



Report No.: SZEM190401266002

1 of 92 Page:

TEST REPORT

Application No.: SZEM1904012660CR

Applicant: Shenzhen Earfun Technology Co., Ltd.

Room 503, No. 3, PingShanMingQi Technology Park PingShan 1st Road, Address of Applicant:

NanShan District, Shenzhen, China 518000

Manufacturer: Shenzhen Earfun Technology Co., Ltd.

Address of Manufacturer: Room 503, 5th Floor, 3rd Building, PingShanMingQi Technology Park,

LiShan Road 65#, PingShan Community, TaoYuan Street, NanShan

District, Shenzhen

Factory: Dongguan Tenji Industrial Co., Ltd.

Address of Factory: No.7, Haiyi Road, Chongtou Community, Chang'an Town, Dongguan, City,

Guangdong Province, P.R. China

Equipment Under Test (EUT):

EUT Name: True wireless earbuds

Model No.: TW100 Trade mark: EarFun

FCC ID: 2ASK7-TW100

47 CFR Part 15, Subpart C 15.247 Standard(s):

Date of Receipt: 2019-04-11

2019-04-23 to 2019-04-30 Date of Test:

Date of Issue: 2019-05-07

Test Result: Pass*

中国・深圳・科技园中区M-10栋一号厂房

Keny Xu **EMC Laboratory Manager**



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^{*} In the configuration tested, the EUT complied with the standards specified above.



Report No.: SZEM190401266002

Page: 2 of 92

| | Revision Record | | | | | | | |
|---------|--------------------------------------|------------|--|----------|--|--|--|--|
| Version | Version Chapter Date Modifier Remark | | | | | | | |
| 01 | | 2019-05-07 | | Original | | | | |
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| Authorized for issue by: | | |
|--------------------------|--------------------------|--|
| | Co. Ci | |
| | Leo Li /Project Engineer | |
| | EvicFu | |
| | Eric Fu /Reviewer | |



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Report No.: SZEM190401266002

Page: 3 of 92

Test Summary

| Radio Spectrum Technical Requirement | | | | | | | |
|--|-------------------------------------|--------|---|--------|--|--|--|
| Item | Standard | Method | Requirement | Result | | | |
| Antenna Requirement | 47 CFR Part 15, Subpart C 15.247 | N/A | 47 CFR Part 15, Subpart C 15.203 & 15.247(b)(4) | Pass | | | |
| Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence | 47 CFR Part 15, Subpart C 15.247 | N/A | 47 CFR Part 15, Subpart C 15.247(a)(1),(g),(h) | Pass | | | |

| Radio Spectrum Matter Part | | | | | | | |
|---|-------------------------------------|---|--|--------|--|--|--|
| Item | Standard | Method | Requirement | Result | | | |
| Conducted Peak Output Power | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 7.8.5 | 47 CFR Part 15, Subpart C 15.247(b)(1) | Pass | | | |
| 20dB Bandwidth | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 7.8.7 | 47 CFR Part 15, Subpart C 15.247(a)(1) | Pass | | | |
| Carrier Frequencies Separation | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 7.8.2 | 47 CFR Part 15, Subpart C 15.247a(1) | Pass | | | |
| Hopping Channel Number | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 7.8.3 | 47 CFR Part 15, Subpart C 15.247a(1)(iii) | Pass | | | |
| Dwell Time | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 7.8.4 | 47 CFR Part 15, Subpart C 15.247a(1)(iii) | Pass | | | |
| Conducted Band Edges Measurement | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 7.8.6 | 47 CFR Part 15, Subpart C 15.247(d) | Pass | | | |
| Conducted Spurious Emissions | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 7.8.8 | 47 CFR Part 15, Subpart C 15.247(d) | Pass | | | |
| Radiated Emissions which fall in the restricted bands | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 6.10.5 | 47 CFR Part 15, Subpart C 15.205 & 15.209 | Pass | | | |
| Radiated Spurious Emissions | 47 CFR Part 15, Subpart C 15.247 | ANSI C63.10 (2013) Section 6.4,6.5,6.6 | 47 CFR Part 15, Subpart C 15.205 & 15.209 | Pass | | | |



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Report No.: SZEM190401266002

Page: 4 of 92

Contents

| 1 COVER PAGE 2 TEST SUMMARY | | | Page |
|---|---|--|------|
| 3 CONTENTS | 1 | COVER PAGE | 1 |
| 4.1 DETAILS OF E.U.T. 4.2 DESCRIPTION OF SUPPORT UNITS. 4.3 MEASUREMENT UNCERTAINTY 4.4 TEST LOCATION 4.5 TEST FACILITY. 4.6 DEVIATION FROM STANDARDS. 4.7 ABNORMALITIES FROM STANDARD CONDITIONS 5 EQUIPMENT LIST 6 RADIO SPECTRUM TECHNICAL REQUIREMENT | 2 | TEST SUMMARY | 3 |
| 4.1 DETAILS OF E.U.T. 4.2 DESCRIPTION OF SUPPORT UNITS. 4.3 MEASUREMENT UNCERTAINTY. 4.4 TEST LOCATION. 4.5 TEST FACILITY. 4.6 DEVIATION FROM STANDARDS. 4.7 ABNORMALTIES FROM STANDARD CONDITIONS. 5 EQUIPMENT LIST. 6 RADIO SPECTRUM TECHNICAL REQUIREMENT 6.1 ANTENNA REQUIREMENT 6.1 6.1.2 Conclusion 1 6.2.2 Conclusion 6.2.3 OTHER REQUIREMENTS FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM HOPPING SEQUENCE 6.2.2 Conclusion 7 RADIO SPECTRUM MATTER TEST RESULTS 7.1 CONDUCTED PEAK OUTPUT POWER 7.1.1 E.U.T. Operation 7.1.2 Test Setup Diagram 7.1.3 Measurement Procedure and Data 7.2.2 Test Setup Diagram 7.2.3 Measurement Procedure and Data 7.3.1 E.U.T. Operation 7.3.2 Test Setup Diagram 7.4.1 E.U.T. Operation 7.5.2 Test Setup Diagram 7.4.1 | 3 | CONTENTS | 4 |
| 4.1 DETAILS OF E.U.T. 4.2 DESCRIPTION OF SUPPORT UNITS. 4.3 MEASUREMENT UNCERTAINTY. 4.4 TEST LOCATION. 4.5 TEST FACILITY. 4.6 DEVIATION FROM STANDARDS. 4.7 ABNORMALTIES FROM STANDARD CONDITIONS. 5 EQUIPMENT LIST. 6 RADIO SPECTRUM TECHNICAL REQUIREMENT 6.1 ANTENNA REQUIREMENT 6.1 6.1.2 Conclusion 1 6.2.2 Conclusion 6.2.3 OTHER REQUIREMENTS FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM HOPPING SEQUENCE 6.2.2 Conclusion 7 RADIO SPECTRUM MATTER TEST RESULTS 7.1 CONDUCTED PEAK OUTPUT POWER 7.1.1 E.U.T. Operation 7.1.2 Test Setup Diagram 7.1.3 Measurement Procedure and Data 7.2.2 Test Setup Diagram 7.2.3 Measurement Procedure and Data 7.3.1 E.U.T. Operation 7.3.2 Test Setup Diagram 7.4.1 E.U.T. Operation 7.5.2 Test Setup Diagram 7.4.1 | 4 | GENERAL INFORMATION | 6 |
| 4.2 DESCRIPTION OF SUPPORT UNITS 4.3 MEASUREMENT UNCERTAINTY 4.4 TEST LOCATION 4.5 TEST FACILITY 4.6 DEVIATION FROM STANDARDS 4.7 ABNORMALITIES FROM STANDARD CONDITIONS 5 EQUIPMENT LIST 6 RADIO SPECTRUM TECHNICAL REQUIREMENT 1 6.1 ANTENNA REQUIREMENT 1 6.1.1 Test Requirement 1 6.1.2 Conclusion 1 6.2.1 Test Requirement 1 6.2.2 Conclusion 1 7 RADIO SPECTRUM MATTER TEST RESULTS 1 7.1 CONDUCTED PEAK OUTPUT POWER 1 7.1.1 E.U.T. Operation 1 7.1.2 Test Setup Diagram 1 7.1.3 Measurement Procedure and Data 1 7.2.1 Full Operation 1 7.2.2 Test Setup Diagram 1 7.2.3 Measurement Procedure and Data 1 7.3.1 CARRIER FREQUENCIES SEPARATION 1 7.3.2 Test Setup Diagram 1 <tr< th=""><th>•</th><th></th><th></th></tr<> | • | | |
| 4.3 MEASUREMENT UNCERTAINTY 4.4 TEST LOCATION 4.5 TEST FACILITY 4.6 DEVIATION FROM STANDARDS 4.7 ABNORMALITIES FROM STANDARD CONDITIONS 5 EQUIPMENT LIST | | | |
| 4.5 TEST FACILITY. 4.6 DEVIATION FROM STANDARDS. 4.7 ABNORMALITIES FROM STANDARD CONDITIONS. 5 EQUIPMENT LIST | | 4.3 MEASUREMENT UNCERTAINTY | 6 |
| 4.6 DEVIATION FROM STANDARDS 4.7 ABNORMALITIES FROM STANDARD CONDITIONS 5 EQUIPMENT LIST | | | |
| 4.7 ABNORMALITIES FROM STANDARD CONDITIONS 5 EQUIPMENT LIST 6 RADIO SPECTRUM TECHNICAL REQUIREMENT 6.1 ANTENNA REQUIREMENT 1 6.1.1 Test Requirement: 6.1.2 Conclusion 1 6.2.2 OTHER REQUIREMENTS FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM HOPPING SEQUENCE 1 6.2.1 Test Requirement: 1 6.2.2 Conclusion 1 7 RADIO SPECTRUM MATTER TEST RESULTS 1 7.1.1 E.U.T. Operation 1 7.1.2 Test Setup Diagram 1 7.1.3 Measurement Procedure and Data 1 7.2.1 E.U.T. Operation 1 7.2.2 Test Setup Diagram 1 7.2.3 Measurement Procedure and Data 1 7.3.1 E.U.T. Operation 1 7.3.2 Test Setup Diagram 1 7.3.3 Measurement Procedure and Data 1 7.4.1 E.U.T. Operation 1 7.4.2 Test Setup Diagram 1 7.4.3 Measurement Procedure and Data 1 7.4.1 E.U.T. Operation 1 7.4.2 Test Setup Diagram 1 7.5.1 E.U.T. Operation 2 < | | | |
| 6 RADIO SPECTRUM TECHNICAL REQUIREMENT 1 6.1 ANTENNA REQUIREMENT 1 6.1.1 Test Requirement: 1 6.1.2 Conclusion 1 6.2 OTHER REQUIREMENTS FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM HOPPING SEQUENCE 1 6.2.1 Test Requirement: 1 6.2.2 Conclusion 1 7 RADIO SPECTRUM MATTER TEST RESULTS 1 7.1 CONDUCTED PEAK OUTPUT POWER 1 7.1.1 E.U.T. Operation 1 7.1.2 Test Setup Diagram 1 7.1.3 Measurement Procedure and Data 1 7.2.1 E.U.T. Operation 1 7.2.2 Test Setup Diagram 1 7.3.1 E.U.T. Operation 1 7.3.2 Test Setup Diagram 1 7.3.3 Measurement Procedure and Data 1 7.4.1 E.U.T. Operation 1 7.4.2 Test Setup Diagram 1 7.4.3 Measurement Procedure and Data 1 7.4.1 E.U.T. Operation 1 7.5.2 <th></th> <th></th> <th></th> | | | |
| 6.1 ANTENNA REQUIREMENT 1 6.1.1 Test Requirement 1 6.1.2 Conclusion 1 6.2 OTHER REQUIREMENTS FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM HOPPING SEQUENCE 1 6.2.1 Test Requirement 1 6.2.2 Conclusion 1 7 RADIO SPECTRUM MATTER TEST RESULTS 1 7.1 CONDUCTED PEAK OUTPUT POWER 1 7.1.1 E.U.T. Operation 1 7.1.2 Test Setup Diagram 1 7.1.3 Measurement Procedure and Data 1 7.2.1 E.U.T. Operation 1 7.2.2 Test Setup Diagram 1 7.2.3 Measurement Procedure and Data 1 7.3.1 E.U.T. Operation 1 7.3.2 Test Setup Diagram 1 7.3.3 Measurement Procedure and Data 1 7.4.1 E.U.T. Operation 1 7.4.2 Test Setup Diagram 1 7.4.3 Measurement Procedure and Data 1 7.4.1 E.U.T. Operation 1 7.4.2 | 5 | EQUIPMENT LIST | 8 |
| 6.1 ANTENNA REQUIREMENT 1 6.1.1 Test Requirement 1 6.1.2 Conclusion 1 6.2 OTHER REQUIREMENTS FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM HOPPING SEQUENCE 1 6.2.1 Test Requirement 1 6.2.2 Conclusion 1 7 RADIO SPECTRUM MATTER TEST RESULTS 1 7.1 CONDUCTED PEAK OUTPUT POWER 1 7.1.1 E.U.T. Operation 1 7.1.2 Test Setup Diagram 1 7.1.3 Measurement Procedure and Data 1 7.2.1 E.U.T. Operation 1 7.2.2 Test Setup Diagram 1 7.2.3 Measurement Procedure and Data 1 7.3.1 E.U.T. Operation 1 7.3.2 Test Setup Diagram 1 7.3.3 Measurement Procedure and Data 1 7.4.1 E.U.T. Operation 1 7.4.2 Test Setup Diagram 1 7.4.3 Measurement Procedure and Data 1 7.4.1 E.U.T. Operation 1 7.4.2 | _ | DADIO ODEOTRUM TEQUINOAL DEQUIDEMENT | 40 |
| 6.1.1 Test Requirement: 1 6.1.2 Conclusion 1 6.2 OTHER REQUIREMENTS FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM HOPPING SEQUENCE 1 6.2.1 Test Requirement: 1 6.2.2 Conclusion 1 7 RADIO SPECTRUM MATTER TEST RESULTS 1 7.1 CONDUCTED PEAK OUTPUT POWER 1 7.1.1 E.U.T. Operation 1 7.1.2 Test Setup Diagram 1 7.1.3 Measurement Procedure and Data 1 7.2.1 E.U.T. Operation 1 7.2.2 Test Setup Diagram 1 7.2.3 Measurement Procedure and Data 1 7.3.1 E.U.T. Operation 1 7.3.2 Test Setup Diagram 1 7.3.3 Measurement Procedure and Data 1 7.4 HOPPING CHANNEL NUMBER 1 7.4.1 E.U.T. Operation 1 7.4.2 Test Setup Diagram 1 7.4.3 Measurement Procedure and Data 1 7.5.1 E.U.T. Operation 2 7.5.2 Test Setup Diagram 1 7.5.2 Test Setup Diagram 2 7.5.2 Test Setup Diagram 2 7.5.2 Test Setup Diagram 2 | ь | | |
| 6.1.2 Conclusion 1 6.2 OTHER REQUIREMENTS FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM HOPPING SEQUENCE 1 6.2.1 Test Requirement: 1 6.2.2 Conclusion 1 7 RADIO SPECTRUM MATTER TEST RESULTS 1 7.1 CONDUCTED PEAK OUTPUT POWER 1 7.1.1 E.U.T. Operation 1 7.1.2 Test Setup Diagram 1 7.1.3 Measurement Procedure and Data 1 7.2.1 E.U.T. Operation 1 7.2.2 Test Setup Diagram 1 7.2.3 Measurement Procedure and Data 1 7.3 CARRIER FREQUENCIES SEPARATION 1 7.3.1 E.U.T. Operation 1 7.3.2 Test Setup Diagram 1 7.3.3 Measurement Procedure and Data 1 7.4 HOPPING CHANNEL NUMBER 1 7.4.1 E.U.T. Operation 1 7.4.2 Test Setup Diagram 1 7.4.3 Measurement Procedure and Data 1 7.5.1 E.U.T. Operation 2 7.5.2 Test Setup Diagram 2 7.5.2 Test Setup Diagram 2 | | | |
| 6.2 OTHER REQUIREMENTS FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM HOPPING SEQUENCE 1 6.2.1 Test Requirement: 1 6.2.2 Conclusion 1 7 RADIO SPECTRUM MATTER TEST RESULTS 1 7.1 CONDUCTED PEAK OUTPUT POWER 1 7.1.1 E.U.T. Operation 1 7.1.2 Test Setup Diagram 1 7.1.3 Measurement Procedure and Data 1 7.2.1 E.U.T. Operation 1 7.2.2 Test Setup Diagram 1 7.2.3 Measurement Procedure and Data 1 7.3.1 E.U.T. Operation 1 7.3.2 Test Setup Diagram 1 7.4.1 E.U.T. Operation 1 7.4.2 Test Setup Diagram 1 7.4.3 Measurement Procedure and Data 1 7.4.3 Measurement Procedure and Data 1 7.4.3 Measurement Procedure and Data 1 7.5.1 E.U.T. Operation 1 7.5.2 Test Setup Diagram 2 7.5.1 E.U.T. Operation 2 | | | |
| 6.2.2 Conclusion 1 7 RADIO SPECTRUM MATTER TEST RESULTS 1 7.1 CONDUCTED PEAK OUTPUT POWER 1 7.1.1 E.U.T. Operation 1 7.1.2 Test Setup Diagram 1 7.1.3 Measurement Procedure and Data 1 7.2 20DB BANDWIDTH 1 7.2.1 E.U.T. Operation 1 7.2.2 Test Setup Diagram 1 7.2.3 Measurement Procedure and Data 1 7.3 CARRIER FREQUENCIES SEPARATION 1 7.3.1 E.U.T. Operation 1 7.3.2 Test Setup Diagram 1 7.3.3 Measurement Procedure and Data 1 7.4 HOPPING CHANNEL NUMBER 1 7.4.1 E.U.T. Operation 1 7.4.2 Test Setup Diagram 1 7.4.3 Measurement Procedure and Data 1 7.5 DWELL TIME 2 7.5.1 E.U.T. Operation 2 7.5.2 Test Setup Diagram 2 7.5.2 Test Setup Diagram 2 | | 6.2 OTHER REQUIREMENTS FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM HOPPING SEQUENCE | 13 |
| 7 RADIO SPECTRUM MATTER TEST RESULTS 1 7.1 CONDUCTED PEAK OUTPUT POWER 1 7.1.1 E.U.T. Operation 1 7.1.2 Test Setup Diagram 1 7.1.3 Measurement Procedure and Data 1 7.2 200B BANDWIDTH 1 7.2.1 E.U.T. Operation 1 7.2.2 Test Setup Diagram 1 7.2.3 Measurement Procedure and Data 1 7.3 CARRIER FREQUENCIES SEPARATION 1 7.3.1 E.U.T. Operation 1 7.3.2 Test Setup Diagram 1 7.3.3 Measurement Procedure and Data 1 7.4 HOPPING CHANNEL NUMBER 1 7.4.1 E.U.T. Operation 1 7.4.2 Test Setup Diagram 1 7.4.3 Measurement Procedure and Data 1 7.5 DWELL TIME 2 7.5.1 E.U.T. Operation 2 7.5.2 Test Setup Diagram 2 7.5.2 Test Setup Diagram 2 | | • | |
| 7.1 CONDUCTED PEAK OUTPUT POWER 1 7.1.1 E.U.T. Operation 1 7.1.2 Test Setup Diagram 1 7.1.3 Measurement Procedure and Data 1 7.2 20DB BANDWIDTH 1 7.2.1 E.U.T. Operation 1 7.2.2 Test Setup Diagram 1 7.2.3 Measurement Procedure and Data 1 7.3.1 E.U.T. Operation 1 7.3.2 Test Setup Diagram 1 7.3.3 Measurement Procedure and Data 1 7.4 HOPPING CHANNEL NUMBER 1 7.4.1 E.U.T. Operation 1 7.4.2 Test Setup Diagram 1 7.4.3 Measurement Procedure and Data 1 7.5 DWELL TIME 2 7.5.1 E.U.T. Operation 2 7.5.2 Test Setup Diagram 2 7.5.2 Test Setup Diagram 2 | | | |
| 7.1.1 E.U.T. Operation 1 7.1.2 Test Setup Diagram 1 7.1.3 Measurement Procedure and Data 1 7.2 20DB BANDWIDTH 1 7.2.1 E.U.T. Operation 1 7.2.2 Test Setup Diagram 1 7.2.3 Measurement Procedure and Data 1 7.3 CARRIER FREQUENCIES SEPARATION 1 7.3.1 E.U.T. Operation 1 7.3.2 Test Setup Diagram 1 7.3.3 Measurement Procedure and Data 1 7.4 HOPPING CHANNEL NUMBER 1 7.4.1 E.U.T. Operation 1 7.4.2 Test Setup Diagram 1 7.4.3 Measurement Procedure and Data 1 7.5 DWELL TIME 2 7.5.1 E.U.T. Operation 2 7.5.2 Test Setup Diagram 2 7.5.2 Test Setup Diagram 2 | 7 | RADIO SPECTRUM MATTER TEST RESULTS | 15 |
| 7.1.2 Test Setup Diagram 1 7.1.3 Measurement Procedure and Data 1 7.2 20DB BANDWIDTH 1 7.2.1 E.U.T. Operation 1 7.2.2 Test Setup Diagram 1 7.2.3 Measurement Procedure and Data 1 7.3 CARRIER FREQUENCIES SEPARATION 1 7.3.1 E.U.T. Operation 1 7.3.2 Test Setup Diagram 1 7.3.3 Measurement Procedure and Data 1 7.4 HOPPING CHANNEL NUMBER 1 7.4.1 E.U.T. Operation 1 7.4.2 Test Setup Diagram 1 7.4.3 Measurement Procedure and Data 1 7.5 DWELL TIME 2 7.5.1 E.U.T. Operation 2 7.5.2 Test Setup Diagram 2 7.5.2 Test Setup Diagram 2 | | | |
| 7.1.3 Measurement Procedure and Data. 1 7.2 20DB BANDWIDTH | | | |
| 7.2 20DB BANDWIDTH 1 7.2.1 E.U.T. Operation 1 7.2.2 Test Setup Diagram 1 7.2.3 Measurement Procedure and Data 1 7.3 CARRIER FREQUENCIES SEPARATION 1 7.3.1 E.U.T. Operation 1 7.3.2 Test Setup Diagram 1 7.3.3 Measurement Procedure and Data 1 7.4 HOPPING CHANNEL NUMBER 1 7.4.1 E.U.T. Operation 1 7.4.2 Test Setup Diagram 1 7.4.3 Measurement Procedure and Data 1 7.5 DWELL TIME 2 7.5.1 E.U.T. Operation 2 7.5.2 Test Setup Diagram 2 | | 1 0 | |
| 7.2.2 Test Setup Diagram 1 7.2.3 Measurement Procedure and Data 1 7.3 CARRIER FREQUENCIES SEPARATION 1 7.3.1 E.U.T. Operation 1 7.3.2 Test Setup Diagram 1 7.3.3 Measurement Procedure and Data 1 7.4 HOPPING CHANNEL NUMBER 1 7.4.1 E.U.T. Operation 1 7.4.2 Test Setup Diagram 1 7.4.3 Measurement Procedure and Data 1 7.5 DWELL TIME 2 7.5.1 E.U.T. Operation 2 7.5.2 Test Setup Diagram 2 7.5.2 Test Setup Diagram 2 | | | |
| 7.2.3 Measurement Procedure and Data 1 7.3 CARRIER FREQUENCIES SEPARATION 1 7.3.1 E.U.T. Operation 1 7.3.2 Test Setup Diagram 1 7.3.3 Measurement Procedure and Data 1 7.4 HOPPING CHANNEL NUMBER 1 7.4.1 E.U.T. Operation 1 7.4.2 Test Setup Diagram 1 7.4.3 Measurement Procedure and Data 1 7.5 DWELL TIME 2 7.5.1 E.U.T. Operation 2 7.5.2 Test Setup Diagram 2 7.5.2 Test Setup Diagram 2 | | | |
| 7.3 CARRIER FREQUENCIES SEPARATION 1 7.3.1 E.U.T. Operation 1 7.3.2 Test Setup Diagram 1 7.3.3 Measurement Procedure and Data 1 7.4 HOPPING CHANNEL NUMBER 1 7.4.1 E.U.T. Operation 1 7.4.2 Test Setup Diagram 1 7.4.3 Measurement Procedure and Data 1 7.5 DWELL TIME 2 7.5.1 E.U.T. Operation 2 7.5.2 Test Setup Diagram 2 | | , , | |
| 7.3.1 E.U.T. Operation 1 7.3.2 Test Setup Diagram 1 7.3.3 Measurement Procedure and Data 1 7.4 HOPPING CHANNEL NUMBER 1 7.4.1 E.U.T. Operation 1 7.4.2 Test Setup Diagram 1 7.4.3 Measurement Procedure and Data 1 7.5 DWELL TIME 2 7.5.1 E.U.T. Operation 2 7.5.2 Test Setup Diagram 2 | | | |
| 7.3.3 Measurement Procedure and Data 1 7.4 HOPPING CHANNEL NUMBER 1 7.4.1 E.U.T. Operation 1 7.4.2 Test Setup Diagram 1 7.4.3 Measurement Procedure and Data 1 7.5 DWELL TIME 2 7.5.1 E.U.T. Operation 2 7.5.2 Test Setup Diagram 2 | | | |
| 7.4 HOPPING CHANNEL NUMBER | | | |
| 7.4.1E.U.T. Operation17.4.2Test Setup Diagram17.4.3Measurement Procedure and Data17.5DWELL TIME27.5.1E.U.T. Operation27.5.2Test Setup Diagram2 | | | |
| 7.4.2 Test Setup Diagram17.4.3 Measurement Procedure and Data17.5 DWELL TIME27.5.1 E.U.T. Operation27.5.2 Test Setup Diagram2 | | | |
| 7.5 DWELL TIME | | 7.4.2 Test Setup Diagram | 19 |
| 7.5.1 E.U.T. Operation | | | |
| 7.5.2 Test Setup Diagram2 | | | |
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Report No.: SZEM190401266002

Page: 5 of 92

| | 7.6 | CONDUCTED BAND EDGES MEASUREMENT | 22 |
|---|---------------|---|----|
| | 7.6.1 | | |
| | 7.6.2 | , | |
| | 7.6.3 | | |
| | 7.7 | CONDUCTED SPURIOUS EMISSIONS | 24 |
| | 7.7.1 | 1 E.U.T. Operation | 25 |
| | 7.7.2 | Part Setup Diagram | 25 |
| | 7.7.3 | Measurement Procedure and Data | 25 |
| | 7.8 | RADIATED EMISSIONS WHICH FALL IN THE RESTRICTED BANDS | |
| | 7.8.1 | 1 E.U.T. Operation | 28 |
| | 7.8.2 | 2 Test Setup Diagram | 28 |
| | 7.8.3 | B Measurement Procedure and Data | 29 |
| | 7.9 | RADIATED SPURIOUS EMISSIONS | |
| | <i>7.9.</i> 1 | 1 E.U.T. Operation | 35 |
| | 7.9.2 | | |
| | 7.9.3 | 3 Measurement Procedure and Data | 36 |
| 8 | PHO | TOGRAPHS | 45 |
| | 8.1 | TEST SETUP | 45 |
| | 8.2 | EUT CONSTRUCTIONAL DETAILS (EUT PHOTOS) | |
| 9 | APP | ENDIX | 46 |
| | 9.1 | APPENDIX 15.247 | 46 |



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Report No.: SZEM190401266002

Page: 6 of 92

General Information

4.1 Details of E.U.T.

| Power supply: | Lithium Ion Battery: 3.7V 50mAh rechargeable battery which charged by USB port for left earbud and right earbud |
|-----------------------------|---|
| Cable: | Type C cable: 50cm unshielded |
| Operation Frequency: | 2402MHz to 2480MHz |
| Bluetooth Version: | V5.0 Classic |
| Spectrum Spread Technology: | Frequency Hopping Spread Spectrum(FHSS) |
| Modulation Type: | GFSK, π/4DQPSK, 8DPSK |
| Number of Channels: | 79 |
| Channel Spacing: | 1MHz |
| Antenna Type: | Monopole Antenna |
| Antenna Gain: | -5.1dBi |
| Remark: | This device contains left earbud and right earbud. The two earbuds are identical on circuitry design, PCB layout, electrical components used, internal wiring and functions. So we choose the Right earbud to do the evaluate in this report. |

4.2 Description of Support Units

The EUT has been tested as an independent unit.

4.3 Measurement Uncertainty

| No. | Item | Measurement Uncertainty |
|-----|---------------------------------|---------------------------|
| 1 | Radio Frequency | ± 7.25 x 10 ⁻⁸ |
| 2 | Duty cycle | ± 0.37% |
| 3 | Occupied Bandwidth | ± 3% |
| 4 | RF conducted power | ± 0.75dB |
| 5 | RF power density | ± 2.84dB |
| 6 | Conducted Spurious emissions | ± 0.75dB |
| 7 | DE Dadiated names | ± 4.5dB (below 1GHz) |
| / | RF Radiated power | ± 4.8dB (above 1GHz) |
| 0 | Dadiated Carriers emission test | ± 4.5dB (Below 1GHz) |
| 8 | Radiated Spurious emission test | ± 4.8dB (Above 1GHz) |
| 9 | Temperature test | ± 1 ℃ |
| 10 | Humidity test | ± 3% |
| 11 | Supply voltages | ± 1.5% |
| 12 | Time | ± 3% |



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Report No.: SZEM190401266002

Page: 7 of 92

4.4 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen Branch

No. 1 Workshop, M-10, Middle Section, Science & Technology Park, Shenzhen, Guangdong, China. 518057.

Tel: +86 755 2601 2053 Fax: +86 755 2671 0594

No tests were sub-contracted.

4.5 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

• CNAS (No. CNAS L2929)

CNAS has accredited SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

A2LA (Certificate No. 3816.01)

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

The 3m Fully-anechoic chamber for above 1GHz, 10m Semi-anechoic chamber for below 1GHz. Shielded Room for Mains Port Conducted Interference Measurement and Telecommunication Port Conducted Interference Measurement of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-20026, R-14188, C-12383 and T-11153 respectively.

• FCC -Designation Number: CN1178

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized as an accredited testing laboratory.

Designation Number: CN1178. Test Firm Registration Number: 406779.

• Innovation, Science and Economic Development Canada

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0006.

IC#: 4620C.

4.6 Deviation from Standards

None

4.7 Abnormalities from Standard Conditions

None



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Page: 8 of 92

Equipment List

| Conducted Peak Output Power | | | | | | |
|-----------------------------|----------------------|-------------------------|--------------|------------|--------------|--|
| Equipment | Manufacturer | Model No | Inventory No | Cal Date | Cal Due Date | |
| DC Power Supply | ZhaoXin | RXN-305D | SEM011-02 | 2018-09-25 | 2019-09-24 | |
| Spectrum Analyzer | Rohde & Schwarz | FSP | SEM004-06 | 2018-09-27 | 2019-09-26 | |
| Measurement Software | JS Tonscend | JS1120-2 BT/WIFI V2. | N/A | N/A | N/A | |
| Coaxial Cable | SGS | N/A | SEM031-02 | 2018-07-12 | 2019-07-11 | |
| Attenuator | Weinschel Associates | WA41 | SEM021-09 | N/A | N/A | |
| Signal Generator | KEYSIGHT | N5173B | SEM006-05 | 2018-09-27 | 2019-09-26 | |
| Power Meter | Rohde & Schwarz | NRVS | SEM014-02 | 2018-09-25 | 2019-09-24 | |

| 20dB Bandwidth | | | | | |
|----------------------|----------------------|-------------------------|--------------|------------|--------------|
| Equipment | Manufacturer | Model No | Inventory No | Cal Date | Cal Due Date |
| DC Power Supply | ZhaoXin | RXN-305D | SEM011-02 | 2018-09-25 | 2019-09-24 |
| Spectrum Analyzer | Rohde & Schwarz | FSP | SEM004-06 | 2018-09-27 | 2019-09-26 |
| Measurement Software | JS Tonscend | JS1120-2 BT/WIFI V2. | N/A | N/A | N/A |
| Coaxial Cable | SGS | N/A | SEM031-02 | 2018-07-12 | 2019-07-11 |
| Attenuator | Weinschel Associates | WA41 | SEM021-09 | N/A | N/A |
| Signal Generator | KEYSIGHT | N5173B | SEM006-05 | 2018-09-27 | 2019-09-26 |
| Power Meter | Rohde & Schwarz | NRVS | SEM014-02 | 2018-09-25 | 2019-09-24 |

| Carrier Frequencies Separation | | | | | | |
|--------------------------------|----------------------|-------------------------|--------------|------------|--------------|--|
| Equipment | Manufacturer | Model No | Inventory No | Cal Date | Cal Due Date | |
| DC Power Supply | ZhaoXin | RXN-305D | SEM011-02 | 2018-09-25 | 2019-09-24 | |
| Spectrum Analyzer | Rohde & Schwarz | FSP | SEM004-06 | 2018-09-27 | 2019-09-26 | |
| Measurement Software | JS Tonscend | JS1120-2 BT/WIFI V2. | N/A | N/A | N/A | |
| Coaxial Cable | SGS | N/A | SEM031-02 | 2018-07-12 | 2019-07-11 | |
| Attenuator | Weinschel Associates | WA41 | SEM021-09 | N/A | N/A | |
| Signal Generator | KEYSIGHT | N5173B | SEM006-05 | 2018-09-27 | 2019-09-26 | |
| Power Meter | Rohde & Schwarz | NRVS | SEM014-02 | 2018-09-25 | 2019-09-24 | |

| Hopping Channel Numb | er | | | | |
|-----------------------------|-----------------|----------|--------------|------------|--------------|
| Equipment | Manufacturer | Model No | Inventory No | Cal Date | Cal Due Date |
| DC Power Supply | ZhaoXin | RXN-305D | SEM011-02 | 2018-09-25 | 2019-09-24 |
| Spectrum Analyzer | Rohde & Schwarz | FSP | SEM004-06 | 2018-09-27 | 2019-09-26 |



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Page: 9 of 92

| Measurement Software | JS Tonscend | JS1120-2 BT/WIFI V2. | N/A | N/A | N/A |
|----------------------|----------------------|-------------------------|-----------|------------|------------|
| Coaxial Cable | SGS | N/A | SEM031-02 | 2018-07-12 | 2019-07-11 |
| Attenuator | Weinschel Associates | WA41 | SEM021-09 | N/A | N/A |
| Signal Generator | KEYSIGHT | N5173B | SEM006-05 | 2018-09-27 | 2019-09-26 |
| Power Meter | Rohde & Schwarz | NRVS | SEM014-02 | 2018-09-25 | 2019-09-24 |

| Dwell Time | | | | | |
|----------------------|----------------------|-------------------------|--------------|------------|--------------|
| Equipment | Manufacturer | Model No | Inventory No | Cal Date | Cal Due Date |
| DC Power Supply | ZhaoXin | RXN-305D | SEM011-02 | 2018-09-25 | 2019-09-24 |
| Spectrum Analyzer | Rohde & Schwarz | FSP | SEM004-06 | 2018-09-27 | 2019-09-26 |
| Measurement Software | JS Tonscend | JS1120-2 BT/WIFI V2. | N/A | N/A | N/A |
| Coaxial Cable | SGS | N/A | SEM031-02 | 2018-07-12 | 2019-07-11 |
| Attenuator | Weinschel Associates | WA41 | SEM021-09 | N/A | N/A |
| Signal Generator | KEYSIGHT | N5173B | SEM006-05 | 2018-09-27 | 2019-09-26 |
| Power Meter | Rohde & Schwarz | NRVS | SEM014-02 | 2018-09-25 | 2019-09-24 |

| Conducted Band Edges Measurement | | | | | |
|----------------------------------|----------------------|-------------------------|--------------|------------|--------------|
| Equipment | Manufacturer | Model No | Inventory No | Cal Date | Cal Due Date |
| DC Power Supply | ZhaoXin | RXN-305D | SEM011-02 | 2018-09-25 | 2019-09-24 |
| Spectrum Analyzer | Rohde & Schwarz | FSP | SEM004-06 | 2018-09-27 | 2019-09-26 |
| Measurement Software | JS Tonscend | JS1120-2 BT/WIFI V2. | N/A | N/A | N/A |
| Coaxial Cable | SGS | N/A | SEM031-02 | 2018-07-12 | 2019-07-11 |
| Attenuator | Weinschel Associates | WA41 | SEM021-09 | N/A | N/A |
| Signal Generator | KEYSIGHT | N5173B | SEM006-05 | 2018-09-27 | 2019-09-26 |
| Power Meter | Rohde & Schwarz | NRVS | SEM014-02 | 2018-09-25 | 2019-09-24 |

| Conducted Spurious Emissions | | | | | |
|------------------------------|----------------------|-------------------------|--------------|------------|--------------|
| Equipment | Manufacturer | Model No | Inventory No | Cal Date | Cal Due Date |
| DC Power Supply | ZhaoXin | RXN-305D | SEM011-02 | 2018-09-25 | 2019-09-24 |
| Spectrum Analyzer | Rohde & Schwarz | FSP | SEM004-06 | 2018-09-27 | 2019-09-26 |
| Measurement Software | JS Tonscend | JS1120-2 BT/WIFI V2. | N/A | N/A | N/A |
| Coaxial Cable | SGS | N/A | SEM031-02 | 2018-07-12 | 2019-07-11 |
| Attenuator | Weinschel Associates | WA41 | SEM021-09 | N/A | N/A |
| Signal Generator | KEYSIGHT | N5173B | SEM006-05 | 2018-09-27 | 2019-09-26 |
| Power Meter | Rohde & Schwarz | NRVS | SEM014-02 | 2018-09-25 | 2019-09-24 |



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Report No.: SZEM190401266002

Page: 10 of 92

| Equipment | Manufacturer | Model No | Inventory No | Cal Date | Cal Due Date |
|-----------------------------------|--|---------------------|--------------|------------|--------------|
| 3m Semi-Anechoic Chamber | AUDIX | N/A | SEM001-02 | 2018-03-13 | 2021-03-12 |
| Measurement Software | AUDIX | e3 V8.2014-6- 27 | N/A | N/A | N/A |
| Coaxial Cable | SGS | N/A | SEM026-01 | 2018-07-12 | 2019-07-11 |
| EXA Spectrum Analyzer | AgilentTechnologies Inc | N9010A | SEM004-12 | 2019-04-12 | 2020-04-11 |
| BiConiLog Antenna (26-3000MHz) | ETS-Lindgren | 3142C | SEM003-01 | 2017-06-27 | 2020-06-26 |
| Horn Antenna (1-18GHz) | Rohde & Schwarz | HF907 | SEM003-07 | 2018-04-13 | 2021-04-12 |
| Horn Antenna (15GHz-40GHz) | Schwarzbeck | BBHA 9170 | SEM003-15 | 2017-10-17 | 2020-10-16 |
| Pre-amplifier (0.1-1300MHz) | HP | 8447D | SEM005-02 | 2018-09-25 | 2019-09-24 |
| Pre-Amplifier (0.1-26.5GHz) | Compliance Directions Systems Inc. | PAP-0126 | SEM004-11 | 2018-11-12 | 2019-11-11 |
| Pre-amplifier (18-26GHz) | Rohde & Schwarz | CH14-H052 | SEM005-17 | 2019-04-01 | 2020-03-31 |
| Pre-amplifier (26GHz-40GHz) | Compliance Directions Systems Inc. | PAP-2640-50 | SEM005-08 | 2019-04-01 | 2020-03-31 |
| DC Power Supply | Zhao Xin | RXN-305D | SEM011-02 | 2018-09-25 | 2019-09-24 |
| Active Loop Antenna | ETS-Lindgren | 6502 | SEM003-08 | 2017-08-22 | 2020-08-21 |

| Radiated Spurious Emissions | | | | | |
|-----------------------------------|-------------------------|---------------------|--------------|------------|--------------|
| Equipment | Manufacturer | Model No | Inventory No | Cal Date | Cal Due Date |
| 3m Semi-Anechoic Chamber | AUDIX | N/A | SEM001-02 | 2018-03-13 | 2021-03-12 |
| Measurement Software | AUDIX | e3 V8.2014-6- 27 | N/A | N/A | N/A |
| Coaxial Cable | SGS | N/A | SEM026-01 | 2018-07-12 | 2019-07-11 |
| EXA Spectrum Analyzer | AgilentTechnologies Inc | N9010A | SEM004-12 | 2019-04-12 | 2020-04-11 |
| BiConiLog Antenna (26-3000MHz) | ETS-Lindgren | 3142C | SEM003-01 | 2017-06-27 | 2020-06-26 |
| Horn Antenna (1-18GHz) | Rohde & Schwarz | HF907 | SEM003-07 | 2018-04-13 | 2021-04-12 |



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Report No.: SZEM190401266002

Page: 11 of 92

| Horn Antenna (15GHz-40GHz) | Schwarzbeck | BBHA 9170 | SEM003-15 | 2017-10-17 | 2020-10-16 |
|--------------------------------|--|-------------|-----------|------------|------------|
| Pre-amplifier (0.1-1300MHz) | HP | 8447D | SEM005-02 | 2018-09-25 | 2019-09-24 |
| Pre-Amplifier (0.1-26.5GHz) | Compliance Directions Systems Inc. | PAP-0126 | SEM004-11 | 2018-11-12 | 2019-11-11 |
| Pre-amplifier (18-26GHz) | Rohde & Schwarz | CH14-H052 | SEM005-17 | 2019-04-01 | 2020-03-31 |
| Pre-amplifier (26GHz-40GHz) | Compliance Directions Systems Inc. | PAP-2640-50 | SEM005-08 | 2019-04-01 | 2020-03-31 |
| DC Power Supply | Zhao Xin | RXN-305D | SEM011-02 | 2018-09-25 | 2019-09-24 |
| Active Loop Antenna | ETS-Lindgren | 6502 | SEM003-08 | 2017-08-22 | 2020-08-21 |

| RE in Chamber | | | | | |
|-----------------------------------|----------------------|---------------------|---------------|------------|---------------|
| Test Equipment | Manufacturer | Model No. | Inventory No. | Cal. Date | Cal. Due date |
| 3m Semi-Anechoic Chamber | ETS-LINDGREN | N/A | SEM001-01 | 2017-08-05 | 2020-08-04 |
| MXE EMI Receiver (20Hz-8.4GHz) | Agilent Technologies | N9038A | SEM004-05 | 2018-09-25 | 2019-09-24 |
| BiConiLog Antenna (26-3000MHz) | ETS-LINDGREN | 3142C | SEM003-01 | 2017-06-27 | 2020-06-26 |
| Pre-amplifier (0.1-1300MHz) | Agilent Technologies | 8447D | SEM005-01 | 2019-04-01 | 2020-03-31 |
| Measurement Software | AUDIX | e3 V8.2014-6- 27 | N/A | N/A | N/A |
| Coaxial Cable | SGS | N/A | SEM025-01 | 2018-07-12 | 2019-07-11 |

| General used equipment | | | | | |
|------------------------------------|---|----------|--------------|------------|--------------|
| Equipment | Manufacturer | Model No | Inventory No | Cal Date | Cal Due Date |
| Humidity/ Temperature Indicator | Shanghai Meteorological Industry Factory | ZJ1-2B | SEM002-03 | 2018-09-27 | 2019-09-26 |
| Humidity/ Temperature Indicator | Shanghai Meteorological Industry Factory | ZJ1-2B | SEM002-04 | 2018-09-27 | 2019-09-26 |
| Humidity/ Temperature Indicator | Mingle | N/A | SEM002-08 | 2018-09-27 | 2019-09-26 |
| Barometer | Changchun Meteorological Industry Factory | DYM3 | SEM002-01 | 2019-04-04 | 2020-04-03 |



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Report No.: SZEM190401266002

Page: 12 of 92

Radio Spectrum Technical Requirement 6

6.1 Antenna Requirement

6.1.1 Test Requirement:

47 CFR Part 15, Subpart C 15.203 & 15.247(b)(4)

6.1.2 Conclusion

Standard Requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

EUT Antenna:

The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is -5.1dBi.

Antenna location: Refer to Appendix(Internal photos)



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Report No.: SZEM190401266002

Page: 13 of 92

6.2 Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence

6.2.1 Test Requirement:

47 CFR Part 15, Subpart C 15.247(a)(1),(g),(h)

6.2.2 Conclusion

Standard Requirement:

The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

Compliance for section 15.247(a)(1):

According to Technical Specification, the pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs; i.e. the shift register is initialized with nine ones.

- > Number of shift register stages: 9
- > Length of pseudo-random sequence: 29 -1 = 511 bits
- > Longest sequence of zeros: 8 (non-inverted signal)

Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:



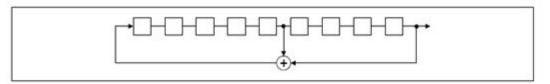
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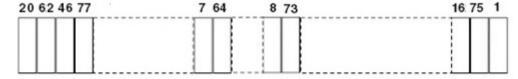
Report No.: SZEM190401266002

14 of 92 Page:



Linear Feedback Shift Register for Generation of the PRBS sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:



Each frequency used equally on the average by each transmitter.

According to Technical Specification, the receivers are designed to have input and IF bandwidths that match the hopping channel bandwidths of any transmitters and shift frequencies in synchronization with the transmitted signals.

Compliance for section 15.247(g):

According to Technical Specification, the system transmits the packet with the pseudorandom hopping frequency with a continuous data and the short burst transmission from the Bluetooth system is also transmitted under the frequency hopping system with the pseudorandom hopping frequency system.

Compliance for section 15.247(h):

According to Technical specification, the system incorporates with an adaptive system to detect other user within the spectrum band so that it individually and independently to avoid hopping on the occupied channels.

The system is designed not have the ability to coordinated with other FHSS System in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitter.



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Page: 15 of 92

Radio Spectrum Matter Test Results

7.1 Conducted Peak Output Power

Test Requirement 47 CFR Part 15, Subpart C 15.247(b)(1) ANSI C63.10 (2013) Section 7.8.5 Test Method:

Limit:

| Frequency range(MHz) | Output power of the intentional radiator(watt) | | |
|----------------------|--|--|--|
| | 1 for ≥50 hopping channels | | |
| 902-928 | 0.25 for 25≤ hopping channels <50 | | |
| | 1 for digital modulation | | |
| | 1 for ≥75 non-overlapping hopping channels | | |
| 2400-2483.5 | 0.125 for all other frequency hopping systems | | |
| | 1 for digital modulation | | |
| 5725-5850 | 1 for frequency hopping systems and digital modulation | | |



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Report No.: SZEM190401266002

Page: 16 of 92

7.1.1 E.U.T. Operation

Operating Environment:

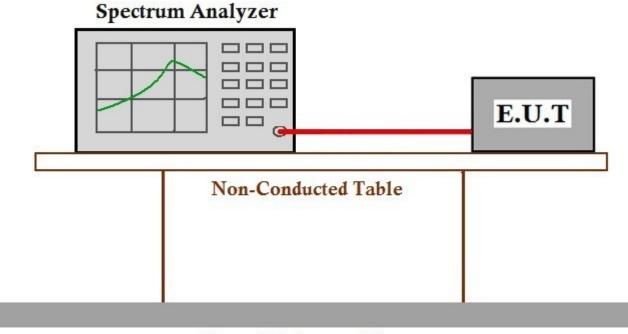
Temperature: 25.2 °C Atmospheric Pressure: 1015 mbar Humidity: 48.7 % RH

Test mode c:TX non-Hop mode Keep the EUT in continuously transmitting mode with GFSK

modulation, π/4DQPSK modulation, 8DPSK modulation. All modes have been

tested and only the data of worst case is recorded in the report.

7.1.2 Test Setup Diagram



Ground Reference Plane

7.1.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247



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Report No.: SZEM190401266002

Page: 17 of 92

7.2 20dB Bandwidth

Test Requirement 47 CFR Part 15, Subpart C 15.247(a)(1) Test Method: ANSI C63.10 (2013) Section 7.8.7

7.2.1 E.U.T. Operation

Operating Environment:

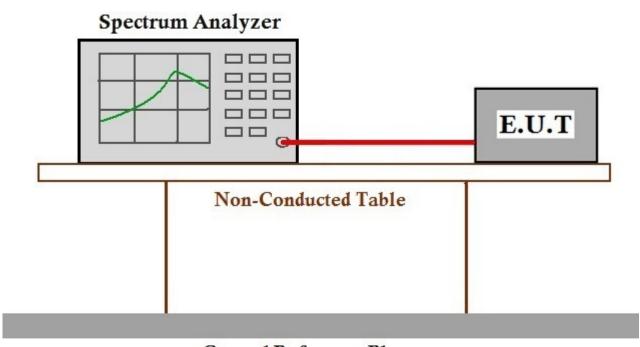
Temperature: 25.2 °C 48.8 % RH Atmospheric Pressure: 1015 mbar Humidity:

Test mode c:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK

modulation, $\pi/4DQPSK$ modulation, 8DPSK modulation. All modes have been

tested and only the data of worst case is recorded in the report.

7.2.2 Test Setup Diagram



Ground Reference Plane

7.2.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247



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Report No.: SZEM190401266002

Page: 18 of 92

7.3 Carrier Frequencies Separation

Test Requirement 47 CFR Part 15, Subpart C 15.247a(1)
Test Method: ANSI C63.10 (2013) Section 7.8.2

Limit: 2/3 of the 20dB bandwidth base on the transmission power is less than

0.125W

7.3.1 E.U.T. Operation

Operating Environment:

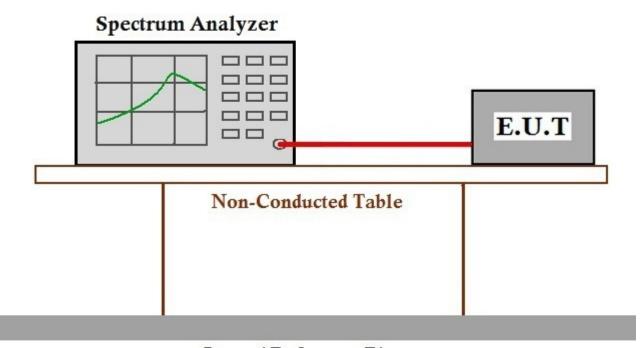
Temperature: 25.2 °C Humidity: 48.7 % RH Atmospheric Pressure: 1015 mbar

Test mode b:TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK

modulation, π/4DQPSK modulation, 8DPSK modulation. All modes have been

tested and only the data of worst case is recorded in the report.

7.3.2 Test Setup Diagram



Ground Reference Plane

7.3.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247



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Report No.: SZEM190401266002

Page: 19 of 92

7.4 Hopping Channel Number

Test Requirement 47 CFR Part 15, Subpart C 15.247a(1)(iii)

Test Method: ANSI C63.10 (2013) Section 7.8.3

Limit:

| Frequency range(MHz) Number of hopping channels (minimum | | | |
|--|-------------------------------|--|--|
| 002 028 | 50 for 20dB bandwidth <250kHz | | |
| 902-928 | 25 for 20dB bandwidth ≥250kHz | | |
| 2400-2483.5 | 15 | | |
| 5725-5850 | 75 | | |

7.4.1 E.U.T. Operation

Operating Environment:

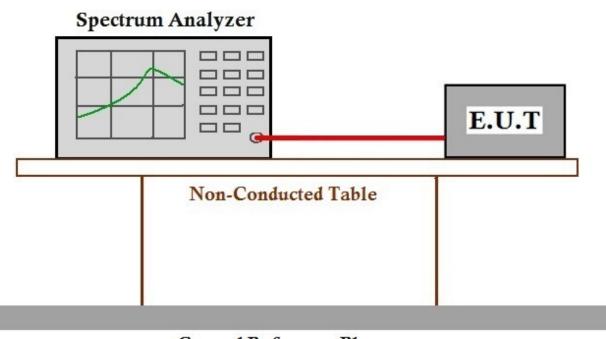
Temperature: 25.2 °C Humidity: 48.7 % RH Atmospheric Pressure: 1015 mbar

Test mode b:TX_Hop mode_Keep the EUT in frequency hopping mode with GFSK

modulation, π/4DQPSK modulation, 8DPSK modulation. All modes have been

tested and only the data of worst case is recorded in the report.

7.4.2 Test Setup Diagram



Ground Reference Plane

7.4.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247



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Report No.: SZEM190401266002

Page: 20 of 92

7.5 Dwell Time

Test Requirement 47 CFR Part 15, Subpart C 15.247a(1)(iii)

ANSI C63.10 (2013) Section 7.8.4 Test Method:

Limit:

| Frequency(MHz) | Limit |
|----------------|---|
| 000.000 | 0.4S within a 20S period(20dB bandwidth<250kHz) |
| 902-928 | 0.4S within a 10S period(20dB bandwidth≥250kHz) |
| 2400 2492 5 | 0.4S within a period of 0.4S multiplied by the number |
| 2400-2483.5 | of hopping channels |
| 5725-5850 | 0.4S within a 30S period |



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Report No.: SZEM190401266002

Page: 21 of 92

7.5.1 E.U.T. Operation

Operating Environment:

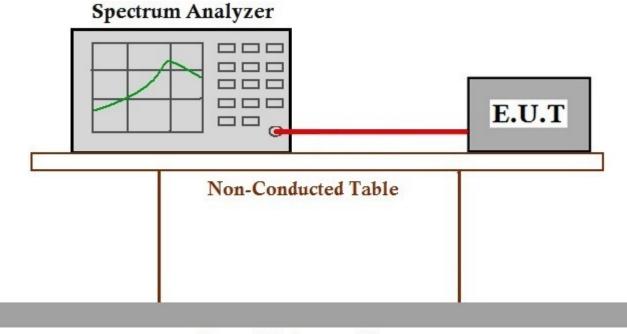
Temperature: 25.2 °C Humidity: 48.7 % RH Atmospheric Pressure: 1015 mbar

Test mode b:TX Hop mode Keep the EUT in frequency hopping mode with GFSK

modulation, $\pi/4DQPSK$ modulation, 8DPSK modulation. All modes have been

tested and only the data of worst case is recorded in the report.

7.5.2 Test Setup Diagram



Ground Reference Plane

7.5.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247



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Report No.: SZEM190401266002

Page: 22 of 92

7.6 Conducted Band Edges Measurement

Test Requirement 47 CFR Part 15, Subpart C 15.247(d) Test Method: ANSI C63.10 (2013) Section 7.8.6

Limit:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in

§15.209(a) (see §15.205(c)



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Report No.: SZEM190401266002

Page: 23 of 92

7.6.1 E.U.T. Operation

Operating Environment:

Temperature: 25.2 °C Humidity: 48.7 % RH Atmospheric Pressure: 1015 mbar

Test mode: b:TX Hop mode Keep the EUT in frequency hopping mode with GFSK

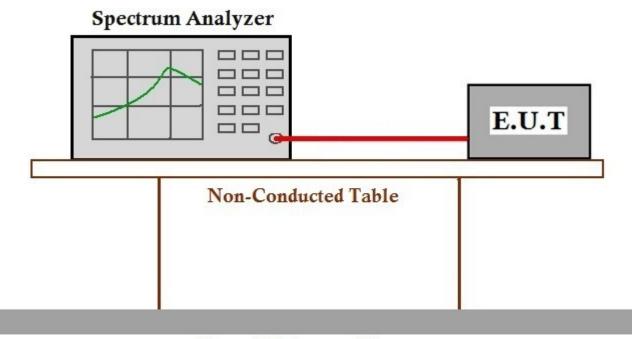
modulation, π/4DQPSK modulation, 8DPSK modulation. All modes have been

tested and only the data of worst case is recorded in the report.

c:TX_non-Hop mode_Keep the EUT in continuously transmitting mode with GFSK modulation, $\pi/4DQPSK$ modulation, 8DPSK modulation. All modes have been

tested and only the data of worst case is recorded in the report.

7.6.2 Test Setup Diagram



Ground Reference Plane

7.6.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247



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Report No.: SZEM190401266002

Page: 24 of 92

7.7 Conducted Spurious Emissions

Test Requirement 47 CFR Part 15, Subpart C 15.247(d) Test Method: ANSI C63.10 (2013) Section 7.8.8

Limit:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in

§15.209(a) (see §15.205(c)



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Report No.: SZEM190401266002

Page: 25 of 92

7.7.1 E.U.T. Operation

Operating Environment:

Temperature: 25.2 °C Atmospheric Pressure: 1015 mbar Humidity: 48.7 % RH

Test mode c:TX non-Hop mode Keep the EUT in continuously transmitting mode with GFSK

modulation, π/4DQPSK modulation, 8DPSK modulation. All modes have been

tested and only the data of worst case is recorded in the report.

7.7.2 Test Setup Diagram

Spectrum Analyzer E.U.T Non-Conducted Table

Ground Reference Plane

7.7.3 Measurement Procedure and Data

The detailed test data see: Appendix 15.247



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Report No.: SZEM190401266002

Page: 26 of 92

7.8 Radiated Emissions which fall in the restricted bands

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209

ANSI C63.10 (2013) Section 6.10.5 Test Method:

Measurement Distance: 3m

Limit:

| Frequency(MHz) | Field strength(microvolts/meter) | Measurement distance(meters) |
|----------------|----------------------------------|------------------------------|
| 0.009-0.490 | 2400/F(kHz) | 300 |
| 0.490-1.705 | 24000/F(kHz) | 30 |
| 1.705-30.0 | 30 | 30 |
| 30-88 | 100 | 3 |
| 88-216 | 150 | 3 |
| 216-960 | 200 | 3 |
| Above 960 | 500 | 3 |

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.



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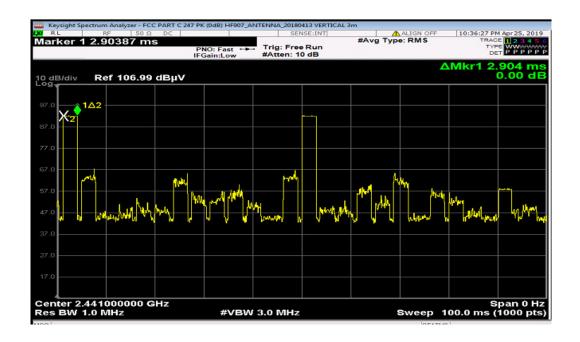


Report No.: SZEM190401266002

Page: 27 of 92

Average value:

| | Average value=Peak value + PDCF |
|--------------------|----------------------------------|
| Calculate Formula: | PDCF=20 log(Duty cycle) |
| | Duty cycle= T on time / T period |
| | Ton time =2.904*2=5.808ms |
| Test data: | T period =100ms |
| | PCDF value= -24.72dB |





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Report No.: SZEM190401266002

Page: 28 of 92

7.8.1 E.U.T. Operation

Operating Environment:

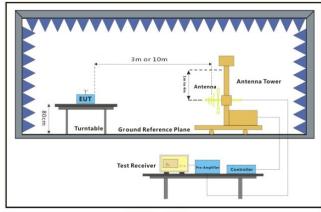
Temperature: 21.2 °C Atmospheric Pressure: 1015 mbar Humidity: 54.9 % RH

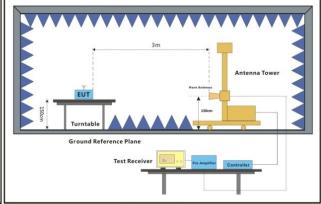
Test mode c:TX non-Hop mode Keep the EUT in continuously transmitting mode with GFSK

modulation, π/4DQPSK modulation, 8DPSK modulation. All modes have been

tested and only the data of worst case is recorded in the report.

7.8.2 Test Setup Diagram





Above 1GHz 30MHz-1GHz



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Report No.: SZEM190401266002

Page: 29 of 92

7.8.3 Measurement Procedure and Data

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

Remark 1: Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor

Remark 2: For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.



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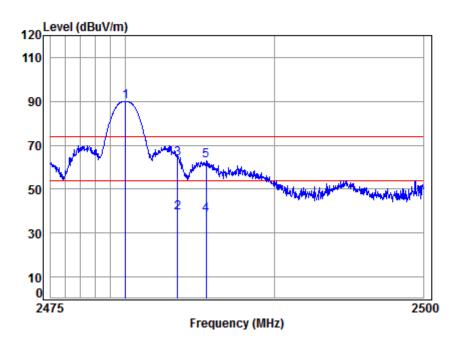
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Page: 30 of 92

Mode:c; Polarization:Horizontal; Channel:High



Site : chamber

Condition: 3m HORIZONTAL

: 12660CR

Mode : 2480 Band edge

Note · BT-R

| ote | | -11 | | | | | | | |
|-----|----------|-------|--------|--------|-------|--------|--------|--------|---------|
| | | Cable | Ant | Preamp | Read | | Limit | 0ver | |
| | Freq | Loss | Factor | Factor | Level | Level | Line | Limit | Remark |
| | | | | | | | | | |
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB | |
| | | | | | | | | | |
| 1 * | 2480.000 | 5.59 | 28.67 | 41.21 | 96.76 | 89.81 | 74.00 | 15.81 | peak |
| 2 | 2483.500 | 5.60 | 28.67 | 41.21 | 46.03 | 39.09 | 54.00 | -14.91 | Average |
| 3 | 2483.500 | 5.60 | 28.67 | 41.21 | 70.75 | 63.81 | 74.00 | -10.19 | peak |
| 4 | 2485.419 | 5.60 | 28.68 | 41.21 | 45.16 | 38.23 | 54.00 | -15.77 | Average |
| 5 | 2485 419 | 5 60 | 28 68 | 41 21 | 69 88 | 62 95 | 74 99 | -11 05 | neak |



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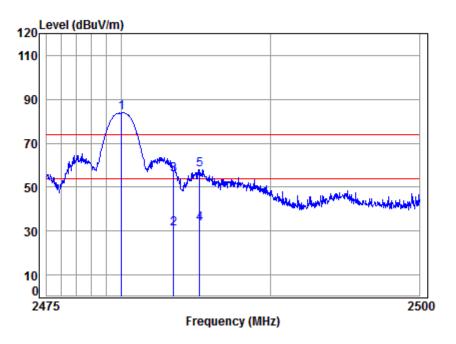
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Report No.: SZEM190401266002

Page: 31 of 92

Mode:c; Polarization:Vertical; Channel:High



: chamber Site Condition: 3m VERTICAL : 12660CR

Mode : 2480 Band edge

Note : BT-R

| | Freq | | | Preamp Factor | | | | | Remark |
|-----|----------|------|-------|------------------|-------|--------|--------|--------|---------|
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB | |
| 1 * | 2480.000 | 5.59 | 28.67 | 41.21 | 90.74 | 83.79 | 74.00 | 9.79 | peak |
| 2 | 2483.500 | 5.60 | 28.67 | 41.21 | 38.00 | 31.06 | 54.00 | -22.94 | Average |
| 3 | 2483.500 | 5.60 | 28.67 | 41.21 | 62.72 | 55.78 | 74.00 | -18.22 | peak |
| 4 | 2485.220 | 5.60 | 28.68 | 41.21 | 40.11 | 33.18 | 54.00 | -20.82 | Average |
| 5 | 2485.220 | 5.60 | 28.68 | 41.21 | 64.83 | 57.90 | 74.00 | -16.10 | peak |



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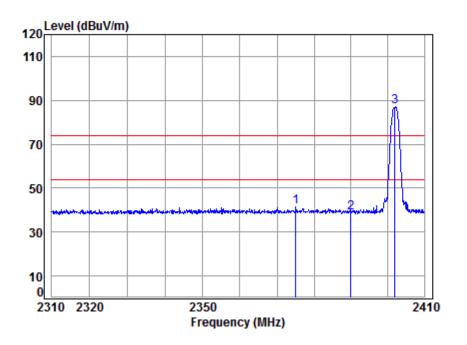
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Report No.: SZEM190401266002

Page: 32 of 92

Mode:c; Polarization:Horizontal; Channel:Low



Site : chamber

Condition: 3m HORIZONTAL

: 12660CR

Mode : 2402 Band edge

Note : BT-R

> 1 2 3

| _ | | 11 | | | | | | | | |
|---|----------|-------|--------|--------|-------|--------|--------|--------|--------|--|
| | | Cable | Ant | Preamp | Read | | Limit | 0ver | | |
| | Freq | Loss | Factor | Factor | Level | Level | Line | Limit | Remark | |
| _ | | | | | | | | | | |
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB | | |
| | | | | | | | | | | |
| | 2375.020 | 5.45 | 28.49 | 41.17 | 48.76 | 41.53 | 74.00 | -32.47 | peak | |
| | 2390.000 | 5.47 | 28.52 | 41.17 | 46.10 | 38.92 | 74.00 | -35.08 | peak | |
| * | 2402 000 | 5 49 | 28 54 | 41 18 | 94 99 | 86 94 | 74 00 | 12 94 | Peak | |



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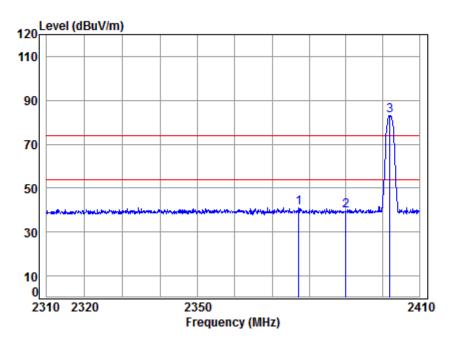
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Report No.: SZEM190401266002

Page: 33 of 92

Mode:c; Polarization:Vertical; Channel:Low



Site : chamber Condition: 3m VERTICAL : 12660CR

Mode : 2402 Band edge

Note : BT-R

> 1 2 3

| | | | | Preamp | | | | | | |
|---|----------|------|--------|--------|-------|---------|--------|--------|--------|---|
| | Freq | Loss | Factor | Factor | Level | Level | Line | Limit | Remark | |
| | | | | | | JD: 3// | | | | _ |
| | MHZ | ав | aB/m | dB | abuv | abuv/m | abuv/m | ав | | |
| | 2377.236 | 5.46 | 28.50 | 41.17 | 48.45 | 41.24 | 74.00 | -32.76 | neak | |
| | 2390.000 | | | | | | | | • | |
| * | 2402.000 | | | | | | | | • | |



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Page: 34 of 92

7.9 Radiated Spurious Emissions

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209 Test Method: ANSI C63.10 (2013) Section 6.4,6.5,6.6

Measurement Distance: 3m

Limit:

| Frequency(MHz) | Field strength(microvolts/meter) | Measurement distance(meters) |
|----------------|----------------------------------|------------------------------|
| 0.009-0.490 | 2400/F(kHz) | 300 |
| 0.490-1.705 | 24000/F(kHz) | 30 |
| 1.705-30.0 | 30 | 30 |
| 30-88 | 100 | 3 |
| 88-216 | 150 | 3 |
| 216-960 | 200 | 3 |
| Above 960 | 500 | 3 |

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.



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Report No.: SZEM190401266002

Page: 35 of 92

7.9.1 E.U.T. Operation

Operating Environment:

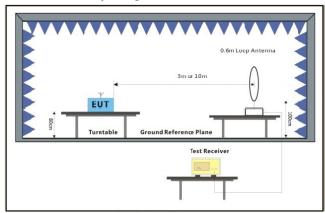
Temperature: 23.9 °C Atmospheric Pressure: 1015 mbar Humidity: 55 % RH

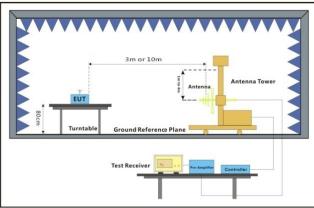
Test mode c:TX non-Hop mode Keep the EUT in continuously transmitting mode with GFSK

modulation, $\pi/4DQPSK$ modulation, 8DPSK modulation. All modes have been

tested and only the data of worst case is recorded in the report.

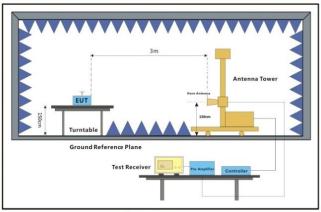
7.9.2 Test Setup Diagram





Below 30MHz

30MHz-1GHz



Above 1GHz



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Report No.: SZEM190401266002

36 of 92 Page:

7.9.3 Measurement Procedure and Data

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

Remark:

- 1) For emission below 1GHz, through pre-scan found the worst case is the lowest channel. Only the worst case is recorded in the report.
- 2) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Final Test Level =Receiver Reading + Antenna Factor + Cable Factor - Preamplifier Factor

- 3) Scan from 9kHz to 25GHz, the disturbance above 18GHz and below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.
- 4) For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.



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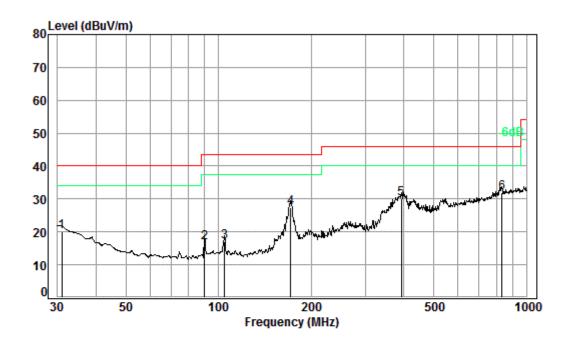


Report No.: SZEM190401266002

Page: 37 of 92

30MHz~1GHz QP value:

Mode: c; Polarization: Horizontal



Condition: 3m HORIZONTAL

Job No. : 12660CR

Test mode: c

| | | Cable | Ant | Preamp | Read | | Limit | 0ver |
|------|--------|-------|--------|--------|-------|--------|--------|--------|
| | Freq | Loss | Factor | Factor | Level | Level | Line | Limit |
| _ | | | | | | | | |
| | MHz | dB | aB/m | dB | aBuv | aBuv/m | aBuv/m | dB |
| 1 | 30.96 | 0.60 | 21.95 | 27.45 | 24.90 | 20.00 | 40.00 | -20.00 |
| 2 | 90.22 | | | 27.36 | | | | |
| 3 | 104.54 | 1.21 | 13.78 | 27.32 | 29.32 | 16.99 | 43.50 | -26.51 |
| 4 | 171.39 | 1.36 | 15.73 | 27.00 | 37.40 | 27.49 | 43.50 | -16.01 |
| 5 | 392.10 | 2.18 | 22.21 | 27.15 | 32.72 | 29.96 | 46.00 | -16.04 |
| 6 pp | 833.32 | 3.34 | 28.95 | 27.44 | 27.04 | 31.89 | 46.00 | -14.11 |



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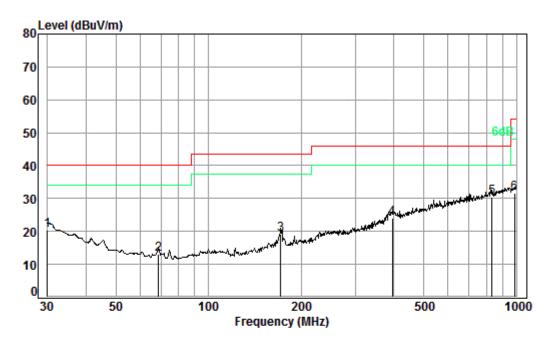
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Report No.: SZEM190401266002

Page: 38 of 92

Mode: c; Polarization: Vertical



Condition: 3m Vertical Job No. : 12660CR

Test mode: c

| | | Cable | Ant | Preamp | Read | | Limit | 0ver |
|------|--------|-------|--------|--------|-------|--------|--------|--------|
| | Freq | Loss | Factor | Factor | Level | Level | Line | Limit |
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB |
| 1 | 30.00 | 0.60 | 22.50 | 27.45 | 24.80 | 20.45 | 40.00 | -19.55 |
| 2 | 68.87 | 0.80 | 12.84 | 27.38 | 26.85 | 13.11 | 40.00 | -26.89 |
| 3 | 171.39 | 1.36 | 15.73 | 27.00 | 29.02 | 19.11 | 43.50 | -24.39 |
| 4 | 394.85 | 2.19 | 22.27 | 27.16 | 26.79 | 24.09 | 46.00 | -21.91 |
| 5 pp | 833.32 | 3.34 | 28.95 | 27.44 | 25.63 | 30.48 | 46.00 | -15.52 |
| 6 | 986.07 | 3.69 | 30.23 | 26.60 | 24.25 | 31.57 | 54.00 | -22.43 |



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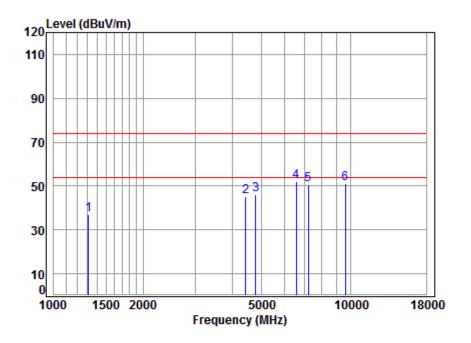


Report No.: SZEM190401266002

Page: 39 of 92

Above 1GHz

Mode:c; Polarization:Horizontal; Channel:Low



Site : chamber

Condition: 3m HORIZONTAL

Job No : 12660CR Mode : 2402 TX SE

Note : BT-R

| | | | | Preamp | | | | | |
|---|----------|-------|--------|--------|-------|--------|--------|--------|--------|
| | Freq | Loss | Factor | Factor | Level | Level | Line | Limit | Remark |
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB | |
| 1 | 1312.187 | 4.84 | 25.07 | 40.57 | 47.65 | 36.99 | 74.00 | -37.01 | peak |
| 2 | 4430.628 | 7.48 | 33.48 | 43.23 | 47.31 | 45.04 | 74.00 | -28.96 | peak |
| 3 | 4804.000 | 7.89 | 33.97 | 43.61 | 48.02 | 46.27 | 74.00 | -27.73 | peak |
| 4 | 6564.209 | 11.35 | 35.64 | 42.35 | 47.27 | 51.91 | 74.00 | -22.09 | peak |
| 5 | 7206.000 | 10.08 | 36.07 | 41.86 | 46.58 | 50.87 | 74.00 | -23.13 | peak |
| 6 | 9608.000 | 10.75 | 37.67 | 38.43 | 40.92 | 50.91 | 74.00 | -23.09 | peak |



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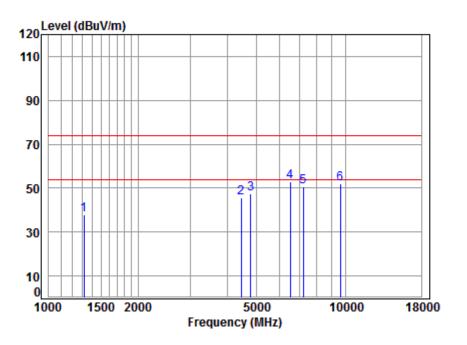
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Report No.: SZEM190401266002

Page: 40 of 92

Mode:c; Polarization:Vertical; Channel:Low



Site : chamber Condition: 3m VERTICAL

Job No : 12660CR Mode : 2402 TX SE

Note : BT-R

| | Cable | Ant | Preamp | Read | | Limit | 0ver | |
|----------|---|--|--|--|---|--|--|--|
| Freq | Loss | Factor | Factor | Level | Level | Line | Limit | Remark |
| | | | | | | | | |
| MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB | |
| | | | | | | | | |
| 1315.985 | 4.86 | 25.09 | 40.57 | 48.38 | 37.76 | 74.00 | -36.24 | peak |
| 4456.315 | 7.51 | 33.53 | 43.26 | 47.66 | 45.44 | 74.00 | -28.56 | peak |
| 4804.000 | 7.89 | 33.97 | 43.61 | 49.04 | 47.29 | 74.00 | -26.71 | peak |
| 6507.536 | 11.52 | 35.60 | 42.40 | 48.38 | 53.10 | 74.00 | -20.90 | peak |
| 7206.000 | 10.08 | 36.07 | 41.86 | 46.23 | 50.52 | 74.00 | -23.48 | peak |
| 9608.000 | 10.75 | 37.67 | 38.43 | 41.92 | 51.91 | 74.00 | -22.09 | peak |
| | MHz 1315.985 4456.315 4804.000 6507.536 7206.000 | Freq Loss MHz dB 1315.985 4.86 4456.315 7.51 4804.000 7.89 6507.536 11.52 7206.000 10.08 | Freq Loss Factor MHz dB dB/m 1315.985 4.86 25.09 4456.315 7.51 33.53 4804.000 7.89 33.97 6507.536 11.52 35.60 7206.000 10.08 36.07 | Freq Loss Factor Factor MHz dB dB/m dB 1315.985 4.86 25.09 40.57 4456.315 7.51 33.53 43.26 4804.000 7.89 33.97 43.61 6507.536 11.52 35.60 42.40 7206.000 10.08 36.07 41.86 | Freq Loss Factor Factor Level MHz dB dB/m dB dBuV 1315.985 4.86 25.09 40.57 48.38 4456.315 7.51 33.53 43.26 47.66 4804.000 7.89 33.97 43.61 49.04 6507.536 11.52 35.60 42.40 48.38 7206.000 10.08 36.07 41.86 46.23 | Freq Loss Factor Factor Level Level MHz dB dB/m dB dBuV dBuV/m 1315.985 4.86 25.09 40.57 48.38 37.76 4456.315 7.51 33.53 43.26 47.66 45.44 4804.000 7.89 33.97 43.61 49.04 47.29 6507.536 11.52 35.60 42.40 48.38 53.10 7206.000 10.08 36.07 41.86 46.23 50.52 | Freq Loss Factor Factor Level Level Line MHz dB dB/m dB dBuV dBuV/m dBuV/m 1315.985 4.86 25.09 40.57 48.38 37.76 74.00 4456.315 7.51 33.53 43.26 47.66 45.44 74.00 4804.000 7.89 33.97 43.61 49.04 47.29 74.00 6507.536 11.52 35.60 42.40 48.38 53.10 74.00 7206.000 10.08 36.07 41.86 46.23 50.52 74.00 | Cable Loss Factor Factor Read Level Level Line Limit Limit Over Limit MHz dB dB/m dB dBuV dBuV/m dBuV/m dBuV/m dB 1315.985 4.86 25.09 40.57 48.38 37.76 74.00 -36.24 4456.315 7.51 33.53 43.26 47.66 45.44 74.00 -28.56 4804.000 7.89 33.97 43.61 49.04 47.29 74.00 -26.71 6507.536 11.52 35.60 42.40 48.38 53.10 74.00 -20.90 7206.000 10.08 36.07 41.86 46.23 50.52 74.00 -23.48 9608.000 10.75 37.67 38.43 41.92 51.91 74.00 -22.09 |



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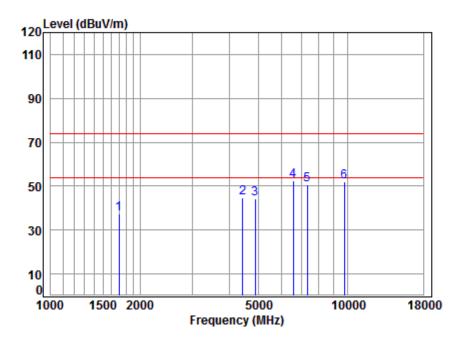
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Report No.: SZEM190401266002

Page: 41 of 92

Mode:c; Polarization:Horizontal; Channel:middle



: chamber Site

Condition: 3m HORIZONTAL

Job No : 12660CR Mode : 2441 TX SE

Note : BT-R

| | | Cable | Ant | Preamp | Read | | Limit | 0ver | |
|---|----------|-------|--------|--------|-------|--------|--------|--------|--------|
| | Freq | Loss | Factor | Factor | Level | Level | Line | Limit | Remark |
| | | | | | | | | | |
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB | |
| | | | | | | | | | |
| 1 | 1697.129 | 5.23 | 26.66 | 40.83 | 46.50 | 37.56 | 74.00 | -36.44 | peak |
| 2 | 4443.453 | 7.50 | 33.50 | 43.25 | 47.09 | 44.84 | 74.00 | -29.16 | peak |
| 3 | 4882.000 | 7.97 | 34.06 | 43.69 | 46.08 | 44.42 | 74.00 | -29.58 | peak |
| 4 | 6564.209 | 11.35 | 35.64 | 42.35 | 47.96 | 52.60 | 74.00 | -21.40 | peak |
| 5 | 7323.000 | 10.05 | 36.16 | 41.77 | 46.02 | 50.46 | 74.00 | -23.54 | peak |
| 6 | 9764.000 | 10.82 | 37.76 | 38.17 | 41.61 | 52.02 | 74.00 | -21.98 | peak |



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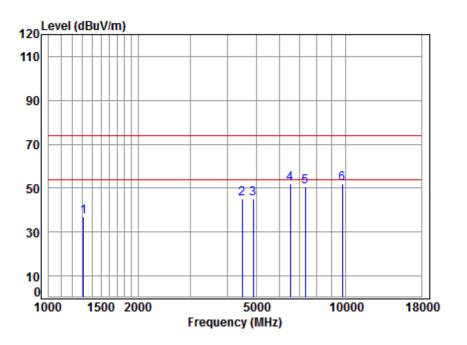
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Report No.: SZEM190401266002

Page: 42 of 92

Mode:c; Polarization:Vertical; Channel:middle



Site : chamber Condition: 3m VERTICAL

Job No : 12660CR Mode : 2441 TX SE

Note : BT-R

| | | Cable | Ant | Preamp | Read | | Limit | 0ver | |
|---|----------|-------|--------|--------|-------|--------|--------|--------|--------|
| | Freq | Loss | Factor | Factor | Level | Level | Line | Limit | Remark |
| | | | | | | | | | |
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB | |
| _ | 4300 300 | | 05.06 | 40 57 | 47.76 | 37.00 | 74.00 | 26.00 | |
| 1 | 1308.399 | 4.83 | 25.06 | 40.5/ | 4/./6 | 37.08 | /4.00 | -36.92 | peak |
| 2 | 4495.125 | 7.55 | 33.59 | 43.30 | 47.23 | 45.07 | 74.00 | -28.93 | peak |
| 3 | 4882.000 | 7.97 | 34.06 | 43.69 | 46.65 | 44.99 | 74.00 | -29.01 | peak |
| 4 | 6526.373 | 11.46 | 35.62 | 42.38 | 47.10 | 51.80 | 74.00 | -22.20 | peak |
| 5 | 7323.000 | 10.05 | 36.16 | 41.77 | 46.18 | 50.62 | 74.00 | -23.38 | peak |
| 6 | 9764.000 | 10.82 | 37.76 | 38.17 | 41.51 | 51.92 | 74.00 | -22.08 | peak |



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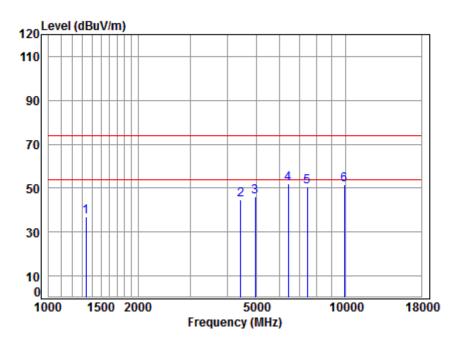
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Report No.: SZEM190401266002

Page: 43 of 92

Mode:c; Polarization:Horizontal; Channel:High



: chamber Site

Condition: 3m HORIZONTAL

Job No : 12660CR Mode : 2480 TX SE

Note : BT-R

| | | Cable | Ant | Preamp | Read | | Limit | 0ver | |
|---|----------|-------|--------|--------|-------|--------|--------|--------|--------|
| | Freq | Loss | Factor | Factor | Level | Level | Line | Limit | Remark |
| | | | | | | | | | |
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB | |
| | | | | | | | | | |
| 1 | 1335.141 | 4.93 | 25.17 | 40.59 | 47.42 | 36.93 | 74.00 | -37.07 | peak |
| 2 | 4443.453 | 7.50 | 33.50 | 43.25 | 47.03 | 44.78 | 74.00 | -29.22 | peak |
| 3 | 4960.000 | 8.05 | 34.15 | 43.76 | 47.42 | 45.86 | 74.00 | -28.14 | peak |
| 4 | 6414.167 | 11.38 | 35.52 | 42.48 | 47.38 | 51.80 | 74.00 | -22.20 | peak |
| 5 | 7440.000 | 10.02 | 36.25 | 41.69 | 46.06 | 50.64 | 74.00 | -23.36 | peak |
| 6 | 9920.000 | 10.90 | 37.85 | 37.93 | 40.83 | 51.65 | 74.00 | -22.35 | peak |



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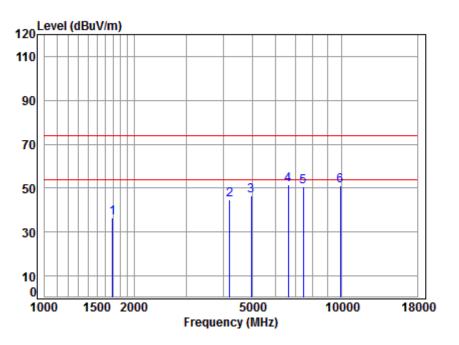
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Report No.: SZEM190401266002

Page: 44 of 92

Mode:c; Polarization:Vertical; Channel:High



Site : chamber Condition: 3m VERTICAL

Job No : 12660CR Mode : 2480 TX SE

Note : BT-R

| | | Cable | Ant | Preamp | Read | | Limit | 0ver | |
|---|----------|-------|--------|--------|-------|--------|--------|--------|--------|
| | Freq | Loss | Factor | Factor | Level | Level | Line | Limit | Remark |
| | | | | | | | | | |
| | MHz | dB | dB/m | dB | dBuV | dBuV/m | dBuV/m | dB | |
| | | | | | | | | | |
| 1 | 1692.231 | 5.24 | 26.64 | 40.83 | 45.63 | 36.68 | 74.00 | -37.32 | peak |
| 2 | 4206.011 | 7.23 | 33.08 | 42.99 | 47.57 | 44.89 | 74.00 | -29.11 | peak |
| 3 | 4960.000 | 8.05 | 34.15 | 43.76 | 48.23 | 46.67 | 74.00 | -27.33 | peak |
| 4 | 6621.375 | 11.19 | 35.67 | 42.31 | 46.96 | 51.51 | 74.00 | -22.49 | peak |
| 5 | 7440.000 | 10.02 | 36.25 | 41.69 | 45.86 | 50.44 | 74.00 | -23.56 | peak |
| 6 | 9920.000 | 10.90 | 37.85 | 37.93 | 40.44 | 51.26 | 74.00 | -22.74 | peak |



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Report No.: SZEM190401266002

Page: 45 of 92

Photographs 8

8.1 Test Setup

Refer to Setup Photos

8.2 EUT Constructional Details (EUT Photos)

Refer to EUT external and internal photos



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Report No.: SZEM190401266002

Page: 46 of 92

9 **Appendix**

9.1 Appendix 15.247

1.20 dB Bandwidth

| Test Mode | Test Channel | EBW[MHz] | Limit[MHz] | Verdict |
|-----------|--------------|----------|------------|---------|
| DH5 | 2402 | 0.980 | | PASS |
| DH5 | 2441 | 0.978 | | PASS |
| DH5 | 2480 | 0.978 | | PASS |
| 2DH5 | 2402 | 1.372 | | PASS |
| 2DH5 | 2441 | 1.370 | | PASS |
| 2DH5 | 2480 | 1.372 | | PASS |
| 3DH5 | 2402 | 1.354 | | PASS |
| 3DH5 | 2441 | 1.354 | | PASS |
| 3DH5 | 2480 | 1.354 | | PASS |



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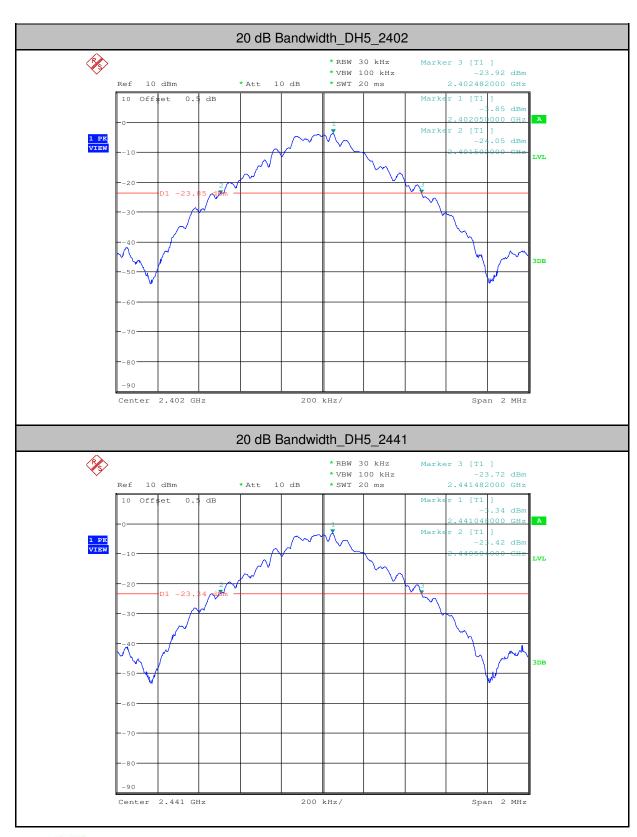
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Page: 47 of 92





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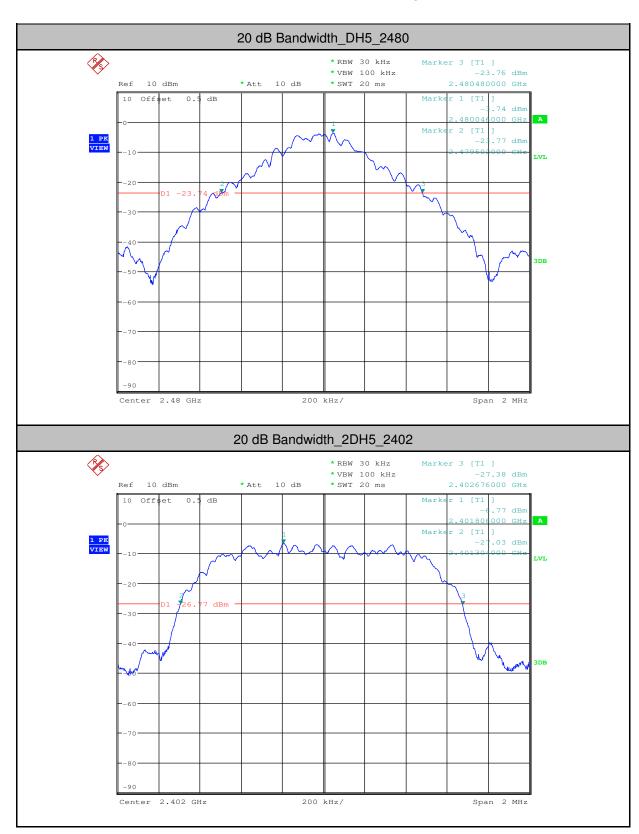
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Page: 48 of 92





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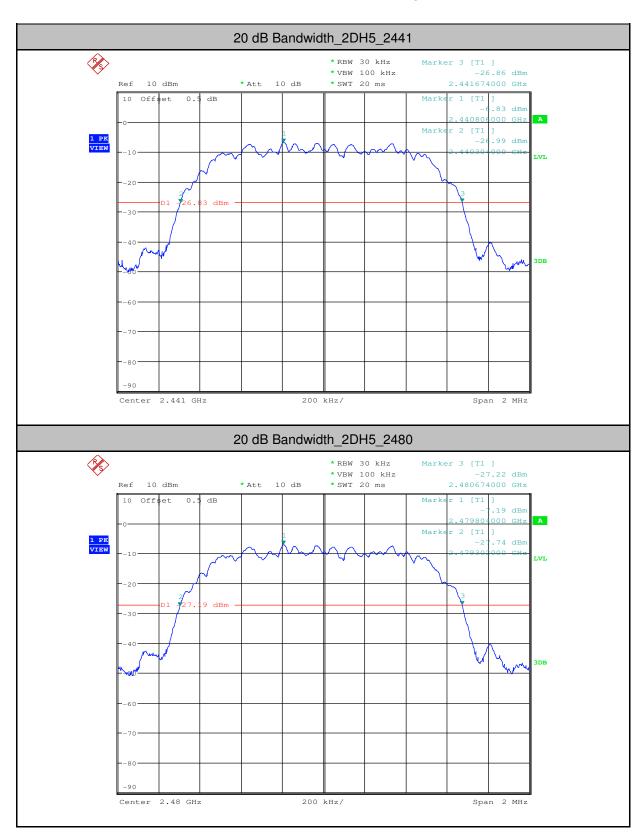
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Page: 49 of 92





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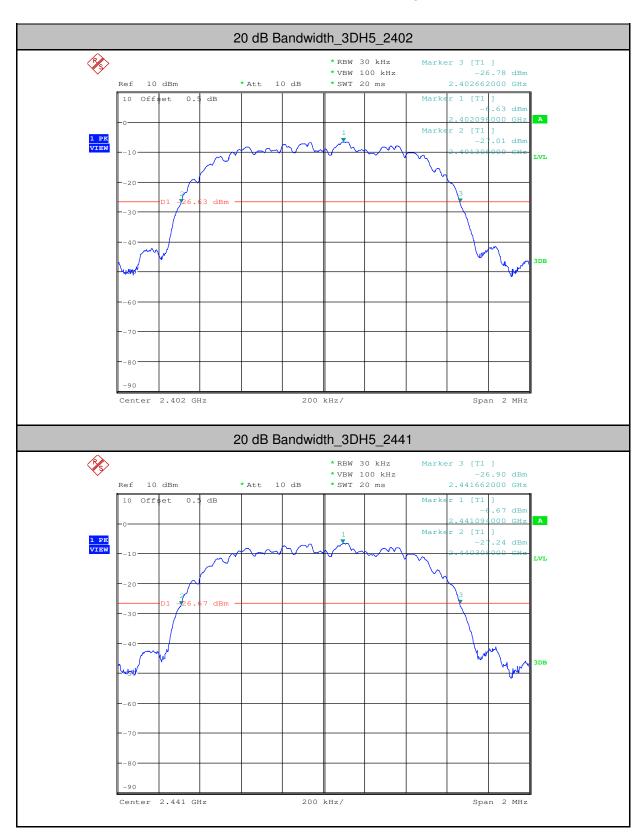
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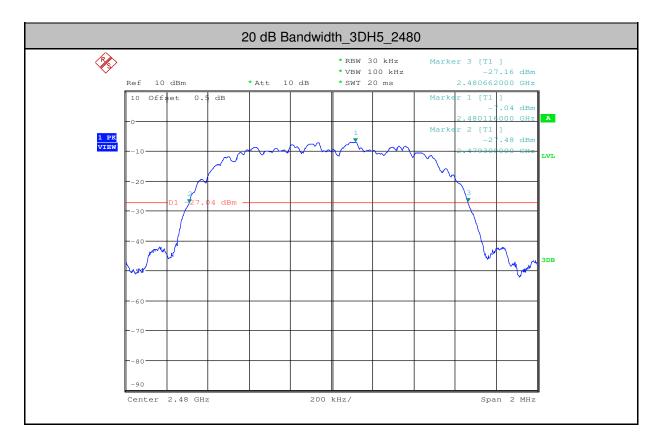
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Report No.: SZEM190401266002

Page: 52 of 92

2.Conducted Peak Output Power

| Test Mode | Test Channel | Power[dBm] | Limit[dBm] | Verdict |
|-----------|--------------|------------|------------|---------|
| DH5 | 2402 | -0.77 | <=20.97 | PASS |
| DH5 | 2441 | -0.21 | <=20.97 | PASS |
| DH5 | 2480 | -0.57 | <=20.97 | PASS |
| 2DH5 | 2402 | 2.1 | <=20.97 | PASS |
| 2DH5 | 2441 | 2.06 | <=20.97 | PASS |
| 2DH5 | 2480 | 1.74 | <=20.97 | PASS |
| 3DH5 | 2402 | 2.67 | <=20.97 | PASS |
| 3DH5 | 2441 | 2.66 | <=20.97 | PASS |
| 3DH5 | 2480 | 2.25 | <=20.97 | PASS |



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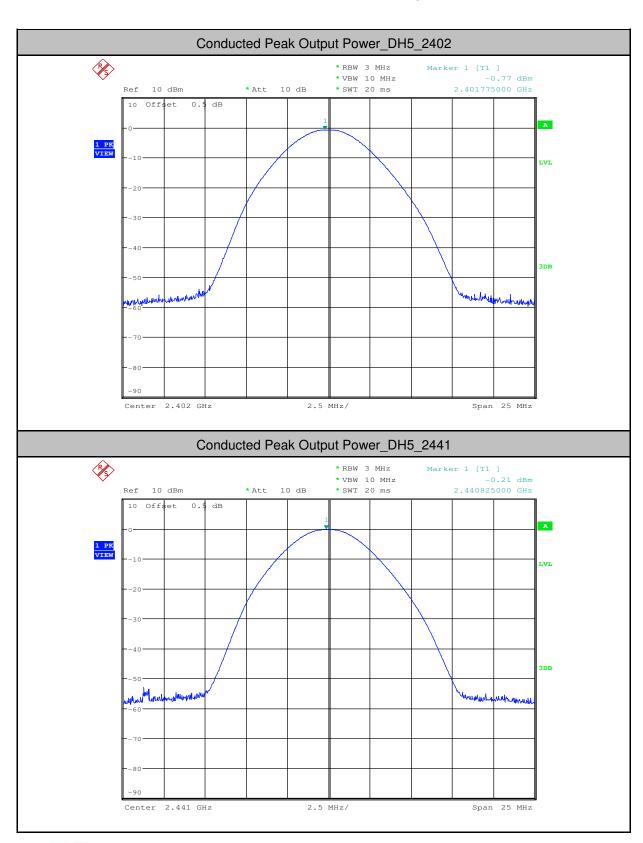
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Page: 53 of 92





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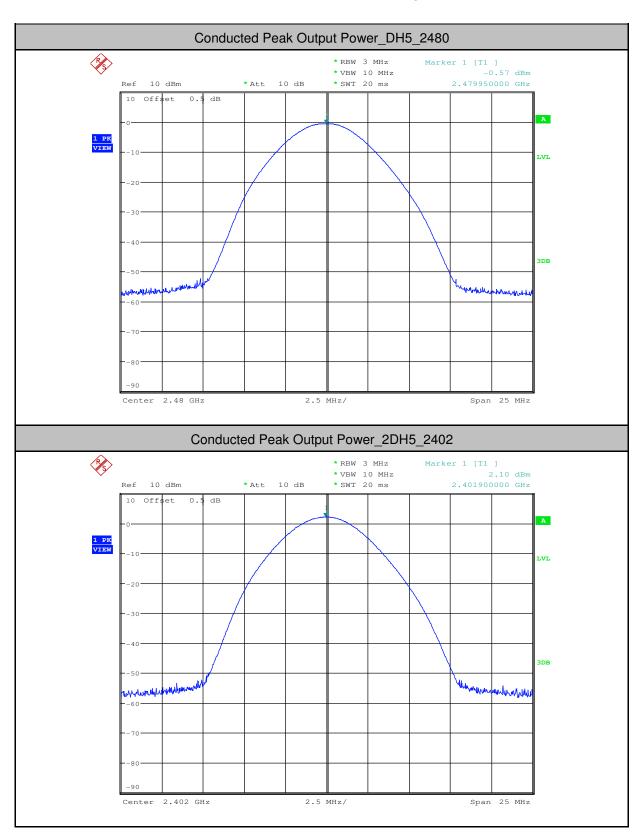
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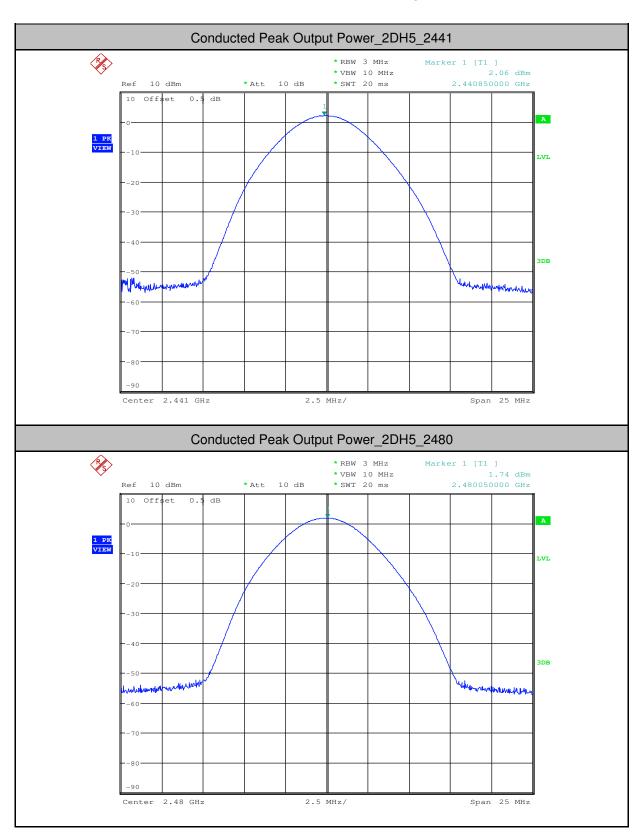
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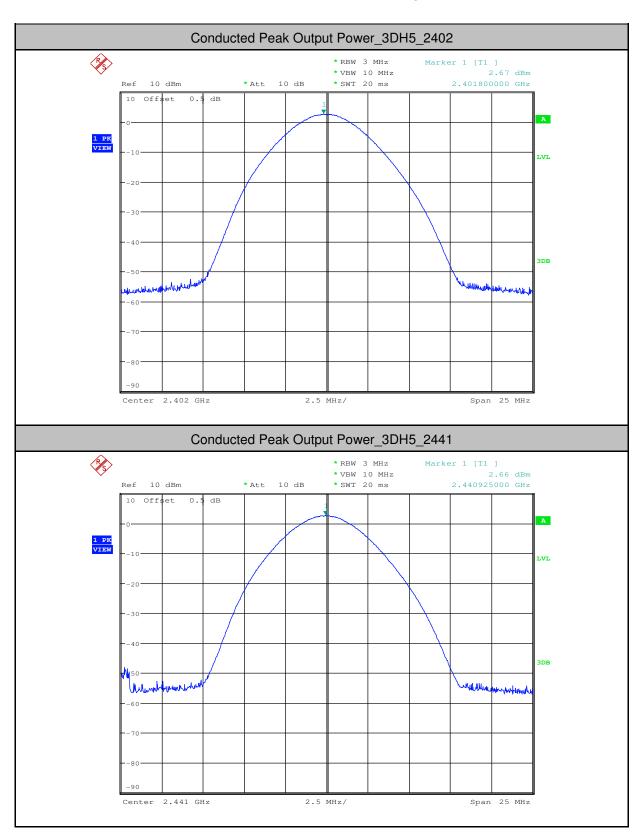
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Report No.: SZEM190401266002

Page: 56 of 92





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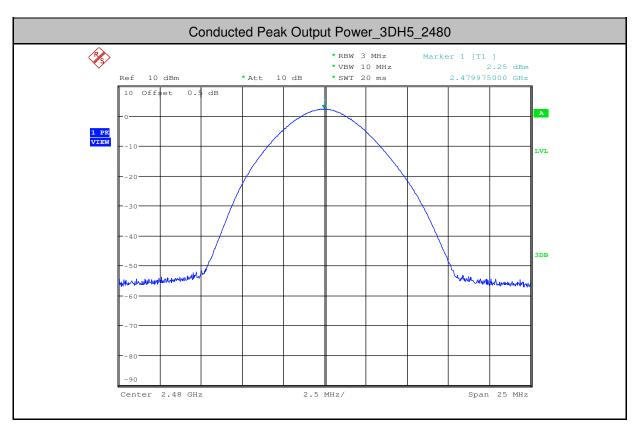
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Report No.: SZEM190401266002

Page: 57 of 92



3. Carrier Frequency Separation

| Test Mode | Test Channel | Result[MHz] | Limit[MHz] | Verdict |
|-----------|--------------|-------------|------------|---------|
| DH5 | 2441 | 1.014 | >=0.65 | PASS |
| 2DH5 | 2441 | 1.005 | >=0.91 | PASS |
| 3DH5 | 2441 | 1.010 | >=0.90 | PASS |



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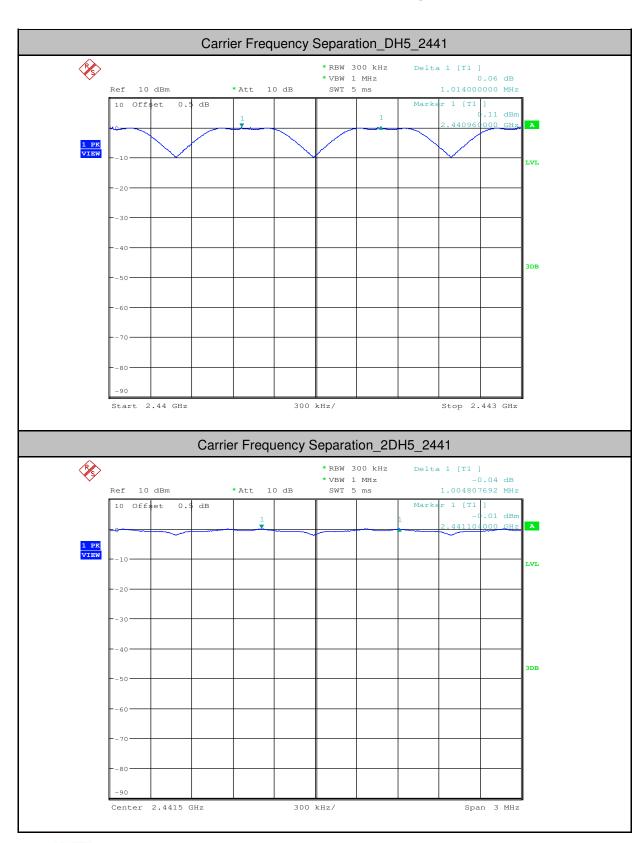
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Report No.: SZEM190401266002

Page: 58 of 92





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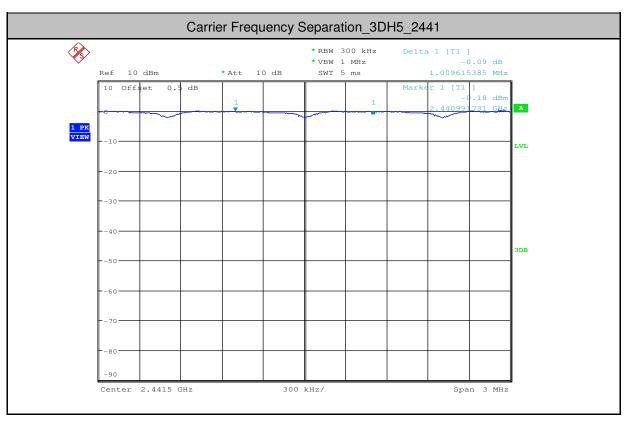
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Report No.: SZEM190401266002

Page: 59 of 92



4.Dwell Time

| Test Mode | Test Channel | Burst Width[ms/hop/ch] | Total Hops[hop*ch] | Dwell Time[s] | Limit[s] | Verdict |
|--------------|-----------------|---------------------------|-----------------------|------------------|----------|---------|
| DH1 | 2402 | 0.38 | 320 | 0.122 | <0.4 | PASS |
| DH3 | 2402 | 1.64 | 150 | 0.246 | <0.4 | PASS |
| DH5 | 2402 | 2.88 | 90 | 0.259 | <0.4 | PASS |
| 2DH1 | 2402 | 0.39 | 320 | 0.125 | <0.4 | PASS |
| 2DH3 | 2402 | 1.64 | 170 | 0.279 | <0.4 | PASS |
| 2DH5 | 2402 | 2.89 | 130 | 0.376 | <0.4 | PASS |
| 3DH1 | 2402 | 0.39 | 320 | 0.125 | <0.4 | PASS |
| 3DH3 | 2402 | 1.65 | 170 | 0.281 | <0.4 | PASS |
| 3DH5 | 2402 | 2.89 | 170 | 0.491 | <0.4 | FAIL |



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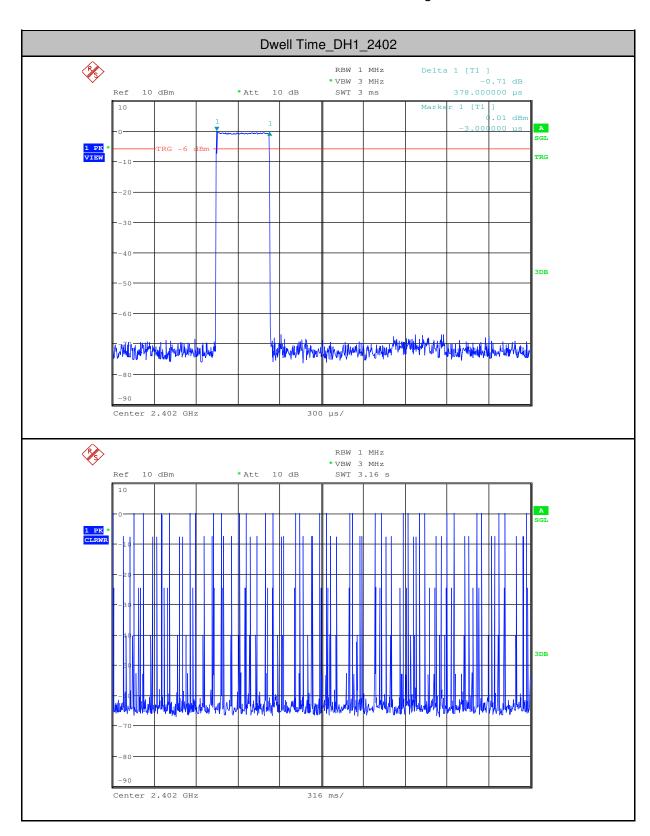
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Page: 60 of 92





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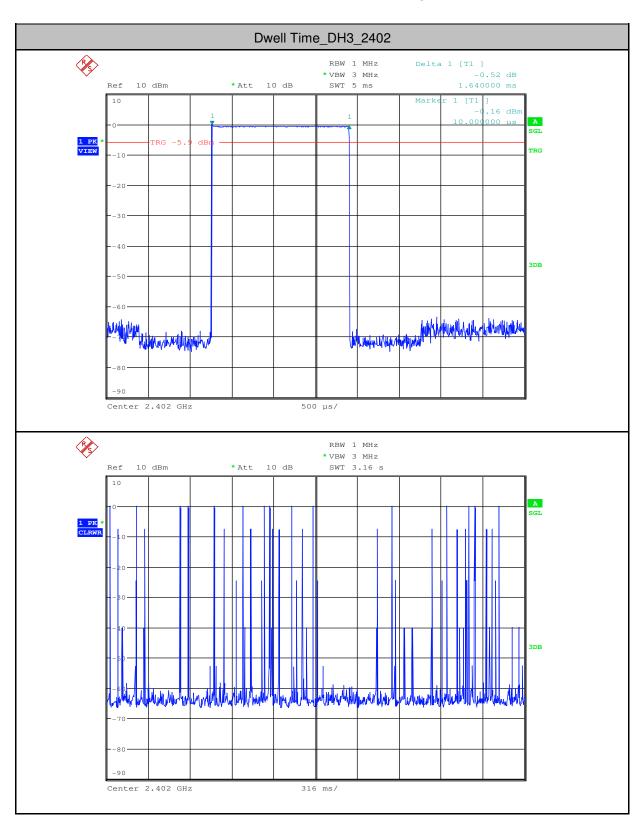
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Report No.: SZEM190401266002

Page: 61 of 92





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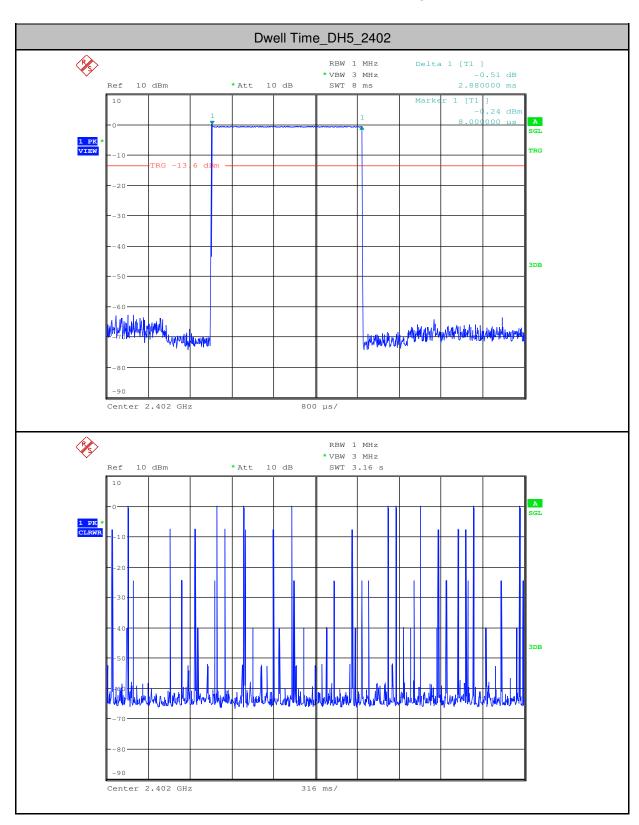
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Page: 62 of 92





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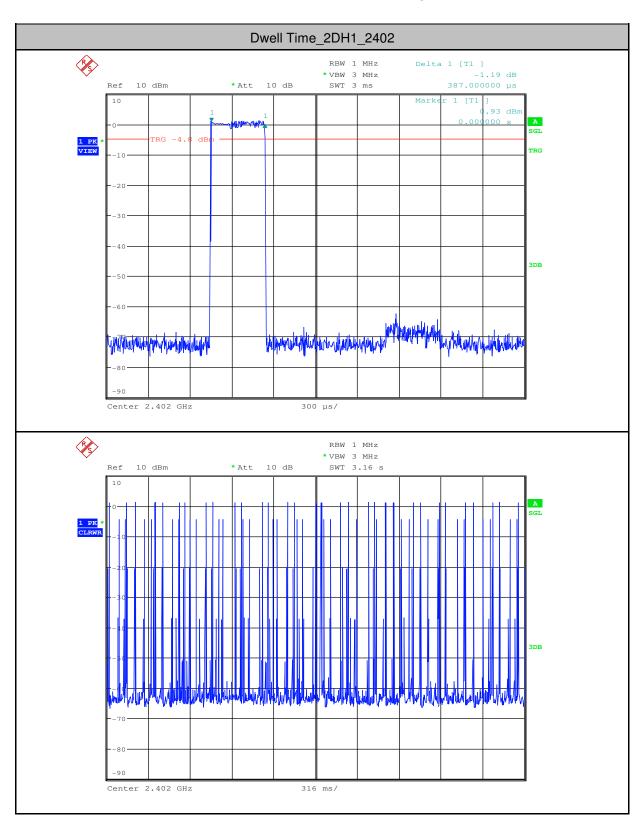
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Report No.: SZEM190401266002

Page: 63 of 92





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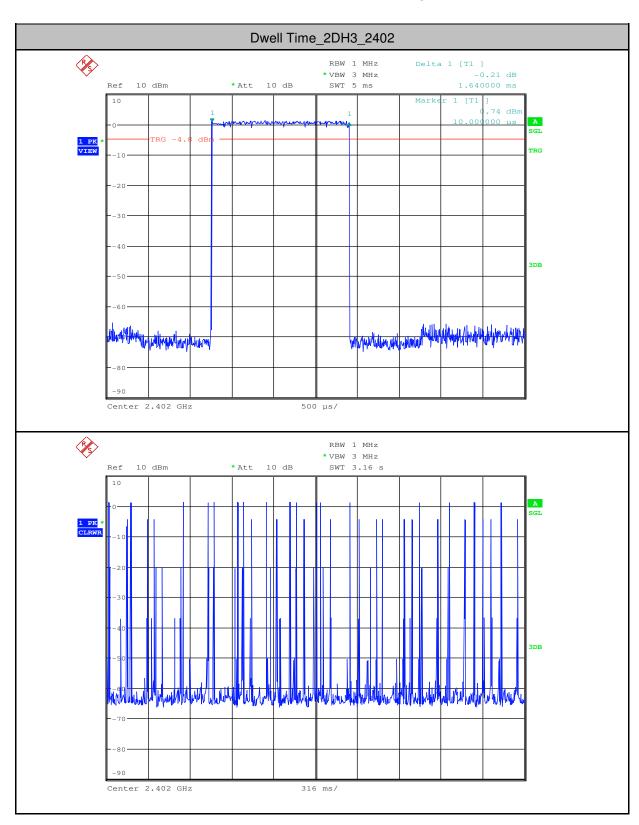
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Page: 64 of 92





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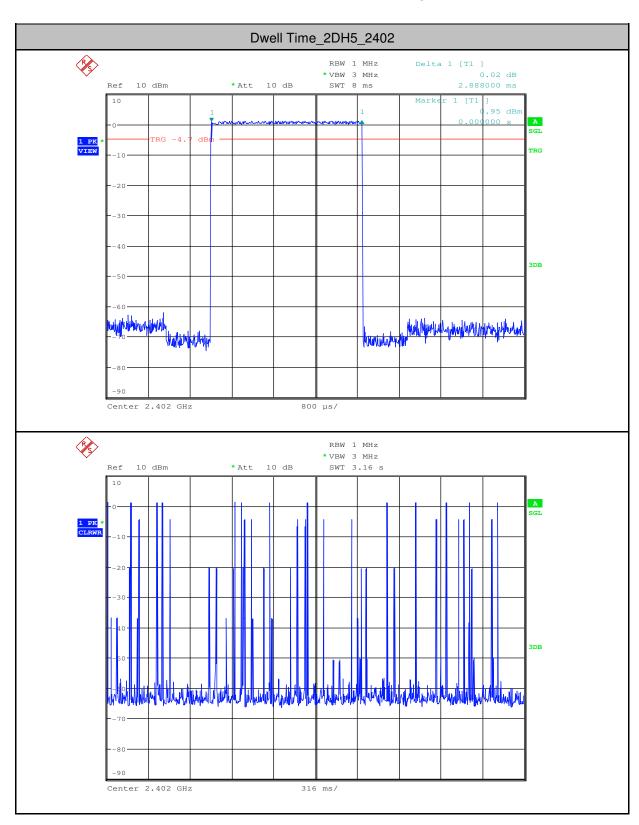
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Page: 65 of 92





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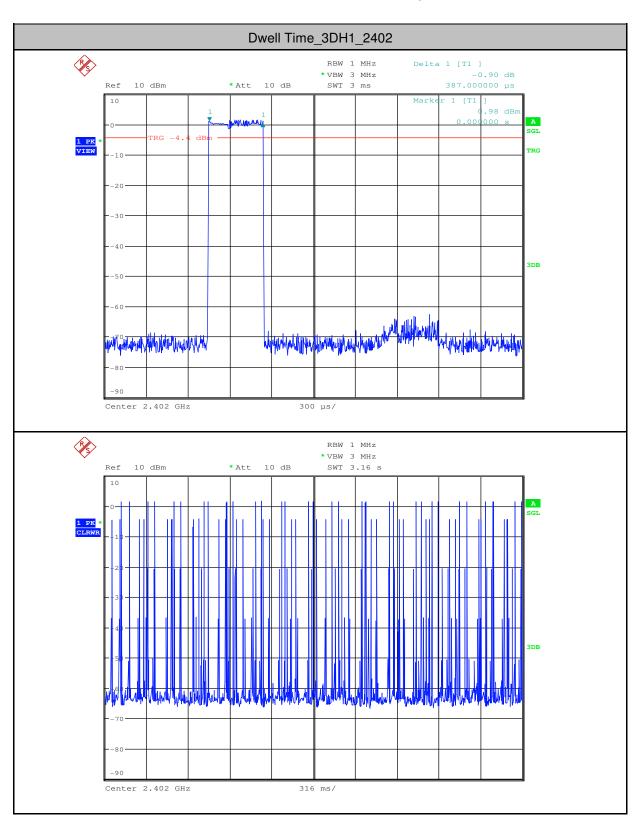
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Page: 66 of 92





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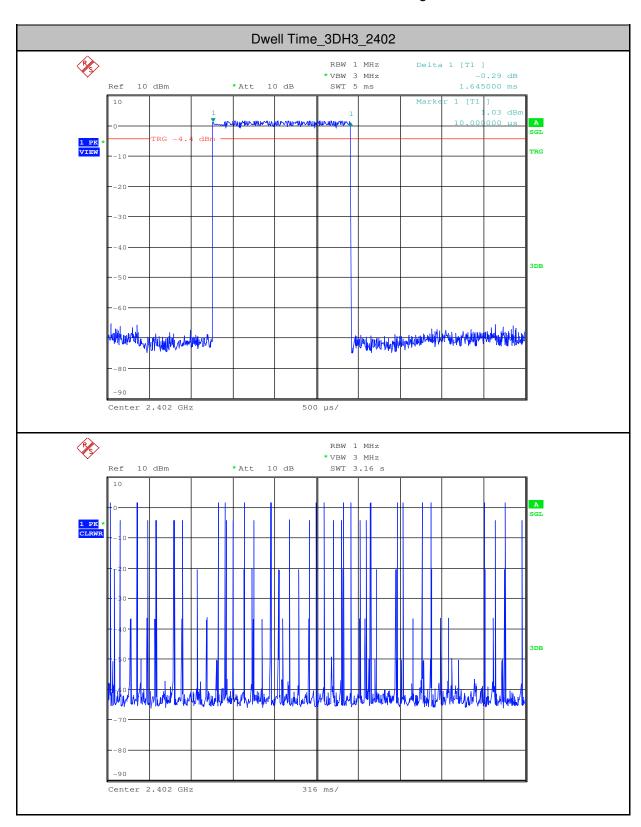
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Page: 67 of 92





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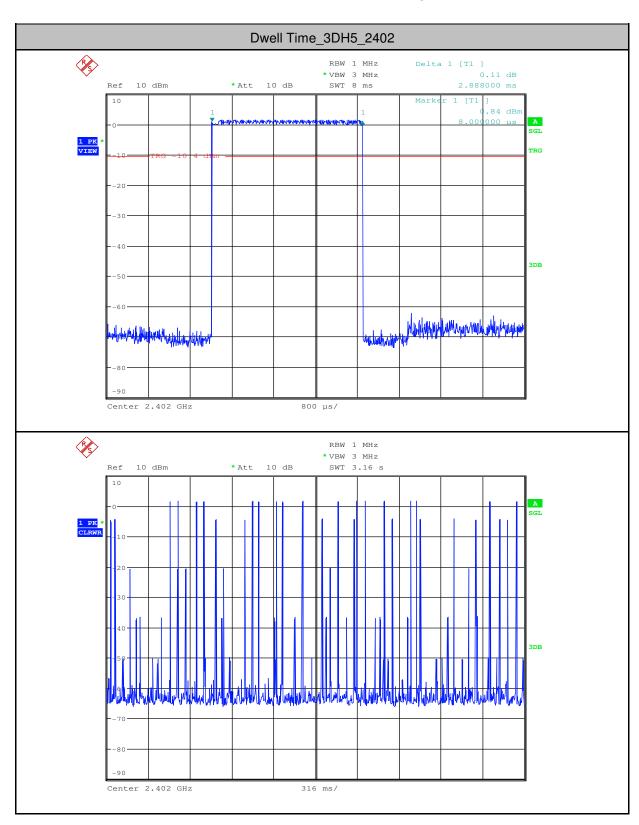
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Report No.: SZEM190401266002

Page: 68 of 92





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Report No.: SZEM190401266002

Page: 69 of 92

5. Hopping Channel Number

| Test Mode | Test Channel | Number of Hopping Channel[N] | Limit[N] | Verdict |
|-----------|--------------|------------------------------|----------|---------|
| DH5 | 2402 | 79 | >=15 | PASS |
| 2DH5 | 2402 | 79 | >=15 | PASS |
| 3DH5 | 2402 | 79 | >=15 | PASS |



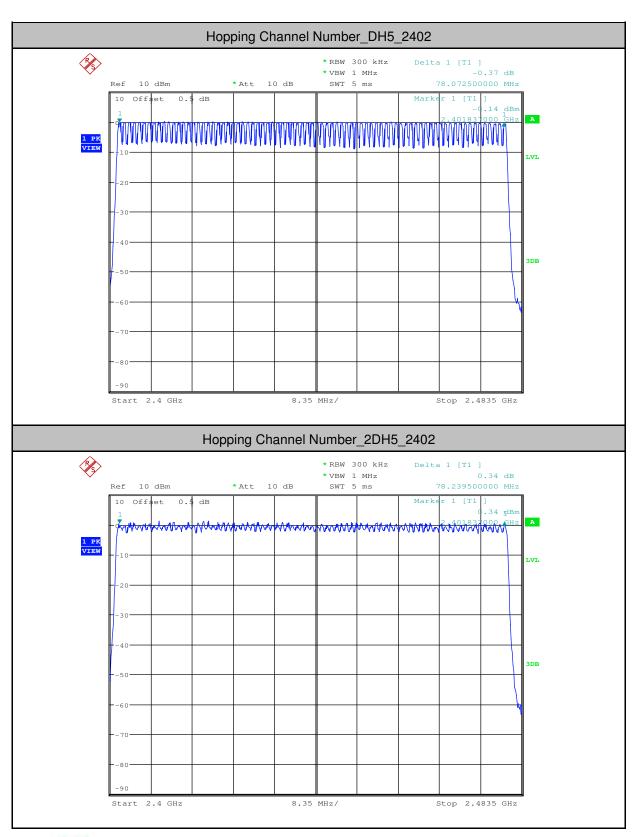
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Page: 70 of 92





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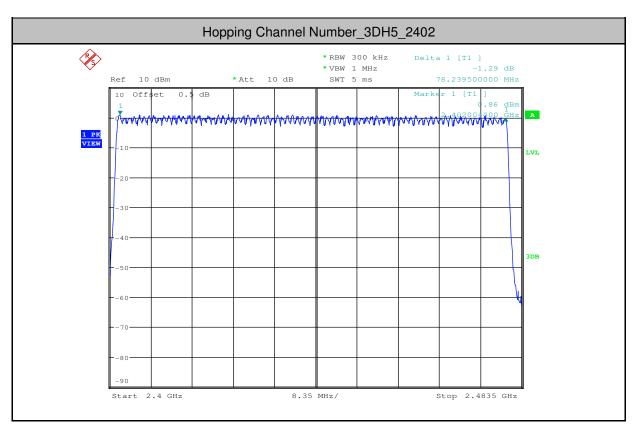
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Report No.: SZEM190401266002

Page: 71 of 92



6.Band-edge for RF Conducted Emissions

| Test Mode | Test Channel | Hopping | Carrier Power[dBm] | Max. Spurious Level [dBm] | Limit[dBm] | Verdict |
|--------------|-----------------|---------|-----------------------|------------------------------|------------|---------|
| DH5 | 2402 | On | -0.730 | -60.851 | <-20.73 | PASS |
| DH5 | 2402 | Off | -1.660 | -64.045 | <-21.66 | PASS |
| DH5 | 2480 | On | -0.910 | -63.889 | <-20.91 | PASS |
| DH5 | 2480 | Off | -1.550 | -62.802 | <-21.55 | PASS |
| 2DH5 | 2402 | On | 0.210 | -61.498 | <-19.79 | PASS |
| 2DH5 | 2402 | Off | -2.320 | -65.121 | <-22.32 | PASS |
| 2DH5 | 2480 | On | -0.390 | -64.591 | <-20.39 | PASS |
| 2DH5 | 2480 | Off | -2.720 | -63.576 | <-22.72 | PASS |
| 3DH5 | 2402 | On | 0.290 | -61.279 | <-19.71 | PASS |
| 3DH5 | 2402 | Off | -2.370 | -65.409 | <-22.37 | PASS |
| 3DH5 | 2480 | On | -0.120 | -64.300 | <-20.12 | PASS |
| 3DH5 | 2480 | Off | -2.800 | -63.047 | <-22.8 | PASS |



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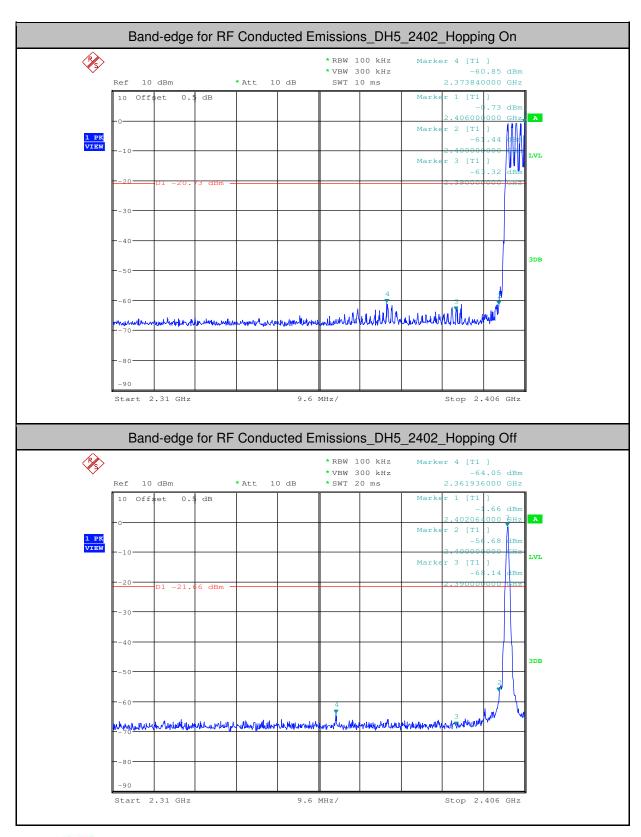
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Report No.: SZEM190401266002

Page: 72 of 92





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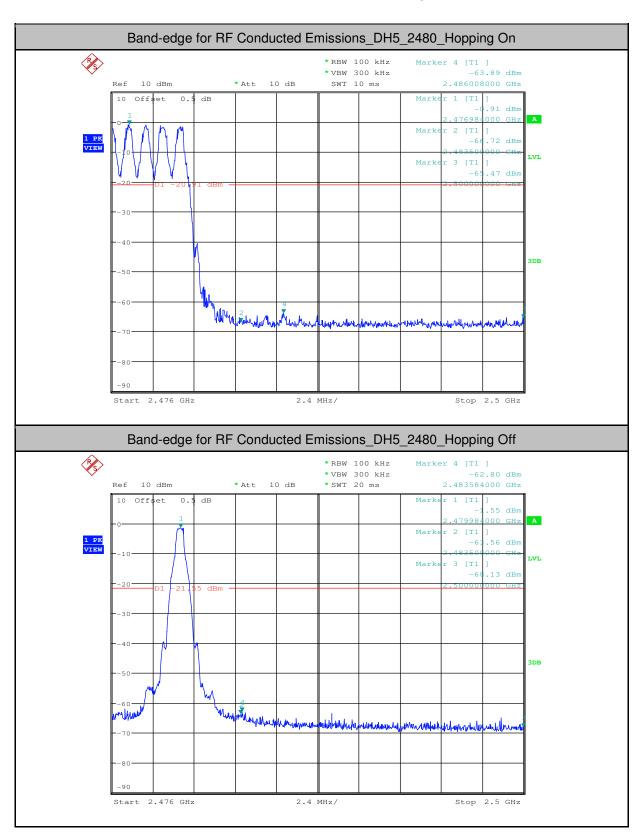
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Report No.: SZEM190401266002

Page: 73 of 92





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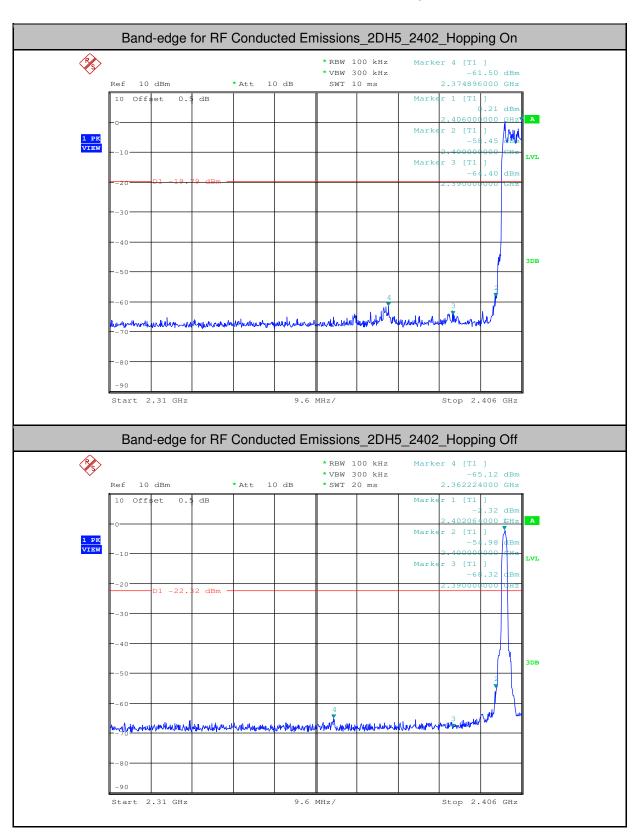
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Report No.: SZEM190401266002

Page: 74 of 92





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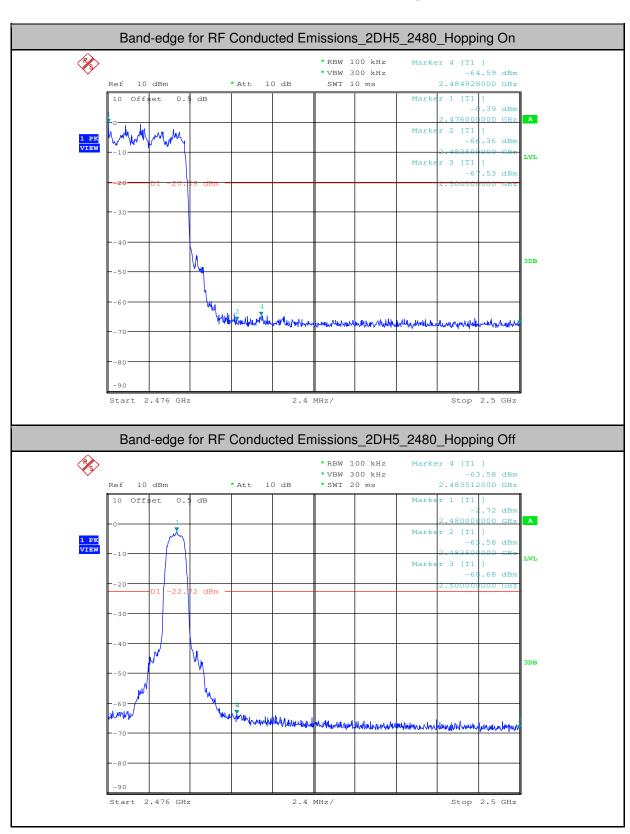
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Report No.: SZEM190401266002

Page: 75 of 92





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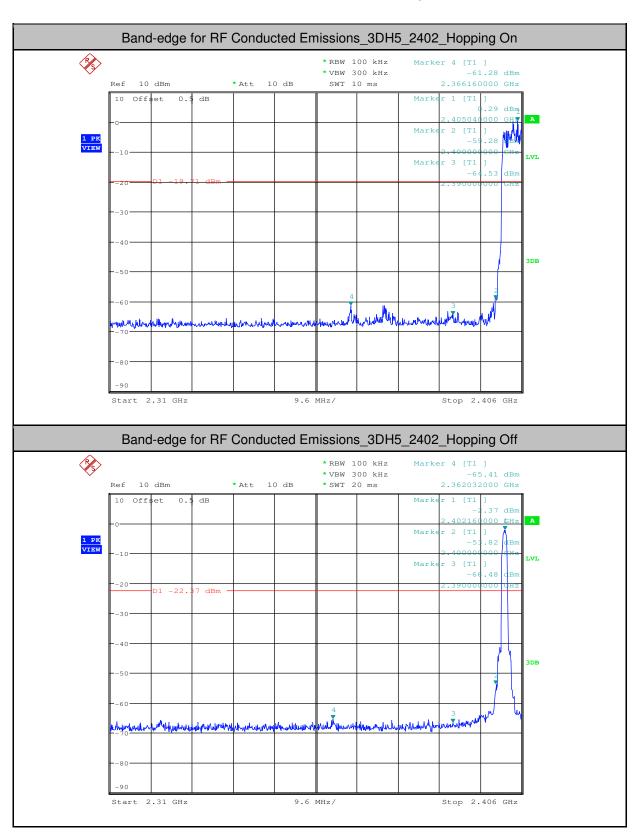
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Page: 76 of 92





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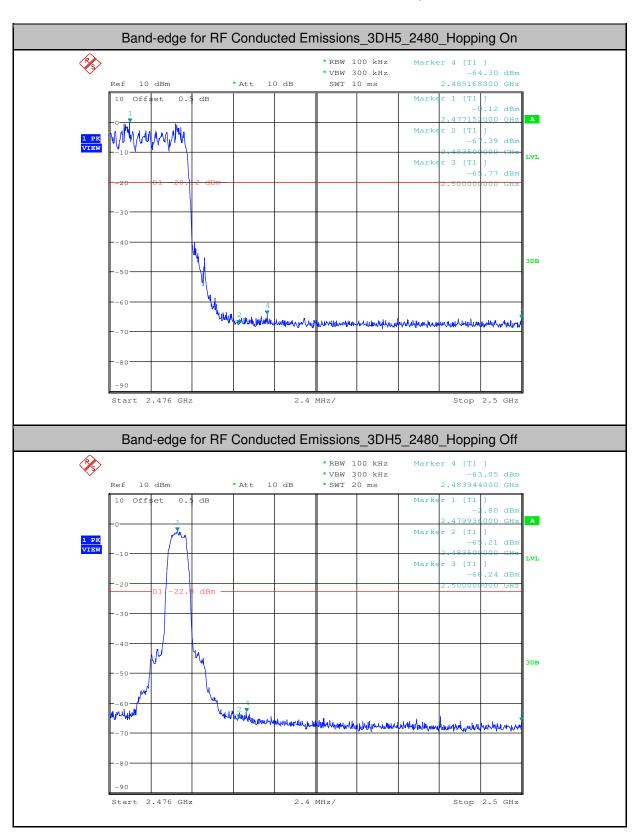
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Report No.: SZEM190401266002

Page: 77 of 92





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Report No.: SZEM190401266002

Page: 78 of 92

7.RF Conducted Spurious Emissions

| | - | | | | | | | | |
|-----------|-----------------|-------------------|------------------|--------------|--------------|-----------|------------------------|----------------|---------|
| Test Mode | Test Channel | StartFre [MHz] | StopFre [MHz] | RBW [kHz] | VBW [kHz] | Pref[dBm] | Max. Level [dBm] | Limit [dBm] | Verdict |
| DH5 | 2402 | 30 | 10000 | 1000 | 3000 | -1.84 | -48.550 | <- 21.84 | PASS |
| DH5 | 2402 | 10000 | 25000 | 1000 | 3000 | -1.84 | -52.160 | <- 21.84 | PASS |
| DH5 | 2441 | 30 | 10000 | 1000 | 3000 | -1.07 | -48.200 | <- 21.07 | PASS |
| DH5 | 2441 | 10000 | 25000 | 1000 | 3000 | -1.07 | -52.920 | <- 21.07 | PASS |
| DH5 | 2480 | 30 | 10000 | 1000 | 3000 | -1.44 | -48.430 | <- 21.44 | PASS |
| DH5 | 2480 | 10000 | 25000 | 1000 | 3000 | -1.44 | -52.580 | <- 21.44 | PASS |
| 2DH5 | 2402 | 30 | 10000 | 1000 | 3000 | -2.4 | -47.650 | <-22.4 | PASS |
| 2DH5 | 2402 | 10000 | 25000 | 1000 | 3000 | -2.4 | -52.510 | <-22.4 | PASS |
| 2DH5 | 2441 | 30 | 10000 | 1000 | 3000 | -2.35 | -48.560 | <- 22.35 | PASS |
| 2DH5 | 2441 | 10000 | 25000 | 1000 | 3000 | -2.35 | -52.580 | <- 22.35 | PASS |
| 2DH5 | 2480 | 30 | 10000 | 1000 | 3000 | -2.77 | -48.640 | <- 22.77 | PASS |
| 2DH5 | 2480 | 10000 | 25000 | 1000 | 3000 | -2.77 | -51.330 | <- 22.77 | PASS |
| 3DH5 | 2402 | 30 | 10000 | 1000 | 3000 | -2.37 | -47.140 | <- 22.37 | PASS |
| 3DH5 | 2402 | 10000 | 25000 | 1000 | 3000 | -2.37 | -52.760 | <- 22.37 | PASS |
| 3DH5 | 2441 | 30 | 10000 | 1000 | 3000 | -2.34 | -47.920 | <- 22.34 | PASS |
| 3DH5 | 2441 | 10000 | 25000 | 1000 | 3000 | -2.34 | -52.550 | <- 22.34 | PASS |
| 3DH5 | 2480 | 30 | 10000 | 1000 | 3000 | -2.83 | -49.170 | <- 22.83 | PASS |
| 3DH5 | 2480 | 10000 | 25000 | 1000 | 3000 | -2.83 | -52.650 | <- 22.83 | PASS |



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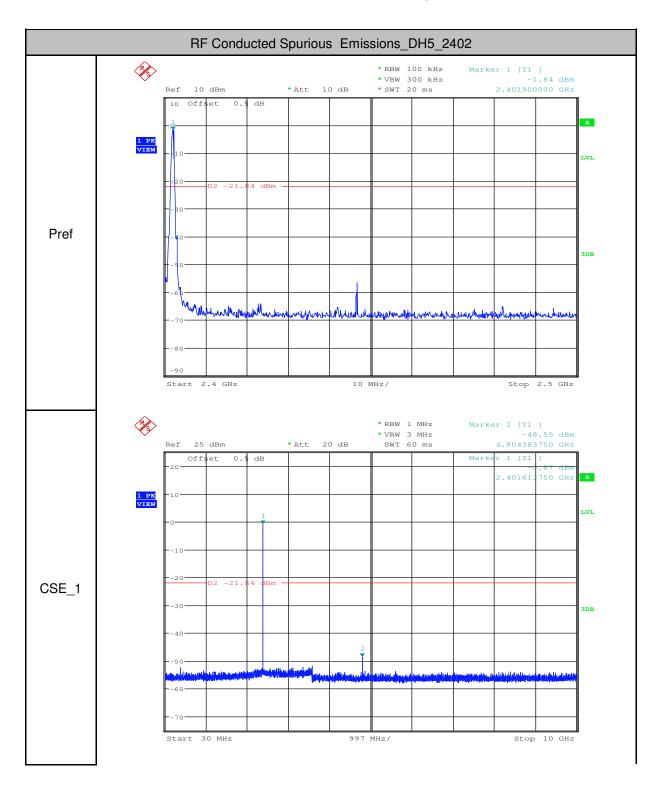
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Page: 79 of 92





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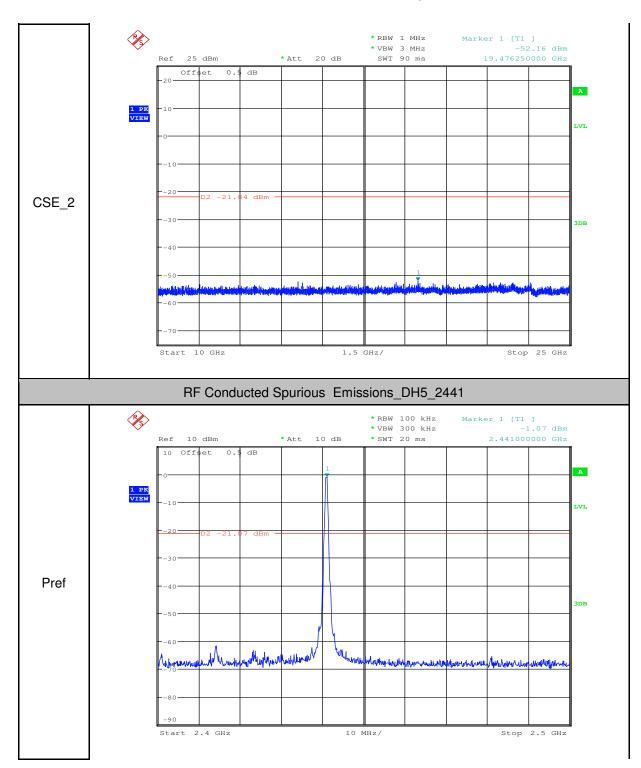
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Page: 80 of 92





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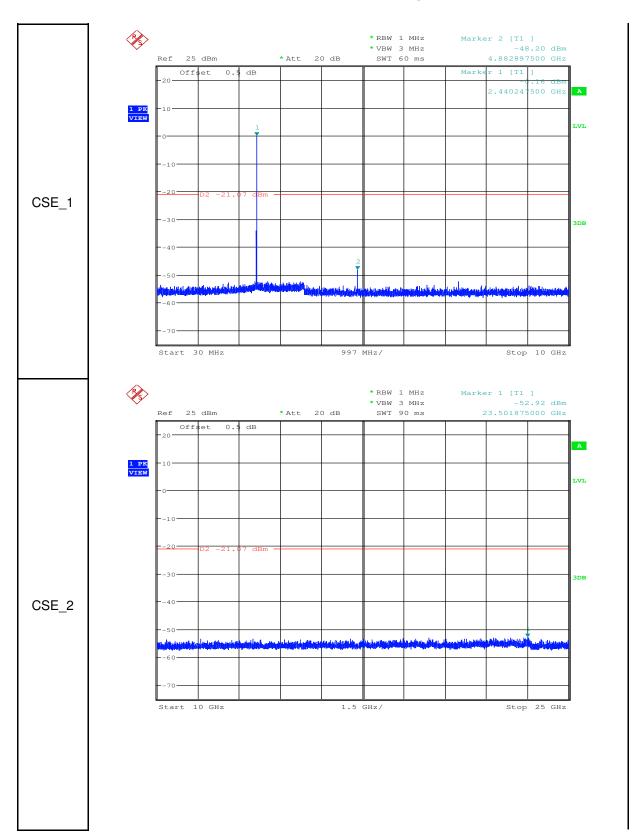
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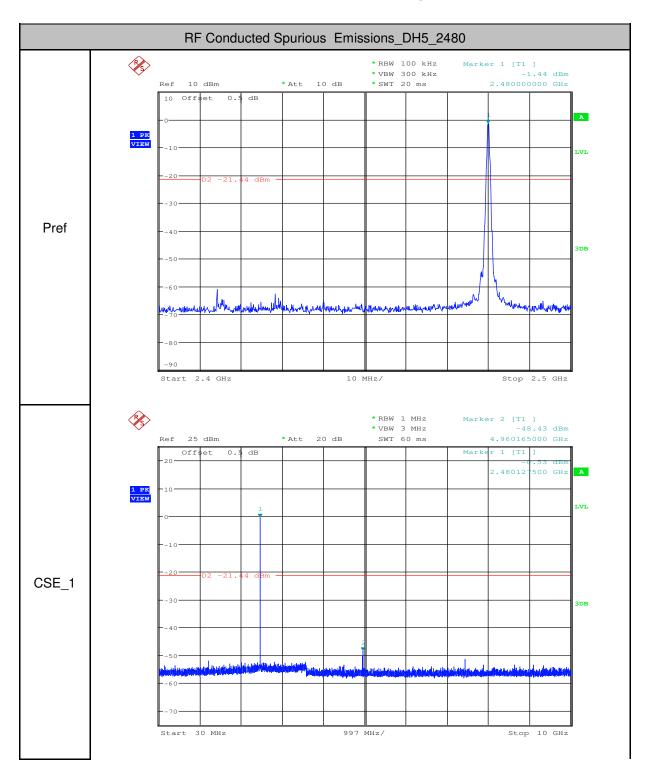
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Page: 82 of 92





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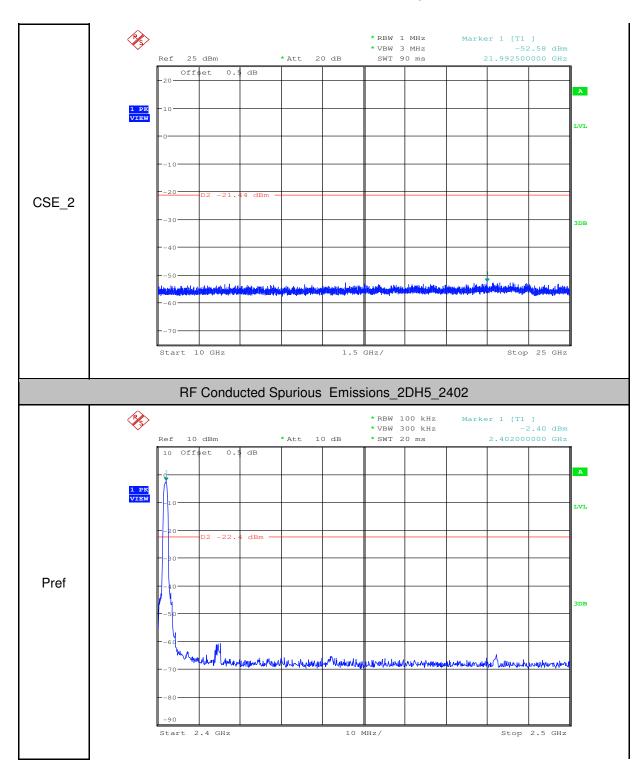
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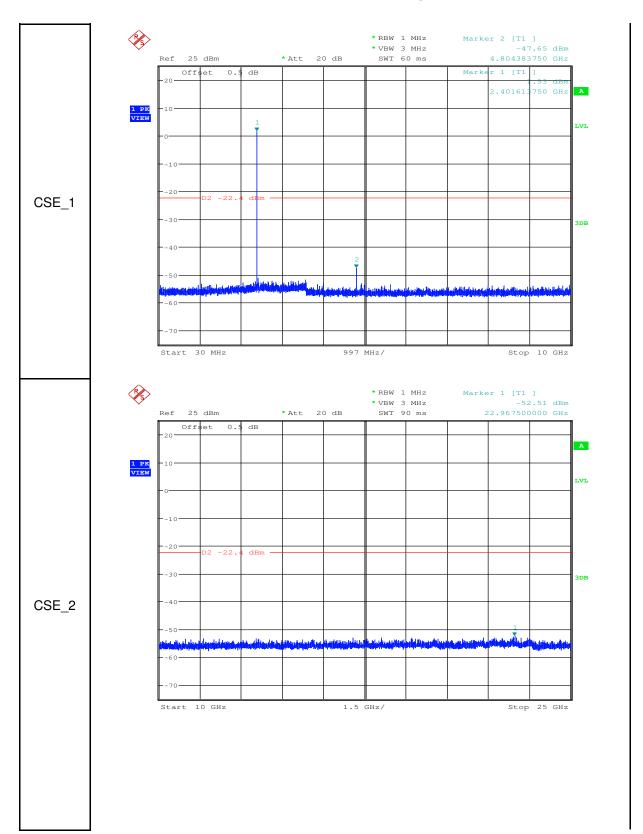
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Page: 84 of 92





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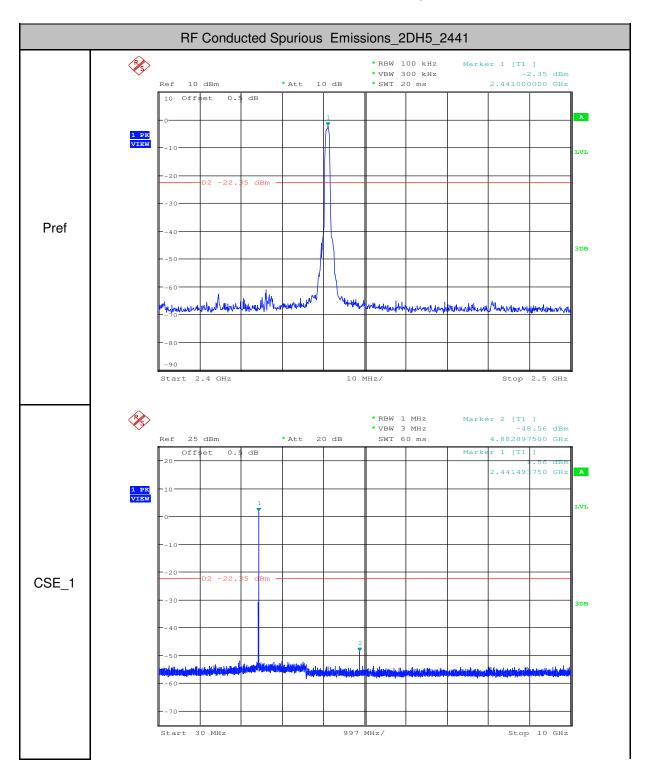
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Report No.: SZEM190401266002

Page: 85 of 92





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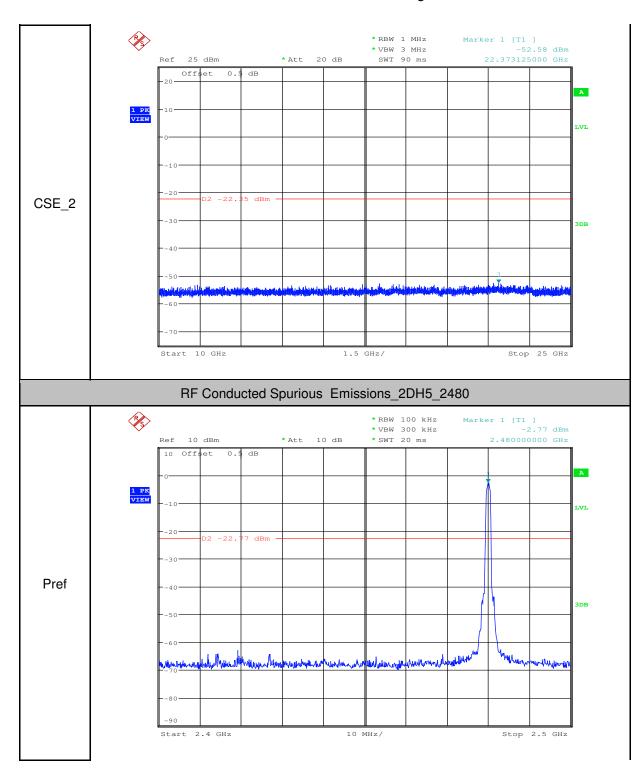
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Report No.: SZEM190401266002

Page: 86 of 92





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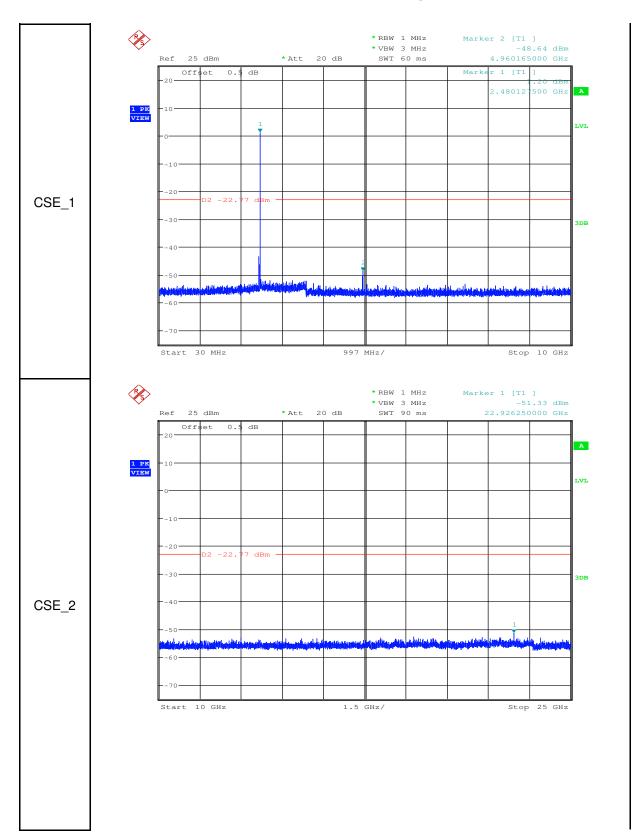
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Report No.: SZEM190401266002

Page: 87 of 92





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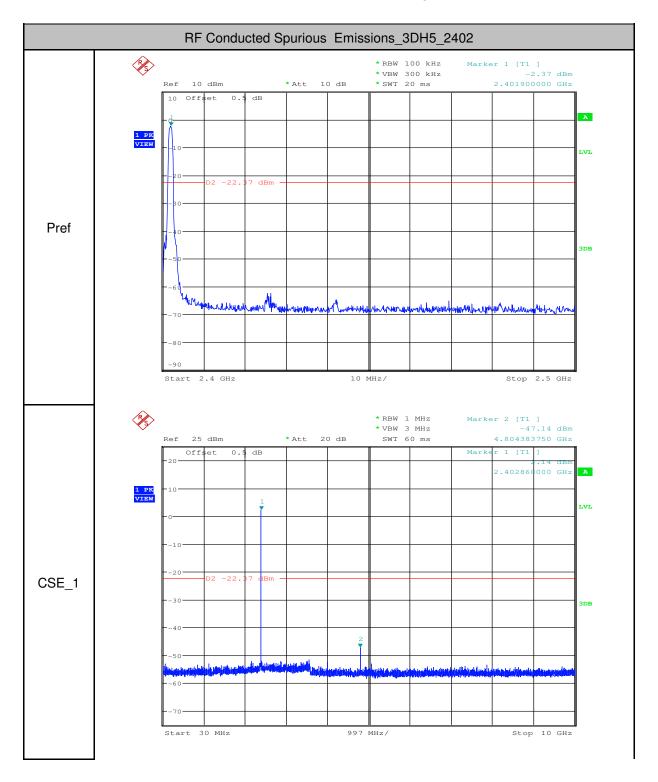
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Report No.: SZEM190401266002

Page: 88 of 92





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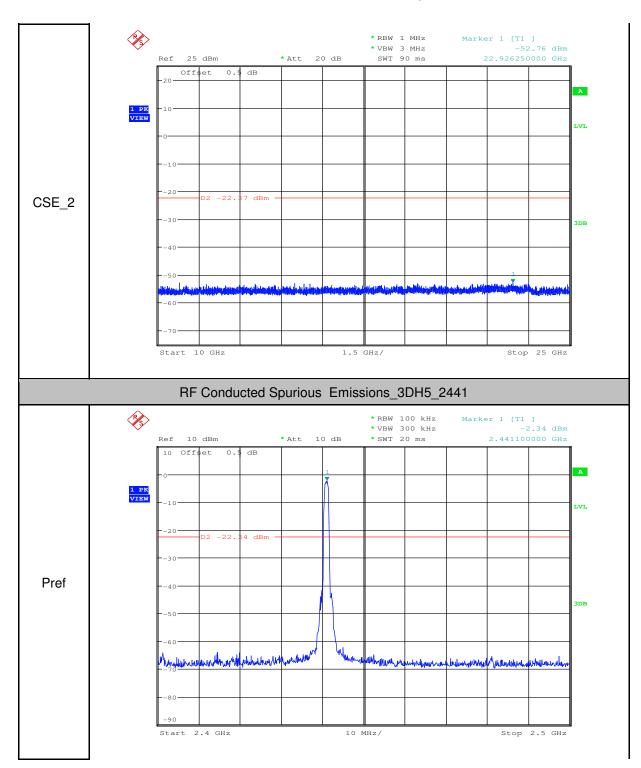
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Report No.: SZEM190401266002

Page: 89 of 92





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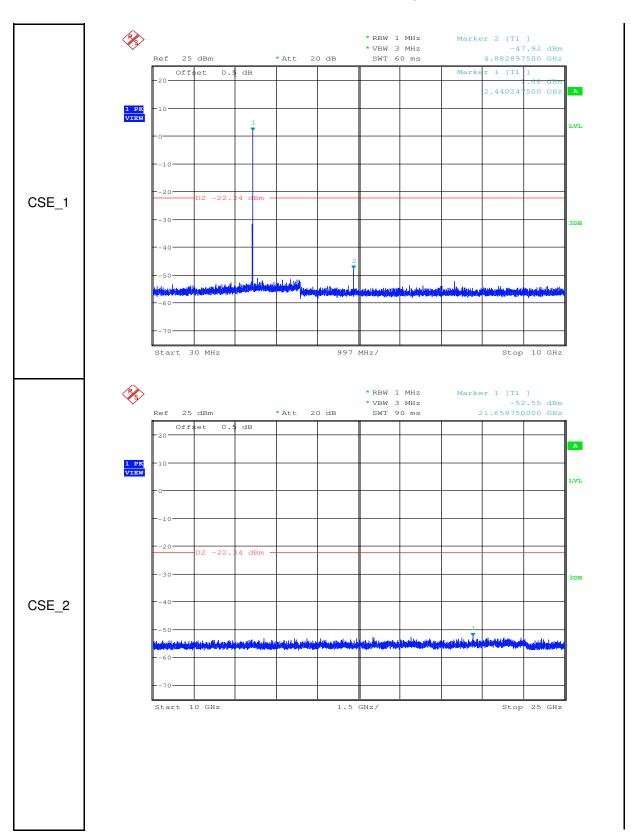
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Report No.: SZEM190401266002

Page: 90 of 92





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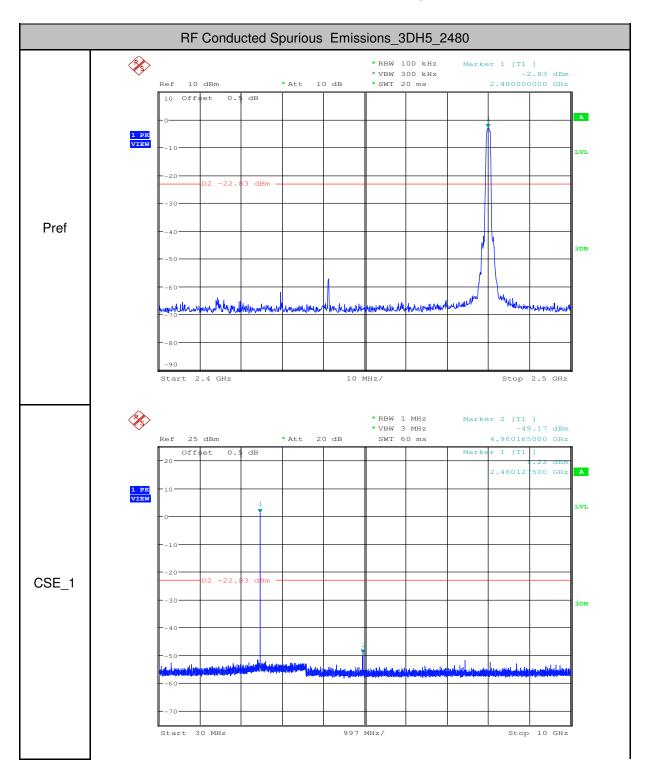
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Report No.: SZEM190401266002

Page: 91 of 92





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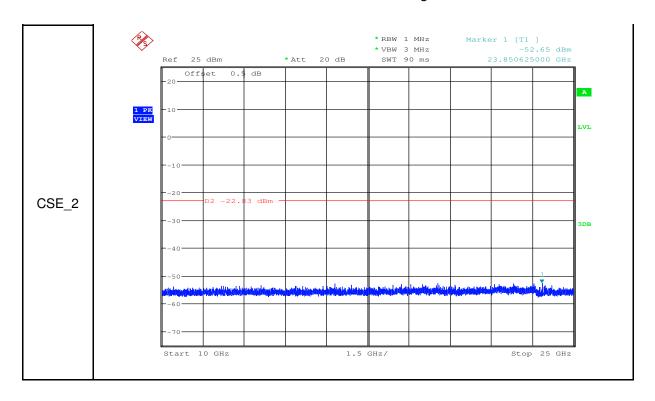
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Report No.: SZEM190401266002

Page: 92 of 92



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