Radio Equipment Compliance

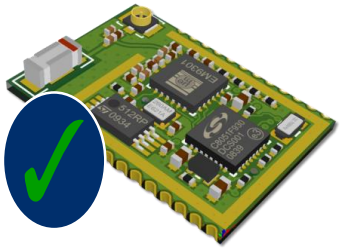
Part I – Rules, Directives, and Standards

Simon Hindle – Business Development Manager

Compliance in the EU (and wider Europe)

element

Radio Equipment in Europe



element

Radio Equipment in Europe

Radio Equipment

Radio Equipment Directive

Article 3.1(a)
Health and Safety

Article 3.1(b)
EMC

Article 3.2
Spectrum Usage

element

Radio Equipment Directive

RED Article 10

Manufacturers shall...

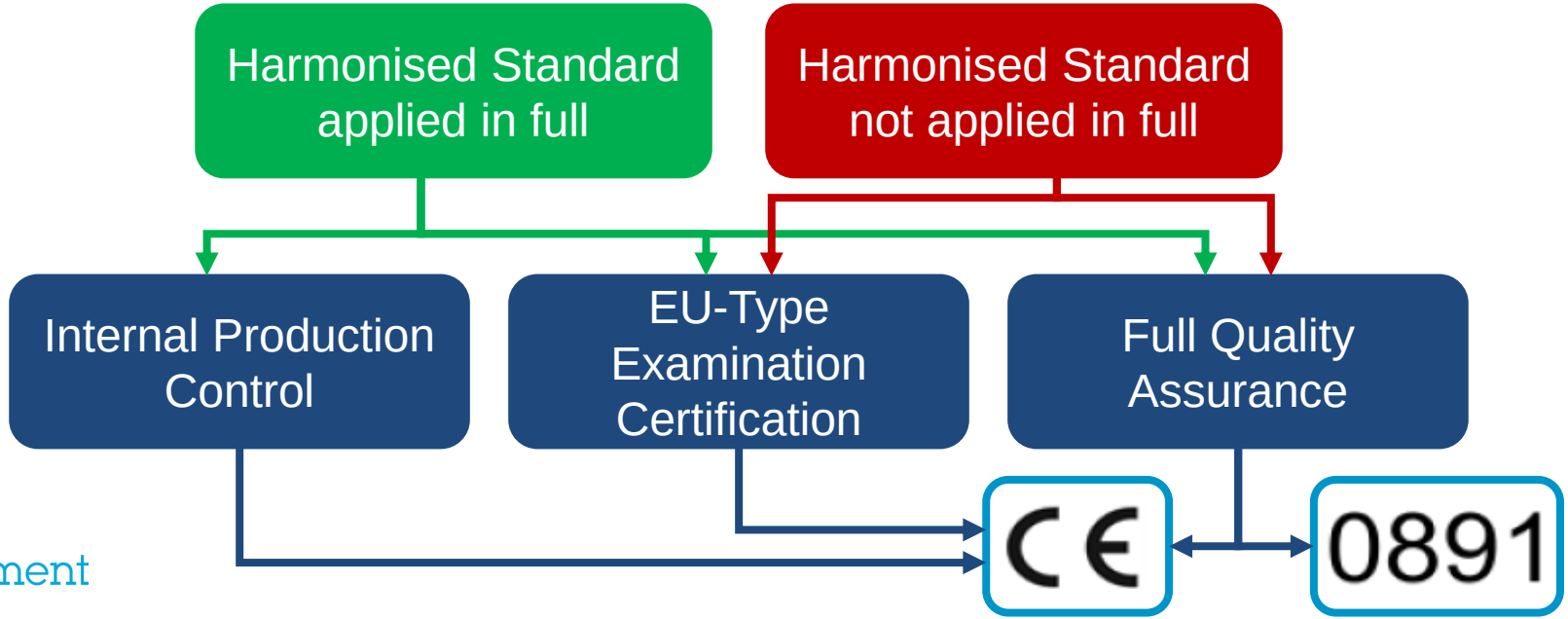
1. Ensure equipment is designed to meet the Essential requirements
2. Ensure it can be used in at least one member state
3. Perform Conformity Assessment

element

Harmonised Standards

Radio Equipment Directive

Chapter III – Conformity of Radio Equipment



element

Radio Equipment Directive

Manufacturers shall...

1. Ensure equipment is designed to meet the Essential requirements
2. Ensure it can be used in at least one member state
3. Perform Conformity Assessment
4. Retain evidence
5. Series production
6. Ensure product bears a type/batch or serial number

element

Radio Equipment Directive

Manufacturers shall...

7. Indicate their name and postal address on the equipment
8. Ensure instructions are provided (with the equipment)
9. Ensure the EU DoC is with the equipment
10. Identify restrictions on use on the packaging
11. Agree to take corrective measures as appropriate
12. Agree to respond to a market surveillance request

element

EU Declaration of Conformity (No 0001)

Bathtub Buddy Limited, Suds House, Bath, UK do hereby declare that the **Internet of Things Bathtub Duck Gateway NN 0001** conforms with the following EU Legislation:

1. Directive 2014/53/EU (Radio Equipment Directive)
2. Directive 2011/65/EU (RoHS)

2014/54/EU Article 3.1a	EN 62368-1:2014; EN 50566:2017
2014/54/EU Article 3.1b	EN 301 489-17 v2.1.1, EN 301 489-52 V1.1.0, EN 301 489-3 v2.1.1
2014/54/EU Article 3.2	EN 300 328v2.1.1 / EN 301 908-2 V11.1.2 / EN 303 413 V1.1.1

Software Version: 0001.4b

Accessories: N/A

Fred Bloggs

Place of Issue: Bathtub Buddy Limited, Suds House, Bath, UK

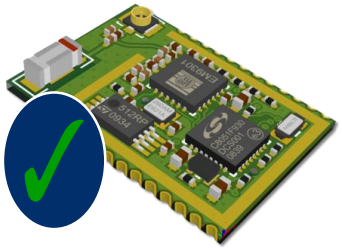
Date of Issue: 7/11/2018

element

Compliance in the USA & Canada

element

Radio Equipment in North America



element

USA– Legislative Structure

Radio Rule Parts	EMC Rule Parts
15, 22, 24, 27, 90	15 (b)
Test Standards (ANSI C63.10)	Test Standards (ANSI C63.4)
Certification	SDoC
FCC ID	FCC

KDB

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

element

Canada – Legislative Structure

RSS Standards	ICE Standards
RSS 247, 210 etc	ICES 003, 004
Test Standards (ANSI C63.10)	Test Standards (ANSI C63.4)
Certification	SDoC
IC ID	**Innovation, Science and Economic Development Canada ICES-003 Compliance Label:** *CAN ICES-3 (A or B)/NMB-3(A or B)*

element

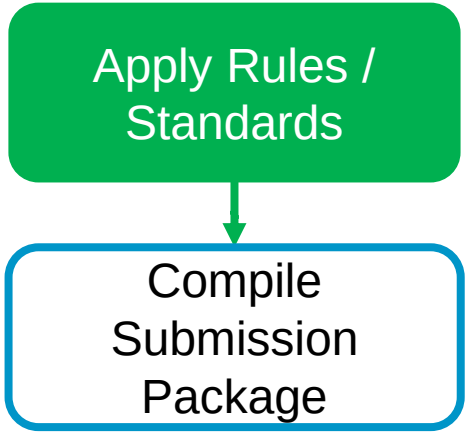
FCC

Responsible party shall...

1. Determine the Rules that apply
2. Determine which Equipment Authorization Procedure(s) is required for your product.
3. Perform compliance testing at an authorized testing laboratory.
4. Obtain the required approval.
5 Label product with the required information and include compliance information in the user manual.

element

Equipment Authorization Procedure



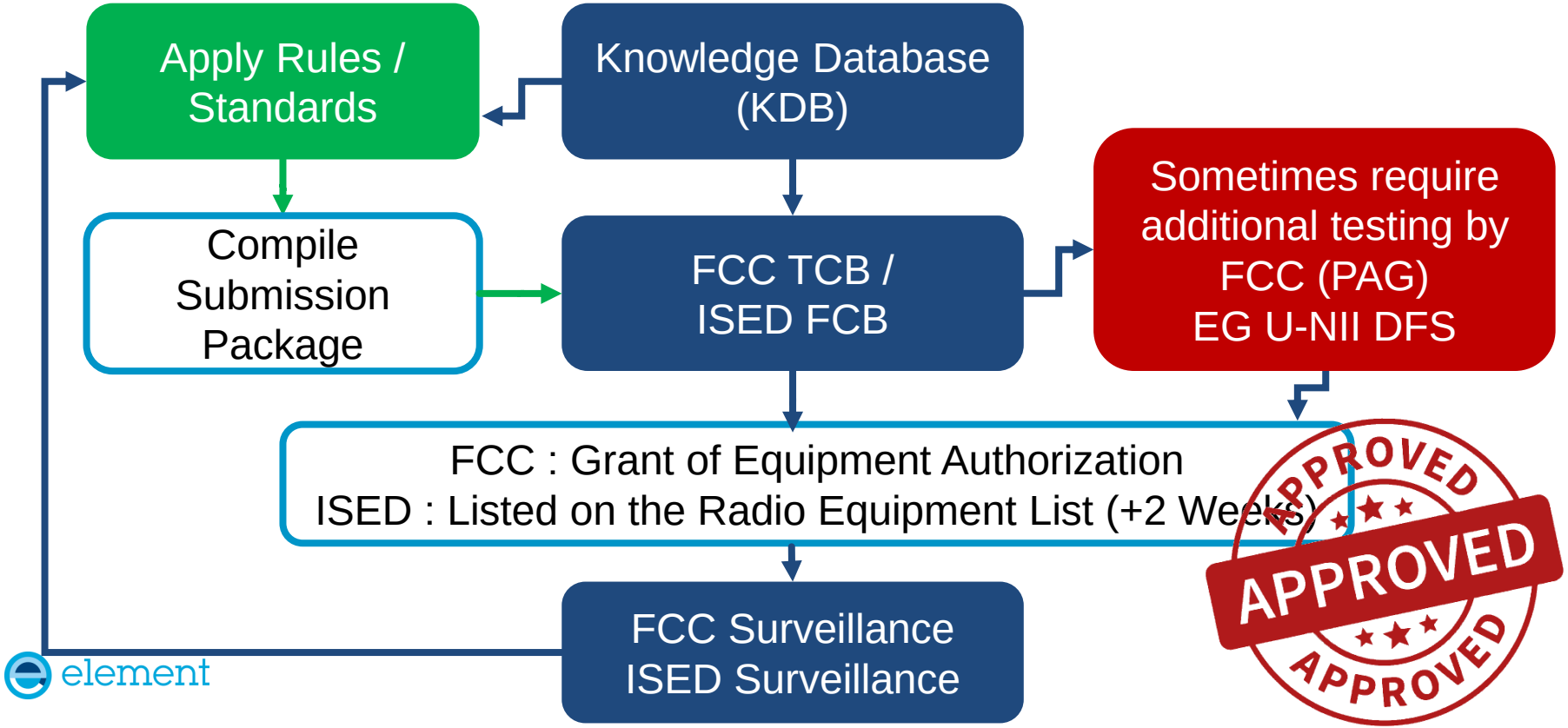
element

Submission Package

- Track and Component layout drawings
- Operational/Product Description/Technical Description
- FCC ID & IC Label Artwork
- Label Position and How It Will Be Affixed to the Device
- User's Manual (with relevant warning statements)
- Block Diagram (listing key RF frequencies)
- Schematics
- Parts List/BOM
- PCB Layout Artwork
- Internal Photographs
- External Photographs (showing all sides)
- Test Report
- Test Setup Photographs (if not provided by Element)

element

Equipment Authorization Procedure



element

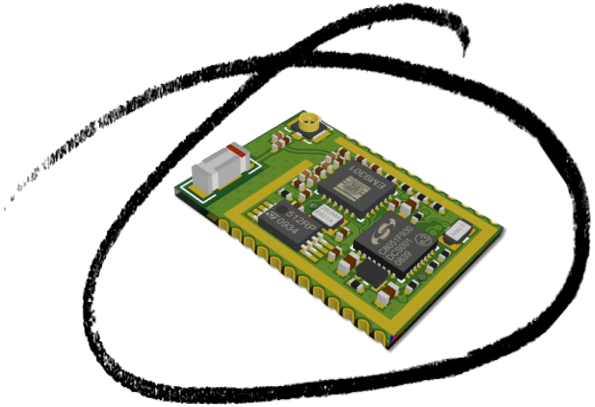
element

Radio Equipment Compliance

Part II – Preparing for Radio Testing

Alexander Toohie – Senior Applications Engineer

Radio Equipment

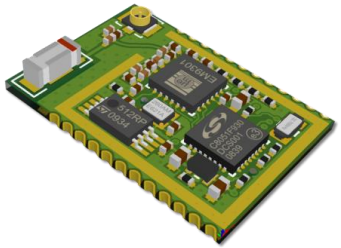


CE Mark

FCC ID

element

Radio Equipment



element

ETSI Guide 203 367 V1.1.1 Clause 6.1:

"If the conditions in which the radio product is used in the combined equipment deviate from the assessment conditions, then the manufacturer … should re-assess the combined equipment against article 3.2 of the RED."

element

It is not sufficient to CE mark a radio product solely on the basis that the module has a CE mark.

Third-Party Radio Modules

FCC KDB 996369 D01 v02:

III. MODULAR TRANSMITTERS SUBJECT TO § 15.212 RULES

a) A single-modular transmitter is a self-contained, physically delineated, component for which compliance can be demonstrated independent of the host operating conditions, and which complies with all eight requirements of § 15.212(a)(1) as summarized below. See § 15.212 for more detailed information, and § 2.901, et seq., for general certification requirements.

1) The radio elements must have the radio frequency circuitry shielded. Physical components and tuning capacitor(s) may be located external to the shield, but must be on the module assembly;
2) The module must have buffered modulation/data inputs to ensure that the device will comply with Part 15 requirements with any type of input signal;
3) The module must contain power supply regulation on the module;
4) The module must contain a permanently attached antenna, or contain a unique antenna connector, and be marketed and operated only with specific antenna(s), per §§ 15.203, 15.204(b), 15.204(c), 15.212(a), 2.929(b);
5) The module must demonstrate compliance in a stand-alone configuration;
6) The module must be labeled with its permanently affixed FCC ID label, or use an electronic display (see KDB Publication 784748);
7) The module must comply with all specific rules applicable to the transmitter, including all the conditions provided in the integration instructions by the grantee;
8) The module must comply with RF exposure requirements (see Clause V below).

element

Third-Party Radio Modules

TCB **TCB**

GRANT OF EQUIPMENT
AUTHORIZATION

Certification
Issued Under the Authority of the
Federal Communications Commission
By:

Element Materials Technology Warwick Ltd
Rothwell Road Warwick
Warwick, CV34 5JX
United Kingdom

Date of Grant: 05/18/2016

Application Dated: 05/18/2016

ZHEJIANG REXENSE TECHNOLOGY CO.,LTD
Room 105, Hangzhou E-Commerce Industry Park, No.7
Hangzhou,
China

Attention: Jessie Shen

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER: O46RY12M03
Name of Grantee: ZHEJIANG REXENSE TECHNOLOGY CO.,LTD
Equipment Class: Digital Transmission System
Notes: 802.15.4 / ZigBee Module
Modular Type: Limited Single Modular

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	15C	2405.0 - 2480.0	0.0049		

COPY

Limited singular-modular approval. RF output power is conducted Approval is limited to Grantee or OEM installation only. Compliance of this device in all final host configurations is the responsibility of the Grantee. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter, except in accordance with FCC multi-transmitter product guidelines. End-users and responsible parties must be provided with operating and installation instructions to ensure RF exposure compliance.

- The antenna used for this transmitter must be installed at least 20 cm from all persons.
- End users must be provided with operating conditions for satisfying RF Exposure compliance
- Only identical antennas with same or lower gain may be used.

element

dules

The antenna used for this transmitter must be installed at least 20 cm rom all persons.

nd users must be ovided with operating nditions for satisfying Exposure compliance

identical antennas same or lower gain e used.

TCB

ZHEJIANG REXENSE TECHNOLOGY CO.,LTD
Room 105, Hangzhou E-Commerce Industry Pa
Hangzhou,
China

Attention: Jessie Shen

EQUIPMENT AUTHORIZ
equipment identified here

FCC IDENTIFIER:
Name of Grantee:
Equipment Class:
Notes:
Modular Type:

Grant Notes

FCC Rule Parts
15C

Limited singular-modular approval. RF output power is conducte
Compliance of this device in all final host configurations is the res
transmitter must be installed to provide a separation distance of a
located or operating in conjunction with any other antenna or trans
product guidelines. End-users and responsible parties must be pro
ensure RF exposure compliance.

Federal Communications Commission
Office of Engineering and Technology
Laboratory Division

October 16, 2015

PERMISSIVE CHANGE POLICY

I. GENERAL

The permissive change rules in § 2.1043 describes the modifications that may be made to an RF device without filing for a new equipment authorization; defines the three different types of permissive changes; and identifies when a permissive change filing with the Commission is required.[1] Note that changes to the basic frequency determining and stabilizing circuitry (including clock and data rates), frequency multiplication stages, basic modulator circuit or maximum power or field strength ratings will always require a new grant of certification (FCC ID) and a new equipment authorization application.[2]

KDB Publication 178919 D01 (this document) describes general permissive change policies – other more specific policies may be described in related documents. KDB Publication 178919 D02 provides additional guidance on various permissive change considerations in question and answer format. Permissive change policies are addressed in this document as they apply to the following categories:

- Antenna changes
- Printed Circuit Board (PCB) and Hardware changes
- Enclosure changes
- Software changes
- RF exposure considerations
- Miscellaneous changes

A. When a device is modified, all proposed changes must be considered to determine the type of filing required. For example, a software change to add additional frequencies may be authorized by a permissive change; however, if the power in the new frequency band increases, then § 2.1043 requires a new equipment grant of certification (new FCC ID) except as discussed in V) G) below.

B. When a Class II permissive change is filed for either EMC or RF exposure purposes, an EMC test report or RF exposure evaluation is required, regardless of whether EMC or the RF exposure levels are degraded.[3]

---

[1] FCC Order (FCC 14-208) adopted December 14, 2014 discontinued the direct processing of applications for equipment certification and permissive changes by the FCC and instead now requires all applications be processed through TCBs. The new rules also require all testing for equipment certification and permissive changes to be performed by a FCC-recognized accredited testing laboratory. See §§ 2.907 and 2.932.

[2] With some exceptions as noted later in this publication – see V) G).

[3] Degradation for EMC parameters:

- Any increase in the fundamental emission for output power rated devices is considered degradation. § 2.1043 does not allow an increase in maximum output power rating without application for equipment authorization under a new grant of certification (new FCC ID).
- Spurious emissions – an increase of up to 3 dB from the original authorization is allowed, if the emission level is compliant.

element

TCB

ZHEJIANG REXENSE TECHNOLOGY CO.,LTD
Room 105, Hangzhou E-Commerce Industry Pa
Hangzhou,
China

Attention: Jessie Shen

EQUIPMENT AUTHORI
equipment identified here

FCC IDENTIFIER:
Name of Grantee:
Equipment Class:
Notes:
Modular Type:

Grant Notes

FCC Rule Parts
15C

Limited singular-modular approval. RF output power is conducte
Compliance of this device in all final host configurations is the rea
transmitter must be installed to provide a separation distance of a
located or operating in conjunction with any other antenna or trans
product guidelines. End-users and responsible parties must be pro
ensure RF exposure compliance.

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Federal Communications Commission
Office of Engineering and Technology
Laboratory Division

February 1, 2019

MODULAR TRANSMITTER INTEGRATION GUIDE— GUIDANCE FOR HOST PRODUCT MANUFACTURERS

1.0 INTRODUCTION

Many modern products are taking advantage of wireless transmitter modules that have been FCC certified by a module manufacturer to demonstrate compliance with the FCC rules. Wireless modules today are integrated transmitter circuits that are imbedded in both simple and complex host products. When using certified transmitter modules, it is necessary for the host product manufacturer or host integrator to have a good understanding of RF engineering and electromagnetic compatibility (EMC) concepts and principles, and knowledge of FCC regulations.

Leveraging the certification of a modular transmitter has the advantage of reducing subsequent FCC filing requirements, but there are limitations on host product manufacturers in making modifications or changes to the modular transmitter and the types of antennas that can be used in final products. Host product manufacturers are responsible to follow the integration guidance and to perform a limited set of transmitter module verification testing, to ensure the end product is in compliance with the FCC rules. Also host product manufacturers are responsible for all additional equipment authorization and testing for technical requirements not covered by the module grant (e.g., unintentional radiator Part 15 Subpart B requirements, or transmitters used in the host that are not certified modules).

2.0 GENERAL GUIDANCE

It is strongly recommended that host product manufacturers using a certified modular transmitter address the following items:

a) Account for all FCC compliance requirements, including those for digital circuitry (unintentional radiators) and transmitters. The host product manufacturer needs to also consider the FCC requirements for certified modular transmitter being used in the host product and maintain documentation on how the host product with the certified modular transmitter complies with the FCC rules.[1]

b) Review the integration instructions provided for the certified modular transmitter(s) and ensure that all the items are properly addressed.

[1] Most end products today are regulated under multiple FCC rules and may be authorized under different equipment authorization procedures. For example, an end product could be authorized under Parts 22, 24, and 27 for cellular frequencies, Part 15 for Wi-Fi and Bluetooth, using certified modules, and SDoC for the Part 15 digital circuitry (intentional radiator) and receiver portions of the device.

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element

FCC KDB 996369 D04 v01 Clause 2.0:

"It is strongly recommended that host product manufacturers … perform testing on the product with the transmitter or transmitters operating to confirm that the host product meets the FCC requirements."

element

The FCC now

“strongly recommend”

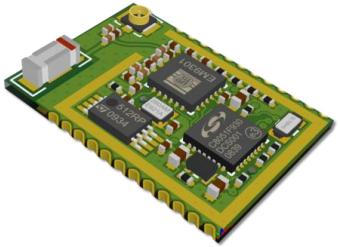
radio tests on the host, even if

the module has an FCC ID.

Third-Party Radio Modules

Fundamental or unwanted frequencies resonating on PCB tracks within host

Reflection of fundamental or unwanted emissions increase eirp or field strength levels



Receiver shielded by structures or components within host, reducing sensitivity

Receiver blocking caused by unwanted RF signals being generated within host

element

to be best in
point of view.
Evidence ['evi
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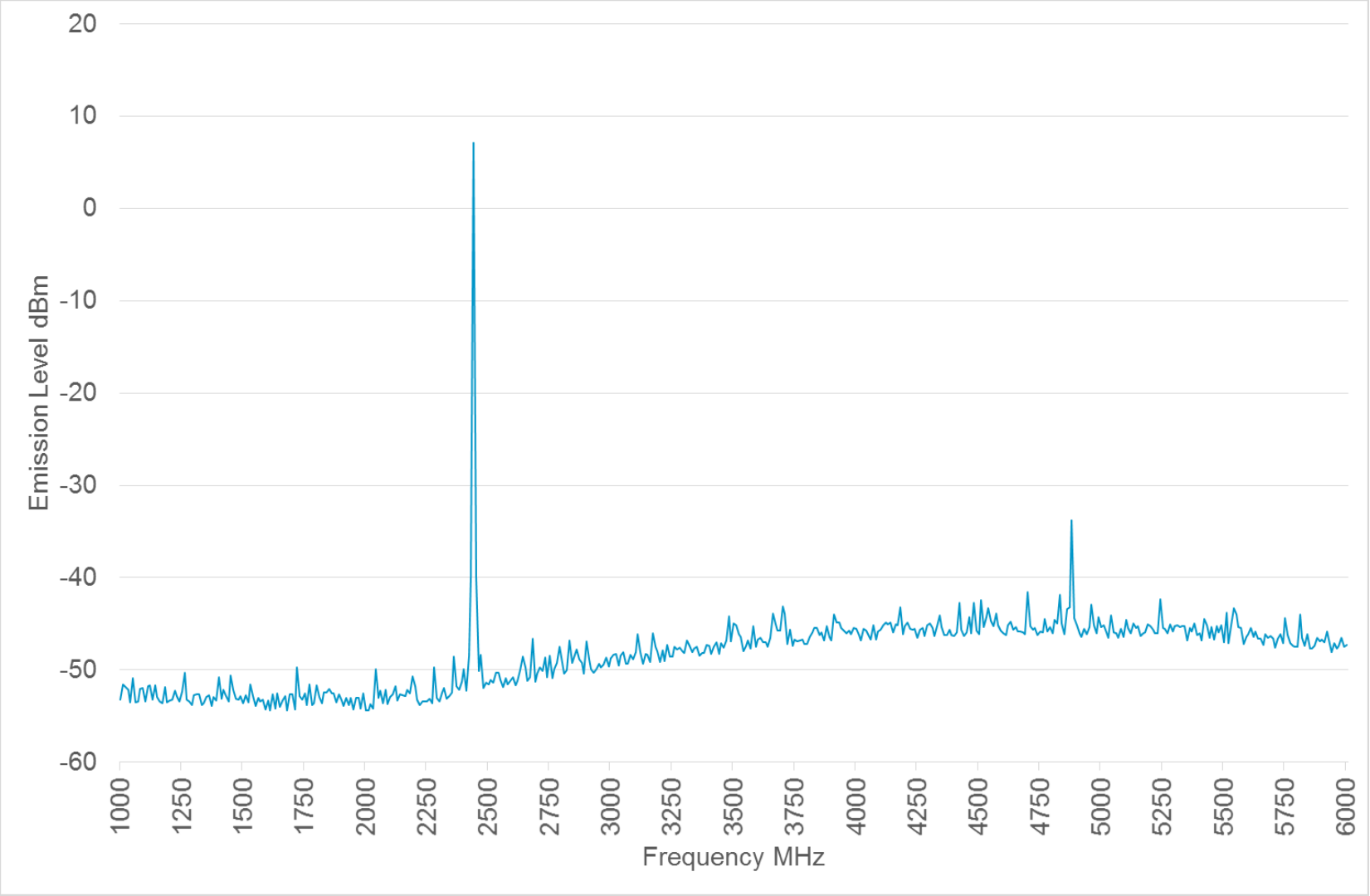
20
10
0
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Emission Level dBm
1000
1250
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1750
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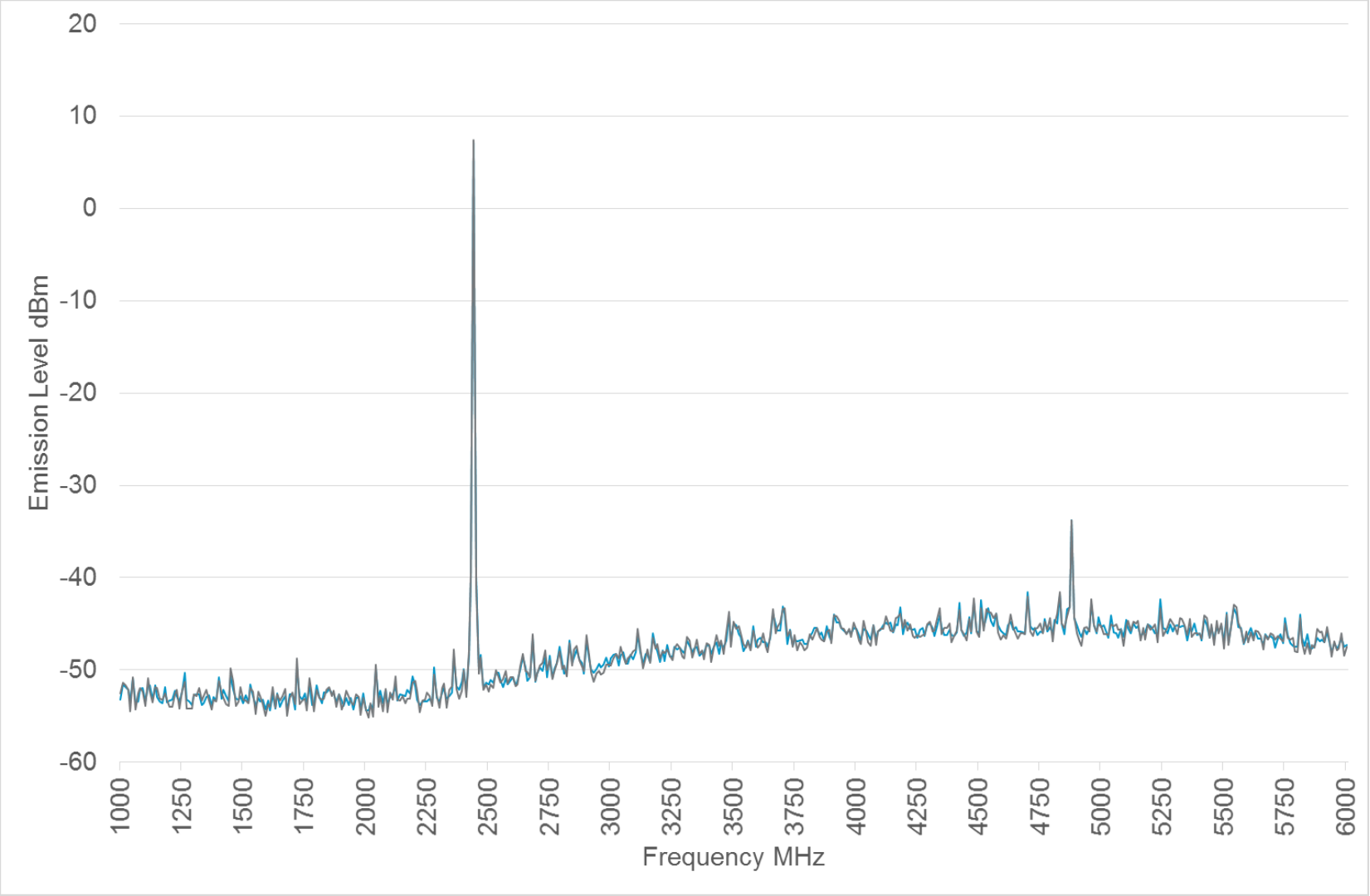
5750
6000
Frequency MHz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Emission Level dBm
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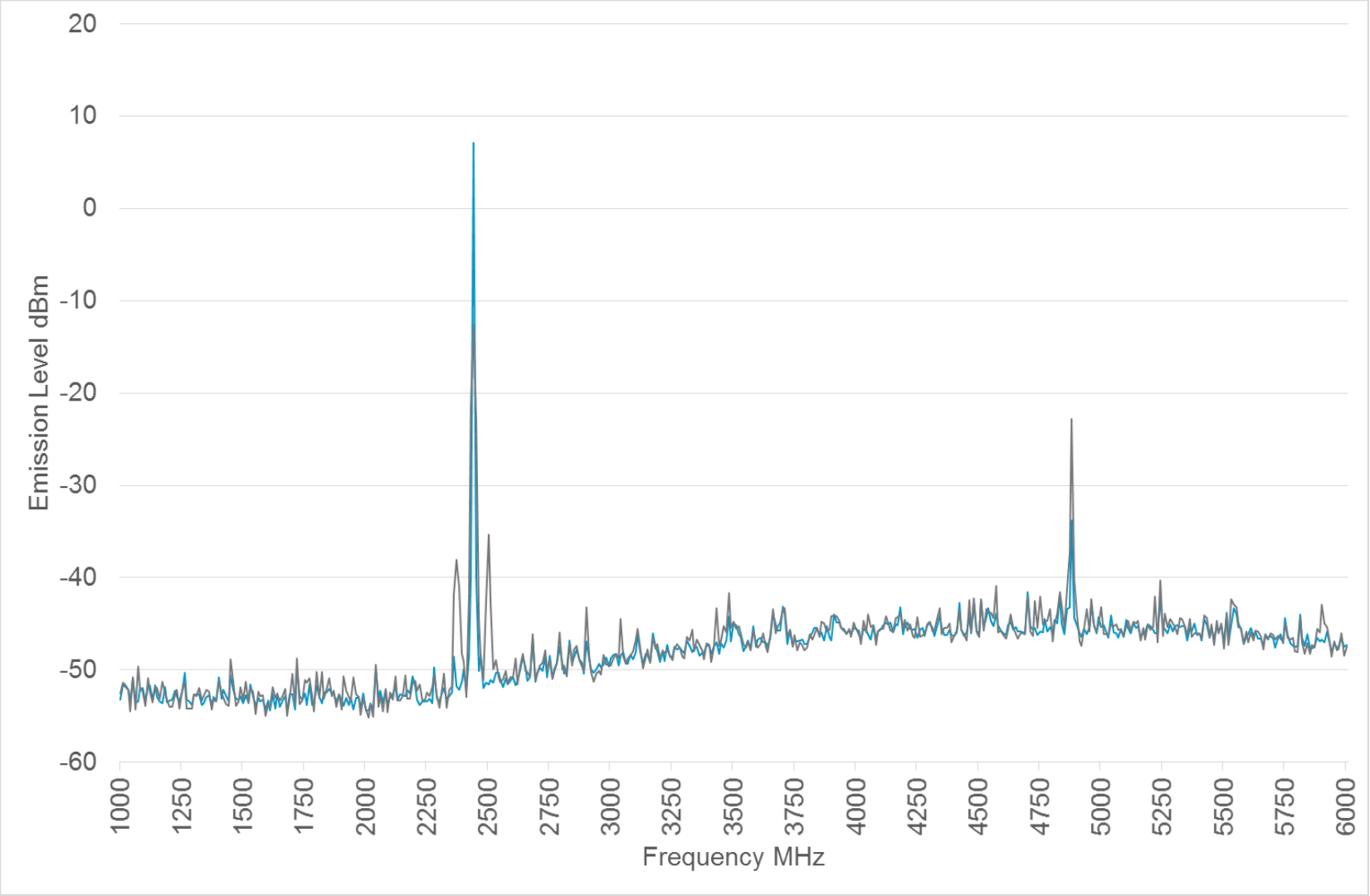
Frequency MHz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Emission Level dBm
1000
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3750
4000
4250
4500
4750
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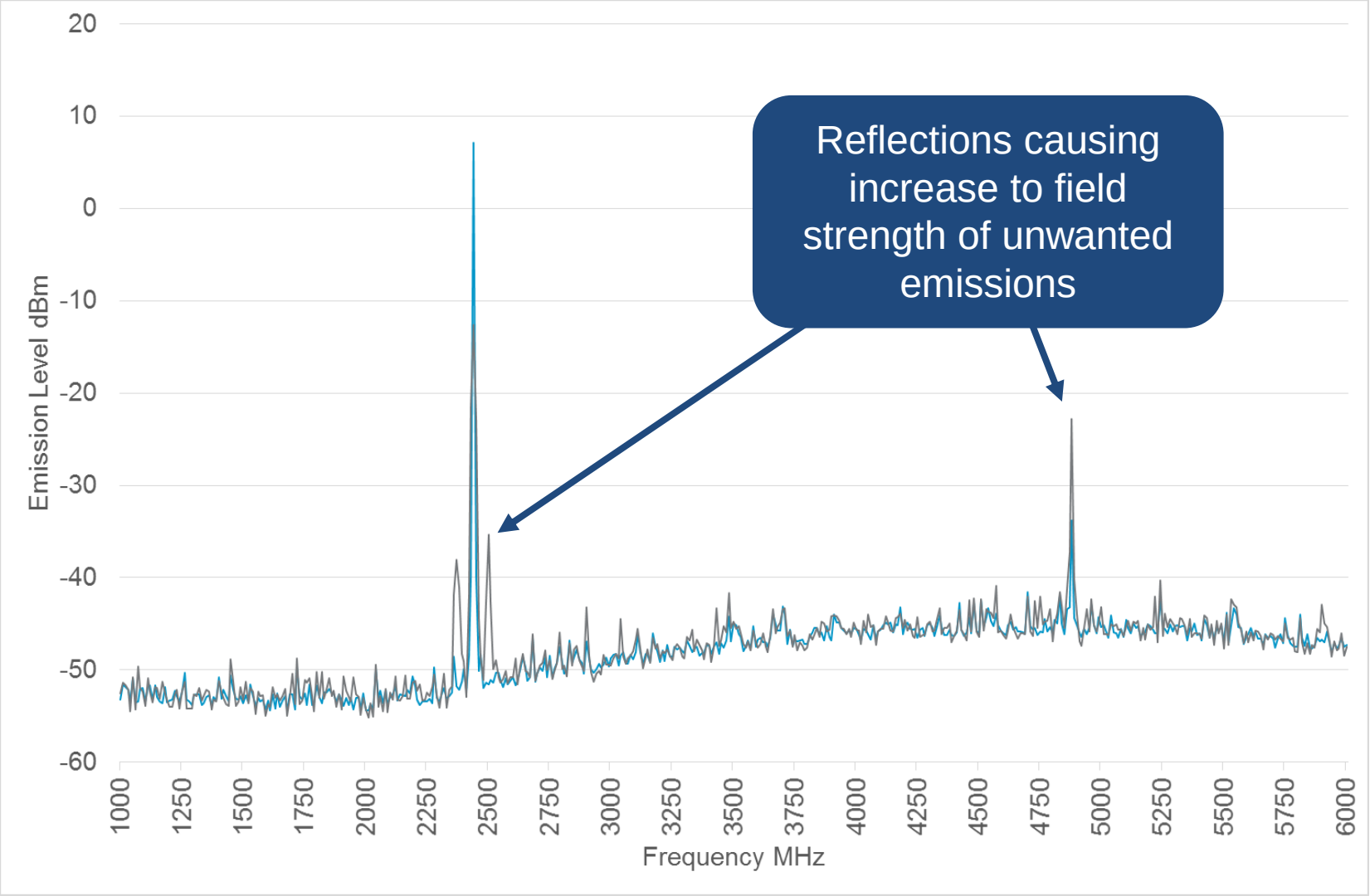
Frequency MHz


Reflections causing increase to field strength of unwanted emissions
Emission Level dBm
20
10
0
-10
-20
-30
-40
-50
-60
1000
1250
1500
1750
2000
2250
2500
2750
3000
3250
3500
3750
4000
4250
4500
4750
5000
5250
5500
5750
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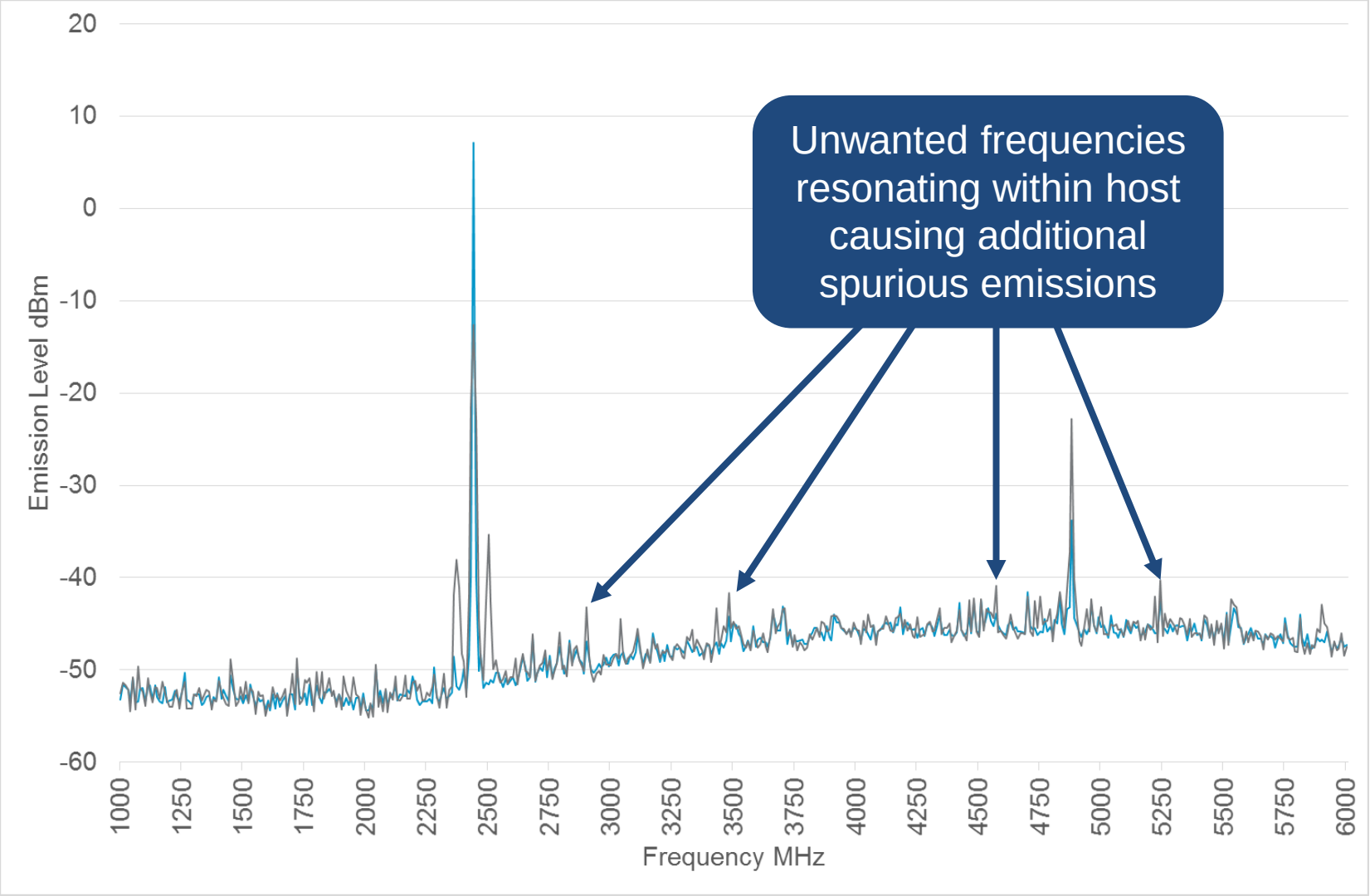
Frequency MHz


Unwanted frequencies resonating within host causing additional spurious emissions
Emission Level dBm
20
10
0
-10
-20
-30
-40
-50
-60
1000
1250
1500
1750
2000
2250
2500
2750
3000
3250
3500
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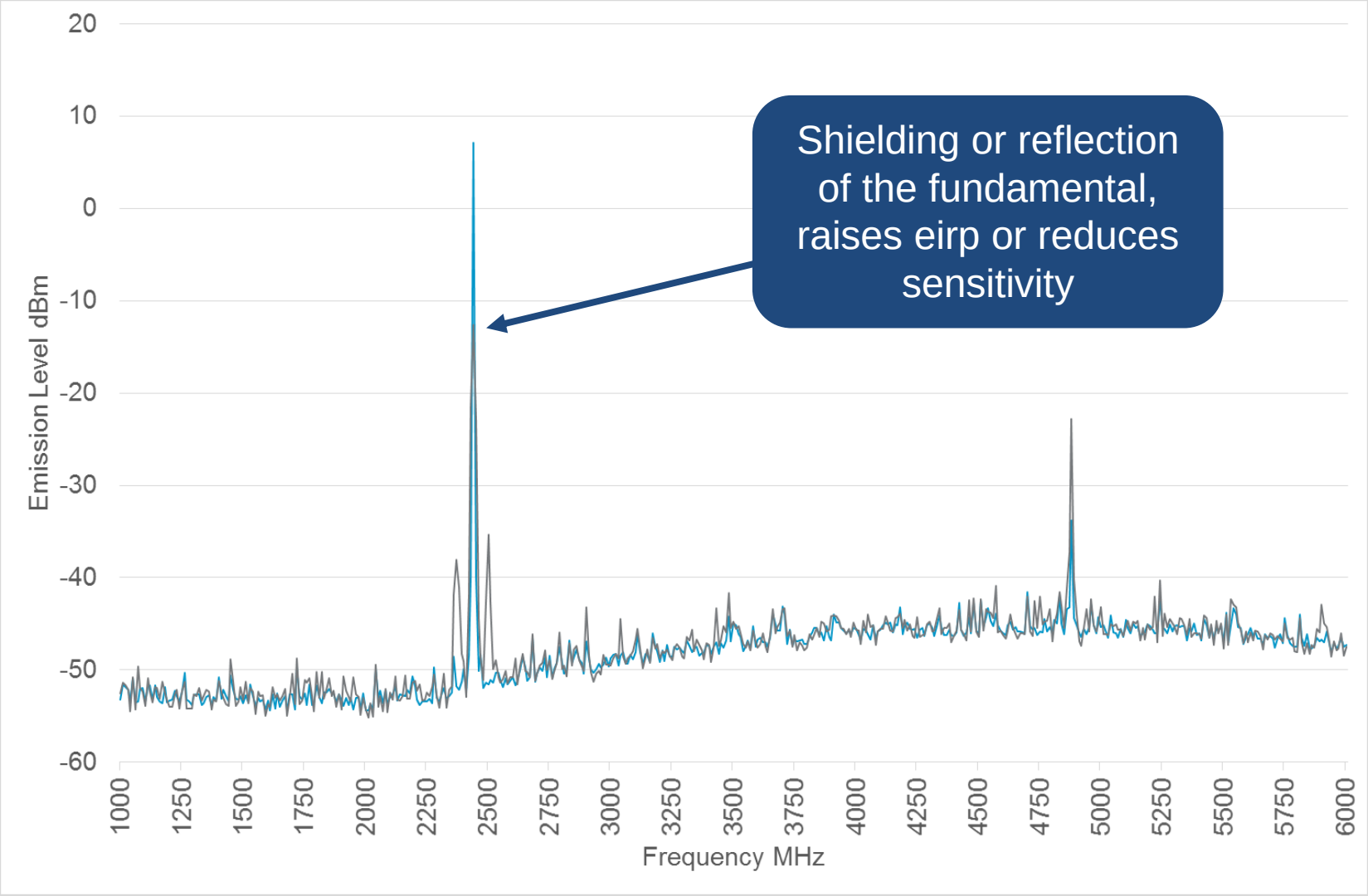
Frequency MHz


Shielding or reflection of the fundamental, raises eirp or reduces sensitivity
Emission Level dBm
20
10
0
-10
-20
-30
-40
-50
-60
1000
1250
1500
1750
2000
2250
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2750
3000
3250
3500
3750
4000
4250
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4750
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5250
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6000
Frequency MHz

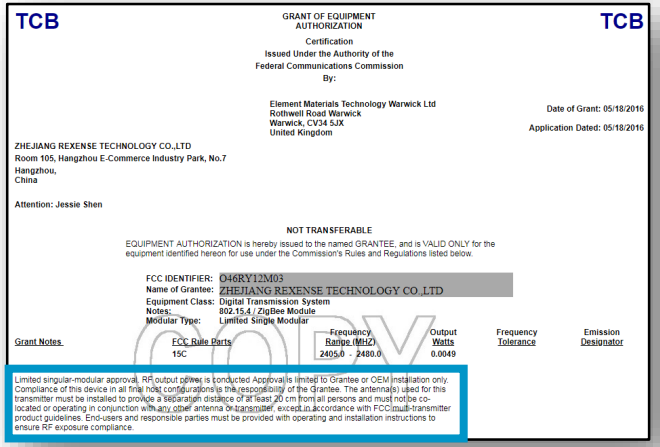
Multi-Transmitter Products

ETSI EG 203 367 Clause 6.2:

"In cases of more than one transmitter operating at the same time then a re-assessment of the spurious emissions and consideration of potential effects of intermodulation should be performed."

element

Multi-Transmitter Products



TCB | GRANT OF EQUIPMENT AUTHORIZATION | TCB

Certification
Issued Under the Authority of the
Federal Communications Commission
By:

Element Materials Technology Warwick Ltd
Rothwell Road Warwick
Warwick, CV34 5JX
United Kingdom

Date of Grant: 05/18/2016
Application Dated: 05/18/2016

ZHEJIANG REXENSE TECHNOLOGY CO.,LTD
Room 105, Hangzhou E-Commerce Industry Park, No.7
Hangzhou,
China

Attention: Jessie Shen

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER: O46RY12M03
Name of Grantee: ZHEJIANG REXENSE TECHNOLOGY CO.,LTD
Equipment Class: Digital Transmission System
Notes: 802.15.4 / ZigBee Module
Modular Type: Limited Single Modular

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	15C	2405.0 - 2480.0	0.0049		

Limited singular-modular approval. RF output power is conducted Approval is limited to Grantee or OEM installation only. Compliance of this device in all final host configurations is the responsibility of the Grantee. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter, except in accordance with FCC multi-transmitter product guidelines. End-users and responsible parties must be provided with operating and installation instructions to ensure RF exposure compliance.

COPY

"Must not be co-located or operating in conjunction with any other antenna or transmitter."

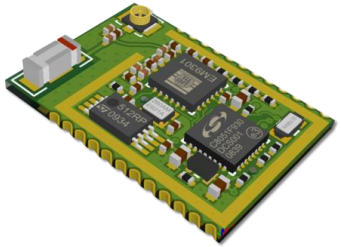
element

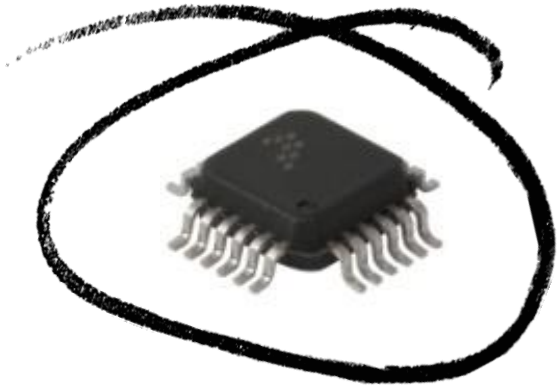
Multi-Transmitter Products

2.4 GHz Wi-Fi					×	×				
5 GHz Wi-Fi				×	×	×	×			
NFC						×				
Bluetooth					×	×				
2G				×	×	×	×			
3G				×	×	×	×			
4G	×	×	×	×	×	×	×	×	×	×

element

Radio Equipment





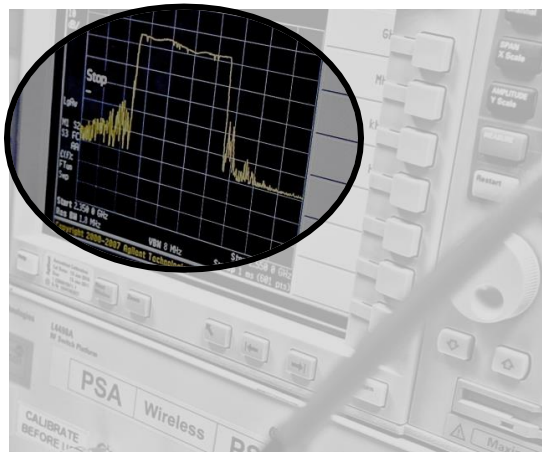
CE Mark

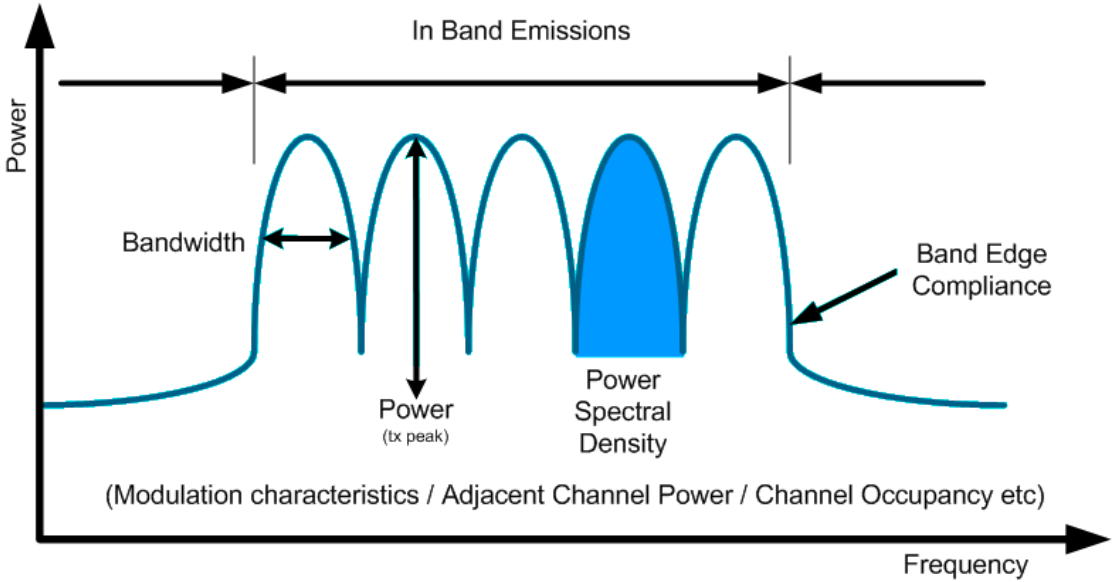
FCC ID

element

Preparing for Radio Compliance

Transmitter Tests

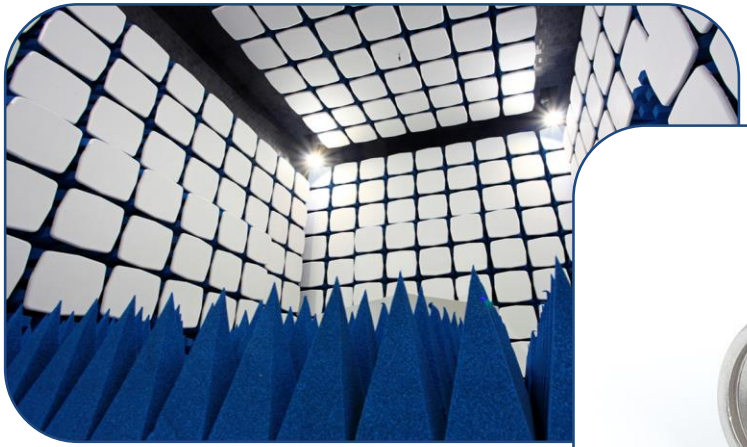




element

Preparing for Radio Compliance

Transmitter Tests



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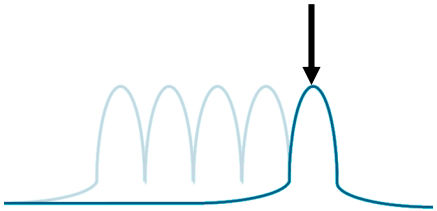
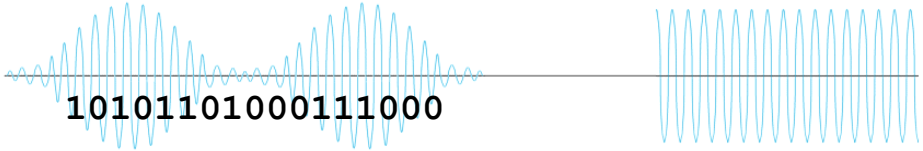
Preparing for Radio Compliance

Transmitter Tests





a	20			
b	20			
g	20			
n	20	40		
ac	20	40	80	160

element

Preparing for Radio Compliance

Receiver Tests

element

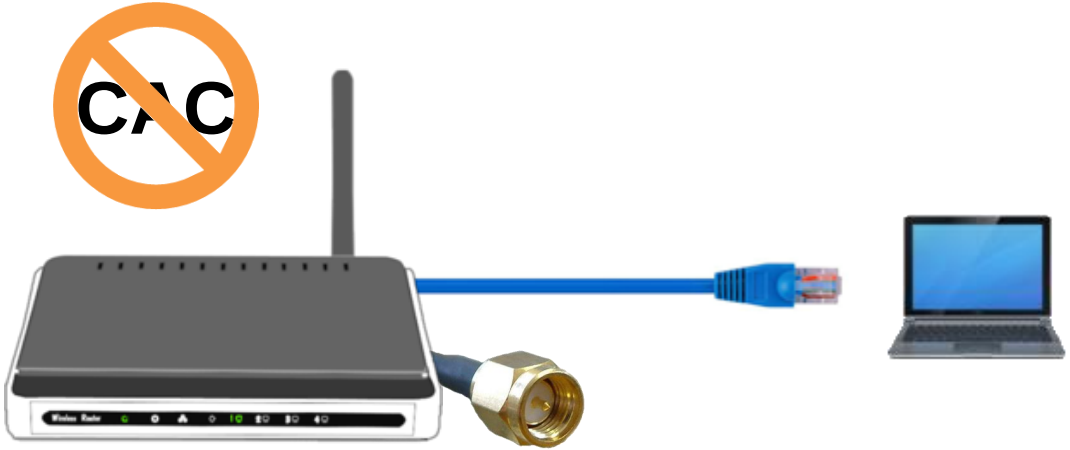
Preparing for Radio Compliance

Receiver Tests

element

Preparing for Radio Compliance

Receiver Tests



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Preparing for Radio Compliance

Receiver Tests

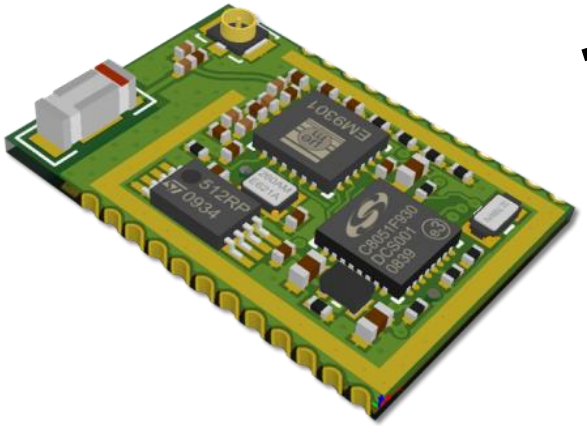
element

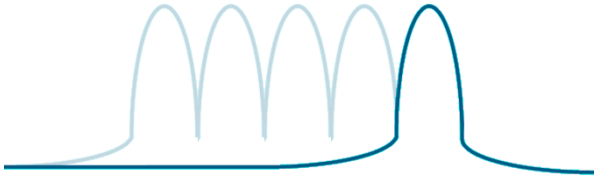
Preparing for Radio Compliance

Broadcast Receivers: GNSS

element

Third-Party Radio Products





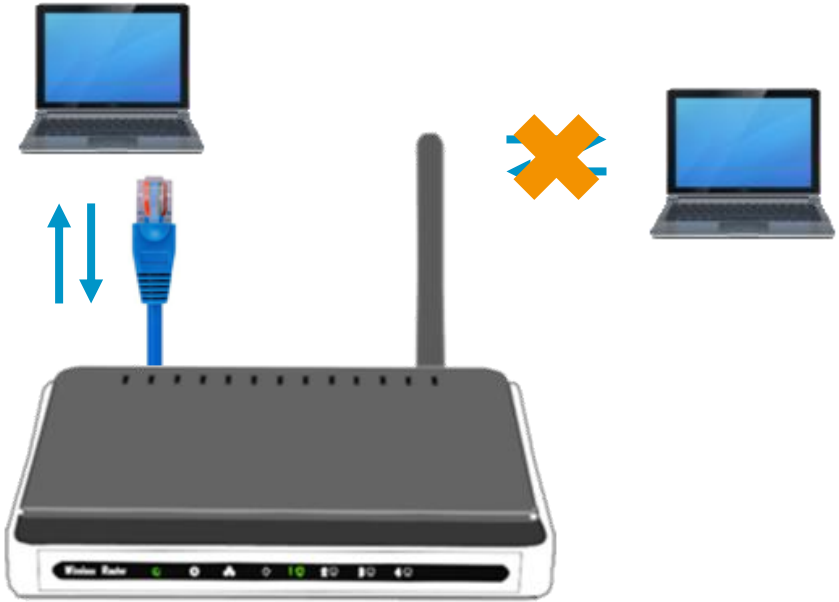
a	20			
b	20			
g	20			
n	20	40		
ac	20	40	80	160

element

It is essential when using radio modules to have a good level of support from the module manufacturers.

Preparing for EMC compliance

Modes of Operation



1. Ethernet traffic and wireless idle
2. Wireless traffic

element

Preparing for EMC compliance

Modes of Operation

1. Ethernet traffic and wireless idle
2. Wireless traffic

element

Preparing for EMC compliance

Modes of Operation

1. Wireless traffic

element

Preparing for EMC compliance

Modes of Operation

1. 2.4 GHz Wi-Fi Traffic
2. 5 GHz Wi-Fi Traffic
3. NFC Traffic
4. Bluetooth Traffic
5. 2G Traffic:
   - 900 MHz
   - 1800 MHz
6. 3G Traffic:
   - 900 MHz
   - 2100 MHz
7. 4G Traffic:
   - 800 MHz
   - 1800 MHz
   - 2600 MHz
8. Wireless Idle
9. Battery Powered
10. Battery Charging
11. SD Card Read/Write
12. Touch Screen
13. Front / Rear Camera
14. GPS / compass
15. Gyroscope / accelerometer
16. Temperature sensor
17. Fingerprint scanner

element

Preparing for EMC compliance

Functional testing

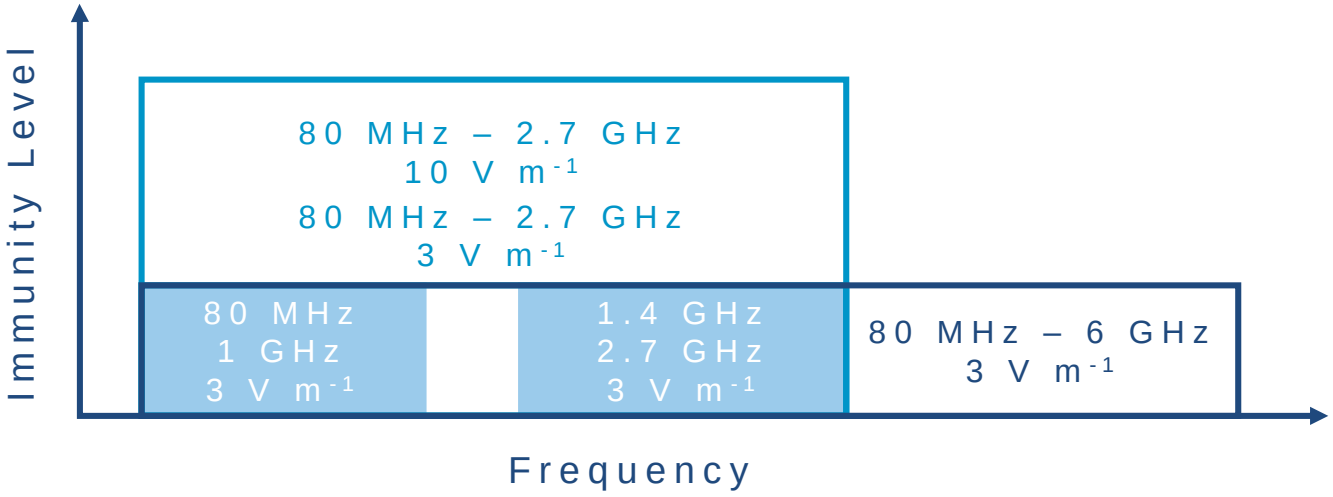
element

Preparing for EMC compliance

Immunity levels and limits

UHF Radio Module

Host Product
Non-Radio Product
301 489-17



element

If you take home nothing else…

Both the EU and USA require additional evidence for radio compliance even when using modules.

It is essential when using radio modules to have a good level of support from the module manufacturers.

Manufacturers' Risk Assessments should assess where Harmonised Standards do not cover product compliance.

element