

# **AW-CU640-P , AW-CU640-E**

**IEEE802.11 a/b/g/n/ac/ax and Bluetooth LE 5.4  
LGA Module**

## **Datasheet**

**Rev. B**

**DF**

**(For Standard)**

**Features**

**MCU**

- ◆ Cortex®-M33 192 MHz runs Wi-Fi and networking stacks.
- ◆ On-chip memory has 2048-KB ROM and 768-KB RAM.
- ◆ User available code size support ~300 KB of 768 KB RAM.
- ◆ Option to boot and XIP from flash with on-the-fly AES encryption.
- ◆ ModusToolbox™ supporting ThreadX RTOS.
- ◆ TCP/IP (NetXDuo), TLS 1.3 (NetXSecure), HTTP(S), MQTT support.
- ◆ 40 Mbps throughput with TCP/IP, TLS over SDIO.
- ◆ 20 Mbps throughput with TCP/IP, TLS over gSPI.
- ◆ 4 Mbps throughput with TCP/IP, TLS over SCB UART.

## Wi-Fi

- ◆ IEEE 802.11a/b/g/n/ac/ax compliant
- ◆ Tri-band (2.4 GHz/5~7 GHz)
- ◆ 1x1 with 20 MHz channels supporting PHY data rates up to 802.11ax (MCS11 1024-QAM 5/6)
- ◆ Transmit (TX) power with internal PA
  - 2.4 GHz: +TBD dBm 1 Mbps DSSS
  - 5 GHz: +TBD dBm 6 Mbps OFDM
  - 6 GHz: +TBD dBm MCS0
- ◆ Sensitivity with internal LNA
  - 2.4 GHz: TBD dBm 1 Mbps DSSS
  - 5 GHz: TBD dBm MCS0

- 6 GHz: +TBD dBm MCS0
- ◆ Wi-Fi 6 release features
  - OFDMA uplink and downlink as STA
  - Downlink multi-user MIMO as STA
  - Individual target-wake-time (TWT)
  - BSS color
- ◆ Support for switched antenna diversity.
- ◆ Interface
  - SDIO and UART shared between Wi-Fi and Bluetooth®
- ◆ Mode support:
  - STA
  - SoftAP
  - Wi-Fi Direct
- ◆ Security
- ◆ TKIP, WEP, WPA2(Personal/Enterprise), WPA3 (Personal/192b)

## Bluetooth

- ◆ Bluetooth® 5.4 (Bluetooth® Low Energy)
- ◆ Bluetooth® 5.0/5.1/5.2/5.3/5.4 features
  - LE long range
  - LE 2 Mbps
  - LE mesh
  - Advertising extensions
  - LE Isochronous Channels
- ◆ Bluetooth® LNA can be shared with WLAN LNA for reduced antenna count
- ◆ Dedicated Bluetooth® LNA for improved RF and coexistence performance
- ◆ +4, +13, and +19 dBm Bluetooth® PA paths optimized for best efficiency, output

power options adjustable in 4 dB steps

- ◆ Receive sensitivity: Bluetooth® LE 125 kbps TBD dBm
- ◆ Bluetooth® LE supported over SDIO shared with Wi-Fi - Four audio controllers available through two audio interfaces.
- ◆ TDM1, TDM2 supporting inter-IC sound (I2S) (2-channels) and PCM (8-channels), 8k to 96k sample rates, and 16- and 24-bit sample widths.
- ◆ Bidirectional PCM (TDM and I2S) with 8k, 16k sample rates and 16-bit sample width. Multiplexed with TDM2 through second audio interface.
- ◆ Single-direction I2S with 48k sample rates and 16-bit sample width. Multiplexed with TDM2 through second audio interface.

## Revision History

Document NO: R2-2640-DST-01

[illegible]

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## 1. Introduction

### 1.1 Product Overview

The AW-CU640 is a ultra-lower power, single-chip, connected MCUs that support 1x1 Wi-Fi 6E, Bluetooth® Low Energy 5.4, Matter, IP networking, with integrated PMU, targeted at Internet-of-Things (IoT) applications for stand-alone operation or to offload a host-processor. An integrated 192 MHz Arm® Cortex®-CM33, runs the Wi-Fi and Networking Stacks, Bluetooth® LE 5.4 and supports a wide array of peripherals. The Wi-Fi supports single stream, 1x1, Wi-Fi 6E (802.11ax), with PHY rates up to 1024 QAM (MCS11) over 20-MHz channels. Included on-chip are 2.4 GHz and 5-6 GHz transmit power amplifiers (PAs), and low-noise amplifiers (LNAs) for best-in-class RF performance. The AW-CU640 supports Tri-Band operation (2.4 GHz and 5-7 GHz).

The AW-CU640 supports Bluetooth® LE 5.4 with support for LE 1 Mbps, LE 2 Mbps, low-energy mesh, low-energy long range (LR), and advertising extensions. The device includes on-chip power amplifiers supporting three different output power paths optimized for best efficiency, 0 dBm, +13 dBm, and +19 dBm path for driving poor antennas in wearable devices or other applications that require longer range for Bluetooth® LE. The device also features a flexible Bluetooth® receiver offering a dedicated Bluetooth® path or a Bluetooth® receive path that can be shared (sLNA) with the 2.4-GHz WLAN receive path.

The integrated Arm® Cortex®-CM33 can operate up to 192 MHz, supporting 2048 KB of ROM, 768 KB of SRAM, running Wi-Fi and networking stacks utilizing ThreadX RTOS, NetX Duo TCP/IP network stack and NetX Secure for TLS 1.3 with Arm® Trustzone CryptoCell312. +300 KB of on-chip SRAM is available for customer application code, with optional XIP from external flash with on-the-fly encryption over SMIF if more application space is required. The device is capable to support > 40 Mbps of throughput over SDIO, >20 Mbps over GSPI, or > 4 Mbps over SPI running all Wi-Fi and Networking stacks. The device also supports three Serial Control Blocks (SCB) which each SCB supporting I2C/SPI/UART, 9x TCPWM blocks, PDM interface for digital microphone support, 12-bit ADC with seven channel mux input for analog microphone support or seven channels of DC sensing. A pair of time-division multiplexing (TDM) interfaces enables a flexible interface for various audio use cases and a PDM interface is available for connecting digital microphones. AW-CU640 does not support Bluetooth® LE Audio. See the AW-CU640 for devices requiring Bluetooth® BR/EDR and Bluetooth® LE Audio support. A 4-wire UART or SDIO (shared with Wi-Fi) interface is available for interfacing with the host processor.

The AW-CU640 also includes a power management unit (PMU) and requires a 37.4 MHz crystal which provides the system reference clock and can operate from an internal high-accuracy (~1%) and external 32.76 kHz crystal (eLPO) for higher accuracy from an external reference clock. The AW-CU640 includes advanced coexistence hardware mechanisms and algorithms which ensure WLAN and Bluetooth® LE simultaneous operation is optimized for maximum performance. In addition, coexistence support is available for external radios such as (LTE, GPS, and ZigBee) via an external interface. The AW-CU640 operates over -40~+85degC temperature range.

## 1.2 Block Diagram

TBD

## 1.3 Specifications Table

### 1.3.1 General

| Features                   | Description                                                                                                                                                                  |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Product Description</b> | IEEE 802.11a/b/g/n/ac/ax Wi-Fi with Bluetooth Combo LGA Module                                                                                                               |
| <b>Major Chipset</b>       | Infineon CYW55913 (wlbga 143b)                                                                                                                                               |
| <b>Host Interface</b>      | MCU: SDIO/UART/PCM                                                                                                                                                           |
| <b>Dimension</b>           | 16mm(L)x 25mm(W) x 2.25 mm(H) (Typical)                                                                                                                                      |
| <b>Form factor</b>         | LGA, 81 pin                                                                                                                                                                  |
| <b>Antenna</b>             | 1T1R for Wi-Fi / BLE<br><br>ANT1 (Option1, Default): Printed Antenna for Wi-Fi / Bluetooth BLE<br>→ TX/RX<br>ANT2 (Option2): RF pad out for Wi-Fi / Bluetooth BLE<br>→ TX/RX |
| <b>Weight</b>              | 1.3g (Typical)                                                                                                                                                               |

### 1.3.2 WLAN

| Features                  | Description                                                                                                                                                                                                                                                                                                                     |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>WLAN Standard</b>      | IEEE 802.11a/b/g/n/ac/ax, Wi-Fi compliant                                                                                                                                                                                                                                                                                       |
| <b>Frequency Range</b>    | WLAN: 2.4 / 5 / 6 GHz Band                                                                                                                                                                                                                                                                                                      |
| <b>Modulation</b>         | DSSS<br>DBPSK(1Mbps), DQPSK(2Mbps), CCK(11/5.5Mbps)<br>OFDM<br>BPSK(9/6Mbps/MCS0), QPSK(18/12Mbps/MCS1~2),<br>16-QAM(36/24Mbps/MCS3~4), 64-QAM(72.2/54/48Mbps/MCS5~7),<br>256-QAM(MCS8~9), 1024-QAM(MCS10~11)                                                                                                                   |
| <b>Number of Channels</b> | <b>2.4GHz</b><br>■ USA, NORTH AMERICA, Canada and Taiwan – 1 ~ 11<br>■ China, Australia, Most European Countries – 1 ~ 13<br><br><b>5GHz</b><br>■ USA, EUROPE – 36, 40, 44, 48, 52, 56, 60, 64, 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 138, 140, 142, 144, 149, 153, 157, 161, 165<br><br><b>6GHz</b><br>■ CH1~CH233 |

|                                                           |                                  |     |     |     |      |
|-----------------------------------------------------------|----------------------------------|-----|-----|-----|------|
| <b>Output Power<sup>12</sup><br/>(Board Level Limit)*</b> | <b>2.4G</b>                      |     |     |     |      |
|                                                           |                                  | Min | Typ | Max | Unit |
|                                                           | 11b (11Mbps)<br>@EVM<35%         |     | TBD |     | dBm  |
|                                                           | 11g (54Mbps)<br>@EVM≤-25 dB      |     | TBD |     | dBm  |
|                                                           | 11n (HT20 MCS7)<br>@EVM≤-27 dB   |     | TBD |     | dBm  |
|                                                           | <b>5G</b>                        |     |     |     |      |
|                                                           |                                  | Min | Typ | Max | Unit |
|                                                           | 11a (54Mbps)<br>@EVM≤-25 dB      |     | TBD |     | dBm  |
|                                                           | 11n (HT20 MCS7)<br>@EVM≤-27 dB   |     | TBD |     | dBm  |
|                                                           | 11ac (VHT20 MCS8)<br>@EVM≤-30 dB |     | TBD |     | dBm  |
|                                                           | 11ax (HE20 MCS11)<br>@EVM≤-32 dB |     | TBD |     | dBm  |
|                                                           | <b>6G</b>                        |     |     |     |      |
|                                                           |                                  | Min | Typ | Max | Unit |
|                                                           | 11ax (HE20 MCS11)<br>@EVM≤-32 dB |     | TBD |     | dBm  |
| <b>Receiver Sensitivity</b>                               | <b>2.4G</b>                      |     |     |     |      |
|                                                           |                                  | Min | Typ | Max | Unit |
|                                                           | 11b (11Mbps)                     |     | TBD |     | dBm  |
|                                                           | 11g (54Mbps)                     |     | TBD |     | dBm  |
|                                                           | 11n (HT20 MCS7)                  |     | TBD |     | dBm  |
|                                                           | <b>5G</b>                        |     |     |     |      |
|                                                           |                                  | Min | Typ | Max | Unit |
|                                                           | 11a (54Mbps)                     |     | TBD |     | dBm  |
|                                                           | 11n (HT20 MCS7)                  |     | TBD |     | dBm  |
|                                                           | 11ac <sup>3</sup> (VHT20 MCS8)   |     | TBD |     | dBm  |
|                                                           | 11ax <sup>4</sup> (HE20 MCS11)   |     | TBD |     | dBm  |

<sup>1</sup> EVM Spec are under typical test conditions.

<sup>2</sup> Output Power means measurement power inside the range (Min and Max) with spectral mask and EVM compliance.

<sup>3</sup> Tested by BCC instead of LDPC.

<sup>4</sup> Tested by BCC instead of LDPC.

|                  |                                                                                                                                                                                                     |     |     |     |      |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|------|
|                  | <b>6G</b>                                                                                                                                                                                           |     |     |     |      |
|                  |                                                                                                                                                                                                     | Min | Typ | Max | Unit |
|                  | 11ax (HE20 MCS11)                                                                                                                                                                                   |     | TBD |     | dBm  |
| <b>Data Rate</b> | WLAN:<br>802.11b : 1, 2, 5.5, 11Mbps<br>802.11a/g : 6, 9, 12, 18, 24, 36, 48, 54Mbps<br>802.11n : MCS0~7 (20MHz channel)<br>802.11ac : MCS0~8 (20MHz channel)<br>802.11ax : MCS0~11 (20MHz channel) |     |     |     |      |
| <b>Security</b>  | TKIP, WEP, WPA2(Personal/Enterprise), WPA3 (Personal/192b).                                                                                                                                         |     |     |     |      |

\* If you have any certification questions about output power please contact FAE directly.

### 1.3.3 Bluetooth

| Features                          | Description                                            |     |     |     |      |  |
|-----------------------------------|--------------------------------------------------------|-----|-----|-----|------|--|
| Bluetooth Standard                | BLE 5.4                                                |     |     |     |      |  |
| Bluetooth VID/PID                 | N/A                                                    |     |     |     |      |  |
| Frequency Rage                    | 2402MHz~2483MHz                                        |     |     |     |      |  |
| Modulation                        | GFSK, 1M<br>GFSK, 2M<br>GFSK, 500kbps<br>GFSK, 125kbps |     |     |     |      |  |
| Output Power                      |                                                        | Min | Typ | Max | Unit |  |
|                                   | BLE(1M)                                                |     | TBD |     | dBm  |  |
|                                   | BLE(2M)                                                |     | TBD |     | dBm  |  |
|                                   | BLE(500k)                                              |     | TBD |     | dBm  |  |
|                                   | BLE(125k)                                              |     | TBD |     | dBm  |  |
| Receiver Sensitivity <sup>5</sup> |                                                        | Min | Typ | Max | Unit |  |
|                                   | BLE(1M)                                                |     | TBD |     | dBm  |  |
|                                   | BLE(2M)                                                |     | TBD |     | dBm  |  |
|                                   | BLE(500k)                                              |     | TBD |     | dBm  |  |
|                                   | BLE(125k)                                              |     | TBD |     | dBm  |  |

<sup>5</sup> Tested by sLNA.

### 1.3.4 Operating Conditions

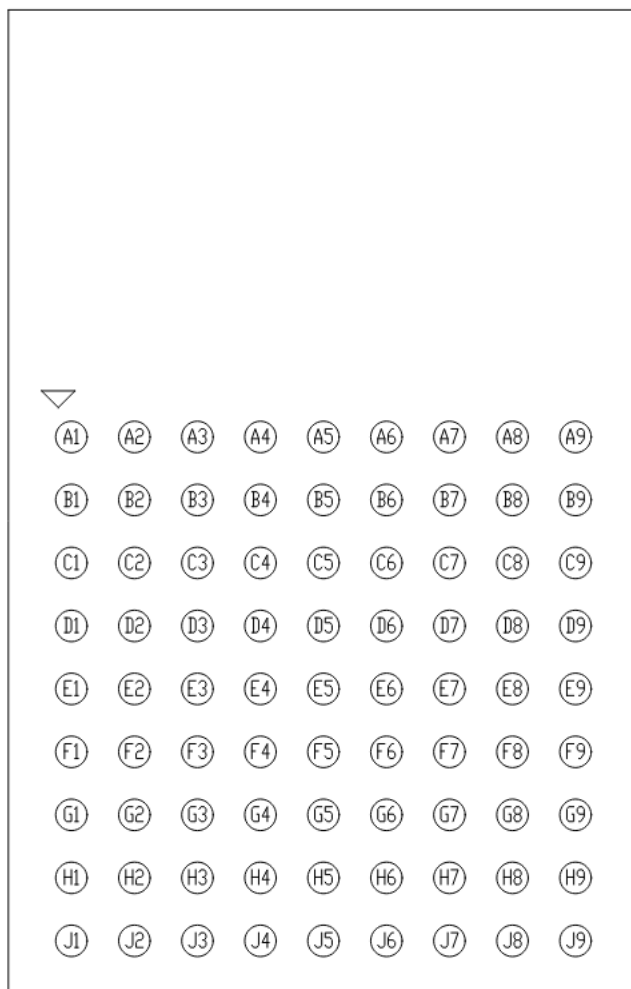
| Operating Conditions         |                                     |
|------------------------------|-------------------------------------|
| <b>Voltage</b>               | Power supply for host:3.3V          |
| <b>Operating Temperature</b> | -40~+85 °C <sup>6</sup>             |
| <b>Operating Humidity</b>    | less than 85% R.H.                  |
| <b>Storage Temperature</b>   | -40~+105 °C                         |
| <b>Storage Humidity</b>      | less than 60% R.H.                  |
| ESD Protection               |                                     |
| <b>Human Body Model</b>      | +/- 2 KV per JEDEC EID/JESD22-A114  |
| <b>Changed Device Model</b>  | +/- 300 V per JEDEC EIA/JESD22-C101 |

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<sup>6</sup> TBD°C is Functional operation, for detail please check with AzureWave FAE.

## 2. Pin Definition

### 2.1 Pin Map



PIN DEFINED (TOP VIEW)

**AW-CU640 Pin Map (Top View)**

## 2.2 Pin Table

| Pin No | Definition         | Basic Description                                                                                                            | Voltage  | Type |
|--------|--------------------|------------------------------------------------------------------------------------------------------------------------------|----------|------|
| A1     | GPIO6_WL_JTAG_TRST | GPIO configuration pin                                                                                                       | VDDIO    | I/O  |
| A2     | GPIO2_WL_JTAG_TCK  | GPIO configuration pin                                                                                                       | VDDIO    | I/O  |
| A3     | GPIO4_WL_JTAG_TDI  | GPIO configuration pin                                                                                                       | VDDIO    | I/O  |
| A4     | LHL_GPIO_2         | GPIO configuration pin                                                                                                       | VDDIO    | I/O  |
| A5     | LHL_GPIO_9         | GPIO configuration pin                                                                                                       | VDDIO    | I/O  |
| A6     | WL_DEV_WAKE        | GPIO configuration pin                                                                                                       | VDDIO    | I/O  |
| A7     | GND                | Ground.                                                                                                                      |          | GND  |
| A8     | GND                | Ground.                                                                                                                      |          | GND  |
| A9     | RF_IN/OUT          | WLAN/BT RF TX/RX path. If you need this pin out, please ask AzureWave FAE for more detail. Otherwise leave this pin floating |          | RF   |
| B1     | GPIO5_WL_JTAG_TDO  | GPIO configuration pin                                                                                                       | VDDIO    | I/O  |
| B2     | GPIO0_WL_HOST_WAKE | GPIO configuration pin                                                                                                       | VDDIO    | I/O  |
| B3     | GND                | Ground.                                                                                                                      |          | GND  |
| B4     | LHL_GPIO_4         | GPIO configuration pin                                                                                                       | VDDIO    | I/O  |
| B5     | LHL_GPIO_6         | GPIO configuration pin                                                                                                       | VDDIO    | I/O  |
| B6     | LHL_GPIO_8         | GPIO configuration pin                                                                                                       | VDDIO    | I/O  |
| B7     | BT_DEV_WAKE        | GPIO configuration pin                                                                                                       | VDDIO    | I/O  |
| B8     | LHL_GPIO_5         | GPIO configuration pin                                                                                                       | VDDIO    | I/O  |
| B9     | RFSW_CTRL_04       | Diversity use. If you need this pin out, please ask AzureWave FAE for more detail. Otherwise leave this pin floating         | VDDIO_RF | O    |
| C1     | GND                | Ground.                                                                                                                      |          | GND  |
| C2     | GPIO3_WL_JTAG_TMS  | GPIO configuration pin                                                                                                       | VDDIO    | I/O  |
| C3     | BT_GPIO_3          | Bluetooth GPIO configuration pin                                                                                             | VDDIO    | I/O  |
| C4     | BT_GPIO_7          | Bluetooth GPIO configuration pin                                                                                             | VDDIO    | I/O  |
| C5     | BT_GPIO_17         | Bluetooth GPIO configuration pin                                                                                             | VDDIO    | I/O  |
| C6     | BT_GPIO_16         | Bluetooth GPIO configuration pin                                                                                             | VDDIO    | I/O  |

|    |                 |                                  |               |     |
|----|-----------------|----------------------------------|---------------|-----|
| C7 | BT_GPIO_0       | Bluetooth GPIO configuration pin | VDDIO         | I/O |
| C8 | TDM1_DI         | TDM1_DI                          | VDDIO         | I/O |
| C9 | GND             | Ground.                          |               | GND |
| D1 | GND             | Ground.                          |               | GND |
| D2 | BT_UART_RTS     | High-Speed UART RTS              | VDDIO         | O   |
| D3 | GND             | Ground.                          |               | GND |
| D4 | GND             | Ground.                          |               | GND |
| D5 | GND             | Ground.                          |               | GND |
| D6 | BT_GPIO_2       | Bluetooth GPIO configuration pin | VDDIO         | I/O |
| D7 | SMIF_SPHB_CS1_N | SMIF_SPHB_CS1                    | VDDIO         | O   |
| D8 | TDM1_DO         | TDM1_DO                          | VDDIO         | I/O |
| D9 | TDM2_DI         | TDM2_DI                          | VDDIO         | I/O |
| E1 | BT_GPIO_6       | Bluetooth GPIO configuration pin | VDDIO         | I/O |
| E2 | BT_UART_RXD     | High-Speed UART Data In          | VDDIO         | I   |
| E3 | GND             | Ground.                          |               | GND |
| E4 | GND             | Ground.                          |               | GND |
| E5 | GND             | Ground.                          |               | GND |
| E6 | GND             | Ground.                          |               | GND |
| E7 | SMIF_SPHB_CS0_N | SMIF_SPHB_CS0_N                  | VDDIO         | O   |
| E8 | TDM1_MCK        | TDM1_MCK                         | VDDIO         | I/O |
| E9 | TDM2_DO         | TDM2_DO                          | VDDIO         | I/O |
| F1 | GND             | Ground.                          |               | GND |
| F2 | BT_UART_TXD     | High-Speed UART Data Out         | VDDIO         | O   |
| F3 | BT_UART_CTS     | High-Speed UART CTS              | VDDIO         | I   |
| F4 | GND             | Ground.                          |               | GND |
| F5 | LPO_IN          | External 32K or RTC clock        | 200~3200 Vp-p | I   |
| F6 | GND             | Ground.                          |               | GND |
| F7 | SMIF_SPHB_DQ0   | SMIF_SPHB_DQ0                    | VDDIO         | I/O |

|    |               |                                   |       |       |
|----|---------------|-----------------------------------|-------|-------|
| F8 | TDM1_SCK      | TDM1_SCK                          | VDDIO | I/O   |
| F9 | TDM2_MCK      | TDM2_MCK                          | VDDIO | I/O   |
| G1 | VDDIO         | 1.8V VDDIO supply for WLAN and BT | VDDIO | Power |
| G2 | BT_GPIO_5     | Bluetooth GPIO configuration pin  | VDDIO | I/O   |
| G3 | MIC_P         | Microphone input.                 | VDDIO | I     |
| G4 | BT_HOST_WAKE  | BT_HOST_WAKE                      | VDDIO | O     |
| G5 | DMIC_CK       | Digital microphone clock.         | VDDIO | O     |
| G6 | DMIC_DQ       | Digital microphone data.          | VDDIO | I     |
| G7 | SMIF_SPHB_DQ1 | SMIF_SPHB_DQ1                     |       | GND   |
| G8 | TDM1_WS       | TDM1_WS                           |       | GND   |
| G9 | TDM2_SCK      | TDM2_SCK                          |       | GND   |
| H1 | VBAT          | Main power supply pin.            | VBAT  | Power |
| H2 | REG_ON        | REG_ON. Internal pull-up.         | VDDIO | I     |
| H3 | GND           | Ground.                           |       | GND   |
| H4 | GND           | Ground.                           |       | GND   |
| H5 | GND           | Ground.                           |       | GND   |
| H6 | SMIF_SPHB_DQ3 | SMIF_SPHB_DQ3                     | VDDIO | I/O   |
| H7 | SMIF_SPHB_DQ2 | SMIF_SPHB_DQ2                     | VDDIO | I/O   |
| H8 | SMIF_SPHB_CLK | SMIF_SPHB_CLK                     | VDDIO | I/O   |
| H9 | TDM2_WS       | TDM2_WS                           | VDDIO | I/O   |
| J1 | VBAT          | Main power supply pin.            | VBAT  | Power |
| J2 | GND           | Ground.                           |       | GND   |
| J3 | SDIO_DATA_2   | SDIO_DATA_2                       | VDDIO | I/O   |
| J4 | SDIO_DATA_1   | SDIO_DATA_1                       | VDDIO | I/O   |
| J5 | SDIO_DATA_3   | SDIO_DATA_3                       | VDDIO | I/O   |
| J6 | SDIO_CLK      | SDIO_CLK                          | VDDIO | I/O   |
| J7 | SDIO_DATA_0   | SDIO_DATA_0                       | VDDIO | I/O   |
| J8 | SDIO_CMD      | SDIO_CMD                          | VDDIO | I/O   |

|    |     |         |  |     |
|----|-----|---------|--|-----|
| J9 | GND | Ground. |  | GND |
|----|-----|---------|--|-----|

## 2.3 Pin Multiplexing Tables

Multiple usage pins are used to conserve pin consumption for different features. The AW-CU640 devices can be used in many different applications but each application will not utilize all the on chip features. As a result, some of the features share the same pin. Most of the multiple usage pins can be used as a GPIO pin as well.

**Table 1 (BT\_UART)**

| No. | Pin Name      | FUNCTION#1    | FUNCTION#5    | FUNCTION#6    |
|-----|---------------|---------------|---------------|---------------|
| F3  | BT_UART_CTS_N | BT_UART_CTS_N | SCB0-SPI_SEL0 | SCB0_UART_CTS |
| D2  | BT_UART_RTS_N | BT_UART_RTS_N | SCB0-SPI_CLK  | SCB0_UART_RTS |
| E2  | BT_UART_RXD   | BT_UART_RXD   | SCB0-SPI_MOSI | SCB0_UART_RXD |
| F2  | BT_UART_TXD   | BT_UART_TXD   | SCB0-SPI_MISO | SCB0_UART_TXD |

**Table 2 (BT\_GPIO)**

| No. | Pin Name     | FUNCTION#1 | FUNCTION#4 | FUNCTION#5    | FUNCTION#7 | FUNCTION#8    | FUNCTION#9    |
|-----|--------------|------------|------------|---------------|------------|---------------|---------------|
| C7  | BT_GPIO_0    |            |            |               |            |               |               |
| G4  | BT_HOST_WAKE | BT_GPIO_1  |            |               |            |               |               |
| D6  | BT_GPIO_2    |            |            | SCB0-SPI_SEL3 | SCB1-SDA   | SCB1-SPI_MISO | SCB1_UART_RXD |
| C3  | BT_GPIO_3    |            |            |               | SCB1-SCL   | SCB1-SPI_MOSI | SCB1_UART_TXD |
| G2  | BT_GPIO_5    |            | SCB0-SCL   | SCB0-SPI_SEL1 |            |               | SCB1_UART_RTS |
| E1  | BT_GPIO_6    |            |            |               |            | SCB1-SPI_SEL3 |               |
| C4  | BT_GPIO_7    |            |            |               |            | SCB1-SPI_SEL2 |               |
| C6  | BT_GPIO_16   |            |            |               | SCB1-SCL   | SCB1-SPI_SEL0 |               |
| C5  | BT_GPIO_17   |            |            |               | SCB1-SDA   | SCB1-SPI_CLK  |               |

**Table 2 (BT\_GPIO) continued**

| No. | Pin Name     | FUNCTION#10 | FUNCTION#11   | FUNCTION#13                        |
|-----|--------------|-------------|---------------|------------------------------------|
| C7  | BT_GPIO_0    |             | SCB2-SPI_SEL3 | TCPWM_TR_ALL_5                     |
| G4  | BT_HOST_WAKE |             |               | TCPWM_TR_ALL_6                     |
| D6  | BT_GPIO_2    |             |               | TCPWM_TR_ALL_7                     |
| C3  | BT_GPIO_3    |             |               | TCPWM_TR_ALL_8                     |
| G2  | BT_GPIO_5    |             |               | TCPWM_OUT_12                       |
| E1  | BT_GPIO_6    | SCB2-SDA    |               | TCPWM_OUT_21                       |
| C4  | BT_GPIO_7    | SCB2-SCL    |               | TCPWM_OUT_22                       |
| C6  | BT_GPIO_16   |             |               | TCPWM_OUT_12/<br>TCPWM_COMP_OUT_12 |
| C5  | BT_GPIO_17   |             |               | TCPWM_OUT_11/<br>TCPWM_COMP_OUT_21 |

**Table 3 (TDM and DMIC)**

| No. | Pin Name | FUNCTION#2 | FUNCTION#3 | FUNCTION#5    | FUNCTION#8    | FUNCTION#10 |
|-----|----------|------------|------------|---------------|---------------|-------------|
| G8  | TDM1_WS  | TDM1_WS    |            |               |               |             |
| F8  | TDM1_SCK | TDM1_SCK   |            |               |               |             |
| E8  | TDM1_MCK | TDM1_MCK   |            | SCB0-SPI_SEL2 |               |             |
| C8  | TDM1_DI  | TDM1_DI    |            |               | SCB1-SPI_SEL3 |             |
| D8  | TDM1_DO  | TDM1_DO    |            |               | SCB1-SPI_SEL2 |             |
| H9  | TDM2_WS  | TDM2_WS    |            |               |               |             |
| G9  | TDM2_SCK | TDM2_SCK   |            |               |               | SCB2-SDA    |
| F9  | TDM2_MCK | TDM2_MCK   |            | SCB0-SPI_SEL1 |               | SCB2-SCL    |
| D9  | TDM2_DI  | TDM2_DI    |            |               |               |             |
| E9  | TDM2_DO  | TDM2_DO    |            |               |               |             |
| G5  | DMIC_CK  |            | DMIC_CK    |               |               |             |
| G6  | DMIC_DQ  |            | DMIC_DQ    |               |               |             |

**Table 3 (TDM and DMIC) continued**

| No. | Pin Name | FUNCTION#11   | FUNCTION#14  |
|-----|----------|---------------|--------------|
| G8  | TDM1_WS  |               | TCPWM_OUT_23 |
| F8  | TDM1_SCK |               | TCPWM_OUT_24 |
| E8  | TDM1_MCK |               | TCPWM_OUT_25 |
| C8  | TDM1_DI  |               | TCPWM_OUT_26 |
| D8  | TDM1_DO  |               | TCPWM_OUT_27 |
| H9  | TDM2_WS  |               |              |
| G9  | TDM2_SCK | SCB2-SPI_SEL1 |              |
| F9  | TDM2_MCK | SCB2-SPI_SEL2 |              |
| D9  | TDM2_DI  | SCB2-SPI_MOSI |              |
| E9  | TDM2_DO  | SCB2-SPI_MISO |              |
| G5  | DMIC_CK  | SCB2-SPI_CLK  |              |
| G6  | DMIC_DQ  | SCB2-SPI_SELO |              |

**Table 4 (LHL\_GPIO)**

| No. | Pin Name    | FUNCTION#0 | FUNCTION#1   | FUNCTION#3 | FUNCTION#4 | FUNCTION#5    |
|-----|-------------|------------|--------------|------------|------------|---------------|
| A6  | WL_DEV_WAKE | LHL_GPIO_0 |              |            |            |               |
| B7  | BT_DEV_WAKE | LHL_GPIO_1 |              |            |            |               |
| A4  | LHL_GPIO_2  | ADCIn0     | LP_COMP_IN_N |            |            |               |
| B4  | LHL_GPIO_4  | ADCIn2     | LP_COMP_IN_N | DMIC_CK    |            | SCB0-SPI_MOSI |
| B8  | LHL_GPIO_5  | ADCIn3     | LP_COMP_IN_N | DMIC_DQ    |            | SCB0-SPI_MISO |
| B5  | LHL_GPIO_6  | ADCIn4     | LP_COMP_IN_N |            | SCB0-SCL   | SCB0-SPI_SELO |
| B6  | LHL_GPIO_8  | ADCIn6     | LP_COMP_IN_N |            |            |               |
| A5  | LHL_GPIO_9  | ADCIn7     | LP_COMP_IN_N |            |            |               |

**Table 4 (LHL\_GPIO) continued**

| No. | Pin Name    | FUNCTION#8    | FUNCTION#9    | FUNCTION#10   | FUNCTION#13       | FUNCTION#14  |
|-----|-------------|---------------|---------------|---------------|-------------------|--------------|
| A6  | WL_DEV_WAKE |               |               |               |                   |              |
| B7  | BT_DEV_WAKE |               |               |               |                   |              |
| A4  | LHL_GPIO_2  |               | SCB1_UART_TXD |               | TCPWM_TR_ALL_1    |              |
| B4  | LHL_GPIO_4  |               | SCB1_UART_CTS |               | TCPWM_TR_ALL_4    |              |
| B8  | LHL_GPIO_5  |               | SCB1_UART_RTS | SCB2_UART_CTS | TCPWM_TR_ALL_3    |              |
| B5  | LHL_GPIO_6  | SCB1-SPI_CLK  |               | SCB2_UART_RTS | TCPWM_COMP_OUT_11 | TCPWM_OUT_23 |
| B6  | LHL_GPIO_8  | SCB1-SPI_MOSI |               | SCB2_UART_RXD | TCPWM_COMP_OUT_21 | TCPWM_OUT_25 |
| A5  | LHL_GPIO_9  | SCB1-SPI_MISO |               | SCB2_UART_TXD | TCPWM_COMP_OUT_22 | TCPWM_OUT_26 |

### 3. Electrical Characteristics

#### 3.1 Absolute Maximum Ratings

| Symbol       | Parameter                   | Minimum | Typical | Maximum         | Unit |
|--------------|-----------------------------|---------|---------|-----------------|------|
| <b>VBAT</b>  | DC supply voltage for VBAT. | -0.5    | -       | +6 <sup>7</sup> | V    |
| <b>VDDIO</b> | DC supply voltage for VDDIO | -0.5    | -       | +2.2            | V    |

#### 3.2 Recommended Operating Conditions

| Symbol       | Parameter                    | Minimum          | Typical | Maximum | Unit |
|--------------|------------------------------|------------------|---------|---------|------|
| <b>VBAT</b>  | DC supply voltage for VBAT.  | 3.0 <sup>8</sup> | 3.3     | 4.8     | V    |
| <b>VDDIO</b> | DC supply voltage for VDDIO. | 1.71             | 1.8     | 1.89    | V    |

<sup>7</sup> The maximum continuous voltage is 5.25 V. Voltage transients up to 6.0 V for up to 10 seconds, cumulative duration over the lifetime of the device, are allowed. Voltage transients as HIGH as 5.5 V for up to 250 seconds, cumulative duration over the lifetime of the device, are allowed.

<sup>8</sup> AW-CU640 is functional across this range of voltages. Optimal RF performance specified in the data sheet, however, is guaranteed only for 3.13V < VBAT < 3.5V.

### 3.3 Digital IO Pin DC Characteristics<sup>9</sup>

VDDIO:

| Symbol                | Parameter                               | Minimum      | Typical | Maximum      | Unit |
|-----------------------|-----------------------------------------|--------------|---------|--------------|------|
| <b>VDDIO=1.8V</b>     |                                         |              |         |              |      |
| <b>V<sub>IH</sub></b> | Input high voltage (V <sub>DDIO</sub> ) | 0.65 × VDDIO | -       | -            | V    |
| <b>V<sub>IL</sub></b> | Input low voltage (V <sub>DDIO</sub> )  | -            | -       | 0.35 × VDDIO | V    |
| <b>V<sub>OH</sub></b> | Output High Voltage @ 2mA               | VDDIO – 0.40 | -       | -            | V    |
| <b>V<sub>OL</sub></b> | Output Low Voltage @ 2mA                | -            | -       | 0.45         | V    |

VDDIO\_RF:

| Symbol                | Parameter                 | Minimum      | Typical | Maximum | Unit |
|-----------------------|---------------------------|--------------|---------|---------|------|
| <b>VDDIO=1.8V</b>     |                           |              |         |         |      |
| <b>V<sub>OH</sub></b> | Output High Voltage @ 2mA | VDDIO – 0.40 | -       | -       | V    |
| <b>V<sub>OL</sub></b> | Output Low Voltage @ 2mA  | -            | -       | 0.4     | V    |

<sup>9</sup> Programmable 2 mA to 16 mA drive strength. Default is 10 mA.

## 3.4 Interface

### 3.4.1 UART Interface

The AW-CU640 UART is a standard 4-wire interface (RX, TX, RTS, and CTS) with adjustable baud rates from 9600 bps to 4.0 Mbps. The interface features an automatic baud rate detection capability that returns a baud rate selection. Alternatively, the baud rate may be selected through a vendor-specific UART HCI command.

UART has a 1040-byte receive FIFO and a 1040-byte transmit FIFO to support EDR. Access to the FIFOs is conducted through the AHB interface through either DMA/CPU. The UART supports the Bluetooth 5.1 UART HCI specification: H4, and H5. The default baud rate is 115.2 Kbaud.

The CYW55913 UART can perform XON/XOFF flow control and includes hardware support for the Serial Line Input Protocol (SLIP). It can also perform wake-on activity. For example, activity on the RX or CTS inputs can wake the chip from a sleep state.

Normally, the UART baud rate is set by a configuration record downloaded after device reset, or by automatic baud rate detection, and the host does not need to adjust the baud rate. Support for changing the baud rate during normal HCI UART operation is included through a vendor-specific command that allows the host to adjust the contents of the baud rate registers. The AW-CU640 UARTs operate correctly with the host UART as long as the combined baud rate error of the two devices is within  $\pm 2\%$ .

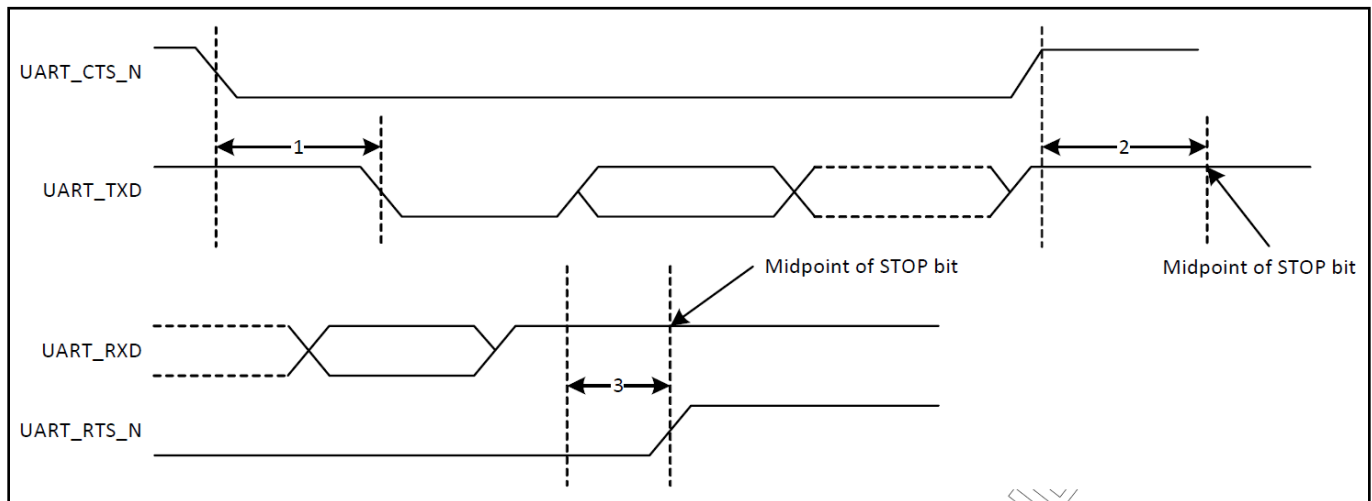
#### UART Interface Signals

| PIN No.   | Name          | Description                                                                                  | Type |
|-----------|---------------|----------------------------------------------------------------------------------------------|------|
| <b>F2</b> | BT_UART_TXD   | Bluetooth UART Serial Output. Serial data output for the HCI UART Interface                  | O    |
| <b>E2</b> | BT_UART_RXD   | Bluetooth UART Series Input. Serial data input for the HCI UART Interface                    | I    |
| <b>D2</b> | BT_UART_RTS_N | Bluetooth UART Request-to-Send. Active-low request-to-send signal for the HCI UART interface | O    |
| <b>F3</b> | BT_UART_CTS_N | Bluetooth UART Clear-to-Send. Active-low clear-to-send signal for the HCI UART interface.    | I    |

#### Example of Common Baud Rates

| Desired Rate | Actual Rate | Error (%) |
|--------------|-------------|-----------|
| 4000000      | 4000000     | 0.00      |
| 3692000      | 3692308     | 0.01      |
| 3000000      | 3000000     | 0.00      |
| 2000000      | 2000000     | 0.00      |
| 1500000      | 1500000     | 0.00      |
| 1444444      | 1454544     | 0.70      |
| 921600       | 923077      | 0.16      |
| 460800       | 461538      | 0.16      |
| 230400       | 230796      | 0.17      |
| 115200       | 115385      | 0.16      |
| 57600        | 57692       | 0.16      |
| 38400        | 38400       | 0.00      |
| 28800        | 28846       | 0.16      |
| 19200        | 19200       | 0.00      |
| 14400        | 14423       | 0.16      |
| 9600         | 9600        | 0.00      |

### UART Timing



### UART Timing Specifications

| Ref No. | Characteristics                                         | Minimum | Typical | Maximum | Unit        |
|---------|---------------------------------------------------------|---------|---------|---------|-------------|
| 1       | Delay time, UART_CTS_N low to UART_TXD valid            | –       | –       | 1.5     | Bit periods |
| 2       | Setup time, UART_CTS_N high before midpoint of stop bit | –       | –       | 0.5     | Bit periods |
| 3       | Delay time, midpoint of stop bit to UART_RTS_N high     | –       | –       | 0.5     | Bit periods |

### 3.4.2 TDM Interface

The AW-CU640 contains a TDM block. The following are the characteristics of the interface:

- Each TDM structure supports simultaneous transmitter/receiver functions
- A single interface consists of a TDM Transmitter and a TDM receiver
- Both, transmitter and receiver support master and slave functionality
- I2S interface is obtained as a special case of TDM

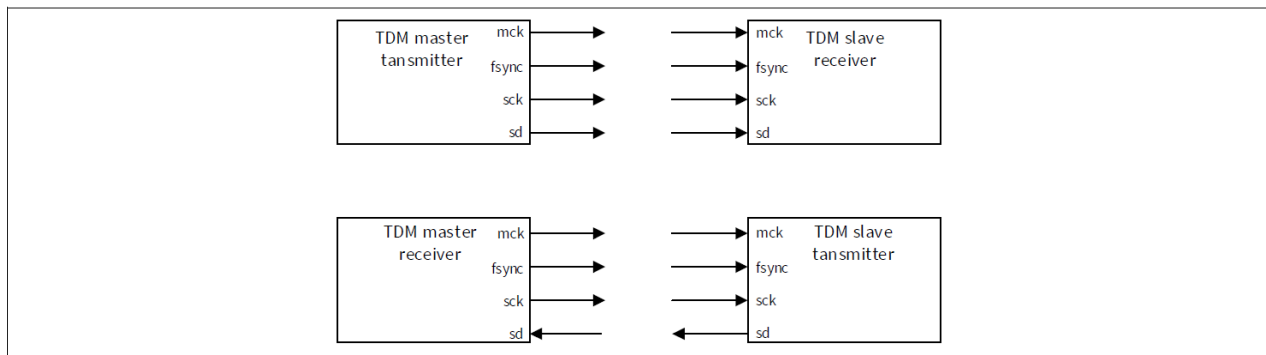
Following are the features of the TDM block:

- Programmable I2S or TDM functionality
- Master and slave functionality
- Full-duplex transmitter and receiver operation.
- Support for up to 32 channels. Each channel can be individually enabled/disabled
- Programmable Interface clock. Independently configurable per TX and RX interface to allow support for differing TX/RX data rates.
- Programmable channel size (up to 32 bits)
- Programmable half cycle delayed sampling support
- Programmable late capture extra delay of 1, 2 or 3 cycles, for multi-cycle round-trip latencies in receiver master mode
- Programmable PCM sample formatting (8, 10, 12, 14, 16, 18, 20, 24, 32 bits)
- Supports all common sampling frequencies: 4 / 8 / 11.025 / 12 / 16 / 20 / 22.05 / 24 / 30 / 32 / 40 / 44.1 / 48 / 60 / 96 kHz
- 8-channel (each 32-bit) TDM can run at a max data rate of 192 kHz
- 32-channel (each 32-bit) TDM can operate at data rate of 48 kHz
- Programmable synchronization pulse type
- Left-aligned and right-aligned sample formatting
- Design time parameter to set the maximum number of channels supported on each interface
- 128- or 64-entry TX FIFO, with interrupt and trigger support
- 128- or 64-entry RX FIFO, with interrupt and trigger support
- Test mode (transmitter to receiver loopback)

### 3.4.2.1 Operating Modes

Each TDM transmitter and receiver can be configured independently. They have two possible configurations – master and slave. Masters output the TDM clock and frame sync, slaves on the other hand take the same signals as inputs.

Operating modes



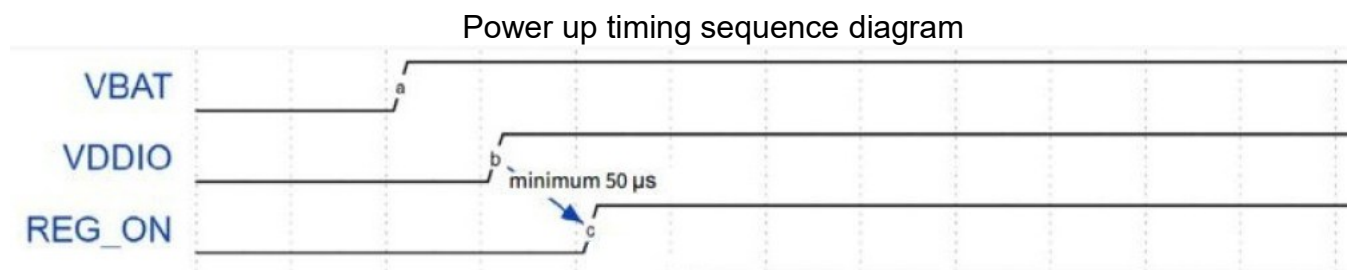
## 3.5 Power Up Timing Sequence

The AW-CU640 has one signals that enable or disable Bluetooth® and WLAN circuits and internal regulator blocks, allowing the host to control power consumption. For timing diagrams of these

signals and the required power-up sequences, see Power up timing sequence diagram.

#### Description of Control Signals (Power-Up/Power-Down/Reset Control Signals)

| Signal        | Description                                                                                                                                                                                                                                                                                                                                                                     |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>REG_ON</b> | This signal is used by the PMU to power up the device and to control the internal AW-CU640 regulators. When this pin is HIGH, the regulators are enabled, and the core is out of reset. If REG_ON is LOW, all the regulators are disabled. This pin has an internal 50 kΩ pull-down resistor that is enabled by default and can be disabled up on recognizing high on this pin. |



1. VBAT and VDDIO should not rise 10%–90% faster than 40 microseconds.
2. VBAT should be up before or at the same time as VDDIO. VDDIO should NOT be present first or be held high before VBAT is high.

## 3.6 Power Consumption<sup>10</sup>

### 3.6.1 WLAN

TBD

### 3.6.2 BT

TBD

<sup>10</sup> For Details, please contact Azurewave FAE

### 3.7 Frequency Reference

The AW-CU640 requires an external low-frequency clock for low-power mode timing. An external 32.768 kHz precision oscillator which meets the requirements listed in below table must be used.

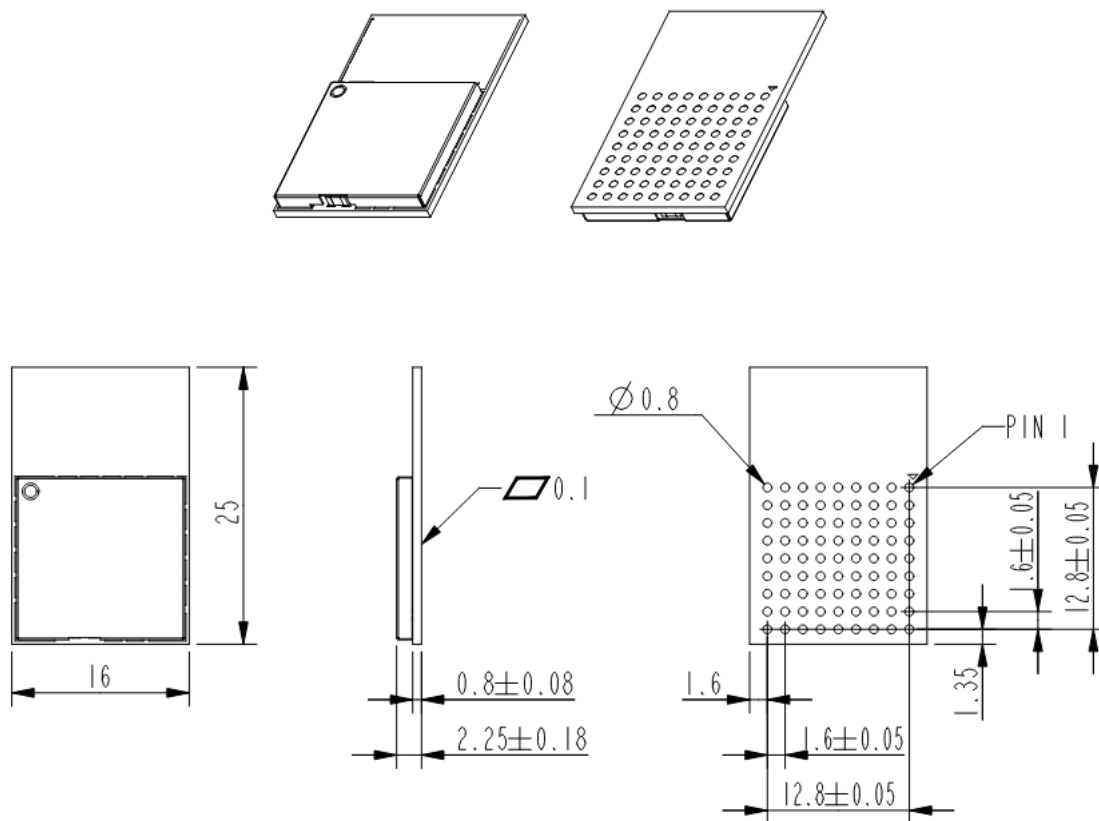
| Parameter                             | LPO Clock                | Unit    |
|---------------------------------------|--------------------------|---------|
| Nominal input frequency               | 32.768                   | kHz     |
| Frequency accuracy                    | ±250                     | ppm     |
| Duty cycle                            | 30–70                    | %       |
| Input signal amplitude                | 200–3300                 | mV, p-p |
| Signal type                           | Square-wave or sine-wave | –       |
| Input impedance <sup>[5]</sup>        | > 100k                   | Ω       |
|                                       | < 5                      | pF      |
| Clock jitter (during initial startup) | < 10,000                 | ppm     |

**Note**

5. When power is applied or switched off.

## 4. Mechanical Information

### 4.1 Mechanical Drawing



TOLERANCE UNLESS OTHERWISE SPECIFIED:  $\pm 0.1\text{mm}$

## 5. Packaging Information

TBD

## Federal Communication Commission Interference Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

### **Radiation Exposure Statement:**

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance **20cm** between the radiator & your body.

This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.

**This module is limited to OEM installation ONLY.**

### **2.2 List of applicable FCC rules**

Compliance with FCC Part 15C, 15E regulation.

### **2.3 Specific operational use conditions**

The module is tested for standalone mobile RF exposure use condition. Any other usage conditions such as co-location with other transmitter(s) will need a separate reassessment through a class II permissive change application or new certification.

### **2.4 Limited module procedures**

Not applicable to this device

### **2.6 RF exposure considerations**

This module is limited to installation in mobile or fixed applications, according to §2.1091(b). The separate approval is required for all other operating configurations, including portable configurations with respect to Part §2.1093 and different antenna configurations

## 2.7 Antennas:

- (1) The antenna must be installed such that **20** cm is maintained between the antenna and users,
- (2) The transmitter module may not be co-located with any other transmitter or antenna.
- (3) To comply with FCC regulations limiting both maximum RF output power and human exposure to RF radiation, the maximum antenna gain including cable loss in a mobile exposure condition must not exceed:

| Antenna Number | Frequency Band      | Model Number             | Antenna Type | Gain(dBi)             |
|----------------|---------------------|--------------------------|--------------|-----------------------|
| Antenna 1      | 2.4GHz<br>5GHz/6GHz | RFA-27-<br>JP326MHF4C198 | PIFA         | 2.4GHz: 3.5           |
|                |                     |                          |              | 5GHz/6GHz: 5          |
| Antenna 2      | 2.4GHz<br>5GHz/6GHz | RFA-27-JP326-<br>C198    | PIFA         | 2.4GHz: 3.5           |
|                |                     |                          |              | 5GHz/6GHz: 5          |
| Antenna 3      | 2.4GHz<br>5GHz/6GHz | AW-CU640                 | PCB          | 2.4GHz: 2.75          |
|                |                     |                          |              | 5.15~5.25GHz: 2.34    |
|                |                     |                          |              | 5.25~5.35GHz: 2.34    |
|                |                     |                          |              | 5.47~5.725GHz: 3.34   |
|                |                     |                          |              | 5.725~5.850GHz : 3.34 |
|                |                     |                          |              | 5.925~6.425GHz : 2.09 |
|                |                     |                          |              | 6.425~6.525GHz : 1.99 |
|                |                     |                          |              | 6.525~6.875GHz : 2.05 |
|                |                     |                          |              | 6.875~7.125GHz : 2.17 |

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID/IC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

## 2.8 Label and compliance information

When the module is installed in the host device, the FCC ID label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily re-moved. If not, a second label must be placed on the outside of the final device that contains the following text: "Contains FCC ID: TLZ-CU640"

The grantee's FCC ID can be used only when all FCC compliance requirements are met.

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

### Federal Communication Commission Interference Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

For a **Class B** digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

The antenna(s) used for this transmitter must be installed to provide a separation distance of at least **20** cm from all persons.

This device and its antenna(s) must **not be co-located** or operating in conjunction with any other antenna or transmitter.

This module cannot be installed into a host with a weatherized enclosure.

The host must be powered from a wired permanent indoor local power connection, battery powered is not allowed.

The host must bear a statement in a conspicuous location on the device and the user's manual: "FCC regulations restrict the operation of this device to indoor use only."

Transmitters in the 5.925-7.125 GHz band are prohibited from operating to control or communicate with unmanned aircraft systems

Label of the end product:

The host product must be labeled in a visible area with the following

" Contains FCC ID: TLZ-CU640 "