ENGLISH TRANSLATION

950MHz-BAND TELEMETER, TELECONTROL AND DATA TRANSMISSION RADIO EQUIPMENT FOR SPECIFIED LOW POWER RADIO STATION

ARIB STANDARD

ARIB STD-T96 Ver. 1.0

Version 1.0 June 6th, 2008

Association of Radio Industries and Businesses (ARIB)

General Notes to the English translation of ARIB Standards and Technical Reports

1. The copyright of this document is ascribed to the Association of Radio Industries and Businesses (ARIB).
2. All rights reserved. No part of this document may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, without the prior written permission of ARIB.
3. The ARIB Standards and ARIB Technical Reports are usually written in Japanese and approved by the ARIB Standard Assembly. This document is a translation into English of the approved document for the purpose of convenience of users. If there are any discrepancies in the content, expressions, etc., between the Japanese original and this translated document, the Japanese original shall prevail.
4. The establishment, revision and abolishment of ARIB Standards and Technical Reports are approved at the ARIB Standard Assembly, which meets several times a year. Approved ARIB Standards and Technical Reports, in their original language, are made publicly available in hard copy, CDs or through web posting, generally in about one month after the date of approval. The original document of this translation may have been further revised and therefore users are encouraged to check the latest version at an appropriate page under the following

   URL:

   http://www.arib.or.jp/english/index.html

Introduction

The Association of Radio Industries and Businesses (ARIB) defines basic technical requirements such as typical specifications for radio equipment relating to various kinds of radio systems as a 'standard' with the participation of radio equipment manufactures, operators, broadcasters and users.

This standard is a private one that is based on two specifications: a technical regulation specified by Japanese government with the purpose of effective use of radio frequencies and avoidance of interference among users, and a private optional standard specified by a private sector with the purpose of improvement of convenience for radio equipment manufactures and users such as appropriate quality of radio equipment, assurance of conformance, and others.

This standard is established principally for '950MHz-band telemeter, telecontrol and data transmission radio equipment for specified low power radio station'. In order to ensure impartiality and openness among all parties involved, during the drafting stages, we invite all of the radio equipment manufactures, telecommunications operators and users both domestically and internationally to participate openly in the activities of the standard assembly so as to develop standards with the consensus of all parties involved.

Radio equipment regulated in this standard uses the frequency of 950-956MHz. In order to avoid the harmful interference given to the same systems in neighboring area, Operational Guidelines for 950MHz-band telemeter, telecontrol and data transmission radio equipment for specified low power radio station is attached as a material for reference.

We hope that the standard will aid all parties involved, including radio equipment manufactures, telecommunications operators, users and others in the development of an excellent radio telecommunication system.

Contents

Chapter 1 General items

1.1 Overview

Among the specified low power radio equipment defined in Article 6 of the Radio Low Enforcement Regulations (Revision by Notification 65 of Ministry of Internal Affairs and Communications), this standard specified the telemeter, telecontrol and data transmission radio equipment that uses the frequency of 954MHz – 955MHz specified in Article 49, Clause 14-6 of Radio Equipment Regulations or uses the frequency of 950MHz – 956MHz specified in Article 49, Clause 14-7 of Radio Equipment Regulations.

1.2 Scope of application

The telemeter, telecontrol and data transmission radio equipment consists of radio equipment, data processing equipment and power supply equipment as shown in fig. 1.1. This standard specifies the technical requirements of the radio equipment.

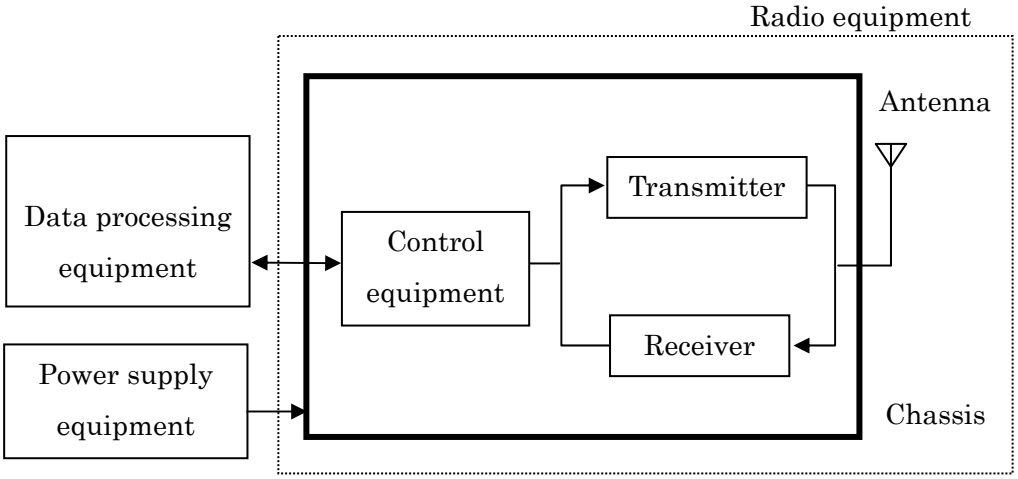


Fig. 1.1 Structure of telemeter, telecontrol and data transmission radio equipment

1.3 Definitions of terminology

In this standard, 'RL' refers to the Radio Law, 'RLE' refers to the Radio Law Enforcement Regulations, 'RE' refers to the Radio Equipment Regulations, 'TC' refers to the Regulations of radio equipment regarding to the certification of conformity with technical standards and 'MN'

refers to a Notification of the Ministry of Posts and Telecommunications until 2000 or a Notification of the Ministry of Internal Affairs and Communications after 2001.

Chapter 2 Overview of the standard system

2.1 Standard system

Standard systems are categorized into a short range communication system and an active tag system. In the following section these systems are described respectively.

(1) Structure of the standard system

a) Short range communication system

The standard system of a short range communication system consists of plural radio stations as shown in fig. 2.1.

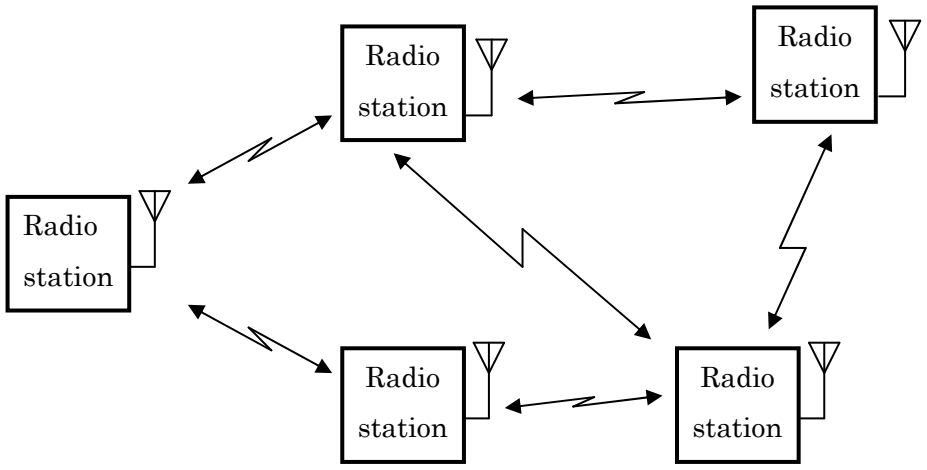


Fig. 2.1 Structure of a standard short range communication system

In this system, radio stations are connected each other and construct a network. In this network, both of pier to pier communication and broadcast communication are possible. Besides, not only direct transmission but also multi hop transmission is possible.

b) Active tag system

The standard system of an active tag system consists of a reader/writer and plural active tags as shown in fig. 2.2.

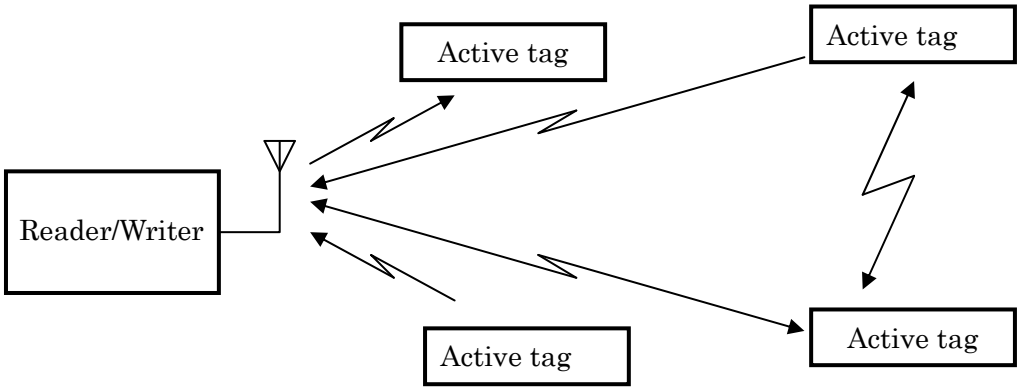


Fig. 2.2 Structure of a standard active tag system

In this system, one way or two way transmission between an active tag and a reader/writer or between active tags in arbitrary timing is possible.

(2) Operation of the standard system

a) Short range communication system

Short range communication system is a low power and a low rate wireless PAN (Personal Area Network) system with the purpose of low power consumption and low cost implementation such as IEEE802.15.4 which is an existing standard in USA. ZigBee, which is a trade mark of ZigBee Alliance inc., is well known as an example of the low rate wireless PAN system using IEEE802.15.4.

It is supposed to be used for home security, safety and security of children and elder people, personal healthcare, home and building control, factory automation and monitoring, hospital management, auto meter reading and outdoor monitoring on the network consisting of wireless sensor nodes and/or wireless actuator nodes which control various kinds of equipments

b) Active tag system

Active tag system is a system that is able to emit a radio signal autonomously by using energy stored within itself such as battery. In comparison with passive tag system whose reader/writer needs large output power to activate a tag, active tag system can reduce the output power and extend the communication area to the wide range.

Most of the existing active tag systems in Japan use 300MHz band (Specified low power radio station or extremely low power radio station), 400MHz band (Specified low power radio station) and 2.4GHz band. 433MHz band is just opened only for international transportation.

Currently most of the existing active tag system is used to transmit a tag ID from an active tag. However, advanced functionalities such as tags with sensor, localization, bi-directional communication, as well as rewriting the information to tag are developing. It is supposed to be used for security support of children on their way, security support in shopping mall, admission control to dangerous area, asset management, management of vehicle and parking area and process control.

There are passive tag systems in 950MHz band. In these systems responder (tag) can not emit radio signal autonomously and transmit a response signal by using only power of carrier signal received from interrogator. These systems are out of scope of this standard. These kind of passive tag systems are specified in ARIB STD-T89 and ARIB STD-T90.

2.2 Key parameters and functionality of the standard system

Key parameters and functionality of the standard system are shown in table 2.1.

Table 2.1 Key parameters and functionality of the standard system

Item		Parameters and functionality
Frequency band		950MHz - 956MHz
Output power		1mW 10mW (only for 954MHz – 955MHz)
Transmission method	Contents	Data signal
	Modulation system	Not specified
Antenna gain		3dB or less (absolute gain) However, in case EIRP is less than the value of 3 dB added by 1mW or by 10mW of antenna power, it is allowed to compensate the difference by the antenna gain.

Chapter 3 Technical requirements for radio equipment

3.1 General conditions

(1) Communication method

One-way method, simplex method, duplex method, semi-duplex method or broadcast

(2) Contents of communications

Primarily the signals for telemeter, telecontrol and data transmission system.

(3) Modulation system

Not specified.

(4) Operating frequency band

950MHz - 956MHz

(RLE: article 6-4)

(Ministerial ordinance for MIC No.65, 2008)

(5) Usage environment condition

Not specified.

3.2 Transmitter

(1) Antenna power (RLE: article 6, MN: No.42, 1988)

(Revised MN: No.320, 2008)

It shall be 1mW or less. Exceptionally, it is allowed to be 10mW or less for radio channels consisting of only unit radio channel which center frequencies are from 954.2MHz to 954.8MHz.

(2) Tolerance of antenna power

+20%, -80% (RE: article 14)

(Ministerial ordinance for MIC No.66, 2008)

(3) Radio channel (RE: article 49-14)

(Ministerial ordinance for MIC No.66, 2008)

Radio channel shall consist of up to 3 consecutive unit radio channels which are defined that their center frequencies are located from 951.0MHz to 955.6MHz with 200kHz

separation and their bandwidth are 200kHz.

The center frequencies of radio channels are shown through Table 3.1 to table 3.6.

a) In the case of antenna power is 1mW or less

i) The case of using one unit radio channel

Table 3.1 Center frequency of radio channel using one unit radio channel (Antenna power: 1mW or less)

Unit radio channel number	Center frequency (MHz)	Unit radio channel number	Center frequency (MHz)
1	951.0	13	953.4
2	951.2	14	953.6
3	951.4	15	953.8
4	951.6	16	954.0
5	951.8	17	954.2
6	952.0	18	954.4
7	952.2	19	954.6
8	952.4	20	954.8
9	952.6	21	955.0
10	952.8	22	955.2
11	953.0	23	955.4
12	953.2	24	955.6

ii) The case of using two unit radio channels

Table 3.2 Center frequency of radio channel using two unit radio channels (Antenna power: 1mW or less)

Unit radio channel number	Center frequency (MHz)	Unit radio channel number	Center frequency (MHz)
1,2	951.1	13,14	953.5
2,3	951.3	14,15	953.7
3,4	951.5	15,16	953.9
4,5	951.7	16,17	954.1
5,6	951.9	17,18	954.3
6,7	952.1	18,19	954.5
7,8	952.3	19,20	954.7
8,9	952.5	20,21	954.9
9,10	952.7	21,22	955.1
10,11	952.9	22,23	955.3
11,12	953.1	23,24	955.5
12,13	953.3		

iii) The case of using three unit radio channels

Table 3.3 Center frequency of radio channel using three unit radio channels (Antenna power: 1mW or less)

Unit radio channel number	Center frequency (MHz)	Unit radio channel number	Center frequency (MHz)
1,2,3	951.2	12,13,14	953.4
2,3,4	951.4	13,14,15	953.6
3,4,5	951.6	14,15,16	953.8
4,5,6	951.8	15,16,17	954.0
5,6,7	952.0	16,17,18	954.2
6,7,8	952.2	17,18,19	954.4
7,8,9	952.4	18,19,20	954.6
8,9,10	952.6	19,20,21	954.8
9,10,11	952.8	20,21,22	955.0
10,11,12	953.0	21,22,23	955.2
11,12,13	953.2	22,23,24	955.4

b) In the case of antenna power is 10mW or less

i) The case of using one unit radio channel

Table 3.4 Center frequency of radio channel using one unit radio channel (antenna power: more than 1mW and less than or equal to 10mW)

Unit radio channel number	Center frequency (MHz)	Unit radio channel number	Center frequency (MHz)
17	954.2	19	954.6
18	954.4	20	954.8

ii) The case of using two unit radio channels

Table 3.5 Center frequency of radio channel using two radio channels (Antenna power: more than 1mW and less than or equal to 10mW)

Unit radio channel number	Center frequency (MHz)	Unit radio channel number	Center frequency (MHz)
17,18	954.3	19,20	954.7
18,19	954.5		

iii) The case of using three unit radio channels

Table 3.6 Center frequency of radio channel using three unit radio channels (Antenna power: more than 1mW and less than or equal to 10mW)

Unit radio channel number	Center frequency (MHz)	Unit radio channel number	Center frequency (MHz)
17,18,19	954.4	18,19,20	954.6

(4) Frequency tolerance (RE: attached table No.1)
(MN: No.50, 1988)
(Revised MN: No.323, 2008)

It shall be within 20 x 10^{-6}.

(5) Modulation method

It shall not be specified.

(6) Occupied frequency bandwidth

(RE: attached table No.2)
(MN: No.659, 2006)
(Revised MN: No.324, 2008)

It shall be (200 x n) kHz or less. (n is a number of unit radio channels constituting the radio channel and is an integer from 1 to 3.)

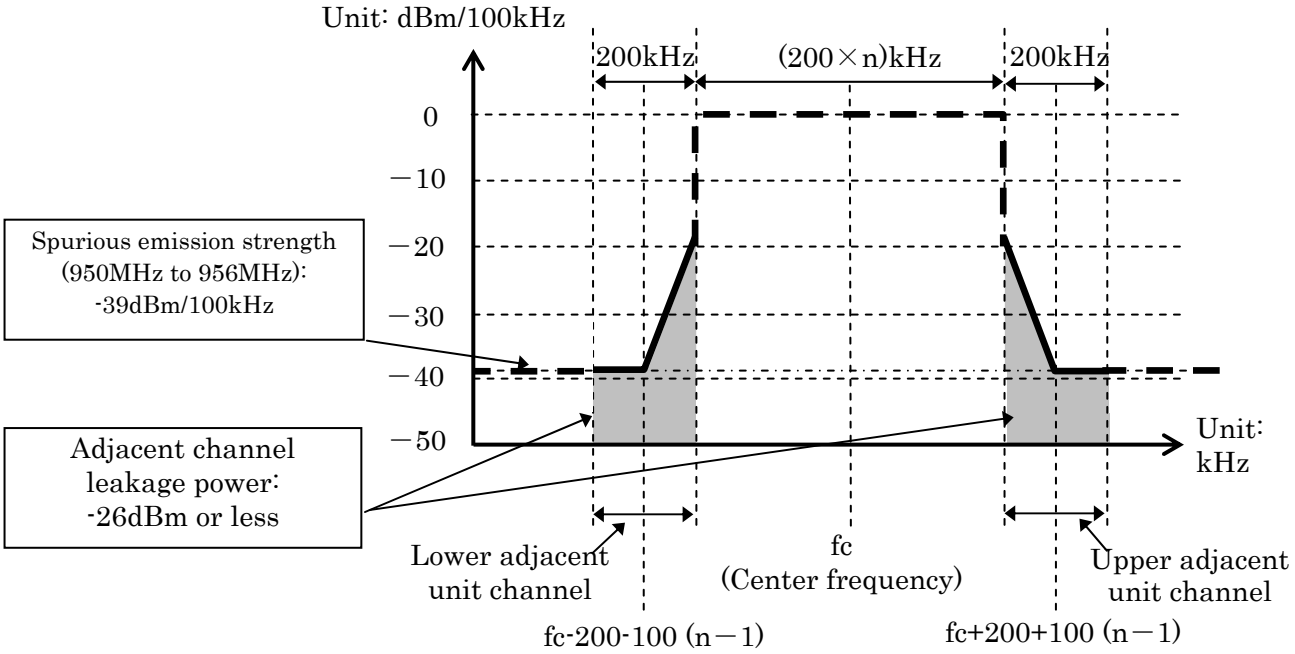
(7) Adjacent channel leakage power (RE: article 49-14)

(Ministerial ordinance for MIC No.66, 2008)

a) Frequency band of signal in use is within more than 950MHz and less than 956MHz. (Antenna power is 1mW or less.)

i) Spectral power at the edge of a radio channel: It shall be -20dBm or less.

ii) Leakage power in unit radio channel adjacent to a radio channel: It shall be -26dBm or less.



(Note: Center frequency is one of frequencies shown in Table 3.1 to Table 3.3 of (3). Radio channel and n is the number of unit radio channels constructing a radio channel.)

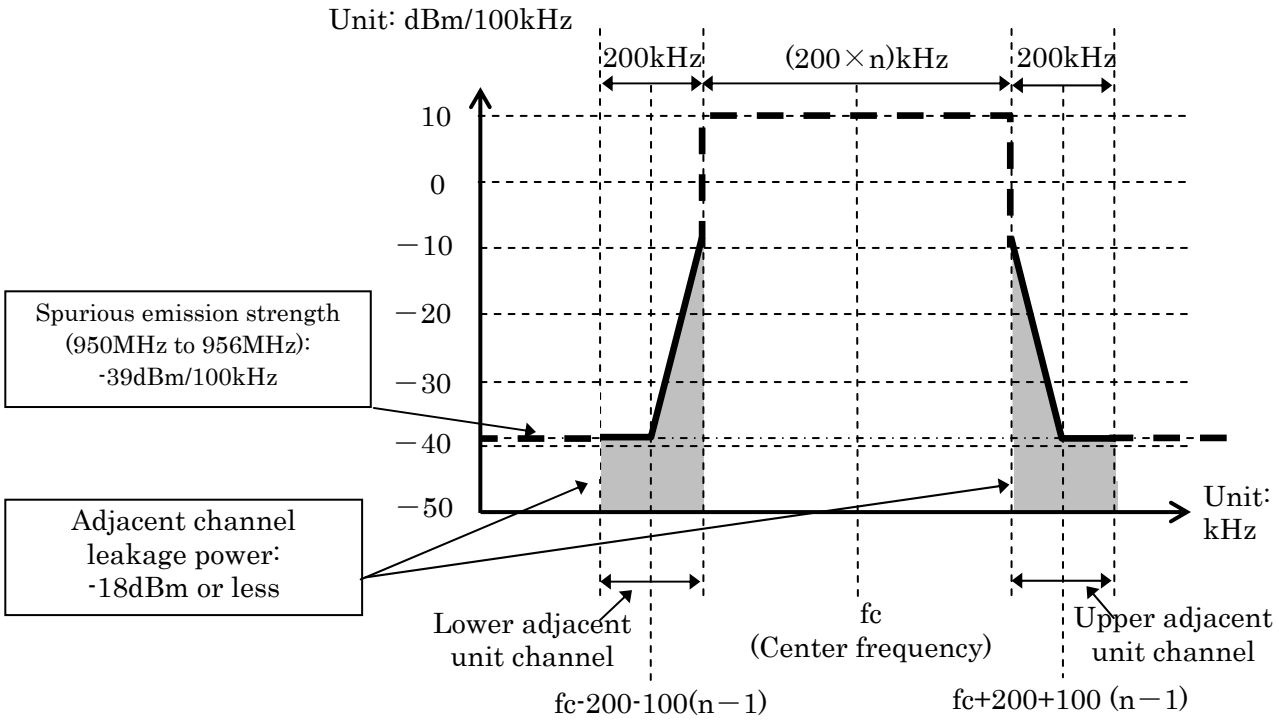
Fig. 3.1 Channel mask of a radio channel whose frequency is more than 950MHz and less than 956MHz. (Antenna power is 1mW or less)

b) Frequency band of signal in use is within more than 954 MHz and less than 955 MHz. (Antenna power is 10mW or less.)

i) Spectral power at the edge of a radio channel: It shall be -10dBm or less.

ii) Leakage power in unit radio channel adjacent to a radio channel: It shall be -18dBm or less.

iii) It is desirable to comply with the conditions i) and ii) described in a) in consideration of interference to the adjacent channels when antenna power is 1mW or less.



(Note: Center frequency is one of frequencies shown in Table 3.4 to Table 3.6 of (3) Radio channel and n is a number of unit radio channels constructing a radio channel.)

Fig. 3.2 Channel mask of a radio channel whose frequency is more than 954MHz and less than 955MHz. (Antenna power is 10mW or less)

(8) Spurious emission strength (RE: article 7)

(Attached table No.3-25)

(Ministerial ordinance for MIC No.66, 2008)

Spurious emission strength at the antenna input shall be less than the value in table 3.7.

Table 3.7 Spurious emission strength (at antenna input)

Frequency band	Spurious emission strength (average power)	Reference bandwidth
f <= 1000MHz (except for 710MHz < f <= 960MHz)	−36dBm	100kHz
710MHz < f <= 945MHz	−55dBm	1MHz
945MHz < f <= 950MHz	−55dBm	100kHz
950MHz < f <= 956MHz (except for |f-fc|<= 200+100x(n-1)kHz)	−39dBm	100kHz
956MHz < f <= 958MHz	−55dBm	100kHz
958MHz < f <= 960MHz	−58dBm	100kHz
1000MHz < f (except for 1884.5MHz < f <= 1919.6MHz)	−30dBm	1MHz
1884.5MHz < f <= 1919.6MHz	−55dBm	1MHz

3.3 Receiver

Conducted spurious component at receiver (RE: article 24-15)

(Ministerial ordinance for MIC No.66, 2008)

Conducted spurious component shall be less than the value in table 3.8

Table 3.8 Conducted spurious component at receiver

Frequency band	Conducted spurious component (antenna input)	Reference bandwidth
f <= 1000MHz (except for 710MHz < f <= 960MHz)	−54dBm	100kHz
710MHz < f <= 945MHz	−55dBm	1MHz
945MHz < f <= 950MHz	−55dBm	100kHz
950MHz < f <= 956MHz	−54dBm	100kHz
956MHz < f <= 958MHz	−55dBm	100kHz
958MHz < f <= 960MHz	−58dBm	100kHz
1000MHz < f (except for 1884.5MHz < f <= 1919.6MHz)	−47dBm	1MHz
1884.5MHz < f <= 1919.6MHz	−55dBm	1MHz

3.4 Controller

Controller shall have the functions that comply with the conditions specified in this section described below.

(1) Sending control (RE: article 49, MN: No.49, 1988)

(Revised MN: No.322, 2008)

a) In the case of the 10ms or more carrier sense is required:

Radio equipment shall stop its emission of radio signal within 1s after it starts to emit. It shall wait 100ms or more for the consecutive emission. However, it may emit again without waiting 100ms, if it is within 1s after its first emission and the emission is finished within this 1s interval.

b) In the case of the 128μs or more carrier sense time is required:

Radio equipment shall stop its emission of radio signal within 100ms after it starts to emit. It shall wait 100ms or more for the consecutive emission. The amount of sending times summed for one hour shall be 360s or less. However, it may emit again without waiting 100ms, if it is within 100ms after its first emission and the emission is finished

within this 100ms interval.

c) In the case of non carrier sense is required:

Radio equipment shall stop its emission of radio signal within 100ms after it starts to emit. It shall wait 100ms or more for the consecutive emission. The amount of sending times summed for one hour shall be 3.6s or less. However, it may emit again without waiting 100ms, if it is within 100ms after its first emission and the emission is finished within this 100ms interval.

(2) Carrier sense (RE: article 49, MN: No.49, 1988)
(Revised MN: No.322, 2008)

a) Radio equipment shall check if the interference exists by the career sense procedure before its new transmission.
b) Carrier sense time shall be 128μs or more when the antenna power is 1mW or less and 10ms or more when the antenna power is more than 1mW.
c) Carrier sense level that is amount of received power at all of unit radio channels included in the radio channel to emit shall be -75dBm at the antenna input. When the carrier sense level is not less than -75dBm, radio equipment shall not transmit any radio signal.
d) Carrier sense is not necessary if the antenna power is 1mW or less and the conditions of 3.4 (1) c) are satisfied

Table 3.9 shows possible combinations of sending control parameters and carrier sense time.

Table 3.9 Possible combinations of sending control parameters and carrier sense time

Antenna power	Carrier sense time	Sending duration	Pause duration	The amount of sending time summed for 1 hour
1mW or less	10ms or more	1s or less(Note1)	100ms or more	Don't care
	128μs or more	100ms or less(Note2)	100ms or more	360s or less
	0	100ms or less(Note2)	100ms or more	3.6s or less
more than 1mW and less than or equal to 10mW	10ms or more	1s or less(Note1)	100ms or more	Don't care

(Note1) It may emit again without waiting 100ms, if it is within 1s after its first emission and the emission is finished within this 1s interval.
(Note2) It may emit again without waiting 100ms, if it is within 100ms after its first emission and the emission is finished within this 100 ms interval.

(2) Interference protection

The radio equipment shall automatically transmit/receive identification codes.

3.5 Chassis

(RE: article 49-14)
(Ministerial ordinance for MIC No.66, 2008)

It shall be structured not to be opened easily.

3.6 Connection to telecommunication carrier's facilities

Radio equipment shall satisfy the following conditions.

(1) It shall have identification code which shall be 48 bits length or more.
(2) Except for particular case which is defined outside of the specification, it shall make decision if channel is used or not before using that channel. Only if that decision is "channel is not used", it can set a communication path on its channel.

3.7 Antenna

(RE: article 49-14)
(Ministerial ordinance for MIC No.66, 2008)

Antenna gain	3dB or less (absolute gain) However, in case EIRP is less than the value 3 dB added by the maximum antenna power defined in 3.2 (1), it is allowed to compensate the difference by the antenna gain.

Chapter 4 Measurement methods

TELEC-T245, which is established based on Notification No. 88-2 of MIC by Telecom Engineering Center, shall be applied. If the other method is specified by Notification of MIC or others, it shall be also applied.

Reference: Operational Guidelines for 950MHz-band telemeter, telecontrol and data transmission radio equipment for specified low power radio station

1. Overview

1.1 Purpose

The purpose of this operational guideline is to avoid the harmful interferences to other neighboring systems or other specified low power radio stations and to achieve the efficient usage of radio and to provide the user convenience when operating 950MHz-band telemeter, telecontrol and data transmission radio equipment for specified low power radio station (call it 'specified low power radio station' below)

1.2 Scope of application

This operational guideline is applied to user and agency of manufacture and distributer, constructor, operator and agency of maintenance of specified low power radio station.

1.3 Target system

The target system of this operational guideline is following.

(1) 950MHz-band telemeter, telecontrol and data transmission radio equipment for specified low power radio station: ARIB STD-T96

2. Avoiding interference

It is desirable that the radio station specified in this standard does not use channel 7, 8, 9, 10, 11, 12, 13, 14 and 15 in consideration of the interference received from the premises radio station specified by STD-T89.

If channel 8 or channel 14 is used by premises radio station employing sub-carrier method, it is desirable that the radio station specified in this standard does not use channel 7 and 9 or channel 13 and 15 as much as possible in consideration of the interference given to the premises radio station because these channels are used by very weak response signals of the passive tag.

Appendix table 1 shows the channel plan of "950MHz-band RFID equipment for premises radio station", "950MHz-band RFID radio equipment for specified low power radio station" and "950MHz-band telemeter, telecontrol and data transmission radio equipment for specified low power radio station".

Appendix table 1 Channel plan of "950MHz-band RFID equipment for premises radio station", "950MHz-band RFID radio equipment for specified low power radio station" and "950MHz-band telemeter, telecontrol and data transmission radio equipment for specified low power radio station"

Center frequency (MHz)	Ch No.	950MHz-band RFID equipment for premises radio station	950MHz-band RFID radio equipment for specified low power radio station	950MHz-band telemeter, telecontrol and data transmission radio equipment for specified low power radio station	
				10mW active	1mW active
951.0	1				X
951.2	2				X
951.4	3				X
951.6	4				X
951.8	5				X
952.0	6				X
952.2	7	A	X		X
952.4	8	A, B	X		X
952.6	9	A	X		X
952.8	10	A	X		X
953.0	11	A	X		X
953.2	12	A	X		X
953.4	13	A	X		X
953.6	14	A, B	X		X
953.8	15	A	X		X
954.0	16		X		X
954.2	17		X	X	X
954.4	18		X	X	X
954.6	19		X	X	X
954.8	20		X	X	X
955.0	21				X
955.2	22				X
955.4	23				X
955.6	24				X

Note: 'x' means that channel is available.

'A' means that channel is available for interrogator that uses transmission control and carrier sense.

'B' means that channel is available for interrogator that does not use transmission control and/or carrier sense.

3. Influence to medical equipments

To avoid the influence to medical equipments, it is desirable to act properly according to the guideline of action described in "Study Report on the Effect of Radio Waves on Medical

Devices”(Note1).

(Note1): When issuing version 1.0 of this standard (6th June, 2008), it indicates the report issued by MIC on March, 2004. However, when it is revised, it indicates the latest version.

4. Protection of privacy

For protection of privacy, it is desirable to act properly according to “Guidelines for Privacy Protection with Regard to RFID Tags”(Note2).

(Note2): When issuing version 1.0 of this standard (6th June, 2008), it indicates the guideline issued by MIC and METI on 8th June, 2004. However, when it is revised, it indicates the latest version.

950MHz-BAND TELEMETER, TELECONTROL
AND DATA TRANSMISSION RADIO EQUIPMENT
FOR SPECIFIED LOW POWER RADIO STATION

ARIB STANDARD

ARIB STD-T96 Version 1.0

Version 1.0 June 26th 2008

Published by

Association of Radio Industries and Businesses

11F, Nittochi Building,
1-4-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-0013,Japan

TEL 03-5510-8590
FAX 03-3592-1103

Printed in Japan