74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA
TEL: +82-31-645-6300 FAX: +82-31-645-6401

FCC GSM REPORT

FCC Certification

Applicant Name:
Suntech International Ltd.

Address:
B-1506, Greatvally, 32, 9-Gil, Digital-Ro,
Geumcheon-Gu, Seoul, Korea

Date of Issue:
November 10, 2015

Location:
HCT CO., LTD.,
74, Seoicheon-ro 578beon-gil, Majang-myeon,
Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA

Report No.: HCT-R-1511-F002
HCT FRN: 0005866421

MODEL: **WA2ST330**

APPLICANT: **Suntech International Ltd.**

FCC Model(s): ST330
EUT Type: Vehicle Tracker
FCC Classification: PCS Licensed Transmitter (PCB)
FCC Rule Part(s): §22, §24, §2

Mode	Tx Frequency (MHz)	Rx Frequency (MHz)	Emission Designator	ERP	
				Max. Power (W)	Max. Power (dBm)
GSM850	824.2 – 848.8	869.2 – 893.8	246 KGXW	1.551	31.91

Mode	Tx Frequency (MHz)	Rx Frequency (MHz)	Emission Designator	EIRP	
				Max. Power (W)	Max. Power (dBm)
GSM1900	1850.2 – 1909.8	1930.2 – 1989.8	244 KGXW	0.645	28.09

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)

Report prepared by
: Jeong Ho Kim
Test engineer of RF Team

Approved by
: Kyoung Houn Seo
Manager of RF Team

Report Revision

TEST REPORT NO.	DATE	DESCRIPTION
HCT-R-1511-F002	November 10, 2015	- First Approval Report

Table of Contents

MEASUREMENT REPORT

1. GENERAL INFORMATION

Applicant Name:	Suntech International Ltd.
Address:	B-1506, Greatvally, 32, 9-Gil, Digital-Ro, Geumcheon-Gu, Seoul, Korea
FCC ID:	WA2ST330
Application Type:	Certification
FCC Classification:	PCS Licensed Transmitter (PCB)
FCC Rule Part(s):	§22, §24, §2
EUT Type:	Vehicle Tracker
FCC Model(s):	ST330
Tx Frequency:	824.20 - 848.80 MHz (GSM850) 1 850.20 - 1 909.80 MHz (GSM1900)
Rx Frequency:	869.20 - 893.80 MHz (GSM850) 1 930.20 - 1 989.80 MHz (GSM1900)
Max. RF Output Power:	1.551 W GSM850 (31.91dBm) / 0.645W GSM1900 (28.09dBm)
Emission Designator(s):	246 KGXW (GSM850) /244 KGXW (GSM1900)
Date(s) of Tests:	October 21, 2015 ~ November 09, 2015
Antenna Specification	Manufacturer: HAE SEUNG CREBIZ Antenna type: Internal Antenna Peak Gain: GSM850 : -1.5dBi GSM1900 : -1.2dBi

2. INTRODUCTION

2.1. EUT DESCRIPTION

The Suntech International Ltd.ST330Vehicle Tracker consists ofGPRS Class10, GSM850 and GSM1900.

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, 17383, Rep. of KOREA**.

3. DESCRIPTION OF TESTS

3.1 CONDUCTED OUTPUT POWER

Test Procedure

Conducted Output Power is tested in accordance with KDB971168 D01 Power Meas License Digital Systems v02r02, October 17, 2014, Section 5.2.

5.2.1 Procedure for use with a spectrum/signal analyzer when EUT can be configured to transmit continuously or when sweep triggering/signal gating can be properly implemented

The EUT is considered to transmit continuously if it can be configured to transmit at a burst duty cycle of greater than or equal to 98% throughout the duration of the measurement. If this condition can be achieved, then the following procedure can be used to measure the average output power of the EUT.

This procedure can also be used when the EUT cannot be configured to transmit continuously, provided that the measurement instrument can be configured to trigger a sweep at the beginning of each full-power transmission burst, and the sweep time is less than or equal to the minimum transmission time during each burst (*i.e.*, no burst off-time is to be included in the measurement).

a) Set span to at least 1.5 times the OBW.

b) Set RBW = 1-5% of the OBW, not to exceed 1 MHz.

c) Set VBW ≥ 3 x RBW.

d) Set number of points in sweep ≥ 2 × span / RBW.

e) Sweep time = auto-couple.

f) Detector = RMS (power averaging).

g) If the EUT can be configured to transmit continuously (*i.e.*, burst duty cycle ≥ 98%), then set the trigger tofree run.

h) If the EUT cannot be configured to transmit continuously (*i.e.*, burst duty cycle < 98 %), then use a sweep trigger with the level set to enable triggering only on full power bursts and configure the EUT to transmit at full power for the entire duration of each sweep. Ensure that the sweep time is less than or equal to the transmission burst duration.

i) Trace average at least 100 traces in power averaging (*i.e.*, RMS) mode.

j) Compute the power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function, with the band limits set equal to the OBW band edges. If the instrument does not have a band power function, then sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

5.2.2 Procedures for use with a spectrum/signal analyzer when EUT cannot be configured to transmit continuously and sweep triggering/signal gating cannot be properly implemented

If the EUT cannot be configured to transmit continuously (burst duty cycle < 98%), then one of the following procedures can be used. The selection of the applicable procedure will depend on the characteristics of the measured burst duty cycle.

Measure the burst duty cycle with a spectrum/signal analyzer or EMC receiver can be used in zero-span mode if the response time and spacing between bins on the sweep are sufficient to permit accurate measurement of the burst on/off time of the transmitted signal.

5.2.2.2 Constant burst duty cycle

If the measured burst duty cycle is constant (i.e., duty cycle variations are less than ± 2 percent), then:

a) Set span to at least 1.5 times the OBW.
b) Set RBW = 1-5% of the OBW, not to exceed 1 MHz.
c) Set VBW ≥ 3 x RBW.
d) Number of points in sweep ≥ 2 × span / RBW. (This gives bin-to-bin spacing ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)
e) Sweep time = auto.
f) Detector = RMS (power averaging).
g) Set sweep trigger to “free run”.
h) Trace average at least 100 traces in power averaging (i.e., RMS) mode.
i) Compute power by integrating the spectrum across the OBW of the signal using the instrument’s band power measurement function with band limits set equal to the OBW band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.
j) Add 10 log (1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times (because the measurement represents an average over both the on and off times of the transmission).
For example, add 10 log (1/0.25) = 6 dB if the duty cycle is a constant 25%.

3.2 ERP/EIRP RADIATED POWER AND RADIATED SPURIOUS EMISSIONS

Note: ERP(Effective Radiated Power), EIRP(Effective Isotropic Radiated Power)

Test Procedure

Radiated emission measurements are performed in the Fully-anechoic chamber. The equipment under test is placed on a non-conductive table 3-meters away from the receive antenna in accordance with ANSI/TIA-603-D-2010 Clause 2.2.17.The turntable is rotated through 360 degrees, and the receiving antenna scans in order to determine the level of the maximized emission. The level and position of the maximized emission is recorded with the spectrum analyzer using RMS detector.

A half wave dipole is then substituted in place of the EUT. For emissions above 1GHz, a horn antenna is substituted in place of the EUT. The substitute antenna is driven by a signal generator and the previously recorded signal was duplicated.

The power is calculated by the following formula;

$$P_{d(dBm)} = Pg_{(dBm)} - \text{cable loss}_{(dB)} + \text{antenna gain}_{(dB)}$$

Where: $P_d$is the dipole equivalent power and $P_g$is the generator output power into the substitution antenna.

The maximum EIRP is calculated by adding the forward power to the calibrated source plus its appropriate gain value. These steps are repeated with the receiving antenna in both vertical and horizontal polarization. the difference between the gain of the horn and an isotropic antenna are taken into consideration

Radiated spurious emissions

1. Frequency Range : 30 MHz ~ 10^{th} Harmonics of highest channel fundamental frequency.
2. The EUT was setup to maximum output power. The 100 kHz RBW was used to scan from 30 MHz to 1 GHz. Also, the 1 MHz RBW was used to scan from 1 GHz to 10 GHz(GSM850) or 20 GHz(GSM1900). The high, low and a middle channel were tested for out of band measurements.

3.3 PEAK- TO- AVERAGE RATIO

Test Procedure

Peak to Average Power Ratio is tested in accordance with KDB971168 D01 Power Meas License Digital Systems v02r02, October 17, 2014, Section 5.7.

- Section 5.7.1 CCDF Procedure for PAPR

a) Set resolution/measurement bandwidth ≥ signal's occupied bandwidth;
b) Set the number of counts to a value that stabilizes the measured CCDF curve;
c) Set the measurement interval as follows:
    1) for continuous transmissions, set to 1 ms,
    2) for 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.
d) Record the maximum PAPR level associated with a probability of 0.1%.

- Section 5.7.2 Alternate Procedure for PAPR

Use one of the procedures presented in 5.1 to measure the total peak power and record as P_{Pk}. Use one of the applicable procedures presented 5.2 to measure the total average power and record as P_{Avg}. Determine the P.A.R. from: $P.A.R_{(dB)} = P_{Pk(dBm)} – P_{Avg(dBm)}$ (P_{Avg} = Average Power + Duty cycle Factor)

5.1.1 Peak power measurements with a spectrum/signal analyzer or EMI receiver

The following procedure can be used to determine the total peak output power.

a) Set the RBW ≥ OBW.
b) Set VBW ≥ 3 × RBW.
c) Set span ≥ 2 x RBW
d) Sweep time = auto couple.
e) Detector = peak.
f) Ensure that the number of measurement points ≥ span/RBW.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the peak amplitude level.

5.2.2 Procedures for use with a spectrum/signal analyzer when EUT cannot be configured to transmit continuously and sweep triggering/signal gating cannot be properly implemented

If the EUT cannot be configured to transmit continuously (burst duty cycle < 98%), then one of the following procedures can be used. The selection of the applicable procedure will depend on the characteristics of the measured burst duty cycle.

Measure the burst duty cycle with a spectrum/signal analyzer or EMC receiver can be used in zero-span mode if the response time and spacing between bins on the sweep are sufficient to permit accurate measurement of the burst on/off time of the transmitted signal.

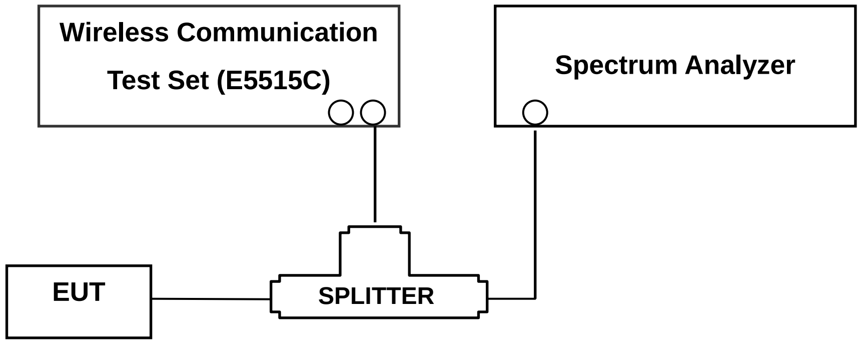
5.2.2.2 Constant burst duty cycle

If the measured burst duty cycle is constant (i.e., duty cycle variations are less than ± 2 percent), then:

a) Set span to at least 1.5 times the OBW.
b) Set RBW = 1-5% of the OBW, not to exceed 1 MHz.
c) Set VBW ≥ 3 x RBW.
d) Number of points in sweep ≥ 2 × span / RBW. (This gives bin-to-bin spacing ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)
e) Sweep time = auto.
f) Detector = RMS (power averaging).
g) Set sweep trigger to “free run”.
h) Trace average at least 100 traces in power averaging (i.e., RMS) mode.
i) Compute power by integrating the spectrum across the OBW of the signal using the instrument’s band power measurement function with band limits set equal to the OBW band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.
j) Add 10 log (1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times (because the measurement represents an average over both the on and off times of the transmission).
   For example, add 10 log (1/0.25) = 6 dB if the duty cycle is a constant 25%.

3.4 OCCUPIED BANDWIDTH.

Test set-up



(Configuration of conducted Emission measurement)

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.

Test Procedure

OBW is tested in accordance with KDB971168 D01 Power Meas License Digital Systems v02r02, October 17, 2014, Section 4.2.

The EUT makes a call to the communication simulator. The power was measured with R&S Spectrum Analyzer. All measurements were done at 3 channels(low, middle and high operational range.)

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

3.5 SPURIOUS AND HARMONIC EMISSIONS AT ANTENNA TERMINAL.

Test Procedure

Spurious and harmonic emissions at antenna terminal is tested in accordance with KDB971168 D01 Power Meas License Digital Systems v02r02, October 17, 2014, Section 6.0.

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer.

On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log(P) dB. The RBW settings used in the testing are greater than 1 % of the occupied bw. The 1 MHz RBW was used to scan from 10 MHz to 10 GHz. (GSM1900 Mode: 10 MHz to 20 GHz). A display line was placed at – 13 dBm to show compliance. The high, lowest and a middle channel were tested for out of band measurements.

Measurements of all out of band are made on RBW = 1MHz and VBW ≥ 3 MHz in the worst case despite RBW = 100 kHz and VBW ≥ 300 kHz upon 1 GHz.

- RBW = 1 MHz
- VBW ≥ 3 MHz
- Detector = Peak
- Trace Mode = max hold
- Sweep time = auto
- Number of points in sweep ≥ 2 * Span / RBW

- Band Edge Requirement : According to FCC 22.917, 24.238 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 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.

In GSM mode, the center frequency of spectrum setto the band edge frequency.The span is 1MHz

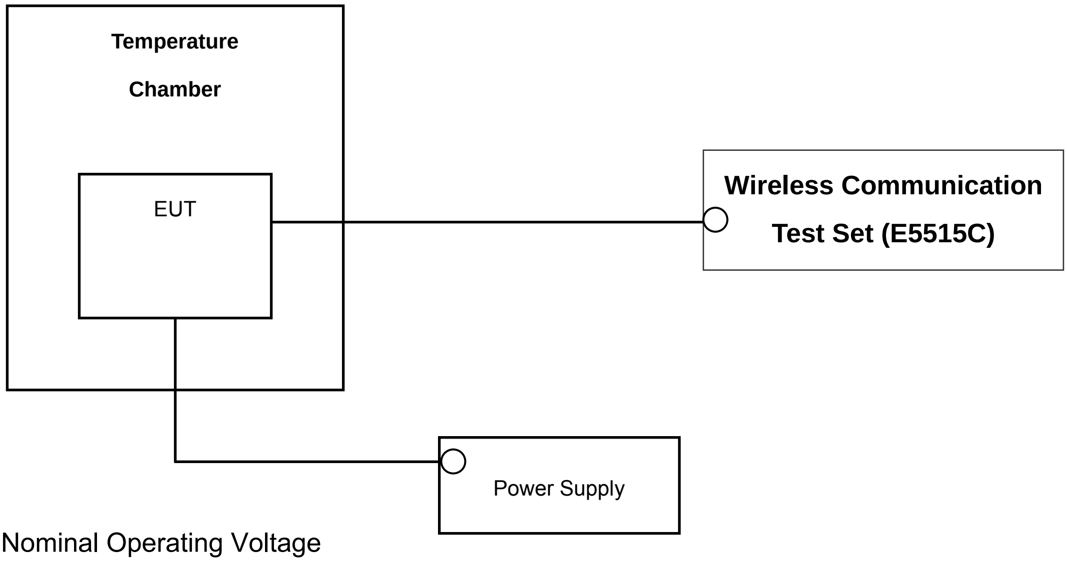
(RBW = at least 1 % of the EBW, VBW ≥ 3*RBW, Detector = Average).

NOTES: The analyzer plot offsets were determined by below conditions.

- For GSM850, total offset 27.0 dB = 20 dB attenuator + 6 dB Splitter + 1.0 dB RF cables.
- For GSM1900, total offset 27.9 dB = 20 dB attenuator + 6 dB Splitter + 1.9 dB RF cables.

3.6 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE

Test Set-up



* Nominal Operating Voltage

Test Procedure

Frequency stability is tested in accordance with ANSI/TIA-603-D-2010 section 2.2.2.

The frequency stability of the transmitter is measured by:
a.) **Temperature:** The temperature is varied from - 30 °C to + 50 °C using an environmental chamber.

b.) **Primary Supply Voltage:** The primary supply voltage is varied from battery end point to 100 % of the voltage normally at the input to the device or at the power supply terminals if cables are not normally supplied.

Specification — the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block(GSM1900). The frequency stability of the transmitter shall be maintained within ± 0.000 25 %(± 2.5 ppm) of the center frequency(GSM850).

Time Period and Procedure:

The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference).
1. The equipment is turned on in a “standby” condition for one minute 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.

2. 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.
NOTE: The EUT is tested down to the battery endpoint.

4. LIST OF TEST EQUIPMENT

Manufacture	Model/ Equipment	Serial Number	Calibration Interval	Calibration Due
Agilent	N1921A/ Power Sensor	MY45241059	Annual	07/09/2016
Agilent	N1911A/ Power Meter	MY45100523	Annual	07/09/2016
CERNEX	CBLU1183540B-01/POWER AMP	25540	Annual	05/21/2016
Wainwright	WHKX 10-900-1000-15000-40SS/H.P.F	5	Annual	08/11/2016
Wainwright	WHKX10-2700-3000-18000-40SS/H.P.F	3	Annual	08/05/2016
Hewlett Packard	11667B / Power Splitter	10545	Annual	02/16/2016
Hewlett Packard	11667B / Power Splitter	11275	Annual	04/29/2016
ITECH	IT6720/ Power Supply	0100215626700119	Annual	11/02/2016
Schwarzbeck	UHAP/ Dipole Antenna	557	Biennial	03/23/2017
Schwarzbeck	UHAP/ Dipole Antenna	558	Biennial	03/23/2017
EXP	EX-TH400/ Chamber	None	Annual	05/29/2016
Schwarzbeck	BBHA 9120D/ Horn Antenna	9210D-1298	Biennial	10/16/2016
Schwarzbeck	BBHA 9120D/ Horn Antenna	9210D-1299	Biennial	10/16/2016
Schwarzbeck	BBHA 9170/ Horn Antenna(15~40GHz)	BBHA9170342	Biennial	04/30/2017
Schwarzbeck	BBHA 9170/ Horn Antenna(15~35GHz)	BBHA9170124	Biennial	04/30/2017
Agilent	E4440A/Spectrum Analyzer	US45303008	Annual	03/18/2016
Hewlett Packard	8493C/ATTENUATOR	17280	Annual	06/29/2016
REOHDE&SCHWARZ	FSV40-N/Signal Analyzer	101068-SZ	Annual	09/23/2016
REOHDE&SCHWARZ	FSV40/Spectrum Analyzer	1307.9002K40-100931-NK	Annual	06/04/2016
Agilent	8960 (E5515C)/ Base Station	MY48360800	Annual	10/30/2016

5. SUMMARY OF TEST RESULTS

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result
2.1049	Occupied Bandwidth	N/A	CONDUCTED	PASS
2.1051, 22.917(a), 24.238(a)	Band Edge / Spurious and Harmonic Emissions at Antenna Terminal.	< 43 + 10log10 (P[Watts]) at Band Edge and for all out-of-band emissions		PASS
2.1046	Conducted Output Power	-		PASS
24.232(d)	Peak- to- Average Ratio	< 13 dB		PASS
2.1055, 22.355	Frequency stability / variation of ambient temperature	< 2.5 ppm (Part22)		PASS
24.235		Emission must remain in band (Part24)		PASS
22.913(a)(2)	Effective Radiated Power	< 7 Watts max. ERP	RADIATED	PASS
24.232(c)	Equivalent Isotropic Radiated Power	< 2 Watts max. EIRP		PASS
2.1053, 22.917(a), 24.238(a)	Radiated Spurious and Harmonic Emissions	< 43 + 10log10 (P[Watts]) for all out-of band emissions		PASS

6. SAMPLE CALCULATION

A. ERP Sample Calculation

Mode	Ch./ Freq.		Measured Level(dBm)	Substitude LEVEL(dBm)	Ant. Gain (dBd)	C.L	Pol.	ERP	
	channel	Freq.(MHz)						W	dBm
GSM850	128	824.20	-21.37	38.40	-10.61	0.95	H	0.483	26.84

ERP = SubstitudeLEVEL(dBm) + Ant. Gain – 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 (**ERP**).

B. Emission Designator

GSM Emission Designator

Emission Designator = 249KGXW

GSM BW = 249 kHz

G = Phase Modulation

X = Cases not otherwise covered

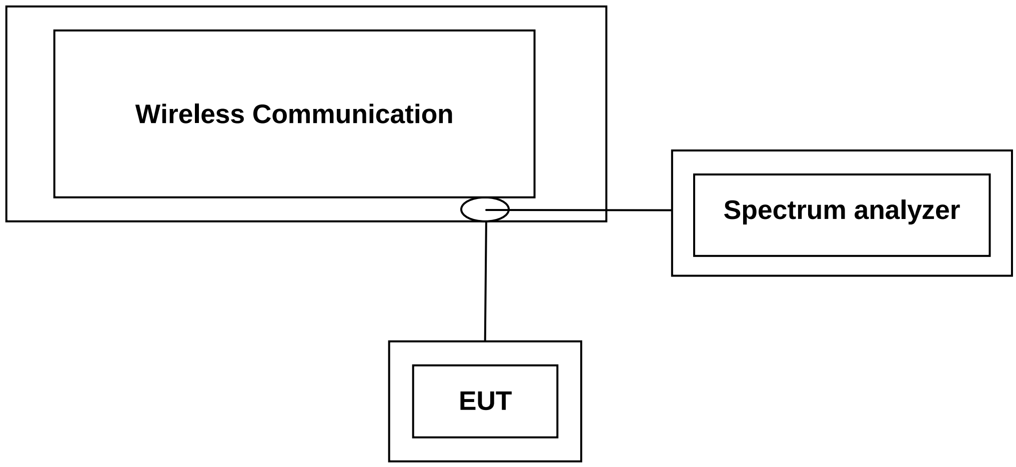
W = Combination (Audio/Data)

7. TEST DATA

7.1 CONDUCTED OUTPUT POWER

Conducted Output Power is tested in accordance with KDB971168 D01 Power Meas License Digital Systems v02r02, October 17, 2014, Section 5.2.

A base station simulator was used to establish communication with the EUT, and Spectrum analyzer was used for test results. This device was tested under all configurations and the highest power is reported. Conducted Output Powers of EUT are reported below.



Test Result

ㅋ Band	Channel	GSM	GPRS Data	
		Voice (dBm)	GPRS 1 TX Slot (dBm)	GPRS 2 TX Slot (dBm)
GSM850	128	32.14	32.13	31.51
	190	32.14	32.14	31.53
	251	32.14	32.14	31.54
GSM1900	512	29.14	29.09	28.50
	661	29.16	29.09	28.52
	810	29.24	29.19	28.62

(GSM Conducted Maximum Output Powers)

Note : Detecting mode is average.

7.2 EFFECTIVE RADIATED POWER

(GSM850 Mode)

Ch./ Freq.		Measured Level(dBm)	Substitude LEVEL (dBm)	Ant. Gain (dBd)	C.L	Pol.	ERP	
channel	Freq.(MHz)						W	dBm
128	824.20	-18.66	43.02	-10.23	0.88	H	1.551	31.91
190	836.60	-19.56	41.87	-10.20	0.89	H	1.196	30.78
251	848.80	-20.16	41.14	-10.17	0.89	H	1.017	30.08

NOTES:

Effective Radiated Power Output Measurements by Substitution Method

according to ANSI/TIA/EIA-603-D-2010June 24, 2010:

The EUT was placed on a non-conductive styrofoam resin table 3-meters from the receive antenna. Turntable rotation was adjusted for the highest reading on the receive spectrum analyzer. For GSM signals, RBW = 1-5% of the OBW,not to exceed 1MHz, VBW ≥ 3 x RBW, Detector = RMS. A half-wave dipole was substituted in place of the EUT. This dipole antenna was driven by a signal generator and the level of the signal generator was adjusted to obtain the same receive spectrum analyzer reading. The conducted power at the terminals of the dipole is measured. The ERP is recorded.
This device was tested under all configurations and the highest power is reported in GSM mode using a Power Control Level of “0” in the PCS Band and “5” in the Cellular Band. This unit was tested with its standard battery. Also, we have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna. The worst case of the EUT is x plane in GSM850mode. Also worst case of detecting Antenna is in horizontal polarization in GSM850mode.

7.3 EQUIVALENT ISOTROPIC RADIATED POWER

(GSM1900 Mode)

Ch./ Freq.		Measured	Substitude	Ant. Gain	C.L	Pol.	EIRP	
channel	Freq.(MHz)	Level(dBm)	LEVEL (dBm)	(dBi)			W	dBm
512	1,850.20	-11.89	19.69	9.82	1.47	V	0.637	28.04
661	1,880.00	-12.56	19.19	9.91	1.47	V	0.579	27.63
810	1,909.80	-12.36	19.58	10.00	1.49	V	0.645	28.09

NOTES:

Equivalent Isotropic Radiated Power Measurements by Substitution Method

according to ANSI/TIA/EIA-603-D-2010June 24, 2010:

The EUT was placed on a non-conductive styrofoam resin table 3-meters from the receive antenna. Turntable rotation was adjusted for the highest reading on the receive spectrum analyzer. For GSM signals, RBW = 1-5% of the OBW,not to exceed 1MHz, VBW ≥ 3 x RBW, Detector = RMS. A Horn antenna was substituted in place of the EUT. This Horn antenna was driven by a signal generator and the level of the signal generator was adjusted to obtain the same receive spectrum analyzer reading. The conducted power at the terminals of the Horn antenna is measured. The difference between the gain of the horn and an isotropic antenna is taken into consideration and the EIRP is recorded.
This device was tested under all configurations and the highest power is reported in GSM mode using a Power Control Level of “0” in the PCS Band and “5” in the Cellular Band. This unit was tested with its standard battery. Also, we have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna. The worst case of the EUT is y plane in GSM1900mode. Also worst case of detecting Antenna is in vertical polarization in GSM1900mode.

7.4 RADIATED SPURIOUS EMISSIONS

7.4.1 RADIATED SPURIOUS EMISSIONS (GSM850)

▣ MEASURED OUTPUT POWER: 31.91dBm = 1.551 W

▣ MODULATION SIGNAL: GSM850

▣ DISTANCE: 3 meters

▣ LIMIT: 43 + 10 $\log_{10}$ (W) = 44.91dBc

Ch.	Freq.(MHz)	Measured Level [dBm]	Ant. Gain (dBd)	Substitute Level [dBm]	C.L	Pol.	ERP (dBm)	dBc
128 (824.2)	1,648.40	-46.12	9.16	-58.34	1.38	V	-50.56	82.47
	2,472.60	-37.19	10.92	-45.93	1.69	V	-36.70	68.61
	3,296.80	-43.77	11.93	-51.01	1.99	V	-41.07	72.98
190 (836.6)	1,673.20	-42.51	9.23	-55.34	1.39	V	-47.50	79.41
	2,509.80	-38.76	10.96	-47.92	1.69	H	-38.65	70.56
	3,346.40	-44.69	12.04	-52.59	1.96	H	-42.51	74.42
251 (848.8)	1,697.60	-38.73	9.34	-51.52	1.41	V	-43.59	75.50
	2,546.40	-39.36	10.99	-48.24	1.73	V	-38.98	70.89
	3,395.20	-44.90	12.14	-52.26	2.02	H	-42.14	74.05

NOTES: 1. Radiated Spurious Emission Measurements at 3 meters by Substitution Method according to ANSI/TIA/EIA-603-D-2010June 24, 2010:

2. We are performed all frequency to 10th harmonics from 30 MHz.Measurements above 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.

3. we have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

7.4.2 RADIATED SPURIOUS EMISSIONS(GSM1900)

- MEASURED OUTPUT POWER: 28.09dBm = 0.645 W
- MODULATION SIGNAL: GSM1900
- DISTANCE: 3 meters
- LIMIT: 43 + 10 log_{10} (W) = 41.09dBc

Ch.	Freq.(MHz)	Measured Level [dBm]	Ant. Gain (dBi)	Substitute Level [dBm]	C.L	Pol.	EIRP (dBm)	dBc
512 (1850.2)	3,700.40	-44.46	12.52	-49.87	2.10	V	-39.45	67.54
	5,550.60	-42.18	13.29	-42.83	2.54	H	-32.08	60.17
	7,400.80	-41.41	11.72	-34.48	2.89	H	-25.65	53.74
661 (1880.0)	3,760.00	-44.28	12.56	-49.60	2.09	H	-39.13	67.22
	5,640.00	-43.75	13.30	-44.61	2.58	H	-33.89	61.98
	7,520.00	-42.78	11.70	-35.92	2.98	H	-27.20	55.29
810 (1909.8)	3,819.60	-41.33	12.60	-46.26	2.09	H	-35.75	63.84
	5,729.40	-44.61	13.31	-44.99	2.67	V	-34.35	62.44
	7,639.20	-40.77	11.61	-34.14	3.00	V	-25.53	53.62

NOTES:
1. Radiated Spurious Emission Measurements at 3 meters by Substitution Method according to ANSI/TIA/EIA-603-D-2010June 24, 2010:
2. We are performed all frequency to 10^{th} harmonics from 30 MHz.Measurements above 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.
3. we have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

7.5 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
				Tx_{Total} (ms)	Tx_{On} (ms)	Factor (dB)			
GSM1900	661	29.09	19.48	4.6232	0.5507	9.24	0.37	13	Pass

- Plots of the EUT's Peak- to- Average Ratio are shown Page 30 ~31.

NOTES:

Peak to Average Power Ratio was tested in accordance with KDB971168 D01 Power Meas License Digital Systems v02r02, October 17, 2014, Section 5.7.

GSM Mode was tested by Section 5.7.2 Alternate Procedure

$P.A.R_{(dB)} = P_{Pk(dBm)} – P_{Avg(dBm)}$ (P_{Avg} = Average Power + Duty cycle Factor)

Duty cycle Factor = 10 log (1/x), x = Tx_{On} / Tx_{Total}

7.6 OCCUPIED BANDWIDTH

Band	Channel	Frequency(MHz)	Data (GSM: kHz)
GSM850	128	824.20	242.9230
	190	836.60	246.0014
	251	848.80	243.2303
GSM1900	512	1,850.20	240.5582
	661	1,880.00	242.7006
	810	1,909.80	244.1037

- Plots of the EUT's Occupied Bandwidth are shown Page 27 ~ 29.

7.7 CONDUCTED SPURIOUS EMISSIONS

Band	Channel	Frequency of Maximum Harmonic (GHz)	Maximum Data (dBm)
GSM850	128	4.681170	-29.90
	190	4.494800	-30.42
	251	4.952040	-30.46
GSM1900	512	6.588020	-28.13
	661	6.526700	-27.68
	810	6.997780	-27.86

- Plots of the EUT's Conducted Spurious Emissions are shown Page 37 ~ 43.

7.7.1 BAND EDGE

- Plots of the EUT's Band Edge are shown Page 31 ~ 37.

7.8 FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE

7.8.1 FREQUENCY STABILITY (GSM850)

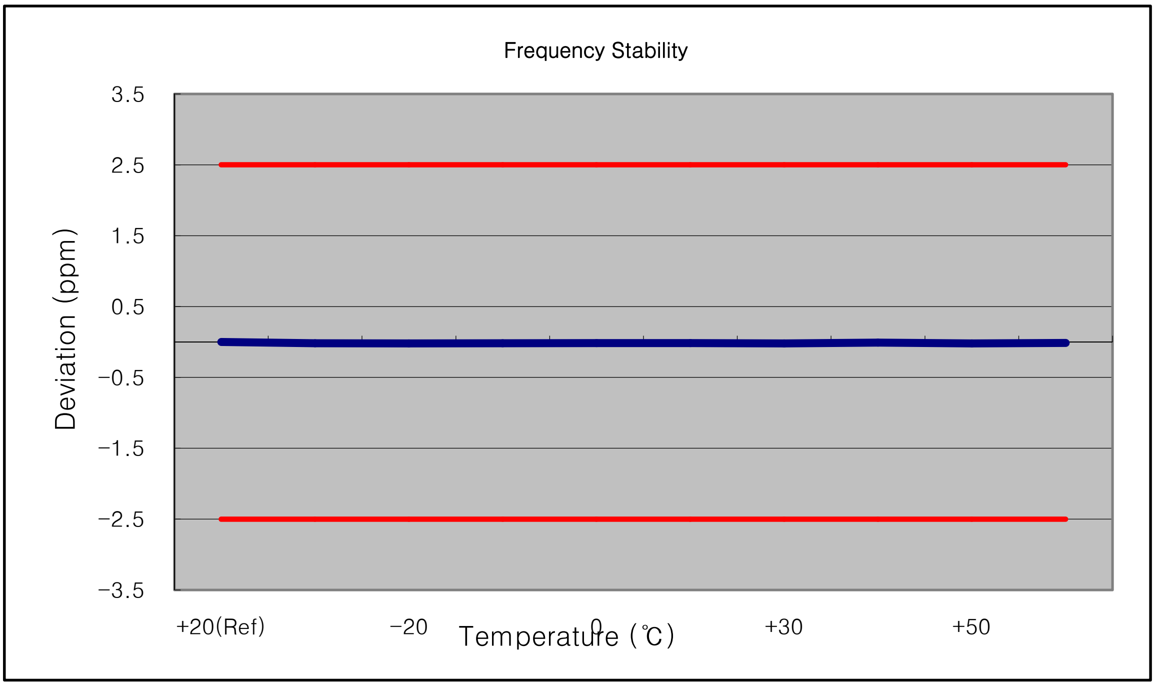
▣OPERATING FREQUENCY: 836,600,000 Hz

▣CHANNEL: 190

▣REFERENCE VOLTAGE: 12.0 VDC

▣DEVIATION LIMIT: ± 0.000 25 % or 2.5 ppm

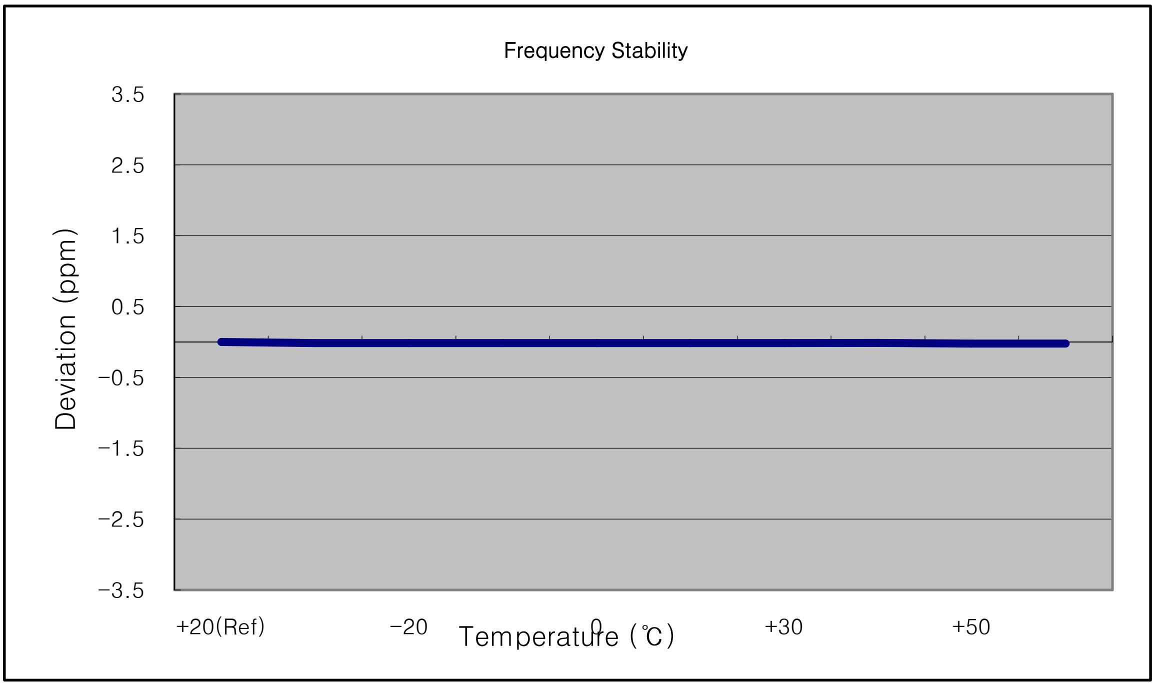
Voltage (%)	Power (VDC)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	12.0	+20(Ref)	836 599 987	0	0.000 000	0.000
100%		-30	836 599 972	-14.87	-0.000 002	-0.018
100%		-20	836 599 969	-17.77	-0.000 002	-0.021
100%		-10	836 599 971	-15.55	-0.000 002	-0.019
100%		0	836 599 973	-14.08	-0.000 002	-0.017
100%		+10	836 599 973	-14.13	-0.000 002	-0.017
100%		+30	836 599 969	-17.71	-0.000 002	-0.021
100%		+40	836 599 978	-8.37	-0.000 001	-0.010
100%		+50	836 599 970	-17.15	-0.000 002	-0.020
Batt. Endpoint	10.2	+20	836 599 975	-11.96	-0.000 001	-0.014



7.8.2 FREQUENCY STABILITY (GSM1900)

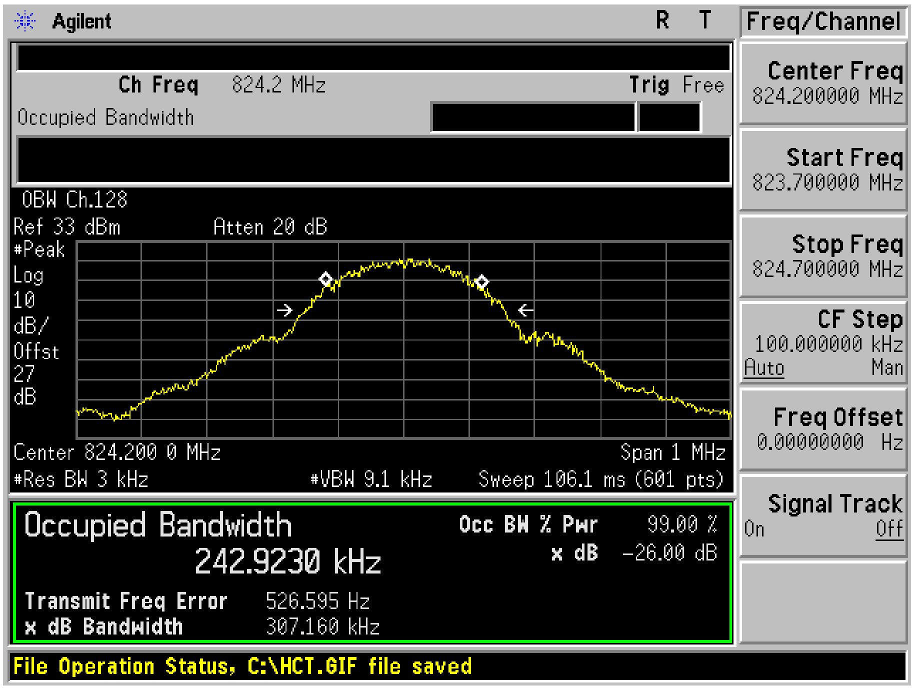
- ▣OPERATING FREQUENCY: 1880,000,000 Hz
- ▣CHANNEL: 661
- ▣REFERENCE VOLTAGE: 12.0 VDC
- ▣DEVIATION LIMIT: -

Voltage (%)	Power (VDC)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (%)	ppm
100%	12.0	+20(Ref)	1879 999 969	0	0.000 000	0.000
100%		-30	1879 999 938	-30.31	-0.000 002	-0.016
100%		-20	1879 999 938	-30.77	-0.000 002	-0.016
100%		-10	1879 999 937	-31.64	-0.000 002	-0.017
100%		0	1879 999 939	-29.73	-0.000 002	-0.016
100%		+10	1879 999 938	-30.48	-0.000 002	-0.016
100%		+30	1879 999 938	-30.26	-0.000 002	-0.016
100%		+40	1879 999 945	-23.54	-0.000 001	-0.013
100%		+50	1879 999 926	-42.35	-0.000 002	-0.023
Batt. Endpoint	10.2	+20	1879 999 928	-40.55	-0.000 002	-0.022

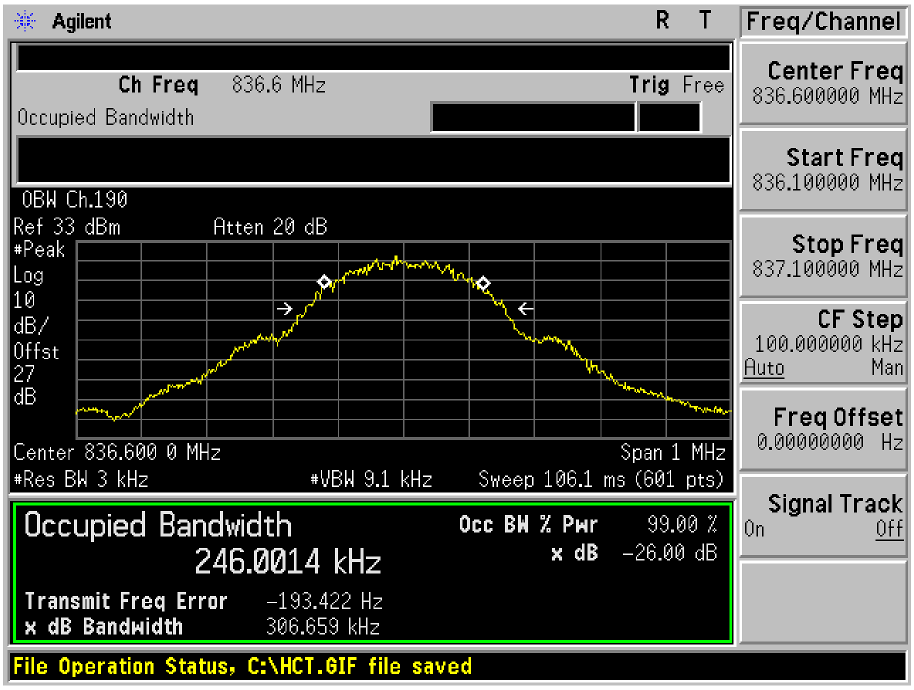


8. TEST PLOTS

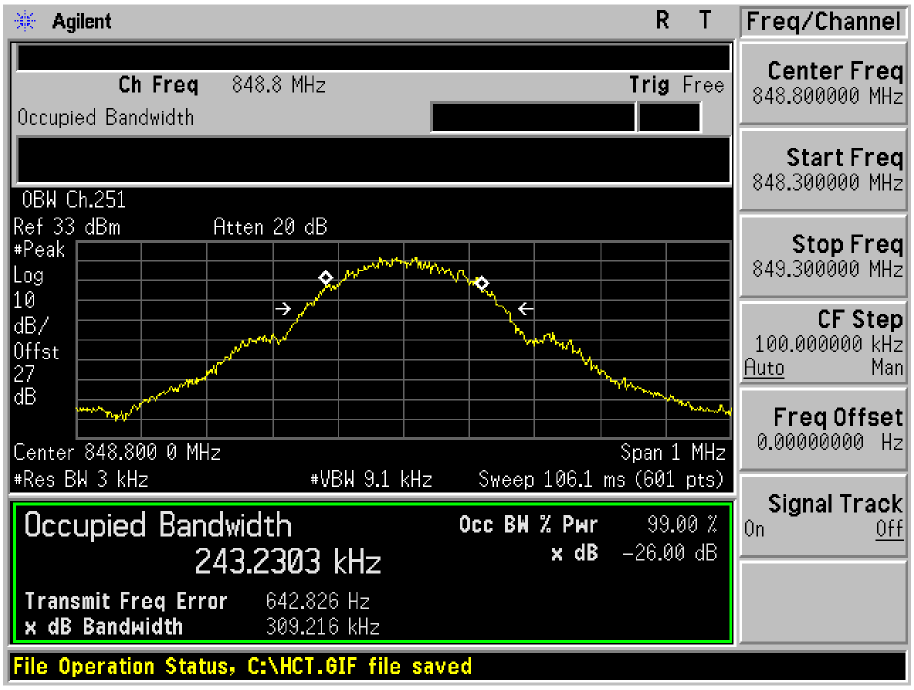
GSM850 MODE (128 CH.) Occupied Bandwidth



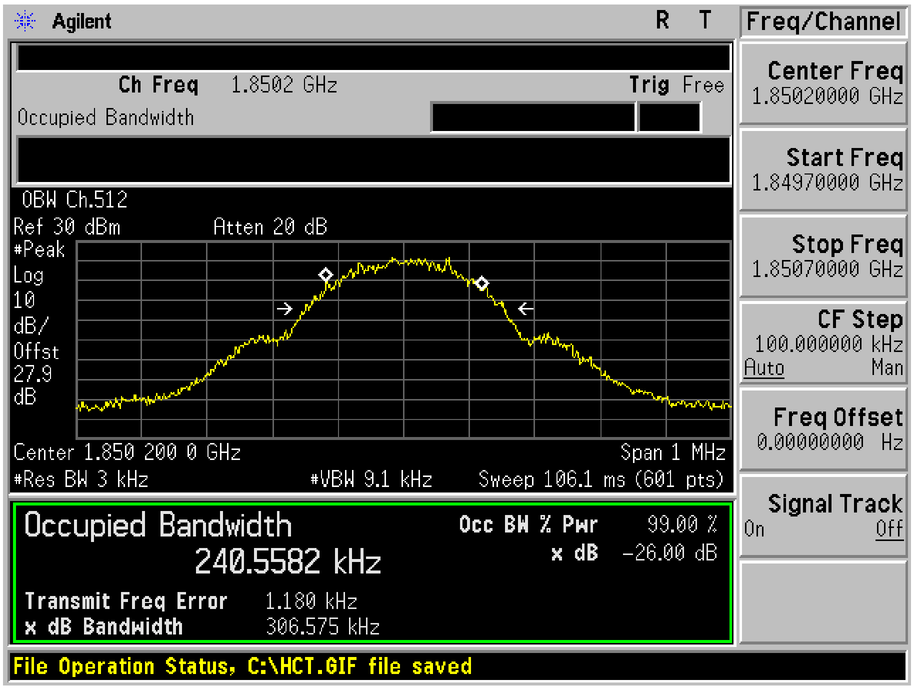
GSM850 MODE (190 CH.) Occupied Bandwidth



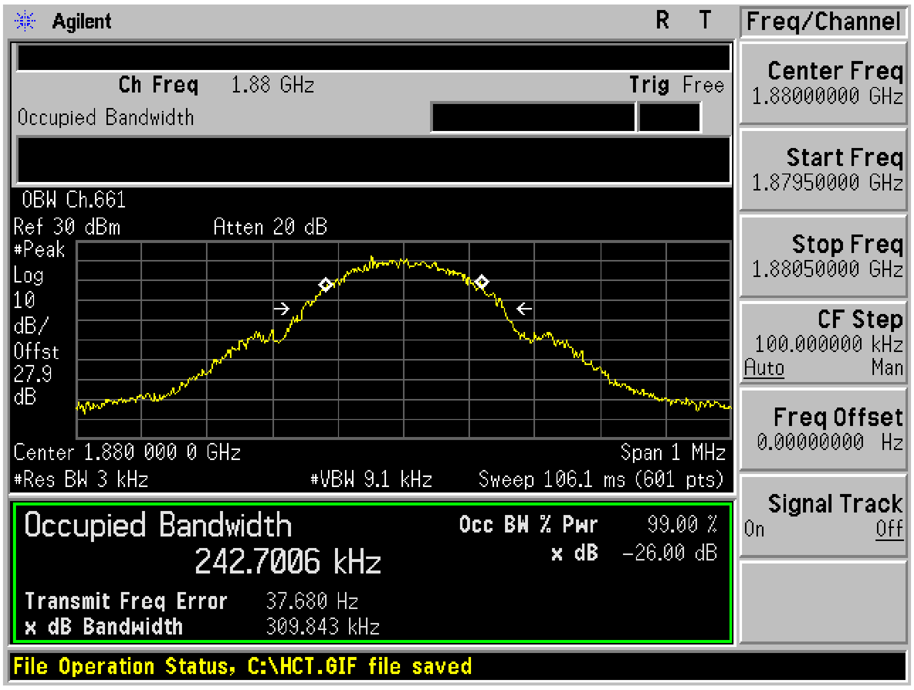
GSM850 MODE (251 CH.) Occupied Bandwidth



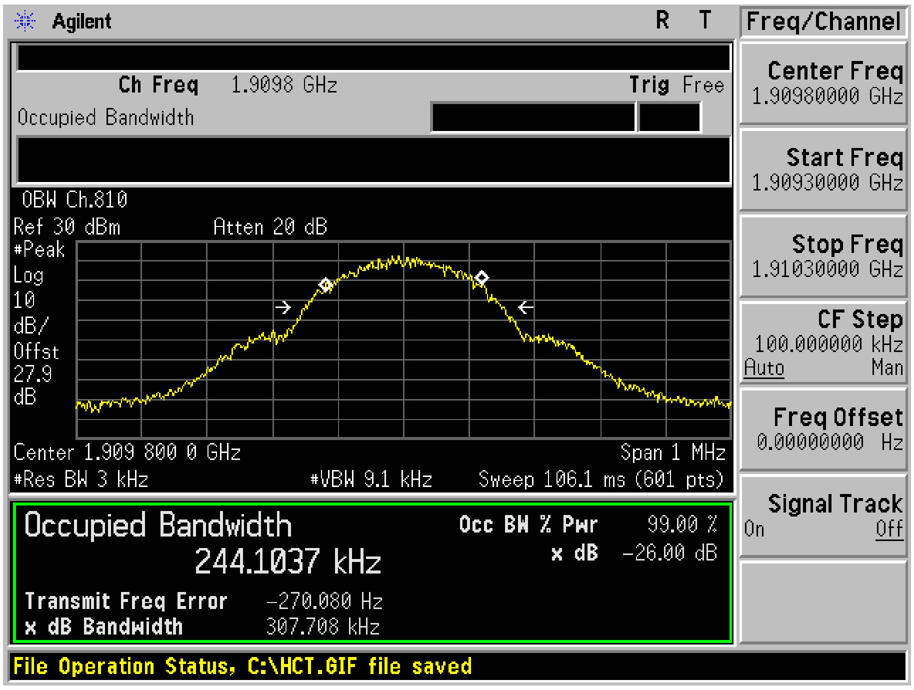
GSM1900 MODE (512 CH.) Occupied Bandwidth



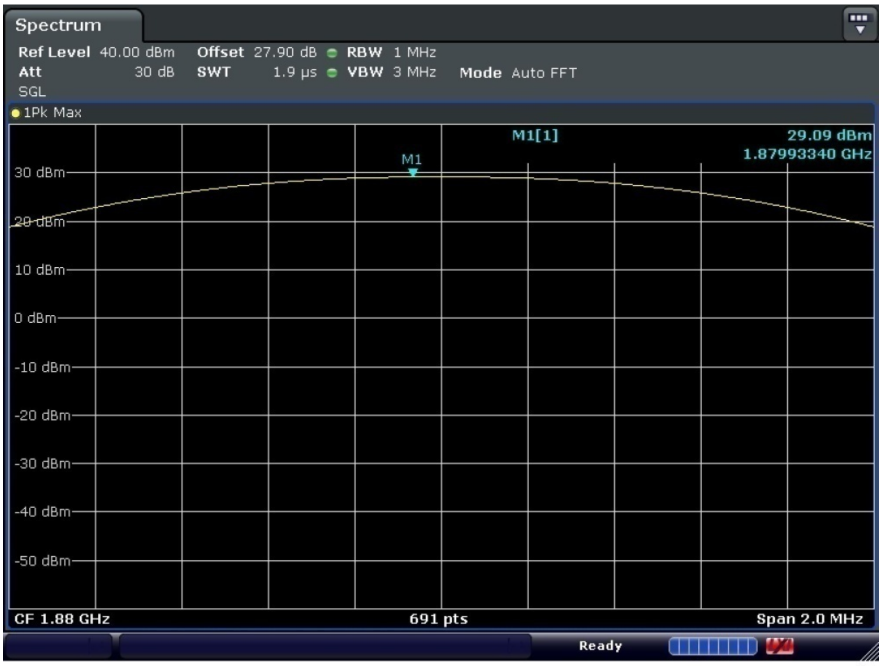
GSM1900 MODE (661 CH.) Occupied Bandwidth



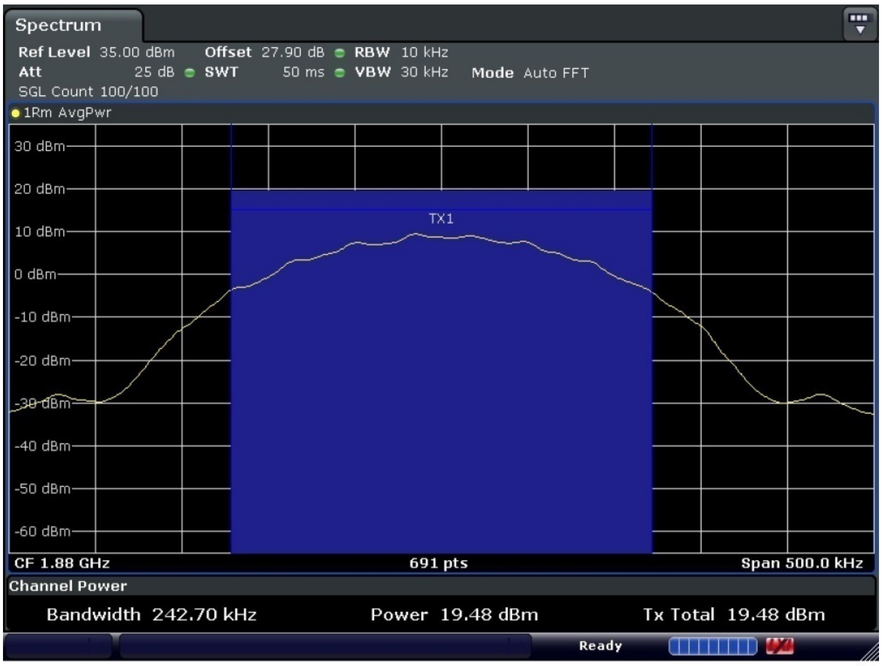
GSM1900 MODE (810 CH.) Occupied Bandwidth



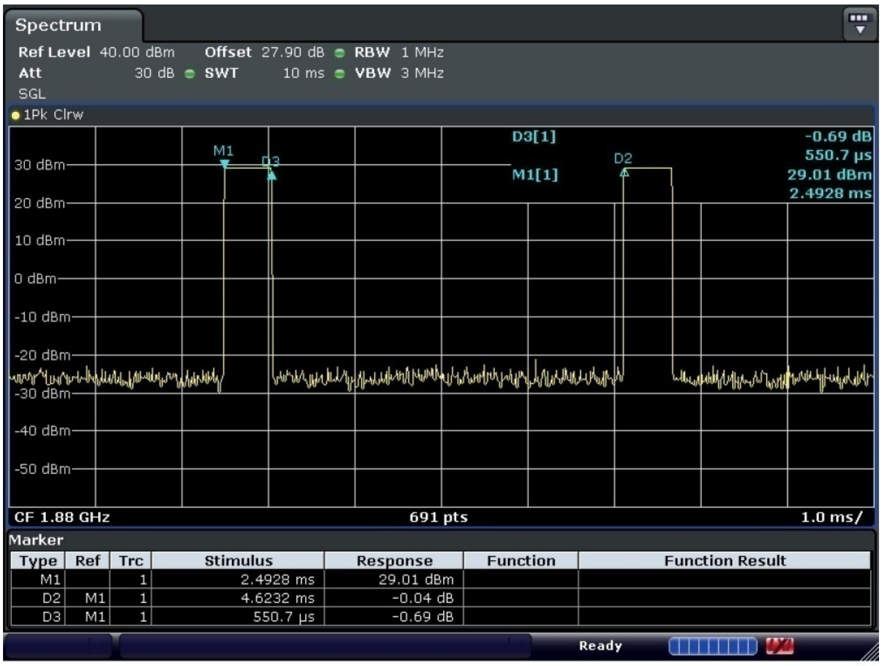
GSM1900 MODE (661 CH.) Peak-to-Average Ratio P_{Pk}



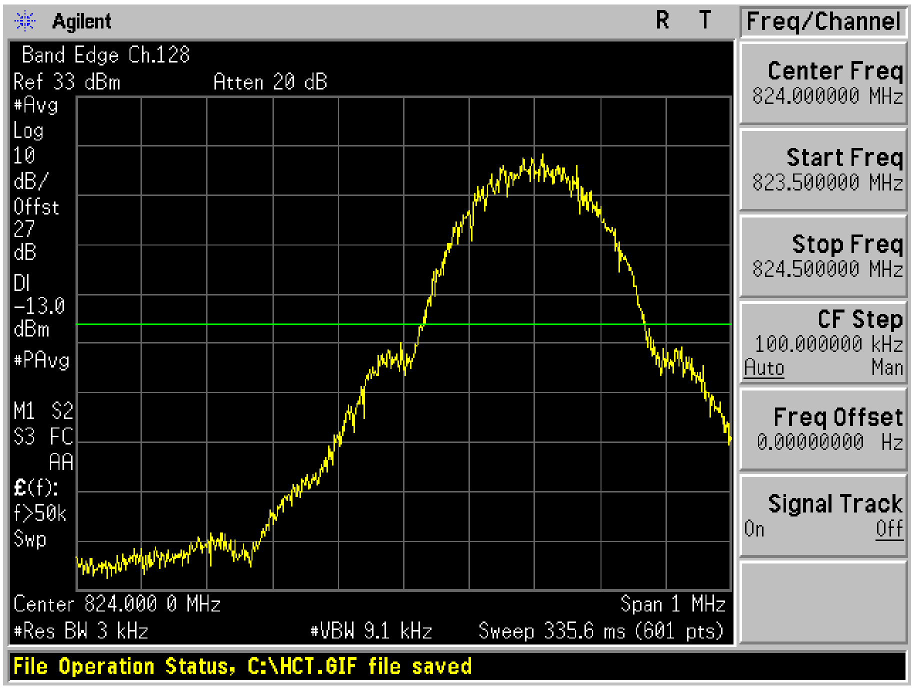
GSM1900 MODE (661 CH.) Peak-to-Average Ratio P_{Avg}



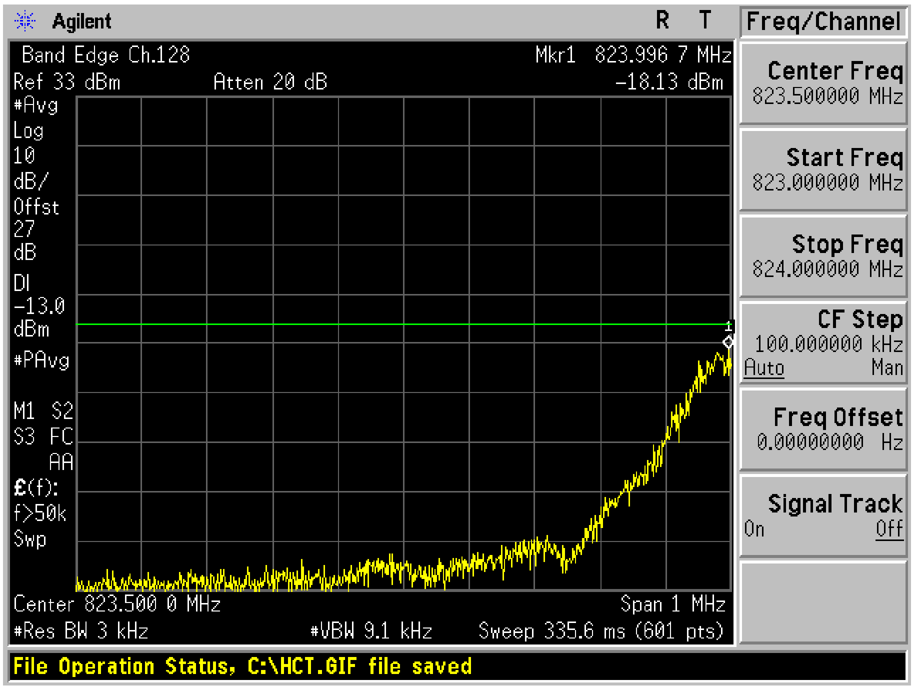
GSM1900 MODE (661 CH.) Peak-to-Average Ratio P_{Avg}



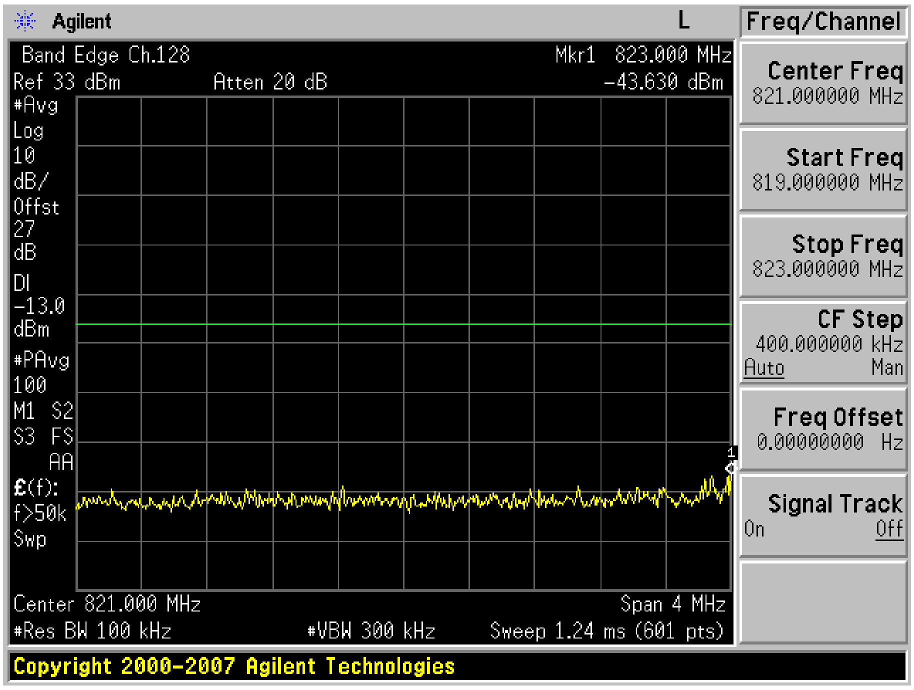
GSM850 MODE (128 CH.) Block Edge 1



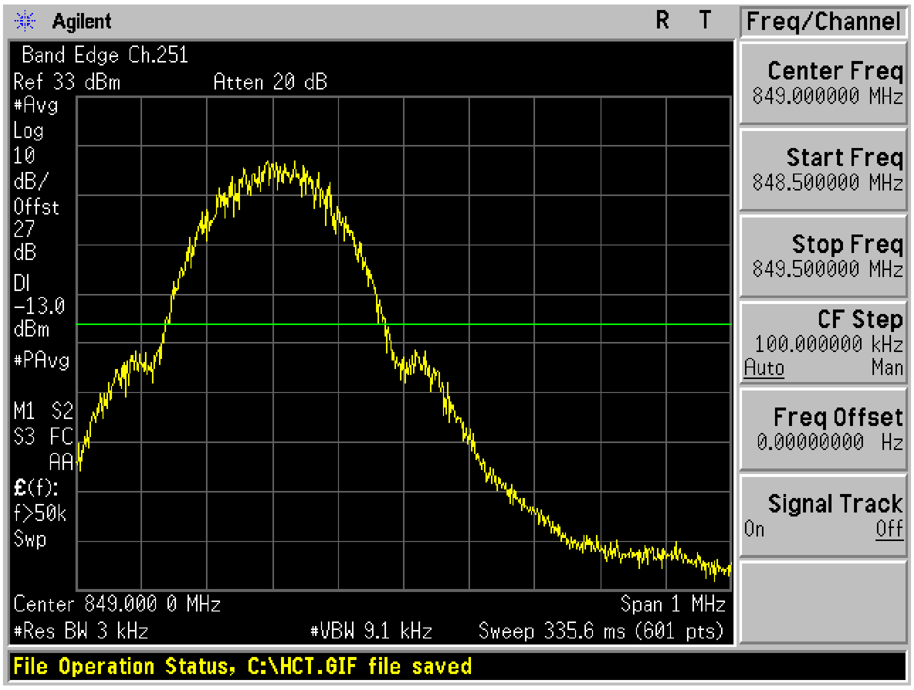
GSM850 MODE (128 CH.) Block Edge 2



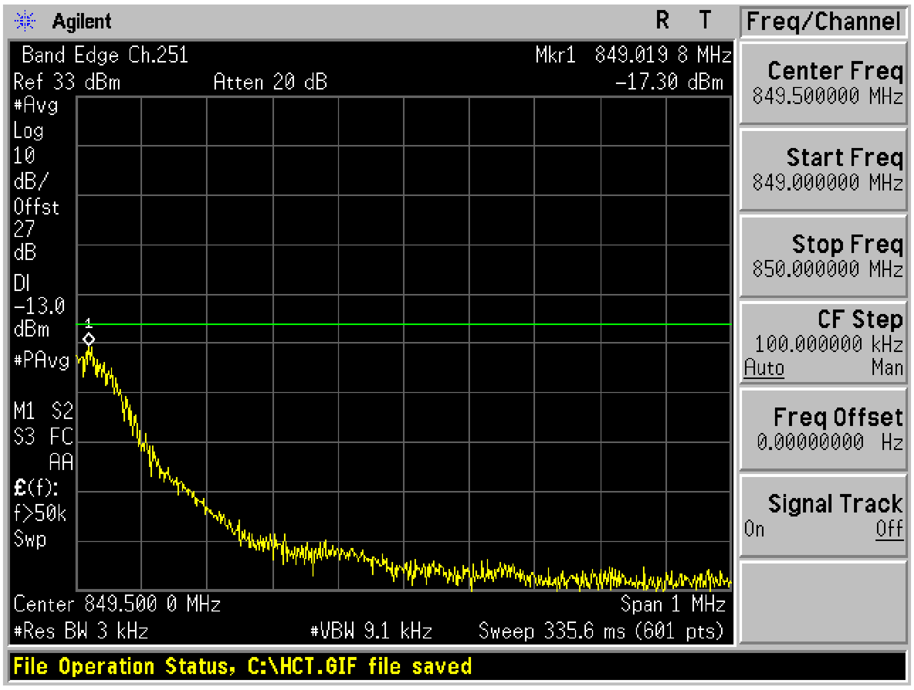
GSM850 MODE (128 CH.) Block Edge 3



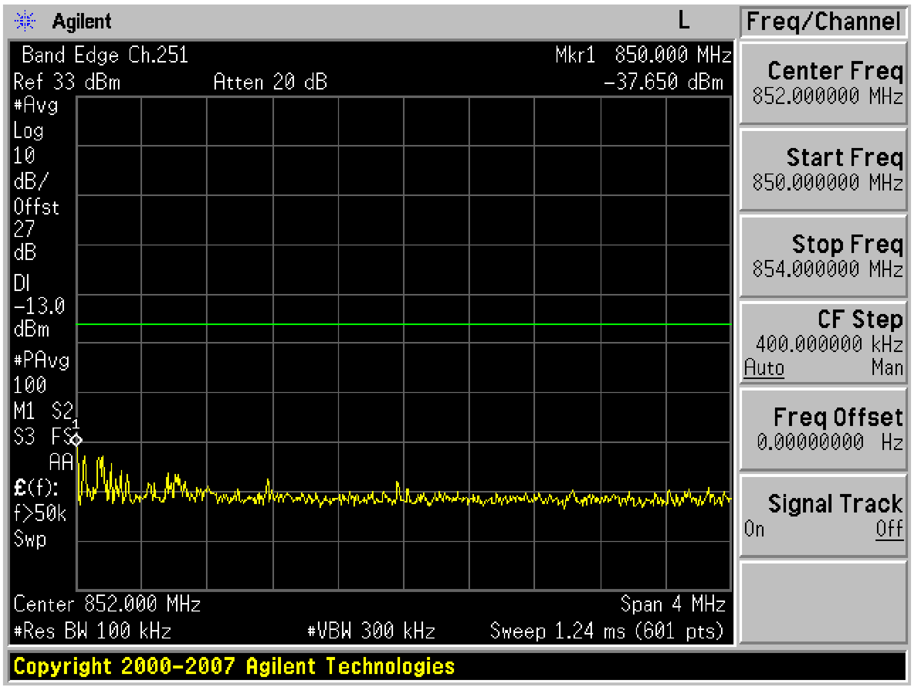
GSM850 MODE (251 CH.) Block Edge 1



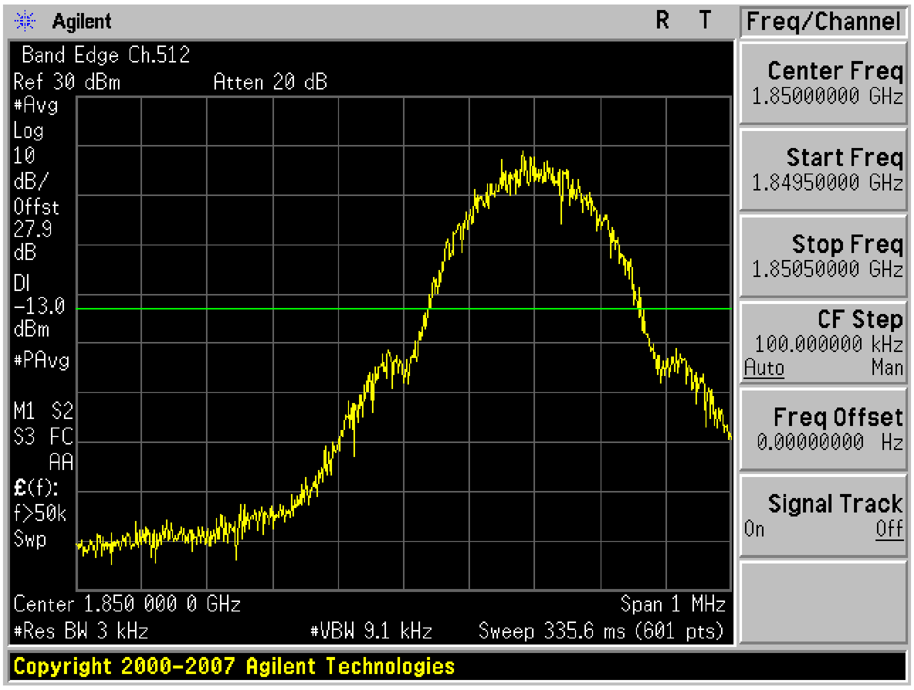
GSM850 MODE (251 CH.) Block Edge 2



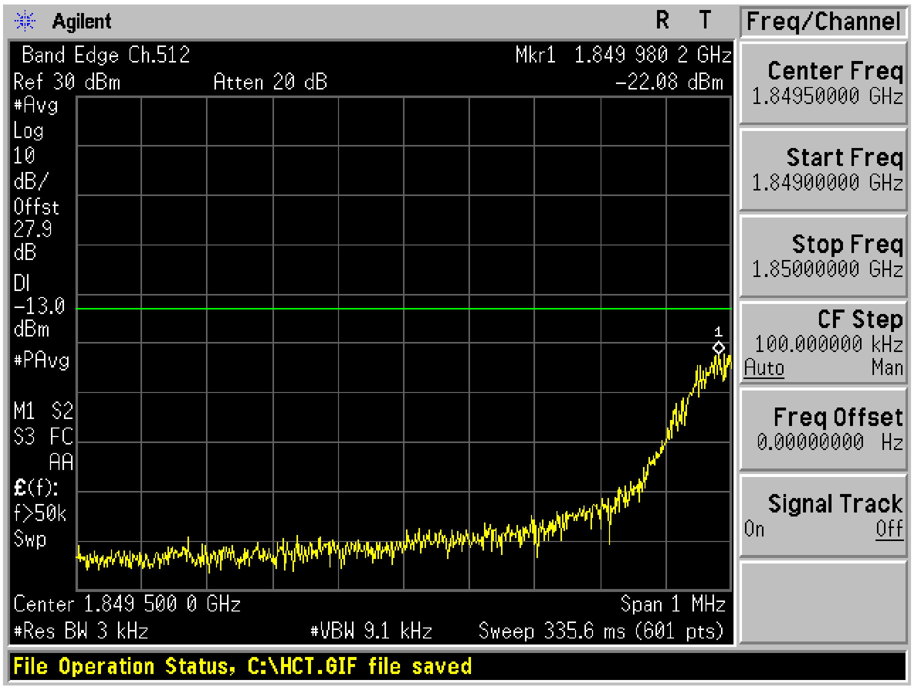
GSM850 MODE (251 CH.) Block Edge 3



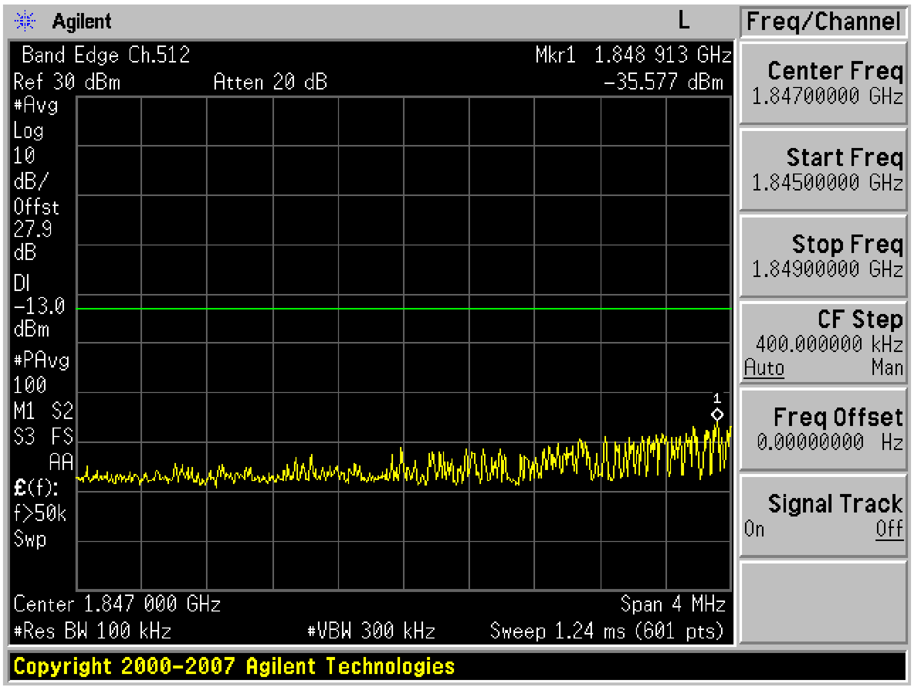
GSM1900 MODE (512 CH.) Block Edge 1



GSM1900 MODE (512 CH.) Block Edge 2



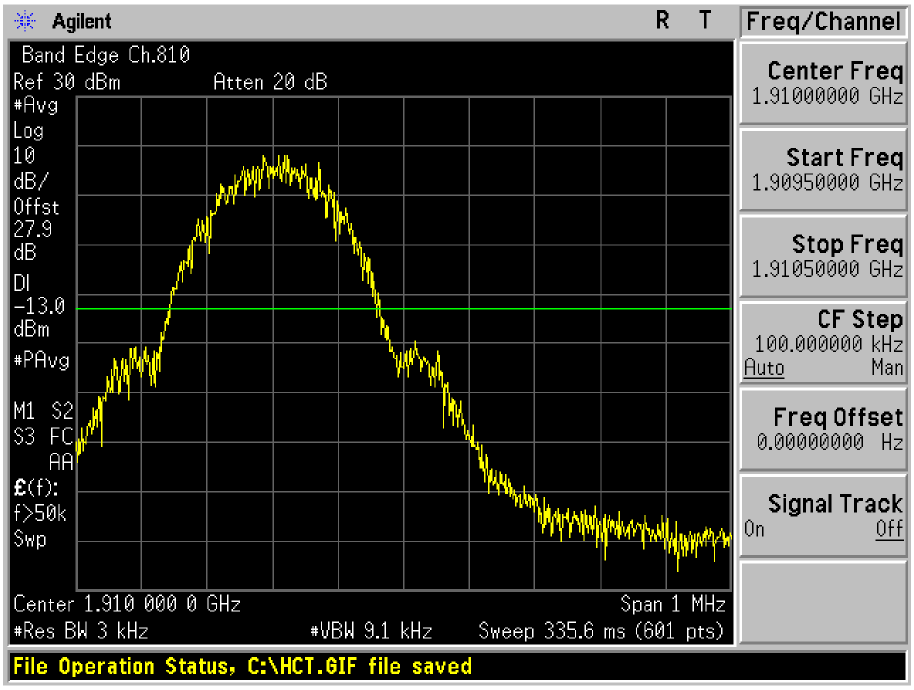
GSM1900 MODE (512 CH.) Block Edge 3



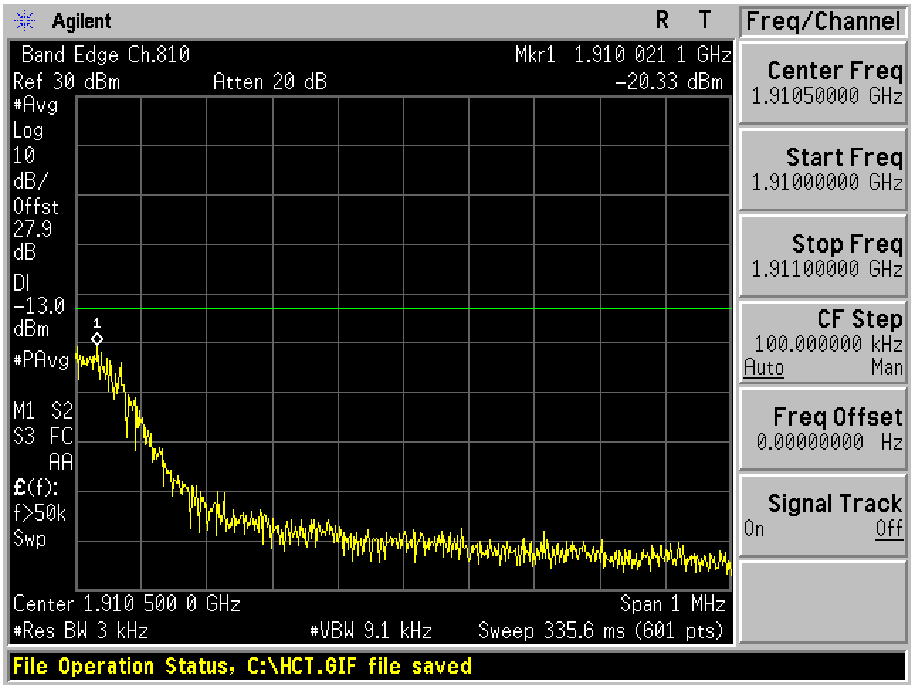
Note : We used a narrower RBW in order to increase accuracy.

Calculation = Reading Value + 10*log(1 MHz/100 kHz) dB = -35.577dBm + 10 dB = **-25.577dBm**

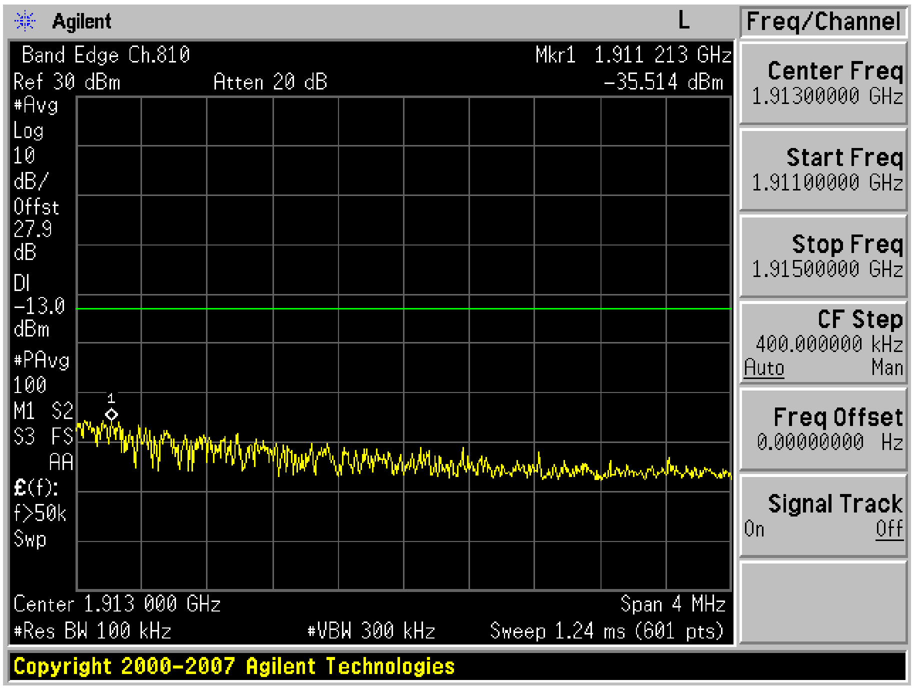
GSM1900 MODE (810 CH.) Block Edge 1



GSM1900 MODE (810 CH.) Block Edge 2



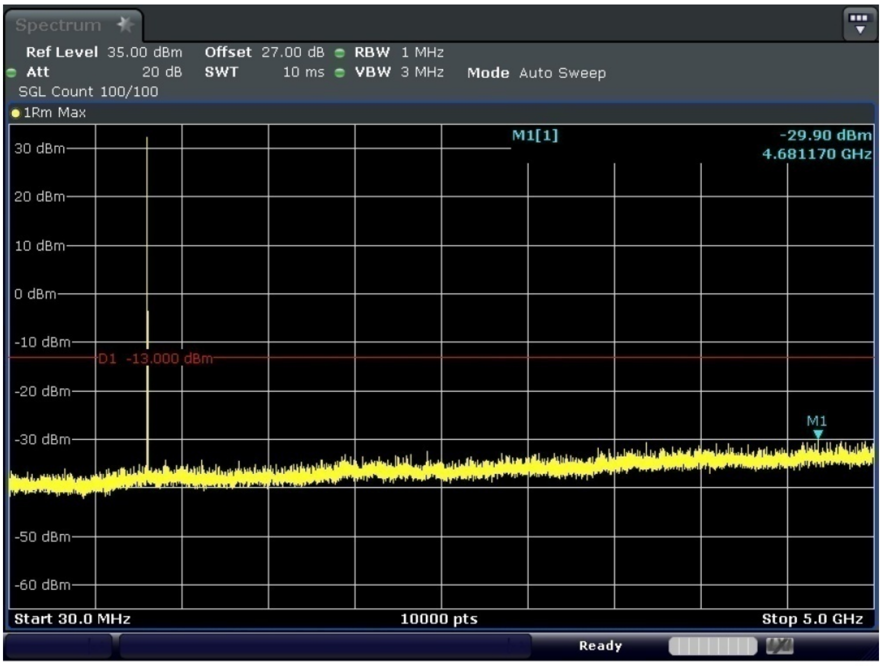
GSM1900 MODE (810 CH.) Block Edge 3



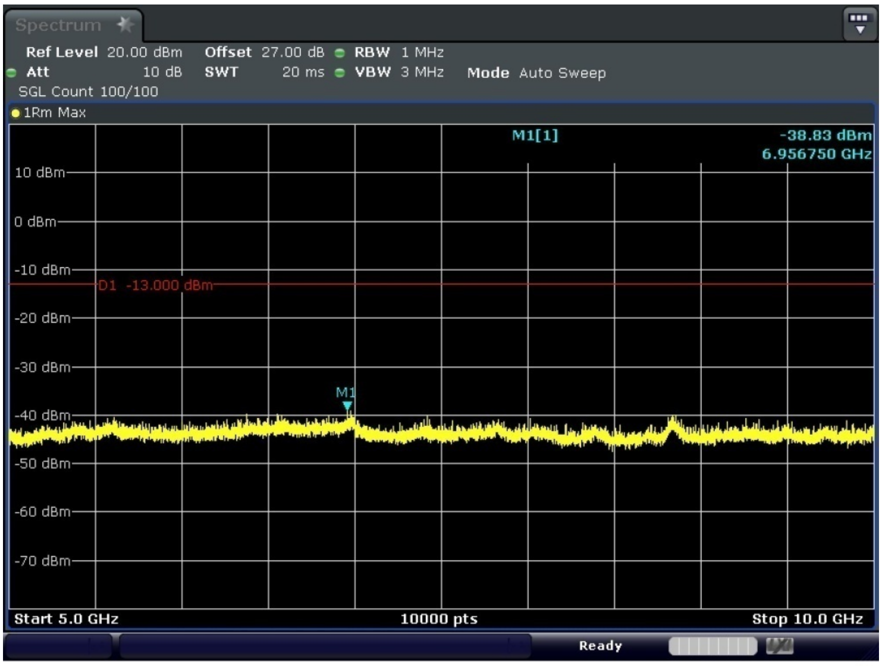
Note : We used a narrower RBW in order to increase accuracy.

Calculation = Reading Value + 10*log(1 MHz/100 kHz) dB = -35.514dBm + 10 dB = **-25.514dBm**

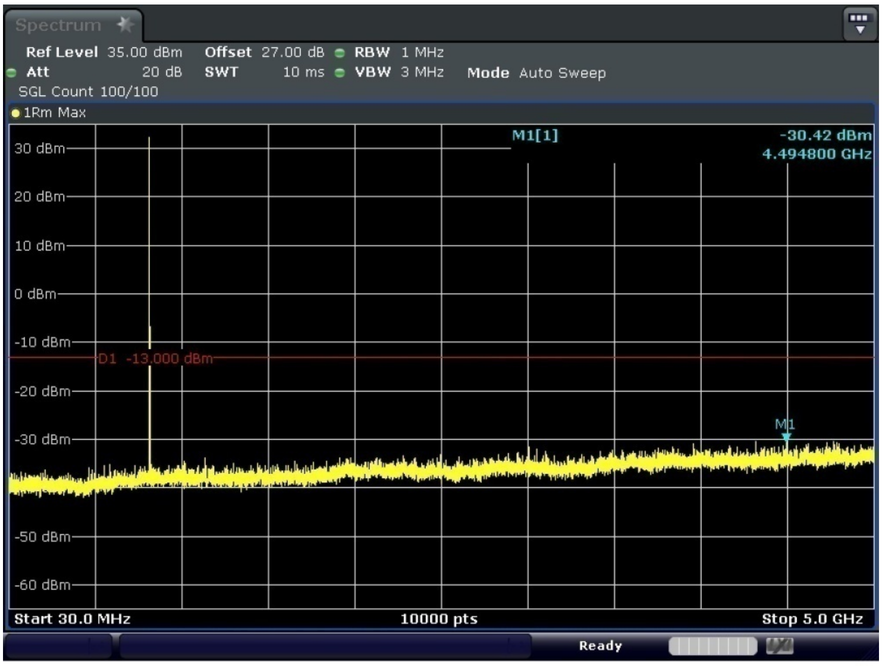
GSM850 MODE (128 CH.) Conducted Spurious Emissions1



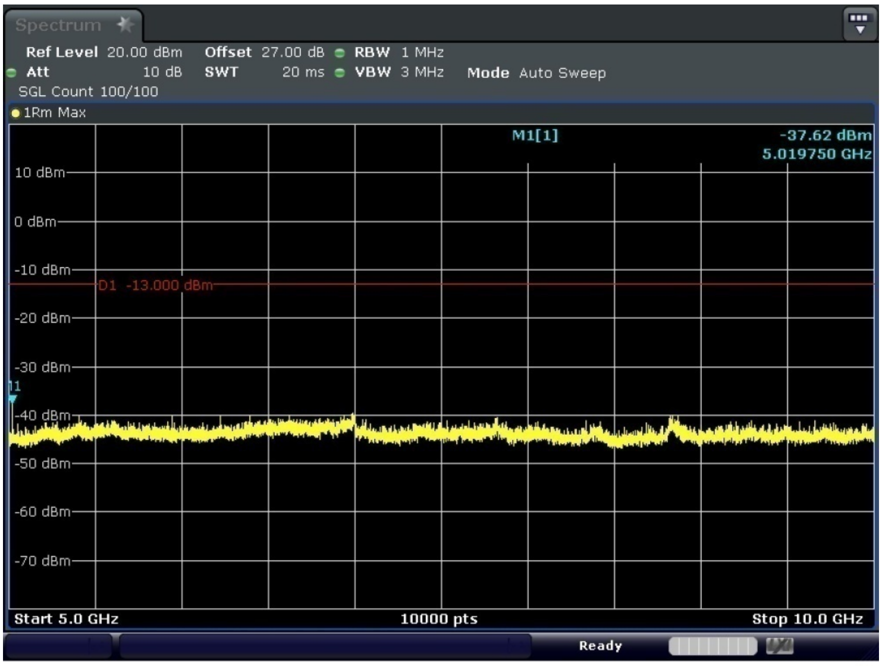
GSM850 MODE (128 CH.) Conducted Spurious Emissions2



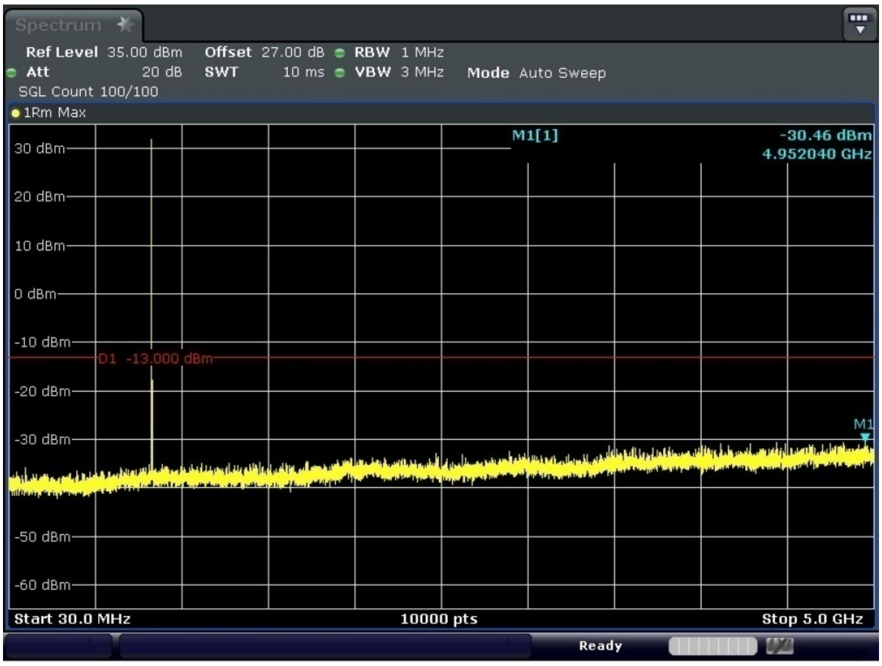
GSM850 MODE (190 CH.) Conducted Spurious Emissions1



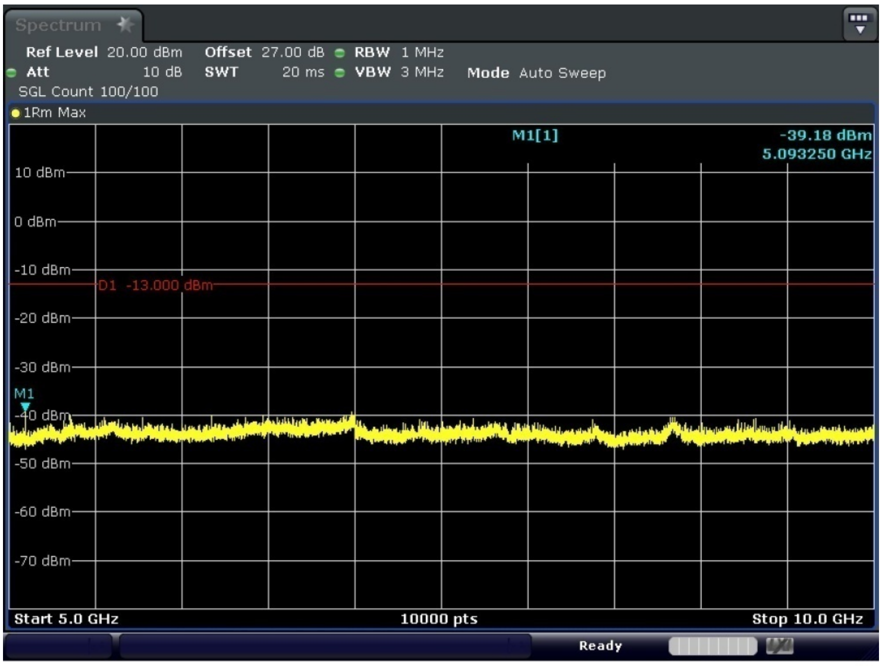
GSM850 MODE (190 CH.) Conducted Spurious Emissions2



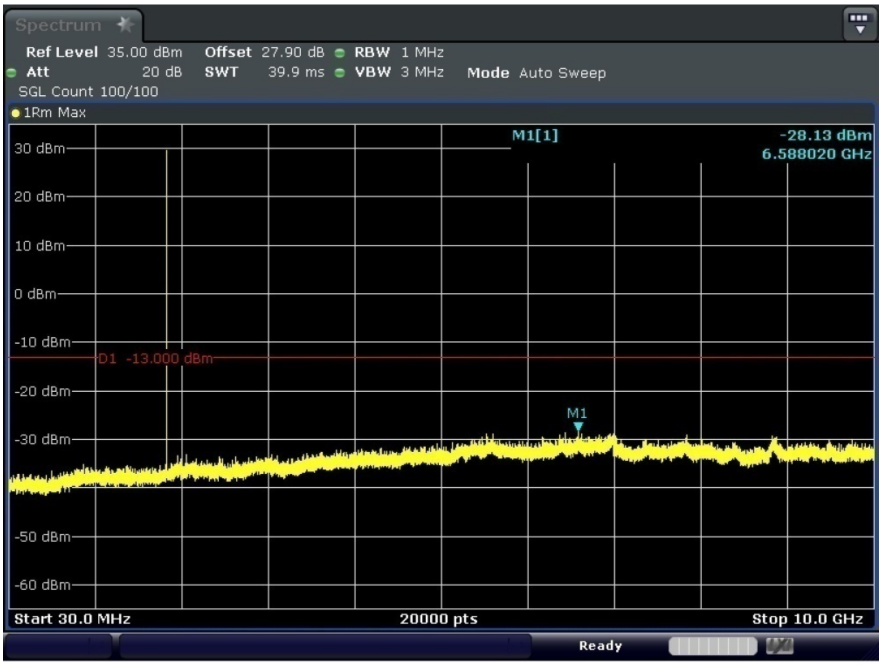
GSM850 MODE (251 CH.) Conducted Spurious Emissions1



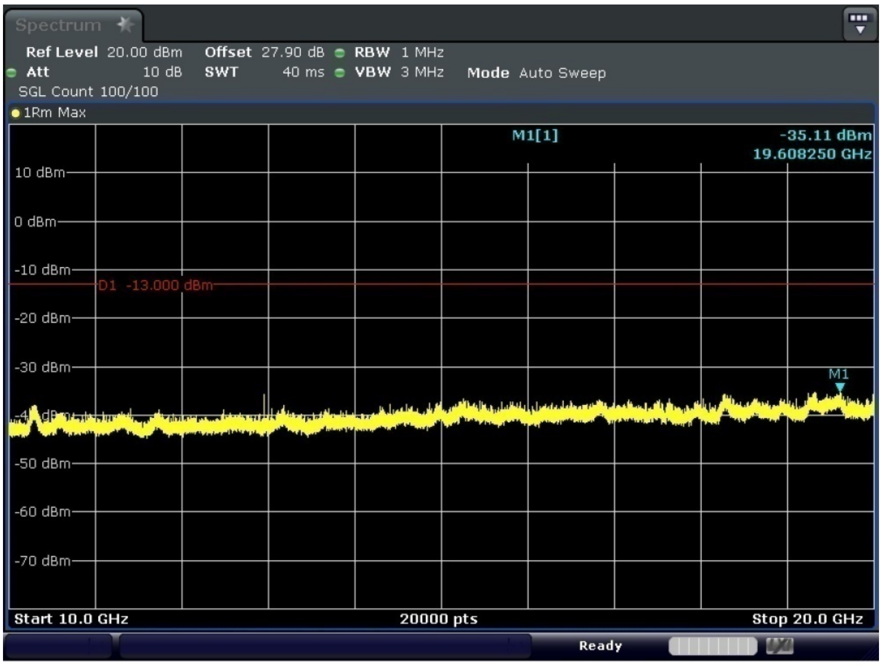
GSM850 MODE (251 CH.) Conducted Spurious Emissions2



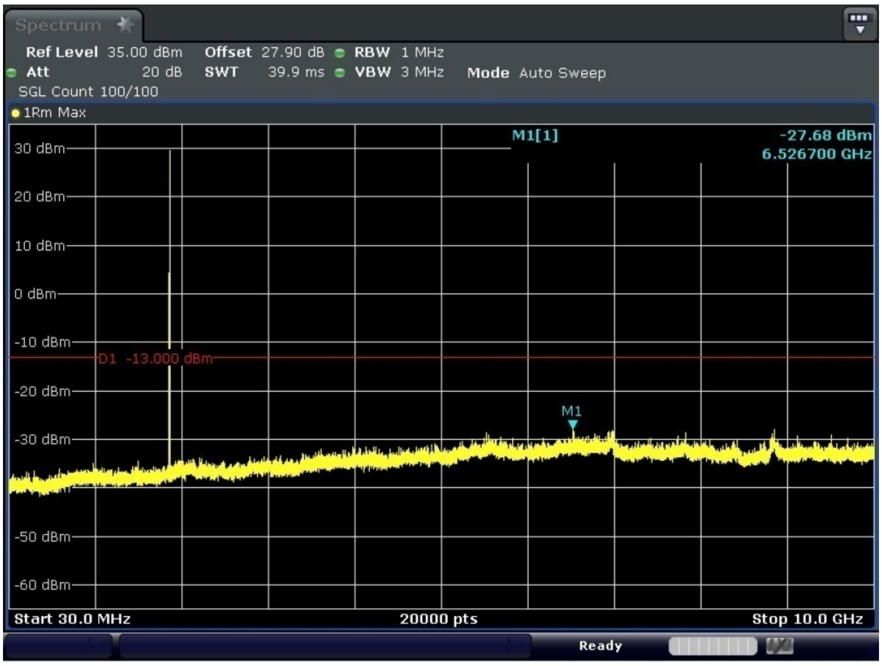
GSM1900 MODE (512 CH.) Conducted Spurious Emissions1



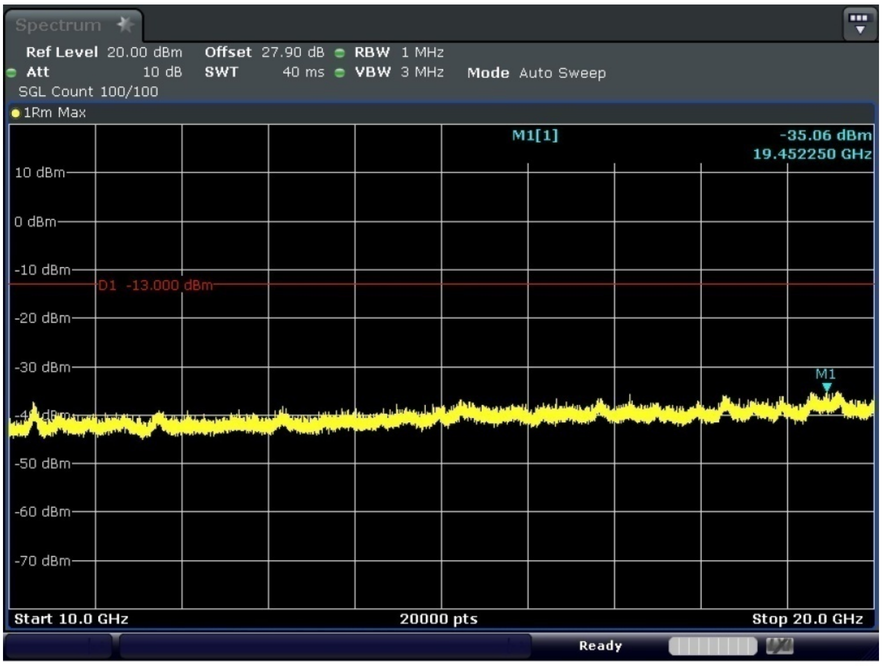
GSM1900 MODE (512 CH.) Conducted Spurious Emissions2



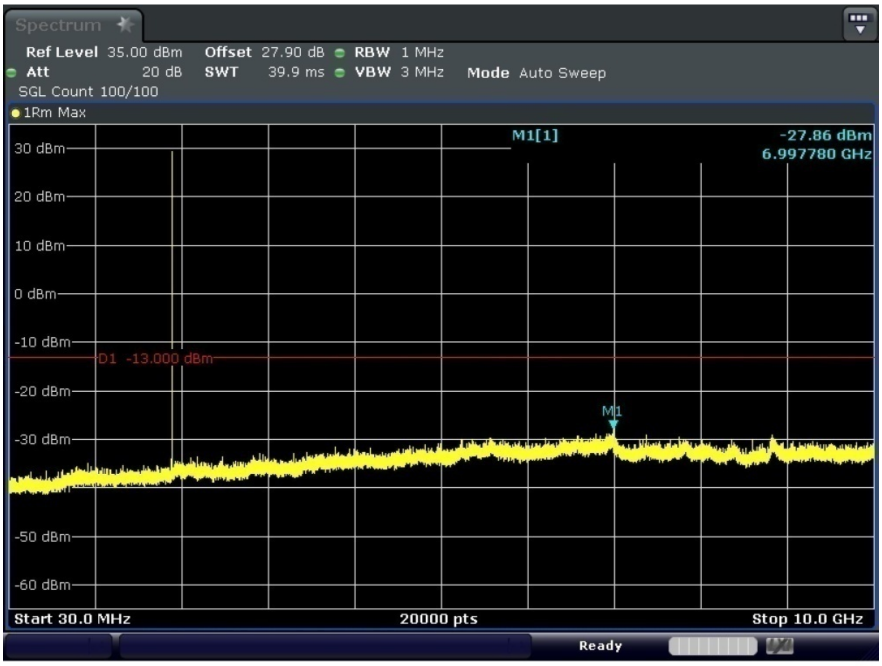
GSM1900 MODE (661 CH) Conducted Spurious Emissions1



GSM1900 MODE (661 CH.) Conducted Spurious Emissions2



GSM1900 MODE (810 CH.) Conducted Spurious Emissions1



GSM1900 MODE (810 CH.) Conducted Spurious Emissions2