Test report

REP057319-2R3TRFWL

Date of issue: March 3, 2025

Applicant:

Echodyne Corporation

Product:

Ku Band Radar

Model:

Echoshield

Model Number(s):

700025-300-100
700025-300-200
700025-300-300
700025-300-400
700025-350-100
700025-350-200
700025-350-300
700025-350-400

FCC ID: 2ANLB-MESA00055

Specifications:

- FCC CFR 47 Part 90
  Private land mobile radio services – radiolocation service
- FCC CFR 47 Part 2
  Frequency Allocations and Radio Treaty Matters, General Rules and Regulations

Lab and test locations

Company name	Nemko USA Inc.
Address	2210 Faraday Ave, Suite 150
City	Carlsbad
State	California
Postal code	92008
Country	USA
Telephone	+1 760 444 3500
Website	www.nemko.com
FCC Site Number	Test Firm Registration Number: 392943; Designation Number: US5058
ISED Test Site	2040B-3

Tested by	Chenhao Ma Wireless test technician
Reviewed by	James Cunningham, EMC/Wireless Manager
Review date	March 3, 2025
Reviewer signature	

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko USA's ISO/IEC 17025 accreditation.

Copyright notification

Table of Contents

Section 1 Report summary

1.1 Test specifications

FCC CFR 47 Part 2	Frequency Allocations and Radio Treaty Matters General Rules and Regulations
FCC 47 CFR Part 90	Private land mobile radio services

1.2 Test methods

ANSI C63.26-2015	American National Standard of Procedures for Compliance Testing of Transmitters Used in Licensed Radio Services

1.3 Exclusions

None.

1.4 Statement of compliance

Testing was performed against all relevant requirements of the test standard(s).

Results obtained indicate that the product under test complies in full with the tested requirements.

The test results relate only to the item(s) tested.

See “Section 2 Summary of test results” for full details.

1.5 Test report revision history

Table 1.5-1: *Test report revision history*

Revision #	Issue Date	Details of changes made to test report
REP057319-2TRFEMC	October 8, 2024	Original report issued
REP057319-2R1TRFEMC	October 31, 2024	Update plots and data
REP057319-2R2RFEMC	February 28, 2025	Updated model numbers
REP057319-2R3RFEMC	March 3, 2025	Corrected frequency stability data point

Section 2 Summary of test results

2.1 FCC Part 2 and Part 90 test results

Part	Test description	Verdict
§90.205	Power and antenna height limits	Pass
§90.207	Types of emissions	Pass
§90.209	Bandwidth limitations (99% OBW)	Pass
§90.209	Frequency stability	Pass
§90.210	Emission masks: Emission limitations	Pass
§90.210	Emission masks: Transmitter spurious emissions	Pass

Section 3 Equipment under test (EUT) details

3.1 Disclaimer

This section contains information provided by the applicant and has been utilized to support the test plan. Inaccurate information provided by the applicant can affect the validity of the results within this test report. Nemko accepts no responsibility for the information contained within this section and the impact it may have on the test plan and resulting measurements.

3.2 Sample information

Receipt date	05-Sep-24
Nemko sample ID number	REP057319

3.3 Testing period

Test start date	05-Sep-24
Test end date	13-Sep-24

3.4 Applicant

Company name	Echodyne Corporation
Address	12112 115th Ave NE
City	Kirkland
State	WA
Postal/Zip code	98034
Country	United States of America

3.5 Manufacturer

Company name	Echodyne Corporation
Address	12112 115th Ave NE
City	Kirkland
State	WA
Postal/Zip code	98034
Country	United States of America

3.6 EUT information

Product name	Ku Band Radar
Model	Echoshield
Variant(s)	700025-300-100 700025-300-200 700025-300-300 700025-300-400 700025-350-100 700025-350-200 700025-350-300 700025-350-400
Serial number	N/A
Part number	N/A
Power requirements	28 VDC
Description/theory of operation	Ground-based location and navigation radar
Software details	N/A
Operating band	Ku Band: 15.7 GHz - 17.3 GHz
Operational frequencies	15.75 GHz – 16.15 GHz – 16.55 GHz (25 MHz BW); 15.80 GHz – 16.15 GHz – 16.50 GHz (50 MHz BW); 15.85 GHz – 16.15 GHz – 16.45 GH (100 MHz BW); 15.90 GHz – 16.15 GHz – 16.40 GHz (200 MHz BW).
Antenna type	AESA (Active Electronically Scanned Array)
Antenna gain (declared)	27 dBi

3.7 EUT exercise and monitoring details

EUT description of the methods used to exercise the EUT and all relevant ports:

- EUT was configured with a channel frequency and bandwidth fixed via ethernet port using a computer (via client's software).

EUT setup/configuration rationale:

- The EUT was set up in a configuration that was expected to produce the highest amplitude emissions.

3.8 EUT setup details

Table 3.8-1: *EUT sub assemblies*

Description	Brand name	Model/Part number	Serial number	Rev.
N/A	N/A	N/A	N/A	N/A

Table 3.8-2: *EUT interface ports*

Description	Qty.
1G Base-T Ethernet.	1

Table 3.8-3: *Support equipment*

Description	Brand name	Model/Part number	Serial number	Rev.
Control PC	ThinkPad	N/A	N/A	N/A
Universal AC/DC Power supply	Echodyne	N/A	N/A	--
Junction Box (1 Channel)	Echodyne	N/A	N/A	--

Table 3.8-4: *Inter-connection cables*

Cable description	From	To	Length (m)
Primary radar cable	EUT	Junction Box (1 CH)	2
CAT5e 1G Ethernet cable	Junction Box (1 CH)	Control PC	5
DC Power cable	Junction Box (1 CH)	Universal AC/DC Power supply	2
NEMA 5-15P Cable	AC Outlet	Universal AC/DC Power supply	1

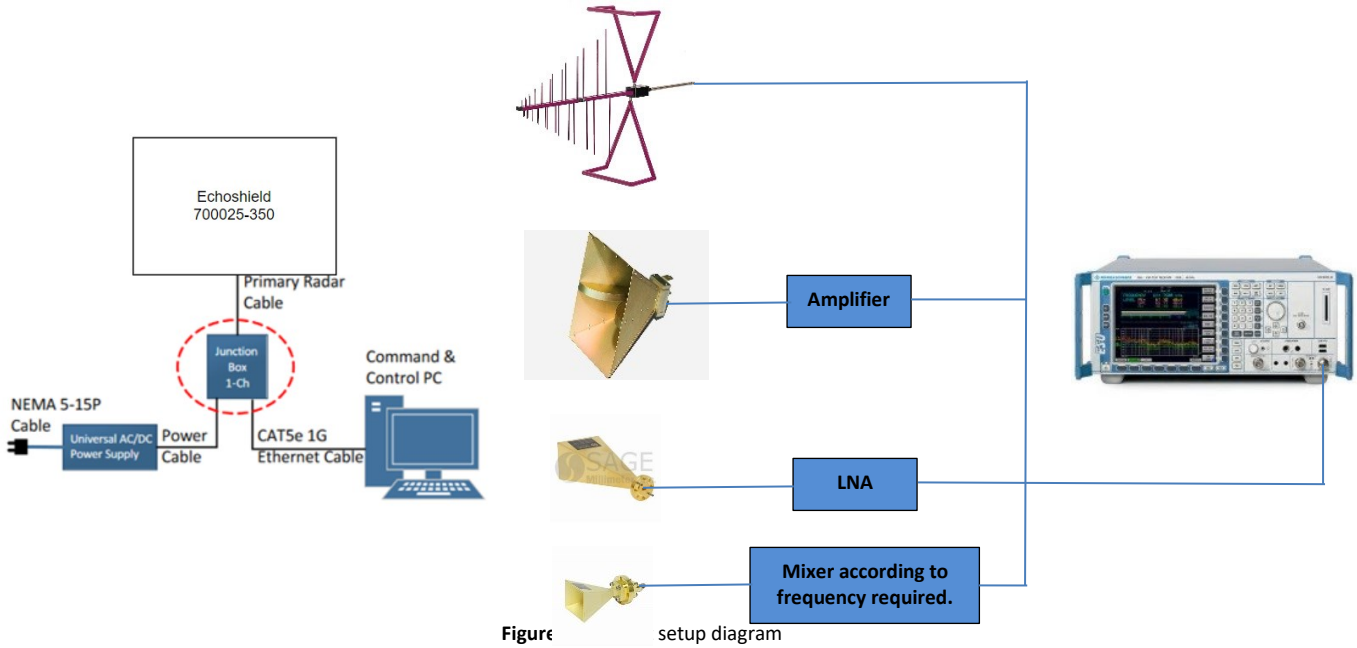

Figure setup diagram

Section 4 Engineering considerations

4.1 Modifications incorporated in the EUT

None.

4.2 Technical judgement

None.

4.3 Deviations from laboratory test procedures

None.

Section 5 Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	86–106 kPa

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

Section 6 Measurement uncertainty

6.1 Uncertainty of measurement

Nemko USA Inc. has calculated measurement uncertainty and is documented in EMC/MUC/001 “Uncertainty in EMC measurements.” Measurement uncertainty was calculated using the methods described in CISPR 16-4-2 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics, and limit modelling – Measurement instrumentation uncertainty. The expression of Uncertainty in EMC testing. Measurement uncertainty calculations assume a coverage factor of K=2 with 95% certainty.

Table 6.1-1: *Measurement uncertainty calculations*

Measurement		**U_{cispr} dB**	**U_{lab} dB**
Conducted disturbance at AC mains and other port power using a V-AMN	9 kHz to 150 kHz	3.8	2.9
	150 kHz to 30 MHz	3.4	2.3
Conducted disturbance at telecommunication port using AAN	150 kHz to 30 MHz	5.0	4.3
Conducted disturbance at telecommunication port using CVP	150 kHz to 30 MHz	3.9	2.9
Conducted disturbance at telecommunication port using CP	150 kHz to 30 MHz	2.9	1.4
Conducted disturbance at telecommunication port using CP and CVP	150 kHz to 30 MHz	4.0	3.1
Radiated disturbance (electric field strength in a SAC)	30 MHz to 1 GHz	6.3	5.5
Radiated disturbance (electric field strength in a FAR)	1 GHz to 6 GHz	5.2	4.7
Radiated disturbance (electric field strength in a FAR)	6 GHz to 18 GHz	5.5	5.0

Notes: Compliance assessment:

If U_{lab} is less than or equal to U_{cispr} then:

- compliance is deemed to occur is no measured disturbance level exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit

If U_{lab} is greater than U_{cispr} then:

- compliance is deemed to occur is no measured disturbance level, increased by (U_{lab} - U_{cispr}), exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance level, increased by (U_{lab} - U_{cispr}), exceeds the disturbance limit

V-AMN: V type artificial mains network
AAN: Asymmetric artificial network
CP: Current probe
CVP: Capacitive voltage probe
SAC: Semi-anechoic chamber
FAR: Fully anechoic room

Section 7 Test equipment

7.1 Test equipment list

Table 7.1-1: *Test equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Signal & Spectrum Analyzer 2Hz / 43.5 GHz	Rohde & Schwarz	FSW43	E1302	1 year	Jan-22-2025
Antenna Horn	EMCO	3115	1033	2 years	Nov-02-2024
EMC Test Receiver	Rohde & Schwarz	ESU 40	E1121	1 year	Dec-14-2025
Antenna, Bilog	Schaffner-Chase	CBL6111C	1480	2 years	June-28-2026
Antenna, Horn	ETS-Lingren	3117-PA	E1160	2 years	Feb-13-2025
Standard Gain Horn Antenna	Eravant	SAZ-2410-42-S1	EW107	1 year	Dec-05-2024
Standard Gain Horn Antenna	Eravant	SAZ-2410-2-S1	EW108	1 year	Dec-05-2024
Low Noise Amplifier	Sage Millimeter	SBL-1834034030-KFKF-SI	E1228	NCR	NCR
Antenna, Horn	Sage Millimeter	SAR-2309-19-S2	E1144	NCR	NCR
Mixer	Rohde & Schwarz	FS-Z60	E1138	VOU	VOU
Antenna, Horn	Sage Millimeter	SAR-2408-15-S2	E1152	NCR	NCR
Mixer	Rohde & Schwarz	FS-Z75	E1149	VOU	VOU
Antenna, Horn	Sage Millimeter	SAR-2507-10-S2	E1146	NCR	NCR
Mixer	Rohde & Schwarz	FS-Z110	E1154	VOU	VOU
Low pass filter	RF-Lambda	RLPF13G14	PBC	VOU	VOU
High pass filter	Anatech Electronics	AE18000SSH6616	PBC	VOU	VOU
High pass filter	Anatech Electronics	AE18000SSH6615	PBC	VOU	VOU

Notes: N/A – not applicable
NCR – no calibration required
VOU – verify on use
PBC – provided by client

Table 7.1-2: *Test software details*

Manufacturer of Software	Details
Rohde & Schwarz	EMC 32 V10.60.15

Notes: None

Section 8 Testing data

8.1 Bandwidth of emission (99%)

8.1.1 References and limits

- FCC 47 CFR Part 90: §90.209
- Test method: ANSI C63.26-2015 (5.4.4)

Each authorization issued to a station licensed under this part will show an emission designator representing the class of emission authorized. The designator will be prefixed by a specified necessary bandwidth. This number does not necessarily indicate the bandwidth occupied by the emission at any instant. In those cases where § 2.202 of this chapter does not provide a formula for the computation of necessary bandwidth, the occupied bandwidth, as defined in part 2 of this chapter, may be used in lieu of the necessary bandwidth.

8.1.2 Test summary

Verdict	Pass		
Test date	September 5, 2024; September 6, 2024;	Temperature	20°C; 18°C
Test engineer	Chenhao Ma, Wireless Test Technician	Air pressure	1002mbar; 1001mbar
Test location	☐ Wireless bench ☒ Other: 3M Chamber	Relative humidity	59%; 56%

8.1.3 Notes

Testing was performed with the transmitter operating on a fixed channel at full power.
Two modes related to the width of the radar pulse were tested and the summary of the time duration of each pulse is described in the following table:

Frequency	Bandwidth declared	Type of pulse	Time duration
15.75 GHz	25 MHz	Longest pulse	30 µs
16.15 GHz	25 MHz	Longest pulse	30 µs
16.55 GHz	25 MHz	Longest pulse	30 µs
15.80 GHz	50 MHz	Longest pulse	30 µs
16.15 GHz	50 MHz	Longest pulse	30 µs
16.50 GHz	50 MHz	Longest pulse	30 µs
15.85 GHz	100 MHz	Longest pulse	30 µs
16.15 GHz	100 MHz	Longest pulse	30 µs
16.45 GHz	100 MHz	Longest pulse	30 µs
15.90 GHz	200 MHz	Longest pulse	28.494 µs
16.15 GHz	200 MHz	Longest pulse	28.494 µs
16.40 GHz	200 MHz	Longest pulse	28.494 µs
15.75 GHz	25 MHz[1]	Shortest pulse	2 µs
16.15 GHz	25 MHz[1]	Shortest pulse	1 µs
16.55 GHz	25 MHz[1]	Shortest pulse	2 µs
15.80 GHz	50 MHz[1]	Shortest pulse	5 µs
16.15 GHz	50 MHz[1]	Shortest pulse	500 ns
16.50 GHz	50 MHz[1]	Shortest pulse	5 µs
15.85 GHz	100 MHz[1]	Shortest pulse	5 µs
16.15 GHz	100 MHz[1]	Shortest pulse	500 ns
16.45 GHz	100 MHz[1]	Shortest pulse	5 µs
15.90 GHz	200 MHz[1]	Shortest pulse	15 µs
16.15 GHz	200 MHz[1]	Shortest pulse	500 ns
16.40 GHz	200 MHz[1]	Shortest pulse	15 µs

Note 1: These bandwidths are declared only as reference, the real number is shown in table 8.1-2 of this section.

Table 8.1-1: Pulse description table.

Testing was done at 3 meters with the antenna and turntable fixed. A maximization of the signal was done to define the position of the max power

8.1.4 Setup details

EUT power input during test	28 V DC
EUT setup configuration	☐ Table-top ☐ Floor standing ☒ Other: Tripod mounted (1.5 m)

Receiver settings:

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	Peak
Trace mode	Max Hold
Measurement time	Long enough for trace to stabilize

8.1.5 Test data

Frequency	Bandwidth	Type of pulse	Time duration
15.75 GHz	25.037MHz	Longest pulse	30 µs
16.15 GHz	24.947MHz	Longest pulse	30 µs
16.55 GHz	24.802MHz	Longest pulse	30 µs
15.80 GHz	48.701MHz	Longest pulse	30 µs
16.15 GHz	48.451MHz	Longest pulse	30 µs
16.50 GHz	48.326MHz	Longest pulse	30 µs
15.85 GHz	97.152MHz	Longest pulse	30 µs
16.15 GHz	96.903MHz	Longest pulse	30 µs
16.45 GHz	96.403MHz	Longest pulse	30 µs
15.90 GHz	192.307MHz	Longest pulse	28.494 µs
16.15 GHz	191.808MHz	Longest pulse	28.494 µs
16.40 GHz	191.300MHz	Longest pulse	28.494 µs
15.75 GHz	27.170MHz	Shortest pulse	2 µs
16.15 GHz	29.870MHz	Shortest pulse	1 µs
16.55 GHz	27.170MHz	Shortest pulse	2 µs
15.80 GHz	49.000MHz	Shortest pulse	5 µs
16.15 GHz	59.065MHz	Shortest pulse	500 ns
16.50 GHz	48.701MHz	Shortest pulse	5 µs
15.85 GHz	97.202MHz	Shortest pulse	5 µs
16.15 GHz	104.590MHz	Shortest pulse	500 ns
16.45 GHz	96.803MHz	Shortest pulse	5 µs
15.90 GHz	192.307MHz	Shortest pulse	15 µs
16.15 GHz	198.301MHz	Shortest pulse	500 ns
16.40 GHz	192.807MHz	Shortest pulse	15 µs

Table 8.1-2: 99% OBW results.

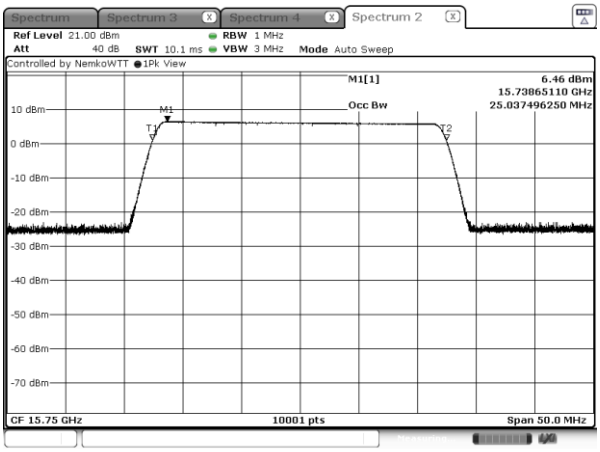

Figure 8.1-1: *99% OBW Low channel: 15.75 GHz, longest pulse (25 MHz BW)*

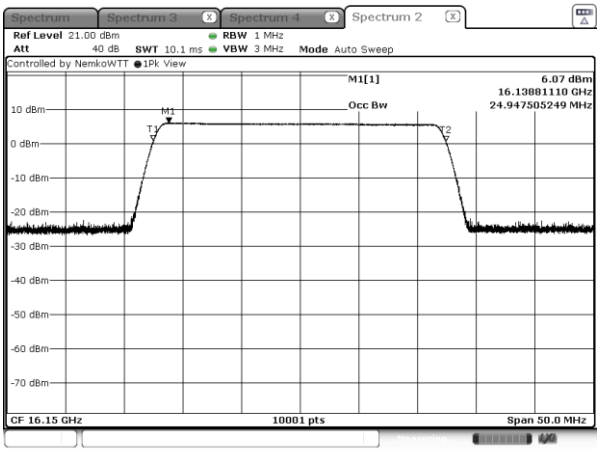

Figure 8.1-2: *99% OBW Middle channel: 16.15 GHz, longest pulse (25 MHz BW)*

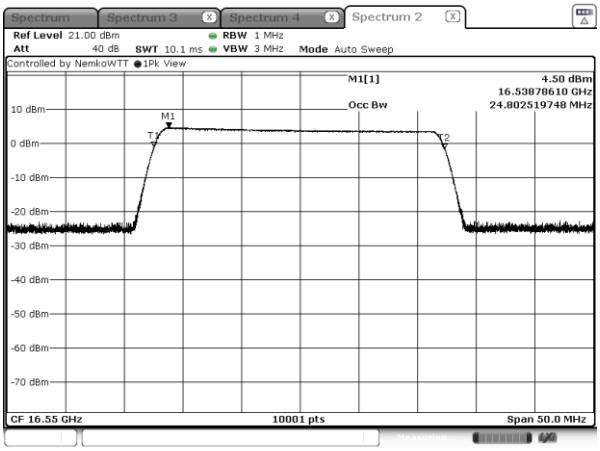

Figure 8.1-3: *99% OBW High channel: 16.55 GHz, longest pulse (25 MHz BW)*

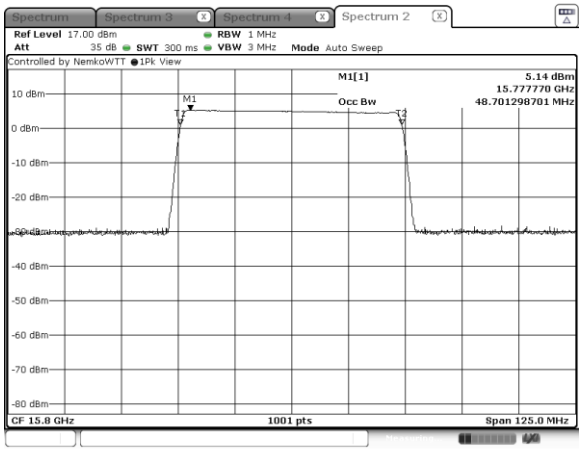

Figure 8.1-4: *99% OBW Low channel: 15.80 GHz, longest pulse (50 MHz BW)*

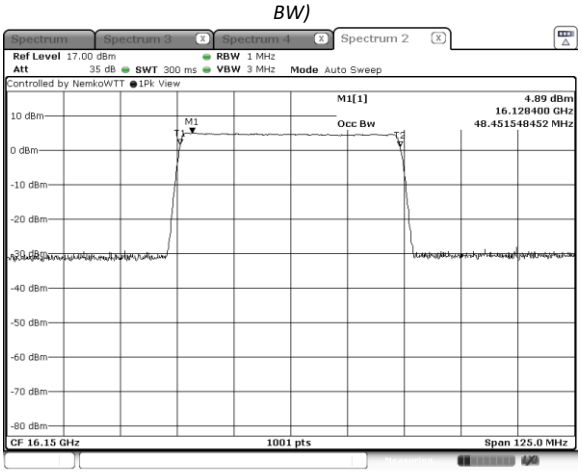

Figure 8.1-5: *99% OBW Middle channel: 16.15 GHz, longest pulse (50 MHz BW)*

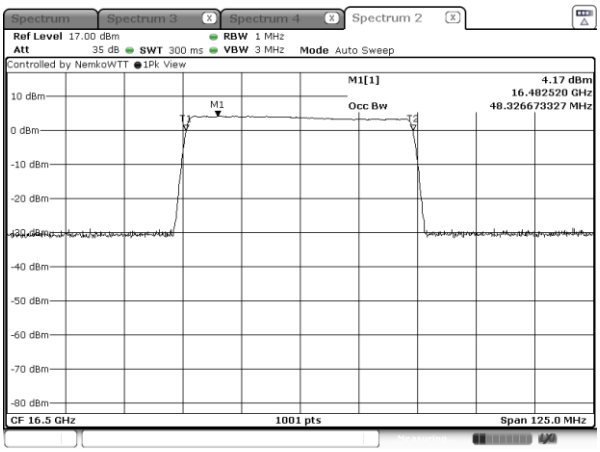

Figure 8.1-6: *99% OBW High channel: 16.50 GHz, longest pulse (50 MHz BW)*

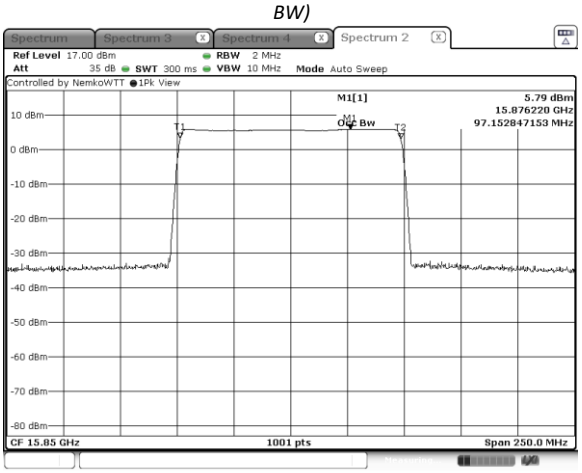

Figure 8.1-7: *99% OBW Low channel: 15.85 GHz, longest pulse (100 MHz BW)*

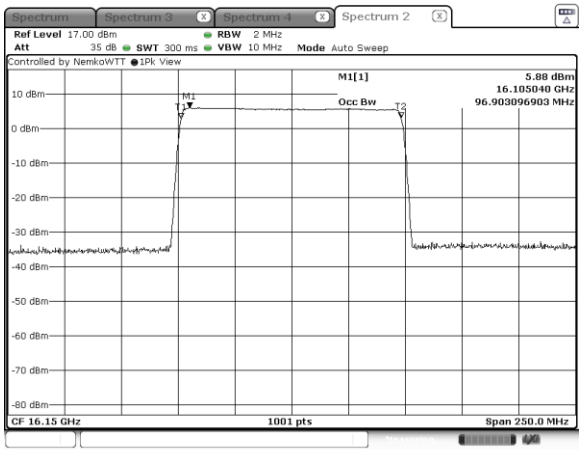

Figure 8.1-8: *99% OBW Middle channel: 16.15 GHz, longest pulse (100 MHz BW)*

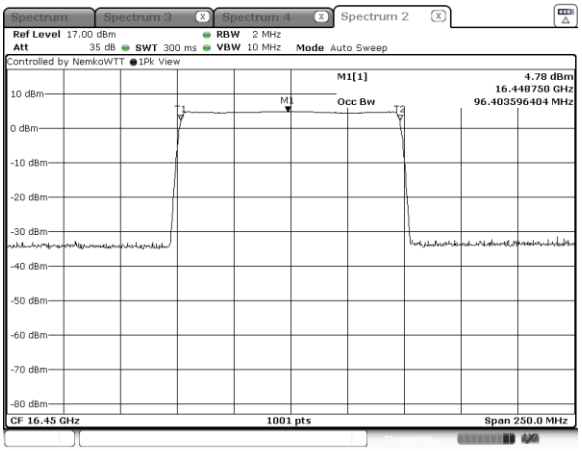

Figure 8.1-9: *99% OBW High channel: 16.45 GHz, longest pulse (100 MHz BW)*

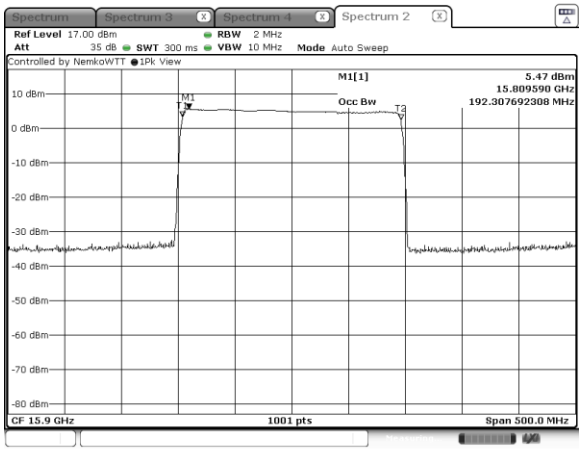

Figure 8.1-10: *99% OBW Low channel: 15.90 GHz, longest pulse (200 MHz BW)*

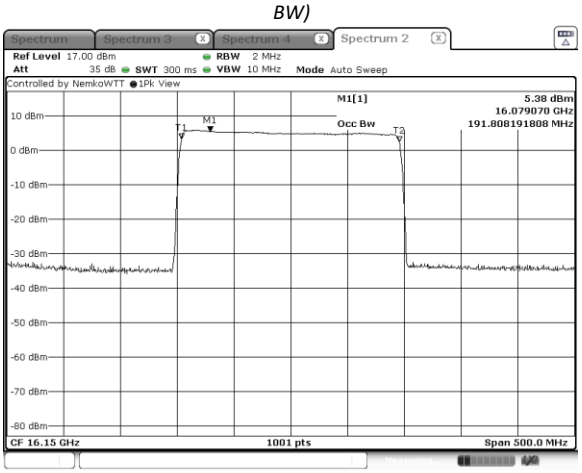

Figure 8.1-11: *99% OBW Middle channel: 16.15 GHz, longest pulse (200 MHz BW)*

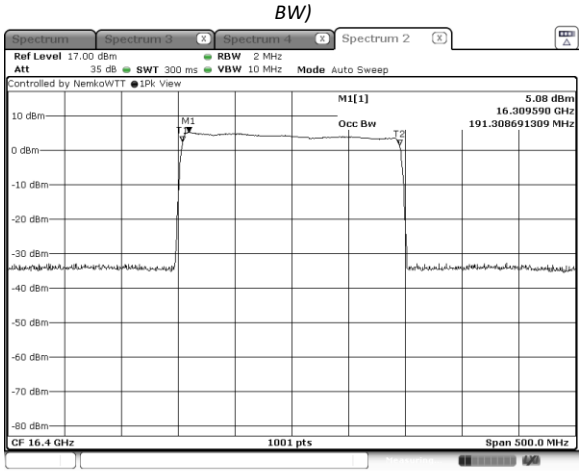

Figure 8.1-12: *99% OBW High channel: 16.40 GHz, longest pulse (200 MHz BW)*

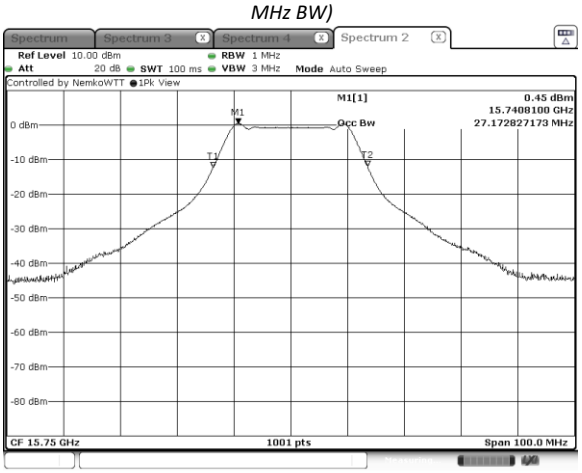

Figure 8.1-13: *99% OBW Low channel: 15.75 GHz, shortest pulse (25 MHz BW)*

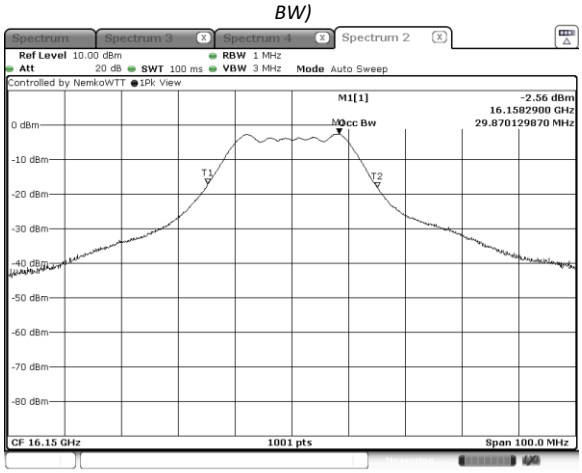

Figure 8.1-14: *99% OBW Middle channel: 16.15 GHz, shortest pulse (25 MHz BW)*

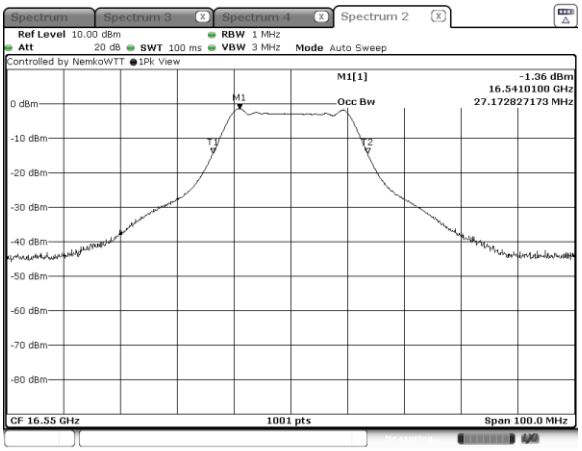

Figure 8.1-15: *99% OBW High channel: 16.55 GHz, shortest pulse (25 MHz BW)*

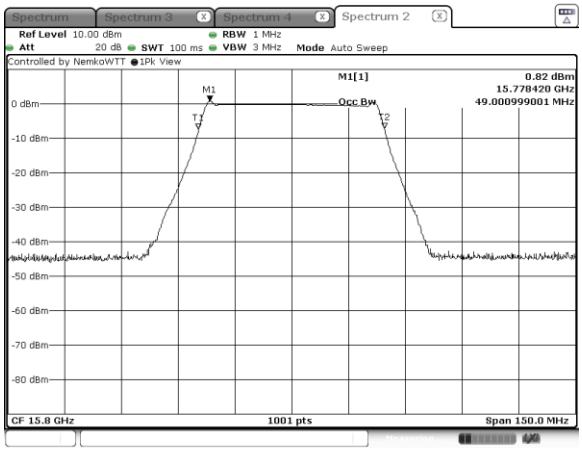

Figure 8.1-16: *99% OBW Low channel: 15.80 GHz, shortest pulse (50 MHz BW)*

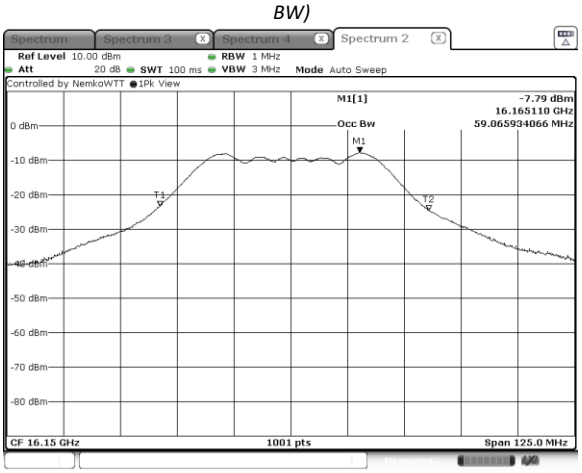

Figure 8.1-17: *99% OBW Middle channel: 16.15 GHz, shortest pulse (50 MHz BW)*

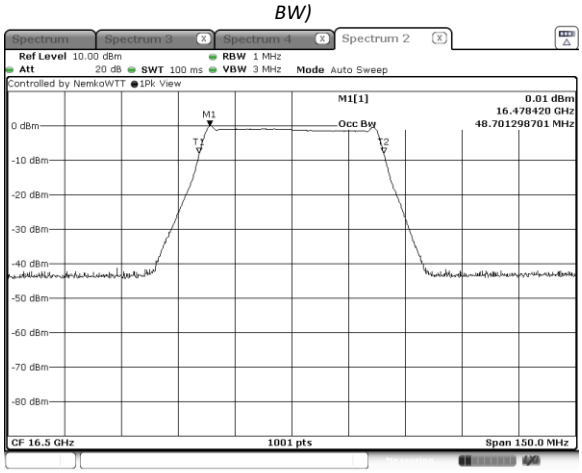

Figure 8.1-18: *99% OBW High channel: 16.50 GHz, shortest pulse (50 MHz BW)*

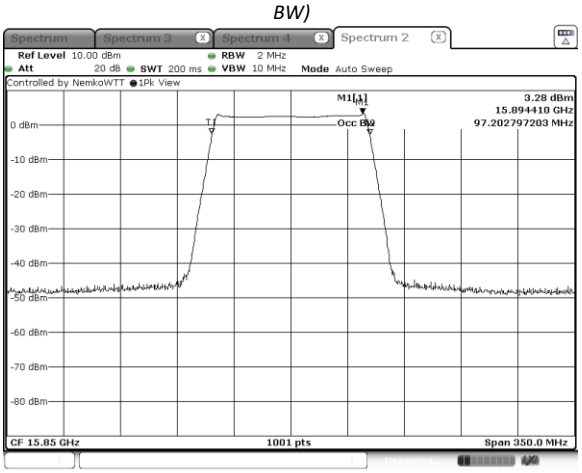

Figure 8.1-19: *99% OBW Low channel: 15.85 GHz, shortest pulse (100 MHz BW)*

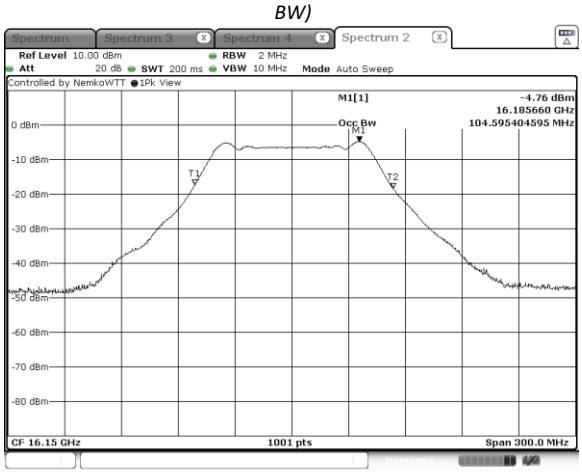

Figure 8.1-20: *99% OBW Middle channel: 16.15 GHz, shortest pulse (100 MHz BW)*

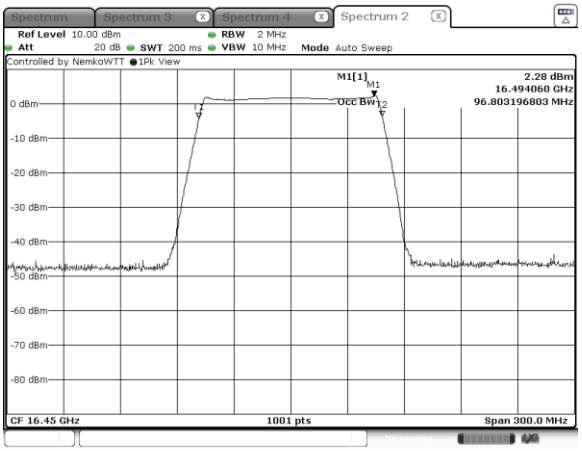

Figure 8.1-21: *99% OBW High channel: 16.45 GHz, shortest pulse (100 MHz BW)*

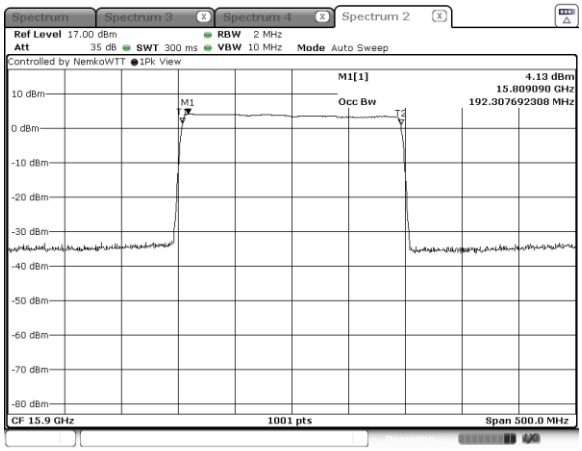

Figure 8.1-22: *99% OBW Low channel: 15.90 GHz, shortest pulse (200 MHz BW)*

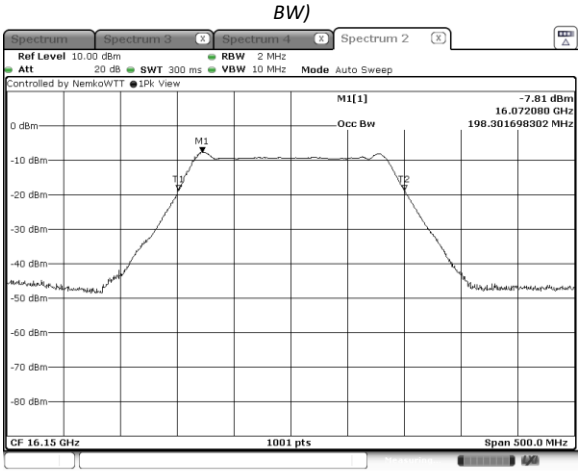

Figure 8.1-23: *99% OBW Middle channel: 16.15 GHz, shortest pulse (200 MHz BW)*

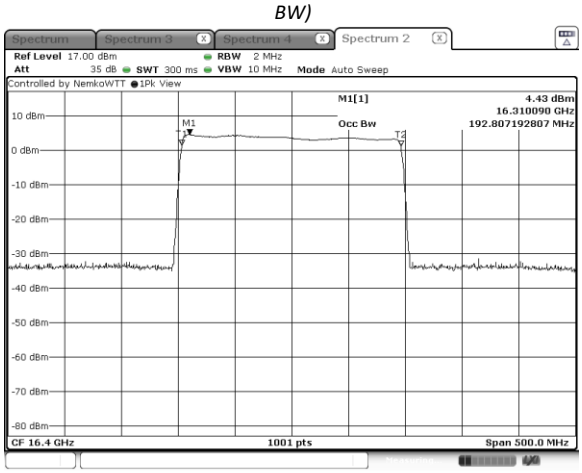

Figure 8.1-24: *99% OBW High channel: 16.40 GHz, shortest pulse (200 MHz BW)*

8.2 Bandwidth of emission (26 dB)

8.2.1 References and limits

- Test method: ANSI C63.26-2015 (5.4.3)

8.2.2 Test summary

Verdict	Pass		
Test date	September 5, 2024; September 6, 2024;	Temperature	20°C; 18°C
Test engineer	Chenhao Ma, Wireless Test Technician	Air pressure	1002mbar; 1001mbar
Test location	☐ Wireless bench ☒ Other: 3M Chamber	Relative humidity	59%; 56%

8.2.3 Notes

Testing was performed with the transmitter operating on a fixed channel at full power following the cases shown on table 8.1-1 from section 8.1.3 of this document. This measurement is not a requirement, but it is used for the mask calculation in section 8.4 of this document.

Testing was done at 3 meters with the antenna and turntable fixed. A maximization of the signal was done to define the position of the max power:

8.2.4 Setup details

EUT power input during test	28 V DC
EUT setup configuration	☐ Table-top ☐ Floor standing ☒ Other: Tripod mounted (1.5 m)

Receiver settings:

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	Peak
Trace mode	Max Hold
Measurement time	Long enough for trace to stabilize

8.2.5 Test data

Frequency	Bandwidth	Type of pulse	Time duration
15.75 GHz	28.17MHz	Longest pulse	30 µs
16.15 GHz	29.016MHz	Longest pulse	30 µs
16.55 GHz	27.57MHz	Longest pulse	30 µs
15.80 GHz	59.54MHz	Longest pulse	30 µs
16.15 GHz	52.45MHz	Longest pulse	30 µs
16.50 GHz	52.15MHz	Longest pulse	30 µs
15.85 GHz	101.9MHz	Longest pulse	30 µs
16.15 GHz	101.7MHz	Longest pulse	30 µs
16.45 GHz	102.3MHz	Longest pulse	30 µs
15.90 GHz	201.3MHz	Longest pulse	28.494 µs
16.15 GHz	200.8MHz	Longest pulse	28.494 µs
16.40 GHz	199.8MHz	Longest pulse	28.494 µs
15.75 GHz	40.16MHz	Shortest pulse	2 µs
16.15 GHz	44.06MHz	Shortest pulse	1 µs
16.55 GHz	39.06MHz	Shortest pulse	2 µs
15.80 GHz	60.24MHz	Shortest pulse	5 µs
16.15 GHz	84.32MHz	Shortest pulse	500 ns
16.50 GHz	60.39MHz	Shortest pulse	5 µs
15.85 GHz	112.09MHz	Shortest pulse	5 µs
16.15 GHz	145.35MHz	Shortest pulse	500 ns
16.45 GHz	111.49MHz	Shortest pulse	5 µs
15.90 GHz	204.55MHz	Shortest pulse	15 µs
16.15 GHz	255.24MHz	Shortest pulse	500 ns
16.40 GHz	202.1MHz	Shortest pulse	15 µs

Table 8.2-1: 26 dB OBW results

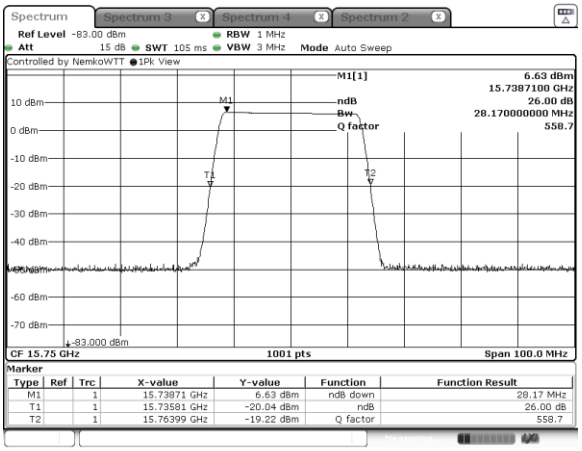

Figure 8.2-1: *26 dB OBW Low channel: 15.75 GHz, longest pulse (25 MHz BW)*

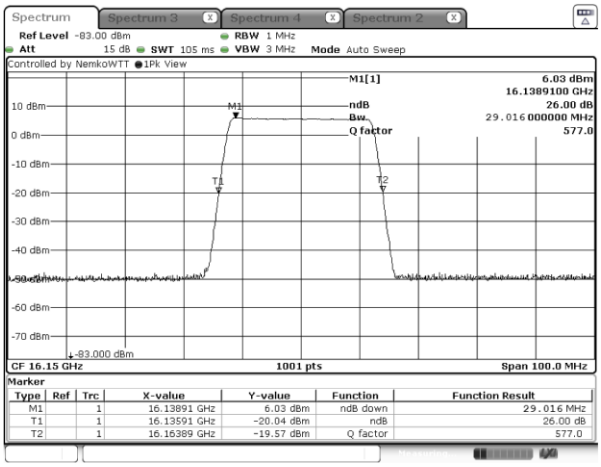

Figure 8.2-2: *26 dB OBW Middle channel: 16.15 GHz, longest pulse (25 MHz BW)*

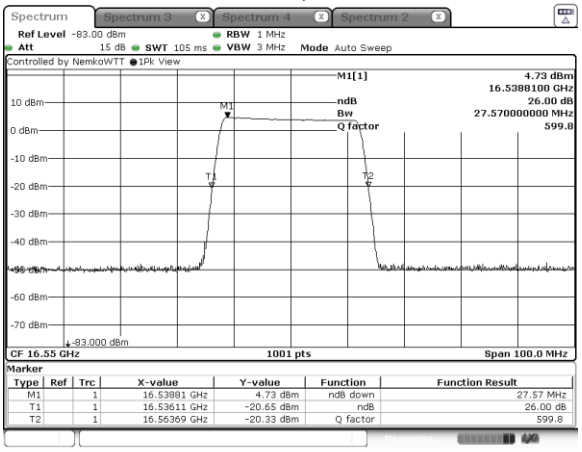

Figure 8.2-3: *26 dB OBW High channel: 16.55 GHz, longest pulse (25 MHz BW)*

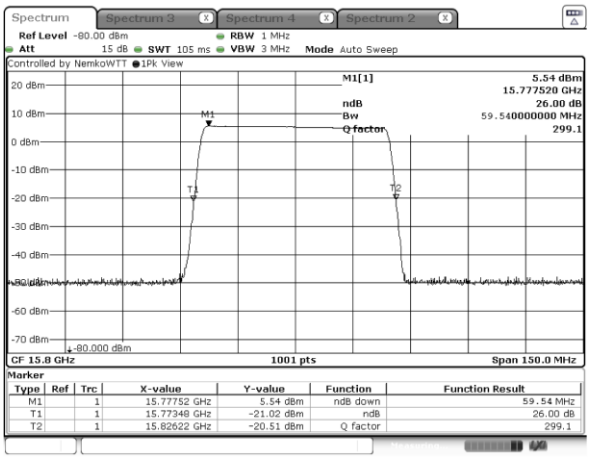

Figure 8.2-4: *26 dB OBW Low channel: 15.80 GHz, longest pulse (50 MHz BW)*

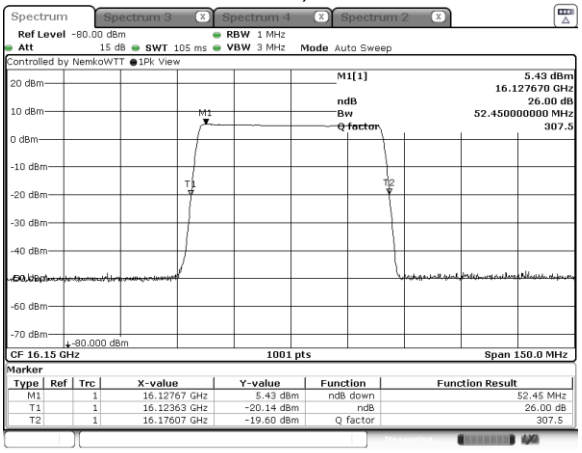

Figure 8.2-5: *26 dB OBW Middle channel: 16.15 GHz, longest pulse (50 MHz BW)*

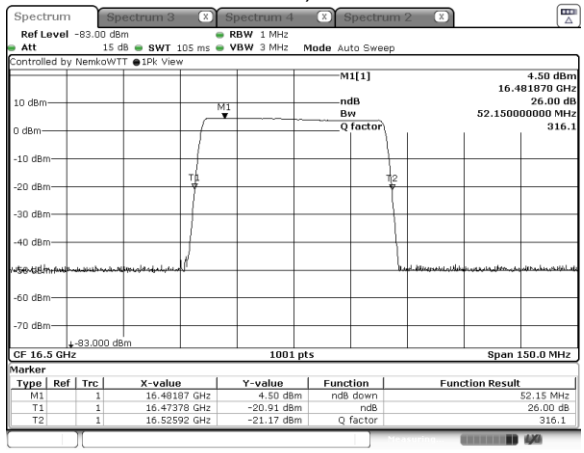

Figure 8.2-6: *26 dB OBW High channel: 16.50 GHz, longest pulse (50 MHz BW)*

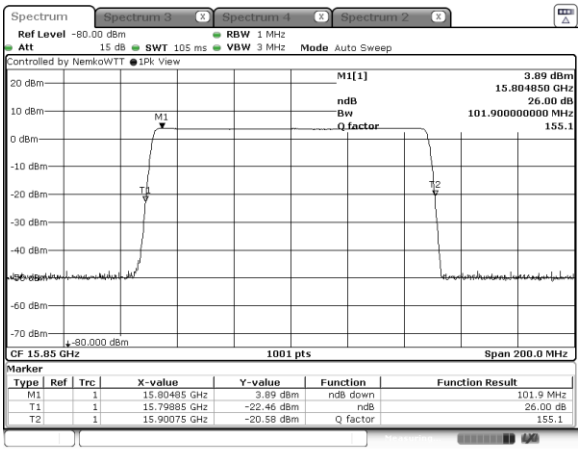

Figure 8.2-7: *26 dB OBW Low channel: 15.85 GHz, longest pulse (100 MHz BW)*

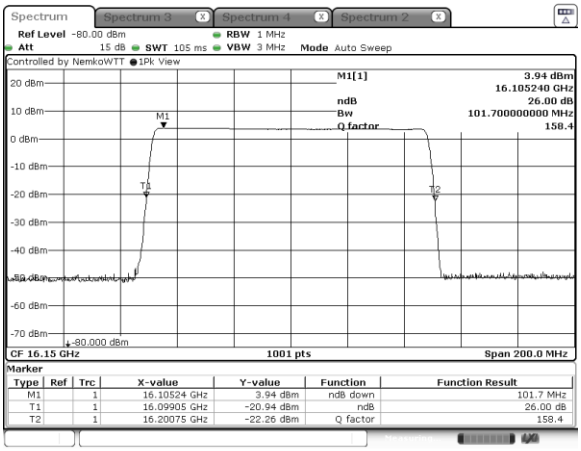

Figure 8.2-8: *26 dB OBW Middle channel: 16.15 GHz, longest pulse (100 MHz BW)*

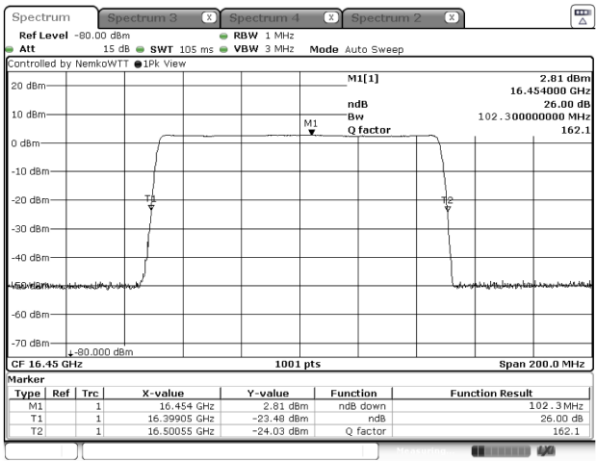

Figure 8.2-9: *26 dB OBW High channel: 16.45 GHz, longest pulse (100 MHz BW)*

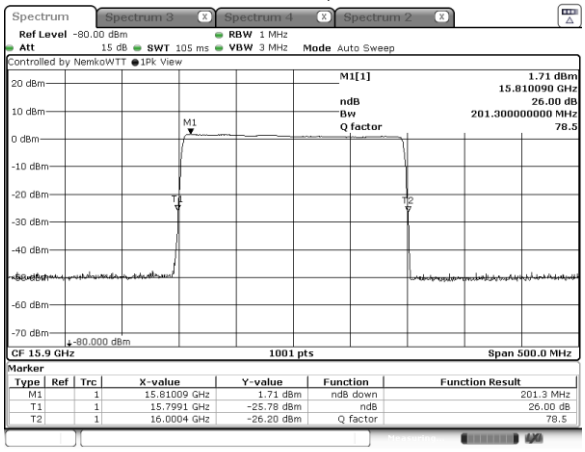

Figure 8.2-10: *26 dB OBW Low channel: 15.90 GHz, longest pulse (200 MHz BW)*

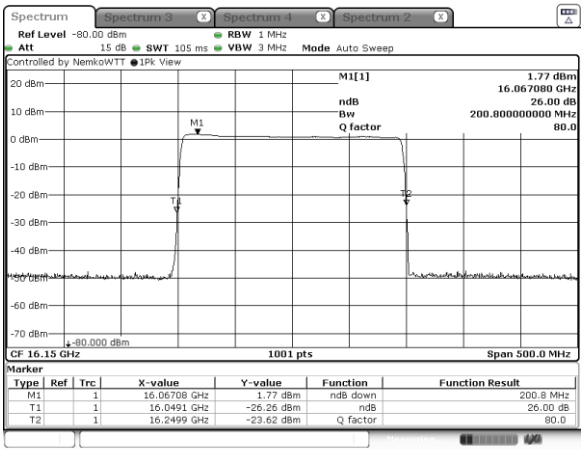

Figure 8.2-11: *26 dB OBW Middle channel: 16.15 GHz, longest pulse (200 MHz BW)*

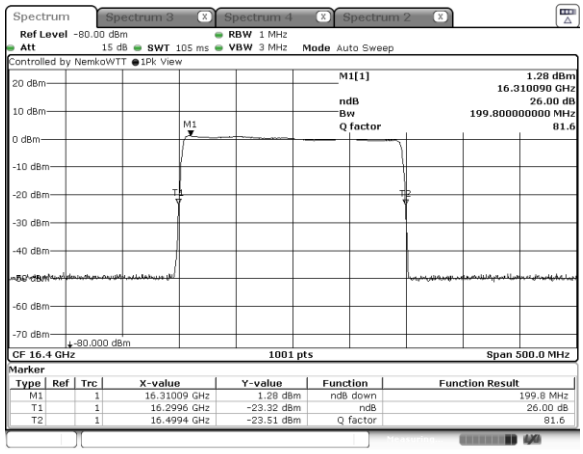

Figure 8.2-12: *26 dB OBW High channel: 16.40 GHz, longest pulse (200 MHz BW)*

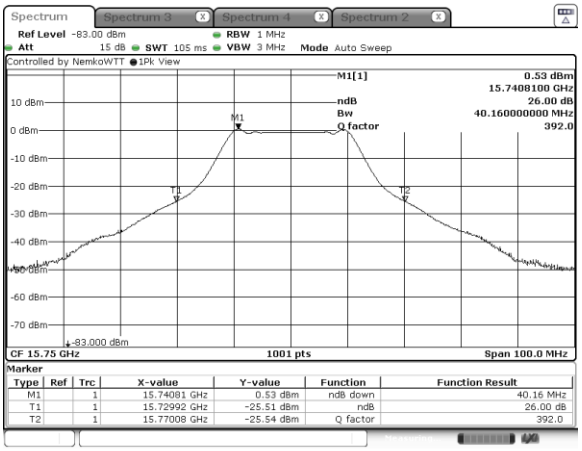

Figure 8.2-13: *26 dB OBW Low channel: 15.75 GHz, shortest pulse (25 MHz BW)*

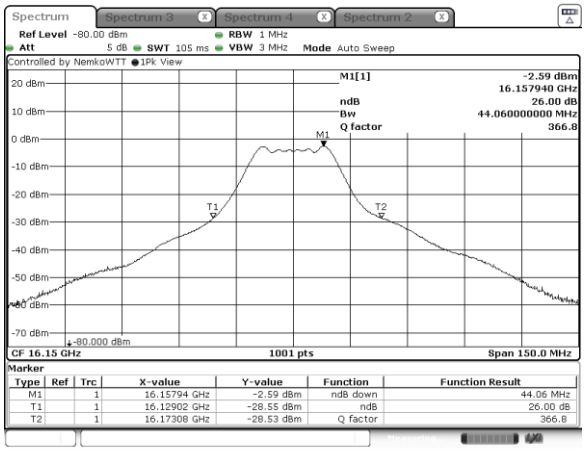

Figure 8.2-14: *26 dB OBW Middle channel: 16.15 GHz, shortest pulse (25 MHz BW)*

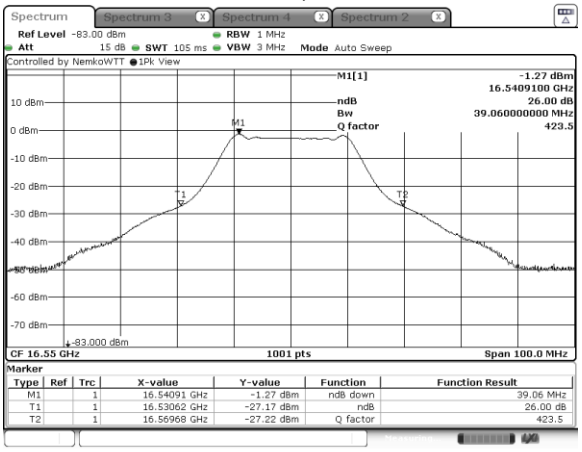

Figure 8.2-15: *26 dB OBW High channel: 16.55 GHz, shortest pulse (25 MHz BW)*

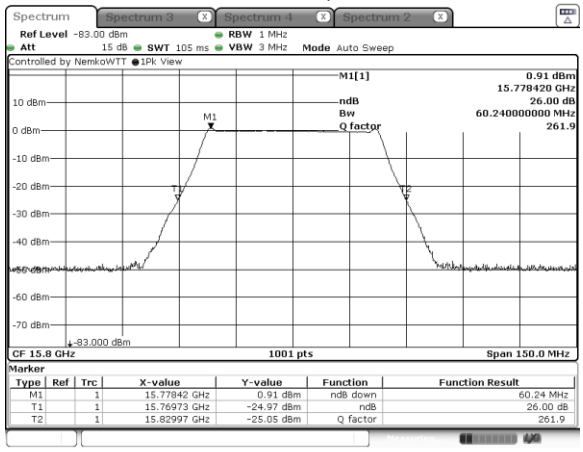

Figure 8.2-16: *26 dB OBW Low channel: 15.80 GHz, shortest pulse (50 MHz BW)*

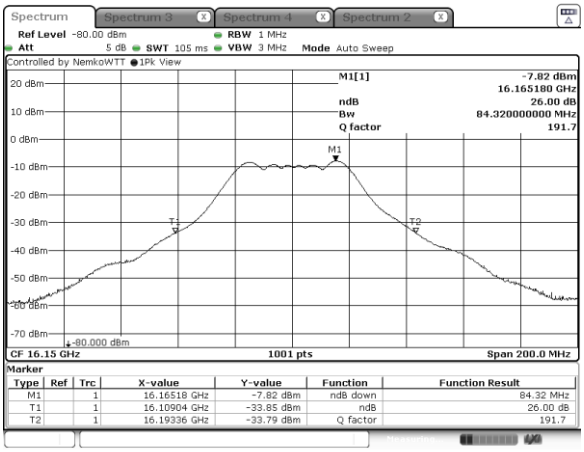

Figure 8.2-17: *26 dB OBW Middle channel: 16.15 GHz, shortest pulse (50 MHz BW)*

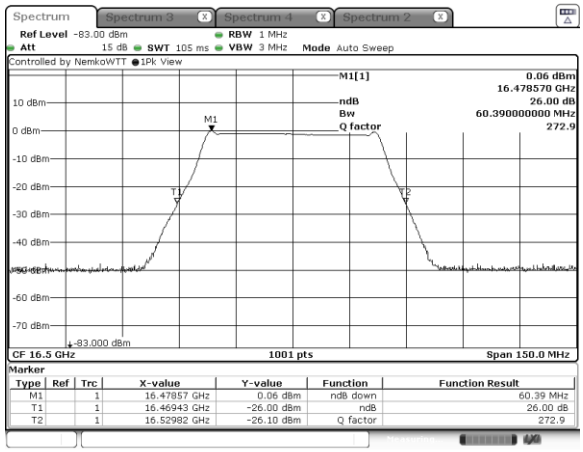

Figure 8.2-18: *26 dB OBW High channel: 16.50 GHz, shortest pulse (50 MHz BW)*

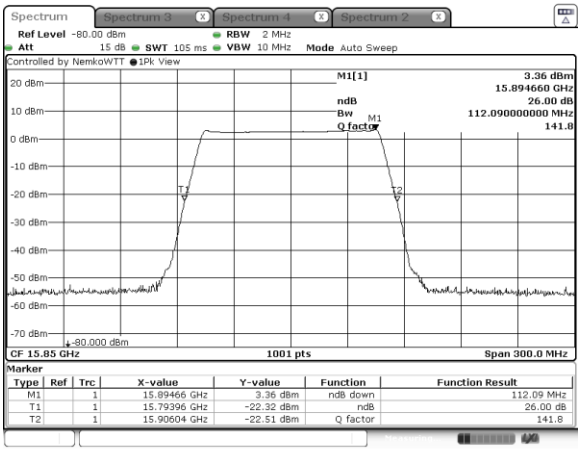

Figure 8.2-19: *26 dB OBW Low channel: 15.85 GHz, shortest pulse (100 MHz BW)*

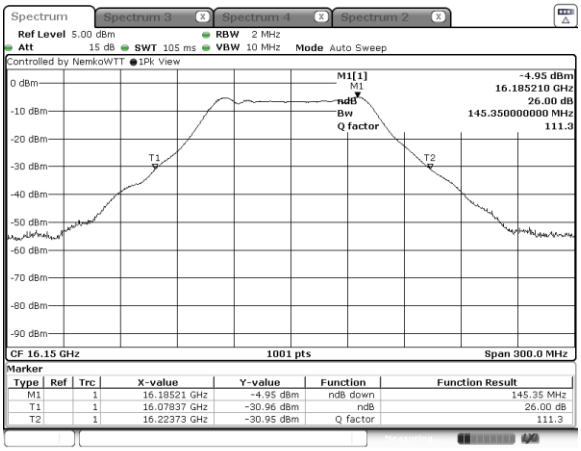

Figure 8.2-20: *26 dB OBW Middle channel: 16.15 GHz, shortest pulse (100 MHz BW)*

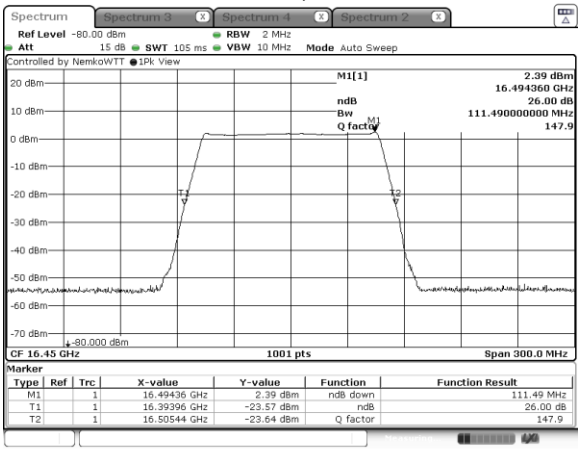

Figure 8.2-21: *26 dB OBW High channel: 16.45 GHz, shortest pulse (100 MHz BW)*

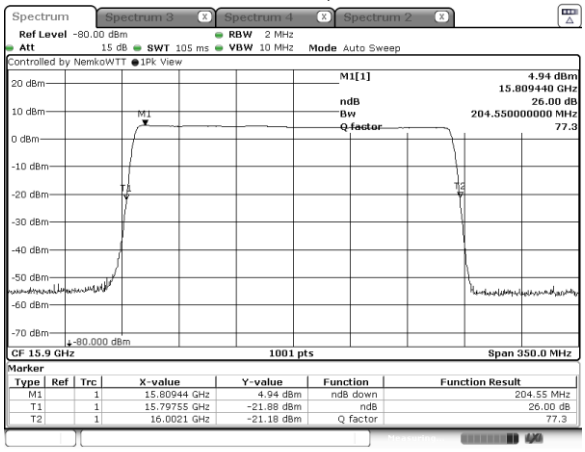

Figure 8.2-22: *26 dB OBW Low channel: 15.90 GHz, shortest pulse (200 MHz BW)*

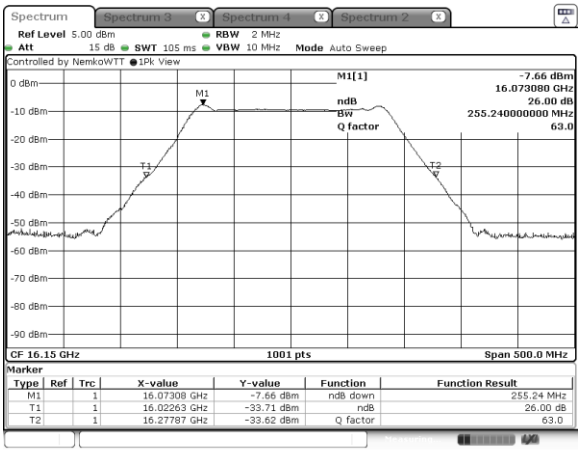

Figure 8.2-23: *26 dB OBW Middle channel: 16.15 GHz, shortest pulse (200 MHz BW)*

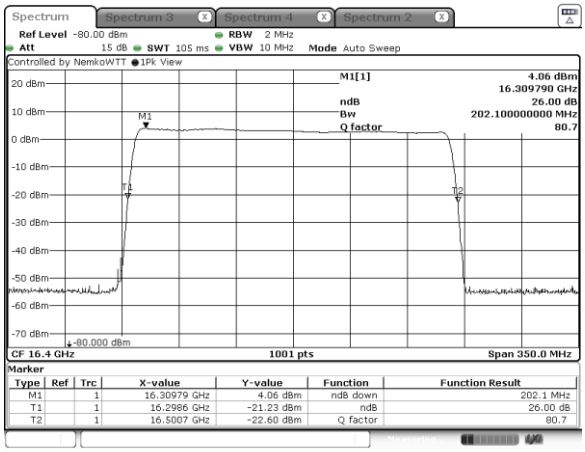

Figure 8.2-24: *26 dB OBW High channel: 16.40 GHz, shortest pulse (200 MHz BW)*

8.3 Power and antenna height limits

8.3.1 References and limits

- FCC 47 CFR Part 90: §90.205
- Test method: ANSI C63.26-2015 (5.2.4.4.2)

Applicants for licenses must request and use no more power than the actual power necessary for satisfactory operation. Except where otherwise specifically provided for, the maximum power that will be authorized to applicants whose license applications for new stations are filed after August 18, 1995, is as follows:

(r) All other frequency bands. Requested transmitter power will be considered and authorized on a case by case basis.

8.3.2 Test summary

Verdict	Pass		
Test date	September 5, 2024; September 6, 2024;	Temperature	20°C; 18°C
Test engineer	Chenhao Ma, Wireless Test Technician	Air pressure	1002mbar; 1001mbar
Test location	☐ Wireless bench ☒ Other: 3M Chamber	Relative humidity	59%; 56%

8.3.3 Notes

Testing was performed with the transmitter operating on a fixed channel at full power following the cases shown on table 8.1-1 from section 8.1.3 of this document. All correction factors corresponding cables losses, receiving antenna gain, and air path losses were compensated to get the real EIRP value of the product. Both polarizations were evaluated, horizontal and vertical (linear polarization per client declaration) and only the worst case (max power) was taken for the testing purposes: horizontal polarization. The duty cycle correction factor was added according to each frequency channel tested. Table 8.3-1 shows the constant duty cycle corresponding to each case.

The equation to calculate the total correction factor corresponding to each frequency tested is given by the following expression as well as the table with the corresponding duty cycle to each case:

$$E.I.R.P = P_r - G_r - 20\log_{10}\left(\frac{\lambda}{4\pi d}\right)$$

Adding cable losses and duty cycle correction factors (absolute values):

$$E.I.R.P = P_r - G_r - 20\log_{10}\left(\frac{\lambda}{4\pi d}\right) + L_{cable} + 10\log_{10}\left(\frac{1}{Duty\ cycle}\right)$$

Where:
P_r = Power received in the spectrum analyzer
λ = Wavelength of the signal
L_{cable} = Losses corresponding to interconnexion cables
d = Measuring distance (3 meters)
G_r = Receiving antenna gain
DC = Duty cycle declared

Example:

$$E.I.R.P = P_r - 16.389 - 20\log_{10}\left(\frac{\frac{299792458}{15750000000}}{4\pi(3)}\right) + 19.96 + 10\log_{10}\left(\frac{1}{0.15}\right)$$

$$E.I.R.P = P_r - 16.389 - (-65.935) + 19.96 + 8.239 = P_r + 77.745 \text{ (offset)}$$

DC = Duty cycle declared

Testing was done at 3 meters with the antenna and turntable fixed. A maximization of the signal was done to define the position of the max power:

Frequency	Type of pulse	Time duration	Duty cycle
15.75 GHz	Longest pulse	30 µs	15%
16.15 GHz	Longest pulse	30 µs	15%
16.55 GHz	Longest pulse	30 µs	15%
15.80 GHz	Longest pulse	30 µs	15%
16.15 GHz	Longest pulse	30 µs	15%
16.50 GHz	Longest pulse	30 µs	15%
15.85 GHz	Longest pulse	30 µs	15%
16.15 GHz	Longest pulse	30 µs	15%
16.45 GHz	Longest pulse	30 µs	15%
15.90 GHz	Longest pulse	28.494 µs	15%
16.15 GHz	Longest pulse	28.494 µs	15%
16.40 GHz	Longest pulse	28.494 µs	15%
15.75 GHz	Shortest pulse	2 µs	10%
16.15 GHz	Shortest pulse	1 µs	10%
16.55 GHz	Shortest pulse	2 µs	10%
15.80 GHz	Shortest pulse	5 µs	10%
16.15 GHz	Shortest pulse	500 ns	10%
16.50 GHz	Shortest pulse	5 µs	10%
15.85 GHz	Shortest pulse	5 µs	10%
16.15 GHz	Shortest pulse	500 ns	10%
16.45 GHz	Shortest pulse	5 µs	10%
15.90 GHz	Shortest pulse	15 µs	10%
16.15 GHz	Shortest pulse	500 ns	10%
16.40 GHz	Shortest pulse	15 µs	10%

Table 8.3-1: Duty cycle table.

8.3.4 Setup details

EUT power input during test	28 V DC
EUT setup configuration	☐ Table-top ☐ Floor standing ☒ Other: Tripod mounted (1.5 m)

Receiver settings:

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	RMS
Trace mode	Average (at least 100 traces)
Measurement points	≥ (2xspan)/RBW
Span	2 times or 3 times the 99% OBW

8.3.5 Test data

Frequency	Type of pulse	Time duration	Power (EIRP)
15.75 GHz	Longest pulse	30 µs	74.17dBm
16.15 GHz	Longest pulse	30 µs	74.37dBm
16.55 GHz	Longest pulse	30 µs	74.00dBm
15.80 GHz	Longest pulse	30 µs	73.94dBm
16.15 GHz	Longest pulse	30 µs	74.35dBm
16.50 GHz	Longest pulse	30 µs	74.04dBm
15.85 GHz	Longest pulse	30 µs	74.19dBm
16.15 GHz	Longest pulse	30 µs	74.67dBm
16.45 GHz	Longest pulse	30 µs	74.45dBm
15.90 GHz	Longest pulse	28.494 µs	74.55dBm
16.15 GHz	Longest pulse	28.494 µs	74.78dBm
16.40 GHz	Longest pulse	28.494 µs	74.62dBm
15.75 GHz	Shortest pulse	2 µs	73.43dBm
16.15 GHz	Shortest pulse	1 µs	72.87dBm
16.55 GHz	Shortest pulse	2 µs	73.37dBm
15.80 GHz	Shortest pulse	5 µs	73.94dBm
16.15 GHz	Shortest pulse	500 ns	72.44dBm
16.50 GHz	Shortest pulse	5 µs	74.15dBm
15.85 GHz	Shortest pulse	5 µs	73.95dBm
16.15 GHz	Shortest pulse	500 ns	72.62dBm
16.45 GHz	Shortest pulse	5 µs	74.58dBm
15.90 GHz	Shortest pulse	15 µs	74.44dBm
16.15 GHz	Shortest pulse	500 ns	72.58dBm
16.40 GHz	**Shortest pulse**	**15 µs**	**75.51dBm**

Table 8.3-2: Power results (EIRP.).

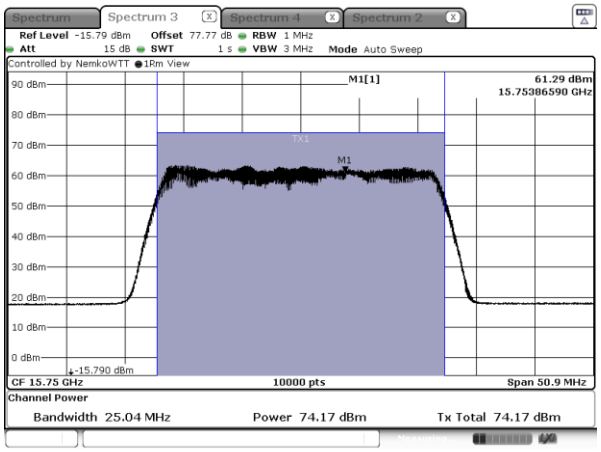

Figure 8.3-1: *EIRP Power, Low channel: 15.75 GHz, longest pulse (25 MHz BW)*

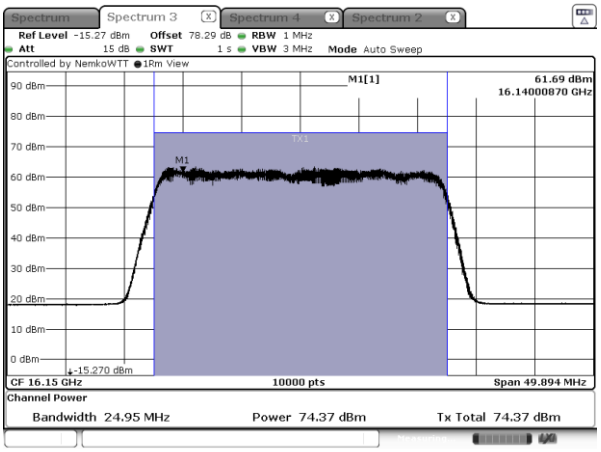

Figure 8.3-2: *EIRP Power, Middle channel: 16.15 GHz, longest pulse (25 MHz BW)*

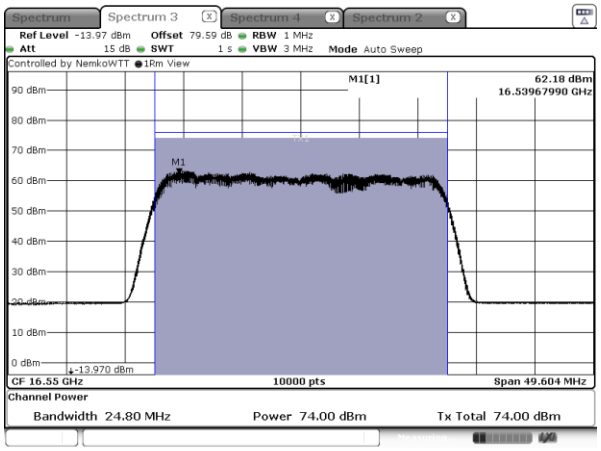

Figure 8.3-3: *EIRP Power, High channel: 16.55 GHz, longest pulse (25 MHz BW)*

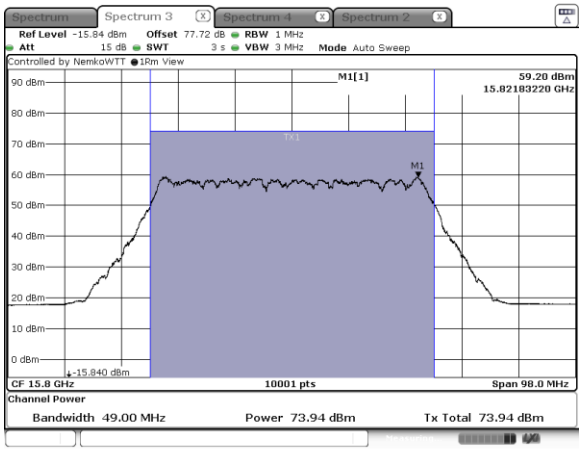

Figure 8.3-4: *EIRP Power, Low channel: 15.80 GHz, longest pulse (50 MHz BW)*

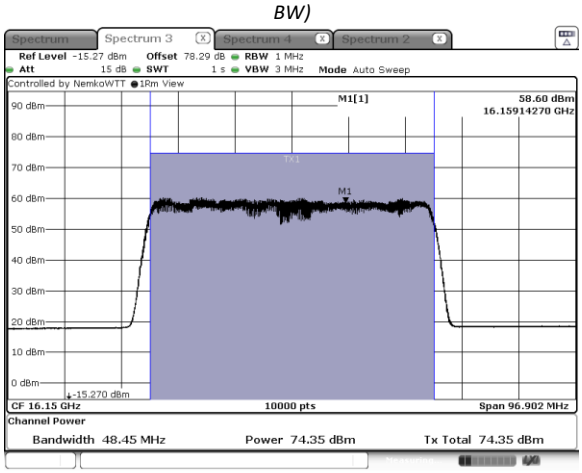

Figure 8.3-5: *EIRP Power, Middle channel: 16.15 GHz, longest pulse (50 MHz BW)*

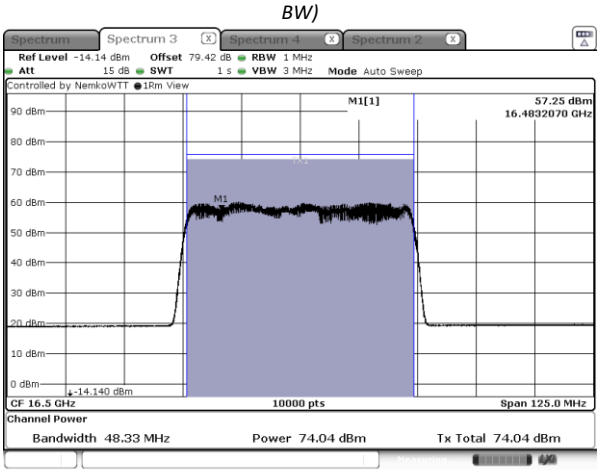

Figure 8.3-6: *EIRP Power, High channel: 16.50 GHz, longest pulse (50 MHz BW)*

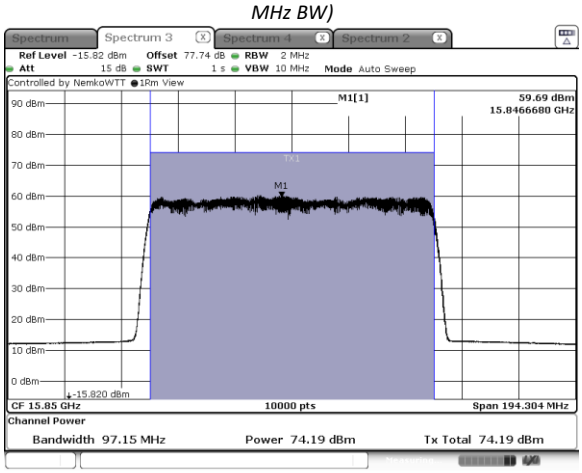

Figure 8.3-7: *EIRP Power, Low channel: 15.85 GHz, longest pulse (100 MHz BW)*

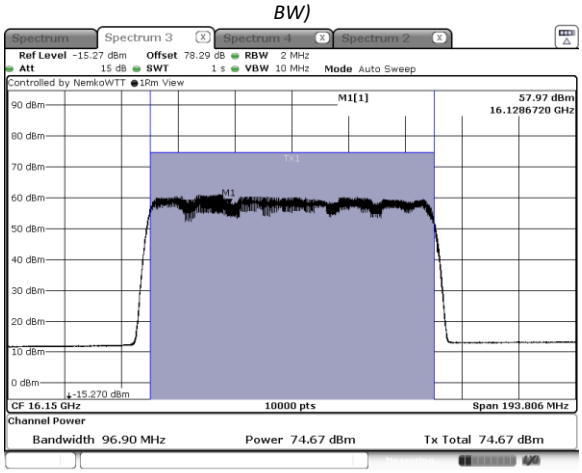

Figure 8.3-8: *EIRP Power, Middle channel: 16.15 GHz, longest pulse (100 MHz BW)*

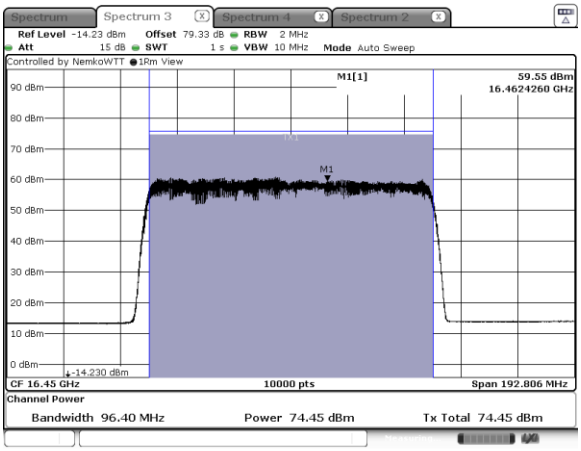

Figure 8.3-9: *EIRP Power, High channel: 16.45 GHz, longest pulse (100 MHz BW)*

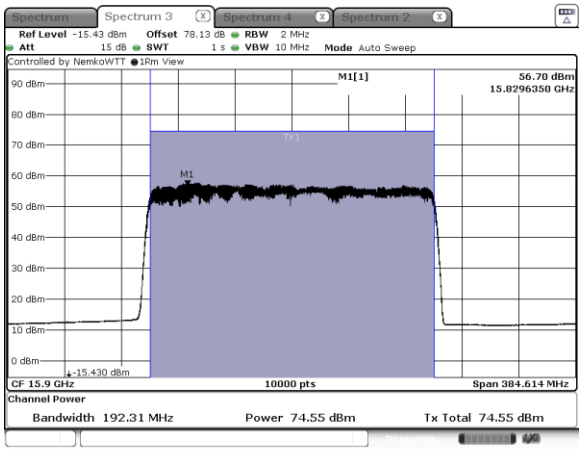

Figure 8.3-10: *EIRP Power, Low channel: 15.90 GHz, longest pulse (200 MHz BW)*

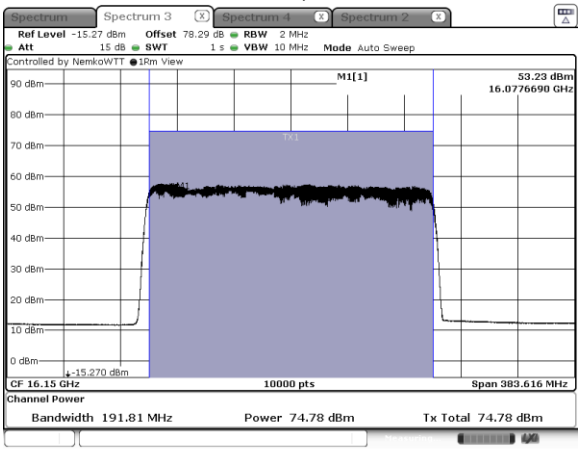

Figure 8.3-11: *EIRP Power, Middle channel: 16.15 GHz, longest pulse (200 MHz BW)*

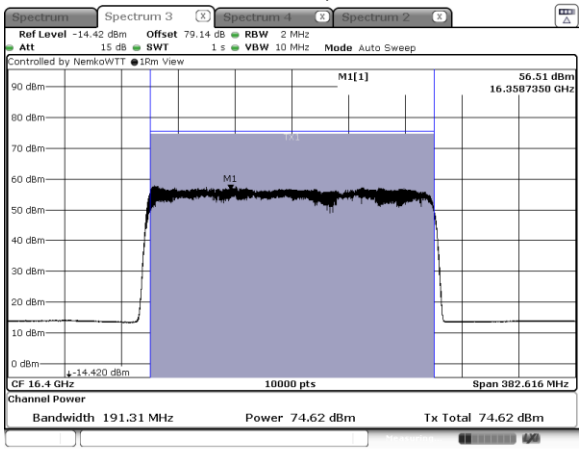

Figure 8.3-12: *EIRP Power, High channel: 16.40 GHz, longest pulse (200 MHz BW)*

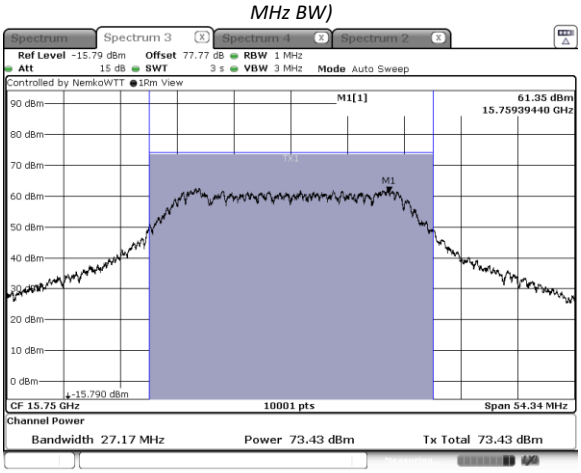

Figure 8.3-13: *EIRP Power, Low channel: 15.75 GHz, shortest pulse (25 MHz BW)*

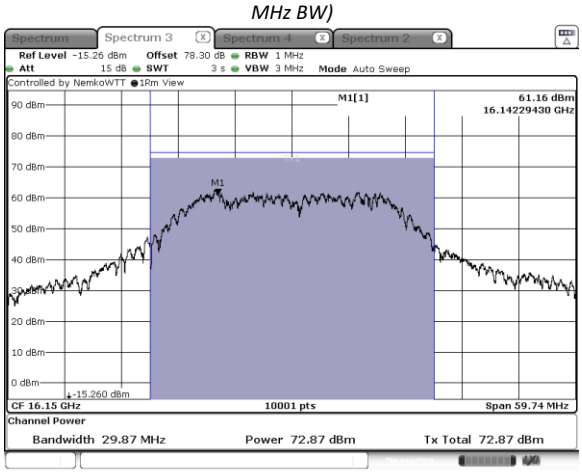

Figure 8.3-14: *EIRP Power, Middle channel: 16.15 GHz, shortest pulse (25 MHz BW)*

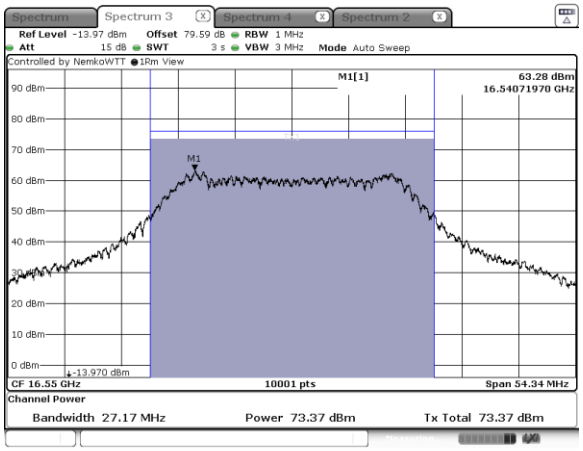

Figure 8.3-15: *EIRP Power, High channel: 16.55 GHz, shortest pulse (25 MHz BW)*

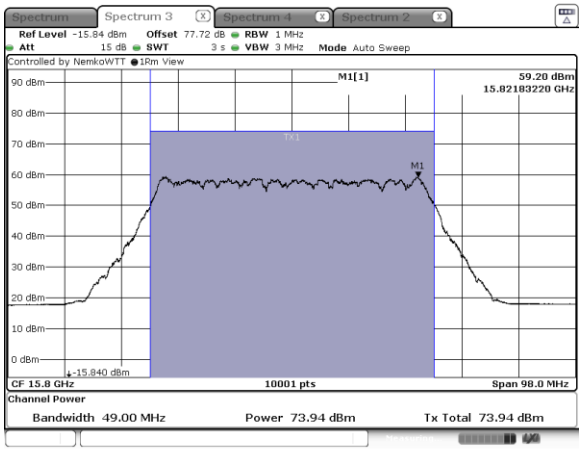

Figure 8.3-16: *EIRP Power, Low channel: 15.80 GHz, shortest pulse (50 MHz BW)*

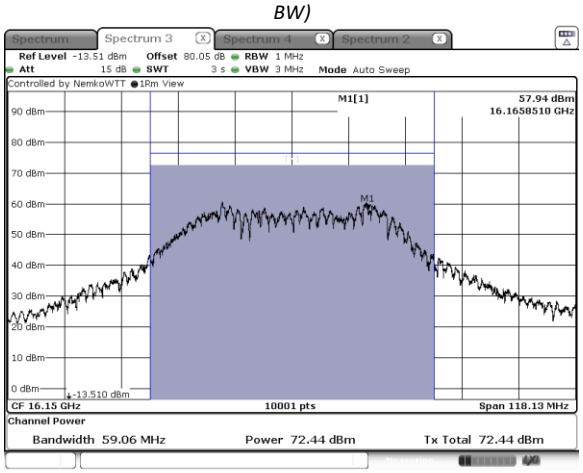

Figure 8.3-17: *EIRP Power, Middle channel: 16.15 GHz, shortest pulse (50 MHz BW)*

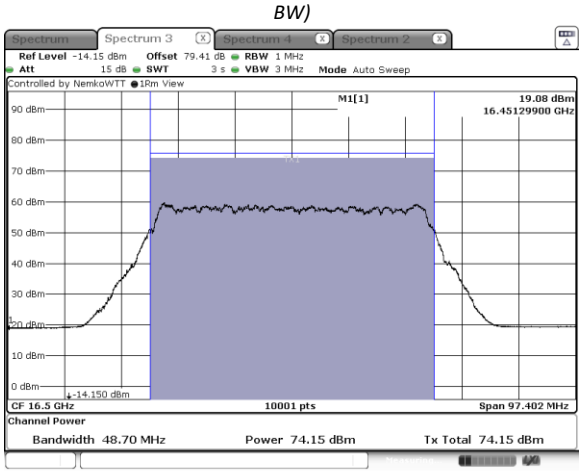

Figure 8.3-18: *EIRP Power, High channel: 16.50 GHz, shortest pulse (50 MHz BW)*

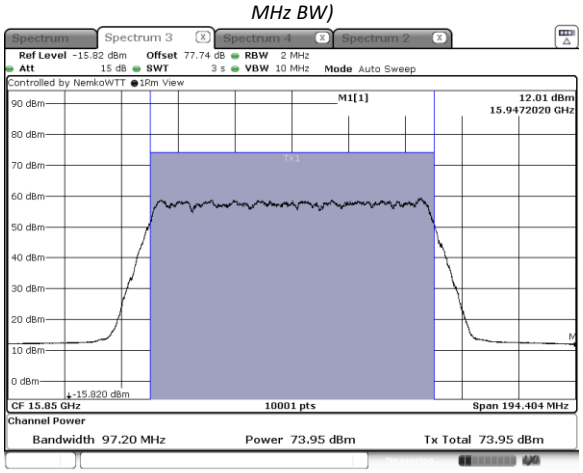

Figure 8.3-19: *EIRP Power, Low channel: 15.85 GHz, shortest pulse (100 MHz BW)*

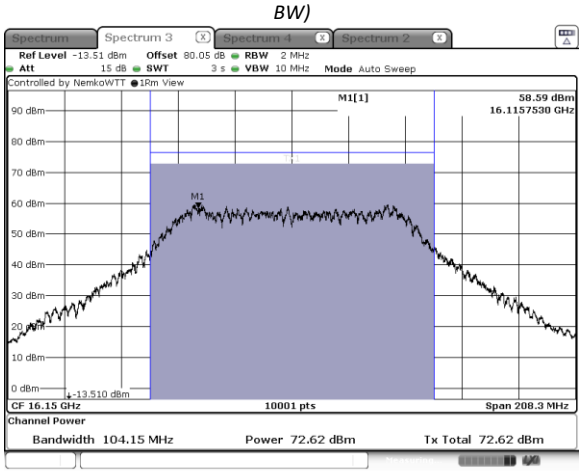

Figure 8.3-20: *EIRP Power, Middle channel: 16.15 GHz, shortest pulse (100 MHz BW)*

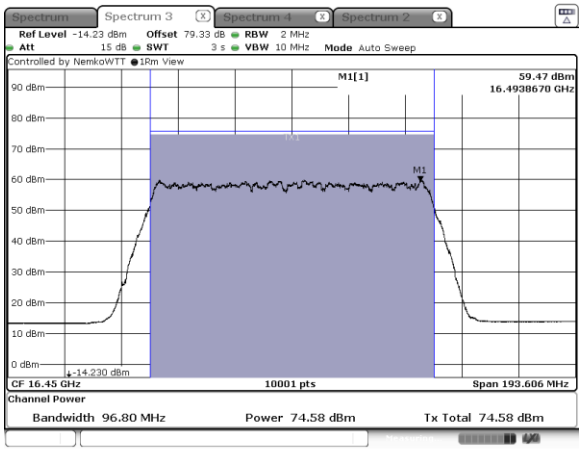

Figure 8.3-21: *EIRP Power, High channel: 16.45 GHz, shortest pulse (100 MHz BW)*

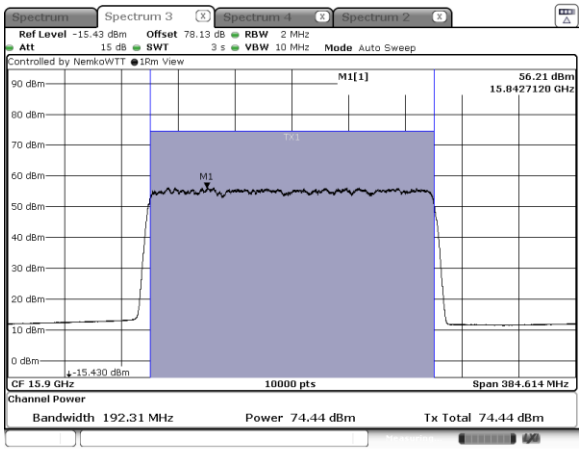

Figure 8.3-22: *EIRP Power, Low channel: 15.90 GHz, shortest pulse (200 MHz BW)*

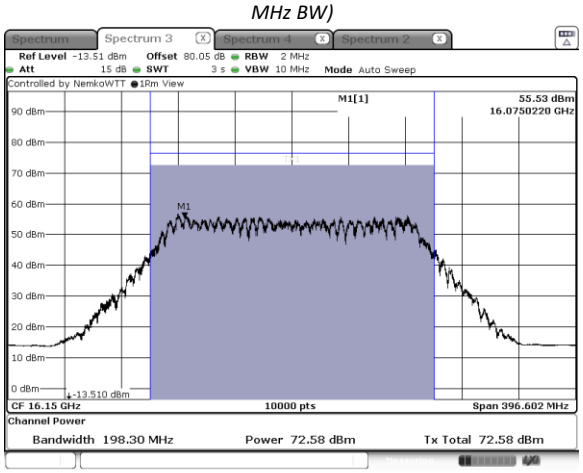

Figure 8.3-23: *EIRP Power, Middle channel: 16.15 GHz, shortest pulse (200 MHz BW)*

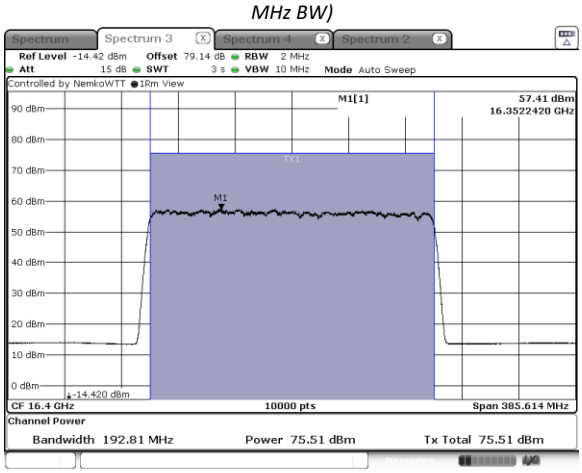

Figure 8.3-24: *EIRP Power, High channel: 16.40 GHz, shortest pulse (200 MHz BW)*

8.4 Emission mask

8.4.1 References and limits

- FCC 47 CFR Part 90: §90.210
- Test method: ANSI C63.26-2015 (5.5)

(b) Emission Mask B. For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:
(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.
(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.
(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

8.4.2 Test summary

Verdict	Pass		
Test date	September 5, 2024; September 6, 2024;	Temperature	20°C; 18°C
Test engineer	Chenhao Ma, Wireless Test Technician	Air pressure	1002mbar; 1001mbar
Test location	☐ Wireless bench ☒ Other: 3M Chamber	Relative humidity	59%; 56%

8.4.3 Notes

Testing was performed with the transmitter operating on a fixed channel at full power following the cases shown on table 8.1-1 from section 8.1.3 of this document. The width of the mask was defined according to the 26 dB bandwidth results (one measured bandwidth selected for each declared bandwidth and each pulse width) shown in table 8.2-1 from section 8.2.5 of this document.

The range between the ±250% is a relative limit, therefore, no correction factors were added. For the frequency range beyond ±250% the limit is an absolute value (-13 dBm), which means the corrections factors corresponding to air path losses and interconnexion cables were added as an offset in the spectrum analyzer.

In this section, offset equivalent to RBW/2 in the edges of frequency can be applied, according to the basic guidelines described on C63.26 (5.7.2).

8.4.4 Setup details

EUT power input during test	28 V DC
EUT setup configuration	☐ Table-top ☐ Floor standing ☒ Other: Tripod mounted (1.5 m)

Receiver settings:

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	RMS
Trace mode	Average (at least 100 traces)
Span	Enough to see the spectrum under investigation

8.4.5 Test data

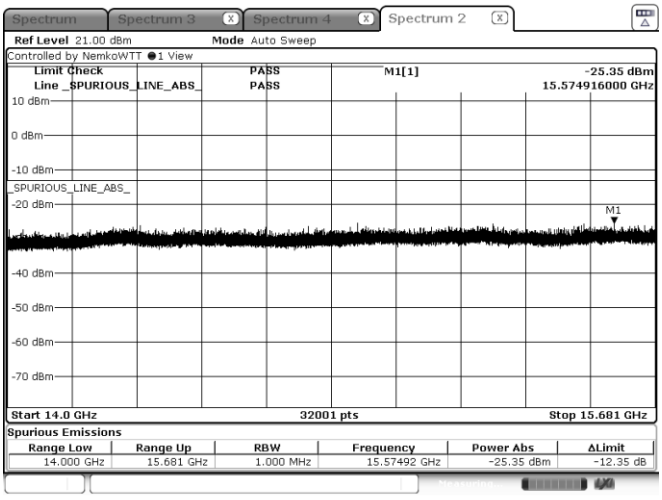

Figure 8.4-1: *Emission mask, beyond ±250% of BW (low frequency range), Low channel: 15.75 GHz, longest pulse. (25 MHz BW)*

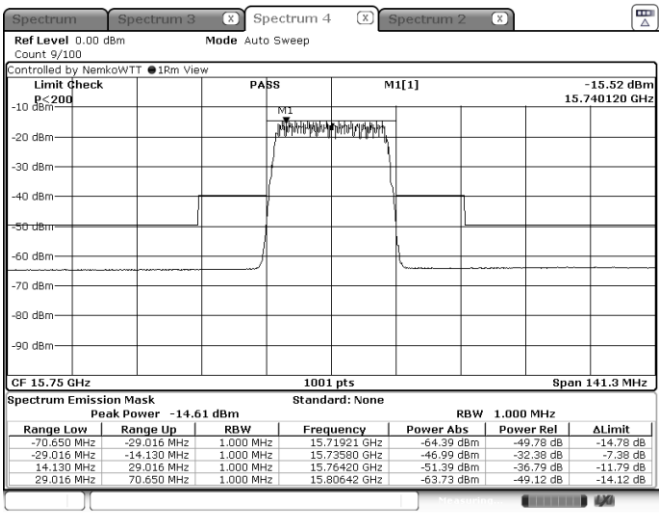

Figure 8.4-2: *Emission mask, Low channel: 15.75 GHz, longest pulse. (25 MHz BW)*

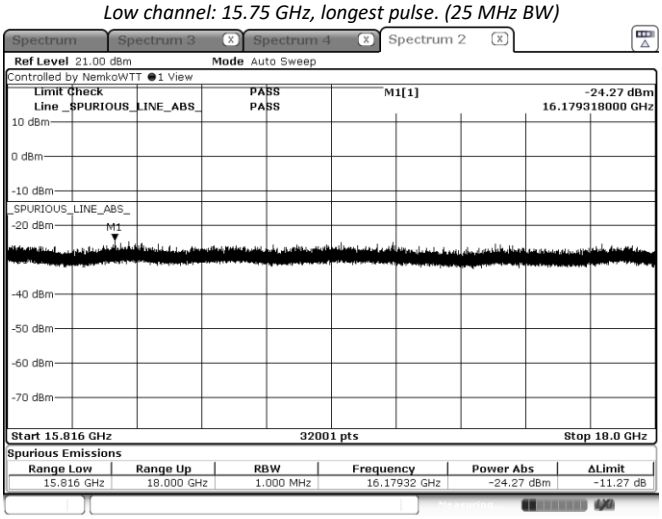

Figure 8.4-3: *Emission mask, beyond ±250% of BW (high frequency range), Low channel: 15.75 GHz, longest pulse. (25 MHz BW)*

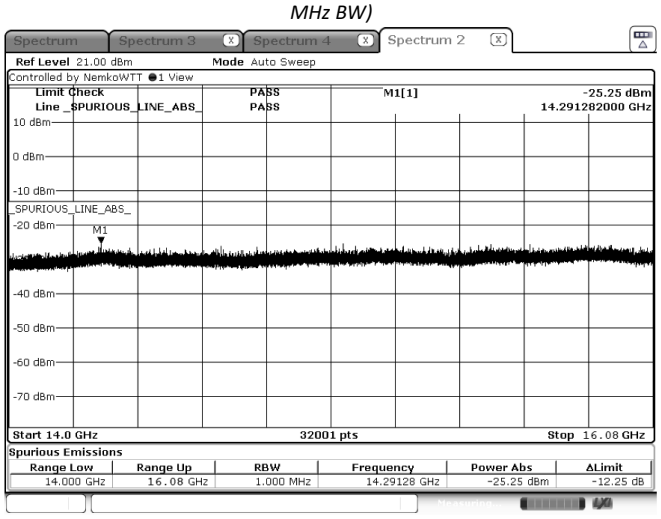

Figure 8.4-4: *Emission mask, beyond ±250% of BW (low frequency range), Middle channel: 16.15 GHz, longest pulse. (25 MHz BW)*

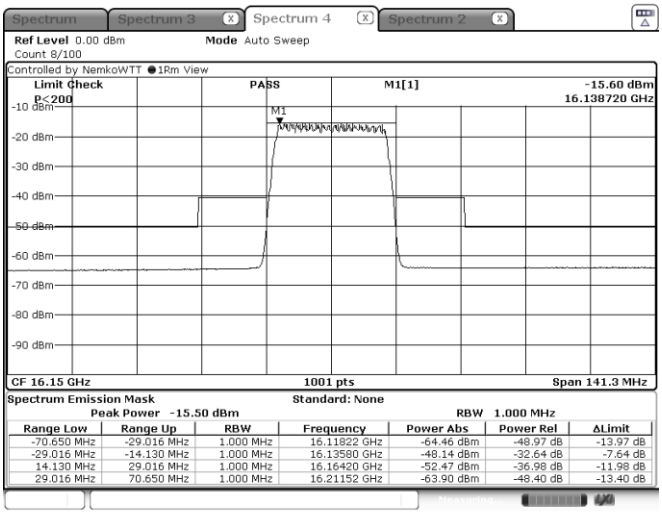

Figure 8.4-5: *Emission mask, Middle channel: 16.15 GHz, longest pulse. (25 MHz BW)*

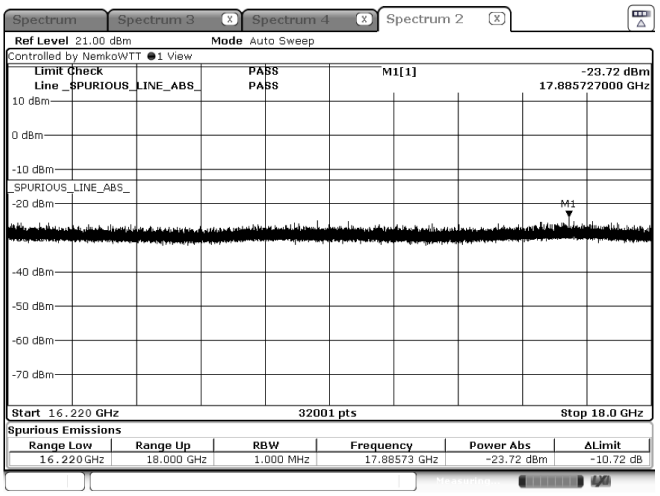

Figure 8.4-6: *Emission mask, beyond ±250% of BW (high frequency range), Middle channel: 16.15 GHz, longest pulse. (25 MHz BW)*

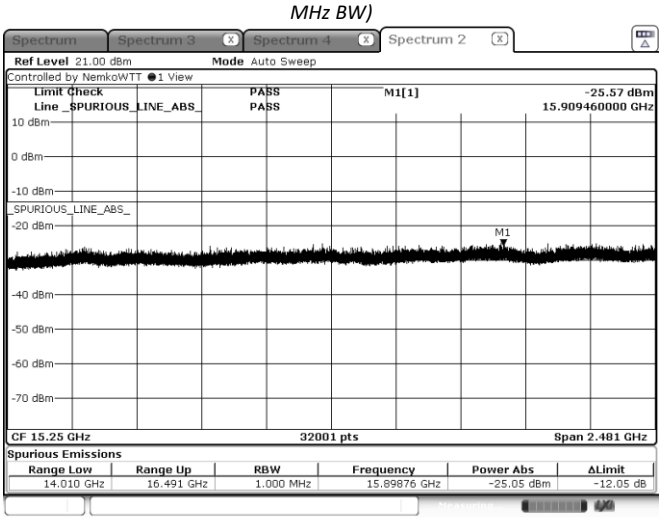

Figure 8.4-7: *Emission mask, beyond ±250% of BW (low frequency range), High channel: 16.55 GHz, longest pulse. (25 MHz BW)*

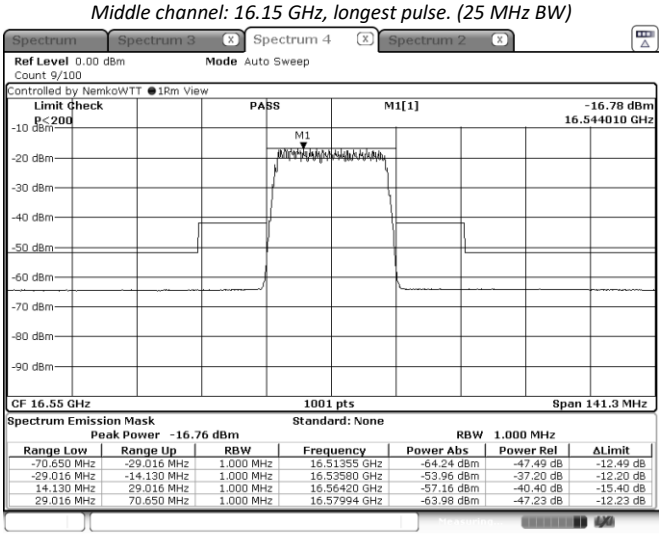

Figure 8.4-8: *Emission mask, High channel: 16.55 GHz, longest pulse. (25 MHz BW)*

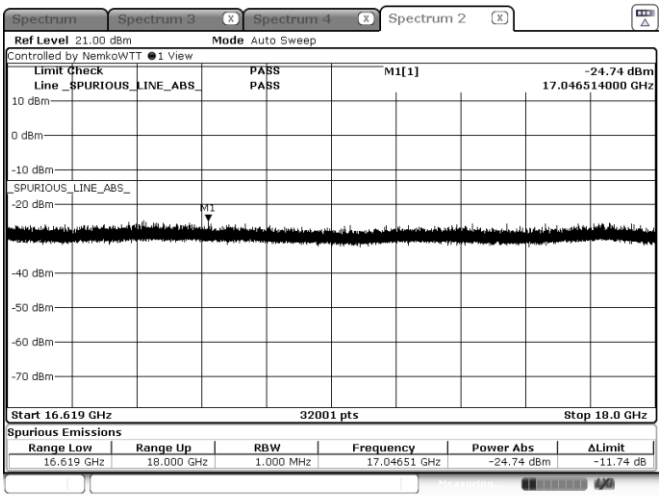

Figure 8.4-9: *Emission mask, beyond ±250% of BW (high frequency range), High channel: 16.55 GHz, longest pulse. (25 MHz BW)*

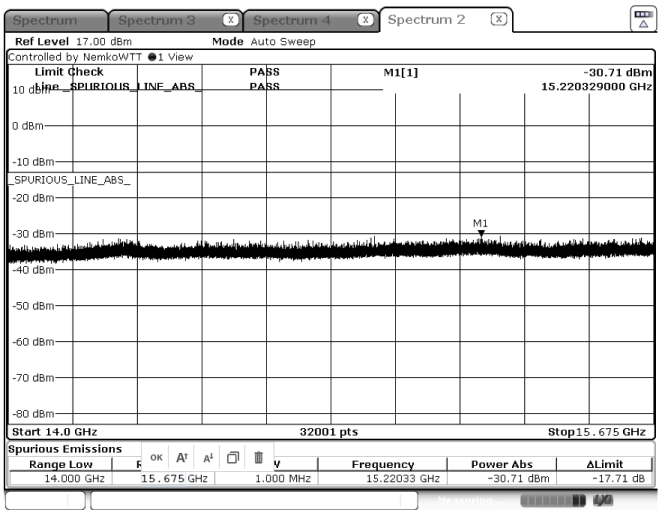

Figure 8.4-10: *Emission mask, beyond ±250% of BW (low frequency range), Low channel: 15.80 GHz, longest pulse. (50 MHz BW)*

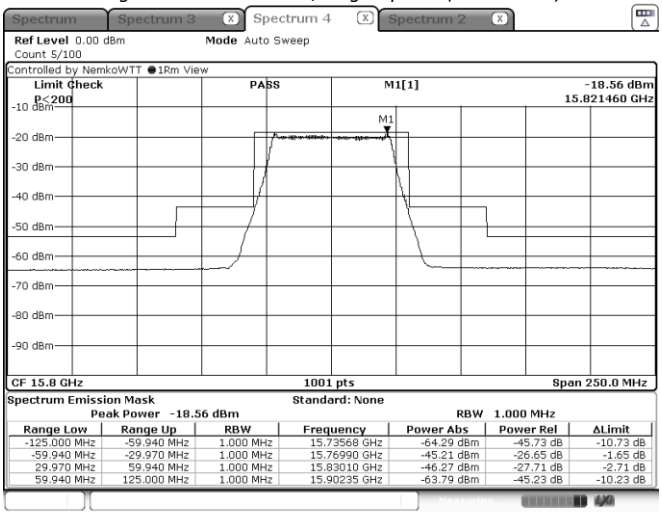

Figure 8.4-11: *Emission mask, Low channel: 15.80 GHz, longest pulse. (50 MHz BW)*

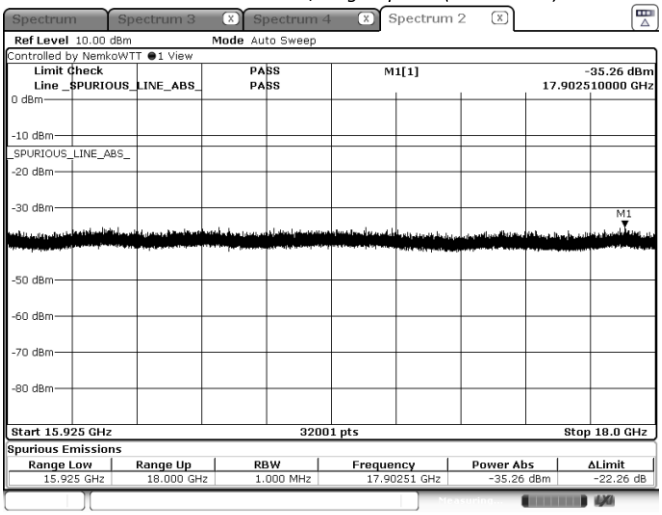

Figure 8.4-12: *Emission mask, beyond ±250% of BW (high frequency range), Low channel: 15.80 GHz, longest pulse. (50 MHz BW)*

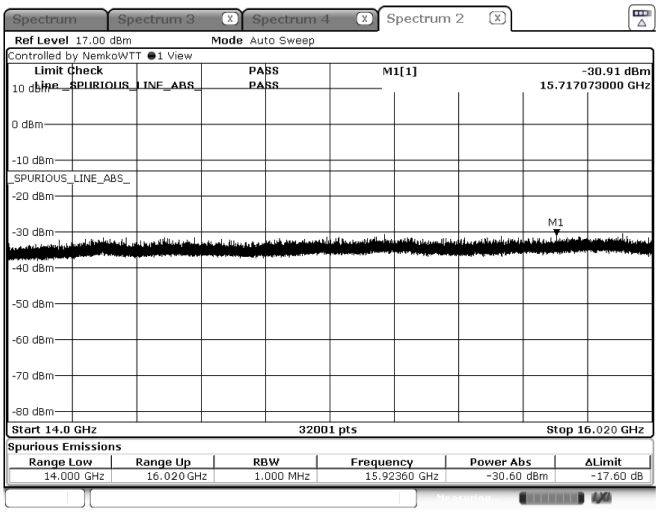

Figure 8.4-13: *Emission mask, beyond ±250% of BW (low frequency range), Middle channel: 16.15 GHz, longest pulse. (50 MHz BW)*

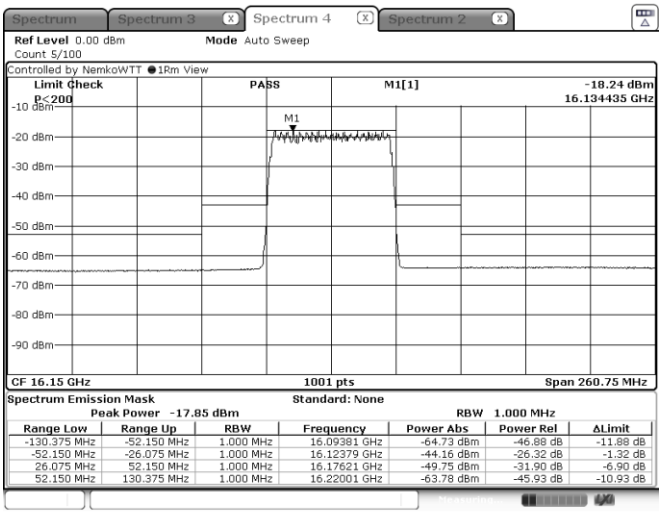

Figure 8.4-14: *Emission mask, Middle channel: 16.15 GHz, longest pulse. (50 MHz BW)*

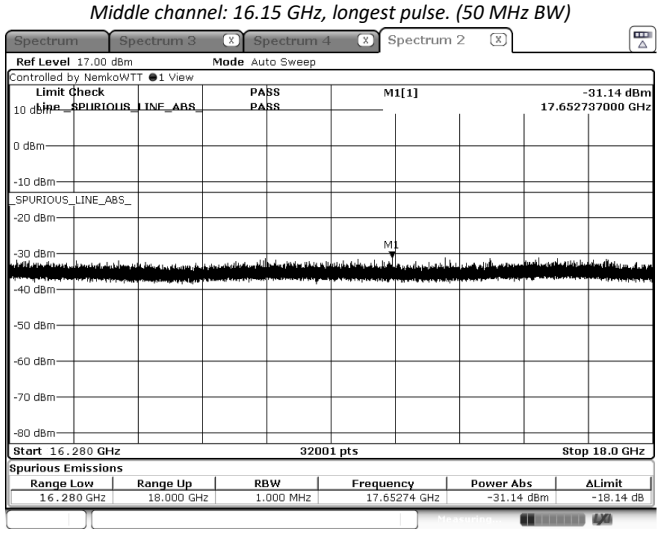

Figure 8.4-15: *Emission mask, beyond ±250% of BW (high frequency range), Middle channel: 16.15 GHz, longest pulse. (50 MHz BW)*

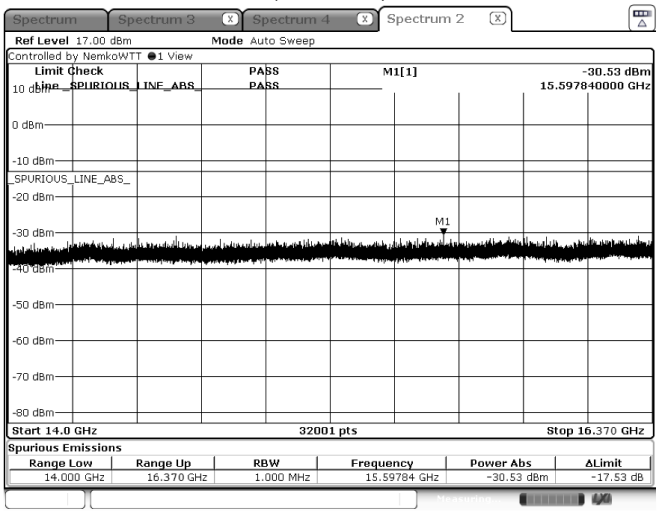

Figure 8.4-16: *Emission mask, beyond ±250% of BW (low frequency range), High channel: 16.50 GHz, longest pulse. (50 MHz BW)*

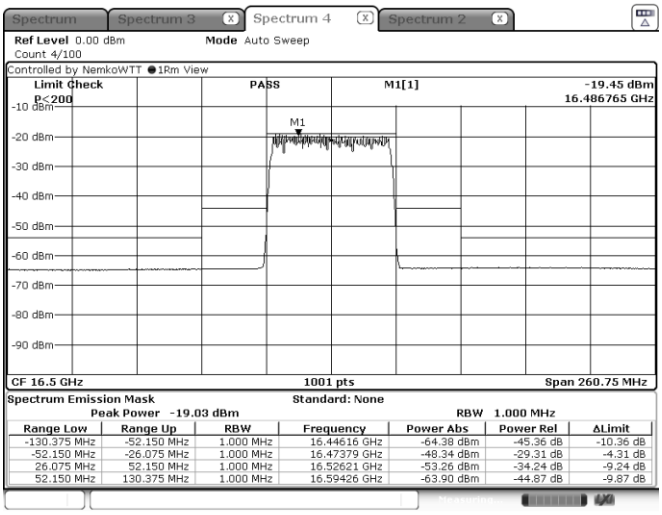

Figure 8.4-17: *Emission mask, High channel: 16.50 GHz, longest pulse. (50 MHz BW)*

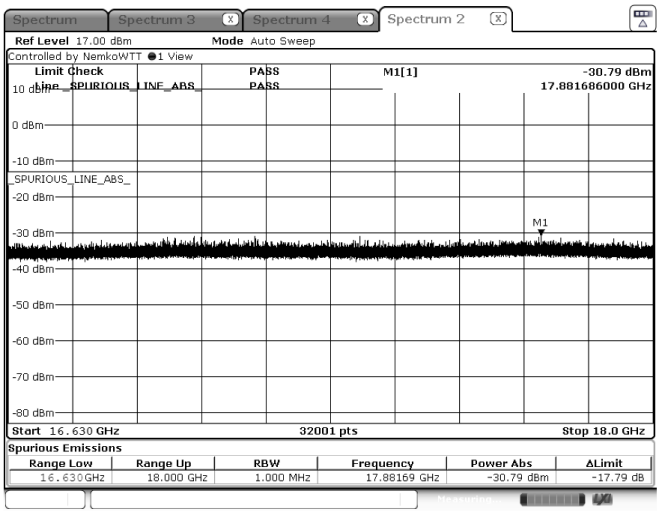

Figure 8.4-18: *Emission mask, beyond ±250% of BW (high frequency range), High channel: 16.50 GHz, longest pulse. (50 MHz BW)*

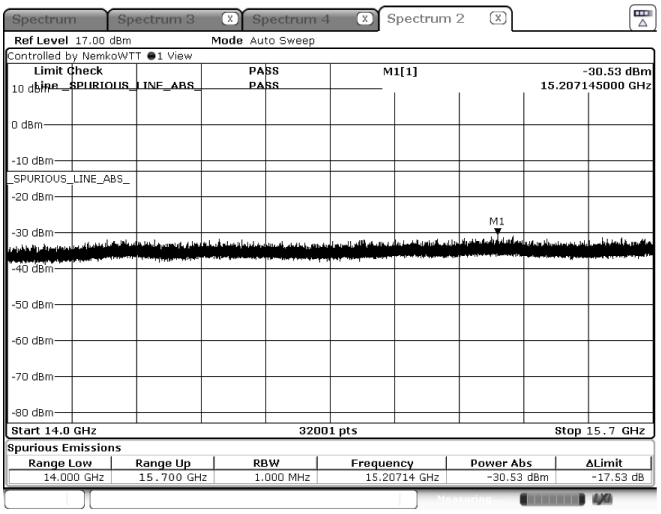

Figure 8.4-19: *Emission mask, beyond ±250% of BW (low frequency range), Low channel: 15.85 GHz, longest pulse. (100 MHz BW)*

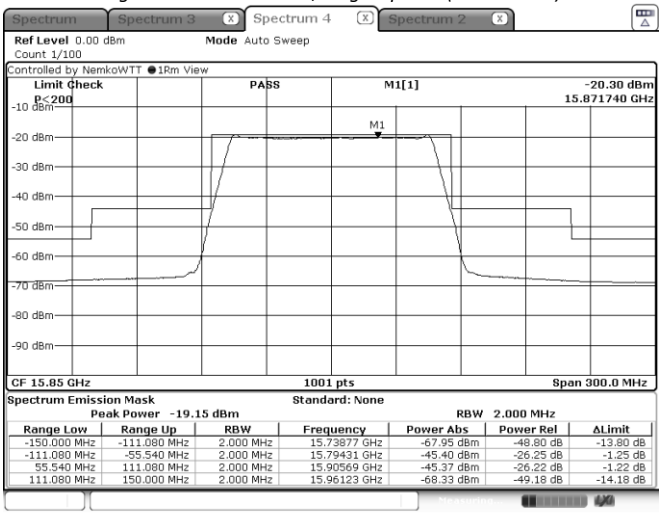

Figure 8.4-20: *Emission mask, Low channel: 15.85 GHz, longest pulse. (100 MHz BW)*

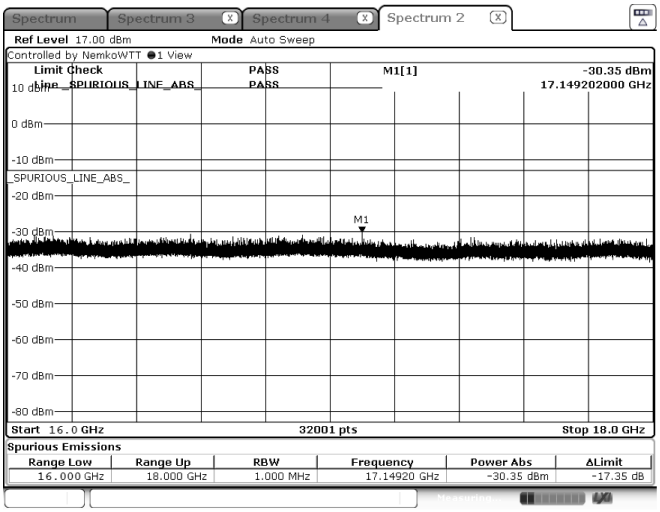

Figure 8.4-21: *Emission mask, beyond ±250% of BW (high frequency range), Low channel: 15.85 GHz, longest pulse. (100 MHz BW)*

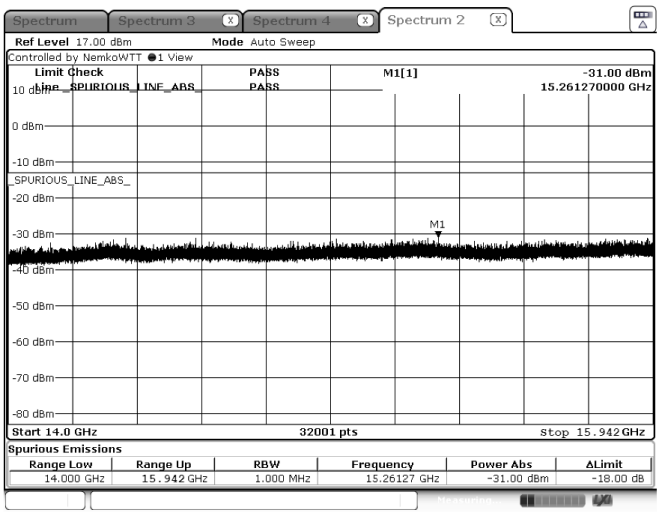

Figure 8.4-22: *Emission mask, beyond ±250% of BW (low frequency range), Middle channel: 16.15 GHz, longest pulse. (100 MHz BW)*

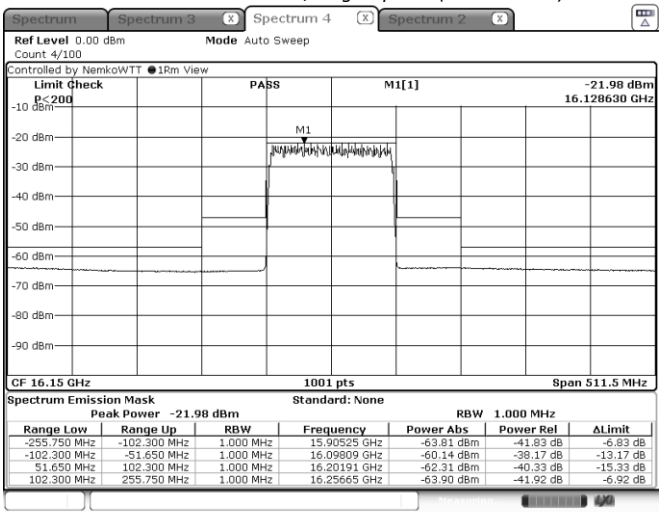

Figure 8.4-23: *Emission mask, Middle channel: 16.15 GHz, longest pulse. (100 MHz BW)*

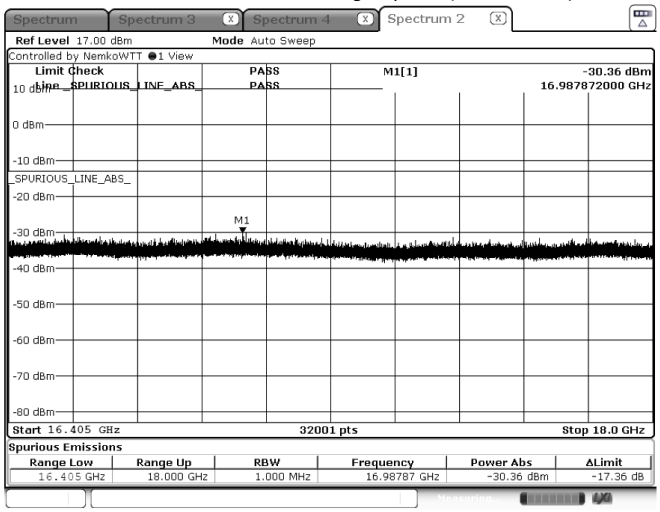

Figure 8.4-24: *Emission mask, beyond ±250% of BW (high frequency range), Middle channel: 16.15 GHz, longest pulse. (100 MHz BW)*

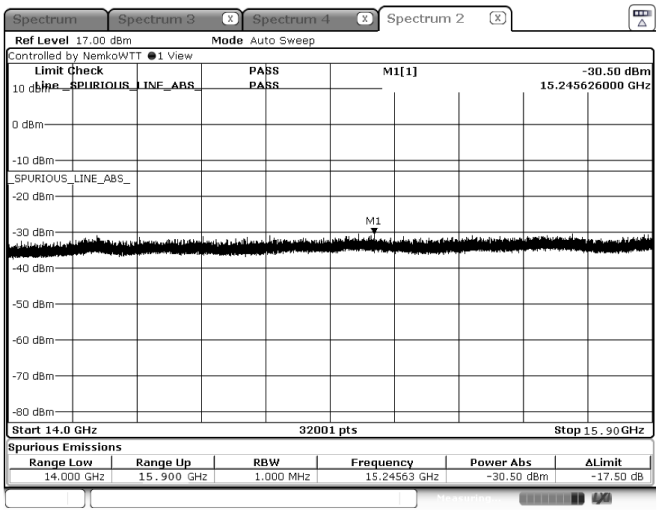

Figure 8.4-25: *Emission mask, beyond ±250% of BW (low frequency range), High channel: 16.45 GHz, longest pulse. (100 MHz BW)*

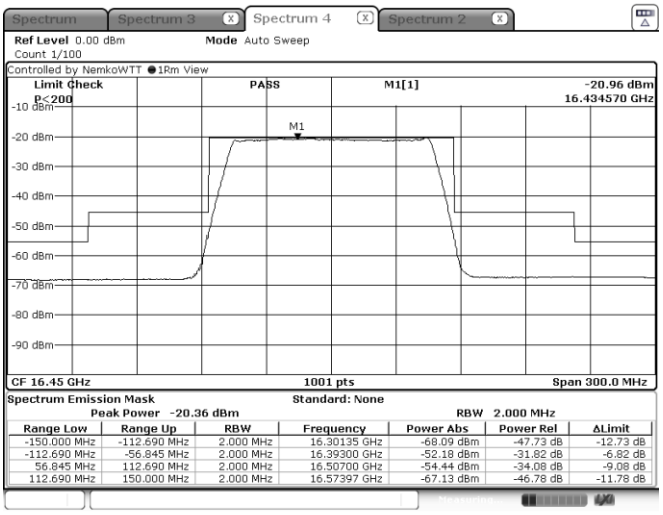

Figure 8.4-26: *Emission mask, High channel: 16.45 GHz, longest pulse. (100 MHz BW)*

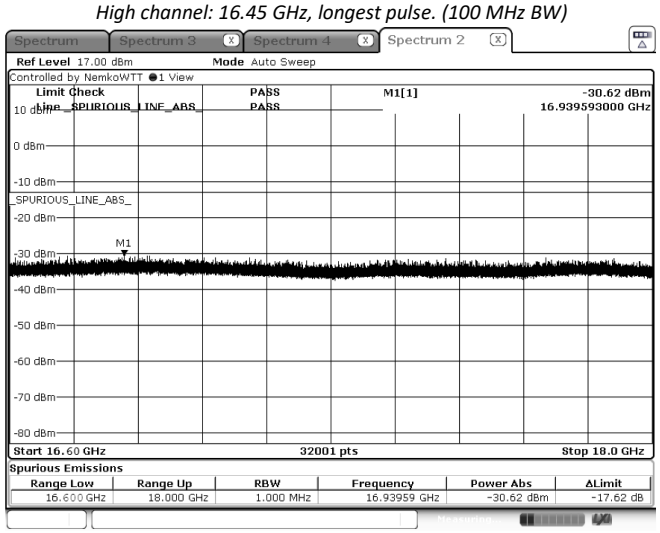

Figure 8.4-27: *Emission mask, beyond ±250% of BW (high frequency range), High channel: 16.45 GHz, longest pulse. (100 MHz BW)*

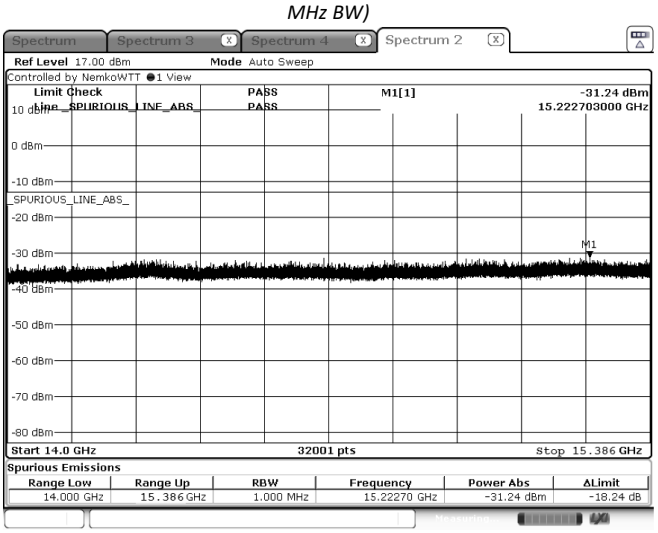

Figure 8.4-28: *Emission mask, beyond ±250% of BW (low frequency range), Low channel: 15.90 GHz, longest pulse. (200 MHz BW)*

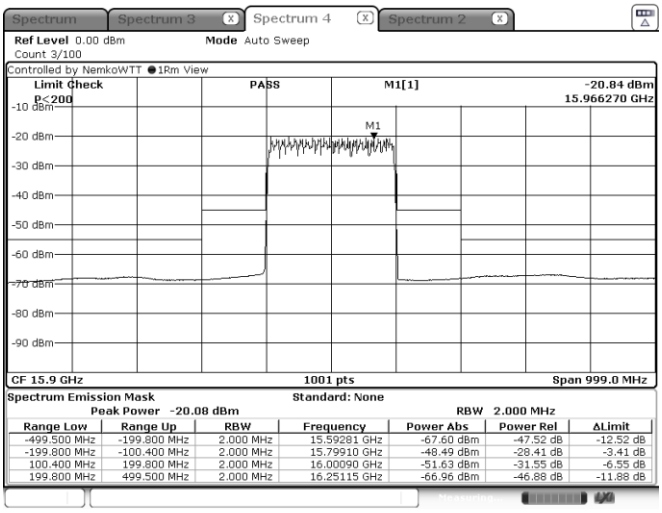

Figure 8.4-29: *Emission mask, Low channel: 15.90 GHz, longest pulse. (200 MHz BW)*

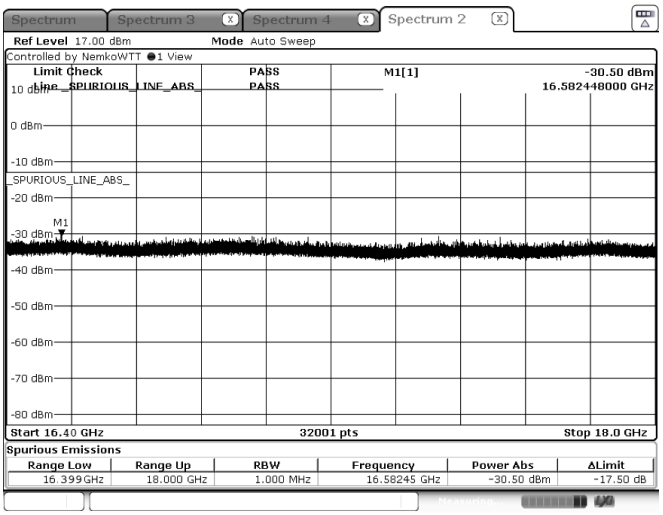

Figure 8.4-30: *Emission mask, beyond ±250% of BW (high frequency range), Low channel: 15.90 GHz, longest pulse. (200 MHz BW)*

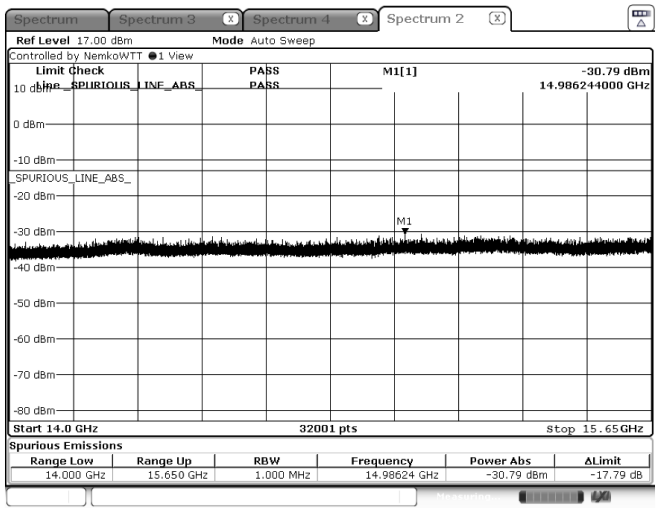

Figure 8.4-31: *Emission mask, beyond ±250% of BW (low frequency range), Middle channel: 16.15 GHz, longest pulse. (200 MHz BW)*

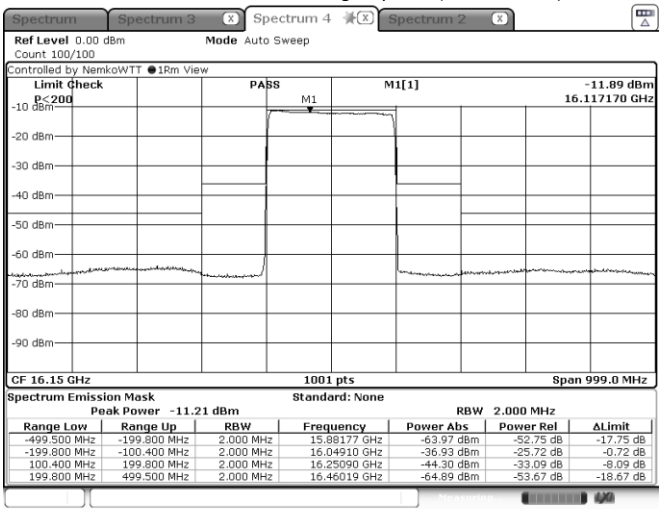

Figure 8.4-32: *Emission mask, Middle channel: 16.15 GHz, longest pulse. (200 MHz BW)*