

Report Reference ID:	REP019826
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Test specification:	Title 47 – Telecommunication Chapter I – Federal Communications Commission Subchapter A – General Part 24 – Personal Communication Services Subpart E – Broadband PCS
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Applicant:	TEKO Telecom Srl. Via Meucci, 24/a 40024 – Castel S. Pietro Terme (BO) – Italy
Apparatus:	Very Very High Power Module Amplifier
Model:	MWHPA2001PCS-D2
FCC ID:	XM2-WHPA19HN

Testing laboratory:	Nemko Italy Spa Via del Carroccio, 4 20853 Biassono (MB) – Italy Telephone: +39 039 2201201 Facsimile: +39 039 2201221
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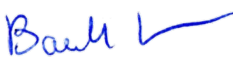
	Name and title	Date
Tested by:	 P. Barbieri, Wireless/EMC Specialist	2023-11-22
Reviewed by:	 D. Guarnone, Wireless/EMC Specialist	2023-11-22

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Section 1: Report summary

1.1 Test specification

Specifications	Part 24 Subpart E, Broadband PCS
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1.2 Statement of compliance

Compliance	In the configuration tested the EUT was found compliant Yes ☒ No ☐ Test method: ANSI C63.26-2015, 935210 D05 Measurements guidance for industrial and non-consumer signal booster, repeater and amplifier devices v01r04, 662911 D01 Multiple Transmitter Output v02r01, 662911 D02 MIMO with Cross-Polarized Antennas v01
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1.3 Exclusions

Exclusions	None
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1.4 Registration number

FCC site number	682159
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1.5 Test report revision history

Revision #	Details of changes made to test report
REP019826	Original report issued

1.6 Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

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Section 2: Summary of test results

2.1 FCC Part 27, test results

Part	Methods	Test description	Verdict
	§ 935210 D05v01r04 (3.2)	AGC threshold	Pass
	§ 935210 D05v01r04 (3.3)	Out of band rejection	Pass
§24.238(b)	§ 935210 D05v01r04 (3.4)	Occupied bandwidth	Pass
§24.232(a)	§ 935210 D05v01r04 (3.5)	Peak output power at RF antenna connector	Pass
§24.238(a)	§ 935210 D05v01r04 (3.6)	Spurious emissions at RF antenna connector	Pass
§24.238(a)	§ 935210 D05v01r04 (3.8)	Radiated spurious emissions	Pass
§24.235	§ 935210 D05v01r04 (3.7)	Frequency stability	N/A a)

Notes:

- a) NOT APPLICABLE: Modulation/frequency conversion circuitry not in use. No frequency change in EUT (input and output have same frequency)

Section 3: Equipment under test (EUT) and application details

3.1 Applicant details

Applicant complete business name	Name:	Teko Telecom Srl
	Federal Registration Number (FRN):	0018963462
	Grantee code	XM2
Mailing address	Address:	Via Meucci, 24/a
	City:	Castel S. Pietro Terme
	Province/State:	Bologna
	Post code:	40024
	Country:	Italy

3.2 Modular equipment

a) Single modular approval	Single modular approval Yes ☐ No ☒
b) Limited single modular approval	Limited single modular approval Yes ☐ No ☒

3.3 Product details

FCC ID	Grantee code:	XM2
	Product code:	-WHPA19HN
Equipment class	B2I	
Description of product as it is marketed	Booster	
	Model name/number:	MWHPA2001PCS-D2
	Serial number:	1017521002

3.4 Application purpose

Type of application	☐ Original certification
	☐ Change in identification of presently authorized equipment
	Original FCC ID: Grant date:
	☒ Class II permissive change or modification of presently authorized equipment

Section 3: Equipment under test

3.5 Composite/related equipment

a) Composite equipment	The EUT is a composite device subject to an additional equipment authorization Yes ☐ No ☒
b) Related equipment	The EUT is part of a system that operates with, or is marketed with, another device that requires an equipment authorization Yes ☐ No ☒
c) Related FCC ID	If either of the above is "yes": ☐ has been granted under the FCC ID(s) listed below: ☐ is in the process of being filled under the FCC ID(s) listed below: ☐ is pending with the FCC ID(s) listed below: ☐ has a mix of pending and granted statues under the FCC ID(s) listed below: i FCC ID: ii FCC ID:

3.6 Sample information

Receipt date:	2023-10-25
Nemko sample ID number:	PRJ00470630001

3.7 EUT technical specifications

Operating band:	Down Link 1930-1995 MHz; Up Link 1850-1915 MHz
Operating frequency:	Wideband
Modulation type:	TDD 5G NR (QAM and QPSK)
Occupied bandwidth:	5G NR: 10 MHz to 45 MHz
Channel spacing:	standard
Emission designator:	5G NR: D7W
RF Output	Down Link: 46dBm (40W) Up Link: N.A. (The EUT does not transmit over the air in the up-link direction)
Gain	Down Link: 51dB Up Link: N.A. (The EUT does not transmit over the air in the up-link direction)
Antenna type:	External Antenna is not provided, equipment that has an external 50 Ω RF connector
Power source:	28-30 Vdc

Section 3: Equipment under test

3.8 Accessories and support equipment

The following information identifies accessories used to exercise the EUT during testing:

Item # 1

Type of equipment:	Power Supply
Brand name:	EA-PS
Model name or number:	8080-60
Serial number:	1421120002
Nemko sample number:	-----
Connection port:	To supply amplifier
Cable length and type:	-----

Item # 2

Type of equipment:	Power supply
Brand name:	GWINSTEK
Model name or number:	GPS4303
Serial number:	GEP893244
Nemko sample number:	-----
Connection port:	To supply cooling fan of heatsink
Cable length and type:	-----

Item # 3

Type of equipment:	Management Module
Brand name:	Teko Telecom
Model name or number:	MSPVRUV0001
Serial number:	2015729111
Nemko sample number:	-----
Connection port:	LAN Port, To manage amplifier module
Cable length and type:	Power Supply

Item # 4

Type of equipment:	
Brand name:	
Model name or number:	
Serial number:	
Nemko sample number:	-----
Connection port:	-----
Cable length and type:	-----

Section 3: Equipment under test

3.9 Operation of the EUT during testing

Details:	In down-link direction, normal working at max gain with max RF power output.
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3.10 EUT setup diagram

In this system, Very Very High Power Amplifier is the EUT and it is intended for mounting in Remote Unit and Digital Service Front-End (optical system with Master Unit that includes only management module and optical module, to convert RF signal in optical signal in down link direction and viceversa optical signal in RF signal in up link direction). As described in "Operational description", master unit is connected directly to base station, so the system doesn't use another equipment (under another FCC ID) to exercise the EUT. Signal generator is linked directly to the RF input connector.

Test setup for output power, occupied bandwidth, spurious emissions:



Procedure

Connect the signal modulated generator to the input of the EUT, so that the EUT works at the max gain. Raise the input level to the EUT until reach the maximum output power. Connect the spectrum analyzer to the RF output connector of the EUT.

Section 4: Engineering considerations

4.1 Modifications incorporated in the EUT

Modifications

Modifications performed to the EUT during this assessment
None ☒ Yes ☐, performed by Client ☐ or Nemko ☐
Details:

4.2 Deviations from laboratory tests procedures

Deviations

Deviations from laboratory test procedures
None ☒ Yes ☐ - details are listed below:

4.3 Technical judgment

Judgment

None

Section 5: Test conditions

5.1 Deviations from laboratory tests procedures

No deviations were made from laboratory test procedures.

5.2 Test conditions, power source and ambient temperatures

Normal temperature, humidity and air pressure test conditions	Temperature: 18–33 °C Relative humidity: 25–75 % Air pressure: 86–106 kPa When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.
Power supply range:	The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages $\pm 5\%$, for which the equipment was designed.

5.3 Measurement uncertainty

The measurement uncertainty was calculated for each test and quantity listed in this test report, according to CISPR 16-4-2 and other specific test standard and is documented in Nemko Spa working manual WML1002. The assessment of conformity for each test performed on the equipment is performed not taking into account the measurement uncertainty. The two following possible verdicts are stated in the report:

P (Pass) - The measured values of the equipment respect the specification limit at the points tested. The specific risk of false accept is up to 50% when the measured result is close to the limit.

F (Fail) - One or more measured values of the equipment do not respect the specification limit at the points tested. The specific risk of false reject is up to 50% when the measured result is close to the limit.

Hereafter Nemko's measurement uncertainties are reported:

Section 5: Test conditions, continued

EUT	Type	Test	Range	Measurement Uncertainty	Notes
Transmitter	Conducted	Frequency error	0.001 MHz ÷ 40 GHz	0.08 ppm	(1)
		Carrier power RF Output Power	0.009 MHz ÷ 30 MHz	1.1 dB	(1)
			30 MHz ÷ 18 GHz	1.5 dB	(1)
			18 MHz ÷ 40 GHz	3.0 dB	(1)
			40 MHz ÷ 140 GHz	5.0 dB	(1)
		Adjacent channel power	1 MHz ÷ 18 GHz	1.4 dB	(1)
		Conducted spurious emissions	0.009 MHz ÷ 18 GHz	3.0 dB	(1)
			18 GHz ÷ 40 GHz	4.2 dB	(1)
			40 GHz ÷ 220 GHz	6.0 dB	(1)
		Intermodulation attenuation	1 MHz ÷ 18 GHz	2.2 dB	(1)
		Attack time – frequency behaviour	1 MHz ÷ 18 GHz	2.0 ms	(1)
		Attack time – power behaviour	1 MHz ÷ 18 GHz	2.5 ms	(1)
		Release time – frequency behaviour	1 MHz ÷ 18 GHz	2.0 ms	(1)
		Release time – power behaviour	1 MHz ÷ 18 GHz	2.5 ms	(1)
		Transient behaviour of the transmitter– Transient frequency behaviour	1 MHz ÷ 18 GHz	0.2 kHz	(1)
		Transient behaviour of the transmitter – Power level slope	1 MHz ÷ 18 GHz	9%	(1)
		Frequency deviation - Maximum permissible frequency deviation	0.001 MHz ÷ 18 GHz	1.3%	(1)
		Frequency deviation - Response of the transmitter to modulation frequencies above 3 kHz	0.001 MHz ÷ 18 GHz	0.5 dB	(1)
		Dwell time	-	3%	(1)
		Hopping Frequency Separation	0.01 MHz ÷ 18 GHz	1%	(1)
		Occupied Channel Bandwidth	0.01 MHz ÷ 18 GHz	2%	(1)
		Modulation Bandwidth	0.01 MHz ÷ 18 GHz	2%	(1)
	Radiated	Radiated spurious emissions	0.009 MHz ÷ 26.5 GHz	6.0 dB	(1)
			26.5 GHz ÷ 66 GHz	8.0 dB	(1)
			66 GHz ÷ 220 GHz	10 dB	(1)
		Effective radiated power transmitter	10 kHz ÷ 26.5 GHz	6.0 dB	(1)
			26.5 GHz ÷ 66 GHz	8.0 dB	(1)
			66 GHz ÷ 220 GHz	10 dB	(1)
Receiver	Radiated	Radiated spurious emissions	0.009 MHz ÷ 26.5 GHz	6.0 dB	(1)
			26.5 GHz ÷ 66 GHz	8.0 dB	(1)
			66 GHz ÷ 220 GHz	10 dB	(1)
		Sensitivity measurement	1 MHz ÷ 18 GHz	6.0 dB	(1)
	Conducted	Conducted spurious emissions	0.009 MHz ÷ 18 GHz	3.0 dB	(1)
			18 GHz ÷ 40 GHz	4.2 dB	(1)
			40 GHz ÷ 220 GHz	6.0 dB	(1)

NOTES:

(1) The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2$, which for a normal distribution corresponds to a coverage probability of approximately 95 %

Section 5: Test conditions, continued

5.4 Test equipment

Equipment	Manufacturer	Model No.	Asset/Serial No.	Next cal.
Vector Signal Generator	Keysight	N5182B MXG	MY59100262	2025-07
Vector Signal Generator	Keysight	N5182B MXG	MY61252595	2024-11
Spectrum Analyzer	Keysight	N9030B PXA	MY62282033	2023-12
Combiner	Miczen	MZP200506GA (0.5-6 GHz)	210314001	COU

Note: N/A = Not Applicable, NCR = No Cal Required, COU = CAL On Use

(*) Equipment supplied by manufacturer's

Appendix A: Test results

Clause 935210 D05v01r04 (3.2) AGC threshold

Measure of EUT AGC Threshold

Test date: 2023-10-25 to 2023-11-02

Test results: Pass

Special notes

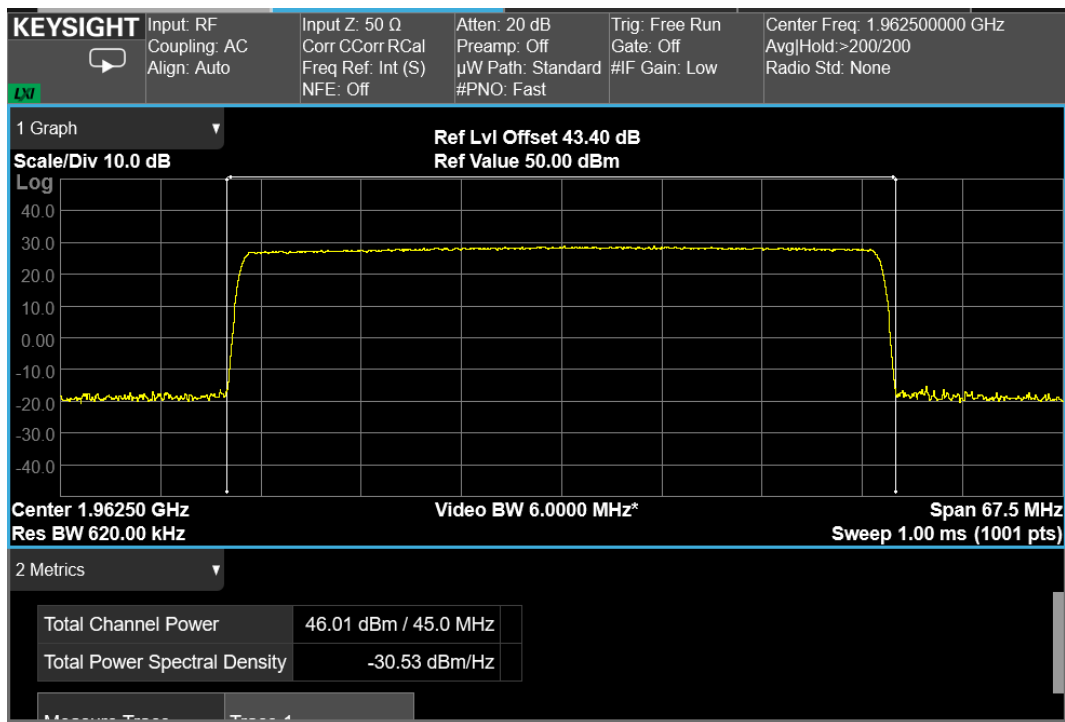
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Test equipment

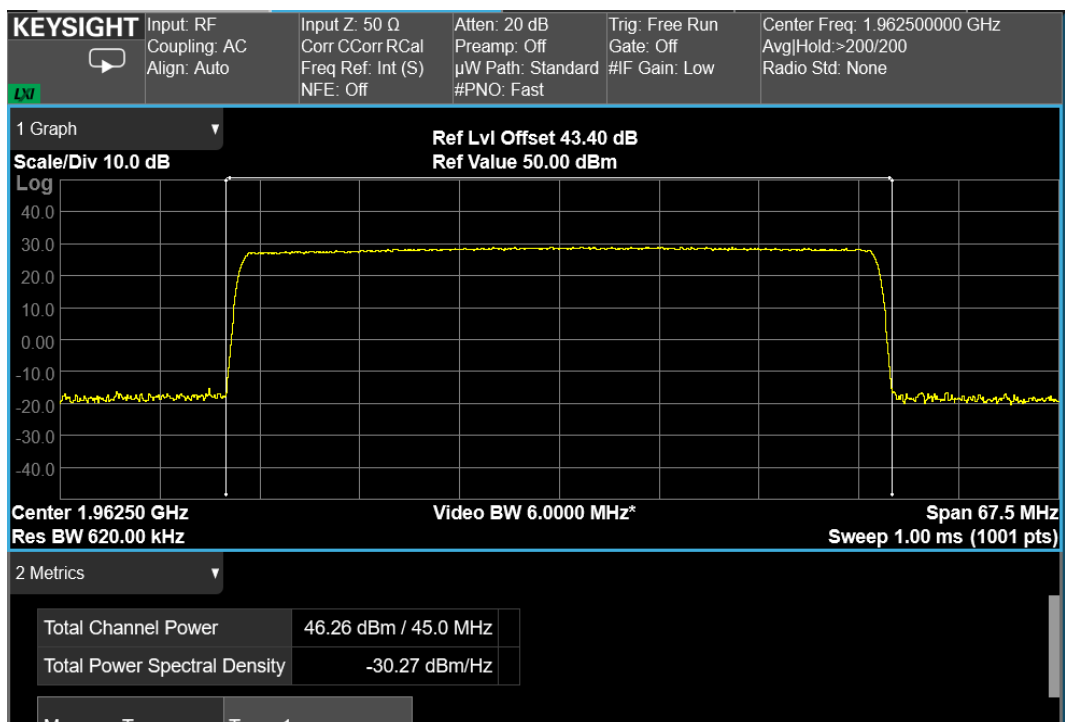
Equipment	Manufacturer	Model No.	Asset/Serial No.	Next cal.
Vector Signal Generator	Keysight	N5182B MXG	MY61252595	2024-11
Spectrum Analyzer	Keysight	N9030B PXA	MY62282033	2023-12

Note: N/A = Not Applicable, NCR = No Cal Required, COU = CAL On Use
(*) Equipment supplied by manufacturer's

Test data



45 MHz signal, middle channel, nominal input signal



45 MHz signal, middle channel, nominal input signal +1 dB

Clause 935210 D05v01r04 (3.3) Out of band rejection

Out of Band Rejection – Test for rejection of out of band signals.

Test date: 2023-10-25 to 2023-11-02

Test results: Pass

Special notes

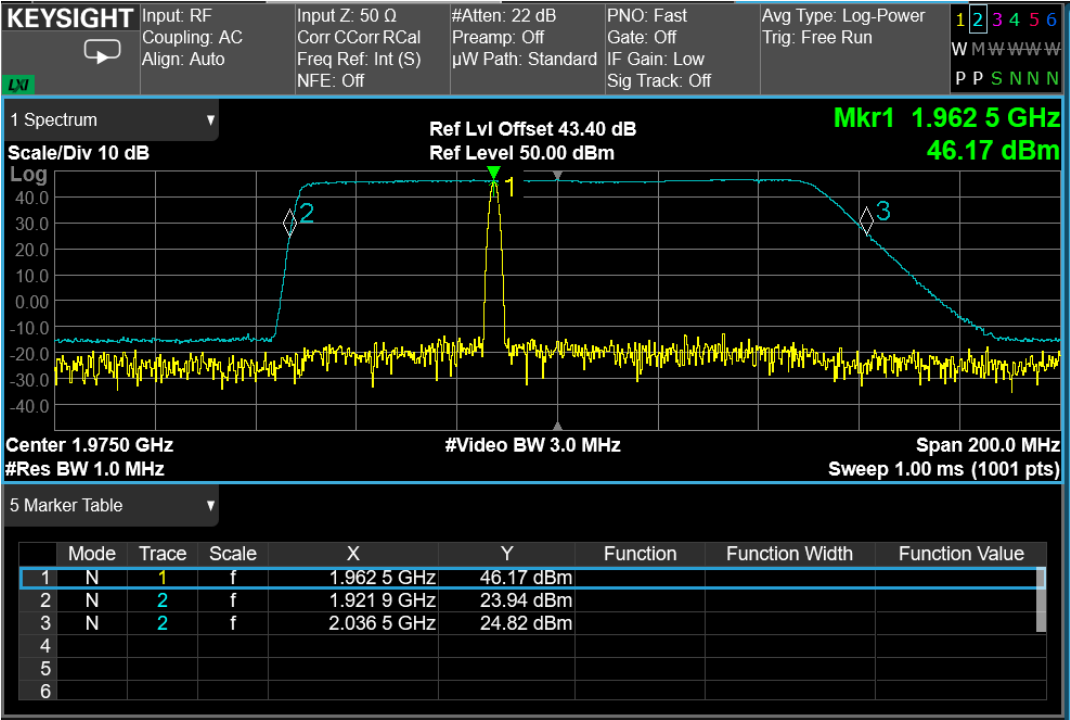
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Test equipment

Equipment	Manufacturer	Model No.	Asset/Serial No.	Next cal.
Vector Signal Generator	Keysight	N5182B MXG	MY61252595	2024-11
Spectrum Analyzer	Keysight	N9030B PXA	MY62282033	2023-12

Note: N/A = Not Applicable, NCR = No Cal Required, COU = CAL On Use
(*) Equipment supplied by manufacturer's

Test data



Clause 24.238(b) Occupied bandwidth

The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

Test date: 2023-10-25 to 2023-11-02

Test results: Pass

Special notes

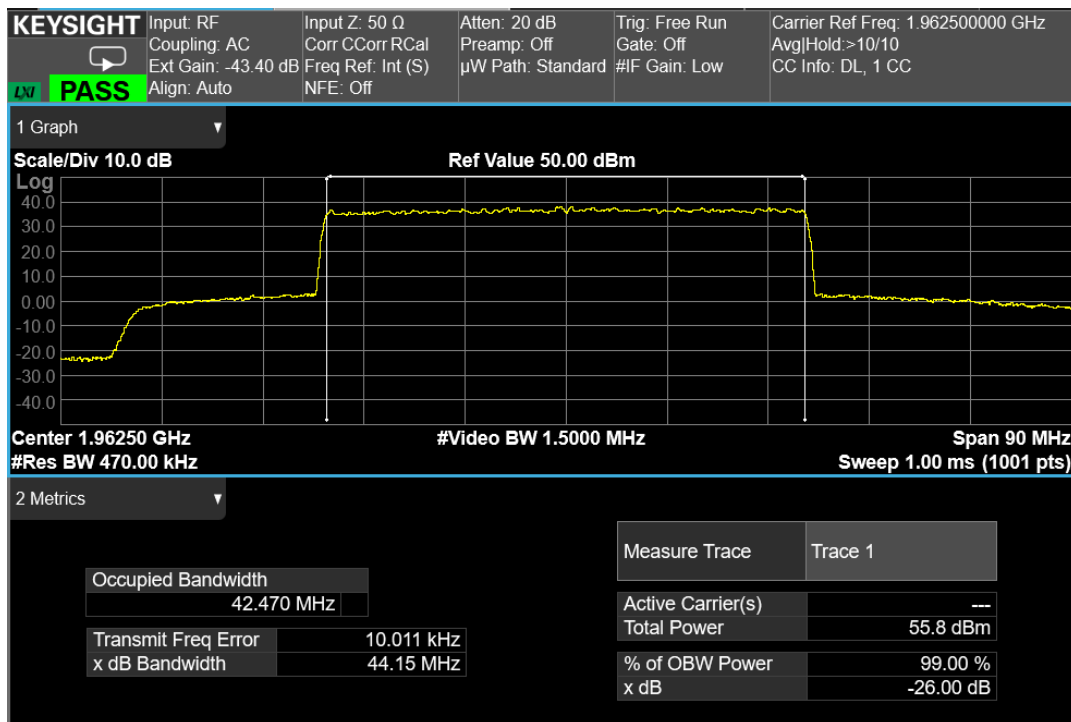
-

Test equipment

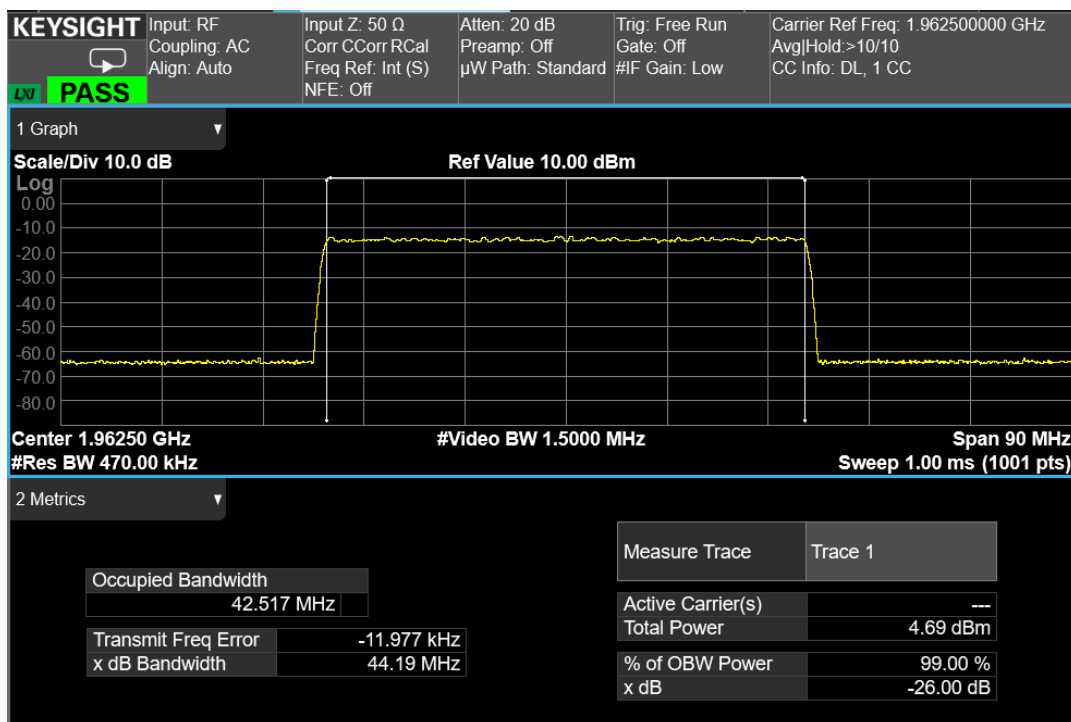
Equipment	Manufacturer	Model No.	Asset/Serial No.	Next cal.
Vector Signal Generator	Keysight	N5182B MXG	MY61252595	2024-11
Spectrum Analyzer	Keysight	N9030B PXA	MY62282033	2023-12

Note: N/A = Not Applicable, NCR = No Cal Required, COU = CAL On Use
(*) Equipment supplied by manufacturer's

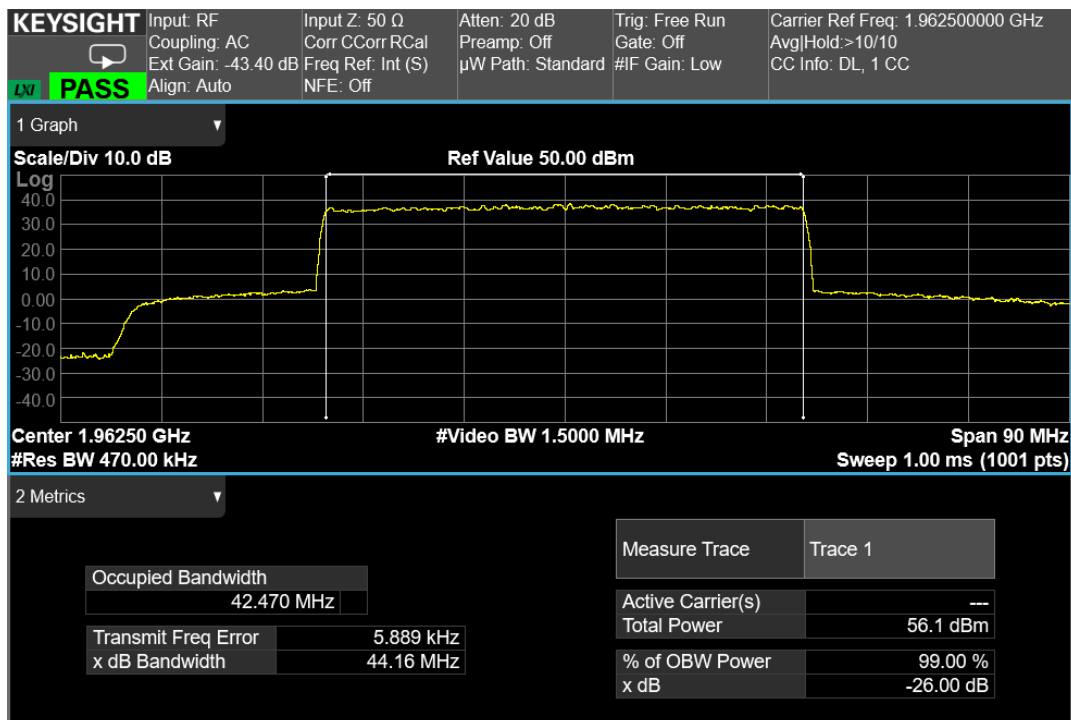
Test data



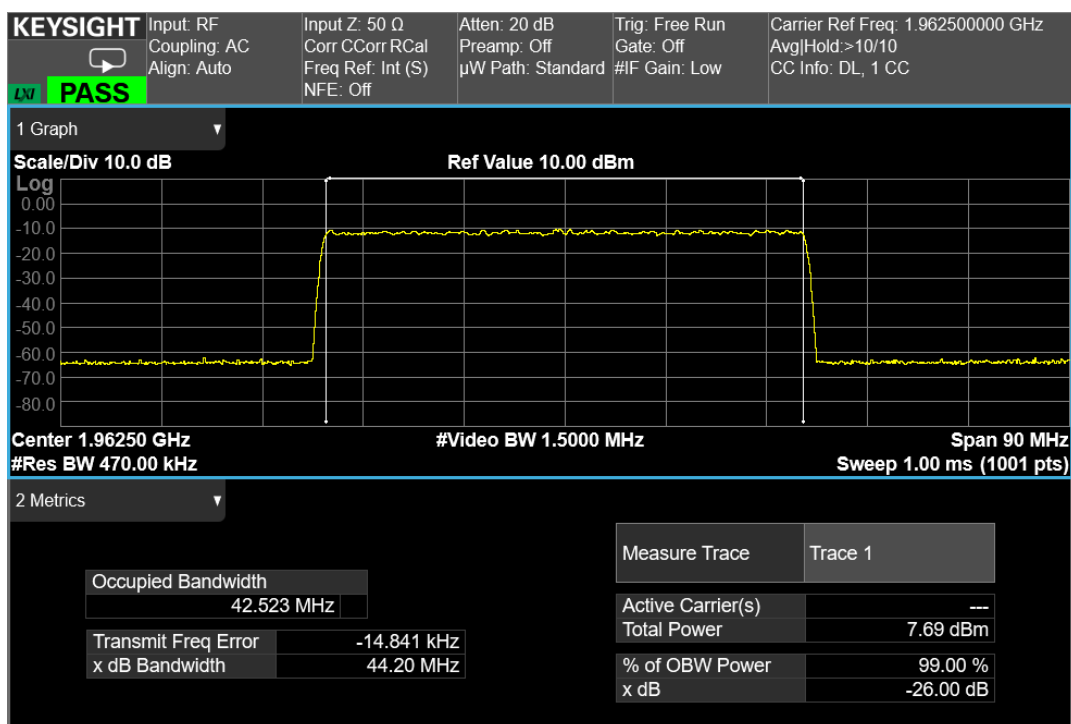
45 MHz signal, middle channel, nominal input signal - Output



45 MHz signal, middle channel, nominal input signal - Input



45 MHz signal, middle channel, nominal input signal + 3dB - Output



45 MHz signal, middle channel, nominal input signal + 3dB - Input

Clause 24.232(a) Peak output power at RF antenna connector

(a) (1) Base stations with an emission bandwidth of 1 MHz or less are limited to 1640 watts equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT, except as described in paragraph (b) below.

(a) (2) Base stations with an emission bandwidth greater than 1 MHz are limited to 1640 watts/MHz equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT, except as described in paragraph (b) below.

(d) Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (e) of this section. In both instances, equipment employed must be authorized in accordance with the provisions of §24.51. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

Test date: 2023-10-25 to 2023-11-02

Test results: Pass

Special notes

-

Test equipment

Equipment	Manufacturer	Model No.	Asset/Serial No.	Next cal.
Vector Signal Generator	Keysight	N5182B MXG	MY61252595	2024-11
Spectrum Analyzer	Keysight	N9030B PXA	MY62282033	2023-12

Note: N/A = Not Applicable, NCR = No Cal Required, COU = CAL On Use
(*) Equipment supplied by manufacturer's

Test data

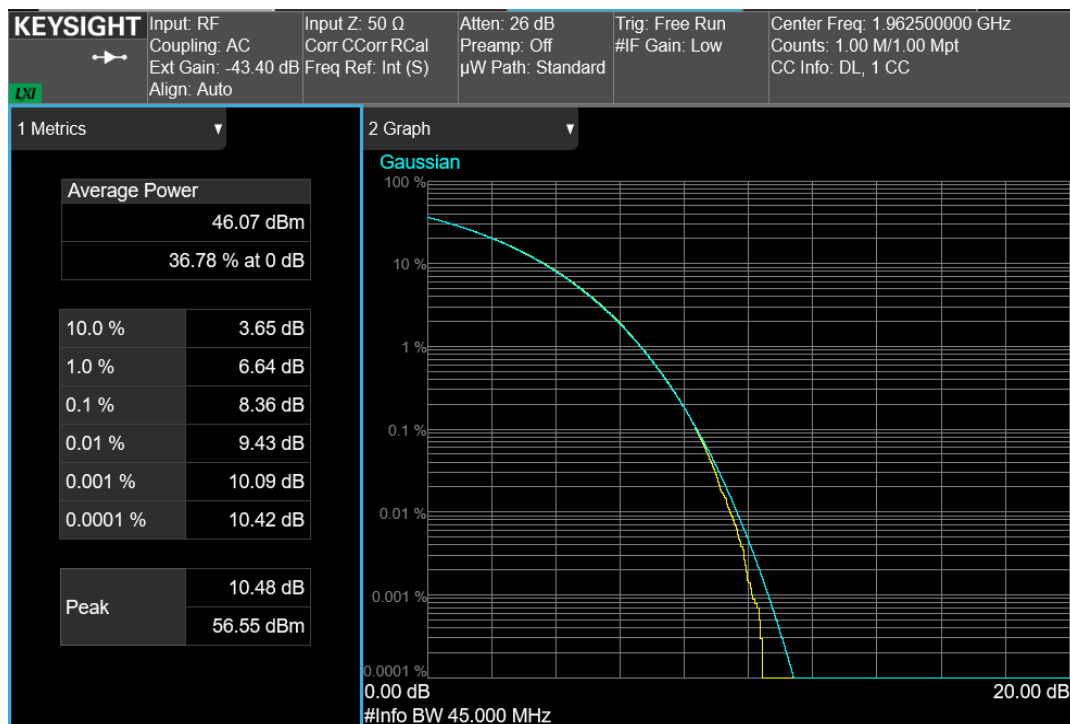
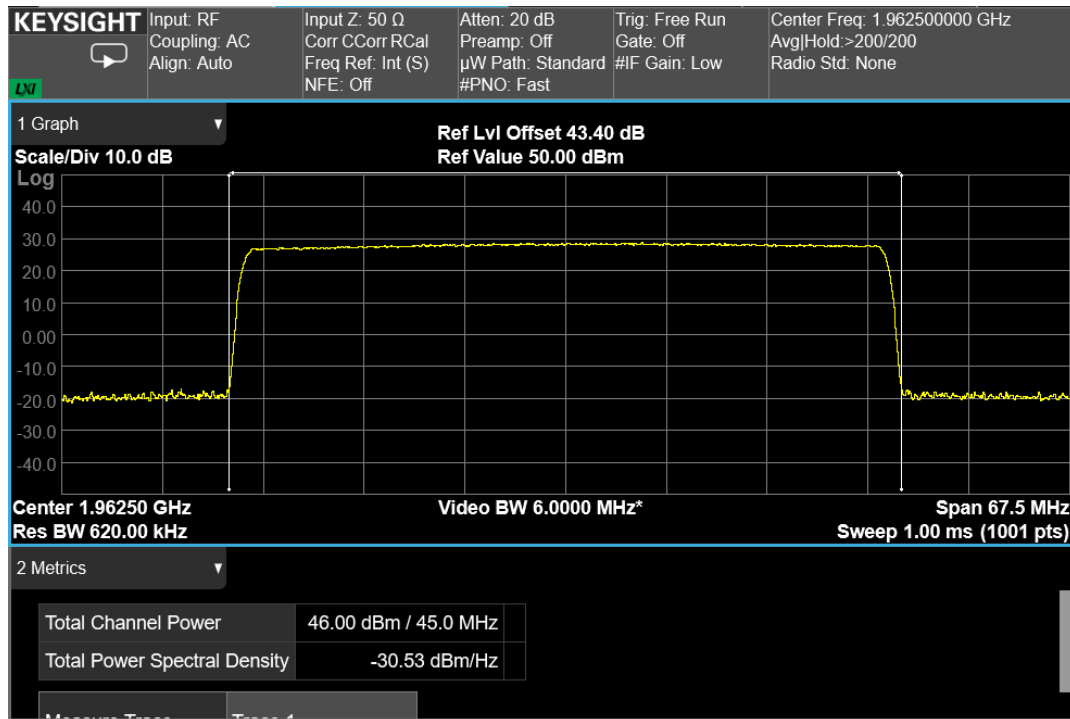
AWGN signal, nominal input signal

Test data						
Direction	Modulation	Frequency (MHz)	RF output Power (dBm)	RF output channel Power (W)	RF output Power (W/MHz)	PAR (dB)
Down-link	5G NR, 45 MHz	1962.5	46.0	40.0	0.9	10.5

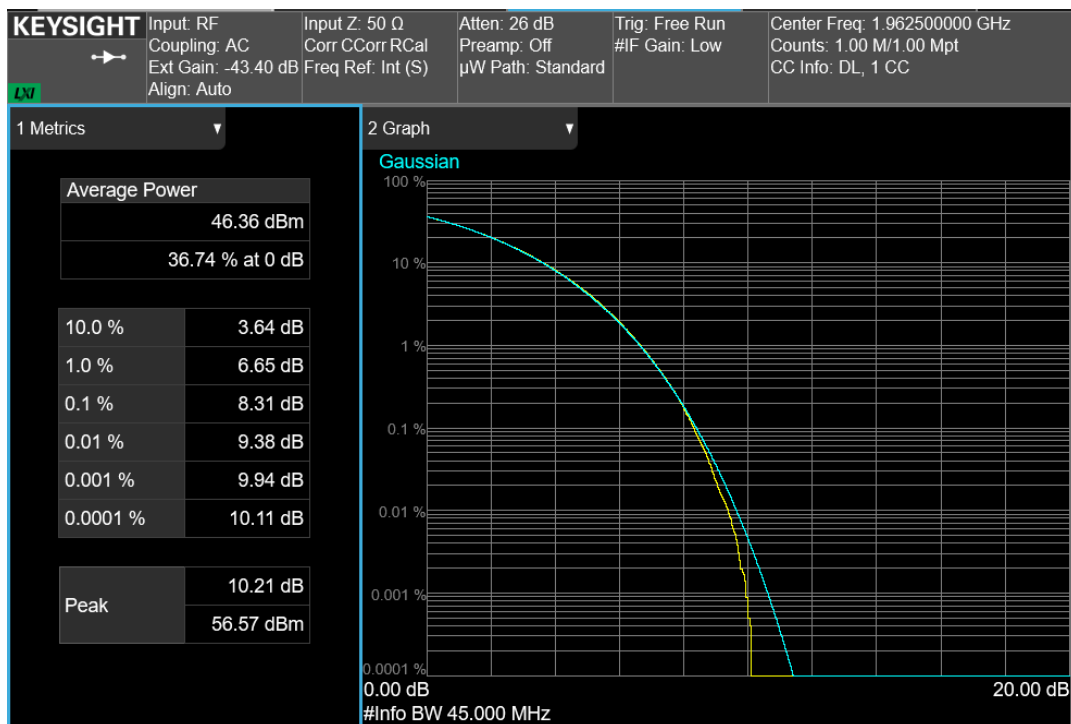
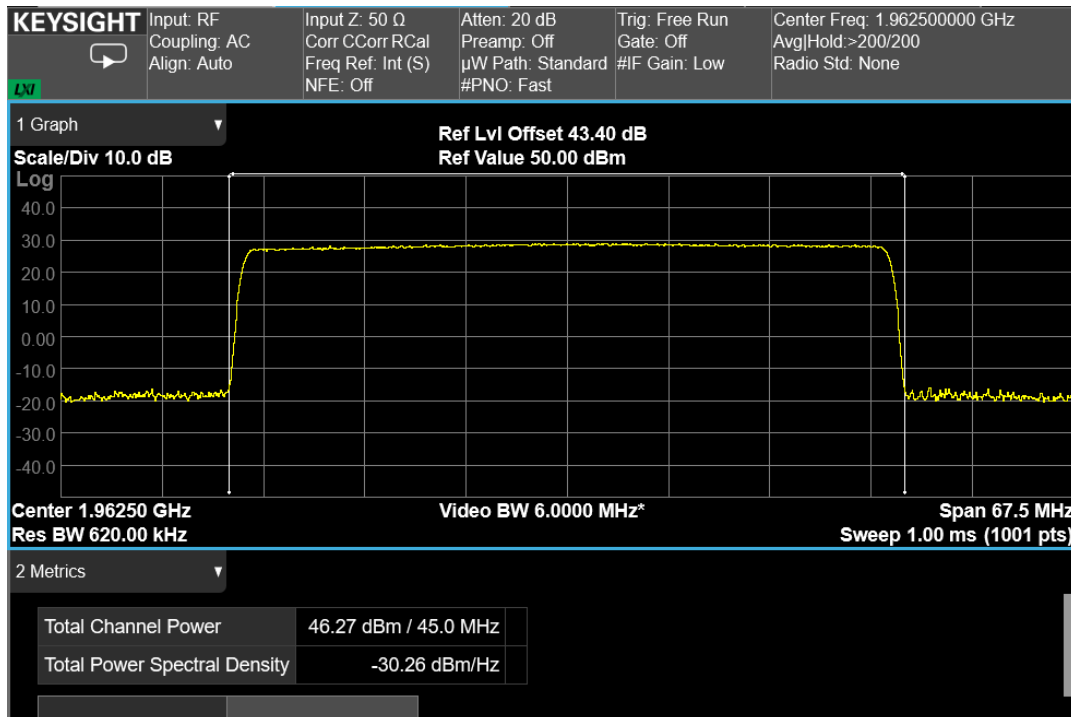
AWGN signal, nominal input signal + 3dB

Test data						
Direction	Modulation	Frequency (MHz)	RF output Power (dBm)	RF output channel Power (W)	RF output Power (W/MHz)	PAR (dB)
Down-link	5G NR, 45 MHz	1962.5	46.3	42.7	1.0	10.2

Note: PAR measure is performed by the “CCDF” function installed on Spectrum analyzer that provides average power (the same measured with “Channel power” function), peak power and PAR.



45 MHz signal, middle channel, nominal input signal



45 MHz signal, middle channel, nominal input signal + 3dB

Clause 24.238(a) Spurious emissions at RF antenna connector

a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

Test date: 2023-10-25 to 2023-11-02

Test results: Pass

Special notes

For Class 2 Permissive Change new tests were performed only on band edges intermodulation. For previous spurious emissions tests at RF antenna connector see **400107-11TRFWL.pdf** report.

Test equipment

Equipment	Manufacturer	Model No.	Asset/Serial No.	Next cal.
Vector Signal Generator	Keysight	N5182B MXG	MY59100262	2025-07
Vector Signal Generator	Keysight	N5182B MXG	MY61252595	2024-11
Spectrum Analyzer	Keysight	N9030B PXA	MY62282033	2023-12
Combiner	Miczen	MZP200506GA (0.5-6 GHz)	210314001	COU

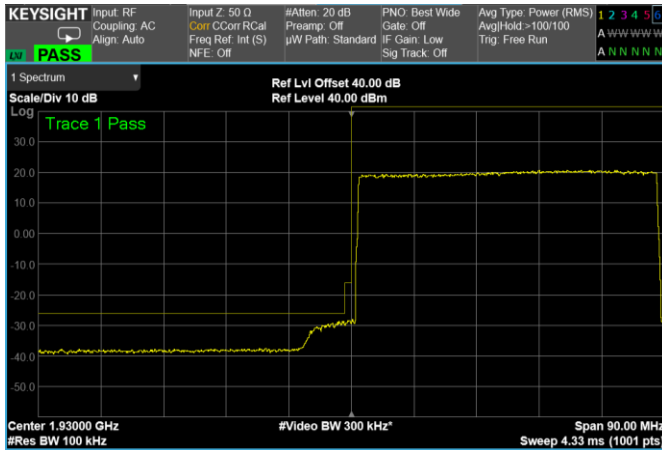
Note: N/A = Not Applicable, NCR = No Cal Required, COU = CAL On Use

(*) Equipment supplied by manufacturer's

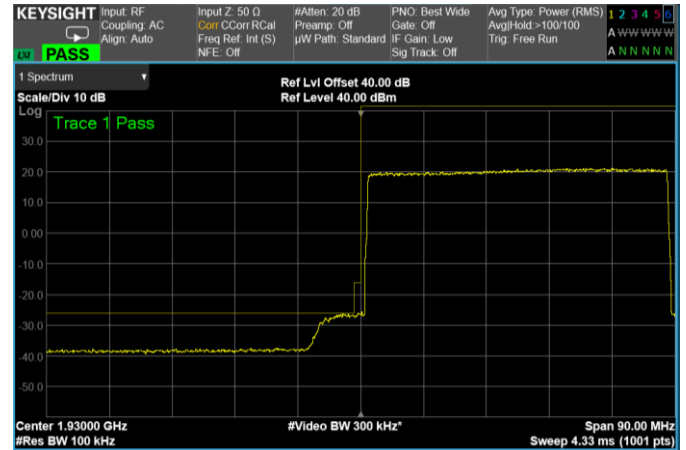
Test data			
See Plots below			
Spurious emissions measurement results:			
Frequency (MHz)	Spurious emission (dBm)	Limit (dBm)	Margin (dB)
First channel	Negligible	-13	
Mid channel	Negligible	-13	
Last channel	Negligible	-13	

MIMO consideration
In the final Remote Unit, the EUT could be used in MIMO configuration according to KDB 662911-D01 v02r01 and 662911-D02 v01 with signals completely uncorrelated. So, the maximum emission is calculated as follows: - MIMO Maximum Emission = Emission at each path + $10\log(N_{ant})$ dB = = Emission at each path + $10\log(2)$ = Emission at each path + 3dB - Spurious emission limit is -16dBm.

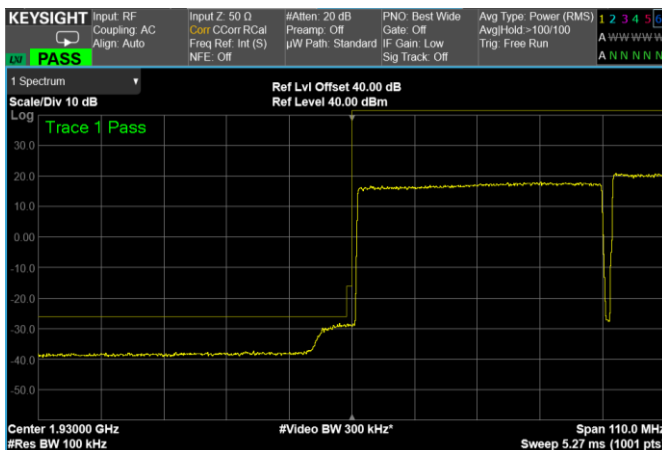
Test data, continued: band edges Inter modulation



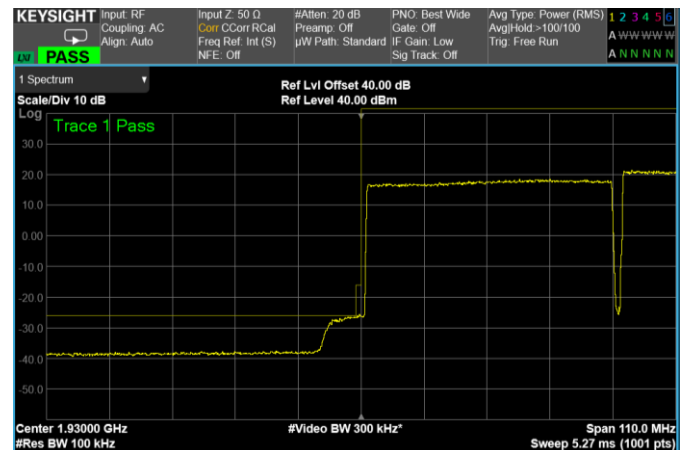
45 MHz signal, Low Band Edge, 1 carrier, nominal input signal



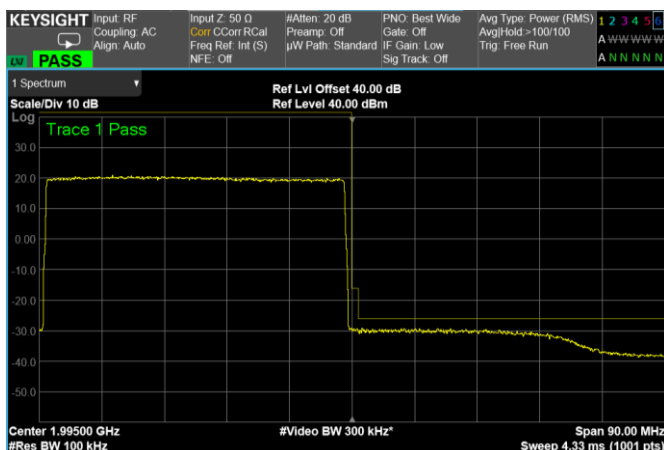
45 MHz signal, Low Band Edge, 1 carrier, nominal input signal + 3dB



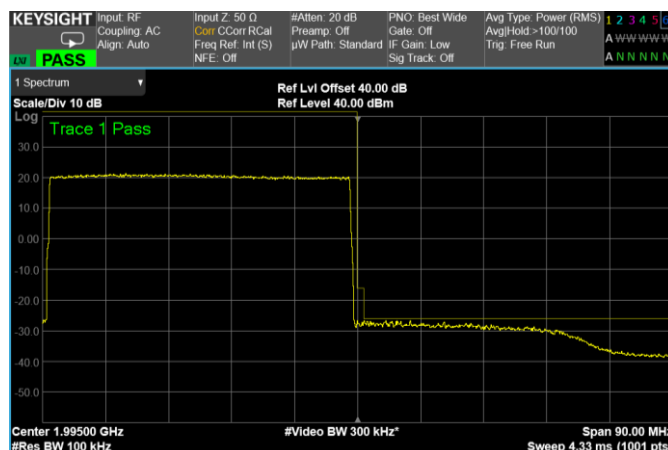
45 MHz + 20 MHz signals, Low Band Edge, 2 carriers, nominal input signal



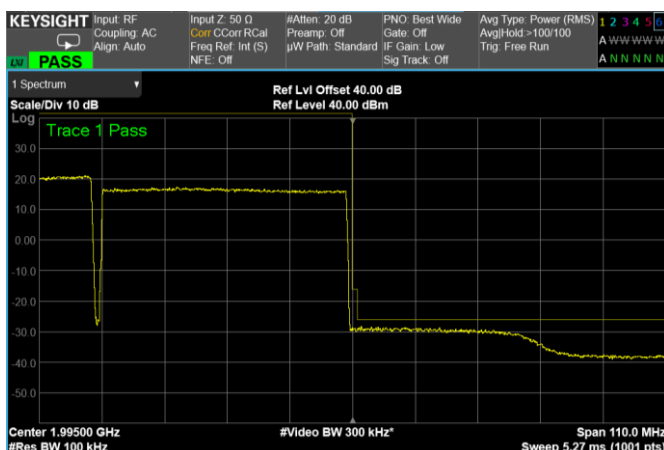
45 MHz + 20 MHz signals, Low Band Edge, 2 carriers, nominal input signal + 3dB



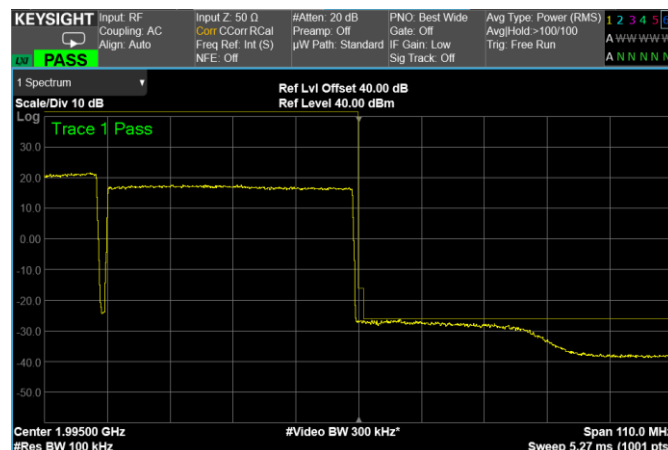
45 MHz signal, High Band Edge, 1 carrier, nominal input signal



45 MHz signal, High Band Edge, 1 carrier, nominal input signal + 3dB



20 MHz + 45 MHz signals, High Band Edge, 2 carriers, nominal input signal



20 MHz + 45 MHz signals, High Band Edge, 2 carriers, nominal input signal + 3dB

Clause 24.238(a) Radiated Spurious emissions

a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

Test date: N/A

Test results: N/A

Special notes

- Test not performed because not requested for a Class 2 Permissive Change.
- For previous radiated spurious emission tests see **400107-11TRFWL.pdf** report.

Test equipment

Equipment	Manufacturer	Model No.	Asset/Serial No.	Next cal.

Note: N/A = Not Applicable, NCR = No Cal Required, COU = CAL On Use
(*) Equipment supplied by manufacturer's

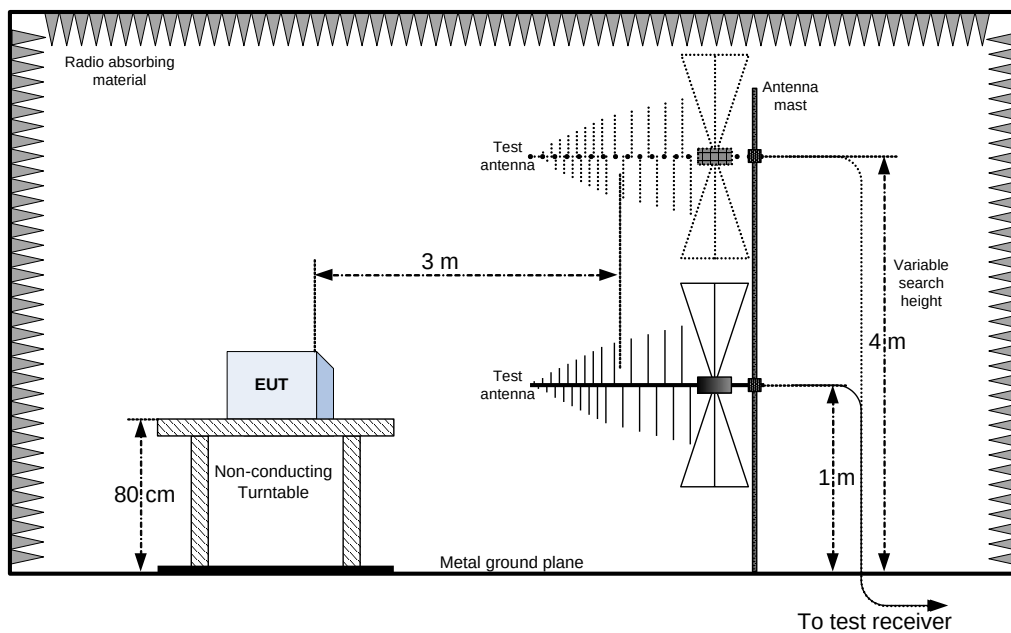
Clause 24.238 (a) Radiated spurious emissions, continued

Test data				
Spurious emissions measurement results:				
Frequency (MHz)	Polarization. V/H	Field strength (dBm)	Limit (dBm)	Margin (dB)
Low channel				
-				
-				
-				
Mid channel				
High channel				
-				
-				
-				
Note:				

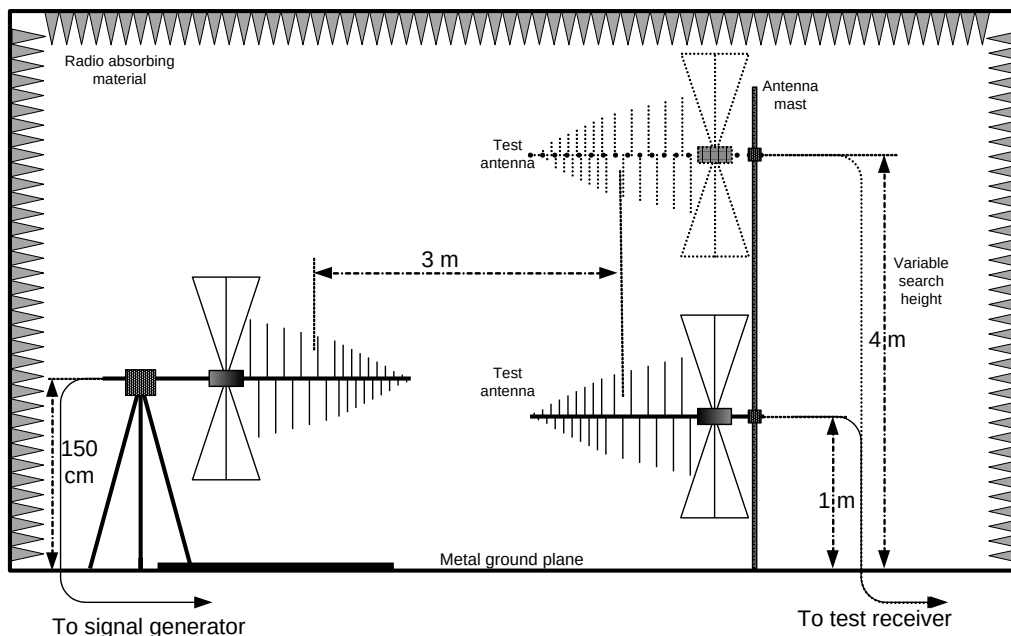
MIMO consideration
In the final Remote Unit, the EUT could be used in MIMO configuration according to KDB 662911-D01 v02r01 and 662911-D02 v01 with signals completely uncorrelated. So, the maximum emission is calculated as follows: - MIMO Maximum Emission = Emission at each path + $10\log(N_{ant})$ dB = = Emission at each path + $10\log(2)$ = Emission at each path + 3dB - Spurious emission limit is -16dBm.

Appendix B: Block diagrams of test set-ups

Radiated emissions set-up



Substitution method set-up



Appendix C: EUT Photos

Photo Set up

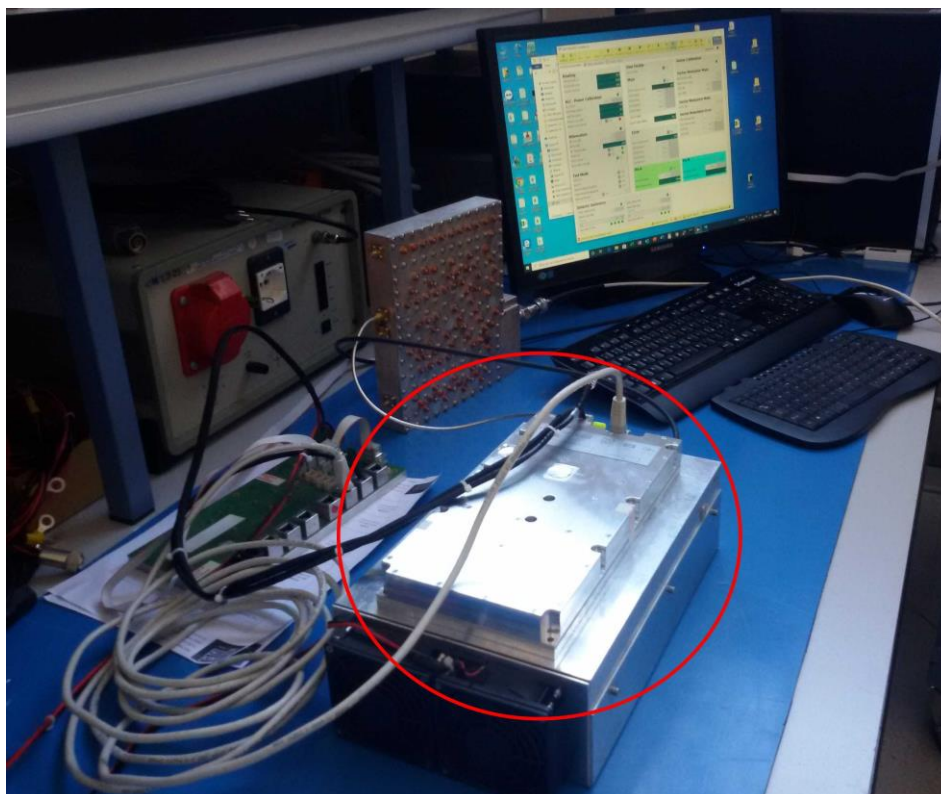


Photo EUT



- END OF REPORT -