

EtherCAT I/O MODULE

(high-speed DC voltage output, 4 points, e-CON connector)

MODEL R7I4DECT-1-YVF4

BEFORE USE

Thank you for choosing M-System. Before use, please check contents of the package you received as outlined below. If you have any problems or questions with the product, please contact M-System's Sales Office or representatives.

■ PACKAGE INCLUDES:

High-speed DC voltage output module(1)
Surface mounter slider(2)

■ MODEL NO.

Confirm Model No. marking on the product to be exactly what you ordered.

■ INSTRUCTION MANUAL

This manual describes necessary points of caution when you use this product, including installation, connection and basic maintenance procedures.

■ ESI FILES

ESI files are downloadable at M-System's website (<https://www.m-system.co.jp/>).

POINTS OF CAUTION

■ CONFORMITY WITH EU DIRECTIVE

- The equipment must be mounted inside the instrument panel of a metal enclosure.
- The actual installation environments such as panel configurations, connected devices, connected wires, may affect the protection level of this unit when it is integrated in a panel system. The user may have to review the CE requirements in regard to the whole system and employ additional protective measures to ensure the CE conformity.

■ POWER INPUT RATING & OPERATIONAL RANGE

- Locate the power input rating marked on the product and confirm its operational range as indicated below:
24V DC rating: $24V \pm 10\%$, $\leq 70mA$

■ GENERAL PRECAUTIONS

- Before you remove the unit or mount it, turn off the power supply and input signal for safety.

■ ENVIRONMENT

- Indoor use.
- When heavy dust or metal particles are present in the air, install the unit inside proper housing with sufficient ventilation.
- Do not install the unit where it is subjected to continuous vibration. Do not subject the unit to physical impact.
- Environmental temperature must be within -10 to $+55^{\circ}C$ (14 to $131^{\circ}F$) with relative humidity within 30 to 90% RH in order to ensure adequate life span and operation.

■ WIRING

- Do not install cables close to noise sources (relay drive cable, high frequency line, etc.).
- Do not bind these cables together with those in which noises are present. Do not install them in the same duct.

■ AND

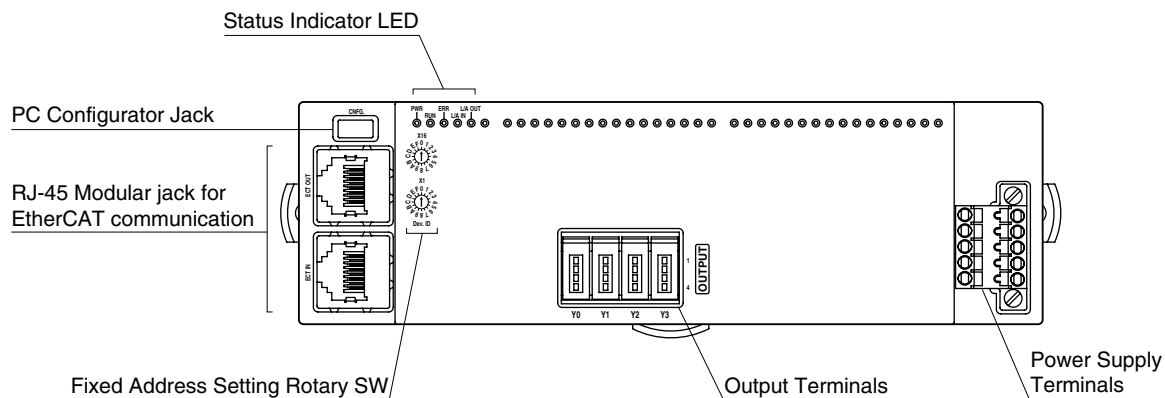
- The unit is designed to function as soon as power is supplied, however, a warm up for 10 minutes is required for satisfying complete performance described in the data sheet.



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COMPONENT IDENTIFICATION

FRONT VIEW



STATUS INDICATOR LED

| ID | FUNCTION | COLOR | STATUS | |
|---------|-----------------|-------|--------------|---|
| Power | Internal power | Green | Off | Error |
| | | | On | Normal |
| RUN | Device state | Green | Off | INIT |
| | | | Blinking | PRE-OPERATIONAL |
| | | | Single Flash | SAFE-OPERATIONAL |
| | | | On | OPERATIONAL |
| ERR | Error | Red | Off | No error |
| | | | Blinking | Invalid Configuration |
| | | | Single Flash | Local error |
| | | | Double Flash | Process data watchdog timeout/ EtherCAT watchdog timeout ^{*1} |
| | | | On | Application controller failure |
| L/A IN | IN port status | Green | Off | No Link |
| | | | Flickering | Link and activity |
| | | | On | Link without activity |
| L/A OUT | OUT port status | Green | Off | No Link |
| | | | Flickering | Link and activity |
| | | | On | Link without activity |

*1. Watchdog timeout is disabled for input-only slaves like R7I4DECT-1-SVF8N according to the EtherCAT specification.

| | |
|--------------|---|
| Blinking | 200ms-On, 200ms-Off |
| Single flash | 200ms-On, 1000ms-Off |
| Double flash | 200ms-On, 200ms-Off, 200ms-On, 1000ms-Off |
| Flickering | 50ms-On, 50ms-Off |

FIXED ADDRESS SETTING ROTARY SW (ID selector)

Fixed address 1 to 255 can be set using the two rotary switches each marked 0 to F in combination.

When fixed address is not used, set the switches to 0.

Settable range: 0 to 255

Factory default: 0



Fixed Address Setting (x16)

Fixed Address Setting (x1)

■ POWER SUPPLY

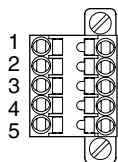
Cable connector: TFMC1,5 / 5-STF-3,5
(Phoenix Contact) (comes with the unit)

Applicable wire size: 0.2 – 1.5 mm²

Stripped length: 10 mm

Recommended solderless terminal

- AI0,25–10YE 0.25 mm² (Phoenix Contact)
- AI0,34–10TQ 0.34 mm² (Phoenix Contact)
- AI0,5–10WH 0.5 mm² (Phoenix Contact)
- AI0,75–10GY 0.75 mm² (Phoenix Contact)
- A1–10 1.0 mm² (Phoenix Contact)
- A1,5–10 1.5 mm² (Phoenix Contact)



| PIN No. | ID | FUNCTION |
|---------|------|------------------|
| 1 | PWR+ | Power Supply |
| 2 | PWR- | Power Supply |
| 3 | FE | Functional earth |
| 4 | NC | ---- |
| 5 | NC | ---- |

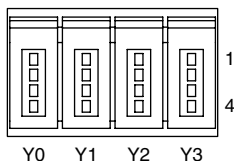
Note: The number marked on the connector is irrelevant to the pin number of the unit.

Perform wiring according to this instruction manual.

■ INPUT TERMINAL ASSIGNMENTS

• e-CON connector

Recommended cable connector: 37104-()-000FL (3M Company) (does not come with the unit)
(Specify wire size instead of (); refer to manufacturer's specifications for details.)



| PIN No. | ID | FUNCTION | PIN No. | ID | FUNCTION |
|---------|----|----------|---------|----|----------|
| Y0 | 1 | NC | Y2 | 1 | NC |
| | 2 | COM0 | | 2 | COM2 |
| | 3 | VL0 | | 3 | VL2 |
| | 4 | VH0 | | 4 | VH2 |
| Y1 | 1 | NC | Y3 | 1 | NC |
| | 2 | COM1 | | 2 | COM3 |
| | 3 | VL1 | | 3 | VL3 |
| | 4 | VH1 | | 4 | VH3 |

PC CONFIGURATOR

The following parameter items can be configured with the PC configurator software (model: R7CFG). Refer to the users manual of the software for detailed operations.

■ CHANNEL INDIVIDUAL SETTING

| PARAMETER | SETTING RANGE | DEFAULT |
|----------------------|---|-------------------|
| Unused setting | CH enable, CH disable | CH enable |
| Output range | -10 to +10V DC -5 to +5V DC -1 to +1V DC 0 to 10V DC 0 to 5V DC 1 to 5V DC 0 to 1V DC -0.5 to +0.5V DC | -10 to +10V DC |
| Bias setting | -320.00 to +320.00 (%) | 0.00 (%) |
| Gain setting | -3.2000 to +3.2000 | 1.0000 |
| Zero scaling value | -32,000 to +32,000 | 0 |
| Full scaling value | -32,000 to +32,000 | 10,000 |
| Output reset value*1 | -15.00 to +115.00 (%) | -15.00 (%) |

■ CHANNEL BATCH SETTING

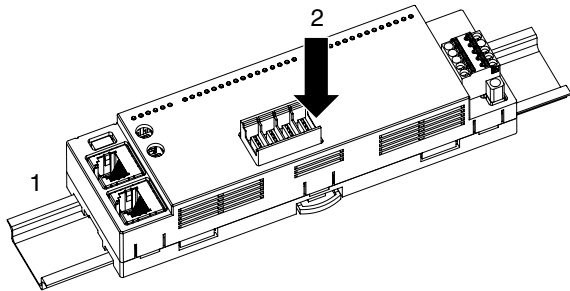
| PARAMETER | SETTING RANGE | DEFAULT |
|-------------------------------|-----------------------------|-------------|
| Output at communication error | Output hold Output clear | Output hold |

MOUNTING INSTRUCTIONS

■ DIN RAIL MOUNTING (PARALLEL)

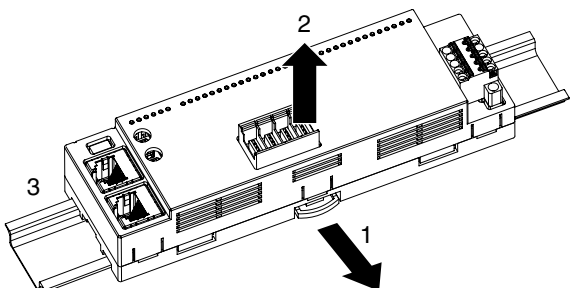
• Mounting the unit

- 1) Hook the upper hook at the rear side of the base onto the DIN rail.
- 2) Push the lower part of the unit in the direction of the arrow until the base is firmly fixed to the DIN rail.



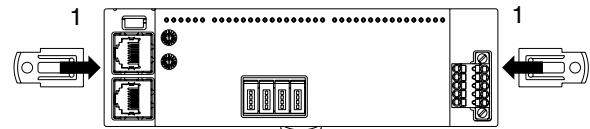
• Removing the unit

- 1) Push down the slider using a minus screwdriver.
- 2) Pull out the lower part of the unit.
- 3) Remove the upper part of the unit from the DIN rail.

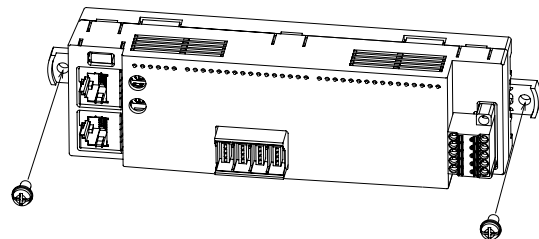


■ WALL MOUNTING

- 1) Insert the two DIN rail mounter sliders until they click once, as shown below.



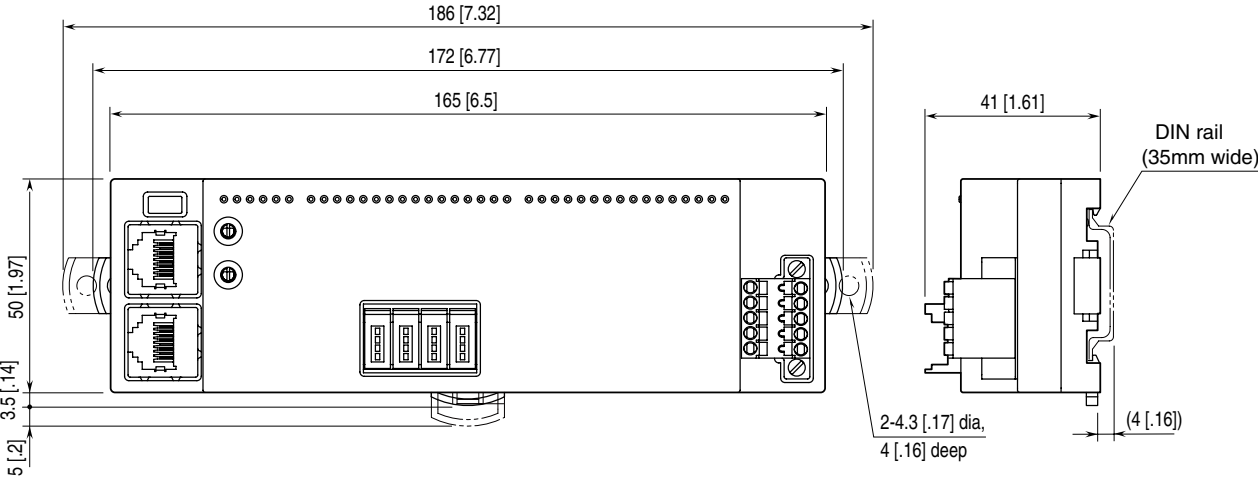
- 2) Mount the unit with M4 screws referring to the "MOUNTING REQUIREMENTS unit: mm (inch)" on page 6. (Torque: 1.4 N·m)



TERMINAL CONNECTIONS

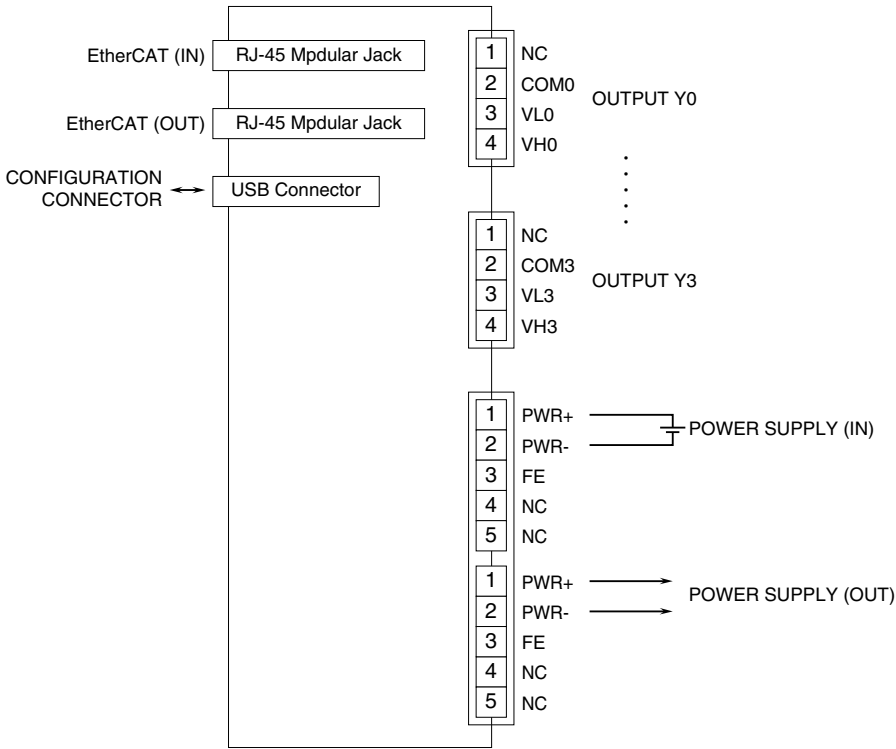
Connect the unit as in the diagram below.

■ EXTERNAL DIMENSIONS unit: mm (inch)

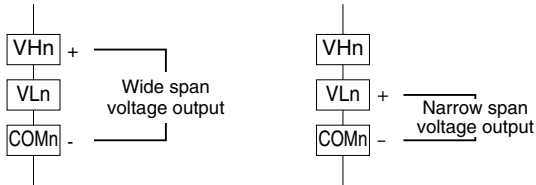


■ CONNECTION DIAGRAM

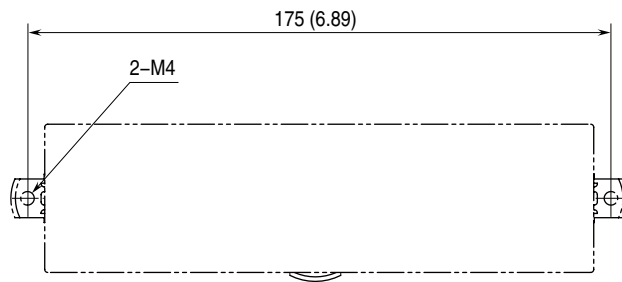
Note: In order to improve EMC performance, bond the FE terminal to ground.
 Caution: FE terminal is NOT a protective conductor terminal.



■ OUTPUT CONNECTION EXAMPLES



MOUNTING REQUIREMENTS unit: mm (inch)



EtherCAT SPECIFICATIONS

■ Modular Device Profile

R7I4DECT-1-YVF4 complies with the Modular Device Profile (MDP) standard, ETG.5001.1 of the EtherCAT standard. Be sure that the master supports the MDP standard.

■ Fixed address

R7I4DECT supports Explicit Device Identification by allowing setting of fixed address using the fixed address setting rotary switches (ID selector).

The fixed address can be set to be 1 to 255.

When fixed address is not used, set the ID selector to 0.

When the power is turned on with the ID selector set to other than 0, the designated address is written in the resistor 0x0012 of ESC (EtherCAT Slave Controller) when R7I4DECT starts up.

■ Initialization

At the start up, objects of the process data mapping (RxPDO, TxPDO) corresponding to the I/O data of the device, and the other objects are created in the object dictionary.

After initialization, the master unit is available to require to the slave unit (R7I4DECT-1-YVF4) to switch the status from INIT to PREOP.

If the initialization is not completed due to any error with the module, switching requirement is rejected with AL status code at switching from INIT to PREOP.

■ Data Configuration

Data are configured in accordance with the EtherCAT Modular Device Profile (MDP) specifications as shown below.

Table 1: Data Configuration

| OBJECT | ADDRESS | CONTENT |
|--------------------------------|----------------|--------------------------------|
| Input Area Objects | 0x6000, 0x6001 | Input data, Output status data |
| Output Area Objects | 0x7000 | Output data |
| PDO Mapping Objects (TxPDO) | 0x1A00 | Input data list |
| PDO Assign (IN) | 0x1C13 | Input data transmission order |
| PDO Assign (OUT) | 0x1C12 | Output data transmission order |
| Sync Manager Type | 0x1C00 | Sync manager type |
| Sync Manager Parameter Objects | 0x1C32, 0x1C33 | Sync mode |
| Device Type | 0x1000 | Device type |
| Error Register | 0x1001 | Error register |
| Manufacturer Device Name | 0x1008 | Device name |
| Manufacturer Hardware Version | 0x1009 | Hardware version |
| Manufacturer Software Version | 0x100A | Software version |
| Identity Objects | 0x1018 | Vendor information |

■ EtherCAT State

EtherCAT defines four states of slave: INIT, PREOP, SAFEOP, and OP.

TxPDO (input configuration data) is updated only in the SAFEOP or OP state, and RxPDO (output configuration data) is updated only in the OP state.

The RUN LED turns on only in the OP state and input and output data are updated, while only input data is updated in the PREOP state.

■ EtherCAT Diagnostics

• AL Status Code

When the slave (R7I4DECT) fails to receive a request from the master or when there is a problem with the slave during normal communication, an error code is set to registers 0x0134 and 0x0135 (AL Status Code) of ESC.

The error codes that R7I4DECT uses are as shown below. (See Table 2.)

Table 2: Error Codes of AL Status Code

| CODE | ERROR |
|--------|---------------------------------------|
| 0x0000 | No error |
| 0x0011 | Invalid requested state change |
| 0x0012 | Unknown requested state |
| 0x0013 | BOOT state not supported |
| 0x0016 | Invalid MailBox configuration (PREOP) |
| 0x0017 | Invalid SyncManager configuration |
| 0x001B | SyncManager Watchdog Timeout |
| 0x001D | Invalid Output Configuration |
| 0x001E | Invalid Input Configuration |
| 0x001F | Invalid Watchdog Configuration |
| 0x0029 | FreeRun needs 3 Buffer mode |

• SDO Abort Code

When the master attempts to access the object dictionary via SDO, if the slave (R7I4DECT) fails to receive SDO messages for any reason, R7I4DECT sends an error code (SDO Abort Code) to the master and denies its access.

The following error codes are used.

Table 3: Error Codes of SDO Abort Code

| CODE | ERROR |
|------------|---|
| 0x05030000 | Toggle bit not changed |
| 0x05040001 | Client/Server command specifier not valid or unknown |
| 0x05040005 | Out of memory |
| 0x06010000 | Unsupported access to an object |
| 0x06010002 | Attempt to a read-only object |
| 0x06020000 | The object does not exist in the object directory |
| 0x06070010 | Data type does not match, length of service parameter does not match |
| 0x06090011 | Sub-index does not exist |
| 0x08000020 | Data cannot be transferred or stored to the application |
| 0x08000022 | Data cannot be transferred or stored to the application because of the present device state |

OBJECT DICTIONARY (DATA DESCRIPTION)

■ Input Area Objects (Input Data Area: 0x6000, 0x6001)

Input data is allocated to object 0x6000.

Input status data is allocated to object 0x6001. (Refer to "I/O DATA DESCRIPTION" on page 10)

Sub-Indexes correspond to channel numbers.

Table 4: Sub-Index Configuration By Module Type

| MODULE TYPE | INDEX | SUB-INDEX | DATA TYPE | BIT | ACCESS | VALUE | CONTENT |
|----------------------------|--------|-----------|-----------|-----|--------|------------|--------------------------|
| Analog output, 4 points | 0x7000 | 0 | UINT8 | 8 | RO | 4 | Number of items |
| | | 1 | UINT16 | 16 | RW | TRUE/FALSE | First point output data |
| | | 2 | UINT16 | 16 | RW | TRUE/FALSE | Second point output data |
| | | 3 | UINT16 | 16 | RW | TRUE/FALSE | Third point output data |
| | | 4 | UINT16 | 16 | RW | TRUE/FALSE | 4th point input data |

■ PDO Mapping Objects (Data List: 0x1600)

• Objects 0x1600

Output data list (RxPDO) is allocated to 0x1600.

In the data of RxPDO (0x1600), object index, sub-index, and the number of bit of each object, which is referred to, are stored. Object with the address starting with 0x7000 is referred to.

Table 5: Object Configuration For Output Data List

| INDEX | SUB-INDEX | DATA TYPE | BIT | ACCESS | VALUE | CONTENT |
|-------------------|-----------|-----------|-----|--------|------------|---|
| 0x1A00 (TxPDO) | 0 | UINT8 | 8 | RO | 16 | Number of items |
| | 1 | UINT32 | 32 | RO | 0xaaaaabcc | aaaa: Index for output channel bb: Sub-Index for output channel cc: Number of bits for output channel |
| | 2 | UINT32 | 32 | RO | | |
| | : | : | : | : | | |
| | 16 | UINT32 | 32 | RO | | |
| | 2 | UINT32 | 32 | RO | | |

■ PDO Assign Objects (Data Transmission Order, Output: 0x1C12, Input: 0x1C13)

An allocation list for RxPDO and an allocation list for TxPDO are allocated to 0x1C12 and 0x1C13, respectively.

The indexes stored in 0x1C12 and 0x1C13 are placed in the order they are actually transmitted via PDO.

Table 6: Object Configuration For PDO Allocation Lists

| INDEX | SUB-INDEX | DATA TYPE | BIT | ACCESS | VALUE | CONTENT |
|--------|-----------|-----------|-----|--------|--------|-----------------|
| 0x1C12 | 0 | UINT8 | 8 | RW | 0 - 1 | Number of items |
| | 1 | UINT16 | 16 | RW | 0x1600 | Output data |
| 0x1C13 | 0 | UINT8 | 8 | RW | 0 - 1 | Number of items |
| | 1 | UINT16 | 16 | RW | - | Unused |

■ Sync Manager Type (0x1C00)

Sync Manager Type is allocated to object 0x1C00 based on the EtherCAT specification.

Table 7: Object Configuration For Sync Manager Type

| INDEX | SUB-INDEX | DATA TYPE | BIT | ACCESS | VALUE | CONTENT |
|--------|-----------|-----------|-----|--------|-------|---------------------|
| 0x1C00 | 0 | UINT8 | 8 | RO | 4 | Number of items |
| | 1 | UINT8 | 8 | RO | 1 | Mailbox Write |
| | 2 | UINT8 | 8 | RO | 2 | Mailbox Read |
| | 3 | UINT8 | 8 | RO | 3 | Process Output Data |
| | 4 | UINT8 | 8 | RO | 4 | Process Input Data |

■ Sync Manager Parameter Objects (0x1C32, 0x1C33)

In R7I4DECT, objects 0x1C32 and 0x1C33 do not exist, as the value of Sync Manager Parameter is fixed.

R7I4DECT supports Free Run mode only as the Sync mode.

Note that Distributed Clock (DC) mode is not supported.

■ Device Type (0x1000)

The device type of this unit is allocated to object 0x1000. The device type is 5001.

Table 8: Object Configuration For Device Type

| INDEX | DATA TYPE | BIT | ACCESS | VALUE | CONTENT |
|--------|-----------|-----|--------|-------|-------------|
| 0x1000 | UINT32 | 32 | RO | 5001 | Device type |

■ Error Register (0x1001)

R7I4DECT does not use Object 0x1001.

■ Manufacturer Device Name (0x1008)

The device name is allocated to object 0x1008 in String form.

Table 9: Object Configuration For Device Name

| INDEX | DATA TYPE | BIT | ACCESS | VALUE | CONTENT |
|--------|-----------|-----|--------|-----------------|--------------|
| 0x1008 | STRING | 32 | RO | R7I4DECT-1-YVF4 | Model number |

■ Manufacturer Hardware Version (0x1009)

The hardware device version of this unit is allocated to object 0x1009 in String form.

The format of version is “n.nn.”

Table 10: Object Configuration For Hardware Version

| INDEX | DATA TYPE | BIT | ACCESS | VALUE | CONTENT |
|--------|-----------|-----|--------|-------|------------------|
| 0x1009 | STRING | 32 | RO | n.nn | Hardware version |

■ Manufacturer Software Version (0x100A)

The software version of this unit is allocated to object 0x100A in String form.

The format of version is “n.nn.”

Table 11: Object Configuration For Software Version

| INDEX | DATA TYPE | BIT | ACCESS | VALUE | CONTENT |
|--------|-----------|-----|--------|-------|------------------|
| 0x100A | STRING | 32 | RO | n.nn | Software version |

■ Identity Object (Vendor information: 0x1018)

Vendor information is allocated to object 0x1018.

While the vendor ID and product code are fixed, the revision number is incremented by one at each major version up of the software.

A unique serial number is allocated to each product.

A serial number consists of 8 digits, starting with two alpha-numeral characters followed by six numeral characters.

The serial number is expressed as 32-bit data divided into 6-bit, 6-bit, and 20-bit groups, with the first two characters converted into 6-bit values.

| 6 BITS | 6 BITS | 20 BITS |
|-----------|-----------|--------------------------------------|
| 1st digit | 2nd digit | 3rd to 8th digits (000000 to 999999) |



| CHARACTER | VALUE |
|-----------|-------|
| 0 | 0 |
| 1 | 1 |
| : | : |
| 9 | 9 |
| A | 10 |
| B | 11 |
| : | : |
| Z | 35 |

Table 12: Object Configuration For Vendor Information

| INDEX | SUB-INDEX | DATA TYPE | BIT | ACCESS | VALUE | CONTENT |
|--------|-----------|-----------|-----|--------|------------|-----------------|
| 0x1018 | 0 | UINT8 | 8 | RO | 4 | Number of items |
| | 1 | UINT32 | 32 | RO | 0x0000060C | Vendor ID |
| | 2 | UINT32 | 32 | RO | 0x52370084 | Product code |
| | 3 | UINT32 | 32 | RO | n | Revision number |
| | 4 | UINT32 | 32 | RO | 0 to n | Serial number |

I/O DATA DESCRIPTION

■ ANALOG OUTPUT MODULE

- Output Area Objects



Data is represented in 16-bit binary.

Negative value is represented in 2's complements.