

How to Qualify Your Bluetooth® Low Energy Product

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ABSTRACT

This application report is provided to guide system designers with an overview of the qualification and listing process needed to bring an end product incorporating a TI SimpleLink™ Bluetooth Low Energy wireless MCU to the market. The content in this document should be considered informative with the actual standards body (for example, Bluetooth SIG, FCC, and so forth) providing the normative requirements.

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1 Introduction

All Bluetooth Low Energy products must go through the Bluetooth SIG qualification and declaration process to demonstrate and declare that they satisfy the requirements of the Bluetooth license agreements and specifications.

This document presents the fundamentals of going through the process of releasing an end product incorporating a TI Bluetooth Low Energy (BLE) wireless MCU.

In addition to the Bluetooth qualification process, all products must comply with regulatory compliance standards applicable to the regions they operate in, such as FCC and CE/RED. This document briefly covers some of the more common regulatory compliance standards applicable to BLE products.

It is important to understand the distinction between a wireless MCU and an end product that incorporates the wireless MCU along with external circuitry such as an PCB, matching network, antenna, and so forth, which together comprise the "end product". Unless otherwise noted, the referenced regulatory and standards body referenced in this guide apply to the end product.

2 Bluetooth Qualification

In order to release a Bluetooth end product to market, the solution needs to be Qualified. Texas Instruments provide Qualified Design Listings (QDL) [2] with corresponding Qualified Design Identification (QDID) for all BLE wireless MCUs and associated BLE SW stacks. This means that no BLE SW stack testing is required by the customer.

In addition to the BLE Stack compliance, RF-PHY testing must be done to ensure the physical performance of the radio interface is according to the Bluetooth requirements. As this is directly connected to the complete hardware(end product) design, PHY testing must be done on all new products. Texas Instruments typically performs PHY qualification on the development kits, and the associated QDIDs are provided as a reference only. The TI RF-PHY QDIDs for evaluation kits cannot be reused by other end products.

RF-PHY testing has to be done by a Bluetooth Qualified Test Facility (BQTF), (such as 7Layers [3], Dekra [4], TUV Rheinland [5] and Wipro [6]). Typically, the test houses also have a Bluetooth Qualification Consultant [7] (BQC), which can be used for further guidance through the qualification process.

The guidelines in this document follows the "Bluetooth Qualification and Declaration Processes" [9] on the Bluetooth SIG website and can be used to complete the Qualification and Declaration Process.

2.1 CC13xx and CC26xx Guidelines

For the CC13xx and CC26xx wireless MCUs, pre-qualified, tested, *Component* QDIDs are used. This means that there are QDIDs available for the complete SW Stack, excluding only the RF-PHY part and selected adopted services and profiles. The TI qualified RF-PHY component QDIDs are for reference only, the customer must always perform a new RF-PHY test when listing a new product.

Follow these steps to create a product listing:

1. Navigate to the Bluetooth SIG qualification page [9] - Select "Path 2: Qualification Process with Required Testing".
2. Give your project a name and enter the appropriate BLE Stack QDID from the list shown in [Table 1](#). Tick off the appropriate Test Case Reference List (TCRL) version, typically the latest, and select the product type and configuration (typically: end product, LE Controller, LE Host). Press "Save and Continue (...)".
3. In the layer selection page, Core Specifications can typically be left as is. If you are using any adopted profiles or services you need to tick off the respective fields. Press "Save and Continue (...)".
4. In the ICS Selection page, press the "Consistency Check" button. Typically, this indicates tells you that one or more RF-PHY capabilities must be supported. Navigate to the RF-PHY section and select the options which applies to your product. Should there be any other inconsistency issues, refer to the [TI E2E Bluetooth forum](#) for additional information. When done, click "Save and Continue (...)".
5. In the Testing page, you can download the test plan that lists the required tests you need to perform on your product (typically limited to RF PHY testing). When you have downloaded the test plan, click "Save and Continue (...)".
6. Upload the filled out test plan and click "Save and Continue (...)".
7. The next steps are all about your specific product. Fill in the required information in the last remaining pages and you will end up with your very own Declaration ID in the end. Congratulations!

2.1.1 CC13xx and CC26xx Qualified Designs

Table 1 lists the QDIDs that are valid for use with Bluetooth end product qualification. As mentioned above, the RF-PHY listings are for reference only and cannot be reused for a product listing (with the exception of the CC2650MODA PHY QDID).

The CC2650 Module from TI (CC2650MODA) has an RF-PHY component in addition to regulatory modular radio pre-certification. For more information, see details in Table 1. This means that you do not have to repeat RF-PHY testing when using CC2650MODA in accordance with the module's data sheet placement requirements [1]. If you are using another pre-certified module, check with your module vendor to see if you can reuse the module's RF-PHY QDID listing.

Table 1. QDIDs for CC13xx and CC26xx

Design Model Number	Device	BT Core Spec	Declaration ID	QDID	Includes	Core Spec Features
BLE-Stack 5-2.1.x	CC13x2, CC26x2	v5.1	D047541	135969	Protocol: HCI, Link Layer, GAP, GATT, ATT, SMP, L2CAP	LE Coded PHYs, Adv. Extensions, LE 2M PHY, CSA#2, AoA/CTE
BLE-Stack 5-2.xx	CC13x2, CC26x2	v5.0	D042757	126526	Protocol: HCI, Link Layer, GAP, GATT, ATT, SMP, L2CAP	LE Coded PHYs, Adv. Extensions, LE 2M PHY, CSA#2
LAUNCHXL-CC26X2R1	CC26x2R	v5.0	D043822	132054	RF-PHY for the CC26x2R LaunchPad: LE 1M PHY, LE 2M PHY, LE Coded PHY	LE 1M PHY, LE 2M PHY, LE Coded PHYs
BLE5-Stack 1.1.x Central + Peripheral	CC2640R2F	v5.0	D041507	118739	Protocol: HCI, Link Layer, GAP, GATT, ATT, SMP, L2CAP	LE Coded PHYs, Adv. Extensions
BLE5-Stack 1.1.x Peripheral	CC2640R2F	v5.0	D041506	118740	Protocol: HCI, Link Layer, GAP, GATT, ATT, SMP, L2CAP	Coded PHYs, Adv. Extensions, LE 2M PHY
BLE5-Stack 1.0.x	CC2640R2F	v5.0	D033411	94079	Protocol: HCI, Link Layer, GAP, GATT, ATT, SMP, L2CAP, Profiles	LE 2M PHY
BLE-Stack 2.2.3	CC2650, CC2640	v5.1	D046537	135680	Protocol: HCI, Link Layer, GAP, GATT, ATT, SMP, L2CAP	v4.2: Privacy 1.2, Secure Connections, DLE
BLE-Stack 2.3.x	CC2640R2F, CC2640R2F-Q1	v5.1	D046537	135680	Protocol: HCI, Link Layer, GAP, GATT, ATT, SMP, L2CAP	v4.2: Privacy 1.2, Secure Connections, DLE
BLE-Stack 2.3.7	CCC1350	v5.1	D046537	135680	Protocol: HCI, Link Layer, GAP, GATT, ATT, SMP, L2CAP	v4.2: Privacy 1.2, Secure Connections, DLE
CC2640R2F	CC2640R2F	v5.0	D035408	94956	RF-PHY for the CC2640R2 LaunchPad: LE 1M PHY, LE 2M PHY	LE 1M PHY, LE 2M PHY
CC2650MODA	CC2650MODA	v4.2	D032680	88415	RF-PHY for TICC2650 Module [19]	LE 1M PHY

NOTE: As specified by section 3.1.7.1, *Testing Requirements for Qualification of Combinations of Bluetooth Products* in the Bluetooth Qualification Program Reference Document (PRD): "Combinations involving Bluetooth Component Products shall repeat all Bluetooth profile interoperability tests applicable to the combination." These tests can be performed on the end product using the PTS dongle, which can be obtained on the BT SIG store: <http://bluetoothstore.org>. Only the Adopted Bluetooth profiles need to be tested, and testing can be self-performed. Custom profiles that utilize a 128-bit custom UUID do not require testing during the listing process.

2.2 CC254x Guidelines

The CC254x family, together with the BLE-Stack, has qualified subsystems that can be referred to when listing your product. The Controller subsystem includes RF PHY testing performed on TI evaluation boards. As this RF PHY testing is not representative for your specific HW, the test facility may request PHY testing on your device in order to ensure your product meets the requirements.

Follow these steps to create a product listing:

1. Navigate to the Bluetooth SIG qualification page [\[9\]](#) - Select "Path 2: Qualification Process with **No** Required Testing".
2. Reference the TI Controller and Host QDIDs from [Table 2](#).
3. The remaining steps are self-explanatory when you are actually doing it. It is basically just a series of one-option buttons to click on.

2.2.1 Qualified Designs CC254x

Table 2. QDIDs for CC254x

Design Model Number	Device	BT Core Spec	Declaration ID	QDID	Includes	Core Spec Features
CC254x Host Subsystem - Core 5.0	CC2540/CC2541	v5.0	D043835	127435	GAP, GATT, ATT, SMP, L2CAP, HCI	v4.0
CC254x Controller Subsystem - Core 5.0	CC2540/CC2541	v5.0	D043834	127418	HCI, Link Layer, RF PHY	v4.0
CC254x BLE v1.5.x Profile Subsystem	CC2540/CC2541	v5.0	D043836	127436	Alert Notification Profile, Battery Service, Blood Pressure Profile and Service, Cycling Speed and Cadence Profile and Service, Device Information Service, Find Me Profile, Glucose Profile and Service, Health Thermometer Profile and Service, Heart Rate Profile and Service, HID over GATT Profile and Service, Immediate Alert Service, Interoperability Test Specification, Link Loss Service, Phone Alert Status Profile, Proximity Profile, Running Speed and Cadence Profile and Service, Scan Parameters Profile and Service, Time Profile, TX Power Service	

2.3 RF PHY Test Parameters

Table 3 lists the required information for performing RF PHY qualification.

Table 3. RF PHY Test Parameters

IXIT Reference	Identifier	Sub-Identifier	CC254x Value	CC26xx/ CC13xx Value	Units
RF-PHY:P1:1	Inband Image frequency	Low frequency	+2	-2	MHz
RF-PHY:P1:2	Inband Image frequency	Middle frequency	≤2440: +2, >2440: -2	-2	MHz
RF-PHY:P1:3	Inband Image frequency	High frequency	-2	-2	MHz
RF-PHY:P2:1	Value n for Intermodulation test	Low frequency	5	3	Integer
RF-PHY:P2:2	Value n for Intermodulation test	Middle frequency	5	3	Integer
RF-PHY:P2:3	Value n for Intermodulation test	High frequency	5	3	Integer
RF-PHY:P11:1	Inband Image Frequency (2Ms/s)	Low frequency	NA	-1.7	MHz
RF-PHY:P11:2	Inband Image Frequency (2Ms/s)	Middle frequency	NA	-1.7	MHz
RF-PHY:P11:3	Inband Image Frequency (2Ms/s)	High frequency	NA	-1.7	MHz
RF-PHY:P12:1	Value n for Intermodulation test (2Ms/s)	Low frequency	NA	3	Integer
RF-PHY:P12:2	Value n for Intermodulation test (2Ms/s)	Middle frequency	NA	3	Integer
RF-PHY:P12:3	Value n for Intermodulation test (2Ms/s)	High frequency	NA	3	Integer

2.4 How to Enable Bluetooth and Regulatory Test Modes

There are multiple ways to enable your product for Bluetooth RF-PHY testing and for regulatory approval testing. This section briefly describes the various options.

2.4.1 Bluetooth RF-PHY testing

Bluetooth RF-PHY testing is performed by placing and controlling the device under test (DUT) in Direct Test Mode (DTM). Through DTM, an external Bluetooth RF test instrument can issue standardized HCI test commands to the DUT over a 2-wire UART interface in order to execute required receiver and transmitter tests. An overview of the DTM interface is provided in the Bluetooth specification, Volume 6, Part F. DTM is only intended for lab test purposes. When DTM is activated, normal Bluetooth LE protocol communication is not permitted.

Note that if your product does not normally provide a UART interface for performing DTM RF-PHY testing, it is usually acceptable to modify your product to expose these pins provided the modification does not interfere with or alter RF/antenna performance.

The TI BLE/BLE5 protocol stack supports the DTM interface and required HCI test commands natively as part of the HostTest network processor project that is supplied within the respective SDK. For standalone embedded projects (for example, simple_peripheral) that do not normally expose a UART/HCI interface, a special Production Test Mode (PTM) can be added to the application in order to expose the required DTM interfaces. With PTM, the required IO pins for are reserved for the UART HCI interface; however, the DTM interface is only activated by the application in response to a software API function call. For details on how to add PTM to your application, see the documentation in the corresponding SDK.

Since the Bluetooth receiver and transmitter radio performance is a function of the BLE protocol stack and radio configuration, it is possible to use the HostTest network processor project for RF-PHY testing of end products that utilize a standalone/embedded project. The use of HostTest for RF-PHY testing purposes is acceptable provided that both your protocol stack and radio configuration are identical to the corresponding standalone/embedded project used by your end product.

2.4.1.1 Regulatory Approval Testing

For regulatory approval testing it is typically required to configure the radio for static receiver and transmitter operation at certain frequencies. To facilitate such testing, the TI BLE/BLE5 protocol stack implements the following HCI vendor-specific test commands:

- HCI_EXT_ModemTestTxCmd
- HCI_EXT_ModemTestRxCmd

For a full overview of the applicable HCI extension commands, parameters and associated events, see the HCI Vendor Specific Guide included with the BLE protocol stack documentation in the SDK.

The above commands can be invoked in a few different ways:

- Through HCI extension commands over a UART interface using the HostTest project as described in the previous “Bluetooth RF-PHY testing” section.
A tool such as BTool or HCITester can be used to enter test commands to the BLE Stack.
- Through Production Test Mode as described in the previous “Bluetooth RF-PHY testing” section.
- Implementing a stand-alone test sequence or test mode in your embedded application which calls the appropriate HCI extension command APIs directly from the application code. This can be, for example, controlled by a timer or push button interface.

Additionally, the [SmartRF Studio](#) tool can be used to perform some of these tests. SmartRF Studio does not rely upon any firmware on the device and instead directly controls the radio over a test interface (JTAG). However, for some regulatory testing purposes, the actual protocol stack firmware may be required.

Since regulatory testing requirements can vary from jurisdiction to jurisdiction, consult your test lab on specific test requirements based on where your product is sold.

2.5 FAQ

Question: What does the Declaration ID cost?

Answer: Details on declaration and listing fees can be found on the Bluetooth SIG Qualification & Listing Fees page.

Question: Can I reuse TI's Declaration ID when listing my product with Bluetooth SIG?

Answer: No. Each product must obtain its own Declaration ID. You can reference TI's qualified components or subsystems (QDID's) in your product's listing, as noted in [Section 2](#), to reduce the amount of testing required to qualify your end product.

Question: If I don't put the Bluetooth logo on my product, do I still need to list my product with Bluetooth SIG?

Answer: For more information, see the "Do I Need to List and/or Qualify My Product?" guide on the Bluetooth SIG website. Additional questions on this topic should be directed to Bluetooth SIG directly via their contact information. Note that TI cannot determine whether a product must be listed or qualified as it is the customer's responsibility to adhere to all regulatory, certification and qualification requirements.

If you determine that you need to list (certify) your product with BT SIG, follow the process that is listed under [Section 2.1](#). You can combine with the TI BLE stack QDID (this saves you the bulk of the testing). Test only the adopted services you are using with the PTS tool and do the RF-PHY testing (if you are not using a per-certified module). The TI software has all the necessary hooks to enable the RF-PHY testing on the device side.

If you determine that you do not need to list your product with BT SIG, then these steps may not be required. However, you may need to perform regulatory testing (for example, FCC) depending on where you sell or ship your product.

Question: My test facility has said that the CC254x QDIDs are expired and, thus, ineligible for use, or I need to test with the latest TCRL.

Answer: The CC254x uses a subsystem certification that does not expire however, the applicability of the QDID may be dependent on whether the associated Bluetooth specification has been withdrawn by the SIG. The status of the specification can be determined during the listing process. TI recommends using the most recent QDID during the qualification process. The CC254x QDIDs listed in [Table 2](#) are still valid and indicated as such when submitted to the SIG Qualification Listing Interface. There is no certification requirement to test with updated TCRLs when using the TI CC254x QDIDs.

Question: What is a Bluetooth Qualification Consultant (BQC)?

Answer:

- Previously known as a BQE or "Bluetooth Qualification Expert (BQE)", an individual recognized by the Bluetooth SIG to provide a Bluetooth member with qualification related services [\[7\]](#).
- Expert in understanding the qualification policy and process
- Optional for members to use them

Question: I have created my own proprietary profiles, do I need to qualify them?

Answer: No, those are not part of the qualification process. However, note that they should follow the GATT protocol (that is, have a primary service, characteristic declarations with proper formatting, and so forth) and use 128-bit custom UUIDs.

Question: Can I reuse the CC2640 or CC254x FCC Certification?

Answer: The CC2640 and CC254x devices are wireless MCUs and thus cannot be individually certified by the FCC (or any regulatory body) since the wireless MCU + external RF design combination must be considered for regulatory listing purposes. However, you may reuse a module certification (MCU + Antenna) provided it is pre-certified with the respective regulatory body and you follow the layout placement guidelines from the data sheet. For example, the CC2650 Module from TI (CC2650MODA [\[19\]](#)) has FCC, ETSI, IC (Canada) and Japan regulatory pre-certification. A listing of modules that incorporate TI Bluetooth Low Energy wireless MCUs can be found on the main BLE Wiki page. TI provides the necessary interfaces to allow you to perform the required regulatory testing. For more details, see the regulatory sections below.

Question: Where can I find a list of test facilities to perform regulatory and Bluetooth testing?

Answer: A list of Test Facilities can be found on the Bluetooth SIG website (Requires login). Many of these test facilities can also perform regulatory testing.

Question: My test lab is requesting me to fill out a form. Where can I find the required information?

Answer: All of the device-specific information can be found in the wireless MCU data sheet and the RF-PHY Test Parameters table listed above. The remaining items will be obtained by performing actual measurements on your board using Direct Test Mode (DTM) or Modem Test Commands. Details about the internal radio architecture needed for regulatory filing can be obtained by reviewing TI CC254x and CC26xx FCC filings. For more information, see [Section 3](#).

3 FCC Certification

Under Part 15 of the FCC rules, all electronic devices with a clock or oscillator exceeding 9 kHz need to be verified that they are not causing harmful radiated emissions. FCC Part 15 covers unintentional testing and evaluation as well as low power un-licensed transmitters. In addition, all transmitters must be registered and certified by the FCC to ensure they are not causing harmful emissions and interference on regulated frequencies.

NOTE: Device that incorporate a radio transceiver ("intentional radiators") must comply with FCC Part 15 Sub Part C, commonly referred to as "FCC Part 15C". All BLE wireless MCUs incorporate a transceiver and fall under the FCC Part 15C requirements.

Section 15.209 of the radio contains general radiated emission limits that apply to all Part 15 transmitters using frequencies at and above 9 kHz. Section 15.247 and 15.249 provide more detailed information about the emission requirements in the unlicensed 2.4 GHz ISM band. Bluetooth Low Energy products are typically certified under 15.247 as Systems Using Digital Modulation. This allows the radio to have higher output power than under 15.249, which is limited to 0 dBm. Bluetooth Low Energy is not considered FHSS under FCC.

There are two ways of getting a FCC certification: directly from the FCC or through a Telecommunications Certification Body (TCB). For almost all devices, you can chose either to use a TCB or FCC for the certification. The exception is when the equipment uses new technology or when the test methods are undefined or unclear, then FCC is the only party that can provide certification.

Devices can reuse a modular radio pre-certification provided that the module manufacturer's layout and placement guidelines are strictly followed, including display of the module's FCC ID. For more information, see the module provider's data sheet.

3.1 FCC ID

The FCC ID is a unique identifier, 4-17 characters, for the equipment and consists of two elements, the Grantee Code and the Equipment Product Code. The Grantee code is a three character alphanumeric string representing the Grantee/Applicant. The Grantee Code always begins with an alphabetic character and does not contain the numbers one or zero. The Grantee Code is assigned by the Commission permanently to a company for authorization of all radio frequency equipment. The Product Code is the non-grantee code portion of the FCC ID that begins after the first three characters. The Product Code may include hyphens and/or dashes (-). The Product code should consist of minimum 1 and maximum 14 characters.

The FCC ID must be permanently marked either directly on the transmitter, or on a tag that is permanently affixed to it. The FCC ID label must be readily visible to the purchaser at the time of purchase. For more information, see the latest FCC regulations at the time of listing.

4 CE Certification

In order to CE Mark and place any radio equipment on the market in EU you need to demonstrate compliance with the Radio Equipment Directive (RED). CE marking is a mandatory conformance mark on products placed on the European market. A CE mark indicates that the manufacturer or its authorized EU representative has declared that the product or equipment complies with all applicable European Directives, and enables the free movements of product within the European market. The CE marking is a declaration by the manufacturer, importer, or the entity first placing the product on the market that the product conforms to the appropriate directives. This is confirmed by the legally binding signature on the Declaration of Conformity.

For Short Range Devices operating in the 2.4 GHz ISM band the relevant Harmonized Standards are:

- EN 300 328 - radio equipment testing of data transmission equipment operating in the 2.4 GHz ISM Band
- EN 301 489 - electromagnetic compatibility
- EN 62479 - compliance to human exposure to electromagnetic fields
- EN 50566 + EN 62209-2 - for handheld and body-mounted devices

BLE does not classify as FHSS under ETSI specification and instead classifies as other type of wideband modulation (see section 4.2.1 of the EN 300 328 specification). Relevant test requirements for BLE are defined in Section 4.3.2. Note that revision 1.9.1 of the test specification introduced a few new tests such as Medium Utilization factor and Duty Cycle, TX-Sequence and TX-Gap. These tests only applies to equipment with higher output power than 10 dBm. Bluetooth Low Energy devices are limited to 10 dBm output power in the EU due to the Power Spectral Density requirement (4.3.2.3), which limits the radiated PSD to 10 dBm/MHz. As such, all required testing for CE/RED can be performed with continuous (static) RF output such as for FCC testing.

EN 300 328 v. 2.1.1, which was released in November 2016, introduced receiver categories, and a receiver blocking test. More details about this and how to perform this test, can be found in this application report: ETSI EN 300 328 RX Blocking Test for Bluetooth Low Energy [23].

There are several routes to demonstrate compliance with the Radio Equipment Directive; for most cases, meeting with the requirements of the relevant Harmonized Standards provides presumption of conformity required, thus enabling you to sign a Declaration of Conformity with confidence. A certified test house will provide the necessary guidance and help required to place your radio product on the market.

5 Industry Canada (IC) Certification

Industry Canada (IC) is the Canadian authorities for certifications and standards making. As for FCC certification can either be done through IC or a TCB. For an IC certification one is required to have a Canadian representative, and IC requires that a confirmation letter from the representative is submitted with the application.

There is no need for extra RF testing when applying for certification in Canada if the equipment is already certified by FCC and meets the following conditions:

- The test report must be less than one year old
- The test house must have their Test Site (OATS or Anechoic chamber) approved by IC
- A cross-reference table must be submitted with the test report to show that the equipment meets all of the applicable Canadian requirements.

5.1 IC-ID

As for equipment intended for the US market the radio/EVM needs to be marked with the IC-ID. The IC-ID consists of two parts: Company Number (CN) and a Unique Product Number (UPN) that is chosen by the manufacturer). To obtain a CN number, use the E-filing system. When submitted, the required information an e-mail will be sent with the CN.

An example would be: IC: 451H-2541SENSOR.

6 References

1. Texas Instruments: *CC2650MODA SimpleLink Multistandard Wireless MCU Module Data Sheet*
2. <https://launchstudio.bluetooth.com/Listings/Search>
3. <https://www.7layers.com/>
4. <https://wireless.dekra-product-safety.com/>
5. <https://www.tuv.com/greater-china/tw/>
6. <https://www.wipro.com/>
7. <https://www.bluetooth.com/develop-with-bluetooth/qualification-listing/qualification-consultants>
8. <https://www.bluetooth.com/develop-with-bluetooth/test-tools/launch-studio>
9. <https://www.bluetooth.com/develop-with-bluetooth/qualification-listing>
10. <https://www.bluetooth.com/>
11. <https://www.bluetooth.com/develop-with-bluetooth/qualification-listing/qualification-listing-fees>
12. <http://www.ti.com/product/cc2650moda>
13. https://www.rohde-schwarz.com/us/product/cbt_cbt32-productstartpage_63493-7927.html
14. <https://www.anritsu.com/en-US/test-measurement/products/MT8852B>
15. <https://www.bluetooth.com/develop-with-bluetooth/qualification-listing/do-i-need-to-list-qualify-my-product>
16. Texas Instruments: *Hardware Migration From CC2640F128 to CC2640R2F*
17. www.ti.com/product/cc2650moda
18. <https://www.fcc.gov/oet/ea/fccid>
19. <http://www.etsi.org/technologies-clusters/technologies/regulation-legislation/red>
20. www.etsi.org/deliver/etsi_en/300300_300399/300328/02.01.01_60/en_300328v020101p.pdf
21. Texas Instruments: *ETSI EN 300 328 RX Blocking Test for Bluetooth® Low Energy*

Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from B Revision (August 2019) to C Revision	Page
• Updates were made in Section 2.1.1	3
• Updates were made in Section 2.3	5

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