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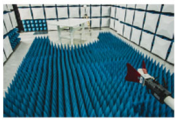

MEASUREMENT REPORT
FCC Part 15F ULTRA WIDEBAND

Applicant Name:
Samsung Electronics Co., Ltd.
129, Samsung-ro,
Yeongtong-gu, Suwon-si
Gyeonggi-do, 16677, Korea

Date of Testing:
05/12 – 06/08/2022
Test Report Issue Date:
06/22/2022
Test Site/Location:
PCTEST Lab. Yongin-Si, Gyeonggi-do, South Korea
Test Report Serial No.:
1M2204010046-12.A3L

FCC ID:	**A3LSMF936U**
APPLICANT:	**Samsung Electronics Co., Ltd.**

Application Type:	Certification
Model:	SM-F936U
Additional Models:	SM-F936U1
EUT Type:	Portable Handset
FCC Classification:	Ultrawide Band (UWB)
FCC Rule Parts(s):	FCC Part 15 Subpart F (15.519, 15.521)
UWB Classification:	Hand-held Communication Device
Test Procedure(s):	ANSI C63.10-2013, KDB 393764 D01 v02r01

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and has been tested in accordance with the measurement procedures specified in ANSI C63.10-2013 (See Test Report). These measurements were performed with no deviation from the standards. Test results reported herein relate only to the item(s) tested.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Prepared by

Reviewed by

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1.0 INTRODUCTION

1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and Innovation, Science and Economic Development Canada.

1.2 PCTEST Test Location

These measurement tests were conducted at the PCTEST facility located at 13, Heungdeok 1-ro, Giheung-gu, Yongin-si, Gyeonggi-do, 16954, South Korea. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014.

1.3 Test Facility / Accreditations

Measurements were performed at PCTEST located in Yongin-si, Gyeonggi-do, 16954, South Korea.

- PCTEST is an ISO 17025-2017 accredited test facility under the National Voluntary Laboratory Accreditation Program (NVLAP) with Certificate number 600143-0 for Specific Absorption Rate (SAR), where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.

- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).

- PCTEST Korea facility is accredited, designated, and recognized in accordance with the provision of Radio Wave Act and International Standard ISO/IEC 17025:2017 under the National Radio Research Agency.

  - Designation Number / CABID: KR0169
  - Test Firm Registration Number of FCC: 417945
  - Test Firm Registration Number of ISED: 26168

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID: A3LSMF936U**. The test data contained in this report pertains only to the EUT's ultra-wideband transmitter.

Test Device Serial No.: 1871M, 2226S

2.2 Device Capabilities

This device contains the following capabilities:

850/1900 GSM/GPRS/EDGE, 850/1700/1900 WCDMA/HSPA, Multi-band LTE, 5G NR (FR1 and FR2), 802.11b/g/n/ax WLAN, 802.11a/n/ac/ax UNII (5,6GHz), Bluetooth (1x, EDR, LE), NFC, UWB, Wireless Power Transfer

2.3 Test Configuration

The EUT was tested per the guidance of Section 10 of ANSI C63.10-2013. The EUT setup procedures of ANSI C63.10-2013 were used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing. See Section 3.2 for AC line conducted emissions test setups, 3.3 for radiated emissions test setups, respectively.

The Equipment Under Test (EUT) was capable of operating on two antennas in two separate modes [HPRF, preamble 27] and [BPRF, preamble 9~12]. Care was taken to ensure the worst-case modes were investigated and reported.

This device supports two configurations: one is with screen open and one is with screen closed. Open, half opened and closed configurations are tested, and the worst case radiated emissions data is shown in this report.

For more information, please see Section 7.0 for test data and the test setup photos document for the test setup photographs.

2.4 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and no modifications were made during testing.

2.5 Antenna Description

Following antenna was used for the testing.

Frequency [GHz]	Antenna 1 Gain [dBi]	Antenna 2 Gain [dBi]
6.25 – 6.75	-2.4	N/A
7.75 – 8.25	-3.9	-2.2

Table 2-1. Maximum Peak Antenna Gain

2.6 Software and Firmware

The test was conducted with firmware version F936USQU0AVD8 installed on the EUT.

3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedure described in the American National Standard for Methods of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz (ANSI C63.4-2014) was used in the measurement of the EUT.

Deviation from measurement procedure…….....None

3.2 AC Line Conducted Emissions

The line-conducted facility is located inside a 10'x16'x9' shielded enclosure. The shielded enclosure is manufactured by SY cooperation RF Enclosures. The line-conducted facility is located inside a 7m x 3.66m x 2.7m shielded enclosure. The shielding effectiveness of the shielded room is in accordance with MIL-Std-285 or NSA 65-5. A 1m x 1.5m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50μH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. The external power line filter is an ETS Lindgren Model LPRX-4X30 (100dB Attenuation, 14kHz-18GHz) and the two EMI/RFI filters are ETS Lindgren Model LRW-2030-S1 (100dB Minimum Insertion Loss, 14kHz – 10GHz). These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and this supply line(s) will be connected to the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference groundplane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the spectrum analyzer and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The spectrum was scanned from 150kHz to 30MHz with a spectrum analyzer. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 10kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions is used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.

Line conducted emissions test results are shown in Section 7.7. The EMI Receiver mode of the R&S ESW was used to perform AC line conducted emissions testing. Automated test software was used to perform the AC line conducted emissions testing. Automated measurement software utilized is Rohde & Schwarz EMC32, Version 10.20.01.

3.3 Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Clause 5, Figure 5.7 of ANSI C63.4-2014. A raised turntable is used for radiated measurement. It is a continuously rotatable, remote-controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. . An 80cm tall test table made of Styrodur is placed on top of the turn table. For measurements above 1GHz, an additional Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33(b)(1) depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up was placed on top of the 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions.

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014. Additionally, radiated emissions below 30MHz are also validated on an Open Area Test Site to assert correlation with the chamber measurements per the requirements of KDB 414788 D01 v01r01.

3.4 Environmental Conditions

The temperature is controlled within range of 15ºC to 35ºC. The relative humidity is controlled within range of 10% to 75%. The atmospheric pressure is monitored within the range 86-106kPa (860-1060mbar).

4.0 ANTENNA REQUIREMENTS

Except from §15.203 of the FCC Rules/Regulations:

“An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.”

- The antenna(s) of the EUT are permanently attached
- There are no provisions for a connection to an external antenna

The EUT complies with the requirements of §15.203.

5.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4-2014. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty (±dB)
Conducted Disturbance	3.09
Radiated Disturbance (<1GHz)	3.01
Radiated Disturbance (>1GHz)	5.56

6.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Huber+Suhner	SF102/11SK/11SK/1500	RF Cable	N/A			SN 804225/2
Huber+Suhner	SF102/11SK/11SK/2000	RF Cable	N/A			SN 804223/2
Keysight Technologies	N9030B	PXA Signal Analyzer	2022-05-09	Annual	2023-05-08	MY57142018
Mini-Circuits	BW-N10W5+	Attenuator	2022-05-09	Annual	2023-05-08	2106
Mini-Circuits	BW-N10W5+	Attenuator	2022-05-09	Annual	2023-05-08	2106
NARDA	180-442A-KF	Horn Antenna (Small)	2020-11-20	Biennial	2022-11-19	T058701-03
Rohde & Schwarz	TS-PR1840	Preamplifier	2021-07-07	Annual	2022-07-06	100049
Rohde & Schwarz	ENV216	Two-Line V-Network	2022-05-09	Annual	2023-05-08	101319
Rohde & Schwarz	ESW	EMI Test Receiver	2021-07-06	Annual	2022-07-05	101761
Rohde & Schwarz	FSW43	Signal & Spectrum Analyzer	2021-09-15	Annual	2022-09-14	101250
Rohde & Schwarz	TS-SFUNIT-Rx	Shielded Filter Unit	2022-03-02	Annual	2023-03-01	102131
Schwarzbeck	VULB9162	Broadband TRILOG Antenna	2021-07-13	Biennial	2023-07-12	9162-217
Sunol Sciences	DRH-118	Horn Antenna	2021-07-14	Biennial	2023-07-13	A102416-1

Table 6-1.Test Equipment Calibration Schedule

Note:

1. For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

2. Equipment with a calibration date of “N/A” shown in this list was not used to make direct calibrated measurements.

7.0 TEST DATA

7.1 Summary

Company Name: Samsung Electronics Co., Ltd.

FCC ID: A3LSMF936U

FCC Classification: Ultra-Wideband (UWB)

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
§15.503, §15.519 (b)	10dBc Bandwidth	≥ 500MHz	RADIATED	PASS	Section 7.2
§15.519(a)(1)	Cessation Time	Transmission shall cease in less than 10s		PASS	Section 7.3
§15.519(e)	Maximum Peak Power	< 0dBm EIRP in 50MHz BW			Section 7.4
§15.519(c)	Maximum Average Emission in the range of 3100 – 10600 MHz	< -41.3 EIRP in dBm			Section 7.4
§15.519(c)	Radiated Emissions Above 960MHz	See table in 15.519(c) for details			Section 7.4, 7.5
§15.519(d)	Radiated Emissions in the 1164 – 1240Mhz and 1559 – 1610MHz GPS Bands	< -85.3 EIRP in dBm			Section 7.5
§15.519(c), §15.519(a)	Radiate Emissions Below 960MHz	Emissions in restricted bands must meet the radiated limits detailed in 15.209			Section 7.6
§15.207	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits (RSS-Gen)	LINE CONDUCTED	PASS	Section 7.7

Table 7-1. Summary of Test Results

7.2 10dBc Bandwidth Measurement

§15.503(a), §15.519(b)

Test Overview and Limit

Per the definition of 15.503, the UWB Bandwidth is the frequency band bounded by the points that are 10 dB below the highest radiated emission, as based on the complete transmission system including the antenna.

The 10dB bandwidth of the UWB signal must remain fully within the 3100 – 10,600MHz band. The 10dB bandwidth of the UWB signal must also be greater than or equal to 500MHz.

Test Procedures Used

ANSI C63.10-2013 Section 10.1

Test Settings

1. RBW = 1MHz
2. VBW = 3MHz
3. Detector = Peak
4. Span was set wide enough to capture the 10dB points of the signal
5. Trace mode = max hold
6. Sweep = 2s
7. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

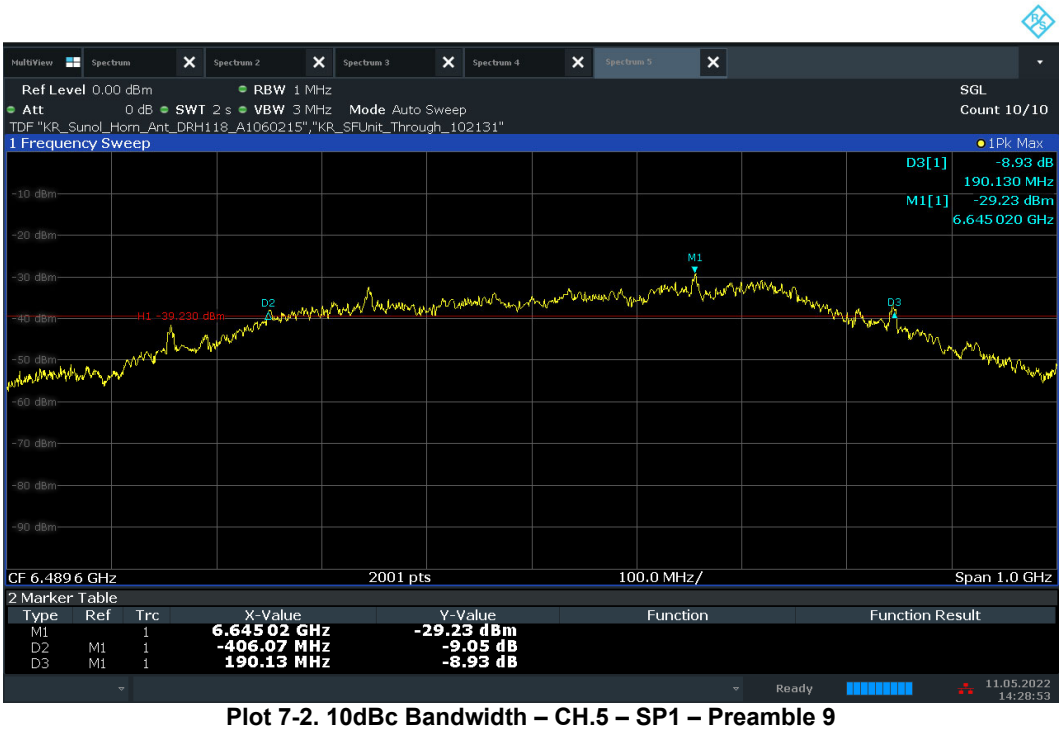
Figure 7-1. Test Instrument and Measurment Setup

Frequency [GHz]	Channel	Preamble ID	Config	Mode	F_M [GHz]	F_L [GHz]	F_H [GHz]	Fc [GHz]	Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
6.5	5	9	SP0	BPRF	6.645	6.241	6.836	6.538	595	500	Pass
		9	SP1	BPRF	6.645	6.239	6.835	6.537	596	500	Pass
		9	SP3	BPRF	6.708	6.242	6.789	6.515	548	500	Pass
		10	SP0	BPRF	6.491	6.297	6.835	6.566	538	500	Pass
		10	SP1	BPRF	6.491	6.298	6.834	6.566	537	500	Pass
		10	SP3	BPRF	6.708	6.239	6.789	6.514	550	500	Pass
		11	SP0	BPRF	6.714	6.237	6.826	6.531	588	500	Pass
		11	SP1	BPRF	6.713	6.240	6.825	6.532	585	500	Pass
		11	SP3	BPRF	6.708	6.238	6.789	6.514	551	500	Pass
		12	SP0	BPRF	6.681	6.232	6.842	6.537	610	500	Pass
		12	SP1	BPRF	6.681	6.242	6.842	6.542	601	500	Pass
		12	SP3	BPRF	6.708	6.239	6.789	6.514	550	500	Pass
		27	SP0	HPRF	6.727	6.228	6.775	6.501	547	500	Pass
		27	SP1	HPRF	6.727	6.248	6.885	6.566	638	500	Pass
		27	SP3	HPRF	6.707	6.272	6.802	6.537	530	500	Pass
8.0	9	9	SP0	BPRF	8.143	7.600	8.385	7.992	785	500	Pass
		9	SP1	BPRF	8.143	7.599	8.384	7.992	784	500	Pass
		9	SP3	BPRF	8.176	7.599	8.384	7.992	785	500	Pass
		10	SP0	BPRF	7.988	7.599	8.230	7.914	632	500	Pass
		10	SP1	BPRF	7.987	7.600	8.374	7.987	774	500	Pass
		10	SP3	BPRF	8.186	7.600	8.384	7.992	784	500	Pass
		11	SP0	BPRF	8.183	7.599	8.384	7.992	785	500	Pass
		11	SP1	BPRF	8.183	7.599	8.384	7.992	785	500	Pass
		11	SP3	BPRF	8.186	7.599	8.384	7.992	785	500	Pass
		12	SP0	BPRF	8.178	7.599	8.384	7.992	784	500	Pass
		12	SP1	BPRF	8.178	7.599	8.384	7.992	785	500	Pass
		12	SP3	BPRF	8.186	7.600	8.384	7.992	784	500	Pass
		27	SP0	HPRF	8.000	7.599	8.383	7.991	784	500	Pass
		27	SP1	HPRF	7.999	7.600	8.375	7.987	774	500	Pass
		27	SP3	HPRF	8.175	7.599	8.384	7.992	784	500	Pass

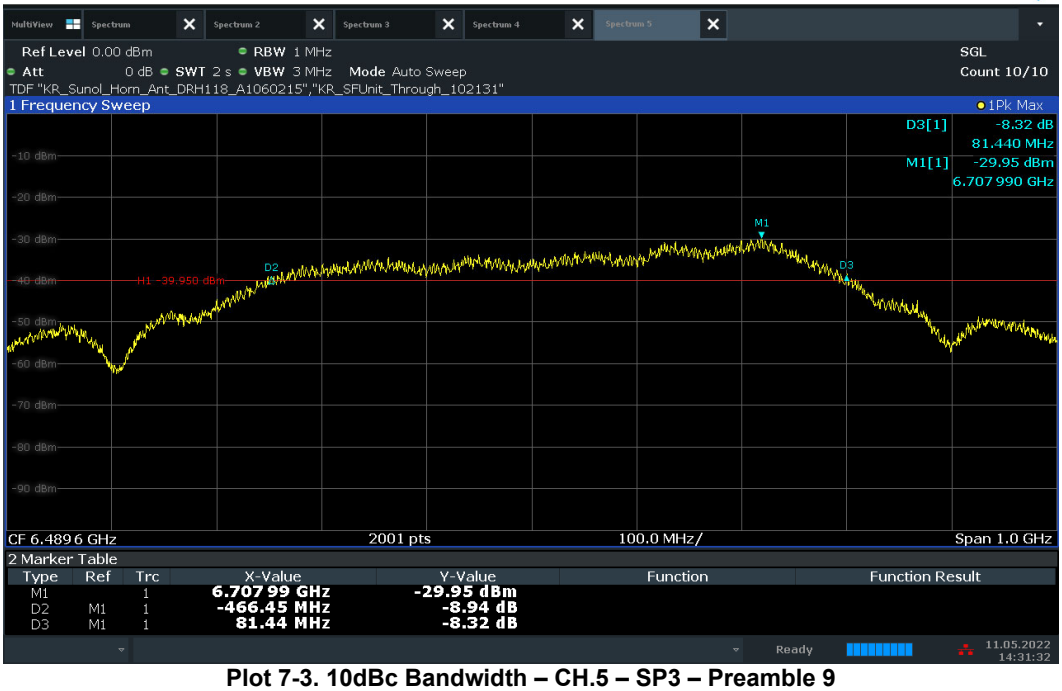
Table 7-2. UWB 10dBc Bandwidth Summary [ANT 1]

10dBc Bandwidth Results

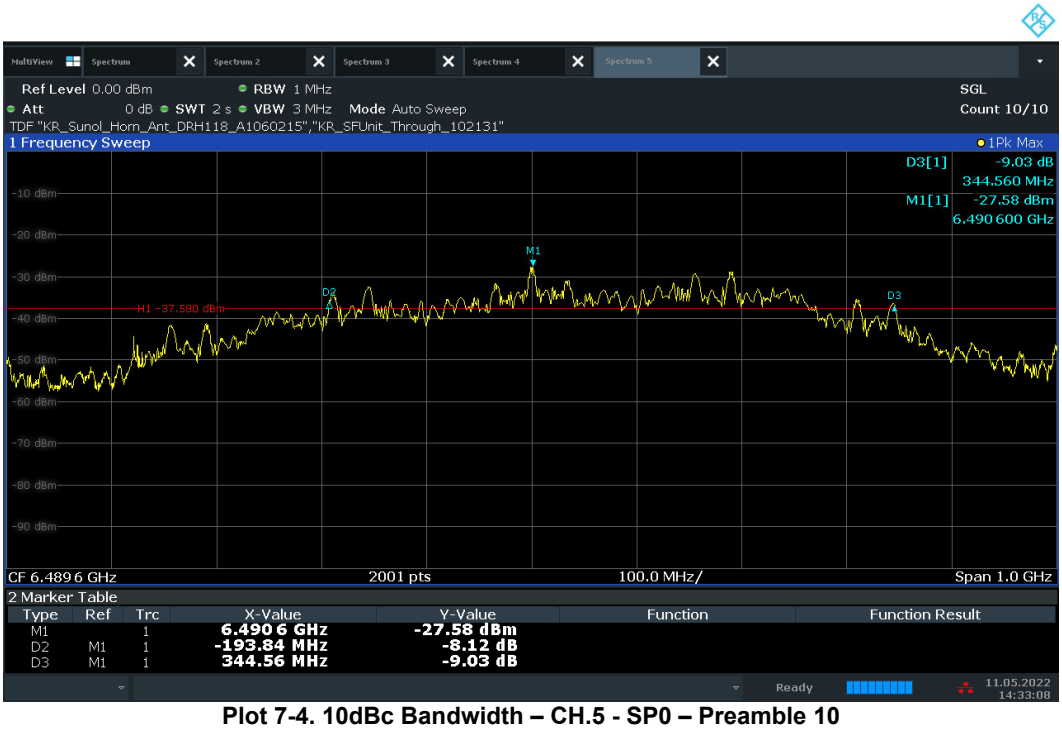
Plot 7-1. 10dBc Bandwidth – CH.5 - SP0 – Preamble 9



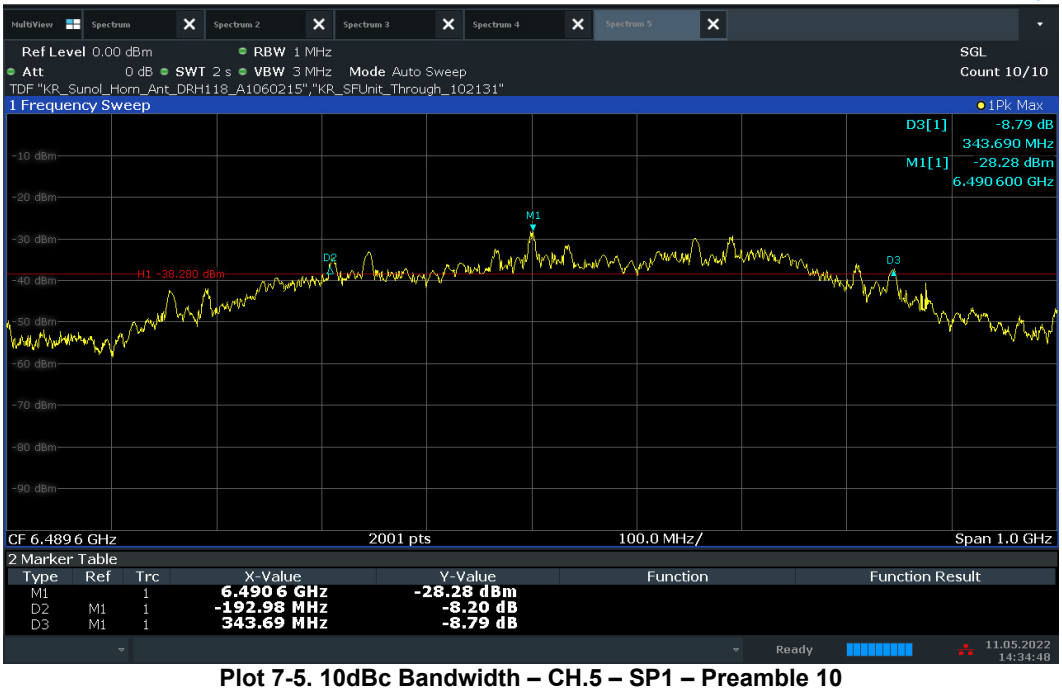
Plot 7-2. 10dBc Bandwidth – CH.5 – SP1 – Preamble 9



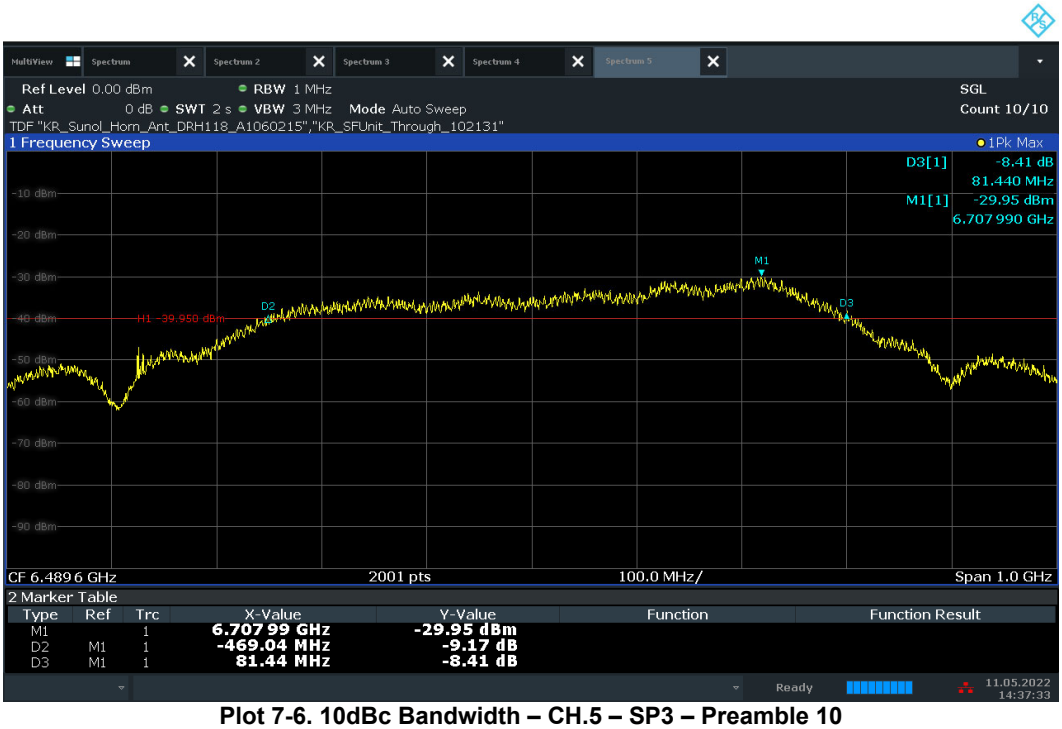
Plot 7-3. 10dBc Bandwidth – CH.5 – SP3 – Preamble 9



Plot 7-4. 10dBc Bandwidth – CH.5 - SP0 – Preamble 10

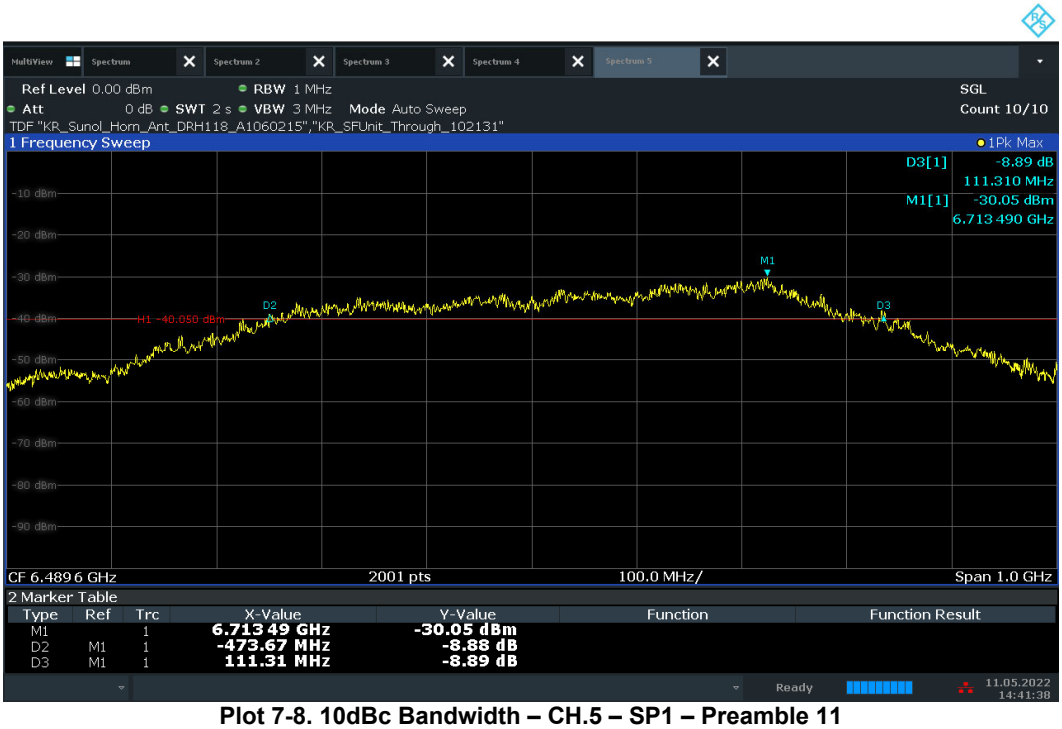


Plot 7-5. 10dBc Bandwidth – CH.5 – SP1 – Preamble 10

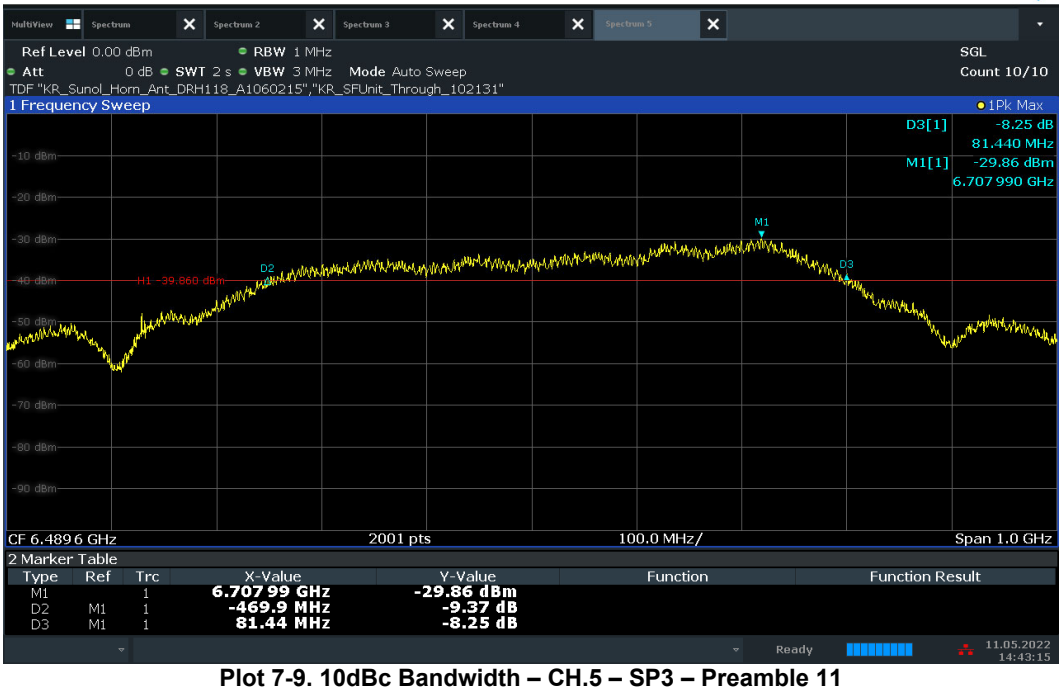


Plot 7-6. 10dBc Bandwidth – CH.5 – SP3 – Preamble 10

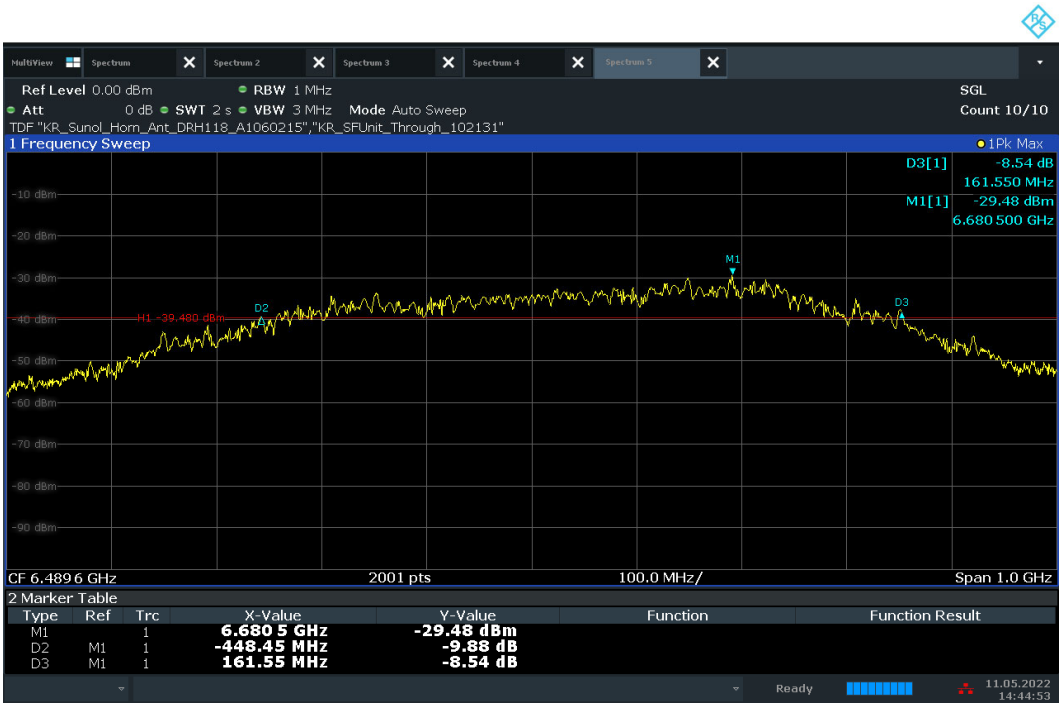
Plot 7-7. 10dBc Bandwidth – CH.5 - SP0 – Preamble 11



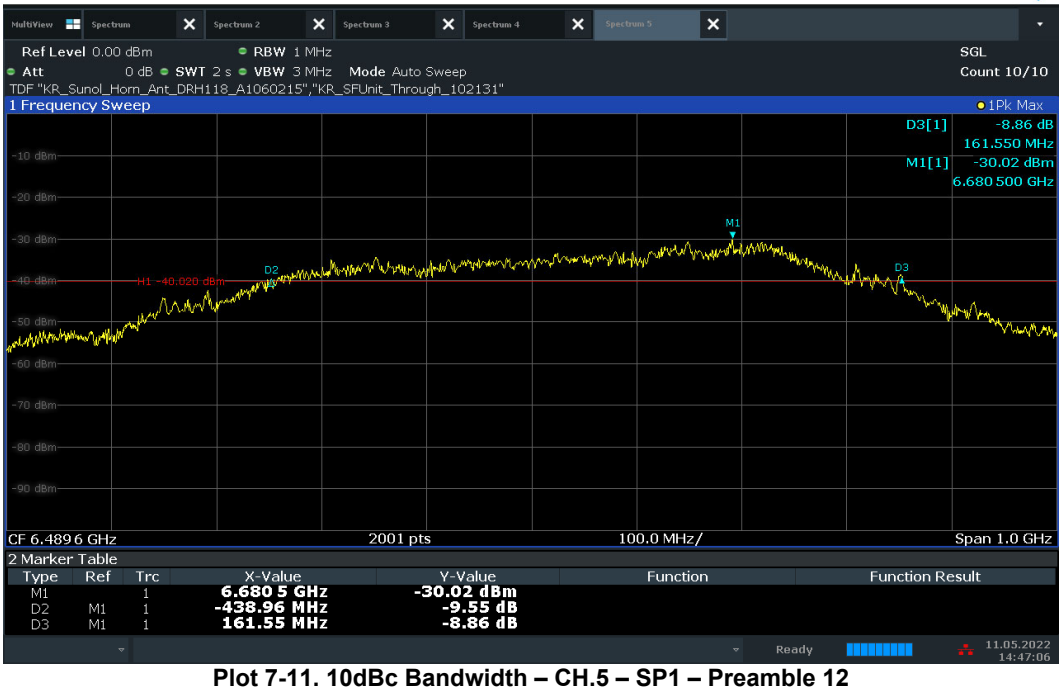
Plot 7-8. 10dBc Bandwidth – CH.5 – SP1 – Preamble 11



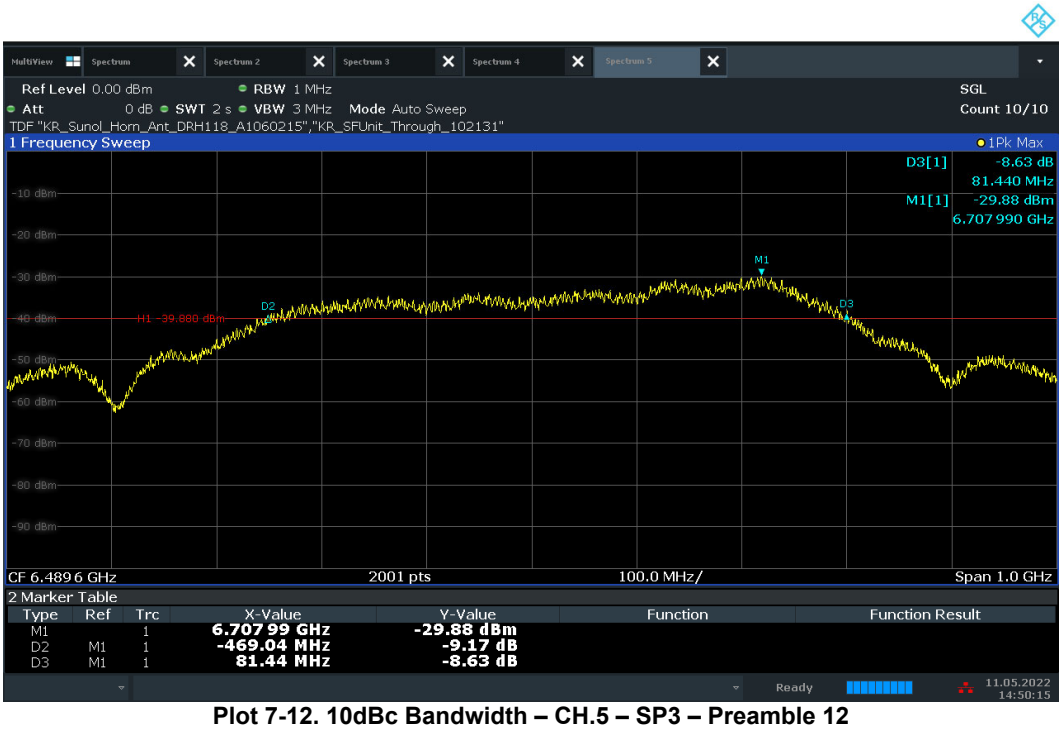
Plot 7-9. 10dBc Bandwidth – CH.5 – SP3 – Preamble 11



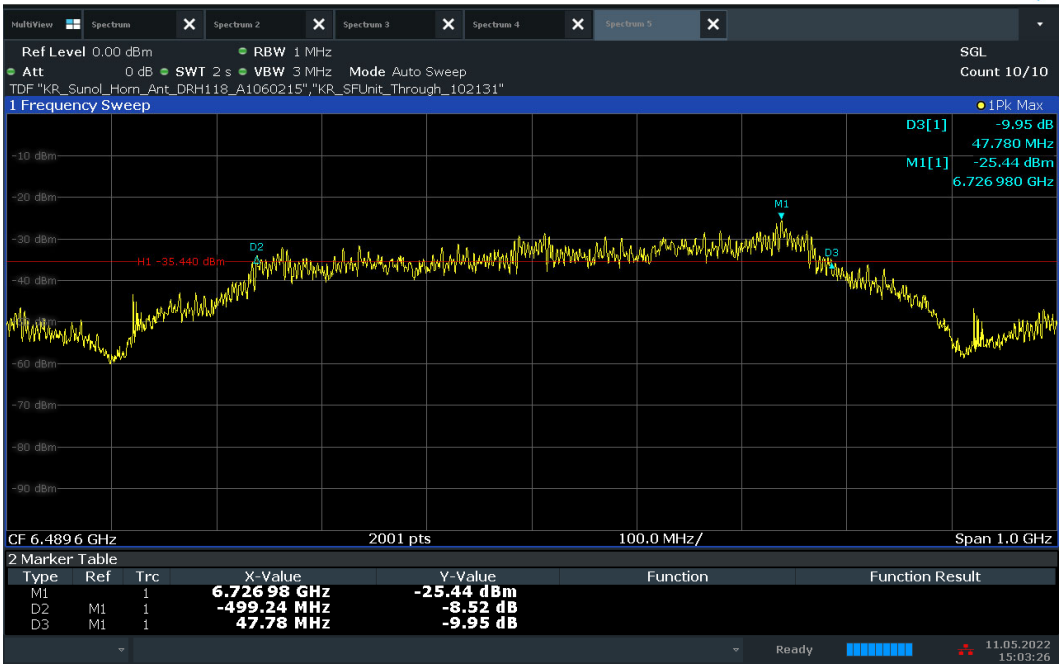
Plot 7-10. 10dBc Bandwidth – CH.5 - SP0 – Preamble 12



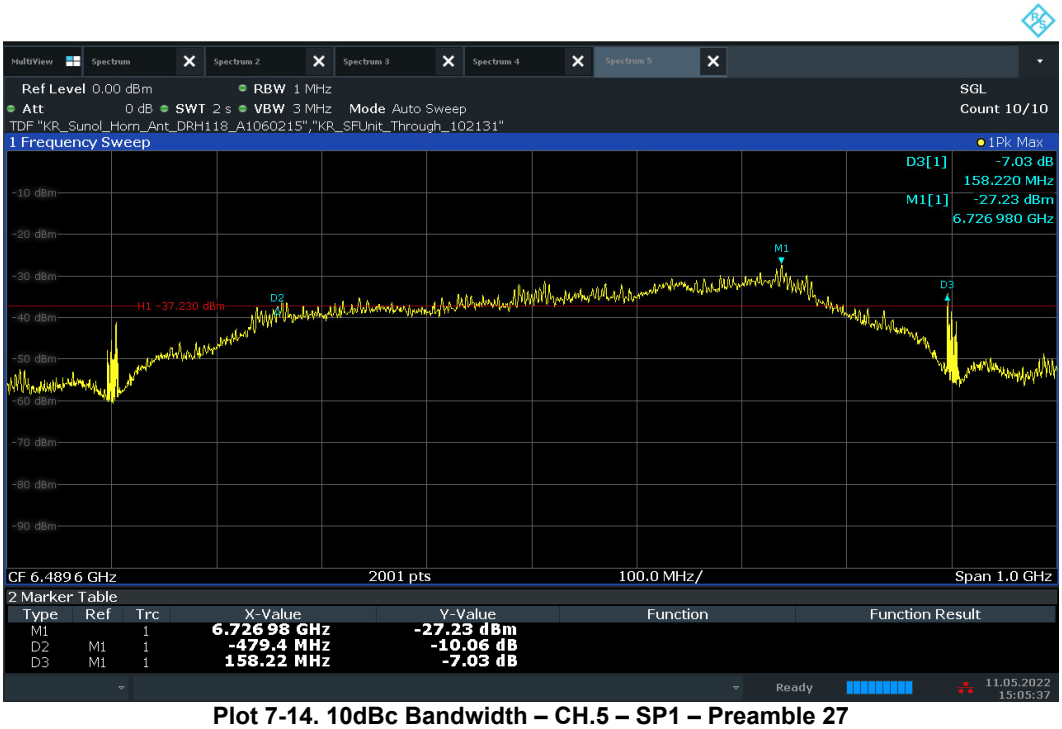
Plot 7-11. 10dBc Bandwidth – CH.5 – SP1 – Preamble 12



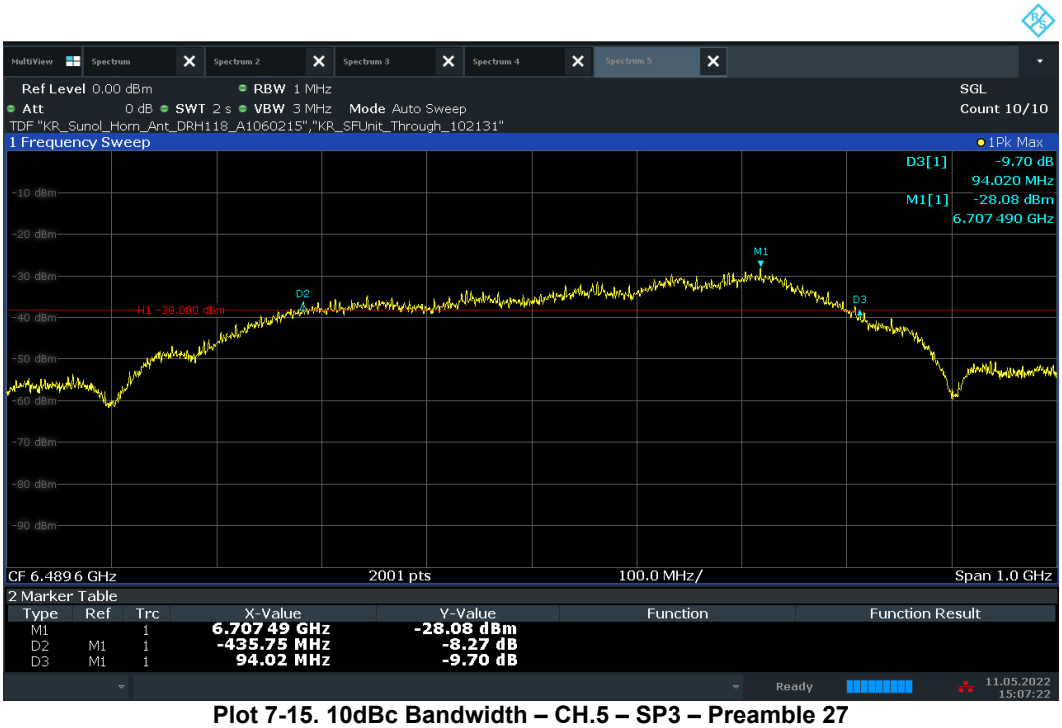
Plot 7-12. 10dBc Bandwidth – CH.5 – SP3 – Preamble 12



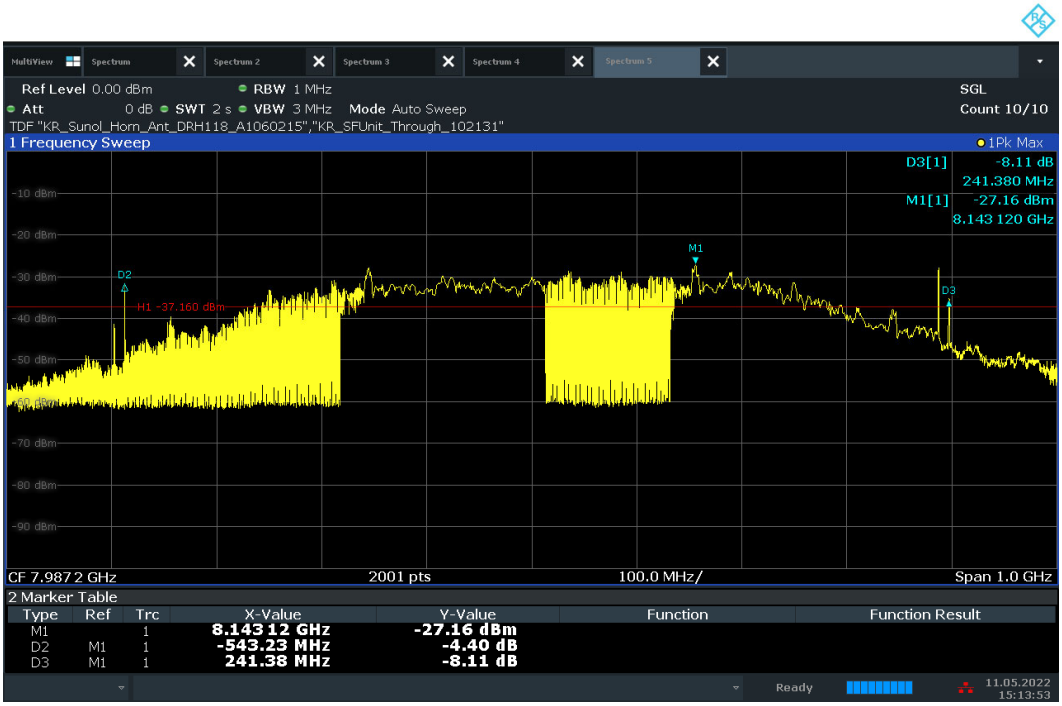
Plot 7-13. 10dBc Bandwidth – CH.5 - SP0 – Preamble 27



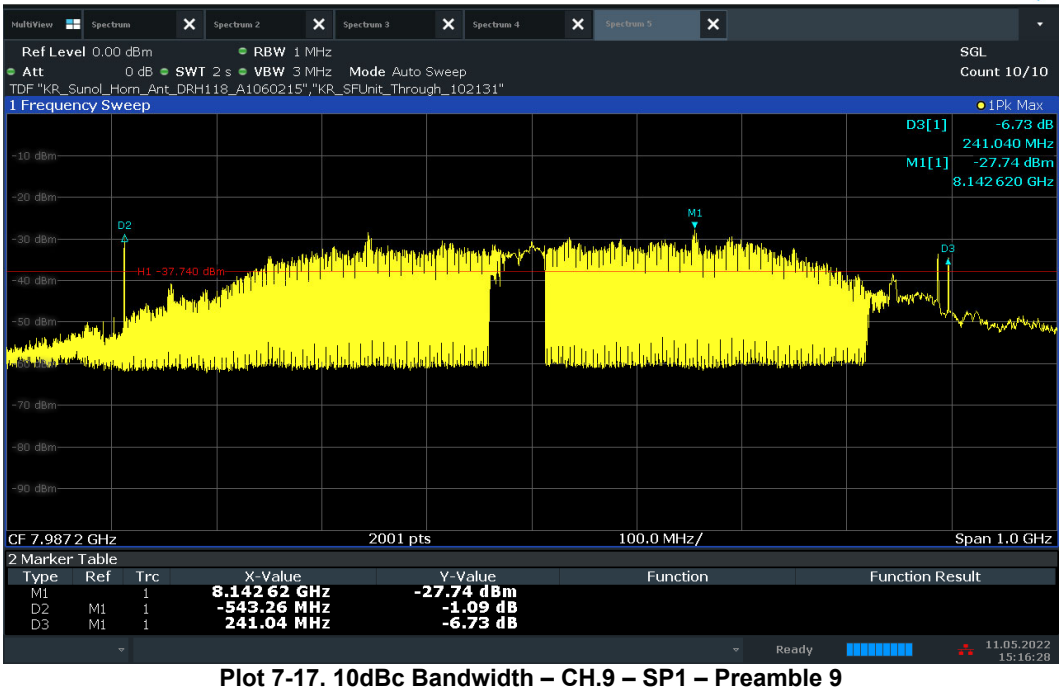
Plot 7-14. 10dBc Bandwidth – CH.5 – SP1 – Preamble 27



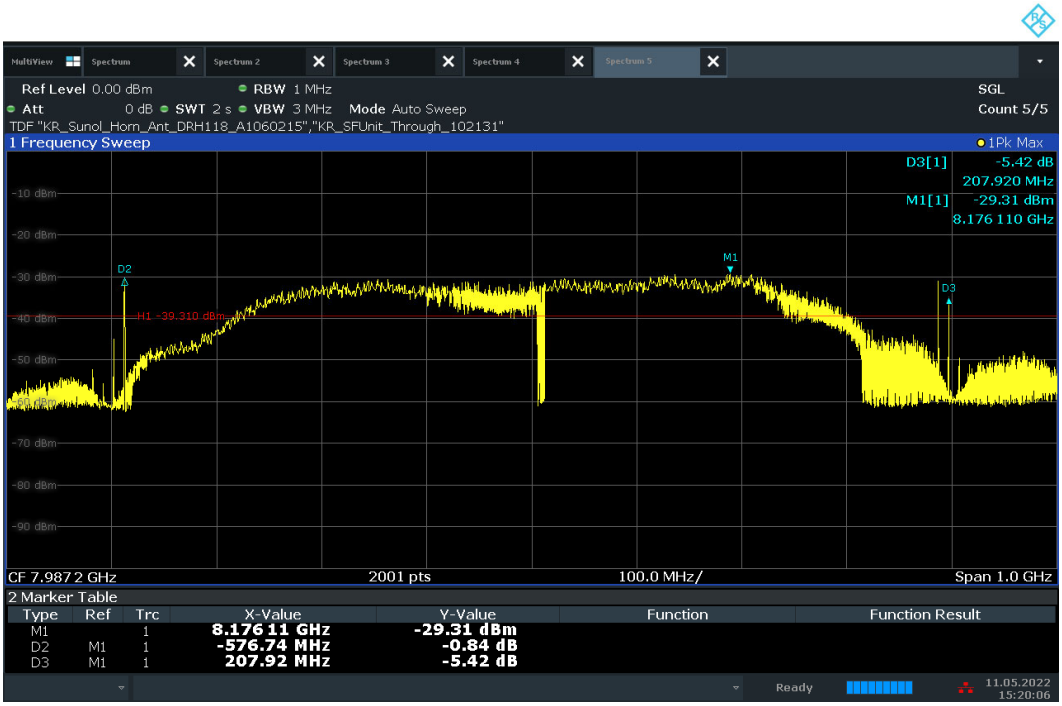
Plot 7-15. 10dBc Bandwidth – CH.5 – SP3 – Preamble 27



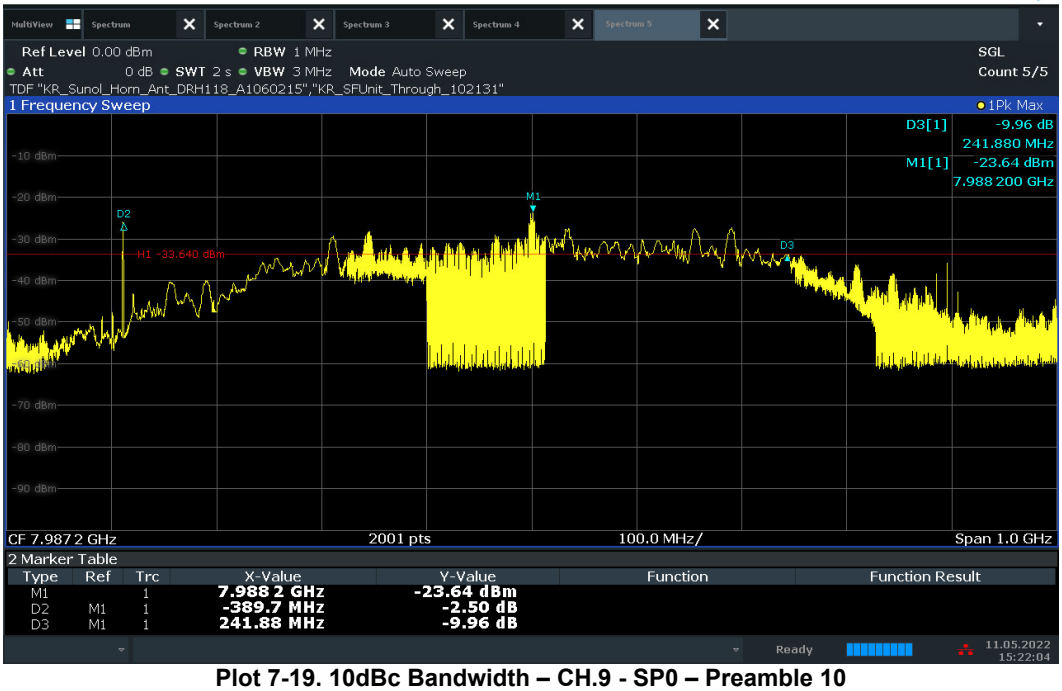
Plot 7-16. 10dBc Bandwidth – CH.9 - SP0 – Preamble 9



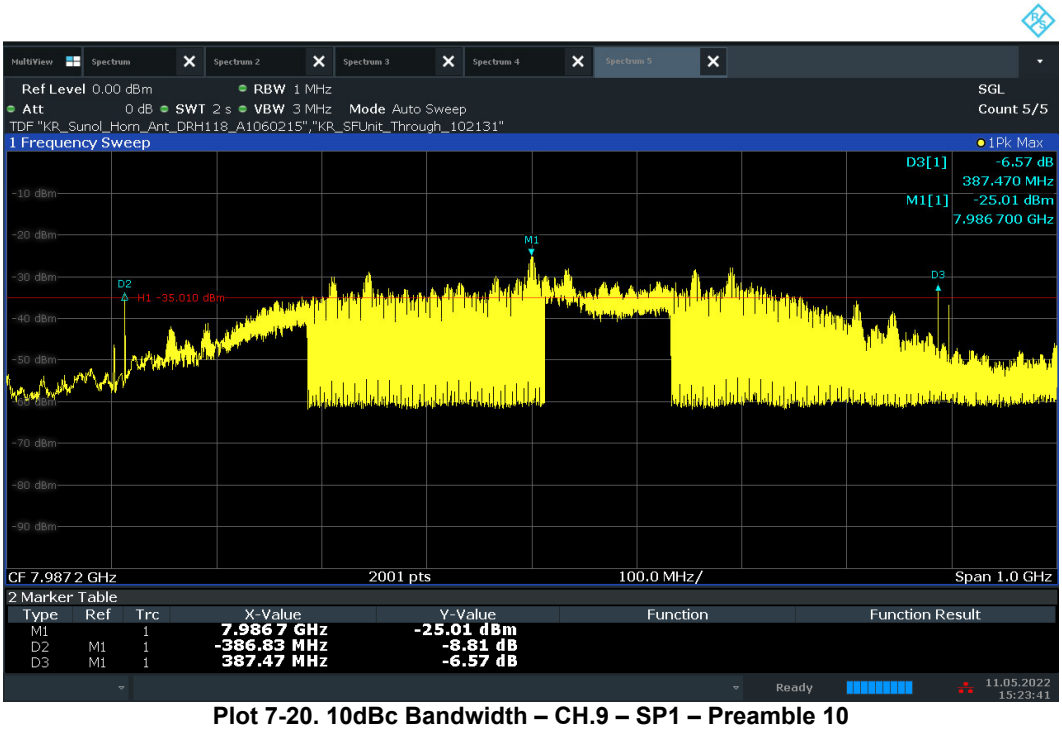
Plot 7-17. 10dBc Bandwidth – CH.9 – SP1 – Preamble 9



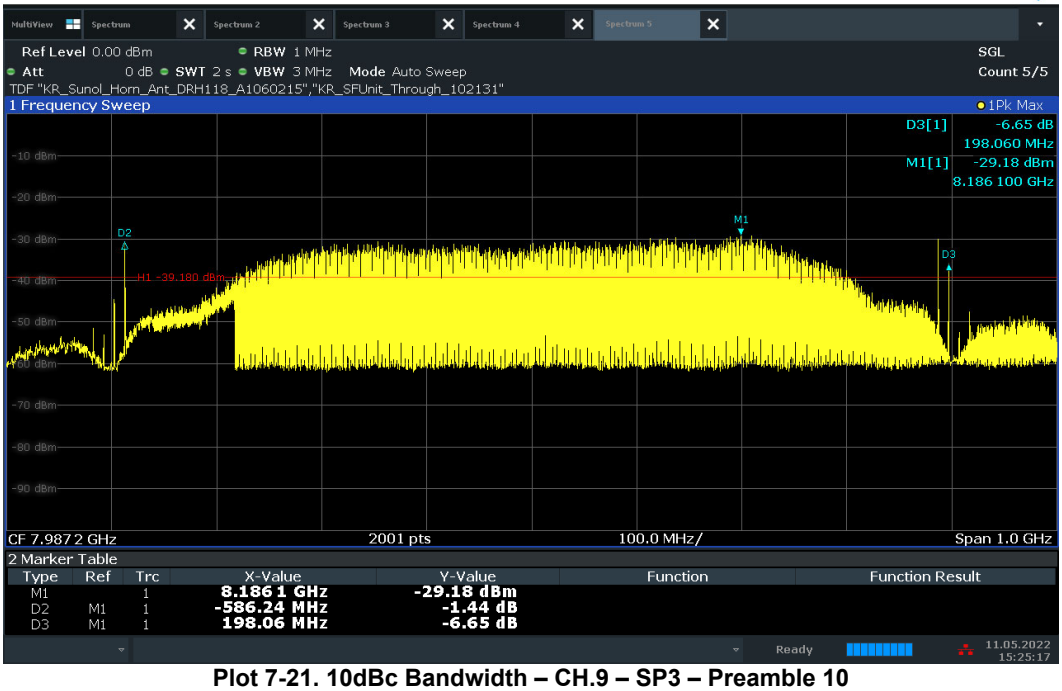
Plot 7-18. 10dBc Bandwidth – CH.9 – SP3 – Preamble 9



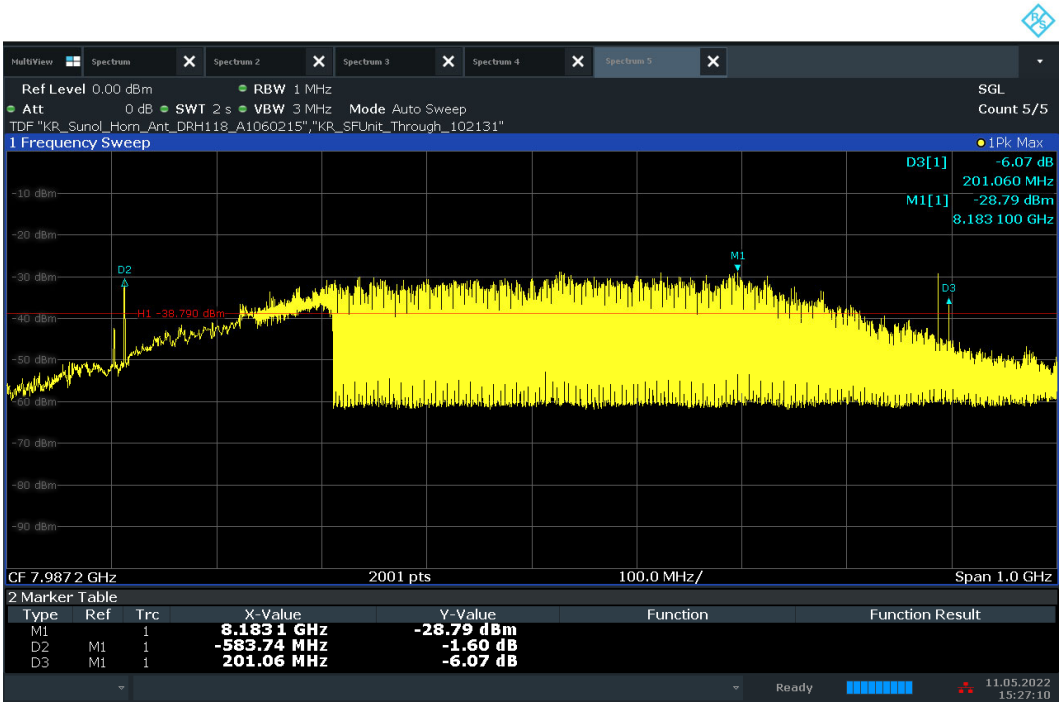
Plot 7-19. 10dBc Bandwidth – CH.9 - SP0 – Preamble 10



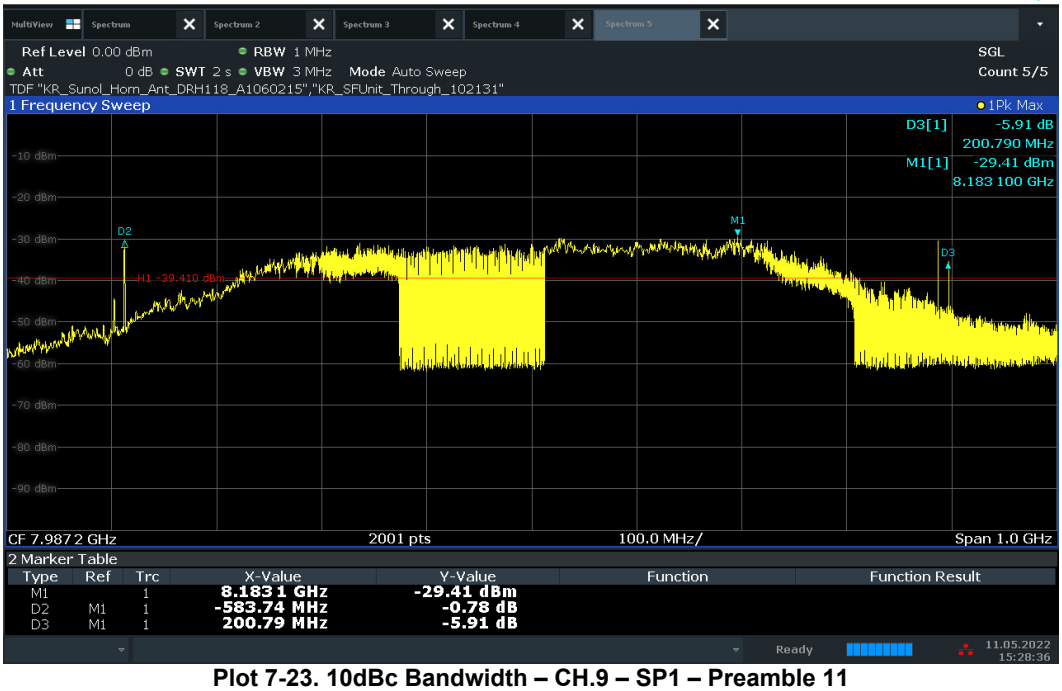
Plot 7-20. 10dBc Bandwidth – CH.9 – SP1 – Preamble 10



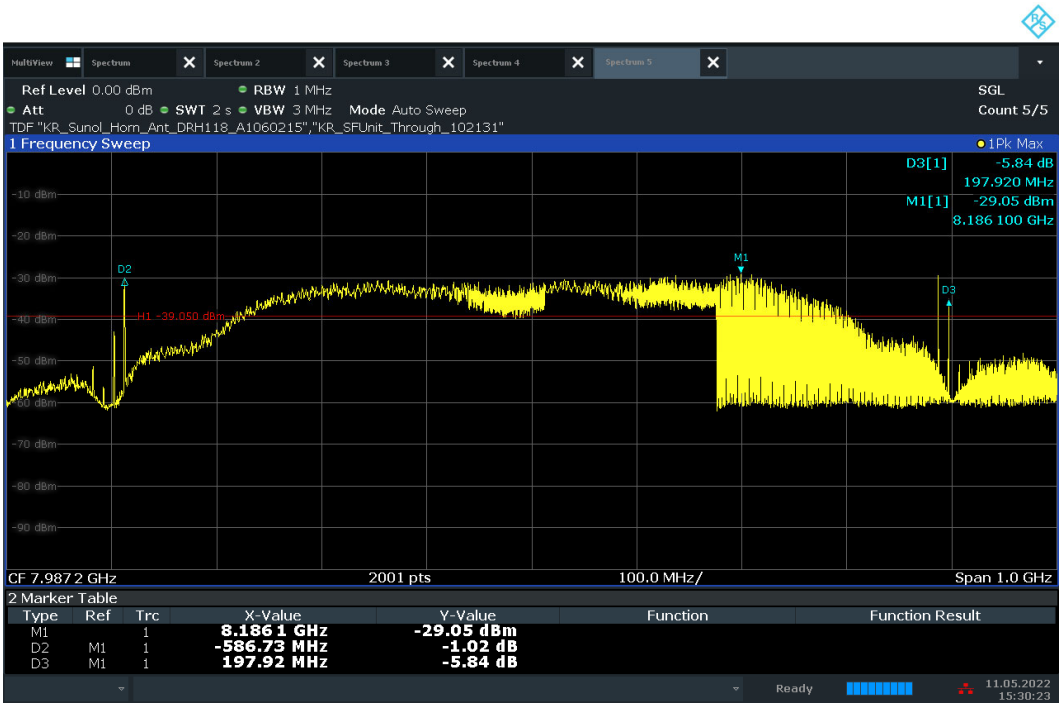
Plot 7-21. 10dBc Bandwidth – CH.9 – SP3 – Preamble 10



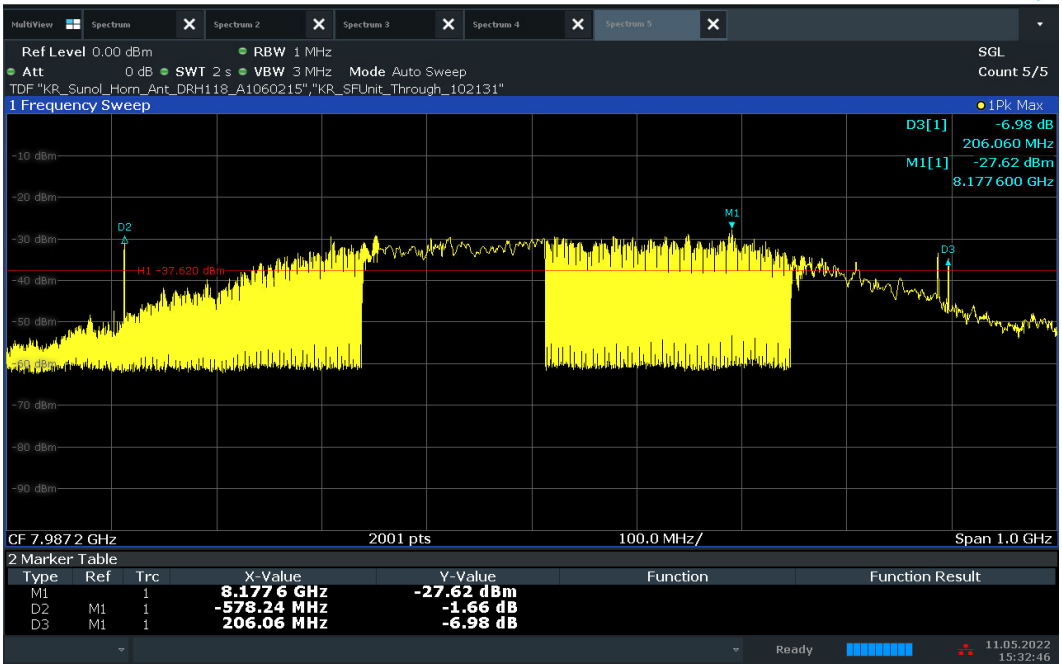
Plot 7-22. 10dBc Bandwidth – CH.9 - SP0 – Preamble 11



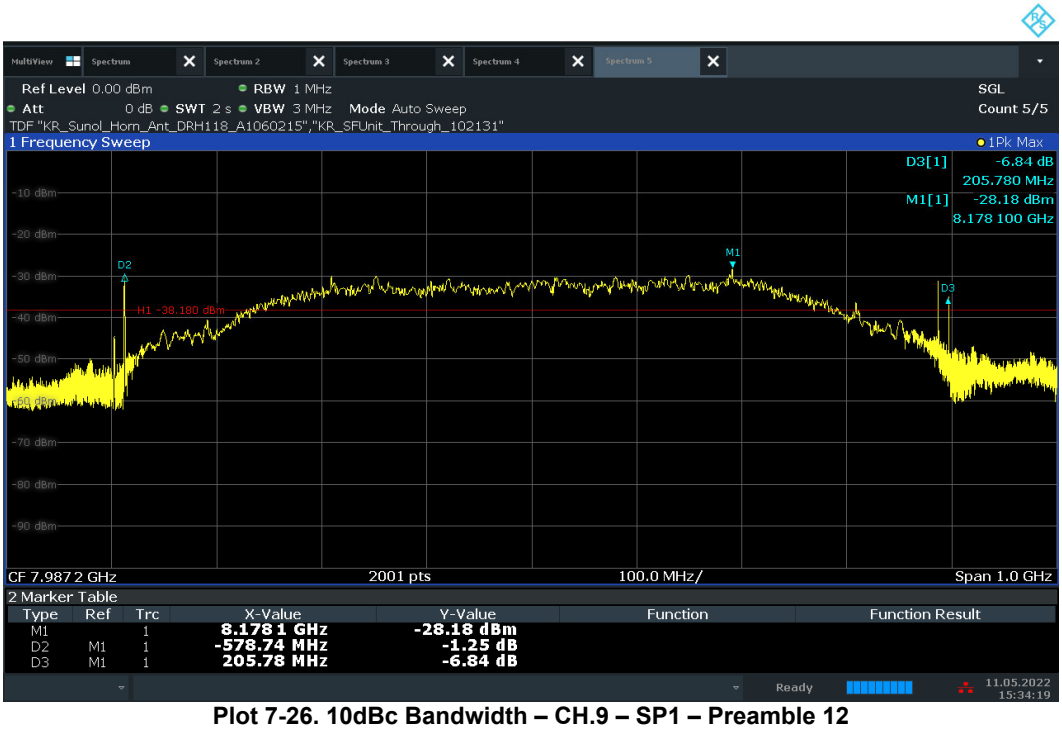
Plot 7-23. 10dBc Bandwidth – CH.9 – SP1 – Preamble 11



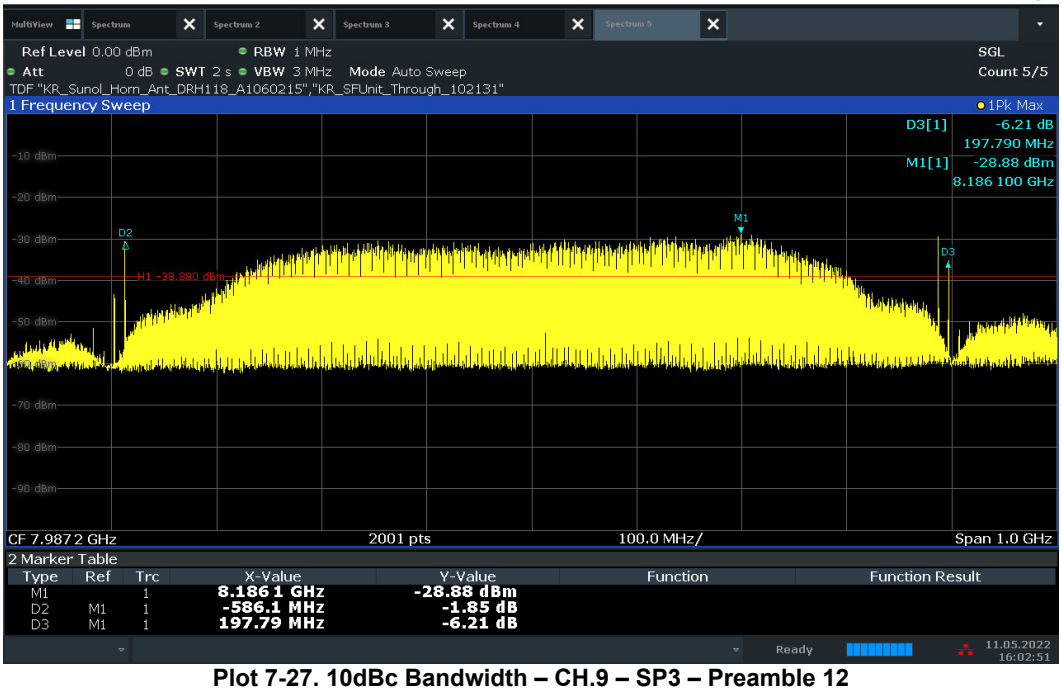
Plot 7-24. 10dBc Bandwidth – CH.9 – SP3 – Preamble 11



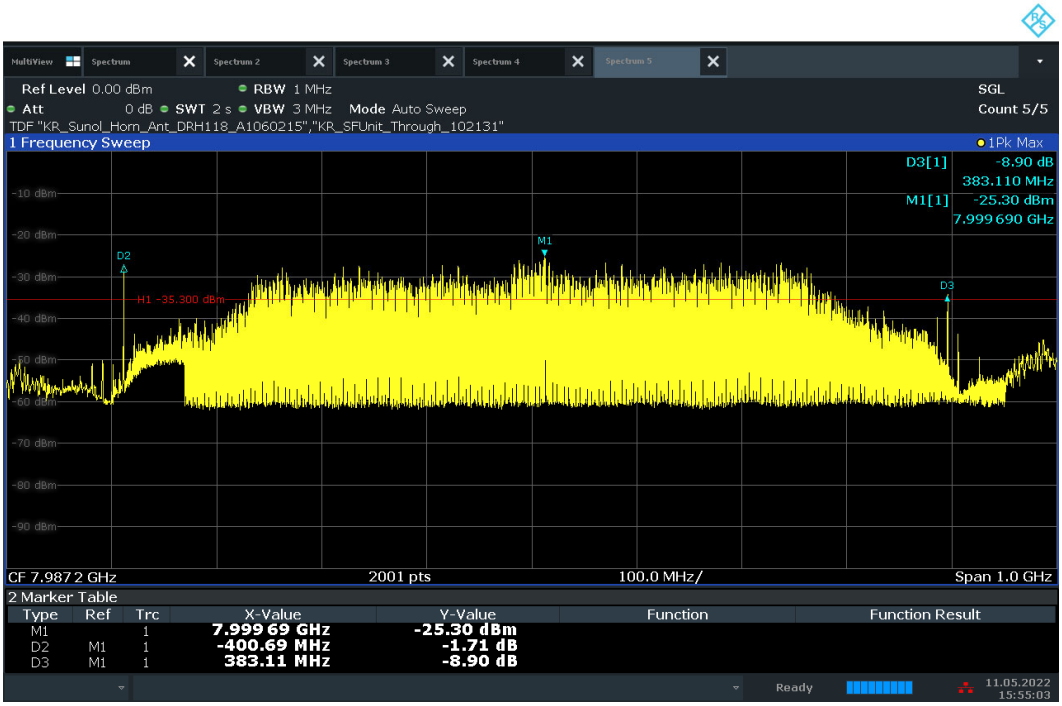
Plot 7-25. 10dBc Bandwidth – CH.9 - SP0 – Preamble 12



Plot 7-26. 10dBc Bandwidth – CH.9 – SP1 – Preamble 12



Plot 7-27. 10dBc Bandwidth – CH.9 – SP3 – Preamble 12



Plot 7-28. 10dBc Bandwidth – CH.9 - SP0 – Preamble 27