R-IN32M3 Module (RY9012A0)

User's Manual: Hardware

RENESAS MCU
R-IN32M3-EC

Renesas Electronics
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The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Precaution against Electrostatic Discharge (ESD)

   A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.

2. Processing at power-on

   The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.

3. Input of signal during power-off state

   Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.

4. Handling of unused pins

   Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.

5. Clock signals

   After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.

6. Voltage application waveform at input pin

   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).

7. Prohibition of access to reserved addresses

   Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.

8. Differences between products

   Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

How to Use This Manual

1. Purpose and Target Readers

This manual is designed to provide the user with an understanding of the hardware functions and electrical characteristics of the R-IN32M3 Module. It is intended for users designing application systems incorporating the MCU. A basic knowledge of electric circuits, logical circuits, and MCUs is necessary in order to use this manual.

The manual comprises an overview of the product; descriptions of the CPU, system control functions, peripheral functions, and electrical characteristics; and usage notes.

> Particular attention should be paid to the precautionary notes when using the manual. These notes occur within the body of the text, at the end of each section, and in the Usage Notes section.

> The revision history summarizes the locations of revisions and additions. It does not list all revisions. Refer to the text of the manual for details.

The following documents apply to the R-IN32M3 Module. Make sure to refer to the latest versions of these documents. Last four digits of document number (described as ****) indicate version information of each document. The newest versions of the documents listed may be obtained from the Renesas Electronics Web site.

Document Type	Description	Document Title	Document No.
Data Sheet	Hardware overview and electrical characteristics	R-IN32M3 Module Datasheet	R19DS0109EDxxxx
User's manual for Hardware	Hardware specifications (pin assignments, peripheral function specifications, electrical characteristics, timing charts) and operation description	R-IN32M3 Module User's Manual: Hardware	This user's manual
User's manual for Software	Description of API	R-IN32M3 Module User's Manual: Software	R17US0002EDxxxx
Quick Start Guide	Information on application examples Sample program for the host CPU.	R-IN32M3 Module Application Note: Quick Start Guide	R12QS0042EDxxxx
Renesas Technical Update	Product specifications, updates on documents, etc.	Available from Renesas Electronics Web site.	

2. Notation of Numbers and Symbols

Note:
explanation of (Note) in the text

Caution:
Item deserving extra attention

Remark:
Supplementary explanation to the text

3. List of Abbreviations and Acronyms

Abbreviation	Full Form
API	Application Programming Interface
CIP	Common Industrial Protocol
CPU	Central Processing Unit
EMC	Electromagnetic Compatibility
ERR	Error
FG	Frame Ground
Hi-Z	High Impedance
ICE	Industrial Communication Explorer
I/O	Input / Output
P. C. B	Print Circuit Board
PDI	Process Data Interface
RC	Resistor-Capacitor
SPI	Serial Peripheral Interface

Table of Contents

1. Overview

This hardware design guide is intended to provide recommended design practices for use of the Renesas industrial Ethernet module solution. Readers of this document are assumed to have general knowledge in the areas of electrical engineering, logic circuits, and microcontrollers.

1.1 Features

- Support for the PROFINET RT and EtherNet/IP^{TM}, EtherCAT$^®$ real-time communications standards
- Ethernet ports supporting rates of 10 Mbit/s and 100 Mbit/s with auto negotiation.
- Device configuration via a Management Tool (Industrial Communication Explorer from the company "port industrial automation GmbH") and API through the application controller
- Comprehensive tool support and application examples in source code for the Renesas Synergy^{TM} SK-S7G2

1.1.1 Applications

Industrial automation, remote I/O, etc.

1.2 Functions

- Complete dual Ethernet interface based on IEEE 802.3, including transformers and PHY layers.
- Embedded dual-port Ethernet switch for bus and ring network topologies.
- High speed SPI interface and power pins to connect the R-IN32M3 Module to a host CPU.
- Integrated processor to handle real-time industrial Ethernet protocols.

1.3   Product Description

1.3.1   Product Name

Part No. R Y 9 0 1 2 A 0 0 0 0 G Z 0 0 # 0 0 1

- Packaing specification
  - #001: 30pcs Tray package
  - #002: 1pcs sample package

- Outline
  - Z00: Module

- Fields of application
  - G: TA = -40 to +70 °C

- ROM code
  - 000: Blank product

- Product development
  - A0: First product (serial number)

- Peculiar code
  - 9012: R-IN32M3 Module

- Renesas module product
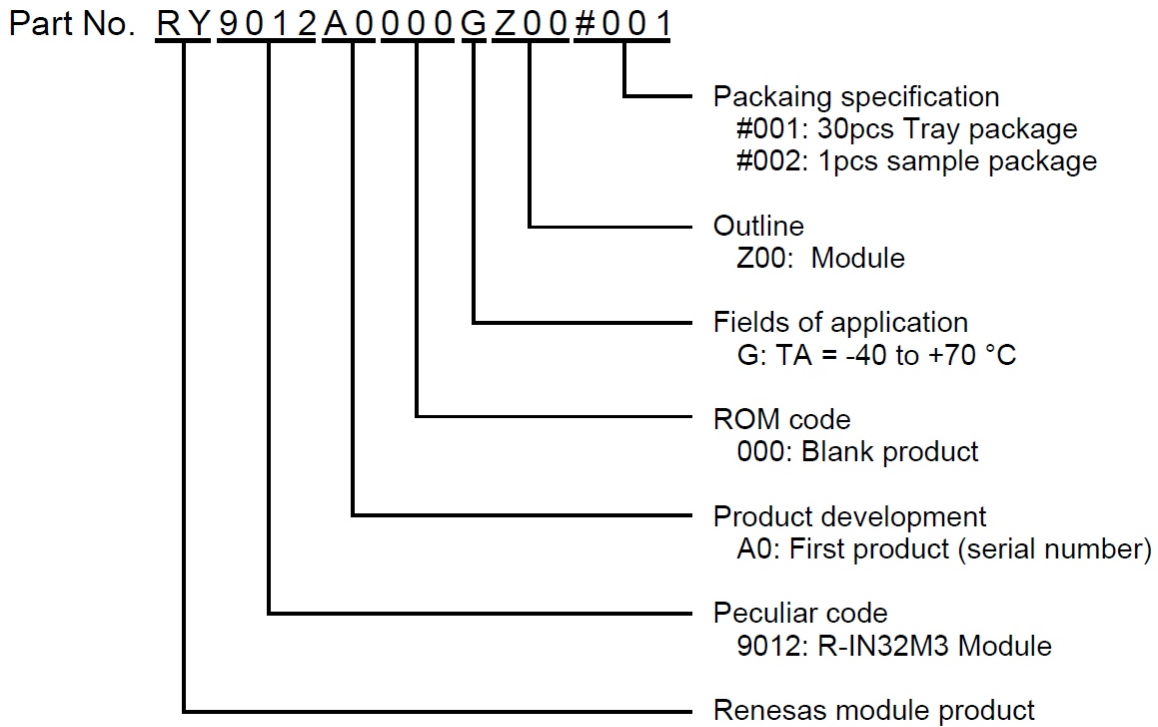
Figure 1.1   Product Name

1.3.2   Ordering Information

Table 1.1   Order Information

Part No.	Application
RY9012A0000GZ00#001	Dual-port Ethernet modules in a 30-piece tray package
RY9012A0000GZ00#002	Dual port Ethernet modules in a 1-piece sample package
YCONNECT-IT-I-RJ4501	Ethernet module solution kit

2.   Host Interface

2.1   Overview

The R-IN32M3 Module operates with a 3.3-V power supply and supports SPI communications. The R-IN32M3 Module is shown in outline as a block diagram below.
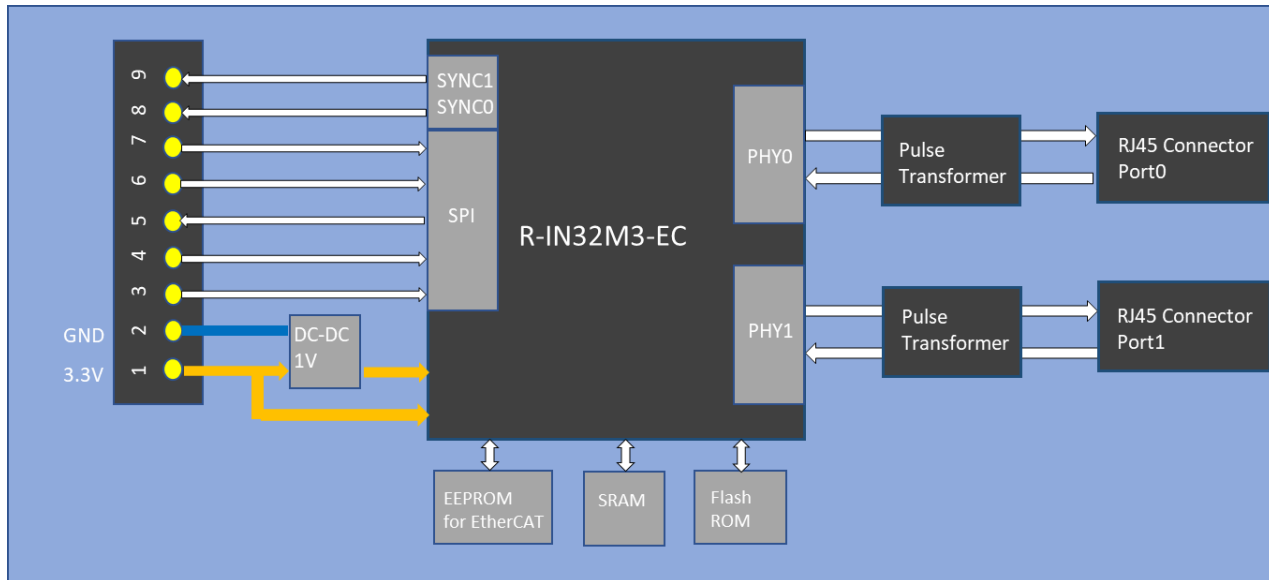
Figure 2.1   R-IN32M3 Module Block Diagram

## 2.2	Module Pins

The R-IN32M3 Module pins are for the interface with the power supply, the SPI, which is a slave interface, applying a reset, and clock signals.

**Table 2.1	Pin Description**

Pin	Signal	I/O	Description
1	Vcc		3.3V ±0.15V DC power supply
2	GND		Ground
3	/SS	I	Slave select: Active low to enable the slave device
4	/RESET	I	Reset of the whole R-IN32M3 Module: Active low
5	MISO	O	Master in slave out. Data from slave to master
6	MOSI	I	Master out slave in. Data from master to slave
7	SCLK	I	Serial clock: The master provides the clock to shift the data.
8	SYNC0	O	EtherCAT sync signal for distributed clocks
9	SYNC1	O	EtherCAT sync signal for distributed clocks

Note. Pin 8 and pin 9 EtherCAT sync signals for distributed clocks are only used for EtherCAT protocol.
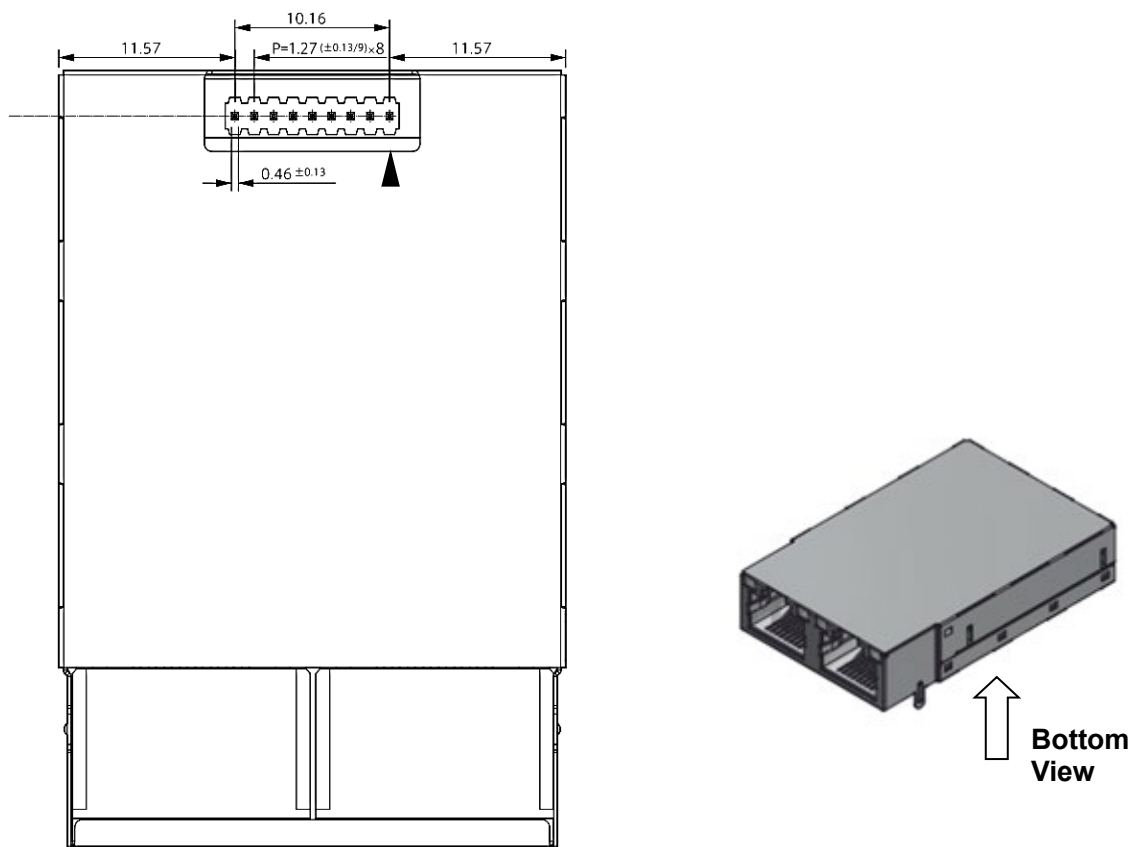
**Figure 2.2	Drawing of Pin Positions (Bottom View)**
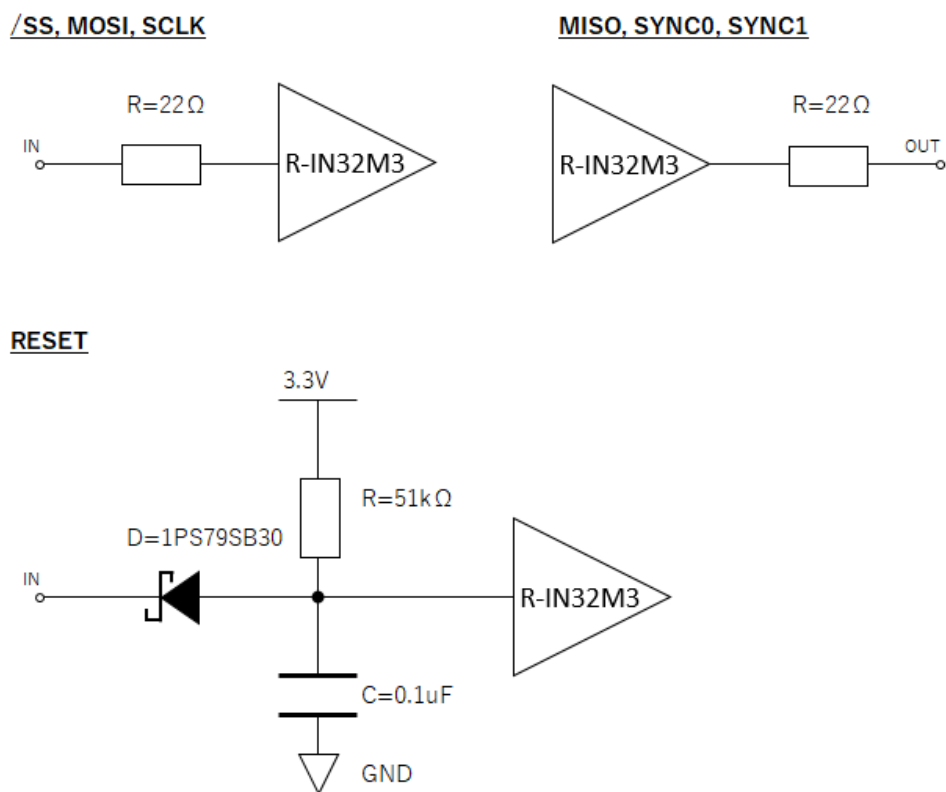
Figure 2.3   R-IN32M3 Module Internal Circuits

2.3   SPI Specification

The R-IN32M3 Module offers a serial peripheral interface which is supported on the R-IN32M3-EC controller. This communication interface uses 4 signal lines which are connected on 9-pin male connector with 1.27-mm pitch as shown in Table 2.2.

The R-IN32M3 Module works always in slave mode and allow to transmit configuration and process data to the host CPU.

Table 2.2   SPI Signal Description

Signal	Description
SCLK	Serial clock input (output from master)
MOSI	Master output slave Input, or master out slave in (data output from master)
MISO	Master input slave output, or master in slave out (data output from slave)
/SS	Slave select (active low, output from master)
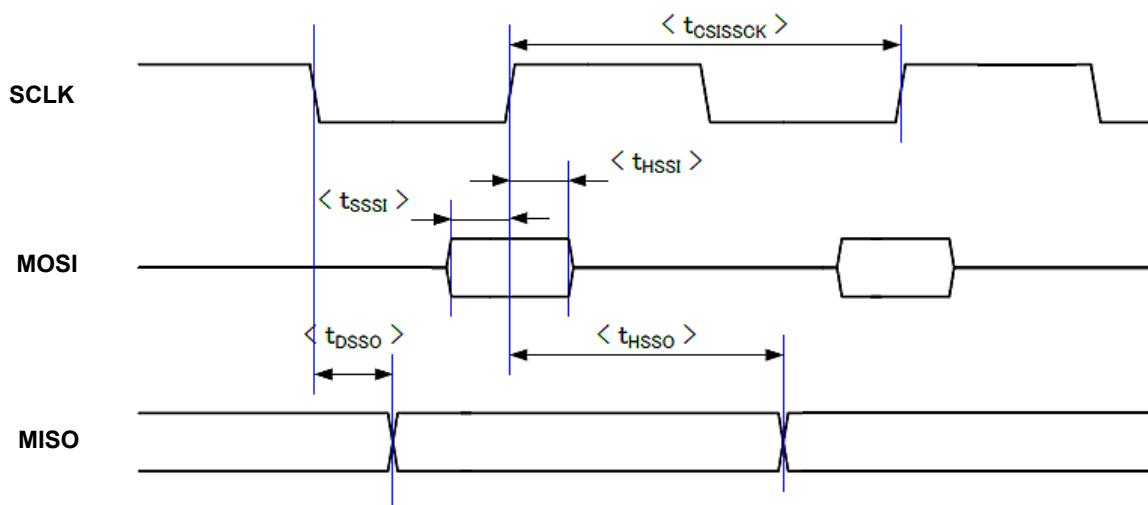
Figure 2.4   SPI Access Timing Chart

Table 2.3   SPI Specifications (Vcc = 3.3±0.15 V, Ta = -40 to +70°C)

Parameter	Symbol	Conditions	Min.	Max.	Unit
SCLK input cycle	tCSISSCK	-	60	-	ns
SCLK output high level width	tWSKH	-	tCSIMSCK × 0.5 - 5.0	-	ns
SCLK output low level width	tWSKL	-	tCSIMSCK × 0.5 - 5.0	-	ns
MOSI input setup time (to CSISCKn↑)	tSSSI	-	10	-	ns
MOSI input setup time (to CSISCKn↓)	tSSSI	-	10	-	ns
MOSI input hold time (from CSISCKn↑)	tHSSI	-	15	-	ns
MOSI input hold time (from CSISCKn↓)	tHSSI	-	15	-	ns
MISO output delay time (from CSISCKn↑)	tDSSO	C_L = 15 pF	-	10	ns
MISO output delay time (from CSISCKn↓)	tDSSO		-	10	ns
MISO output hold time (from CSISCKn↑)	tHSSO		tCSISSCK × 0.5 - 5.0	-	ns
MISO output hold time (from CSISCKn↓)	tHSSO		tCSISSCK × 0.5 - 5.0	-	ns

2.4   Control Reset

The R-IN32M3 Module has a single reset pin on the 9-pin connector interface. The R-IN32M3 Module can be deactivated by the input of a low-level voltage to the reset pin, and it can be restarted by the input of a high-level voltage to the reset pin.

Figure 2.3 shows the internal circuits of the R-IN32M3 Module. The rest pin has a built-in pull-up resistor, so there is no need to place an external pull-up resistor.

The figure below shows the signal timing of the reset operation to the R-IN32M3 Module. A wait of at least 10 ms is required until the power supply voltage becomes stable, after which the /RESET signal can be de-asserted. The /RESET signal must be at the active level for at least 1 µs in order for the R-IN32M3 Module to properly recognize a reset.
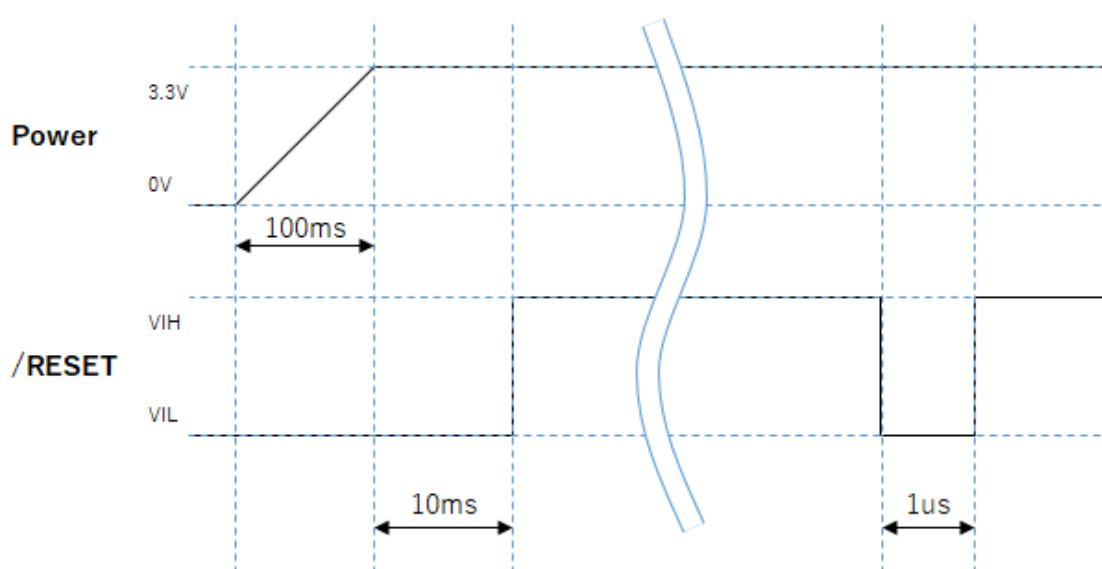
Figure 2.5   Reset Signal Timing Chart

The states of each of the pins during a reset are as follows.

Table 2.4   Pin Logic in Reset State

Pin	Signal	I/O	Logic (Reset State)
1	Vcc	-	-
2	GND	-	-
3	/SS	I	Hi-Z (pulled up by an internal resistor)
4	/RESET	I	High (pulled up by an internal resistor)
5	MISO	O	Hi-Z (pulled up by an internal resistor)
6	MOSI	I	Hi-Z (pulled up by an internal resistor)
7	SCLK	I	Hi-Z (pulled up by an internal resistor)
8	SYNC0	O	Hi-Z (pull down by an internal resistor)
9	SYNC1	O	Hi-Z (pulled up by an internal resistor)

2.5   Sequence of Supplying and Cutting off Power

The recommended sequence of supplying and cutting off power to the R-IN32M3 Module is shown in the following figure. Wait at least 10 ms after the power supply voltage has become stable before de-asserting the reset signal. 3.3 V must only be applied to the I/O pins after applying the power supply voltages. It is recommended that the time difference between the start of the power supply voltage rising and power supply stabilization and the time difference between the start of the power supply voltage falling and arrival at the low level arrival is within 100 ms.
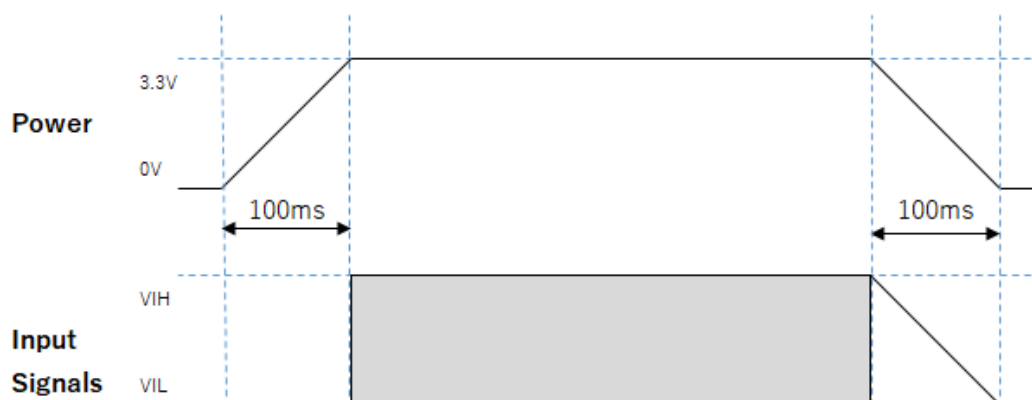

Figure 2.6   Sequence of Supplying and Cutting off Power

2.6   EtherCAT Sync Outputs

The following two signals are to work as EtherCAT sync interrupts.

- CATSYNC0   - EtherCAT SYNC0 output
- CATSYNC1   - EtherCAT SYNC1 output

3.   Network Interface Specification

3.1   Overview

With two RJ45 network connectors, the R-IN32M3 Module is ready for external connection in several network topologies. The internal PHY layers in the R-IN32M3-EC can handle different industrial communications protocols and support 10BASE-T and 100BASE-TX. The following listed protocols are (or are to be) supported:

- PROFINET
- EtherNet/IP
- EtherCAT

3.2   Hardware Specification

The Ethernet ports have the following pin assignment:

Table 3.1   Ethernet Port Pin Assignment

Pin	Signal	I/O	Description
1	TX+	O	Transmit signal positive
2	TX-	O	Transmit signal negative
3	RX+	I	Receive signal positive
4	Not used		Drain wire
5	Not used		Drain wire
6	RX-	I	Receive signal negative
7	Not used		Drain wire
8	Not used		Drain wire

The Ethernet port supports 100 Mbits/s with auto negotiation.
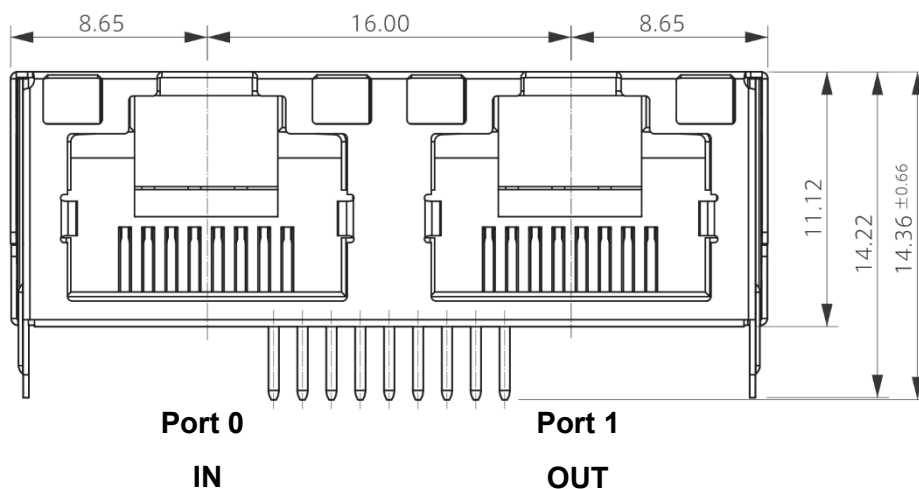
Figure 3.1   Ethernet Port Drawings (2 Ports)

3.3 LED Status Specification

The R-IN32M3 Module has two RJ45 Ethernet ports and two LEDs per RJ45 jack. Therefore, this section describes four LEDs.
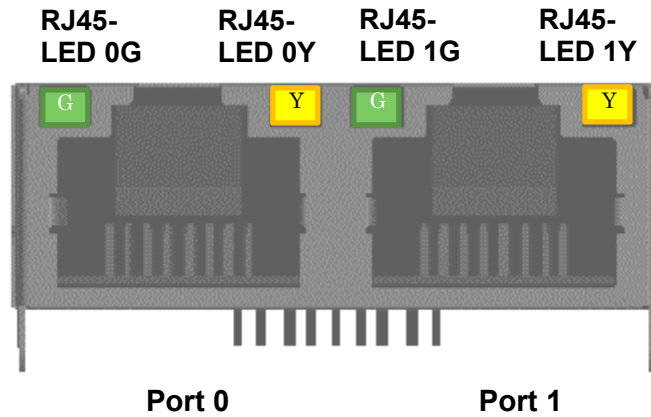
Figure 3.2 Link and Activity LEDs

Table 3.2 LED Location/Function

port	RJ45-LED	Signal	Description
0	0G	Network link	Green LED for connected link on port 0
	0Y	Network activity	Yellow LED for communication activity on port 0
1	1G	Network link	Green LED for connected link on port 1
	1Y	Network activity	Yellow LED for communication activity on port 1

4.   Electrical Characteristics

4.1   Absolute Maximum Ratings

Stress exceeding the maximum ratings even for short time may damage the R-IN32M3 Module. Functional operation above the recommended operating conditions is not guaranteed. Extended exposure to stress above the recommended operating conditions may affect device reliability.

Table 4.1   Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Supply voltage	V_{CC}	-0.2 to +3.6	V
I/O voltage	VI/Vo	-0.3 to +3.6	V
Output current	Io	15	mA
Storage temperature	T_{stg}	-40 to +85	°C

Tests performed IEC 60512-11-4(-40℃/125℃), IEC 60512-11-9(125℃), IEC 60512-11-10(-40℃), IEC 60512-11-3(40℃/85%RH), IEC 60512-11-12

Caution:	Product quality may suffer if any absolute maximum rating is even momentarily exceeded. That is, the absolute maximum ratings are rated values at which the product is on the verge of suffering physical damage, and therefore the product must be used under conditions that ensure that these ratings are not exceeded.

Remark:	3.3 V must be applied to the I/O pins only after applying the power supply voltage.

4.2   Operating Conditions

Table 4.2   Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply	Vcc	3.15	3.3	3.45	V
Power consumption	P		1.3	2.0	W
Input voltage high	VIH	2.0		Vcc + 0.3	V
Input voltage low	VIL	-0.3		0.8	V
Input voltage high (/RESET)	VIH_{RESET}	2.2		Vcc	V
Input voltage low (/RESET)	VIL_{RESET}	-0.2		0.3	V
Output voltage high	VOH	Vcc - 0.1			V
Output voltage low	VOL			0.1	V
Output current low	IOL	6			mA
Output current high	IOH	-6			mA
Operating temperature	T_a	-40		70	°C

All further specifications and statements of timing assume the application of the above-mentioned operating conditions.

4.3   Functional Earth and Shielding

The shield of R-IN32M3 Module is internally connected with GND via a RC-combination. Connect the shield to the frame ground (FG) for electrical testing to obtain CE marking.

4.4   Shock and Vibration

4.4.1   Vibration Test

20 to 2,000 to 20 Hz, amplitude 5 G (max.)

Sweep 4 min.   X/Y/Z direction, 4 times

IEC 60068-2-64

4.4.2   Shock Test

50 G, 6 mS, X1/X2/Y1/Y2/Z1/Z2 direction, 3 times

IEC 60068-2-27

4.4.3   Drop Test

For packing condition (delivery box) JIS Z 0200

JIS Z 0200/ISO 4180

5.   Guideline

5.1   Overview

This chapter provides guidelines and design examples for developing with the R-IN32M3 Module.

5.2   Circuit Design Guideline for Common

5.2.1   Overview

The following figure shows an example of connection when the R-IN32M3 Module and the host CPU are connected.
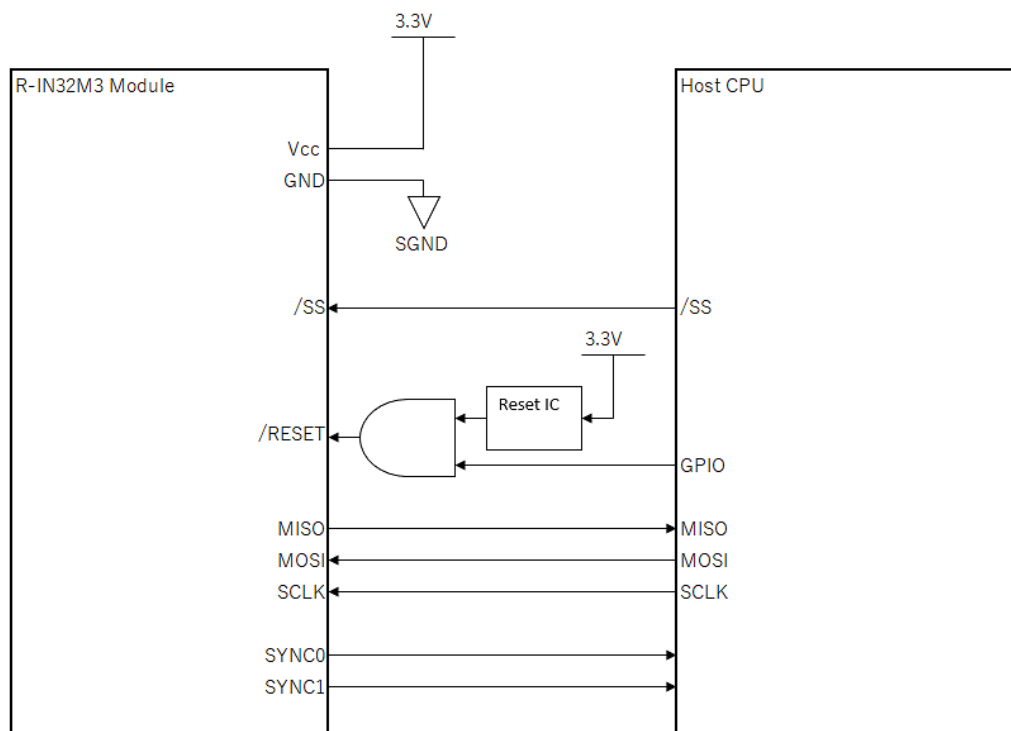
Figure 5.1   Connection to a Host CPU

5.2.2 Power Supply

The supply voltage for the R-IN32M3 Module is specified with 3.3V DC ± 0.15V DC (3.15 V to 3.45 V).
Since the R-IN32M3 Module has a maximum power consumption of about 2.0 W, it is recommended that the external power be capable of supplying 1.0 A (or more).
 An example of a power supply circuit is shown below.
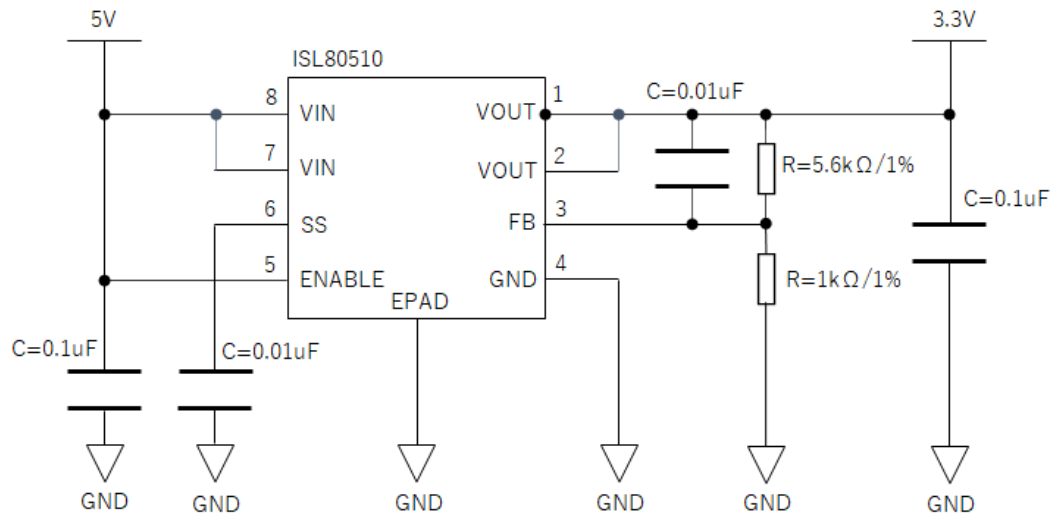
Figure 5.2   Power supply example

5.2.3   Reset Circuit Example

The example reset circuit in the figure shows a common 3.3-V supervisor to satisfy the specifications in Chapter 2.4. The main usage is to ensure a defined delay until reset de-assertion after the 3.3-V power is switched on.
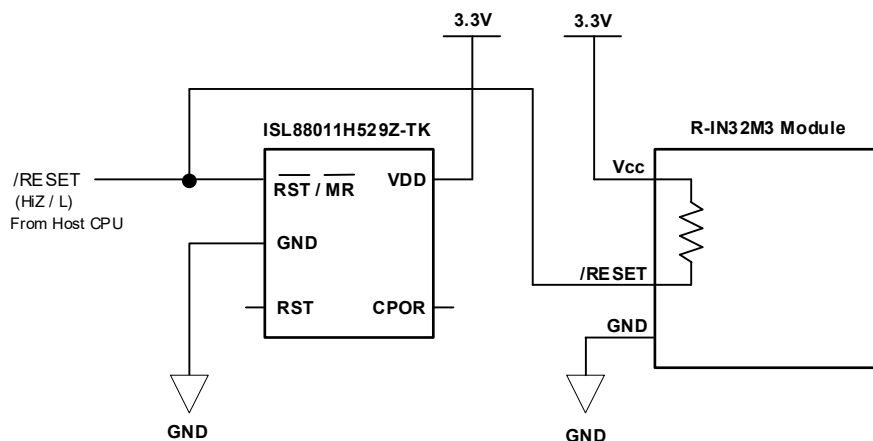
Figure 5.3   Reset Circuit Example

5.2.4   Host CPU Specifications

The recommended specifications of the host CPU are as follows.

ROM capacity: More than 128 KB

RAM capacity: More than 128 KB

SPI packet transfer size: 128 bytes (8 bits x 128 times) bulk data transfer

Note: When using a Renesas CPU, select the Simple SPI (SCI), as the maximum batch data transfer amount of RSPI is 32 bytes.

5.3   Circuit design guidelines for each industrial Ethernet protocol

This chapter describes the circuit design requirements required for each industrial Ethernet protocol.

As shown in Chapter 3.3, the R-IN32M3 Module has an RJ45 female connector with two indicator LEDs (RJ45-LED 0G,0Y,1G,1Y) on each Ethernet port. The green LED indicates the link status and the yellow LED lights up in response to network activity. These two indicator LEDs are controlled by the R-IN32M3 Module side, so there is no need to design them on the user side.

To comply with Industrial Ethernet protocol, the LEDs shown in **Table 5.1** must be added for each supported protocol. (Strictly speaking, PROFINET does not prescribed other than a DCP indicator).

The host CPU must control the LEDs according to the LED status received from the R-IN32M3 Module. Major protocol status conditions are listed in the following **Table 5.1.**

Table 5.1   State Indication

Industrial Ethernet Standard	Status LED 1RG		Status LED 2RG	
PROFINET[Note 1]	SF	*Red*	BF	*Red*
	Connection	*Green*	DCP Indicator	*Green*
EtherNet/IP[Note 2]	MS	*Green/ Red*	NS	*Green/ Red*
EtherCAT[Note 3]	RUN	*Green*	ERR	*Red*

[Note 1] PROFINET Diagnosis Guideline V1.4 Chapter 6.7

[Note 2] The CIP Networks Library Volume 2: EtherNet/IP Adaptation of CIP

[Note 3] EtherCAT   Indicator and Labeling ETG.1300S(R) Vx.x.x

5.3.1   PROFINET

PROFINET requires one DCP (Discovery and Configuration Protocol) signal indicator, which indicate which device is assigned a symbolic name and IP addresses. Also, it is not mandatory, but normaly recommended to add several LEDs. R-IN32M3 Module supports the following LED controls.

    BF (Bus Failure)

    SF (System Fialure)

    Connection

    DCP blink signaling

The **Figure 5.4** shows a circuit example of PROFINET LED connection.
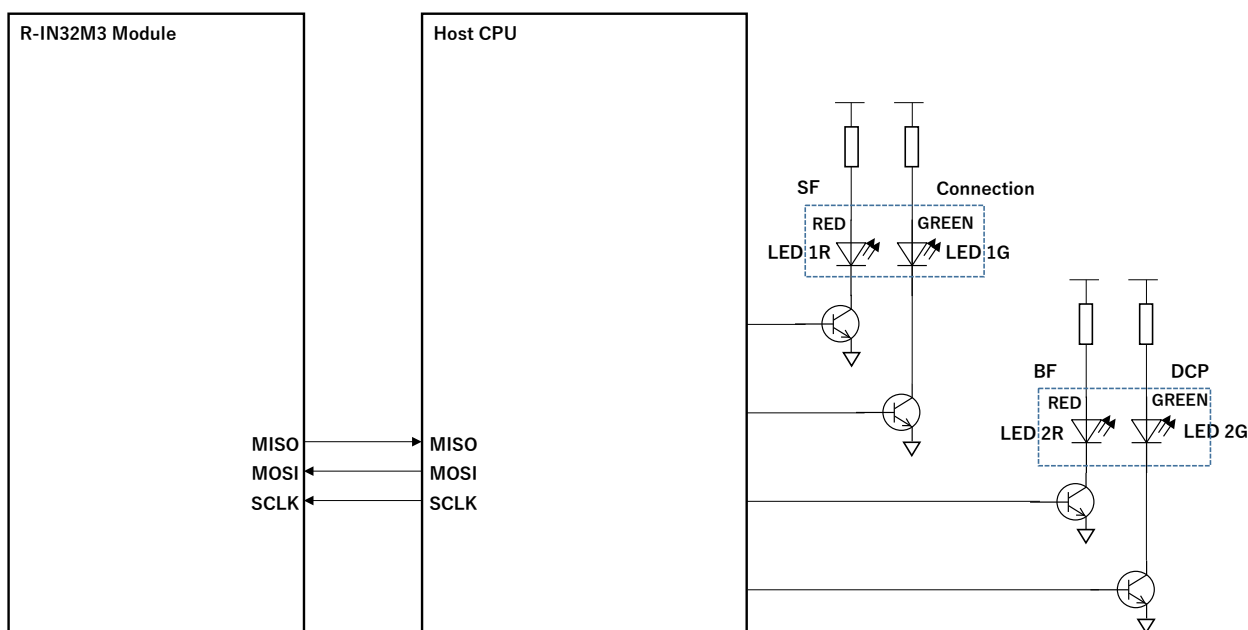
Figure 5.4   Example of PROFINET LED Connections

The LEDs in **Figure 5.4** are mounted separately from R-IN32M3 Module and controlled by the host controller. It controls the LEDs according to the LED status received from R-IN32M3 Module. See the table below for more information.

Table 5.2   PROFINET State Indication by the host controller

LED	LED Name	Colour	State	Description
1R	SF	Red	ON	Maintenance required. At least one diagnosis exists.
			OFF	No bus error is present
1G	Connection	Green	ON	Connection established
			OFF	Not connected
2R	BF	Red	ON	ERROR. Bus error occurred; the connection was deleted. An alarm was issued.25
			OFF	No error is present
2G	DCP	Green	Blink	DCP blink
			OFF	No DCP service

5.3.2   EtherNet/IP

In addition to **Table 5.1**, EtherNet/IP has more detailed LED control guidelines. EtherNet/IP communication requires two types of bi-colour LED displays:

    MS (module status indicator)
    NS (network status indicator)

The **Figure 5.5** shows a circuit example of EtherNet/IP LED connection.
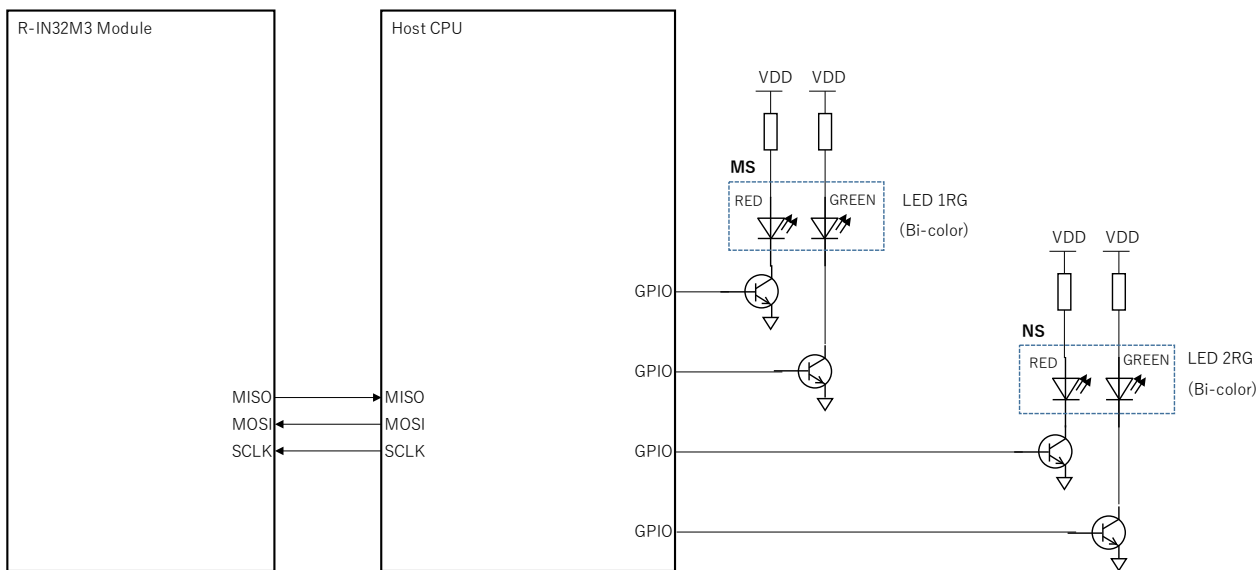
Figure 5.5   Example of EtherNet/IP LED Connections

The MS and NS indicators must be implemented separately from the R-IN32M3 Module and controlled by the application controller. The host CPU must control the LEDs according to the LED status received from the R-IN32M3 Module.

Details are shown in **Table 5.3** and **Table 5.4**.

Note: The R-IN32M3 Module does not support the address conflict detection, which is optional in EtherNet/IP specifications.

Table 5.3   MS (Module Status Indicator LED 1RG)

Indicator State	Summary	Requirements
Steady off	No power	If power is not being supplied to the device, the module state indicator is to be steadily off.
Steady green	Device operational	If the device is operating correctly, the module status indicator shall be steady green.
Flashing green	Standby	If the device has not been configured, the module state indicator is to be flashing green.
Flashing red	Major recoverable fault	If the device has detected a major recoverable fault, the module state indicator is to be flashing red. Note: An incorrect or inconsistent configuration would be considered a major recoverable fault.
Steady red	Major unrecoverable fault	If the device has detected a major non-recoverable fault, the module state indicator is to be steadily red.
Flashing green / red	Self-test	While the device is performing its power up testing, the module status indicators shall apply the test sequence described below. -The module state indicator shall turn green for approximately 0.25 seconds, turn red for approximately 0.25 seconds, and then turn green and retain that state until the power-up test has been completed. -If both module state and network state indicators are present, the module state indicator test sequence shall occur before or simultaneously with the network state indicator test sequence(s). If more than one network state indicator is present, then each network state indicator test sequence may proceed in succession or simultaneously. -After completion of this power-up test, the indicator(s) are to represent a normal operational state.

Table 5.4   NS (Network Status Indicator LED 2RG)

Indicator State	Summary	Requirement
Steady off	Not powered, no IP address	Power to the device is off or is on but no IP address has been configured (Interface Configuration attribute of the TCP/IP Interface Object).
Flashing green	No connections	An IP address has been configured but no CIP (common industrial protocol) connections[Note 1] have been established, and an exclusive owner connection[Note 2] has not reached time-out.
Steady green	Connected	An IP address has been configured, at least one CIP connection (in any transport class) has been established, and an exclusive owner connection has not reached time-out.
Flashing red	Connection timeout	An IP address has been configured, and the exclusive owner connection for which this device is the target has reached time-out. The network state indicator shall only return to being steadily green when all timed-out exclusive owner connections are re-established. In devices that support a single exclusive owner connection, a transition to being steadily green is to proceed when any subsequent exclusive owner connection is established. Devices that support multiple exclusive owner connections shall retain the O->T (Originator to Target) connection path information when an exclusive owner connection reaches time-out. The network status indicator shall make the transition from flashing red to steadily green only when all connections to previously timed-out O->T connection points have been re-established. Time-out of connections other than exclusive owner connections are not to cause the indicator to flash red. The flashing red state applies to target connections only. Originators and CIP routers are not to cause the LED to enter this state.
Flashing green / red	Self-test	While the device is performing its power up testing, the network status indicator shall perform a test sequence as described in Table 5.3.

[Note 1] The common industrial protocol (CIP) is an open application layer protocol, and EtherNet/IP uses this protocol for the application layer. Refer to the Ethernet/IP Specifications for details.

[Note 2] The exclusive owner connection is used for controlling the outputs of the module and shall not be dependent on any other condition. Only one exclusive owner connection can be opened against the module. Refer to the Ethernet/IP Specifications for details.

5.3.3   EtherCAT

In addition to **Table 5.1**, EtherCAT has more detailed LED control guidelines. EtherCAT communication requires four types of LED displays:

L/A IN (Link/Activity In)

L/A OUT (Link Activity Out)

RUN (device status indicator)

ERR (error status indicator)

And EtherCAT requires an explicit device ID selector. The ID selector can be any type, such as a rotary switch or a display with controls.

When connecting multiple units such as daisy chain topology or ring topology as EtherCAT standard, it is necessary to connect communication port 0 as IN and communication port 1 as OUT as shown in **Figure 3.1**, according to the EtherCAT standard.

The relationship between each communication port and IN and OUT is fixed in terms of hardware according to the EtherCAT standard, and it is necessary to indicate IN and OUT on the device.

Figure 5.6 shows an example of an EtherCAT LED connection, ID selector. In the example, the RUN LED(LED 1G) and ERR LED(LED 2R) are independent LEDs, but they can be replaced with a single bi-color LED (STATUS LED).
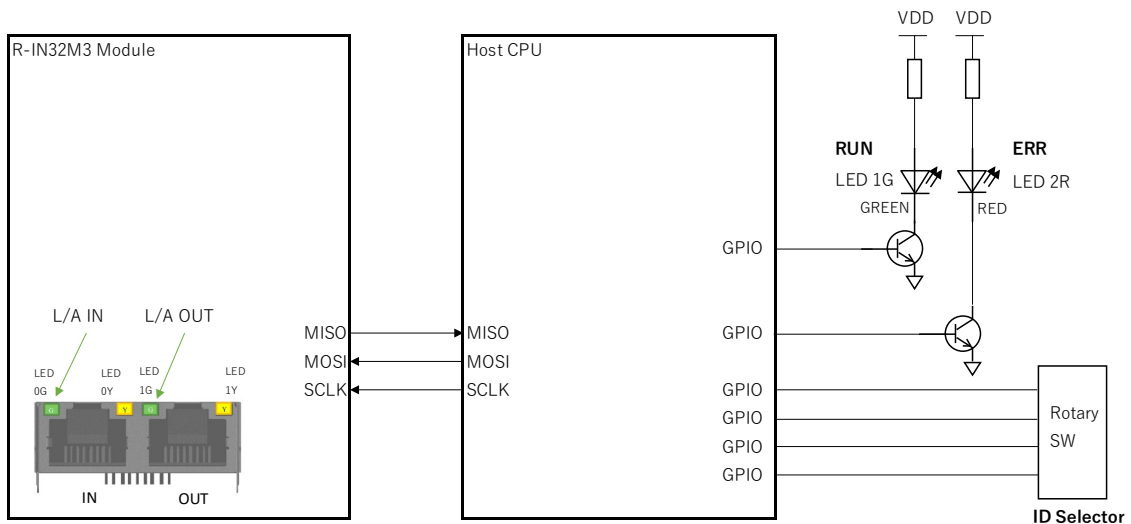
Figure 5.6   Example of EtherCAT LED and ID-selector connection

The LEDs for L / A IN and L / A OUT are included in the R_IN32M3 Module and are controlled by the R-IN32M3 Module. Therefore, it does not need to be designed by the user. Details are shown in **Table 5.5Table 5.5**.

**Table 5.5   LED status display for L /A IN and L/ A OUT by R-IN32M3Module**

RJ45-LED	LED Name	Colour	State	Description
0G,1G	L/A IN and L/A OUT Indicator	Green	OFF	The Link is not established.
			Flickering	The Link is established with transmitted and received data
			ON	The Link is not established without transmitted and received data

RUN LED and ERR LED must be implemented separately from the R-IN32M3 Module and controlled by the host controller. The host controller can obtain information to control the LEDs from the R-IN32M3 Module via SPI protocol. The example in **Figure 5.6** shows details in **Table 5.6**.

Table 5.6   EtherCAT status indicator by host controller

LED	LED Name	Colour	State	Description
1G	RUN	Green	OFF	The device is in state INIT
			Blinking	The device is in state PRE-OPERATIONAL
			Single flash	The device is in state SAFE-OPERATIONAL
			ON	The device is in state OPERATIONAL
2R	ERR	Red	OFF	No error. The EtherCAT communication of the device is in working condition
			Blinking	General Configuration Error
			Single flash	Synchronization Error.
			Double flash	Sync Manager Watchdog timeout
			Flickering	Booting Error.
			ON	PDI Error.

In addition to ON and OFF, there are four LED display states as shown in **Figure 5.7Figure 5.7**.
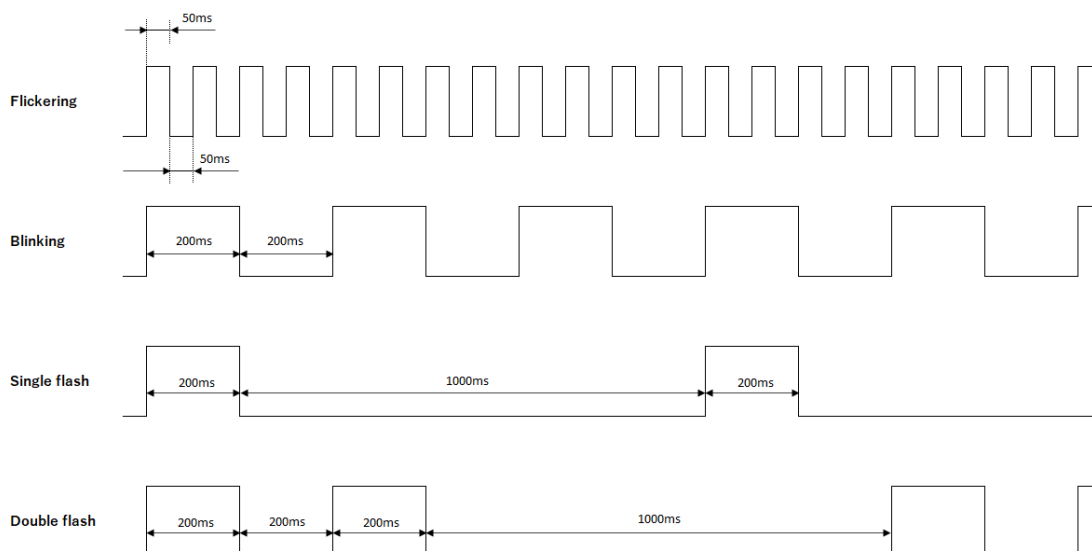
Figure 5.7   Indicator flash rates

5.4 Layout Design Guideline

The following figure shows the footprints needed to implement the R-IN32M3 Module. Gray areas indicate through holes and red areas indicate land patterns. The R-IN32M3 Module mounting surface should be solid ground except in the wiring lead-out parts. No restrictions apply to the inner layers of the P.C.B. The thickness of the P.C.B should be 1.6 mm. Any mounting of components on the back side of the R-IN32M3 Module is prohibited.
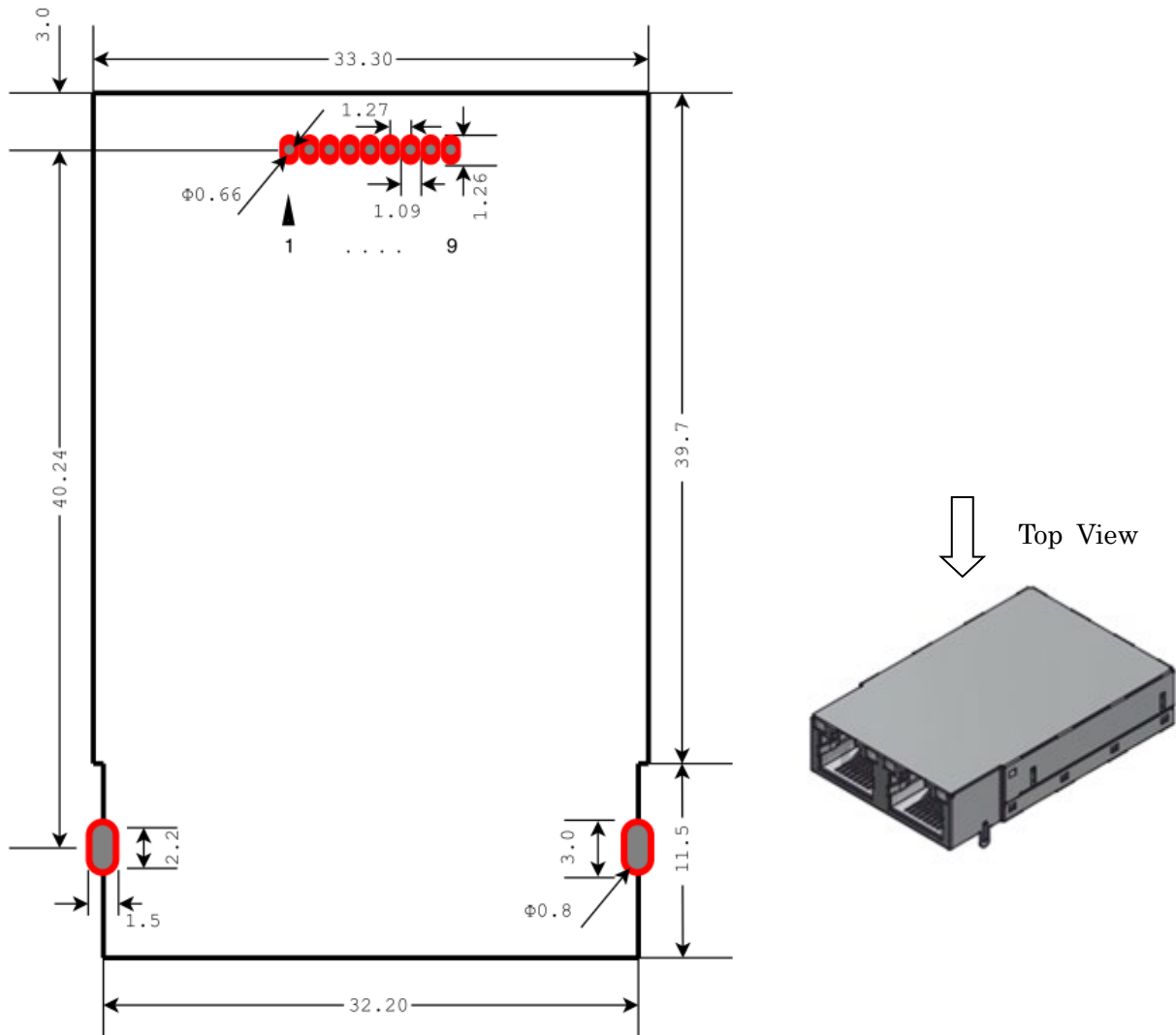

Figure 5.8   Footprint Drawing (Top View)

6.   Mounting Conditions

6.1   Recommended Soldering Condition (Through Holes)

6.1.1   Wave Soldering

The recommended temperature profile by wave soldering is shown below.
Maximum temperature (solder temperature): 260°C or below
Time at maximum temperature: 10 sec. or less
Preheating temperature: 140°C or below
Preheating time: 80 sec. or less
Maximum number of flow processes: 1 time

6.1.2   Hand Soldering

The following conditions are recommended for hand soldering.

- 350°C ± 5°C

- Within 3 seconds per lead

6.1.3   Reflow Soldering

This product does not support reflow soldering.

Note:

Since the solder melting temperature varies depending on the board and solder material used, confirm the optimum temperature that meets the recommended conditions regarding to the temperature profile for wave soldering.

6.2   Storage Conditions of the Products without Moisture-Proof Packing

In storage and handling of devices not in the moisture-proof packing, keep them under the following conditions taking solderability, lead corrosion, electrical characteristics and so on into consideration.

Table 6.1   Storage Conditions

Item	Conditions
Temperature	5 to 30 °C
Humidity	$\leq$ 85%RH
Storage period	$\leq$ 1 year

7. Applicable Standards

7.1 CE Marking

7.1.1 EMC

Measuring task, preliminary measurement of unwanted radiated emissions as per

Emission EN61000-6-4

    EN55016-2-3 Radiated emission

    EN55022   Conducted emission

Immunity EN61000-6-2

    EN61000-4-2 Electrostatic Discharge immunity test

    EN61000-4-3 Immunity to radiated radio frequencies

    EN61000-4-4 Electrical fast transient / burst immunity test

    EN61000-4-5 Surge immunity test

    EN61000-4-6 Immunity to conducted disturbances, induced by radio-frequency fields

7.1.2 RoHS/REACH

The R-IN32M3 Module is compliant to following environmental guidelines:

- RoHS

- REACH

- RENESAS ELECTRONICS GREENPROCUREMENT GUIDELINE
  https://www.renesas.com/ja-jp/media/about/company/csr/green/guideline-en.pdf

- Management according to the chemical substance list in Renesas Electronics Cooperation

7.2 UL

The R-IN32M3 Module is a UL-recognized component.

7.3 International Protection Code (IP Code)

The R-IN32M3 Module supports the protection class IP-20.

8. Mechanical Specifications
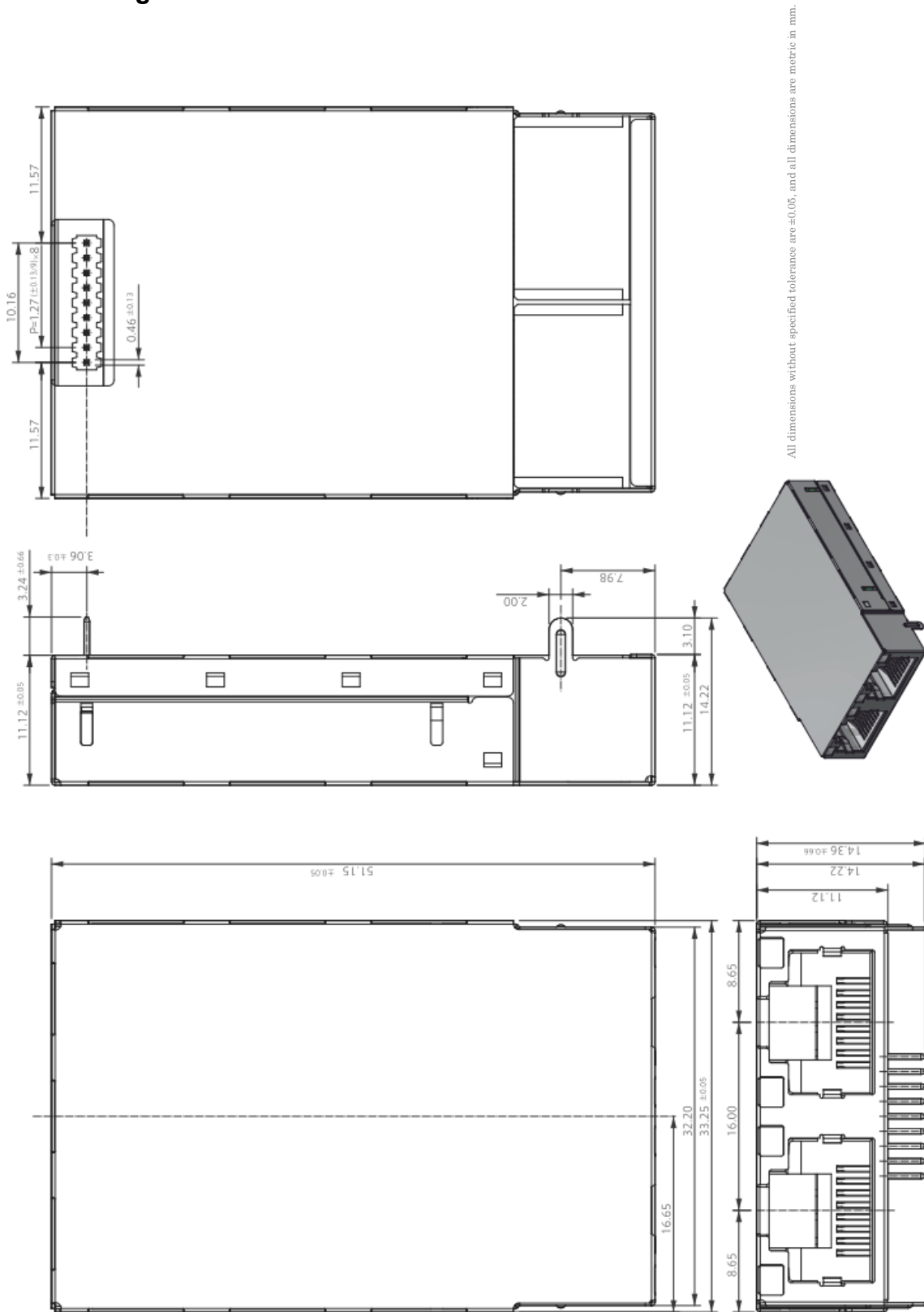
8.1 Package Dimensions

Figure 8.1 Package Dimensions

8.2   Dimensions

The dimensions of each part of R-IN32M3 Module are as follows.

Table 8.1   Dimensions of Main Unit

	Typical Value	Tolerance
Width [mm]	33.25	±0.05
Depth [mm]	51.15	±0.05
Height [mm] Excluding protrusions on terminals	11.12	±0.05
Weight [g]	21.0	±1.0

Table 8.2   Dimensions of Terminals of the 9-Pin Connector

	Typical Value	Tolerance
Diameter [mm]	0.46	±0.13
Length [mm] Based on the bottom of the case	3.24	±0.66
Pitch [mm]	1.27	±0.015

Table 8.3   Dimensions of Two Terminals for Fixing on the Board

	Typical Value	Tolerance
Width [mm]	2.0	±0.05
Length [mm] Based on the bottom of the case	3.1	±0.05
Thickness [mm]	0.25	±0.05

9.   Marking Specifications

9.1   Product Label

Image of Product Label

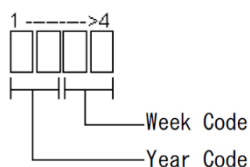Position of Product Label

Figure 9.1   Product Label

Logo: RENESAS LOGO
Model: RY9012A0000GZ00
MAC Address: XXXX XXXX XXXX
Country name of origin: Germany
Year/Week Code: YY/WW
CE mark: Standard conformity mark for CE
UL mark: The UL number is put on the product label.
2D code: Includes the MAC address.
(Data-Matrix-Code)

Year/Week Code

a) Use Weekly Code for SPL that was automatically generated.
b) The first week of the year shall be the week that includes January 1.
c) A week is switched to the next week on the Saturday to Sunday change timing.
d) The beginning and end of a year is shown as an example:

```
       December 2004
 Sun Mon Tue Wed Thu Fri Sat
0452 19   20   21   22   23   24   25
0501 26   27   28   29   30   31

       January 2005
 0501                   01
0502 02   03   04   05   06   07   08
```

Use the last two digits of the year as the Year code, as follows:

Table 9.1   Year Code

Year	Symbol	Year	Symbol
2001	01	2021	21
2002	02	2022	22
2003	03	2023	23
2004	04	2024	24
:	:	:	:
2020	20	2040	40
		:	:

Rev.	Date	Description	
		Page	Summary
1.00	Aug 03, 2020	—	First edition issued
2.00	Nov 06, 2020	9	Update to Industrial Communication Explorer
		19	Clarified LED status specifications in Chapter 3.3
		23	Added circuit example of power supply
		25-31	Optimized chapter 5.3 Added the EtherCAT function
2.01	Apr 26, 2021	26	Modify LED description for PROFINET
		19, 25, 27, 30	Rearrange LED names and number
		24	Update recommended memory size for the host CPU
2.02	Jun. 14, 2021	24	Change reset circuit example in Figure 5.3
		25	Replace SF and BF in Table 5.1 and Table 5.2

R-IN32M3 Module