

# **Dust Networks**

## **Quick Start Guide for D1120 Network with M1030 Mote**



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This equipment has been tested and found to comply with the limits pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in an appropriate 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 communication. 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:

- (1) Reorient or relocate the receiving antenna.
- (2) Increase the separation between the equipment and receiver
- (3) Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- (4) Consult the dealer or an experienced radio or television technician for assistance.

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# About This Guide

This guide provides information required to successfully demonstrate the capabilities of the D1120 SmartMesh network. It provides specifications for the M1030 mote and instructions for setting up a network.

## Related Documents

The following documents are available for a SmartMesh Network:


- *Quick Start Guide for D1120 Network with M1030 Mote* (this guide)
- *SmartMesh Evaluation Kit Guide*
- *SmartMesh Manager Application Programming Interface (API) Guide*
- *Sensor OEM Guide*
- *System Integrator Guide*
- *SmartMesh Console Reference Guide*




## Conventions Used

The following conventions are used in this guide:

- `Computer type` indicates information that you enter, such as specifying a URL.
- **Bold type** indicates buttons, fields, and menu commands.
- *Italic type* is used to introduce a new term.

 **Note:** Notes provide more detailed information about concepts.

 **Cautions:** Cautions advise you about actions that might result in a loss of data.

   **Warning!** Warnings advise you about actions that may cause physical harm to the hardware or your person.



# M1030 Mote Specifications

This chapter describes the features of the M1030 mote, and provides detailed information about hardware and software specifications and operating conditions.

## Overview

The M1030 mote is the core element in Dust Network's new generation of robust, easy-to-use wireless solutions for industrial, commercial, security, and logistics markets.

The mote provides a drop-in OEM solution for adding wireless mesh network capabilities to a wide variety of sensors. In most applications, these extremely low-power motes last two to four years on a set of AA batteries.

Mote features include:

- Ultra low-power 3-volt design
- Easy to integrate with a wide variety of sensors and actuators
- Self-configuring and self-healing, multipath routing
- 902–928 MHz frequency-hopping spread-spectrum communication:
- Small: 1.2" x 1.1"
- Solder-mount and edge connector options
- High sensitivity: -93 dBm (typical)
- Optimized to run SmartMesh software
- Analog, digital, and serial interfaces
- Supports up to seven time-stamped analog measurements per transmission
- Supports averaging of up to 255 analog measurements per transmission
- 128-bit encryption

# Functional Block Diagram

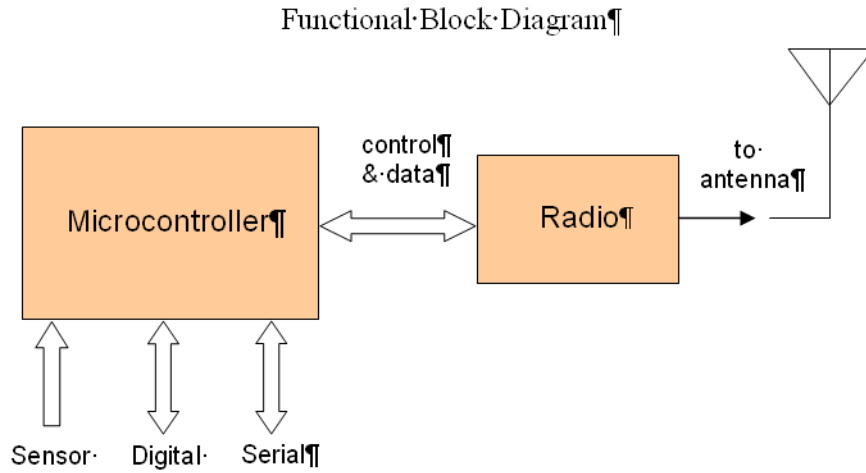
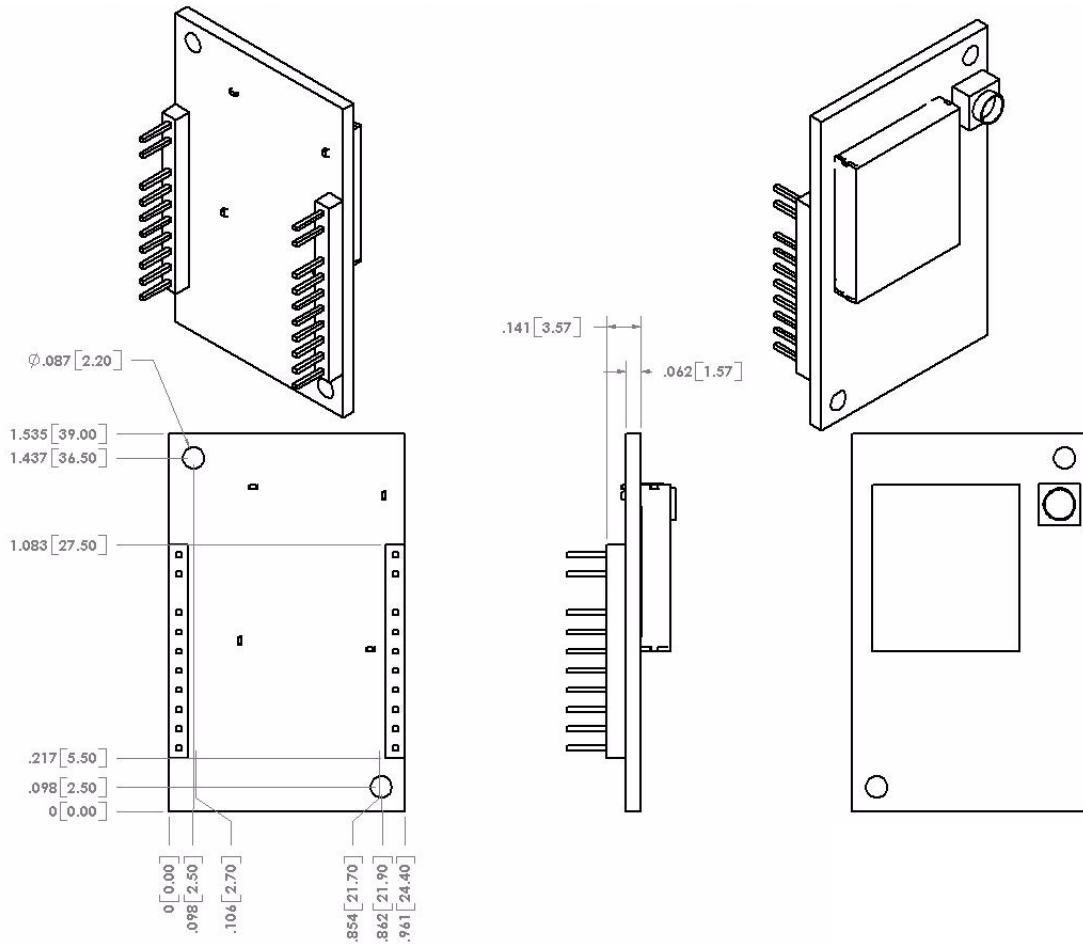


Figure 1-1. Functional Block Diagram for Mote



# Mechanical Interface

The following are mechanical diagrams for the M1030 mote.



**Figure 1-2. Mechanical Interface for M1030 Mote**

## Connector Pinouts

The following table shows the pinouts for the mote connectors.

**Table 1-3. Pinouts for J1 Connector**

| Pin Number | Pin Name     | I/O | Description                    |
|------------|--------------|-----|--------------------------------|
| 1          | GND          | I   | System ground/Analog ground    |
| 2          | VCC          | I   | 3.0 V battery supply           |
| 3          | KEY1         |     | Insertion key (not used)       |
| 4          | RX           | I   | UART Rx                        |
| 5          | TX           | O   | UART Tx                        |
| 6          | GP3/LED1     | I/O | Digital I/O 1 and Status LED 1 |
| 7          | GP1          | I   | Analog input 1                 |
| 8          | GP2/CTS/LED2 | I/O | Digital I/O 2/CTS/Status LED 2 |
| 9          | RTS          | I/O | RTS                            |
| 10         | GP4/TIME     | I/O | Digital I/O 5/TIME             |
| 11         | GP5          | I   | Analog input 2                 |

**Table 1-4. Pinouts for J2 Connector**

| Pin Number | Pin Name | I/O | Description              |
|------------|----------|-----|--------------------------|
| 1          | RST      | I   | Reset                    |
| 2          | FCS      |     | FCS                      |
| 3          | KEY2     |     | Insertion key (not used) |
| 4          | SIMPISO  |     | SIMPISO                  |
| 5          | SIMPOSI  |     | SIMPOSI                  |
| 6          | SPICLK   |     | SPI Clock                |
| 7          | TCK      |     | TCK                      |
| 8          | TDO      |     | TDO                      |
| 9          | TDI      |     | TDI                      |
| 10         | TMS      |     | TMS                      |
| 11         | VREF     | O   | Reference voltage        |

## Power and Ground Pinouts

The M1030 mote has an onboard regulator. Connect power to the J1 VCC pin (pin 2). Power and digital or analog I/O should be referenced to the J1 GND pin (pin 1).

 **Important:** To guarantee a known start-up state, the mote should be issued a reset after power is applied.

## Serial Port

Motes can be configured at run time to act as a serial bridge to legacy hardware, or new *smart sensor* applications whose requirements exceed onboard mote capabilities. (Smart sensors are sensors containing a microprocessor). Use the serial port (J1 pins 4 and 5) in conjunction with Clear-To-Send (CTS) and Time pins (J1 pins 8 and 10) to provide a flow-controlled serial interface with timing information. Time pin 10 allows the sensor processor (SP) to request the current time from the network. When Time pin 10 is high, the mote replies by sending a network time packet via the serial port.

Serial port settings are 4800 bps, 8 data bits, no parity, 1 stop bit. All lines are LVTTTL (3 V) signals.

## Antenna Requirements


A U.FL-compatible male connector is provided on board for the antenna connection. Nearson offers a number of 900 MHz antennae with U.FL connectors as a custom option. The antenna should be omni-directional, single-ended, with a  $50 \Omega$  impedance. The following are FCC-approved antenna specifications for the M1030 mote:

| Gain   | Pattern          | Type          | Frequency   | Connector |
|--------|------------------|---------------|-------------|-----------|
| +2 dBi | Omni-directional | $1/4 \lambda$ | 902–928 MHz | U.FL      |
| +2 dBi | Omni-directional | $1/2 \lambda$ | 902–928 MHz | U.FL      |

When placing the mote inside an enclosure, the antenna should be mounted such that the radiating portion of the antenna protrudes from the enclosure, and connected using a U.FL connector on a coaxial cable. For optimum performance, allow the antenna to be positioned vertically when installed.

## Sleep Mode

Motes come with a special *sleep mode* feature that can ease deployment of battery operated systems. If the serial port (J1 pins 4 and 5) is shorted, and the device is physically reset, it assumes a very low-power mode that typically consumes less than 2  $\mu\text{A}$ . The status LEDs remain off, and the device remains in sleep mode until it is physically reset. No power switch is needed.

 **Note:** A mote cannot join the network while in sleep mode. The mote must be physically reset to return it to normal mode before it can join the network.

## Absolute Maximum Ratings

**Table 1-5. Absolute Maximum Ratings**

| Parameter   | Min  | Max            | Units | Condition          |
|---|------|----------------|-------|--------------------|
| Supply voltage<br>$V_{SUP}$ ( $V_{CC} = 2.8\text{ V}$ )         | 2.9  | 12             | V     | Referenced to GND  |
| Voltage on any pin  | -0.3 | $V_{CC} + 0.3$ | V     | Referenced to GND* |
| Storage temperature   | -40  | +85            | °C    |                    |
| Operating ambient temperature<br>(internal package temperature) | -40  | +85            | °C    |                    |

\* Do not source or sink more than 2 mA through the ESD diodes.  
**Note:** Under no circumstances should the absolute maximum ratings given above be violated. Stress exceeding one or more of the limiting values may cause permanent damage to the device.

⚠⚠⚠ **Warning:** The mote is an electrostatic discharge (ESD) sensitive device. Use caution when handling in order to prevent permanent damage to the device.

## Recommended Operating Maximums

**Table 1-6. Recommended Operating Maximums**

| Parameter                               | Min                 | Max                  | Units      |
|---|---------------------|----------------------|------------|
| Digital current*                        |                     |                      |            |
| Output source (single pin)              |                     | 1                    | mA         |
| Output sink (single pin)                |                     | 1.5                  | mA         |
| Total output I/O (all digital I/O pins) |                     | 6                    | mA         |
| Digital Inputs                          |                     |                      |            |
| Logic 0 (VIL)                           |                     | $0.25 \times V_{CC}$ | V          |
| Logic 1 (VIH)                           | $0.7 \times V_{CC}$ |                      | V          |
| Analog input                            |                     |                      |            |
| Analog source impedance***              |                     | 75                   | k $\Omega$ |
| ADC input capacitance                   |                     | 40                   | pF         |
| Load current on Vref                    |                     | 1                    | mA         |
| Input voltage**                         | 0                   | Vref                 | V          |

\* This current level guarantees that the output voltage meets VOL of  $0.25 \times V_{CC}$  and VOH of  $0.7 \times V_{CC}$ .  
 \*\* Vref is  $1.5 \pm 30\text{ mV}$ .  
 \*\*\* Larger input impedances may result in reduced ADC accuracy.

⚠ **Note:** All mote edge connector pins can withstand ESD events up to 2 kV HBM and 1 kV CDM. HBM and CBM refer to the ESD model. The antenna connector can withstand ESD events up to 50 V HBM.

## Wireless Specifications

**Table 1-7. Wireless Specifications for M1030 Mote**

| Parameter  | Value           | Units |
|--|-----------------|-------|
| Frequency band   | 902–928 (range) | MHz   |
| RF output power  | +4 (max)        | dBm   |
| Transmit data rate                                       | 76.8 (max)      | kbps  |
| Receiver sensitivity<br>(at 15 dB SNR and $10^{-3}$ BER) | –93 (typical)   | dBm   |
| Range (with +2 dBi antenna)                              |                 |       |
| Outdoors (1m elevation)                                  | >200            | m     |
| Indoors  | 25–80 (typical) | m     |

## Technical Specifications

**Table 1-8. Technical Specifications for M1030 Mote**

| Category                | Description  |
|-------------------------|--|
| Microprocessor          | TI MSP430F149 16-bit processor                                     |
| Operating frequency     | 902–928 MHz, frequency hopping (FCC15.247)                         |
| Current consumption     |  |
| Sleep                   | 5–8 $\mu$ A  |
| Receive                 | 13.7 mA  |
| Transmit                | 27.3 mA  |
| General purpose inputs  | Five 0–1.5 V general purpose inputs                                |
| Onboard sensors         | Temperature, RF signal strength, and battery voltage               |
| Data rate               | Up to 76.8 kbps  |
| Sample rate             | 10 ksp/s (theoretical maximum—determined by network configuration) |
| Hardware interface      | Two 11-pin connectors  |
| Software                | SmartMesh OS   |
| Unique ID               | 64-bit unique serial number on each mote                           |
| Networking              | Robust multihop, multipath networking                              |
| Gateway/Controller      | SmartMesh Manager connects to other networks using Ethernet        |
| Range                   |  |
| Outdoors (1m elevation) | >100 m   |
| Indoors                 | 15–30 m (typical)  |

## Regulatory Information

FCC ID: SJC-M1030. 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.
- (2) This device must accept any interference received, including interference that may cause undesired operation.

The outside of the device into which the M1030 mote is installed must display a label referring to the enclosed module. This exterior label can use the following or similar wording expressing the same meaning:

“Contains transmitter module FCC ID: SJC- M1030”

or

“Contains FCC ID: SJC-M1030.”

The FCC ID and certification code must be in Arabic letters and numbers and visible without magnification.

! **Caution:** Unauthorized modification or changes not expressly approved by Dust Networks™ Inc. could void compliance with regulatory rules, and thereby your authority to use this equipment.

# SmartMesh Manager

This chapter describes the D1120 SmartMesh Manager, which configures and controls a network of M1030 motes and provides data and configuration information via an XML/RPC interface.

## Description

The D1120 SmartMesh Manager consists of a single board computer and an M1020 mote. The M1020 mote acts as a radio gateway between the single board computer and the Dust Network. An API is provided to allow users to develop custom interfaces or data logging applications. Refer to the *SmartMesh Manager API Guide* for further information.

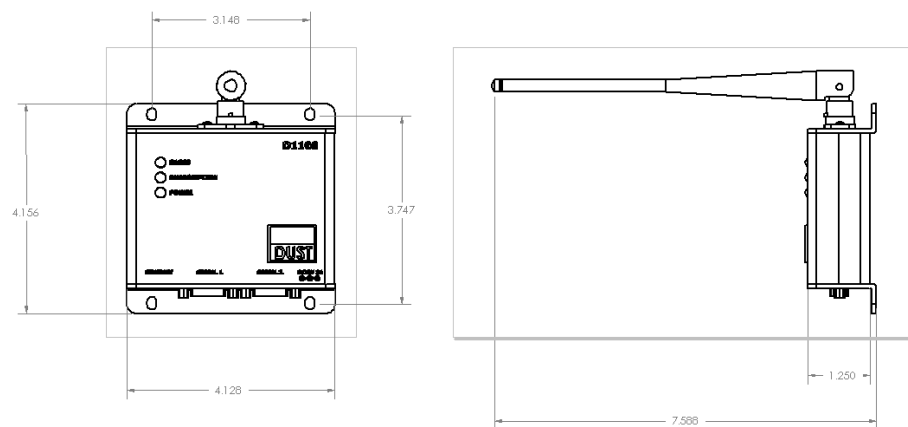


Figure 2-1. SmartMesh Manager (Top View) and Antenna (Side View)

## Connections

The D1120 SmartMesh Manager has the following ports available:

- **10/100 Ethernet port**—Used for connection to a LAN or direct connection to a computer using the cross-over cable provided in the D1120 Evaluation Kit. Refer to the *SmartMesh Evaluation Kit Guide* for information on configuring the IP address of the SmartMesh Manager.
- **Serial 1 port (RS232)**—Reserved for future connection. 115 kbps maximum. Not flow controlled (TX, RX, ground only).
- **Serial 2 port (RS232)**—Command line interface (38400 bps, 8 data bits, no parity, 1 stop bit. Not flow controlled (TX, RX, ground only).
- **Power**—5 VDC, center positive, 2A.

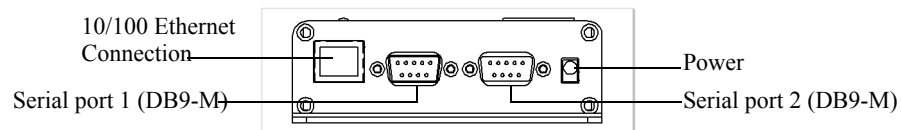


Figure 2-2. SmartMesh Manager Connectors

## Technical Specifications

Table 2-1. Technical Specifications for SmartMesh Manager

| Category                  | Description                                    |
|---------------------------|--|
| Processor                 | Intel PXA255, 400 MHz                          |
| Radio                     | M1020 gateway mote                             |
| Radio operating frequency | 902 - 928 MHz, frequency hopping (FCC 15.247)  |
| Transmit power            | 4 dBm  |
| Receive sensitivity       | -93 dBm  |
| Connectors                | 10/100 Ethernet, 2 RS232 (5 V) serial, 1 power |
| Power                     | 5VDC, 2A max                                   |
| Antenna                   | Nearson 1/2 wave dipole                        |
| Range                     | 10-30 m indoors (typical)<br>100 m outdoors    |
| Environment               | -10 °C to +70 °C                               |
| API interface             | XML/RPC  |



## Regulatory Information

The FCC ID: SJC-D1120. 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.
- (2) This device must accept any interference received, including interference that may cause undesired operation.

! **Caution:** Unauthorized modification or changes not expressly approved by Dust Networks™ Inc. could void compliance with regulatory rules, and thereby your authority to use this equipment.



# Setting Up a Network

This chapter describes how to set up a D1120 Evaluation Kit in a simple sensor network. For a more detailed explanation, see the guide that came with your Evaluation Kit.

## Setting Up the SmartMesh Manager

- 1 Install the SmartMesh Console software.
- 2 Connect Manager to the PC using the cross-over cable.
- 3 Connect power to the Manager.
- 4 If necessary, adjust the IP address of the PC to allow connection with the manager.
- 5 Start Console.
- 6 Connect to Manager.
- 7 Go on to set up the network.

## Setting Up the Network

- 1 Power up one evaluation module by resetting it.
- 2 Press the Test button on the module.  
The green Power LED should turn on. If it does not, make sure that the batteries are properly seated. The Link LED starts blinking when the module has found the network. When the module joins the network, the Link LED remains on.
- 3 Form the network by powering up additional modules (repeat steps 1 and 2).
- 4 Use the Console to verify network connectivity. For more information about configuring and managing the network, refer to the *SmartMesh Console Reference Guide*.

