FCC/IC Test Report

FOR:

iRhythm Technologies, Inc.

Model Name:

A102A5001

Product Description:

Zio AT ECG Gateway

FCC ID: 2AFBP-AT17G
IC ID: N/A

Per:
47 CFR: Part 22, Part 24, Part 15.247
RSS-132 Issue 3, RSS-133 Issue 6, RSS-247 Issue 1

Report #:
EMC-IRHYT-007-17001_RADIATED_EMISSION_GATEWAY

Date:
May 09, 2017

***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 parts 22, 24, and relevant ISED standards RSS-132 Issue 3, RSS-133 Issue 6.

No deviations from the limits were ascertained.

Company Name	Product Description	Model #
iRhythm Technologies, Inc.	Zio AT ECG Gateway	A102A5001

Review:

Date	Section	Name	Signature
May 09, 2017	RC&E	Dr. Peter Nevermann (Director RC&E)	Digitally signed by CETECOMCA1 \PNevermann DN: cn=CETECOMCA1 \PNevermann Date: 2017.05.11 10:15:22 -07'00'

Responsible for evaluation and report:

Date	Section	Name	Signature
May 09, 2017	RC&E	Cindy Li (EMC Engineer)	Cindy Li Digitally signed by Cindy Li DN: cn=Cindy Li, o=Cetecom.inc., ou, email=cindy.li@cetecom.com, c=US Date: 2017.05.11 10:13:48 -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
Compliance Manager:	Peter Nevermann
Project Engineer:	Cindy Li

2.2 Identification of the Client

Applicant's Name:	iRhythm Technologies, Inc.
Street Address:	650 Townsend St # 500
City/Zip Code	San Francisco, CA 94103
Country	USA
Contact Person:	Matt Ho, Chase Hathaway

2.3 Identification of the Manufacturer

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

3. Equipment under Test (EUT)

3.1 EUT Specifications

Model No:	A102A5001
HW Version :	K102A6001.03
SW Version :	Application firmware: 170426 Gateway EFM32GG290 Production 2.1.4.4 Release. hex BLE firmware: 160914 Gateway CC2541 Production 2.1.1.3.hex
FCC-ID :	2AFBP-AT17G
IC-ID:	N/A
HVIN:	N/A
PMN:	N/A
Product Description:	Zio AT ECG Gateway, based on BTLE module: LSR TiWi-uB1, FCC ID: TFB-BT2 CDMA / 1xRTT module: Telit CE910, FCC ID: R17CE910-DUAL
Frequency Range / number of channels:	BTLE: 2402 MHz – 2480 MHz, 40 channels CDMA BC0: 815 MHz – 849 MHz CDMA BC1: 1850 MHz – 1910 MHz
Type(s) of Modulation:	BTLE: GFSK modulation. CDMA: Direct Sequence Spread Spectrum
Modes of Operation:	BTLE and CDMA co-transmit
Antenna Information:	BTLE: PCB trace antenna internal to module CDMA/1xRTT: Taoglas PA.25a ceramic broadband with max gain 1.8dBi in BC0 and 2.5dBi in BC1
Max. declared (operational description) Output Powers conducted:	CDMA / 1xRTT: 27dBm BTLE: 0dBm
Power Supply/ Rated Operating Voltage Range:	1 Lithium Polymer Cell (3.5V - 4.2V)
Operating Temperature Range	5 to 40 degrees C
Other Radios included in the device:	Report already focused on evaluating simultaneous transmission of CDMA and BTLE.
Sample Revision	■Prototype Unit ☐Production Unit ☐Pre-Production

3.2 EUT Sample details

EUT #	Radio Serial Number	HW Version	SW Version	Antenna cable	Antenna
1	J152001488	K102A6001.03	Application firmware: 170426 Gateway EFM32GG290 Production 2.1.4.4 Release. hex BLE firmware: 160914 Gateway CC2541 Production 2.1.1.3.hex	BTLE: Soldered to the Gateway printed circuit board CDMA/1xRTT: Soldered to the Gateway printed circuit board	BTLE: PCB trace antenna internal to module CDMA/1xRTT: Taoglas PA.25a ceramic broadband with max gain 1.8dBi in BC0 and 2.5dBi in BC1

3.3 Accessory Equipment (AE) details

AE #	Type	Model	Manufacturer	Serial Number
NA	N/A	N/A	N/A	N/A

4. Test Sample Configuration

Set-up #	EUT / AE used for set-up	Measurement	Comments
1	J152001488	Simultaneous transmission radiated emissions	Radiated unit both radios active

5. Subject of Investigations

The objective of the measurements done by CETECOM Inc. was to evaluate the compliance of the device described under 3 against the relevant requirements specified in the Code of Federal Regulations Title 47 parts 22, 24, and relevant ISED standards RSS-132 Issue 3, RSS-133 Issue 6.
This evaluation is intended to support product certification under above FCC ID.

Both radio modules included in the device described under 3.1 have already been certified under the FCC IDs listed in 3.1. This report is focused on verifying the radiated emissions with both radios transmitting simultaneously.

6. Measurement

6.1 Dates of Testing:

April 20, 2017 – May 2, 2017

6.2 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 3000 MHz	±2.0 dB (Biconilog Antenna)
3 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

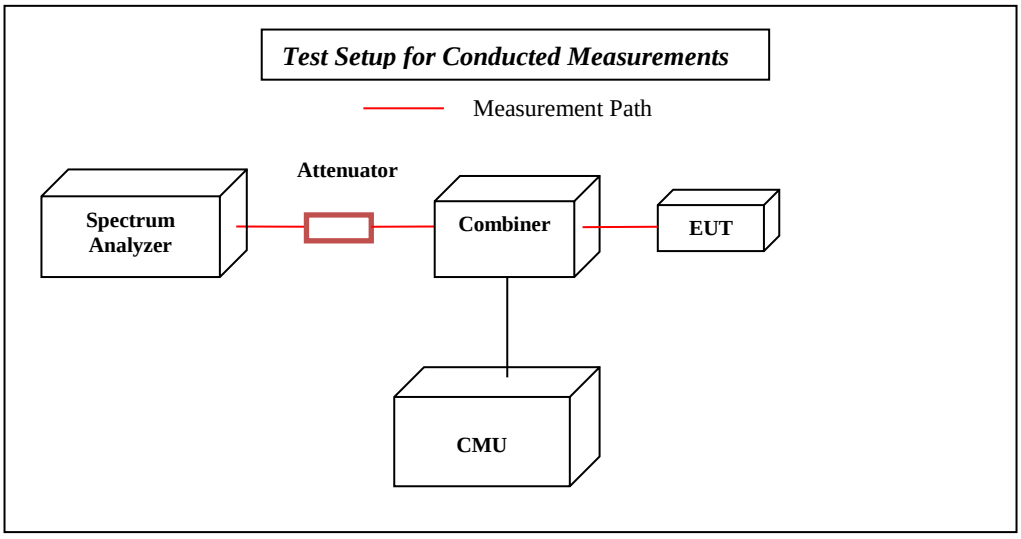
6.3 Environmental Conditions during Testing:

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

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

6.4 Conducted measurement setup

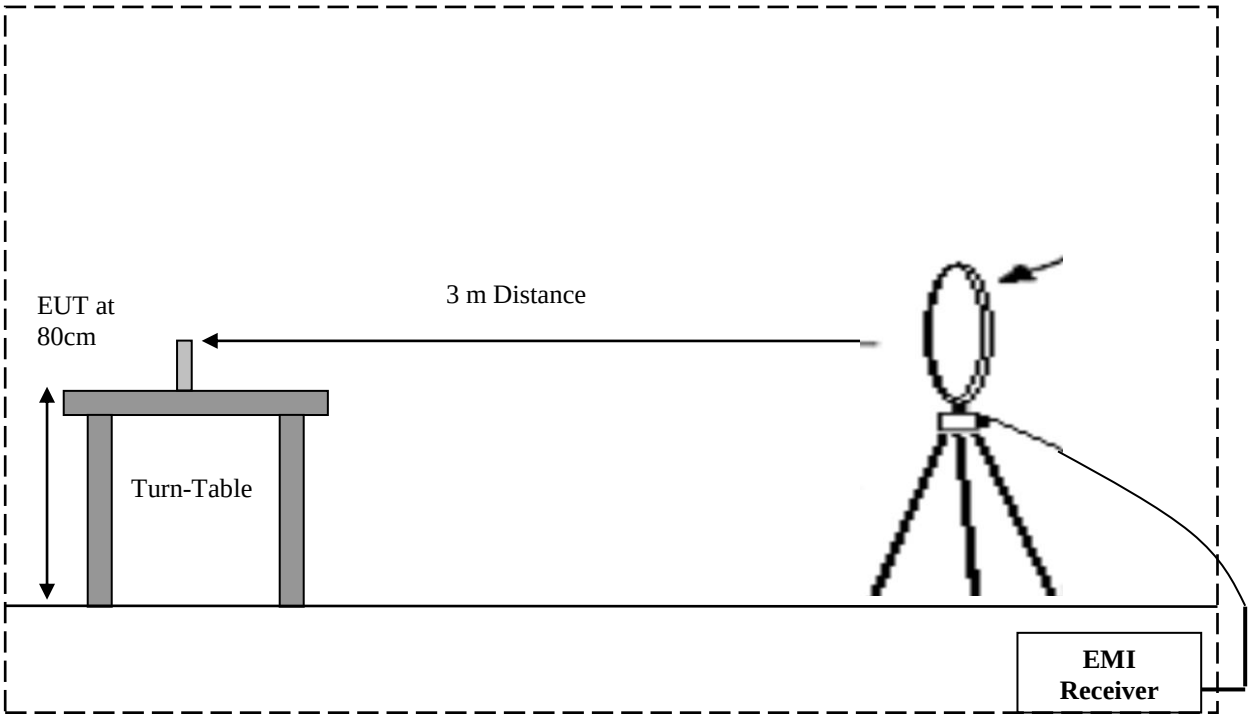
Testing is performed according to the guidelines provided in FCC publication (KDB) 971168 D01 v02r02 – "Measurement Guidance for Certification of Licensed Digital Transmitters" and according to relevant parts of TIA-603C 2004 as detailed below.



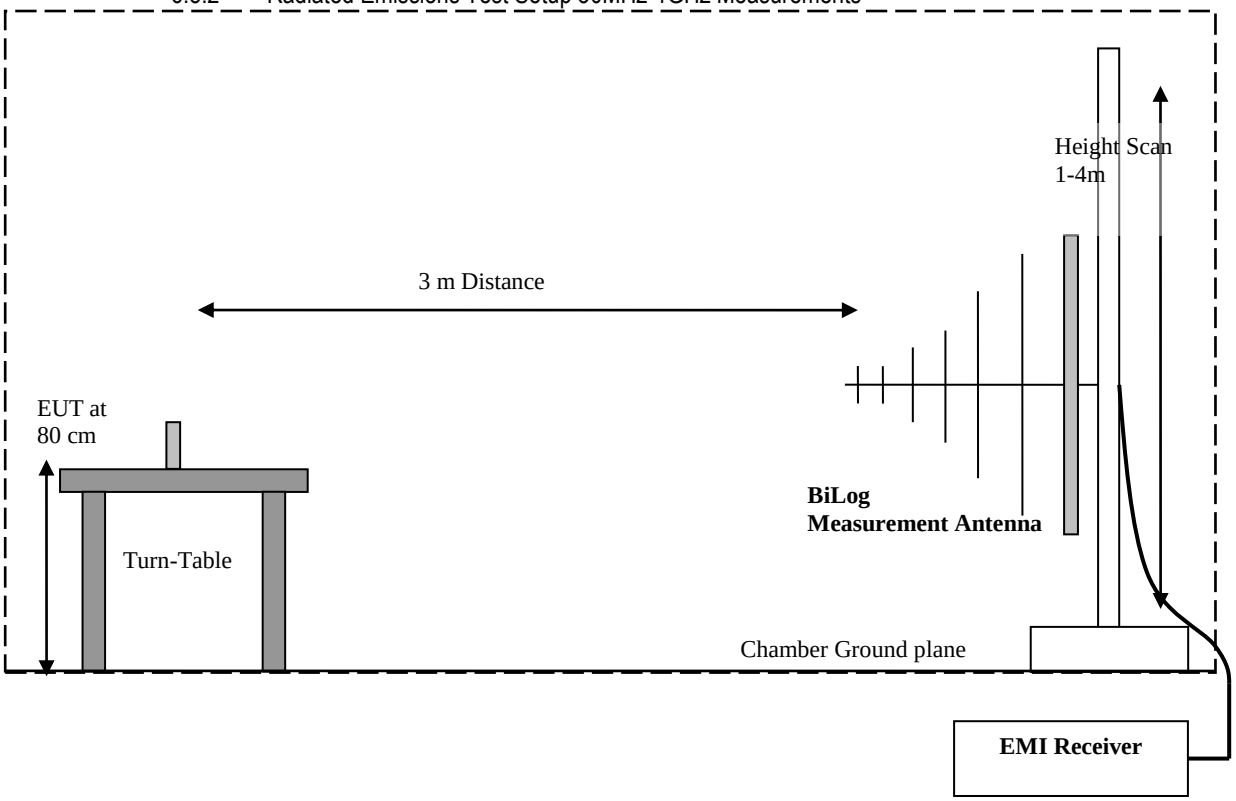
6.5 Radiated Measurement setup

- 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 3 GHz, and two different horn antennas are used to cover frequencies up to 40 GHz.

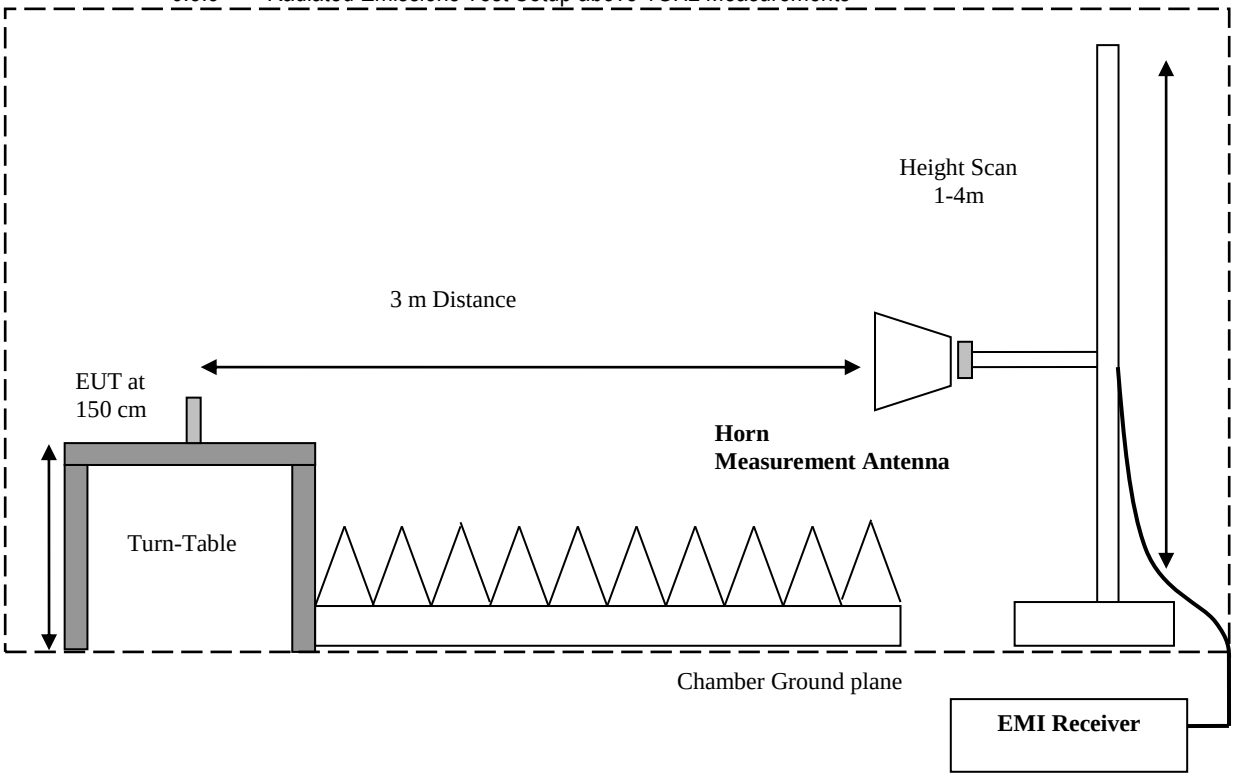
6.5.1 Radiated Emissions Test Setup below 30MHz Measurements



6.5.2 Radiated Emissions Test Setup 30MHz-1GHz Measurements



6.5.3 Radiated Emissions Test Setup above 1GHz Measurements



7 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

8 Measurement Results Summary

8.1 FCC 22,24,RSS-132, RSS-133

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§22.917(a); RSS-132 Issue 3-5.5	Radiated Spurious Emissions BTLE with BC0	Nominal	Low, Mid High channel on BC0 with mid channel BT-LE	■	☐	☐	☐	Complies
§24.238 (a); RSS-133 Issue 6–6.5	Radiated Spurious Emissions BTLE with BC1	Nominal	Low, Mid High channel on BC1 with mid channel BT-LE	■	☐	☐	☐	Complies

Note 1: NA= Not Applicable; NP= Not Performed.

9 Radiated Spurious Emissions

9.1 Reference

Measurement according to KDB 971168 D01 Power Meas License Digital Systems v02r02, and according to TIA-603C 2004- 2.2.12

Spectrum Analyzer Settings

Frequency Range	9kHz – 150kHz	150kHz – 30MHz	30MHz – 1 GHz	1 – 40 GHz
Resolution Bandwidth	200Hz	9kHz	100 kHz	1 MHz
Video Bandwidth	1kHz	30kHz	100 kHz	1 MHz
Detector	Peak	Peak	Peak	Peak
Trace Mode	Max Hold	Max Hold	Max Hold	Max Hold
Sweep Time	Auto	Auto	Auto	Auto

9.2 Limits:

9.2.1 UMTS II, LTE 2, CDMA BC1

FCC Part 24.238 (a)

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.

RSS133- 6.5.1

Equipment shall comply with the limits in (i) and (ii) below.

In the 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 $\log_{10}$p(watts).

After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 $\log_{10}$p(watts). If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required.

EIRP Limit -13dBm

9.2.2 UMTS V, LTE 5, CDMA BC0

FCC Part 22.917 (a)

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.

RSS-132 - 5.5

Mobile and base station equipment shall comply with the limits in (i) and (ii) below.

In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10p (watts).

After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10 p (watts). If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

EIRP Limit -13dBm

9.3 Test plan

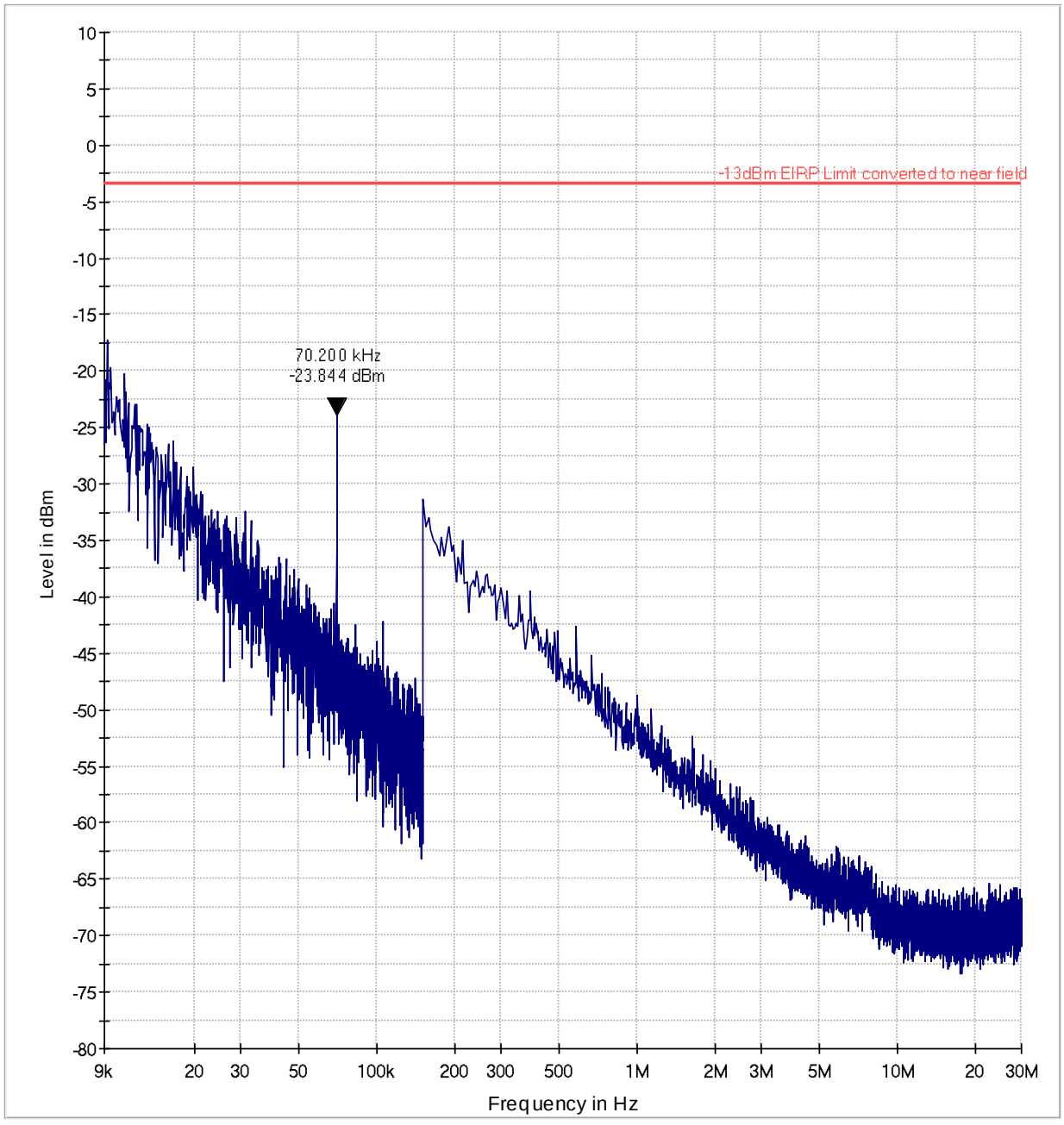
CDMA power setting set to all bits up to provide maximum output power.
BTLE set to maximum supported power of 0dBm
Both radios were transmitting simultaneously.
CDMA iterated through Low Mid High and BTLE remained on Mid channel as CDMA powers are 30dB higher than BTLE powers.

9.4 Summary Measurement result:

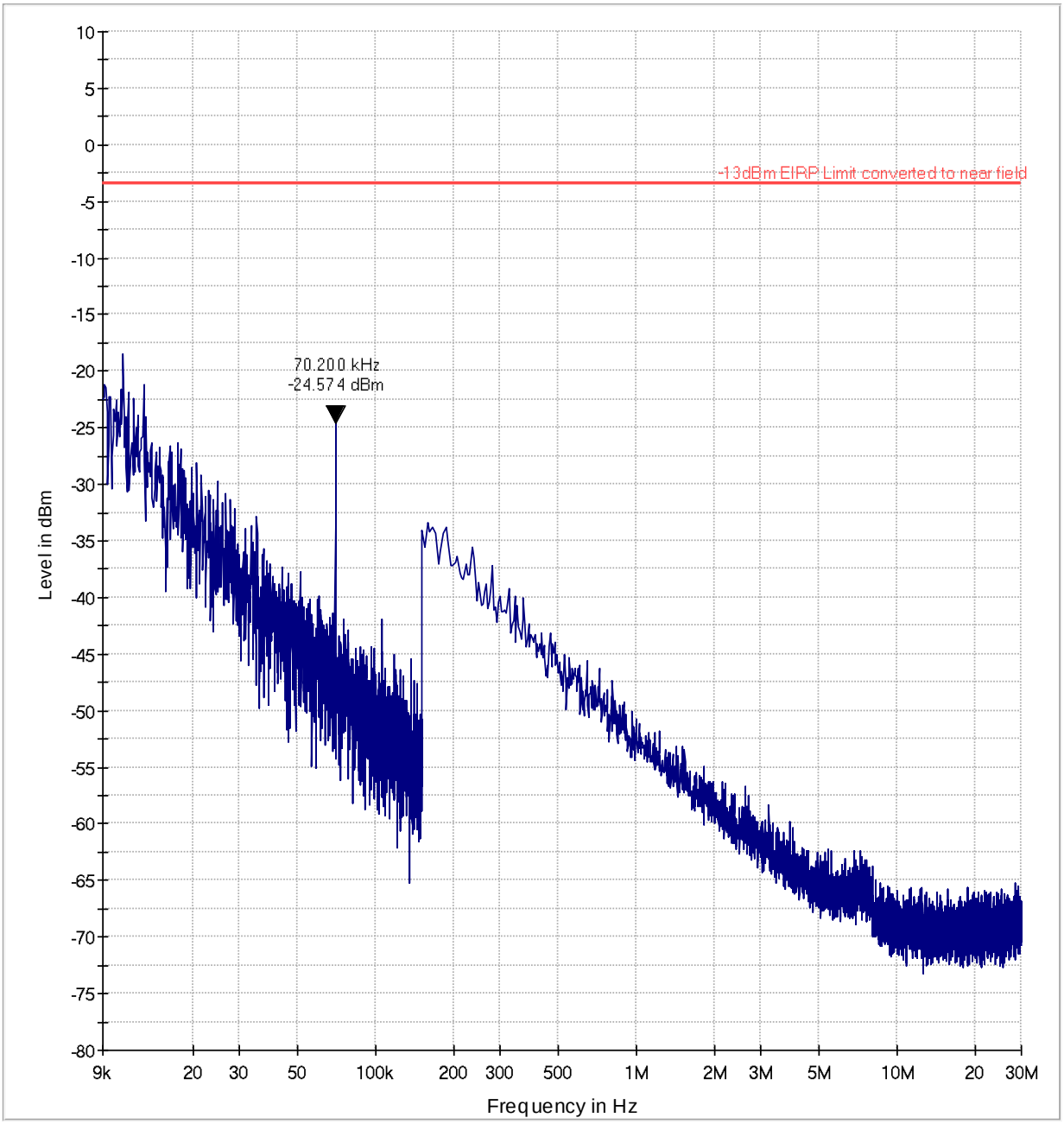
Channel	EUT Operating Mode	Scan Frequency	Limit [dBm] converted to 3m	Result	Frequency of highest emission [MHz]	Highest Emission [dBm]
Low	CDMA BC0	9kHz – 30MHz	-13	Pass	0.07	-23.8
Mid	CDMA BC0	9kHz – 30MHz	-13	Pass	0.07	-24.6
High	CDMA BC0	9kHz – 30MHz	-13	Pass	0.07	-24.5
Low	CDMA BC0	30MHz – 1 GHz	-13	Pass	823.9	-35.3
Mid	CDMA BC0	30MHz – 1 GHz	-13	Pass	105.7	-78.1
High	CDMA BC0	30MHz – 1 GHz	-13	Pass	N/A	N/A
Low	CDMA BC0	1GHz – 9GHz	-13	Pass	1583	-44.2
Mid	CDMA BC0	1GHz – 9GHz	-13	Pass	1580	-43.6
High	CDMA BC0	1GHz – 9GHz	-13	Pass	1582	-43.4
Low	CDMA BC1	9kHz – 30MHz	-13	Pass	0.07	-23.9
Mid	CDMA BC1	9kHz – 30MHz	-13	Pass	0.07	-24.2
High	CDMA BC1	9kHz – 30MHz	-13	Pass	0.07	-23.4
Low	CDMA BC1	30MHz – 1 GHz	-13	Pass	N/A	N/A
Mid	CDMA BC1	30MHz – 1 GHz	-13	Pass	N/A	N/A
High	CDMA BC1	30MHz – 1 GHz	-13	Pass	N/A	N/A
Low	CDMA BC1	1GHz – 3GHz	-13	Pass	N/A	N/A
Mid	CDMA BC1	1GHz – 3GHz	-13	Pass	N/A	N/A
High	CDMA BC1	1GHz – 3GHz	-13	Pass	N/A	N/A
Low	CDMA BC1	3GHz – 18GHz	-13	Pass	3703	-37.1
Mid	CDMA BC1	3GHz – 18GHz	-13	Pass	3759	-34.4
High	CDMA BC1	3GHz – 18GHz	-13	Pass	3818	-42.4

9.5 Measurement Plots CDMA BC0

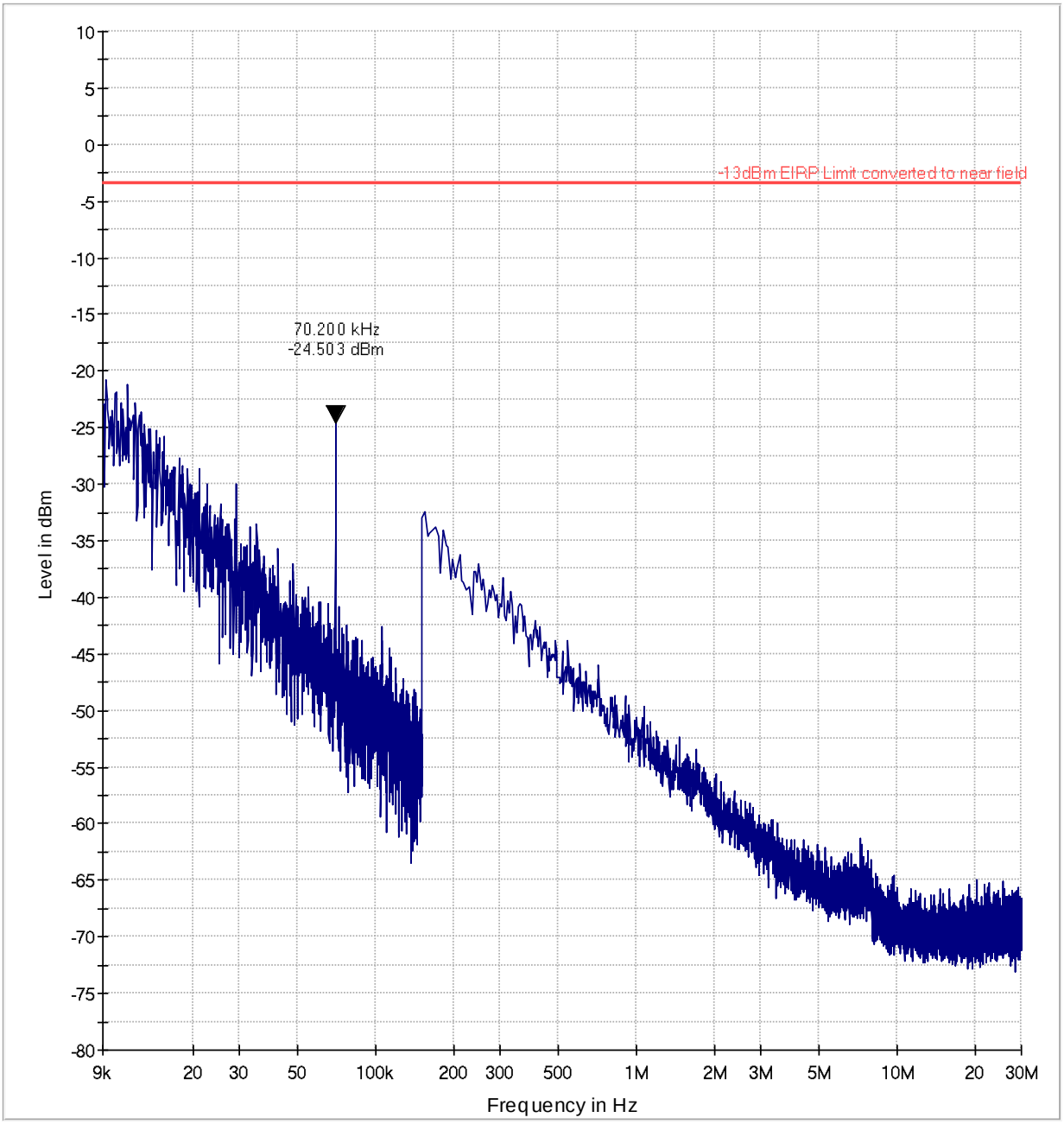
9.5.1 9 kHz – 30MHz, Ch. Low



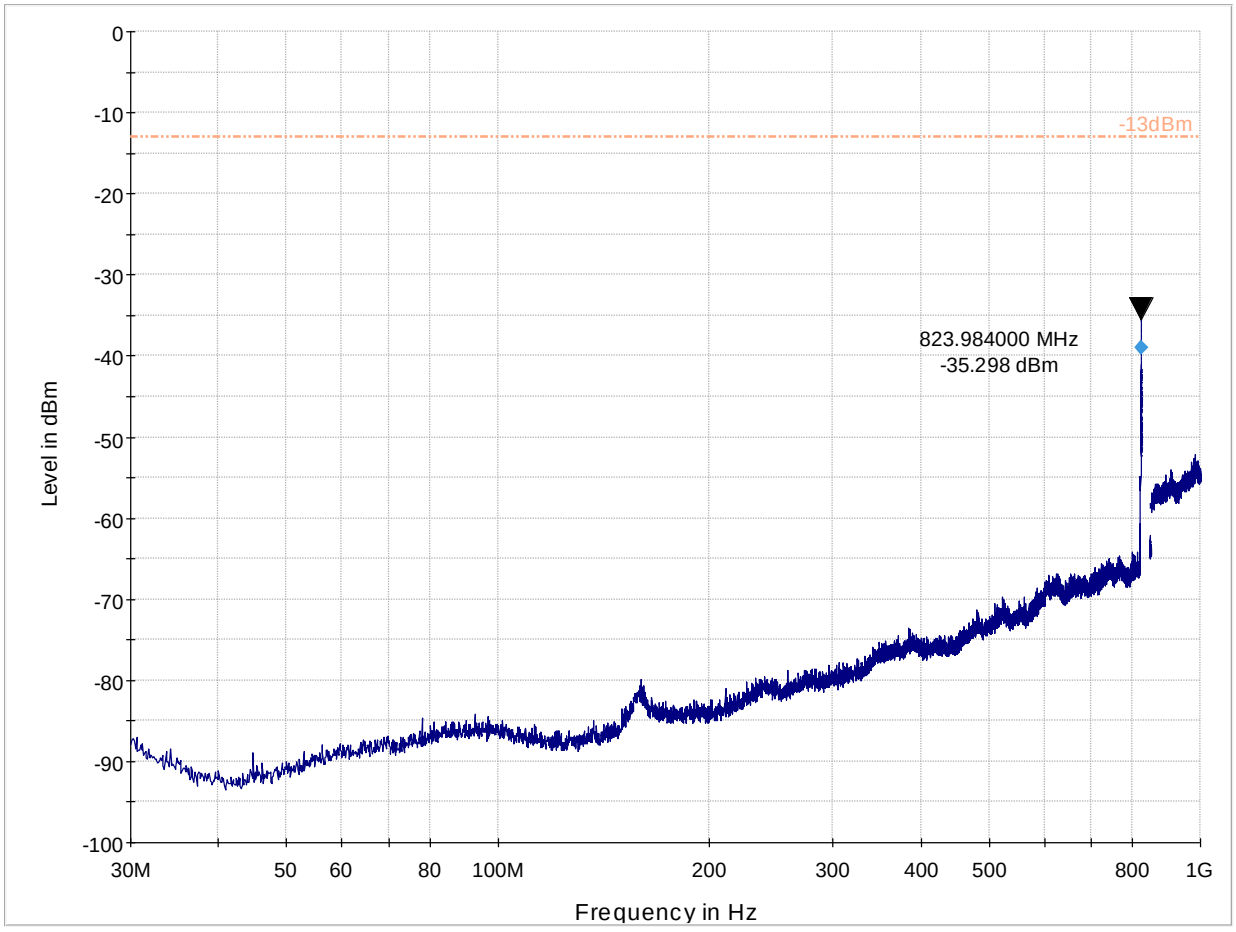
9.5.2 9 kHz – 30MHz, Ch. Mid



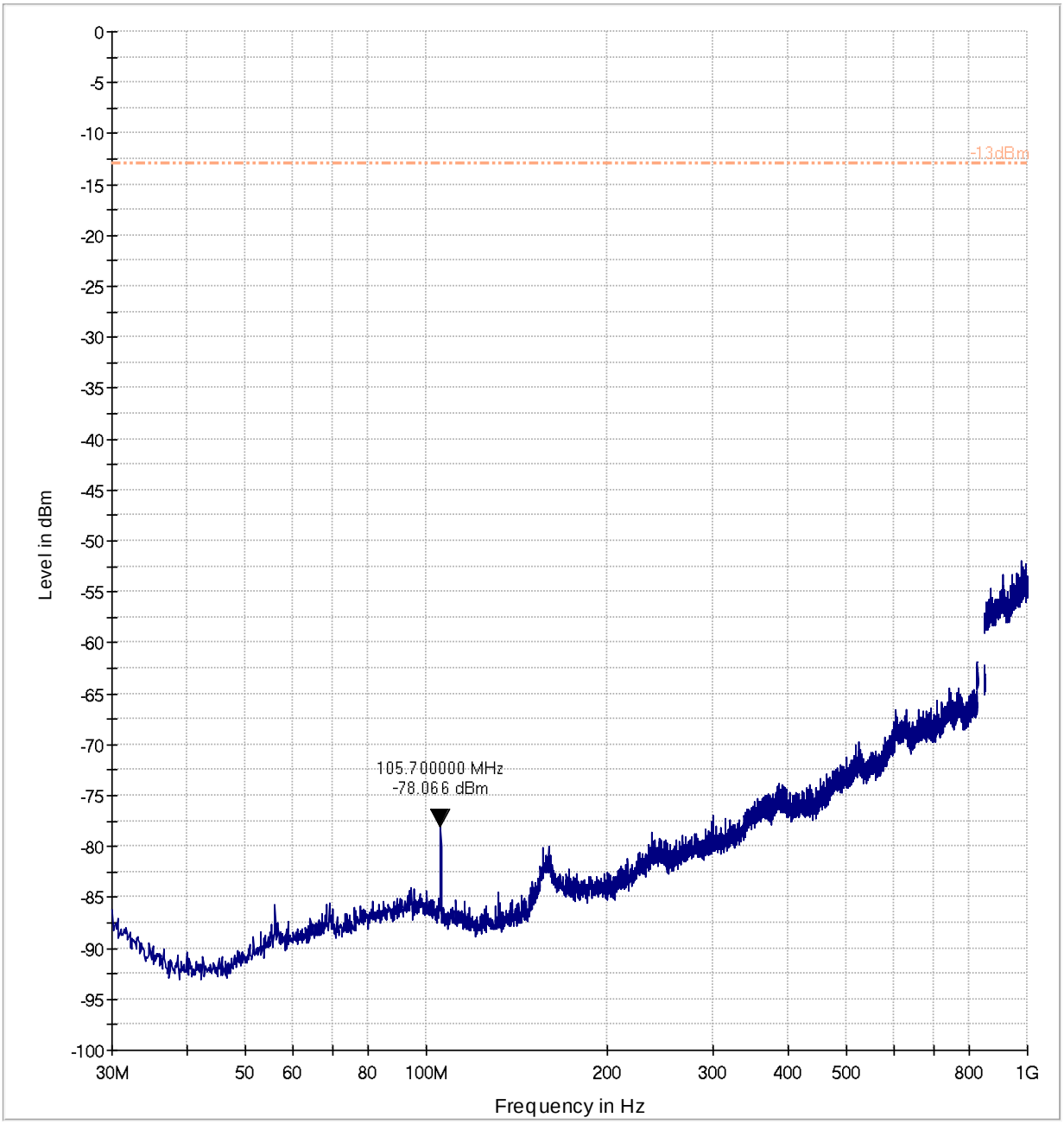
9.5.3 9 kHz – 30MHz, Ch. High



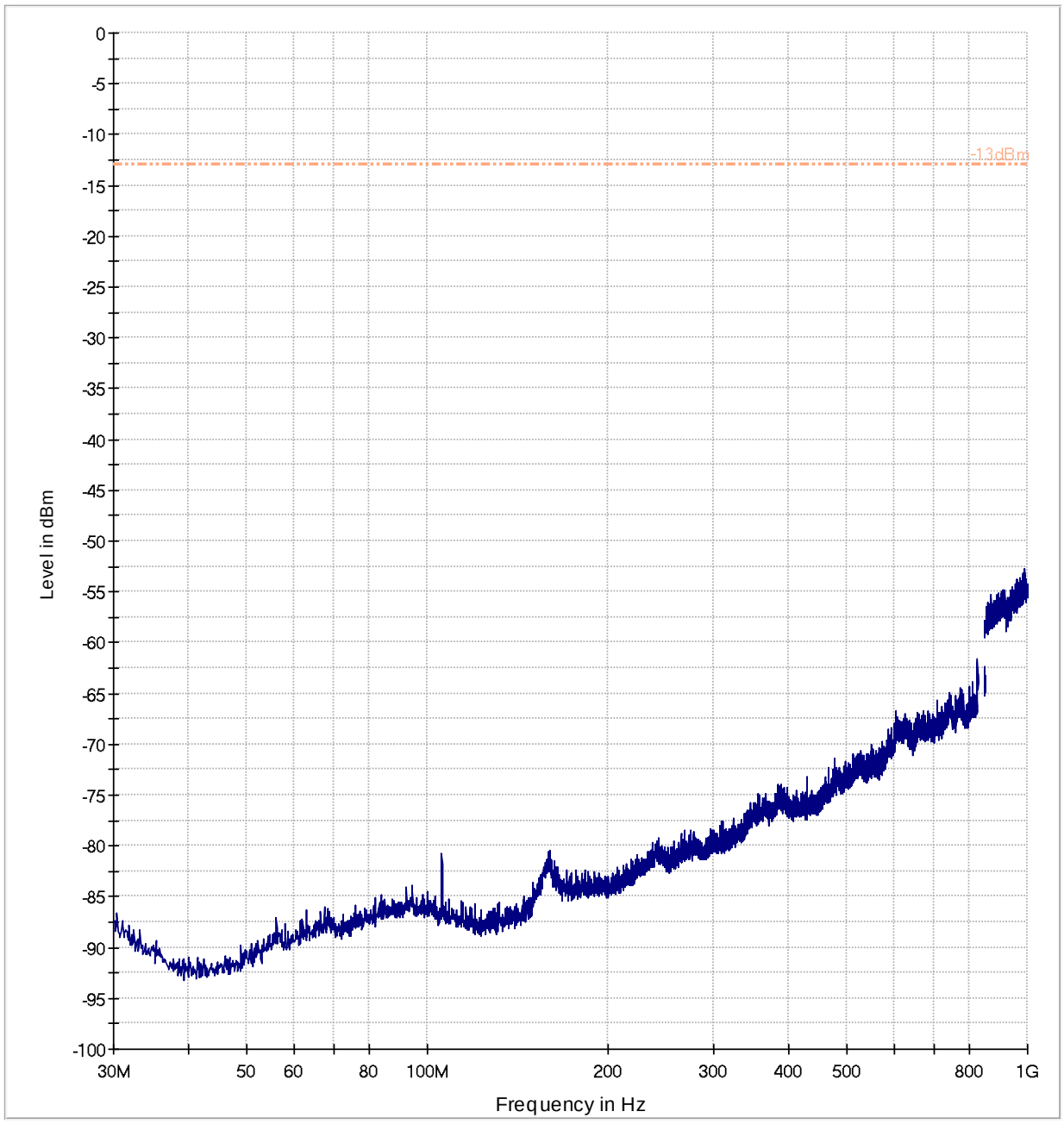
9.5.4 30MHz - 1GHz, Ch. Low



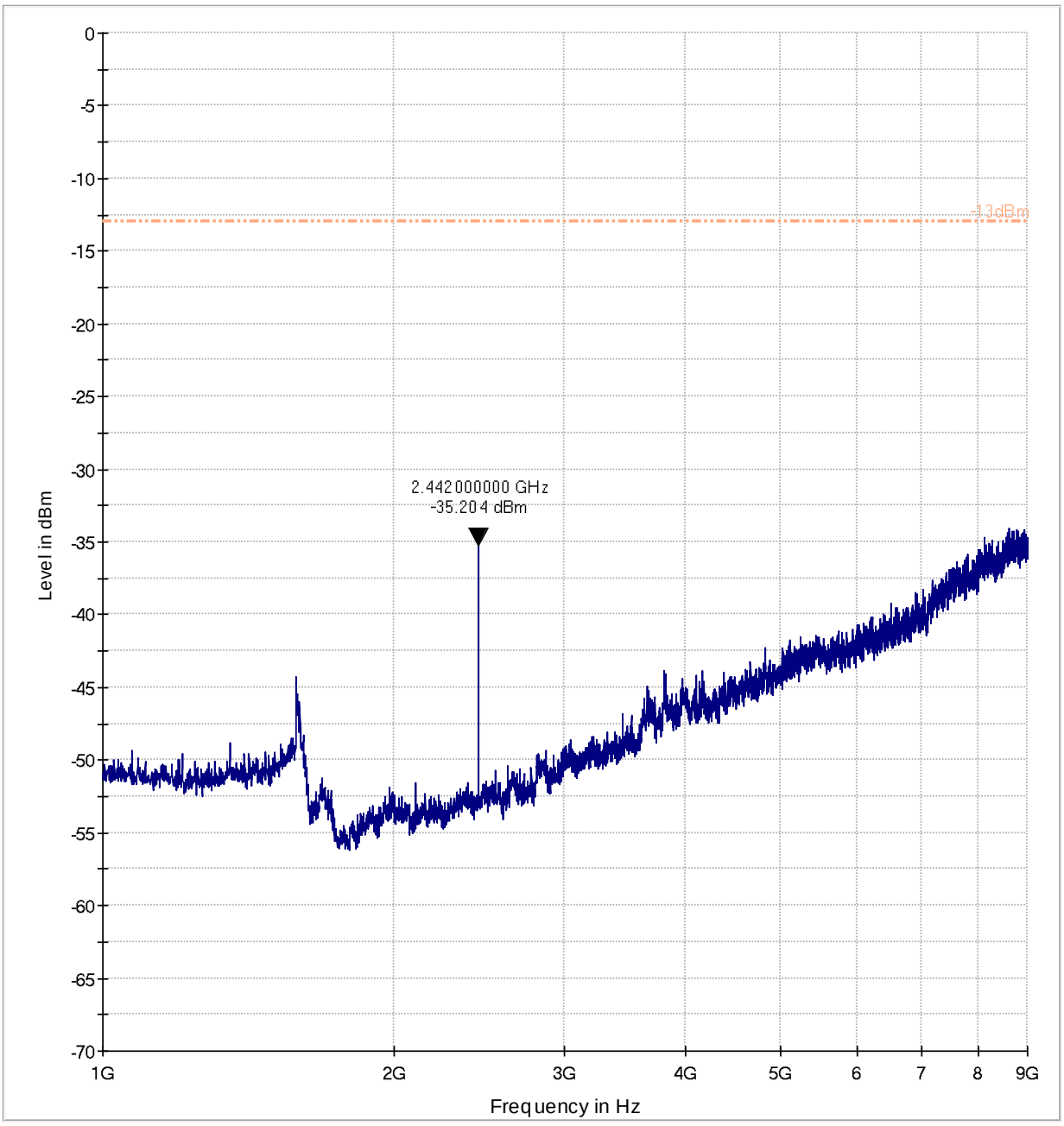
9.5.5 30MHz - 1GHz, Ch. Mid



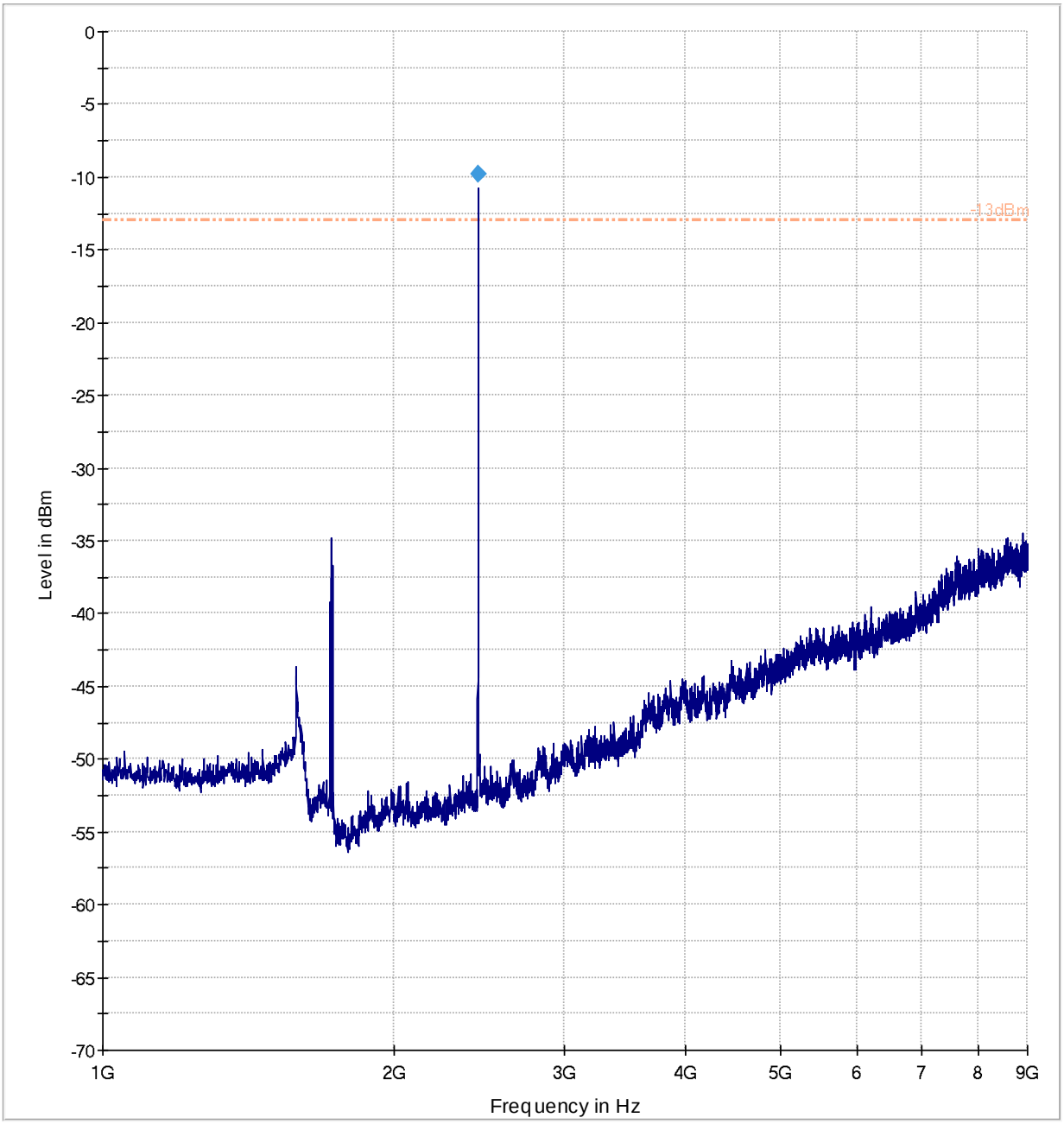
9.5.6 30MHz - 1GHz, Ch. High



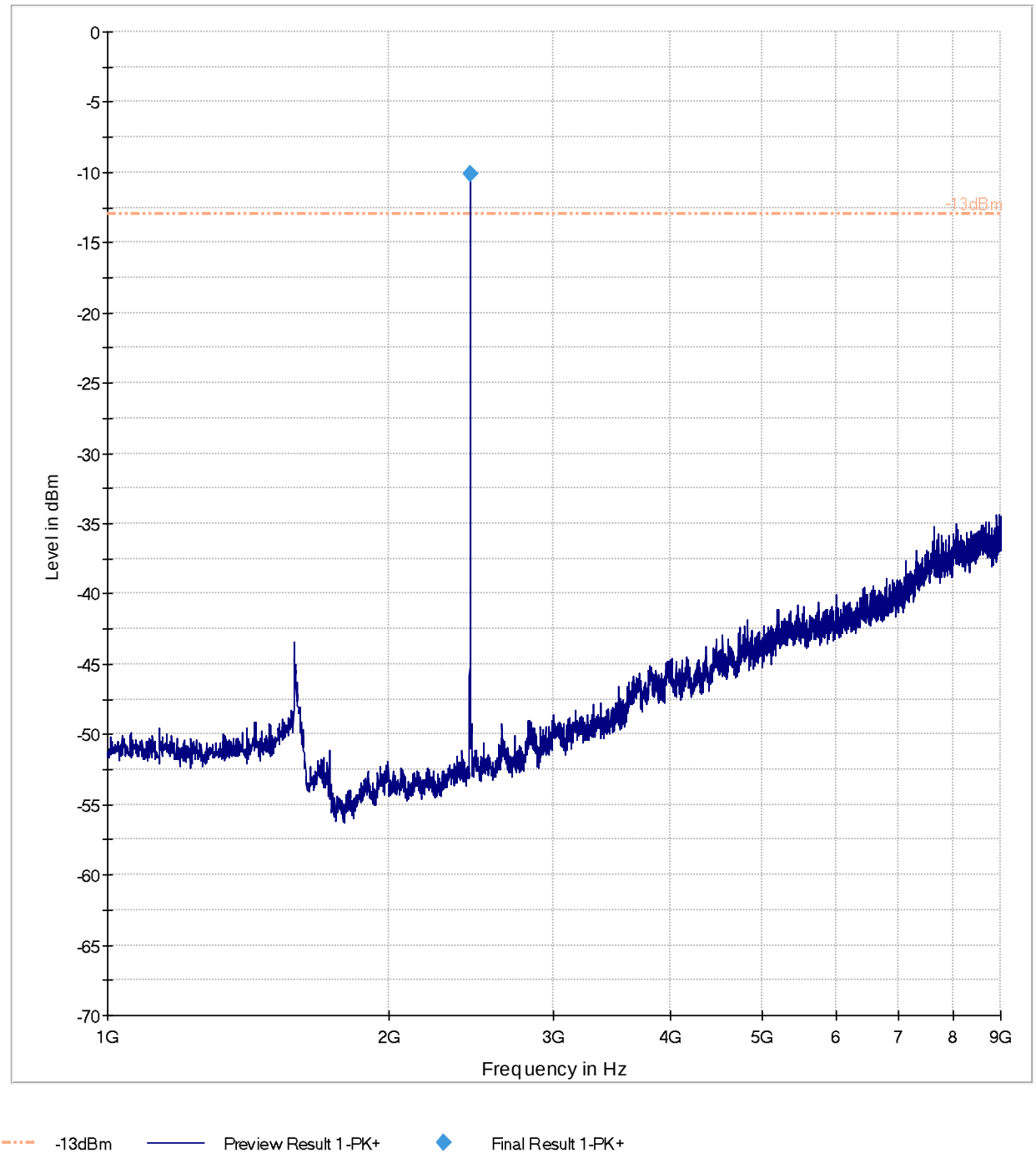
9.5.7 1GHz - 9GHz, Ch. Low



9.5.8 1GHz - 9GHz, Ch. Mid

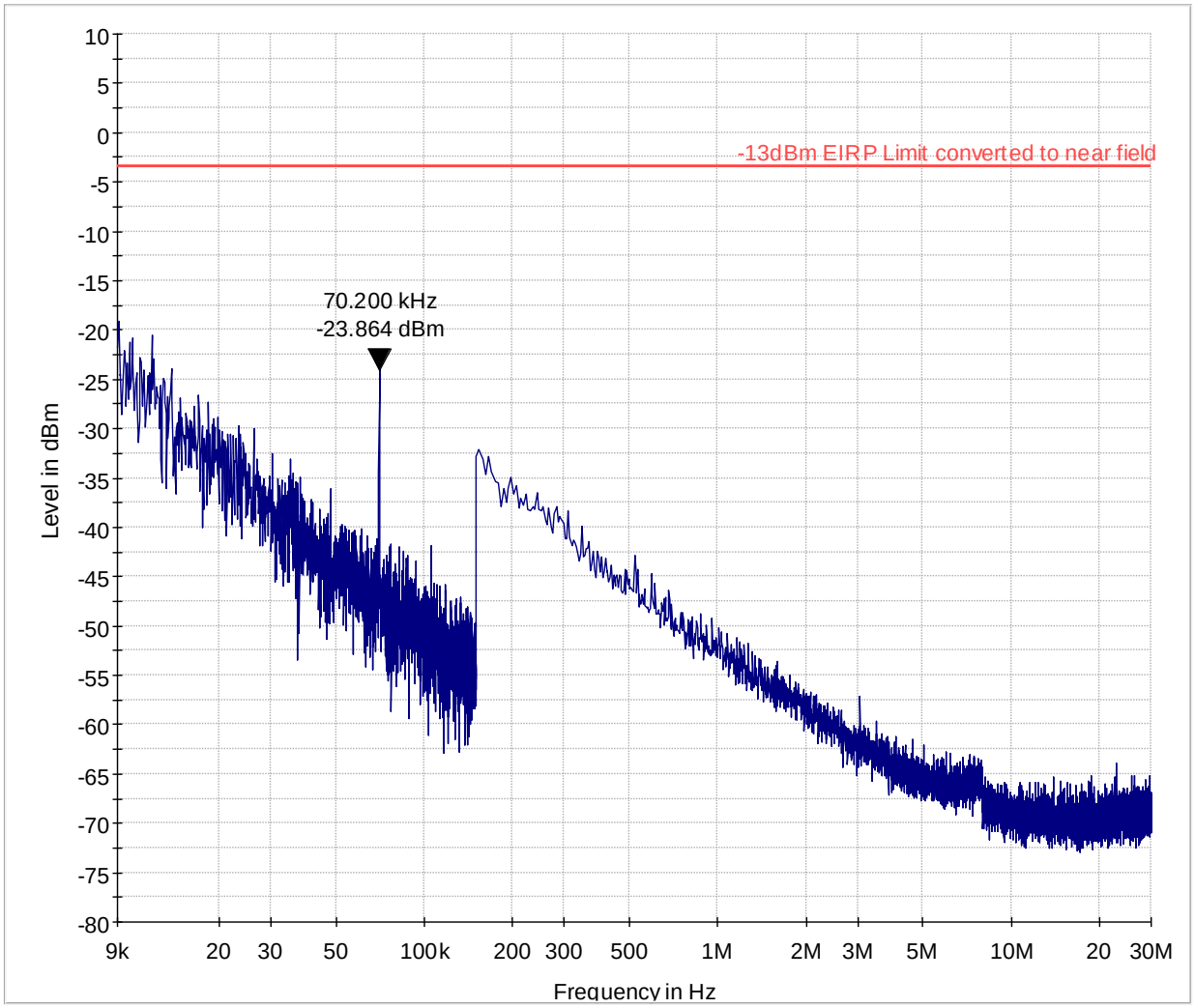


9.5.9 1GHz - 9GHz, Ch. High

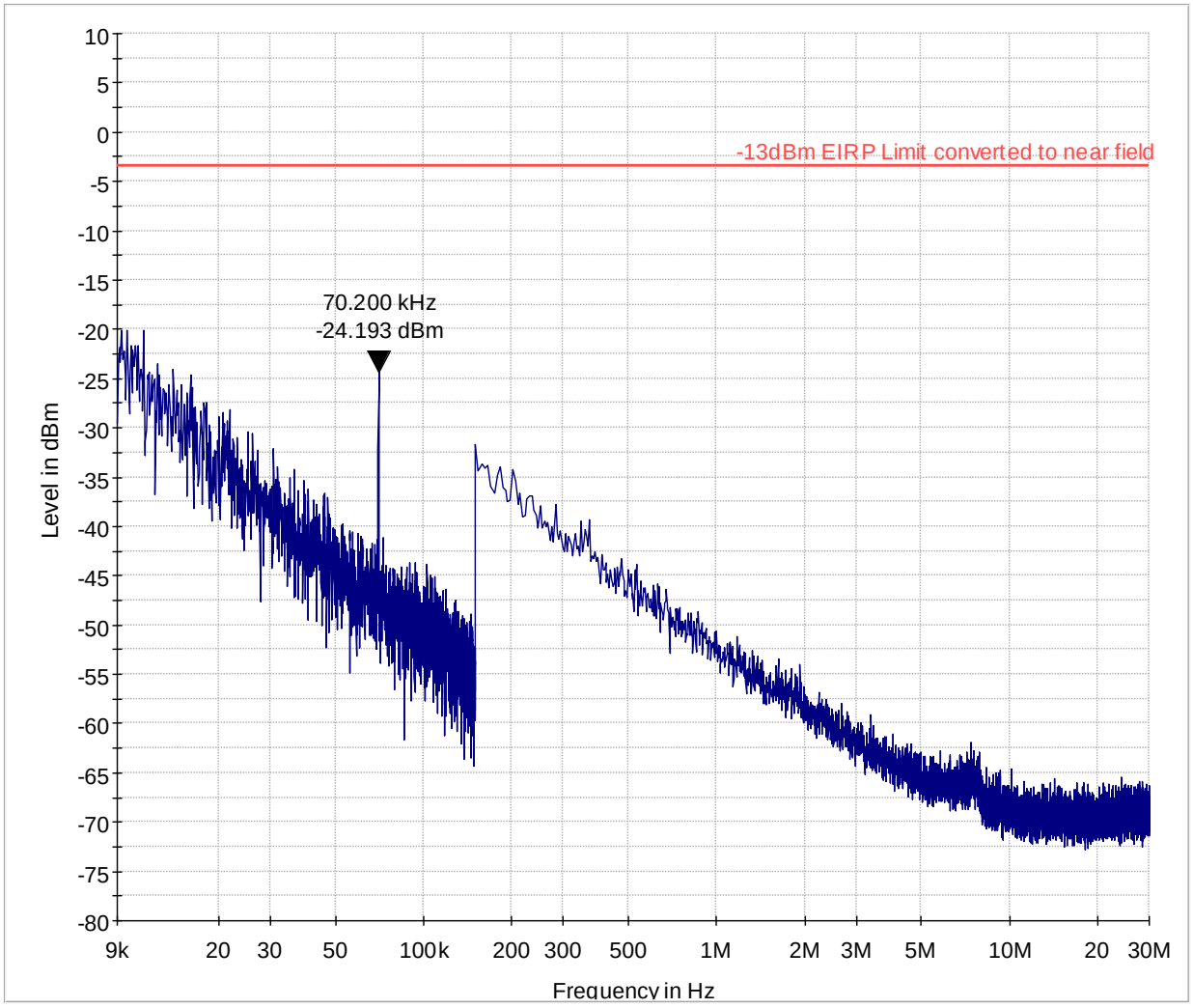


9.6 Measurement Plots CDMA BC1:

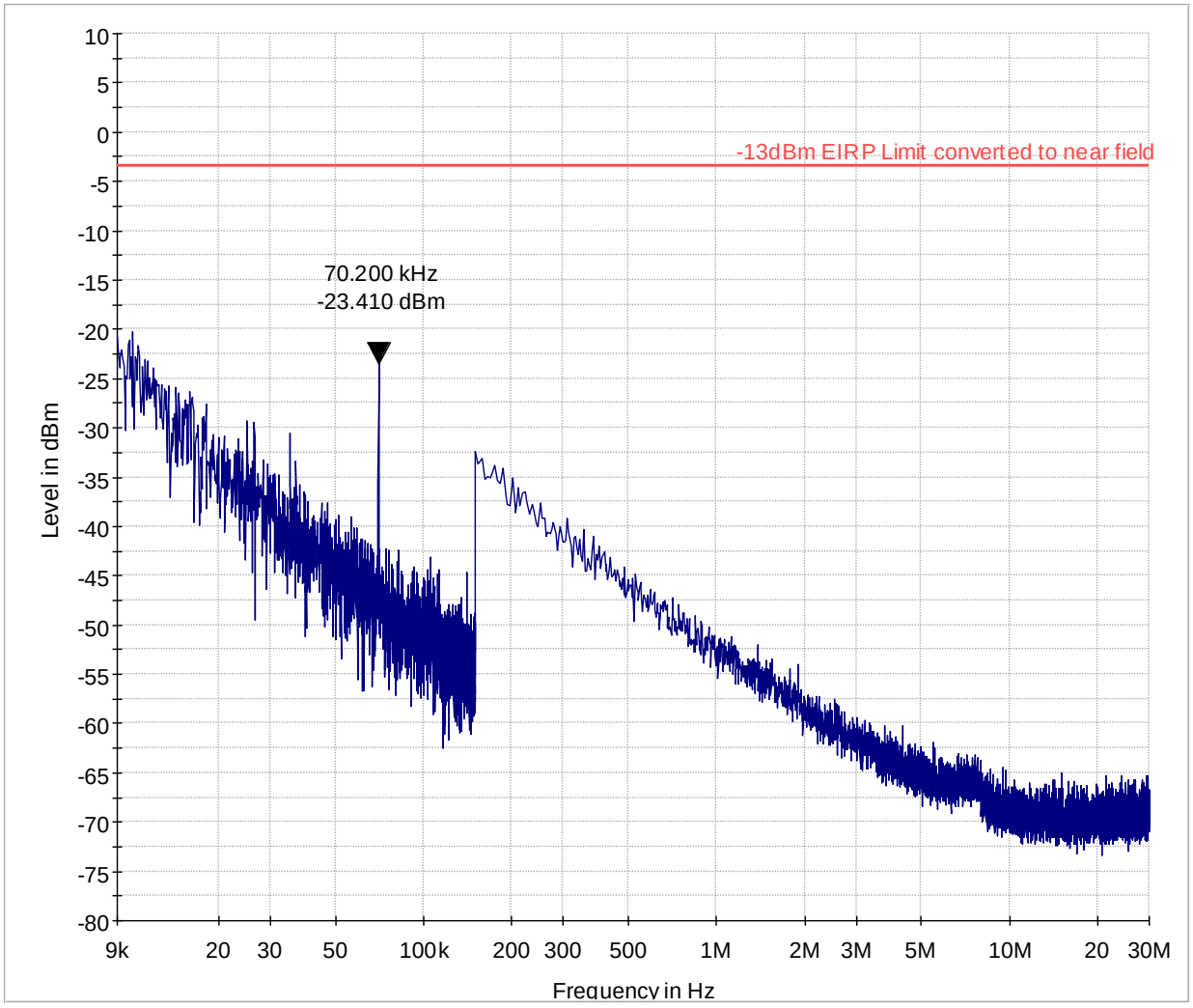
9.6.1 9 kHz – 30MHz, Ch. Low



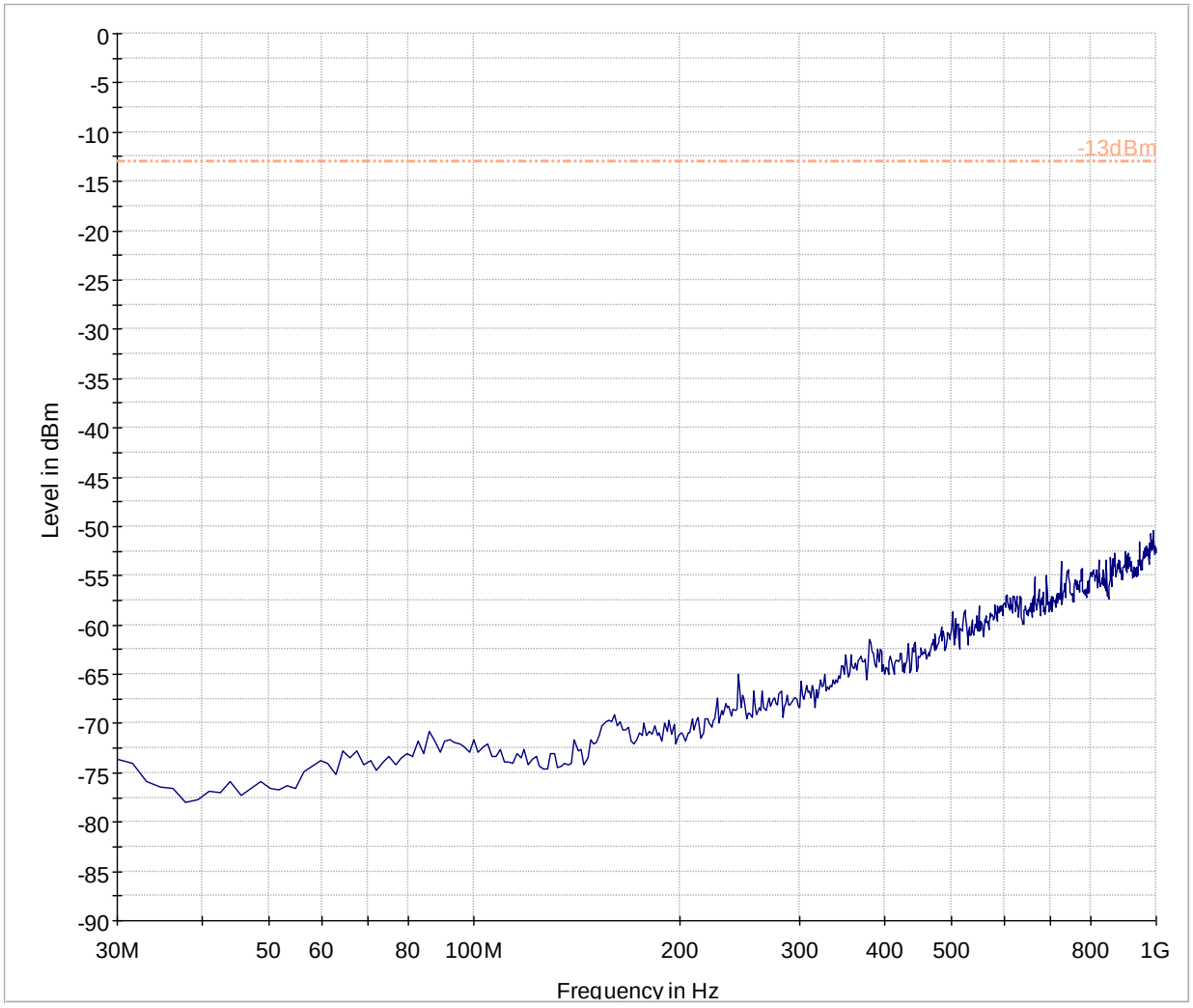
9.6.2 9 kHz – 30MHz, Ch. Mid



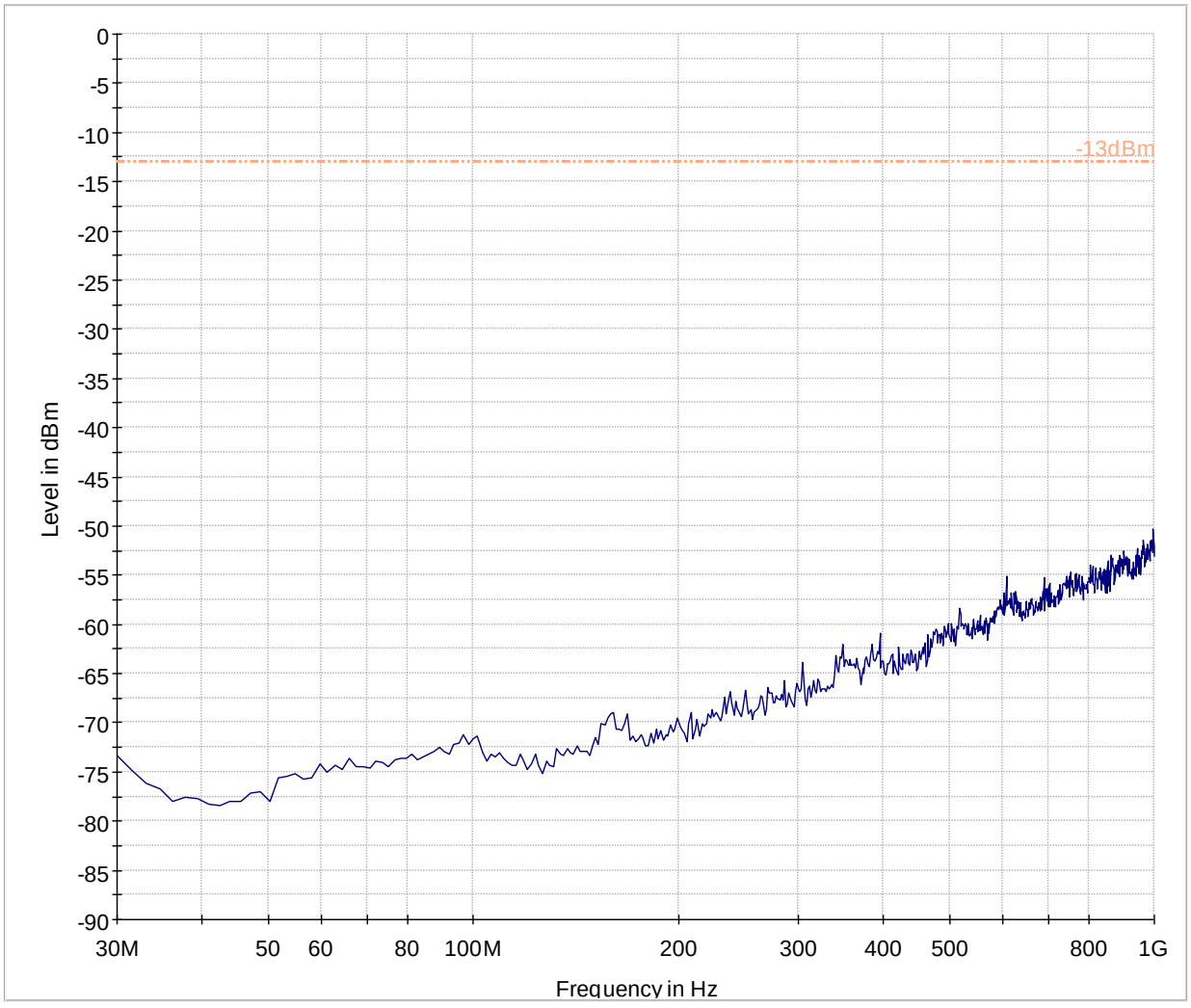
9.6.3 9 kHz – 30MHz, Ch. High



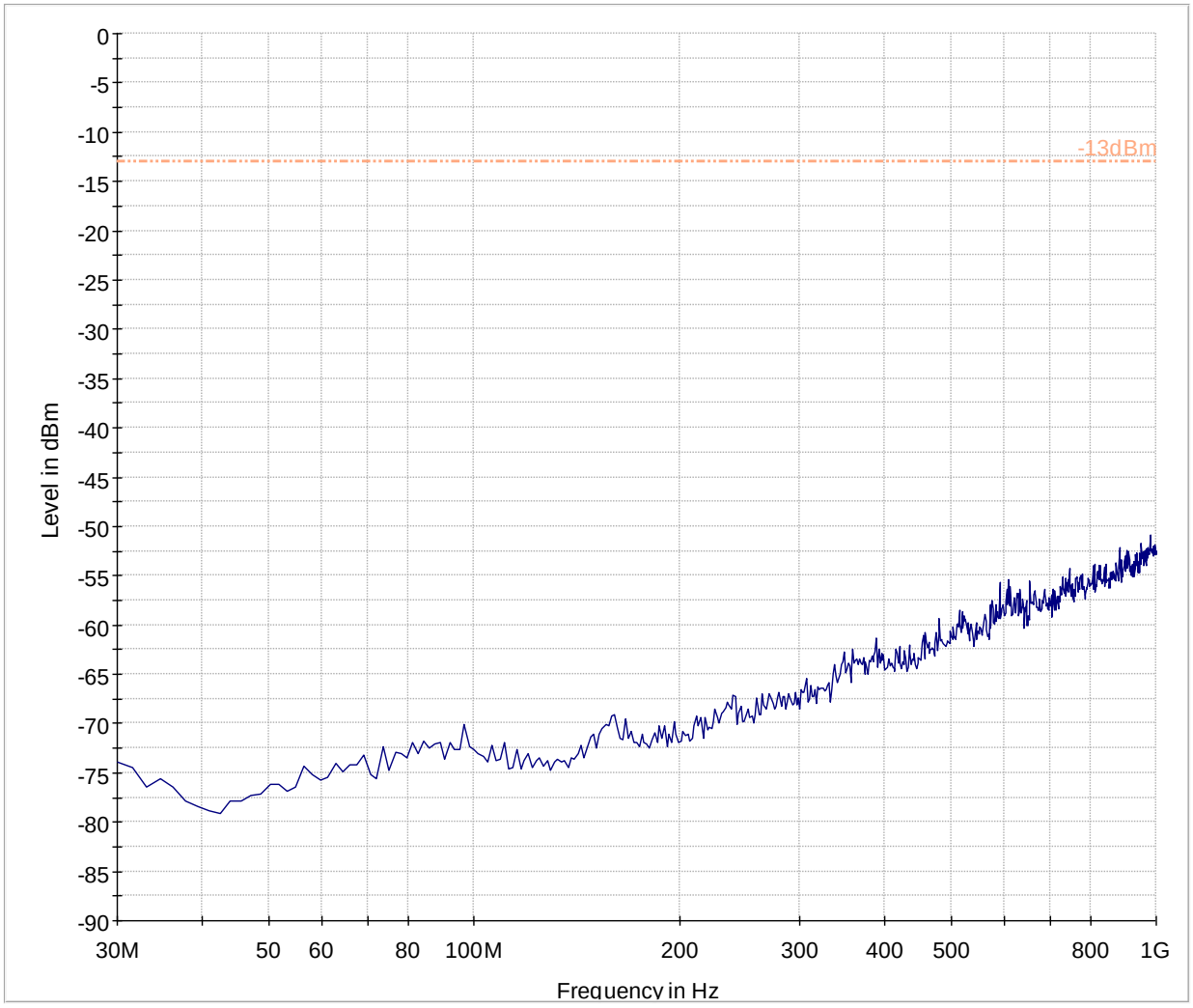
9.6.4 30 MHz – 1 GHz, Ch. Low



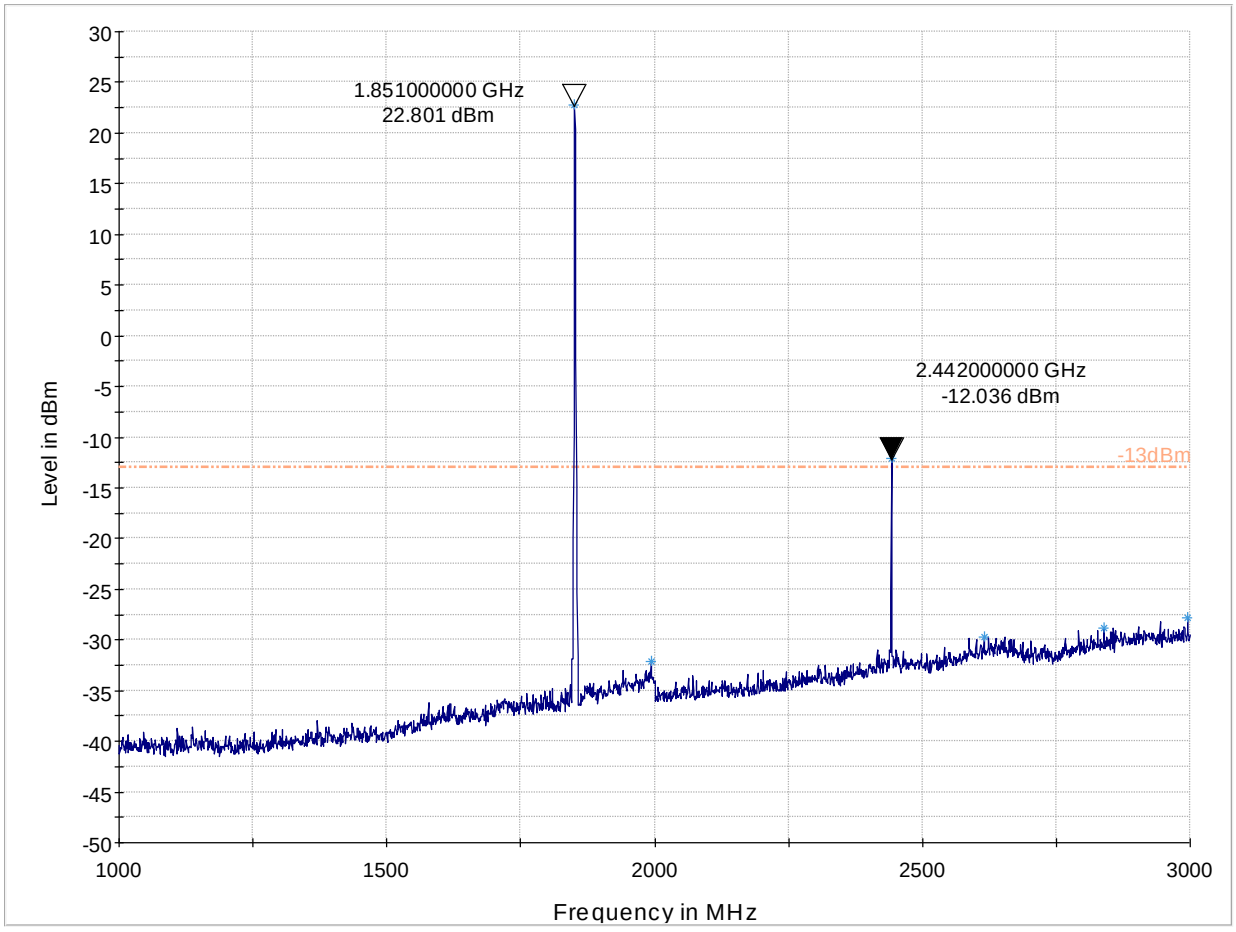
9.6.5 30 MHz – 1 GHz, Ch. Mid



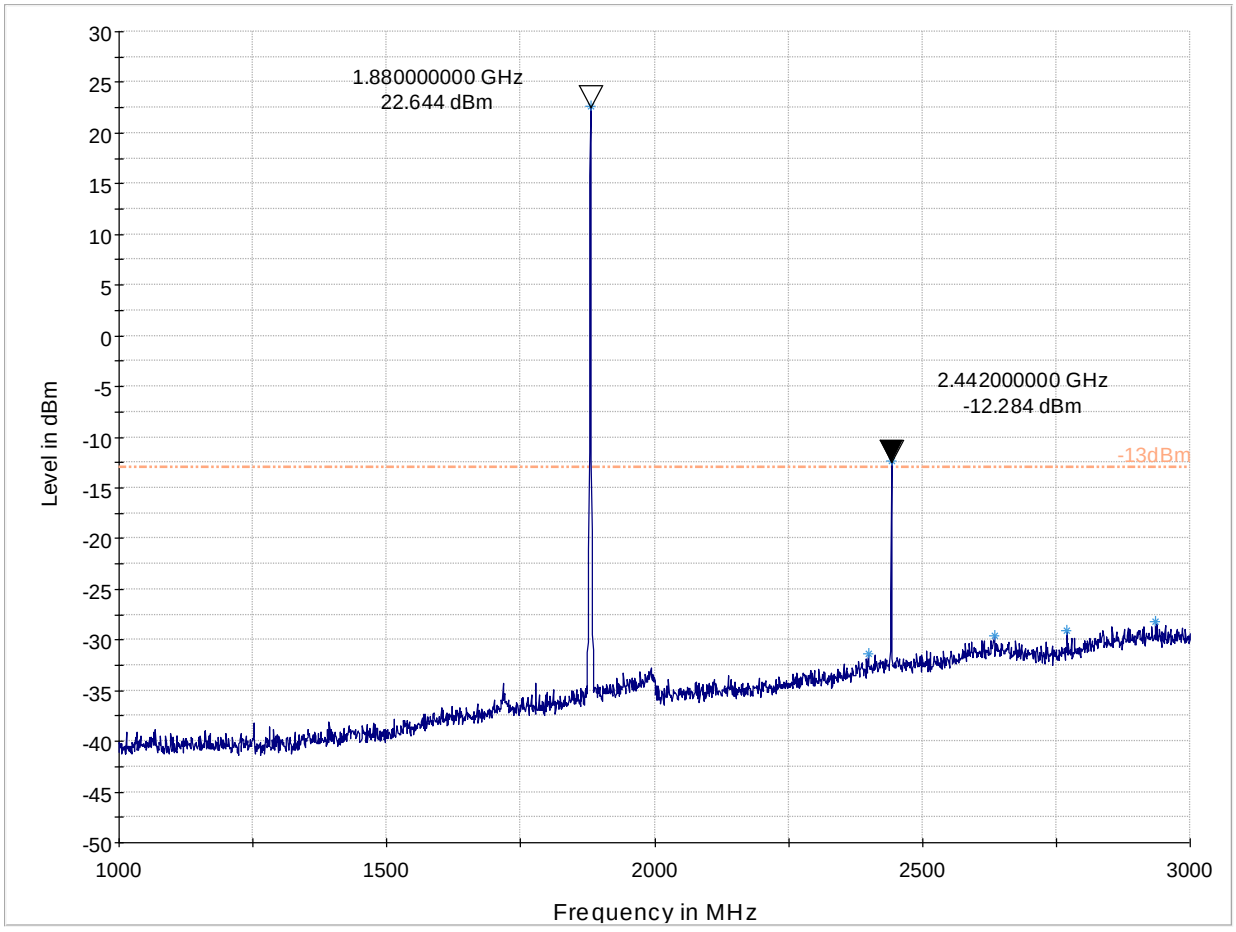
9.6.6 30 MHz – 1 GHz, Ch. High



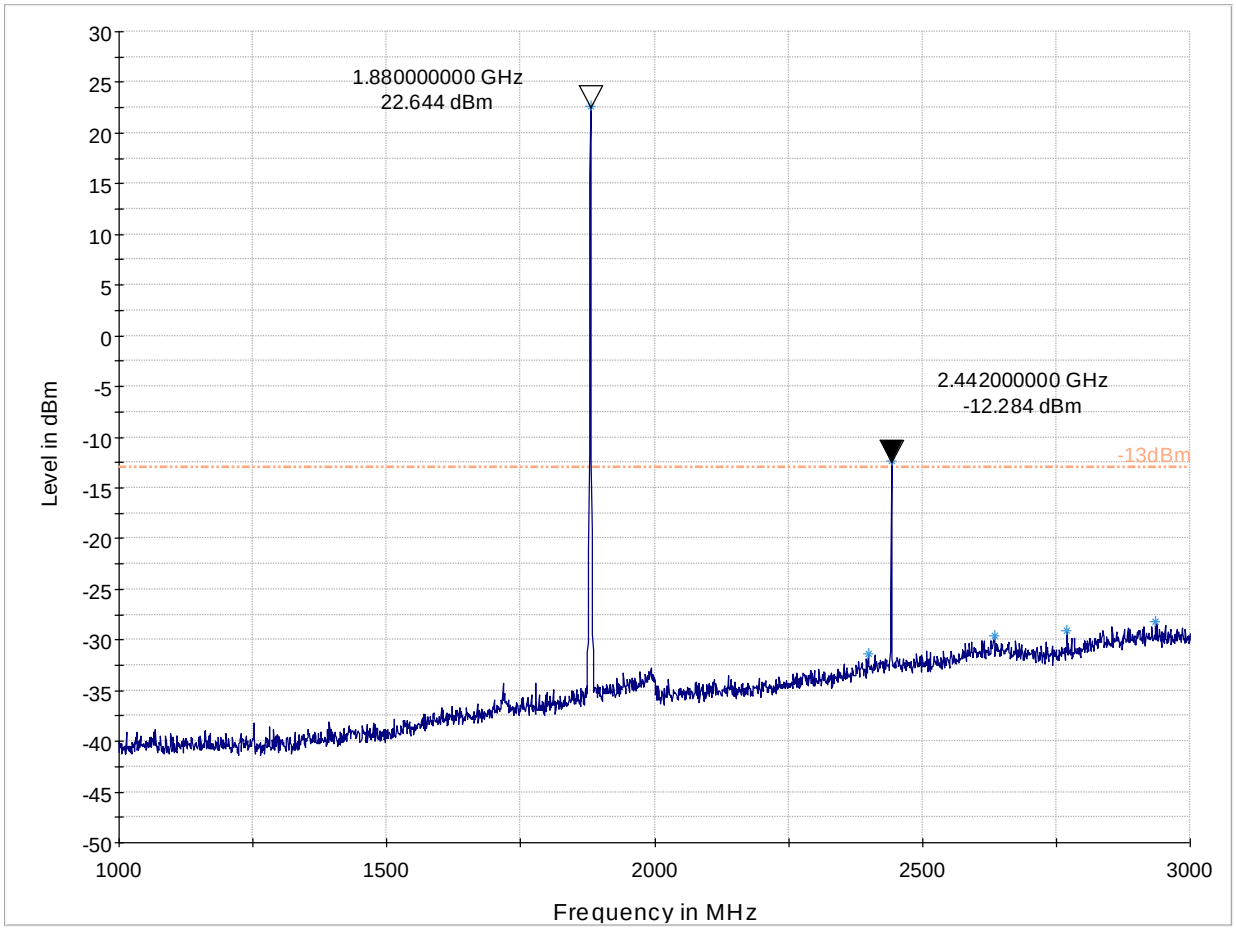
9.6.7 1 GHz – 3GHz, Ch. Low



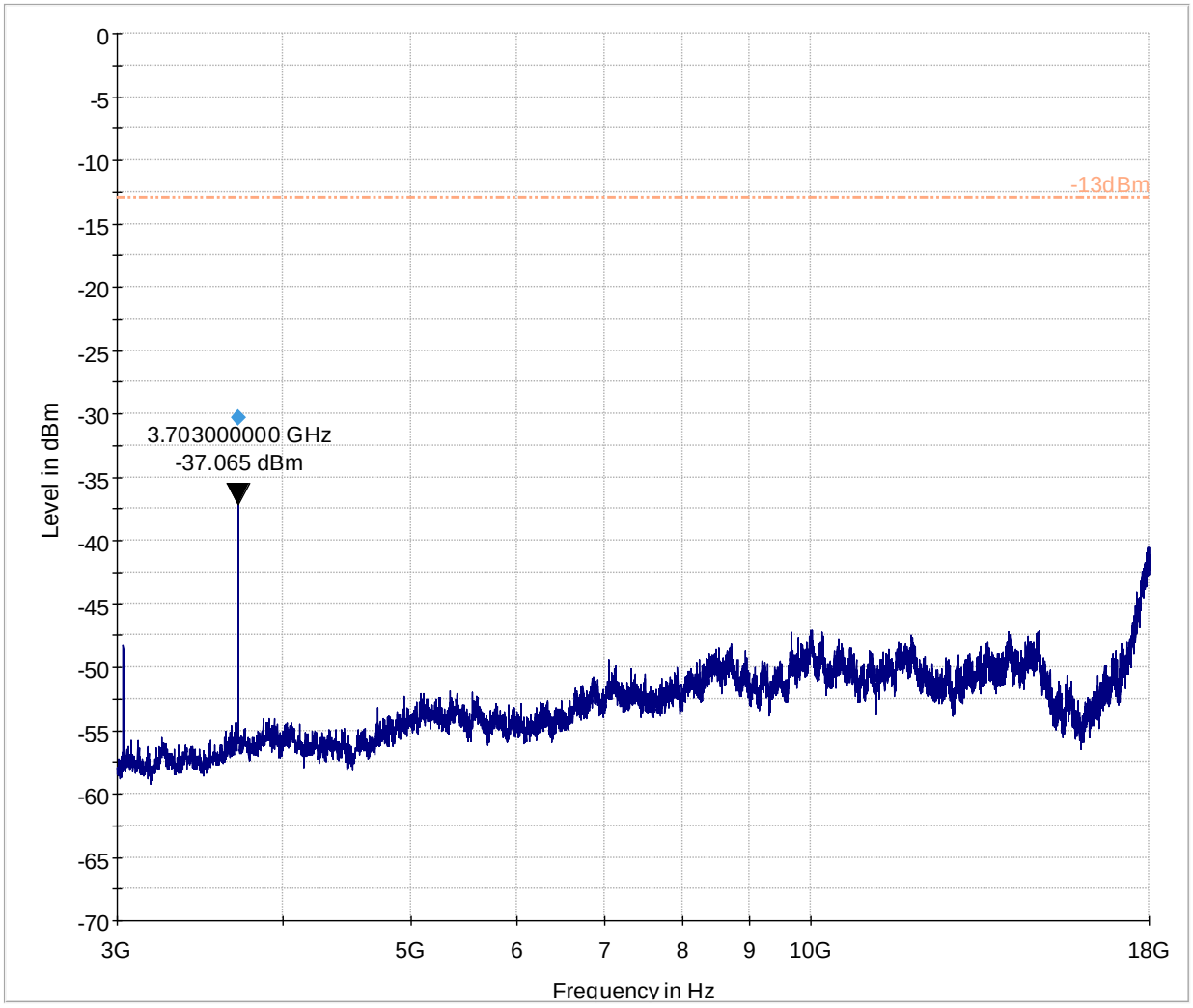
9.6.8 1 GHz – 3 GHz, Ch. Mid



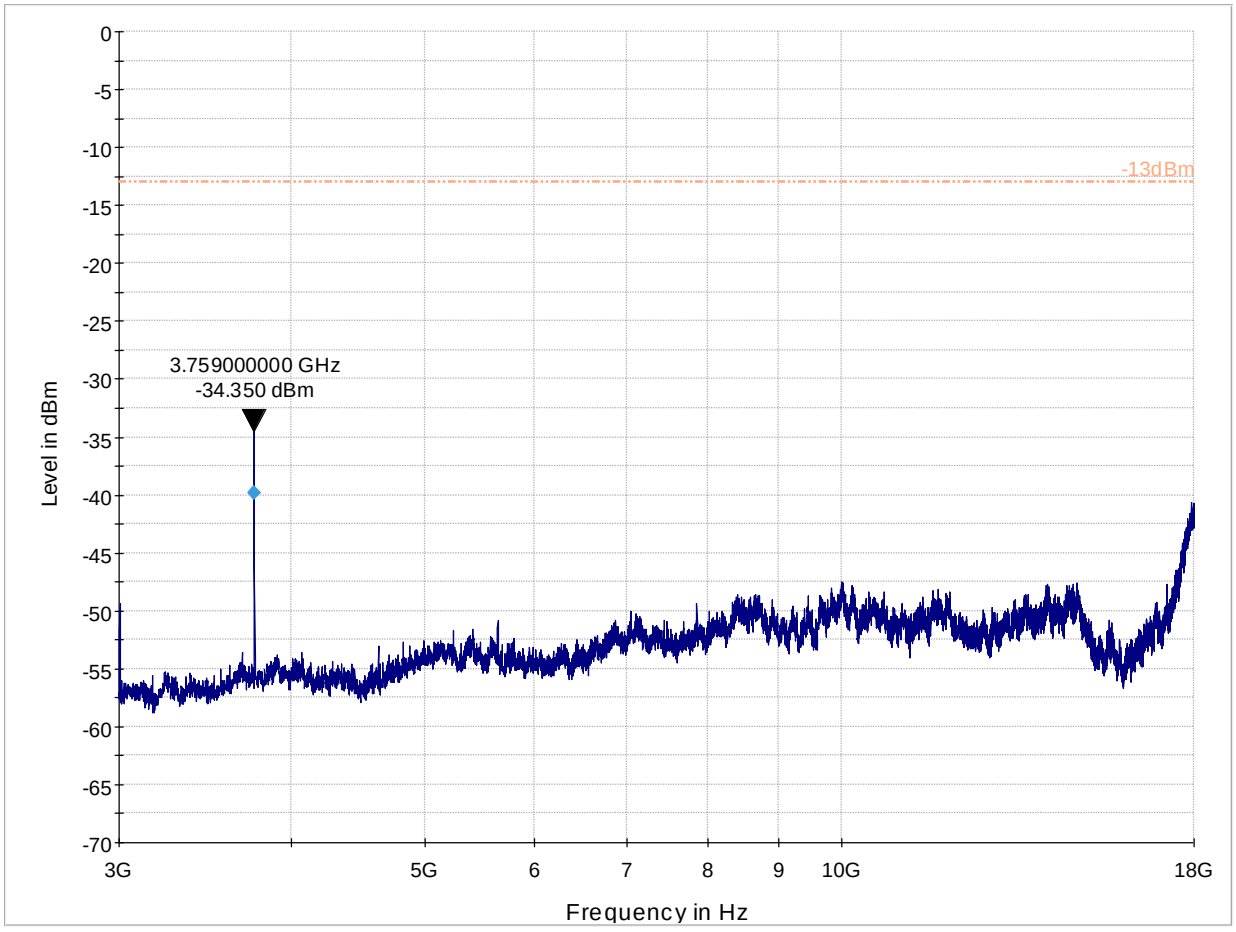
9.6.9 1 GHz – 3 GHz, Ch. High



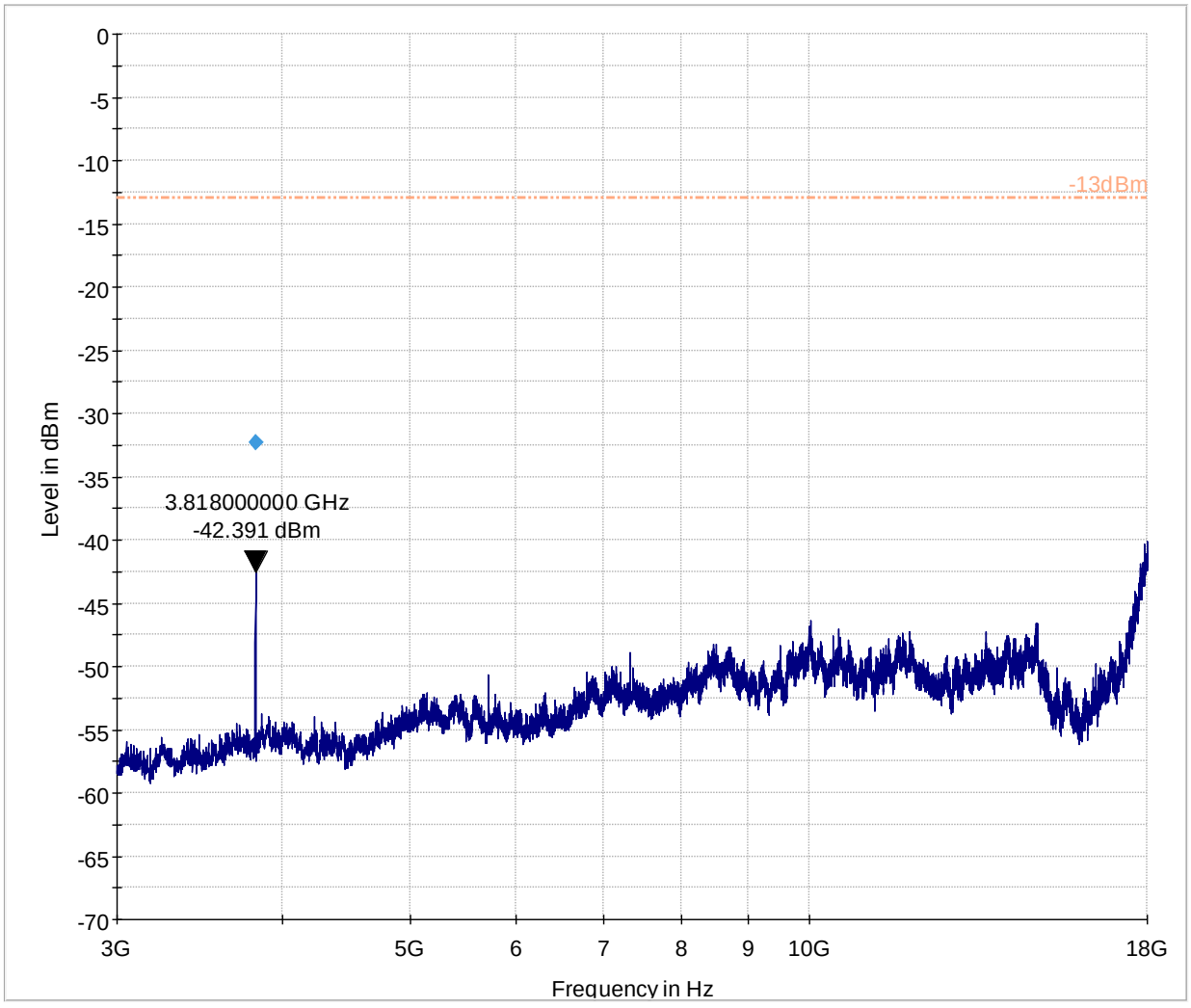
9.6.10 3 GHz – 18GHz, Ch. Low



9.6.11 3 GHz – 18GHz, Ch. Mid



9.6.12 3 GHz – 18GHz, Ch. High



10 Test Setup Photos

Setup photos are included in supporting file name: “EMC-IRHYT-007-17001_TestSetupPhotos.pdf”

11 Test Equipment and Ancillaries Used For Testing

Item Name	Equipment Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
Antenna Loop 6512	Loop (Passive)	ETS Lindgren	6512	00164698	3 years	7/22/2014
Antenna Biconilog	Biconilog (Type 3)	Rohde & Schwarz	HL652	100495	3 years	6/24/2015
Antenna Horn 3116	DTG Horn(Small 1)	ETS Lindgren	3116C-PA	00169535	3 years	8/14/2014
Antenna Horn 3117	DTG Horn(Medium)	ETS Lindgren	3117-PA	00167061	3 years	8/13/2014
Digital Barometer	Compact Digital Barometer	Control Company	35519-055	91119547	3 Years	4/7/2015
Digital Radio Comm. Tester CMU 200 #1	Digital Radio Comm. Tester	R&S	CMU 200 #1	101821	2 Years	7/4/2015
Signal Analyzer	Receiver/FSV 40	R&S	ESU 40	101022	3 years	7/28/2014
Thermometer Humidity TM320	Thermometer Humidity	Dickson	TM320	5280063	3 Year	7/29/2016

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.

12 Revision History

Date	Report Name	Changes to report	Report prepared by
May 09, 2017	EMC-IRHYT-007-17001_RADIATED_EMISSIONS_GATEWAY	Initial Version	Cindy Li