TIMCO ENGINEERING, Inc.

849 NW STATE ROAD 45
NEWBERRY, FL 32669 USA
PH: 888.472.2424 OR
352.472.5500
FAX: 352.472.2030
EMAIL: INFO@TIMCOENGR.COM
HTTP://WWW.TIMCOENGR.COM

FCC PART 90 RADAR TEST REPORT

APPLICANT	**BARON SERVICES INC.**
	4930 Research Dr. **Huntsville, Alabama 35805**
FCC ID	NX5-GEN3-1000HSK
MODEL NUMBER	GEN3-1000HSK
PRODUCT DESCRIPTION	BARON GEN3 1 MW HF S-BAND KLYSTRON
DATE SAMPLE RECEIVED	9/18/2017
FINAL TEST DATE	9/20/2017
TESTED BY	Tim Royer
APPROVED BY	Franklin Rose
TEST RESULTS	☒ PASS ☐ FAIL

Report Number	Version Number	Description	Issue Date
1677AUT17TestReport_	Rev1	Initial Issue	9/28/2017
	Rev2	Revised Report	3/5/2018

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GENERAL REMARKS

The attached report shall not be reproduced except in full without the written permission of Timco Engineering Inc.

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 by:

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

Tested by:
Name and Title: Tim Royer, Project Manager/Testing Engineer

Date: 9/27/2017

Reviewed and approved by:

Name and Title: Franklin Rose, Project Manager/Testing Technician

Date: 02/26/2018

EUT SPECIFICATION

EUT Description	BARON GEN3 1MW HF S-BAND KLYSTRON
FCC ID	NX5-GEN3-1000HSK
Model Number	GEN3-1000HSK
Operating Frequency	3525 MHz
Type of Emission	12M3P0N
Modulation	Pulse Compression FM
EUT Power Source	☒ 110–240Vac/50– 60Hz
	☐ DC Power (48 VDC)
	☐ Battery Operated Exclusively
Test Item	☐ Prototype
	☐ Pre-Production
	☒ Production
Type of Equipment	☒ Fixed
	☐ Mobile
	☐ Portable

TEST SETUP INFORMATION

Test facility	**Timco Engineering, Inc.** **849 NW State Road 45** **Newberry, FL 32669 USA** **Designation #: US1070**
Test Condition	The EUT was tested under normal temperature and humidity. The temperature was 20-26ºC with a relative humidity of 35 - 55%.
Modifications	None
Test Exercise	The EUT was transmitting a modulated pulse with a 0.8, 1, 2 and 4.5 us pulses, with the exception of frequency stability testing in which CW signal was used.
Regulatory Standards	FCC CFR 47 Part 2, 90
Measurement Standards	TIA_603-D:2010, CISPR 16-2

TEST REPORT SUMMARY

Rule Part No.	Test Item	Status Pass/ Fail/ NA
2.1046, 90.205	RF Power Output	Pass
2.1047, 90.207, 90.209	Modulation Characteristics	Pass
2.1049, 90.210 (b)(1)(2)(3)	Occupied Bandwidth	Pass
2.1051, 90.210 (b)(3)	Antenna Conducted Emissions	Pass
2.1053, 90.210(b)(3)	Field Strength Spurious Emissions	Pass
2.1055, 90.213	Frequency Stability	Pass

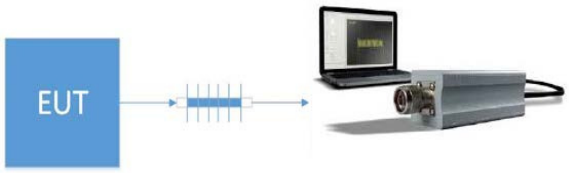
RF POWER OUTPUT

Rule Part No.: 2.1046, 90.205

Requirements: Manufacturers specifications

Procedure: RF power is measured by connecting a 50-ohm, Peak Power Watt meter to the RF output connector. The EUT was supplied with a nominal voltage, and the transmitter properly adjusted for the target output power.

Setup Diagram:



Notes: The EUT has 2 transmitters; all conducted measurement results are summed and compared to the limit following the procedures listed above

The mean power was calculated based on formula:

Pa = Pm* DC

Pa is Mean linear power in watts
Pm is Peak linear power in watts
DC is duty cycle in %

Example: 404.79 (W) * (91.6/833) = 44.51 (w)

Test Data: **Measurement Table**

Pulse Type	Tuned Freq (MHz)	T_d (uSec)	Period (uSec)	DC (%)	Ant 1 Peak Power (dBm)	Ant Peak Power (W)	Ant Mean Power (W)
0.8 us	3524	0.78	2014	0.04%	89.291	849376.03	0.03
1 us	3524	0.95	2014	0.05%	89.307	852511.02	0.04
2us	3524	1.98	2014	0.10%	89.254	842170.45	0.09
4.5 us	3524	4.48	4010	0.11%	89.424	875790.04	0.10

Part 2.1033 (C) (8) DC Input into the final amplifier

DC INPUT POWER is no greater than: P (W) = E (V) * I (A) = 240 VAC * 25 Amps = 6000 Watts

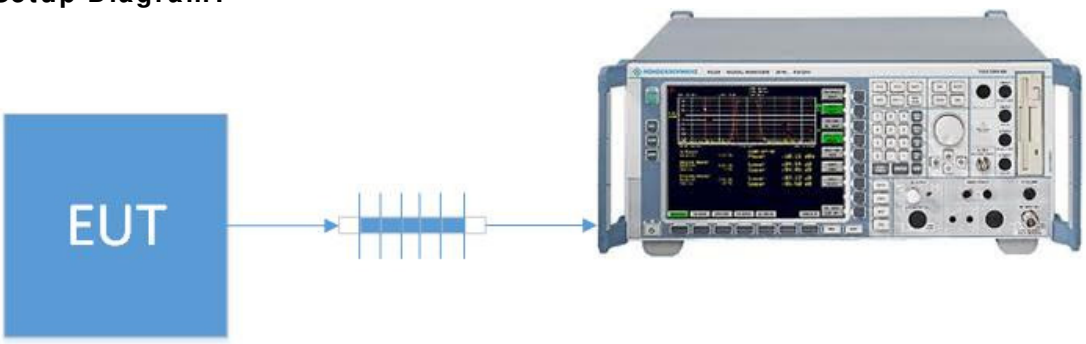
MODULATION CHARACTERISTICS

Rule Part No.: 2.1047, 90.207, 90.209

Requirements: Manufacturers specification, authorization reviewed on a case-by case-basis

Procedure: As detailed in the procedures listed above

Setup Diagram:



Notes: The manufacturer specifications declare that the EUT is normally operated with a pulse compression modulation scheme with pulse durations of 0.8, 1, 2 and 4.5 US.

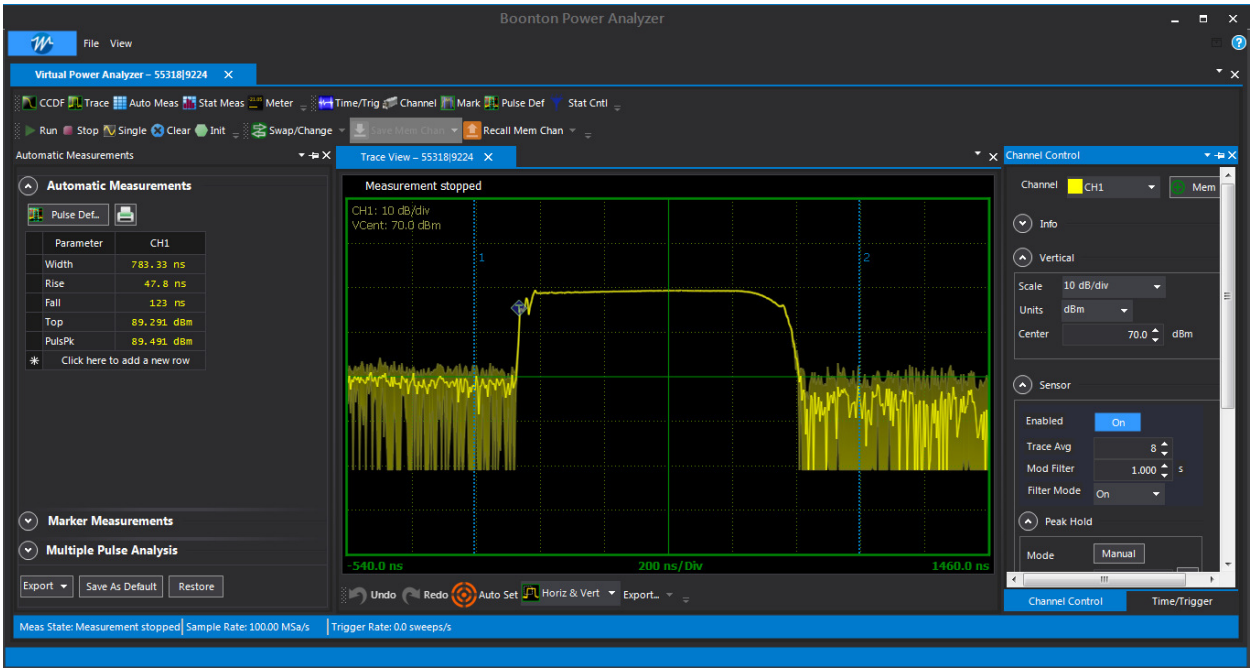
Further detailed specifications are contained in "product specifications" manual.

Test Data: Measurement Table

Pulse Type	Pulse widths (µs)	Pulse rep. rate (Hz)	40 dB BW (MHz)
0.8 us	0.78	500	23.68
1 us	0.95	500	20.32
2 us	1.98	500	15.93
4.5 us	4.48	250	13.22

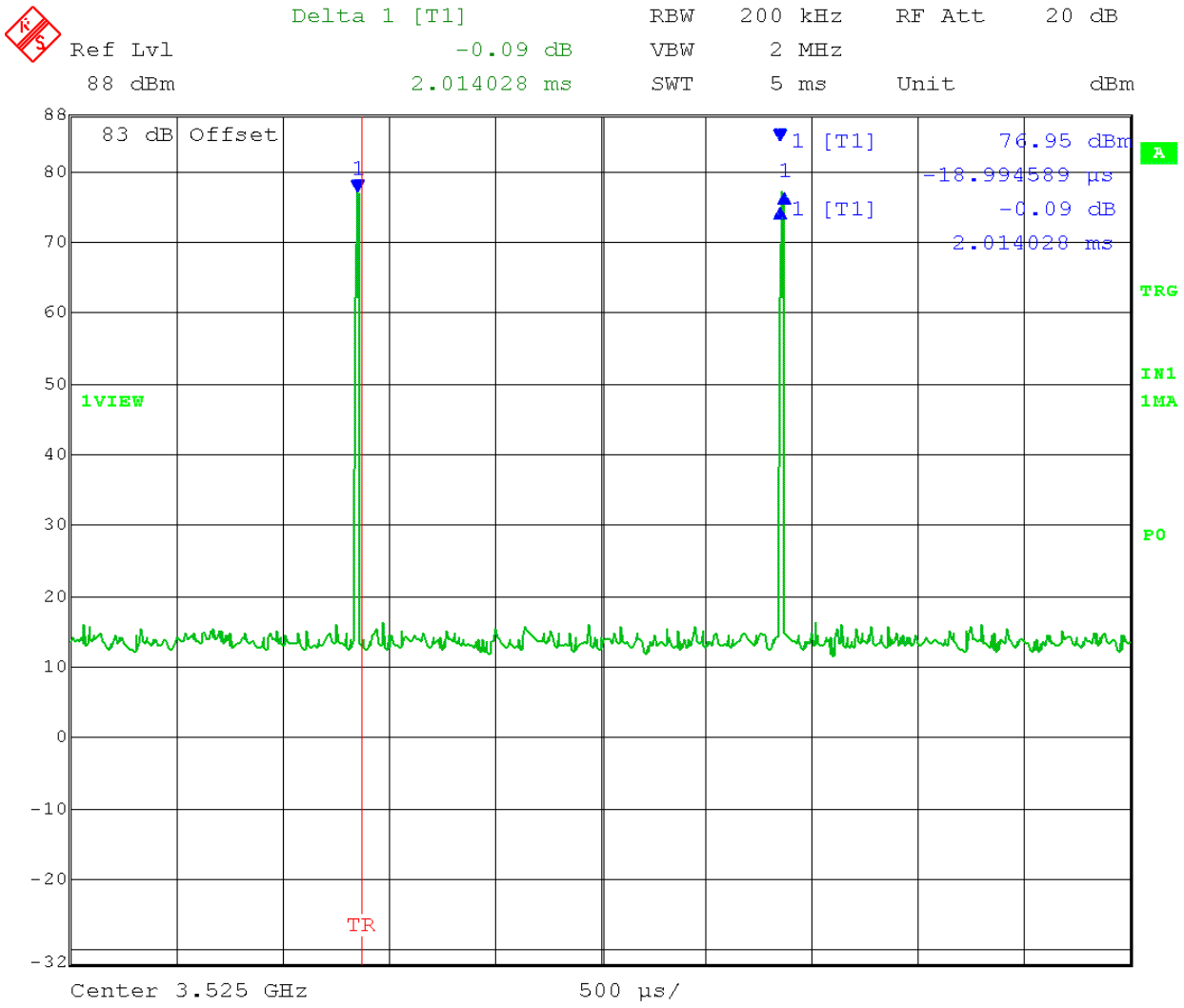
MODULATION CHARACTERISTICS

Test Data: 0.8 uS Pulse width Plot



MODULATION CHARACTERISTICS

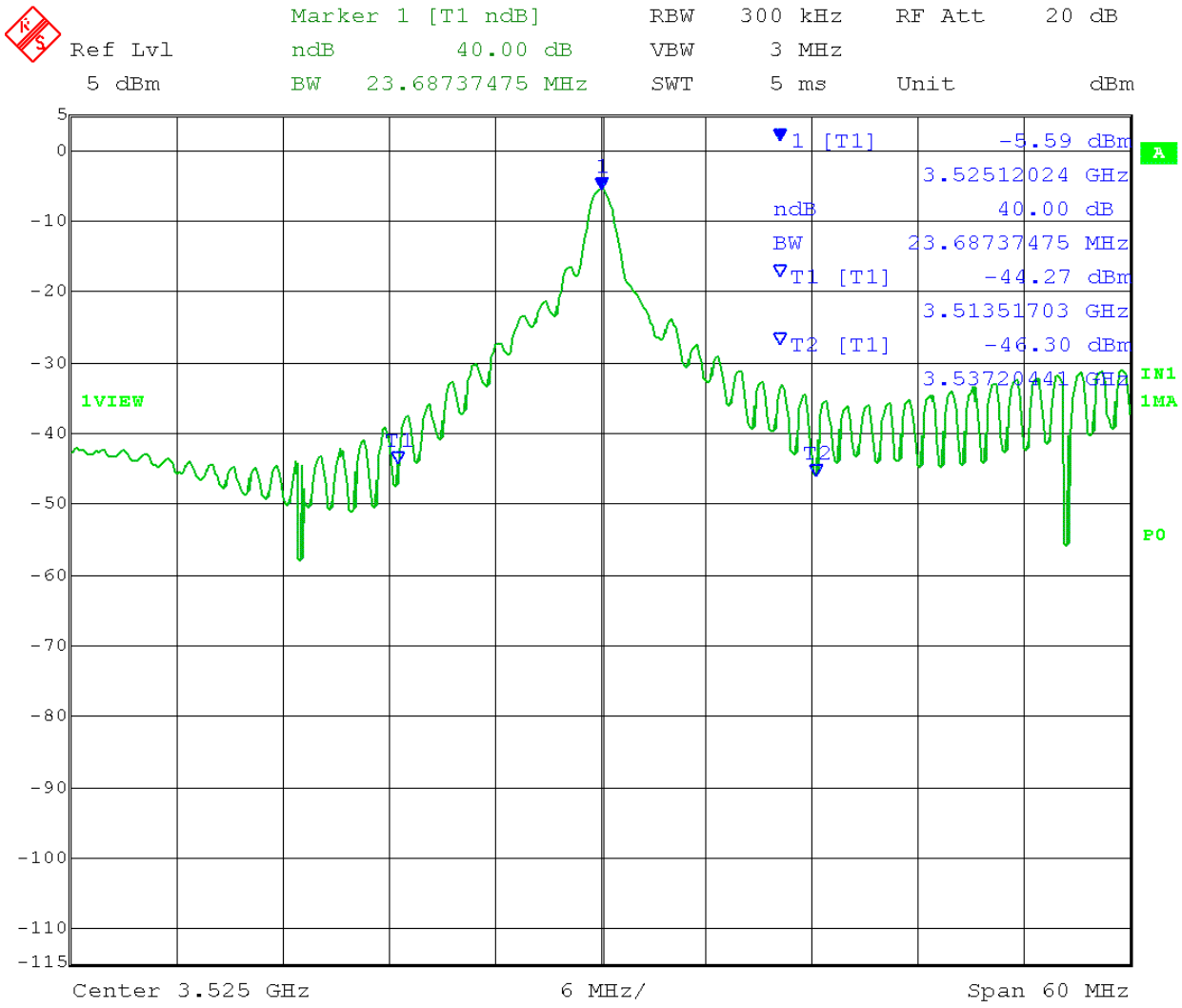
Test Data: 0.8 uS Rep Rate Plot



Date: 20.SEP.2017 15:03:12

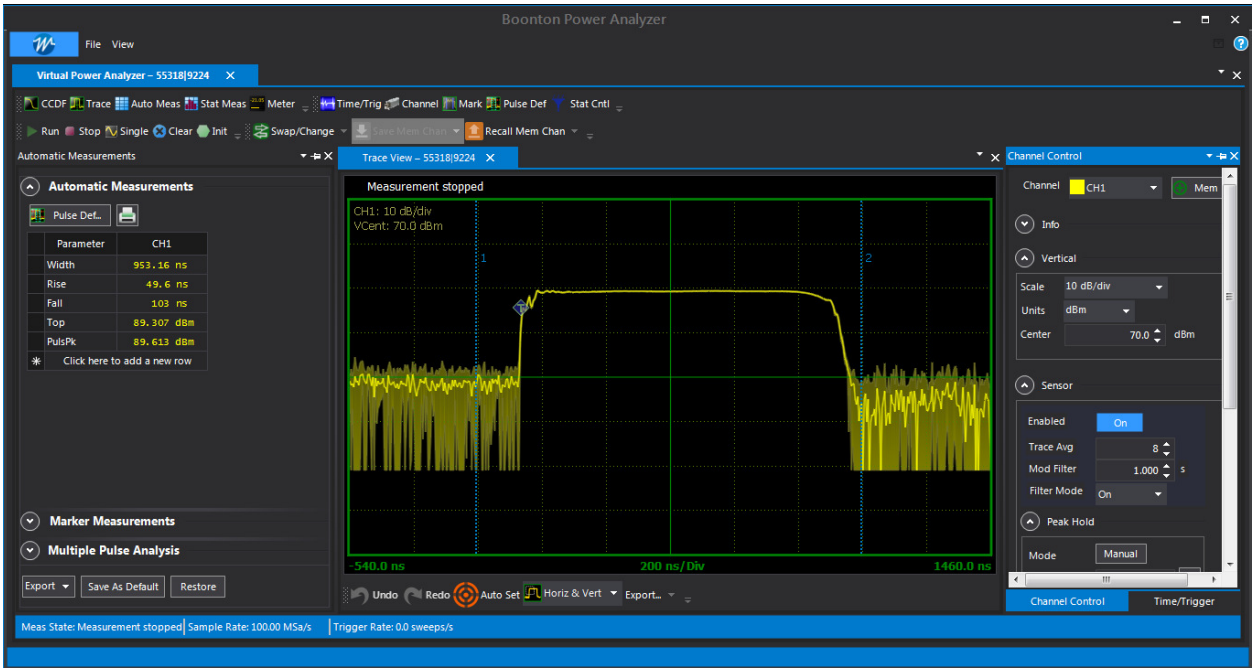
MODULATION CHARACTERISTICS

Test Data: 0.8 uS 40 dB BW Plot



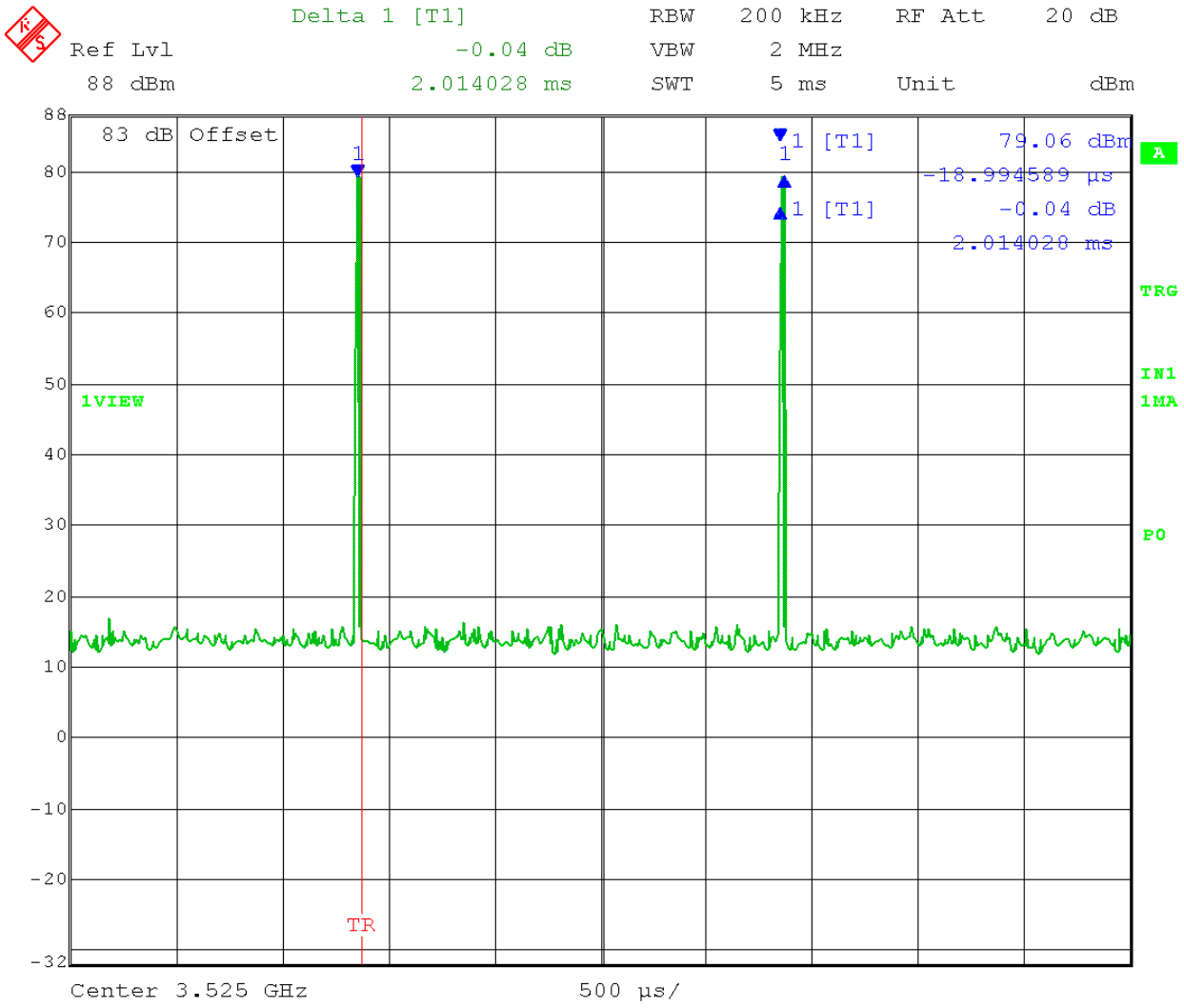
MODULATION CHARACTERISTICS

Test Data: 1 uS Pulse width Plot



MODULATION CHARACTERISTICS

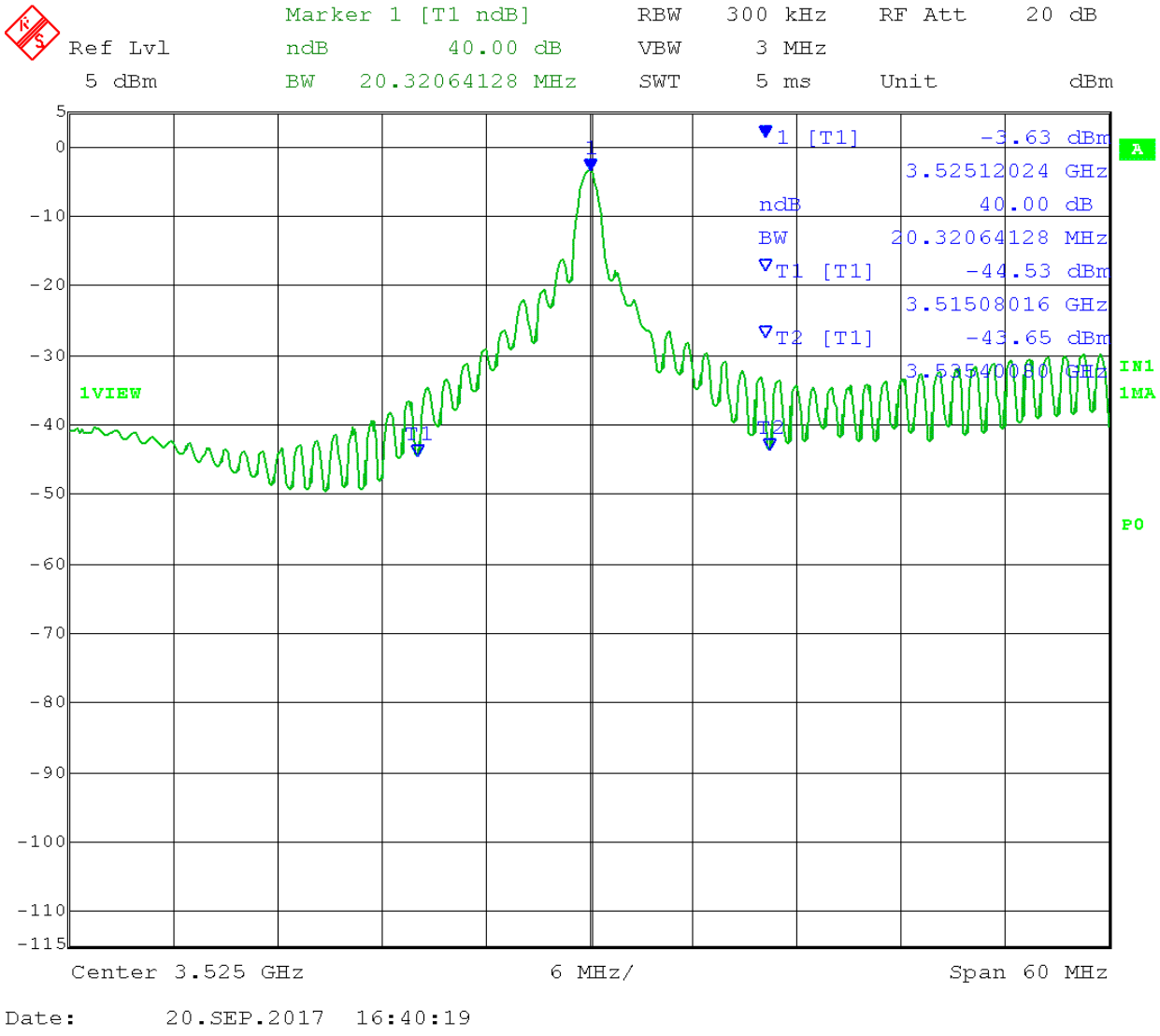
Test Data: 1 uS Rep Rate Plot



Date: 20.SEP.2017 15:03:46

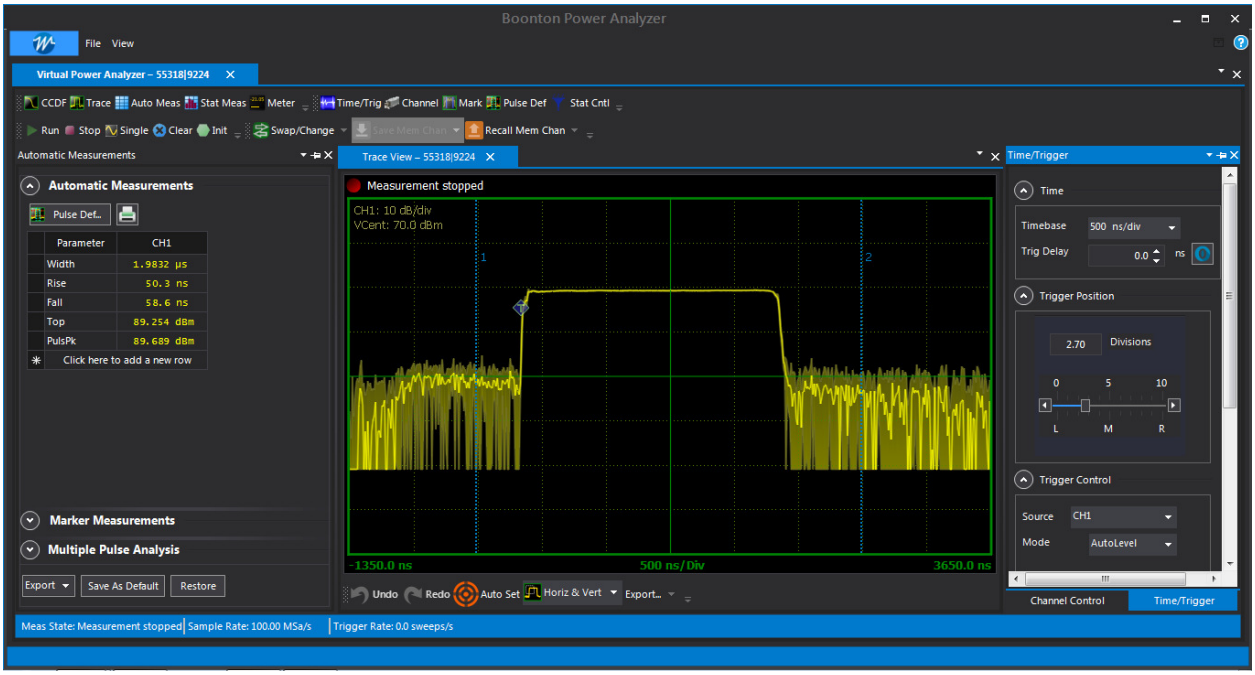
MODULATION CHARACTERISTICS

Test Data: 1 uS 40 dB BW Plot

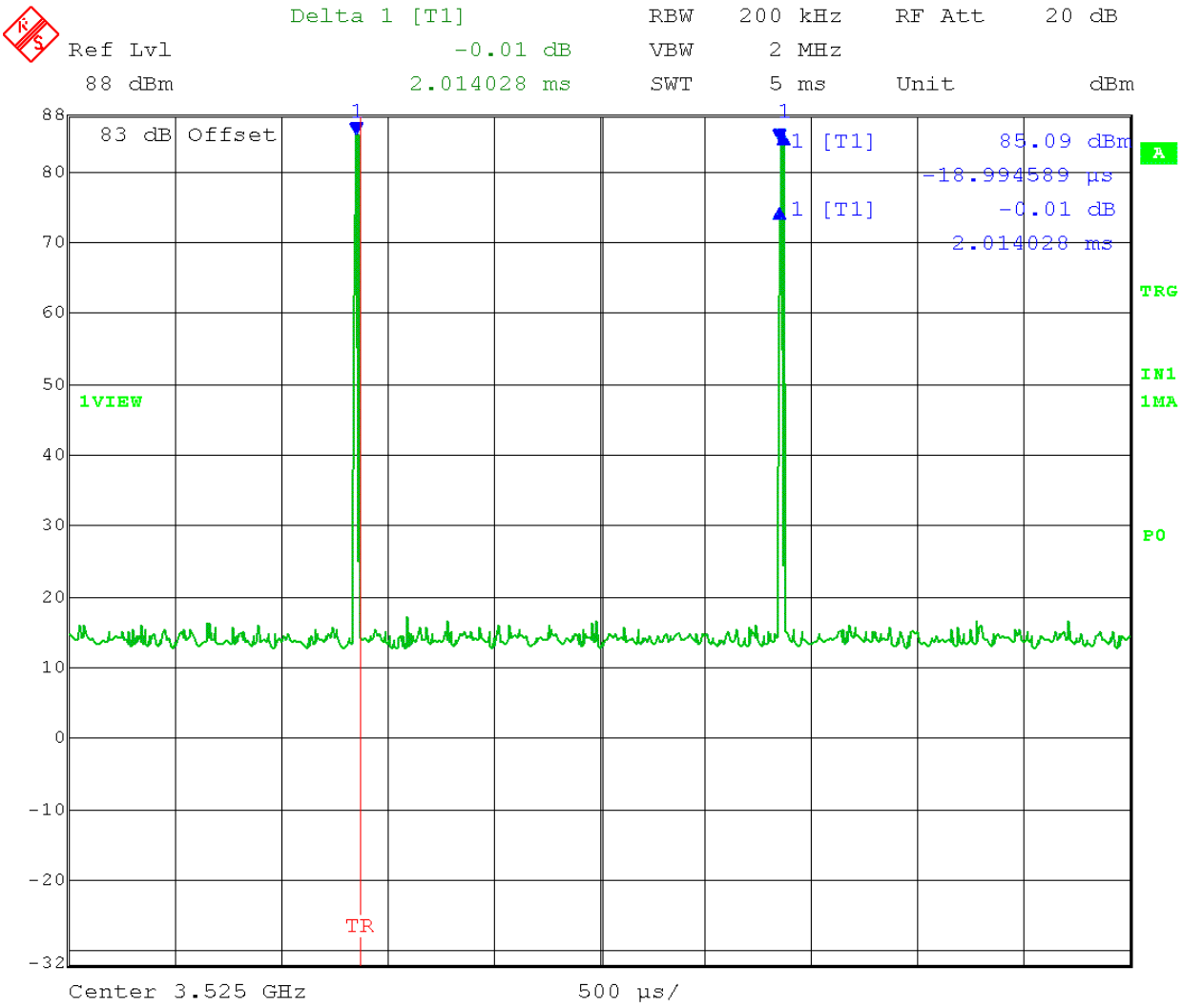


MODULATION CHARACTERISTICS

Test Data: 2 uS Pulse width Plot



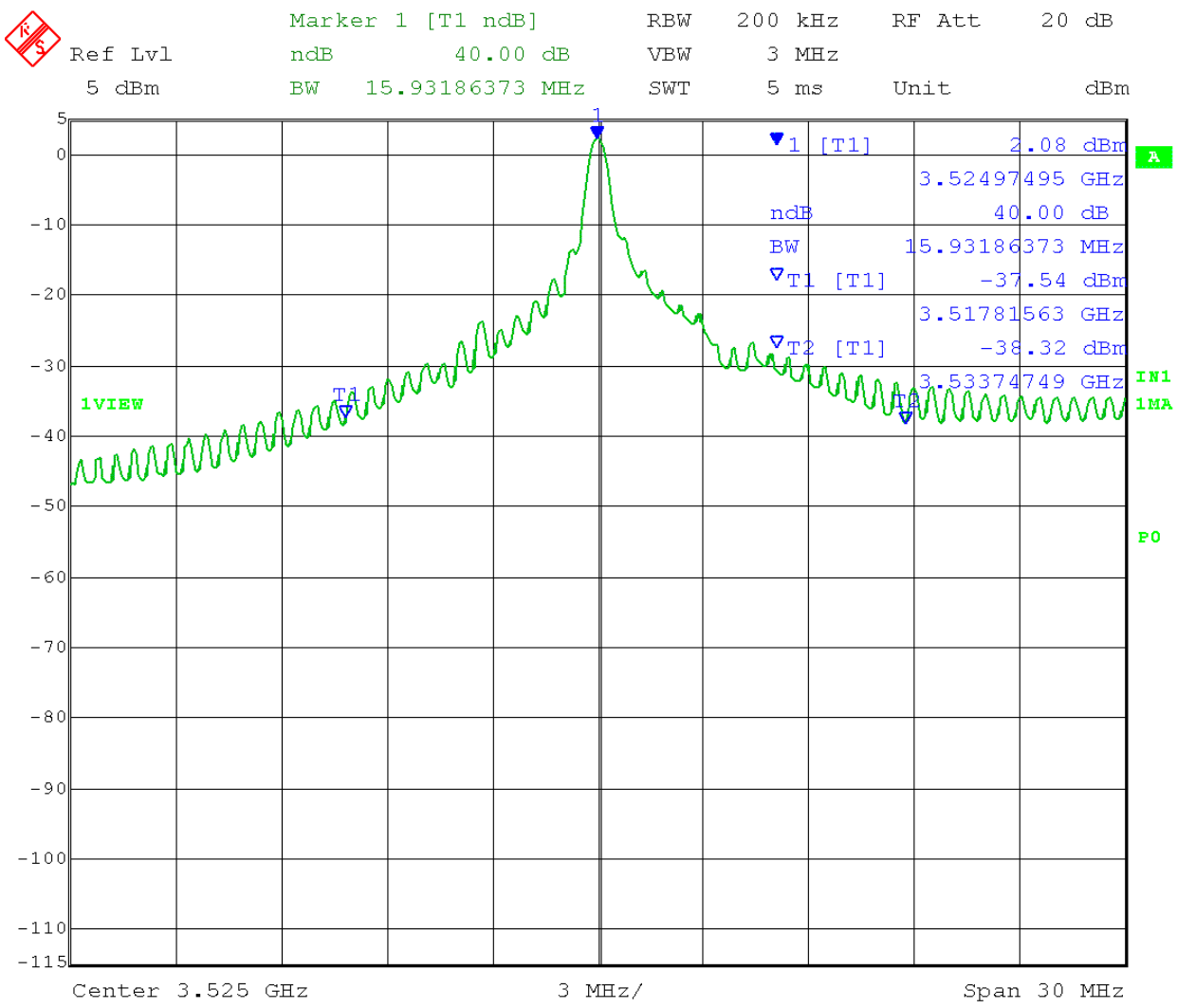
Test Data: 2 uS Rep Rate Plot



Date: 20.SEP.2017 15:04:16

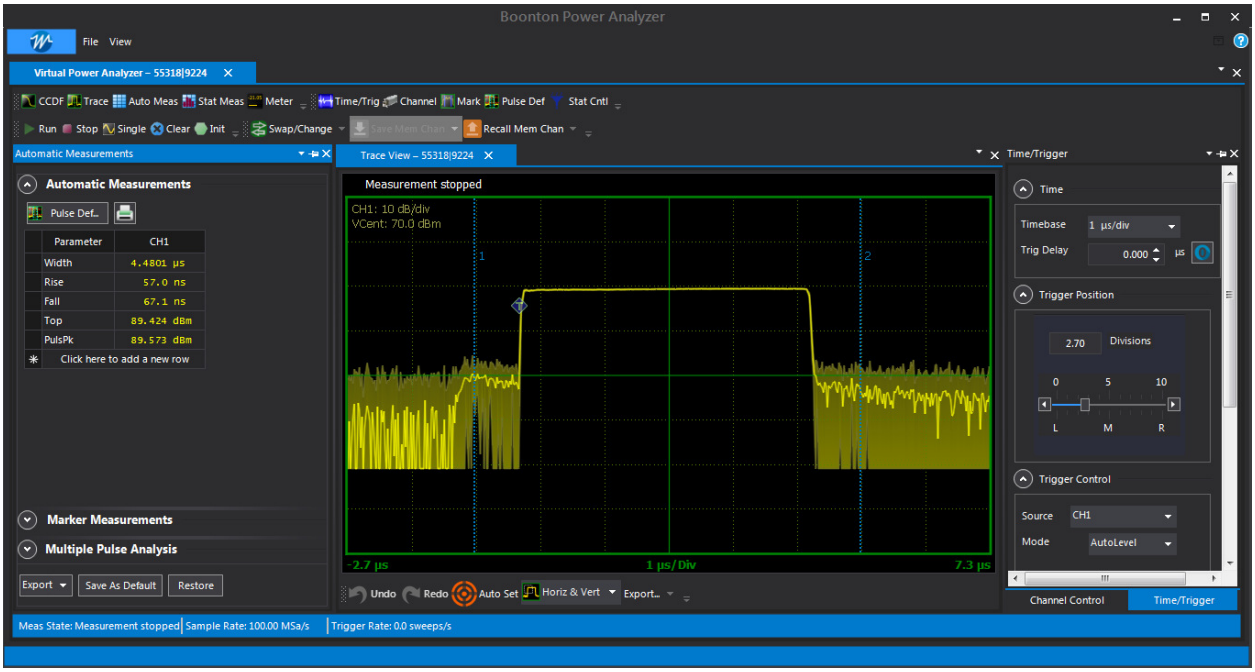
MODULATION CHARACTERISTICS

Test Data: 2 uS 40 dB BW Plot



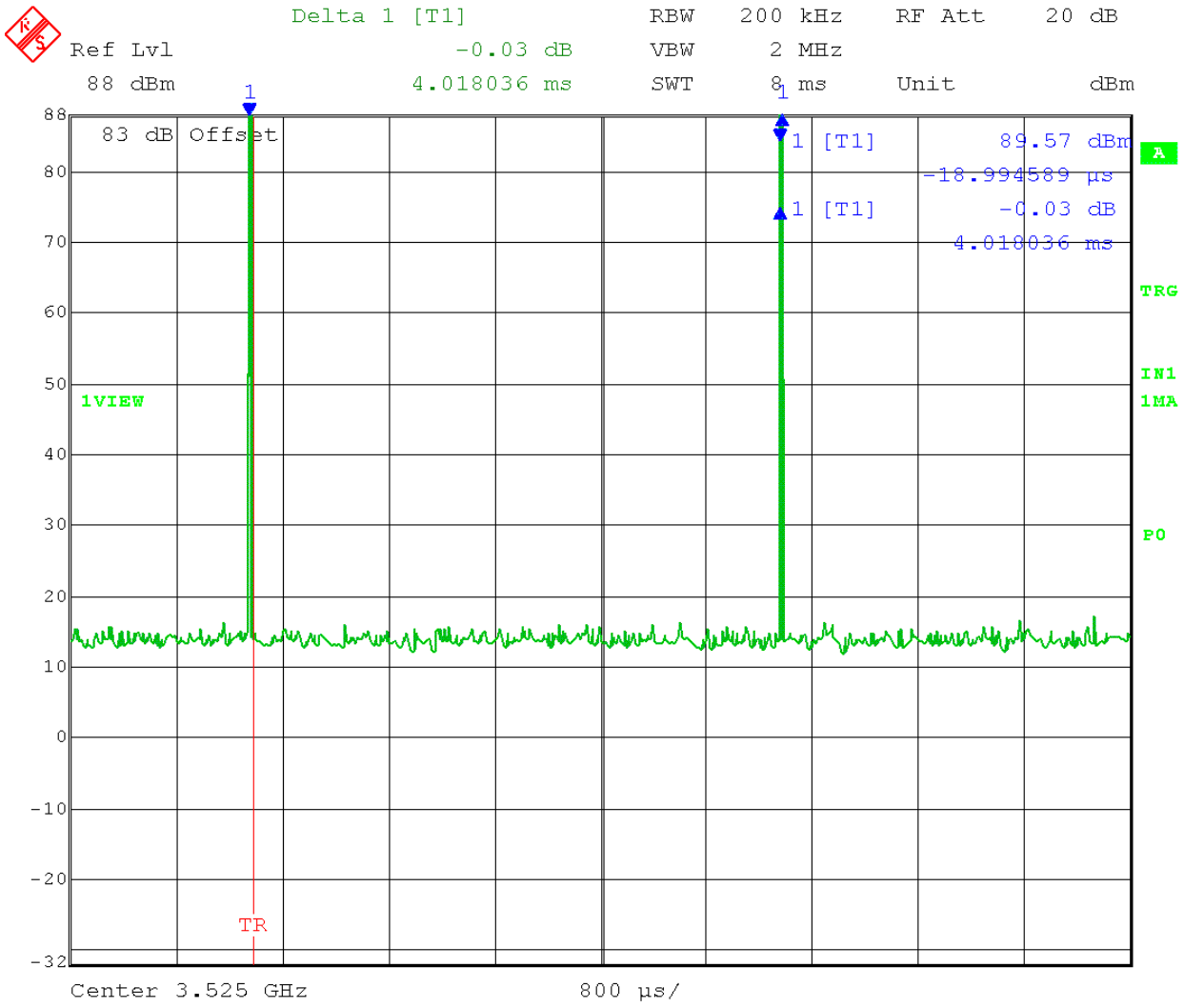
MODULATION CHARACTERISTICS

Test Data: 4.5 uS Pulse width Plot



MODULATION CHARACTERISTICS

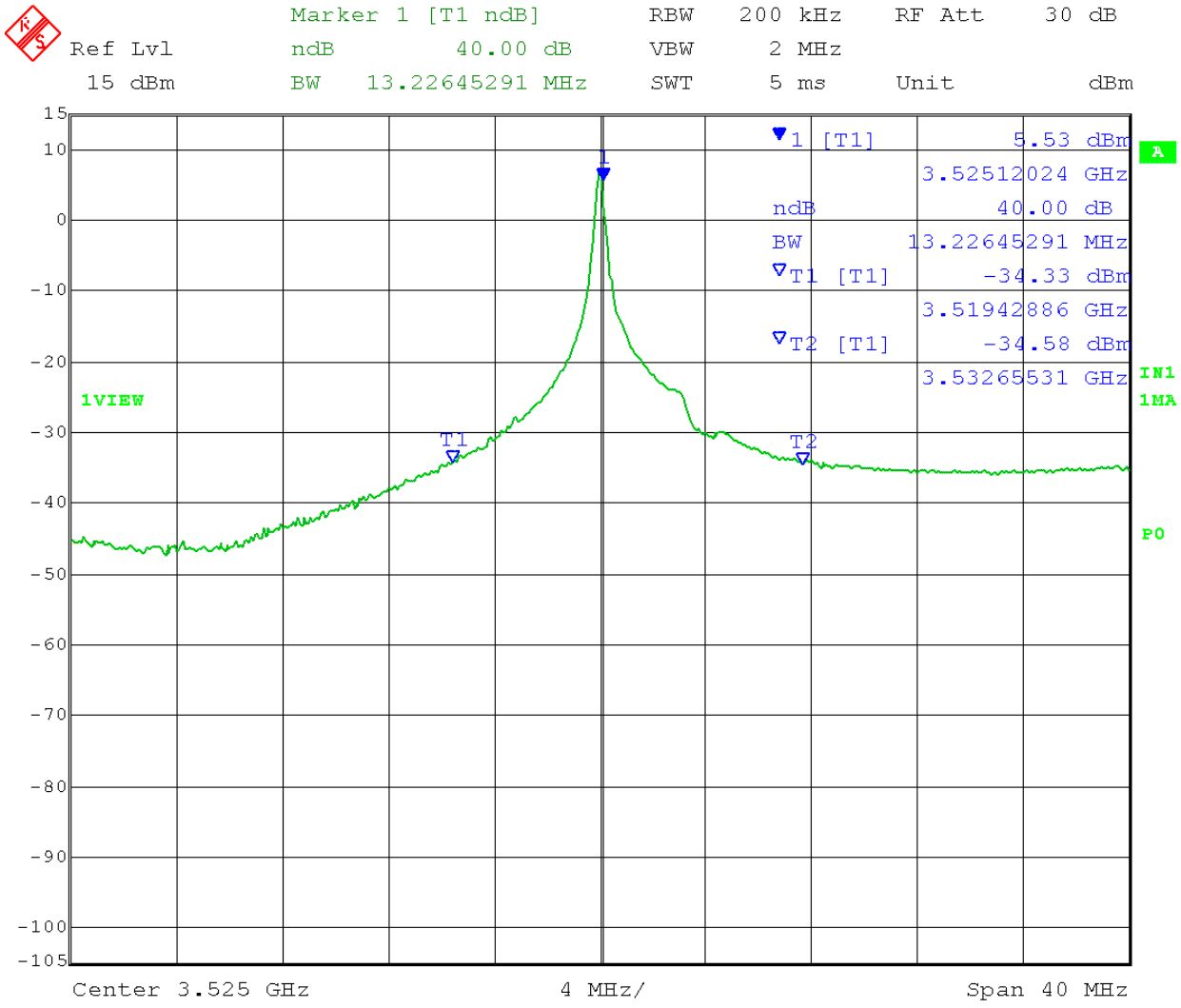
Test Data: 4.5 uS Rep Rate Plot



Date: 20.SEP.2017 15:05:19

MODULATION CHARACTERISTICS

Test Data: 4.5 uS 40 dB BW Plot



Date: 20.SEP.2017 16:52:29

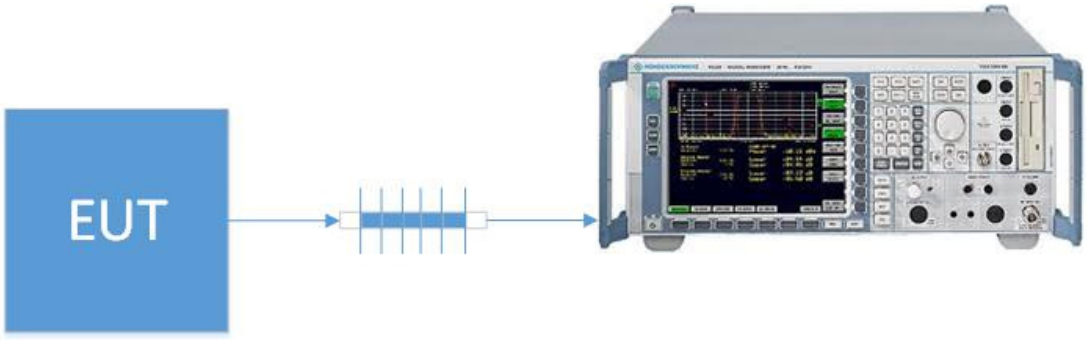
OCCUPIED BANDWIDTH

Rule Part No.: 2.1049

Requirements: 99% OBW Reporting Only

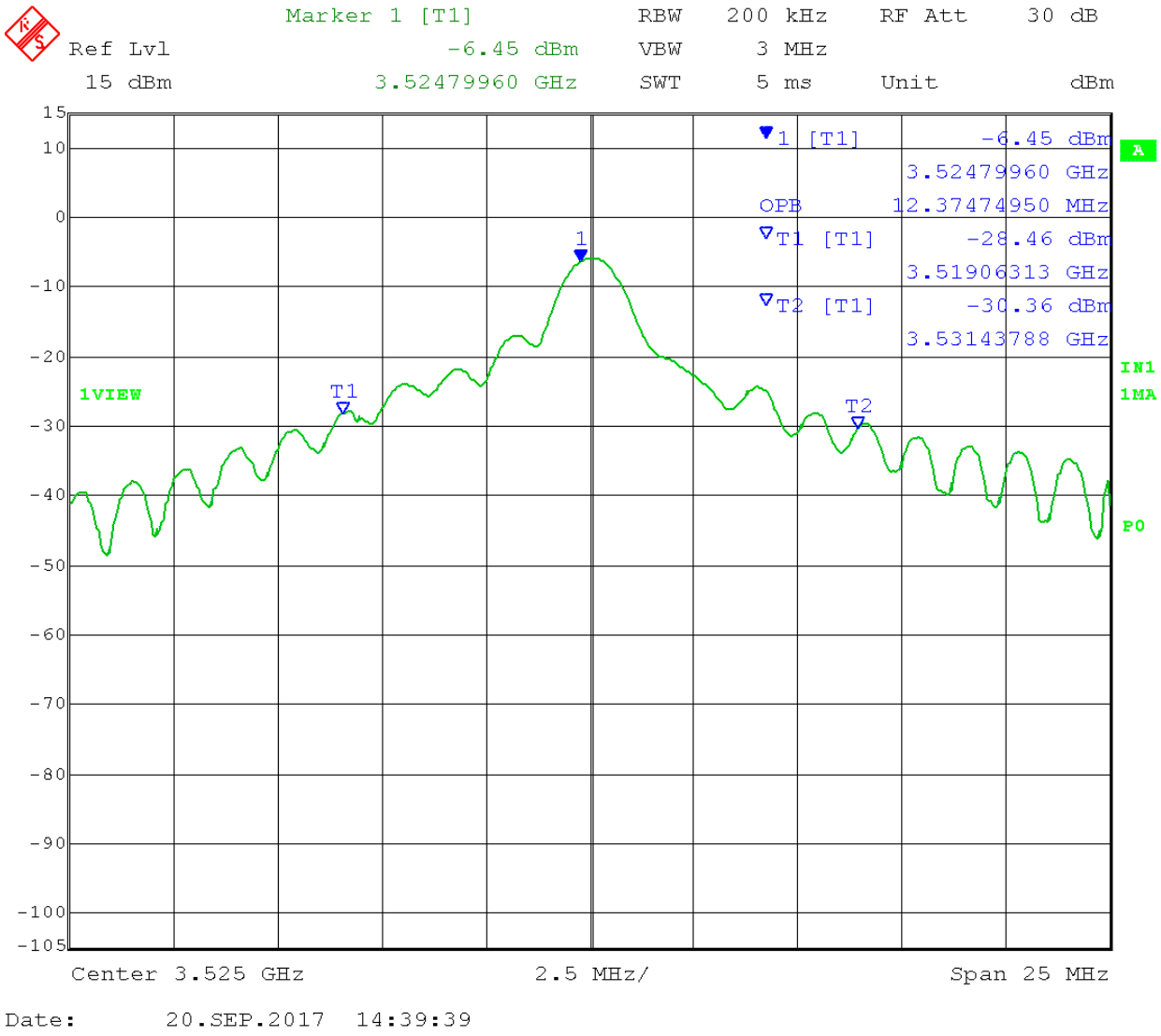
Procedure: ANSI/TIA-603

Setup Diagram:



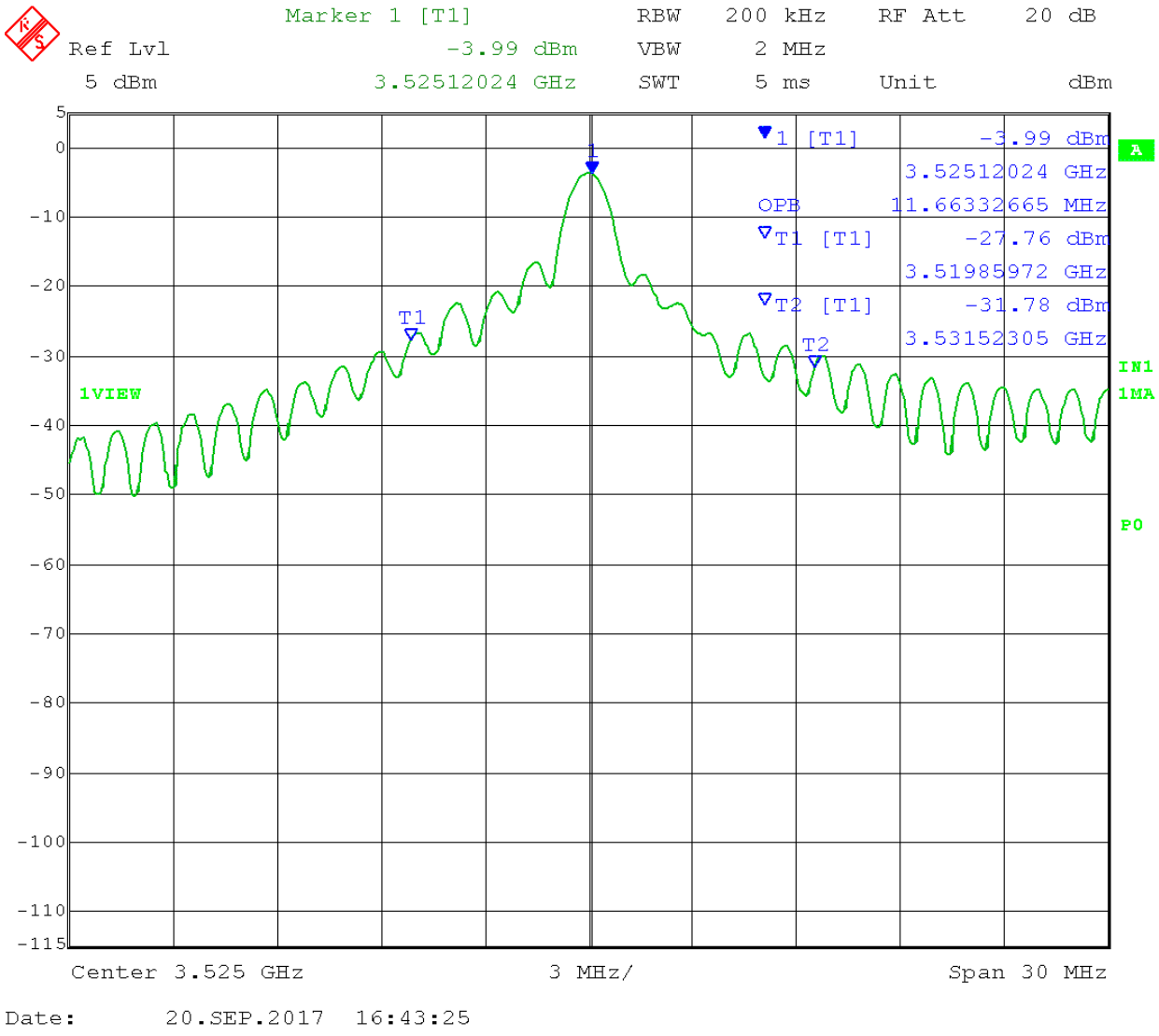
OCCUPIED BANDWIDTH

Test Data: 0.8uS 99% OBW Plot



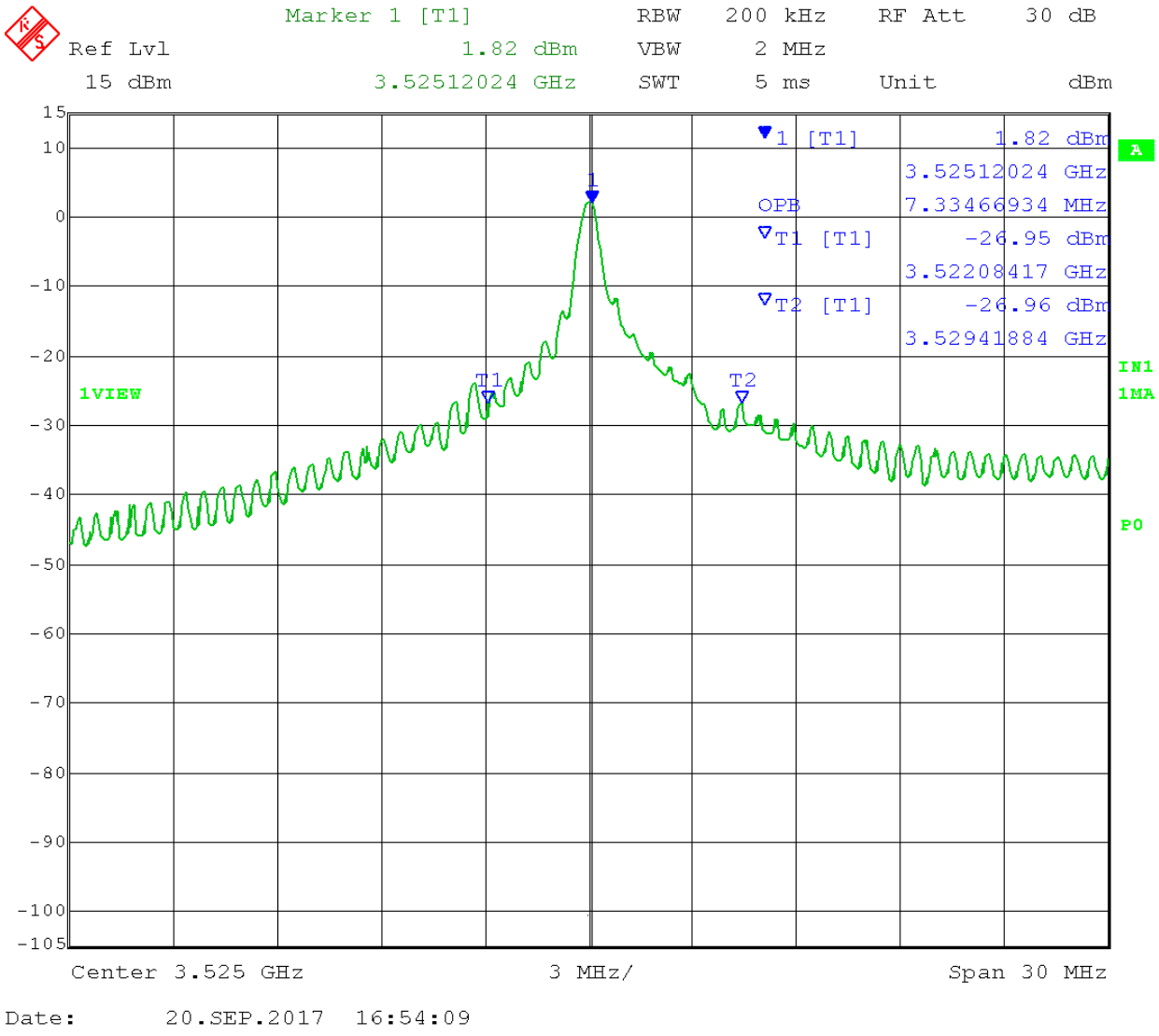
OCCUPIED BANDWIDTH

Test Data: 1uS 99% OBW Plot



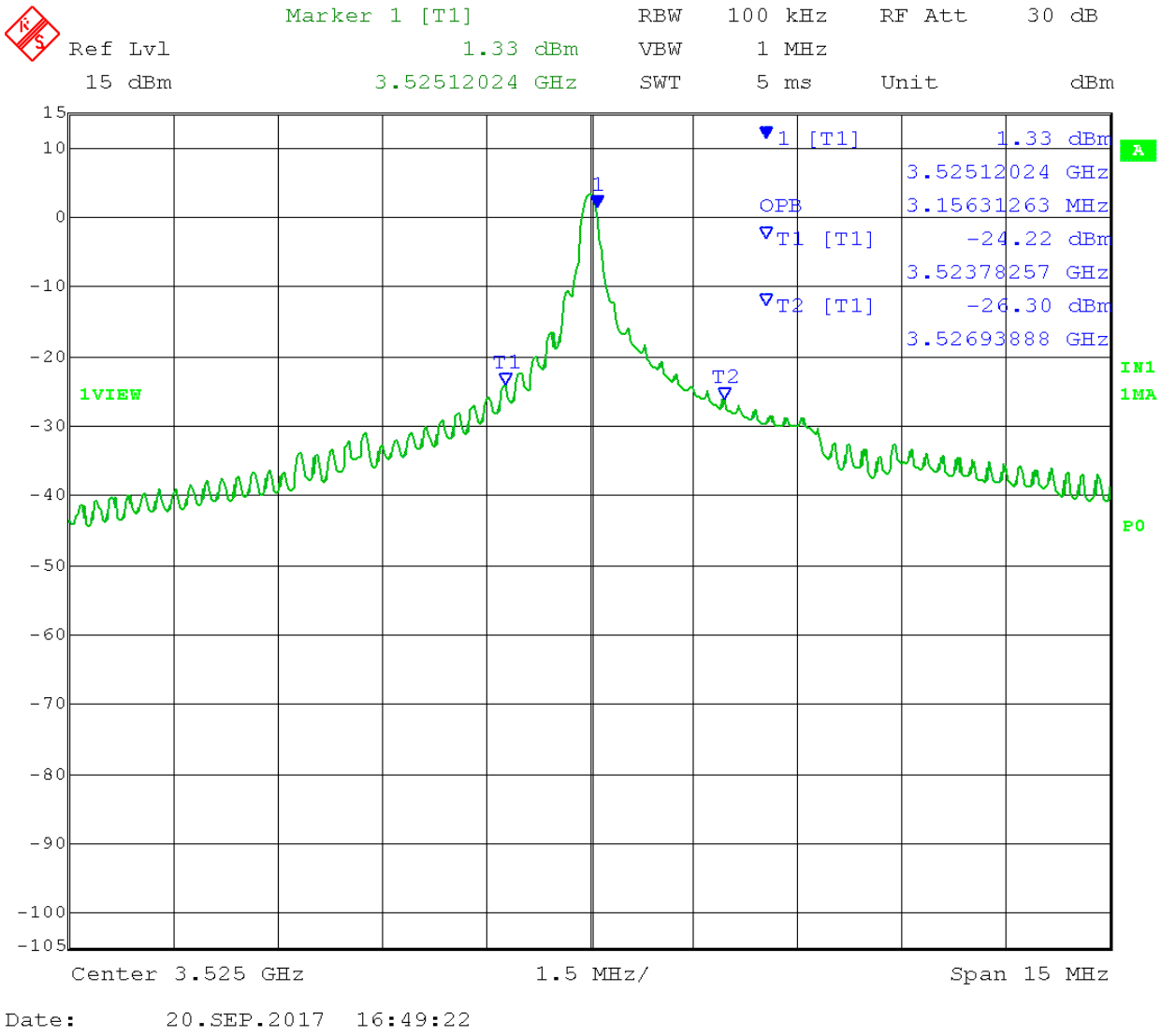
OCCUPIED BANDWIDTH

Test Data: 2uS 99% OBW Plot



OCCUPIED BANDWIDTH

Test Data: 4.5uS 99% OBW Plot



Date: 20.SEP.2017 16:49:22

SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)

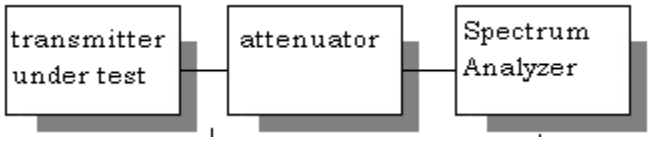
Rule Part No.: 2.1051, 90.210 (b) (3)

Requirements: 43+10log (P)

Procedure: The spectrum was scanned from9 KHz - 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:
Pa = Pm* Td * fr. Where Td is pulse duration, Pm is peak power, and fr is pulse rep rate.

Setup Diagram:



Notes: Only emissions that are within 20 dB of the limit are reported

Test Data: **Measurement Table**

Power Output	dBm		Watts	Limit (dBc)
	89.291		849376.03	102.291

Frequency		dBc	Margin dB
3525.000		0.00	0.00
7050.000		123.03	20.74
10575.000		103.16	0.87
14100.000		103.22	0.93
17625.000		102.68	0.39
21150.000	*	116.42	14.13
24675.000	*	120.59	18.30
28200.000	*	113.22	10.93
31725.000	*	116.40	14.11
35250.000	*	120.41	18.12

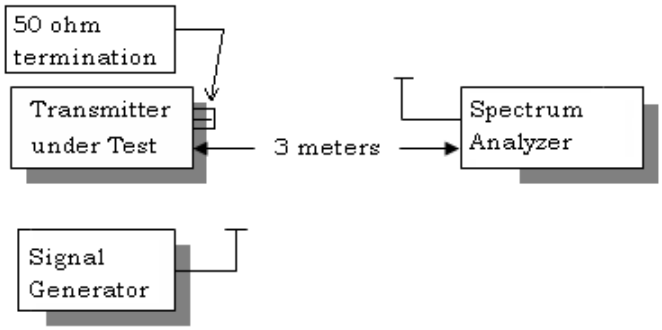
FIELD STRENGTH OF SPURIOUS EMISSIONS

Rule Parts. No.: 2.1053, 90.210(b) (3)

Requirements: 43+10log (P)

Procedure: The tabulated data shows the results of the substitution measurement of radiated field strength emissions test. The spectrum was scanned from 9 KHz - 40 GHz.

Setup Diagram:



Notes: Only emissions that are within 20 dB of the limit are reported

FIELD STRENGTH OF SPURIOUS EMISSIONS

Test Data: Measurement Table

Power Output	dBm	Watts	Limit (dB)
	89.424	875790.04	102.424

Tuned Freq MHz	Emission Frequency MHz	Antenna Polarity	erp (dBmW)	**Margin dB**
3500.00	7000.00	H	-13.51	0.51
3500.00	10500.00	V	-22.45	9.45
3500.00	14000.00	V	-19.00	6.00
3500.00	17500.00	V	-15.89	2.89
3500.00	21000.00	V	-26.27	13.27
3500.00	24500.00	V	-24.24	11.24
3500.00	28000.00	V	-21.20	8.20
3500.00	31500.00	V	-18.84	5.84
3500.00	35000.00	V	-13.01	0.01
3525.00	7050.00	V	-14.82	1.82
3525.00	10575.00	V	-21.45	8.45
3525.00	14100.00	H	-17.83	4.83
3525.00	17625.00	H	-14.89	1.89
3525.00	21150.00	H	-28.21	15.21
3525.00	24675.00	H	-26.05	13.05
3525.00	28200.00	H	-23.10	10.10
3525.00	31725.00	H	-20.69	7.69
3525.00	35250.00	V	-15.67	2.67
3550.00	7100.00	H	-24.03	11.03
3550.00	10650.00	H	-19.41	6.41
3550.00	14200.00	H	-18.47	5.47
3550.00	17750.00	H	-15.80	2.80
3550.00	21300.00	V	-16.42	3.42
3550.00	24850.00	V	-14.53	1.53
3550.00	28400.00	H	-22.38	9.38
3550.00	31950.00	H	-18.61	5.61
3550.00	35500.00	V	-14.11	1.11

FREQUENCY STABILITY

Rule Parts. No.: 2.1055, 90.213

Requirements: Manufacturers specification, authorization reviewed on a case-by-case basis.

Procedure: The test procedures used are detailed in the standard listed that is listed above.

Modifications to Standard: EUT voltage was not varied because it will always be connected to a UPS battery backup system. The EUT was not tested below 0ºC because manufacturer specification stated the EUT would not function.

Test Data Measurement Table

Temperature	Frequency MHz	Cycles	PPM
25°C (reference)	3524.978080		
0°C	3524.978080	0	0.000
10°C	3524.793340	-184740	-52.409
20°C	3524.974320	-3760	-1.067
30°C	3524.976830	-1250	-0.355
40°C	3524.974320	-3760	-1.067
50°C	3524.978558	478	0.136

STATE OF THE MEASUREMENT UNCERTAINITY

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

Test Items	Measurement Uncertainty	Notes
RF Frequency Accuracy	± 49.5 Hz	(1)
RF Conducted Power	±0.93dB	(1)
Conducted spurious emission of transmitter valid up to 40GHz	±1.86dB	
Occupied Bandwidth	±2.65%	
Audio Frequency Response	±1.86dB	
Modulation limiting	±1.88%	
Radiated RF Power	±1.4dB	
Maximum frequency deviation: Within 300 Hz and 6kHz of audio freq. Within 6kHz and 25kHz of audio Freq.	 ±1.88% ±2.04%	
Rad Emissions Sub Meth up to 26.5GHz	±2.14dB	
Adjacent channel power	±1.47dB	(1)
Transient Frequency Response	±1.88%	
Temperature	±1.0°C	(1)
Humidity	±5.0%	

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

EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/ Char Date	Due Date
Antenna: Biconical 1057	Eaton	94455-1	1057	11/18/15	11/18/17
Antenna: Log-Periodic 1122	Electro-Metrics	LPA-25	1122	07/26/17	07/26/19
Coaxial Cable - Chamber 3 cable set (backup)	Micro-Coax	Chamber 3 cable set (backup)	KMKM-0244-02 ; KMKM-0670-01; KFKF-0197-00	N/A	N/A
Sweep/Signal Generator	Anritsu	68369B	985112	10/28/15	10/28/17
Antenna: Double-Ridged Horn/ETS Horn 2	ETS-Lindgren	3117	00041534	03/01/17	03/01/19
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	N/A	Version 4.10.7.0	N/A	N/A
Antenna: Active Loop	ETS-Lindgren	6502	00062529	11/18/15	11/18/17
RF Power Meter	Boonton	4531	11793	01/12/17	01/12/19
Type K J Thermometer	Martel	303	080504494	10/26/15	10/26/17
Attenuator N 30dB 500W DC-2.5G	Bird	8325	1761	05/18/15	09/28/17
Antenna: Double-Ridged Horn 18-40 GHz	EMCO	3116	9011-2145	11/18/15	11/18/17
Non Radiating 50 OHM Load	Sierra Elec	160B-600X	1038	09/13/16	09/13/18
Attenuator K 3dB 2W DC-40G	Narda	4768-3	1023-2	06/25/15	09/25/17
Attenuator K 6dB 2W DC-40G	Narda	4768-6	1044-2	06/25/15	09/25/17
Bore-sight Antenna Positioning Tower	Sunol Sciences	TLT2	N/A	N/A	N/A

* EMI RECEIVER SOFTWARE VERSION
The receiver firmware used was version 4.43 Service Pack 3

END OF REPORT