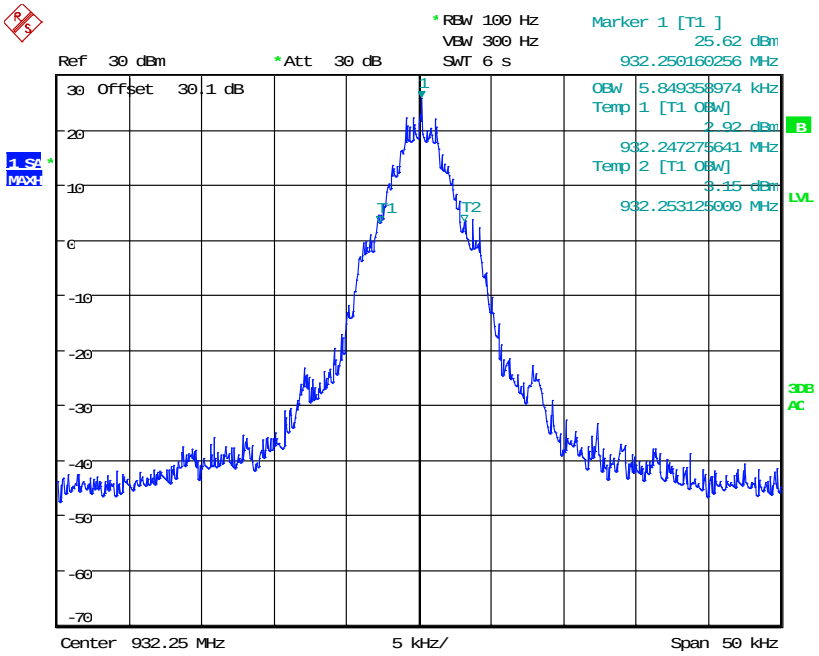


Figure 7.2.3-17: 932.25 MHz – C&I Mode

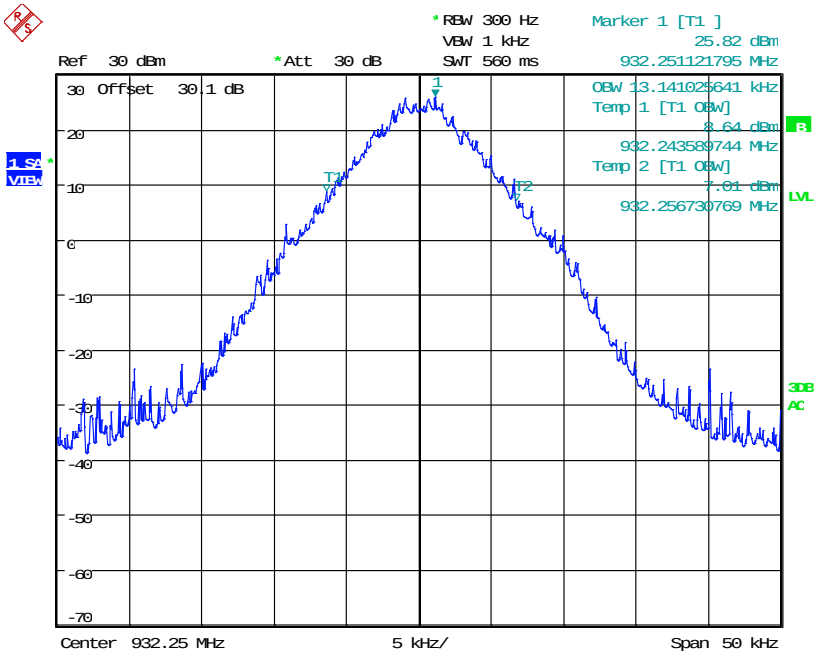


Figure 7.2.3-18: 932.25 MHz – Double Density Mode

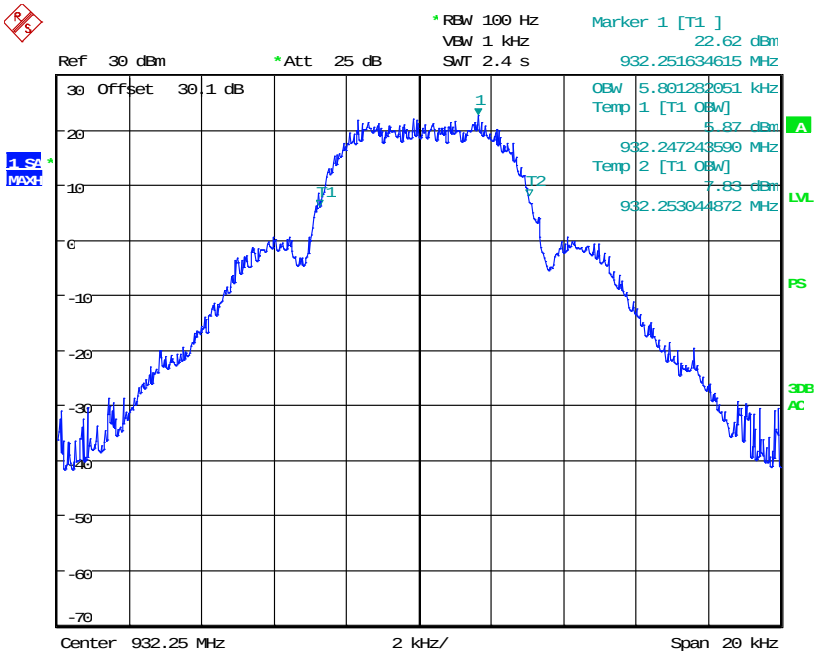


Figure 7.2.3-19: 932.25 MHz – MPass 5k Mode

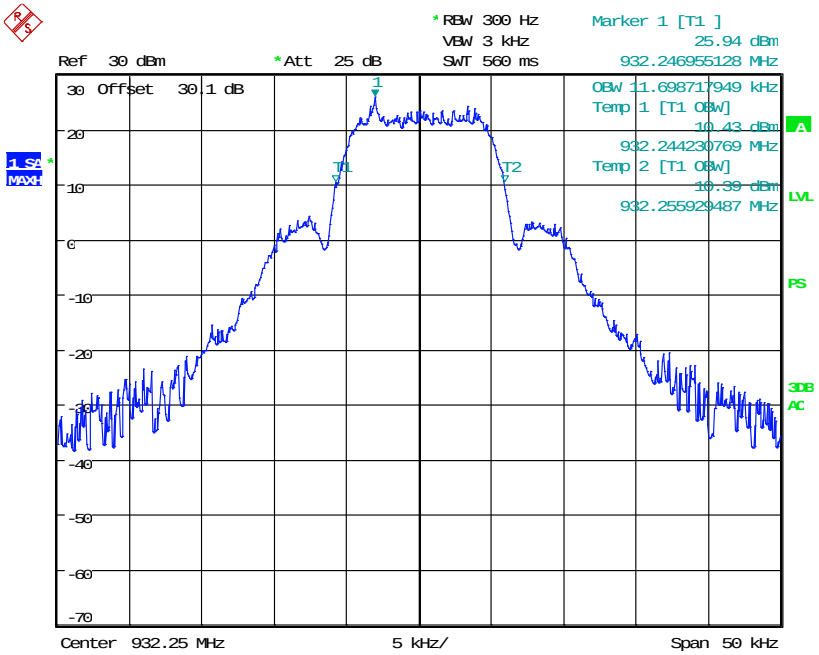


Figure 7.2.3-20: 932.25 MHz – MPass 10k Mode

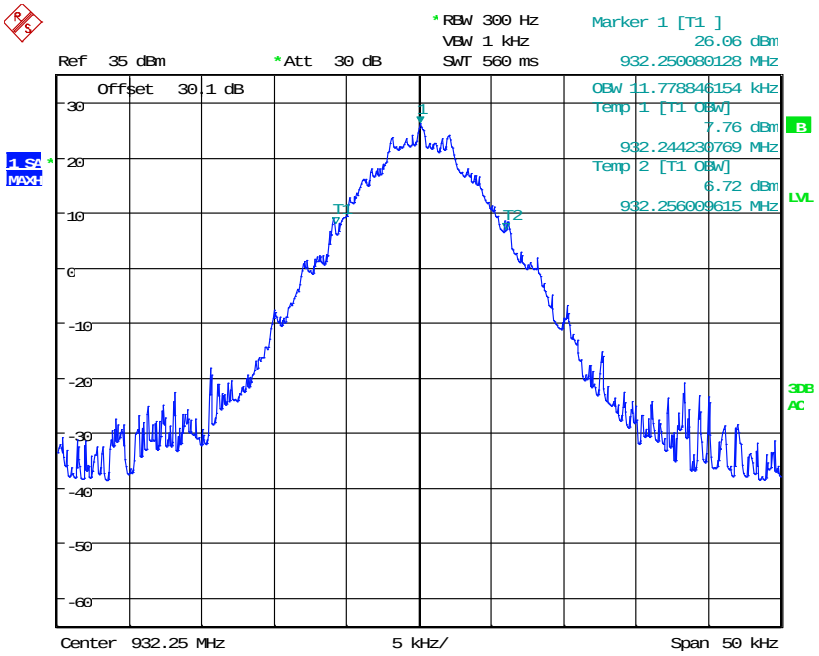


Figure 7.2.3-21: 932.25 MHz – Normal Mode

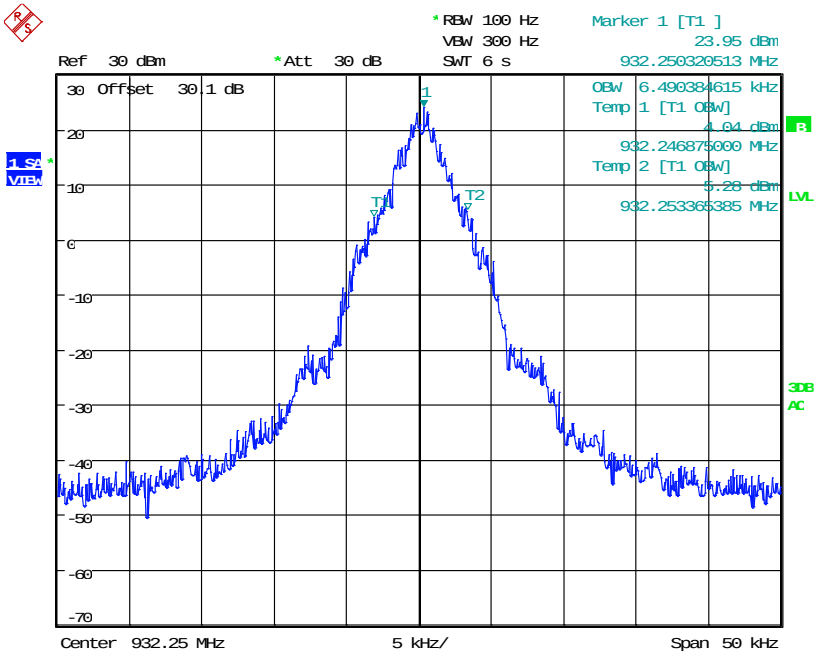


Figure 7.2.3-22: 932.25 MHz –– Priority Mode

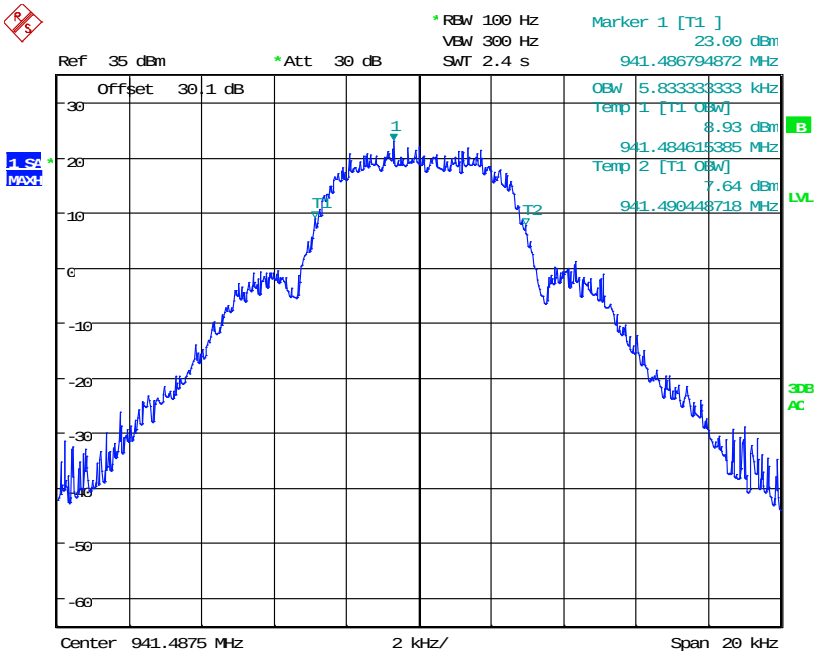


Figure 7.2.3-23: 941.4875 MHz – mPass 5k Mode

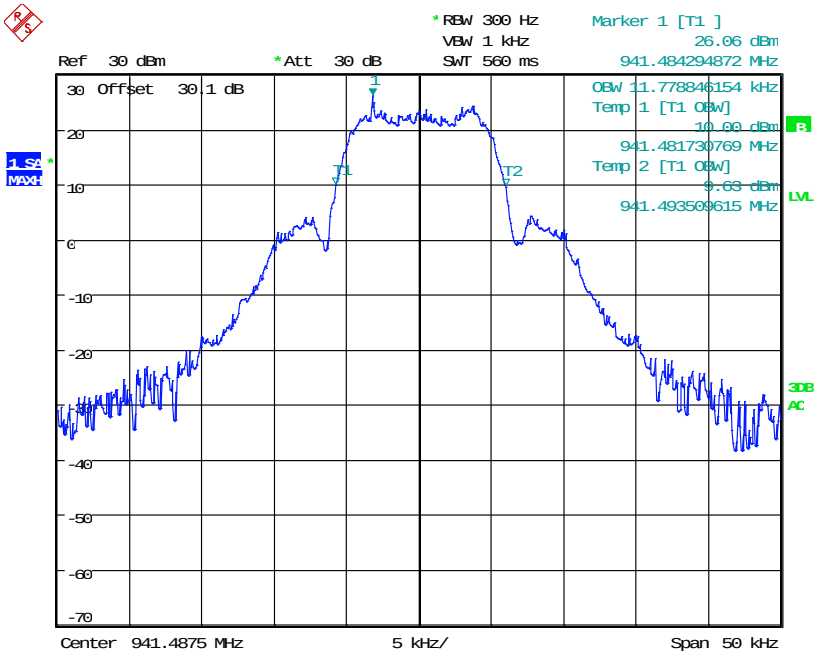


Figure 7.2.3-24: 941.4875 MHz – mPass 10k Mode

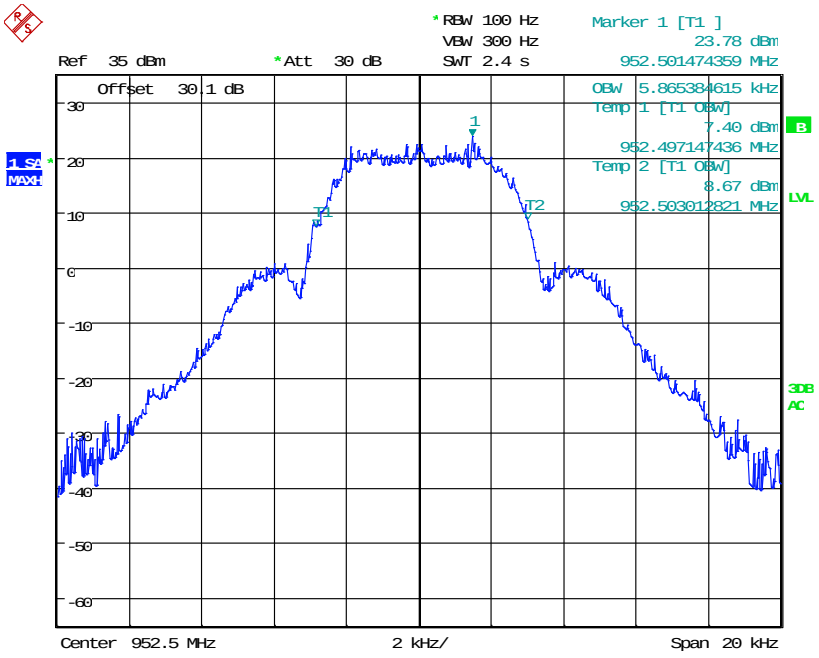


Figure 7.2.3-25: 952.5 MHz – mPass 5k Mode

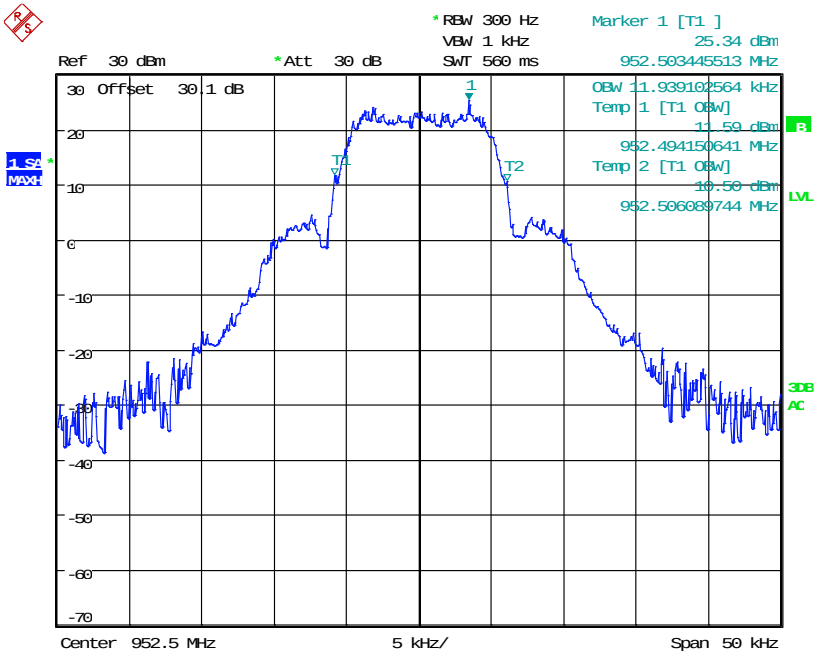
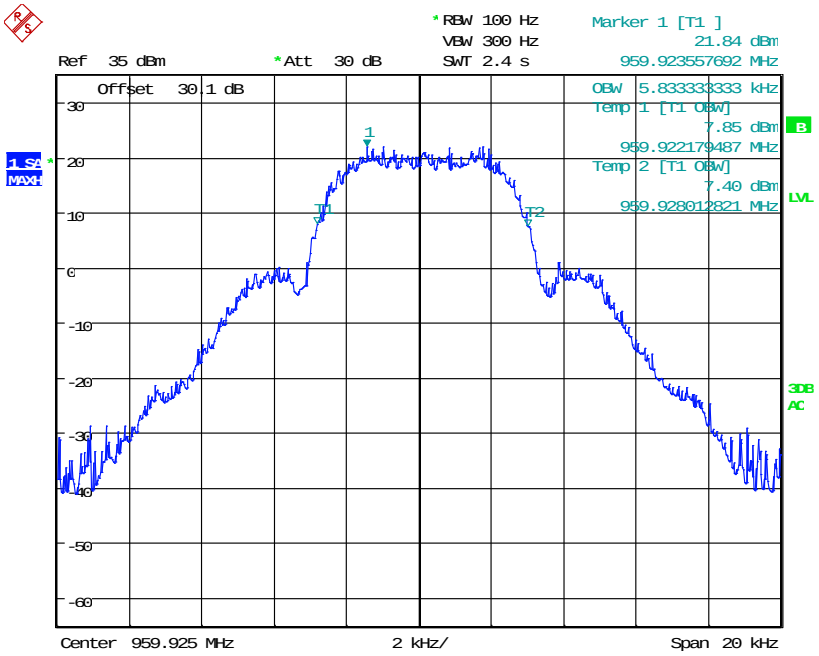
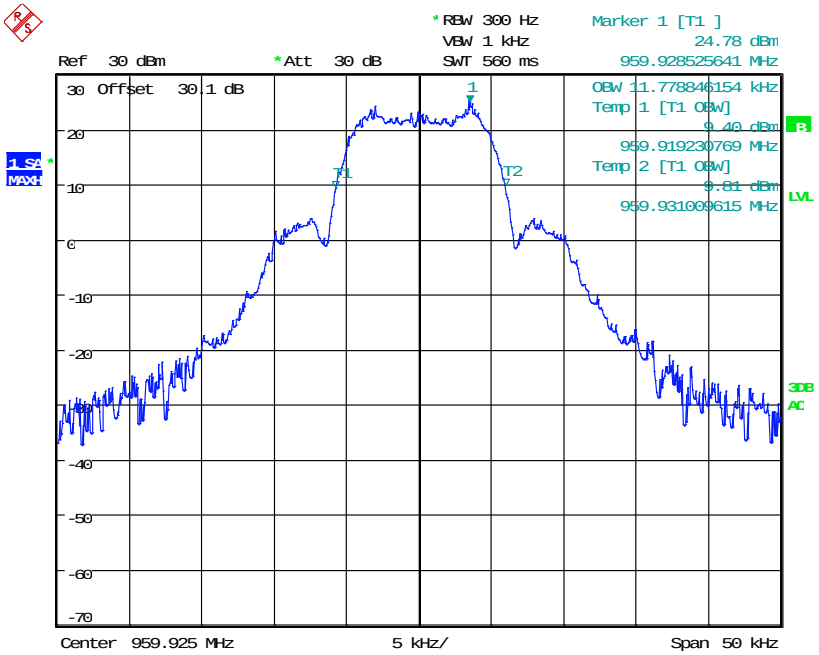


Figure 7.2.3-26: 952.5 MHz – mPass 10k Mode



Date: 24.MAR.2015 17:20:24

Figure 7.2.3-27: 959.925 MHz – mPass 5k Mode



Date: 26.MAR.2015 14:34:37

Figure 7.2.3-28: 959.925 MHz – mPass 10k Mode

7.3 Spurious Emissions at Antenna Terminals

7.3.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer through a 30 dB passive attenuator. The spectrum analyzer resolution bandwidth was set to 100 kHz below 1000 MHz and 1 MHz above 1000 MHz. The internal correction factors of the spectrum analyzer were employed to correct for any cable, attenuator or filter losses. The spectrum was investigated in accordance to CFR 47 Part 2.1057. Results are shown below.

7.3.2 Measurement Results

Part 24.133 a(1), a(2), IC RSS-134 6.3(i), (ii)

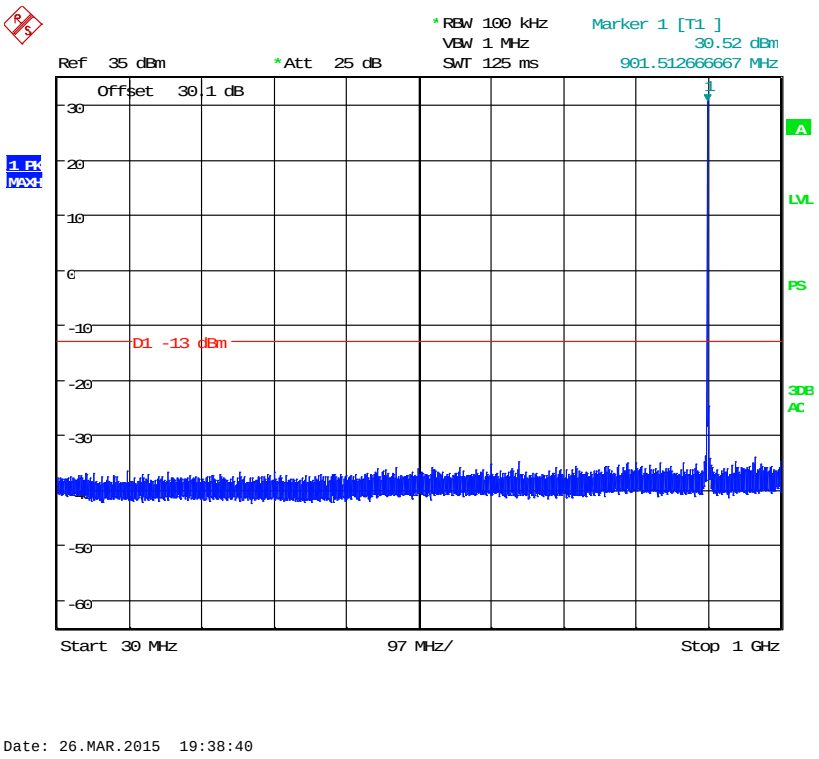


Figure 7.3.2-1: 901.5 MHz – 30MHz to 1GHz

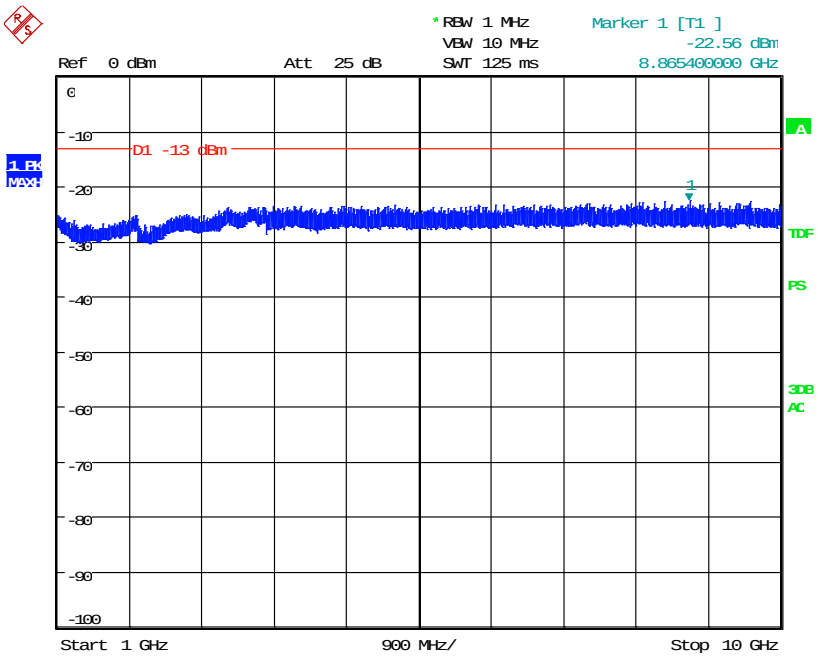


Figure 7.3.2-2: 901.5 MHz – 1GHz to 10GHz

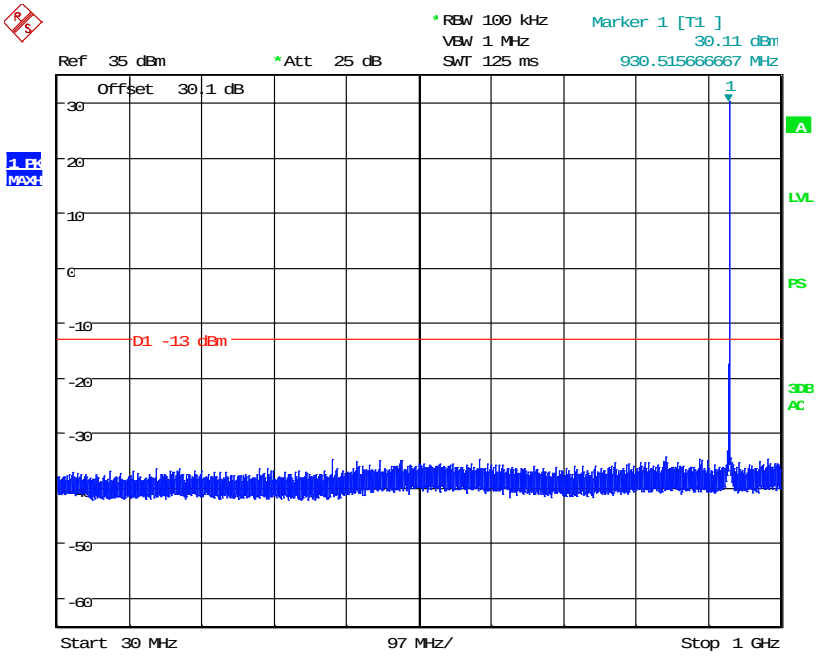


Figure 7.3.2-3: 930.5 MHz – 30MHz to 1GHz

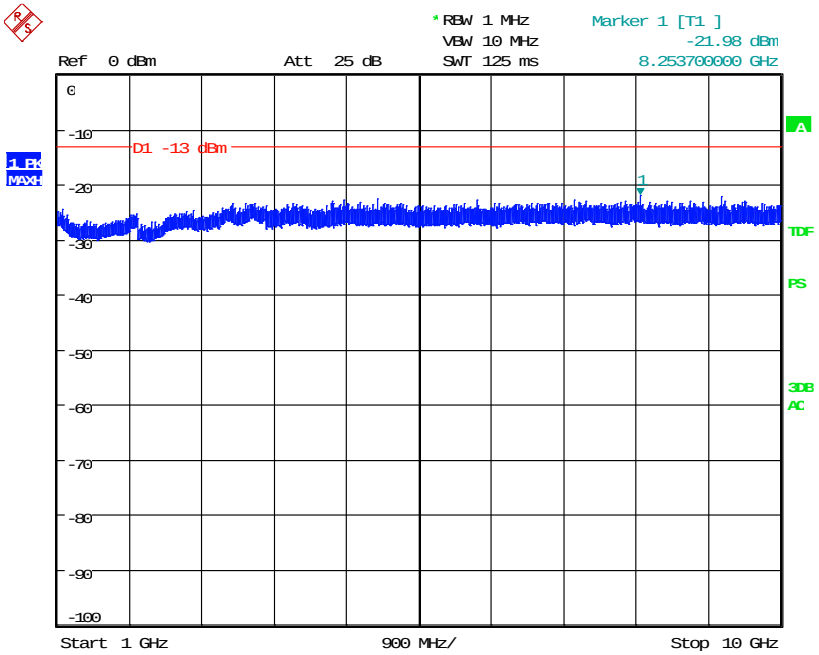
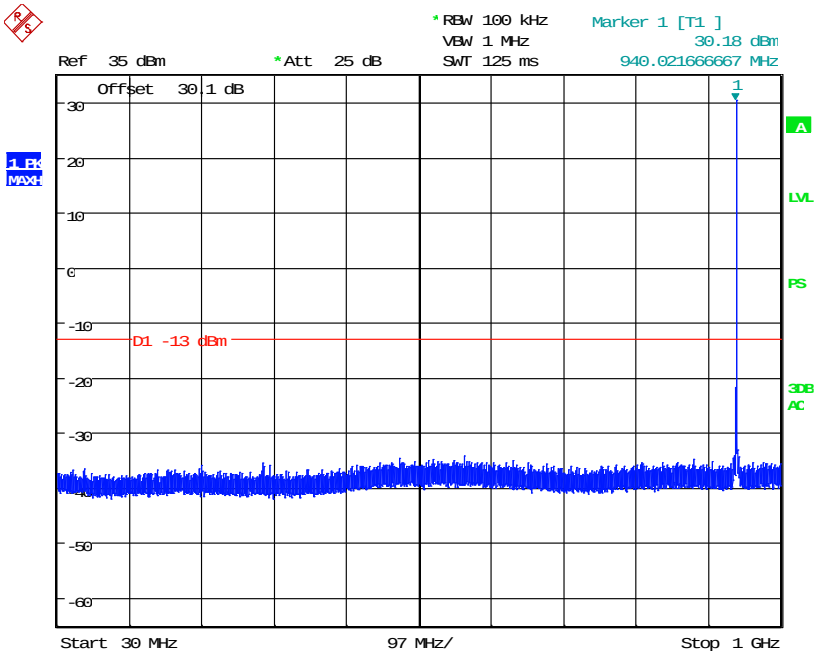
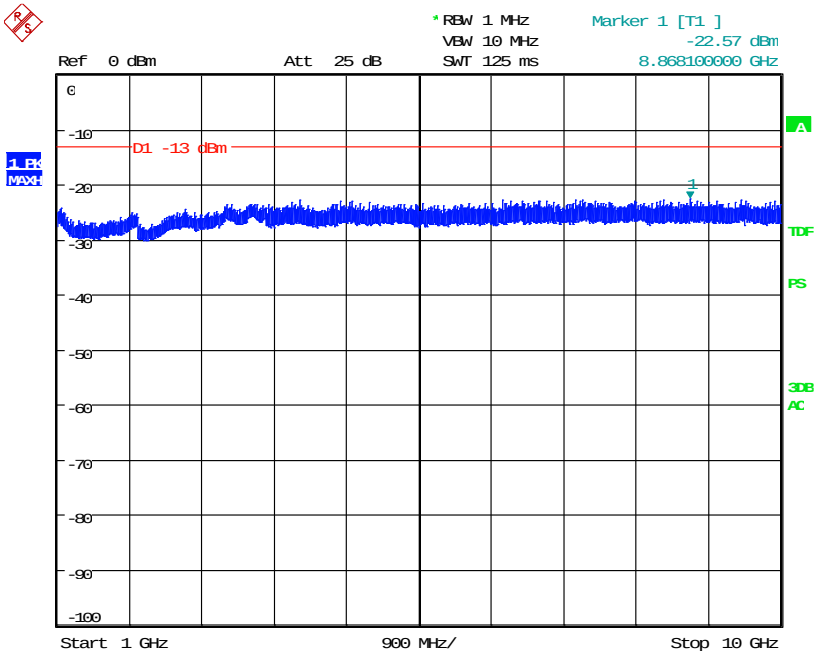


Figure 7.3.2-4: 930.5 MHz – 1GHz to 10GHz



Date: 26.MAR.2015 19:25:52

Figure 7.3.2-5: 940.0125 MHz – 30MHz to 1GHz



Date: 26.MAR.2015 20:08:15

Figure 7.3.2-6: 940.0125 MHz – 1GHz to 10GHz

Part 101.111 a(6), RSS-119 5.8.6

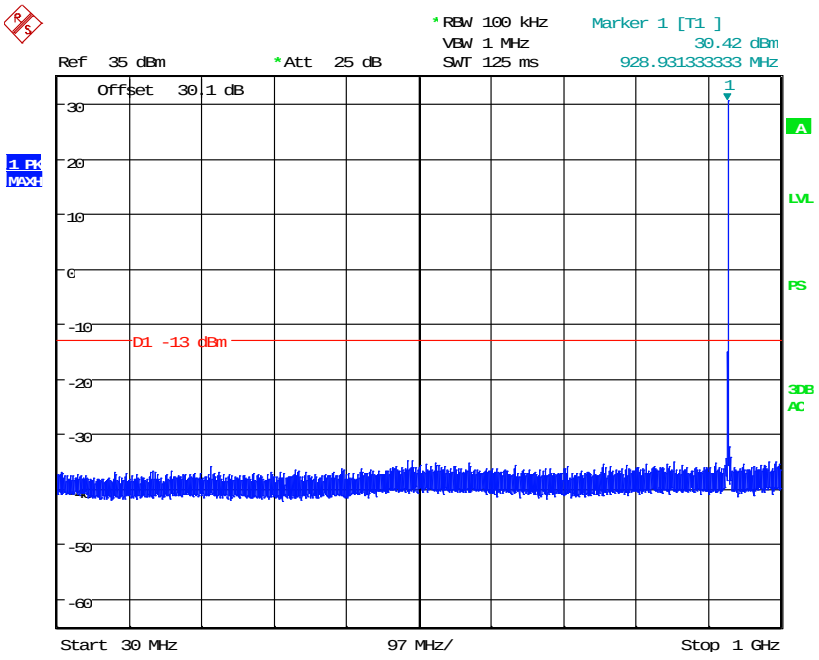


Figure 7.3.2-7: 928.925 MHz – 30MHz to 1GHz

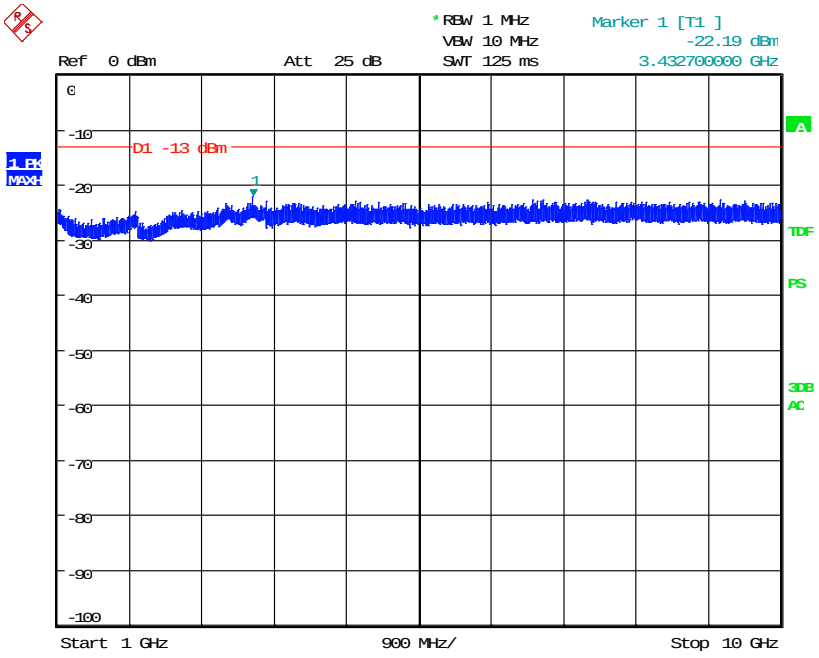


Figure 7.3.2-8: 928.925 MHz – 1GHz to 10GHz

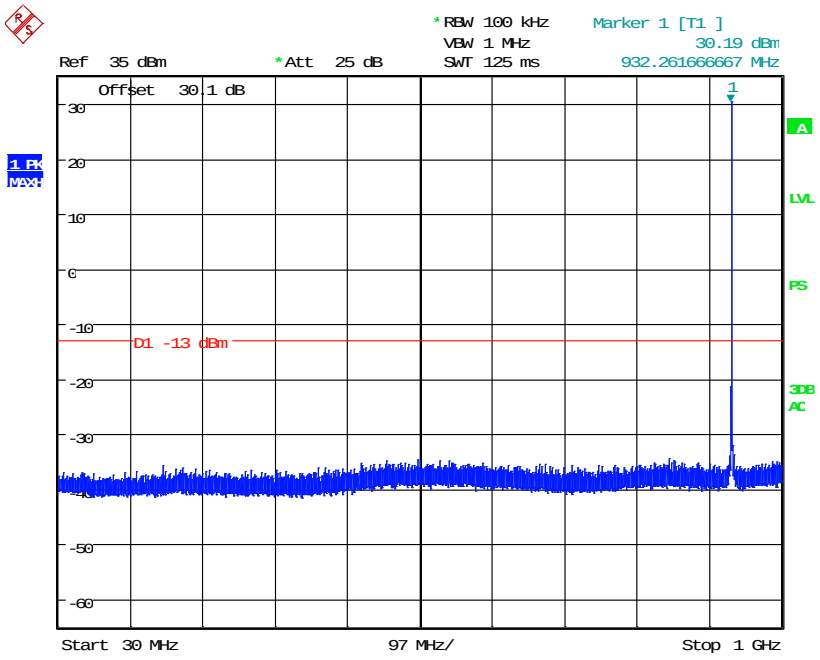


Figure 7.3.2-9: 932.25 MHz – 30MHz to 1GHz

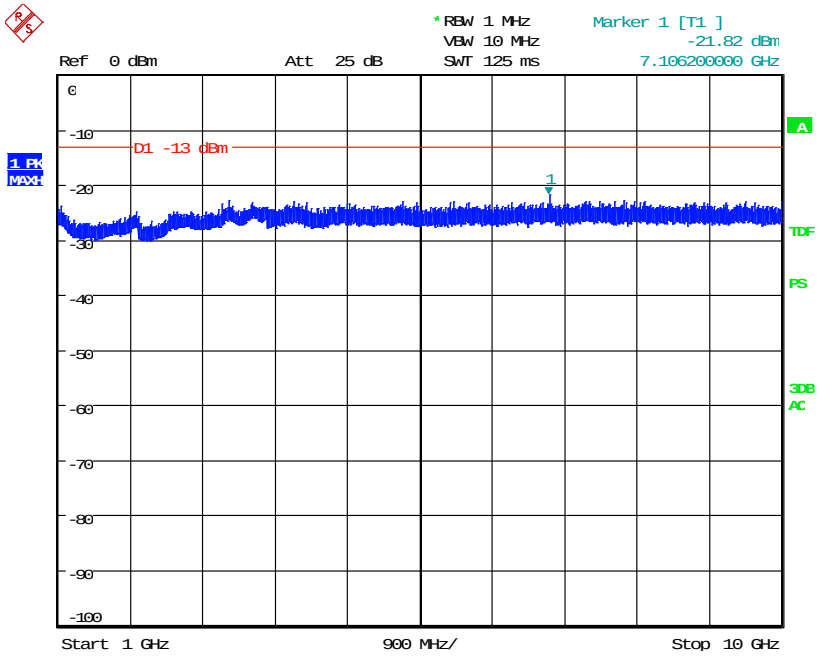


Figure 7.3.2-10: 932.25 MHz – 1GHz to 10GHz

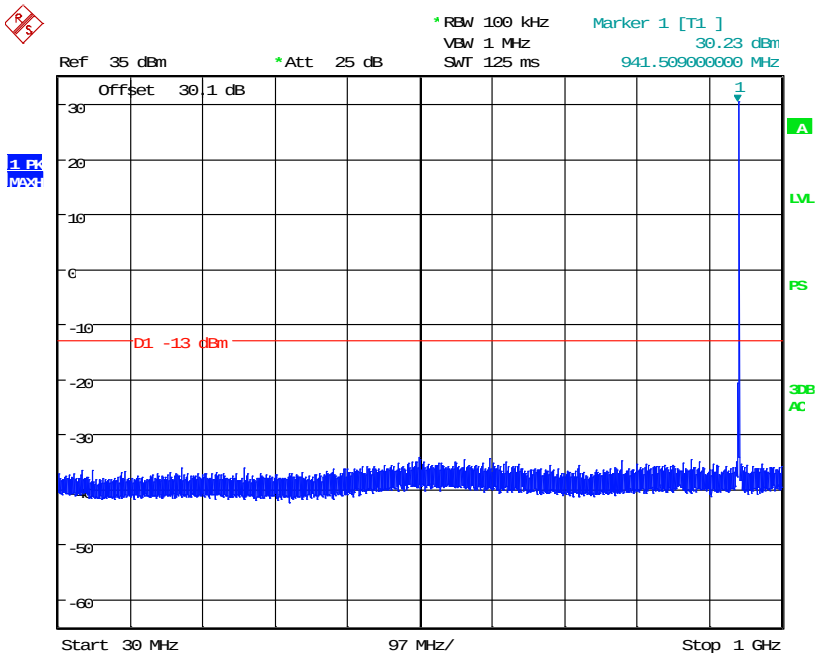


Figure 7.3.2-11: 941.4875 MHz – 30MHz to 1GHz

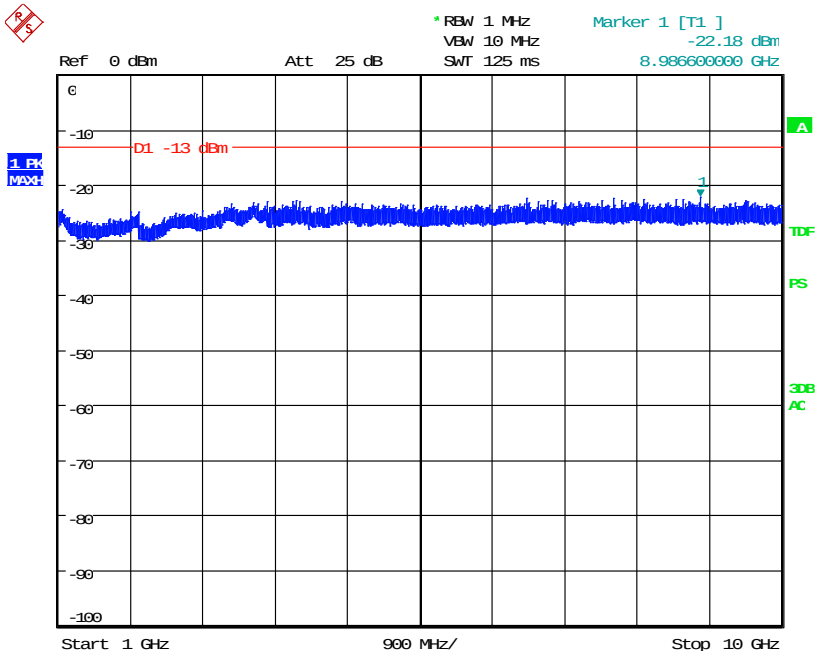


Figure 7.3.2-12: 941.4875 MHz – 1GHz to 10GHz

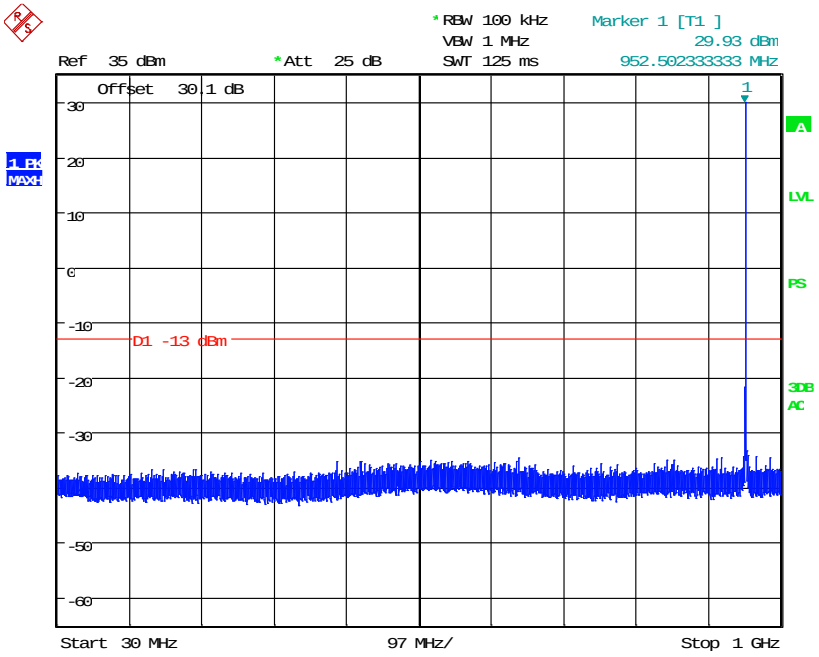


Figure 7.3.2-13: 952.5 MHz – 30MHz to 1GHz

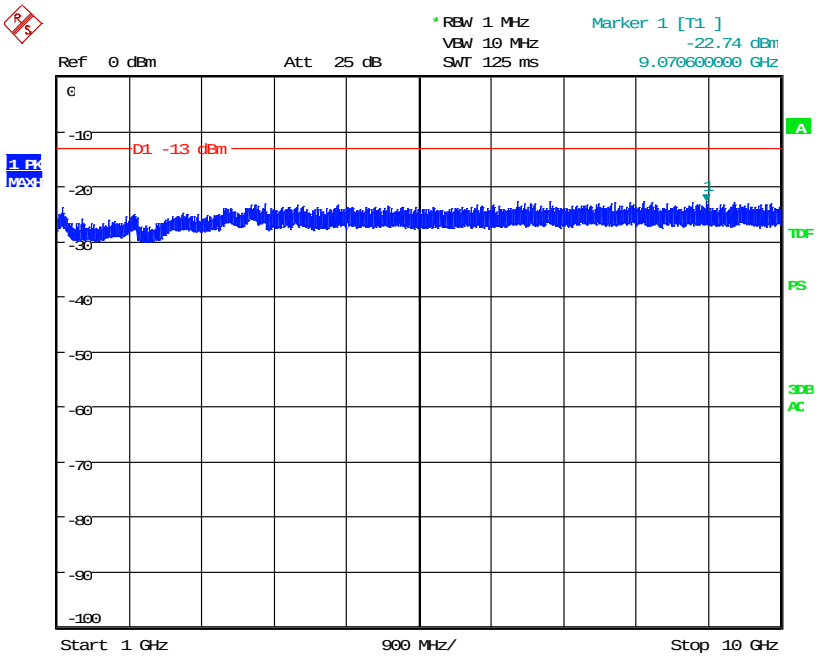


Figure 7.3.2-14: 952.5 MHz – 1GHz to 10GHz

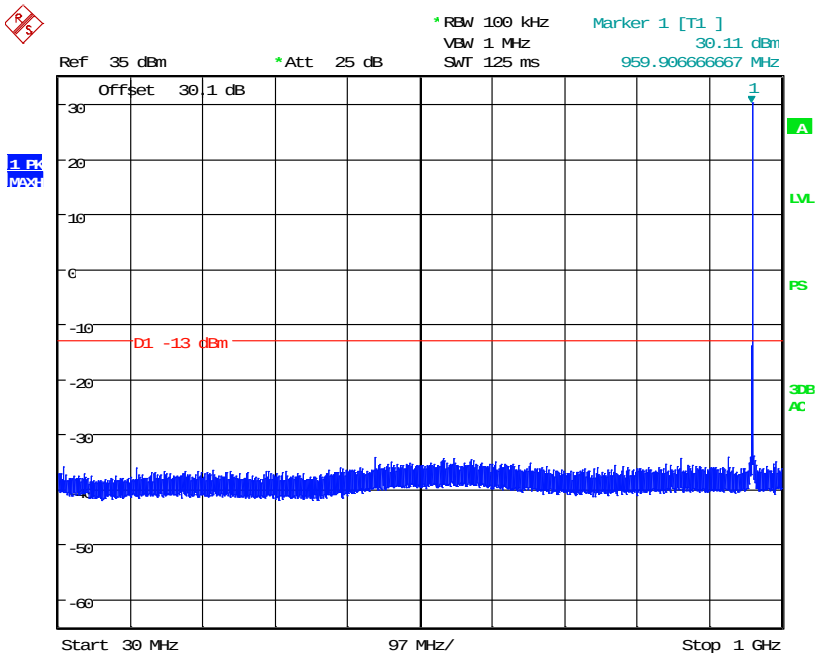


Figure 7.3.2-15: 959.925 MHz – 30MHz to 1GHz

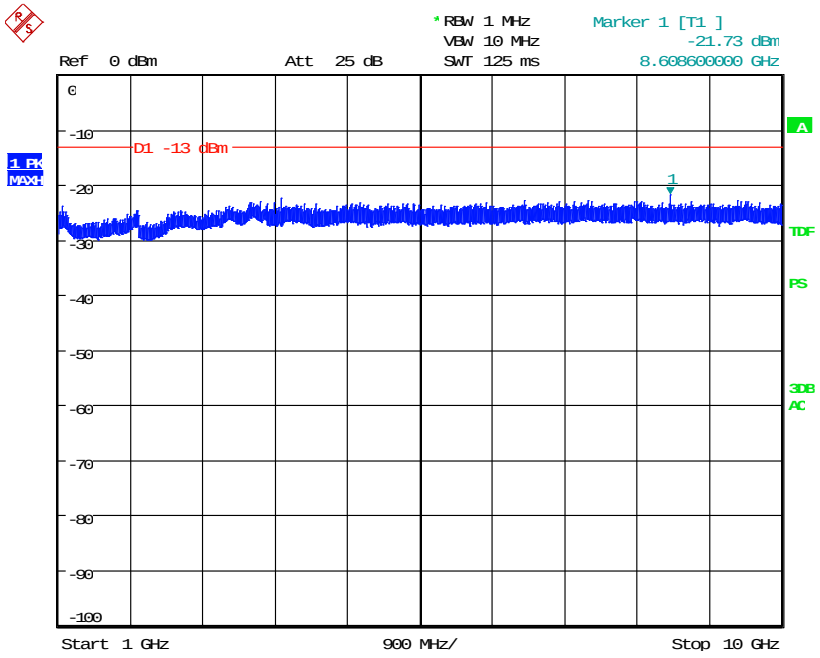


Figure 7.3.2-16: 959.925 MHz – 1GHz to 10GHz

7.4 Field Strength of Spurious Emissions

7.4.1 Measurement Procedure

The equipment under test is placed in the Semi-Anechoic Chamber (described in section 2.3.1) on a wooden table at the turntable center. For each spurious emission, the antenna mast is raised and lowered from one (1) to four (4) meters and the turntable is rotated 360º and the maximum reading on the spectrum analyzer is recorded. This was repeated for both horizontal and vertical polarizations of the receive antenna.

The equipment under test is then replaced with a substitution antenna fed by a signal generator. The signal generator's frequency is set to that of the spurious emission recorded from the equipment under test. The antenna mast is raised and lowered from one (1) to four (4) meters to obtain a maximum reading on the spectrum analyzer. The output of the signal generator is then adjusted until the reading on the spectrum analyzer matches that obtained from the equipment under test. The signal generator level is recorded. The power in dBm of each spurious emission is calculated by correcting the signal generator level for the cable loss and gain of the substitution antenna referenced to a dipole. The spectrum was investigated in accordance to CFR 47 Part 2.1057.

The magnitude of all spurious emissions not reported were attenuated below the noise floor of the measurement system and therefore not specified in this report. Results are shown below.

7.4.2 Measurement Results

Part 24.133 a(1), a(2), RSS-134 6.3(i), (ii)

Table 7.4.2-1: Field Strength of Spurious Emissions – 901.5 MHz – Normal Mode

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1803	-36.35	H	-31.74	-13.00	18.74
2704.5	-43.27	H	-35.49	-13.00	22.49
3606	-52.12	H	-40.54	-13.00	27.54
4507.5	-63.02	H	-50.42	-13.00	37.42
5409	-65.71	H	-51.77	-13.00	38.77
6310.5	-66.39	H	-49.71	-13.00	36.71
7212	-66.15	H	-48.85	-13.00	35.85
1803	-35.97	V	-32.32	-13.00	19.32
2704.5	-45.03	V	-35.04	-13.00	22.04
3606	-55.81	V	-43.12	-13.00	30.12
4507.5	-64.34	V	-53.24	-13.00	40.24
5409	-65.50	V	-50.85	-13.00	37.85
6310.5	-66.67	V	-49.10	-13.00	36.10
7212	-65.55	V	-45.92	-13.00	32.92

NOTE: All frequencies not listed were below the noise floor of the spectrum analyzer.

Table 7.4.2-2: Field Strength of Spurious Emissions – 930.5 MHz – MPass 5k Mode

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1861	-34.17	H	-29.30	-13.00	16.30
2791.5	-45.68	H	-37.04	-13.00	24.04
3722	-51.88	H	-38.44	-13.00	25.44
4652.5	-62.61	H	-49.40	-13.00	36.40
5583	-66.62	H	-53.18	-13.00	40.18
6513.5	-67.12	H	-49.31	-13.00	36.31
7444	-66.32	H	-47.39	-13.00	34.39
1861	-37.16	V	-32.33	-13.00	19.33
2791.5	-45.71	V	-34.64	-13.00	21.64
3722	-57.04	V	-44.24	-13.00	31.24
4652.5	-62.31	V	-47.99	-13.00	34.99
5583	-65.25	V	-49.79	-13.00	36.79
6513.5	-68.30	V	-52.47	-13.00	39.47
7444	-65.68	V	-45.90	-13.00	32.90

NOTE: All frequencies not listed were below the noise floor of the spectrum analyzer.

Table 7.4.2-3: Field Strength of Spurious Emissions – 940.0125 MHz – MPass 5k Mode

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1880.025	-36.15	H	-31.24	-13.00	18.24
2820.0375	-48.47	H	-40.63	-13.00	27.63
3760.05	-54.69	H	-41.64	-13.00	28.64
4700.0625	-64.03	H	-54.47	-13.00	41.47
5640.075	-66.94	H	-55.22	-13.00	42.22
6580.0875	-66.79	H	-55.15	-13.00	42.15
7520.1	-66.43	H	-48.19	-13.00	35.19
1880.025	-38.69	V	-34.09	-13.00	21.09
2820.0375	-47.48	V	-37.17	-13.00	24.17
3760.05	-59.13	V	-46.66	-13.00	33.66
4700.0625	-62.93	V	-49.88	-13.00	36.88
5640.075	-66.41	V	-53.19	-13.00	40.19
6580.0875	-66.81	V	-53.30	-13.00	40.30
7520.1	-65.65	V	-47.15	-13.00	34.15

NOTE: All frequencies not listed were below the noise floor of the spectrum analyzer.

Part 101.111 a(6), RSS-119 5.8.6

Table 7.4.2-4: Field Strength of Spurious Emissions – 928.925 MHz – Normal Mode

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1857.85	-33.65	H	-28.89	-13.00	15.89
2786.775	-47.95	H	-39.57	-13.00	26.57
3715.7	-53.64	H	-41.67	-13.00	28.67
4644.625	-62.84	H	-49.68	-13.00	36.68
5573.55	-66.26	H	-52.30	-13.00	39.30
6502.475	-66.96	H	-48.44	-13.00	35.44
1857.85	-37.15	V	-32.58	-13.00	19.58
2786.775	-46.69	V	-36.15	-13.00	23.15
3715.7	-57.75	V	-45.90	-13.00	32.90
4644.625	-62.16	V	-47.06	-13.00	34.06
5573.55	-65.96	V	-50.67	-13.00	37.67
6502.475	-68.25	V	-52.87	-13.00	39.87
7431.4	-65.40	V	-42.72	-13.00	29.72

NOTE: All frequencies not listed were below the noise floor of the spectrum analyzer.

Table 7.4.2-5: Field Strength of Spurious Emissions – 932.25 MHz – Normal Mode

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1864.5	-34.66	H	-30.03	-13.00	17.03
2796.75	-46.78	H	-38.21	-13.00	25.21
3729	-52.47	H	-39.55	-13.00	26.55
4661.25	-62.93	H	-49.93	-13.00	36.93
5593.5	-66.59	H	-53.27	-13.00	40.27
6525.75	-67.06	H	-49.40	-13.00	36.40
7458	-66.14	H	-45.83	-13.00	32.83
1864.5	-39.47	V	-35.01	-13.00	22.01
2796.75	-45.98	V	-34.93	-13.00	21.93
3729	-56.61	V	-44.03	-13.00	31.03
4661.25	-62.14	V	-48.08	-13.00	35.08
5593.5	-65.75	V	-50.55	-13.00	37.55
6525.75	-66.71	V	-48.32	-13.00	35.32
7458	-65.80	V	-65.44	-13.00	52.44

NOTE: All frequencies not listed were below the noise floor of the spectrum analyzer.

Table 7.4.2-6: Field Strength of Spurious Emissions – 941.4875 MHz – MPass 5k Mode

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1882.975	-38.41	H	-33.18	-13.00	20.18
2824.4625	-48.19	H	-39.68	-13.00	26.68
3765.95	-55.99	H	-43.28	-13.00	30.28
4707.4375	-62.54	H	-48.36	-13.00	35.36
5648.925	-67.28	H	-56.13	-13.00	43.13
6590.4125	-67.16	H	-56.20	-13.00	43.20
1882.975	-43.17	V	-38.57	-13.00	25.57
2824.4625	-47.15	V	-35.70	-13.00	22.70
3765.95	-56.35	V	-42.59	-13.00	29.59
4707.4375	-63.31	V	-49.30	-13.00	36.30
5648.925	-67.14	V	-55.12	-13.00	42.12
6590.4125	-67.30	V	-55.16	-13.00	42.16
7531.9	-65.21	V	-44.78	-13.00	31.78
8473.3875	-66.25	V	-47.20	-13.00	34.20

NOTE: All frequencies not listed were below the noise floor of the spectrum analyzer.

Table 7.4.2-7: Field Strength of Spurious Emissions – 952.5 MHz – MPass 5k Mode

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1905	-43.01	H	-37.70	-13.00	24.70
2857.5	-53.14	H	-44.66	-13.00	31.66
3810	-60.39	H	-50.40	-13.00	37.40
4762.5	-64.36	H	-51.87	-13.00	38.87
5715	-67.50	H	-55.93	-13.00	42.93
6667.5	-67.68	H	-50.39	-13.00	37.39
1905	-44.08	V	-38.22	-13.00	25.22
2857.5	-52.54	V	-41.24	-13.00	28.24
3810	-61.66	V	-52.56	-13.00	39.56
4762.5	-63.23	V	-48.33	-13.00	35.33
5715	-67.28	V	-54.71	-13.00	41.71
6667.5	-67.90	V	-49.14	-13.00	36.14
7620	-67.43	V	-48.57	-13.00	35.57

NOTE: All frequencies not listed were below the noise floor of the spectrum analyzer.

Table 7.4.2-8: Field Strength of Spurious Emissions – 959.925 MHz – MPass 5k Mode

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1919.85	-47.78	H	-42.81	-13.00	29.81
2879.775	-51.50	H	-39.88	-13.00	26.88
3839.7	-60.34	H	-50.60	-13.00	37.60
4799.625	-64.40	H	-53.31	-13.00	40.31
5759.55	-68.32	H	-59.26	-13.00	46.26
1919.85	-46.73	V	-41.29	-13.00	28.29
2879.775	-52.77	V	-41.71	-13.00	28.71
3839.7	-61.31	V	-51.44	-13.00	38.44
4799.625	-62.42	V	-48.43	-13.00	35.43
5759.55	-66.59	V	-52.84	-13.00	39.84
6719.475	-66.78	V	-53.53	-13.00	40.53

NOTE: All frequencies not listed were below the noise floor of the spectrum analyzer.

7.5 Frequency Stability

7.5.1 Measurement Procedure

The equipment under test is placed inside an environmental chamber. The RF output is directly coupled to the input of the measurement equipment and a power supply is attached to the primary supply voltage.

Frequency measurements were made at the extremes of the of temperature range -30º C to +50º C and at intervals of 10º C at normal supply voltage. A period of time sufficient to stabilize all components of the equipment was allowed at each frequency measurement. At a temperature 20º C the measurements were performed at +/- 15% of the nominal voltage. The maximum variation of frequency was recorded.

Results of the test are shown below.

7.5.2 Measurement Results

Part 24.135, RSS-134 (7)

Frequency Stability

Frequency (MHz): 901.5
Deviation Limit (PPM): 1ppm

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VDC)
-30 C	**901.500048**	**0.053**	100%	4.00
-20 C	**901.499519**	**-0.533**	100%	4.00
-10 C	**901.499928**	**-0.080**	100%	4.00
0 C	**901.499976**	**-0.027**	100%	4.00
10 C	**901.499960**	**-0.044**	100%	4.00
20 C	**901.499840**	**-0.178**	100%	4.00
30 C	**901.499808**	**-0.213**	100%	4.00
40 C	**901.499744**	**-0.284**	100%	4.00
50 C	**901.500096**	**0.107**	100%	4.00
20 C	**901.499840**	**-0.178**	85%	3.40
20 C	**901.499840**	**-0.178**	115%	4.60

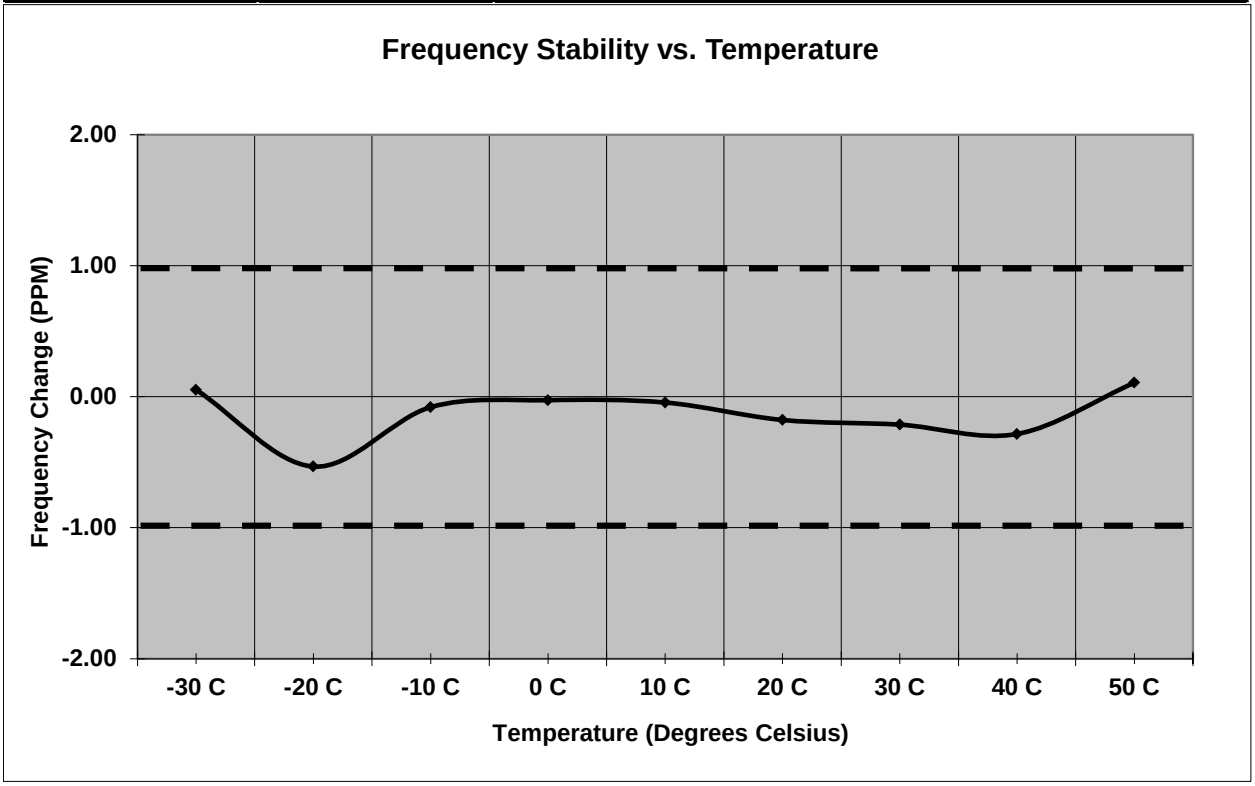


Figure 7.5.2-1: Frequency Stability – 901.5 MHz

Part 24.135, RSS-134 (7)

Frequency Stability

Frequency (MHz): 930.5

Deviation Limit (PPM): 1ppm

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VDC)
-30 C	**930.500056**	**0.060**	100%	4.00
-20 C	**930.500024**	**0.026**	100%	4.00
-10 C	**930.499944**	**-0.060**	100%	4.00
0 C	**930.499984**	**-0.017**	100%	4.00
10 C	**930.499952**	**-0.052**	100%	4.00
20 C	**930.499872**	**-0.138**	100%	4.00
30 C	**930.499808**	**-0.207**	100%	4.00
40 C	**930.499808**	**-0.207**	100%	4.00
50 C	**930.500128**	**0.138**	100%	4.00
20 C	**930.499872**	**-0.138**	85%	3.40
20 C	**930.499872**	**-0.138**	115%	4.60

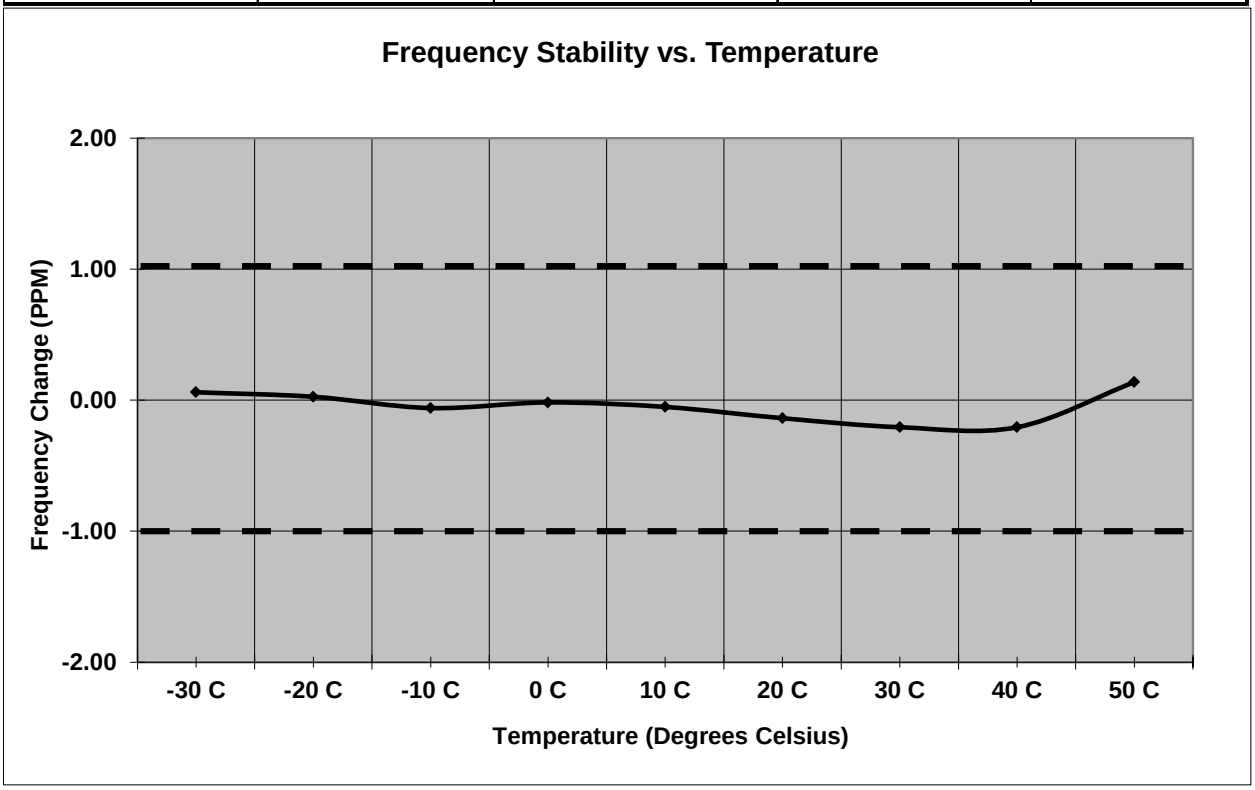


Figure 7.5.2-2: Frequency Stability – 930.5 MHz

Part 101.107, RSS-119 5.3

Frequency Stability

Frequency (MHz): 959.925

Deviation Limit (PPM): 1ppm

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VDC)
-30 C	**959.925064**	**0.067**	100%	4.00
-20 C	**959.925024**	**0.025**	100%	4.00
-10 C	**959.924928**	**-0.075**	100%	4.00
0 C	**959.925016**	**0.017**	100%	4.00
10 C	**959.924968**	**-0.033**	100%	4.00
20 C	**959.924904**	**-0.100**	100%	4.00
30 C	**959.924872**	**-0.134**	100%	4.00
40 C	**959.924808**	**-0.200**	100%	4.00
50 C	**959.924840**	**-0.167**	100%	4.00
20 C	**959.924904**	**-0.100**	85%	3.40
20 C	**959.924904**	**-0.100**	115%	4.60

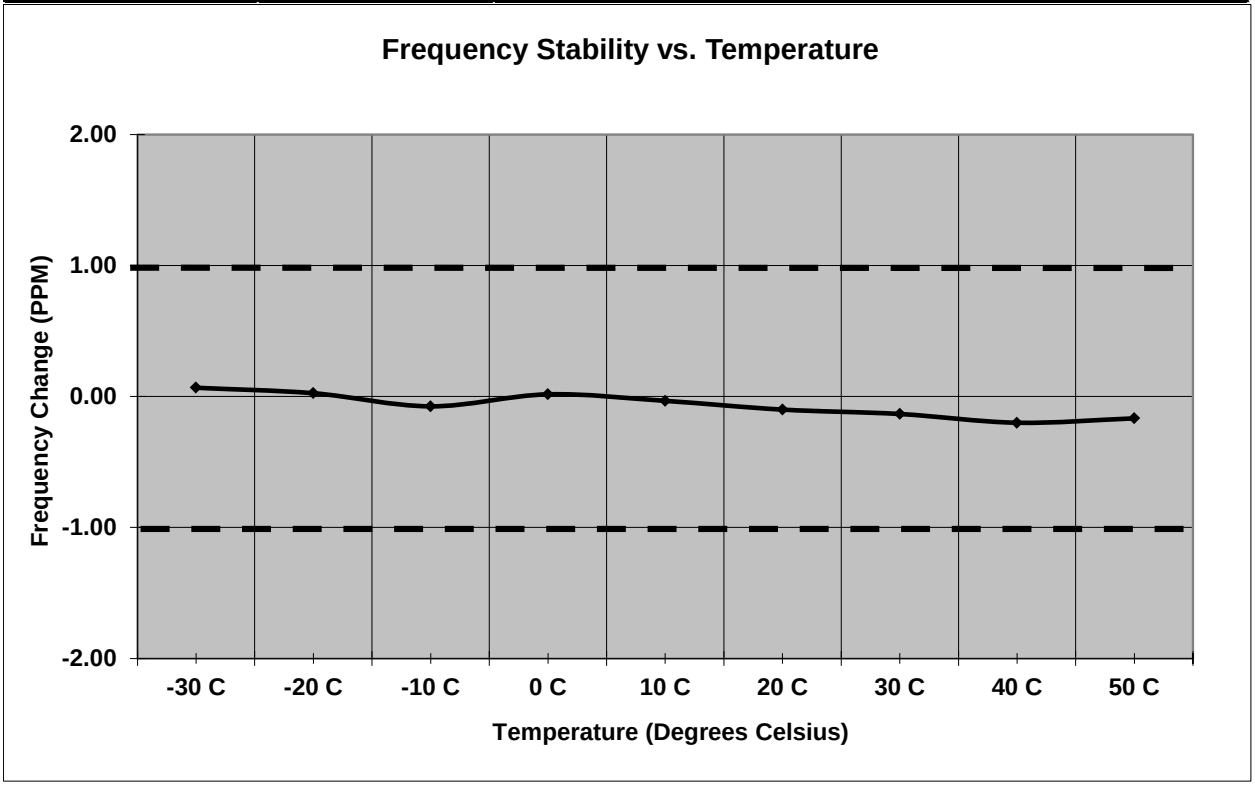


Figure 7.5.2-3: Frequency Stability – 959.925 MHz

8.0 CONCLUSION

In the opinion of ACS, Inc. the model FLEXI210, manufactured by Sensus Metering Systems, Inc., meets all the requirements of FCC Part 24D and Part 101 as well as Industry Canada RSS-119 and RSS-134 where applicable.

End Report