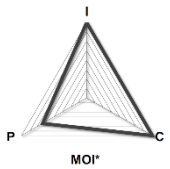
# E20 Class, Series B

MPN prefix:

## ACB-QCA206x-xxxx

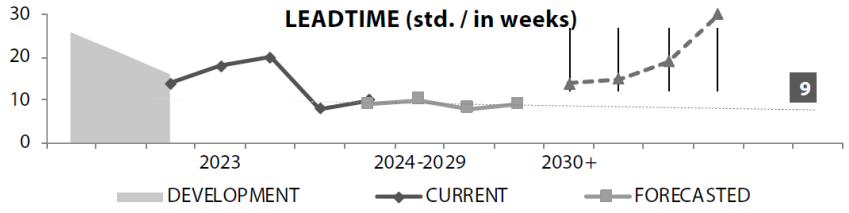
# Tri-band, 3 Gbps Dual-Band Simultaneous (DBS) operation on 2.4 GHz plus 5 GHz or 6 GHz - 802.11ax WLAN via PCIe with combo Bluetooth 5.3 via HCI UART or USB – LGA SMD Chip-on-Board (CoB) module.

RESOURCES




| A | A | C | 4 | 4 | 8 weeks |
|---|---|---|---|---|---|
| TECHPOINT | LIFESPOT | VAROD | VERTICALS | DCO | ELT |

* Page 2 for key legend. Commercial data refresh: January 2024




**Based on Qualcomm's Verona and Hastings Prime Reference Designs**




| | ANTENNA TYPE | PEAK GAIN | COMPLIANT CUSTOMIZATION |
|---|---|---|---|
| **WAPH Series** | Internal, PCB Dipole | < 3 dBi | Cable length / type / shielding, PCB, labelling, material grade, fine tuning. |
| **WAFH Series** | Internal, FPC Dipole | < 3 dBi | Cable length / type / shielding, FPC, labelling, material grade, fine tuning. |
| **WAND & WEAD Series** | External, PCB Dipole | < 4 dBi | Cable length / type / shielding, PCB, enclosure, identification, material grade, fine tuning. |



PRE-APROVED ANTENNA:

When indicated: * certified On-Demand † list may vary by domain

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# Revision History

| RELEASES | DATE | NOTES | PREPARED | APPROVED |
|---|---|---|---|---|
| Version 1.0 | 2023-01-09 | Based on completed EVT test schedule. | N Manoukian | L Tu |
| Version 1.1 | 2023-02-21 | Updated packaging section. | N Manoukian | L Tu |
| Version 1.2 | 2023-03-10 | Updated Reflow Profile. Improved Ordering Information Section. | N Manoukian | L Tu |
| Version 1.3 | 2023-05-25 | Updated document structure, product pictures, packaging details and labelling information. | J Cheng | L Tu |
| Version 1.4 | 2023-05-31 | Document fixes and minor clarifications of MSL indicator card. | J Cheng | L Tu |
| Version 1.5 | 2024-02-01 | BT compatibility upgraded to 5.3. Pinout visual representation and minor document fixes. | J Cheng | L Tu |
| Version 1.6 | 2024-02-09 | Refreshed mechanical & thermal testing info; added Compliance and Tools sections. | J Cheng | L Tu |
| Rev B | 2026-10-29 | Reflow solder paste, BT test set and reference-design names made generic. Follows Version 1.6 (registered as Rev A). | Product Management | L Tu |
| Rev C | 2026-10-30 | Qualcomm reference-design names and the BT test set restored as in Rev A. Solder-paste fix of Rev B kept; BT level unit corrected to dBm. | Product Management | L Tu |

# * Commercial Key Legend

Indicators that assess the specific product for its position in the technology curve and the supply chain responsiveness it enjoys. They combine an inner-outer view: both from outside factors and from internal corporate and production support.

| | |
|---|---|
| **MOI [Market Orientation Index]** | A value calculated from the grading of the factors below. Used as a rule-of-thumb to aid design-in and procurement evaluation. MOI depicts the present product affinity to Innovation (I), Customer Empathy (C) and Price Focus (P). |
| **TECHNOLOGY** | High to Low: Advanced (A), Barring (B), Common (C), Dissolving (D) |
| **AGE** | Life cycle spot. Early to Late: Agonist (A), Bold (B), Current (C), Distressed (D) |
| **VAROD [Variants On-Demand]** | Flexibility in creating variants (Rigid to Flexible): Auxiliary (A), Basic (B), Core (C), Deep (D). |
| **VERTICALS** | Applicability in vertical markets: Specialized to a single market (1), to application in multiple verticals (4). |
| **DCO [Design Cost Orientation]** | Commodity index related to the cost point for the product's design conception. VALUES: 1 to 4; the higher the number the more cost aware is the core design. |
| **ELT [Effective Lead Time]** | Adjusted lead-time in weeks. This is a compound value based on the timeframe for the fulfilment of the 90% of unscheduled orders received accounting also for the industrial lead-time and internal inventory buffering. VALUE: number of ELT weeks. |

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E20 CLASS, SERIES B ..... 1
ACB-QCA206X-XXXX ..... 1
TRI-BAND, 3 GBPS DUAL-BAND SIMULTANEOUS (DBS) OPERATION ON 2.4 GHZ PLUS 5 GHZ OR 6 GHZ - 802.11AX WLAN VIA PCIE WITH COMBO BLUETOOTH 5.3 VIA HCI UART OR USB – LGA SMD CHIP-ON-BOARD (COB) MODULE. ..... 1
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# 1. Description

**Tri-Band Capable, Dual-Band Simultaneous 2x2 Wi-Fi 6E LGA CoB:** SMD modules that offer a full implementation of the Wi-Fi 6E standard (IEEE 802.11ax extended to include the ISM 6Ghz bands). The E20B deploys the QCA206x wireless SoC processor family, with the QCA2066 as the flagship model and part of the FastConnect 6900 and Networking Pro architectures.

- The E20B Series provides a core platform that flexibly leverages the technology elements of this IC Vendor in a compact solder-down module format for surface transfer mount implementations in a wide variety of embedded applications.
- Support for dual-MAC for connections up to 3 Gbps data rate in Dual Band Simultaneous modes (2x2+2x2 11ax DBS), when using QCA2066 or QCA2064. The use of OFDMA and 160MHz wide channels, effectively quadruples the throughput performance and delivers up to 50 percent additional range compared to Wi-Fi 5 devices; even in dense networking environments and with multiple concurrent MU-MIMO links running via a single module.

**All the WiFi6 advanced features and tools:** empower system design with all the actual advanced features of power-management, seamless antenna sharing with LTE, LTE-U and 5G, offloading traffic for minimal host utilization, support for 160Mhz channel bandwidth for 5 GHz and 6 GHz at 11ax speeds, low power PCIe (w/L1 sub-state) interface, integrated close-loop power detector, Dynamic Frequency Selection (DFS, radar detection) and more.

- Complemented by a complete HDK including an Evaluation Board and an LGA CoB socket tool, for access to all PCM, Debug and UART interfaces.
- Systematically supported with open source drivers for Linux (ATH11K) and Android, as well with Closed Source Drivers (CLD) for advanced features.

**Combo Bluetooth 5.3 on-board:** all the latest features of BT5.3 and more, like: BLE long range, class 1 and class 2 power-level transmissions without requiring an external PA, dual eSCO and dual A2DP streams, ACL support for A2DP true stereo.

**Flexible configuration: CoB + carrier, choice of BT interface bus, antenna and grade.** Other than for direct SMT, the E20B Series is available adapted on carriers with edge-connectors for standard slot-in form-factors: M.2 E-Key (Series W), M.2 B-Key (Series F) and miniPCIe (Series X).

# 2. Top Features

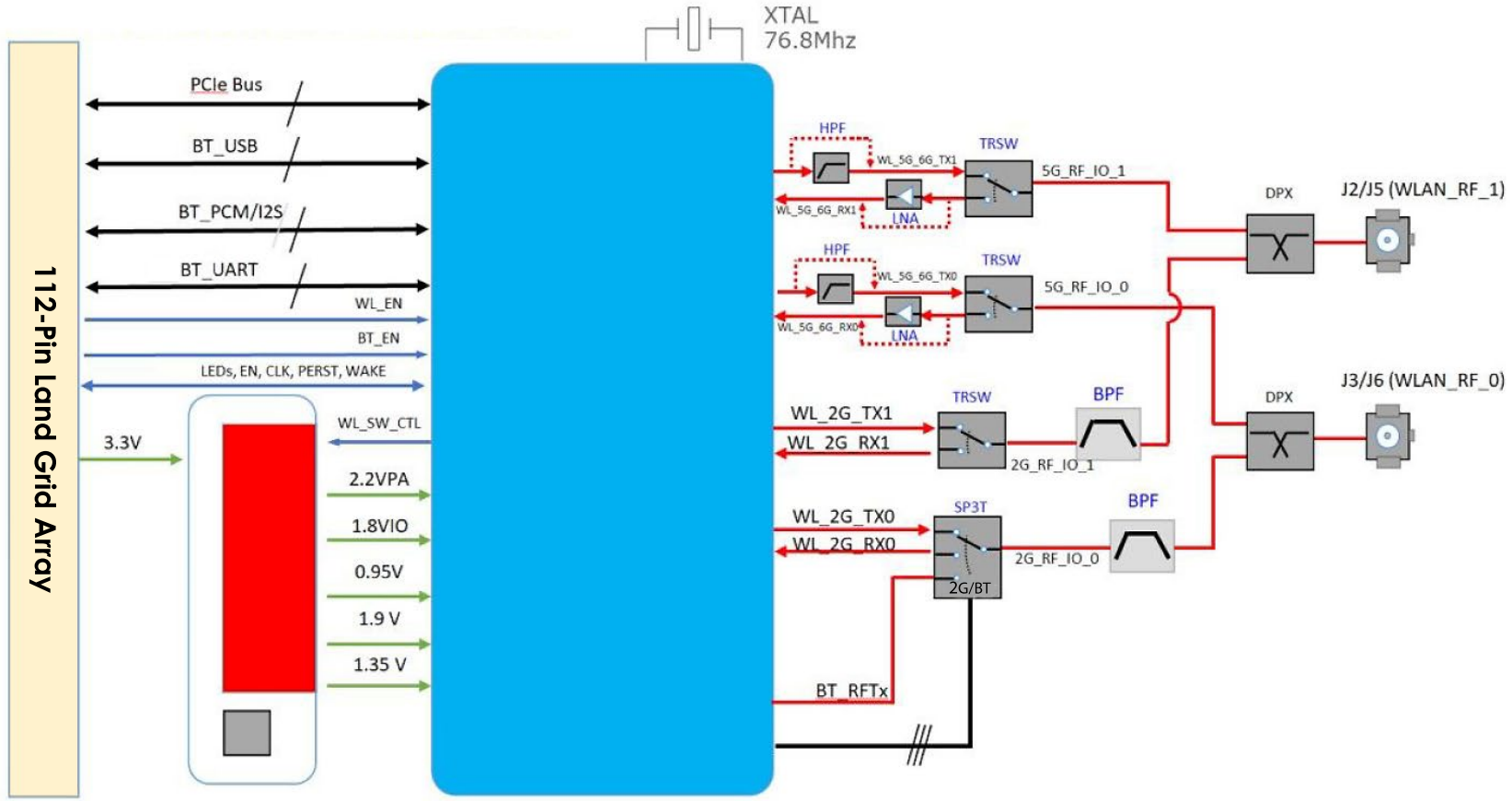



- Industrial Grade (-40 ~ +85°C) performance, fully featured Wi-Fi6 LGA CoB module with flexible configurations.
- Dual Band Simultaneous (DBS) with dual MAC for 2.4Ghz plus 5 GHz or 6GHz wireless connection up to 3Gbps that supports DL and UL MU-MIMO.
- Full external FEM design with enhanced range, energy and Tx power accuracy; 24dBm aggregate output for WLAN and 10dBm for BT.
- E20 LGA CoB module: a complete platform for use with the QCA206x family of SoCs and more Qualcomm ASICs for targeted design requirements.
- Available with a complete E20 Evaluation Board and an LGA CoB socket tool, for access to production, diagnostic and development features.
- Matches to a variety of carrier adaptors for easy development or production on different edge connector interfaces

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## 3. Block Diagram

Follows the E20B LGA CoB Block Diagram, with co-layout options for the Bluetooth interface and the antenna connectors.



# 4. Specifications

| | | |
|---|---|---|
| **SOLUTION DESIGN** | **Chipset** | Qualcomm QCA2066-0 for BT via UART or QCA2066-5 for BT via USB as the main high-availability and low effective lead-time ASIC choices.<br>• optional use of the respective QCA2065, QCA2064 or QCA2062 chip variants<br>• the WCN685x family and the QCA6898 IC are also supported |
| | **Standard** | IEEE 802.11ax Wi-Fi6E plus Bluetooth 5.3 Combo, full backwards compatibility to previous standards |
| | **Industrial Reference** | Based on Qualcomm Verona reference design; hardware compatible also to Hastings-Prime reference design |
| **APPEARANCE** | **Communications Interface** | LGA-type solder pads:<br>WLAN: via PCI Express Standard 3.0 host I/O<br>BT: via UART (with QCA206x-0 SoCs), or via USB 1.1 (with QCA206x-5 SoCs)<br>BT Audio: via selectable Slimbus/PCM (with QCA206x-0 SoCs), or via I2S (with QCA206x-5 SoCs). I2C in pin-mapped. |
| | **Form Factor** | SMD, Chip-on-Board, Soldered, Stamp down, 112 each of Land Grid Array (LGA) type pins, 23.0 x 25.0 mm |
| **ANTENNA** | **Configuration** | WLAN: Two Streams (2 chains), 2x2, 2 Connectors, MU-MIMO<br>BT: One Stream (1 chain), 1x1, 1 Connector |
| | **Type** | MHF1 Connectors with option for MHF4 : 2 each (one of which provides co-existence to Bluetooth with WLAN) |
| **WIRELESS PARAMETERS** | **Frequency Bands** | WLAN: 2.4 GHz ISM Bands 2.412-2.472 GHz, 2.484 GHz up to a max of 2.496 GHz<br>4.9 GHz (optional band support for Japan only)<br>5.15-5.25 GHz (FCC UNII-low band) for US/Canada, Japan and Europe<br>5.25-5.35 GHz (FCC UNII-middle band) for US/Canada and Europe<br>5.47-5.725 GHz for Europe<br>5.725-5.825 GHz (FCC UNII-high band) for US/Canada<br>5.850–5.925 GHz (optional band support for U-NII-4 DSRC/ITS)<br>5.925–6.425 GHz (U-NII-5) [implemented with QCA2066 and QCA2065 only]<br>6.425–6.525 GHz (U-NII-6) [implemented with QCA2066 and QCA2065 only]<br>6.525–6.875 GHz (U-NII-7) [implemented with QCA2066 and QCA2065 only]<br>6.875–7.125GHz (U-NII-8) [implemented with QCA2066 and QCA2065 only]<br>BT: 2402MHz~2480MHz |
| | **Data Transfer Rates** | WLAN: 802.11ax: Up to 3000Mbps (dynamic)<br>802.11ac: Up to 867Mbps (dynamic)<br>802.11n: Up to 300Mbps (dynamic)<br>802.11a/g: Up to 54Mbps (dynamic)<br>802.11b: Up to 11Mbps (dynamic)<br>BT: GFSK at 1Mbp<br>π/4-DQPSK at 2Mpbs<br>8DPSK at 3Mpbs |
| | **Media Access Control** | CSMA/CA with ACK |

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**WIRELESS PARAMETERS**

| | |
|---|---|
| **Channels** | 2.4GHz: 1-13 (14 only for Japan)<br>5GHz: 36-64, 100-165<br>6GHz: 191-423 (depending on operating domain) |
| **Channel Spacing** | 5MHz, 10MHz, 20 MHz, 40Mhz selectable for 2.4Ghz band. 80Mhz and 160MHz also selectable for 5Ghz and 6Ghz spectrums. |
| **Spreading / Modulation** | WLAN: 802.11ax: OFDMA (BPSK, adds 1024-QAM on MCS10 and MCS11)<br>802.11ac/g/n: OFDM (BPSK, DSSS-OFDM, QPSK,16-QAM,64-QAM, 256-QAM), MRC, STBC, LDPC, ML Demodulation<br>802.11b: CCK (11, 5.5Mbps), DQPSK (2Mbps), BPSK (1Mbps)<br><br>BT: GFSK, π/4-DQPSK, 8DPSK |

**RF Output Power**

| | | | |
|---|---|---|---|
| 802.11b: | 18.5 dBm at 11M | ±2 dBm | |
| 802.11g: | 17.5 dBm at 54M | ±2 dBm | |
| 802.11a: | 14.5 dBm at 54M | ±2 dBm | |
| 802.11n/ax 2.4G V/HT20 | 17.5 dBm at MCS0 | 14 dBm at MCS7 | ±2dBm |
| 802.11n/ax 2.4G V/HT40 | 16.5 dBm at MCS0 | 14 dBm at MCS7 | ±2dBm |
| 802.11ax 2.4G HE20 | 17.5 dBm at MCS0 | 11.5 dBm at MCS11 | ±2dBm |
| 802.11ax 2.4G HE40 | 16.5 dBm at MCS0 | 10 dBm at MCS11 | ±2dBm |
| 802.11n/ac/ax 5G V/HT20 | 16 dBm at MCS0 | 12 dBm at MCS8 | ±2dBm |
| 802.11n/ac/ax 5G V/HT40 | 15 dBm at MCS0 | 11 dBm at MCS9 | ±2dBm |
| 802.11ax 5G VHT80 | 14.5 dBm at MCS0 | 10 dBm at MCS11 | ±2dBm |
| 802.11ax 5G HE80 | 14.5 dBm at MCS0 | 9.5 dBm at MCS11 | ±2dBm |
| 802.11ax 5G HE160 | 14 dBm at MCS0 | 9 dBm at MCS11 | ±2dBm |

- DBm values reflect single RF chain output power performance. Two chain combined output power can be calculated as the single chain output power plus 3dB (2Tx = 1Tx + 3dB).

BT: (Class 2 Mode) +2 dBm ≤ Output Power ≤ +6 dBm
(Class 1 Mode) +2 dBm ≤ Output Power ≤ +10 dBm

**RF Receive Sensitivity (Typical, 1x1 chain)**

| | | |
|---|---|---|
| 802.11b | 11M less than 97.5 dBm | |
| 802.11g | 54M less than 92.5 dBm | |
| 802.11a | 54M less than 92 dBm | |
| 802.11n/ax 2.4G V/HT20 | MCS7 less than 72.5 dBm | 92.5 dBm at MCS0 |
| 802.11n/ax 2.4G V/HT40 | MCS7 less than 71.5 dBm | 91.5 dBm at MCS0 |
| 802.11ax 2.4G HE20 | MCS11 less than 63 dBm | 92.5 dBm at MCS0 |
| 802.11ax 2.4G HE40 | MCS11 less than 61 dBm | 92 dBm at MCS0 |
| 802.11n/ac/ax 5G V/HT20 | MCS7 less than 77 dBm | 95 dBm at MCS0 |
| 802.11n/ac/ax 5G V/HT40 | MCS7 less than 74.5 dBm | 92.5 dBm at MCS0 |
| 802.11ax 5G VHT80 | MCS11 less than 60 dBm | 88 dBm at MCS0 |
| 802.11ax 5G HE80 | MCS11 less than 57 dBm | 84 dBm at MCS0 |
| 802.11ax 5G HE160 | MCS11 less than 54 dBm | 81 dBm at MCS0 |

BT: BER < 0.1% (Anritsu 8852B Tx –83 dBm)

| | |
|---|---|
| **Operating Range** | Open Space: ~300 m; Indoor: :~100 m<br>(Coverage vary according to environment, antenna and topography) |

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| | | |
|---|---|---|
| | **Wireless Security** | WEP 64-bit and 128-bit encryption<br>WPA/WPA2/WPA3 UL/DL (Wi-Fi Protected Access) |
| **MODALITIES** | Infrastructure, AP/STA, Client, Bridge, Mixed-mode, P2P/Ad-hoc, EasyMesh. DBS & NON-DBS (SCC & MCC) | |
| **SAFETY & REGULATORY** | Compliant with FCC, IC ISED , CE RED and more.<br>Compliant with RoHS3. | |
| **PROTOCOLS** | **IEEE WLAN Network** | IEEE 802.11a/b/g/n/ac/ax (Wi-Fi6E),<br>IEEE 802.11d, e, h, i, j, k, r, u, v, w, z, ae |
| | **Other Standards** | Bluetooth 5.3 & ANT+ with advanced features: Host to Controller Encryption Key Control Enhancements, LE Power Control, LE Channel Classification Errata, Advertisement Extensions, Channel selection, LE2M, LELR, High Duty Cycle non-connectable advertisements, BT 5.1, ESR11 & ESR12, Minor Functional Enhancements, Advertisement channel, Index, Periodic Advertisement Sync Transfer, Control Length Extension, HID over GATT Profile, SPP Over BR/EDR, A2DP Source, A2DP Sink, AVRCP |
| | **Industry Standards** | |
| **HOST SYSTEM REQUIREMENTS** | **Operating System** | Android/Linux Closed Source, Android/Linux Open Source, Qualcomm Embedded Platform, Windows, MacOS<br>* Host supporting PCIe 32 or single MSI interrupts is required for some setups.<br>** 50+ MB memory (RAM) is recommended for best performance. |
| **ENVIRONMENTAL** | **Operating Temperature** | -40° ~ +85° Celsius |
| | **Storage Temperature** | -40° ~ +125° Celsius |
| | **Operating Humidity** | 10% ~ 90% non-condensing |
| | **Storage Humidity** | 5% ~ 90% non-condensing |
| | **Moisture Sensitivity Level** | MSL3 based on IPC/JEDEC J-STD-020D. Standard for handling see IPC/JEDEC J-STD-033C |
| **ELECTRICAL** | **I/O Voltage** | 3.3V +/-5% |
| | **Power Consumption** | max 2.45W on CTx @ 2.4GHz max 2.75W on CTx @ 5GHz max 3.55W on CTx @ 6GHz |
| **MECHANICAL** | **Dimensions** | 23.0mm x 25.0mm x 2.5mm (with shielding) |
| | **Weight** | 3.6 g |
| **PACKAGING** | **Packing style** | Tape & Reel, stored sealed under vacuum |
| | **Package Contents** | Module only |

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# 5. Electrical Characteristics

## 5.1 Absolute Maximum Ratings

| SYMBOL | PARAMETER | MAX. RATING | UNIT |
|---|---|---|---|
| $RF_{in}$ | Maximum RF input (reference to 50 Ω) | 0 | dBm |
| $T_{store}$ | Storage temperature | -55 ~ +155 | °C |

## 5.2 GPIO Interface Characteristics

See related detailed Pin Mapping and Application Notes documents.

# 6. Mechanical Drawing

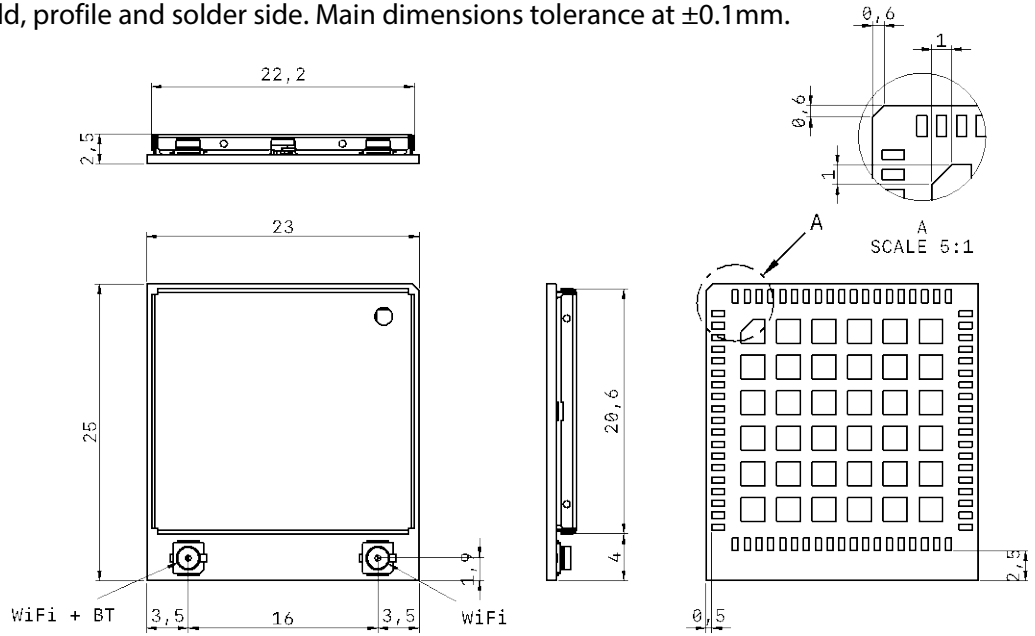
Mechanical drawings in millimeters (mm), showing the module's shield, profile and solder side. Main dimensions tolerance at ±0.1mm.

RESOURCES

***Related Resources** (available from the product page):*

- *3D Mechanical STEP file: DCN # 08A-PD3D-98_E20B(UFL)_Device-3D*
- *AEBPO-190012 - AIRETOS ACB-QCA206x-xWx1 Mechanical Drawing.pdf*

*MHF4 versions of the same resources are on-demand.*

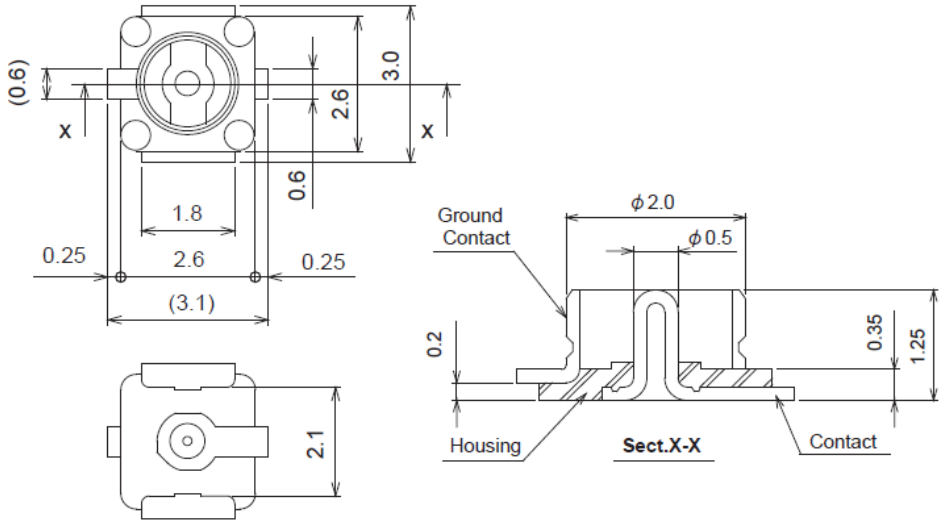


## 6.1 MHF1 Antenna Receptacle

The standard, higher availability E20 configurations come with MHF1 (U.Fl./IPEX) antenna connectors.

Those connectors offer the benefits of a larger, firmer grip and more durable joints at the RF cable assembly side. Larger diameter RF cables also benefit from reduced signal losses and wider material and shielding choices.

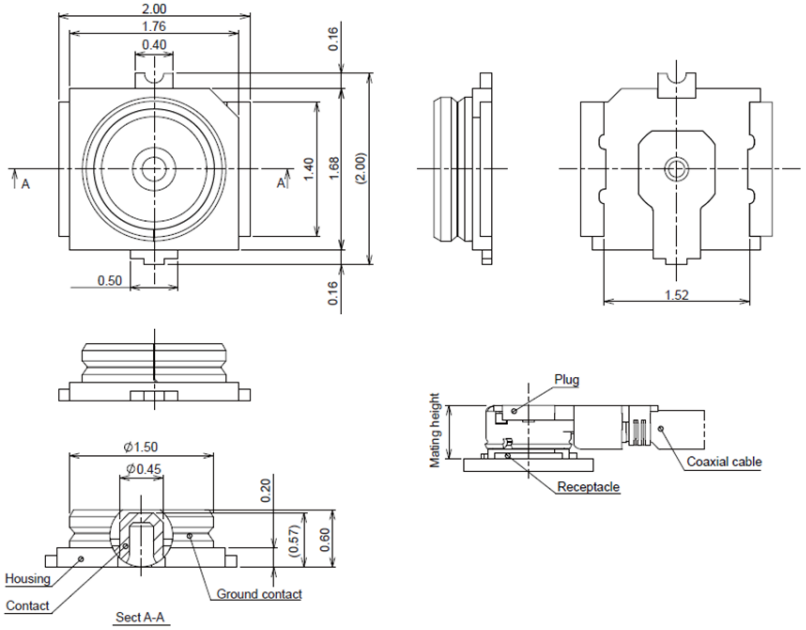
Present in all MPNs with suffix 1.



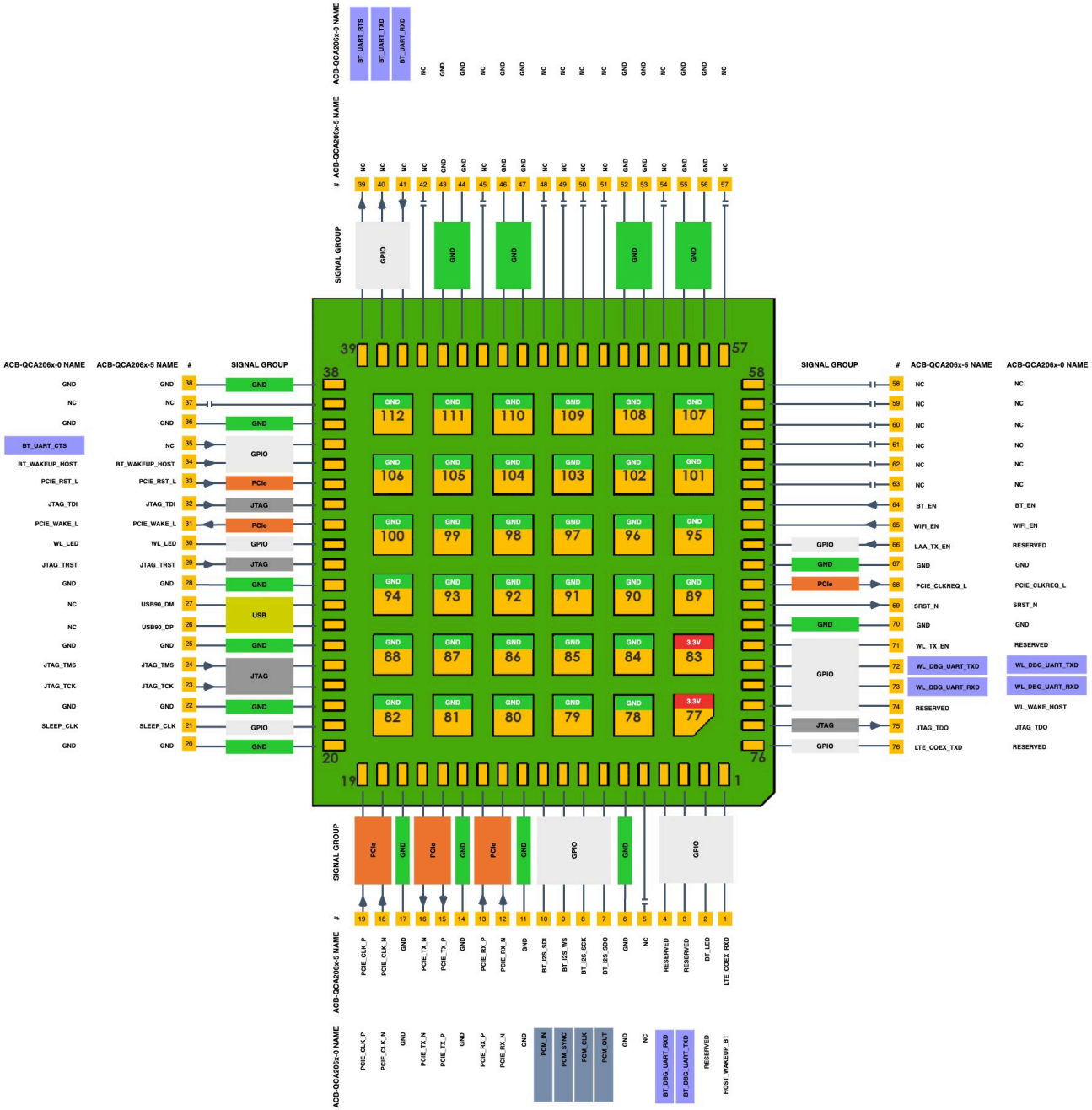

## 6.2 MHF4 Antenna Receptacle

Narrower connectors that permit the use of thinner cables, usually seen in tighter device assemblies.

Present in all MPNs with suffix 4.



# 7. LGA Pin-out




| INTERFACE TYPE | BUS SIGNALING | STANDARD |
|---|---|---|
| LGA Pads | PCIe | PCIe 3.0 |
| LGA Pads | HCI UART* | 3.2Mbps |
| LGA Pads | PCM/I2S/Slimbus | |
| LGA Pads | USB** | 1.1 |

* via UART (only with QCA206x-0 SoCs).
** via USB (only with QCA206x-5 SoCs).

Showing graphical representation of the bottom side of the E20B module, with pin guidance of the LGA pads both for QCA2066-0 and QCA2066-5 ICs.

***Related Resources (available from the product page):***

- *DCN # AEBPO-190001 - AIRETOS_ACB-QCA206x-xxxx_Pin-Mapping.pdf with the full Pin-out list with Contact Numbers and short descriptive of each pad.*

RESOURCES

SIGNAL GROUPS

- PCIe
- UART
- USB
- PCM
- GPIO
- JTAG
- POWER

# 8. External sleep clock timing

Sleep clock reference input clock requirements.

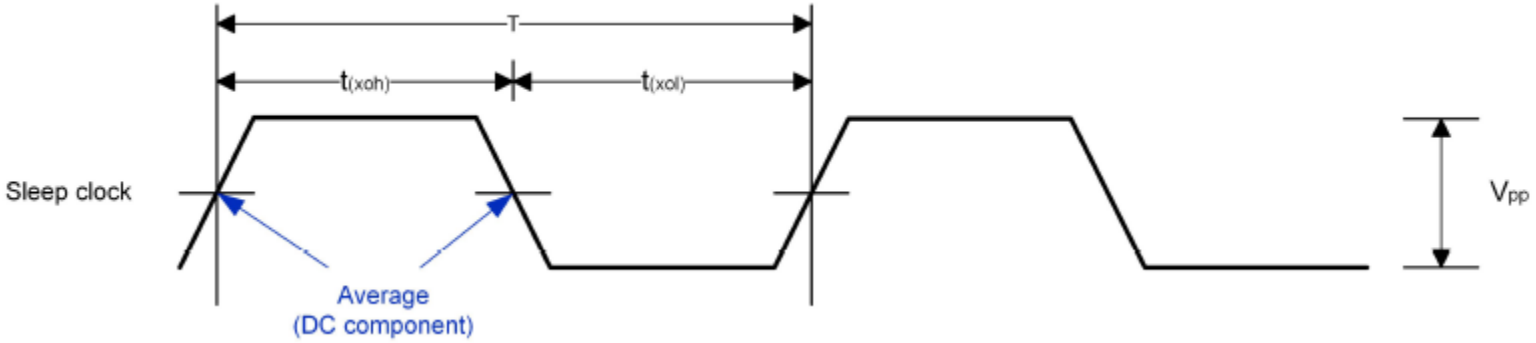


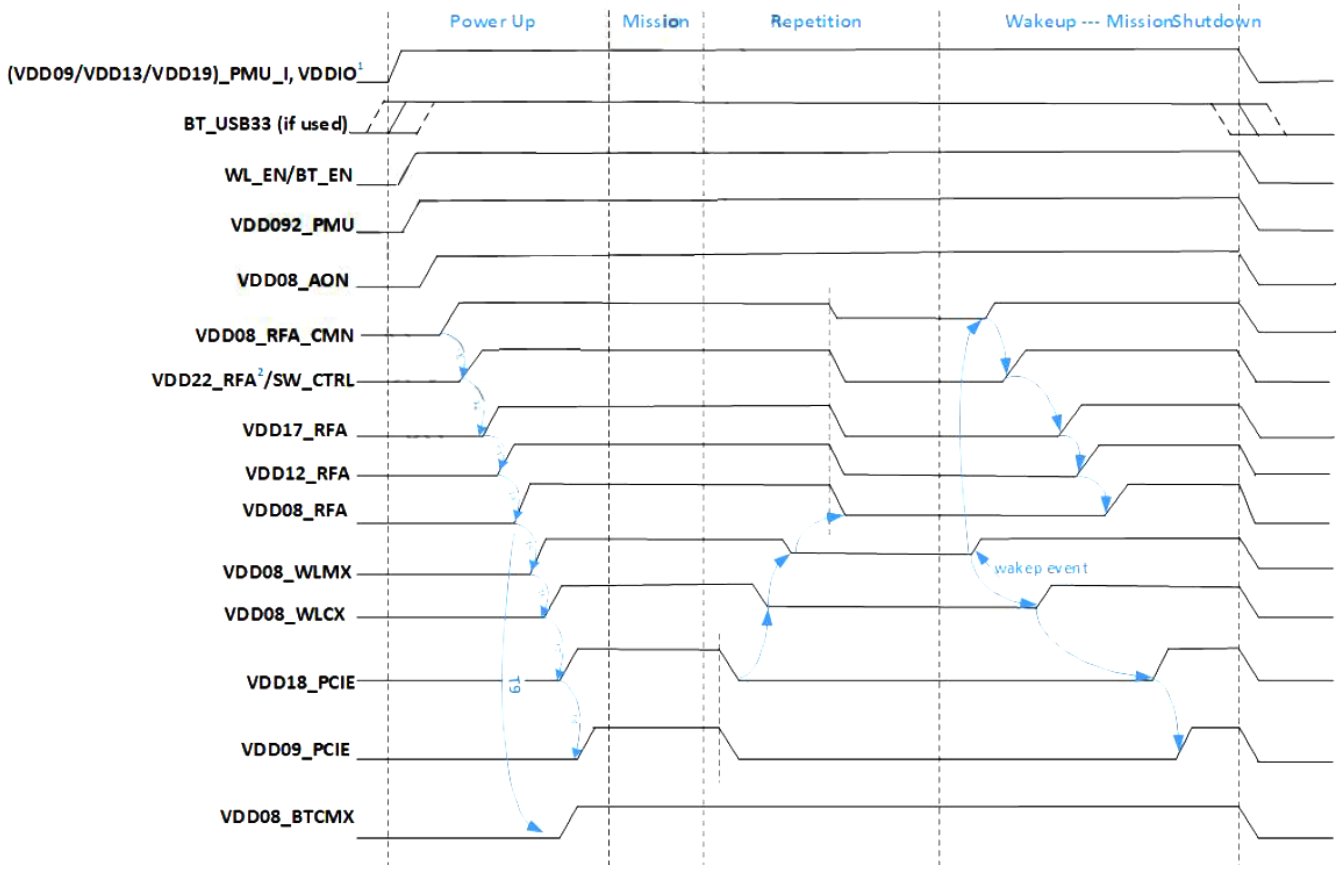

*Figure 8-1: External sleep clock*

| Parameter | | Comments | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| t(xoh) | Sleep-clock logic High | | 4.58 | - | 25.94 | µs |
| t(xol) | Sleep-clock logic Low | | 4.58 | - | 25.94 | µs |
| T | Sleep-clock Period | | - | 30.5208 | - | µs |
| F | Sleep-clock Frequency | F = 1/T | - | 32.7645 | - | kHz |
| Vpp | Peak-to-Peak Voltage | | - | 1.8 | - | V |

*Table 8-1: External sleep clock timing*

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# 9. Power sequences




E20's power-up sequence timing recommendations on the left.

**Notes:**
All input supplies must be ON and available before WLAN/BT_EN is asserted. There is no requirement on the order of input supply

VDD22_RFA is used as internal PA supply and follows SW_CTRL. For design with external PA only, VDD22 pins need to be connected to the 1.9V input. See the reference schematic for details.

| Symbol | Description | Timing | Unit |
|---|---|---|---|
| T1 | The delay time from RFACMN LDO to SW_CTRL = H | 1.35 | ms |
| T2 | The delay time from SW_CTRL = H to enable RFA_VDD17 | 2 | ms |
| T3 | The delay time from turn on RFA_VDD17 to turn on RFA_VDD12 | 80 | µs |
| T4 | The delay time from turn on RFA_VDD12 to turn on RFA_VDD08 | 80 | µs |
| T5 | The delay time from turn on RFA_VDD08 to turn on both WL_MX | 3.43 | ms |
| T6 | The delay time from turn on WL_MX to turn on WL_CX | 1.205 | ms |
| T7 | The delay time from turn on WL_CX to turn on PCIE_VDD_18 | 1.205 | ms |

*Table 10-1: Timing Parameter Definition*

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# 10. Bluetooth Digital Design

## 10.1 USB interface (active only with QCA206x-5 chips)

1.5 KΩ pull up to D+ is integrated in the device. No external resistor is required. Ensure that host has 15 KΩ pull down resistor on both D+ and D- according to USB1.1 specification. USB implementation follows USB1.1 specification.

## 10.2 HCI UART interface (active only with QCA206x-0 chips)

QCA206x-0 support the HCI UART transport layer as defined in the Bluetooth core specification, version 4.0, volume 4, part A. In addition to communication with the host, the HCI UART interface also supports Bluetooth software (in-band) sleep control. The HCI UART interface circuits use digital I/O pins that receive power from the VDD_IO supply.
The HCI UART transport layer uses the following settings for RS232.

| UART parameters | Value |
|---|---|
| Number of data bits | Eight |
| Parity bit | No parity |
| Stop bit | One stop bit |
| Flow control | RTS/CTS (hardware) |
| Flow off response | Two bytes maximum |
| Supported transport bit rates (bps) | 9.6 K, 19.2 K, 38.4 K, 57.6 K, 115.2 K, 125 K, 230.4 K, 250 K, 460.8 K, 500 K, 720 K, 921.6 K, 1 M, 1.6 M, 2 M, 3 M, 3.2 M, with an accuracy of +1.5/-2.5% |

*UART maximum baud rate is 3.2 Mbps.*




*Figure 10-1: HCI UART transmit flow control timing*

| Parameter | Description | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $toff_{tdx}$ | Delay from CTS to TxD stop | - | - | 8 | byte |

*Table 10-1: HCI UART transmit flow control timing*

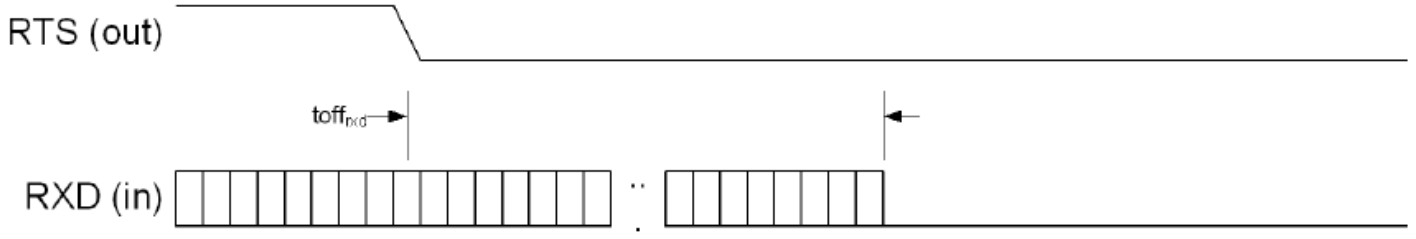



*Figure 10-2: HCI UART receive flow control timing*

| Parameter | Description | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $toff_{rxd}$ | Delay from RTS to RxD stop | - | - | 8 | byte |

*Table 10-2: HCI UART receive flow control timing*

## 10.3 Bluetooth PCM interface

The pulse coded modulation (PCM) interface connects the QCA2066 device to the phone's audio interface, or to peripheral devices, such as a codec. The PCM interface circuits use digital I/O pins that receive power from the VDD_IO supply. The QCA2066 PCM interface has been designed to minimize audio latency. Table 11-3 lists the typical audio latencies for various packet types.

| Packet Type | Audio Latency |
|---|---|
| HV3/EV3 $T_{eSCO} = 6$, $W_{eSCO} = 0$ | 4.4 ms |
| EV3 $T_{eSCO} = 6$, $W_{eSCO} = 2$ | 5.7 ms |
| EV3 $T_{eSCO} = 6$, $W_{eSCO} = 4$ | 6.9 ms |

*Table 10-3: Typical PCM interface audio latency*

The PCM interface is configured to operate as master or slave. In each case, the PCM_IN pin is the data receive terminal (an input), and the PCM_OUT pin is the data transmit terminal (an output). The clock and sync pins function as inputs or outputs, depending on whether the QCA2066 PCM interface is configured as a master or slave:

- When the QCA206x PCM interface is the master, PCM_CLK and PCM_SYNC are outputs from the QCA206x to one or more PCM bus slaves.
- When the QCA206x PCM interface is the slave, PCM_CLK and PCM_SYNC are inputs to the QCA206x device from the PCM bus master.

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| Parameter | Description | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| Clock rate (slave) | Determined by the master | 64 | - | 2,048 | kHz |
| Clock rate (master) | (32 MHz * N/4,000), in which N is an integer, 8 ≤ N ≤ 256 | 64 | - | 2,048 | kHz |
| Frame size | | 1 | 8 | 256 | Bits |
| Slot size | | 1 | 13 | 16 | Bits |
| Slot number | Number of slots that can be configured per frame | 1 | - | 32 | Slots/frame |

*Table 10-4: PCM interface specifications*

Example timing diagrams and specifications for slave and master configurations are described in the following tables and illustrations.

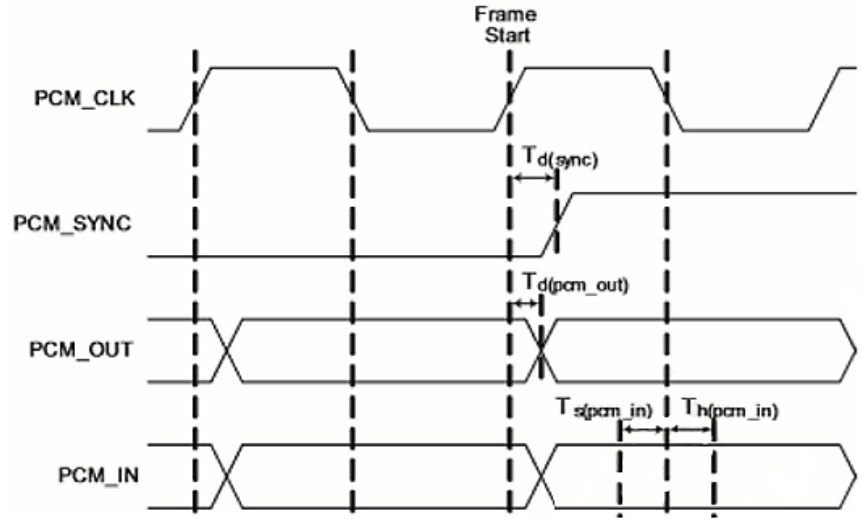



*Figure 10-3:PCM interface timing diagram (slave)*

| Symbol | Description | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| $F_{(pcm_clk)}$ | PCM_CLK frequency | 64 | - | 2,048 | kHz |
| $T_{s(pcm_sync)}$ | Setup time PCM_SYNC to PCM_CLK fall | 0 | - | - | ns |
| $T_{h(pcm_sync)}$ | Hold time PCM_CLK fall to PCM_SYNC fall | 150 | - | - | ns |
| $T_{d(pcm_out)}$ | Delay from PCM_CLK rise to PCM_OUT | 0 | - | 150 | ns |
| $T_{s(pcm_in)}$ | Setup time PCM_IN to PCM_CLK fall | 0 | - | - | ns |
| $T_{h(pcm_in)}$ | Hold time PCM_IN after PCM_CLK fall | 150 | - | - | ns |

*Table 10-5: PCM interface timing in slave mode*

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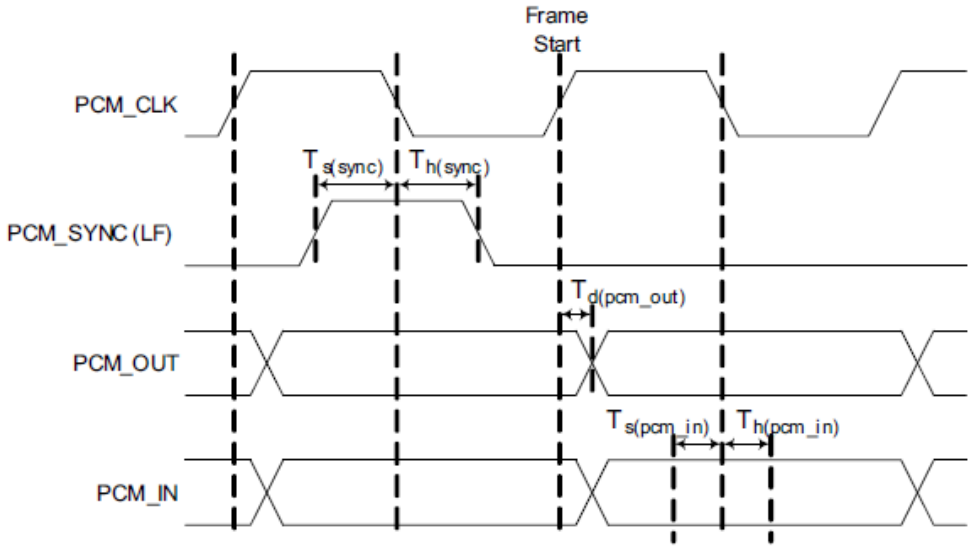



*Figure 10-4: PCM interface timing diagram (master)*

| Symbol | Description | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| $F_{(pcm_clk)}$ | PCM_CLK frequency | 64 | - | 2,048 | kHz |
| $T_{d(sync)}$ | Delay from PCM_CLK rise to long SYNC | -10 | - | 50 | ns |
| $T_{d(pcm_out)}$ | Delay from PCM_CLK rise to PCM_OUT | -10 | - | 50 | ns |
| $T_{s(pcm_in)}$ | Setup time PCM_IN to PCM_CLK fall | 50 | - | - | ns |
| $T_{h(pcm_in)}$ | Hold time PCM_IN after PCM_CLK fall | 150 | - | - | ns |

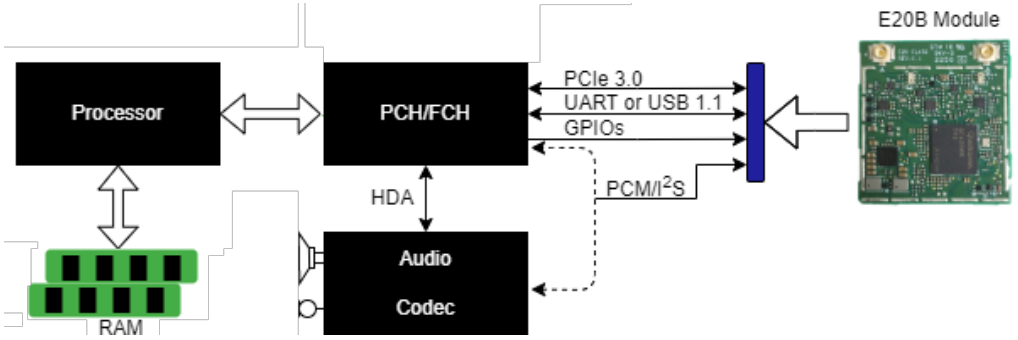
*Table 10-6: PCM interface timing in master mode*

# 11. Design-In References

## 11.1 Platform Connection Topology

A general Platform Connection Topology, like the one shown here, applies to both PCH and FCH platform designs.

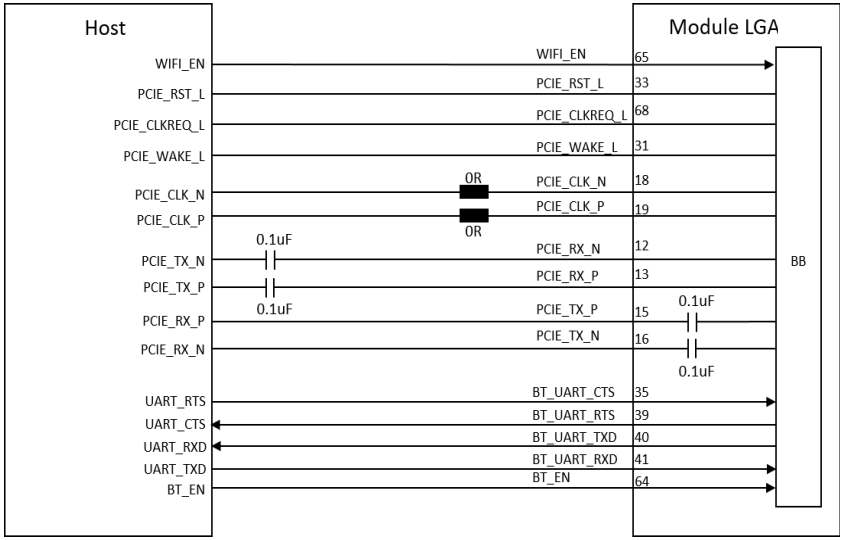
- PCH: Platform Controller Hub for Intel-based platforms
- FCH: Fusion Controller Hub for AMD-based platforms

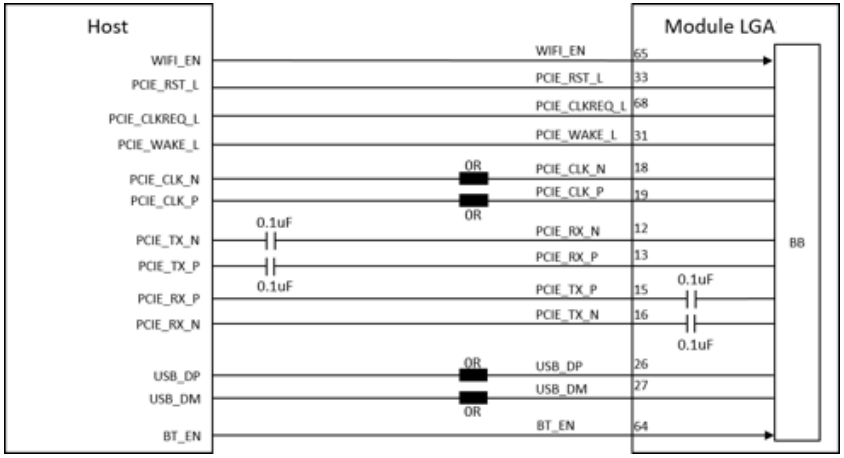


## 11.2 Reference Schematics

Follow reference schematics applicable when integrating the E20 into host platforms:

- for variants supporting the Bluetooth via UART (ACB-QCA206x-0xxx variants) on the left &
- for variants supporting the Bluetooth via USB (ACB-QCA206x-5xxx variant); on the right:




## 11.3 Layout Recommendations

Please refer to the following layout recommendations for the high-speed signal trace routing when integrating the E20 into a host platform:

- The differential impedances are recommended to be 90 ohm.
- Do not place test point on the high speed-signal trace.
- Do not route high-speed trace under or near crystals, oscillators, and switching power regulators.
- Maximize differential pair-to-pair spacing when possible.

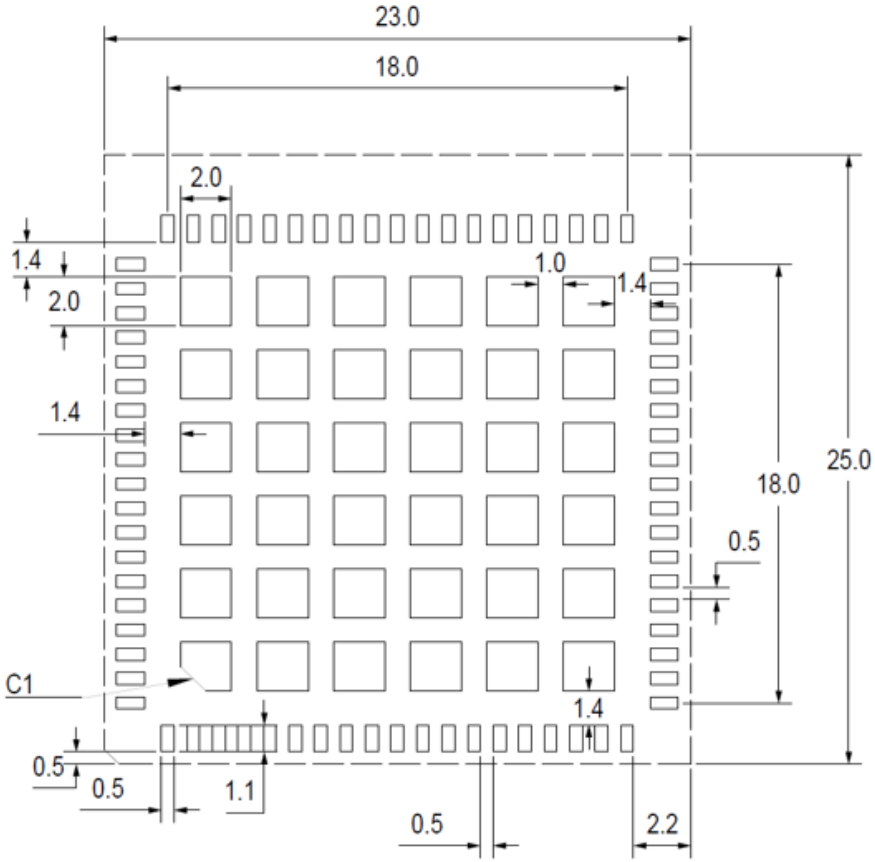
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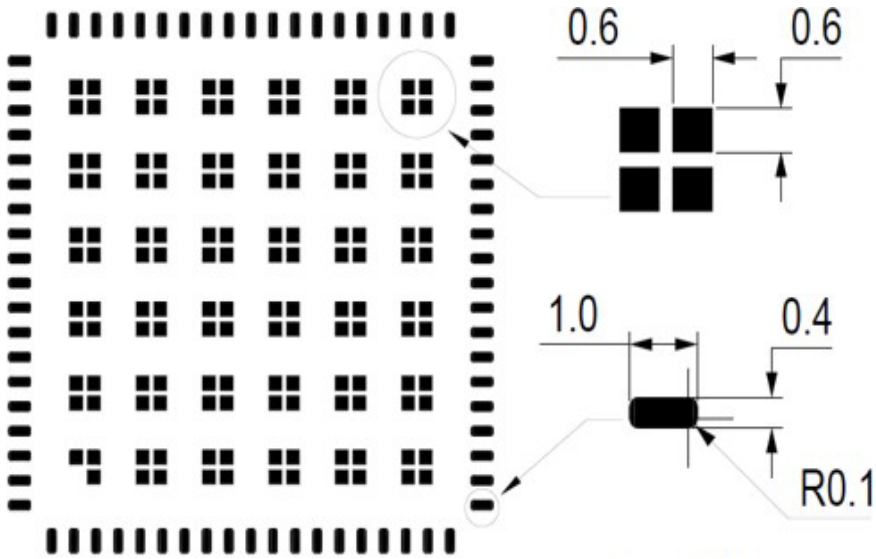
## 11.4 Land Pattern & Stencil Recommendations

- On the left the mechanical drawing in millimeters (mm), showing the module's land pattern from the top.
- On the right the recommendation for the stencil aperture dimensions, based on 0.1mm stencil thickness. Fine-tune for your SMT aperture and thickness.

The E20B Series has all its electrical and mechanical connections made through 112 LGA pads, which include 30 larger electrical ground pads in the center of its footprint.

** Available CAD Models include symbols and footprints for a wide range of design packages, like Altium, OrCAD, Autodesk, PADS, Eagle, etc..*

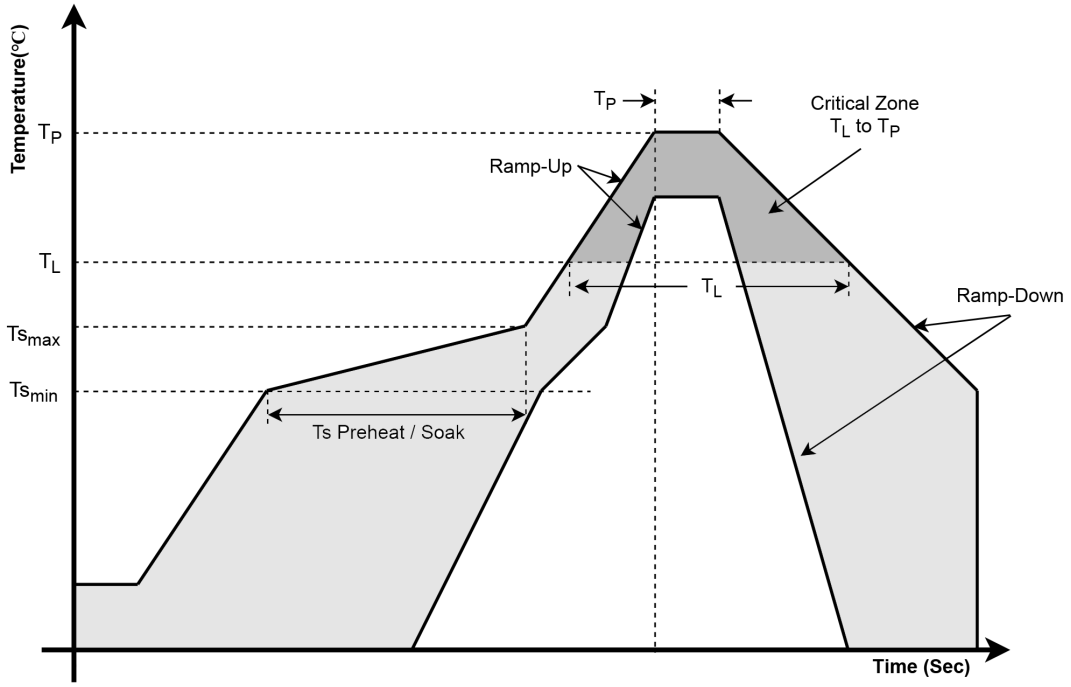


## 12. Reflow Recommended Thermal Profile

The following reference reflow profile is based on a halogen-free Type 4 solder paste.

| Profile Feature | Parameters | Conditions | | | |
|---|---|---|---|---|---|
| | | Min | Typ | Max | Units |
| Average ramp-up rate | $Ts_{max}$ to $T_P$ | - | 4 | 5 | °C/Sec |
| Preheat / Soak | Temperature $Ts_{min}$ | 140 | 150 | 160 | °C |
| | Temperature $Ts_{max}$ | 160 | 180 | 200 | °C |
| | Time($Ts_{min}$ to $Ts_{max}$) $T_s$ | 60 | 80 | 100 | Sec |
| Peak Temperature | $T_P$ | 230 | 240 | 255 | °C |
| Time maintained above | Temperature $T_L$ | 217 | 220 | 235 | °C |
| | Time $T_L$ | 30 | 40 | 60 | Sec |
| Average cool-down rate | $T_L$ to $Ts_{min}$ | -1 | - | - | °C/Sec |



## 13. Environmental Performance Qualification

Follow power consumption and peak temperature findings from the E20 when placed on maximum Wi-Fi throughput at 2.4G, 5G and 6G separately. Such performance runs were executed for a minimum of eight-hour run at ambient temperature of 25℃.

| Continuous Transmit Configuration | Current @3.3V (mA) | Consumption (W) | Max temperature (℃) |
|---|---|---|---|
| 2.4GHz HE40M MCS11 CH=6 | 670~740 | 2.22~2.45 | 52.86~58.42 |
| 5GHz HE160 MCS11 CH=100 | 750~830 | 2.49~2.75 | 60.66~67.04 |
| 6GHz HE160 MCS11 CH=149 | 970~1080 | 3.22~3.55 | 64.83~71.66 |

*• Electronic current values in milliampere. Readings retrieved under stable, typical current and voltage.*
*• Power consumption ratings are statistical maximums in test system setups which are placed in continuous operating modes.*
*• Real-life application system power budgets are dependent on traffic mix, environment, topology and domain configuration.*

Reliability and throughput performance tests at cycled controlled thermal conditions with 50dB attenuation and dwell periods of 12 hours per cycle show stable link and good performance across periods.

## 14. Standard Domain Code & Vendor IDs

The default code pre-programmed Regulatory Domain is 0x6A [wide open world mode]. Other regulatory domain codes can be pre-programmed on-request at production level. Standard identifiers are based on the Qualcomm reference design:

| | VENDOR ID (VID) | SUBSYSTEM VENDOR ID (SVID) | DEVICE ID (DID) | SUBSYSTEM ID (SSID) |
|---|---|---|---|---|
| STANDARD WLAN | 0x17CB | 0x17CB | 1103 | 0108 |

## 15. Software & Compliance

Drivers, firmware and regulatory compliance are key in integrating, operating and in shipping products with embedded E20 Class modules. This is an evolving area with some key resources and pointers at the E20 Product Page online.

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RESOURCES

***Key Resources** (available from the product page):*

- *09A-CPD24-B1 – AIRETOS E20 Class Manual.pdf*
- *07A-CDLF-31 E20 CLD Linux FW.zip [on request]: the Linux Firmware Package for fine-tuned operation.*

*Access to the Regulatory Certificate and Test Report Repository is available to customers upon request.*

# 16. Product Identification

## 16.1 Front (Shield) Identification

Etched shield shows the production date code in the format YYWW, where YY stands for the last two digits of the calendar year and WW stands for the calendar week at the time of production. It also presents applicable marking, including major regulatory domain identifiers:

- FCC (USA), ISED (Canada), CE RED (Europe).
- Serial number plus Wireless LAN NIC and BT MAC in a single QR code with the following formal: SN:[16-characters],WiFi:[12-characters],BT:[12-characters].




## 16.2 On-Demand Labelling

Labels and product support materials can be flexibly tailored to OEM/ODM customer's requirements and custom identifications to support own practices, target domains and specific markets.

# 17. ESD Processes

The ACB-QCA206x constitutes a sensitive electronic device and caution is required when handling it. ESD handling, shipment and storage notices apply. Also see the general Notices Section included in this document.



**DO NOT OPEN OR HANDLE EXCEPT AT A STATIC-FREE WORKSTATION**



**DO NOT SHIP OR STORE NEAR STRONG ELECTROSTATIC, ELECTROMAGNETIC OR RADIOACTIVE FIELDS**

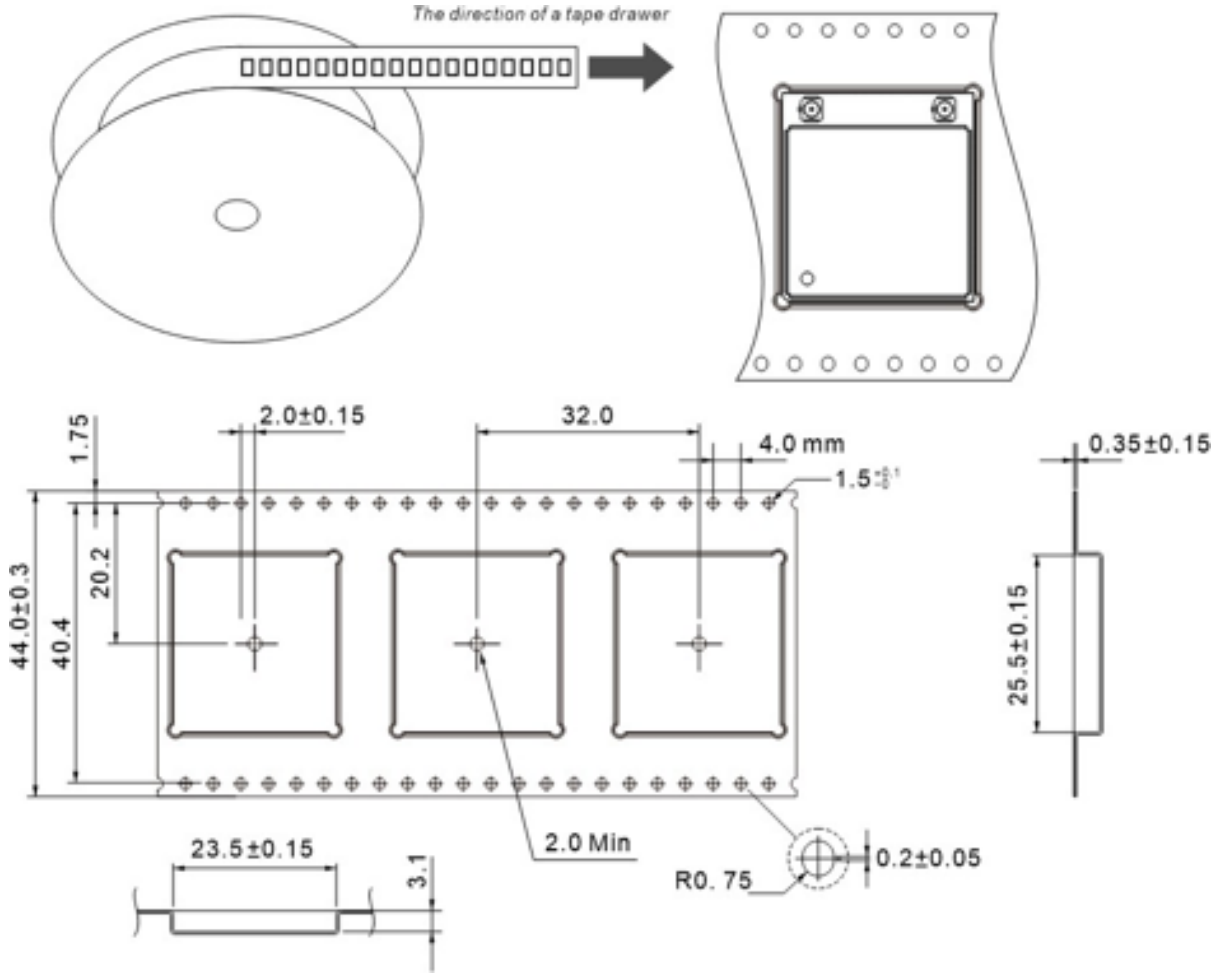
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# 18. Packaging, Labelling, Storage and Handling

## 18.1 Tape and Reel specifications:

Dimensions of the Tape and Reel packaging:

- Reel Size: 13" inches
- Reel Pitch: 32mm
- Carrier Tape: W44mm
- Heat seal Cover Tape: W37.5mm

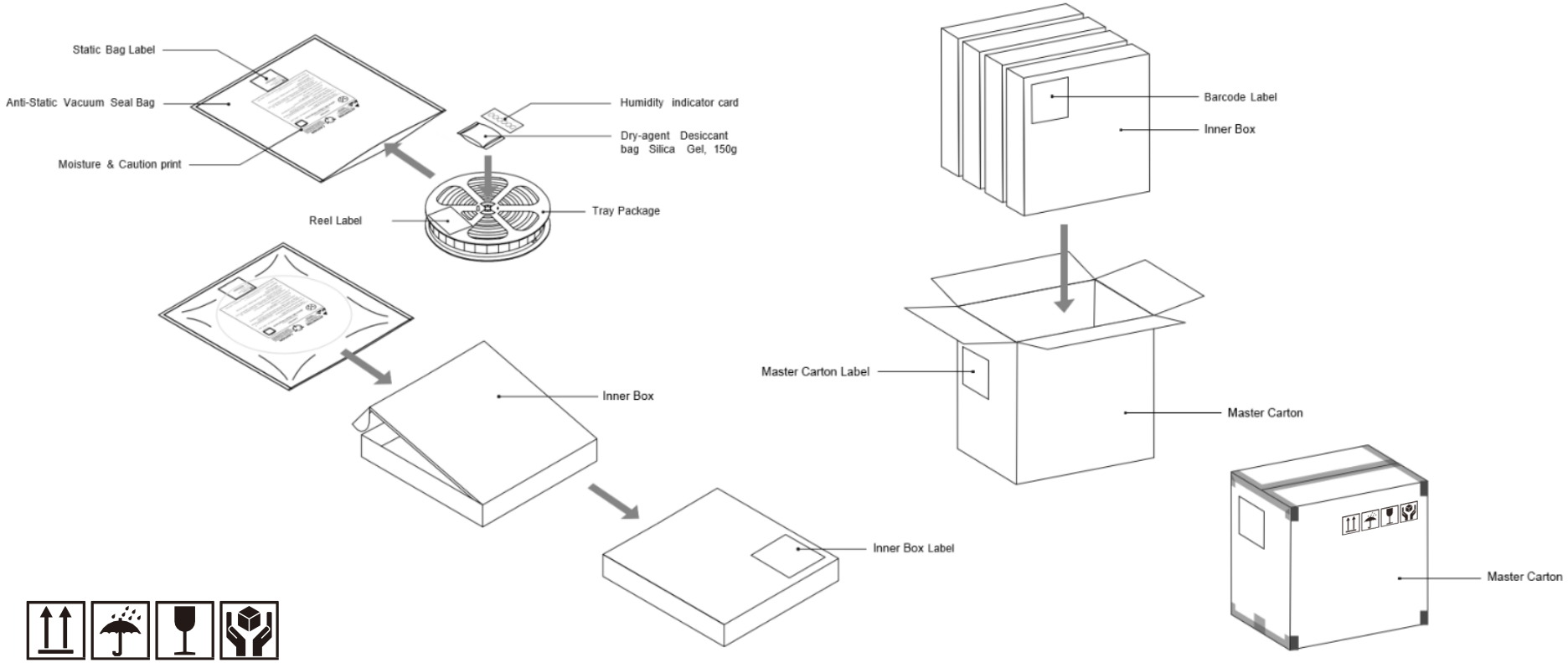


## 18.2 Packaging Methodology

Dimensions in millimeters (mm) of the Tape and Reel packaging:

- 500pcs per Reel (sealed inside Anti-Static Vacuum Bag)
- 1 Reel per inner box [REEL PACK]
- 4 Inner Boxes per Master Carton

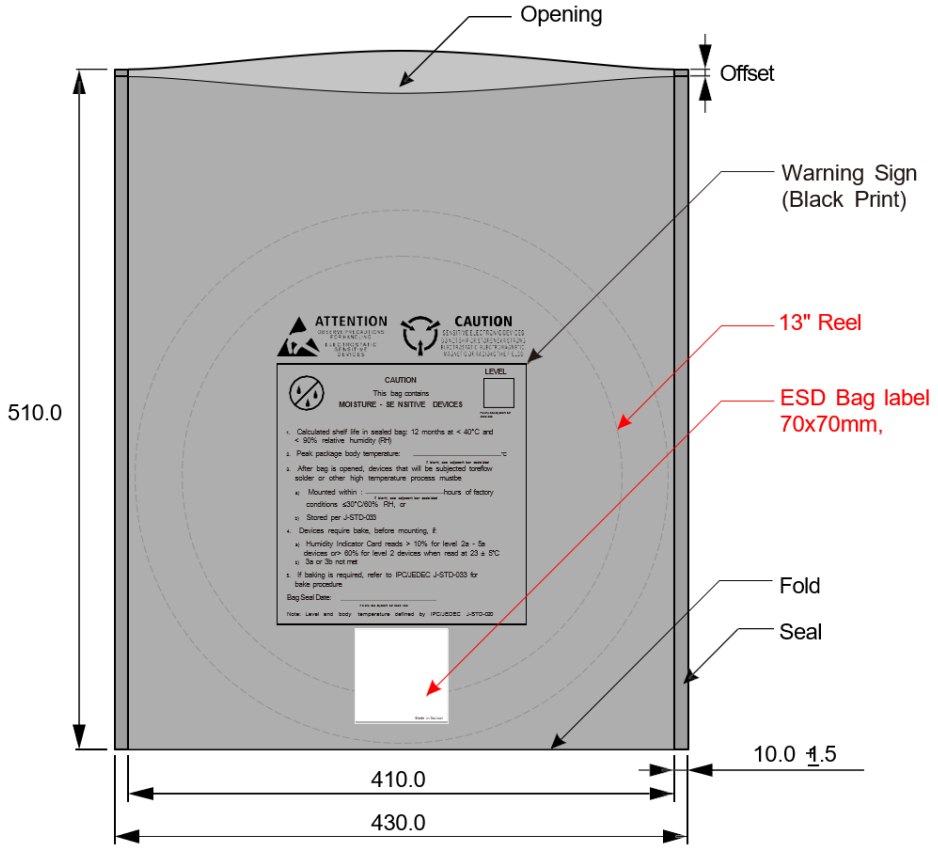
Reel Pack Box and Master Carton are made with B Flute material, with bursting strength >10Kgf/cm$^2$ and edge compression strength 5Kgf/cm. Handle with care.



## 18.3 ESD Vacuum Bag

Dimensions in millimetres (mm) of the anti-static vacuum bag used to seal under vacuum ready for storage one 500-piece reel. Detailed warning label is shown on the left.

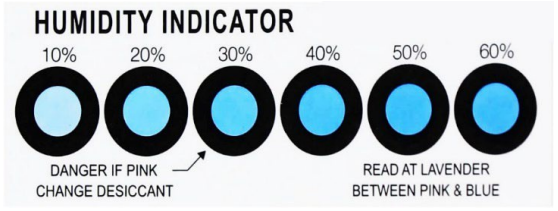


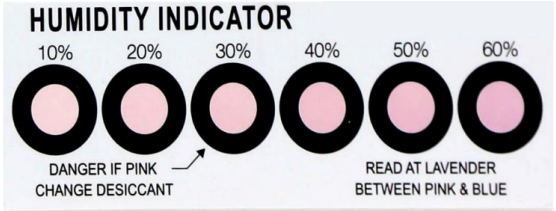

## 18.4 Moisture Sensitive Level (MSL)

The moisture sensitive level (MSL) of this module is rated as "3". Here depicted is the Indicator Card that is included inside the ESD vacuum bag.

Before reflow soldering, please confirm the status of humidity indicator card; baking is required if humidity indicator card is not blue above 30%.




*Indicator Card that has not been exposed to humidity.*




*Humidity Card exposed to humidity above 60%.*

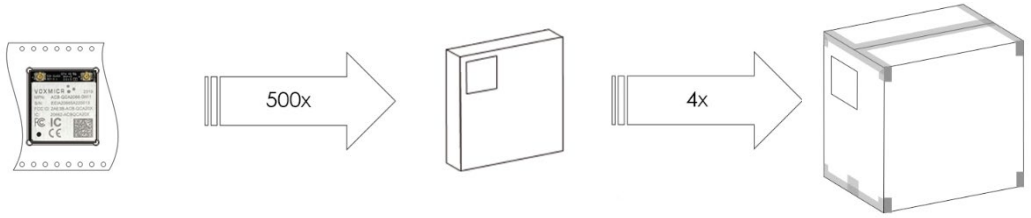
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## 18.5 Retail and Boxed Packing specifications:

Tape, Reel Pack & Master Outer Carton level standard packing methods are as follows. Samples and less-than-reel quantities ship as cut-tape portions.

*Packaging modality and artwork can flexibly follow OEM/ODM customer requirements.*

*The Packaging modality and the selection of its materials is made with environmental responsibility and commitment to resource preservation. Please reuse and recycle where possible.*




| | MODULE IN CUT-TAPE | REEL PACK (R) | MASTER CARTON (M) |
|---|---|---|---|
| CONTENT (UNITS) | 1 | 500 | 2000 |
| INVENTORY SKU | ACB-QCA206x-xxxx | ACB-QCA206x-xxxx-R | ACB-QCA206x-xxxx -M |
| OUTER DIMENSIONS | 44 x 32 x 3.1 mm | 160 x 142 x 62 mm | 430 x 350 x 285 mm |
| GROSS WEIGHT | 3.9 gr | 2000 gr | 8000 gr |
| PICK & PACK METHOD | Padded envelope or carton box depending on quantity. Best ships under vacuum, padded & separated. | In outer carton packaging. | As-is. |
| PACKAGING COMPLIANCE ** | ANSI/ESD S20.20, IEC 61340-5-1, RoHS3 | RoHS3 | RoHS3 |
| HTS CODE (HS) | 8517.62 | 8517.62 | 8517.62 |
| COUNTRY OF ORIGIN (COO) | 764 - Thailand | 764 - Thailand | 764 - Thailand |
| NAFTA / ECCN | 5A992c | 5A992c | 5A992c |

## 18.6 Package Labelling

Reel labels, reel bag and pack, as well as master carton labels include, as a minimum, the following information. See example label on the right:

- MPN (#4) and UPC (#2) for the E20 variant within
- short description of the product (#5)
- item quantity included (#6)
- production date code in the format YYWW (#3), where YY stands for the last two digits of the calendar year and WW stands for the calendar week at the time of production
- Country of Origin (#8) and the respective ISO country code
- BOX ID (#10) for traceability and identification the single units included. The BOX ID is required when retrieving Serial Numbers and MAC addresses of the products in the specific packaging unit.

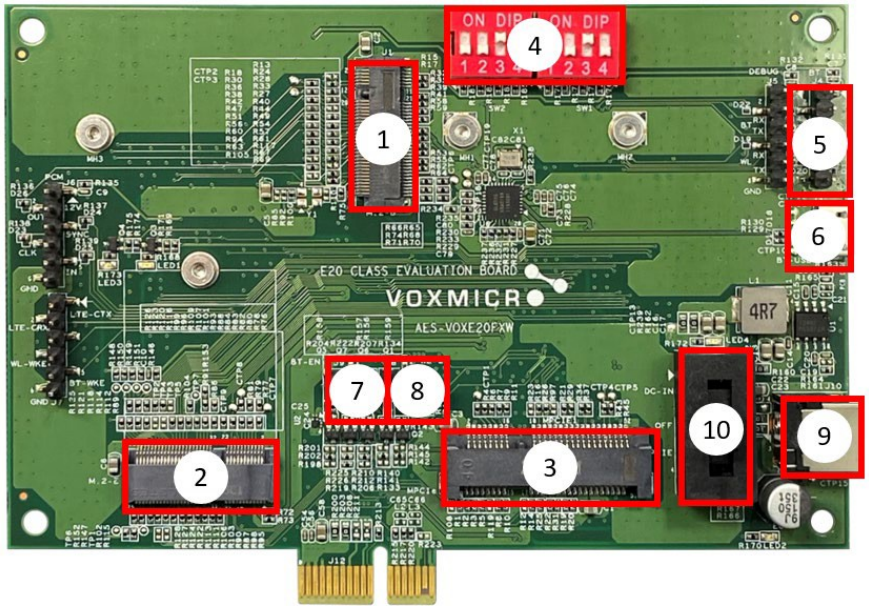



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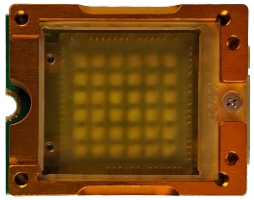
# 19. Tools & Kits

The AES-VOXE20FXW is a powerful evaluation board (EVB) kit which is designed to support hardware integration, performance validation and extended access to interfaces and I/Os, for all the form-factors of the E20 Class. This EVB:

- Can interface to all three different slotted E20 Class Modules; the M.2 E-Key (Series W), the M.2 B-Key (Series F) and the miniPCIe (Series X).
- Routes selectively the PCIE signals from the mPCIe socket and both the M.2 sockets to a standard PCIEx1 edge-connector.
- Exposes the BT UART interface, when present, and the BT USB interface, when instead this is present, to separate side connectors.
- Provides access to debug and development UART pads.




For assessing E20B LGA Chip-on-Board modules a special shielded socket is also available (PN# AFS-VOXE20B); one that is adapted to M.2 B-key edge-connector.



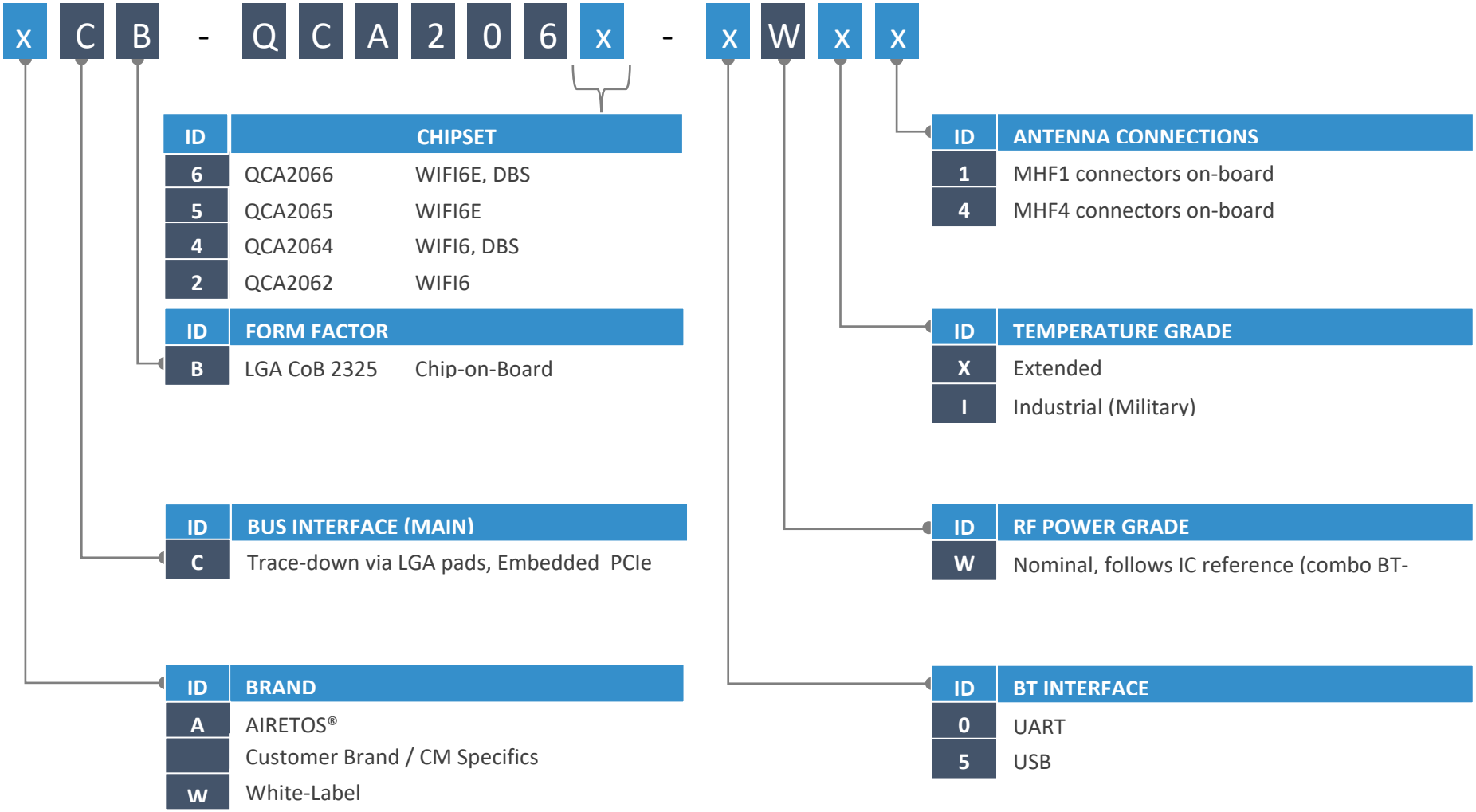
** Tools and Kits are separately documented and available.*

## 20. Ordering Information

Follows the E20B Series MPN Legend. Reference MPNs, with high-availability and low effective lead-time for this Series are:

- **ACB-QCA2066-0WI1** AIRETOS branded, BT via UART, Industrial temperature grade with MHF1 connectors
- **ACB-QCA2066-5WI1** AIRETOS branded, BT via USB, Industrial temperature grade with MHF1 connectors

The E20B Series (ACB-QCA206x-xxxx) is also available soldered on carriers with edge-connectors for standard slot-in form-factors for M.2 E-Key (Series W), M.2 B-Key (Series F) and mini PCIe (Series X).



# 21. Notices

**STORAGE:** The product shall be stored, and the package shall remain closed according to storage environmental conditions noted within this datasheet. - The product shall be stored in non-corrosive gas (Cl2, NH3, SO2, Nox, etc.). - No excess mechanical shock shall be applied including, but not limited to, sticking the packing materials by sharp object and dropping the product, in order to avoid damaging the packing materials.
**SHELVE LIFE:** Products left more than two years after reception need to have their specifications confirmed prior to use.
**HANDLING:** Care in handling or transporting products is required as excessive stress or mechanical shock may break products. – Cracks or damages on products' terminals may lead to changes in their characteristics. Products are not to be touched with bare hands as this may result in electrostatic damage. - Application of static electricity or overvoltage may cause defect in the product or deterioration of its reliability, and caution must be taken against exposure to any static electricity generated by electrified items such as workbenches, soldering irons, tools, carrying containers, etc.
**LAND PATTERN & DIMENSIONS:** All ground terminals should be connected to the ground patterns. Furthermore, the ground pattern should be provided between IN and OUT terminals. Please refer to the specifications for standard land dimensions.
**MECCHANICAL PLACEMENT:** When mounting products connected to other components, products may be stressed and broken by uneven forces. To prevent such damages, compliance with specifications for the tools and interfaces being used is required.
**CLEANING:** As this Product is Moisture Sensitive, no cleaning is permitted.
**OPERATIONAL EVNIRONMENTAL CONDITIONS:** Products are designed to work as part of electronic compositions under normal environmental conditions (ambient temperature, humidity and pressure). Operation under the following circumstances may damage the products and leakage of electricity and abnormal temperature may occur:
In an atmosphere containing corrosive gasses (Cl2, NH3, SOx, NOx) or combustible / volatile gases - Dusty places – Places of direct sunlight - Water splashing zones - Humid places where water condenses - Freezing places
In the instance of potential operation in such environments, consult with AIRETOS before actual use. Application of static electricity or excessive voltage while assembling and measuring is discouraged as it might be a cause of degradation or destruction.
**INPUT POWER CAPACITY:** Products shall be used in the input power capacity specified in this datasheet. If components are to be used beyond the documented input power capacity range, prior consultation with VOXMICRO is advised.
**LIMITATION OF APPLICATIONS:** The product is designed and manufactured for consumer application only and is not available for any application listed below which requires significantly high reliability for the prevention of defects that may directly cause damage to the third party's life, body or property.
- Aircraft equipment - Aerospace equipment - Undersea equipment - Power plant control equipment - Medical equipment - Transportation equipment (vehicles, trains, ships, etc.) - Traffic signal equipment - Disaster prevention / crime prevention equipment - Data-processing equipment - Application of similar complexity and/ or reliability requirements to the applications listed in the above.
If the product is to be used in equipment or electric circuit that requires high safety or reliability function / performances, sufficient reliability evaluation check for safety shall be performed prior to commercial shipment and consideration for the installation of a protective circuit at customer's design stage is strongly recommended. Please provide and appropriate fail-safe function on the customer's product to prevent any damages that may be caused by the abnormal function or the failure of our product.
**QUALITY CONTROL:** Testing and quality control is applied to the extent VOXMICRO deems necessary. Unless mandated by government requirements, VOXMICRO does not necessarily test all parameters of each product.
**LIFECYCLE:** Please note that VOXMICRO may discontinue the manufacture of products, due to reasons such as end of supply of materials and/or components from our suppliers.
**CONFORMITY:** Please make sure that your product has been evaluated and confirmed against your specifications when the AIRETOS product is mounted to your product. Please conduct validation and verification of the products in actual condition of mounting and operating environment before commercial shipment of the equipment. All the items and parameters in this product specification have been prescribed on the premise that our product is used for the purpose, under the condition and in the environment agreed upon between you and us. You are requested not to use our product deviating from such agreement. We consider it not appropriate to include other terms and conditions for transaction warranty in product specifications, drawings or other technical documents. Therefore, even if your original part of this product specification includes such terms and conditions as warranty clause, product liability clause, or intellectual property infringement liability clause, we are not able to accept such terms and conditions in this product specification unless they are based on the governmental regulation or what we have agreed otherwise in a separate contact. We would like to suggest that you propose to discuss them under negotiation of contract.

**DISCLAIMER:** Please note that the only warranty that provides regarding the products is its conformance to the specifications provided herein. Accordingly, VOXMICRO shall not be responsible for any defects in products or equipment incorporating such products, which are caused under the conditions other than those specified in this specification.
VOXMICRO HEREBY DISCLAIMS ALL OTHER WARRANTIES REGARDING THE PRODUCTS, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, THAT THEY ARE DEFECT-FREE, OR AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. YOU AGREE TO INDEMNIFY AND DEFEND VOXMICRO AND ITS AFFILIATES AGAINST ALL CLAIMS, DAMAGES, COSTS, AND EXPENSES THAT MAY BE INCURRED, INCLUDING WITHOUT LIMITATION, ATTORNEY FEES AND COSTS, DUE TO THE USE OF PRODUCTS.
VOXMICRO's liability under this warranty shall be limited to products that are returned during the warranty period to the address designated by VOXMICRO and that are determined by VOXMICRO not to conform to such warranty. If VOXMICRO elects to repair or replace such products, AIRETOS shall have reasonable time to repair such products or provide replacements. Repaired products shall be warranted for the remainder of the original warranty period. Replaced products shall be warranted for a new full warranty period.
For avoidance of doubt, VOXMICRO shall not be liable for any defects that are caused by neglect, misuse or mistreatment by an entity other than VOXMICRO including improper installation or testing, or for any products that have been altered or modified in any way by an entity other than VOXMICRO. Moreover, VOXMICRO shall not be liable for any defects that result from your or third party's design, specifications or instructions for such products.

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# VOXMICRO PROFILE

## Distributed Locations & Customer-Centric Operations




## Quality processes at all stages

Sourcing Assurance

Application / Custom / ODM

Materials Management

Supply Chain

FAE

**R&D** → **DESIGN** → **PRODUCTION** → **DISTRIBUTION** → **TQM**

5%
OF REVENUE
• **INVESTED IN INNOVATION R&D**

12 YEARS
HANDS-ON IN
• **OEM/ODM WIRELESS MODULE MARKET**

DECADES OF
• **CUMMILATIVE ENGINEERING EXPERIENCE**

HUNDREDS OF
• **ROUTINE INDUSTRIAL CUSTOMERS**

THOUSANDS OF
• **TUNING HOURS YEARLY**

MILLIONS OF
• **INTERNAL AND EXTERNAL INVESTMENTS**

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