# MiniZed Wireless Guide

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# Overview

This document provides information relevant to the Murata Type 1DX wireless module on Avnet's MiniZed development board, part number AES-MINIZED-7Z007-G. For more information on this Zynq 7007S platform, please see http://zedboard.org/product/minized.

The Murata Type 1DX provides 2.4GHz Wi-Fi (802.11b/g/n), as well as Bluetooth 4.1. Bluetooth Classic supports both the Basic Rate and the Enhanced Data Rate (EDR), while Bluetooth Low Energy (BLE) is also supported.

There is a Hardware User Guide and there are a number of reference design documents that describe how to implement and use Wi-Fi and Bluetooth on MiniZed. If these features interest you and you would like to use the Murata Type 1DX module (Murata part number LBEE5KL1DX) in your own design, this document will provide information and considerations regarding **certification, drivers and testing** that is not necessarily covered elsewhere.

The module is based on the Cypress CYW4343W radio chipset. Software and drivers for the 1DX originate from Murata at their wireless portal (https://github.com/murata-wireless) and are adapted for use within Xilinx's PetaLinux build environment. The 1DX module runs under Linux only. Bare metal and FreeRTOS are not supported.
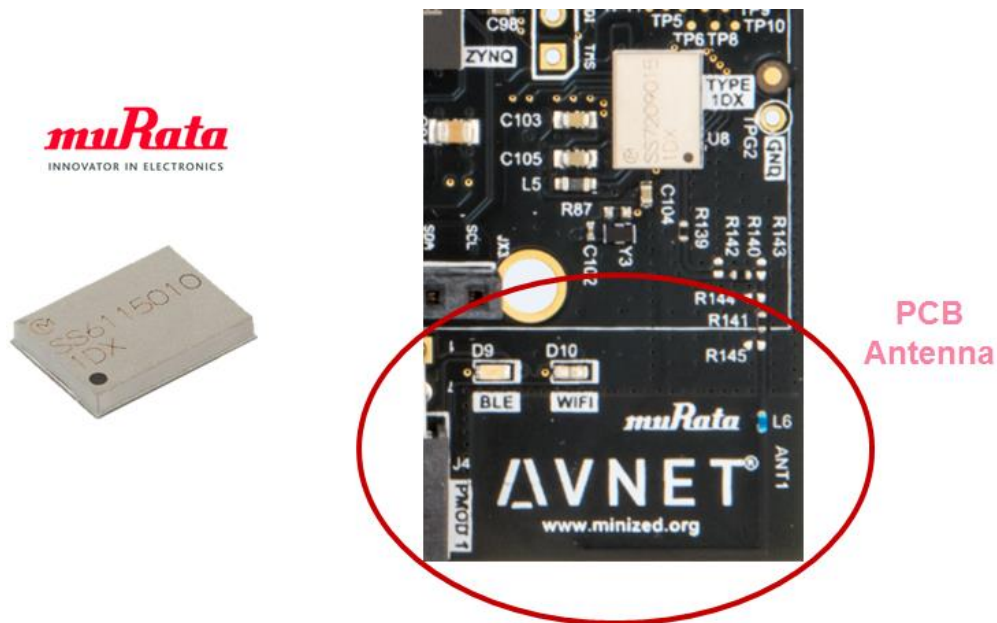


**Figure 1 –The Murata Type 1DX on MiniZed has a PCB Antenna**

# Device Connection

The diagram below shows how the MiniZed Zynq's PS (Processor System) interfaces with the Type 1DX wireless module via the PL (Programmable logic).
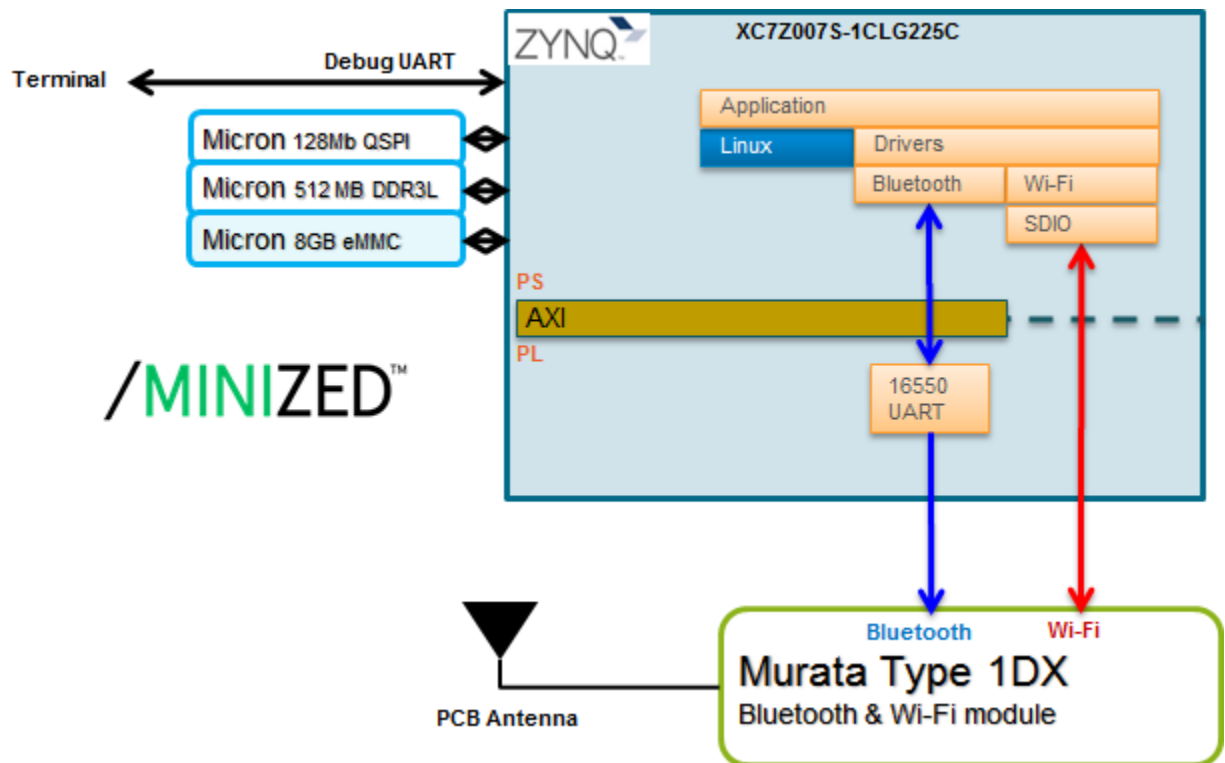


Figure 2 –Interface between the Zynq PS and the Murata Type 1DX

# Designing with the Murata Type 1DX

Murata and other suppliers provide various pre-certified wireless modules that have built-in antennas, which generally are more expensive.  This device is less expensive as it requires an external antenna that is designed into the PCB.

The Murata 1DX module is a SIP (System In Package) that incorporates the CYW4343W radio along with other passive components, easing the end PCB design.  It's provided with a reference design utilizing a PCB antenna, although other antenna form factors are possible.  MiniZed copies Murata's reference PCB antenna design.

Murata provides a number of design guidelines for proper implementation of the Type 1DX external antenna.  These guidelines were followed for the creation of the MiniZed PCB design.

**Relevant reference material from the Murata website:**

https://wireless.murata.com/eng/products/rf-modules-1/wi-fi-bluetooth-for-nxp-i-mx/type-1dx.html

- The W-LAN+Bluetooth Combo Module Data Sheet (Preliminary Specification Number: SP-KL1DX-N, currently Feb 28, 2017) provides datasheet-type information with pinout and timing information, as well a reference circuit.
- There are two "Quick Start Guide" documents.  One is for Android and the other for Linux.  They assume the use of an NXP i.MX6 development board into which can be plugged evaluation boards for either the Type ZP, 1BW, 1DX or 1FX Murata modules.  There is body of documents that support this NXP platform, as well as the various Murata modules that plug into them.
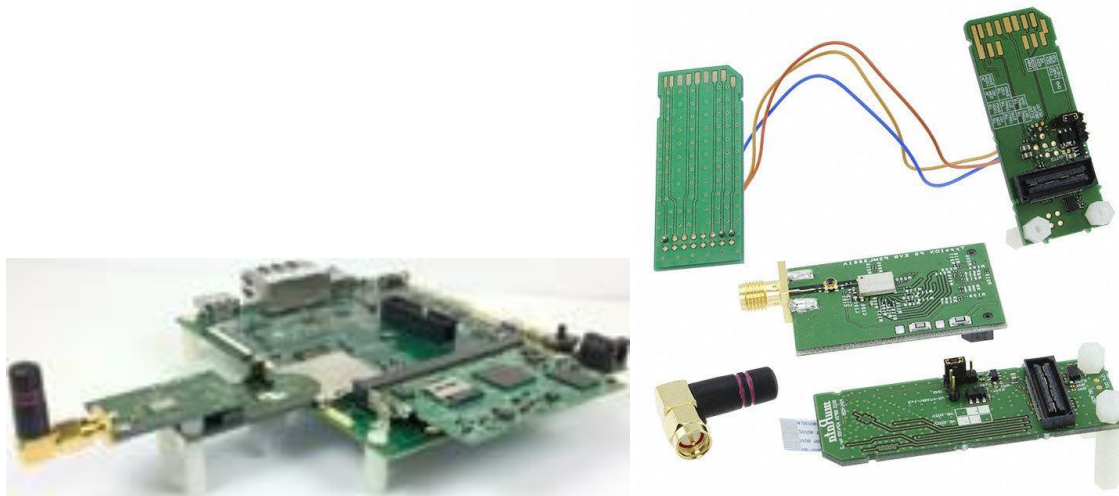


**Figure 3 –The XNP i.MX6 Development Kit with Murata Type 1DX Modules**

**Directly from Murata:**

- The Type1DX User Manual Application note (2015/08/06) provides an example schematic, BOM list, as well as PCB layout images that show module and antenna traces.
- Murata also has a (Confidential) "Type 1DX Antenna Performance" document that provides a specific layout guide for good performance that includes some layout images.

# MiniZed Certification Considerations

## Regulatory Approvals

If you follow the exact antenna design instructions that are provided in the Murata documentation, you should be able to file for FCC and IC (Industry Canada) modular approval as an intentional radiator.  Murata can also provide a CE test report as well as a TELEC (Telecom Engineering Center) report for Japan to assist with this.

In addition to the Murata Type 1DX module certifications, the MiniZed design has been certified for the following:

- US (FCC)
- Canada (IC)
- Europe (CE)
- Japan (MIC)

At the time of this document, certification for Malaysia and Vietnam are still in process.

| Country | Regulatory Marking |
|---|---|
| United States | FCC ID: VPYLB1DX |
| Canada | IC ID: 772C-LB1DX |
| Europe (CE) | CE |
| China (RoHS) | (10) |
| Japan | R  018-170252 |

**Table 1 – MiniZed Regulatory Certification Markings**

# Certification Testing of Customer Designs

Some regions allow for certification based on the FCC and/or CE reports (initial test results from Murata). The FCC, CE and Japan MIC certifications required physical MiniZed samples to be shipped to them.

If you intend to ship MiniZed to additional countries other than the US, Canada, EU and Japan then please contact Avnet Regulatory Services at RegulatoryServices@avnet.com. They can assist you with obtaining global market access to countries not listed above.

## Wi-Fi Emissions Tests

For Wi-Fi, the production MiniZed device had to execute commands using the **"wl" diagnostic tool,** which is included in the driver package by Murata. Ordinarily, the Wi-Fi driver (brcmfmac) includes a firmware binary, **brcmfmac43430-sdio.bin** which is loaded by the driver onto the module. The **wl** test utility requires a special radio firmware binary, **brcmfmac43430-sdio-mfgtest.bin** to be loaded instead.

Load this file onto a USB stick, mount the USB stick as a drive (% mount /dev/sda1 /mnt), then copy the file (# cp /mnt/fw_bcmdhd_mfgtest.bin /lib/firmware/brcm)
Remove the existing symbolic link to the firmware binary and then create a new one to the new file:
% cd /lib/firmware/brcm
% rm fw_bcmdhd.bin
% ln –s fw_bcmdhd_mfgtest.bin fw_bcmdhd.bin

Here are typical "wl" tool commands:

Note: Make sure you're using the correct firmware for manufacturer test (fw_bcmdhd_mfgtest.bin)
1.     Power up the board and login
2.     Type the below command
% cd /usr/local/bin
% modprobe bcmdhd
% wl down
% wl mpc 0
% wl phy_watchdog 0
% wl glacial_timer 0x7fffffff
% wl country ALL
% wl band b
% wl 2g_rate -h 7 -b 20
% wl chanspec 7/20
% wl scansuppress 1
% wl phy_txpwrctrl 1
% wl txpwr1 -o -d 13
% wl up
% wl phy_forcecal 1
<i# ./wl pkteng_start 00:11:22:33:44:55 tx 20 1024 0
% sleep 60
% wl pkteng_stop tx

## Bluetooth Emissions Tests

For Bluetooth, the **"hcitool" tool** that is included on MiniZed by default, was used to put the Type 1DX module in the correct modes for testing in the lab.  Again, scripts were run to put the device through its paces.

## Bluetooth Certification

Note that **MiniZed has not passed Bluetooth certification**.

In order to put the Bluetooth logo and/or the word "Bluetooth" anywhere on the end product, the end customer must join the BT SIG and ultimately purchase a Declaration ID.  Getting this Declaration ID may involve additional testing, especially if the entire solution contained within the end product doesn't already come with a Qualified Design ID (QDID).

The Murata 1DX and alternatively the Laird/LSR Sterling LWB each come with *partial* QDIDs.  This means that the QDIDs only cover the portion of the Bluetooth stack up to and including the Host Control Interface (HCI).  This is the protocol that runs over the UART connection between the module and the host processor.  The upper portion of the Bluetooth stack that runs on the host up to and including the supported profiles (HFP, A2DP, etc.) aren't covered by the above two QDIDs.  In all likelihood, since the open source BlueZ stack that will run on the Xilinx device doesn't come with a QDID, this means some additional testing may be required by the BT SIG before they grant a Declaration ID to the end customer for the final product.

| | |
|---|---|
| **Application** | **(btgatt-server.c Linux program)** |
| **GATT Server** | **(Generic Attribute Protocol)** |
| **L2CAP** | **(Protocol and packet assembly)** |
| **HCI** | **(Host Controller Interface)** |
| **PHY** | **(Physical Layer = Murata Type 1DX module)** |

**Table 2 – Rough Protocol Stack for MiniZed as a BLE Server Device**

# Considerations when Designing with the Murata Type 1DX

The Type 1DX typically has a per-unit cost advantage, but requires the customer to provide the external antenna and also to pay for further global certifications as required.

An alternative will be to use a different device that already has global certification.  An example of such a device is the Laird/LSR Sterling LWB module.

https://www.lsr.com/embedded-wireless-modules/wifi-plus-bluetooth-module/sterling-lwb

This device also uses the CYW4343W that the Murata Type 1DX uses, but it is more broadly certified for FCC (USA), IC (Canada), ICE (Europe), MIC (Japan), and RCM (AUS/NZ).

For any questions regarding certification of the customer's end product, please contact the Avnet Regulatory Services at RegulatoryServices@Avnet.com for assistance.

# Revision History

| Date | Version | Revision |
|------|---------|----------|
| 20 Mar 18 | 01 | Initial Release |
| | | |