



REGULATORY COMPLIANCE TEST REPORT

WInnForum WINNF-TS-0112

Report No.: XCOL07-U5 Rev A

Company: Globalstar, Inc

Model Name: XCOMRU30N48I

REGULATORY COMPLIANCE TEST REPORT

Company Name: Globalstar, Inc

Model Name: XCOMRU30N48I

To: WinnForum WINNF-TS-0112

Test Report Serial No.: XCOL07-U5 Rev A

This report supersedes: NONE

Applicant: Globalstar, Inc
9450 Carroll Park Dr
San Diego, California 92121
USA

Issue Date: 14th January 2026

This Test Report is Issued Under the Authority of:

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TESTING CERT #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

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1. ACCREDITATION, LISTINGS & RECOGNITION

1.1. TESTING ACCREDITATION

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard ISO/IEC 17025:2017. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL: www.a2la.org/scopepdf/2381-01.pdf



Accredited Laboratory

A2LA has accredited

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for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



Presented this 28th day of February 2024.



Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2381.01
Valid to November 30, 2025

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

1.2. RECOGNITION

MiCOM Labs, Inc is widely recognized for its wireless testing and certification capabilities. In addition to being recognized for Testing and Certification under Phase 2 Mutual Recognition Agreements (MRA) with Canada, Europe, United Kingdom and Japan, our international recognition includes Conformity Assessment Body (CAB) designation status under agreements with Asia Pacific (APEC) MRA Phase 1 countries giving acceptance of MiCOM Labs test reports. MiCOM Labs test reports are accepted globally.

Country	Recognition Body	Status	MRA Phase	Identification No.
USA	Federal Communications Commission (FCC)	TCB	-	US0159 Test Firm Designation#: US1084
Canada	Industry Canada (ISED)	FCB	APEC MRA 2	US0159 ISED#: 4143A
Japan	MIC (Ministry of Internal Affairs and Communication)	CAB	Japan MRA 2	RCB 210
	Japan Approvals Institute for Telecommunication Equipment (JATE)			
	VCCI			
Europe	European Commission	NB	EU MRA 2	A-0012 NB 2280
United Kingdom	Department for Business, Energy & Industrial Strategy (BEIS)	AB	UK MRA 2	AB 2280
Mexico	Instituto Federal de Telecomunicaciones (IFT)	CAB	Mexico MRA 1	US0159
Australia	Australian Communications and Media Authority (ACMA)	CAB	APEC MRA 1	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)			
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)			
Singapore	Infocomm Development Authority (IDA)			
Taiwan	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)			
Vietnam	Ministry of Communication (MIC)			

TCB – Telecommunications Certification Bodies (TCB)

FCB – Foreign Certification Body

CAB – Conformity Assessment Body

NB – Notified Body

AB – Approved Body

MRA – Mutual Recognition Agreement

MRA Phase I - recognition for product testing

Phase II – recognition for both product testing and certification

1.3. PRODUCT CERTIFICATION

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard ISO/IEC 17065:2012. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.02. MiCOM Labs test schedule is available at the following URL; www.a2la.org/scopepdf/2381-02.pdf



Accredited Product Certification Body

A2LA has accredited

MiCOM LABS

Pleasanton, CA

This product certification body is accredited in accordance with the recognized International Standard ISO/IEC 17065:2012 *Requirements for bodies certifying products, processes and services*. This product certification body also meets the A2LA R322 – *Specific Requirements – Notified Body Accreditation Requirements* and A2LA R308 – *Specific Requirements – ISO-IEC 17065 – Telecommunication Certification Body Accreditation Program*. This accreditation demonstrates technical competence for a defined scope and the operation of a management system.



Presented this 28th day of February 2024.



Mr. Trace McInturf, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2381.02
Valid to November 30, 2025

For the product certification schemes to which this accreditation applies, please refer to the organization's Product Certification Scope of Accreditation.

United States of America – Telecommunication Certification Body (TCB)
Industry Canada – Certification Body, CAB Identifier – US0159
Europe – Notified Body (NB), NB Identifier - 2280
UK – Approved Body (AB), AB Identifier - 2280
Japan – Recognized Certification Body (RCB), RCB Identifier - 210

2. DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft	4 th November 2025	Draft report for client review.
Draft 2	12 th November 2025	Additional draft for review
Rev A	14 th January 2026	Initial Release

In the above table the latest report revision will replace all earlier versions.

3. TEST RESULT CERTIFICATE

Manufacturer: Globalstar, Inc 9450 Carroll Park Dr San Diego California 92121 USA	Tested By: MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Model: XCOMRU30N48I	Telephone: +1 925 462 0304
Equipment Type: Indoor Remote Radio Unit	Fax: +1 925 462 0306
S/N's: 25383791B10003	
Test Date(s): 27 th – 29 th October 2025	Website: www.micomlabs.com

STANDARD(S)	TEST RESULTS
WinnForum WINNF-TS-0112	EQUIPMENT COMPLIES

MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

Notes:

1. This document reports conditions under which testing was conducted and the results of testing performed.
2. Details of test methods used have been recorded and kept on file by the laboratory.
3. Test results apply only to the item(s) tested.

Approved & Released for MiCOM Labs, Inc. by:



Graeme Grieve
Quality Manager MiCOM Labs, Inc.

Gordon Hurst
President & CEO MiCOM Labs, Inc.

4. REFERENCES AND MEASUREMENT UNCERTAINTY

4.1. Normative References

REF.	PUBLICATION	YEAR	TITLE
I	WINNF-TS-0112	2024	Requirements for Commercial Operation in the U.S. 3550-3700 MHz Citizens Broadband Radio Service Band - Version V1.9.2
II	WINNF-TS-0122	2020	Test and Certification for Citizens Broadband Radio Service (CBRS); Conformance and Performance Test Technical Specification; CBSD/DP as Unit Under Test (UUT) - Version V1.0.2
III	WINNF-IN-00129	2018	WinnForum CBSD/DP UUT Security Test Cases Tutorial
IV	WINNF-IN-0156	2018	WinnForum SAS Test Harness for CBSD UUT Tutorial
V	FCC 47 CFR Part 96	2025	Citizens Broadband Radio Service
VI	KDB 662911 D01	2013	Guidance for measurement of output emission of devices that employ single transmitter with multiple outputs or systems with multiple transmitters operating simultaneously in the same frequency band
VII	KDB 971168 D01 v03r01	2018	Power Measurement License Digital Systems
VIII	KDB 940660 D01 v03	2020	Part 96 CBRS Equipment v01
IX	ANSI C63.26	2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
X	ANSI/TIA-603-E-2016	2016	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
XI	M 3003	Edition 6 March 2024	The expression of uncertainty and confidence in measurement
XII	LAB34	Edition 1 August 2002	The expression of uncertainty in EMC Testing
XIII	ETSI TR 100 028	2001-12	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
XIV	A2LA	October 2020	Reference to A2LA Accreditation Status – A2LA Advertising Policy

4.2. Test and Uncertainty Procedure

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.

5. PRODUCT DETAILS AND TEST CONFIGURATIONS

5.1. Technical Details

Details	Description
Purpose:	Test of the Globalstar, Inc XCOMRU30N48I to WinnForum Certification for Citizens Broadband Radio Service (CBRS); CBSD/DP as Unit Under Test.
Applicant:	Globalstar, Inc 9450 Carroll Park Dr San Diego California 92121 USA
Manufacturer:	Same as Applicant
Laboratory performing the tests:	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Test report reference number:	XCOL07-U5
Date EUT received:	21 st October 2025
Application Type:	Certification
FCC Classification:	Citizen Band Category A Devices (CBD)
Standard(s) applied:	FCC CFR 47 Part 96, WinnForum WINNF-TS-0112
Dates of test (from - to):	27 th – 29 th October 2025
No of Units Tested:	1
Product Family Name:	XRRU
Marketing Name:	XCOM RAN by Globalstar
Model(s):	XCOMRU30N48
Location for use:	Indoor
Declared Frequency Range(s):	3550 - 3700 MHz;
Type of Modulation:	QPSK, 16QAM, 64QAM, 256QAM
EUT Modes of Operation:	10 MHz; 20 MHz; 40 MHz; 100 MHz;
Declared Nominal Output Power:	+30 dBm
Equipment Category:	Category A CBSD
Transmit/Receive Operation:	Transceiver
Rated Input Voltage and Current:	48 Vdc, 1.45A
Operating Temperature Range:	-10 to +50°C
Equipment Dimensions:	9.5 inches (H), 9.5 inches (W), 3.5 inches (D)
Weight:	8.9 lbs
Hardware Rev:	R1.0
Firmware Rev:	R1.0
Software Rev:	R1.0

5.2. Scope Of Test Program

Globalstar, Inc - XRRU

The scope of the test program was to test the Globalstar, Inc XCOMRU30N48I configurations in the frequency ranges 3550 - 3700 MHz, for compliance against the following specification:

FCC CFR 47 Part 96

Citizens Broadband Radio Service

5.3. Equipment Model(s) and Serial Number(s)

Type (EUT/ Support)	Equipment Description	Manufacturer	Model No.	Serial No.
EUT	Small Cell Radio Unit	Globalstar, Inc	XCOMRU30N48I	25383791B10003
Support	5G BBU	Globalstar, Inc	--	--

5.4. Antenna Details

Type	Manufacturer	Model	Family	Gain* (dBi)	BF Gain	Dir BW	X-Pol	Frequency Band (MHz)
External	Linx	MON	Dipole	6.0	-	360	-	3600 – 3800
Integral	XCOM	ANT 1	OMNI	6.0	-	360	-	3400 – 3800
BF Gain - Beamforming Gain Dir BW - Directional BeamWidth X-Pol - Cross Polarization								

*NOTE: Per applicant power settings will not be changed to accommodate different antenna configurations, so the highest antenna gain was used for EIRP calculations to present the worst case.

5.5. Cabling and I/O Ports

Port Type	Max Cable Length	# of Ports	Screened	Conn Type	Data Type	Bit Rate	Environment
USB	<3m	1	No	USB Type-C	Digital	5	Admin
dc Jack	>30m	1	No	DC	Analog	--	Power
SFP	>30m	2	No	SFP+	Digital	10,000	End-User

5.6. Test Configurations

Results for the following configurations are provided in this report:

Operational Mode(s)	Channel Frequency (MHz)		
	Low	Mid	High
	3550 - 3700 MHz		
10 MHz	--	--	--
20 MHz	--	--	--
40 MHz	--	3,620.00	--
100 MHz	--	--	--

Only 3,620 MHz variant was tested to satisfy the WinnForum WINNF-TS-0112 requirement

5.7. Conditional Test Case Configurations

Table 6-2 defines the applicability of conditional test cases listed in Table 6-3. Test cases marked as Conditional in Table 6-3 are mandatory for devices, as defined by the UUT vendor, according to the conditional definitions below.

Table 6-2 Conditional Test Case Definitions

C1	Mandatory for UUT which supports multi-step registration message
C2	Mandatory for UUT which supports single-step registration with no CPI-signed data in the registration message. By definition, this is a subset of Category A devices which determine all registration information, including location, without CPI intervention.
C3	Mandatory for UUT which supports single-step registration containing CPI-signed data in the registration message.
C4	Mandatory for UUT which supports RECEIVED_POWER_WITHOUT_GRANT measurement report type.
C5	Mandatory for UUT which supports RECEIVED_POWER_WITH_GRANT measurement report type.
C6	Mandatory for UUT which supports parameter change being made at the UUT and prior to sending a deregistration.

Per client specification the EUT supports Conditional Cases C3 and C4.

5.8. Equipment Modifications

The following modifications were required to bring the equipment into compliance:

1. NONE

5.9. Deviations from the Test Standard

The following deviations from the test standard were required in order to complete the test program:

1. NONE

6. TEST SUMMARY

Test Case	Test Case Classification	Result	Data Link
6.1. CBSD Registration Process			
6.1.4.1.1. WINNF.FT.C.REG.1	C1	Not Applicable ¹	--
6.1.4.1.2. WINNF.FT.D.REG.2	C1	Not Applicable ^{1,2}	--
6.1.4.1.3. WINNF.FT.C.REG.3	C2	Not Applicable ²	--
6.1.4.1.4. WINNF.FT.D.REG.4	C2	Not Applicable ^{1,2}	--
6.1.4.1.5. WINNF.FT.C.REG.5	C3	Pass	View Data
6.1.4.1.6. WINNF.FT.D.REG.6	C3	Not Applicable ^{1,2}	--
6.1.4.1.7. WINNF.FT.C.REG.7	C6	Not Applicable ²	--
6.1.4.2.1. WINNF.FT.C.REG.8	M	Pass	View Data
6.1.4.2.2. WINNF.FT.D.REG.9	M	Not Applicable ¹	--
6.1.4.2.3. WINNF.FT.C.REG.10	M	Pass	View Data
6.1.4.2.4. WINNF.FT.D.REG.11	M	Not Applicable ¹	--
6.1.4.2.5. WINNF.FT.C.REG.12	M	Pass	View Data
6.1.4.2.6. WINNF.FT.D.REG.13	M	Not Applicable ¹	--
6.1.4.2.7. WINNF.FT.C.REG.14	M	Pass	View Data
6.1.4.2.8. WINNF.FT.D.REG.15	M	Not Applicable ¹	--
6.1.4.2.9. WINNF.FT.C.REG.16	M	Pass	View Data
6.1.4.2.10. WINNF.FT.D.REG.17	M	Not Applicable ¹	--
6.1.4.2.11. WINNF.FT.C.REG.18	M	Pass	View Data
6.1.4.2.12. WINNF.FT.D.REG.19	M	Not Applicable ¹	--
6.1.4.3.1. WINNF.FT.C.REG.20	C2	Not Applicable ²	--
6.2. CBSD Spectrum Inquiry Process			
6.2.4.1.1. WINNF.FT.C.SIQ.1	M	Pass	View Data
6.2.4.1.2. WINNF.FT.D.SIQ.2	M	Not Applicable ²	--
6.3. CBSD Spectrum Grant Process			
6.3.4.2.1. WINNF.FT.C.GRA.1	M	Pass	View Data
6.3.4.2.2. WINNF.FT.C.GRA.2	M	Pass	View Data

Test Case	Test Case Classification	Result	Data Link
6.4. CBSD Heart Beat Process			
6.4.4.1.1. WINNF.FT.C.HBT.1	M	Pass	View Data
6.4.4.1.2. WINNF.FT.D.HBT.2	M	Not Applicable ¹	--
6.4.4.2.1. WINNF.FT.C.HBT.3	M	Pass	View Data
6.4.4.2.2. WINNF.FT.C.HBT.4	M	Pass	View Data
6.4.4.2.3. WINNF.FT.C.HBT.5	M	Pass	View Data
6.4.4.2.4. WINNF.FT.C.HBT.6	M	Pass	View Data
6.4.4.2.5. WINNF.FT.C.HBT.7	M	Pass	View Data
6.4.4.2.6. WINNF.FT.D.HBT.8	M	Not Applicable ¹	--
6.4.4.3.1. WINNF.FT.C.HBT.9	M	Pass	View Data
6.4.4.3.2. WINNF.FT.C.HBT.10	M	Pass	View Data
6.4.4.4.1. WINNF.FT.C.HBT.11	O	Pass	View Data
6.5. CBSD Measurement Report			
6.5.4.2.1. WINNF.FT.C.MES.1	C4	Pass	View Data
6.5.4.2.2. WINNF.FT.D.MES.2	C4	Not Applicable ^{1,2}	--
6.5.4.2.3. WINNF.FT.C.MES.3	C5	Not Applicable ²	--
6.5.4.2.4. WINNF.FT.C.MES.4	C5	Not Applicable ²	--
6.5.4.2.5. WINNF.FT.D.MES.5	C5	Not Applicable ^{1,2}	--
6.6. CBSD Relinquishment Process			
6.6.4.1.1. WINNF.FT.C.RLQ.1	M	Pass	View Data
6.6.4.1.2. WINNF.FT.D.RLQ.2	M	Not Applicable ¹	--
6.6.4.2.1. WINNF.FT.C.RLQ.3	O	Pass	View Data
6.6.4.2.2. WINNF.FT.D.RLQ.4	O	Not Applicable ¹	--
6.6.4.3.1. WINNF.FT.C.RLQ.5	O	Pass	View Data
6.6.4.3.2. WINNF.FT.D.RLQ.6	O	Not Applicable ¹	--
6.7. CBSD Deregistration Process			
6.7.4.1.1. WINNF.FT.C.DRG.1	M	Pass	View Data
6.7.4.1.2. WINNF.FT.D.DRG.2	M	Not Applicable ¹	--

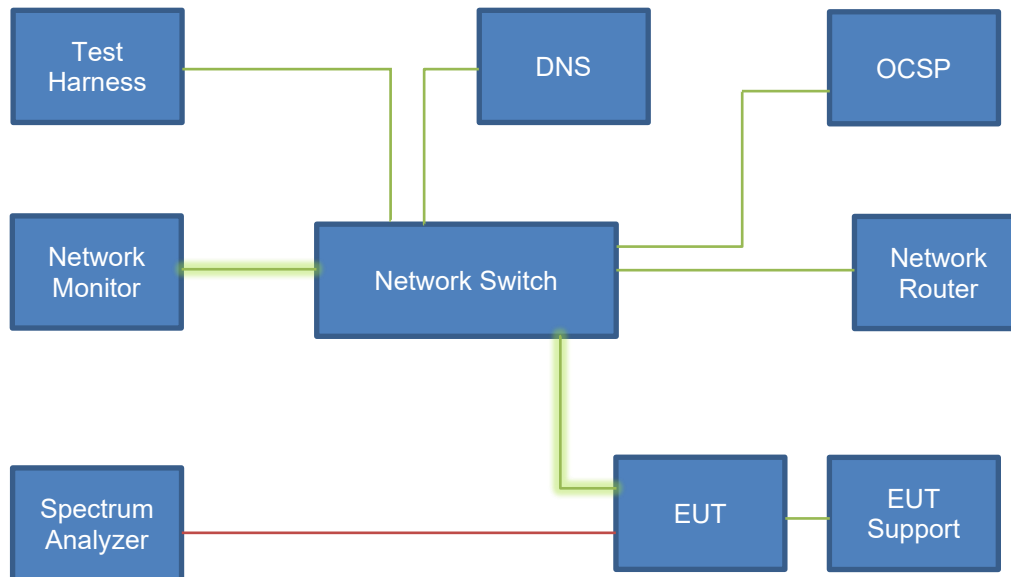
Test Case	Test Case Classification	Result	Data Link
6.7.4.2.1. WINNF.FT.C.DRG.3	O	Pass	View Data
6.7.4.2.2. WINNF.FT.D.DRG.4	O	Not Applicable ¹	--
6.7.4.3.1. WINNF.FT.C.DRG.5	O	Pass	View Data
6.8. CBSD Security Validation			
6.8.4.1.1. WINNF.FT.C.SCS.1	M	Pass	View Data
6.8.4.2.1. WINNF.FT.C.SCS.2	M	Pass	View Data
6.8.4.2.2. WINNF.FT.C.SCS.3	M	Pass	View Data
6.8.4.2.3. WINNF.FT.C.SCS.4	M	Pass	View Data
6.8.4.2.4. WINNF.FT.C.SCS.5	M	Pass	View Data
7.1. CBSD RF Power Measurement			
7.1.4.1.1. WINNF.PT.C.HBT.1	M	Pass	View Data

NOTE¹ – EUT does not use Domain Proxy

NOTE² – Not required due to Conditional Cases

7. TEST EQUIPMENT CONFIGURATION(S)

7.1. WinnForum Testing



- RF Cable Connection
- Ethernet Connection
- Mirrored Ethernet Connection

A full system calibration was performed on the test station and any resulting system losses (or gains) were taken into account in the production of all final measurement data.

Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
248	Resistance Thermometer	Thermotronics	GR2105-02	9340 #1	30 Oct 2026
266	Signal Analyzer	Keysight	N9020B	MY60110791	25 Jul 2026
510	Barometer/Thermometer	Digi Sense	68000-49	170871375	4 Jan 2026
RF#2 SMA#SA	SMA Cable SA	Flexco	SMA Cable SA	None	9 Jan 2026
--	Lenovo Laptop	Lenovo	Ideapad	YD04NTQX	--

8. MEASUREMENT AND PRESENTATION OF TEST DATA

The measurement and graphical data presented in this test report were generated using advanced data acquisition and analysis systems to ensure accuracy and consistency. The report structure is designed to facilitate review by clearly separating numerical measurement data from associated graphical representations through the use of embedded hyperlinks. This format allows direct access to quantitative results without the need to navigate through multiple graphical sections.

All tests were performed under the following Equipment Configuration.

Equipment Configuration for WinnForum			
Variant:	040MHz	Duty Cycle (%):	75
Data Rate:	100.00 MBit/s	Antenna Gain (dBi):	Not Applicable
Modulation:	256QAM	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	AD
Engineering Test Notes:			

Test Measurement Results

All graphical plots are compiled in Appendix – Graphical Data for comprehensive reference.

9. TEST RESULT

9.1. Registration Process

Test Conditions for CBSD Registration Process			
Standard:	WINNF-TS-0122	Ambient Temp. (°C):	24.0 - 27.5
Test Heading:	WINNF.FT.C.REG	Rel. Humidity (%):	32 - 45
Standard Section(s):	6.1	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		

6.1.1 Definition and applicability and Scope of Test Case

This section provides test steps, conditions and procedures to test the conformance of the CBSD implementation for the CBSD Registration Procedure. A precondition is the CBSD has successfully discovered the SAS it wants to register with.

Each test generates a CBSD registration request and validates the CBSD takes the appropriate action following the SAS registration response, covering all the defined responseCodes available that pertain to the CBSD registration process in WINNF-TS-0016. This includes successful registration as well, which is signified by responseCode 0.

6.1.3 Method of test

6.1.3.1 Initial Conditions / Test Pre-conditions

- The pre-conditions of the test case are:
 - o CBSD has gone through SAS discovery process and can authenticate with the SAS. The exact condition of the CBSD after the discovery process are detailed in each test case.
- The applicable structure of the RegistrationRequest parameter and RegistrationRequest object are defined in WINNF-TS-0016.

In summary, the CBSD parameters used for the registration process are categorized into the following WINNF-TS-0016:

- o Required
- o REG-Conditional
- o Optional

Two cases are considered:

- o When the location and other installation parameters are reported by the CBSD, and are included in the registration message. Information may be determined solely by the CBSD, or by CPI uploading the data into the CBSD.
- o When the location and other installation parameters are uploaded offline by a professional installer.

Note: In this Section, "Multi-Step Registration" refers to the Registration process where the REG-conditional parameters are not included in the "RegistrationRequest Object". "Single-Step Registration" refers to the Registration process where the conditional parameters are included in the "RegistrationRequest Object". A CBSD vendor may support one or more of these registration methods. Test cases apply according to the type of registration process(es) supported by the CBSD under test.

If a CBSD has a valid FCC-ID, the assumption is the measurement capability shall be included in the Registration Request. The CBSD vendor may ask the FCC for a waiver to the measurement capability. The Single-Step registration test cases assume there is no waiver and therefore the test case will fail if the measurement capability is not provided.

The commercial SAS shall not reject a CBSD Registration request due to the fact the CBSD has left the measurement capability empty. If a waiver has been obtained for the UUT, a similar test case shall be executed that is not requiring a measurement capability be supplied in the registration message. Since this is based on obtaining an FCC waiver, the waiver specific test cases are not listed in Table 6-3.

The following two rules shall also be applied for a Single-Step registration for CBSD with CPI signed data.

- o If the installationParam object is provided outside of cpiSignedData, the Registration request shall be rejected.

- The installationParam object shall be provided inside the cpiSignedData and shall include all of its REG-Conditional parameters. If incomplete, the Registration request shall be rejected.

6.1.4 Test Procedure

6.1.4.1 Successful registration (responseCode 0)

Upon a successful response from the SAS (responseCode = 0), the CBSD will generate its next message to the SAS. The SAS Test Harness when configured for verification of a particular CBSD-SAS protocol procedure (i.e. registration), will / may not respond to any subsequent messages sent by CBSD once the procedure being tested is complete.

6.1.4.2 Unsuccessful registration: non-zero responseCodes

CBSD under test cannot be expected to generate a message with a missing or invalid parameter. To test for responseCode not equal to 0, the SAS Test Harness will respond to a valid registrationRequest message with a registrationResponse with a non-zero responseCode.

The purpose of these tests is to ensure that the CBSD does not transmit when a responseCode other than 0 is received. The information sent in the registration request message is not important, only that it shall conform to the protocol.

Missing/Invalid response codes are tested by injecting those responseCodes into the SAS Test Harness generated response message, even though the UUT has sent a valid message

Test configuration and setup used for the measurement was per the WinnForum Test Set-up section specified in this document.

Test Case	Registration Result	Expected Status	Transmissions Present	Result
WINNF.FT.C.REG.5	Registered	Registered	None	Pass
WINNF.FT.C.REG.8	Not Registered	Not Registered	None	Pass
WINNF.FT.C.REG.10	Not Registered	Not Registered	None	Pass
WINNF.FT.C.REG.12	Not Registered	Not Registered	None	Pass
WINNF.FT.C.REG.14	Not Registered	Not Registered	None	Pass
WINNF.FT.C.REG.16	Not Registered	Not Registered	None	Pass
WINNF.FT.C.REG.18	Not Registered	Not Registered	None	Pass

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

Note: click the links in the above matrix to view the graphical image (plot).

9.2. Spectrum Inquiry Process

Test Conditions for CBSD Spectrum Inquiry Process			
Standard:	WINNF-TS-0122	Ambient Temp. (°C):	24.0 - 27.5
Test Heading:	WINNF.FT.C.SIQ	Rel. Humidity (%):	32 - 45
Standard Section(s):	6.2	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		

6.2.1. Definition and applicability and Scope of Test Case

Spectrum Inquiry is an optional set of messages between the CBSD or DP/CBSD and SAS. If Spectrum Inquiry is used by the UUT, the specific Spectrum Inquiry test cases shall be executed.

This section provides test steps, condition and procedures to test the conformance of the CBSD implementation for the CBSD Spectrum Inquiry Procedure. It assumes as a precondition the CBSD has successfully discovered the SAS it wants to communicate with.

Each test generates a CBSD spectrum inquiry request and validates the CBSD takes the appropriate action following the SAS spectrum inquiry response.

6.2.3 Method of test

6.2.3.1 Initial Conditions / Test Pre-conditions

- The pre-conditions of the test case are:
 - o CBSD has gone through SAS discovery process and can authenticate with the SAS. The exact condition of the CBSD after the discovery process are detailed in each test case.
 - o The CBSD has already registered with SAS and has obtained a valid *cbsdId*
- The applicable structure of the SpectrumInquiryRequest parameter and SpectrumInquiryResponse objects are defined in WINNF-TS-0016.

6.2.4 Test Procedure

6.2.4.1 Successful response from the SAS Test Harness

In all test cases under this category, the SpectrumInquiry Request is correct and valid. That is, the SAS Test Harness has checked that all the "Required" parameters are present in the SpectrumInquiry Request and their values are valid and correct. This part makes sure that CBSD is able to send correct and valid SpectrumInquiry Request.

6.2.4.1.1 Successful spectrum Inquiry response from SAS

This test case is incorporated into WINNF.FT.C.HBT.1, which validates successful Spectrum Inquiry messaging, if it is used by the UUT, as part of that test case.

Test configuration and setup used for the measurement was per the WinnForum Test Set-up section specified in this document.

Test Case	Request Valid	Spectrum	Result
WINNF.FT.C.SIQ.1	True	--	Pass

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

9.3. Spectrum Grant Process

Test Conditions for CBSD Spectrum Grant Process			
Standard:	WINNF-TS-0122	Ambient Temp. (°C):	24.0 - 27.5
Test Heading:	WINNF.FT.C.GRA	Rel. Humidity (%):	32 - 45
Standard Section(s):	6.3	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		

6.3.1. Definition and applicability and Scope of Test Case

This section provides test steps, condition and procedures to test the conformance of the CBSD implementation for the CBSD Spectrum Grant Procedure. A precondition is the CBSD has successfully discovered the SAS it wants to communicate with.

Each test generates a CBSD spectrum grant request and validates the CBSD takes the appropriate action following the SAS spectrum grant response.

6.3.3.1 Initial Conditions

- The pre-conditions of the test case are:
 - o CBSD has gone through SAS discovery process and can authenticate with the SAS. The exact condition of the CBSD after the discovery process are detailed in each test case.
 - o The CBSD has already registered with SAS and has obtained a valid *cbsdId*
- The applicable structure of the GrantRequest parameter and GrantResponse objects are defined in WINNF-TS-0016.

6.3.4 Test Procedure

6.3.4.1 Successful responses from the SAS Test Harness

In all test cases under this category, the Grant Request is correct and valid. That is, the SAS Test Harness has checked that all the "Required" parameters are present in the Grant Request and their values are valid and correct. This part makes sure that CBSD is able to send correct and valid Grant Request.

6.3.4.1.1 Successful Grant response

The test case is incorporated into WINNF.FT.C.HBT.1, which validates successful Grant messaging as part of that test case.

6.3.4.2. Unsuccessful responses from the SAS Test Harness

The test cases in this section are for verifying the handling of CBSD for various responseCodes in response from the-SAS Test Harness.

Test configuration and setup used for the measurement was per the WlnnForum Test Set-up section specified in this document.

Test Case	Transmissions Seen	Spectrum	Result
WINNF.FT.C.GRA.1	None	View (HBT1)	Pass
WINNF.FT.C.GRA.2	None	View	Pass

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	± 2.81 dB

Note: click the links in the above matrix to view the graphical image (plot).

9.4. Heart Beat Process

Test Conditions for CBSD Heart Beat Process			
Rules and Sections:	WINNF-TS-0122	Ambient Temp. (°C):	24.0 - 27.5
Test Heading:	WINNF.FT.C.HBT	Rel. Humidity (%):	32 - 45
Standard Section(s):	6.4	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		

6.4.1 Definition and applicability and Scope of Test Case

This section provides procedures for testing CBSD behavior during the Heartbeat Process. It assumes as precondition that CBSD has successfully discovered the SAS that it wants to register with, has successfully registered, has a successful Grant request, and is in the Granted or Authorized state.

6.4.3.1 Initial Conditions / Test Pre-Conditions

Test case entry for all test cases includes:

- Test harness SAS Discovery and Authentication by CBSD is complete
- CBSD has registered successfully with SAS Test Harness

6.4.4 Test Procedure

6.4.4.1 Successful Heartbeat (responseCode=0)

The test cases in this section test the success path for the Heartbeat process. The SAS Test Harness shall use a heartBeatInterval of 60 seconds, unless specifically provided in the test case.

6.4.4.2 Unsuccessful Heartbeat Test Cases (responseCode != 0)

The test cases in this section cover Heartbeat Response messages with non-zero responseCodes. Part of the pass/fail criteria of these test cases is the cessation of all UUT RF transmission. Therefore, in all test cases, after the non-zero responseCode is sent, the SAS Test Harness shall not allow any new Grant Request from the UUT to succeed.

6.4.4.3 Heartbeat Response Absent Test Cases

These test cases cover the case where communication is lost between the UUT and the SAS during the Heartbeat Process.

6.4.4.4 Heartbeat Grant Renewal Cases

Test cases in this section test Grant Renewal within the Heartbeat Process.

Test configuration and setup used for the measurement was per the WinnForum Test Set-up section specified in this document.

Test Case	Valid Request	Transmission Action	Expected	Spectrum	Result
	(Yes/No)				
WINNF.FT.C.HBT.1	Yes	Continued	Continued	View	Pass
WINNF.FT.C.HBT.3	Yes	Ceased	Ceased	View	Pass
WINNF.FT.C.HBT.4	Yes	Ceased	Ceased	View	Pass
WINNF.FT.C.HBT.5	Yes	No Transmission	No Transmission	View	Pass
WINNF.FT.C.HBT.6	Yes	Ceased	Ceased	View	Pass
WINNF.FT.C.HBT.7	Yes	Ceased	Ceased	View	Pass
WINNF.FT.C.HBT.9	Yes	No Transmission	No Transmission	View	Pass
WINNF.FT.C.HBT.10	Yes	Ceased	Ceased	View	Pass
WINNF.FT.C.HBT.11	Yes	Continued	Continued	View	Pass

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

Note: click the links in the above matrix to view the graphical image (plot).

9.5. Measurement Report

Test Conditions for CBSD Measurement Report			
Standard:	WINNF-TS-0122	Ambient Temp. (°C):	24.0 - 27.5
Test Heading:	WINNF.FT.C.MEAS	Rel. Humidity (%):	32 - 45
Standard Section(s):	6.5	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		

6.5.1 Definition and applicability and Scope of Test Case

This section explains test steps/condition/procedure for CBSD behavior for Measurement Reports.

The main test cases for Measurement Report are outlined below, in terms of Measurement Report Stimulus (in a Response message from SAS) and a Measurement Report Response (in the subsequent Request message from the UUT).

Devices which support one measurement capability must satisfy the test cases mandatory for that measurement capability. Devices which support multiple measurement capabilities must satisfy the test cases mandatory for each type of supported measurement capability.

Case	Stimulus (from SAS)	Response (from CBSD)	CBSD Capability	
			WITHOUT_GRANT**	WITH_GRANT**
1	RegistrationResponse(measReportConfig)	Subsequent SpectrumInquiryRequest(measReport)* AND GrantRequest(measReport)	M	n/a
2	GrantResponse(measReportConfig)	Subsequent HeartbeatRequest(measReport)	n/a	M
3	HeartbeatResponse(measReportConfig)	Subsequent HeartbeatRequest(measReport)	n/a	M

* Note: SpectrumInquiryRequest is an optional message. If present, measReport shall be in both SpectrumInquiryRequest and GrantRequest

** Indicates test is Mandatory (M) or n/a to UUT which supports RECEIVED_POWER_WITHOUT_GRANT or RECEIVED_POWER_WITH_GRANT

Since there is no measurement accuracy requirement, Measurement Reports are tested for proper format, but not for reporting accuracy.

6.5.3.1 Initial Conditions / Test Preconditions

Test case entry for all test cases includes:

- Test harness SAS Discovery and Authentication by CBSD is complete

6.5.4 Test Procedure

Test cases in this section test the proper reporting of Measurement Capability by the CBSD.

6.5.4.1 Measurement Capability Test Cases

Test cases in this section test the proper reporting of Measurement Capability by the CBSD.

6.5.4.1.1 Measurement Capability in Registration Request Message

Testing of CBSD measurement capability (measCapability) reporting is done in the appropriate registration test case(s): WINNF.FT.C.REG.3, WINNF.FT.D.REG.4, WINNF.FT.REG.5, and WINNF.FT.D.REG.6.

Test configuration and setup used for the measurement was per the WinnForum Test Set-up section specified in this document.

Test Case	Valid Request	Spectrum	Result
	(True/False)		
WINNF.FT.C.MEAS.1	True	--	Pass

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

9.6. Relinquishment Process

Test Conditions for CBSD Relinquishment Process			
Standard:	WINNF-TS-0122	Ambient Temp. (°C):	20.0 - 24.5
Test Heading:	WINNF.FT.C.RLQ	Rel. Humidity (%):	32 - 45
Standard Section(s):	6.6	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		

6.6.1 Definition and applicability and Scope of Test Case

This section provides test steps, condition and procedures to test the conformance of the CBSD implementation for the CBSD Relinquishment Procedure. A precondition is the CBSD has successfully discovered the SAS it wants to communicate with.

Each test generates a CBSD relinquishment request and validates the CBSD takes the appropriate action following the SAS relinquishment response. The CBSD shall send the Relinquishment request message after stopping the RF transmission.

6.6.3.1 Initial Conditions / Test Pre-conditions

- The pre-conditions of the test case are:
 - o CBSD has gone through SAS discovery process and can authenticate with the SAS. The exact condition of the CBSD after the discovery process are detailed in each test case.
 - o The CBSD has registered with SAS Test Harness and obtained a valid *cbsdId* (C).
 - o The CBSD has received a successful grant, *grantId* (G).
- The applicable structure of the relinquishmentRequest parameter and relinquishmentResponse objects are defined in WINNF-TS-0016.

6.6.4 Test Procedure

6.6.4.1 Successful Relinquishment Request (responseCode 0)
Successful Relinquishment

6.6.4.2 Missing Parameter (responseCode 102)

CBSD under test cannot be expected to generate a message with a missing or invalid parameter. To test for responseCode not equal to 0, the SAS Test Harness will respond to a message with a non-zero responseCode.

Test configuration and setup used for the measurement was per the WinnForum Test Set-up section specified in this document.

Test Case	Valid Request	Transmission Action	Expected	Spectrum	Result
	(Yes/No)				
WINNF.FT.C.RLQ.1	Yes	Ceased	Ceased	View	Pass
WINNF.FT.C.RLQ.3	Yes	Ceased	Ceased	View	Pass
WINNF.FT.C.RLQ.5	Yes	Ceased	Ceased	View	Pass

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	± 2.81 dB

Note: click the links in the above matrix to view the graphical image (plot).

9.7. Deregistration Process

Test Conditions for CBSD Deregistration Process			
Standard:	WINNF-TS-0122	Ambient Temp. (°C):	20.0 - 24.5
Test Heading:	WINNF.FT.C.DRG	Rel. Humidity (%):	32 - 45
Standard Section(s):	6.7	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		

6.7.1 Definition and applicability and Scope of Test Case

This section explains test steps/condition/procedure for the CBSD Deregistration Request and its subsequent actions following the reception of the Deregistration Responses from the SAS.

A Deregistration request is issued by a CBSD to request a SAS to deregister the CBSD from the SAS. A Deregistration Request Message issued by a CBSD is provided in WINNF-TS-0016, Section 10.11.

In the Deregistration Response message, the SAS should echo back an array of DeregistrationResponse object. Each deregistrationResponse object consists of a cbsdId and a responseCode. If the deregistration request was successful, the responseCode should be set to 0, otherwise responseCode is set to appropriate error value. The deregistrationResponse Message and the deregistrationResponse object are provided in WINNF-TS-0016, Section 10.12.

Each test generates a CBSD deregistration request and validates the CBSD takes the appropriate actions following the SAS deregistration response.

These deregistration test cases assume the CBSD is the source (operator initiated, for instance reset site). Deregistrations triggered by the SAS in a response message with a responseCode of 105 are covered in other test cases.

6.7.3 Method of test

6.7.3.1 Initial Conditions

The typical pre-conditions of the test case are the following:

- CBSD has registered with the SAS Test Harness and obtained a valid *cbsdId* (C).
- CBSD has received a successful grant, *grantId* (G). The CBSD is in the authorized state and is transmitting.
- CBSD UUT must provide functionality to trigger a deregistration.
- From WINNF-TS-0016, the CBSD should send a RelinquishmentRequest object for each Grant prior to sending the DeregistrationRequest object. The CBSD will cease RF transmission with the relinquishment message.

6.7.4. Test Procedure

A Deregistration request is issued by a CBSD to request a SAS to deregister the CBSD from the SAS. A Deregistration Request Message issued by a CBSD is provided in WINNF-TS-0016, Section 10.11.

6.7.4.1 Successful Deregistration Request (responseCode 0)

Successful Deregistration

6.7.4.2 Missing Parameter (responseCode 102)

CBSD under test cannot be expected to generate a message with a missing or invalid parameter. To test for responseCode not equal to 0, the SAS Test Harness will respond to a message with a non-zero responseCode.

Test configuration and setup used for the measurement was per the WlnnForum Test Set-up section specified in this document.

Test Case	Valid Request	Transmission Action	Expected	Spectrum	Result
	(Yes/No)				
WINNF.FT.C.DRG.1	Yes	Ceased	Ceased	View	Pass
WINNF.FT.C.DRG.3	Yes	Ceased	Ceased	View	Pass
WINNF.FT.C.DRG.5	Yes	Ceased	Ceased	View	Pass

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	± 2.81 dB

Note: click the links in the above matrix to view the graphical image (plot).

9.8. Security Validation

Test Conditions for CBSD Security Validation			
Standard:	WINNF-TS-0122	Ambient Temp. (°C):	20.0 - 24.5
Test Heading:	WINNF.FT.C.SCS	Rel. Humidity (%):	32 - 45
Standard Section(s):	6.8	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		

6.8.1 Definition and applicability and Scope of Test Case

This section provides test steps, condition and procedures to test the conformance of the CBSD implementation for the Security Establishment Procedure. A precondition is the CBSD has successfully discovered the SAS it wants to communicate with.

Certificate generation for executing the security test cases shall be according to section 9.1.

Each test initiates communication between CBSD and SAS and verifies that the communication is started over a secured communication.

6.8.3.1 Initial Conditions / Test Pre-conditions

- The pre-conditions of the test case are:
 - o CBSD has gone through SAS discovery process. The exact condition of the CBSD after the discovery process are detailed in each test case.
 - o The test certificates are loaded on CBSD as well as on the SAS Test Harness.

6.8.4 Test Procedure

6.8.4.1 Successful TLS Connection

In all test cases under this category, the TLS connection is established successfully between the SAS Test Harness and CBSD. A pre-condition for these tests is that Certificates at CBSD and SAS Test Harness are correct and valid. The security procedure is irrespective of the procedures defined for the SAS Test Harness to CBSD communication.

6.8.4.2 Unsuccessful TLS Connection

In all test cases under this category, the TLS connection is not established successfully between the SAS Test Harness and CBSD. The security procedure is irrespective of the procedures defined for the SAS Test Harness to CBSD communication.

Test configuration and setup used for the measurement was per the WinnForum Test Set-up section specified in this document.

Test Case	Connection Established	Connection Expected	Result
	(Yes/No)	(Yes/No)	
WINNF.FT.C.SCS.1	Yes	Yes	Pass
WINNF.FT.C.SCS.2	No	No	Pass
WINNF.FT.C.SCS.3	No	No	Pass
WINNF.FT.C.SCS.4	No	No	Pass
WINNF.FT.C.SCS.5	No	No	Pass

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

Note: click the links in the above matrix to view the graphical image.

9.9. RF Power Measurement

Test Conditions for CBSD RF Power Measurement			
Standard:	WINNF-TS-0122	Ambient Temp. (°C):	20.0 - 24.5
Test Heading:	WINNF.PT.C.HBT	Rel. Humidity (%):	32 - 45
Standard Section(s):	7.1	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		

7.1.1 Definition and applicability and Scope of Test Case

This section provides test steps, condition and procedures to demonstrate conformance of the CBSD to limitations on transmit power due to maxEirp setting of AUTHORIZED grants for that CBSD.

7.1.3.1 Initial Conditions / Test Pre-conditions

- The pre-conditions of the test case are:
 - o CBSD has gone through SAS discovery process and can authenticate with the SAS. The exact condition of the CBSD after the discovery process are detailed in each test case.

7.1.4 Test Procedure

7.1.4.1 UUT RF Transmit Power Measurement Performance Test Case

This test case places the UUT in REGISTERED state, with a grant in AUTHORIZED state, with grant parameters: {lowFrequency, highFrequency, maxEirp}. The maxEirp value is varied by performing multiple iterations of the test case.

To perform this test case, the vendor of the UUT must declare the following parameters:

1. Maximum rated power (EIRP, dBm/MHz) for the UUT
2. Transmit dynamic range of the UUT (in EIRP, dBm/MHz). The transmit dynamic range is the difference between the largest and smallest transmit power levels over which the device may operate, under SAS approved grant.
3. Occupied bandwidth (OBW) of the transmitted signal for the UUT for the test case.
4. maxEirp values for the test case. A total of N maxEirp values shall be chosen: maxEirp = {P1, P2, ... PN} across the transmit dynamic range of the UUT.

This may also require declaration of antenna gain and any feeder loss of the product, if conducted power measurements are to be used for measurement.

To demonstrate compliance, the following parameters shall be chosen:

- o lowFrequency, highFrequency of the grant. These values should correspond to the bandwidth of operation for the test, appropriate to the OBW of signal under test. Where a UUT is capable of multiple bandwidth operation modes, a single bandwidth operation mode shall be chosen for this test.

The test case below shall be performed for each of the maxEirp values: {P1, P2, ... PN}, determining a pass or fail for each. The UUT must comply with the grant maxEirp parameter for each test. Choice of maxEirp values {P1, P2, ... PN} should be made with knowledge of any limitations on UUT power control steps.

The UUT should be configured during the test to apply the maxEirp values to the entire occupied bandwidth and is implicitly expected to not exceed the dBm/MHz grant requirement.

Test Procedure for Power Spectral Density

The in-band power spectral density was measured using the test technique specified in KDB 789033. A 1 MHz measurement bandwidth was implemented for the analyzer sweep. Once the sweep is complete the analyzer trace data is downloaded and used for post processing purposes.

Where the device operated with multiple antenna ports i.e. MIMO device, each port was measured separately. The Peak Power Spectral Density is the highest level found across the emission bandwidth. With multiple antenna port measurements, the numerical analyzer data from each port is summed (Σ) and a link to this additional graphic is provided.

Test configuration and setup used for the measurement was per the WinnForum Test Set-up section specified in this document.

Measure and sum the spectra across the outputs. With this technique, spectra are measured at each output of the device at the required resolution bandwidth. The individual spectra are then summed mathematically in linear power units. Unlike in-band power measurements, in which the sum involves a single measured value (output power) from each output, measurements for compliance with PSD limits involve summing entire spectra across corresponding frequency bins on the various outputs. Consistency is

maintained for any device with multiple transmitter outputs to be certain the individual outputs are all aligned with the same span and same number of points. In this instance, the linear power spectrum value within the first spectral bin of output 0 is summed with that in the first spectral bin of output 1, and the first spectral bin of output 2, and so on up to the Nth output to obtain the true value for the first frequency bin of the summed spectrum. The summed spectrum value for each frequency bin is computed in this fashion. These summed spectral values were post processed and the resulting numerical and graphical data presented.

NOTE: It may be observed that spectrum in some plots break the limit line however this in itself does NOT constitute a failure. In all cases a spectrum summation plot is provided in order to prove compliance. A failure occurs only after the summation of all spectrum plots have been summed and are found to be greater than the limit line.

Supporting Information

Calculated Power = $A + 10 \log (1/x)$ dBm

A = Total Power Spectral Density [$10 \cdot \log_{10} (10^{a/10} + 10^{b/10} + 10^{c/10} + 10^{d/10})$]

x = Duty Cycle

maxEirp	Measured Power Spectral Density				Summation Peak Marker + DCCF	E.I.R.P.	Margin	Result
	Port(s) (dBm/MHz)							
dBm/MHz	a	b	c	D	dBm/10MHz	dBm/10MHz	dB	
11.0	-1.45	-1.65	-1.44	-1.74	4.45	10.45	-0.55	Pass
0.0	-12.93	-12.99	-12.69	-12.78	-6.83	-0.83	-0.83	Pass
-10.0	-22.95	-21.94	-21.66	-22.75	-16.27	-10.27	-0.27	Pass

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

DCCF - Duty Cycle Correction Factor

Note: click the links in the above matrix to view the graphical image (plot).

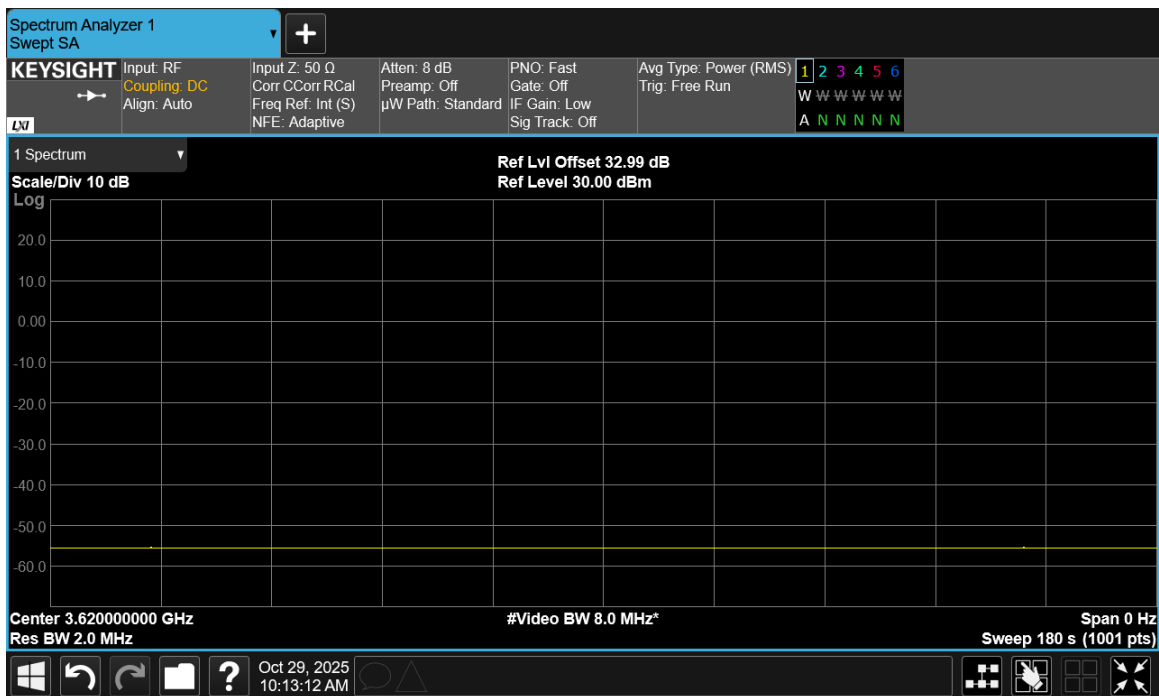
APPENDIX A - GRAPHICAL IMAGES

A.1. Registration Process

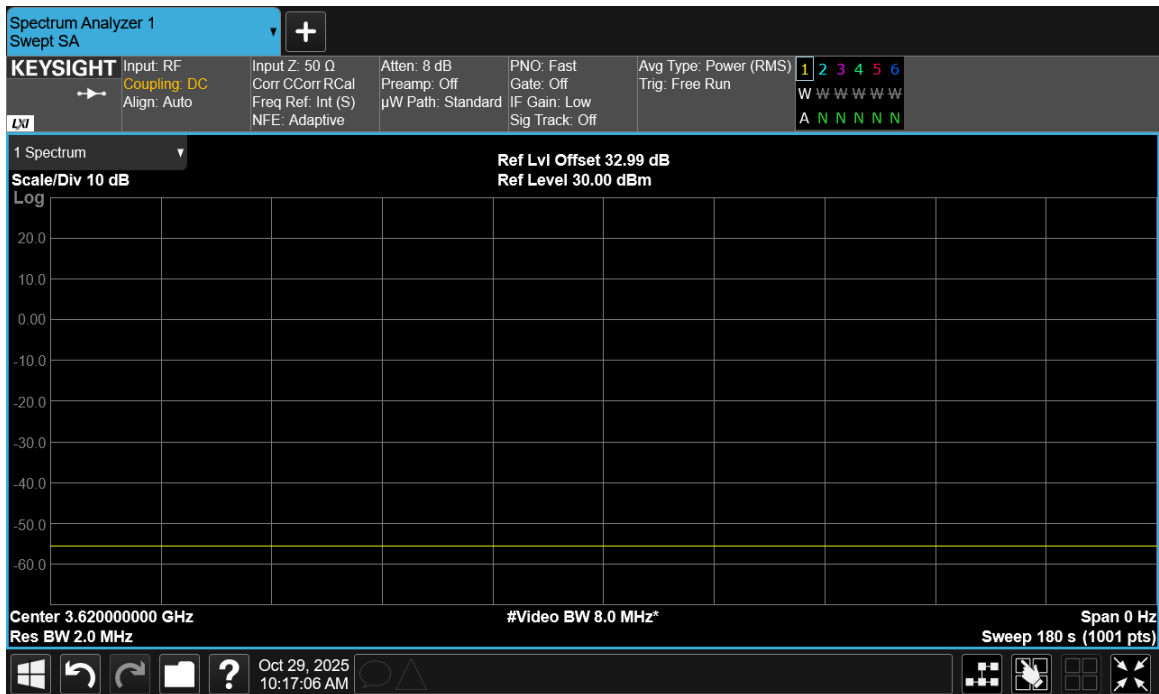
WINNF.FT.C.REG.5



Variant: 40 MHz, Channel: 3620.00 MHz, Combined



[back to matrix](#)

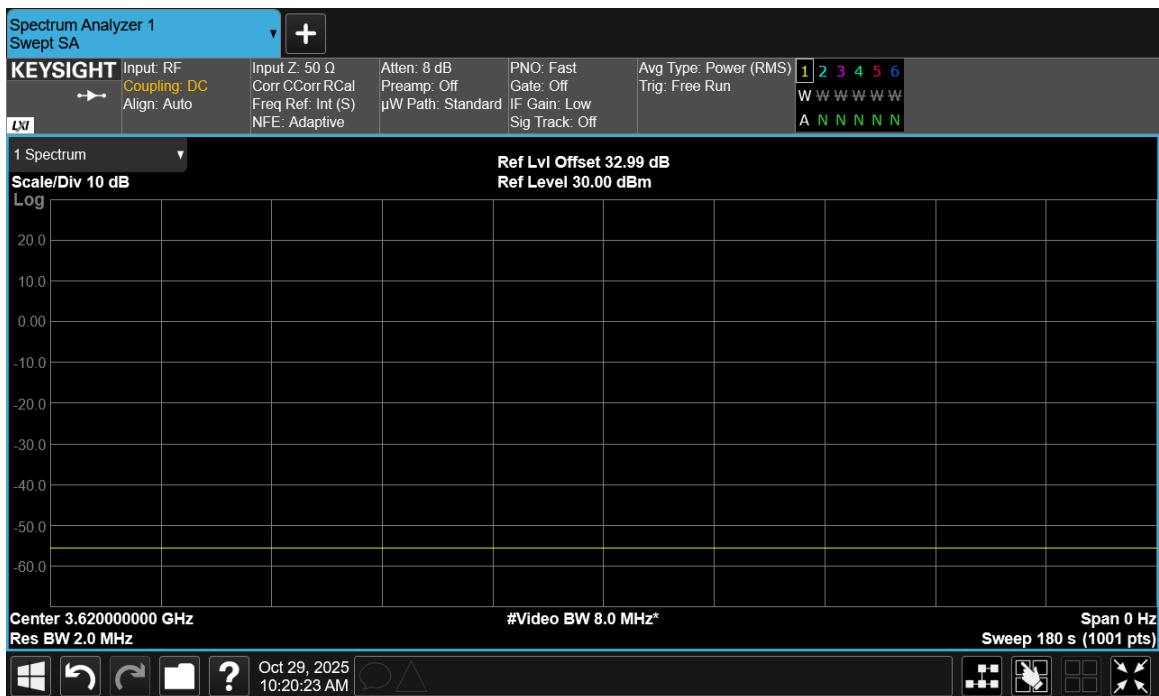


[back to matrix](#)

WINNF.FT.C.REG.10



Variant: 40 MHz, Channel: 3620.00 MHz, Combined

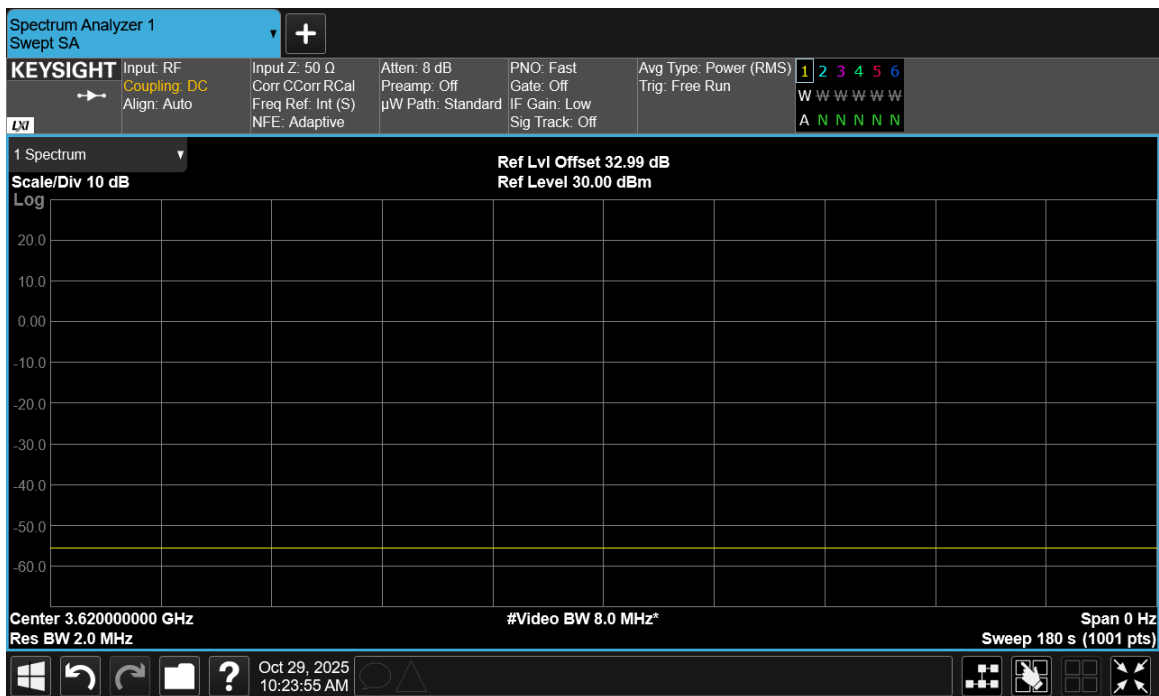


[back to matrix](#)

WINNF.FT.C.REG.12



Variant: 40 MHz, Channel: 3620.00 MHz, Combined

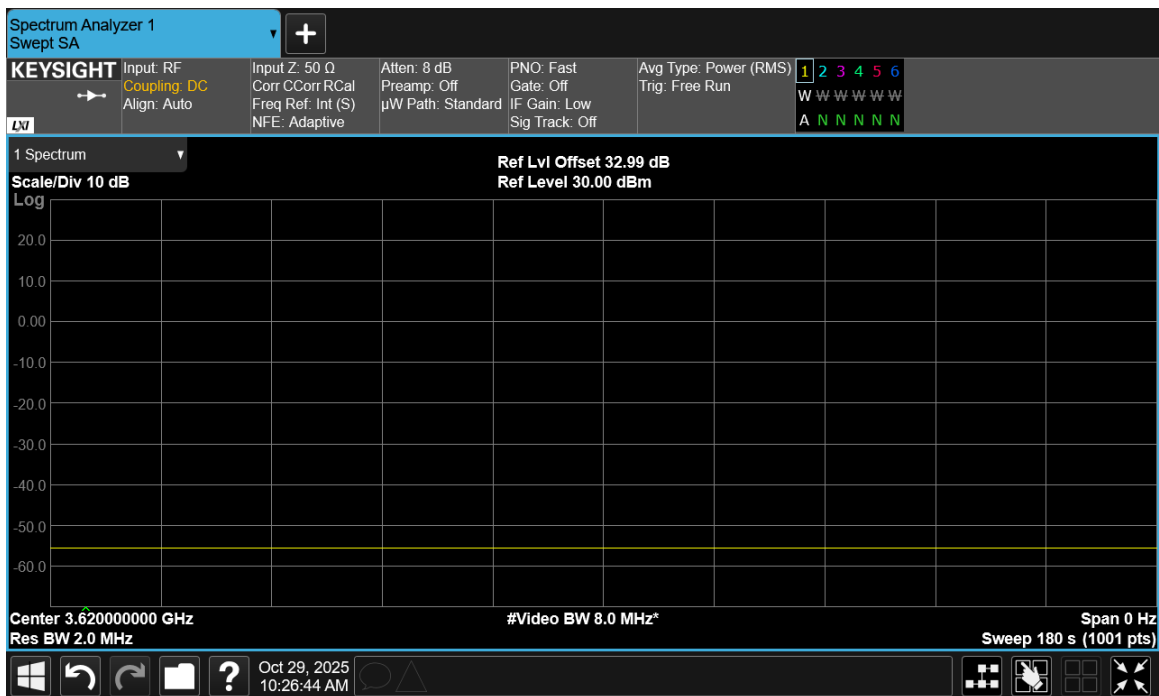


[back to matrix](#)

WINNF.FT.C.REG.14



Variant: 40 MHz, Channel: 3620.00 MHz, Combined

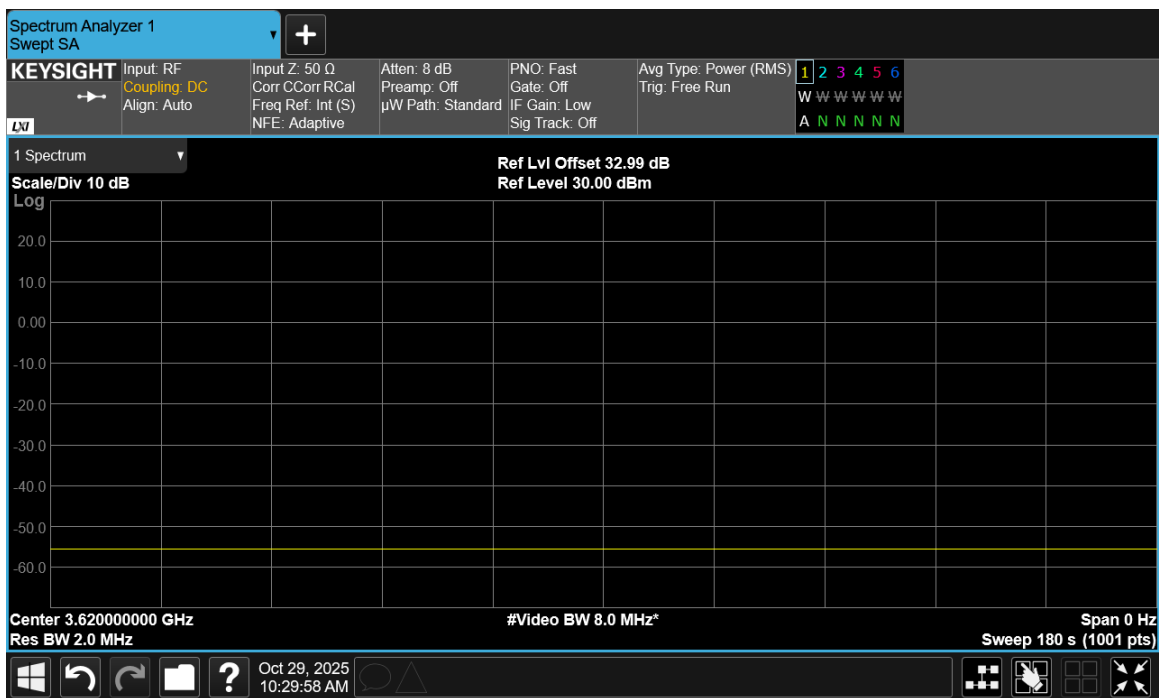


[back to matrix](#)

WINNF.FT.C.REG.16



Variant: 40 MHz, Channel: 3620.00 MHz, Combined

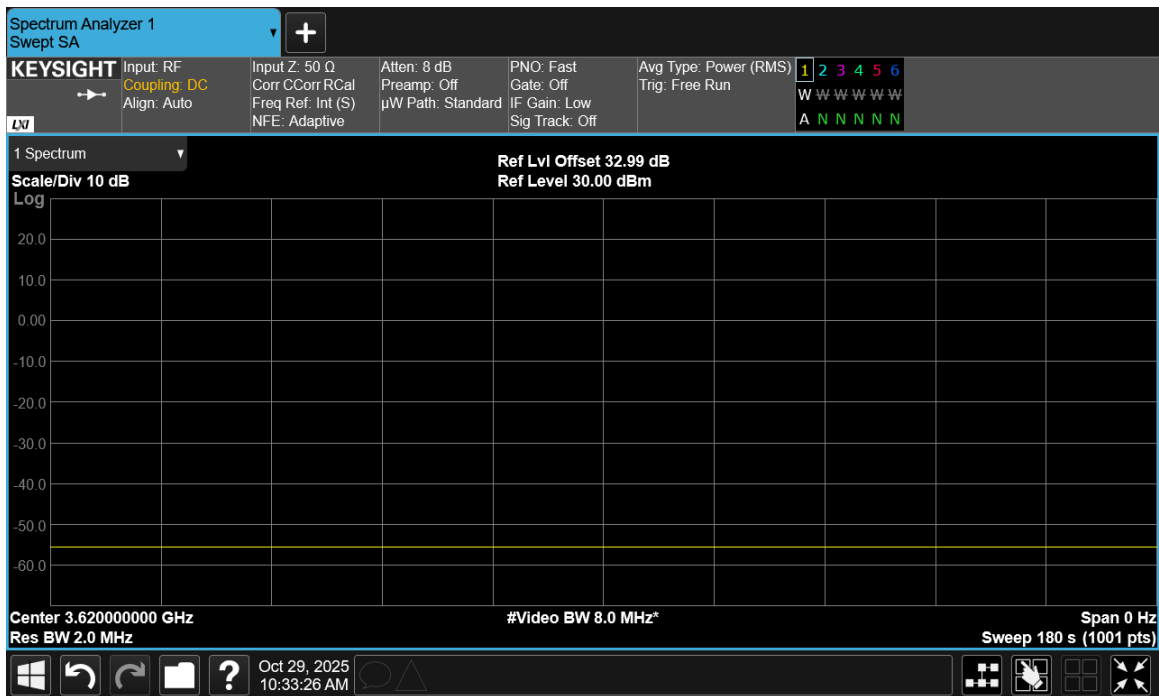


[back to matrix](#)

WINNF.FT.C.REG.18



Variant: 40 MHz, Channel: 3620.00 MHz, Combined



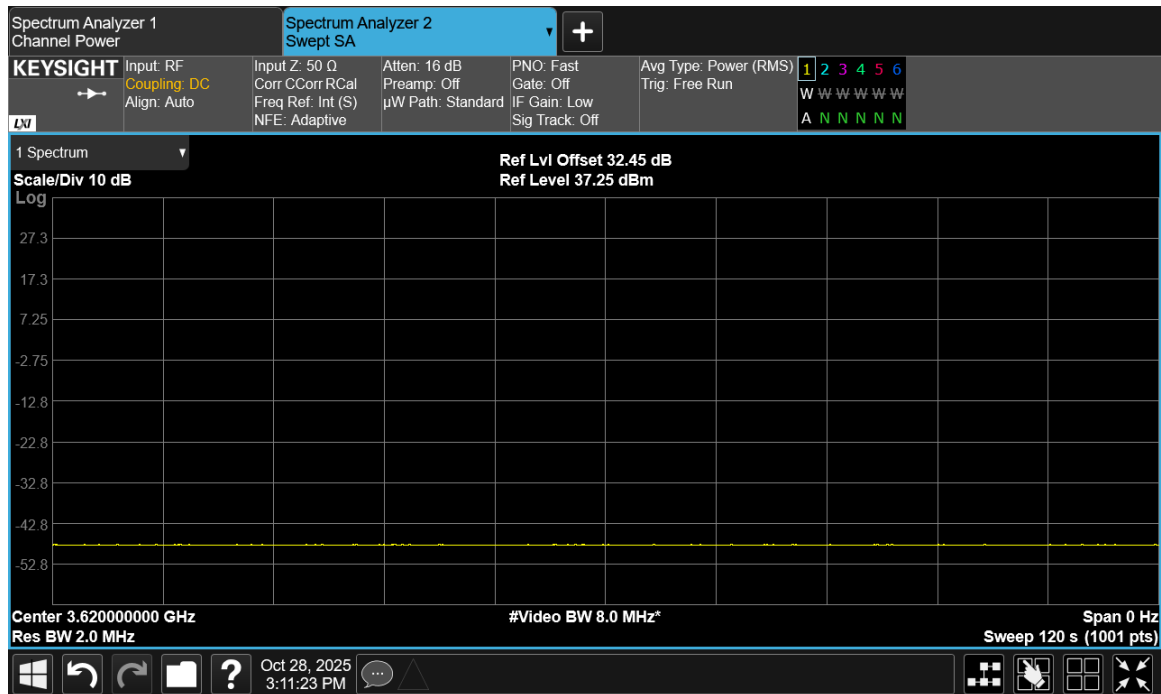
[back to matrix](#)

A.2. Spectrum Grant Process

WINNF.FT.C.GRA.2



Variant: 40 MHz, Channel: 3620.00 MHz, Combined



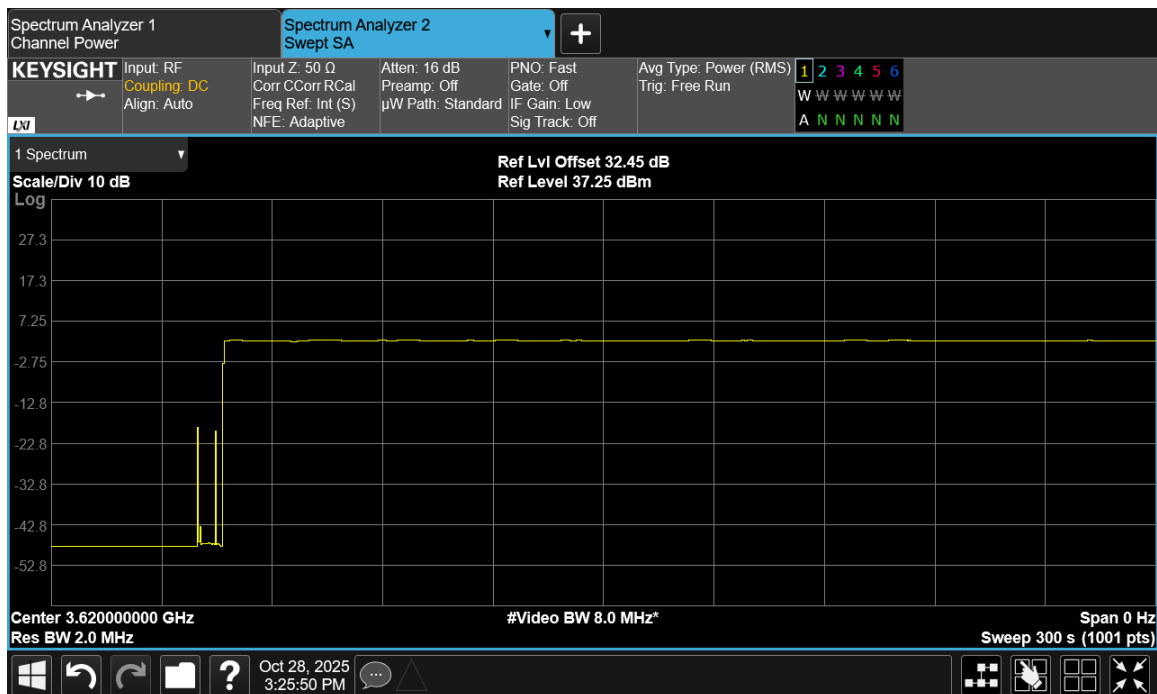
[back to matrix](#)

A.3. Heart Beat Process

WINNF.FT.C.HBT.1



Variant: 40 MHz, Channel: 3620.00 MHz, Combined



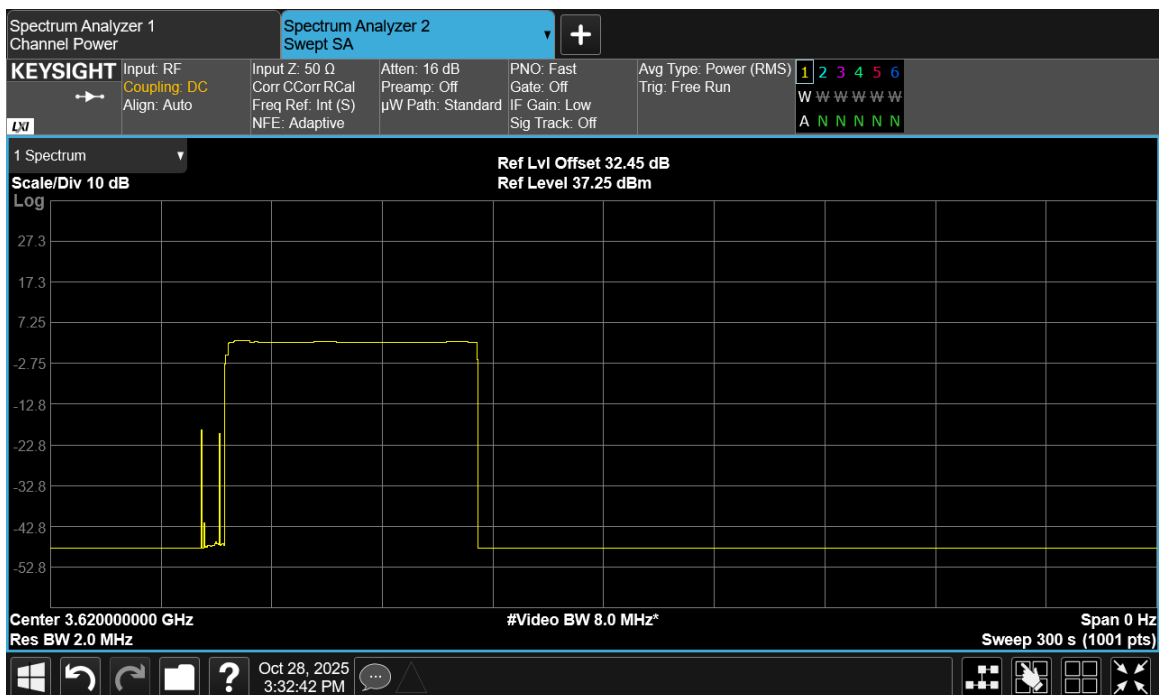
[back to matrix \(GRA\)](#)

[back to matrix \(HBT\)](#)

WINNF.FT.C.HBT.3



Variant: 40 MHz, Channel: 3620.00 MHz, Combined

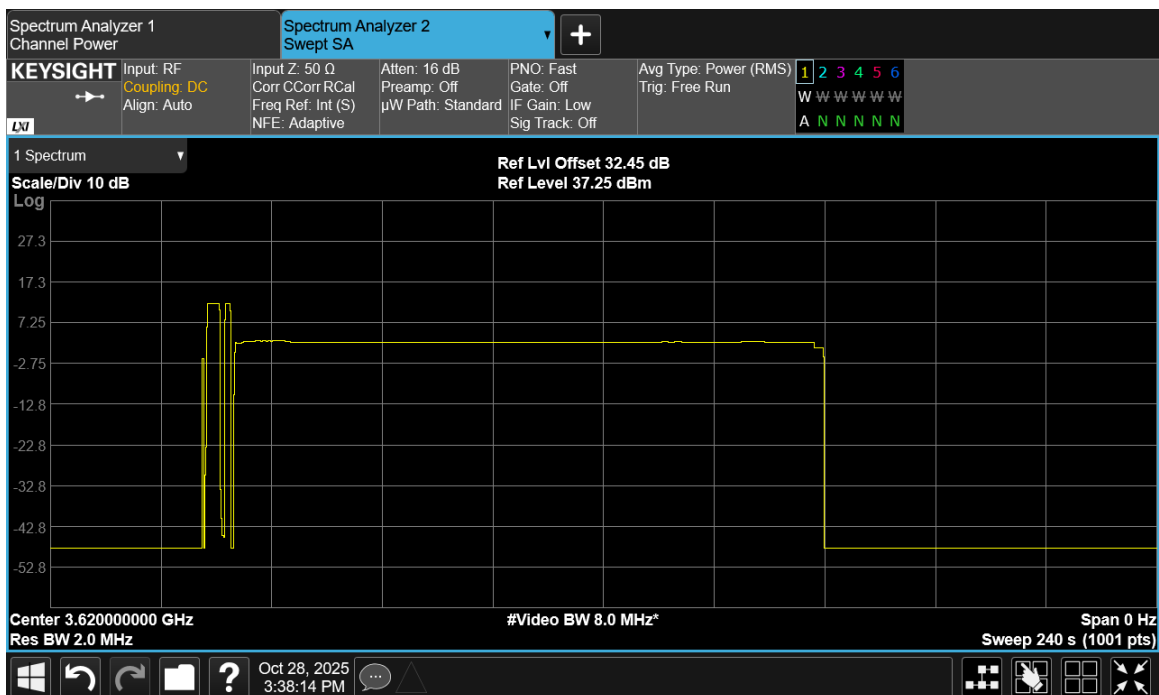


[back to matrix](#)

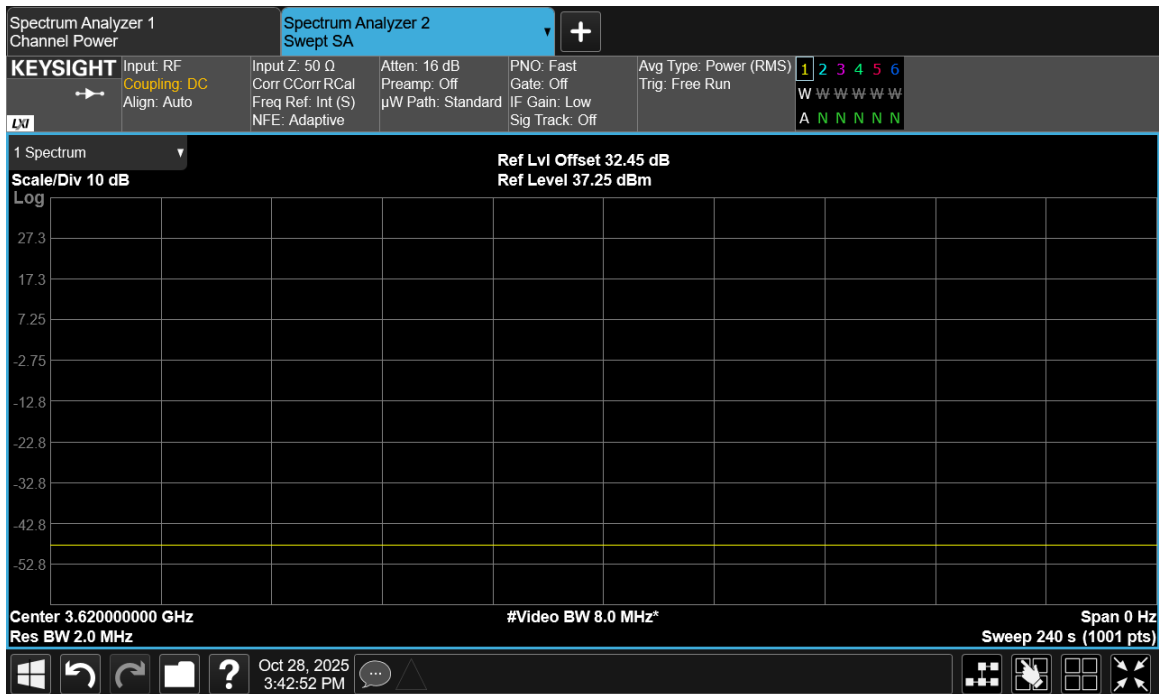
WINNF.FT.C.HBT.4



Variant: 40 MHz, Channel: 3620.00 MHz, Combined



[back to matrix](#)

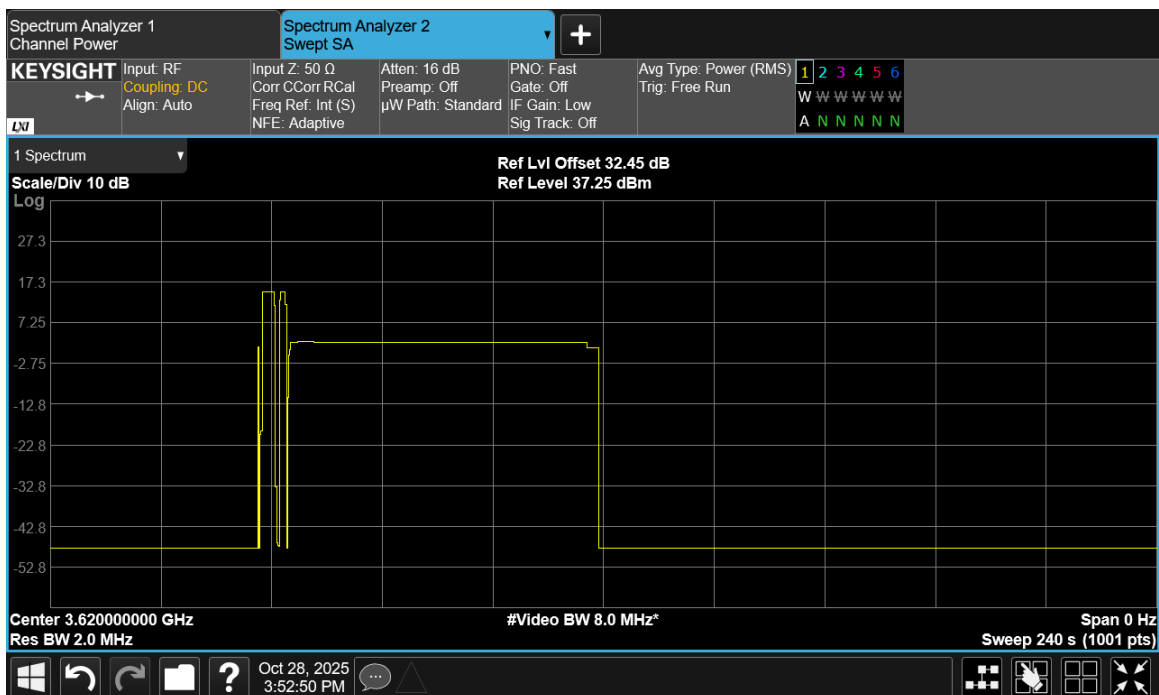


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WINNF.FT.C.HBT.6



Variant: 40 MHz, Channel: 3620.00 MHz, Combined

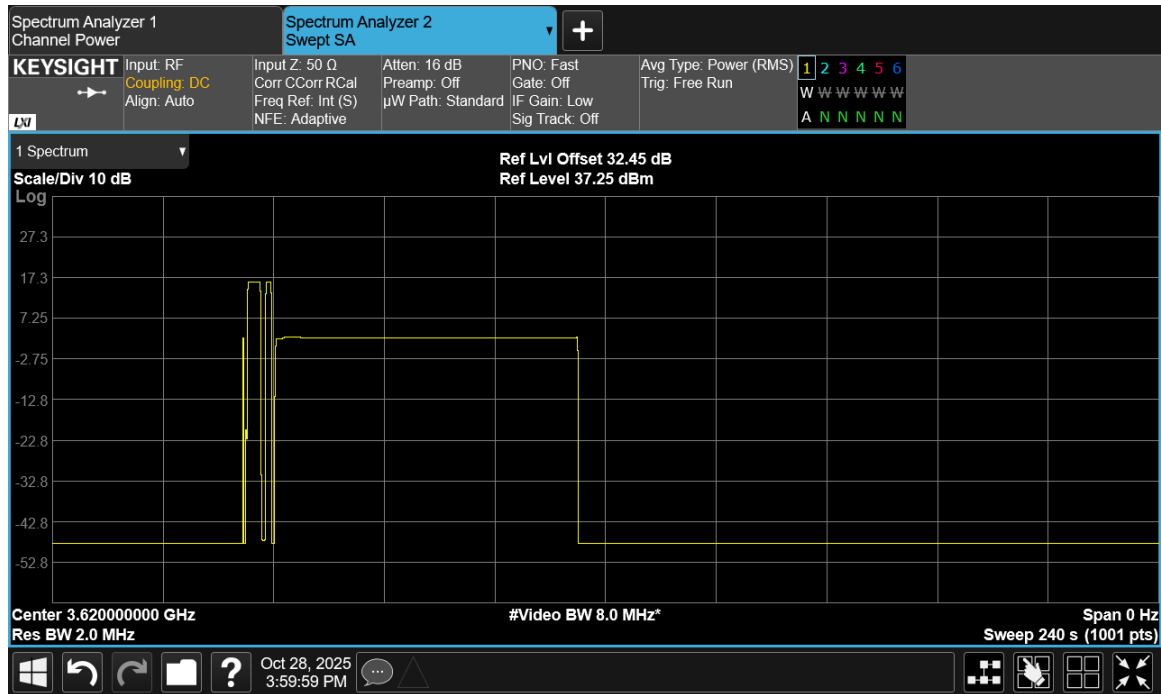


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WINNF.FT.C.HBT.7



Variant: 40 MHz, Channel: 3620.00 MHz, Combined

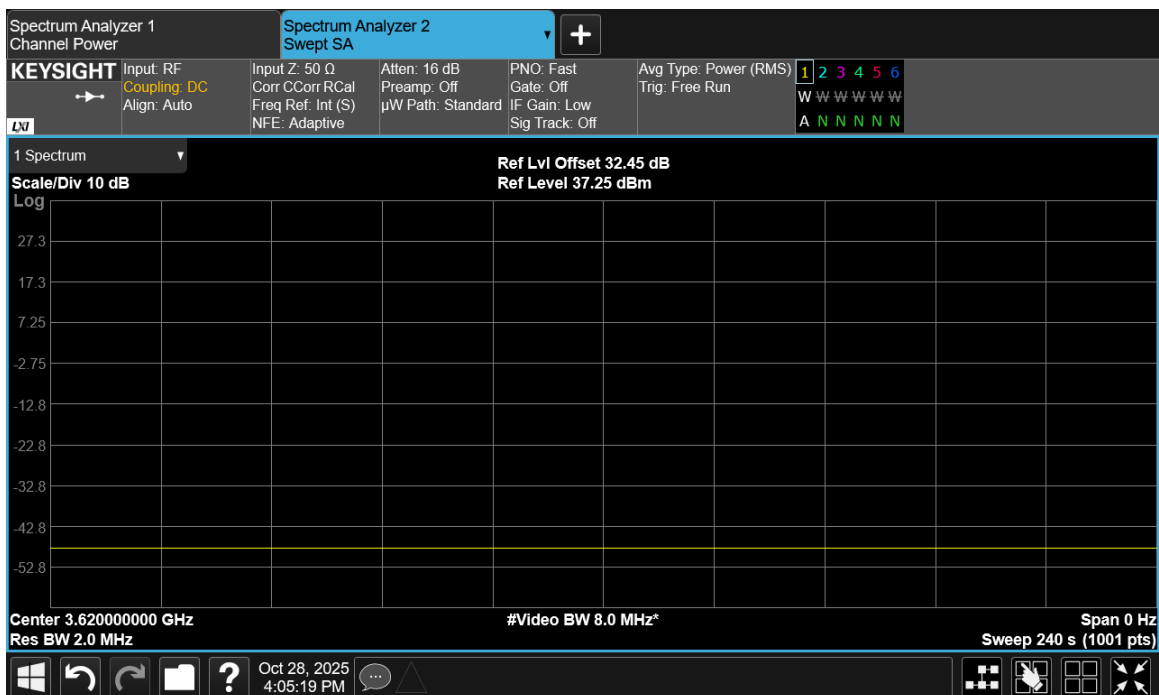


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WINNF.FT.C.HBT.9



Variant: 40 MHz, Channel: 3620.00 MHz, Combined

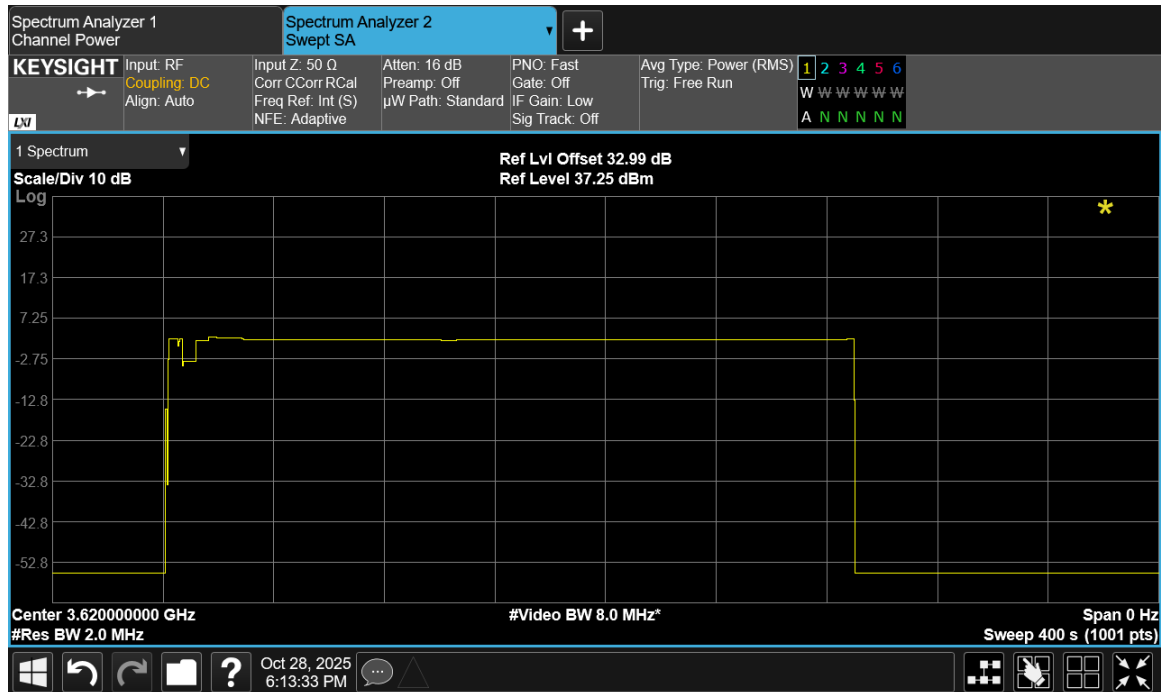


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WINNF.FT.C.HBT.10



Variant: 40 MHz, Channel: 3620.00 MHz, Combined

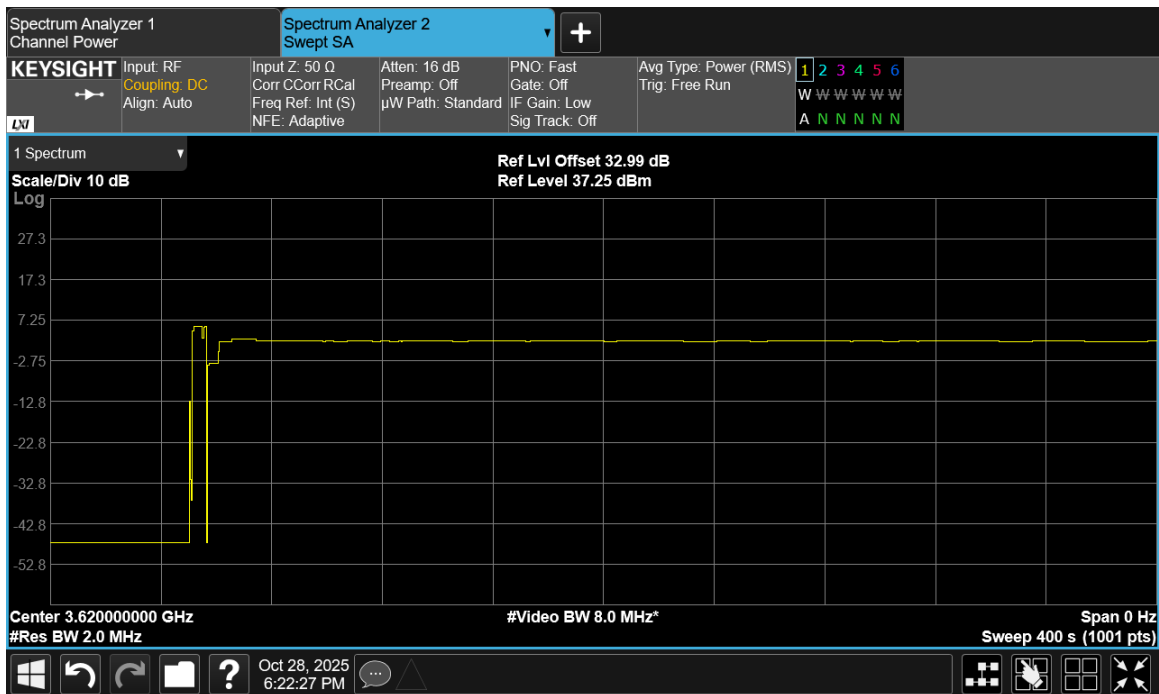


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WINNF.FT.C.HBT.11

Variant: 40 MHz, Channel: 3620.00 MHz, Combined



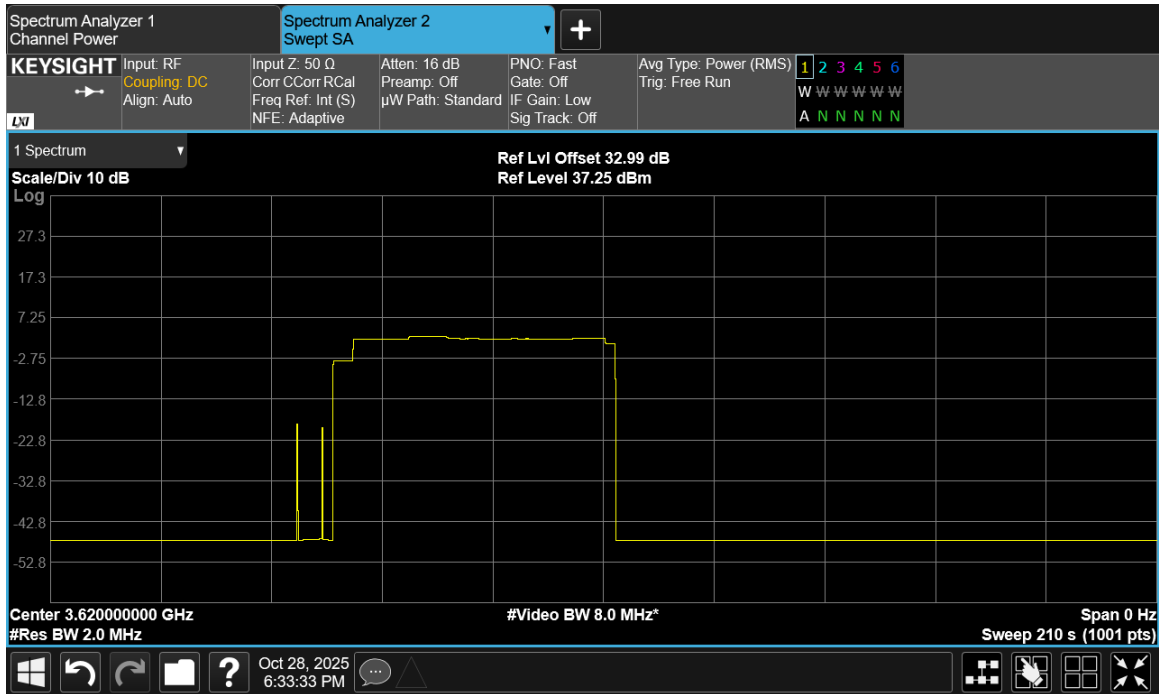
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A.4. Relinquishment Process

WINNF.FT.C.RLQ.1



Variant: 40 MHz, Channel: 3620.00 MHz, Combined

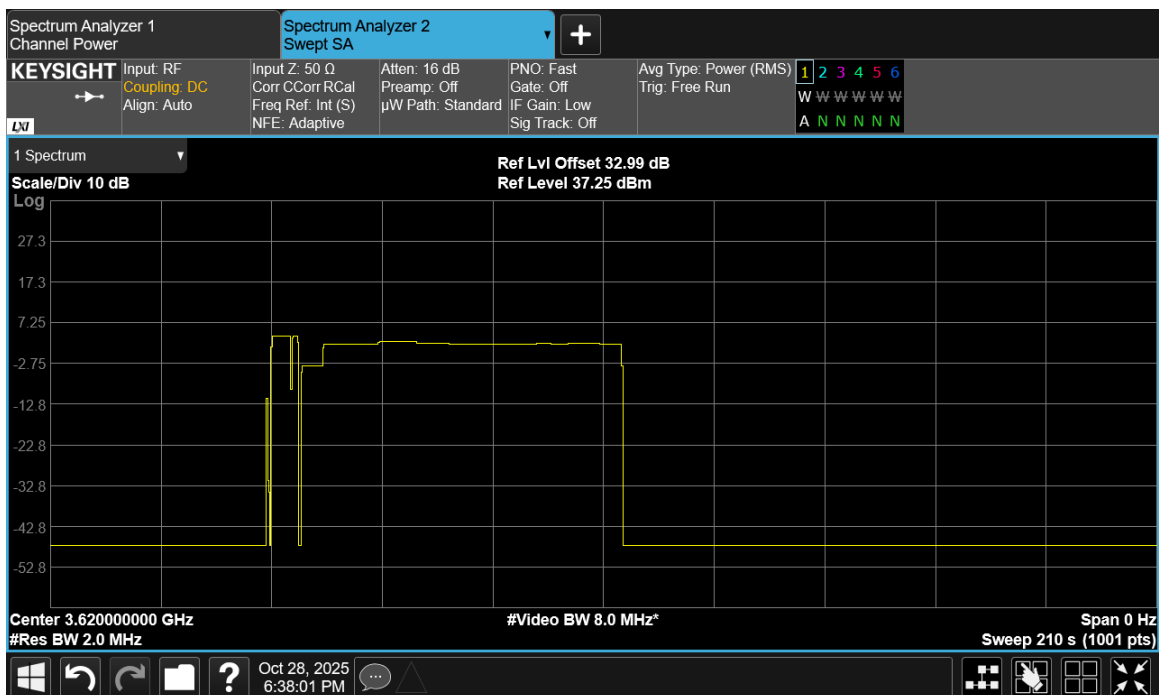


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WINNF.FT.C.RLQ.3



Variant: 40 MHz, Channel: 3620.00 MHz, Combined

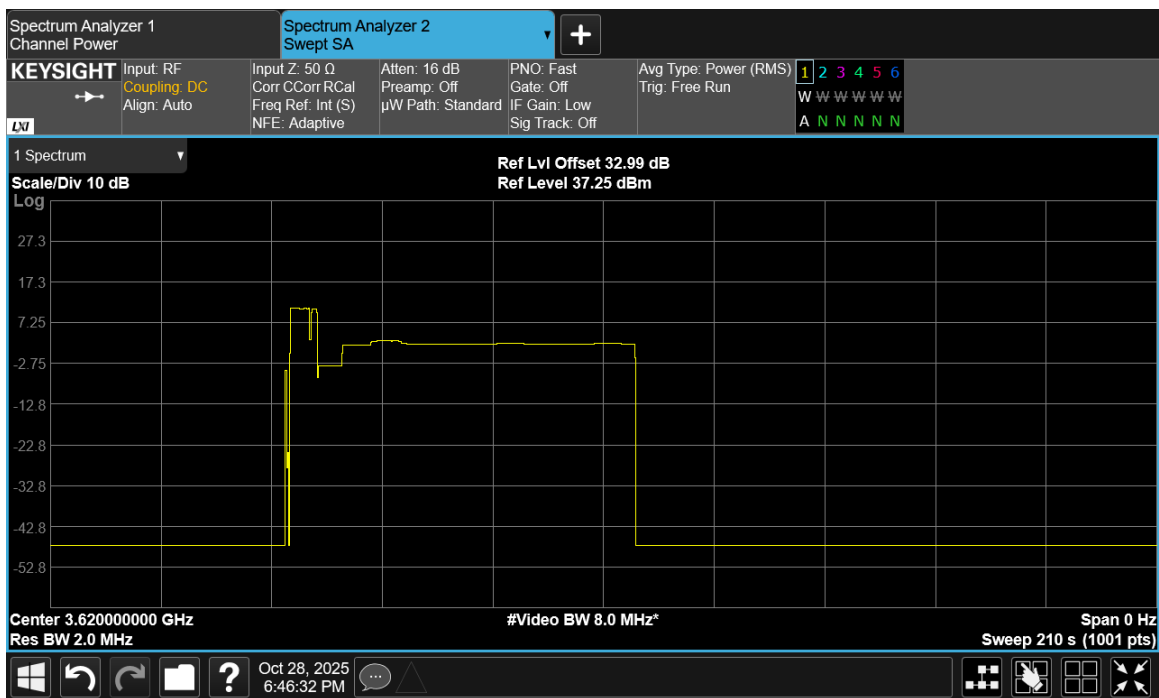


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WINNF.FT.C.RLQ.5



Variant: 40 MHz, Channel: 3620.00 MHz, Combined



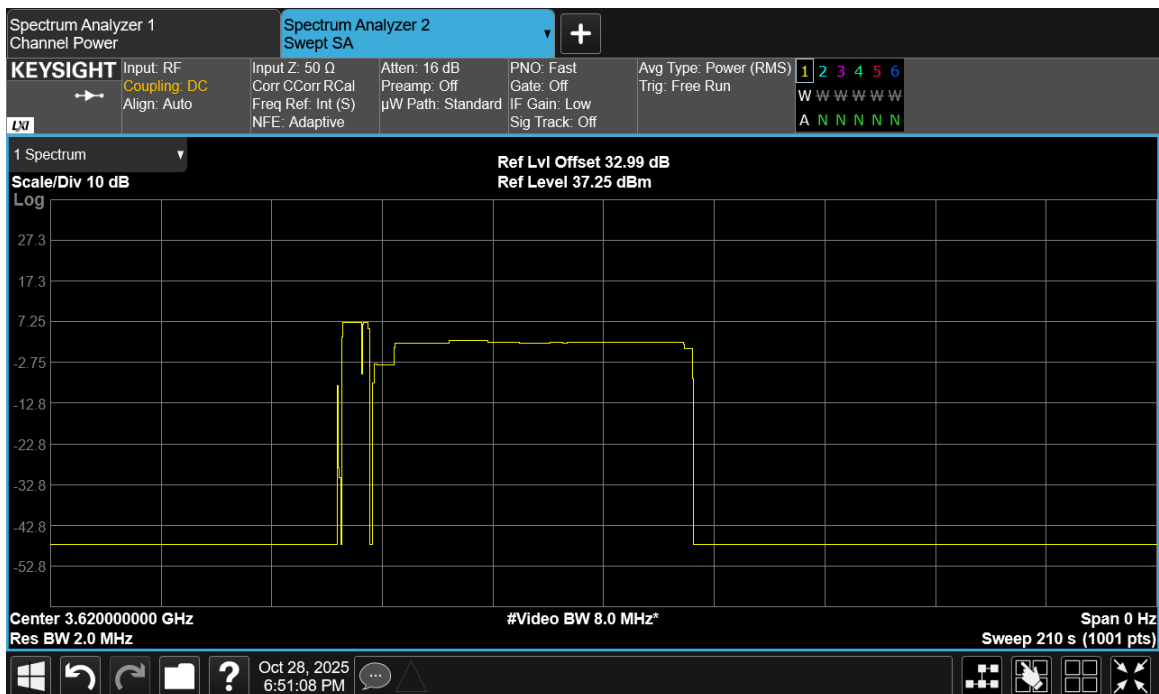
[back to matrix](#)

A.5. Deregistration Process

WINNF.FT.C.DRG.1



Variant: 40 MHz, Channel: 3620.00 MHz, Combined

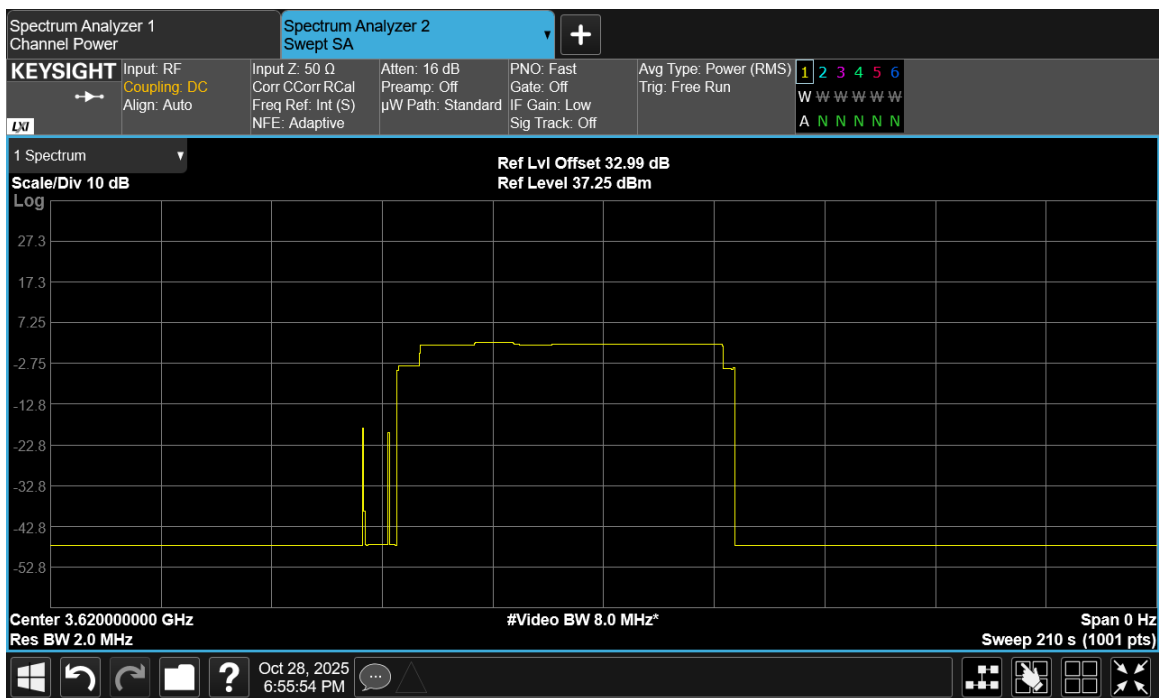


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WINNF.FT.C.DRG.3



Variant: 40 MHz, Channel: 3620.00 MHz, Combined

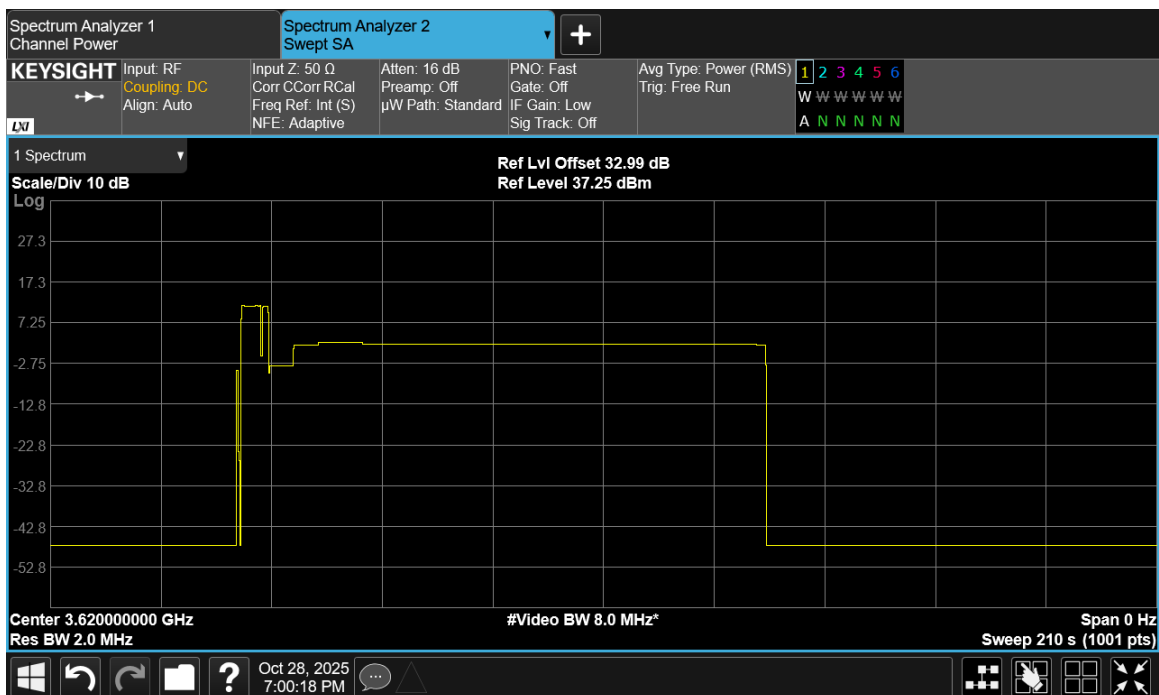


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WINNF.FT.C.DRG.5



Variant: 40 MHz, Channel: 3620.00 MHz, Combined



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A.6. Security Validation



WINNF.FT.C.SCS.1

Variant: 40 MHz, Channel: 3620.00 MHz, Combined

Client Hello

No.	Time	Source	Destination	Protocol	Length	Info
4	2025-10-29 16:27:40.6230022	10.100.238.161	10.100.238.252	TLSv1.2	583	Client Hello
6	2025-10-29 16:27:40.6310172	10.100.238.252	10.100.238.161	TLSv1.2	3143	Server Hello, Certificate, Certificate Request, Server Hello Done
8	2025-10-29 16:27:40.6329322	10.100.238.161	10.100.238.252	TLSv1.2	3543	Certificate, Client Key Exchange, Certificate Verify, Change Cipher Spec, Encrypted Handshake Message
10	2025-10-29 16:27:40.6471722	10.100.238.252	10.100.238.161	TLSv1.2	117	Change Cipher Spec, Encrypted Handshake Message
11	2025-10-29 16:27:40.6473432	10.100.238.161	10.100.238.252	TLSv1.2	238	Application Data
12	2025-10-29 16:27:40.6473622	10.100.238.161	10.100.238.252	TLSv1.2	1244	Application Data
14	2025-10-29 16:27:40.6693632	10.100.238.252	10.100.238.161	TLSv1.2	112	Application Data
16	2025-10-29 16:27:40.7151712	10.100.238.252	10.100.238.161	TLSv1.2	558	Application Data, Application Data, Application Data, Application Data, Application Data, Application Data, Application Data
18	2025-10-29 16:27:40.7152922	10.100.238.161	10.100.238.252	TLSv1.2	97	Encrypted Alert
25	2025-10-29 16:27:40.7198302	10.100.238.161	10.100.238.252	TLSv1.2	583	Client Hello
27	2025-10-29 16:27:40.7255372	10.100.238.252	10.100.238.161	TLSv1.2	3143	Server Hello, Certificate, Certificate Request, Server Hello Done
29	2025-10-29 16:27:40.7255502	10.100.238.161	10.100.238.252	TLSv1.2	3543	Certificate, Client Key Exchange, Certificate Verify, Change Cipher Spec, Encrypted Handshake Message
31	2025-10-29 16:27:40.7331662	10.100.238.252	10.100.238.161	TLSv1.2	117	Change Cipher Spec, Encrypted Handshake Message
32	2025-10-29 16:27:40.7332772	10.100.238.161	10.100.238.252	TLSv1.2	240	Application Data
33	2025-10-29 16:27:40.7332902	10.100.238.161	10.100.238.252	TLSv1.2	249	Application Data
35	2025-10-29 16:27:40.7413522	10.100.238.252	10.100.238.161	TLSv1.2	112	Application Data
37	2025-10-29 16:27:40.7928442	10.100.238.252	10.100.238.161	TLSv1.2	817	Application Data, Application Data, Application Data, Application Data, Application Data, Application Data, Application Data
39	2025-10-29 16:27:40.7929502	10.100.238.161	10.100.238.252	TLSv1.2	97	Encrypted Alert
46	2025-10-29 16:27:40.8037522	10.100.238.161	10.100.238.252	TLSv1.2	583	Client Hello
48	2025-10-29 16:27:40.8125572	10.100.238.252	10.100.238.161	TLSv1.2	3143	Server Hello, Certificate, Certificate Request, Server Hello Done
50	2025-10-29 16:27:40.8143082	10.100.238.161	10.100.238.252	TLSv1.2	2963	Certificate
51	2025-10-29 16:27:40.8144462	10.100.238.161	10.100.238.252	TLSv1.2	647	Client Key Exchange, Certificate Verify, Change Cipher Spec, Encrypted Handshake Message
53	2025-10-29 16:27:40.8250672	10.100.238.252	10.100.238.161	TLSv1.2	117	Change Cipher Spec, Encrypted Handshake Message
54	2025-10-29 16:27:40.8251492	10.100.238.161	10.100.238.252	TLSv1.2	238	Application Data
55	2025-10-29 16:27:40.8252602	10.100.238.161	10.100.238.252	TLSv1.2	172	Application Data
57	2025-10-29 16:27:40.8332882	10.100.238.252	10.100.238.161	TLSv1.2	112	Application Data
59	2025-10-29 16:27:40.8845762	10.100.238.252	10.100.238.161	TLSv1.2	561	Application Data, Application Data, Application Data, Application Data, Application Data, Application Data, Application Data
61	2025-10-29 16:27:40.8846802	10.100.238.161	10.100.238.252	TLSv1.2	97	Encrypted Alert

Transport Layer Security (Stream Index: 0) TLSv1.2 Record Layer: Handshake Protocol: Client Hello Content Type: Handshake (22) Version: TLS 1.0 (0x0301) Length: 512 Handshake Protocol: Client Hello Handshake Type: Client Hello (1) Length: 508 > Version: TLS 1.2 (0x0303) > Random: 41c84571a0d4dc48ba7e8d83852bb3d93521cc7fa830ca2b90869b5d0a90 Session ID Length: 32 Session ID: 309a8400615bdfbe028162882ad0cfcd83bcfc31c524ce5a95f176c236f692f Cipher Suites Length: 18 > Cipher Suites (9 suites) Cipher Suite: TLS_AES_256_GCM_SHA384 (0x1302) Cipher Suite: TLS_CHACHA20_POLY1305_SHA256 (0x1303) Cipher Suite: TLS_AES_128_GCM_SHA256 (0x1301) Cipher Suite: TLS_RSA_WITH_AES_128_GCM_SHA256 (0x009c) Cipher Suite: TLS_RSA_WITH_AES_256_GCM_SHA384 (0x009d) Cipher Suite: TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 (0xc02f) Cipher Suite: TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256 (0xc02b) Cipher Suite: TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384 (0xc02c) Cipher Suite: TLS_EMPTY_RENEGOTIATION_INFO_SCSV (0x00ff) Compression Methods Length: 1	0000 c3 c3 1c 52 4c e5 a9 5f 17 6c 23 6f 69 2f 00 12 ...RL... 1m0l/... 0000 13 02 13 03 13 01 00 00 00 00 00 00 00 00 00 00 ... 0000 00 ff 01 00 01 a1 00 00 00 04 03 00 01 02 00 0a ... 0000 00 0c 00 0a 00 1d 00 17 00 1e 00 19 00 18 33 74 ... 0000 00 00 00 10 00 0e 00 0c 02 68 32 08 68 74 74 70 ...h2-http 0000 2f 31 2e 31 00 16 00 00 00 17 00 00 00 31 00 00 .../1... 0000 00 00 30 00 2e 04 03 05 03 06 03 08 07 08 08 ...0... 0000 00 09 0a 00 0e 00 04 00 05 06 06 04 01 05 01 ... 0100 00 01 03 03 02 03 01 02 01 03 02 02 04 02 ... 0110 05 02 06 02 00 2b 00 05 04 03 04 03 03 00 2d 00 ... 0120 02 01 01 00 33 00 26 00 24 00 1d 00 20 e1 a4 70 ...3-8...p 0130 52 a5 ea c3 9a 66 5b c3 93 96 e4 13 27 6a 08 c9 ...rf...5... 0140 15 b7 b0 dc 6c d8 0c 9b 00 b7 97 b1 47 00 15 00 ...1...G... 0150 f6 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ... 0160 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ... 0170 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ... 0180 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ... 0190 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ... 01a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ... 01b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ... 01c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ... 01d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ... 01e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ... 01f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ... 0200 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ... 0210 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ... 0220 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ... 0230 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ... 0240 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ...
--	--

Server Hello

No.	Time	Source	Destination	Protocol	Length	Info
4	2025-10-29 16:27:40.6230022	10.100.238.161	10.100.238.252	TLSv1.2	583	Client Hello
6	2025-10-29 16:27:40.6310172	10.100.238.252	10.100.238.161	TLSv1.2	3143	Server Hello, Certificate, Certificate Request, Server Hello Done
8	2025-10-29 16:27:40.6329322	10.100.238.161	10.100.238.252	TLSv1.2	3543	Certificate, Client Key Exchange, Certificate Verify, Change Cipher Spec, Encrypted Handshake Message
10	2025-10-29 16:27:40.6372722	10.100.238.161	10.100.238.252	TLSv1.2	117	Change Cipher Spec, Encrypted Handshake Message
11	2025-10-29 16:27:40.6473432	10.100.238.161	10.100.238.252	TLSv1.2	238	Application Data
12	2025-10-29 16:27:40.6473622	10.100.238.161	10.100.238.252	TLSv1.2	1244	Application Data
13	2025-10-29 16:27:40.6516322	10.100.238.161	10.100.238.252	TLSv1.2	112	Application Data
16	2025-10-29 16:27:40.7151712	10.100.238.252	10.100.238.161	TLSv1.2	559	Application Data, Application Data, Application Data, Application Data, Application Data, Application Data, Application Data
18	2025-10-29 16:27:40.7152922	10.100.238.161	10.100.238.252	TLSv1.2	97	Encrypted Alert
25	2025-10-29 16:27:40.7198302	10.100.238.161	10.100.238.252	TLSv1.2	583	Client Hello
27	2025-10-29 16:27:40.7233772	10.100.238.161	10.100.238.252	TLSv1.2	3143	Server Hello, Certificate, Certificate Request, Server Hello Done
29	2025-10-29 16:27:40.7253502	10.100.238.161	10.100.238.252	TLSv1.2	3543	Certificate, Client Key Exchange, Certificate Verify, Change Cipher Spec, Encrypted Handshake Message
31	2025-10-29 16:27:40.7331662	10.100.238.252	10.100.238.161	TLSv1.2	117	Change Cipher Spec, Encrypted Handshake Message
32	2025-10-29 16:27:40.7332772	10.100.238.161	10.100.238.252	TLSv1.2	240	Application Data
33	2025-10-29 16:27:40.7339902	10.100.238.161	10.100.238.252	TLSv1.2	249	Application Data
35	2025-10-29 16:27:40.7413522	10.100.238.252	10.100.238.161	TLSv1.2	112	Application Data
37	2025-10-29 16:27:40.7928442	10.100.238.252	10.100.238.161	TLSv1.2	817	Application Data, Application Data, Application Data, Application Data, Application Data, Application Data, Application Data
39	2025-10-29 16:27:40.7929502	10.100.238.161	10.100.238.252	TLSv1.2	97	Encrypted Alert
40	2025-10-29 16:27:40.8203752	10.100.238.161	10.100.238.252	TLSv1.2	583	Client Hello
48	2025-10-29 16:27:40.8212572	10.100.238.252	10.100.238.161	TLSv1.2	3143	Server Hello, Certificate, Certificate Request, Server Hello Done
50	2025-10-29 16:27:40.8413082	10.100.238.161	10.100.238.252	TLSv1.2	2962	Certificate
51	2025-10-29 16:27:40.8414042	10.100.238.161	10.100.238.252	TLSv1.2	247	Client Key Exchange, Certificate Verify, Change Cipher Spec, Encrypted Handshake Message
53	2025-10-29 16:27:40.8250672	10.100.238.252	10.100.238.161	TLSv1.2	117	Change Cipher Spec, Encrypted Handshake Message
54	2025-10-29 16:27:40.8251492	10.100.238.161	10.100.238.252	TLSv1.2	238	Application Data
55	2025-10-29 16:27:40.8252662	10.100.238.161	10.100.238.252	TLSv1.2	172	Application Data
57	2025-10-29 16:27:40.8332882	10.100.238.252	10.100.238.161	TLSv1.2	112	Application Data
59	2025-10-29 16:27:40.8454762	10.100.238.252	10.100.238.161	TLSv1.2	561	Application Data, Application Data, Application Data, Application Data, Application Data, Application Data
61	2025-10-29 16:27:40.8464882	10.100.238.161	10.100.238.252	TLSv1.2	97	Encrypted Alert

```

Transport Layer Security
[Stream index: 0]
  TLSv1.2 Record Layer: Handshake Protocol: Server Hello
    Content Type: Handshake (22)
    Version: TLS 1.2 (0x0303)
    Length: 85
  TLS Handshake Protocol: Server Hello
    Handshake Type: Server Hello (2)
    Length: 81
    Version: TLS 1.2 (0x0303)
    Session ID: 60b78a9dc27ac36532ef4017ef905d7fcd6ae2f7e5b65e69f80bcf94910bb
    Random ID Length: 32
    Session ID Length: 32
    Cipher Suite: TLS_RSA_WITH_AES_256_GCM_SHA384 (0x009d)
    Compression Method: null (0)
    Extensions Length: 9
    Extension: renegotiation_info (len=1)
    Extension: extended_master_secret (len=0)
    [3A55 Fullstring: 771,157,05281-23]
    [3A55: 0d9581041f9b6f707c355ef122da6a4]
  TLSv1.2 Record Layer: Handshake Protocol: Certificate
    Content Type: Handshake (22)
    Version: TLS 1.2 (0x0303)
    Length: 2916
  TLS Handshake Protocol: Certificate
    Certificate (0000)
0000 00 5b 03 00 1a 17 60 00 9a cb cc e8 f8 0b 0c [55] .....
0000 00 00 00 ff 01 00 01 00 00 17 00 00 16 03 03 00 .....
0000 64 00 00 00 00 00 00 5d 00 05 35 30 82 05 31 30 .....
0000 82 03 19 a0 03 02 01 02 02 14 6e 05 f4 e8 3f ed .....
0000 64 79 4d 81 7c 52 73 7a 05 6e c2 88 08 00 30 00 .....
0000 06 2a 86 48 86 47 0d 01 01 05 00 30 06 31 03 .....
0000 00 10 09 06 03 55 04 06 13 02 05 53 31 00 00 00 .....
0000 06 03 55 04 06 04 0d 69 43 4f 4d 20 4c 61 62 .....
0100 73 31 20 30 1e 06 03 55 04 0b 17 52 53 41 20 81 .....
0100 53 41 53 20 02 6f 76 69 64 65 72 20 43 31 30 .....
0120 30 31 31 21 26 30 2a 08 55 04 03 0c 15 49 00 .....
0130 6e 46 6f 72 75 6d 02 53 23 41 53 17 04 53 20 .....
0140 50 72 6f 69 64 65 72 20 43 31 30 17 02 31 30 .....
0150 35 31 30 32 31 31 36 30 34 31 37 5a 17 0d 32 36 .....
0160 34 32 36 31 69 43 31 37 5a 30 68 31 0b 30 .....
0170 89 06 03 55 04 06 13 02 55 31 13 30 01 00 03 .....
0180 55 04 06 31 69 43 4f 4d 20 4c 61 62 73 31 00 .....
0190 20 39 06 03 55 04 0c 22 57 49 69 64 65 6e 46 .....
01a0 72 75 6d 6f 69 64 53 53 50 72 6f 76 69 64 53 .....
01b0 20 43 65 72 74 69 69 69 63 61 74 65 31 17 30 15 .....
01c0 06 55 04 03 0c 31 30 21 31 30 30 26 32 33 .....
01d0 18 2a 32 35 32 32 02 22 30 04 06 29 86 48 .....
01e0 86 7f 0d 01 01 05 00 82 01 01 00 30 82 01 .....
01f0 0e 82 01 01 00 08 19 09 71 56 86 08 26 21 22 .....
0200 0d 07 00 01 00 02 05 e8 09 03 78 5f 54 .....
0210 04 5c b4 06 b5 1a bd 06 12 b2 02 27 77 96 .....
0220 0f 0b 06 39 6f 59 04 08 28 0c 5f dc a8 52 52 .....
0230 0e 7b fd 63 e2 7c ae 6d 29 a5 16 17 09 6d 19 .....
0240 e9 f5 44 58 08 97 2a 69 7c 28 0a 04 04 5f .....

```

Spectrum Analyzer 1
Swept SA

KEYSIGHT Input: RF Coupling: DC Align: Auto
Input Z: 50 Ω Corr C: Corr R: Cal Freq Ref: Int (S) NFE: Adaptive
Atten: 8 dB Preamplifier: Off μ W Path: Standard
PNO: Fast Gate: Off IF Gain: Low Sig Track: Off
Avg Type: Power (RMS) Trg: Free Run

1 2 3 4 5 6
W W W W W W
A N N N N N

1 Spectrum
Scale/Div 10 dB
Log

Ref Lvl Offset 32.99 dB
Ref Level 30.00 dBm

Center 3.620000000 GHz
Res BW 2.0 MHz
#Video BW 8.0 MHz*
Span 0 Hz
Sweep 210 s (1001 pts)

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WINNF.FT.C.SCS.2

Variant: 40 MHz, Channel: 3620.00 MHz, Combined

No.	Time	Source	Destination	Protocol	Length	Info
1	2025-10-29 16:53:17.2982572	10.100.238.161	10.100.238.252	TCP	74	43792 → 9050 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM TSval=1553824403 TSecr=0 WS=128
2	2025-10-29 16:53:17.3861972	10.100.238.252	10.100.238.161	TCP	74	9050 → 43792 [SYN, ACK] Seq=0 Ack=1 Win=65160 Len=0 MSS=1460 SACK_PERM TSval=492861654 TSecr=1553824403 WS=128
3	2025-10-29 16:53:17.3862432	10.100.238.161	10.100.238.252	TCP	66	43792 → 9050 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=1553824411 TSecr=492861654
4	2025-10-29 16:53:17.3871142	10.100.238.161	10.100.238.252	TLSv1.2	583	Client Hello
5	2025-10-29 16:53:17.3887142	10.100.238.252	10.100.238.161	TCP	66	9050 → 43792 [ACK] Seq=1 Ack=518 Win=64768 Len=0 TSval=492861657 TSecr=1553824411
6	2025-10-29 16:53:17.3895262	10.100.238.252	10.100.238.161	TLSv1.2	1744	Server Hello, Certificate, Certificate Request, Server Hello Done
7	2025-10-29 16:53:17.3895452	10.100.238.161	10.100.238.252	TCP	66	43792 → 9050 [ACK] Seq=518 Ack=1679 Win=63488 Len=0 TSval=1553824414 TSecr=492861657
8	2025-10-29 16:53:17.3897882	10.100.238.161	10.100.238.252	TLSv1.2	73	Alert (Level: Fatal, Description: Unknown CA)
9	2025-10-29 16:53:17.3897602	10.100.238.161	10.100.238.252	TCP	66	43792 → 9050 [RST, ACK] Seq=525 Ack=1679 Win=64128 Len=0 TSval=1553824414 TSecr=492861657

> Frame 8: Packet, 73 bytes on wire (584 bits), 73 bytes captured (584 bits)

> Ethernet II, Src: de:a7:a0:8b:45:f2 (de:a7:a0:8b:45:f2), Dst: Intel_eb:ea:ba (04:cf:4b:eb:ea:ba)

> Internet Protocol Version 4, Src: 10.100.238.161, Dst: 10.100.238.252

> Transmission Control Protocol, Src Port: 43792, Dst Port: 9050, Seq: 518, Ack: 1679, Len: 7

> Transport Layer Security

[Stream Index: 0]

▼ TLSv1.2 Record Layer: Alert (Level: Fatal, Description: Unknown CA)

Content Type: Alert (21)

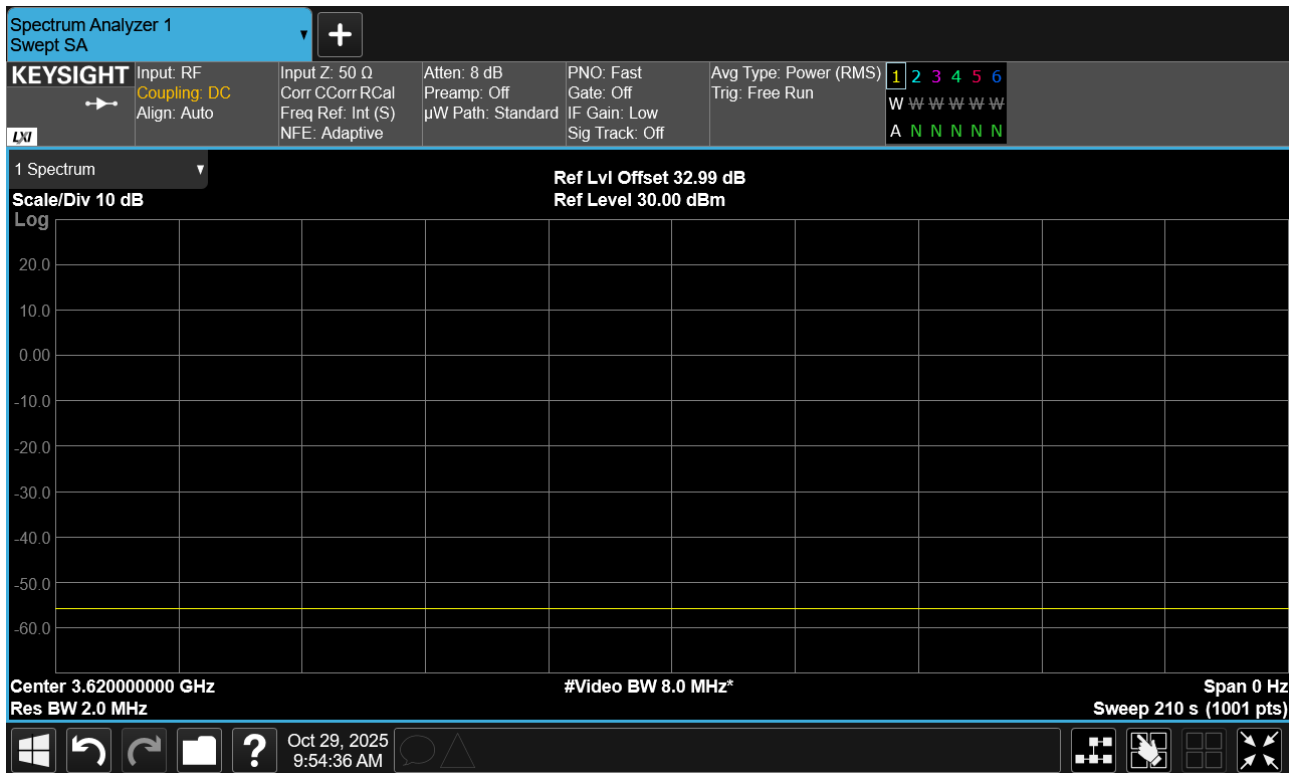
Version: TLS 1.2 (0x0303)

Length: 2

▼ Alert Message

Level: Fatal (2)

Description: Unknown CA (48)



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No.	Time	Source	Destination	Protocol	Length	Info
1	2025-10-29 17:04:06.7189592	10.100.238.161	10.100.238.252	TCP	74	45878 → 9050 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM TSval=1554473823 TSecr=0 WS=128
2	2025-10-29 17:04:06.7238212	10.100.238.252	10.100.238.161	TCP	74	9050 → 45878 [SYN, ACK] Seq=0 Ack=1 Win=65160 Len=0 MSS=1460 SACK_PERM TSval=492711069 TSecr=1554473823 WS=128
3	2025-10-29 17:04:06.7238652	10.100.238.161	10.100.238.252	TCP	66	45878 → 9050 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=1554473827 TSecr=492711069
4	2025-10-29 17:04:06.7239352	10.100.238.161	10.100.238.252	TLSv1.2	583	Client Hello
5	2025-10-29 17:04:06.7268662	10.100.238.252	10.100.238.161	TCP	66	9050 → 45878 [ACK] Seq=1 Ack=518 Win=64768 Len=0 TSval=492711073 TSecr=1554473828
6	2025-10-29 17:04:06.7275932	10.100.238.252	10.100.238.161	TLSv1.2	1514	Server Hello
7	2025-10-29 17:04:06.7276812	10.100.238.161	10.100.238.252	TCP	66	45878 → 9050 [ACK] Seq=518 Ack=1449 Win=64128 Len=0 TSval=1554473832 TSecr=492711073
8	2025-10-29 17:04:06.7306172	10.100.238.252	10.100.238.161	TLSv1.2	1670	Certificate, Certificate Request, Server Hello Done
9	2025-10-29 17:04:06.7306262	10.100.238.161	10.100.238.252	TCP	66	45878 → 9050 [ACK] Seq=518 Ack=3053 Win=63072 Len=0 TSval=1554473835 TSecr=492711073
10	2025-10-29 17:04:06.7310722	10.100.238.161	10.100.238.252	TLSv1.2	73	Alert (Level: Fatal, Description: Certificate Expired)
11	2025-10-29 17:04:06.7311078	10.100.238.161	10.100.238.252	TCP	66	45878 → 9050 [RST, ACK] Seq=525 Ack=3053 Win=64128 Len=0 TSval=1554473035 TSecr=492711073
12	2025-10-29 17:04:26.7322762	10.100.238.161	10.100.238.252	TCP	74	57612 → 9050 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM TSval=1554493837 TSecr=0 WS=128
13	2025-10-29 17:04:26.7341572	10.100.238.252	10.100.238.161	TCP	74	9050 → 57612 [SYN, ACK] Seq=0 Ack=1 Win=65160 Len=0 MSS=1460 SACK_PERM TSval=492731081 TSecr=1554493837 WS=128
14	2025-10-29 17:04:26.7342032	10.100.238.161	10.100.238.252	TCP	66	57612 → 9050 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=1554493838 TSecr=492731081
15	2025-10-29 17:04:26.7346852	10.100.238.161	10.100.238.252	TLSv1.2	583	Client Hello
16	2025-10-29 17:04:26.7357972	10.100.238.161	10.100.238.252	TCP	66	9050 → 57612 [ACK] Seq=1 Ack=518 Win=64768 Len=0 TSval=492731084 TSecr=1554493839
17	2025-10-29 17:04:26.7376832	10.100.238.252	10.100.238.161	TLSv1.2	3118	Server Hello, Certificate, Certificate Request, Server Hello Done
18	2025-10-29 17:04:26.7378962	10.100.238.161	10.100.238.252	TCP	66	57612 → 9050 [ACK] Seq=518 Ack=3053 Win=62848 Len=0 TSval=1554493842 TSecr=492731084
19	2025-10-29 17:04:26.7382982	10.100.238.161	10.100.238.252	TLSv1.2	73	Alert (Level: Fatal, Description: Certificate Expired)
20	2025-10-29 17:04:26.7383542	10.100.238.161	10.100.238.252	TCP	66	57612 → 9050 [RST, ACK] Seq=525 Ack=3053 Win=64128 Len=0 TSval=1554493843 TSecr=492731084

> Frame 19: Packet, 73 bytes on wire (584 bits), 73 bytes captured (584 bits)

> Ethernet II, Src: de:a7:a0:8b:45:f2 (de:a7:a0:8b:45:f2), Dst: Intel_eb:ea:ba (04:cf:4b:eb:ea:ba)

> Internet Protocol Version 4, Src: 10.100.238.161, Dst: 10.100.238.252

> Transmission Control Protocol, Src Port: 57612, Dst Port: 9050, Seq: 518, Ack: 3053, Len: 7

> Transport Layer Security

[Stream index: 1]

▼ TLSv1.2 Record Layer: Alert (Level: Fatal, Description: Certificate Expired)

Content Type: Alert (21)

Version: TLS 1.2 (0x0303)

Length: 2

▼ Alert Message

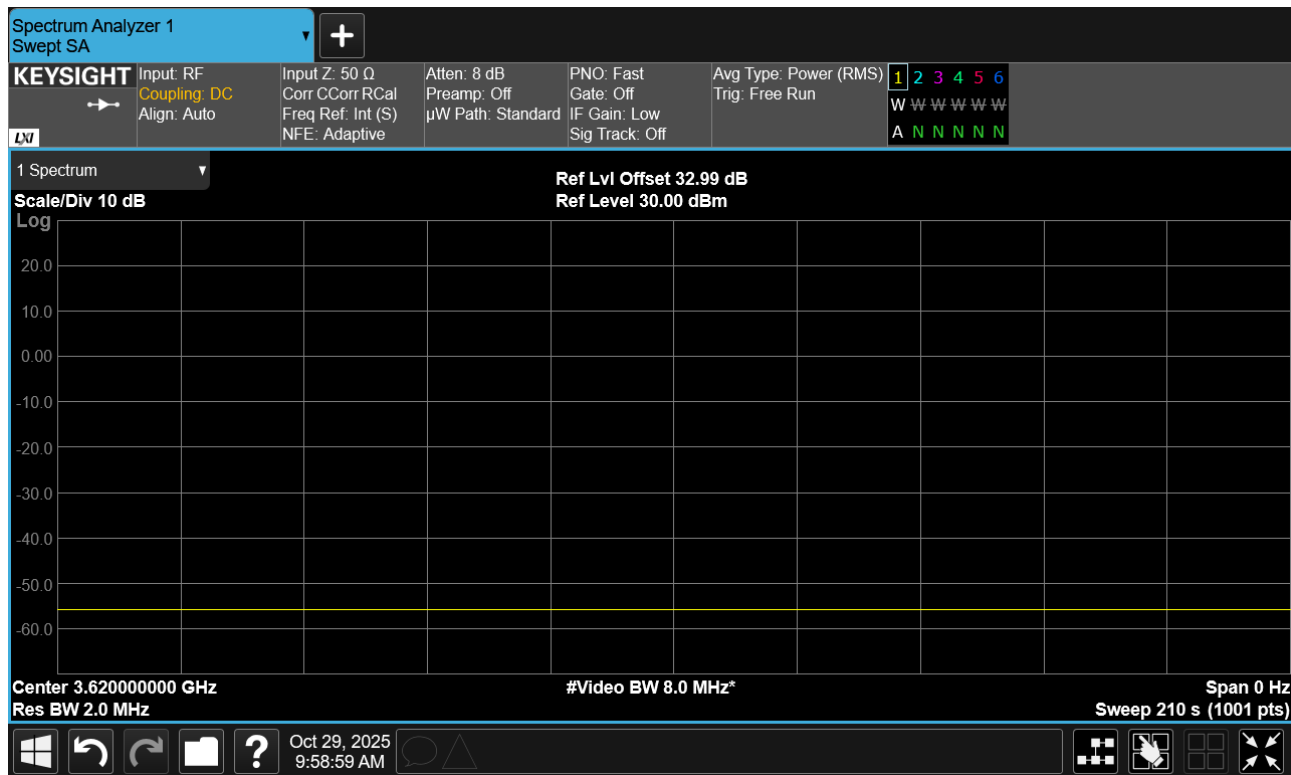
Level: Fatal (2)

Description: Certificate Expired (45)

```

0000  04 cf 4b eb ea ba de a7 a0 8b 45 f2 00 00 45 00  ..K.....E...
0010  00 3b f4 9d 40 00 40 06 53 b9 0a 64 ee a1 0a 64  .:~@.S:d:d
0020  ee fc e1 9c 23 5a 01 aa 9d da 77 6f af 6c 00 18  ....#...no...
0030  01 eb f2 93 00 00 01 01 00 0a 5c a7 d1 93 1d 5e  .....A
0040  7a cc 03 03 00 02 02 2d  z.....

```



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No.	Time	Source	Destination	Protocol	Length	Info
1	2025-10-29 17:00:56.7109902	10.100.238.161	10.100.238.252	TCP	74	43620 → 9050 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM TSval=1554283815 TSecr=0 WS=128
2	2025-10-29 17:00:56.7828862	10.100.238.252	10.100.238.161	TCP	74	9050 → 43620 [SYN, ACK] Seq=0 Ack=1 Win=65160 Len=0 MSS=1460 SACK_PERM TSval=492521129 TSecr=1554283815 WS=128
3	2025-10-29 17:00:56.7829292	10.100.238.161	10.100.238.252	TCP	66	43620 → 9050 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=1554283887 TSecr=492521129
4	2025-10-29 17:00:56.7838042	10.100.238.161	10.100.238.252	TLSv1.2	583	Client Hello
5	2025-10-29 17:00:56.7866362	10.100.238.252	10.100.238.161	TCP	66	9050 → 43620 [ACK] Seq=1 Ack=518 Win=64768 Len=0 TSval=492521134 TSecr=1554283888
6	2025-10-29 17:00:56.7882822	10.100.238.252	10.100.238.161	TLSv1.2	1599	Server Hello, Certificate, Certificate Request, Server Hello Done
7	2025-10-29 17:00:56.7882982	10.100.238.161	10.100.238.252	TCP	66	43620 → 9050 [ACK] Seq=518 Ack=1534 Win=63872 Len=0 TSval=1554283893 TSecr=492521134
8	2025-10-29 17:00:56.7884662	10.100.238.161	10.100.238.252	TLSv1.2	73	Alert (Level: Fatal, Description: Unknown CA)
9	2025-10-29 17:00:56.7885172	10.100.238.161	10.100.238.252	TCP	66	43620 → 9050 [RST, ACK] Seq=525 Ack=1534 Win=64128 Len=0 TSval=1554283893 TSecr=492521134

> Frame 8: Packet, 73 bytes on wire (584 bits), 73 bytes captured (584 bits) > Ethernet II, Src: de:a7:a0:8b:45:f2 (de:a7:a0:8b:45:f2), Dst: Intel_eb:ea:ba (04:cf:4b:eb:ea:ba) > Internet Protocol Version 4, Src: 10.100.238.161, Dst: 10.100.238.252 > Transmission Control Protocol, Src Port: 43620, Dst Port: 9050, Seq: 518, Ack: 1534, Len: 7 ✓ Transport Layer Security (Stream index: 0) ✓ TLSv1.2 Record Layer: Alert (Level: Fatal, Description: Unknown CA) Content Type: Alert (21) Version: TLS 1.2 (0x0303) Length: 2 ✓ Alert Message Level: Fatal (2) Description: Unknown CA (48)	<pre> 0000 04 cf 4b eb ea ba de a7 a0 8b 45 f2 00 00 45 00 ..K....E... 0010 00 3b 4c c5 40 00 40 06 fb 91 0a 64 ee a1 0a 64 ..jL@...d... 0020 ee fc aa 64 23 5a 02 ed 91 41 c7 72 96 a8 80 18 ...QZ...A... 0030 01 f3 f2 03 00 00 01 01 00 0a 5c a4 7d 75 1d 5b Vju[0040 46 ae 15 03 03 00 02 02 30 E </pre>
--	---

[back to matrix](#)

No.	Time	Source	Destination	Protocol	Length	Info
1	2025-10-29 17:07:25.7569872	10.100.238.161	10.100.238.252	TCP	74	57148 → 9050 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM TSval=1554672861 TSecr=0 WS=128
2	2025-10-29 17:07:25.7988392	10.100.238.252	10.100.238.161	TCP	74	9050 → 57148 [SYN, ACK] Seq=0 Ack=1 Win=65160 Len=0 MSS=1460 SACK_PERM TSval=492910144 TSecr=1554672861 WS=128
3	2025-10-29 17:07:25.7988822	10.100.238.161	10.100.238.252	TCP	66	57148 → 9050 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=1554672903 TSecr=492910144
4	2025-10-29 17:07:25.7997682	10.100.238.161	10.100.238.252	TLSv1.2	583	Client Hello
5	2025-10-29 17:07:25.8022642	10.100.238.252	10.100.238.161	TCP	66	9050 → 57148 [ACK] Seq=1 Ack=518 Win=64768 Len=0 TSval=492910149 TSecr=1554672904
6	2025-10-29 17:07:25.8045462	10.100.238.252	10.100.238.161	TLSv1.2	3143	Server Hello, Certificate, Certificate Request, Server Hello Done
7	2025-10-29 17:07:25.8045602	10.100.238.161	10.100.238.252	TCP	66	57148 → 9050 [ACK] Seq=518 Ack=3078 Win=62848 Len=0 TSval=1554672909 TSecr=492910149
8	2025-10-29 17:07:25.8050162	10.100.238.161	10.100.238.252	TLSv1.2	73	Alert (Level: Fatal, Description: Decrypt Error)
9	2025-10-29 17:07:25.8050742	10.100.238.161	10.100.238.252	TCP	66	57148 → 9050 [RST, ACK] Seq=525 Ack=3078 Win=64128 Len=0 TSval=1554672909 TSecr=492910149
10	2025-10-29 17:07:25.8062182	10.100.238.161	10.100.238.252	TCP	74	45284 → 9050 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM TSval=1554692910 TSecr=0 WS=128
11	2025-10-29 17:07:25.8099972	10.100.238.252	10.100.238.161	TCP	74	9050 → 45284 [SYN, ACK] Seq=0 Ack=1 Win=65160 Len=0 MSS=1460 SACK_PERM TSval=492930156 TSecr=1554692910 WS=128
12	2025-10-29 17:07:25.8100392	10.100.238.161	10.100.238.252	TCP	66	45284 → 9050 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=1554692914 TSecr=492930156
13	2025-10-29 17:07:25.8105332	10.100.238.161	10.100.238.252	TLSv1.2	583	Client Hello
14	2025-10-29 17:07:25.8129672	10.100.238.252	10.100.238.161	TCP	66	9050 → 45284 [ACK] Seq=1 Ack=518 Win=64768 Len=0 TSval=492930160 TSecr=1554692915
15	2025-10-29 17:07:25.8137882	10.100.238.252	10.100.238.161	TLSv1.2	3143	Server Hello, Certificate, Certificate Request, Server Hello Done
16	2025-10-29 17:07:25.8138022	10.100.238.161	10.100.238.252	TCP	66	45284 → 9050 [ACK] Seq=518 Ack=3078 Win=62848 Len=0 TSval=1554692918 TSecr=492930160
17	2025-10-29 17:07:25.8141982	10.100.238.161	10.100.238.252	TLSv1.2	73	Alert (Level: Fatal, Description: Decrypt Error)
L	2025-10-29 17:07:25.8142552	10.100.238.161	10.100.238.252	TCP	66	45284 → 9050 [RST, ACK] Seq=525 Ack=3078 Win=64128 Len=0 TSval=1554692919 TSecr=492930160

> Frame 17: Packet, 73 bytes on wire (584 bits), 73 bytes captured (584 bits)

> Ethernet II, Src: de:a7:a0:80:45:f2 (de:a7:a0:80:45:f2), Dst: 04:cf:4b:eb:ea:ba (04:cf:4b:eb:ea:ba)

> Internet Protocol Version 4, Src: 10.100.238.161, Dst: 10.100.238.252

> Transmission Control Protocol, Src Port: 45284, Dst Port: 9050, Seq: 518, Ack: 3078, Len: 7

▼ Transport Layer Security

[Stream Index: 1]

▼ TLSv1.2 Record Layer: Alert (Level: Fatal, Description: Decrypt Error)

[Content Type: Alert (21)]

Version: TLS 1.2 (0x0303)

Length: 2

▼ Alert Message

Level: Fatal (2)

Description: Decrypt Error (51)

```

0000  04 cf 4b eb ea ba de a7 a0 80 45 f2 08 00 45 00  ..K.....E...
0010  00 30 b8 be 40 00 40 06 90 48 0a 04 ee a1 0a 64  .:..@...H.d...
0020  ee fc d0 e4 23 5a f2 7f 27 58 94 6e 27 15 80 18  ....#...X.n...
0030  01 eb f2 93 00 00 01 01 00 0a 5c aa bb 37 1d 61  .....7.a
0040  84 70 15 03 03 00 02 02 33  .....p.....3

```

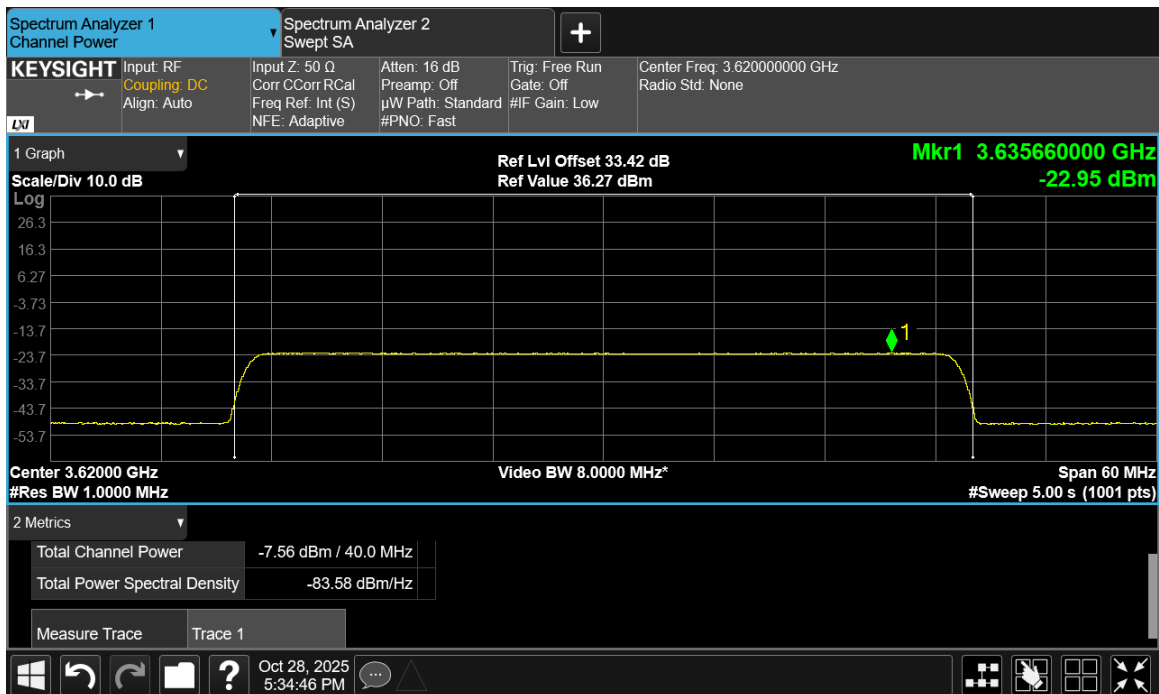
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A.7. RF Power Measurement

WINNF.PT.C.HBT -10 dBm



Variant: 40 MHz, Channel: 3620.00 MHz, Chain a, Temp: 20, Voltage: NA Vdc

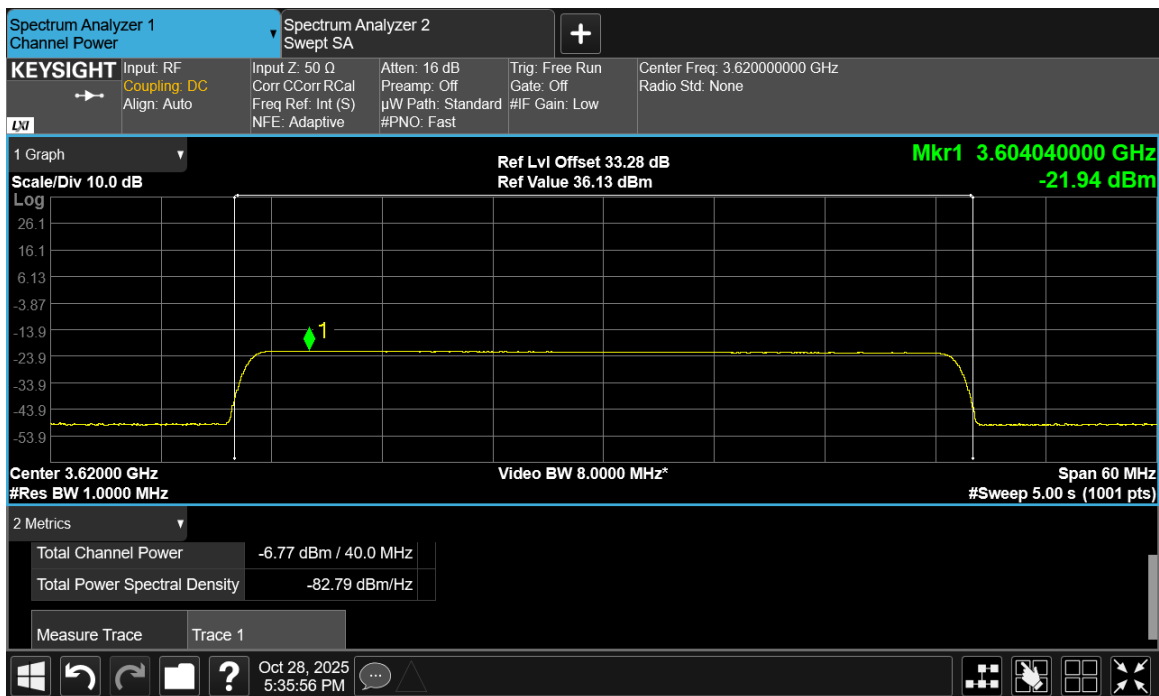


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WINNF.PT.C.HBT -10 dBm



Variant: 40 MHz, Channel: 3620.00 MHz, Chain b, Temp: 20, Voltage: NA Vdc

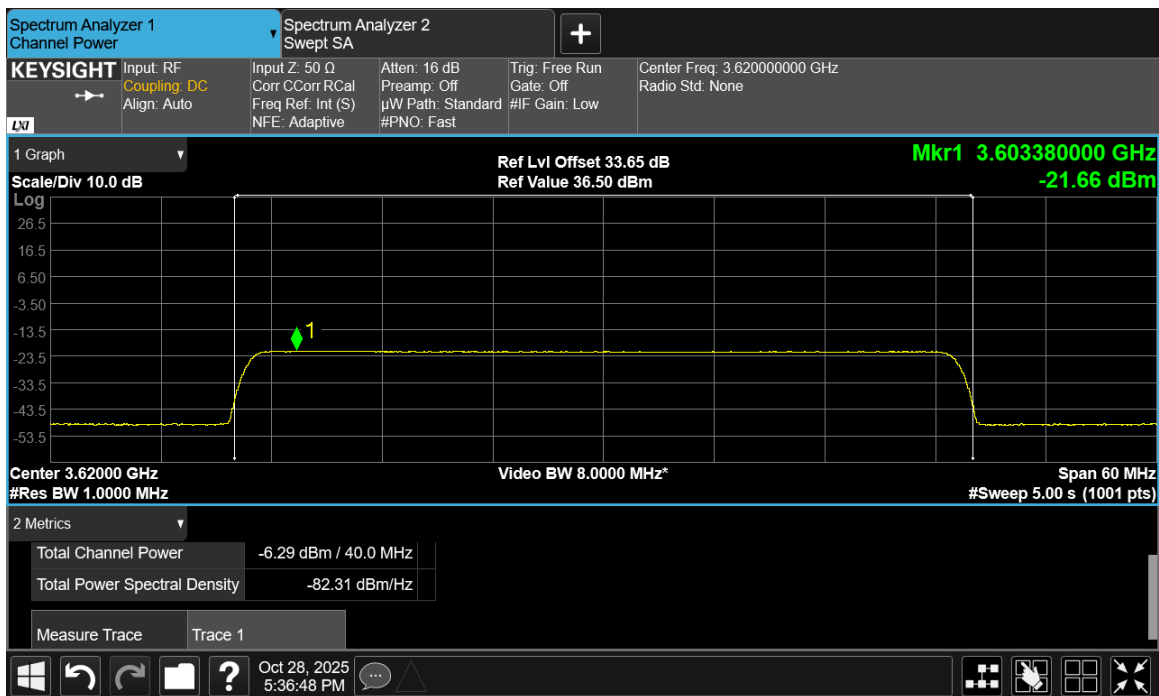


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WINNF.PT.C.HBT -10 dB



Variant: 40 MHz, Channel: 3620.00 MHz, Chain c, Temp: 20, Voltage: NA Vdc

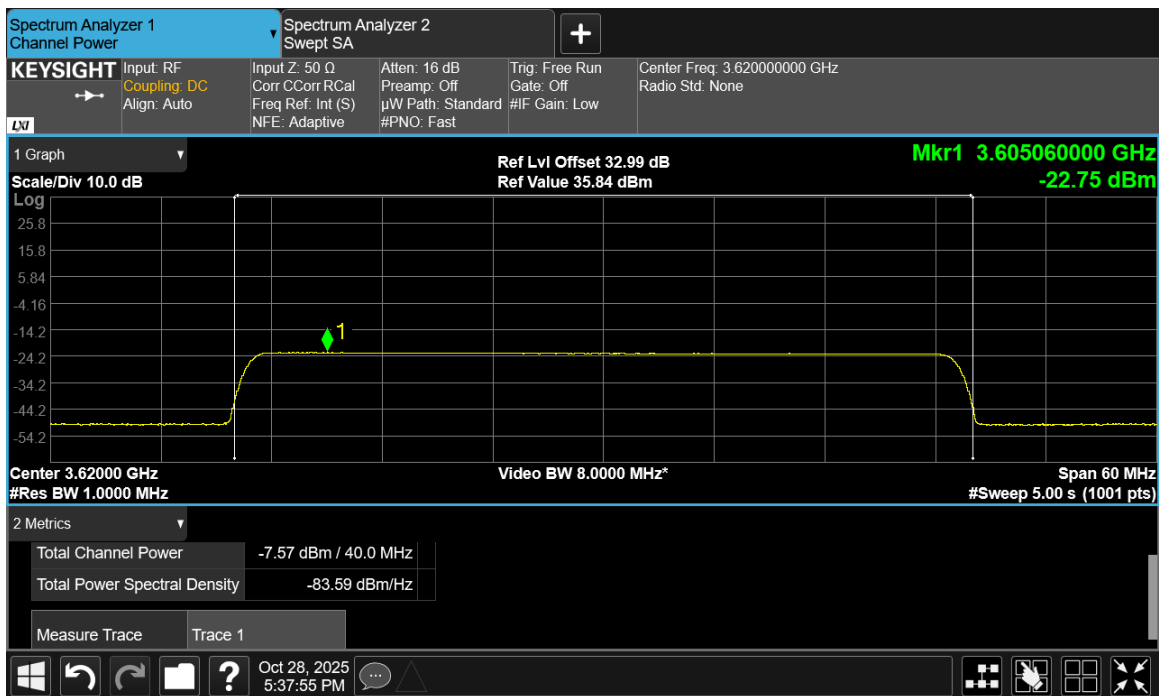


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WINNF.PT.C.HBT -10 dBm



Variant: 40 MHz, Channel: 3620.00 MHz, Chain d, Temp: 20, Voltage: NA Vdc

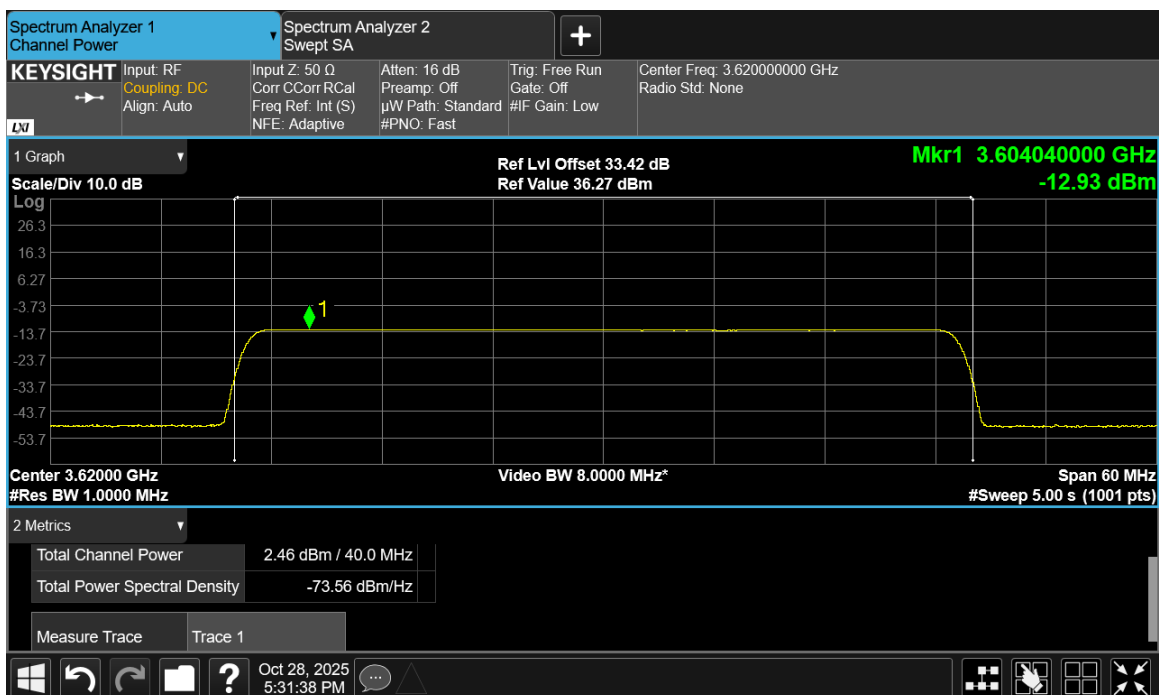


[back to matrix](#)

WINNF.PT.C.HBT 0 dBm



Variant: 40 MHz, Channel: 3620.00 MHz, Chain a, Temp: 20, Voltage: NA Vdc

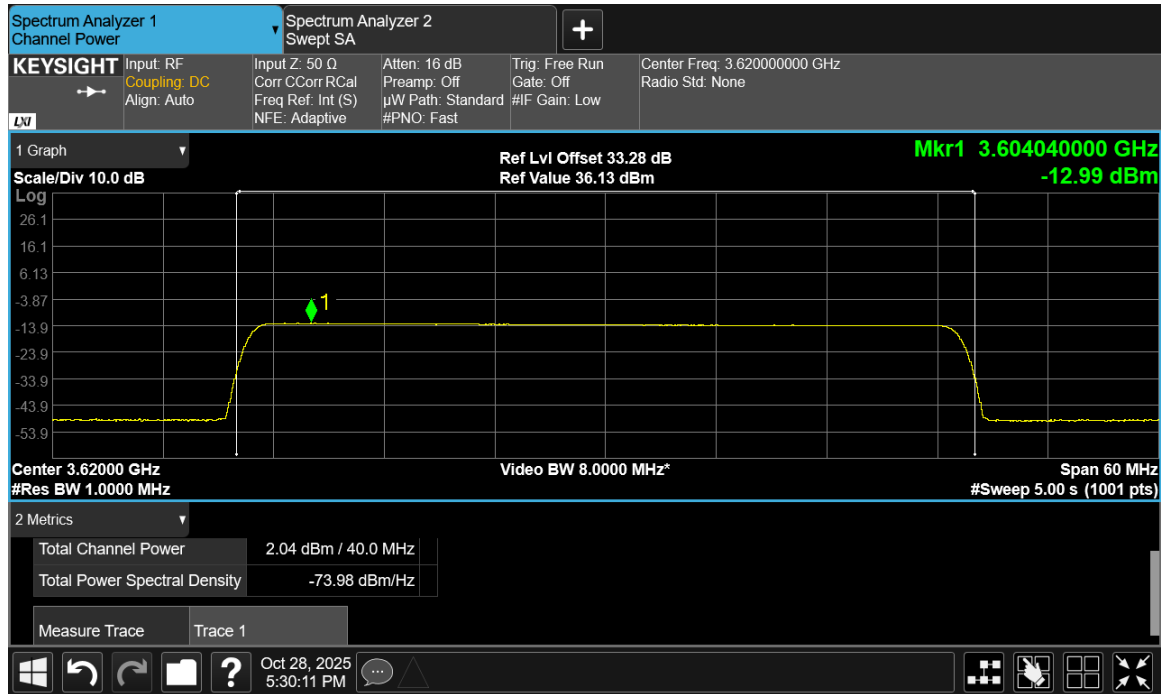


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WINNF.PT.C.HBT 0dBm



Variant: 40 MHz, Channel: 3620.00 MHz, Chain b, Temp: 20, Voltage: NA Vdc

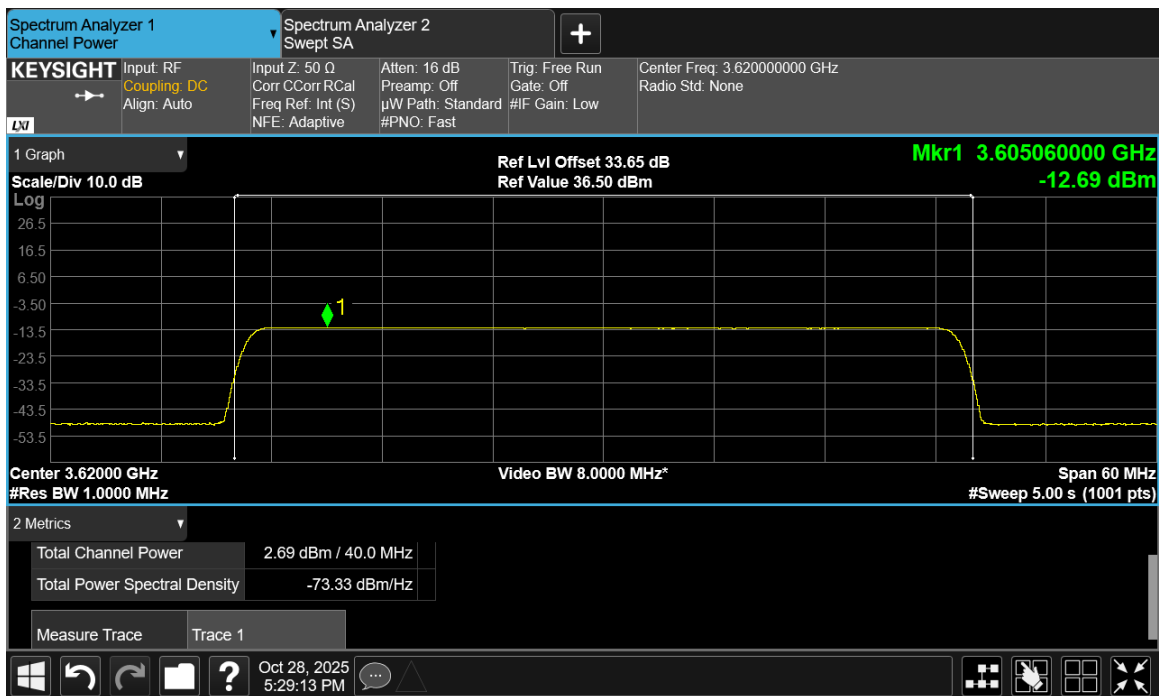


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WINNF.PT.C.HBT 0 dBm



Variant: 40 MHz, Channel: 3620.00 MHz, Chain c, Temp: 20, Voltage: NA Vdc

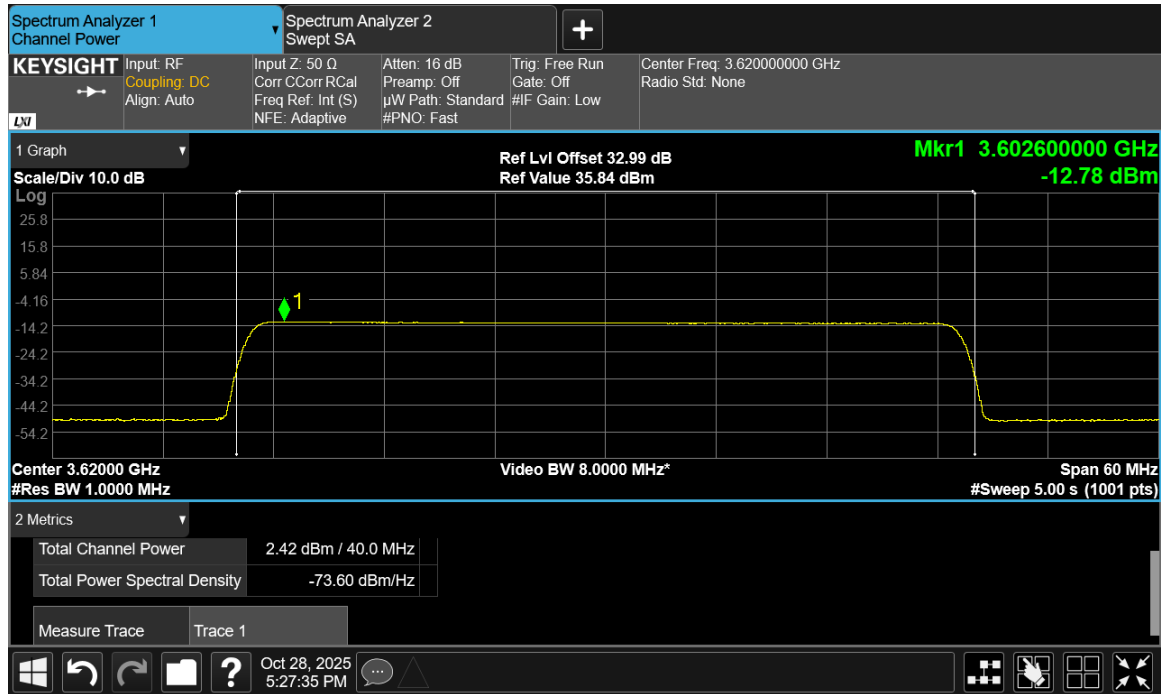


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WINNF.PT.C.HBT 0 dBm



Variant: 40 MHz, Channel: 3620.00 MHz, Chain d, Temp: 20, Voltage: NA Vdc

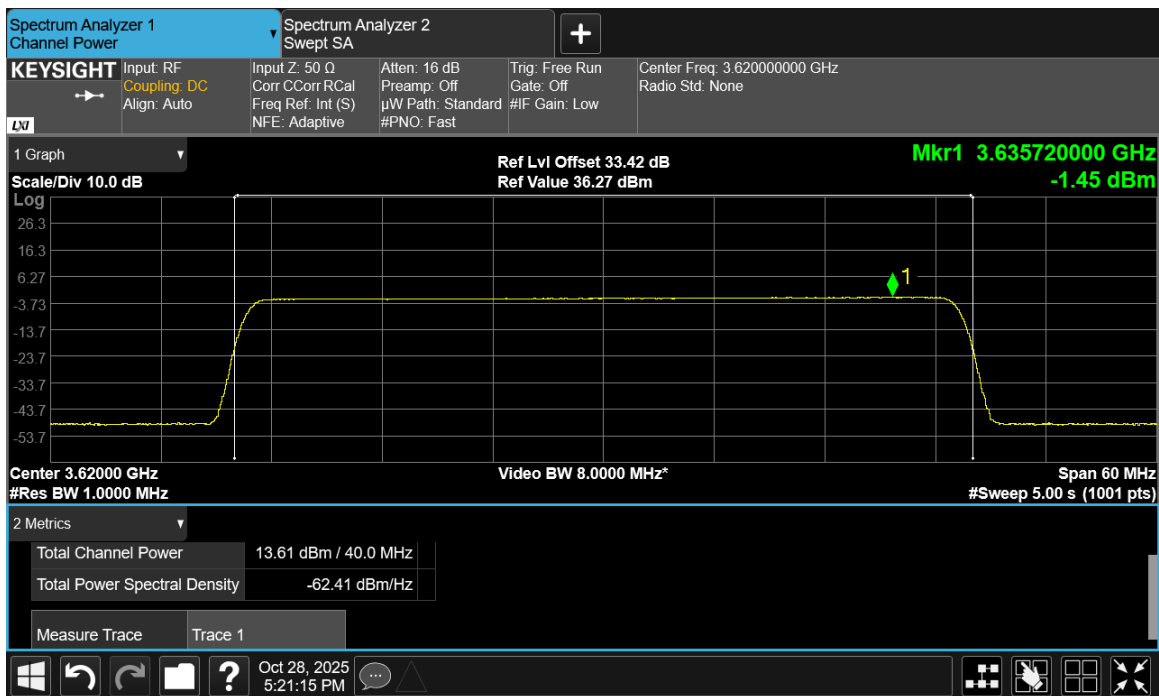


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WINNF.PT.C.HBT 11 dBm



Variant: 40 MHz, Channel: 3620.00 MHz, Chain a, Temp: 20, Voltage: NA Vdc

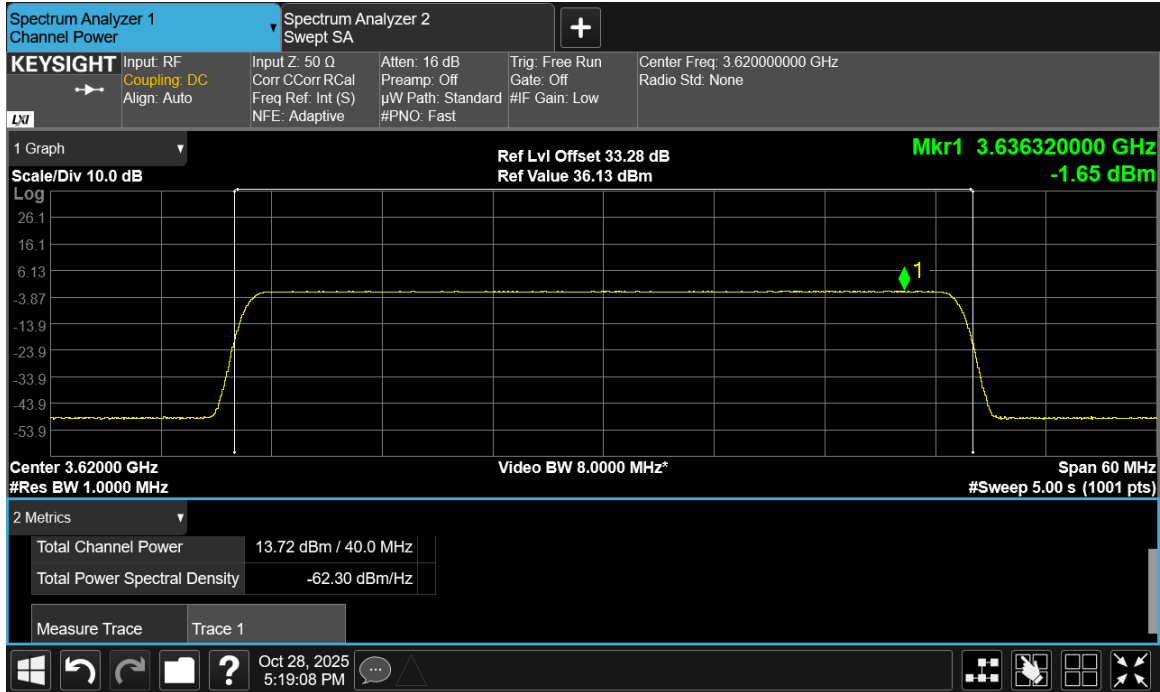


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WINNF.PT.C.HBT 11 dBm



Variant: 40 MHz, Channel: 3620.00 MHz, Chain b, Temp: 20, Voltage: NA Vdc

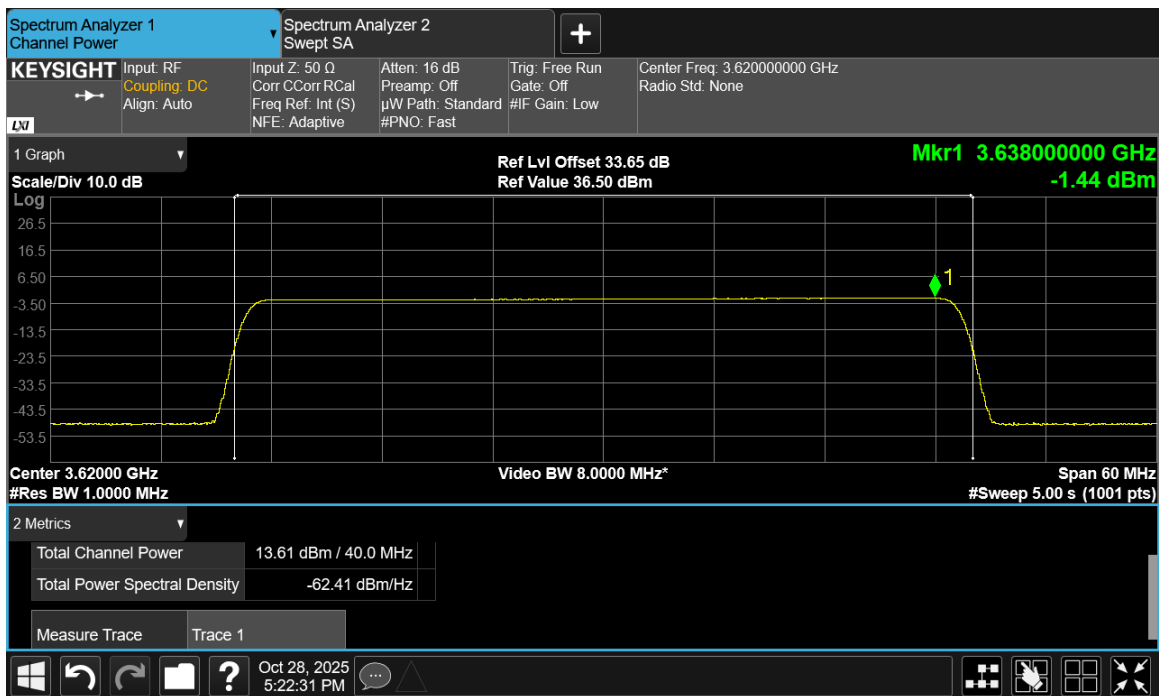


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WINNF.PT.C.HBT 11 dBm



Variant: 40 MHz, Channel: 3620.00 MHz, Chain c, Temp: 20, Voltage: NA Vdc

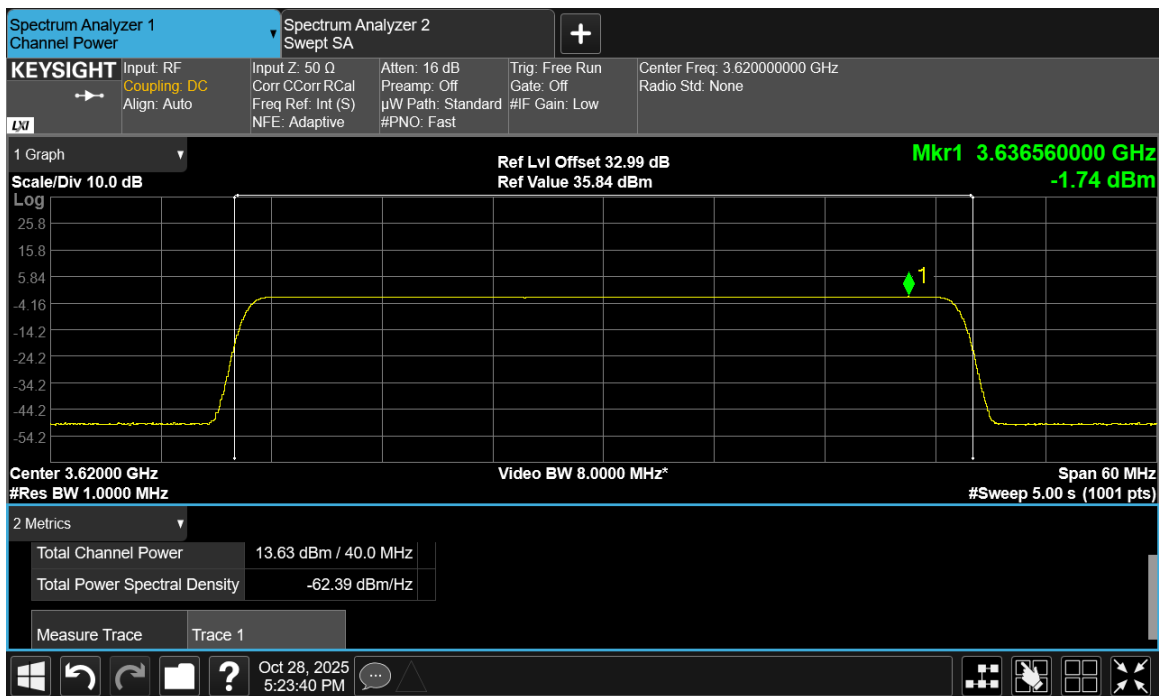


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WINNF.PT.C.HBT 11 dBm



Variant: 40 MHz, Channel: 3620.00 MHz, Chain d, Temp: 20, Voltage: NA Vdc



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