

TEST REPORT

1. Applicant

Name : MTH Inc.
Address : 10F, Mtek IT Tower, 688-1, Sampyeong-dong, Bundang-gu,
Seongnam-si, Gyeonggi-do, South Korea

2. Products

Name : GSM/GPRS/EDGE module
Model/Type : MGM-312E
Manufacturer : MTH Inc.

3. Test Standard : FCC CFR 47 Part 2, Part 22(H), Part 24(E)

4. Test Method : ANSI/TIA/EIA-603-C, ANSI C63.4-2009

5. Test Result : Positive

6. Date of Application : January 11, 2012

7. Date of Issue : January 31, 2012

Tested by



Jong-gon Ban

Telecommunication Center
Senior Engineer

Approved by



Jeong-min Kim

Telecommunication Center
Manager

The test results contained apply only to the test sample(s) supplied by the applicant, and this test report shall not be reproduced in full or in part without approval of the KTL in advance.

Korea Testing Laboratory

TABLE OF CONTENTS

1. GENERAL INFORMATION	4
1.1. Applicant (Client)	4
1.2. Equipment (EUT)	4
1.3. Testing Laboratory	5
1.4. Description of test mode	6
2. SUMMARY OF TEST RESULTS	7
3. MEASUREMENT & RESULTS	8
3.1. Conducted Output Power	8
3.1.1. Test Procedure	8
3.1.2. Test Results	8
3.2. Effective Radiated Power	9
3.2.1. Test Procedure	9
3.2.2. Limit	9
3.2.3. Test Result	10
3.3. Field Strength of Spurious Radiation	11
3.3.1. Limit	11
3.3.2. Test Results (GSM850 test data)	11
3.3.3. Test Results (GSM1900 test data)	12
3.4. Occupied Bandwidth	13
3.4.1. Test Procedure	13
3.4.2. Limit	13
3.4.3. Test Results	14
3.5. Conducted Spurious Emission	23
3.5.1. Test Procedure	24
3.5.2. Limit	24
3.5.3. Test Results	24
3.6. Frequency Stability / Temperature Variation	30

3.6.1.	Test Procedure	30
3.6.2.	Limit.....	30
3.6.3.	Test Results.....	31
4.	TEST EQUIPMENTS	33

1. GENERAL INFORMATION

1.1. Applicant (Client)

Name	MTH Inc.
Address	10F, Mtek IT Tower, 688-1, Sampyeong-dong, Bundang-gu, Seongnam-si, Gyeonggi-do, South Korea
Contact Person	Woo Sung Hee
Telephone No.	+82-31-627-0316
Facsimile No.	+82-31-627-0304
E-mail address	woosh@mth-modem.com
Manufacturer Name	MTH Inc.
Manufacturer Address	10F, Mtek IT Tower, 688-1, Sampyeong-dong, Bundang-gu, Seongnam-si, Gyeonggi-do, South Korea

1.2. Equipment (EUT)

Type of equipment	Quad band GSM/GPRS/EDGE Module
Model Name	MGM-312E
FCC ID	A7XMGM-312E
FCC Classification	PCS Licensed Transmitter
Tx frequency Band	824.2 ~ 848.8 MHz (GSM850) 1850.2 ~ 1909.8 MHz (GSM1900)
Rx frequency Band	869.2 ~ 893.8 MHz (GSM850) 1930.2 ~ 1989.8 MHz (GSM1900)
Max. Power Rating	31.17 dBm (GSM850) / 28.11 dBm (GSM1900)
Emission Designators	249K3GXW(GSM850) / 245K8GXW(GSM1900)
MODE	GSM / GPRS / EGPRS
Antenna Type	Swivel type
Antenna Gain	-0.03 dBi (GSM850) / 2.13 dBi (GSM1900)
Power class	Class 4 for GSM850, Class 1 for GSM1900
Class of GPRS/EGPRS	12
Hardware Version	V1.0
Software Version	V1.0

1.3. Testing Laboratory

Testing Place	Korea Testing Laboratory (KTL) 723, Hae-an-ro, Sangnok-Gu, Ansan-si Gyeonggi-Do , Korea
FCC registration number	408324
Industry Canada filing number	6298A
Test Engineer	Jong-gon Ban
Telephone number	+82 31 5000 133
Facsimile number	+82 31 5000 149
E-mail address	banjg@ktl.re.kr
Other Comments	-

1.4. Description of test mode

Band	Mode	Frequency (MHz)	Average Output Power (dBm)			
			1 Tx slot	2 Tx slots	3 Tx slots	4 Tx slots
GSM 850	GSM	824.2	31.17	-	-	-
		836.6	31.03	-	-	-
		848.8	30.95	-	-	-
	GPRS	824.2	31.17	31.16	31.15	31.00
		836.6	30.98	31.02	30.99	30.90
		848.8	30.91	30.94	30.90	30.82
	EGPRS	824.2	25.59	25.40	24.61	23.98
		836.6	25.60	25.40	24.66	24.04
		848.8	25.66	25.30	24.58	24.00

* We found out the test mode with the highest power level after we analyze all the data rates. So we chose GSM mode (worst case) as a representative of GSM 850 band.

Band	Mode	Frequency (MHz)	Average Output Power (dBm)			
			1 Tx slot	2 Tx slots	3 Tx slots	4 Tx slots
GSM 1900	GSM	1850.2	28.11	-	-	-
		1880.0	28.01	-	-	-
		1909.8	27.88	-	-	-
	GPRS	1850.2	28.10	28.04	28.01	27.97
		1880.0	28.00	27.95	27.90	27.81
		1909.8	27.87	27.81	27.78	27.68
	EGPRS	1850.2	28.04	27.97	27.92	27.89
		1880.0	27.95	27.86	27.85	27.78
		1909.8	27.82	27.73	27.69	27.66

* We found out the test mode with the highest power level after we analyze all the data rates. So we chose GSM mode (worst case) as a representative of GSM 1900 band.

2. SUMMARY OF TEST RESULTS

Testing performed for : MTH Inc.

Equipment Under Test : MGM-312E

Receipt of Test Sample : 2012.01.11

Test Start Date : 2012. 01. 11

Test End Date : 2012. 01. 25

The following table represents the list of measurements required under the FCC CFR47 Part 22H and 24E.

FCC Rules	Test Requirements	Result
22.913(a), 24.232(c)	Conducted RF power output	Pass
22.913(a), 24.232(c)	ERP & EIRP	Pass
22.917, 24.238	Radiated Spurious Emission	Pass
2.1049	Occupied bandwidth	Pass
22.917, 24.238	Conducted Spurious Emission	Pass
22.355, 24.235	Frequency Stability	Pass

Note 1 : Test results reported in this document relate only to the items tested

Note 2 : The required tests demonstrated compliance as per client declaration of test configuration, monitoring methodology and associated pass/fail criteria

Note 3 : Test results apply only to the item(s) tested

*** Modifications required for compliance**

No modifications were implemented by KTL.

All results in this report pertain to the un-modified sample provided to KTL.

3. Measurement & Results

3.1. Conducted Output Power

3.1.1. Test Procedure

A base station simulator (CMU200) was used to establish communication with the EUT. The base station simulator parameters were set to produce the maximum power from the EUT. Conducted Output Powers of EUT are reported below.

3.1.2. Test Results

Mode	Frequency (MHz)	Average Output Power (dBm)
GSM 850	824.2	31.17
	836.6	31.03
	848.8	30.95

Mode	Frequency (MHz)	Average Output Power (dBm)
GSM 1900	1850.2	28.11
	1880.0	28.01
	1909.8	27.88

3.2. Effective Radiated Power

3.2.1. Test Procedure

The radiated and spurious measurements were made Fully-anechoic chamber at a 3-meter test range. The EUT was placed on the rotating device at 1.5m and at a distance of 3-meters from the receive antenna. The rotating device which can rotate horizontal axis was mounted on the turn unit to facilitate rotation around a vertical axis. The measurement was made for each horizontal/vertical position combination with receive antenna horizontally polarized. This measurement was repeated with receive antenna vertically polarized. The substitution antenna will replace the EUT antenna at the same position and in vertical polarization. The frequency of the signal generator shall be set to the frequencies that were measured on the EUT. The signal generator, output level, shall be adjusted until an equal or a known related level to what was measured from the EUT is obtained in the spectrum analyzer. This level was recorded. For readings above 1 GHz, the above procedure is repeated using horn antennas and the difference between the gain of the horn and an isotropic antenna are taken into consideration.

All modes of operation were investigated, and the worst-case results are reported.

3.2.2. Limit

FCC 22.913(b) : The Effective Radiated Power (ERP) of mobile transmitters must not exceed 7 Watts.

FCC 24.232(b) : The equivalent Isotropic Radiated Power (EIRP) must not exceed 2 Watts.

3.2.3. Test Result

• GSM 850 Test Data

Frequency(MHz)	Measured Level [dBm]	Substitute Level [dBm]	Antenna Gain [dBd]	Polarization [H/V]	ERP [dBm]
824.2	-33.46	17.42	-1.18	H	18.60
836.6	-31.58	18.26	-1.03	H	19.29
848.8	-29.10	20.58	-0.90	H	21.48

• GSM 1900 Test Data

Frequency(MHz)	Measured Level [dBm]	Substitute Level [dBm]	Antenna Gain [dBi]	Polarization [H/V]	EIRP [dBm]
1850.2	-31.34	26.08	-0.21	H	26.29
1880.0	-35.99	21.92	-0.27	H	22.19
1909.8	-38.55	19.49	-0.29	H	19.78

3.3. Field Strength of Spurious Radiation

3.3.1. Limit

FCC 22.917(a): The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10\log(P)$ dB.

- Limit : -13 dBm

3.3.2. Test Results (GSM850 test data)

Operating Frequency : 824.2 MHz

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBd]	E.R.P [dBm]	Polarization [H/V]	Limit [dBm]
1648.4	-62.96	7.66	-55.3	H	-13
2472.6	-57.08	10.78	-46.3	H	-13
3296.8	-60.72	11.32	-49.4	H	-13
4121.0	-59.37	12.57	-46.8	H	-13

Operating Frequency : 836.60 MHz

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBd]	E.R.P [dBm]	Polarization [H/V]	Limit [dBm]
1673.2	-47.30	7.70	-39.6	V	-13
2509.8	-53.11	10.81	-42.3	V	-13
3346.4	-52.51	11.41	-41.1	V	-13
4183.0	-57.98	12.58	-45.4	H	-13

Operating Frequency : 848.80 MHz

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBd]	E.R.P [dBm]	Polarization [H/V]	Limit [dBm]
1697.6	-52.62	8.02	-44.6	H	-13
2546.4	-52.02	10.82	-41.2	H	-13
3395.2	-60.23	11.43	-48.8	V	-13
4244.0	-52.46	12.56	-39.9	H	-13

3.3.3. Test Results (GSM1900 test data)

Operating Frequency : 1850.2 MHz

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	E.I.R.P [dBm]	Polarization [H/V]	Limit [dBm]
3700.4	-60.12	12.02	-48.1	V	-13
5550.6	-50.48	12.58	-37.9	V	-13
7400.8	-32.80	10.80	-22.0	V	-13
9251.0	-29.31	10.71	-18.6	V	-13

Operating Frequency : 1880.0 MHz

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	E.I.R.P [dBm]	Polarization [H/V]	Limit [dBm]
3760.0	-55.43	12.23	-43.2	H	-13
5640.0	-51.29	12.59	-38.7	V	-13
7520.0	-36.86	10.86	-26.0	H	-13
11280.0	-49.10	10.80	-38.3	H	-13

Operating Frequency : 1909.8 MHz

Frequency [MHz]	Level at Antenna Terminals [dBm]	Substitute Antenna Gain [dBi]	E.I.R.P [dBm]	Polarization [H/V]	Limit [dBm]
3819.6	-62.29	12.29	-50.0	H	-13
5729.4	-52.10	12.60	-39.5	V	-13
7639.2	-42.28	10.88	-31.4	H	-13
9549.0	-47.77	10.87	-36.9	V	-13
11458.8	-49.68	11.78	-37.9	H	-13

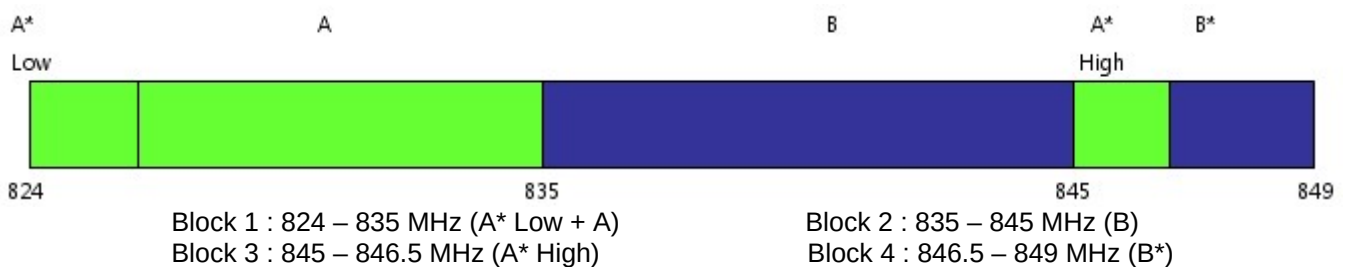
3.4. Occupied Bandwidth

3.4.1. Test Procedure

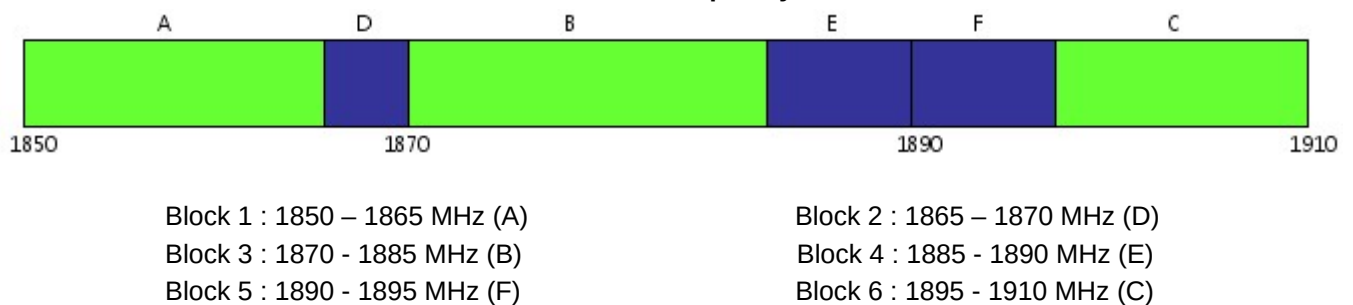
The EUT's output RF connector was connected with a short cable to spectrum analyzer. The EUT was setup to maximum output power. The EUT's occupied bandwidth is measured as the width of the signal between two points, one below the carrier center frequency and one above the carrier frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power. RBW was set to about 1% of emission BW, VBW is set to 3 times.

3.4.2. Limit

- 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
- Compliance with these provisions is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, 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. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emission are attenuated at least 26 dB Below the transmitter power.
- When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the license's frequency block edges, both upper and lower, as the design permits.
- The measurement of emission power can be expressed in peak or average values, provided they are expressed in the same parameters as the transmitter power.



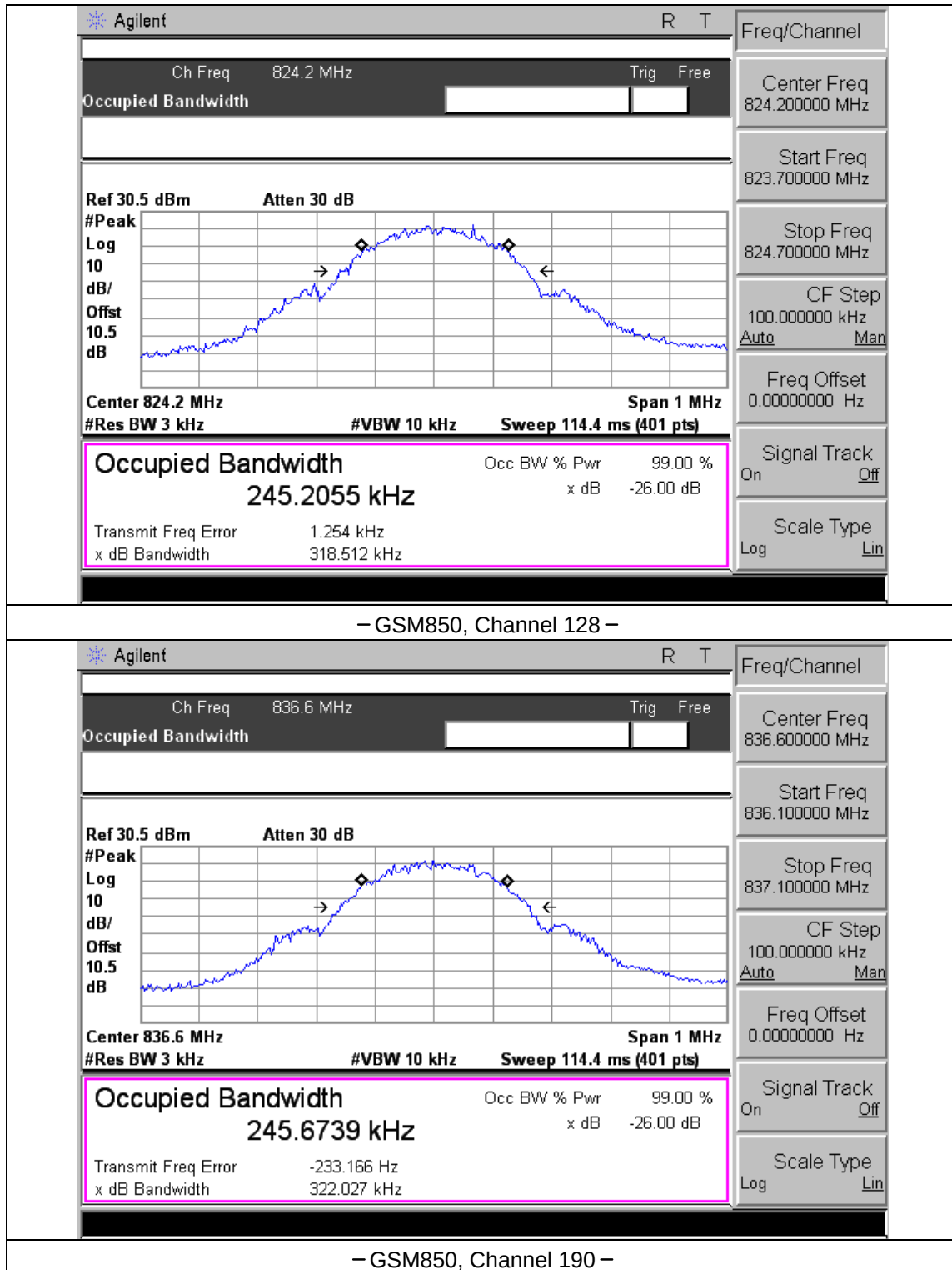
- Cellular Service Frequency Blocks -

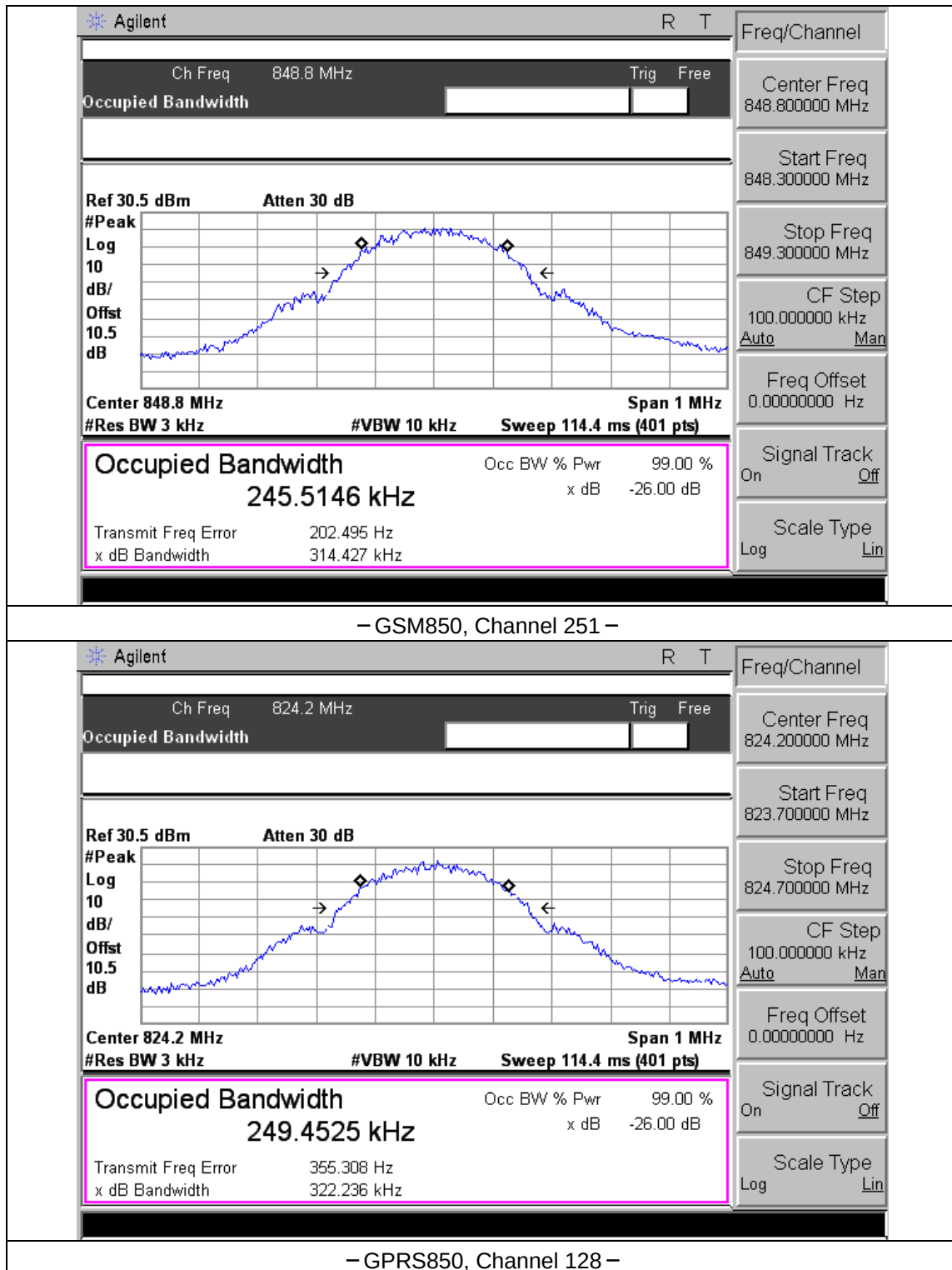


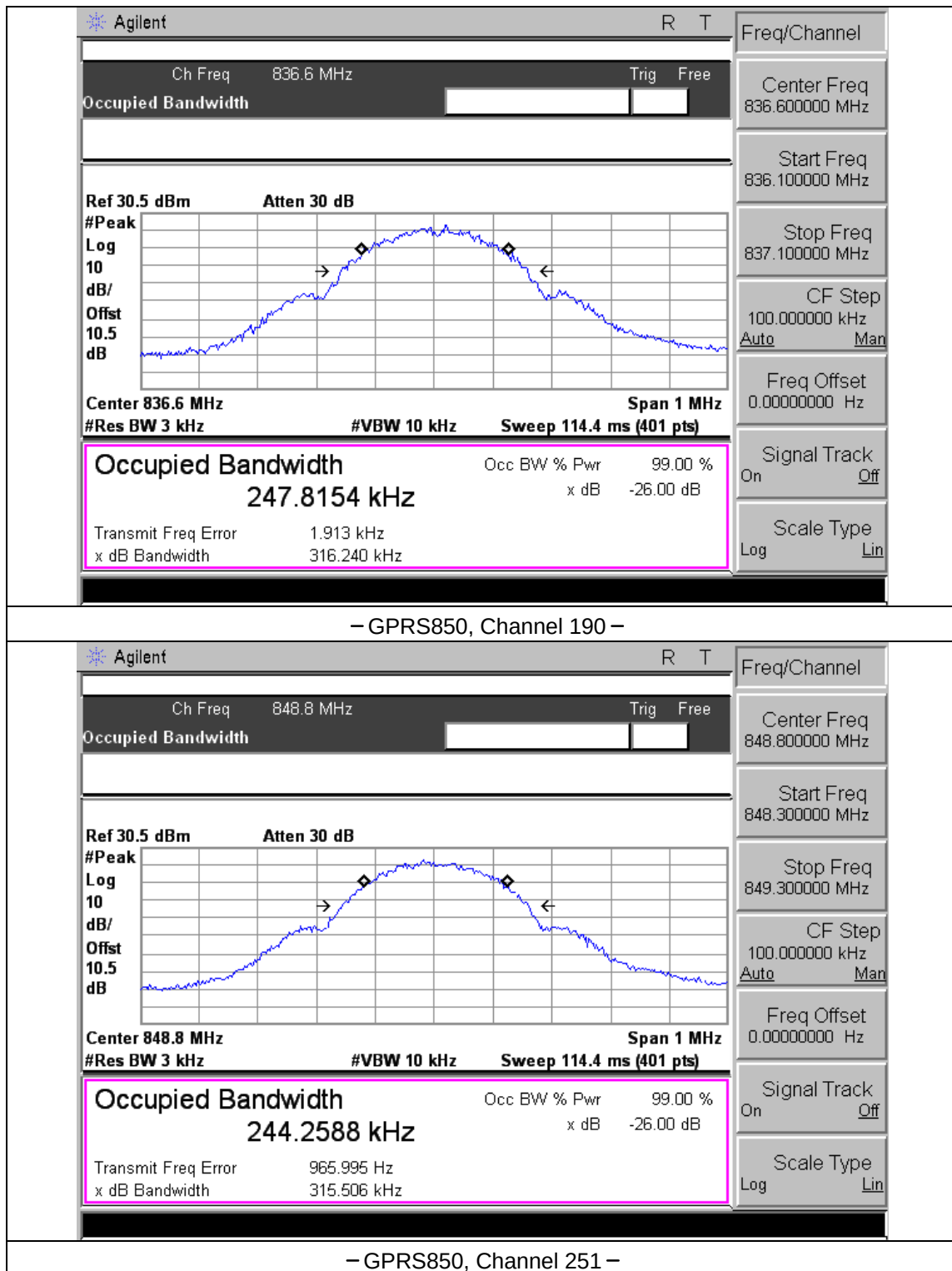
- Broadband PCS Service Frequency Blocks -

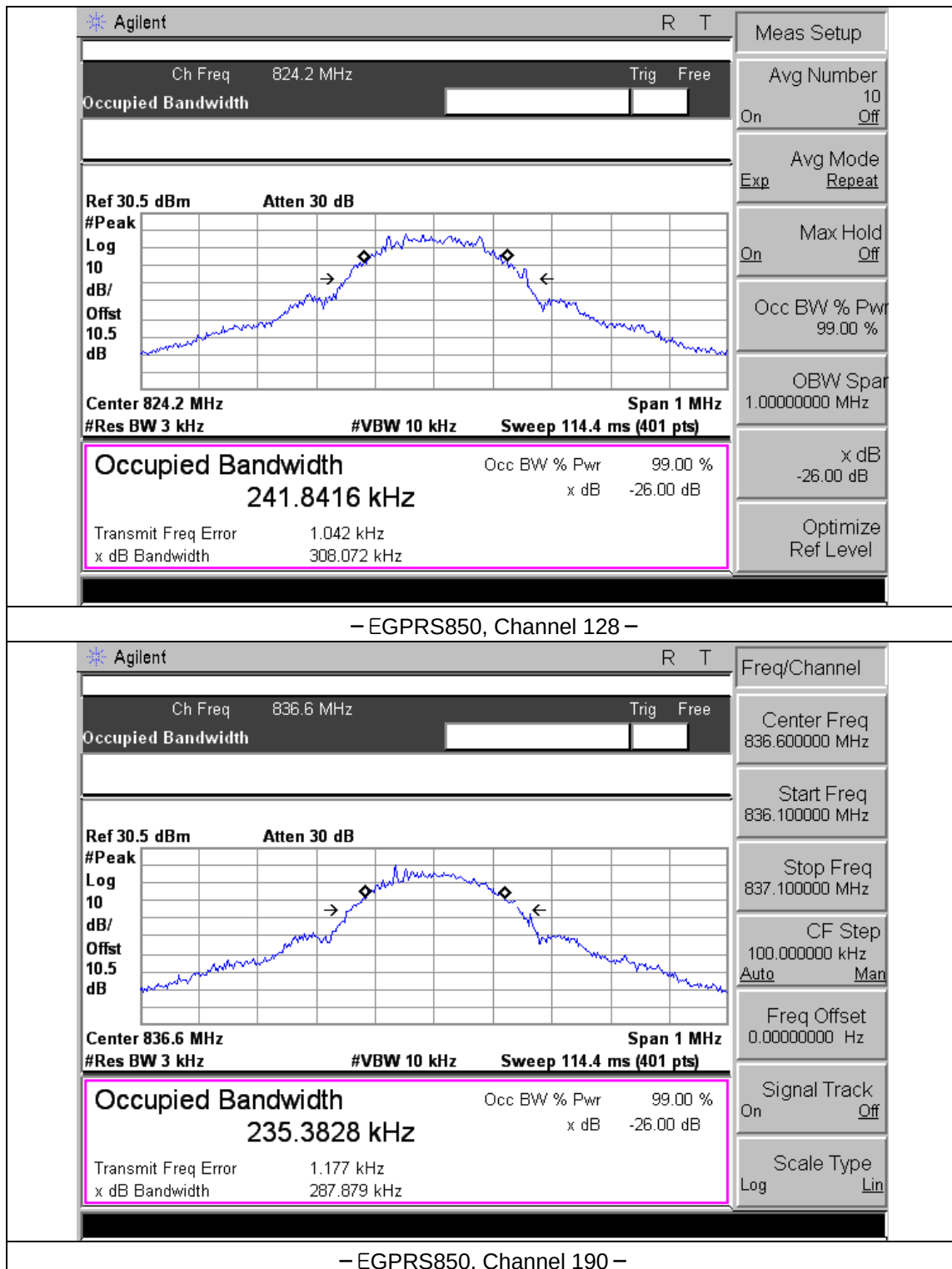
3.4.3. Test Results

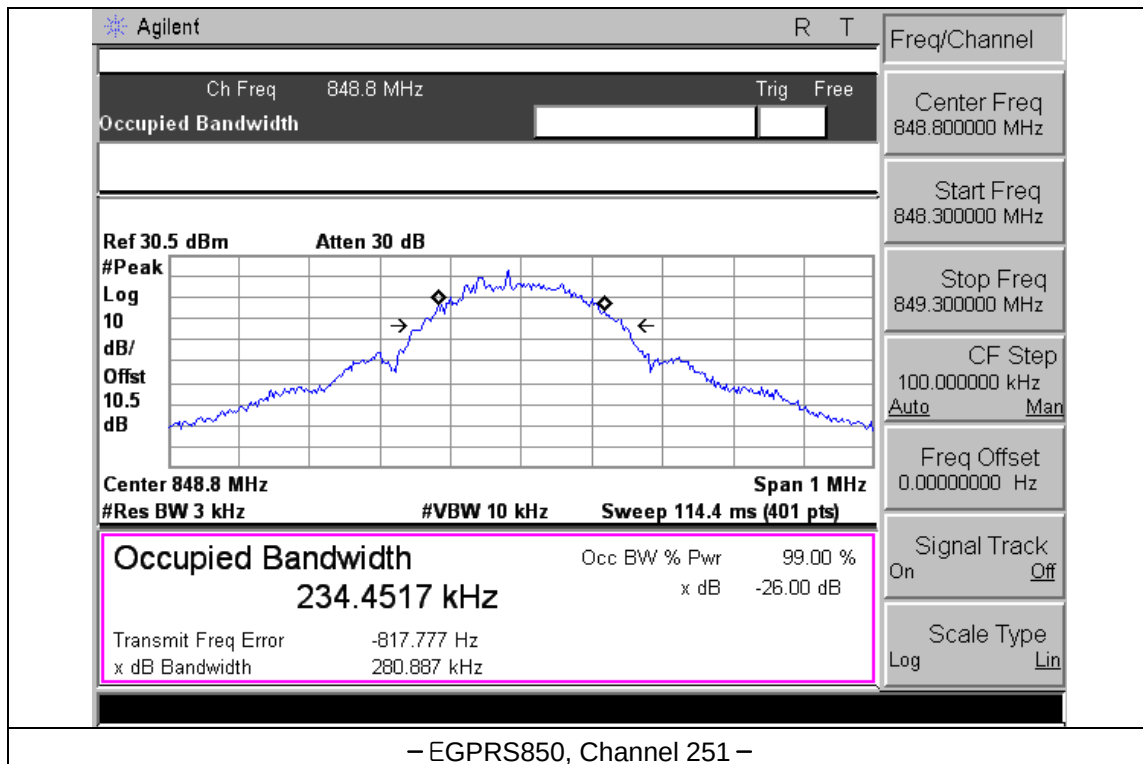
• GSM 850 Test Data



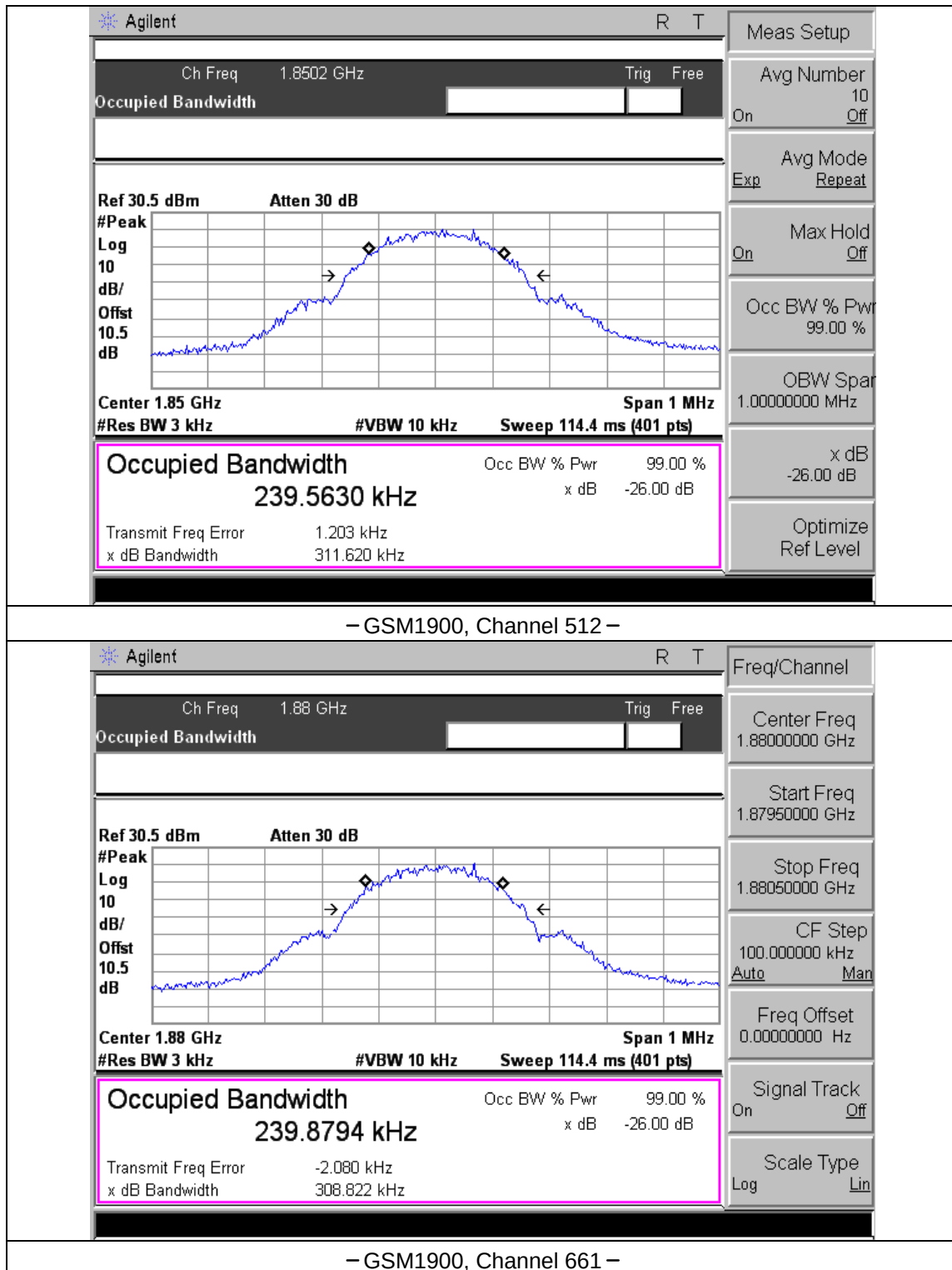


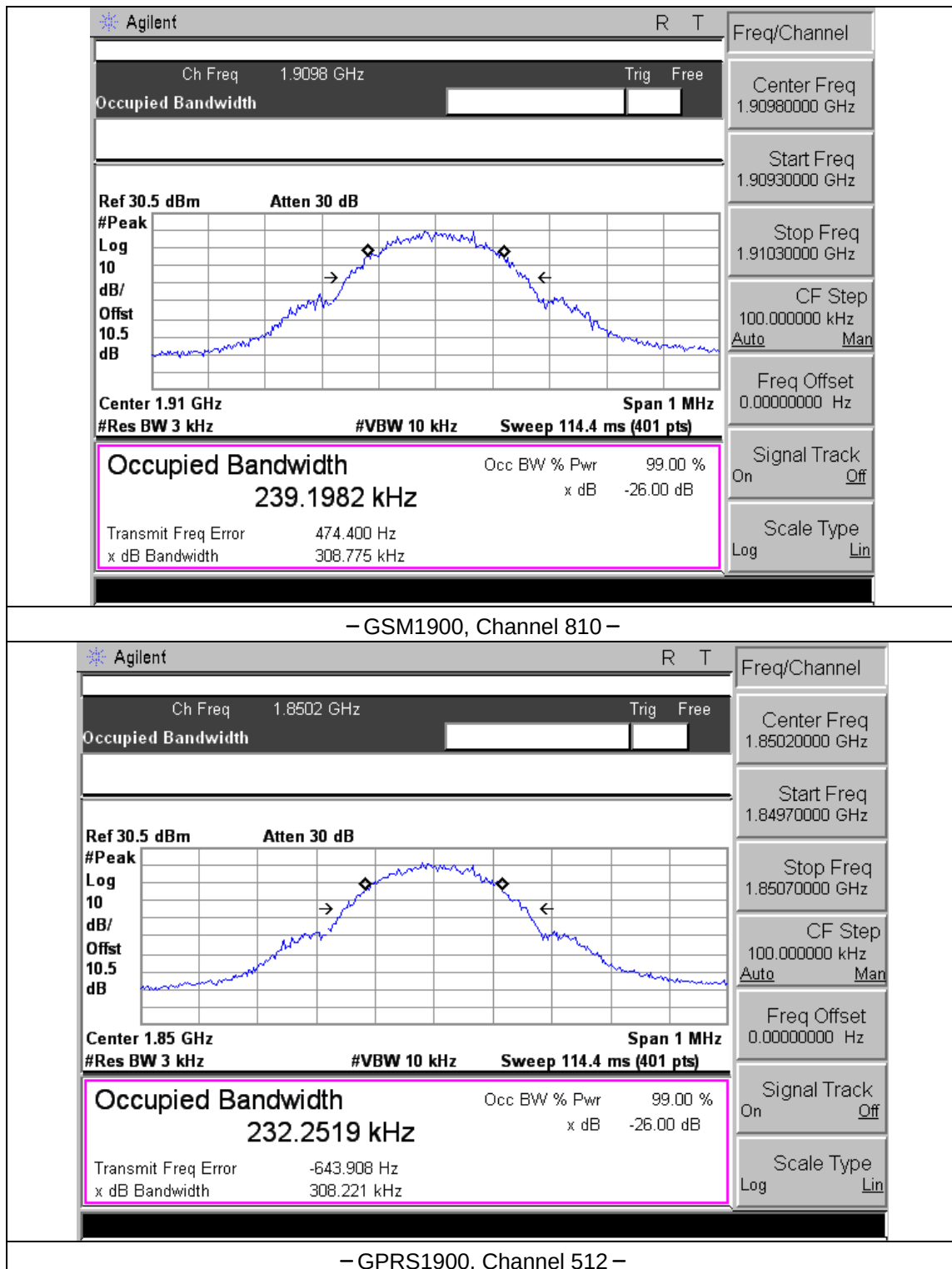


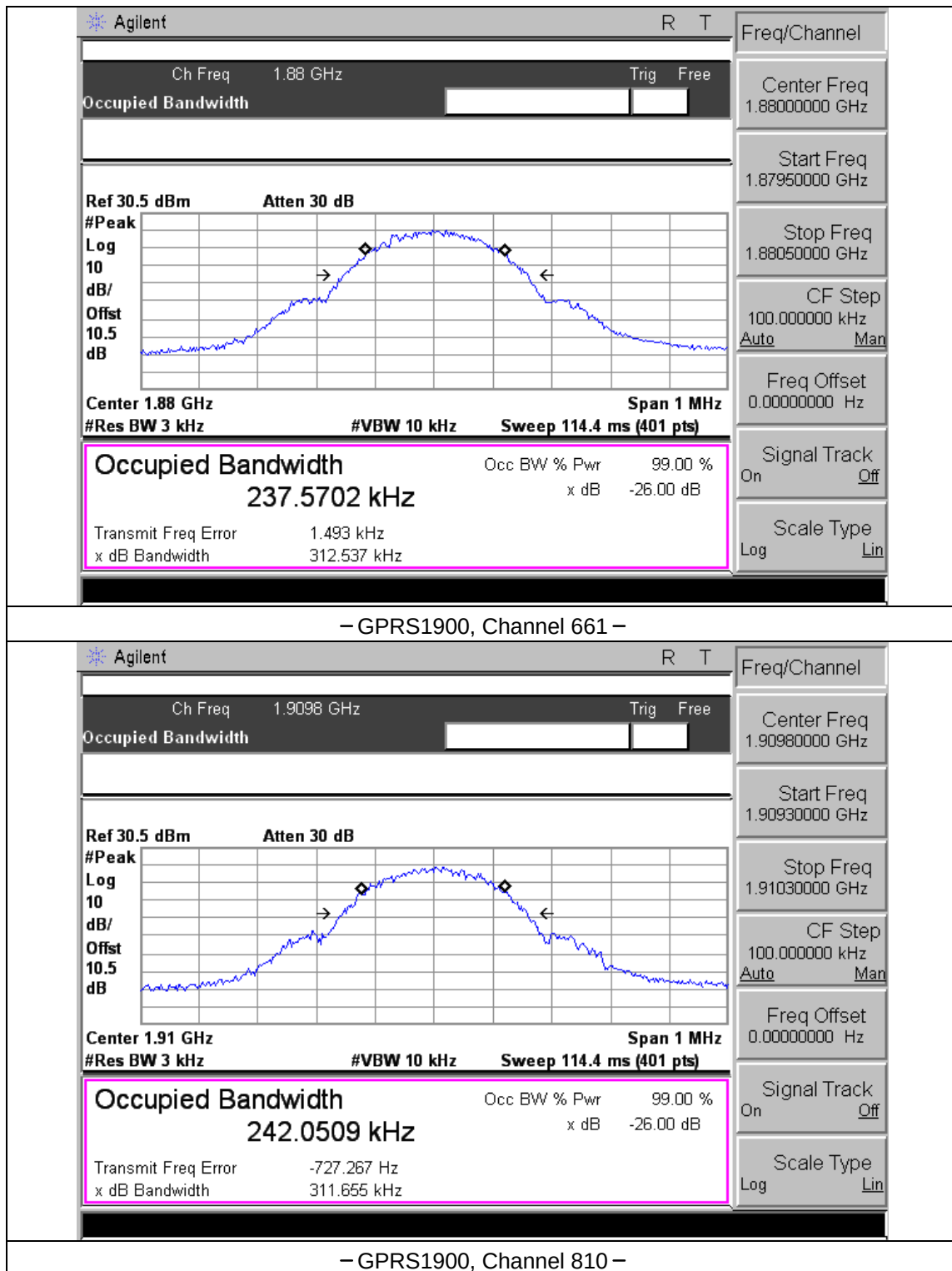


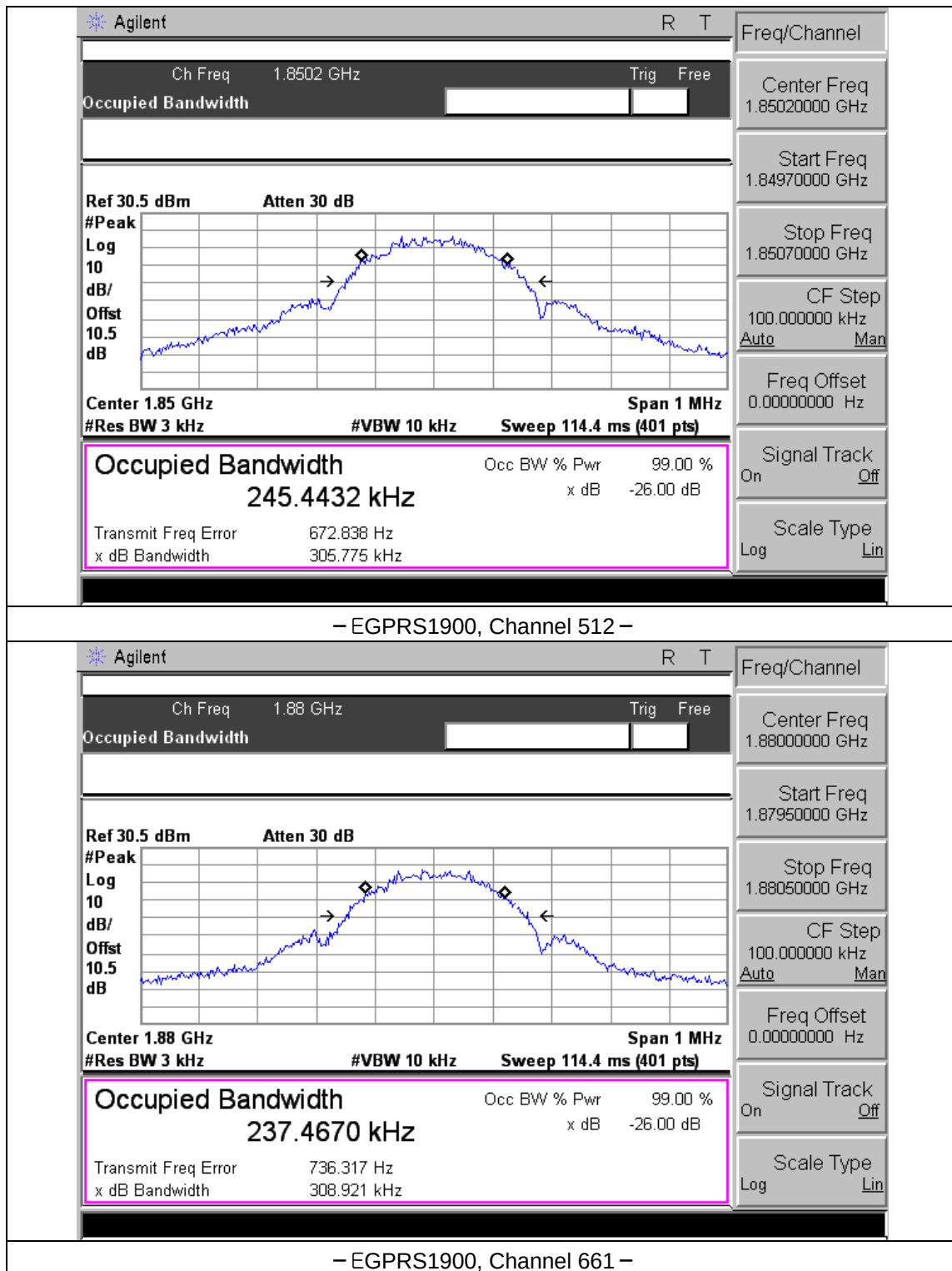


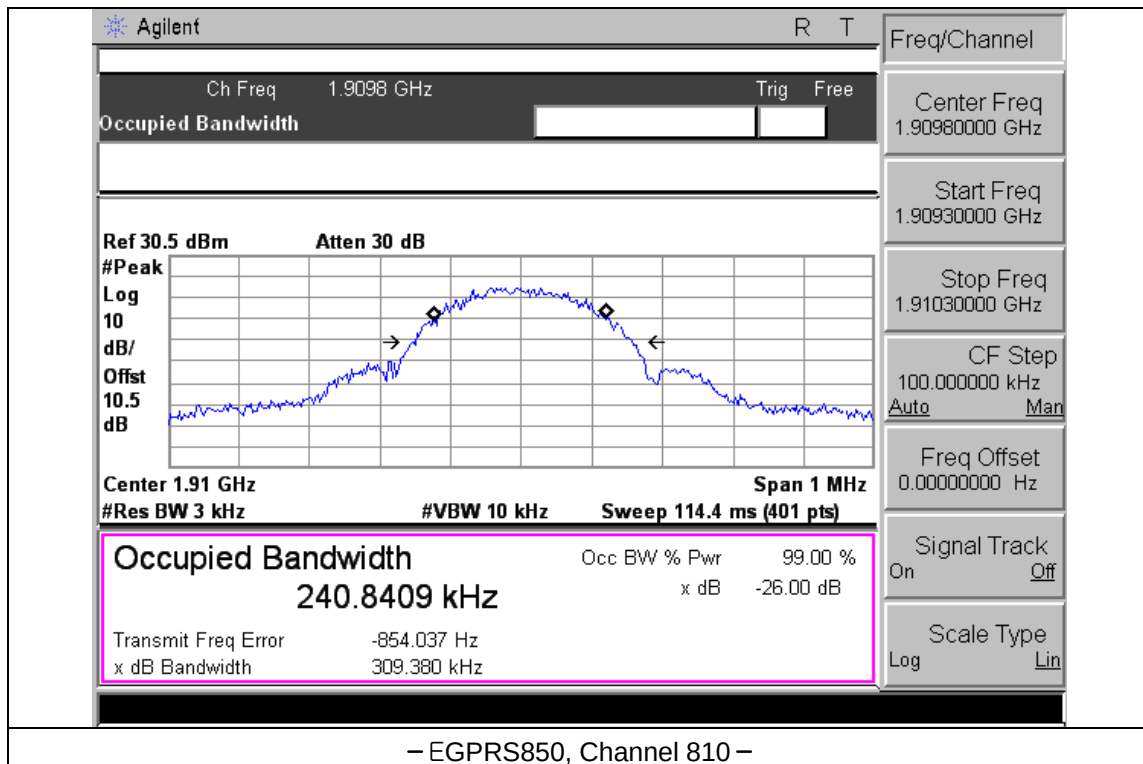
• GSM 1900 Test Data











3.5. Conducted Spurious Emission

3.5.1. Test Procedure

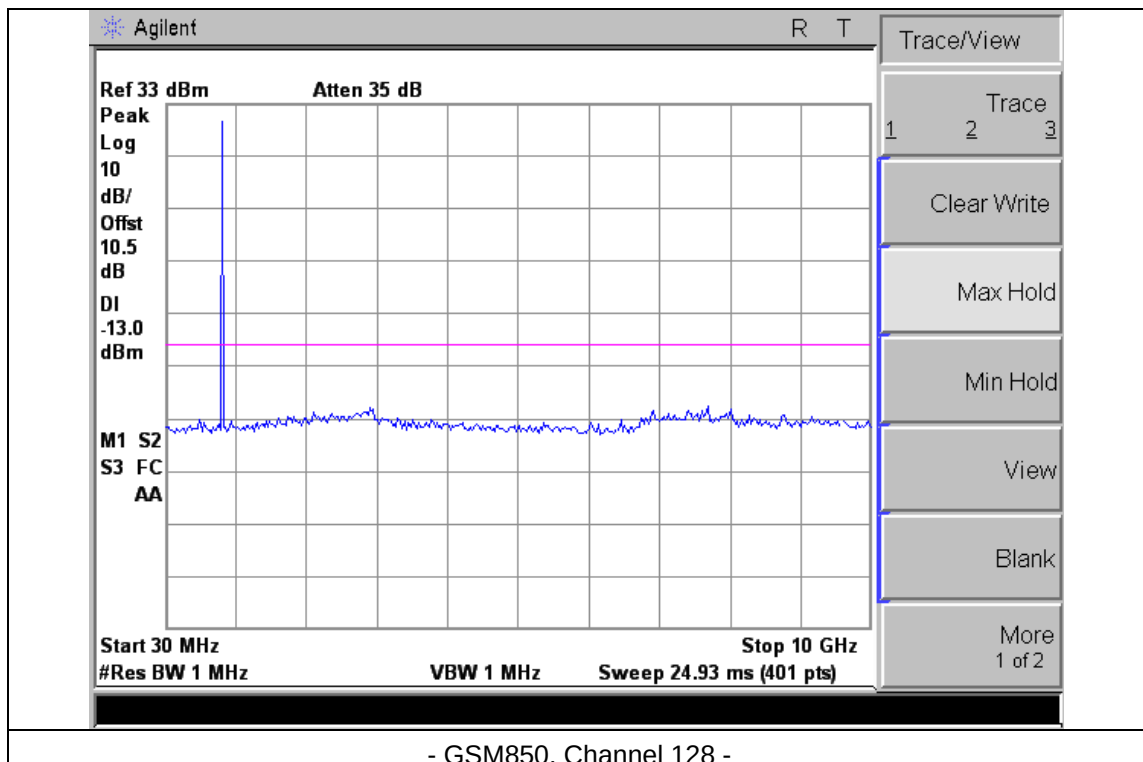
The EUT's output RF connector was connected with a short cable to spectrum analyzer. The EUT was setup to maximum output power. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. Compliance with the out-of-band emissions requirement is based on test being performed with an analyzer resolution bandwidth of 1 MHz. However in the 1 MHz band immediately outside and adjacent to the frequency block a resolution bandwidth of at least 1% of the fundamental emissions bandwidth may be employed. A display line was placed at -13 dBm to show compliance.

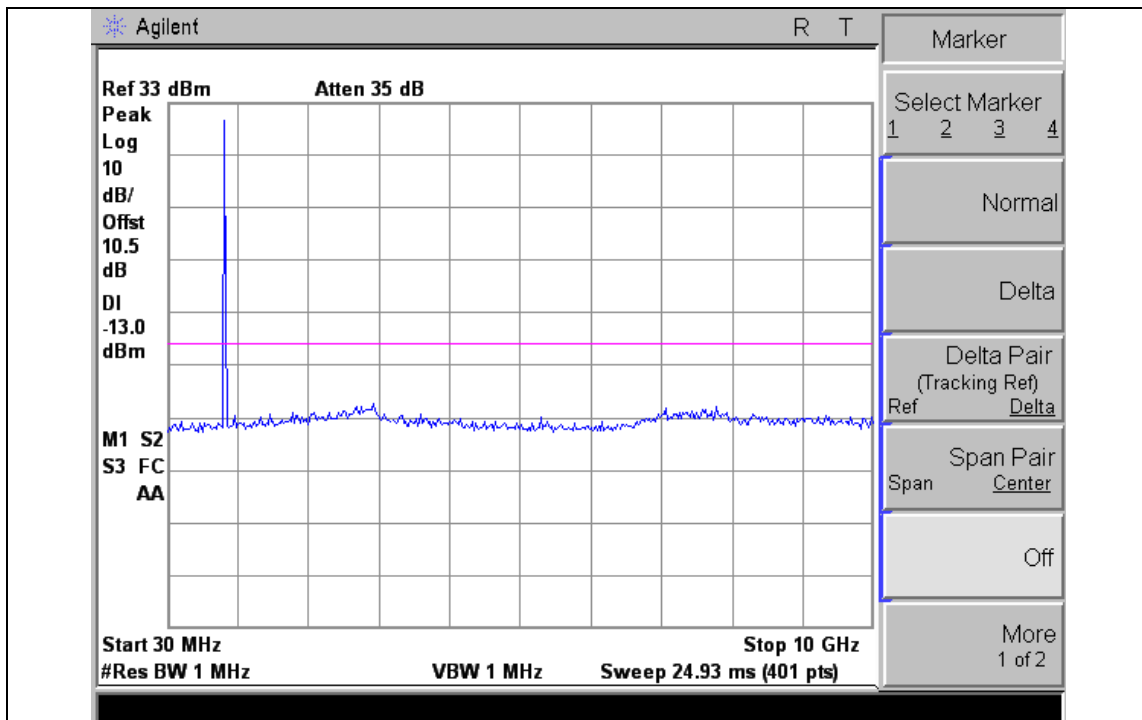
3.5.2. Limit

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. For all power levels +30 dBm to 0 dBm, this becomes a constant specification limit of -13 dBm.

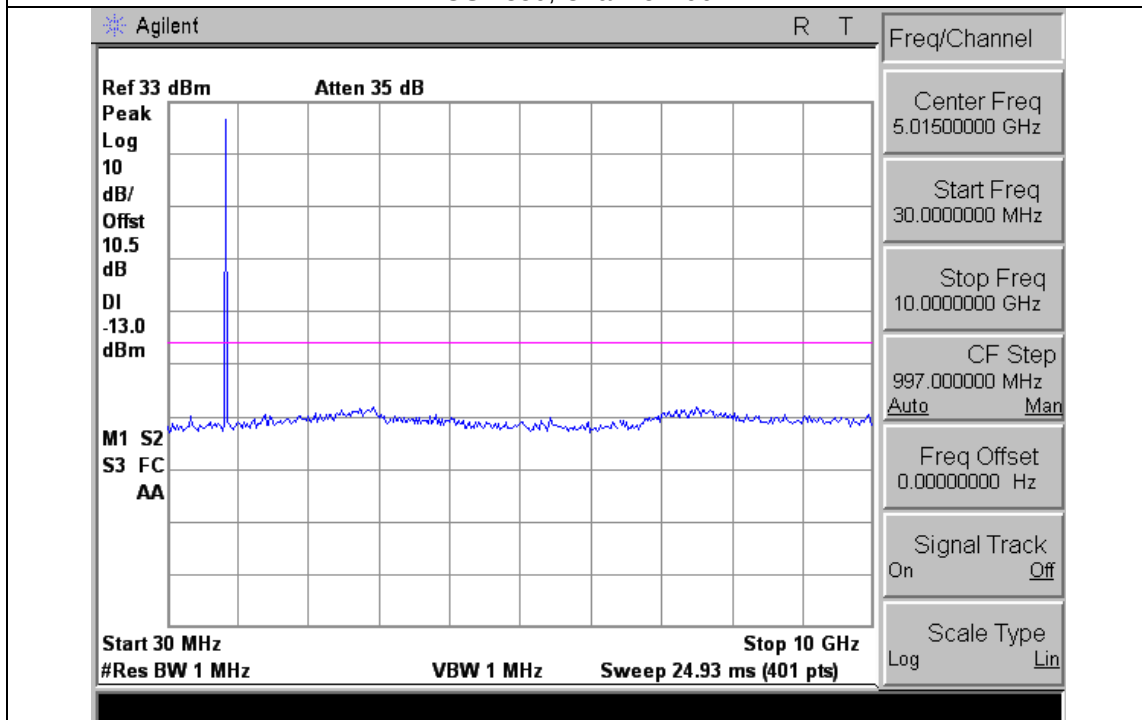
3.5.3. Test Results

- GSM 850 Test Data

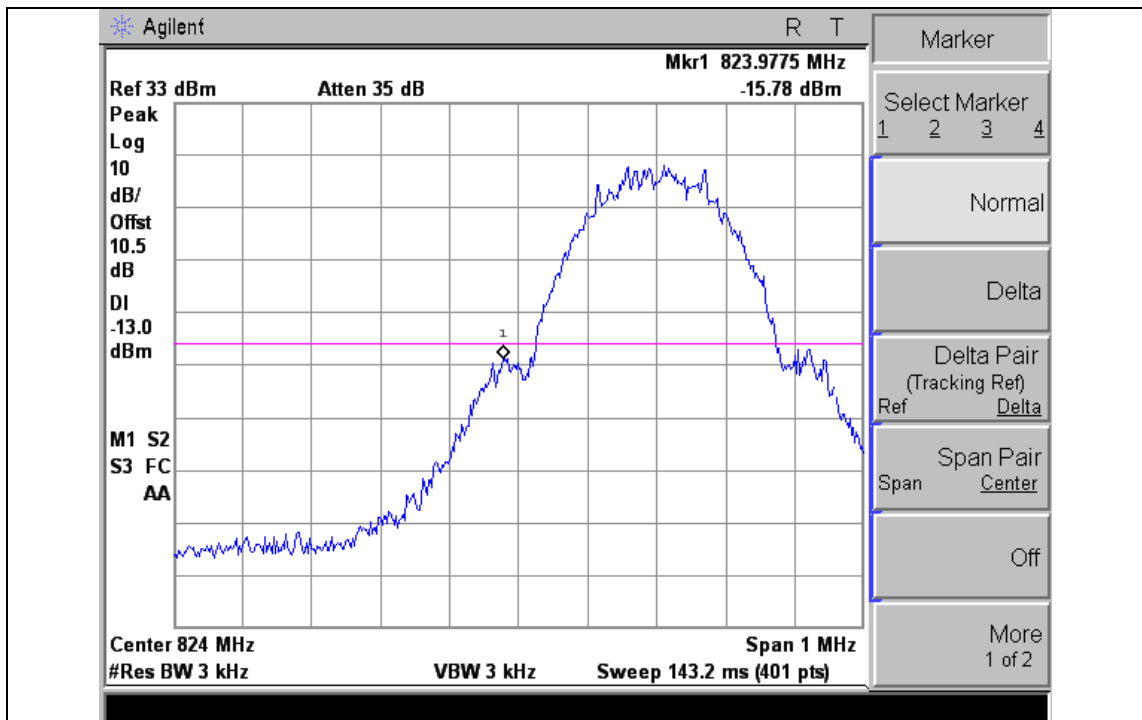




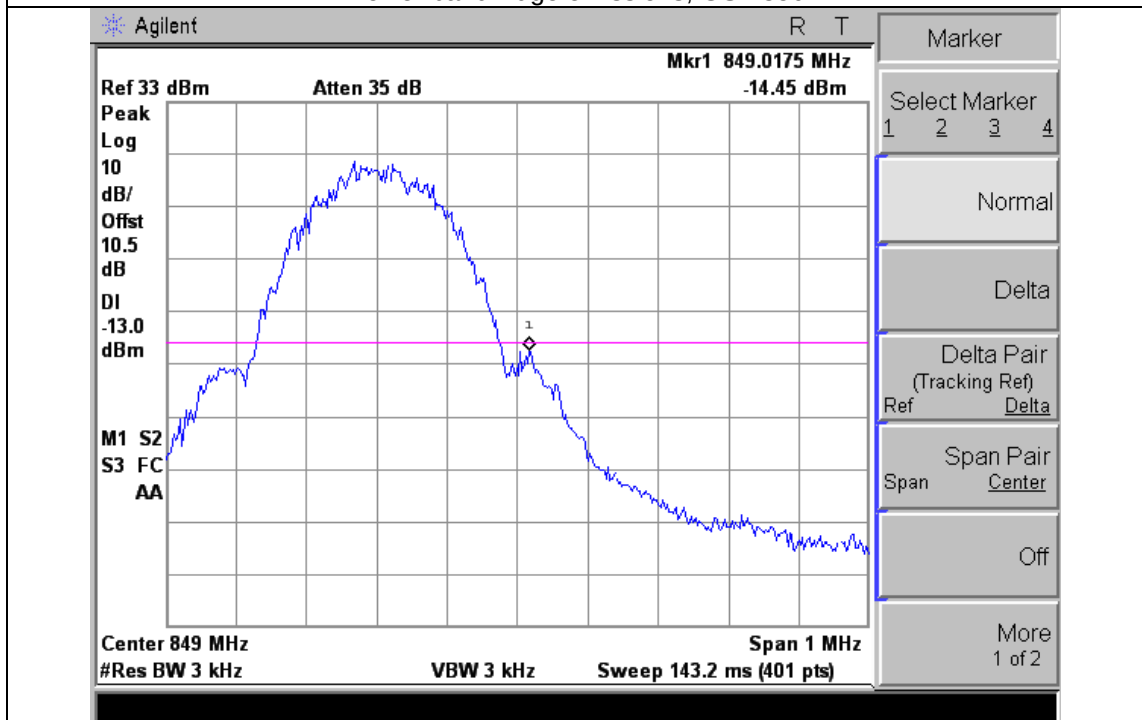
- GSM850, Channel 190 -



- GSM850, Channel 251 -

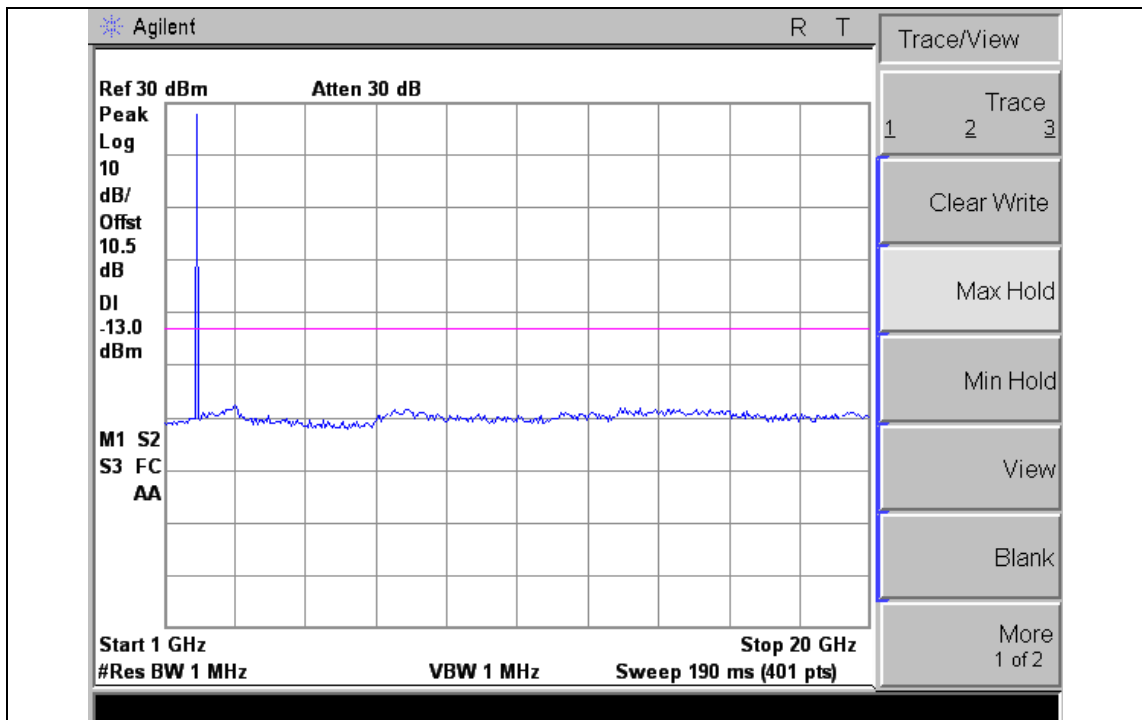


- Lower band Edge emissions, GSM850 -

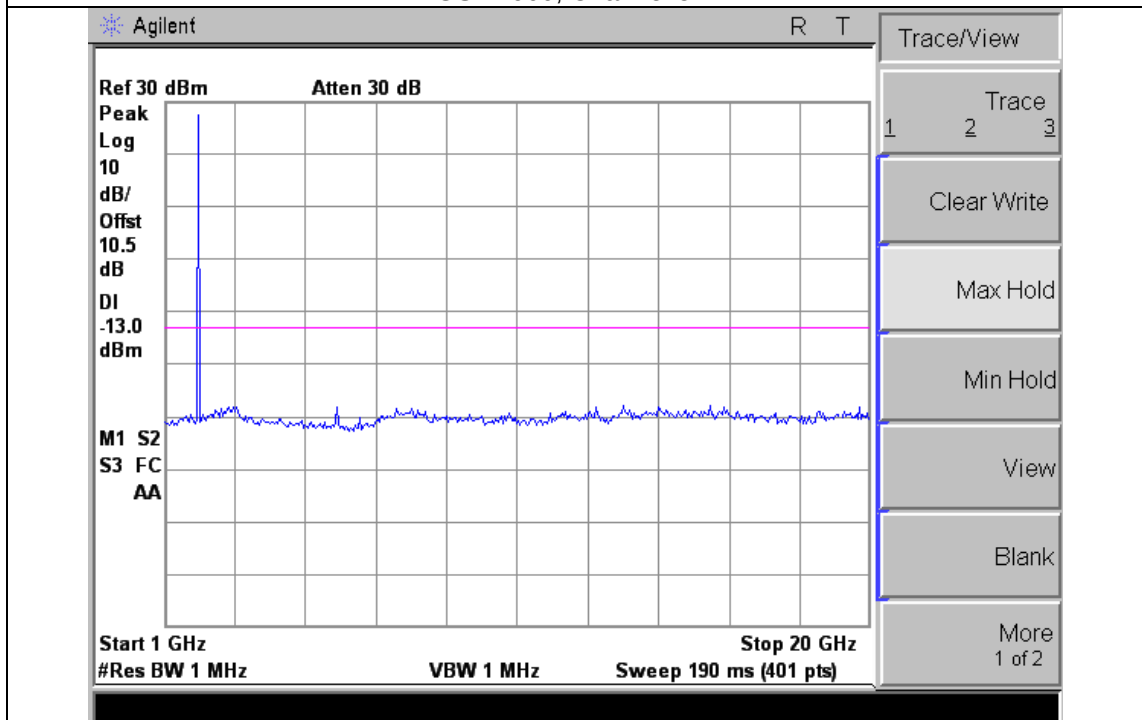


- Upper band Edge emissions, GSM850 -

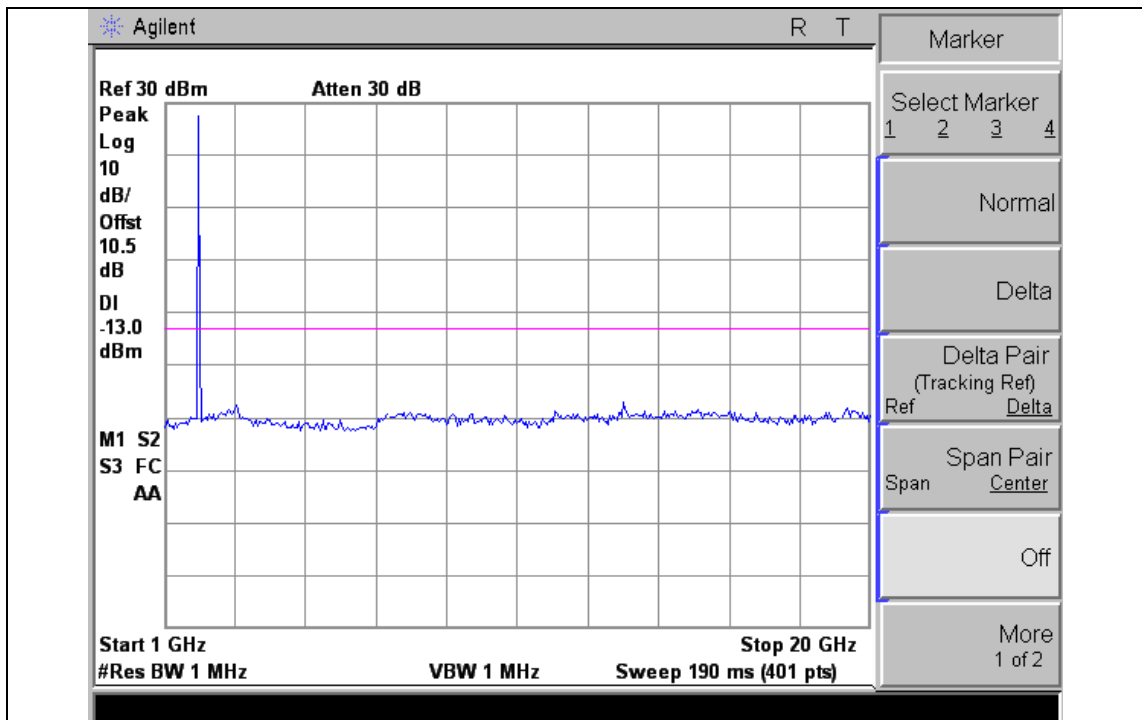
• GSM 1900 Test Data



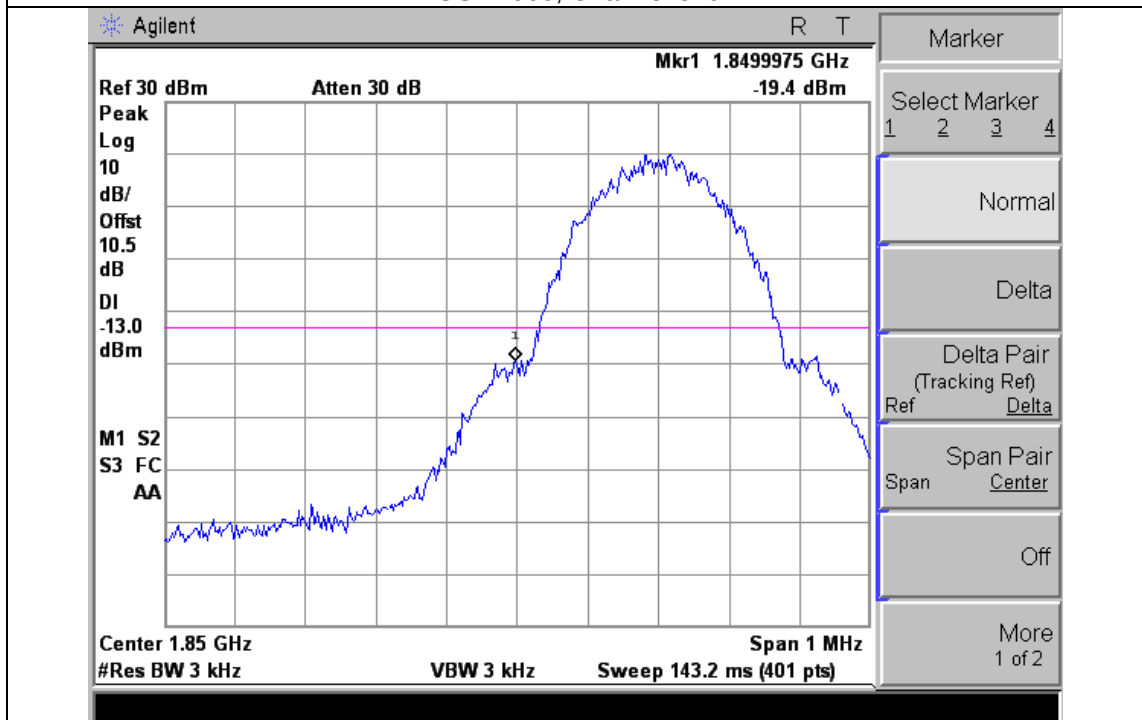
- GSM1900, Channel 512 -



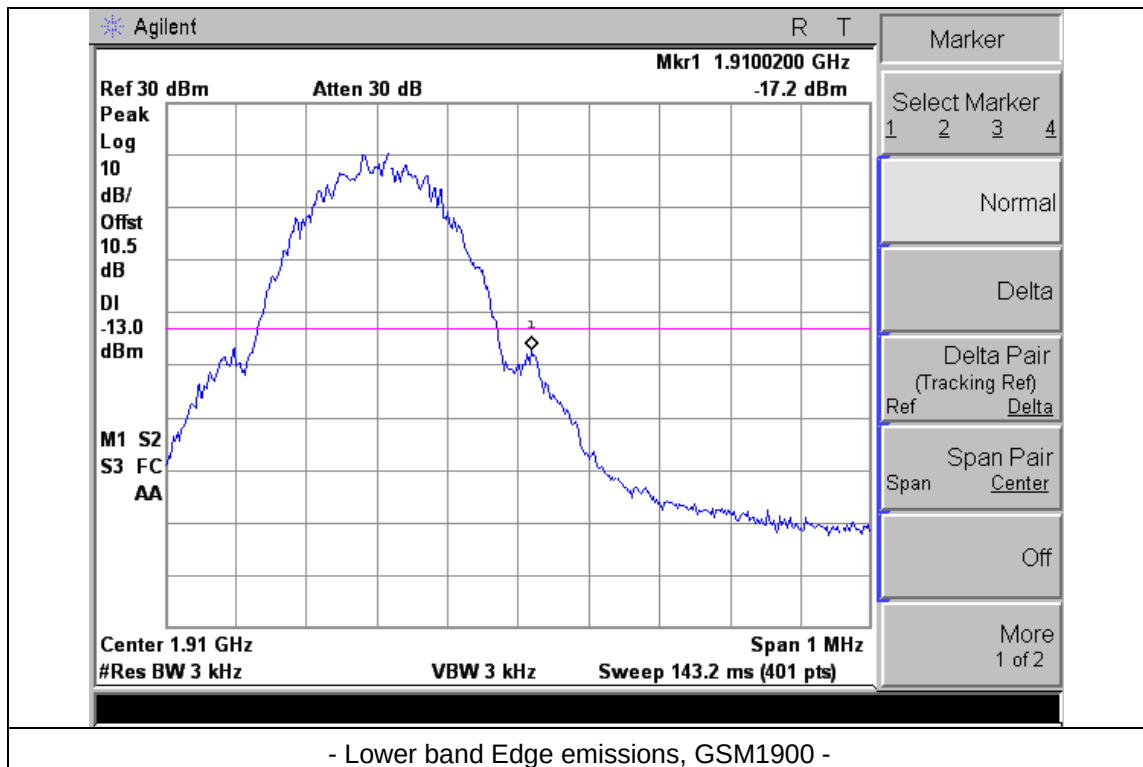
- GSM1900, Channel 661 -



- GSM1900, Channel 810 -



- Lower band Edge emissions, GSM1900 -



3.6. Frequency Stability / Temperature Variation

3.6.1. Test Procedure

The equipment under test is placed in an environmental chamber. Frequency measurements are made at the extremes of the temperature range -30°C to $+50^{\circ}\text{C}$ and at intervals of 10°C with the primary supply voltage set to the nominal battery operating voltage. A period of time sufficient to stabilize all components of the equipment is allowed at each frequency measurement. The maximum variation of frequency is measured. The test was done at middle channel.

3.6.2. Limit

The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block. The frequency stability of the transmitter shall be maintained within ± 0.00025 ($\pm 2.5\text{ppm}$) of the center frequency.

3.6.3. Test Results

- GSM 850 Test Data

Frequency Stability Under Temperature Variations

Temperature(°C)	Frequency Error (Hz)	Frequency Error (ppm)
-30	+17	0.020
-20	+19	0.023
-10	+11	0.013
0	+21	0.025
+10	+8	0.010
+20	+17	0.020
+30	+12	0.014
+40	+17	0.020
+50	+16	0.019

Voltage Variations

Voltage (V)		Frequency Error (Hz)	Frequency Error (ppm)
Nominal	3.8	+17	0.020
Low	3.4	+16	0.019
High	4.5	+18	0.022

• GSM 1900 Test Data

Frequency Stability Under Temperature Variations

Temperature(°C)	Frequency Error (Hz)	Frequency Error (ppm)
-30	-43	-0.023
-20	+93	0.049
-10	+97	0.052
0	+75	0.040
+10	+15	0.008
+20	+30	0.016
+30	+32	0.017
+40	+99	0.053
+50	+102	0.054

Voltage Variations

Voltage (V)		Frequency Error (Hz)	Frequency Error (ppm)
Nominal	3.8	+30	0.016
Low	3.4	+28	0.015
High	4.5	+31	0.016

4. TEST EQUIPMENTS

No.	Equipment	Manufacturer	Model	S/N	Effective Cal.Duration
1	Spectrum Analyzer (100 Hz ~ 26.5 GHz)	Agilent	E4407B	US41443316	01/31/2011 ~ 01/31/2012
2	Spectrum Analyzer (3 Hz ~ 50 GHz)	Agilent	E4448A	MY43360322	01/31/2011 ~ 01/31/2012
3	Pre-Amplifier (10 MHz ~ 18 GHz)	R&S	SCU18	137144	01/27/2011 ~ 01/27/2012
4	Pre-Amplifier (0.5 GHz ~ 26.5 GHz)	Agilent	83017A	MY39500982	02/15/2011 ~ 02/15/2012
5	Biconi-Log Ant. (30 MHz ~ 1000 MHz)	Schwarzbeck	VULB9168	9168-181	04/21/2010 ~ 04/21/2012
6	Horn Ant. (1 GHz ~ 18 GHz)	Schwarzbeck	BBHA 9120	9120D-654	11/21/2011 ~ 11/21/2013
7	Tuned Dipole Antenna	Schwarzbeck	VHA 9103	--	09/09/2010 ~ 09/09/2012
8	Horn Ant. (18 GHz ~ 40 GHz)	EMCO	3116	2664	03/26/2010 ~ 03/26/2012
9	Dipole Antenna	ETS-Lindgren	3126-880	00052703	06/14/2010 ~ 06/14/2012
10	DC Power Supply	Agilent	E3645A	MY40000851	01/26/2011 ~ 01/26/2012
11	Power Meter	Agilent	E4417A	GB4129075	02/09/2011 ~ 02/09/2012
12	Power sensor	Agilent	8482A	MY41092389	02/14/2011 ~ 02/14/2012
13	Universal Radio Communication tester	R&S	CMU200	110019	01/31/2011 ~ 01/31/2012
14	Highpass Filter	Wainwright	WHK1.0/15G	6	02/11/2011 ~ 02/11/2012
15	Highpass Filter	Wainwright	WHK3.5/18G	8	02/11/2011 ~ 02/11/2012
16	Band Reject Filter	Wainwright	WRCG1850/19 10-1834/1926- 60/11SS	13	02/10/2011 ~ 02/10/2012
17	Band Reject Filter	Wainwright	WRCG824/849 -814/859- 60/10SS	1	02/10/2011 ~ 02/10/2012