

TEST REPORT

FCC 2G3G Test for TM15FNEUJL0
Certification

APPLICANT
LG Electronics Inc.

REPORT NO.
HCT-RF-2502-FC069-R1

DATE OF ISSUE
April 8, 2025

Tested by
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Technical Manager
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Accredited by KOLAS, Republic of KOREA

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TEST REPORT

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April 08, 2025

Applicant	LG Electronics Inc. 128, Yeoui-daero, Yeongdeungpo-gu, Seoul, Republic of Korea
Product Name Model Name	Telematics TM15FNEUJL0
Date of Test	December 9, 2024 ~ February 24, 2025
Location of Test	☒ Permanent Testing Lab ☐ On Site Testing (Address: 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Republic of Korea)
FCC ID	BEJTM15FNEUJL0
FCC Classification:	PCS Licensed Transmitter (PCB)
Test Standard Used	FCC Rule Part: § 22, § 24, § 27
Test Results	PASS

REVISION HISTORY

The revision history for this test report is shown in table.

Revision No.	Date of Issue	Description
0	February 24, 2025	Initial Release
1	April 08, 2025	Revised the Product Name.

Notice

Content

The measurements shown in this report were made in accordance with the procedures specified in CFR47 section § 2.947. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them.

HCT CO., LTD. Certifies that no party to this application has subject to a denial of Federal benefits that includes FCC benefits pursuant to section 5301 of the Anti-Drug Abuse Act of 1998, 21 U.S. C.853(a)

The results shown in this test report only apply to the sample(s), as received, provided by the applicant, unless otherwise stated.

The test results have only been applied with the test methods required by the standard(s).

The laboratory is not accredited for the test results marked *.

Information provided by the applicant is marked **.

Test results provided by external providers are marked ***.

When confirmation of authenticity of this test report is required, please contact www.hct.co.kr

This test report provides test result(s) under the scope accredited by the Korea Laboratory Accreditation Scheme (KOLAS), which signed the ILAC-MRA.

(KOLAS (KS Q ISO/IEC 17025) Accreditation No. KT197)

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MEASUREMENT REPORT

1. GENERAL INFORMATION

Applicant Name:	LG Electronics Inc.
Address:	128, Yeoui-daero, Yeongdeungpo-gu, Seoul, Republic of Korea
FCC ID:	BEJTM15FNEUJL0
Application Type:	Certification
FCC Classification:	PCS Licensed Transmitter (PCB)
FCC Rule Part(s):	§ 22, § 24, § 27
EUT Type:	Telematics
Model(s):	TM15FNEUJL0
Tx Frequency:	824.20 - 848.80 MHz (GSM850) 826.40 - 846.60 MHz (WCDMA850) 1 850.20 - 1 909.80 MHz (GSM1900) 1 852.4 - 1 907.6 MHz (WCDMA1900) 1 712.4 - 1 752.6 MHz (WCDMA1700)
Rx Frequency:	869.20 - 893.80 MHz (GSM850) 871.40 - 891.60 MHz (WCDMA850) 1 930.20 - 1 989.80 MHz (GSM1900) 1 932.4 - 1 987.6 MHz (WCDMA1900) 2 112.4 - 2 152.6 MHz (WCDMA1700)
Date(s) of Tests:	December 9, 2024 ~ February 24, 2025
EUT Serial number:	Radiated : 410VIXV000304(NAD) Conducted : 410VIXV000305(NAD)
Antenna Information	Please refer to the Antenna Specification document.

1.1 MAXIMUM OUTPUT POWER

Mode	Tx Frequency (MHz)	Rx Frequency (MHz)	Emission Designator	Conducted Output Power	
				Max. Power (W)	Max. Power (dBm)
GSM850	824.2 – 848.8	869.2 – 893.8	245KGXW	2.495	33.97
GSM850 EDGE			255KG7W	0.482	26.83
WCDMA850	826.4 – 846.6	871.4 – 891.6	4M15F9W	0.263	24.20

Mode	Tx Frequency (MHz)	Rx Frequency (MHz)	Emission Designator	Conducted Output Power	
				Max. Power (W)	Max. Power (dBm)
GSM1900	1850.2 – 1909.8	1930.2 – 1989.8	246KGXW	1.352	31.31
GSM1900 EDGE			247KG7W	0.442	26.45
WCDMA1900	1852.4 – 1907.6	1932.4 – 1987.6	4M14F9W	0.219	23.41
WCDMA1700	1712.4 – 1752.6	2112.4 – 2152.6	4M15F9W	0.215	23.33

2. INTRODUCTION

2.1 DESCRIPTION OF EUT

The EUT was a Telematics GSM/GPRS/EGPRS/UMTS and LTE, Sub 6..

2.2 MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

2.3 TEST FACILITY

The Fully-anechoic chamber and conducted measurement facility used to collect the radiated data are located at the **74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Republic of Korea**

3. DESCRIPTION OF TESTS

3.1 TEST PROCEDURE

Test Description	Test Procedure Used
Occupied Bandwidth	- KDB 971168 D01 v03r01 – Section 4.3 - ANSI C63.26-2015 – Section 5.4.4
Band Edge	- KDB 971168 D01 v03r01 – Section 6.0 - ANSI C63.26-2015 – Section 5.7
Spurious and Harmonic Emissions at Antenna Terminal	- KDB 971168 D01 v03r01 – Section 6.0 - ANSI C63.26-2015 – Section 5.7
Conducted Output Power	- N/A (See SAR Report)
Peak- to- Average Ratio	- KDB 971168 D01 v03r01 – Section 5.7 - ANSI C63.26-2015 – Section 5.2.3.4 - ANSI C63.26-2015 – Section 5.2.6(only GSM)
Frequency stability	- ANSI C63.26-2015 – Section 5.6
Radiated Power	- ANSI C63.26-2015 – Section 5.2.4.4 - KDB 971168 D01 v03r01 – Section 5.8
Radiated Spurious and Harmonic Emissions	- KDB 971168 D01 v03r01 – Section 6.2 - ANSI/TIA-603-E-2016 – Section 2.2.12

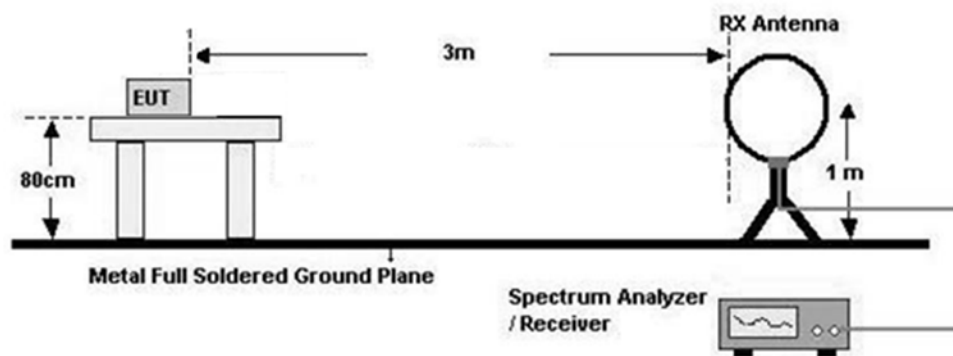
3.2 RADIATED TEST

Test Overview

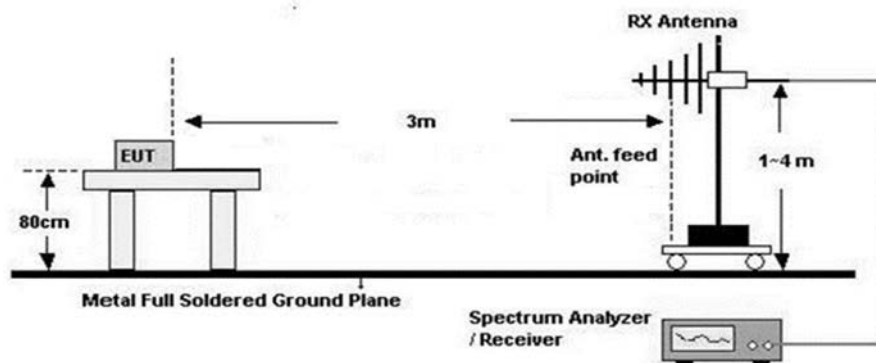
Radiated tests are performed in the semi-anechoic chamber. The equipment under test is placed on a non-conductive table on semi-anechoic chamber.

Test Configuration

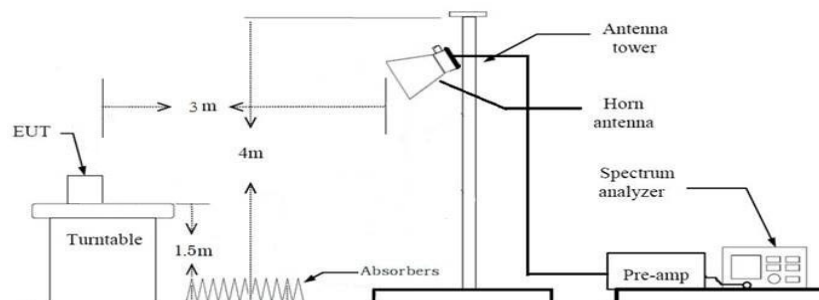
Below 30 MHz



30 MHz - 1 GHz



Above 1 GHz



3.2.1 RADIATED POWER

Test Settings

1. Radiated power measurements are performed using the signal analyzer's "channel power" measurement capability for signals with continuous operation.
2. RBW = 1 – 5 % of the expected OBW, not to exceed 1 MHz
3. VBW $\geq 3 \times$ RBW
4. Span = 1.5 times the OBW
5. No. of sweep points $> 2 \times$ span / RBW
6. Detector = RMS
7. Trigger is set to "free run" for signals with continuous operation with the sweep times set to "auto".
8. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with continuous operation.
9. Trace mode = trace averaging (RMS) over 100 sweeps
10. The trace was allowed to stabilize

Test Note

1. The EUT is placed on a turntable, which is 0.8 m above ground plane. (Below 1 GHz)
2. The EUT is placed on a turntable, which is 1.5 m above ground plane. (Above 1 GHz)
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
5. EUT is set 3 m away from the receiving antenna, which is varied from 1 m to 4 m to find out the highest emissions.
6. All measurements are performed as RMS average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.
7. $\text{Total(dB}\mu\text{V/m)} = \text{Measured Value(dB}\mu\text{V)} + \text{Cable Loss(dB)} + \text{Antenna Factor(dB/m)} + \text{Distance Factor(D.F)}$
8. EIRP (dBm)
 $= \text{Total (dB}\mu\text{V/m)} + 20 \log D - 104.8$ (where D is the measurement distance in meters. $D=3$)
 $= \text{Total (dB}\mu\text{V/m)} - 95.2(\text{dB})$
9. $\text{ERP(dBm)} = \text{EIRP(dBm)} - 2.15(\text{dB})$

3.2.2 RADIATED SPURIOUS EMISSIONS

Test Settings

1. RBW = 100 kHz for emissions below 1 GHz and 1 MHz for emissions above 1 GHz
2. VBW $\geq 3 \times$ RBW
3. Span = 1.5 times the OBW
4. No. of sweep points $> 2 \times$ span / RBW
5. Detector = Peak
6. Trace mode = Max Hold
7. The trace was allowed to stabilize
8. Test channel : Low/ Middle/ High
9. Frequency range : We are performed all frequency to 10th harmonics from 9 kHz.

Test Note

1. The EUT was tested in three orthogonal planes(X, Y, Z) and in all possible test configurations and positioning.
The worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the test data
2. Measurements value show only up to 3 maximum emissions noted, or would be lesser
if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit)
and considered that's already beyond the background noise floor.

Below 30 MHz

1. The loop antenna was placed at a location 3 m from the EUT
2. The EUT is placed on a turntable, which is 0.8 m above ground plane.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization and Parallel to the ground plane in detecting antenna.
4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
5. Distance Correction Factor(0.009 MHz – 0.490 MHz) = $40\log(3 \text{ m}/300 \text{ m}) = - 80 \text{ dB}$
Measurement Distance : 3 m
6. Distance Correction Factor(0.490 MHz – 30 MHz) = $40\log(3 \text{ m}/30 \text{ m}) = - 40 \text{ dB}$
Measurement Distance : 3 m
7. Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)
8. EIRP (dBm)
= Total (dB μ V/m) + $20 \log D - 104.8$ (where D is the measurement distance in meters. D=3)
= Total (dB μ V/m) - 95.2(dB)
9. ERP(dBm) = EIRP(dBm) - 2.15(dB)

KDB 414788 OFS and Chamber Correlation Justification

Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

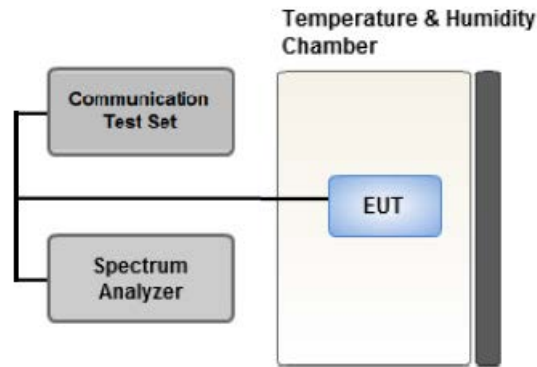
Below 1 GHz

1. The EUT is placed on a turntable, which is 0.8 m above ground plane.
2. The Hybrid antenna was placed at a location 3 m from the EUT, which is varied from 1 m to 4 m to find out the highest emissions.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
5. Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L)
7. Total(dBμV/m) = Measured Value(dBμV) + Cable Loss(dB) + Antenna Factor(dB/m) + Distance Factor(D.F)
8. EIRP (dBm)
= Total (dBμV/m) + 20 log D – 104.8 (where D is the measurement distance in meters. D=3)
= Total (dBμV/m) - 95.2(dB)
9. ERP(dBm) = EIRP(dBm) - 2.15(dB)

Above 1 GHz

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3 m away from the receiving antenna, which is varied from 1 m to 4 m to find out the highest emissions.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. Total(dBμV/m) = Measured Value(dBμV) + Cable Loss(dB) + Antenna Factor(dB/m) + Distance Factor(D.F)
+ H.P.F(dB) - Amp Gain(dB)
8. EIRP (dBm)
= Total (dBμV/m) + 20 log D – 104.8 (where D is the measurement distance in meters. D=3)
= Total (dBμV/m) - 95.2(dB)

3.3 PEAK- TO- AVERAGE RATIO



Test setup

① CCDF Procedure for PAPR

Test Settings

1. Set resolution/measurement bandwidth $\geq$ signal's occupied bandwidth;
2. Set the number of counts to a value that stabilizes the measured CCDF curve;
3. Set the measurement interval as follows:
 - for continuous transmissions, set to 1 ms,
 - or burst transmissions, employ an external trigger that is synchronized with the EUT burst timing sequence, or use the internal burst trigger with a trigger level that allows the burst to stabilize and set the measurement interval to a time that is less than or equal to the burst duration.
4. Record the maximum PAPR level associated with a probability of 0.1 %.

② Alternate Procedure for PAPR

Use one of the procedures presented in 5.2(ANSI C63.26-2015) to measure the total peak power and record as P_{Pk} .
 Use one of the applicable procedures presented 5.2(ANSI C63.26-2015) to measure the total average power and record as P_{Avg} . Determine the P.A.R. from:

$$P.A.R. (dB) = P_{Pk} (dBm) - P_{Avg} (dBm) \quad (P_{Avg} = \text{Average Power} + \text{Duty cycle Factor})$$

Test Settings(Peak Power)

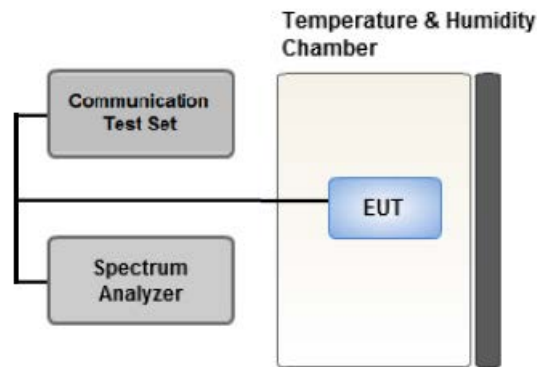
The measurement instrument must have a RBW that is greater than or equal to the OBW of the signal to be measured and a VBW $\geq 3 \times$ RBW.

1. Set the RBW $\geq$ OBW.
2. Set VBW $\geq 3 \times$ RBW.
3. Set span $\geq 2 \times$ OBW.
4. Sweep time $\geq 10 \times$ (number of points in sweep) $\times$ (transmission symbol period).
5. Detector = peak.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use the peak marker function to determine the peak amplitude level.

Test Settings(Average Power)

1. Set span to $2 \times$ to $3 \times$ the OBW.
2. Set RBW $\geq$ OBW.
3. Set VBW $\geq 3 \times$ RBW.
4. Set number of measurement points in sweep $\geq 2 \times$ span / RBW.
5. Sweep time:
Set $\geq [10 \times (\text{number of points in sweep}) \times (\text{transmission period})]$ for single sweep (automation-compatible) measurement. The transmission period is the (on + off) time.
6. Detector = power averaging (rms).
7. Set sweep trigger to "free run."
8. Trace average at least 100 traces in power averaging (rms) mode if sweep is set to auto-couple. (To accurately determine the average power over the on and off period of the transmitter, it can be necessary to increase the number of traces to be averaged above 100 or, if using a manually configured sweep time, increase the sweep time.)
9. Use the peak marker function to determine the maximum amplitude level.
10. Add $[10 \times \log (1/\text{duty cycle})]$ to the measured maximum power level to compute the average power during continuous transmission. For example, add $[10 \times \log (1/0.25)] = 6 \text{ dB}$ if the duty cycle is a constant 25 %.

3.4 OCCUPIED BANDWIDTH.



Test setup

The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5 % of the total mean power of a given emission.

The EUT makes a call to the communication simulator.

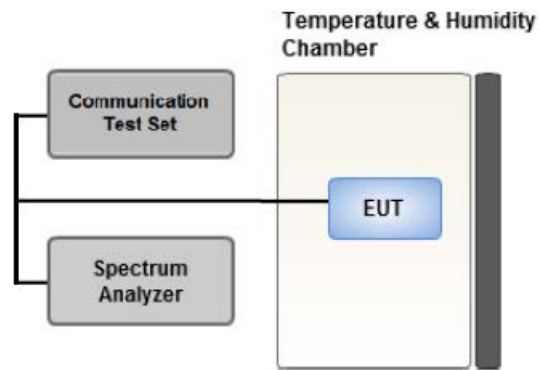
The conducted occupied bandwidth used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.

The communication simulator station system controlled a EUT to export maximum output power under transmission mode and specific channel frequency. Use OBW measurement function of Spectrum analyzer to measure 99 % occupied bandwidth

Test Settings

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99 % occupied bandwidth and the 26 dB bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5 % of the expected OBW
3. VBW $\geq 3 \times$ RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5 % of the 99 % occupied bandwidth observed in Step 7

3.5 SPURIOUS AND HARMONIC EMISSIONS AT ANTENNA TERMINAL



Test setup

Test Overview

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

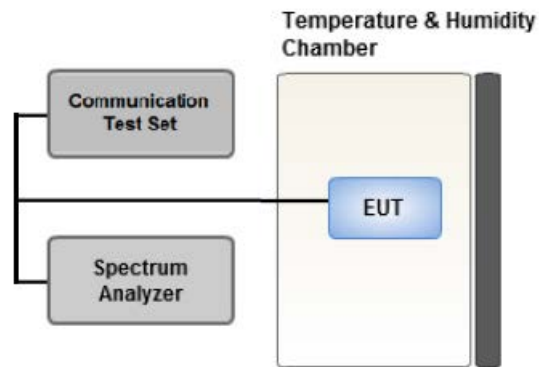
Test Settings(GSM)

1. RBW = 1 MHz
2. VBW $\geq$ 3 MHz
3. Detector = Peak
4. Trace Mode = max hold
5. Sweep time = auto
6. Number of points in sweep $\geq 2 \times \text{Span} / \text{RBW}$

Test Settings(WCDMA)

1. RBW = 1 MHz
2. VBW $\geq$ 3 MHz
3. Detector = Peak
4. Trace Mode = Max Hold
5. Sweep time = auto
6. Number of points in sweep $\geq 2 \times \text{Span} / \text{RBW}$

3.6 BAND EDGE



Test setup

Test Overview

All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

Test Settings

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW > 1 % of the emission bandwidth
4. VBW > 3 x RBW
5. Detector = RMS
6. Number of sweep points $\geq 2 \times \text{Span/RBW}$
7. Trace mode = trace average
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Test Notes

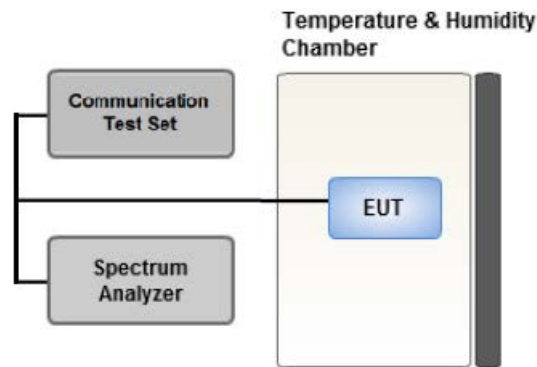
According to FCC 22.917, 24.238, 27.53 specified that power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \times \log(P)$ dB. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

All measurements were done at 2 channels (low and high operational frequency range.)

The band edge measurement used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.

Where $\text{Margin} < 1$ dB the emission level is either corrected by $10 \log(1 \text{ MHz} / \text{RB})$ or the emission is integrated over a 1 MHz bandwidth to determine the final result. When using the integration method the integration window is either centered on the emission or, for emissions at the band edge, centered by an offset of 500 kHz from the block edge so that the integration window is the 1 MHz adjacent to the block edge.

3.7 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE



Test setup

Test Overview

Frequency stability testing is performed in accordance with the guidelines of ANSI C63.26-2015.

The frequency stability of the transmitter is measured by:

1. Temperature:

The temperature is varied from -30 °C to +50 °C in 10 °C increments using an environmental chamber.

2. Primary Supply Voltage:

- .- Unless otherwise specified, vary primary supply voltage from 85 % to 115 % of the nominal value for other than hand carried battery equipment.
- .- For hand carried, battery powered equipment, reduce the primary ac or dc supply voltage to the battery operating end point, which shall be specified by the manufacturer.

Test Settings

1. The carrier frequency of the transmitter is measured at room temperature

(20 °C to provide a reference).

2. The equipment is turned on in a “standby” condition for fifteen minutes before applying power to the transmitter.

Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.

3. Frequency measurements are made at 10 °C intervals ranging from -30 °C to +50 °C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

3.8 WORST CASE(CONDUCTED TEST)

- All modes of operation were investigated and the worst case configuration results are reported.
- JIG was used to test the EUT. (EUT + JIG)

[Worst case]

Test Description	Modulation	Test Channel
Occupied Bandwidth	GSM : Voice & EDGE(1 TX Slot) WCDMA : QPSK(RMC)	Low, Mid, High
Band Edge	GSM : Voice & EDGE(1 TX Slot) WCDMA : QPSK(RMC)	Low, High
Peak-To-Average Ratio	GSM : Voice & EDGE(1 TX Slot) WCDMA : QPSK(RMC)	Mid
Spurious and Harmonic Emissions at Antenna Terminal	GSM : Voice WCDMA : QPSK(RMC)	Low, Mid, High

[Test Channel]

	Uplink Channel				
	2G (GSM850)	2G (GSM1900)	3G (WCDMA B2)	3G (WCDMA B4)	3G (WCDMA B5)
Low	128	512	9262	1312	4132
Mid	190	661	9400	1412	4183
High	251	810	9538	1513	4233

3.9 WORST CASE(RADIATED TEST)

- The EUT was tested in three orthogonal planes(X, Y, Z) and in all possible test configurations and positioning.
- All modes of operation were investigated and the worst case configuration results are reported.
- All simultaneous transmission scenarios of operation were investigated, and the test results showed no additional significant emissions relative to the least restrictive limit were observed.
Therefore, only the worst case(stand-alone) results were reported.
- The worst case is reported with the EUT positioning, modulations, and paging service configurations shown in the test data.
- Please refer to the table below.
- JIG was used to test the EUT. (EUT + JIG)

[Worst case_3G]

Test Description	Modulation	Paging Service	Axis	Test Channel
Effective Radiated Power, Effective Isotropic Radiated Power	QPSK (WCDMA)	12.2 kbps RMC	WCDMA B2 : Y WCDMA B4 : Y WCDMA B5 : Y	Low, Mid, High
Radiated Spurious and Harmonic Emissions	QPSK (WCDMA)	12.2 kbps RMC	WCDMA B2 : Y WCDMA B4 : Y WCDMA B5 : Y	Low, Mid, High

[Worst case_2G]

Test Description	Modulation	Axis	Test Channel
Effective Radiated Power, Effective Isotropic Radiated Power	Voice	GSM850 : Y GSM1900 : Y	Low, Mid, High
	EDGE (1 TX Slot)	GSM850 : Y GSM1900 : Y	GSM 850 : Low GSM1900 : Mid
Radiated Spurious and Harmonic Emissions	Voice	GSM850 : Y GSM1900 : Y	Low, Mid, High

[Test Channel]

	UplinkChannel				
	2G (GSM850)	2G (GSM1900)	3G (WCDMA B2)	3G (WCDMA B4)	3G (WCDMA B5)
Low	128	512	9262	1312	4132
Mid	190	661	9400	1412	4183
High	251	810	9538	1513	4233

4. LIST OF TEST EQUIPMENT

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
Antenna Position Tower	MA4640	Innco systems	S4AM	08/07/2025	Annual
Turn Table	DS2000-S	Innco systems	N/A	N/A	-
Turn Table	Turn Table	Ets	N/A	N/A	-
Controller (Antenna mast & Turn Table)	CO3000	Innco systems	CO3000/1251/48920320/P	N/A	-
Amp & Filter Bank Switch Controller	FBSM-01B	TNM system	TM20090002	N/A	-
RF Switch System	FBSR-04C(3G HPF+LNA)	TNM System	S4L1	04/11/2025	Annual
RF Switch System	FBSR-04C(7G HPF+LNA)	TNM System	S4L5	04/11/2025	Annual
RF Switch System	FBSR-04C(LNA)	TNM System	S4L4	04/11/2025	Annual
RF Switch System	FBSR-04C(Thru)	TNM System	S4L6	04/11/2025	Annual
HIGHPASS FILTER	WHKX10-900-1000-15000-40SS	WAINWRIGHT INSTRUMENTS	16	07/24/2025	Annual
LOW NOISE AMPLIFIER	310N	SONOMA Instrument	186169	02/05/2026	Annual
LOW NOISE AMPLIFIER	TK-PA1840H	TESTEK	170011-L	10/11/2025	Annual
Loop Antenna(9 kHz ~ 30 MHz)	FMZB1513	Schwarzbeck	1513-333	03/07/2026	Biennial
Horn Antenna(1 ~ 18 GHz)	BBHA 9120	Schwarzbeck	937	02/07/2027	Biennial
Horn Antenna(15 ~ 40 GHz)	BBHA 9170	Schwarzbeck	BBHA9170342	09/20/2026	Biennial
Trilog Broadband Antenna	VULB 9168	Schwarzbeck	9168-0895	08/28/2026	Biennial
DC Power Supply	E3632A	Agilent	MY40010147	08/06/2025	Annual
Spectrum Analyzer(10 Hz ~ 40 GHz)	FSV40	REOHDE & SCHWARZ	101436	02/04/2026	Annual
Base Station	8960 (E5515C)	Agilent	MY48360800	08/05/2025	Annual
Wideband Radio Communication Tester	MT8821C	Anritsu Corp.	6262287701	05/16/2025	Annual
Wideband Radio Communication Tester	MT8000A	Anritsu Corp.	6272613402	08/28/2025	Annual
Signal Analyzer(3 Hz ~ 50 GHz)	N9030A	Agilent	MY49430478	02/12/2026	Annual
FCC LTE Mobile Conducted RF Automation Test Software	-	HCT CO., LTD.,	-	-	

Note:

- Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.
- Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2017).

5. 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 data shown herein 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.

Parameter	Expanded Uncertainty ($\pm$ kHz)
Occupied Bandwidth	95 (Confidence level about 95 %, $k=2$)
Frequency stability	28 (Confidence level about 95 %, $k=2$)

Parameter	Expanded Uncertainty ($\pm$ dB)
Block Edge	0.70 (Confidence level about 95 %, $k=2$)
Conducted Spurious Emissions	1.18 (Confidence level about 95 %, $k=2$)
Peak- to- Average Ratio	0.68 (Confidence level about 95 %, $k=2$)
Radiated Disturbance (9 kHz ~ 30 MHz)	4.36 (Confidence level about 95 %, $k=2$)
Radiated Disturbance (30 MHz ~ 1 GHz)	5.70 (Confidence level about 95 %, $k=2$)
Radiated Disturbance (1 GHz ~ 18 GHz)	5.52 (Confidence level about 95 %, $k=2$)
Radiated Disturbance (18 GHz ~ 40 GHz)	5.66 (Confidence level about 95 %, $k=2$)
Radiated Disturbance (Above 40 GHz)	5.58 (Confidence level about 95 %, $k=2$)

6. SUMMARY OF TEST RESULTS

Note. The decision rule applies ‘simple acceptance’

6.1 Test Condition : Conducted Test

Test Description	FCC Part Section(s)	Test Limit	Test Result
Occupied Bandwidth	§ 2.1049	N/A	PASS
Band Edge / Spurious and Harmonic Emissions at Antenna Terminal.	§ 2.1051, § 22.917(a), § 24.238(a), § 27.53(h)	$< 43 + 10 \times \log_{10} (P[\text{Watts}])$ at Band Edge and for all out-of-band emissions	PASS
Conducted Output Power	§ 2.1046	N/A	<u>See Note1</u>
Peak- to- Average Ratio	§ 22.913(d), § 24.232(d), § 27.50(d)(5)	$< 13 \text{ dB}$	PASS
Frequency stability / variation of ambient temperature	§ 2.1055, § 22.355	$< 2.5 \text{ ppm}$	PASS
	§ 24.235, § 27.54	Emission must remain in band	PASS

Note:

1. See SAR Report

6.2 Test Condition: Radiated Test

Test Description	FCC Part Section(s)	Test Limit	Test Result
Effective Radiated Power	§ 22.913(a)(5)	$< 7 \text{ Watts max. ERP}$	PASS
Equivalent Isotropic Radiated Power	§ 24.232(c), § 27.50(d)(4)	$< 2 \text{ Watts max. EIRP}$ $< 1 \text{ Watts max. EIRP}$	PASS
Radiated Spurious and Harmonic Emissions	§ 2.1053, § 22.917(a), § 24.238(a), § 27.53(h)	$< 43 + 10 \times \log_{10} (P[\text{Watts}])$ for all out-of band emissions	PASS

7. SAMPLE CALCULATION

7.1 ERP Sample Calculation

Ch./ Freq.		Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain (dBd)	C.L	Pol.	ERP	
channel	Freq.(MHz)						W	dBm
128	824.20	-21.37	38.40	-10.61	0.95	H	0.483	26.84

$$\text{ERP} = \text{Substitute LEVEL(dBm)} + \text{Ant. Gain} - \text{CL(Cable Loss)}$$

- 1) The EUT mounted on a non-conductive turntable is 2.5 meter above test site ground level.
- 2) During the test, the turn table is rotated until the maximum signal is found.
- 3) Record the field strength meter's level.
- 4) Replace the EUT with dipole/Horn antenna that is connected to a calibrated signal generator.
- 5) Increase the signal generator output till the field strength meter's level is equal to the item (3).
- 6) The signal generator output level with Ant. Gain and cable loss are the rating of effective radiated power.

7.2 EIRP Sample Calculation

Ch./ Freq.		Measured Level (dBm)	Substitute Level (dBm)	Ant. Gain (dBi)	C.L	Pol.	EIRP	
channel	Freq.(MHz)						W	dBm
20175	1,732.50	-15.75	18.45	9.90	1.76	H	0.456	26.59

$$\text{EIRP} = \text{Substitute LEVEL(dBm)} + \text{Ant. Gain} - \text{CL(Cable Loss)}$$

- 1) The EUT mounted on a non-conductive turntable is 2.5 meter above test site ground level.
- 2) During the test, the turn table is rotated until the maximum signal is found.
- 3) Record the field strength meter's level.
- 4) Replace the EUT with dipole/Horn antenna that is connected to a calibrated signal generator.
- 5) Increase the signal generator output till the field strength meter's level is equal to the item (3).
- 6) The signal generator output level with Ant. Gain and cable loss are the rating of equivalent isotropic radiated power.

7.3. Emission Designator

GSM Emission Designator

Emission Designator = 249KGXW
GSM BW = 249 kHz
G = Phase Modulation
X = Cases not otherwise covered
W = Combination (Audio/Data)

EDGE Emission Designator

Emission Designator = 249KG7W
GSM BW = 249 kHz
G = Phase Modulation
7 = Quantized/Digital Info
W = Combination (Audio/Data)

WCDMA Emission Designator

Emission Designator = 4M17F9W
WCDMA BW = 4.17 MHz
F = Frequency Modulation
9 = Composite Digital Info
W = Combination (Audio/Data)

QPSK Modulation

Emission Designator = 4M48G7D
LTE BW = 4.48 MHz
G = Phase Modulation
7 = Quantized/Digital Info
D = Data transmission; telemetry; telecommand

QAM Modulation

Emission Designator = 4M48W7D
LTE BW = 4.48 MHz
W = Amplitude/Angle Modulated
7 = Quantized/Digital Info
D = Data transmission; telemetry; telecommand

8. TEST DATA

8.1 EFFECTIVE RADIATED POWER

Mode	Ch./ Freq.		Measured (dBμV/m)	A.F.+D.F.+C.L. (dB)	Total (dBμV/m)	Pol.	Limit	ERP	
	channel	Freq.(MHz)					W	W	dBm
GSM850	128	824.2	93.37	29.64	123.01	H	< 7.00	3.090	34.90
	190	836.6	93.16	29.56	122.72	H		2.892	34.61
	251	848.8	93.14	29.65	122.79	H		2.940	34.68
EDGE	128	824.2	86.49	29.65	116.14	H		0.636	28.03

Mode	Ch./ Freq.		Measured (dBμV/m)	A.F.+D.F.+C.L. (dB)	Total (dBμV/m)	Pol.	Limit	ERP	
	channel	Freq.(MHz)					W	W	dBm
WCDMA850	4132	826.4	93.63	29.64	123.24	H	< 7.00	0.391	25.92
	4183	836.6	93.17	29.56	122.71	H		0.345	25.38
	4233	846.6	92.30	29.65	121.94	H		0.288	24.60

8.2 EQUIVALENT ISOTROPIC RADIATED POWER

Mode	Ch./ Freq.		Measured (dBμV/m)	A.F.+D.F.+C.L. (dB)	Total (dBμV/m)	Pol.	Limit	EIRP	
	channel	Freq.(MHz)					W	W	dBm
GSM1900	512	1850.2	85.67	30.02	115.69	H	< 2.00	0.940	29.73
	661	1880.0	86.17	30.57	116.74	H		1.197	30.78
	810	1909.8	85.67	30.57	116.24	H		1.067	30.28
EDGE	661	1880.0	85.58	30.57	116.15	H		1.045	30.19

Mode	Ch./ Freq.		Measured (dBμV/m)	A.F.+D.F.+C.L. (dB)	Total (dBμV/m)	Pol.	Limit	EIRP	
	channel	Freq.(MHz)					W	W	dBm
WCDMA1900	9262	1852.4	92.66	30.02	122.68	H	< 2.00	0.560	27.48
	9400	1880.0	93.28	30.57	123.85	H		0.733	28.65
	9538	1907.6	91.92	30.57	122.49	H		0.536	27.29

Mode	Ch./ Freq.		Measured (dBμV/m)	A.F.+D.F.+C.L. (dB)	Total (dBμV/m)	Pol.	Limit	EIRP	
	channel	Freq.(MHz)					W	W	dBm
WCDMA1700	1312	1712.4	90.96	29.84	120.80	H	< 1.00	0.363	25.60
	1412	1732.4	91.49	29.58	121.07	H		0.386	25.87
	1513	1752.6	91.62	29.58	121.20	H		0.398	26.00

8.3 RADIATED SPURIOUS EMISSIONS

MODULATION SIGNAL: GSM850
 DISTANCE: 3 meters

Ch.	Freq. (MHz)	Measured Level (dBμV)	A.F. + C.L.+ H.P.F. - A.G. + D.F. (dB)	Total (dBμV/m)	Pol.	Result (dBm)	Limit
128 (824.2)	1 648.40	63.79	-16.38	47.41	H	-47.79	-13.00
	2 472.60	54.18	-12.74	41.44	H	-53.76	-13.00
	3 296.80	52.40	-10.23	42.17	H	-53.03	-13.00
	4 121.00	50.47	-7.90	42.57	H	-52.63	-13.00
	4 945.20	50.92	-4.51	46.41	H	-48.79	-13.00
190 (836.6)	1 673.20	64.67	-16.38	48.29	H	-46.91	-13.00
	2 509.80	54.22	-12.59	41.63	H	-53.57	-13.00
	3 346.40	52.71	-10.35	42.36	H	-52.84	-13.00
	4 183.00	50.90	-7.54	43.36	H	-51.84	-13.00
	5 019.60	50.16	-4.32	45.84	H	-49.36	-13.00
251 (848.8)	1 697.60	69.32	-16.54	52.78	H	-42.42	-13.00
	2 546.40	52.58	-12.75	39.83	H	-55.37	-13.00
	3 395.20	52.59	-9.92	42.67	H	-52.53	-13.00
	4 244.00	50.57	-7.30	43.27	H	-51.93	-13.00
	5 092.80	49.34	-3.97	45.37	H	-49.83	-13.00

MODULATION SIGNAL: GSM1900

DISTANCE: 3 meters

Ch.	Freq. (MHz)	Measured Level (dBμV)	A.F. + C.L. + H.P.F. - A.G. + D.F. (dB)	Total (dBμV/m)	Pol.	Result (dBm)	Limit
512 (1850.2)	3 700.40	54.11	-5.62	48.49	H	-46.71	-13.00
	5 550.60	49.32	-0.60	48.72	H	-46.48	-13.00
	7 400.80	47.26	4.17	51.43	H	-43.77	-13.00
	9 251.00	47.62	7.32	54.94	H	-40.26	-13.00
	11 101.20	45.90	8.92	54.82	H	-40.38	-13.00
661 (1880.0)	3 760.00	53.38	-5.23	48.15	H	-47.05	-13.00
	5 640.00	48.75	-0.75	48.00	H	-47.20	-13.00
	7 520.00	47.50	4.15	51.65	H	-43.55	-13.00
	9 400.00	45.94	8.24	54.18	H	-41.02	-13.00
	11 280.00	44.24	10.06	54.30	H	-40.90	-13.00
810 (1909.8)	3 819.60	52.45	-4.26	48.19	H	-47.01	-13.00
	5 729.40	49.00	0.33	49.33	H	-45.87	-13.00
	7 639.20	47.65	4.18	51.83	H	-43.37	-13.00
	9 549.00	46.10	7.44	53.54	H	-41.66	-13.00
	11 458.80	44.18	10.14	54.32	H	-40.88	-13.00

MODULATION SIGNAL: WCDMA850

DISTANCE: 3 meters

Ch.	Freq. (MHz)	Measured Level (dBμV)	A.F. + C.L. + H.P.F. - A.G. + D.F. (dB)	Total (dBμV/m)	Pol.	Result (dBm)	Limit
4132 (826.4)	1 652.80	54.42	-16.38	38.04	H	-57.16	-13.00
	2 479.20	54.08	-12.59	41.49	H	-53.71	-13.00
	3 305.60	51.70	-10.23	41.47	H	-53.73	-13.00
	4 132.00	49.97	-7.95	42.02	H	-53.18	-13.00
	4 958.40	49.71	-4.51	45.20	H	-50.00	-13.00
4183 (836.6)	1 673.20	55.05	-16.38	38.67	H	-56.53	-13.00
	2 509.80	53.57	-12.59	40.98	H	-54.22	-13.00
	3 346.40	52.28	-10.35	41.93	H	-53.27	-13.00
	4 183.00	50.47	-7.54	42.93	H	-52.27	-13.00
	5 019.60	49.99	-4.32	45.67	H	-49.53	-13.00
4233 (846.6)	1 693.20	54.62	-16.54	38.08	H	-57.12	-13.00
	2 539.80	53.20	-12.75	40.45	H	-54.75	-13.00
	3 386.40	52.02	-9.92	42.10	H	-53.10	-13.00
	4 233.00	50.14	-7.30	42.84	H	-52.36	-13.00
	5 079.60	49.78	-3.97	45.81	H	-49.39	-13.00

MODULATION SIGNAL: WCDMA1900

DISTANCE: 3 meters

Ch.	Freq. (MHz)	Measured Level (dBμV)	A.F. + C.L. + H.P.F. - A.G. + D.F. (dB)	Total (dBμV/m)	Pol.	Result (dBm)	Limit
9262 (1852.4)	3 704.80	51.68	-5.62	46.06	H	-49.14	-13.00
	5 557.20	49.50	-0.60	48.90	H	-46.30	-13.00
	7 409.60	48.12	4.17	52.29	H	-42.91	-13.00
	9 262.00	46.85	7.32	54.17	H	-41.03	-13.00
	11 114.40	45.59	8.92	54.51	H	-40.69	-13.00
9400 (1880.0)	3 760.00	51.93	-5.23	46.70	H	-48.50	-13.00
	5 640.00	48.95	-0.75	48.20	H	-47.00	-13.00
	7 520.00	47.28	4.15	51.43	H	-43.77	-13.00
	9 400.00	46.10	8.24	54.34	H	-40.86	-13.00
	11 280.00	45.55	10.06	55.61	H	-39.59	-13.00
9538 (1907.6)	3 815.20	51.62	-4.26	47.36	H	-47.84	-13.00
	5 722.80	49.94	-0.24	49.70	H	-45.50	-13.00
	7 630.40	47.83	4.18	52.01	H	-43.19	-13.00
	9 538.00	46.22	7.44	53.66	H	-41.54	-13.00
	11 445.60	44.55	10.14	54.69	H	-40.51	-13.00

MODULATION SIGNAL: WCDMA1700

DISTANCE: 3 meters

Ch.	Freq. (MHz)	Measured Level (dBμV)	A.F. + C.L. + H.P.F. - A.G. + D.F. (dB)	Total (dBμV/m)	Pol.	Result (dBm)	Limit
1312 (1712.4)	3 424.80	52.67	-6.15	46.52	H	-48.68	-13.00
	5 137.20	50.28	-0.93	49.35	H	-45.85	-13.00
	6 849.60	48.70	2.51	51.21	H	-43.99	-13.00
	8 562.00	46.96	6.20	53.16	H	-42.04	-13.00
	10 274.40	46.47	8.11	54.58	H	-40.62	-13.00
1412 (1732.4)	3 464.80	52.40	-6.16	46.24	H	-48.96	-13.00
	5 197.20	50.83	-0.92	49.91	H	-45.29	-13.00
	6 929.60	47.54	2.76	50.30	H	-44.90	-13.00
	8 662.00	46.61	6.54	53.15	H	-42.05	-13.00
	10 394.40	45.49	8.62	54.11	H	-41.09	-13.00
1513 (1752.6)	3 505.20	51.34	-5.72	45.62	H	-49.58	-13.00
	5 257.80	50.55	-0.80	49.75	H	-45.45	-13.00
	7 010.40	48.51	2.85	51.36	H	-43.84	-13.00
	8 763.00	46.74	6.93	53.67	H	-41.53	-13.00
	10 515.60	45.42	8.89	54.31	H	-40.89	-13.00

8.4 PEAK-TO-AVERAGE RATIO

Band	Ch.	Measured P_{Pk} (dBm)	Measured P_{Avg} (dBm)	P_{Avg} (Duty Cycle)			P.A.R. $= P_{Pk} - P_{Avg}$ (dB)	Limit (dB)	Pass / Fail
				T_{XTotal} (ms)	T_{XOn} (ms)	Factor (dB)			
GSM1900	661	31.03	21.61	4.6160	0.5475	9.26	0.16	13	Pass
GSM1900 EDGE	661	28.560	14.14	4.616	0.5475	9.26	5.16		
GSM850	190	CCDF Procedure					3.76		
GSM850 EDGE	190						6.35		
WCDMA850	4408						2.46		
WCDMA1900	9400						2.89		
WCDMA1700	1732.4						2.85		

Note:

1. Plots of the EUT's Peak- to- Average Ratio are shown Page 66 ~ 73.
2. Only GSM(include EDGE) Mode was tested by alternate procedure for PAPR

$$P.A.R. (dB) = P_{Pk} (dBm) - P_{Avg} (dBm) \quad (P_{Avg} = \text{Average Power} + \text{Duty cycle Factor})$$

$$\text{Duty cycle Factor} = 10 \times \log (1/X), \quad X = T_{XOn} / T_{XTotal}$$

8.5 OCCUPIED BANDWIDTH

Band	Channel	Frequency (MHz)	Data (GSM: kHz / WCDMA : MHz)
GSM850	128	824.20	244.01
	190	836.60	243.44
	251	848.80	244.54
GSM850 EDGE	128	824.20	245.76
	190	836.60	254.54
	251	848.80	246.75
GSM1900	512	1850.20	243.77
	661	1880.00	246.23
	810	1909.80	241.34
GSM1900 EDGE	512	1850.20	245.61
	661	1880.00	246.75
	810	1909.80	243.38
WCDMA850	4132	826.40	4.1362
	4183	836.60	4.1407
	4233	846.60	4.1541
WCDMA1900	9262	1852.40	4.1357
	9400	1880.00	4.1380
	9538	1907.60	4.1411
WCDMA1700	1312	1712.40	4.1496
	1412	1732.40	4.1400
	1513	1752.60	4.1395

Note:

1. Plots of the EUT's Occupied Bandwidth are shown Page 49 ~ 65.

8.6 CONDUCTED SPURIOUS EMISSIONS

Band	Channel	Frequency of Maximum Harmonic (GHz)	Factor (dB)	Measurement Maximum Data (dBm)	Result	Limit (dBm)
GSM850	128	5.2443	27.520	-55.700	-28.184	-13.00
	190	3.7688	26.600	-55.600	-29.001	
	251	3.8884	26.600	-55.520	-28.922	
GSM1900	512	19.5200	31.710	-53.954	-22.244	
	661	18.7300	31.710	-53.021	-21.311	
	810	19.9700	31.710	-53.780	-22.070	
WCDMA850	4132	8.9232	27.520	-65.901	-38.381	
	4183	4.9352	26.600	-64.976	-38.376	
	4233	3.8186	26.600	-65.453	-38.853	
WCDMA1900	9262	3.7987	26.600	-63.901	-37.301	
	9400	19.0200	31.710	-63.741	-32.031	
	9538	19.0800	31.710	-64.912	-33.202	
WCDMA1700	1712.4	18.9900	31.710	-64.203	-32.493	
	1732.4	19.7000	31.710	-64.382	-32.672	
	1752.6	19.5100	31.710	-63.987	-32.277	

Note:

1. Plots of the EUT's Conducted Spurious Emissions are shown Page 110 ~ 133.
2. Result (dBm) = Measurement Maximum Data (dBm) + Factor (dB)
3. Factor (dB) = Cable Loss + Attenuator + Power Splitter

Frequency Range (GHz)	Factor [dB]
0.03 – 1	26.080
1 – 5	26.600
5 – 10	27.520
10 – 15	29.120
15 – 20	31.710
Above 20(26.5)	32.350

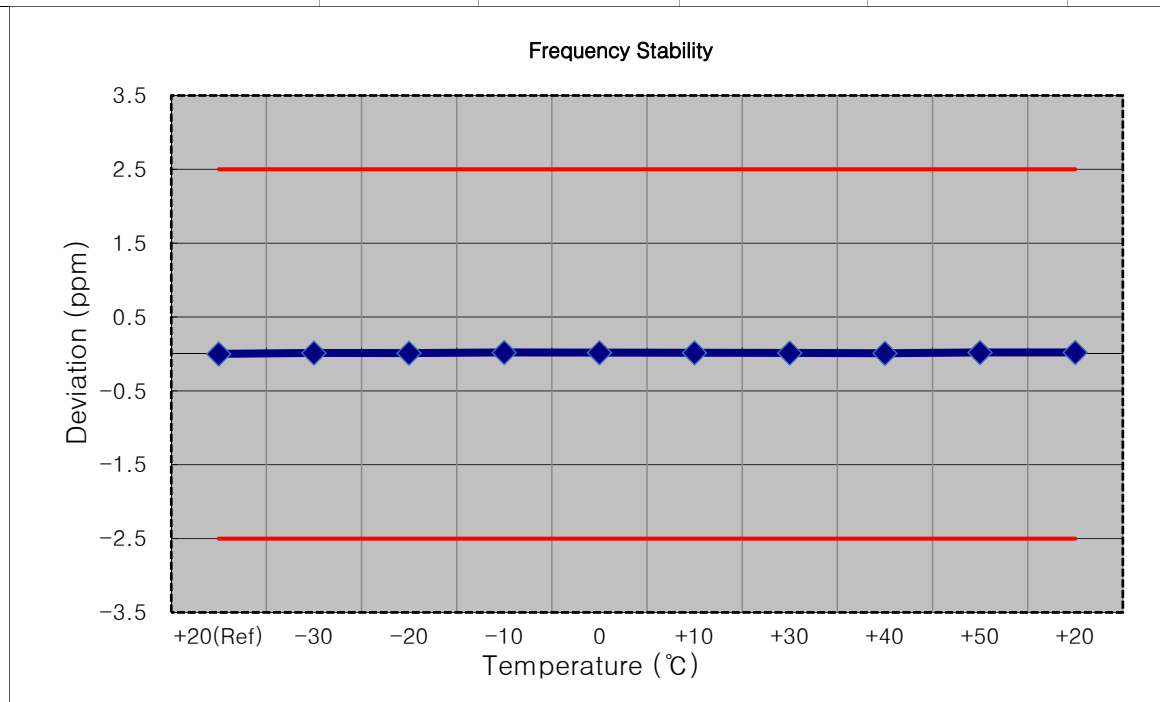
8.7 BAND EDGE

- Plots of the EUT's Band Edge are shown Page 74 ~ 109.

8.8 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE

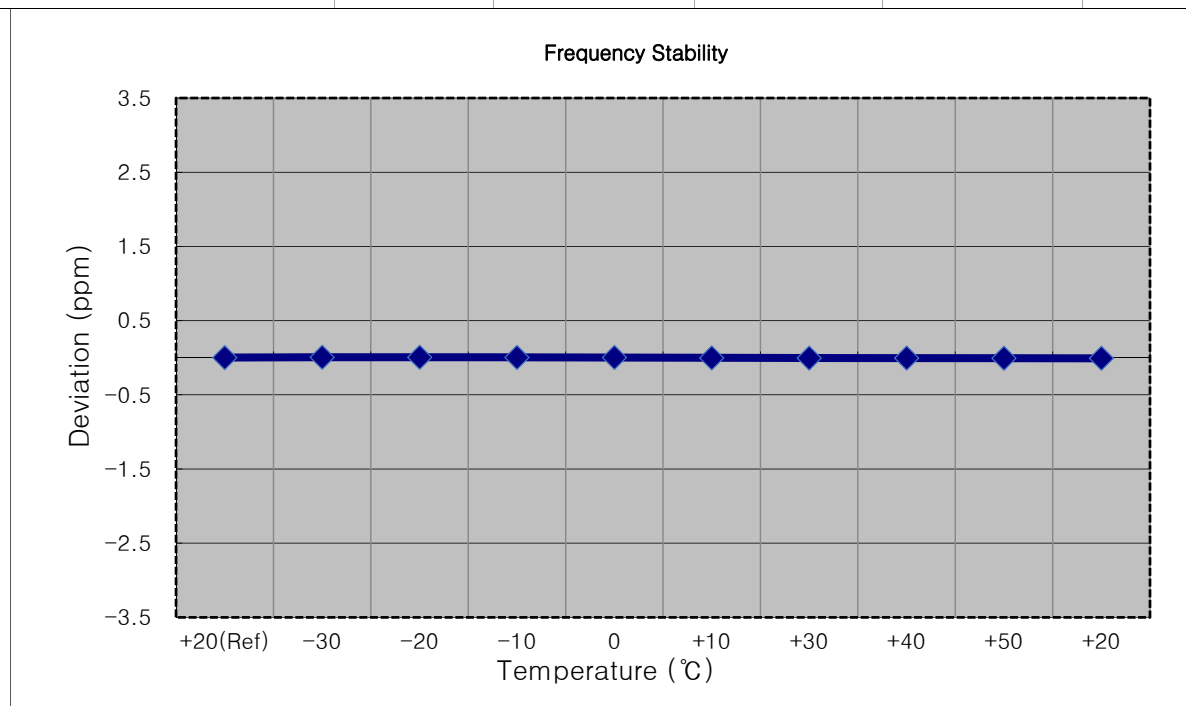
MODE:	GSM850
OPERATING FREQUENCY:	836,600,000 Hz
CHANNEL:	190
REFERENCE VOLTAGE:	12.000 VDC
DEVIATION LIMIT:	$\pm 0.000\ 25\ \%$ or $2.5\ \text{ppm}$

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100 %	12.000	+20(Ref)	836 600 015	0.0	0.000 000	0.0000
100 %		-30	836 600 027	11.7	0.000 001	0.0140
100 %		-20	836 600 023	8.3	0.000 001	0.0099
100 %		-10	836 600 031	15.6	0.000 002	0.0187
100 %		0	836 600 029	14.2	0.000 002	0.0170
100 %		+10	836 600 028	12.8	0.000 002	0.0154
100 %		+30	836 600 026	11.2	0.000 001	0.0134
100 %		+40	836 600 023	8.0	0.000 001	0.0095
100 %		+50	836 600 032	16.9	0.000 002	0.0203
115 %		+20	836 600 024	9.4	0.000 001	0.0112
85 %		+20	836 600 023	7.8	0.000 001	0.0093



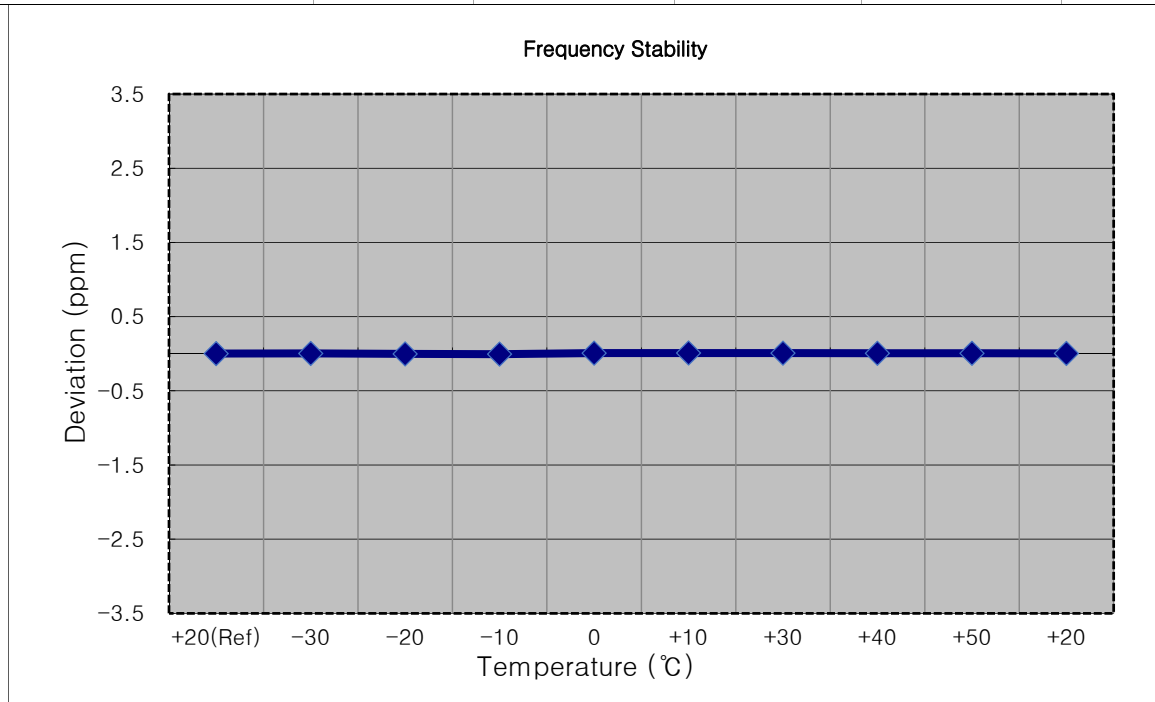
Mode:	<u>GSM1900</u>
OPERATING FREQUENCY:	<u>1850,200,000 Hz</u>
CHANNEL:	<u>512</u>
REFERENCE VOLTAGE:	<u>12.000 VDC</u>
DEVIATION LIMIT:	<u>Emission must remain in band</u>

Voltage	Power	Temp.	Frequency	Frequency	Deviation	ppm
(%)	(VDC)	(°C)	(Hz)	Error (Hz)	(%)	
100 %	12.000	+20(Ref)	1850 199 983	0.0	0.000 000	0.0000
100 %		-30	1850 199 994	11.3	0.000 001	0.0061
100 %		-20	1850 199 992	8.6	0.000 000	0.0047
100 %		-10	1850 199 991	7.6	0.000 000	0.0041
100 %		0	1850 199 989	6.2	0.000 000	0.0033
100 %		+10	1850 199 976	-7.3	0.000 000	-0.0040
100 %		+30	1850 199 975	-8.5	0.000 000	-0.0046
100 %		+40	1850 199 972	-10.6	-0.000 001	-0.0057
100 %		+50	1850 199 970	-13.1	-0.000 001	-0.0071
115 %		+20	1850 199 975	-7.7	0.000 000	-0.0042
85 %		+20	1850 199 974	-8.9	0.000 000	-0.0048



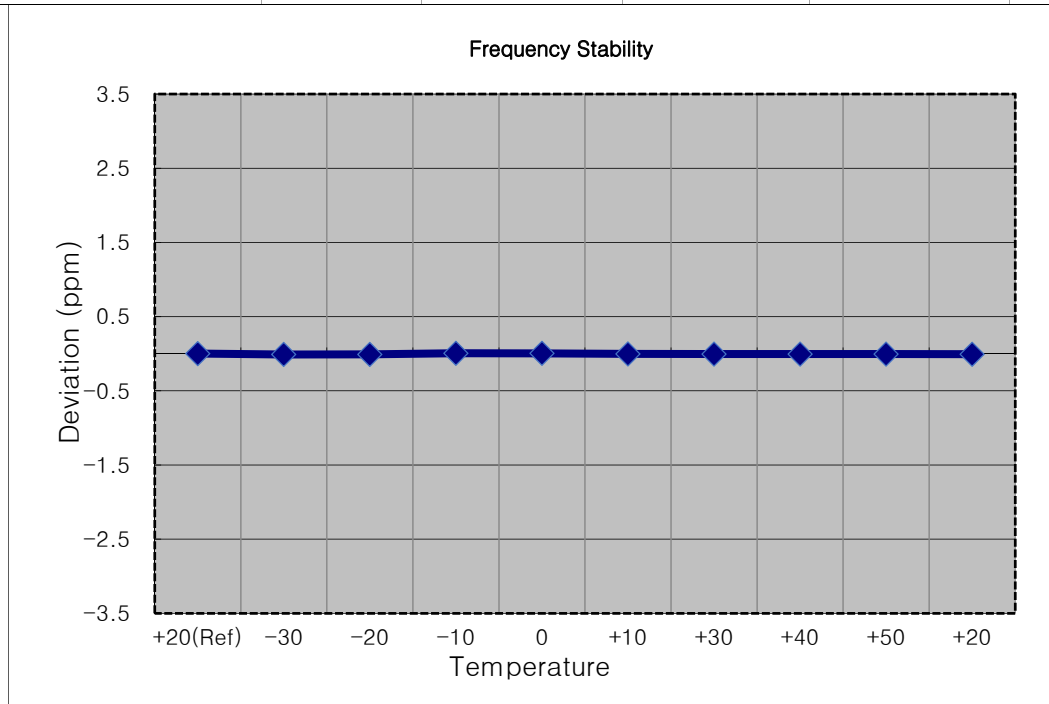
Mode:	GSM1900
OPERATING FREQUENCY:	1880,000,000 Hz
CHANNEL:	661
REFERENCE VOLTAGE:	12.000 VDC
DEVIATION LIMIT:	Emission must remain in band

Voltage	Power	Temp.	Frequency	Frequency	Deviation	ppm
(%)	(VDC)	(°C)	(Hz)	Error (Hz)	(%)	
100 %	12.000	+20(Ref)	1880 000 011	0.0	0.000 000	0.000
100 %		-30	1880 000 017	5.7	0.000 000	0.003
100 %		-20	1880 000 004	-7.6	0.000 000	-0.004
100 %		-10	1880 000 001	-10.5	-0.000 001	-0.006
100 %		0	1880 000 026	14.5	0.000 001	0.008
100 %		+10	1880 000 028	16.6	0.000 001	0.009
100 %		+30	1880 000 025	13.7	0.000 001	0.007
100 %		+40	1880 000 023	11.5	0.000 001	0.006
100 %		+50	1880 000 021	9.9	0.000 001	0.005
115 %		+20	1880 000 017	5.9	0.000 000	0.003
85 %		+20	1880 000 019	7.9	0.000 000	0.004



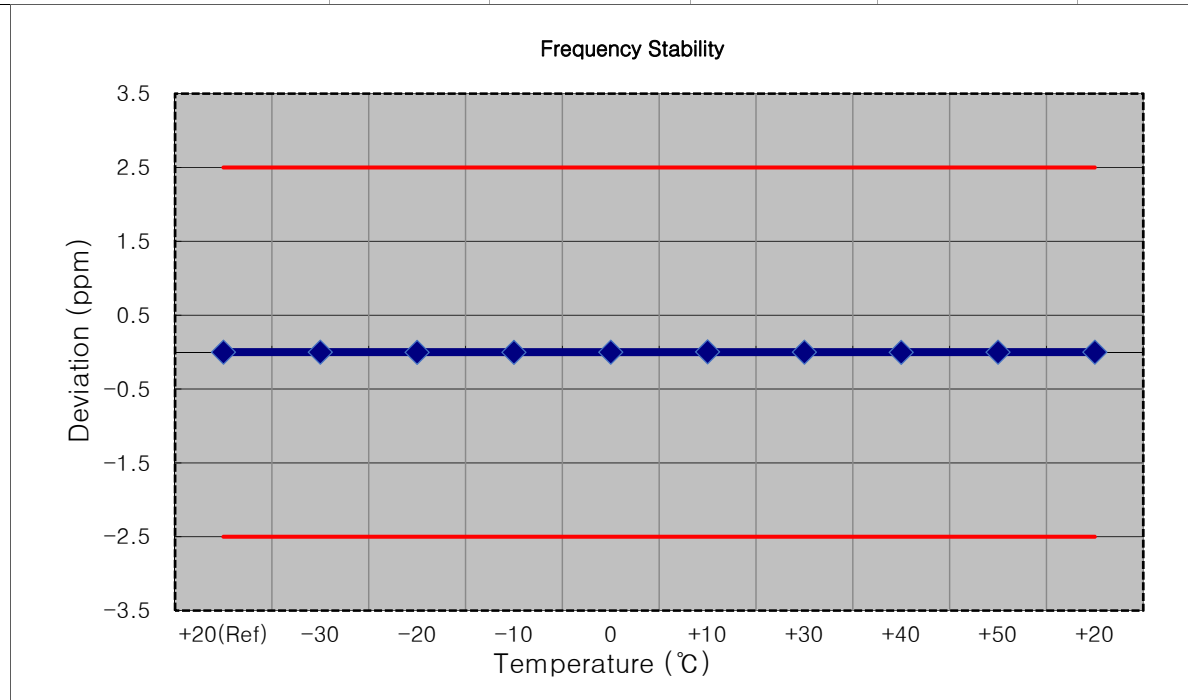
■ Mode: GSM1900
 ■ OPERATING FREQUENCY: 1909,800,000 Hz
 ■ CHANNEL: 810
 ■ REFERENCE VOLTAGE: 12.000 VDC
 ■ DEVIATION LIMIT: Emission must remain in band

Voltage	Power	Temp.	Frequency	Frequency	Deviation	ppm
(%)	(VDC)	(°C)	(Hz)	Error (Hz)	(%)	
100 %	12.000	+20(Ref)	1909 799 982	0.0	0.000 000	0.000
100 %		-30	1909 799 963	-19.4	-0.000 001	-0.010
100 %		-20	1909 799 964	-18.2	-0.000 001	-0.010
100 %		-10	1909 799 992	9.7	0.000 001	0.005
100 %		0	1909 799 992	9.8	0.000 001	0.005
100 %		+10	1909 799 974	-8.3	0.000 000	-0.004
100 %		+30	1909 799 974	-8.7	0.000 000	-0.005
100 %		+40	1909 799 972	-10.5	-0.000 001	-0.006
100 %		+50	1909 799 972	-10.5	-0.000 001	-0.006
115 %		+20	1909 799 972	-10.4	-0.000 001	-0.005
85 %		+20	1909 799 973	-9.7	-0.000 001	-0.005



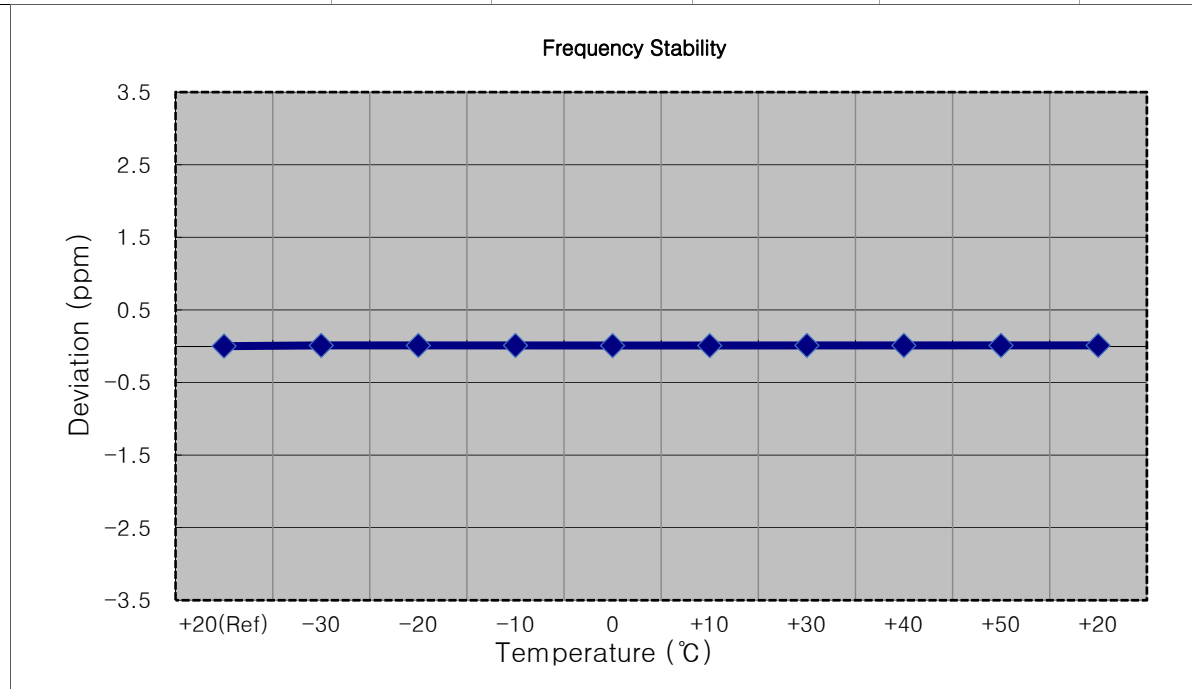
Mode:	WCDMA850
OPERATING FREQUENCY:	836,600,000 Hz
CHANNEL:	4183
REFERENCE VOLTAGE:	12.000 VDC
DEVIATION LIMIT:	$\pm 0.000\ 25\ \%$ or 2.5 ppm

Voltage	Power	Temp.	Frequency	Frequency	Deviation	ppm
(%)	(VDC)	(°C)	(Hz)	Error (Hz)	(%)	
100 %	12.000	+20(Ref)	836 599 999	0.0	0.000 000	0.0000
100 %		-30	836 599 997	-1.3	0.000 000	-0.0016
100 %		-20	836 599 996	-2.4	0.000 000	-0.0028
100 %		-10	836 599 997	-2.0	0.000 000	-0.0024
100 %		0	836 599 997	-1.4	0.000 000	-0.0017
100 %		+10	836 600 001	2.8	0.000 000	0.0033
100 %		+30	836 599 998	-1.0	0.000 000	-0.0012
100 %		+40	836 599 997	-1.9	0.000 000	-0.0023
100 %		+50	836 599 997	-1.6	0.000 000	-0.0019
115 %		+20	836 599 996	-2.9	0.000 000	-0.0035
85 %		+20	836 599 997	-1.7	0.000 000	-0.0020



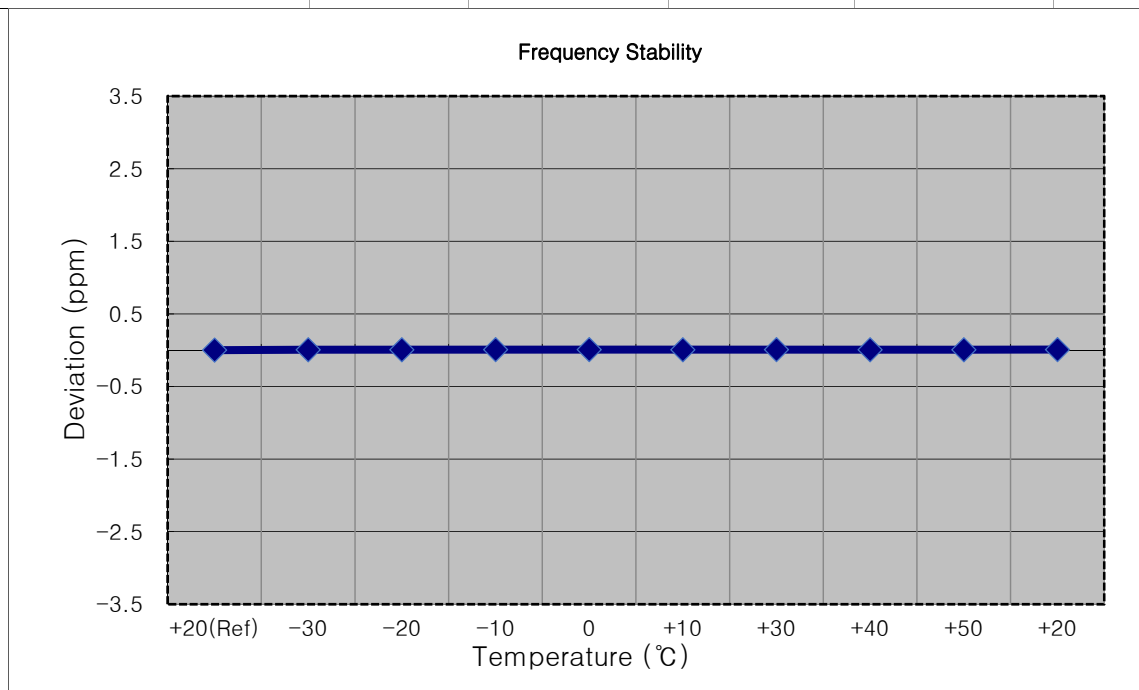
Mode: WCDMA1900
 OPERATING FREQUENCY: 1,852,400,000 Hz
 CHANNEL: 9262
 REFERENCE VOLTAGE: 12.000 VDC
 DEVIATION LIMIT: Emission must remain in band

Voltage	Power	Temp.	Frequency	Frequency	Deviation	ppm
(%)	(VDC)	(°C)	(Hz)	Error (Hz)	(%)	
100 %	12.000	+20(Ref)	1852 400 017	0.0	0.000 000	0.0000
100 %		-30	1852 400 033	16.4	0.000 001	0.0089
100 %		-20	1852 400 034	16.6	0.000 001	0.0090
100 %		-10	1852 400 035	17.6	0.000 001	0.0095
100 %		0	1852 400 033	15.6	0.000 001	0.0084
100 %		+10	1852 400 033	16.0	0.000 001	0.0086
100 %		+30	1852 400 033	16.3	0.000 001	0.0088
100 %		+40	1852 400 034	17.3	0.000 001	0.0093
100 %		+50	1852 400 035	17.7	0.000 001	0.0096
115 %		+20	1852 400 030	12.6	0.000 001	0.0068
85 %		+20	1852 400 028	11.4	0.000 001	0.0062



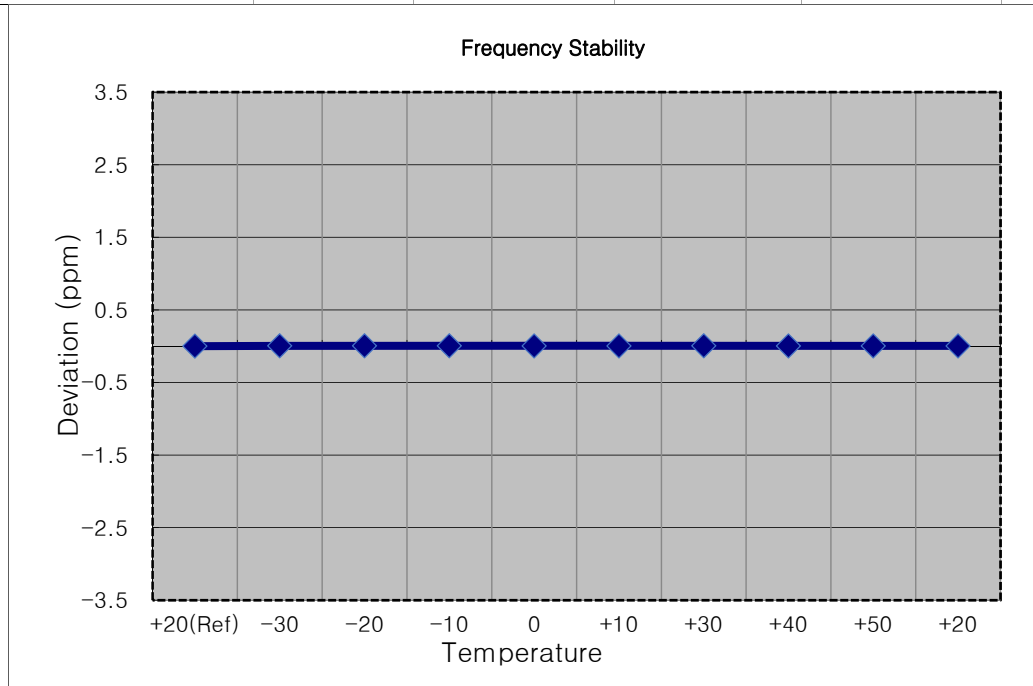
Mode:	WCDMA1900
OPERATING FREQUENCY:	1,880,000,000 Hz
CHANNEL:	9400
REFERENCE VOLTAGE:	12.000 VDC
DEVIATION LIMIT:	Emission must remain in band

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100 %	12.000	+20(Ref)	1880 000 012	0.0	0.000 000	0.0000
100 %		-30	1880 000 025	12.2	0.000 001	0.0065
100 %		-20	1880 000 025	12.4	0.000 001	0.0066
100 %		-10	1880 000 026	13.4	0.000 001	0.0071
100 %		0	1880 000 025	12.5	0.000 001	0.0067
100 %		+10	1880 000 024	12.1	0.000 001	0.0065
100 %		+30	1880 000 026	13.6	0.000 001	0.0072
100 %		+40	1880 000 024	11.3	0.000 001	0.0060
100 %		+50	1880 000 024	11.5	0.000 001	0.0061
115 %		+20	1880 000 023	10.6	0.000 001	0.0056
85 %		+20	1880 000 024	11.7	0.000 001	0.0062



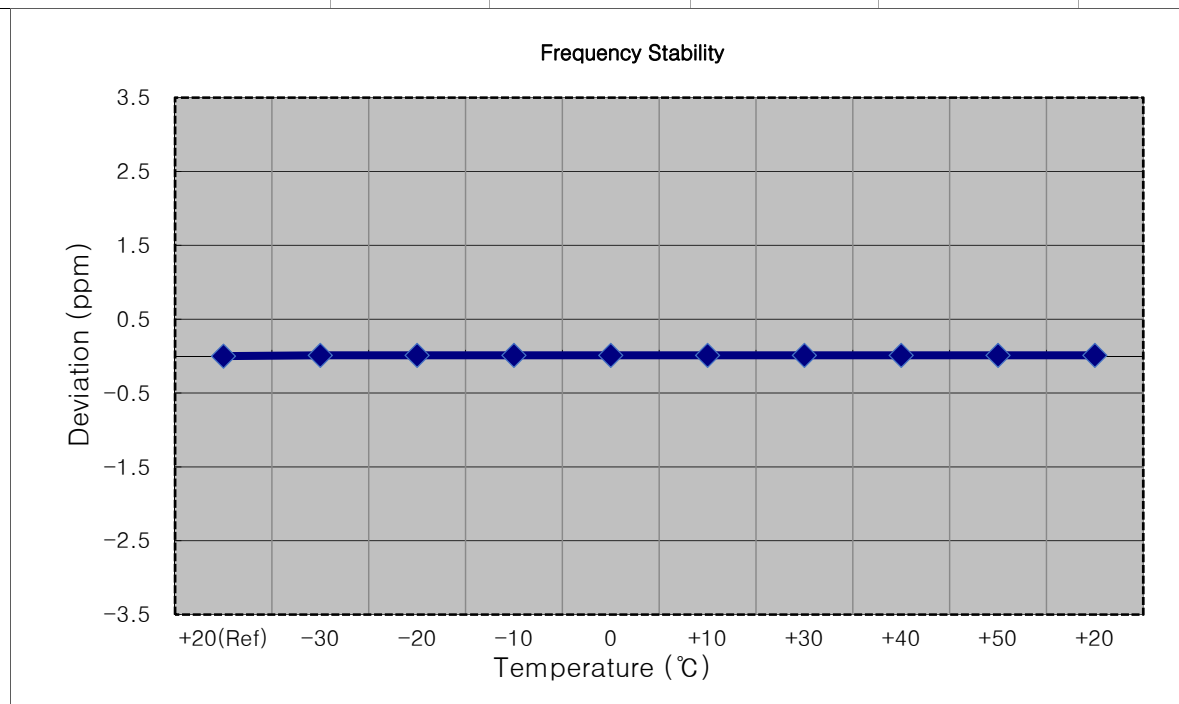
Mode:	WCDMA1900
OPERATING FREQUENCY:	1,907,600,000 Hz
CHANNEL:	9538
REFERENCE VOLTAGE:	12.000 VDC
DEVIATION LIMIT:	Emission must remain in band

Voltage	Power	Temp.	Frequency	Frequency	Deviation	ppm
(%)	(VDC)	(°C)	(Hz)	Error (Hz)	(%)	
100 %	12.000	+20(Ref)	1907 600 007	0.0	0.000 000	0.0000
100 %		-30	1907 600 017	9.9	0.000 001	0.0052
100 %		-20	1907 600 016	9.1	0.000 000	0.0047
100 %		-10	1907 600 016	9.5	0.000 000	0.0050
100 %		0	1907 600 014	7.5	0.000 000	0.0039
100 %		+10	1907 600 015	8.3	0.000 000	0.0043
100 %		+30	1907 600 015	8.7	0.000 000	0.0046
100 %		+40	1907 600 015	8.3	0.000 000	0.0044
100 %		+50	1907 600 014	7.9	0.000 000	0.0041
115 %		+20	1907 600 013	6.5	0.000 000	0.0034
85 %		+20	1907 600 012	5.7	0.000 000	0.0030



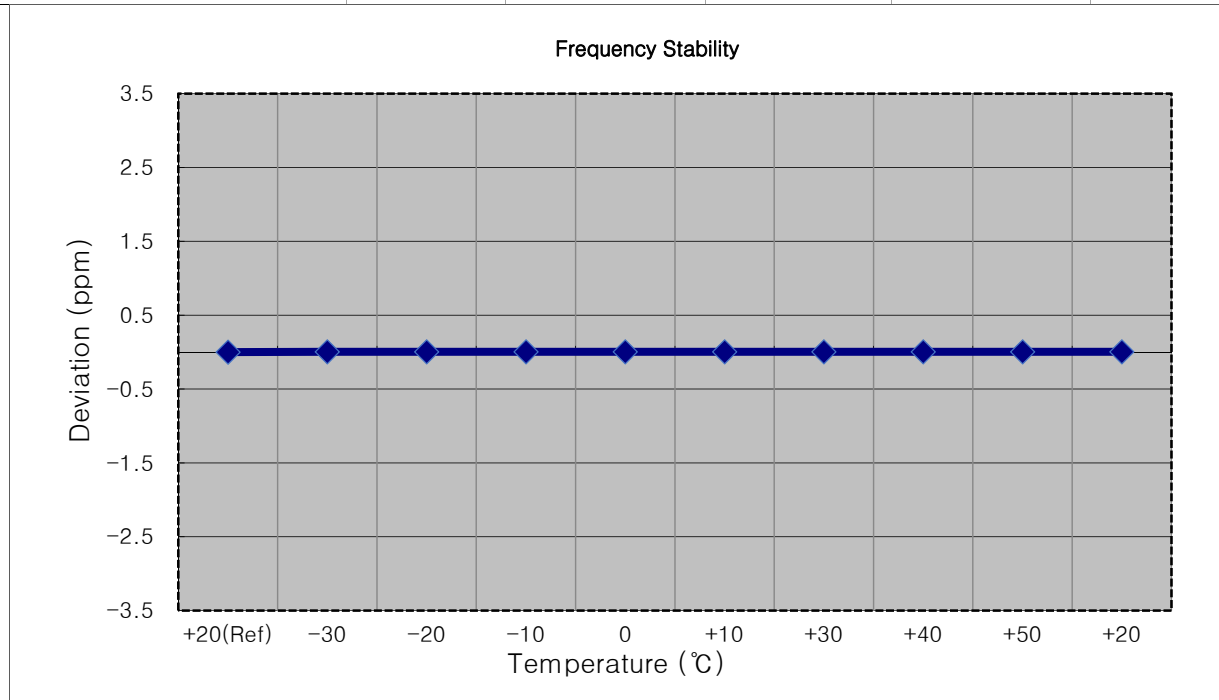
Mode:	WCDMA1700
OPERATING FREQUENCY:	1,712,400,000 Hz
CHANNEL:	1312
REFERENCE VOLTAGE:	12.000 VDC
DEVIATION LIMIT:	Emission must remain in band

Voltage	Power	Temp.	Frequency	Frequency	Deviation	ppm
(%)	(VDC)	(°C)	(Hz)	Error (Hz)	(%)	
100 %	12.000	+20(Ref)	1712 400 016	0.0	0.000 000	0.0000
100 %		-30	1712 400 033	17.3	0.000 001	0.0101
100 %		-20	1712 400 031	15.3	0.000 001	0.0089
100 %		-10	1712 400 032	16.3	0.000 001	0.0095
100 %		0	1712 400 033	17.0	0.000 001	0.0099
100 %		+10	1712 400 033	16.4	0.000 001	0.0096
100 %		+30	1712 400 033	16.4	0.000 001	0.0096
100 %		+40	1712 400 031	15.3	0.000 001	0.0089
100 %		+50	1712 400 032	15.6	0.000 001	0.0091
115 %		+20	1712 400 047	15.3	0.000 001	0.0089
85 %		+20	1712 400 045	13.1	0.000 001	0.0077



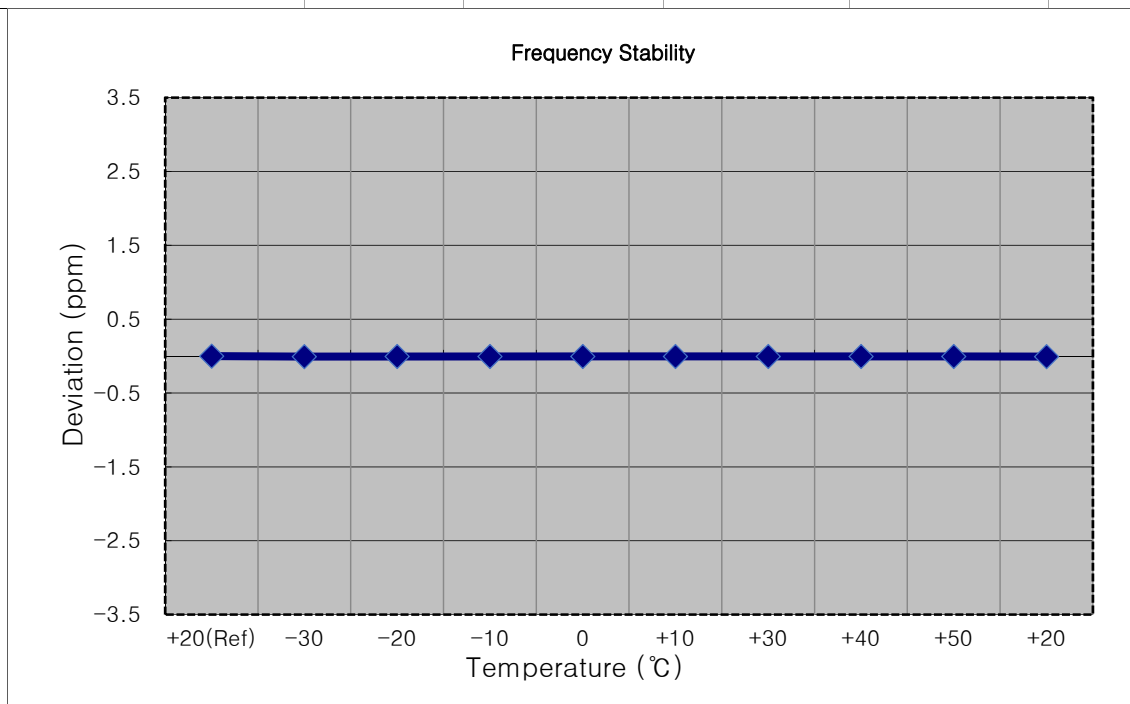
Mode: WCDMA1700
 OPERATING FREQUENCY: 1,732,400,000 Hz
 CHANNEL: 1412
 REFERENCE VOLTAGE: 12.000 VDC
 DEVIATION LIMIT: Emission must remain in band

Voltage	Power	Temp.	Frequency	Frequency	Deviation	ppm
(%)	(VDC)	(°C)	(Hz)	Error (Hz)	(%)	
100 %	12.000	+20(Ref)	1732 400 007	0.0	0.000 000	0.0000
100 %		-30	1732 400 013	5.4	0.000 000	0.0031
100 %		-20	1732 400 015	7.4	0.000 000	0.0043
100 %		-10	1732 400 014	6.9	0.000 000	0.0040
100 %		0	1732 400 014	6.4	0.000 000	0.0037
100 %		+10	1732 400 013	6.3	0.000 000	0.0036
100 %		+30	1732 400 014	6.8	0.000 000	0.0039
100 %		+40	1732 400 014	6.7	0.000 000	0.0039
100 %		+50	1732 400 012	4.8	0.000 000	0.0027
115 %		+20	1732 400 018	5.8	0.000 000	0.0033
85 %		+20	1732 400 019	7.1	0.000 000	0.0041



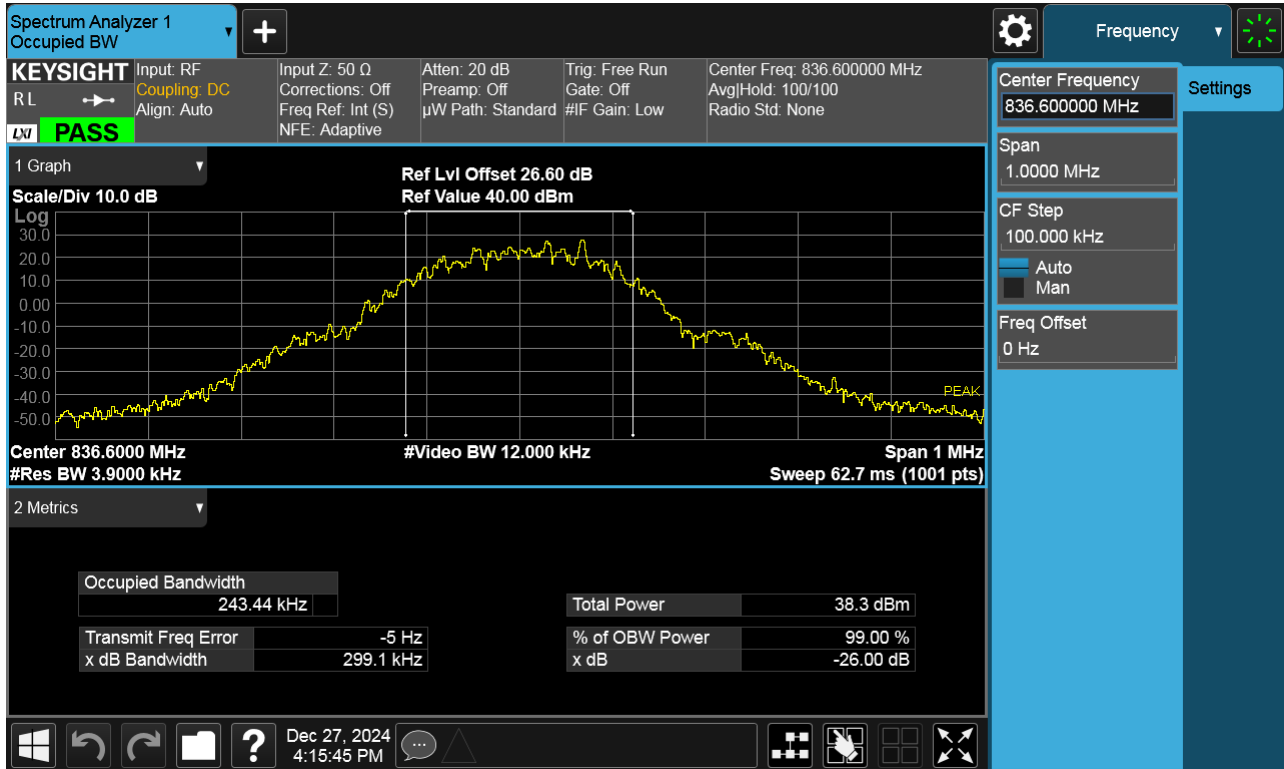
Mode:	WCDMA1700
OPERATING FREQUENCY:	1,752,600,000 Hz
CHANNEL:	1513
REFERENCE VOLTAGE:	12.000 VDC
DEVIATION LIMIT:	Emission must remain in band

Voltage	Power	Temp.	Frequency	Frequency	Deviation	ppm
(%)	(VDC)	(°C)	(Hz)	Error (Hz)	(%)	
100 %	12.000	+20(Ref)	1752 599 990	0.0	0.000 000	0.0000
100 %		-30	1752 599 979	-11.3	-0.000 001	-0.0064
100 %		-20	1752 599 981	-9.1	-0.000 001	-0.0052
100 %		-10	1752 599 979	-10.8	-0.000 001	-0.0062
100 %		0	1752 599 979	-10.9	-0.000 001	-0.0062
100 %		+10	1752 599 980	-9.8	-0.000 001	-0.0056
100 %		+30	1752 599 981	-9.6	-0.000 001	-0.0055
100 %		+40	1752 599 981	-9.2	-0.000 001	-0.0052
100 %		+50	1752 599 980	-10.0	-0.000 001	-0.0057
115 %		+20	1752 599 971	-8.7	0.000 000	-0.0050
85 %		+20	1752 599 985	4.9	0.000 000	0.0028

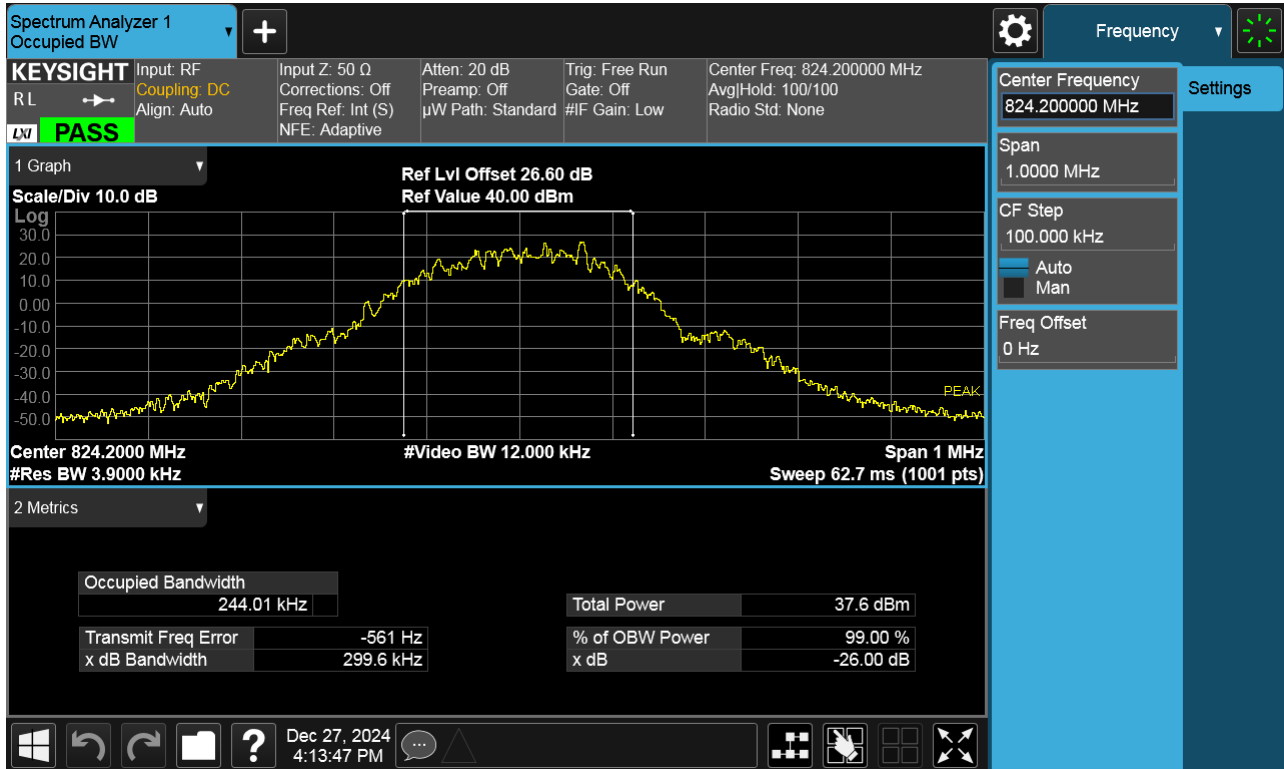


9. TEST PLOTS

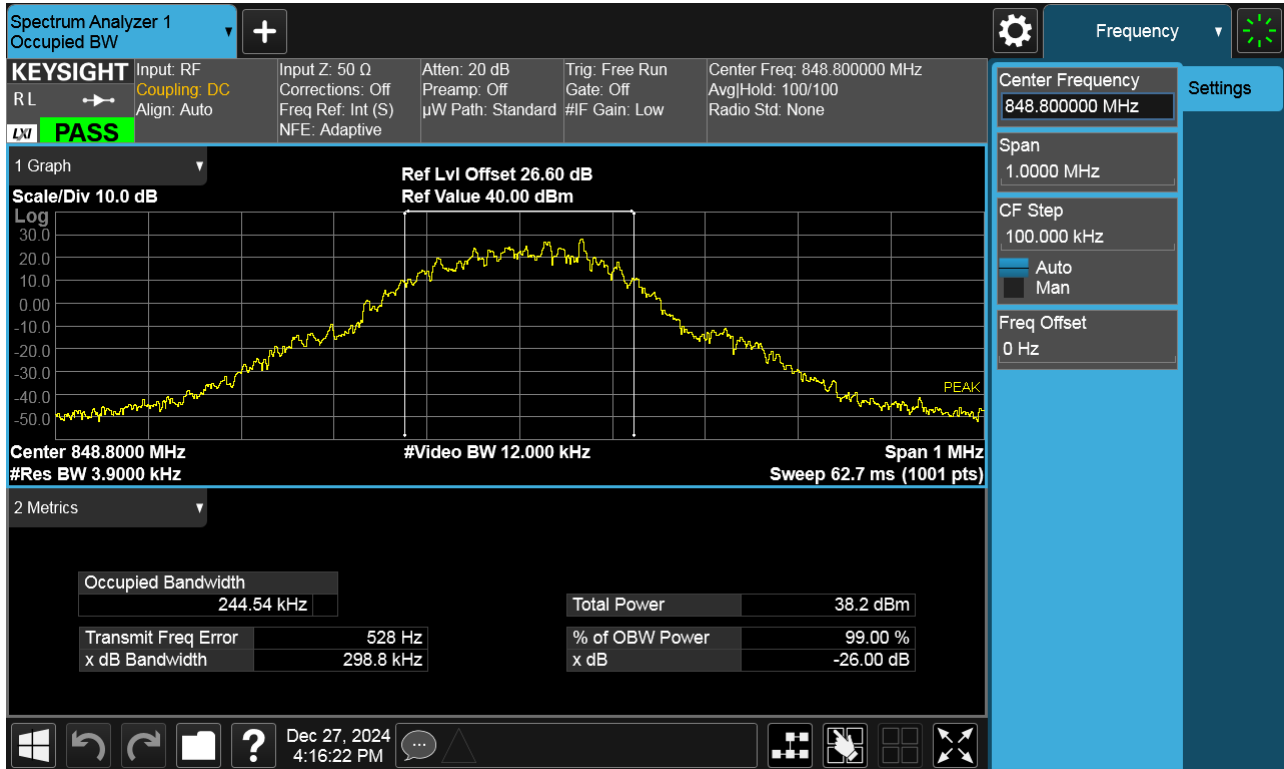
■ GSM850 MODE (128 CH.) Occupied Bandwidth



■ GSM850 MODE (190 CH.) Occupied Bandwidth



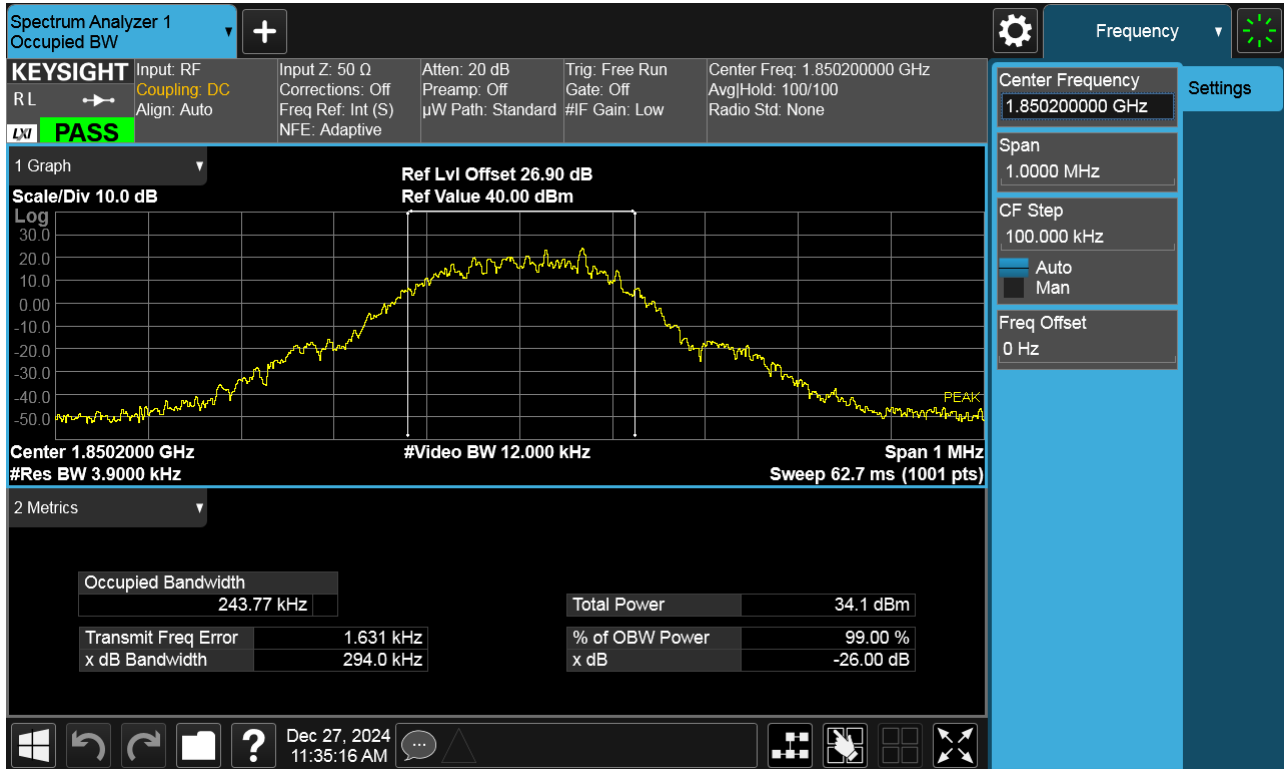
■ GSM850 MODE (251 CH.) Occupied Bandwidth



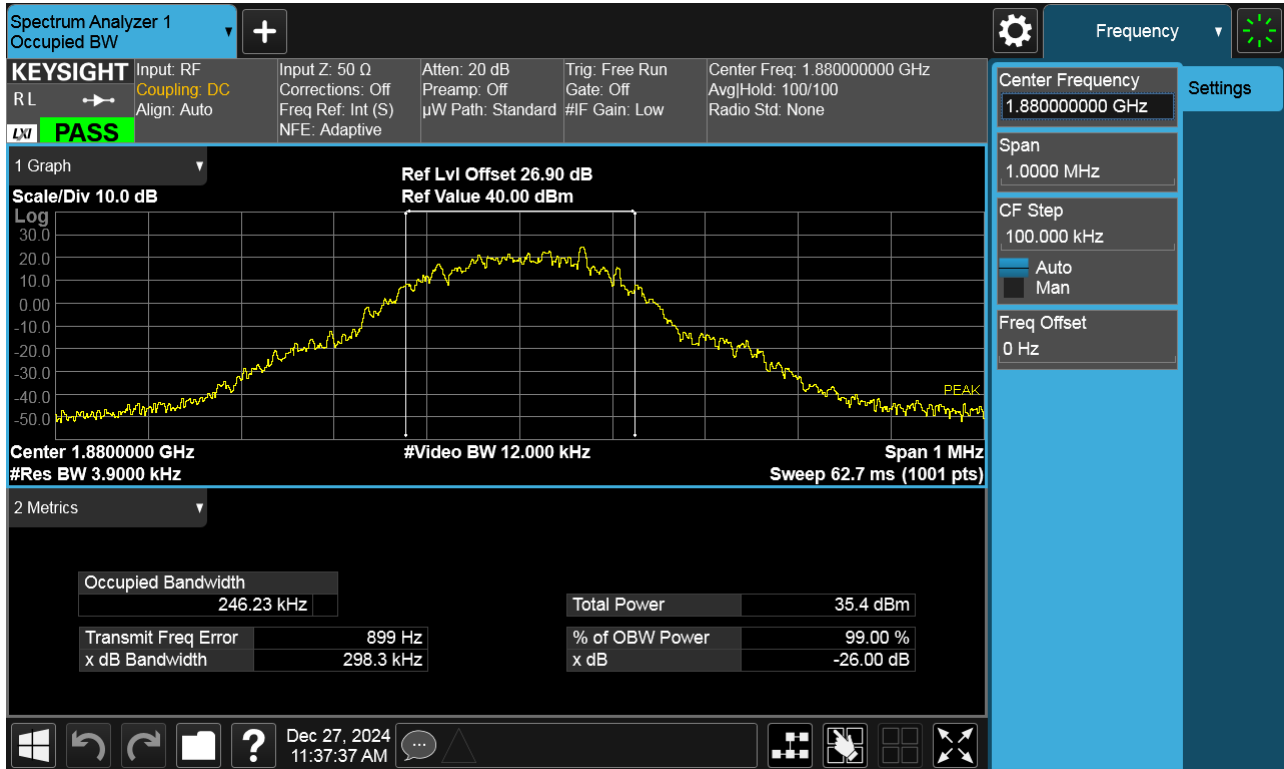
■ GSM850 EDGE (190 CH.) Occupied Bandwidth



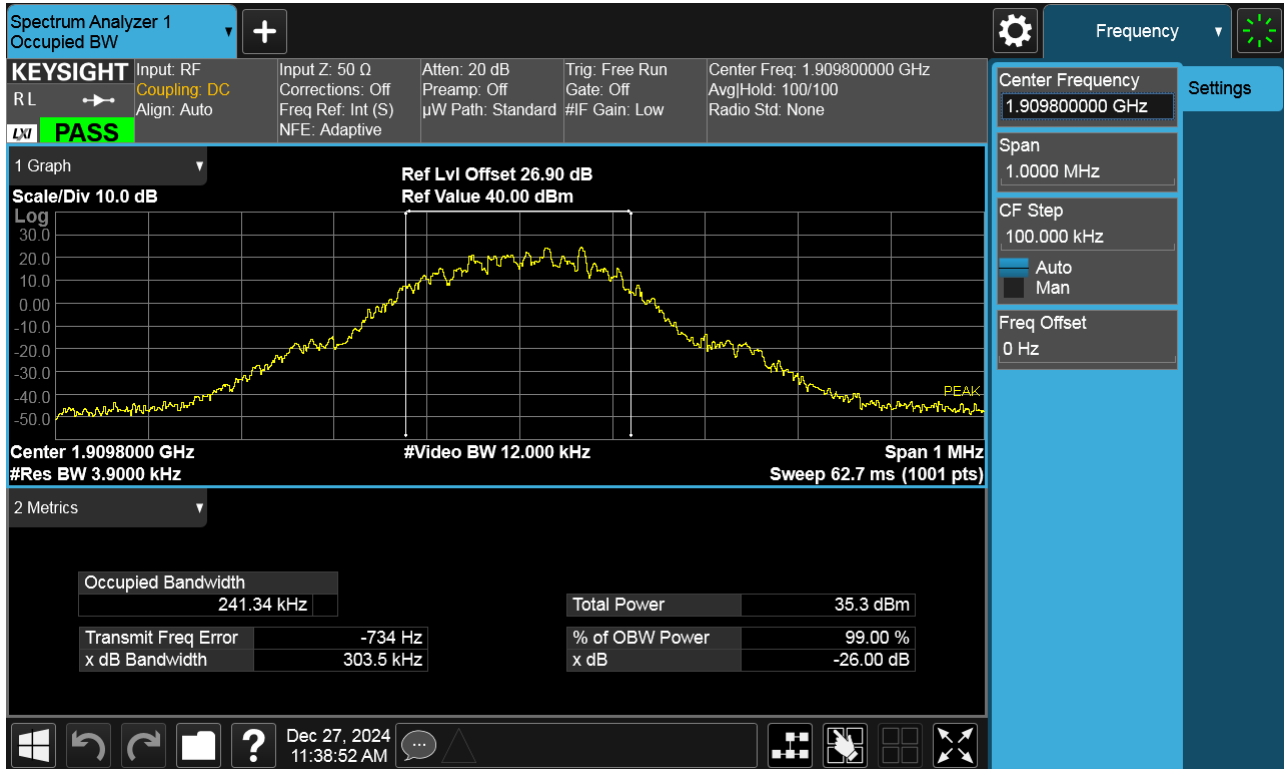
■ GSM1900 MODE (512 CH.) Occupied Bandwidth



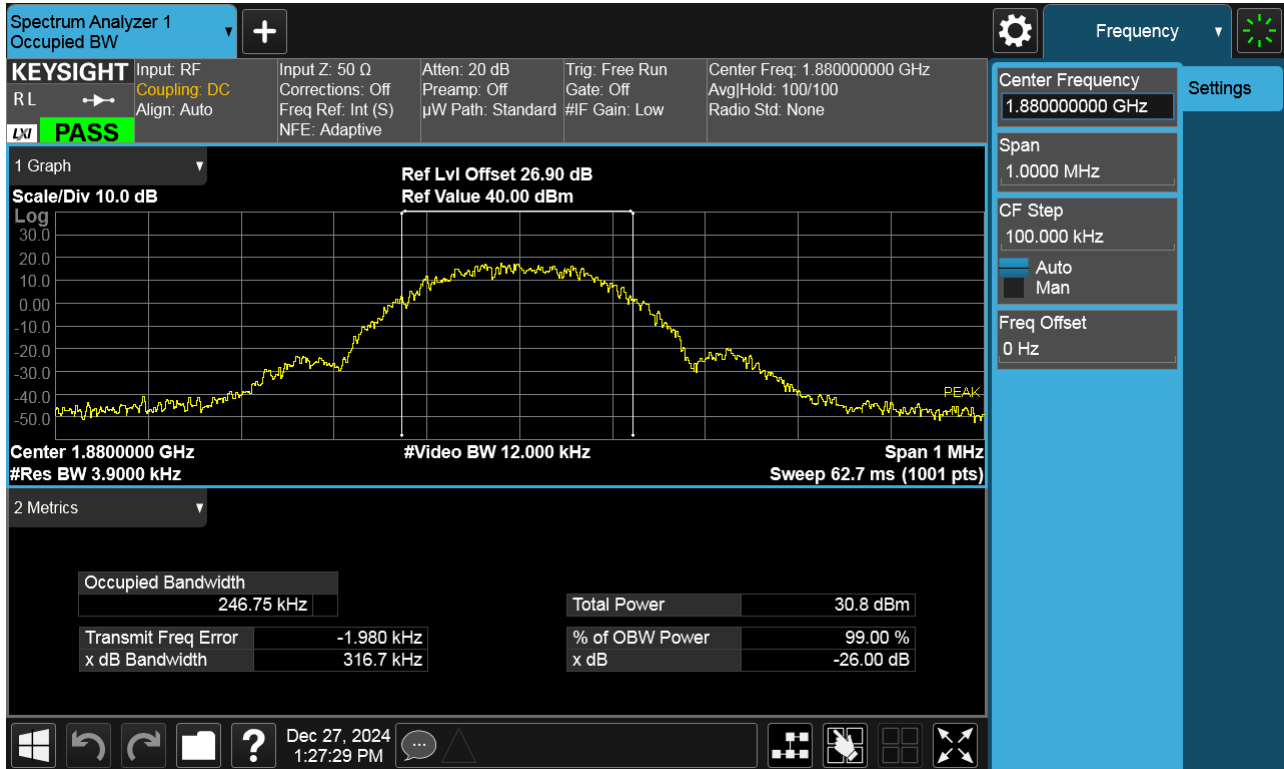
■ GSM1900 MODE (661 CH.) Occupied Bandwidth



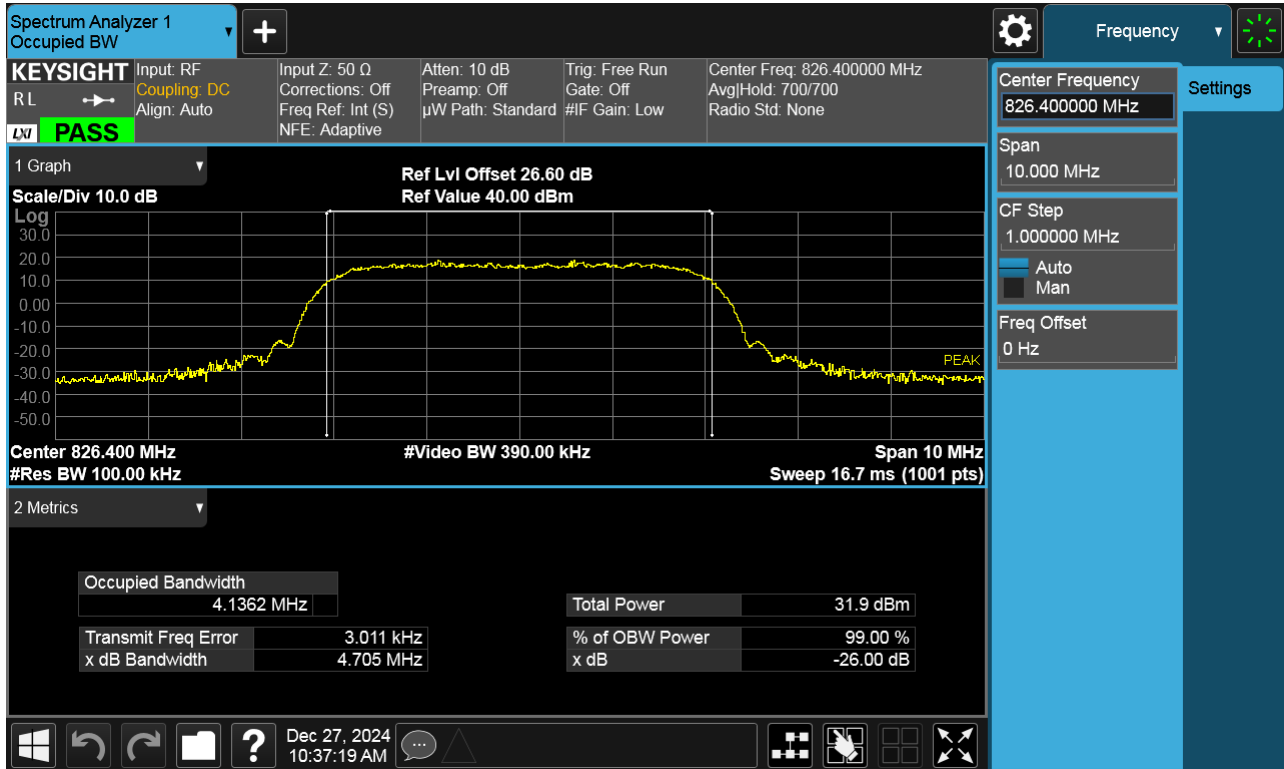
■ GSM1900 MODE (810 CH.) Occupied Bandwidth



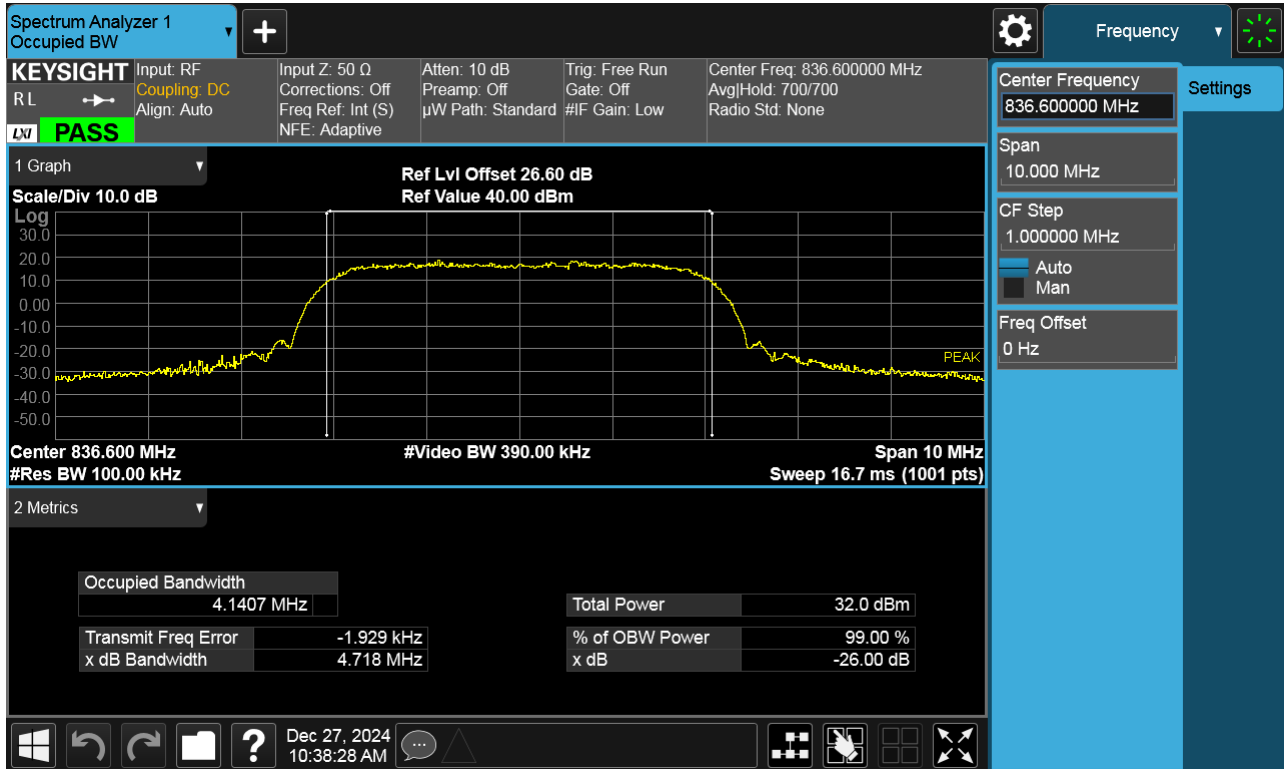
■ GSM1900 EDGE (661 CH.) Occupied Bandwidth



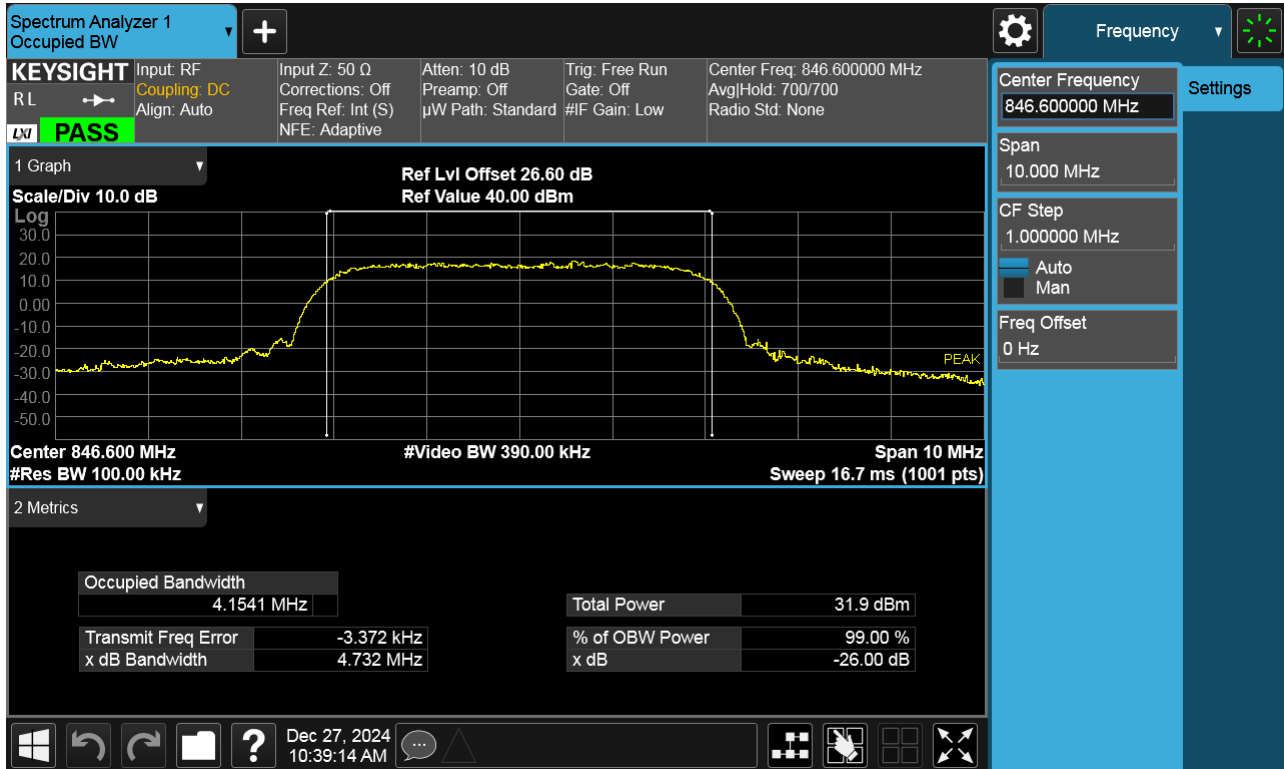
■ WCDMA850 MODE (4132 CH.) Occupied Bandwidth



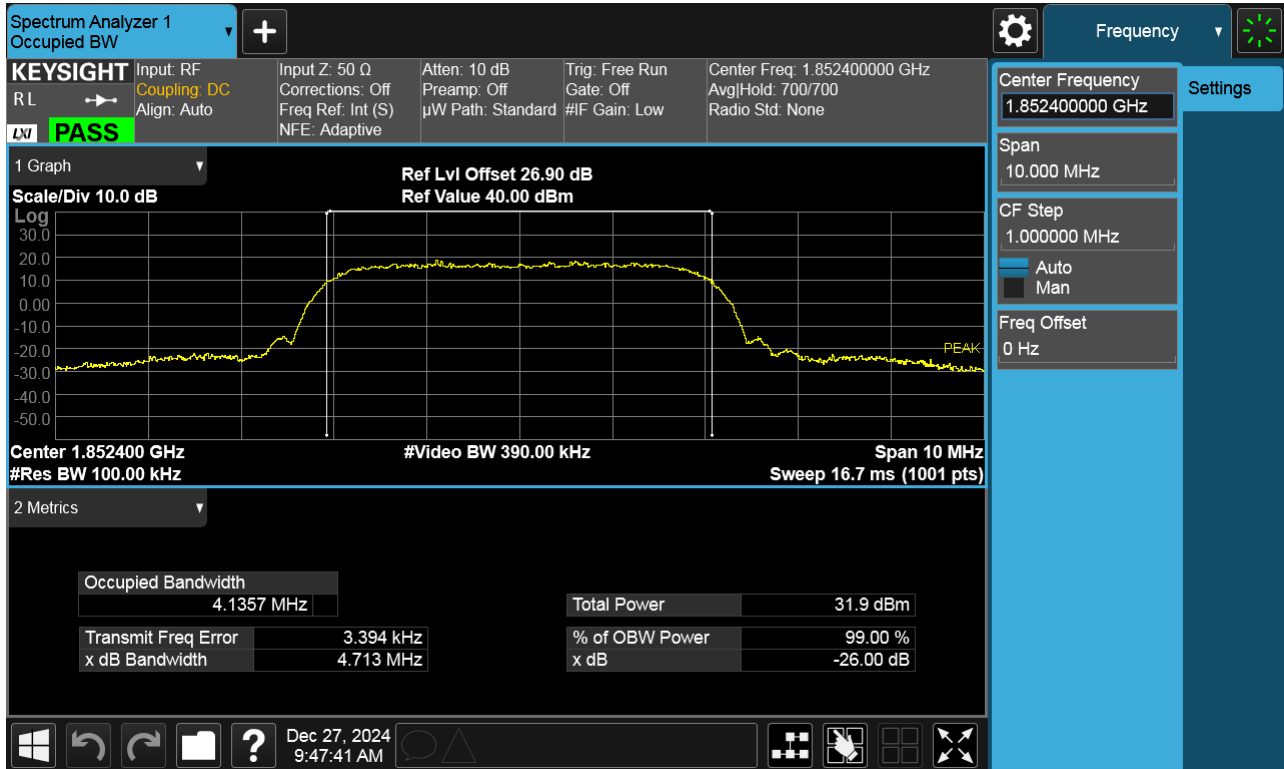
■ WCDMA850 MODE (4183 CH.) Occupied Bandwidth



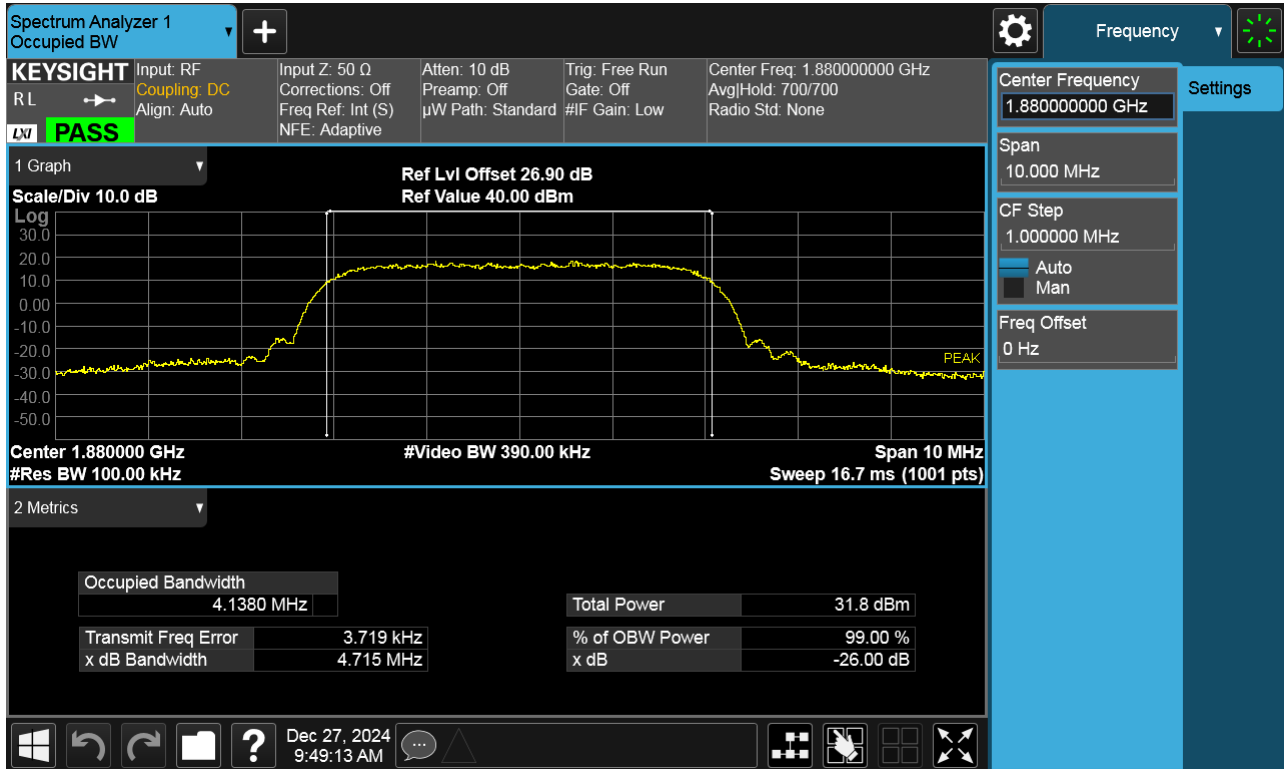
■ WCDMA850MODE (4233 CH.) Occupied Bandwidth



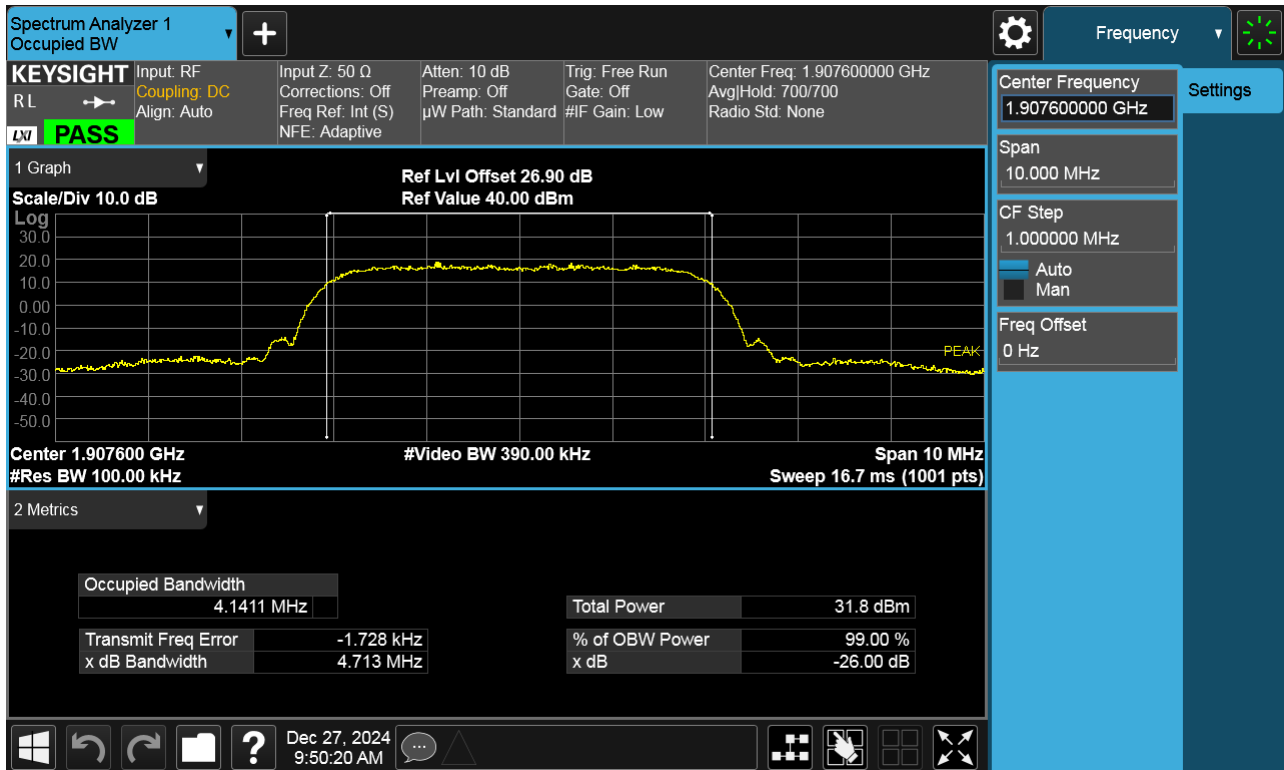
■ WCDMA1900 MODE (9262 CH.) Occupied Bandwidth



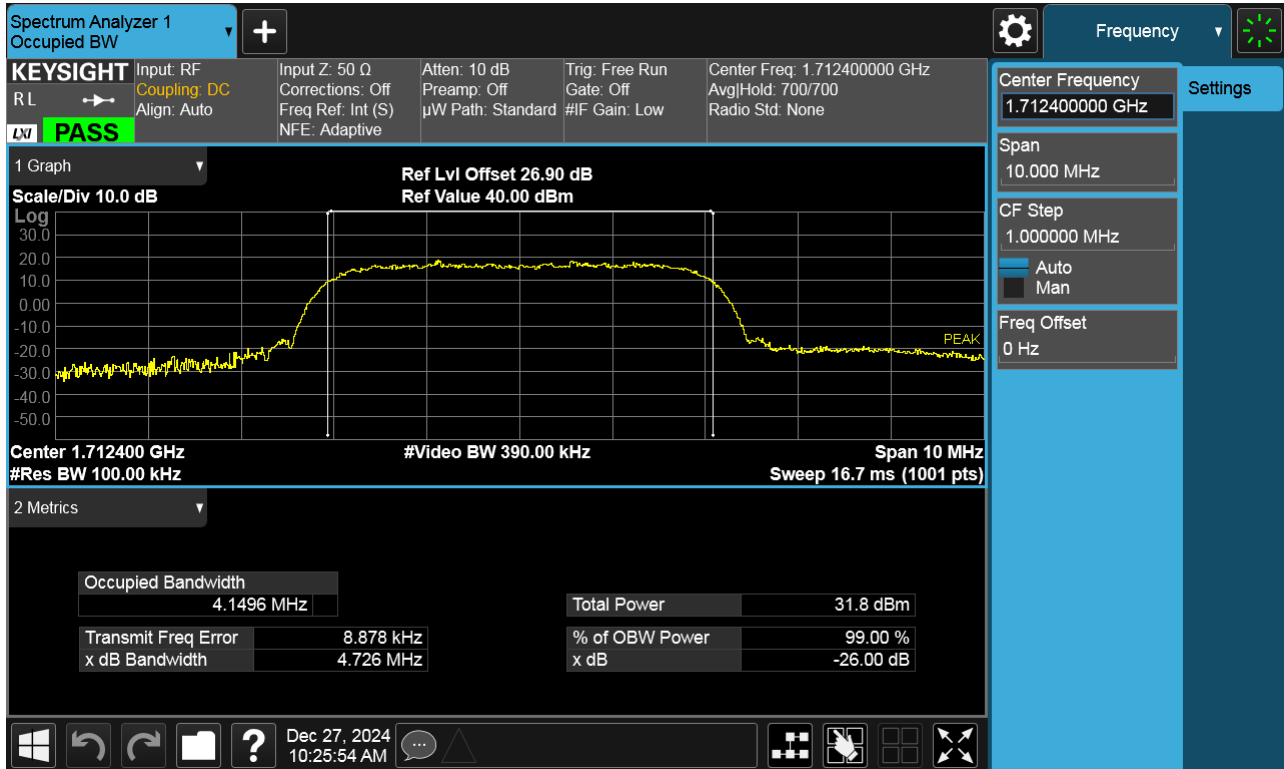
■ WCDMA1900 MODE (9400 CH.) Occupied Bandwidth



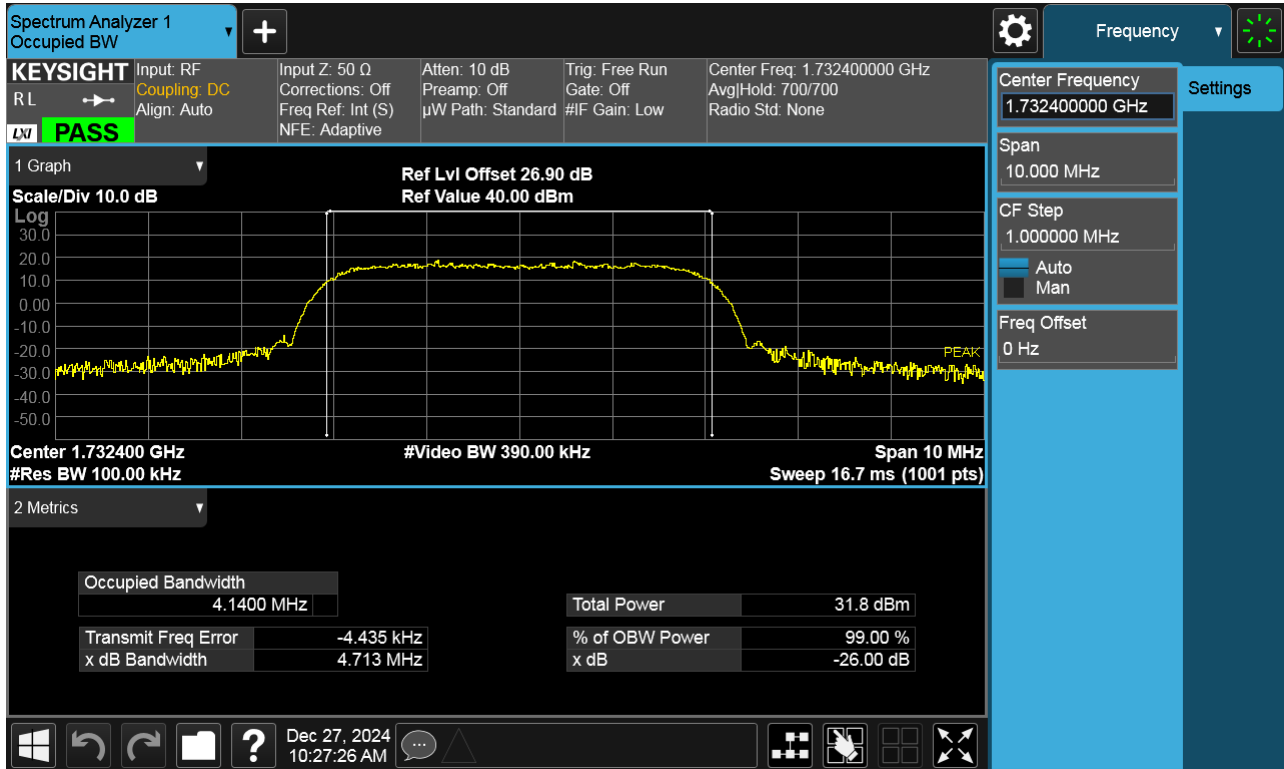
WCDMA1900 MODE (9538 CH.) Occupied Bandwidth



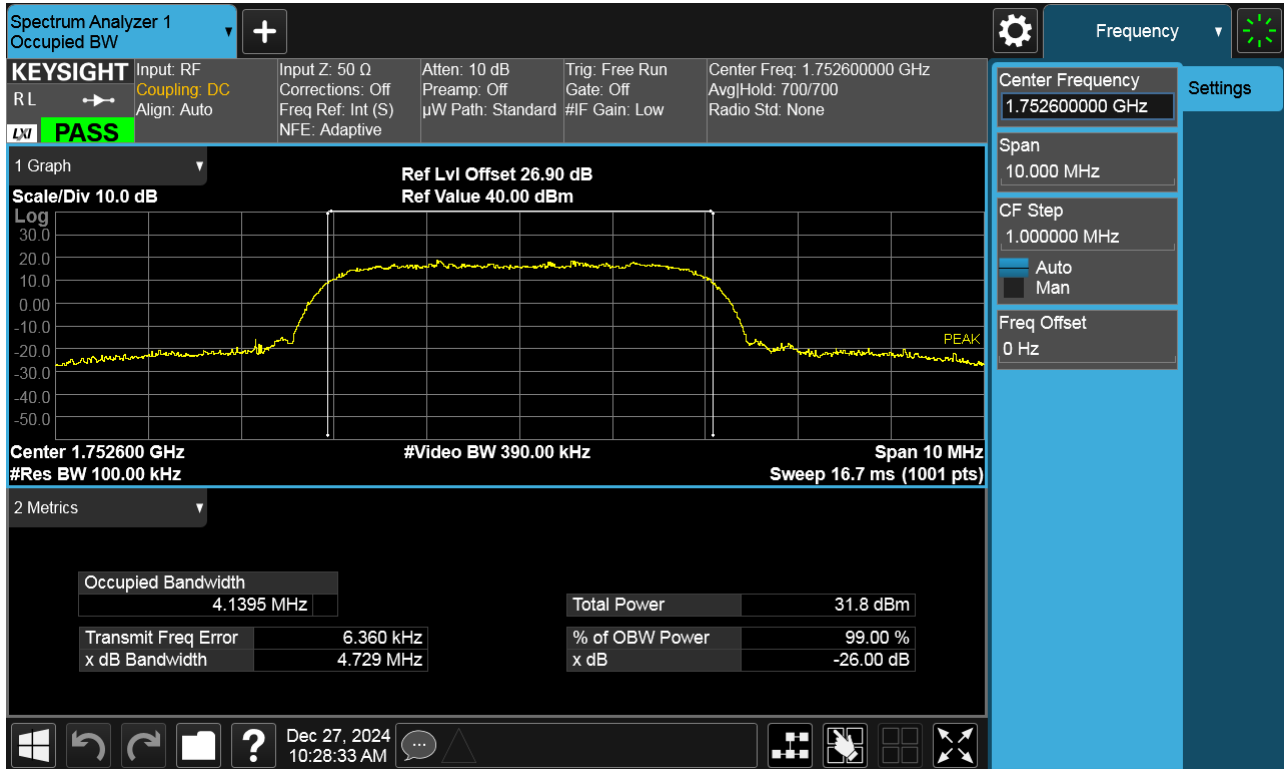
■ WCDMA1700 MODE (1312 CH.) Occupied Bandwidth



■ WCDMA1700 MODE (1412 CH.) Occupied Bandwidth



■ WCDMA1700 MODE (1513 CH.) Occupied Bandwidth



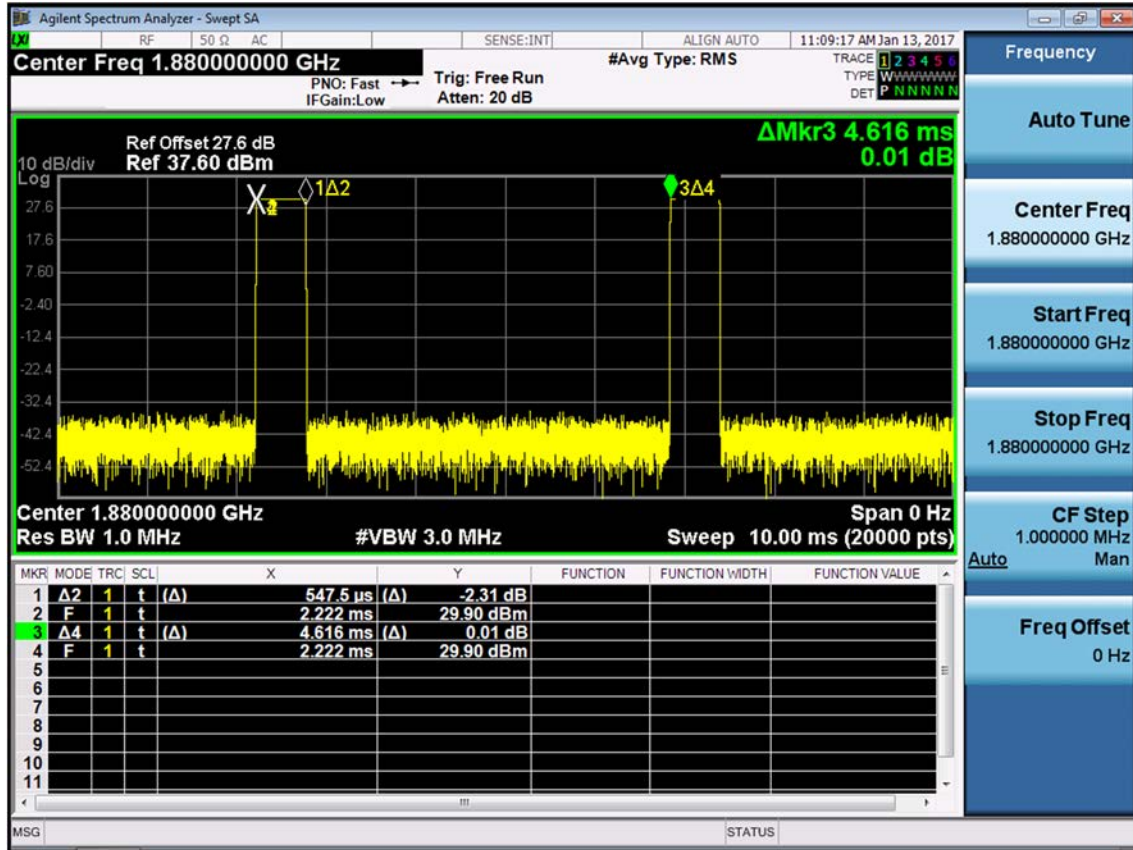
■ GSM1900 MODE (661 CH.) Peak-to-Average Ratio P_{PK}



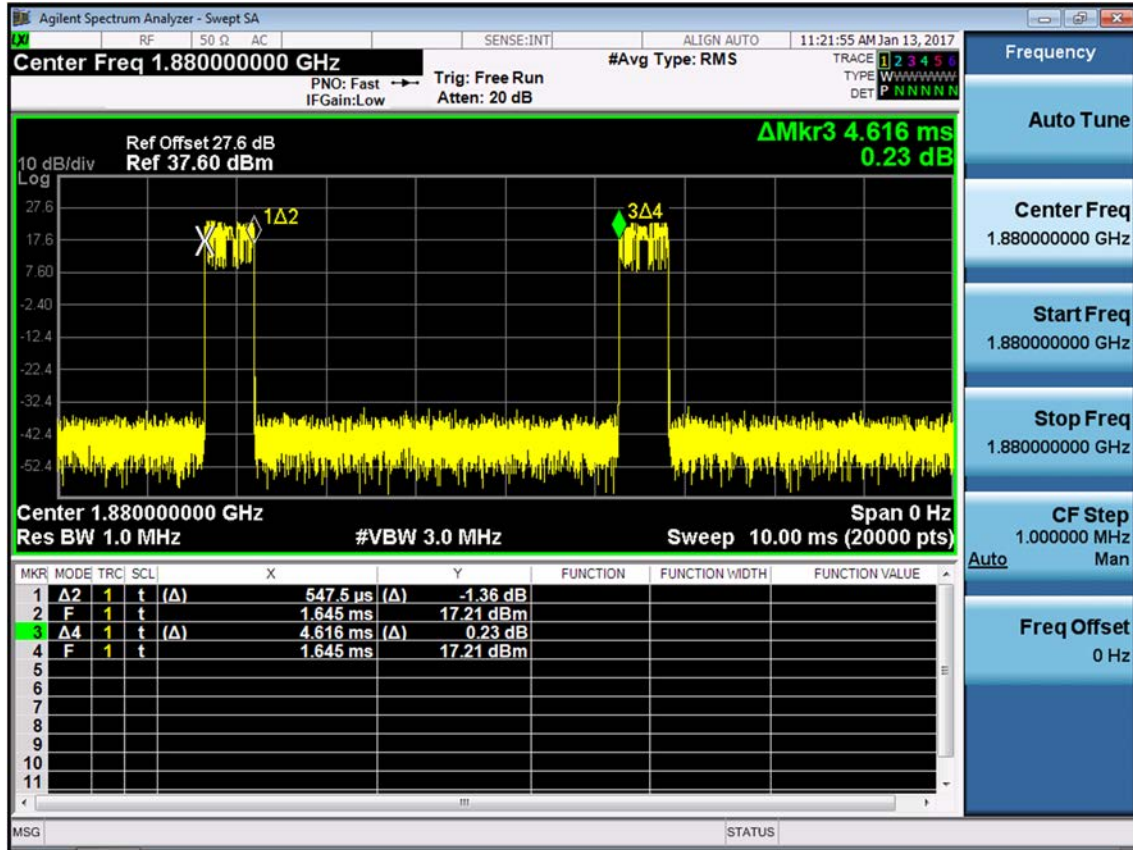
■ GSM1900 MODE (661 CH.) Peak-to-Average Ratio P_{Avg}



■ GSM1900 MODE (661 CH.) Peak-to-Average Ratio Duty



■ GSM1900 EDGE (661 CH.) Peak-to-Average Ratio Duty



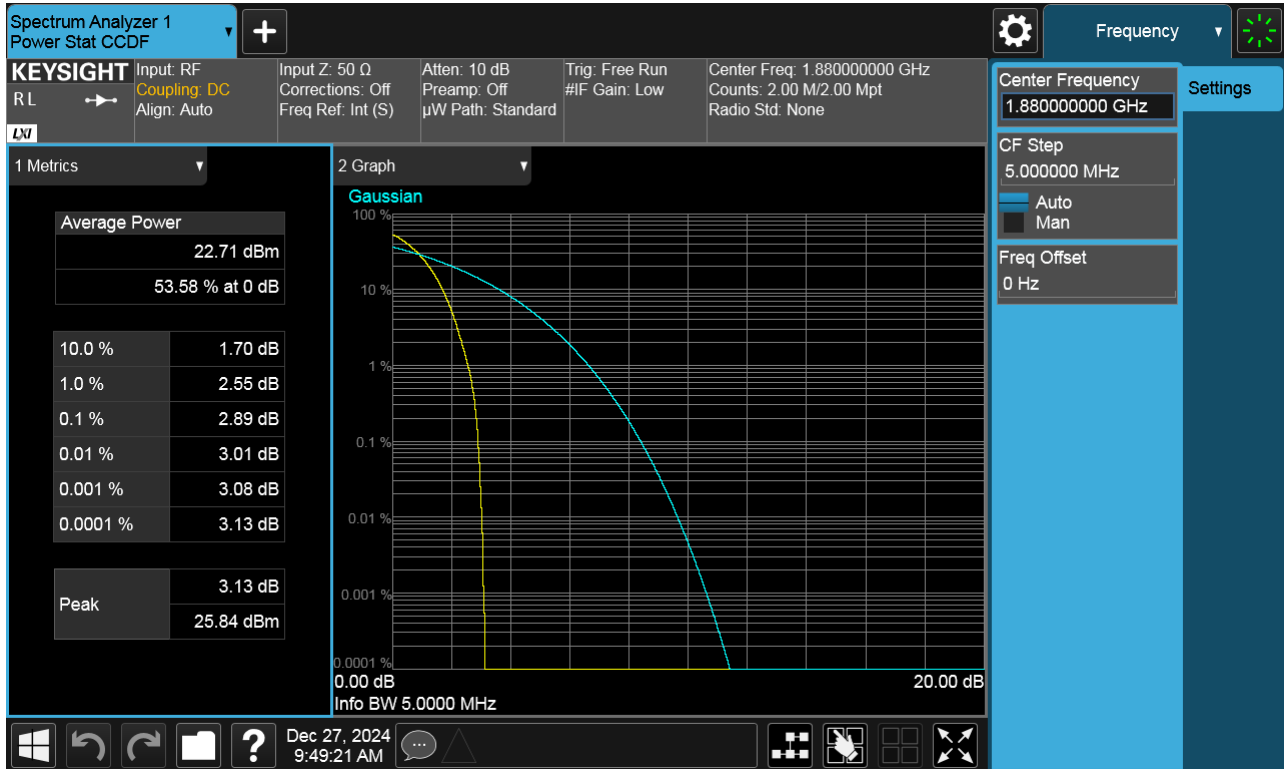
■ GSM1900 EDGE (661 CH.) Peak-to-Average Ratio P_{Pk}



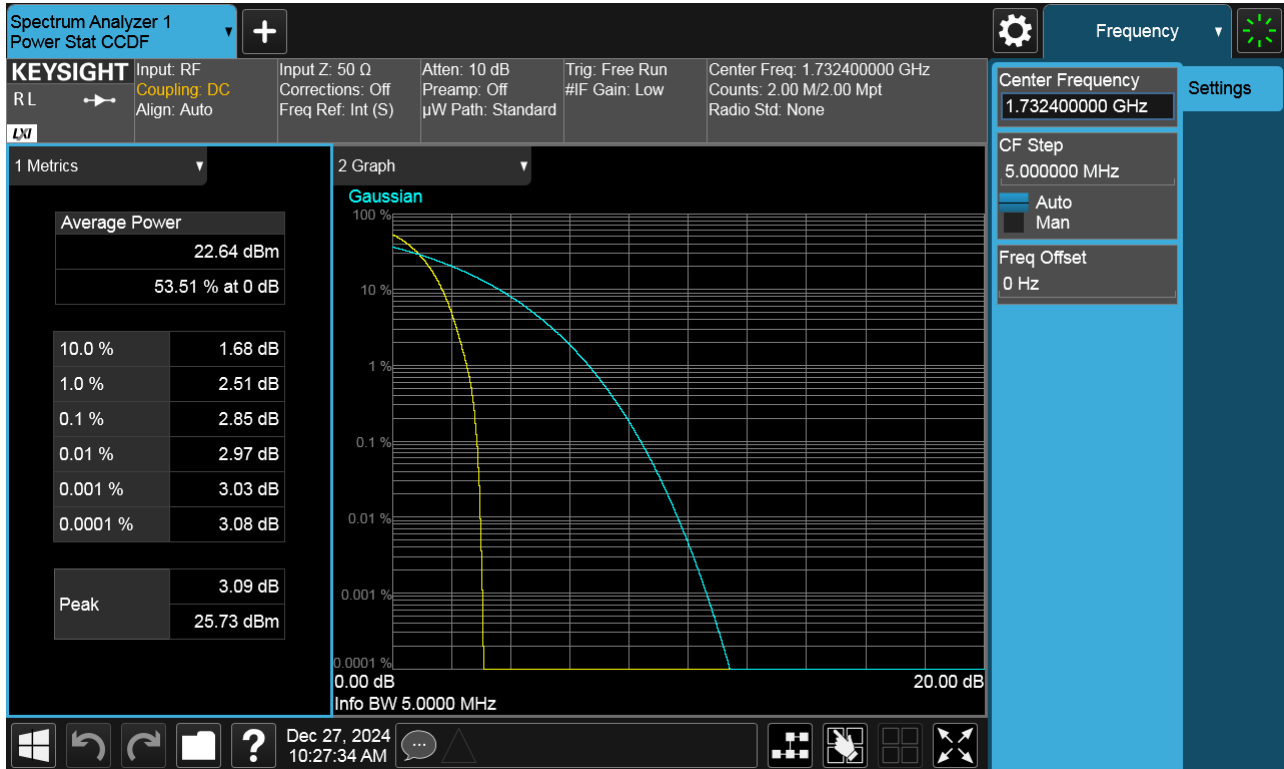
■ GSM1900 EDGE (661 CH.) Peak-to-Average Ratio P_{Avg}



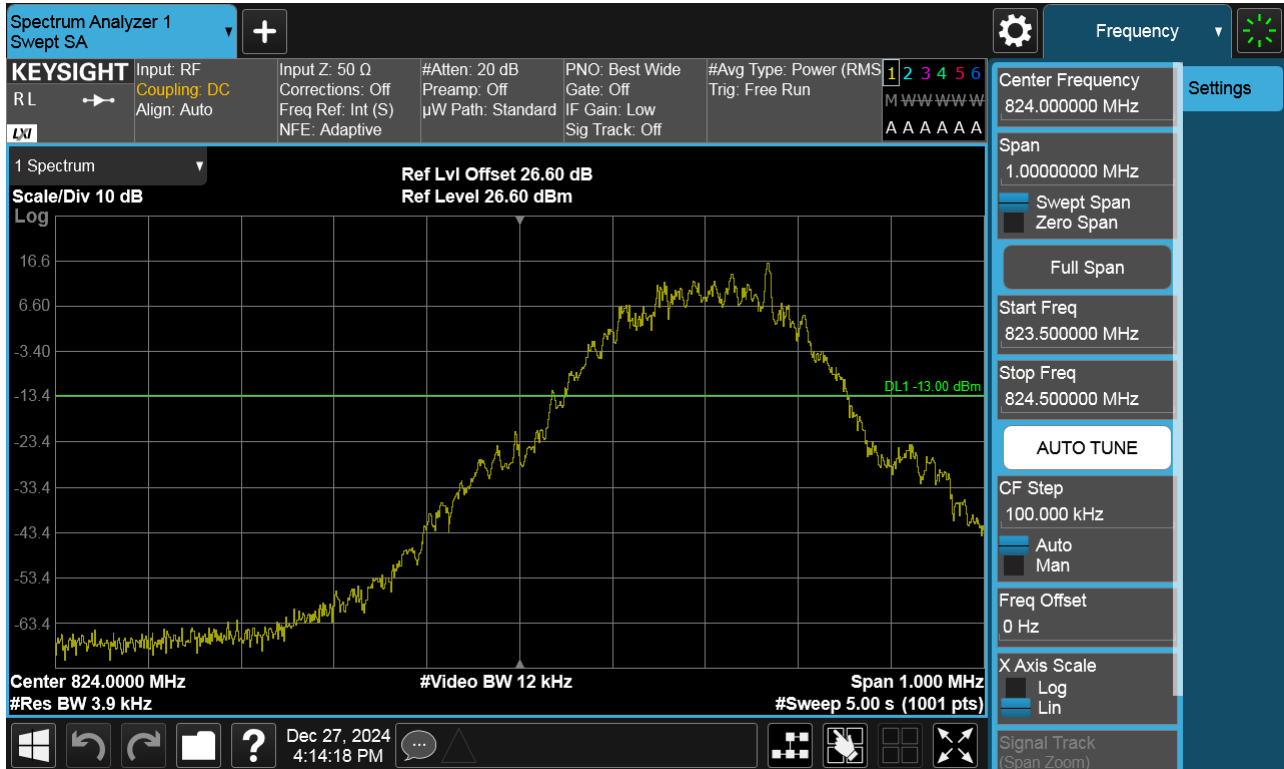
■ WCDMA1900 MODE (9400 CH.) Peak-to-Average Ratio



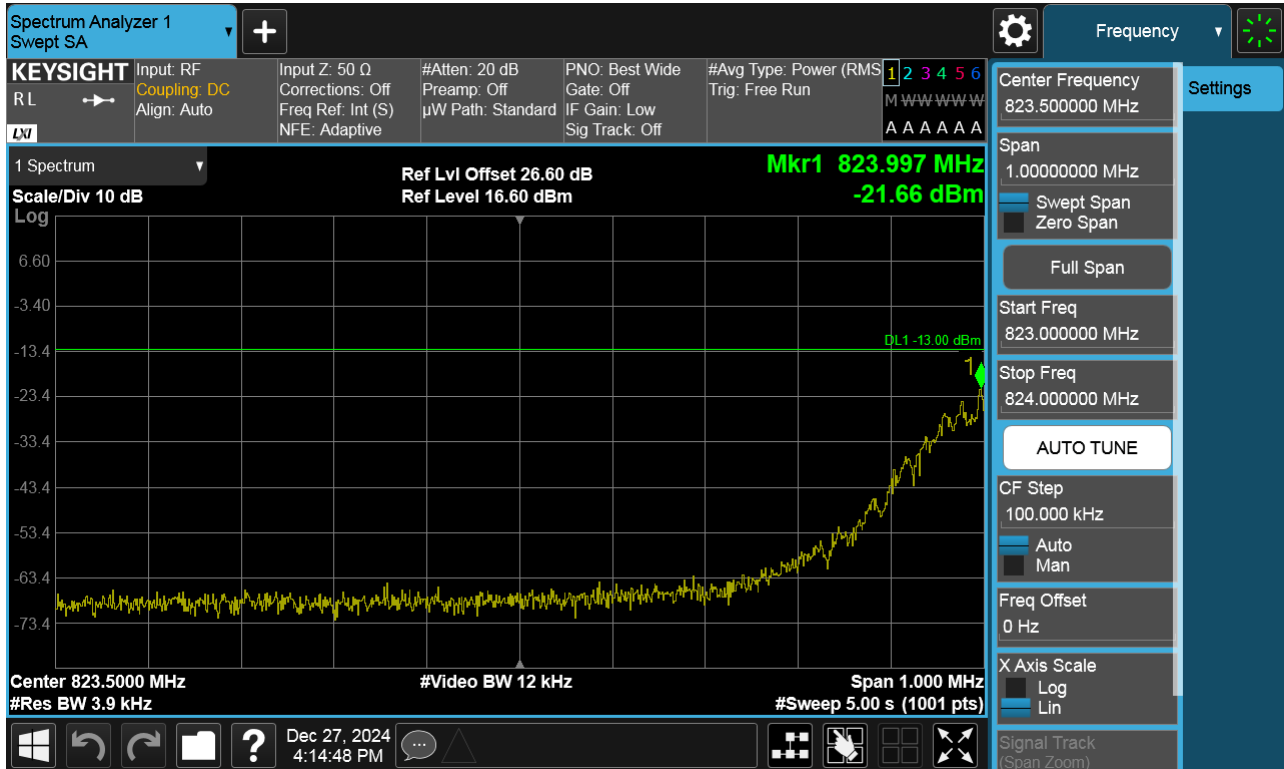
WCDMA1700 MODE (1412 CH.) Peak-to-Average Ratio



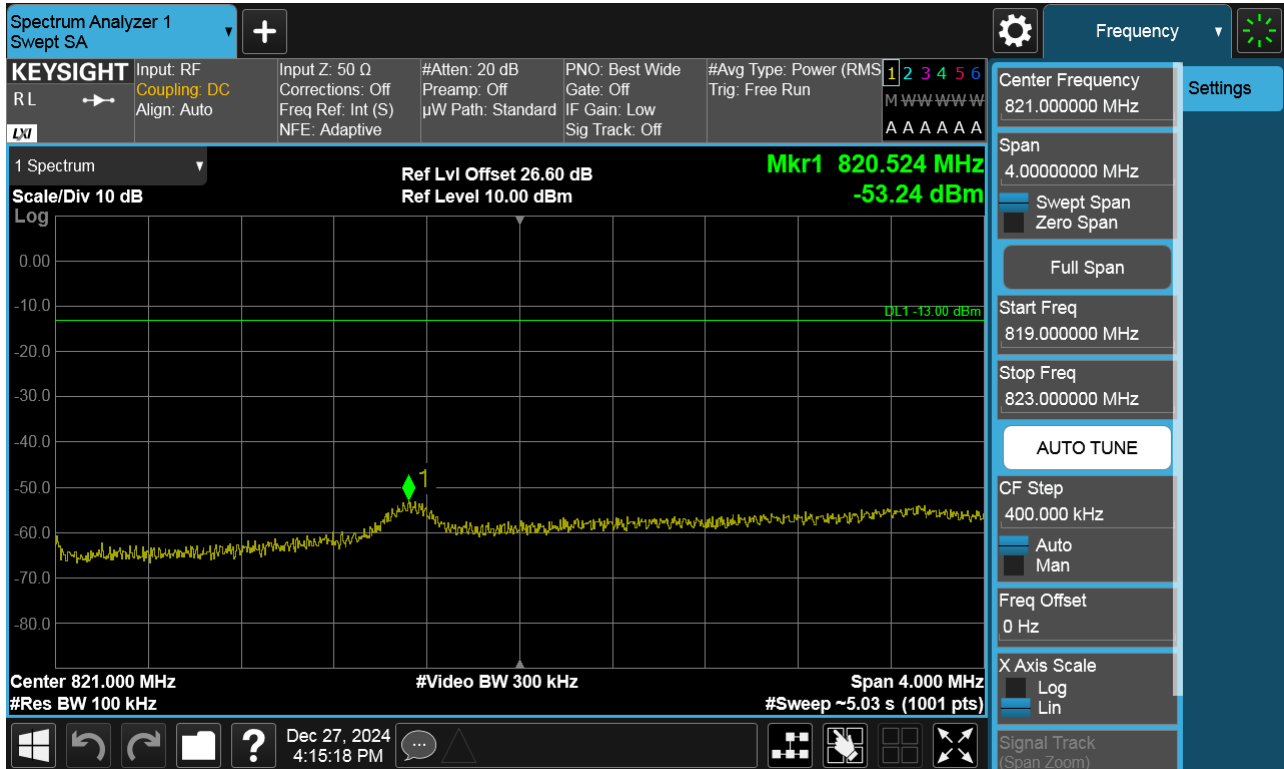
■ GSM850 MODE (128 CH.) Block Edge 1



■ GSM850 MODE (128 CH.) Block Edge 2



■ GSM850 MODE (128 CH.) Block Edge 3



■ GSM850 MODE (251 CH.) Block Edge 1



Keysight Spectrum Analyzer 1
Swept SA

KEYSIGHT Input: RF
RL **Coupling: DC**
Align: Auto

Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive

#Atten: 20 dB
Preamp: Off
 μ W Path: Standard

PNO: Best Wide
Gate: Off
IF Gain: Low
Sig Track: Off

#Avg Type: Power (RMS)
Trig: Free Run

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

Center Frequency
849.500000 MHz

Span
1.00000000 MHz

Swept Span
Zero Span

Full Span

Start Freq
849.000000 MHz

Stop Freq
850.000000 MHz

AUTO TUNE

CF Step
100.000 kHz

Auto
Man

Freq Offset
0 Hz

X Axis Scale
Log
Lin

Signal Track
(Span Zoom)

1 Spectrum
Scale/Div 10 dB
Log

Ref Lvl Offset 26.60 dB
Ref Level 16.60 dBm

Mkr1 849.019 MHz
-23.33 dBm

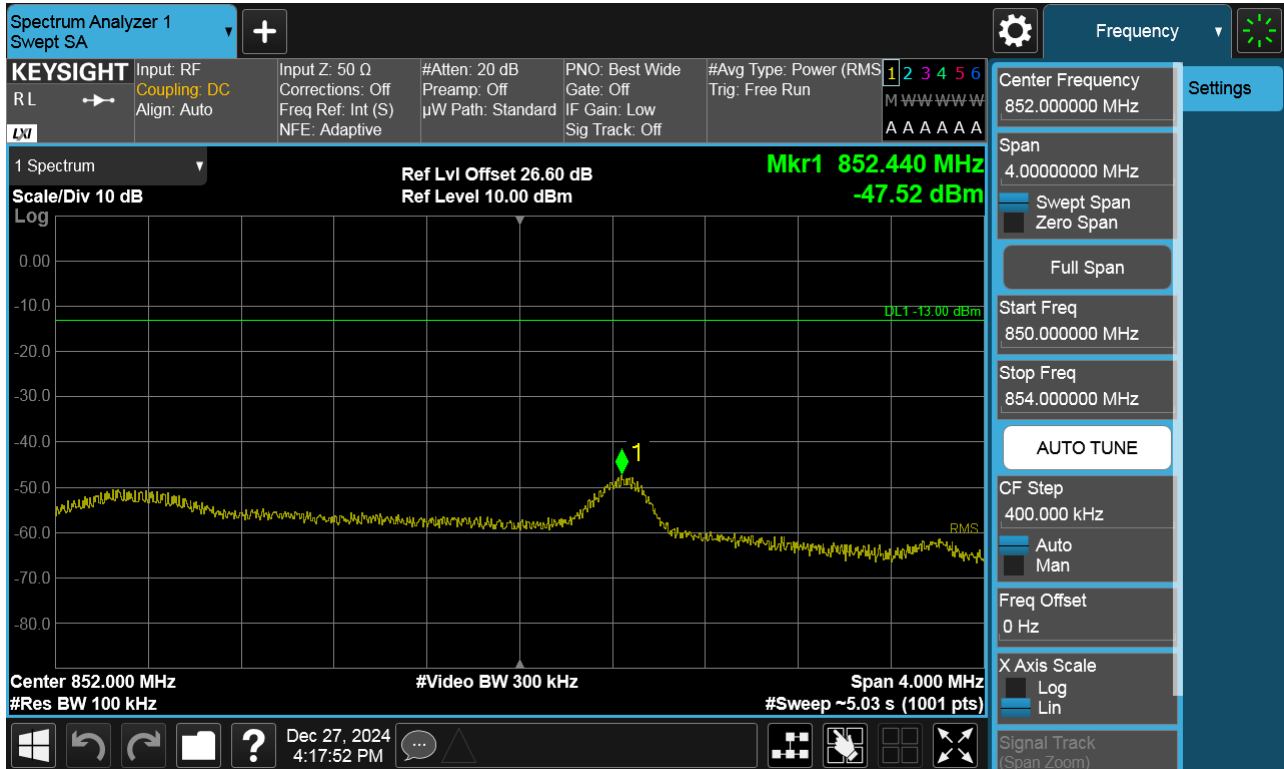
DL1 -13.00 dBm

Center 849.5000 MHz
#Res BW 3.9 kHz

#Video BW 12 kHz

Span 1.000 MHz
#Sweep 5.00 s (1001 pts)

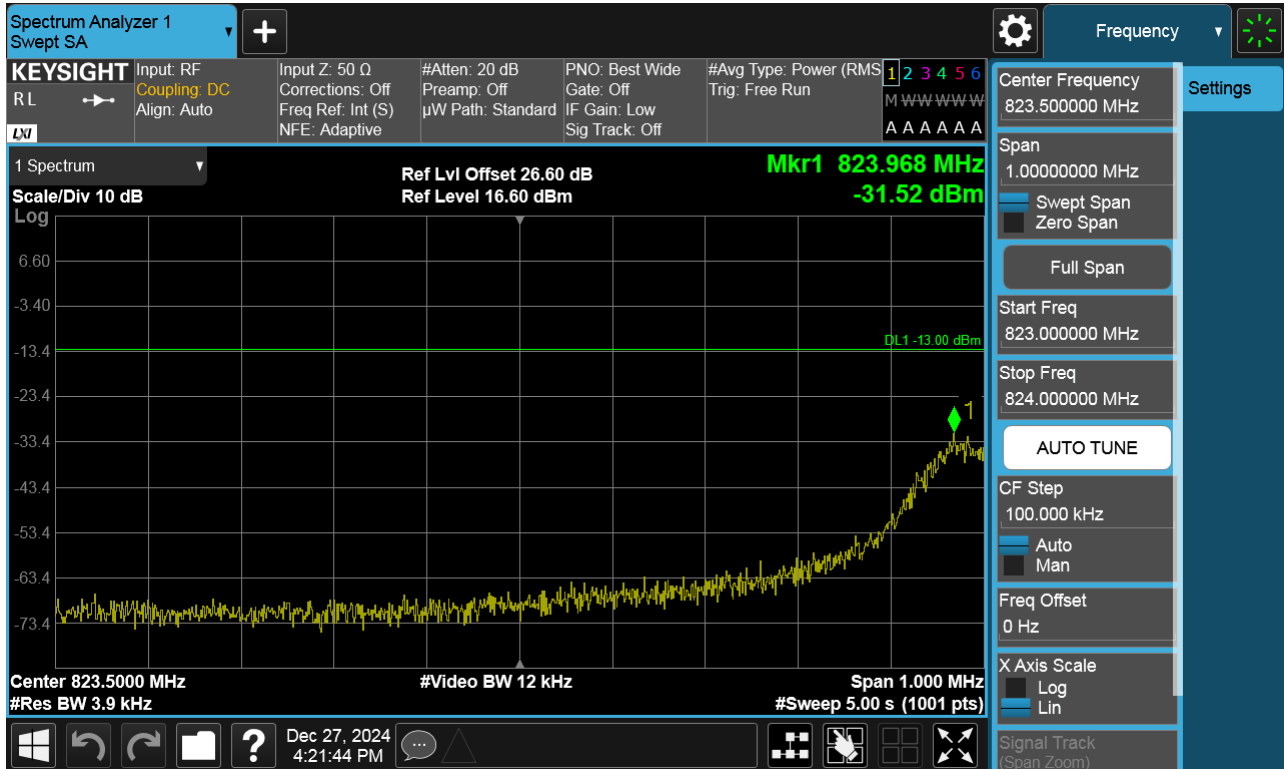
■ GSM850 MODE (251 CH.) Block Edge 3



■ GSM850 EDGE MODE (128 CH.) Block Edge 1



■ GSM850 EDGE MODE (128 CH.) Block Edge 2



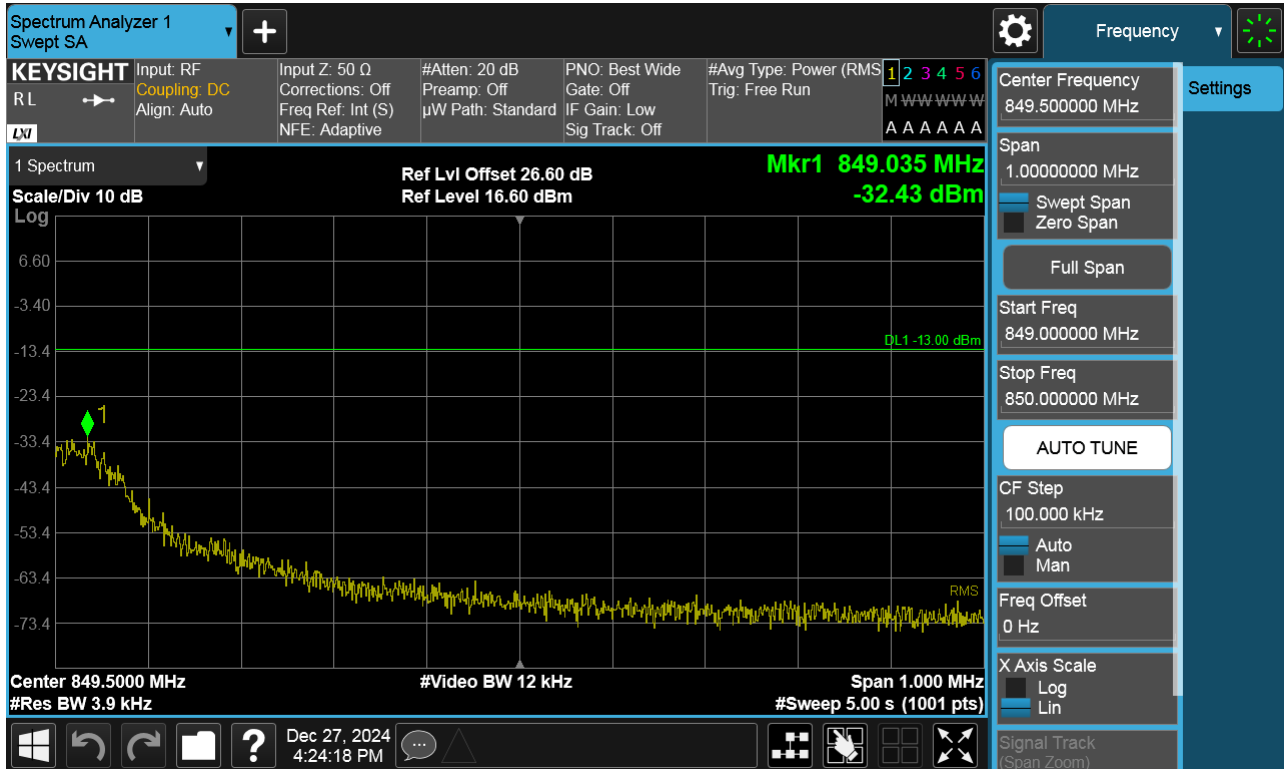
■ GSM850 EDGE MODE (128 CH.) Block Edge 3



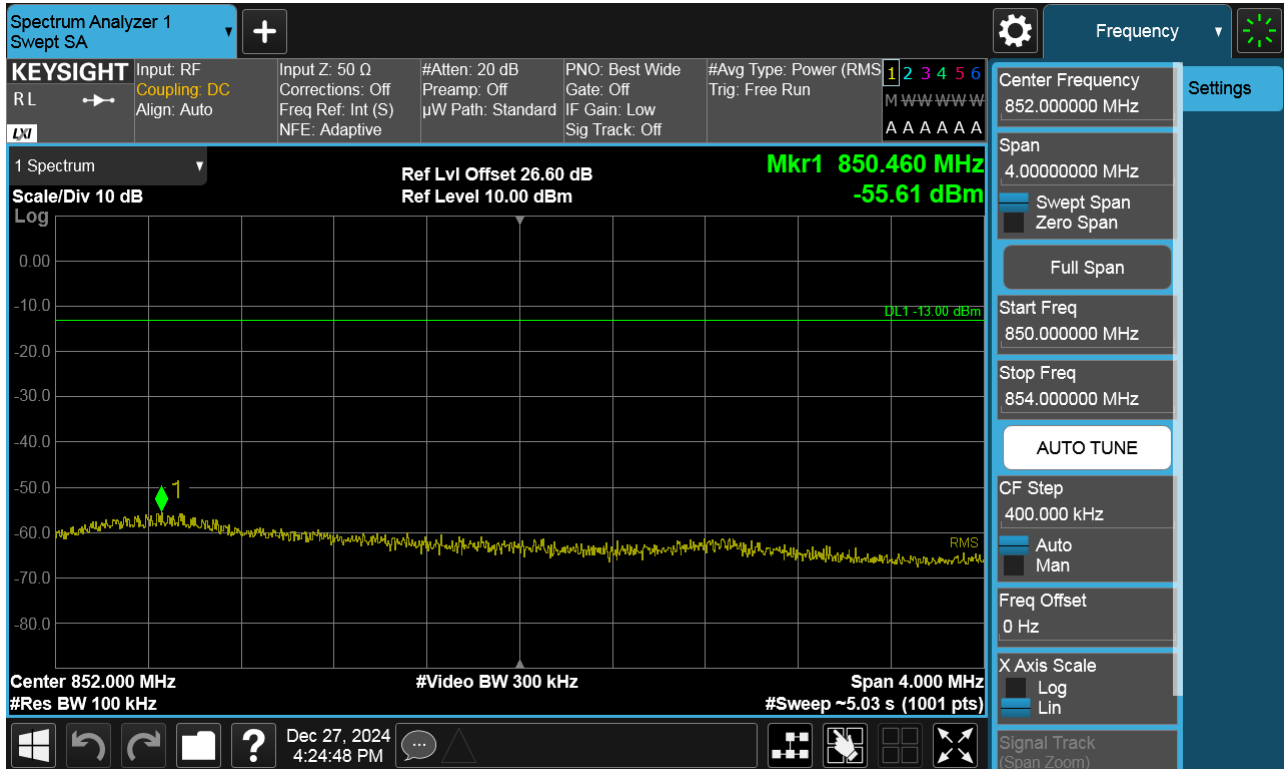
■ GSM850 EDGE MODE (251 CH.) Block Edge 1



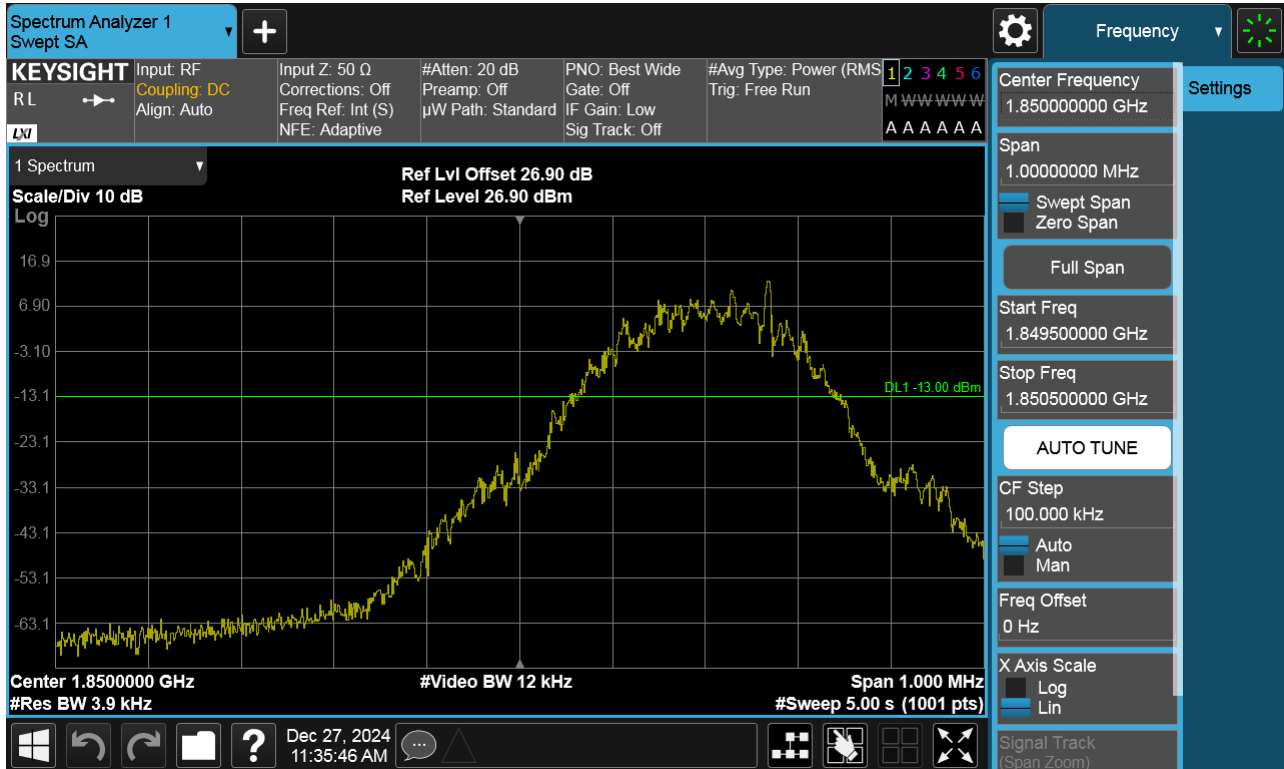
■ GSM850 EDGE MODE (251 CH.) Block Edge 2



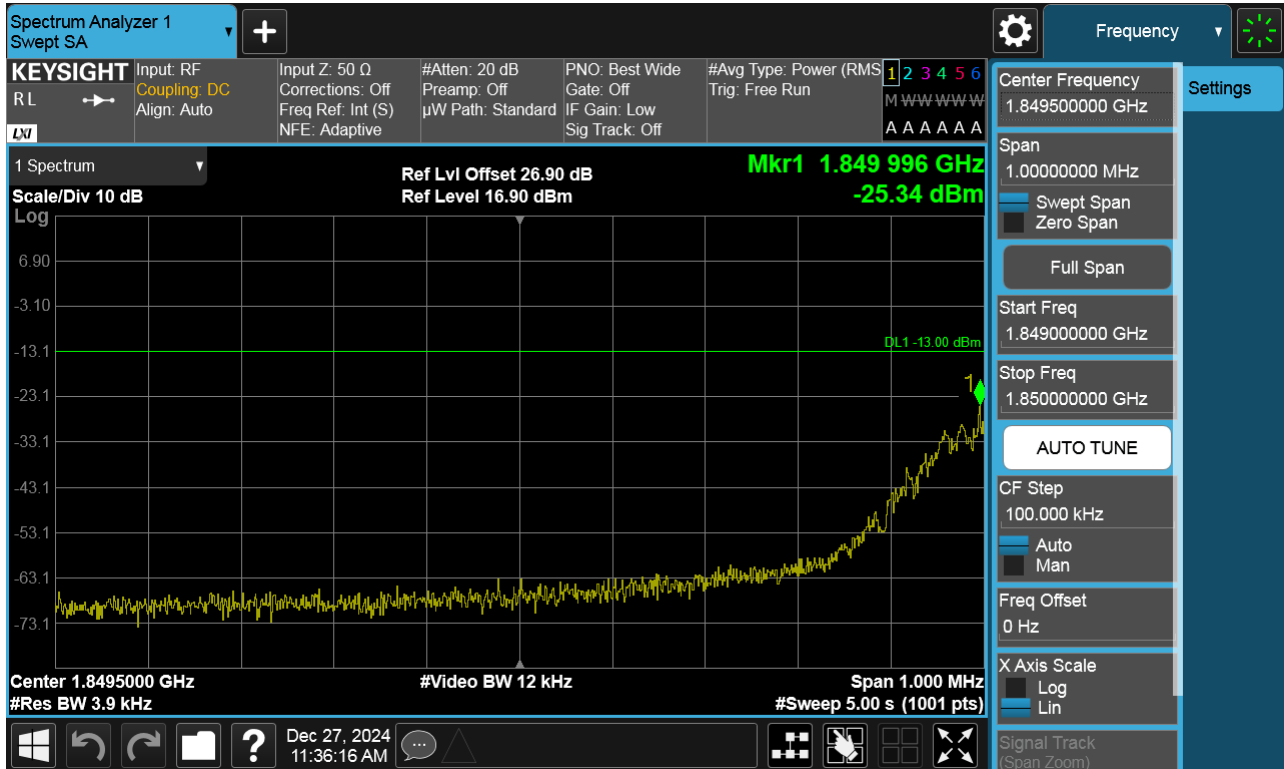
■ GSM850 EDGE MODE (251 CH.) Block Edge 3



■ GSM1900 MODE (512 CH.) Block Edge 1



■ GSM1900 MODE (512 CH.) Block Edge 2



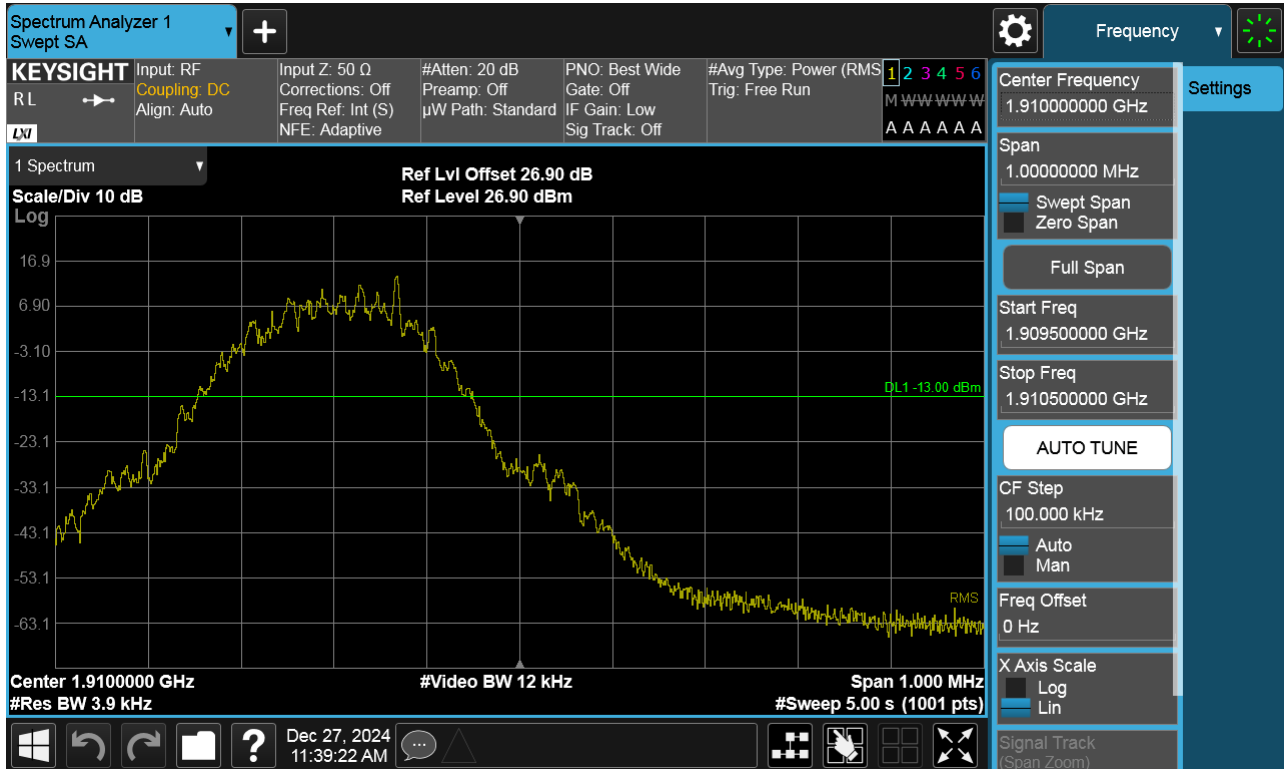
■ GSM1900 MODE (512 CH.) Block Edge 3



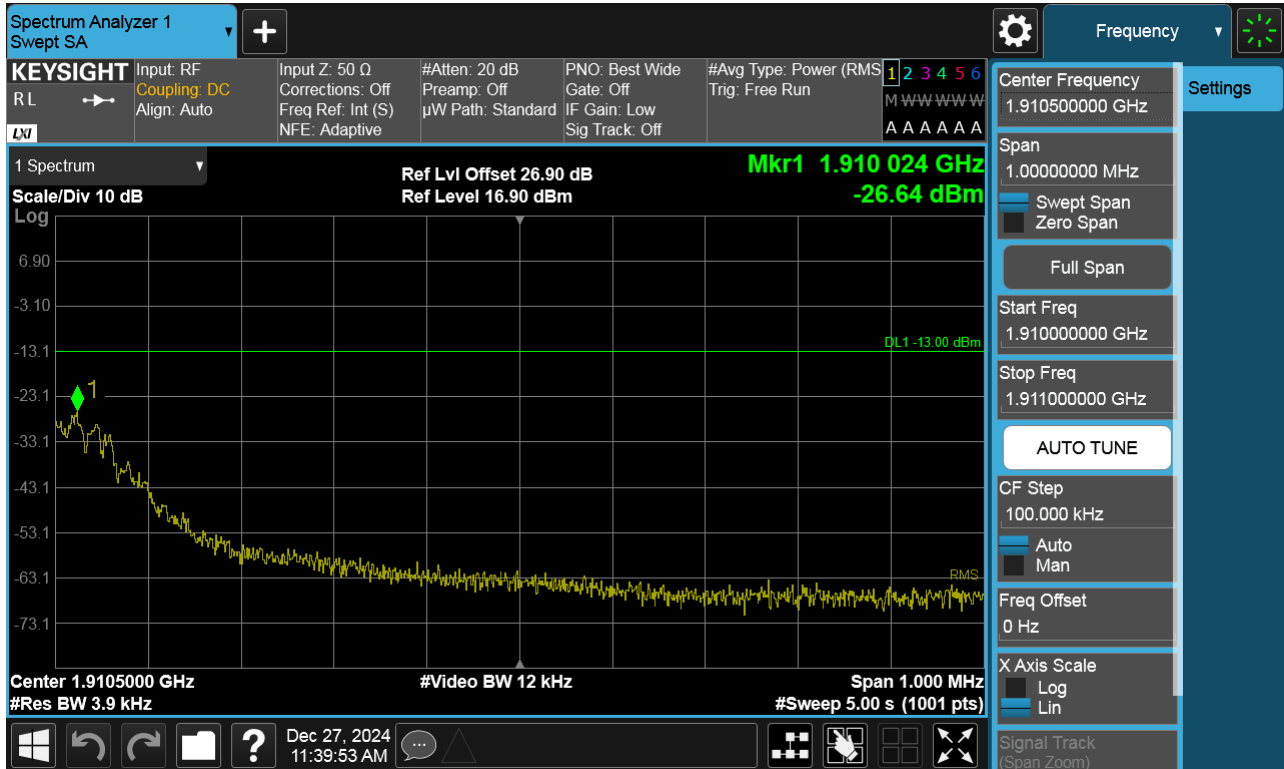
Note : We used a narrower RBW in order to increase accuracy.

Calculation = Reading Value + 10 x log(1 MHz/100 kHz) dB = 54.70 dBm + 10 dB = -44.70 dBm

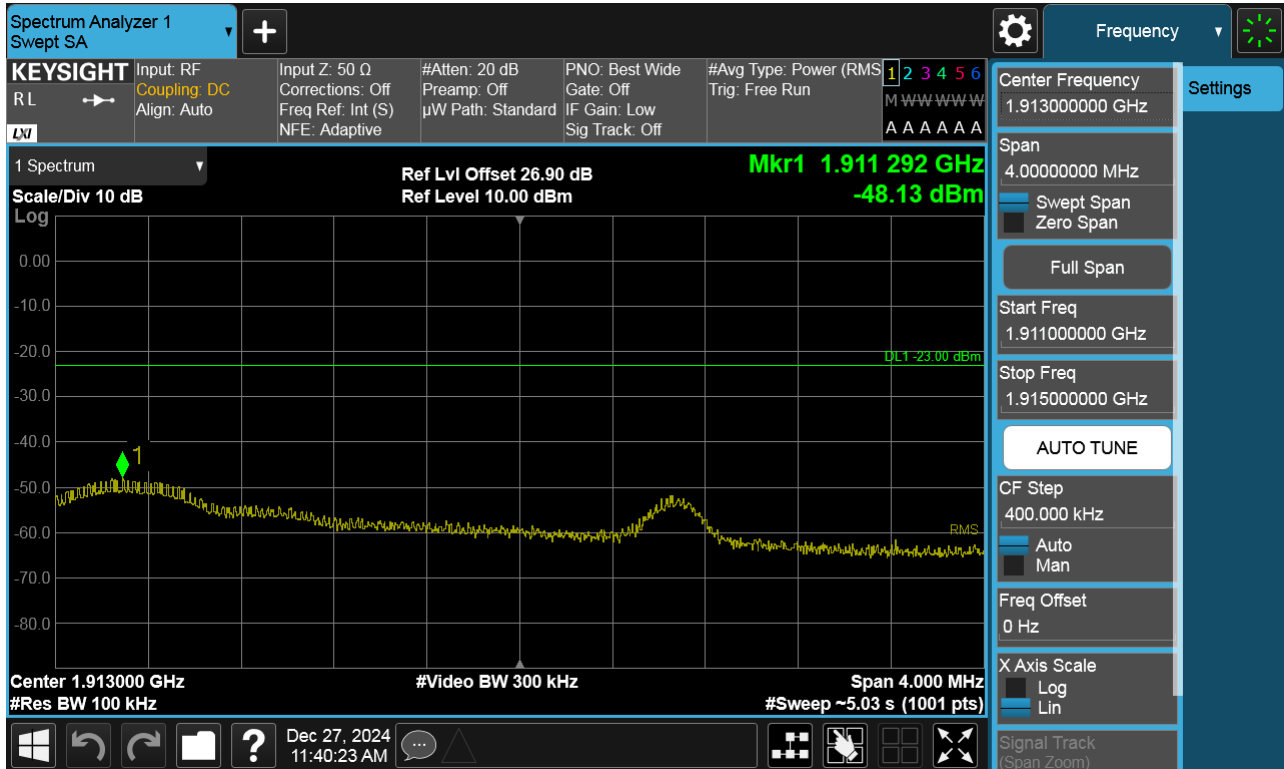
■ GSM1900 MODE (810 CH.) Block Edge 1



■ GSM1900 MODE (810 CH.) Block Edge 2



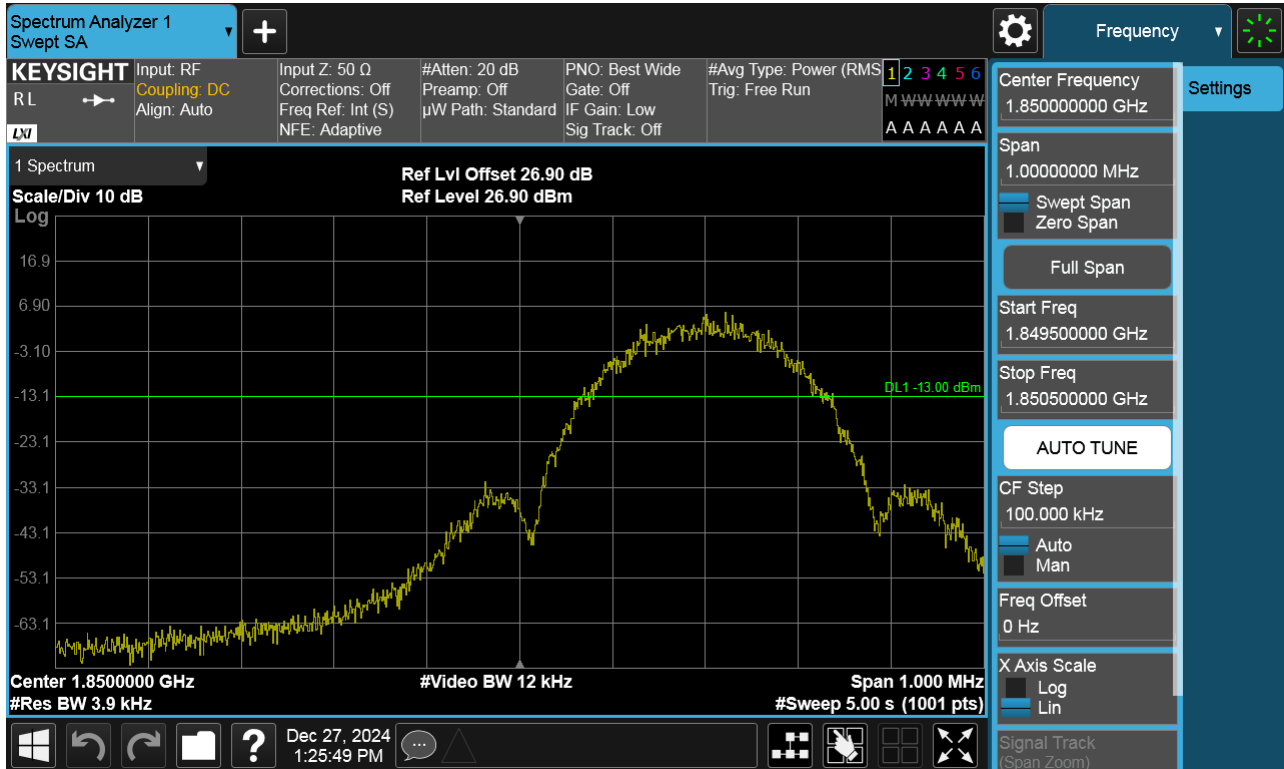
■ GSM1900 MODE (810 CH.) Block Edge 3



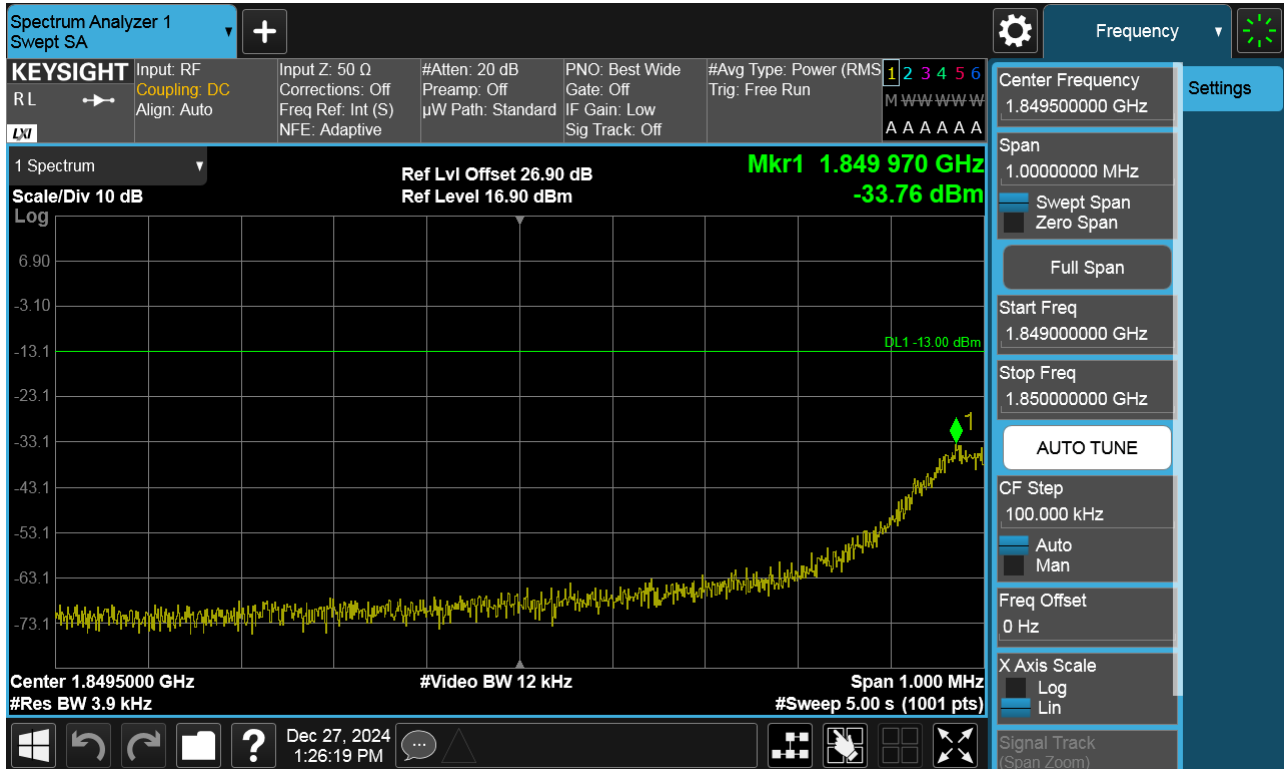
Note : We used a narrower RBW in order to increase accuracy.

$$\text{Calculation} = \text{Reading Value} + 10 \times \log(1 \text{ MHz}/100 \text{ kHz}) \text{ dB} = -48.13 \text{ dBm} + 10 \text{ dB} = -38.13 \text{ dBm}$$

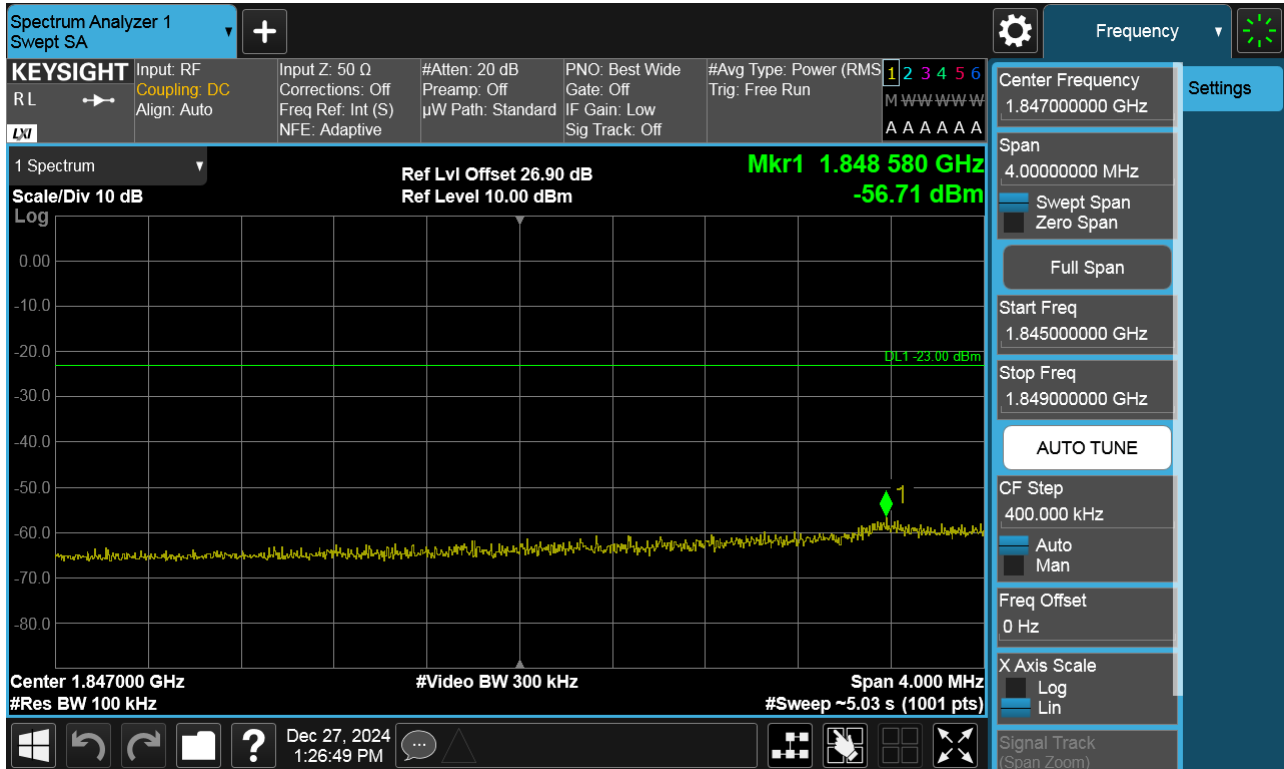
■ GSM1900 EDGE MODE (512 CH.) Block Edge 1



■ GSM1900 EDGE MODE (512 CH.) Block Edge 2



■ GSM1900 EDGE MODE (512 CH.) Block Edge 3



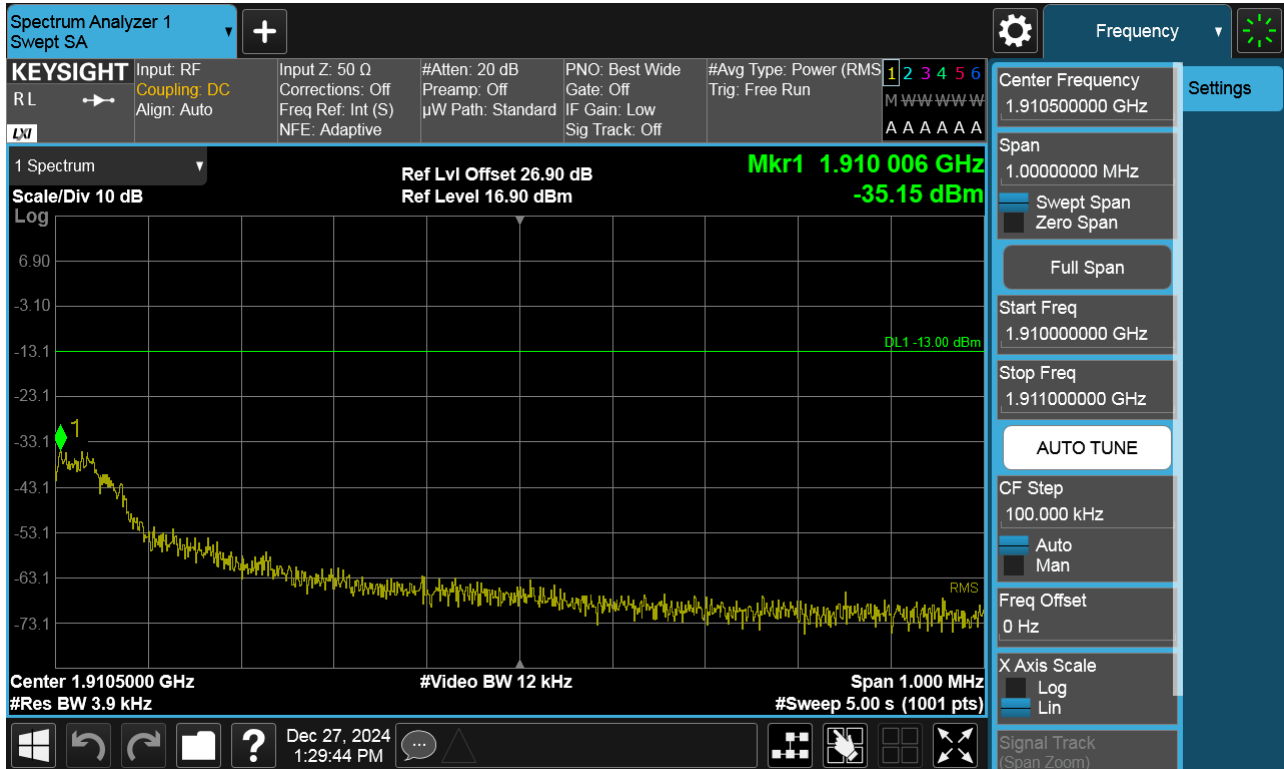
Note : We used a narrower RBW in order to increase accuracy.

$$\text{Calculation} = \text{Reading Value} + 10 \times \log(1 \text{ MHz}/100 \text{ kHz}) \text{ dB} = -56.71 \text{ dBm} + 10 \text{ dB} = -46.71 \text{ dBm}$$

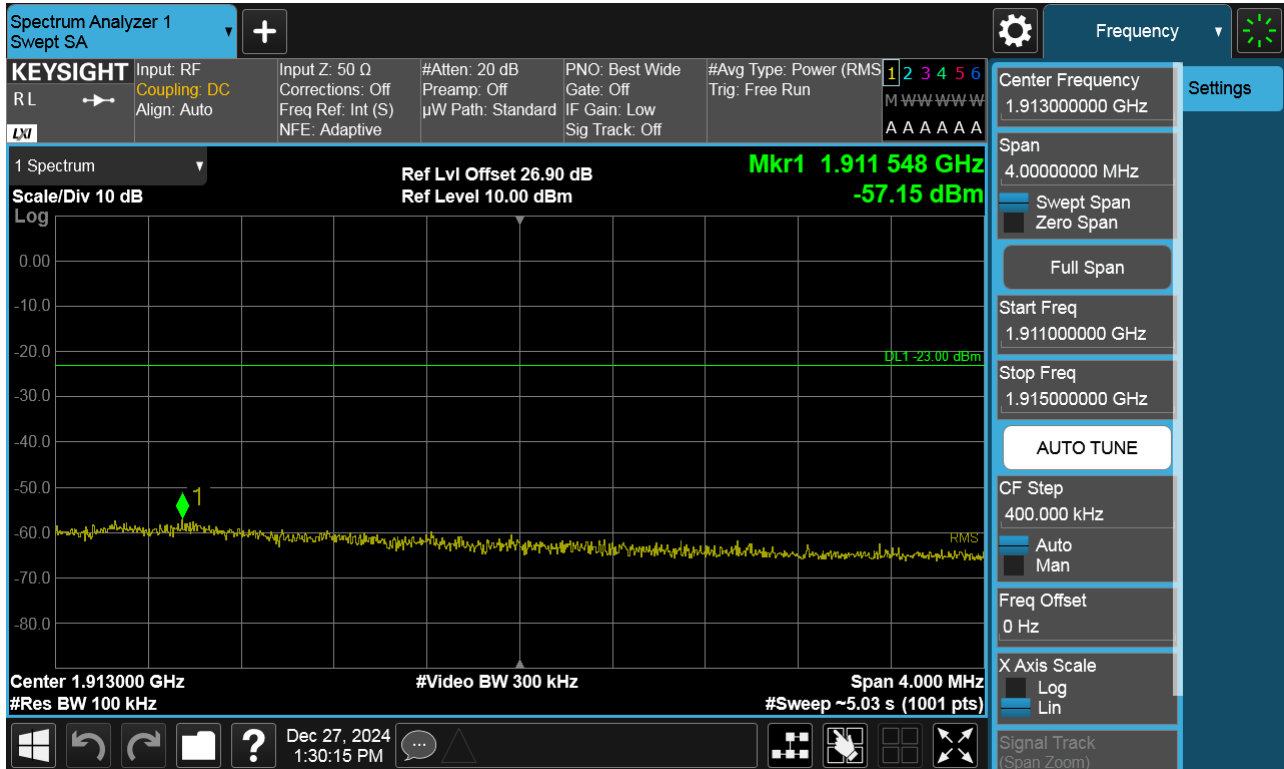
■ GSM1900 EDGE MODE (810 CH.) Block Edge 1



■ GSM1900 EDGE MODE (810 CH.) Block Edge 2



■ GSM1900 EDGE MODE (810 CH.) Block Edge 3



Note : We used a narrower RBW in order to increase accuracy.

Calculation = Reading Value + 10 x log(1 MHz/100 kHz) dB = -57.15 dBm + 10 dB = -47.15 dBm

■ WCDMA850 MODE (4132 CH.) Block Edge



■ WCDMA850 MODE (4132 CH.) – 4 MHz Span



■ WCDMA850MODE (4233 CH.) Block Edge



■ WCDMA850MODE (4233 CH.) – 4 MHz Span



■ WCDMA1900 MODE (9262 CH.) Block Edge



WCDMA1900 MODE (9262 CH.) – 4 MHz Span



WCDMA1900 MODE (9538 CH.) Block Edge



■ WCDMA1900 MODE (9538 CH.) – 4 MHz Span



■ WCDMA1700 MODE (1312 CH.) Block Edge



■ WCDMA1700 MODE (1312 CH.) – 4 MHz Span



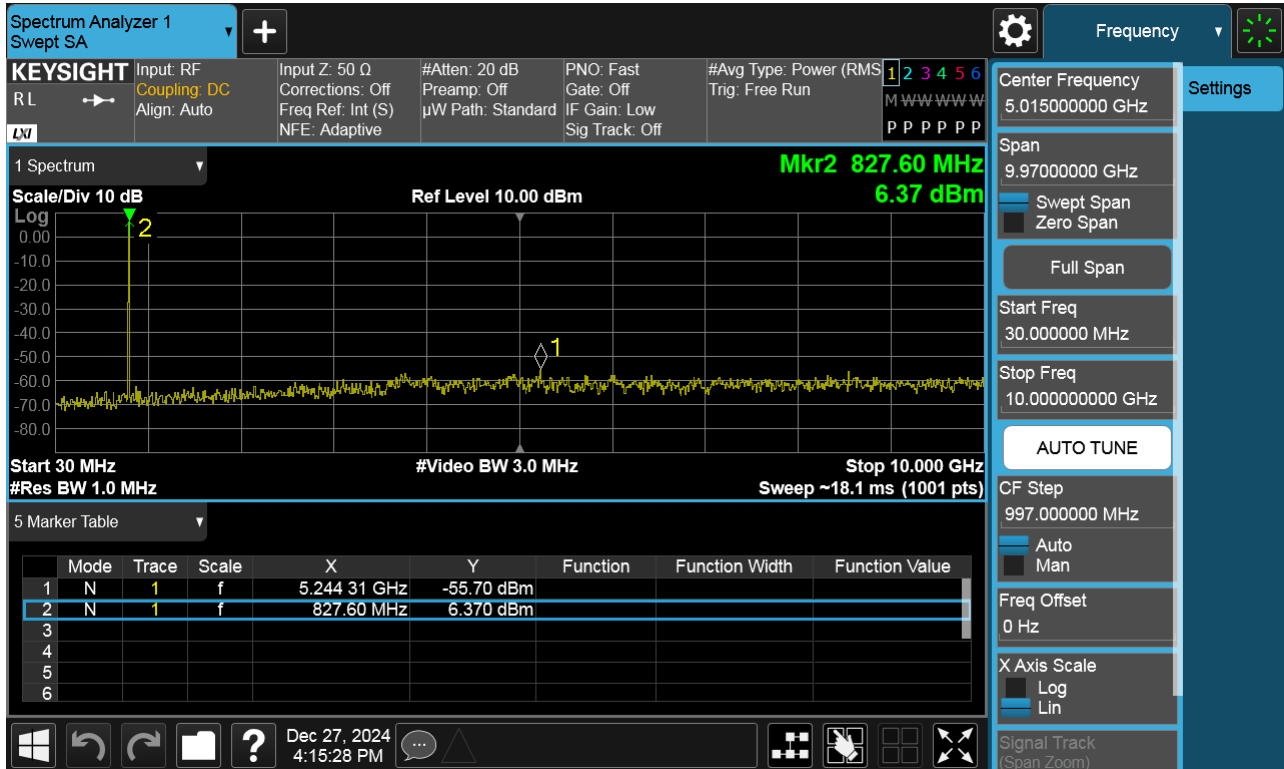
■ WCDMA1700 MODE (1513 CH.) Block Edge



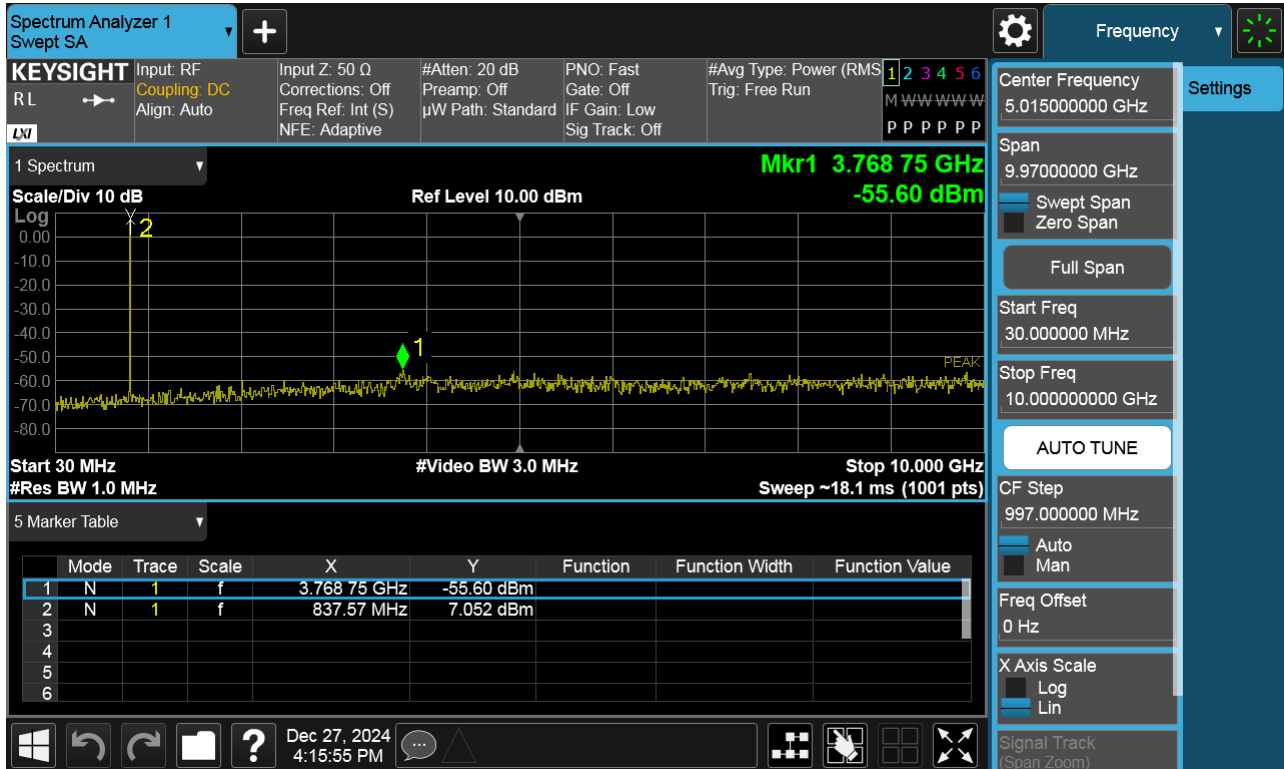
■ WCDMA1700 MODE (1513 CH.) – 4 MHz Span



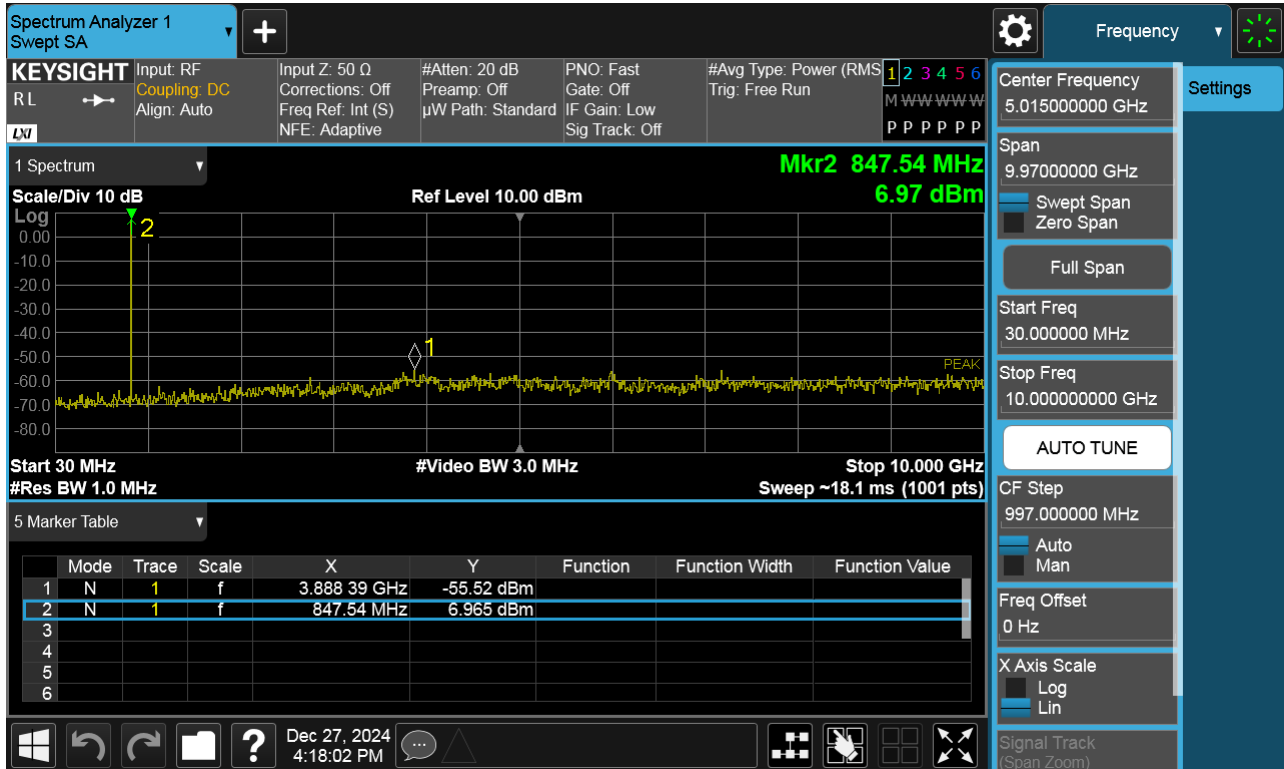
■ GSM850 MODE (128 CH.) Conducted Spurious Emissions



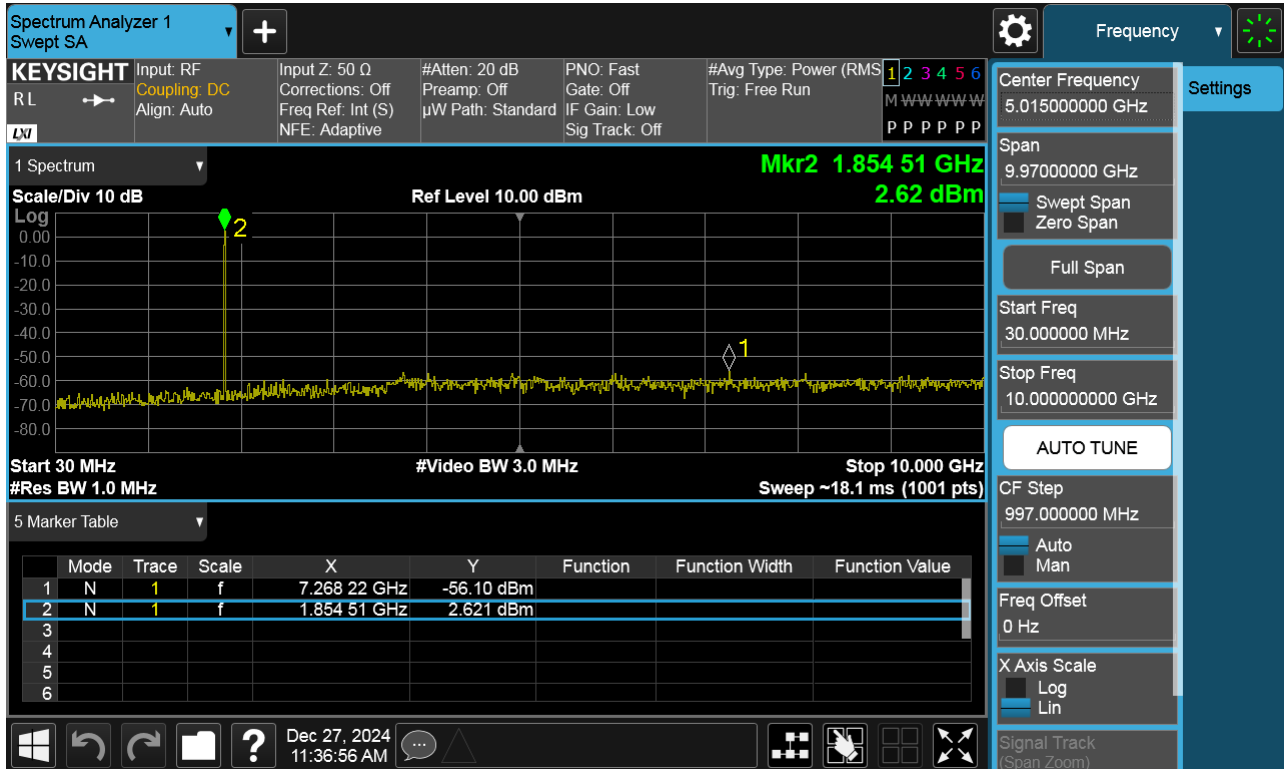
■ GSM850 MODE (190 CH.) Conducted Spurious Emissions



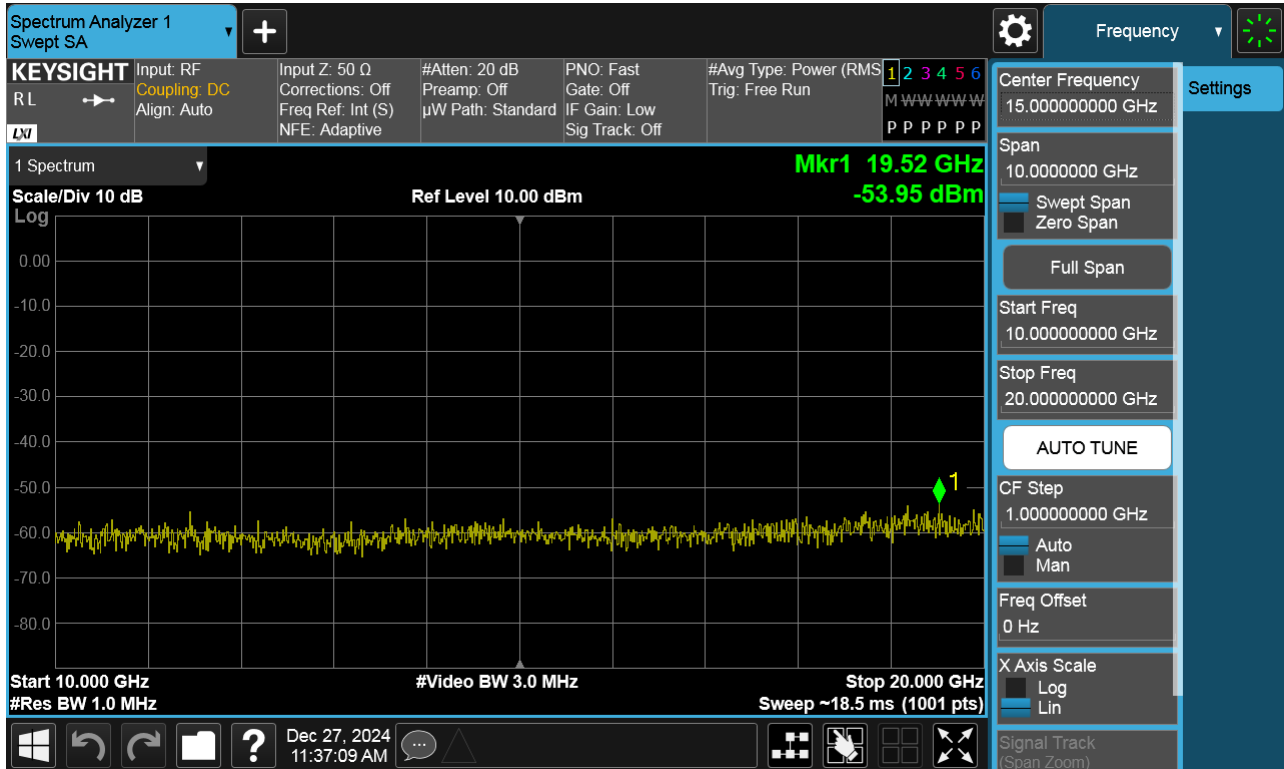
■ GSM850 MODE (251 CH.) Conducted Spurious Emissions



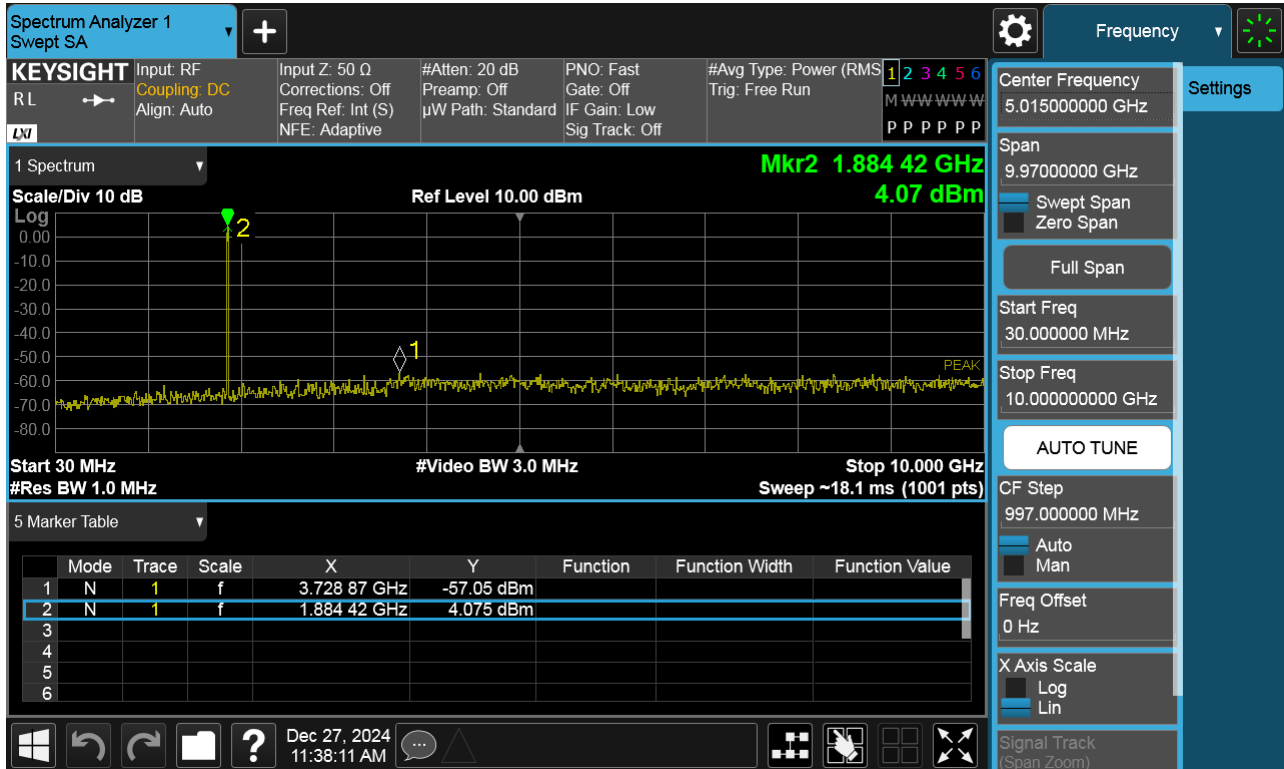
GSM1900 MODE (512 CH.) Conducted Spurious Emissions1



GSM1900 MODE (512 CH.) Conducted Spurious Emissions2



■ GSM1900 MODE (661 CH) Conducted Spurious Emissions1



■ GSM1900 MODE (661 CH.) Conducted Spurious Emissions2

