Ultra-Low Power Wi-Fi
Ready2Go with AT Commands

BIG IDEAS FOR EVERY SPACE

RENESAS

ABOUT RENESAS

Global design centres coupled with local sales and expert field application support

EMEA

China

Americas

Asia
(excl. China and Japan)

Japan

† 1,000 employees*

● Headquarters ● Major sales offices ● R&D sites ● Manufacturing sites (□Front-end, △Back-end)
* Consolidated, as of December 31, 2021
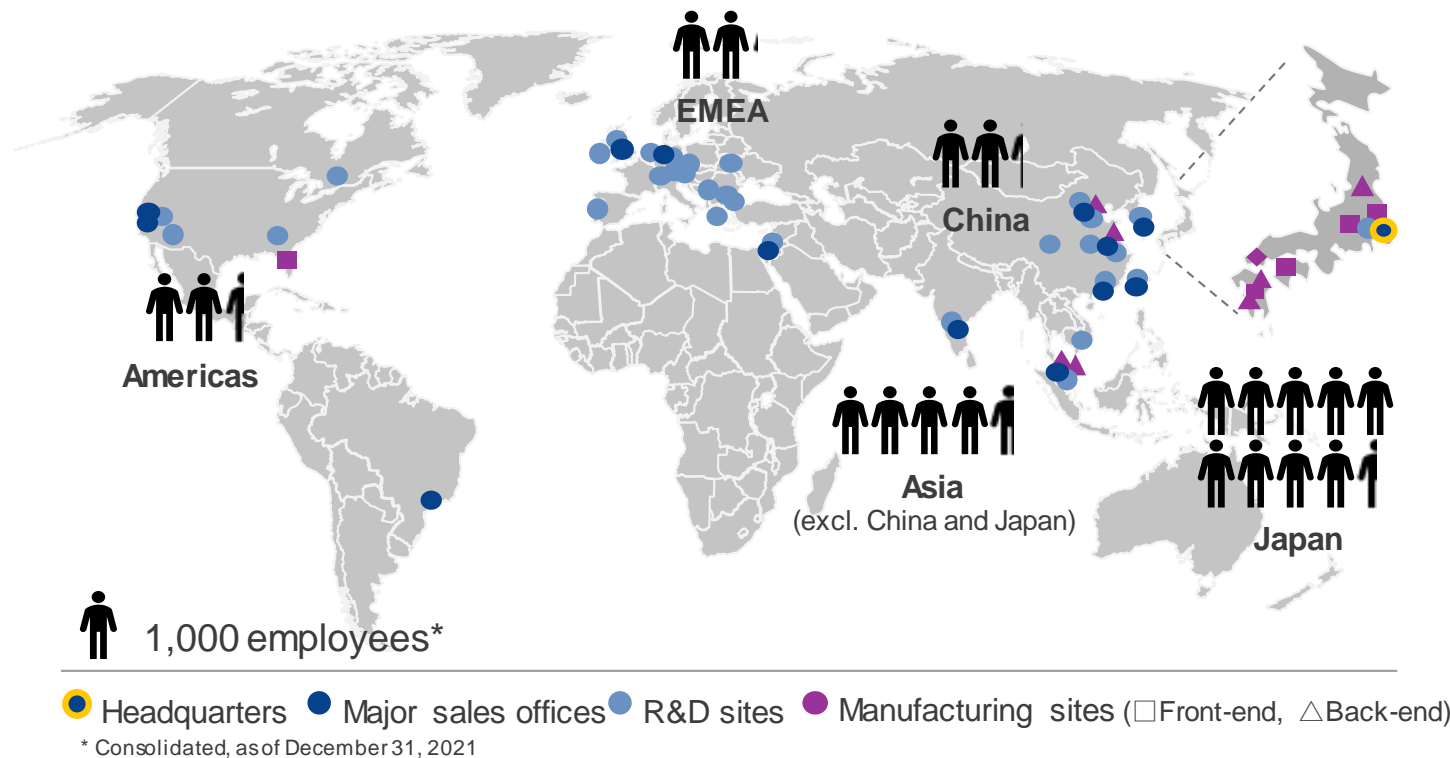
Headquarters
Tokyo, Japan

Approx. 21,000
employees

Operating in
30+ countries

994.4 billion yen
revenue in 2021

Approx. 20,000
patents & pending applications

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RENESAS: LONG TERM COMMITMENT TO WI-FI MARKET

- Full range of products in Wi-Fi. Several billion dollars on acquisitions in IoT Connectivity Space

Low Power ←→ High Data Rate

Smart Home   Wearables   Portable Electronics   TV   PC/Laptops   Phone   Router/Access Points

Dialog Acquisition
Low power Wi-Fi a,b,g,n,ax

Celeno Acquisition
High speed Wi-Fi ac/ax

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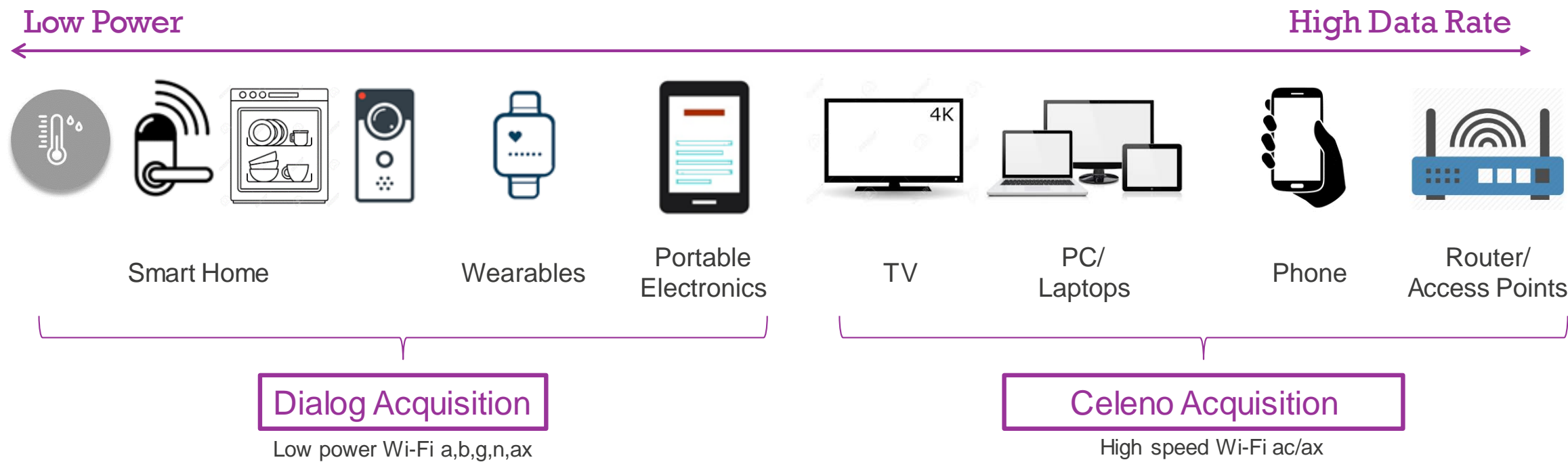
SPEAKER INTRODUCTION

Ture Nielsen
Head of Wi-Fi Marketing EMEA

RENESAS

Paolo Scarlata
Principal Field Application Engineer

RENESAS

Sandeep Mistry
Staff Software Engineer

arm

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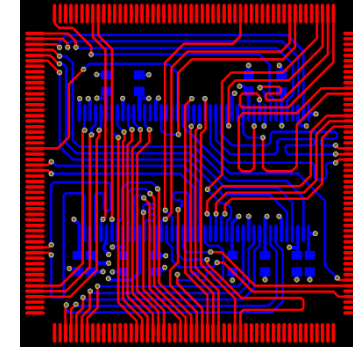
ULTRA-LOW POWER WI-FI READY2GO WITH AT COMMANDS

- What is ultra–Low Power Wi-Fi?

- Showcase building blocks to make your Wi-Fi development easy

- Live demonstrate Ready2Go examples for your Wi-Fi development.

BIG IDEAS FOR EVERY SPACE

AGENDA

- Renesas - Ultra-Low Power Wi-Fi introduction
- Renesas - Wi-Fi Ready2Go
- Renesas – Host MCU AT Command examples
- ARM Presents – Arduino Sketch with DA16200 Wi-Fi Shield
- Q&A and Quiz

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INTRODUCTION - DA16200 BLOCK DIAGRAM

- **Fully integrated** Wi-Fi system on an SoC

  - ARM® Cortex®-M4 Wi-Fi SOC @160MHz

  - 802.11 b/g/n 1x1 2.4 GHz

  - All full front-end included

    - Wi-Fi BB/MAC/RF PA, LNA, RF switch

  - CPU, SRAM, ROM, OTP

  - Dedicated HW encryption security block

  - Extensive I/O

  - Low external component count to reduced BOM

Package Type
+ QFN - 6x6 - 48 pin
+ fcCSP - 3.8x3.8 - 72 pin

MCU Interface
+ Runs independent of micro (hostless)
+ Optionally works w/ MCU via UART, SPI, SDIO, and I²C

Security
+ AES, TKIP encryption
+ 802.11i, 802.11s
+ EAP authentication including EAP-TTLS, PEAP, EAP-GTC, EAP-FAST
+ HTTPs with TLS/SSL
+ Elliptic curve encryption
+ WPA/2/3 – Enterprise and Personal
+ Secure boot, secure flash
+ Digital certificates

I/O Processor FEM

UART · SPI · SDIO · I²C · PWM · I²S · GPIO · ADC · JTAG · SWD

Processor ARM Cortex-M4F · FEM PA, LNA · Integrated Radio 2.4 GHz 802.11n 1x1

Encryption Engine (TLS, AES) · ROM OTP 8 KB · SRAM 512 KB

eMMC/SD Host · RTC · External Flash Controller · Flash Memory

Integrated Radio
Frequency band:
+ 2.4 GHz worldwide
+ 20 MHz channels

Antenna
+ Single antenna
+ Option for dual antenna with Rx and Tx diversity

On Chip Memory
+ To execute XIP software code
+ For over-the-air firmware updates

External Flash Memory
+ 1-32 MB

Operating Temperature
+ Temperature range: -40º C to 85º C

Expandable Memory

RTC Real Time Clock

External Flash Memory Controller
Up to 32 MB external quad-lane flash

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INTRODUCTION: LOWEST POWER WI-FI SOC IN INDUSTRY

Lowest Power Wi-Fi SoC in industry that delivers a **multi-year battery life** while maintaining industry leading **range and security capabilities**

- Lowest power validated by industry benchmarks
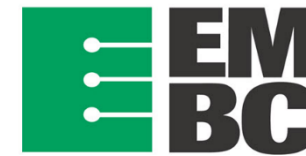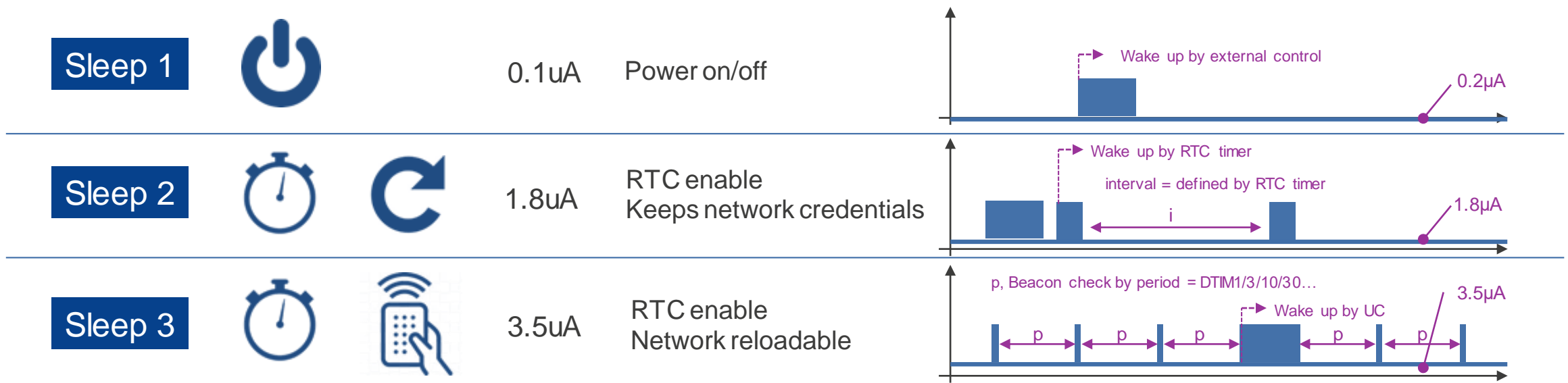
  Score: 815 (~815 days of battery life on 2 AA alkaline batteries)

- Fully Integrated System on Chip: Processor, SRAM, Security, ROM, OTP, Wi-Fi (b/g/n)

- Industry leading range (119.5 dBm)

- End to end security features

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INTRODUCTION - DA16200 VIRTUALZERO™ SLEEP MODE

SLEEP MODE

Unique sleep modes to optimize power consumption for each IoT application

- Virtually no power consumption in sleep state

- Validated for 200+ commonly used Legacy Access Points

- Has interoperability for both lower current and communication success

- Supports 3 sleep modes based on application requirement as below:

Sleep 1		0.1uA	Power on/off
Sleep 2		1.8uA	RTC enable Keeps network credentials
Sleep 3		3.5uA	RTC enable Network reloadable

Sleep 1: Wake up by external control — 0.2µA

Sleep 2: Wake up by RTC timer, interval = defined by RTC timer, i — 1.8µA

Sleep 3: p, Beacon check by period = DTIM1/3/10/30…, Wake up by UC — 3.5µA

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INTRODUCTION - VIRTUALZERO™ TECHNOLOGY

DA16200 shows **the lowest average current**

Sleep period	Average Current Consumption
1 second sleep (DTIM10)	72µA [1]
3 second sleep (DTIM30)	34µA [1]
5 second sleep (DTIM50)	26uA [2]
10 second sleep (DTIM100)	21uA [2]

Note 1) Measured value, average value from 200+ APs result, Based on DTIM=1 @ AP

Note 2) Calculated value based on AP KA 30sec, AP reauthentication check 30secs, ARP update 150sec

- Beacon check and Keep Alive (KA) is supported

- In case of DTIM10, the longest response time is 1 second and average response time is 0.5 seconds

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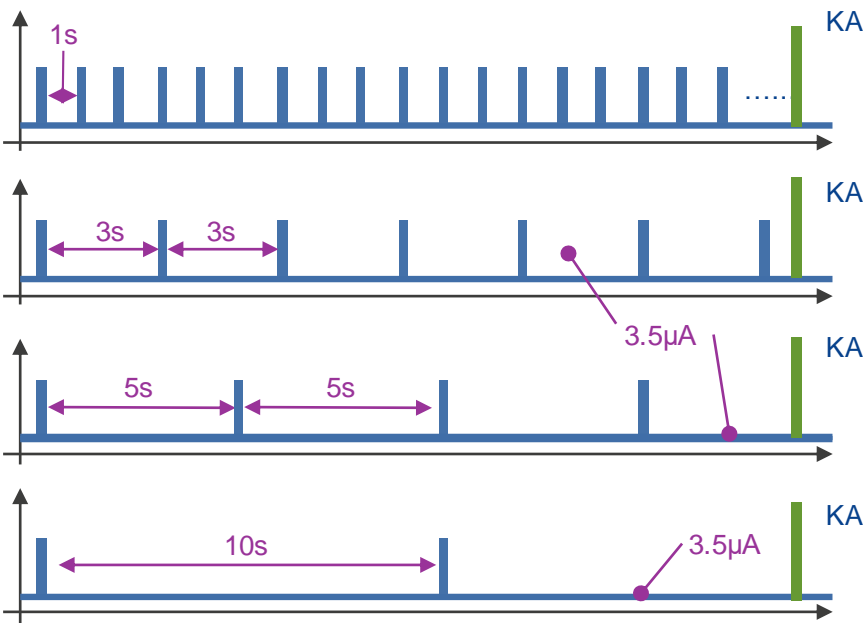
INTRODUCTION – RF PERFORMANCE

For extended range, DA16200 has **market leading link budget**

- +20dBm TX output power

- -99.5 dBm RX sensitivity

- 119.5 dB Link Budget

Long distance checks @ open air

Item	Normal mode
Tx (.11b - 1Mbps)	+20.0dBm @ 280mA
Tx (.11n – MCS7)	+15.5dBm @ 200mA
Rx Sens (1Mbps)	-99.5dBm
Link Budget	119.5dB

Distance	RSSI	TCP Tx	TCP Rx	UDP Tx	UDP Rx
10m	-3dBm	17.6	14.3	25	39.5
50m	-48dBm	17.5	13.8	25.5	38
100m	-55dBm	17.8	13.6	24.3	25.5
200m	-76dBm	4.7	2.8	20.3	24.3
250m	-76dBm	1.8	2.1	4.9	10.2
300m	-80dBm	0.2	0.5	4.2	3.9

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INTRODUCTION: INDUSTRY LEADING SECURITY

DA16200 Secures PSA Certified Level 1 to ensure security of IoT devices (press release)

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RENESAS WI-FI READY2GO

- Modern day design dilemma

  - Complex applications

    - Complex and powerful MCUs

    - Requirements for multiple communication interfaces

    - Cloud data management

  - Competitive market

    - Product needs to stand out from competition

    - Fast to market is essential

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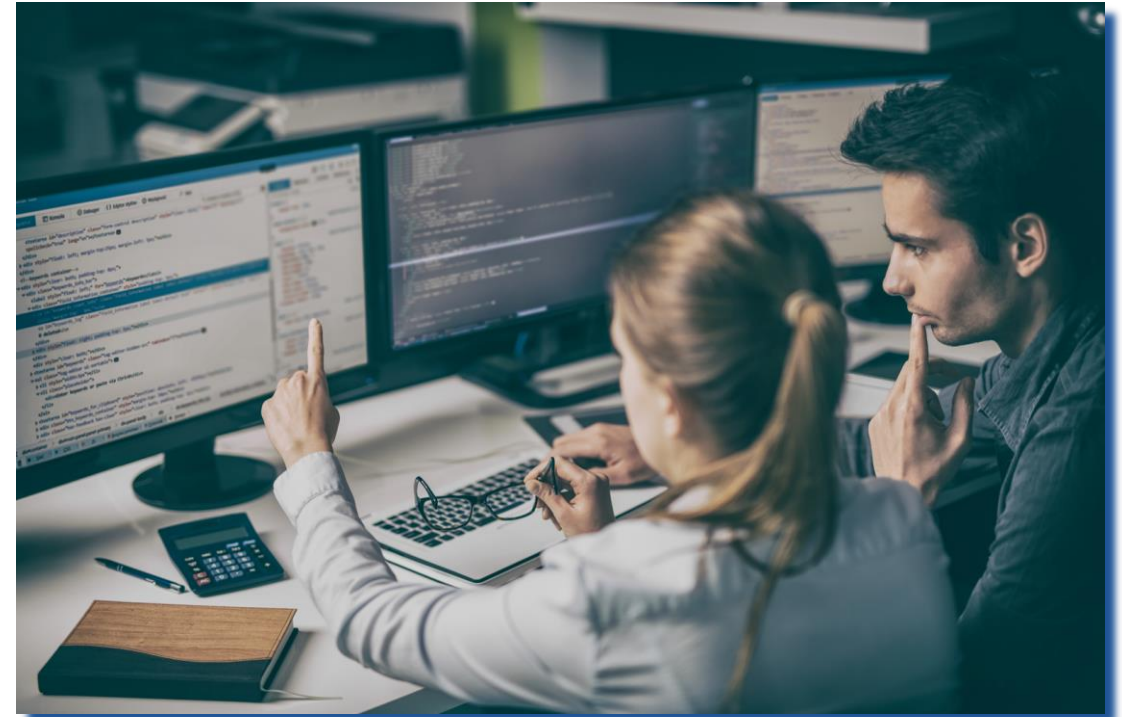
RENESAS WI-FI READY2GO

- Fast prototyping is essential

- Reduce development time and effort from first idea through concept and development phase to until production

  - HW – plug and play shields available for concept design

  - SW – Reference examples to reuse for concept design

  - Minimize time consuming tasks like certification and type approvals.

  - High level of reusability ensure fast time to market for next design.

Fast prototyping

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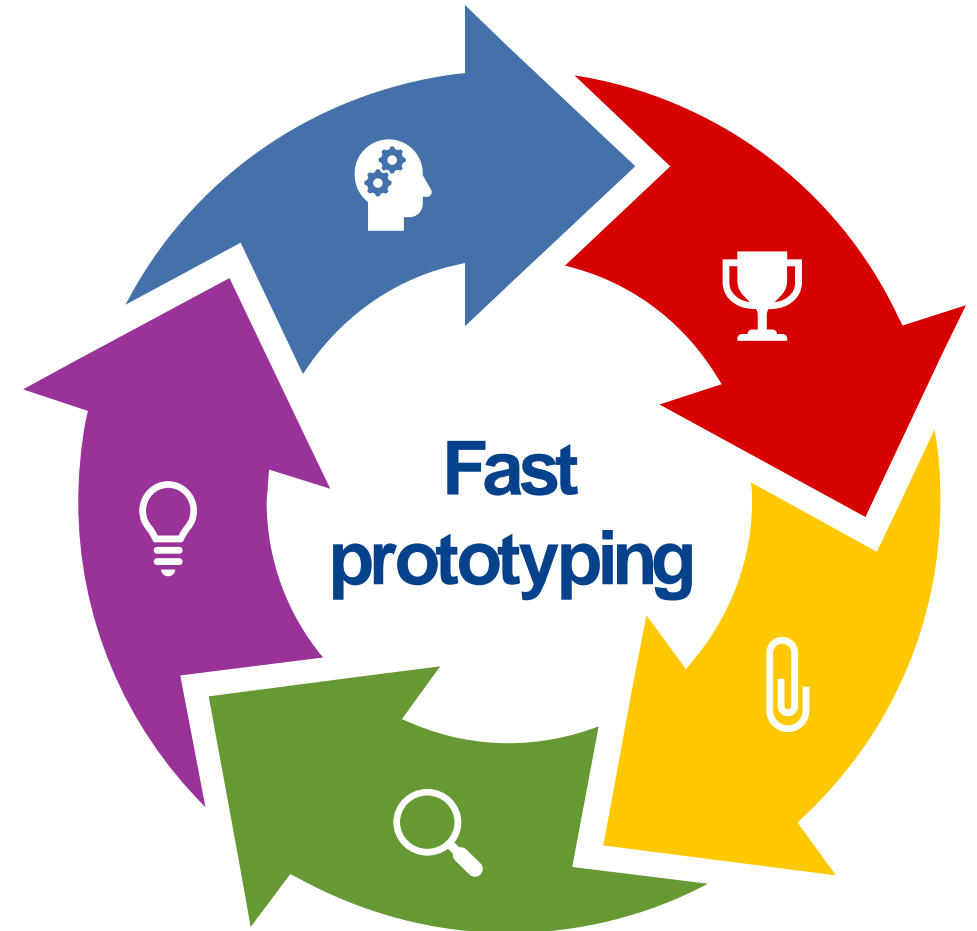
RENESAS WI-FI READY2GO - DA16200MOD
LOW POWER WI-FI MODULE

- The fully integrated module consists of:

  - DA16200 SoC

  - 32Mbit (4MB) FLASH onboard

  - Two XTAL integrated; 40MHz / 32.768KHz

- DA16200 module SKUs

  - DA16200MOD-AAC4WA32: with on board chip antenna

  - DA16200MOD-AAE4WA32: with u.FL connector for external Ant.

- DA16200 is part of the longevity program

  - 10 years longevity guarantee availability until 2030

- Worldwide certifications

  FC CE IC ⊖ KC CCC SRRC

- Dimensions: 13.8 x 22.1 x 3.3mm

Optional Host Device depending on application
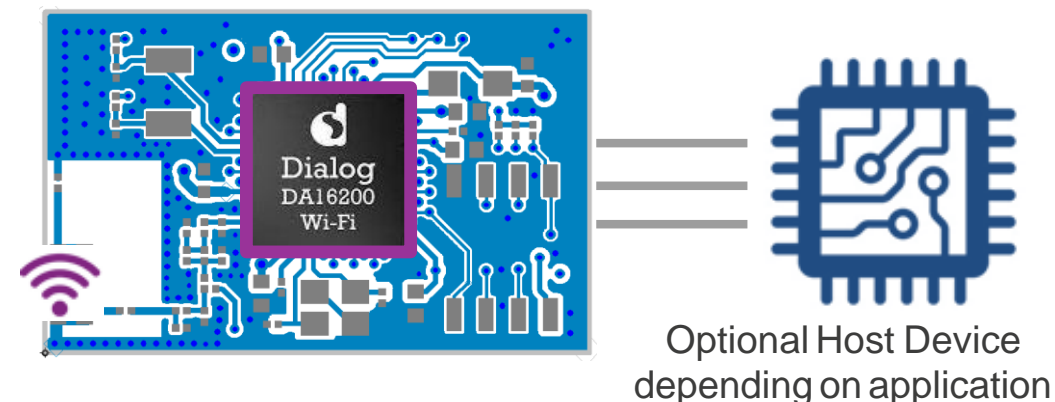
DA16200MOD, all components have integrated

DA16200MOD-AAC4WA32   DA16200MOD-AAE4WA32

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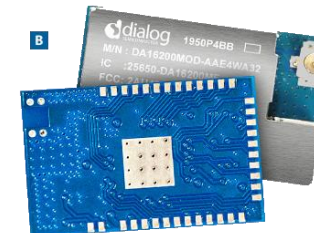
RENESAS WI-FI READY2GO - AT COMMANDS

Making Ultra Low Power Wi-Fi development easy

- Fast and easy development

- Limited the SW development

- No Wi-Fi Stack knowledge needed

- Supports the fully Certified modules DA16200/DA16600

- Comprehensive example and use cases included

UART or SPI

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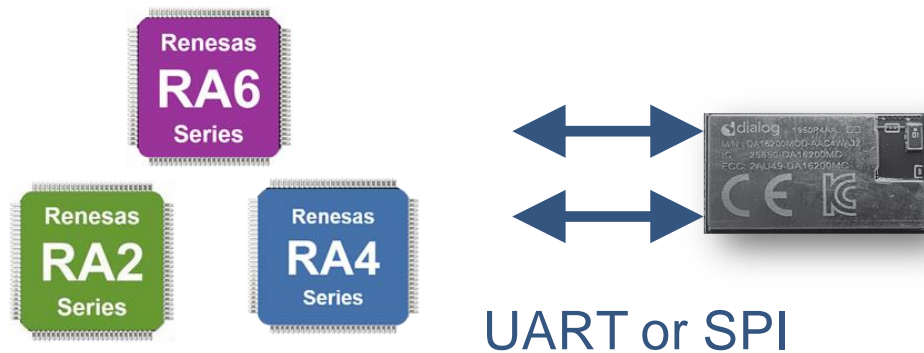
RENESAS WI-FI READY2GO – FULLY FEATURED

AT Commands with DA16200/DA16600

- **All features supported over AT Command**
  - All low power modes
  - Wi-Fi Provisioning
  - Support of network protocols for communication
    - TCP/UDP
    - HTTP
    - MQTT Commands
    - Sleep Commands
    - Firmware update Over The Air Commands (OTA)
    - GPIO Configuration Commands
    - Custom AT Command creation

- **AT command user manual**
  - UM-WI-003 DA16200 AT-Command User Manual

- **Proven solution in the market today**

UART or SPI

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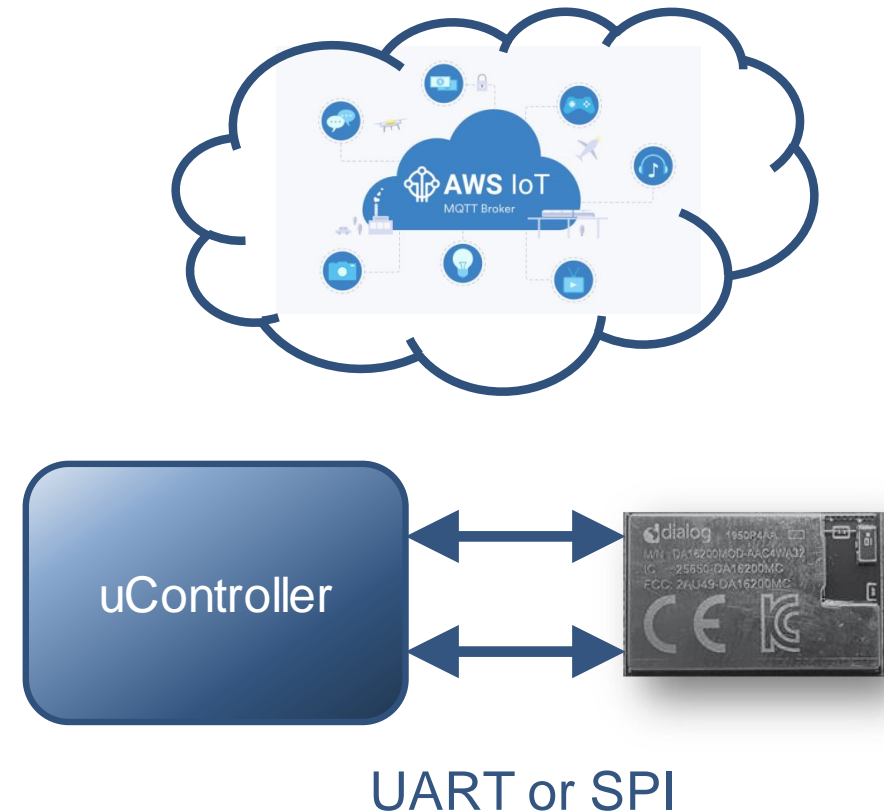
RENESAS WI-FI READY2GO – 3RD PARTY SHIELD

Out of the box AT Command support

- All features supported over AT Command
  - All low power modes
  - Wi-Fi Provisioning

MIKROE

- mikroBUS™ Clik board
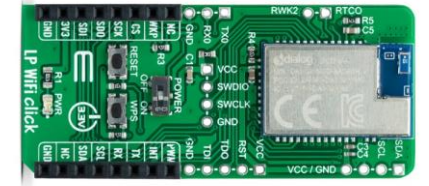
sparkfun ELECTRONICS

- Arduino UNO R3 Shield

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- DA16200 – PMOD

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RENESAS WI-FI READY2GO – FAST PROTOTYPING

- **Quick - Connect IoT**
  - Wi-Fi enabled Cloud IoT Solution
  - Available today
- **RA MCU – Ready2Go Wi-Fi examples**
  - AT Command examples for DA16200
  - Easy to import examples for Arm based RA MCU
  - 4 examples released today and more will come
  - Available today
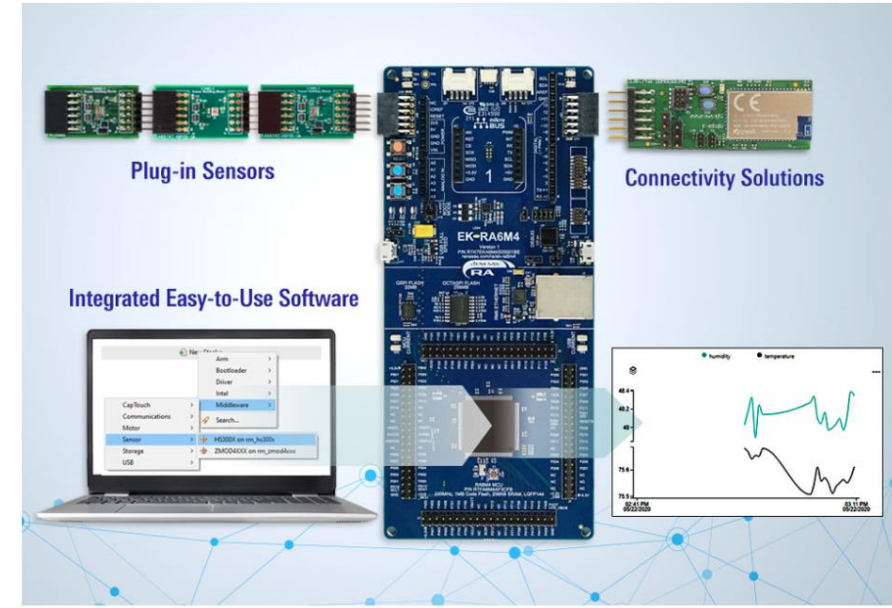
Renesas RA6 Series

Renesas RA4 Series

Renesas RA2 Series

arm

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AGENDA

Renesas - Ultra-Low Power Wi-Fi introduction

Renesas - Wi-Fi Ready2Go

Renesas – Host MCU AT Command examples

ARM presents – Arduino Sketch with DA16200 Wi-Fi Shield

Q&A and Quiz

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HANDS-ON WORKSHOP INTRODUCTION

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RENESAS QUICK-CONNECT IOT PLATFORM:
DIALOG CONNECTIVITY ADDS NEW DIMENSION

Complete IoT system with Renesas Analog + Power + Embedded processing solutions

- Out of the box IoT solution using new 6A PMOD™ interface and Renesas SW package

- Supports RX, RL78 & RA MCUs and Many sensors & Connectivity devices

- RZ, RE, other Renesas devices continuously added to Quick-Connect platform
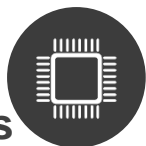
ZMOD Air Quality Sensors

HS3001 Temp/Humidity Sensor

MEMS Mic (Knowles)

MCU Devkits

DA14531MOD BLE

DA16200 Wi-Fi

DA16600MOD Wi-Fi/BLE Combo

Dialog Haptic Driver PMOD
Dialog IO-Link Master PMOD

The Power of Dialog Connectivity

- Dialog connectivity options
  - Bluetooth Low Energy
  - Wi-Fi
  - Wi-Fi / BLE combo
- Hardware support with example applications and mobile app

Providing Customers with a Renesas End-to-End Solution

- Dialog connectivity enables Renesas MCUs, MPUs and sensors to talk to smartphones, other devices and the cloud

- Hardware and software solutions simplify prototyping and development

- Customers can now build complete IoT solutions, using Renesas kits

- Customer can use any third party board or device with new interface

Easy-to-Use Quick-Connect System

- Sensor and connectivity boards plug into nearly all MCU/MPU dev kits
  - Software building blocks integrated into software packages to jumpstart code development

Supports third party device with new PMOD interface

RENESAS QUICK-CONNECT IOT PLATFORM
IDE OVERVIEW

You need to install first our Flexible Software Package (FSP):

- FSP is an enhanced software package designed to provide easy-to-use, scalable, high-quality software for embedded system designs using Renesas RA Family of Arm Microcontrollers.
  Note: FSP with e² studio Installer (Platform Installer) will install the e² studio tool, FSP packs, GCC toolchain and Segger J-Link drivers required to use this software. No additional installations are required.

The steps to write the application code are straight-forward:

- Start a new RA project.
- Select a BSP.
- Insert Middleware Stacks.
- Resolve middleware issues (remove the red out) by defining user items such as which I2C port to use.
- Generate code.

A step by step video can be followed here:

Rapidly Build an Air Quality Sensor System with Renesas' Quick-Connect IoT Platform

At this point, you have a buildable project with limited to no debug required, so you can start to write your application code

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RENESAS WI-FI READY2GO – WI-FI EXAMPLES

Wi-Fi Development using AT Command Set

Learn More
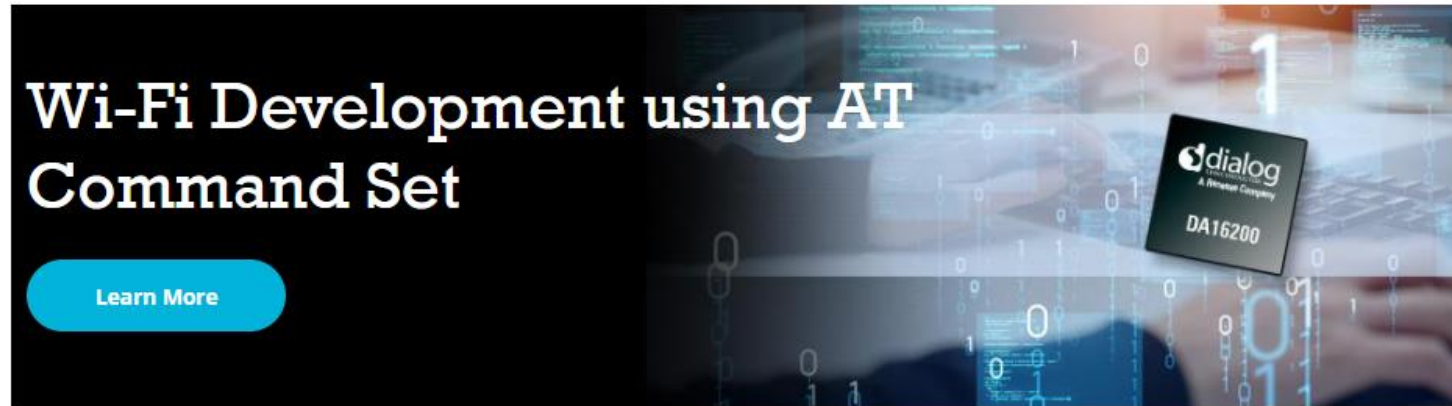
dialog
DA16200

[DA16200 Wi-Fi AT Command Set | Dialog (dialog-semiconductor.com)](https://dialog-semiconductor.com)

Ready2Go Wi-Fi examples released today:

- Simple MQTT Client example (Button press)

- MQTT Client Air Quality example

- HTTP Client example

- Wi-Fi Enabled Cloud IoT solution kit

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WEB SERVER EXAMPLE

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WEB SERVER EXAMPLE

- Hardware and software used in the example

- Example features

- AT CMD sequence to setup DA16200 wifi as Soft AP

- AT CMD exchange to refresh web page

- Live demo

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HARDWARE AND SOFWTARE USED IN THE DEMO

Hardware

- EK-RA6M4
- DA16200 PMOD (US159-DA16200MEVZ)
- HS3001 PMOD (US082-HS3001EVZ)
- EU065-ARDUINO SHIELD SENSOR BOARD
- An USB-to-UART bridge to monitor
  UART0 (console) and UART1 (AT-CMD) of DA16200

Software

For this demo we will use below project and we will walk through the code to see how wifi application has been implemented:

Wi-Fi Enabled Cloud IoT Solution Kit Sample Code

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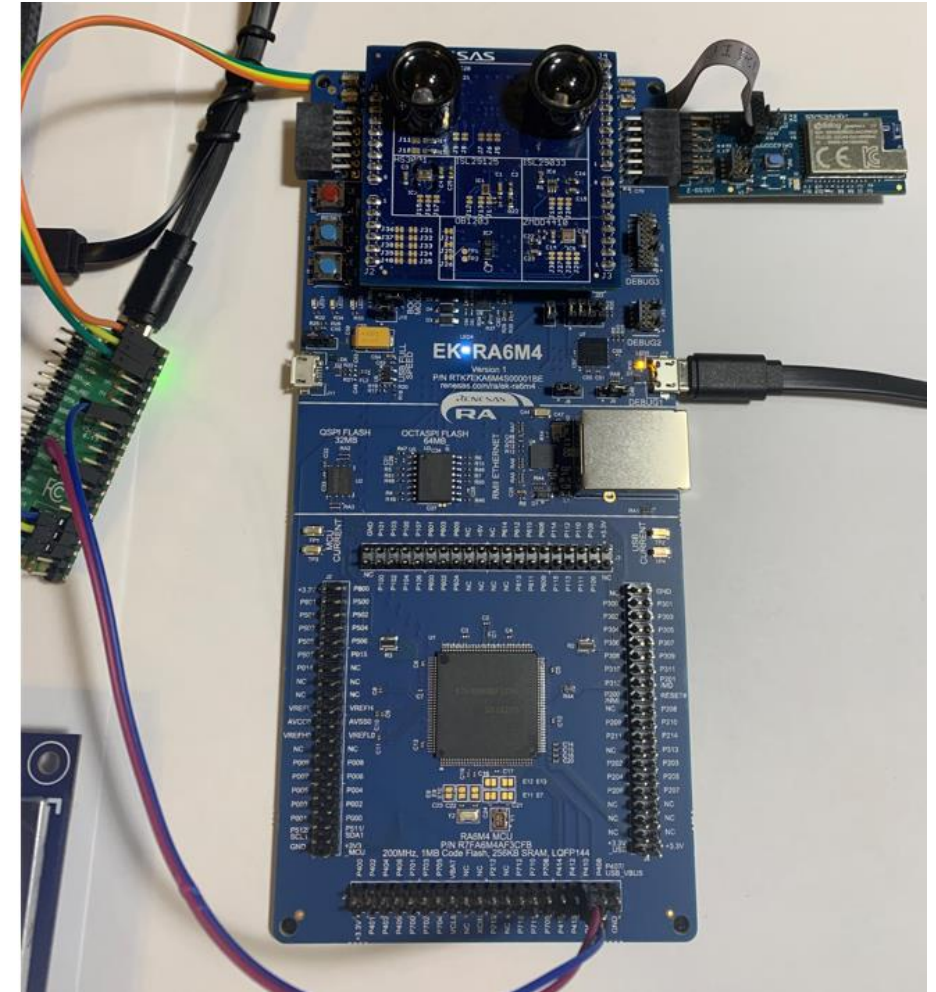
RA6M4 – HIGH PERFORMANCE 200-MHz ARM® CORTEX® - M33 CORE
FOR IOT ENDPOINTS SUCH AS WHITE GOODS, METERS, AND OTHER INDUSTRIAL AND CONSUMER

High Performance
- 200MHz Arm® Cortex®-M33 CPU

Highly integrated capabilities
- 512KB-1MB Flash Memory and 256KB SRAM
- 12-Bit ADC (x2),12-Bit DAC(x2)
- GPT 32-BIT (4 ch)/GPT 16-bit(6 ch)/Low power GPT(6 ch)

Communication interfaces
- USB 2.0(Full Speed/ High Speed)
- Ethernet Controller with DMA
- SCI x10/SPIx2/IICx2/QSPI/SDHI/SSI/CANx2

HMI Interface
- Capacitive Touch Sensing Unit (20ch.)

Security and Encryption
- AES128/192/256, SHA224/SHA256, GHASH, RSA(incl.3K/4K)/DSA/ECC
- True Random Number Generator (TRNG), 128-bit unique ID

Part #	Flash Memory	RAM	Temp	Package
R7FA6M4AF3CFB#AA0	1MB	256KB	40~105℃	144 LQFP
R7FA6M4AE3CFP#AA0	768KB	256KB	40~105℃	100 LQFP
R7FA6M4AD3CFM#AA0	512KB	256KB	40~105℃	64 LQFP

RA6M4 200MHz 32-Bit Arm® Cortex®-M33 Core | NVIC | JTAG | SWD | ETB

Memory
- Code Flash (512kB, 768kB, 1MB)
- BGO/SWAP Function
- SRAM (192kB) Parity
- SRAM (64kB) ECC
- Data Flash (8kB)
- Standby SRAM (1kB)

Analogue
- 12-bit A/D (9ch) 1S/H
- 12-bit A/D (8ch) 1S/H
- 12-bit DAC (2ch)
- Temperature Sensor

Timers
- GPT 32-bit (4ch)
- GPT 16-bit (6ch)
- Low Power GPT (6ch)
- WDT
- RTC, Calendar, Vbat, 128Byte SRAM

HMI
- Capacitive Touch Sensing Unit (20ch)

Communication
- Ethernet MAC with DMA
- USB2.0 FS x1
- CAN x2
- I2C x2
- SCI x10
- SPI x2
- QSPI x1 + OctaMemory
- SDHI x1
- SSI x1
- External Memory Bus

System
- DMA (8ch)
- DTC
- Clock Generation
- On-Chip Oscillator HOCO (16,18,20MHz), LOCO (32kHz), ILOCO (15kHz)
- Low Power Modes
- ELC
- Interrupt Controller
- Trust Zone

Safety
- Memory Protection Unit
- SRAM Parity Check
- ECC in SRAM
- Clock Frequency Accuracy Measurement
- CRC Calculator
- IWDT
- Data Operation Circuit
- Flash Area Protection
- ADC Self Test

Security
- AES (128/192/256)
- TRNG
- Key Management
- RSA (incl.3K/4K)
- SHA256
- ECC
- Tamper Resistance
- SPA/DPA Enhanced Resistance

Package
- LQFP 64, 100, 144

RA6M4 Block Diagram

Renesas RA6 Series

Performance
- ARM® Cortex-M33® Core
- Power consumption
- Wake-up time

Up to 200MHz

Integration
- Connectivity:
  - QSPI
  - SDHI
  - CAN FD
  - Octa Memory

Security
- Crypto Module with cryptography accelerator and TRNG
- Cyrpto Module supports Key management
- TrustZone and Tamper resistance

Major Enhancements in RA6 Series With CM33

EU065 ARDUINO SHIELD SENSOR BOARD

System Overview:

Renesas has a wealth of sensors; however, to use these in a sensible environment, a control MCU is needed as well as an output medium. To enable the sensors to be tested/connected to different MCU families, a common electrical and mechanically stable plug-in interface is needed. The latest MCU evaluation kits are being equipped with an Arduino Shield interface, which is a standardized interface. A set of widely used sensors have been integrated in this Arduino Shield, which all share the I2C control interface – on different addresses.

System Benefits

- The six different I2C-connected sensors that are implemented, share the common interface with some overlapping I2C addresses, therefore an I2C buffer/splitter IC has been added into the design.
- An Arduino interface has only two interrupt lines (by default), therefore a wired AND has been added to the circuit to allow the use of interrupt outputs from the sensors.
- The sensor board is completely passive, this allows the board to be plugged into any Arduino Shield equipped evaluation kit.
- Single 3.3V input picked up from the host MCU (Arduino) interface.
- Multiple sensors on one board for quick evaluation.
- All sensors are enabled by default, but jumpers allow sensors to be disabled individually.

Target Applications:

- Evaluation of any sensor platform.

EU065
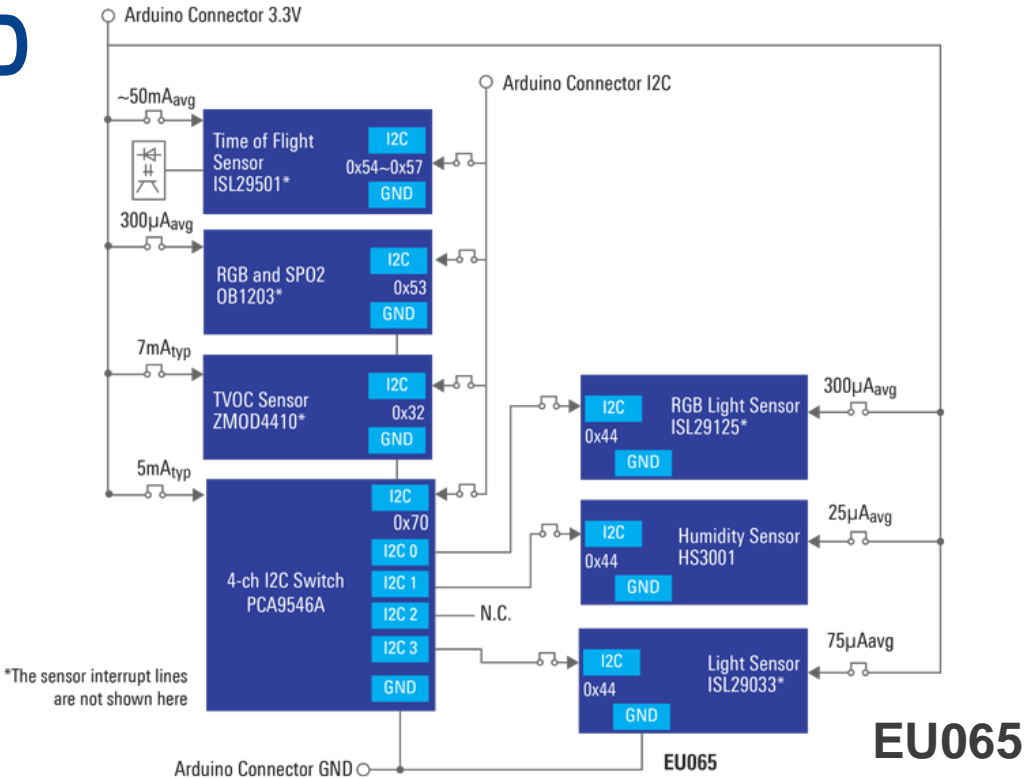
Device Category	P/N	Key Features
Analog	ISL29125	Digital RGB Light and proximity sensor
	ZMOD4410	TVOC Sensor
	HS3001	Temperature & Relative Humidity Sensor
	ISL29033	Ambient Light Sensor
	ISL29501	Time-of-flight Sensor
	OB1203	Heart Rate, Blood Oxygen Concentration, Pulse Oximetry

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DA16200 – WI-FI MODULE FOR IOT APPLICATIONS
LOWEST POWER WI-FI MODULE IN THE INDUSTRY

Dialog Achieves Industry's Highest Ranking
in IoTMark™-Wi-Fi Benchmark

Ultra Low Power

- The module solution for IoT applications featuring lowest power Wi-Fi (DA16200) platform in the industry

Fully Integrated

- DA16200 (Wi-Fi) ultra low power SoC
- Wi-Fi Specs: IEEE 802.11b/g/n, 1x1, 20 MHz channel bandwidth, 2.4 GHz
- 32Mbit (4MB) Flash memory
- Two XTAL integrated; 40MHz / 32.768KHz

Best RF Performance

- Tx Power: +19dBm, 1Mbps DSSS
- Rx Sensitivity: -98.5dBm, 1Mbps DSSS

Module Worldwide Certified:

FC CE IC ⏚ KC CCC SRRC

US159-DA16200MEVZ

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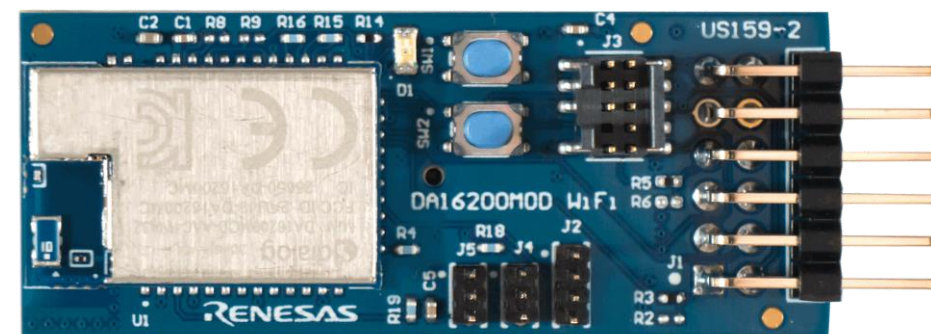
EXAMPLE FEATURES

- Measure values including temperature and humidity of HS3001, how many time S1 key on EK-RA6M4 has been pressed, and display these on web (the web page will have a different colors if S1 pressed time is even or odd)
- Initialize and control Wi-Fi module DA16200 by AT command to realize HTTP protocol
- Control LED1 on EK-RA6M4 to on, off or blink by selecting related button on the specific webpage

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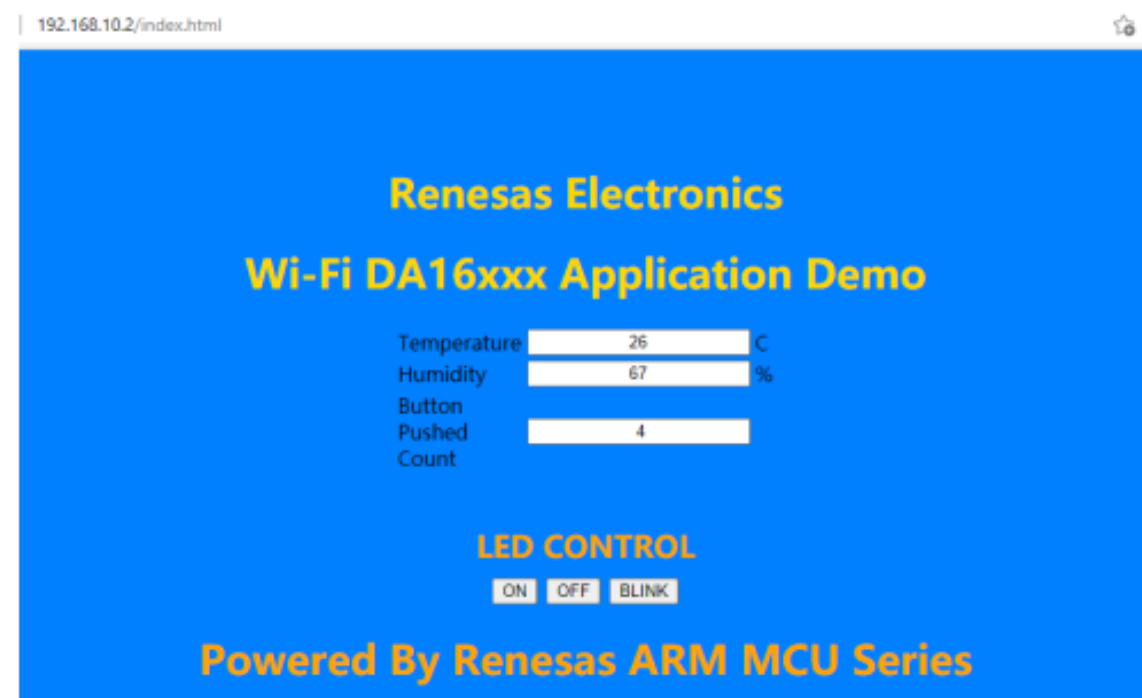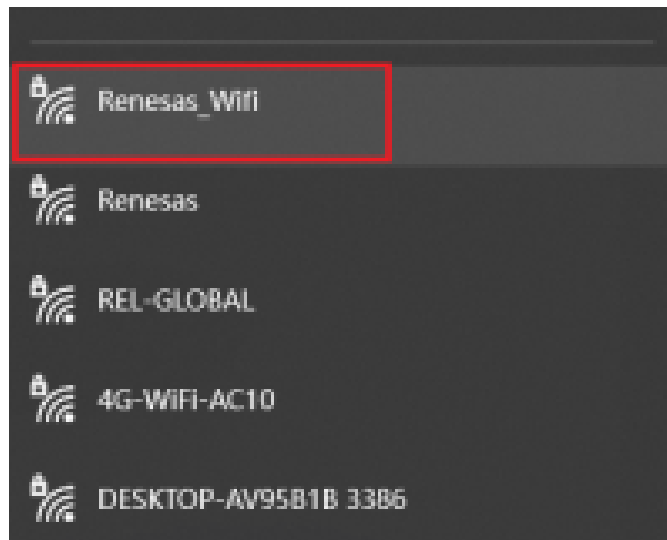
AT CMD SEQUENCE TO SETUP DA16200 WIFI AS SOFT AP

RA6MA TX => DA16200 RX (P410 RXD0 PMOD2)

DA16200 TX (P411 TXD0 PMOD3) =>RA6MA RX

Initialize AT command → `ATZ`
Set the Wi-Fi mode to 1 (Soft-AP) → `ATZ`
Set country code to IT → `AT+WFMODE=1`
Set up Soft-AP with SSID, WPA2, AES, PW, Ch 1, IT → `AT+WFCC=IT`
System restart → `AT+WFSAP=Renesas_Wifi,3,1,12345678,1,IT`
Set the WLAN1(Soft-AP), IP address, Subnet, Gateway → `AT+RESTART`
Start DHCP server → `AT+NWIP=1,192.168.10.2,255.255.255.0,192.168.10.1`
Set an IP address range of the DHCP server → `AT+NWDHS=1`
Open a TCP server socket at local port 80 → `AT+NWDHR=192.168.10.3,192.168.10.10`
Save status of all sessions to NVRAM → `AT+TRTS=80`
`AT+TRSAVE`

```
+INIT:DONE,1

Display result on
                Echo off
OK

OK

OK

OK

+WFSAP:Renesas_Wifi
OK

OK

+INIT:DONE,1

OK

OK

OK

OK

OK

OK

+WFCST:48:5f:99:cf:ab:39
```

Wi-Fi list:
- Renesas_Wifi
- Renesas
- REL-GLOBAL
- 4G-WiFi-AC10
- DESKTOP-AV95B1B 33B6

A Wi-Fi station connected in Soft-AP mode with showed MAC

BIG IDEAS FOR EVERY SPACE

RENESAS

AT CMD EXCHANGE TO REFRESH WEB PAGE

RA6MA TX => DA16200 RX (P410 RXD0 PMOD2)

DA16200 TX (P411 TXD0 PMOD3) =>RA6MA RX

Transmit data through a socket:
<ESC>S
0(TCP Server)
Length
Remote IP
Remote Port
<Data>

A remote TCP client is connected to the TCP server that was opened by AT+TRTS, followed by IP and Port #

Receive data through TCP server socket, IP, Port, Length, <Data>

Data received when a button is clicked on the web page

A remote TCP client is disconnected

BIG IDEAS FOR EVERY SPACE

LIVE DEMO

BIG IDEAS FOR EVERY SPACE

SMARTCTHERMO EXAMPLE

BIG IDEAS FOR EVERY SPACE
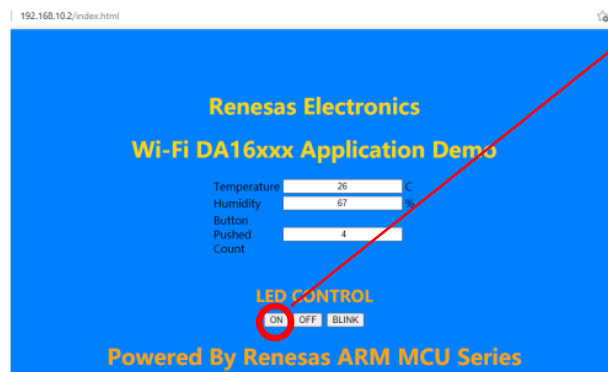
SMARTCTHERMO EXAMPLE

- Hardware and software used in the example

- Example features

- AT CMD sequence to setup DA16200 wifi as MQTT client

- AT CMD exchange to publish a message with sensors data

- Live demo

BIG IDEAS FOR EVERY SPACE

HARDWARE AND SOFWTARE USED IN THE DEMO

Hardware

- EK-RA6M3G
  - Evaluation Kit for RA6M3 MCU Group with Graphics Expansion Boards
- SparkFun Qwiic WiFi Shield with DA16200MOD
- HS3001 PMOD (US082-HS3001EVZ)
- ZMOD4410 PMOD (US082-ZMOD4410EVZ)
- Interposer Board for Pmod™ Type 2A/3A to 6A (US082-INTERPEVZ)
- An USB-to-UART bridge to monitor
  UART0 (console) and UART1 (AT-CMD) of DA16200

Software

For this demo we will use the Wifi version of the SmartCTherm solution developed by one of our distributor.

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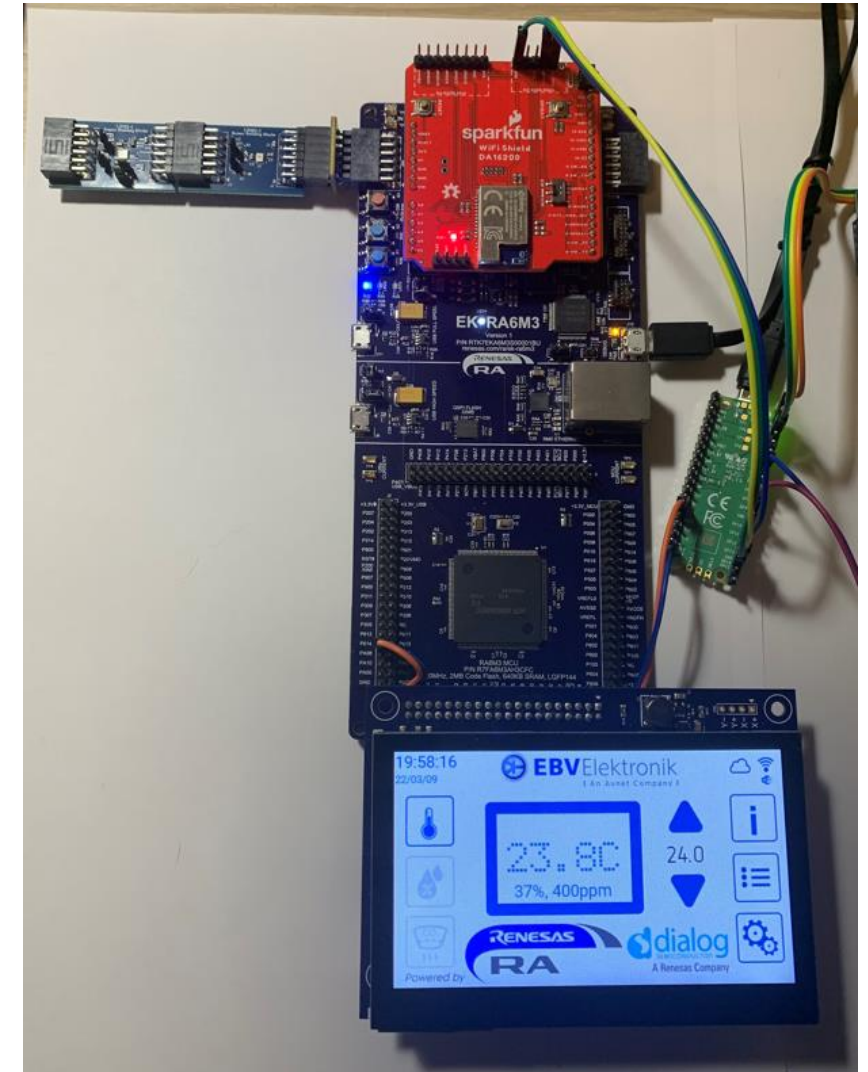
RA6M3 – ULTRA-LOW POWER 120-MHz ARM® CORTEX®- M4 CORE
FOR APPLICATIONS NEEDING HMI/CONTROL/ SECURITY/GRAPHICAL AND CAPACITIVE TOUCH

High Performance
- 120MHz Arm® Cortex®-M4 CPU

Highly integrated capabilities
- 1MB-2MB Flash Memory and 640kB SRAM
- 128-bit unique ID
- 12-Bit ADC (x2)
- 12-Bit DAC

Communication interfaces
- USB 2.0(Full Speed/ High Speed)
- Ethernet Controller with DMA
- SCI x10/SPIx2/IICx3

HMI Interface
- Capacitive Touch Sensing Unit (18ch.)
- Graphics LCD Controller

Security and Encryption
- AES128/192/256, 3DES/ARC4, SHA1/SHA224/SHA256/MD5, GHASH, RSA/DSA/ECC
- True Random Number Generator (TRNG)

FLASH / RAM	2MB / 640kB	RA6M3	RA6M3	RA6M3	RA6M3	RA6M3
	1MB / 640kB	RA6M3	RA6M3	RA6M3	RA6M3	RA6M3
Pin Count Package Size Pitch		100pin LQFP 14x14 0.5mm	144pin LQFP 20x20 0.5mm	145pin LGA 7x7 0.5mm	176pin LQFP 24x24 0.5mm	176pin BGA 13x13 0.8mm

Flash/ RAM/ Package Table

RTK7EKA6M3S00001BU

Part #	Flash Memory	RAM	Temp	Package
R7FA6M3AH3CFC#AA0	2MB	640KB	40~105℃	176 LQFP
R7FA6M3AF3CFC#AA0	1MB	640KB	40~105℃	176 LQFP

BIG IDEAS FOR EVERY SPACE
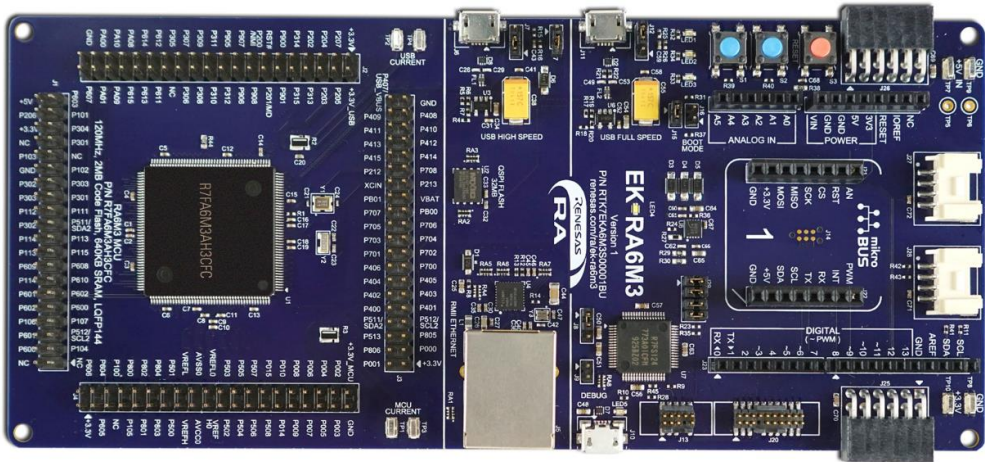
RENESAS

RENESAS QUICK-CONNECT IOT PLATFORM

THIRD PARTY DA16200 SHIELDS: SPARKFUN ARDUINO WIFI SHIELD DA16200

Connection to the DA16200MOD
- UART to GPIOA4/5 (UART1)
- SPI to GPIOA0/1/2/3 (SPI1)
- I2C to GPIOA8/9
- PWR_KEY signal
- WAKE_UP pin to wake-up DA16200
- INT pin (GPIOA11) to wake-up host
- Factory Reset button (GPIOA7)
- GPIOA7 also connected to Arduino D7
- Arduino Reset button
- Jumper to measure current
- Extra Headers for GPIOC6/7/8-A0/1/2/3/6/10/WK2
- Solder jumper to switch Arduino or Extra Headers
- PWM out (GPIOA10)
- JTAG 10-pin 1.27mm connector
- UART0 (UART_TXD/RXD) console connector
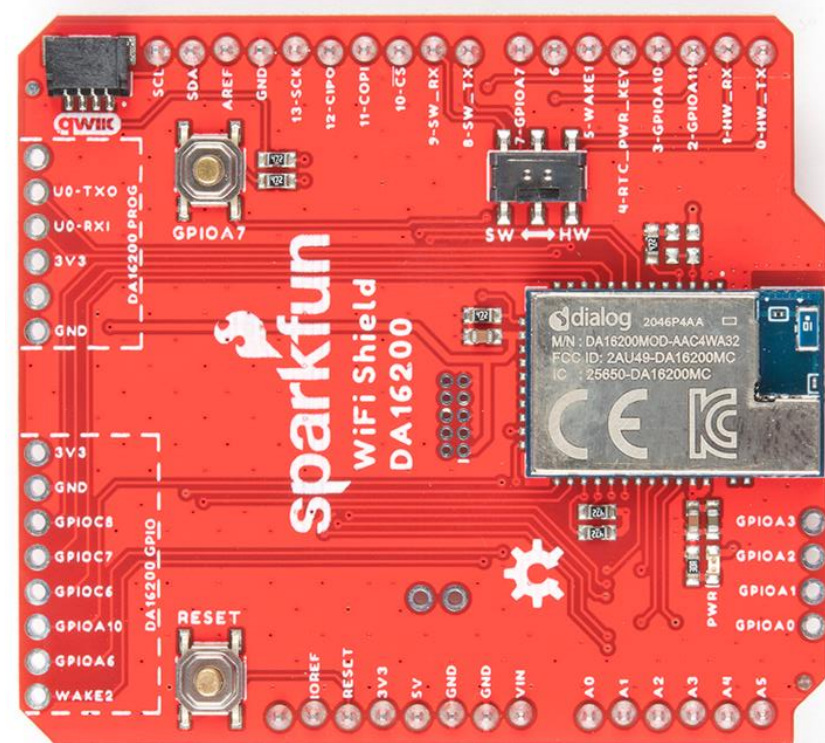
Additional resources
- Qwiic I2C header
- UART1 HW/SW switch

[SparkFun Qwiic WiFi Shield - DA16200 - WRL-18567](#)

BIG IDEAS FOR EVERY SPACE

HS300X – RELATIVE HUMIDITY AND TEMPERATURE SENSOR
HIGH ACCURACY HUMIDITY AND TEMPERATURE MEASUREMENT FOR ENVIRONMENTAL MONITORING

High Accuracy

- ±1.5%RH accuracy (HS3001)
- ±0.2°C temperature accuracy (HS3001, HS3002)

Excellent Stability

- 0.1%RH per year drift
- MEMS silicon-carbide sensor technology

Fast Response

- Less than 6 seconds humidity response time constant, in still air
- Less than 2 seconds temperature response time constant

Extended Supply Voltage

- 2.3V to 5.5V, 24.4µA at 3.3V (one RH+Temp per second)
- 1.8V custom order

Part #	Feature	Package
HS3001	±1.5%RH	3×2.41×0.8 LGA
HS3002	±1.8%RH	3×2.41×0.8 LGA
HS3003	±2.5%RH	3×2.41×0.8 LGA
HS3004	±3.5%RH	3×2.41×0.8 LGA

R_P = Pull-up resistor (2.2kΩ typical)
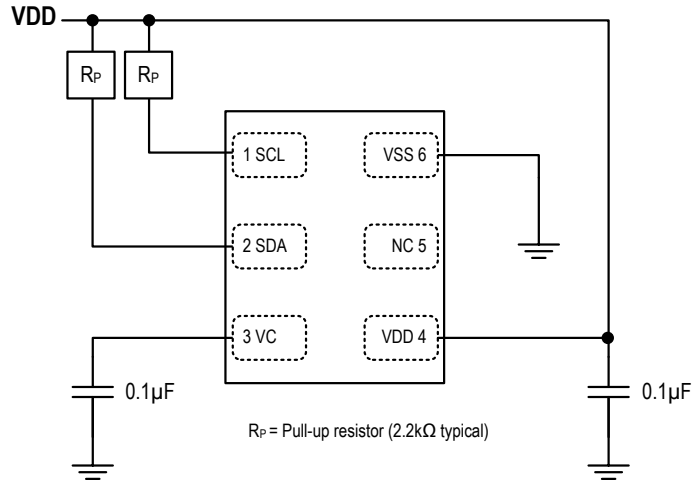
Typical Operating Circuit
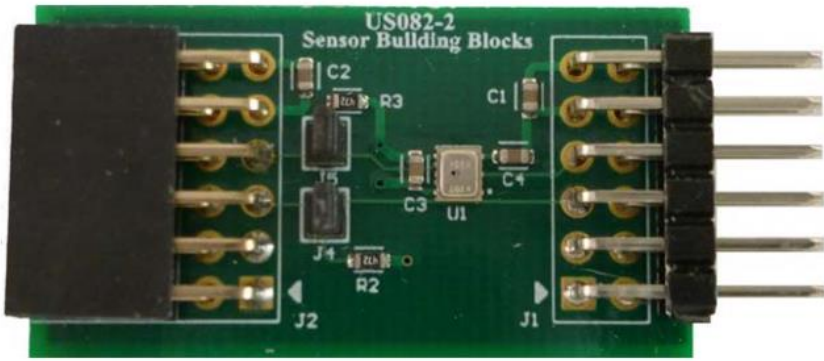
US082-HS3001EVZ Pmod Board

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ZMOD4410 – INDOOR AIR QUALITY SENSOR PLATFORM
TVOC SENSOR FOR INDOOR AIR QUALITY APPLICATION

Flexible Measure Target:

- Measurement of total organic compounds (TVOC)
- Concentrations and indoor air quality (IAQ)
- Module algorithm estimates carbon dioxide level (eCO2)
- Algorithm to set a control signal to trigger an external action based on IAQ and odor change
- Configurable alarm/interrupt output with static and adaptive Levels

Easy to Use:

- ZMOD4410 Evaluation Kit
- Manuals, application notes, blog, and white papers
- Instructional videos
- Programming libraries, example codes, and
- Algorithm support to optimize performance
- Third-party certification for compliance with well-accepted international IAQ standards

Part #	Version	Operation Condition	Package
ZMOD4410AI1V ZMOD4410AI1R	Standard	1.7-3.6V -40° to +65° Est. CO2 400-5000ppm Ethanol in air 0-1000ppm	3.0 × 3.0 × 0.7mm, 12-LGA
ZMOD4410AI2V ZMOD4410AI2R	Sticker		
ZMOD4410AI3V ZMOD4410AI3R	Waterproof		
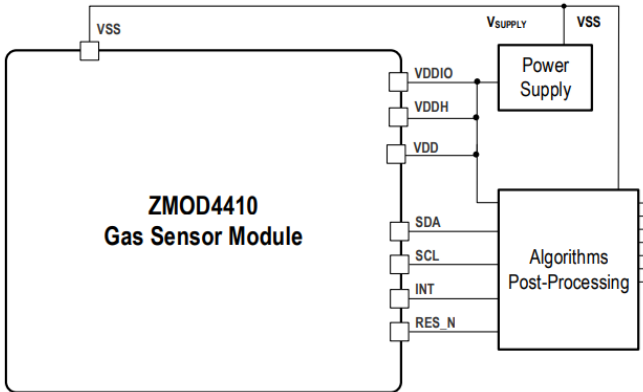
ZMOD4410 typical application
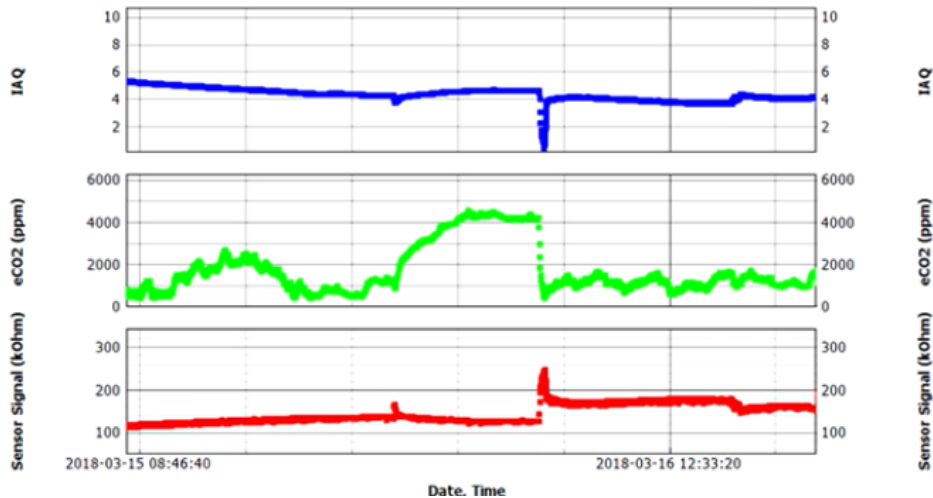
Measuring IAQ and Est CO2 level with ZMOS4410

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EXAMPLE FEATURES

SmartCTherm is a smart IoT sensor node solution that can monitor indoor climate conditions, including temperature, humidity, indoor air quality, and the presence of Total Volatile Organic Compounds (TVOC), and send the collected data to the Cloud. It is designed around the following three key points:
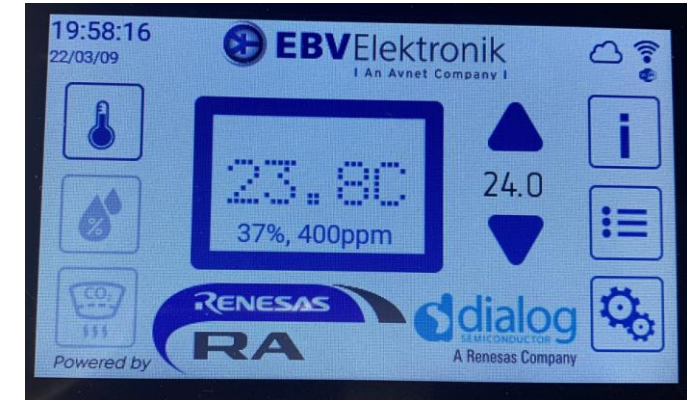
Everywhere: One of its key features is its ability to connect to the Cloud - from everywhere.
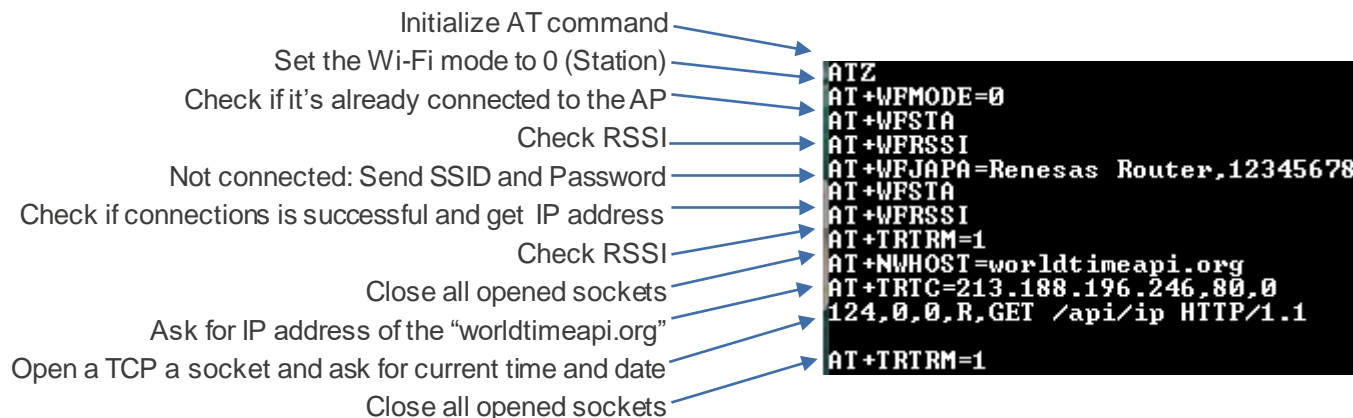
- This is possible thanks to the Wifi Shield with **DA16200MOD**

Bring value: By utilizing the advanced **RA6M3** MCU, SmartCTherm is well capable of processing the raw data on its own.

- With enough horsepower to perform the most demanding tasks, this Arm® Cortex®-M4 based MCU platform can be used not only to collect raw data, but also to perform different kinds of complex data analysis.

Visualize: Humans, as mostly visual beings, process visual data representation much more efficiently.

- Appealing **GUIs** can be easily generate with the graphic libraries and tools provided by Renesas RA6M3G platform Combining a sizeable capacitive-touch display and the powerful RA6M3 MCU, SmartCTherm delivers a very crisp and fluid visual experience for the best user experience.

BIG IDEAS FOR EVERY SPACE

AT CMD SEQUENCE TO SET CLOUD 1/2

Initialize AT command

Set the Wi-Fi mode to 0 (Station)

Check if it's already connected to the AP

Check RSSI

Not connected: Send SSID and Password

Check if connections is successful and get IP address

Check RSSI

Close all opened sockets

Ask for IP address of the "worldtimeapi.org"

Open a TCP a socket and ask for current time and date

Close all opened sockets

```
ATZ
AT+WFMODE=0
AT+WFSTA
AT+WFRSSI
AT+WFJAPA=Renesas Router,12345678
AT+WFSTA
AT+WFRSSI
AT+TRTRM=1
AT+NWHOST=worldtimeapi.org
AT+TRTC=213.188.196.246,80,0
124,0,0,R,GET /api/ip HTTP/1.1

AT+TRTRM=1
```

```
+INIT:DONE,0

+ATPROV=STATUS 0

OK

Display result on
                Echo off
OK

OK

+WFSTA:0
OK

+RSSI:NOT_CONN

ERROR:-7

OK

+WFJAP:1,'Renesas Router',192.168.137.54

OK

+WFSTA:1
OK

+RSSI:-42

OK

ERROR:-99

+NWHOST:213.188.196.246
OK

+TRDTC:1,213.188.196.246,80,974,HTTP/1.1 200 OK
```

Response from "worldtimeapi.org"

```
{"abbreviation":"CET","client_ip":"151.20.20.189","datetime":"2022-03-09T23:22:5
8.725047+01:00","day_of_week":3,"day_of_year":68,"dst":false,"dst_from":null,"ds
t_offset":0,"dst_until":null,"raw_offset":3600,"timezone":"Europe/Rome","unixtim
e":1646864578,"utc_datetime":"2022-03-09T22:22:58.725047+00:00","utc_offset":"+0
1:00","week_number":10}

OK
```

BIG IDEAS FOR EVERY SPACE

RENESAS

AT CMD SEQUENCE TO SET CLOUD 2/2

Set the IP address and the port number of the MQTT Broker
Set the MQTT QoS level - 0 (at most once)
MQTT login information
Set the MQTT Client ID
Check the result of the MQTT client connection
Check if wifi still connected
Publish T/H/eCO2 and rsssi to the topic "air_value"

```
AT+NWMQBR=192.168.137.1,1883
AT+NWMQQOS=0
AT+NWMQLI=admin,Renesas
AT+NWMQCID='DA16200-client'
AT+NWMQCL=1
AT+WFSTA
AT+WFRSSI
AT+NWMQMSG=T:23.6℃ H:42.9% eCO2:0ppm rssi:-41dBm,air_value

AT+NWMQMSG=T:23.6℃ H:42.8% eCO2:0ppm rssi:-41dBm,air_value

AT+NWMQMSG=T:23.6℃ H:42.8% eCO2:0ppm rssi:-41dBm,air_value

AT+NWMQMSG=T:23.6℃ H:42.9% eCO2:0ppm rssi:-41dBm,air_value

AT+NWMQMSG=T:23.6℃ H:42.8% eCO2:0ppm rssi:-41dBm,air_value

AT+NWMQMSG=T:23.6℃ H:42.8% eCO2:0ppm rssi:-41dBm,air_value

AT+WFSTA
AT+WFRSSI
AT+NWMQMSG=T:23.6℃ H:42.9% eCO2:0ppm rssi:-44dBm,air_value
```

```
OK
OK
OK
OK
OK
+NWMQCL:1
+WFSTA:1
OK
+RSSI:-41
OK
OK
OK
OK
OK
+WFSTA:1
OK
+RSSI:-44
OK
```

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RENESAS

MOSQUITTO BROKER AND MQTT CLIENT


```
PS C:\Program Files\mosquitto> .\mosquitto -c .\mosquitto.conf -v
1646863904: mosquitto version 2.0.14 starting
1646863904: Config loaded from .\mosquitto.conf.
1646863904: Opening ipv6 listen socket on port 1883.
1646863904: Opening ipv4 listen socket on port 1883.
1646863904: mosquitto version 2.0.14 running
1646863906: New connection from 192.168.137.54:31526 on port 1883.
1646863906: New client connected from 192.168.137.54:31526 as DA16200-client (p1, c1, k600, u'admin').
1646863906: No will message specified.
1646863906: Sending CONNACK to DA16200-client (0, 0)
1646863916: New client connected from 192.168.137.85:57967 as Paolo iPhone (p2, c1, k60, u'admin').
1646863916: No will message specified.
1646863916: Sending CONNACK to Paolo iPhone (0, 0)
1646863916: Received SUBSCRIBE from Paolo iPhone
1646863916:     air_value (QoS 0)
1646863916: Paolo iPhone 0 air_value
1646863916: Sending SUBACK to Paolo iPhone
1646864008: Received PUBLISH from DA16200-client (d0, q0, r0, m0, 'air_value', ... (39 bytes))
1646864008: Sending PUBLISH to Paolo iPhone (d0, q0, r0, m0, 'air_value', ... (39 bytes))
1646864019: Received PUBLISH from DA16200-client (d0, q0, r0, m0, 'air_value', ... (39 bytes))
1646864019: Sending PUBLISH to Paolo iPhone (d0, q0, r0, m0, 'air_value', ... (39 bytes))
1646864029: Received PUBLISH from DA16200-client (d0, q0, r0, m0, 'air_value', ... (39 bytes))
1646864029: Sending PUBLISH to Paolo iPhone (d0, q0, r0, m0, 'air_value', ... (39 bytes))
1646864036: Received PINGREQ from Paolo iPhone
1646864036: Sending PINGRESP to Paolo iPhone
```
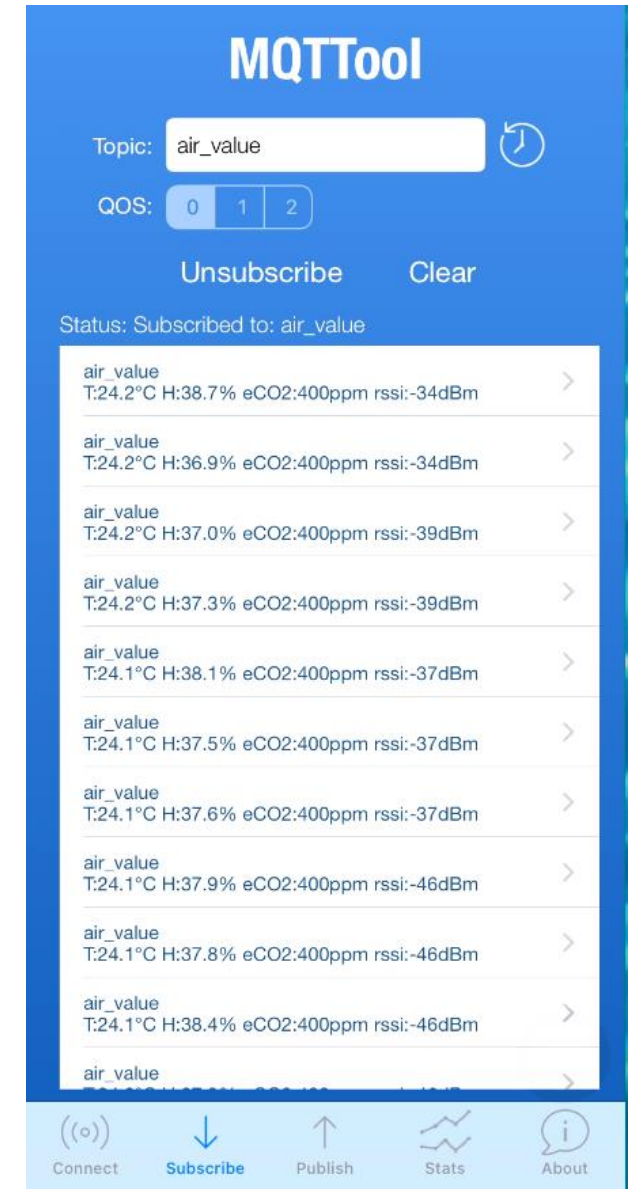
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RENESAS

LIVE DEMO

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AGENDA

- Renesas - Ultra-Low Power Wi-Fi introduction
- Renesas - Wi-Fi Ready2Go
- Renesas – Host MCU AT Command examples
- ARM presents – Arduino Sketch with DA16200 Wi-Fi Shield
- Q&A and Quiz

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Arduino - Ecosystem

Open-source electronics prototyping platform

- Used by **millions** of makers, hobbyists, artists, students, and engineers worldwide!

- Supports a broad set of official Arduino hardware and unofficial Arduino compatible hardware from 3rd parties
  - Hardware: boards and shields

- There are over **4600** open-source libraries developed by Arduino and the Arduino community

arm

Arm based Arduino boards

Highlights

- **Arduino Zero** released by Arduino team in 2015
  - Arm Cortex-M0+ processor running @ 48 MHz

- **SparkFun RedBoard Turbo** based on Arduino Zero design
  - Removed
    - On-board debugger
  - Added
    - RGB LED
    - LiPo battery connector
    - On-board external flash
    - **Qwiic connector**
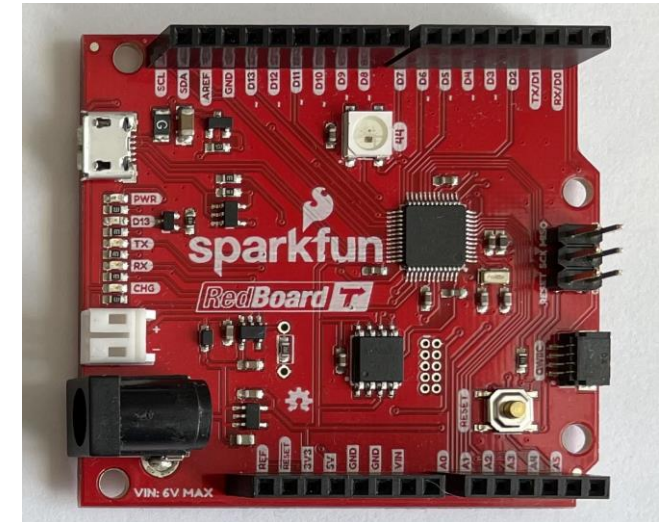
arm

DA16200 Wi-Fi Library for Arduino

Maps the Arduino Wi-Fi API the DA16200's AT command set

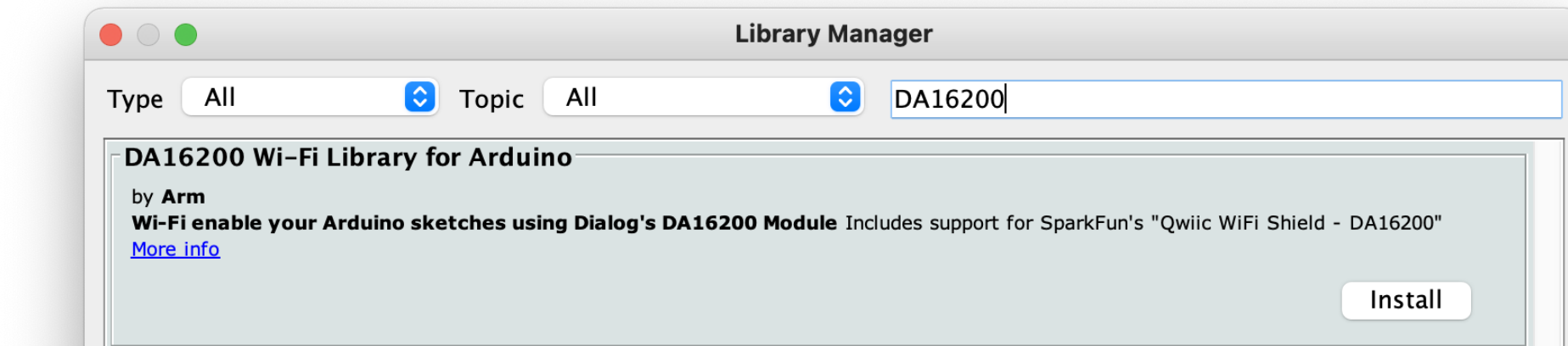https://github.com/ArmDeveloperEcosystem/DA16200-WiFi-Library-for-Arduino

DA16200 Wi-Fi Library for Arduino
Maps the Arduino Wi-Fi API the DA16200's AT command set

- **Included** in the Arduino IDE's library manager!
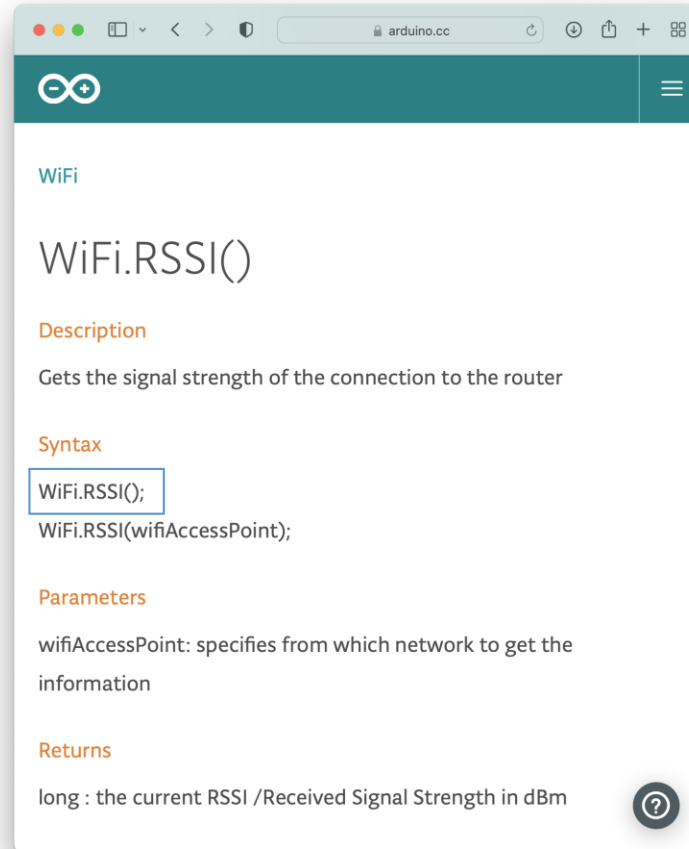 - Sketch -> Include Libraries -> Manage Libraries ...
  - Then search for "DA16200"

- **Supports** the SparkFun WiFi Shield DA16200!

arm

DA16200 Wi-Fi Library for Arduino

Maps the Arduino Wi-Fi API the DA16200's AT command set

arm

DA16200 Wi-Fi Library for Arduino

Maps the Arduino Wi-Fi API the DA16200's AT command set

Host Board   Shield

`long rssi = WiFi.RSSI();`


```
AT+WFRSSI
```

UART

```
+RSSI:-61

OK
```



```
// rssi variable now
// has value of -61
```

arm

DA16200 Wi-Fi Library for Arduino

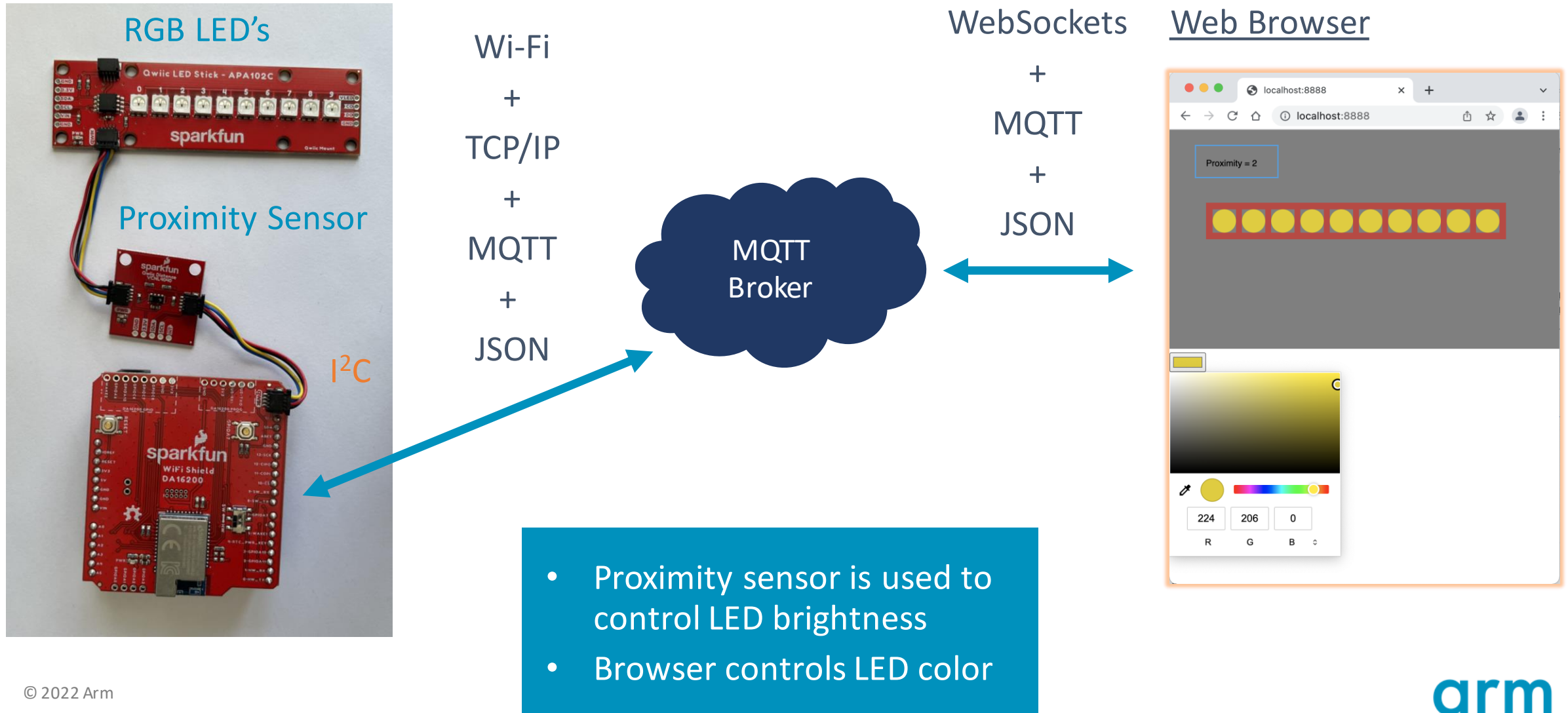Maps the Arduino Wi-Fi API the DA16200's AT command set

```cpp
int32_t WiFiClass::RSSI()
{
  int rssi = 0;

  if (this->AT("+WFRSSI") == 0 && _extendedResponse.startsWith("+RSSI:")) {
    sscanf(_extendedResponse.c_str(), "+RSSI:%d", &rssi);
  }

  return rssi;
}
```

arm
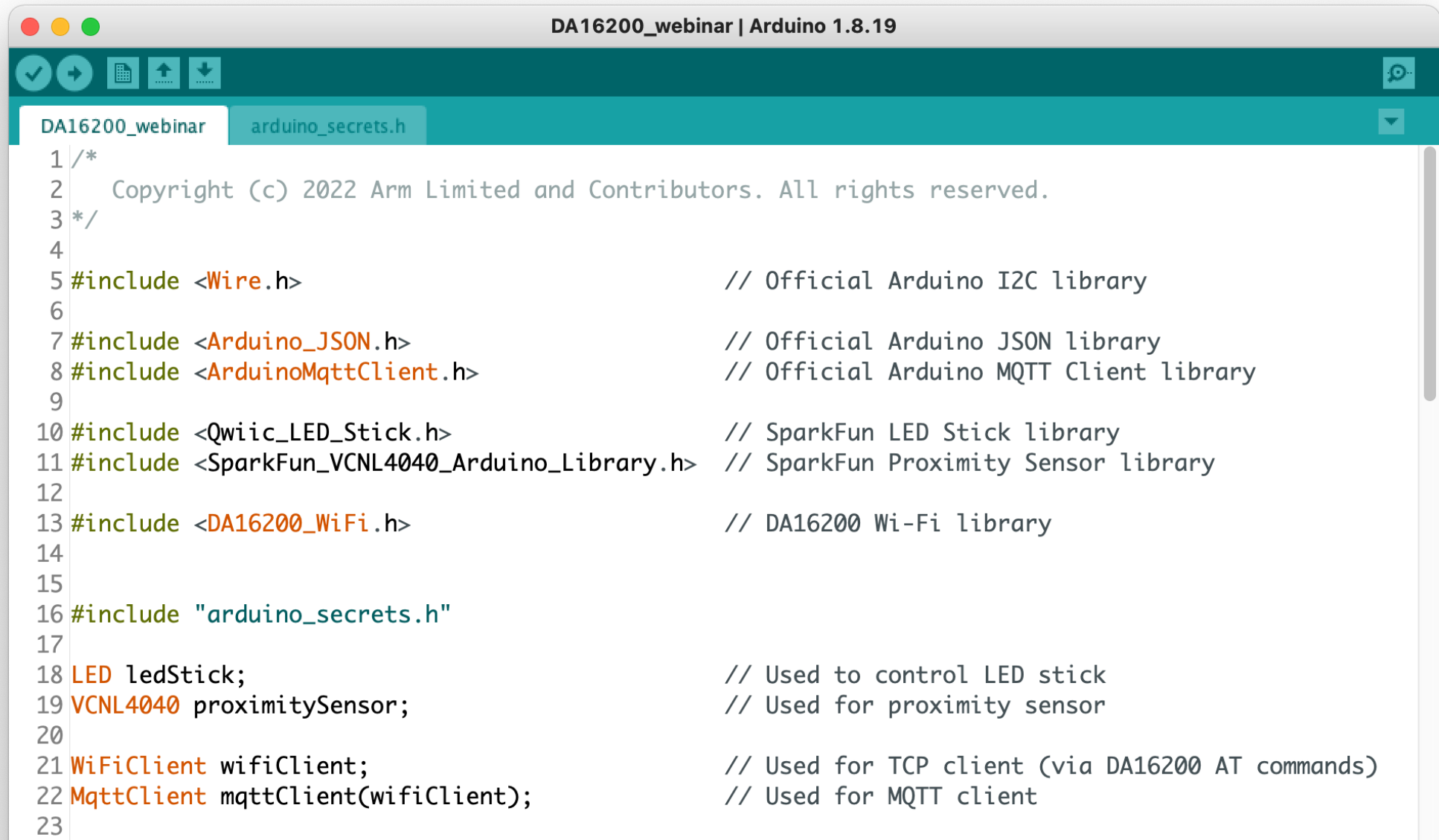
SparkFun "Qwiic" based Wi-Fi Demo
Digital Twin

RGB LED's

Proximity Sensor

I²C

Wi-Fi

+

TCP/IP

+

MQTT

+

JSON

MQTT
Broker

WebSockets

+

MQTT

+

JSON

Web Browser

- Proximity sensor is used to control LED brightness
- Browser controls LED color

© 2022 Arm

arm

SparkFun "Qwiic" based Wi-Fi Live Demo

Backup Code


```
DA16200_webinar | Arduino 1.8.19

DA16200_webinar    arduino_secrets.h

 1 /*
 2    Copyright (c) 2022 Arm Limited and Contributors. All rights reserved.
 3 */
 4
 5 #include <Wire.h>                                  // Official Arduino I2C library
 6
 7 #include <Arduino_JSON.h>                          // Official Arduino JSON library
 8 #include <ArduinoMqttClient.h>                     // Official Arduino MQTT Client library
 9
10 #include <Qwiic_LED_Stick.h>                       // SparkFun LED Stick library
11 #include <SparkFun_VCNL4040_Arduino_Library.h>     // SparkFun Proximity Sensor library
12
13 #include <DA16200_WiFi.h>                          // DA16200 Wi-Fi library
14
15
16 #include "arduino_secrets.h"
17
18 LED ledStick;                                      // Used to control LED stick
19 VCNL4040 proximitySensor;                          // Used for proximity sensor
20
21 WiFiClient wifiClient;                             // Used for TCP client (via DA16200 AT commands)
22 MqttClient mqttClient(wifiClient);                 // Used for MQTT client
23
```

arm

SparkFun "Qwiic" based Wi-Fi Live Demo
Backup video

arm
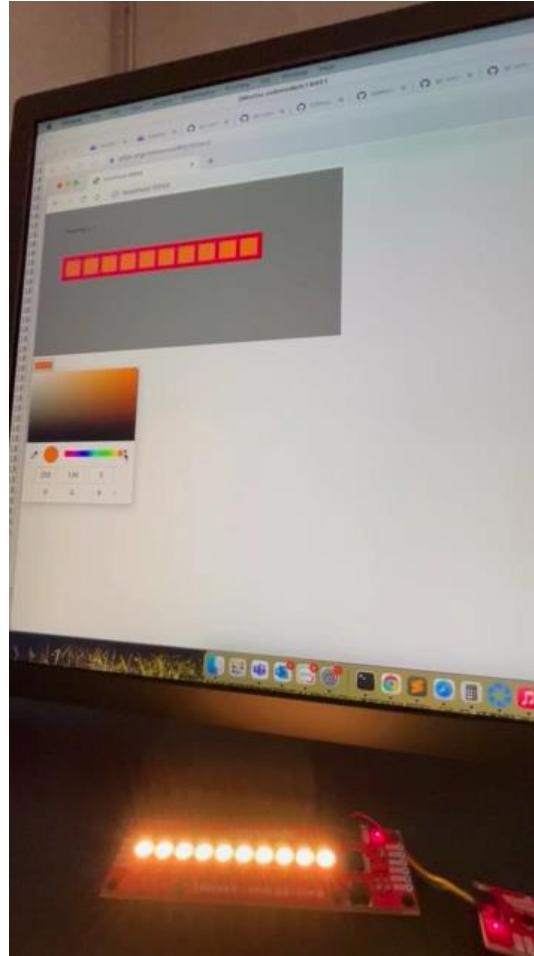
SparkFun "Qwiic" based Wi-Fi Demo
Code highlights - Arduino Libraries used

```
#include <Wire.h>                                // Official Arduino I2C library

#include <Arduino_JSON.h>                         // Official Arduino JSON library
#include <ArduinoMqttClient.h>                    // Official Arduino MQTT Client library



#include <Qwiic_LED_Stick.h>                      // SparkFun LED Stick library
#include <SparkFun_VCNL4040_Arduino_Library.h>    // SparkFun Proximity Sensor library



#include <DA16200_WiFi.h>                         // DA16200 Wi-Fi library
```

arm

SparkFun "Qwiic" based Wi-Fi Demo
Code highlights

```
LED        ledStick;                // Used to control LED stick
VCNL4040   proximitySensor;         // Used for proximity sensor



WiFiClient wifiClient;              // Used for TCP client (via DA16200 AT commands)
MqttClient mqttClient(wifiClient); // Used for MQTT client



// ...


ledStick.setLEDColor(r, g, b);


proximitySensor.getProximity();
```
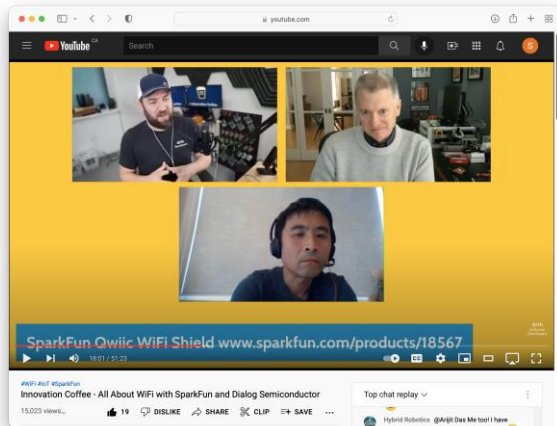
arm

Recap

+ Arm based Arduino compatible boards from SparkFun can be used with the Arduino IDE
  - This allows you to tap into broad set of open-source libraries from Arduino, SparkFun, and others
  - SparkFun has many Qwiic connector based sensors and actuators with accompanying libraries

+ SparkFun WiFi Shield DA16200 is now part of the Arduino library ecosystem
  - It can be used in your projects with other Arduino libraries

+ Learn more about the SparkFun WiFi Shield DA16200 on Arm's Innovation Coffee "All About WiFi with SparkFun and Dialog Semiconductor" episode (weekly live stream from Arm)

https://youtu.be/gn5wfFNjp4w

arm

Renesas.com

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