



Maker Power™ DUST™

Temperature

Features

Bluetooth Enabled Temperature Monitor
 Powered by 16mm coin cell or 5VDC
 Onboard 32Mbit memory
 Open API
 Direct control by Mobile device

Applications

Remote Temperature Monitoring
 Temperature Profiling

Description

The DUST Temperature device is a small module to monitor the temperature in your Maker projects. The app provides all the control functions for a T-Dust device. This includes displaying in Fahrenheit or Centigrade, setting the data rate, recording to internal memory and placing the device in the power down collection mode. The module has a 32Mbit memory on board for recording temperature data. The app will chart the temperature data on the mobile device or convert to a CSV file for download. The module can record for over 120 hours at a 1 second rate. The device is powered by either a 16mm coin cell (approximately 24 hours) or an external 3.6VDC to 5.5VDC source.

Electrical Characteristics

Parameter	Min	Max	Unit
Input Voltage	3.6	5.5	VDC
Quiescent Current		5	mA
Operating Temperature ¹	-40	80	°C
Temperature Accuracy ²		+/-2	°C

Note 1. Temperature range listed is for the device. Care must be taken to ensure that the power source can withstand this temperature also.

Note 2. Accuracy depends on resolution. Resolution is set to 9 bits by default to conserve power. See section on accuracy vs power.

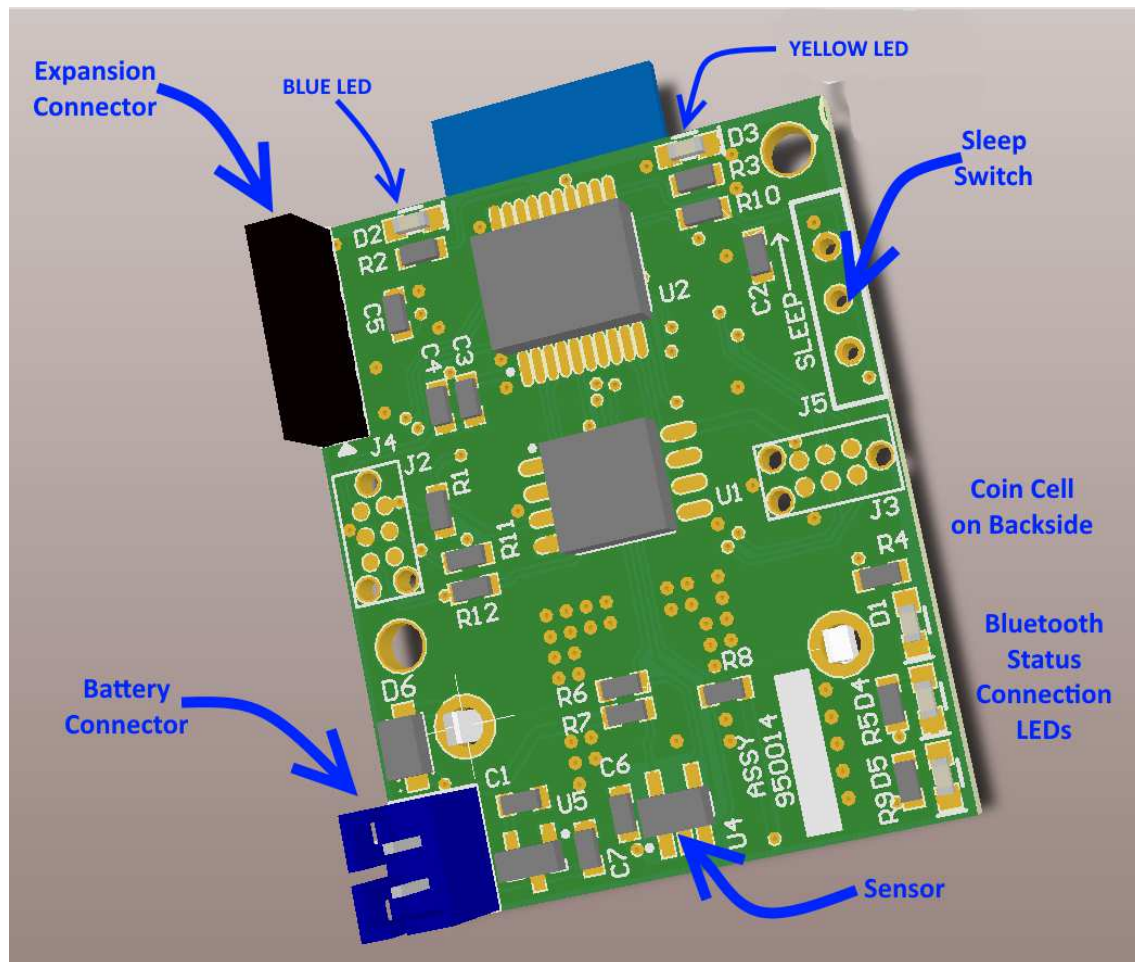
DUST™ Temperature Device

Figure 1 DUST™ Temperature Sensor

Device Description

Below is a description of the user accessible portions of the temperature sensor.

- Expansion Connector will allow the user to string together multiple DUST devices on a single cable.
- Battery connector is for long term active monitoring that cannot be done with the coin cell. Uses the standard JST connector for LiPo batteries from AdaFruit and Sparkfun. MyMakerTools also has a cable with bare wire ends available, that allow the user to connect to any acceptable power source.
- Sleep Switch will place the device in the sleep mode. For use with the coin cell and remote recording.
- LEDs on the right side are used by the Bluetooth connection to signify the state of the connection as Described in the Bluetooth connection table, Table 1. The two LEDs at the top of the device indicate the state as described in Table 2.

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Module Status LEDs

There are 3 possible states and they are indicated by the BLUE and YELLOW LEDs on the top of the device as shown in Figure 1. The different states are shown in Table 1 below.

Table 1 Module Status LEDs

State	Blue LED	Yellow LED
Low Power Recording Mode	OFF	Flash @ 2 sec rate
Normal Recording Mode	Flash @ 1sec rate	OFF
Normal Operation	Alternating	Alternating

Bluetooth Operation

Bluetooth operation is dependent on the mobile application used and thus exact operation is not discussed here. There are three LEDs on the right side of the device as shown in Figure 1. These indicate the state of the Bluetooth connection.

Table 2 Bluetooth Status LEDs

LED	State
BLUE	Bluetooth powered on and operating
GREEN	Bluetooth connected
RED	Application Dependent

Accuracy vs Power

The resolution is set to 9 bits by default. At 9 bits each acquisition cycle will require 30ms to complete. When the resolution is set to 12 bits, the acquisition cycle will require 240ms to complete. During this time the sensor is consuming 400uA of current as compared to 1uA when it is sleeping (not acquiring the temperature). On battery this is not a major consideration. When using the coin cell this can be a significant current draw. With the CR1632 type coin cell and a rated capacity of 130mA-Hr, 400uA for 240ms is a considerable amount of power just to get 1°C improvement in accuracy. The API will let you set the resolution.

Data Recording

There is a 32Mbit FLASH memory on the device for long term recording. This will store approximately 458,000 temperature readings. Data retrieval depends on the Bluetooth interface used. The Data is only accessible via Bluetooth.

Directories

In the internal device memory, a simple directory structure is created as the recording is cycled. Each directory entry contains the following:

1. Start Date and Time (when connected to mobile device)
2. Stop Date and Time (when connected to mobile device)
3. Data count (how many temperature entries there are)
4. Data Rate the temperature data was collected at

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5. Starting Address in internal device memory (may be deprecated in future versions)

Expansion Connector

The expansion connector is used to connect multiple Dust™ devices together. It can also be used as a learning experience for I2C communications. The connector pinout is shown in Table 3 below. Pin #1 is located at the bottom of the connector next to the triangle on the silkscreen.

Table 3 Expansion Connector Pinout

Pin	Function
1	3.3VDC (maximum current draw is 25mA)
2	SCL
3	SDA
4	Sensor Alert* (tristate output with active low)
5	Ground

How to use the DUST Device

Steps for monitoring the temperature of a Maker Power™ Dust™ Temperature sensor.

Normal Operation

1. Attach a battery to the battery connector and ensure the sleep switch is off (switch towards the bottom of the device).
2. The device will start the boot sequence.
3. The Status LEDs will blink a few times followed by the BLUE LED in the Bluetooth status section illuminating,
4. After a few seconds the BLUE LED in the Bluetooth Status section will cycle off then on. At this point the device is ready for a Bluetooth connection.
5. Once the connection is established the GREEN LED will illuminate.
6. Once the connection is established, set the temperature update rate to the desired setting and temperature data will stream to the mobile device at that rate.
7. Depending on the mobile app used, you can chart the temperature data as it is displayed.

Recording Operation

1. Complete the steps 1-6 for normal operation.
2. Press the record button (switch) to start recording at the data rate selected.
3. Press the record button to stop.
4. Depending on the mobile/Bluetooth app, you will be able to view the data collected on a chart or download a CSV file for viewing on another device. These are the only methods for viewing the recorded data.

Standalone Operation

1. Complete steps 1-3 for recording operation.
2. Disconnect the battery
3. Set the Sleep switch to on (switch towards the top of the device)

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4. Insert the 16mm coin cell into the back of the device
5. The YELLOW Status LED will blink at a 2 second rate to indicate it is recording at the rate set.
6. When done recording, set the sleep switch to off and remove the coin cell.

WARNING

Do NOT connect the coin cell and the battery simultaneously. Unpredictable operation can happen causing a failure of the power system.

7. Follow step 4 in recording operation to view the collected data.

Using the MyMakerTools T-Dust App

When starting the App the splash screen will appear followed by the Application Screen, as shown below. Pressing the menu button in the upper left will present the following choices:

- Application (Home Screen)
- Data (data management)
- Options (device options)
- Setup (device/App setup)
- Close (exit the App immediately)

Quick Start

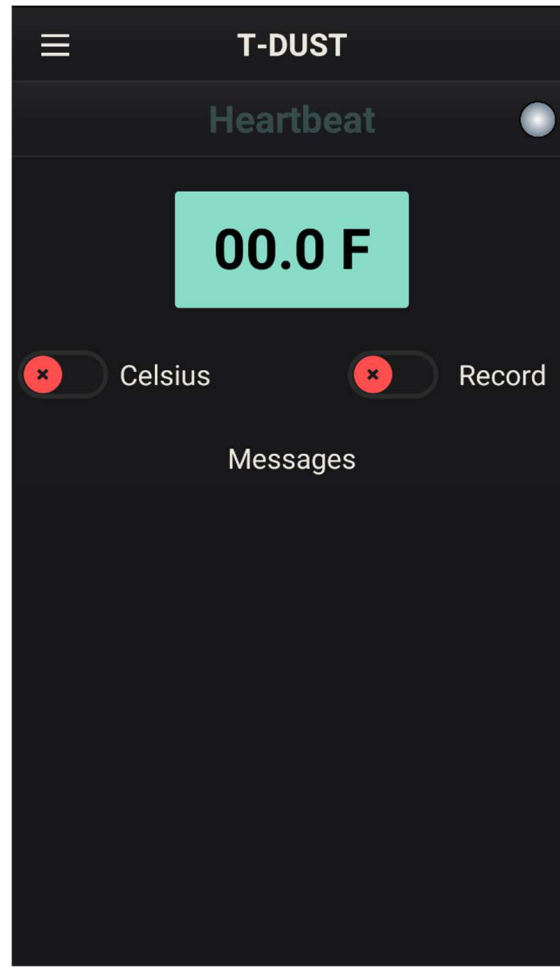
The first time you start the App you must go to the setup screen. This is depicted below. The quick start process is to turn Auto Connect ON and press SCAN. The App will look for available TDust devices. If only one is found it will connect. If more than one is found, then it will present the ID for each and allow you to choose which one.

Note

The App cannot discern between different MyMakerTools devices. Each device will have it's name followed by a unique 4 digit number. In this case choose TDustnnnn.

Then go back to the Application screen and press the temperature display. The App will start to display temperature at the data selected in the Options Screen (described later).

Application Screen



Temperature Display – Pressing this display starts and stops the display.

Heartbeat – When the Heartbeat function is enabled (see Setup), the text will fade in and out to indicate that the “I am alive” message has been received.

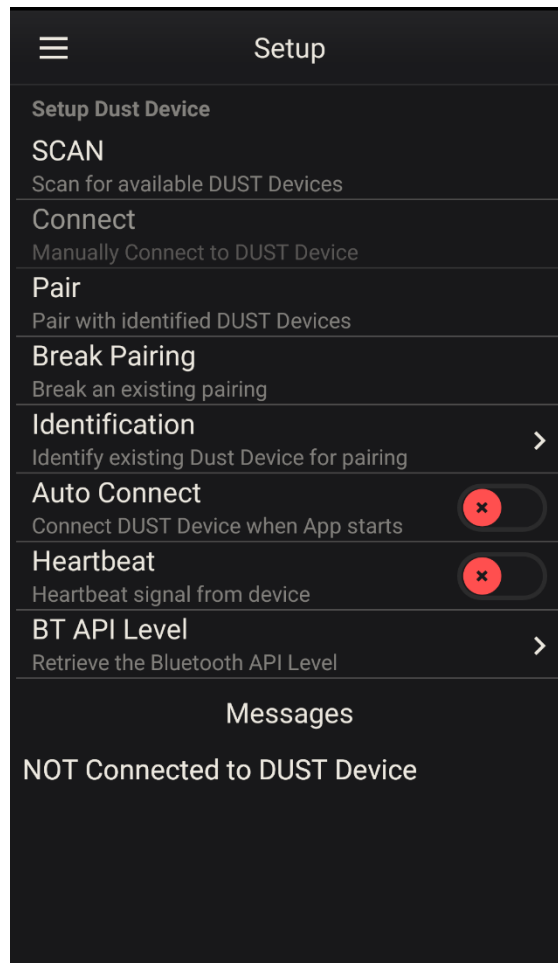
LED – Right of the Heartbeat text indicates if a device is connected (GREEN) or not connected (GRAY)

Celsius Switch – Controls the temperature display in Fahrenheit (OFF) or Celsius (ON).

Record Switch – Controls the recording of temperature data to the device internal memory. When selected only the BLUE LED status on the top will flash.

Messages - Various informational messages are displayed here, depending on the App revision level. Swiping to the left will clear the field.

Setup Screen



Scan – Pressing SCAN will start the Bluetooth scanning process looking for valid devices. If it finds one, it will display the T-DUST label followed by a unique 4 digit number (T-DUST-34:56). If Auto Connect is enabled, it will automatically connect to the T-DUST device. If more than one is found, the list will be presented for you to choose which device you wish to connect to.

Connect – Pressing Connect will connect to the device found and selected during the scan process. This is for manual connection. If the Auto Connect is enabled this is bypassed and a connection established. Once a connection is established this selection is grayed out and cannot be used.

Pair – Pressing Pair will present a list of T-DUST device names entered into the App. Selecting one of the device names will pair this name with T-DUST device. In the future the name will appear instead of the “T-DUST-34:56”. If no names have been entered through the Identification setup (see below), then an error message will appear, “No devices available to pair”. If the device is already paired, then another error message will appear, “This DUST device is already paired”.

Break Pairing – Pressing Break Pairing will break the link between the selected device and the name. If no pairing exists, an error message will appear, “You must be paired to break pairing”.

Identification – Pressing Identification will bring up another screen where you can enter the names of

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T-DUST devices that you have. This makes it convenient to identify multiple devices. They can be named for where they are in the system or some other identifier you put on them. You could use the Bluetooth status LEDs to discriminate between devices. Tapping on the top of the screen where indicated will bring up a dialog box to enter the name. Once entered a long tap on the name will present an option to delete the name. A double tap on the name will bring back the dialog box and allow you to change the name.

Auto Connect – Pressing Auto Connect will allow the App to complete the connection process automatically. When the App is started, it will automatically scan for valid devices. If only one is found it will automatically connect. If more than one is found, the list will be presented for you to choose the device you want to use.

Note

Regardless of how the connection is achieved, you will still be required to go the application screen and press the temperature display to start the data flow.

Heartbeat – Pressing Heartbeat will cause the device to send an “I am alive” message every 2 seconds. This is shown on the application screen by the fading Heartbeat text.

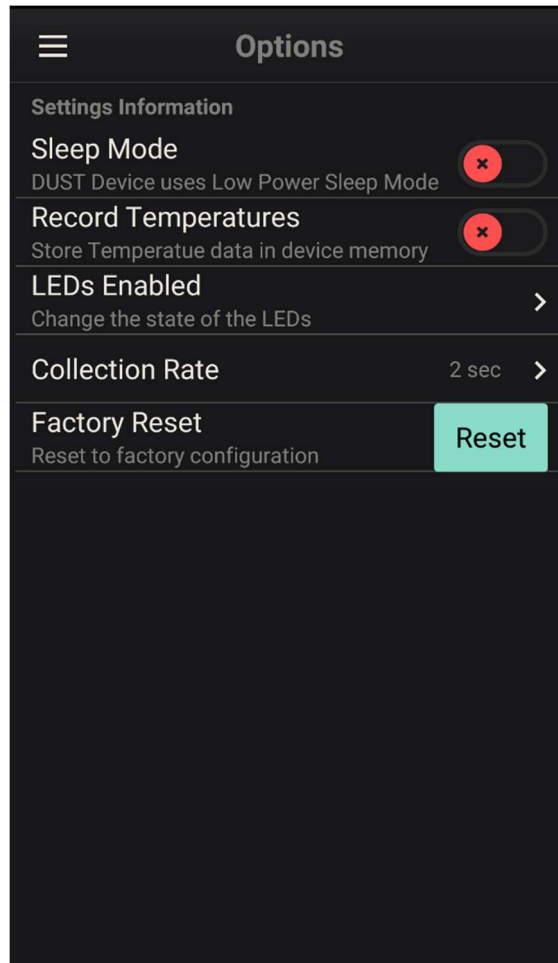
Note

This function may be deprecated in future versions.

BT API Level – Pressing this will display the current Bluetooth API level the device supports and the hardware revision level.

Messages – Various informational messages are displayed here, depending on the App revision level. Swiping to the left will clear the field.

Options Screen



Sleep Mode – Pressing the switch will immediately place the device into low power sleep mode. The Bluetooth interface is also shutdown to conserve power. Unless the record temperatures function was also set, nothing else will happen.

Note

The only way to regain Bluetooth control is to cycle the power.

Record Temperature – Pressing the switch will start the recording of temperature data. Pressing the switch again will stop the recording of temperature data. Repeated cycles will create a simple directory structure in the device internal memory. See the discussion above about Directories.

LEDs Enabled – Pressing LEDs Enabled will bring up another screen that allows you to use the Bluetooth LEDs for you own purpose. Once you enable one, the other two will then follow the state of this screen. Press the Update button to apply the new state. Bluetooth status can only be restored through a power cycle.

Collection Rate – Pressing Collection rate shows a selection box of the different data collection rates from 1 sec to 60 mins.

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Factory Reset – Pressing Factory reset will restore the device to factory settings. This includes erasing all internal memory.

Data Screen

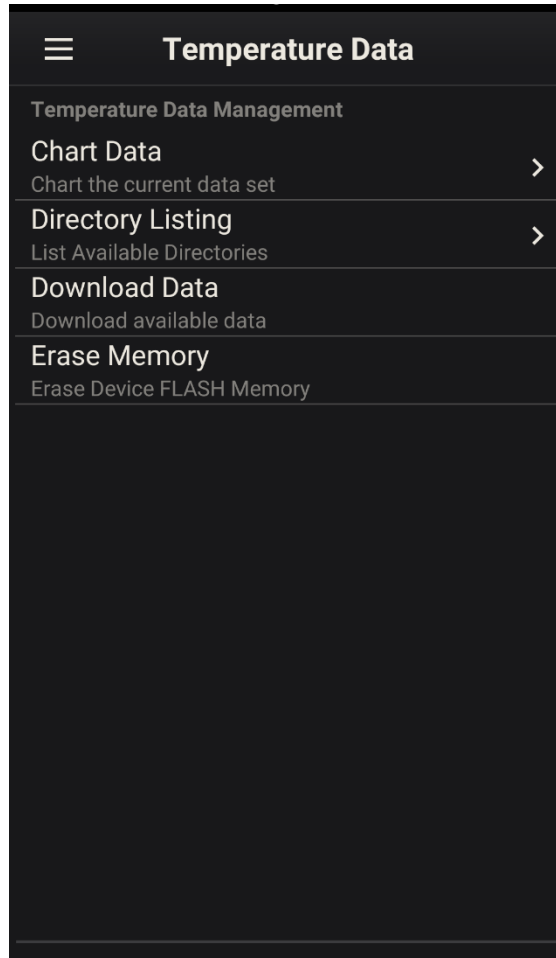


Chart Data – Pressing Chart Data will shift to the chart screen and display the current data set on the chart. Use the standard “pinch” gestures to expand or contract the chart and swipe to move through the data.

Directory Listing – Pressing Directory listing will display the directory entries. Scroll through the screen with the swipe up gesture. Press the Close button to return to the Data Screen. Using the long tap gesture on the data count will download the data contained in that directory to the mobile device in the form of a CSV file as described in the next section. Using the double tap gesture on the data count will chart the data contained in that directory.

Download Data – Pressing Download Data will transfer all of the temperature data in the internal device memory to the mobile device in the form of a CSV file. While the download is in progress, a message at the bottom of the screen will show the “Downloading Now!” and a progress bar below that. The format is at the end of this document. The file is located in the Documents directory in Local (Internal) storage on the mobile device. The file name will be TemperatureData -xxxxxx-yyyyymmddhhmm.csv where

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- xxxxxx is a paired instrument name from the Setup screen or Instrument# if no pairing exists.
- yyyymmddhhmm is the date and time the file was recorded.

Note

The data is all of the data contained in the onboard memory. The starting timestamp is the time the data was downloaded. Downloading data in this way does not retain the directory timestamps.

Erase Memory – Pressing Erase Memory will erase the internal device memory containing the temperature data.

CSV File Format

Device-Fence		
App Version: 1.0.1		
S/N: DTM10001 Firmware Ver: 1.02		
File Date/Time 5/20/18 6:24:43 PM		
Collection Data Rate 2 sec		
Records-2		
Date/Time	Temperature in C	Temperature in F
5/20/2018 18:22	22.5	72.5
5/20/2018 18:24	20.0	68.0
Collection End		

The first line indicates the name of the device. This is set to Instrument# (where # is a sequential number) or the Device Name entered during pairing. In this example it was Fence.

The second line indicates the version of the Mobile App that was used to collect the data, while the third line indicates the serial number of the T-DUST device and its firmware revision.

The fourth, fifth and sixth line indicates when the file was written out, the collection data rate used and the number of records.

The data columns are:

Date/Time – Date and time of the collection

Temperature in °C

Temperature in °F

The final entry is Collection End to indicate there are no more entries.