Japan UWB Radio Certification

Application Note

APR004

1 Introduction

This application note describes the process required to obtain a certificate of approval to operate UWB radio equipment in Japan. This process is sometimes referred to as 'TELEC testing' or 'TELEC certification'.

Table of Contents

1 Introduction 1
1.1 Overview 2
1.2 Japan Regulatory Structure 2
2 Certification Requirements 3
2.1 Requirements Documentation 3
2.1.1 ARIB STD-T91 3
2.1.2 TELEC T406 3
3 Certification Test Procedure 4
3.1 Selection of Test Center 4
3.2 Emission Tests 4
3.2.1 Transmit Masks for UWB Channel 9 4
3.2.2 Second Transmit Harmonic 5
3.2.3 Peak Power Measurement 5
3.2.4 Average Power Measurement 6
3.2.5 Spurious Emissions Measurement 7
3.3 Product Documentation 8
3.4 Mechanical Requirements 8
3.4.1 Anti-Tamper Shield 8
4 Qorvo Support for Japan Certification 9
4.1 Pulse Shape 9
4.2 Software Support 9
5 Appendix A: ARIB STD-T91 Emission Limits 10
References 11
Abbreviations 11
Important Notices 12
Document History 12

1.1 Overview

Radio certification testing in Japan differs from the methods used in other regions. Although Japanese radio law permits both conducted and radiated measurements, radio test centers typically favor conducted testing because it does not require a complex test environment and is therefore more cost-effective. In contrast, most other regulatory authorities, such as the FCC and ETSI, primarily rely on radiated performance measurements taken within shielded test environments.

Given the differences in test methods used in Japan, it is essential to understand the specifics of Japan's radio certification requirements before engaging with a certification test center. This document aims to equip certification applicants with the information needed to prepare for a successful test program.

1.2 Japan Regulatory Structure

Japan UWB certification test requirements are documented by several organizations, of which the most significant is the *Ministry of Internal Affairs and Communications* (MIC).

The MIC controls radio spectrum allocation and use through official ordinances, which it documents as *Ordinance for Regulating Radio Equipment* (ORE) and *Ordinance Concerning Technical Regulations Conformity Certification* (OTRCC). Ordinances relevant to UWB use are described in more detail in section 3.2.

The MIC UWB ordinances are organized into a UWB user requirements specification by the Association of Radio Industries and Businesses (ARIB), which collaborates with the MIC to facilitate the development of new radio systems and to create technical standards. ARIB has defined the standard STD-T91 [1] for UWB use in Japan, incorporating the MIC ordinances and establishing the certification processes required to evaluate radio products. Test centers rely on STD-T91 to develop their test procedure documents.

MIC-approved test centers, known as Registered Certification Bodies (RCBs), base their UWB radio test procedures on the requirements of the STD-T91 standard. Since the MIC has not published an official UWB test methods document, each RCB develops its own set of procedures for testing UWB radios. While these procedures may vary slightly between test centers, all are subject to approval by the MIC to ensure compliance with regulatory standards.

2 Certification Requirements

To prepare for Japan UWB certification testing, applicants should review the ARIB standard and the test procedure documentation provided by their chosen test center.

2.1 Requirements Documentation

2.1.1 ARIB STD-T91

The ARIB UWB standard, STD-T91 [1], is written in Japanese and can be purchased from the ARIB's web store [2]. English language translations can also be downloaded for free from the web store, but at the time of writing only revisions 3.0 and earlier are available.

The standard has undergone several updates since revision 1 was released in 2006. Prior to revision 3, the standard only permitted indoor UWB use, from revision 3 onwards requirements for both indoor and outdoor use are defined.

The latest T91 standard, revision 4, is divided into two sections: section 1 covers indoor-only use, section 2 covers indoor and outdoor use. Section 1 is essentially the original indoor-only specification, whereas section 2, whilst being based upon section 1, includes additional requirements for outdoor use.

The way T91 has been split to accommodate outdoor use has led to some uncertainty regarding which ORE transmission mask should be applied when testing outdoor-use radio equipment. For indoor-only use, the MIC initially released a transmission mask defined by ordinance ORE 49.27.1, which remains valid for products certified for indoor use. When ARIB requested permission for UWB outdoor use, the MIC introduced an indoor+outdoor ordinance, ORE 49.27.3. Starting with ARIB STD-T91 revision 4, an additional indoor+outdoor ordinance, ORE 49.27.4, was defined to support UWB bandwidths of up to 1.75 GHz, whereas the bandwidth limit for ORE 49.27.3 is 813 MHz.

Assuming their radio equipment complies with the bandwidth limit, the certification applicant can choose which of the two indoor+outdoor ordinances to be tested against. **Since ORE 49.27.4 has less stringent emission mask requirements, Qorvo recommends applicants should request their test center to use this ordinance as the test reference.** For further details about emission masks, see sections 3.2.1 and 5.

2.1.2 TELEC T406

There are 23 RCBs registered by the MIC in Japan, including TELEC. TELEC has a historical association with Japan radio certification testing, as it was originally the *Telecommunications Engineering Centre* (TELEC) for the former *Japan Ministry of Posts and Telecommunications* (MPT), now MIC. So close was the TELEC, MPT relationship that Japan radio certification testing was, and still is, often referred to as 'TELEC testing'.

Although today TELEC is a commercial organization, and just one of many RCBs in Japan, it still disproportionately influences Japan radio certification testing, not least by creating certification test procedures that other RCBs base their procedures on. ARIB STD-T91 does not define compliance test methods, but it does suggest that TELEC's test methods, approved by the MIC, can be used as a reference.

TELEC's UWB test procedures are outlined in TELEC document T406 [3], which is written in Japanese. An official English version is not available, but readers can contact TELEC to inquire whether a translation is available.

While T406 provides a valuable foundation for understanding how conducted certification testing is performed, it is still essential to consult with your chosen test center to review their MIC-approved test procedures and methods.

3 Certification Test Procedure

3.1 Selection of Test Center

Japan UWB certification testing can be undertaken by approved test centers both in Japan and elsewhere. Because Japan generally uses conducted test measurements, it is advisable to select a test center that has previous experience of Japan UWB testing. In addition, check that the test center is equipped with appropriate test equipment for UWB RF measurements, **in particular Qorvo recommends that the test center have a spectrum analyser with a 50 MHz RBW capability** – see section 3.2.3 for further details.

3.2 Emission Tests

Most of the tests required by the T91 standard are straightforward and can be pre-tested before engaging with a test center. However, some of the emission tests have special requirements that the applicant should be aware of before certification testing – in particular, the spurious emissions mask and peak/average transmit power tests need special attention.

Additional care must be taken when considering the performance of your product's antenna. Because Japan testing is conducted, your product's equivalent isotropic radiated power is calculated by adding the antenna gain (or loss) to the conducted power measurement. For this reason, the test center will require a gain versus frequency profile of your antenna, from 30MHz to 26GHz. Depending on the test center, you may be able to submit your own antenna profile documentation, or documents from an antenna maker, if appropriate, or the test center may profile your antenna as part of their certification process.

3.2.1 Transmit Masks for UWB Channel 9

As described in section 2.1.1, for indoor+outdoor operation, two transmit masks are defined by the MIC. The ORE 49.27.3 mask has more stringent emission limits for the lower side of channel 9, as can be seen in Figure 1, below:

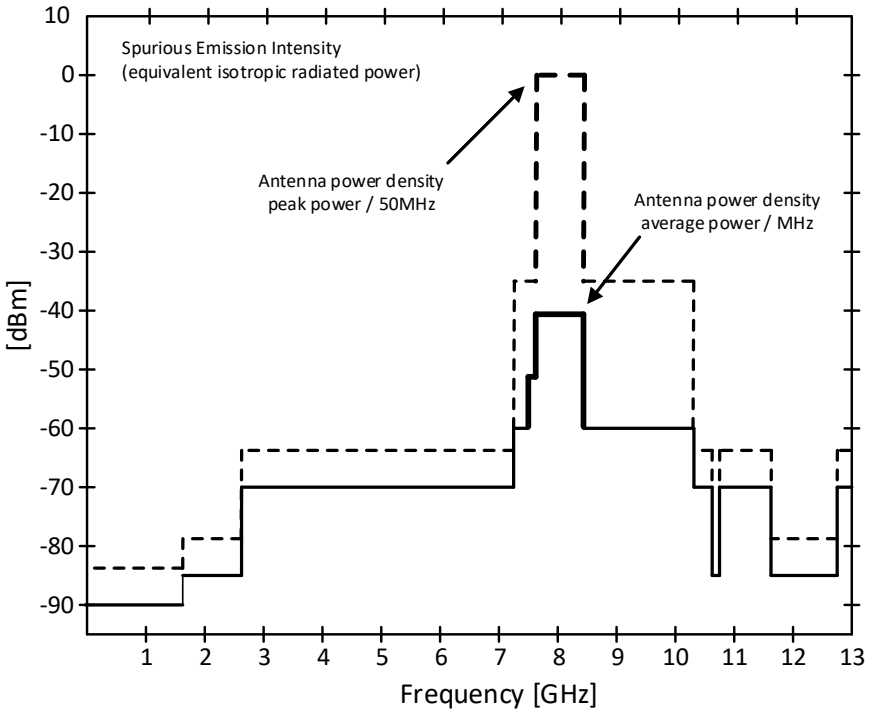

Figure 1: ORE 49.27.3 Transmission Mask

The solid line in Figure 1 indicates the spurious emissions limit determined by average power measurement in dBm/MHz equivalent isotropic radiated power, the lightly dashed line indicates the spurious limit for peak power, also in dBm/MHz. The upper arrow (heavy dashed line) indicates the antenna power density for peak power in dBm/50MHz, the lower arrow (solid line) indicates antenna power density for average power in dBm/MHz.

The ORE 49.27.3 mask is more stringent in its emission requirements on the lower side of the band, as can be seen if it is compared to the ORE 49.27.4 mask, below:

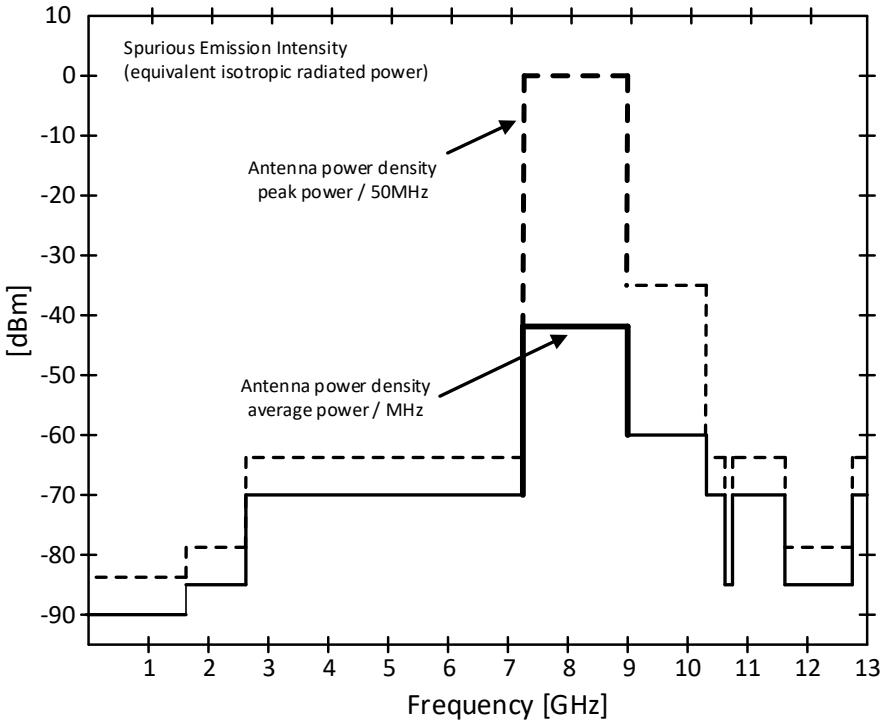

Figure 2: ORE 49.27.4 Transmission Mask

Figure 2 uses the same dotted/continuous line format to indicate peak and average power limits, as described for Figure 1above. The ORE 49.27.4 specification describes itself as being a 7.25 GHz to 9 GHz band mask, the additional bandwidth on the lower side of the mask is a benefit in avoiding mask incursions by channel 9 lower-side spurious emissions.

3.2.2 Second Transmit Harmonic

Since Japan's certification testing typically uses conducted measurements, issues may arise if the second harmonic of the channel 9 transmission exceeds the spurious emissions limit. If the second harmonic, at 16 GHz, does exceed the ORE mask limit (-70 dBm/MHz average, -64 dBm/MHz peak), it will be necessary to include a band-pass filter in your product's transmit path.

For additional information regarding band-pass filters, please see the relevant Qorvo device datasheet and hardware design guide [4], [5].

3.2.3 Peak Power Measurement

Peak power measurement methods will be defined in the documentation your test center provides - most test centers have adopted the method described in TELEC T406. The following test method was used by SGS-Japan when qualifying a Qorvo QM33110WEVB evaluation board [6].

When using this method, be aware that the capabilities of the spectrum analyser affect the accuracy of the peak power measurement. The measurement method is detailed below:

1. Peak power search, configure spectrum analyser settings:
    a. Center frequency set for channel 9 (7.9872 GHz)
    b. Span, start frequency 7.25 GHz, stop frequency 9.0 GHz (for ORE 49.27.4)
    c. RBW, 3 MHz
    d. VBW, 3 x RBW (9 MHz)
    e. Detector, positive peak
    f. Trace mode, max hold
2. Make a measurement to find the peak value of the power envelope, record the frequency of the peak.
3. Measure peak power, spectrum analyser settings:
    a. Center frequency set to value recorded in step 2.
    b. Span, 0 Hz
    c. RBW: *see explanation below*
    d. Detector, positive peak
    e. Trace mode, max hold

In TELEC's T406 document, the peak power measurement is made with the spectrum analyser configured with a RBW value of 3 MHz, the final power figure is calculated by the addition of a resolution bandwidth conversion value. The peak power calculation is defined as:

$$peak\ power\ (dBm/50MHz) = measured\ amplitude\ (dBm) + conversion\ factor\ (dB)$$

Equation 1: peak power

The conversion factor is defined as:

$$conversion\ factor\ (dB) = 20\ log\ ((50MHz)\ /\ 3MHz))$$

Equation 2: peak power conversion factor

For a UWB transmission, this conversion factor method does not provide an accurate assessment of peak power because a multiplier of 20 is used instead of 10, resulting in an artificially high peak power measurement. **For this reason, before engaging with a test center, ensure that they have a spectrum analyser with a 50 MHz RBW,** which will allow a true assessment of peak power, as defined in the ARIB standard, over a 50 MHz span, without the need for a conversion factor.

This modification to the T406 test procedure is valid because the MIC allows for changes in measurement methods where an improved measurement technique or tool is available, with the understanding that the improvement will result in a more accurate measurement.

The ARIB STD-T91 limit for peak power is 0 dBm/50MHz. Note that the measured peak power must be added to the antenna gain and include any cable losses to derive an equivalent isotropic radiated power figure.

3.2.4 Average Power Measurement

As with the peak power measurement procedure, described above, the average power measurement is likely to follow the procedure described in TELEC T406.

TELEC describes two test procedures for average power measurement: a time domain measurement of peak power found in a spectral scan, and a simpler spectral scan measurement using a spectrum analyser with an RMS feature. In this document we describe the simpler RMS measurement technique, as used by SGS-Japan during testing of a Qorvo QM33120W evaluation board.

3.2.4.1 Average Power Measurement Procedure

1. Configure the spectrum analyser as below, to search for the frequency of maximum average power in the bands described in section (2), below:
    a. Resolution: 1 MHz
    b. Video bandwidth: > 3 x resolution (> 3 MHz)
    c. Y axis bandwidth 10 dB/div
    d. Data points: 400 or more (e.g. 1001 points)
    e. Sweep time: minimum time for which measurement accuracy is guaranteed
    f. Sweep mode: continuous (until waveform stops fluctuating, e.g. 20 times or more)
    g. Detection mode: positive peak
    h. Display mode: max hold
2. Search for peak power in the following bands, with the following sweep frequency widths:
    a. Band: 4.1 GHz, Sweep: 3.4 GHz to 4.8 GHz
    b. Band: 7.9935 GHz, Sweep: 7.587 GHz to 8.4 GHz
    c. Band; 8.125 GHz, Sweep: 7.25 GHz to 9.0 GHz
    d. Band: 8.75 GHz, Sweep: 7.25 GHz to 10.25 GHz
3. If the peak power measured in the scanned bands do not exceed the permitted average power defined in ARIB STD-T91 (see tables in section 5) then the peak power is recorded as the average power measurement and the procedure is complete. If any of the peak power measurements do exceed the permitted limits, then proceed with the next measurement procedure, below.
4. Repeat the search procedure in 2, above, whilst successively narrowing the sweep frequency to 100 MHz and then 10 MHz in order to acquire an accurate measurement of peak power and peak power frequency.
5. Average power measurement using RMS function[1]. Spectrum analyser configuration:
    a. Center frequency set to value recorded in step 2.
    b. Span, 100 MHz
    c. RBW, 1 MHz
    d. VBW, 3 x RBW (3 MHz)
    e. Detector, RMS
    f. Trace mode, max hold

The ARIB STD-T91 limit for average power is -41.3 dBm/MHz. As with the peak power measurement, the measured average power must be added to the antenna gain and include any cable losses to derive an equivalent isotropic radiated power figure.

3.2.5 Spurious Emissions Measurement

The transmit spurious emission limits are shown in section 5, Appendix A: ARIB STD-T91 Emission Limits. As explained before, you should request that your test centre measure against the limits defined in Table 2: ORE 49.27.4 Emission Limits, which are less demanding than those defined in ORE 49.27.3.

For the peak emissions measurement, scan the frequency bands specified in Table 2 using a spectrum analyzer. Configure the analyzer with a resolution bandwidth (RBW) of 1 MHz, a video bandwidth (VBW) of 3 MHz, positive peak detector mode, and set the trace mode to max hold. The measurement range should start at 30 MHz (covering 30 MHz to 1.6 GHz) and extend to 26 GHz (covering 12.75 GHz to 26 GHz). Identify any emissions that exceed the permitted peak limit, after allowing for any antenna gain and cable loss.

[1] Note that TELEC's T406 test procedure also describes an alternative measurement technique using zero-span measurements of the peaks found in step 2.

For the average emissions measurement, if the peak measurements obtained during the scan are below the average limits, no further measurements are required. However, if a peak measurement exceeds the average limit, re-measure using the spectrum analyzer with the center frequency set to the frequency of the offending emission. Configure the analyzer in zero span mode with a span of 0 Hz, an RBW of 1 MHz, a VBW of 3 MHz, single sweep mode, and the detector set to RMS average or sample mode (but not video average). Verify that the re-measured value is below the average emission limit, after allowing for any antenna gain and cable loss.

3.3 Product Documentation

Product documentation is required as part of the certification process. For *Type Certification* testing, you must provide not only radio performance details but also information on the radio's manufacturing process. While each test center may have its own specific requirements, you can typically expect to supply the following details:

1. Product company details, including contact person and company registration.
2. Type of product, product name and serial number of test units.
3. Emission mode (X1D), frequency (7.9872 GHz) and transmit power (-41.3 dBm/MHz).
4. Product block diagram, including Qorvo transceiver, control processor, power source(s), antenna ports, control interface, any other RF components (active or inactive/ disabled).
5. Mechanical details, product dimensions, RF shield details.
6. Photographs of the product, including inside casework and RF shields.
7. Overview of test software and control interfaces.
8. Manufacturing details such as production location and company.
9. Quality control standards such as ISO certification and RoHS compliance.

3.4 Mechanical Requirements

3.4.1 Anti-Tamper Shield

Japan radio law requires that products containing radio transmitters be designed to prevent modification or tampering. If the radio equipment is enclosed within a product case, reasonable measures should be taken to restrict access, such as using secure fasteners like Torx screws to seal the enclosure.

For RF modules, the anti-tamper requirement is often already satisfied by the presence of an RF shield for emission and interference avoidance. Where RF shields are used, your certification test center may ask that you include with your application documents a photograph of the components hidden beneath the shield.

4 Qorvo Support for Japan Certification

4.1 Pulse Shape

Qorvo QM33xxx and QM35xxx products support an alternative channel 9 pulse shape which is optimized for use in Japan. The alternative (Japan) pulse shape can be selected through an API call, as described in the API User Guide [7]. Whilst the alternative pulse shape can be used in regions other than Japan, it is recommended for best performance to use the alternative channel 9 pulse in Japan and the standard pulse shape in all other regions.

Please note that use of UWB channel 5 is not permitted in Japan. Please also note that the DW3000 family of devices do not support the alternative Japan pulse and are therefore not recommended for products intended for Japan certification.

4.2 Software Support

Qorvo provides support for certification testing with certification test modes, which are included in the relevant device Software Development Kit (SDK) [7].

5 Appendix A: ARIB STD-T91 Emission Limits

These emission limits are based on tables in ARIB STD-T91 [1], part 2, section 3.2.

Frequency band	Spurious Emissions Limit	
	Equivalent average isotropic radiated power, dBm/MHz	Equivalent peak isotropic radiated power, dBm/MHz
< 1,600 MHz	-90	-84
>= 1,600 MHz, < 2,700 MHz	-85	-79
>= 2,700 MHz, < 7.25 GHz	-70	-64
>= 7.25 GHz, < 8.5 GHz	-59.3	-35
>= 8.5 GHz, < 10.25 GHz	-60	-35.7
>= 10.25 GHz, <10.6 GHz	-70	-64
>= 10.6 GHz, < 10.7 GHz	-85	-79
>= 10.7 GHz, < 11.7 GHZ	-70	-64
>= 11.7 GHZ, < 12.75 GHz	-85	-79
>= 12.75 GHz	-70	-64

Table 1: ORE 49.27.3 Emission Limits

Frequency band	Spurious Emissions Limit	
	Equivalent average isotropic radiated power, dBm/MHz	Equivalent peak isotropic radiated power, dBm/MHz
< 1,600 MHz	-90	-84
>= 1,600 MHz, < 2,700 MHz	-85	-79
>= 2,700 MHz, < 7.25 GHz	-70	-64
>= 9.0 GHz, < 10.25 GHz	-60	-35.7
>= 10.25 GHz, <10.6 GHz	-70	-64
>= 10.6 GHz, < 10.7 GHz	-85	-79
>= 10.7 GHz, < 11.7 GHZ	-70	-64
>= 11.7 GHZ, < 12.75 GHz	-85	-79
>= 12.75 GHz	-70	-64

Table 2: ORE 49.27.4 Emission Limits

References

[1] ARIB, STD-T91, "UWB (ultra wideband) Radio Systems", Association of Radio Industries and Businesses, Version 4.0, April 2022.

[2] ARIB, "Access to ARIB STD-T91 UWB Standard," [Online]. Available: https://www.arib.or.jp/english/std_tr/telecommunications/std-t91.html.

[3] TELEC, T406, "Characterisitics Test Method for Ultra-Wideband Wireless Systems, Telecom Engineering Test Centre, www.telec.or.jp/eng, 2021.

[4] Qorvo, QM33110W Datasheet.

[5] Qorvo, "APH301 DW3000 QM33100 Hardware Design Guide," www.qorvo.com.

[6] Qorvo, "QM33110WEVB SGS Japan, Test Report," Qorvo, June 2024.

[7] Qorvo, "DW3_QM33_SDK," check www.qorvo.com for latest release.

Abbreviations

ARIB	Association of Radio Industries & Businesses
BPF	Band-Pass Filter
EIRP	Equivalent Isotropic Radiated Power
MIC	Ministry of Internal Affairs & Communications
ORE	Ordinance for Radio Equipment
RF	Radio Frequency
SDK	Software Development Kit
TELEC	Telecom Engineering Test Center
UWB	Ultrawide Band

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Document History

Rev	Date	Section	Changes
1.00	15th May 2015		Decawave internal release. Minor changes to revision 1.01 in June 205
B	4th July 2025		First public release. Updated and Qorvo format.