Doodle Labs Industrial WiFi Transceivers

Integration Guide

Overview

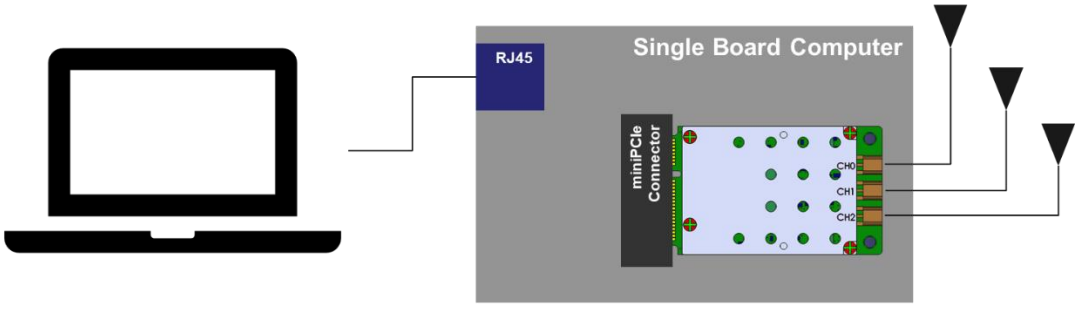
Doodle Labs' Industrial WiFi Transceivers (IEEE 802.11ac and 802.11n) feature the industry's best performance: Long-Range, high transmit power, receive sensitivity, and interference immunity. With an eye towards operation in the most complex and harsh conditions, the modules have been designed and manufactured to military-grade standards.

In this integration guide we hope to provide the necessary information, answers to frequently asked questions and tips for a smooth and quick modem development.

Quickstart

This section includes a basic hardware setup guide and information on how to quickly evaluate Doodle Labs' Industrial WiFi Transceivers.

The Doodle Labs Industrial WiFi Transceivers insert into a standard miniPCIe connector. If this is your first time trying to work with a dedicated WiFi transceiver, then we recommend using a single-board-computer (SBC) running OpenWrt with a miniPCIe slot (e.g. Gateworks Ventana). It is also possible to use a PCIe to miniPCIe converter on a PC. The Doodle Labs Industrial WiFi Transceivers are supported by the Ath10k (ACM-DB-x) and Ath9k (NM-DB-x) drivers which are included in the Linux kernel.



In an OpenWrt platform, the general steps to start working with a Doodle Labs Industrial WiFi Radio are:

1. Insert the WiFi module into a miniPCIe slot
2. Power up the SBC (hot-plugging is not supported)

3. Open up a shell session in the SBC (typically over SSH or Serial)
4. After the system has booted up, you can check that Ath10k has loaded with

```
$ lsmod | grep ath10k
ath10k_core           256516  1 ath10k_pci
ath10k_pci             27340  0
```

5. If you have more than one radio interface, you can identify which device is the new module with

```
$ iw dev | grep "phy\|wlan\|addr"
phy#0
      Interface wlan0
      addr 00:30:1a:4e:4e:4f
```

   You should be able to identify the new module by the MAC address.
6. New wireless interfaces are disabled by default. OpenWrt uses the UCI system for configuration. You can view the current wireless configuration with

```
$ uci show wireless
```

   Use UCI to enable the new module

```
$ uci set wireless.radio0.disabled=0
$ uci commit
$ /etc/init.d/network restart
```

   where radio0 corresponds to phy0.

By default, the new interface should start in AP mode, and you can try connecting to the AP with any WiFi client device. There are extensive guides for OpenWrt configuration at the OpenWrt website.

Hardware Integration - Industrial Wi-Fi Transceivers

Doodle Labs offers a large portfolio of Wi-Fi transceivers with the IEEE 802.11n (MAC QCA9590, ath9k driver) and 802.11ac (MAC QCA9890, ath10k driver). The 802.11n model numbers are N*-*-* and 802.11ac model numbers are AC*-*-*.

Both types of transceivers have similar RF performance and form factor. The transceiver designs use a similar RF front end with different MAC ICs to allow customers to choose the driver type.

Please take note of the following when integrating Industrial WiFi transceivers:

1. Doodle Labs Industrial Wi-Fi transceivers are electrically and mechanically compatible with all the host CPU boards compliant to the miniPCI Express 1.2 standard.

2. Wi-Fi antennas are a commodity item, available from many sources. Please make sure that the “pig tail” to connect to the antenna has the appropriate MMCX or U.FL connector to match the samples.
3. On 2-stream models, all 3 MMCX-Female connectors are populated. CH0 and CH1 are active and CH2 connector is a dummy.
4. For your system’s thermal design, please note that the PAs are located on the top edge (near the RF connectors) and generate most of the heat. Hence, it will be useful to provide heat extraction method on the top half of the transceiver.
5. During initial design and evaluation, the Samples Characteristics Report may be a useful reference. It provides important radio characteristics measured on the samples. This report is always emailed with shipping documents.
6. Please refer to Appendix C for mechanical drawings. CAD models are available upon request.
7. Doodle Labs Industrial WiFi transceivers consume up to 6W of DC power to support its high RF power. Please make sure that the host CPU board is able to support this power requirement.
8. Please refer to Appendix A and B for the miniPCIe pin-out of the transceivers.
9. Doodle Labs has implemented the hardware “RF Kill” function required by FAA for all airborne applications. Driving Pin 20 low in the Rugged models (*M-*-*)will immediately disable RF transmission
10. The customer equipment label should have a note “Contains FCC ID: xxxxxxxx”

Many models in both the N*-*-* and AC-*-* families have gone through regulatory certifications. Please check individual model datasheets for their certification details. This is an ongoing activity so please inquire about the certification status of the model # used in your project. Doodle Labs may be able to help for additional certification related services.

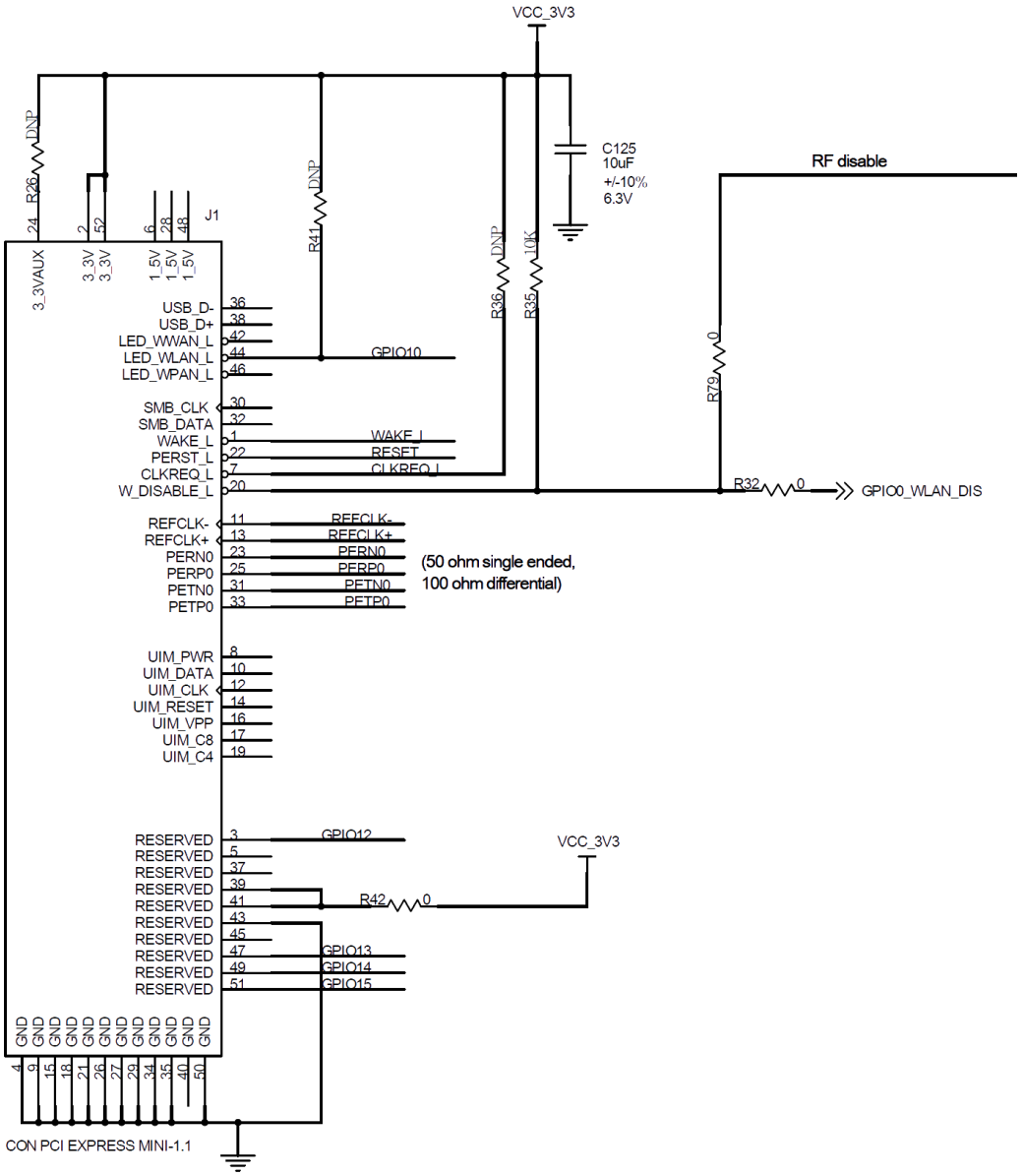
Software Integration of the Wi-Fi Transceivers

1. Doodle Labs Industrial WiFi transceivers work with standard open source drivers ath9k (N*-*-* models) and ath10k (AC*-*-*).
2. For modem development, we recommend the following open source tools and resources for documentation and support questions:
    a. OpenWrt is a mature open source Linux wireless router. Many of our customers use it as a starting point and further customize it for their needs. https://openwrt.org/
    b. Linux Wireless Mailing list - https://wireless.wiki.kernel.org/en/developers/mailinglists
    c. ath9k driver - https://wireless.wiki.kernel.org/en/users/drivers/ath9k
    d. ath10k driver - https://wireless.wiki.kernel.org/en/users/drivers/ath10k
    e. iw Wireless configuration tool - https://helpmanual.io/help/iw/
    f. QCA Wireless Settings - https://wiki.dd-wrt.com/wiki/index.php/QCA_wireless_settings
3. Due to many factors involved with software related issues, Doodle Labs is not able to provide significant support or value add. However, for unique issues, please feel free to ask us for help. We may be able to give you some tips or connect you with someone in our network of 3rd party software developers that can help you solve the problem.

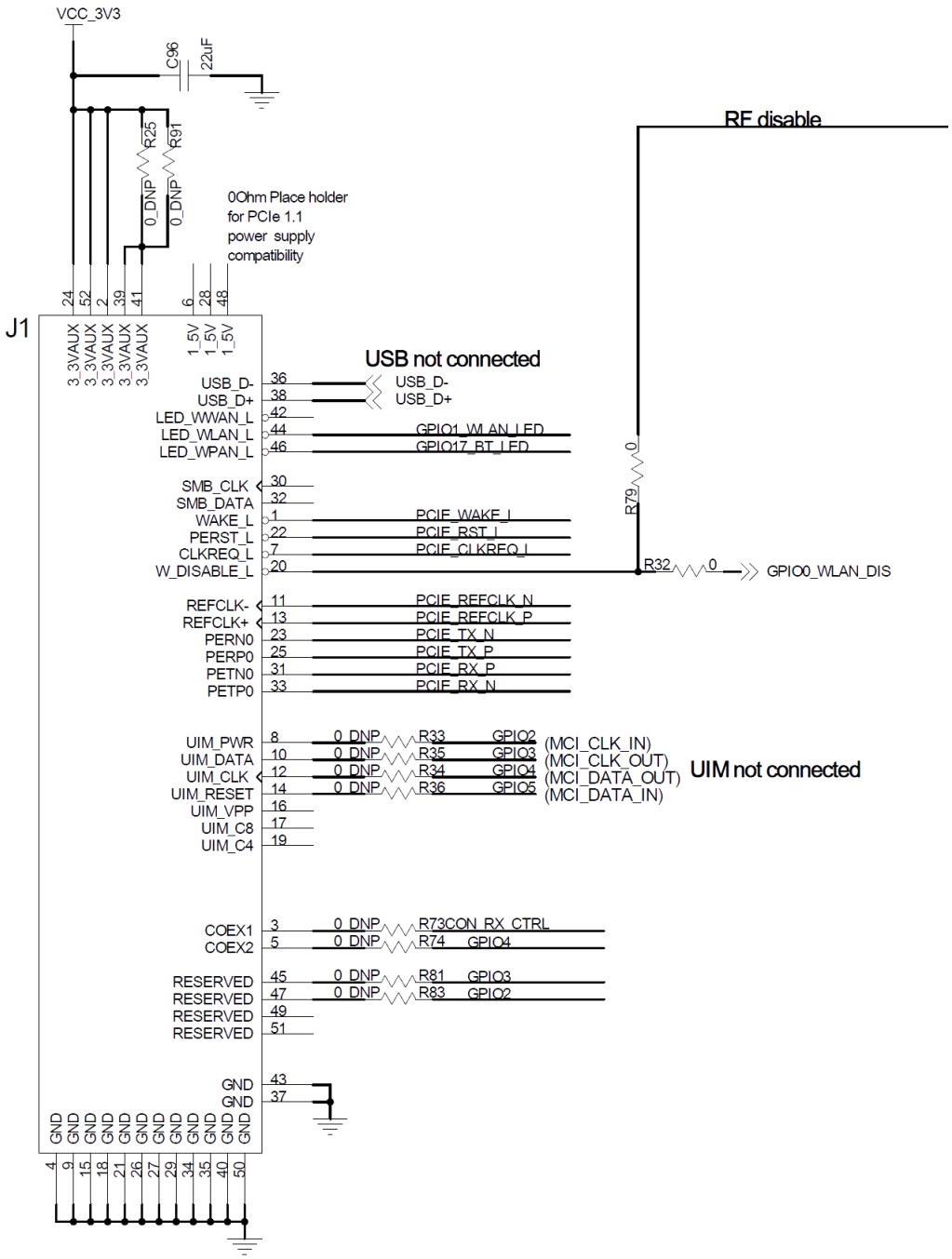
Tips – Problems to avoid

1. Ensure CONFIG_PCI_MSI setting is disabled in the kernel. Accidentally enabling it will stop sending the beacons.
2. Make sure Pin 20 of the miniPCIe interface is high. Driving it low disables the WLAN interface (RF Kill function required by FAA for airborne applications).
3. Make sure that the power supply voltage at the miniPCIe pins does not drop at full transmit power.
4. To achieve long distance operation, adjust the distance setting using iw. The default ACK timeout in ath9k is about 200 meters. To achieve longer range, this parameter should be either set to Auto or the desired distance setting.
5. During ground testing, please be aware that the antenna height above the Fresnel Zone may play a significant role in achieving long range.

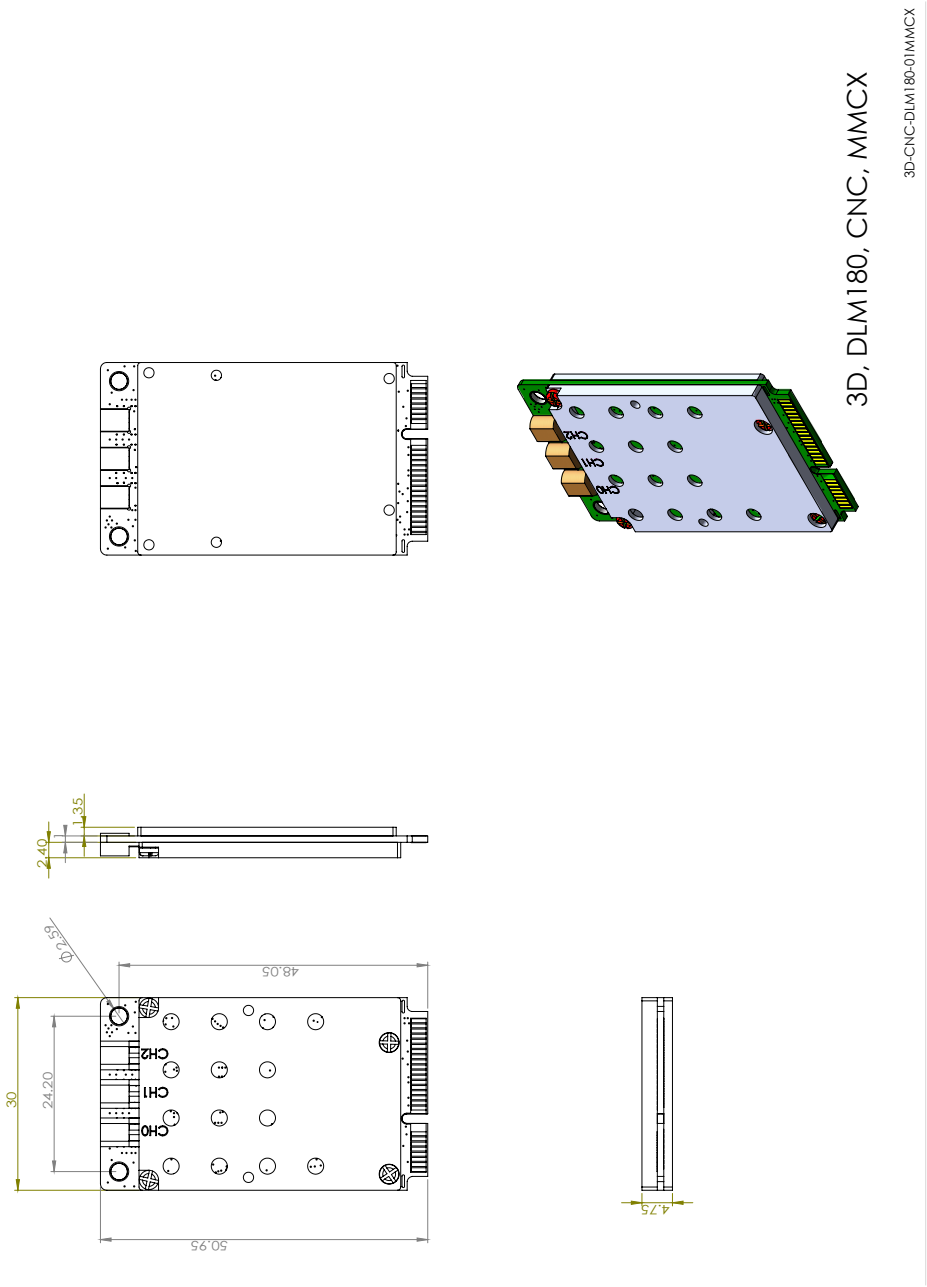
Appendix A – miniPCIe Pin-out for 802.11n Transceiver



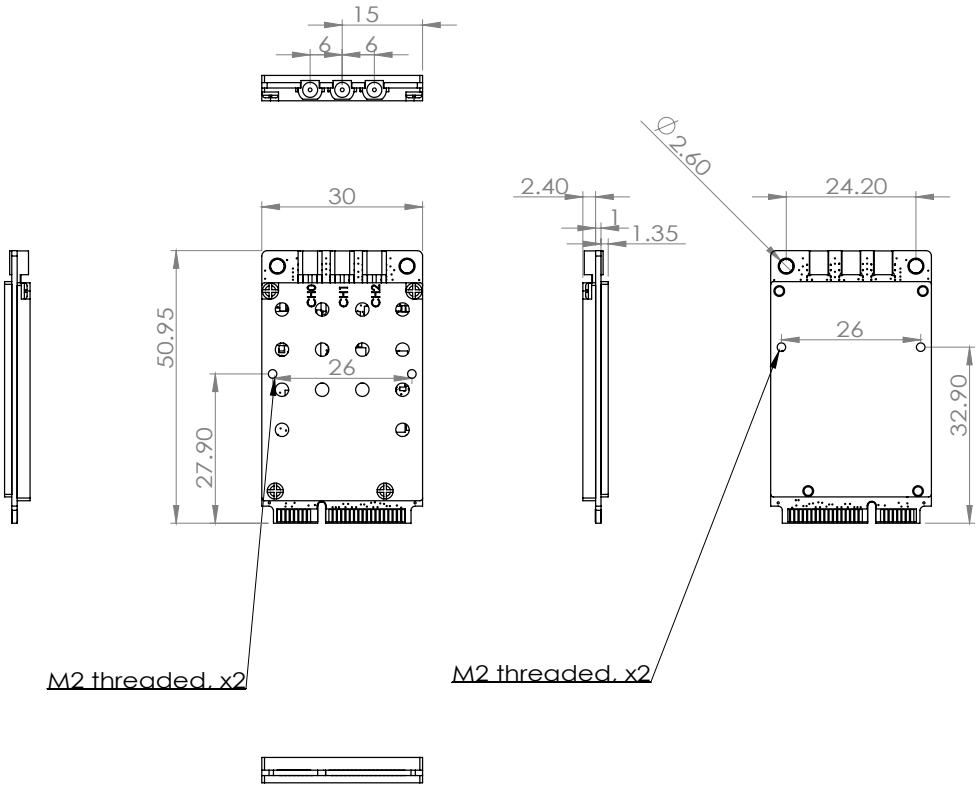
Appendix B– miniPCIe Pin-out for 802.11ac Transceiver

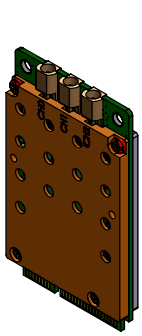


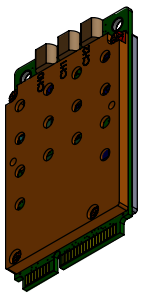
Appendix C – Mechanical Drawing for 11n Transceiver



Appendix D – Mechanical Drawing for 11ac Transceiver







3D, DLM168, MMCX
UNIT IN MM
Tolerance 0.2mm

3D-DLM168-04M-R1

FCC Statement

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

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

-- Reorient or relocate the receiving antenna.

-- Increase the separation between the equipment and receiver.

-- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

-- Consult the dealer or an experienced radio/TV technician for help

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

IC Statement

This device complies with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions:

1. This device may not cause interference; and
2. This device must accept any interference, including interference that may cause undesired operation of the device.

The term "IC: " before the certification/registration number only signifies that the Industry Canada technical specifications were met. This product meets the applicable Industry Canada technical specifications.

Le présent appareil est conforme aux CNR d'Industrie Canada applicable aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage,

et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement