

PART 22 MEASUREMENT REPORT

Applicant Name:
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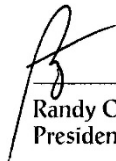
Date of Testing:
09/15 - 11/10/2020
Test Site/Location:
PCTEST Lab. Columbia, MD, USA
Test Report Serial No.:
1M2009140143-18.A3L

FCC ID:	A3LSMG996U
Applicant Name:	Samsung Electronics Co., Ltd.

Application Type: Certification
Model: SM-G996U
Additional Model(s): SM-G996U1
EUT Type: Portable Handset
FCC Classification: PCS Licensed Transmitter Held to Ear (PCE)
FCC Rule Part: 22
Test Procedure(s): ANSI C63.26-2015, ANSI/TIA-603-E-2016, KDB 971168 D01 v03r01, KDB 648474 D03 v01r04

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in §2.947. Test results reported herein relate only to the item(s) tested.

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


Randy Ortanez
President








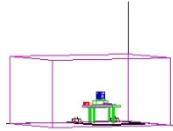
FCC ID: A3LSMG996U	 <small>Proud to be part of  element</small>	PART 22 MEASUREMENT REPORT		Approved by: Quality Manager
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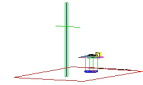
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Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	ERP		EIRP		Emission Designator
				Max. Power [W]	Max. Power [dBm]	Max. Power [W]	Max. Power [dBm]	
LTE Band 26/5	15MHz (Band 26 only)	QPSK	831.5 - 841.5	0.083	19.19	0.136	21.34	13M5G7D
		16QAM	831.5 - 841.5	0.029	14.62	0.048	16.77	13M5W7D
		64QAM	831.5 - 841.5	0.022	13.49	0.037	15.64	13M5W7D
		256QAM	831.5 - 841.5	0.011	10.26	0.017	12.41	13M5W7D
	10 MHz	QPSK	829.0 - 844.0	0.083	19.19	0.136	21.34	9M01G7D
		16QAM	829.0 - 844.0	0.030	14.76	0.049	16.91	8M98W7D
		64QAM	829.0 - 844.0	0.023	13.65	0.038	15.80	9M00W7D
		256QAM	829.0 - 844.0	0.011	10.49	0.018	12.64	9M00W7D
	5 MHz	QPSK	826.5 - 846.5	0.085	19.31	0.140	21.46	4M57G7D
		16QAM	826.5 - 846.5	0.031	14.85	0.050	17.00	4M52W7D
		64QAM	826.5 - 846.5	0.026	14.07	0.042	16.22	4M51W7D
		256QAM	826.5 - 846.5	0.012	10.80	0.020	12.95	4M53W7D
	3 MHz	QPSK	825.5 - 847.5	0.084	19.23	0.137	21.38	2M71G7D
		16QAM	825.5 - 847.5	0.030	14.76	0.049	16.91	2M71W7D
		64QAM	825.5 - 847.5	0.023	13.71	0.039	15.86	2M72W7D
		256QAM	825.5 - 847.5	0.011	10.51	0.018	12.66	2M70W7D
	1.4 MHz	QPSK	824.7 - 848.3	0.082	19.14	0.135	21.29	1M11G7D
		16QAM	824.7 - 848.3	0.030	14.78	0.049	16.93	1M09W7D
		64QAM	824.7 - 848.3	0.023	13.67	0.038	15.82	1M09W7D
		256QAM	824.7 - 848.3	0.011	10.40	0.018	12.55	1M09W7D
NR Band n5	20 MHz	π/2 BPSK	834.0 - 839.0	0.063	18.00	0.104	20.15	17M9G7D
		QPSK	834.0 - 839.0	0.059	17.68	0.096	19.83	19M0G7D
		16QAM	834.0 - 839.0	0.041	16.08	0.067	18.23	19M0W7D
		64QAM	834.0 - 839.0	0.031	14.95	0.051	17.10	19M0W7D
		256QAM	834.0 - 839.0	0.017	12.36	0.028	14.51	19M0W7D
	15 MHz	π/2 BPSK	831.5 - 841.5	0.062	17.89	0.101	20.04	13M5G7D
		QPSK	831.5 - 841.5	0.043	16.35	0.071	18.50	14M2G7D
		16QAM	831.5 - 841.5	0.038	15.75	0.062	17.90	14M2W7D
		64QAM	831.5 - 841.5	0.024	13.82	0.040	15.97	14M2W7D
		256QAM	831.5 - 841.5	0.016	12.12	0.027	14.27	14M2W7D
	10 MHz	π/2 BPSK	829.0 - 844.0	0.060	17.78	0.098	19.93	9M00G7D
		QPSK	829.0 - 844.0	0.043	16.35	0.071	18.50	9M33G7D
		16QAM	829.0 - 844.0	0.038	15.76	0.062	17.91	9M34W7D
		64QAM	829.0 - 844.0	0.025	13.98	0.041	16.13	9M37W7D
		256QAM	829.0 - 844.0	0.016	12.17	0.027	14.32	9M34W7D
	5 MHz	π/2 BPSK	826.5 - 846.5	0.061	17.88	0.101	20.03	4M51G7D
		QPSK	826.5 - 846.5	0.044	16.45	0.072	18.60	4M50G7D
		16QAM	826.5 - 846.5	0.038	15.82	0.063	17.97	4M50W7D
		64QAM	826.5 - 846.5	0.026	14.07	0.042	16.22	4M51W7D
		256QAM	826.5 - 846.5	0.024	13.82	0.040	15.97	4M52W7D

Mode	Modulation	Tx Frequency Range [MHz]	ERP		EIRP		Emission Designator
			Max. Power [W]	Max. Power [dBm]	Max. Power [W]	Max. Power [dBm]	
GSM/GPRS	GMSK	824.2 - 848.8	1.259	31.00	2.065	33.15	243KGXW
EDGE	8-PSK	824.2 - 848.8	0.472	26.74	0.774	28.89	237KG7W
WCDMA	Spread Spectrum	826.4 - 846.6	0.396	25.973	0.649	28.123	4M16F9W
CDMA	Spread Spectrum	824.70 - 848.31	0.328	25.155	0.538	27.305	1M28F9W

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1.0 INTRODUCTION

1.1 Scope

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



1.2 PCTEST Test Location

These measurement tests were conducted at the PCTEST Engineering Laboratory, Inc. facility located at 7185 Oakland Mills Road, Columbia, MD 21046. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014.

1.3 Test Facility / Accreditations

Measurements were performed at PCTEST Engineering Lab located in Columbia, MD 21046, U.S.A.

- PCTEST is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.01 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.
- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).
- PCTEST facility is a registered (2451B) test laboratory with the site description on file with ISED.

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID:A3LSMG996U**. The test data contained in this report pertains only to the emissions due to the EUT's licensed transmitters that operate under the provisions of Part 22.

Test Device Serial No.: 0506M, 0564M, 0501M

2.2 Device Capabilities

This device contains the following capabilities:

800/850/1900 CDMA/EVDO Rev. 0/A (BC0, BC1, BC10), 850/1900 GSM/GPRS/EDGE, 850/1700/1900 WCDMA/HSPA, Multi-band LTE, 5G NR (FR1/FR2), 802.11b/g/n/ax WLAN, 802.11a/n/ac/ax UNII, Bluetooth (1x, EDR, LE), NFC, UWB, Wireless Power Transfer



2.3 Test Configuration

The EUT was tested per the guidance of ANSI/TIA-603-E-2016 and KDB 971168 D01 v03r01. See Section 0 of this test report for a description of the radiated and antenna port conducted emissions tests.

This device supports wireless charging capability and, thus, is subject to the test requirements of KDB 648474 D03 v01r04. Additional radiated spurious emission measurements were performed with the EUT lying flat on an authorized wireless charging pad (WCP) Model: EP-N5100 while operating under normal conditions in a simulated call or data transmission configuration. The worst case radiated emissions data is shown in this report.

2.4 EMI Suppression Device(s)/Modifications

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

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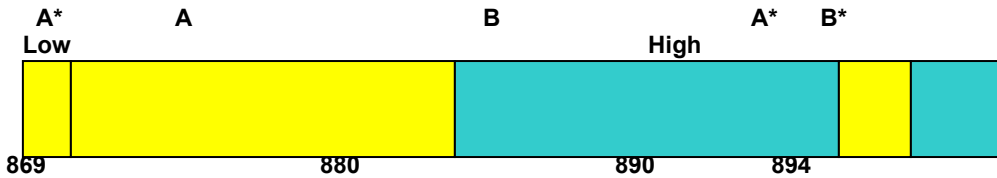
3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedures described in the “Land Mobile FM or PM – Communications Equipment – Measurements and Performance Standards” (ANSI/TIA-603-E-2016) and “Measurement Guidance for Certification of Licensed Digital Transmitters” (KDB 971168 D01 v03r01) were used in the measurement of the EUT.

Deviation from Measurement Procedure.....None

3.2 Cellular - Base Frequency Blocks



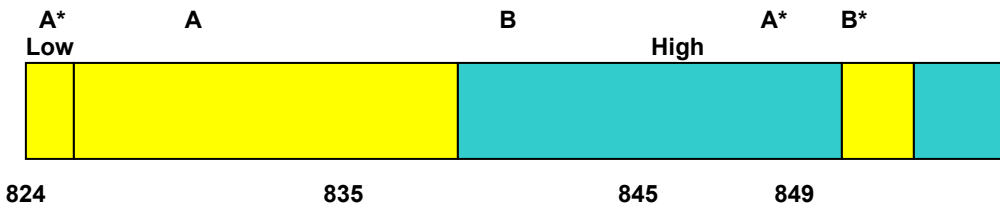
BLOCK 1: 869 – 880 MHz (A* Low + A)

BLOCK 2: 880 – 890 MHz (B)

BLOCK 3: 890 – 891.5 MHz (A* High)

BLOCK 4: 891.5 – 894 MHz (B*)

3.3 Cellular - Mobile Frequency Blocks





BLOCK 1: 824 – 835 MHz (A* Low + A)

BLOCK 2: 835 – 845 MHz (B)

BLOCK 3: 845 – 846.5 MHz (A* High)

BLOCK 4: 846.5 – 849 MHz (B*)

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3.4 Radiated Power and Radiated Spurious Emissions

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

The equipment under test was transmitting while connected to its integral antenna and is placed on a turntable 3 meters from the receive antenna. The receive antenna height is adjusted between 1 and 4 meter height, the turntable is rotated through 360 degrees, and the EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest reading on the receive spectrum analyzer.

For radiated power measurements, substitution method is used per the guidance of ANSI/TIA-603-E-2016. A half-wave dipole is 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 with the level of the signal generator being adjusted to obtain the same receive spectrum analyzer level previously recorded from the spurious emission from the EUT. The power of the emission is calculated using the following formula:

$$P_d \text{ [dBm]} = P_g \text{ [dBm]} - \text{cable loss [dB]} + \text{antenna gain [dBd/dBi]}$$

where P_d is the dipole equivalent power, P_g is the generator output into the substitution antenna, and the antenna gain is the gain of the substitute antenna used relative to either a half-wave dipole (dBd) or an isotropic source (dBi). The substitute level is equal to $P_g \text{ [dBm]} - \text{cable loss [dB]}$.

For radiated spurious emissions measurements and calculations, conversion method is used per the formulas in KDB 971168 Section 5.8.4. Field Strength (EIRP) is calculated using the following formulas:



$$E_{\text{[dB}\mu\text{V/m]}} = \text{Measured amplitude level}_{\text{[dBm]}} + 107 + \text{Cable Loss}_{\text{[dB]}} + \text{Antenna Factor}_{\text{[dB/m]}}$$

And

$$\text{EIRP}_{\text{[dBm]}} = E_{\text{[dB}\mu\text{V/m]}} + 20\log D - 104.8; \text{ where } D \text{ is the measurement distance in meters.}$$

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014. Additionally, radiated emissions below 30MHz are also validated on an Open Area Test Site to assert correlation with the chamber measurements per the requirements of KDB 474788 D01.



Radiated power and radiated spurious emission levels are investigated with the receive antenna horizontally and vertically polarized per ANSI/TIA-603-E-2016.

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4.0 MEASUREMENT UNCERTAINTY

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

Contribution	Expanded Uncertainty (\pm dB)
Conducted Bench Top Measurements	1.13
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

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5.0 TEST EQUIPMENT CALIBRATION DATA



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

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
-	LTx3	Licensed Transmitter Cable Set	10/30/2019	Annual	10/30/2020	LTx3
-	LTx4	Licensed Transmitter Cable Set	7/9/2020	Annual	7/9/2021	LTx4
Agilent	N9020A	MXA Signal Analyzer	8/4/2020	Annual	8/4/2021	US46470561
Agilent	N9030A	PXA Signal Analyzer (44GHz)	7/17/2020	Annual	7/17/2021	MY52350166
Agilent	E5515C	Wireless Communications Test Set	N/A			GB45360985
Anritsu	MT8820C	Radio Communication Analyzer	N/A			6201300731
Anritsu	MT8821C	Radio Communication Analyzer	N/A			6200901190
Com-Power	AL-130	9kHz - 30MHz Loop Antenna	10/10/2019	Biennial	10/10/2021	121034
Emco	3115	Horn Antenna (1-18GHz)	6/18/2020	Biennial	6/18/2022	9704-5182
ETS Lindgren	3164-08	Quad Ridge Horn Antenna	3/12/2020	Biennial	3/12/2022	128337
Mini Circuits	TVA-11-422	RF Power Amp	N/A			QA1317001
Mini-Circuits	SSG-4000HP	Synthesized Signal Generator	N/A			11208010032
Rohde & Schwarz	CMW500	Radio Communication Tester	N/A			100976
Rohde & Schwarz	CMW500	Radio Communication Tester	N/A			112347
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	7/15/2020	Annual	7/15/2021	100342
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	2/10/2020	Annual	2/10/2021	102134
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	2/21/2020	Annual	2/21/2021	102133
Sunol	DRH-118	Horn Antenna (1-18GHz)	10/3/2019	Biennial	10/3/2021	A050307
Sunol	DRH-118	Horn Antenna (1-18 GHz)	8/27/2019	Biennial	8/27/2021	A042511
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	7/27/2020	Biennial	7/27/2022	A051107
Micro-Tronics	BRM50714	Notch filter for B2/25	N/A			G015
Micro-Tronics	BRM50710	Notch filter for B30	N/A			G017
Micro-Tronics	BRM50711	Notch filter for B48	N/A			G039

Table 5-1. Test Equipment

Notes:

1. For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.
2. Equipment with a calibration date of "N/A" shown in this list was not used to make direct calibrated measurements.

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6.0 SAMPLE CALCULATIONS

GSM Emission Designator

Emission Designator = 250KGXW

GSM BW = 250 kHz

G = Phase Modulation

X = Cases not otherwise covered

W = Combination (Audio/Data)

EDGE Emission Designator

Emission Designator = 250KG7W

EDGE BW = 250 kHz

G = Phase Modulation

7 = Quantized/Digital Info

W = Combination (Audio/Data)

CDMA Emission Designator

Emission Designator = 1M25F9W

CDMA BW = 1.25 MHz

F = Frequency Modulation

9 = Composite Digital Info

W = Combination (Audio/Data)

WCDMA Emission Designator

Emission Designator = 4M16F9W

WCDMA BW = 4.16 MHz

F = Frequency Modulation

9 = Composite Digital Info

W = Combination (Audio/Data)

QPSK Modulation

Emission Designator = 8M62G7D

LTE BW = 8.62 MHz

G = Phase Modulation

7 = Quantized/Digital Info

D = Data transmission, telemetry, telecommand

QAM Modulation



Emission Designator = 8M45W7D

LTE BW = 8.45 MHz

W = Amplitude/Angle Modulated

7 = Quantized/Digital Info



D = Data transmission, telemetry, telecommand

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Spurious Radiated Emission

Example: Spurious emission at 3700.40 MHz

The receive spectrum analyzer reading at 3 meters with the EUT on the turntable was -81.0 dBm. The gain of the substituted antenna is 8.1 dBi. The signal generator connected to the substituted antenna terminals is adjusted to produce a reading of -81.0 dBm on the spectrum analyzer. The loss of the cable between the signal generator and the terminals of the substituted antenna is 2.0 dB at 3700.40 MHz. So 6.1 dB is added to the signal generator reading of -30.9 dBm yielding -24.80 dBm. The fundamental EIRP was 25.50 dBm so this harmonic was 25.50 dBm $- (-24.80) = 50.3$ dBc.

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7.0 TEST RESULTS

7.1 Summary



Company Name: Samsung Electronics Co., Ltd.
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 FCC Classification: PCS Licensed Transmitter Held to Ear (PCE)
 Mode(s): GSM/GPRS/WCDMA/CDMA/LTE/NR

Test Condition	Test Description	FCC Part Section(s)	RSS Section(s)	Test Limit	Test Result	Reference
CONDUCTED	Transmitter Conducted Output Power	2.1046	RSS-132(5.4)	N/A	PASS	See RF Exposure Report
	Occupied Bandwidth	2.1049	RSS-139(2.3)	N/A	PASS	Section 7.2
	Conducted Band Edge / Spurious Emissions	2.1051, 22.917(a)	RSS-132(5.5)	> 43 + 10log10(P[Watts]) at Band Edge and for all out-of-band emissions	PASS	Sections 7.3, 7.4
	Frequency Stability	2.1055, 22.355	RSS-132(5.3)	Fundamental emissions stay within authorized frequency block	PASS	Section 7.8
RADIATED	Effective Radiated Power / Equivalent Isotropic Radiated Power	22.913(a)(5)	RSS-132(5.4)	< 7 Watts max. ERP	PASS	Section 7.6
	Radiated Spurious Emissions	2.1053, 22.917(a)	RSS-132(5.5)	> 43 + 10 log10 (P[Watts]) for all out-of-band emissions	PASS	Section 7.7

Table 7-1. Summary of Test Results

Notes:

- 1) All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
- 2) The analyzer plots were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables, directional couplers, and attenuators used as part of the system to maintain a link between the call box and the EUT at all frequencies of interest.
- 3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables, attenuators, and couplers.
- 4) All conducted emissions measurements are performed with automated test software to capture the corresponding plots necessary to show compliance. The measurement software utilized is PCTEST 2G/3G Automation Version 4.5, LTE Automation Version 5.3.

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7.2 Occupied Bandwidth

Test Overview

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured. All modes of operation were investigated and the worst case configuration results are reported in this section.

Test Procedure Used

KDB 971168 D01 v03r01 – Section 4.2

Test Settings

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99% occupied bandwidth and the 26dB 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 x 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

Test Setup

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

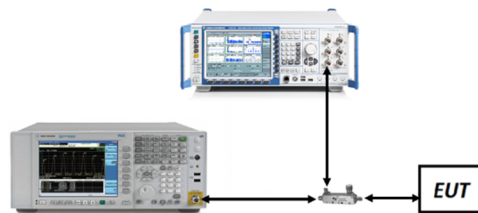




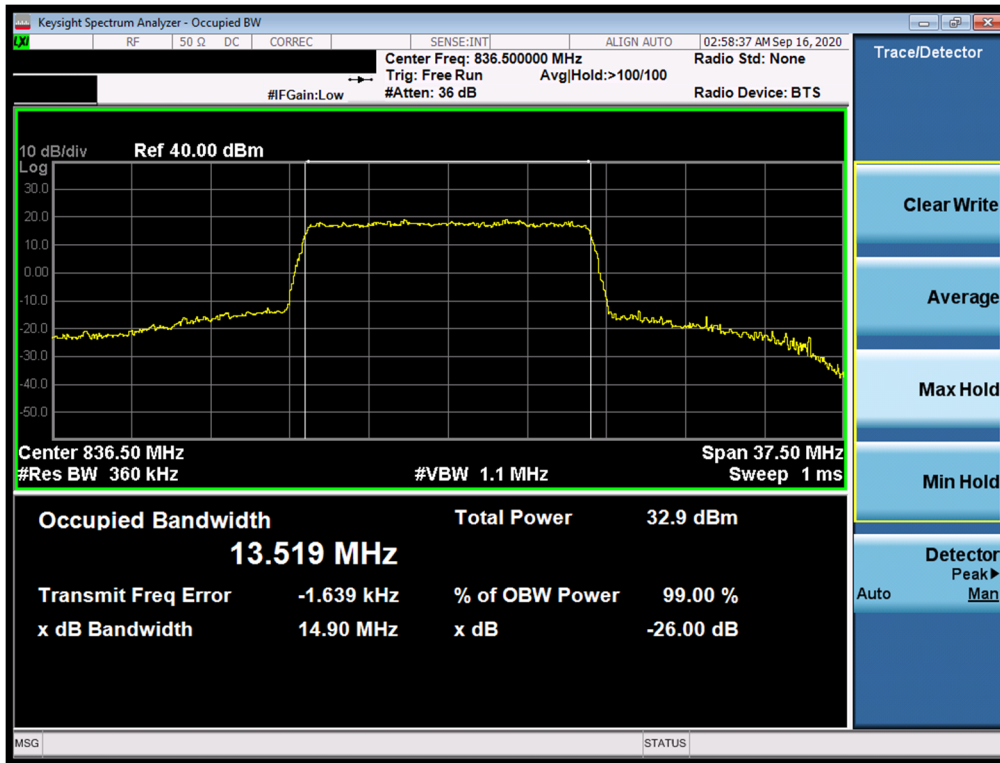
Figure 7-1. Test Instrument & Measurement Setup

Test Notes

None.

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LTE Band 26/5

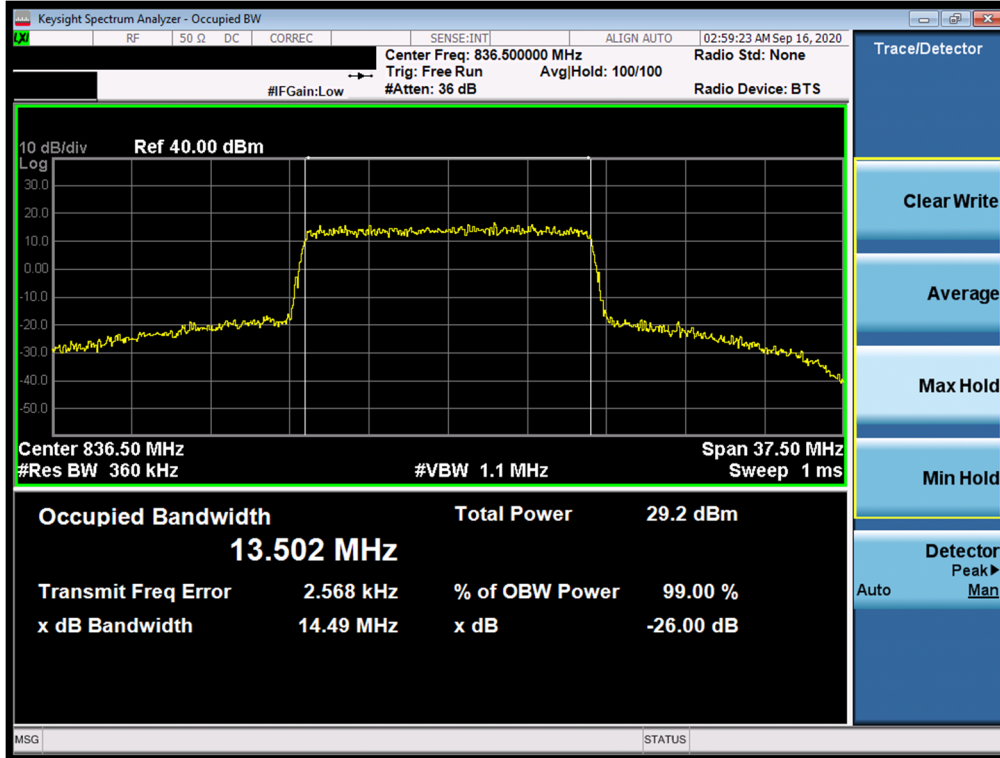


Plot 7-1. Occupied Bandwidth Plot (LTE Band 26 - 15MHz QPSK - Full RB Configuration)

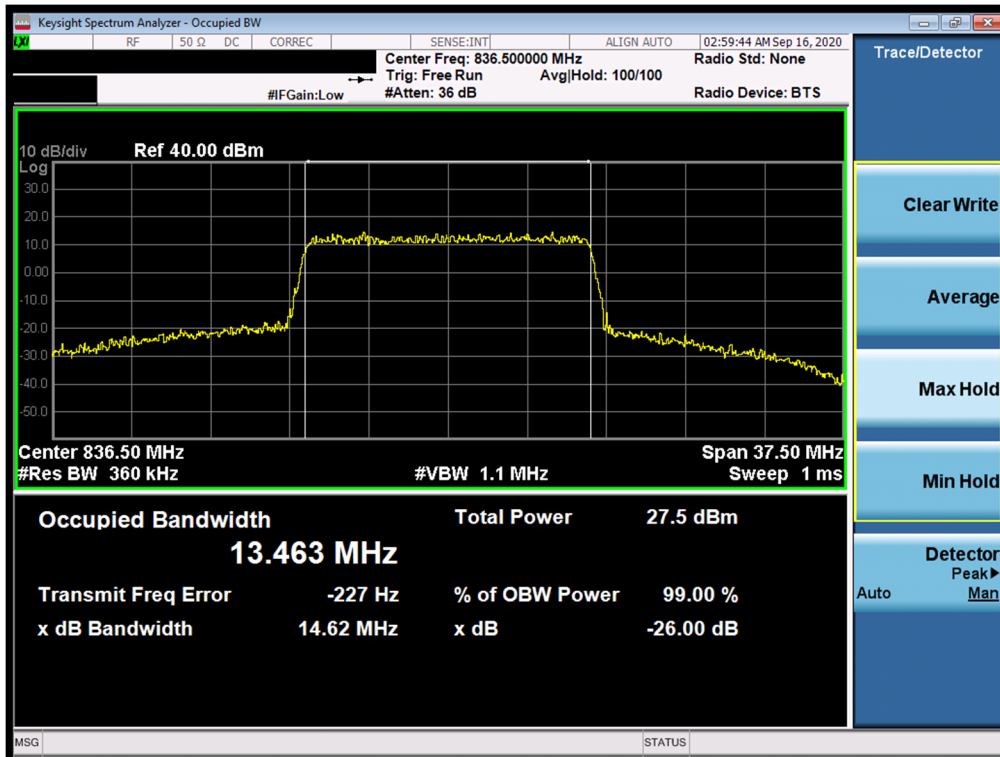


Plot 7-2. Occupied Bandwidth Plot (LTE Band 26 - 15MHz 16-QAM - Full RB Configuration)

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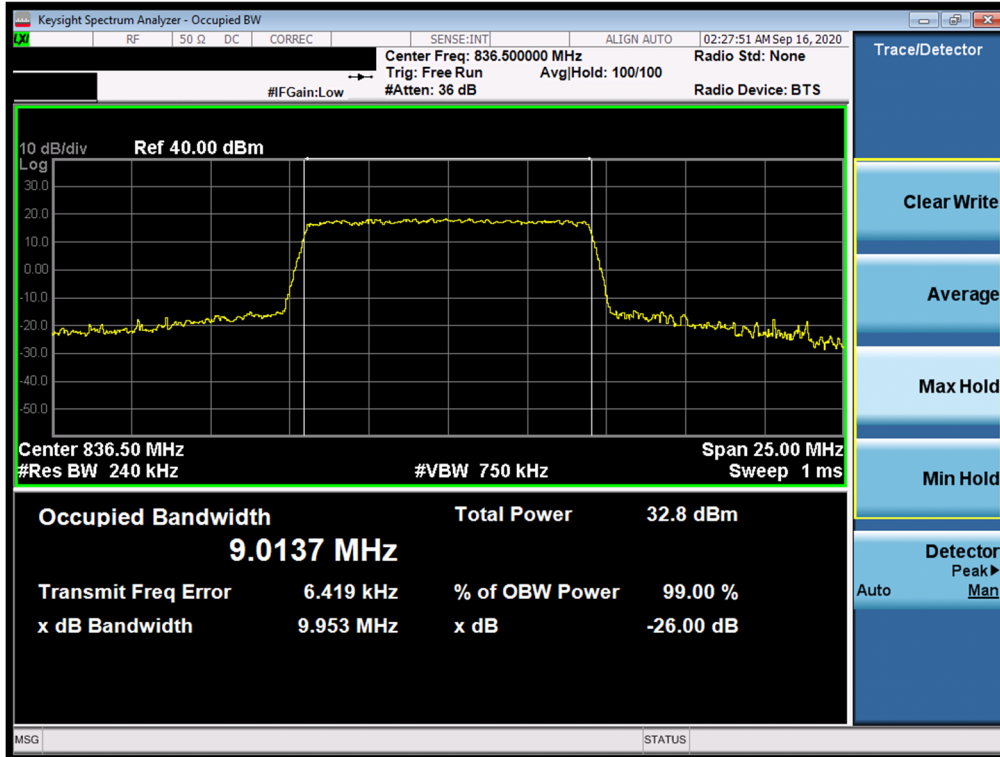


Plot 7-3. Occupied Bandwidth Plot (LTE Band 26 - 15MHz 64-QAM - Full RB Configuration)

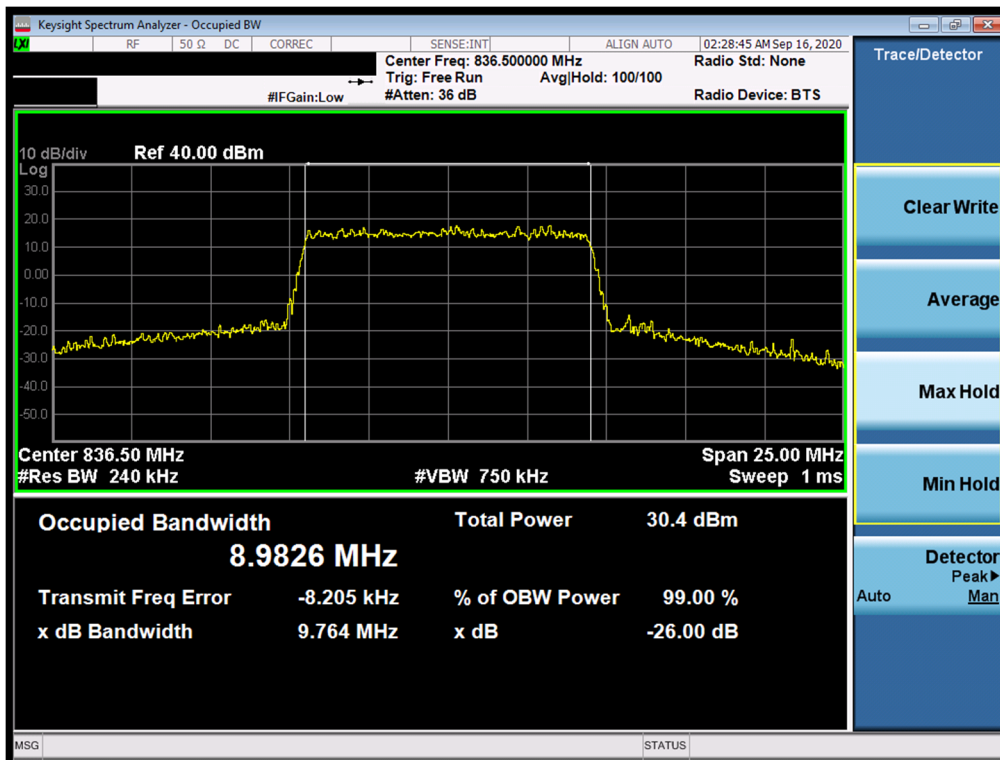


Plot 7-4. Occupied Bandwidth Plot (LTE Band 26 - 15MHz 256-QAM - Full RB Configuration)

FCC ID: A3LSMG996U	PCTEST Proud to be part of element	PART 22 MEASUREMENT REPORT	SAMSUNG	Approved by: Quality Manager
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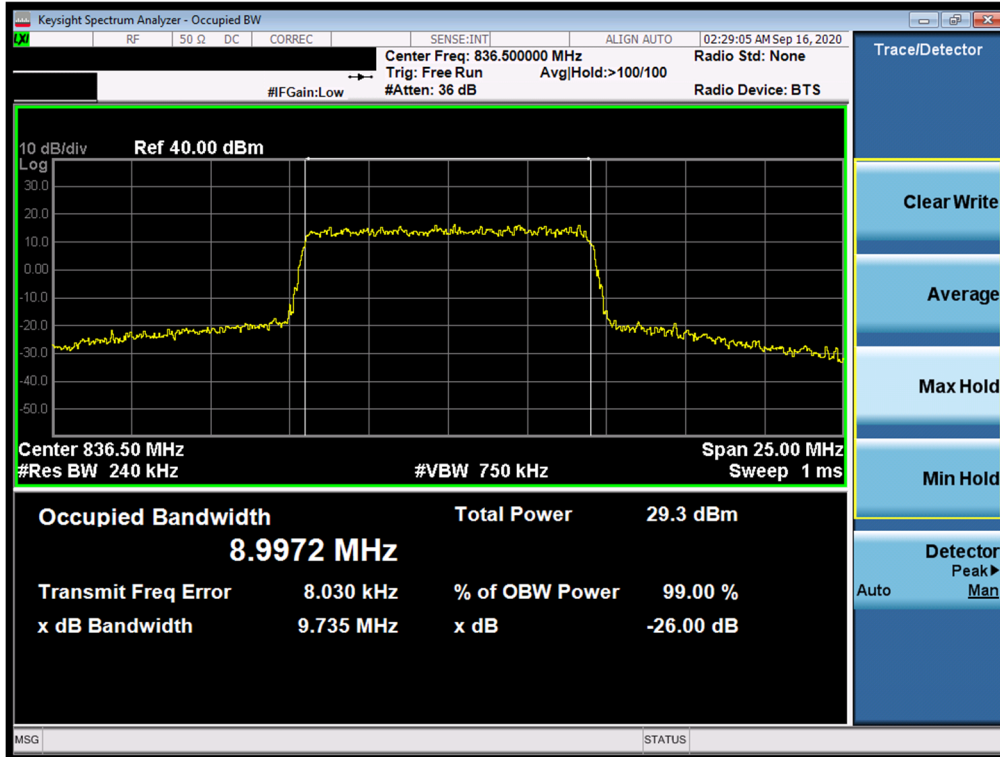


Plot 7-5. Occupied Bandwidth Plot (LTE Band 26/5 - 10MHz QPSK - Full RB Configuration)

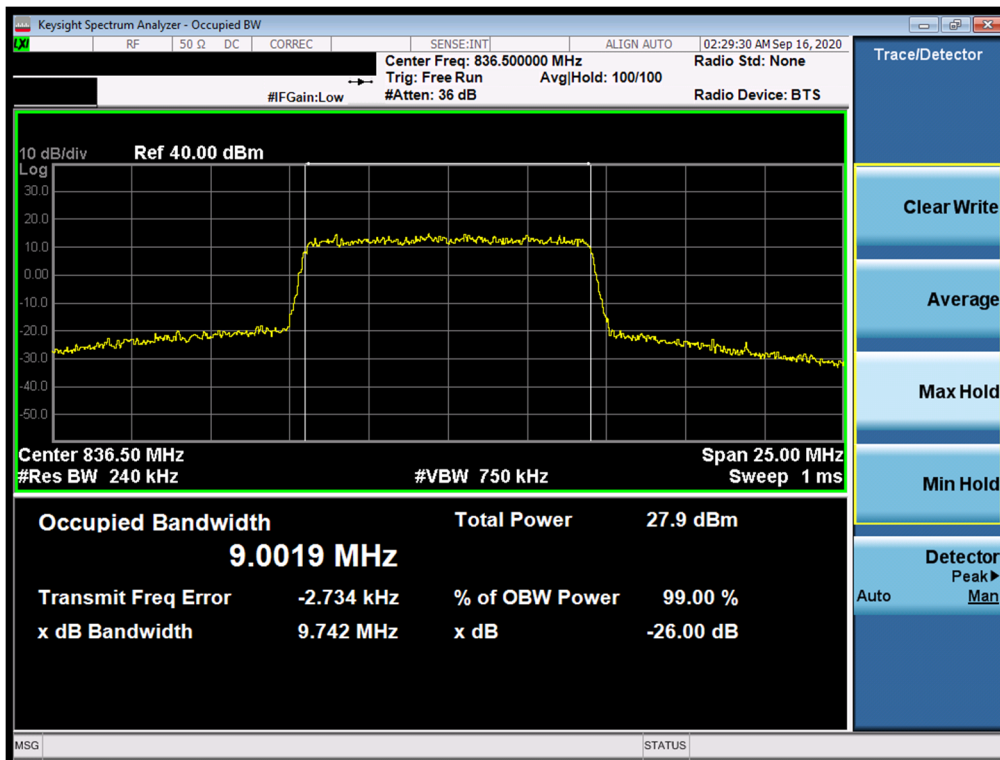


Plot 7-6. Occupied Bandwidth Plot (LTE Band 26/5 - 10MHz 16-QAM - Full RB Configuration)

FCC ID: A3LSMG996U	PCTEST Proud to be part of element	PART 22 MEASUREMENT REPORT	SAMSUNG	Approved by: Quality Manager
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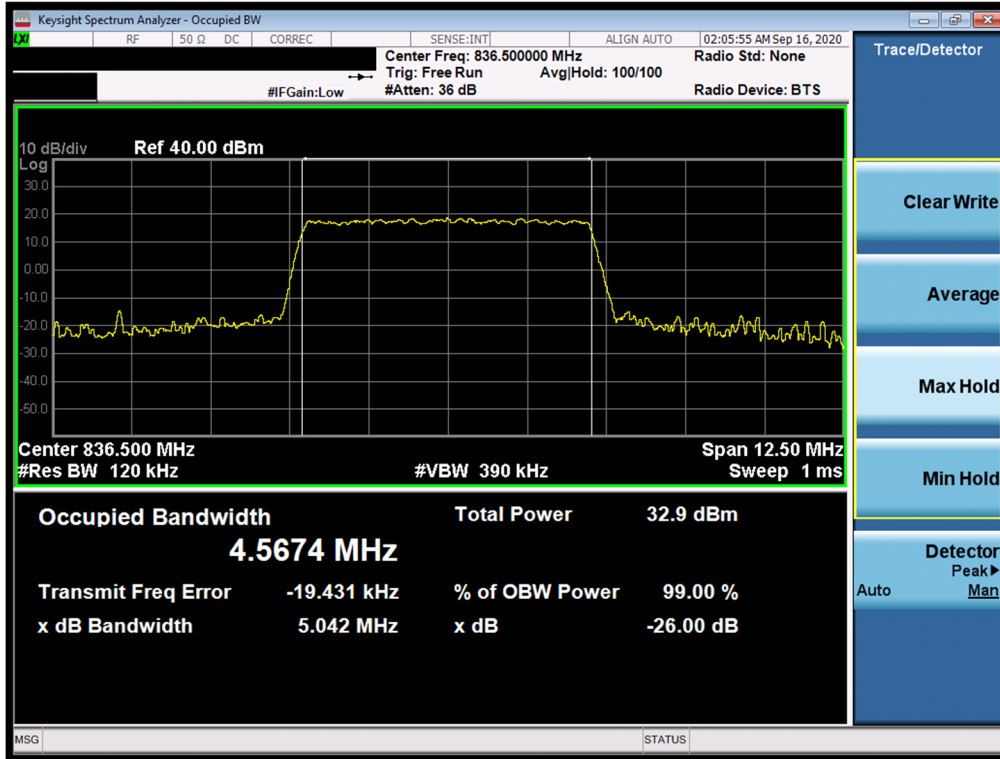


Plot 7-7. Occupied Bandwidth Plot (LTE Band 26/5 - 10MHz 64-QAM - Full RB Configuration)

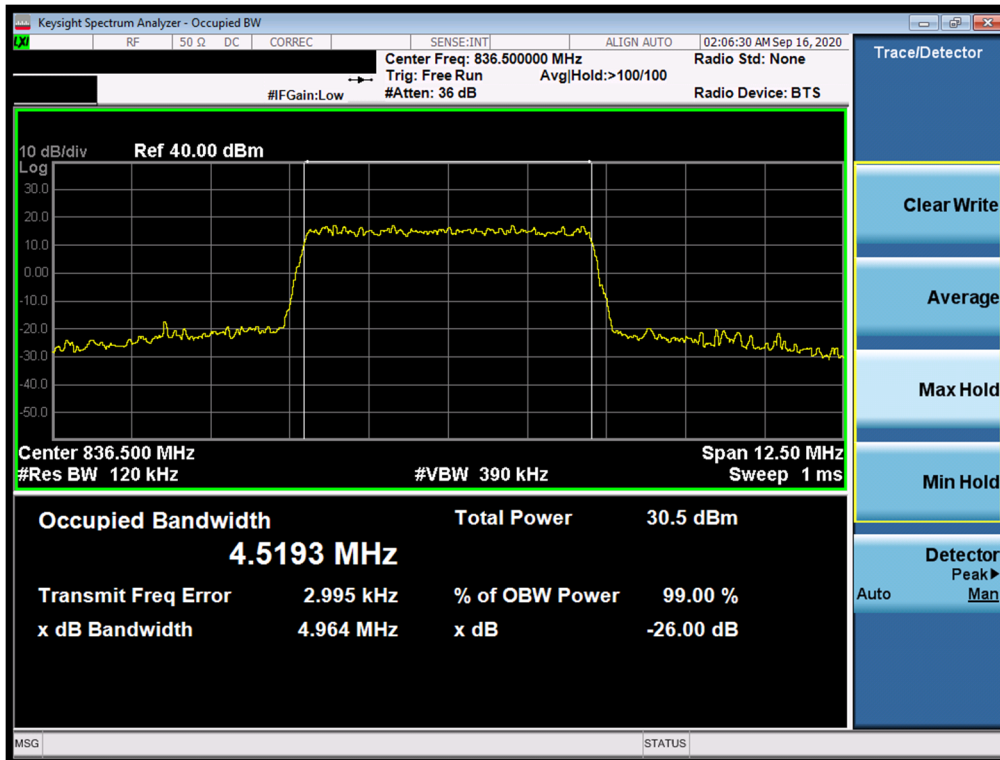


Plot 7-8. Occupied Bandwidth Plot (LTE Band 26/5 - 10MHz 256-QAM - Full RB Configuration)

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Plot 7-9. Occupied Bandwidth Plot (LTE Band 26/5 - 5MHz QPSK - Full RB Configuration)



Plot 7-10. Occupied Bandwidth Plot (LTE Band 26/5 - 5MHz 16-QAM - Full RB Configuration)

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