

## RX Family

# RYZ014A Cellular Module Control Module Using Firmware Integration Technology

## Introduction

This application note describes the usage of the RYZ014A Cellular module control module software, which conforms to the Firmware Integration Technology (FIT) standard.

In the following pages, the RYZ014A Cellular module control module is referred to collectively as “the RYZ014A Cellular FIT module” or “the FIT module”.

The FIT module supports the following Cellular module:

Renesas Electronics RYZ014A Cellular PMOD Module (RYZ014A).

In the following pages, the Renesas Electronics RYZ014A Cellular PMOD Module is referred to as “the RYZ014A Cellular module” or “the Cellular module.”

The FIT module makes use of the functionality of an RTOS. It is intended to be used in conjunction with an RTOS. In addition, the FIT module makes use of the following FIT modules:

- RX Family Board Support Package Module (R01AN1685)
- RX Family SCI Module (R01AN1815)
- RX Family BYTEQ, byte-based circular buffers, Module (R01AN1683)
- RX Family IRQ Module (R01AN1668)

## Target Device

RX65N/RX651 Group

RX66N Group

RX72M Group

RX72N Group

When using this application note with other Renesas MCUs, careful evaluation is recommended after making modifications to comply with the alternate MCU.

## Related Documents

- [1] Firmware Integration Technology User's Manual (R01AN1833)
- [2] RX Family Board Support Package Module Using Firmware Integration Technology (R01AN1685)
- [3] Adding Firmware Integration Technology Modules to Projects (R01AN1723)
- [4] Adding Firmware Integration Technology Modules to CS+ Projects (R01AN1826)
- [5] RX Smart Configurator User's Guide: e<sup>2</sup> studio (R20AN0451)
- [6] RX Family SCI Module Using Firmware Integration Technology (R01AN1815)
- [7] RX Family BYTEQ Module Using Firmware Integration Technology (R01AN1683)
- [8] RX Family IRQ Module Using Firmware Integration Technology (R01AN1668)
- [9] RYZ014 Modules User's Manual: AT Command (R11UZ0093)

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## 1. Overview

### 1.1 RYZ014A Cellular FIT Module

The FIT module is designed to be added to user projects as an API. For instructions on adding the FIT module, refer to “2.11 Adding the FIT Module to Your Project”.

### 1.2 Overview of RYZ014A Cellular FIT Module

This FIT module supports UART communication with the Cellular module.

The Cellular module driver is available in two implementation types, listed below, and the FIT module uses driver implementation type A.

1. Implementation type A:  
Driver software supporting the TCP/IP communication functionality of the module.
2. Implementation type B:  
Driver software supporting SSL communication functionality in addition to the functionality supported by implementation type A. The module handles processing for functions essential to SSL communication, such as protocol control and encryption.

#### 1.2.1 Connection with RYZ014A Cellular Module

Examples of connections between RX65N Cloud Kit and RYZ014A Cellular module are shown in Figure 1.1. The PMOD\_9 pin and the PMOD\_10 pin are not used by the FIT module.

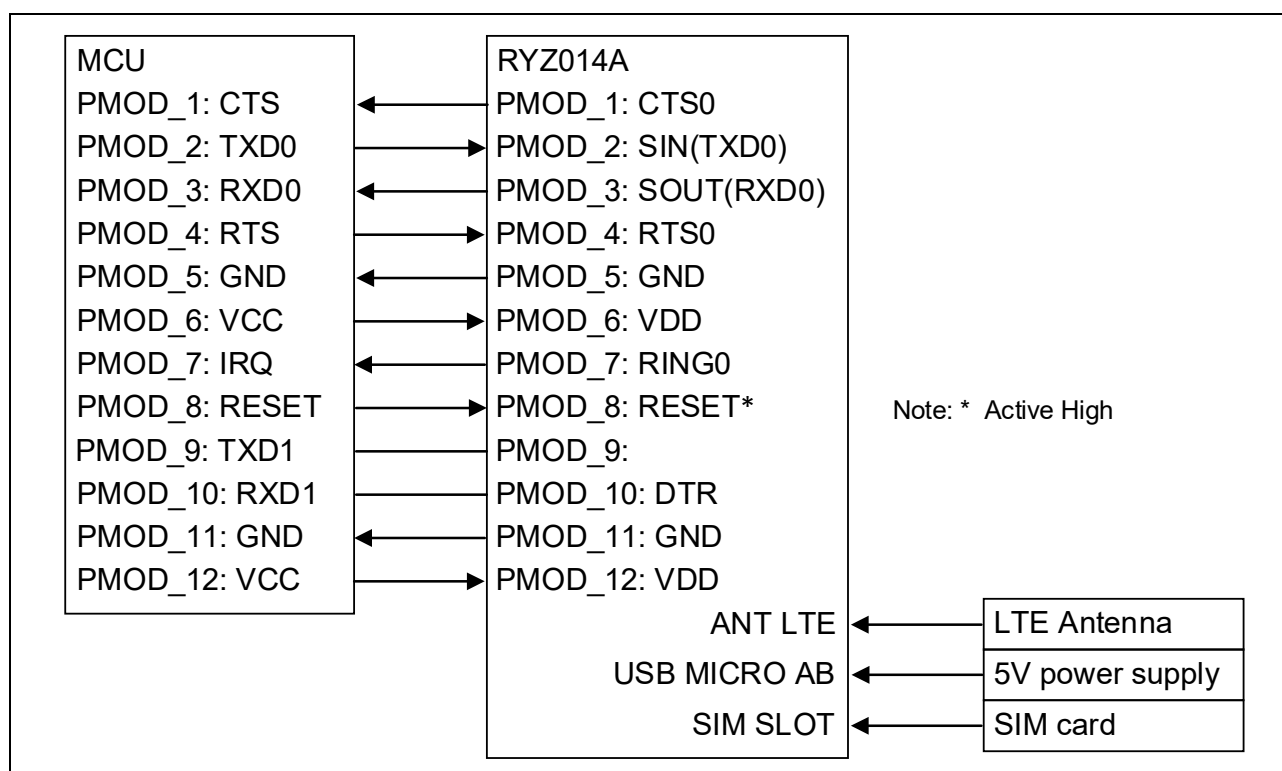
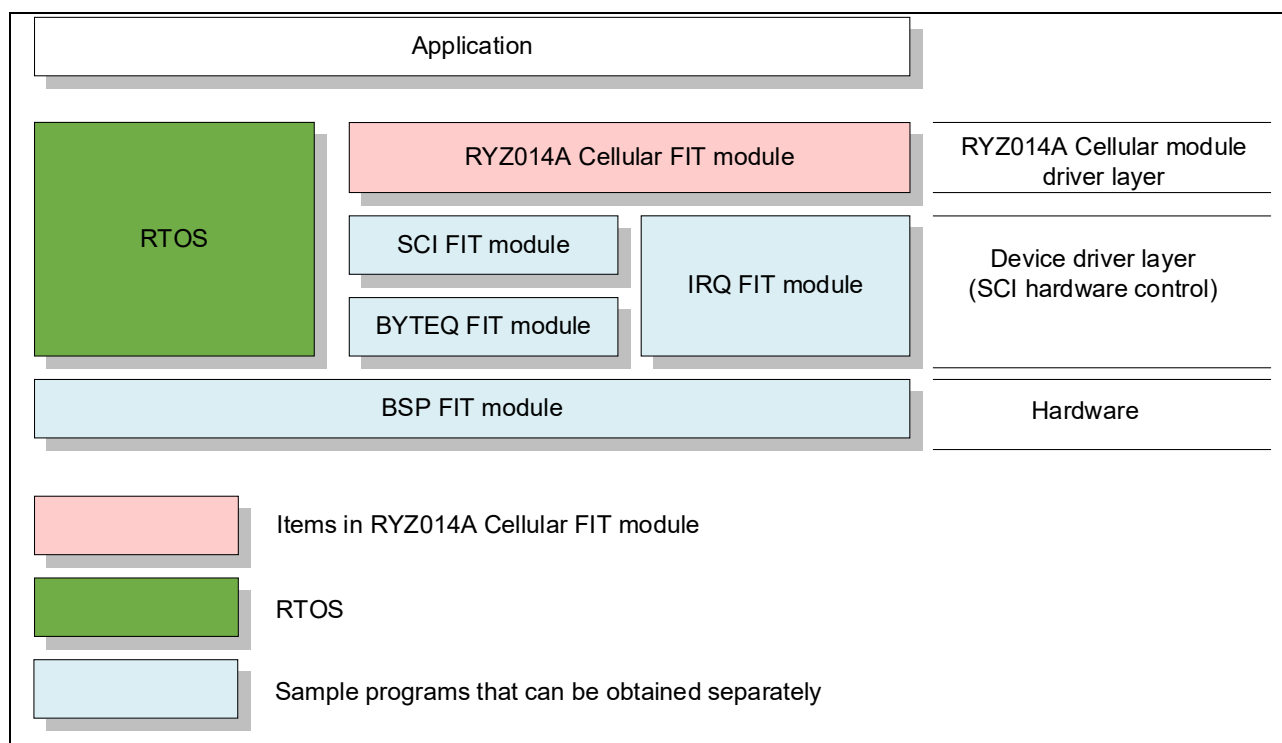


Figure 1.1 Example Connections between RX65N Cloud Kit and RYZ014A Cellular module

### 1.2.2 Software Configuration

Figure 1.2 shows the software configuration.



**Figure 1.2 Software Configuration Diagram**

- (1) RYZ014A Cellular FIT module  
The FIT module. This software is used to control the RYZ014A Cellular module.
- (2) SCI FIT module  
Implements communication between the RYZ014A Cellular module and the MCU. A sample program is available. Refer to “Related Documents” on page 1 and obtain the software.
- (3) IRQ FIT module  
Processes specific notifications from the RYZ014A Cellular module as interrupts. A sample program is available. Refer to “Related Documents” on page 1 and obtain the software.
- (4) BYTEQ FIT module  
Implements circular buffers used by the SCI FIT module. A sample program is available. Refer to “Related Documents” on page 1 and obtain the software.
- (5) BSP FIT module  
The Board Support Package module. A sample program is available. Refer to “Related Documents” on page 1 and obtain the software.
- (6) RTOS  
The RTOS manages the system overall. Operation of the FIT module has been verified using FreeRTOS and AzureRTOS.

### 1.2.3 Overview of API

Table 1.1 lists the API functions included in the FIT module.

**Table 1.1 API functions**

Function	Description
R_CELLULAR_Open	Initializes the FIT module and the Cellular module.
R_CELLULAR_Close	Closes communication between the FIT module and the Cellular module.
R_CELLULAR_APConnect	Connects the Cellular module to an access point.
R_CELLULAR_Disconnect	Disconnects the Cellular module from an access point.
R_CELLULAR_IsConnected	Obtains the FIT module's access point connection status.
R_CELLULAR_CreateSocket	Creates a socket.
R_CELLULAR_ConnectSocket	Starts communication via a socket.
R_CELLULAR_CloseSocket	Closes a socket.
R_CELLULAR_ShutdownSocket	Ends socket communication.
R_CELLULAR_SendSocket	Transmits data via a socket.
R_CELLULAR_ReceiveSocket	Receives data via a socket.
R_CELLULAR_DnsQuery	Executes a DNS query.
R_CELLULAR_GetTime	Obtains the time information setting of the Cellular module.
R_CELLULAR_SetTime	Configures the time information setting of the Cellular module.
R_CELLULAR_SetEDRX	Enables extended discontinuous reception (eDRX).
R_CELLULAR_SetPSM	Enables power saving mode (PSM).
R_CELLULAR_GetICCID	Obtains the IC Card Identifier (ICCID).
R_CELLULAR_GetIMEI	Obtains the International Mobile Equipment Identifier (IMEI).
R_CELLULAR_GetIMSI	Obtains the International Mobile Subscriber Identity (IMSI).
R_CELLULAR_GetPhonenum	Obtains the phone number.
R_CELLULAR_GetRSSI	Obtains Received Signal Strength Indicator (RSSI) and Bit Error Rate (BER).
R_CELLULAR_GetSVN	Obtains Software Version Number (SVN).
R_CELLULAR_Ping	Pings the host.
R_CELLULAR_GetAPConnectState	Obtains the Cellular module's access point connection status.
R_CELLULAR_GetCellInfo	Obtains information on cells.
R_CELLULAR_AutoConnectConfig	Enables autoconnect mode.
R_CELLULAR_SetBand	Configures list of 4G LTE bands the Cellular module is allowed to use.
R_CELLULAR_GetPDPAddress	Obtains a PDP address.
R_CELLULAR_SoftwareReset	Resets the Cellular module with the hardware reset AT command.
R_CELLULAR_HardwareReset	Resets the Cellular module with the RESET pin.
R_CELLULAR_FactoryReset	Perform a factory reset to reset the Cellular module to the factory default configuration.
R_CELLULAR_RTS_Ctrl	Controls the RTS0 pin of the Cellular module.

### 1.2.4 Status Transitions

Figure 1.3 shows the status transitions of the FIT module. The indications in the format “R\_CELLULAR\_XXX” in the figure designate calls to API functions listed in Table 1.1.

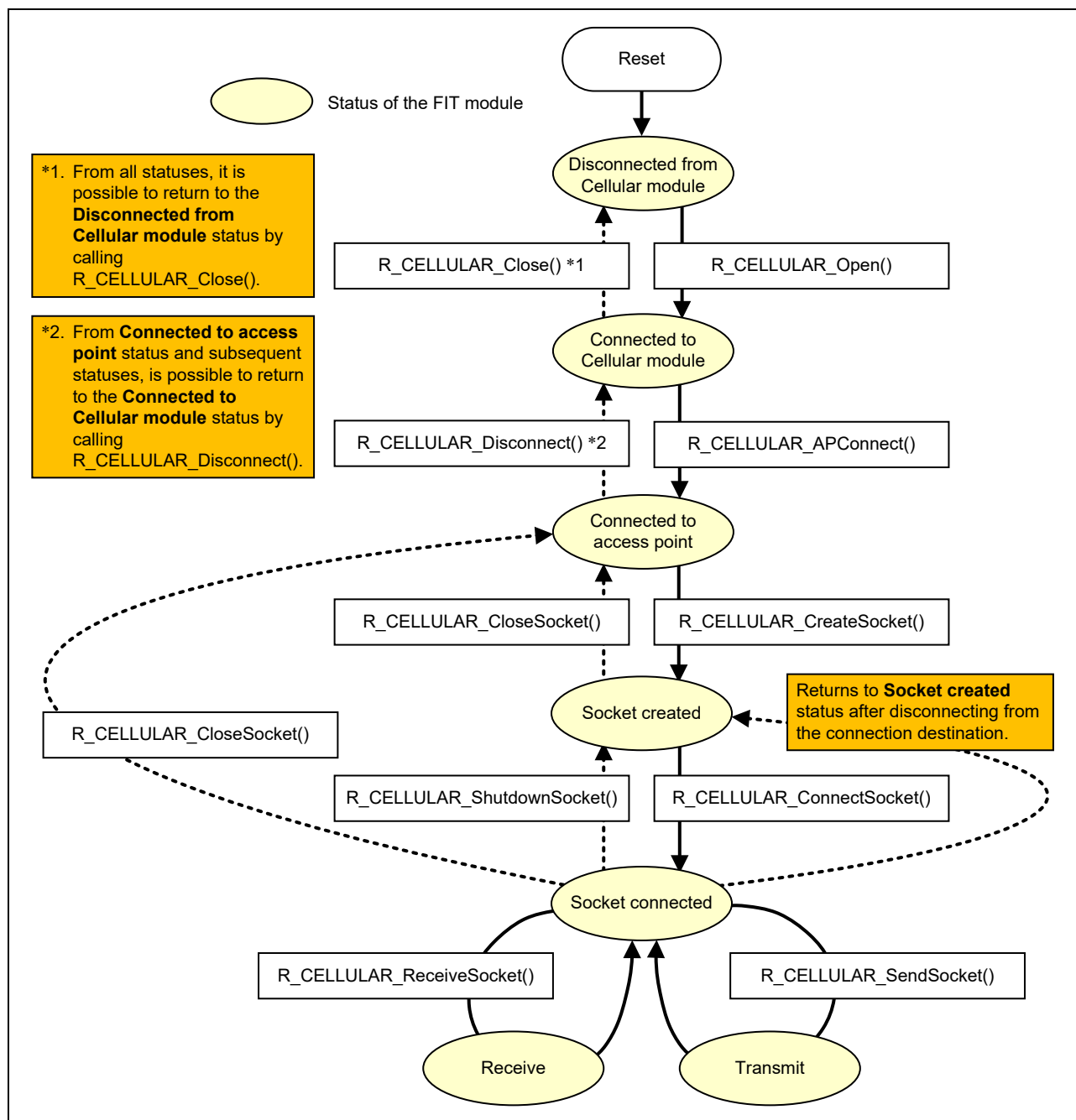


Figure 1.3 Status transitions of RYZ014A Cellular FIT module

## 2. API Information

The FIT module has been confirmed to operate under the following conditions.

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### 2.1 Hardware Requirements

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The MCU used must support the following functions:

- Serial communication
- I/O ports
- IRQ
- One or more IRQ input pins that can be configured as interrupt sources

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### 2.2 Software Requirements

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The driver is dependent upon the following FIT module:

- r\_bsp
- r\_sci\_rx
- r\_byteq
- r\_irq\_rx

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### 2.3 Supported Toolchain

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The FIT module has been confirmed to work with the toolchain listed in 4.1, Confirmed Operation Environment.

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### 2.4 Interrupt Vector

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None

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### 2.5 Header Files

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All API calls and their supporting interface definitions are located in r\_cellular\_if.h.

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### 2.6 Integer Types

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The FIT module uses ANSI C99. These types are defined in stdint.h.



## 2.7 Compile Settings

The configuration option settings of the FIT module are contained in `r_cellular_config.h`.

The names of the options and their setting values are listed in Table 2.1.

**Table 2.1 Configuration options (`r_cellular_config.h`)**

Configuration options in <code>r_cellular_config.h</code>	
CELLULAR_CFG_AP_NAME Note: The default is "globaldata.iot".	Specifies the name of the access point to connect to. Set this option to match the SIM card used.
CELLULAR_CFG_AP_USERID Note: No default is defined.	Sets the username of the access point to connect to. Set this option to match the SIM card used. This setting may be omitted if there is no username.
CELLULAR_CFG_AP_PASSWORD Note: No default is defined.	Sets the password of the access point to connect to. Set this option to match the SIM card used. This setting may be omitted if there is no password.
CELLULAR_CFG_AP_PIN_CODE Note: No default is defined.	Sets the PIN code of the SIM card used. This setting may be omitted if no PIN code has been set.
CELLULAR_CFG_AUTH_TYPE Note: The default is 1.	Specifies authentication protocol used for PDP contexts. Set this option to match the SIM card used. 0: None, 1: PAP, 2: CHAP
CELLULAR_CFG_NETWORK_NOTIFY_LEVEL Note: The default is 2.	Configures value to control the presentation of an unsolicited result code (URC) +CEREG which notifies occurrence of an event such as registration and location information. Set this option to a value of 0 to 5. In order to output the URC to log information, set CELLULAR_CFG_DEBUGLOG to 4. 0: Disabled, 1: Enable registration URC, 2: Enable registration and location information URC, 3: Enable registration, location information and EMM cause value information URC, 4: Enable registration, location information and PSM parameters URC, 5: Enable registration, location information, EMM cause value information and PSM parameters URC.
CELLULAR_CFG_ATC_RETRY_GATT Note: The default is 100.	Specifies the maximum number of retries when connection to an access point fails. Set this option to a value of 0 to 100.
CELLULAR_CFG_EX_TIMEOUT Note: The default is 0.	Specifies the exchange timeout. Set this option to a value of 0 to 120. Use a value of 0 to perform no exchange timeout.
CELLULAR_CFG_SCI_PRIORITY Note: The default is 4.	Sets the interrupt priority of the serial module used for communication with the Cellular module. Set this option to a value of 2 to 15 to match the system priority.
CELLULAR_CFG_SEMAPHORE_BLOCK_TIME Note: The default is 15000.	Sets the API maximum wait time to prevent interference with the various functions. The unit is milliseconds. Set this option to a value of 1 to 15000.
CELLULAR_CFG_PSM_PREPARATION_TIME Note: The default is 100.	Configures guard period during which no character should be received on UART before module entering in sleep mode when UART power saving is activated. The unit is milliseconds. Set this option to a value of 100 to 10000.
CELLULAR_CFG_PSM_WAKEUP_LATENCY Note: The default is 5000.	Maximum wake-up latency to come back to operational mode whenever host needs access to the Cellular module's services. The unit is milliseconds. Set this option to a value of 0 to 10000.
CELLULAR_CFG_RING_LINE_ACTIVE_TIME Note: The default is 1000.	Configures how long the RING0 line is activated in order to indicate a URC or pending data. The unit is milliseconds. Set this option to a value of 1000 to 5000.

CELLULAR_CFG_URC_CHARGET_ENABLED Note: The default is 0.	Specifies whether to use callback function to receive an AT command response from the Cellular module such as unsolicited result code (URC). 0: Not used, 1: Used.
CELLULAR_CFG_URC_CHARGET_FUNCTION Note: The default is "my_sw_urc_charget_function".	Specifies function name of the callback function called when an AT command response from the Cellular module such as unsolicited result code (URC) is received.
CELLULAR_CFG_DEBUGLOG Note: The default is 0.	Configures the output setting for log information. The log information output setting of 1 to 4 can be used with FreeRTOS logging task. Set this option to a value of 0 to 4, as required. 0: Off, 1: Error log output, 2: Output of warnings in addition, 3: Output of status notifications in addition, 4: Output of Cellular module communication information in addition
CELLULAR_CFG_UART_SCI_CH Note: The default is 0.	Specifies the SCI port number used for communication with the Cellular module. The default value specifies SCI port number 0. Set this option to match the SCI port to be controlled.
CELLULAR_CFG_RESET_SIGNAL_LOGIC Note: The default is 1.	Changes the output format of the reset signal sent to the Cellular module. The default value specifies high-level reset signal output.
CELLULAR_CFG_CTS_SW_CTRL Note: The default is 0.	Configures the UART flow control mode. 0: CTS hardware flow control is enabled, RTS flow control is performed by the FIT module using GPIO, 1: RTS hardware flow control is enabled, CTS flow control is performed by the FIT module using GPIO.
CELLULAR_CFG_CTS_PORT Note: The default is 2.	Configures the port direction register (PDR) setting for the general port that controls the CTS pin of the Cellular module. The default value is suitable when port 22 is used. Set this option to match the port to be controlled. This option takes effect when CELLULAR_CFG_CTS_SW_CTRL is set to 1.
CELLULAR_CFG_CTS_PIN Note: The default is 2.	Configures the port output data register (PODR) setting for the general port that controls the CTS pin of the Cellular module. The default value is suitable when port 22 is used. Set this option to match the port to be controlled. This option takes effect when CELLULAR_CFG_CTS_SW_CTRL is set to 1.
CELLULAR_CFG_PFS_SET_VALUE Note: The default is 0x0BU.	Specifies the pin function control register (PFS) setting value to select the peripheral function of the MCU pin used to control the RTS pin of the Cellular module. Set this option to match the pin to be used. This option takes effect when CELLULAR_CFG_CTS_SW_CTRL is set to 1.
CELLULAR_CFG_RTS_PORT Note: The default is 2	Configures the port direction register (PDR) setting for the general port that controls the RTS pin of the Cellular module. The default value is suitable when port 22 is used. Set this option to match the port to be controlled.
CELLULAR_CFG_RTS_PIN Note: The default is 2.	Configures the port output data register (PODR) setting for the general port that controls the RTS pin of the Cellular module. The default value is suitable when port 22 is used. Set this option to match the port to be controlled.
CELLULAR_CFG_RESET_PORT Note: The default is D.	Configures the port direction register (PDR) setting for the general port that controls the PWD_L pin of the Cellular module. The default value is suitable when port D0 is used. Set this option to match the port to be controlled.
CELLULAR_CFG_RESET_PIN Note: The default is 0.	Configures the port output data register (PODR) setting for the general port that controls the PWD_L pin of the Cellular module. The default value is suitable when port D0 is used. Set this option to match the port to be controlled.

CELLULAR_CFG_IRQ_NUM Note: The default is 4.	Specifies the IRQ pin number corresponding to the IRQ pin which is connected to the RING0 pin of the Cellular module to use its output as an external pin interrupt signal. The default value is suitable when IRQ4 is used. Set this option to match the MCU used.
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The configuration option settings of the SCI FIT module used by the FIT module are contained in `r_cellular_config.h`.

The names of the options for SCI FIT module and their setting values are listed in Table 2.2. Refer to the application note, "RX Family SCI Module Using Firmware Integration Technology (R01AN1815)" for details.

**Table 2.2 Configuration options (`r_sci_rx_config.h`)**

Configuration options in <code>r_sci_rx_config.h</code>	
SCI_CFG_CHx_INCLUDED Notes: 1. CHx = CH0 to CH12 2. The default values are as follows: CH0: 1, CH1 to CH12: 0	Each channel has resources such as transmit and receive buffers, counters, interrupts, other programs, and RAM. Setting this option to 1 assigns related resources to the specified channel.
SCI_CFG_CHx_TX_BUFSIZ Notes: 1. CHx = CH0 to CH12 2. The default value is 80 for all channels.	Specifies the transmit buffer size of an individual channel. The buffer size of the channel specified by <code>CELLULAR_CFG_UART_SCI_CH</code> should be set to 2048.
SCI_CFG_CHx_RX_BUFSIZ Notes: 1. CHx = CH0 to CH12 2. The default value is 80 for all channels.	Specifies the receive buffer size of an individual channel. The buffer size of the channel specified by <code>CELLULAR_CFG_UART_SCI_CH</code> should be set to 2048.
SCI_CFG_TEI_INCLUDED Note: The default is 0.	Enables the transmit end interrupt for serial transmissions. The FIT module uses the interrupt, then this option should be set to 1.

The configuration option settings of the IRQ FIT module used by the FIT module are contained in `r_irq_rx_config.h`.

The names of the options for IRQ FIT module and their setting values are listed in Table 2.3. Refer to the application note, "RX Family IRQ Module Using Firmware Integration Technology (R01AN1668)" for details.

**Table 2.3 Configuration options (`r_irq_rx_config.h`)**

Configuration options in <code>r_sci_rx_config.h</code>	
IRQ_CFG_FILT_EN_IRQx Notes: 1. IRQx = IRQ0 to IRQ15 2. The default value is 0 for all channels.	Specifies the channel to be used as IRQ. Set a value of 1 for the channel to which the RING0 pin of the Cellular module is connected.

The configuration option settings of the BSP FIT module used by the FIT module are contained in `r_bsp_config.h`.

The names of the options for BSP FIT module and their setting values are listed in Table 2.4. Refer to the application note, "RX Family Board Support Package Module Using Firmware Integration Technology (R01AN1685)" for details.

**Table 2.4 Configuration options (`r_bsp_config.h`)**

Configuration options in <code>r_bsp_config.h</code>	
<b>BSP_CFG_RTOS_USED</b> Note: The default is 0.	Specifies the type of real-time operating system. When using this FIT module, set the following: FreeRTOS:1, AzureRTOS:5.

The configuration option settings of the RTOS used by the FIT module are contained in `src/frtos_config/FreeRTOSConfig.h` when FreeRTOS used or `libs/threadx/tx_user.h` when AzureRTOS used. The name of the option for FreeRTOS and its setting value is listed in Table 2.5. The names of the options for AzureRTOS and their setting values are listed in Table 2.6. Set the suitable value, as used RTOS.

**Table 2.5 Configuration options (`FreeRTOSConfig.h`)**

Configuration options in <code>FreeRTOSConfig.h</code>	
<b>configTICK_RATE_HZ</b> Note: The default is "( TickType_t )1000".	Specifies RTOS tick interrupt cycle. When using this FIT module, set this option to "( TickType_t )1000".

**Table 2.6 Configuration options (`tx_user.h`)**

Configuration options in <code>tx_user.h</code>	
<b>USE_TX_TIMER_TICKS_PER_SECOND</b> The default is 0.	Enables the user setting for RTOS tick interrupt cycle. When using this FIT module, set this option to 1.
<b>TX_TIMER_TICKS_PER_SECOND</b> The default is 100.	Specifies RTOS tick interrupt cycle. When using this FIT module, set this option to 1000.

## 2.8 Code Size

Table 2.5 lists the ROM size, RAM size, and maximum stack size used by the FIT module. The ROM (code and constants) and RAM (global data) sizes are determined by the configuration options specified at build time (see 2.7, Compile Settings).

The values listed in Table 2.5 have been confirmed under the following conditions.

FIT module revision: r\_cellular rev1.09

Compiler version: Renesas Electronics C/C++ Compiler Package for RX Family V3.04.00  
("-lang = c99" option added to default settings of integrated development environment)

Configuration options: Default settings

**Table 2.7 Code Sizes**

ROM, RAM and Stack Code Sizes			
Device	Category	Memory Used	Remarks
RX65N RX72N	ROM	Approx. 35 KB	-
	RAM	Approx. 600 bytes	-
	Max. stack size used	Approx. 700 bytes	-

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## 2.9 Parameters

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This section describes the parameter structures used by the API functions in this module. The structures are defined in `r_cellular_if.h`.

Management structure (used by all APIs)

- `st_cellular_ctrl_t`

Configuration structure (used by `R_CELLULAR_Open()`)

- `st_cellular_cfg_t`

Structure for setting to connect to access point (used by `R_CELLULAR_APConnect()`)

- `st_cellular_ap_cfg_t`

Structures for setting and obtaining the time (used by `R_CELLULAR_GetTime()` and `R_CELLULAR_SetTime()`)

- `st_cellular_datetime_t`

Structures for setting and obtaining eDRX configuration (Used by `R_CELLULAR_SetEDRX()`)

- `st_cellular_edrx_config_t`

Structures for setting and obtaining PSM configuration (Used by `R_CELLULAR_SetPSM()`)

- `st_cellular_edrx_config_t`

Structures for obtaining the ICCID (used by `R_CELLULAR_GetICCID()`)

- `st_cellular_iccid_t`

Structures for obtaining the IMEI (used by `R_CELLULAR_GetIMEI()`)

- `st_cellular_imei_t`

Structures for obtaining the IMSI (used by `R_CELLULAR_GetIMSI()`)

- `st_cellular_imsi_t`

Structures for obtaining the phone number (used by `R_CELLULAR_GetPhonenum()`)

- `st_cellular_phonenum_t`

Structures for obtaining the RSSI (used by `R_CELLULAR_GetRSSI()`)

- `st_cellular_rssi_t`

Structures for obtaining the SVN (used by `R_CELLULAR_GetSVN()`)

- `st_cellular_svn_t`

Structures for obtaining the Cellular module's access point connection status (used by `R_CELLULAR_GetAPConnectState()`)

- `st_cellular_notice_t`

Structures for obtaining the IP addresses (used by `R_CELLULAR_DnsQuery()` and `R_CELLULAR_GetPDPAddress()`)

- `st_cellular_ipaddr_t`

Structures for setting ping parameters (used by `R_CELLULAR_Ping()`)

- `st_cellular_ping_cfg_t`

## 2.10 Return Values

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The APIs returns enumerated types listed below. The enumerated types of return values are defined in `r_cellular_if.h`.

API error codes:

- `e_cellular_err_t`

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## 2.11 Adding the FIT Module to Your Project

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This module must be added to each project in which it is used. Renesas recommends the method using the Smart Configurator described in (1) or (3) or (5) below. However, the Smart Configurator only supports some RX devices. Please use the methods of (2) or (4) for RX devices that are not supported by the Smart Configurator.

- (1) Adding the FIT module to your project using the Smart Configurator in e<sup>2</sup> studio  
By using the Smart Configurator in e<sup>2</sup> studio, the FIT module is automatically added to your project. Refer to “RX Smart Configurator User’s Guide: e<sup>2</sup> studio (R20AN0451)” for details.
- (2) Adding the FIT module to your project using the FIT Configurator in e<sup>2</sup> studio  
By using the FIT Configurator in e<sup>2</sup> studio, the FIT module is automatically added to your project. Refer to “RX Family Adding Firmware Integration Technology Modules to Projects (R01AN1723)” for details.
- (3) Adding the FIT module to your project using the Smart Configurator in CS+  
By using the Smart Configurator Standalone version in CS+, the FIT module is automatically added to your project. Refer to “RX Smart Configurator User Guide: CS+ (R20AN0470)” for details.
- (4) Adding the FIT module to your project in CS+  
In CS+, please manually add the FIT module to your project. Refer to “RX Family Adding Firmware Integration Technology Modules to CS+ Projects (R01AN1826)” for details.
- (5) Adding the FIT module to your project using the Smart Configurator in IAREW  
By using the Smart Configurator Standalone version, the FIT module is automatically added to your project. Refer to “RX Smart Configurator User Guide: IAREW (R20AN0535)” for details.

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## 2.12 RTOS Usage Requirement

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The FIT module utilizes RTOS functionality.

### 3. API Functions

#### 3.1 R\_CELLULAR\_Open()

Initializes the RYZ014A Cellular FIT module and the Cellular module.

##### Format

```
e_cellular_err_t R_CELLULAR_Open (
    st_cellular_ctrl_t * const p_ctrl,
    st_cellular_cfg_t * const p_cfg
)
```

##### Parameters

<i>p_ctrl</i> (IN/OUT)	Pointer to <i>st_cellular_ctrl_t</i> structure defined by the user
<i>p_cfg</i> (IN)	Pointer to <i>st_cellular_cfg_t</i> structure defined by the user

##### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_ALREADY_OPEN</i>	<i>/* R_CELLULAR_Open has already been run */</i>
<i>CELLULAR_ERR_SERIAL_OPEN</i>	<i>/* Serial initialization failure */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_SEMAPHORE_INIT</i>	<i>/* Semaphore initialization failure */</i>
<i>CELLULAR_ERR_EVENT_GROUP_INIT</i>	<i>/* Event group initialization failure */</i>
<i>CELLULAR_ERR_CREATE_TASK</i>	<i>/* Failure creating task */</i>
<i>CELLULAR_ERR_MEMORY_ALLOCATION</i>	<i>/* Memory allocation failure */</i>

##### Properties

Prototype declarations are contained in *r\_cellular\_if.h*.

##### Description

Initializes the RYZ014A Cellular FIT module and the Cellular module to prepare for wireless communication.

If *p\_cfg* is set to NULL, the default values of the FIT module and the values set by Smart Configurator are used.

Once setting to use callback function using the Smart Configurator, an AT command response from the Cellular module such as unsolicited result code (URC) can be received with the callback function. (Refer to Table 2.1 for details.)

Default values used when *p\_cfg* is set to NULL:

```
<baud_rate = 921600 / ap_gatt_retry_count = 100 / sci_timeout = 10000 / tx_process_size = 1500
/ rx_process_size = 1500 / packet_data_size = 0 / exchange_timeout = 60
/ connect_timeout = 200 / send_timeout = 10 / creatable_socket = 6>
```



## Reentrant

Reentrant operation is not possible.

## Thread Safety

This function is not thread safe.

## Examples

[Using default configuration values]

```
e_cellular_err_t ret;
st_cellular_ctrl_t cellular_ctrl = {0};
ret = R_CELLULAR_Open(&cellular_ctrl, NULL);
```

[Setting new configuration values]

```
/* Callback function example (Using the default function name) */
uint8_t portBuffer[2049] = {'\0'};
void my_sw_urc_charget_function(void * p_arg)
{
    //Obtains an AT command response such as URC.
    sprintf((char *)portBuffer, "%.2048s", (char *)p_arg);
}

e_cellular_err_t ret;
st_cellular_ctrl_t cellular_ctr = {0};
st_cellular_cfg_t cellular_cfg = {
    "0000",          // PIN code of SIM card
    921600,          // Baud rate for communication with module
                    // (921600 recommended)
    0,               // Retry limit when connecting to access point
    0xffff,          // MCU communication timeout setting
    100,             // Data size of single transmission to Cellular module
    100,             // Data size of single reception from Cellular module
    100,             // Data size per packet
    100,             // Exchange timeout
    100,             // Socket connection timeout
    100,             // Packet transmission timeout
    3};              // Maximum socket creation count
ret = R_CELLULAR_Open(&cellular_ctrl, &cellular_cfg);
```

## Special Notes

None

---

## 3.2 R\_CELLULAR\_Close()

---

Closes communication with the Cellular module and shuts down it.

### Format

```
e_cellular_err_t R_CELLULAR_Close (  
    st_cellular_ctrl_t * const p_ctrl  
)
```

### Parameters

*p\_ctrl* (IN/OUT)                      *Pointer to st\_cellular\_ctrl\_t structure defined by the user*

### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

### Properties

Prototype declarations are contained in r\_cellular\_if.h.

### Description

Closes communication with the Cellular module and shuts down it.

When a connection has been established to an access point, the connection to the access point is closed. When communication is taking place via a socket, the connection to the socket and the connection to the access point are closed.

### Reentrant

Reentrant operation is not possible.

### Thread Safety

This function is thread safe.

### Examples

```
e_cellular_err_t ret;  
st_cellular_ctrl_t cellular_ctrl = {0};  
ret = R_CELLULAR_Open(&cellular_ctrl, NULL);  
ret = R_CELLULAR_Close(&cellular_ctrl);
```

### Special Notes

None

### 3.3 R\_CELLULAR\_APConnect()

Connects the Cellular module to an access point.

#### Format

```
e_cellular_err_t R_CELLULAR_APConnect (
    st_cellular_ctrl_t * const p_ctrl,
    const st_cellular_ap_cfg_t * const p_ap_cfg
)
```

#### Parameters

<i>p_ctrl</i> (IN/OUT)	Pointer to <i>st_cellular_ctrl_t</i> structure defined by the user
<i>p_ap_cfg</i> (IN)	Pointer to <i>st_cellular_ap_cfg_t</i> structure defined by the user

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_ALREADY_CONNECT</i>	<i>/* Already connected to access point */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in *r\_cellular\_if.h*.

#### Description

Connects the Cellular module to an access point.

In order to connect to an access point, it is necessary to configure the required information, including access point information, before running this function, using either of the following methods.

- (1) Configure the macros in *r\_cellular\_config.h* listed in Table 3.1 with appropriate values.

(Refer to Table 2.1 for details.)

Note1: In this case, set *p\_ap\_cfg* to NULL.

Note2: Configure macro settings in Smart Configurator. Do not edit macro values directly.

- (2) While *R\_CELLULAR\_Open()* is running, set as the second argument a pointer to the *st\_cellular\_cfg\_t* structure, with appropriate values configured for the members listed in Table 3.2. Then, while *R\_CELLULAR\_APConnect()* is running, set as the second argument a pointer to the *st\_cellular\_ap\_cfg\_t* structure, with appropriate values configured for the members listed in Table 3.3.

The number of connection retries is the value of the *CELLULAR\_CFG\_AT\_COMMAND\_RETRY\_GATT* macro or the value of the *ap\_gatt\_retry\_count* member in the *st\_cellular\_cfg\_t* structure, with one-second intervals in between.

When a connection is successfully established to the access point, the network time is obtained automatically and stored in the nonvolatile memory of the RYZ014A Cellular module. To obtain the time, run `R_CELLULAR_GetTime()`. In addition, the IP address assigned when a connection to an access point is established is stored in the `pdp_addr` member of the `st_cellular_ctrl_t` structure referenced by the pointer `p_ctrl`.

Before running this API, run `R_CELLULAR_Open()` to initialize the RYZ014A Cellular FIT module and the Cellular module. If `R_CELLULAR_Open()` has not been run, a value of `CELLULAR_ERR_NOT_OPEN` is returned.

**Table 3.1 Macros Required to Connect to an Access Point**

Configuration options in <code>r_cellular_config.h</code>	
<code>CELLULAR_CFG_AP_NAME</code>	Connection destination access point name
<code>CELLULAR_CFG_AP_USERID</code>	Username of connection destination access point
<code>CELLULAR_CFG_AP_PASSWORD</code>	Password of connection destination access point
<code>CELLULAR_CFG_PIN_CODE</code>	PIN code of SIM card used
<code>CELLULAR_CFG_AUTH_TYPE</code>	Authentication protocol (0: None, 1: PAP, 2: CHAP)
<code>CELLULAR_CFG_AT_COMMAND_RETRY_GATT</code>	Maximum number of retries when connecting to an access point

**Table 3.2 Members Required to Connect to an Access Point (`R_CELLULAR_Open()`)**

Members in <code>st_cellular_cfg_t</code> structure	
<code>uint8_t sim_pin_code</code>	PIN code of SIM card used
<code>uint8_t ap_gatt_retry_count</code>	Maximum number of retries when connecting to an access point

**Table 3.3 Members Required to Connect to an Access Point (`R_CELLULAR_APConnect()`)**

Members in <code>st_cellular_ap_cfg_t</code> structure	
<code>uint8_t ap_name</code>	Connection destination access point name
<code>uint8_t ap_user_name</code>	Username of connection destination access point
<code>uint8_t ap_pass</code>	Password of connection destination access point
<code>uint8_t auth_type</code>	Authentication protocol (0: None, 1: PAP, 2: CHAP)

**Reentrant**

Reentrant operation is not possible.

**Thread Safety**

This function is thread safe.

**Examples**

```
e_cellular_err_t ret;  
st_cellular_ctrl_t cellular_ctrl = {0};  
ret = R_CELLULAR_Open(&cellular_ctrl, NULL);  
ret = R_CELLULAR_APConnect(&cellular_ctrl, NULL);
```

**Special Notes**

None

---

### 3.4 R\_CELLULAR\_IsConnected()

---

Obtains the FIT module's access point connection status.

#### Format

```
e_cellular_err_t R_CELLULAR_IsConnected (  
    st_cellular_ctrl_t * const p_ctrl  
)
```

#### Parameters

*p\_ctrl* (IN/OUT)                      *Pointer to st\_cellular\_ctrl\_t structure defined by the user*

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Connected to access point */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_NOT_CONNECT</i>	<i>/* Not connected to access point */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in r\_cellular\_if.h.

#### Description

Obtains the FIT module's access point connection status.

#### Reentrant

Reentrant operation is possible.

#### Thread Safety

This function is thread safe.

#### Examples

```
e_cellular_err_t ret;  
st_cellular_ctrl_t cellular_ctrl = {0};  
ret = R_CELLULAR_Open(&cellular_ctrl, NULL);  
ret = R_CELLULAR_IsConnect(&cellular_ctrl);
```

#### Special Notes

None

---

### 3.5 R\_CELLULAR\_Disconnect()

---

Disconnects the Cellular module from an access point.

#### Format

```
e_cellular_err_t R_CELLULAR_Disconnect (  
    st_cellular_ctrl_t * const p_ctrl  
)
```

#### Parameters

*p\_ctrl* (IN/OUT)                      *Pointer to st\_cellular\_ctrl\_t structure defined by the user*

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_NOT_CONNECT</i>	<i>/* Not connected to access point */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in r\_cellular\_if.h.

#### Description

Disconnects the Cellular module from an access point.

**Reentrant**

Reentrant operation is not possible.

**Thread Safety**

This function is thread safe.

**Examples**

```
e_cellular_err_t ret;  
st_cellular_ctrl_t cellular_ctrl = {0};  
ret = R_CELLULAR_Open(&cellular_ctrl, NULL);  
ret = R_CELLULAR_APConnect(&cellular_ctrl, NULL);  
ret = R_CELLULAR_Disconnect(&cellular_ctrl);
```

**Special Notes**

None



### 3.6 R\_CELLULAR\_CreateSocket()

Creates a socket.

#### Format

```
int32_t R_CELLULAR_CreateSocket (
    st_cellular_ctrl_t * const p_ctrl,
    const uint8_t protocol_type,
    const uint8_t ip_version
)
```

#### Parameters

<i>p_ctrl</i> (IN/OUT)	Pointer to <i>st_cellular_ctrl_t</i> structure defined by the user
<i>protocol_type</i> (IN)	Protocol type (specified as TCP = 6)
<i>ip_version</i> (IN)	IP version (specified as IPv4 = 4 or IPv6 = 6)

#### Return values

Value of 1 to 6	<i>/* Normal end */</i>
CELLULAR_ERR_PARAMETER	<i>/* Invalid argument value */</i>
CELLULAR_ERR_NOT_OPEN	<i>/* Open function has not been run */</i>
CELLULAR_ERR_MODULE_COM	<i>/* Failure communicating with Cellular module */</i>
CELLULAR_ERR_MODULE_TIMEOUT	<i>/* Timeout communicating with Cellular module */</i>
CELLULAR_ERR_NOT_CONNECT	<i>/* Not connected to access point */</i>
CELLULAR_ERR_SOCKET_CREATE_LIMIT	<i>/* Socket creation limit exceeded */</i>
CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING	<i>/* Another AT command is running */</i>
CELLULAR_ERR_OTHER_API_RUNNING	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in *r\_cellular\_if.h*.

#### Description

Sets the protocol type and IP version of a usable socket. For *protocol\_type*, specify CELLULAR\_PROTOCOL\_TCP (6), and for *ip\_version*, specify CELLULAR\_PROTOCOL\_IPV4 (4) or CELLULAR\_PROTOCOL\_IPV6 (6).

When the function is completed successfully, a socket is created, and a number is returned as the return value. The number of the created socket is an integer value between 1 and 6.

Before running this API, run R\_CELLULAR\_APConnect() to connect to an access point. If R\_CELLULAR\_APConnect() has not been run, a value of CELLULAR\_ERR\_NOT\_CONNECT is returned.

**Reentrant**

Reentrant operation is not possible.

**Thread Safety**

This function is thread safe.

**Examples**

```
e_cellular_err_t ret;
st_cellular_ctrl_t cellular_ctrl = {0};
ret = R_CELLULAR_Open(&cellular_ctrl, NULL);
ret = R_CELLULAR_APConnect(&cellular_ctrl, NULL);
ret = R_CELLULAR_CreateSocket (&cellular_ctrl, CELLULAR_PROTOCOL_TCP,
                                CELLULAR_PROTOCOL_IPV4);
```

**Special Notes**

None

### 3.7 R\_CELLULAR\_ConnectSocket()

Connects to the specified IP address and port.

#### Format

```
e_cellular_err_t R_CELLULAR_ConnectSocket (
    st_cellular_ctrl_t * const p_ctrl,
    const uint8_t socket_no,
    const uint8_t * const p_ip_addr,
    const uint16_t port
)
```

#### Parameters

<i>p_ctrl</i> (IN/OUT)	<i>Pointer to st_cellular_ctrl_t structure defined by the user</i>
<i>socket_no</i> (IN)	<i>Socket number</i>
<i>p_ip_addr</i> (IN)	<i>Pointer to connection destination address in string type</i> <i>Using an IPv4 address, it should be period separated decimal format,</i> <i>e.g., "104.120.11.132"</i> <i>Using an IPv6 address, it should be colon separated hexadecimal format,</i> <i>e.g., "1234:5678:9ABC:DEF0:1234:5678:9ABC:DEF0"</i> <i>A fully qualified domain name (FQDN) as a host name also can be used,</i> <i>e.g., "www.renesas.com"</i>
<i>port</i> (IN)	<i>Connection destination port number</i>

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_NOT_CONNECT</i>	<i>/* Not connected to access point */</i>
<i>CELLULAR_ERR_ALREADY_SOCKET_CONNECT</i>	<i>/* Already connected to socket */</i>
<i>CELLULAR_ERR_SOCKET_NOT_READY</i>	<i>/* Socket is in error status */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in r\_cellular\_if.h.

## Description

Using the socket specified by *socket\_no*, connects to the destination specified by either the IP address or the host name referenced by the pointer *p\_ip\_addr*, and contacts to the port specified by *port*. The IP address and the host name should be expressed as a string type data.

Before running this API, run `R_CELLULAR_CreateSocket()` to create a socket. If

`R_CELLULAR_CreateSocket()` has not been run, a value of `CELLULAR_ERR_SOCKET_NOT_READY` is returned.

## Reentrant

Reentrant operation is not possible.

## Thread Safety

This function is thread safe.

## Examples

```
e_cellular_err_t ret;
st_cellular_ctrl_t cellular_ctrl = {0};
int8_t socket_no;
uint16_t port_no = 33333;
uint8_t ip_addr[] = "104.120.11.132";

ret = R_CELLULAR_Open(&cellular_ctrl, NULL);
ret = R_CELLULAR_APConnect(&cellular_ctrl, NULL);
socket_no = R_CELLULAR_CreateSocket (&cellular_ctrl, CELLULAR_PROTOCOL_TCP,
                                     CELLULAR_PROTOCOL_IPV4);

if (0 < socket_no)
{
    ret = R_CELLULAR_ConnectSocket(&p_ctrl, socket_no, ip_addr, port_no);
}
```

## Special Notes

None

---

### 3.8 R\_CELLULAR\_ShutdownSocket()

---

Shuts down socket communication.

#### Format

```
e_cellular_err_t R_CELLULAR_ShutdownSocket (
    st_cellular_ctrl_t * const p_ctrl,
    const uint8_t socket_no
)
```

#### Parameters

<i>p_ctrl</i> (IN/OUT)	<i>Pointer to st_cellular_ctrl_t structure defined by the user</i>
<i>socket_no</i> (IN)	<i>Socket number</i>

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_NOT_CONNECT</i>	<i>/* Not connected to access point */</i>
<i>CELLULAR_ERR_SOCKET_NOT_READY</i>	<i>/* Socket is in error status */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in r\_cellular\_if.h.

#### Description

Shuts down communication on the socket specified by *socket\_no*.

**Reentrant**

Reentrant operation is not possible.

**Thread Safety**

This function is thread safe.

**Examples**

```
e_cellular_err_t ret;
st_cellular_ctrl_t cellular_ctrl = {0};
int8_t socket_no;
uint16_t port_no = 33333;
uint8_t ip_adder[] = "104.120.11.132";

ret = R_CELLULAR_Open(&cellular_ctrl, NULL);
ret = R_CELLULAR_APConnect(&cellular_ctrl, NULL);
socket_no = R_CELLULAR_CreateSocket (&cellular_ctrl, CELLULAR_PROTOCOL_TCP,
                                     CELLULAR_PROTOCOL_IPV4);
if (0 < socket_no)
{
    ret = R_CELLULAR_ConnectSocket(&p_ctrl, socket_no, ip_adder, port_no);
    ret = R_CELLULAR_ShutdownSocket(&p_ctrl, socket_no);
}
```

**Special Notes**

None

---

### 3.9 R\_CELLULAR\_CloseSocket()

---

Closes a socket.

#### Format

```
e_cellular_err_t R_CELLULAR_CloseSocket (
    st_cellular_ctrl_t * const p_ctrl,
    const uint8_t socket_no
)
```

#### Parameters

<i>p_ctrl</i> (IN/OUT)	<i>Pointer to st_cellular_ctrl_t structure defined by the user</i>
<i>socket_no</i> (IN)	<i>Socket number</i>

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_NOT_CONNECT</i>	<i>/* Not connected to access point */</i>
<i>CELLULAR_ERR_SOCKET_NOT_READY</i>	<i>/* Socket is in error status */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in r\_cellular\_if.h.

#### Description

Closes the socket specified by *socket\_no*. If communication is in progress on the socket, the socket is disconnected.

## Reentrant

Reentrant operation is not possible.

## Thread Safety

This function is thread safe.

## Examples

```
e_cellular_err_t ret;
st_cellular_ctrl_t cellular_ctrl = {0};
int8_t socket_no;
uint16_t port_no = 33333;
uint8_t ip_adder[] = "104.120.11.132";

ret = R_CELLULAR_Open(&cellular_ctrl, NULL);
ret = R_CELLULAR_APConnect(&cellular_ctrl, NULL);
socket_no = R_CELLULAR_CreateSocket (&cellular_ctrl, CELLULAR_PROTOCOL_TCP,
                                     CELLULAR_PROTOCOL_IPV4);
if (0 < socket_no)
{
    ret = R_CELLULAR_ConnectSocket(&p_ctrl, socket_no, ip_adder, port_no);
    ret = R_CELLULAR_CloseSocket(&p_ctrl, socket_no);
}
```

## Special Notes

None



### 3.10 R\_CELLULAR\_SendSocket()

Transmits data via the specified socket.

#### Format

```
e_cellular_err_t R_CELLULAR_SendSocket (
    st_cellular_ctrl_t * const p_ctrl,
    const uint8_t socket_no,
    uint8_t * const data,
    const int32_t length,
    const uint32_t timeout_ms
)
```

#### Parameters

<i>p_ctrl</i> (IN/OUT)	<i>Pointer to st_cellular_ctrl_t structure defined by the user</i>
<i>socket_no</i> (IN)	<i>Socket number</i>
<i>data</i> (IN)	<i>Pointer to transmit data</i>
<i>length</i> (IN)	<i>Transmit data size (1 or more)</i>
<i>timeout_ms</i> (IN)	<i>Timeout setting (ms units, setting value = 0 to 0xffffffff, 0 = no timeout)</i>

#### Return values

<i>Number of bytes transmitted</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_NOT_CONNECT</i>	<i>/* Not connected to access point */</i>
<i>CELLULAR_ERR_SOCKET_NOT_READY</i>	<i>/* Socket is in error status */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in r\_cellular\_if.h.

#### Description

Transmits the number of bytes specified by *length* of the data stored in *data* from the socket specified by *socket\_no*.

Before running this API, run R\_CELLULAR\_ConnectSocket(). If R\_CELLULAR\_ConnectSocket() has not been run, a value of CELLULAR\_ERR\_SOCKET\_NOT\_READY is returned.

## Reentrant

Reentrant operation is not possible.

## Thread Safety

This function is thread safe.

## Examples

```
e_cellular_err_t ret;
st_cellular_ctrl_t cellular_ctrl = {0};
int8_t socket_no;
uint16_t port_no = 33333;
uint8_t ip_adder[] = "104.120.11.132";

ret = R_CELLULAR_Open(&cellular_ctrl, NULL);
ret = R_CELLULAR_APConnect(&cellular_ctrl, NULL);
socket_no = R_CELLULAR_CreateSocket (&cellular_ctrl, CELLULAR_PROTOCOL_TCP,
                                     CELLULAR_PROTOCOL_IPV4);
if (0 < socket_no)
{
    ret = R_CELLULAR_ConnectSocket(&p_ctrl, socket_no, ip_adder, port_no);
    ret = R_CELLULAR_SendSocket(&p_ctrl, socket_no, data, length, timeout);
}
```

## Special Notes

None

### 3.11 R\_CELLULAR\_ReceiveSocket()

Receives data via the specified socket.

#### Format

```
e_cellular_err_t R_CELLULAR_ReceiveSocket (
    st_cellular_ctrl_t * const p_ctrl,
    const uint8_t socket_no,
    uint8_t * const data,
    const int32_t length,
    const uint32_t timeout_ms
)
```

#### Parameters

<i>p_ctrl</i> (IN/OUT)	<i>Pointer to st_cellular_ctrl_t structure defined by the user</i>
<i>socket_no</i> (IN)	<i>Socket number</i>
<i>data</i> (IN)	<i>Pointer to received data</i>
<i>length</i> (IN)	<i>Received data size (1 or more)</i>
<i>timeout_ms</i> (IN)	<i>Timeout setting (ms units, setting value = 0 to 0xffffffff, 0 = no timeout)</i>

#### Return values

<i>Number of bytes transmitted</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_NOT_CONNECT</i>	<i>/* Not connected to access point */</i>
<i>CELLULAR_ERR_SOCKET_NOT_READY</i>	<i>/* Socket is in error status */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in r\_cellular\_if.h.

#### Description

Acquires and stores the number of received bytes specified by *length* of the data in the receive data area *data* from the socket specified by *socket\_no*.

Before running this API, run R\_CELLULAR\_ConnectSocket(). If R\_CELLULAR\_ConnectSocket() has not been run, a value of CELLULAR\_ERR\_SOCKET\_NOT\_READY is returned.

## Reentrant

Reentrant operation is not possible.

## Thread Safety

This function is thread safe.

## Examples

```
e_cellular_err_t ret;
st_cellular_ctrl_t cellular_ctrl = {0};
int8_t socket_no;
uint16_t port_no = 33333;
uint8_t ip_adder[] = "104.120.11.132";

ret = R_CELLULAR_Open(&cellular_ctrl, NULL);
ret = R_CELLULAR_APConnect(&cellular_ctrl, NULL);
socket_no = R_CELLULAR_CreateSocket (&cellular_ctrl, CELLULAR_PROTOCOL_TCP,
                                     CELLULAR_PROTOCOL_IPV4);
if (0 < socket_no)
{
    ret = R_CELLULAR_ConnectSocket(&p_ctrl, socket_no, ip_adder, port_no);
    ret = R_CELLULAR_ReceiveSocket(&p_ctrl, socket_no, data, length, timeout);
}
```

## Special Notes

None

### 3.12 R\_CELLULAR\_DnsQuery()

Executes a DNS query.

#### Format

```
e_cellular_err_t R_CELLULAR_DnsQuery (
    st_cellular_ctrl_t * const p_ctrl,
    uint8_t *const domain_name,
    const uint8_t ip_version,
    st_cellular_ipaddr_t * const p_addr
)
```

#### Parameters

<i>p_ctrl</i> (IN/OUT)	<i>Pointer to st_cellular_ctrl_t structure defined by the user</i>
<i>domain_name</i> (IN)	<i>Pointer to domain name storage area</i>
<i>ip_version</i> (IN)	<i>IP version (specified as IPv4 = 4 or IPv6 = 6)</i>
<i>p_addr</i> (IN/OUT)	<i>Pointer to st_cellular_ipaddr_t structure defined by the user</i>

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_NOT_CONNECT</i>	<i>/* Not connected to access point */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>
<i>CELLULAR_ERR_SIM_NOT_SUPPORT_IPV6</i>	<i>/* IPv6 is not available */</i>

#### Properties

Prototype declarations are contained in `r_cellular_if.h`.

#### Description

Executes a DNS query, obtains the IP address of the IP version specified by *ip\_version* for the domain specified by *domain\_name*, and saves it in the `st_cellular_ipaddr_t` structure referenced by the pointer *p\_addr*.

Before running this API, run `R_CELLULAR_APConnect()` to connect to an access point. If `R_CELLULAR_APConnect()` has not been run, a value of `CELLULAR_ERR_NOT_CONNECT` is returned. If *ip\_version* is set to IPv6 (6) when IPv6 is not available, a value of `CELLULAR_ERR_SIM_NOT_SUPPORT_IPV6` is returned.

**Reentrant**

Reentrant operation is possible.

**Thread Safety**

This function is thread safe.

**Examples**

```
e_cellular_err_t ret;
st_cellular_ctrl_t cellular_ctrl = {0};
st_cellular_ipaddr_t addr = {0};
uint8_t domain_name[] = "www.renesas.com";

ret = R_CELLULAR_Open(&cellular_ctrl, NULL);
ret = R_CELLULAR_APConnect(&cellular_ctrl, NULL);
ret = R_CELLULAR_DnsQuery (&cellular_ctrl, domain_name, CELLULAR_PROTOCOL_IPV4,
                           &addr);
```

**Special Notes**

None

### 3.13 R\_CELLULAR\_GetTime()

Obtains the date and time information stored in the RYZ014A Cellular module.

#### Format

```
e_cellular_err_t R_CELLULAR_GetTime (
    st_cellular_ctrl_t * const p_ctrl,
    st_cellular_datetime_t * const p_time
)
```

#### Parameters

<i>p_ctrl</i> (IN/OUT)	<i>Pointer to st_cellular_ctrl_t structure defined by the user</i>
<i>p_time</i> (IN/OUT)	<i>Pointer to structure for storing acquired date and time</i>

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in *r\_cellular\_if.h*.

#### Description

Obtains the date and time information setting of the RYZ014A Cellular module and saves it in the *st\_cellular\_datetime\_t* structure referenced by the pointer *p\_time*.

The value of the date and time information is "70/01/01/00:00:00+00" (year/month/date/hour:minute:second:time zone) when the Cellular module is activated. To use date and time information, run *R\_CELLULAR\_SetTime()* to obtain the current date and time.

**Reentrant**

Reentrant operation is possible.

**Thread Safety**

This function is thread safe.

**Examples**

```
e_cellular_err_t ret;  
st_cellular_ctrl_t cellular_ctrl = {0};  
st_cellular_datetime_t cellular_time = {0};  
  
ret = R_CELLULAR_Open(&cellular_ctrl, NULL);  
ret = R_CELLULAR_GetTime(&cellular_ctrl, &cellular_time);
```

**Special Notes**

None



---

### 3.14 R\_CELLULAR\_SetTime()

---

This function configures the date and time information setting of the RYZ014A Cellular module.

#### Format

```
e_cellular_err_t R_CELLULAR_SetTime (  
    st_cellular_ctrl_t * const p_ctrl,  
    const st_cellular_datetime_t * const p_time  
)
```

#### Parameters

<i>p_ctrl</i> (IN/OUT)	<i>Pointer to st_cellular_ctrl_t structure defined by the user</i>
<i>p_time</i> (IN/OUT)	<i>Pointer to structure for storing acquired date and time</i>

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in r\_cellular\_if.h.

#### Description

Configures the RYZ014A Cellular module with the date and time information stored in *p\_time*.

If this function is run before connecting to an access point, the date and time information set by the function is overwritten by the network time obtained automatically when a connection to an access point is established.

**Reentrant**

Reentrant operation is possible.

**Thread Safety**

This function is thread safe.

**Examples**

```
e_cellular_err_t ret;
st_cellular_ctrl_t cellular_ctrl = {0};
st_cellular_datetime_t cellular_time = {21,8,1,12,34,56,36};
                                     // 2021, August, 1st, 12:34:56 + 36
                                     // The time zone is specified in 15-minute units.
ret = R_CELLULAR_Open(&cellular_ctrl, NULL);
ret = R_CELLULAR_SetTime(&cellular_ctrl, &cellular_time);
```

**Special Notes**

None

### 3.15 R\_CELLULAR\_SetEDRX()

Configures the extended discontinuous reception (eDRX) parameter settings of the Cellular module.

#### Format

```
e_cellular_err_t R_CELLULAR_SetEDRX (
    st_cellular_ctrl_t * const p_ctrl,
    const st_cellular_edrx_config_t * const p_config,
    st_cellular_edrx_config_t * const p_result
)
```

#### Parameters

<i>p_ctrl</i> (IN/OUT)	<i>Pointer to st_cellular_ctrl_t structure defined by the user</i>
<i>p_config</i> (IN)	<i>Pointer to st_cellular_edrx_config_t structure defined by the user (For setting eDRX parameters)</i>
<i>p_result</i> (IN/OUT)	<i>Pointer to st_cellular_edrx_config_t structure defined by the user (For obtaining applied eDRX parameters)</i>

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in r\_cellular\_if.h.

#### Description

Configures eDRX parameter settings in the Cellular module.

Obtains the applied eDRX cycle and Paging Time Window (PTW) and saves them in the st\_cellular\_edrx\_config\_t structure referenced by the pointer *p\_result*.

The values that may be set for the edrx\_mode member of the st\_cellular\_edrx\_config\_t structure are as follows.

```
typedef enum
{
    CELLULAR_EDRX_MODE_INVALID = 0,           // Disable the edrx function
    CELLULAR_EDRX_MODE_ACTIVE = 1,           // Enable the edrx function
    CELLULAR_EDRX_MODE_ACTIVE_RESULT = 2,    // Activate the edrx function and return the results
    CELLULAR_EDRX_MODE_INIT = 3,             // Initialize and disable the edrx function
} e_cellular_edrx_mode_t;
```

The values that may be set for the `edrx_cycle` (eDRX cycle) member of the `st_cellular_edrx_config_t` structure are as follows.

```
typedef enum
{
    CELLULAR_EDRX_CYCLE_5_SEC = 0,        // edrx cycle (5.12sec)
    CELLULAR_EDRX_CYCLE_10_SEC,           // edrx cycle (10.24sec)
    CELLULAR_EDRX_CYCLE_20_SEC,           // edrx cycle (20.48sec)
    CELLULAR_EDRX_CYCLE_40_SEC,           // edrx cycle (40.96sec)
    CELLULAR_EDRX_CYCLE_81_SEC,           // edrx cycle (81.92sec)
    CELLULAR_EDRX_CYCLE_163_SEC,          // edrx cycle (163.84sec)
    CELLULAR_EDRX_CYCLE_327_SEC,          // edrx cycle (327.68sec)
    CELLULAR_EDRX_CYCLE_655_SEC,          // edrx cycle (655.36sec)
    CELLULAR_EDRX_CYCLE_1310_SEC,         // edrx cycle (1,310.72sec)
    CELLULAR_EDRX_CYCLE_2621_SEC,         // edrx cycle (2,621.44sec)
} e_cellular_edrx_cycle_t;
```

The values that may be set for the `ptw_cycle` (paging time window cycle) member of the `st_cellular_edrx_config_t` structure are as follows.

```
typedef enum
{
    CELLULAR_PTW_CYCLE_1_SEC,             // PTW (1.28sec)
    CELLULAR_PTW_CYCLE_2_SEC,             // PTW (2.56sec)
    CELLULAR_PTW_CYCLE_4_SEC,             // PTW (3.84sec)
    CELLULAR_PTW_CYCLE_5_SEC,             // PTW (5.12sec)
    CELLULAR_PTW_CYCLE_6_SEC,             // PTW (6.40sec)
    CELLULAR_PTW_CYCLE_7_SEC,             // PTW (7.68sec)
    CELLULAR_PTW_CYCLE_9_SEC,             // PTW (8.96sec)
    CELLULAR_PTW_CYCLE_10_SEC,            // PTW (10.24sec)
    CELLULAR_PTW_CYCLE_11_SEC,            // PTW (11.52sec)
    CELLULAR_PTW_CYCLE_13_SEC,            // PTW (12.80sec)
    CELLULAR_PTW_CYCLE_14_SEC,            // PTW (14.08sec)
    CELLULAR_PTW_CYCLE_15_SEC,            // PTW (15.36sec)
    CELLULAR_PTW_CYCLE_16_SEC,            // PTW (16.64sec)
    CELLULAR_PTW_CYCLE_18_SEC,            // PTW (17.92sec)
    CELLULAR_PTW_CYCLE_19_SEC,            // PTW (19.20sec)
    CELLULAR_PTW_CYCLE_20_SEC,            // PTW (20.48sec)
} e_cellular_ptw_cycle_t;
```

## Reentrant

Reentrant operation is not possible.

## Thread Safety

This function is thread safe.

## Examples

Setting the eDRX cycle to 20 seconds and PTW to 2 seconds (For details of setting values, refer to the comments in `r_cellular_if.h`.)

```
e_cellular_err_t ret;  
st_cellular_ctrl_t cellular_ctrl = {0};  
st_cellular_edrx_config_t edrx_cfg = {CELLULAR_EDRX_MODE_ACTIVE,  
                                     CELLULAR_EDRX_CYCLE_20_SEC,  
                                     CELLULAR_PTW_CYCLE_2_SEC};  
st_cellular_edrx_config_t edrx_ret = {0};  
  
/* The third parameter is not used */  
ret = R_CELLULAR_Open(&cellular_ctrl, &edrx_cfg, NULL);  
  
/* Obtaining applied parameters using edrx_ret */  
ret = R_CELLULAR_SetEDRX(&cellular_ctrl, &edrx_cfg, &edrx_ret);
```

## Special Notes

Figure 3.1 shows the eDRX parameters corresponding to the setting values of this function.

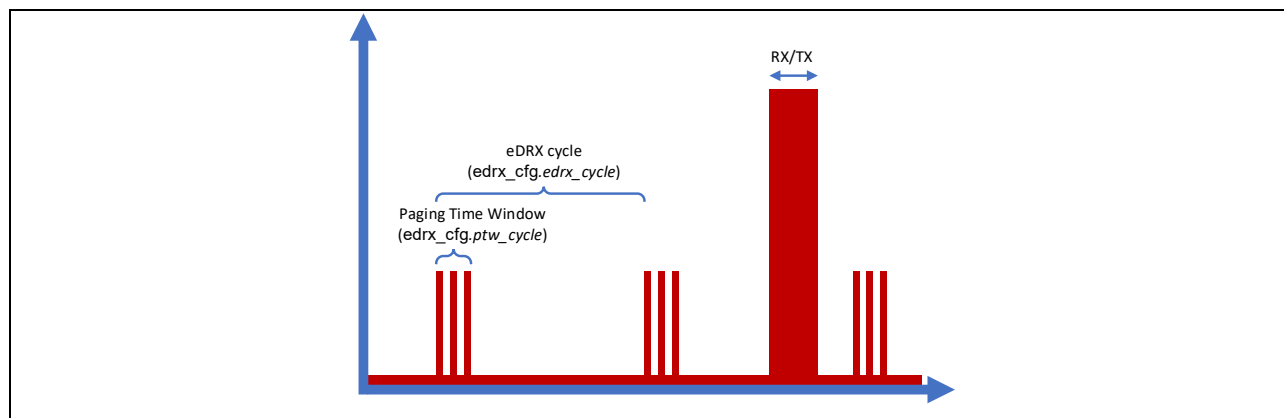


Figure 3.1 eDRX parameter

### 3.16 R\_CELLULAR\_SetPSM()

Configures the power saving mode (PSM) settings of the Cellular module.

#### Format

```
e_cellular_err_t R_CELLULAR_SetPSM (
    st_cellular_ctrl_t * const p_ctrl,
    const st_cellular_psm_config_t * const p_config,
    st_cellular_psm_config_t * const p_result
)
```

#### Parameters

<i>p_ctrl</i> (IN/OUT)	Pointer to <i>st_cellular_ctrl_t</i> structure defined by the user
<i>p_config</i> (IN)	Pointer to <i>st_cellular_psm_config_t</i> structure defined by the user (For setting PSM parameters)
<i>p_result</i> (IN/OUT)	Pointer to <i>st_cellular_psm_config_t</i> structure defined by the user (For obtaining applied PSM parameters)

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in *r\_cellular\_if.h*.

#### Description

Configures the PSM parameters of the Cellular module.

Obtains the applied PSM parameters and saves them in the *st\_cellular\_psm\_config\_t* structure referenced by the pointer *p\_result*.

The values set in the Cellular module are calculated using the following formula.

$$TAU = \tau \times \tau\_multiplier$$

$$ActiveTime = active \times active\_multiplier$$

The values that may be set for the *psm\_mode* member of the *st\_cellular\_psm\_config\_t* structure are as follows.

```
typedef enum
{
    CELLULAR_PSM_MODE_INVALID      = 0,    // Disable the PSM function
    CELLULAR_PSM_MODE_ACTIVE       = 1,    // Enable the PSM function
    CELLULAR_PSM_MODE_INIT        = 2,    // Initialize and disable the PSM function
} e_cellular_psm_mode_t;
```

The values that may be set for the `tau_cycle` (tracking area update cycle) member of the `st_cellular_psm_config_t` structure are as follows.

```
typedef enum
{
    CELLULAR_TAU_CYCLE_10_MIN = 0,           // TAU cycle (10min)
    CELLULAR_TAU_CYCLE_1_HOUR,               // TAU cycle (1hour)
    CELLULAR_TAU_CYCLE_10_HOUR,              // TAU cycle (10hour)
    CELLULAR_TAU_CYCLE_2_SEC,                // TAU cycle (2sec)
    CELLULAR_TAU_CYCLE_30_SEC,               // TAU cycle (30sec)
    CELLULAR_TAU_CYCLE_1_MIN,                // TAU cycle (1min)
    CELLULAR_TAU_CYCLE_320_HOUR,             // TAU cycle (320hour)
    CELLULAR_TAU_CYCLE_NONE,                 // TAU cycle (Timer is deactivated)
} e_cellular_tau_cycle_t;
```

The values that may be set for the `active_cycle` (active time cycle) member of the `st_cellular_psm_config_t` structure are as follows.

```
typedef enum
{
    CELLULAR_ACTIVE_CYCLE_2_SEC = 0,         // Active time (2sec)
    CELLULAR_ACTIVE_CYCLE_1_MIN,             // Active time (1min)
    CELLULAR_ACTIVE_CYCLE_6_MIN,             // Active time (6min)
    CELLULAR_ACTIVE_CYCLE_NONE,              // Active time (Timer is deactivated)
} e_cellular_active_cycle_t;
```

The values that may be set for the `tau_multiplier` and the `active_multiplier` member of the `st_cellular_psm_config_t` structure are as follows.

```
typedef enum
{
    CELLULAR_CYCLE_MULTIPLIER_0 = 0,         // Multiplier 0
    CELLULAR_CYCLE_MULTIPLIER_1 = 1,         // Multiplier 1
    CELLULAR_CYCLE_MULTIPLIER_2 = 2,         // Multiplier 2
    :
    CELLULAR_CYCLE_MULTIPLIER_30 = 30,       // Multiplier 30
    CELLULAR_CYCLE_MULTIPLIER_31 = 31,       // Multiplier 31
} e_cellular_cycle_multiplier_t;
```

## Reentrant

Reentrant operation is not possible.

## Thread Safety

This function is thread safe.

## Examples

Setting the TAU to 10 minutes and the active time to 1 minute (For details of setting values, refer to the comments in `r_cellular_if.h`.)

```
e_cellular_err_t ret;
st_cellular_ctrl_t cellular_ctrl = {0};
st_cellular_psm_config_t psm_cfg = {CELLULAR_EDRX_MODE_ACTIVE,
                                     CELLULAR_TAU_CYCLE_10_MIN,
                                     CELLULAR_CYCLE_MULTIPLIER_1,
                                     CELLULAR_ACTIVE_CYCLE_1_MIN,
                                     CELLULAR_CYCLE_MULTIPLIER_1};

st_cellular_psm_config_t psm_ret = {0};

ret = R_CELLULAR_Open(&cellular_ctrl, NULL);

/* The third parameter is not used */
ret = R_CELLULAR_SetPSM(&cellular_ctrl, &psm_cfg, NULL);

/* Obtaining applied parameters using psm_ret */
ret = R_CELLULAR_SetPSM(&cellular_ctrl, &psm_cfg, &psm_ret);
```

- The `tau_cycle` field of `psm_cfg` set to 10 minutes and the `tau_multiplier` field of `psm_cfg` set to a multiplier of 1 = 10 minutes  $\times$  1 = 10 minutes
- The `active_cycle` field of `psm_cfg` set to 1 minute and the `active_multiplier` field of `psm_cfg` set to a multiplier of 1 = 1 minute  $\times$  1 = 1 minute

## Special Notes

Figure 3.2 shows the PSM parameters corresponding to the setting values of this function.

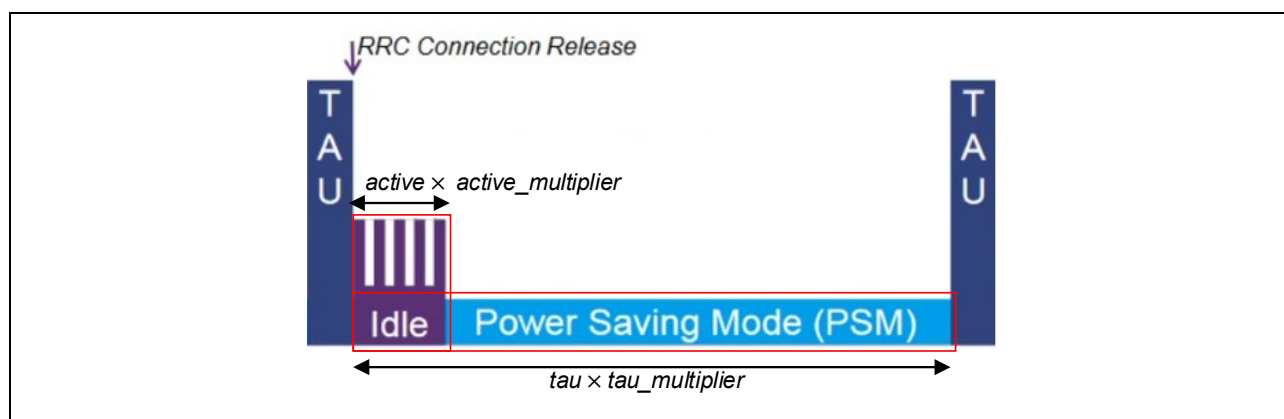


Figure 3.2 PSM parameter



---

### 3.17 R\_CELLULAR\_GetICCID()

---

Obtains the IC card identifier (ICCID) assigned to the SIM card used.

#### Format

```
e_cellular_err_t R_CELLULAR_GetICCID (  
    st_cellular_ctrl_t * const p_ctrl,  
    st_cellular_iccid_t * const p_iccid  
)
```

#### Parameters

<i>p_ctrl</i> (IN/OUT)	<i>Pointer to st_cellular_ctrl_t structure defined by the user</i>
<i>p_iccid</i> (IN/OUT)	<i>Pointer to structure for storing acquired ICCID</i>

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in r\_cellular\_if.h.

#### Description

Obtains the ICCID from the SIM card used and saves it in the st\_cellular\_iccid\_t structure referenced by the pointer *p\_iccid*. The ICCID obtained is up to 22 digits.

**Reentrant**

Reentrant operation is possible.

**Thread Safety**

This function is thread safe.

**Examples**

```
e_cellular_err_t ret;  
st_cellular_ctrl_t cellular_ctrl = {0};  
st_cellular_iccid_t cellular_iccid = {0};  
  
ret = R_CELLULAR_Open(&cellular_ctrl, NULL);  
ret = R_CELLULAR_GetICCID(&cellular_ctrl, &cellular_iccid);
```

**Special Notes**

None

### 3.18 R\_CELLULAR\_GetIMEI()

Obtains the international mobile equipment identifier (IMEI) assigned to the RYZ014A Cellular module used.

#### Format

```
e_cellular_err_t R_CELLULAR_GetIMEI (
    st_cellular_ctrl_t * const p_ctrl,
    st_cellular_imei_t * const p_imei
)
```

#### Parameters

<i>p_ctrl</i> (IN/OUT)	<i>Pointer to st_cellular_ctrl_t structure defined by the user</i>
<i>p_imei</i> (IN/OUT)	<i>Pointer to structure for storing acquired IMEI</i>

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in *r\_cellular\_if.h*.

#### Description

Obtains the IMEI from the Cellular module used and saves it in the *st\_cellular\_imei\_t* structure referenced by the pointer *p\_imei*. The IMEI obtained is up to 15 digits.

**Reentrant**

Reentrant operation is possible.

**Thread Safety**

This function is thread safe.

**Examples**

```
e_cellular_err_t ret;  
st_cellular_ctrl_t cellular_ctrl = {0};  
st_cellular_imei_t cellular_imei = {0};  
  
ret = R_CELLULAR_Open(&cellular_ctrl, NULL);  
ret = R_CELLULAR_GetIMEI(&cellular_ctrl, &cellular_imei);
```

**Special Notes**

None

### 3.19 R\_CELLULAR\_GetIMSI()

Obtains the international mobile subscriber identity (IMSI) assigned to the SIM card used.

#### Format

```
e_cellular_err_t R_CELLULAR_GetIMSI (
    st_cellular_ctrl_t * const p_ctrl,
    st_cellular_imsi_t * const p_imsi
)
```

#### Parameters

<i>p_ctrl</i> (IN/OUT)	<i>Pointer to st_cellular_ctrl_t structure defined by the user</i>
<i>p_imsi</i> (IN/OUT)	<i>Pointer to structure for storing acquired IMSI</i>

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in r\_cellular\_if.h.

#### Description

Obtains the IMSI from the SIM card used and saves it in the st\_cellular\_imsi\_t structure referenced by the pointer p\_imsi. The IMSI obtained is up to 15 digits.

**Reentrant**

Reentrant operation is possible.

**Thread Safety**

This function is thread safe.

**Examples**

```
e_cellular_err_t ret;  
st_cellular_ctrl_t cellular_ctrl = {0};  
st_cellular_imsi_t cellular_imsi = {0};  
  
ret = R_CELLULAR_Open(&cellular_ctrl, NULL);  
ret = R_CELLULAR_GetIMSI(&cellular_ctrl, &cellular_imsi);
```

**Special Notes**

None

---

### 3.20 R\_CELLULAR\_GetPhonenum()

---

Obtains the phone number associated with the SIM card used.

#### Format

```
e_cellular_err_t R_CELLULAR_GetPhonenum (  
    st_cellular_ctrl_t * const p_ctrl,  
    st_cellular_phonenum_t * const p_phonenum  
)
```

#### Parameters

<i>p_ctrl</i> (IN/OUT)	<i>Pointer to st_cellular_ctrl_t structure defined by the user</i>
<i>p_phonenum</i> (IN/OUT)	<i>Pointer to structure for storing acquired phone number</i>

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in r\_cellular\_if.h.

#### Description

Obtains the phone number from the SIM card used and saves it in the st\_cellular\_phonenum\_t structure referenced by the pointer *p\_phonenum*. The phone number obtained is up to 15 digits.

**Reentrant**

Reentrant operation is possible.

**Thread Safety**

This function is thread safe.

**Examples**

```
e_cellular_err_t ret;  
st_cellular_ctrl_t cellular_ctrl = {0};  
st_cellular_phonenum_t cellular_phonenum = {0};  
  
ret = R_CELLULAR_Open(&cellular_ctrl, NULL);  
ret = R_CELLULAR_GetPhonenum(&cellular_ctrl, &cellular_phonenum);
```

**Special Notes**

None



### 3.21 R\_CELLULAR\_GetRSSI()

Obtains received strength indication (RSSI) and channel bit error rate (BER) from the RYZ014A Cellular module.

#### Format

```
e_cellular_err_t R_CELLULAR_GetRSSI (
    st_cellular_ctrl_t * const p_ctrl,
    st_cellular_rssi_t * const p_rssi
)
```

#### Parameters

<i>p_ctrl</i> (IN/OUT)	<i>Pointer to st_cellular_ctrl_t structure defined by the user</i>
<i>p_rssi</i> (IN/OUT)	<i>Pointer to structure for storing acquired RSSI and BER</i>

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in r\_cellular\_if.h.

#### Description

Obtains RSSI and BER from the Cellular module and saves it in the st\_cellular\_rssi\_t structure referenced by the pointer *p\_rssi*.

If RSSI and BER are not known or not detectable owing to such factors as the Cellular module is not connected to an access point, "99" is acquired.

**Reentrant**

Reentrant operation is possible.

**Thread Safety**

This function is thread safe.

**Examples**

```
e_cellular_err_t ret;  
st_cellular_ctrl_t cellular_ctrl = {0};  
st_cellular_rssi_t cellular_rssi = {0};  
  
ret = R_CELLULAR_Open(&cellular_ctrl, NULL);  
ret = R_CELLULAR_APConnect(&cellular_ctrl, NULL);  
ret = R_CELLULAR_GetRSSI(&cellular_ctrl, &cellular_rssi);
```

**Special Notes**

None

---

### 3.22 R\_CELLULAR\_GetSVN()

---

Obtains software version number (SVN) and revision information of the RYZ014A Cellular module.

#### Format

```
e_cellular_err_t R_CELLULAR_GetSVN (  
    st_cellular_ctrl_t * const p_ctrl,  
    st_cellular_svn_t * const p_svn  
)
```

#### Parameters

<i>p_ctrl (IN/OUT)</i>	<i>Pointer to st_cellular_ctrl_t structure defined by the user</i>
<i>p_svn (IN/OUT)</i>	<i>Pointer to structure for storing acquired SVN and revision</i>

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in r\_cellular\_if.h.

#### Description

Obtains SVN and revision information from the Cellular module and saves it in the st\_cellular\_svn\_t structure referenced by the pointer p\_svn.

**Reentrant**

Reentrant operation is possible.

**Thread Safety**

This function is thread safe.

**Examples**

```
e_cellular_err_t ret;  
st_cellular_ctrl_t cellular_ctrl = {0};  
st_cellular_svn_t cellular_svn = {0};  
  
ret = R_CELLULAR_Open(&cellular_ctrl, NULL);  
ret = R_CELLULAR_GetSVN(&cellular_ctrl, &cellular_svn);
```

**Special Notes**

None

### 3.23 R\_CELLULAR\_Ping()

Pings the host.

#### Format

```
e_cellular_err_t R_CELLULAR_Ping (
    st_cellular_ctrl_t * const p_ctrl,
    const uint8_t * const p_host,
    const st_cellular_ping_cfg_t * const p_cfg
)
```

#### Parameters

<i>p_ctrl</i> (IN/OUT)	Pointer to <i>st_cellular_ctrl_t</i> structure defined by the user
<i>p_host</i> (IN)	Pointer to structure for storing host name or host IP address
<i>p_cfg</i> (IN/OUT)	Pointer to <i>st_cellular_ping_cfg_t</i> structure defined by the user

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_NOT_CONNECT</i>	<i>/* Not connected to access point */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in *r\_cellular\_if.h*.

#### Description

Pings the host. Either the host IP address or the host name referenced by the pointer *p\_host* should be string type.

This function can be run with one of the following two settings of *p\_cfg*. (Refer to Table 3.4 for setting value details.)

- (1) Sets *p\_cfg* to NULL, then pings with the default configuration.
- (2) Sets *p\_cfg* to the pointer which references the *st\_cellular\_ping\_cfg\_t* structure with members set to the applicable value.

Once setting *CELLULAR\_CFG\_URC\_CHARGET\_ENABLED* to 1 using the Smart Configurator to use callback function, the ping status can be received with the callback function. (Refer to Table 2.1 for details.)

**Table 3.4 Members to Configure Pings (R\_CELLULAR\_Ping())**

Members in st_cellular_ping_cfg_t structure		
uint8_t	count	Number of ping echo request to send. (Default: 4, minimum: 1, maximum: 64)
uint16_t	len	Length of ping echo request message in bytes. (Default: 32, minimum: 32, maximum: 1400)
uint16_t	interval	Length of ping echo request message in seconds. (Default: 1, minimum: 1, maximum: 600)
uint8_t	timeout	Time to wait for an echo reply in seconds. (Default: 10, minimum: 1, maximum: 60)

**Reentrant**

Reentrant operation is not possible.

**Thread Safety**

This function is thread safe.

**Examples**

```

/* Callback function example (Using the default function name) */
void my_sw_urc_charget_function(void * p_arg)
{
    uint8_t * p_urc = p_arg;
    printf("URC = %s\n", p_urc);
}

e_cellular_err_t ret;
st_cellular_ctrl_t cellular_ctrl = {0};
st_cellular_ping_cfg_t ping_cfg = {64, 1400, 1, 10};

ret = R_CELLULAR_Open(&cellular_ctrl, NULL);
ret = R_CELLULAR_APConnect(&cellular_ctrl, NULL);

/* Setting a host name */
ret = R_CELLULAR_Ping(&cellular_ctrl, www.renesas.com, NULL);

/* Setting an IP address */
ret = R_CELLULAR_Ping(&cellular_ctrl, "104.120.11.132", NULL);

/* Setting with the st_cellular_ping_cfg_t structure */
ret = R_CELLULAR_Ping(&cellular_ctrl, "www.renesas.com", &ping_cfg);

```

**Special Notes**

None

### 3.24 R\_CELLULAR\_GetAPConnectState()

Obtains the RYZ014A Cellular module's access point connection status.

#### Format

```
e_cellular_err_t R_CELLULAR_GetAPConnectState (
    st_cellular_ctrl_t * const p_ctrl,
    const e_cellular_network_result_t level,
    st_cellular_notice_t * const p_result
)
```

#### Parameters

<i>p_ctrl</i> (IN/OUT)	<i>Pointer to st_cellular_ctrl_t structure defined by the user</i>
<i>level</i> (IN)	<i>Setting value to control the notification of occurrence of an event</i>
<i>p_result</i> (IN/OUT)	<i>Pointer to structure for storing the access point connection status</i>

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in r\_cellular\_if.h.

#### Description

Obtains the Cellular module's access point connection status and saves it in the st\_cellular\_notice\_t structure referenced by the pointer *p\_result*.

In addition, Once setting CELLULAR\_CFG\_URC\_CHARGET\_ENABLED to 1 using the Smart Configurator to use callback function, a change in the Cellular module's access point connection status can be received with the callback function. (Refer to Table 2.1 for details.)

The values that may be set for the argument *level* are as follows.

```
typedef enum
{
    CELLULAR_DISABLE_NETWORK_RESULT_CODE = 0,
        // Disable notification of network registration status change
    CELLULAR_ENABLE_NETWORK_RESULT_CODE_LEVEL1,
        // Enable notification of network registration status change
    CELLULAR_ENABLE_NETWORK_RESULT_CODE_LEVEL2,
        // Enable detailed notification of network registration status change
    CELLULAR_ENABLE_NETWORK_RESULT_CODE_LEVEL3,
        // Enable network registration, location information and EMM cause value information
    CELLULAR_ENABLE_NETWORK_RESULT_CODE_LEVEL4,
        // For a UE that wants to apply PSM, enable network registration and location information
    CELLULAR_ENABLE_NETWORK_RESULT_CODE_LEVEL5,
        // For a UE that wants to apply PSM, enable network registration, location information and
        // EMM cause value information
} e_cellular_network_result_t;
```

### Reentrant

Reentrant operation is not possible.

### Thread Safety

This function is thread safe.

### Examples

```
/* Callback function example (Using the default function name) */
void my_sw_urc_charget_function(void * p_arg)
{
    uint8_t * p_urc = p_arg;
    printf("URC = %s\n", p_urc);
}

e_cellular_err_t ret;
st_cellular_ctrl_t cellular_ctrl = {0};
st_cellular_notice_t cellular_notice = {0};

ret = R_CELLULAR_Open(&cellular_ctrl, NULL);
ret = R_CELLULAR_APConnect(&cellular_ctrl, NULL);
ret = R_CELLULAR_GetAPConnectState(&cellular_ctrl,
    CELLULAR_ENABLE_NETWORK_RESULT_CODE_LEVEL2, &cellular_notice);
```

### Special Notes

None



### 3.25 R\_CELLULAR\_GetCellInfo()

Obtains information on cells.

#### Format

```
e_cellular_err_t R_CELLULAR_GetCellInfo (
    st_cellular_ctrl_t * const p_ctrl,
    const e_cellular_info_type_t type
)
```

#### Parameters

<i>p_ctrl</i> (IN/OUT)	<i>Pointer to st_cellular_ctrl_t structure defined by the user</i>
<i>type</i> (IN)	<i>Setting value to configure the cell from which to report information</i>

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in r\_cellular\_if.h.

#### Description

Obtains information on the serving and neighbor cells and notifies the information via the callback function. Before running this API, setting CELLULAR\_CFG\_URC\_CHARGET\_ENABLED to 1 using the Smart Configurator to use callback function. If callback function has not been set to use, a value of CELLULAR\_ERR\_PARAMETER is returned.

The values that may be set for the argument *type* are as follows.

```
typedef enum
{
    CELLULAR_INFO_TYPE0 = 0, // Report information for the serving cell only
    CELLULAR_INFO_TYPE1 = 1, // Report information for the intra-frequency cells only
    CELLULAR_INFO_TYPE2 = 2, // Report information for the intra-frequency cells only
    CELLULAR_INFO_TYPE7 = 7, // Report information for all cells
    CELLULAR_INFO_TYPE9 = 9,
                          // Report information for the serving cell only with RSRP/CINR on main antenna.
} e_cellular_info_type_t;
```

## Reentrant

Reentrant operation is not possible.

## Thread Safety

This function is thread safe.

## Examples

```
/* Callback function example (Using the default function name) */
void my_sw_urc_charget_function(void * p_arg)
{
    uint8_t * p_urc = p_arg;
    printf("URC = %s\n", p_urc);
}

e_cellular_err_t ret;
st_cellular_ctrl_t cellular_ctrl = {0};

ret = R_CELLULAR_Open(&cellular_ctrl, NULL);
ret = R_CELLULAR_APConnect(&cellular_ctrl, NULL);
ret = R_CELLULAR_GetCellInfo(&cellular_ctrl, CELLULAR_INFO_TYPE9);
```

## Special Notes

None

### 3.26 R\_CELLULAR\_AutoConnectConfig()

Configures the autoconnect mode of the RYZ014A Cellular module.

#### Format

```
e_cellular_err_t R_CELLULAR_AutoConnectConfig (
    st_cellular_ctrl_t * const p_ctrl,
    e_cellular_auto_connect_t const type
)
```

#### Parameters

<i>p_ctrl</i> (IN/OUT)	<i>Pointer to st_cellular_ctrl_t structure defined by the user</i>
<i>type</i> (IN)	<i>Autoconnect mode setting value</i>

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in r\_cellular\_if.h.

#### Description

Configures autoconnect mode of the Cellular module. When enabled, the Cellular module will automatically try to connect to an access point after each reboot. The setting is persistent across reboot.

The values that may be set for the argument *type* are as follows.

```
typedef enum
{
    CELLULAR_DISABLE_AUTO_CONNECT = 0,          // Disable automatic connection to an access point
    CELLULAR_ENABLE_AUTO_CONNECT,               // Enables automatic connection to an access point (next start-up or reboot)
} e_cellular_auto_connect_t;
```

**Reentrant**

Reentrant operation is not possible.

**Thread Safety**

This function is thread safe.

**Examples**

```
e_cellular_err_t ret;  
st_cellular_ctrl_t cellular_ctrl = {0};  
ret = R_CELLULAR_Open(&cellular_ctrl, NULL);  
ret = R_CELLULAR_AutoConnctConfig(&cellular_ctrl,  
                                   CELLULAR_ENABLE_AUTO_CONNECT);
```

**Special Notes**

None

### 3.27 R\_CELLULAR\_SetBand()

This function configures list of 4G LTE bands the Cellular module is allowed to use.

#### Format

```
e_cellular_err_t R_CELLULAR_SetBand(
    st_cellular_ctrl_t * const p_ctrl,
    const uint8_t * const p_band
)
```

#### Parameters

<i>p_ctrl</i> (IN/OUT)	<i>Pointer to st_cellular_ctrl_t structure defined by the user</i>
<i>p_band</i> (IN)	<i>List of authorized LTE bands</i>

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in r\_cellular\_if.h.

#### Description

This function configures list of 4G LTE bands the Cellular module is allowed to use. The list of authorized LTE bands referenced by the pointer *p\_band* should be string type. If the list contains more than one band, separate them with a comma. For instance, when specifying bands 1, 2, and 3, the syntax of the list is "1,2,3".

The possible bands the RYZ014A Cellular module is allowed to use are 1, 2, 3, 4, 5, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28 and 66. Specify an appropriate list according to the carrier and destination to be used.

**Reentrant**

Reentrant operation is not possible.

**Thread Safety**

This function is thread safe.

**Examples**

```
e_cellular_err_t ret;  
st_cellular_ctrl_t cellular_ctrl = {0};  
  
ret = R_CELLULAR_Open(&cellular_ctrl, NULL);  
ret = R_CELLULAR_SetBand(&g_cellular_ctrl, "1,2,3");
```

**Special Notes**

None

### 3.28 R\_CELLULAR\_GetPDPAddress()

Obtains a PDP address.

#### Format

```
e_cellular_err_t R_CELLULAR_GetPDPAddress (
    st_cellular_ctrl_t * const p_ctrl,
    st_cellular_ipaddr_t * const p_addr
)
```

#### Parameters

<i>p_ctrl</i> (IN/OUT)	<i>Pointer to st_cellular_ctrl_t structure defined by the user</i>
<i>p_addr</i> (IN/OUT)	<i>Pointer to st_cellular_ipaddr_t structure defined by the user</i>

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_NOT_CONNECT</i>	<i>/* Not connected to access point */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in *r\_cellular\_if.h*.

#### Description

Obtains a PDP address that identifies the Cellular module in the address space applicable to the PDP. If IPv6 is available, IPv4 address and IPv6 address are obtained and stored in the *ipv4* member and *ipv6* member of the *st\_cellular\_ipaddr\_t* structure referenced by the pointer *p\_addr*, respectively. If IPv6 is not available owing to factors such that the SIM card used does not support IPv6, only IPv4 address is obtained and stored in the *ipv4* member of the structure, then the *ipv6* member of the structure is filled with zero. Before running this API, run *R\_CELLULAR\_APConnect()* to connect to an access point. If the Cellular module has not been connected to an access point when this API is run, a value of *CELLULAR\_ERR\_NOT\_CONNECT* is returned.

**Reentrant**

Reentrant operation is not possible.

**Thread Safety**

This function is thread safe.

**Examples**

```
e_cellular_err_t ret;  
st_cellular_ctrl_t cellular_ctrl = {0};  
st_cellular_ipaddr_t addr = {0};  
  
ret = R_CELLULAR_Open(&cellular_ctrl, NULL);  
ret = R_CELLULAR_APConnect(&cellular_ctrl, NULL);  
ret = R_CELLULAR_GetPDPAAddress (&cellular_ctrl, &addr);
```

**Special Notes**

None



---

### 3.29 R\_CELLULAR\_SoftwareReset()

---

Resets the RYZ014A Cellular module.

#### Format

```
e_cellular_err_t R_CELLULAR_SoftwareReset (
    st_cellular_ctrl_t * const p_ctrl,
)
```

#### Parameters

*p\_ctrl* (IN/OUT)                      *Pointer to st\_cellular\_ctrl\_t structure defined by the user*

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in r\_cellular\_if.h.

#### Description

Resets the Cellular module with the hardware reset AT command.

The status of the FIT module after reboot depends on the autoconnect setting configured by R\_CELLULAR\_AutoConnectConfig(). If autoconnect is disabled, the FIT module goes to the status after completion of R\_CELLULAR\_Open(), called **Connect to Cellular module** status in Figure 1.3. If autoconnect is enabled, the Cellular module will automatically try to connect to an access point after this function is completed successfully, going to the status after completion of R\_CELLULAR\_APConnect(), called **Connected to access point** status in Figure 1.3. Refer to Figure 1.3 for the status transitions of the FIT module.

Note: To use autoconnect mode, R\_CELLULAR\_APConnect() must be completed successfully.

**Reentrant**

Reentrant operation is not possible.

**Thread Safety**

This function is thread safe.

**Examples**

```
e_cellular_err_t ret;
st_cellular_ctrl_t cellular_ctrl = {0};

ret = R_CELLULAR_Open(&cellular_ctrl, NULL);
ret = R_CELLULAR_AutoConnctConfig(&cellular_ctrl,
                                   CELLULAR_ENABLE_AUTO_CONNECT);
ret = R_CELLULAR_APConnect(&cellular_ctrl, NULL);
ret = R_CELLULAR_SoftwareReset(&cellular_ctrl);
```

**Special Notes**

None

### 3.30 R\_CELLULAR\_HardwareReset()

Resets the RYZ014A Cellular module with the RESET pin.

#### Format

```
e_cellular_err_t R_CELLULAR_HardwareReset (
    st_cellular_ctrl_t * const p_ctrl
)
```

#### Parameters

*p\_ctrl (IN/OUT)*                      *Pointer to st\_cellular\_ctrl\_t structure defined by the user*

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in r\_cellular\_if.h.

#### Description

Resets the Cellular module with the RESET pin.

The status of the FIT module after reboot depends on the autoconnect setting configured by R\_CELLULAR\_AutoConnectConfig(). If autoconnect is disabled, the FIT module goes to the status after completion of R\_CELLULAR\_Open(), called **Connect to Cellular module** status in Figure 1.3. If autoconnect is enabled, the Cellular module will automatically try to connect to an access point after this function is completed successfully, going to the status after completion of R\_CELLULAR\_APConnect(), called **Connected to access point** status in Figure 1.3. Refer to Figure 1.3 for the status transitions of the FIT module.

Note: To use autoconnect mode, R\_CELLULAR\_APConnect() must be completed successfully.

**Reentrant**

Reentrant operation is not possible.

**Thread Safety**

This function is thread safe.

**Examples**

```
e_cellular_err_t ret;
st_cellular_ctrl_t cellular_ctrl = {0};

ret = R_CELLULAR_Open(&cellular_ctrl, NULL);
ret = R_CELLULAR_AutoConnctConfig(&cellular_ctrl,
                                   CELLULAR_ENABLE_AUTO_CONNECT);
ret = R_CELLULAR_APConnect(&cellular_ctrl, NULL);
ret = R_CELLULAR_HardwareReset(&cellular_ctrl);
```

**Special Notes**

None

---

### 3.31 R\_CELLULAR\_FactoryReset()

---

Performs a factory reset to reset the RYZ014A Cellular module to the factory default configuration.

#### Format

```
e_cellular_err_t R_CELLULAR_FactoryReset (  
    st_cellular_ctrl_t * const p_ctrl  
)
```

#### Parameters

*p\_ctrl (IN/OUT)*                      *Pointer to st\_cellular\_ctrl\_t structure defined by the user*

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_MODULE_COM</i>	<i>/* Failure communicating with Cellular module */</i>
<i>CELLULAR_ERR_MODULE_TIMEOUT</i>	<i>/* Timeout communicating with Cellular module */</i>
<i>CELLULAR_ERR_OTHER_ATCOMMAND_RUNNING</i>	<i>/* Another AT command is running */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in r\_cellular\_if.h.

#### Description

Reset the Cellular module to the factory default configuration.

Once completing this API successfully, the FIT module goes to the status after completion of R\_CELLULAR\_Open(), called **Connect to Cellular module** status in Figure 1.3.

Creating an OEM restoration point is not supported by the FIT module. When using the Cellular module that the restoration point has not been created, running this API, it is reset to the factory state of the device but a value of CELLULAR\_ERR\_MODULE\_COM is returned. Refer to section 3.34 of [9] for details.

**Reentrant**

Reentrant operation is not possible.

**Thread Safety**

This function is thread safe.

**Examples**

```
e_cellular_err_t ret;  
st_cellular_ctrl_t cellular_ctrl = {0};  
  
ret = R_CELLULAR_Open(&cellular_ctrl, NULL);  
ret = R_CELLULAR_FactoryReset(&cellular_ctrl);
```

**Special Notes**

None

---

### 3.32 R\_CELLULAR\_RTS\_Ctrl()

---

Controls the RTS0 pin of the RYZ014A Cellular module.

#### Format

```
e_cellular_err_t R_CELLULAR_RTS_Ctrl (  
    st_cellular_ctrl_t * const p_ctrl,  
    const uint8_t lowhigh  
)
```

#### Parameters

<i>p_ctrl</i> (IN/OUT)	<i>Pointer to st_cellular_ctrl_t structure defined by the user</i>
<i>lowhigh</i> (IN)	<i>Logic level of the RTS0 pin</i>

#### Return values

<i>CELLULAR_SUCCESS</i>	<i>/* Normal end */</i>
<i>CELLULAR_ERR_PARAMETER</i>	<i>/* Invalid argument value */</i>
<i>CELLULAR_ERR_NOT_OPEN</i>	<i>/* Open function has not been run */</i>
<i>CELLULAR_ERR_OTHER_API_RUNNING</i>	<i>/* Another API is running */</i>

#### Properties

Prototype declarations are contained in r\_cellular\_if.h.

#### Description

Controls the RTS0 pin of the Cellular module.

In order to set the RTS0 pin to high-level signal output, set the argument *lowhigh* to 1. In order to set the RTS0 pin to low-level signal output, set the argument *lowhigh* to 0.

**Reentrant**

Reentrant operation is not possible.

**Thread Safety**

This function is thread safe.

**Examples**

```
e_cellular_err_t ret;  
st_cellular_ctrl_t cellular_ctrl = {0};  
  
ret = R_CELLULAR_Open(&cellular_ctrl, NULL);  
ret = R_CELLULAR_RTS_Ctrl (&cellular_ctrl, 1); //RTS0 is high  
ret = R_CELLULAR_RTS_Ctrl (&cellular_ctrl, 0); //RTS0 is low
```

**Special Notes**

None



## 4. Appendices

### 4.1 Confirmed Operation Environment

The confirmed operation environment for the FIT module is listed in Table 4.1.

**Table 4.1 Confirmed Operation Environment**

Item		Contents
Integrated development environment		Renesas Electronics e <sup>2</sup> studio Ver.2022-04
C compiler	CC-RX	Renesas Electronics C/C++ Compiler for RX Family V3.04.00 Compiler option: The following option is added to the default settings of the integrated development environment. -lang = c99
	GCC	GCC for Renesas 8.3.0. 2022002-GNURX Toolchain
Endian order		Little endian
Revision of the module		Rev1.09
Board used		Renesas RX65N Cloud Kit (product No.: RTK5RX65N0SxxxxxBE)
		Renesas RX72N Envision Kit (product No.: RTK5RX72N0C00000BJ)
RTOS	FreeRTOS	10.4.3-rx-1.0.1 (kernel only)
	Azure RTOS	v6.1.12_rel-rx-1.0.0
FIT	BSP FIT	Ver 7.10
	SCI FIT	Ver 4.30
	IRQ FIT	Ver 4.00

### 4.2 Troubleshooting

- (1) Q: I have added the FIT module to the project and built it. Then I got the error: Could not open source file "platform.h".

A: The FIT module may not be added to the project properly. Check if the method for adding FIT modules is correct with the following documents:

- Using CS+:  
Application note "Adding Firmware Integration Technology Modules to CS+ Projects (R01AN1826)"
- Using e<sup>2</sup> studio:  
Application note "Adding Firmware Integration Technology Modules to Projects (R01AN1723)"

When using this FIT module, the board support package FIT module (BSP module) must also be added to the project. Refer to the application note "Board Support Package Module Using Firmware Integration Technology (R01AN1685)".

- (2) Q: I have added the FIT module to the project and built it. Then I got an error for when the configuration setting is wrong.

A: The setting in the file "r\_cellular\_config.h" may be wrong. Check the file "r\_cellular\_config.h". If there is a wrong setting, set the correct value for that. Refer to 2.7 Compile Settings for details.

### 4.3 Recovery operation

---

If the events described in this section are encountered when using the RYZ014A Cellular module and the FIT module, perform the recovery operation.

#### 4.3.1 RYZ014A Cellular module notifying ^EXIT URC

The Cellular module might perform a self-reset with notifying ^EXIT URC. It is recommended to detect the ^EXIT URC with the callback function. If the ^EXIT URC is detected, the following operation should be run.

- (1) Detect +SYSSTART URC.  
The +SYSSTART URC following the ^EXIT URC should be detected.
- (2) Run R\_CELLULAR\_Close().
- (3) Run R\_CELLULAR\_Open().

The operation will recover the Cellular module and the FIT module, the FIT module going to **Connect to Cellular module** status in Figure 1.3.

#### 4.3.2 Getting timeout on API processing

If an API processing times out, a value of CELLULAR\_ERR\_MODULE\_TIMEOUT is returned to notify the user of the timeout. If getting the timeout, the following operation should be run.

- (1) Run R\_CELLULAR\_HardwareReset().  
Resets the Cellular module with the RESET pin.

The operation will recover the Cellular module and the FIT module, the FIT module going to **Connect to Cellular module** status in Figure 1.3.

## 5. Reference Documents

User's Manual: Hardware

(The latest versions can be downloaded from the Renesas Electronics website.)

Technical Update/Technical News

(The latest information can be downloaded from the Renesas Electronics website.)

User's Manual: Development Tools

RX Family CC-RX Compiler User's Manual (R20UT3248)

(The latest versions can be downloaded from the Renesas Electronics website.)

## Revision History

Rev.	Date	Description	
		Page	Summary
1.04	Mar. 31, 2022	-	First edition issued
1.05	Apr. 28, 2022	9	Added the following macro definitions in section 2.7 Compile Settings: - CELLULAR_CFG_EX_TIMEOUT
		11	Added Table 2.5 Configuration options. (FreeRTOSConfig.h). Added Table 2.6 Configuration options. (tx_user.h).
		18	Revised settings to connect to access point. (See section 3.3)
		19	Added setting authentication protocol. (See section 3.3)
1.06	Jun. 7, 2022	6	Added the following APIs to Table 1.1: - R_CELLULAR_GetICCID - R_CELLULAR_GetIMEI - R_CELLULAR_GetIMSI - R_CELLULAR_GetPhonenum - R_CELLULAR_GetRSSI - R_CELLULAR_GetSVN - R_CELLULAR_Ping - R_CELLULAR_GetAPConnectState - R_CELLULAR_GetCellInfo - R_CELLULAR_AutoConnectConfig - R_CELLULAR_SoftwareReset
		9	Added the following macro definitions in section 2.7 Compile Settings: - CELLULAR_CFG_AUTH_TYPE
		12	Code size is updated in 2.8 Code Size.
		13	Added the following structures in section 2.9 Parameters: - st_cellular_iccid_t - st_cellular_imei_t - st_cellular_imsi_t - st_cellular_phonenum_t - st_cellular_rssi_t - st_cellular_svn_t - st_cellular_notice_t
		45-60	Added the following APIs in section 3 API Functions: - 3.17 R_CELLULAR_GetICCID - 3.18 R_CELLULAR_GetIMEI - 3.19 R_CELLULAR_GetIMSI - 3.20 R_CELLULAR_GetPhonenum - 3.21 R_CELLULAR_GetRSSI - 3.22 R_CELLULAR_GetSVN - 3.23 R_CELLULAR_Ping - 3.24 R_CELLULAR_GetAPConnectState - 3.25 R_CELLULAR_GetCellInfo - 3.26 R_CELLULAR_AutoConnectConfig - 3.27 R_CELLULAR_SoftwareReset
1.07	Jul. 21, 2022	6	Added the following APIs to Table 1.1: - R_CELLULAR_SetBand - R_CELLULAR_GetPDPAddress
		9	Added the following macro definitions in section 2.7 Compile Settings: - CELLULAR_CFG_NETWORK_NOTIFY_LEVEL - CELLULAR_CFG_PSM_PREPARATION_TIME - CELLULAR_CFG_RING_LINE_ACTIVE_TIME

		61-62	Added the following APIs in section 3 API Functions: - 3.28 R_CELLULAR_SetBand - 3.29 R_CELLULAR_GetPDPAAddress
		Program	The number of available digits of the phone number obtained with R_CELLULAR_GetPhonenum() is modified to up to 15.
1.08	Sep. 30, 2022	6	Added the following APIs to Table 1.1: - R_CELLULAR_HardwareReset - R_CELLULAR_FactoryReset - R_CELLULAR_RTS_Ctrl
		9	Added the following macro definitions in section 2.7 Compile Settings: - CELLULAR_CFG_PSM_WAKEUP_LATENCY - CELLULAR_CFG_URC_CHARGET_ENABLED - CELLULAR_CFG_URC_CHARGET_FUNCTION - CELLULAR_CFG_IRQ_NUM
		14	Added the following structures in section 2.9 Parameters: - st_cellular_notice_t - st_cellular_edrx_config_t - st_cellular_psm_config_t
		16-17	Revised the contents in section 3.1 R_CELLULAR_Open owing to the modified specification of callback function. The callback function can be set by Table 2.1 Configuration options (r_cellular_config.h).
		18	Revised the description part in section 3.2 R_CELLULAR_Close owing to the modified specification of R_CELLULAR_Close().
		41-43	Revised the contents in section 3.15 R_CELLULAR_SetEDRX owing to the modified argument of R_CELLULAR_SetEDRX().
		44-46	Revised the contents in section 3.16 R_CELLULAR_SetPSM owing to the modified argument of R_CELLULAR_SetPSM().
		53-58	Revised the contents in the following sections owing to the modified specification of callback function: - 3.23 R_CELLULAR_Ping - 3.24 R_CELLULAR_GetAPConnectState - 3.25 R_CELLULAR_GetCellInfo
		65-66	Moved section 3.27 R_CELLULAR_SoftwareReset to section 3.29.
		67-70	Added the following APIs in section 3 API Functions: - 3.30 R_CELLULAR_HardwareReset - 3.31 R_CELLULAR_FactoryReset - 3.32 R_CELLULAR_RTS_Ctrl
1.09	Nov. 30, 2022	72	Added the following section: - 4.3 Recovery operation
		4	Revised Figure 1.1.
		9-10	Revised the default values of the following macro definition in section 2.7: - CELLULAR_CFG_AP_NAME - CELLULAR_CFG_AUTH_TYPE Revised the following macro definition in section 2.7: - CELLULAR_CFG_SCI_PRIORITY Added the following macro definitions in section 2.7: - CELLULAR_CFG_CTS_SW_CTRL - CELLULAR_CFG_CTS_PORT - CELLULAR_CFG_CTS_PIN - CELLULAR_CFG_PFS_SET_VALUE
		14	Added the following structures in section 2.9 Parameters:

			<ul style="list-style-type: none"> <li>- st_cellular_ipaddr_t</li> <li>- st_cellular_ping_cfg_t</li> </ul>
		16-80	<p>All API functions except R_CELLULAR_Open() defined in section 3 are made thread safe.</p> <p>Added the following return value to the thread-safe API functions:</p> <ul style="list-style-type: none"> <li>- CELLULAR_ERR_OTHER_API_RUNNING</li> </ul>
		19	<p>Revised the contents in the following section owing to the FIT module supporting IPv6:</p> <ul style="list-style-type: none"> <li>- 3.3 R_CELLULAR_APConnect</li> </ul>
		25	<p>Revised the contents in the following section owing to the FIT module supporting IPv6:</p> <ul style="list-style-type: none"> <li>- 3.6 R_CELLULAR_CreateSocket</li> </ul> <p>Added the following return value to R_CELLULAR_CreateSocket():</p> <ul style="list-style-type: none"> <li>- CELLULAR_ERR_SIM_NOT_SUPPORT_IPV6</li> </ul>
		27	<p>Revised the contents in the following section owing to the FIT module supporting IPv6:</p> <ul style="list-style-type: none"> <li>- 3.7 R_CELLULAR_ConnectSocket</li> </ul>
		37	<p>Revised the contents in the following section owing to the FIT module supporting IPv6:</p> <ul style="list-style-type: none"> <li>- 3.12 R_CELLULAR_DnsQuery</li> </ul> <p>Added the following return value to R_CELLULAR_DnsQuery():</p> <ul style="list-style-type: none"> <li>- CELLULAR_ERR_SIM_NOT_SUPPORT_IPV6</li> </ul>
		49	<p>Revised the description part in section 3.17 R_CELLULAR_GetICCID to add that of the number of available digits of ICCID.</p>
		51	<p>Revised the description part in section 3.18 R_CELLULAR_IMEI to add that of the number of available digits of IMEI.</p>
		53	<p>Revised the description part in section 3.19 R_CELLULAR_IMSI to add that of the number of available digits of IMSI.</p>
		55	<p>Revised the description part in section 3.20 R_CELLULAR_GetPhonenum to add that of the number of available digits of phone number.</p>
		61	<p>Revised the contents in the following section owing to R_CELLULAR_Ping() being configurable:</p> <ul style="list-style-type: none"> <li>- 3.23 R_CELLULAR_Ping</li> </ul>
		71	<p>Revised the contents in the following section owing to the FIT module supporting IPv6:</p> <ul style="list-style-type: none"> <li>- 3.28 R_CELLULAR_GetPDPAddress</li> </ul> <p>Added the following return value to R_CELLULAR_GetPDPAddress():</p> <ul style="list-style-type: none"> <li>- CELLULAR_ERR_SIM_NOT_SUPPORT_IPV6</li> </ul>

# General Precautions in the Handling of Microprocessing Unit and Microcontroller Unit Products

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.

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