US159-DA16XXXMEVZ Wi-Fi Control Module Using Software Integration System

Introduction

This application note describes the usage of the US159-DA16XXXMEVZ Wi-Fi control module, which conforms to the Software Integration System (SIS) standard.

In the following pages, the US159-DA16XXXMEVZ Wi-Fi control module software is referred to collectively as “the DA16XXX Wi-Fi SIS module” or “the SIS module.”

The SIS module supports the following Wi-Fi Pmod modules:

- DA16200MOD (US159-DA16200MEVZ)
- DA16600MOD (US159-DA16600MEVZ)

In the following pages, the DA16XXXMOD is referred to as “the Wi-Fi module”. The DA16200 and DA16600 products will collectively be referred to as “DA16XXX”.

Target Device

- RL78/G23 (R7F100GSN)

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

Target Compilers

- Renesas Electronics C Compiler Package for RL78 Family

For details of the confirmed operation contents of each compiler, refer to 6.1 Confirmed Operation Environment.

Related Documents

[1] RL78 Family Board Support Package Module Using Software Integration System (R01AN5522)
[2] RL78 Smart Configurator User’s Guide: e2 studio (R20AN0579)
[3] Smart Configurator User’s Guide: RL78 API Reference (R20UT4852)
[4] RL78/G23 Serial Array Unit (UART Communication) (R01AN6645)
[5] RL78/G23-128p Fast Prototyping Board – User’s Manual (R20UT4870)

Contents

1. Overview

1.1. DA16XXX SIS Module

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

1.2. Overview of the DA16XXX Wi-Fi SIS Module

DA16XXX is a low-power Wi-Fi networking SoC that delivers a dramatic breakthrough in battery life even for devices that are continuously connected to the Wi-Fi network. The module comes readily equipped with radio certification for Japan, North America, and Europe.

The Wi-Fi SIS module supplies these features:

- Supports connect/disconnect to a b/g/n (2.4GHz) Wi-Fi Access Point using Open, WPA, and WPA2 security. Encryption types can be either TKIP, or CCMP(AES).
- Supports retrieval of the module device MAC address.
- Supports retrieval of the module device IP address once connected to an Access Point.
- Supports a Wi-Fi network scan capability to get a list of local Access Points.
- Supports a Ping function to test network connectivity.
- Supports a DNS Query call to retrieve the IPv4 address of a supplied URL.
- Supports a SNTP Client to synchronize the local time with a server that provides time services.
- Supports TCP client sockets.
- Supports TLS on-chip client for secure sockets.
- Supports MQTT on-chip client.
  - Supports connect/disconnect to an MQTT broker via hostname, port, and user credentials.
  - Supports unsecure and secure connection via TLS encryption.
  - Supports the MQTT subscribe/publish model for multiple topics.
  - Supports other optional configurations such as MQTT v3.1.1, Quality-of-service (QoS) level, TLS cipher suites, and ALPNs.
- Supports HTTP on-chip client.
  - Supports sending a request header (GET, PUT, and POST) to an HTTP server and receiving a response header.
  - Supports unsecure and secure connection via TLS encryption.
  - Supports parsing of the response header and returning to the user.
  - Supports other optional configurations such as Server Name Indication (SNI) and ALPNs.
- Supports 1 UART channel for interfacing with the DA16XXX module.
- Supports FreeRTOS-based user applications.
- Supports Bare Metal-based user applications.

1.2.1. Connection with the DA16XXX Wi-Fi Module

Examples of connection to the DA16XXX Wi-Fi module are shown below.

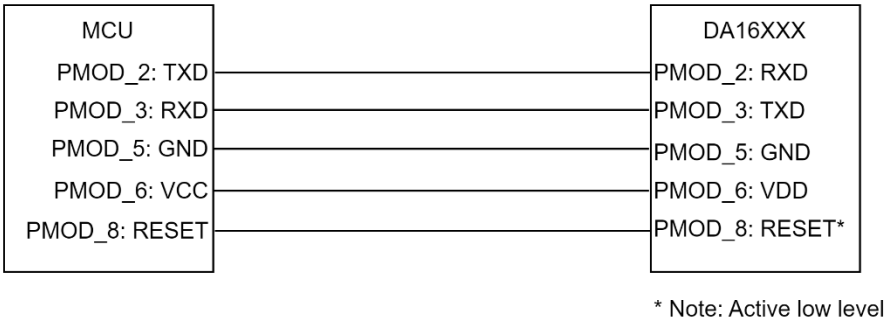

Figure 1.1 Example Connection to the DA16XXX Wi-Fi Module

1.2.2. Software Configuration

Figure 1.2 shows the software configuration.

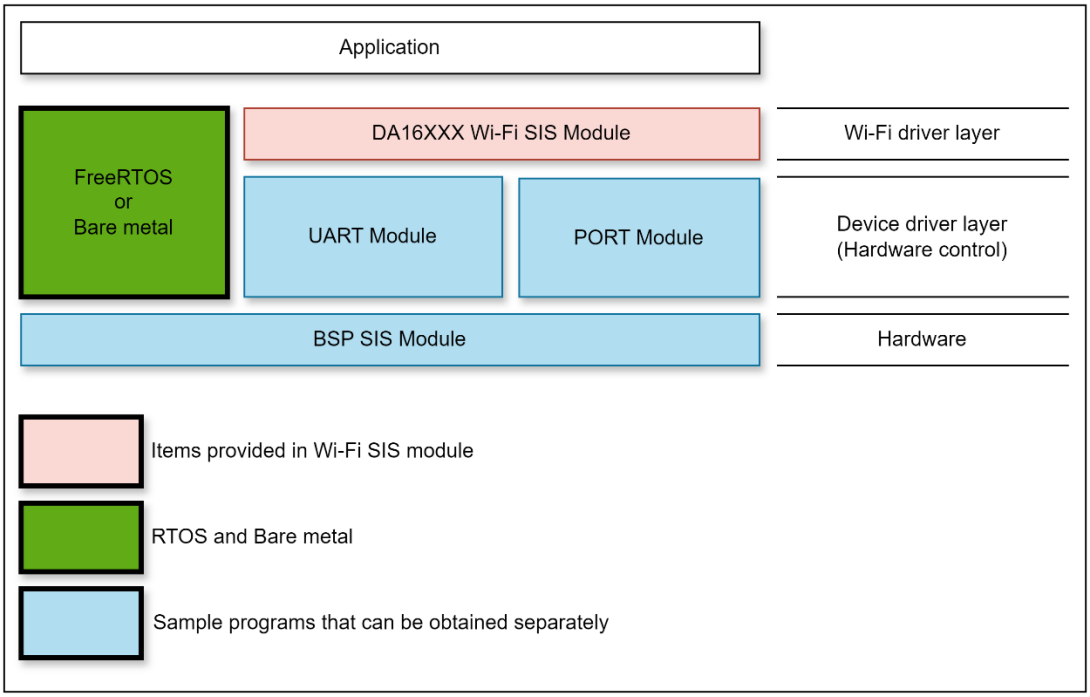

Figure 1.2 Software Configuration Diagram

1. DA16XXX Wi-Fi SIS module
   The SIS module. This software is used to control the Wi-Fi module.
2. UART module
   Implements communication between the Wi-Fi module and the MCU. A sample program is available.
   Refer to “Related Documents” on page 1 and obtain the software.
3. PORT module
   Implements the reset control between Wi-Fi module and the MCU.
   Refer to “Related Documents” on page 1 and obtain the software.
4. BSP SIS Module
   The Board Support Package module. A sample program is available.
   Refer to “Related Documents” on page 1 and obtain the software.
5. RTOS
   The RTOS manages the system overall. Operation of the SIS module has been verified using FreeRTOS or Bare Metal.

1.3. API Overview

Table 1.1 lists the API functions included in the SIS module. The required memory sizes are lists in 2.8 Code Size.

Table 1.1 API Functions

Function	Function Description
Wi-Fi Common API	
R_WIFI_DA16XXX_Open()	Initialize the Wi-Fi module
R_WIFI_DA16XXX_IsOpened()	Check Wi-Fi is opened
R_WIFI_DA16XXX_Close()	Close the Wi-Fi module
R_WIFI_DA16XXX_Ping()	Pings a specified IP address
R_WIFI_DA16XXX_Scan()	Scan Access points
R_WIFI_DA16XXX_Connect()	Connects to an access point
R_WIFI_DA16XXX_Disconnect()	Disconnects from an access point
R_WIFI_DA16XXX_IsConnected()	Check connected access point
R_WIFI_DA16XXX_DnsQuery()	Execute DNS query
R_WIFI_DA16XXX_SntpServerIpAddressSet()	Set SNTP server IP address
R_WIFI_DA16XXX_SntpEnableSet()	Enable or disable SNTP client service
R_WIFI_DA16XXX_SntpTimeZoneSet()	Set SNTP time zone
R_WIFI_DA16XXX_LocalTimeGet()	Get the local time based on current time zone
R_WIFI_DA16XXX_SetDnsServerAddress()	Set DNS Server Address
R_WIFI_DA16XXX_GetMacAddress()	Get MAC Address
R_WIFI_DA16XXX_GetIpAddress()	Get IP Address
R_WIFI_DA16XXX_HardwareReset()	Reset the Wi-Fi module
R_WIFI_DA16XXX_GetVersion()	Returns version information for the module
Wi-Fi TCP Client API	
R_WIFI_DA16XXX_GetAvailableSocket()	Get the next available socket ID
R_WIFI_DA16XXX_GetSocketStatus()	Get the socket status
R_WIFI_DA16XXX_CreateSocket()	Create a new socket instance
R_WIFI_DA16XXX_TcpConnect()	Connect to a specific IP and Port using socket
R_WIFI_DA16XXX_SendSocket()	Send data on connecting socket
R_WIFI_DA16XXX_ReceiveSocket()	Receive data on connecting socket
R_WIFI_DA16XXX_CloseSocket()	Disconnect a specific socket connection
R_WIFI_DA16XXX_TcpReconnect()	Reconnect TCP socket
Wi-Fi TLS On-chip Client API	
R_WIFI_DA16XXX_GetAvailableTlsSocket()	Get the next available socket ID
R_WIFI_DA16XXX_GetTlsSocketStatus()	Get the socket status
R_WIFI_DA16XXX_CreateTlsSocket()	Create a new socket instance
R_WIFI_DA16XXX_TlsConnect()	Connect to a specific IP and Port using socket
R_WIFI_DA16XXX_SendTlsSocket()	Send data on connecting socket
R_WIFI_DA16XXX_ReceiveTlsSocket()	Receive data on connecting socket
R_WIFI_DA16XXX_CloseTlsSocket()	Disconnect a specific socket connection

R_WIFI_DA16XXX_TlsReconnect()	Reconnect TLS socket
R_WIFI_DA16XXX_RegistServerCertificate()	Register server certificate on Wi-Fi module
R_WIFI_DA16XXX_RequestTlsSocket()	Request TLS socket communication
R_WIFI_DA16XXX_GetServerCertificate()	Get stored server certificate on Wi-Fi module
R_WIFI_DA16XXX_WriteCertificate()	Write certificate on Wi-Fi module
R_WIFI_DA16XXX_DeleteCertificate()	Delete certificate on Wi-Fi module
Wi-Fi MQTT On-chip Client API	
R_WIFI_DA16XXX_MqttOpen()	Initialize MQTT on-chip Client service
R_WIFI_DA16XXX_MqttDisconnect()	Disconnect from MQTT on-chip Client service
R_WIFI_DA16XXX_MqttConnect()	Configure and connect the MQTT on-chip Client service
R_WIFI_DA16XXX_MqttPublish()	Publish a message for a given MQTT topic
R_WIFI_DA16XXX_MqttSubscribe()	Subscribe to MQTT topics
R_WIFI_DA16XXX_MqttUnSubscribe()	Unsubscribe from MQTT topics
R_WIFI_DA16XXX_MqttReceive()	Receive data subscribed from MQTT Client service
R_WIFI_DA16XXX_MqttClose()	Close the MQTT on-chip Client service
Wi-Fi HTTP On-chip Client API	
R_WIFI_DA16XXX_HttpOpen()	Initialize the HTTP on-chip Client service
R_WIFI_DA16XXX_HttpClose()	Close the HTTP Client service
R_WIFI_DA16XXX_HttpSend()	Send the HTTP request with the configured buffers

1.4. Status Transitions

1.4.1. Status Transitions of TCP Client

Figure 1.3 shows the status transitions of the SIS module up to communication status using TCP sockets.

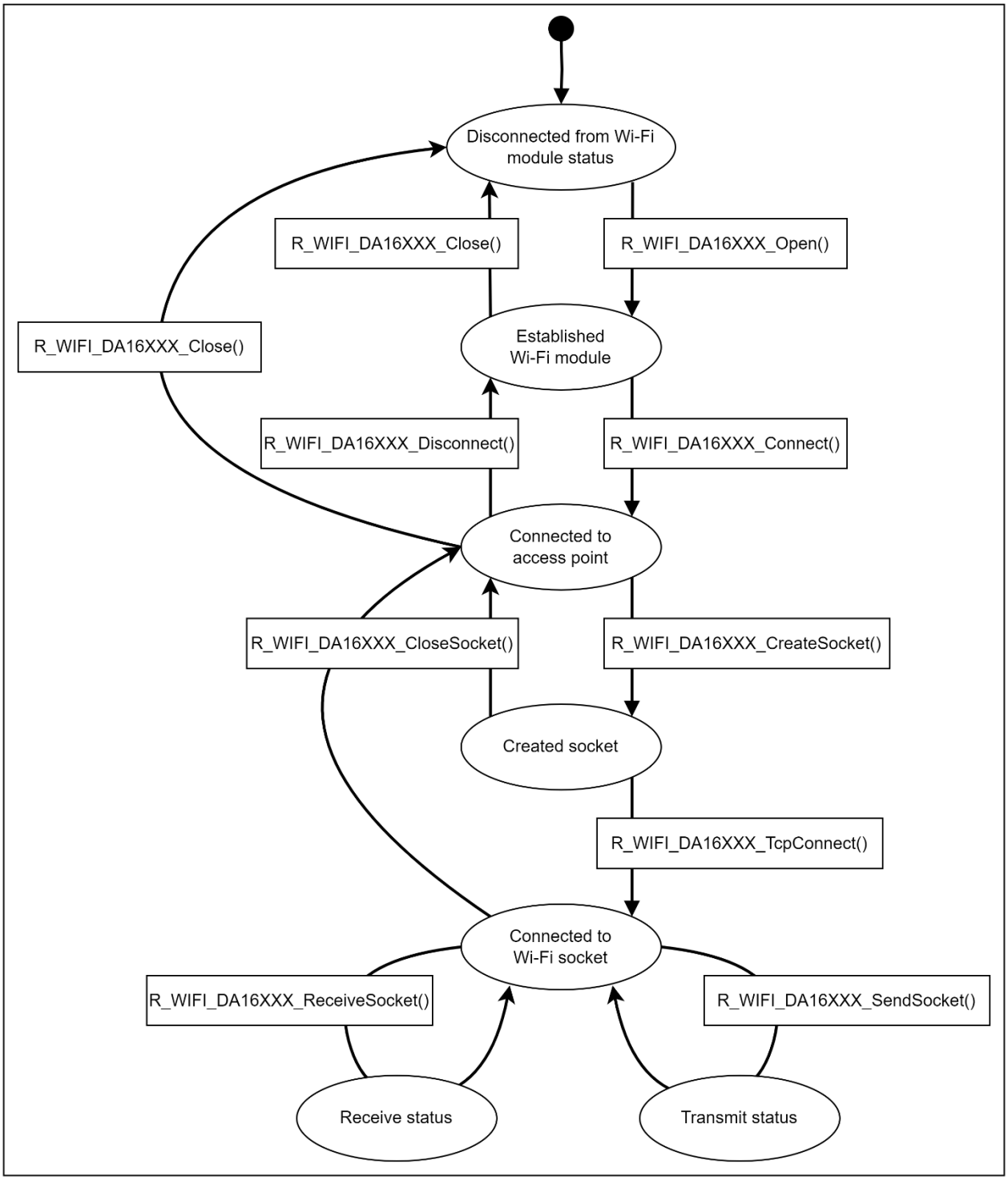

Figure 1.3 Status Transitions When Using TCP Socket

1.4.2. Status Transitions of TLS On-Chip Client

Figure 1.4 shows the status transitions of the SIS module up to communication status using TLS sockets.

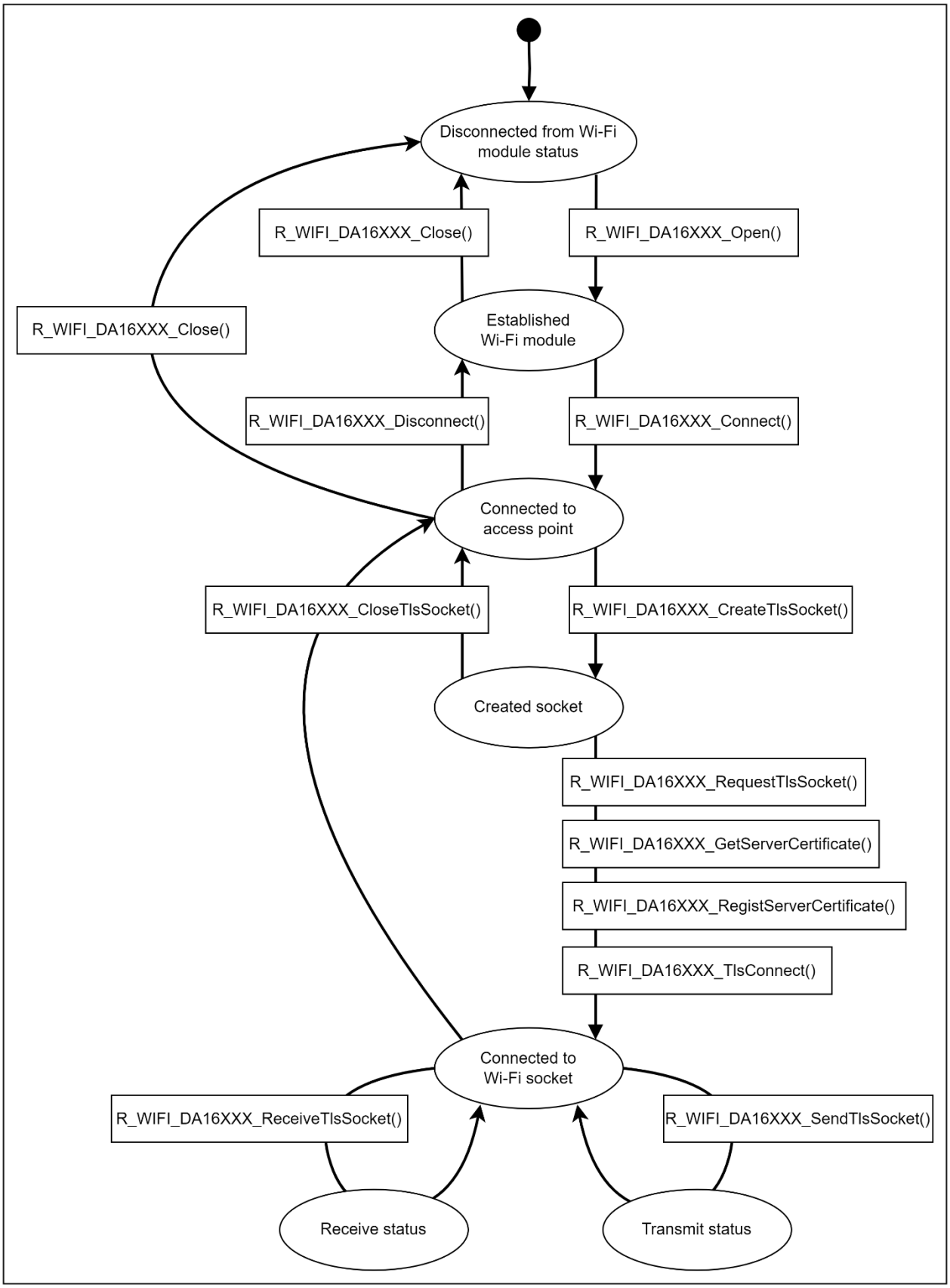

Figure 1.4 Status Transitions When Using TLS Socket

1.4.3. Status Transitions of MQTT On-Chip Client

Figure 1.5 shows the status transitions of the SIS module up to communication status using the MQTT on-chip client.

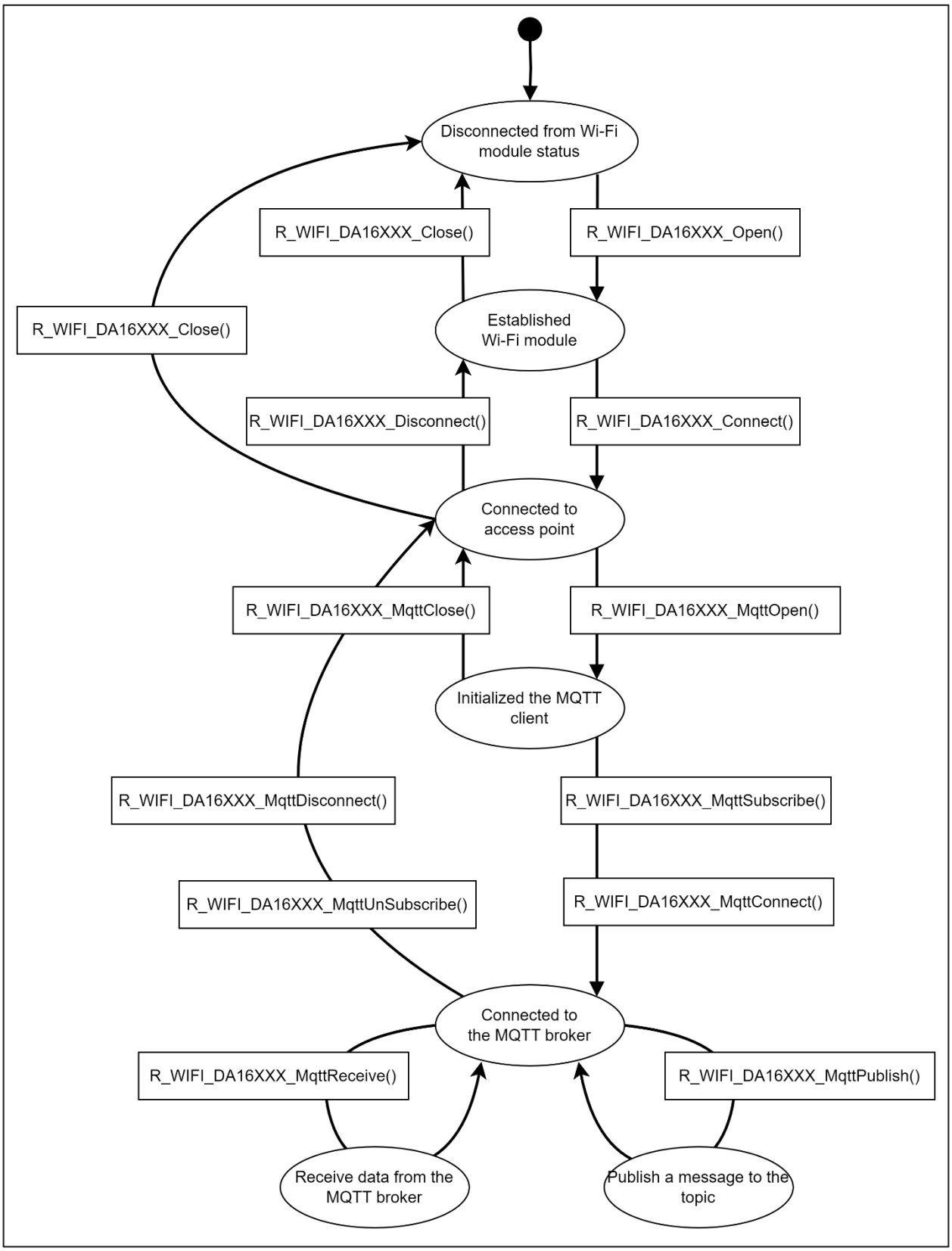

Figure 1.5 Status Transitions When Using the MQTT On-Chip Client

1.4.4. Status Transitions of HTTP On-Chip Client

Figure 1.6 shows the status transitions of the SIS module up to communication status using the HTTP on-chip client.

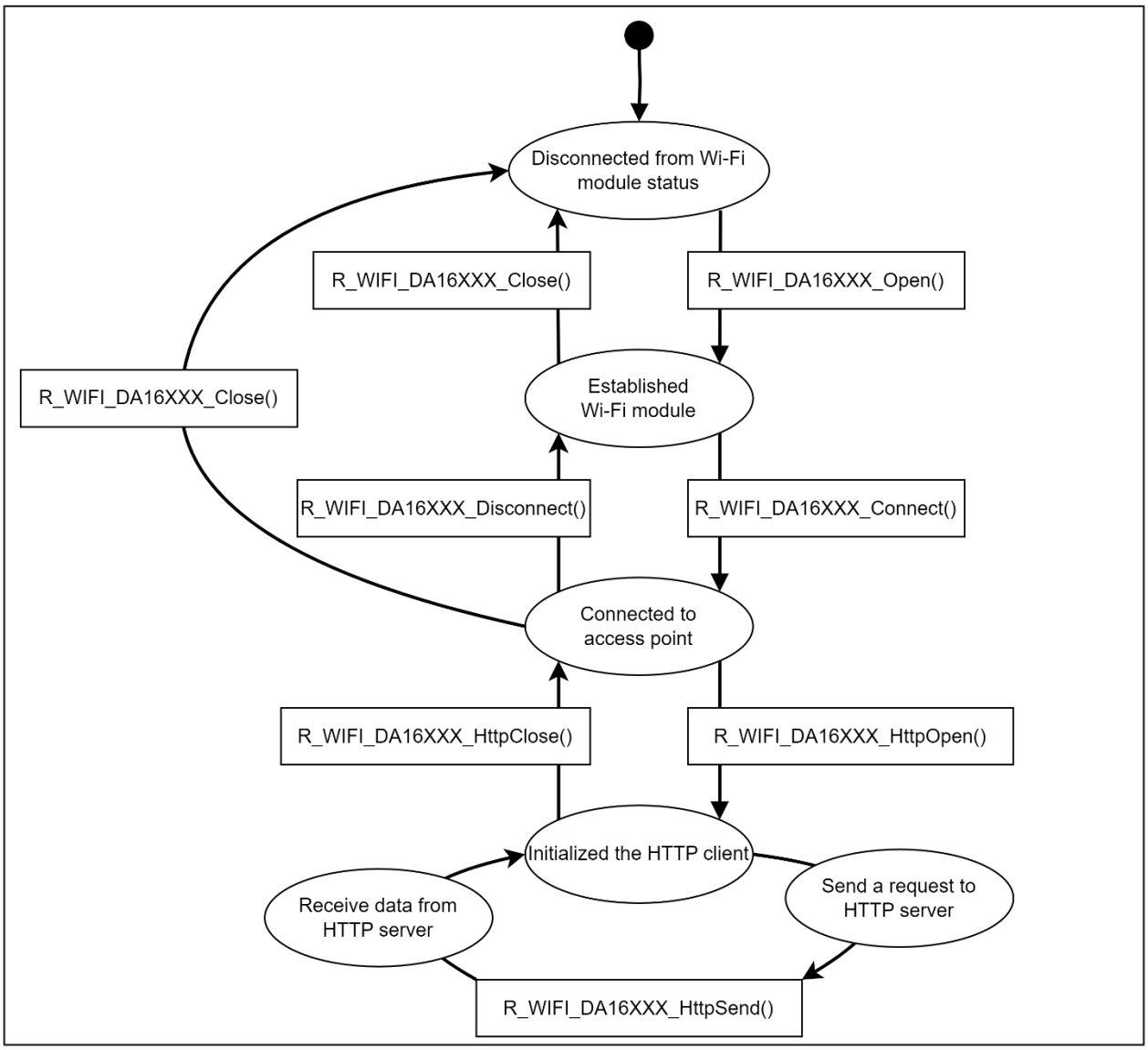

Figure 1.6 Status Transitions When Using the HTTP On-Chip Client

2. API Information

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

2.1. Hardware Requirements

The MCU used must support the following functions:

- Serial communication
- I/O ports

2.2. Software Requirements

The driver is dependent upon the following SIS modules:

- r_bsp
- r_sci_rl (see section 5.1.4)
- r_byteq (see section 5.1.4)
- FreeRTOS

2.3. Supported Toolchain

The SIS module has been confirmed to work with the toolchain listed in 6.1 Confirmed Operation Environment.

2.4. Interrupt Vector

None

2.5. Header Files

All API calls and their supporting interface definitions are located in r_wifi_da16xxx_if.h.

2.6. Integer Types

This project uses ANSI C99. These types are defined in stdint.h.

2.7. Compile Settings

The configuration option settings of the SIS module are contained in r_wifi_da16xxx_config.h.
The names of the options and their setting values are listed in the table below.

Table 2.1 Configuration Options (r_wifi_da16xxx_config.h)

Configuration Options in r_wifi_da16xxx_config.h	
Wi-Fi Common Configuration	
WIFI_CFG_DA16600_SUPPORT Default: “0”	Use DA16600 module. 1 = enabled, 0 = disabled.
WIFI_CFG_SCI_CHANNEL Default: “3”	SCI Channel for AT command communication. Set this option to match the SCI port to be controlled.
WIFI_CFG_SCI_INTERRUPT_LEVEL Default: “3”	Interrupt priority of the serial module used for communication with the Wi-Fi module. Set this option to a value of 1 to 15 to match the system priority.
WIFI_CFG_SCI_PCLK_HZ Default: “60000000”	Peripheral clock speed for WIFI_CFG_SCI_CHANNEL
WIFI_CFG_SCI_BAUDRATE Default: “115200”	Communication baud rate for WIFI_CFG_SCI_CHANNEL. Set this option to a value of 115200, 230400.
WIFI_CFG_RESET_PORT Default: “0”	Configures RESET port of the Wi-Fi module. Set this option to match the port to be controlled.
WIFI_CFG_RESET_PIN Default: “0”	Configures RESET pin of the Wi-Fi module. Set this option to match the port to be controlled.
WIFI_CFG_AT_CMD_TX_BUFFER_SIZE Default: “512”	AT command transfer buffer size. Set this value in range from 1 to 3000.
WIFI_CFG_AT_CMD_RX_BUFFER_SIZE Default: “512”	AT command receive buffer size. Set this value in range from 1 to 3000.
WIFI_CFG_USE_CALLBACK_FUNCTION Default: “0”	Enables or disables the user Wi-Fi callback function. 0 = Unused, 1 = Used.
WIFI_CFG_CALLBACK_FUNCTION_NAME Default: “NULL”	Specifies function name of the Wi-Fi callback function called when an error occurs. This option takes effect when WIFI_CFG_USE_CALLBACK_FUNCTION is set to 1.
WIFI_CFG_MAX_SSID_LEN Default: “32”	Configures max SSID Length
WIFI_CFG_MAX_BSSID_LEN Default: “6”	Configures max BSSID Length
WIFI_CFG_SNTP_ENABLE Default: “0”	Enables or disables the SNTP client service. 1 = enabled, 0 = disabled
WIFI_CFG_SNTP_SERVER_IP Default: “0.0.0.0”	Configures SNTP server IP address string. This option takes effect when WIFI_CFG_SNTP_ENABLE is set to 1.
WIFI_CFG_SNTP_UTC_OFFSET Default: “7”	Configures time zone offset in hours (-12 ~ 12).
WIFI_CFG_COUNTRY_CODE Default: “”	Configures a country code. The country code defined in ISO3166-1 alpha-2 standard. E.g. “VN”, “JP”, “US”.
WIFI_CFG_LOGGING_OPTION Default: “0”	Configures logging option. 0 = None, 1 = FreeRTOS logging, 2 = Serial port logging.
WIFI_CFG_LOG_TERM_CHANNEL Default: “0”	SCI Channel for DA16XXX logging function. Set this option to match the SCI port to be controlled. This option takes effect when WIFI_CFG_LOGGING_OPTION is set to 2.

WIFI_CFG_DEBUG_LOG Default: “0”	Configures the output setting for log information. The log information output setting of 1 to 4 can be used with FreeRTOS logging task or Serial port logging. 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 module communication information in addition. This option takes effect when WIFI_CFG_LOGGING_OPTION is set to value other than 0.
Wi-Fi TCP Client Configuration	
WIFI_CFG_TCP_SUPPORT Default: “1”	Enables or disables TCP protocol. 1 = enabled, 0 = disabled.
WIFI_CFG_TCP_CREATABLE_SOCKETS Default: “1”	Configures the number of TCP client socket. Set this value in range from 1 to 2.
WIFI_CFG_TCP_SOCKET_RECEIVE_BUFFER_SIZE Default: “1024”	Configures the receive buffer size for the socket. Set this value in range from 1 to 4096.
Wi-Fi MQTT On-Chip Configuration	
WIFI_CFG_MQTT_SUPPORT Default: “0”	Enables or disables MQTT on-chip protocol. 1 = enabled, 0 = disabled.
MQTT_CFG_MQTT_CERTS Default: “0”	Flag to use MQTT Certificates. 1 = Used, 0 = Unused.
WIFI_CFG_MQTT_CERTS_HEADER Default: “NULL”	Name of header file that will contain certificates (macros). User must create header file. Example: "cert_storage.h"
WIFI_CFG_MQTT_ROOT_CA Default: “NULL”	Links to user-defined macro of the same name for Root CA which user must define in application header.
WIFI_CFG_MQTT_CLIENT_CERT Default: “NULL”	Links to user-defined macro of the same name for client certificate which user must define in application header.
WIFI_CFG_MQTT_PRIVATE_KEY Default: “NULL”	Links to user-defined macro of the same name for private key which user must define in application header.
WIFI_CFG_MQTT_CMD_TX_BUF_SIZE Default: “512”	Configures the MQTT buffer used for sending commands and publishing data. Maximum publishing length is 2063 bytes. Set this value in range from 200 to 2064 and must be less than or equal to WIFI_CFG_AT_CMD_TX_BUFFER_SIZE.
WIFI_CFG_MQTT_CMD_RX_BUF_SIZE Default: “512”	Configures MQTT buffer used for receiving subscribed data. Set this value in range from 1 to 3000 and must be less than or equal to WIFI_CFG_AT_CMD_TX_BUFFER_SIZE.
WIFI_CFG_MQTT_USE_MQTT_V311 Default: “1”	Flag to use MQTT version 3.1.1. 1 = Used, 0 = Unused.
WIFI_CFG_MQTT_RX_TIMEOUT Default: “1000”	Timeout for the MQTT Receive function to check the buffer for incoming MQTT messages in milliseconds
WIFI_CFG_MQTT_TX_TIMEOUT Default: “1000”	Timeout for publishing MQTT messages in milliseconds.
WIFI_CFG_MQTT_CLEAN_SESSION Default: “1”	Flag to use MQTT clean session. 1 = Used, 0 = Unused.
WIFI_CFG_MQTT_ALPN1 Default: “NULL”	Select 1st Application Layer Protocol Negotiation (ALPN).
WIFI_CFG_MQTT_ALPN2 Default: “NULL”	Select 2nd ALPN.

WIFI_CFG_MQTT_ALPN3 Default: “NULL”	Select 3rd ALPN.
WIFI_CFG_MQTT_KEEP_ALIVE Default: “60”	MQTT ping period to check if connection is still active.
WIFI_CFG_MQTT_CLIENT_IDENTIFIER Default: “NULL”	Configures client identifier.
WIFI_CFG_MQTT_HOST_NAME Default: “NULL”	Configures MQTT Host Name (or IP address).
WIFI_CFG_MQTT_PORT Default: “1883”	Configures MQTT Port for communication.
WIFI_CFG_MQTT_USER_NAME Default: “NULL”	Configures MQTT Username.
WIFI_CFG_MQTT_PASSWORD Default: “NULL”	Configures MQTT Password.
WIFI_CFG_MQTT_WILL_TOPIC Default: “NULL”	Configures Topic for MQTT Last Will message.
WIFI_CFG_MQTT_WILL_MESSAGE Default: “NULL”	Configures Payload for MQTT Last Will message.
WIFI_CFG_MQTT_SNI_NAME Default: “NULL”	Configures Server Name Indication (SNI).
WIFI_CFG_MQTT_WILL_QOS Default: “0”	Configures Quality-of-Service. 0: At most once (QoS 0). 1: At least once (QoS 1). 2: Exactly once (QoS 2).
WIFI_CFG_MQTT_TLS_CIPHER_SUITES Default: “0”	Flag to use TLS Cipher Suites. 1 = Used, 0 = Unused.
WIFI_CFG_MQTT_TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA Default: “0”	Select TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA Cipher. Unused: 0. Used: WIFI_TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA
WIFI_CFG_MQTT_TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA Default: “0”	Select TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA Cipher. Unused: 0. Used: WIFI_TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA
WIFI_CFG_MQTT_TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA256 Default: “0”	Select TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA256 Cipher. Unused: 0. Used: WIFI_TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA256
WIFI_CFG_MQTT_TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA384 Default: “0”	Select TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA384 Cipher. Unused: 0. Used: WIFI_TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA384
WIFI_CFG_MQTT_TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 Default: “0”	Select TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 Cipher. Unused: 0. Used: WIFI_TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256
WIFI_CFG_MQTT_TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384 Default: “0”	Select TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384 Cipher. Unused: 0. Used: WIFI_TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384
WIFI_CFG_MQTT_TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA Default: “0”	Select TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA Cipher. Unused: 0. Used: WIFI_TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA
WIFI_CFG_MQTT_TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA Default: “0”	Select TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA Cipher. Unused: 0. Used: WIFI_TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA

WIFI_CFG_MQTT_TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA256 Default: “0”	Select TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA256 Cipher. Unused: 0. Used: WIFI_TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA256
WIFI_CFG_MQTT_TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA384 Default: “0”	Select TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA384 Cipher. Unused: 0. Used: WIFI_TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA384
WIFI_CFG_MQTT_TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256 Default: “0”	Select TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256 Cipher. Unused: 0. Used: WIFI_TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256
WIFI_CFG_MQTT_TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384 Default: “0”	Select TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384 Cipher. Unused: 0. Used: WIFI_TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384
WIFI_CFG_MQTT_P_CALLBACK Default: “1”	Enables or disables the user MQTT callback function. 0 = Unused, 1 = Used.
WIFI_CFG_MQTT_P_CALLBACK_FUNCTION_NAME Default: “mqtt_userCallback”	Specifies function name of the MQTT callback function called when receive data subscribed.
Wi-Fi TLS On-Chip Client Configuration	
WIFI_CFG_TLS_SUPPORT Default: “0”	Enables or disables TLS on-chip protocol. 1 = enabled, 0 = disabled.
WIFI_CFG_TLS_CREATABLE_SOCKETS Default: “1”	Configures the number of TLS client socket. Set this value in range from 1 to 2.
WIFI_CFG_TLS_SOCKET_RECEIVE_BUFFER_SIZE Default: “1024”	Configures the receive buffer size for the socket. Set this value in range from 1 to 4096.
WIFI_CFG_TLS_USE_CA_CERT Default: “1”	Flag to use CA certificates. 0 = Unused, 1 = Used.
WIFI_CFG_TLS_CERT_MAX_NAME Default: “32”	Configures length for certificate’s name.
WIFI_CFG_TLS_CERT_CA_NAME Default: “NULL”	Configures CA certificate name.
WIFI_CFG_TLS_CERT_CLIENT_NAME Default: “NULL”	Configures Client certificate name.
WIFI_CFG_TLS_CERT_PRIVATE_NAME Default: “NULL”	Configures Private certificate name.
Wi-Fi HTTP On-Chip Configuration	
WIFI_CFG_HTTP_SUPPORT Default: “0”	Enables or disables HTTP on-chip protocol. 1 = enabled, 0 = disabled.
WIFI_CFG_HTTP_SNI_NAME Default: “NULL”	Configures Server Name Indication (SNI).
WIFI_CFG_HTTP_ALPN1 Default: “NULL”	Select 1st Application Layer Protocol Negotiation (ALPN).
WIFI_CFG_HTTP_ALPN2 Default: “NULL”	Select 2nd ALPN.
WIFI_CFG_HTTP_ALPN3 Default: “NULL”	Select 3rd ALPN.
WIFI_CFG_HTTP_TLS_AUTH Default: “0”	Configures HTTP TLS Authentication levels. 0: None - No authentication required; accept connections without any form of authentication. 1: Optional - Allow both authenticated and unauthenticated connections. 2: Require - Demand authentication for connections.

WIFI_CFG_HTTP_CERTS_HEADER Default: “NULL”	Name of header file that will contain certificates (macros). User must create header file. Example: "cert_storage.h"
WIFI_CFG_HTTP_ROOT_CA Default: “NULL”	Links to user-defined macro of the same name for Root CA which user must define in application header.
WIFI_CFG_HTTP_CLIENT_CERT Default: “NULL”	Links to user-defined macro of the same name for client certificate which user must define in application header.
WIFI_CFG_HTTP_PRIVATE_KEY Default: “NULL”	Links to user-defined macro of the same name for private key which user must define in application header.

Table 2.2 Configuration Options (r_sci_rl_config.h)

Configuration Options in r_ sci_rl_config.h	
#define SCI_CFG_CHx_INCLUDED Notes: 1. CHx = CH0 to CH12 2. The default values are as follows: CH0 CH2 to CH12: 0, CH1: 1	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.
#define 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 WIFI_CFG_SCI_CHANNEL should be set to 512.
#define 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 WIFI_CFG_SCI_CHANNEL should be set to 512.
#define SCI_CFG_TEI_INCLUDED Note: The default is 0.	Enables the transmit end interrupt for serial transmissions. This option should be set to 1.

Table 2.3 Configuration Options (r_bsp_config.h)

Configuration Options in r_ bsp_config.h	
#define BSP_CFG_RTOS_USED Note: The default is 0.	Specifies the type of real-time OS. When using this SIS module, set the following. FreeRTOS:1 Bare Metal:0

2.8. Code Size

Typical code sizes associated with this module are listed below.
The ROM (code and constants) and RAM (global data) sizes are determined by the build-time configuration options described in 2.7 Compile Settings. The table lists reference values when the C compiler's compile options are set to their default values, as described in 2.3 Supported Toolchain. The compile option default values are optimization level: Code Size Precedence (-Osize), and data endianness: little-endian. The code size varies depending on the C compiler version and compile options.

The values in the table below are confirmed under the following conditions.

Module Revision: r_wifi_da16xxx rev1.30.
Compiler Version: Renesas Electronics C Compiler Package for RL78 Family V1.13.00
Configuration Options: Default settings.

Table 2.4 Memory Sizes

Device	Protocol	FreeRTOS	Category	Memory usage Renesas Compiler
RL78/G23 128p FPB	TCP only (Default settings)	FreeRTOS	ROM	13444 bytes
			RAM	3096 bytes
		Bare Metal	ROM	23660 bytes
			RAM	3224 bytes
	TLS only	FreeRTOS	ROM	14648 bytes
			RAM	3094 bytes
		Bare Metal	ROM	24864 bytes
			RAM	3222 bytes
	MQTT only	FreeRTOS	ROM	15243 bytes
			RAM	3950 bytes
		Bare Metal	ROM	25459 bytes
			RAM	4078 bytes
	HTTP only	FreeRTOS	ROM	12546 bytes
			RAM	2058 bytes
		Bare Metal	ROM	22762 bytes
			RAM	2186 bytes
	All protocols	FreeRTOS	ROM	21651 bytes
			RAM	6120 bytes
		Bare Metal	ROM	31867 bytes
			RAM	6248 bytes

Note: The memory sizes are only for the Wi-Fi module itself and do not include the UART and additional code required to build the module.

2.9. Return Values

The error codes returned by the API functions are listed below. The enumerated types of the return values and API function declarations are contained in r_wifi_da16xxx_if.h.

Table 2.5 API Error Codes (wifi_err_t)

Value	Error code	Description
0	WIFI_SUCCESS	OK, no error
-1	WIFI_ERR_PARAMETER	Invalid parameter
-2	WIFI_ERR_ALREADY_OPEN	Wi-Fi module already opens
-3	WIFI_ERR_NOT_OPEN	Wi-Fi module has not been opened
-4	WIFI_ERR_SERIAL_OPEN	Failed to open serial port
-5	WIFI_ERR_MODULE_COM	Failed communicating with Wi-Fi module
-6	WIFI_ERR_MODULE_TIMEOUT	Timed out communicating with Wi-Fi module
-7	WIFI_ERR_NOT_CONNECT	Not connected to AP
-8	WIFI_ERR_SOCKET_NUM	There are no available TCP/TLS sockets
-9	WIFI_ERR_SOCKET_CREATE	Failed creating TCP/TLS socket
-10	WIFI_ERR_CHANGE_SOCKET	Failed to change TCP/TLS socket number
-11	WIFI_ERR_SOCKET_CONNECT	Failed connecting a TCP/TLS socket
-12	WIFI_ERR_BYTEQ_OPEN	Failed to open BYTEQ module
-13	WIFI_ERR_SOCKET_TIMEOUT	TCP/TLS socket timeout
-14	WIFI_ERR_TAKE_MUTEX	Failed to take mutex
-15	WIFI_ERR_MQTT_ALREADY_OPEN	MQTT module already opens
-16	WIFI_ERR_MQTT_NOT_OPEN	MQTT module has not been opened
-17	WIFI_ERR_MQTT_NOT_CONNECT	Not connected to a MQTT broker
-18	WIFI_ERR_MQTT_CONNECTED	MQTT module is already connected
-19	WIFI_ERR_MQTT_INVALID_DATA	Invalid send/receive MQTT data
-20	WIFI_ERR_MQTT_OUT_OF_MEMORY	Out of memory for MQTT communication
-21	WIFI_ERR_HTTP_ALREADY_OPEN	HTTP module is already opened
-22	WIFI_ERR_HTTP_NOT_OPEN	HTTP module has not been opened
-23	WIFI_ERR_HTTP_INVALID_DATA	Invalid send/receive HTTP data

Table 2.6 Error Event for User Callback (wifi_err_event_enum_t)

Value	Error code	Description
0	WIFI_EVENT_WIFI_REBOOT	Reboot Wi-Fi module
1	WIFI_EVENT_WIFI_DISCONNECT	Disconnected to Wi-Fi module
2	WIFI_EVENT_SERIAL_OVF_ERR	Serial overflow error
3	WIFI_EVENT_SERIAL_FLM_ERR	Serial flaming error
4	WIFI_EVENT_SERIAL_RXQ_OVF_ERR	Serial receive queue overflow
5	WIFI_EVENT_RCV_TASK_RXB_OVF_ERR	Received buffer overflow
6	WIFI_EVENT_SOCKET_CLOSED	Socket is closed
7	WIFI_EVENT_SOCKET_RXQ_OVF_ERR	Socket receive queue overflow

2.10. Parameters

This section describes the parameter structures used by the API functions in this module. The structures are defined in r_wifi_da16xxx_if.h.

Table 2.7 Definition of Security Type (wifi_security_t)

Value	Type	Description
0	WIFI_SECURITY_OPEN	Open – No security
1	WIFI_SECURITY_WEP	WEP security
2	WIFI_SECURITY_WPA	WPA security
3	WIFI_SECURITY_WPA2	WPA2 security
4	WIFI_SECURITY_WPA2_ENT	WPA2 enterprise security
5	WIFI_SECURITY_WPA3	WPA3 security
6	WIFI_SECURITY_UNDEFINED	Unknown security

Table 2.8 Definition of Encryption Type (wifi_encryption_t)

Value	Type	Description
0	WIFI_ENCRYPTION_TKIP	TKIP encryption
1	WIFI_ENCRYPTION_AES	AES encryption
2	WIFI_ENCRYPTION_TKIP_AES	TKIP+AES encryption
3	WIFI_ENCRYPTION_UNDEFINED	Unknown encryption

Table 2.9 Definition of Socket Type (wifi_socket_type_t)

Value	Type	Description
0	WIFI_SOCKET_TYPE_TCP_SERVER	TCP server
1	WIFI_SOCKET_TYPE_TCP_CLIENT	TCP client
2	WIFI_SOCKET_TYPE_UDP	UDP
3	WIFI_SOCKET_TYPE_TLS	TLS client

Table 2.10 Definition of Certificate Type (wifi_tls_key_type_t)

Value	Type	Description
0	WIFI_TLS_TYPE_CA_CERT	CA Certificate
1	WIFI_TLS_TYPE_CLIENT_CERT	Client Certificate
2	WIFI_TLS_TYPE_CLIENT_PRIVATE_KEY	Client Private Key
3	WIFI_TLS_TYPE_UNDEFINED	Unknown Encryption

Table 2.11 Definition of Socket Status (wifi_socket_status_t)

Value	Type	Description
0	WIFI_SOCKET_STATUS_CLOSED	Socket is closed
1	WIFI_SOCKET_STATUS_SOCKET	Socket is created
2	WIFI_SOCKET_STATUS_BOUND	Bounding
3	WIFI_SOCKET_STATUS_LISTEN	Listening socket
4	WIFI_SOCKET_STATUS_CONNECTED	Socket is connected

Table 2.12 MQTT Quality-of-Service (QoS) Levels (wifi_mqtt_qos_t)

Value	Type	Description
0	WIFI_MQTT_QOS_0	Delivery at most once
1	WIFI_MQTT_QOS_1	Delivery at least once
2	WIFI_MQTT_QOS_2	Delivery exactly once

Table 2.13 Cipher Suites Support for MQTT TLS (wifi_tls_cipher_suites_t)

Value	Type	Description
0xC011	WIFI_TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA	TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA
0xC014	WIFI_TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA	TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA
0xC027	WIFI_TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA256	TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA256
0xC028	WIFI_TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA384	TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA384
0xC02F	WIFI_TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256	TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256
0xC030	WIFI_TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384	TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384
0xC009	WIFI_TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA	TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA
0xC00A	WIFI_TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA	TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA
0xC023	WIFI_TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA256	TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA256
0xC024	WIFI_TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA384	TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA384
0xC02B	WIFI_TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256	TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256
0xC02C	WIFI_TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384	TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384

Table 2.14 SNTP Options (wifi_sntp_enable_t)

Value	Type	Description
0	WIFI_SNTP_DISABLE	Disable SNTP
1	WIFI_SNTP_ENABLE	Enable SNTP

Table 2.15 Member in Structure for Obtaining the Result of AP Scan (wifi_scan_result_t)

Type	Name	Description
uint8_t	ssid[WIFI_CFG_MAX_SSID_LEN]	SSID
uint8_t	bssid[WIFI_CFG_MAX_BSSID_LEN]	BSSID
wifi_security_t	security	Security type
wifi_encryption_t	encryption	Encryption type
int8_t	rssi	RSSI
uint8_t	hidden	Hidden channel

Table 2.16 Member in Structure for IP Configurations (wifi_ip_configuration_t)

Type	Name	Description
uint8_t	ipaddress[4]	IP address
uint8_t	subnetmask[4]	Subnet mask
uint8_t	gateway[4]	Gateway

Table 2.17 Member in Structure for MQTT Subscription (wifi_mqtt_sub_info_t)

Type	Name	Description
wifi_mqtt_qos_t	qos	Quality of Service for subscription
const char *	p_topic_filter	Topic filter to subscribe to
uint16_t	topic_filter_length	Length of subscription topic filter

Table 2.18 Member in Structure for MQTT Publish (wifi_mqtt_pub_info_t)

Type	Name	Description
wifi_mqtt_qos_t	qos	Quality of Service for subscription
const char *	p_topic_name	Topic name on which the message is published
uint16_t	topic_name_length	Length of topic name
const char *	p_payload	Message payload
uint32_t	payload_length	Message payload length

Table 2.19 Member in Structure to be Passed to MQTT User Callback (wifi_mqtt_call_args_t)

Type	Name	Description
uint8_t *	p_data	Payload received from subscribed MQTT topic
const char *	p_topic	Topic to which the message payload belongs to
uint32_t	data_length	Length of the MQTT payload
void const *	p_context	Placeholder for user data

Table 2.20 Member in Structure for TLS Client on Chip Certificate Information (wifi_tls_cert_info_t)

Type	Name	Description
uint8_t	cert_ca[WIFI_CFG_TLS_CERT_MAX_NAME]	CA certificate name
uint8_t	cert_name[WIFI_CFG_TLS_CERT_MAX_NAME]	Client certificate name

Table 2.21 Definition of HTTP Methods (wifi_http_method_t)

Value	Type	Description
0	WIFI_HTTP_GET	GET method
1	WIFI_HTTP_POST	POST method
2	WIFI_HTTP_PUT	PUT method

Table 2.22 Definition of HTTP TLS Authentication (wifi_http_tls_auth_t)

Value	Type	Description
0	WIFI_HTTP_TLS_VERIFY_NONE	No needed verify client certification
1	WIFI_HTTP_TLS_VERIFY_OPTIONAL	Request client certification but not mandatory
2	WIFI_HTTP_TLS_VERIFY_REQUIRED	Require client certification

Table 2.23 Member in Structure for HTTP request (wifi_http_request_t)

Type	Name	Description
const char *	http_endpoint	HTTP endpoint
wifi_http_method_t	method	HTTP request method
const char *	request_body	HTTP request header
uint32_t	length	HTTP request length

Table 2.24 Member in Structure for HTTP response (wifi_http_buffer_t)

Type	Name	Description
const char *	response_buffer	HTTP response buffer
uint32_t	resp_length	HTTP response length

2.11. Adding the SIS Module to Your Project

The SIS module must be added to each project in which it is used. Renesas recommends the method using the Smart Configurator described in below:

(1) Adding the SIS module to your project using the Smart Configurator in e2 studio. By using the Smart Configurator in e2 studio, the SIS module is automatically added to your project. Refer to “RL78 Smart Configurator User’s Guide: e² studio (R20AN0579)” for details.

2.12. “for”, “while” and “do while” Statements

In SIS module, “for”, “while” and “do while” statements (loop processing) are used in processing to wait for register to be reflected and so on. For these loop processing, comments with “WAIT_LOOP” as a keyword are described. Therefore, if user incorporates fail-safe processing into loop processing, user can search the corresponding processing with “WAIT_LOOP”.

This SIS module does not have any WAIT_LOOP. But others might have. Please take care for this WAIT_LOOP.

2.13. Limitations

2.13.1 Wi-Fi Security Type Limitations

Wi-Fi AP connections do not currently support WEP security.

2.13.2 Wi-Fi SDK Limitations

The default UART baud rate supported by v3.2.1 Wi-Fi SDK is 115200 and v3.2.4 Wi-Fi SDK is 230400. User needs to explicitly configure the default UART baud settings in the UART driver configurator properties based on the version of Wi-Fi SDK used in their testing.

2.13.3 The Daylight Savings Time Setting Limitations

In v3.2.1 Wi-Fi SDK, the daylight savings time setting is disabled by default. The user needs to mandatorily set the following parameters such as minutes = 0, daylight savings to disable when calling **R_WIFI_DA16XXX_SntpTimeZoneSet()** API.

2.13.4 Wi-Fi Network Connection Limitations

Network connection parameters SSID and Passphrase for the Access Point cannot contain any commas. This is a current limitation of the da16xxx module firmware. The **R_WIFI_DA16XXX_Connect()** function will return an error if a comma is detected.

2.13.5 Wi-Fi Access Point Scanning Limitations

Wi-Fi AP Scanning is currently limited to max of 10 Access Points.

2.14. Restriction

The SIS module is subject to the following restrictions.
If WIFI_ERR_SERIAL_OPEN occurs, use R_WIFI_DA16XXX_Close() to close the Wi-Fi SIS module.

3. API Functions

3.1. R_WIFI_DA16XXX_Open()

This function initializes the SIS module and Wi-Fi module.

Format

```
wifi_err_t R_WIFI_DA16XXX_Open(
      void
)
```

Parameters

None

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_ALREADY_OPEN	Already open
WIFI_ERR_SERIAL_OPEN	Failed to initialize serial
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_BYTEQ_OPEN	BYTEQ allocation failure
WIFI_ERR_TAKE_MUTEX	Failed to obtain mutex

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function initializes the SIS module and Wi-Fi module.

Reentrant

No

Example

```
R_WIFI_DA16XXX_Open();
```

Special Notes:

If WIFI_ERR_SERIAL_OPEN occurs, execute R_WIFI_DA16XXX_Close().

3.2. R_WIFI_DA16XXX_IsOpened()

This function checks Wi-Fi is opened.

Format

```
int32_t R_WIFI_DA16XXX_IsOpened(
      void
)
```

Parameters

None

Return values

0	Wi-Fi is opened
-1	Wi-Fi is not opened

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function checks Wi-Fi is opened.

Reentrant

No

Example

```
if (0 != R_WIFI_DA16XXX_IsOpened())
{
    return WIFI_SUCCESS;
}
```

Special Notes:

None

3.3. R_WIFI_DA16XXX_Close()

This function initializes the SIS module and Wi-Fi module.

Format

```
wifi_err_t R_WIFI_DA16XXX_Close(
      void
)
```

Parameters

None

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_TAKE_MUTEX	Failed to obtain mutex

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function closes the Wi-Fi module.

If this function is executed while the access point is connected, the access point will be disconnected, and the Wi-Fi module will be closed.

Reentrant

No

Example

```
R_WIFI_DA16XXX_Open();
R_WIFI_DA16XXX_Close();
```

Special Notes:

None

3.4. R_WIFI_DA16XXX_Ping()

This function pings the specified IP address.

Format

```
wifi_err_t R_WIFI_DA16XXX_Ping(
      uint8_t * ip_address,
      uint16_t count
)
```

Parameters

ip_address	IP address
count	Number of ping transmissions

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_NOT_CONNECT	Not connected to access point
WIFI_ERR_TAKE_MUTEX	Failed to obtain mutex

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function pings the IP address specified by ip_address.

The parameter (count) specifies the number of transmissions.

Reentrant

No

Example

```
uint8_t ip_addr[4] = {192, 168, 5, 13};
R_WIFI_DA16XXX_Ping(ip_addr, 4);
```

Special Notes:

None

3.5. R_WIFI_DA16XXX_Scan()

This function scans for access points.

Format

```
wifi_err_t R_WIFI_DA16XXX_Scan(
      wifi_scan_result_t * ap_results,
      uint32_t max_networks
)
```

Parameters

ap_results	Pointer to the structure that stores the scan results
max_networks	Maximum number of access points to store in ap_results

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_NOT_OPEN	Wi-Fi module not initialized
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_TAKE_MUTEX	Failed to obtain mutex

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function scans for access points in the periphery of the Wi-Fi module.

The results of the scan are stored in the area specified by the ap_results argument, up to the maximum number of values specified by the max_networks argument.

Example

```
wifi_scan_result_t scan_rslt[5];
uint32_t max_networks = 5;
R_WIFI_DA16XXX_Scan(scan_rslt, max_networks);
for (int i = 0; i < 5; i++)
{
    printf(" --------------------\n");
    printf(" ssid : %s\n", scan_rslt[i].ssid);
    printf(" rssi : %d\n", scan_rslt[i].rssi);
    printf(" security : %d\n", scan_rslt[i].security);
    printf(" encryption : %d\n", scan_rslt[i].encryption);
}
```

Special Notes:

None

3.6. R_WIFI_DA16XXX_Connect()

This function connects to the specified access point.

Format

```
wifi_err_t R_WIFI_DA16XXX_Connect(
      const uint8_t * ssid,
      const uint8_t * pass,
      wifi_security_t security,
      wifi_encryption_t enc_type
)
```

Parameters

ssid	Pointer to SSID of access point
pass	Pointer to password of access point
security	Security type information
enc_type	Encryption type information

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_NOT_OPEN	Wi-Fi module not initialized
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_NOT_CONNECT	Not connected to access point
WIFI_ERR_TAKE_MUTEX	Failed to obtain mutex

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

Connects to the access point specified by “ssid”.

Reentrant

No

Example

```
uint8_t ssid[] = “ssid”;
uint8_t pass[] = “passwd”;
wifi_security_t security = WIFI_SECURITY_WPA2;
wifi_encryption_t encryption = WIFI_ENCRYPTION_AES;

R_WIFI_DA16XXX_Open();
R_WIFI_DA16XXX_Connect(ssid, passwd, security, encryption);
```

Special Notes:

None

3.7. R_WIFI_DA16XXX_Disconnect()

This function disconnects the connecting access point.

Format

```
wifi_err_t R_WIFI_DA16XXX_Disconnect(
      void
)
```

Parameters

None

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_NOT_OPEN	Wi-Fi module not initialized
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function disconnects the connecting access point.

Reentrant

No

Example

```
uint8_t ssid[] = “ssid”;
uint8_t pass[] = “passwd”;
wifi_security_t security = WIFI_SECURITY_WPA2;
wifi_encryption_t encryption = WIFI_ENCRYPTION_AES;

R_WIFI_DA16XXX_Open();
R_WIFI_DA16XXX_Connect(ssid, passwd, security, encryption);
R_WIFI_DA16XXX_Disconnect();
```

Special Notes:

None

3.8. R_WIFI_DA16XXX_IsConnected()

This function obtains the connection status of the Wi-Fi module and access point.

Format

```
wifi_err_t R_WIFI_DA16XXX_IsConnected(
      void
)
```

Parameters

None

Return values

0	Connecting to the access point
-1	Not connected to access point

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

Returns the connection status of the Wi-Fi module and access point.

Reentrant

No

Example

```
if (0 == R_WIFI_DA16XXX_IsConnected())
{
    printf("connected \n");
}
else
{
    printf("not connect \n");
}
```

Special Notes:

None

3.9. R_WIFI_DA16XXX_DnsQuery()

This function performs a DNS query.

Format

```
wifi_err_t R_WIFI_DA16XXX_DnsQuery(
      uint8_t * domain_name,
      uint8_t * ip_address
)
```

Parameters

domain_name	Domain name
ip_address	IP address storage area

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_NOT_CONNECT	Not connected to access point
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module or domain does not exist
WIFI_ERR_TAKE_MUTEX	Failed to obtain mutex

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function performs a DNS query to obtain the IP address of the specified domain.

Reentrant

No

Example

```
Uint8_t ipaddr[4];
R_WIFI_DA16XXX_DnsQuery("hostname", ipaddr);
```

Special Notes:

None

3.10. R_WIFI_DA16XXX_SntpServerIpAddressSet()

This function sets SNTP server IP address.

Format

```
wifi_err_t R_WIFI_DA16XXX_SntpServerIpAddressSet(
      uint8_t * ip_address
)
```

Parameters

ip_address	IP address storage area

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_NOT_OPEN	Wi-Fi module not initialized
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function sets SNTP server IP address.

Reentrant

No

Example

```
uint8_t ip_address_sntp_server[4] = {0, 0, 0, 0};
R_WIFI_DA16XXX_SntpServerIpAddressSet(ip_address_sntp_server);
```

Special Notes:

None

3.11. R_WIFI_DA16XXX_SntpEnableSet()

This function enables or disables SNTP client service.

Format

```
wifi_err_t R_WIFI_DA16XXX_SntpEnableSet(
      wifi_sntp_enable_t * enable
)
```

Parameters

ip_address	IP address storage area

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_NOT_OPEN	Wi-Fi module not initialized
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function enables or disables SNTP client service.

Reentrant

No

Example

```
uint8_t ip_address_sntp_server[4] = {0, 0, 0, 0};
R_WIFI_DA16XXX_SntpServerIpAddressSet(ip_address_sntp_server);
R_WIFI_DA16XXX_SntpEnableSet(WIFI_SNTP_ENABLE);
```

Special Notes:

None

3.12. R_WIFI_DA16XXX_SntpTimeZoneSet()

This function sets SNTP time zone.

Format

```
wifi_err_t R_WIFI_DA16XXX_SntpTimeZoneSet(
      int8_t utc_offset_in_hour
)
```

Parameters

utc_offset_in_hour	Time zone in UTC offset in hours

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_NOT_OPEN	Wi-Fi module not initialized
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function sets SNTP time zone.

Reentrant

No

Example

```
uint8_t ip_address_sntp_server[4] = {0, 0, 0, 0};
R_WIFI_DA16XXX_SntpServerIpAddressSet(ip_address_sntp_server;
R_WIFI_DA16XXX_SntpEnableSet(WIFI_SNTP_ENABLE);
R_WIFI_DA16XXX_SntpTimeZoneSet(25200);  /* UTC+07:00 */
```

Special Notes:

None

3.13. R_WIFI_DA16XXX_LocalTimeGet()

This function gets the current local time based on current time zone in a string.

Format

```
wifi_err_t R_WIFI_DA16XXX_LocalTimeGet(
      uint8_t * local_time,
      uint32_t size_string
)
```

Parameters

local_time	Pointer to local time in string format
size_string	size of string. The size of this string needs to be at least 25 bytes

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_NOT_OPEN	Wi-Fi module not initialized
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_TAKE_MUTEX	Failed to obtain mutex

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function gets the current local time based on the current time zone in a string.

Example: YYYY-MM-DD,HOUR:MIN:SECS.

Reentrant

No

Example

```
uint8_t time[25];
R_WIFI_DA16XXX_LocalTimeGet(time, 25);
printf("It is %s\n", time);
```

Special Notes:

None

3.14. R_WIFI_DA16XXX_SetDnsServerAddress()

This function sets DNS Server Address.

Format

```
wifi_err_t R_WIFI_DA16XXX_SetDnsServerAddress(
      uint8_t * dns_address
)
```

Parameters

dns_address	Pointed to DNS address storage area

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_NOT_CONNECT	Not connected to access point
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function sets DNS Server Address.

Reentrant

No

Example

```
uint8_t dns[4] = {0, 0, 0, 0};
R_WIFI_DA16XXX_SetDnsServerAddress(dns);
```

Special Notes:

None

3.15. R_WIFI_DA16XXX_GetMacAddress()

This function obtains the MAC address value of the Wi-Fi module.

Format

```
wifi_err_t R_WIFI_DA16XXX_GetMacAddress(
      uint8_t * mac_address
)
```

Parameters

mac_address	Pointer to storage area for MAC address (6 bytes)

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_NOT_CONNECT	Not connected to access point
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_TAKE_MUTEX	Failed to obtain mutex

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

Obtains the MAC address value of the Wi-Fi module. The MAC address is stored as binary data in mac_address.

Reentrant

No

Example

```
uint8_t mac[6];
R_WIFI_DA16XXX_Open();
R_WIFI_DA16XXX_GetMacAddress(mac);
printf("— MAC addr : %lx:%lx:%lx:%lx:%lx:%lx\r\n",
mac[0], mac[1], mac[2], mac[3], mac[4], mac[5]);
```

Special Notes:

None

3.16. R_WIFI_DA16XXX_GetIpAddress()

This function obtains the IP address assigned to the Wi-Fi module.

Format

```
wifi_err_t R_WIFI_DA16XXX_GetIpAddress(
      wifi_ip_configuration_t * ip_config
)
```

Parameters

ip_config	Pointer to IP address storage area

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_NOT_CONNECT	Not connected to access point
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_TAKE_MUTEX	Failed to obtain mutex

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function obtains the IP address, subnet mask and gateway assigned to the Wi-Fi module and stores them in ip_config.

Reentrant

No

Example

```
wifi_ip_configuration_t ip_cfg;
R_WIFI_DA16XXX_GetIpAddress(&ip_cfg);
```

Special Notes:

None

3.17. R_WIFI_DA16XXX_HardwareReset()

This function resets the Wi-Fi module.

Format

```
wifi_err_t R_WIFI_DA16XXX_HardwareReset (
      void
)
```

Parameters

None

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_SERIAL_OPEN	Failed to initialize serial
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_NOT_CONNECT	Not connected to access point
WIFI_ERR_BYTEQ_OPEN	BYTEQ allocation failure
WIFI_ERR_TAKE_MUTEX	Failed to obtain mutex
WIFI_ERR_SOCKET_CREATE	Failed to create socket

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function resets the Wi-Fi module with the RESET pin.

Reentrant

No

Example

```
R_WIFI_DA16XXX_HardwareReset();
```

Special Notes:

None

3.18. R_WIFI_DA16XXX_GetVersion()

This function obtains version information for the SIS module.

Format

```
uint32_t R_WIFI_DA16XXX_GetVersion (
      void
)
```

Parameters

None

Return values

Upper 2 bytes:	Major version (decimal notation)
Lower 2 bytes:	Minor version (decimal notation)

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function returns the version number of the SIS module.

The upper 2 bytes indicate the major version and the lower 2 bytes indicate the minor version.

Reentrant

No

Example

```
uint32_t ver;
ver = R_WIFI_DA16XXX_GetVersion();
printf("Version V%d.%2d\n", ((ver >> 16) & 0x0000FFFF), (ver & 0x0000FFFF));
```

Special Notes:

None

3.19. R_WIFI_DA16XXX_GetAvailableSocket()

This function gets the next available socket ID.

Format

```
wifi_err_t R_WIFI_DA16XXX_GetAvailableSocket(
      uint32_t * socket_id
)
```

Parameters

socket_id	Pointer to socket id storage area

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_NOT_CONNECT	Not connected to access point
WIFI_ERR_SOCKET_NUM	No socket available for connection socket

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function gets the next available socket ID.

Reentrant

No

Example

```
uint32_t socket_no;
R_WIFI_DA16XXX_GetAvailableSocket(&socket_no);
```

Special Notes:

None

3.20. R_WIFI_DA16XXX_GetSocketStatus()

This function gets the socket status.

Format

```
wifi_err_t R_WIFI_DA16XXX_GetSocketStatus(
      uint32_t socket_number,
      wifi_socket_status_t * socket_status
)
```

Parameters

socket_number	Socket number
socket_status	Pointer to socket status storage area

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_NOT_OPEN	Wi-Fi module not initialized
WIFI_ERR_SOCKET_NUM	Socket number is invalid

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function gets socket status.

Reentrant

No

Example

```
  if (WIFI_SOCKET_STATUS_CLOSED == R_WIFI_DA16XXX_GetSocketStatus(socket_no,
&socket_status))
  {
      printf("Socket is available \n");
  }
  else
  {
      printf("Socket is not available \n");
  }
```

Special Notes:

None

3.21. R_WIFI_DA16XXX_CreateSocket()

This function creates a socket by specifying the socket type and IP type.

Format

```
wifi_err_t R_WIFI_DA16XXX_CreateSocket(
      uint32_t socket_number,
      wifi_socket_type_t type,
      uint8_t ip_version
)
```

Parameters

socket_number	Socket number
type	Socket type
ip_version	IP version

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_NOT_CONNECT	Not connected to access point
WIFI_ERR_SOCKET_CREATE	Failed to create socket

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function creates a TCP socket by specifying the socket type (WIFI_SOCKET_TYPE_TCP_CLIENT) and IP type.

Reentrant

No

Example

```
int32_t socket_no;
wifi_socket_type_t type = WIFI_SOCKET_TYPE_TCP_CLIENT;
R_WIFI_DA16XXX_GetAvailableSocket(&socket_no);
Sock_tcp = R_WIFI_DA16XXX_CreateSocket(socket_no, type, 4);
```

Special Notes:

None

3.22. R_WIFI_DA16XXX_TcpConnect()

This function connects to a specific IP and Port using socket.

Format

```
wifi_err_t R_WIFI_DA16XXX_TcpConnect(
      uint32_t socket_number,
      uint8_t * ip_address,
      uint16_t port
)
```

Parameters

socket_number	Socket number
ip_address	Pointer to IP address of TCP server in byte array format
port	Port of TCP server

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_NOT_CONNECT	Not connected to access point
WIFI_ERR_SOCKET_NUM	Socket numbet is invalid
WIFI_ERR_TAKE_MUTEX	Failed to obtain mutex

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function connects to a specific IP and Port using socket.

Reentrant

No

Example

```
int32_t socket_no;
uint8_t ip_addr[4] = {192, 168, 1, 10};
uint16_t port = 1234;
da16xxx_socket_type_t type = DA16XXX_SOCKET_TYPE_TCP_CLIENT;
R_WIFI_DA16XXX_GetAvailableSocket(&socket_no);
Sock_tcp = R_WIFI_DA16XXX_CreateSocket(socket_no, type, 4);
R_WIFI_DA16XXX_TcpConnect(socket_no, ip_addr, port);
```

Special Notes:

None

3.23. R_WIFI_DA16XXX_SendSocket()

This function transmits data using the specified socket.

Format

```
wifi_err_t R_WIFI_DA16XXX_SendSocket(
      uint32_t socket_number,
      uint8_t * data,
      uint32_t length,
      uint32_t timeout_ms
)
```

Parameters

socket_number	Socket number
data	Pointer to transmit data in byte array format
length	Number of bytes of data to be transmitted
timeout_ms	Transmission timeout duration (millisecond)

Return values

Number of sent data	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_MODULE_TIMEOUT	Communicate with module timed out
WIFI_ERR_NOT_CONNECT	Not connected to access point
WIFI_ERR_SOCKET_NUM	Socket number is invalid
WIFI_ERR_TAKE_MUTEX	Failed to obtain mutex

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function sends the data stored in the data from the specified socket the number of bytes specified by length.

Reentrant

No

Example

```
int32_t recv_num;
uint8_t buffer[50];
recv_num = R_WIFI_DA16XXX_SendSocket(sock, buffer, sizeof(buffer), 1000);
```

Special Notes:

None

3.24. R_WIFI_DA16XXX_ReceiveSocket()

This function receives data from the specified socket.

Format

```
wifi_err_t R_WIFI_DA16XXX_ReceiveSocket(
      uint32_t socket_number,
      uint8_t * data,
      uint32_t length,
      uint32_t timeout_ms
)
```

Parameters

socket_number	Socket number
data	Pointer to receive data storage area
length	Number of bytes of data to be received
timeout_ms	Transmission timeout duration (millisecond)

Return values

Number of received data	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_NOT_CONNECT	Not connected to access point
WIFI_ERR_SOCKET_NUM	Socket number is invalid

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function sends the data stored in the data from the specified socket the number of bytes specified by length.

Reentrant

No

Example

```
int32_t recv_num;
uint8_t buffer[50];
recv_num = R_WIFI_DA16XXX_ReceiveSocket(sock, buffer, sizeof(buffer), 1000);
```

Special Notes:

None

3.25. R_WIFI_DA16XXX_CloseSocket()

This function disconnects communication with the specified socket and deletes the socket.

Format

```
wifi_err_t R_WIFI_DA16XXX_CloseSocket(
      uint32_t socket_number
)
```

Parameters

socket_number	Socket number

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_NOT_OPEN	Wi-Fi module not initialized
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_MODULE_TIMEOUT	Communicate with module timed out
WIFI_ERR_SOCKET_NUM	Socket number is invalid

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function disconnects communication with the specified socket and deletes the socket.

Reentrant

No

Example

```
R_WIFI_DA16XXX_TcpConnect(sock, ipaddr, port);
R_WIFI_DA16XXX_CloseSocket(sock);
```

Special Notes:

None

3.26. R_WIFI_DA16XXX_TcpReconnect()

This function reconnects to the existing socket.

Format

```
wifi_err_t R_WIFI_DA16XXX_TcpReconnect(
      uint32_t socket_number
)
```

Parameters

socket_number	Socket number

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_NOT_CONNECT	Not connected to access point
WIFI_ERR_SOCKET_NUM	Socket number is invalid
WIFI_ERR_TAKE_MUTEX	Failed to obtain mutex

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function reconnects to the existing socket.

If sock_number is UINT8_MAX, this function will reconnect all disconnected sockets.

Reentrant

No

Example

```
R_WIFI_DA16XXX_TcpReconnect(socket_no);
```

Special Notes:

None

3.27. R_WIFI_DA16XXX_GetAvailableTlsSocket()

This function gets the next available TLS socket ID.

Format

```
wifi_err_t R_WIFI_DA16XXX_GetAvailableTlsSocket(
      uint32_t * socket_id
)
```

Parameters

socket_id	Pointer to socket id storage area

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_NOT_CONNECT	Not connected to access point
WIFI_ERR_SOCKET_NUM	No socket available for connection socket

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function gets the next available TLS socket ID.

Reentrant

No

Example

```
uint32_t socket_no;
R_WIFI_DA16XXX_GetAvailableTlsSocket(&socket_no);
```

Special Notes:

None

3.28. R_WIFI_DA16XXX_GetTlsSocketStatus()

This function gets the TLS socket status.

Format

```
wifi_err_t R_WIFI_DA16XXX_GetTlsSocketStatus(
      uint32_t socket_number,
      wifi_socket_status_t * socket_status
)
```

Parameters

socket_number	Socket number
socket_status	Pointer to socket status storage area

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_NOT_OPEN	Wi-Fi module not initialized
WIFI_ERR_SOCKET_NUM	Socket number is invalid

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function gets TLS Client socket status.

Reentrant

No

Example

```
 if(WIFI_SOCKET_STATUS_CLOSED == R_WIFI_DA16XXX_GetTlsSocketStatus(socket_no,
&socket_status))
 {
     printf("Socket is available \n");
 }
 else
 {
     printf("Socket is not available \n");
 }
```

Special Notes:

None

3.29. R_WIFI_DA16XXX_CreateTlsSocket()

This function creates a TLS socket by specifying the socket type and IP type.

Format

```
wifi_err_t R_WIFI_DA16XXX_CreateSocket(
      uint32_t socket_number,
      wifi_socket_type_t type,
      uint8_t ip_version
)
```

Parameters

socket_number	Socket number
type	Socket type
ip_version	IP version

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_NOT_CONNECT	Not connected to access point
WIFI_ERR_SOCKET_CREATE	Failed to create socket

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function creates a TLS socket by specifying the socket type (WIFI_SOCKET_TYPE_TLS) and IP type.

Reentrant

No

Example

```
int32_t socket_no;
wifi_socket_type_t type = WIFI_SOCKET_TYPE_TLS;
R_WIFI_DA16XXX_GetAvailableTlsSocket(&socket_no);
Sock_tcp = R_WIFI_DA16XXX_CreateTlsSocket(socket_no, type, 4);
```

Special Notes:

None

3.30. R_WIFI_DA16XXX_TlsConnect()

This function connects to a specific IP and Port using TLS socket.

Format

```
wifi_err_t R_WIFI_DA16XXX_TlsConnect(
      uint32_t socket_number,
      uint8_t * ip_address,
      uint16_t port
)
```

Parameters

socket_number	Socket number
ip_address	IP address of TLS server in byte array format
port	Port of TLS server

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_NOT_CONNECT	Not connected to access point
WIFI_ERR_SOCKET_NUM	Socket number is invalid
WIFI_ERR_TAKE_MUTEX	Failed to obtain mutex

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function connects to a specific IP and Port using TLS socket.

Reentrant

No

Example

```
int32_t socket_no;
uint8_t ip_addr[4] = {192, 168, 1, 10};
uint16_t port = 1234;
da16xxx_socket_type_t type = DA16XXX_SOCKET_TYPE_TLS;
R_WIFI_DA16XXX_GetAvailableTlsSocket(&socket_no);
Sock_tcp = R_WIFI_DA16XXX_CreateTlsSocket(socket_no, type, 4);
R_WIFI_DA16XXX_TlsConnect(socket_no, ip_addr, port);
```

Special Notes:

None

3.31. R_WIFI_DA16XXX_SendTlsSocket()

This function transmits data using the specified socket.

Format

```
wifi_err_t R_WIFI_DA16XXX_SendTlsSocket(
      uint32_t socket_number,
      uint8_t * data,
      uint32_t length,
      uint32_t timeout_ms
)
```

Parameters

socket_number	Socket number
data	Pointer to transmit data in byte array format
length	Number of bytes of data to be transmitted
timeout_ms	Transmission timeout duration (millisecond)

Return values

Number of sent data	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_MODULE_TIMEOUT	Communicate with module timed out
WIFI_ERR_NOT_CONNECT	Not connected to access point
WIFI_ERR_SOCKET_NUM	Socket number is invalid or disconnected
WIFI_ERR_TAKE_MUTEX	Failed to obtain mutex

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function sends the data stored in the data from the specified socket the number of bytes specified by length.

Reentrant

No

Example

```
int32_t recv_num;
uint8_t buffer[50];
recv_num = R_WIFI_DA16XXX_SendTlsSocket(sock, buffer, sizeof(buffer), 1000);
```

Special Notes:

None

3.32. R_WIFI_DA16XXX_ReceiveTlsSocket()

This function receives data from the specified socket.

Format

```
wifi_err_t R_WIFI_DA16XXX_ReceiveTlsSocket(
      uint32_t socket_number,
      uint8_t * data,
      uint32_t length,
      uint32_t timeout_ms
)
```

Parameters

socket_number	Socket number
data	Pointer to receive data storage area
length	Number of bytes of data to be received
timeout_ms	Transmission timeout duration (millisecond)

Return values

Number of received data	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_NOT_CONNECT	Not connected to access point
WIFI_ERR_SOCKET_NUM	Socket number is invalid

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function sends the data stored in the data from the specified socket the number of bytes specified by length.

Reentrant

No

Example

```
  int32_t recv_num;
  uint8_t buffer[50];
  recv_num = R_WIFI_DA16XXX_ReceiveTlsSocket(sock, buffer, sizeof(buffer),
1000);
```

Special Notes:

None

3.33. R_WIFI_DA16XXX_CloseTlsSocket()

This function disconnects communication with the specified TLS socket and deletes the socket.

Format

```
wifi_err_t R_WIFI_DA16XXX_CloseTlsSocket(
      uint32_t  socket_number
)
```

Parameters

socket_number	Socket number

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_NOT_OPEN	Wi-Fi module not initialized
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_MODULE_TIMEOUT	Communicate with module timed out
WIFI_ERR_SOCKET_NUM	Socket number is invalid

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function disconnects communication with the specified socket and deletes the socket.

Reentrant

No

Example

```
R_WIFI_DA16XXX_TlsConnect(sock, ipaddr, port);
R_WIFI_DA16XXX_CloseTlsSocket(sock);
```

Special Notes:

None

3.34. R_WIFI_DA16XXX_TlsReconnect()

This function reconnects to the existing socket.

Format

```
wifi_err_t R_WIFI_DA16XXX_TcpReconnect(
      uint32_t  socket_number
)
```

Parameters

socket_number	Socket number

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_NOT_CONNECT	Not connected to access point
WIFI_ERR_SOCKET_NUM	Socket number is invalid
WIFI_ERR_TAKE_MUTEX	Failed to obtain mutex

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function reconnects to the existing socket.

If sock_number is UINT8_MAX, this function will reconnect all disconnected sockets.

Reentrant

No

Example

```
  R_WIFI_DA16XXX_TlsReconnect(socket_no);
```

Special Notes:

None

3.35. R_WIFI_DA16XXX_RegistServerCertificate()

This function registers server certificates on the Wi-Fi module.

Format

```
wifi_err_t R_WIFI_DA16XXX_RegistServerCertificate(
      uint8_t socket_num,
      wifi_tls_cert_info_t * cert_info,
      uint32_t trans_buf_size,
      uint32_t recv_buf_size
)
```

Parameters

socket_num	Socket number
cert_info	Pointer to certificate information storage area
trans_buf_size	Incoming buffer length for TLS socket
recv_buf_size	Outgoing buffer length for TLS socket

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_NOT_OPEN	Wi-Fi module not initialized
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function configures SSL connection for specifies socket number with below list of configurations:

- Set SSL CA Certificate.
- Set SSL Certificate.
- Set the Incoming buffer length.
- Set the Outgoing buffer length.

This function must be called before calling this function: R_WIFI_DA16XXX_TlsConnect().

Reentrant

No

Example

```
R_WIFI_DA16XXX_RegistServerCertificate(socketId, &cert_info, 8192, 8192);
```

Special Notes:

None

3.36. R_WIFI_DA16XXX_RequestTlsSocket()

This function allocates the created TLS socket for SSL connection.

Format

```
wifi_err_t R_WIFI_DA16XXX_RequestTlsSocket (
      uint8_t socket_number
)
```

Parameters

socket_number	Socket number

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_NOT_CONNECT	Not connected to access point
WIFI_ERR_SOCKET_CREATE	Failed to create socket

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function allocates the created TLS socket for SSL connection:

R_WIFI_DA16XXX_CreateTlsSocket() must be called before calling this function.

Reentrant

No

Example

```
  R_WIFI_DA16XXX_RequestTlsSocket(socketId);
```

Special Notes:

None

3.37. R_WIFI_DA16XXX_GetServerCertificate()

This function gets stored server certificates on the Wi-Fi module.

Format

```
wifi_err_t R_WIFI_DA16XXX_GetServerCertificate(
      wifi_tls_cert_info_t * cert_info
)
```

Parameters

cert_info	Pointer to certificate information storage area

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_NOT_OPEN	Wi-Fi module not initialized
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function obtains certificate information stored in the Wi-Fi module and returns the certificate information in cert_info.

Reentrant

No

Example

```
R_WIFI_DA16XXX_GetServerCertificate(&cert_info);
```

Special Notes:

None

3.38. R_WIFI_DA16XXX_WriteCertificate()

This function stores certificates on the Wi-Fi module.

Format

```
wifi_err_t R_WIFI_DA16XXX_WriteCertificate(
      const uint8_t * name,
      wifi_tls_key_type_t type_key,
      const uint8_t * p_data,
      uint32_t len
)
```

Parameters

name	Name of the certificate
type_key	Certificate type
p_data	Pointer to certificate data stored area
len	Certificate data size

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_NOT_OPEN	Wi-Fi module not initialized
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_TAKE_MUTEX	Failed to obtain mutex

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function writes a certificate or secret key in the sflash memory of the Wi-Fi module.

For the certificate type, see da16xxx_tls_key_type_t in 2.10 Parameter.

Reentrant

No

Example

```
R_WIFI_DA16XXX_WriteCertificate(WIFI_CFG_TLS_CERT_CA_NAME,
                                WIFI_TLS_TYPE_CA_CERT,
                                DEVICE_CERTIFICATE_AUTHORITY_PEM,
                                strlen(DEVICE_CERTIFICATE_AUTHORITY_PEM));
```

Special Notes:

None

3.39. R_WIFI_DA16XXX_DeleteCertificate()

This function deletes certificates on the Wi-Fi module.

Format

```
wifi_err_t R_WIFI_DA16XXX_DeleteCertificate(
      wifi_tls_key_type_t type_key,
      wifi_tls_cert_info_t * cert_info
)
```

Parameters

type_key	Certificate type
cert_info	Pointer to certificate information storage area

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid argument
WIFI_ERR_NOT_OPEN	Wi-Fi module not initialized
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function removes a certificate or secret key in the sflash memory of the Wi-Fi module.

For the certificate type, see wifi_tls_key_type_t in 2.10 Parameter.

Reentrant

No

Example

```
R_WIFI_DA16XXX_DeleteCertificate(WIFI_TLS_TYPE_CA_CERT, &cert_info);
```

Special Notes:

None

3.40. R_WIFI_DA16XXX_MqttOpen()

This function initializes DA16XXX MQTT Client module.

Format

```
wifi_err_t R_WIFI_DA16XXX_MqttOpen (
      void
)
```

Parameters

None

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid parameter
WIFI_ERR_NOT_CONNECT	Not connect to access point
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_MQTT_ALREADY_OPEN	Already WIFI MQTT opened
WIFI_ERR_MQTT_INVALID_DATA	Invalid data to send/receive
WIFI_ERR_MQTT_OUT_OF_MEMORY	Out of memory for MQTT communication

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

Initialize the DA16XXX on-chip MQTT Client service.

Reentrant

No

Example

```
R_WIFI_DA16XXX_MqttOpen();
```

Special Notes:

None

3.41. R_WIFI_DA16XXX_MqttDisconnect()

This function disconnects from the DA16XXX MQTT Client service.

Format

```
wifi_err_t R_WIFI_DA16XXX_MqttDisconnect (
      void
)
```

Parameters

None

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_MQTT_NOT_OPEN	Wi-Fi MQTT module is not opened
WIFI_ERR_MQTT_NOT_CONNECT	Not connect to MQTT channel

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function disconnects from the DA16XXX MQTT Client service.

Reentrant

No

Example

```
uint32_t timeout;

R_WIFI_DA16XXX_MqttOpen();
R_WIFI_DA16XXX_MqttConnect(timeout);
R_WIFI_DA16XXX_MqttDisconnect();
```

Special Notes:

None

3.42. R_WIFI_DA16XXX_MqttConnect()

This function configures and connects to the DA16XXX MQTT Client service.

Format

```
wifi_err_t R_WIFI_DA16XXX_MqttConnect (
      uint32_t  timeout_ms
)
```

Parameters

timeout_ms	Time out (ms)

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_MQTT_NOT_OPEN	Wi-Fi MQTT module is not opened
WIFI_ERR_MQTT_CONNECTED	Not connect to access point

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function configures and connects to the DA16XXX MQTT Client service.

Reentrant

No

Example

```
uint32_t timeout;

R_WIFI_DA16XXX_MqttOpen();
R_WIFI_DA16XXX_MqttConnect(timeout);
```

Special Notes:

None

3.43. R_WIFI_DA16XXX_MqttPublish()

This function publishes a message for a given MQTT topic.

Format

```
wifi_err_t R_WIFI_DA16XXX_MqttPublish (
      wifi_mqtt_pub_info_t * const  p_pub_info
)
```

Parameters

p_pub_info	MQTT publish package parameters

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid parameter
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_MQTT_NOT_CONNECT	Not connect to MQTT channel
WIFI_ERR_MQTT_INVALID_DATA	Invalid data to send/receive

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function publishes a message for a given MQTT topic.

For the MQTT publish package, see da16xxx_mqtt_pub_info_t in 2.10 Parameter.

Reentrant

No

Example

```
wifi_mqtt_pub_info_t * const p_pub_info;

R_WIFI_DA16XXX_MqttPublish(p_pub_info);
```

Special Notes:

None

3.44. R_WIFI_DA16XXX_MqttReceive()

This function receives data subscribed to DA16XXX MQTT Client service.

Format

```
wifi_err_t R_WIFI_DA16XXX_MqttReceive (
      void
)
```

Parameters

None

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_MQTT_INVALID_DATA	Invalid data to send/receive
WIFI_ERR_MQTT_NOT_CONNECT	Not connect to MQTT channel

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function receives data subscribed to DA16XXX MQTT Client service.

Reentrant

No

Example

```
R_WIFI_DA16XXX_MqttReceive();
```

Special Notes:

None

3.45. R_WIFI_DA16XXX_MqttSubscribe()

This function subscribes to DA16XXX MQTT topics.

Format

```
wifi_err_t R_WIFI_DA16XXX_MqttSubscribe (
      wifi_mqtt_sub_info_t * const        p_sub_info,
      size_t                              subscription_count
)
```

Parameters

p_sub_info	MQTT subscribe package parameters
subscription_count	Number of subscribe topic.

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid parameter
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_MQTT_NOT_OPEN	Wi-Fi MQTT module is not opened
WIFI_ERR_MQTT_INVALID_DATA	Invalid data to send/receive

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function subscribes to DA16XXX MQTT topics.

For the MQTT subscribe package, see da16xxx_mqtt_sub_info_t in 2.10 Parameter.

Reentrant

No

Example

```
wifi_mqtt_sub_info_t * const  p_sub_info;
size_t          subscription_count;

 R_WIFI_DA16XXX_MqttSubscribe(p_sub_info, subscription_count);
```

Special Notes:

None

3.46. R_WIFI_DA16XXX_MqttUnSubscribe()

This function unsubscribes from DA16XXX MQTT topics.

Format

```
wifi_err_t R_WIFI_DA16XXX_MqttUnSubscribe (
      wifi_mqtt_sub_info_t * const  p_sub_info
)
```

Parameters

p_sub_info	MQTT subscribe package parameters

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid parameter
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_MQTT_NOT_CONNECT	Not connect to MQTT channel
WIFI_ERR_MQTT_INVALID_DATA	Invalid data to send/receive

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function unsubscribes from DA16XXX MQTT topics.

For the MQTT subscribe package, see da16xxx_mqtt_sub_info_t in 2.10 Parameter.

Reentrant

No

Example

```
wifi_mqtt_sub_info_t * const  p_sub_info;

R_WIFI_DA16XXX_MqttUnSubscribe(p_sub_info);
```

Special Notes:

None

3.47. R_WIFI_DA16XXX_MqttClose()

This function closes the DA16XXX MQTT Client service.

Format

```
wifi_err_t R_WIFI_DA16XXX_MqttClose (
      void
)
```

Parameters

None

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_MODULE_COM	Cannot communicate WIFI module
WIFI_ERR_MQTT_NOT_OPEN	WIFI MQTT module is not opened

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function closes the DA16XXX MQTT Client service.

Reentrant

No

Example

```
R_WIFI_DA16XXX_MqttOpen();
R_WIFI_DA16XXX_MqttClose();
```

Special Notes:

None

3.48. R_WIFI_DA16XXX_HttpOpen()

This function initializes DA16XXX HTTP Client module.

Format

```
wifi_err_t R_WIFI_DA16XXX_HttpOpen (
      void
)
```

Parameters

None

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid parameter
WIFI_ERR_NOT_OPEN	Wi-Fi module not initialized
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_NOT_CONNECT	Not connect to access point
WIFI_ERR_TAKE_MUTEX	Failed to obtain mutex
WIFI_ERR_HTTP_ALREADY_OPEN	Already WIFI HTTP opened

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

Initialize the DA16XXX on-chip HTTP Client service.

Reentrant

No

Example

```
R_WIFI_DA16XXX_HttpOpen();
```

Special Notes:

None

3.49. R_WIFI_DA16XXX_HttpClose()

This function closes the DA16XXX HTTP Client service.

Format

```
wifi_err_t R_WIFI_DA16XXX_HttpClose (
      void
)
```

Parameters

None

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_MODULE_COM	Cannot communicate WIFI module
WIFI_ERR_HTTP_NOT_OPEN	WIFI HTTP module is not opened

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function closes the DA16XXX HTTP Client service.

Reentrant

No

Example

```
R_WIFI_DA16XXX_HttpOpen();
R_WIFI_DA16XXX_HttpClose();
```

Special Notes:

None

3.50. R_WIFI_DA16XXX_HttpSend()

This function sends the HTTP request with the configured buffers.

Format

```
wifi_err_t R_WIFI_DA16XXX_HttpSend (
      wifi_http_request_t request,
      wifi_http_buffer_t *buffer
)
```

Parameters

request	Pointer to HTTP request control structure
buffer	Pointer to HTTP user buffer struct for request and response

Return values

WIFI_SUCCESS	Normal end
WIFI_ERR_PARAMETER	Invalid parameter
WIFI_ERR_NOT_OPEN	Wi-Fi module not initialized
WIFI_ERR_MODULE_COM	Failed to communicate with Wi-Fi module
WIFI_ERR_NOT_CONNECT	Not connect to access point
WIFI_ERR_TAKE_MUTEX	Failed to obtain mutex
WIFI_ERR_HTTP_NOT_OPEN	WIFI HTTP module is not opened

Properties

Prototype declarations are contained in r_wifi_da16xxx_if.h.

Description

This function sends the HTTP request with the configured buffers.

For the HTTP request and HTTP user buffer, see wifi_http_request_t and wifi_http_buffer_t in 2.10 Parameter.

Reentrant

No

Example

```
R_WIFI_DA16XXX_HttpSend(http_post_req, &resp_buffer);
```

Special Notes:

None

4. Callback Function

4.1. Wi-Fi callback function

This function notifies the user application of a Wi-Fi module the errors related to communication.

Format

```
void * callback(
      void * pevent
)
```

Parameters

pevent Pointer to error information area

Return Values

None

Properties

This function is implemented by the user.

Description

Enable this API with the following configuration. The function name does not have to be “callback”.

```
#define WIFI_CFG_USE_CALLBACK_FUNCTION         (1)

#if WIFI_CFG_USE_CALLBACK_FUNCTION == 1

#define WIFI_CFG_CALLBACK_FUNCTION_NAME        (wifi_callback)

#endif
```

Since the event is notified as a void pointer type, cast it to wifi_err_event_t type before referencing it.

```
void wifi_callback(void * p_args)
{
    wifi_err_event_t *pevent;
    pevent = (wifi_err_event_t *)p_args;

    switch(pevent->event)
    {
        case WIFI_EVENT_SERIAL_OVF_ERR:
            break;
        …
    }
}
```

Reentrant

No

The notification events are as follows.

• WIFI_EVENT_SERIAL_OVF_ERR
Reports that the SCI module has detected a receive overflow error.
• WIFI_EVENT_SERIAL_FLM_ERR
Reports that the SCI module has detected a receive framing error.
• WIFI_EVENT_SERIAL_RXQ_OVF_ERR
Reports that the SCI module has detected a receive queue (BYTEQ) overflow.
• WIFI_EVENT_RCV_TASK_RXB_OVF_ERR
Reports that the SIS module has detected the overflow of the AT command receive buffer.
• WIFI_EVENT_SOCKET_RXQ_OVF_ERR
Reports that the socket has detected a receive queue (BYTEQ) overflow.

Example

```
[r_wifi_da16xxx_config.h]
#define WIFI_CFG_USE_CALLBACK_FUNCTION  (1)
#define WIFI_CFG_CALLBACK_FUNCTION_NAME (wifi_callback)

[xxx.c]
void wifi_callback(void *p_args)
{
    wifi_err_event_t *pevent;
    pevent = (wifi_err_event_t *)p_args;

    switch(pevent->event)
    {
        case WIFI_EVENT_SERIAL_OVF_ERR:
            break;
        case WIFI_EVENT_SERIAL_FLM_ERR:
            break;
        case WIFI_EVENT_SERIAL_RXQ_OVF_ERR:
            break;
        case WIFI_EVENT_RCV_TASK_OVF_ERR:
            break;
        case WIFI_EVENT_SOCKET_RXQ_OVF_ERR:
            switch(pevent->socket_number)
            {
                case 0:
                    break;
                case 1:
                    break;
                case 2:
                    break;
                case 3:
                    break;
            }
            break;
        default:
            break;
    }
}
```

Special Notes:

Do not call any of the functions listed in section 3. API Functions from the callback function.

4.2. MQTT callback function

This function notifies the user application of a Wi-Fi module the errors related to communication.

Format

```
void (* p_mqtt_callback) (
      void * pevent
)
```

Parameters

pevent Pointer to callback information to handle

Return Values

None

Properties

This function is implemented by the user.

Description

Enable this API with the following configuration. The function name does not have to be “callback”.

```
#define WIFI_CFG_MQTT_P_CALLBACK        (1)

#if WIFI_CFG_MQTT_P_CALLBACK == 1

#define WIFI_CFG_MQTT_P_CALLBACK_FUNCTION_NAME    /* Call back function name */

#endif
```

Reentrant

No

Example

```
[r_wifi_da16xxx_config.h]
#define WIFI_CFG_MQTT_P_CALLBACK  (1)
#define WIFI_CFG_MQTT_P_CALLBACK_FUNCTION_NAME (mqtt_userCallback)

[xxx.c]
void mqtt_userCallback (void * pevent)
{
    wifi_mqtt_callback_args_t * p_args;
    p_args = (wifi_mqtt_callback_args_t *)pevent;

    /* Code to handle incoming data */
    char * ptr = strstr(p_args->p_topic, "test/MQTT/senddata");
    if (ptr != NULL)
    {
        if (0 == strcmp((const char *)p_args->p_data, "closeMQTT"))
        {
            cb_flag = 1;
        }
    }
}
```

Special Notes:

The R_WIFI_DA16XXX_MqttReceive() API should be called to use this callback function.

5. Demo Projects

Demo projects include function main() that utilizes the SIS module and its dependent modules (e.g. r_bsp). This SIS module includes the following demo project.

5.1 Wi-Fi DA16600 Multiple Protocols Demo Project

5.1.1 Prerequisites

- Hardware requirements:
  - RL78/G23-128p: RL78/G23-128p Fast Prototyping Board (RTK7RLG230CSN000BJ).
  - DA16600: US159-DA16600MEVZ as Wi-Fi module.
  - PC running Windows® 10.
  - Micro-USB cable for Power supply (included as part of the kit. See *RL78/G23-128p Fast Prototyping Board – User's Manual* at "Related Documents" on page 1).
  - USB to UART TTL module for the Wi-Fi module logging output.
- Software requirements for Windows 10 PC:
  - IDE: e^2 studio 2024-1 or later.
  - Compiler: Renesas Electronics C Compiler for RL78 Family V1.13.00.
  - Tera Term v4.99 or later.
  - Socket Test (for TCP Client demo): http://sockettest.sourceforge.net/.
  - Java Virtual Machine (JVM)1.3 or above (for Socket Test): http://www.java.com/.

5.1.2 Import the Demo Project

Users can import the demo project by adding the demo to their e^2 studio workspace (see section 5.2) or by downloading the demo project (see section 5.4).

- Import "rl78_wifi_da16xxx_baremetal_multiple_protocol" for Bare metal application.
- Import "rl78_wifi_da16xxx_freertos_multiple_protocol" for FreeRTOS application.

5.1.3 Hardware Setup

- Connect the Wi-Fi DA16600 Pmod module to the RL78/G23-128p PMOD1 connector.
- Connect the USB to UART TTL from PC to the RL78/G23-128p PMOD2 connector.

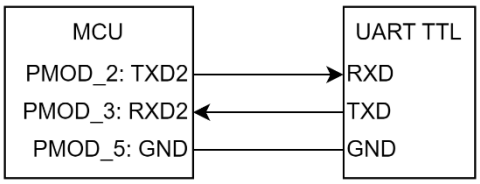

Figure 5.1 Connection to the UART TTL

- Connect the micro-USB cable from PC to the RL78/G23-128p micro-USB connector (J12).

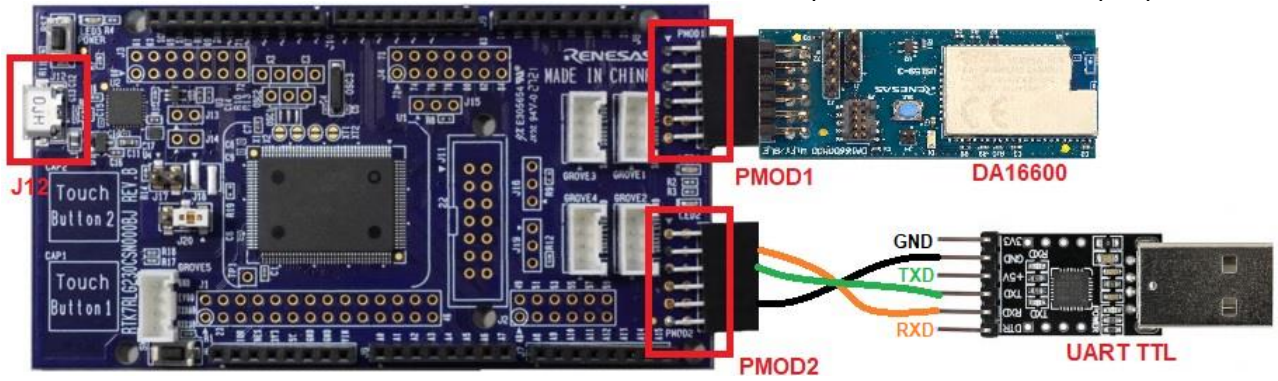

Figure 5.2 Operating Environment

5.1.4 Software Setup

a) Folder Structure

The following table lists the file structure of the Bare metal sample program.

Table 5.1 File Structure of the Bare Metal Sample Program

Folder name, file name	Explanation
src	Program storage folder
├ demo_config	Demo configures storage folder
├ bsp_wrapper	BSP wrapper functions storage folder
├ r_byteq	BYTEQ module storage folder
├ r_sci	SCI module storage folder
├ r_config	BYTEQ, SCI configuration storage folder
├ smc_gen	Smart Configurator generator folder
│ ├ Config_PORT	
│ ├ Config_UART2	
│ ├ Config_UART3	
│ ├ general	
│ ├ r_bsp	
│ ├ r_config	
│ ├ r_pincfg	
│ └ r_wifi_da16xxx	
└ rl78_wifi_da16xxx_baremetal_multiple_protocol.c	Main processing source file

The following table lists the file structure of the FreeRTOS sample program.

Table 5.2 File Structure of the FreeRTOS Sample Program

Folder name, file name	Explanation
src	Program storage folder
├ freertos_config	FreeRTOS packages
├ freertos_kernel	
├ frtos_startup	
├ frtos_skeleton	
│ ├ task_function.h	
│ ├ wifi_task.c	Wi-Fi main thread
│ ├ tcp_task.c	TCP demo thread
│ ├ mqtt_task.c	MQTT on-chip demo thread
│ └ http_task.c	HTTP on-chip demo thread
├ demo_config	Demo configures storage folder
├ bsp_wrapper	BSP wrapper functions storage folder
├ r_byteq	BYTEQ module storage folder
├ r_sci	SCI module storage folder
├ r_config	BYTEQ, SCI configuration storage folder
├ smc_gen	Smart Configurator generator folder
│ ├ Config_PORT	
│ ├ Config_UART2	
│ ├ Config_UART3	
│ ├ general	
│ ├ r_bsp	
│ ├ r_config	
│ ├ r_pincfg	
│ └ r_wifi_da16xxx	
└ rl78_wifi_da16xxx_freertos_multiple_protocol.c	Main processing source file

b) Project Settings

Open the Project Settings, go to Tool Settings -> Compiler -> Source and add these paths below for r_byteq and r_sci_rl modules:

```
"${workspace_loc:/${ProjName}/src/bsp_wrapper}"
"${workspace_loc:/${ProjName}/src/r_byteq}"
"${workspace_loc:/${ProjName}/src/r_sci}"
"${workspace_loc:/${ProjName}/src/r_config}"
```

Note: The Wi-Fi module depends on the r_byteq and r_sci_rl modules. When creating a new project, please copy the folders “bsp_wrapper”, “r_byteq”, “r_sci”, and “r_config” into “src” folder and configure the Project Settings as indicated above.

5.1.5 How to Run the Demo

a) Country Code Setting
Use the Smart Configurator to configure the country code.
Open the Smart Configurator as shown in the image below and set the parameter.

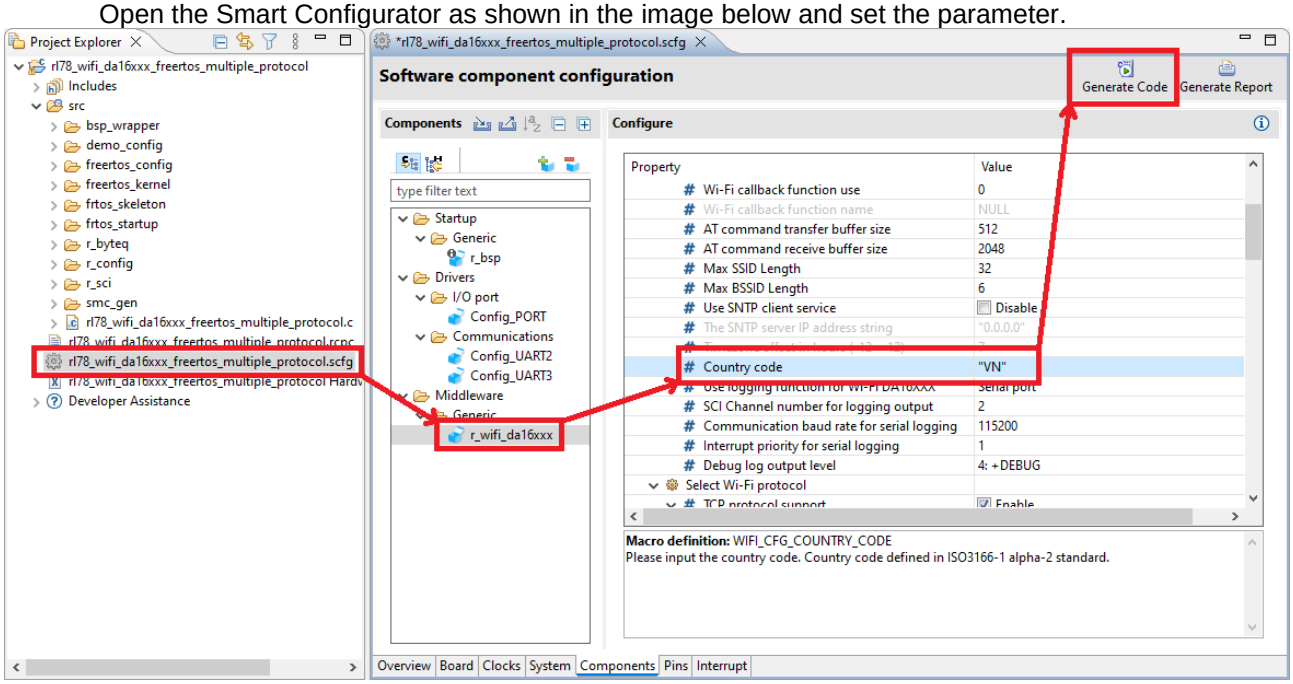

Figure 5.3 Country Code Setting

- "WIFI_CFG_COUNTRY_CODE": Country code defined in ISO 3166-1 alpha-2 standard. Such as KR, US, JP, and CH.

b) Wi-Fi Network Settings
Configure Wi-Fi network settings for the Wi-Fi module. Configure the following macro in "src/demo_config/demo_config.h".
Note: Ensure that the PC running Socket Test app and the Wi-Fi module are connected to the same Wi-Fi network.

```
/*
 * @brief Wi-Fi network to join.
 *
 * @todo If you are using Wi-Fi, set this to your network name.
 */
#define AP_WIFI_SSID                    "ssid"
/*
 * @brief Password needed to join Wi-Fi network.
 * @todo If you are using WPA, set this to your network password.
 */
#define AP_WIFI_PASSWORD                "password"
/*
 * @brief Wi-Fi network security type.
 *
 * @see WIFISecurity_t.
 *
 * @note Possible values are WIFI_SECURITY_OPEN, WIFI_SECURITY_WPA,
 * WIFI_SECURITY_WPA2 (depending on the support of your device Wi-Fi radio).
 */
#define AP_WIFI_SECURITY                WIFI_SECURITY_WPA2
```

Figure 5.4 Wi-Fi Network Settings

- AP_WIFI_SSID: Set the access point name of the Wi-Fi network.
- AP_WIFI_PASSWORD: Set the Wi-Fi network password.
- AP_WIFI_SECURITY: Set the Wi-Fi network security type (WIFI_SECURITY_OPEN, WIFI_SECURITY_WPA, WIFI_SECURITY_WPA2).

c) TCP Server Demo Settings

Follow the steps below to obtain the IP address in Windows OS.

- Select **Start** > **Settings** > **Network & internet** > **Wi-Fi** and then select the Wi-Fi network you're connected to.
- Under **Properties**, look for your IP address listed next to **IPv4 address**.

Or running "**ipconfig**" command in CMD or PowerShell to get the IP address.

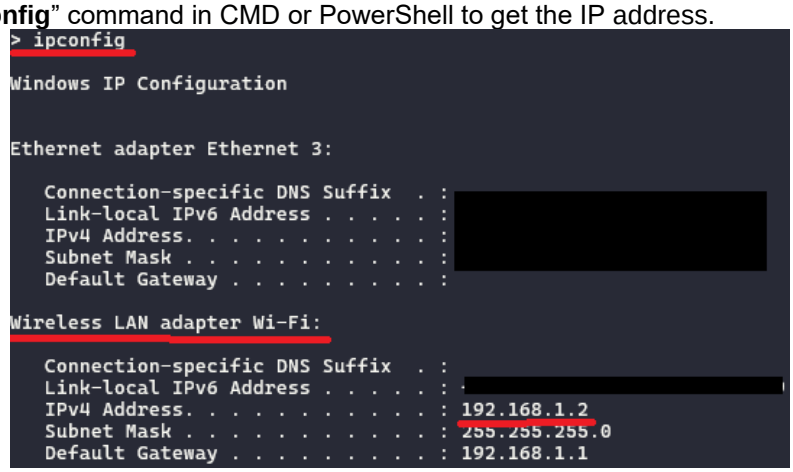

Figure 5.5 Get Server IP Address

Run Socket Master: "SocketTest-master\dist\SocketTest.jar" on PC.

Input the IP address in the designated text box, the port number is user-defined. In this demo, we use 1883.

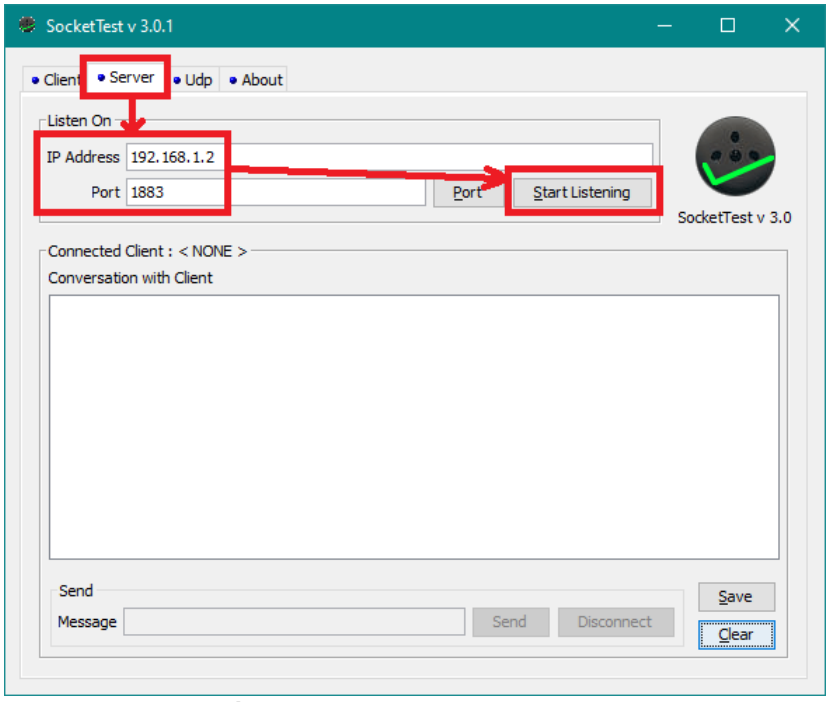

Figure 5.6 Start TCP Server

d) TCP Client Demo Settings

Use the Smart Configurator to configure TCP protocol support.

Open the Smart Configurator as shown in the image below and set parameters.

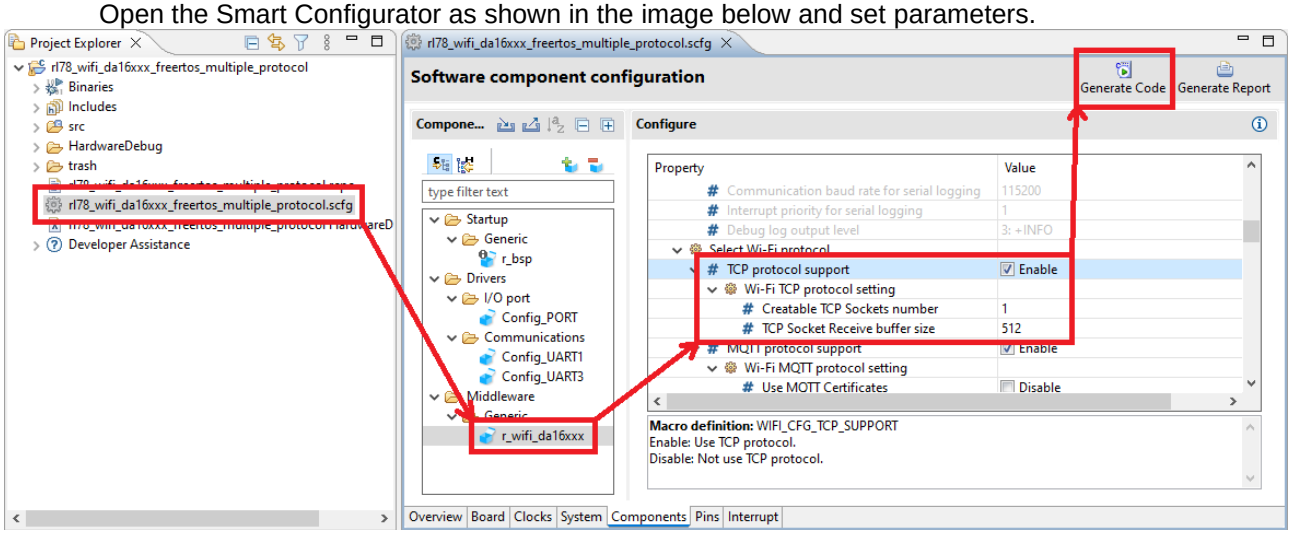

Figure 5.7 TCP Client Settings

- TCP protocol support: tick “Enable” to use the TCP demo or “Disable” to not use it.
- Creatable TCP Sockets number: This demo project only uses 1 socket number.
- Configures the TCP Receive buffer size: default is 512.

Configure TCP server settings from **c) TCP Server Demo Settings** to the following macro in “src/demo_config/demo_config.h”.

```
/*
 * @brief TCP server host name.
 *
 * @note Set this to your TCP host name server.
 */
#define TCP_SERVER_HOSTNAME             "192.168.1.2"
/*
 * @brief TCP server port.
 *
 * @note Set this to your TCP port server.
 */
#define TCP_SERVER_PORT                 1883
```

Figure 5.8 TCP Server Settings

- TCP_SERVER_HOSTNAME: TCP server hostname of IP.
- TCP_SERVER_PORT: TCP server port.

e) MQTT On-Chip Client Demo Settings
Use the Smart Configurator to configure the MQTT protocol.
Open the Smart Configurator as shown in the image below and set the parameter.

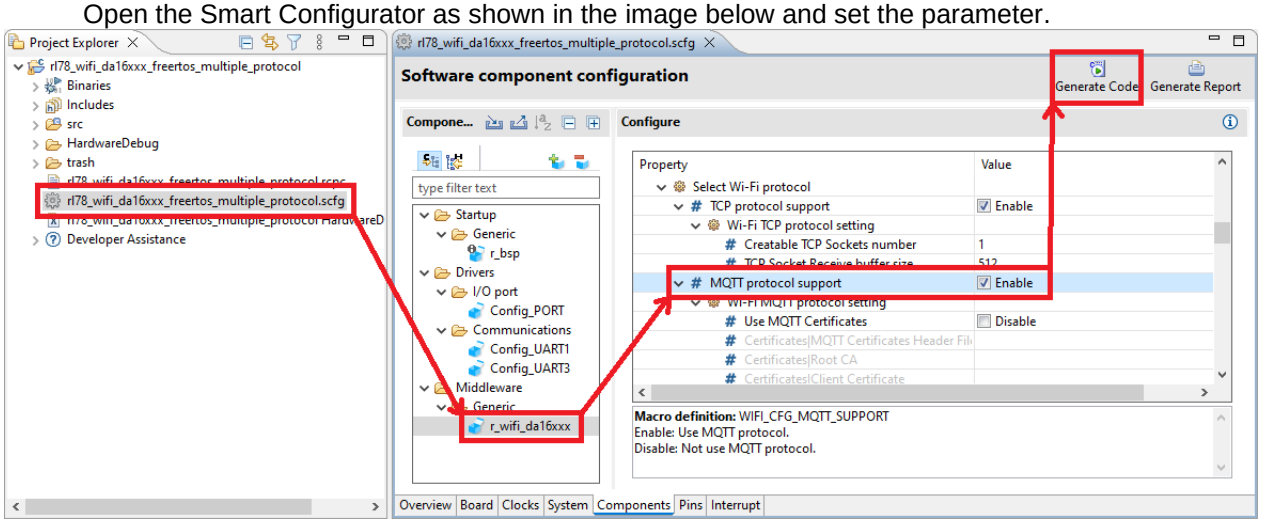

Figure 5.9 MQTT On-Chip Client Settings

- MQTT protocol support: tick “Enable” to use the MQTT on-chip client demo or “Disable” to not use it.

Configure the MQTT Publish/Subscribe topics. Configure the following macro in “src/demo_config/demo_config.h”

```
/*
 * @brief MQTT subscribe topic.
 *
 * @note Set subscribe topic for MQTT.
 */
#define MQTT_SUBSCRIBE_TOPIC            "test/MQTT/senddata"
/*
 * @brief MQTT publish topic.
 *
 * @note Set publish topic for MQTT.
 */
#define MQTT_PUBLISH_TOPIC              "test/MQTT/testdata"
```

Figure 5.10 MQTT Topics Settings

- MQTT_SUBSCRIBE_TOPIC: MQTT subscribe topic.
- MQTT_PUBLISH_TOPIC: MQTT publish topic.

f) MQTT Broker Settings
Open URL: https://testclient-cloud.mqtt.cool/ and select a Broker below.

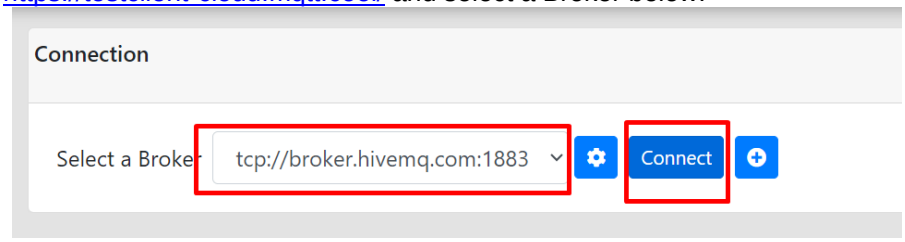

Figure 5.11 Start MQTT Broker

Enter the subscribe topic that was configured in demo_config.h.

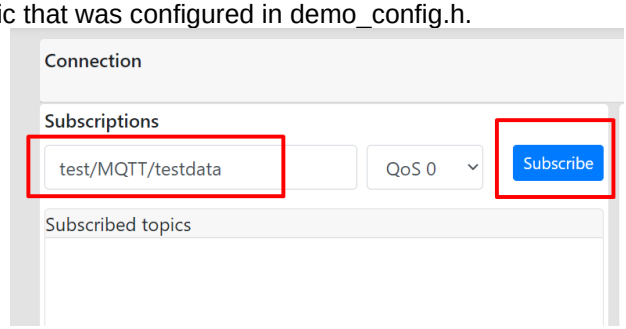

Figure 5.12 Subscribe Topic

g) HTTP On-Chip Client Demo Settings
Use the Smart Configurator to configure the HTTP protocol.
Open the Smart Configurator as shown in the image below and set the parameter.

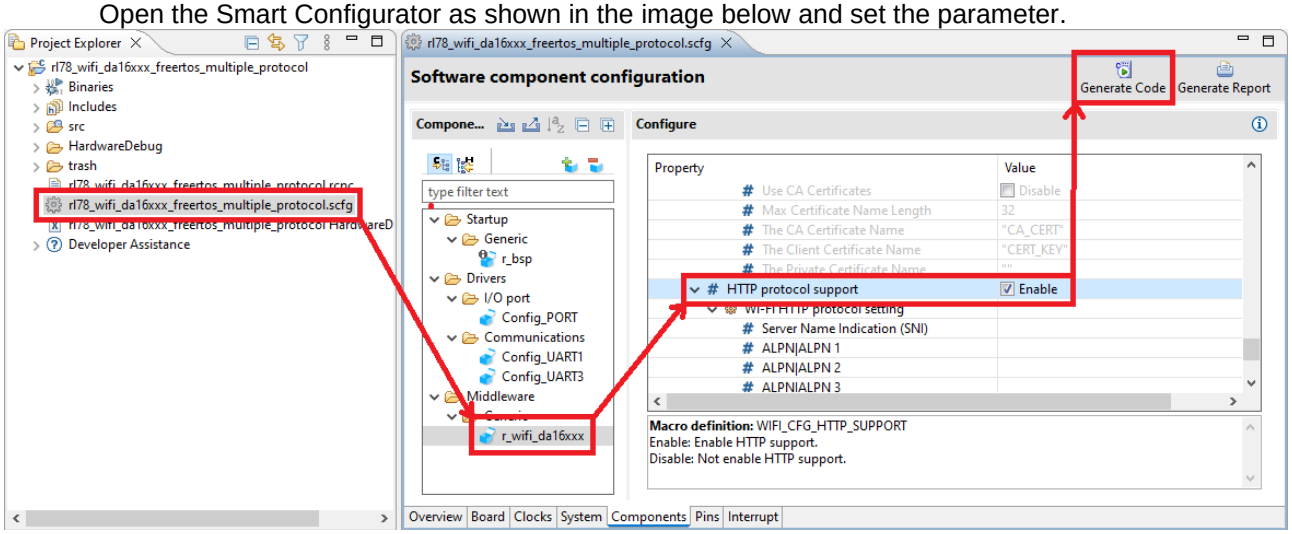

Figure 5.13 HTTP On-Chip Client Settings

- HTTP protocol support: tick “Enable” to use the HTTP on-chip client demo or “Disable” to not use it.

Configure HTTP server settings. Configure the following macro in “src/demo_config/demo_config.h”

```
/*
 * @brief HTTP server endpoint.
 *
 * @note Set this to your HTTP endpoint.
 */

#define HTTP_SERVER_ENDPOINT            "http://httpbin.org/get"
/*
 * @brief HTTP server method.
 *
 * @note Set this to your HTTP method (WIFI_HTTP_GET, WIFI_HTTP_POST, WIFI_HTTP_PUT).
 */
#define HTTP_SERVER_METHOD              WIFI_HTTP_GET
```

Figure 5.14 HTTP Server Settings

- HTTP_SERVER_ENDPOINT: Defines the URL to send HTTP requests to.
- HTTP_SERVER_METHOD: Request method to be used.

The HTTP demo only checks the data in the debug log on Tera Term. Please refer to **6.2 Support Logging Function** for instructions on using the logging function.

h) Building the Demo Project
Build the project and confirm no build errors occur.

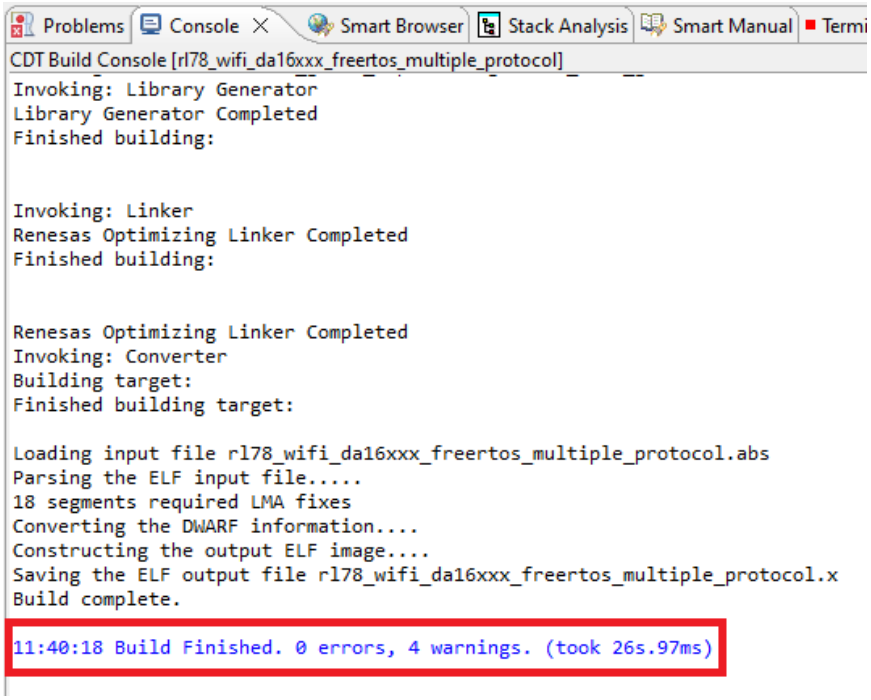

Figure 5.15 Confirm the Demo Project Build

In the **Project Explorer** panel of e^2 studio, right click on the project and select **Debug As** --> **Debug Configurations…**

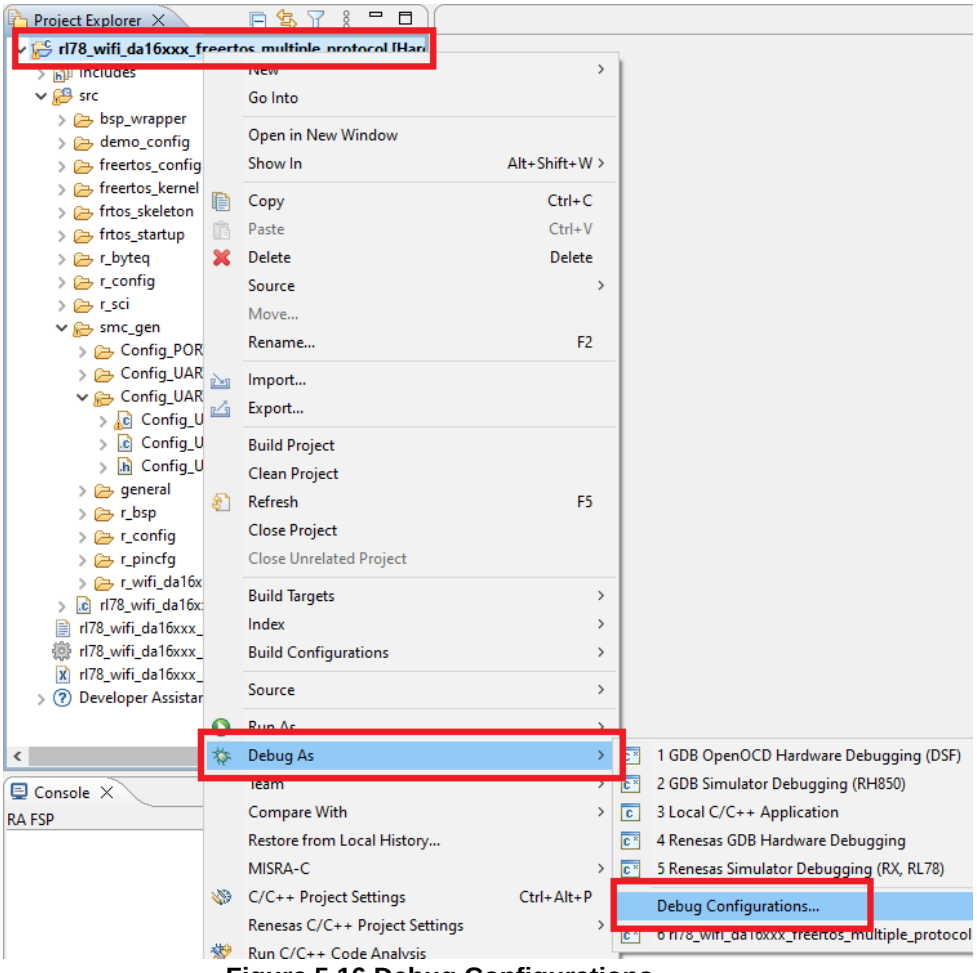

Figure 5.16 Debug Configurations

Configures COM port for debugging.

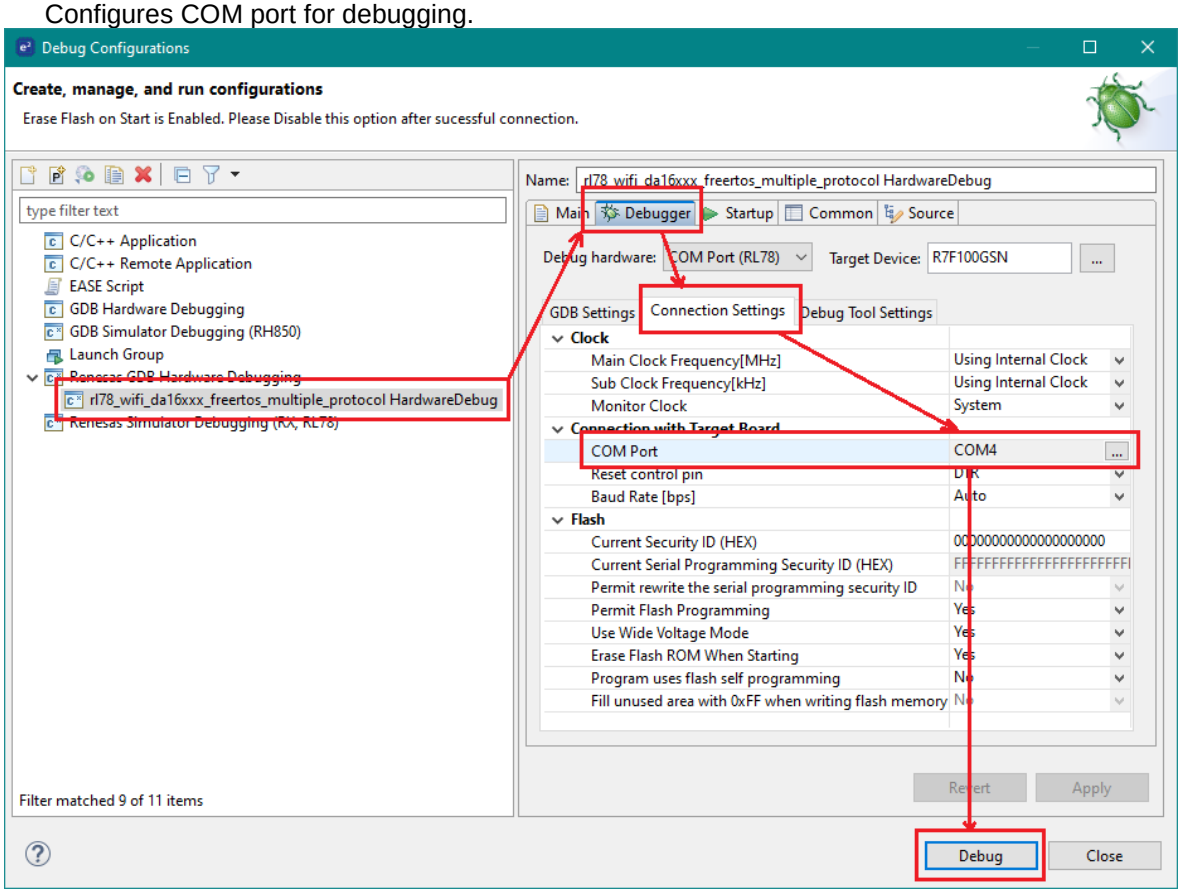

Figure 5.17 Configures COM Port

Identify RL78 device's COM port with Device Manager.

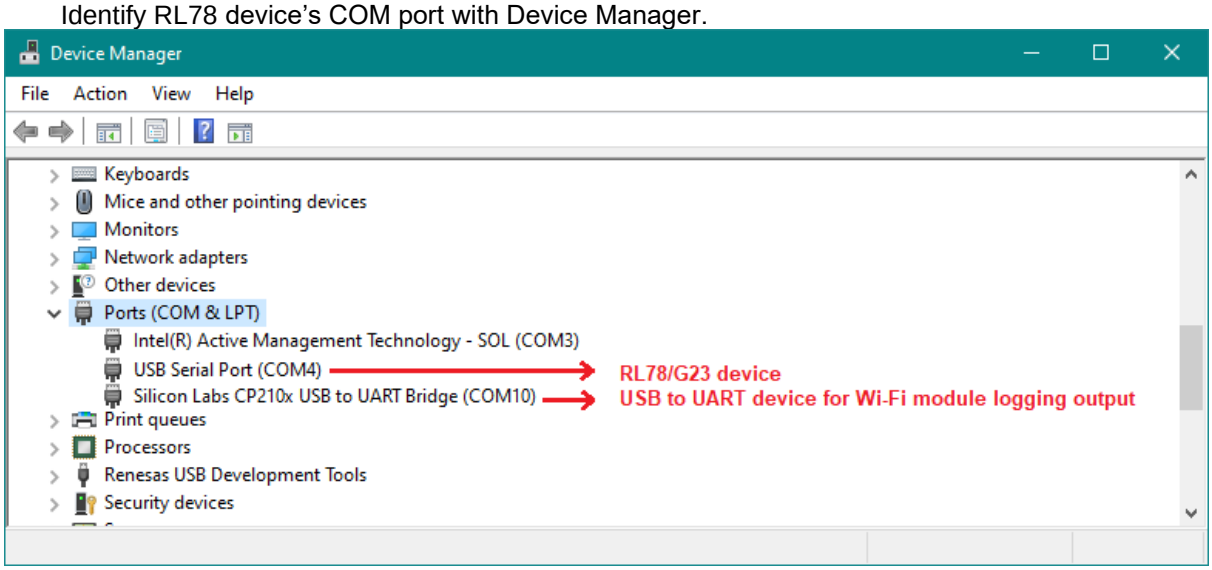

Figure 5.18 Identify COM Port with Device Manager

If the window below appears, press "Switch".

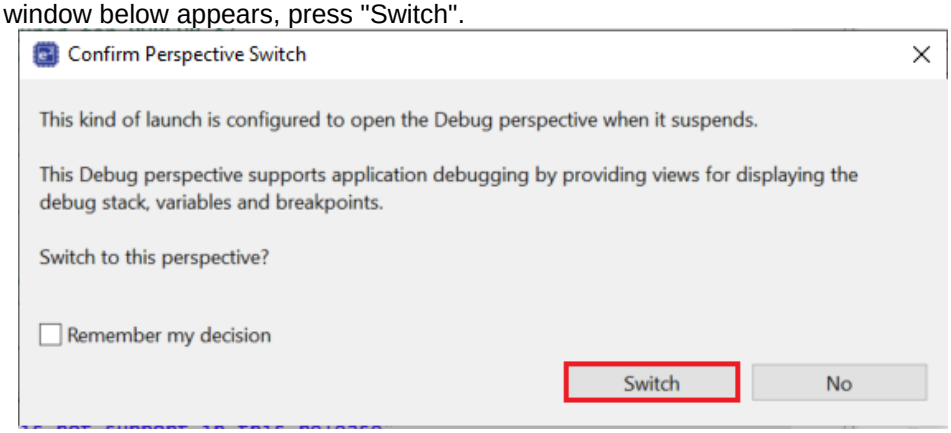

Figure 5.19 Confirm Perspective Switch

Press the following button to start debugging.

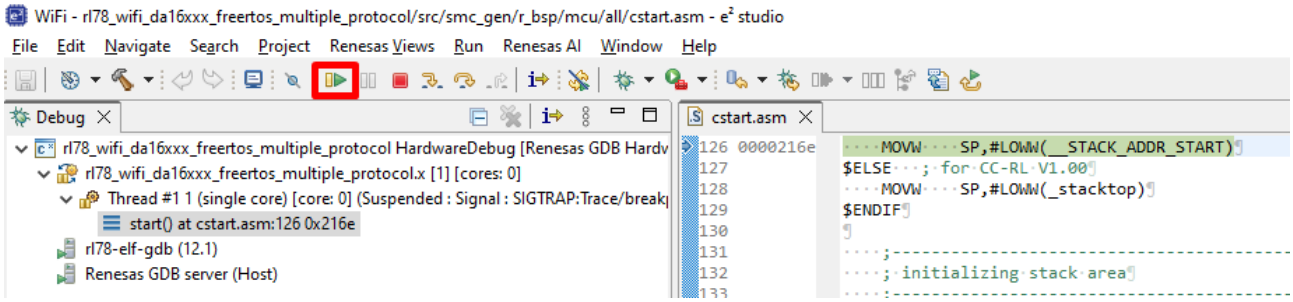

Figure 5.20 Start Debugging

i) Starting the TCP Client Demo
Wait for the SocketTest to display "**New Client:...**" to confirm that the Wi-Fi module is ready to run the TCP protocol.
After that, send a message and check if the sent data matches the received data in the message box.

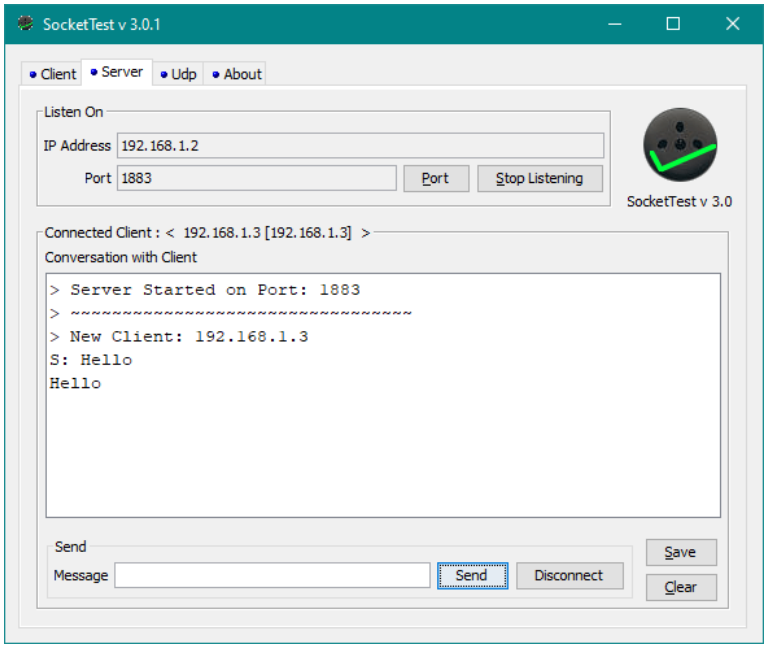

Figure 5.21 Demo with TCP Client

j) Starting the MQTT On-Chip Client Demo
Wait for the Wi-Fi module sends a topic to a subcribe topic that was configured in demo_config.h. It will display in Messages box.

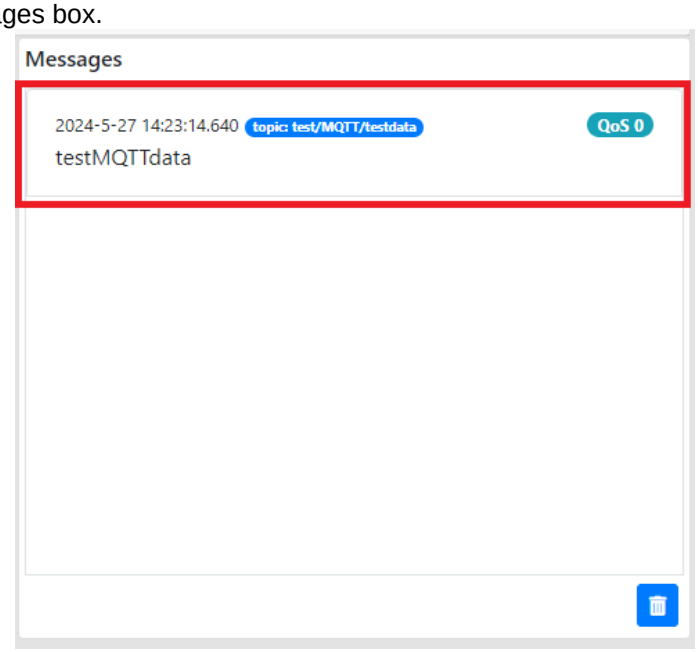

Figure 5.22 MQTT Message From the Wi-Fi Module

Send a data from topic “test/MQTT/senddata”, and check if the sent data matches the received data in the Messages box.

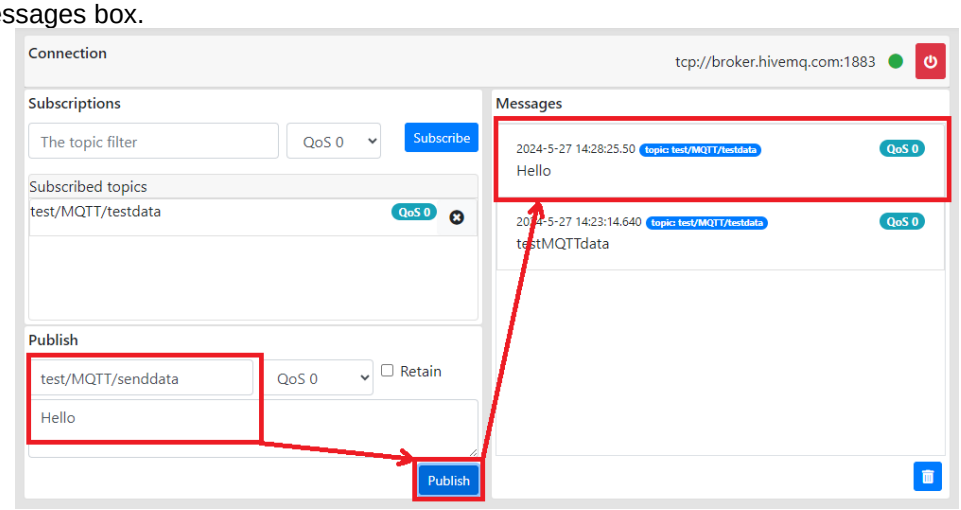

Figure 5.23 Demo with MQTT On-Chip Client

k) Starting the HTTP On-Chip Client Demo
Confirm debug log on Tera Term.

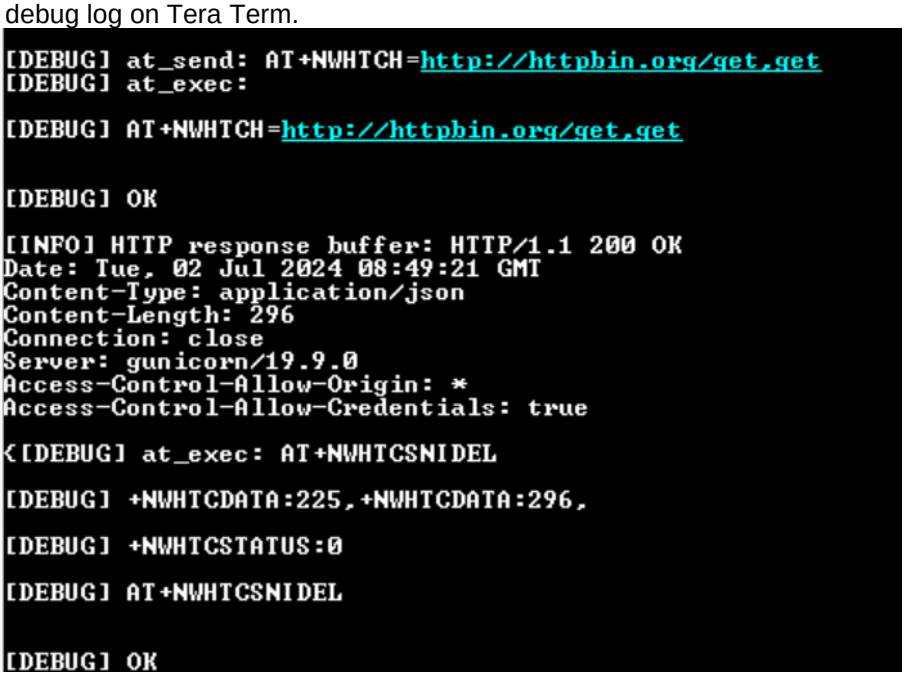

Figure 5.24 HTTP On-Chip Client Debug Log

Note: The log output setting in this demo is enabled as follows:

- WIFI_CFG_LOGGING_OPTION: "**Serial port**" to print debug log on Tera Term via SCI channel 2 from PMOD2.
- WIFI_CFG_DEBUG_LOG: debug log **level 4** to display all log information of the Wi-Fi module.

Please refer to **6.2 Support Logging Function** for instructions on using the logging function.

5.2 Creating a New Wi-Fi DA16600 Project

In this section, we are using RL78/G23-128p Fast Prototyping Board to create a new Wi-Fi DA16600 project.

5.2.1 Prerequisites

- Hardware requirements:
  - RL78/G23-128p: RL78/G23-128p Fast Prototyping Board (RTK7RLG230CSN000BJ).
  - DA16600: US159-DA16600MEVZ as Wi-Fi module.
  - PC running Windows® 10.
  - Micro-USB cable for Power supply (included as part of the kit. See *RL78/G23-128p Fast Prototyping Board – User's Manual* at "Related Documents" on page 1).
- Software requirements for Windows 10 PC:
  - IDE: e^2 studio 2024-1 or later.
  - Compiler: Renesas Electronics C Compiler for RL78 Family V1.13.00.

5.2.2 Hardware Setup

- Connect the Wi-Fi DA16600 Pmod module to the RL78/G23-128p PMOD1 connector.
- Connect the micro-USB cable from PC to the RL78/G23-128p micro-USB connector (J12).

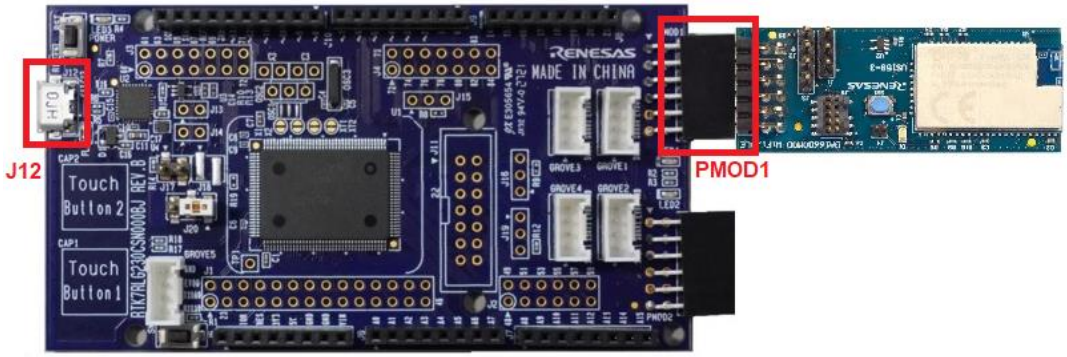

Figure 5.25 Operating Environment

5.2.3 Project Creation

Launch e2 studio and create a new project, select **File** -> **New** -> **Renesas C/C++ Project** -> **Renesas RL78**.

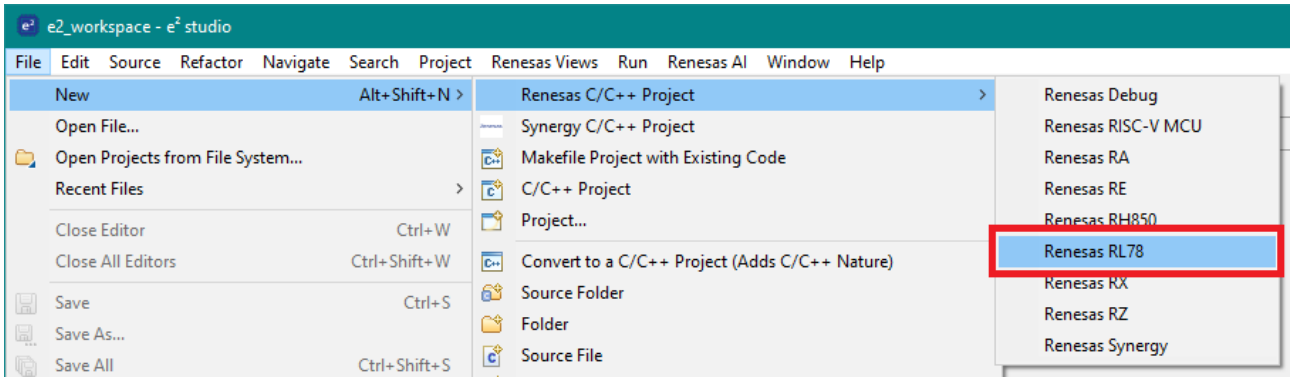

Figure 5.26 Creating a New Project

Select **Renesas CC-RL C/C++ Executable Project**.

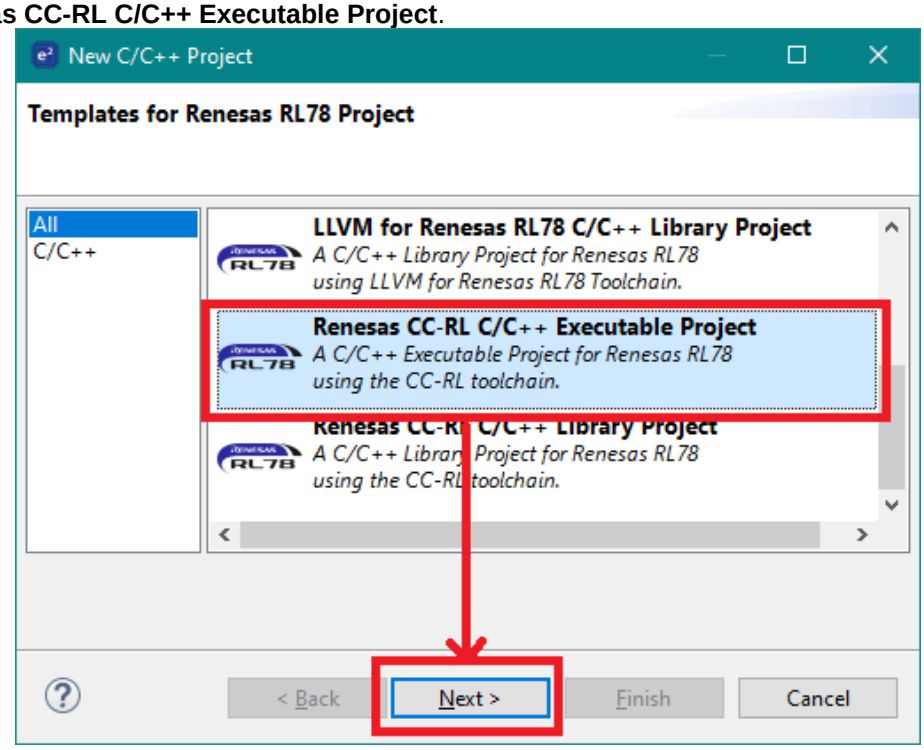

Figure 5.27 Selecting Project Template

Input the project name and select **Next**.

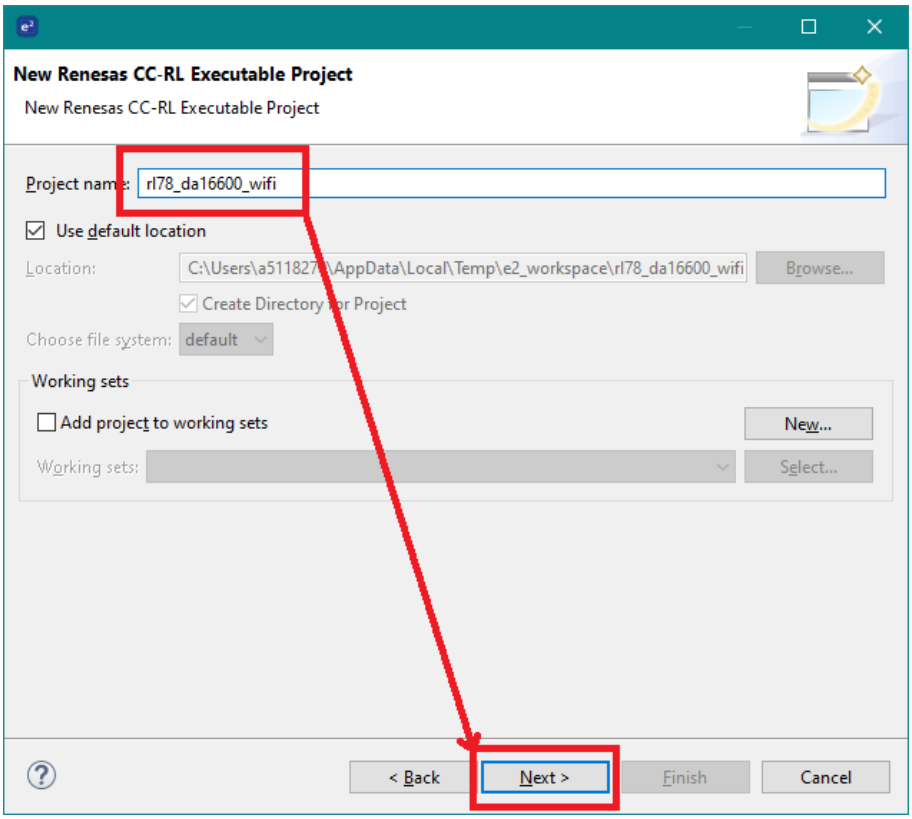

Figure 5.28 Project Name

In the Device Settings, choose **RL78G23-128p_FastPrototypingBoard** for the **Target Board**.

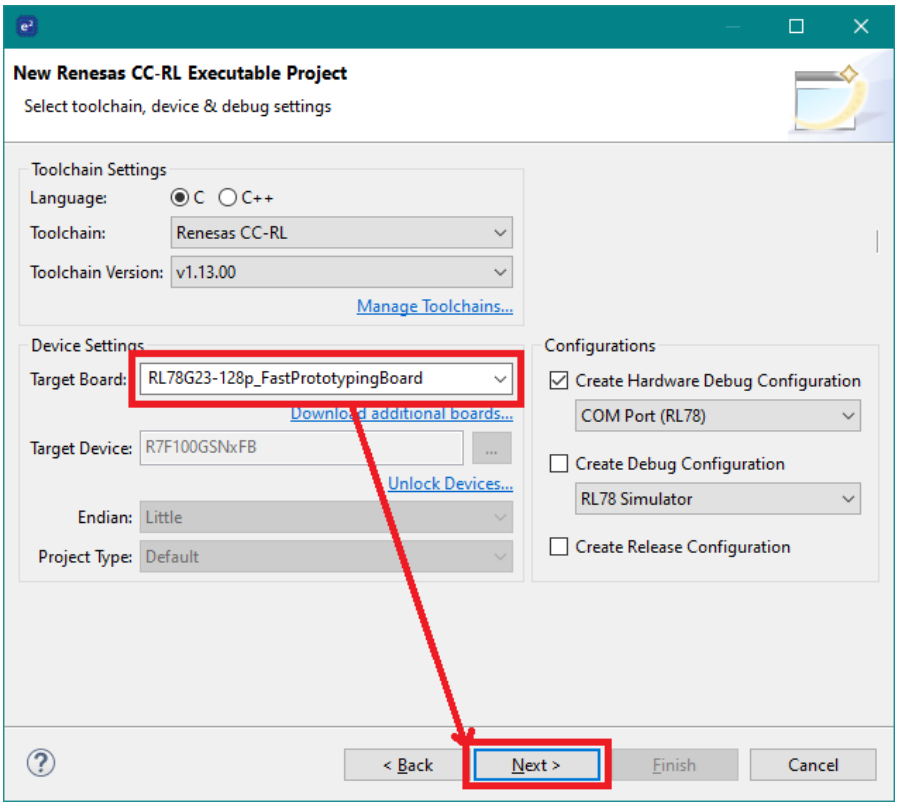

Figure 5.29 Device Settings

If the device is not available, select **Download additional boards…** and download the Board description file for **Fast Prototyping Board for RL78/G23-128p Board Description File**.

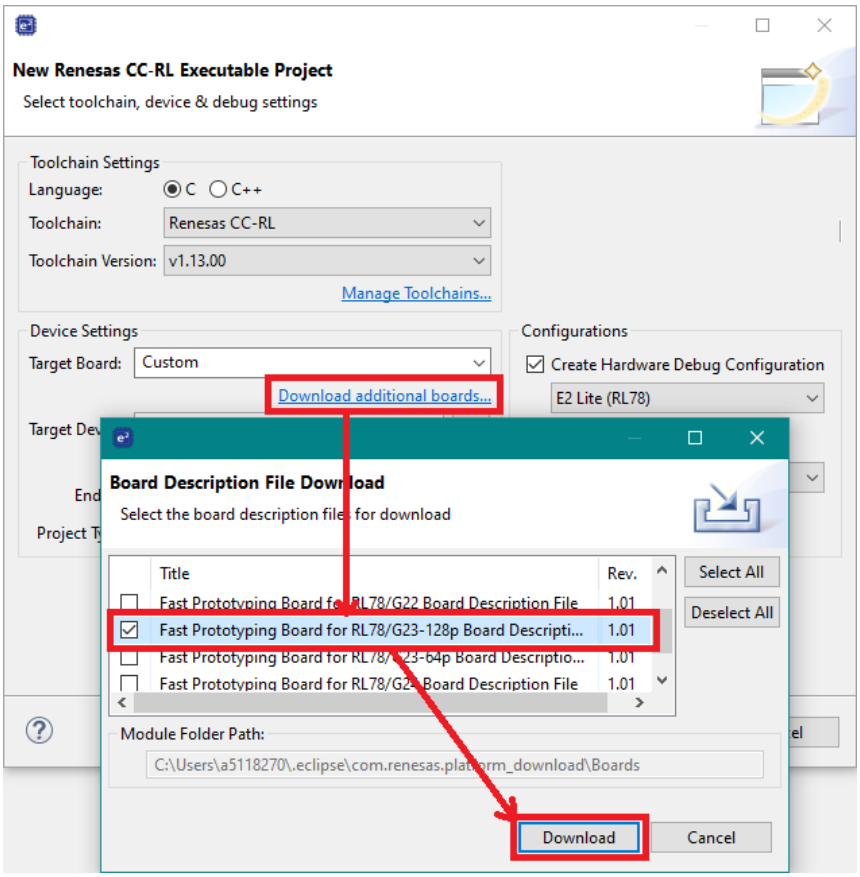

Figure 5.30 Download Board Description File

Check **Use Smart Configurator** and click the **Finish** button.

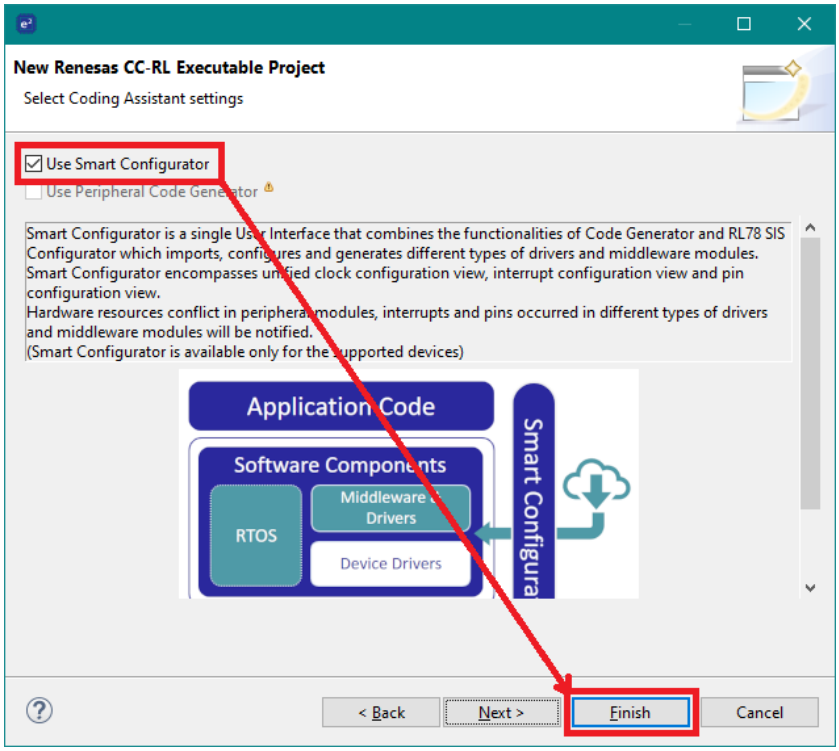

Figure 5.31 Finalizing the Project

5.2.4 Setup of SIS (Software Integration System) Modules

a) Download of SIS Module
Download DA16XXX Wi-Fi module by Smart Configurator.
If you have already installed it, this section is not necessary.

Select **Components** tab in the Smart Configurator. Click **Add Components** button.

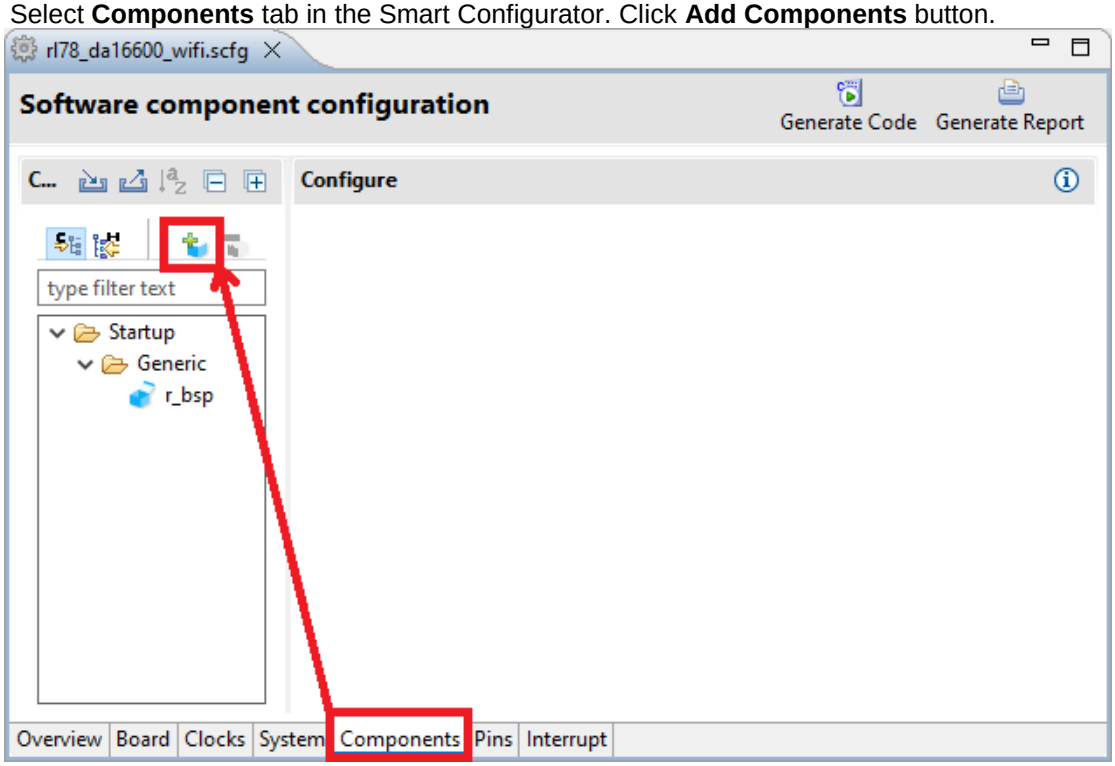

Figure 5.32 Software Component Configuration

Click **Download RL78 Software Integration System modules**.

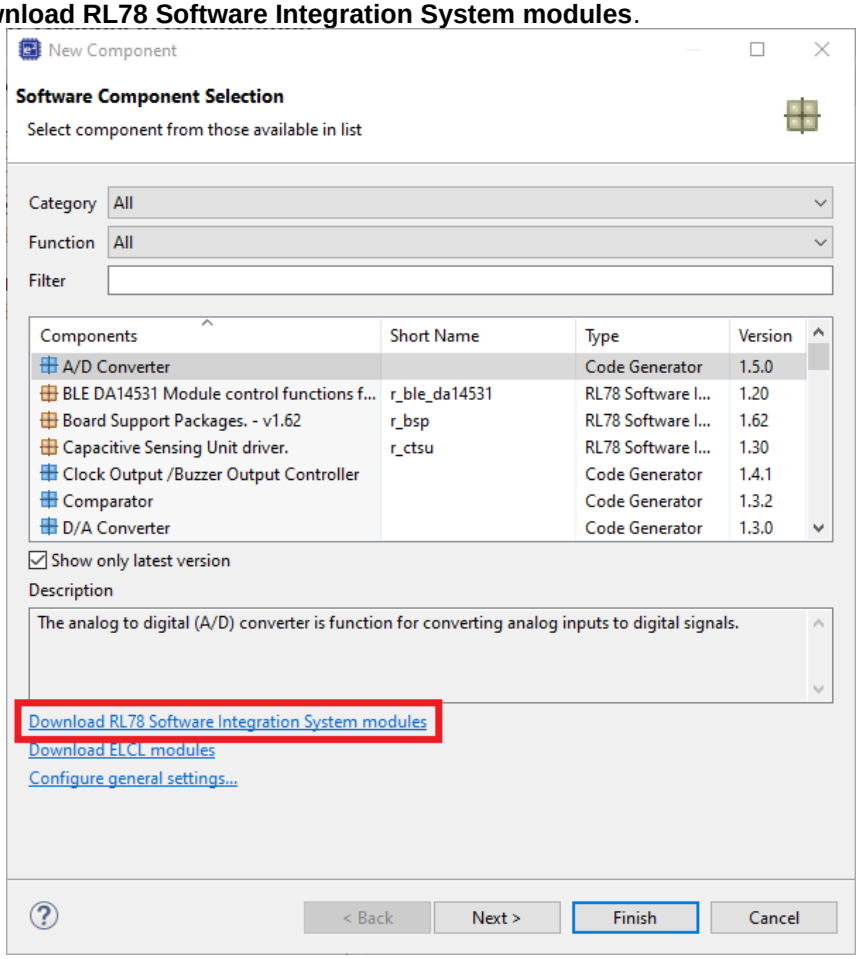

Figure 5.33 Software Component Selection

Select the following, and click **Download**:

- RL78 Family US159-DA16XXXMEVZ Wi-Fi Control Module Using Software Integration System.

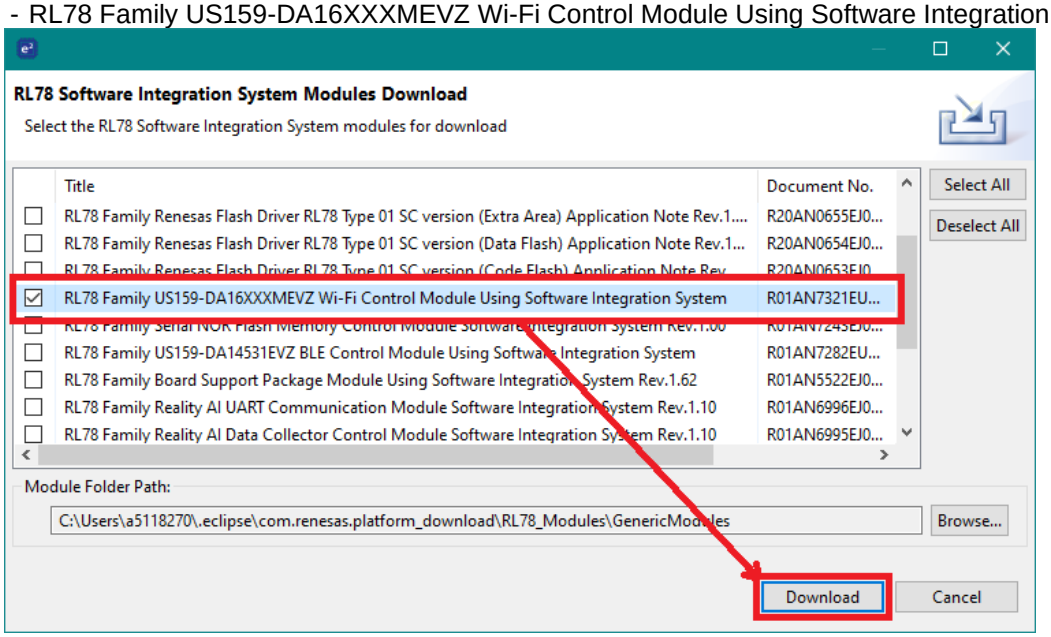

Figure 5.34 Download Wi-Fi Module

b) Setup of Wi-Fi Module
Select **Components** tab in the Smart Configurator.
Click **Add Components** button to add the Wi-Fi module and click **Finish** button on the window.

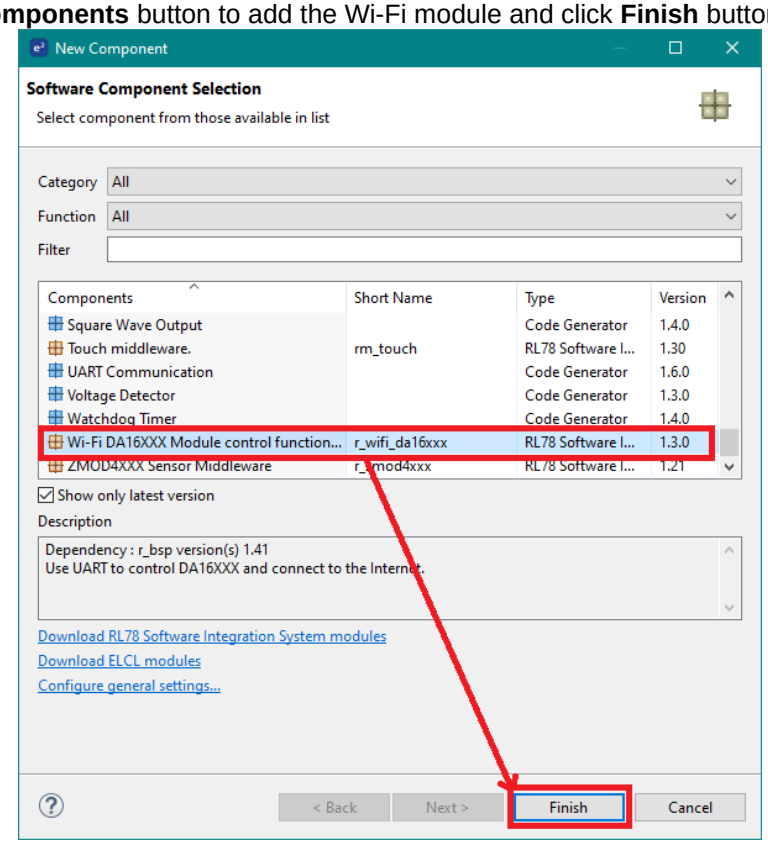

Figure 5.35 Add Wi-Fi module

Select **r_wifi_da16xxx** and tick **Enable** for **Enable DA16600 support**.

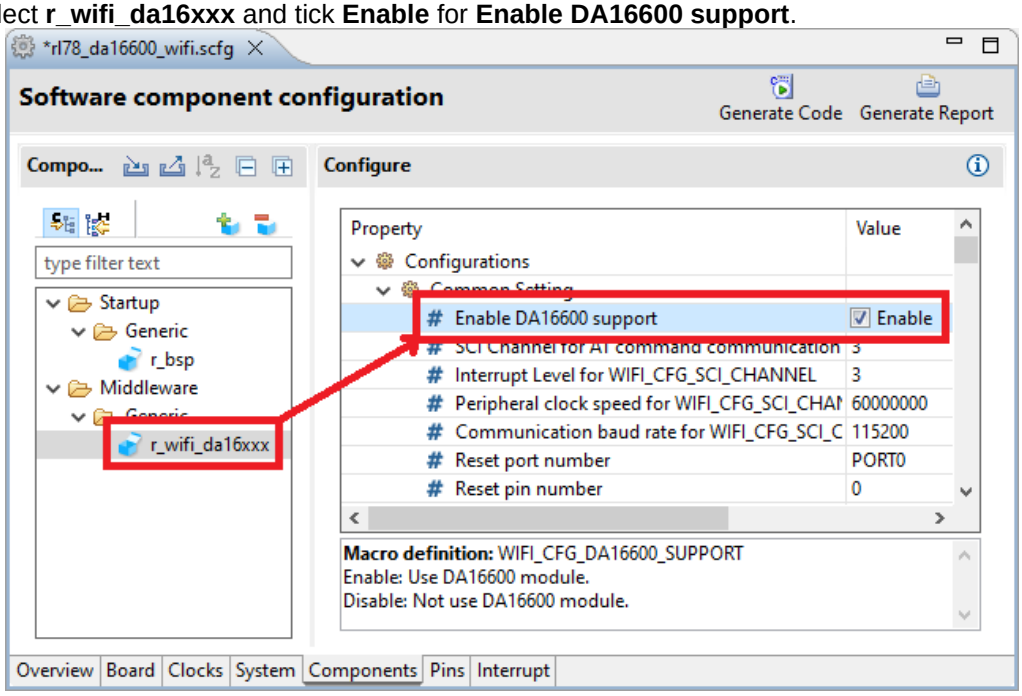

Figure 5.36 Enable DA16600 Support

c) Setup of Serial Interface (UART)
Select **Components** tab in the Smart Configurator.
Click **Add Components** button. In the displayed dialog, select **UART Communication** module and click **Next** button. Then set as follows and click **Finish**:
- Operation: Transmission/reception
- Resource: UART3

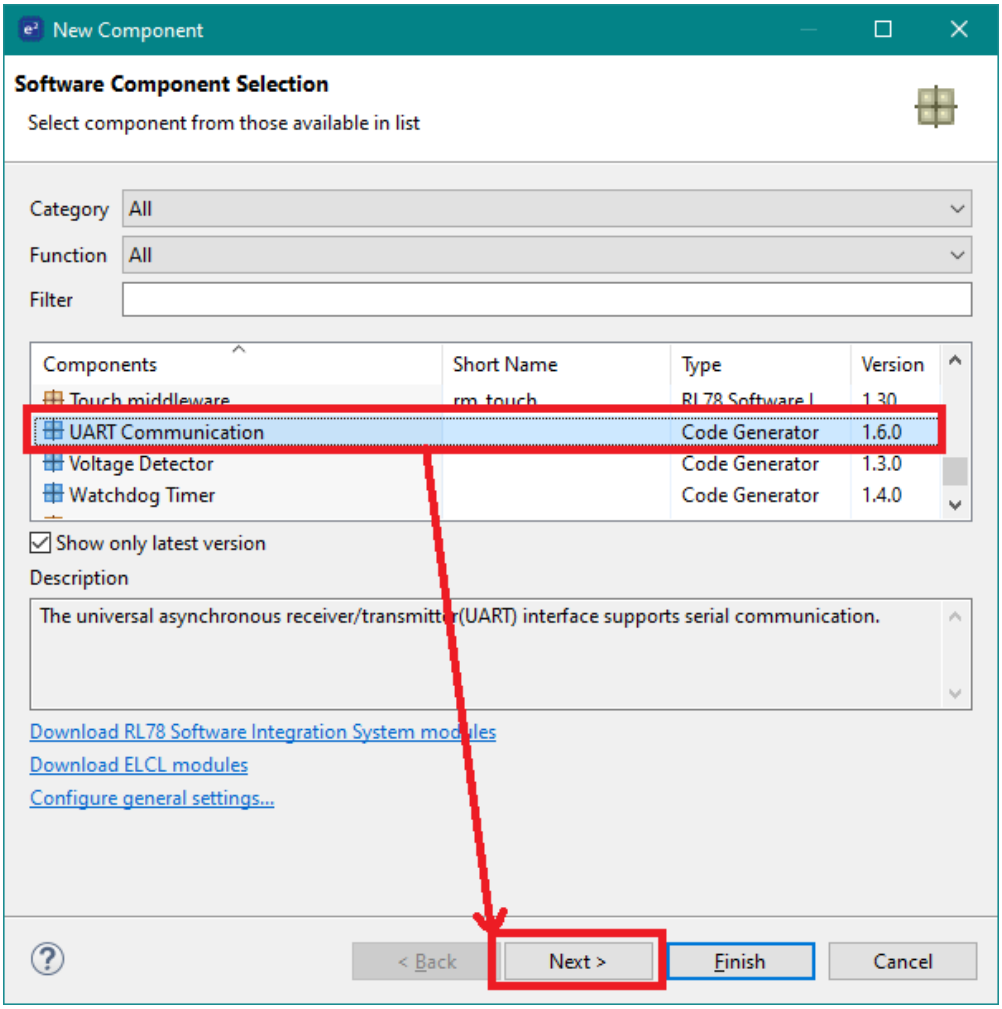

Figure 5.37 UART Communication Module

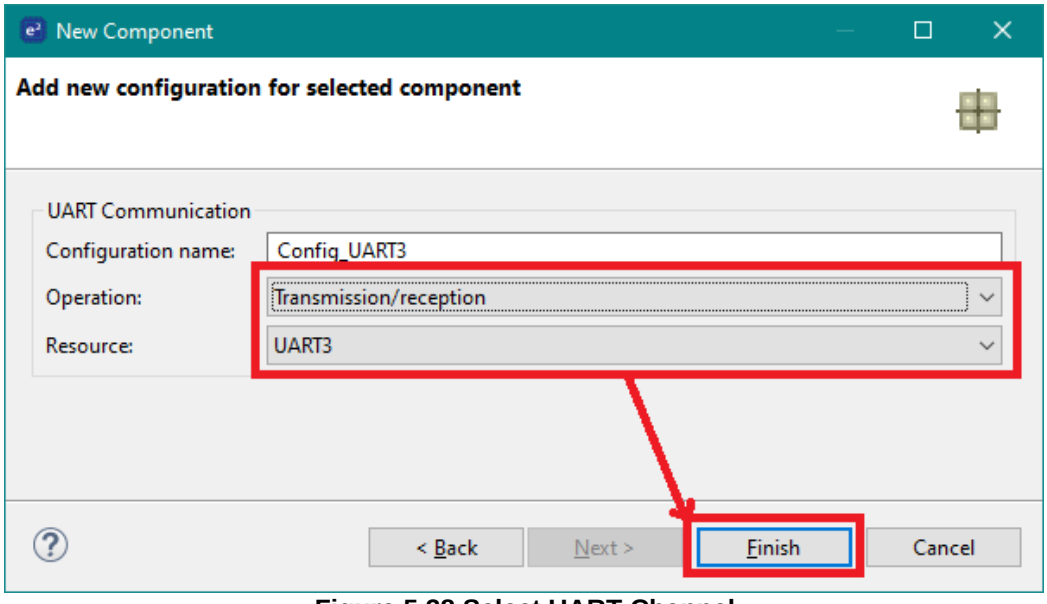

Figure 5.38 Select UART Channel

Click the added **UART Communication** module and set the operation clock and transfer rate (baud rate) in the **Transmission** and **Reception** sections.

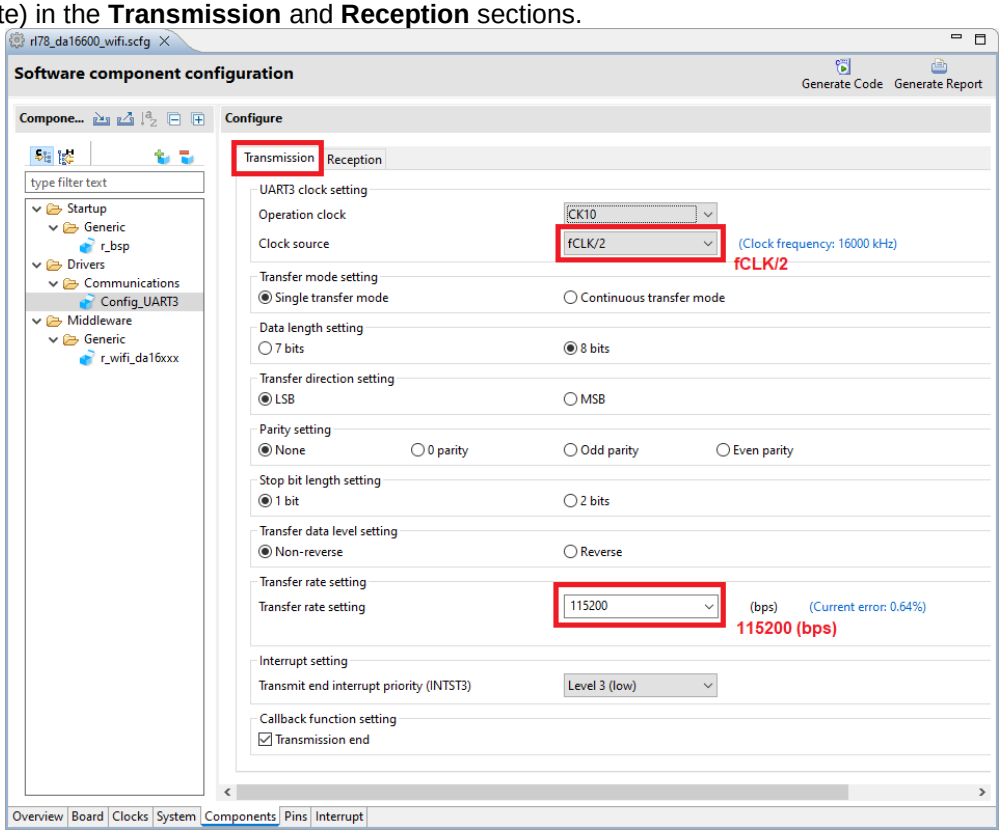

Figure 5.39 Setup Transmission of UART Communication Module (UART3)

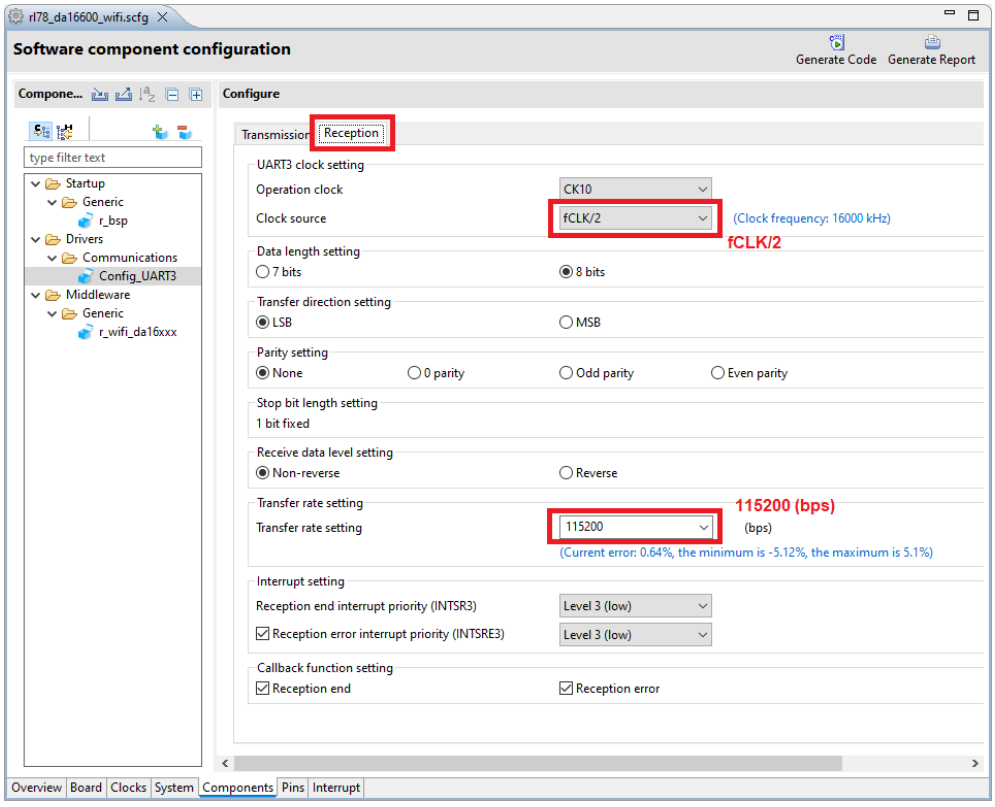

Figure 5.40 Setup Reception of UART Communication Module (UART3)

d) Generating Code

Select **r_bsp** module and confirm that **Initialization of peripheral function by Code Generator/Smart Configurator** is set to **Enable**.

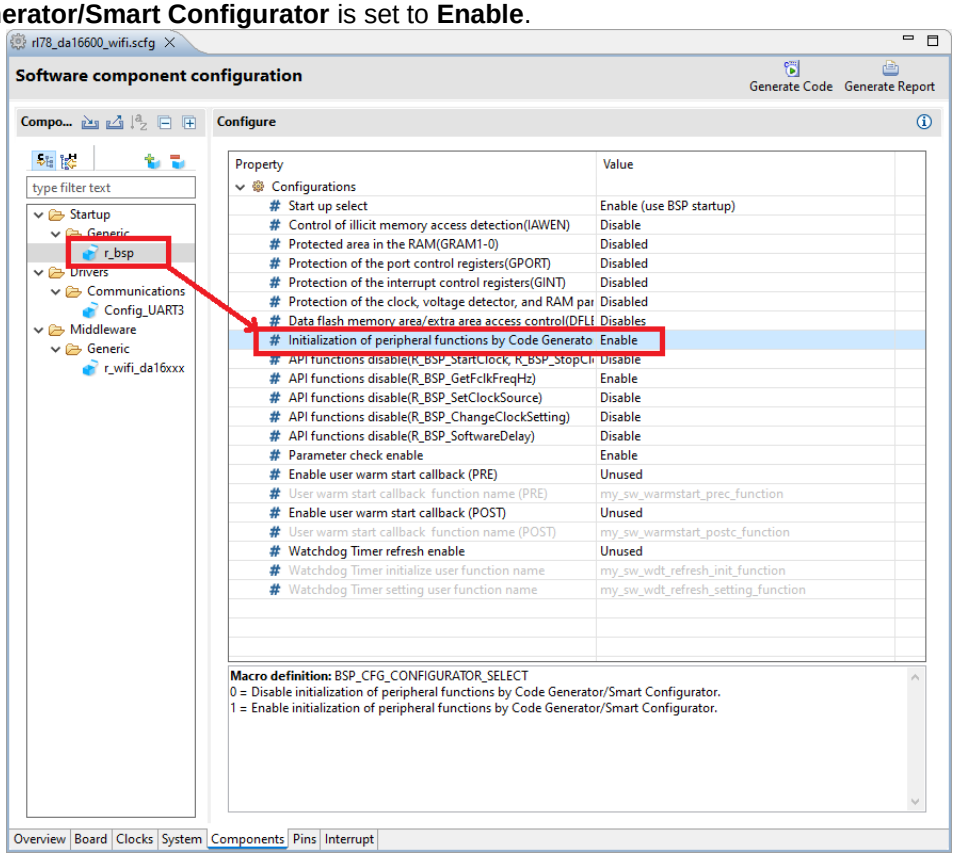

Figure 5.41 Setup of r_bsp

Click **Generate Code** button to perform generating code.

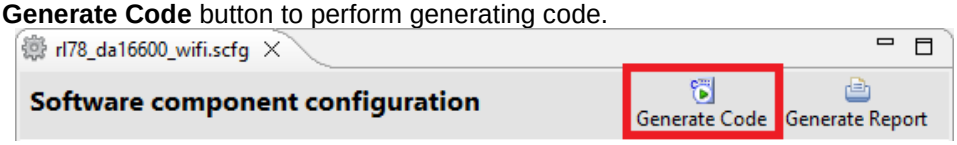

Figure 5.42 Generating Code

5.2.5 Modify the UART Communication Module

Refer to section **6.3 How to Change UART Module to Work with Wi-Fi Module** for instructions on modifying UART communication module.

5.2.6 Setup of Wi-Fi Module Dependencies

The Wi-Fi module depends on the **r_byteq** and **r_sci_rl** modules. When creating a new project, please copy the folders **bsp_wrapper**, **r_byteq**, **r_sci**, and **r_config** from demo project into **src** folder and configure the Project Settings.
Refer to **5.1.2 Import the Demo Project** for instructions on how to import the demo project.

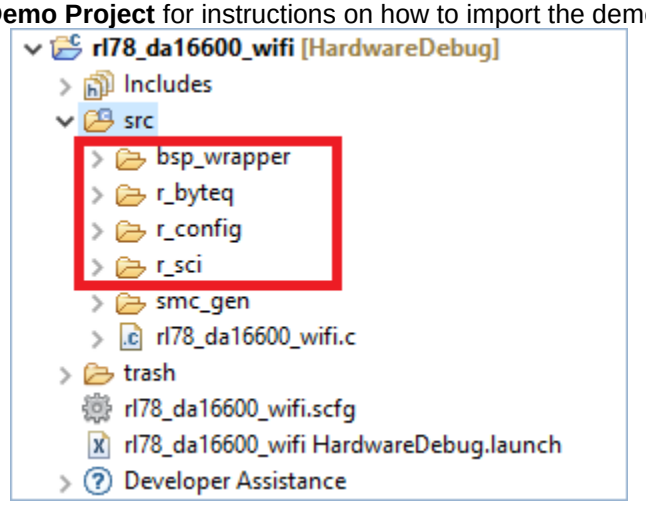

Figure 5.43 Wi-Fi Module Dependencies

Right click to the project and choose the **C/C++ Project Settings**, go to **Tool Settings** -> **Compiler** -> **Source** and add these paths below for **r_byteq** and **r_sci_rl** modules:

```
"${workspace_loc:/${ProjName}/src/bsp_wrapper}"
"${workspace_loc:/${ProjName}/src/r_byteq}"
"${workspace_loc:/${ProjName}/src/r_sci}"
"${workspace_loc:/${ProjName}/src/r_config}"
```

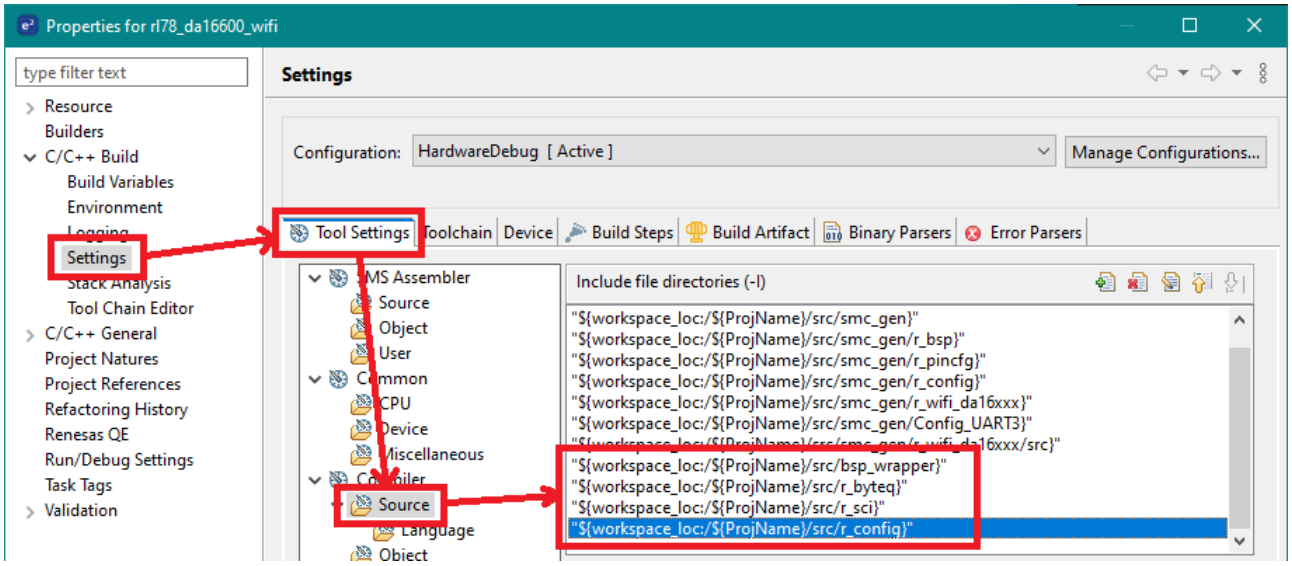

Figure 5.44 Project Settings

Open **r_sci_rl_config.h** in **r_config** folder mentioned above for configuring **r_sci_rl** module.
Because UART channel 3 is used for the Wi-Fi module, ensure **SCI_CFG_CH3_INCLUDED** is set to **1**.

```
/* SPECIFY CHANNELS TO INCLUDE SOFTWARE SUPPORT FOR 1=included, 0=not */
#define SCI_CFG_CH0_INCLUDED            (0)
#define SCI_CFG_CH1_INCLUDED            (0)
#define SCI_CFG_CH2_INCLUDED            (0)
#define SCI_CFG_CH3_INCLUDED            (1)
```

Figure 5.45 Enable UART Channel

The TX/RX queue buffer sizes of the UART channel depend on the users' requirements.
In this example, the buffer sizes are set to **512**.

```
/* SPECIFY ASYNC MODE TX QUEUE BUFFER SIZES (will not allocate if chan not enabled */
#define SCI_CFG_CH0_TX_BUFSIZ           (512)
#define SCI_CFG_CH1_TX_BUFSIZ           (512)
#define SCI_CFG_CH2_TX_BUFSIZ           (512)
#define SCI_CFG_CH3_TX_BUFSIZ           (512)

/* SPECIFY ASYNC MODE RX QUEUE BUFFER SIZES (will not allocate if chan not enabled */
#define SCI_CFG_CH0_RX_BUFSIZ           (512)
#define SCI_CFG_CH1_RX_BUFSIZ           (512)
#define SCI_CFG_CH2_RX_BUFSIZ           (512)
#define SCI_CFG_CH3_RX_BUFSIZ           (512)
```

Figure 5.46 Specifies TX/RX Queue Buffer Sizes

Ensure **SCI_CFG_TEI_INCLUDED** is set to **1**.

```
/*
* ENABLE TRANSMIT END INTERRUPT (ASYNCHRONOUS)
* This interrupt only occurs when the last bit of the last byte of data
* has been sent and the transmitter has become idle. The interrupt calls
* the user's callback function specified in R_SCI_Open() and passes it an
* SCI_EVT_TEI event. A typical use of this feature is to disable an external
* transceiver to save power. It would then be up to the user's code to
* re-enable the transceiver before sending again. Not including this feature
* reduces code space used by the interrupt. Note that this equate is only
* for including the TEI code. The interrupt itself must be enabled using an
* R_SCI_Control(hdl, SCI_CMD_EN_TEI, NULL) call.
*/
#define SCI_CFG_TEI_INCLUDED            (1)     /* 1=included, 0=not */
```

Figure 5.47 Enable the Transmit End Interrupt

5.2.7 Setup of FreeRTOS Components (Only for FreeRTOS Project)

Download the FreeRTOS project for the RL78 MCU v202210.01-LTS-rl78-1.0.0 from the release page on GitHub.
https://github.com/renesas/iot-reference-rl78/releases/tag/v202210.01-LTS-rl78-1.0.0
-> v202210.01-LTS-rl78-1.0.0.tar.gz

Extract file, and copy the following file and folders to **src** folder of Wi-Fi project:

- **frtos_config** folder in “Configuration/rl78g23-fpb/pubsub/cellular/”, but include only **FreeRTOSConfig.h** file
- **FreeRTOS_Kernel** folder in “Middleware/FreeRTOS/”.
- **frtos_skeleton** and **frtos_startup** folders in “Projects/rl78g23-fpb/rtos_skelton”.

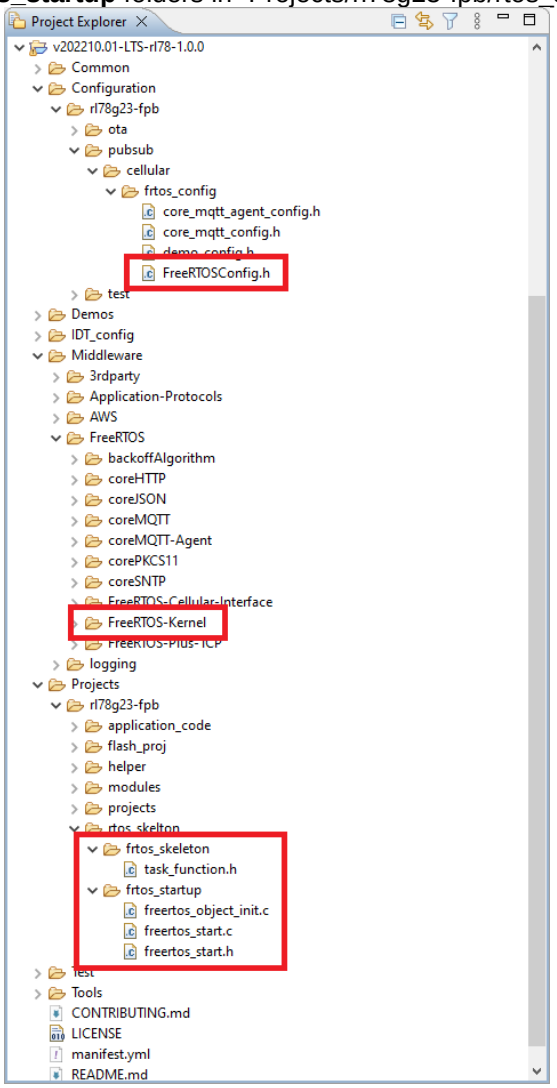

Figure 5.48 FreeRTOS Components

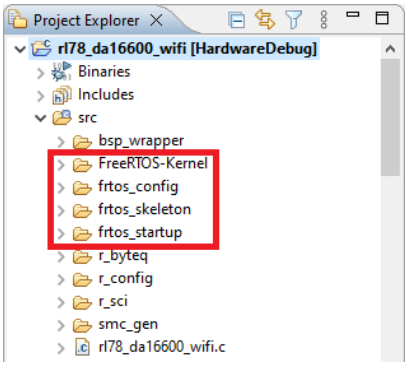

Figure 5.49 FreeRTOS Project Structure

Right click on **FreeRTOS-Kernel** folder and choose **Properties**. Select **Resource Filters** and add the following filter:

- Filter type: **Include only**
- Applies to: **Files**
- Filter Details: **.+\.(c|h|asm)**
- Regular Expression: **Enable**

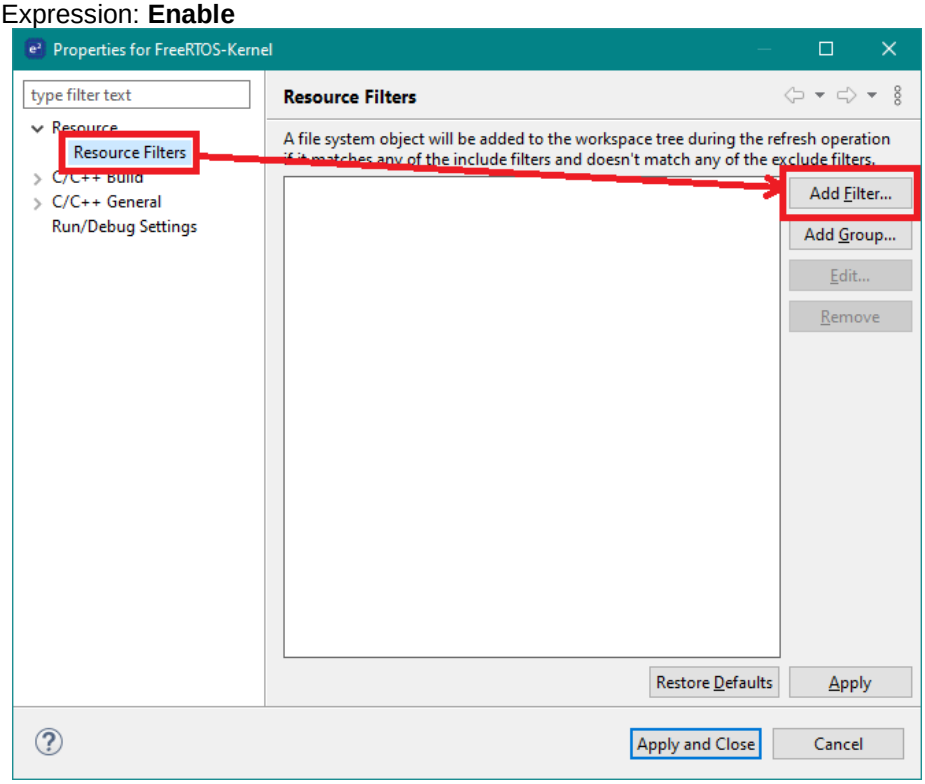

Figure 5.50 Add Filter

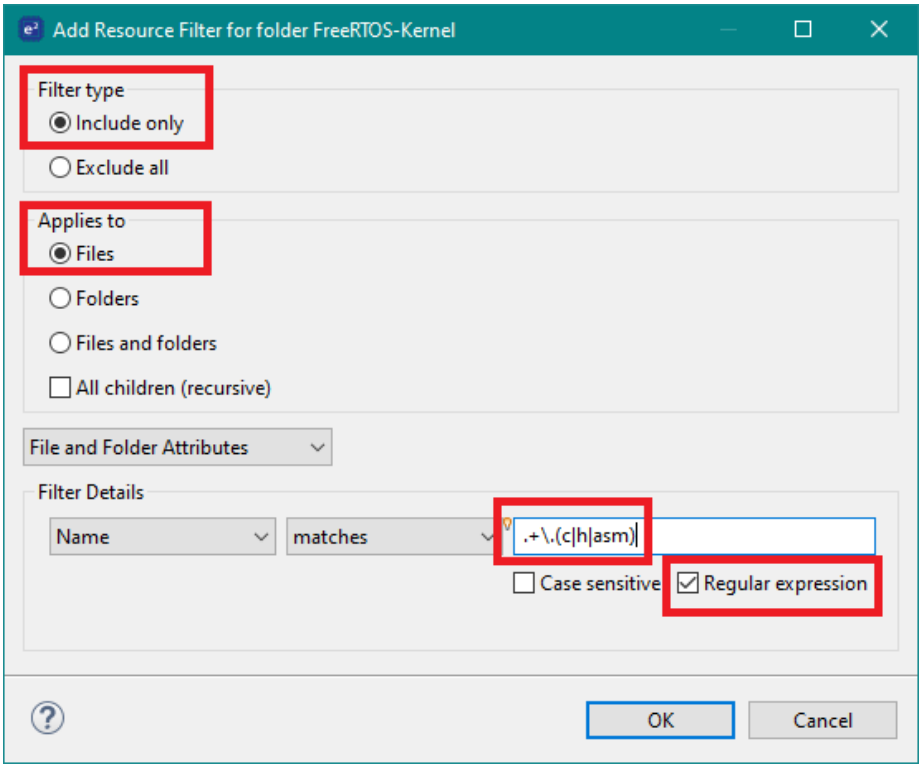

Figure 5.51 Filter Rule for FreeRTOS-Kernel

Right click on **portable** folder in **FreeRTOS-Kernel** folder and add the following filters:

Filter for files:
- Filter type: **Include only**
- Applies to: **Files**
- Filter Details: **.+\.(c|h|asm)**
- Regular Expression: **Enable**

Filter for folders:
- Filter type: **Include only**
- Applies to: **Folders**
- Filter Details: **MemMang|Renesas**
- Regular Expression: **Enable**

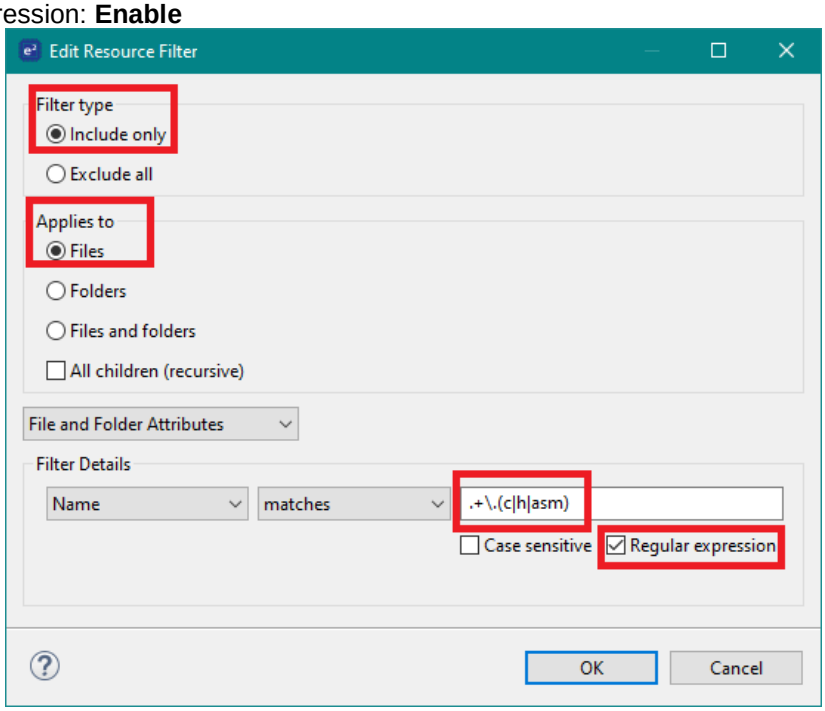

Figure 5.52 File Filter for Portable

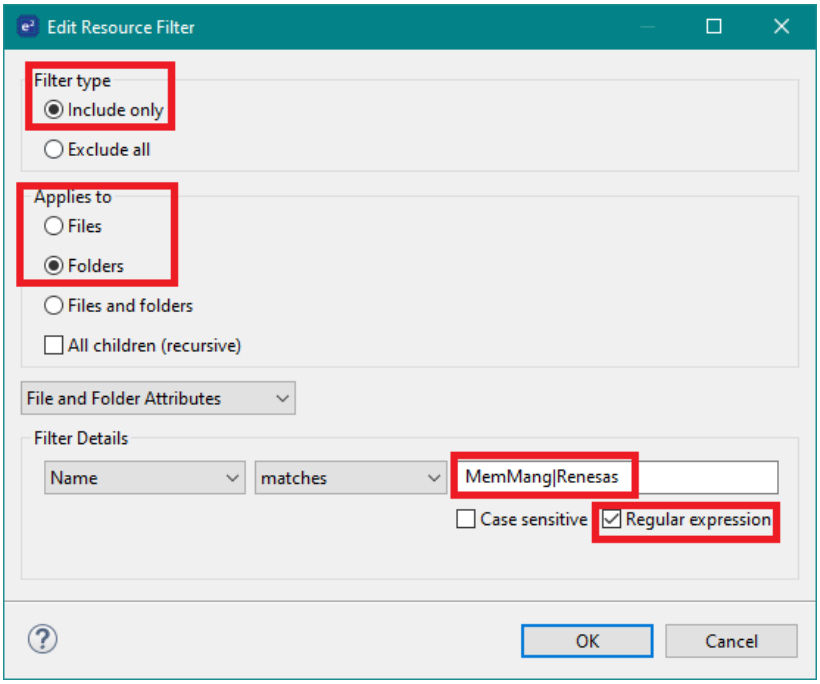

Figure 5.53 Folder Filter for Portable

Right click on **MemMang** folder in **FreeRTOS-Kernel/portable** and add the following filter:

- Filter type: **Include only**
- Applies to: **Files**
- Filter Details: **heap_4***
- Regular Expression: **Disable**

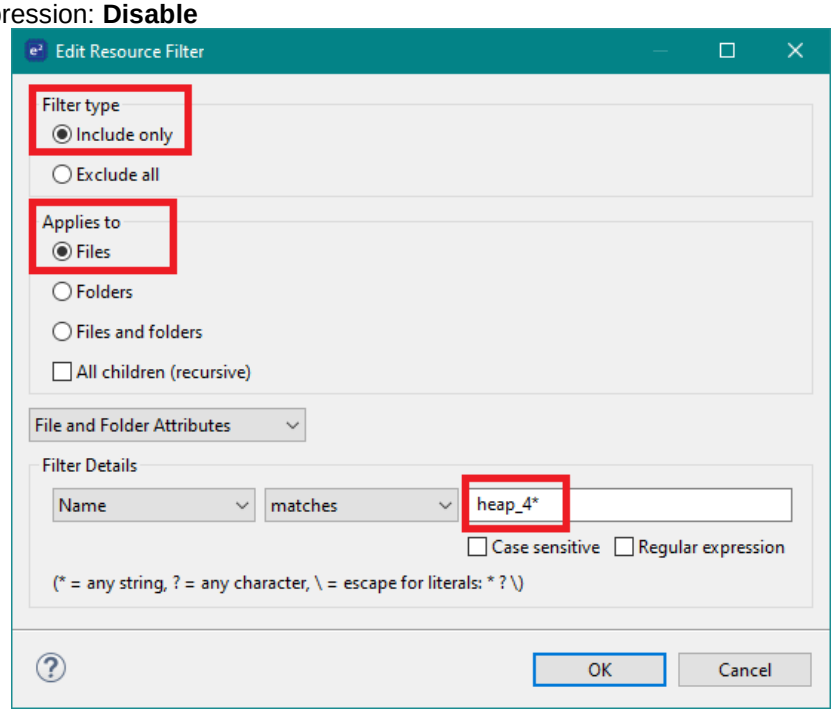

Figure 5.54 Filter for MemMang

Right click to the project and choose the **C/C++ Project Settings**, go to **Tool Settings** -> **Compiler** -> **Source** and add these paths below:

```
"${workspace_loc:/${ProjName}/src/frtos_startup}"
"${workspace_loc:/${ProjName}/src/frtos_config}"
"${workspace_loc:/${ProjName}/src/frtos_skeleton}"
"${workspace_loc:/${ProjName}/src/FreeRTOS-Kernel/include}"
"${workspace_loc:/${ProjName}/src/FreeRTOS-Kernel/portable/Renesas/RL78G2x}"
```

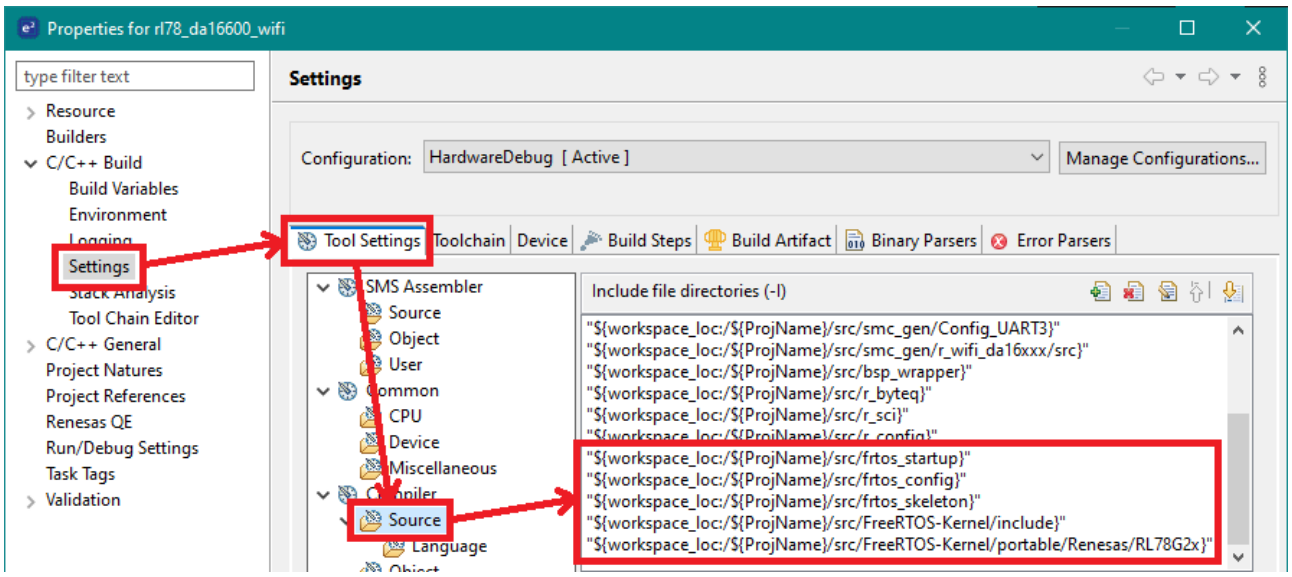

Figure 5.55 Project Settings for FreeRTOS Components

Disable configUSE_DAEMON_TASK_STARTUP_HOOK and configCHECK_FOR_STACK_OVERFLOW in **FreeRTOSConfig.h** file.

```
#define configUSE_DAEMON_TASK_STARTUP_HOOK 0

#define configCPU_CLOCK_HZ              (BSP_ICLK_HZ)
#define configPERIPHERAL_CLOCK_HZ       (BSP_PCLKB_HZ)
#define configUSE_QUEUE_SETS            1

/* Hook function related definitions. */
#define configUSE_TICK_HOOK                         0
#define configUSE_IDLE_HOOK                         0
#define configUSE_MALLOC_FAILED_HOOK                0
#define configCHECK_FOR_STACK_OVERFLOW              0
```

Figure 5.56 FreeRTOS Configuration

Ensure **BSP_CFG_RTOS_USED** in r_bsp_config.h file is set to **1** (FreeRTOS is used).

```
/* This macro lets other modules no if a RTOS is being used.
   0 = RTOS is not used.
   1 = FreeRTOS is used.(This is not available.)
   2 = embOS is used.(This is not available.)
   3 = MicroC_OS is used.(This is not available.)
   4 = Renesas ITRON is used.
*/
#define BSP_CFG_RTOS_USED               (1)
```

Figure 5.57 BSP Configuration

Modify **freertos_start.c** file as follows:

```
/***********************************************************************************
External functions
***********************************************************************************/
extern void main_task (void *pvParameters);
void Processing_Before_Start_Kernel(void);
void main(void);
```

```
/***********************************************************************************
Private global variables and functions
***********************************************************************************/
void main(void)
{

    Processing_Before_Start_Kernel();

    vTaskStartScheduler();

    while(1)
    {
        ;
    }

}
```

Add these two functions at the end of **freertos_start.c** file:

```
void vApplicationGetIdleTaskMemory( StaticTask_t ** ppxIdleTaskTCBBuffer,
                                    StackType_t ** ppxIdleTaskStackBuffer,
                                    uint32_t * pulIdleTaskStackSize )
{
    /* If the buffers to be provided to the Idle task are declared inside this
     * function then they must be declared static - otherwise they will be allocated
on
     * the stack and so not exists after this function exits. */
    static StaticTask_t xIdleTaskTCB;
    static StackType_t uxIdleTaskStack[ configMINIMAL_STACK_SIZE ];

    /* Pass out a pointer to the StaticTask_t structure in which the Idle
     * task's state will be stored. */
    *ppxIdleTaskTCBBuffer = &xIdleTaskTCB;
    /* Pass out the array that will be used as the Idle task's stack. */
    *ppxIdleTaskStackBuffer = uxIdleTaskStack;
    /* Pass out the size of the array pointed to by *ppxIdleTaskStackBuffer.
     * Note that, as the array is necessarily of type StackType_t,
     * configMINIMAL_STACK_SIZE is specified in words, not bytes. */
    *pulIdleTaskStackSize = configMINIMAL_STACK_SIZE;
}
/*-----------------------------------------------------------*/
void vApplicationGetTimerTaskMemory( StaticTask_t ** ppxTimerTaskTCBBuffer,
                                     StackType_t ** ppxTimerTaskStackBuffer,
                                     uint32_t * pulTimerTaskStackSize )
{
    /* If the buffers to be provided to the Timer task are declared inside this
     * function then they must be declared static - otherwise they will be allocated
on
     * the stack and so not exists after this function exits. */
    static StaticTask_t xTimerTaskTCB;
    static StackType_t uxTimerTaskStack[ configTIMER_TASK_STACK_DEPTH ];

    /* Pass out a pointer to the StaticTask_t structure in which the Idle
     * task's state will be stored. */
    *ppxTimerTaskTCBBuffer = &xTimerTaskTCB;
    /* Pass out the array that will be used as the Timer task's stack. */
    *ppxTimerTaskStackBuffer = uxTimerTaskStack;
    /* Pass out the size of the array pointed to by *ppxTimerTaskStackBuffer.
     * Note that, as the array is necessarily of type StackType_t,
     * configMINIMAL_STACK_SIZE is specified in words, not bytes. */
    *pulTimerTaskStackSize = configTIMER_TASK_STACK_DEPTH;
}
/*-----------------------------------------------------------*/
```

Replace main file (in this example is **rl78_da16600_wifi.c** file) as follows:

```
#include "FreeRTOS.h"
#include "task.h"
#include "r_smc_entry.h"

void main_task(void *pvParameters)
{

    while(1) {
        vTaskDelay(10000);
    }

}
```

5.2.8 First Project Code

Update main function to using Wi-Fi module APIs.
In case of non-RTOS project:

```
#include "r_smc_entry.h"
#include "r_wifi_da16xxx_if.h"

int main (void);

int main(void)
{
    EI();
    R_WIFI_DA16XXX_Open();

    while (1)
    {
    }
}
```

In case of FreeRTOS project:

```
#include "FreeRTOS.h"
#include "task.h"
#include "r_smc_entry.h"
#include "r_wifi_da16xxx_if.h"

void main_task(void *pvParameters)
{
    R_WIFI_DA16XXX_Open();
    while(1) {
        vTaskDelay(10000);
    }

}
```

Build the project.

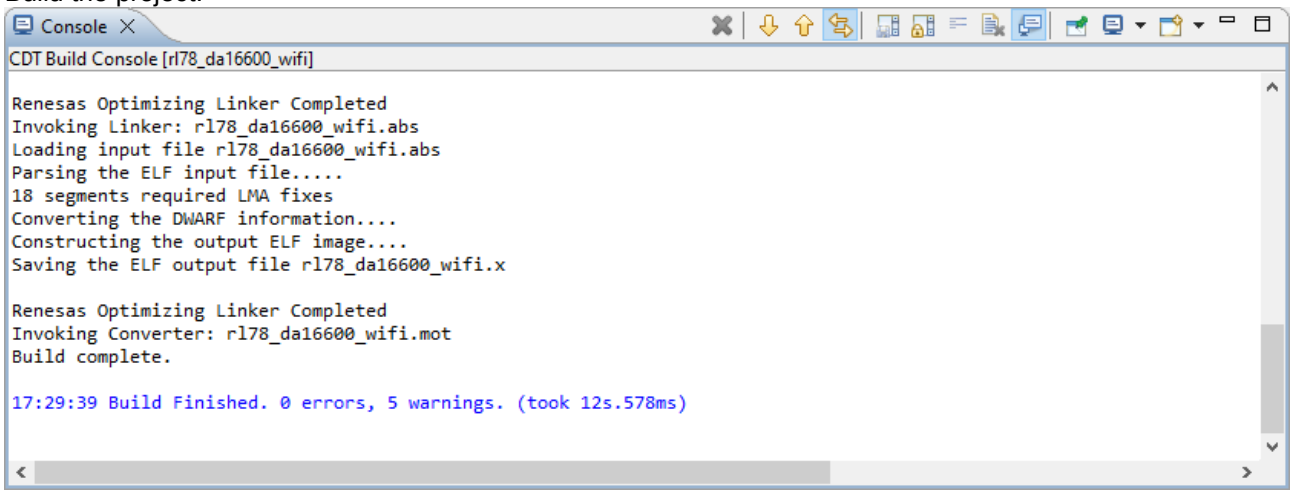

Figure 5.58 Confirm the Project Build

For debugging the project, refer to section **h) Building the Demo Project** for the details.

5.3 Adding a Demo to a Workspace

Demo projects are found in the sample_code subdirectory of the distribution file for this application note. To add a demo project to a workspace, select File >> Import >> General >> Existing Projects into Workspace, then click “Next”. From the Import Projects dialog, choose the “Select archive file” radio button. “Browse” to the sample_code subdirectory, select the desired demo zip file, then click “Finish”.

5.4 Downloading Demo Projects

When using the demo project, the SIS module needs to be downloaded. To download the SIS module, right click on this application note and select “Sample Code (download)” from the context menu in the Smart Brower >> Application Notes tab.

6. Appendices

6.1 Confirmed Operation Environment

This section describes the confirmed operation environment for the SIS module.

Table 6.1 Confirmed Operation Environment (Ver. 1.00)

Item	Contents
Integrated development environment	Renesas Electronics e2 studio 2023.01
C compiler	Renesas Electronics C Compiler for RL78 Family V1.08.00
	Compiler option: The following option is added to the default settings of the integrated development environment. -lang = c99
Revision of the module	Rev.1.00
Board used	RL78/G23-128p Fast Prototyping Board (RTK7RLG230CSN000BJ)

Table 6.2 Confirmed Operation Environment (Ver. 1.10)

Item	Contents
Integrated development environment	Renesas Electronics e2 studio 2023.07
C compiler	Renesas Electronics C Compiler for RL78 Family V1.12.00
	Compiler option: The following option is added to the default settings of the integrated development environment. -lang = c99
Revision of the module	Rev.1.10
Board used	RL78/G23-128p Fast Prototyping Board (RTK7RLG230CSN000BJ)

Table 6.3 Confirmed Operation Environment (Ver. 1.20)

Item	Contents
Integrated development environment	Renesas Electronics e2 studio 2024.01
C compiler	Renesas Electronics C Compiler for RL78 Family V1.13.00
	Compiler option: The following option is added to the default settings of the integrated development environment. -lang = c99
Revision of the module	Rev.1.20
Board used	RL78/G23-128p Fast Prototyping Board (RTK7RLG230CSN000BJ)

Table 6.4 Confirmed Operation Environment (Ver. 1.30)

Item	Contents
Integrated development environment	Renesas Electronics e2 studio 2024.04
C compiler	Renesas Electronics C Compiler for RL78 Family V1.13.00
	Compiler option: The following option is added to the default settings of the integrated development environment. -lang = c99
Revision of the module	Rev.1.30
Board used	RL78/G23-128p Fast Prototyping Board (RTK7RLG230CSN000BJ)

6.2 Support Logging Function

Configure the logging function for Wi-Fi module to print the debug log via SCI channel have been selected.

For the RL78/G23-128p Fast Prototyping Board (RTK7RLG230CSN000BJ), the log will be output to the PMOD2 as follows:

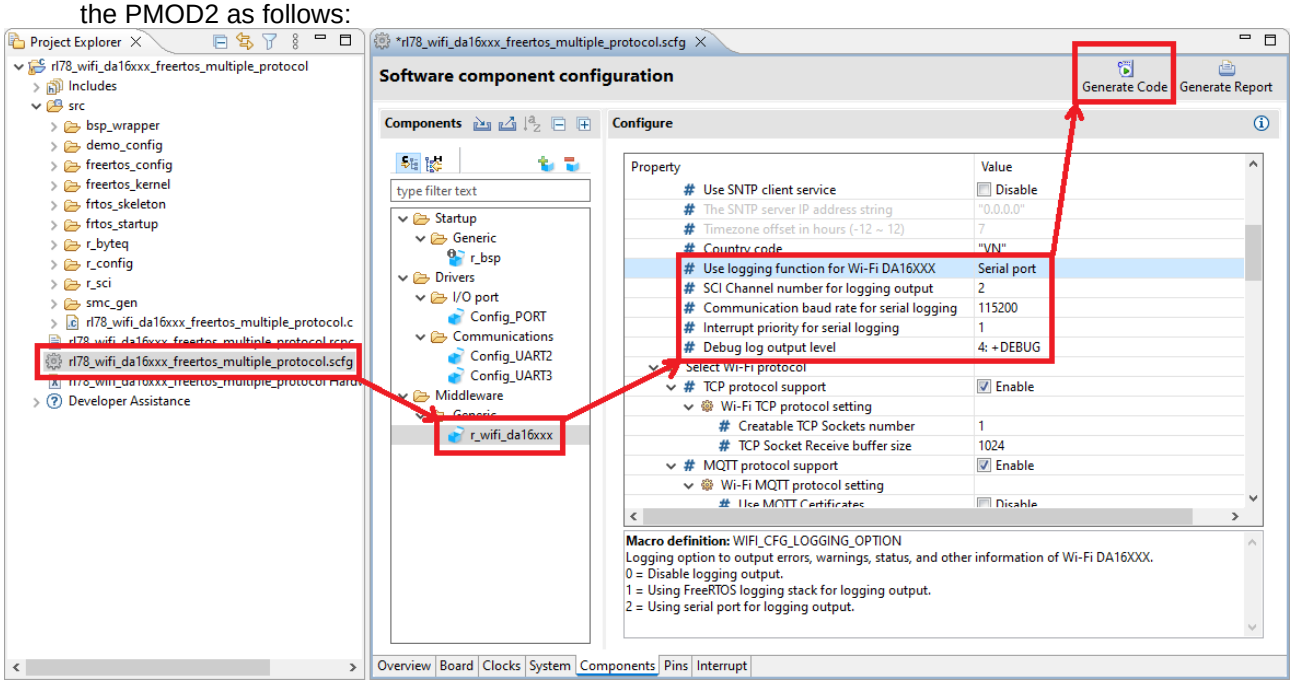

Figure 6.1 Logging Output Settings for Serial Port

- WIFI_CFG_LOGGING_OPTION: Choose “Serial port”.
- WIFI_CFG_LOG_TERM_CHANNEL: SCI channel for logging function.
- WIFI_CFG_SCI_UART_TERMINAL_BAUDRATE: Baud rate for serial port (unit in bps).
- WIFI_CFG_SCI_UART_INTERRUPT_PRIORITY: Interrupt priority (default is 1).
- WIFI_CFG_DEBUG_LOG: Debug log level.

Configures Tera Term terminal, please select **Setup** -> **Terminal…**

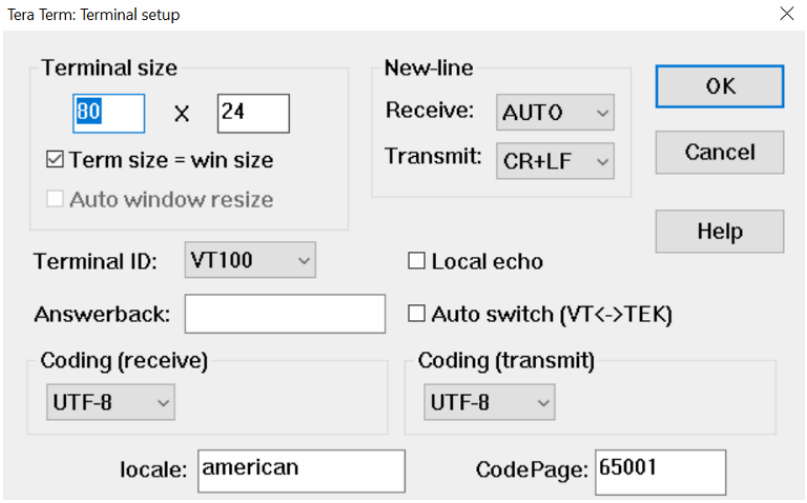

Figure 6.2 Tera Term Settings

Configures Port debug, please select **Setup** -> **Port…**

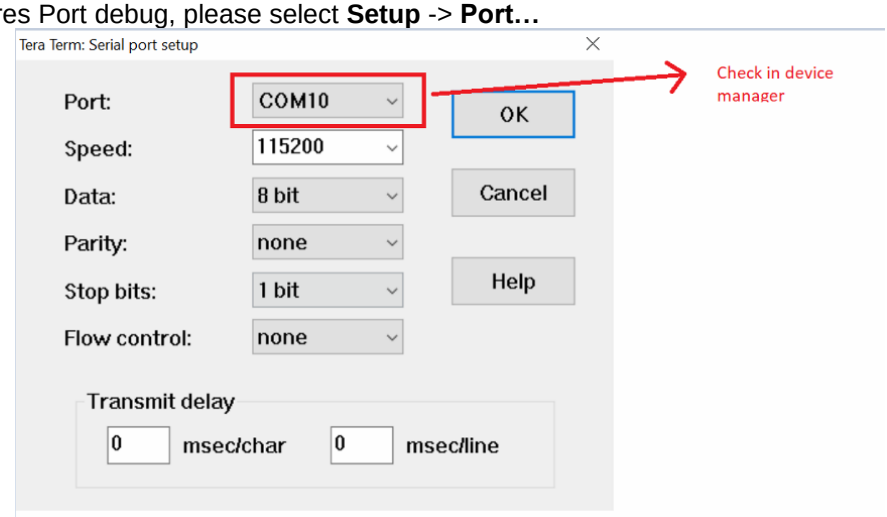

Figure 6.3 Tera Term Serial Port Settings

Ensure the COM port selected here is **NOT** the RL78 device when using COM port for debugging.

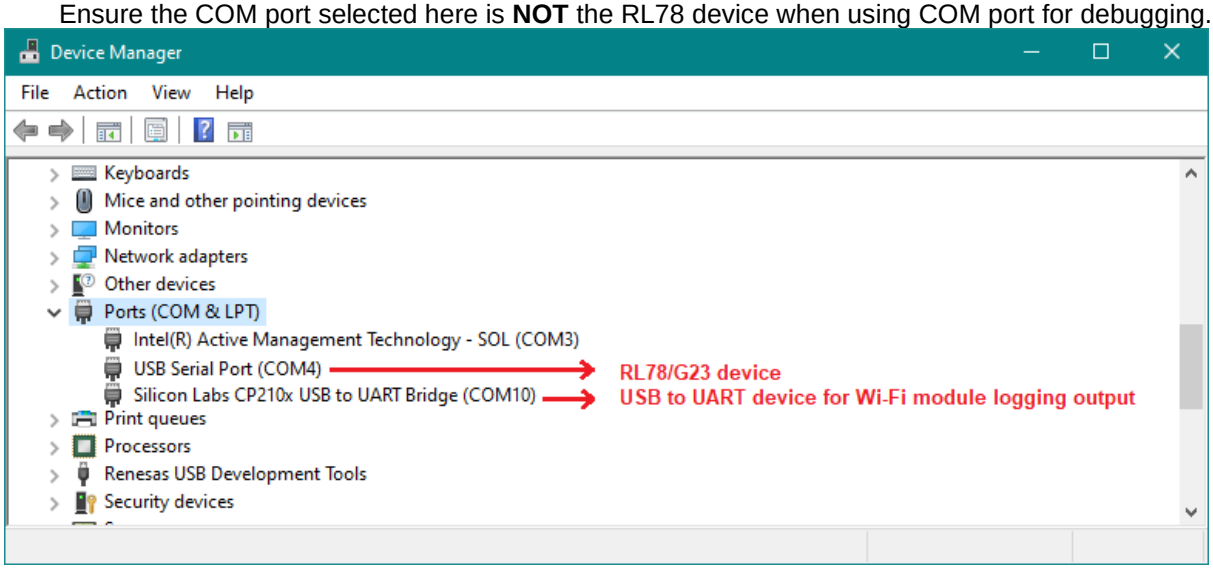

Figure 6.4 Identify COM Port with Device Manager

With this setting, the log will be output to the serial port. The user can debug the project and see the result on Tera Term as follows.

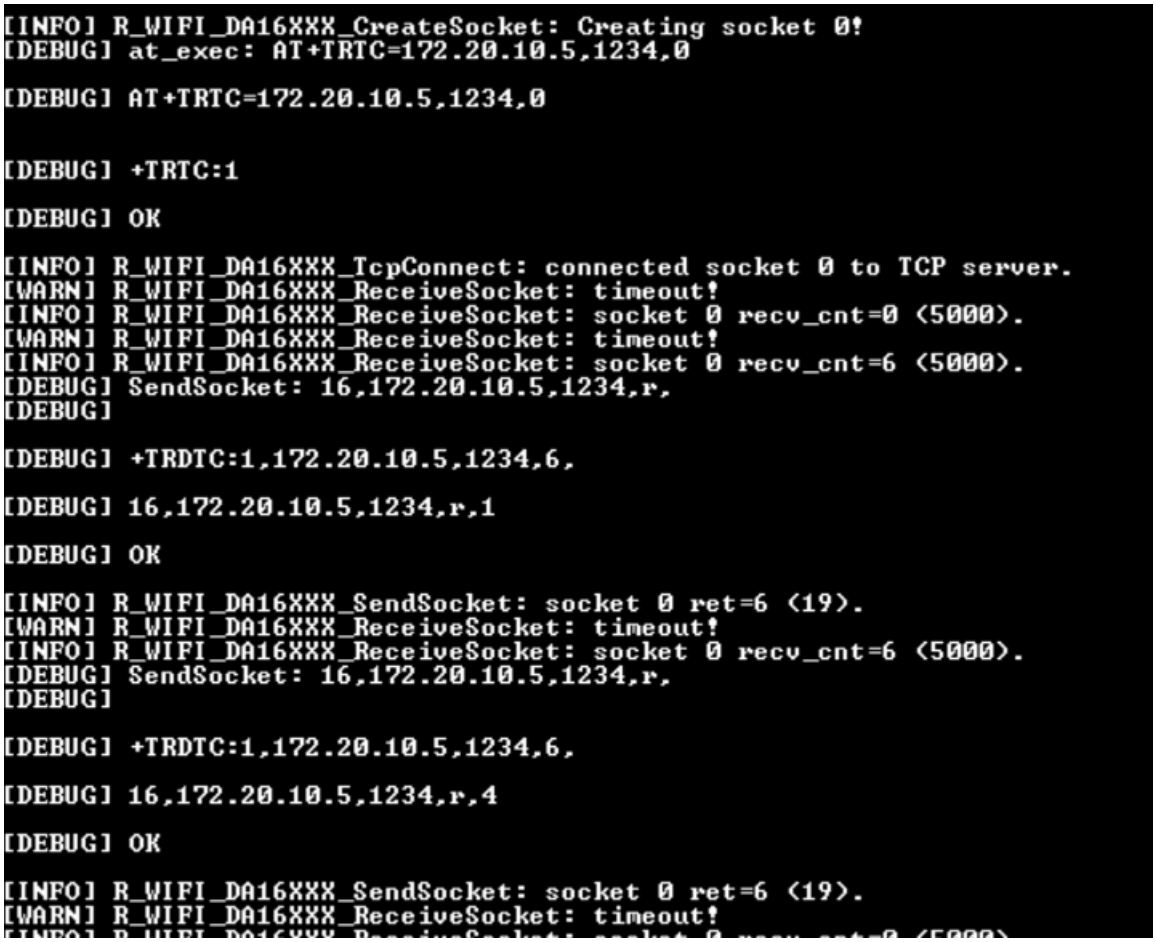

Figure 6.5 Wi-F Logging on Tera Term

6.3 How to Change UART Module to Work with Wi-Fi Module

This section describes how to change the UART module to work with Wi-Fi module in a demo project.

a. Adding a new UART module for communication between MCU and Wi-Fi module.

After creating new UART module, modify Config_UARTx_user.c file as below (UART3 has used in this example, same for others):

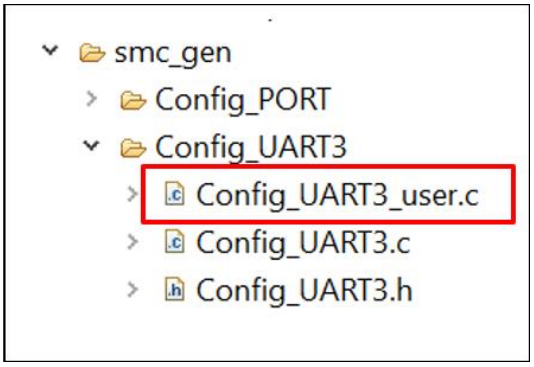

Figure 6.6 UART Configuration User File

b. Change the interrupt vectors in “Config_UARTx_user.c” by adding two lines as following:

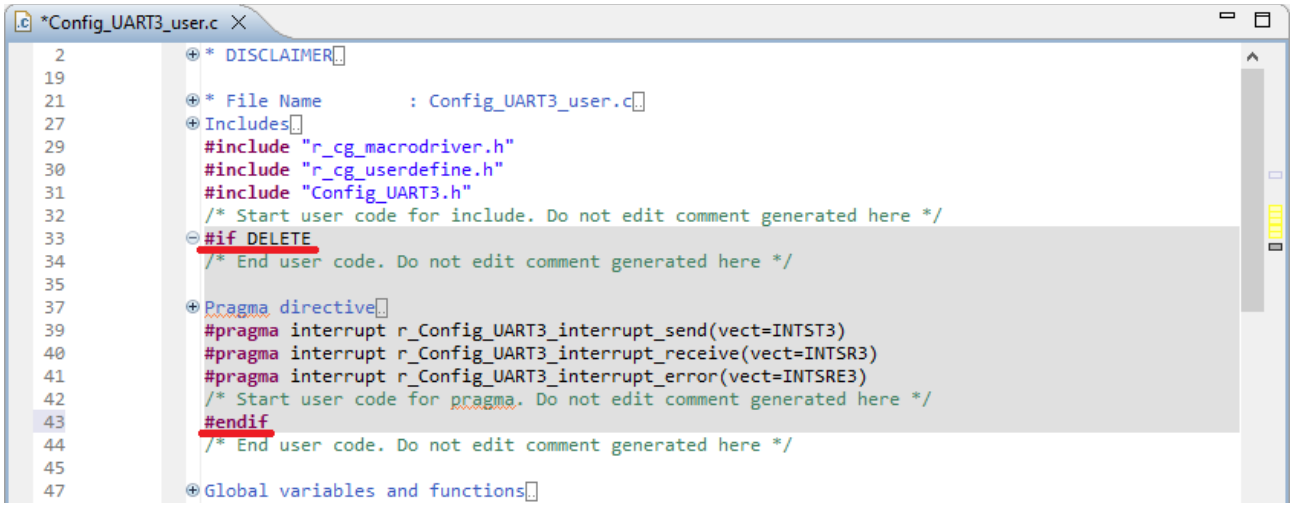

Figure 6.7 Modifying UART Module

Rebuild the project.

c. Repeat step a) and b) if using a serial port for Wi-Fi module logging output.

7. 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
RL78 Family's C Compiler CC-RL User's Manual (R20UT3123)
(The latest versions can be downloaded from the Renesas Electronics website.)

Revision History

Rev.	Date	Revision History	
		Page	Summary
1.00	Mar. 10, 2023	-	First edition issued
1.10	Dec. 04, 2023	-	Rename DA16200 to DA16XXX
		9	Updated table 2-1 to add these configuration options below: • WIFI_CFG_LOGGING_ENABLE • WIFI_CFG_USE_FREERTOS_LOGGING • WIFI_CFG_LOG_TERM_CHANNEL • WIFI_CFG_DEBUG_LOG
		40	Added table 5-2 Confirmed Operation Environment (Ver. 1.10)
1.20	Mar. 22, 2024	5	Added Wi-Fi module features in section 1.2
		6	Updated Figure 1-1
		7-8	Added new APIs for TLS, MQTT on-chip, HTTP on-chip in Table 1-1
		10-12	Added Status transitions of TLS Client, MQTT on-chip, HTTP on-chip
		14-18	Added configuration option for TLS, MQTT, HTTP in table 2-1
		20	Updated Code Size for r_wifi_da16xxx rev.1.20
		21	Updated Return values
		22-24	Updated Parameters
		26	Added section 2.12. “for”, “while” and “do while” statements
		28	Added new API: R_WIFI_DA16XXX_IsOpened()
		43	Added new API: R_WIFI_DA16XXX_HardwareReset()
		44	Added new API: R_WIFI_DA16XXX_GetVersion()
		52	Added new API: R_WIFI_DA16XXX_TcpReconnect()
		52-65	Added new APIs for TLS socket
		66-73	Added new APIs for MQTT on-chip
		74-76	Added new APIs for HTTP on-chip
		78	Added callback function for MQTT on-chip
		80-90	Added Section 5. Demo Projects
		91	Added Table 6-3 Confirmed Operation Environment (Ver. 1.20)
1.30	July. 23, 2024	5	Updated section 1.2 to add Bare Metal feature
		6	Updated Figure 1.2 to add Bare Metal
		14	Updated Table 2.1 to add Logging output function
		18	Updated Table 2.3 to add Bare Metal option
		20	Updated Table 2.4 with memory sizes for r_wifi_da16xxx rev 1.30
		21	Updated Section 2.9 with API error code tables
		22-24	Updated Section 2.10 with Parameter structure tables
		44-61	Updated socket number type from uint8_t to uint32_t
		82-91	Updated Section 5.1.5 How to Run the Demo
		92-110	Added Section 5.2 Creating a New Wi-Fi DA16600 Project
		113	Added Table 6.4 Confirmed Operation Environment (Ver. 1.30)
		114-116	Added Section 6.2 Support Logging Function

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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