MultiConnect® xDot™

MTXDOT Developer Guide

MultiConnect xDot Developer Guide

Models: MTXDOT-NA1-xxx, MTXDOT-EU1-xxx

Part Number: S000645, Version 1.0

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Contacting MultiTech

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The Knowledge Base provides immediate access to support information and resolutions for all MultiTech products. Visit http://www.multitech.com/kb.go.

Support Portal

To create an account and submit a support case directly to our technical support team, visit: https://support.multitech.com.

Support

Business Hours: M-F, 8am to 5pm CT

Country	By Email	By Phone
Europe, Middle East, Africa:	support@multitech.co.uk	+(44) 118 959 7774
U.S., Canada, all others:	support@multitech.com	(800) 972-2439 or (763) 717-5863

Warranty

To read the warranty statement for your product, visit www.multitech.com/warranty.go. For other warranty options, visit www.multitech.com/es.go.

World Headquarters

Multi-Tech Systems, Inc.

2205 Woodale Drive, Mounds View, MN 55112

Phone: (800) 328-9717 or (763) 785-3500

Fax (763) 785-9874

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Chapter 1 Product Overview

Overview

The MultiConnect xDot (MTXDOT) is a LoRaWAN™, low-power RF device, capable of two way communication over long distances, deep into buildings, or within noisy environments* using the unlicensed ISM bands in North America, Europe and worldwide. The xDot is a compact surface-mount device with an mbed enabled processor and enhanced security. The xDot features an integrated ARM® Cortex®-M3 processor and mbed™ compatible software library for developers to control, monitor and bring edge intelligence to their Internet of Things (IoT) applications.

*Actual distance depends on conditions, configuration, antennas, desired throughput, and usage frequency. In dense urban environments, a typical range is 1-2 miles.

Documentation Overview

This manual is one part of xDot documentation. Refer to the *Related Documentation* and *mbed* sections for additional information needed to program your xDot and integrate your application with the MultiConnect Conduit gateway.

This document includes:

- **xDot device information:** including mechanical drawings, specifications, safety and regulatory information, and other device specific content.
- **Developer Kit information:** including design considerations, schematics, and installation and operation information.

This current version of this manual is available at www.multitech.com/support.

Related Documentation

- **DOT Series AT Command Reference:** Includes details on the AT commands available for xDots.
- **MultiTech Developer Site:** Application notes, LoRa information, and documentation for related products such as the MultiConnect Conduit (MTCDT) gateway and the LoRa accessory card (MTAC-LORA) are available on the MultiTech developer site. This site includes information on using the Conduit with xDots. Go to: www.multitech.net
- **Processor Datasheet:** ST ARM® Cortex®-M3 processor (STM32L151CCU6) datasheet is available on the ST website: http://www.st.com/resource/en/datasheet/stm32l151cc.pdf

mbed Documentation

ARM mbed is a free, open-source platform and operating system for embedded devices using the ARM Cortex-M microcontrollers. The mbed website provides free software libraries, hardware designs, and online tools for rapid prototyping of products. The platform includes a standards-based C/C++ SDK, a microcontroller HDK, and supported development boards, an online compiler and online developer collaboration tools.

Note: To send and receive data, you need a LoRaWAN 1.0 gateway, such as MultiTech's MultiConnect Conduit (MTCDT) with an MTAC-LORA accessory card installed.

Programming the xDot Microcontroller

Note: To program an xDot application, you need the xDot Developer kit, which includes an xDot mounted on a developer board.

Use the ARM mbed ecosystem to program the microcontroller. Compile in the cloud or locally, copy the resulting binary file to the mbed USB drive, and reset the xDot.

On the xDot mbed page, MultiTech supplies source code for non-RF portions of the xDot. To comply with FCC and ETSI certification, some portions of the software is available only as binary libraries.

MultiTech offers both development and stable release versions of the library.

- Development version: libmxDot-dev-mbed5
- Stable release version: libmxDot-mbed5

You can use either the mbed online compiler or offline tools.

- Online: Use the mbed-os library in your mbed application
- Offline: Use mbed-cli tools to create, manage, and build your mbed 5.1 application.

General mBed Links

- Explore mbed: http://developer.mbed.org/explore
- Getting Started with mbed: http://developer.mbed.org/getting-started
- mbed Handbook: http://developer.mbed.org/handbook/Homepage
- mbed online compiler documentation: https://developer.mbed.org/handbook/mbed-Compiler
- mbed cli documentation: https://github.com/ARMmbed/mbed-cli/blob/master/README.md
- mbed workspace tools documentation: https://github.com/ARMmbed/mbed-os/blob/master/docs/BUILDING.md#workspace-tools

xDot Platform

The xDot mbed page includes the xDot library, firmware, and test cases
https://developer.mbed.org/platforms/MTS-xDot-L151CC/

EUI and Networking

xDots have an Extended Unique Identifier (EUI). To query the device for the EUI, AT+DI:

AT+DI=<8-BYTE-HEX-MSB>

AT+DI=001122AABBCCDDEE

For information on setting up xDots as part of a LoRa network, go to www.multitech.net.

Product Build Options

Product	Description	Package Quantity
North America		
MTXDOT-NA1-A00	915 MHz LoRa Module UFL/TRC (NAM)	1 or 100
MTXDOT-NA1-A01	915 MHz LoRa Module TRC (NAM)	100
EMEA		
MTXDOT-EU1-A00	868 MHz LoRa Module UFL/TRC (EU)	1 or 100
MTXDOT-EU1-A01	868 MHz LoRa Module TRC (EU)	100
Developer Kits		
MTMDK-XDOT-NA1-A00	MultiConnect xDot Micro Developer Kit - Includes a 915 MHz xDot	
MTMDK-XDOT-EU1-A00	MultiConnect xDot Micro Developer Kit - Includes a 868 MHz xDot	

Note:

- The complete product code may end in .Rx. For example, MTXDOT-NA1-A00.Rx, where R is revision and x is the revision number.

Chapter 2 Getting Started

Getting Started with the xDot Developer Kit

Getting started depends on what you want to do. By default, xDot ships with firmware that supports AT Commands that use the serial I/O. For AT Commands, refer to the separate *MultiConnect Dots AT Command Reference Guide*.

Two serial interfaces are available through the USB interface, one is used to send AT commands to the xDot and the other is for debug messages. Refer to *Chapter 4, Specifications and Pin Information* for information on which pins are available out of the box.

Before starting your project development, make sure you have the latest firmware for the Developer Kit and xDot. Go to the xDot mbed page for firmware. https://developer.mbed.org/platforms/MTS-xDot-L151CC/

To send commands to the xDot:

1. Plug the developer board into a USB port.
2. Open communications software, such as TeraTerm, Putty, or Minicom.
3. Set the following:
    - Baud rate = 115,200
    - Data bits = 8
    - Parity = N
    - Stop bits = 1
    - Flow control = Off

To develop using mbed, the xDot mbed page includes libraries and test cases. Refer to mbed Documentation for details and links.

For help setting up a MultiConnect® Conduit™ to send data to and from an xDot, refer to Related Documentation .

COM Port Enumeration by Operating System

xDots create an AT Commands port and a debug port.

Linux

The following COM ports are created on Linux systems:

- /dev/ttyACMx
- /dev/ttyACMy

Where x and y may be 0 and 1, 3 and 4, etc.

The COM port with lower number is the AT command port and COM port with the higher number is the debug port.

Windows

On Windows systems, COM ports appear in the Device Manager:

- **Debug Port:** mbed Serial Port

- **AT Command Port:** XR21V1410 USB UART

You may need to install a driver for the debug port to function properly. Go to: https://developer.mbed.org/handbook/Windows-serial-configuration

Mac

On Mac systems, COM ports appear in the Device Manager as:

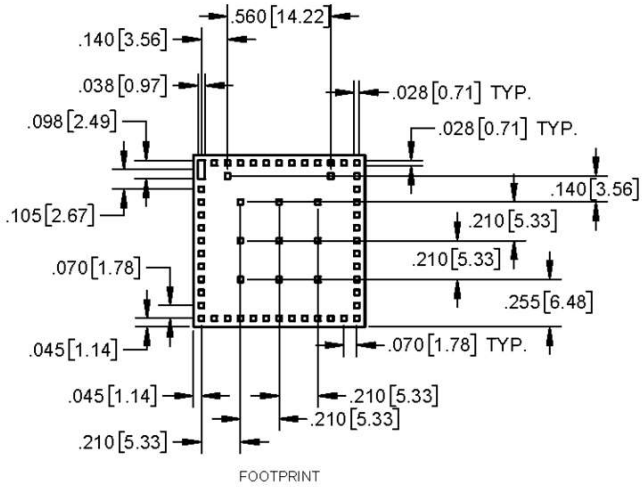
- /dev/cu.usbmodemx

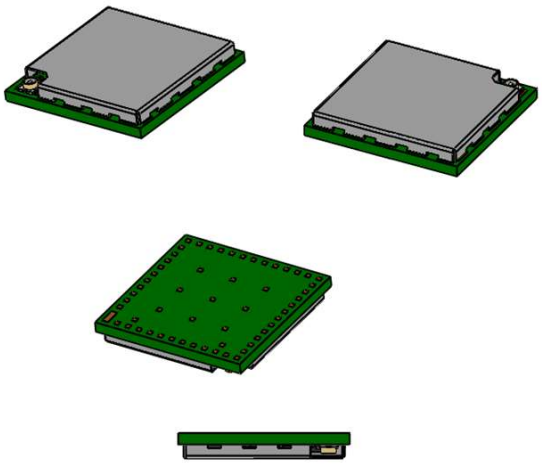
Where x is a string of numbers and possibly letters, ending in a number.

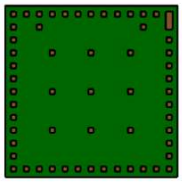
The COM port with lower number is the AT command port and COM port with the higher number is the debug port.

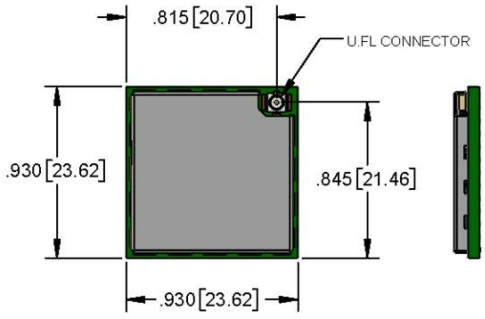
Chapter 3 Mechanical Drawings with Pinouts

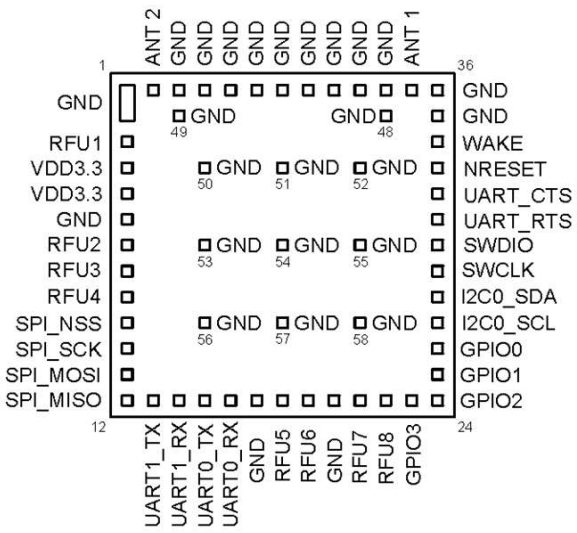
xDot

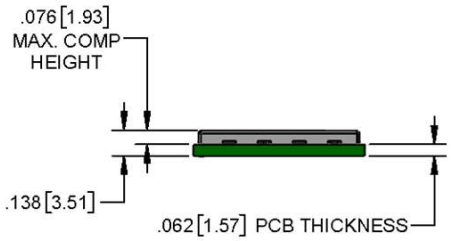












DIMENSIONS IN In [mm]

XDOT

Chapter 4 Specifications and Pin Information

MTXDOT Specifications

Category	Description
General	
Compatibility	LoRaWAN 1.0 specifications
Interfaces	Note that pin functions are multiplexed.
	Up to 19 digital I/O
	Up to 10 analog inputs
	2 DAC outputs
	I2C
	SPI
	Wake pin
	Reset pin
	Full UART
	mbed/simple UART (RX & TX only)
	mbed programming interface
CPU Performance	
CPU	32 MHz
Max Clock	32 MHz
Flash Memory	256 KB, with xDot library 136 KB available; with AT firmware, 56 KB available
EEPROM	8 KB, available 6 KB
SRAM	32 KB
Backup Register	128 byte, available 88
Radio Frequency	
ISM Bands	863 MHz - 868 MHz, 902 MHz - 928 MHz, 915 MHz - 935 MHz
Physical Description	
Weight	0.0001 oz. (0.003g)
Dimensions	Refer to Mechanical Drawings for Dimensions.
RF Connectors	
-UFL Models	U.FL
-Trace Models	Trace Connection

Category	Description	
Environment		
Operating Temperature	-40° C to +85° C	
Storage Temperature	-40° C to +85° C	
Humidity	20%-90% RH, non-condensing	
Power Requirements		
Operating Voltage	2.4 to 3.57 V	
Certifications and Compliance		
EMC and Radio Compliance	EN 300 220-2 V2.4.1:2012	EN 300 220-2 V2.4.1:2012
	EN 301 489-03 V1.6.1:2013	ICES-003:2012
	FCC 15.247:2015	CISPR 22:2008
	FCC 15.109:2015	AS/NZS CISPR 22
	FCC 15.107:2015	AS/NZS 4268:2012 + a1:2013
	RSS 247:2015	Standard 2014 MPE
Safety Compliance	UL 60950-1 2nd ED	
	cUL 60950-1 2nd ED	
	IEC 60950-1 2nd ED AM1 + AM2	
	AS/NZS 60950.1:2015	

Category	Description	
Transmission		
	North America	**EMEA**
Max Transmitter Power Output (TPO)	19 dBm	14 dBm
Maximum Receive Sensitivity	-137 dBm	-137 dBm
Link Budget[1]	147 dB Point-to-Point	147 dB Point-to-Point
Max Effective Isotropic Radiated Power (EiRP)	22 dBm	10 dBm

Category	Description	
Receive Sensitivity		
Spreading Factor	**North America Typical Sensitivity**[2]	**EMEA Typical Sensitivity**[3]
6	-111 dBm	-121 dBm
7	-116 dBm	-124 dBm
8	-119 dBm	-127 dBm
9	-122 dBm	-130 dBm
10	-125 dBm	-133 dBm
11	-127 dBm	-135 dBm
12	-129 dBm	-137 dBm

[1]Greater link budget is possible with higher gain antenna.

[2]RFS_L500: RF sensitivity, Long-Range Mode, highest LNA gain, LNA boost, 500 kHz bandwidth using split Rx/Tx path.

[3]RFS_L125: RF sensitivity, Long-Range Mode, highest LNA gain, LNA boost, 125 kHz bandwidth using split Rx/Tx path.

Mapping Data Rate to Spreading Factor/Bandwidth

	Uplink	Downlink
US/AU	DR0: SF10BW125	DR8: SF12BW500
	DR1: SF9BW125	DR9: SF11BW500
	DR2: SF8BW125	...
	DR3: SF7BW125	DR13: SF7BW500
	DR4: SF8BW500	
	DR5-DR7: RFU	
EU	DR0: SF12BW125	
	...	
	DR5: SF7BW15	
	DR6: SF7BW250	
	DR7: FSK	