OKI

*Oki, Network Solutions
for a Global Society*

OKI Semiconductor

MK70110/MK70120

PEDLMK70-02
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Preliminary

Bluetooth™ Module

GENERAL DESCRIPTION

The MK70110 and MK70120 are Bluetooth modules that operate in the 2.4 GHz band. Mounted on the board of each of these modules are Bluetooth baseband & RF transceiver IC, RF filter, flash memory, and TCXO. Lower protocol stacks up to the HCI are already installed in these modules as software. These modules can be connected to user's board product by using the connector the modules have. Since the modules are provided not only with the UART and USB interfaces as communication control interfaces but with a PCM interface as a voice control interface, they can cope with any application for data and voice communication.

The MK70110 is equipped with an RF coaxial connector, and the MK70120 has a chip antenna built-in.

By utilizing the MK70110/MK70120, the development TAT for products equipped with Bluetooth can be shortened very effectively.

FEATURES

- Conforms to the Bluetooth Specification Version 1.1
- Optimized design where originally developed LSI chips and authorized Oki software are used
- HCI full module includes Bluetooth baseband IC & RF transceiver IC, flash memory and TCXO
- RF output power: Class 2
- RF I/O: MK70110: RF coaxial connector / MK70120: Internal chip antenna
- Interfaces provided
  UART interface* (up to 921.6 kbps)
  USB interface* (USB1.1-conformed)
  PCM interface (selectable between PCM Linear/A-law/μ-law)
  * Supports HCI commands.

BLOCK DIAGRAM
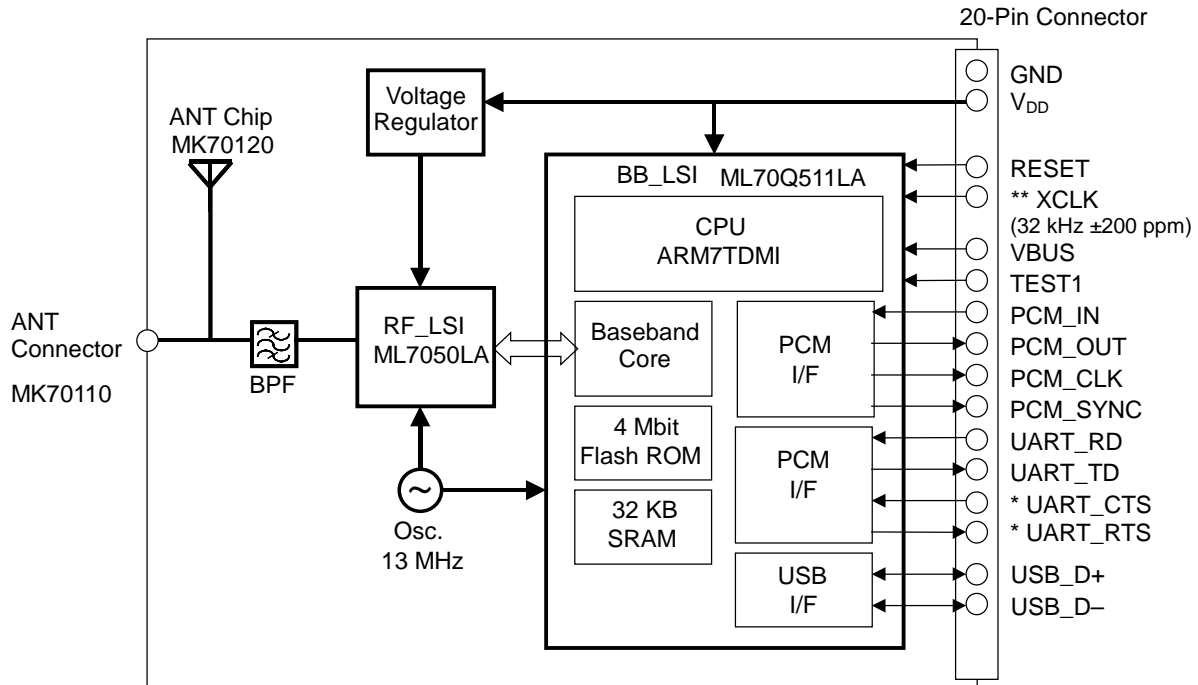
Note: * indicates that the pin will be supported later.
** XCLK is optional

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Condition	Rating	Unit
Power supply voltage	V_{DD}	Ta = 25°C	−0.3 to 4.5	V
Input voltage	V_{IN}	Ta = 25°C	−0.3 to 4.5	V
Input RF power	—	Ta = 25°C	20	dBm
Storage temperature	T_{stg}	—	−20 to +70	°C

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RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Power supply voltage	V_{DD}	—	3.2	—	3.45	V
"H" level input voltage	V_{ih}	—	2.2	—	3.6	V
"L" level input voltage	V_{il}	—	0	—	0.8	V
Operating temperature	T_{OP}	—	0	25	50	°C

ELECTRICAL CHARACTERISTICS

Specifications in this section are fulfilled under the conditions that V_{DD} = 3.3 V ±0.1 V, Ta = 0 to 50°C. Values of the RF characteristics represent those specified at the edge of the module for both the MK70110 and the MK70120.

General Specifications

Items	Specification	Note
Conformance Specifications	Bluetooth Specification Version 1.1	—
Power Class	Class 2	—
Frequency range	2,402 to 2,480 MHz	—
Number of channels	79ch	—
Channel separation	1 MHz	—
Modulation method	GFSK	—
RF input-output impedance	Nominal 50 Ω	2,402 to 2,480 MHz
Symbol Rate	1 Mbps	—

DC Characteristics

Output voltage (Applies to digital pins except USB ports)

Parameter	Symbol	Min.	Typ.	Max.	Unit
"H" level output voltage	V_{oh}	2.4	—	—	V
"L" level output voltage	V_{ol}	—	—	0.4	V

Output voltage (Applies to USB ports (USB_D+, USB_D–))

Parameter	Symbol	Min.	Typ.	Max.	Unit
"H" level output voltage	V_{oh}	2.8	—	3.6	V
"L" level output voltage	V_{ol}	—	—	0.3	V

Power consumption (UART interface, with 32 kHz XCLK)

Mode	Typ.	Max.	Unit
Initialize (Stop mode)	10	—	mA
Idle (Cold standby)	6	—	mA
Hold mode (Slave)	40	—	mA
Sniff mode (Slave)	40	—	mA
ACL connection DH1	103	125	mA
SCO connection HV1	113	135	mA

RF Transmission Characteristics

Parameter	Min.	Max.	Unit	Remarks
Output power	−6	+4	dBm	
Frequency deviation	−50	+50	kHz	
Frequency drift				
DH1	−25	+25	kHz	
DH3, DH5	−40	+40	kHz	
Frequency shift				
$\Delta f1_{avg}$: payload = 11110000	140	175	kHz	
$\Delta f2_{max}$: payload = 1010…	115	—	kHz	
$\Delta f2_{avg}/\Delta f1_{avg}$	80	—	%	
20 dB band width	—	1	MHz	
In-band spurious emission				Measured by peak detection
Freq. offset = ±2 MHz	—	−20	dBm	
Freq. offset ≥ ±3 MHz	—	−40	dBm	
Out-of-band spurious emission				
30 MHz ≤ f < 1GHz	—	−36	dBm	
1 GHz ≤ f ≤ 12.75 GHz	—	−30	dBm	
1.8 GHz ≤ f ≤ 1.9 GHz	—	−47	dBm	
5.15 GHz ≤ f ≤ 5.30 GHz	—	−47	dBm	

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Reception Characteristics

Parameter	Min.	Max.	Unit	Remarks
Reception sensitivity	—	0.1	%	at –70 dBm input
C/I characteristics				Specification at ordinary temperature
Co-channel	—	14	dB	(Bluetooth Ver.1.1 Test Specification)
Adjacent channel C/I = 1 MHz	—	4	dB	
Adjacent channel C/I = 2 MHz	—	–30[*1]	dB	
Adjacent channel C/I $\geq$ 3 MHz	—	–40[*1]	dB	
Image frequency[*2]	—	–6	dB	
Image frequency ±1 MHz[*2]	—	–16	dB	
Out-of-band blocking				Specification at ordinary temperature
30 MHz $\leq$ f < 2,000 MHz	–10	—	dBm	
2,000 MHz $\leq$ f $\leq$ 2,399 MHz	–27	—	dBm	
2,498 MHz $\leq$ f < 3,000 MHz	–27	—	dBm	
3,000 MHz $\leq$ f $\leq$ 12.75 GHz	–10	—	dBm	
Intermodulation characteristic	–25	—	dB	Specification at ordinary temperature
Maximum input level	—	0.1	%	Specification at ordinary temperature, at –20 dBm input
Limit of collateral radio waves				Spurious emission during inquiry scan operation
30 MHz $\leq$ f < 1 GHz	—	–57	dBm	
1 GHz $\leq$ f $\leq$ 12.75 GHz	—	–47	dBm	

*1 Relaxed C/I specification
    On five spurious response frequencies with a distance of $\geq$ 2 MHz from the wanted signal (except for image frequency and image ±1 MHz), a relaxed interference requirement C/I = –17 dB is applied. (According to Bluetooth Specification 1.1, Part A Radio Specification)

*2 Image Frequencies and adjacent interference to image
    Image frequency = Co-channel –4 MHz
    ±1 MHz adjacent interference to image frequency = Co-channel –3 MHz, Co-channel –5 MHz

MECHANICAL CHARACTERISTICS

Weight Specifications

Model Name	Weight
MK70120 (antenna built-in type)	3.6 g (Max.)
MK70110 (RF coaxial connector type)	3.5 g (Max.)

RF I/O Pin Specifications

The following chip antenna and RF coaxial connector are mounted:

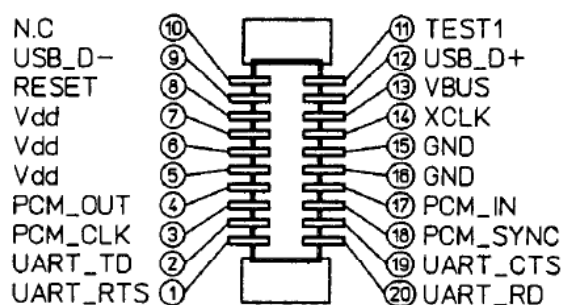| Model Name	RF I/O Type	Manufacturer / Model Name
MK70120	Chip antenna	MURATA MFG. / ANCM12G45
MK70110	RF coaxial connector	HIROSE ELECTRIC / U.FL-R-SMT

Connector Specifications

The following board-to-board connector is mounted:

Interface Type	Manufacturer / Series Name
Board-to-board connector	Matsushita Electric Works / AXK6F20345

A header is mounted on the module side.
It is therefore recommended that a 2.0 mm high socket (AXK5F20545) be used against the socket insertion side of the connector.

Board-to-board Connector Detail

```
N.C        ⑩        ⑪ TEST1
USB_D-     ⑨        ⑫ USB_D+
RESET      ⑧        ⑬ VBUS
Vdd        ⑦        ⑭ XCLK
Vdd        ⑥        ⑮ GND
Vdd        ⑤        ⑯ GND
PCM_OUT    ④        ⑰ PCM_IN
PCM_CLK    ③        ⑱ PCM_SYNC
UART_TD    ②        ⑲ UART_CTS
UART_RTS   ①        ⑳ UART_RD
```

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CONNECTOR PIN DESCRIPTIONS

Pin	Symbol	Type	Description	If Not Used
5, 6, 7	V_{DD}	—	Power supply pin[*1]	—
15, 16	GND	—	Ground pin	—
1	UART_RTS	O	UART Ready To Send (transmission data ready)[*2]	Pull_up or V_{DD}
19	UART_CTS	I	UART Clear To Send (transmission ready)[*2]	Pull_down or GND
2	UART_TD	O	UART transmission data	Pull_up or V_{DD}
20	UART_RD	I	UART receive data	Pull_up or V_{DD}
12	USB_D+	I/O	USB Data +	Open
9	USB_D–	I/O	USB Data –	Open
13	VBUS	I	HCI transport selection pin 　H: USB is used as HCI 　L: UART is used as HCI adhering to the above logic at power-on	—
4	PCM_OUT	O	PCM data output	Open
17	PCM_IN	I	PCM data input[*5]	Open
3	PCM_CLK	O	PCM clock output (64 kHz/128 kHz)[*5]	Open
18	PCM_SYNC	O	PCM synchronous signal input (8 kHz)[*5]	Open
8	RESET[*6]	I	Reset signal input pin Reset = L Effective reset pulse width > 10 µsec	Pull_up
14	XCLK	I	Subclock input pin 32 kHz[*3]	GND
11	TEST1	I	Test pin for our company's use[*4]	Open
10	N.C	—	N.C.	Open

*1 Mount an approximately 10 µF tantalum or electrolytic capacitor to the power supply input pin.
　 The capacitor should be mounted as close to the power supply pin of the module as possible.
*2 At present, this pin is not supported. Must be left open.
*3 At present, this pin does not support a 32 kHz sub-clock. Connect to GND.
*4 Test pin for our company's use. Must be left open.
*5 The PCM_IN, CLK, and SYNC pins are pulled-down internally.
*6 Setting the reset signal input pin RESET to a "L" level can reset the LSI. The reset state of the LSI is
　 held for a duration of 10 msec even after the reset signal is switched to a "H" level.

INTERFACE SPECIFICATIONS

USB Interface

- Conforms to USB1.1
- Supports 12 Mbps

Parameter	Symbol	Condition [1], [2], [3]	Min.	Typ.	Max.	Unit
Rise time	TR	C_L = 50 pF	4	—	20	ns
Fall time	TF	C_L = 50 pF	4	—	20	ns
Output signal crossover voltage	VCRS	C_L = 50 pF	1.3	—	2	V
Driver output resistance	ZDRV	When being driven in a steady state	28	—	44	Ω
Data rate	TDRATE	Average bit rate (12 Mbps ±0.25%)	11.97	—	12.03	Mbps

[1]   TR and TF are the intervals of the transition time from 10% to 90% (TR) or from 90% to 10% (TF) of an amplitude.

[2]   Input signal crossover point (When USB connector is not attached)
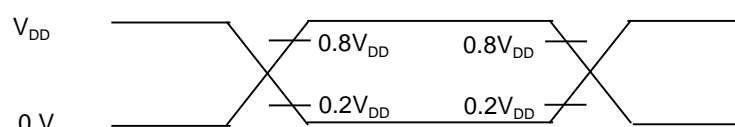
UART Interface

Various settings can be made for the UART interface by using the Vendor specific command (refer to the ML70110/MK70120 User's Manual).
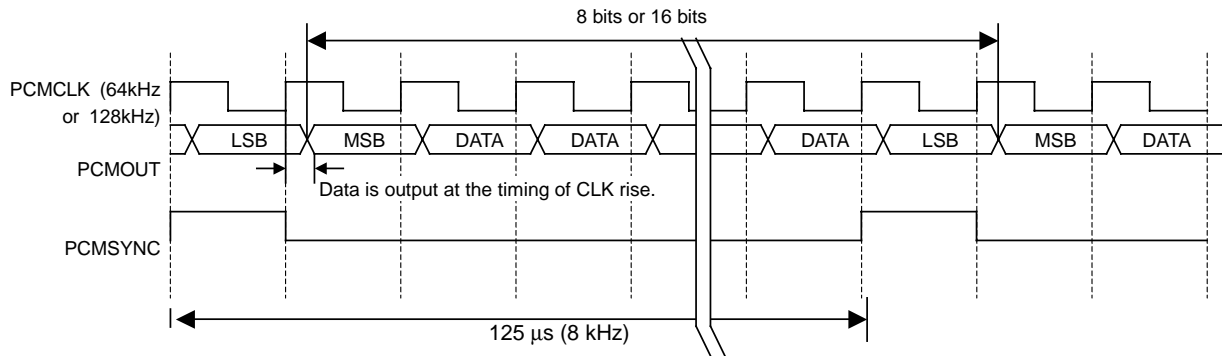The default values are as follows:

- Baud rate: 115.2 kbps
- Parity: Non-parity
- Data length: 8 bits
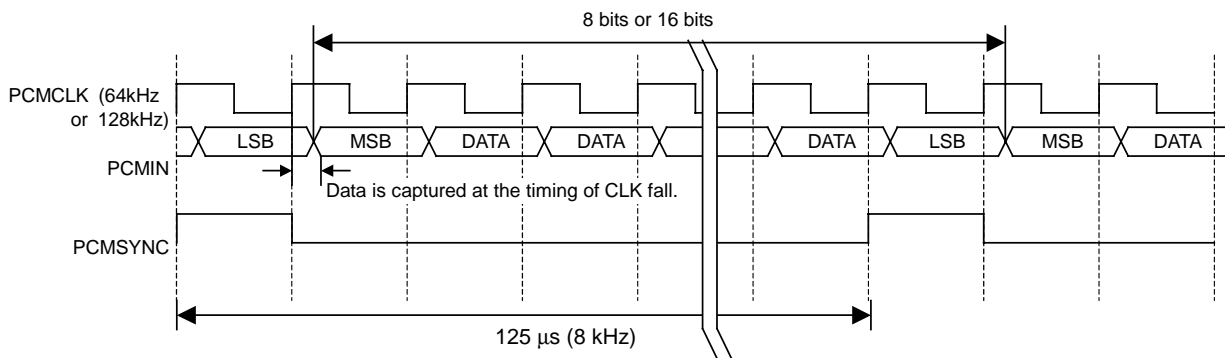- Stop bit: 1 bit
- Flow control: off

PCM Interface

- Application format
  PCM linear (8, 16 bits/sample, 64 kHz sampling frequency)/A-law/μ-law
- Bluetooth format
  CVSD/A-law/μ-law

8 bits or 16 bits

PCMCLK (64kHz
or 128kHz)

LSB | MSB | DATA | DATA | DATA | LSB | MSB | DATA

PCMOUT

Data is output at the timing of CLK rise.

PCMSYNC

125 μs (8 kHz)

PCM Output Timing

8 bits or 16 bits

PCMCLK (64kHz
or 128kHz)

LSB | MSB | DATA | DATA | DATA | LSB | MSB | DATA

PCMIN

Data is captured at the timing of CLK fall.

PCMSYNC

125 μs (8 kHz)

PCM Input Timing

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PCM Timing Specifications

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
PCMIN setup time to PCMCLK (input) fall	t_{PC0}		500	—	—	
PCMIN hold time to PCMCLK (input) fall	t_{PC1}		500	—	—	
PCMOUT setup time to PCMCLK (input) rise	t_{PC2}		500	—	—	
PCMOUT hold time to PCMCLK (input) rise	t_{PC3}		500	—	—	
PCMSYNC (input) setup time to PCMCLK (input) rise	t_{PC4}		500	—	—	
PCMSYNC (input) hold time to PCMCLK (input) rise	t_{PC5}		500	—	—	
Delay time from PCMCLK (input) rise to PCMSYNC (output)	t_{PC6}	$C_L = 50$ pF	—	—	500	ns
PCMIN setup time to PCMCLK (output) fall	t_{PC7}		500	—	—	
PCMIN hold time to PCMCLK (output) fall	t_{PC8}		500	—	—	
PCMOUT setup time to PCMCLK (output) rise	t_{PC9}		500	—	—	
PCMOUT hold time to PCMCLK (output) rise	t_{PC10}		500	—	—	
PCMSYNC (input) setup time to PCMCLK (output) rise	t_{PC11}		500	—	—	
PCMSYNC (input) hold time to PCMCLK (output) rise	t_{PC12}		500	—	—	
Delay time from PCMCLK (output) rise to PCMSYNC (output)	t_{PC13}		—	—	500	

PCM Timing

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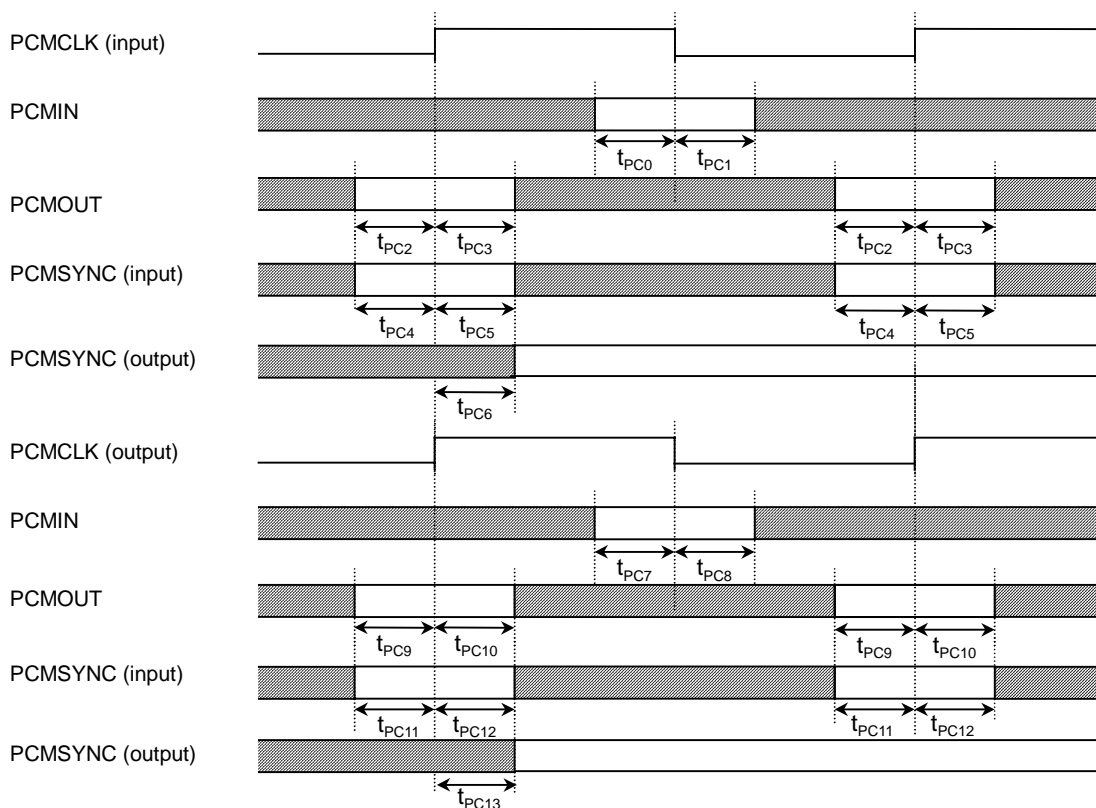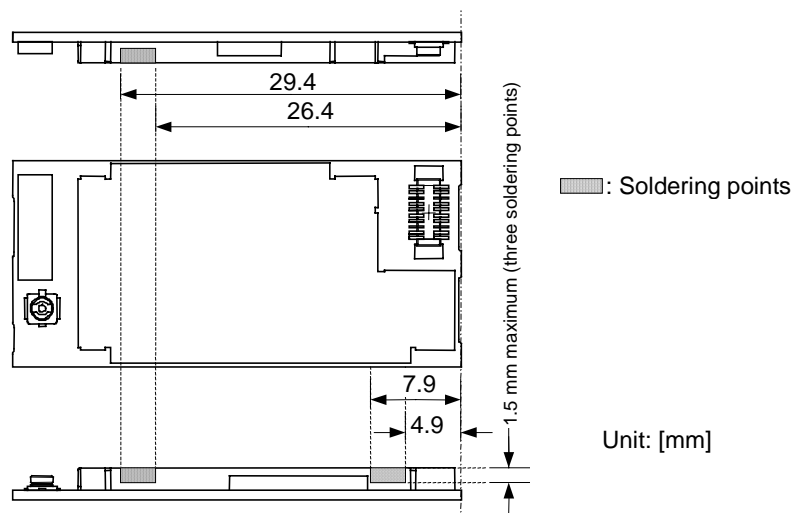
MOUNTING MODULE

Recommended Module Fixing Method

When this module is fixed on a product, our recommended method is to fit the module board-to-board connector (header) into the board-to-board connector (socket) mounted on the product board, and to solder the module shielding case to the product board.

Soldering Pattern

Pad dimension

Unit: [mm]

Board-to-board connector
(AXK5F20545)
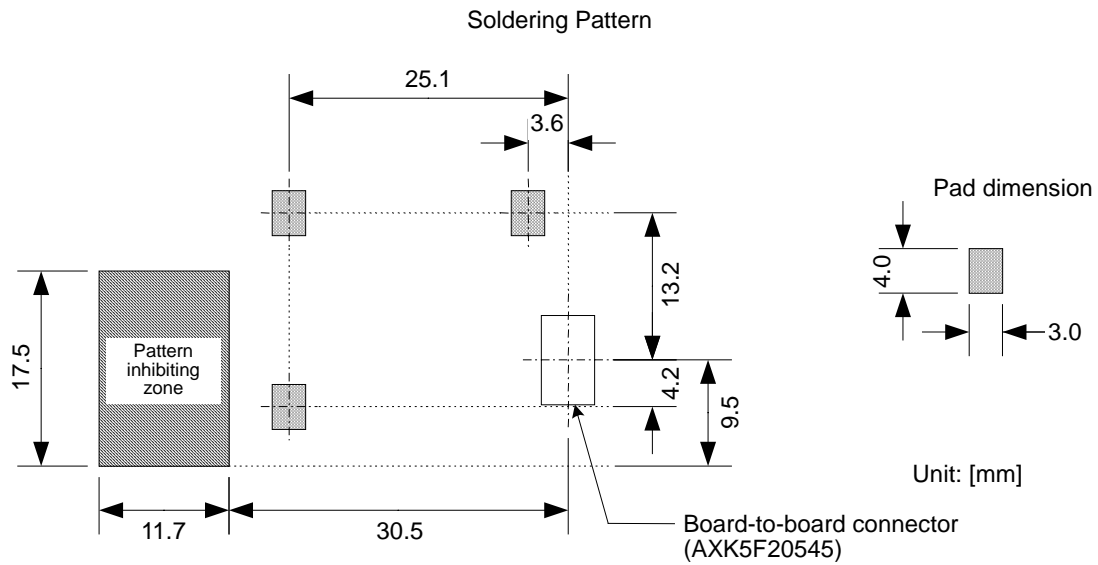
The pattern inhibiting zone is applied to the MK70120 (antenna built-in type).

: Soldering points

Unit: [mm]

Soldering points in the shielding case for fixation on a product board

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Notes on Mounting the Module

1. This module is not adaptable to reflow mounting. When soldering the shielding case to a product board, use a soldering iron.

2. If metal is placed around the antenna, the antenna characteristics may deteriorate. Do not place copper foil in the pattern inhibiting zone shown in the above section. Do not place metal around the antenna if possible. (Only for MK70120).

3. The shielding case is connected to GND in the module. For mounting the module, when pattern wiring that touches the shielding case is carried out on the product board, do not cause a short-circuit between the shielding case and the pattern. For example, apply resist on the entire surface that touches the shielding case.

4. The effects of noise on a product board depend on the connection of GND/NC to the fixation pads. Select the connection with better electrical characteristics in the module mounted state.
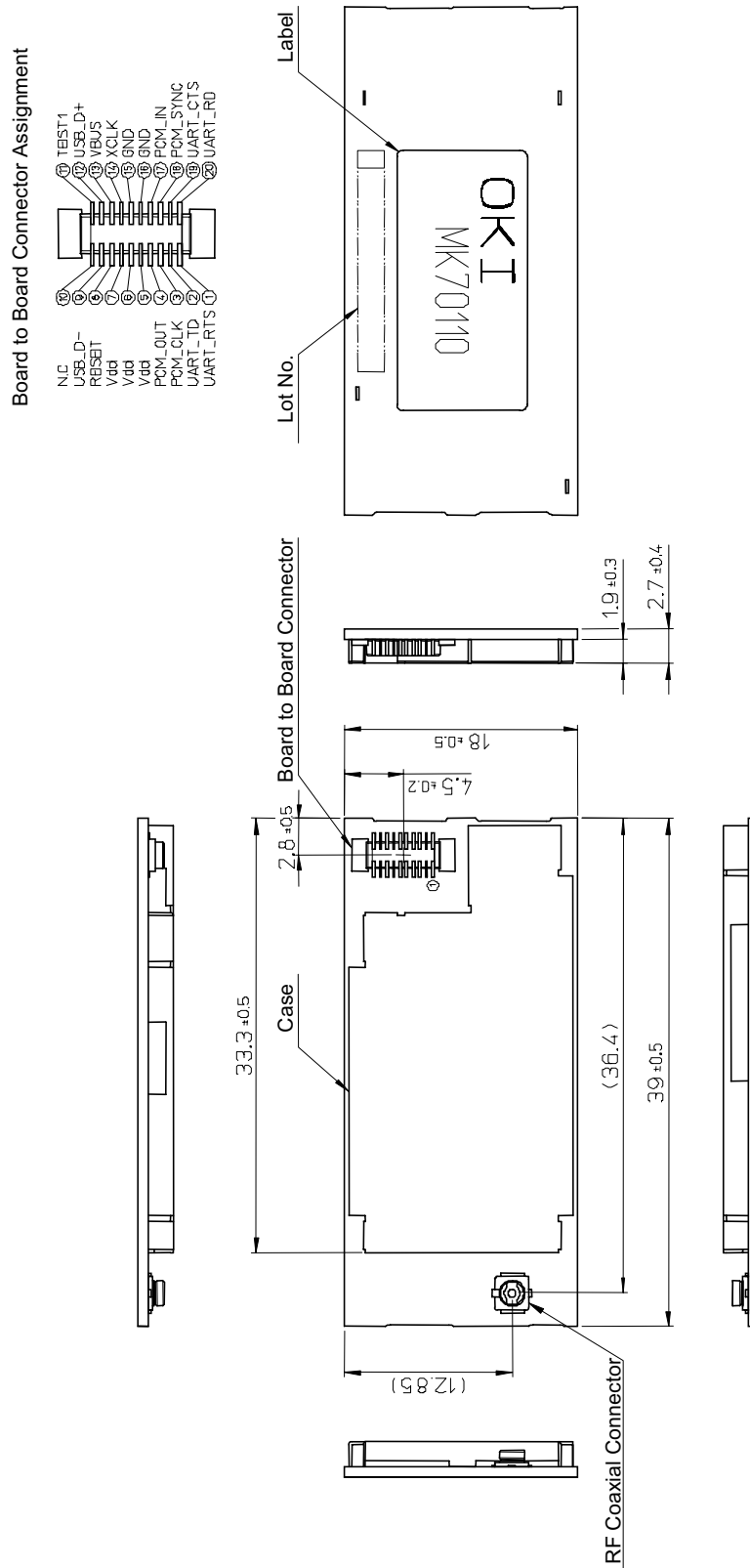

CAUTIONS IN USE

This module consists of precision electronic components. Therefore, note the following when handling the module:

1. In a case of decomposition or recomposition of this module, the operations in these specifications are not assured.

2. This module is not waterproof or drip-proof. Do not use the module in wet locations.

3. Do not use this module under high temperature or high humidity conditions, in direct sunlight, or in dusty places.
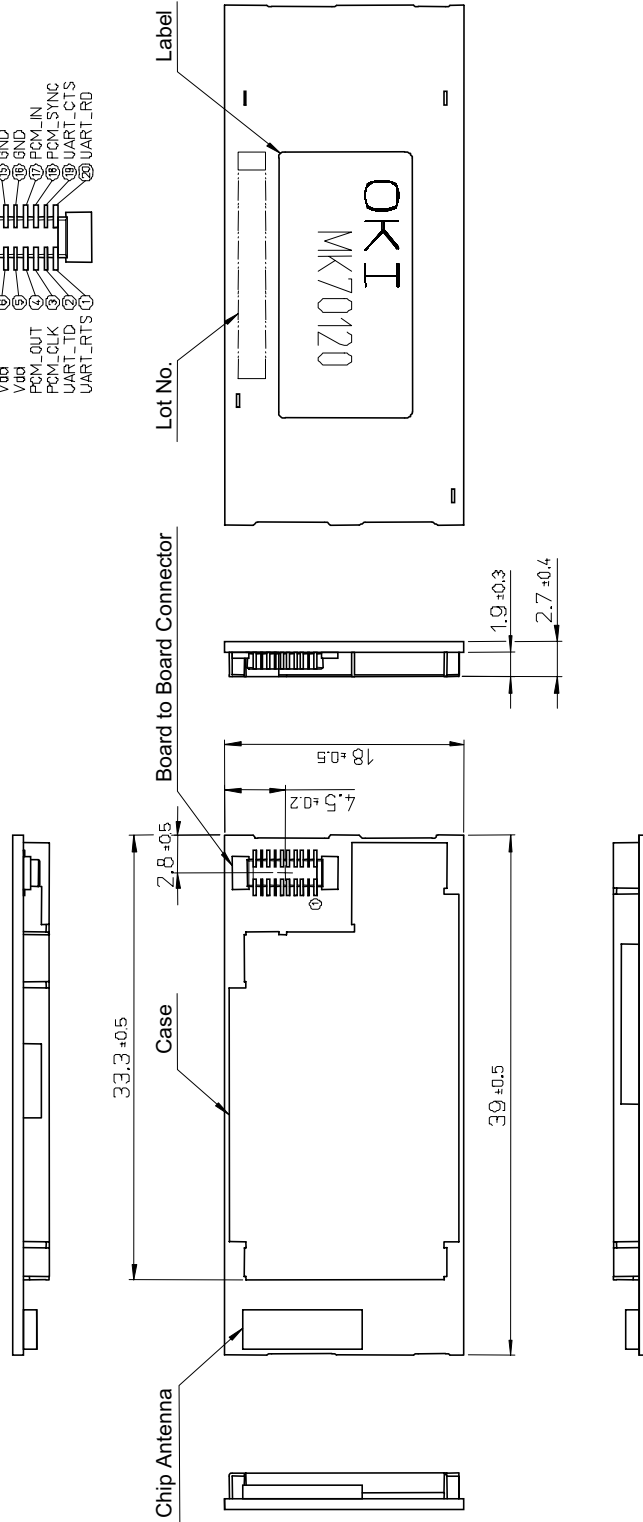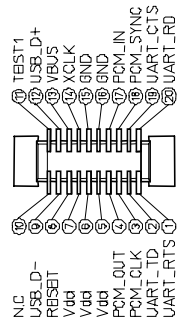
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MODULE OUTLINE

Outline of MK70110

Outline of MK70120

Board to Board Connector Assignment

N.C. ⑪ TEST1
USB_D– ⑫ USB_D+
RESET ⑬ VBUS
Vdd ⑭ XCLK
Vdd ⑮ GND
Vdd ⑯ GND
PCM_OUT ⑰ PCM_IN
PCM_CLK ⑱ PCM_SYNC
UART_TD ⑲ UART_CTS
UART_RTS ① ⑳ UART_RD

Label

OKI
MK70120

Lot No.

Board to Board Connector

1.9 ±0.3
2.7 ±0.4

18 ±0.5

4.5 ±0.2

2.8 ±0.5

33.3 ±0.5

Case

39 ±0.5

Chip Antenna

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REVISION HISTORY

Document No.	Date	Page		Description
		Previous Edition	Current Edition	
PEDLMK70-01	Aug. 2001	–	–	Preliminary edition 1
PEDLMK70-02	Apr. 24, 2002	–	–	Preliminary edition 2
				Owing to the device name change from MK70 Series to MK70110/MK70120, the contents have been changed throughout the document.

NOTICE

1. The information contained herein can change without notice owing to product and/or technical improvements. Before using the product, please make sure that the information being referred to is up-to-date.

2. The outline of action and examples for application circuits described herein have been chosen as an explanation for the standard action and performance of the product. When planning to use the product, please ensure that the external conditions are reflected in the actual circuit, assembly, and program designs.

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4. Oki assumes no responsibility or liability whatsoever for any failure or unusual or unexpected operation resulting from misuse, neglect, improper installation, repair, alteration or accident, improper handling, or unusual physical or electrical stress including, but not limited to, exposure to parameters beyond the specified maximum ratings or operation outside the specified operating range.

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