

Doodle Labs ACO-DB-2 Wi-Fi Transceiver

Dual Band – 5.x and 2.4 GHz, MIMO, IEEE802.11ac outdoor transceiver

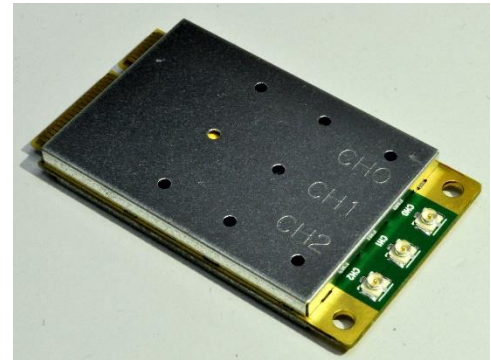
Product Family Overview

Doodle Labs' portfolio of Industrial Wi-Fi transceivers offer the industry's best-in-class performance. These transceivers have high transmit power for long-range communication and has been designed to withstand operation in extremely challenging environments. In addition, these transceivers feature high interference immunity that allows successful operation in today's congested Wi-Fi environments. The transceivers are FCC, CE, and IC certified and have been deployed in numerous demanding applications.

Target Applications

The Doodle Labs Outdoor Wi-Fi transceivers meet the demanding needs of customers across a broad range of industries. Examples include:

- IoT applications
- Access Points for large area coverage
- Fixed wireless PtP links
- Mesh networking deployments
- Streaming HD video surveillance cameras
- Fixed wireless infrastructure for campuses



Features

Best-in-class features include:

- Modular FCC, CE, and IC certifications to expedite system integration and deployment
- Integrated LNA for high Rx sensitivity to pick up low energy signals from mobile phones
- Up to 27 dBm of RF power to communicate over a large area
- Extended temperature range from -40C to +60C for outdoor operation
- Electrical stress protection on antenna ports for outdoor operation

ACO-DB-2 Specifications

Table 1. Technical Specifications.

Ordering Code	ACO-DB-2U with U.FL connectors
Radio Configuration	2x2 MIMO, Dual Band
Design-In Documentation	https://www.doodlelabs.com/technologies/technical-library/
MAC Chipset	Qualcomm Atheros: QCA9890-BR4B with Extended Temperature range
Software Support	Open Source Linux Drivers <u>ath10k</u> for 11ac models <u>OpenWRT</u> (Wireless Router/Linux OS)
Center Frequency Range	5.180 GHz ~ 5.825 GHz 2.412 GHz ~ 2.484 GHz This varies by the regulatory domain
Channel Bandwidth*	20, 40 and 80 MHz channels
Radio Modulation/Data Rates (Dynamic Link Adaptation)	<u>802.11ac</u> : MCS0-9 (5.x GHz) <u>802.11a</u> : 6, 9, 12, 18, 24, 36, 48 and 54 Mbps (5.x GHz) <u>802.11n</u> : MCS0-23 (5.x and 2.4 GHz) <u>802.11b/g</u> : 1, 2, 5.5, 6, 9, 11, 12, 18, 24, 36, 48 and 54 Mbps (2.4 GHz)
802.11ac Wave 1 Capabilities	<ul style="list-style-type: none"> • 802.11 dynamic frequency selection (DFS) as an AP and Client • Packet aggregation: A-MPDU (Tx/Rx), A-MSDU (Tx/Rx), Maximal ratio combining (MRC), Cyclic shift diversity (CSD), Frame aggregation, block ACK, 802.11e compatible bursting, Spatial multiplexing, cyclic-delay diversity (CDD), low-density parity check (LDPC), Space Time Block Code (STBC) • Phy data rates up to 1.3 Gbps (80 MHz channel)
802.11n version 2.0 Capabilities	<ul style="list-style-type: none"> • 802.11 dynamic frequency selection (DFS) as an AP and Client • Packet aggregation: A-MPDU (Tx/Rx), A-MSDU (Tx/Rx), Maximal ratio combining (MRC), Cyclic shift diversity (CSD), Frame aggregation, block ACK, 802.11e compatible bursting, Spatial multiplexing, cyclic-delay diversity (CDD), low-density parity check (LDPC), Space Time Block Code (STBC) • Phy data rates up to 450 Mbps (40 MHz channel)

Operating Modes	AP, Client, and Adhoc modes for Access Point, PtP, PtMP, and Mesh networks
MAC Protocol	TDD with Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA)
Wireless Error Correction	FEC, ARQ
Wireless Data Security	128 bit AES, WEP, TKIP and WAPI hardware encryption. Support for IEEE 802.11d, e, h, i, k, r, v, w and time stamp standards

Table 2. Tx and Rx performance at 5 GHz.

Tx/Rx Specification	Radio Modulation	Coding Rate	Tx Power ($\pm 2\text{dBm}$) ²	Rx Sensitivity (Typ)
5 GHz (20 MHz Channel) – 11ac models				
802.11a, STBC	BPSK	1/2	24	-94
802.11a	64 QAM	3/4	19	-79
802.11ac, 802.11n	BPSK	1/2	24	-93
802.11ac, 802.11n	16 QAM	3/4	23	-83
802.11ac, 802.11n	64 QAM	5/6	19	-72
802.11ac	256 QAM	3/4	18	-66
5 GHz (40 MHz Channel) – 11ac models				
802.11ac, 802.11n	BPSK	1/2	24	-89
802.11ac, 802.11n	16 QAM	3/4	23	-78
802.11ac, 802.11n	64 QAM	5/6	19	-68

802.11ac	256 QAM	5/6	18	-65
5 GHz (80 MHz Channel) – 11ac models				
802.11ac	BPSK	1/2	24	-87
802.11ac	16 QAM	3/4	23	-77
802.11ac	64 QAM	5/6	19	-66
802.11ac	256 QAM	5/6	18	-62

Table 3. Tx and Rx performance at 2.4 GHz.

Tx/Rx Specification	Radio Modulation	Coding Rate	Tx Power ($\pm 2\text{dBm}$) ²	Rx Sensitivity (Typ)
2.4 GHz (20 MHz Channel) – 11ac models				
802.11b Single Stream, STBC	1 Mbps	CCK	25	-96
802.11g	64 QAM	3/4	19	-80
802.11n	BPSK	1/2	25	-92
802.11n	16 QAM	3/4	24	-82
802.11n	64 QAM	5/6	19	-72
2.4 GHz (40 MHz Channel) – 11ac models				
802.11n	BPSK	1/2	25	-90

802.11n	16 QAM	3/4	24	-79
802.11n	64 QAM	5/6	19	-70

Note 1: It is advantageous to use the smallest channel bandwidth that can support throughput requirements. Smaller bandwidths provide more channels to choose from and help avoid interference issues.

Note 2: Total Tx power for all streams. Max allowed Tx power depends on the regulatory domain.

Table 4. Additional RF performance information.

Antenna Signal Strength	-35 to -85 dBm (recommended), Absolute Maximum=+12 dBm
Integrated Antenna Port Protection	10 kV
Receiver LNA Gain	>10 dB
Receiver Adjacent Channel Rejection (ACR)	>18 dB @ 11a, 6 Mbps (Typ)
Receiver Alternate Channel Rejection (ALCR)	>35 dB @ 11a, 6 Mbps (Typ)
Receive chain Noise Figure	+6 dB
Transmitter Adjacent Channel Leakage Power Ratio (ACLR)	45 dB (Fc ± ChBW)
Transmitter Spurious Emission Suppression	-40 dBc
RF Power control	In 0.5 dBm steps. Accuracy of power calibration loop ±2 dBm. Each transceiver individually calibrated and tested.

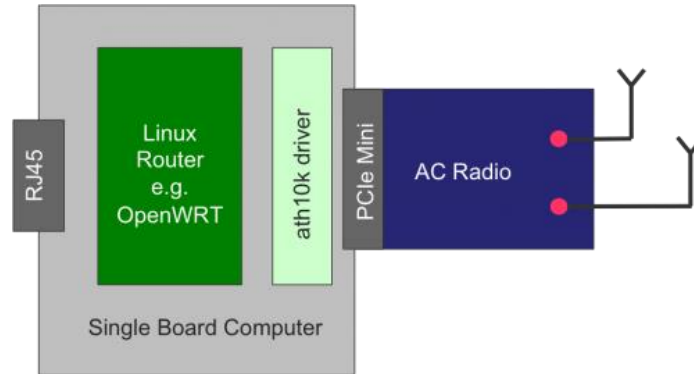
Table 5. Physical, Environment, and Other Specifications.

Host Interface	miniPCI-Express 1.2 Standard
Host CPU Board	Any CPU board with miniPCIe interface with minimum 6 mm connector height
Operating Voltage	3.3 Volts from miniPCI-Express connector
Power Consumption	4W @ Max power, in continuous data transfer mode on all chains 2W @ 20 dBm power (ETSI max), in continuous data transfer mode on all chains 0.7W in continuous data receive mode 250 mW in Sleep mode

Temperature range	-40°C to +85°C (shield case)
Humidity (Operating)	0% – 95% (Non-condensing)
Dimensions	30 x 50 x 5.3 mm, 12 grams. Mechanical drawings and 3D-CAD files available upon request
MTBF	25 years
Regulatory Requirements	Designed and verified to meet various regulatory requirements. Formal testing and approval is required based on the integrator’s particular host platform and antenna type. The integrator is also responsible for obtaining all required regulatory approvals in target markets for the finished product.
FCC ID	2AG87DLM168N
CE/ETSI	Conforms with all the requirements of the European Directive 1999/5/EC – EN 301 893 V1.8.1, EN 300 328 V.1.8.1, EN 301 489-1 V1.9.2, EN 301 489-17 V2.2.1, EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011+ A2:2013
Industry Canada (IC)	21411-DLM1683
RoHS/WEEE Compliance	Yes. 100% Recyclable/Biodegradable packaging

System Integration

Figure 3. System Integration Block Diagram.



As shown in the block diagram, the modular nature of the MIMO radio transceivers allows for accelerated development of the wireless modem. An embedded Single Board Computer with standard miniPCI-Express interface is required. The Linux distribution OpenWRT has evolved over time and provides advanced features in a wireless router. It is a stable distribution and many OEMs are using OpenWRT as a starting point and then customize further for their application. The distribution includes the ath10k driver to interface with the MIMO transceivers. Both OpenWRT and open source drivers (ath9k and ath10k) have extensive online documentation available. User group forums also provide responsive technical support.

Portfolio Index

Doodle Labs' Outdoor Wi-Fi transceiver portfolio provides configurations for a vast variety of project needs. All models are form-factor compatible. For information on other models, please visit - <http://www.doodlelabs.com/products/wi-fi-band-radio-transceivers/>

Doodle Labs provides extensive design-in documents at:

<https://www.doodlelabs.com/technologies/technical-library/>