FCC 47CFR part 2J and part 101C
Test Report
For
Umbra V4

Reference Standard: FCC 47CFR part 2J and part 101C
Manufacturer: Cambridge Communications Systems Ltd
For type of equipment and serial number, refer to section 3
Report Number: 09-7558-1-14 Issue 01
Report Produced by: -

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Certificate of Test 7558-1

The unit noted below has been tested by **R.N. Electronics Limited** and, where appropriate, conforms to the relevant subpart of FCC 47CFR Part 101. This is a certificate of test only and should not be confused with an equipment authorisation. Other standards may also apply.

Equipment:	UMBRA
Model Number:	V4
Proposed FCC ID:	2ACV4-UMBRA28-001
Unique Serial Numbers:	227 (29.1875 GHz unit) 229 (28.2485 GHz unit) 231 (27.6045 GHz unit)
Applicant:	Cambridge Communication Systems Ltd 3rd Floor Mount Pleasant House Huntingdon Road Cambridge CB3 0RN United Kingdom
Full measurement results are detailed in Report Number:	09-7558-1-14 Issue 01
Test Standards:	FCC 47CFR part 2J and part 101C effective date **October 1st 2013,** Class TNB Intentional Radiator

DEVIATIONS: None.

This certificate relates only to the unit tested as identified by a unique serial number and in the condition at the time it was tested. It does not relate to any other similar equipment and performance of the product before or after the test cannot be guaranteed. Whilst every effort is made to assure quality of testing, type tests are not exhaustive and although no non-conformances may be found, this doesn't exclude the possibility of unit not meeting the intentions of the standard or the requirements of the Directive, particularly under different conditions to those during testing. Any compliance statements are made reliant on (a) the application of the product and use of the assigned band being acceptable to the FCC and (b) the modes of operation as instructed to us by the Customer based on their specific knowledge of the application and functionality of the EUT. Statements of compliance, where measurements were made, do not include the measurement uncertainty. The measurement uncertainty, where stated, is the expanded uncertainty based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

Date of Test: 20th August to 2nd September 2014

Test Engineer: Digitally signed by: Daniel Sims DN: CN = Daniel Sims C = GB O = RN Electronics Ltd Date: 2014.10.09 21:23:28 Z

Approved By:
Technical Director

Customer Representative:

1 Contents

2 Equipment Under Test (EUT)

2.1 Equipment Specification

Applicant	Cambridge Communication Systems Ltd 3rd Floor Mount Pleasant House Huntingdon Road Cambridge CB3 0RN United Kingdom
Manufacturer of EUT	Cambridge Communication Systems Ltd
Brand name of EUT	CCS
Model Number of EUT	V4
Serial Numbers of EUT	227 (29.1875 GHz unit) 229 (28.2485 GHz unit) 231 (27.6045 GHz unit)
Date when equipment was received by RN Electronics	20th August 2014
Date of test:	20th August to 2nd September 2014
Visual description of EUT:	Metal Finned enclosure with a plastic environmental cover over the top half. Under the plastic cover is a 16 sector antenna. On the underside of the EUT are two RJ45 Ethernet ports, a mains port and several status LED's.
Main function of the EUT:	28 GHz wireless backhaul
Height	170 mm
Width	202 mm
Depth	202 mm
Weight	4.5 kg
Voltage	90 – 265 V AC @ 50/60 Hz
Current required from above voltage source	0.15 A @ 240 V

2.2 EUT Configurations for testing

General parameters	
EUT Normal use position	Mounted on a lamppost
Choice of model(s) for type tests	3 production samples
Antenna details	Integral 16 sector antenna
Antenna port	WR34 waveguide port
Baseband Data port (yes/no)?	No
Highest Signal generated in EUT	29.1875 GHz
Lowest Signal generated in EUT	25 MHz Clock
TX Parameters	
Alignment range – transmitter	27.5 – 29.5 GHz
EUT Declared Modulation Parameters	QPSK, 16QAM, 64QAM
EUT Declared Power level	+25dBm (QPSK), +21dBm (16QAM), +18dBm (64QAM)
EUT Declared Signal Bandwidths	100 MHz & 112 MHz
EUT Declared Channel Spacing's	100 MHz & 112 MHz
EUT declared Duty Cycle	100% Transmit test modes are available, In normal operation duty cycle is variable depending on capacity

	requirements and network topology
Unmodulated carrier available?	Yes
Declared frequency stability	+/- 1ppm
RX Parameters	
Alignment range – receiver	27.5 – 29.5 GHz
EUT Declared RX Signal Bandwidth	100 MHz & 112 MHz
Fixed Link Parameters	
ATPC used	Yes
RTPC used	Yes RPTC-2 only
RFC used	No
Adaptive mod used	Yes – Node software changes modulation used on a per slot basis, depending on the conditions of the particular link the slot is assigned to

2.3 Functional Description

The product is a 28 GHz self-organising transceiver capable of sustaining simultaneous links with multiple peer nodes to provide wireless backhaul for access equipment such as cellular base stations. The product is designed to be mounted on street furniture such as lampposts, to support dense deployments of small cell base stations.

2.4 EUT Modes

Mode Reference	Description	Used for testing
TX Mode 1	Transmitting at 27.6045GHz with QPSK modulation and channel BW 100MHz at a duty cycle of 65.9%	Yes
TX Mode 2	Transmitting at 27.6045GHz with QAM16 modulation and channel BW 100MHz at a duty cycle of 84.8%	Yes
TX Mode 3	Transmitting at 27.6045GHz with QAM64 modulation and channel BW 100MHz at a duty cycle of 89.7%	Yes
TX Mode 4	Transmitting at 28.2485GHz with QPSK modulation and channel BW 100MHz at a duty cycle of 65.9%	Yes
TX Mode 5	Transmitting at 28.2485GHz with QAM16 modulation and channel BW 100MHz at a duty cycle of 84.8%	Yes
TX Mode 6	Transmitting at 28.2485GHz with QAM64 modulation and channel BW 100MHz at a duty cycle of 89.7%	Yes
TX Mode 7	Transmitting at 27.6045GHz with QPSK modulation and channel BW 112MHz at a duty cycle of 100%	Yes
TX Mode 8	Transmitting at 27.6045GHz with QAM16 modulation and channel BW 112MHz at a duty cycle of 100%	Yes
TX Mode 9	Transmitting at 27.6045GHz with QAM64 modulation and channel BW 112MHz at a duty cycle of 100%	Yes
TX Mode 10	Transmitting at 28.2485GHz with QPSK modulation and channel BW 112MHz at a duty cycle of 100%	Yes
TX Mode 11	Transmitting at 28.2485GHz with QAM16 modulation and channel BW 112MHz at a duty cycle of 100%	Yes
TX Mode 12	Transmitting at 28.2485GHz with QAM64 modulation and channel BW 112MHz at a duty cycle of 100%	Yes
TX Mode 13	Transmitting at 29.1875GHz with QPSK modulation and channel BW 100MHz at a duty cycle of 65.9%	Yes
TX Mode 14	Transmitting at 29.1875GHz with QAM16 modulation and channel BW 100MHz at a duty cycle of 84.8%	Yes
TX Mode 15	Transmitting at 29.1875GHz with QAM64 modulation and channel BW 100MHz at a duty cycle of 89.7%	Yes
TX Mode 16	Transmitting at 29.1875GHz with QPSK modulation and channel BW 112MHz at a duty cycle of 100%	Yes
TX Mode 17	Transmitting at 29.1875GHz with QAM16 modulation and channel BW 112MHz at a duty cycle of 100%	Yes
TX Mode 18	Transmitting at 29.1875GHz with QAM64 modulation and channel BW 112MHz at a duty cycle of 100%	Yes
TX Mode 19	Transmitting at 27.6045GHz a CW tone 100% Duty	Yes

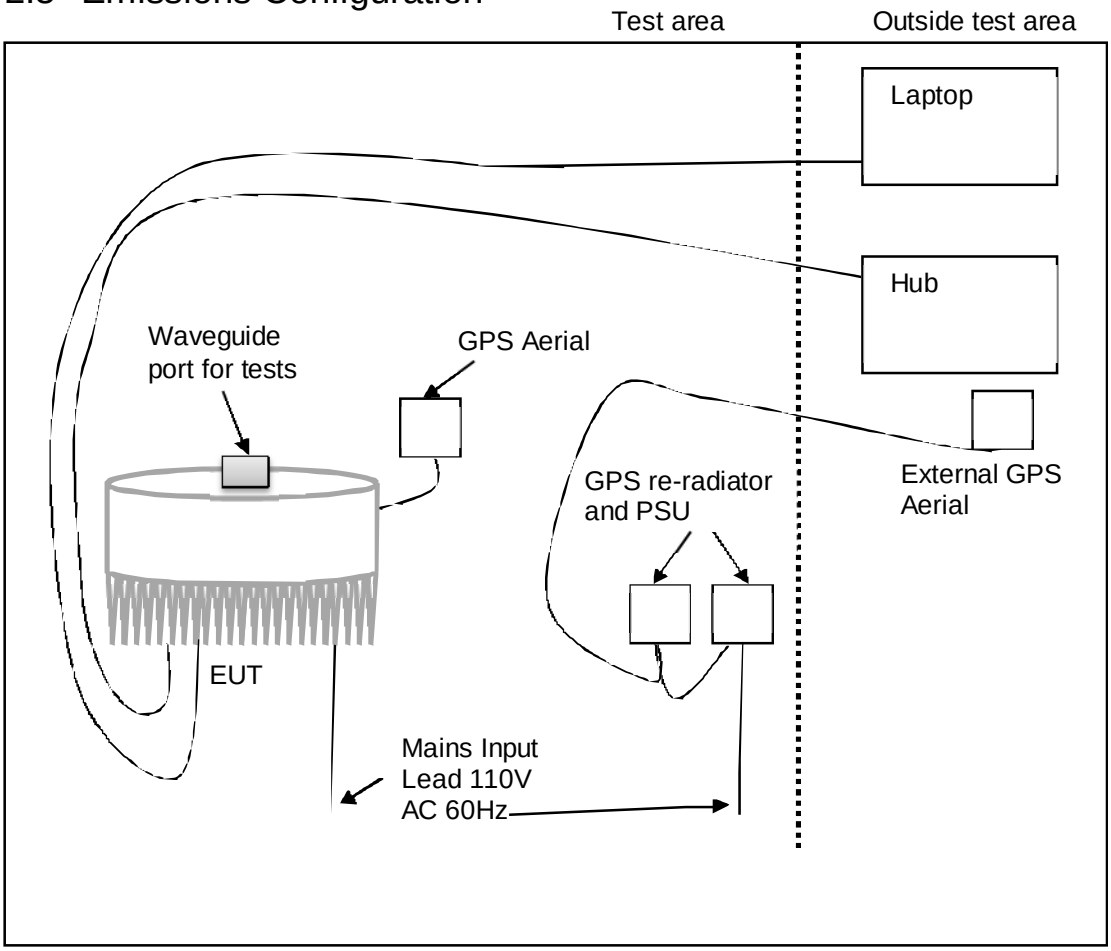
TX Mode 20	Transmitting at 28.2485GHz a CW tone 100% Duty	Yes
TX Mode 21	Transmitting at 29.1875GHz a CW tone 100% Duty	Yes

Description of ancillary equipment connected to the equipment under test, for the purpose of tests, can be found in Section 11.

Any modifications made to the EUT, whilst under test, can be found in Section 12.

This report was printed on: 09 October 2014

2.5 Emissions Configuration



The unit was powered using the supplied mains lead. All conducted tests were performed at the waveguide port with the antenna array removed. For radiated emissions tests the antenna array was also removed and a transition with a 20dB attenuator plus load were fitted to the transition. The unit also required a GPS lock, in order to operate, and has a GPS antenna located on the top of the antenna array. However as the testing was performed at the waveguide port, the GPS antenna board was situated on the unit next to the waveguide port. To obtain a GPS lock signal for the EUT's GPS antenna a 2nd external GPS antenna connected to an internal GPS re-radiator antenna located within close proximity to the unit was used. In order to pass the GPS signal into the EUT without the antenna array in place, the GPS antenna RF lead was soldered directly to the riser PCB board which was then plugged into the port next to the waveguide port/mount. The unit was set-up and controlled from a laptop connected to its Ethernet port by using a terminal window and SSH to communicate with the EUT via its IP address. Special GUI software control was provided by CCS Ltd to access and set-up the EUT channel frequency, power level and modulation scheme. However, only the 112MHz signal bandwidth setting was supported by this engineering software interface. For tests associated with the 100MHz signal bandwidth setting, the EUT had to be sent direct SSH commands from the terminal window. The direct commands also allowed setting of power and modulation scheme. For all tests performed using the 112MHz bandwidth setting the EUT TX duty cycle was 100%. For all tests using the 100MHz bandwidth setting, the following EUT duty cycles were measured and accounted for in applicable tests:

QPSK 65.9%
16QAM 84.8%
64QAM 89.7%

Refer to section 2.4 of this report for further information on modes of test.

Three units were provided for test covering the bands 27.500 – 28.350 GHz (s/n 229 & 231) and 29.100 – 29.250 GHz (s/n 227).

As automatic power control was inhibited for all tests within this report, a power calibration was made by a Cambridge Communications System Ltd representative for all modulation schemes and for all 3 nodes before full tests commenced. These resulted in the following power setting values, set within the nodes before each test:

Node s/n 227:

QPSK = +19
16QAM = +22
64QAM = +28

Node s/n 229:

QPSK = +19
16QAM = +23
64QAM = +28

Node s/n 231:

QPSK = +20
16QAM = +24
64QAM = +30

The EUT mains lead and Ethernet leads came supplied with Wurth ferrite 742 711 31 fitted which were left in place for Field strength spurious emissions tests.

3 Summary of test results

The **Umbra V4** was tested to the following standards: -

FCC 47CFR part 2J and part 101C (effective date October 1st, 2013);
Class TNB Intentional Radiator

Any compliance statements are made reliant on the modes of operation as instructed to us by the Manufacturer based on their specific knowledge of the application and functionality of the equipment tested. Whilst every effort is made to assure quality of testing, type tests are not exhaustive and although no non-conformances may be found, this doesn't exclude the possibility of equipment not meeting the intentions of the standard, particularly under different conditions to those during testing.

Title	Reference	Results
1. RF Power Output	FCC 47CFR part 2.1046 & part 101.113	PASSED
2. Spurious emissions at antenna terminals	FCC 47CFR part 2.1051 & part 101.111	PASSED[1]
3. Field strength of spurious radiations	FCC 47CFR part 2.1053 & part 101.111	PASSED
4. Modulation characteristics	FCC 47CFR part 2.1047 & part 101.111	PASSED
5. Occupied bandwidth	FCC 47CFR part 2.1049 & part 101.109	PASSED
6. Frequency stability	FCC 47CFR part 2.1055 & part 101.107	PASSED

[1] Spectrum investigated started at a frequency of 17GHz due to the EUT's WR34 waveguide port low frequency cut off being 17.3GHz. Please see section 7 calculations / explanations for further justification.

4 Specifications

4.1 Relevant Standards

The tests were performed by an RN Electronics Engineer who set up the tests, the test equipment, and operated it in accordance with the ***R.N. Electronics Ltd*** procedures manual and the basic standards listed below.

R.N. Electronics Ltd sites M and OATS are listed with the FCC. Registration Number 293246

Reference	Standard Number	Year	Description
4.1.1	47CFR part 101, subpart C	2013	Part 101 – Fixed Microwave Services
4.1.2	47CFR part 2, subpart J	2013	Part 2 – Frequency Allocations and radio treaty matters; General rules and regulations Subpart J – Equipment authorisation procedures
4.1.3	ITU.Rec SM.329	12/09/2012	Unwanted emissions in the spurious domain
4.1.4	TIA-603-C	2004	*Land Mobile FM or PM Communications Equipment Measurement and Performance Standards*, Telecommunications Industry Association, November, 2002.
4.1.5	971168 D01 v02r01	2013	Measurement Guidance for Certification of Licensed Digital Transmitters
4.1.6	ANSI C63.4	2009	American National Standard for Methods of Measurement of Radio- Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

4.2 Deviations

None.

4.3 Tests at Extremes of Temperature & Voltage

The following test conditions were used to simulate testing at nominal or extremes.

Temperature Test Conditions		Voltage Test Conditions	
T amb	20 °C	V nom	110V AC
T cold	-30 °C	V min	90V AC
T hot	50 °C	V max	265V AC

Extremes of voltage are based on manufacturers declaration of 90-265V AC rather than +/- 15% of nominal 110V AC as worst case. Extremes of temperature are based upon specification requirement. The ambient test conditions of humidity and pressure in the laboratory were as follows: 18-20 %; 101-102 kPa.

☐ A permanent internal RF port was used for testing.
☐ A test fixture was used for testing.
☐ A temporary RF port was created for testing.
☒ The equipment internal waveguide port was used for testing.

4.4 Measurement Uncertainties

Parameter	Uncertainty
Transmitter Tests	
RF frequency	<± 0.7 ppm
Conducted RF power	<± 1.0 dB
Occupied bandwidth	± 1.9 %
Radiated RF power	± 3.5 dB
Radiated spurious emissions	30MHz - 1000MHz ±5.1dB 1 – 18 GHz ±3.5dB 18 – 26.5 GHz ±3.9dB 26.5 – 60 GHz ±3.9dB 60 – 110 GHz ±4.4dB
Conducted spurious emissions	30MHz – 26.5 GHz ±2.8dB 26.5 – 60 GHz ±3.1dB 60 – 110 GHz ±3.2dB

5 Tests, Methods and Results

5.1 Field strength of spurious radiation

5.1.1 Test Methods

Test Requirements:	FCC Part 2.1053, Subpart J FCC Part 101.111
Test Method:	TIA-603-C KDB 971168

5.1.2 Configuration of EUT

The EUT was tested in an ALSE and ambient conditions were monitored. The EUT was examined in its declared normal use position. All test modes specified in section 2.4 were initially checked; QPSK modulation scheme using both 100MHz and 112MHz bandwidth settings were found to be worst case for emissions and, therefore, the EUT was operated in TX Mode 1, TX Mode 4, TX Mode 7, TX Mode 10, TX Mode 13 and TX Mode 16 modes for this test.

5.1.3 Test Procedure

Tests were made in accordance with the Test Method noted above using the measuring equipment noted in the 'Test Equipment' Section at Site M. Peak field strength from the EUT was maximised by rotating it 360 degrees. An RMS detector was used for final measurements.

25MHz - 1GHz.
The measuring antenna was scanned 1 - 4m in both Horizontal and Vertical polarisations. Substitution method was performed using tuned dipoles and a calibrated bi-conical antenna. Measurement distance of 3metres was used.
1GHz – 100GHz.
The measuring antenna was used in both Horizontal and Vertical polarisations. Substitution method was performed using standard gain horn antennas. Measurement distances used were: 1 – 6 GHz at 3metres, 6 – 18 GHz at 1.2metres, 18 – 40 GHz at 0.3metres, & 40 – 100 GHz at 0.1metres

5.1.4 Test Equipment used

E007-2, E131, E136, E268, E410, E411, E412, TMS78, TMS79, TMS814, TMS82, TMS933, E331, E580, E503, E579, E204, E404, E296, E329, E455, E433, E498

See Section 10 for more details

5.1.5 Test results

Ambient conditions.
Temperature: 18-22°C Relative humidity: 40-53% Pressure: 100-102kPa

No spurious emissions found within 20dB of limits for any of the channel frequencies, in combination with channel bandwidths & modulation schemes.

LIMITS:
Part 101.111, -13dBm

These results show that the EUT has **PASSED** this test.

5.2 Spurious emissions at antenna terminals

5.2.1 Test Methods

Test Requirements:	FCC Part 2.1051, Subpart J FCC Part 101.111
Test Method:	TIA-603-C ITU-R.Rec SM.329 KDB 971168

5.2.2 Configuration of EUT

The EUT was operated on a test bench. Measurements were made at the waveguide port. All test modes specified in section 2.4 were initially checked; QPSK modulation scheme using 100MHz bandwidth setting was found to be worst case for emissions and, therefore, the EUT was operated in TX Mode 1, TX Mode 4 and TX Mode 13 modes for this test.

5.2.3 Test Procedure

Tests were made in accordance with the Test Method noted above using the measuring equipment noted in the 'Test Equipment' Section at Site A. A complete scan of emissions from 17GHz up to 100GHz was made, to identify any signals within 20dB of the limits. 17GHz start frequency was used as the EUT's WR34 waveguide ports lowest cut-off frequency is stated as 17.3GHz Any identified spurious signals were measured in the required bandwidths using an RMS detector. Emissions limitations of part 101C for conducted spectrum mask requirements are also included within this section.

5.2.4 Test Equipment

E290, E397, E412, E433, E381, E329, E561, E521, E490, E486, E485-2, E489, E577, E487, E550, E455, E456, E296, E498

See Section 10 for more details

5.2.5 Test Results

Ambient conditions.
Temperature: 20-25 °C Relative humidity: 40-57 % Pressure: 100-102 kPa

Radio Parameters 1

Band	27.5-28.35 GHz
Power level	25 dBm
Channel spacing	100 MHz
Mod scheme	QPSK
Low channel	27.6045 GHz

Results relating to Radio Parameters 1

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
No spurious emissions found within 20dB of limits		

Plot reference table relating to Radio Parameters 1

Plot Reference
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 17 - 18GHz
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 18 - 22GHz
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 22 - 26GHz

J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 26 - 26.5GHz
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 26.5 - 30GHz
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 30 - 34GHz
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 34 - 38GHz
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 38 - 40GHz
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 40 - 44GHz
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 44 - 48GHz
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 48 - 52GHz
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 52 - 56GHz
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 56 - 60GHz
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 60 - 64GHz
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 64 - 68GHz
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 68 - 72GHz
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 72 - 75GHz
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 75 - 79GHz
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 79 - 83GHz
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 83 - 87GHz
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 87 - 91GHz
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 91 - 95GHz
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 95 - 99GHz
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 99 - 100GHz

Radio Parameters 2

Band	27.5-28.35 GHz
Power level	25 dBm
Channel spacing	100 MHz
Mod scheme	QPSK
Top channel	28.2485 GHz

Results relating to Radio Parameters 2

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
27744.3	-22.4	-9.4
29215.5	-21.0	-8.0

Plot reference table relating to Radio Parameters 2

Plot Reference
J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 17 - 18GHz
J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 18 - 22GHz
J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 22 - 26GHz
J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 26 - 26.5GHz
J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 26.5 - 30GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 30 - 34GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 34 - 38GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 38 - 40GHz
J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 40 - 44GHz
J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 44 - 48GHz
J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 48 - 52GHz
J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 52 - 56GHz
J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 56 - 60GHz
J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 60 - 64GHz
J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 64 - 68GHz
J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 68 - 72GHz
J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 72 - 75GHz
J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 75 - 79GHz
J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 79 - 83GHz
J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 83 - 87GHz

J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 87 - 91GHz
J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 91 - 95GHz
J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 95 - 99GHz
J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 99 - 100GHz

Radio Parameters 3

Band	29.1-29.25 GHz
Power level	25 dBm
Channel spacing	100 MHz
Mod scheme	QPSK
Low channel	29.1875 GHz

Results relating to Radio Parameters 3

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
27675.5	-26.7	-13.7
28144.2	-24.3	-11.3

Plot reference table relating to Radio Parameters 3

Plot Reference
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 17 - 18GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 18 - 22GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 22 - 26GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 26 - 26.5GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 26.5 - 30GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 30 - 34GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 34 - 38GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 38 - 40GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 40 - 44GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 44 - 48GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 48 - 52GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 52 - 56GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 56 - 60GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 60 - 64GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 64 - 68GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 68 - 72GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 72 - 75GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 75 - 79GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 79 - 83GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 83 - 87GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 87 - 91GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 91 - 95GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 95 - 99GHz
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 99 - 100GHz

Note: For additional emissions limitations at the band edge/spectrum mask, plots for all combinations of modulation schemes, channel bandwidths and Low and high channel frequencies have been shown. Please see 5.2.5.1.

LIMITS:
Part 101.111, -13dBm.

The plots referred to in the above table may be found in section 6.1 Graphical Results

These results show that the EUT has **PASSED** this test.

5.2.5.1 Band edge / spectrum mask emissions limitations

Radio Parameter 1

Band	27.5-28.35 GHz
Power level	25 dBm
Channel spacing	100 MHz
Mod scheme	QPSK
Low channel	27.6045 GHz
Top channel	28.2485 GHz

Results relating to Radio Parameters 1

	Lower band edge	Upper band edge
Plot reference	J7558-1 Band Edge Chan 27.6045GHz BW100MHz QPSK	J7558-1 Band Edge Chan 28.2485GHz BW100MHz QPSK

Radio Parameter 2

Band	29.1-29.25 GHz
Power level	25 dBm
Channel spacing	100 MHz
Mod scheme	QPSK
Low channel	29.1875 GHz

Results relating to Radio Parameters 2

	Lower band edge	Upper band edge
Plot reference	J7558-1 Low Band Edge Chan 29.1875GHz BW100MHz QPSK	J7558-1 High Band Edge Chan 29.1875GHz BW100MHz QPSK

Radio Parameter 3

Band	27.5-28.35 GHz
Power level	25 dBm
Channel spacing	100 MHz
Mod scheme	16 QAM
Low channel	27.6045 GHz
Top channel	28.2485 GHz

Results relating to Radio Parameters 3

	Lower band edge	Upper band edge
Plot reference	J7558-1 Band Edge Chan 27.6045GHz BW100MHz QAM16	J7558-1 Band Edge Chan 28.2485GHz BW100MHz QAM16

Radio Parameter 4

Band	29.1-29.25 GHz
Power level	25 dBm
Channel spacing	100 MHz
Mod scheme	16 QAM
Low channel	29.1875 GHz

Results relating to Radio Parameters 4

	Lower band edge	Upper band edge
Plot reference	J7558-1 Low Band Edge Chan 29.1875GHz BW100MHz QAM16	J7558-1 High Band Edge Chan 29.1875GHz BW100MHz QAM16

Radio Parameter 5

Band	27.5-28.35 GHz
Power level	25 dBm
Channel spacing	100 MHz
Mod scheme	64 QAM
Low channel	27.6045 GHz
Top channel	28.2485 GHz

Results relating to Radio Parameters 5

	Lower band edge	Upper band edge
Plot reference	J7558-1 Band Edge Chan 27.6045GHz BW100MHz QAM64	J7558-1 Band Edge Chan 28.2485GHz BW100MHz QAM64

Radio Parameter 6

Band	29.1-29.25 GHz
Power level	25 dBm
Channel spacing	100 MHz
Mod scheme	64 QAM
Low channel	29.1875 GHz

Results relating to Radio Parameters 6

	Lower band edge	Upper band edge
Plot reference	J7558-1 Low Band Edge Chan 29.1875GHz BW100MHz QAM64	J7558-1 High Band Edge Chan 29.1875GHz BW100MHz QAM64

Radio Parameter 7

Band	27.5-28.35 GHz
Power level	25 dBm
Channel spacing	112 MHz
Mod scheme	QPSK
Low channel	27.6045 GHz
Top channel	28.2485 GHz

Results relating to Radio Parameters 7

	Lower band edge	Upper band edge
Plot reference	J7558-1 Band Edge Chan 27.6045GHz BW112MHz QPSK	J7558-1 Band Edge Chan 28.2485GHz BW112MHz QPSK

Radio Parameter 8

Band	29.1-29.25 GHz
Power level	25 dBm
Channel spacing	112 MHz
Mod scheme	QPSK
Low channel	29.1875 GHz

Results relating to Radio Parameters 8

	Lower band edge	Upper band edge
Plot reference	J7558-1 Low Band Edge Chan 29.1875GHz BW112MHz QPSK	J7558-1 High Band Edge Chan 29.1875GHz BW112MHz QPSK

Radio Parameter 9

Band	27.5-28.35 GHz
Power level	25 dBm
Channel spacing	112 MHz
Mod scheme	16 QAM
Low channel	27.6045 GHz
Top channel	28.2485 GHz

Results relating to Radio Parameters 9

	Lower band edge	Upper band edge
Plot reference	J7558-1 Band Edge Chan 27.6045GHz BW112MHz QAM16	J7558-1 Band Edge Chan 28.2485GHz BW112MHz QAM16

Radio Parameter 10

Band	29.1-29.25 GHz
Power level	25 dBm
Channel spacing	112 MHz
Mod scheme	16 QAM
Low channel	29.1875 GHz

Results relating to Radio Parameters 10

	Lower band edge	Upper band edge
Plot reference	J7558-1 Low Band Edge Chan 29.1875GHz BW112MHz QAM16	J7558-1 High Band Edge Chan 29.1875GHz BW112MHz QAM16

Radio Parameter 11

Band	27.5-28.35 GHz
Power level	25 dBm
Channel spacing	112 MHz
Mod scheme	64 QAM
Low channel	27.6045 GHz
Top channel	28.2485 GHz

Results relating to Radio Parameters 11

	Lower band edge	Upper band edge
Plot reference	J7558-1 Band Edge Chan 27.6045GHz BW112MHz QAM64	J7558-1 Band Edge Chan 28.2485GHz BW112MHz QAM64

Radio Parameter 12

Band	29.1-29.25 GHz
Power level	25 dBm
Channel spacing	112 MHz
Mod scheme	64 QAM
Low channel	29.1875 GHz

Results relating to Radio Parameters 12

	Lower band edge	Upper band edge
Plot reference	J7558-1 Low Band Edge Chan 29.1875GHz BW112MHz QAM64	J7558-1 High Band Edge Chan 29.1875GHz BW112MHz QAM64

LIMITS:
Part 101.111, mask calculation to (a)(2)(ii).

These results show that the EUT has **PASSED** this test.

The plots referred to in the above table may be found in section 6.3 Graphical Results

5.3 Modulation Characteristics

5.3.1 Test Methods

Test Requirements:	FCC Part 2.1047, Subpart J FCC Part 101.109
Test Method:	TIA-603-C KDB 971168

5.3.2 Configuration of EUT

The EUT was operated on a test bench. Measurements were made at the waveguide port. All test modes specified in section 2.4 were tested.

5.3.3 Test Procedure

Tests were performed using Test Site **A**.
Tests were made in accordance with the Test Method noted above using the measuring equipment noted in the 'Test Equipment' Section. A 2.4MHz RBW, 8MHz VBW, auto sweep time and max hold settings were used to show the modulation characteristics. All modulation schemes / rates in combination with channel bandwidths and Low, Middle, High channel frequencies were assessed and plotted. (See section 2.4 for modes details).

5.3.4 Test Equipment used

E412, E301, E490, E486, E485-2, E433, E397, E290

See Section 10 for more details.

5.3.5 Test results

Ambient conditions.
Temperature: 20-25 °C Relative humidity: 40-57 % Pressure: 100-102 kPa

Analyser plots showing modulation characteristics can be found in Section 6.4 of this report.

LIMITS:

Part 101.109: 150 MHz (band 29.1 – 29.25 GHz)
850 MHz (band 27.5 – 28.35 GHz)

These results show that the EUT has **PASSED** this test.

5.4 Occupied bandwidth

5.4.1 Test Methods

Test Requirements:	FCC Part 2.1049, Subpart J FCC Part 101.109
Test Method:	TIA-603-C KDB 971168

5.4.2 Configuration of EUT

The EUT was tested on a bench. The EUT was operated in all modes listed in section 2.4.

5.4.3 Test Procedure

Tests were performed using Test Site A.
Tests were made in accordance with the Test Method noted above using the measuring equipment noted in the 'Test Equipment' Section. A 2.4MHz RBW, 8MHz VBW, auto sweep time and max hold settings were used for the 99% bandwidth.
The EUT was set to each Bandwidth/mod scheme in turn (see section 2.4) and 99% bandwidth recorded.

5.4.4 Test Equipment used

E412, E301, E490, E486, E485-2, E433, E397, E290

See Section 10 for more details.

5.4.5 Test results

Ambient conditions.
Temperature: 21 °C Relative humidity: 40 % Pressure: 101.7 kPa

Analyser plots for the 99% bandwidth can be found in Section 6.3 of this report.

Radio Parameter 1

Band	27.5-28.35 GHz
Power level	25 dBm
Channel spacing	100 MHz
Mod scheme	QPSK
Low channel	27.6045 GHz
Top channel	28.2485 GHz

Results relating to Radio Parameters 1

	Low	High
99% BW (MHz)	95.92	96.56
Plot reference	7558-1 OBW Chan 27.6045GHz BW100MHz QPSK	7558-1 OBW Chan 28.2485GHz BW100MHz QPSK

Radio Parameter 2

Band	29.1-29.25 GHz
Power level	25 dBm
Channel spacing	100 MHz
Mod scheme	QPSK
Low channel	29.1875 GHz

Results relating to Radio Parameters 2

	Low
99% BW (MHz)	96.4
Plot reference	7558-1 OBW Chan 29.1875GHz BW100MHz QPSK

Radio Parameter 3

Band	27.5-28.35 GHz
Power level	25 dBm
Channel spacing	100 MHz
Mod scheme	16 QAM
Low channel	27.6045 GHz
Top channel	28.2485 GHz

Results relating to Radio Parameters 3

	Low	High
99% BW (MHz)	92.51	91.93
Plot reference	7558-1 OBW Chan 27.6045GHz BW100MHz QAM16	7558-1 OBW Chan 28.2485GHz BW100MHz QAM16

Radio Parameter 4

Band	29.1-29.25 GHz
Power level	25 dBm
Channel spacing	100 MHz
Mod scheme	16 QAM
Low channel	29.1875 GHz

Results relating to Radio Parameters 4

	Low
99% BW (MHz)	91.89
Plot reference	7558-1 OBW Chan 29.1875GHz BW100MHz QAM16

Radio Parameter 5

Band	27.5-28.35 GHz
Power level	25 dBm
Channel spacing	100 MHz
Mod scheme	64 QAM
Low channel	27.6045 GHz
Top channel	28.2485 GHz

Results relating to Radio Parameters 5

	Low	High
99% BW (MHz)	92.73	92.14
Plot reference	7558-1 OBW Chan 27.6045GHz BW100MHz QAM64	7558-1 OBW Chan 28.2485GHz BW100MHz QAM64

Radio Parameter 6

Band	29.1-29.25 GHz
Power level	25 dBm
Channel spacing	100 MHz
Mod scheme	64 QAM
Low channel	29.1875 GHz

Results relating to Radio Parameters 6

	Low
99% BW (MHz)	92.12
Plot reference	7558-1 OBW Chan 29.1875GHz BW100MHz QAM64

Radio Parameter 7

Band	27.5-28.35 GHz
Power level	25 dBm
Channel spacing	112 MHz
Mod scheme	QPSK
Low channel	27.6045 GHz
Top channel	28.2485 GHz

Results relating to Radio Parameters 7

	Low	High
99% BW (MHz)	105.44	103.82
Plot reference	7558-1 OBW Chan 27.6045GHz BW112MHz QPSK	7558-1 OBW Chan 28.2485GHz BW112MHz QPSK

Radio Parameter 8

Band	29.1-29.25 GHz
Power level	25 dBm
Channel spacing	112 MHz
Mod scheme	QPSK
Low channel	29.1875 GHz

Results relating to Radio Parameters 8

	Low
99% BW (MHz)	104.45
Plot reference	7558-1 OBW Chan 29.1875GHz BW112MHz QPSK

Radio Parameter 9

Band	27.5-28.35 GHz
Power level	25 dBm
Channel spacing	112 MHz
Mod scheme	16 QAM
Low channel	27.6045 GHz
Top channel	28.2485 GHz

Results relating to Radio Parameters 9

	Low	High
99% BW (MHz)	101.11	101.1
Plot reference	7558-1 OBW Chan 27.6045GHz BW112MHz QAM16	7558-1 OBW Chan 28.2485GHz BW112MHz QAM16

Radio Parameter 10

Band	29.1-29.25 GHz
Power level	25 dBm
Channel spacing	112 MHz
Mod scheme	16 QAM
Low channel	29.1875 GHz

Results relating to Radio Parameters 10

	Low
99% BW (MHz)	101
Plot reference	7558-1 OBW Chan 29.1875GHz BW112MHz QAM16

Radio Parameter 11

Band	27.5-28.35 GHz
Power level	25 dBm
Channel spacing	112 MHz
Mod scheme	64 QAM
Low channel	27.6045 GHz
Top channel	28.2485 GHz

Results relating to Radio Parameters 11

	Low	High
99% BW (MHz)	100.52	100.84
Plot reference	7558-1 OBW Chan 27.6045GHz BW112MHz QAM64	7558-1 OBW Chan 28.2485GHz BW112MHz QAM64

Radio Parameter 12

Band	29.1-29.25 GHz
Power level	25 dBm
Channel spacing	112 MHz
Mod scheme	64 QAM
Low channel	29.1875 GHz

Results relating to Radio Parameters 12

	Low
99% BW (MHz)	101.04
Plot reference	7558-1 OBW Chan 29.1875GHz BW112MHz QAM64

LIMITS:

Part 101.109: 150 MHz (band 29.1 – 29.25 GHz)
850 MHz (band 27.5 – 28.35 GHz)

The plots referred to in the above table may be found in section 6.2 Graphical Results

These results show that the EUT has **PASSED** this test.

5.5 RF power output

5.5.1 Test Methods

Test Requirements: FCC Part 2.1046, Subpart J
FCC Part 101.113

Test Method: TIA-603-C
KDB 971168

5.5.2 Configuration of EUT

The EUT was measured on a bench using a power meter connected to the waveguide port.

The EUT was operated in all modes listed in section 2.4. covering all Bandwidths, modulation schemes and channel settings.

5.5.3 Test Procedure

Tests were made in accordance with the Test Method noted above using the measuring equipment noted in the 'Test Equipment' Section.
Power meter reading stated is maximum power observed using an average power head. For test modes not utilising 100% duty cycle, a duty cycle correction was performed on the result using the following equation: 10.Log(100/x) where x is the duty cycle in percent, this was performed in the power meter and confirmed by calculation.

Measurements were made on a test bench in site A.

5.5.4 Test Equipment used

E290, E397, E412, E486, E490, E485-2, E433, E301

See Section 10 for more details

5.5.5 Test results

Ambient conditions.
Temperature: 20-22 °C Relative humidity: 34-40 % Pressure: 102 kPa

Radio Parameter 1

Band	27.5-28.35 GHz
Power level	25 dBm
Channel spacing	100 MHz
Mod scheme	QPSK
Low channel	27.6045 GHz
Top channel	28.2485 GHz

Results relating to Radio Parameters 1

Test conditions		**Carrier Power (dBm)**	
		Low	**High**
Temp Ambient	**Volts Nominal**	24.14	23.64
Maximum TX Power observed (dBm)		24.14	
Variation in TX power observed (dB)		-0.86 / -1.36	

Radio Parameter 2

Band	29.1-29.25 GHz
Power level	25 dBm
Channel spacing	100 MHz
Mod scheme	QPSK
Low channel	29.1875 GHz

Results relating to Radio Parameters 2

Test conditions		**Carrier Power (dBm)**
		Low
Temp Ambient	**Volts Nominal**	25.29
Maximum TX Power observed (dBm)		25.29
Variation in TX power observed (dB)		0.29

Radio Parameter 3

Band	27.5-28.35 GHz
Power level	21 dBm
Channel spacing	100 MHz
Mod scheme	16 QAM
Low channel	27.6045 GHz
Top channel	28.2485 GHz

Results relating to Radio Parameters 3

Test conditions		**Carrier Power (dBm)**	
		Low	**High**
Temp Ambient	**Volts Nominal**	21.09	20.79
Maximum TX Power observed (dBm)		21.09	
Variation in TX power observed (dB)		0.09 / -0.21	

Radio Parameter 4

Band	29.1-29.25 GHz
Power level	21 dBm
Channel spacing	100 MHz
Mod scheme	16 QAM
Low channel	29.1875 GHz

Results relating to Radio Parameters 4

Test conditions		**Carrier Power (dBm)**
		Low
Temp Ambient	**Volts Nominal**	21.58
Maximum TX Power observed (dBm)		21.58
Variation in TX power observed (dB)		0.58

Radio Parameter 5

Band	27.5-28.35 GHz
Power level	18 dBm
Channel spacing	100 MHz
Mod scheme	64 QAM
Low channel	27.6045 GHz
Top channel	28.2485 GHz

Results relating to Radio Parameters 5

Test conditions		Carrier Power (dBm)	
		Low	High
Temp Ambient	Volts Nominal	17.91	17.46
Maximum TX Power observed (dBm)		17.91	
Variation in TX power observed (dB)		-0.09 / -0.54	

Radio Parameter 6

Band	29.1-29.25 GHz
Power level	18 dBm
Channel spacing	100 MHz
Mod scheme	64 QAM
Low channel	29.1875 GHz

Results relating to Radio Parameters 6

Test conditions		Carrier Power (dBm)
		Low
Temp Ambient	Volts Nominal	19.15
Maximum TX Power observed (dBm)		19.15
Variation in TX power observed (dB)		0.15

Radio Parameter 7

Band	27.5-28.35 GHz
Power level	25 dBm
Channel spacing	112 MHz
Mod scheme	QPSK
Low channel	27.6045 GHz
Top channel	28.2485 GHz

Results relating to Radio Parameters 7

Test conditions		Carrier Power (dBm)	
		Low	High
Temp Ambient	Volts Nominal	24.00	23.82
Maximum TX Power observed (dBm)		24.00	
Variation in TX power observed (dB)		-1 / -1.18	

Radio Parameter 8

Band	29.1-29.25 GHz
Power level	25 dBm
Channel spacing	112 MHz
Mod scheme	QPSK
Low channel	29.1875 GHz

Results relating to Radio Parameters 8

Test conditions		Carrier Power (dBm)
		Low
Temp Ambient	Volts Nominal	24.99
Maximum TX Power observed (dBm)		24.99
Variation in TX power observed (dB)		-0.01

Radio Parameter 9

Band	27.5-28.35 GHz
Power level	21 dBm
Channel spacing	112 MHz
Mod scheme	16 QAM
Low channel	27.6045 GHz
Top channel	28.2485 GHz

Results relating to Radio Parameters 9

Test conditions		**Carrier Power (dBm)**	
		Low	**High**
Temp Ambient	**Volts Nominal**	20.92	21.18
Maximum TX Power observed (dBm)		21.18	
Variation in TX power observed (dB)		0.18 / -0.08	

Radio Parameter 10

Band	29.1-29.25 GHz
Power level	21 dBm
Channel spacing	112 MHz
Mod scheme	16 QAM
Low channel	29.1875 GHz

Results relating to Radio Parameters 10

Test conditions		**Carrier Power (dBm)**
		Low
Temp Ambient	**Volts Nominal**	21.10
Maximum TX Power observed (dBm)		21.10
Variation in TX power observed (dB)		0.10

Radio Parameter 11

Band	27.5-28.35 GHz
Power level	18 dBm
Channel spacing	112 MHz
Mod scheme	64 QAM
Low channel	27.6045 GHz
Top channel	28.2485 GHz

Results relating to Radio Parameters 11

Test conditions		**Carrier Power (dBm)**	
		Low	High
Temp Ambient	**Volts Nominal**	18.10	18.17
Maximum TX Power observed (dBm)		18.17	
Variation in TX power observed (dB)		0.17 / 0.1	

Radio Parameter 12

Band	29.1-29.25 GHz
Power level	18 dBm
Channel spacing	112 MHz
Mod scheme	64 QAM
Low channel	29.1875 GHz

Results relating to Radio Parameters 12

Test conditions		**Carrier Power (dBm)**
		Low
Temp Ambient	**Volts Nominal**	18.47
Maximum TX Power observed (dBm)		18.47
Variation in TX power observed (dB)		0.47

LIMITS:

Part 101.113, +55dBW.

These results show that the EUT has **PASSED** this test.

5.6 Frequency stability

5.6.1 Test Methods

Test Requirements: FCC Part 2.1055, Subpart J
FCC Part 101.107

Test Method: TIA-603-C
KDB 971168

5.6.2 Configuration of EUT

The EUT was placed in a temperature controlled chamber. The EUT emissions were observed by means of a test fixture. The EUT was operated in TX Mode 19, TX Mode 20 and TX Mode 21 modes for this test.

5.6.3 Test Procedure

Tests were made in accordance with the Test Method noted above using the measuring equipment noted in the 'Test Equipment' Section.

Temperature stability was achieved at each test level before taking measurements.
The measurement was performed on a CW signal.
Tests were performed using Test Site **A.**

5.6.4 Test Equipment used

C016, L264, TMS10, TMS38, TMS80, E301, LPE377, E555, S036

See Section 10 for more details

5.6.5 Test results

Ambient conditions.
Temperature: 20 °C Relative humidity: 42 % Pressure: 100.7 kPa

Radio Parameter 1

Band	27.5-28.35 GHz
Power level	25 dBm
Channel spacing	N/A
Mod scheme	CW Tone
Low channel	27.6045 GHz
Top channel	28.2485 GHz

Results relating to Radio Parameters 1

Temp (°C)	Voltage (V)	Low channel (MHz)	High channel (MHz)
-30	**110**	27604.499540	28248.499650
-20	**110**	27604.499710	28248.499690
-10	**110**	27604.499560	28248.499630
0	**110**	27604.499650	28248.499680
10	**110**	27604.499670	28248.499630
20	**90**	27604.499740	28248.499730
20	**110**	27604.499640	28248.499740
20	**265**	27604.499880	28248.499750
30	**110**	27604.499900	28248.499820
40	**110**	27604.499990	28248.500300
50	**110**	27604.500140	28248.500540
Max Frequency Error per chan (Hz)		+140 / -460	+540 / -370
Max Frequency Error observed (%)		+/- 0.000002	

Radio Parameter 2

Band	29.1-29.25 GHz
Power level	25 dBm
Channel spacing	N/A
Mod scheme	CW Tone
Low channel	29.1875 GHz

Results relating to Radio Parameters 2

Temp (°C)	Voltage (V)	Low channel (MHz)
-30	**110**	29187.499760
-20	**110**	29187.499780
-10	**110**	29187.499820
0	**110**	29187.499940
10	**110**	29187.500050
20	**90**	29187.500210
20	**110**	29187.500220
20	**265**	29187.500200
30	**110**	29187.500250
40	**110**	29187.500290
50	**110**	29187.500600
Max Frequency Error per chan (Hz)		+600 / -240
Max Frequency Error observed (%)		+/- 0.000002

LIMITS: Part 101.107, +/-0.001%

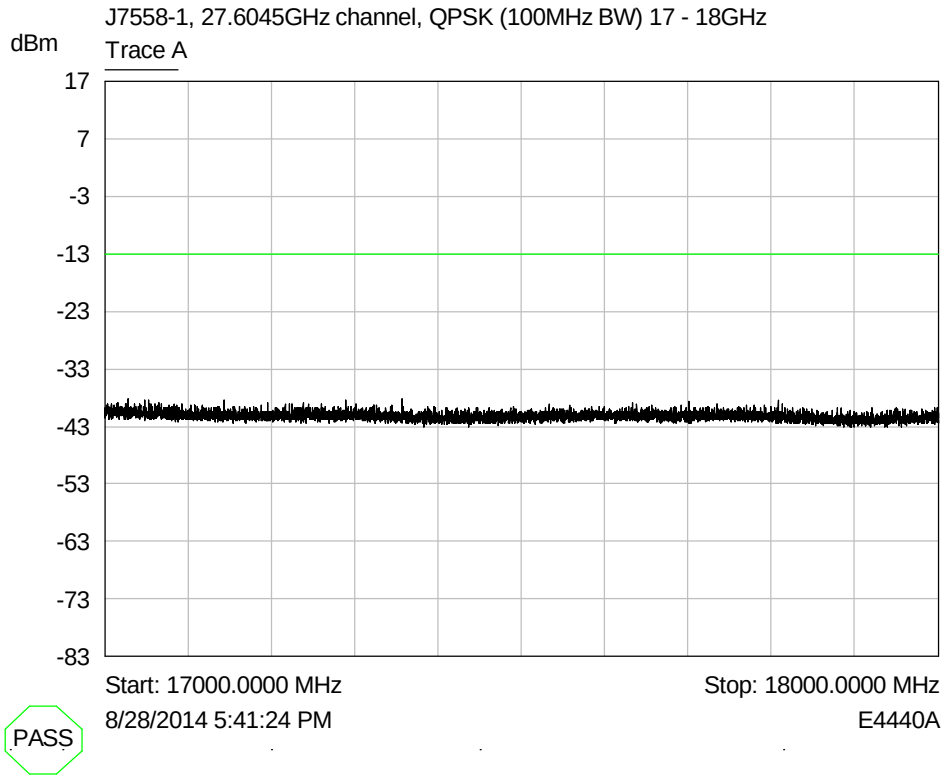
These results show that the **EUT** has **PASSED** this test.

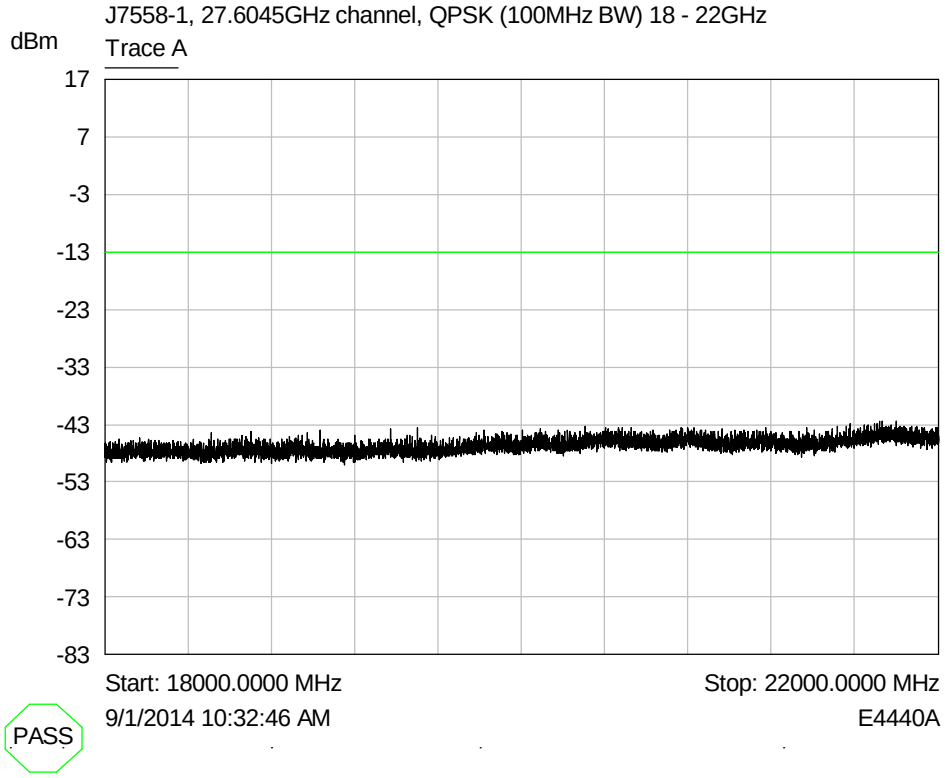
6 Plots and Results

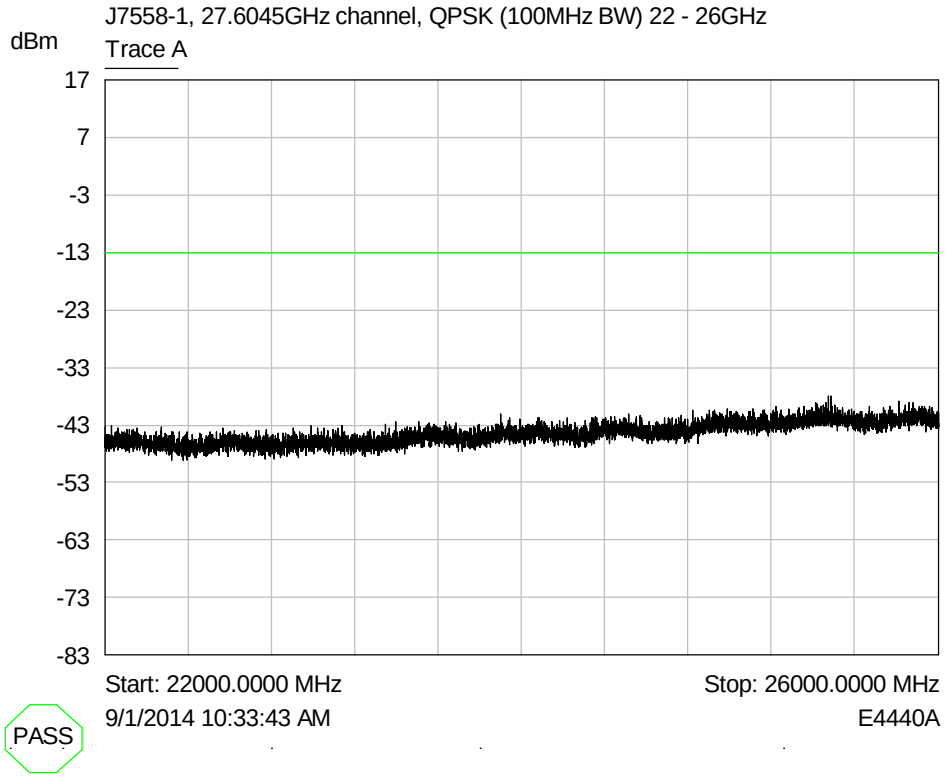
6.1 Antenna port Conducted emissions plots

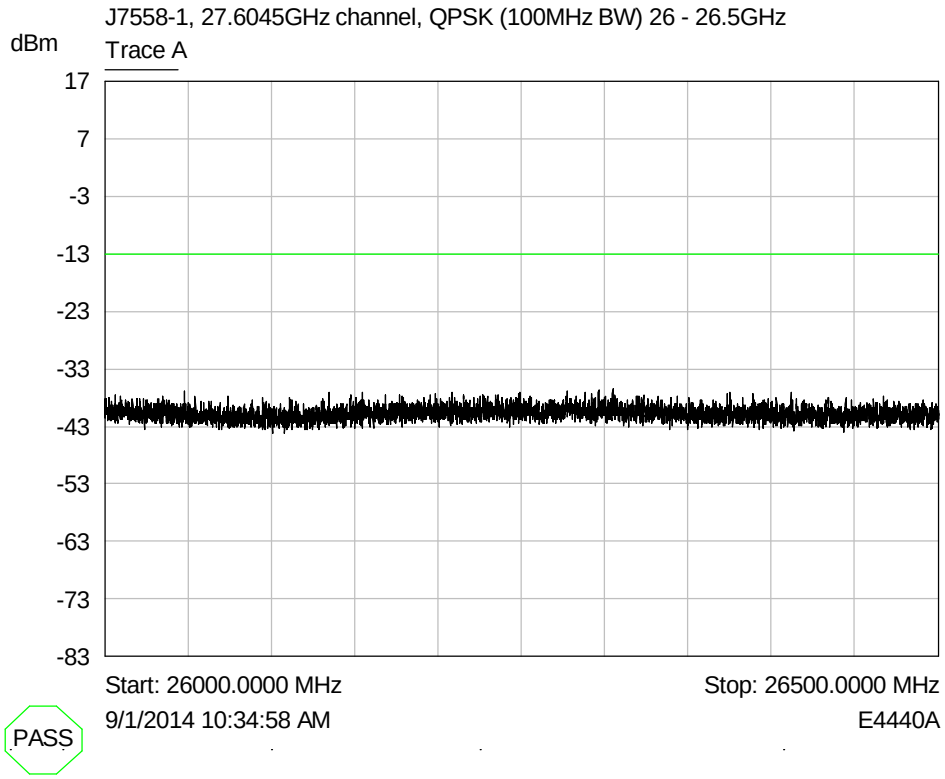
6.1.1 Plots for Band 27.5-28.35 GHz, Power 25 dBm, Spacing 100 MHz, and Modulation QPSK

27.6045 GHz channel.

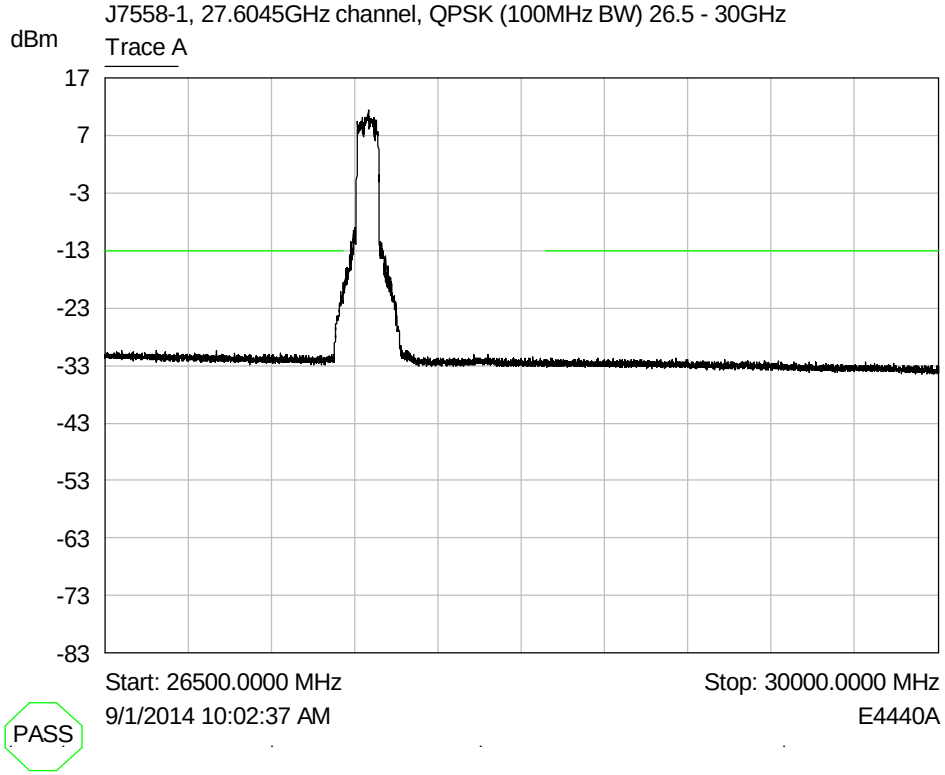




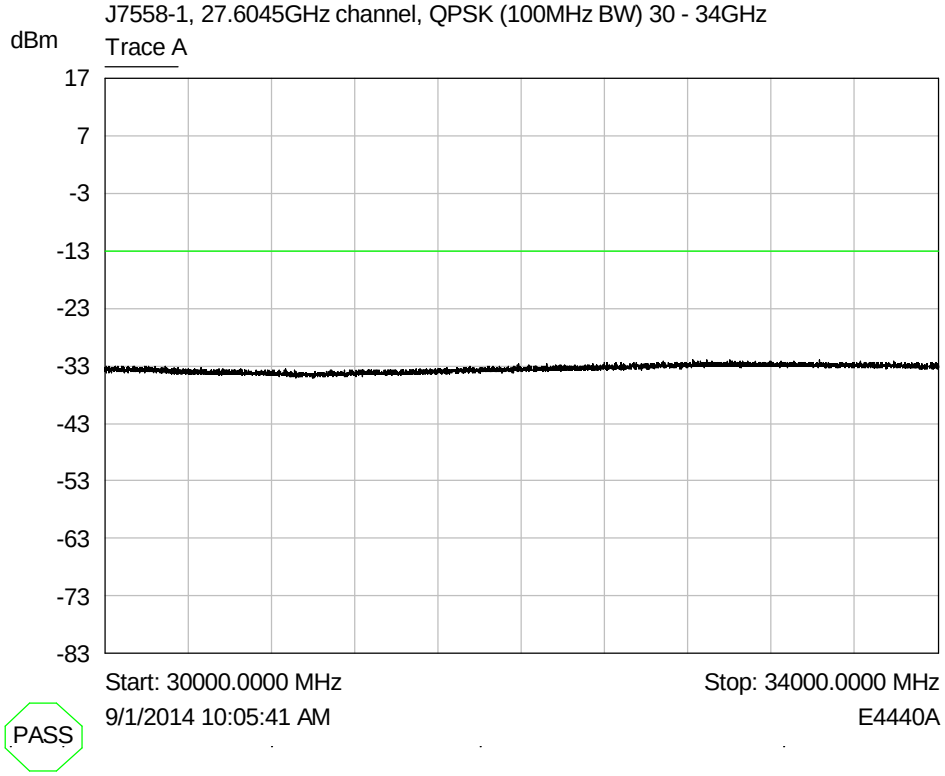

J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 22 - 26GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 22000.0000 MHz
Stop: 26000.0000 MHz
9/1/2014 10:33:43 AM
E4440A
PASS


J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 26 - 26.5GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 26000.0000 MHz
Stop: 26500.0000 MHz
9/1/2014 10:34:58 AM
E4440A
PASS

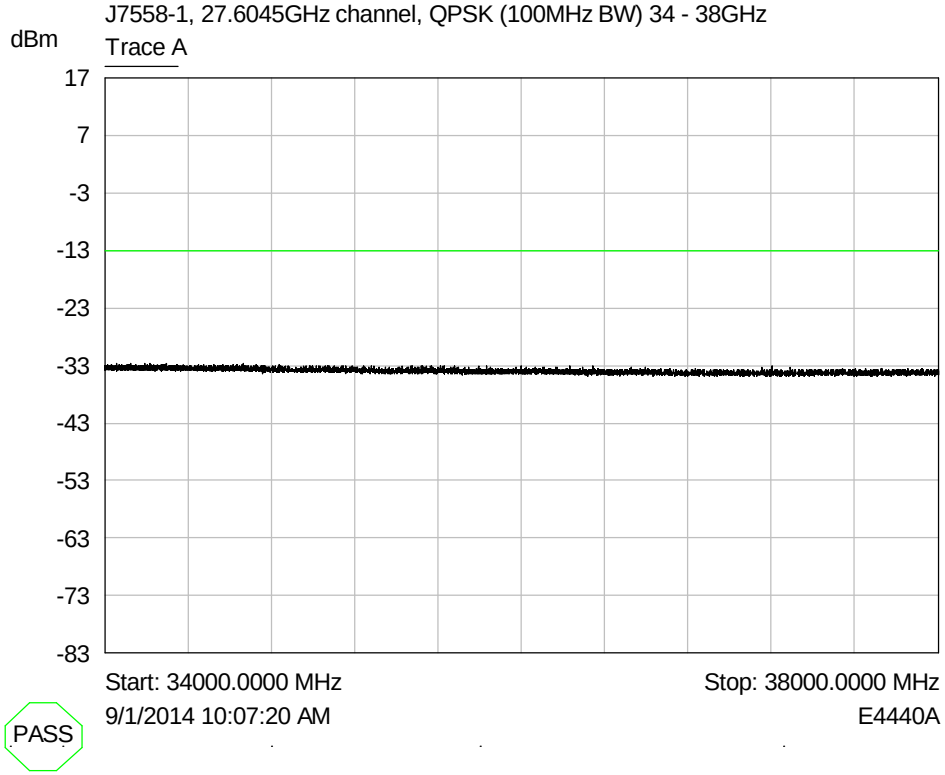
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 26.5 - 30GHz



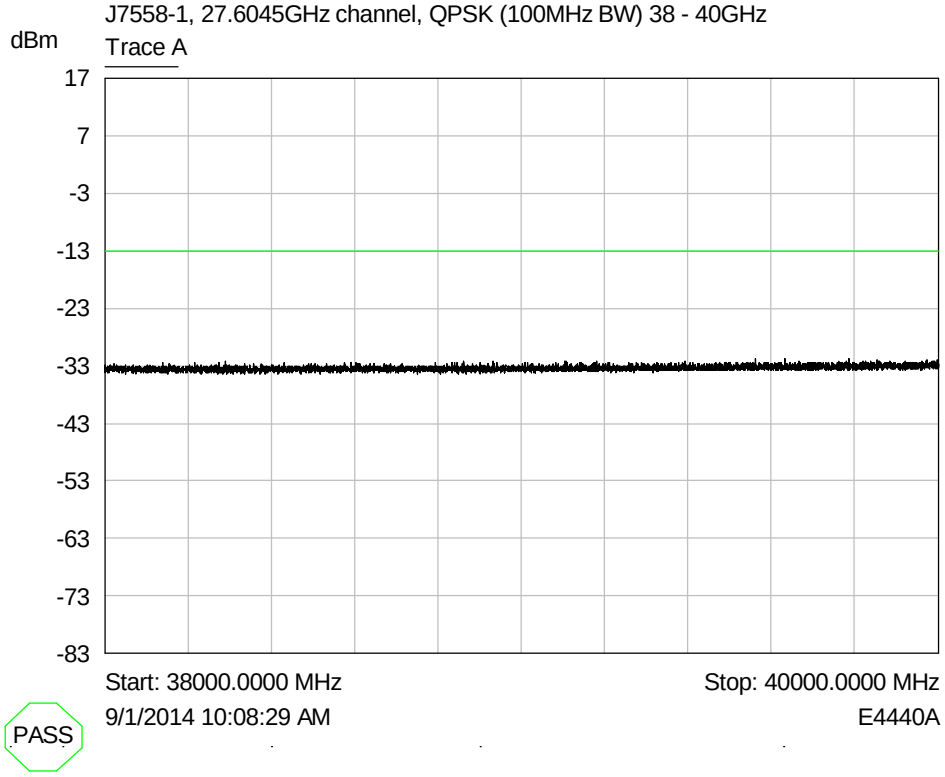
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 30 - 34GHz

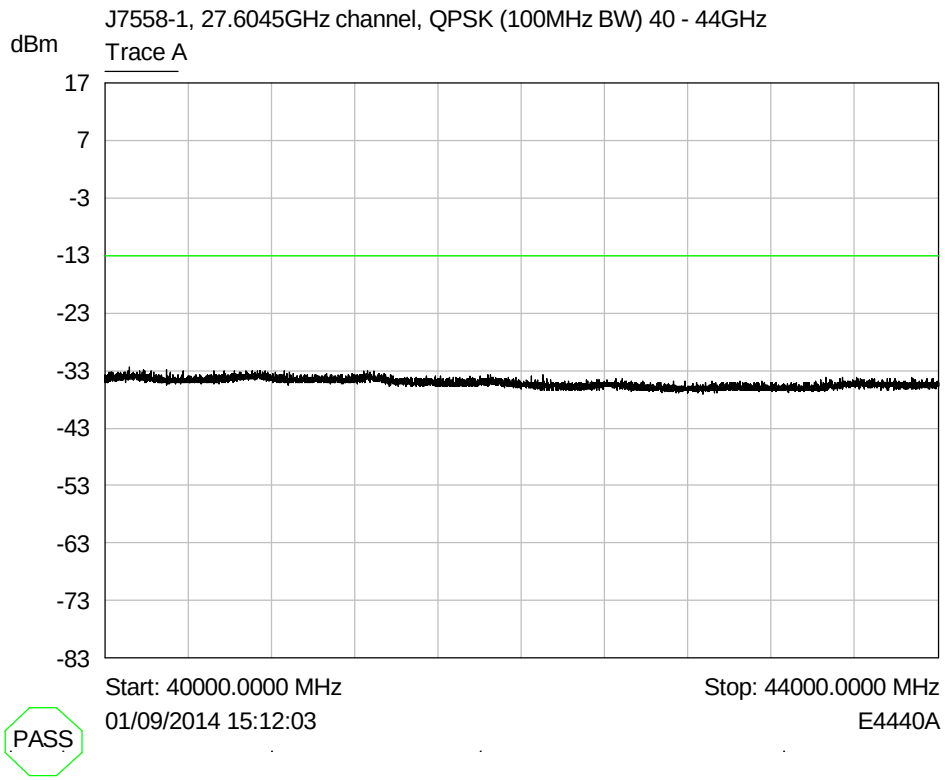


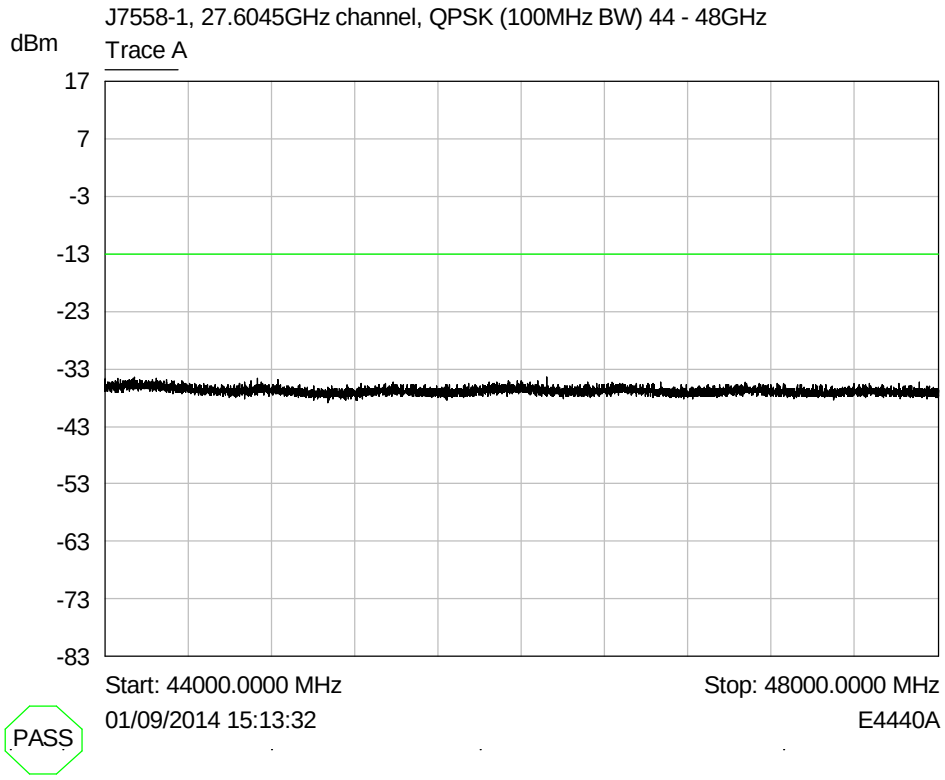
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 34 - 38GHz

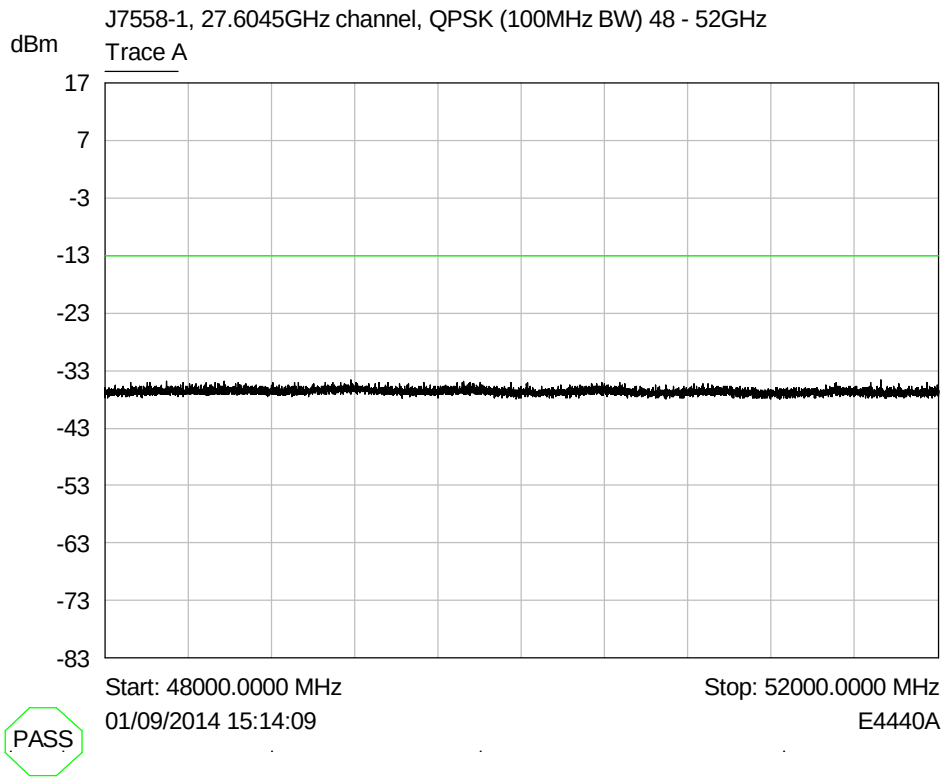


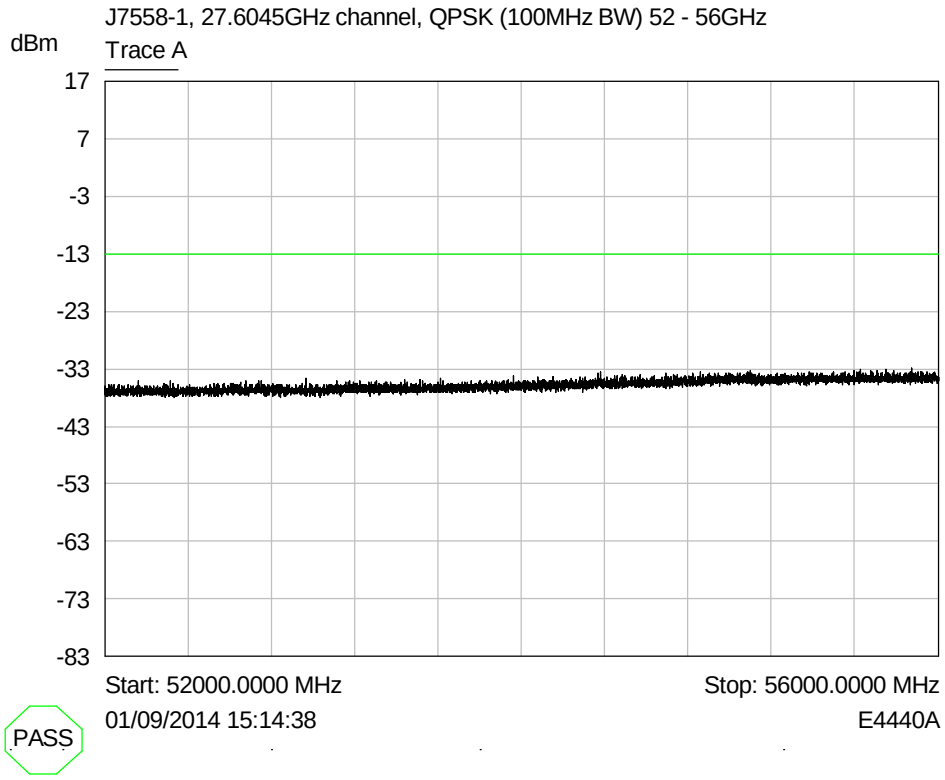
J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 38 - 40GHz

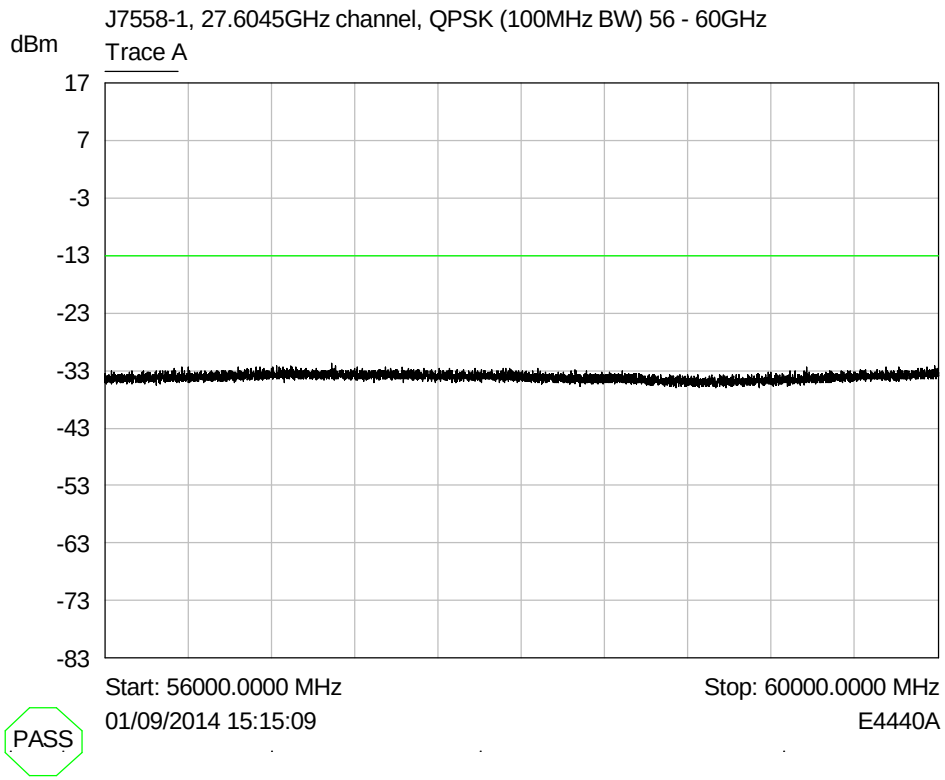


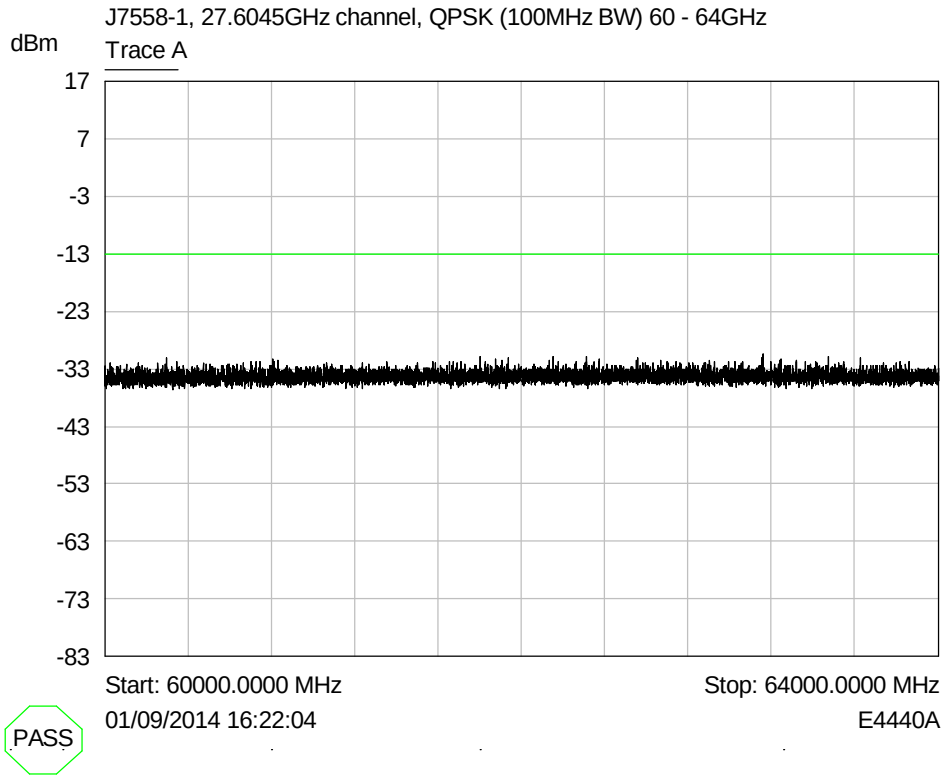

J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 40 - 44GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 40000.0000 MHz
Stop: 44000.0000 MHz
01/09/2014 15:12:03
E4440A
PASS

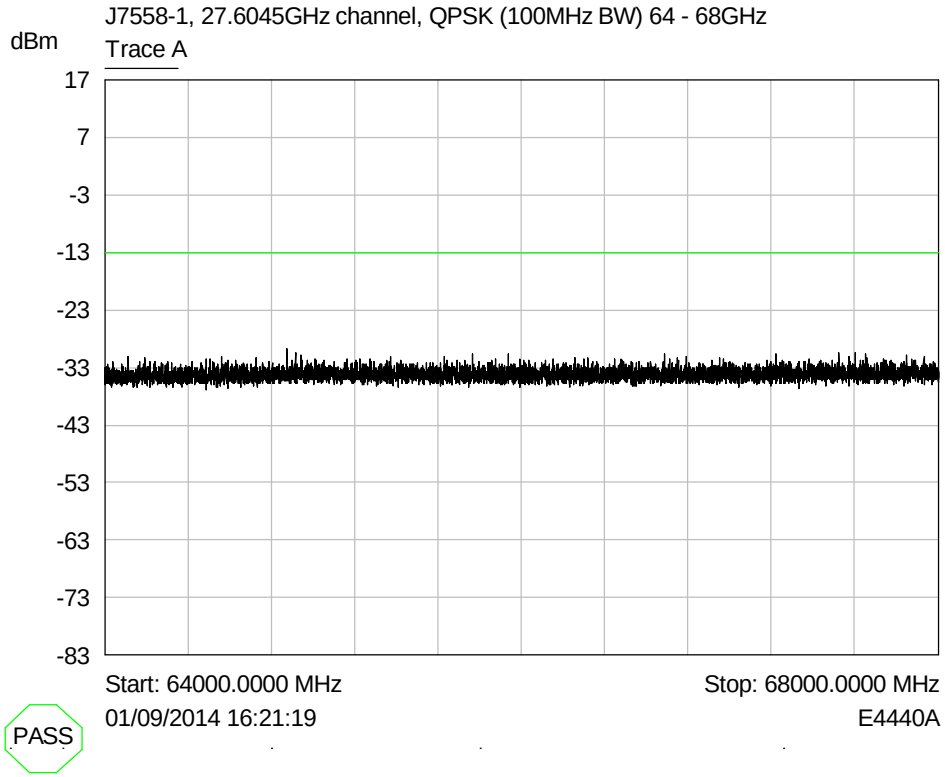

J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 44 - 48GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 44000.0000 MHz
Stop: 48000.0000 MHz
01/09/2014 15:13:32
E4440A
PASS

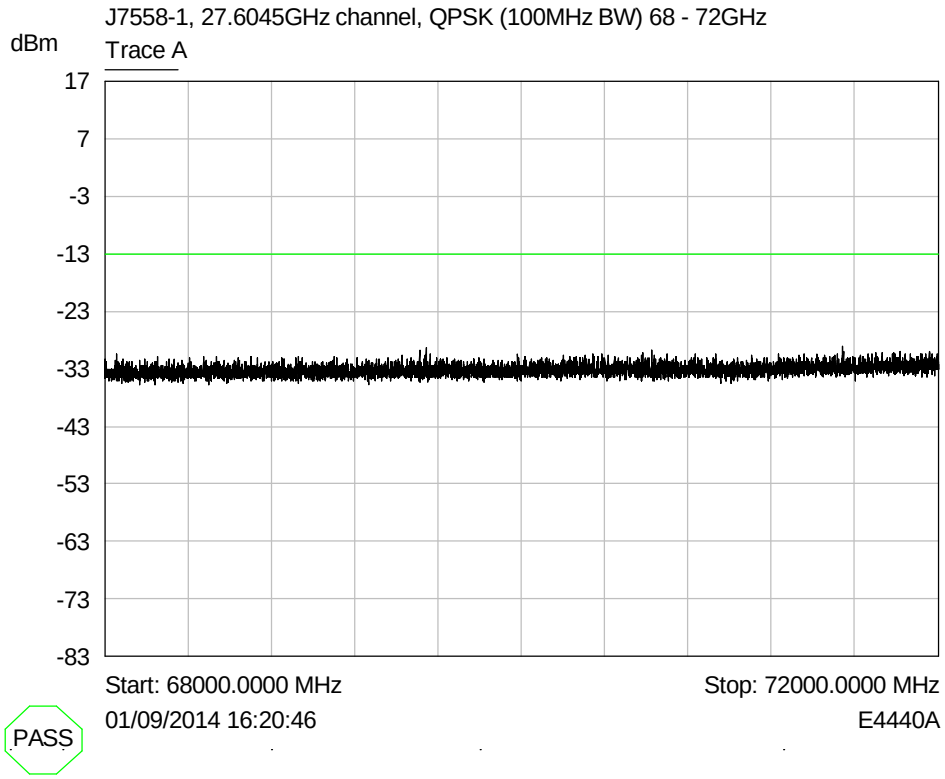

J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 48 - 52GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 48000.0000 MHz
Stop: 52000.0000 MHz
01/09/2014 15:14:09
E4440A
PASS

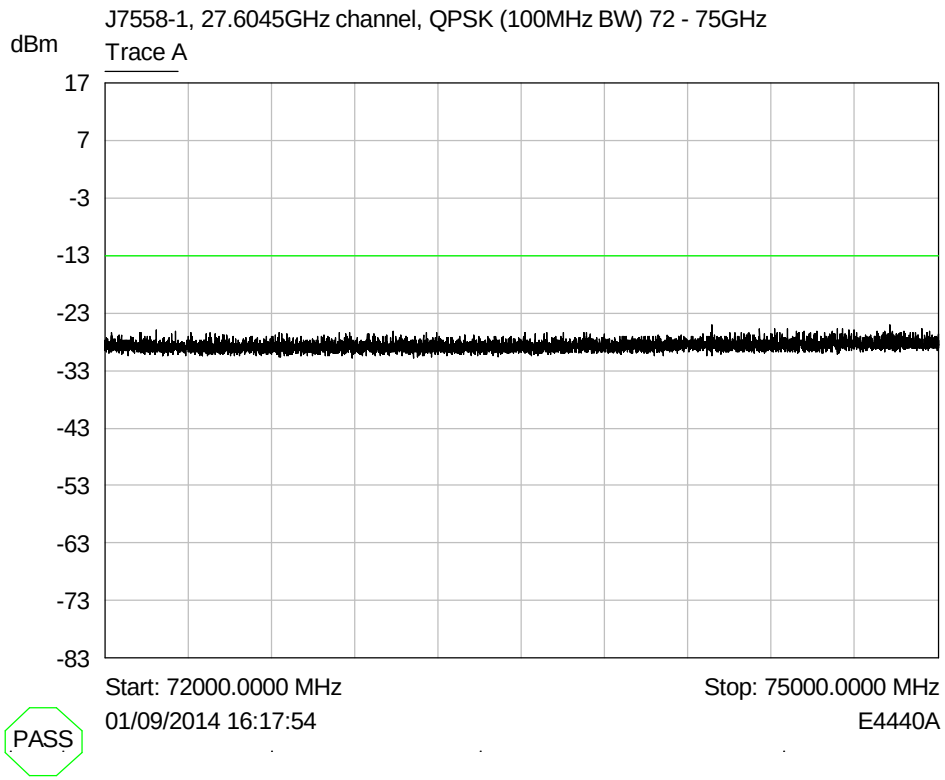

J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 52 - 56GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 52000.0000 MHz
Stop: 56000.0000 MHz
01/09/2014 15:14:38
E4440A
PASS

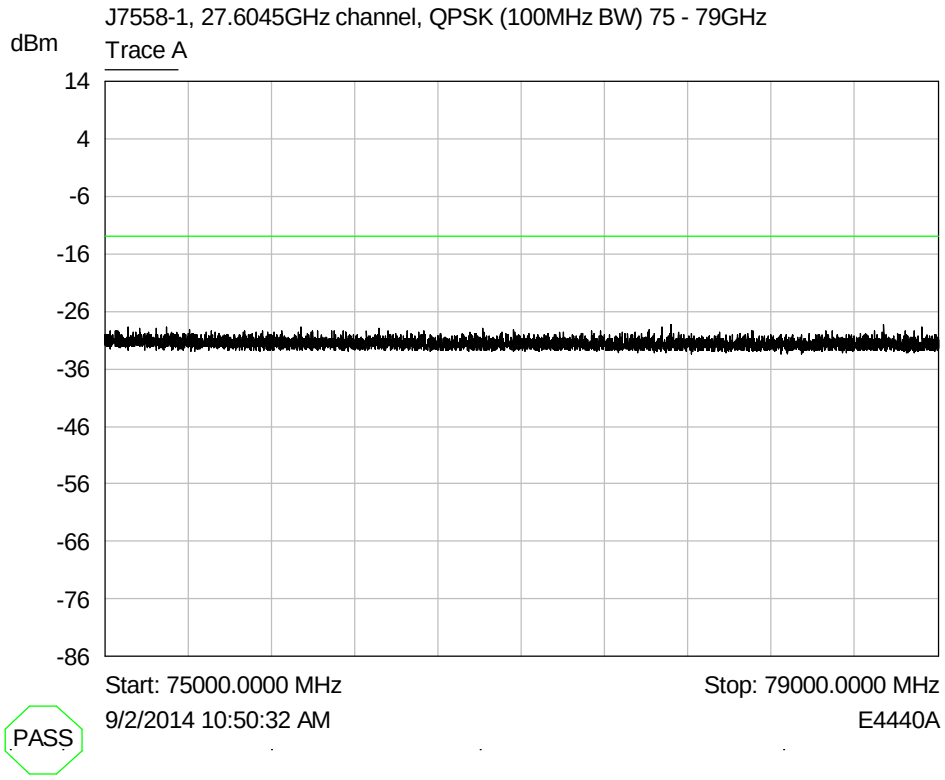

J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 56 - 60GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 56000.0000 MHz
Stop: 60000.0000 MHz
01/09/2014 15:15:09
E4440A
PASS

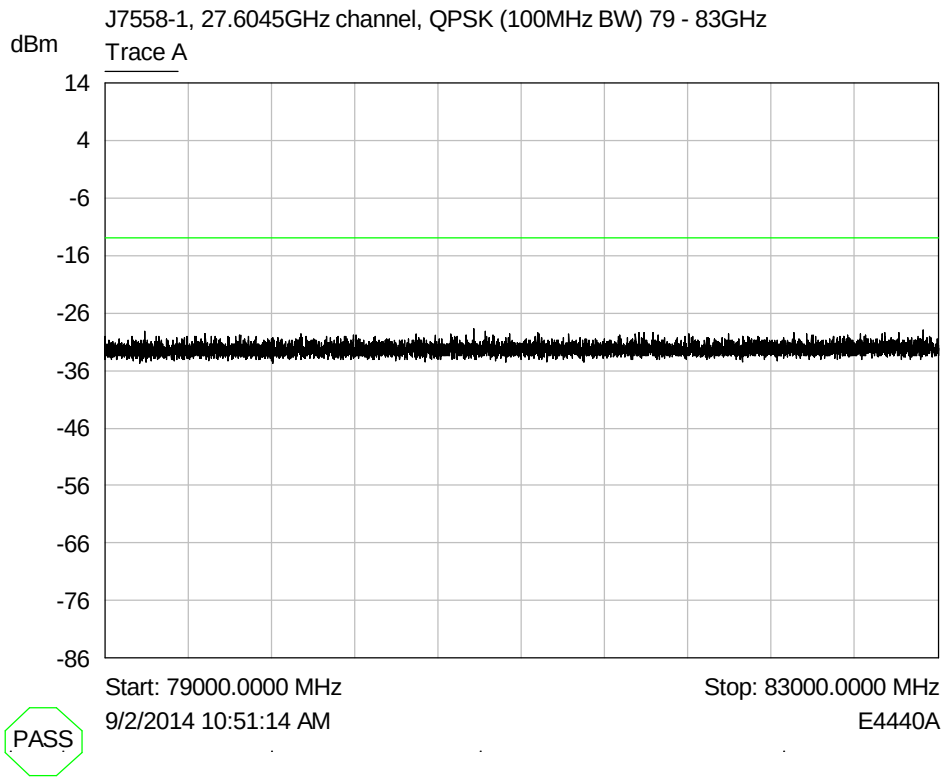

J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 60 - 64GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 60000.0000 MHz
Stop: 64000.0000 MHz
01/09/2014 16:22:04
E4440A
PASS

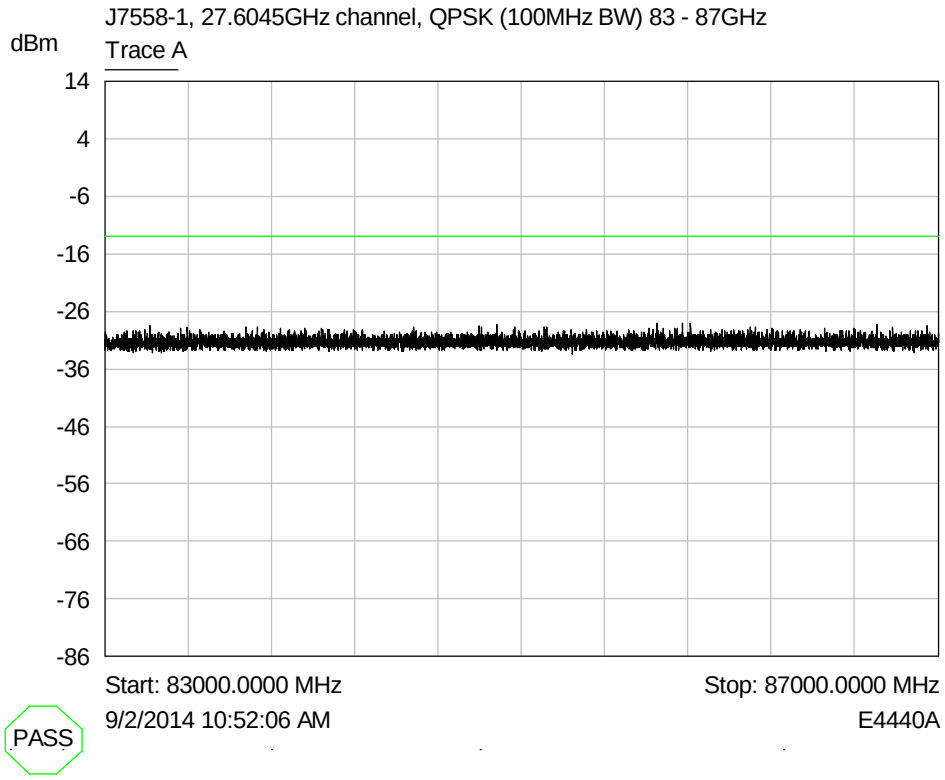

J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 64 - 68GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 64000.0000 MHz
Stop: 68000.0000 MHz
01/09/2014 16:21:19
E4440A
PASS

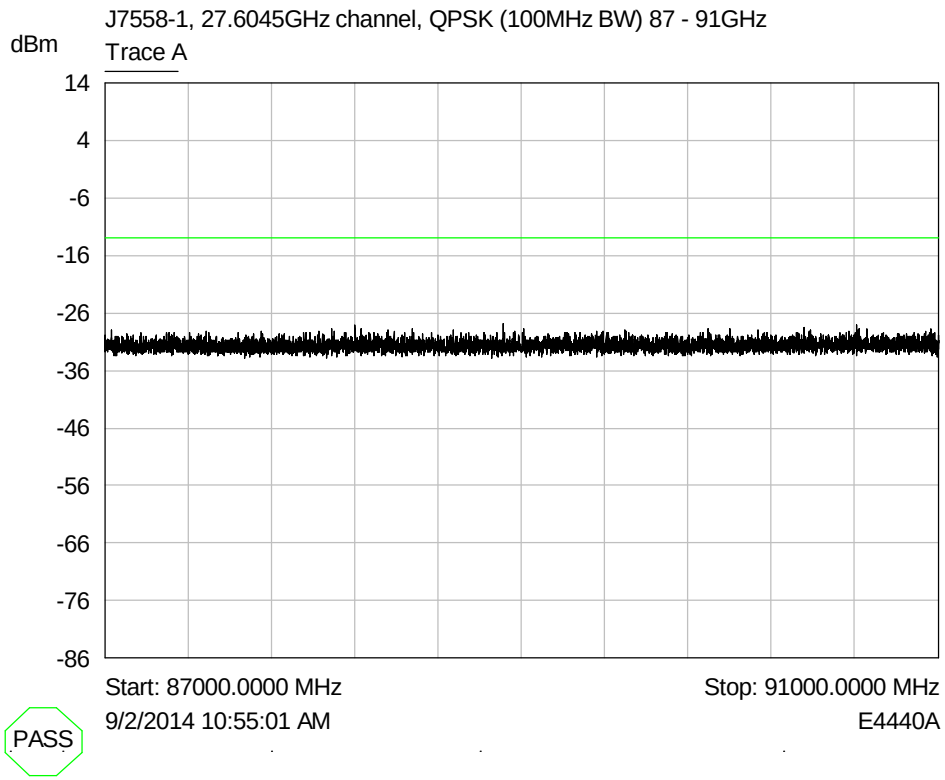

J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 68 - 72GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 68000.0000 MHz
Stop: 72000.0000 MHz
01/09/2014 16:20:46
E4440A
PASS

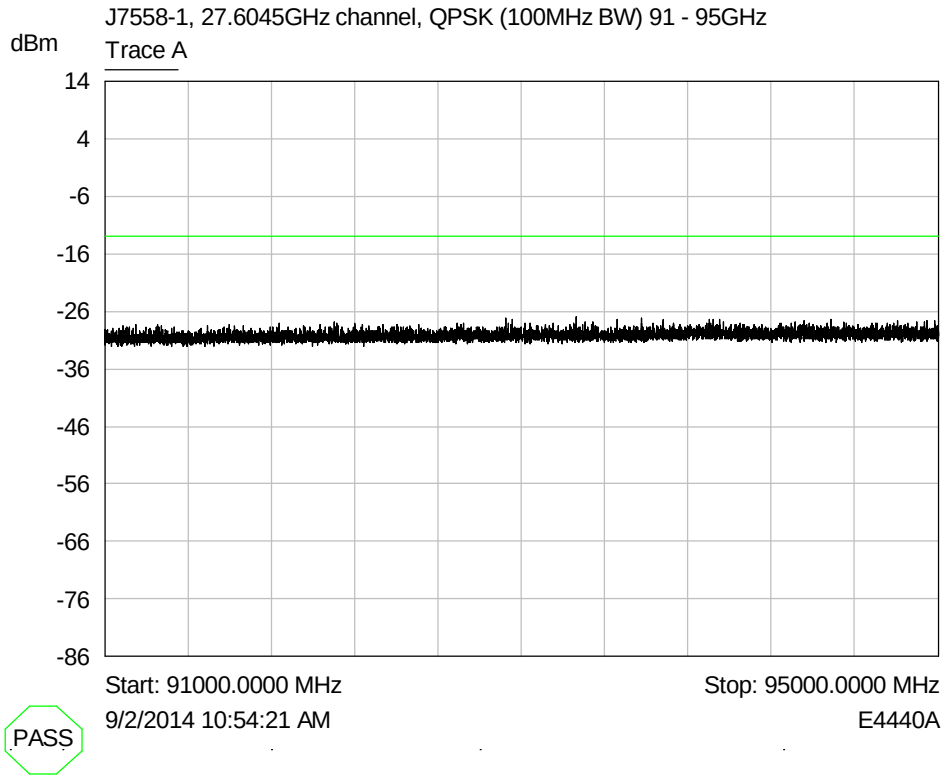

J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 72 - 75GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 72000.0000 MHz
Stop: 75000.0000 MHz
01/09/2014 16:17:54
E4440A
PASS

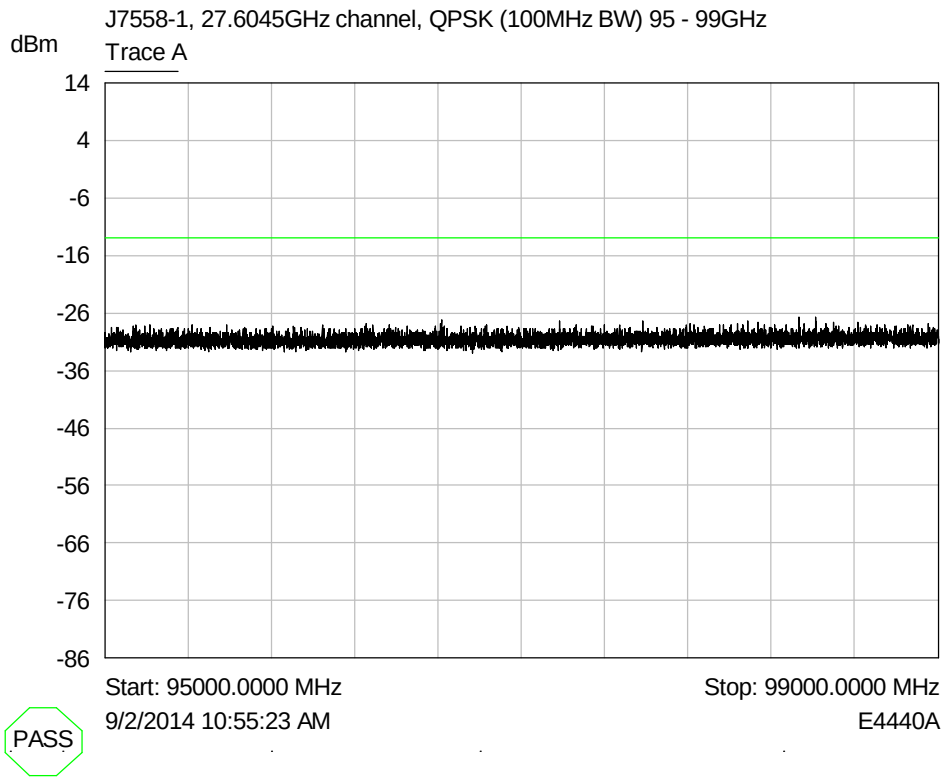

J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 75 - 79GHz
dBm
Trace A
14
4
-6
-16
-26
-36
-46
-56
-66
-76
-86
Start: 75000.0000 MHz
Stop: 79000.0000 MHz
9/2/2014 10:50:32 AM
E4440A
PASS

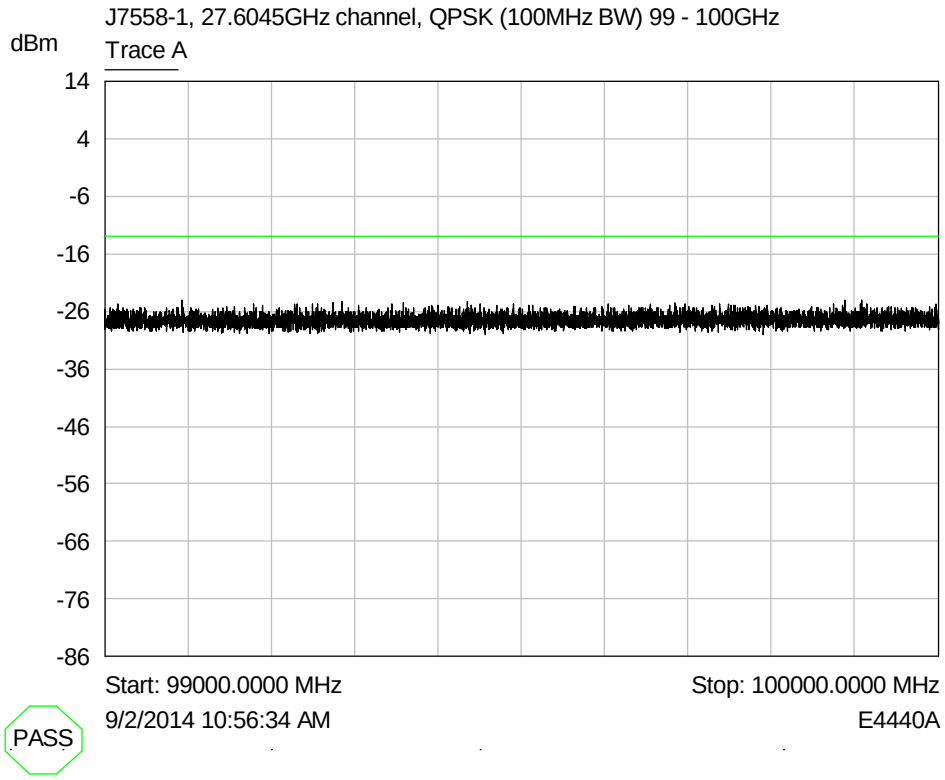

J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 79 - 83GHz
dBm
Trace A
14
4
-6
-16
-26
-36
-46
-56
-66
-76
-86
Start: 79000.0000 MHz
Stop: 83000.0000 MHz
9/2/2014 10:51:14 AM
E4440A
PASS


J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 83 - 87GHz
dBm
Trace A
14
4
-6
-16
-26
-36
-46
-56
-66
-76
-86
Start: 83000.0000 MHz
Stop: 87000.0000 MHz
9/2/2014 10:52:06 AM
E4440A
PASS

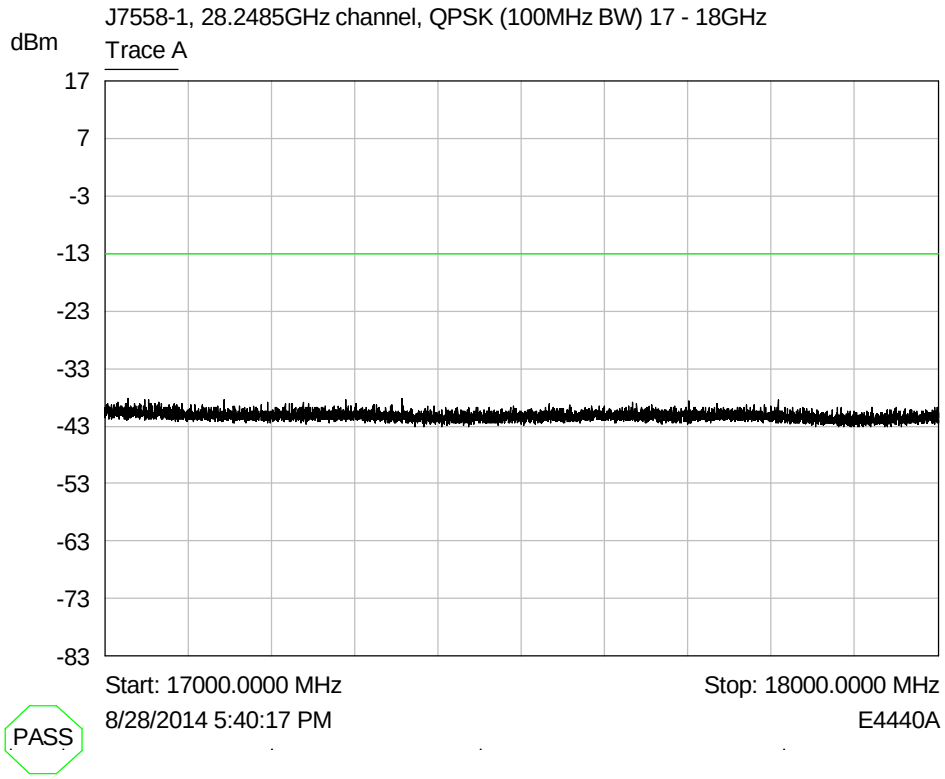

J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 87 - 91GHz
dBm
Trace A
14
4
-6
-16
-26
-36
-46
-56
-66
-76
-86
Start: 87000.0000 MHz
Stop: 91000.0000 MHz
9/2/2014 10:55:01 AM
E4440A
PASS

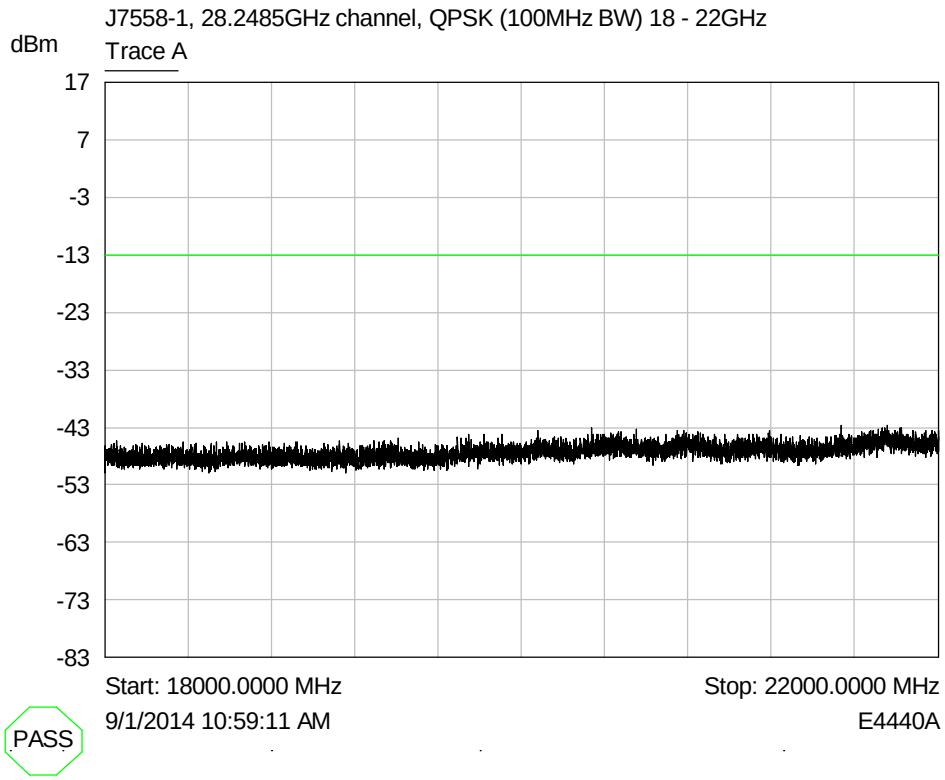

J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 91 - 95GHz
dBm
Trace A
14
4
-6
-16
-26
-36
-46
-56
-66
-76
-86
Start: 91000.0000 MHz
Stop: 95000.0000 MHz
9/2/2014 10:54:21 AM
E4440A
PASS

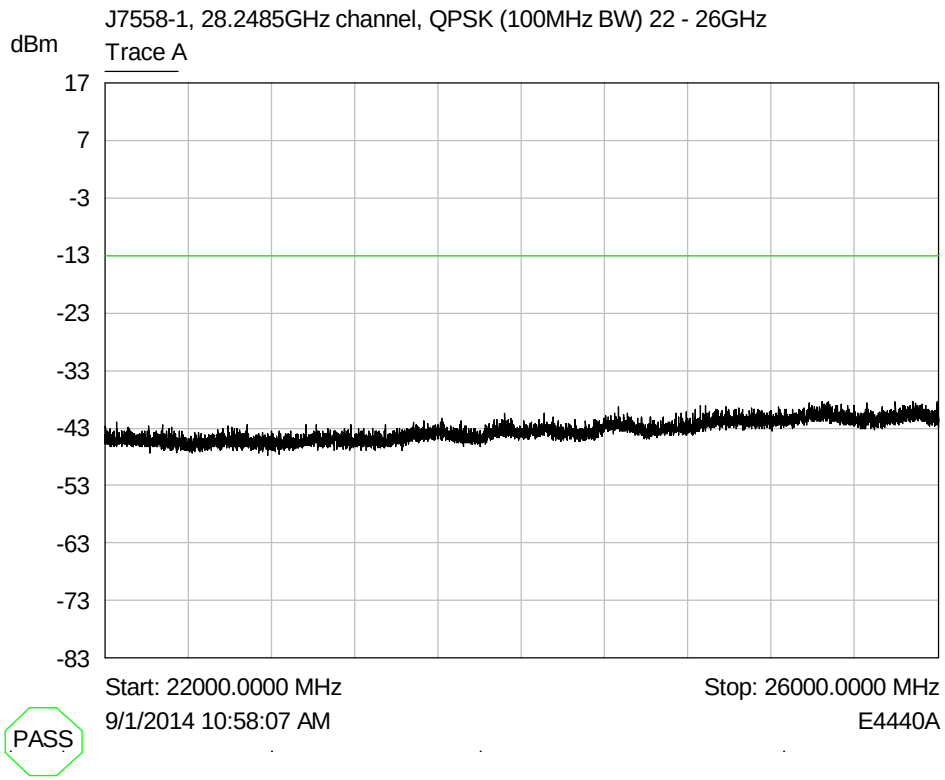

J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 95 - 99GHz
dBm
Trace A
14
4
-6
-16
-26
-36
-46
-56
-66
-76
-86
Start: 95000.0000 MHz
Stop: 99000.0000 MHz
9/2/2014 10:55:23 AM
E4440A
PASS

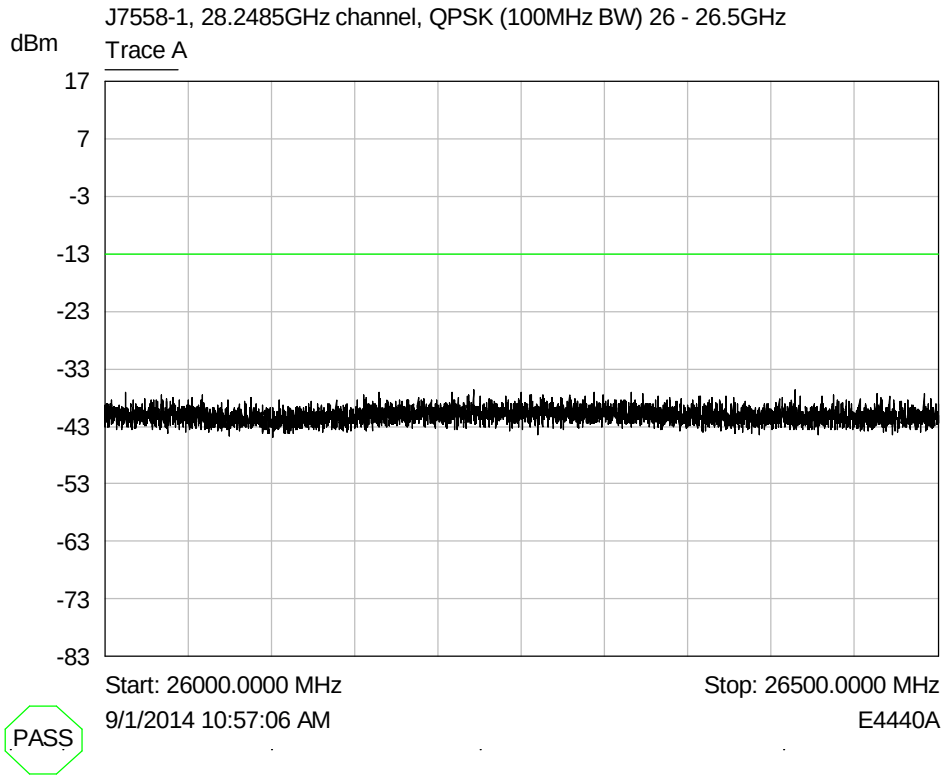

J7558-1, 27.6045GHz channel, QPSK (100MHz BW) 99 - 100GHz
dBm
Trace A
14
4
-6
-16
-26
-36
-46
-56
-66
-76
-86
Start: 99000.0000 MHz
Stop: 100000.0000 MHz
9/2/2014 10:56:34 AM
E4440A
PASS

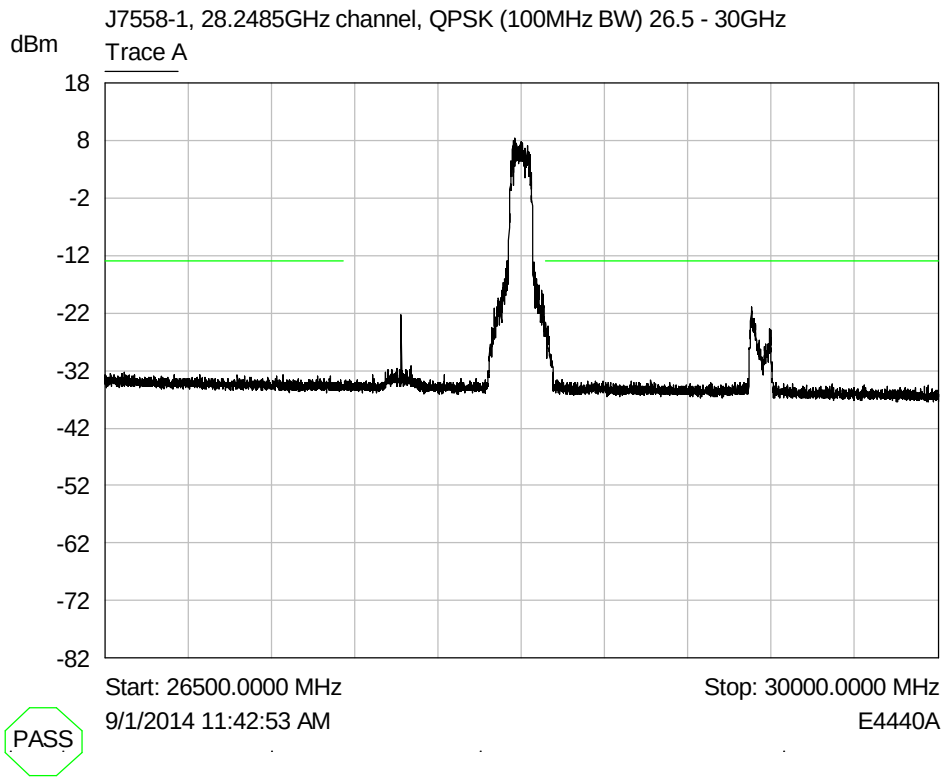
28.2485 GHz channel.

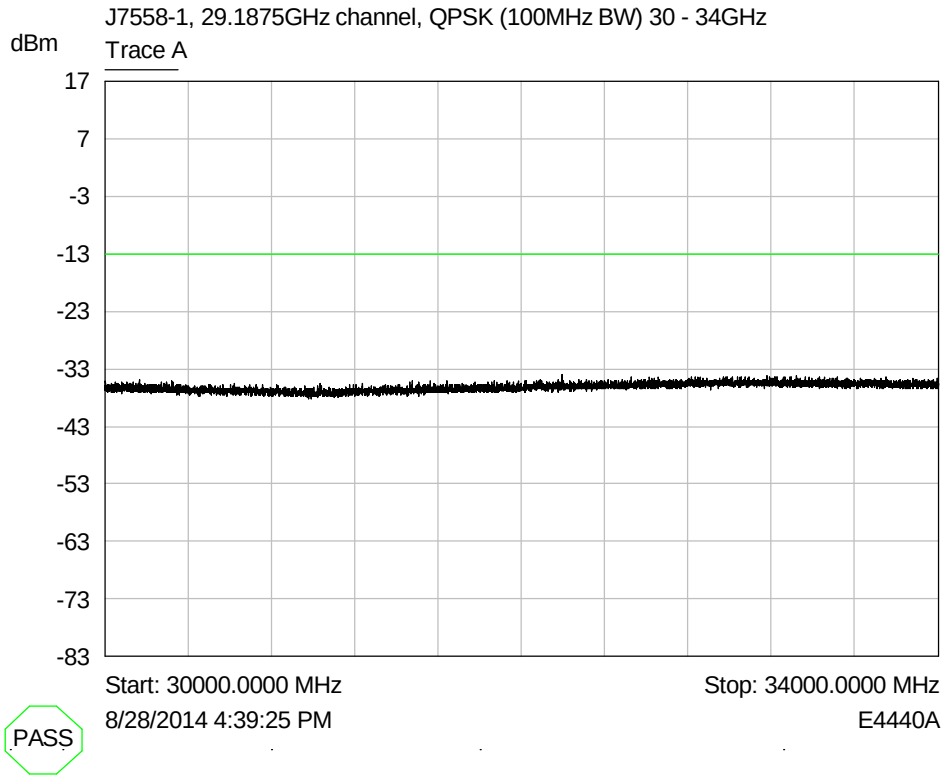




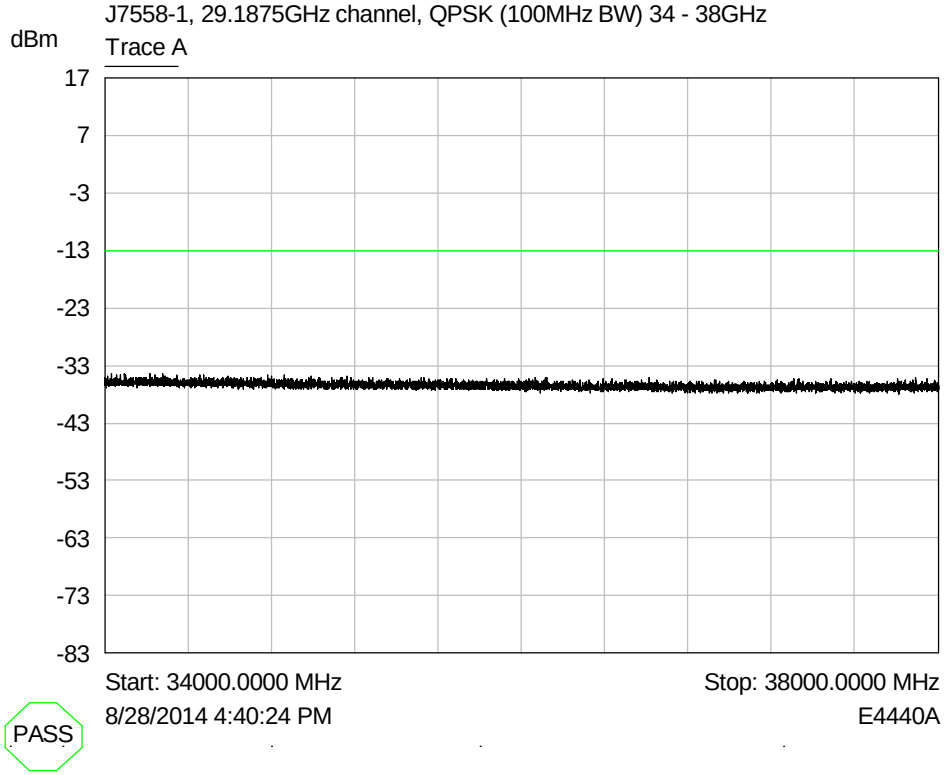

J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 22 - 26GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 22000.0000 MHz
Stop: 26000.0000 MHz
9/1/2014 10:58:07 AM
E4440A
PASS


J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 26 - 26.5GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 26000.0000 MHz
Stop: 26500.0000 MHz
9/1/2014 10:57:06 AM
E4440A
PASS

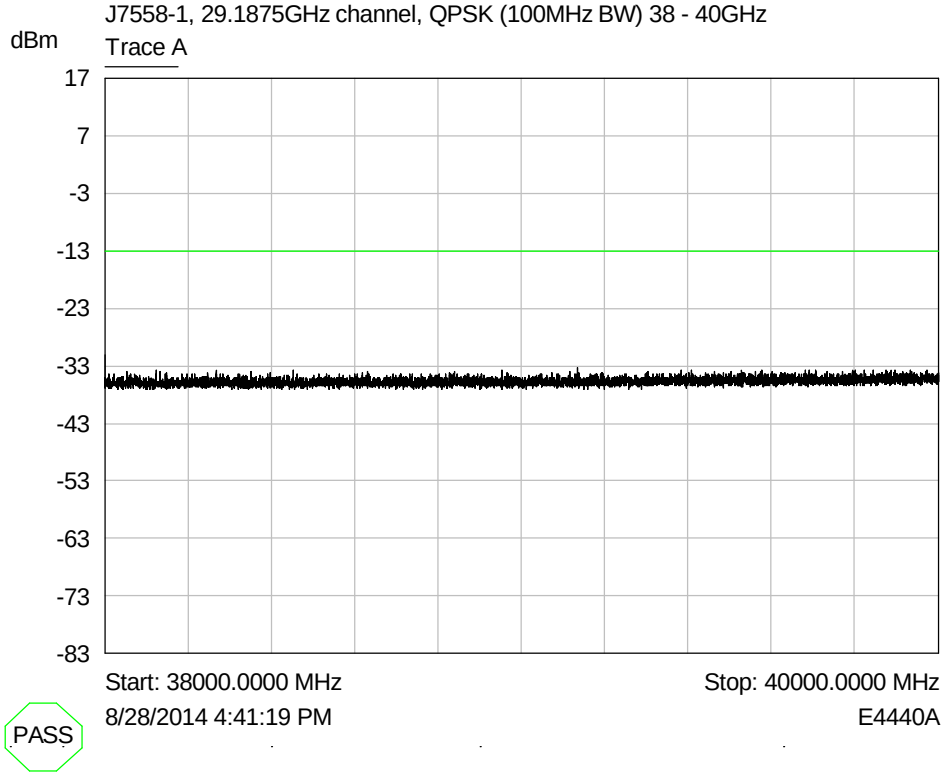

J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 26.5 - 30GHz
dBm
Trace A
18
8
-2
-12
-22
-32
-42
-52
-62
-72
-82
Start: 26500.0000 MHz
Stop: 30000.0000 MHz
9/1/2014 11:42:53 AM
E4440A
PASS

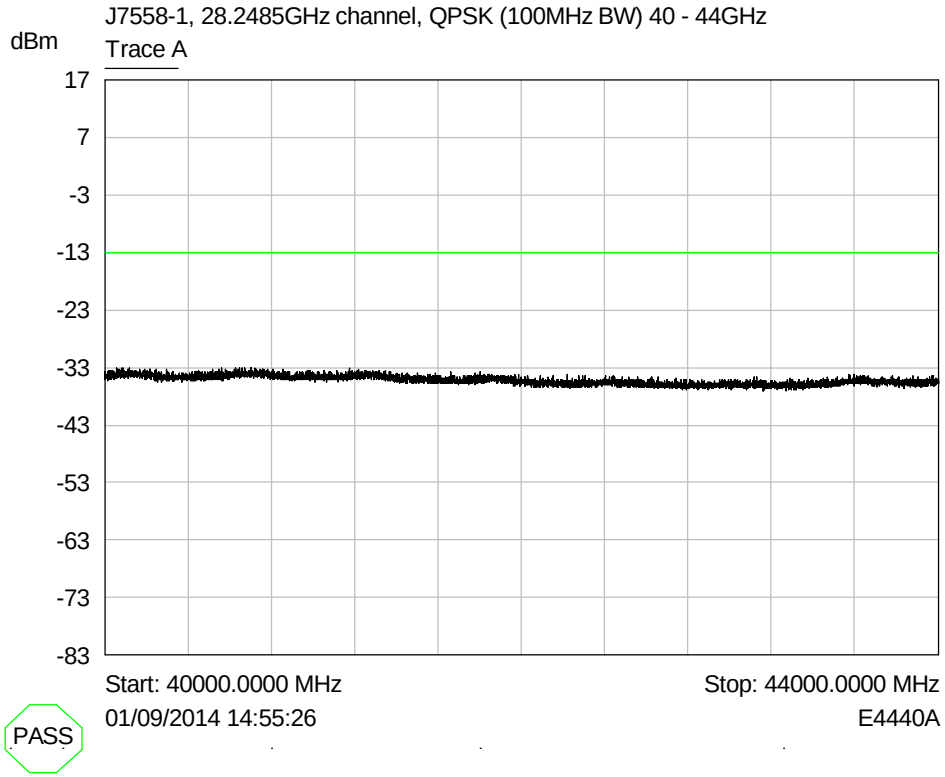

J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 30 - 34GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 30000.0000 MHz
Stop: 34000.0000 MHz
8/28/2014 4:39:25 PM
E4440A
PASS

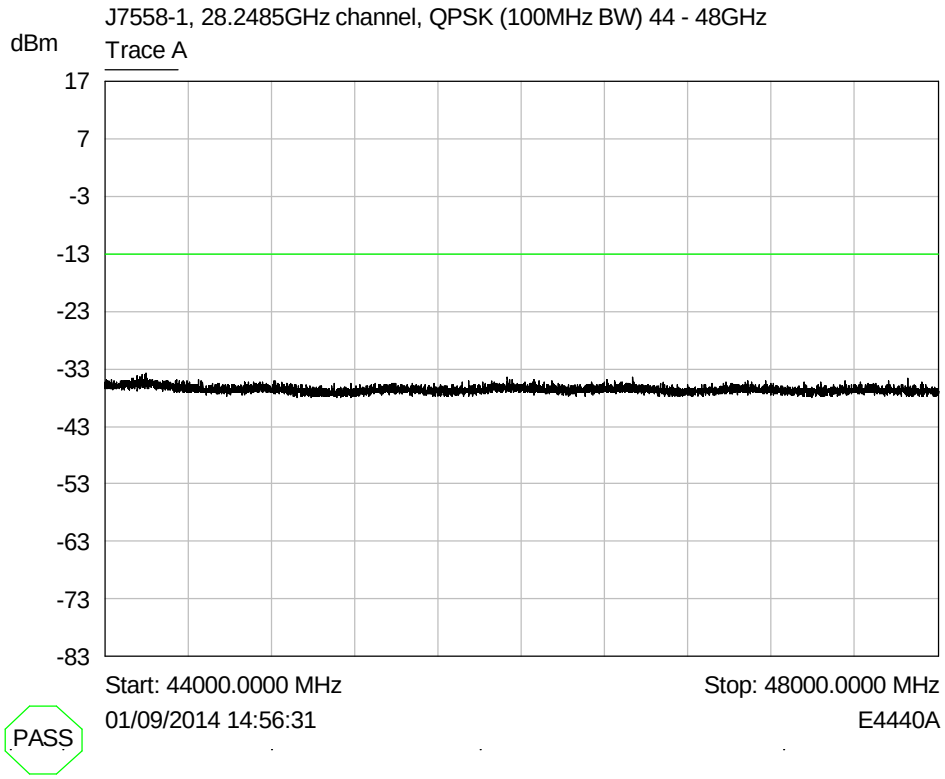
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 34 - 38GHz

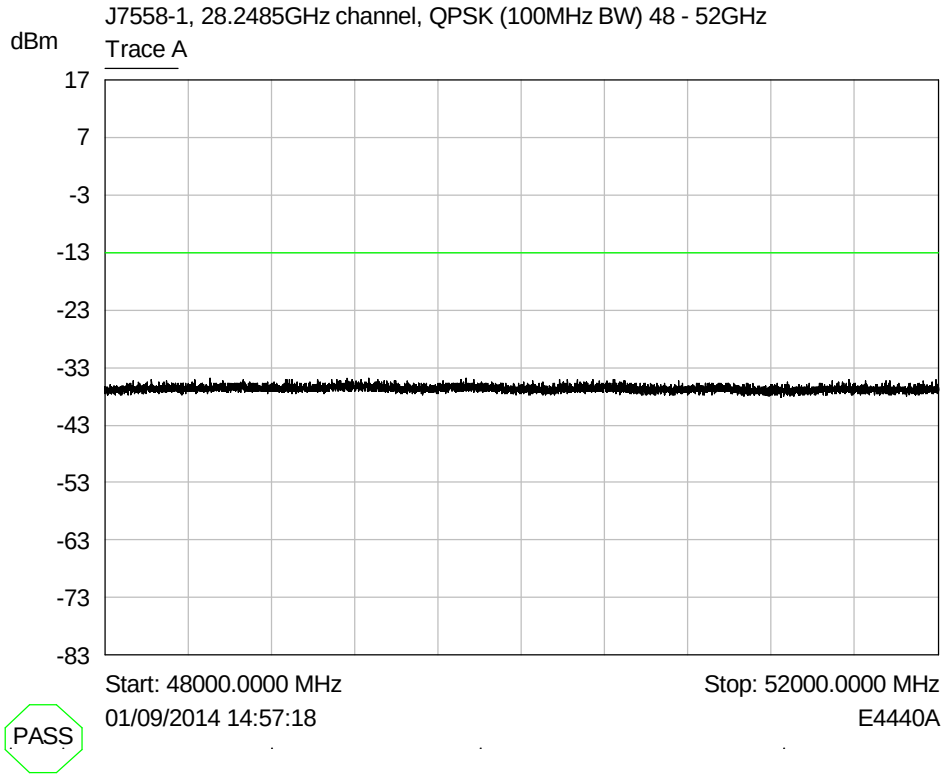


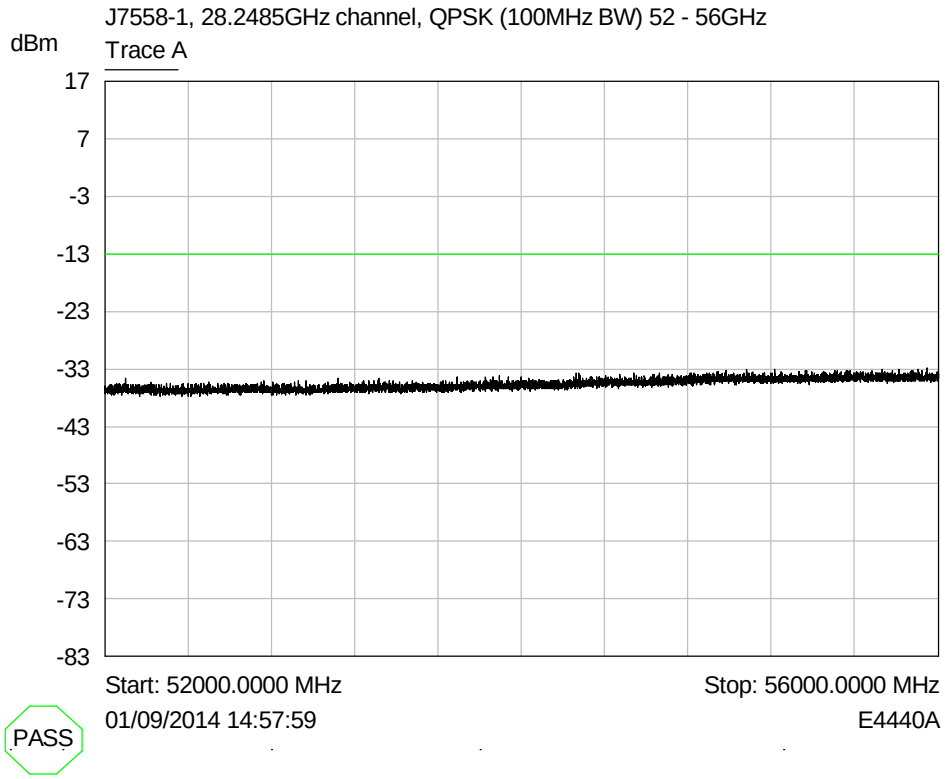
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 38 - 40GHz

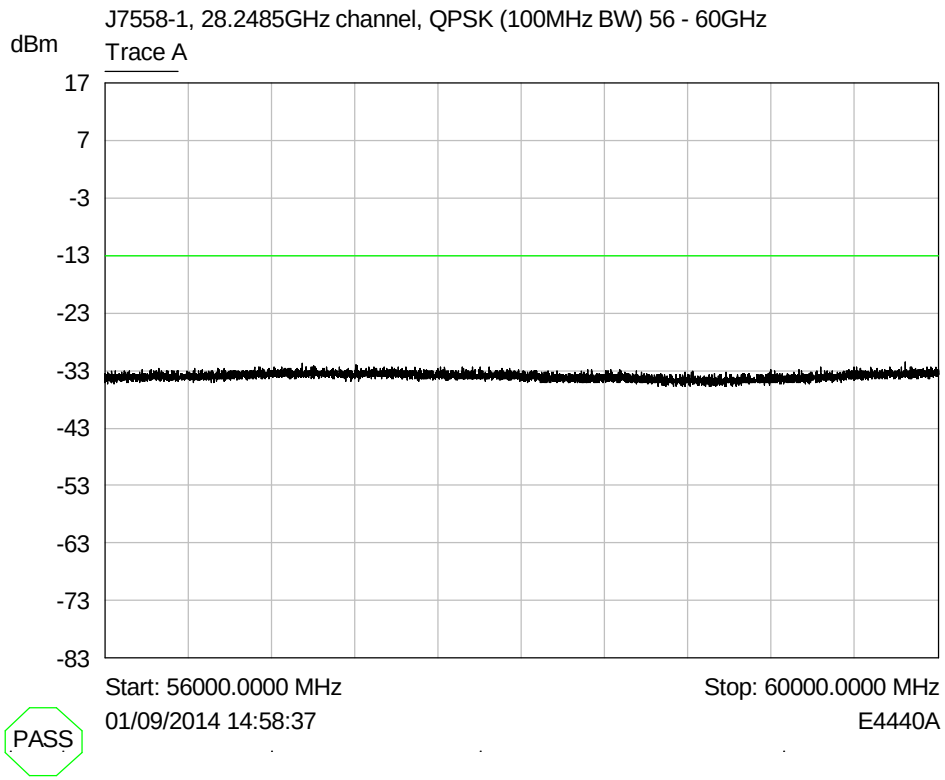


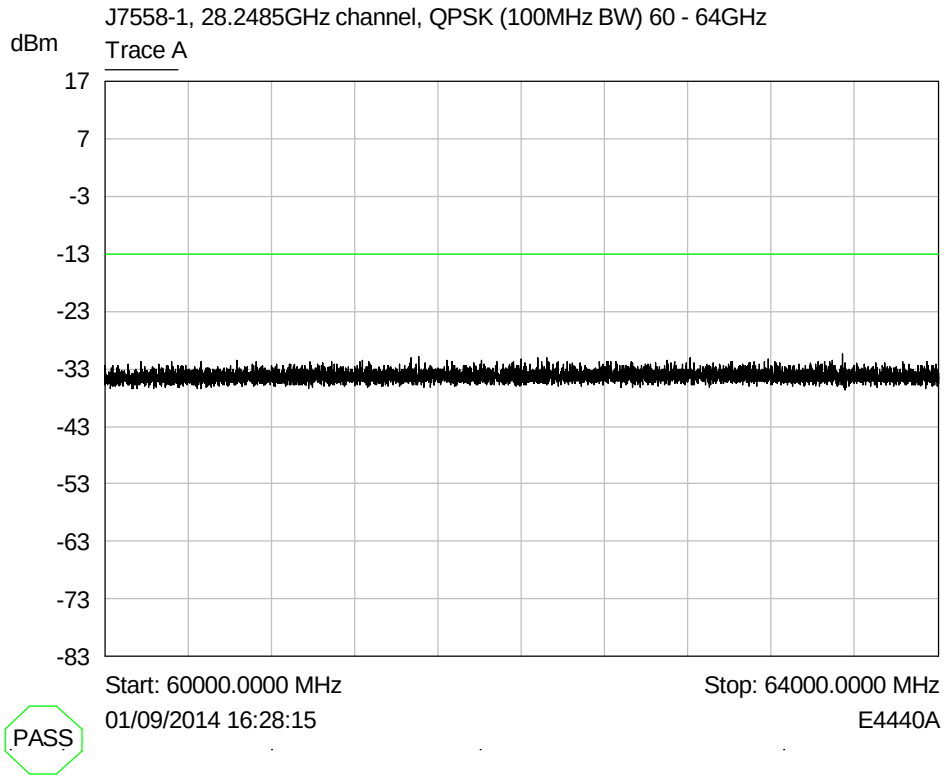

J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 40 - 44GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 40000.0000 MHz
Stop: 44000.0000 MHz
01/09/2014 14:55:26
E4440A
PASS

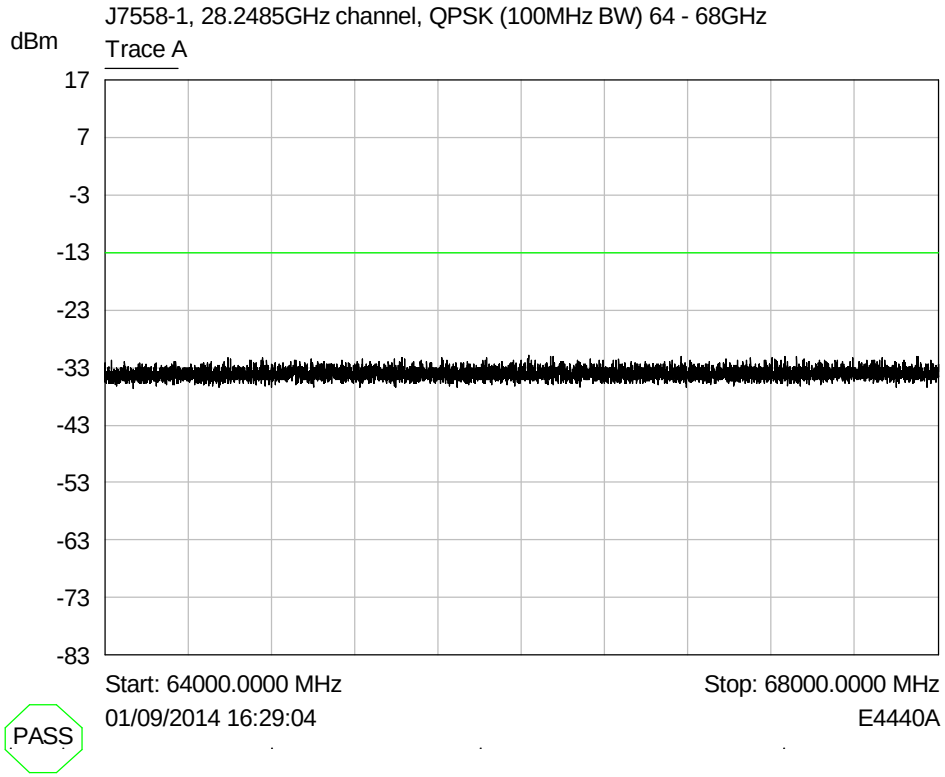

J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 44 - 48GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 44000.0000 MHz
Stop: 48000.0000 MHz
01/09/2014 14:56:31
E4440A
PASS

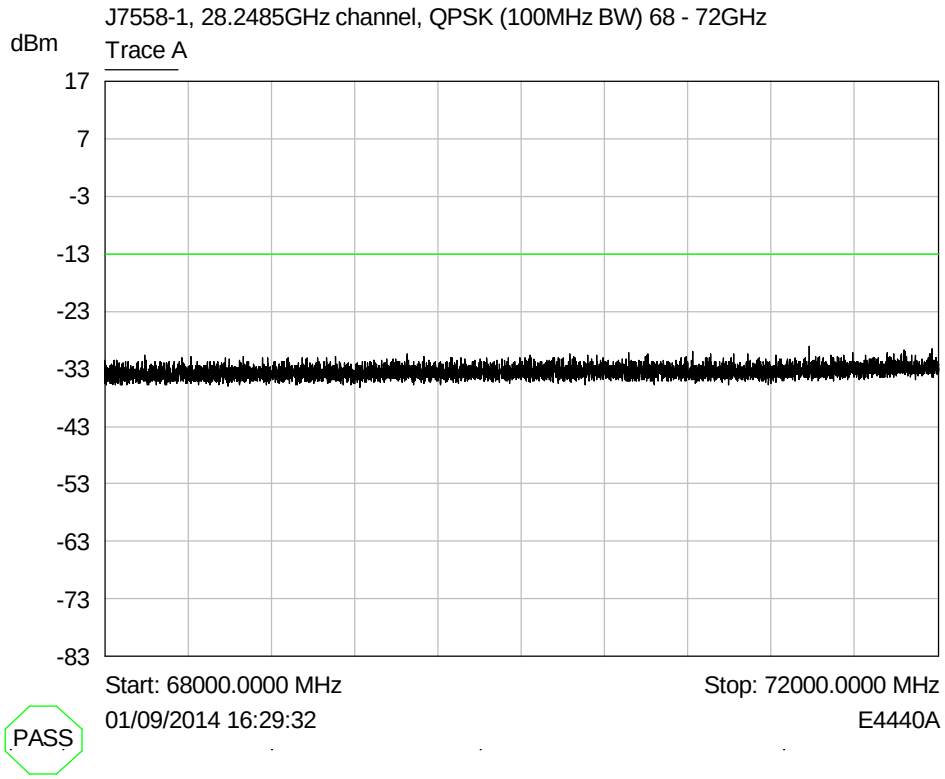

J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 48 - 52GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 48000.0000 MHz
Stop: 52000.0000 MHz
01/09/2014 14:57:18
E4440A
PASS

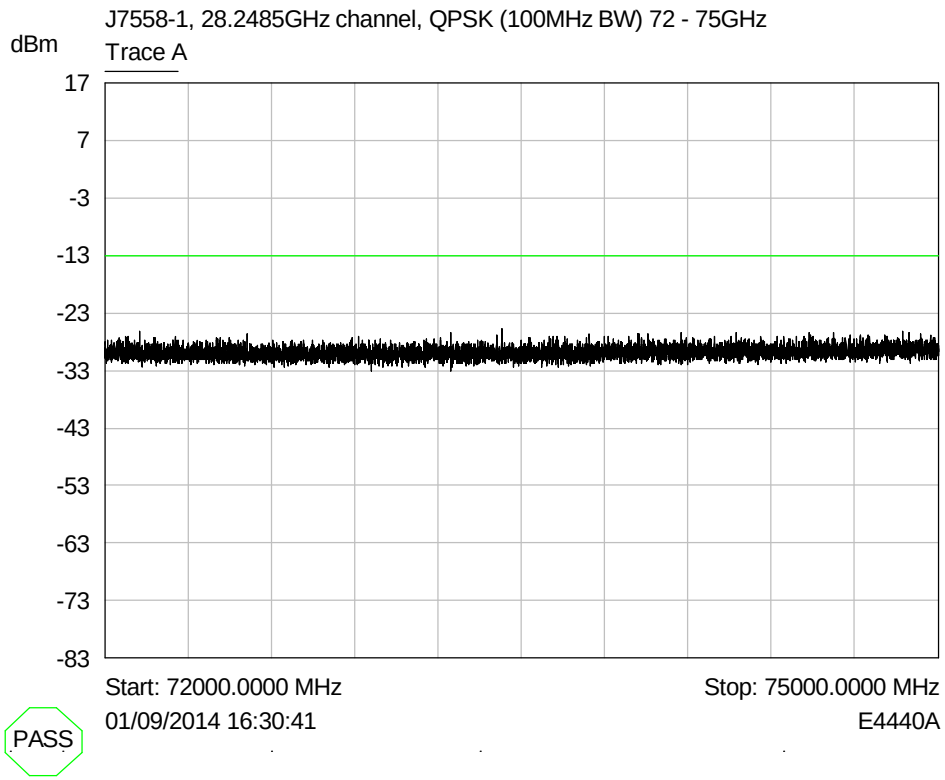

J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 52 - 56GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 52000.0000 MHz
Stop: 56000.0000 MHz
01/09/2014 14:57:59
E4440A
PASS

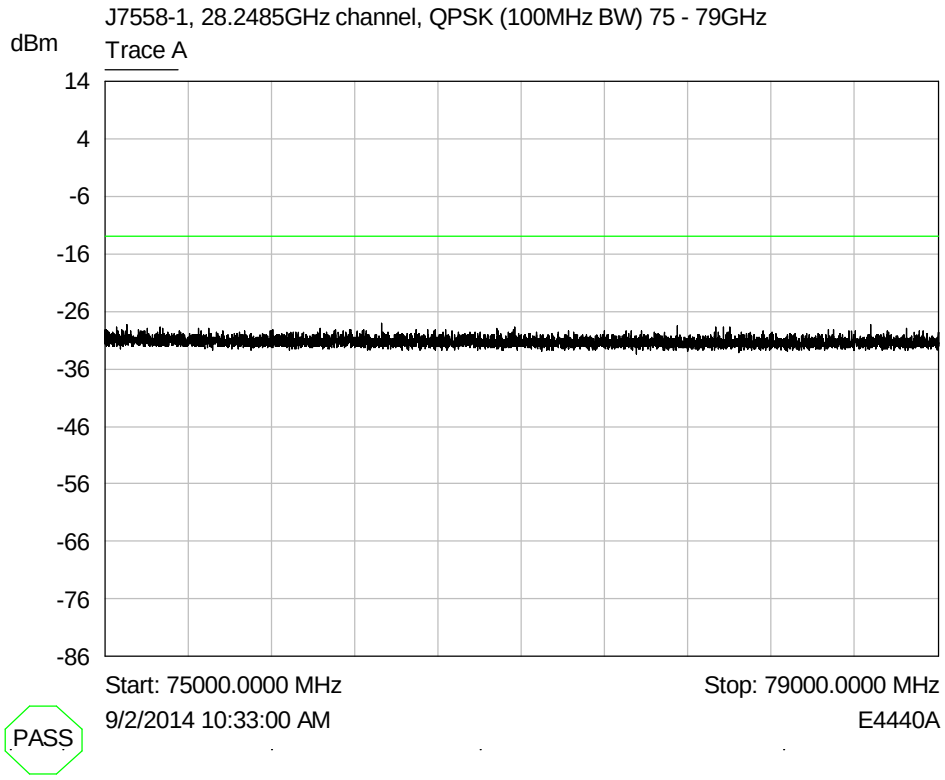

J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 56 - 60GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 56000.0000 MHz
Stop: 60000.0000 MHz
01/09/2014 14:58:37
E4440A
PASS

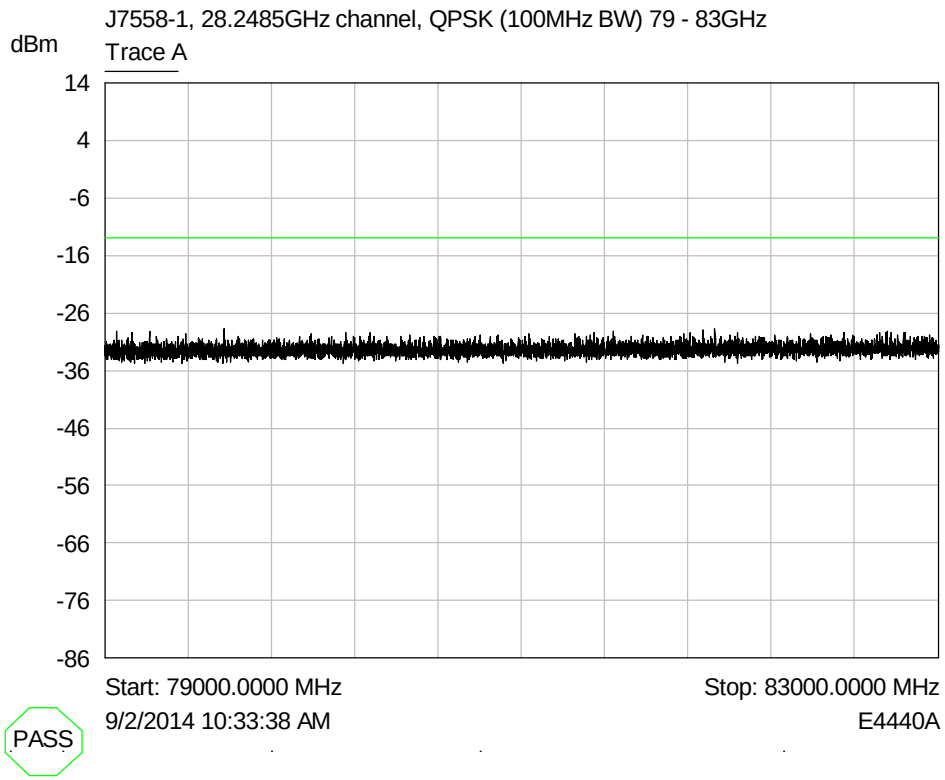

J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 60 - 64GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 60000.0000 MHz
Stop: 64000.0000 MHz
01/09/2014 16:28:15
E4440A
PASS

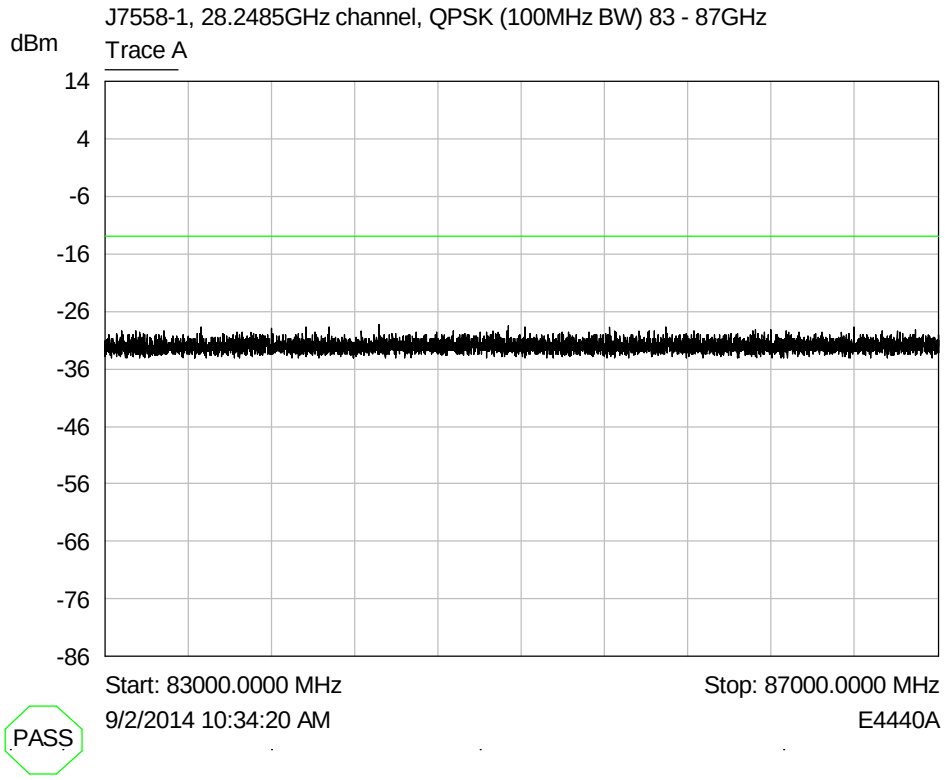

J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 64 - 68GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 64000.0000 MHz
Stop: 68000.0000 MHz
01/09/2014 16:29:04
E4440A
PASS

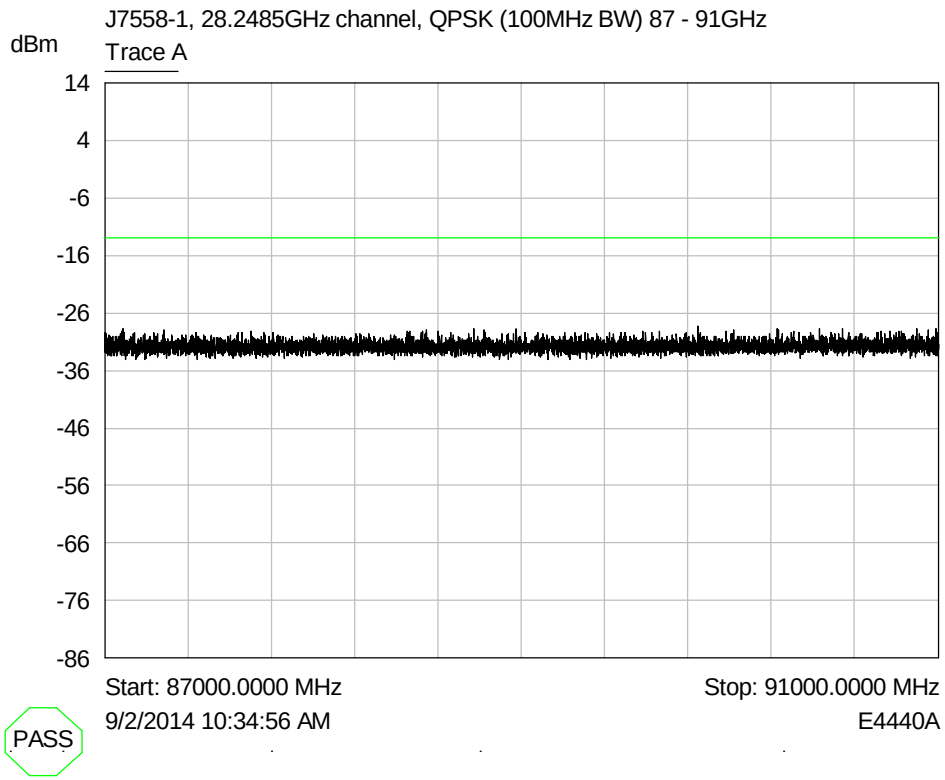

J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 68 - 72GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 68000.0000 MHz
Stop: 72000.0000 MHz
01/09/2014 16:29:32
E4440A
PASS

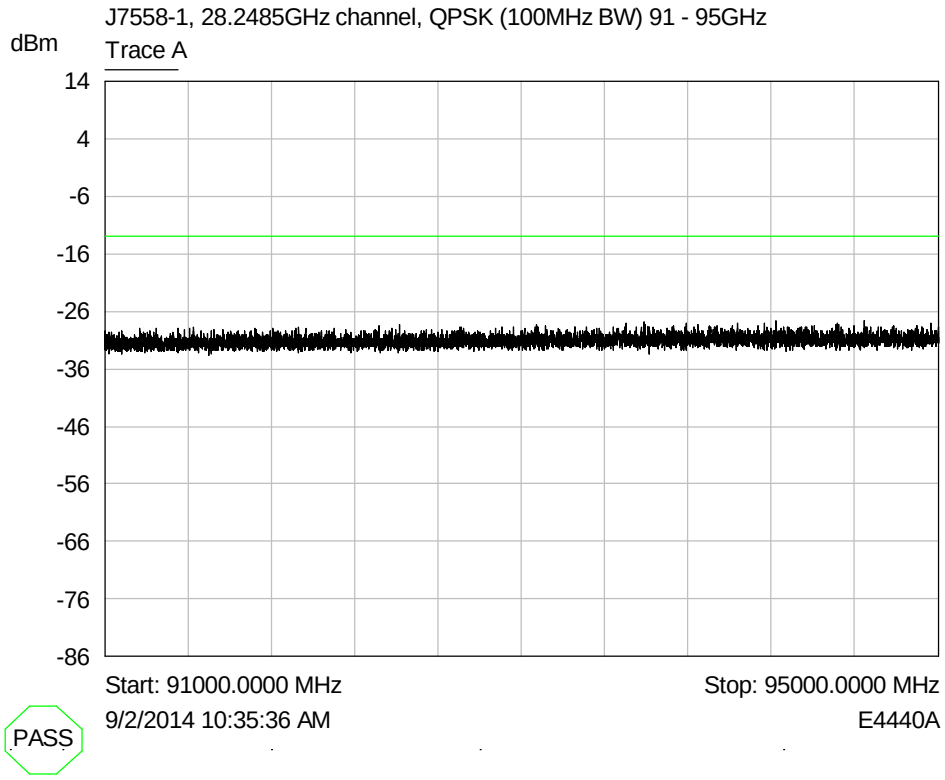

J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 72 - 75GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 72000.0000 MHz
Stop: 75000.0000 MHz
01/09/2014 16:30:41
E4440A
PASS

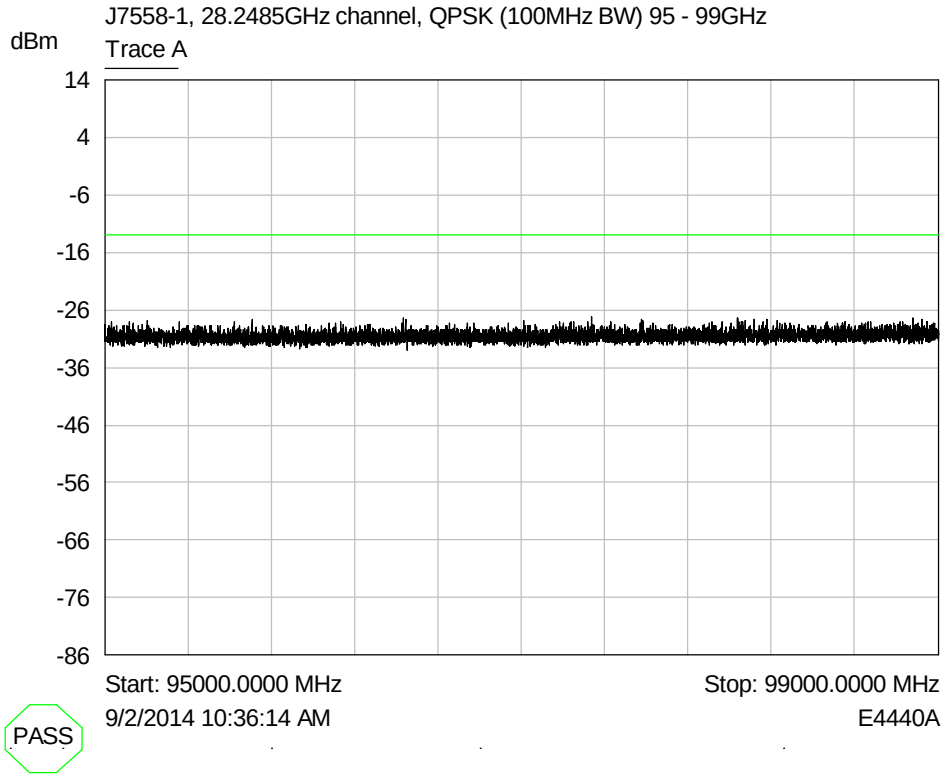

J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 75 - 79GHz
dBm
Trace A
14
4
-6
-16
-26
-36
-46
-56
-66
-76
-86
Start: 75000.0000 MHz
Stop: 79000.0000 MHz
9/2/2014 10:33:00 AM
E4440A
PASS

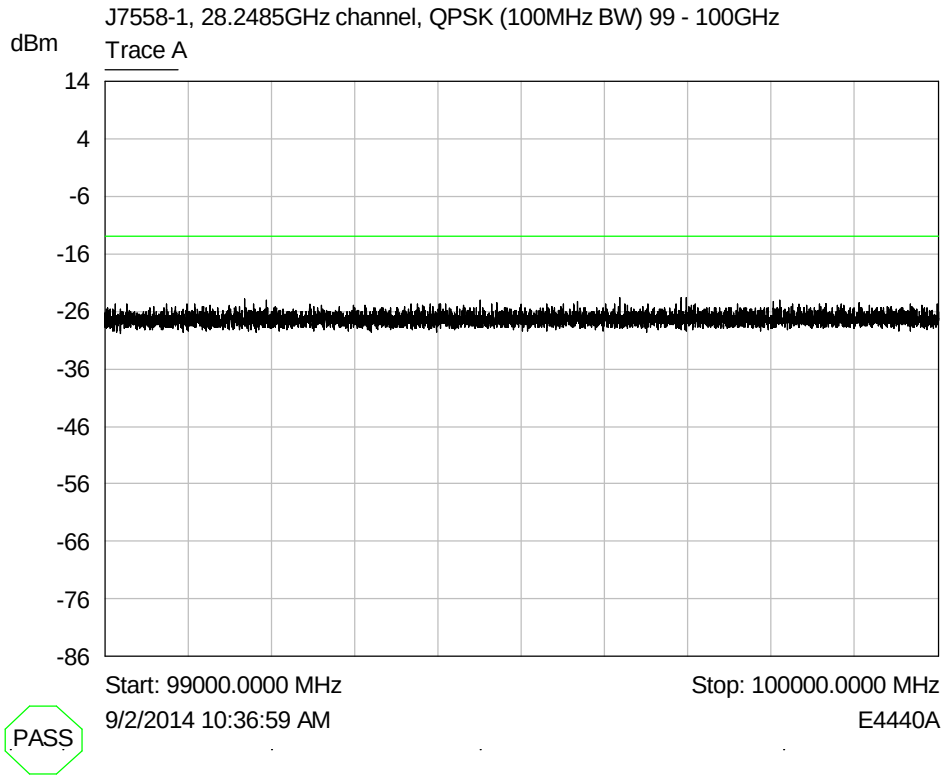

J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 79 - 83GHz
dBm
Trace A
14
4
-6
-16
-26
-36
-46
-56
-66
-76
-86
Start: 79000.0000 MHz
Stop: 83000.0000 MHz
9/2/2014 10:33:38 AM
E4440A
PASS


J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 83 - 87GHz
dBm
Trace A
14
4
-6
-16
-26
-36
-46
-56
-66
-76
-86
Start: 83000.0000 MHz
Stop: 87000.0000 MHz
9/2/2014 10:34:20 AM
E4440A
PASS


J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 87 - 91GHz
dBm
Trace A
14
4
-6
-16
-26
-36
-46
-56
-66
-76
-86
Start: 87000.0000 MHz
Stop: 91000.0000 MHz
9/2/2014 10:34:56 AM
E4440A
PASS

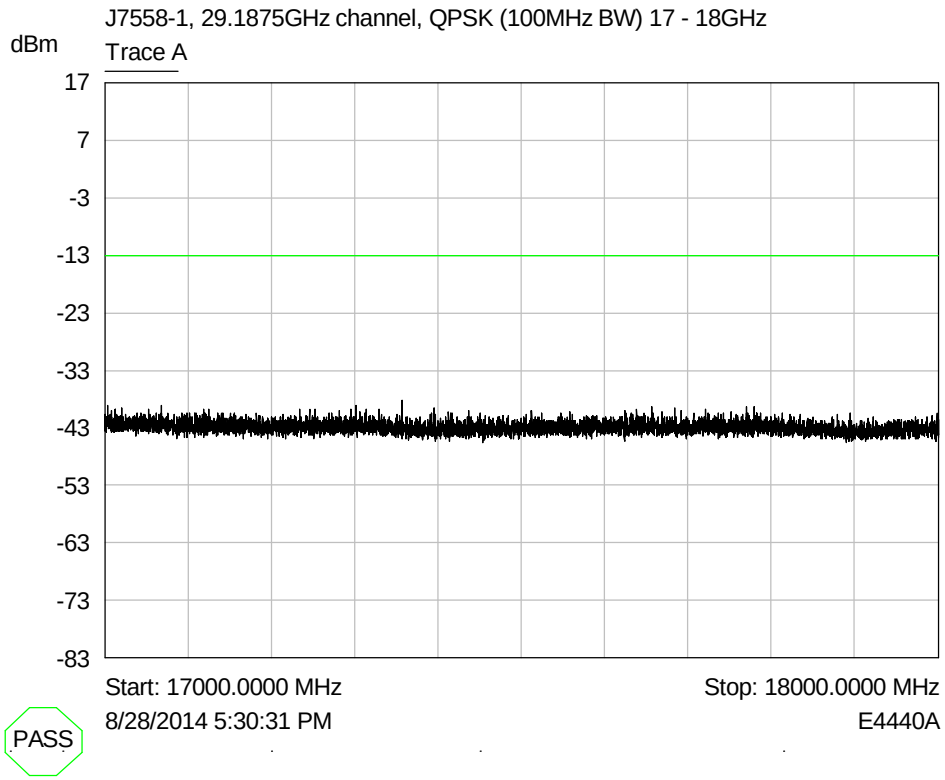

J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 91 - 95GHz
dBm
Trace A
14
4
-6
-16
-26
-36
-46
-56
-66
-76
-86
Start: 91000.0000 MHz
Stop: 95000.0000 MHz
9/2/2014 10:35:36 AM
E4440A
PASS

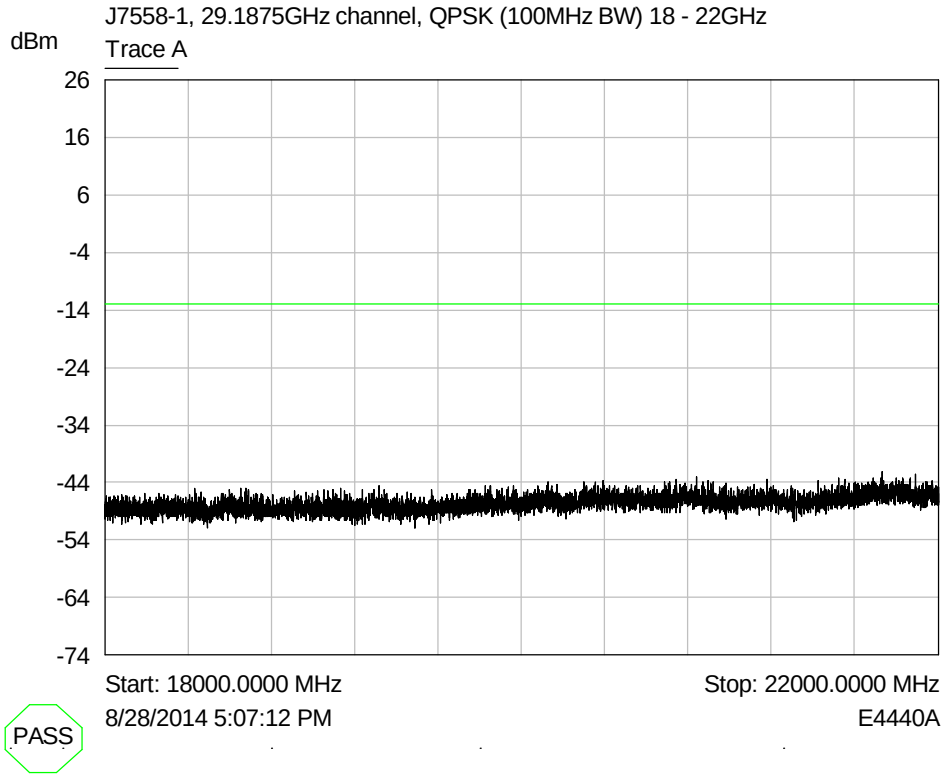

J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 95 - 99GHz
dBm
Trace A
14
4
-6
-16
-26
-36
-46
-56
-66
-76
-86
Start: 95000.0000 MHz
Stop: 99000.0000 MHz
9/2/2014 10:36:14 AM
E4440A
PASS


J7558-1, 28.2485GHz channel, QPSK (100MHz BW) 99 - 100GHz
dBm
Trace A
14
4
-6
-16
-26
-36
-46
-56
-66
-76
-86
Start: 99000.0000 MHz
Stop: 100000.0000 MHz
9/2/2014 10:36:59 AM
E4440A
PASS

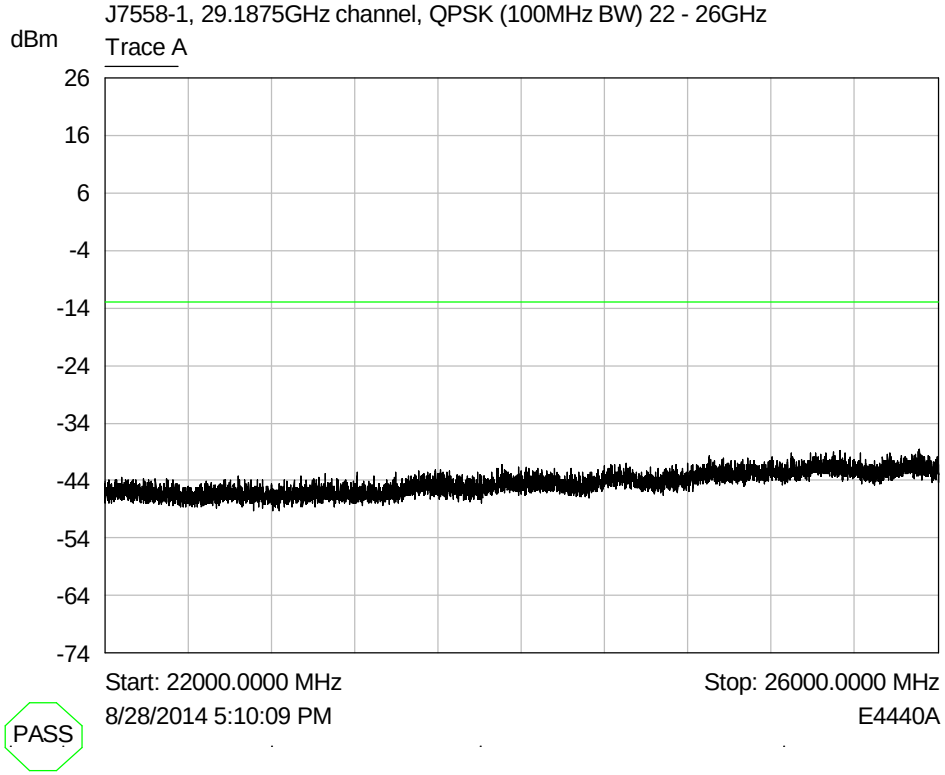
6.1.2 Plots for Band 29.1-29.25 GHz, Power 25 dBm, Spacing 100 MHz, and Modulation QPSK

29.1875 GHz channel.

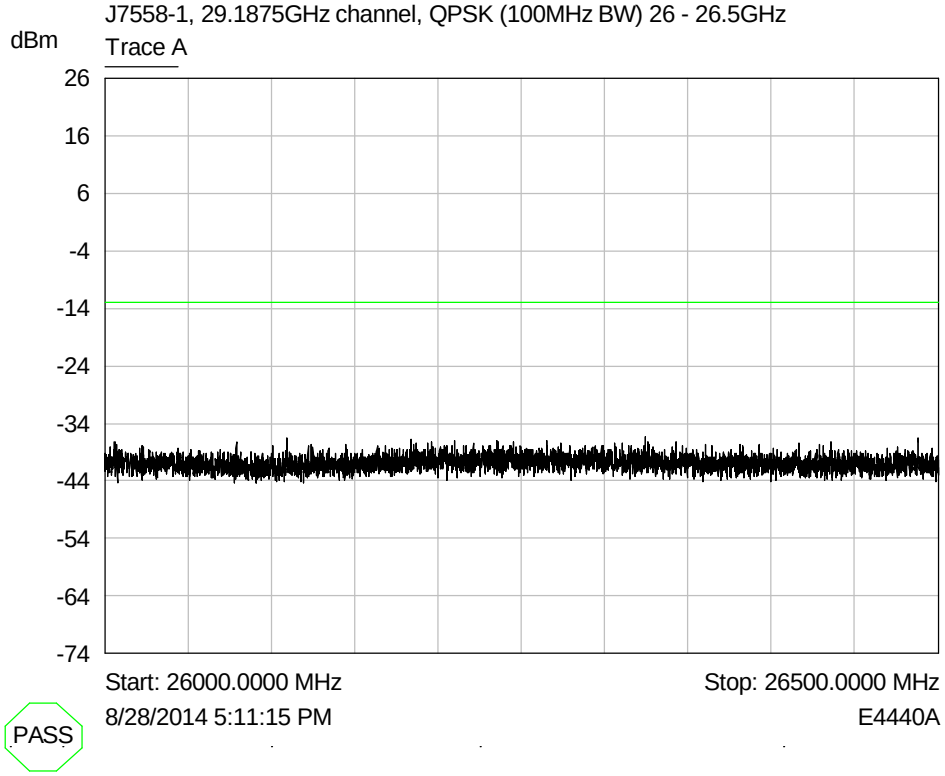


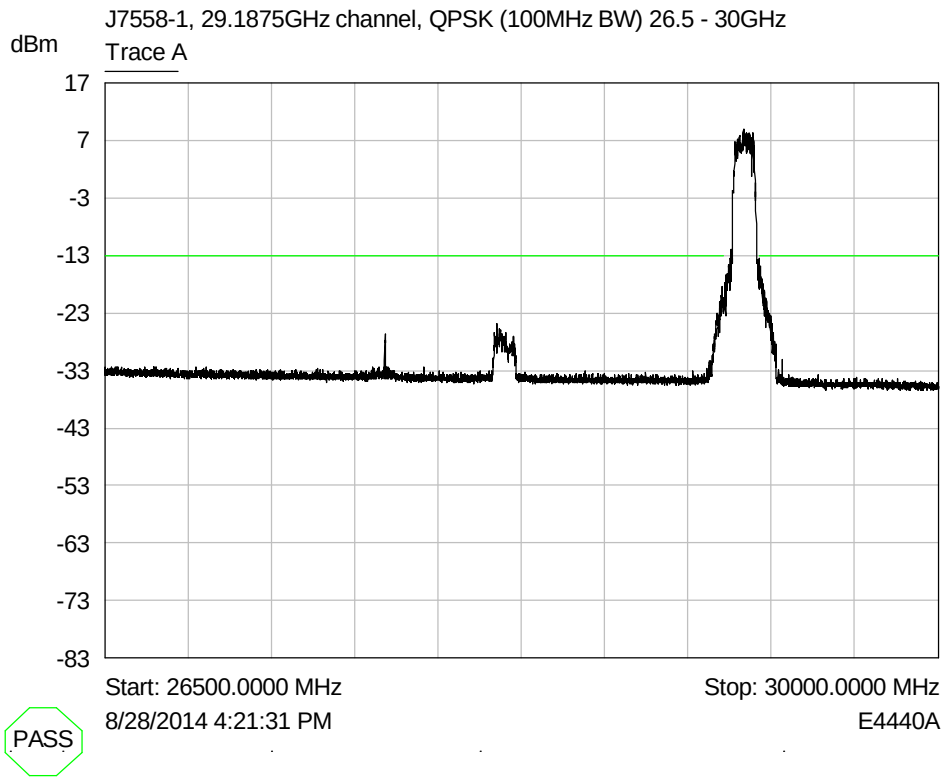


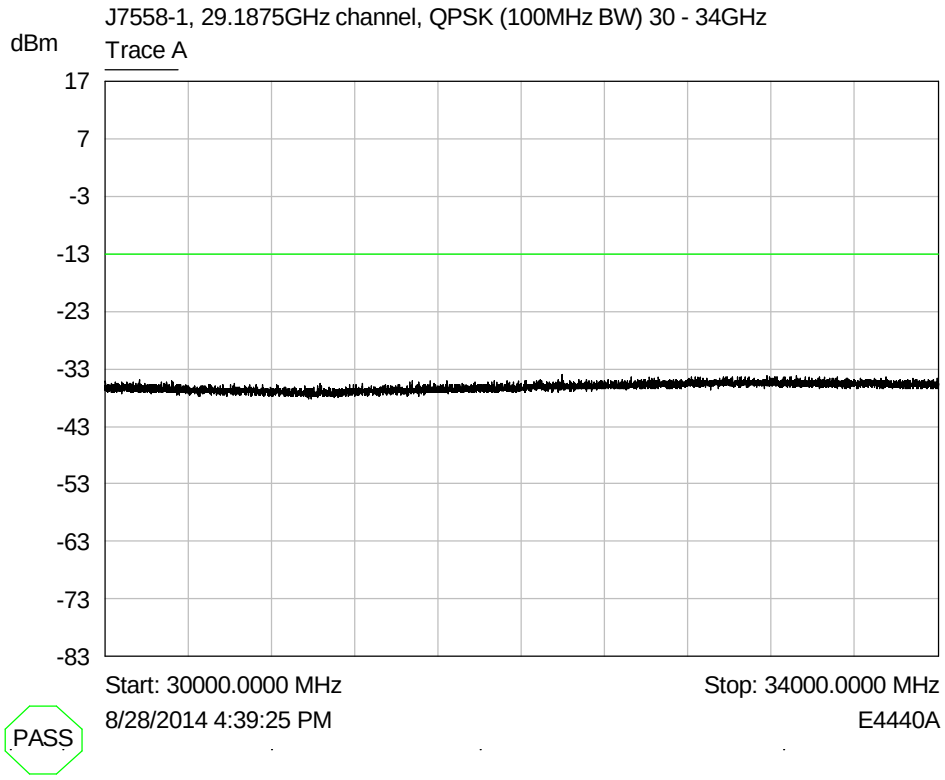
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 22 - 26GHz



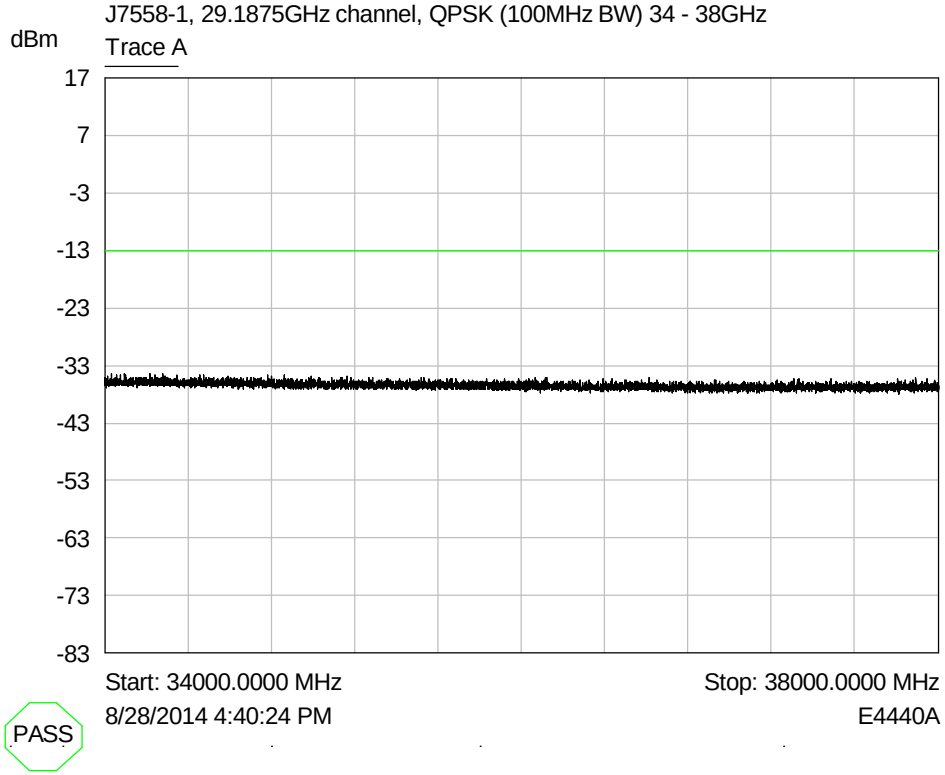
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 26 - 26.5GHz



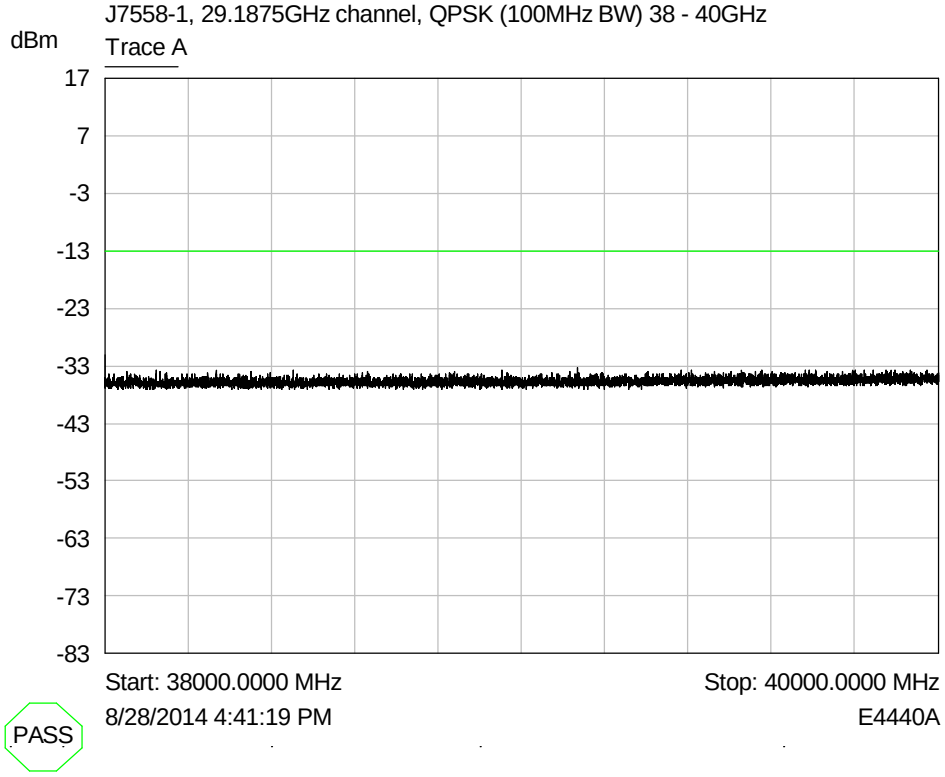

J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 26.5 - 30GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 26500.0000 MHz
Stop: 30000.0000 MHz
8/28/2014 4:21:31 PM
E4440A
PASS

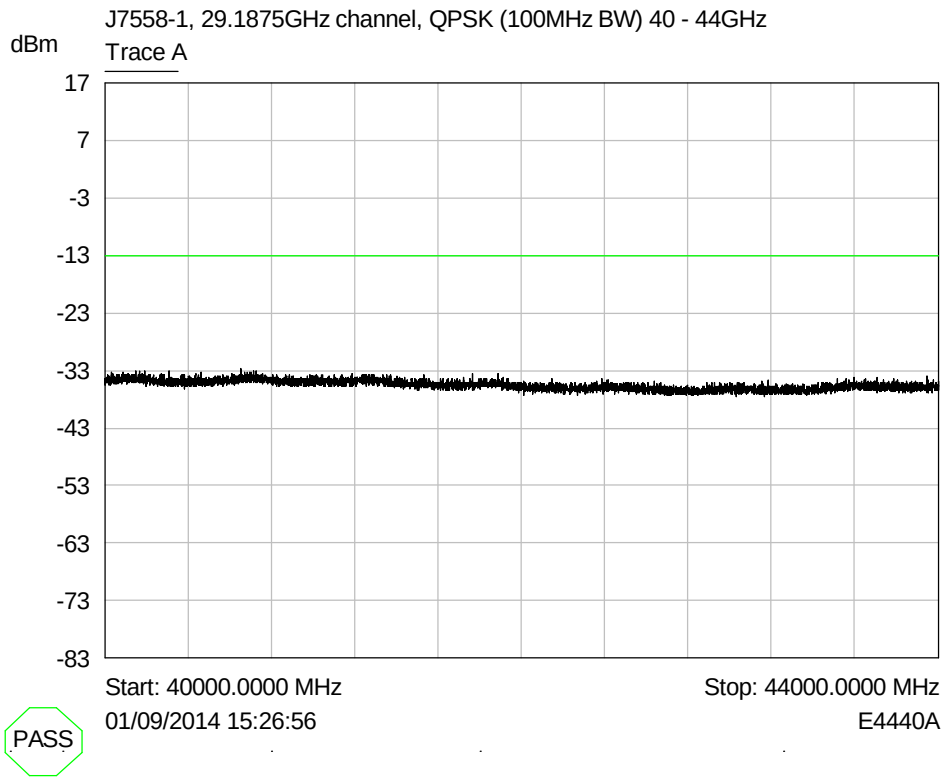

J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 30 - 34GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 30000.0000 MHz
Stop: 34000.0000 MHz
8/28/2014 4:39:25 PM
E4440A
PASS

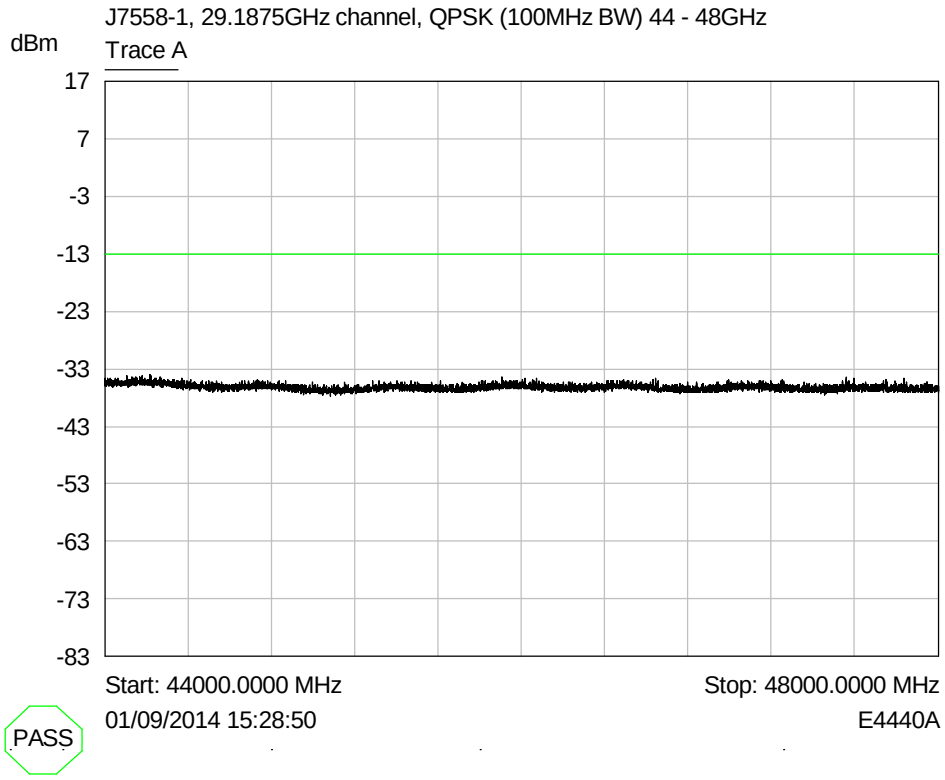
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 34 - 38GHz

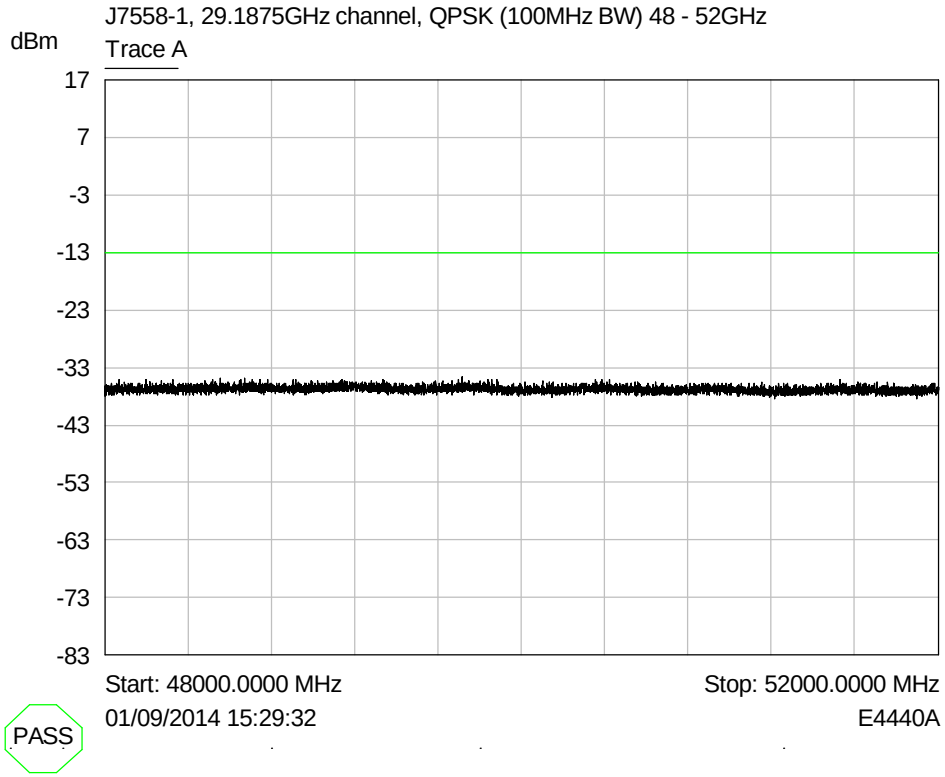


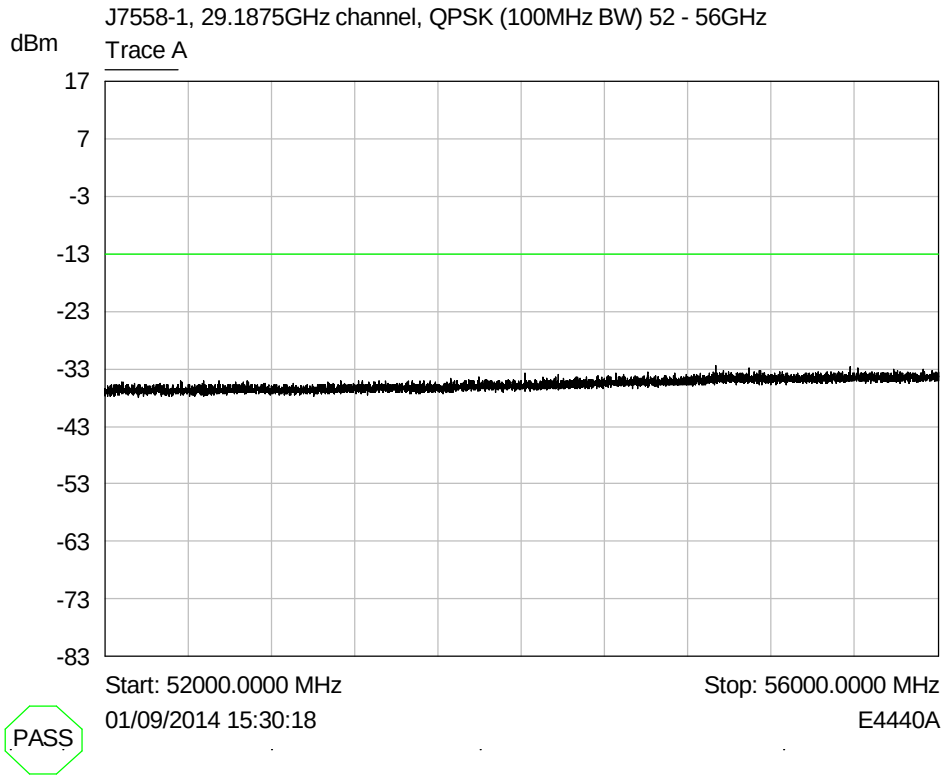
J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 38 - 40GHz

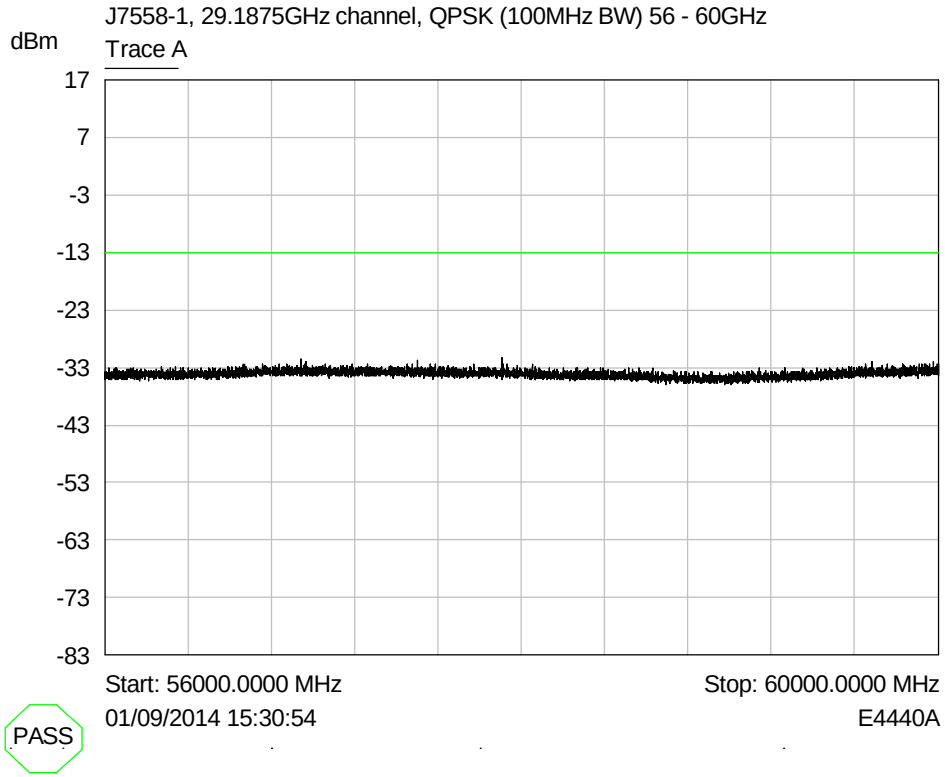


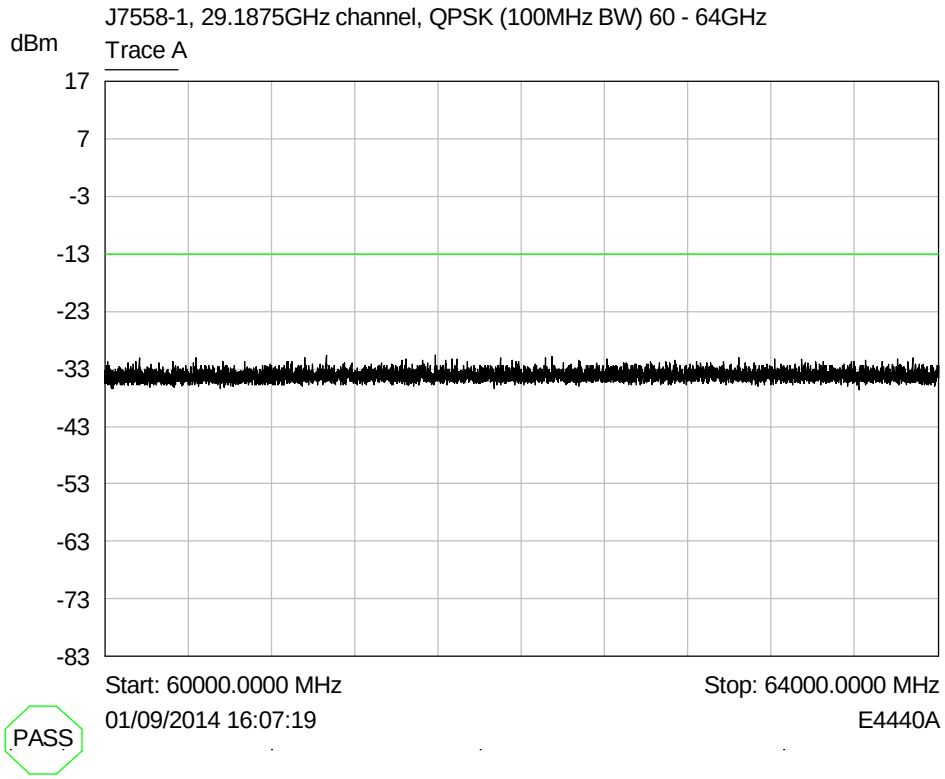

J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 40 - 44GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 40000.0000 MHz
Stop: 44000.0000 MHz
01/09/2014 15:26:56
E4440A
PASS

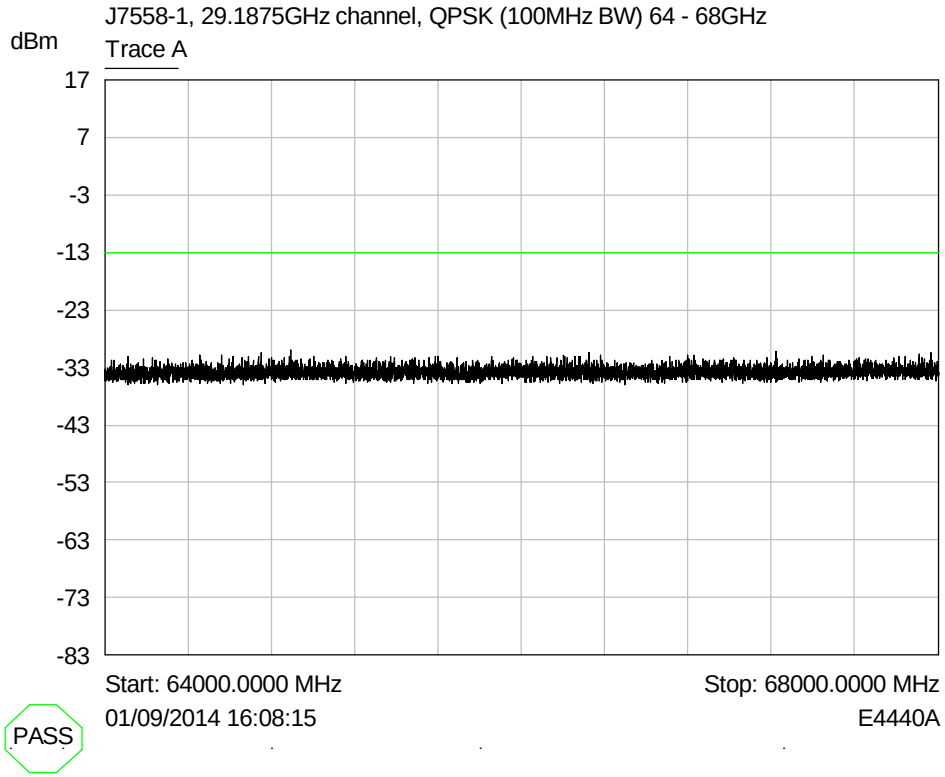

J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 44 - 48GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 44000.0000 MHz
Stop: 48000.0000 MHz
01/09/2014 15:28:50
E4440A
PASS

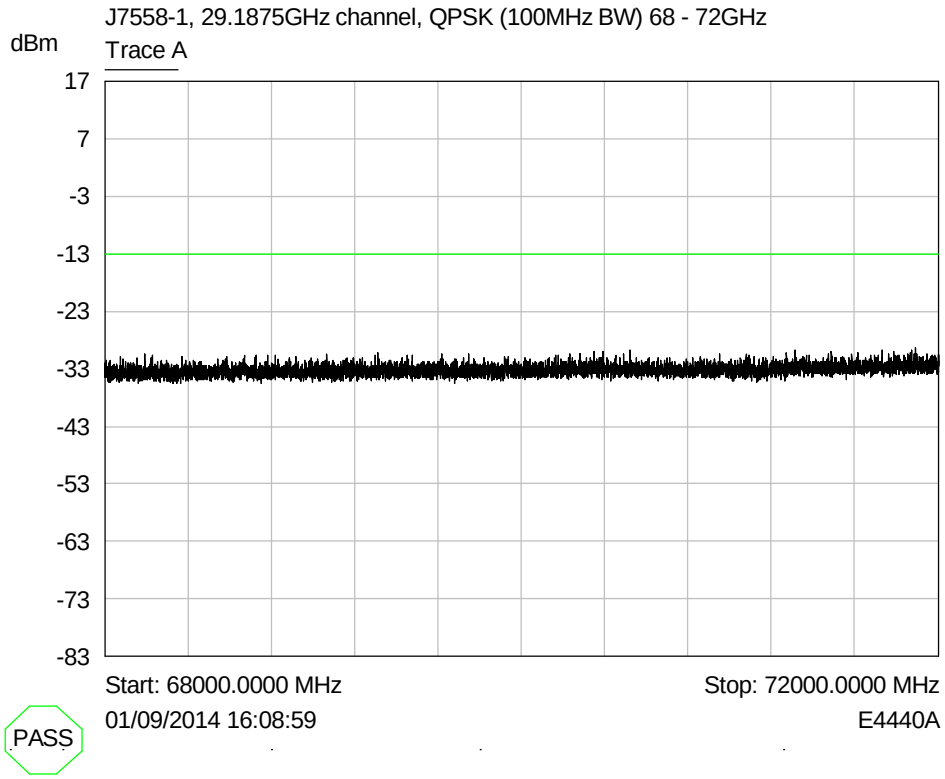

J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 48 - 52GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 48000.0000 MHz
Stop: 52000.0000 MHz
01/09/2014 15:29:32
E4440A
PASS

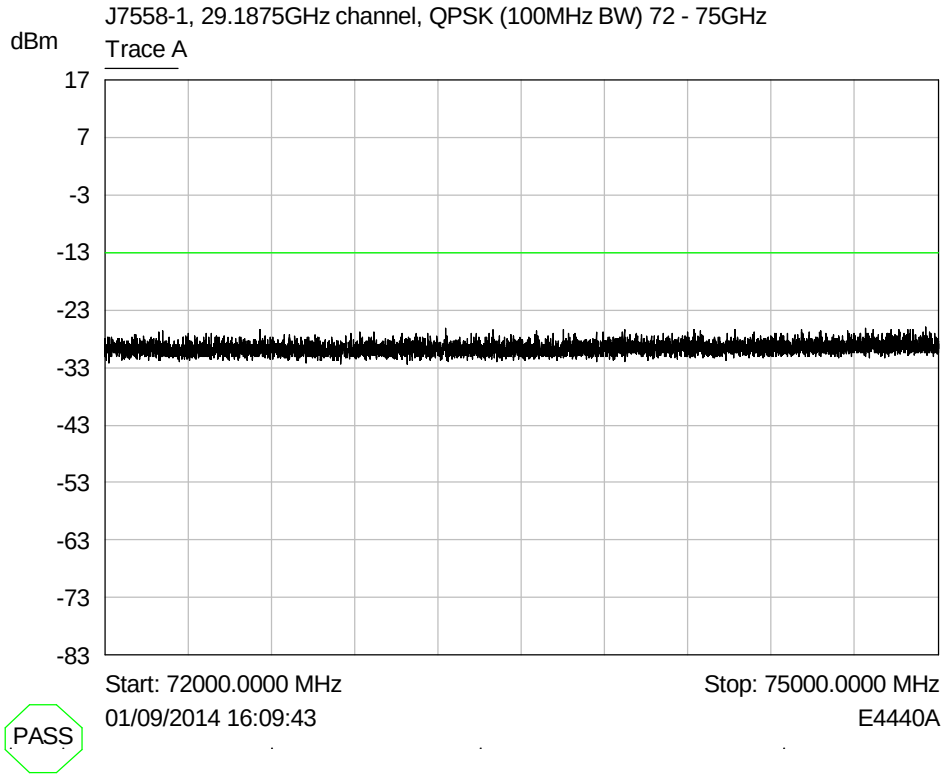

J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 52 - 56GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 52000.0000 MHz
Stop: 56000.0000 MHz
01/09/2014 15:30:18
E4440A
PASS

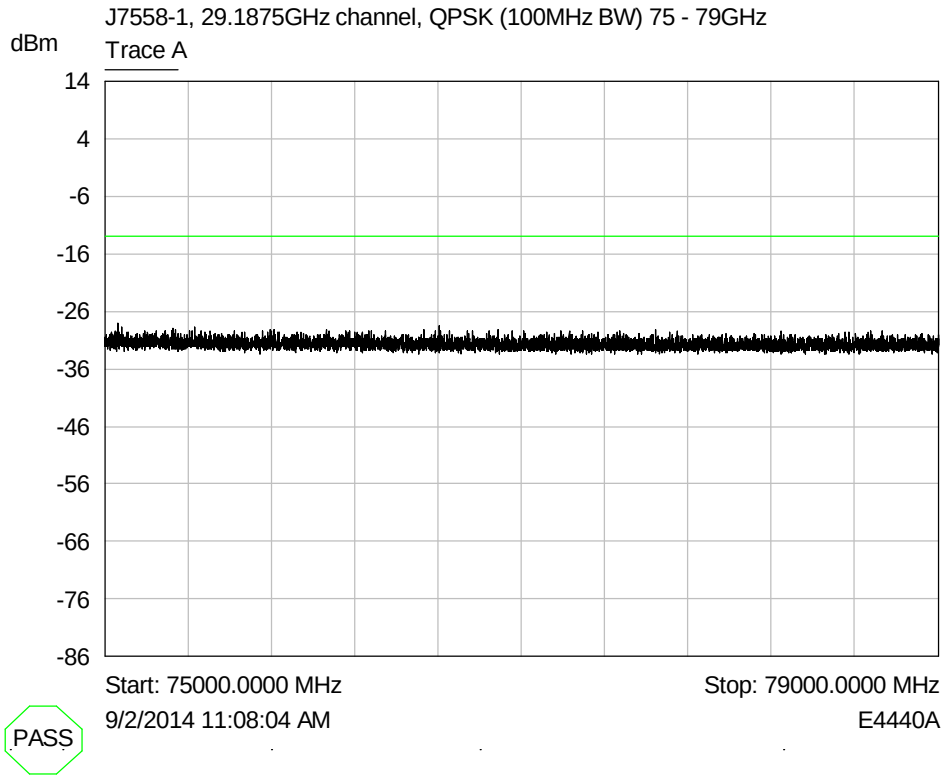

J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 56 - 60GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 56000.0000 MHz
Stop: 60000.0000 MHz
01/09/2014 15:30:54
E4440A
PASS

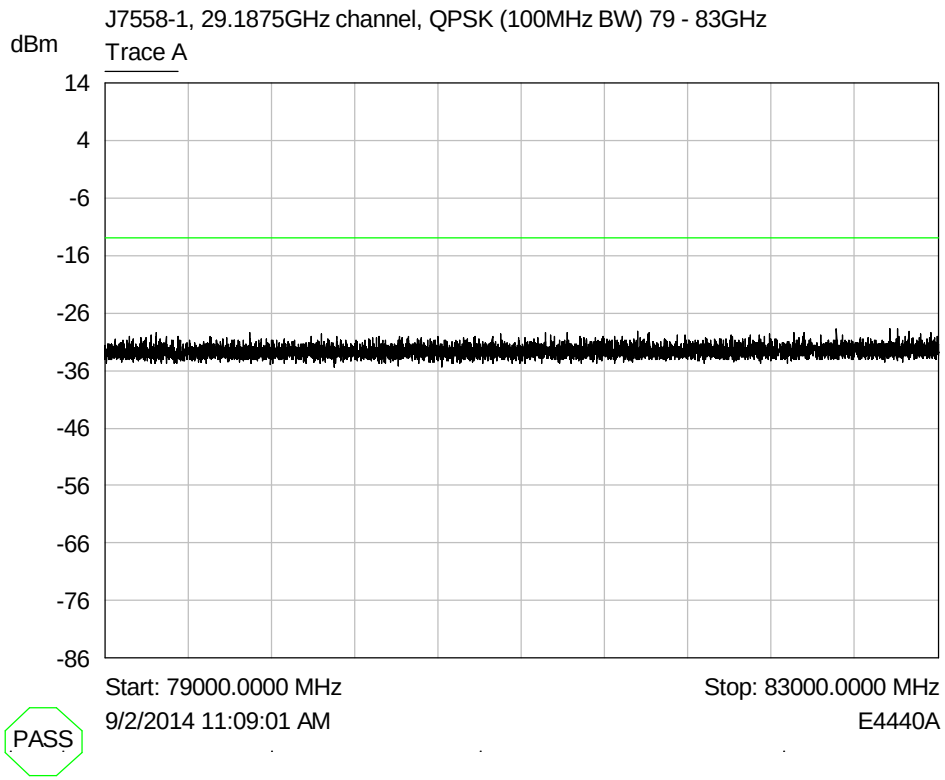

J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 60 - 64GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 60000.0000 MHz
Stop: 64000.0000 MHz
01/09/2014 16:07:19
E4440A
PASS

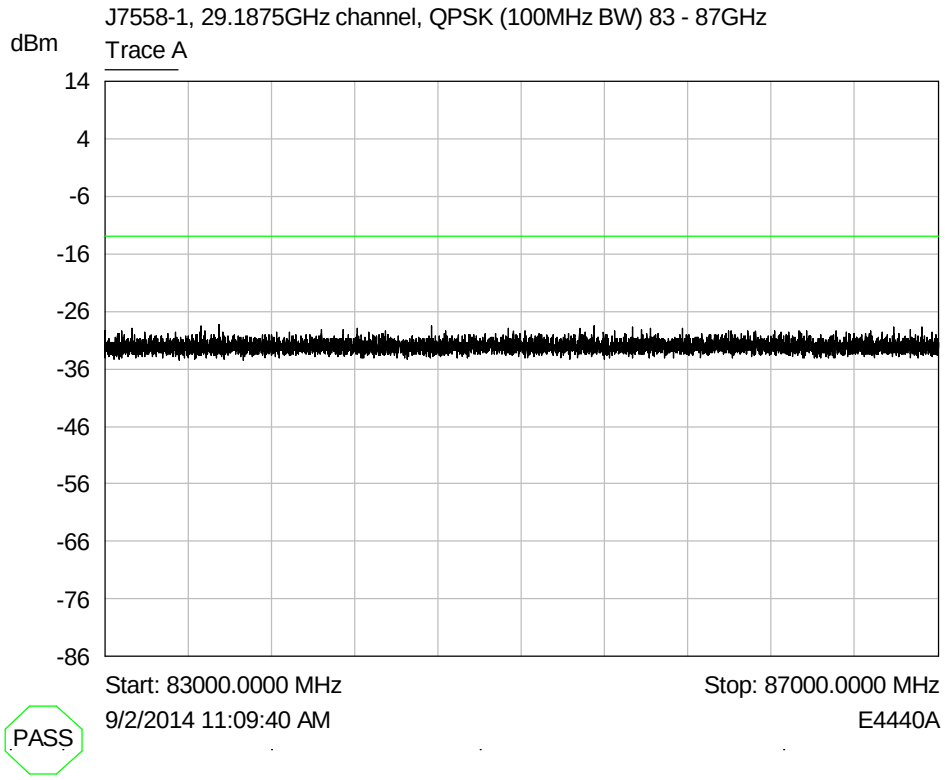

J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 64 - 68GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 64000.0000 MHz
Stop: 68000.0000 MHz
01/09/2014 16:08:15
E4440A
PASS

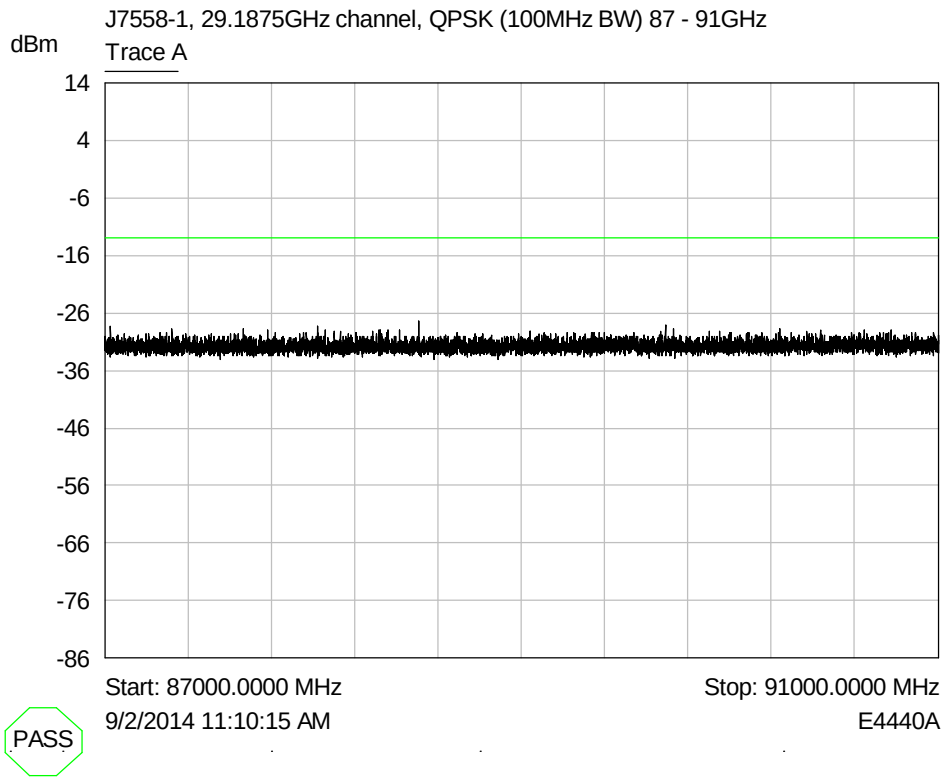

J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 68 - 72GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 68000.0000 MHz
Stop: 72000.0000 MHz
01/09/2014 16:08:59
E4440A
PASS

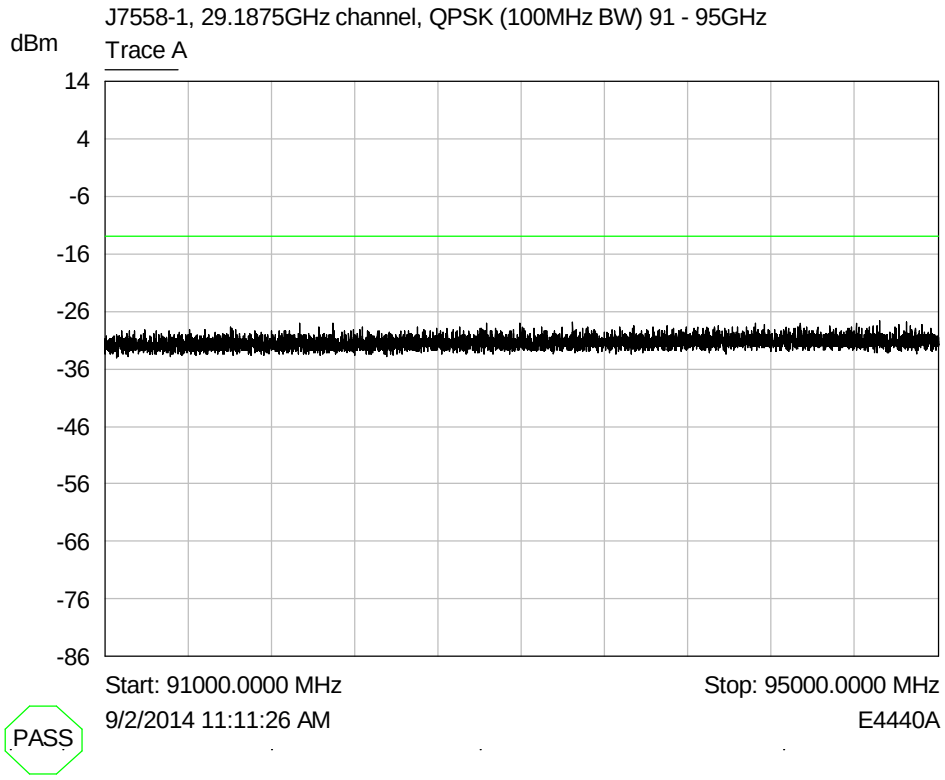

J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 72 - 75GHz
dBm
Trace A
17
7
-3
-13
-23
-33
-43
-53
-63
-73
-83
Start: 72000.0000 MHz
Stop: 75000.0000 MHz
01/09/2014 16:09:43
E4440A
PASS

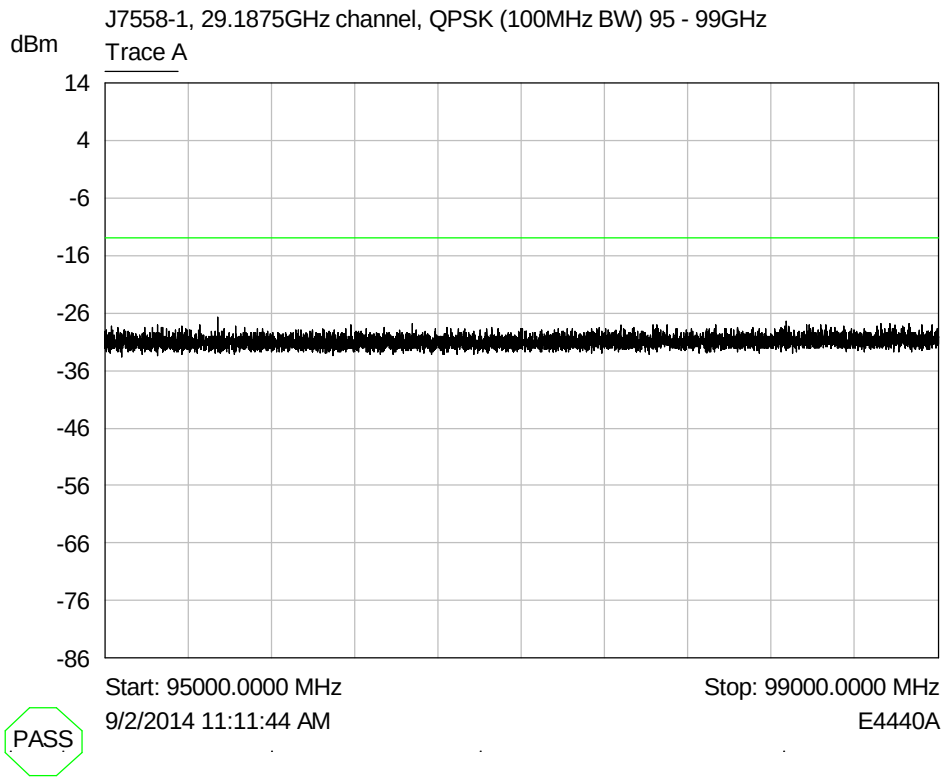

J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 75 - 79GHz
dBm
Trace A
14
4
-6
-16
-26
-36
-46
-56
-66
-76
-86
Start: 75000.0000 MHz
Stop: 79000.0000 MHz
9/2/2014 11:08:04 AM
E4440A
PASS

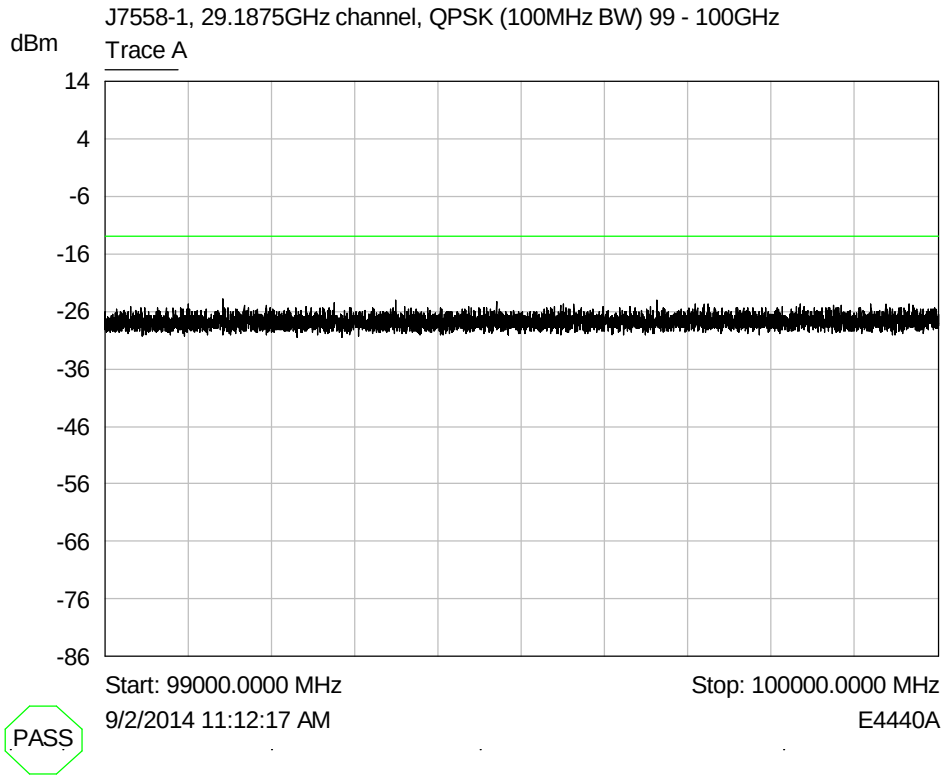

J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 79 - 83GHz
dBm
Trace A
14
4
-6
-16
-26
-36
-46
-56
-66
-76
-86
Start: 79000.0000 MHz
Stop: 83000.0000 MHz
9/2/2014 11:09:01 AM
E4440A
PASS


J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 83 - 87GHz
dBm
Trace A
14
4
-6
-16
-26
-36
-46
-56
-66
-76
-86
Start: 83000.0000 MHz
Stop: 87000.0000 MHz
9/2/2014 11:09:40 AM
E4440A
PASS


J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 87 - 91GHz
dBm
Trace A
14
4
-6
-16
-26
-36
-46
-56
-66
-76
-86
Start: 87000.0000 MHz
Stop: 91000.0000 MHz
9/2/2014 11:10:15 AM
E4440A
PASS

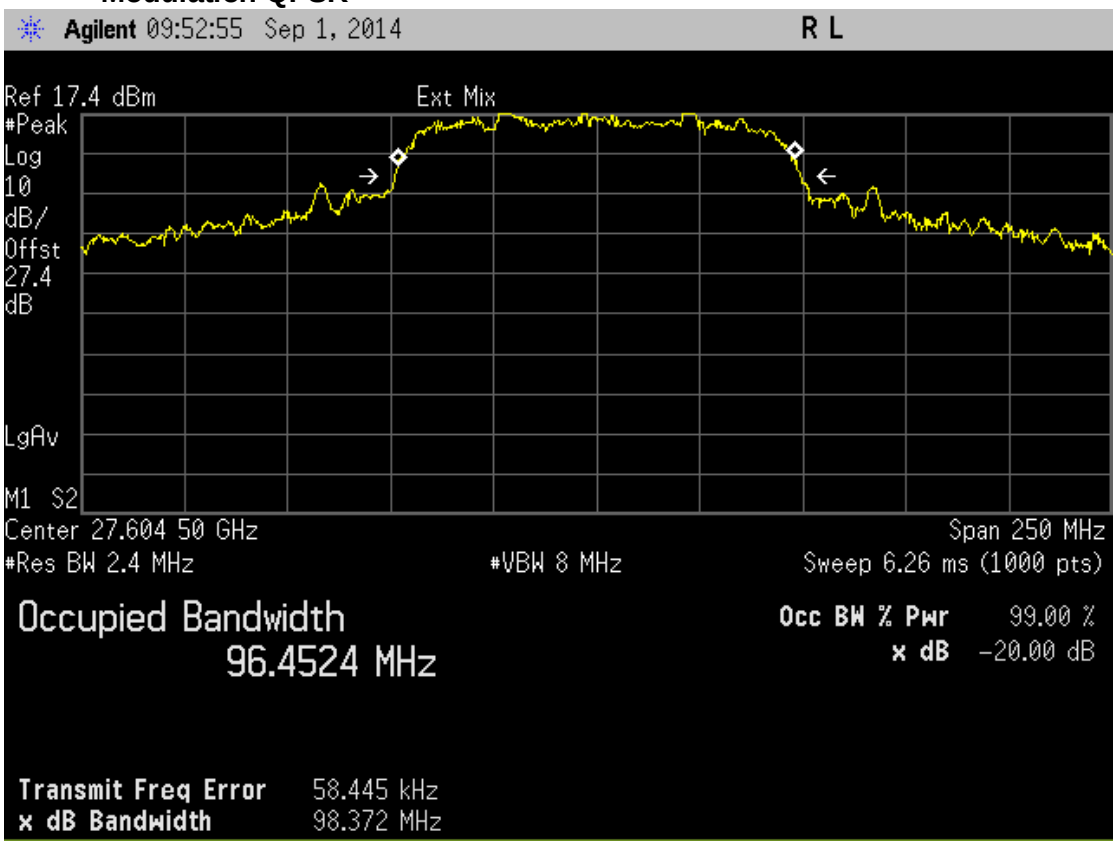

J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 91 - 95GHz
dBm
Trace A
14
4
-6
-16
-26
-36
-46
-56
-66
-76
-86
Start: 91000.0000 MHz
Stop: 95000.0000 MHz
9/2/2014 11:11:26 AM
E4440A
PASS


J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 95 - 99GHz
dBm
Trace A
14
4
-6
-16
-26
-36
-46
-56
-66
-76
-86
Start: 95000.0000 MHz
Stop: 99000.0000 MHz
9/2/2014 11:11:44 AM
E4440A
PASS

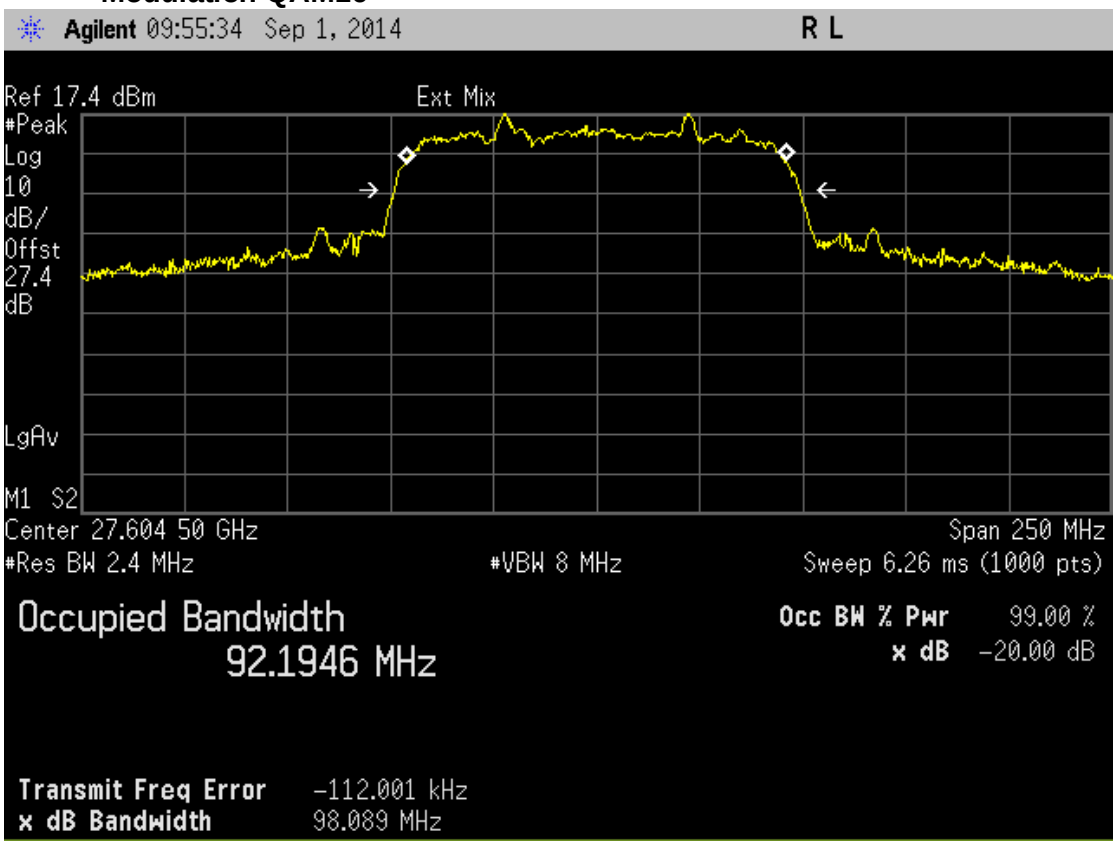

J7558-1, 29.1875GHz channel, QPSK (100MHz BW) 99 - 100GHz
dBm
Trace A
14
4
-6
-16
-26
-36
-46
-56
-66
-76
-86
Start: 99000.0000 MHz
Stop: 100000.0000 MHz
9/2/2014 11:12:17 AM
E4440A
PASS

6.2 Occupied bandwidth

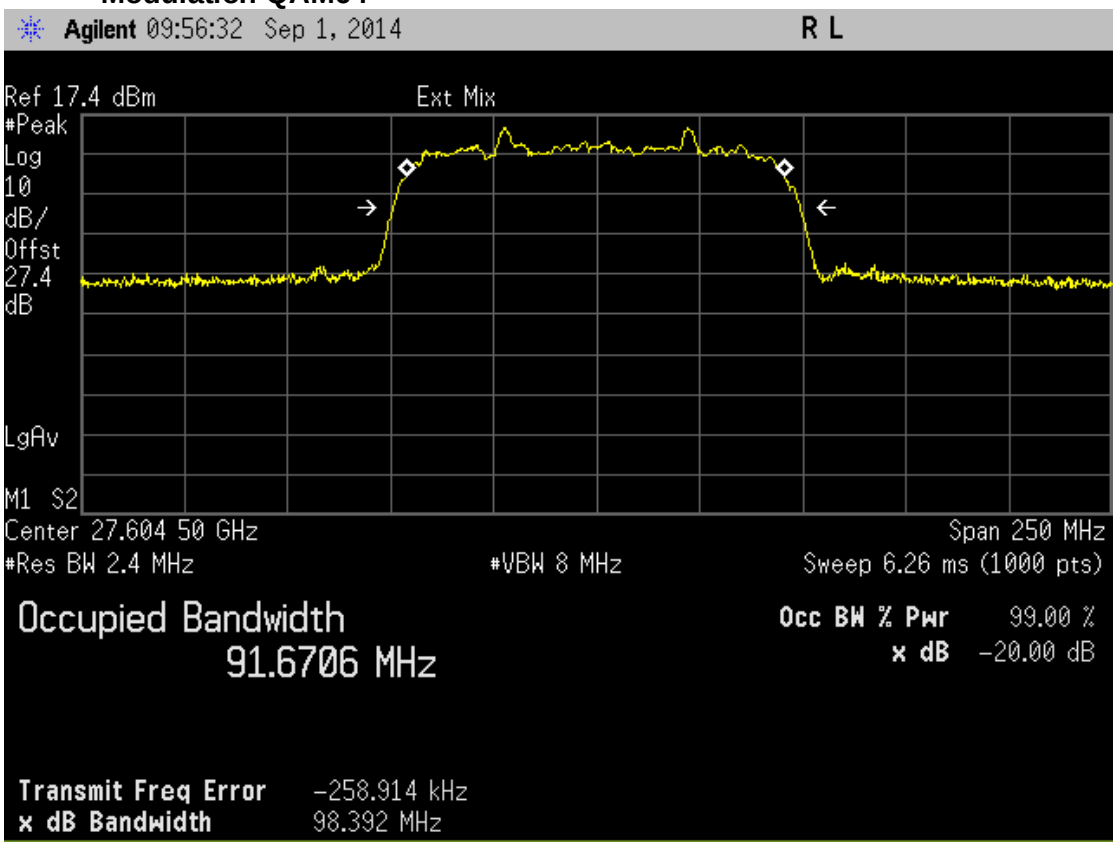
6.2.1 Plot for 27.6045 GHz channel, Power 25 dBm, Spacing 100 MHz, and Modulation QPSK



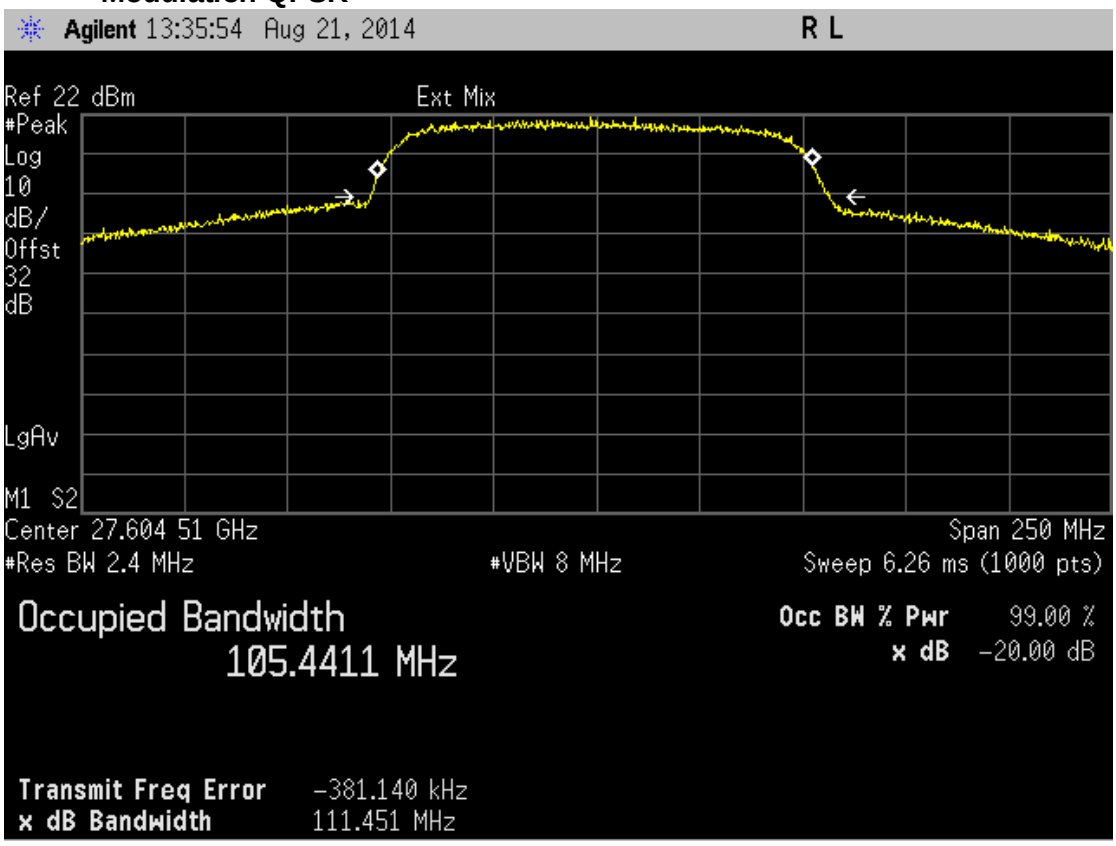
6.2.2 Plot for 27.6045 GHz channel, Power 21 dBm, Spacing 100 MHz, and Modulation QAM16



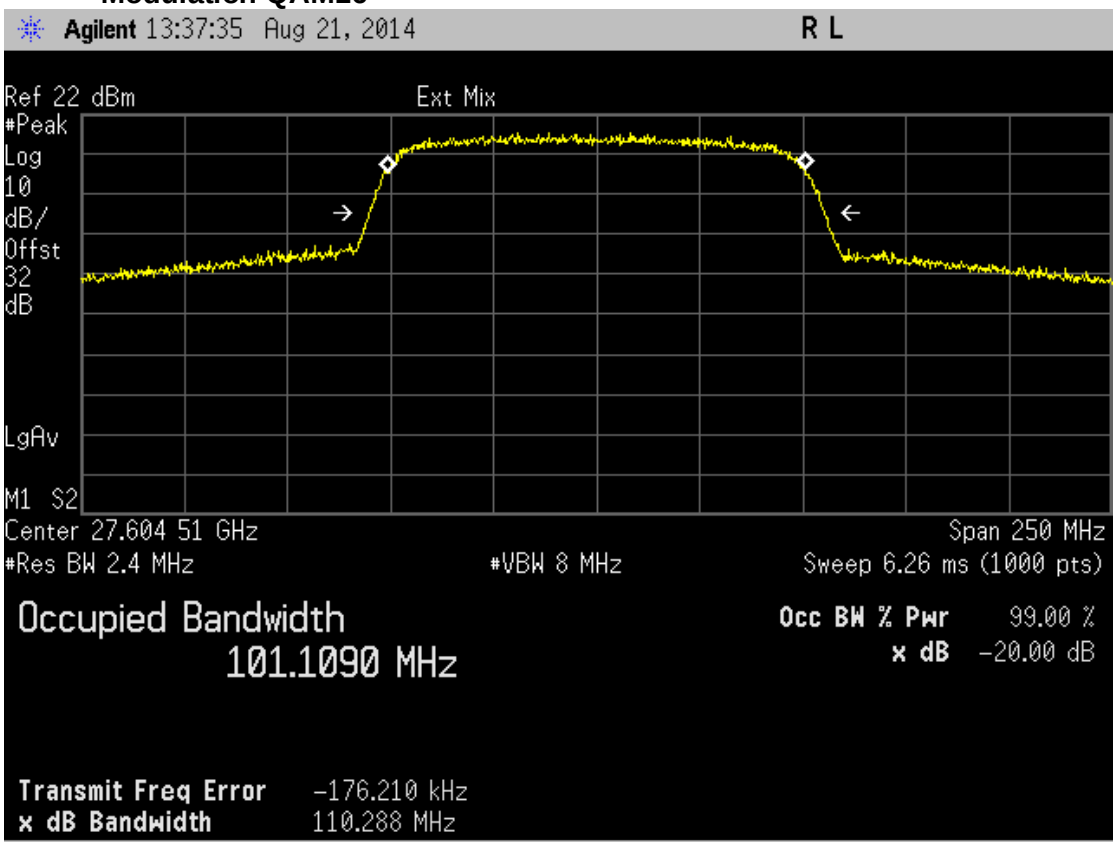
6.2.3 Plot for 27.6045 GHz channel, Power 18 dBm, Spacing 100 MHz, and Modulation QAM64



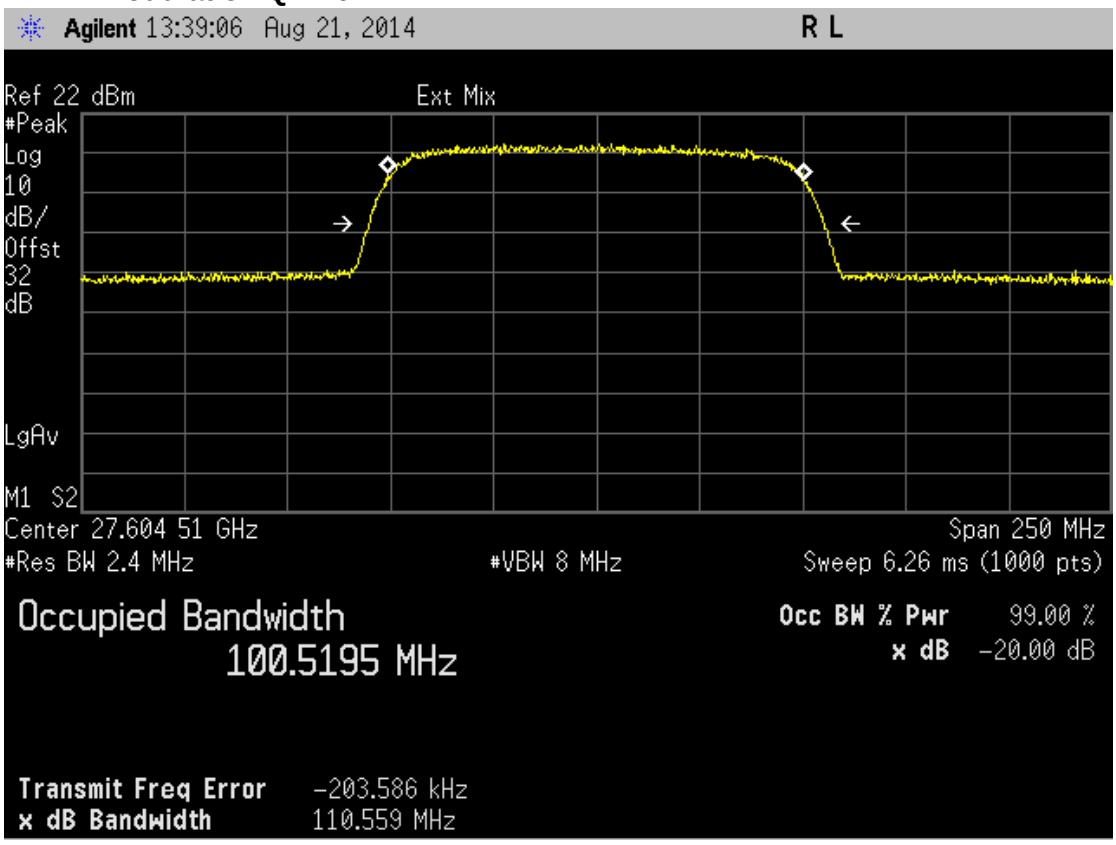
6.2.4 Plot for 27.6045 GHz channel, Power 25 dBm, Spacing 112 MHz, and Modulation QPSK



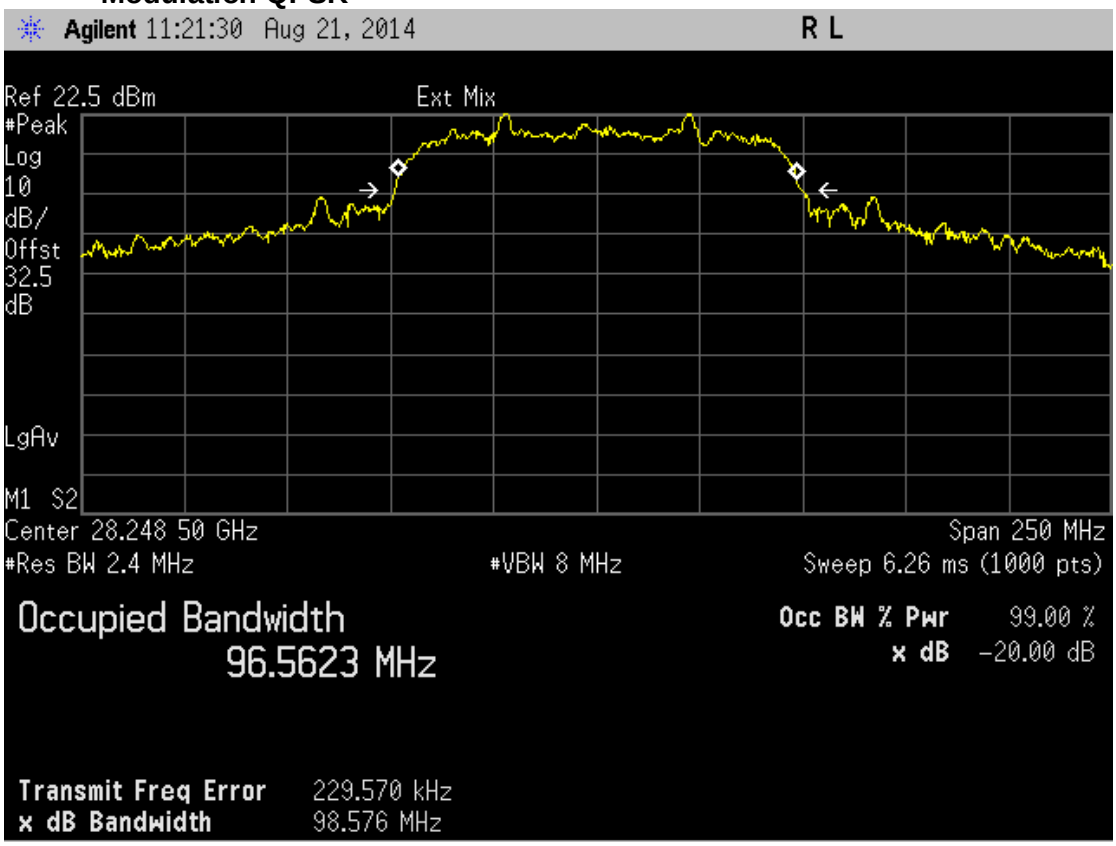
6.2.5 Plot for 27.6045 GHz channel, Power 21 dBm, Spacing 112 MHz, and Modulation QAM16



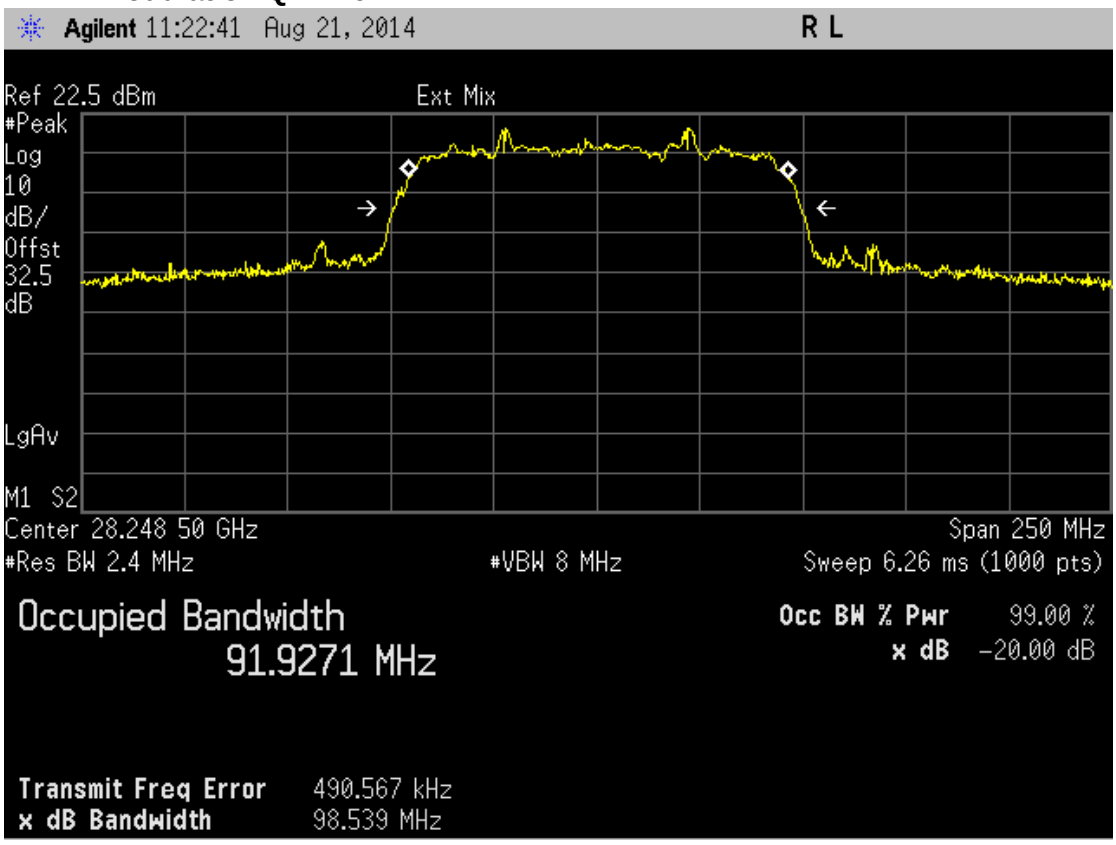
6.2.6 Plot for 27.6045 GHz channel, Power 18 dBm, Spacing 112 MHz, and Modulation QAM64



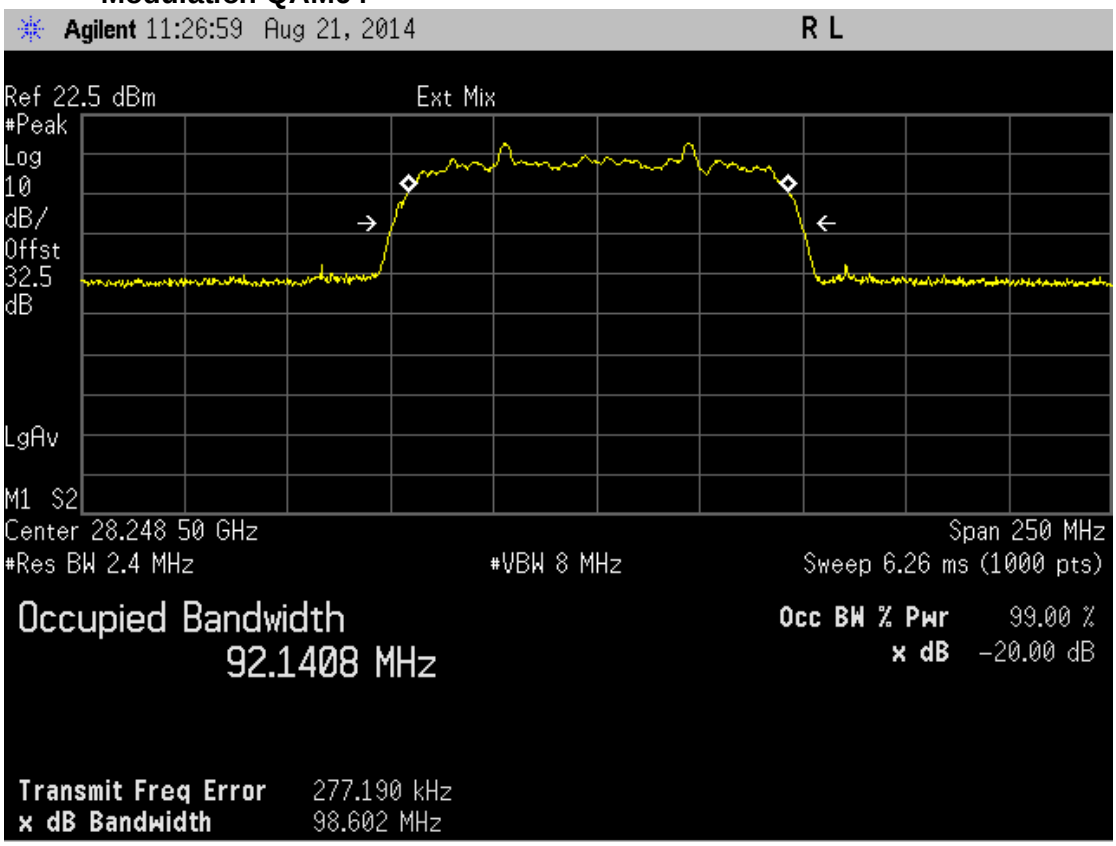
6.2.7 Plot for 28.2485 GHz channel, Power 25 dBm, Spacing 100 MHz, and Modulation QPSK



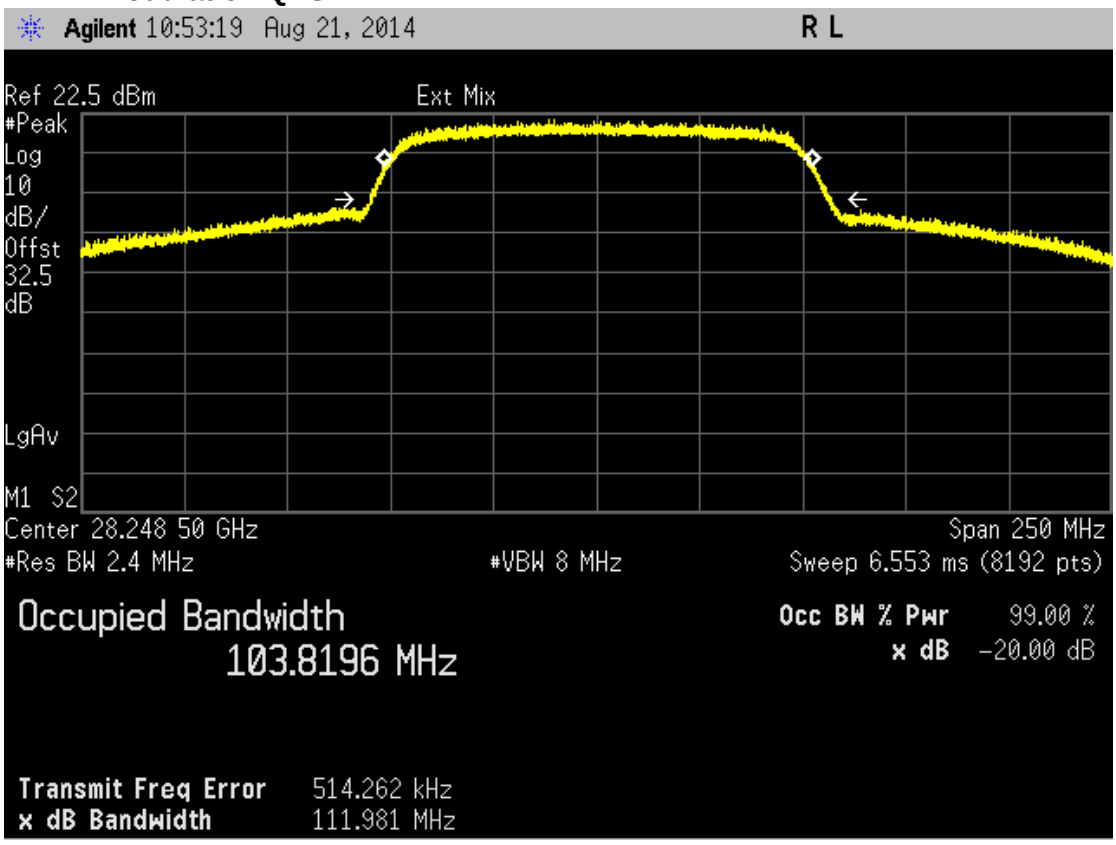
6.2.8 Plot for 28.2485 GHz channel, Power 21 dBm, Spacing 100 MHz, and Modulation QAM16



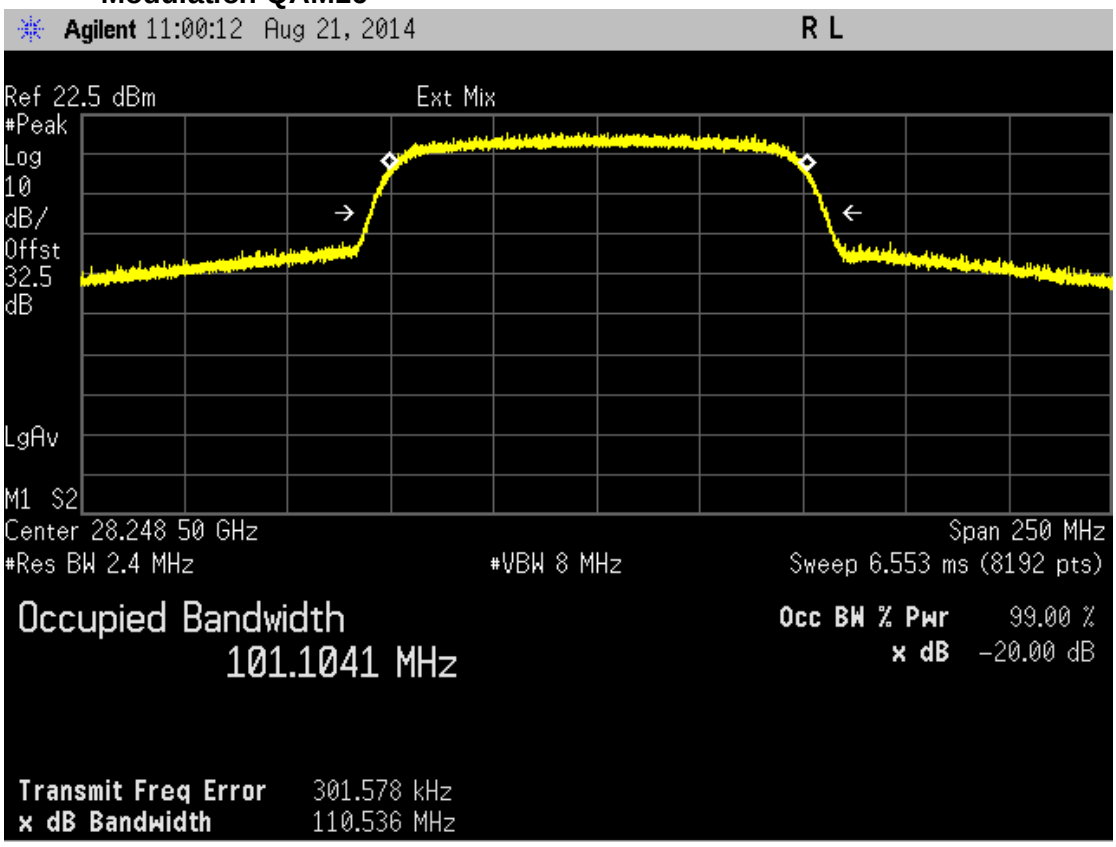
6.2.9 Plot for 28.2485 GHz channel, Power 18 dBm, Spacing 100 MHz, and Modulation QAM64



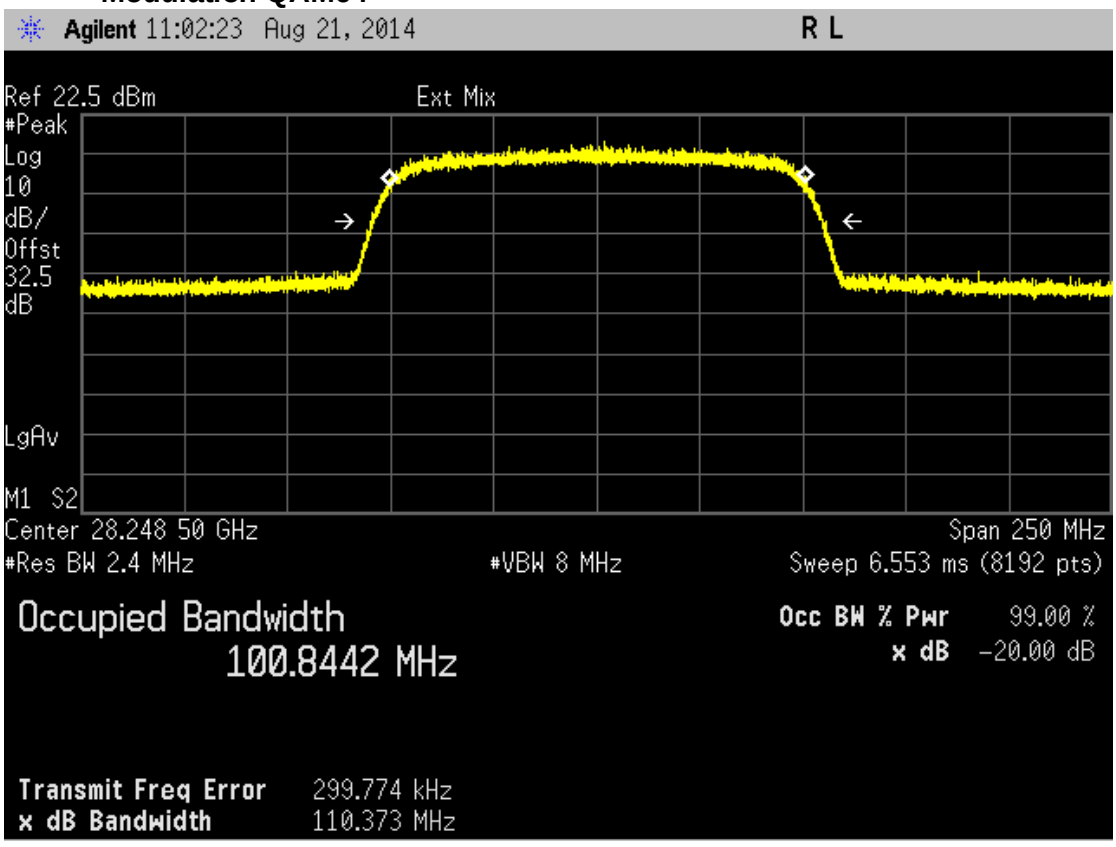
6.2.10 Plot for 28.2485 GHz channel, Power 25 dBm, Spacing 112 MHz, and Modulation QPSK



6.2.11 Plot for 28.2485 GHz channel, Power 21 dBm, Spacing 112 MHz, and Modulation QAM16

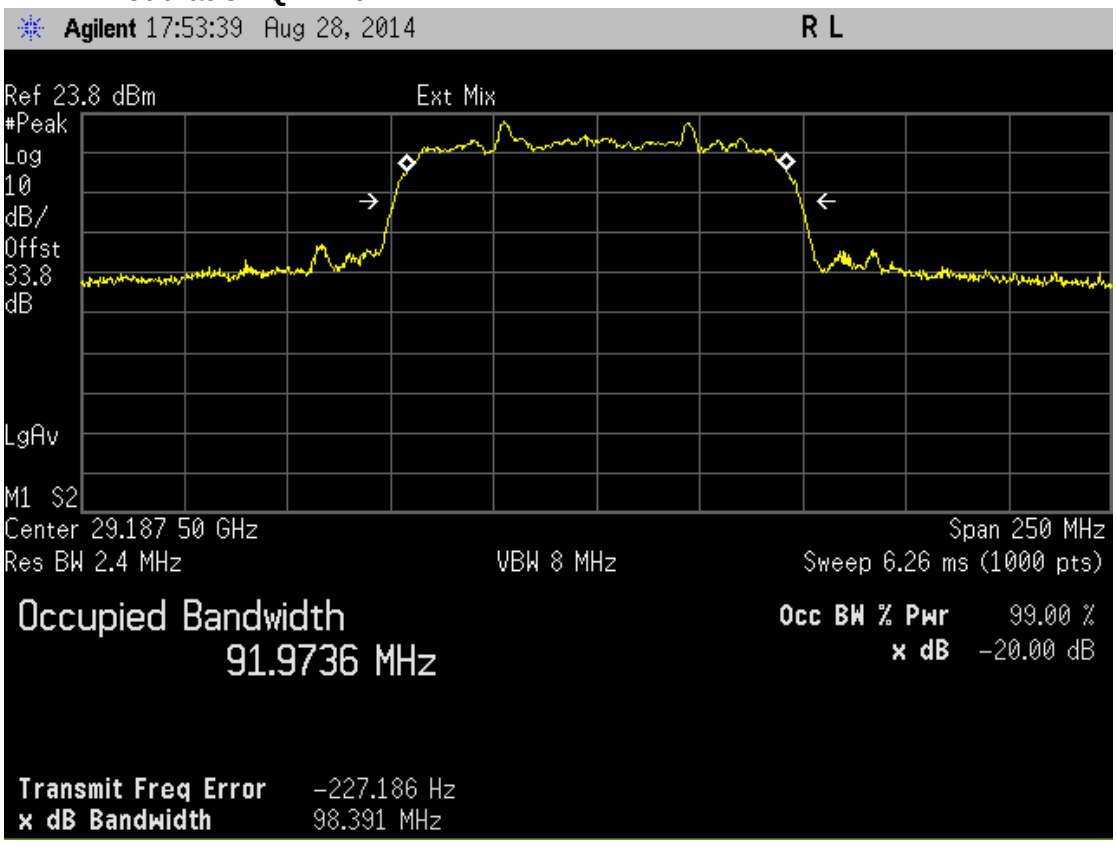


6.2.12 Plot for 28.2485 GHz channel, Power 18 dBm, Spacing 112 MHz, and Modulation QAM64

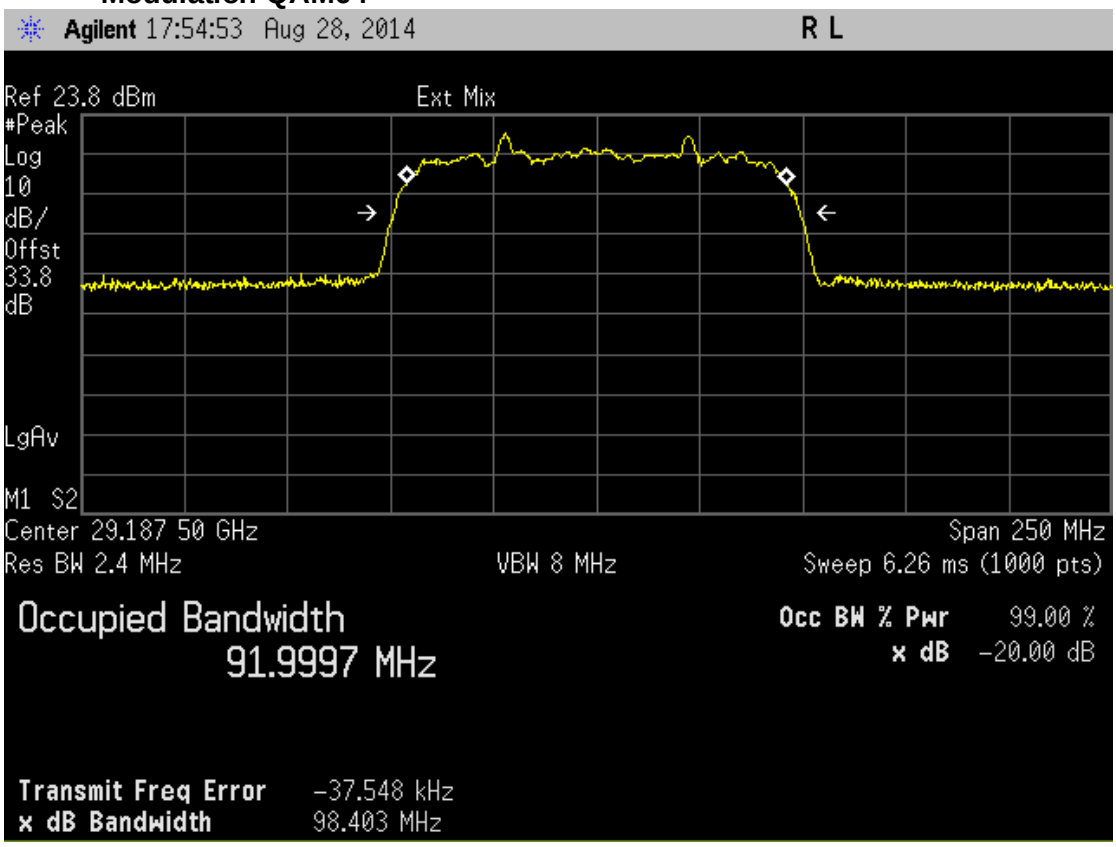


6.2.13 Plot for 29.1875 GHz channel, Power 25 dBm, Spacing 100 MHz, and Modulation QPSK

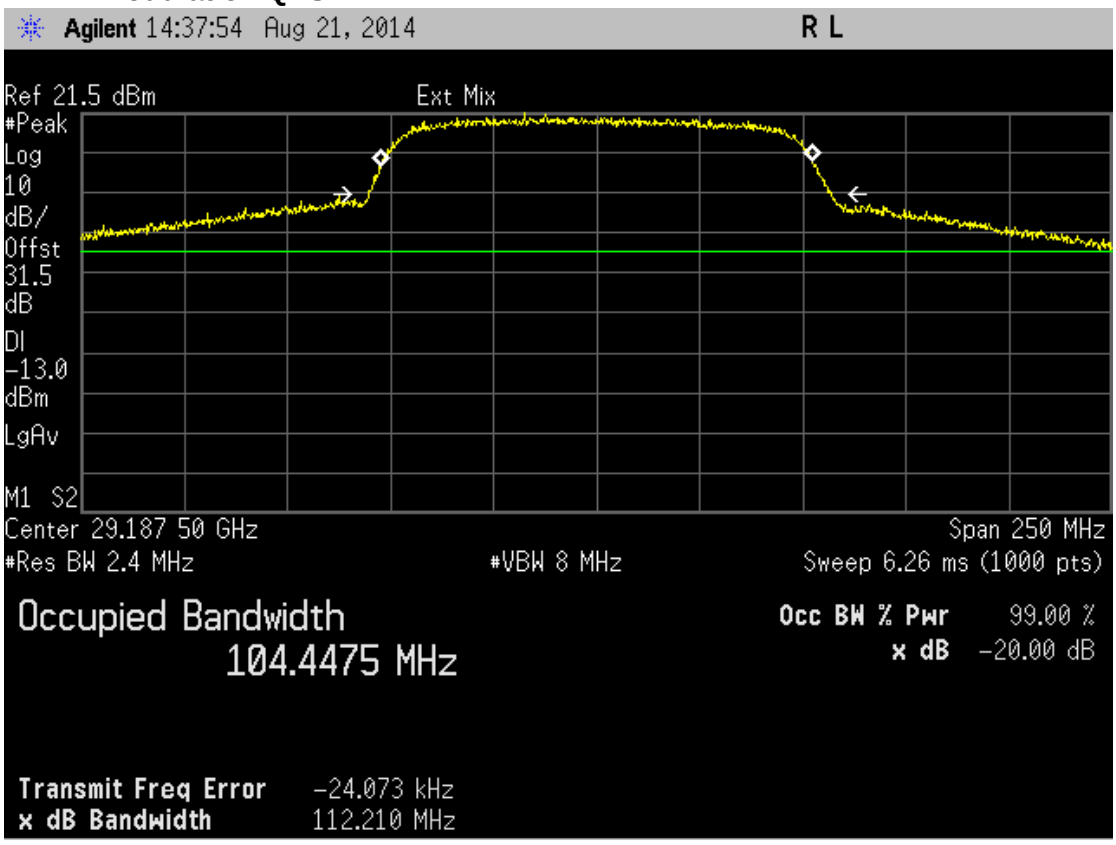
6.2.14 Plot for 29.1875 GHz channel, Power 21 dBm, Spacing 100 MHz, and Modulation QAM16



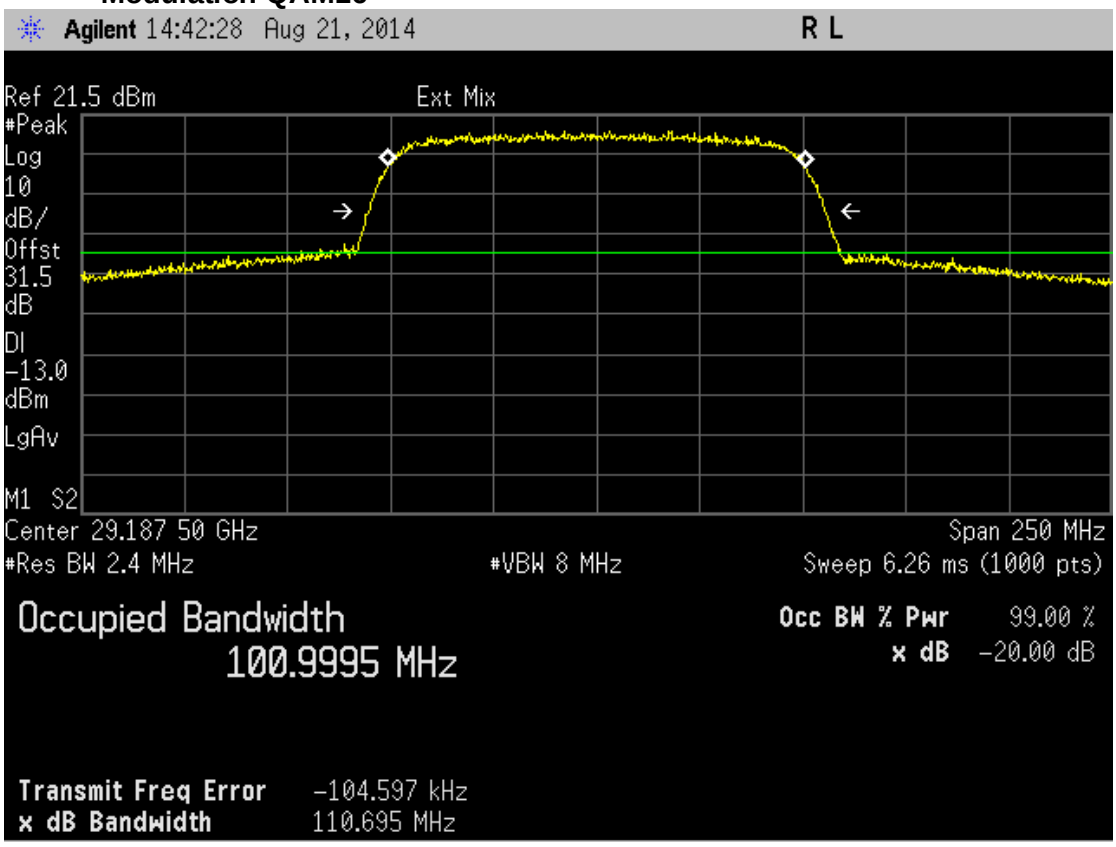
6.2.15 Plot for 29.1875 GHz channel, Power 18 dBm, Spacing 100 MHz, and Modulation QAM64



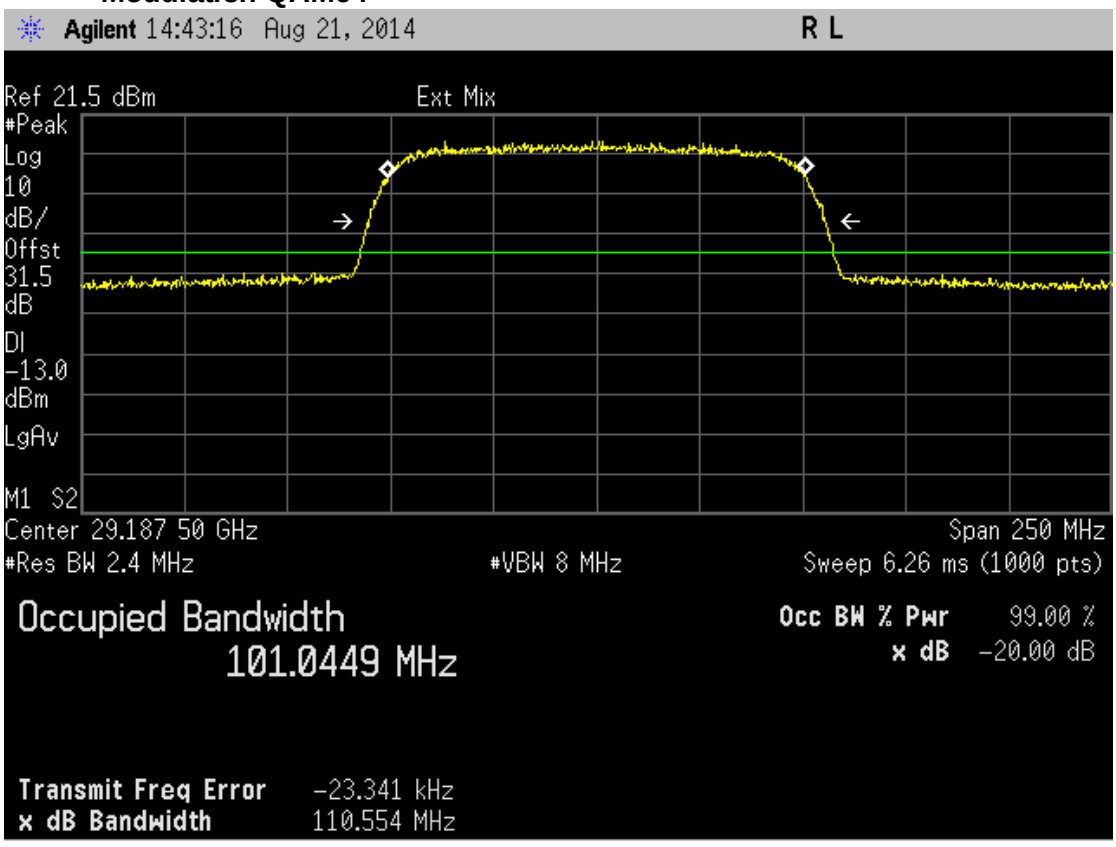
6.2.16 Plot for 29.1875 GHz channel, Power 25 dBm, Spacing 112 MHz, and Modulation QPSK



6.2.17 Plot for 29.1875 GHz channel, Power 21 dBm, Spacing 112 MHz, and Modulation QAM16



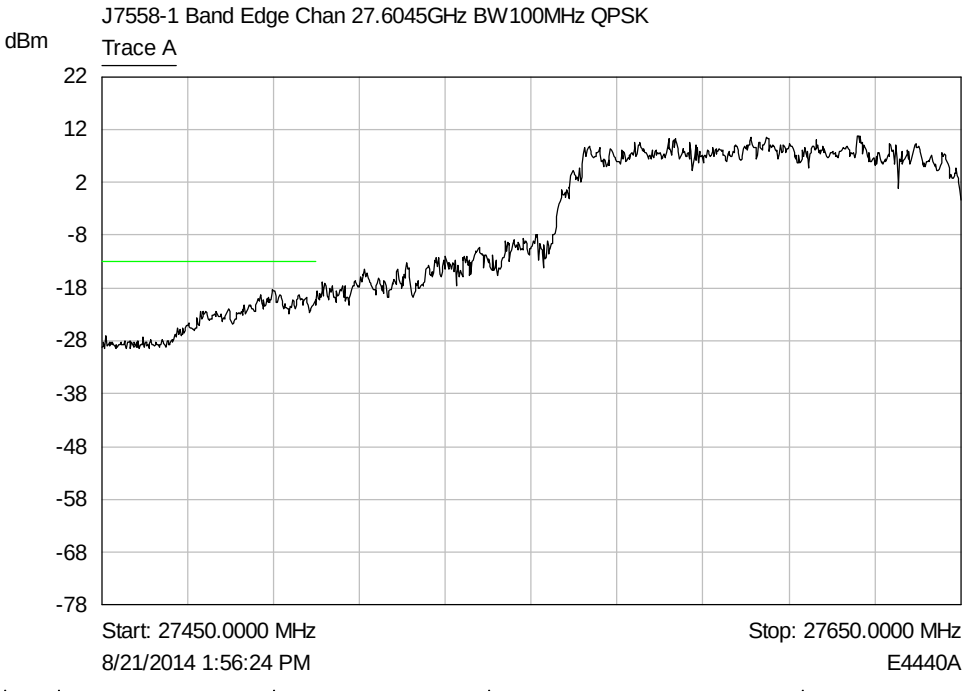
6.2.18 Plot for 29.1875 GHz channel, Power 18 dBm, Spacing 112 MHz, and Modulation QAM64



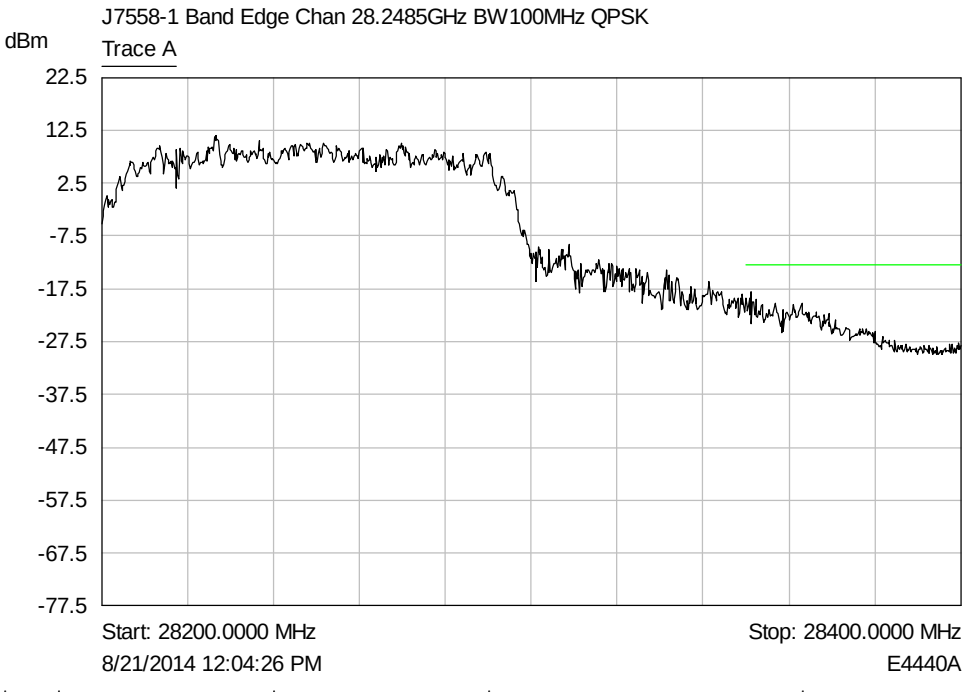
6.3 Band edge plots

6.3.1 Plots for 27.5 – 28.35 GHz band, Power 25 dBm, Spacing 100 MHz, and Modulation QPSK

Lower

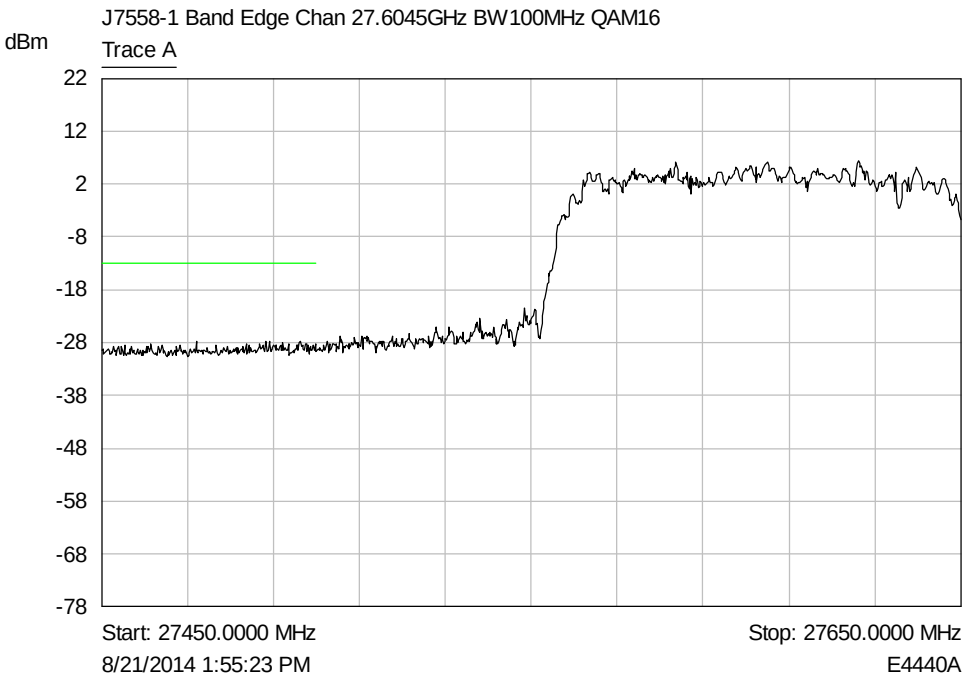


Upper

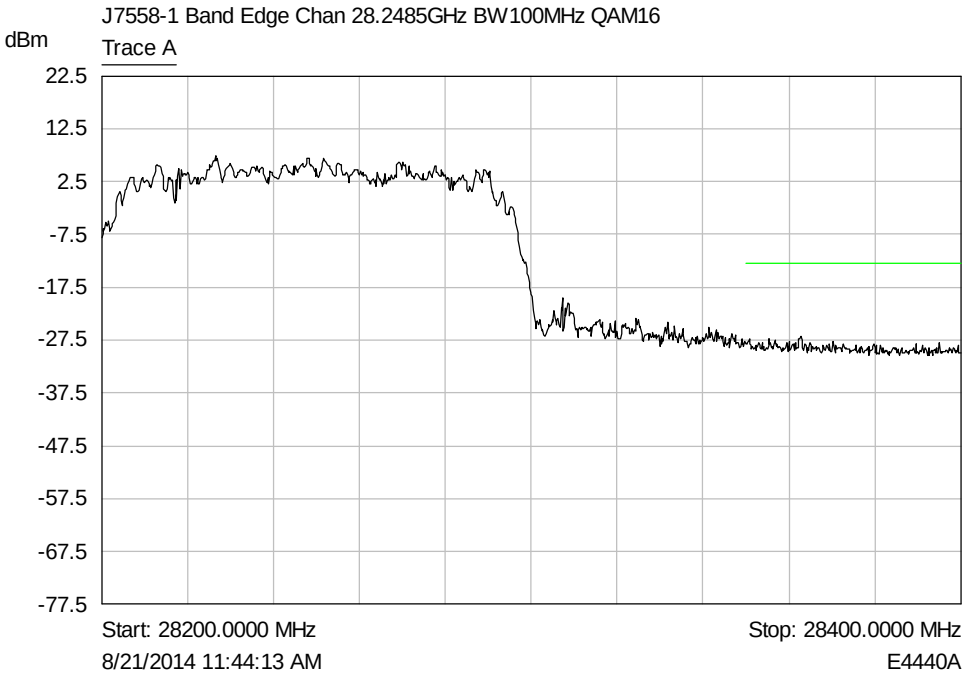


6.3.2 Plots for 27.5 – 28.35 GHz band, Power 21 dBm, Spacing 100 MHz, and Modulation QAM16

Lower

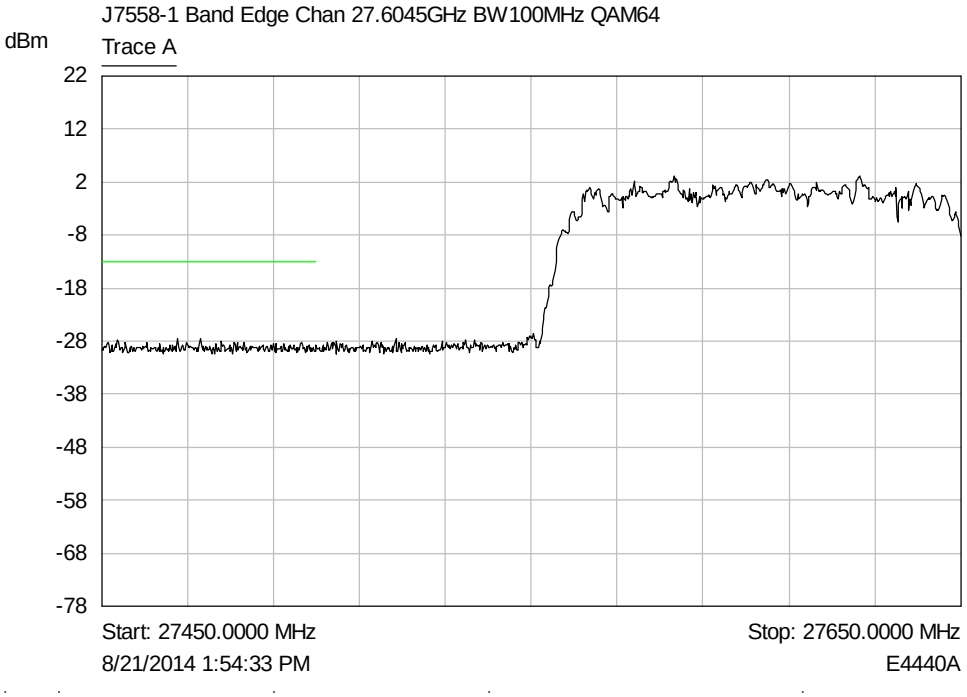


Upper

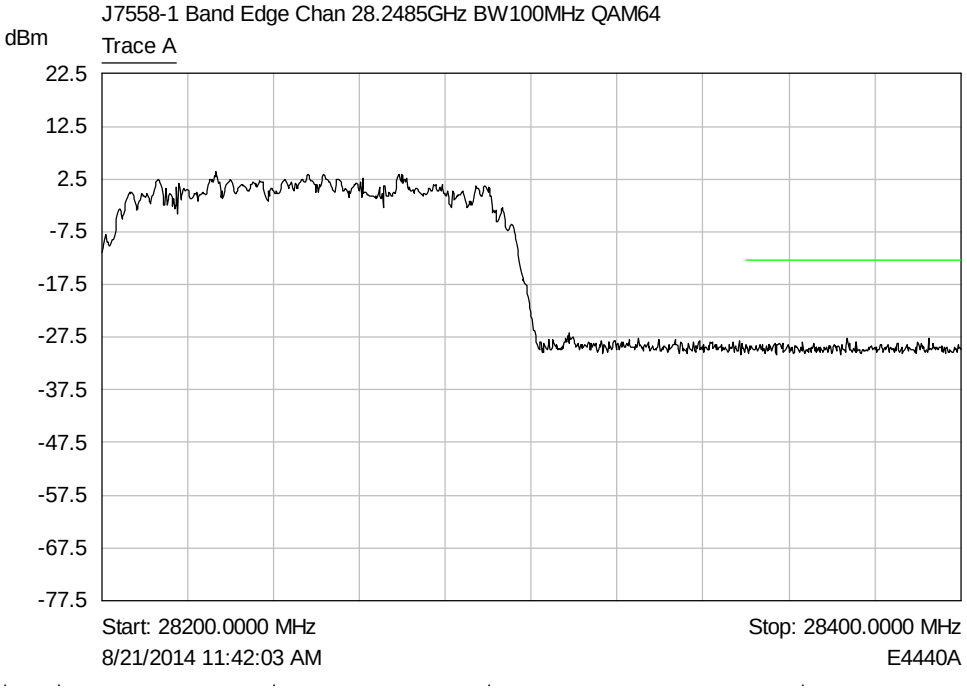


6.3.3 Plots for 27.5 – 28.35 GHz band, Power 18 dBm, Spacing 100 MHz, and Modulation QAM64

Lower

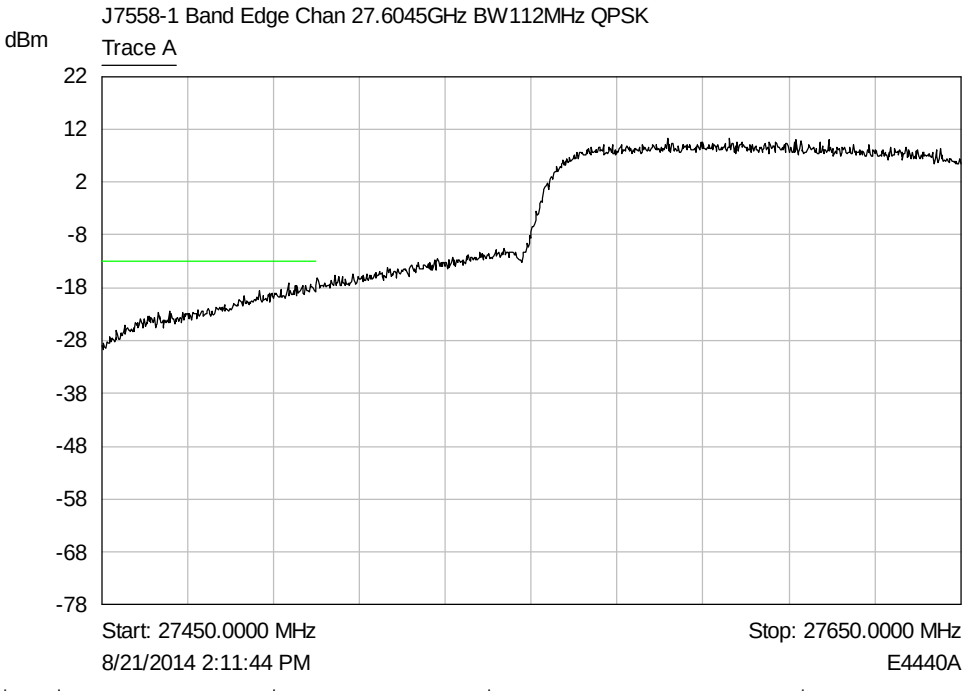


Upper

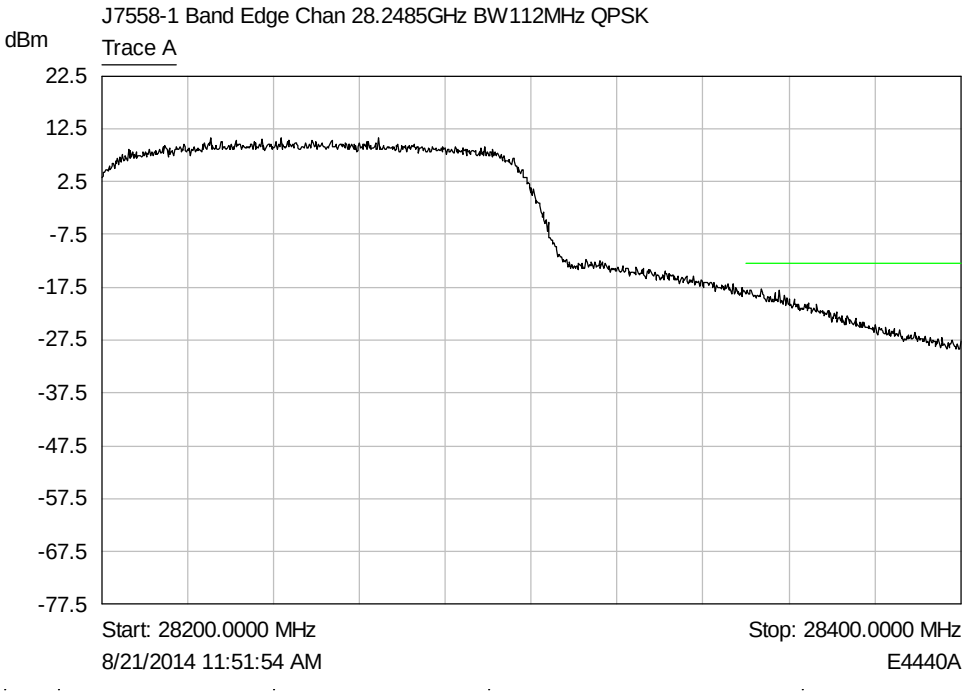


6.3.4 Plots for 27.5 – 28.35 GHz band, Power 25 dBm, Spacing 112 MHz, and Modulation QPSK

Lower

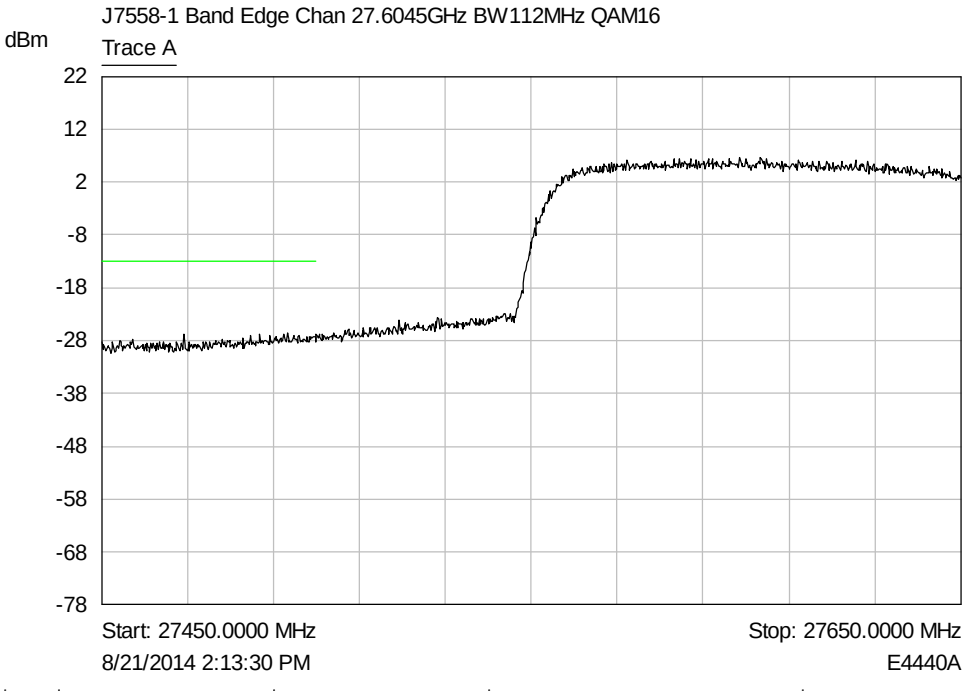


Upper

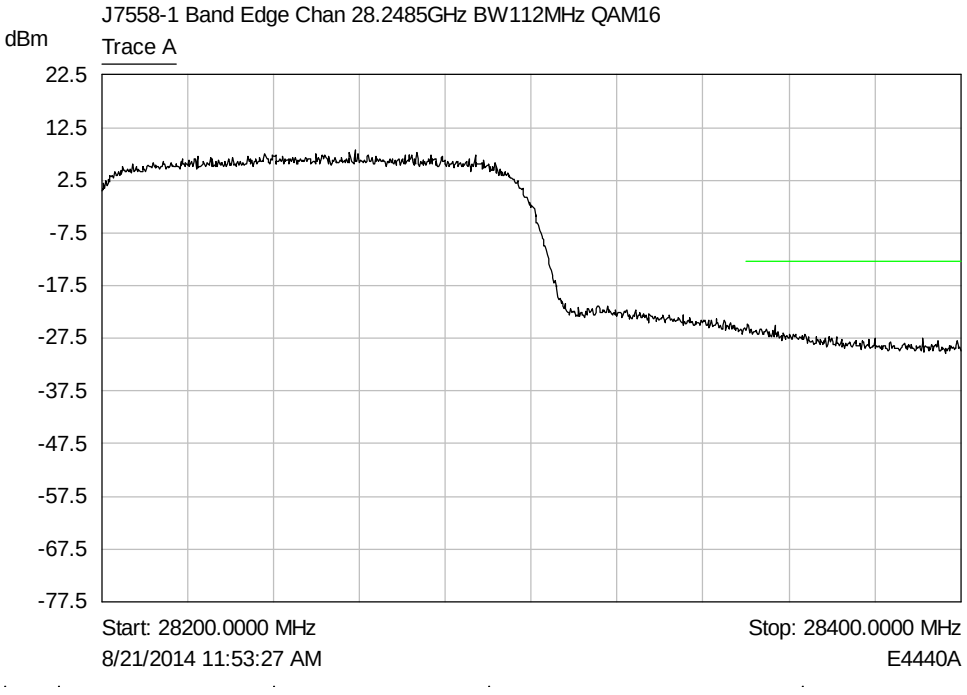


6.3.5 Plots for 27.5 – 28.35 GHz band, Power 21 dBm, Spacing 112 MHz, and Modulation QAM16

Lower

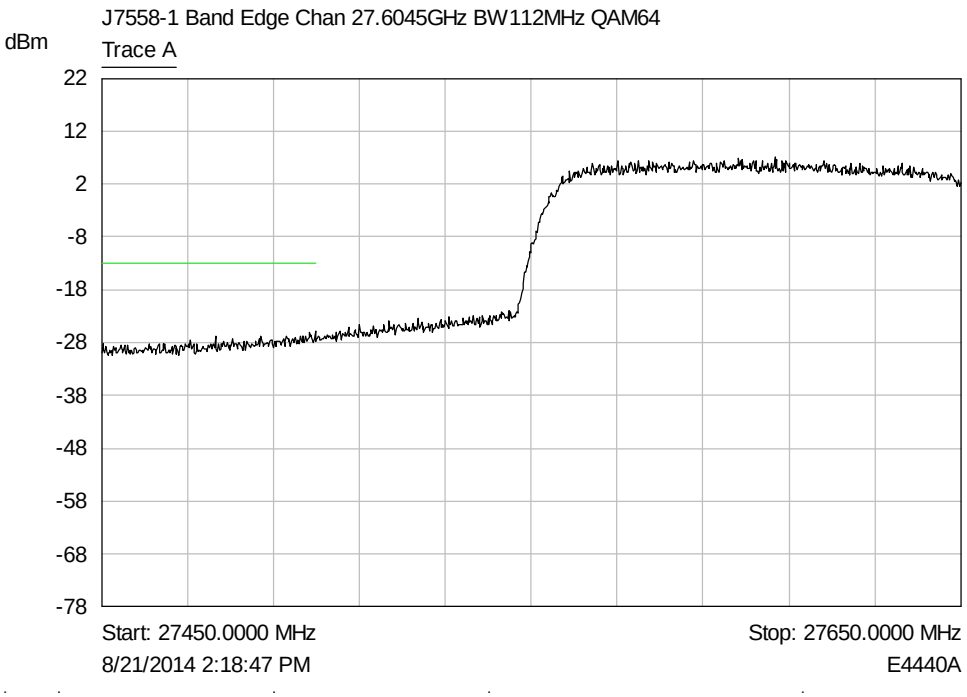


Upper

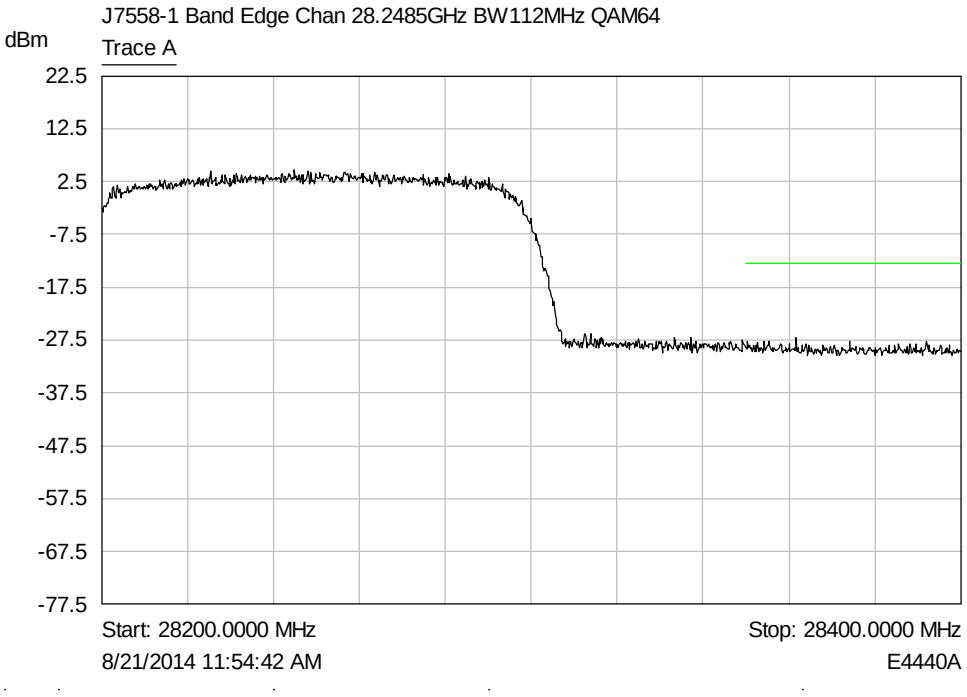


6.3.6 Plots for 27.5 – 28.35 GHz band, Power 18 dBm, Spacing 112 MHz, and Modulation QAM64

Lower

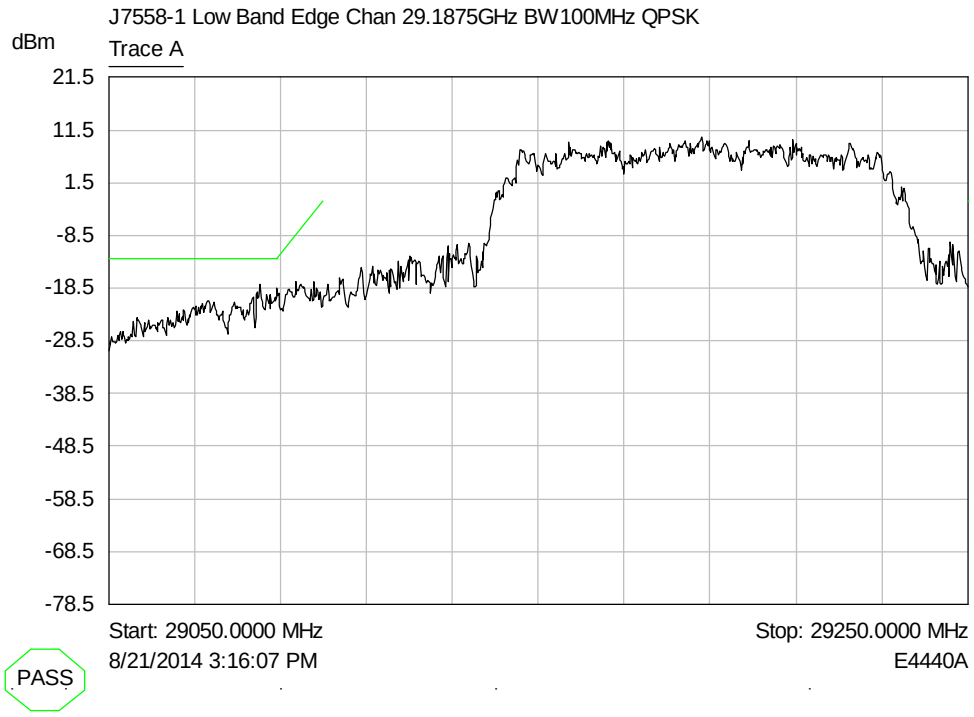


Upper

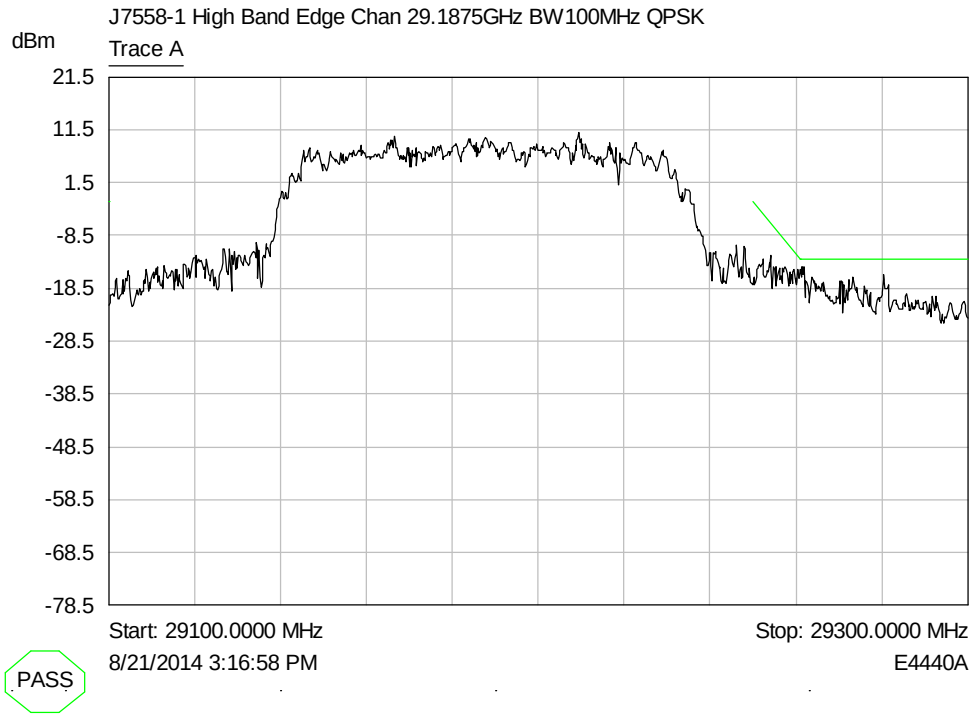


6.3.7 Plots for 29.1 – 29.25 GHz band, Power 25 dBm, Spacing 100 MHz, and Modulation QPSK

Lower

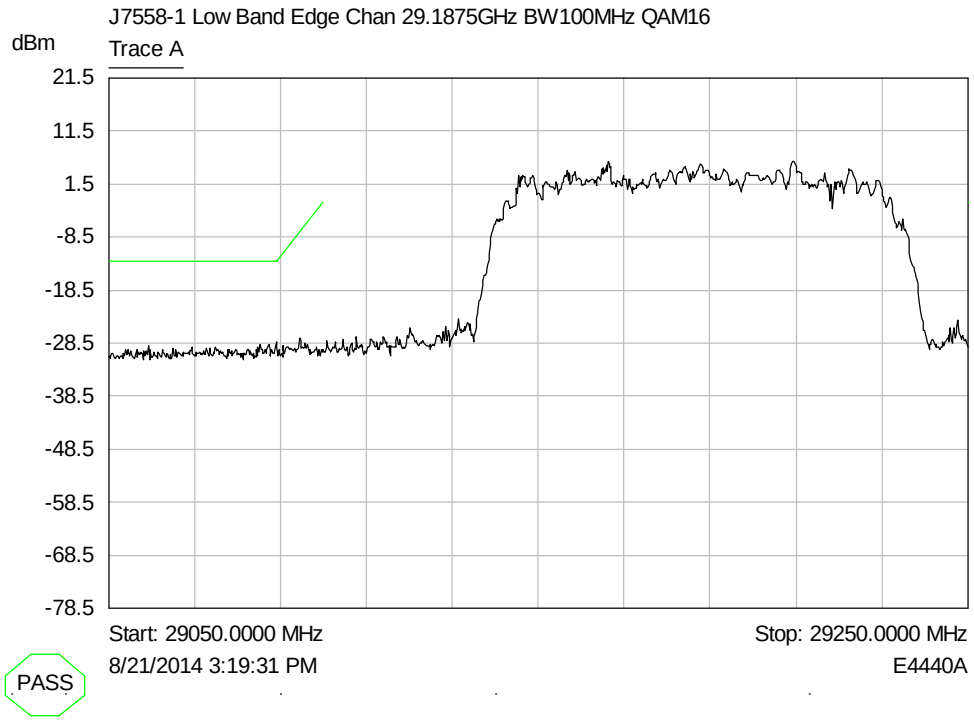


Upper

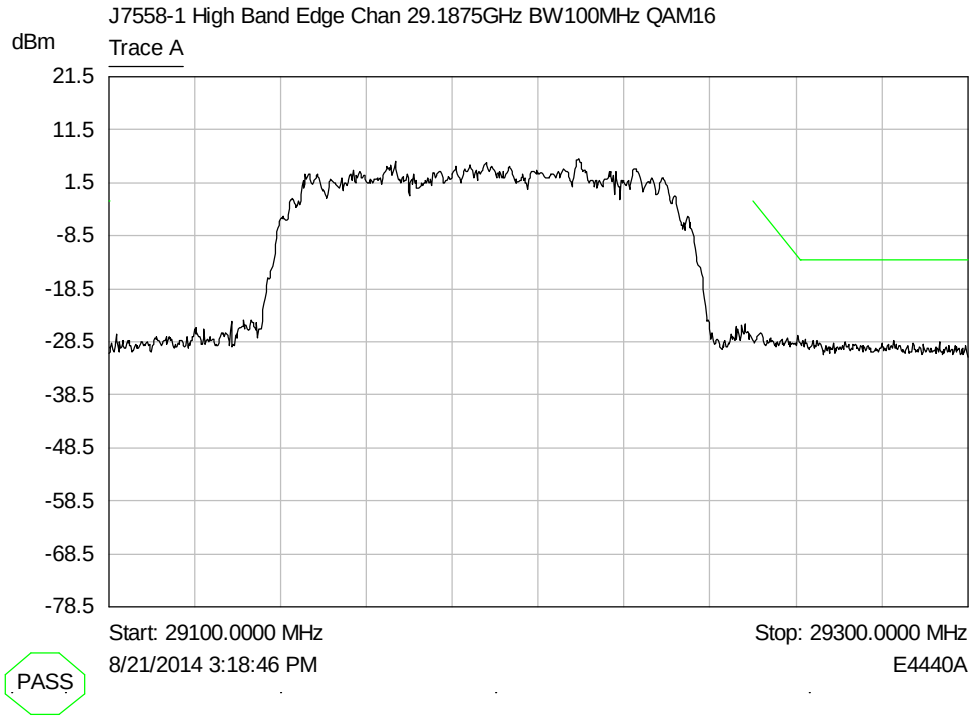


6.3.8 Plots for 29.1 – 29.25 GHz band, Power 21 dBm, Spacing 100 MHz, and Modulation QAM16

Lower

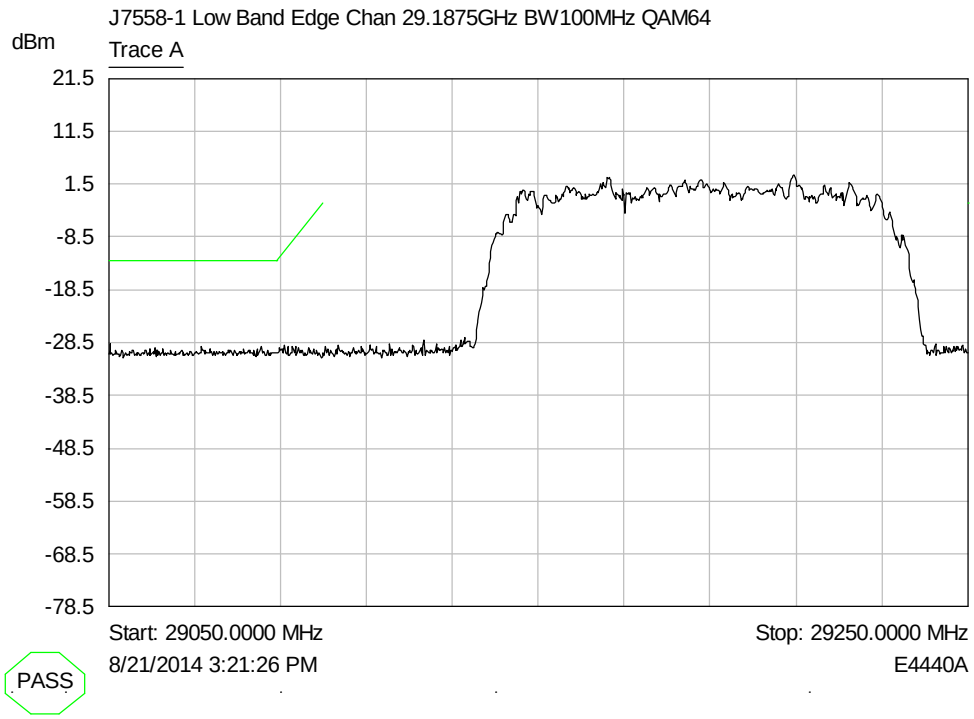


Upper

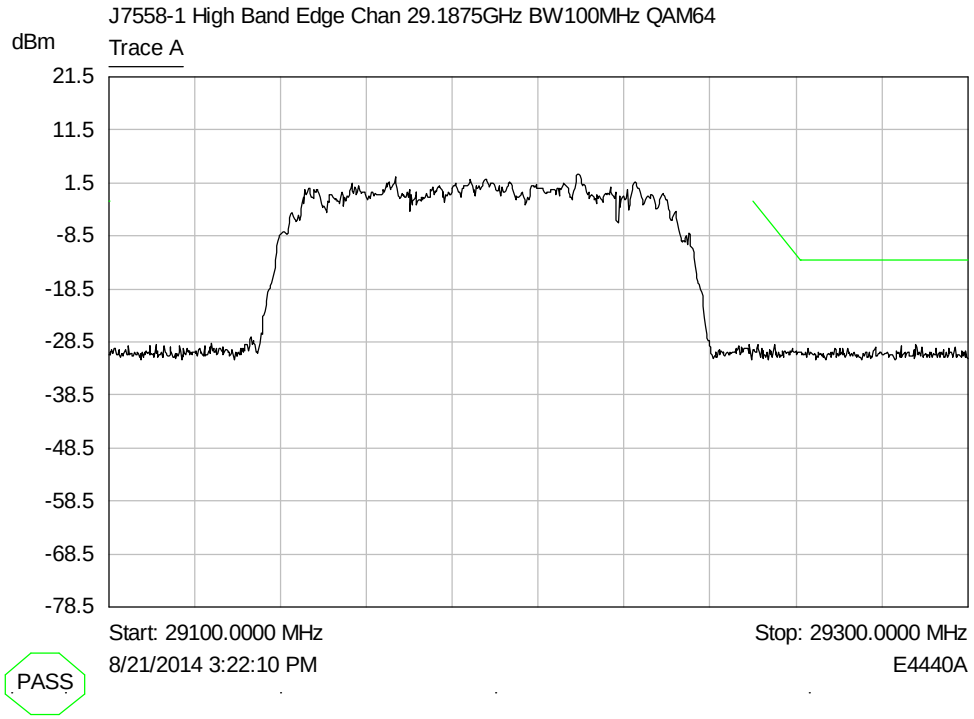


6.3.9 Plots for 29.1 – 29.25 GHz band, Power 18 dBm, Spacing 100 MHz, and Modulation QAM64

Lower

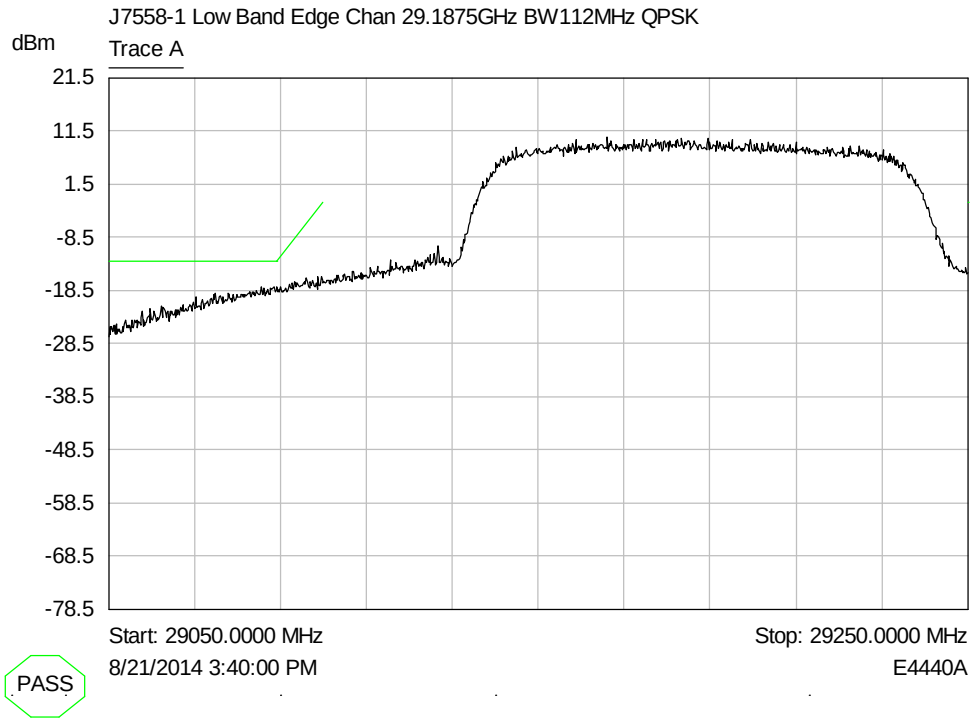


Upper

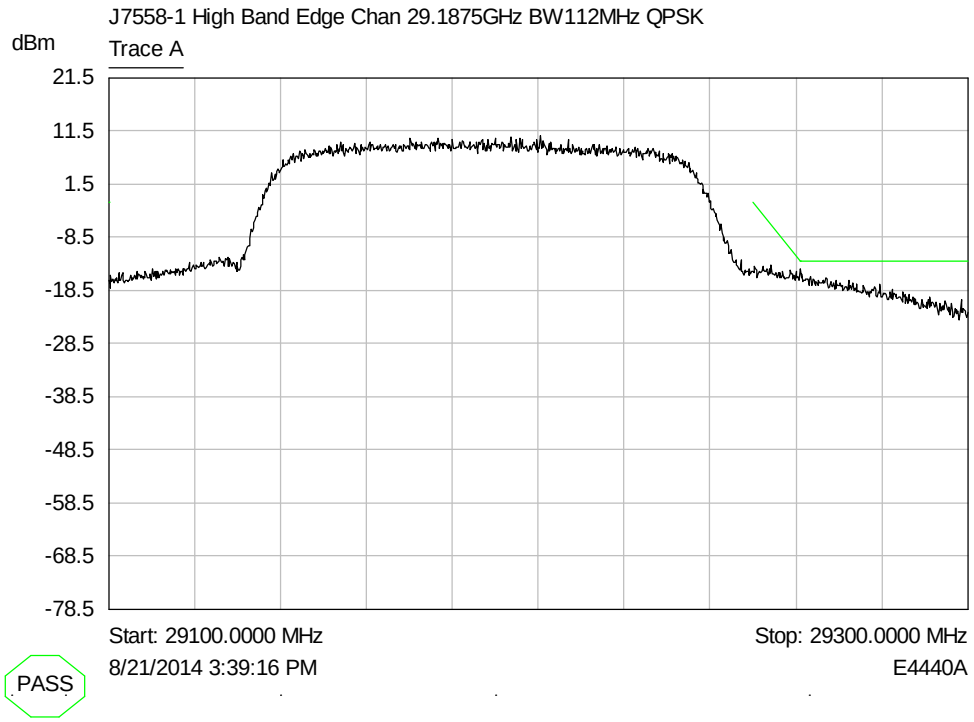


6.3.10 Plots for 29.1 – 29.25 GHz band, Power 25 dBm, Spacing 112 MHz, and Modulation QPSK

Lower

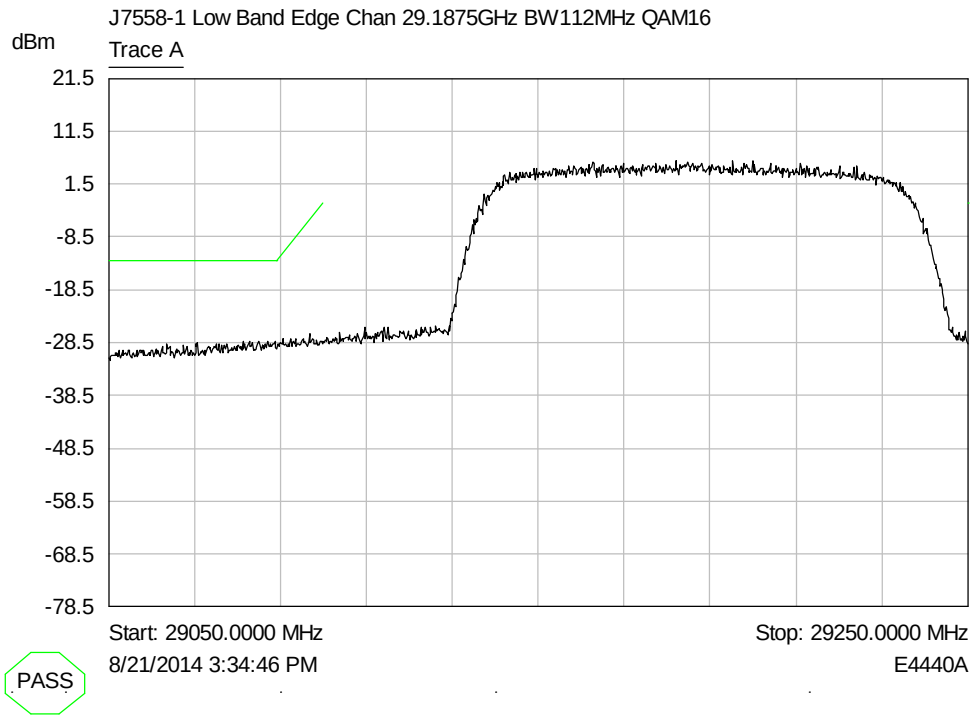


Upper

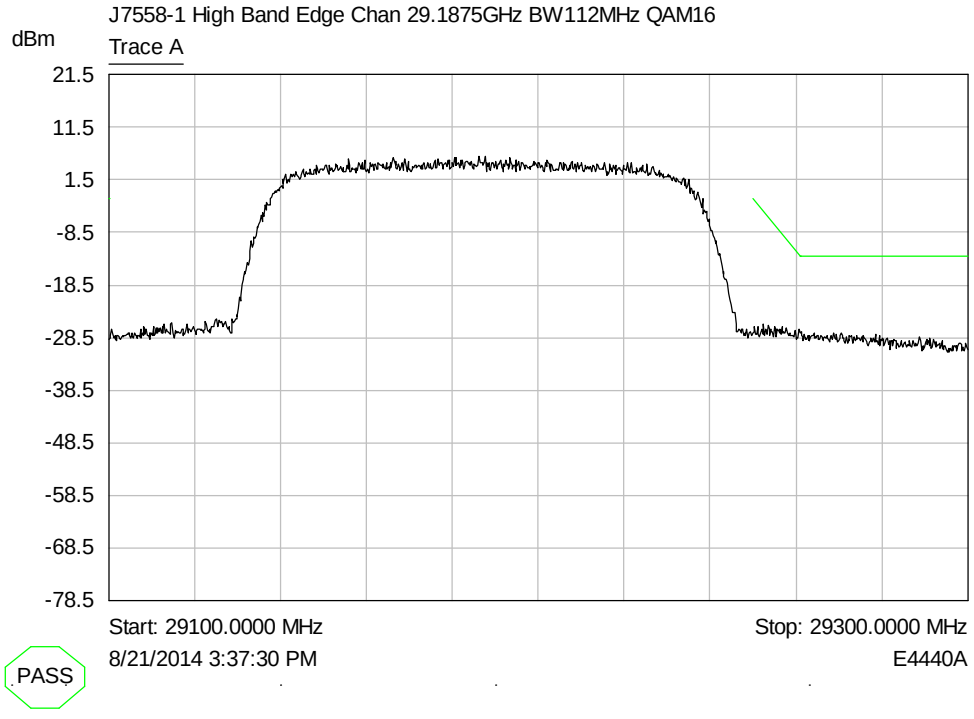


6.3.11 Plots for 29.1 – 29.25 GHz band, Power 21 dBm, Spacing 112 MHz, and Modulation QAM16

Lower

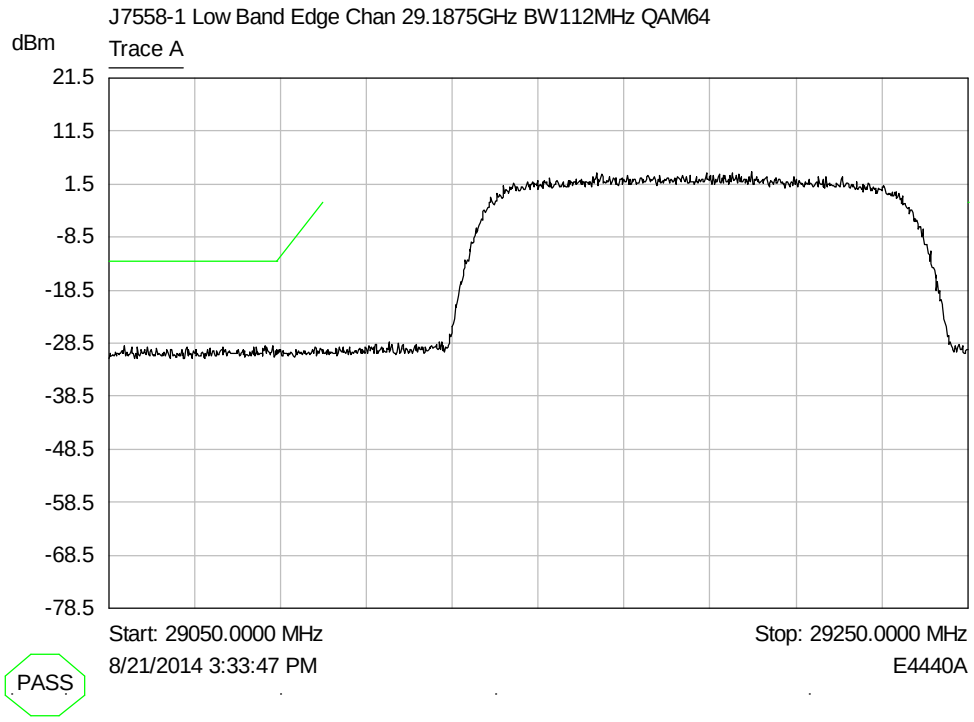


Upper

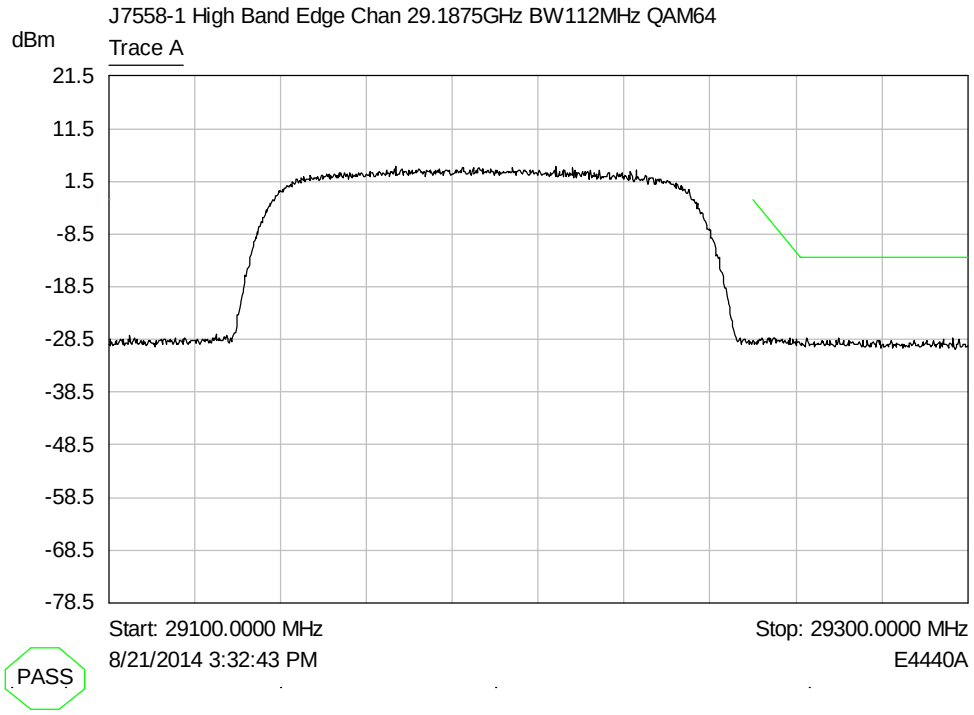


6.3.12 Plots for 29.1 – 29.25 GHz band, Power 18 dBm, Spacing 112 MHz, and Modulation QAM64

Lower

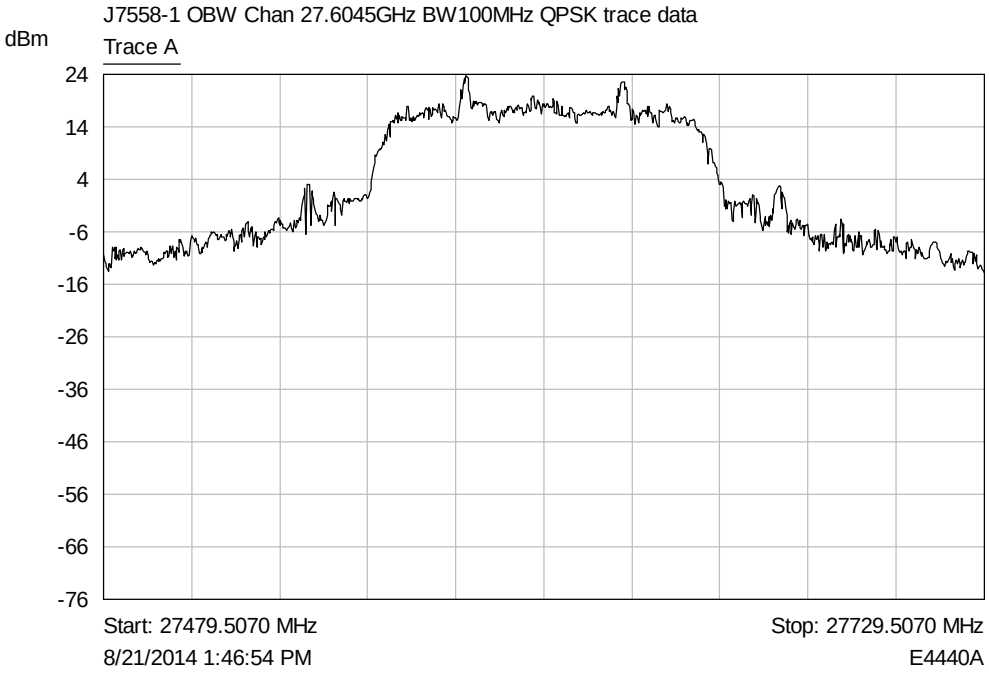


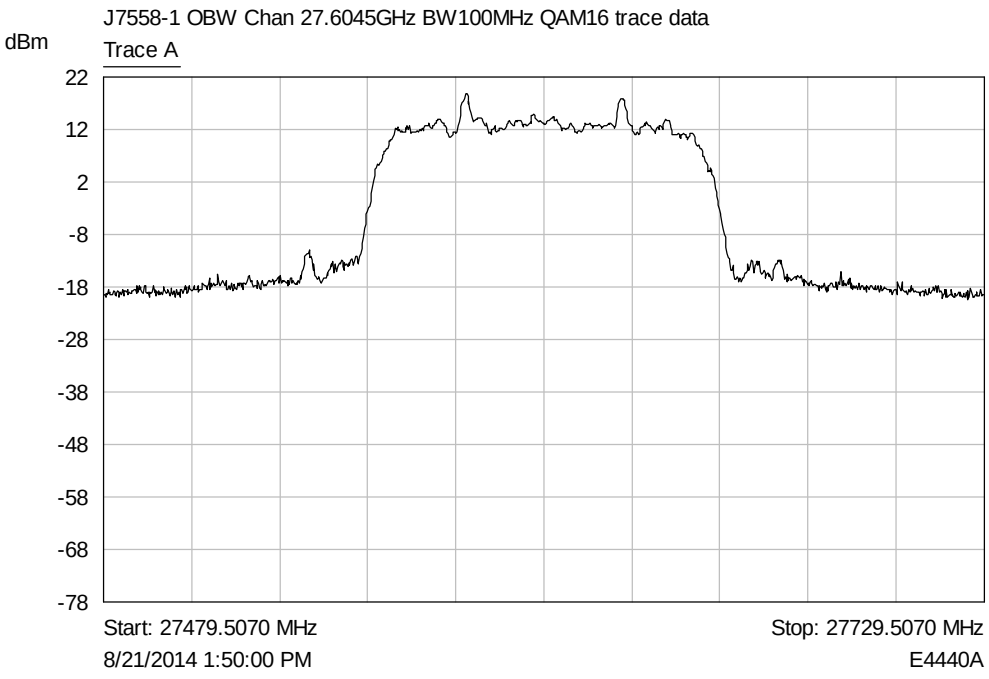
Upper

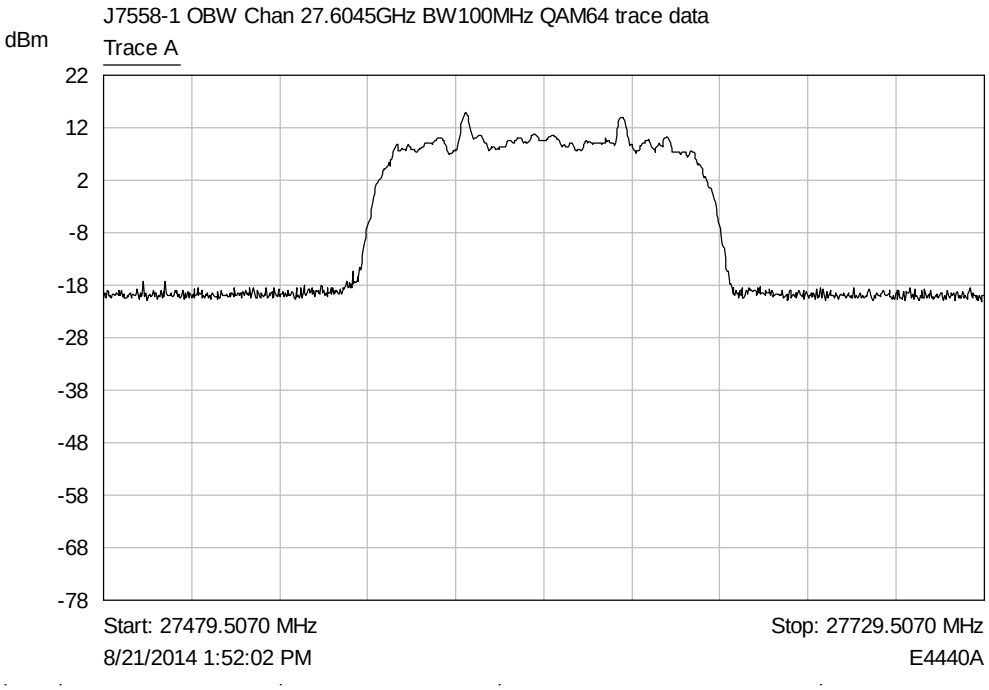


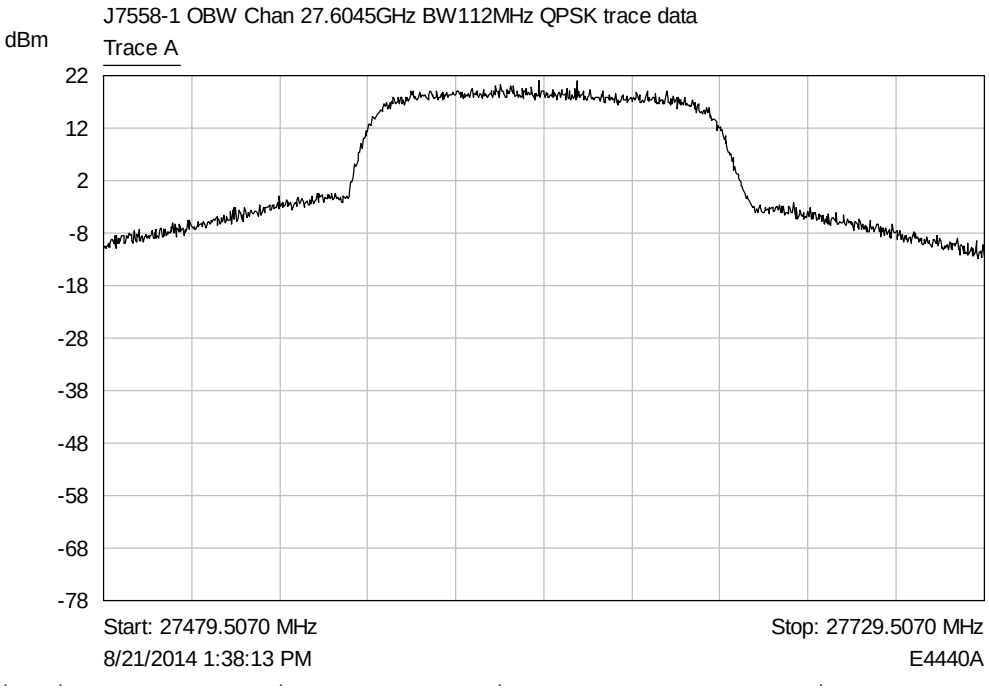
6.4 Modulation Characteristics plots

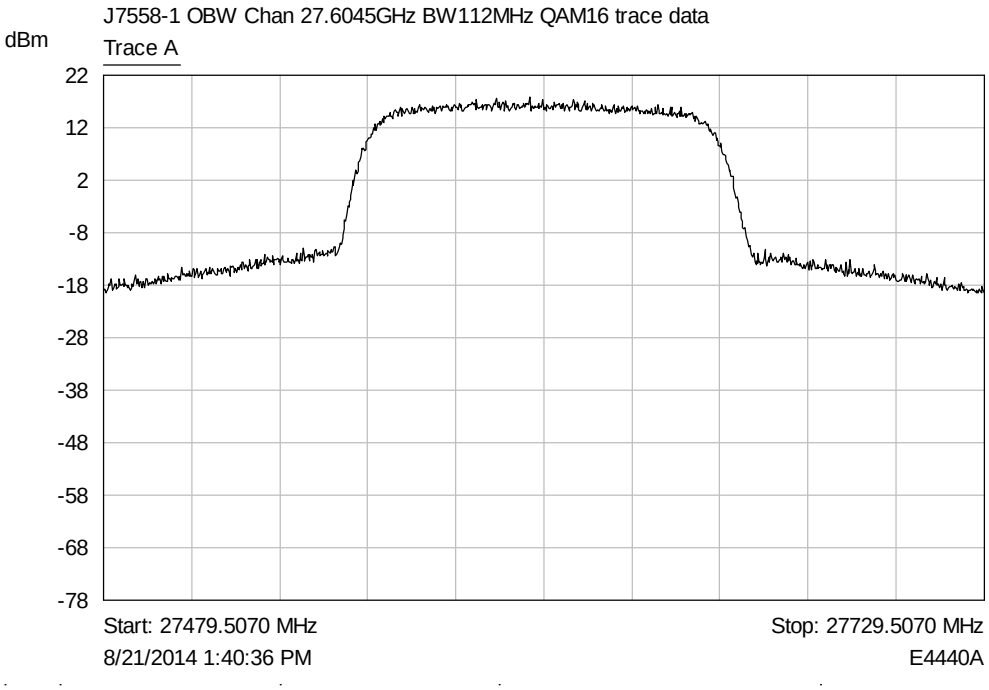
6.4.1 Plots for 27.6045 GHz Channel

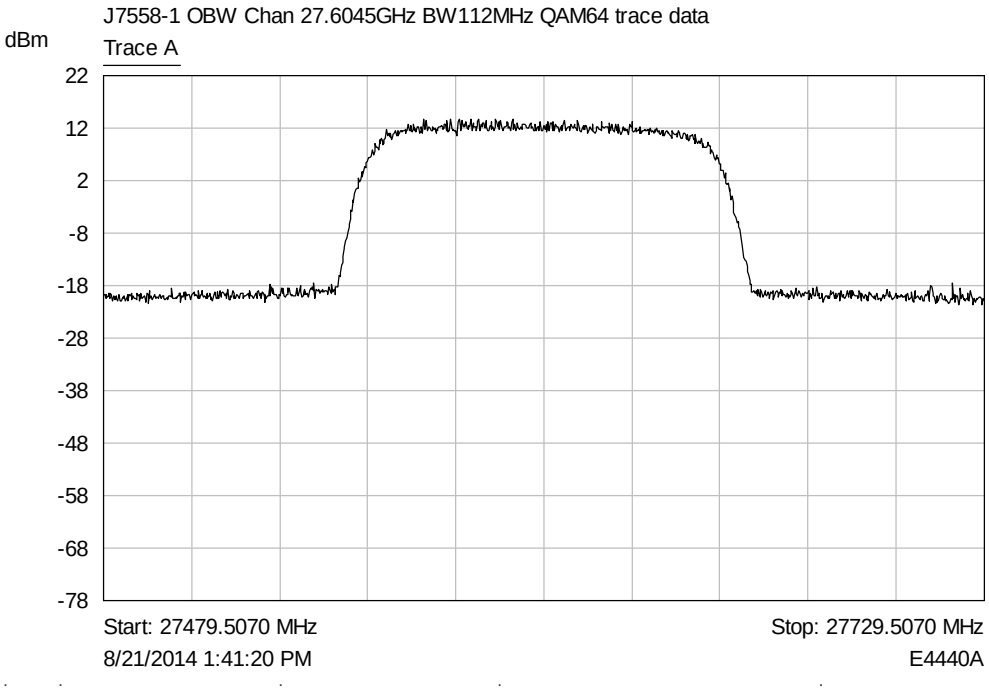




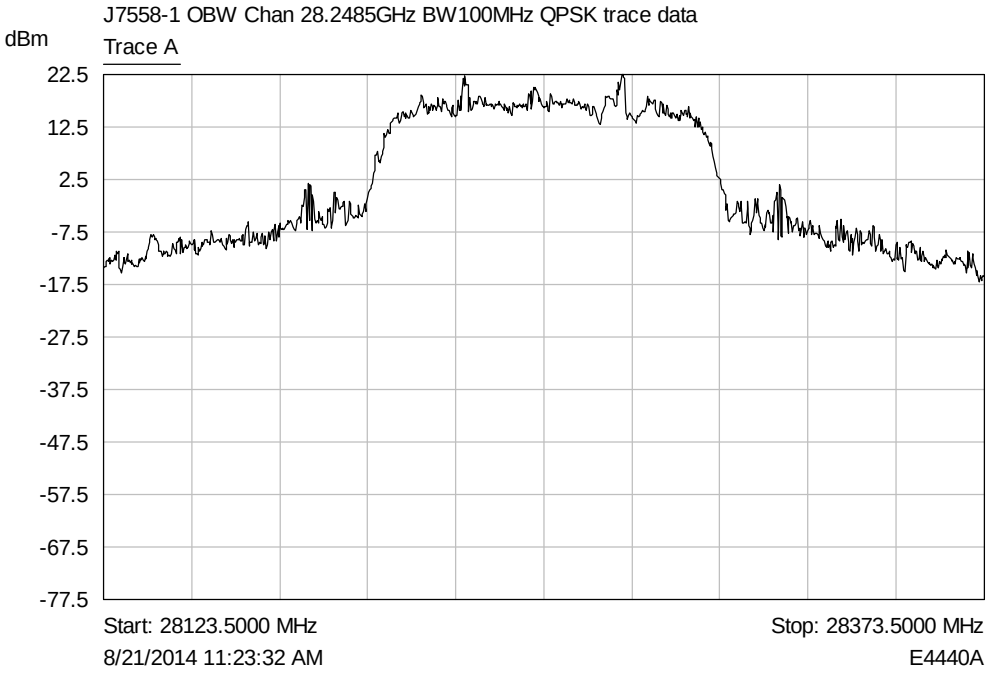

J7558-1 OBW Chan 27.6045GHz BW100MHz QAM64 trace data
dBm
Trace A
22
12
2
-8
-18
-28
-38
-48
-58
-68
-78
Start: 27479.5070 MHz
Stop: 27729.5070 MHz
8/21/2014 1:52:02 PM
E4440A

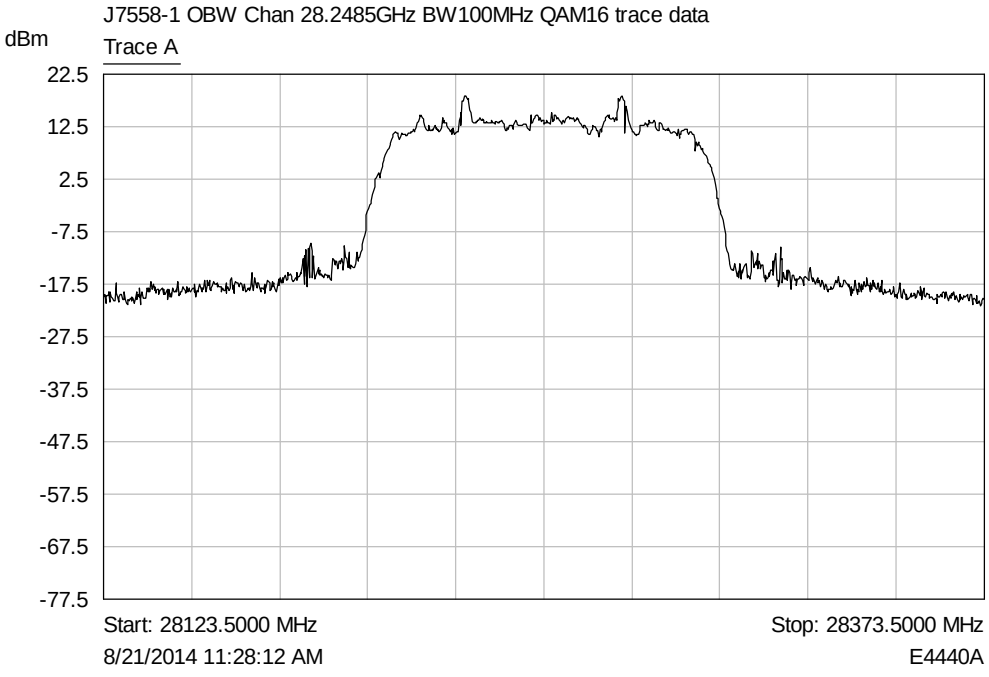

J7558-1 OBW Chan 27.6045GHz BW112MHz QPSK trace data
dBm
Trace A
22
12
2
-8
-18
-28
-38
-48
-58
-68
-78
Start: 27479.5070 MHz
Stop: 27729.5070 MHz
8/21/2014 1:38:13 PM
E4440A

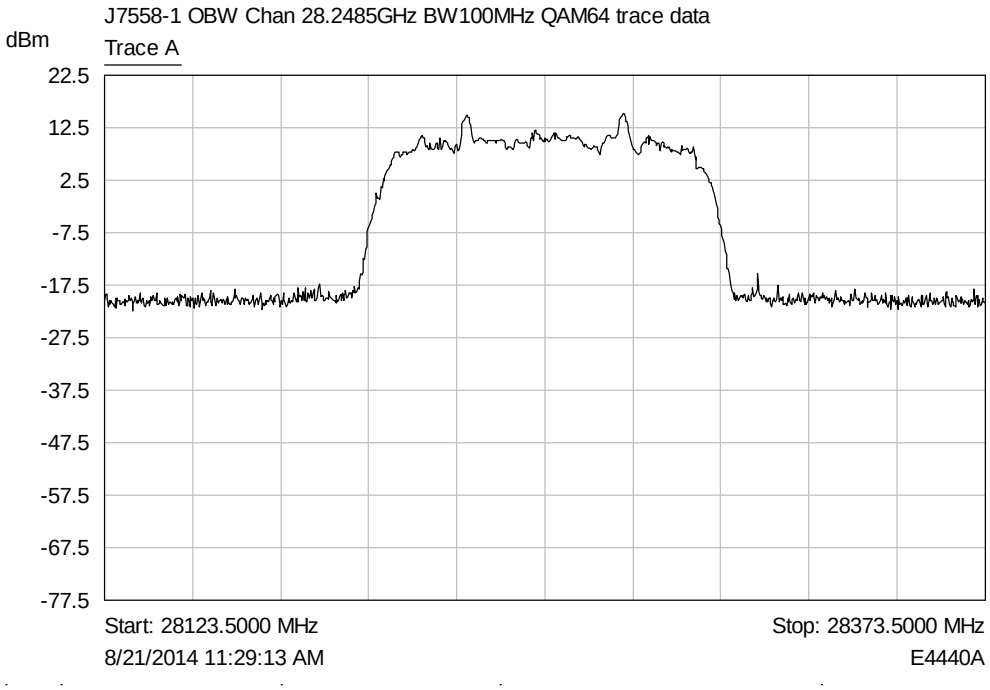

J7558-1 OBW Chan 27.6045GHz BW112MHz QAM16 trace data
dBm
Trace A
22
12
2
-8
-18
-28
-38
-48
-58
-68
-78
Start: 27479.5070 MHz
Stop: 27729.5070 MHz
8/21/2014 1:40:36 PM
E4440A

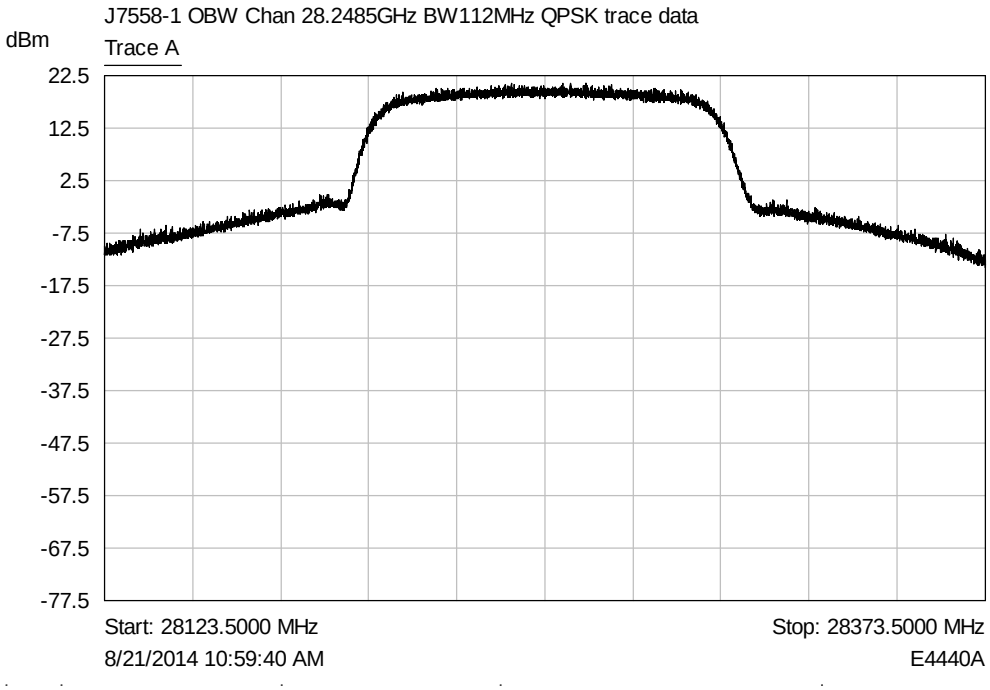

J7558-1 OBW Chan 27.6045GHz BW112MHz QAM64 trace data
dBm
Trace A
22
12
2
-8
-18
-28
-38
-48
-58
-68
-78
Start: 27479.5070 MHz
Stop: 27729.5070 MHz
8/21/2014 1:41:20 PM
E4440A

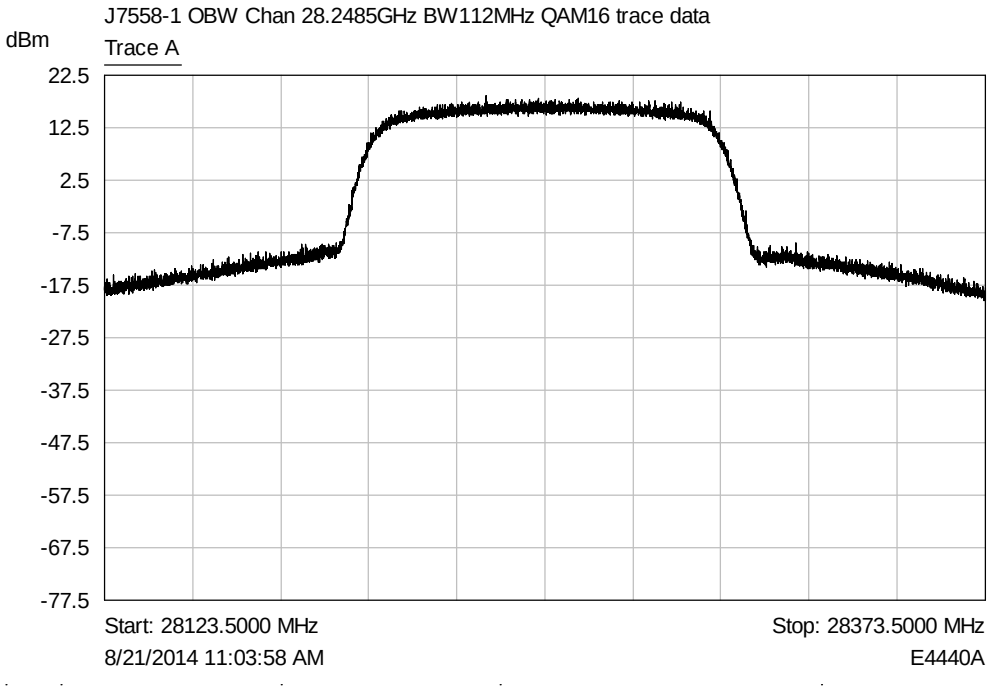
6.4.2 Plots for 28.2485 GHz Channel

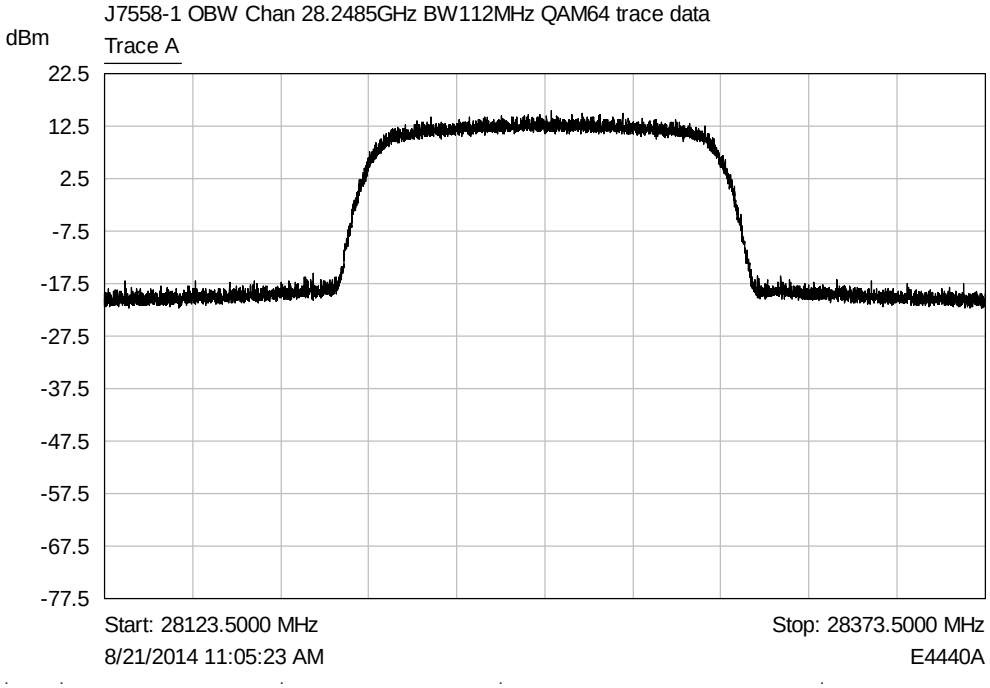




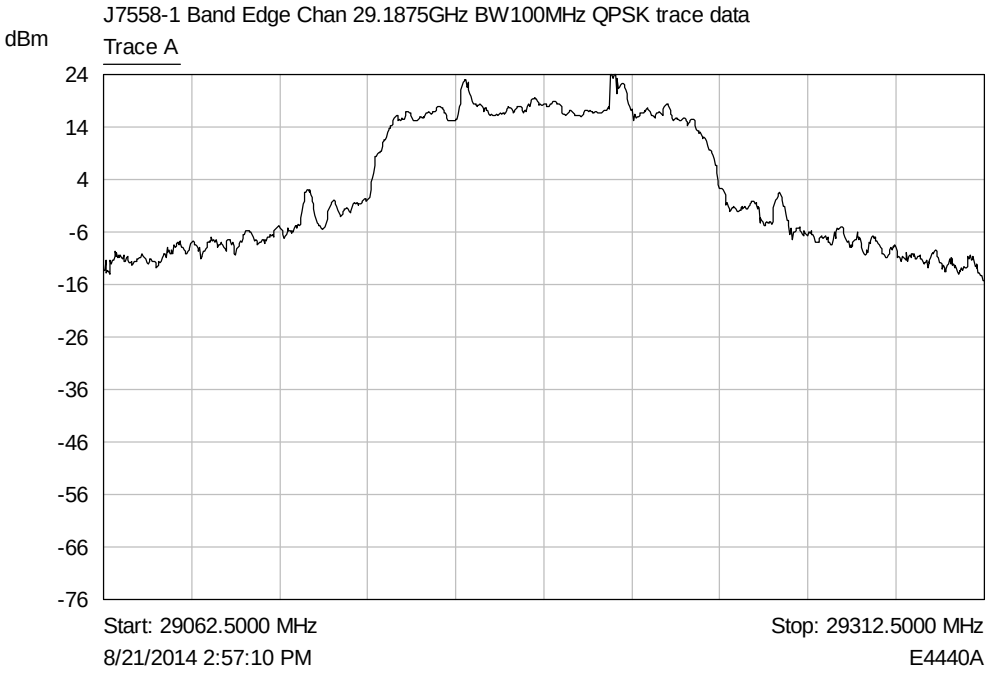

J7558-1 OBW Chan 28.2485GHz BW100MHz QAM64 trace data
dBm
Trace A
22.5
12.5
2.5
-7.5
-17.5
-27.5
-37.5
-47.5
-57.5
-67.5
-77.5
Start: 28123.5000 MHz
Stop: 28373.5000 MHz
8/21/2014 11:29:13 AM
E4440A

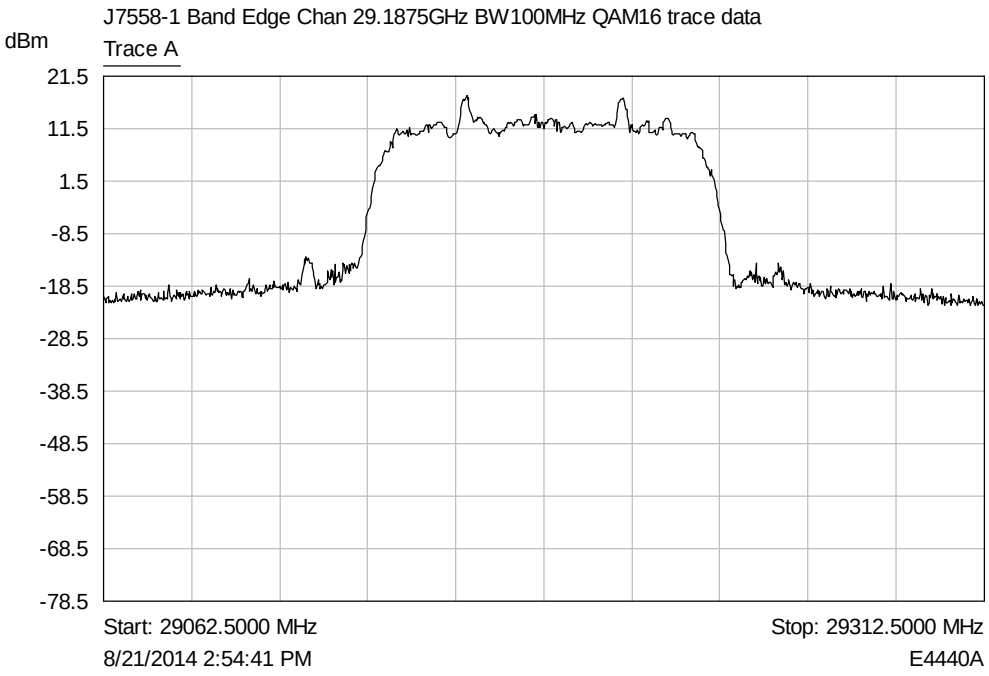

J7558-1 OBW Chan 28.2485GHz BW112MHz QPSK trace data
dBm
Trace A
22.5
12.5
2.5
-7.5
-17.5
-27.5
-37.5
-47.5
-57.5
-67.5
-77.5
Start: 28123.5000 MHz
Stop: 28373.5000 MHz
8/21/2014 10:59:40 AM
E4440A

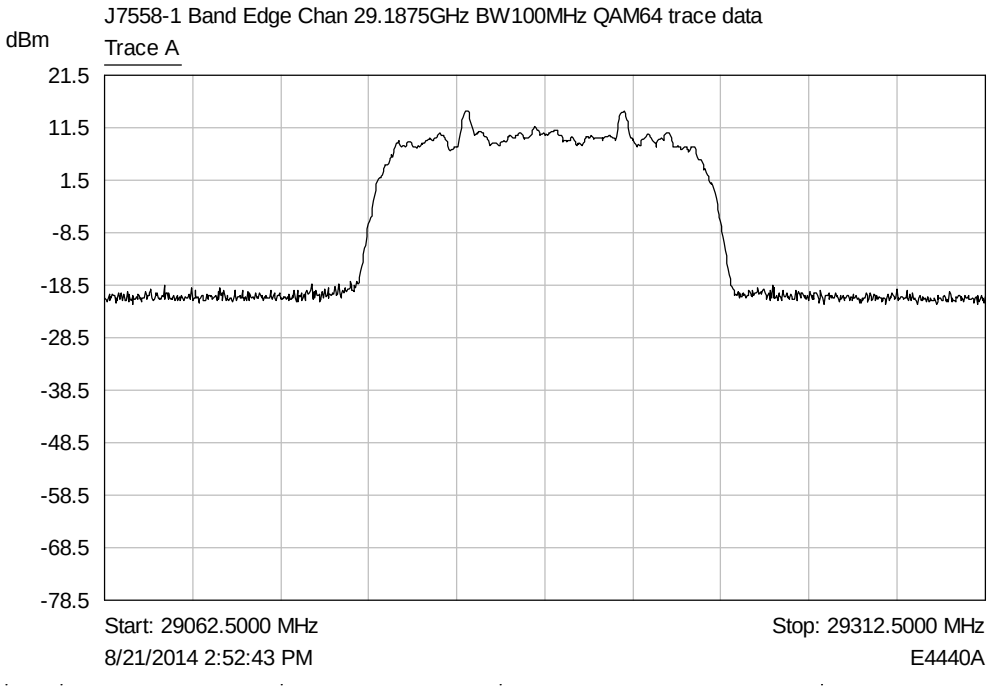

J7558-1 OBW Chan 28.2485GHz BW112MHz QAM16 trace data
dBm
Trace A
22.5
12.5
2.5
-7.5
-17.5
-27.5
-37.5
-47.5
-57.5
-67.5
-77.5
Start: 28123.5000 MHz
Stop: 28373.5000 MHz
8/21/2014 11:03:58 AM
E4440A

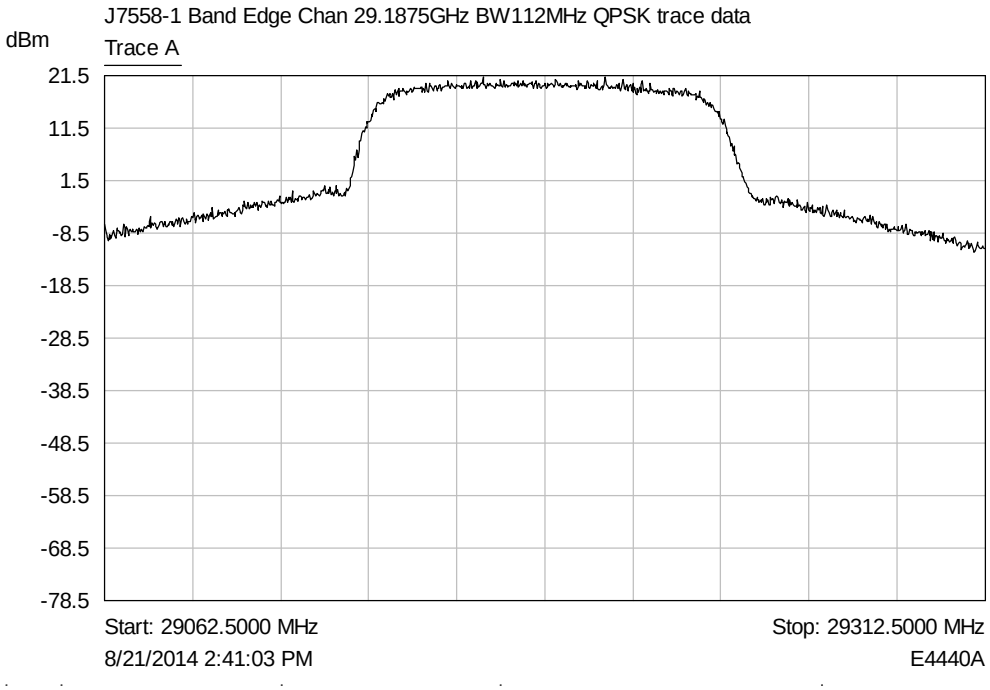

J7558-1 OBW Chan 28.2485GHz BW112MHz QAM64 trace data
dBm
Trace A
22.5
12.5
2.5
-7.5
-17.5
-27.5
-37.5
-47.5
-57.5
-67.5
-77.5
Start: 28123.5000 MHz
Stop: 28373.5000 MHz
8/21/2014 11:05:23 AM
E4440A

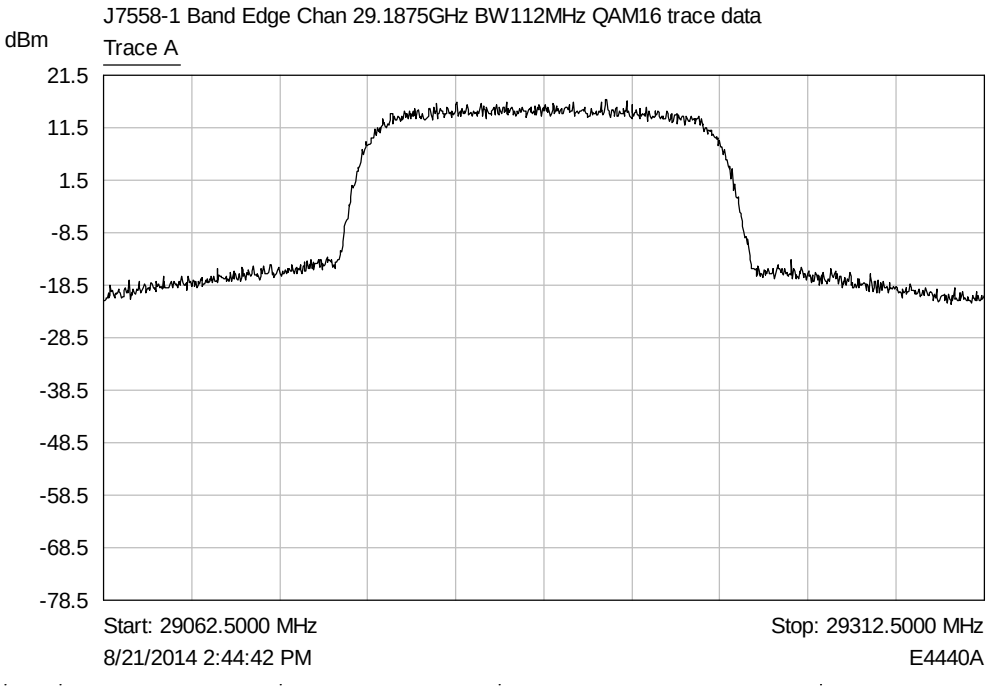
6.4.3 Plots for 29.1875 GHz Channel

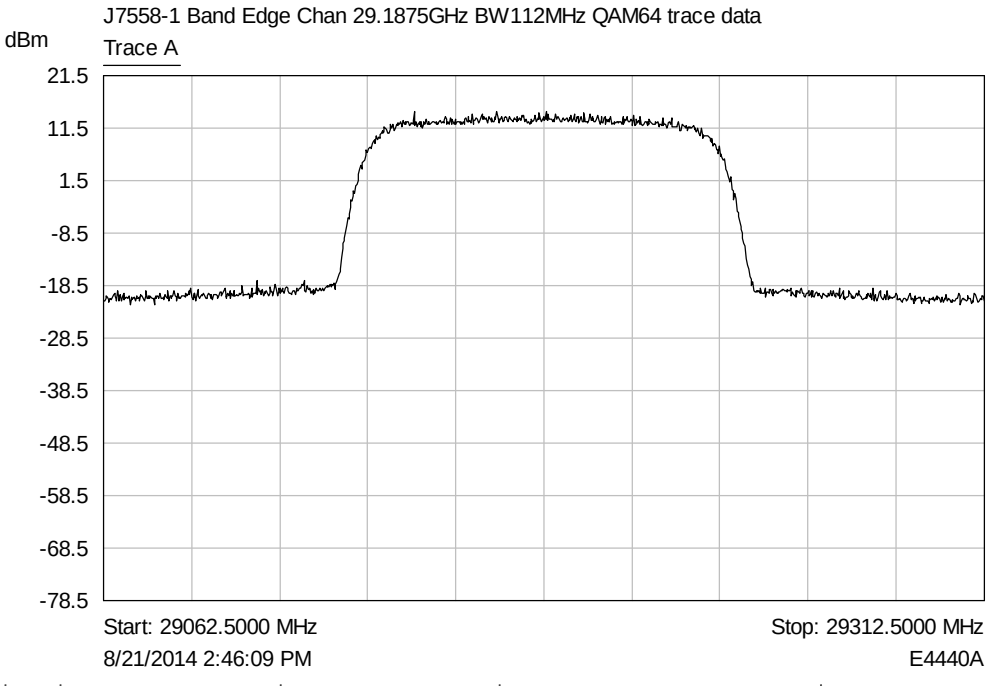





J7558-1 Band Edge Chan 29.1875GHz BW100MHz QAM64 trace data
dBm
Trace A
21.5
11.5
1.5
-8.5
-18.5
-28.5
-38.5
-48.5
-58.5
-68.5
-78.5
Start: 29062.5000 MHz
Stop: 29312.5000 MHz
8/21/2014 2:52:43 PM
E4440A


J7558-1 Band Edge Chan 29.1875GHz BW112MHz QPSK trace data
dBm
Trace A
21.5
11.5
1.5
-8.5
-18.5
-28.5
-38.5
-48.5
-58.5
-68.5
-78.5
Start: 29062.5000 MHz
Stop: 29312.5000 MHz
8/21/2014 2:41:03 PM
E4440A


J7558-1 Band Edge Chan 29.1875GHz BW112MHz QAM16 trace data
dBm
Trace A
21.5
11.5
1.5
-8.5
-18.5
-28.5
-38.5
-48.5
-58.5
-68.5
-78.5
Start: 29062.5000 MHz
Stop: 29312.5000 MHz
8/21/2014 2:44:42 PM
E4440A


J7558-1 Band Edge Chan 29.1875GHz BW112MHz QAM64 trace data
dBm
Trace A
21.5
11.5
1.5
-8.5
-18.5
-28.5
-38.5
-48.5
-58.5
-68.5
-78.5
Start: 29062.5000 MHz
Stop: 29312.5000 MHz
8/21/2014 2:46:09 PM
E4440A

7 Explanatory Notes

7.1 Explanation of waveguide cut-off frequency

Rationale for lowest conducted emissions test frequency for EUT's using Waveguide RF ports:

In order to determine lowest frequency cut-off of a waveguide the following must be known:

Broadwall (largest) Dimension in mm of waveguide (for purposes of this equation = A)

Speed of light (29.979 cm/ns) (for purposes of this equation = B)

The wavelength (λ) upper frequency cut-off distance in cm (= 2 x A).

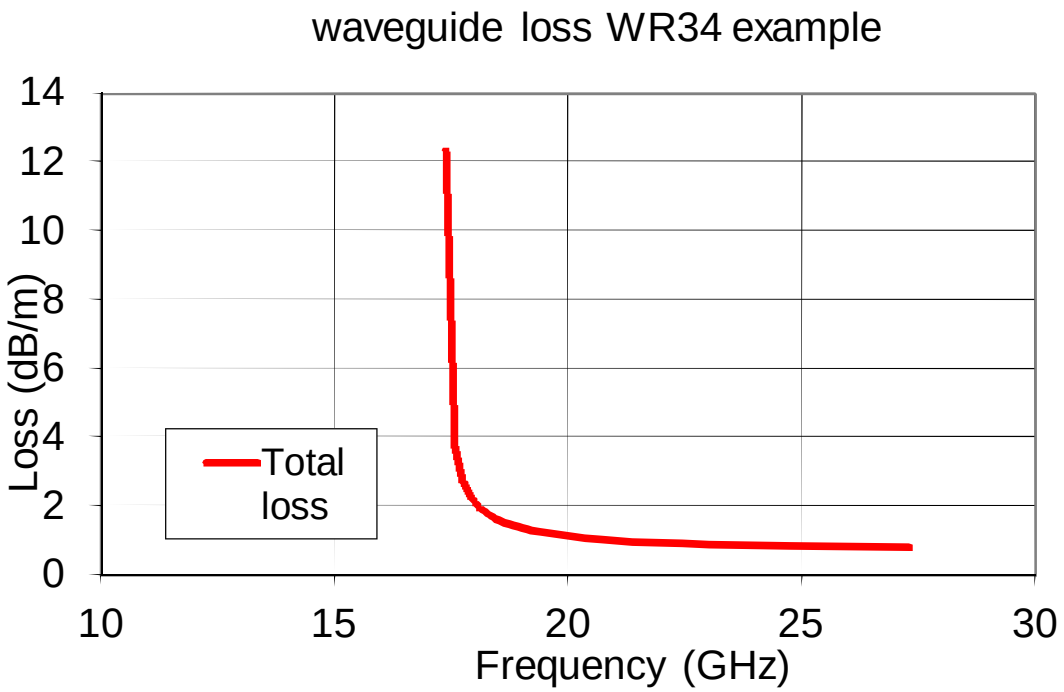
Waveguide used by the EUT within this test report is WR34 which has a Broadwall (largest) dimension of = 8.636mm.

Thus:
The wavelength (λ) upper frequency cut-off distance in cm is 2 x 0.8636 = 1.7272.cm

The following equation may then be used to calculate the lowest cut off frequency of the waveguide:

$f_{lowercutoff}$ = (B / 2A)

$f_{lowercutoff}$ = 29.979 / 1.7272 = 17.35699398 GHz.



7.2 Explanation of Duty cycle calculation

10.Log(100/x)
Where x is duty cycle in percent

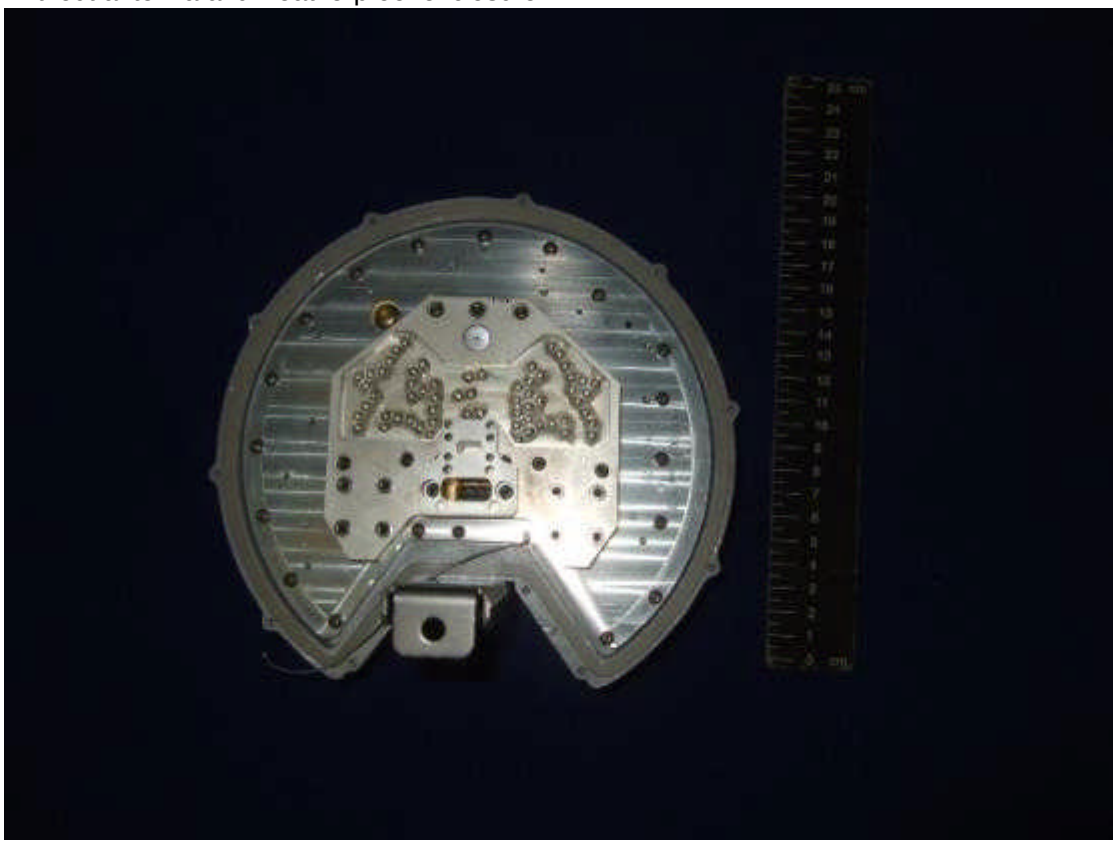
i.e. 69% duty would give:

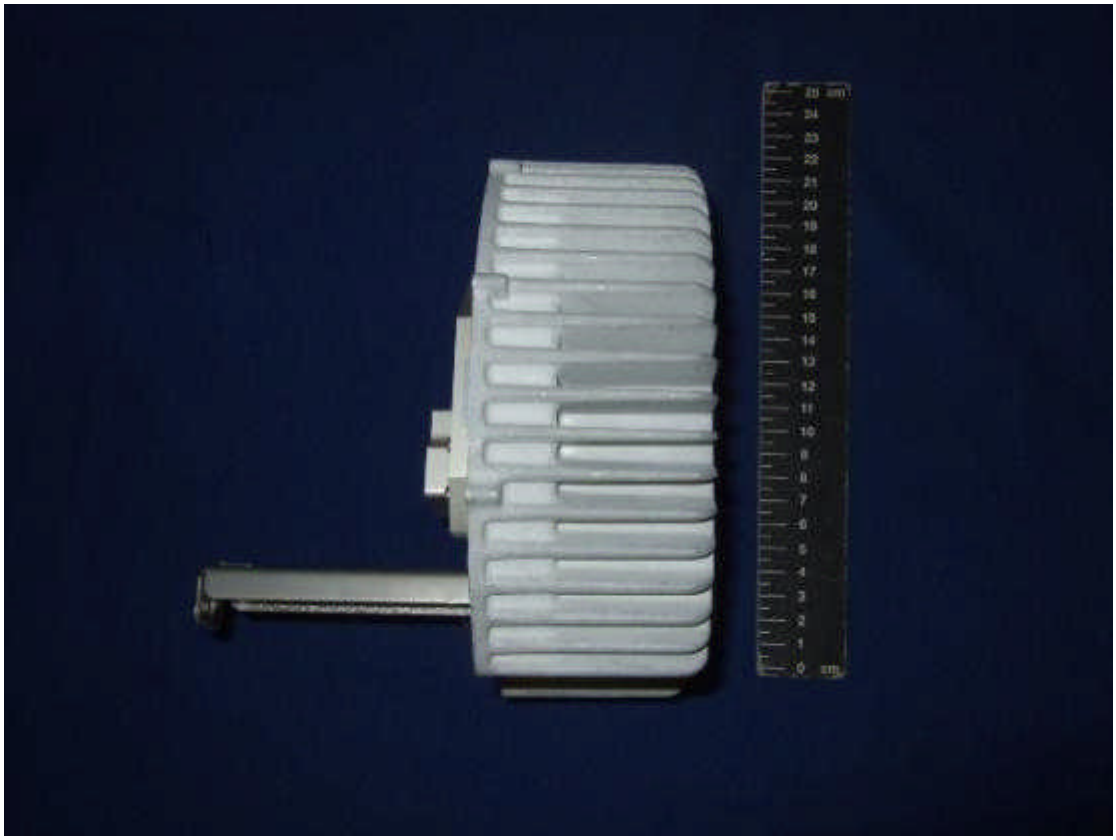
10.Log (100/69) = 1.61 dB correction to be added to result.

8 Photographs

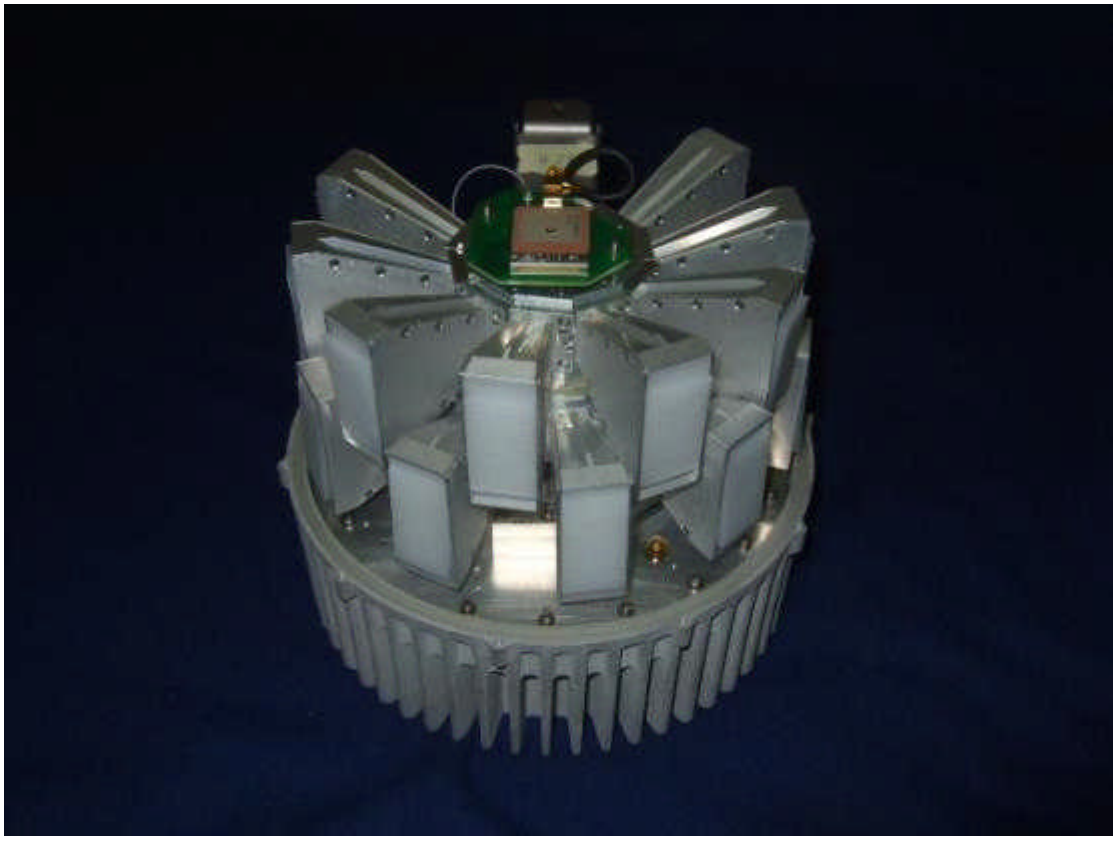
8.1 EUT Front View

Without antenna and weatherproof enclosure.





EUT with Antenna section fitted.

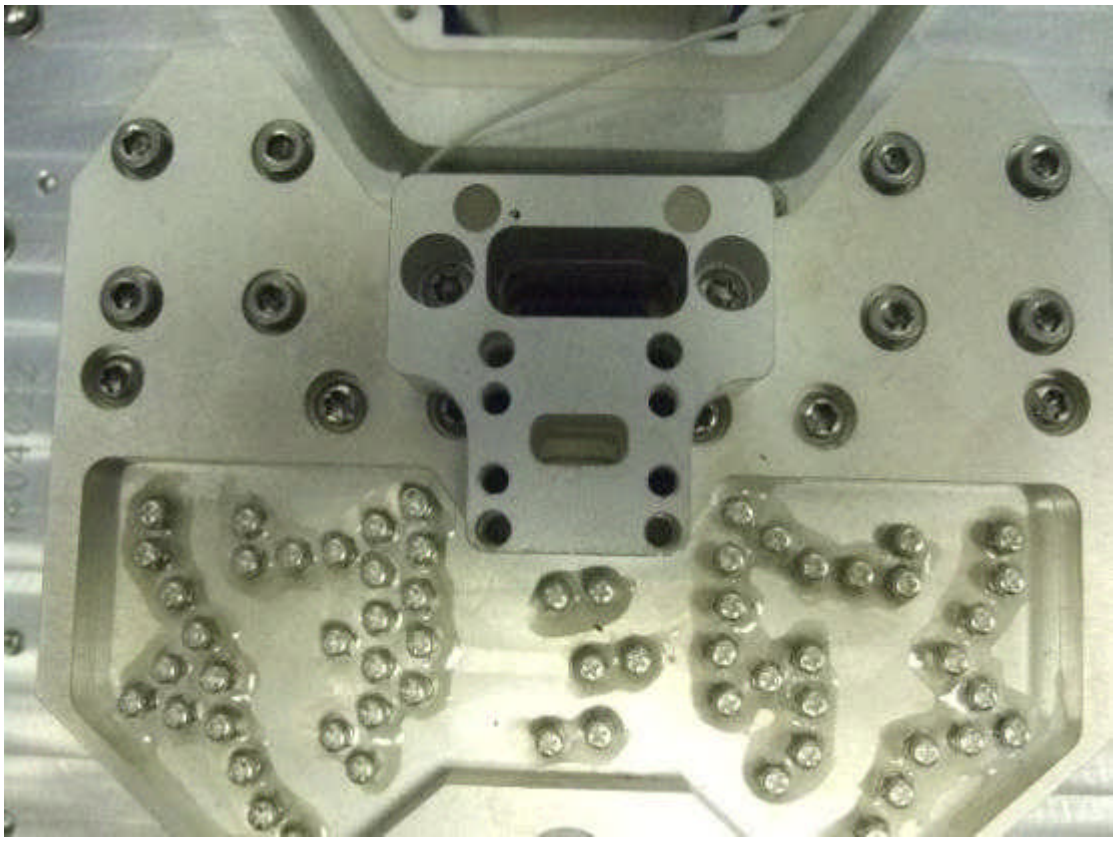


Complete EUT with weatherproof enclosure.

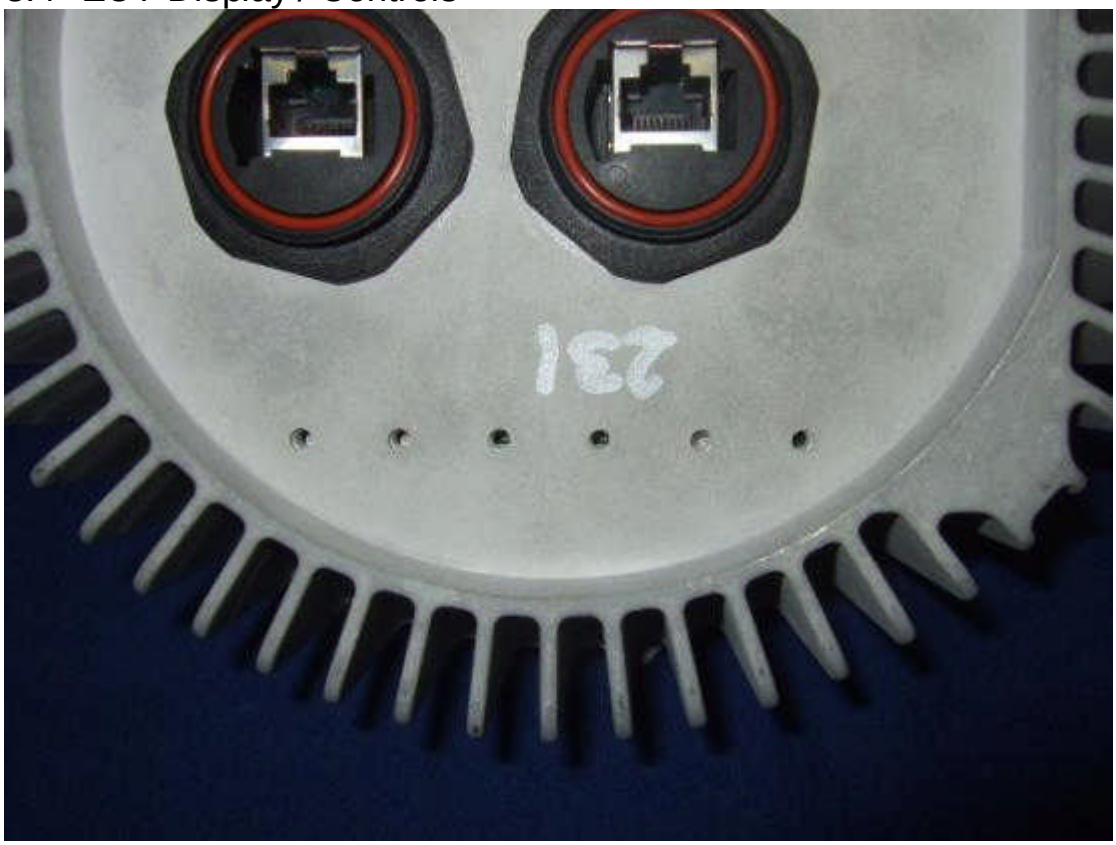
8.2 EUT Reverse Angle

Without antenna and weatherproof enclosure

8.3 EUT Antenna Connector Port



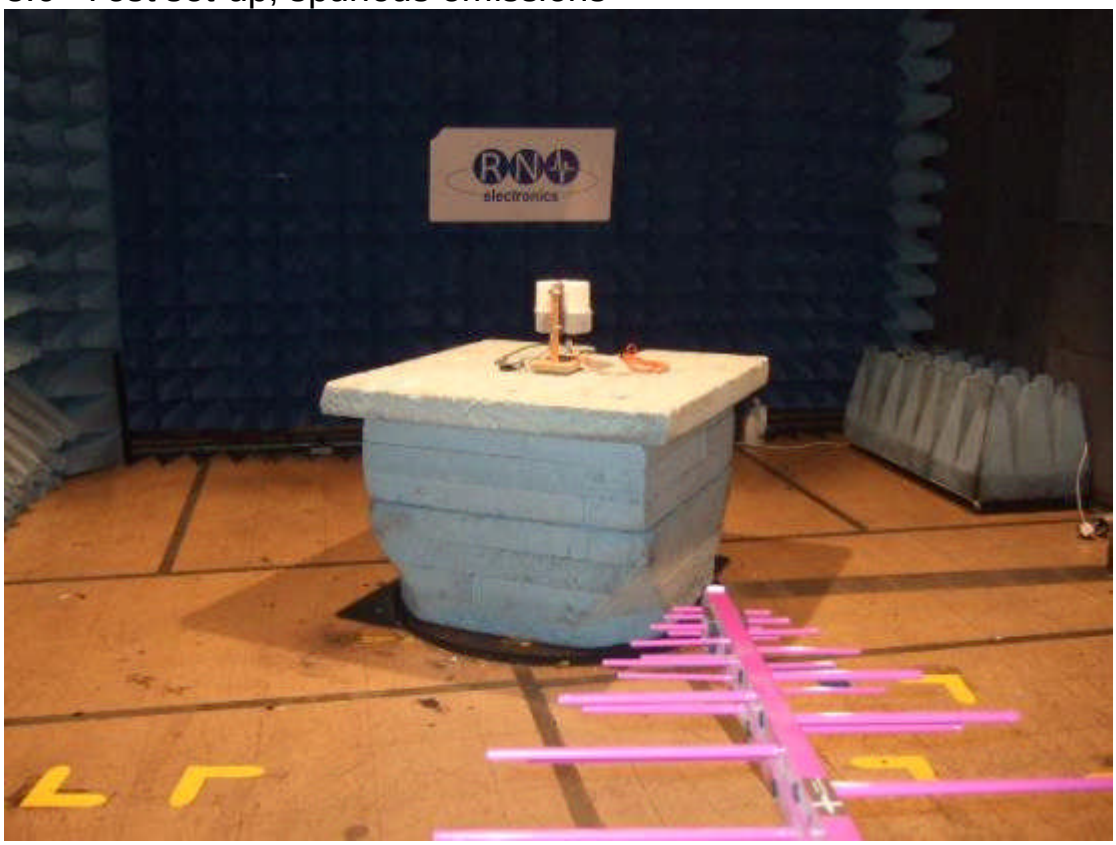
8.4 EUT Display / Controls

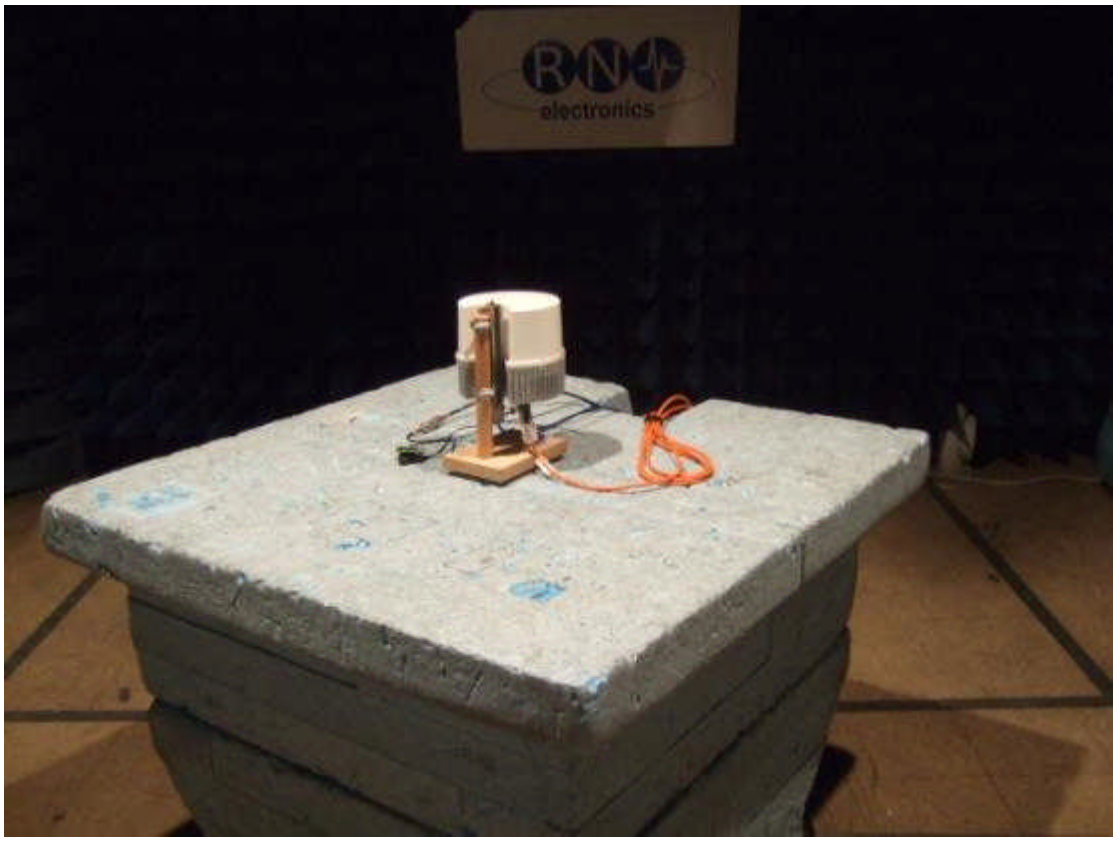


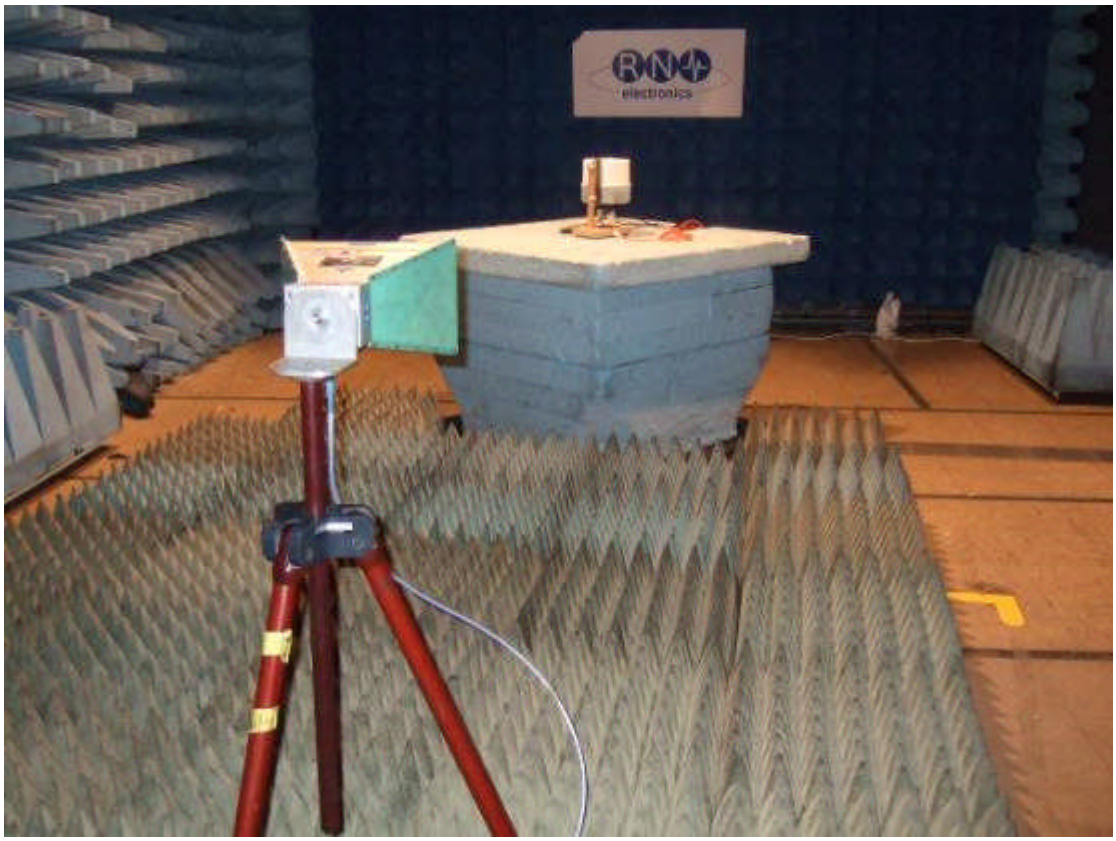
8.5 EUT Internal Photos

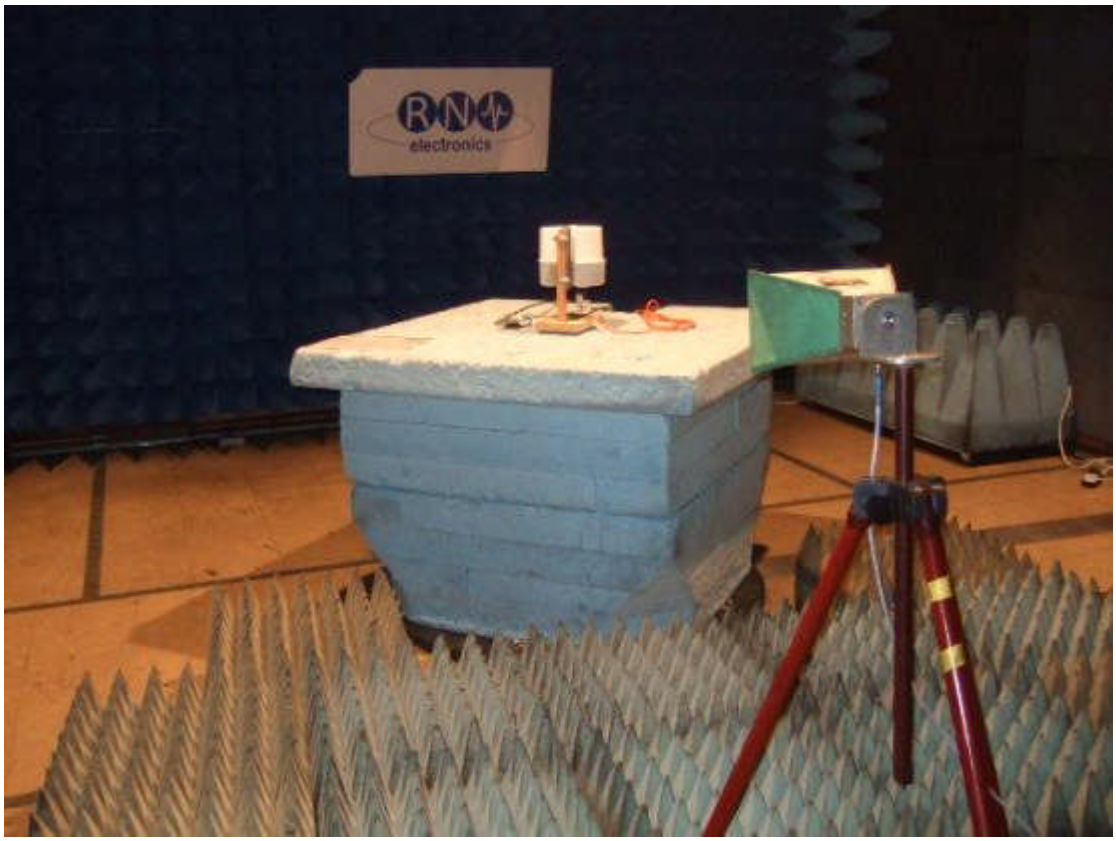
Due to complexity of the EUT these photos were not taken at time of test.

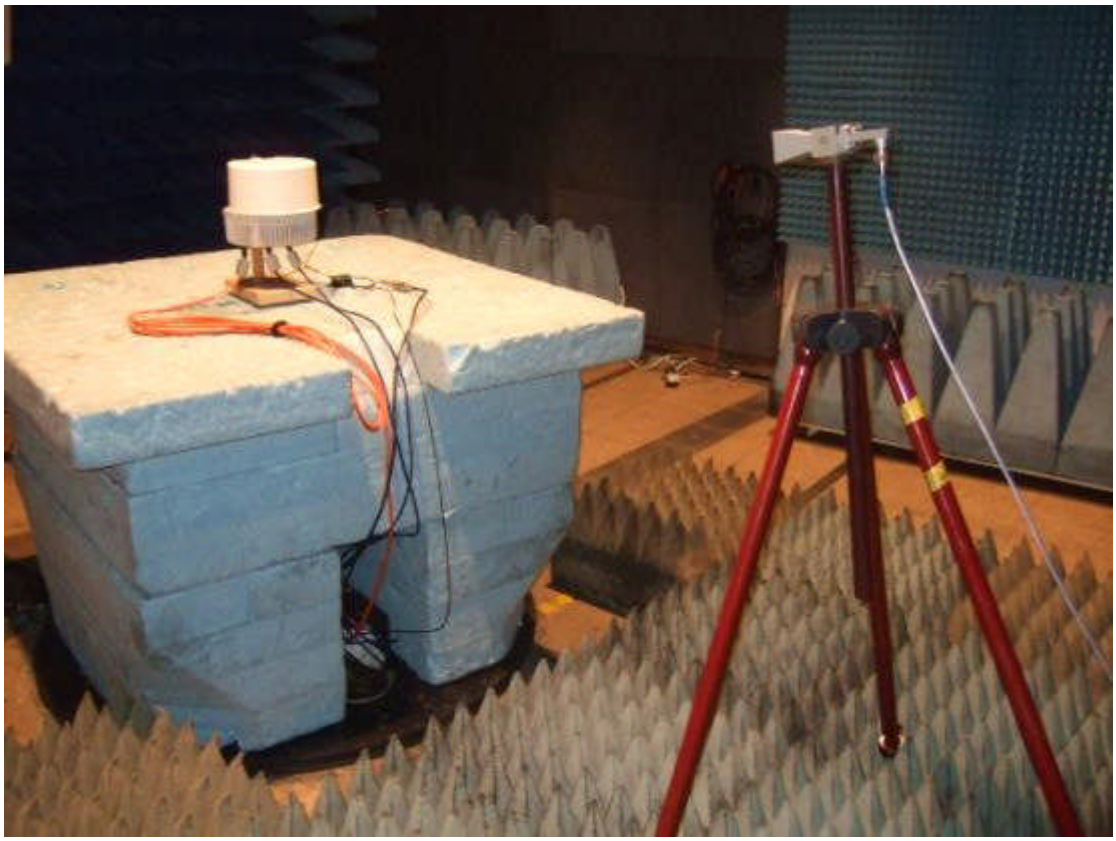
8.6 Test set-up, spurious emissions

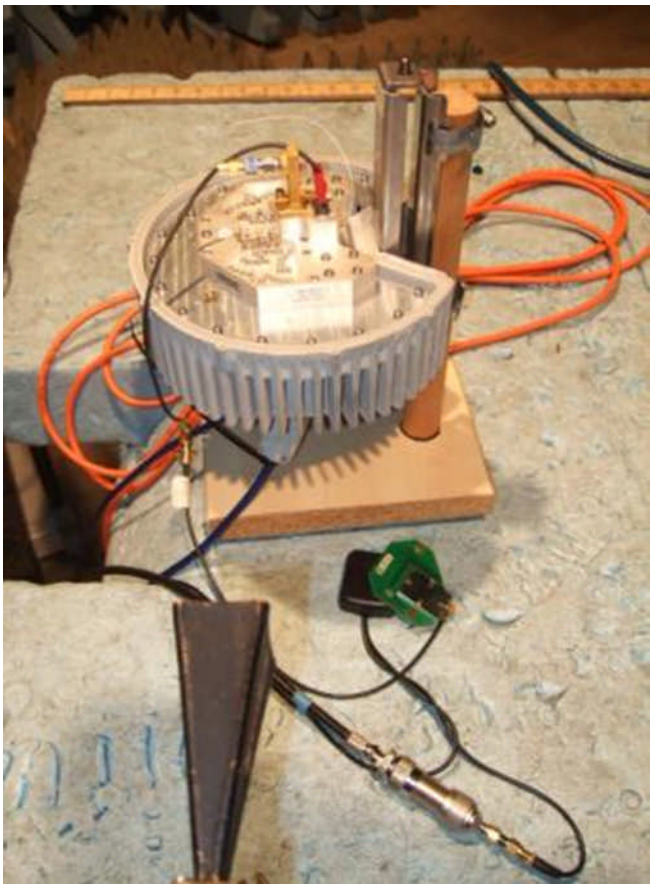


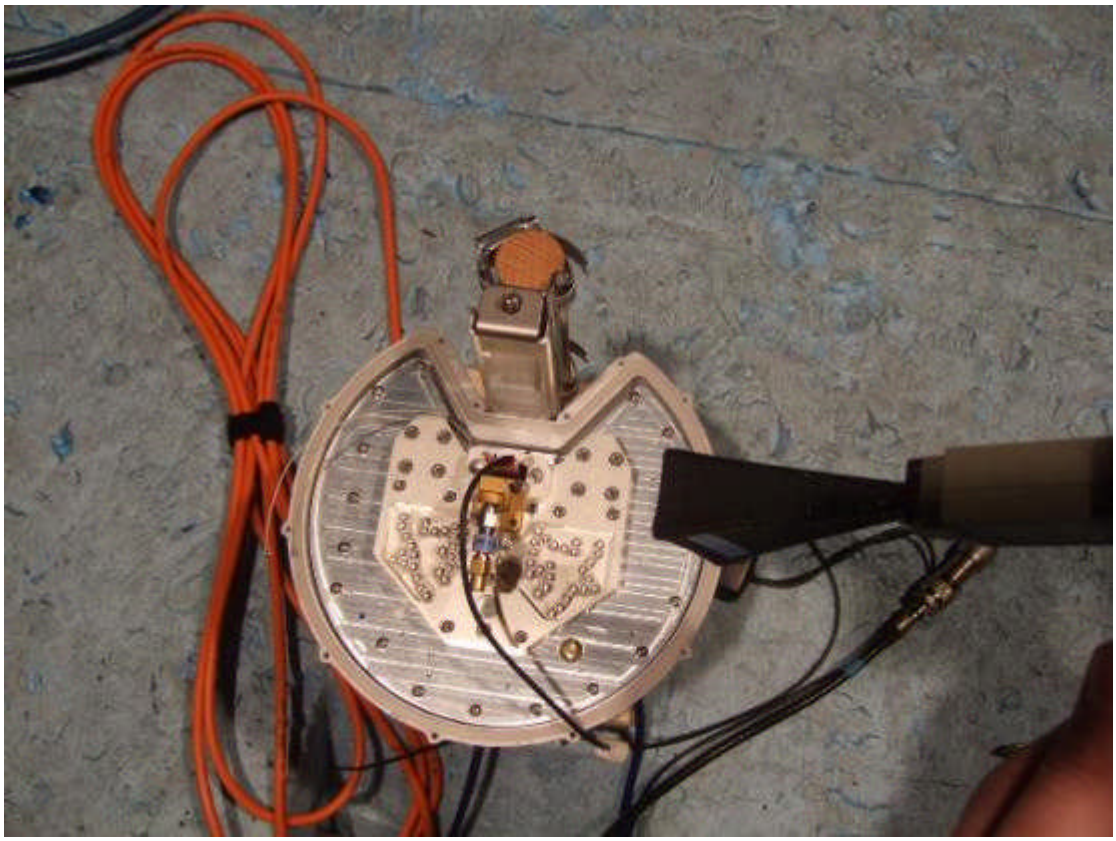


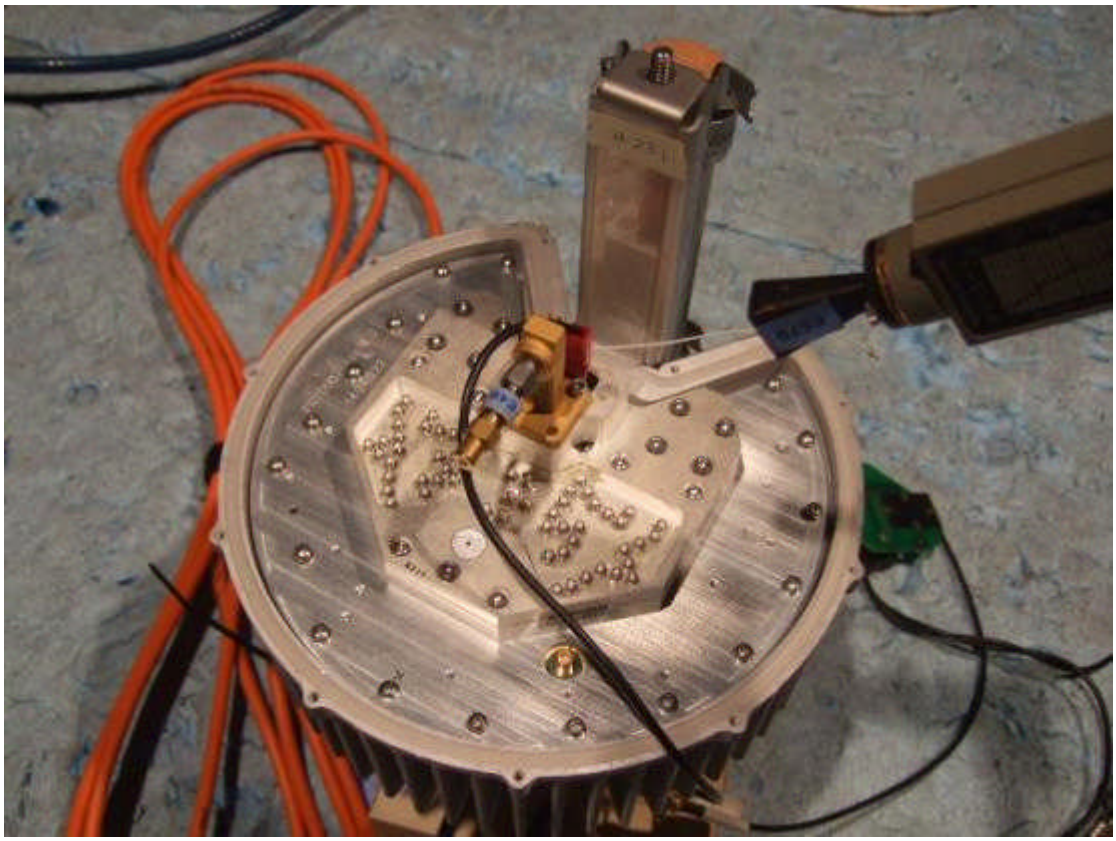

RNE
electronics


RNE
electronics









Photographs of the EUT as viewed from in front of the antennas, site M.

8.7 Set-up diagrams

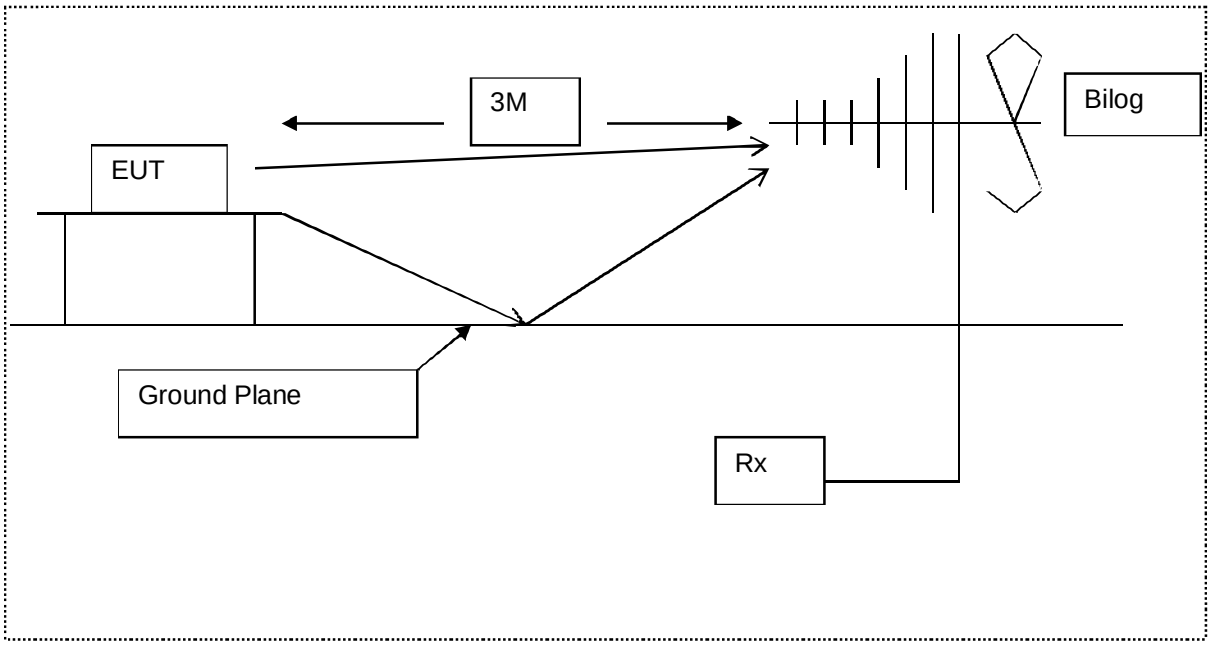


Diagram of the radiated emissions test setup.

9 Signal Leads

Port Name	Cable Type	Connected
Mains input	3 core mains	Yes
Ethernet 1	Cat 5 Screened	Yes
Ethernet 2	Cat 5 Screened	Yes

10 Test Equipment Calibration list

The following table lists the test equipment used, last calibration date and calibration interval. All test equipment used has been maintained within the calibration requirements of ***R.N. Electronics Ltd.*** test facility quality system. Calibration intervals are regularly reviewed dependent on equipment manufacturer's recommendations and actual usage of the equipment.

RN No.	Model	Description	Manufacturer	Calibration date	Cal period
C016	OFS-1A	Off Air Frequency Standard	Halcyon	N/A	N/A
E007-2	VHA9103	Bi-con Antenna	Schwarzbeck	14-Apr-14	36 months
E131	ESG-3000A	Signal Generator	Hewlett Packard	02-Jan-13	24 months
E136	3105	Horn Antenna	EMCO	28-Jan-14	24 months
E204	45821H-2020	Horn 26-40 GHz	Hughes	17-Apr-14	12 months
E268	BHA 9118	1-18 GHz Horn Antenna	Schaffner	29-Apr-14	24 months
E290	6914	Power Sensor	Marconi Instruments	19-Sep-13	24 months
E296-3	11970Q	Harmonic Mixer 33-50 GHz	HP	26-Feb-14	24 months
E296-4	11970U	Harmonic Mixer 40-60 GHz	HP	26-Feb-14	24 months
E296-5	11970V	Harmonic Mixer 50-75 GHz	HP	26-Feb-14	24 months
E296-6	11970W	Harmonic Mixer 75-110 GHz	HP	26-Feb-14	24 months
E301	8493C	20dB 26.5GHz Attenuator	HP	14-Jan-14	12 months
E329	8349B	Microwave Amplifier 2-20 GHz	HP	*16-Sep-14	12 months
E331	22093-KF20	Flann Horn 26.5-40 GHz	FMI	17-Apr-14	12 months
E381	6669A	10 MHz - 40 GHz Generator	Wiltron	*16-Sep-14	months
E397	6960B	RF Power Meter	Marconi Instruments	31-Jul-13	24 months
E404	2024-20	17.6-26.7GHz Standard Gain Horn	FMI	17-Apr-14	12 months
E410	N5181A	3 GHz MXG Signal Generator	Agilent Technologies	26-Oct-11	36 months
E411	N9039A	9 kHz - 1 GHz RF Filter Section	Agilent Technologies	21-Jan-14	12 months
E412	E4440A	3 Hz - 26.5 GHz PSA	Agilent Technologies	21-Jan-14	24 months
E433	MG3693A	Signal Generator 30GHz	Anritsu	01-Jul-14	24 months
E455	-	Wave Source Module 50 - 75 GHz	HP	02-Jul-14	24 months
E456	83554A MM	Wave Source Module 26.5 - 40.0 GHz	HP	*21-Aug-14	24 months
E485	11974-60028	Pre-selector PSU	Agilent	N/A	N/A
E486	11974A	Pre-select Mixer 26.5 - 40GHz	Agilent	13-Jun-13	24 months
E487	11974U	40 - 60GHz Preselect Mixer	Agilent	13-Jun-13	24 months
E489	24/11	WR19 Rotary Attenuator	Flann Microwave	13-Feb-14	24 months
E490	22/11	WR28 Rotary Attenuator	Flann Microwave	13-Feb-14	24 months
E498	4768-20	20dB Attenuator	Narda	*07-Oct-14	12 months
E503	2524-20	40-60 GHz Horn Antenna	FMI	17-Apr-14	12 months
E521	ML83A	Power Meter 10MHz - 140GHz	Anritsu	02-Jul-14	12 months
E550	11974V	Preselected Mixer 50 - 75GHz	HP	13-Jun-13	24 months
E555	CMV 5E-1	5A Variac	Carroll & Meynell Ltd	N/A	N/A
E561	85100W	75-100GHz mm Source	Agilent	02-Jul-14	12 months
E577	2511	Rotary Attenuator	Flann Microwave	*21-Aug-14	24 months
E579	27240	Standard Gain Horn 75GHz - 110GHz	FMI Ltd	17-Apr-14	24 months
E580	24240	Standard Gain Horn 40GHz - 60GHz	FMI Ltd	17-Apr-14	12 months
L264	DT75	Digital Thermometer	Instrotech Ltd	06-Dec-13	24 months
LPE377	8564E	Spectrum Analyser 9kHz - 40GHz	HP	24-Apr-14	24 months
S036	FMH1 420	Temperature & Humidity Test Chamber	JTS Ltd	N/A	N/A

TMS10	TH200	ThermoHygrometer	RS Components	*14-Sep-14	24 months
TMS38	VMT04/140	Environmental Oven	Heraeus Votsch	N/A	N/A
TMS78	3160-08	Std Gain Horn Antenna 12.4-18 GHz	ETS Systems	07-Jun-13	24 months
TMS79	3160-09	Std Gain Horn Antenna 18-26.5 GHz	ETS Systems	07-Jun-13	24 months
TMS80	206-3722	Digital Thermometer & K Probe	RS Components Ltd	31-Oct-13	12 months
TMS814	MP627A	Doublet Antenna 200-1700 MHz	Anritsu Electric Co Ltd	29-Oct-13	24 months
TMS82	8449B	Pre Amplifier 1 - 26 GHz	Agilent	26-Nov-13	12 months
TMS933	CBL6141A	Bilog Antenna 30MHz - 2GHz	York EMC	09-Sep-12	36 months

*Equipment was in calibration and has been calibrated during or since date of tests.

11 Auxiliary equipment

11.1 Customer supplied Equipment

Auxiliary equipment used for the purpose of test supplied by the above has been listed below

No customer supplied equipment was used

11.2 Supplied by RN Electronics Limited

Auxiliary equipment used for the purpose of test supplied by the above has been listed below

No RN Electronics supplied equipment was used

12 Modifications

In order for the EUT to produce the results shown within this report the following modifications, if any, were implemented.

12.1 Modifications before test

No modifications were made before test by RN Electronics Ltd, However, as the automatic power control was inhibited for the duration of tests, before tests commenced power calibrations of the EUTs were made by a Cambridge Communications Systems representative. This resulted in the following power settings which were used for all tests:

Node s/n 227:

QPSK = +19
16QAM = +22
64QAM = +28

Node s/n 229:

QPSK = +19
16QAM = +23
64QAM = +28

Node s/n 231:

QPSK = +20
16QAM = +24
64QAM = +30

12.2 Modifications during test

No modifications were made during test by RN Electronics Ltd.

13 Compliance information

Products subject to the Declaration of Conformity procedure are required to be supplied with a compliance information statement. A copy of this statement may be included here:

Certified equipment - DoC not required.

14 Description of Test Sites

Site A	Radio / Calibration Laboratory and anechoic chamber
Site B	Semi-anechoic chamber
Site B1	Control Room for Site B
Site C	Transient Laboratory
Site D	Screened Room (Conducted Immunity)
Site E	Screened Room (Control Room for Site D)
Site F	Screened Room (AC power line conducted Emissions) VCCI Registration No. C-2823
Site G	Screened Room (Control Room for Site H)
Site H	3m Semi-anechoic chamber (indoor OATS) IC Registration No. 5612A-2
Site J	Screened Room
Site K	Screened Room (Control Room for Site M)
Site M	3m Semi-anechoic chamber (indoor OATS) FCC Registration No. 293246
Site Q	Fully-anechoic chamber
Site OATS	3m and 10m Open Area Test Site FCC Registration No. 293246 IC Registration No. 5612A-1 VCCI Registration No. R-2580
Site R	Screened Room (Conducted Immunity)
Site S	Safety Laboratory
Site T	Transient Laboratory

15 Abbreviations and Units

%	Percent
µV	microVolts
µW	microWatts
AC	Alternating Current
ALSE	Absorber Lined Screened Enclosure
AM	Amplitude Modulation
Amb	Ambient
ANSI	American National Standards Institute
ºC	Degrees Celsius
CFR	Code of Federal Regulations
CS	Channel Spacing
CW	Continuous Wave
dB	deciBels
dBµV	deciBels relative to 1µV
dBc	deciBels relative to Carrier
dBm	deciBels relative to 1mW
DC	Direct Current
EIRP	Equivalent Isotropic Radiated Power
ERP	Effective Radiated Power
EUT	Equipment Under Test
FCC	Federal Communications Commission
FM	Frequency Modulation
FSK	Frequency Shift Keying
g	Grams
GHz	GigaHertz
Hz	Hertz
IF	Intermediate Frequency
kHz	kiloHertz
LO	Local Oscillator
mA	milliAmps
max	maximum
kPa	milliBars
MHz	MegaHertz
min	minimum
mm	milliMetres
ms	milliSeconds
mW	milliWatts
NA	Not Applicable
nom	Nominal
nW	nanoWatt
OATS	Open Area Test Site
OFDM	Orthogonal Frequency Division Multiplexing
ppm	Parts per million
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
Ref	Reference
RF	Radio Frequency
RTP	Room Temperature and Pressure
s	Seconds
Tx	Transmitter
V	Volts