E20 Class, Series W

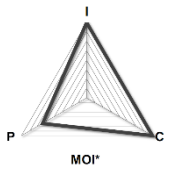
MPN prefix:

AFW-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 – M.2 E-Key 3030 Module

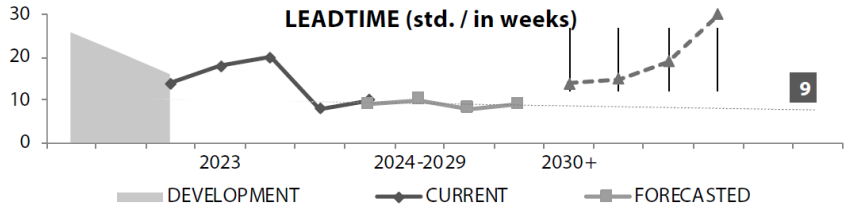
AIRETOS PCI EXPRESS 20B SERIES

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	< 2.5 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	< 5 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

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	2023-03-10	Improved Ordering Information Section.	N Manoukian	L Tu
Version 1.11	2023-03-23	Added backside label information.	N Manoukian	L Tu
Version 1.4	2023-06-26	Document fixes and refreshed images.	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

* 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.

E20 CLASS, SERIES W 1
AFW-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 – M.2 E-KEY 3030 MODULE 1
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1. Description

Tri-Band Capable, Dual-Band Simultaneous 2x2 Wi-Fi 6E M.2 E-Key module: widely compatible slot-in modules that offer a full implementation of the Wi-Fi 6E standard (IEEE 802.11ax extended to include the ISM 6Ghz bands). The E20W deploys the QCA206x wireless SoC processor family, with the QCA2066 as the flagship model and part of the FastConnect 6900 and Networking Pro architectures.

- Provides standard M.2 connector and form-factor for the LGA CoB E20B Series, which is a platform that flexibly leverages the technology elements of this Qualcomm IC in a configurable product for use in a wide variety of applications, industries and markets.
- The AIRETOS® E20 Class operates a dual-MAC for connections up to 3 Gbps data rate in Dual Band Simultaneous modes (2x2+2x2 11ax DBS). 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.

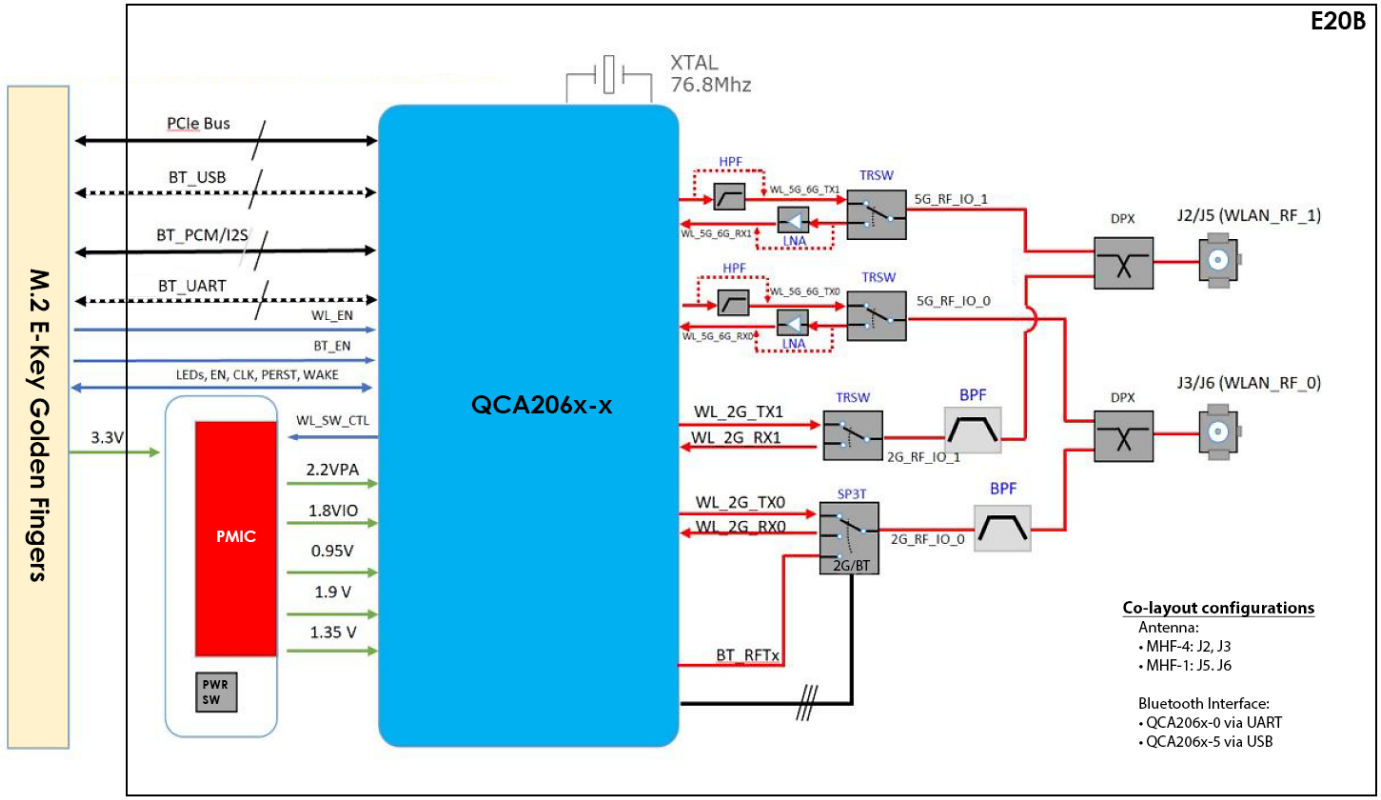
Flexible configuration: chipset options, choice of BT interface bus, antenna and grade. The same LGA CoB core module, the Series B (ACB-QCA2066-xxxx), is also available soldered on carriers with edge-connectors for standard slot-in form-factors for M.2 B-Key (Series F) and mini PCIe (Series X).

2. Top Features

- Industrial Grade (-40 ~ +85°C) performance, fully featured Wi-Fi6 M.2 E-Key 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.
- Based on a multipotent 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

3. Block Diagram

Follows the E20W Block Diagram, showing as framed the E20B LGA CoB, which carries 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. • optional use of the respective QCA2065, QCA2064 or QCA2062 chip variants • 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**	Edge-connector golden-finger pads: WLAN: via PCI Express Standard 3.0 host I/O BT: via UART (with QCA206x-0 SoCs). or via USB 1.1 (with QCA206x-5 SoCs) BT Audio: via selectable Slimbus/PCM (with QCA206x-0 SoCs), or via I2S (with QCA206x-5 SoCs). I2C in pin-mapped.
	Form Factor	M.2 E-Key 3030, Slotted, Socketed (30mm x 30mm) [CoB soldered on carrier]
ANTENNA	**Configuration**	WLAN: Two Streams (2 chains), 2x2, 2 Connectors, MU-MIMO 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 4.9 GHz (optional band support for Japan only) 5.15-5.25 GHz (FCC UNII-low band) for US/Canada, Japan and Europe 5.25-5.35 GHz (FCC UNII-middle band) for US/Canada and Europe 5.47-5.725 GHz for Europe 5.725-5.825 GHz (FCC UNII-high band) for US/Canada 5.850–5.925 GHz (optional band support for U-NII-4 DSRC/ITS) 5.925–6.425 GHz (U-NII-5) [implemented with QCA2066 and QCA2065 only] 6.425–6.525 GHz (U-NII-6) [implemented with QCA2066 and QCA2065 only] 6.525–6.875 GHz (U-NII-7) [implemented with QCA2066 and QCA2065 only] 6.875–7.125GHz (U-NII-8) [implemented with QCA2066 and QCA2065 only] BT: 2402MHz~2480MHz
	Data Transfer Rates	WLAN: 802.11ax: Up to 3000Mbps (dynamic) 802.11ac: Up to 867Mbps (dynamic) 802.11n: Up to 300Mbps (dynamic) 802.11a/g: Up to 54Mbps (dynamic) 802.11b: Up to 11Mbps (dynamic) BT: GFSK at 1Mbp π/4-DQPSK at 2Mpbs 8DPSK at 3Mpbs
	Media Access Control	CSMA/CA with ACK

WIRELESS PARAMETERS

Channels

2.4GHz: 1-13 (14 only for Japan)
5GHz: 36-64, 100-165
6GHz: 191-423 (depending on operating domain, with QCA2066 and QCA2065 chips only)

Channel Spacing

5MHz, 10MHz, 20 MHz, 40Mhz selectable for 2.4Ghz band. 80Mhz and 160MHz* are also selectable for 5Ghz and 6Ghz spectrums. * 160Mhz is implemented with QCA2066 and QCA2065 chips only.

Spreading / Modulation

WLAN: 802.11ax: OFDMA (BPSK, adds 1024-QAM on MCS10 and MCS11)
802.11ac/g/n: OFDM (BPSK, DSSS-OFDM, QPSK,16-QAM,64-QAM, 256-QAM), MRC, STBC, LDPC, ML Demodulation
802.11b: CCK (11, 5.5Mbps), DQPSK (2Mbps), BPSK (1Mbps)

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 -83Bm)

	Operating Range	Open Space: ~300 m; Indoor: :~100 m (Coverage vary according to environment, antenna and topography)
	Wireless Security	WEP 64-bit and 128-bit encryption WPA/WPA2/WPA3 UL/DL (Wi-Fi Protected Access)
MODALITIES	Infrastructure, AP/STA, Client, Bridge, Mixed-mode, P2P/Ad-hoc, Easy Mesh. DBS & NON-DBS (SCC & MCC)	
SAFETY & REGULATORY	Compliant with FCC, IC ISED , CE RED and more. Compliant with RoHS3.	
PROTOCOLS	**IEEE WLAN Network**	IEEE 802.11a/b/g/n/ac/ax (Wi-Fi6E), 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 * Host supporting PCIe 32 or single MSI interrupts is required for some setups. ** 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	MSL2 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**	30.0mm x 30.0mm x 3.3mm (with shielding)
	Weight	5.4 g
PACKAGING	**Packing style**	ESD Sleeves in Carton Package
	Package Contents	Module only

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

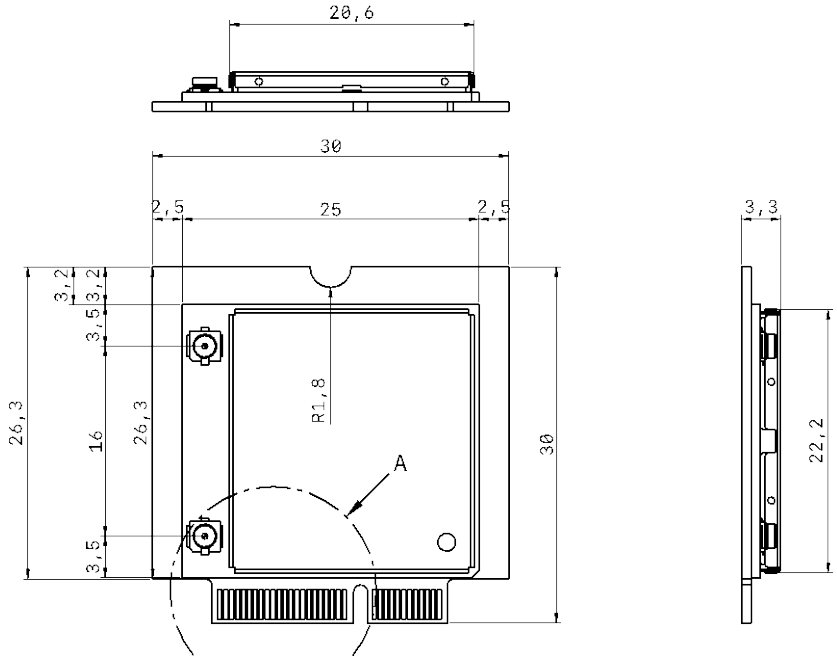
Mechanical drawings in millimeters (mm). For further information and dimensions refer to the PCIE Express M.2 specification.

RESOURCES

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

- *3D Mechanical STEP file: DCN # 08A-PD3D-99_E20W(UFL)_Device-3D*
- *AEBPO-190013 - AIRETOS AFW-QCA206x-xWx1 Mechanical Drawing.pdf*

MHF4 versions of the same resources are on-demand.

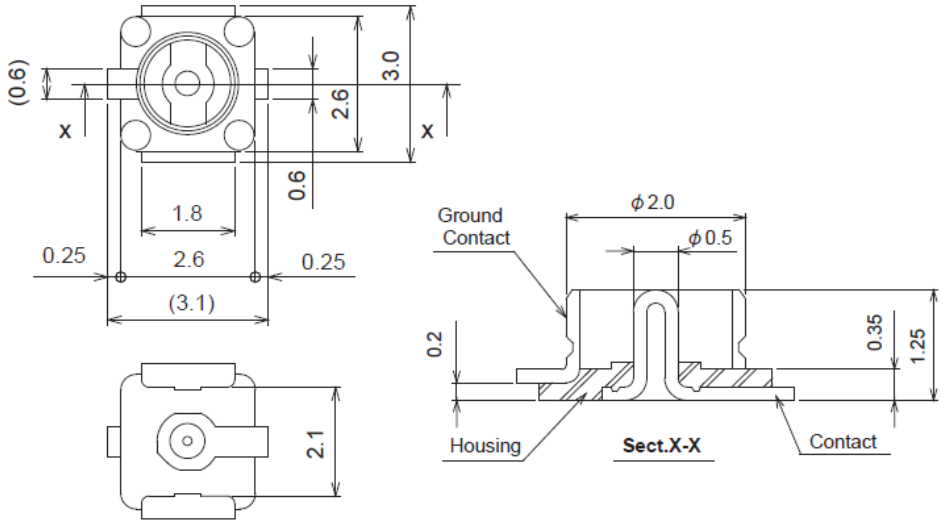


6.1 MHF1 Antenna Receptacle

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.

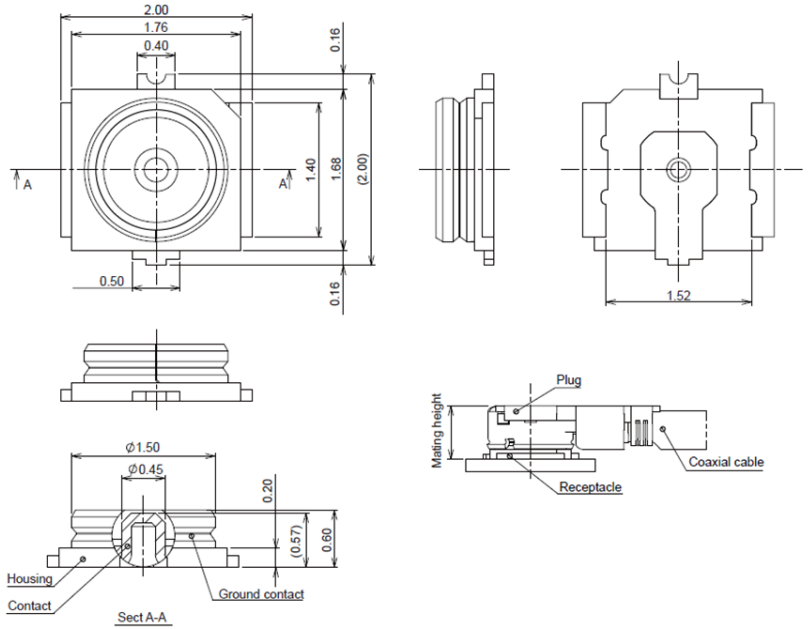
Present in all MPNs with suffix 1.



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. Module Pin-out

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.

RESOURCES

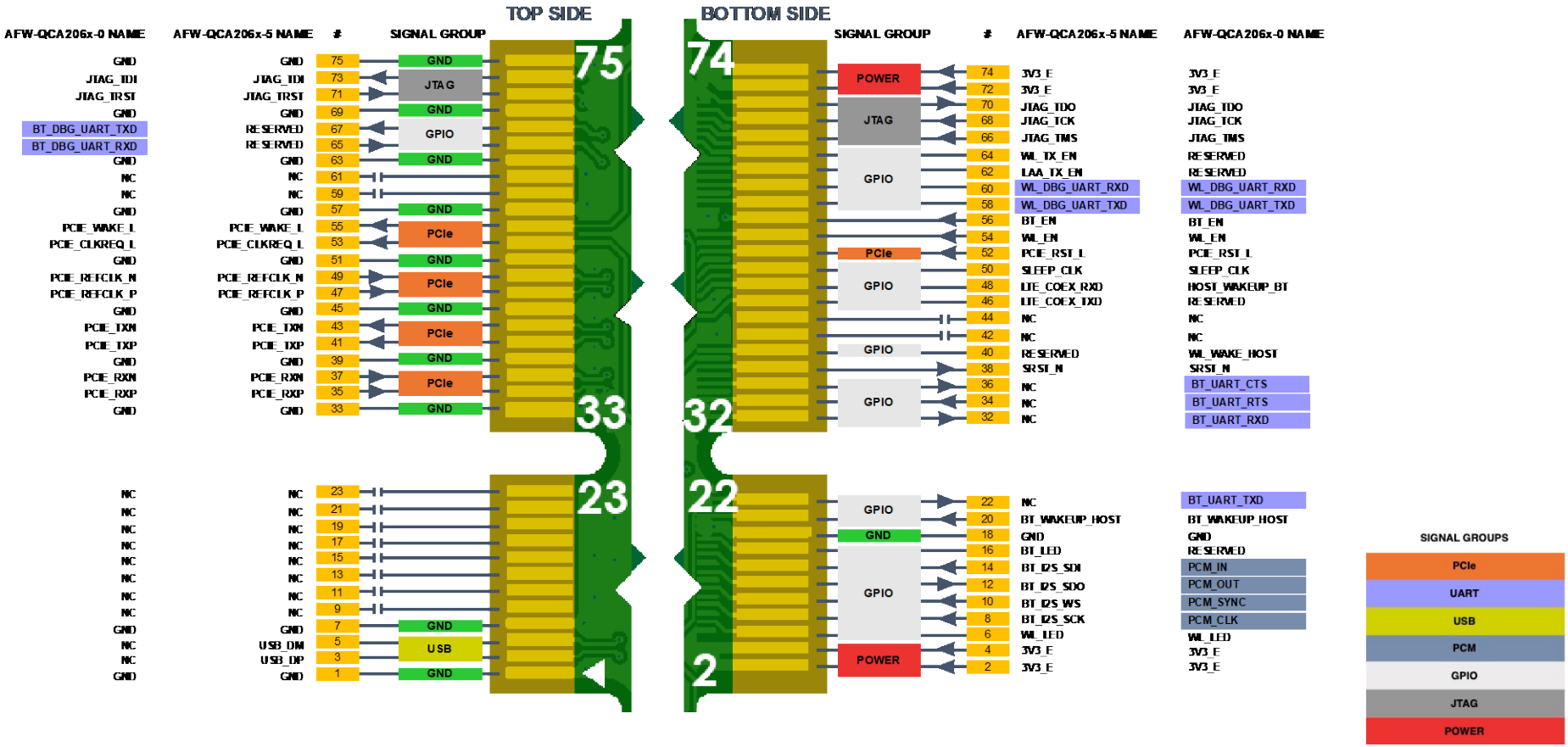
***Related Resources** (available from the product page):*

- *DCN # AEBPO-190003 - AIRETOS_AXW-QCA206x-xxxx_Pin-Mapping.pdf with the full Pin-out list with Contact Numbers and short descriptive of each pad.*

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

INTERFACE TYPE	BUS SIGNALING	STANDARD
M.2 Pads	PCIe	PCIe 3.0
M.2 Pads	HCI UART*	3.2Mbps
M.2 Pads	PCM/I2S/Slimbus	
M.2 Pads	USB**	1.1

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



8. External sleep clock timing

Sleep clock reference input requirements.

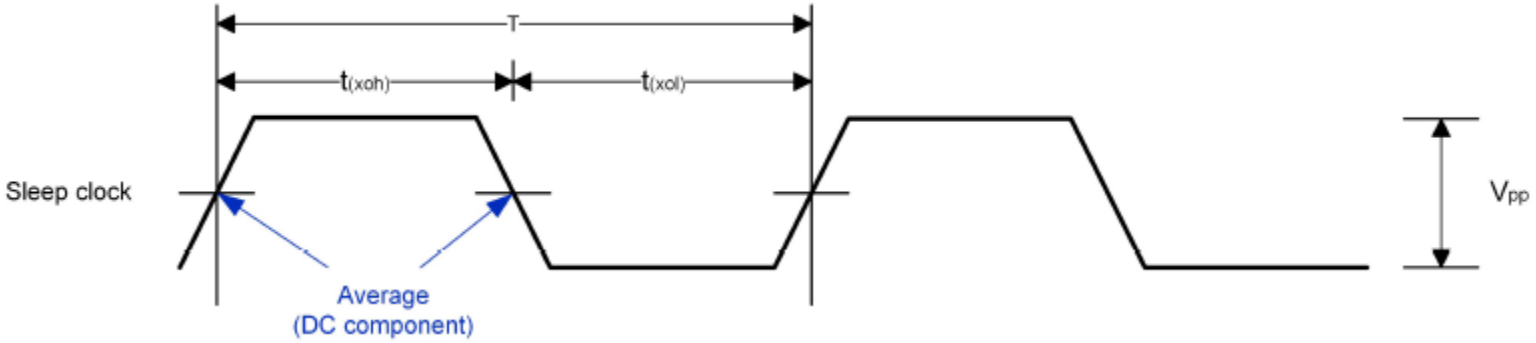


Figure 8-1: External sleep clock

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

9. Power sequences

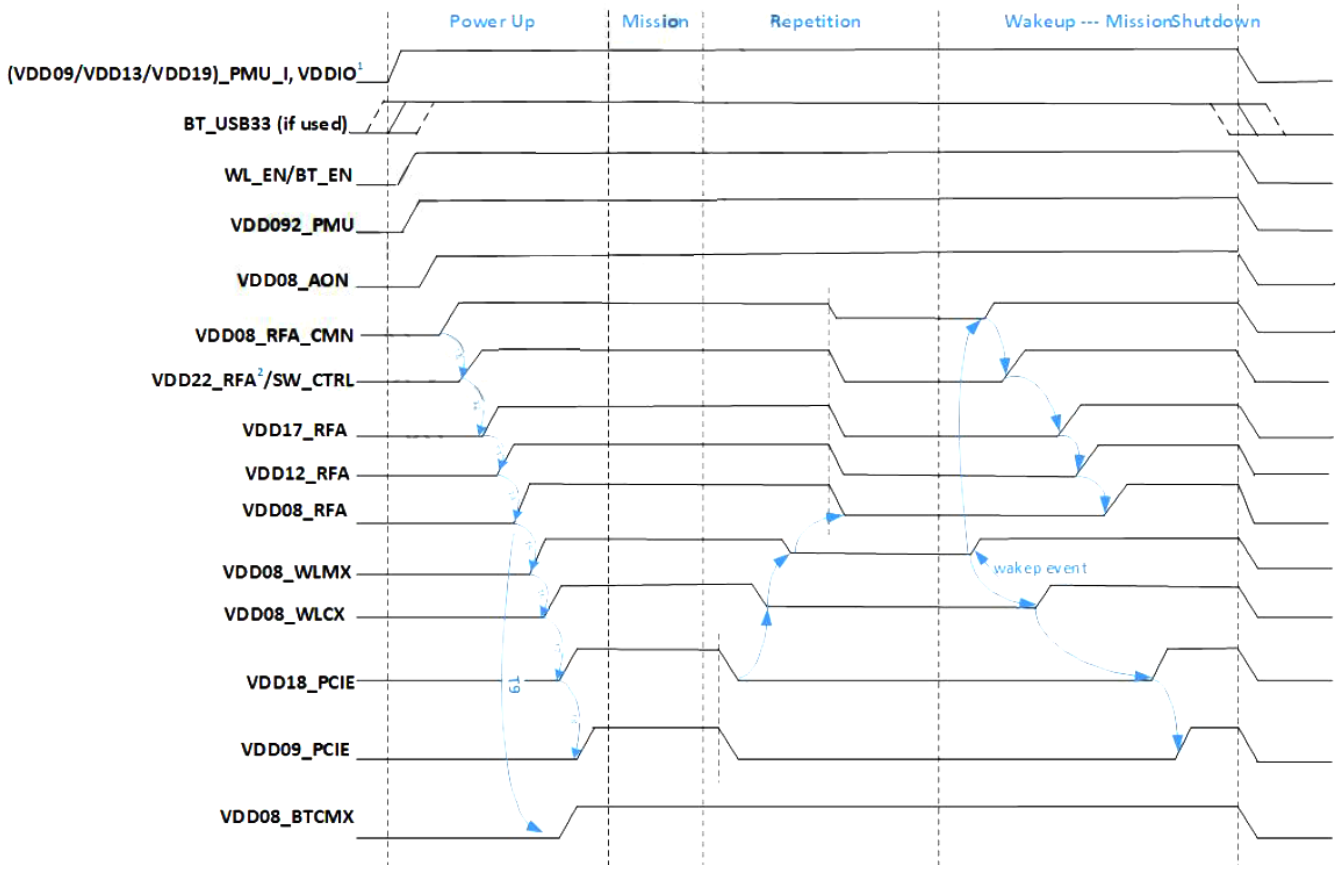


Figure 9-1: Module power sequences requirement

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 7-1: Timing Parameter Definition

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

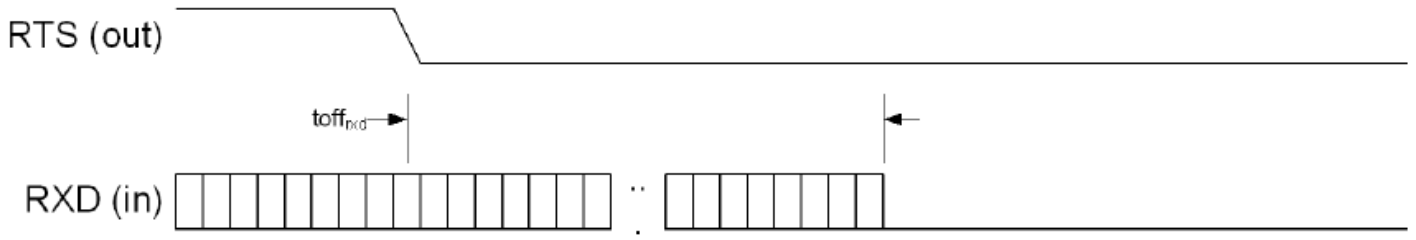


Figure 10-2: HCI UART receive flow control timing

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 9-3 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 QCA2066 PCM interface is the master, PCM_CLK and PCM_SYNC are outputs from the QCA2066 to one or more PCM bus slaves.
- When the QCA2066 PCM interface is the slave, PCM_CLK and PCM_SYNC are inputs to the QCA2066 device from the PCM bus master.

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.

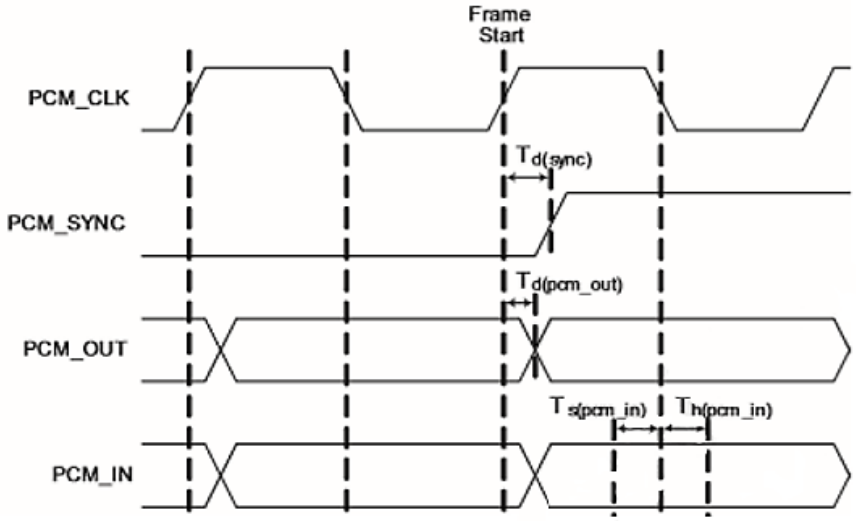


Figure 10-3:PCM interface timing diagram (slave)

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

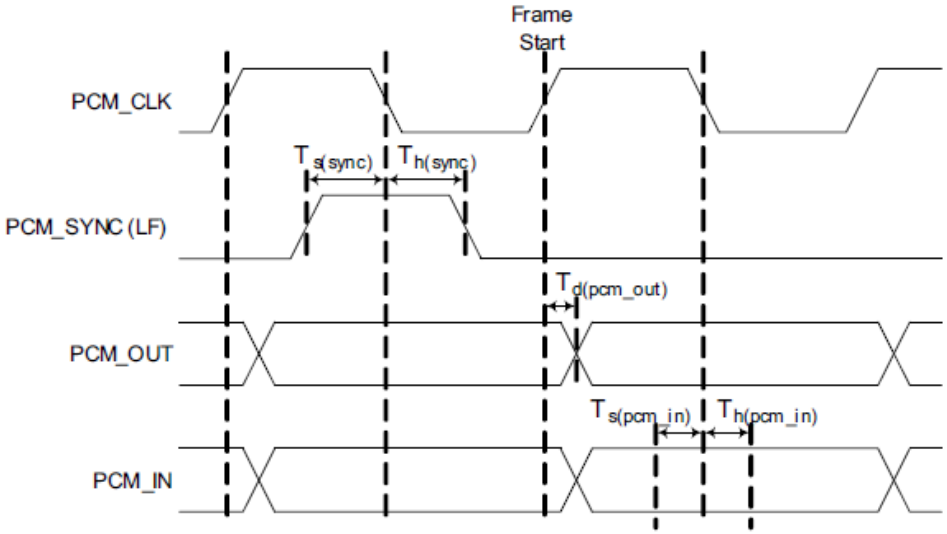


Figure 10-4: PCM interface timing diagram (master)

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

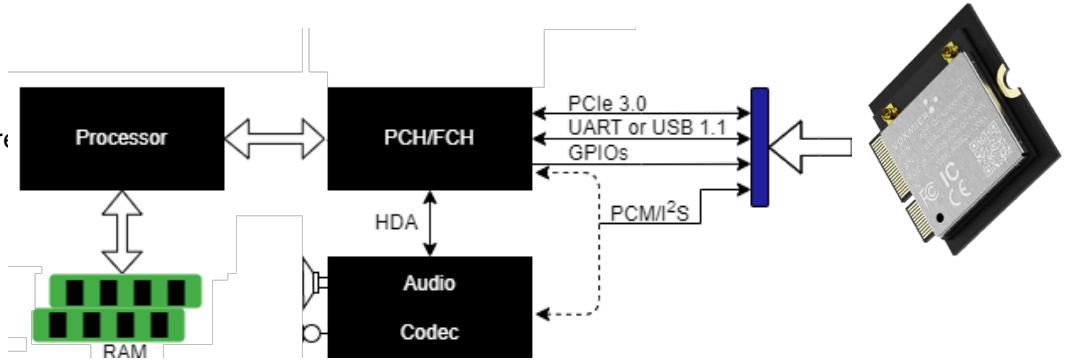
Table 10-6: PCM interface timing in master mode

11. Design-in References

11.1 Platform Connection Topology

A general Platform Connection Topology, like the one shown here

- 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:

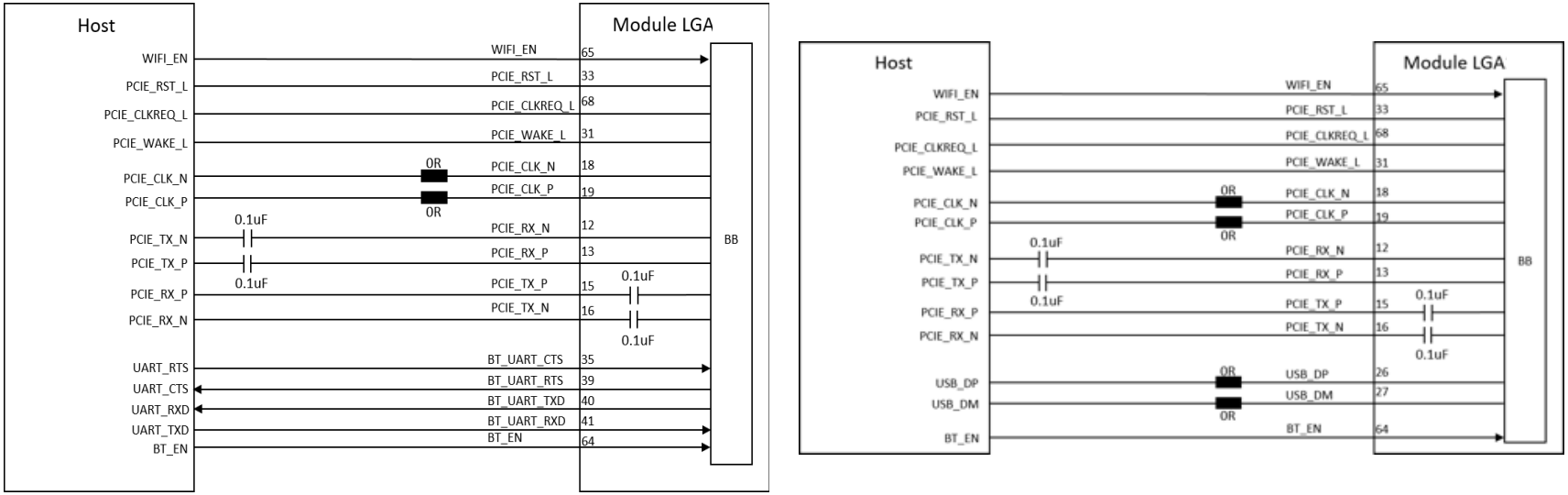


Figure 11-1: General Platform Connection Topology

11.3 Layout Recommendations

Please refer to the following layout recommendations for the high-speed signal trace routing.

- The differential impedances are recommended 90ohm.
- 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.

12. Environmental Performance Qualification

Follow the power consumption and the 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°C.

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.

13. Standard Domain Code & Identification

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

14. 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.

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.

15. Product Label

15.1 Front (Shield) Regulatory Label

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].

15.2 Back (Carrier PCB) Label

The PCB silkscreen contains the AIRETOS brand logo and the module's description with series Model ID.

15.3 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.

16. 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

17. Packaging, Labelling, Storage and Handling

17.1 Retail and Boxed Packing specifications:

ESD Sleeve, Inner Box & Master Outer Carton level standard packing method*, follows. Packaging in matrix tray is TBC.

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 ESD SLEEVE	INNER BOX KIT (R)	MASTER CARTON (M)
CONTENT (UNITS)	1	60	960
INVENTORY SKU	AFW-QCA206x-xxxx	AFW-QCA206x-xxxx-K	AFW-QCA206x-xxxx -M
OUTER DIMENSIONS	70 x 60 x 4 mm	204 x 165 x 65 mm	430 x 350 x 285 mm
GROSS WEIGHT	5.5 gr	365 gr	6000 gr
PICK & PACK METHOD	Padded envelope or carton box depending on quantity. 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

17.2 Package Labelling

Inner box and master carton labels include, as a minimum, the following information. See an example inner box label on the right:

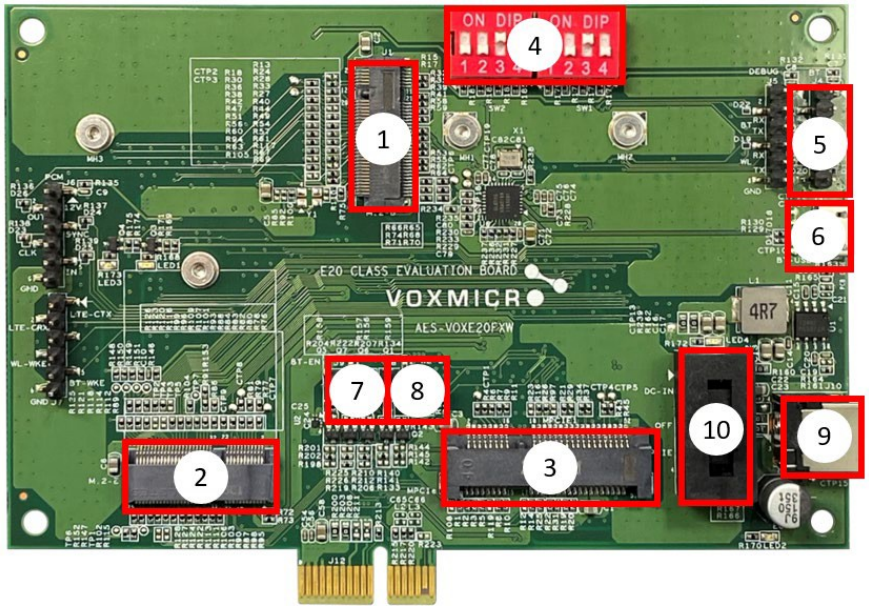
- MPN and UPC for the E20 variant within
- short description of the product
- key regulatory markings
- item quantity included
- Country of Origin and the respective ISO country code
- Specific SKU of the product packaging

BOX ID 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.

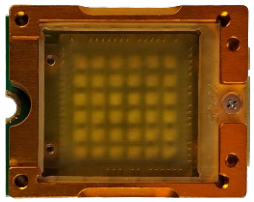
18. Tools & Kits

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.



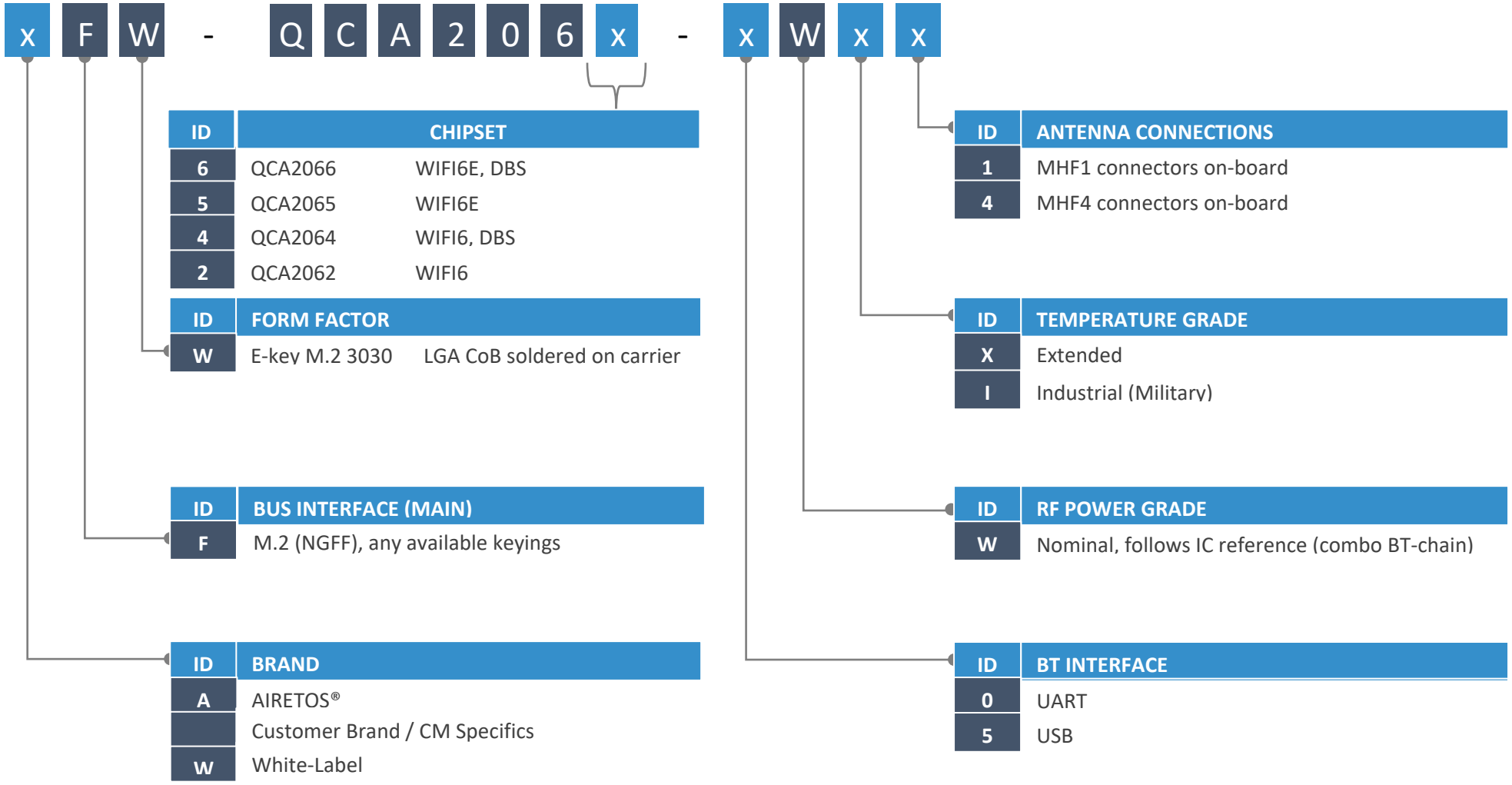
** Tools and Kits are separately documented and available.*

19. Ordering Information

Follows the E20W Series MPN Legend. Reference MPNs, with high-availability and low effective lead-time for this Series are:

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

The same LGA CoB core module, the Series B (ACB-QCA2066-xxxx), is also available soldered on carriers with edge-connectors for standard slot-in form-factors for M.2 B-Key (Series F) and mini PCIe (Series X).



20. 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.

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**