



Engineering Solutions & Electromagnetic Compatibility Services

FCC Certification Report

**Harris Corporation
221 Jefferson Ridge Parkway
Lynchburg, VA 24501**

**MASTR V 900 MHz Transceiver
FCC ID: OWDTR-0155-E**

August 2, 2017

Standards Referenced for this Report	
Part 2: 2016	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
Part 90: 2016	Private Land Mobile Radio Services
ANSI C63.26-2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services

Frequency Range (MHz)	Rated Conducted Output Power (W)	Frequency Tolerance (ppm)	Transmit Mode	Emission Designator
935 – 940	0.001	0.04	C4FM Data/Voice	8K00F1D/E
935 – 940	0.001	0.04	WCQPSK	9K70D1W
935 – 940	0.001	0.04	HDQPSK	9K80D7W

Report Prepared By: Daniel W. Baltzell

Document Number: 2017093TNF

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*These tests are accredited and meet the requirements of ISO/IEC 17025 as verified by ANAB.
Refer to certificate and scope of accreditation AT-1445.*

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1 Test Result Summary

Test	FCC Reference	Result
RF Power Output	2.1046(a), Part 90.205(k), 90.635	Complies
Spurious Emissions at Antenna Terminals	2.1051, 90.210	Complies
Field Strength of Spurious Radiation	2.1053(a), 90.210	Complies
Occupied Bandwidth/Emission Masks	2.1049(c)(1), 90.210	Complies
Frequency Stability vs. Temperature and Voltage	2.1055, 90.213	Complies

2 General Information

The following Certification Report is prepared on behalf of Harris Corporation in accordance with the Federal Communications Commission rules and regulations. The Equipment Under Test (EUT) was the MASTR V 900 MHz Transceiver; FCC ID: OWDTR-0155-E.

The radio is subject to FCC DoC. DoC testing was performed and the data is contained in a separate DoC report.

All measurements contained in this application were conducted in accordance with the applicable sections of FCC Rules and Regulations CFR 47 Parts 2, 90. Calibration checks are performed regularly on the instruments, and all accessories including high pass filter, coaxial attenuator, preamplifier and cables.

2.1 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located on the parking lot of Rhein Tech Laboratories, Inc. 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report submitted to, and approved by, the Federal Communications Commission to perform AC line conducted and radiated emissions testing.

2.2 Related Submittal(s)/Grant(s)

This is a new FCC certification application.

2.3 Grant Notes

RF power fixed at 0.001 W typical.

2.4 Tested System Details

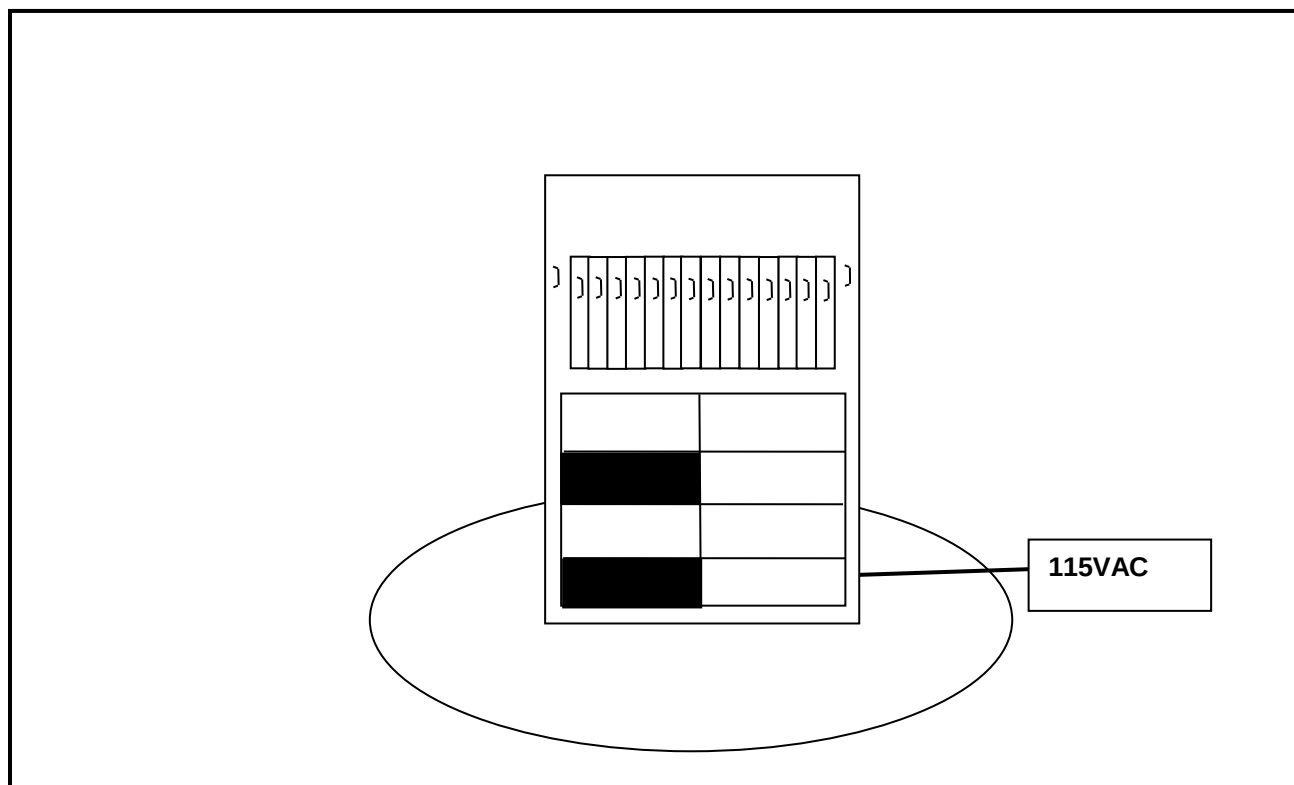
The test sample was received on May 19, 2017. Listed below are the identifiers and descriptions of all equipment, cables, and internal devices used with the EUT for this test, as applicable.

The device was programmed for multiple modes of operation and modulation types.

Table 2-1: Equipment Under Test (EUT)

Part	Manufacturer	Model	PN/SN	FCC ID	RTL Bar Code
Transceiver	Harris Corporation	MASTR V, P25T, 900 MHz	MASV-900M1-EM	OWDTR-0155-E	22517
Transceiver	Harris Corporation	MASTR V, P25C, 900 MHz	SV-9CXMV-EM	OWDTR-0155-E	22517

Figure 2-1: Configuration of Tested System



3 FCC Part 2.1033(C)(8): Voltages and Currents through the Final Amplifying Stage

5V / 120mA

4 FCC Part 2.1046(a): RF Power Output: Conducted; Part 90.205(k) Power and Antenna Height Limits; 90.635 Limitations on power and antenna height.

4.1 Test Procedure

ANSI 63.26, section 5.2

The EUT was connected to a coaxial attenuator having a 50 Ω load impedance.

Manufacturer's rated power: 0.001 W.

4.2 Test Data

Table 4-1: RF Conducted Output Power – Measured

Frequency (MHz)	C4FM (dBm)	WCQPSK (dBm)	HDQPSK (dBm)
935.0125	0.6	0.4	0.0
937.5000	0.3	0.2	-0.2
937.3375	0.5	0.3	0.0
939.9875	0.5	0.3	0.0

Notes: Data presented is for analog mode. All other modes were investigated and found to have equivalent power within measurement tolerances.

Table 4-2: Test Equipment Used For Testing RF Power Output – Conducted

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901184	Agilent Technologies	E4416A	EPM-P Power Meter, single channel	GB41050573	6/21/19
901671	Agilent	E9300H	E-Series Avg Power Sensor	MY41495766	6/21/19

Test Personnel:

Daniel W. Baltzell
EMC Test Engineer



Signature

June 13, 2017
Date of Test

5 FCC Part 2.1051: Spurious Emissions at Antenna Terminals; Part 90.210: Emission Limitations

5.1 Test Procedure

ANSI 63.26, section 5.2

The transmitter is terminated with a 50 Ω load and interfaced with a spectrum analyzer.

Device with digital modulation: Modulated to its maximum extent using a pseudo-random data sequence.

5.2 Test Data

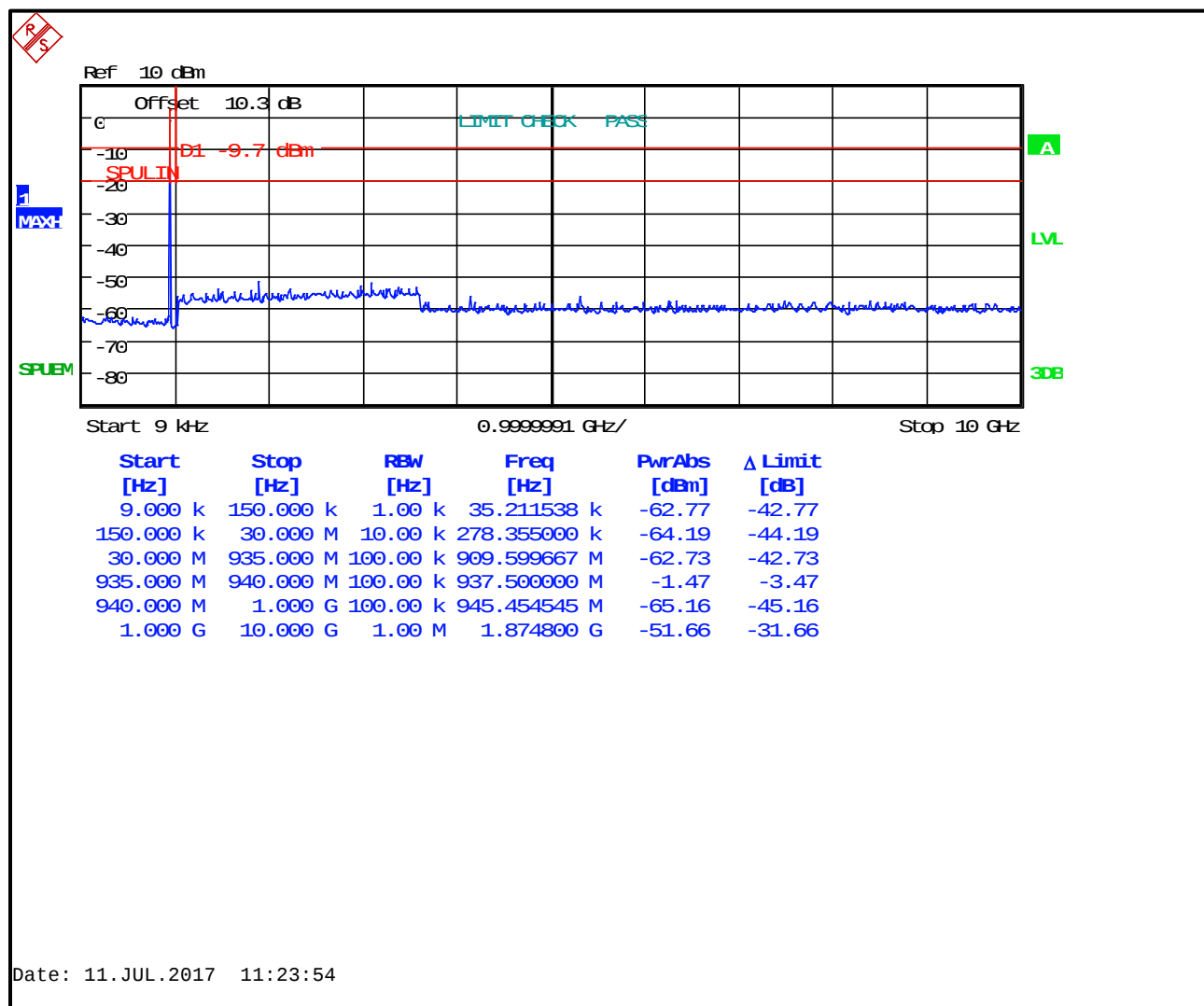
Frequency range of measurement per Part 2.1057: 9 kHz to 10 x Fc

Limits: 50 + 10 LOG P(W)) narrowband limit

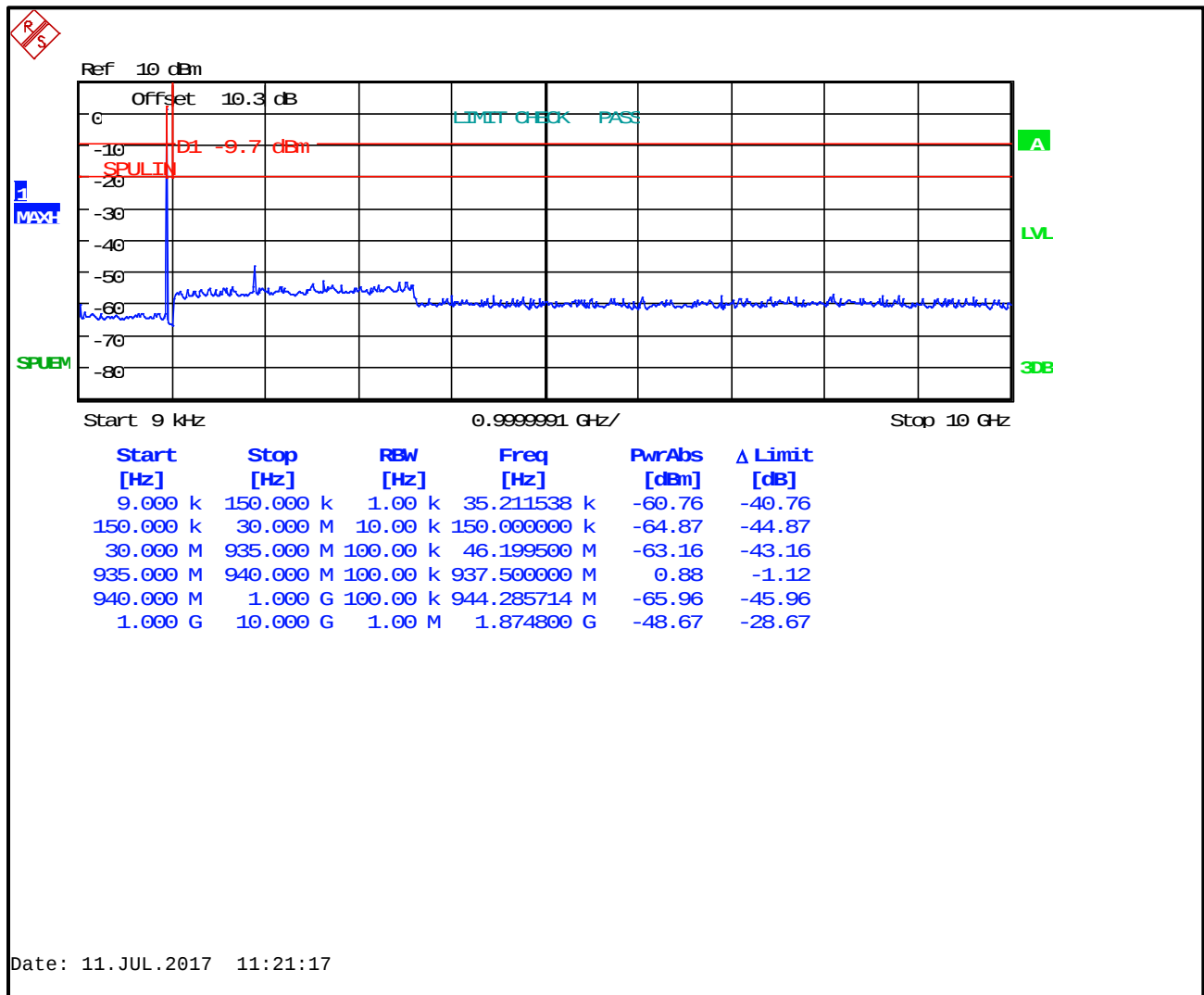
The following frequencies (in MHz) were investigated: 935.0125, 937.5, 937.3375, and 939.9875

All modes were investigated and no emissions were found within 20 dB below the limit.

Plot 5-1: Conducted Antenna Spurious Emissions – 937.5 MHz; C4FM



Plot 5-2: Conducted Antenna Spurious Emissions – 937.5 MHz; WCQPSK



Plot 5-3: Conducted Antenna Spurious Emissions – 937.5 MHz; HDQPSK

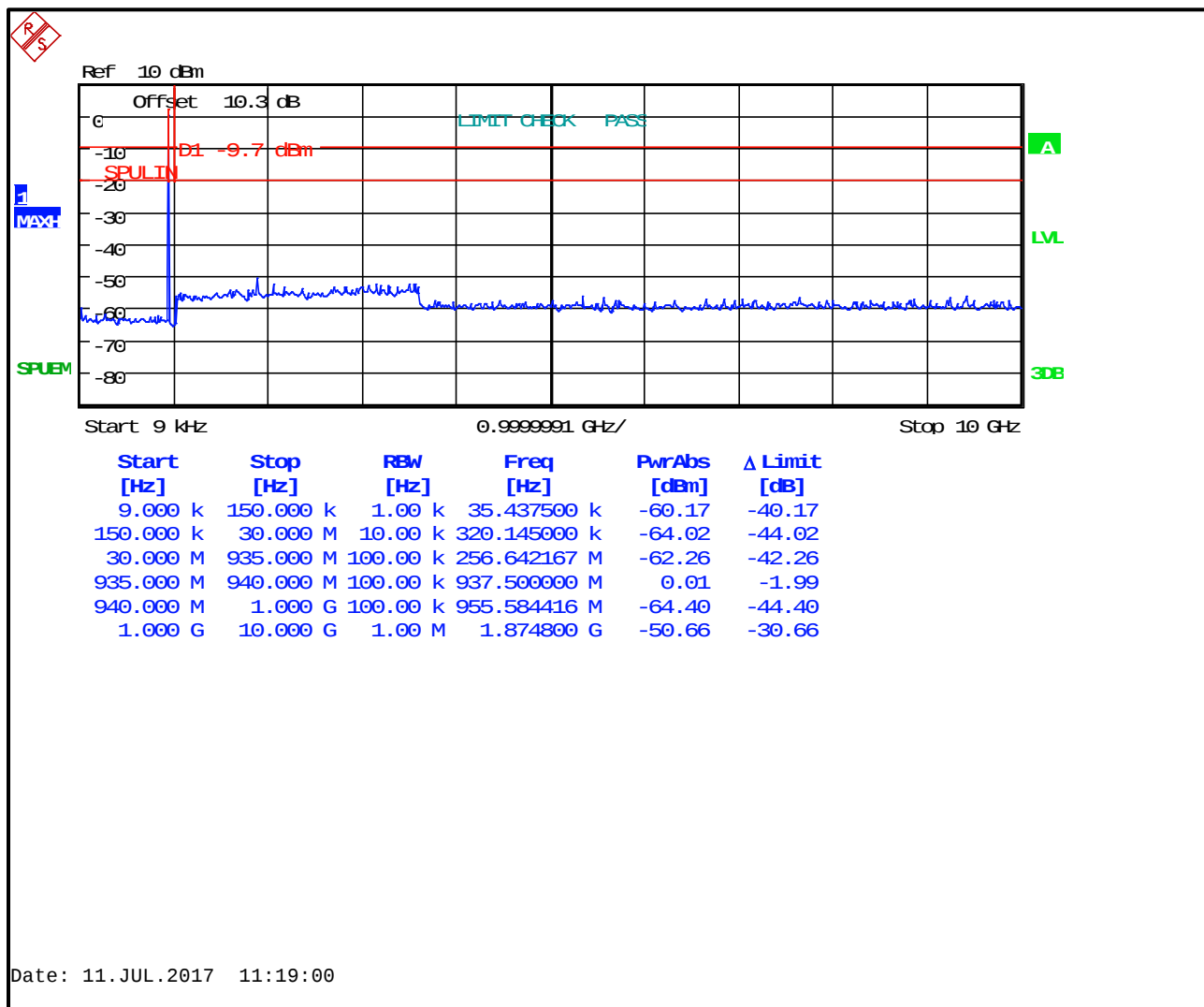


Table 5-1: Test Equipment Used For Testing Spurious Emissions

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	3/22/18

Test Personnel:

Daniel W. Baltzell
EMC Test Engineer

Signature

July 11, 2017
Date of Test

6 FCC Part 2.1053(a): Field Strength of Spurious Radiation

6.1 Test Procedure

ANSI 63.26, section 5.5.

The device uses digital modulation modulated to its maximum extent using a pseudo-random data sequence.

The spurious emissions levels were measured, and the device under test was replaced by a substitution antenna connected to a signal generator. This signal generator level was then corrected by subtracting the cable loss from the substitution antenna to the signal generator, and the gain of the antenna (dBi) was added to achieve the EIRP level, then converted from the corrected signal generator level (dBm) to dBc, and compared to the limit.

6.2 Test Data

Table 6-1: Field Strength of Spurious Radiation – 935.0125 MHz

Conducted Power 0.6 dBm; 0.001 W; Limit=50+10LogP=20.6 dBc

Frequency (MHz)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss to Transmit Antenna (dB)	Substitution Antenna Gain (dBi)	Corrected Signal Generator Level (dBc)	Margin (dB)
1870.025	-21.3	-93.2	0.5	7.1	87.1	-66.5
2805.038	-17.3	-94.8	0.6	10.1	85.9	-65.3
3740.050	-19.3	-93.2	0.8	8.4	86.2	-65.6
4675.063	-19.5	-90.9	0.9	12.8	79.6	-59.0
5610.075	-22.3	-93.5	1.1	12.3	82.9	-62.3
6545.088	-21.3	-91.6	1.2	15.3	78.1	-57.5
7480.100	-20.7	-89.7	1.4	12.6	79.0	-58.4
8415.113	-19.6	-80.5	1.5	14.0	68.6	-48.0
9350.125	-19.4	-82.7	1.6	14.1	70.8	-50.2

Table 6-2: Field Strength of Spurious Radiation – 939.9875 MHz

Conducted Power 0.05 dBm; 0.001 W; Limit=50+10LogP=20.5 dBc

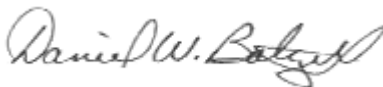
Frequency (MHz)	Spectrum Analyzer Level (dBuV)	Signal Generator Level (dBm)	Cable Loss to Transmit Antenna (dB)	Substitution Antenna Gain (dBi)	Corrected Signal Generator Level (dBc)	Margin (dB)
1879.975	-18.2	-89.9	0.5	7.1	83.8	-63.3
2819.963	-16.8	-92.6	0.6	10.1	83.7	-63.2
3759.950	-18.2	-93.2	0.8	8.3	86.2	-65.7
4699.938	-19.3	-90.8	0.9	12.9	79.4	-58.9
5639.925	-19.7	-90.9	1.1	12.5	80.0	-59.5
6579.913	-18.9	-89.2	1.2	15.2	75.7	-55.2
7519.900	-19.8	-89.0	1.4	12.9	78.0	-57.5
8459.888	-20.6	-85.3	1.5	14.2	73.2	-52.7
9399.875	-19.7	-83.1	1.7	14.2	71.0	-50.5

Table 6-3: Test Equipment Used For Testing Field Strength of Spurious Radiation

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900878	Rhein Tech Laboratories	AM3-1197-0005	3 meter antenna mast, polarizing	OATS1	N/A
901592	Insulated Wire Inc.	KPS-1503-3600-KPR	SMK RF Cables 20'	NA	8/3/17
901593	Insulated Wire Inc.	KPS-1503-360-KPR	SMK RF Cables 36"	NA	8/1/17
901242	Rhein Tech Laboratories	WRT-000-0003	Wood rotating table	N/A	N/A
900791	Chase	CBL6111B	Bilog Antenna (30 MHz – 2000 MHz)	N/A	6/11/18
900321	EMCO	3161-03	Horn Antenna (4.0 - 8.2 GHz)	9508-1020	4/9/18
900323	EMCO	3160-07	Horn Antenna (8.2 - 12.4 GHz)	9605-1054	4/9/18
900772	EMCO	3161-02	Horn Antenna (2 - 4 GHz)	9804-1044	4/9/18
901582	Rohde & Schwarz	1167.0000.02	Signal Generator	101903	3/20/18
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	3/22/18

Test Personnel:

Daniel W. Baltzell
Test Engineer



Signature

June 19, 2017
Date of Test

7 FCC Part 2.1049(c)(1): Occupied Bandwidth; Part 90.210 Emission Masks

Occupied Bandwidth - Compliance with the Emission Masks

7.1 Test Procedure

ANSI 63.26, section 5.4.

Device with digital modulation: Modulated to its maximum extent using a pseudo-random data sequence.

Part 90.210 Authorized Bandwidth

Applicable Emission Masks		
Frequency Band (MHz)	Mask for Equipment With Audio Low Pass Filter	Mask for Equipment Without Audio Low Pass Filter
Below 25 ¹	A or B.....	A or C
25–50.....	B.....	C
72–76.....	B.....	C
150–174 ²	B, D, or E.....	C, D, or E
150 Paging-only	B.....	C
220–222	F.....	F
421–512 ²	B, D, or E.....	C, D, or E
450 Paging-only	B.....	G
806–809/851–854	B.....	H
809–824/854–869 ^{3 5}	B.....	G
896–901/935–940	I.....	J
902–928	K.....	K
929–930	B.....	G
4940–4990 MHz	L or M.....	L or M
5850–5925 ⁴		
All other bands	B.....	C

¹ Equipment using single sideband J3E emission must meet the requirements of Emission Mask A. Equipment using other emissions must meet the requirements of Emission Mask B or C, as applicable.

² Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D, and equipment designed to operate with a 6.25 kHz channel bandwidth must meet the requirements of Emission Mask E.

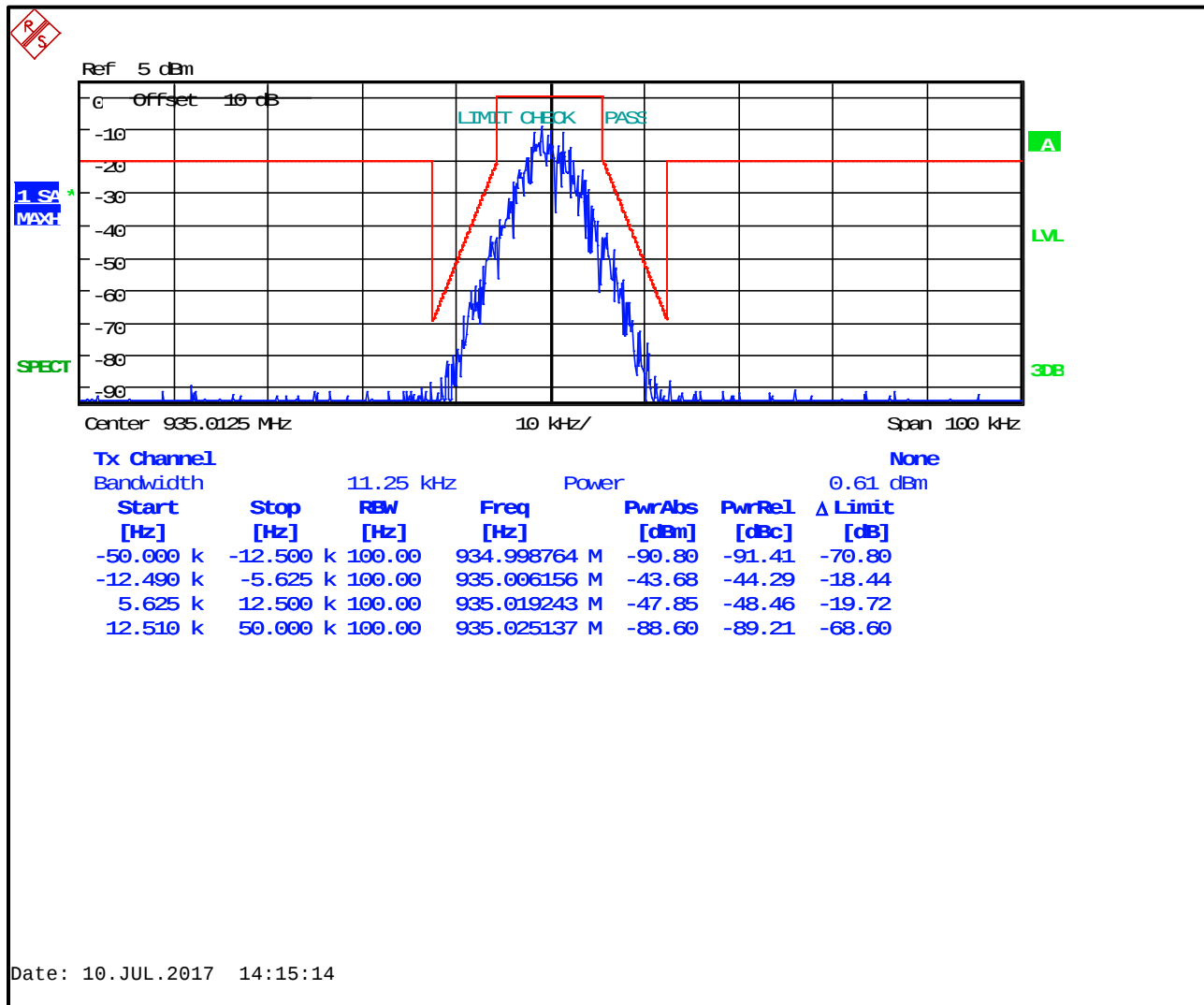
³ Equipment used in this licensed to EA or non-EA systems shall comply with the emission mask provisions of §90.691.

⁴ DSRCS Roadside Unit equipment in the 5850–5925 MHz band is governed under subpart M of this part.

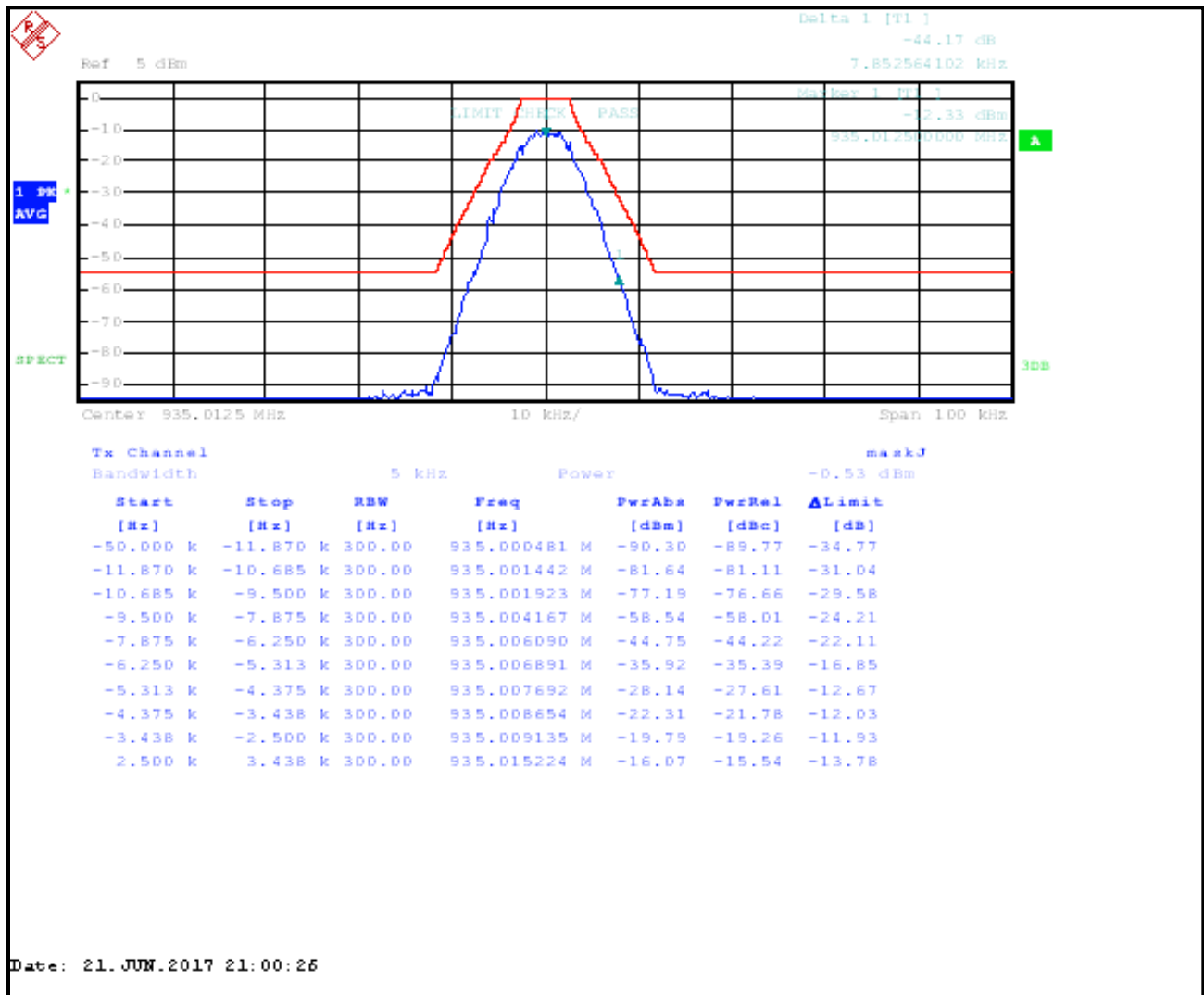
⁵ Equipment may alternatively meet the Adjacent Channel Power limits of §90.221.

7.2 Test Data

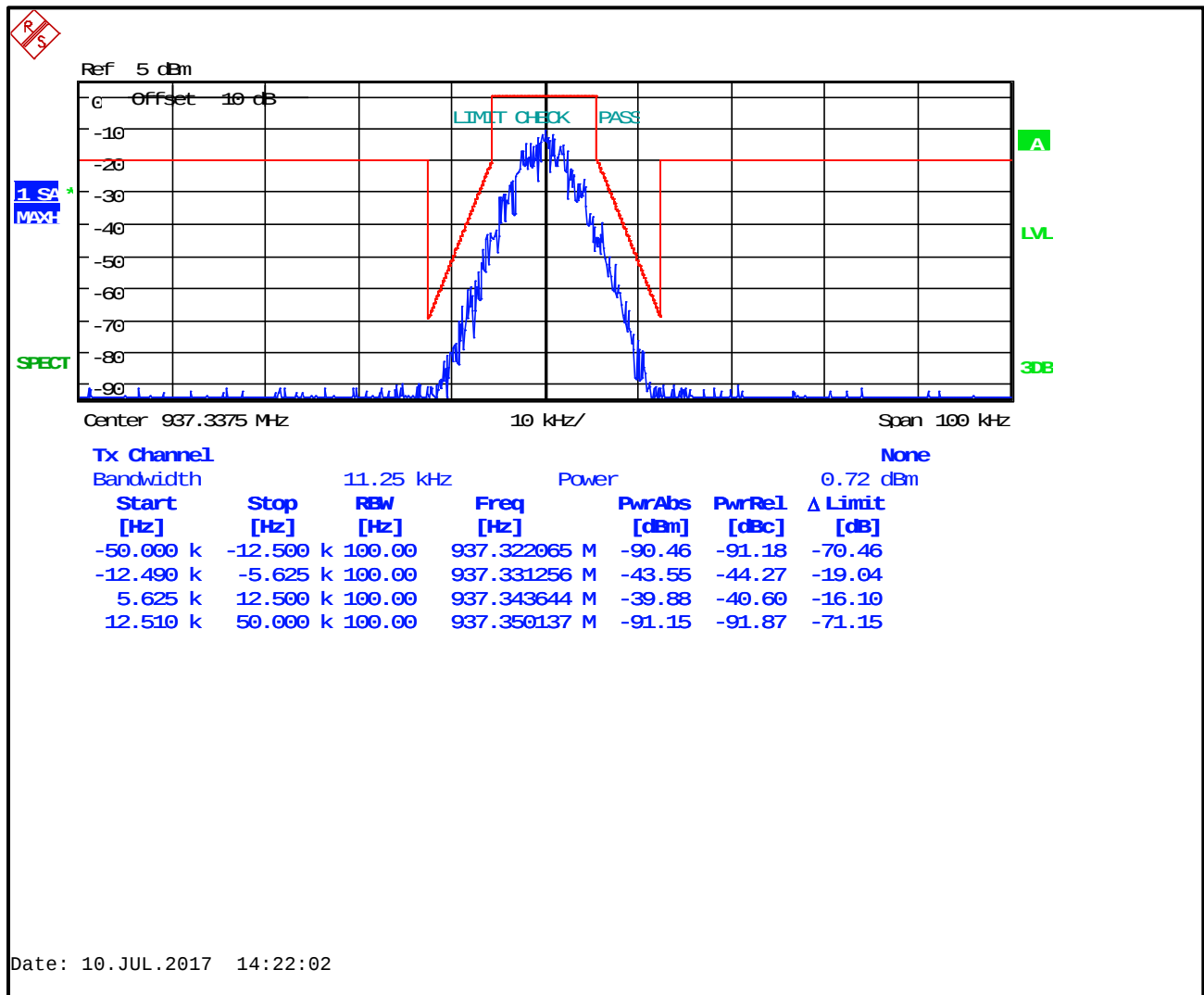
Plot 7-1: Occupied Bandwidth – 935.0125 MHz; C4FM; Mask D



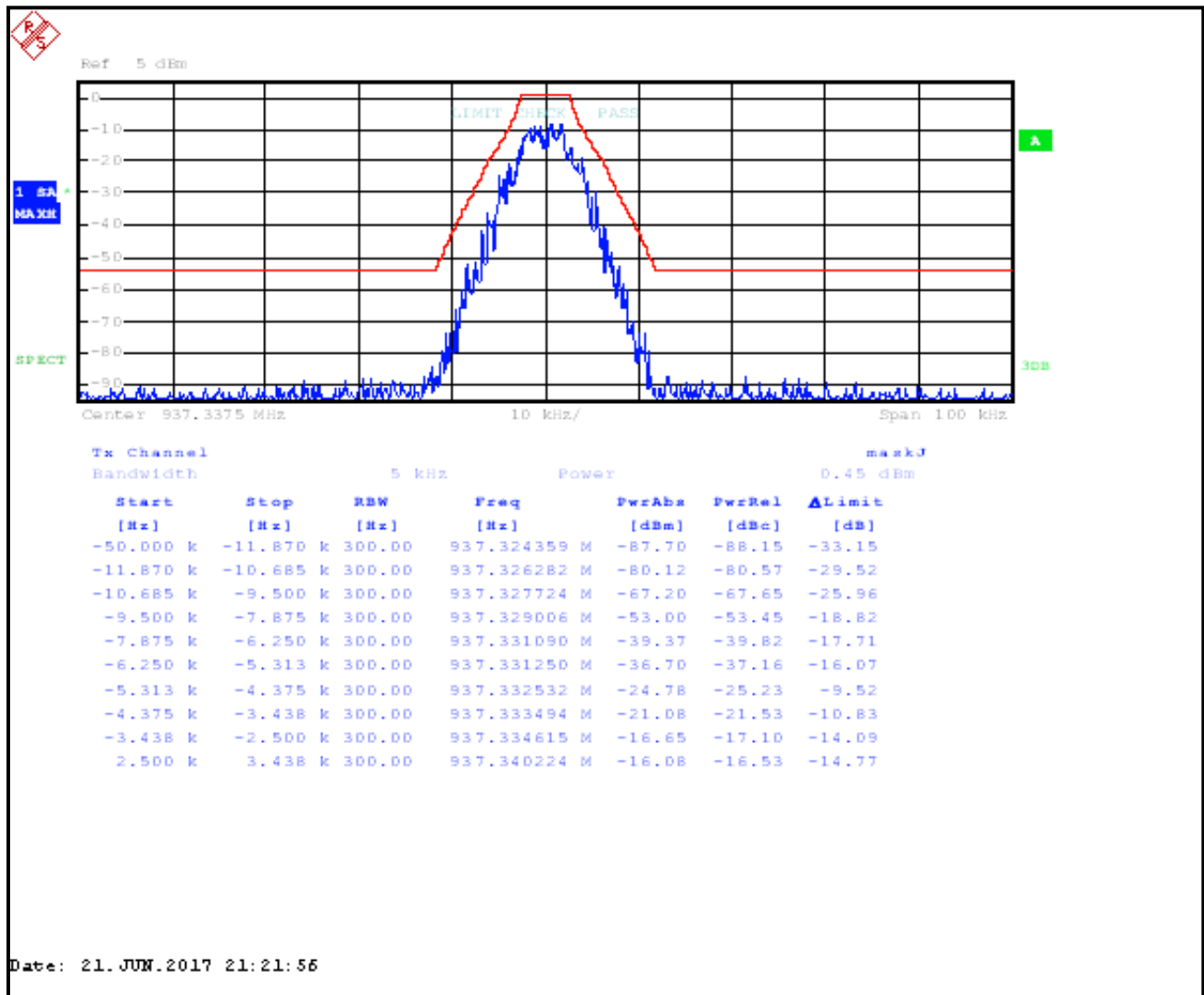
Plot 7-2: Occupied Bandwidth – 935.0125 MHz; C4FM; Mask J



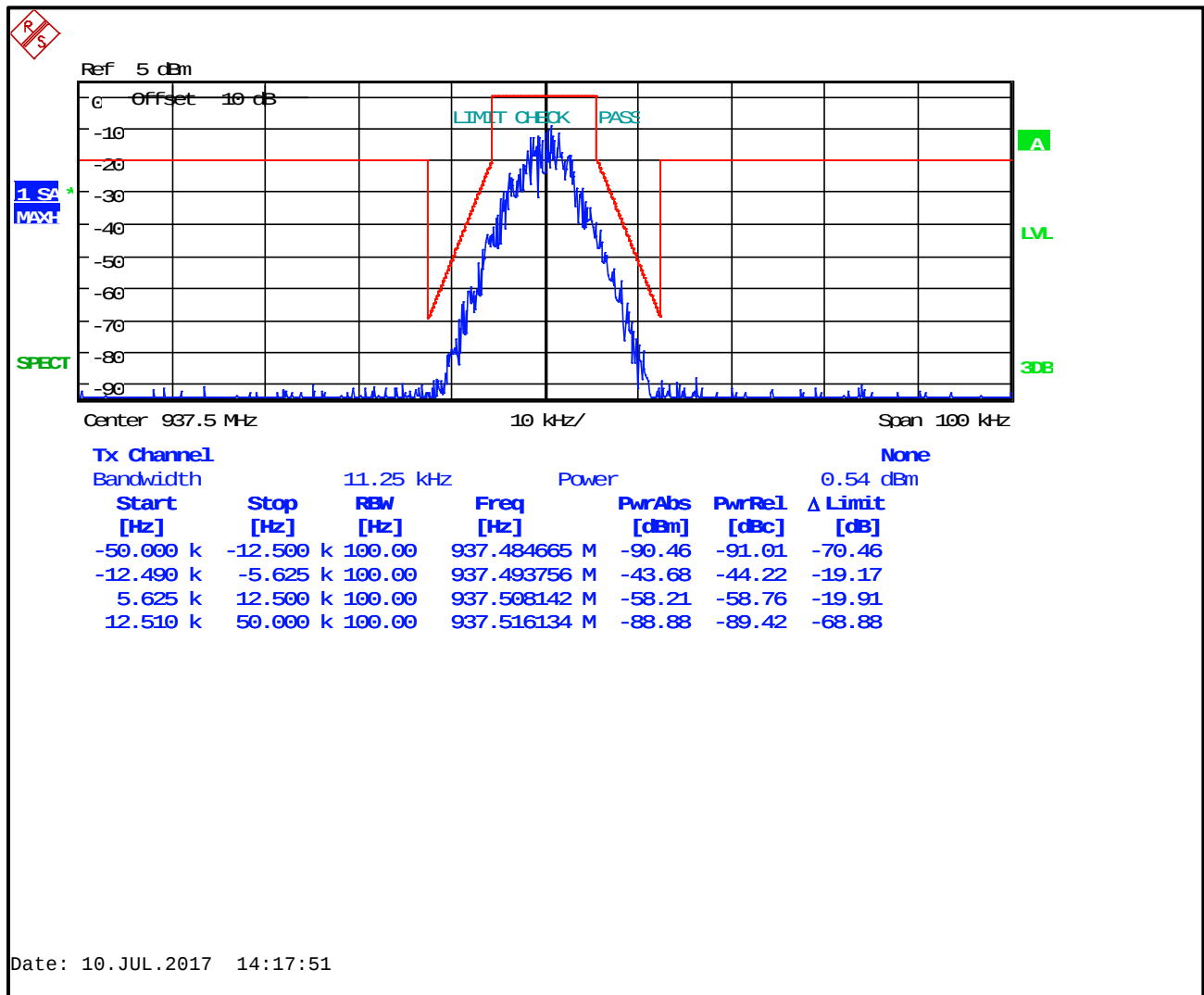
Plot 7-3: Occupied Bandwidth – 937.3375 MHz; C4FM; Mask D



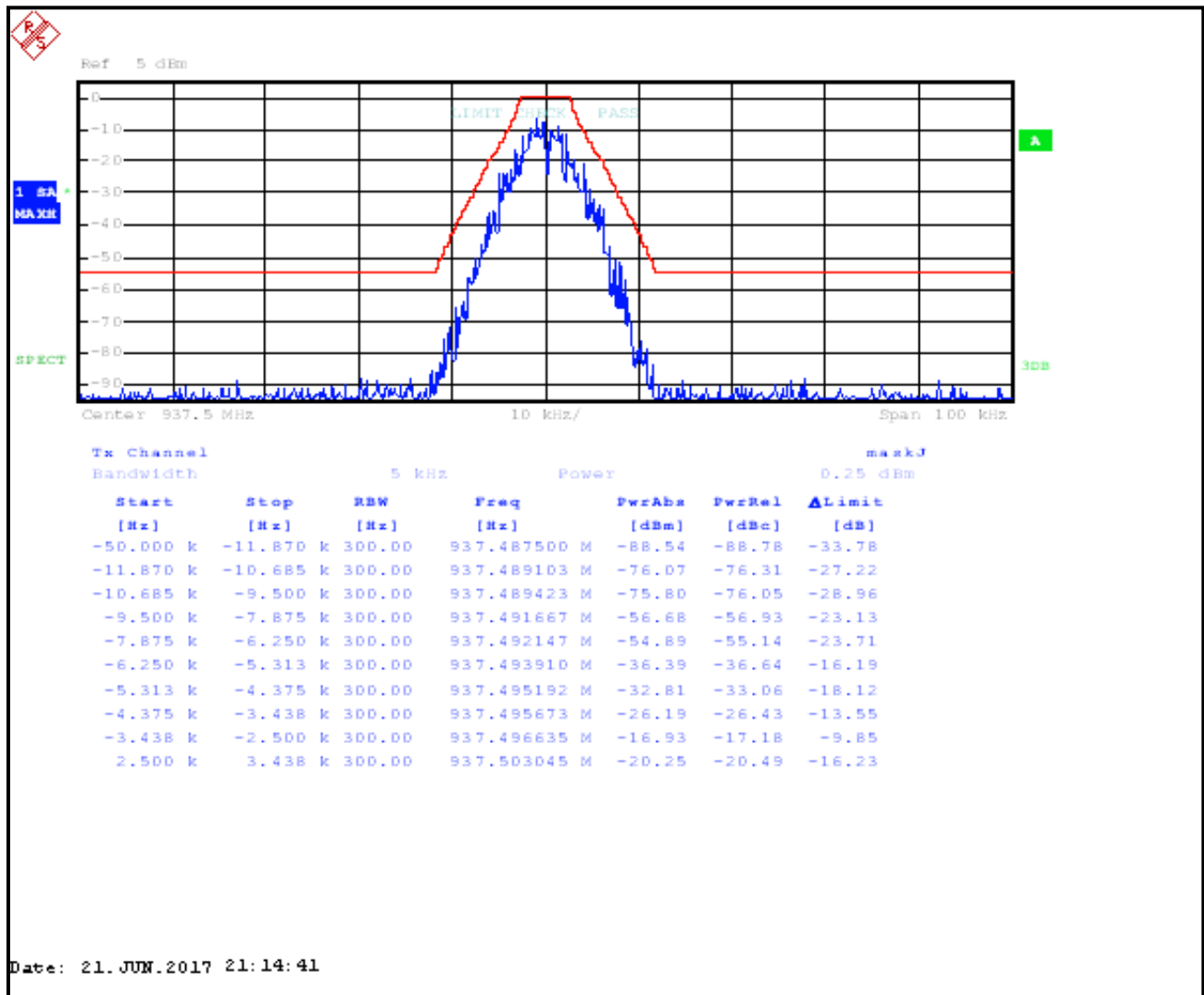
Plot 7-4: Occupied Bandwidth – 937.3375 MHz; C4FM; Mask J



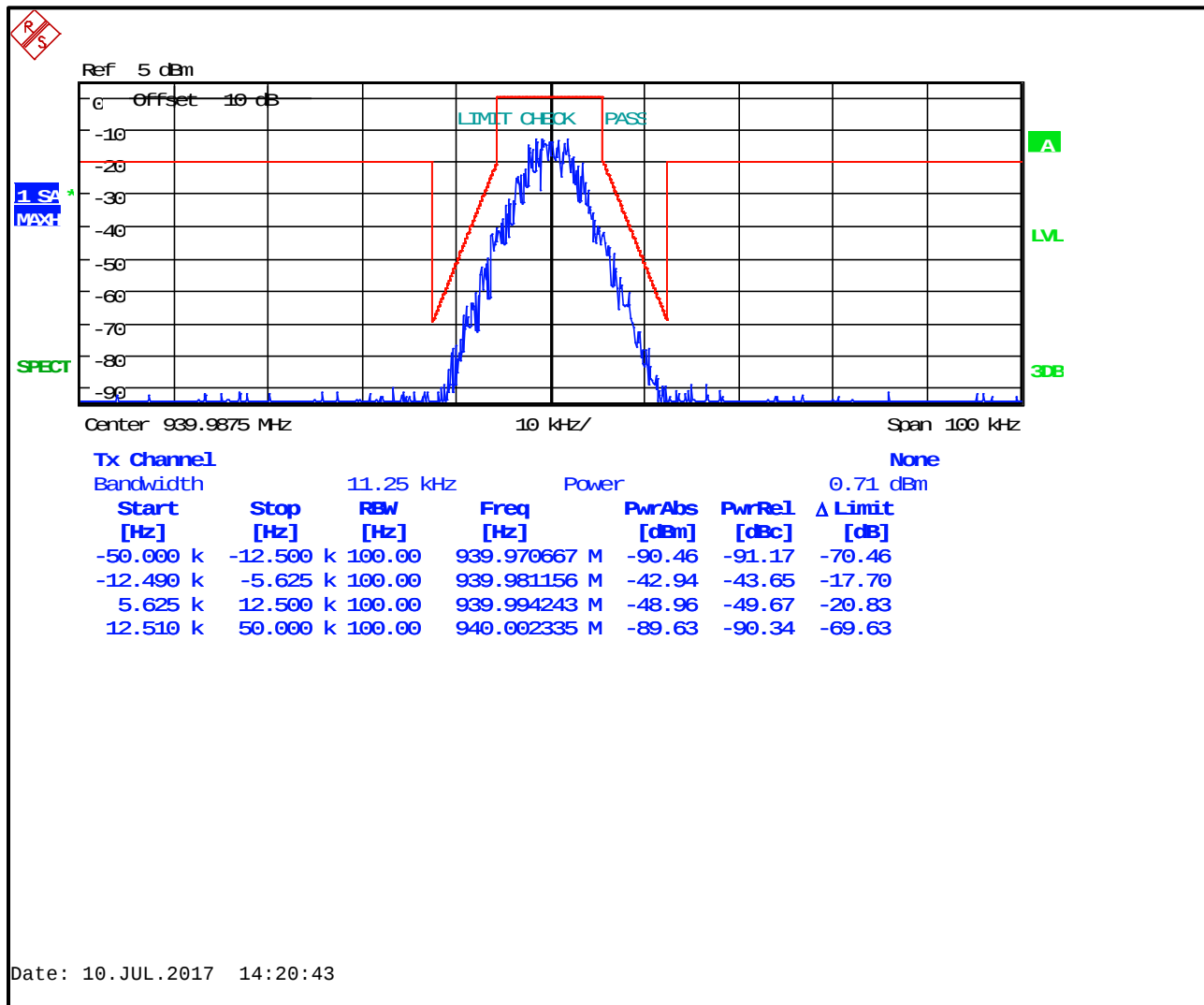
Plot 7-5: Occupied Bandwidth – 937.5000 MHz; C4FM; Mask D



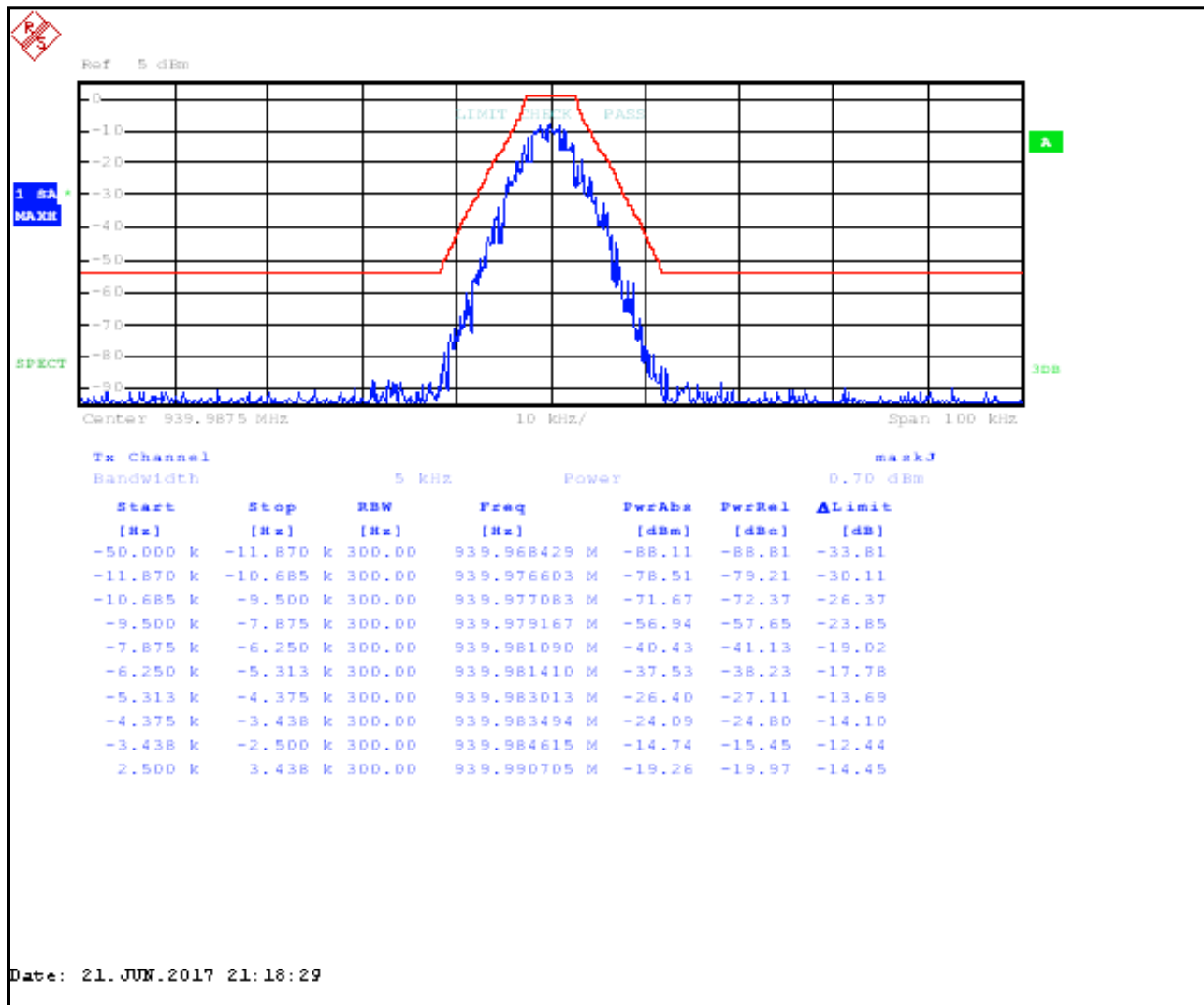
Plot 7-6: Occupied Bandwidth – 937.5000 MHz; C4FM; Mask J



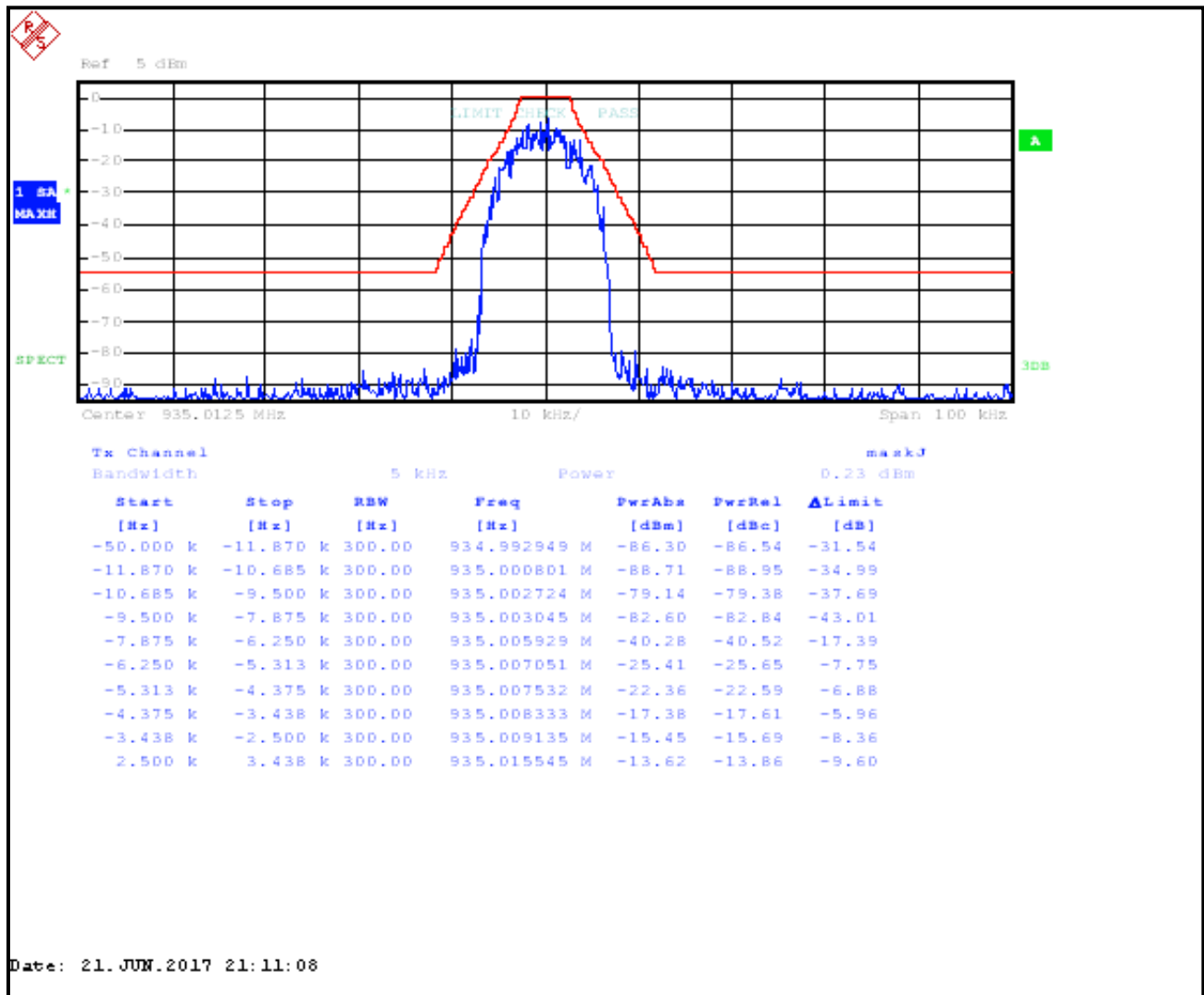
Plot 7-7: Occupied Bandwidth – 939.9875 MHz; C4FM; Mask D



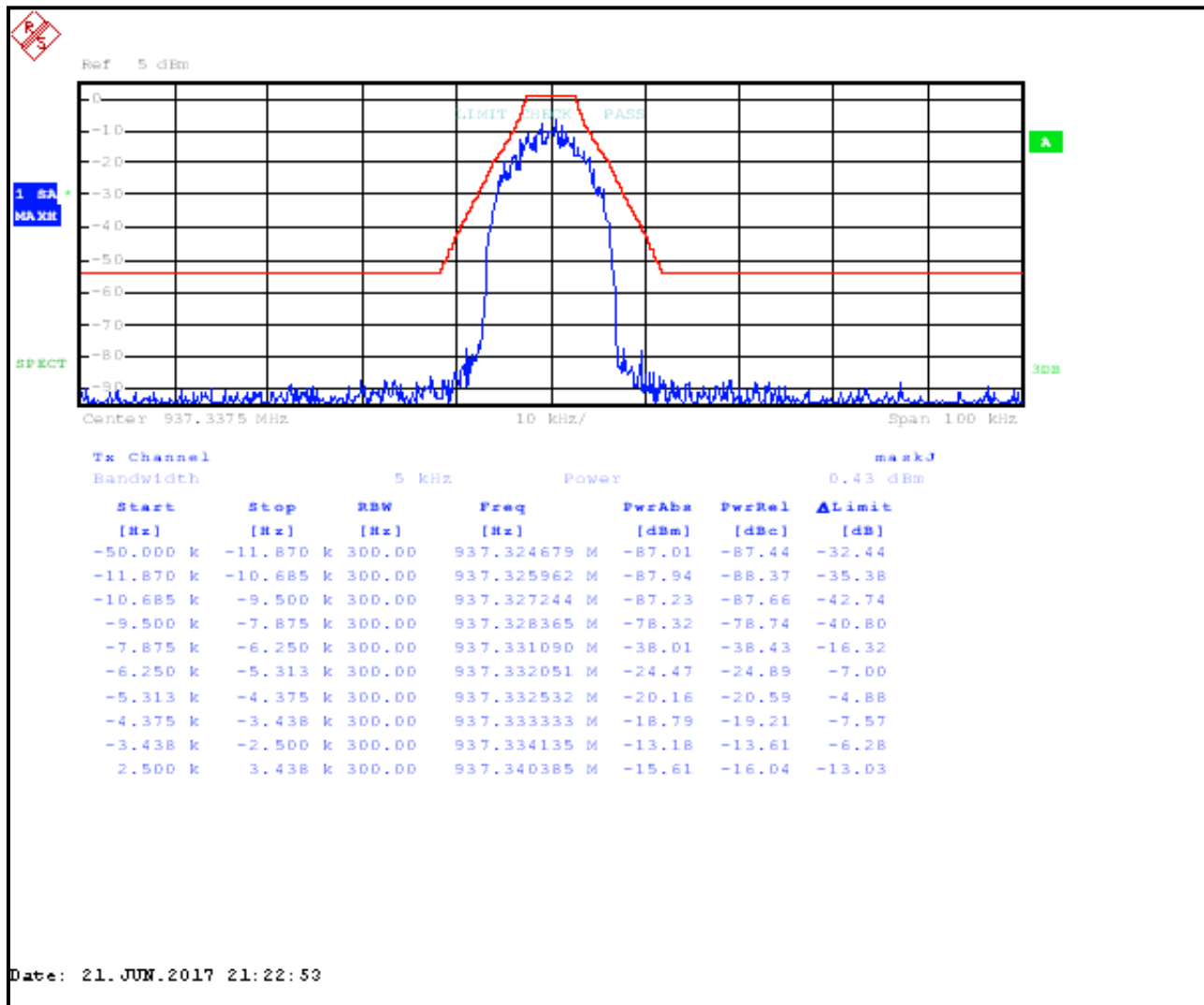
Plot 7-8: Occupied Bandwidth – 939.9875 MHz; C4FM; Mask J



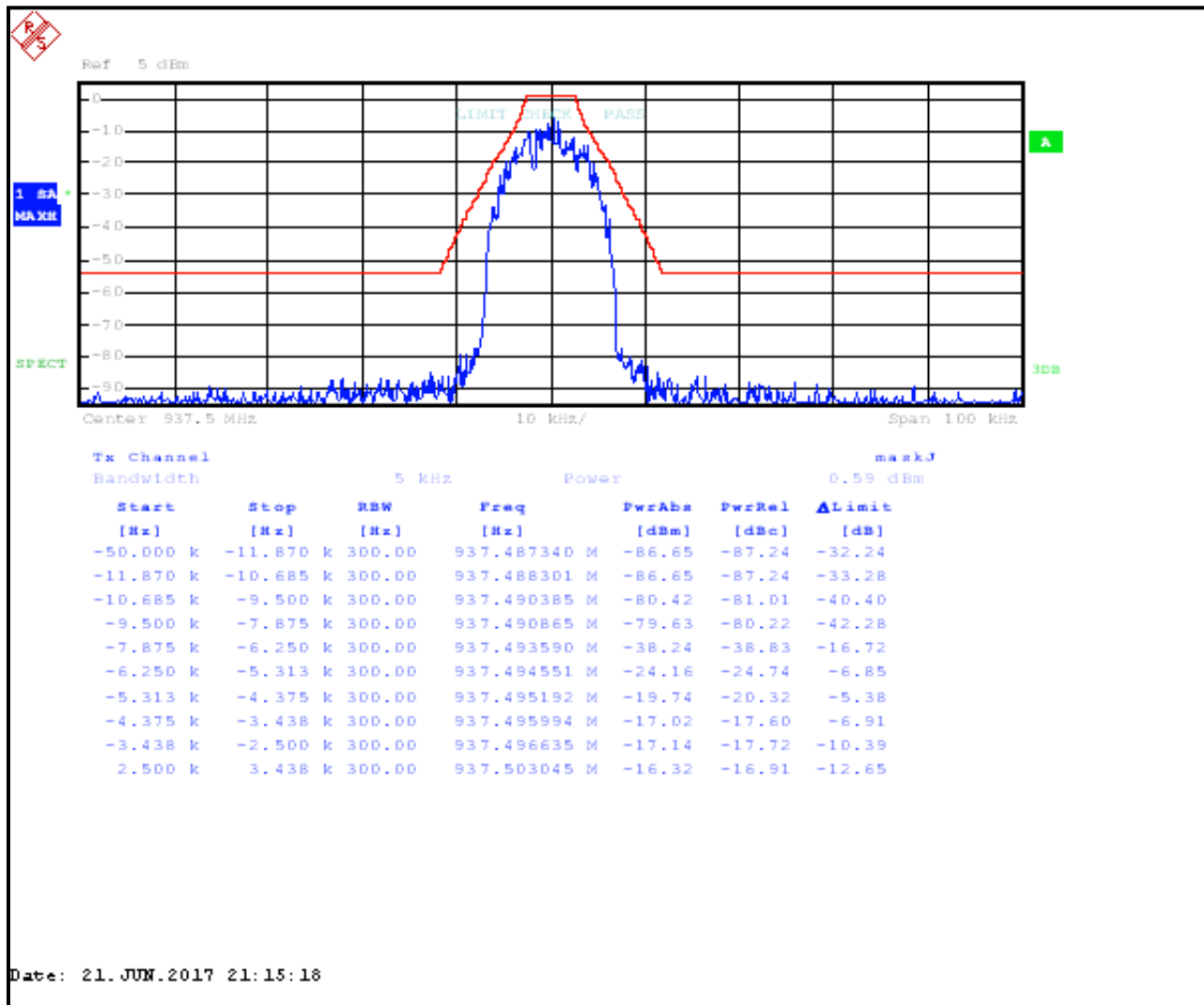
Plot 7-9: Occupied Bandwidth – 935.0125 MHz; WCQPSK; Mask J



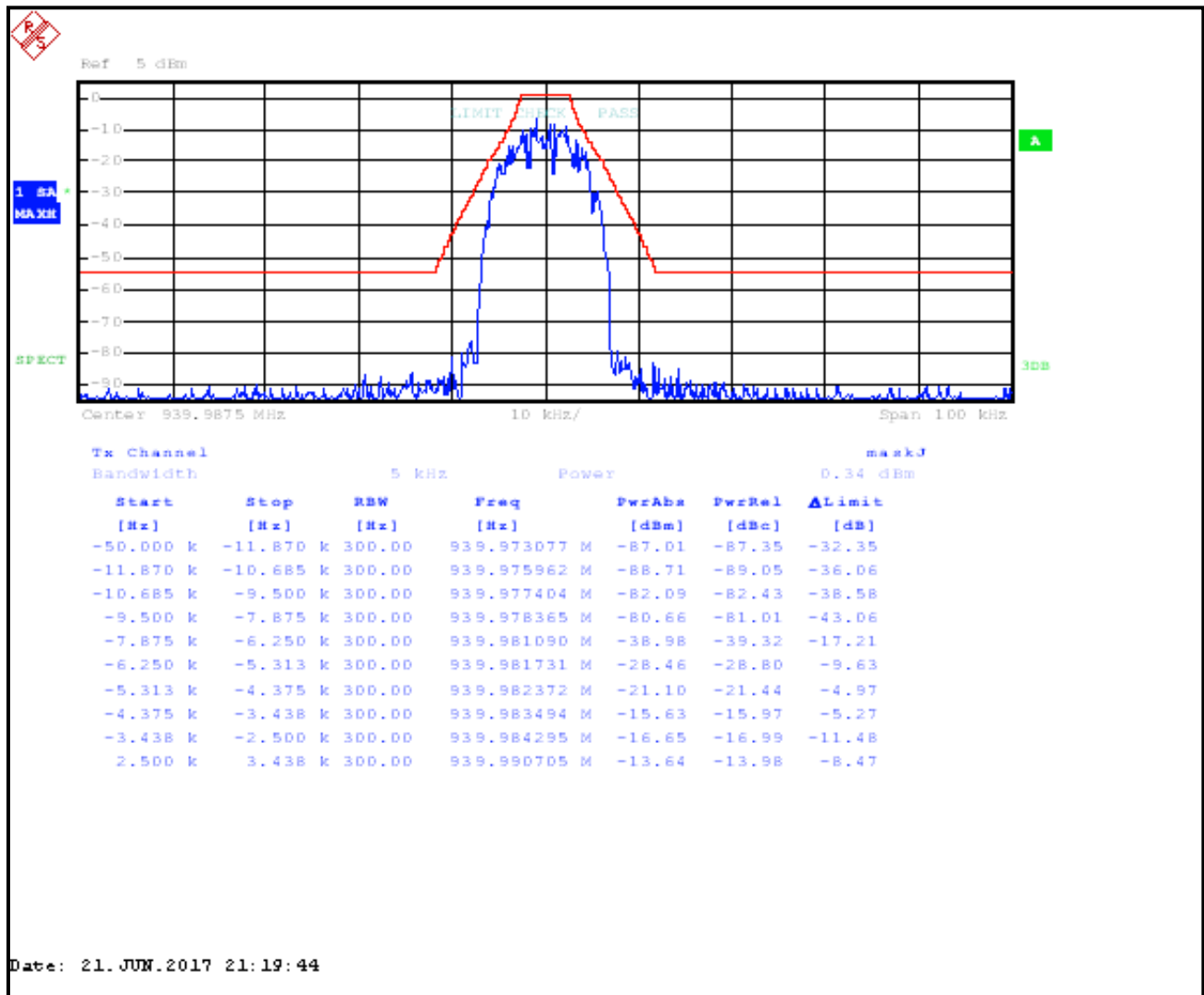
Plot 7-10: Occupied Bandwidth – 937.3375 MHz; WCQPSK; Mask J



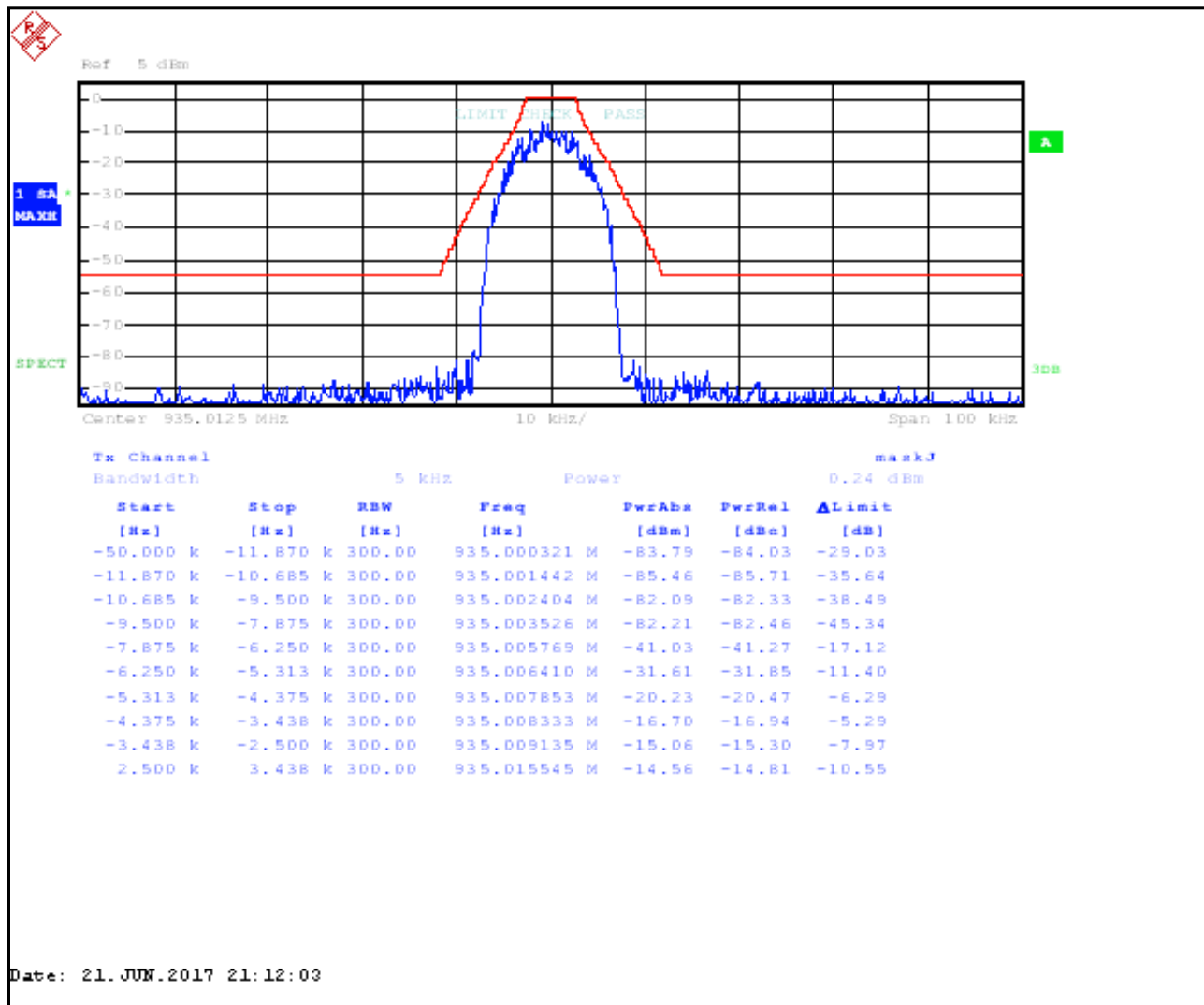
Plot 7-11: Occupied Bandwidth – 937.5000 MHz; WCQPSK; Mask J



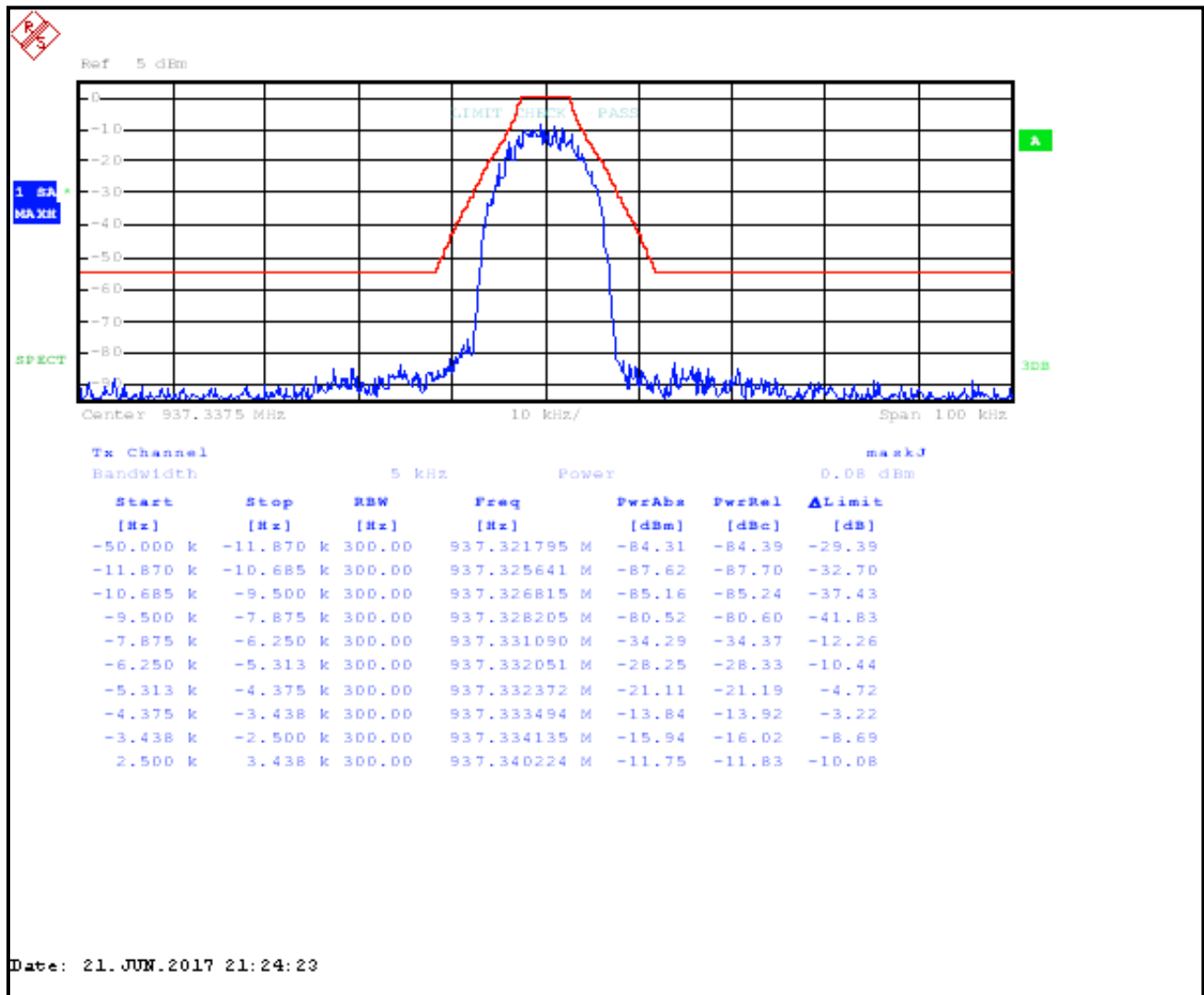
Plot 7-12: Occupied Bandwidth – 939.9875 MHz; WCQPSK; Mask J



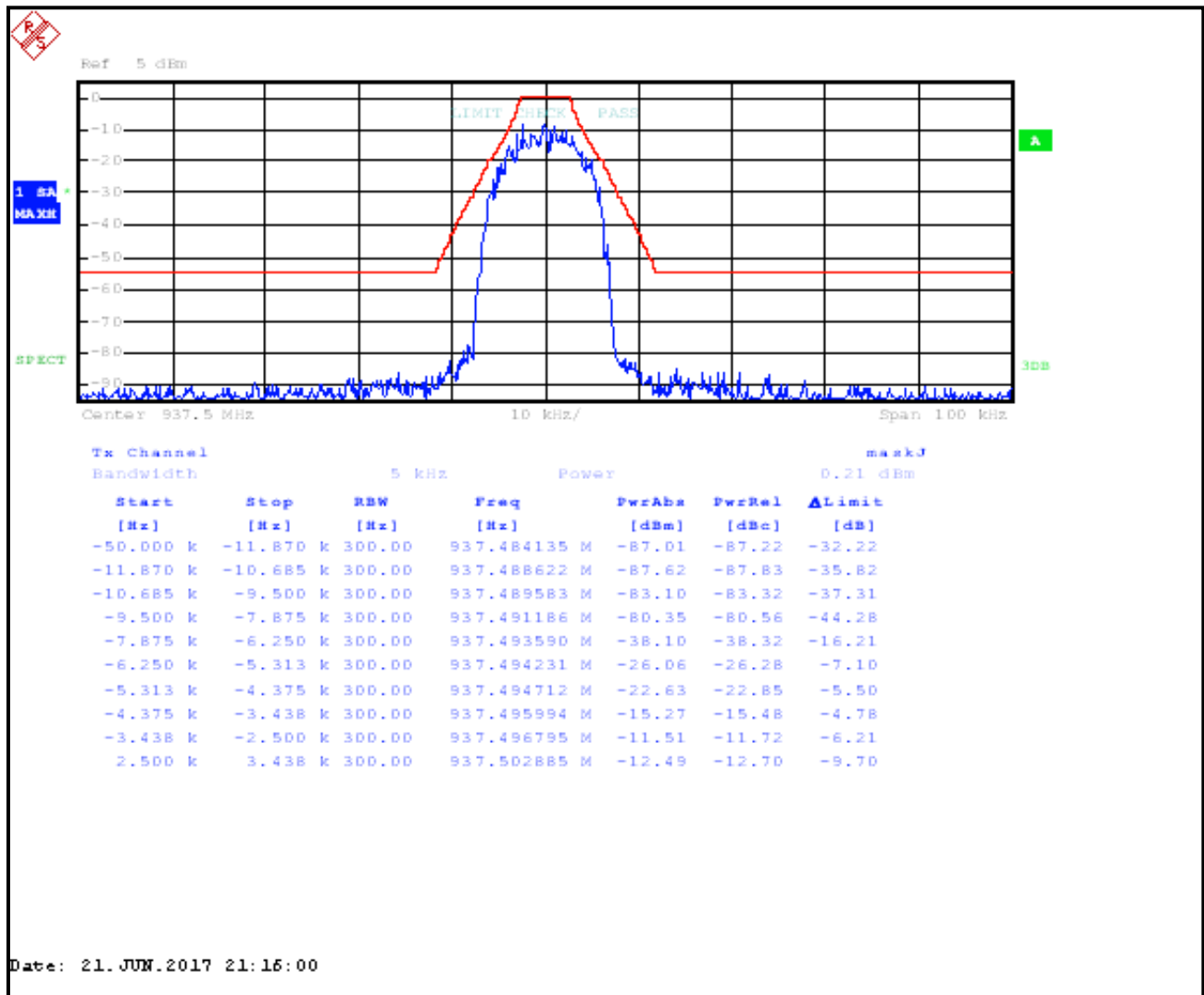
Plot 7-13: Occupied Bandwidth – 935.0125 MHz; HDQPSK; Mask J



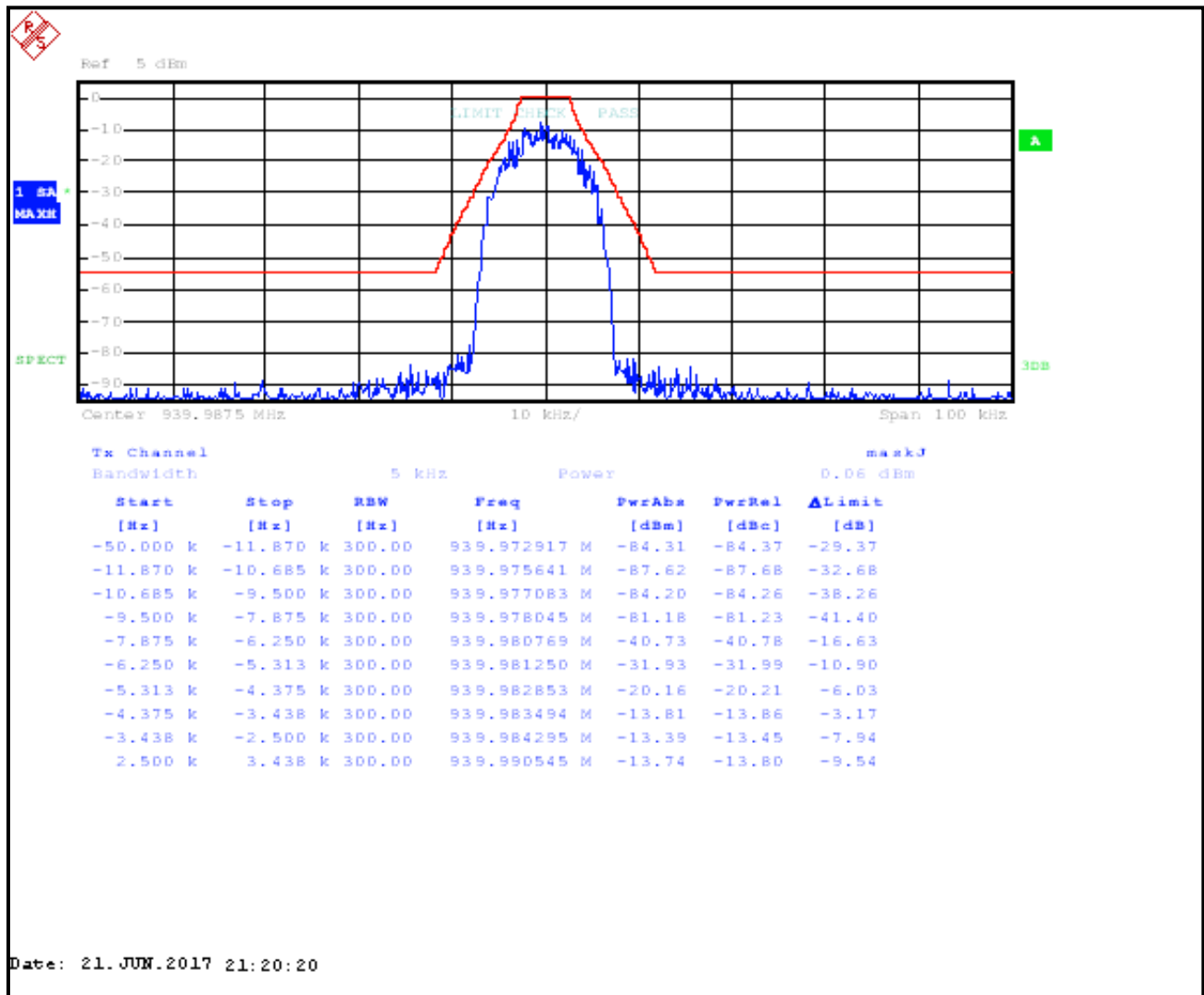
Plot 7-14: Occupied Bandwidth – 937.3375 MHz; HDQPSK; Mask J



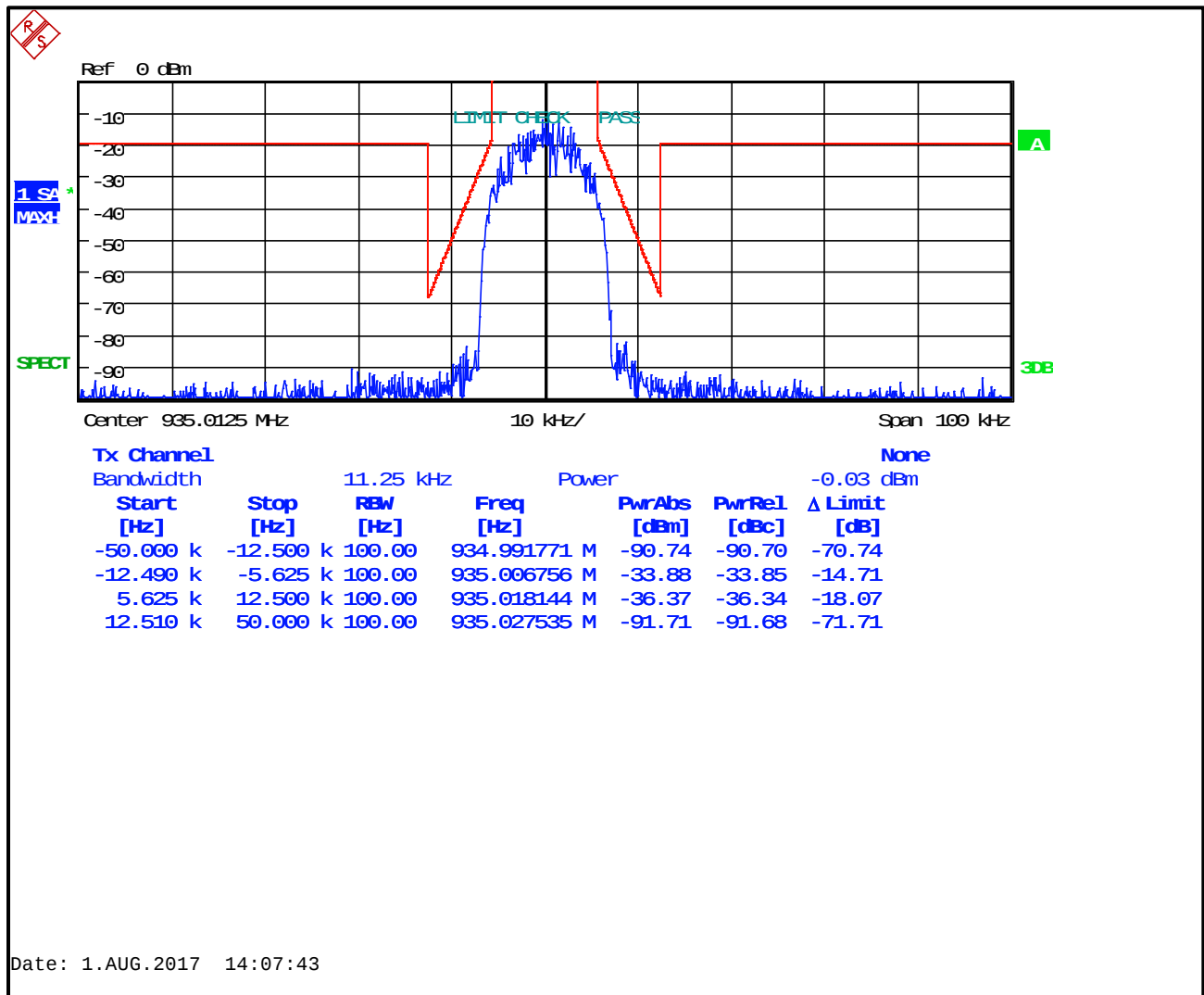
Plot 7-15: Occupied Bandwidth – 937.5000 MHz; HDQPSK; Mask J



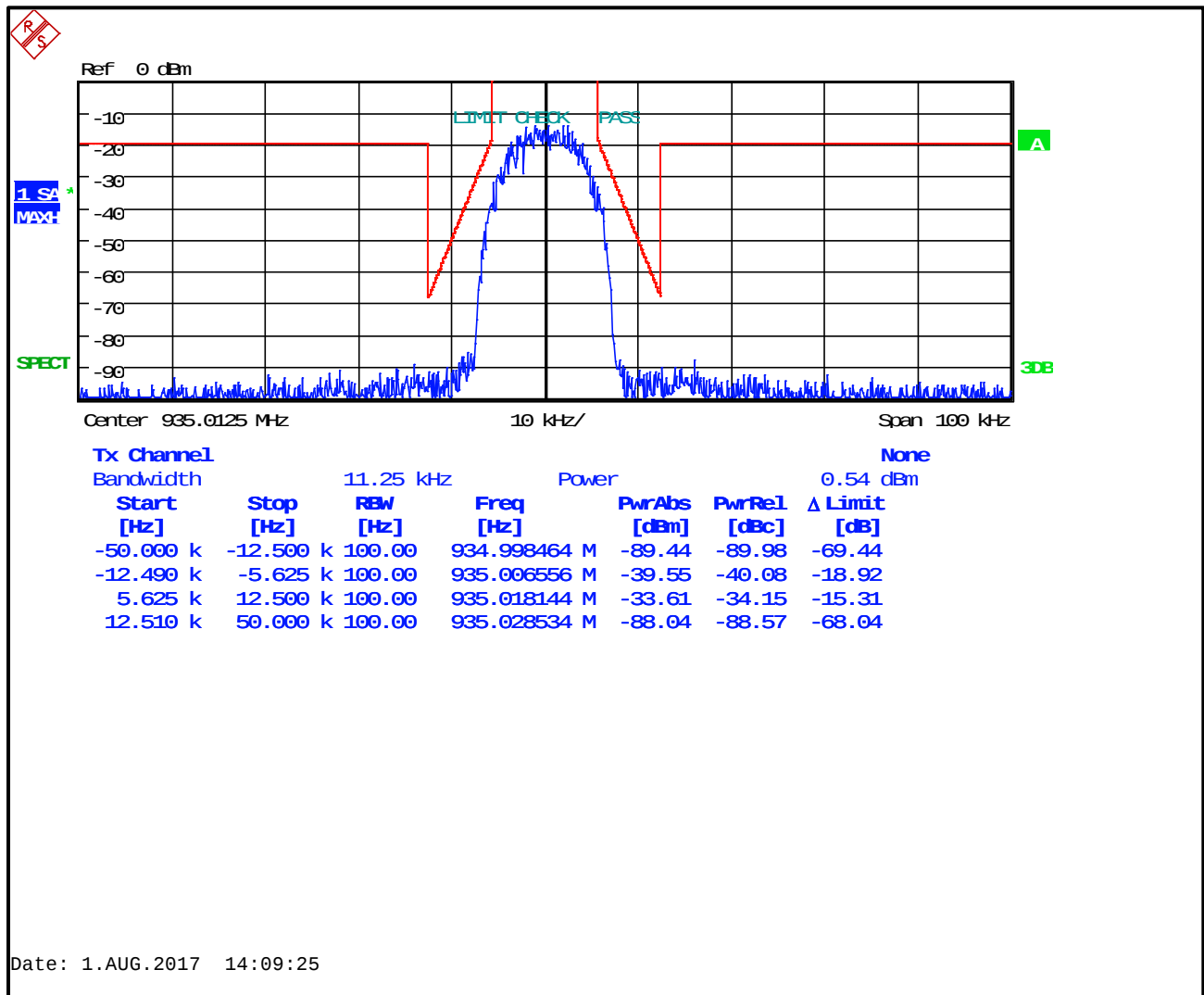
Plot 7-16: Occupied Bandwidth – 939.9875 MHz; HDQPSK; Mask J



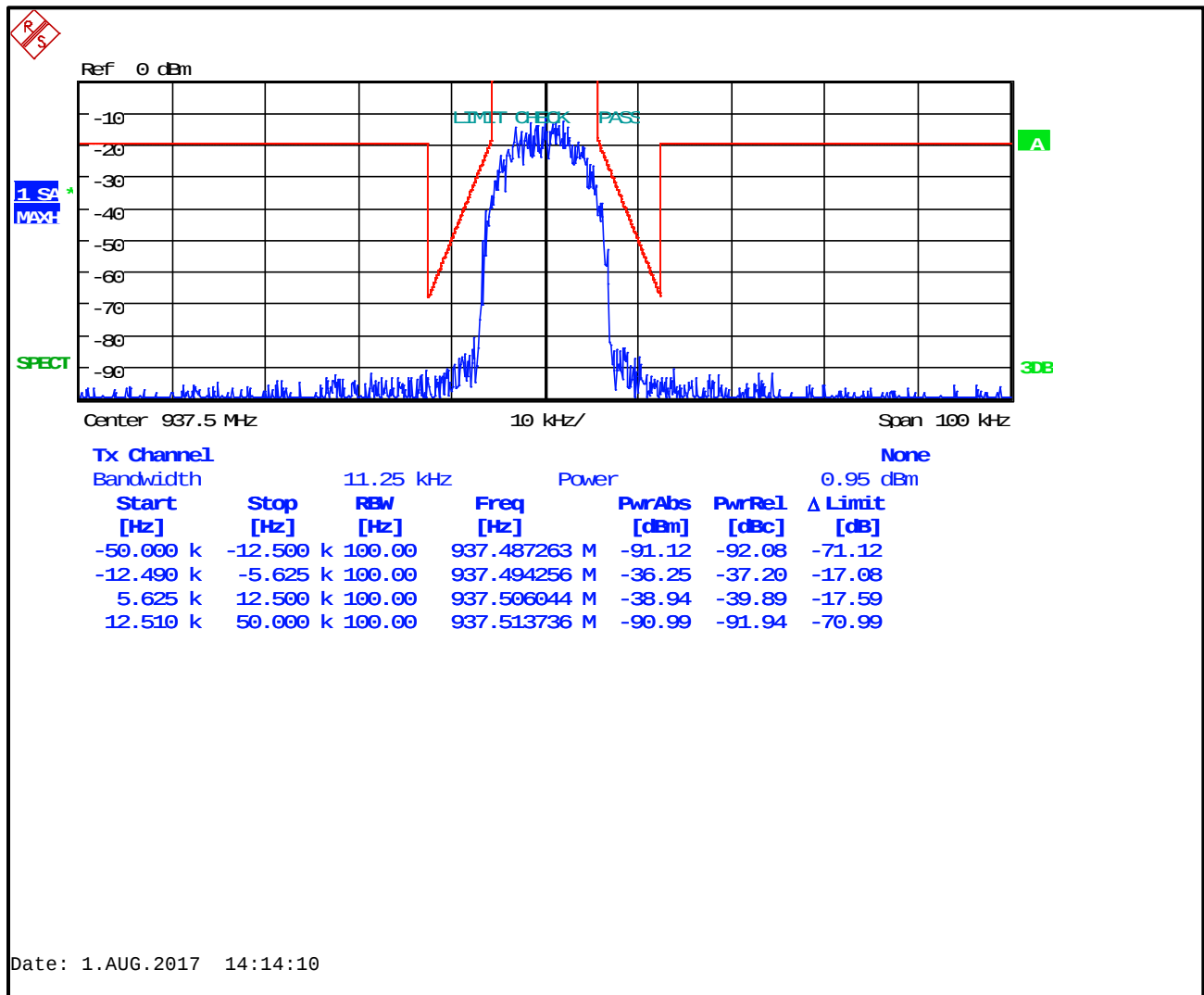
Plot 7-17: Occupied Bandwidth – 935.0125 MHz; WCQPSK; Mask D



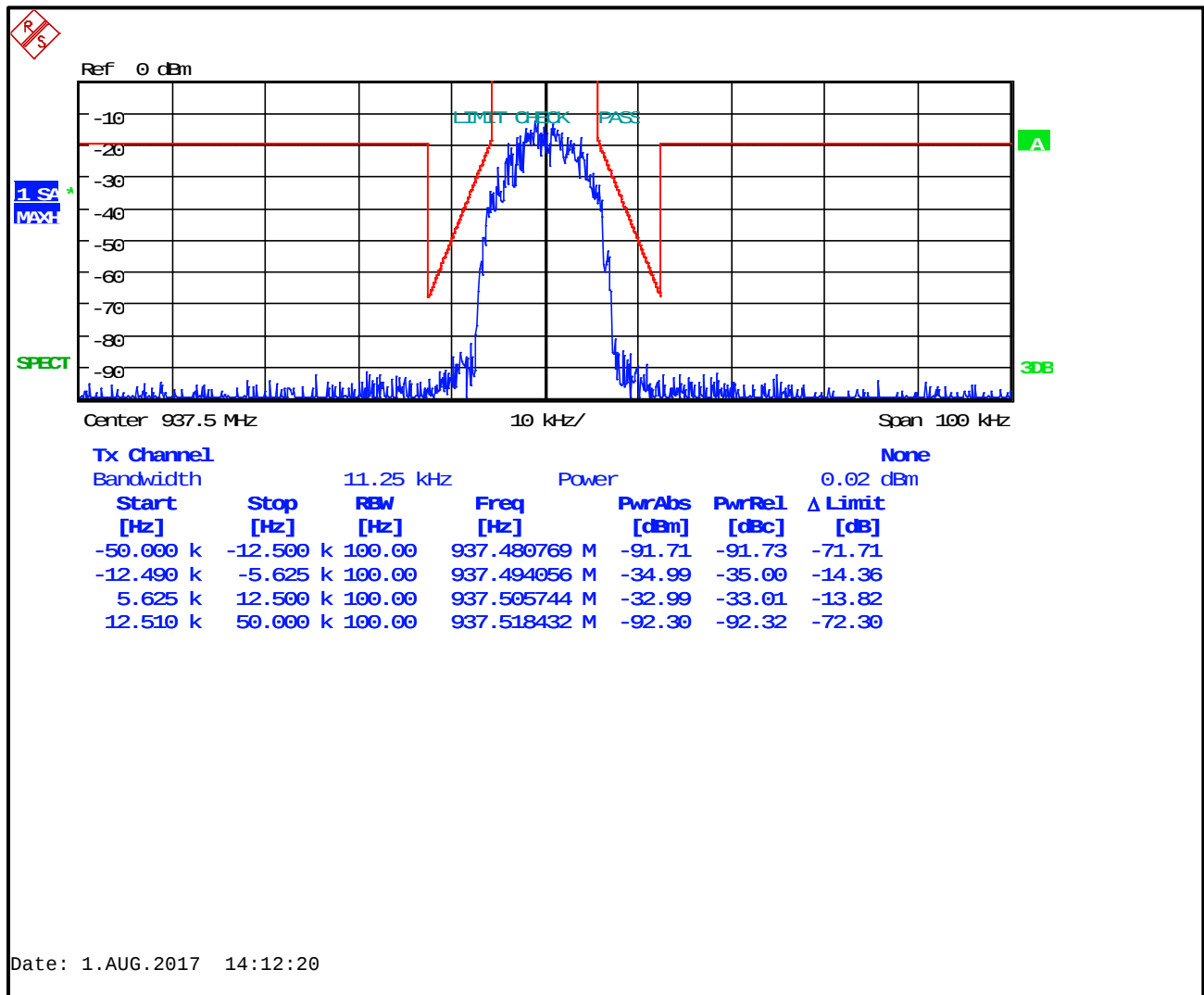
Plot 7-18: Occupied Bandwidth – 935.0125 MHz; HDQPSK; Mask D



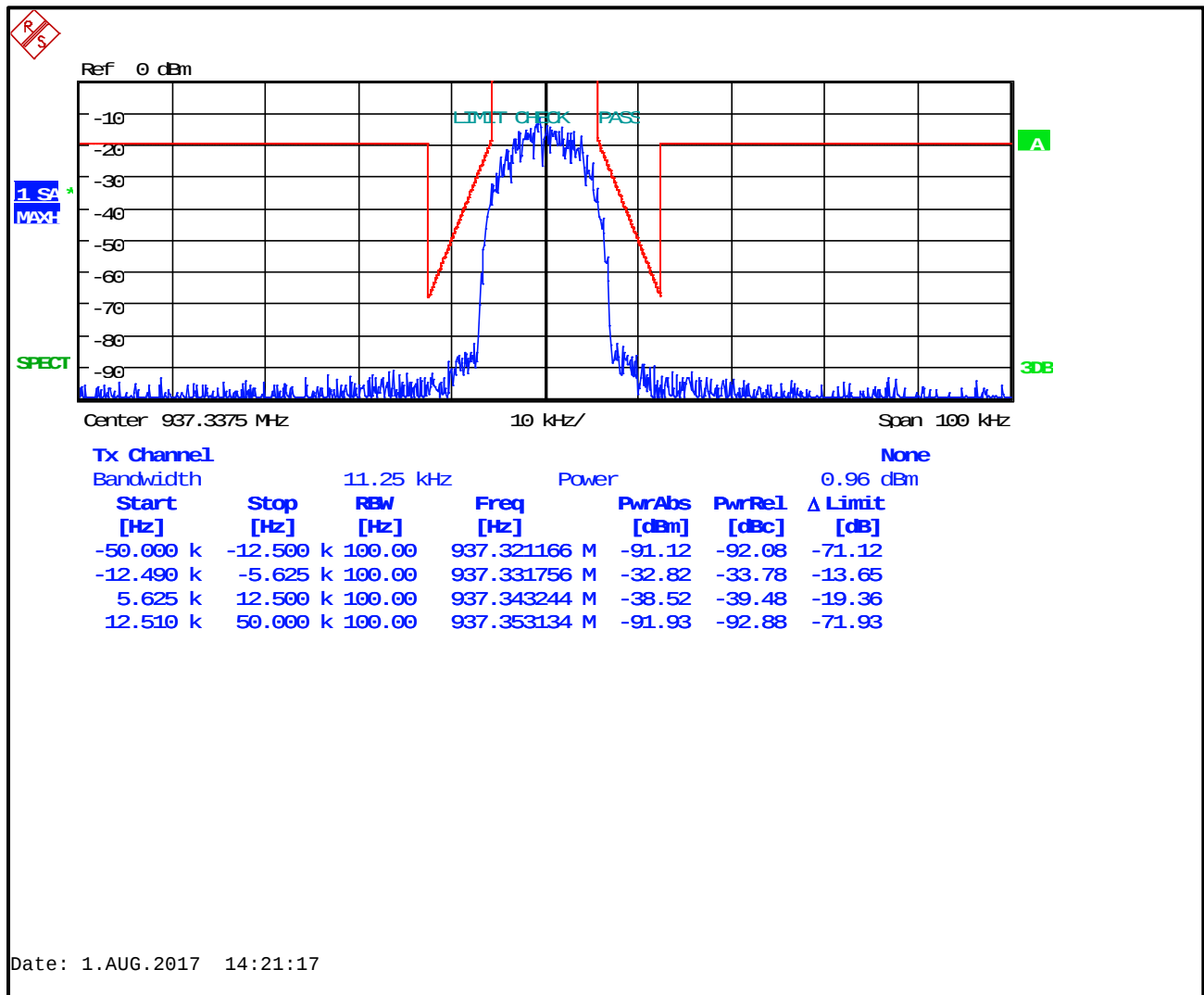
Plot 7-19: Occupied Bandwidth – 937.5 MHz; WCQPSK; Mask D



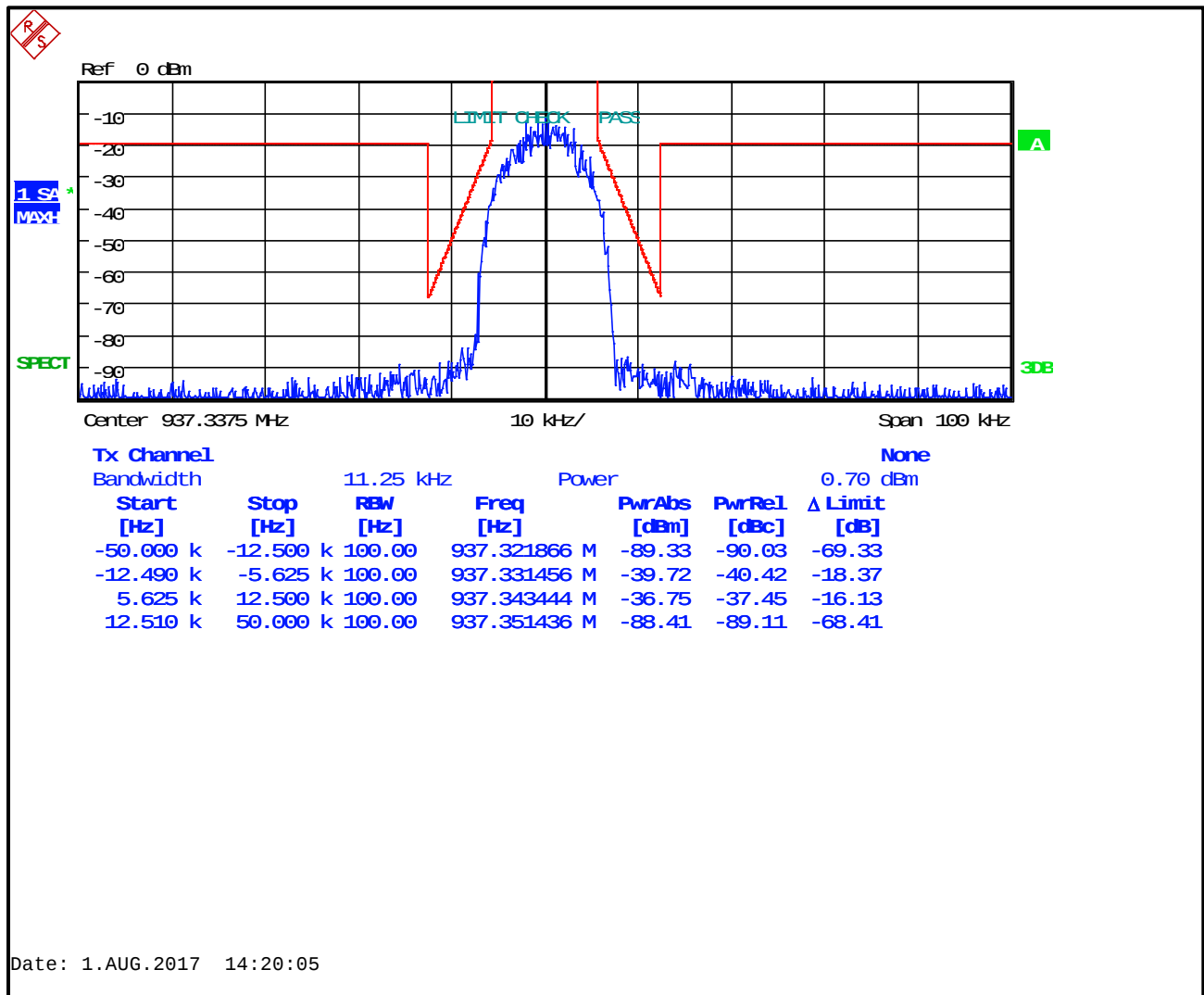
Plot 7-20: Occupied Bandwidth – 937.5 MHz; HDQPSK; Mask D



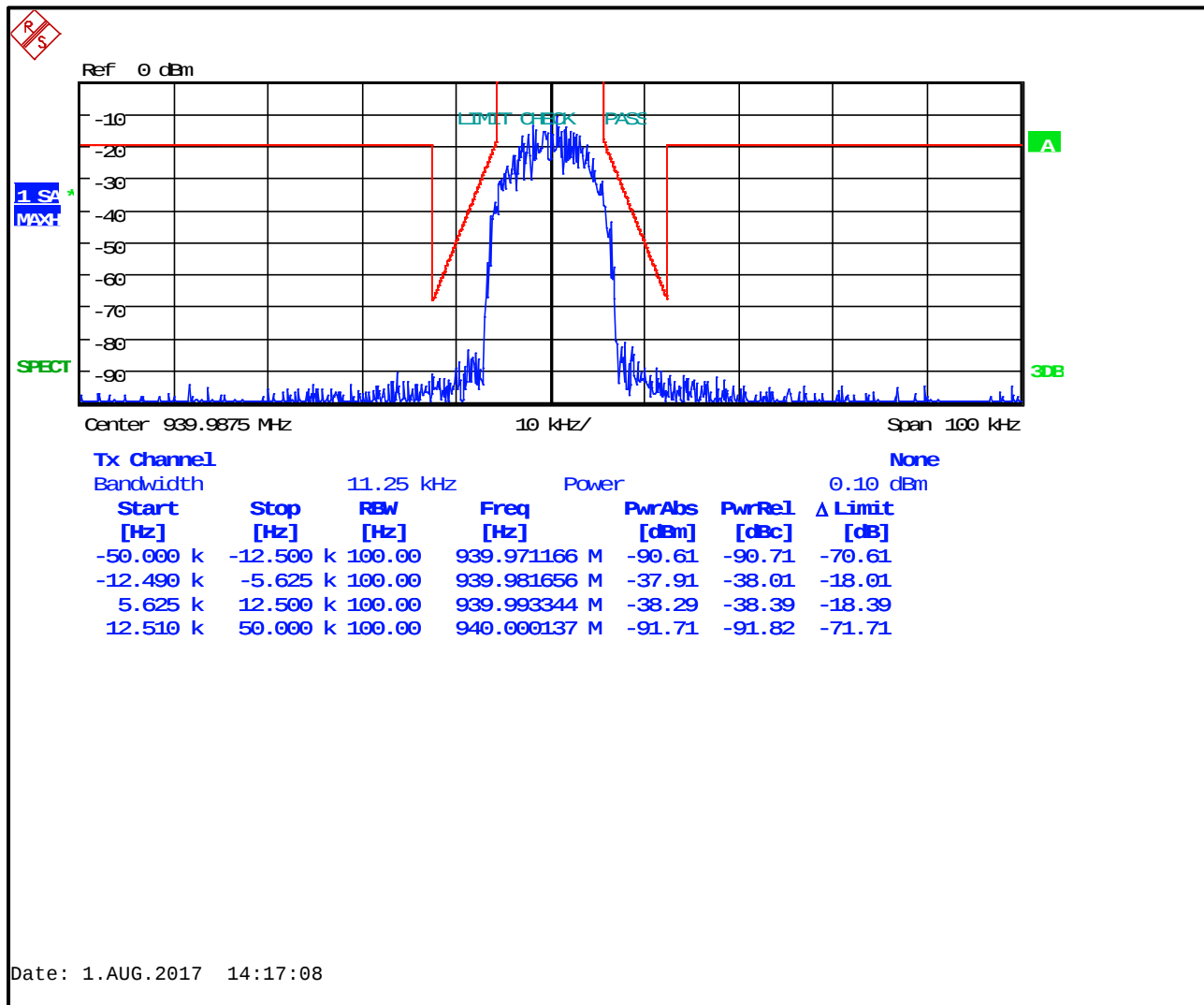
Plot 7-21: Occupied Bandwidth – 937.3375 MHz; WCQPSK; Mask D



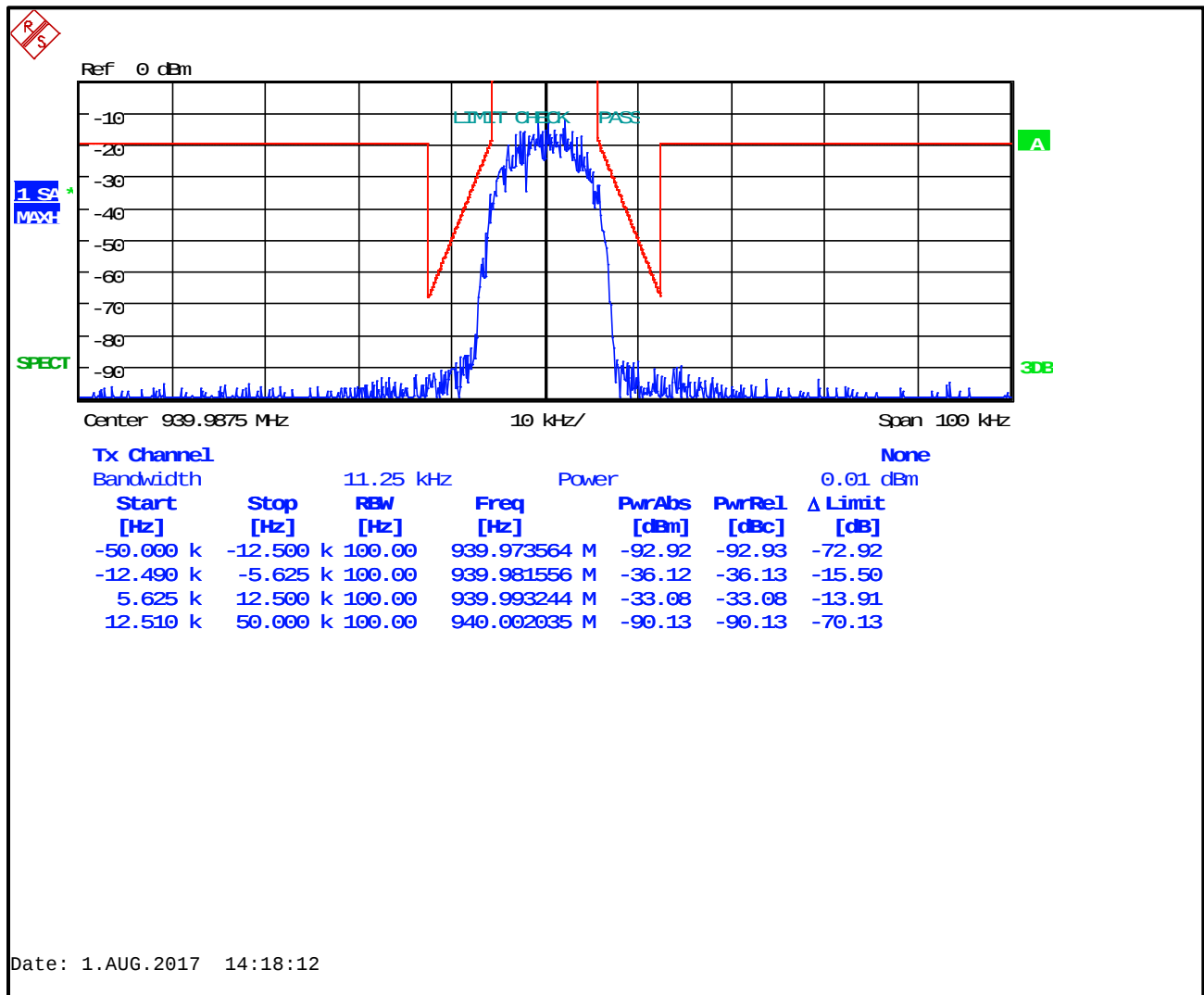
Plot 7-22: Occupied Bandwidth – 937.3375 MHz; HDQPSK; Mask D



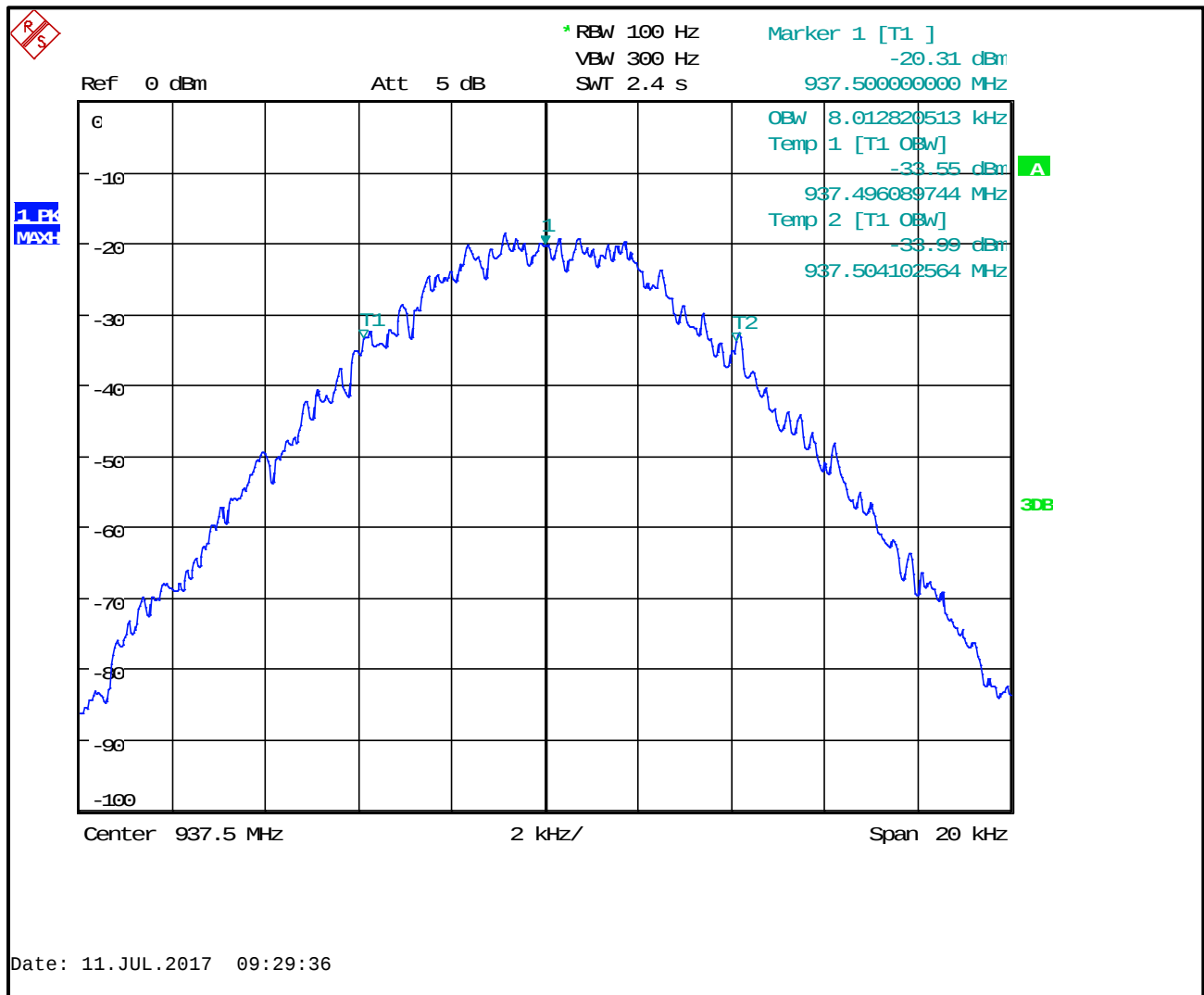
Plot 7-23: Occupied Bandwidth – 939.9875 MHz; WCQPSK; Mask D



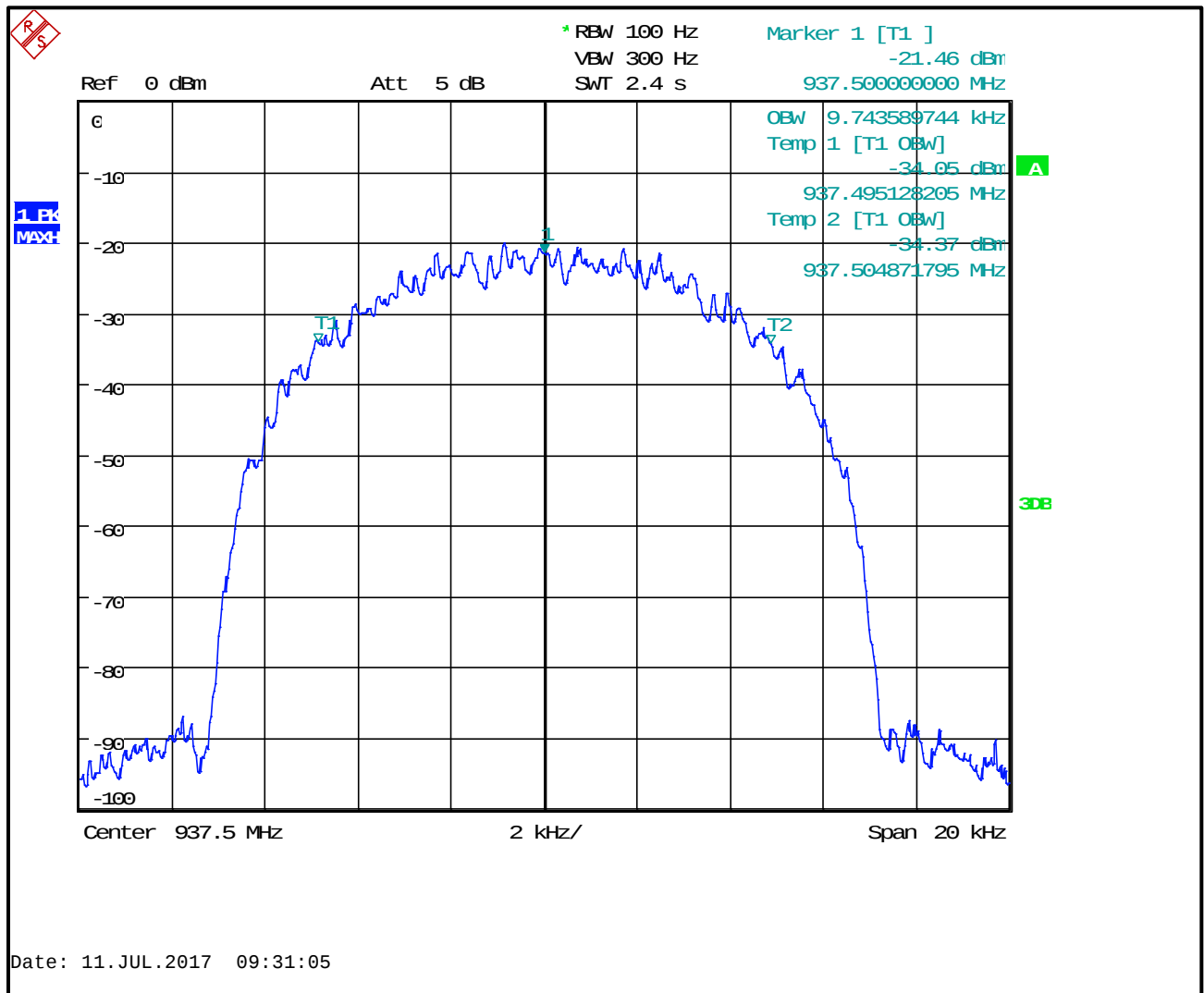
Plot 7-24: Occupied Bandwidth – 939.9875 MHz; HDQPSK; Mask D



Plot 7-25: Occupied Bandwidth – 937.5; C4FM; 99% BW



Plot 7-26: Occupied Bandwidth – 937.5; WCQPSK; 99% BW



Plot 7-27: Occupied Bandwidth – 937.5; HDQPSK; 99% BW

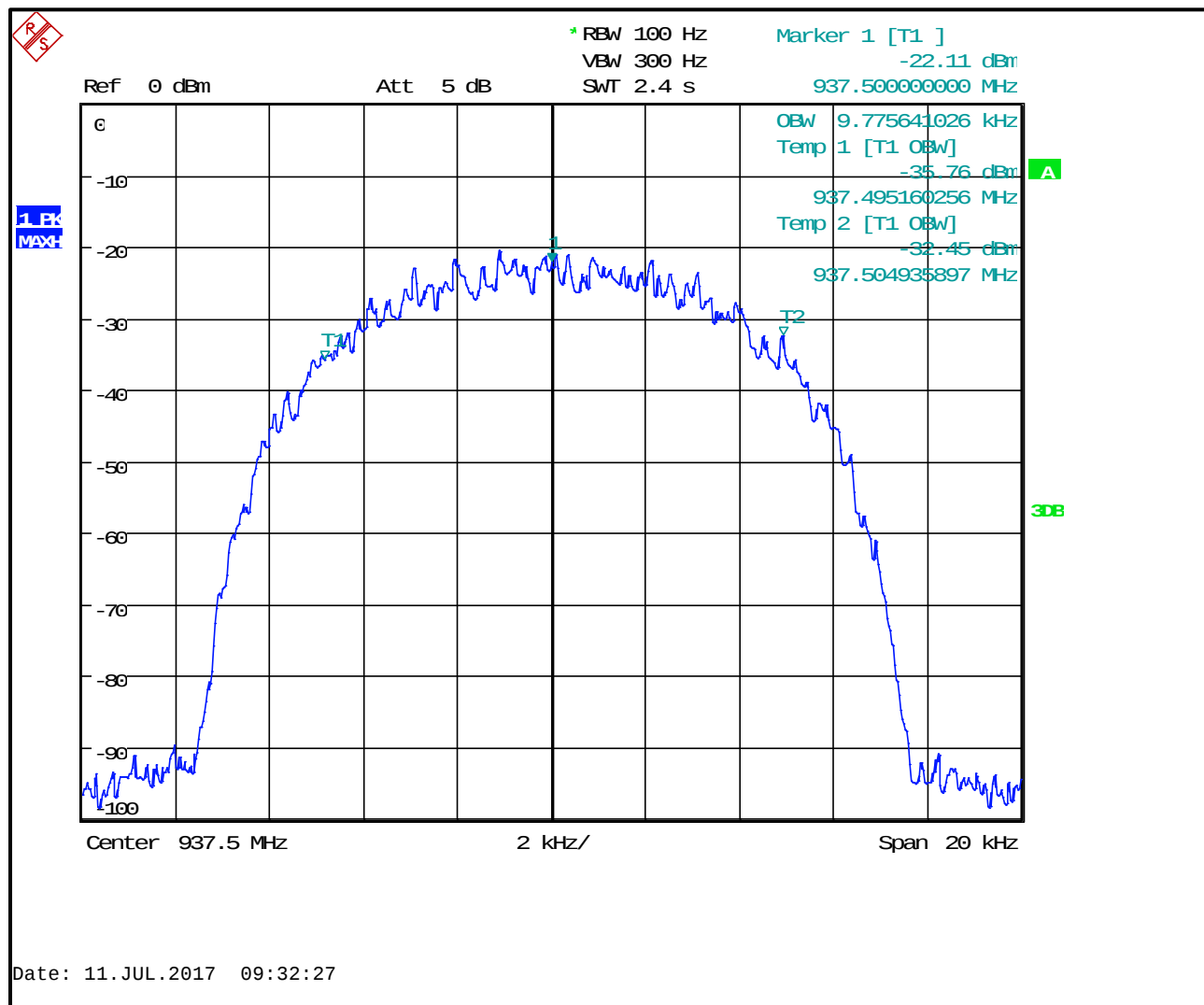


Table 7-1: Test Equipment Used For Testing Occupied Bandwidth

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	3/22/18

Test Personnel:

Daniel W. Baltzell
EMC Test Engineer

Daniel W. Baltzell

Signature

June 21-Aug 1, 2017
Date of Test

8 FCC Part 2.1055: Frequency Stability; Part 90.213: Frequency Stability

8.1 Test Procedure

ANSI 63.26, section 5.6.

The carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency.

The EUT was evaluated over the temperature range -30°C to +55°C.

The temperature was initially set to -30°C and a 1-hour period was observed for stabilization of the EUT. The frequency stability was measured within one minute after application of primary power to the transmitter. The temperature was raised at intervals of 10 degrees centigrade through the range. A ½-hour period was observed to stabilize the EUT at each measurement step and the frequency stability was measured within one minute after application of primary power to the transmitter. Additionally, the supply voltage to the EUT was varied +/-15% nominal input voltage.

Part 90.213: Base stations within 935-940 MHz – 0.1 ppm

Part 90.213 Frequency Stability

(a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table.

MINIMUM FREQUENCY STABILITY [Parts per million (ppm)]			
Frequency range (MHz)	Fixed and base stations	Mobile stations	
		Over 2 watts output power	2 watts or less output power
Below 25	^{1,2,3} 100	100	200
25–50	20	20	50
72–76	5		50
150–174	^{5,11} 5	⁶ 5	^{4,6} 50
216–220	1.0		1.0
220–222 ¹²	0.1	1.5	1.5
421–512	^{7,11,14} 2.5	⁸ 5	⁸ 5
806–809	¹⁴ 1.0	1.5	1.5
809–824	¹⁴ 1.5	2.5	2.5
851–854	1.0	1.5	1.5
854–869	1.5	2.5	2.5
896–901	¹⁴ 0.1	1.5	1.5
902–928	2.5	2.5	2.5
902–928 ¹³	2.5	2.5	2.5
929–930	1.5		
935–940	0.1	1.5	1.5
1427–1435	⁹ 300	300	300
Above 2450 ¹⁰			

8.2 Test Data

8.2.1 Temperature Frequency Stability

Table 8-1: Temperature Frequency Stability – 937.5000 MHz

Temperature (°C)	Measured Frequency (Hz)	ppm
-30	937.50000002	0.02
-20	937.50000000	0.00
-10	937.50000000	0.00
0	937.50000000	0.00
10	937.50000000	0.00
20 (reference)	937.50000000	0.00
30	937.49999	-0.01
40	937.49998	-0.02
50	937.49998	-0.02
60	937.49997	-0.03

Table 8-2: Temperature Frequency Stability – 939.9875 MHz

Temperature (°C)	Measured Frequency (Hz)	ppm
-30	939.987516	0.02
-20	939.987531	0.03
-10	939.987523	0.02
0	939.987508	0.01
10	939.987500	0.00
20 (reference)	939.987500	0.00
30	939.987500	0.00
40	939.987458	-0.05
50	939.987469	-0.03
60	939.987461	-0.04

8.2.2 Frequency Stability/Voltage Variation

Table 8-3: Frequency Stability/Voltage Variation – 937.5000 MHz

Voltage (VDC)	Measured Frequency (Hz)	ppm
97.75	937.500000000	0.00
115 (reference)	937.500000000	0.00
132.25	937.500000000	0.00

Table 8-4: Frequency Stability/Voltage Variation – 899.9875 MHz

Voltage (VDC)	Measured Frequency (Hz)	ppm
97.75	939.987500	0.00
115 (reference)	939.987500	0.00
132.25	939.987500	0.00

Results: The EUT is compliant.

Table 8-5: Test Equipment Used For Testing Frequency Stability

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901350	Meterman	33XR	Multimeter	040402802	4/26/19
901672	Rohde & Schwarz	FSEM30	Spectrum Analyzer	FSEM30	4/17/19
900946	Tenney Engineering, Inc	TH65	Temperature Chamber with Humidity	11380	3/26/18

Test Personnel:

 Daniel W. Baltzell EMC Test Engineer	Signature	June 15, 2017 Date of Test
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9 FCC Part 2.202: Necessary Bandwidth and Emission Bandwidth

P25 Phase 1 (C4FM)

Calculation:

Data rate in bps (R) = 9600
 Peak deviation of carrier (D) = 1800
 $B_n = [9600/\log_2(4) + 2 (1800) (0.89) = 8.0 \text{ kHz}]$
 Emission designator: 8K00F1D, 8K00F1E

P25 Linear Simulcast (WCQPSK)

Calculation:

Data rate in bps (R) = 9600
 Peak deviation of carrier (D) = 1800
 $B_n = [9600/\log_2(4) + 2 (1800) (1.362) = 9.7 \text{ kHz}]$
 Emission designator: 9K70D1W

P25 Phase 2 (HDQPSK)

Calculation:

Data rate in bps (R) = 12000
 Peak deviation of carrier (D) = 2250
 $B_n = [12000/\log_2(4) + 2 (2250) (0.841) = 9.8 \text{ kHz}]$
 Emission designator: 9K80D7W

10 Conclusion

The data in this measurement report shows that the Harris Corporation MASTR V 900 MHz Transceiver, FCC ID: OWDTR-0155-E, complies with the applicable requirements of Parts 2 and 90 of the FCC Rules.