

# BLUETOOTH® CHIP DEVELOPMENT

## A WEARABLE EXAMPLE

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# AGENDA

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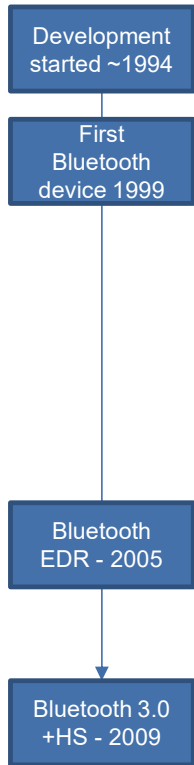
- Overview Bluetooth®
- SmartBond™ Bluetooth® LE Portfolio
- Bluetooth® chip development – an example DA1470x

# OVERVIEW

BLUETOOTH®



The global standard for simple, secure device communication and positioning



### Bluetooth® Classic

**Solution Areas**

AUDIO STREAMING      DATA TRANSFER

**Device Communication**

POINT-TO-POINT

**Basic Rate/Enhanced Data Rate Radio**

2.402-2.480 GHz ISM

SPECTRUM: 2.4 GHz ISM band  
 CHANNELS: 79 one MHz channel with Adaptive Frequency Hopping  
 BIT RATES: 1 Mb/s, 2 Mb/s, 3 Mb/s

### Bluetooth® Low Energy

**Solution Areas**

AUDIO STREAMING (COMING)      DATA TRANSFER      LOCATION SERVICES      DEVICE NETWORKS

**Device Communication**

POINT-TO-POINT      BROADCAST      MESH

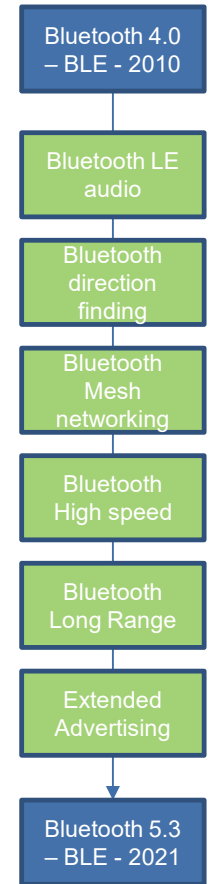
**Device Positioning**

PRESENCE      DISTANCE      DIRECTION

**Low Energy Radio**

2.402-2.480 GHz ISM

SPECTRUM: 2.4 GHz ISM band  
 CHANNELS: 40 two MHz channel with Adaptive Frequency Hopping  
 BIT RATES: 125 Kb/s, 500 Kb/s, 1 Mb/s, 2 Mb/s



Source: [bluetooth.com](https://www.bluetooth.com)

Source: [Wikipedia](https://en.wikipedia.org/wiki/Bluetooth)

# FUTURE ADVANCEMENTS

## Bluetooth® LE Audio

- Auracast™ broadcast audio

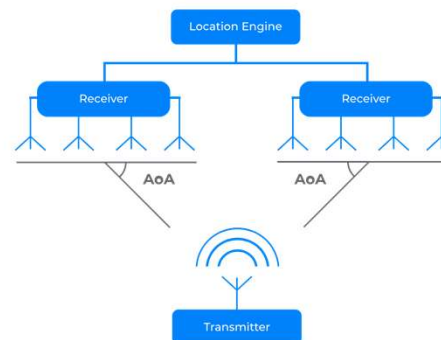


Auracast™ broadcast audio is a new Bluetooth® capability that will deliver life-changing audio experiences. It will let you share your audio, unmute your world, and hear your best, enhancing the way you engage with others and the world around you.

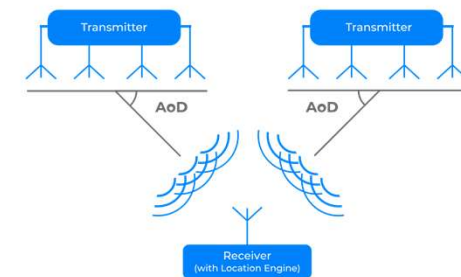
## Bluetooth® Direction Finding

- Angle of Arrival (AoA)
  - Real Time Location Systems (RTLS)
- Angle of Departure (AoD)
  - Indoor Positioning Systems (IPS)
- Channel Sounding distance measurement

Angle of Arrival (AoA) Method



Angle of Departure (AoD) Method



# SMARTBOND™

BLUETOOTH® LOW ENERGY

# DIALOG'S FIRST BLE SOC @ISSCC2015

- Low Cost
- Low Power / High performance
- Small size / small BOM

## A 10mW Bluetooth Low-Energy Transceiver with On-Chip Matching

Jan Prummel, Michail Papamichail, Michele Ancis,  
John Willms, Rahul Todi, William Aartsen,  
Wim Kruiskamp, Johan Haanstra, Enno Opbroek,  
Søren Rievers, Peter Seesink, Harrie Woering,  
Chris Smit

Dialog Semiconductor  
's-Hertogenbosch – The Netherlands

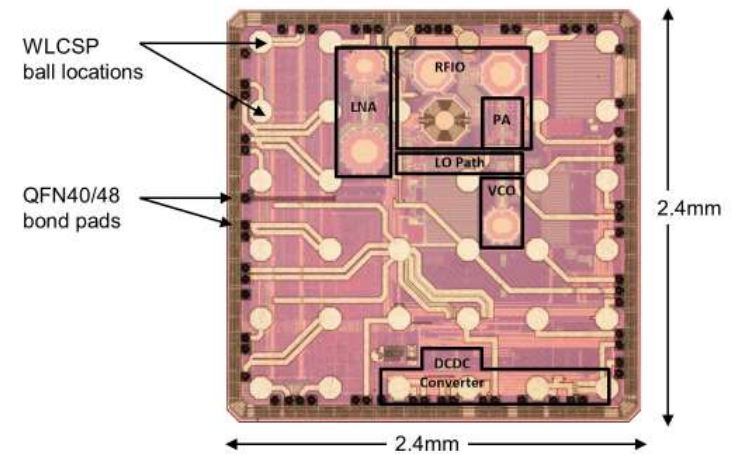


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13.3: A 10mW Bluetooth Low-Energy Transceiver with On-Chip Matching

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## Die Micrograph



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13.3: A 10mW Bluetooth Low-Energy Transceiver with On-Chip Matching

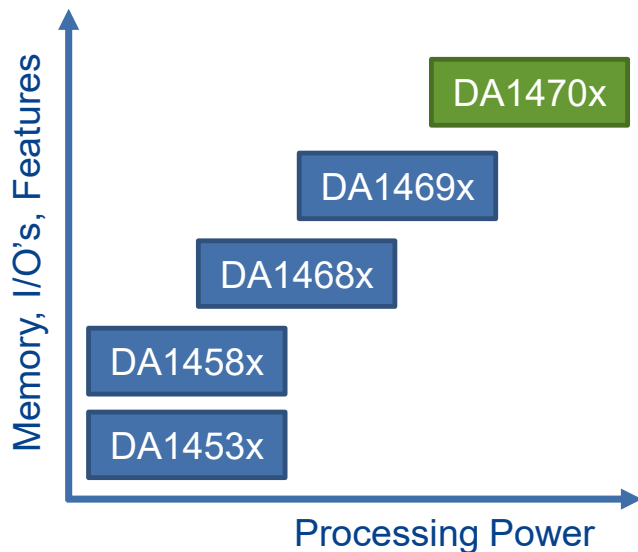
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# SMARTBOND™ BLUETOOTH® LE PORTFOLIO



Portfolio spanning from lowest cost to highly integrated wireless application processor

- **Highest integration level:** PMU, security, voice, display controller, haptics and charger
- **Mature Bluetooth protocol stack:** proven in millions of customer products



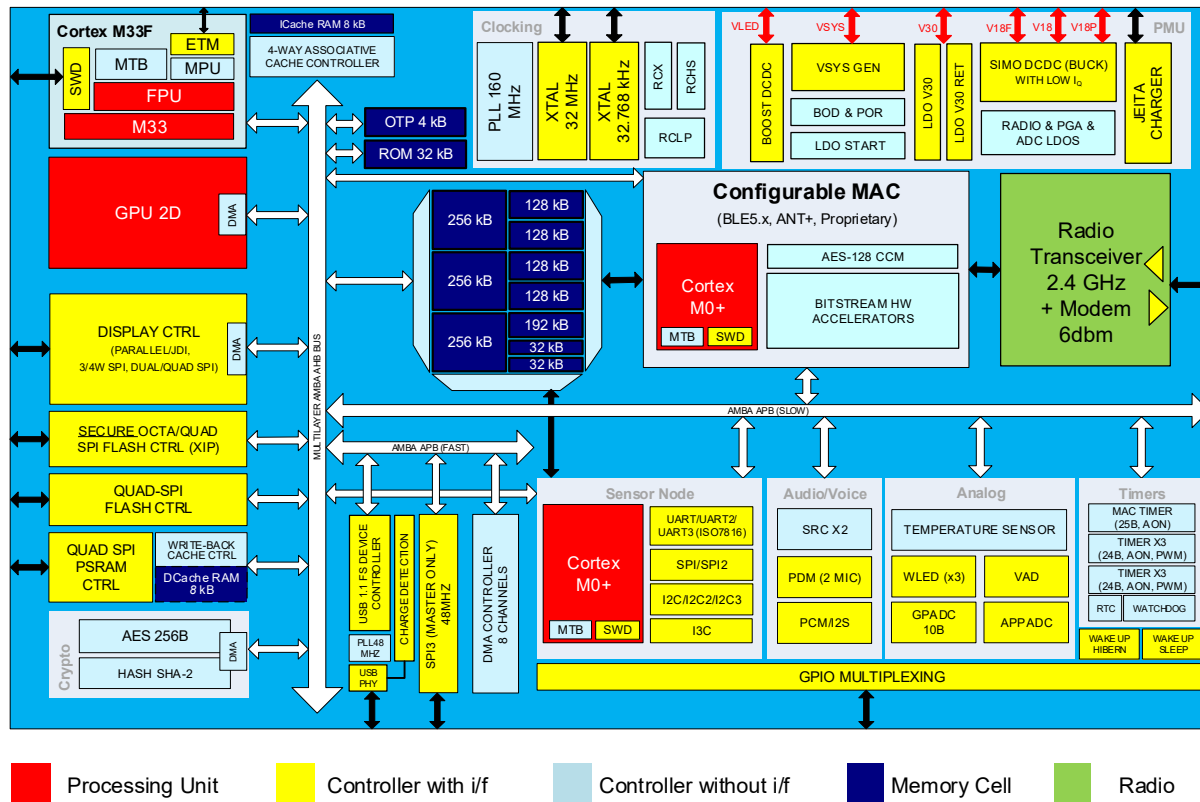
- **DA1470x:** Highly Advanced Wireless MCU/SoC with, 2D Graphics processor, Voice Activity Detector (VAD) and PMU
- **DA1469x:** Multi-core wireless MCU/SoC with integrated PMU, charger, display controller
- **DA1468x:** Bluetooth LE SoC with on-chip battery charger and security accelerators
- **DA1458x:** Cost and power efficient, general purpose Bluetooth LE SoC
- **DA1453x TINY™:** World's most compact, lowest cost, lowest power Bluetooth LE IC

Roadmap driving towards lowest power consumption and lowest system cost



# DA1470X

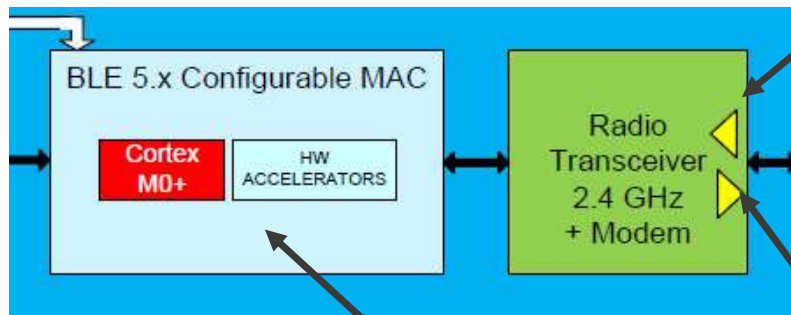
# DA1470X BLOCK DIAGRAM



- ✓ Application Cortex-M33 and 4-way 8K cache with MTB and ETM running at 32/64/96/160 MHz
- ✓ 2D GPU running at M33 speed
- ✓ SNC Cortex M0+ running at 32MHz
- ✓ CMAC Cortex M0+ running at 32MHz
- ✓ Shared system 1.5 MB retainable RAM
- ✓ Secure Octa/Quad SPI FLASH controller for XIP
- ✓ Quad-SPI PSRAM
- ✓ Voice Activity Detection with <30 uA while sleeping
- ✓ Single/Dual/Quad SPI, and Parallel interface supported for external displays
- ✓ Low I<sub>Q</sub> DCDC SIMO Converter supplying external components
- ✓ Boost DCDC converter (4.5-5V)
- ✓ Enhanced JEITA battery charger with 720mA max charge current
- ✓ Rich set of Analog & Digital Peripheral

# DA1470X WIRELESS CONNECTIVITY

Future-Proof your design investment  
Deliver best-in-class products



## Maximize range

- Output power up to +6 dBm
- Receive sensitivity of -97 dBm

## Trade-off power for range

- Configurable transmit output power up to +6 dBm in steps of 0.8 dBm

## Low system Bill of Materials

- Single wire antenna
- No RF matching or RX/TX switching required

## Future proof protocol engine

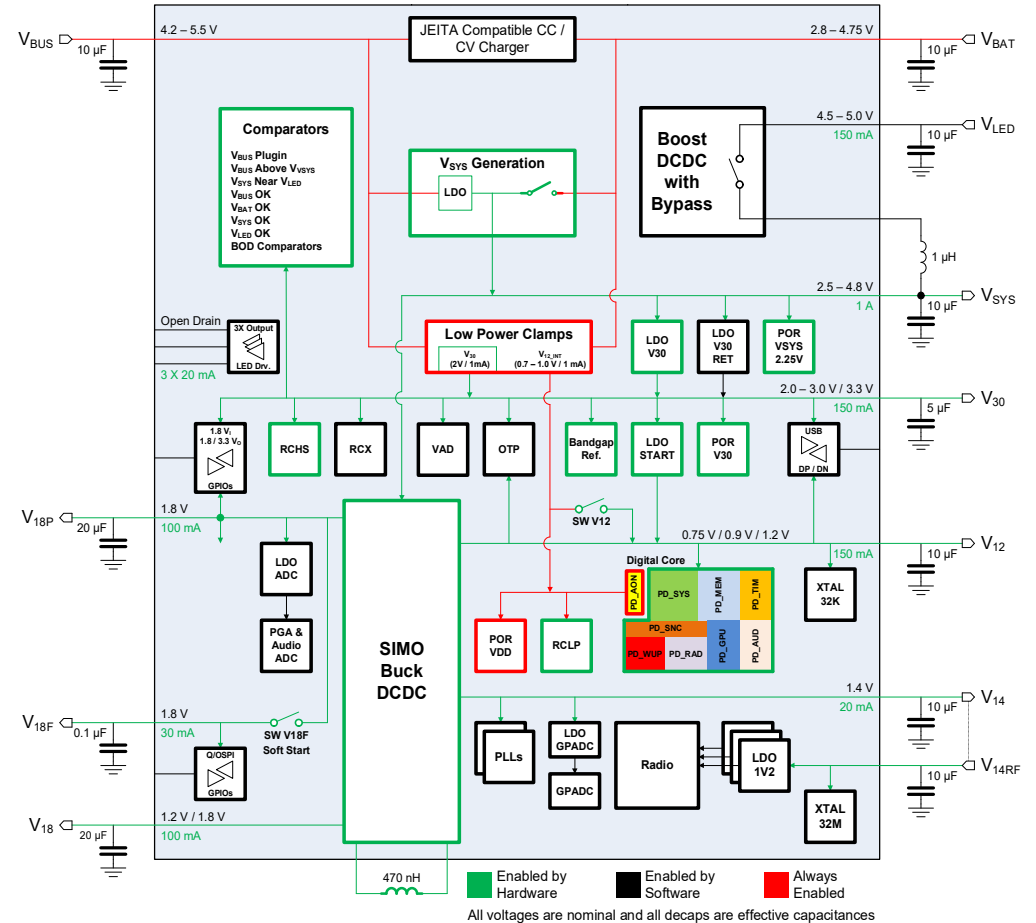
- SW programmable
- Bluetooth low energy 5.2 and beyond
- Proprietary protocols

## Ultra low power RF

- Supply current at VBAT3V with ideal DC-DC:
- TX: 3.0 mA @ 0 dBm output power
- RX: 1.85 mA @ -97 dBm sensitivity

# POWER MANAGEMENT UNIT

- Hardware charger (up 720 mA) with programmable curves and JEITA support.
- Integrate Power path management. V<sub>SYS</sub> rail for external loads.
- Boost DCDC 4.5V-5V, 150mA
- Buck SIMO DCDC, always active
  - Quiescent Current ( $I_Q$ ) < 1uA
  - Typical efficiency is 80%
- Four power supply pins for external devices
- Very low Hibernation Current of around 200 nA.



# SECURE APPLICATION AND COMMUNICATION

Prevent unwanted key access

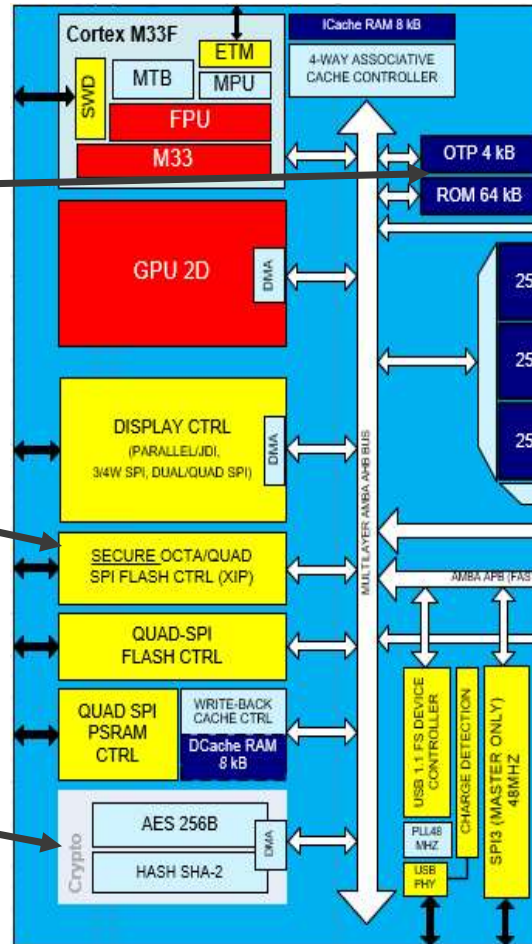
- Dedicated OTP secure key storage
- HW-based secure key management
- Access from serial ports or application processor is blocked

Secure your IP

- Encrypted application code and data in Flash
- On-the-fly code decryption
- Secure bootloader

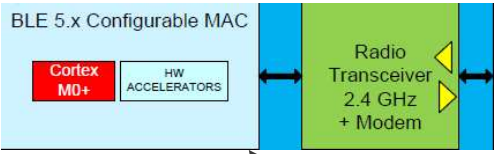
Low power cryptography

- Dedicated HW crypto engine
- FIPS140-2 compliant



Protect your IP  
Secure your users' data

- Image authentication
- Secure key handling
- End-to-end encryption

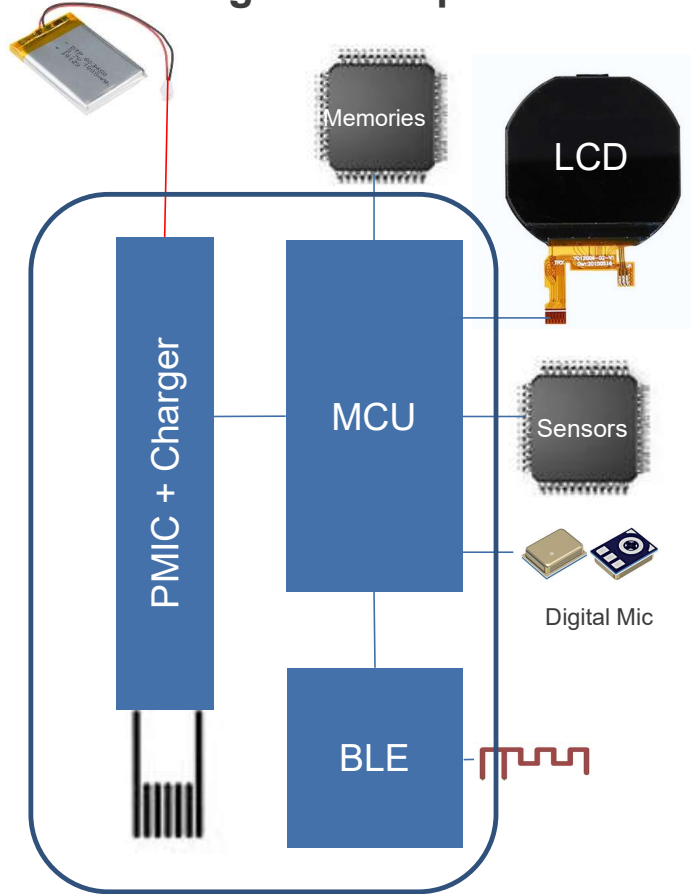


Secure data link

- Dedicated Bluetooth link crypto engine

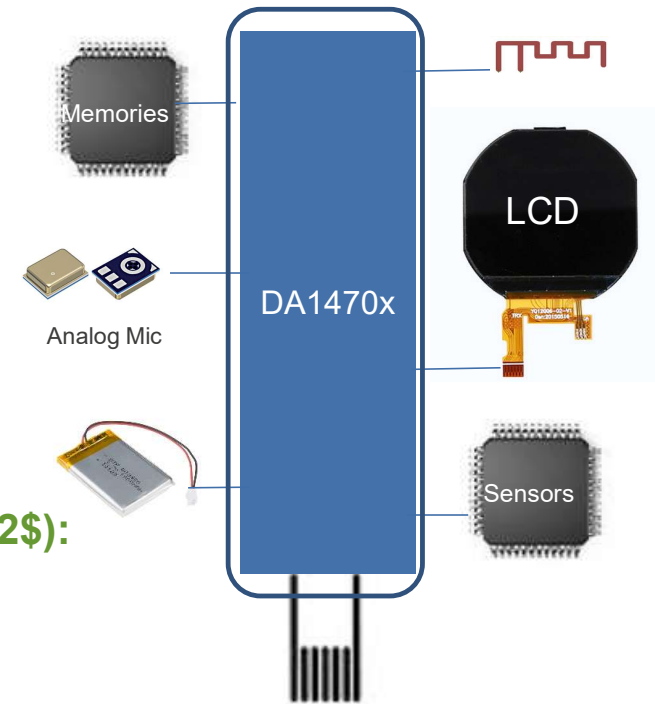
# VALUE PROPOSITION

## Block Diagram Competition



- **Smaller PCB size;**
- **Easier system design;**
- **Total BOM Cost savings (1-2\$):**
  - **Up to 3 chips;**
  - **Passives**

## Block Diagram Renesas



# DA1470X FAMILY AND TARGET APPLICATIONS

# DA1470X EXAMPLE APPLICATIONS



Smart Home Appliances with displays



Medical Readers



Bands and Watches

As a  
co-processor /  
Sensor Hub

Along with High End  
Application Processor



Bluetooth® Consoles (Example: E-bike, Exercise Equipment)



Mobile POS & HMI Terminals

and more.....



# HARDWARE DEVELOPMENT KIT: PRO KIT OVERVIEW

Easy to use  
Expandable functionality  
Application power insights

DA1470x daughterboard (DA14706/8)

- Swappable boards
- RF antenna
- RF port for RF characterization

Understand your application's power profile

- On-board current measurement

Easy prototyping, programming & debugging

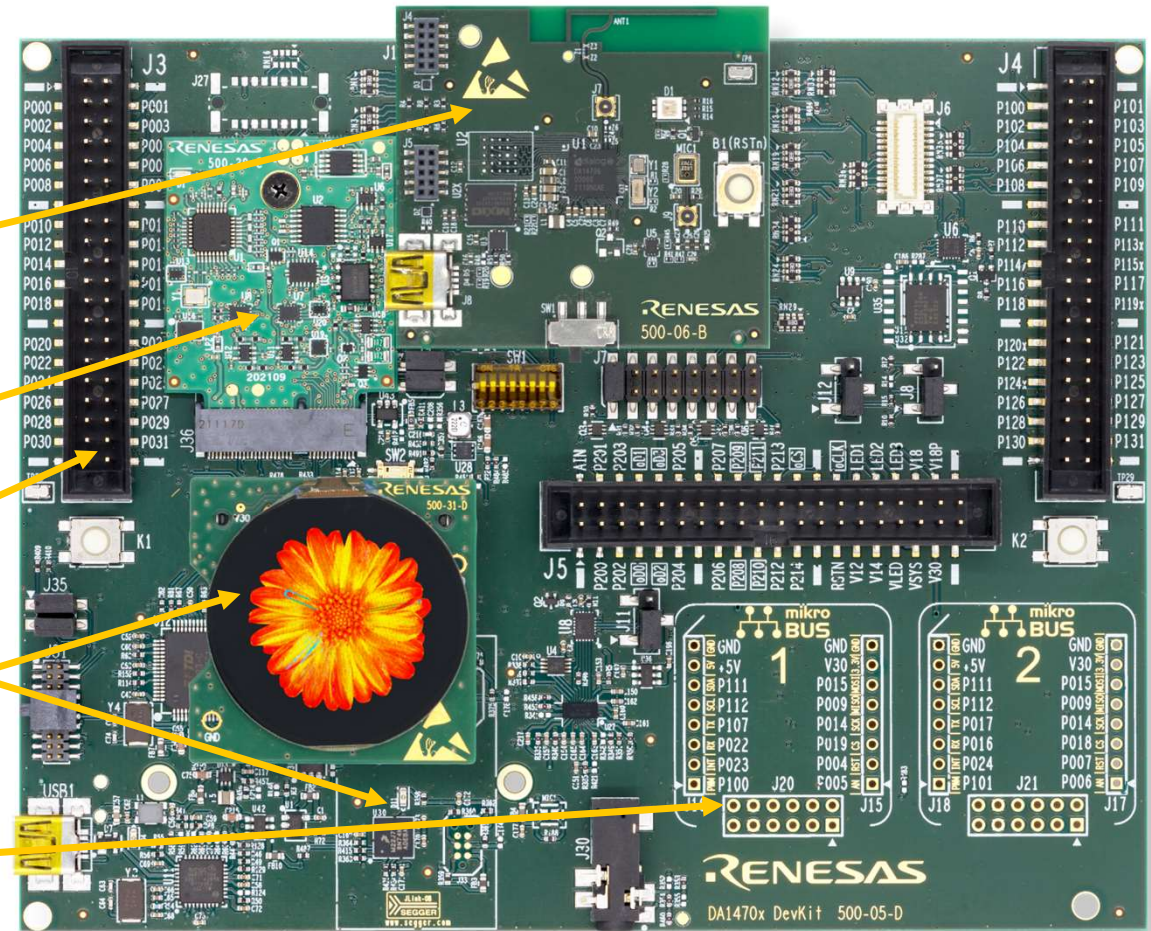
- Access to all GPIOs
- Segger J-link on motherboard

1.19 inch 390X390 QSPI Display Unit Board

- For GFX development

Support for leading shield ecosystems

- 2x mikroBUS™ headers
- 2 PMOD interfaces



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Renesas.com