Electromagnetic Compatibility Measurements and Test Report

GMSL2 SerDes: MAX96717 and MAX96724

Version 0; 7/23

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1 General Information

1.1 Scope

This report is intended to document the results of electromagnetic compatibility (EMC) testing performed on the GMSL2 serializer/deserializer (SerDes) devices, MAX96717 and MAX96724, in accordance with test standard CISPR25 Class 5 (edition 4.0). This report only applies to the specific samples tested under the stated test conditions.

The results detailed in this report include the following specified tests:

Table 1 Test Scope Summary

TEST	STANDARD	LEVEL
Radiated Emissions	CISPR25	Class 5
Conducted Emissions	CISPR25	Class 5
BCI	ISO-11452-4	2

1.2 Purpose

Testing was performed to evaluate the EMC performance of the Equipment Under Test (EUT) in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and standards listed in this report.

1.3 Description for Equipment Under Test

Table 2 EUT Details

Part#	MAX96717 (device revision 4), MAX96724 (device revision 1) The MAX96717 may be referred to as serializer or SER. The MAX96724 may be referred to as deserializer or DES.
Hardware Platform	MAX96717: max96717_emi_coax_poc_apps_p6 MAX96724: max96724_emi_coax_poc_apps_p2
Mode	GMSL2, 6G, Single-Link
Power	LISN and 12V battery provide local power to each DES PoC provides SER power
Cable	2m Coax (Leoni Dacar 302), single segment
Connector	HFM
Other Feature Description	N/A
Reference over Reverse (RoR)	Enabled
Spread Spectrum	Enabled (2530ppm) on reverse channel
Enclosure Used	MAX96717 installed in metal enclosure box

	MAX96724 installed in metal enclosure box
Chassis Ground	Chassis ground lead from DES metal enclosure box to GND. SER metal enclosure does not include local chassis GND. PCBs are electrically connected internally to shield boxes.
Testing Date	March 2022

1.4 Equipment List

1.4.1Radiated Emissions

Table 3 Radiated Emissions Equipment List

FUNCTION	INSTRUMENT
EMI Test Receiver	R&S ESRP
Monopole Antenna	ETS 3301C
Log Periodic Antenna	ETS 3148B
Biconical Antenna	ETS 3110C
Horn Antenna	Schwarzbeck BBHA 9210 E

1.4.2Conducted Emissions

Table 4 Conducted Emissions Equipment List

FUNCTION	INSTRUMENT
EMI Test Receiver	R&S ESRP
Current Probe	ETS 94430-1

1.4.3BCI

Table 5 BCI Equipment List

FUNCTION	INSTRUMENT
BCI Tester	Schlöder CDG7000
BCI Injection Clamp	Schlöder BCI-P1
BCI Calibration Fixture	Schlöder
BCI Monitor Clamp	The EMC Shop RFCP500M

1.5 Test Standards

Testing was performed to evaluate the EMC performance of the Equipment Under Test or EUT in accordance with the test standard ISO-11452-4 (BCI Test) and industry standard CISPR25 (emissions).

1.6 Test Methodology

All measurements contained in this report were conducted in accordance with the standards specified in the *Test Standards* section.

1.7 Test Facility

All tests were performed at the Analog Devices, Inc. facility located in Beaverton, Oregon.

1.8 EUT Setup and Operation Mode

The EUT was configured for operation in GMSL2 6Gbps operating mode with one active link, RoR-enabled, and spread spectrum enabled on reverse channel.

Power is connected to the deserializer using a local LISN. The deserializer also includes a chassis GND strap. Serializer power is provided through PoC from the deserializer. The serializer does not include a local chassis ground.

All video interfaces were idle during the testing.

2 Summary of Test Results

Table 6 Test Results Summary

TEST	DESCRIPTION	LEVEL	RESULT	DETAILS
CISPR25	Radiated Emissions	Class5 (edition 4.0)	PASS	Section 3
CISPR25	Conducted Emissions	Class5 (edition 4.0)	PASS	Section 4
ISO11452-4	BCI	200mA (Level 2)	PASS	Section 5

3 Radiated Emissions

3.1 Test Procedure and Setup

Radiated emissions tests were performed according to the test procedures and setup conditions specified by CISPR25.

3.2 Test Equipment

Table 7 Radiated Emissions Equipment List

FUNCTION	INSTRUMENT
EMI Test Receiver	R&S ESRP
Monopole Antenna	ETS 3301C
Log Periodic Antenna	ETS 3148B
Biconical Antenna	ETS 3110C
Horn Antenna	Schwarzbeck BBHA 9210 E

3.3 Environmental Conditions

Table 8 Radiated Emissions Environmental Conditions

PARAMETER	VALUE
Temperature	Room

3.4 Measurement Uncertainty/Calibration

All equipment is calibrated as required.

3.5 Overview of Test and Test Conditions

Table 9 Overview of Radiated Emissions Test Details and Conditions

Results	**PASSED** all radiated emissions tests
Standard	CISPR25 Class 5 (edition 4.0)
Part Numbers	MAX96717, MAX96724
Configuration	6Gbps/187Mbps, Single Link, PoC, RoR, SS ON 2530ppm rev channel, Coax, HFM, 2m cable
Test Setup	See *Setup Pictures (*Section 3.6)
EUT Power	12V supply and LISN at DES, SER power through PoC
Ground	Chassis ground lead connected to DES SER does not include local chassis GND
Additional Notes	-
Antenna Positions	Monopole, Biconical, and Log Periodic antennas focused on center of harness. Horn antenna focused independently on SER and DES. H and V polarizations for all antennas/positions with exception of monopole.
Frequency Range	**150kHz to 2500MHz**

	Monopole = 150kHz to 30MHz Biconical = 30MHz to 200MHz Log Periodic = 200MHz to 1000MHz Horn = 1000MHz to 2500MHz
Limit Level	Class 5

3.5.1Pass/Fail Criteria

- The presence of one or more measurement points at or above the peak or average emissions limit is considered a failure.

3.6 Setup Pictures

Figure 1. Monopole Antenna Setup

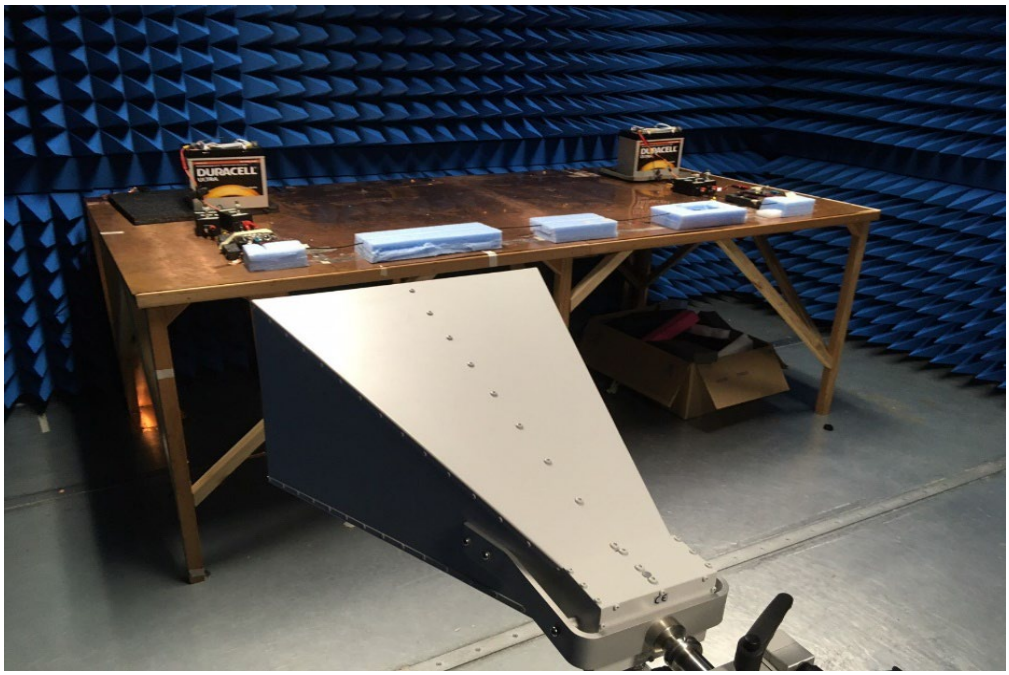


Figure 2. Horn Antenna Setup

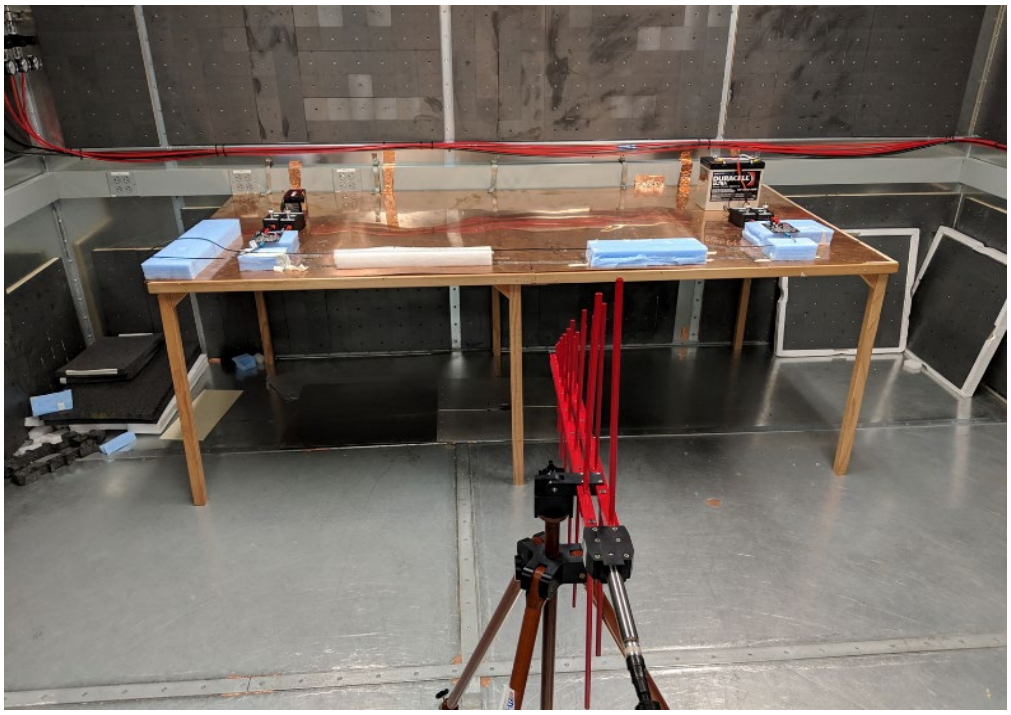


Figure 3. Log Periodic Antenna Setup

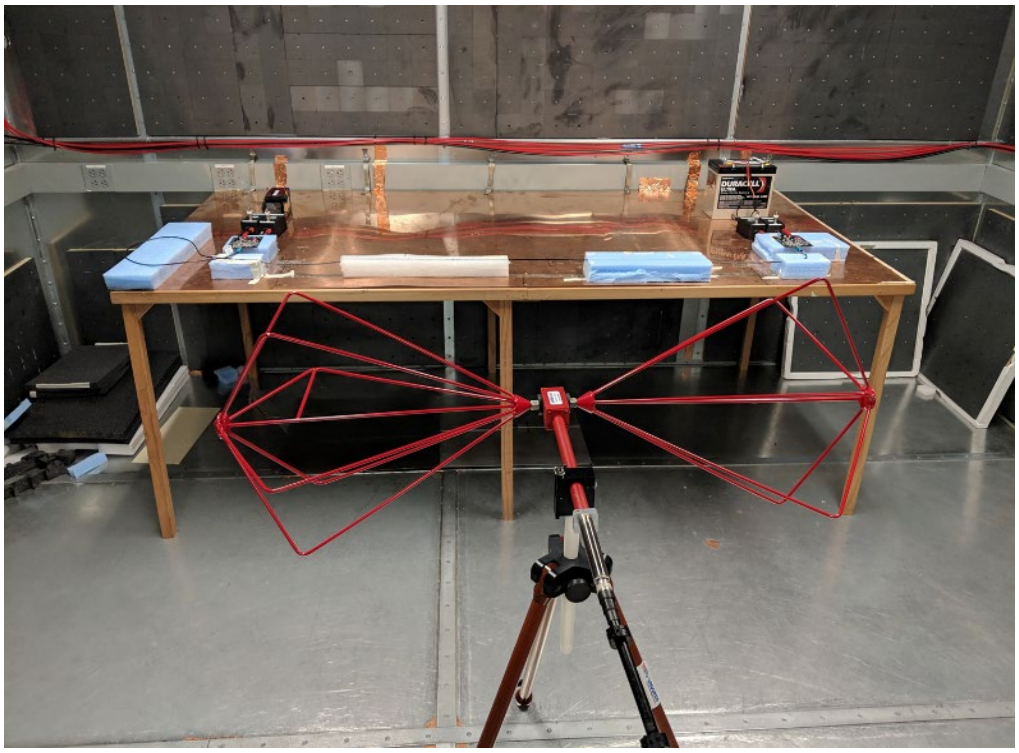


Figure 4. Biconical Antenna Setup

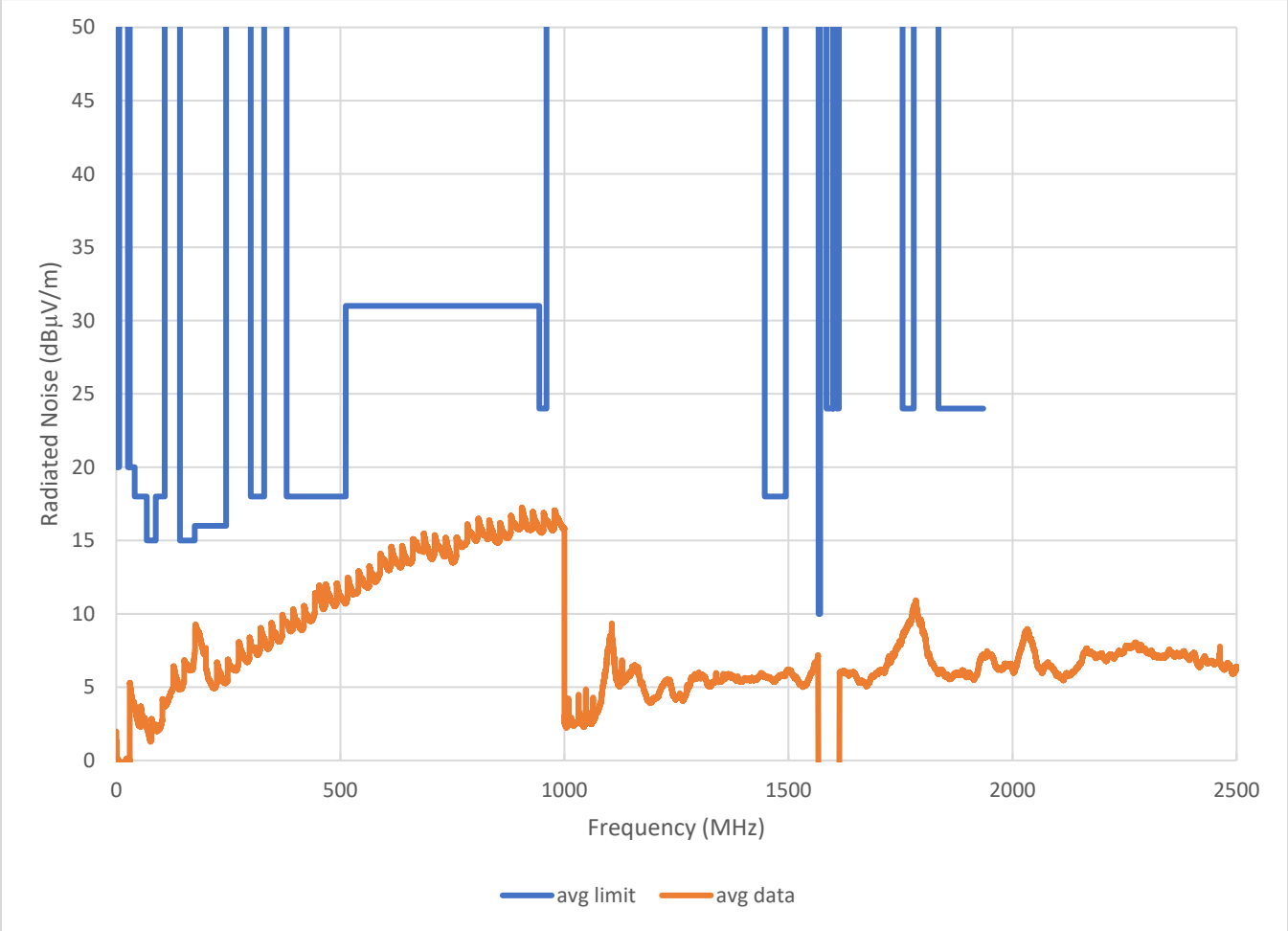
3.7 Summary of Test Results

Overall Result: PASS

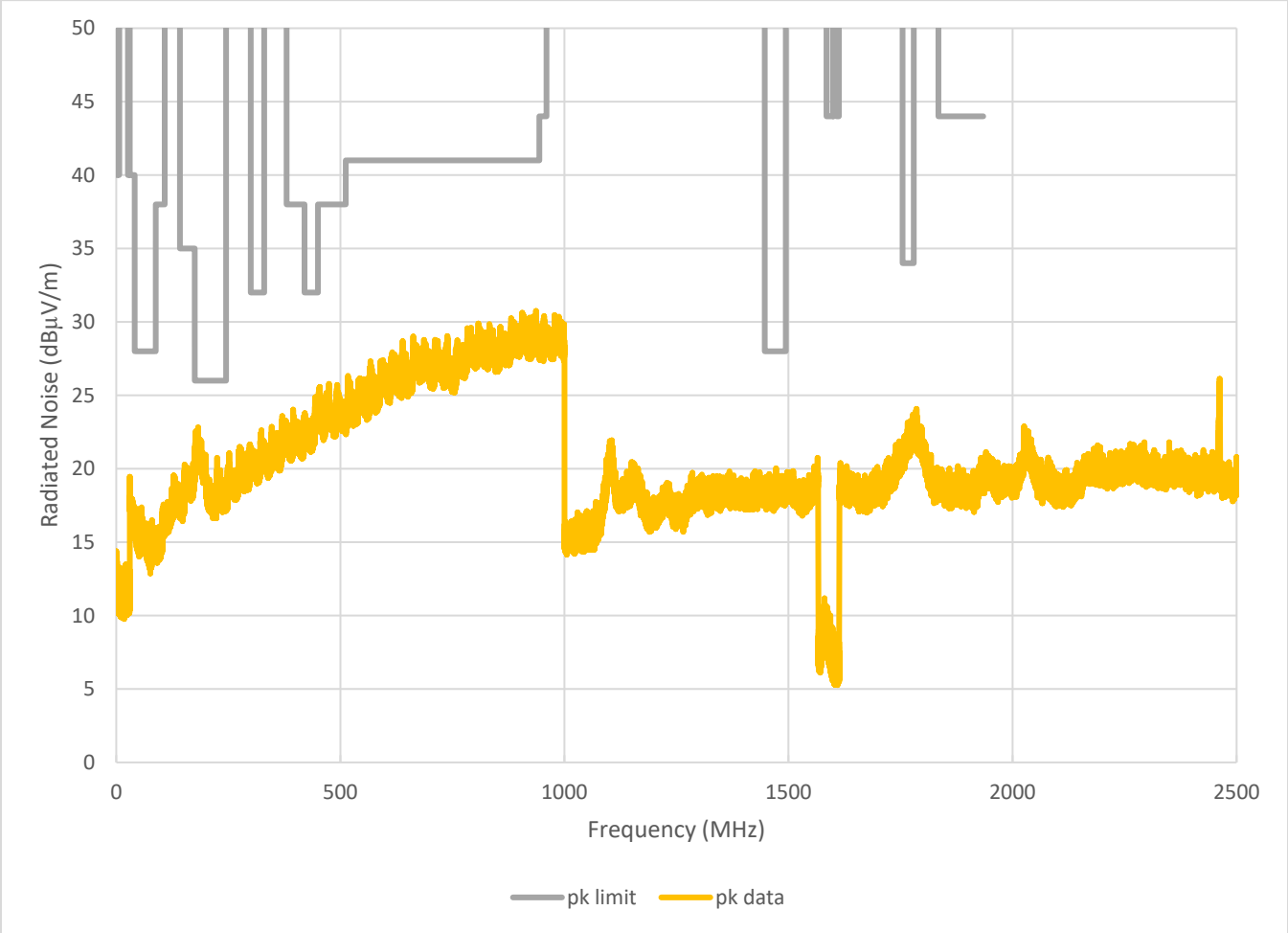
Table 10 Radiated Emissions Test Results Summary

ANTENNA POSITION	TEST RESULT/DEVIATIONS
Monopole	**PASS**
Biconical H	**PASS**
Biconical V	**PASS**
Log Periodic H	**PASS**
Log Periodic V	**PASS**
Horn H SER	**PASS**
Horn V SER	**PASS**
Horn H DES	**PASS**
Horn V DES	**PASS**

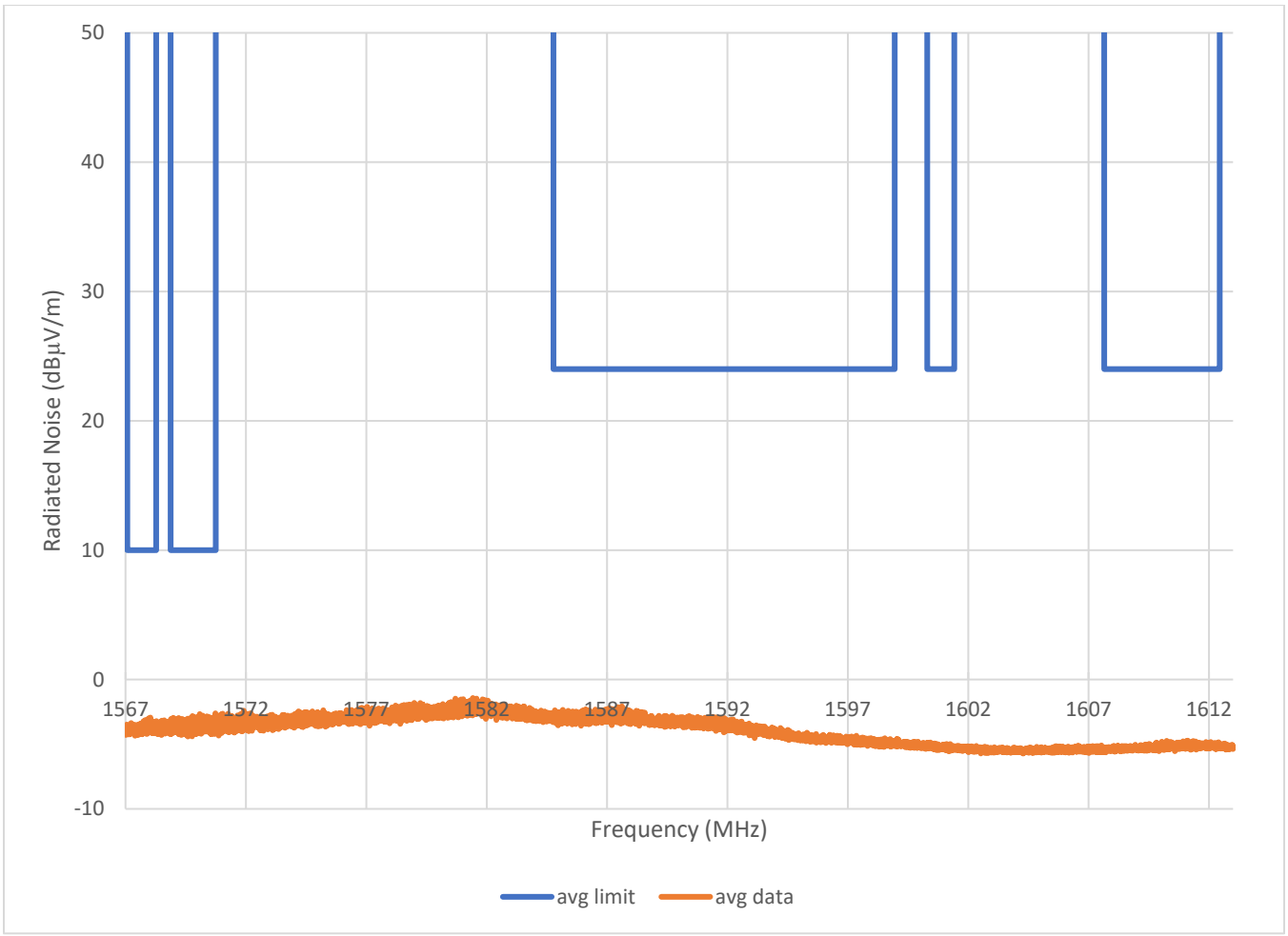
3.7.1Test Result Details



Plot 1. Radiated Emission Detailed Test Data – Average



Plot 2. Radiated Emissions Detailed Test Data – Peak



Plot 3. Radiated Emissions Detailed Test Data (GPS Band) – Average

4 Conducted Emissions

4.1 Test Procedure and Setup

Conducted emissions tests were performed according to the test procedures and setup conditions specified by CISPR25.

4.2 Test Equipment

Table 11 Conducted Emissions Equipment List

FUNCTION	INSTRUMENT
EMI Test Receiver	R&S ESRP
Current Probe	ETS 94430-1

4.3 Environmental Conditions

Table 12 Conducted Emissions Environmental Conditions

PARAMETER	VALUE
Temperature	Room

4.4 Measurement Uncertainty/Calibration

All equipment is calibrated as required.

4.5 Overview of Test and Test Conditions

Table 13 Overview of Conducted Emissions Test Details and Conditions

Results	**PASSED** all conducted emissions tests
Standard	CISPR25 Class 5 (edition 4.0)
Part Numbers	MAX96717, MAX96724
Configuration	6Gbps/187Mbps, Single Link, PoC, RoR, SS ON 2530ppm rev channel, Coax, HFM, 2m cable
Test Setup	See *Setup Pictures* (Section 4.6)
EUT Power	12V supply and LISN at DES, SER power through PoC
Ground	Chassis ground lead connected to DES SER does not include local chassis GND
Additional Notes	-
Clamp Positions	50mm and 750mm from each SER and DES
Frequency Range	150kHz to 245MHz
Limit Level	Class 5

4.5.1Pass/Fail Criteria

- The presence of one or more measurement points at or above the peak or average emissions limit is considered a failure.

4.6 Setup Pictures

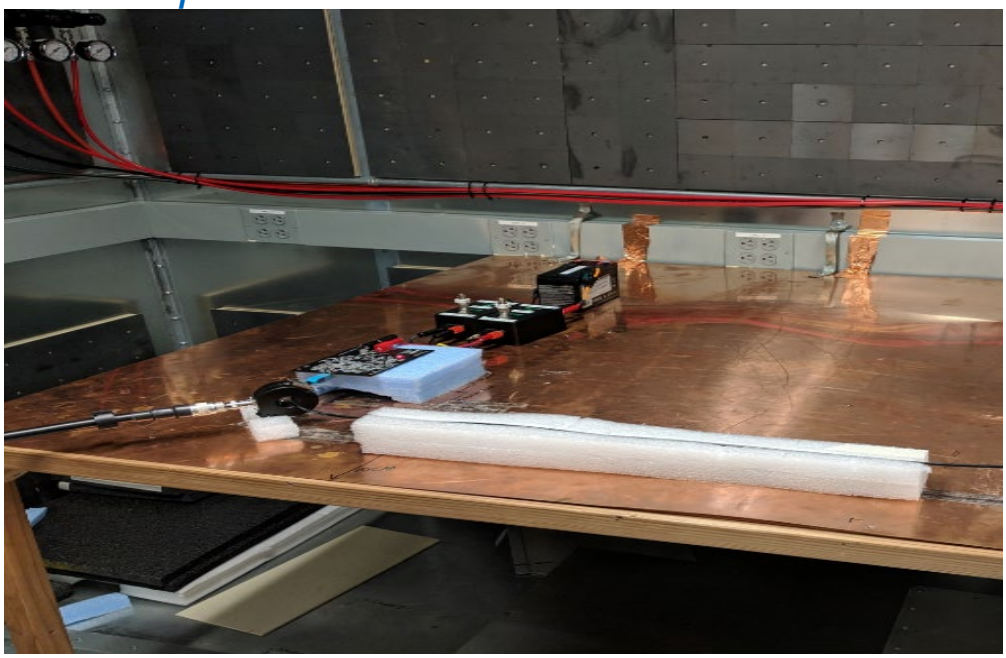


Figure 5. Current Probe 50mm from the Serializer

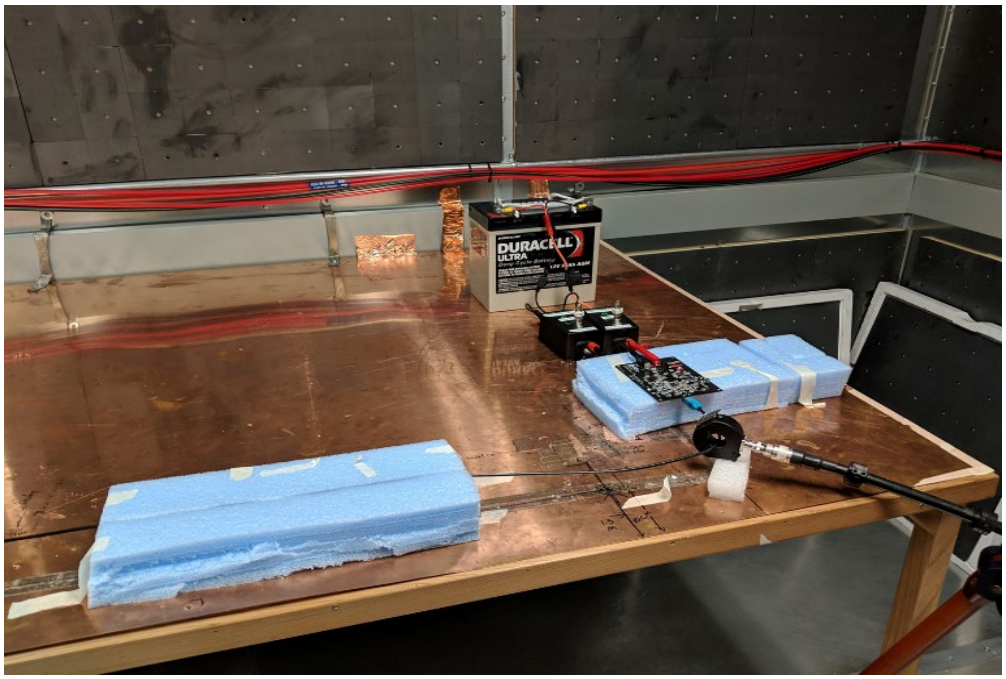


Figure 6. Current Probe 50mm from the Deserializer

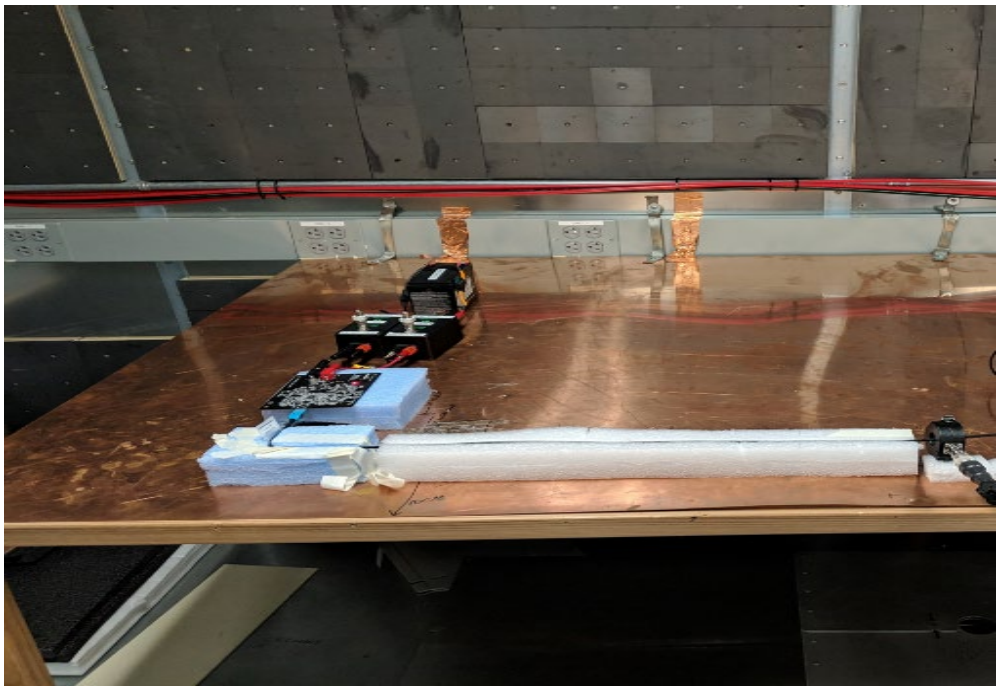


Figure 7. Current Probe 750mm from the Serializer

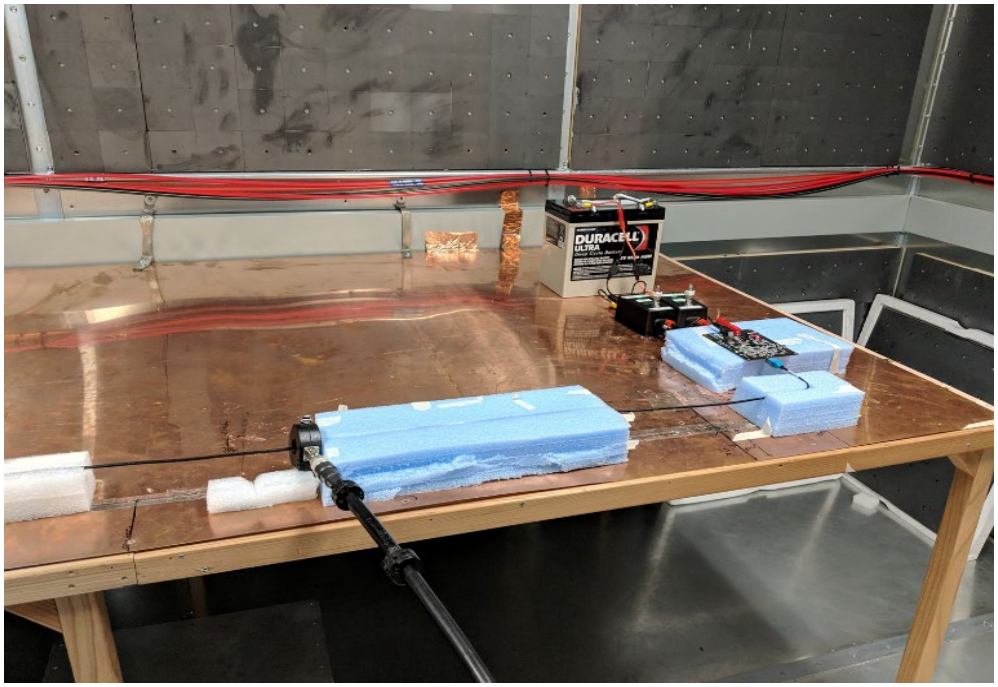


Figure 8. Current Probe 750mm from the Deserializer

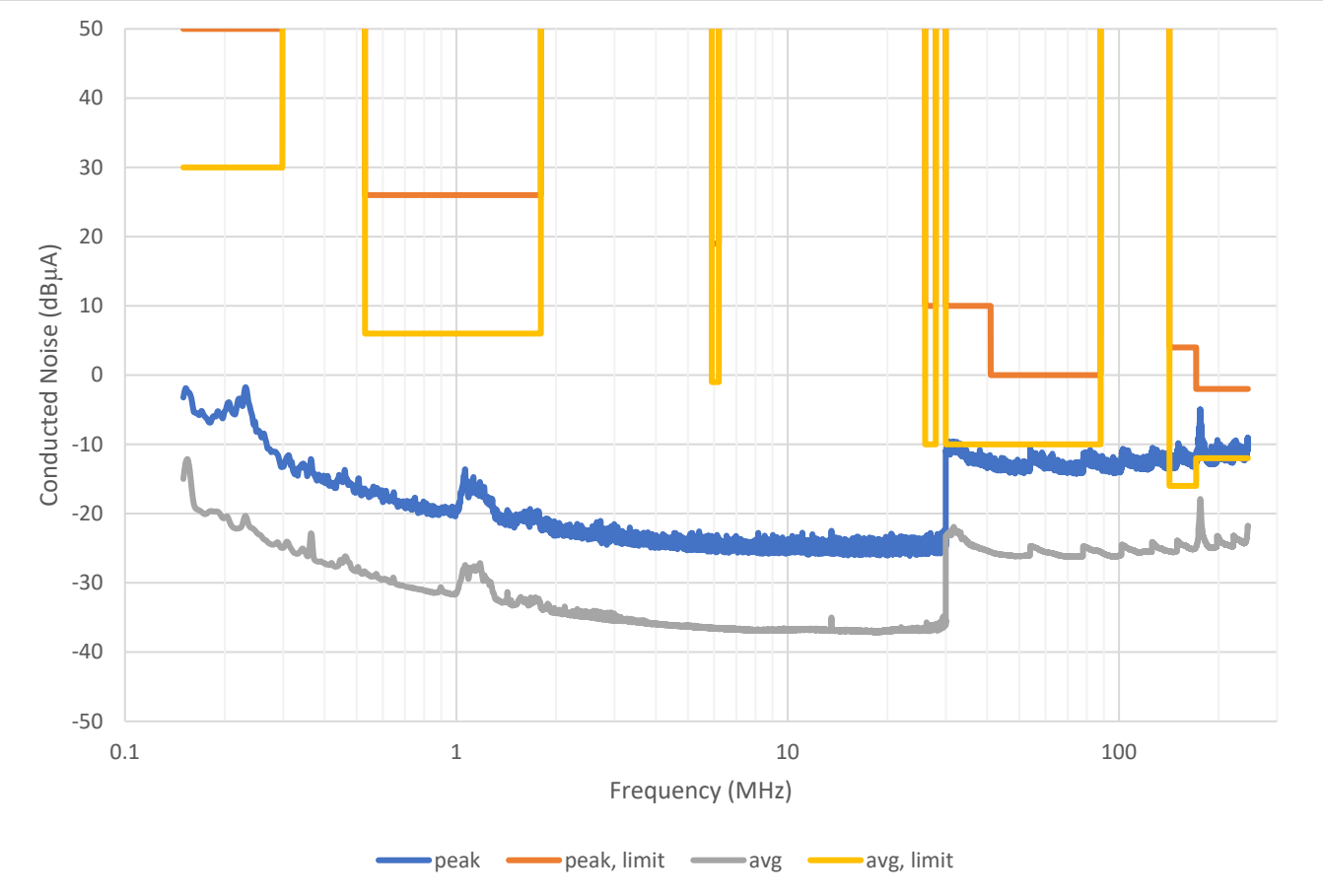
4.7 Summary of Test Results

Overall Result: PASS

Table 14 Conducted Emissions Test Results Summary

CLAMP POSITION	TEST RESULT/DEVIATIONS
50mm from SER	**PASS**
50mm from DES	**PASS**
750mm from SER	**PASS**
750mm from DES	**PASS**

4.7.1Test Result Details



Plot 4. Conducted Emissions Detailed Test Data

5 Bulk Current Injection

5.1 Test Procedure and Setup

The bulk current injection (BCI) tests were performed according to the test procedures and setup conditions specified by ISO-11452-4.

5.2 Test Equipment

Table 15 BCI Equipment List

FUNCTION	INSTRUMENT
BCI Tester	Schlöder CDG7000
BCI Injection Clamp	Schlöder BCI-P1
BCI Calibration Fixture	Schlöder
BCI Monitor Clamp	The EMC Shop RFCP500M

5.3 Environmental Conditions

Table 16 BCI Environmental Conditions

PARAMETER	VALUE
Temperature	Room

5.4 Measurement Uncertainty/Calibration

The BCI injection levels are calibrated in the BCI calibration fixture to specified limits. The system under test is then substituted for the calibration fixture as specified for the substitution method. Actual injected levels may vary significantly from calibrated levels and as a function of frequency.

5.5 Overview of Test and Test Conditions

Table 17 Overview of BCI Test Details and Conditions

Results	**PASSED** all BCI tests
Standard	ISO11452-4 (level 2)
Part Numbers	MAX96717, MAX96724
Configuration	6Gbps/187Mbps, Single Link, PoC, RoR, SS ON 2530ppm rev channel, Coax, HFM, 2m cable
Test Setup	See *Setup Pictures* (Section 5.6)
EUT Power	12V supply and LISN at DES, SER power through PoC
Ground	Chassis ground lead connected to DES SER does not include local chassis GND
Additional Notes	-
Clamp Positions	6 clamp positions: 150mm, 450mm, 750mm from each serializer and deserializer Frequency ranges for each clamp position are specified to cover both CBCI and DBCI requirements.
Frequency Range	150mm clamp position → 1MHz–60MHz (DBCI) 450mm clamp position → 1MHz–400MHz (DBCI and CBCI)

	750mm clamp position → 60MHz–400MHz (CBCI) System is physically a CBCI system, but we have used the full frequency test range including DBCI.
Injection Level	Level 2 Max current in calibration fixture = 200mA See the *Pass/Fail Criteria* section
Other Test Details	Dwell time: 2 seconds per frequency point for each modulation scheme AM Modulation: 1kHz, 80% CW Modulation

5.5.1Nominal Test Level/Frequency Details

BCI Injection Levels (tested at level 2)
(calibrated levels shown; actual injected current varies)

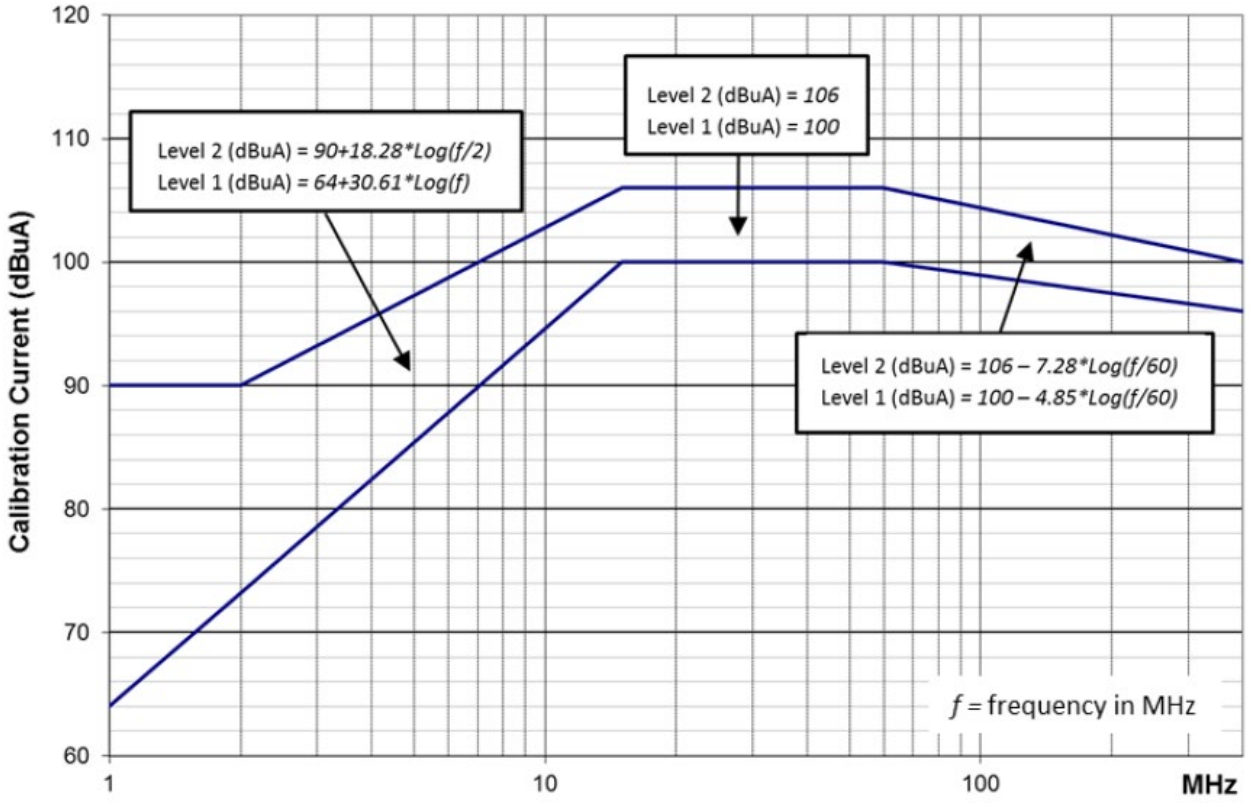


Figure 9 Nominal BCI Injection Levels

5.5.2Pass/Fail Criteria

- During test, monitor LOCK and ERRB LEDs/signals:
  - Lock LED must remain illuminated continuously. No Loss of lock is permitted.

    - ERRB LED must not be illuminated during test; error reporting should be configured to report only errors that constitute a failure state as specified below.
    - Note failure frequency if either of the two LEDs indicates a problem.
- Test is considered to have failed if Decode errors (or uncorrectable FEC errors if FEC is enabled), ARQ max retry errors, or loss of lock errors are observed.

5.6 Setup Pictures

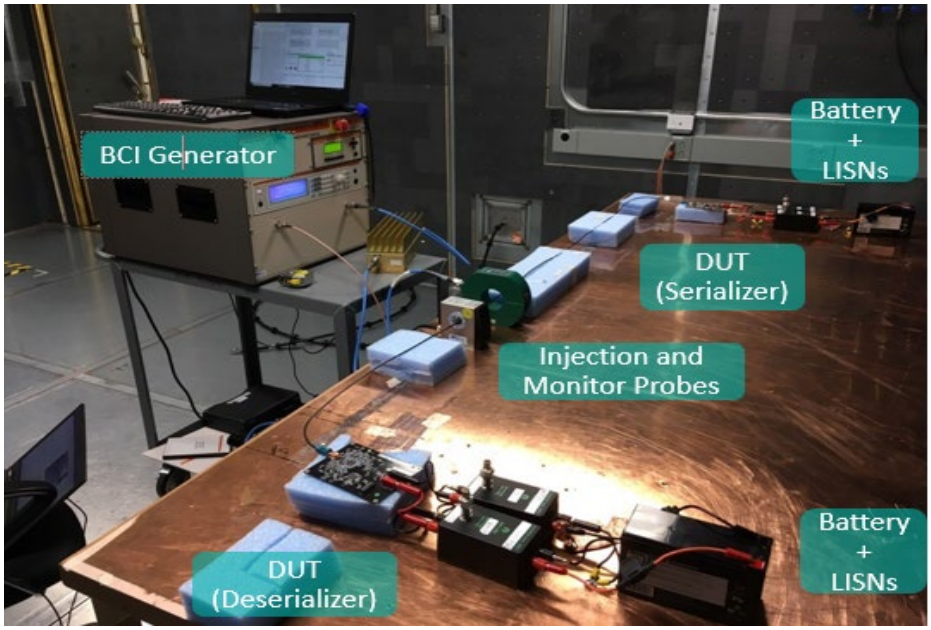


Figure 10. BCI Test Setup

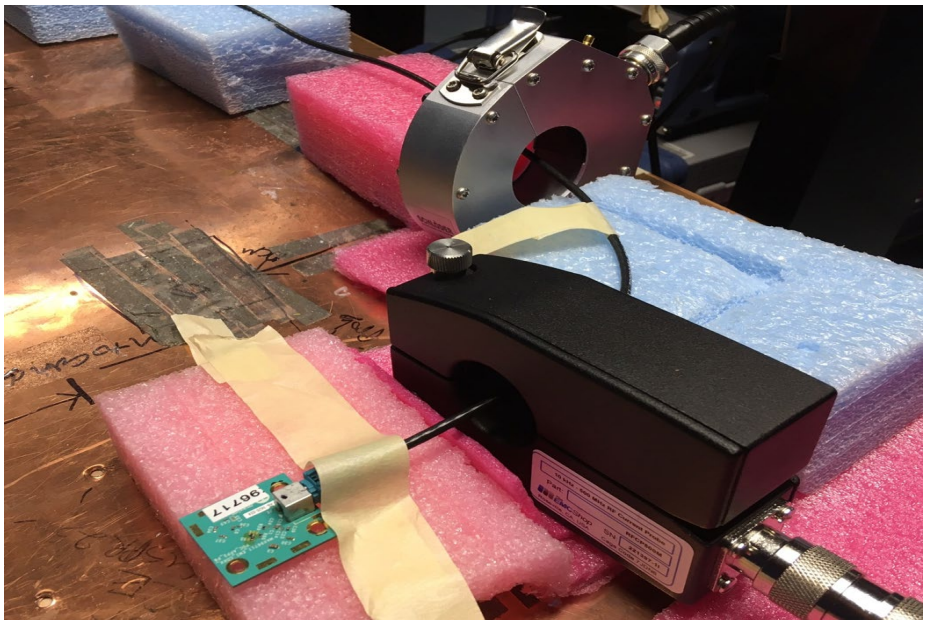


Figure 11. BCI Test Setup with 2m Cable

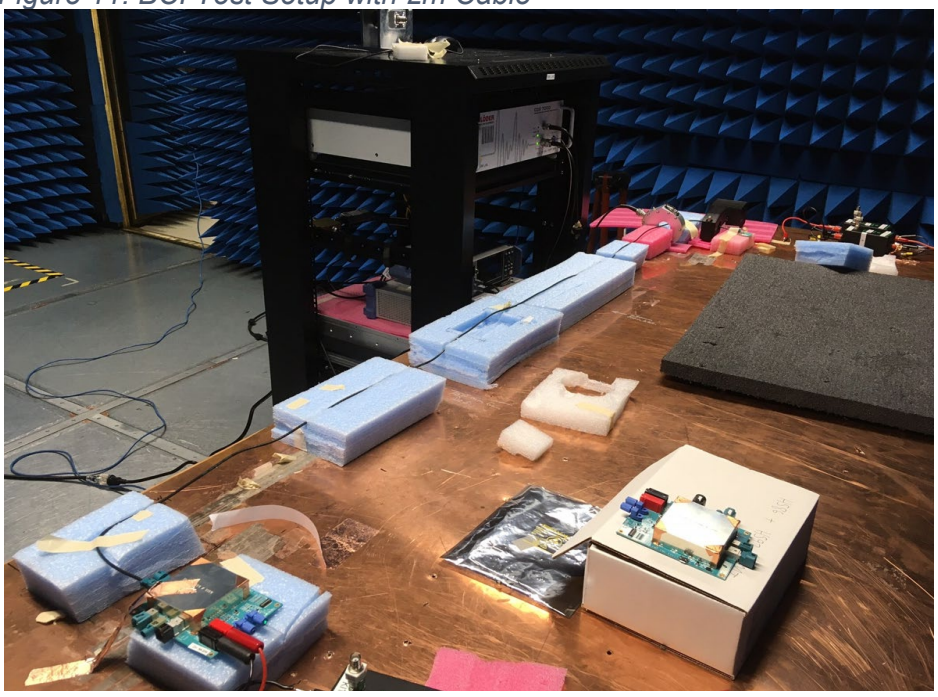


Figure 12. BCI Test Setup with 2m Cable

Figure 13. BCI Test Setup with 2m Cable

5.7 Summary of Test Results

Overall Result: PASS

Table 18 BCI Test Results Summary

CLAMP POSITION	FREQUENCY RANGE	RESULT
150mm from SER	1MHz–60MHz	**PASS**
450mm from SER	1MHz–400MHz	**PASS**
750mm from SER	60MHz–400MHz	**PASS**
150mm from DES	1MHz–60MHz	**PASS**
450mm from DES	1MHz–400MHz	**PASS**
750mm from DES	60MHz–400MHz	**PASS**

5.8 Plot of BCI Calibration Data

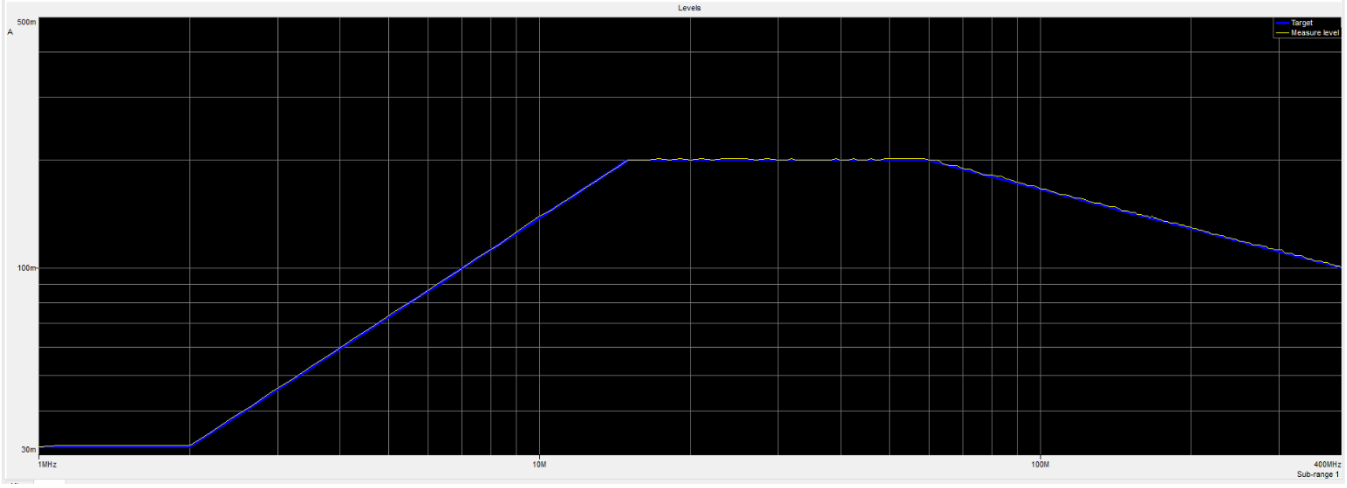


Figure 14 BCI Calibration Cycle

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION
0	7/23	Initial release