FEATURES

- Wireless communication over the widely accepted 2.4 GHz frequency band
- High power radio 1200 meters (10x Gen 1 MN-ENV Radio)
- Buffer stores up to 2048 readings with time stamps
- Highly accurate (±0.1°C) and precise 4 Wire RTD probes readings
- RTD fault detection
- Programmable user friendly name & transmission rate
- Globally unique 64-Bit EUI (Extended Unique Identifier)
- Supports repeaters enlarging the wireless network and providing additional transmission routes for the sensor data
- Transmission strength reported on all devices, allowing troubled areas to be identified and addressed proactively (e.g. adding Repeaters)
- Robust Communication protocol includes acknowledgements and retries
- Energy efficient design optimizes battery life
- Low battery buffer only mode
- Optional pole mounting kit
- Applications include monitoring laboratory equipment and cooking processes
- *Complies with FCC, Industry Canada and CE Marking requirements*

DESCRIPTION

The **MeshNet Wireless Dual Channel 4 Wire RTD Input Gen 2**, MN-RTD4W-H, offers an innovative way to monitor up to two 4-Wire RTD temperature probes. The RTD Input provides highly accurate and precise readings from the RTD probes. The product also contains a memory buffer capable of holding 2048 sets of sensor readings, a high power radio with 10x Gen 1 sensor's transmission range, RTD fault detection, and screw-down terminals. Together these features offer an efficient and flexible system for monitoring wide temperature ranges from -200 to 800°C (RTD dependent) the temperature at multiple indoor and outdoor locations.

Part Numbers	Description	MOQ
MN-RTD4W-H	Two 4-Wire RTD Connections with Battery Power	1
MN-RTD4W-H-PLUG	Two 4-Wire RTD Connections Plugin Power with Battery Power Backup	45

SYSTEM DESCRIPTION

The MeshNet RTD Input is part of the MeshNet Wireless Sensor Ecosystem, designed to wirelessly monitor and control real world environmental conditions. The system is completed with the Embedded Data Systems MeshNet Controller (MN-CTRL). The controller communicates directly with the MeshNet RTD Input and presents all data via Ethernet. The MeshNet RTD Input and Controller communicate with each other using a proprietary protocol. An optional system component is Embedded Data Systems' MeshNet Repeater (MN-RPT-H) which is used to extend the range of communication between the Controller and Sensor Nodes.

Controller: Each wireless system contains a MeshNet Controller. The Controller interfaces the wireless system to a local area network (LAN) or the Internet via Ethernet. It manages, reads/writes to the wireless devices, presents the data in easy to use formats such as HTTP and XML, and optionally pushes the data on a timed basis and/or per reception of wireless sensor packet to a HTTP Post server.
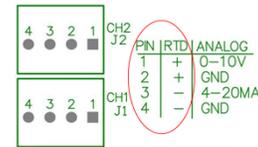
Repeater: Repeaters are used to extend the distance a Sensor Node can be located from the Controller. Many Sensor Nodes can communicate with the Controller through a single Repeater. Each Controller can manage up to 7 Repeaters, and there can be 1 Repeater between a Controller and Sensor Node.

Sensor Nodes: The MeshNet Sensor Nodes provide the means to monitor and control real world environmental conditions. They are typically battery-powered devices that wake on a timed basis, take readings, send the readings to the controller, confirm successful transmission, and check to see if any data is waiting for them. Sensor Nodes currently exist for monitoring: Temperature (Ambient & Stainless Steel Probes), Humidity, Light, Pressure, RTDs, 4-20mA, and 0-10V Sensors.

INSTALLING 4-WIRE RTD

Inside the RTD Input's packaging you will find 2 AA batteries along with a hardware bag including four screws, 2 cable grommets for the RTDs, 1 grommet which outlines the perimeter of the enclosure, and a plastic plug.
1. Remove the lid of the enclosure and insert the rubber grommet along the grooves along the perimeter of the lid where the board is mounted.
2. Insert the cable grommets in the holes where an RTD will be installed. If only one probe will be installed, insert the provided plug in the unused hole.
3. Insert the RTD's 4 wire leads through the cable grommet.
4. Detach the vertically installed screw-down terminal and note the orientation.
5. Connect the probe's leads to the screw-down terminal.
    a. Red wires are connected to pins 1 & 2 ("+" in the wiring chart).
    b. White wires are connected to pins 3 & 4 ("-" in the wiring chart).
6. Reinstall screw-down terminal with the vertical orientation with the screw heads pointing away from the batteries.
7. Insert the two AA batteries provided, upon insertion a red LED will flash rapidly indicating that the sensor is now in an active state.
8. Close the enclosure making sure that the screw down terminal is on the opposite side of the cable grommet to improve wireless performance by keeping the cables away from the wireless antenna.
9. Lightly pull the cable to remove excess cabling from within the enclosure.
10. Take the 4 screws included in your hardware bag and secure the lid to the base by firmly screwing the enclosure from the bottom of the base.
11. Sensor is now ready to be linked.

LINKING INSTRUCTIONS

1. Go to MeshNet Controller's homepage and select System Configuration>Devices.
2. Insert batteries (if not installed during the RTD installation) into sensor's battery holder.
3. Select the sensor when it appears[1] on the "Unlinked Devices" section of the MeshNet Controllers page.
4. Click "OK" on the popup to link the sensor to the Controller.
5. Confirmed sensor moves to "Linked Devices" section. This may take up to 1 minute or longer[2].

OPERATION

All data from the MeshNet Sensors are read using a MeshNet Controller. The MeshNet Controller makes the data available in a number of ways which include HTTP GET, HTTP POST, and TCP Access. Buffered data is only made available through the HTTP POST interface. See the *MeshNet Controller User's Manual* for more information.

PrimaryValue
This is likely the most important value for users of the deployed sensors. The MN-RTD-H's primary value would be Probe1Value denoted in the following format "xxx.xxx   Deg C".

RTD1Temperature, RTD2Temperature
Current temperature readings, displayed with 0.001 °C resolution. -250°C indicates the probe is not connected. Temperature calculations

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[1] A factory reset may be necessary if the device was previously linked to a different Controller and wasn't unlinked.
[2] The sensor will respond when its next transmission is made.

RTD1Ohms, RTD2Ohms
Current Ohms readings, displayed in 0.001Ω resolution. A reading of 0Ω indicates the probe is not connected.

RTD1Fault, RTD2Fault
Identifies RTD wiring issues. "0" is good. A reading of "1" indicates a problem.

TimeStamp
The date and time when the temperature readings are taken.

Battery
Displays voltage of the battery.

PowerSource
A special order variant is available that allows the RTD Input to be powered by inline or battery power. A reading of "1" indicates battery power. A reading of "0" indicates currently receiving inline power.

OPERATIONAL PARAMETERS

Name
The Name or ID used to indicate the sensor model in the Controller. A list of the current IDs is available at the EDS Environmental Sensor IDs section.

EUI
The EUI, or Extended Unique Identifier, is a globally unique 64-bit number, represented by 16 hexadecimal digits. This number can be used by software to uniquely identify every MeshNet wireless device.

ControllerRSSI
This indicates the strength of the radio signal at the controller; higher numbers equate to stronger signals. Due to hardware limitations, the highest number that can be displayed is -34 dBm. However, the actual signal strength may be much higher.

DeviceRSSI
This indicates the strength of the radio signal at the sensor. Due to hardware limitations, the highest number that can be displayed is -34 dBm, however the actual signal strength may be much higher.

Address
This is the address of the sensor, which was assigned by the controller.

Repeater
When the repeater joins the controller, it is assigned a repeater number, which is displayed here. A zero indicates there is no repeater in the communication path.

Health
This is a number ranging from 0 to 7; 0 is not connected and 7 is healthy. The number is incremented when a packet is received from the repeater and decremented when two packets are not received after a predetermined period of time. Numbers less than 7 other indicate a weak[3] wireless link or other problem.

Version
This indicates the firmware version of the sensor.

UserName
The user programmable string used to identify any given Sensor; it may be up to 29 characters long. It is saved in non-volatile memory so it is retained even when power is cycled. The string is best used as a human readable label, which can uniquely identify each MeshNet RTD Input.

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[3] During initial configuration readings below 7

ReadCounter
Counts the number of times a packet has been sent to the controller. This number has a maximum of 4294967296. When the maximum is reached, the number rolls back to 0 and begins counting up again.

SensorReadPeriod
Used to define frequency the current sensor readings are transmitted. Larger periods between transmissions will conserve battery power.

At power up, the device sends data packets every 10 seconds for the first 6 packets. After the first 6 packets are sent, the device reverts to sending packets at the Read / Send Data setting (1 minute buy default). This is to facilitate programming in cases where a long read period is desired. Even with very long read periods, simply cycling the power[4] will cause parameters to be written without having to wait for the sensor read period to time out.

BufferState
It is used to indicate whether the data packet was buffered by the sensor prior to successfully transmitting the data to the Controller. "0" indicates the data wasn't buffered by the sensor. "1" Indicates the data was stored in the sensor's buffer.

BufferHeadPointer
Indicates the most recent packet held in the buffer.

BufferTailPointer
It indicates the oldest unsent buffered packet in the buffer. When the BufferHeadPointer and BufferTailPointer are the same, the buffer is empty.

Configuration Options	
Setting	**Period**
0	5 seconds
1	10 seconds
2	15 seconds
3	30 seconds
4	1 minute
5	2 minutes
6	5 minutes
7	10 minutes
8	15 minutes
9	30 minutes
10	1 hour

RTD1ValueCalibration, RTD2ValueCalibration
It contains the factory calibration for the input channels.

Factory Reset

Web (soft reset)
Writing anything to the <FactoryReset> location will return all parameters except for the <UserName> and the Network Key to factory defaults. This parameter is not sent from the sensor to the controller so no data is presented.

Short (hard reset)
All parameters can be reset by shorting the two circled pads labeled "RESET" together for 4 seconds[5]. The LED will blink rapidly once the reset is triggered. Please note the factory reset will move the sensor to its unlinked state.

WRITE PARAMETERS

In order to conserve power, MeshNet sensors sleep when not reading the sensors or sending data. When sleeping, they cannot receive wireless data. Because of this, writes are queued by the MeshNet Controller and sent when the Sensors are awake.

Writes Pending
The number of writes waiting to be sent to the sensor.

Writes Succeeded
The number of writes that have been received and acknowledged by the sensor.

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[4]Power should be removed for 30 seconds to ensure immediate transmission.
[5] Shorting the "Reset" pads briefly (less than 4 seconds) will trigger a sensor transmission.

Writes Failed
The number of writes that were not able to be sent to the sensor or were not acknowledged.

WIRELESS COMMUNICATIONS

The device communicates at 2.4 GHz via an industry standard 802.15.4 wireless link. Wireless packets are acknowledged, all data is checked for errors using CRC and corrupted data is resent.

DIAGNOSTIC PARAMETERS

The following parameters are provided for diagnostic purposes. Wireless communications are acknowledged and retried if no acknowledgment is received. The parameters below can be used to determine link quality. Wireless performance can be improved with the introduction of MeshNet Repeaters within the wireless network. The repeaters provide sensors additional paths to the controller. Sensors will continue to use an established path until a failed transmission.

ConnectionCounter
Counts the number of connections made to the controller. When a device is first powered, it connects to a controller, obtaining an address and thus belonging to the network. If the signal strength is good and power is not lost at the controller, this number will stay low. A high number could be due to low signal strength, periodic interference or power problems. Maximum is 65535, after which it no longer increments until the counter is reset.

MessageAttempts
The number of packets attempted to have been sent. It can be reset and has a maximum of 65535, after which it no longer increments until the counter is reset.

MessagePacketRetries
The number of times wireless packets had to be resent due to no acknowledgment being received. The maximum is 65535, after which it no longer increments until the counter is reset.

MessageFailures
When no acknowledgment is received, the packet is resent. After 4 retries, the message has failed. The counter increments when a failure has occurred. The maximum is 65535, after which it no longer increments until the counter is reset.

MessageCounterReset
It is used to reset the 3 message counters along with the ConnectionCounter to zero.

BUFFERED DATA

The MeshNet Wireless Dual Channel 4 Wire RTD Input Gen 2 includes a 64K byte EEPROM which is capable of storing up to 2048 complete sets of the probe readings. To receive the buffered data from the controller, the POST Client and the "Use Buffer" option must be enabled. Once enabled, the MeshNet Controller transmits any sensor data it receives in near real-time. Packets received with a few seconds of each other may be bundled. The bundling will commonly occur when multiple Gen 2 sensors are configured to the same transmission rate and when Gen 2 sensors are clearing their buffers. The readings are buffered in two instances:

- When a sensor transmission is not acknowledged, sets of readings are stored at every send period, but attempts to contact the controller may not happen every send period after a failed transmission. This saves battery power when a short send period is selected. Once a connection with the controller is reestablished, the buffer is emptied.
- When battery voltage becomes extremely low, the RTD Input will revert to a buffer only mode. This extends battery life by avoiding consuming power for transmissions.

BUFFERED DATA PACKETS

The MN-RTD-H transmits two types of wireless packets:
- owd_EDS2030_Tag – This packet primarily provides the EUI of the sensor and the writeable UserName. It is sent on a number of situations including:
    - The sensor has just connected/reconnected.
    - The UserName has been modified.
- owd_EDS2030_Data – This provides the bulk of the sensor data.

Below is a sample packet which includes:
- Controller Data in Black
- owd_EDS2030_tag in Green
- owd_EDS2030_Data in Blue

```
<Devices-Detail-Response>
<DeviceName>WirelessController-Enet</DeviceName>
<MACAddress>54:10:EC:14:97:0E</MACAddress>
<owd_EDS2030_Tag>
<Name>EDS2030</Name>
<EUI>801F12FFFE35964A</EUI>
<ControllerRSSI Units="dBm">-34</ControllerRSSI>
<Address>1</Address>
<Repeater>0</Repeater>
<UserName Writable="True">EDS RTD Sensor</UserName>
</owd_EDS2030_Tag>
<owd_EDS2030_Data Description="RTD Sensor with high power transceiver and power management">
<Name>EDS2030</Name>
<EUI>801F12FFFECB7C0C</EUI>
<ControllerRSSI Units="dBm">-41</ControllerRSSI>
<Address>1</Address>
<Repeater>0</Repeater>
<TimeStamp>2020-05-05 12:19:31</TimeStamp>
<RTD1Temperature>-250.000</RTD1Temperature>
<RTD1Ohms>0.000</RTD1Ohms>
<RTD1Fault>1</RTD1Fault>
<RTD1CalibrationValue>1.000000</RTD1CalibrationValue>
<RTD2Temperature>-250.000</RTD2Temperature>
<RTD2Ohms>0.000</RTD2Ohms>
<RTD2Fault>1</RTD2Fault>
<RTD2CalibrationValue>1.000000</RTD2CalibrationValue>
<DeviceRSSI Units="dBm">-38</DeviceRSSI>
<PowerSource>1</PowerSource>
<BufferState>0</BufferState>
<BufferHeadPointer>200</BufferHeadPointer>
<BufferTailPointer>200</BufferTailPointer>
<ReadCounter>281</ReadCounter>
<SensorReadPeriod Writable="True">3</SensorReadPeriod>
<ConnectionCounter>3</ConnectionCounter>
<MessageAttempts>484</MessageAttempts>
<MessagePacketRetries>30</MessagePacketRetries>
<MessageFailures>2</MessageFailures>
<Battery Units="Volts">2.98</Battery>
<OTASequenceNumber>33252</OTASequenceNumber>
</owd_EDS2030_Data>
</Devices-Detail-Response>
```

PROGRAMMABLE/WRITEABLE PARAMETER SUMMARY

Parameter	Description	Limitations
UserName	User friendly name for the sensor	29 characters 0-9, A-z, and special characters (space and ".")
SensorReadPeriod	Selects the transmission rate (see selectable transmission rates on page 4)	11 transmission rate options
ResetMessageCounters	Resets MessageAttempts, MessagePacketRetries, and MessageFailures to 0.	
InputSend	Enabling (set to 1) configures sensor to transmit when scheduled and when the input state changes.	0 to 1
FactoryReset	Resets all programmable settings except UserName and Network Key.	Only occurs if ReadCounter is below 20.
Linked	Writing a Controller's NetKey to the Linked Parameter has it join the Controller's network. The unlinked NetKey is FFFFFFFF.	Must write an 8 digit Hexadecimal number (0-9 & A-F).
CalibrationKey	Writing the appropriate command will calibrate to RTD Input to 100 Ohms. Details available in the calibration section.	

BATTERY LIFE

The RTD Input spends most of its time in sleep mode; it wakes up to take readings, send data and see if any packets are in the queue to be received. Battery life can be maximized by reading/sending the sensor data as infrequently as possible. Battery life is highly variable on a number of parameters.
1. How often data is read/sent.
2. Extreme temperatures reduce the useful life of the battery.
3. If the sensor is sending data through a repeater, battery life will be reduced because the sensor has to wait longer for the acknowledgment.
4. If the sensor has to reconnect to the controller frequently, battery life will be reduced. This happens when the signal is low or there is interference.
5. Channel hopping
6. The battery chemistry will affect the performance. Lithium batteries will provide substantially better performance especially in cold environments.

Expected battery life in normal conditions at a 1 minute transmission rate is 2+ years.

INLINE POWER (Optional with MOQ)

A RTD Input with inline power and battery backup is available for special order. A power supply capable of providing 4 to 16VDC with a right angle 2.5mm barrel connector is suggested. The battery backup is not charged by the presence of inline power.

RTD INPUT CALIBRATION

Each input is factory calibrated to ±0.01% accuracy at 21°C. The Callendar-Van Dusen equation and calibration performed on each reading. It has an accuracy of ± 0.1° across probes temperature (with MeshNet RTD Input at 21°C[6]).

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[6] The MeshNet RTD Input may be recalibrated at temperatures significantly different than 21°C. Contact Sales@EmbeddedDataSystems.com for more details.

LINKING PROCEDURE (CABLE FREE)

1. **Apply power to the MeshNet Controller.** The green PWR/ACT LED located on the front of the Controller will begin to flash at one-second intervals, indicating that the product is operating normally. Power must be 5 volts +/- 10% at 400 milliamp.

2. *Connect the MeshNet Controller to your Network*. Connect a live network cable to the Ethernet Port on the device. The green LED on the Ethernet connector will light, indicating a valid network connection. The yellow LED on the Ethernet connector blinks only when there is network traffic.

3. **Determine the IP address of the MeshNet Controller** by checking your DHCP server logs or using EDS Appliance Scanner Software available from the EDS website and http://short.eds.bz/apps-edsscanner. If the MeshNet Controller does not find a DHCP server running on your network, it will default to the following IP address: 169.254.1.1.

4. **Navigate to the MeshNet Controller**. Type the IP address of the MeshNet Controller into your web browser (e.g., http://192.168.1.27) and press enter. Go to System Configuration>Devices. When the name and password is requested, enter "**admin**" for the name and "**eds**" for the password. A page similar to below will appear:

5. **Insert AA batteries into sensor**. Once this is done the sensor will appear[7] in the "Unlinked Devices" section.

6. **Click the unlinked sensor.** A window will pop up confirming you want to link the sensor. Click "OK". The sensor will move to the "Linked Devices" section upon its next transmission. (Sensors at power up transmit every 10 seconds for the first minute then they move to the configured transmission rate which is 1 minute by default.)

7. **Congratulations!** You have successfully installed a MeshNet Wireless Sensor System. *Please refer to the Web Access section of the Operation Manual to obtain an understanding of the function of each of the web pages served by the MeshNet Controller.*
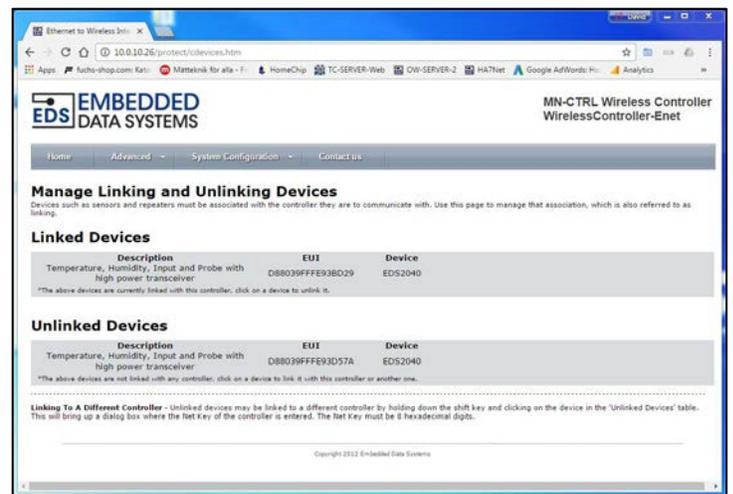
Some things to keep in mind:

- Support is provided for MeshNet Controller IP address identification only when utilizing the EDS Appliance Scanner Software (http://short.eds.bz/apps-edsscanner). Please consult your network administrator if you cannot locate the DHCP address.
- *For instructions on appropriate placement of the components of the MeshNet Wireless Sensor System, please refer to Proper Placement section of the Operation Manual.*

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[7] Previously linked MeshNet sensors (which were not unlinked) will not appear. A hard reset (page 4) should be performed to move the sensor into an unlinked state.

EDS ENVIRONMENTAL SENSOR IDS

ID	Features
EDS1064	Temperature
EDS1065	Temperature & humidity
EDS1066	Temperature & barometric pressure
EDS1067	Temperature & light
EDS1068	Temperature, humidity, barometric pressure, & light
EDS2030	Dual RTD Input with high power radio
EDS2033	Dual Analog Input with high power radio
EDS2040	Temperature, humidity, external probe support, memory buffer, & high power radio
EDS2041	Temperature, humidity, external probe support, 2K memory buffer, high power radio, & buffer only mode
EDS2042	Up to 3 waterproof external temperature probes, 2K memory buffer, high power radio, & buffer only mode

EDS REPEATER DEVICE IDS

ID	Features
EDS2101	MeshNet Repeater with high power radio

SPECIFICATIONS

PARAMETER	MIN	TYP	MAX	UNITS
Operating Temperature Range	-40	-	85	°C
Accuracy (-200 to 800) with Input at 21°C	-0.1	-	0.1	°C
Battery Supply Voltage (battery in series)	2.2	-	3.1	Volts
Inline Power Supply	4	-	16	Volts
Enclosure Dimensions (L x W x H)	100	100	40	Mm

Notes:
1. The battery voltage varies depending on how much current is flowing. When the sensor is sleeping, the voltage is higher than when it is awake. The reading is taken when the sensor is awake.

Regulatory Compliance

FEDERAL COMMUNICATIONS COMMISSION (FCC) COMPLIANCE STATEMENT

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.

INDUSTRY CANADA (IC) COMPLIANCE STATEMENT

This Class B digital apparatus complies with Canadian ICES-003.
Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

EUROPEAN COMMUNITY (EC) DIRECTIVES CONFORMITY

~~APPLICATION OF COUNCIL DIRECTIVE 2004/108/EC Standard to which Conformity is Declared:~~
~~EN 61326-1:2006~~ ~~(Emmissions)~~
~~EN 61326-2-3:2006~~ ~~(Immunity)~~
~~EN 61000-3-2:2006+A1:2009+A2:2009~~ ~~(Harmonics)~~
~~EN 61000-3-3:2008~~ ~~(Flicker)~~

CE FC

Caution: The manufacturer is not responsible for any radio or television interference caused by using other than recommended cables or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate this equipment.