



PART 27 MEASUREMENT REPORT

Applicant Name:

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

Date of Testing:

11/19/2021 - 12/2/2021

Test Report Issue Date:

12/17/2021

Test Site/Location:

PCTEST Lab. Yongin-Si, Gyeonggi-do, South Korea

Test Report Serial No.:

1M2109290114-29.A3L

FCC ID:

A3LSMS901E

Applicant Name:

Samsung Electronics Co., Ltd.

Application Type:

Certification

Model:

SM-S901E/DS

Additional Model(s):

SM-S901E

EUT Type:

Portable Handset

FCC Classification:

PCS Licensed Transmitter Held to Ear (PCE)

FCC Rule Part:

27

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.



Prepared by



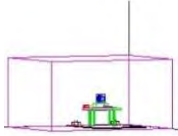
Reviewed by

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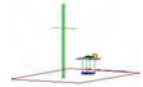
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Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	EIRP		Emission Designator
				Max. Power [W]	Max. Power [dBm]	
LTE Band 41(PC2)	20 MHz	QPSK	2506.0 - 2680.0	0.270	24.31	18M1G7D
		16QAM	2506.0 - 2680.0	0.235	23.71	18M1W7D
	15 MHz	QPSK	2503.5 - 2682.5	0.309	24.90	13M6G7D
		16QAM	2503.5 - 2682.5	0.287	24.58	13M6W7D
	10 MHz	QPSK	2501.0 - 2685.0	0.296	24.71	9M06G7D
		16QAM	2501.0 - 2685.0	0.243	23.85	9M09W7D
	5 MHz	QPSK	2498.5 - 2687.5	0.312	24.94	4M54G7D
		16QAM	2498.5 - 2687.5	0.265	24.23	4M55W7D

EUT Overview

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

1.3 Test Facility / Accreditations

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

- PCTEST is an ISO 17025-2017 accredited test facility under the National Voluntary Laboratory Accreditation Program (NVLAP) with Certificate number 600143-0 for Specific Absorption Rate (SAR), where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.
- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISSED Standards (RSS).
- PCTEST facility is a registered (26168) test laboratory with the site description on file with ISSED.

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID:A3LSMS901E**. 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 27.

Test Device Serial No.: 1612M, 1122M, 1603M, 1604M

2.2 Device Capabilities

This device contains the following capabilities:

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

This device uses a tuner circuit that dynamically updates the antenna impedance parameters to optimize antenna performance for certain bands and modes of operation. The tuner for this device was set to simulate a "free space" condition where the transmit antenna is matched to the medium into which it is transmitting and, thus, the power is at its maximum level.

2.3 Test Configuration

The EUT was tested per the guidance of ANSI/TIA-603-E-2016 and KDB 971168 D01 v03r01. See Section 7.0 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 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 414788 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	1.20
Radiated Disturbance (<1GHz)	3.01
Radiated Disturbance (>1GHz)	5.56
Radiated Disturbance (>18GHz)	3.16

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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
Agilent	E5515C	WIRELESS COMMUNICATION TEST SET	2/19/2021	Annual	2/18/2022	MY50262130
Agilent	N9030A	PXA Signal Analyzer	7/6/2021	Annual	7/5/2022	MY49432391
Anritsu	S820E	Cable and Antenna Analyzer	7/7/2021	Annual	7/6/2022	6201300731
Anritsu	MA24106A	USB Power Sensor	7/7/2021	Annual	7/6/2022	1244512
Espec	SH-242	Environmental Chamber	9/15/2021	Annual	9/14/2022	93011064
ETS Lindgren	3110C	Biconical Antenna	7/9/2020	Biennial	7/8/2022	00211248
ETS Lindgren	3110C	Biconical Antenna	7/9/2020	Biennial	7/8/2022	00211250
Fairview Microwave	FM2CP1122-10	Coupler	7/7/2021	Annual	7/6/2022	1946
Keysight Technologies	N9030B	MXA Signal Analyzer	5/11/2021	Annual	5/10/2022	MY57142018
Mini Circuits	ZUDC10-83-S+	Coupler	9/15/2021	Annual	9/14/2022	2111
Mini-Circuits	BW-N10W5+	Attenuator	7/6/2021	Annual	7/5/2022	1607
Mini-Circuits	BW-N10W5+	Attenuator	7/6/2021	Annual	7/5/2022	1607
Rohde & Schwarz	TS-PR18	Preamplifier	7/8/2021	Annual	7/7/2022	102141
Rohde & Schwarz	SMBV100B	Signal Generator	11/4/2021	Annual	11/3/2022	101568
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	7/6/2021	Annual	7/5/2022	116851
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	2/19/2021	Annual	2/18/2022	131453
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	2/19/2021	Annual	2/18/2022	131454
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	2/19/2021	Annual	2/18/2022	150117
Rohde & Schwarz	ESW	EMI Test Receiver	7/6/2021	Annual	7/5/2022	101761
Rohde & Schwarz	FSW43	Signal & Spectrum Analyzer	9/15/2021	Annual	9/14/2022	101250
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	2/19/2021	Annual	2/18/2022	102131
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	3/29/2021	Annual	3/28/2022	102151
Schwarzbeck	UHA9105	Dipole Antenna	7/9/2020	Biennial	7/8/2022	91052522
Sunol	DRH-118	Horn Antenna	7/14/2021	Biennial	7/13/2023	A102416-1
Sunol	DRH-118	Horn Antenna	1/12/2021	Biennial	1/11/2023	A060215

Table 5-1. Test Equipment

Notes:

- 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.
- 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

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

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.
 FCC ID: A3LSMS901E
 FCC Classification: PCS Licensed Transmitter Held to Ear (PCE)
 Mode(s): NR

Test Condition	Test Description	FCC Part Section(s)	Test Limit	Test Result	Reference
CONDUCTED	Transmitter Conducted Output Power	2.1046(a), 2.1046(c)	N/A	PASS	See RF Exposure Report
	Additional Maximum Power Reduction(A-MPR)	2.1046	N/A	PASS	Section 7.2
	Occupied Bandwidth	2.1049(h)	N/A	PASS	Section 7.3
	Conducted Band Edge / Spurious Emissions (LTE Band 41)	2.1051, 27.53(m)	Undesirable emissions must meet the limits detailed in 27.53(m)	PASS	Sections 7.4, 7.5
	Frequency Stability	2.1055, 27.54	Fundamental emissions stay within authorized frequency block	PASS	Section 7.8
RADIATED	Equivalent Isotropic Radiated Power (LTE Band 41)	27.50(h)(2)	≤ 2 Watts max. EIRP	PASS	Section 7.6
	Radiated Spurious Emissions (LTE Band 41)	2.1053, 27.53(m)	Undesirable emissions must meet the limits detailed in 27.53(m)	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 EMC Software Tool v1.0.

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7.2 Conducted Power Output Data

Test Overview

The EUT is set up to transmit two contiguous LTE channels. The power level of both carriers is measured by means of a calibrated spectrum analyzer. All 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.

A-MPR is implemented in this device when operating at Power Class 2 in LTE Band 41 per the A-MPR specification in 3GPP TS 36.101. The conducted powers are shown herein to cover the different A-MPR levels specified in the standard. Measurement equipment was set up with triggering/gating on the spectrum analyzer such that powers were measured only during the on-time of the signal.

Test Procedure Used

KDB 971168 D01 v03r01 – Section 6.0

Test Settings

1. Span = 2 x OBW to 3 x OBW
2. Detector = RMS
3. Trace mode = trace average for continuous emissions, max hold for pulse emissions
4. Sweep time = auto couple
5. The trace was allowed to stabilize
6. Please see test notes below for RBW and VBW settings

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

1. For A-MPR conducted power measurements, RBW is set to: $RBW = 1\% \text{ to } 5\% \text{ of the OBW}$.
2. All other conducted power measurements are contained in the RF exposure report for this filing.

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Test Case	NS	MCC	MNC	Channel BW [MHz]	Channel Number	Channel Frequency [MHz]	RB Size	RB Offset	A-MPR [dB]	Modulation	MPR [dB]	Measured Power [dBm]	Lowest Typical Power [dBm]	Delta [dB]
1	01	312	530	5	39675	2498.5	1	0	3	QPSK	0	22.77	21.5	1.27
										16-QAM	1	22.10	20.5	1.60
										64-QAM	2	20.89	19.5	1.39
2				5	39675	2498.5	1	9	0	256-QAM	5	17.95	16.5	1.45
										QPSK	0	25.84	24.5	1.34
										16-QAM	1	25.13	23.5	1.63
3				10	39700	2501	1	0	5	64-QAM	2	24.12	22.5	1.62
										256-QAM	5	21.30	19.5	1.80
										QPSK	0	20.81	19.5	1.31
4				10	39700	2501	20	0	2	16-QAM	1	19.89	18.5	1.39
										64-QAM	2	19.01	17.5	1.51
										256-QAM	5	16.13	14.5	1.63
5				10	39700	2501	50	0	3	QPSK	1	22.87	21.5	1.37
										16-QAM	2	21.85	20.5	1.35
										64-QAM	3	20.91	19.5	1.41
6				10	39700	2501	25	20	1	256-QAM	5	18.79	17.5	1.29
										QPSK	1	22.48	20.5	1.98
										16-QAM	2	21.47	19.5	1.97
7				10	39700	2501	1	36	0	64-QAM	3	20.49	18.5	1.99
										256-QAM	5	17.70	16.5	1.20
										QPSK	1	23.72	22.5	1.22
8				15	39725	2503.5	1	0	5	16-QAM	2	22.85	21.5	1.35
										64-QAM	3	21.79	20.5	1.29
										256-QAM	5	20.47	18.5	1.97
9				15	39725	2503.5	20	0	2	QPSK	0	25.78	24.5	1.28
										16-QAM	1	25.22	23.5	1.72
										64-QAM	2	24.02	22.5	1.52
10				15	39725	2503.5	75	0	4	256-QAM	5	21.04	19.5	1.54
										QPSK	0	20.69	19.5	1.19
										16-QAM	1	19.89	18.5	1.39
11				15	39725	2503.5	50	15	3	64-QAM	3	19.06	17.5	1.56
										256-QAM	5	15.91	14.5	1.41
										QPSK	1	22.77	21.5	1.27
12				15	39725	2503.5	1	60	0	16-QAM	2	21.78	20.5	1.28
										64-QAM	3	20.88	19.5	1.38
										256-QAM	5	18.48	17.5	0.98
13				20	39750	2506	1	0	5	QPSK	1	20.59	19.5	1.09
										16-QAM	2	19.52	18.5	1.02
										64-QAM	3	18.62	17.5	1.12
14				20	39750	2506	20	0	2	256-QAM	5	16.70	15.5	1.20
										QPSK	1	21.61	20.5	1.11
										16-QAM	2	20.64	19.5	1.14
15				20	39750	2506	100	0	4	64-QAM	3	19.67	18.5	1.17
										256-QAM	5	17.66	16.5	1.16
										QPSK	0	25.70	24.5	1.20
16				20	39750	2506	75	24	3	16-QAM	1	20.18	18.5	1.68
										64-QAM	2	18.91	17.5	1.41
										256-QAM	5	15.72	14.5	1.22
17				20	39750	2506	1	77	0	QPSK	1	22.74	21.5	1.24
										16-QAM	2	21.82	20.5	1.32
										64-QAM	3	20.71	19.5	1.21
18	01	311	490	5	39675	2498.5	1	0	3	256-QAM	5	18.23	17.5	0.73
										QPSK	1	20.55	19.5	1.05
										16-QAM	2	19.51	18.5	1.01
										64-QAM	3	18.60	17.5	1.10
										256-QAM	5	16.60	15.5	1.10
19	01	001	01	5	39675	2498.5	1	0	0	QPSK	1	21.53	20.5	1.03
										16-QAM	2	20.60	19.5	1.10
										64-QAM	3	19.65	18.5	1.15
										256-QAM	5	17.51	16.5	1.01
										QPSK	0	25.81	24.5	1.31
										16-QAM	1	25.12	23.5	1.62
										64-QAM	2	24.07	22.5	1.57
										256-QAM	5	21.01	19.5	1.51
										QPSK	0	22.78	21.5	1.28
										16-QAM	1	22.01	20.5	1.51
										64-QAM	2	20.99	19.5	1.49
										256-QAM	5	18.06	16.5	1.56
										QPSK	0	25.76	24.5	1.26
										16-QAM	1	24.81	23.5	1.31
										64-QAM	2	24.13	22.5	1.63
										256-QAM	5	21.29	19.5	1.79

Table 7-1. A-MPR Conducted Power Data (LTE Band 41(PC2) – Ant1)

FCC ID: A3LSMS901E	 PART 27 MEASUREMENT REPORT 		Approved by: Technical Manager
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7.3 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 $\geq 3 \times$ 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

Test Setup

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



Figure 7-2. Test Instrument & Measurement Setup

Test Notes

None.

FCC ID: A3LSMS901E	 PART 27 MEASUREMENT REPORT 	Approved by: Technical Manager
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LTE Band 41(PC2)



Plot 7-2. Occupied Bandwidth Plot (LTE Band 41(PC2) - 20MHz QPSK - Full RB)



Plot 7-3. Occupied Bandwidth Plot (LTE Band 41(PC2) - 20MHz 16-QAM - Full RB)

FCC ID: A3LSMS901E	PCTEST Proud to be part of Samsung	PART 27 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1M2109290114-29.A3L	Test Dates: 11/19/2021 - 12/2/2021	EUT Type: Portable Handset	Page 14 of 40

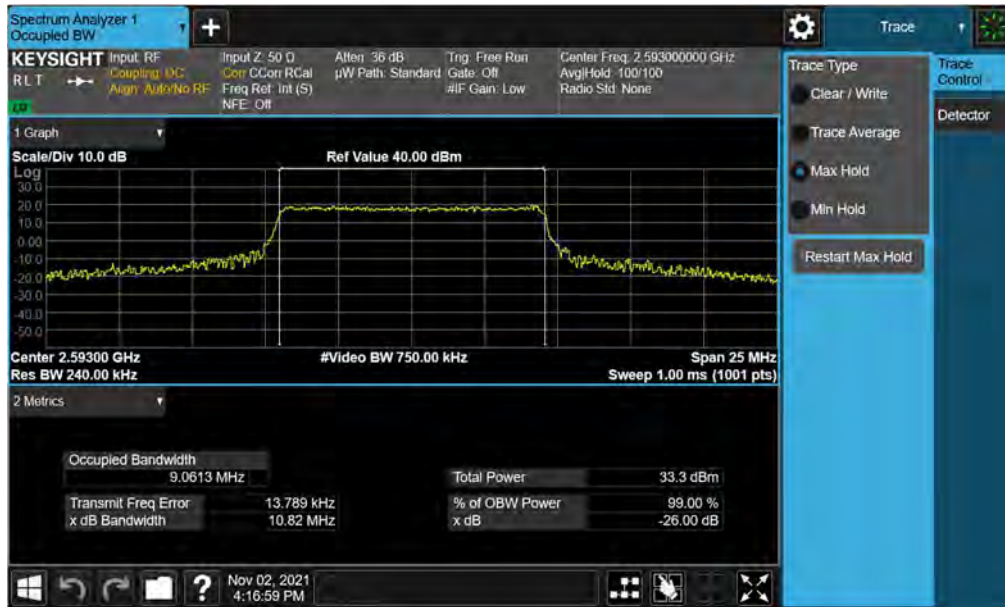


Plot 7-4. Occupied Bandwidth Plot (LTE Band 41(PCI2) - 15MHz QPSK - Full RB)



Plot 7-5. Occupied Bandwidth Plot (LTE Band 41(PCI2) - 15MHz 16-QAM - Full RB)

FCC ID: A3LSMS901E	PCTEST Proud to be part of Samsung	PART 27 MEASUREMENT REPORT	Approved by: Technical Manager
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Plot 7-6. Occupied Bandwidth Plot (LTE Band 41(PC2) - 10MHz QPSK - Full RB)



Plot 7-7. Occupied Bandwidth Plot (LTE Band 41(PC2) - 10MHz 16-QAM - Full RB)

FCC ID: A3LSMS901E	PCTEST Proud to be part of Samsung	PART 27 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1M2109290114-29.A3L	Test Dates: 11/19/2021 - 12/2/2021	EUT Type: Portable Handset	Page 16 of 40



Plot 7-8. Occupied Bandwidth Plot (LTE Band 41(PC2) - 5MHz QPSK - Full RB)



Plot 7-9. Occupied Bandwidth Plot (LTE Band 41(PC2) - 5MHz 16-QAM - Full RB)

FCC ID: A3LSMS901E	PCTEST Proud to be part of Samsung	PART 27 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1M2109290114-29.A3L	Test Dates: 11/19/2021 - 12/2/2021	EUT Type: Portable Handset	Page 17 of 40

7.4 Spurious and Harmonic Emissions at Antenna Terminal

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 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.

For Band 41, the minimum permissible attenuation level of any spurious emission is $55 + 10 \log_{10}(P_{\text{Watts}})$.

Test Procedure Used

KDB 971168 D01 v03r01 – Section 6.0

Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 10GHz (separated into at least two plots per channel)
2. Detector = RMS
3. Trace mode = trace average for continuous emissions, max hold for pulse emissions
4. Sweep time = auto couple
5. The trace was allowed to stabilize
6. Please see test notes below for RBW and VBW settings

Test Setup

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



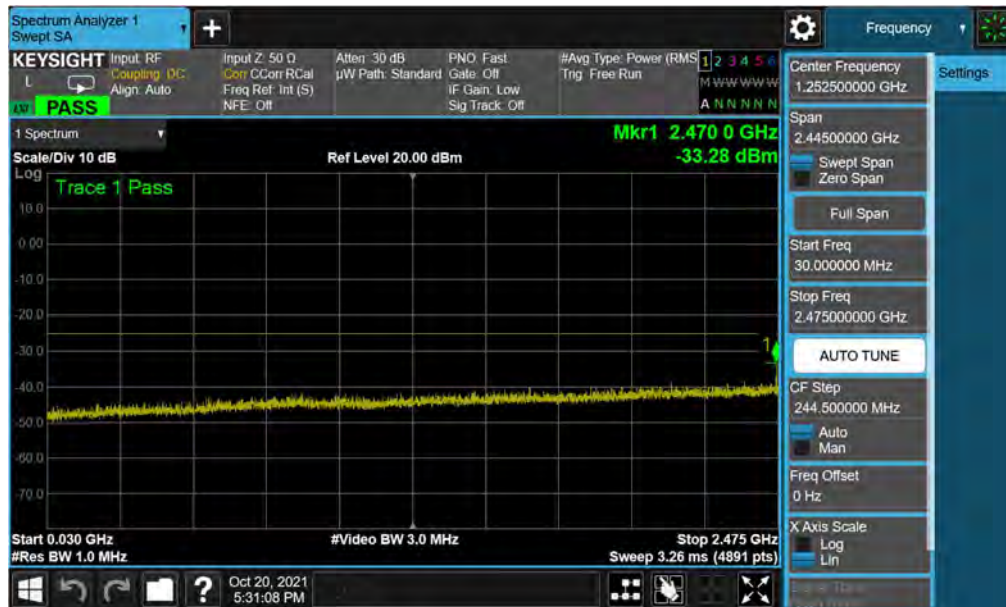
Figure 7-3. Test Instrument & Measurement Setup

Test Notes

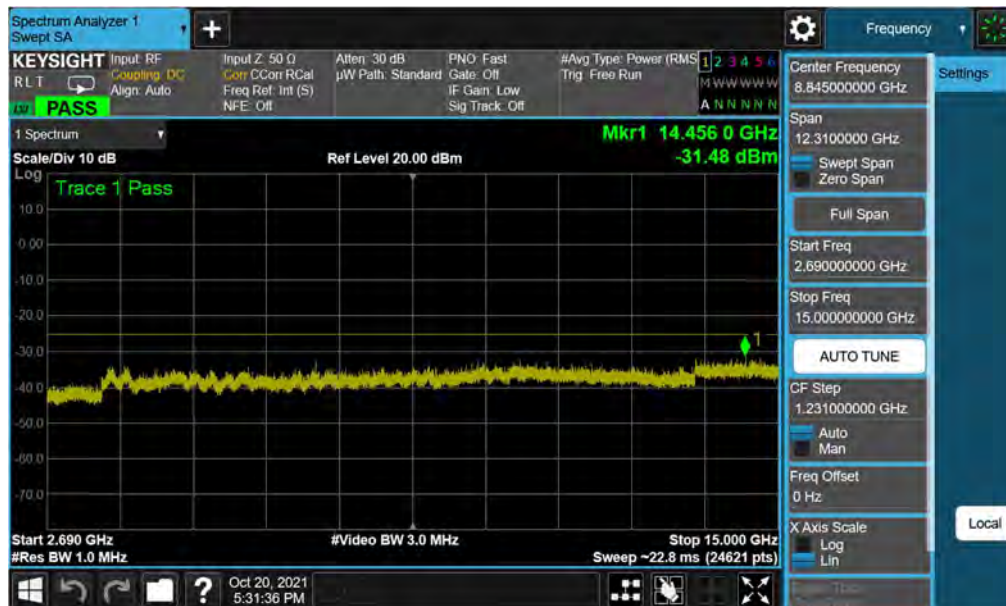
Per Part 27 and RSS-199, compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth 100 kHz or greater for measurements below 1GHz. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth 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.

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LTE Band 41(PC2)

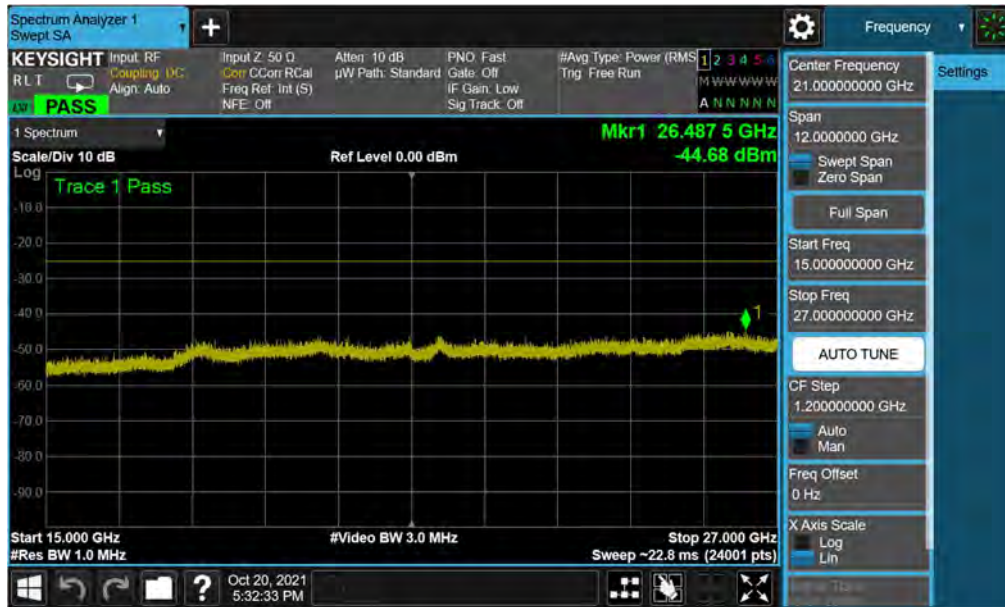


Plot 7-10. Conducted Spurious Plot (LTE Band 41(PC2) - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

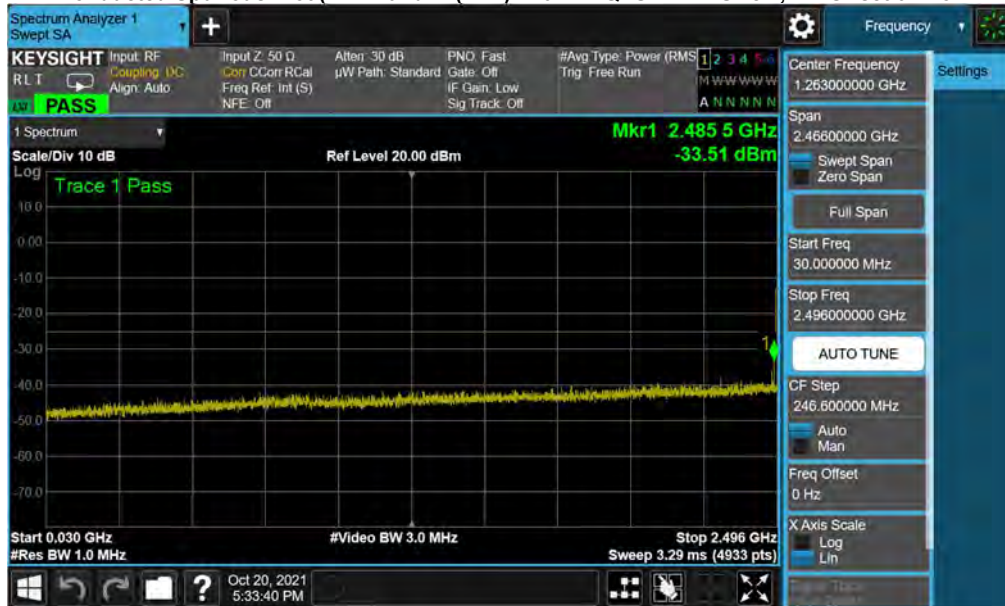


Plot 7-11. Conducted Spurious Plot (LTE Band 41(PC2) - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

FCC ID: A3LSMS901E	PCTEST Product to be part of Samsung	PART 27 MEASUREMENT REPORT	Approved by: Technical Manager
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Plot 7-12. Conducted Spurious Plot (LTE Band 41(PC2) - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)



Plot 7-13. Conducted Spurious Plot (LTE Band 41(PC2) - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

FCC ID: A3LSMS901E	PCTEST Product to be part of Samsung	PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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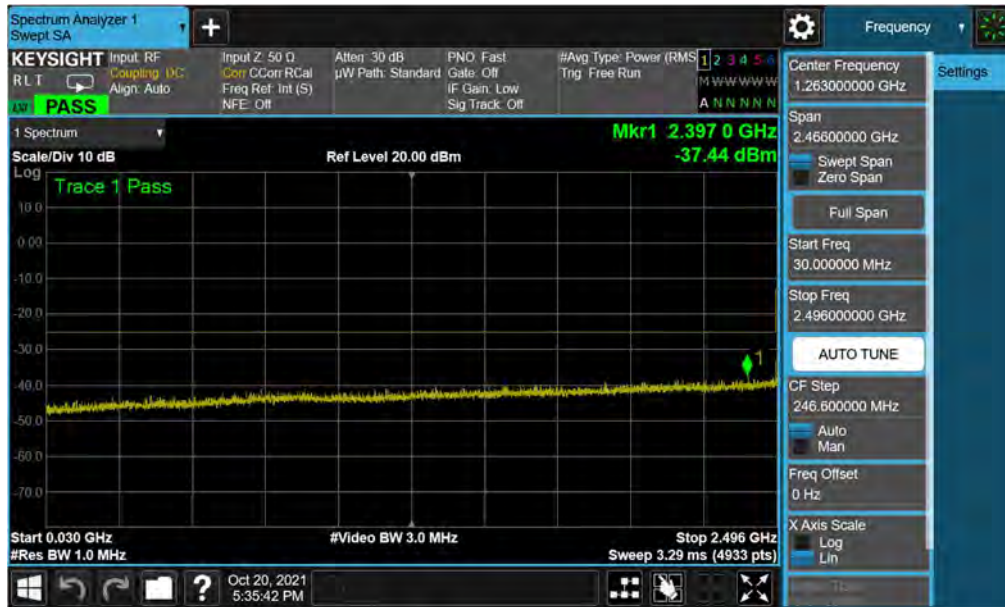


Plot 7-14. Conducted Spurious Plot (LTE Band 41(PC2) - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

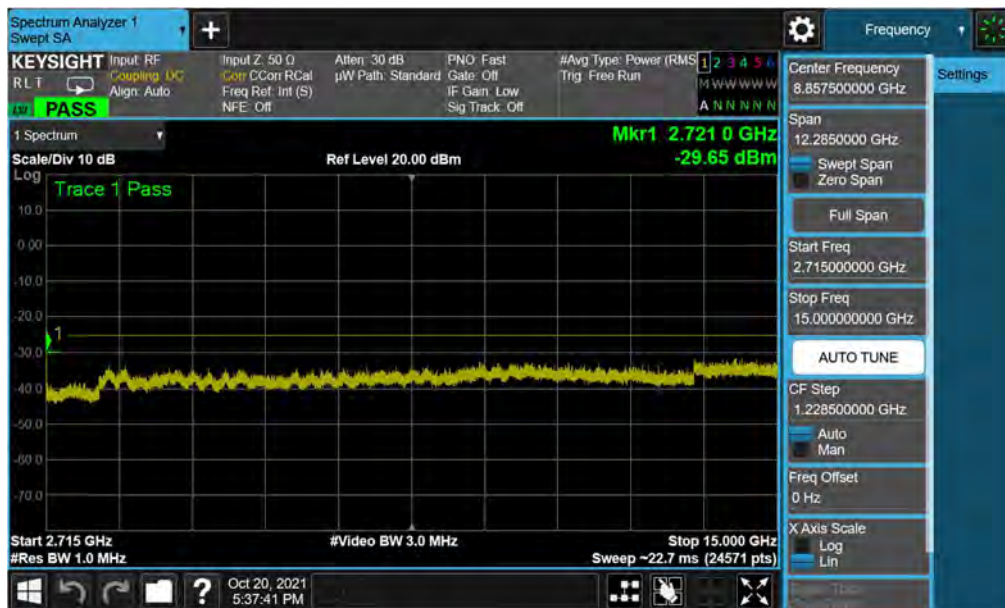


Plot 7-15. Conducted Spurious Plot (LTE Band 41(PC2) - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)

FCC ID: A3LSMS901E	PCTEST Proud to be part of Samsung	PART 27 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1M2109290114-29.A3L	Test Dates: 11/19/2021 - 12/2/2021	EUT Type: Portable Handset	Page 21 of 40

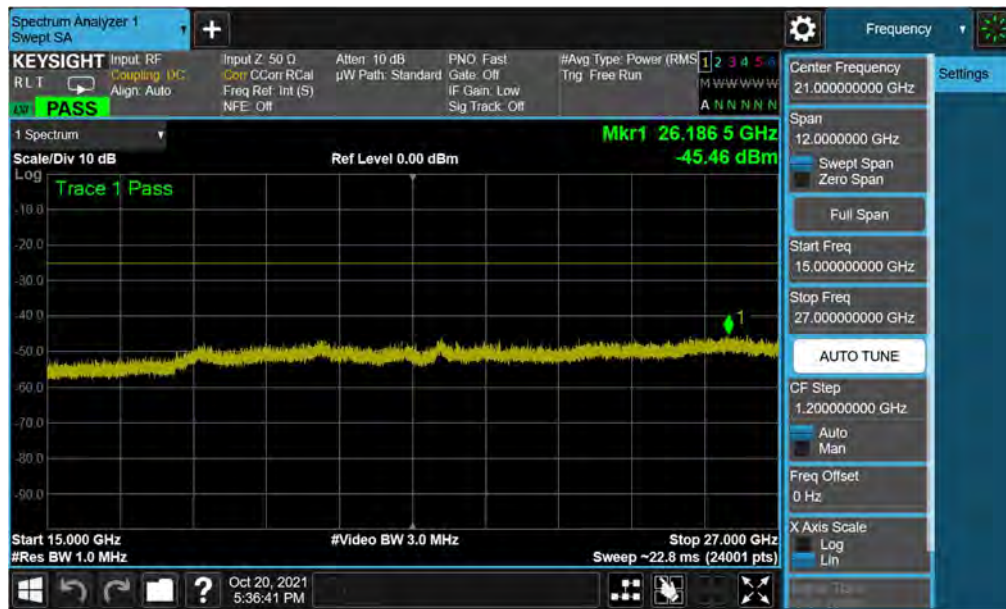


Plot 7-16. Conducted Spurious Plot (LTE Band 41(PC2) - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)



Plot 7-17. Conducted Spurious Plot (LTE Band 41(PC2) - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

FCC ID: A3LSMS901E	PCTEST Proud to be part of Samsung	PART 27 MEASUREMENT REPORT	Approved by: Technical Manager
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Plot 7-18. Conducted Spurious Plot (LTE Band 41(PC2) - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

FCC ID: A3LSMS901E	PCTEST Proud to be part of Samsung	PART 27 MEASUREMENT REPORT	Approved by: Technical Manager
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7.5 Band Edge Emissions at Antenna Terminal

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 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.

The minimum permissible attenuation level for Band 41 is as noted in the Test Notes on the following page.

Test Procedure Used

KDB 971168 D01 v03r01 – Section 6.0

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 $\geq 1\%$ of the emission bandwidth
4. VBW $\geq 3 \times$ RBW
5. Detector = RMS
6. Number of sweep points $\geq 2 \times$ Span/RBW
7. Trace mode = trace average for continuous emissions, max hold for pulse emissions
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Test Setup

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



Figure 7-4. Test Instrument & Measurement Setup

FCC ID: A3LSMS901E	PCTEST Product to be part of Samsung	PART 27 MEASUREMENT REPORT	Approved by: Technical Manager
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Test Notes

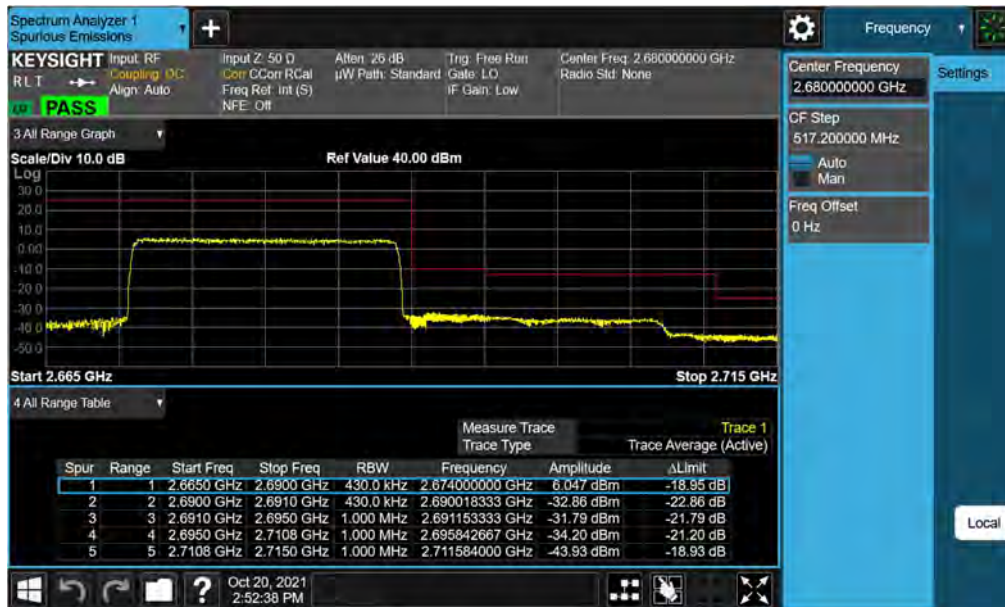
- Per 27.53(m)(6) for operations in the BRS/EBS bands, the attenuation factor shall be not less than $40 + 10 \log (P)$ dB on all frequencies between the channel edge and 5 megahertz from the channel edge, $43 + 10 \log (P)$ dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and $55 + 10 \log (P)$ dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth. In addition, the attenuation factor shall not be less than $43 + 10 \log (P)$ dB on all frequencies between 2490.5 MHz and 2496 MHz and $55 + 10 \log (P)$ dB at or below 2490.5 MHz.

FCC ID: A3LSMS901E	 PART 27 MEASUREMENT REPORT 	Approved by: Technical Manager
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LTE Band 41(PC2)



Plot 7-19. Lower ACP Plot (LTE Band 41(PC2) - 20MHz QPSK – Full RB)



Plot 7-20. Upper ACP Plot (LTE Band 41(PC2) - 20MHz QPSK – Full RB)

FCC ID: A3LSMS901E		PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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Plot 7-21. Lower ACP Plot (LTE Band 41(PC2) - 15MHz QPSK – Full RB)



Plot 7-22. Upper ACP Plot (LTE Band 41(PC2) - 15MHz QPSK – Full RB)

FCC ID: A3LSMS901E	PCTEST Product to be part of Samsung	PART 27 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1M2109290114-29.A3L	Test Dates: 11/19/2021 - 12/2/2021	EUT Type: Portable Handset	Page 27 of 40

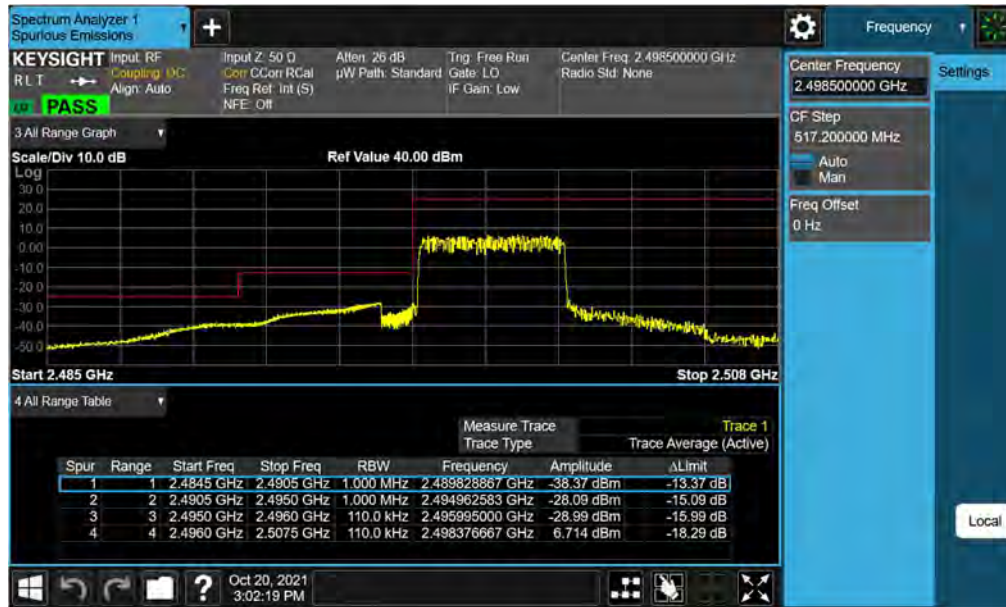


Plot 7-23. Lower ACP Plot (LTE Band 41(PC2) - 10MHz QPSK - Full RB)



Plot 7-24. Upper ACP Plot (LTE Band 41(PC2) - 10MHz QPSK - Full RB)

FCC ID: A3LSMS901E	PCTEST Proud to be part of Samsung	PART 27 MEASUREMENT REPORT	Approved by: Technical Manager
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Plot 7-25. Lower ACP Plot (LTE Band 41(PC2) - 5MHz QPSK – Full RB)



Plot 7-26. Upper ACP Plot (LTE Band 41(PC2) - 5MHz QPSK – Full RB)

FCC ID: A3LSMS901E	PCTEST Product to be part of Samsung	PART 27 MEASUREMENT REPORT	Approved by: Technical Manager
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7.6 Radiated Power (EIRP)

Test Overview

Equivalent Isotropic Radiated Power (EIRP) measurements are performed using the substitution method described in ANSI/TIA-603-E-2016 with the EUT transmitting into an integral antenna. Measurements on signals operating below 1GHz are performed using vertically and horizontally polarized tuned dipole antennas. Measurements on signals operating above 1GHz are performed using vertically and horizontally polarized broadband horn antennas. All measurements are performed as RMS average measurements while the EUT is operating at maximum power, and at the appropriate frequencies.

Test Procedures Used

KDB 971168 D01 v03r01 – Section 5.2.1

ANSI/TIA-603-E-2016 – Section 2.2.17

Test Settings

1. Radiated power measurements are performed using the signal analyzer's "channel power" measurement capability for signals with continuous operation. For signals with burst transmission, the signal analyzer's "time domain power" measurement capability is used
2. RBW = 1 – 5% of the expected OBW, not to exceed 1MHz
3. VBW $\geq 3 \times$ RBW
4. Span = 1.5 times the OBW
5. No. of sweep points $\geq 2 \times$ span / RBW
6. Detector = RMS
7. Trigger is set to "free run" for signals with continuous operation with the sweep times set to "auto". Trigger is set to enable triggering only on full power bursts with the sweep time set less than or equal to the transmission burst duration
8. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with continuous operation. For signals with burst transmission, the "gating" function was enabled to ensure that measurements are performed during times in which the transmitter is operating at its maximum power
9. Trace mode = trace averaging (RMS) over 100 sweeps
10. The trace was allowed to stabilize

FCC ID: A3LSMS901E		PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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Test Setup

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

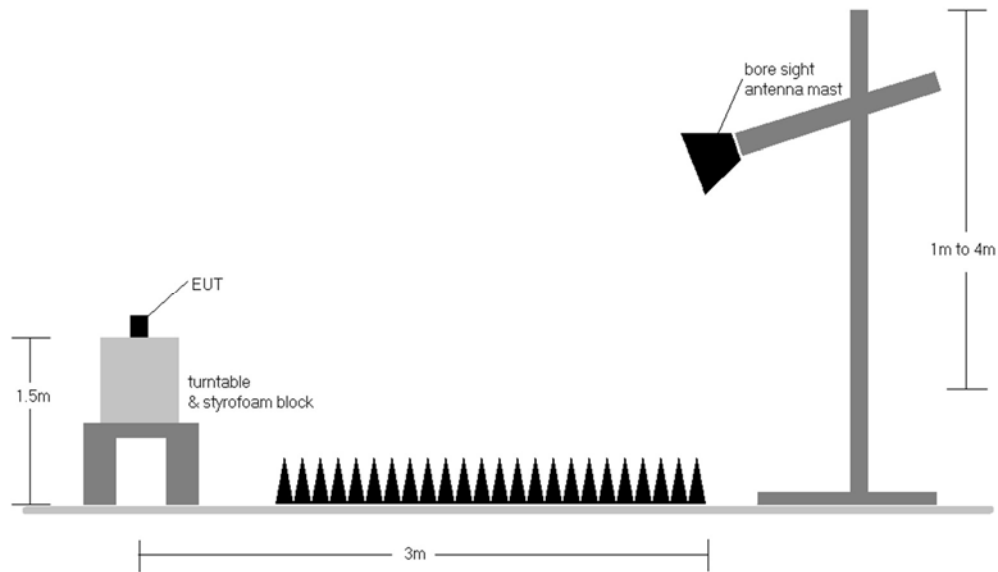


Figure 7-5. Radiated Test Setup >1GHz

Test Notes

- 1) The EUT was tested in three orthogonal planes 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 tables below.
- 2) This unit was tested with its standard battery.
- 3) The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst case setup is reported in the tables below.

FCC ID: A3LSMS901E	PCTEST Proud to be part of Samsung	PART 27 MEASUREMENT REPORT	Approved by: Technical Manager
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Bandwidth	Mod.	Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Ant. Gain [dBi]	RB Size/Offset	Substitute Level [dBm]	EIRP [dBm]	EIRP [Watts]	EIRP Limit [dBm]	Margin [dB]
20 MHz	QPSK	2506.0	H	100	195	9.40	1 / 50	14.21	23.61	0.229	33.01	-9.40
	QPSK	2593.0	H	110	210	9.53	1 / 50	14.28	23.81	0.240	33.01	-9.21
	QPSK	2680.0	H	127	213	9.65	1 / 99	14.66	24.31	0.270	33.01	-8.70
	16-QAM	2680.0	H	127	213	9.65	1 / 99	14.06	23.71	0.235	33.01	-9.30
15 MHz	QPSK	2503.5	H	100	195	9.39	1 / 37	15.51	24.90	0.309	33.01	-8.11
	QPSK	2593.0	H	110	210	9.53	1 / 74	14.04	23.57	0.227	33.01	-9.45
	QPSK	2682.5	H	127	213	9.65	1 / 37	14.29	23.94	0.248	33.01	-9.07
	16-QAM	2503.5	H	100	195	9.39	1 / 37	15.19	24.58	0.287	33.01	-8.43
10 MHz	QPSK	2501.0	H	100	195	9.39	1 / 25	15.32	24.71	0.296	33.01	-8.30
	QPSK	2593.0	H	110	210	9.53	1 / 49	13.37	22.90	0.195	33.01	-10.12
	QPSK	2685.0	H	127	213	9.66	1 / 49	13.34	23.00	0.199	33.01	-10.01
	16-QAM	2501.0	H	100	195	9.39	1 / 25	14.46	23.85	0.243	33.01	-9.16
5 MHz	QPSK	2498.5	H	100	195	9.39	1 / 24	15.55	24.94	0.312	33.01	-8.07
	QPSK	2593.0	H	110	210	9.53	1 / 24	14.51	24.04	0.253	33.01	-8.98
	QPSK	2687.5	H	127	213	9.66	1 / 12	14.49	24.15	0.260	33.01	-8.86
	16-QAM	2498.5	H	100	195	9.39	1 / 24	14.84	24.23	0.265	33.01	-8.78
5 MHz	Opposite Pol.	2498.5	V	400	236	9.39	1 / 12	13.25	22.64	0.184	33.01	-10.37
	WCP	2498.5	H	121	207	9.39	1 / 12	15.54	24.93	0.311	33.01	-8.08

Table 7-2. EIRP Data (LTE Band 41(PC2))

FCC ID: A3LSMS901E	 PART 27 MEASUREMENT REPORT 		Approved by: Technical Manager
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7.7 Radiated Spurious Emissions Measurements

Test Overview

Radiated spurious emissions measurements are performed using the field strength conversion method described in KDB 971168 with the EUT transmitting into an integral antenna. Measurements on signals operating below 1GHz are performed using horizontally and vertically polarized tuned dipole antennas. Measurements on signals operating above 1GHz are performed using vertically and horizontally polarized broadband horn antennas. All measurements are performed as peak measurements while the EUT is operating at maximum power, and at the appropriate frequencies.

Test Procedures Used

KDB 971168 D01 v03r01 – Section 5.8

Test Settings

1. RBW = 100kHz for emissions below 1GHz and 1MHz for emissions above 1GHz
2. VBW $\geq 3 \times$ RBW
3. Span = 1.5 times the OBW
4. No. of sweep points $\geq 2 \times$ span / RBW
5. Detector = RMS
6. Trace mode = Average (Max Hold for pulsed emissions)
7. The trace was allowed to stabilize

FCC ID: A3LSMS901E		PART 27 MEASUREMENT REPORT		Approved by: Technical Manager
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Test Setup

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

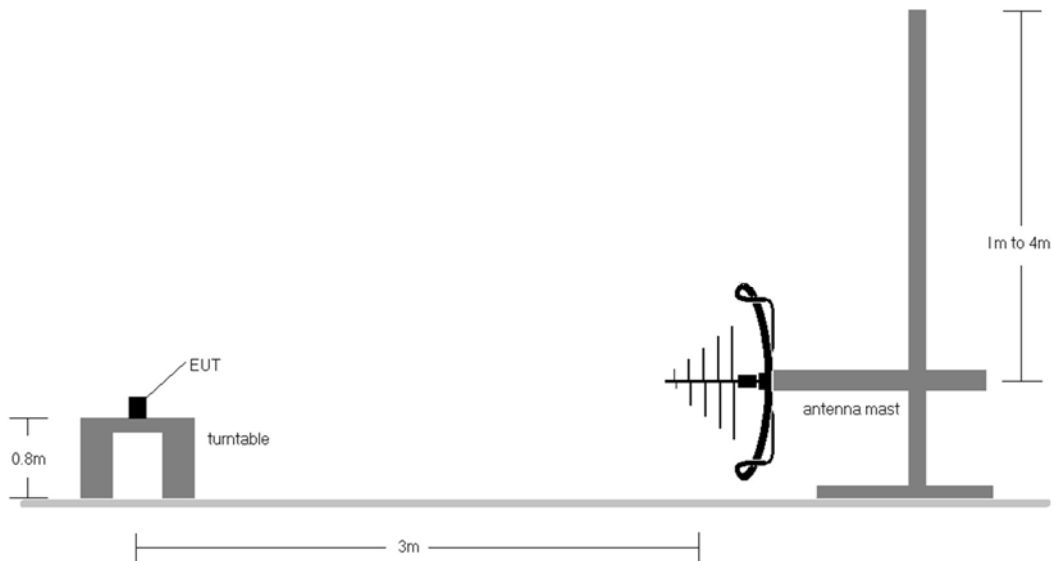


Figure 7-6. Test Instrument & Measurement Setup < 1GHz

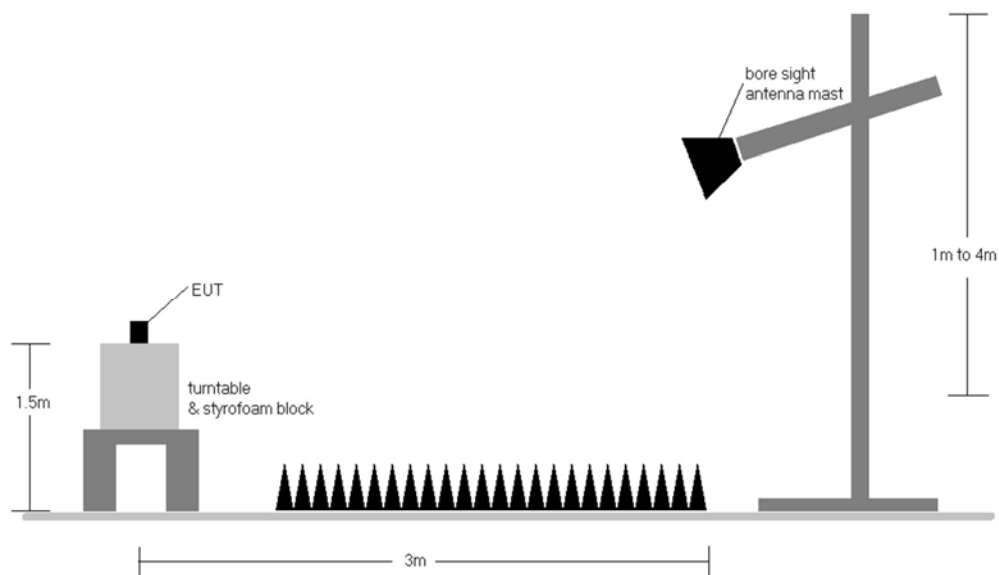


Figure 7-7. Test Instrument & Measurement Setup >1 GHz

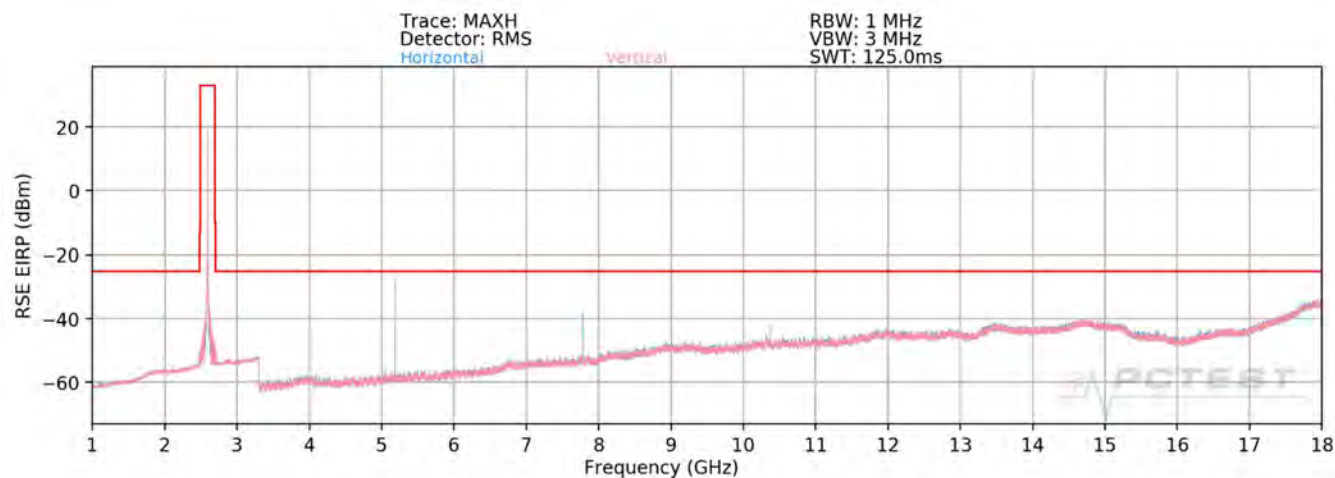
FCC ID: A3LSMS901E	PCTEST Proud to be part of Samsung	PART 27 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1M2109290114-29.A3L	Test Dates: 11/19/2021 - 12/2/2021	EUT Type: Portable Handset	Page 34 of 40

Test Notes

- 1) Field strengths are calculated using the Measurement quantity conversions in KDB 971168 Section 5.8.4.
 - b) $E(\text{dB}\mu\text{V/m}) = \text{Measured amplitude level (dBm)} + 107 + \text{Cable Loss (dB)} + \text{Antenna Factor (dB/m)}$
 - d) $\text{EIRP (dBm)} = E(\text{dB}\mu\text{V/m}) + 20\log D - 104.8$; where D is the measurement distance in meters.
- 2) The EUT was tested in three orthogonal planes 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 tables below.
- 3) This unit was tested with its standard battery.
- 4) The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst case setup is reported in the tables below.
- 5) The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter. The worst-case emissions are reported.
- 6) Emissions below 18GHz were measured at a 3 meter test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor. No radiated emissions were found in the 18000 – 26500MHz.
- 7) The "-" shown in the following RSE tables are used to denote a noise floor measurement.

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LTE Band 41(PC2)



Plot 7-27. Radiated Spurious Plot (LTE Band 41(PC2))

Bandwidth (MHz):	5
Frequency (MHz):	2498.5
RB / Offset:	1 / 0

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBμV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
4997.00	V	103	53	-45.76	1.51	62.75	-32.51	-25.00	-7.51
7495.50	V	115	42	-64.02	8.58	51.56	-43.70	-25.00	-18.70
9994.00	V	100	26	-74.61	12.28	44.67	-50.59	-25.00	-25.59
12492.50	V	-	-	-84.52	15.25	37.73	-57.53	-25.00	-32.53
14991.00	V	-	-	-84.18	19.54	42.36	-52.90	-25.00	-27.90
17489.50	V	-	-	-84.46	21.26	43.80	-51.46	-25.00	-26.46

Table 7-3. Radiated Spurious Data (LTE Band 41(PC2) – Low Channel)

Bandwidth (MHz):	5
Frequency (MHz):	2593.0
RB / Offset:	1 / 0

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBμV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
5186.00	V	101	47	-43.45	2.33	65.88	-29.38	-25.00	-4.38
7779.00	V	106	38	-67.37	9.91	49.54	-45.72	-25.00	-20.72
10372.00	V	103	39	-74.21	13.36	46.15	-49.10	-25.00	-24.10
12965.00	V	100	9	-83.02	16.53	40.51	-54.74	-25.00	-29.74
15558.00	V	-	-	-83.84	15.87	39.03	-56.23	-25.00	-31.23

Table 7-4. Radiated Spurious Data (LTE Band 41(PC2) – Mid Channel)

FCC ID: A3LSMS901E	PCTEST Product to be part of Samsung	PART 27 MEASUREMENT REPORT	Approved by: Technical Manager
Test Report S/N: 1M2109290114-29.A3L	Test Dates: 11/19/2021 - 12/2/2021	EUT Type: Portable Handset	Page 36 of 40

Bandwidth (MHz):	5
Frequency (MHz):	2687.5
RB / Offset:	1 / 0

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBμV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
5375.00	V	100	50	-52.21	3.84	58.63	-36.63	-25.00	-11.63
8062.50	V	116	59	-76.32	9.75	40.43	-54.82	-25.00	-29.82
10750.00	V	103	31	-79.61	12.76	40.15	-55.11	-25.00	-30.11
13437.50	V	100	31	-83.05	17.08	41.03	-54.23	-25.00	-29.23
16125.00	V	101	26	-82.87	14.25	38.38	-56.88	-25.00	-31.88

Table 7-5. Radiated Spurious Data (LTE Band 41(PC2) – High Channel)

FCC ID: A3LSMS901E	 PART 27 MEASUREMENT REPORT 	Approved by: Technical Manager
Test Report S/N: 1M2109290114-29.A3L	Test Dates: 11/19/2021 - 12/2/2021	EUT Type: Portable Handset
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7.8 Frequency Stability / Temperature Variation

Test Overview and Limit

Frequency stability testing is performed in accordance with the guidelines of ANSI/TIA-603-E-2016. The frequency stability of the transmitter is measured by:

- a.) **Temperature:** The temperature is varied from -30°C to +50°C in 10°C increments using an environmental chamber.
- b.) **Primary Supply Voltage:** The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battery operating end point which shall be specified by the manufacturer.

Test Procedure Used

ANSI/TIA-603-E-2016

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.

Test Setup

The EUT was connected via an RF cable to a spectrum analyzer with the EUT placed inside an environmental chamber.

Test Notes

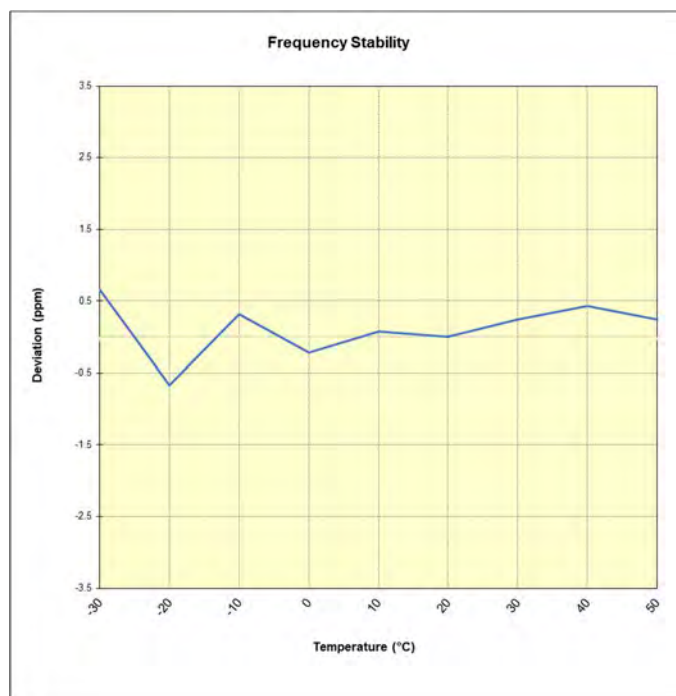
None

FCC ID: A3LSMS901E	 PART 27 MEASUREMENT REPORT 		Approved by: Technical Manager
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LTE Band 41

LTE Band 41					
Operating Frequency (Hz):			2,593,000,000		
Ref. Voltage (VDC):			4.39		
Voltage (%)	Power (VDC)	Temp (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	4.39	- 30	2,592,995,598	1,700	0.0000656
		- 20	2,592,992,166	-1,732	-0.0000668
		- 10	2,592,994,717	819	0.0000316
		0	2,592,993,319	-579	-0.0000223
		+ 10	2,592,994,104	206	0.0000079
		+ 20 (Ref)	2,592,993,898	0	0.0000000
		+ 30	2,592,994,527	629	0.0000243
		+ 40	2,592,995,012	1,114	0.0000430
		+ 50	2,592,994,523	625	0.0000241
Battery Endpoint	3.85	+ 20	2,592,993,082	-816	-0.0000315

Table 7-6. LTE Band 41(PC2) Frequency Stability Data



Plot 7-28. LTE Band 41(PC2) Frequency Stability Chart

FCC ID: A3LSMS901E	PCTEST Product to be part of Samsung	PART 27 MEASUREMENT REPORT	Approved by: Technical Manager
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8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the Samsung **Portable Handset** **FCC ID: A3LSMS901E** complies with all the requirements of Part 27 of the FCC rules.

FCC ID: A3LSMS901E	 PART 27 MEASUREMENT REPORT 	Approved by: Technical Manager
Test Report S/N: 1M2109290114-29.A3L	Test Dates: 11/19/2021 - 12/2/2021	EUT Type: Portable Handset
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