ENGLISH TRANSLATION

UWB (ULTRA-WIDEBAND) RADIO SYSTEMS

ARIB STANDARD

ARIB STD-T91 Ver. 1. 1

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Association of Radio Industries and Businesses

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Introduction

With participation of radio communication equipment manufacturers, broadcasting equipment manufacturers, telecommunication operators, broadcasters and general equipment users, Association of Radio Industries and Businesses (ARIB) defines basic technical requirements for standard specifications of radio equipment, etc. as an "ARIB STANDARD" in the field of various radio systems.

In conjunction with national technical standards which are intended for effective spectrum utilization and avoidance of interference with other spectrum users, an ARIB STANDARD is intended as a standard for use by the private sector by compiling various voluntary standards regarding the adequate quality of radio and broadcasting service, compatibility issues, etc. It aims to enhance convenience for radio equipment manufacturers, telecommunication operators, broadcasting equipment manufacturers, broadcasters and general users.

An ARIB STANDARD herein is published as "UWB (Ultra-Wideband) Radio Systems". In order to ensure fairness and transparency in the defining stage, the standard was decided by consensus of the standard council with participation of interested parties including radio equipment manufacturers, telecommunication operators, broadcasters, testing organizations, general users, etc. with impartiality.

With the radio system described in the ARIB STANDARD herein, the electrical power spreads over a wide bandwidth, and therefore it is necessary to avoid radio interference to various radio systems in the band. In order to avoid harmful radio interferences to other radio systems, "Operational Guidelines for UWB Radio Systems" and "Design Guidelines for UWB Radio Systems" were also documented and attached hereto as a reference material.

It is our sincere hope that the standard would be widely used by radio equipment manufacturers, testing organizations, general users, etc.

Contents

Chapter 1 General Descriptions

1.1 Outline

The standard defines requirements of the radio equipment of ultra-wideband radio stations stipulated in item 2 of paragraph 2, Article 4.4 of Regulations for Enforcement of Radio Law (This refers to the radio stations that mainly handle data transmissions with the required frequency bandwidth of 450 MHz or more and uses 0.001 W or less for the antenna input power (hereinafter referred to as "antenna power") with use of frequency from 3.4GHz to 4.8 GHz or from 7.25GHz to 10.25GHz for indoor use), and also the radio equipment of the radio stations of "UWB (Ultra-Wideband) Radio System" for the communication application.

1.2 Scope of the Standard

The radio station of a UWB Radio System consists of radio equipment and data terminal equipment (including one connected to telecommunication circuit facilities), etc. as shown in the Figure 1-1.

The standard defines the said radio equipment.

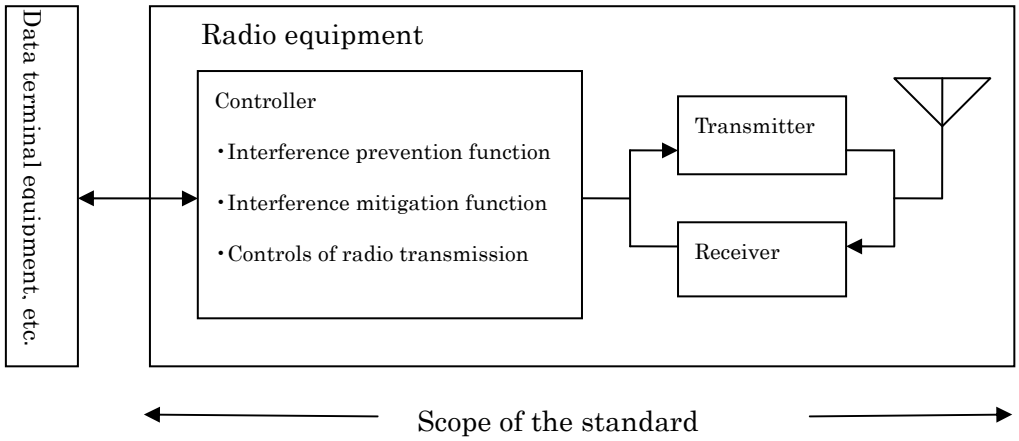


Figure 1-1 Configuration of radio station of UWB Radio System

1.3 Reference regulations

In the standard, "RERL" refers to Regulations for Enforcement of Radio Law, "ORE" refers to Ordinance Regulating Radio Equipment, "OTRCC" refers to Ordinance Concerning Technical Regulations Conformity Certification etc. of Specified Radio Equipment, "OTF" refers to Ordinance Concerning Terminal Facilities etc., "RTCCA" refers to Rules Concerning the

Technical Conditions Compliance Approval etc. for Terminal Equipment, “NT” refers to a Notification of the Ministry of Posts and Telecommunications if issued in 2000 or earlier, and a Notification of the Ministry of Internal Affairs and Communications (MIC) if issued in 2001 or later.

Chapter 2 Standard System

2.1 System Overview

UWB Radio System is a radio system that spreads electric power over a very wide bandwidth. On the other hand, the standard does not specify a protocol layer.

2.2 System Configurations

In the radio equipment of the radio station of a UWB Radio System, a radio equipment not connected to the AC mains power supply shall be permitted to emit radio waves only after it receives a signal from another radio equipment connected to the AC mains power supply. (ORE, Article 49.27)

Examples of a compliant system configuration are shown in Figure 2-1, 2-2 and 2-3.

(1) The case of radio equipment connected to the AC mains power supply which transmits signals to another radio equipment:

If a radio equipment is connected to the AC mains power supply, it can start transmission at any time.

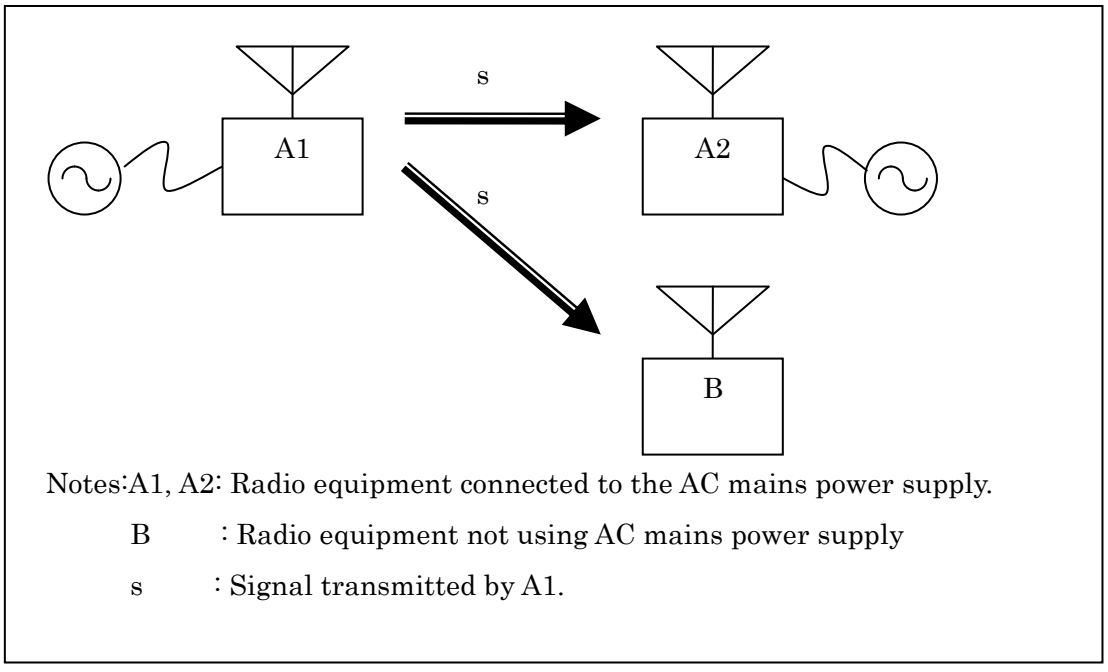
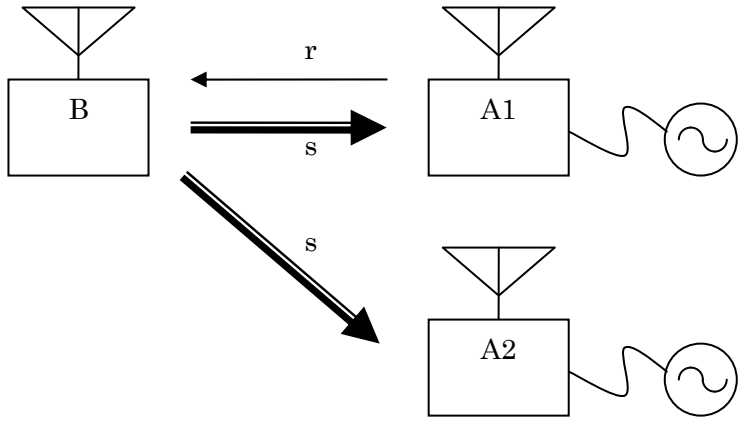


Figure 2-1 Example of standard system configuration (1)

(2) The case of radio equipment not connected to the AC mains power supply which transmits signals to another radio equipment connected to the AC mains power supply:

If a radio equipment is not connected to the AC mains power supply, it can emit radio waves only after it detects a signal from another radio equipment which is connected to the AC mains power supply.

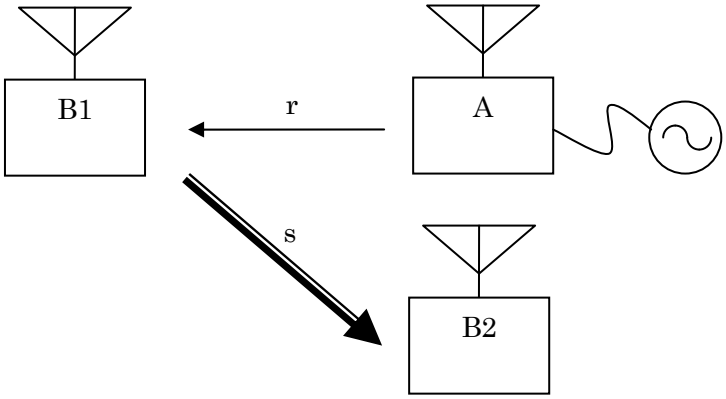


Notes: A1, A2: Radio equipment connected to the AC mains power supply
B : Radio equipment not connected to the AC mains power supply
r : Signal received by B.
s : Signal transmitted by B.

Figure 2-2 Example of standard system configuration (2)

(3) The case of radio equipment not connected to the AC mains power supply which transmits signals to another radio equipment not connected to the AC mains power supply:

If a radio equipment is not connected to the AC mains power supply and transmits signal to another radio equipment not connected to the AC mains power supply, it can emit radio waves after it receives signal from another radio equipment that is connected to the AC mains power supply.



Notes:A : Radio equipment connected to the AC mains power supply
B1, B2 : Radio equipment not connected to the AC mains power supply
r : Signal received by B1.
s : Signal transmitted by B1.

Figure 2-3 Example of standard system configuration (3)

Chapter 3 Technical Requirements for Radio Equipment

3.1 General Conditions

(1) Contents of communications (RERL, Article 4.4)

Content of communication shall primarily be for data transmissions.

(2) Communication methods (ORE, Article 49.27)

Communication methods shall be either simplex operation, full duplex operation or half duplex operation.

(3) Operating Frequency band (RERL, Article 4.4)

Operating frequency band to be used shall be from 3.4 GHz to 4.8 GHz or from 7.25 GHz to 10.25 GHz.

(4) Usage environment condition (RERL, Article 4.4)

The radio equipment shall be used indoors.

3.2 Transmitter

(1) Modulation method

There is no specific restriction on the modulation method.

(2) Antenna power (ORE, Article 49.27)

Antenna power for the operating frequency band shall satisfy respective values as follows:

- Average power per 1MHz bandwidth shall be -41.3 dBm or less.

> As an interim measure until December 31, 2010, the following condition shall apply: Of radio equipment with use of frequency from 3.4 GHz to 4.8 GHz, those without an interference mitigation function stipulated in 3.4 (2) shall have the average power of -70 dBm or less per 1 MHz bandwidth within the frequency band from 3.4 GHz to 4.2 GHz, and the average power of -41.3 dBm or less per 1 MHz bandwidth within the frequency band from 4.2 GHz to 4.8 GHz. (According to ORE, Supplementary provision (MIC Ordinance No. 105 on August 1, 2006) (Revised by MIC Ordinance No. 98 on August 29, 2008).)

- Peak power per 50MHz bandwidth shall be 0 dBm or less.

> As an interim measure until December 31, 2010, the following condition shall apply:
>
> Of radio equipment with use of frequency from 3.4 GHz to 4.8 GHz, those without an interference mitigation function stipulated in 3.4 (2) shall have a peak power of -30 dBm or less per 50 MHz bandwidth within the frequency band from 3.4 GHz to 4.2 GHz, and the peak power of 0 dBm or less per 50 MHz bandwidth within the frequency band from 4.2 GHz to 4.8 GHz. (According to ORE, Supplementary provision (MIC Ordinance No. 105 on August 1, 2006) (Revised by MIC Ordinance No. 98 on August 29, 2008).)

(3) Tolerances for antenna power (ORE, Article 14)

The tolerance of the antenna power from shall be less than the allowed maximum value + 20%.

(4) Transmission data rate (ORE, Article 49.27)

Transmission data rate shall be higher than 50 Mbps excepting for such cases as noise or interference from other radio stations need be avoided.

(5) Frequency bandwidth (ORE, Article 49.27)

Frequency bandwidth between the upper and lower frequencies for which the radiation power drops 10 dB below the maximum radiation power shall be 450 MHz or more.

(6) Permissible values for occupied bandwidth (ORE, Article 6 / Table 2-49.)

Permissible values for the occupied bandwidth shall be as follows:

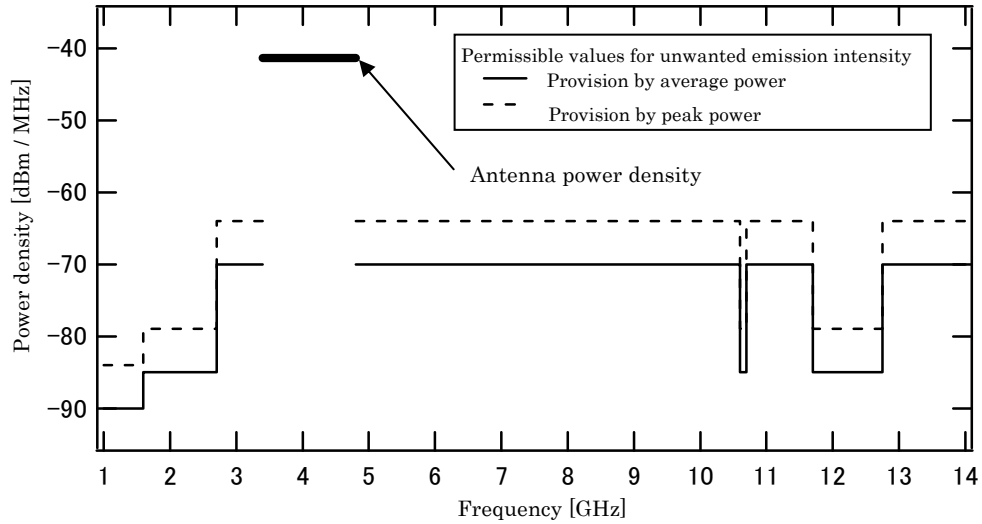
- For those with use of the frequency from 3.4 GHz to 4.8 GHz 1.4 GHz
- For those with use of the frequency from 7.25 GHz to 10.25 GHz 3 GHz

(7) Permissible values for unwanted emission intensity (ORE, Article 7 / Table 3-41)

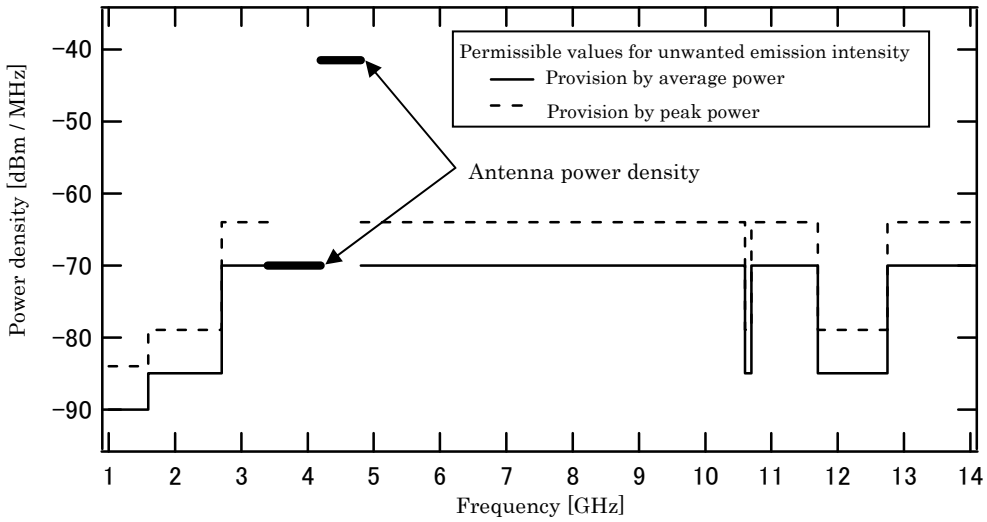
Permissible values for the unwanted emission intensity from the transmitter are as follows:

Frequency band	Permissible values for unwanted emission intensity	
	Average power per 1 MHz bandwidth	Peak power per 1 MHz bandwidth
Less than 1,600 MHz	-90 dBm or less	-84 dBm or less
From 1,600 MHz to 2,700 MHz	-85 dBm or less	-79 dBm or less
From 2,700 MHz to 10.6 GHz	-70 dBm or less	-64 dBm or less
From 10.6 GHz to 10.7 GHz	-85 dBm or less	-79 dBm or less
From 10.7 GHz to 11.7 GHz	-70 dBm or less	-64 dBm or less
From 11.7 GHz to 12.75 GHz	-85 dBm or less	-79 dBm or less
More than 12.75 GHz	-70 dBm or less	-64 dBm or less

Note: In the case that the use of the frequency is within a range from 3.4 GHz to 4.8 GHz, the antenna power for the frequency band from 3.4 GHz to 4.8 GHz shall comply with Article 3.2 (2) instead of 3.2 (7). Similarly, in the case that the use of the frequency is within a range from 7.25 GHz to 10.25 GHz, the antenna power for the frequency band from 7.25 GHz to 10.25 GHz shall comply with the Article 3.2 (2) instead of 3.2 (7).



1) With an interference mitigation function



2) Without an interference mitigation function (until December 31, 2010)

Figure 3-1 Permissible values for unwanted emission intensity (when using frequency from 3.4 GHz to 4.8 GHz)

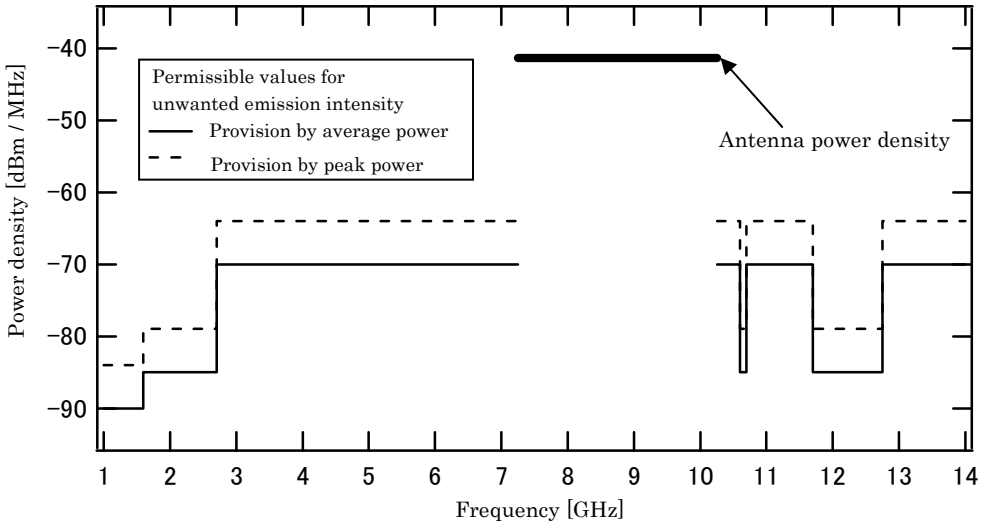


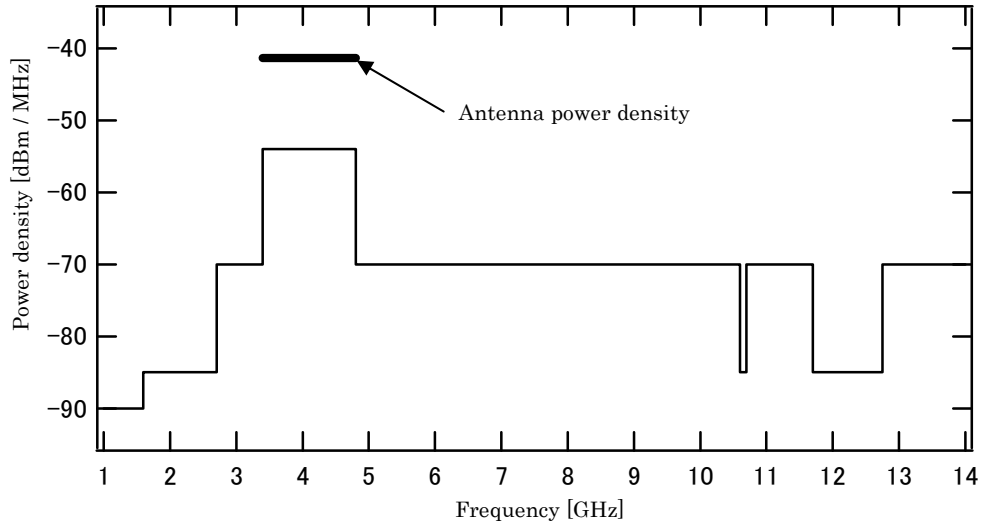
Figure 3-2 Permissible values for unwanted emission intensity (when using frequency from 7.25 GHz to 10.25 GHz)

3.3 Receiver

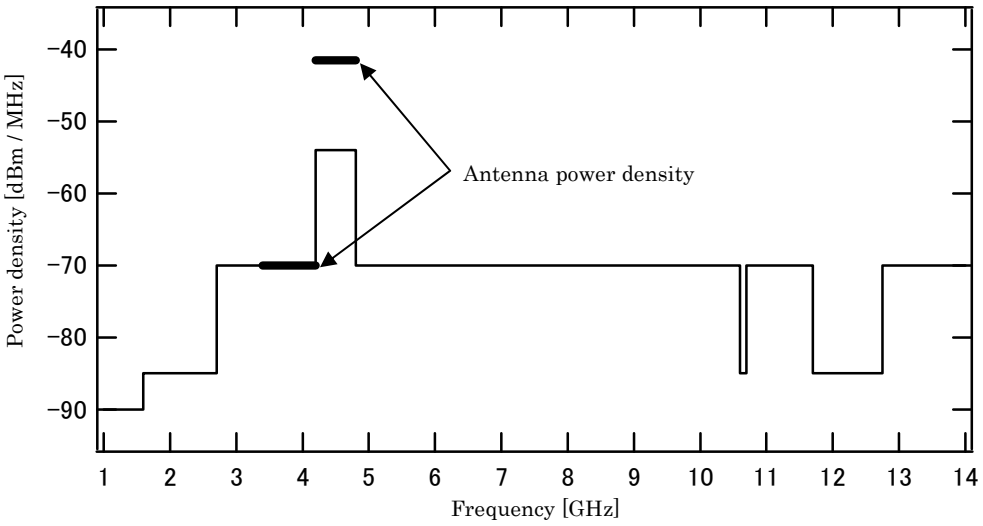
(1) Limit on Secondary Radiated Emissions, etc. (ORE, Article 24)

Limit on Secondary Radiated Emissions, etc. from the receiver shall be as follows:

Frequency band	Average power at any 1 MHz bandwidth	
	When using frequency from 3.4 GHz to 4.8 GHz	When using frequency from 7.25 GHz to 10.25 GHz
Less than 1,600 MHz	-90 dBm or less	
From 1,600 MHz to 2,700 MHz	-85 dBm or less	
From 2,700 MHz to 3.4 GHz	-70 dBm or less	
From 3.4 GHz to 4.8 GHz	-54 dBm or less	-70 dBm or less
From 4.8 GHz to 7.25 GHz	-70 dBm or less	
From 7.25 GHz to 10.25 GHz	-70 dBm or less	-54 dBm or less
From 10.25 GHz to 10.6 GHz	-70 dBm or less	
From 10.6 GHz to 10.7 GHz	-85 dBm or less	
From 10.7 GHz to 11.7 GHz	-70 dBm or less	
From 11.7 GHz to 12.75 GHz	-85 dBm or less	
More than 12.75 GHz	-70 dBm or less	



1) With an interference mitigation function



2) Without an interference mitigation function (until December 31, 2010)

Figure 3-3 Limit on Secondary Radiated Emissions
(when using frequency from 3.4 GHz to 4.8 GHz)

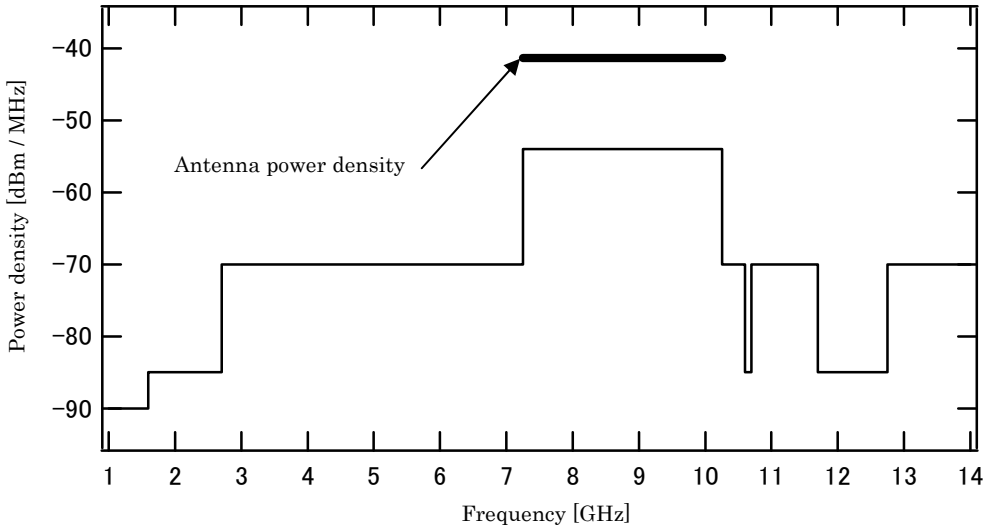


Figure 3-4 Limit on Secondary Radiated Emissions
(when using frequency from 7.25 GHz to 10.25 GHz)

As an interim measure until December 31, 2010, the following conditions shall apply: For radio equipment using radio with frequency from 3.4 GHz to 4.8 GHz, those without an interference mitigation function stipulated in 3.4 (2) shall have the limit on secondary emissions, etc. as in the table below. (According to ORE, Supplementary provision (MIC Ordinance No. 105 on August 1, 2006) (Revised by MIC Ordinance No. 98 on August 29, 2008).)	
Frequency band	Average power at any 1 MHz bandwidth When using frequency from 3.4 GHz to 4.8 GHz (without an interference mitigation function stipulated in 3.4 (2).)
Less than 1,600 MHz	-90 dBm or less
From 1,600 MHz to 2,700 MHz	-85 dBm or less
From 2,700 MHz to 4.2 GHz	-70 dBm or less
From 4.2 GHz to 4.8 GHz	-54 dBm or less
From 4.8 GHz to 10.6 GHz	-70 dBm or less
From 10.6 GHz to 10.7 GHz	-85 dBm or less
From 10.7 GHz to 11.7 GHz	-70 dBm or less
From 11.7 GHz to 12.75 GHz	-85 dBm or less
More than 12.75 GHz	-70 dBm or less

3.4 Controller

A controller shall have the following devices and functions, and meet each of the following conditions.

(1) Interference prevention function (RERL, Article 6.2 / ORE Article, 9.4)

The radio equipment of the radio station shall mainly be used in the same premises. It shall automatically transmit identification signs or receive them.

(2) Interference mitigation function (ORE, Article 49.27)

The radio equipment using radio with frequency from 3.4 GHz to 4.8 GHz shall have the interference mitigation function that meets the technical conditions notified separately by Minister of Internal Affairs and Communications.

> As an interim measure until December 31, 2010, it is not mandatory to install an interference mitigation function. (According to ORE, Supplementary provision (MIC Ordinance No. 105 on August 1, 2006) (Revised by MIC Ordinance No. 98 on August 29, 2008))
>
> When the interim measure is applied, the description of 3.2 (2) shall be noted for the antenna power, the description of 3.2 (7) for permissible values for unwanted emission intensity and the description of 3.3 (1) for the limit on secondary radiated emissions, etc.

(3) Controls of radio emission (ORE, Article 49.27)

A radio equipment not connected to the AC mains power supply shall be permitted to emit radio waves only after it receives a signal from another radio equipment connected to the AC mains power supply.

3.5 Connections with Telecommunication Circuit Equipment

A radio equipment that is connected to the telecommunication circuit equipment shall meet the following conditions:

(1) Identification devices (OTF, Article 9)

An identification device shall have a unique identification sign (sign designed to identify the radio equipment used for the terminal equipment and to be collated when configuring a communication channel).

(2) Identification signs (NT No. 424 in 1994)

The coding length of the identification sign shall be 48 bits or more.

(3) Method to judge the availability of the operating frequency band (NT No. 424 in 1994)

Judgment of the availability of the operating frequency band shall be made by detecting a radio wave emitted from another radio station, or by calculating the received signal and detecting the signal level. However, for the equipment that has a function to disconnect the channel when the communication quality is degraded, the judgment may be replaced by checking the operating condition of the channel.

3.6 Antenna

(1) Antenna structures

There is no specific provision for the antenna structure.

(2) Gain of the transmitting antenna (ORE, Article 49.27)

Absolute gain of the transmitting antenna shall be 0 dBi or less. However, in the case that the e.i.r.p. (Equivalent Isotropic Radiated Power) falls short of the antenna power provided in 3.2 (2) added with the transmitting antenna gain of 0 dBi absolute gain, the difference may be complemented by adjusting the gain of the transmitting antenna.

(3) Gain of the receiving antenna

There is no specific provision for the gain of the receiving antenna.

3.7 Others

(1) Cabinet (ORE, Article 49.27)

The cabinet shall be constructed so as to be not be easily tampered with.

(2) Mark of usage restrictions (ORE, Article 49.27)

A mark of the usage restriction that radio waves can be emitted only indoor shall be visibly shown on the cabinet.

(3) Mark in relation to technical regulations conformity certification (OTRCC, Article 8)

A mark in relation to technical regulations conformity certification in the specified format shall be visibly displayed on the radio equipment.

(4) Mark in relation to technical conditions compliance approval for terminal equipment (RTCCA, Article 10)

In case a radio equipment connects to the telecommunication circuit equipment, a mark in relation to technical conditions compliance approval for terminal equipment in the specified format shall be visibly displayed on it.

Chapter 4 Measurement Methods

Measurement methods shall be in accordance with MIC Ordinance related with OTRCC, Item 1 (3) in Appendix 1 [1]. Items that are not specified in the MIC Ordinance, however, shall be based on conventionally practiced methods.

[1] At the release date of ARIB STD-T91 Ver. 1,1 on September 25, 2008, it means MIC Ordinance No, 88 on January 26, 2004. However if the MIC Ordinance and the contents of the MIC Ordinance are revised in near future, measurement methods shall be in accordance with latest versions of the MIC Ordinance and the contents,

In addition, TELEC-T406 (“Characteristics Test Methods for Radio Equipment Used for Radio Station of Ultra-Wideband Radio System”) what is issued by Telecom Engineering Center (TELEC) Foundation commissioned by the paragraph 2 of MIC Ordinance No. 88 on January 26, 2004, may be referred as the measurement method.

Annex 1 Test Items in relation to Technical Regulations Conformity Certification for Specified Radio Equipment

(OTRCC, Appendix 1)

Test items in relation to the technical regulation conformity certification for radio equipment of radio stations of UWB (Ultra-Wideband) radio system are as follows:

See ARIB STD-T91 Chapter 4 for details.

(1) Transmitter

Frequency

Occupied bandwidth

Intensity of spurious emission or unwanted emission

Antenna power

Gain of transmitting antenna

Frequency Bandwidth

(2) Receiver

Limit on secondary radiated emissions

(3) Others

Interference mitigation function (When using radio wave within the frequency from 3.4 GHz to 4.8 GHz)

As an interim measure until December 31, 2010, the interference mitigation function is not mandatory (According to ORE, Supplementary provision (MIC Ordinance No. 105 on August 1, 2006) (Revised by MIC Ordinance No. 98 on August 29, 2008)). Therefore, the test item of interference mitigation function is not required for the radio equipment without the interference mitigation function. (According to OTRCC, Supplementary provision (MIC Ordinance No. 106 on August 1, 2006)

Annex 2 Operational Guidelines for UWB Radio Systems

1 Summary

1.1 Objectives

The Operational Guidelines are aimed at avoiding harmful radio interference to other radio equipment, and ensuring users' convenience as well as achieving effective spectrum utilization, for operating UWB (Ultra-wideband) radio systems.

The harmful radio interference is meant to refer to continuous and serious interference to other radio equipment (Radio Law Article 82).

1.2 General scope

The Operational Guidelines apply to users of UWB radio systems and vendors (hereinafter referred to as "vendors") who manufacture, sell and install the radio equipment of radio stations of UWB radio systems (hereinafter referred to as "UWB radio equipment").

1.3 Target Systems

The Operational Guideline is intended for the following system.

- UWB (Ultra-Wideband) Radio Systems ARIB STD-T91

1.4 Basic agreements

(1) Clarification of problems

Vendors shall in good faith take preventive measures including warning messages in operation manuals, etc. and to pursue PR activities for prevention of radio interference.

(2) Preliminary survey

In case users or vendors intend to introduce UWB radio equipment, it shall be confirmed prior to the introduction that the said radio equipment will not cause radio interference which is harmful to other radio equipment.

(3) Coordinated responses

In the event that a UWB radio system has caused radio interference which is harmful to other radio equipment, the users and/or vendors shall, in good faith, help for reduction of radio interference.

2 Clarification of problems

(1) Operation manuals

Vendors shall include the intended meanings of the following messages in operation manuals of UWB radio equipment.

The frequency band used for the UWB radio function is also used for radio equipment of other radio systems.

1. The use of equipment with UWB radio function shall be limited to indoors, i.e. within environments such as houses, apartments, buildings, etc. Not approved for outdoor use.

Even when used indoors, such as at broadcast events , please confirm with the event organizer about the use of UWB radio function as it might cause interference to broadcasting operations.

2. The use of equipment with UWB radio function may cause influence to radio astronomy operations, etc. When the equipment is used near a radio astronomy observatory, contact the following address.

3. In case that harmful interference to other non-UWB radio equipment (satellite earth station antennas, 5GHz band wireless LAN, mobile phones, etc.) is caused due to the emission from the UWB radio function of the equipment, take discretionary actions, such as to remove the UWB radio equipment from the interfering area. If interference remains, promptly stop the radio emission and contact the following address:

Contact us at :_____

Note: The "UWB radio function" stated in the operation manual refers to the wireless communication function of the UWB radio systems,

(2) Catalogs, brochures, websites

Vendors shall include similar warning message as shown in the operational manuals in catalogs, brochures, websites, etc.

(3) Indication by labels

Vendors shall indicate one of the following messages visibly displayed on the UWB radio equipment.

1) 2)

UWB：Do not use outdoors

3)

Do not use UWB radio function outdoors

Notes:

1) Show that the equipment is UWB radio equipment.
2) Show that the equipment shall only be used indoors.
3) Show that the equipment is UWB radio equipment, and that UWB radio function shall only be used indoors .

The method, size, horizontal to vertical ratio, color and the use of a frame of the label are not specified. The quality of the label material is not specified either but the label shall not be easily removed nor scratched. The font type and color of the label characters are not specified either, but should be clear and easy-to-read.

3 Preliminary survey

3.1 Method of preliminary survey

(1) Survey of existing radio astronomy observatories

Users who intend to operate UWB radio system shall check whether there is a radio astronomy operation currently in use or planed in the neighborhood.

If a radio astronomy observatory is found or assumed to be in operation in the neighborhood, UWB radio system shall not be operated, unless the user receives consent from an authorized person of the radio astronomy observatory.

(2) Preliminary survey at an event site, etc.

Users who intend to operate a UWB radio system at an event site, etc. shall confirm its use with the event organizer. If broadcast radio relay equipment is used on site, the user of the UWB radio system shall notify its use to the authorized person of the broadcast service, perform a priori test before the operation of the system if necessary,, and then obtain permission from the event organizer.

A UWB radio system shall not be operated at an event site, etc. unless permission from the event organizer can be obtained.

3.2 Response by Vendors

When installing a UWB radio system, vendors shall execute a preliminary survey upon

request by the user. Vendors should voluntarily execute a preliminary survey even if such a request is not issued.

4 Cooperation

4.1 Cooperation for interference avoidance

In the case that harmful radio interference is caused to radio equipment other than UWB radio systems, by the use of a UWB radio system manufactured, sold and installed by a vendor, and that there is a need to discuss a radio interference avoidance measure between the user of the UWB radio system and the management representative of the interfered radio equipment , the vendor shall, in good faith, extend cooperation to avoid the radio interference.

In the case that radio emission was found to cause harmful interference to radio equipment other than UWB radio systems, after a UWB radio system had started operation, the radio emission shall be promptly stopped, and an interference avoidance measure shall be taken.

4.2 Cooperation for interference avoidance from January 1, 2011 and later for radio equipment using radio frequency from 3.4 GHz to 4.8 GHz without interference mitigation function

With respect to future new mobile communications systems, etc., and development of domestic radio ordinances, vendors shall refrain from manufacturing, selling and installing UWB radio equipment using the frequency from 3.4 GHz to 4.8 GHz without an interference mitigation function (hereinafter referred to “radio equipment not supporting mitigation”) from January 1, 2011 and later.

Also, vendors shall cooperate to assist public organizations to estimate the remaining number of UWB radio equipment not supporting mitigation, by tracking the number of shipped radio equipment not supporting a mitigation function as well as the UWB radio equipment using the same bandwidth with an interference mitigation function (hereinafter referred to “radio equipment supporting interference mitigation”).

As an appropriate measure to limit the number of remaining UWB radio equipment not supporting interference mitigation to below an allowed limit in 2011, the vendors shall cooperate with future mobile communications system operators for an early shift to and replacement with radio equipment supporting interference mitigation.

Annex 3 Design Guidelines for UWB Radio Equipment

1 Design Guideline for the Protection of Broadcast Receiver

1.1 Lowered Permissible Levels of Unwanted Emission Intensity for the Protection of Broadcast Receivers

Permissible values for unwanted emission intensity provided in ARIB STD-T91 are set lower than those for unwanted emission intensity for other popular radio equipment such as a land mobile station for mobile wireless communications (mobile phone), low power data communications radio equipment (wireless LAN) and radio frequency identification (RFID). Therefore, UWB (ultra-wideband) radio systems may not immediately cause interference with other radio equipment such as broadcast receivers. However, if the radio equipment of the radio station of UWB radio systems (hereinafter referred to as "UWB radio equipment") is used in a very close neighborhood of a broadcast receiver, and the level of broadcast emission is near the receiver sensitivity limit , it is necessary to further lower the unwanted emission intensity of the specified frequency below those specified in ARIB STD-T91 so as not to cause interference with broadcast receivers. For this reason, the UWB radio equipment should be designed with due consideration of permissible values for unwanted emission intensity that protects broadcast receivers as shown in Table A3-1.In case permissible values for unwanted emission intensity of the frequency band are not shown in Table A3-1, then ARIB STD-T91 shall apply.

Table A3-1 Permissible values for unwanted emission intensity for protecting broadcast receiver

Frequency band		Permissible values unwanted emission intensity
	Interfered system	Average power at any 1 MHz bandwidth (e.i.r.p.)
From 170 MHz to 222 MHz	Terrestrial broadcasting (VHF 4-12 ch)	-114.7 dBm or less
From 470 MHz to 770 MHz	Terrestrial broadcasting (UHF 13-62 ch)	-106.1 dBm or less
From 2630 MHz to 2655 MHz	Mobile broadcasting	-111.7 dBm or less

Note: e.i.r.p.: Effective Isotropic Radiated Power

The design guideline is subject to change depending on the VHF and UHF bands usage scenarios for the future planned termination of terrestrial analog broadcasting on July 24, 2011.

1.2 Indirect Measurement Method for Unwanted Emission Intensity

1.2.1 Use of an indirect measurement method for unwanted emission intensity

The permissible values for unwanted emission intensity shown in Table A3-1 are at the measuring limit comparable with thermal noise at an ordinary temperature. It is thus extremely difficult to measure the unwanted emission intensity of the final products incorporating UWB radio equipment and to measure products at the design and manufacturing stage. It is, therefore, allowed to estimate the unwanted emission intensity of UWB radio equipment in the frequency bandwidth shown in Table A3-1 (hereinafter referred to as "interference bandwidth") in accordance with the measurement method hereinafter described, after separating signals generated by the UWB radio equipment and noise generated by non-UWB portion of the equipment.

1.2.2 An example of Indirect Measurement of Unwanted Emission Intensity

An example of indirect measurement of unwanted emission intensity for UWB radio equipment at 600 MHz is shown below. The same method can be applied for measurements for other frequencies.

(1) A measurement schematic diagram

A measurement schematic diagram used in the measurement example is shown in Figure A3-1. The signal generated by the UWB radio equipment is input to a spectrum analyzer via an attenuator (ATT), a low-pass filter (LPF) and a high-frequency amplifier (AMP) for the measurement. In the measurement example, the signal that the UWB radio equipment generates in a frequency band is suppressed by the use of LPF and AMP, to prevent intermodulation of the spectrum analyzer due to overloading by the input signal, and to enable measurement of the unwanted emission intensity of the frequency bandwidth. Also, regarding reflections to UWB radio equipment due to LPF, an attenuator (ATT) of 6 dB is added, to attain voltage standing wave ratio (VSWR) <1.67, which is a realistic value, in case of any load changes.

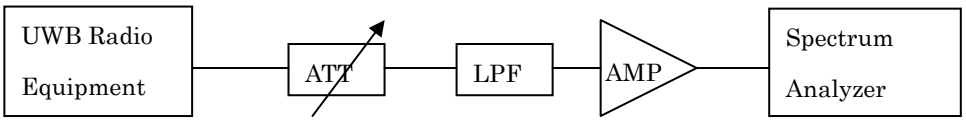


Figure A3-1 A measurement schematic diagram used for the measurement example

(2) Equipment for an experiment

A list of equipment used for the measurement experiment is shown in Table A3-2:

Table A3-2 Equipment for experiment

Equipment name	Manufacturer	Model	Qtty	Remarks
UWB radio equipment			1	
ATT	HP	8495B 8494B	1	DC-18 GHz 1 dB, 10 dB step
LPF	Mini-Circuits	BPF-750	1	750 MHz LPF
AMP	R&K	A-528-LN	1	0.01 - 1 GHz, 32 dB
Spectrum analyzer	Anritsu	MS8901A	1	9 kHz - 3 GHz

(3) Characteristics of LPF and AMP

The transmission characteristics when combining LPF and AMP in the measurement example are shown in Figure A3-2. Frequency characteristics for “LPF input signal” and “(AMP output signal) – (AMP gain) + (LPF insertion loss)” are shown here. In the measurement example, attenuation of 50 dB or more was obtained in the frequency band between1.5 GHz and 10 GHz by combining LPF and AMP.

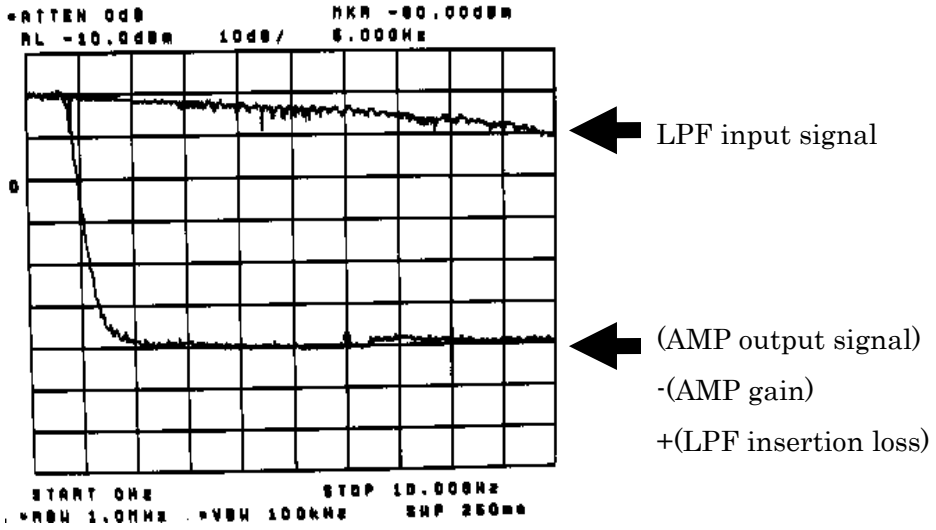


Figure A3-2 Transmission characteristics of signals when combining LPF and AMP (A display example from a spectrum analyzer)

(4) Characteristics of AMP

Gain and noise figure (NF) of AMP at 600 MHz in the measurement example are shown in Table A3-3.

Table A3-3 Characteristics of AMP

Frequency	600 MHz
Gain	36.0 dB
NF	3.9 dB

(5) Setting of spectrum analyzer

Parameters of spectrum analyzer used in the measurement example are shown in Table A3-4.

Table A3-4 Measurement parameters of a spectrum analyzer

Item	Set value
Resolution bandwidth (RBW)	1 MHz
Video bandwidth(VBW)	Auto
Sweep time (SWP)	1 s
Attenuation (ATT)	0 dB
Data points (Point)	1001
Detection (Detect)	RMS
Average count(Average)	100
Frequency span(SPAN)	10 MHz
Preamplifier (Pre AMP)	ON

(6) Estimation equations for unwanted emission intensity

The signal level M of AMP output observed by the spectrum analyzer is a combined value of ATT input signal level (unwanted emission intensity) α , ATT thermal noise and AMP thermal noise, and can be expressed in the Equation (1).

$$M = \left\{ \frac{\alpha}{L} + kT_a \left(1 - \frac{1}{L} \right) + kT_1 \right\} \cdot G \qquad \cdots \quad (1)$$

M: AMP output signal level

α: ATT input signal level (unwanted emission intensity)

L: ATT attenuation

k: Boltzamann constant

T_a: Ambient temperature (K)

T_1: Equivalent noise temperature (obtained by converting AMP noise into AMP input.) (K)

G: AMP gain

Here, T1 can be expressed as Equation (2).

$$T_1 = (F - 1)T_0 \qquad \cdots \quad (2)$$

F: AMP noise figure (antilog)

T_0: Temperature 290 K

From Equation (1) and (2), α can be obtained by making $T_a=T_0$ as in the Equation (3).

$$\alpha = L\left\{\frac{M}{G} - kT_0\left(F - \frac{1}{L}\right)\right\} \qquad \cdots \quad (3)$$

As shown in the Equation (3), α can be calculated when AMP gain (G) and noise figure (F) are obtained.

(7) Measured results of the measurement example

Parameters set in the measurement example are shown in Table A3-5, and the measured results in Table A3-6, respectively. The estimated value for unwanted emission intensity at 600 MHz has become -111.3 dBm / MHz by making a band conversion upon obtaining α from the measured values.

Table A3-5 Parameters for the measurement example

Item	Unit	600 MHz	
		log	antilog
L		6+1.3 dB	5.37
k	J / K (W・s)		1.38 E-23
T_0	K		290
G		36-0.4 dB	3631
F		3.9 dB	2.45

L : ATT+(Cable loss + ATT insertion loss + LPF insertion loss)

G : AMP gain - cable loss

Table A3-6 Measured results

Item	ATT [dB]	600 MHz
M	6	-134.2 dBm / Hz
α		-111.3 dBm / MHz

1.2.3 A design example for UWB radio equipment

A configuration of UWB radio equipment using filter is shown in Figure A3-3. In the figure, transmitter of the UWB radio equipment (hereinafter referred to as "UWB transmitter"), filter and antenna are connected. The receiver as well as controller of the UWB radio equipment are

omitted in the Figure A3-3.

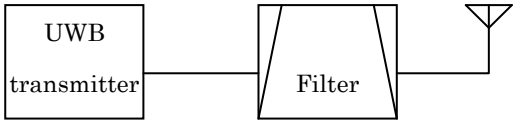


Figure A3-3 A configuration of UWB radio equipment using a filter

The following descriptions are a design example of indirect measurements of unwanted emission intensity of UWB radio equipment, based on the Figure A3-3.

(1) Measurements of characteristics of UWB transmitter equipment

Connect the UWB transmitter to measurement device as shown in FigureA3-4, and measure the unwanted emission intensity of the UWB transmitter equipment by itself in the interference band. The measurement should be conducted as described in 1.2.2 for example, paying enough attention to the noise level of the measurement device.

α [dBm / MHz] is obtained as a measured result.

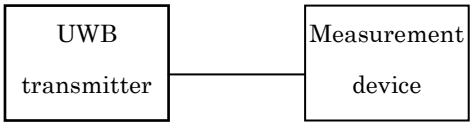


Figure A3-4 A connection example for characteristics measurement of UWB transmitter

(2) Measurement of characteristics of a filter

Connect a filter to a signal source as well as a measurement device as shown in Figure A3-5, and measure the attenuation of the filter by itself at the interference band. In general, filter shows identical linear characteristics irrespective of different input levels. In the measurement, therefore, it is easy to eliminate influences of measurement device's noise, as a signal sufficiently larger than the noise level can be used.

Attenuation Lf [dB] is obtained as a measured result.

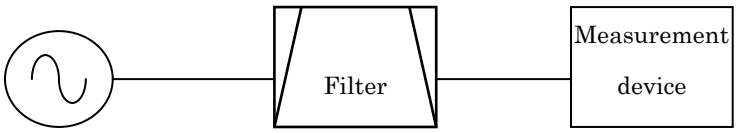


Figure A3-5 A connection example for characteristics measurement of a filter

(3) Measurement of characteristics of an antenna

Connect a signal source and a measured antenna as well as a measurement device and a standard antenna as shown in Figure A3-6 in an environment such as a radio anechoic chamber, and measure the absolute gain of the antenna. The absolute gain of the antenna is likely to be a negative value in most cases because the frequency in the interference band deviates from the frequency used for UWB radio system.

Absolute gain of an antenna Ga [dBi] is obtained as a measured result.

Figure A3-6 A connection example for characteristics measurement of an antenna

(4) Estimates of unwanted emission intensity

It can be estimated that the unwanted emission intensity is

α-Lf+Ga [dBm / MHz e.i.r.p.] .

(5) Design of UWB radio equipment

Based on the unwanted emission intensity estimated by (1) - (4), it is possible to design UWB radio equipment to meet the conditions of Table A3-1.

2 Ban on the use of UWB Radio Equipment for Toys

UWB radio equipment shall not be included in toys. This is because a child may not be able to properly restrict the UWB radio system usage outdoors, in airplane, or at an event site, etc. The terminology of toy is not strictly defined in this Annex, but manufacturers, etc. of UWB radio equipment should properly judge by themselves with due consideration of the intent of this standard.

In this regard, toys which do not permit embedded UWB radio equipment shall include but not be limited to game machines that run without AC mains power supply.

Amendment History

UWB(Ultra-wideband) Radio Systems

ARIB STANDARD

(ARIB STD-T91)

The 1.1th edition amendment history

Page	Para.no	Content of Amendment	Present	Reason
6-7	3.2 (2)	As an interim measure until December 31, 2010, the following condition shall apply: Of radio equipment with use of frequency from 3.4 GHz to 4.8 GHz, those without an interference mitigation function stipulated in 3.4 (2) shall have the average power of -70 dBm or less per 1 MHz bandwidth within the frequency band from 3.4 GHz to 4.2 GHz, and the average power of -41.3 dBm or less per 1 MHz bandwidth within the frequency band from 4.2 GHz to 4.8 GHz. (According to ORE, Supplementary provision (MIC Ordinance No. 105 on August 1, 2006) (Revised by MIC Ordinance No. 98 on August 29, 2008).)	As an interim measure until December 31, ~~2008~~, the following condition shall apply: Of radio equipment with use of frequency from 3.4 GHz to 4.8 GHz, those without an interference mitigation function stipulated in 3.4 (2) shall have the average power of -70 dBm or less per 1 MHz bandwidth within the frequency band from 3.4 GHz to 4.2 GHz, and the average power of -41.3 dBm or less per 1 MHz bandwidth within the frequency band from 4.2 GHz to 4.8 GHz. (According to ORE, Supplementary provision (MIC Ordinance No. 105 on August 1, 2006).)	Change related to low revision
9	3.2 (7) Fig. 3-1	Without an interference mitigation function (until December 31, 2010)	Without an interference mitigation function (until December 31, ~~2008~~)	Change related to low revision
11	3.3 (1) Fig. 3-3	Without an interference	Without an interference	Change

		mitigation function (until December 31, 2010)	mitigation function (until December 31, ~~2008~~)	related to low revision
12	3.3 (2)	As an interim measure until December 31, 2010, the following conditions shall apply: For radio equipment using radio with frequency from 3.4 GHz to 4.8 GHz, those without an interference mitigation function stipulated in 3.4 (2) shall have the limit on secondary emissions, etc. as in the table below. (According to ORE, Supplementary provision (MIC Ordinance No. 105 on August 1, 2006) (Revised by MIC Ordinance No. 98 on August 29, 2008).)	As an interim measure until December 31, ~~2008~~, the following conditions shall apply: For radio equipment using radio with frequency from 3.4 GHz to 4.8 GHz, those without an interference mitigation function stipulated in 3.4 (2) shall have the limit on secondary emissions, etc. as in the table below. (According to ORE, Supplementary provision (MIC Ordinance No. 105 on August 1, 2006)	Change related to low revision
13	3.4 (2)	As an interim measure until December 31, 2010, it is not mandatory to install an interference mitigation function. (According to ORE, Supplementary provision (MIC Ordinance No. 105 on August 1, 2006) (Revised by MIC Ordinance No. 98 on August 29, 2008))	As an interim measure until December 31, ~~2008~~, it is not mandatory to install an interference mitigation function. (According to ORE, Supplementary provision (MIC Ordinance No. 105 on August 1, 2006))	Change related to low revision
15	4	Measurement methods shall be in accordance with MIC Ordinance related with OTRCC, Item 1 (3) in Appendix 1 [1]. Items that are not specified in the MIC Ordinance, however, shall be	Measurement methods shall be in accordance with ~~TELEC-T406 ("Characteristics Test Methods for Radio Equipment Used for Radio Station of Ultra-Wideband~~	Change related to low

		based on conventionally practiced methods. [1] At the release date of ARIB STD-T91 Ver. 1.1 on September 25, 2008, it means MIC Ordinance No. 88 on January 26, 2004. However if the MIC Ordinance and the contents of the MIC Ordinance are revised in near future, measurement methods shall be in accordance with latest versions of the MIC Ordinance and the contents. In addition, TELEC-T406 ("Characteristics Test Methods for Radio Equipment Used for Radio Station of Ultra-Wideband Radio System") what is issued by Telecom Engineering Center (TELEC) Foundation commissioned by the paragraph 2 of MIC Ordinance No. 88 on January 26, 2004, may be referred as the measurement method.	~~Radio System") issued by Telecom Engineering Center (TELEC) Foundation commissioned by the paragraph 2 of MIC Ordinance No. 88 on January 26, 2004. Items that are not specified in the report, however, shall be based on conventionally practiced methods.~~ ~~In case the measurement methods are separately specified by Notification, etc., such Notification shall override the method cited above.~~	revision
17	Annex 1 (3)	As an interim measure until December 31, 2010, the interference mitigation function is not mandatory (According to ORE, Supplementary provision (MIC Ordinance No. 105 on August 1, 2006) (Revised by MIC Ordinance No. 98 on August 29, 2008)).	As an interim measure until December 31, ~~2008~~, the interference mitigation function is not mandatory (According to ORE, Supplementary provision (MIC Ordinance No. 105 on August 1, 2006)).	Change related to low revision

21	Annex 2 4.2	With respect to future new mobile communications systems, etc., and development of domestic radio ordinances, vendors shall refrain from manufacturing, selling and installing UWB radio equipment using the frequency from 3.4 GHz to 4.8 GHz without an interference mitigation function (hereinafter referred to "radio equipment not supporting mitigation") from January 1, 2011 and later.	With respect to future new mobile communications systems, etc., and development of domestic radio ordinances, vendors shall refrain from manufacturing, selling and installing UWB radio equipment using the frequency from 3.4 GHz to 4.8 GHz without an interference mitigation function (hereinafter referred to "radio equipment not supporting mitigation") from January 1, ~~2009~~ and later.	Change related to low revision
21	Annex 2 4.2	As an appropriate measure to limit the number of remaining UWB radio equipment not supporting interference mitigation to below an allowed limit in 2011, the vendors shall cooperate with future mobile communications system operators for an early shift to and replacement with radio equipment supporting interference mitigation.	As an appropriate measure to limit the number of remaining UWB radio equipment not supporting interference mitigation to below an allowed limit in ~~2009~~, the vendors shall cooperate with future mobile communications system operators for an early shift to and replacement with radio equipment supporting interference mitigation.	Change related to low revision

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Communication Note of ARIB Standard-related Proposals, etc.

ARIB Standard Name (No.)	**UWB (Ultra-Wideband) Radio Systems (ARIB STD-T91)**

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ARIB STANDARD

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