Installation Procedure Recommendations

Basic Components of the Tehama System:

- MDT (Metering Data Transceivers): A single MDT is connected to one utility meter. A dual MDT can connect to two utility meters (usually cold and hot water meters).
- Repeaters: High powered transceivers that forward metering data to the DCAP.
- DCAP (Data Concentrating Access Point): A combined Data receiver, database collector, and Internet gateway device that collects and forwards metering data by email or FTP to billing centers or energy monitor centers. Tehama also publishes an API you can use to *pull* your data rather than use the Tehama system to *push* the data to you. Refer to the API App Note for details.

The key to a successful site installation is having a robust Network Backbone (DCAP plus Repeaters) in order to forward radio messages from remote MDTs on toward the DCAP. The Tehama system provides a wealth of network performance data to help troubleshoot and verify that you have achieved a robust Backbone and that all MDT units are communicating within acceptable parameters.

Operational Background

The Tehama system uses a two-way radio communication protocol whereby each transmitting unit (MDT or Repeater) receives an ACK (Acknowledgment) from a Link Partner (the Repeater or DCAP to which the message was directed). If the ACK is not received, a unit will try again a number of times before either giving up (in our basic pulse only memory-less units) or storing the message to re-send again at the next measurement interval (in our Time of Use products).

A Tehama transmitting unit needs to synchronize itself to a member of the Network Backbone before it is able to communicate. First each unit starts by listening for Beacon signals that are periodically sent by the DCAP and Repeaters. Once a Beacon is heard, a unit then tries to "join" the network by sending a message to the strongest radio Beacon generator, then to other members of the Network Backbone whose Beacons were heard, until an ACK is received, verifying that Link Partner.

After joining the Network, an MDT or Repeater will always direct its radio messages to the selected Link Partner. Should it not receive an ACK for a number of transmission attempts, the unit will select another member of the Network Backbone and continue to operate seamlessly. Each Link Partner in turn forwards the radio message toward the DCAP using the same mechanism of ACKs to ensure the best subsequent Link Partner is always being used.

Network Setup

Site Survey

Before setting up an installation, a site survey is recommended to determine locations where house power can be used to run the Repeaters, and where property supplied Internet connections are available for the DCAP. If you use our LTE Cellular DCAP system, the DCAP location will not be restricted to where property Internet is available, allowing the DCAP to be optimally placed at the site. Our solar offerings allow

Repeater Power & Placement

Next step is to install Repeater power as required.

- For Garden style properties, Repeaters should generally be placed outside in **PLASTIC** weather sealed electrically rated boxes with house power running through plastic conduit to a standard 120 VAC socket within the box.
- The plastic box should be mounted at least six feet off the ground, if possible, to minimize potential tampering and provide good signal propagation. Placement of the box should be away from any nearby metal breaker boxes.
- For tower style properties, Repeaters should be placed in utility closets or other similar locations inaccessible to a tenant. Placement within those rooms should be away from large areas of metal like furnaces, ducts, breaker panels, or wire mesh screens.
- Avoid using house power that is on a switched circuit (i.e. automatic light control).
- Avoid using power from a GFCI (ground fault circuit interrupt) source unless code requires it.
- The only ones we know of that have been specifically designed to shield RF interference are manufactured by Leviton, specifically their part number GFWR1-W.
- Use only 5 VDC (1 AMP typical) power transformers (wall warts) for Repeaters.

Under no circumstances should Repeaters be placed:

- Inside a metal box.
- On a metal wall.
- Where water may submerge the repeater (i.e. pooling water on a roof).

Network Activation

DCAP

The Tehama Network starts with the DCAP. Without a DCAP there are no originating Beacons and therefore no Network to join. Thus, it needs to be the first device that is installed and powered.

With the DCAP in place and plugged in, the Repeater Backbone can then be installed.

Repeaters

Repeaters should be powered up starting with those closest to the DCAP and working your way out to the remote edges of the property. This will allow remote Repeaters to see the Network Backbone when they are turned on. Powering up in this order is not necessarily critical, but if not followed then the power-up LED indications on a remote Repeater may not provide the useful feedback to the installer that it has successfully joined the Network.

Once the Repeaters are in place, you can use the CIT tool or webapp or phone app to observe the performance of the Network Backbone.

MDT's

Once the Network is in place, you can begin to place the MDTs in their locations and turn them on. Alternatively, the MDTs can be installed with the meters in the off state. As soon as the meter begins to generate pulses, the first pulse will automatically turn on the MDT and begin to transmit.

MDTs can also be placed and turned on before the Network Backbone is up and operating, but there are a few disadvantages:

- MDTs could take up to four hours to check in after the Network Backbone is put in place.
- You don't get the LED feedback that gives you instant feedback that the MDT is communicating successfully with the Network.
- There is a small battery life penalty when MDTs are powered up but do not communicate with a Network for long periods of time (i.e. a few weeks or more).

Placement:

- Like repeaters, MDTS should not be mounted inside a metal box or near a metal wall (i.e. heating furnace or electrical panel).
- MDTs must be mounted using Velcro, tie-wraps, or screws. Don't let the MDT dangle by the pulse input wire. For best mounting practices use the keyhole with a #6 drywall screw and screw in wall for our latest MDTs (160 and 170 models. For Display MDTs, it is best to mount the back plate in a standard 1-gang electrical box for a professional looking installation.

- Avoid locations with dampness, high humidity, or an abundance of mold.

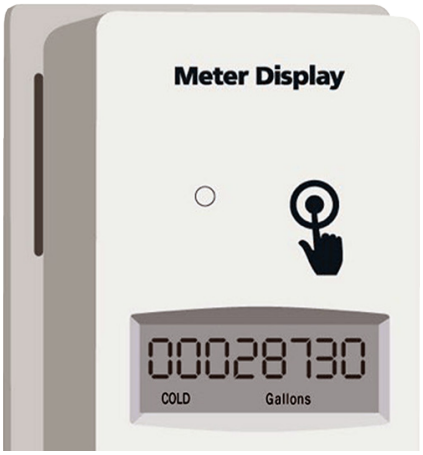
MDT & Repeater Power-up

MDT and Repeater devices come from the factory in a powered off state. They need to be powered up during the commissioning process so they can register themselves with the DCAP. They do not need to be wired to a meter for commissioning.

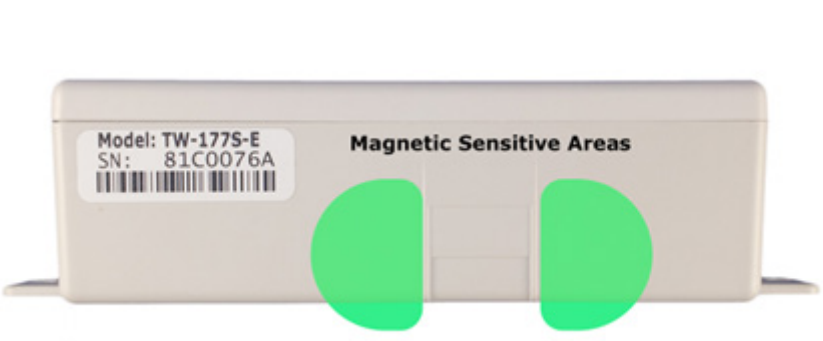
For our first-generation MDTs, the yellow circle shows where a hidden button is on the enclosure. It may take a few times to get the feel of it, but an LED in the clear window to the right gives you feedback when the button is pushed.

The latest generation MDT, the green circle shows where the hidden button is on the enclosure. An LED to the left gives you feedback when the button is pushed.

For our Display MDT the icon of the finger pressing a button is where the hidden button on the enclosure. The small circle to the left is an LED that gives you feedback when the button is pushed.



For our Submersible MDT a magnet must be waved across the side of the MDT to activate the internal button. Once a magnet is detected the LED on the front gives feedback that the MDT has been activated.



- To turn a device ON, press and hold the button until the LED flashes off (about four seconds) then release the button. For a Submersible MDT the magnet is used as the button press.
- For our first-generation MDT after about 30 seconds the LED flash frequency should change from slow to fast. After another 30 seconds or so, the LED will stay solid for 10 seconds then go out. The long flash indicates the device is communicating with the network.

- Our latest MDT including our Submersible MDT responds immediately upon hearing a beacon, and if it gets an ACK back the LED goes solid. In the background it continues to search for a better link partner, but at least the user knows (with the solid LED) that it CAN communicate. If that initial ACK is not received, then it goes rapid flash and listens for more and responds immediately to the next beacon heard then goes solid if successful.
- To turn a device OFF, press and hold the button until the LED flashes off (about four seconds) then release the button. The unit will give a double flash indicating the off state.

LED Flash Indication States during power-up

Slow flash: The device is listening for Beacons from a DCAP and/or Repeaters.

Rapid Flash: The device has heard a DCAP and/or Repeater and is in process of joining the Network.

Solid Flash: The device has confirmation that it has successfully joined the Network.

LED Flash indication States when button is momentarily pressed

Single Flash: The device is in a light sleep mode. It will wake up every so often to listen for Beacons.

Double Flash: The device is OFF

10 second on: The device is successfully communicating with a Network.

Note that a light sleep mode is entered when a device is turned on but cannot hear a radio network beacon. If no network is present, a device will stay in the slow flash state for 90 seconds then go to sleep for some time before trying to listen again for a beacon. It is highly recommended that a device be turned off if no Network is nearby.

Detailed definitions of terms used in this installation guide:

Link Partner	The unit to which an MDT or Repeater sends its message.
Beacon	A periodic transmission sent out by the DCAP and Repeaters containing the time of day, the RadioID, and other information about the transmitting unit.
RSSI	Receive Signal Strength Indicator (This is similar to the number of bars indicating radio signal strength on a cell phone).
Link Quality	An internal metric each MDT and Repeater generate to determine the quality of the radio link. RSSI is often a bad indicator of actual quality.
Hop Count	An indication of how far away (how many hops via Link Partners) it takes to reach the DCAP.
Network Backbone	A Tehama network consisting of one DCAP and a number of Repeaters.