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FCC PART 80

RADAR TEST REPORT

APPLICANT	GUIDANCE NAVIGATION LIMITED
	5 TIBER WAY MERIDIAN BUSINESS PARK
	LEICESTER LE19 1RP UNITED KINGDOM
FCC ID	VYMARTEMIS
MODEL NUMBER	ARTEMIS
PRODUCT DESCRIPTION	MARINE RADAR
DATE SAMPLE RECEIVED	7/20/2016
FINAL TEST DATE	10/3/2016
TESTED BY	Christian Pawlak
APPROVED BY	Cory Leverett
TEST RESULTS	<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL

Report Number	Version Number	Description	Issue Date
1422AUT16TestReport_	Rev1	Initial Issue	01/20/2017
1422AUT16TestReport_	Rev2	Added antenna information	01/31/2017

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WITHOUT THE WRITTEN APPROVAL OF TIMCO ENGINEERING, INC.

TABLE OF CONTENTS

GENERAL REMARKS.....	3
EUT SPECIFICATION.....	4
TEST SETUP INFORMATION	4
TEST REPORT SUMMARY	5
RF POWER OUTPUT	6
TEST DATA: MEASUREMENT TABLE	6
MODULATION CHARACTERISTICS	7
TEST DATA: PULSE PROFILE – F1 – OPEN PLOT	8
Test Data: PULSE INTERVAL – F1 – OPEN PLOT	9
TEST DATA: PULSE PROFILE – F1 – CLOSED PLOT	10
TEST DATA: PULSE INTERVAL – F1 – CLOSED PLOT	11
TEST DATA: PULSE PROFILE – F2 – OPEN PLOT	12
TEST DATA: PULSE INTERVAL – F2 – OPEN PLOT	13
TEST DATA: PULSE PROFILE – F2 – CLOSED PLOT	14
TEST DATA: PULSE INTERVAL – F2 – CLOSED PLOT	15
TEST DATA: PULSE PROFILE – F3 – OPEN PLOT	16
TEST DATA: PULSE INTERVAL – F3 – OPEN PLOT	17
TEST DATA: PULSE PROFILE – F3 – CLOSED PLOT	18
TEST DATA: PULSE INTERVAL – F3 – CLOSED PLOT	19
OCCUPIED BANDWIDTH.....	20
TEST DATA: F1 – OPEN PLOT	21
TEST DATA: F1 – CLOSED PLOT	22
TEST DATA: F2 – OPEN PLOT	23
TEST DATA: F2 – CLOSED PLOT	24
TEST DATA: F3 – OPEN PLOT	25
TEST DATA: F3 – CLOSED PLOT	26
SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)	27
TEST DATA: MEASUREMENT TABLE	27
FIELD STRENGTH OF SPURIOUS EMISSIONS.....	28
TEST DATA: MEASUREMENT TABLE	28
FREQUENCY STABILITY.....	29
TEST DATA: MEASUREMENT TABLE	29
EQUIPMENT LIST	30

GENERAL REMARKS

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Summary

The device under test does:

- Fulfill the general approval requirements as identified in this test report and was selected by the customer.
- Not fulfill the general approval requirements as identified in this test report

Attestations

This equipment has been tested in accordance with the standards identified in this test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report.

All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025 requirements.

I attest that the necessary measurements were made at:

Timco Engineering Inc.
849 NW State Road 45
Newberry, FL 32669



Tested by: _____
Christian Pawlak, Project Manager/Testing Technician

Date: 12/27/2016



Reviewed and approved by: _____
Name and Title: Cory Leverett, Engineer

Date: 01/20/2016

EUT SPECIFICATION

EUT Description	MARINE RADAR
FCC ID	VYMARTEMIS
Model Number	ARTEMIS
Serial Number	N/A
Operating Frequency	9.2-9.3 GHz
Type of Emission	PON
Antenna	Model 20-0212-4, Slotted Waveguide, 28dBi Gain
EUT Power Source	<input checked="" type="checkbox"/> 240VAC/50–60Hz Shipboard Only
	<input type="checkbox"/> DC Power ()
	<input type="checkbox"/> Battery Operated Exclusively
Test Item	<input type="checkbox"/> Prototype
	<input type="checkbox"/> Pre-Production
	<input checked="" type="checkbox"/> Production
Type of Equipment	<input type="checkbox"/> Fixed
	<input checked="" type="checkbox"/> Mobile
	<input type="checkbox"/> Portable

TEST SETUP INFORMATION

Test facility	Timco Engineering, Inc. 849 NW State Road 45, Newberry, FL 32669
Test Condition	The EUT was tested under normal temperature and humidity. The temperature was 26°C with a relative humidity of 50%.
Modifications	None
Test Exercise	The EUT was placed in continuous transmit mode of operation
Applicable Standards	FCC CFR 47 Part 80

TEST REPORT SUMMARY

Rule Part No.	Scope of Work	Status Pass/Fail/NA
<u>Part 2.1033(c)(8),</u> <u>Part 2.1046(a), Part 80</u>	RF Power Output	Pass
<u>Part 2.1033(c) (4)</u> <u>Part 2.1047(a)(6)</u> <u>Part 80.213</u>	Modulation Characteristics	Pass
<u>2.1049(c), 80.209(b), 80.211(f)</u>	Emission Mask and Occupied Bandwidths	Pass
<u>2.1051(a), 80.211(f)</u>	Antenna Conducted Emissions	Pass
<u>2.1053, 80.211(f)</u>	Field Strength Spurious Emissions	Pass
<u>Part 2.1055, Part 80.209</u>	Frequency Stability	Pass

RF POWER OUTPUT

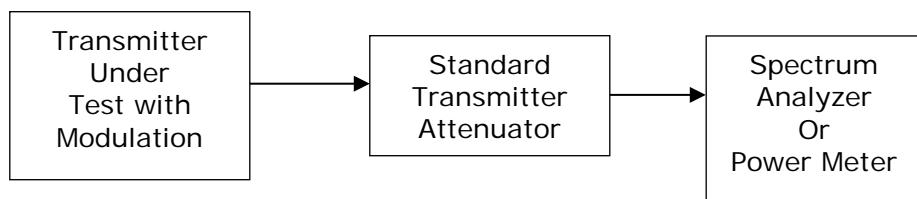
Rule Part No.: Part 2.1046(a), Part 80.215(a)(3)

Requirements: None

Method of Measurement: RF power is measured by connecting a 50-ohm, Peak Power meter to the RF output connector. With a nominal voltage, and the transmitter properly adjusted the RF output measures:

Test Setup Diagram:

b) Method of Measurement



TEST DATA: MEASUREMENT TABLE

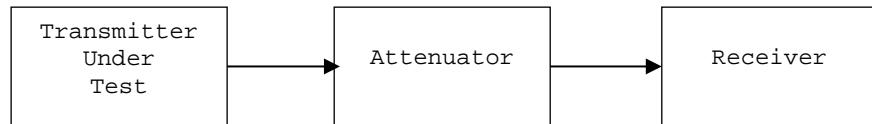
Pulse Type	Peak Power	Mean Power
Open	100 mW	33 mW
Closed	100 mW	33 mW

MODULATION CHARACTERISTICS

Rule Part No.: 2.1047, 80.213(g)

Method of Measurement: ANSI/TIA 603-D

Test Setup Diagram:

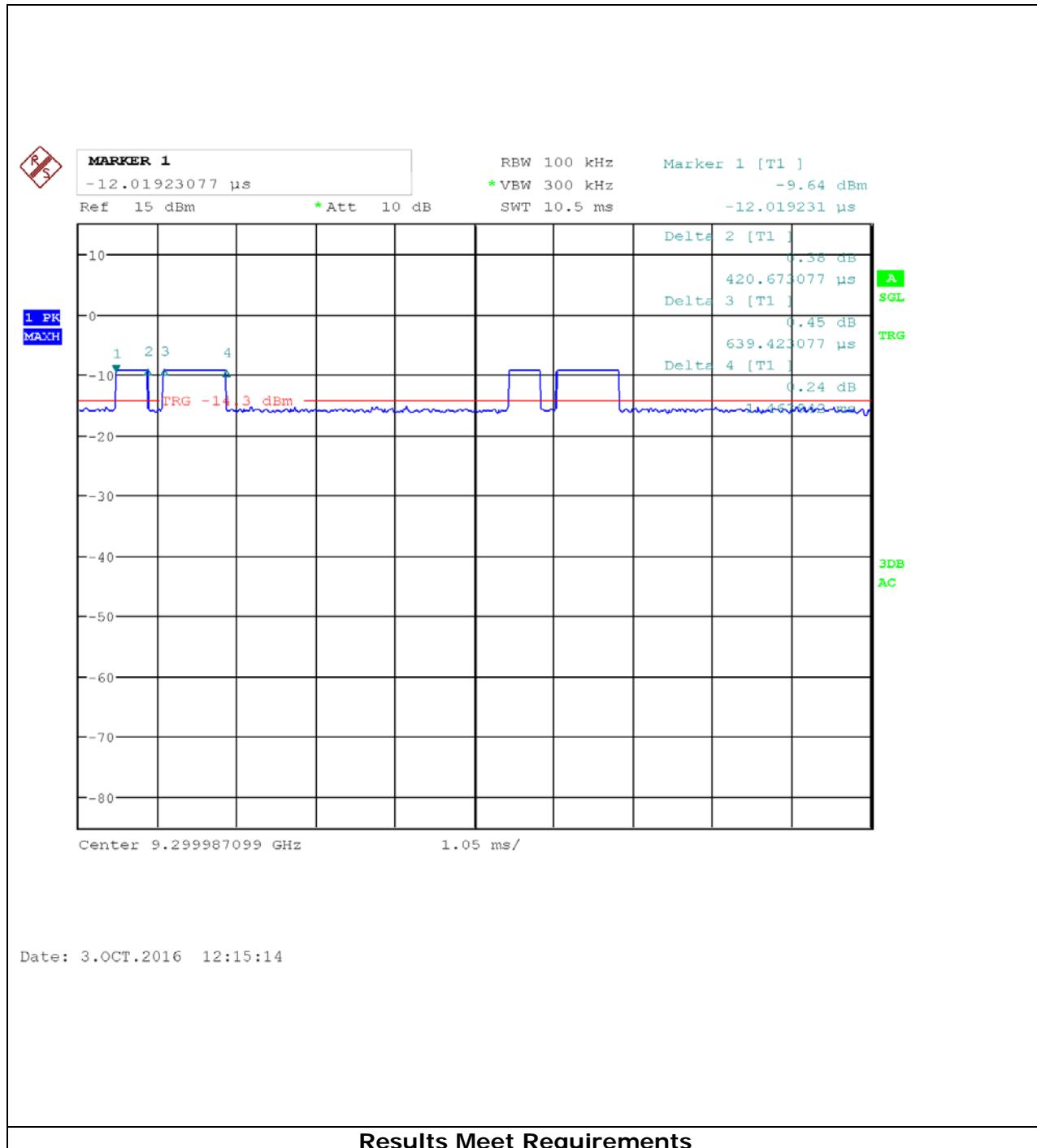


Requirements: Band edge tested in Occupied Bandwidth section.
No additional requirements.

Test Data: EUT emits a pulse train over a lower power CW carrier.

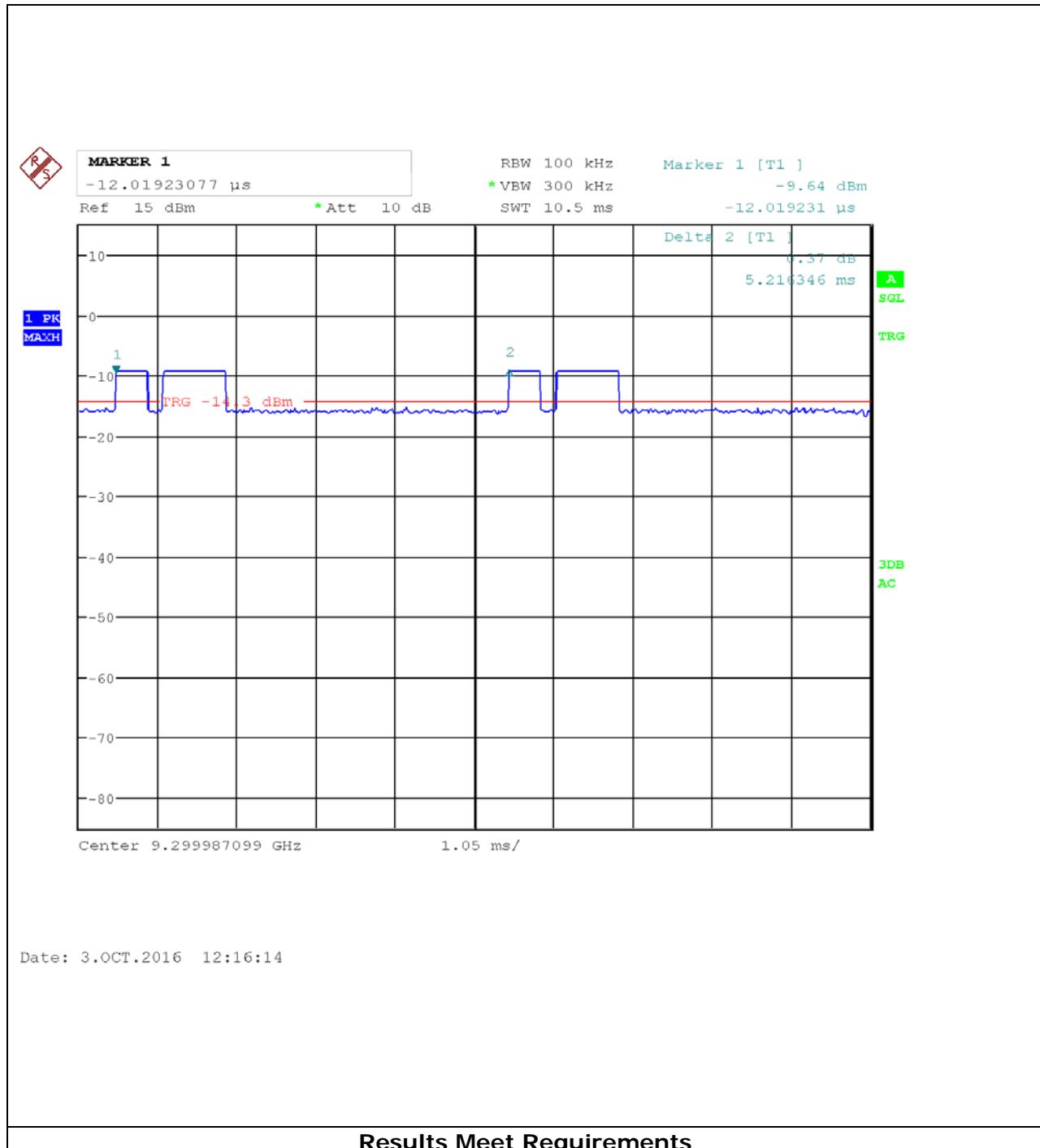
MODULATION CHARACTERISTICS

TEST DATA: PULSE PROFILE – F1 – OPEN PLOT



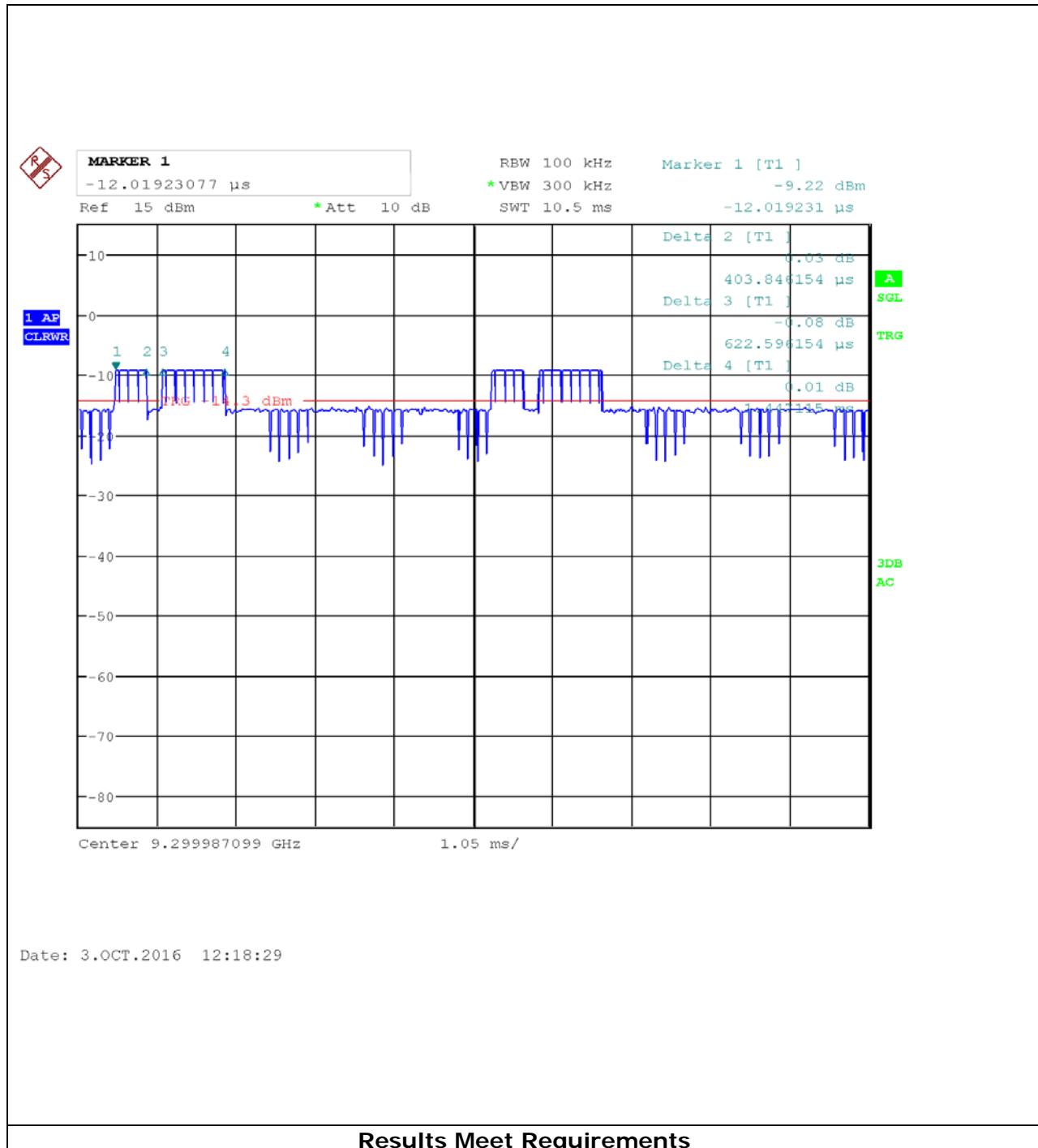
MODULATION CHARACTERISTICS

Test Data: PULSE INTERVAL – F1 – OPEN PLOT



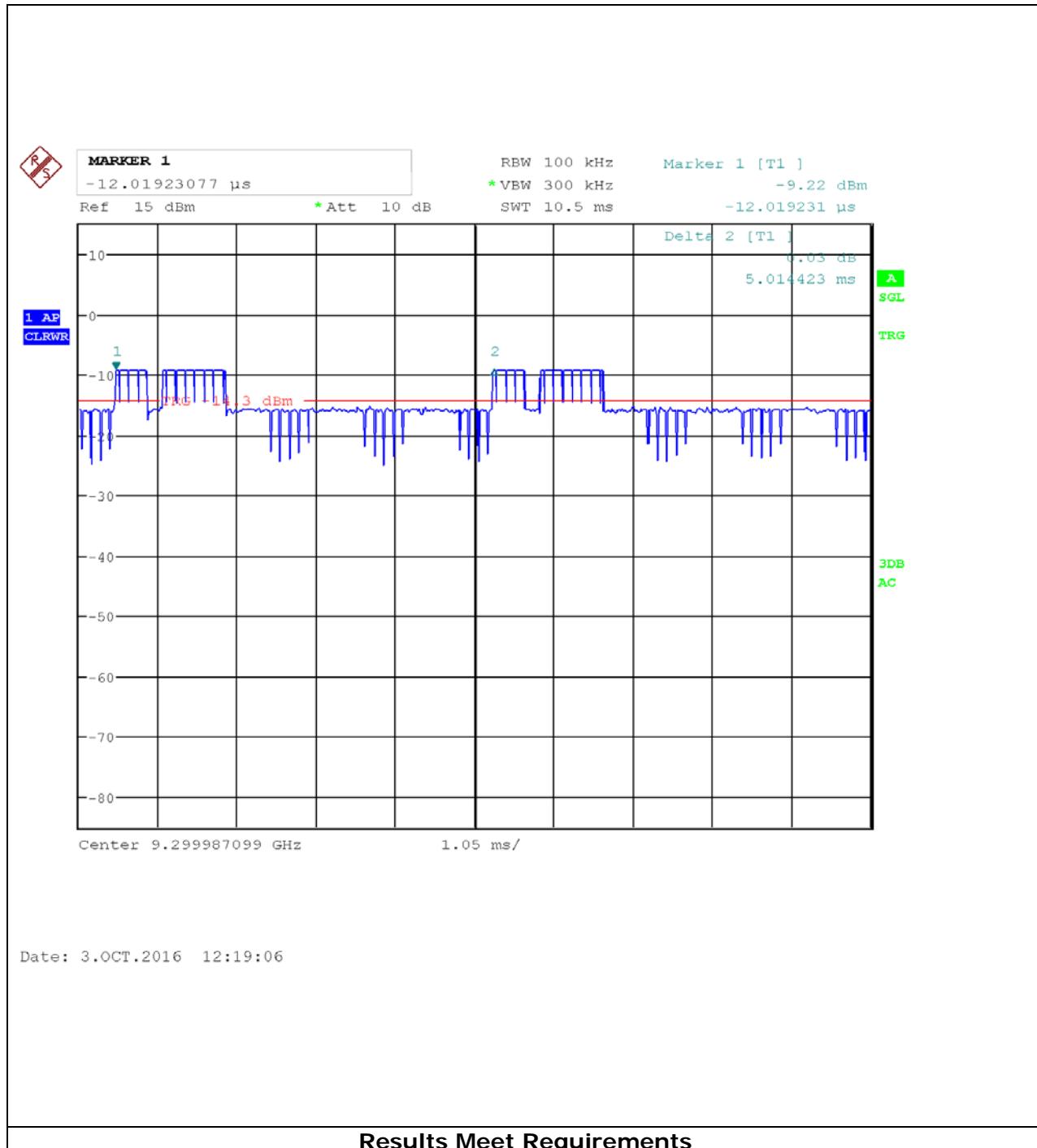
MODULATION CHARACTERISTICS

TEST DATA: PULSE PROFILE – F1 – CLOSED PLOT



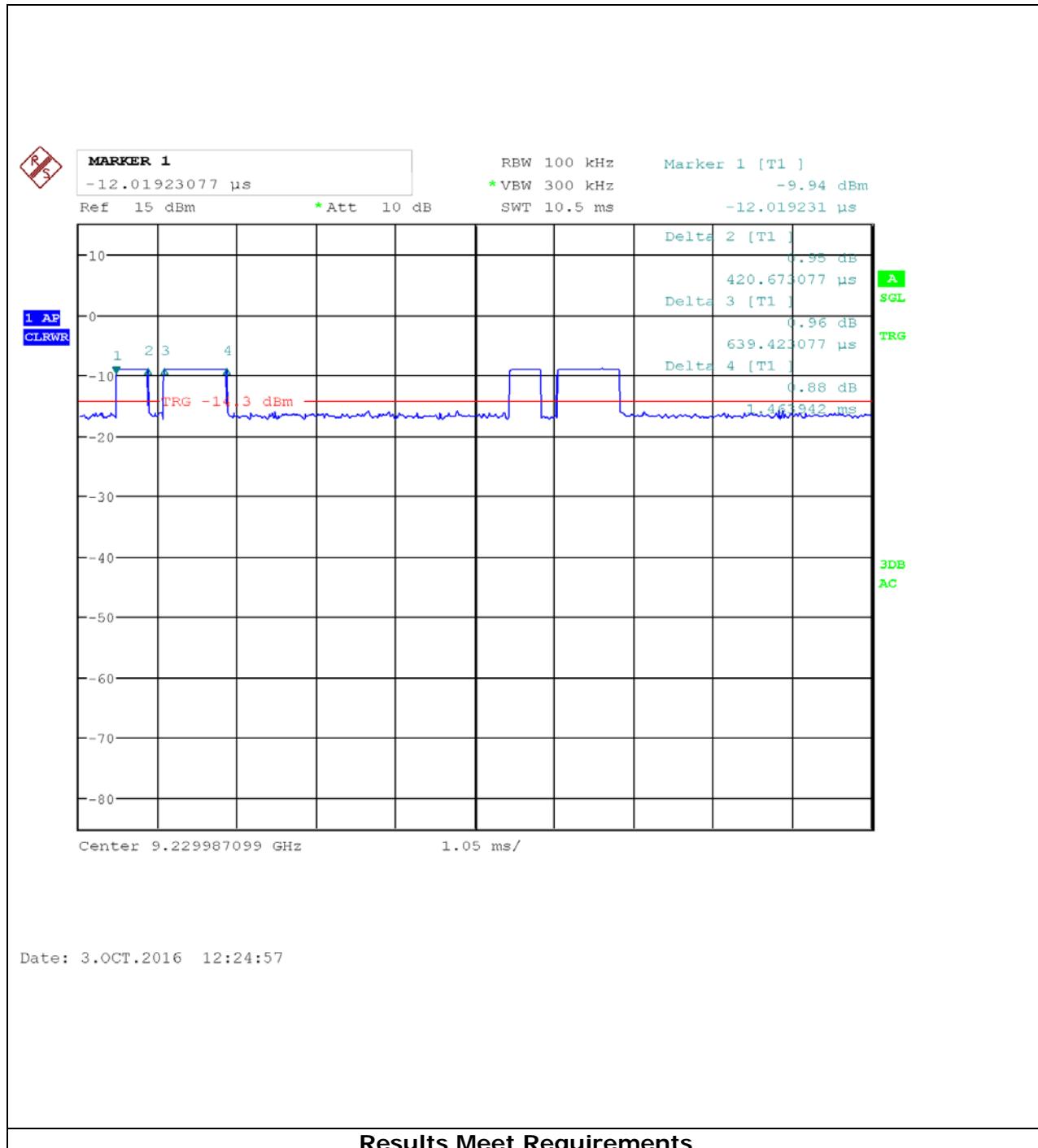
MODULATION CHARACTERISTICS

TEST DATA: PULSE INTERVAL – F1 – CLOSED PLOT



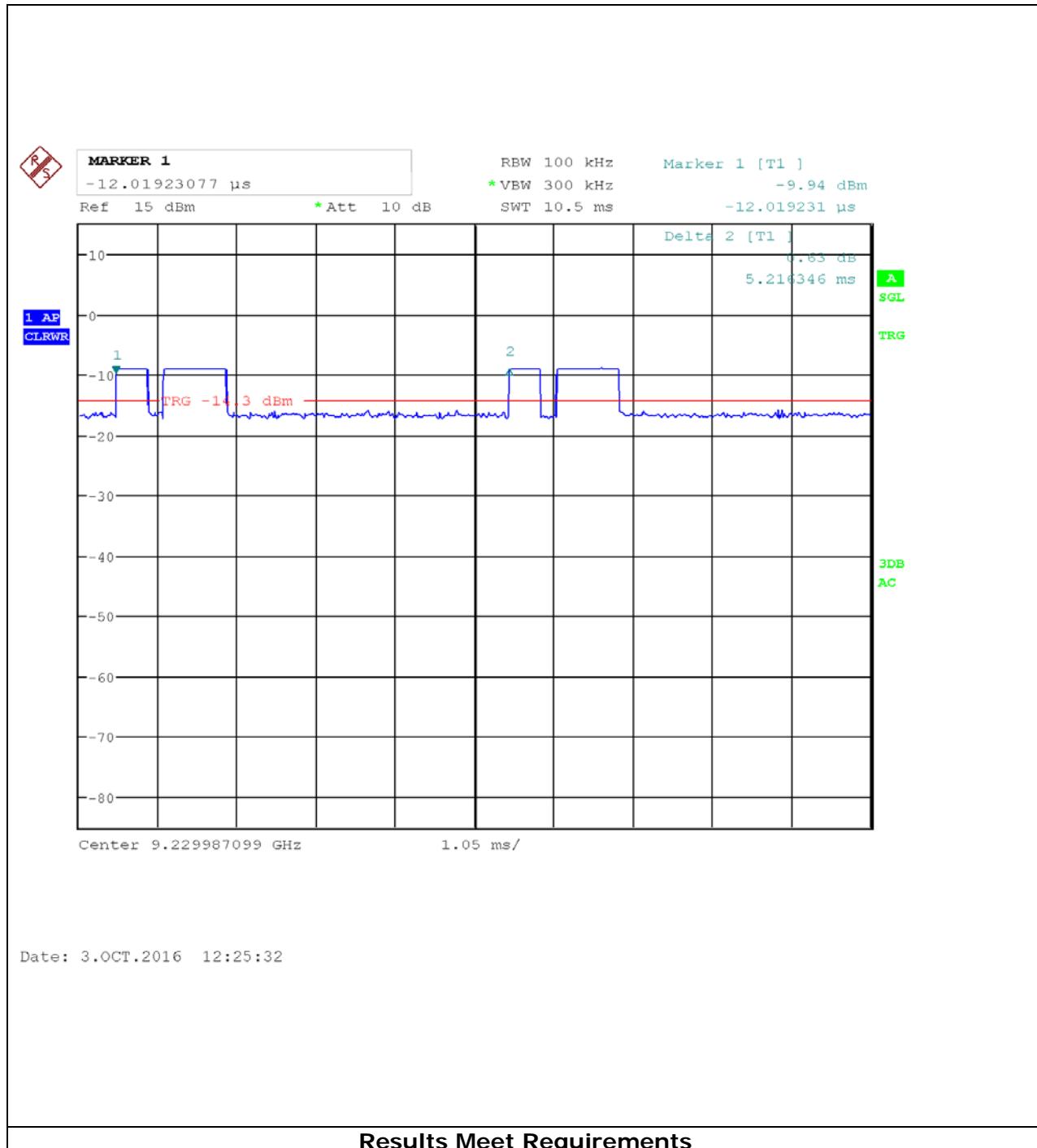
MODULATION CHARACTERISTICS

TEST DATA: PULSE PROFILE – F2 – OPEN PLOT



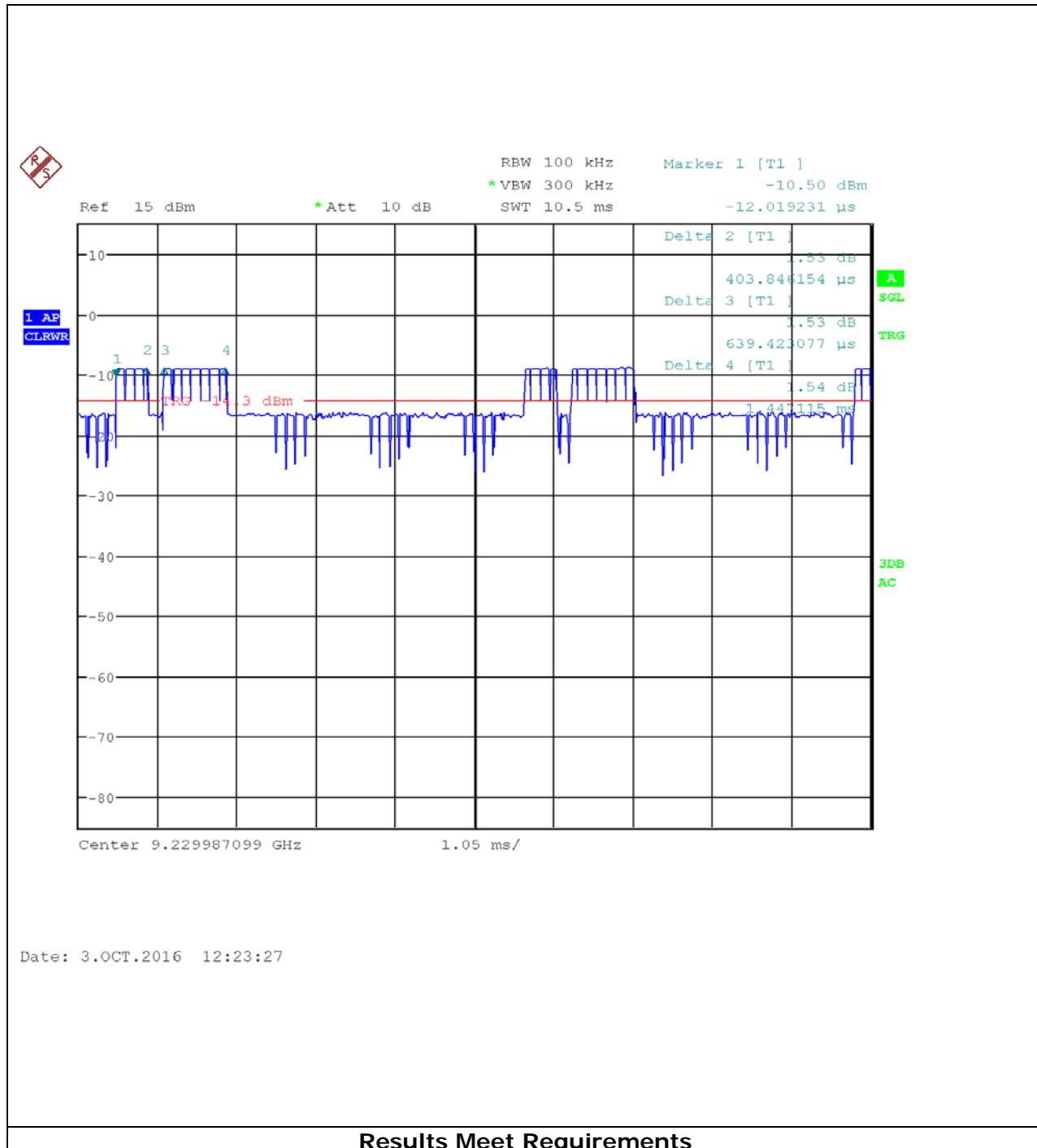
MODULATION CHARACTERISTICS

TEST DATA: PULSE INTERVAL – F2 – OPEN PLOT



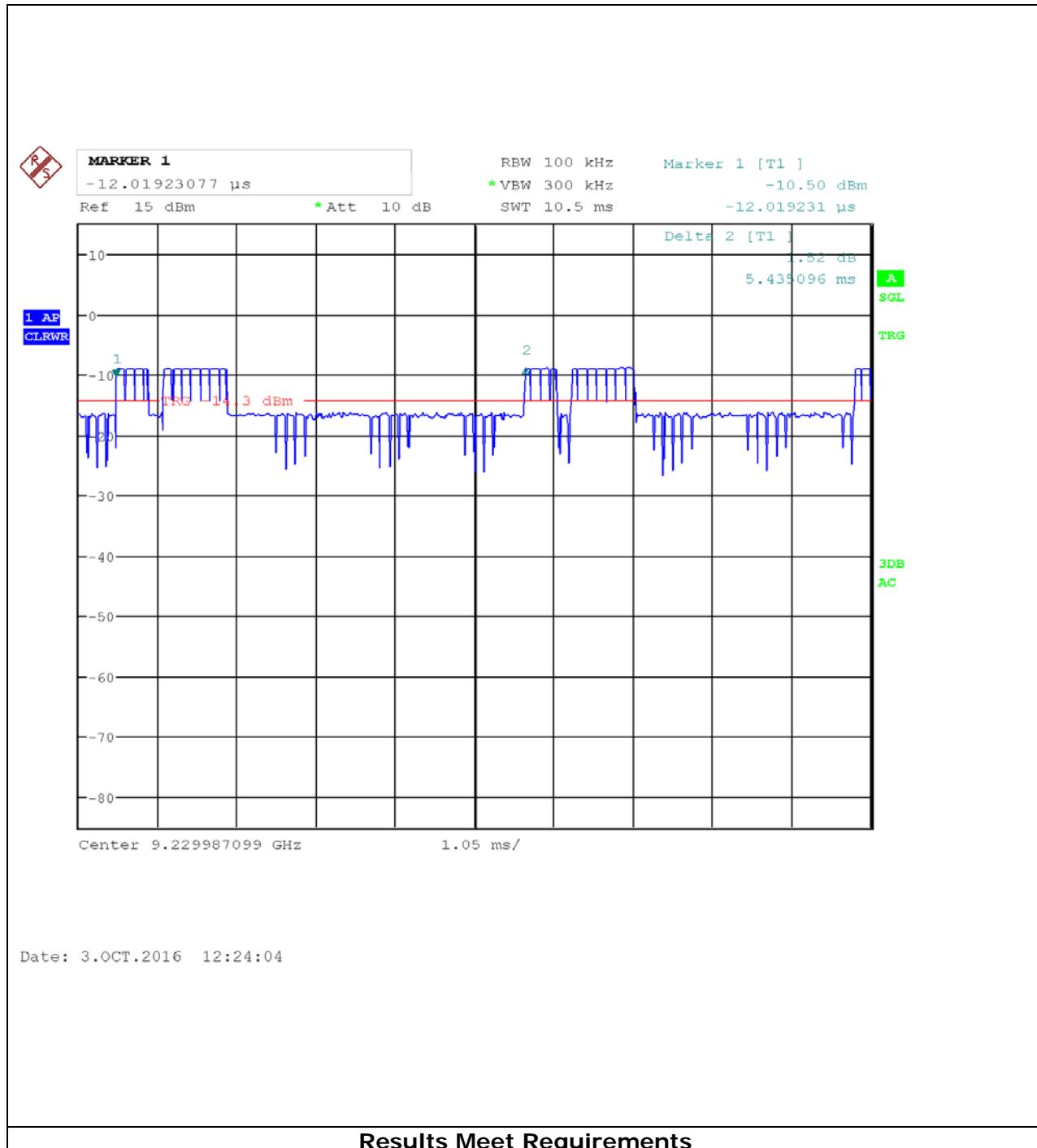
MODULATION CHARACTERISTICS

TEST DATA: PULSE PROFILE – F2 – CLOSED PLOT



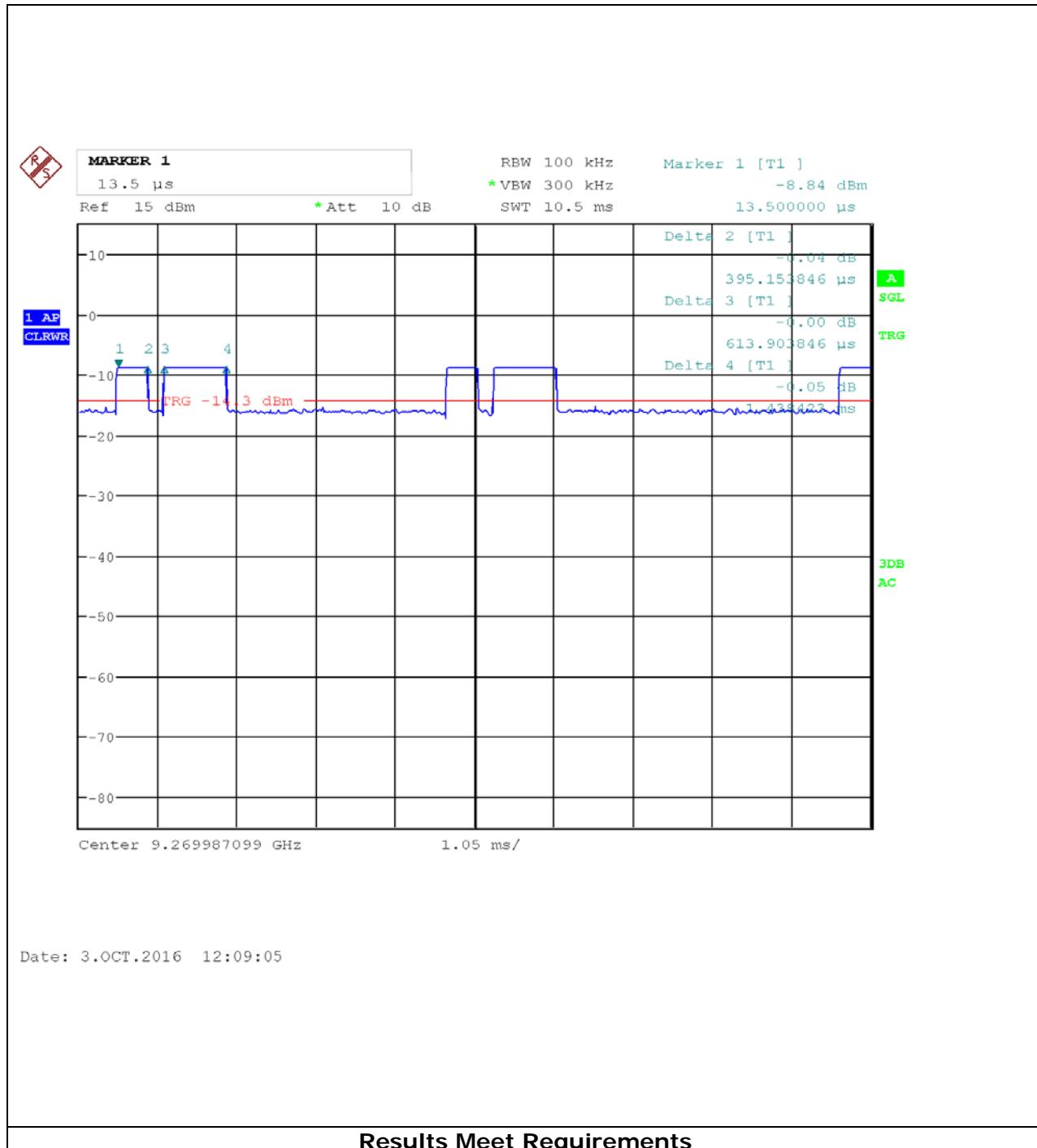
MODULATION CHARACTERISTICS

TEST DATA: PULSE INTERVAL – F2 – CLOSED PLOT



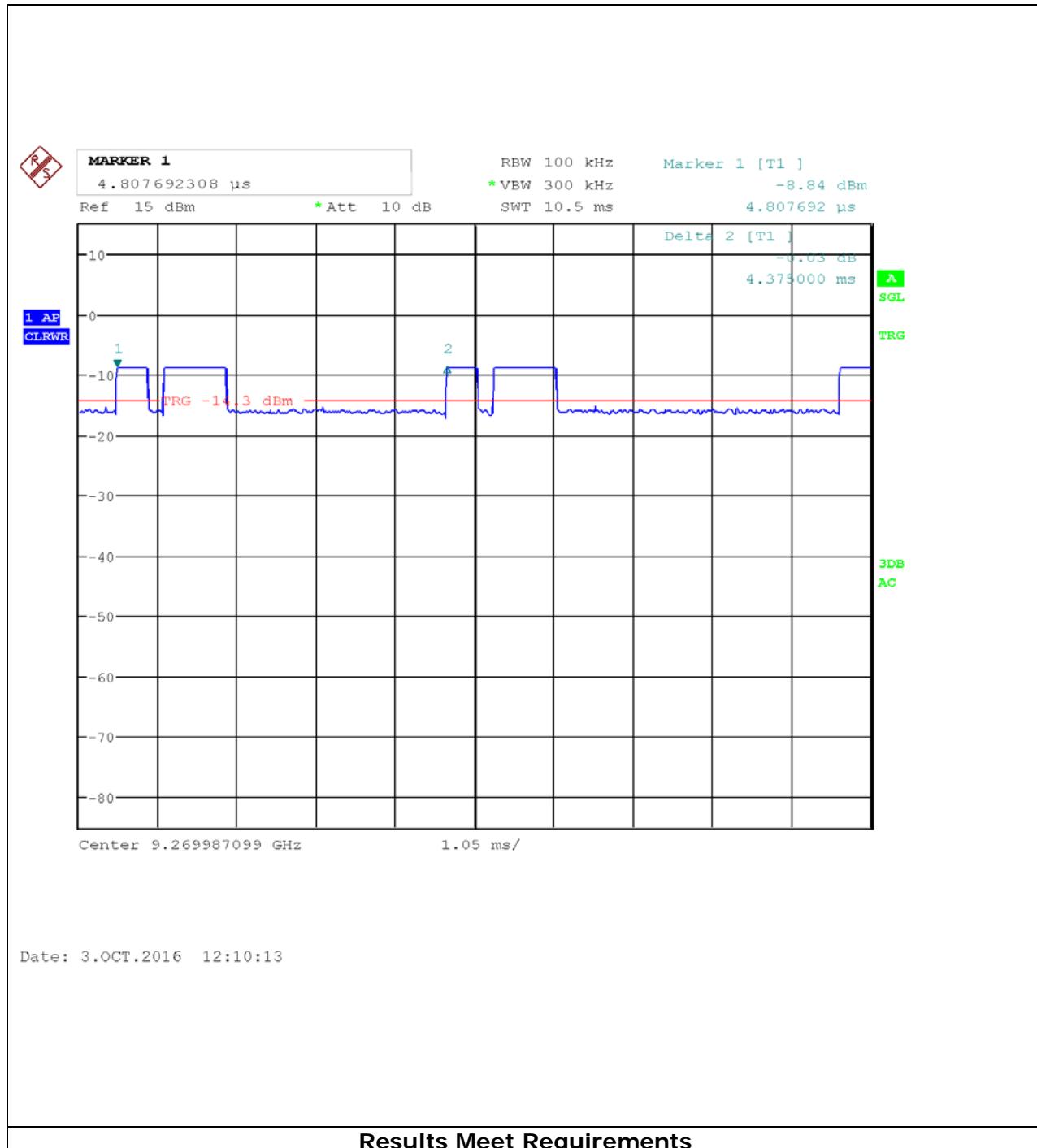
MODULATION CHARACTERISTICS

TEST DATA: PULSE PROFILE – F3 – OPEN PLOT



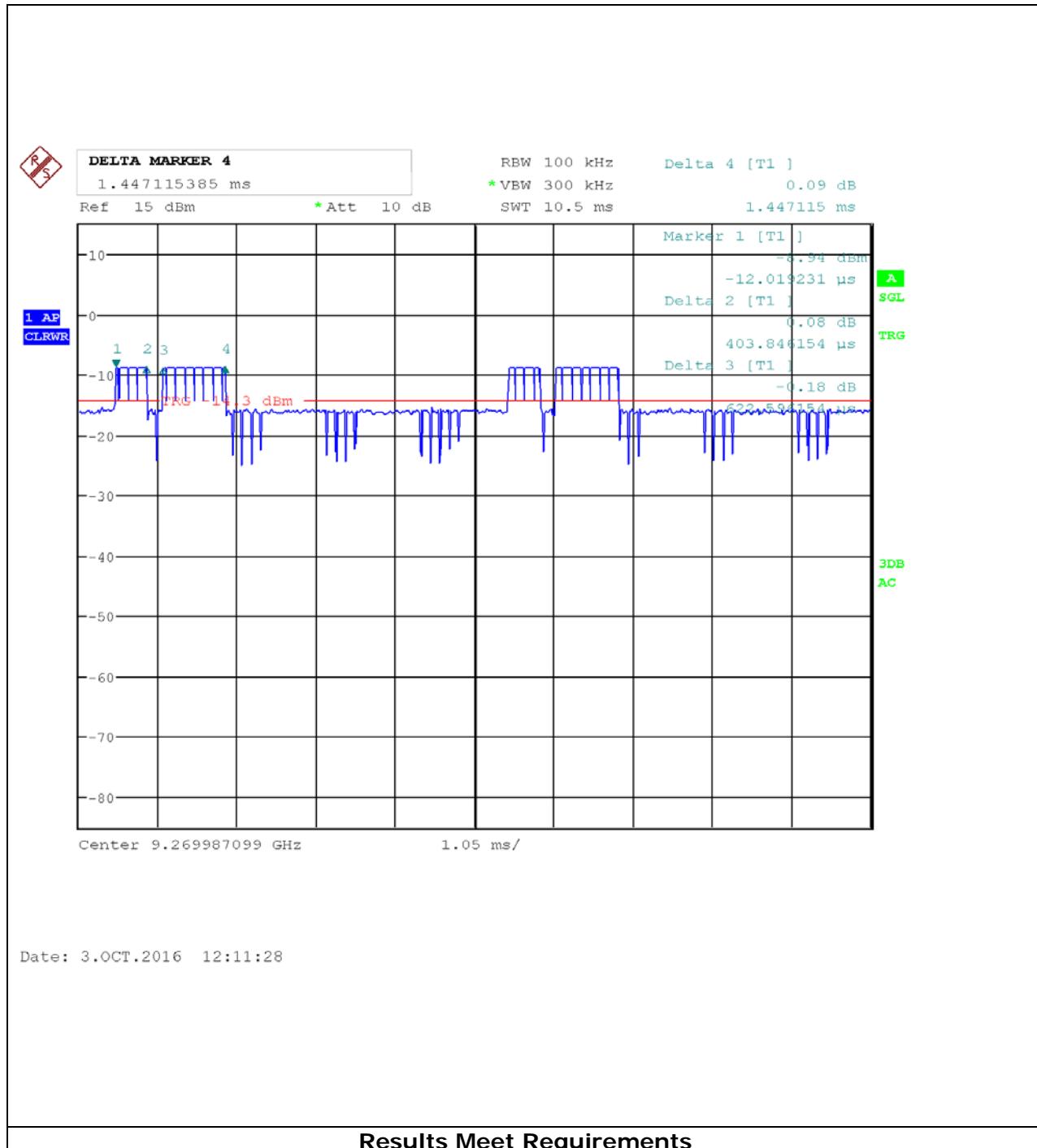
MODULATION CHARACTERISTICS

TEST DATA: PULSE INTERVAL– F3 – OPEN PLOT



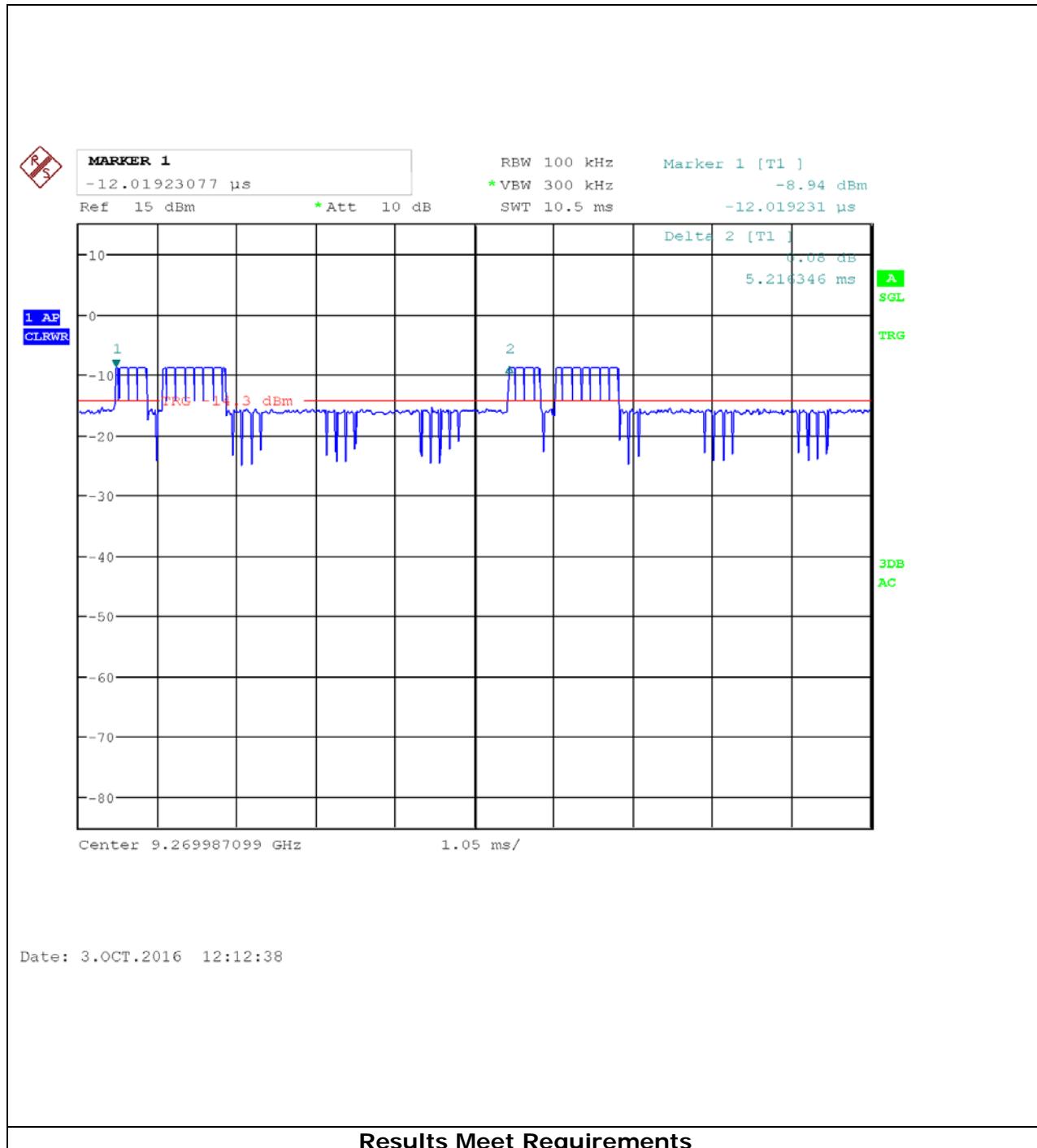
MODULATION CHARACTERISTICS

TEST DATA: PULSE PROFILE – F3 – CLOSED PLOT



MODULATION CHARACTERISTICS

TEST DATA: PULSE INTERVAL– F3 – CLOSED PLOT



OCCUPIED BANDWIDTH

Rule Part No.: Part 80.205(a), Part 80.209(b)

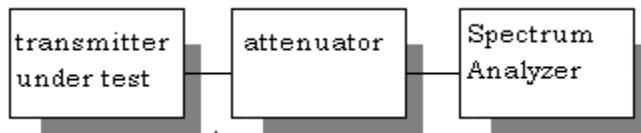
Requirements:

Part 80.205(a): Emissions must remain within the band

Part 80.209(b): The frequency at which maximum emission occurs must be within the authorized bandwidth and must not be closer than $1.5/T$ MHz to the upper and lower limits of the authorized bandwidth where "T" is the pulse duration in microseconds.

Method of Measurement: Measurements were made in accordance with standard listed above.

Block Diagram:

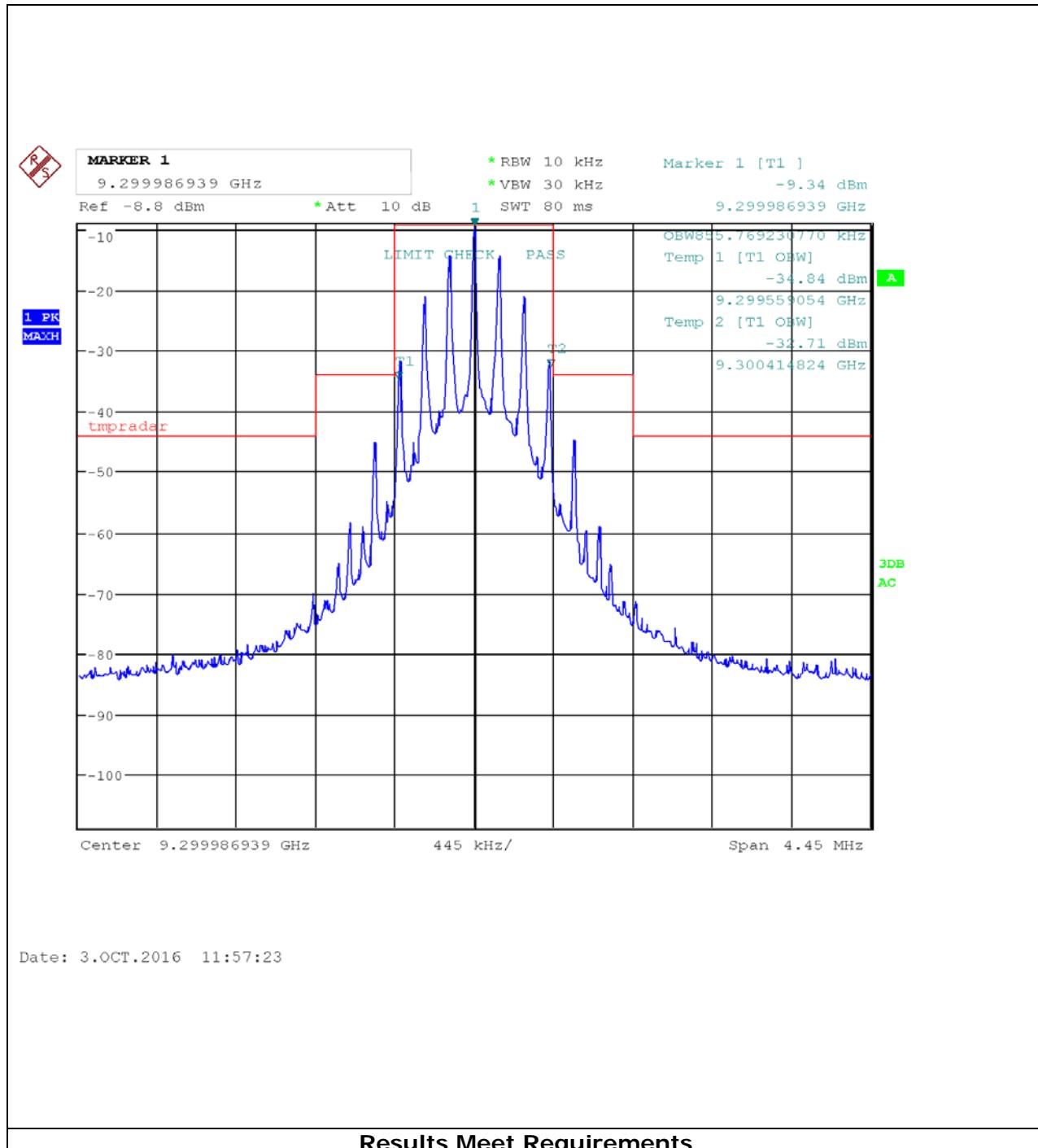


TEST DATA: MEASUREMENT TABLE

Pulse Type	Measurement Type	Occupied Bandwidth (kHz)
F1 Open	99%	855.8
F1 Closed	99%	862.9
F2 Open	99%	870.0
F2 Closed	99%	912.8
F3 Open	99%	855.8
F3 Closed	99%	870.0

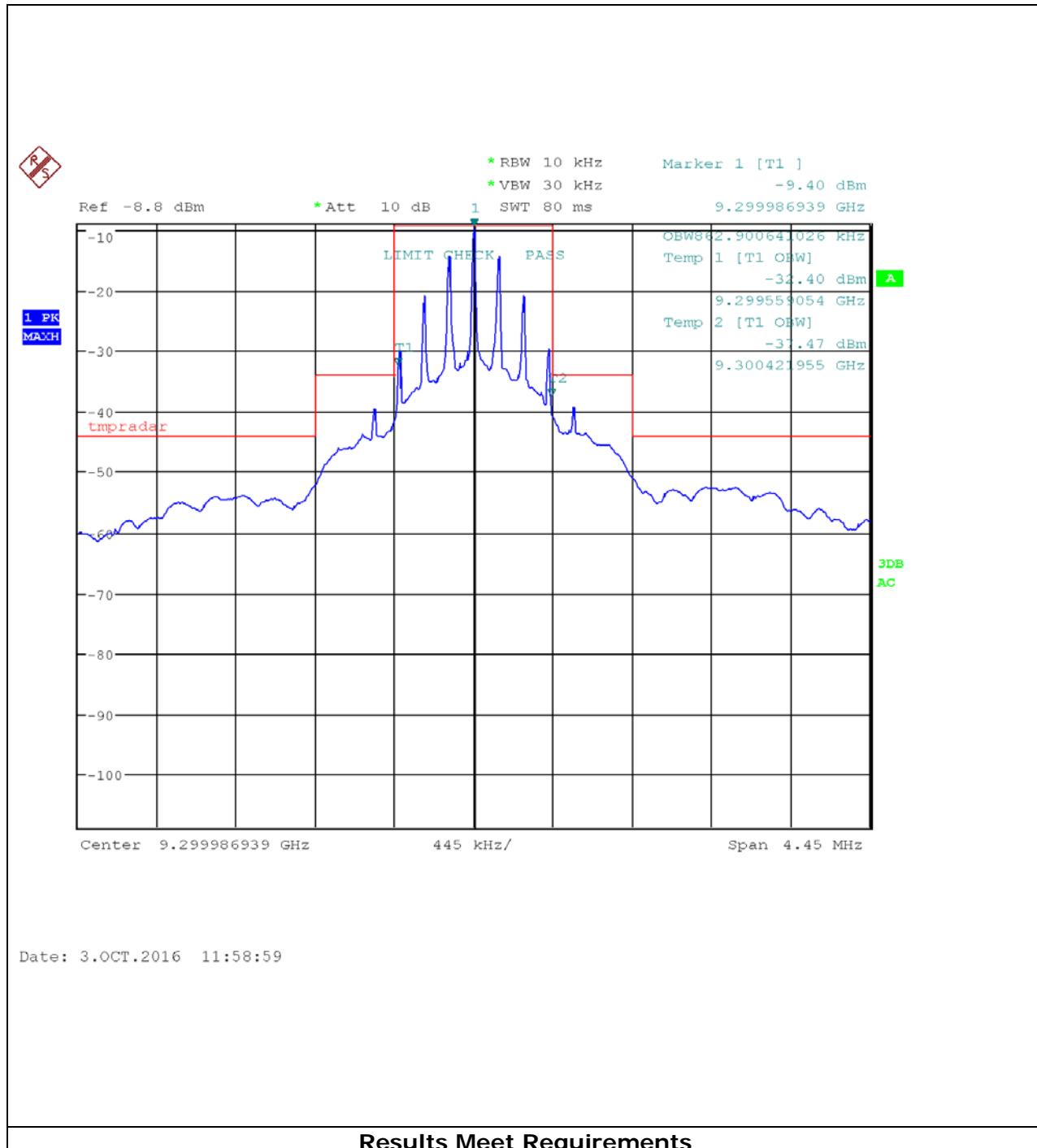
OCCUPIED BANDWIDTH

TEST DATA: F1 – OPEN PLOT



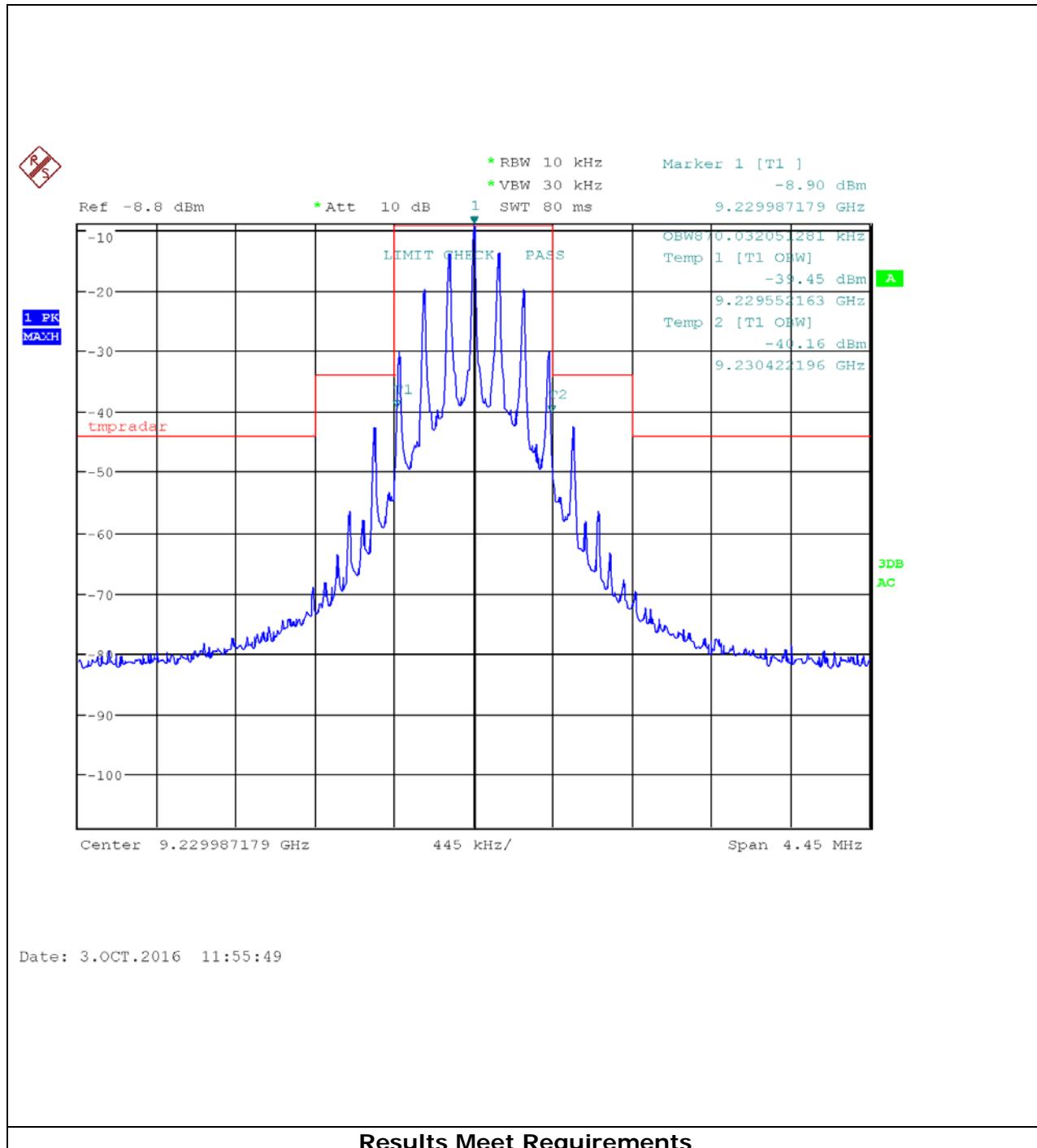
OCCUPIED BANDWIDTH

TEST DATA: F1 – CLOSED PLOT



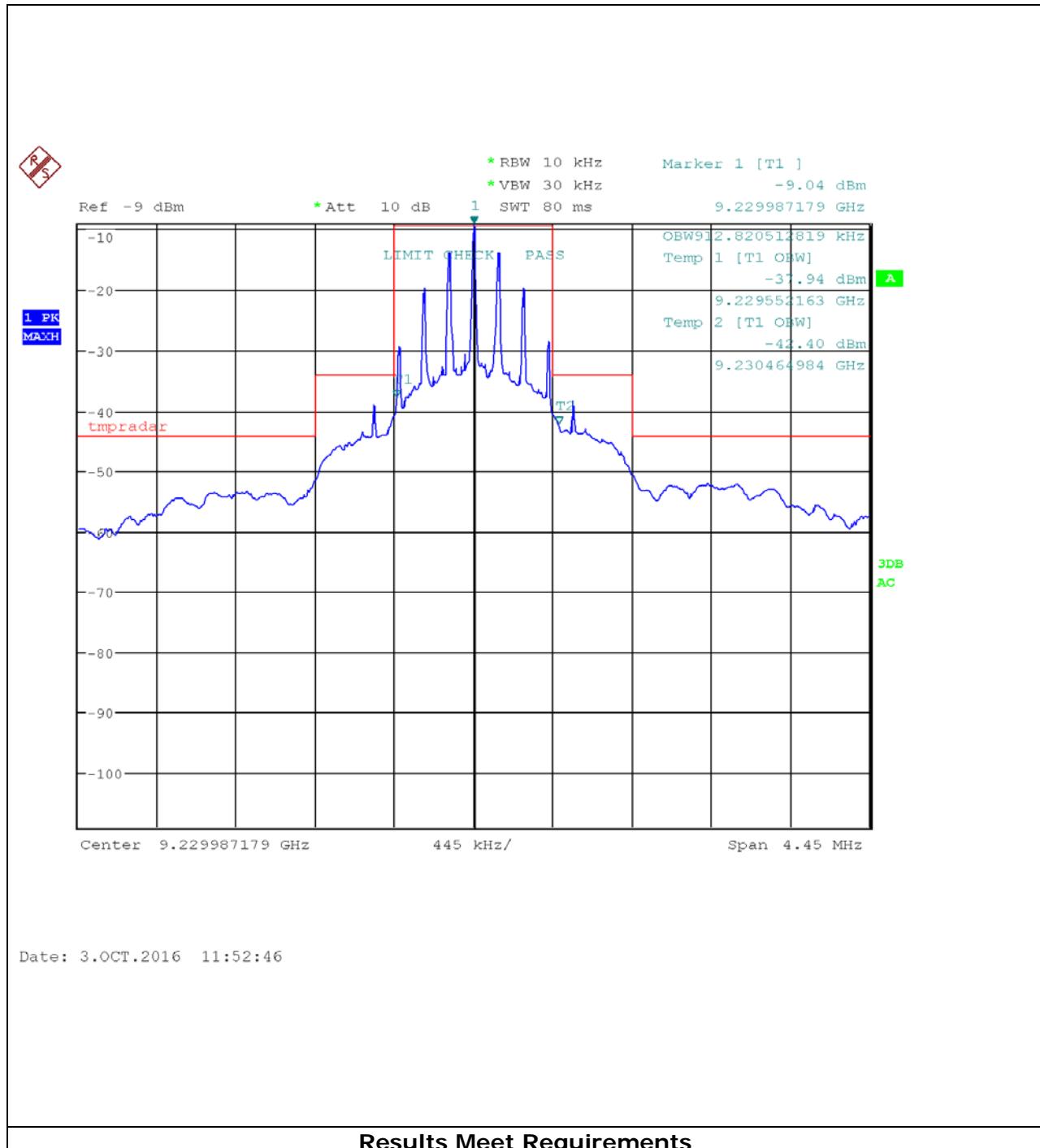
OCCUPIED BANDWIDTH

TEST DATA: F2 – OPEN PLOT



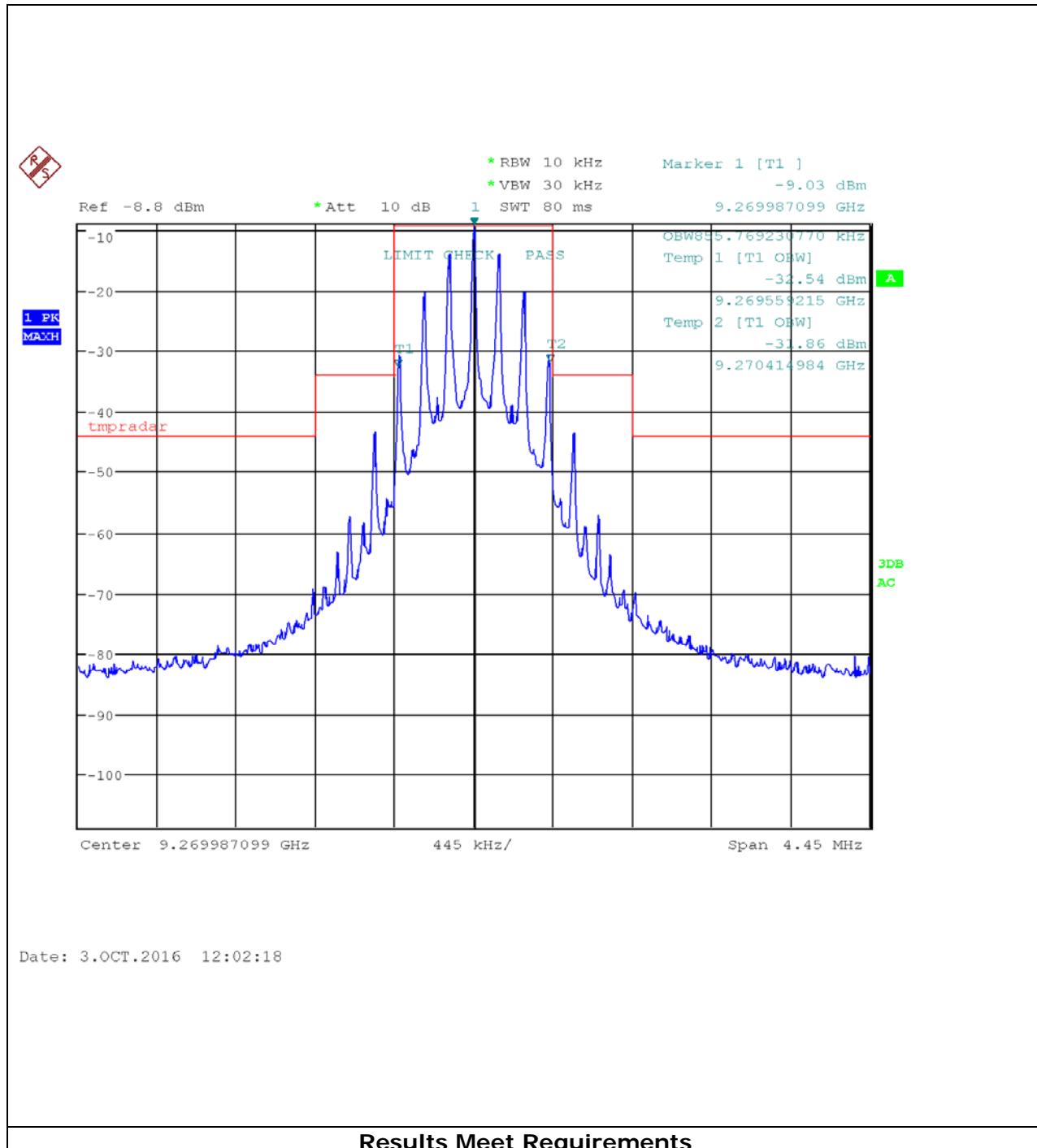
OCCUPIED BANDWIDTH

TEST DATA: F2 – CLOSED PLOT



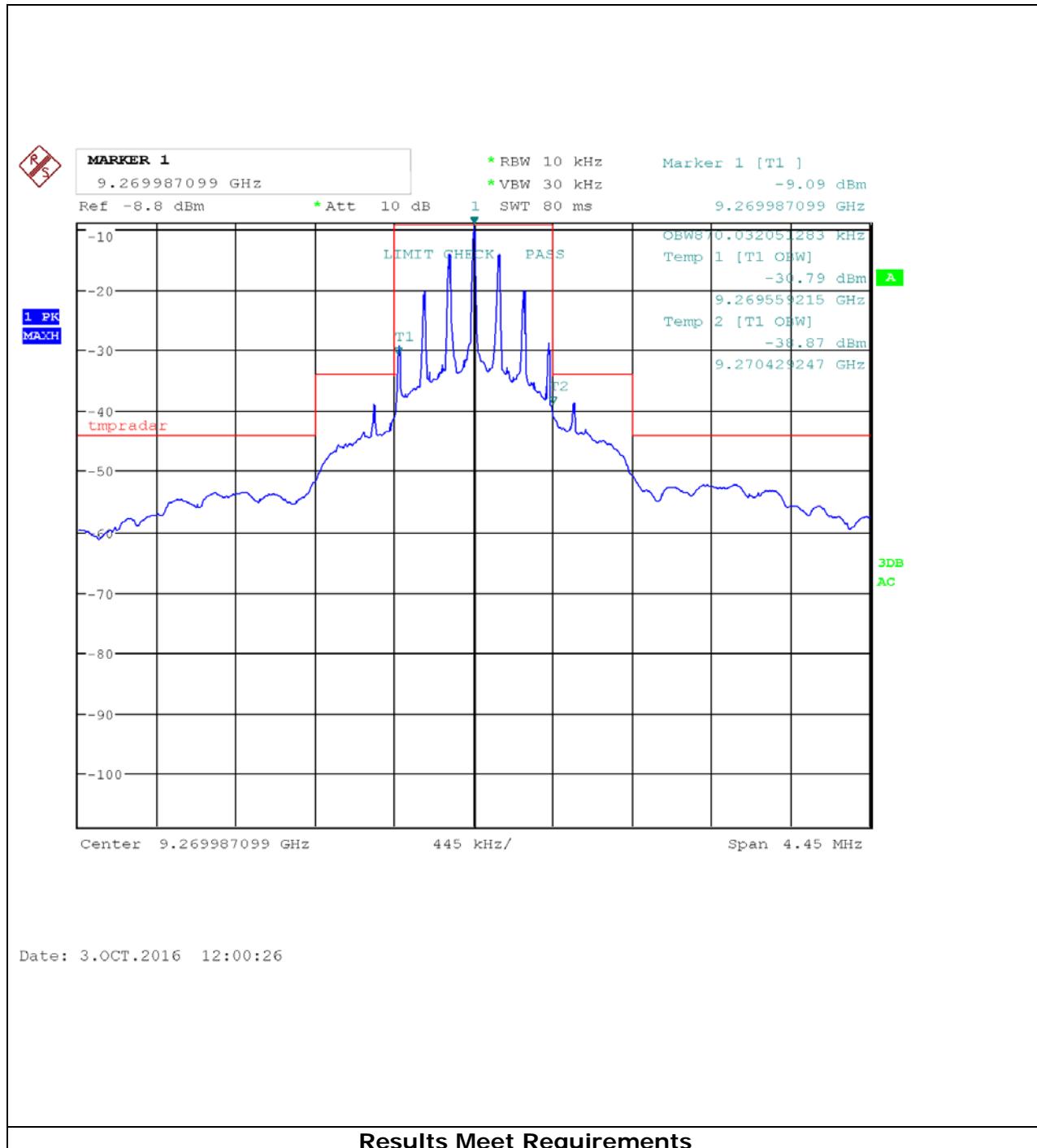
OCCUPIED BANDWIDTH

TEST DATA: F3 – OPEN PLOT



OCCUPIED BANDWIDTH

TEST DATA: F3– CLOSED PLOT



SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

Rule Part No.: Part 2.1051(a) & 80.217

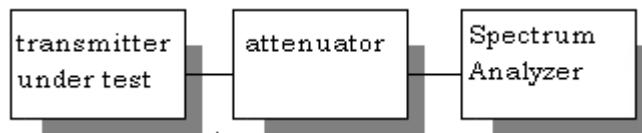
Requirements: Peak spurious emissions must be $43 + 10\log$ (mean power) below peak power.

$$43 + 10\log (0.033) = 28.19 \text{ dBc}$$

$$20 \text{ dBm} - 28.19 \text{ dBc} = -8.19 \text{ dBm limit}$$

Method of Measurement: The spectrum was scanned from 0.4 to at least the 10th harmonic of the fundamental or 40 GHz. The measurements were made in accordance with standard that is listed above.

The mean power was calculated based on the standard formula for radar systems: $P_a = P_m * T_d * f_r$. Where T_d is pulse duration, P_m is peak power, and f_r is pulse rep rate.



TEST DATA: MEASUREMENT TABLE

Mode	Emission Frequency GHz	Measured Level dBm	Loss dB	Actual Level dBm	Margin dB	Status
Open	18.5398	-64.86	16.27	-48.59	40.40	Pass
Closed	18.5413	-63.96	16.27	-47.69	39.50	Pass

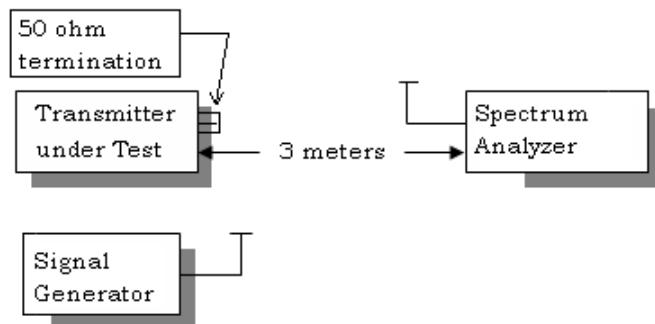
FIELD STRENGTH OF SPURIOUS EMISSIONS

Rule Parts. No.: Part 2.1053, 80.217

Requirements: The FCC limits for radiated emissions are the same as previously stated for the conducted emissions.

METHOD OF MEASUREMENT: The tabulated data shows the results of the radiated field strength emissions test. The spectrum was scanned from 30 MHz to at least the tenth harmonic of the fundamental or 40 GHz. This test procedures are detailed in the standard listed that is listed above using the substitution method.

Test Setup Diagram:



TEST DATA: MEASUREMENT TABLE

Mode	Emission Frequency (MHz)	Antenna Polarity (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
F1 TX	96.03	V	-57.85	-8.19	49.66
F1 TX	117.00	H	-51.74	-8.19	43.55
F1 TX	117.25	V	-62.87	-8.19	54.68
F1 TX	336.10	H	-56.94	-8.19	48.75
F1 TX	384.12	H	-52.25	-8.19	44.06

Results meet requirements

FREQUENCY STABILITY

Rule Parts. No.: Part 2.1055, Part 80

Requirements: Emission need only remain in the band.

Method of Measurements: The test procedures used are detailed in the standard listed that is listed above.

TEST DATA: MEASUREMENT TABLE

Temperature	Emission Frequency MHz	Difference in MHz	PPM	Result
-15 °C	9268.52	-0.11	-11.689	Pass
-10 °C	9268.58	-0.05	-5.313	Pass
0 °C	9268.60	-0.03	-3.188	Pass
10 °C	9268.60	-0.03	-3.188	Pass
20 °C	9268.63	0.00	0.000	Pass
25 °C (reference)	9268.63	0.00	0.000	N/A
30 °C	9268.61	-0.02	-2.125	Pass
40 °C	9268.65	0.02	2.125	Pass
50 °C	9268.64	0.01	1.063	Pass
55 °C	9268.66	0.03	3.188	Pass

Results meet requirements

EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
24 Volt Power Supply	Astron	VLS-25M	9510040	N/A	N/A
Antenna: Log-Periodic Chamber	Eaton	96005	1243	02/09/16	02/09/18
Temperature Chamber LARGE	Tenney Engineering	TTRC	11717-7	09/01/16	09/01/18
3-Meter Semi-Anechoic Chamber	Panashield	N/A	N/A	04/25/16	12/31/17
Sweep/Signal Generator	Anritsu	68369B	985112	10/28/15	10/28/17
Oscilloscope	LeCroy	LT364	00414	01/26/16	01/26/18
EMI Test Receiver R & S ESIB 40 Screen Room	Rohde & Schwarz	ESIB 40	100274	08/16/16	08/16/18
Software: Field Strength Program	Timco	Version 4.0	N/A	N/A	N/A
USB Peak Power Sensor 50 MHz to 18 GHz	Boonton	55318	9224	09/13/16	09/13/18
RF Power Meter	Boonton	4531	11793	02/17/15	02/17/17
EMI Test Receiver R & S ESU 40 Chamber	Rohde & Schwarz	ESU 40	100320	04/01/16	04/01/18
Preamplifier	RF-LAMBDA	RLNA00M45GA	N/A	01/04/16	01/04/18
Bi-Directional Coupler	HP	778D	1144A08107	09/16/15	09/16/17
Directional Coupler	HP	X752D	1829A24209	N/A	N/A
WR90 to SMA Adapter	Pasternack	PE9804	N/A	N/A	N/A
WR90 End Load	Lectronic Research Lab	WL-108	N/A	N/A	N/A

***EMI RECEIVER SOFTWARE VERSION**

The receiver firmware used was version 4.43 Service Pack 3

END OF REPORT