FCC / ISED & Test Report

For:

Teledyne Controls

Model Name:

2243800

Product Description:

Wireless Groundlink® Quick Access Recorder (Comm+)

Applied Rules and Standards:

47 CFR Part 90

FCC ID: SYK-WQAR-464-4R/SYK-WQAR-462-2R
IC ID: 11369A-WQAR4644R/11369A-WQAR4622R

REPORT #: EMC_TELED-009-19001_FCC_90
DATE: 2019-05-29

A2LA Accredited

IC recognized # 3462B-1

***CETECOM* Inc.**
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CETECOM Inc. is a Delaware Corporation with Corporation number: 2905571

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1 Assessment

The following device as further described in section 3 of this report was evaluated against the applicable criteria specified in the Code of Federal Regulations Title 47 part 90.

No deficiencies were ascertained.

Company Name	Product Description	Model #
Teledyne Controls	Wireless Groundlink® Quick Access Recorder (Comm+)	2243800

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2019-05-29	Compliance	Kris Lazarov (Senior EMC Engineer)	Digitally signed by Kris Lazarov Date: 2019.05.29 17:09:52 -07'00'

Responsible for the Report:

Date	Section	Name	Signature
2019-05-29	Compliance	Kevin Wang (Senior EMC Engineer)	Kevin Wang Digitally signed by: Kevin Wang DN: CN = Kevin Wang email = kevin.wang@cetecom.com C = US O = Cetecom Inc. Date: 2019.05.29 17:08:24 -07'00'

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Street Address:	411 Dixon Landing Road
City/Zip Code	Milpitas, CA 95035
Country	USA
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
EMC Lab Manager:	Cindy Li
Responsible Project Leader:	Kevin Wang

2.2 Identification of the Client

Applicant's Name:	Teledyne Controls
Street Address:	501 Continental Blvd
City/Zip Code	El Segundo, CA / 90245
Country	United States

2.3 Identification of the Manufacturer

Manufacturer's Name:	Same as Applicant
Manufacturers Address:	----------
City/Zip Code	----------
Country	----------

3 Equipment Under Test (EUT)

3.1 EUT Specifications

Model No	2243800
HW Version	Mod 0
SW Version	711745 Ver G
FCC-ID :	SYK-WQAR-464-4R / SYK-WQAR-462-2R
IC-ID:	11369A-WQAR4644R / 11369A-WQAR4622R
FVIN:	Operational Software OPS 711745 Version G
HVIN:	2243800-464/2243800-462
PMN:	2243800-464/2243800-462
Product Description	The WGL Comm+ performs the recording and wireless transmission of flight data. The model 2243800-462 is equipped with 2 identical cellular radio modules, and the main antenna connection of each module (UFL) is routed to a single external SMA antenna connector. The model 2243800-464 is equipped with 4 identical cellular radio modules, and each of the 2 radio modules use a RF combiner to connect the main antenna.
Transceiver Technology / Type(s) of Modulation	Sierra Wireless Airprime EM7565; FCCID: N7NEM75 •FDD I / II / III / IV / V / VI / VII / VIII / IX / 19 HSPA+/DC-HHSDPA/DC-HSUPA/UMTS •FDD LTE Band 1/2/3/4/5/7/8/9/12/13/18/19/20/26/28/29/30 •TDD LTE Band 41/42/43/46/48/66 Modulations: QPSK, 16-QAM, 64-QAM
Max. declared antenna gain	Pangu Tech, LLC, model: JQRD-0018-LTE; peak gain: 2dBi norm.
Power Supply/ Rated Operating Voltage Range	Vmin: 100VAC, 360 Hz / Vnom: 115VAC, 400 Hz / Vmax: 122VAC, 800 Hz
Operating Temperature Range	–15°C ~ +55°C
Sample Revision	☐Prototype ■Production ☐Pre-Production

3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Comments
1	08195	2243800-464	OPS SW 711745	-
2	08206	2243800-462	OPS SW 711745	-

3.3 Accessory Equipment (AE) details

AE #	Type	Model	Manufacturer	Serial Number
1	Power Supply	112-AMX	Pacific Smart Source	-

3.4 Test Sample Configuration

Set-up #	EUT / AE used for set-up	Comments
1	EUT#1+AE#1	The EUT was mounted with a cable harness fixture attached on a copper ground plate. The AC power was provided to the EUT from the power supply.

4 Subject of Investigation

The objective of the measurements done by CETECOM Inc. was to evaluate the compliance of the EUT against the relevant requirements specified in the Code of Federal Regulations Title 47 part 90.

4.1 Dates of Testing:

08/15/2018 - 08/27/2018

4.2 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus, with 95% confidence interval (in dB delta to result), based on a coverage factor k=1.

Radiated measurement

9 kHz to 30MHz	±2.5 dB (Magnetic Loop Antenna)
30 MHz to 1000 MHz	±2.0 dB (Biconilog Antenna)
1 GHz to 40 GHz	±2.3 dB (Horn Antenna)

Conducted measurement

150 kHz to 30 MHz	±0.7 dB (LISN)

RF conducted measurement	±0.5 dB

4.3 Environmental Conditions during Testing:

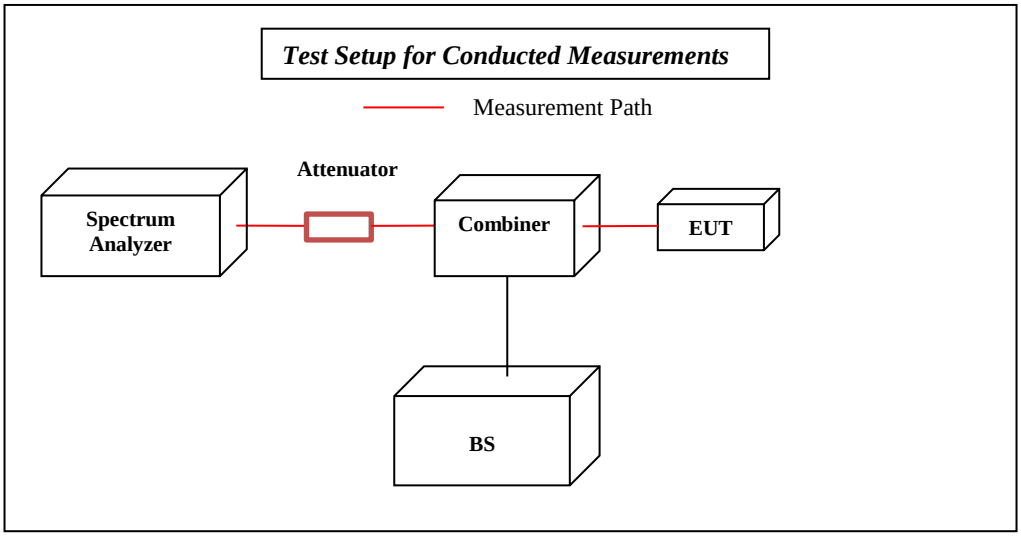
The following environmental conditions were maintained during the course of testing:

- Ambient Temperature: 20-25°C
- Relative humidity: 40-60%

Deviating test conditions are indicated at individual test description where applicable.

5 Measurement Procedures

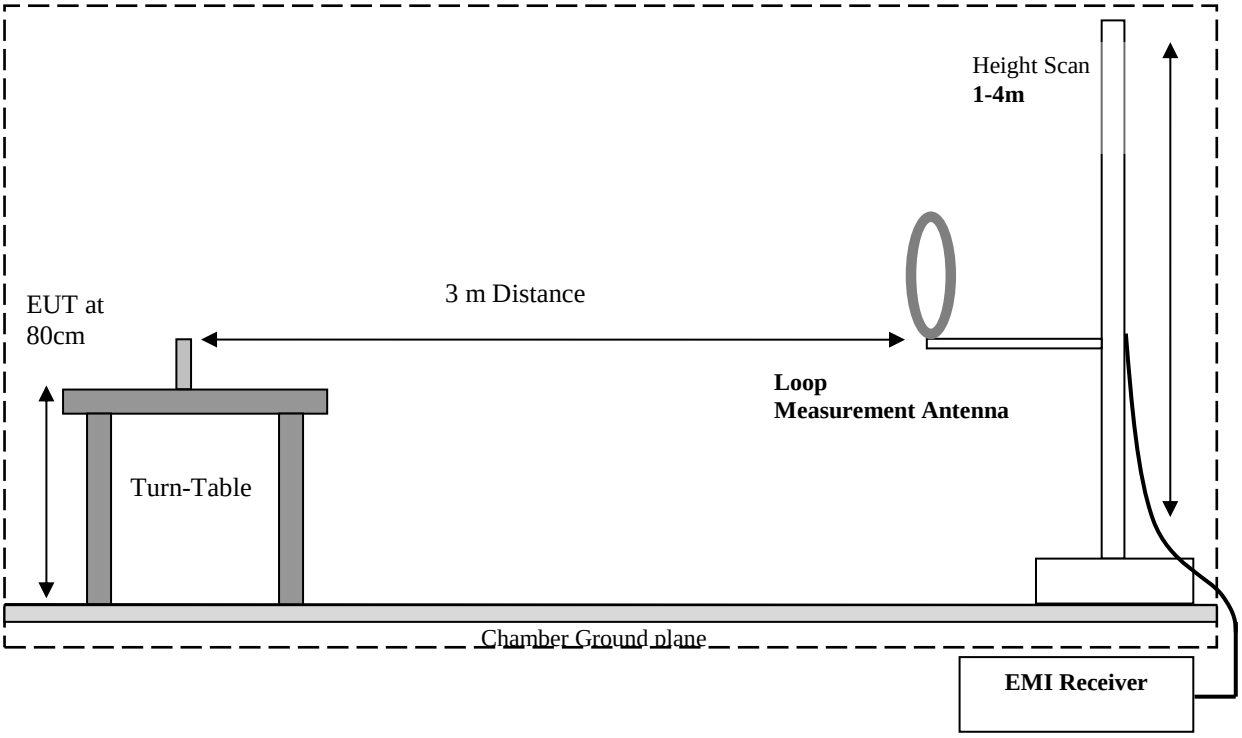
Testing is performed according to the guidelines provided in FCC publication (KDB) 971168 D01 v02r02 – "Measurement Guidance for Certification of Licensed Digital Transmitters" and according to relevant parts of ANSI/TIA-603-D-2010 as detailed below.



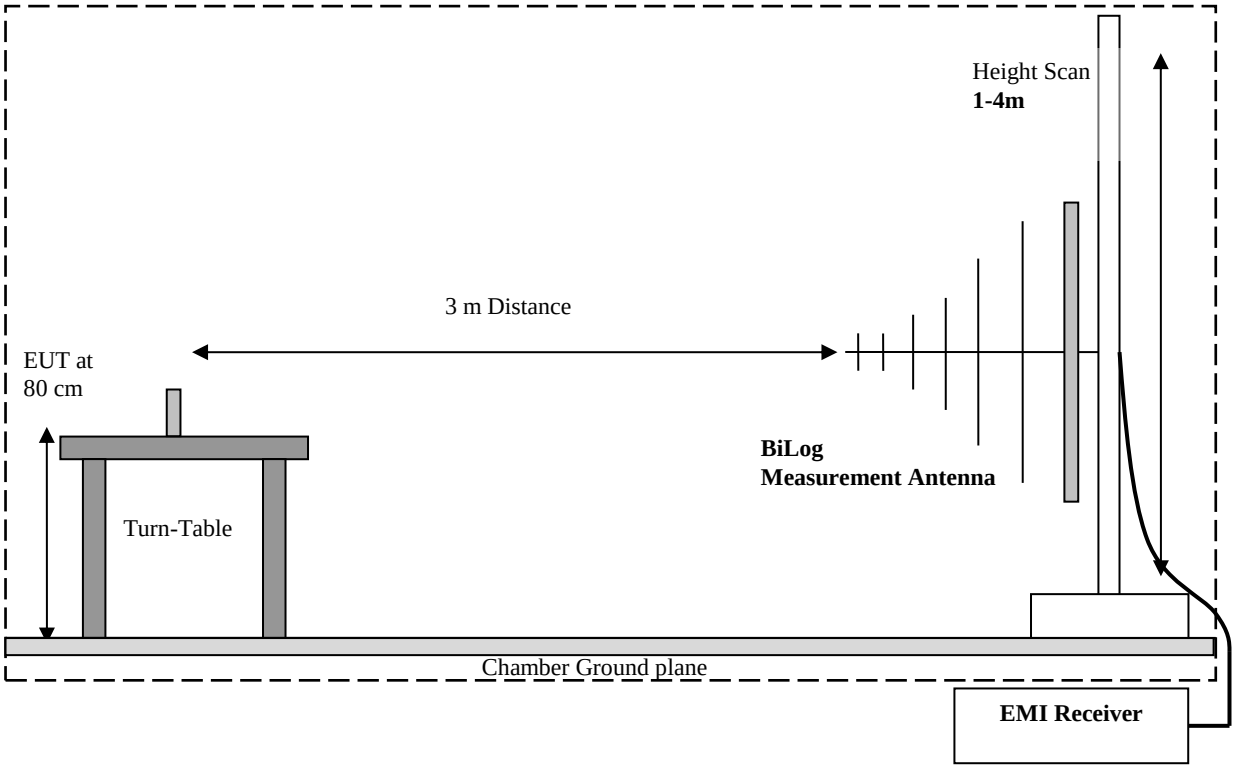
5.1 Radiated Measurement

- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to cover the 3 orthogonal axis of the EUT. A max peak detector is utilized during the exploratory measurement. The Test-SW creates an overall maximum trace for all 12 sweeps and saves the settings for each point of this trace. The maximum trace is part of the test report.
- The 10 highest emissions are selected with an automatic algorithm of EMC32 searching for peaks in the noise floor and ensuring that broadband signals are not selected multiple times.
- The maxima are then put through the final measurement and again maximized in a 90deg range of the turntable, fine search in frequency domain and height scan between 1m and 4m.
- The above procedure is repeated for all possible ways of power supply to EUT and for all supported modulations.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- The results are split up into up to 4 frequency ranges due to antenna bandwidth restrictions. A magnetic loop is used from 9 kHz to 30 MHz, a Biconilog antenna is used from 30 MHz to 1 GHz, and two different horn antennas are used to cover frequencies up to 40 GHz.

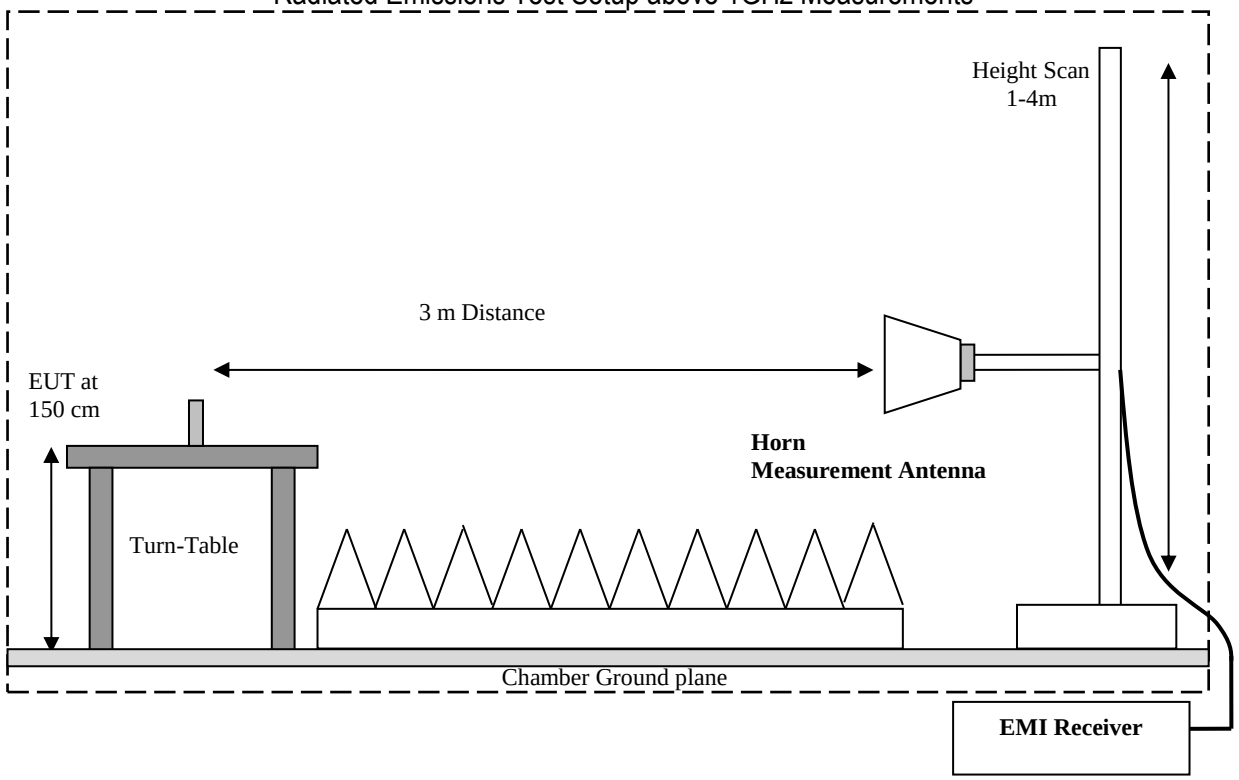
Radiated Emissions Test Setup below 30MHz Measurements



Radiated Emissions Test Setup 30MHz-1GHz Measurements



Radiated Emissions Test Setup above 1GHz Measurements



5.2 Sample Calculations for Field Strength Measurements

Field Strength is calculated from the Spectrum Analyzer/ Receiver readings, taking into account the following parameters:

- Measured reading in dBµV
- Cable Loss between the receiving antenna and SA in dB and
- Antenna Factor in dB/m

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the following equation:

FS (dBµV/m) = Measured Value on SA (dBµV)- Cable Loss (dB)+ Antenna Factor (dB/m)

Example:

Frequency (MHz)	Measured SA (dBµV)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dBµV/m)
1000	80.5	3.5	14	98.0

6 Measurement Results Summary

6.1 Part 90

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§2.1046	RF Output Power	Nominal	-	☐	☐	☐	■	Note 2
§2.1055; §90.213	Frequency Tolerance	Extreme Temperature and Voltage	-	☐	☐	☐	■	Note 2
§2.1049	Occupied Bandwidth	Nominal	-	☐	☐	☐	■	Note 2
§2.1051; §90.691	Emission mask – In-band emissions	Nominal	-	☐	☐	☐	■	Note 2
§2.1051; §90.691	Emission mask – Out of band emissions	Nominal	-	☐	☐	☐	■	Note 2
§2.1053; §90.691	Radiated Spurious Emissions	Nominal	LTE Band 26	■	☐	☐	☐	Complies

Note 1: NA= Not Applicable; NP= Not Performed.
Note 2: Data leveraged from modular approval, FCC ID: N7NEM75

7 Test Result Data

7.1 Radiated Spurious Emissions

7.1.1 Measurement utilizing KDB 971168 D01 Power Meas License Digital Systems v02r02, and according to ANSI/TIA-603-D-2010

Spectrum Analyzer Settings for FCC 90

Frequency Range	30MHz – 1 GHz	1 – 3 GHz	3 – 18 GHz
Resolution Bandwidth	100 kHz	1 MHz	1 MHz
Video Bandwidth	100 kHz	1 MHz	1 MHz
Detector	Peak	Peak	Peak
Trace Mode	Max Hold	Max Hold	Max Hold
Sweep Time	Auto	Auto	Auto

7.1.2 Limits:

7.1.2.1 FCC Part 90.691;

Out of band emissions. 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.

Note: The limit calculation result is a constant of -13 dBm.

7.1.3 Test conditions and setup:

EUT operating mode	EUT Set-Up #	Power Input	Note
1	1	115V / 400Hz	Co-transmission for Cellular 1 + Cellular 2 combination was tested. Cellular 1 and 2 are using the same antenna through a RF combiner. The UMTS and LTE combination are checked. The worst UMTS is FDD V, High Channel.
2	1	115V / 400Hz	Co-transmission for Cellular 2 + Cellular 3 combination was tested. Cellular 2 and 3 are using separate antenna. The UMTS and LTE combination are checked. The worst UMTS is FDD V, High Channel.

7.1.4 Measurement result:

Plot #	Channel	EUT operating mode	Cellular 1	Cellular 2	Scan Frequency	Limit (dBm)	Result
1-3	Low	1	LTE Band 26	FDD Band V	30 MHz – 18 GHz	-13	Pass
4-7	Mid	1	LTE Band 26	FDD Band V	9 kHz – 18 GHz	-13	Pass
8-10	High	1	LTE Band 26	FDD Band V	30 MHz – 18 GHz	-13	Pass

Plot #	Channel	EUT operating mode	Cellular 2	Cellular 3	Scan Frequency	Limit (dBm)	Result
11-13	Low	1	LTE Band 26	FDD Band V	30 MHz – 18 GHz	-13	Pass
14-17	Mid	1	LTE Band 26	FDD Band V	9 kHz – 18 GHz	-13	Pass
18-20	High	1	LTE Band 26	FDD Band V	30 MHz – 18 GHz	-13	Pass

7.1.5 Measurement Plots:

Plot # 1 Radiated Emissions: 30-1000MHz		
Module 1+2	LTE Band 26 + UMTS Band V	Channel: Low

Final_Result

Frequency (MHz)	MaxPeak (dBm)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
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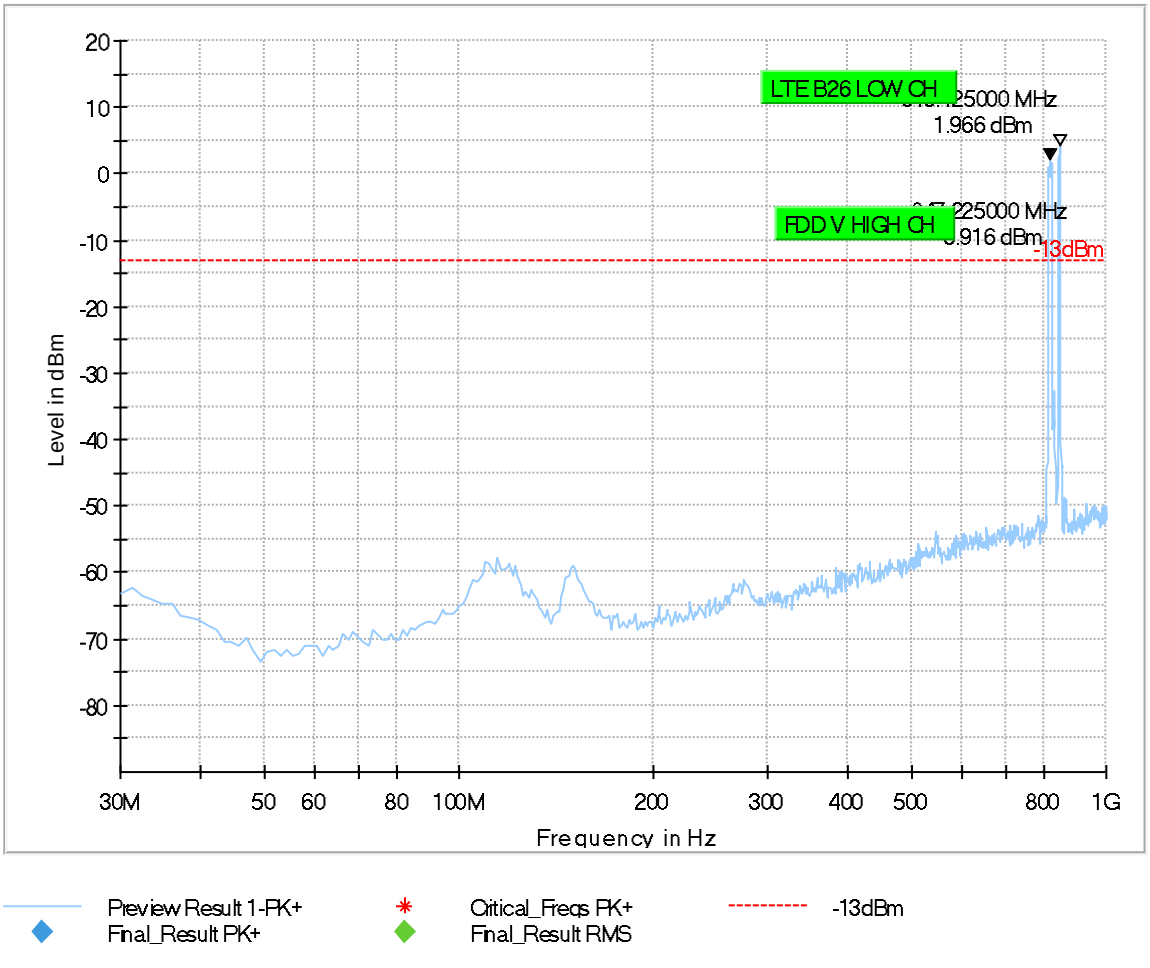
(continuation of the "Final_Result" table from column 16 ...)

Frequency (MHz)	Comment



Plot # 2 Radiated Emissions: 1-3 GHz		
Module 1+2	LTE Band 26 + UMTS Band V	Channel: Low

Final_Result

Frequency (MHz)	MaxPeak (dBm)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
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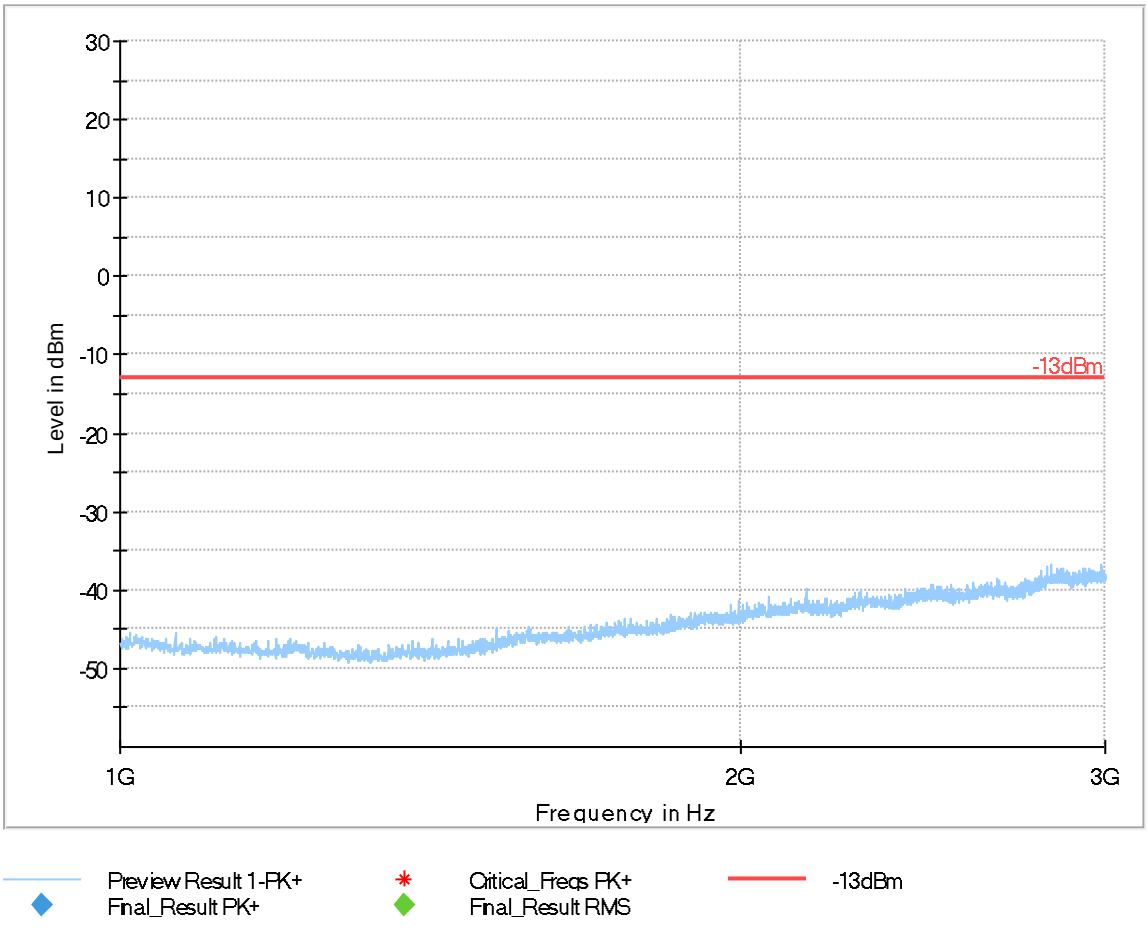
(continuation of the "Final_Result" table from column 16 ...)

Frequency (MHz)	Comment



Plot # 3 Radiated Emissions: 3-18GHz		
Module 1+2	LTE Band 26 + UMTS Band V	Channel: Low

Final_Result

Frequency (MHz)	MaxPeak (dBm)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
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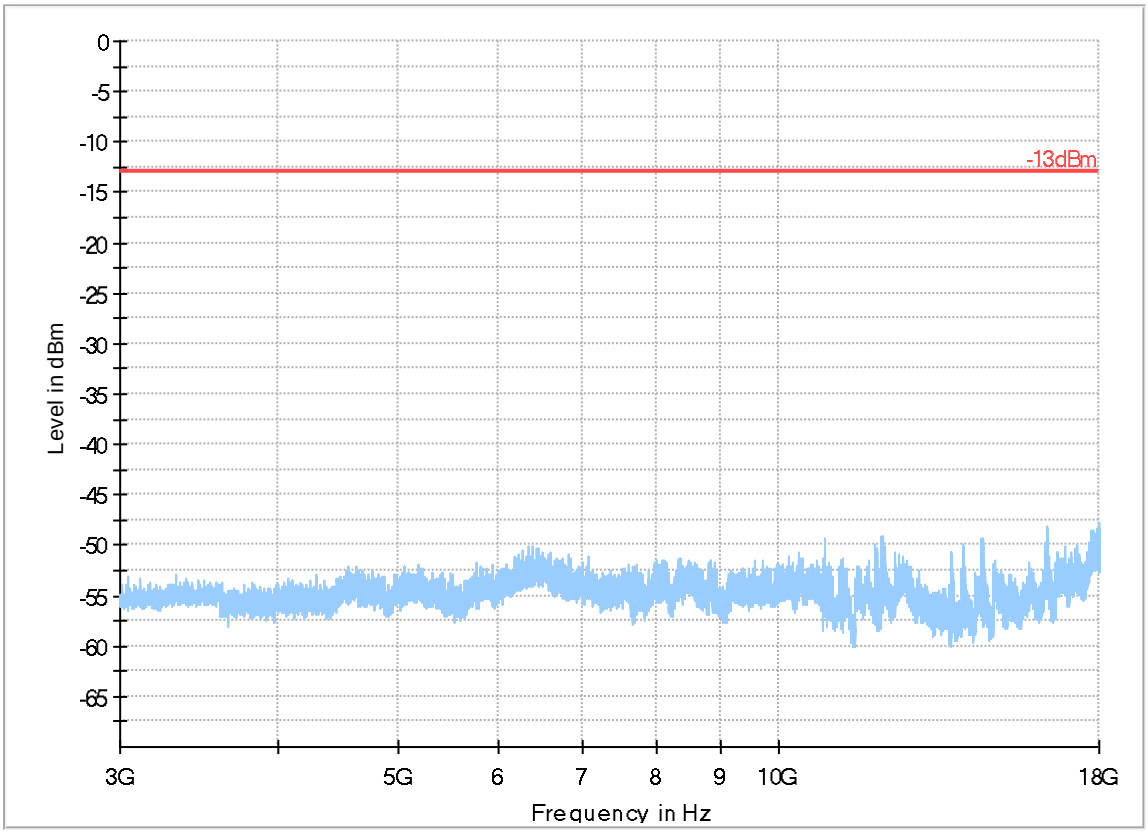
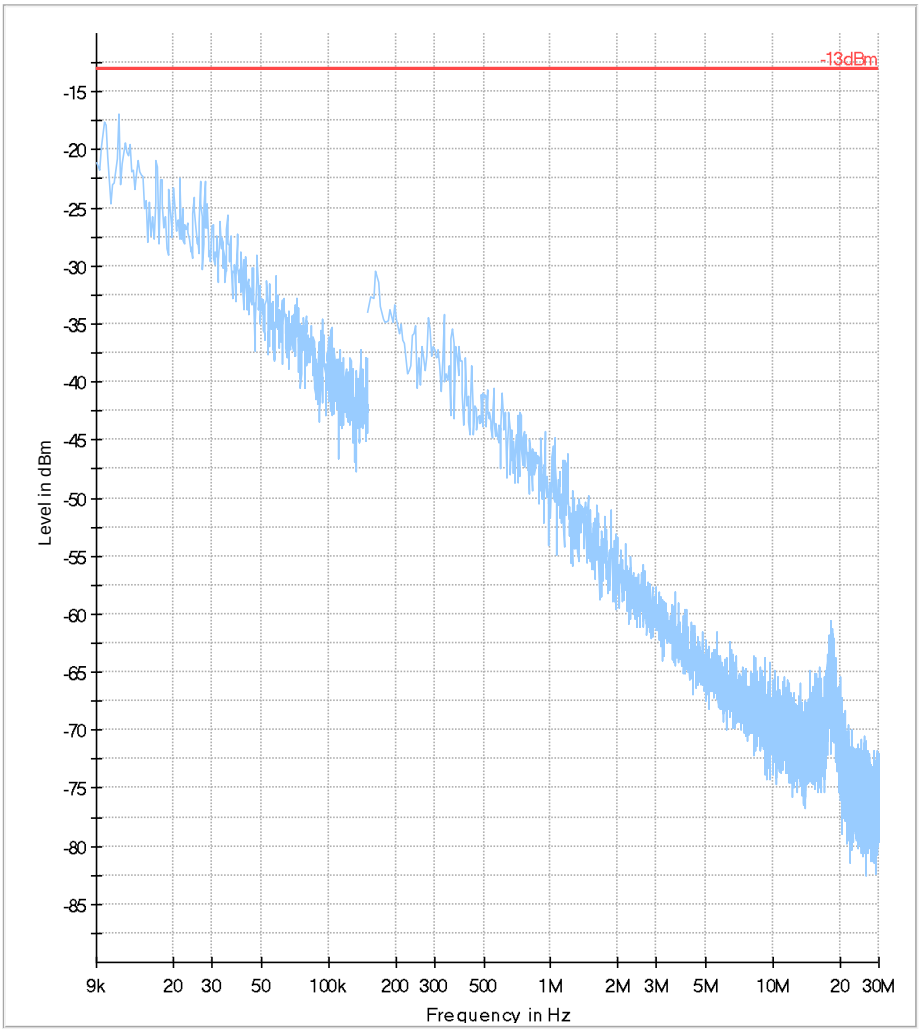
(continuation of the "Final_Result" table from column 16 ...)

Frequency (MHz)	Comment



Plot # 4 Radiated Emissions: 9kHz-30MHz		
Module 1+2	**LTE Band 26 + UMTS Band V**	**Channel: Mid**



Plot # 5 Radiated Emissions: 30-1000MHz		
Module 1+2	LTE Band 26 + UMTS Band V	Channel: Mid

Final_Result

Frequency (MHz)	MaxPeak (dBm)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
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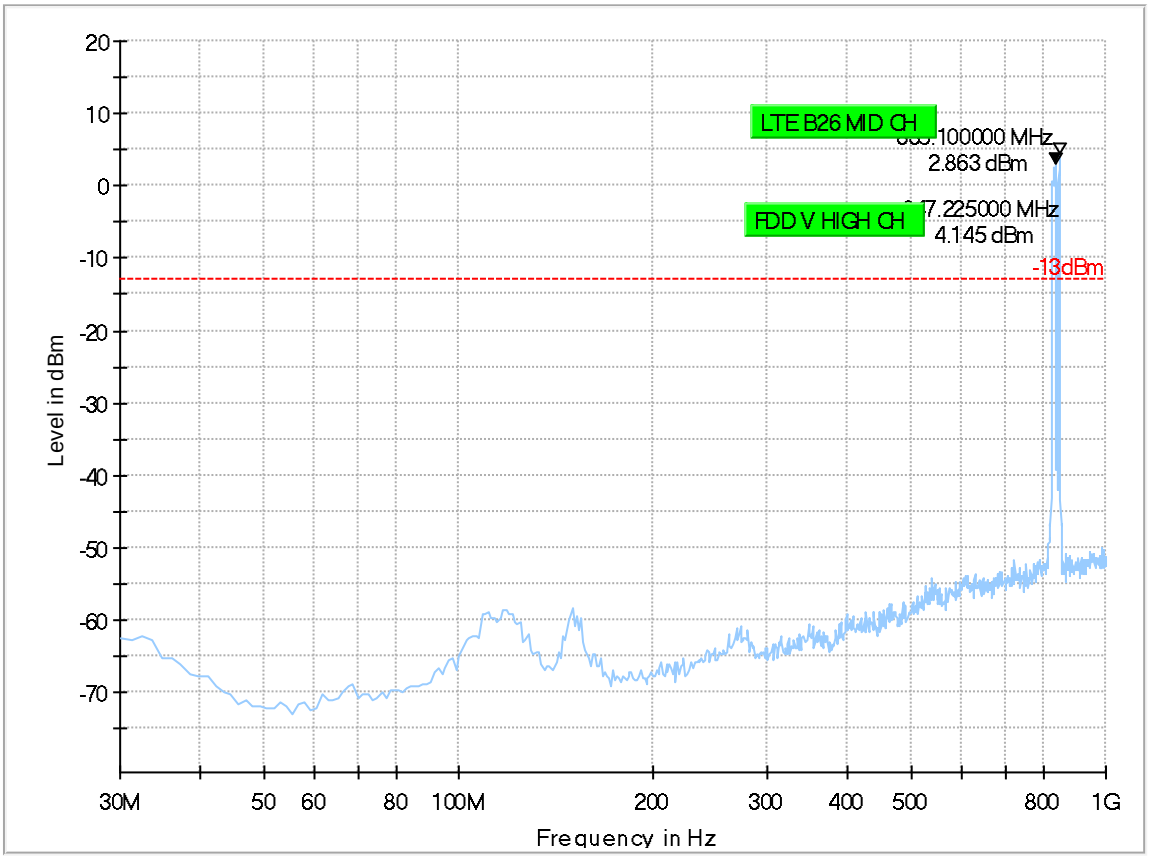
(continuation of the "Final_Result" table from column 16 ...)

Frequency (MHz)	Comment



Plot # 6 Radiated Emissions: 1-3 GHz		
Module 1+2	LTE Band 26 + UMTS Band V	Channel: Mid

Final_Result

Frequency (MHz)	MaxPeak (dBm)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
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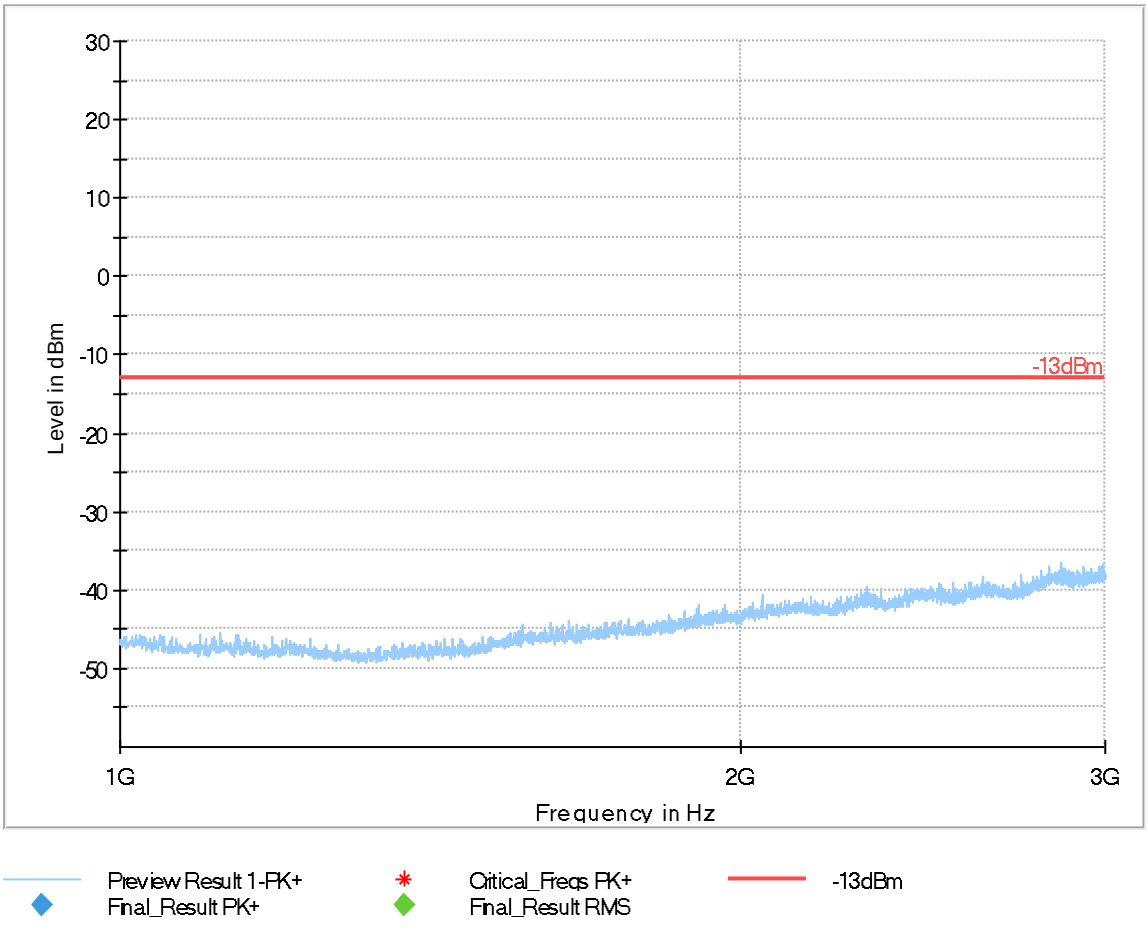
(continuation of the "Final_Result" table from column 16 ...)

Frequency (MHz)	Comment



Plot # 7 Radiated Emissions: 3-18GHz		
Module 1+2	LTE Band 26 + UMTS Band V	Channel: Mid

Final_Result

Frequency (MHz)	MaxPeak (dBm)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
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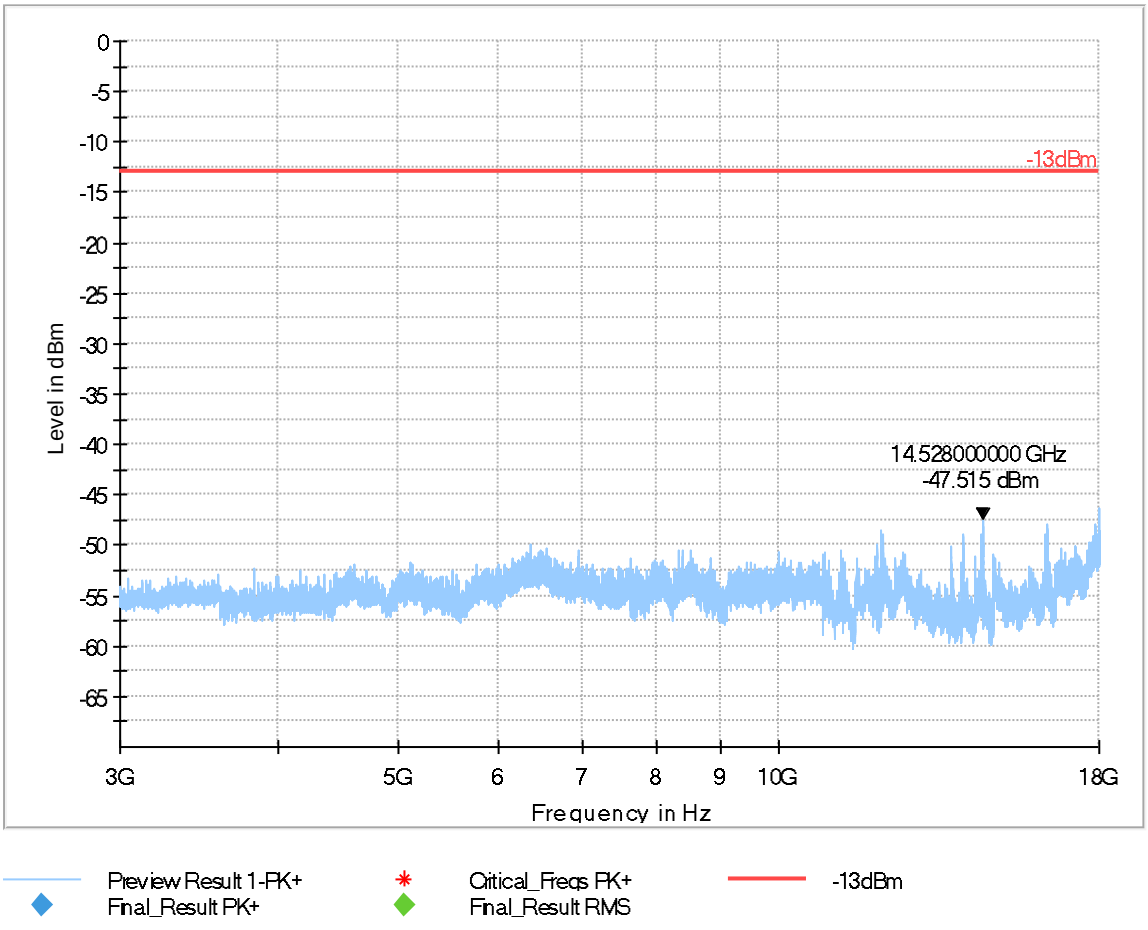
(continuation of the "Final_Result" table from column 16 ...)

Frequency (MHz)	Comment



Plot # 8 Radiated Emissions: 30-1000MHz		
Module 1+2	LTE Band 26 + UMTS Band V	Channel: High

_Result

Frequency (MHz)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
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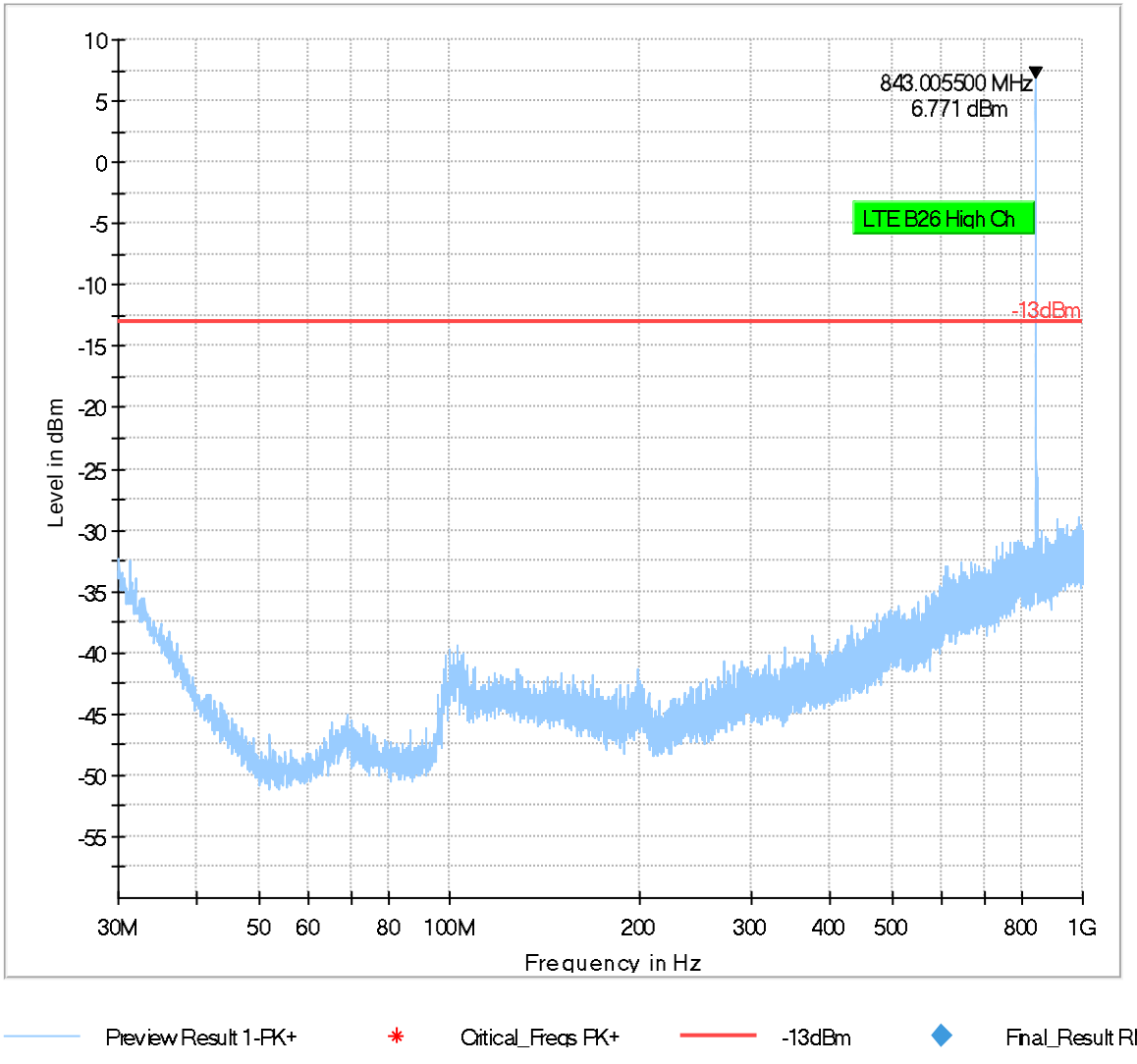


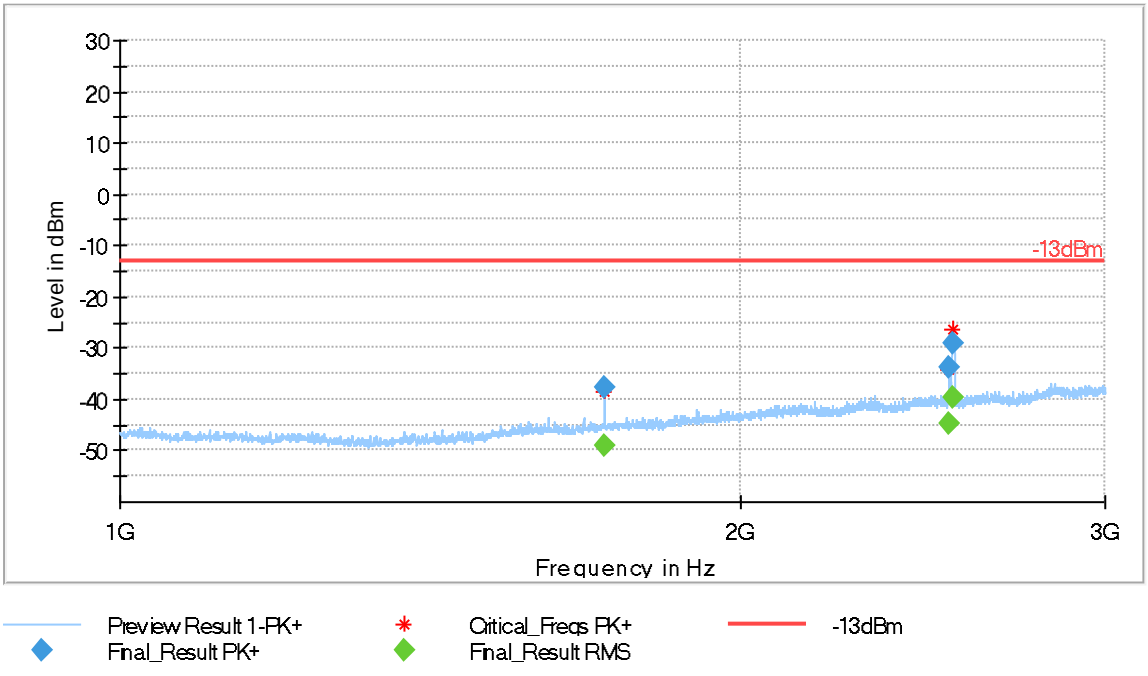
Plot # 9 Radiated Emissions: 1-3 GHz		
Module 1+2	LTE Band 26 + UMTS Band V	Channel: High

Final_Result

Frequency (MHz)	MaxPeak (dBm)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1716.065625	-37.73	---	-13.00	24.73	100.0	1000.000	270.0	V	285.0	-62.8
1716.065625	---	-48.96	---	---	100.0	1000.000	270.0	V	285.0	-62.8
2520.485625	-33.73	---	-13.00	20.73	100.0	1000.000	233.0	H	43.0	-59.4
2520.485625	---	-44.88	---	---	100.0	1000.000	233.0	H	43.0	-59.4
2532.803625	---	-39.70	---	---	100.0	1000.000	263.0	V	340.0	-59.4
2532.803625	-29.15	---	-13.00	16.15	100.0	1000.000	263.0	V	340.0	-59.4

(continuation of the "Final_Result" table from column 16 ...)

Frequency (MHz)	Comment
1716.065625	3:33:22 PM - 4/9/2019
1716.065625	3:33:22 PM - 4/9/2019
2520.485625	3:31:25 PM - 4/9/2019
2520.485625	3:31:25 PM - 4/9/2019
2532.803625	3:35:10 PM - 4/9/2019
2532.803625	3:35:10 PM - 4/9/2019



Plot # 10 Radiated Emissions: 3-18GHz		
Module 1+2	LTE Band 26 + UMTS Band V	Channel: High

Final_Result

Frequency (MHz)	MaxPeak (dBm)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
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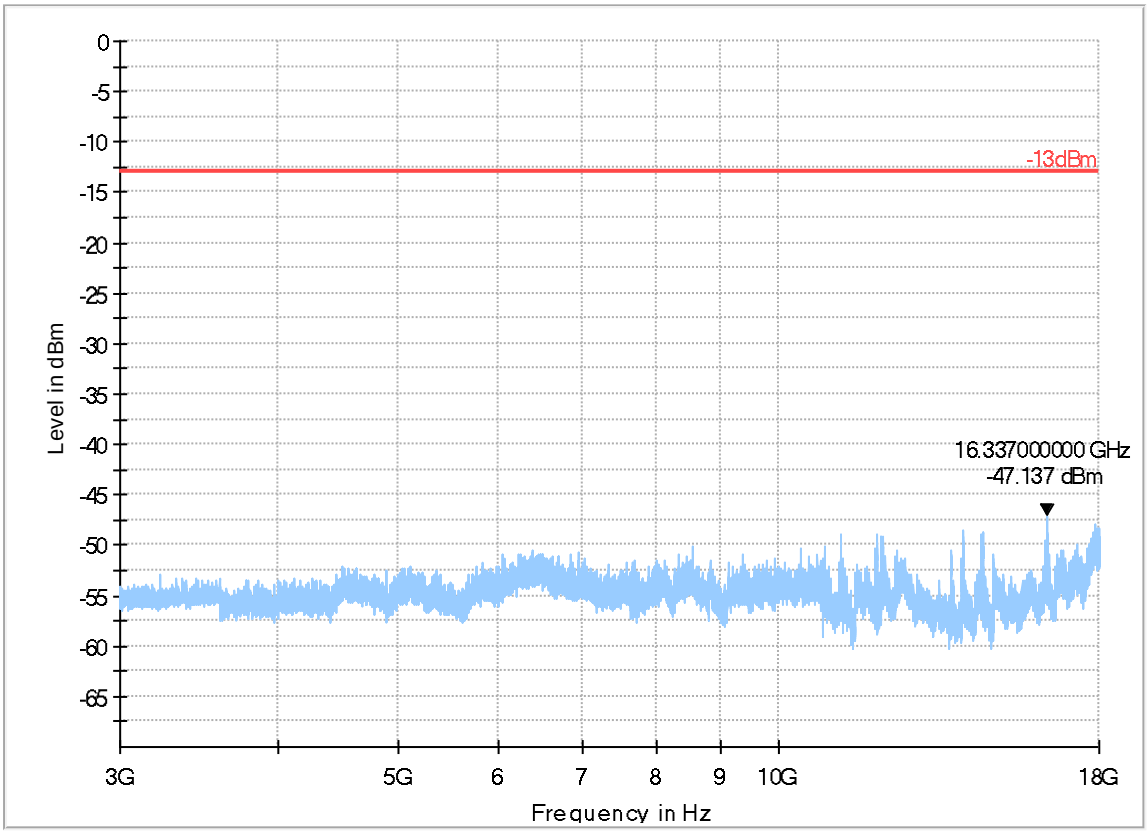
(continuation of the "Final_Result" table from column 16 ...)

Frequency (MHz)	Comment



Plot # 11 Radiated Emissions: 30-1000MHz		
Module 2+3	LTE Band 26 + UMTS Band V	Channel: Low

Final_Result

Frequency (MHz)	MaxPeak (dBm)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
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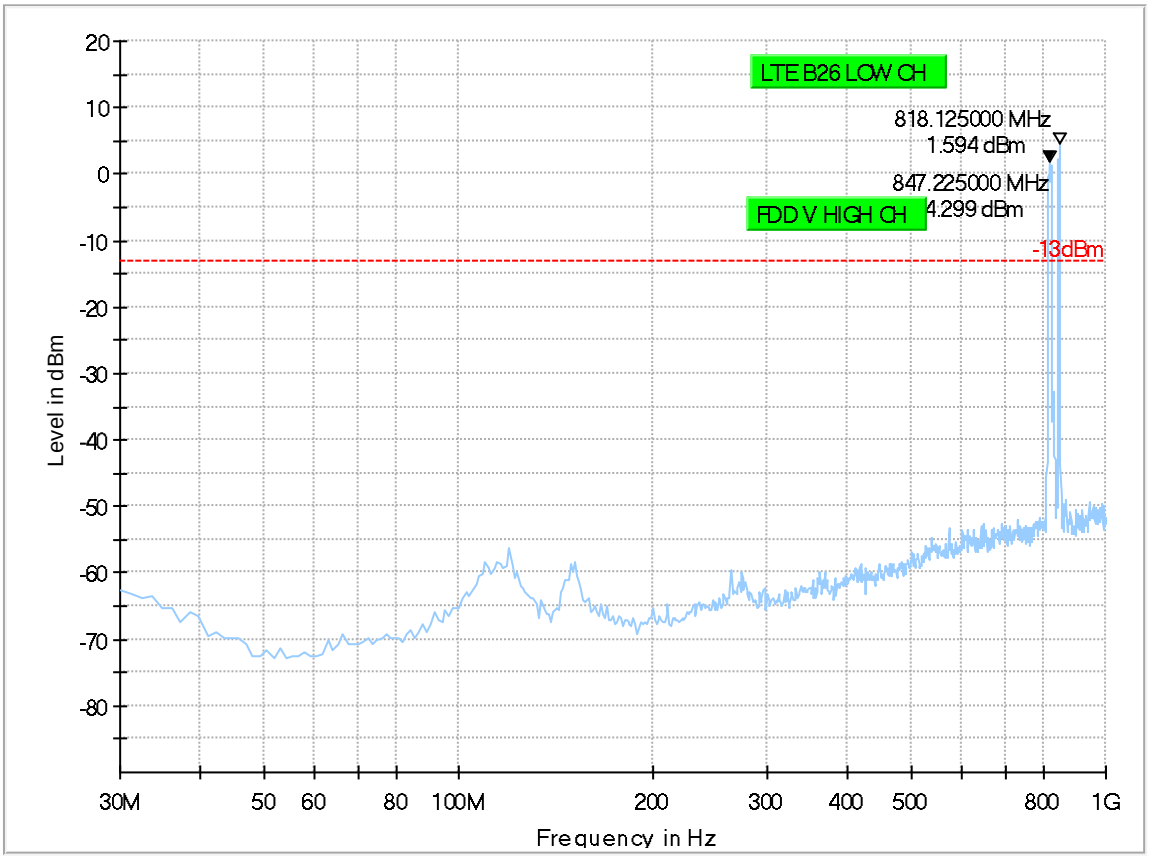
(continuation of the "Final_Result" table from column 16 ...)

Frequency (MHz)	Comment



Plot # 12 Radiated Emissions: 1-3 GHz		
Module 2+3	LTE Band 26 + UMTS Band V	Channel: Low

Final_Result

Frequency (MHz)	MaxPeak (dBm)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
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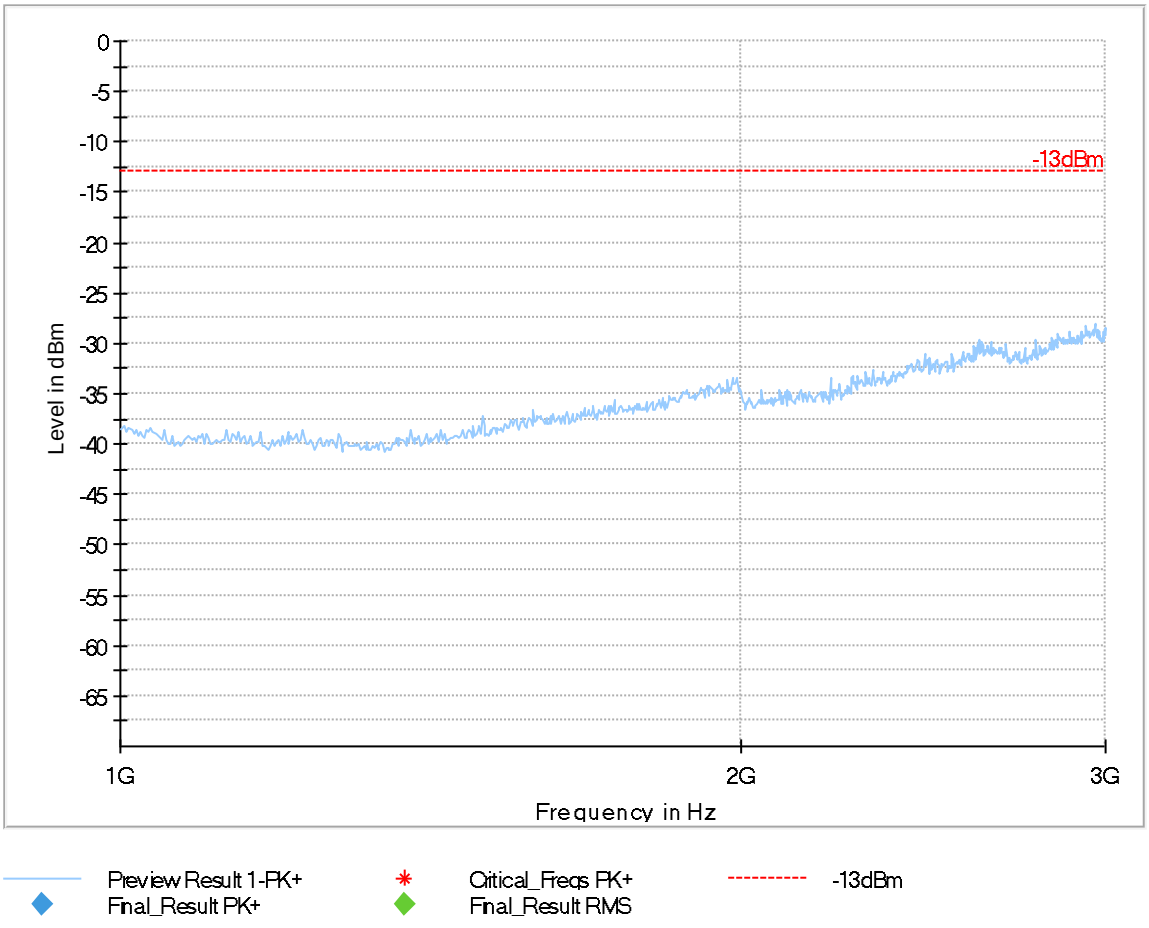
(continuation of the "Final_Result" table from column 16 ...)

Frequency (MHz)	Comment



Plot # 13 Radiated Emissions: 3-18GHz		
Module 2+3	LTE Band 26 + UMTS Band V	Channel: Low

Final_Result

Frequency (MHz)	MaxPeak (dBm)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
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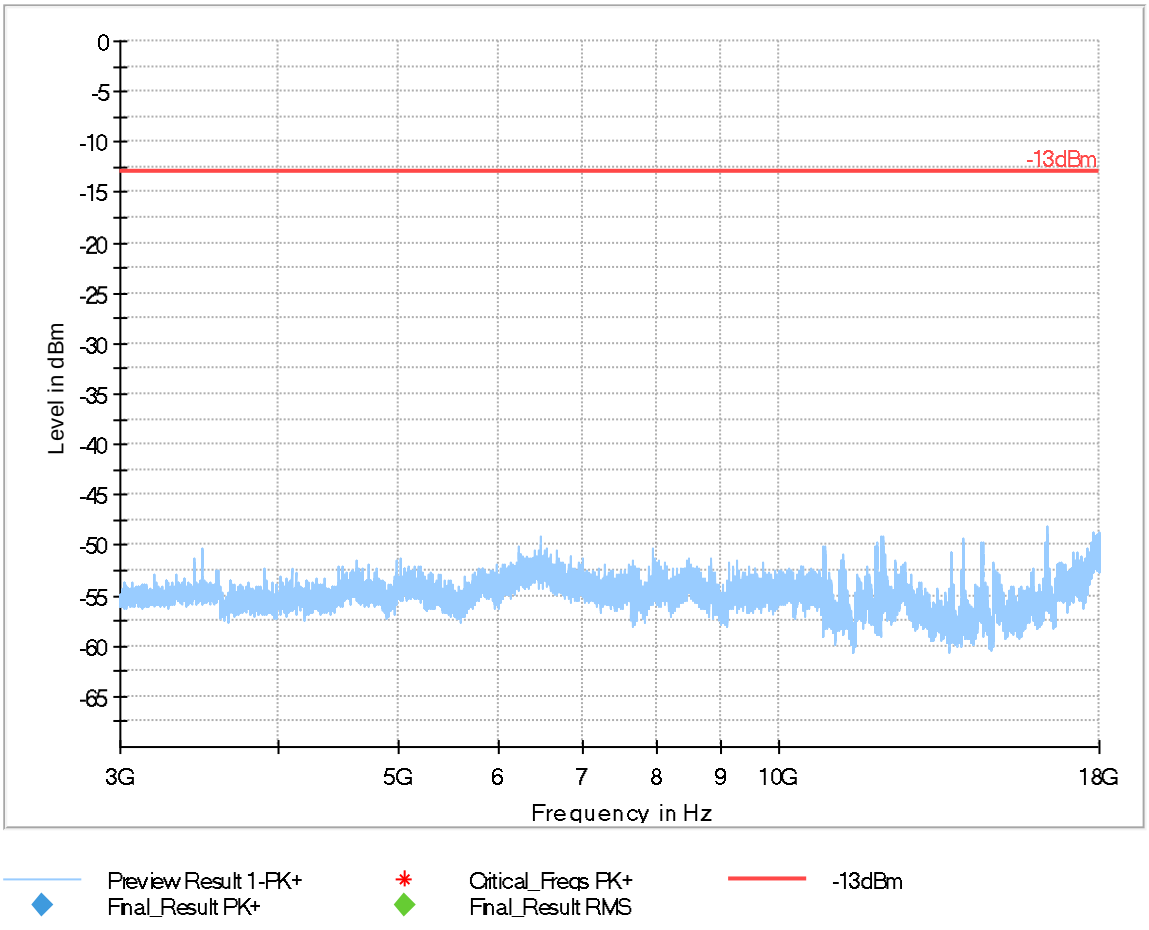
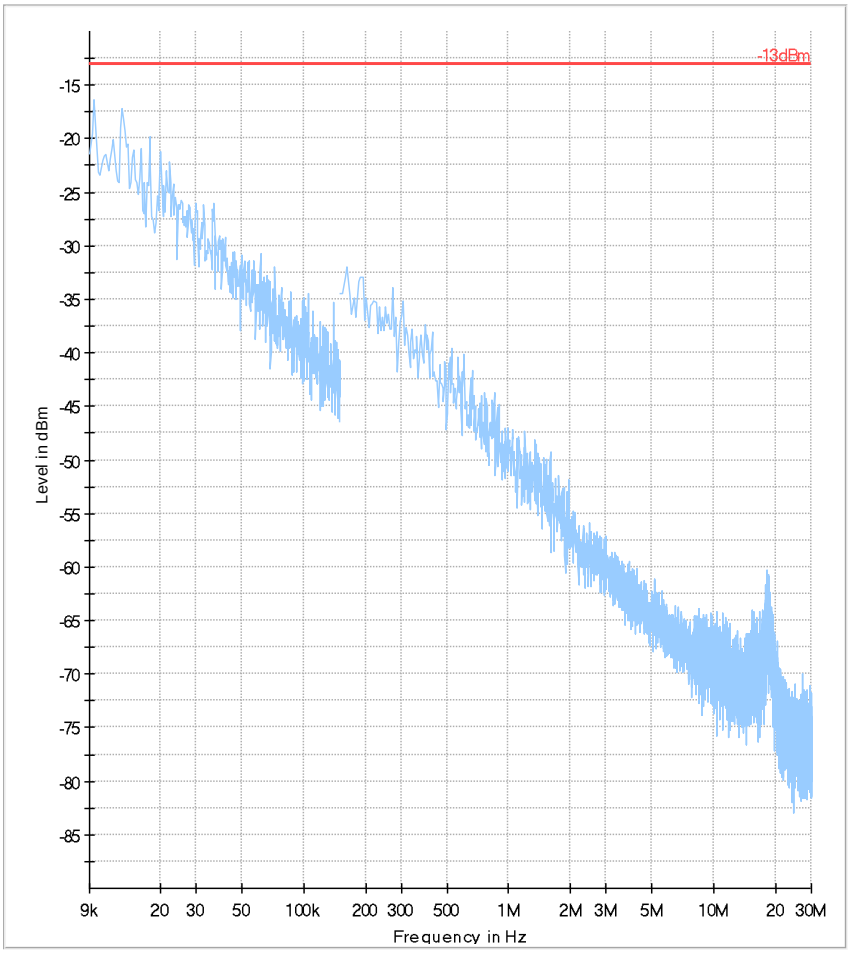
(continuation of the "Final_Result" table from column 16 ...)

Frequency (MHz)	Comment



Plot # 14 Radiated Emissions: 9kHz-30MHz		
Module 2+3	**LTE Band 26 + UMTS Band V**	**Channel: Mid**



Plot # 16 Radiated Emissions: 30-1000MHz		
Module 2+3	LTE Band 26 + UMTS Band V	Channel: Mid

Final_Result

Frequency (MHz)	MaxPeak (dBm)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
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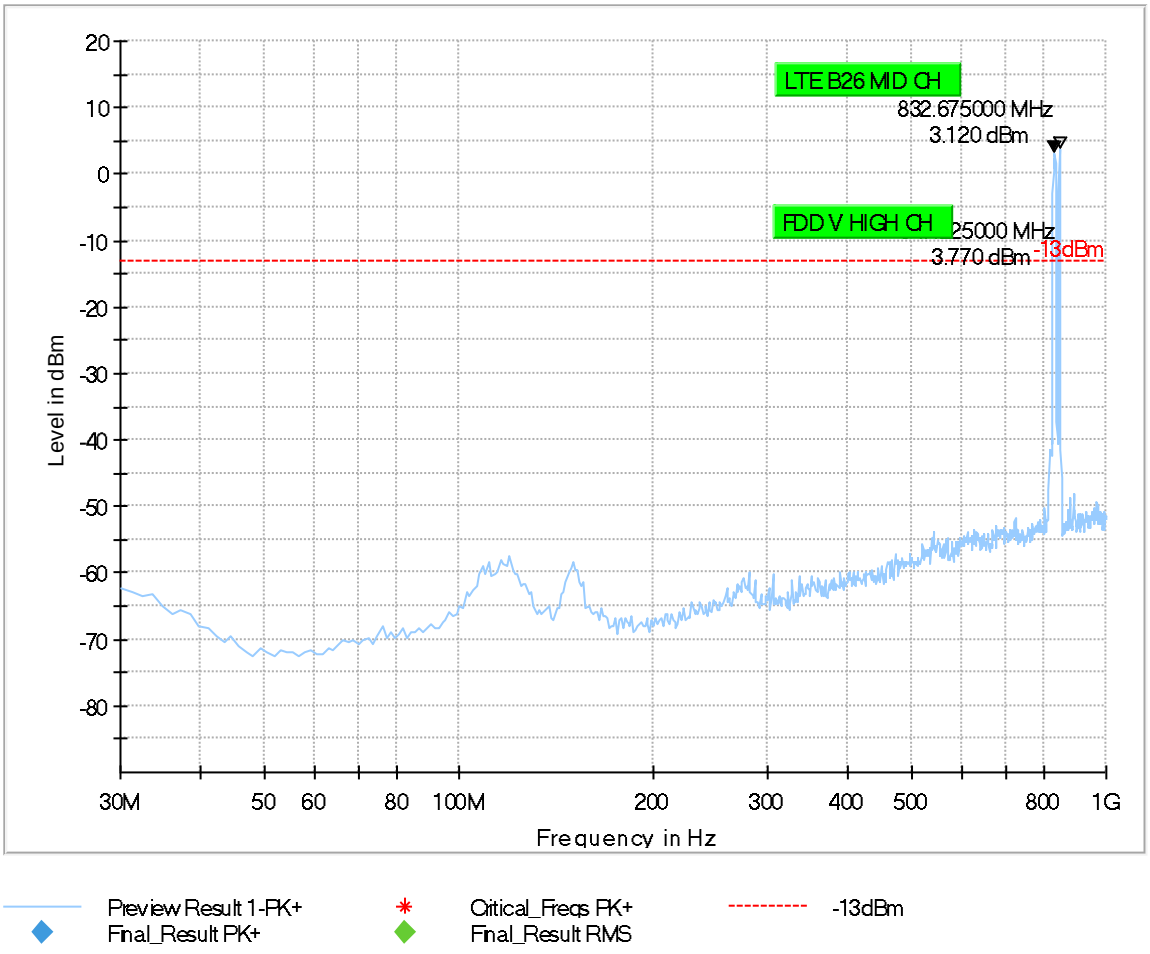
(continuation of the "Final_Result" table from column 16 ...)

Frequency (MHz)	Comment



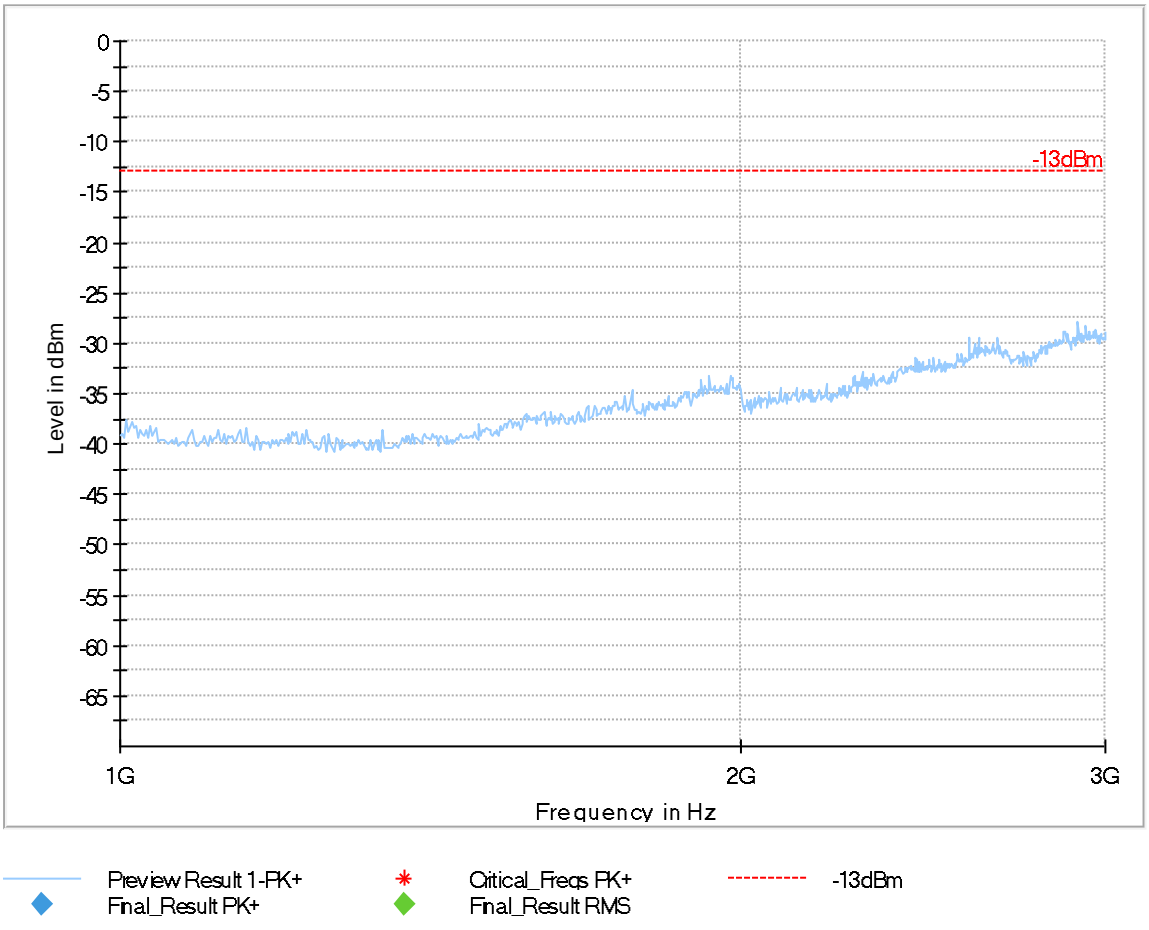
Plot # 17 Radiated Emissions: 1-3 GHz		
Module 2+3	LTE Band 26 + UMTS Band V	Channel: Mid

Final_Result

Frequency (MHz)	MaxPeak (dBm)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
---	---	---	---	---	---	---	---		---	---

(continuation of the "Final_Result" table from column 16 ...)

Frequency (MHz)	Comment



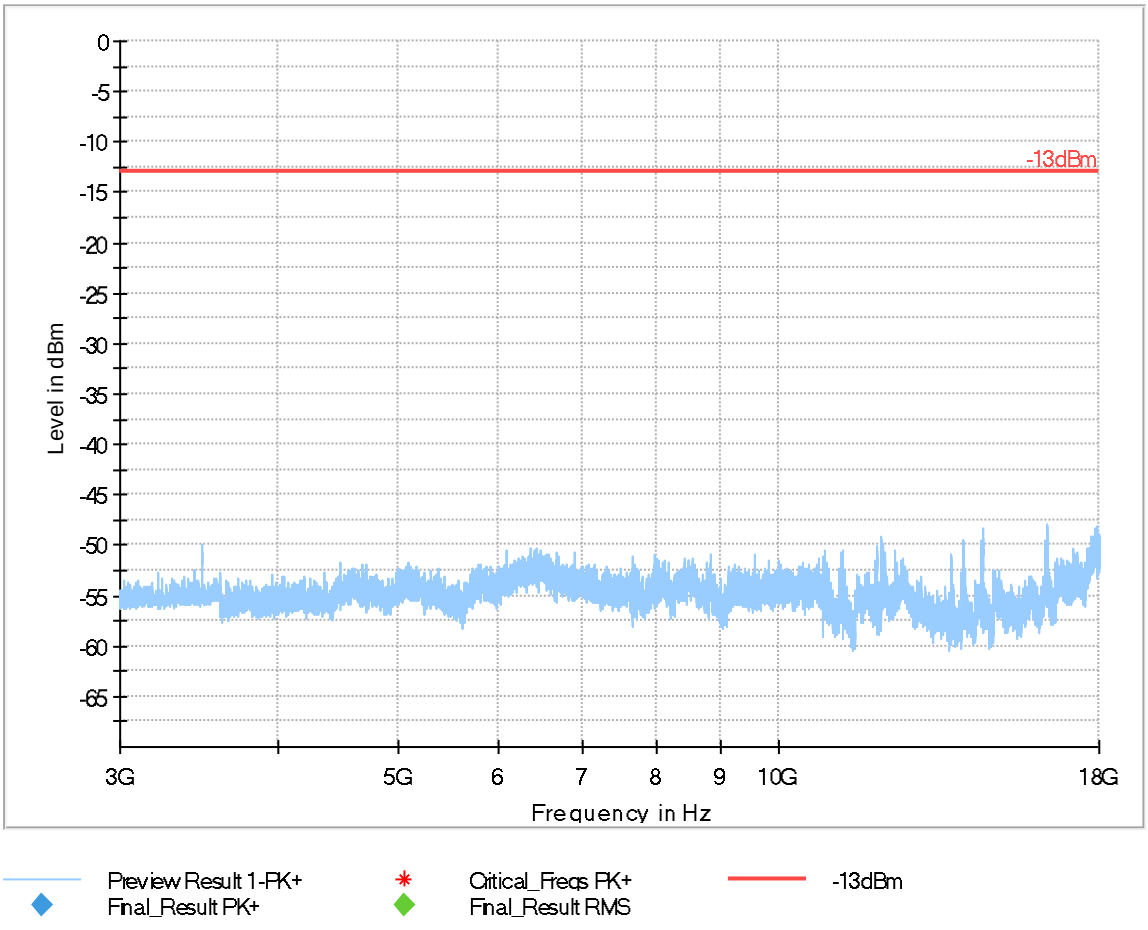
Plot # 18 Radiated Emissions: 3-18GHz		
Module 2+3	LTE Band 26 + UMTS Band V	Channel: Mid

Final_Result

Frequency (MHz)	MaxPeak (dBm)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
---	---	---	---	---	---	---	---		---	---

(continuation of the "Final_Result" table from column 16 ...)

Frequency (MHz)	Comment



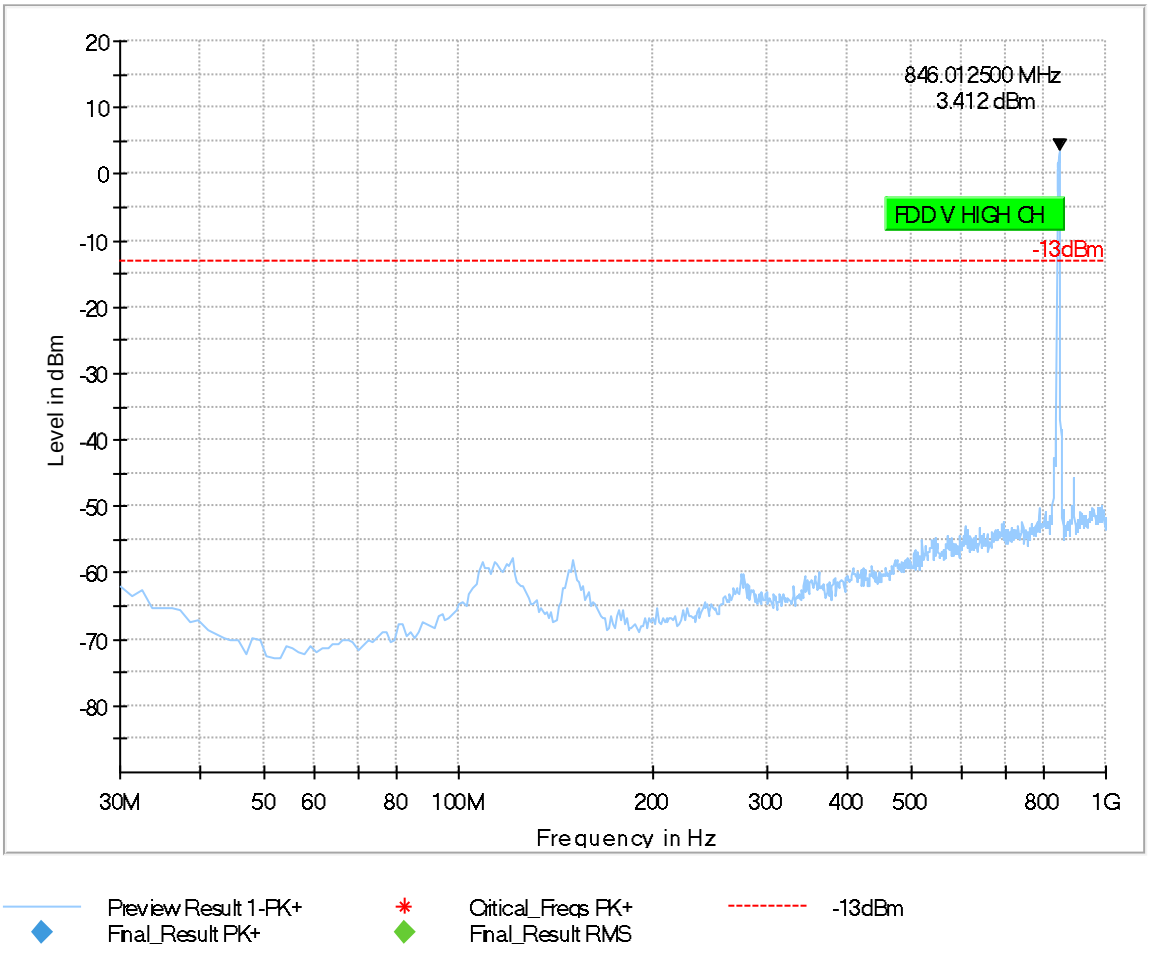
Plot # 20 Radiated Emissions: 30-1000MHz		
Module 2+3	LTE Band 26 + UMTS Band V	Channel: High

Final_Result

Frequency (MHz)	MaxPeak (dBm)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
---	---	---	---	---	---	---	---		---	---

(continuation of the "Final_Result" table from column 16 ...)

Frequency (MHz)	Comment



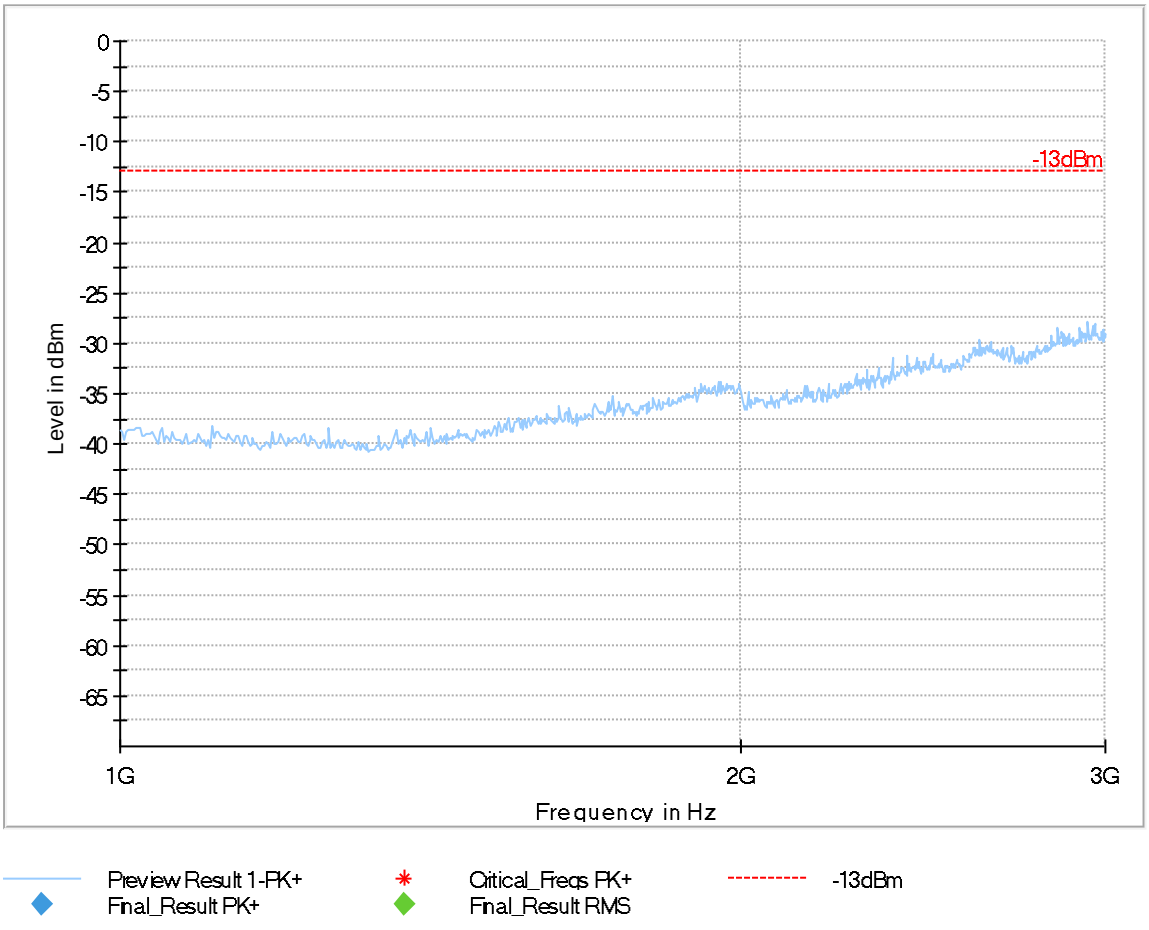
Plot # 21 Radiated Emissions: 1-3 GHz		
Module 2+3	LTE Band 26 + UMTS Band V	Channel: High

Final_Result

Frequency (MHz)	MaxPeak (dBm)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
---	---	---	---	---	---	---	---		---	---

(continuation of the "Final_Result" table from column 16 ...)

Frequency (MHz)	Comment



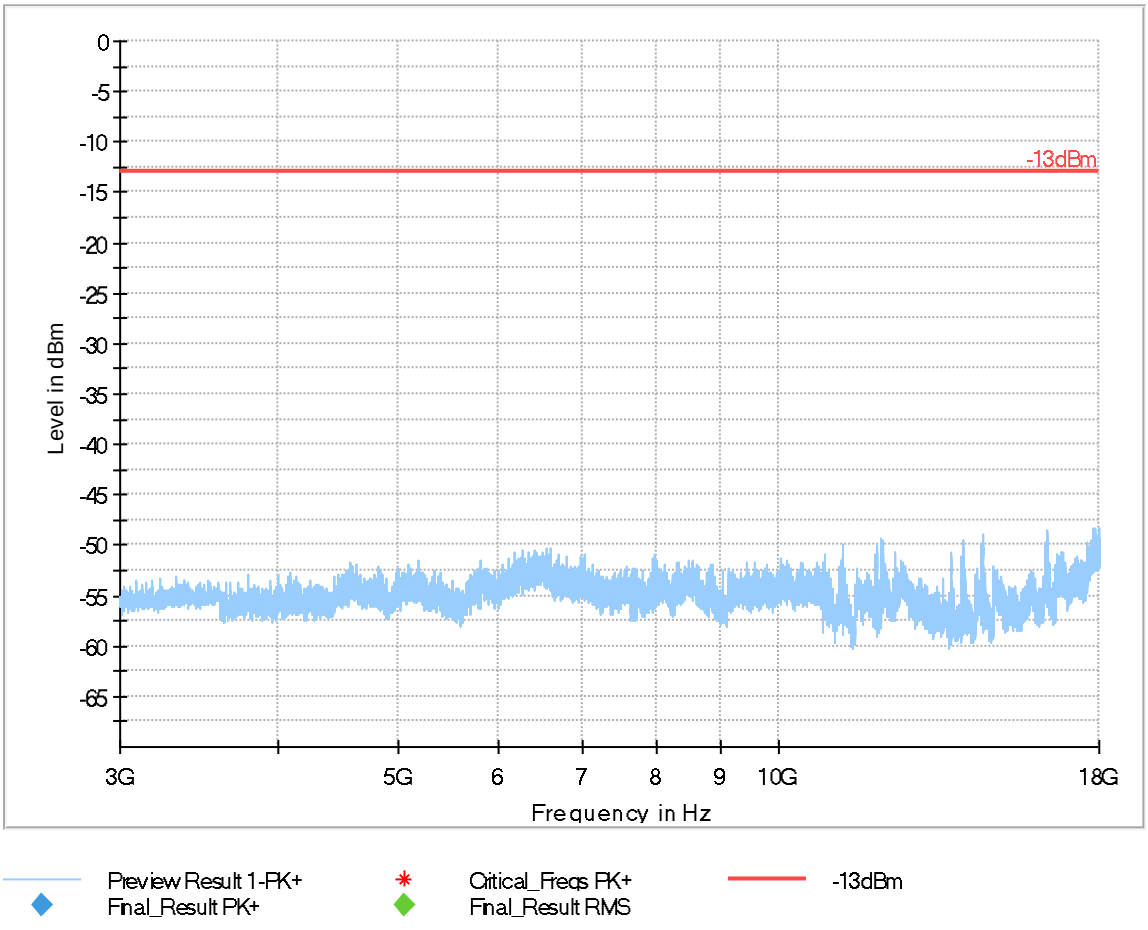
Plot # 23 Radiated Emissions: 3-18GHz		
Module 2+3	LTE Band 26 + UMTS Band V	Channel: High

Final_Result

Frequency (MHz)	MaxPeak (dBm)	RMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
---	---	---	---	---	---	---	---		---	---

(continuation of the "Final_Result" table from column 16 ...)

Frequency (MHz)	Comment



8 Test setup photos

Setup photos are included in supporting file name: “EMC_TELED-009-19001_FCC_Setup_photos.pdf”

9 Test Equipment And Ancillaries Used For Testing

Item Name	Equipment Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
Antenna Loop 6507	Active Loop Antenna	ETS Lindgren	6507	161344	3 years	10/26/2017
Antenna Biconilog 3142E	Biconlog Antenna	EMCO	3142E	166067	3 years	06/27/2017
Antenna Horn 3115 SN 35114	Horn Antenna	EMCO	3115	35114	3 years	07/31/2017
Antenna Horn 3117	Horn Antenna	ETS Lindgren	3117-PA	215984	3 years	01/26/2018
Antenna Horn 3116	Horn Antenna	ETS Lindgren	3116	70497	3 years	10/31/2017
EMI Test Receiver	EMI Test Receiver	Rohde & Schwarz	ESU40	100251	3 years	01/31/2018
Digital Barometer	Compact Digital Barometer	Control Company	35519-055	91119547	3 Years	06/08/2017
CMU 200	Digital Radio Comm. Tester	R&S	CMU 200	101821	2 Years	07/06/2017
CMW 500	Base Station Simulator	R&S	CMW 500	127068	2 Years	07/01/2017
Thermometer	THERMOMETER HUMIDITY MONITOR	CONTROL COMPANY	36934-164	191871994	2 Years	01/10/2019
Turn table	Turn table	EMCO	2075	N/A	N/A	N/A
MAPS Position Controller	MAPS Position Controller	ETS Lindgren	2092	0004-1510	N/A	N/A
Antenna Mast	Antenna Mast	EMCO	2075	N/A	N/A	N/A
Relay Switch Unit	Relay Switch Unit	R&S	RSU	338964/001	N/A	N/A

Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels.
Calibration due dates, unless defined specifically, falls on the last day of the month. Items indicated “N/A” for cal status either do not specifically require calibration or is internally characterized before use.

10 Revision History

Date	Report Name	Changes to report	Report prepared by
2019-04-26	EMC_TELED-009-19001_FCC_90	Initial Version	Kevin Wang