Technical Brief

On-Demand 1.2 Overview

Y20984-TEB Rev. A

A product of
Aclara Technologies LLC
Confidential and Proprietary

FCC/ISED Compliance

This product/device has been tested and certified to be in compliance with all appropriate requirements of both the FCC and ISED.

Any changes or modification to this product/device, or the use of any antenna other than the one provided by or authorized with expressed written approval by Aclara Technologies LLC may void the user's authority to operate this product/device.

This product/device and/or its antenna must be fixed-mounted on indoor or outdoor permanent structure(s) providing a separation distance of greater than 20 cm from all persons during normal operation. This device is not designed (and it has no external connection) to operate in conjunction with any other antennas or transmitters. No other operating instructions for satisfying RF exposure compliance are needed.

This product/device has been tested and calibrated at the factory. It has no user adjustable controls and can only be adjusted by authorized, trained personnel.

Conformité FCC/ISDE

Cet équipement a été testé et il est conforme à toutes les exigences appropriées de la FCC et de l'ISDE.

Tout changement ou toute modification à cet appareil, ou l’emploi de n’importe quelle antenne autre que celle fournie par ou autorisée sous l’accord exprès donné par écrit d’Aclara Technologies LLC peut annuler l'autorisation d’utiliser de cet appareil.

Cet appareil ainsi que son antenne doivent être montés de manière fixe sur des structures intérieures ou extérieures permanentes en conférant une distance d’au moins 20 cm des personnes pendant le fonctionnement normal. Cet appareil n’est pas conçu (et il n'a aucun branchement externe) pour être utilisé en association avec toute autre antenne ou tout émetteur. Aucune autre instruction d’utilisation n’est requise pour assurer la conformité aux règles d’exposition aux RF.

Cet appareil a été soumis à des tests et calibré en usine. Il n’a pas de contrôle d’ajustement et ne peut être ajusté que par un personnel autorisé et qualifié.

Introduction

The Aclara RF™ network is an advanced metering infrastructure or AMI that allows for meter readings to be transmitted directly to a utility along with various system performance and diagnostic information. It allows for unmanned reading of water and gas meters. It is currently deployed in more than 700 utilities worldwide.

The three major components of the Aclara RF™ Automated Metering Infrastructure system are:

Meter Transmission Units (MTUs) - These are connected to the meter, whether wired to it for water, or physically attached for gas. They take hourly readings from the meter and transmit them via radio frequency on a regular basis. Each meter in the system will have an MTU.

Data Collector Units (DCUs) - These are installed in the field to collect readings from nearby MTUs. The DCU performs some treatment and consolidation of these readings and transmits the, typically via cellular service, to the Network Control Computer.

AclaraONE - This is the head end, the brain of the system and its command center. It collects all the data from the DCUs in the system, stores it, and uses a web portal to present that data in usable form for the utility.

MTUs

Aclara's series 3000 devices connect to the meter, record readings hourly, and store them in memory. They can hold 12 readings in memory, and every 6 hours they transmit those readings via radio frequency to nearby DCUs.

Since the MTU can hold no more than 12 readings, each hour a new reading is added to memory and the oldest reading, the one that is 13 hours old, drops off. Because MTUs transmit 12 readings every 6 hours, there is redundancy in the readings transmitted. The first 6 readings from the 6:00 a.m. transmission will be the last 6 readings in the noon transmission. By the 6:00 p.m. transmission, those 6 readings will have been replaced by 6 newer readings.

This redundancy means that if a transmission fails to reach the DCU for whatever reason, the readings still have a second chance in the next transmission. Duplicate readings are filtered by the DCU, so only a single hourly reading is transmitted to AclaraONE.

Water and gas MTUs differ slightly in the way they connect to the meter. Gas MTUs are attached to the face of the gas meter, and consequently cannot be repositioned. (Meter-specific gas meter installation instructions are also available on Aclara Connect.) A water MTU is connected to the meter register by means of a three-wire cable. Because water meters may be installed indoors in cold climates, and either outdoors or in pits in warm climates, the length of the cable allows for some flexibility in placement of the MTU for optimum radio signal propagation.

Users may find additional information on water MTUs in the *Water MTU Field Guide, Y20376-TRD*.

Refer to the *MTU Installation Instructions Technical Brief, Y20355-TEB* for more information on MTU installations.

All Aclara RF ™ MTUs in a single AMI system use a unique FCC-licensed frequency for one-way transmission of readings. The frequencies we use fall in the range of 450-470 MHz. Aclara works with the utility to find a frequency that has the least local interference possible and to have that frequency licensed with the FCC for the client's geographical area for 10 years. If interference should arise, the FCC will address any unlicensed use.

NOTES There are only two authorized antenna options: the internal antenna etched into the printed circuit board (PCB) and the external antenna, MicroAnt (Aclara part number 073-3002.

Maximum gain allowable is 3dBi.

The MTU also uses a second licensed frequency, within the same range, for a two-way communication with the DCU. This frequency is used primarily for time synchronization from the DCU. Having the entire system synchronized to within one minute allows for system consumption snapshots for the amount of water being used across the network at any one time.

The signal from Aclara's standard range MTU typically reaches from a half-mile to a mile, depending on terrain. Aclara's extended range MTU can reach about twice that distance, or up to two miles.

Once an MTU is installed at a meter site, it must be activated. This is performed using a programming device such as a laptop or tablet computer and Aclara STAR Programmer software. (For more information on Aclara's STAR Programmer, please refer to the *STAR Programmer Software User Guide*, *Y20348-TUM*).

The technician installing the MTU enters some basic information such as the type of meter and its location when programming the MTU. The software communicates electromagnetically with the circuitry in the MTU and activates its radio transmitter. This process creates a programming record for each MTU programmed. At the end of the day, the installer uploads these programming records to AclaraONE, so the system will have all the information for each MTU.

DCUs

The DCU acts as an intermediary device. It gathers readings from MTUs and transmits those readings, as well as system diagnostic information such as signal strength and battery power, back to AclaraONE. This data may be encrypted for additional security, though encryption is not necessary.

This interface to AclaraONE is known as the backhaul, and it is typically via cellular data service, though other technologies such as Wi-Fi, fiber optics, and Ethernet can also be used. Typically a cellular backhaul DCU will make several calls a day to transmit data to AclaraONE. Those using Wi-Fi, Ethernet or fiber optics will be in Always On mode, so data flows across the backhaul as it comes in from the MTU network and as AclaraONE issues commands back.

Raised a minimum of 30 feet off the ground, DCUs are installed on a half-mile to one-mile grid. When installing a new system, Aclara's Global Information Service, or GIS department, will conduct a site survey to determine the location for all DCUs in the system for optimum radio reception. Factors such as topography and building density will affect reception and DCU placement.

Because the signal range of a standard MTU is a half-mile to a mile, each MTU transmission will typically reach multiple DCUs. This creates additional redundancy in the system, so if a DCU were to be temporarily out of service, the readings from MTUs near it will still be collected by neighboring DCUs.

In order to achieve the elevation required to allow MTU transmissions to reach them, DCUs are typically installed on utility poles, microwave or cellular towers, water towers, water tanks, or flat roofs.

The DCU has several components. These include a pair of antennas mounted on a boom, which connect via cables to a metal cabinet that contains a number of circuit boards, radio receivers, and a battery to power its operation. The battery is charged by AC or solar power. If the battery is solar powered, then the third component of the DCU will be a solar panel. If the battery is AC powered, there will be no solar panel.

The DCU cabinet is typically mounted near the antennas and solar panel, high off the ground for security. In locations where there is a security fence or other secure enclosure, the DCU cabinet may be mounted near ground level for user convenience.

Inside the DCU cabinet is a 12-volt battery that powers its operation. There are also ports for the incoming power source and for the incoming antenna cables. Additionally there is a metallic cylinder is called a bandpass filter. This filter is tuned to the FCC-licensed frequency in use by the system, so only signals on that very narrow band will be received. Lastly there is a weatherproof enclosure containing the printed circuit boards.

AclaraONE®

The AclaraONE headend, is the central control for the entire system. Most utility clients think of AclaraONE as the web portal that allows them to view readings, monitor consumption and system health, and generate reports from the data it contains.

Behind the scenes, it consists of four components or servers. These servers may be on a single machine in a small Aclara RF™ AMI system, or they may be on multiple machines in a larger system. Each of these servers has a primary function that it performs:

The communication server provides communication services for the Aclara RF™ data collector units.

The database server is the central repository for storage meter readings and other system information.

The web server provides access to the readings and other data stored in the database.

The application server is the web interface that allows users, such as system administrators and customer service personnel, to view readings, system data, and reports.

As data flows into the communications server, it is logged and parsed and then sent to the database server. The database server stores all the readings and system performance data, as well as processing alarms. The web server communicates with the database, feeding it information from the programming records uploaded by MTU installers. It also provides users with a means to issue commands that are sent to the database. The application server also communicates with the database, issuing commands through a service bus from both a web job scheduler and the web job generator.

On-Demand 1.2 Functionality

With the required AclaraONE headend, DCUs, and MTUs in place, On-Demand 1.2 provides expanded functionality, which is described below.

Group On-Demand

On-Demand 1.2, provides functionality to send an On-Demand Read request for more than one MTU/Meter at a time. Requests may be immediate or scheduled and will filter out invalid MTU types and MTUs that are not in the network.

Disaster Recovery

On-Demand 1.2 provides functionality to send a Data Recovery request for more than one MTU/Meter at a time. Requests may be immediate or scheduled and will filter out invalid MTU types and MTUs not in the network.

RF Check

The new RF Check feature in the MTU programming software allows for better reliability in confirming the level of RF communication between the MTU and nearby DCU(s). This feature uses both RF frequencies to test the signal strength between both devices. This ensures a more accurate test to aid those in the field who want to confirm a proper and complete installation before leaving the work site.

MTU Encryption / Authentication

On-Demand 1.2 adds AES 256 encryption and decryption message processing. This includes a check for AES-128 encryption and a “bad actor” check if an MTU message is expected to be encrypted but is not.

Firmware Over the Air

When transponders are ready for upgrades or new features, it is much more convenient to update those transponders automatically from a series of substations, than it is to manually pull or swap every metering device. Firmware Over the Air enables utilities to keep their endpoint devices operating at peak functionality and upgraded to the latest firmware release without the task of manually removing every device from service in order to reprogram it. Downloading new firmware for every endpoint module can be managed from a single interface. To ensure the impact of firmware upgrades on system bandwidth remains minimal, the downloading firmware can be spread over days or weeks, even targeting the daily low usage windows of network traffic.

Advanced Alarms

On-Demand 1.2 adds advanced alarm processing for Badger, Ecoder, Diehl, and Kamstrup meters. Data will process and display in AclaraOne event charts and notifications. Extended Alarms are new, advanced, alarms from special meters, e.g., Short Leak, Big Leak, Air-in-Pipe, Low Temperature, etc.

Remote Disconnect Device (RDD)

A Remote Disconnect Device (RDD) is a valve that can be activated by a user to alter the flow of water to the meter.

The RDD can be used to:

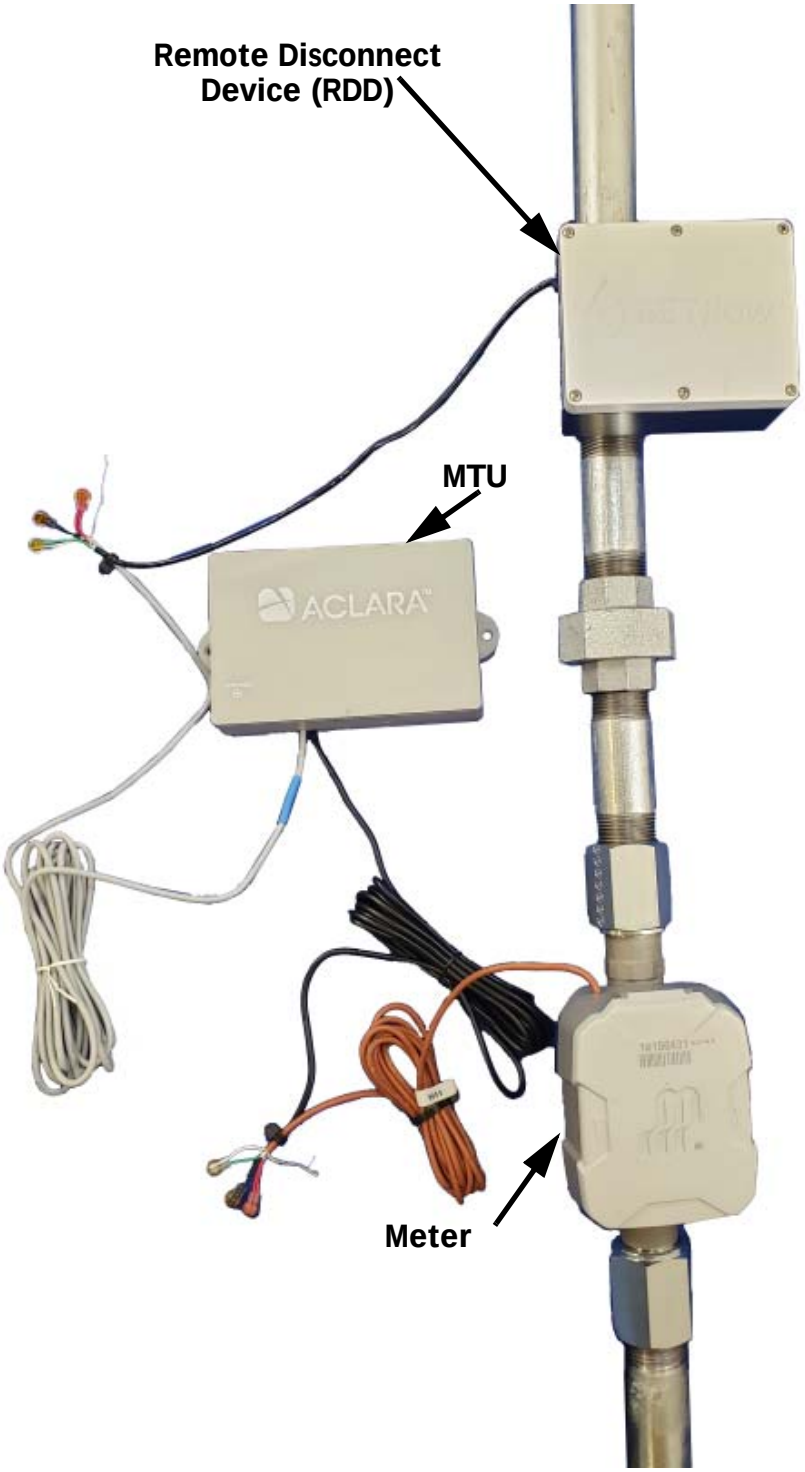
- Stop service to a consumer
- Start service to a consumer
- Restrict flow to a consumer in times of shortage
- Perform a sediment turn to remove impediments to the turning of the valve

This technical brief addresses the following aspects of RDD functionality:

- Physically connecting the RDD
- Using the RDD to change the valve position
- RDD troubleshooting

Connecting the RDD

The following image displays the connections of an RDD, an MTU, and a water meter.


Remote Disconnect
Device (RDD)
MTU
ACLARA
Meter

The following tables provide wiring connections for the MTU to the meter and for the MTU to the RDD, respectively.

MTU to Meter Wiring Connections	
MTU	**Meter**
Wire Color	
Black	**Black**
Red	**Red**
Green	**White**

MTU to RDD Wiring Connections		
MTU	**RDD (option 1)**	**RDD (option 2)**
Wire Color		
Black	**Black**	**Purple**
Red	**Red**	**Blue**
White	**Green or White**	**Orange**

Using the RDD

The status of an RDD consists of all the information the RDD is able to report to an external source. This includes:

- Serial Number
- Current Valve Position
- Battery Status
- Source of Last Actuation Command
- Last Actuation Command
- Success or Failure of last Command

This can be read by the MTU Programmer. This information can also be sent to AclaraONE with a periodic status message or in response to an On Demand Read Request.

Valid RDD states are:

- Open
- Closed
- Partial Open
- In Motion

RDD Actuation Commands are:

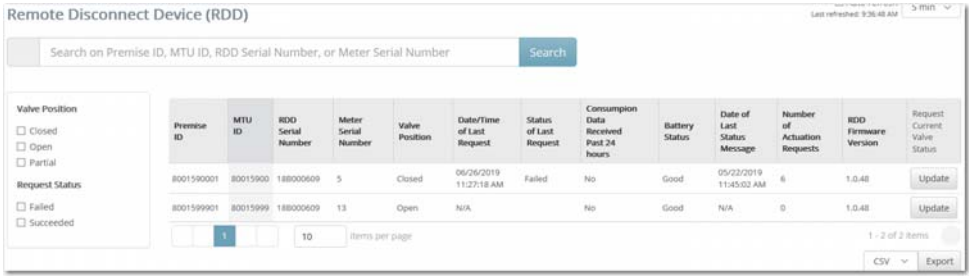
- Open
- Close
- Partial Open
- Sediment Turn

NOTE The RDD's valve can be made to change positions by either a command from the MTU Programmer or from AclaraONE via the On-Demand Functionality. AclaraONE tracks the total number of actuation requests over the lifetime of the RDD. This is required because excess usage will decrease the battery life of the device. The user is allowed two requests per month per RDD.

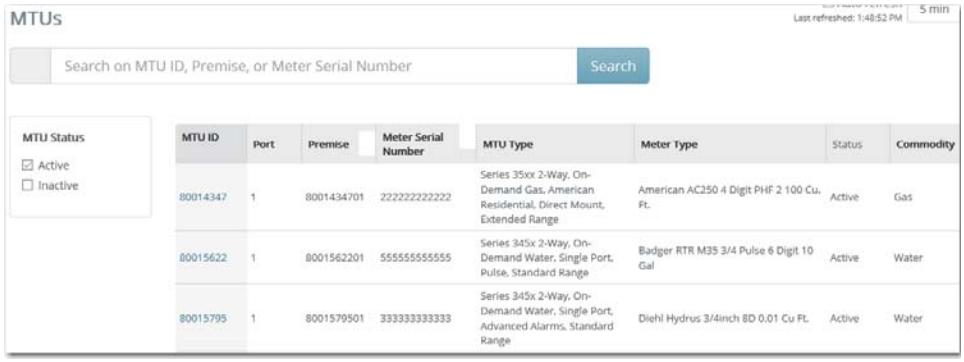
Battery Information

The RDD battery condition is defined as either Good or Low, and users can view RDD and MTU battery voltage via the AclaraONE head end.

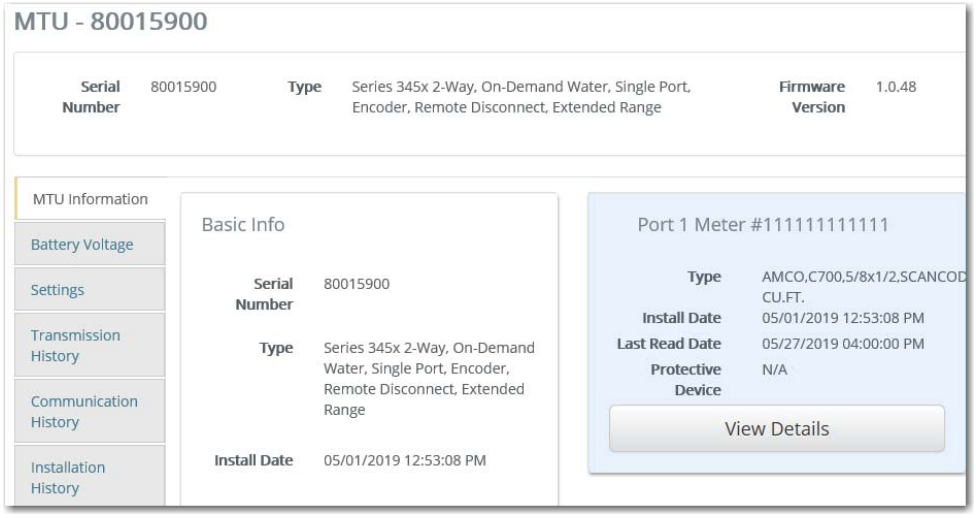
1. Follow the menu path ***AclaraONE > STAR > Equipment > RDDs*** to view information about an RDD.



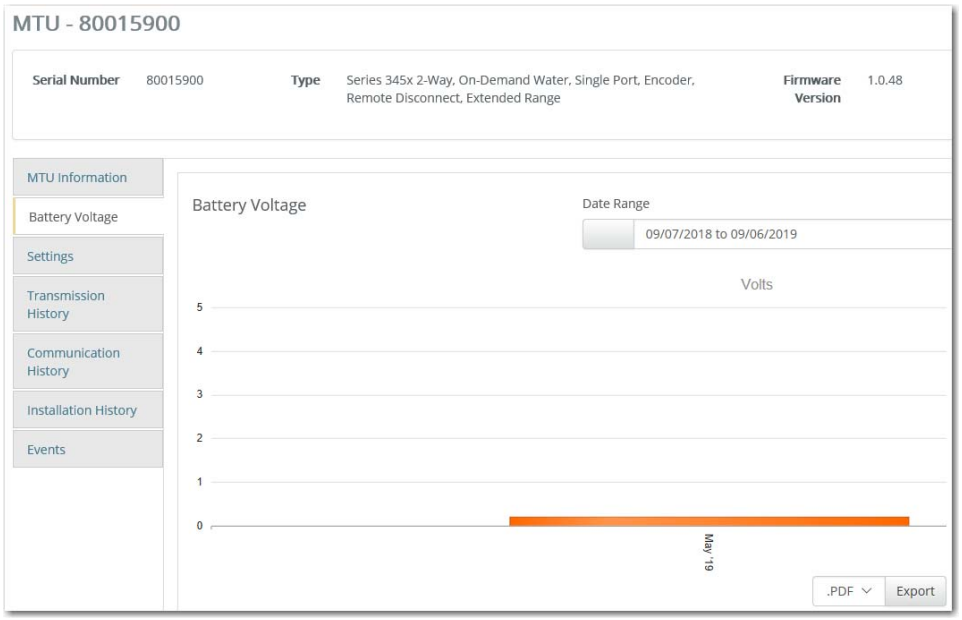
2. To view battery information about an MTU, follow the menu path ***AclaraONE > STAR > Equipment > MTUs*** to view the MTUs window.



3. Click the link in the MTU ID column to view the MTU detail window.



4. Click the **Battery Voltage** tab on the left side of the window to view battery voltage details.



To help ensure each MTU obtains maximum life expectancy from its battery, the following conditions are required:

- The MTU is configured for a periodic read interval that is compatible with a 20-year battery life
- The MTU is configured to transmit readings with no more than 2x redundancy
- The MTU is configured to transmit readings no more frequently than every 6 hours
- No more than 480 On-Demand reads, or remote configuration commands are sent to the MTU over its lifetime (2 per month, on average)
- The MTU sends no more than three alarm messages per month.
- The MTU has redundant DCU coverage, throughout its lifetime, of at least 2 DCUs
- The MTU undergoes no more than two over-the-air firmware upgrades
- The MTU undergoes no more than two over-the-coil firmware upgrades
- The MTU undergoes no more than one full data recovery operation (96 days of hourly reads)
- The MTU's Window A and Window B fast messaging settings are configured for no more than 480 listen windows per day

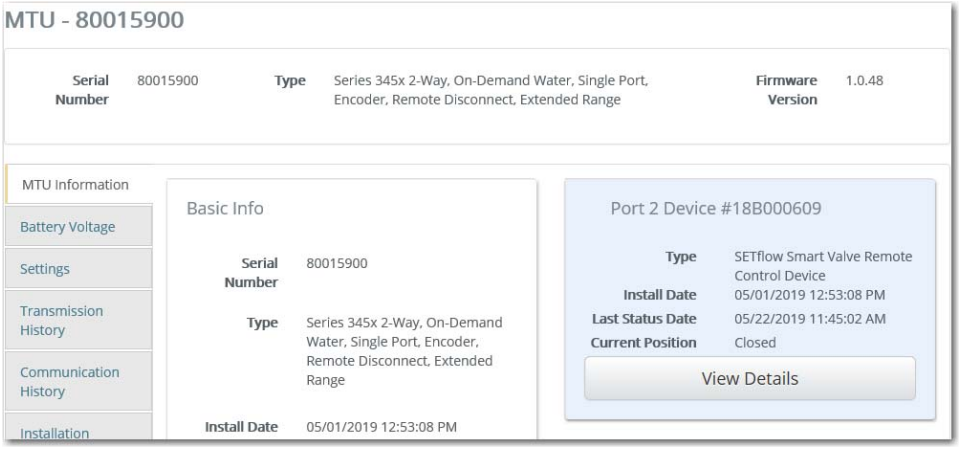
NOTE To maintain a 20-year battery life, an MTU shall be stored for less than a cumulative week above 60° C.

The voltage reported through AclaraONE is taken from the MTU's monthly health message. It is important to note that the MTU sends a "Last Gasp" alarm immediately before its battery falls below acceptable operational levels. After sending the "Last Gasp" alarm the MTU places itself in ship mode, which means it will no longer transmit, receive, take meter readings, etc.

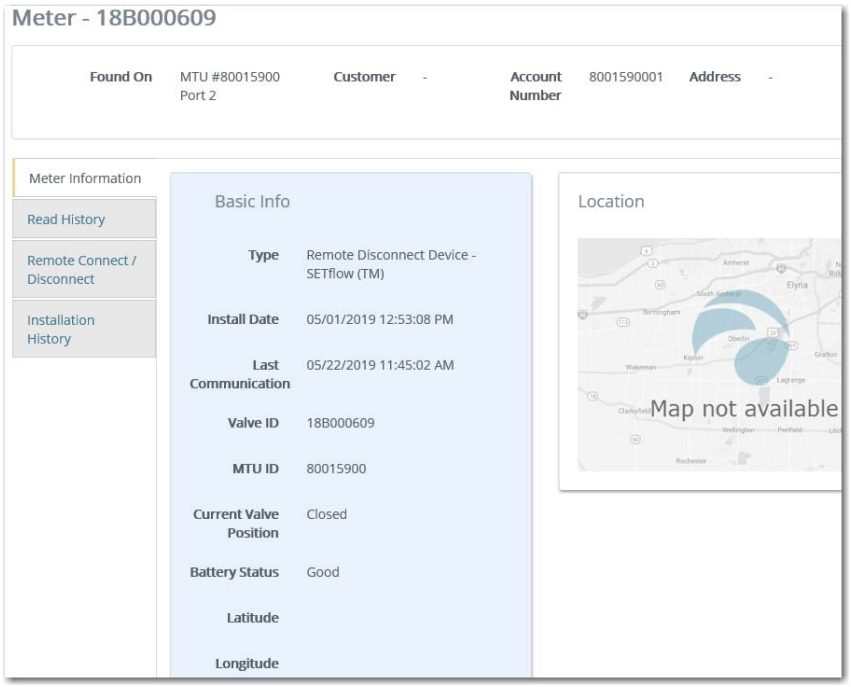
To maximize battery life, AclaraONE tracks the number of on-demand reads, reading recovery operations, remote configuration operations, firmware-over-the-air (FOTA), and firmware-over-the-coil (FOTC) performed by each MTU. AclaraONE warns the operator if an On-Demand read request exceeds agreed upon usage (defined as an average of 2 per month).

Each Remote Disconnect Device (RDD) is connected to an MTU. To issue RDD commands, you must navigate to the appropriate MTU through the AclaraONE head end. Use following procedure to issue an RDD command.

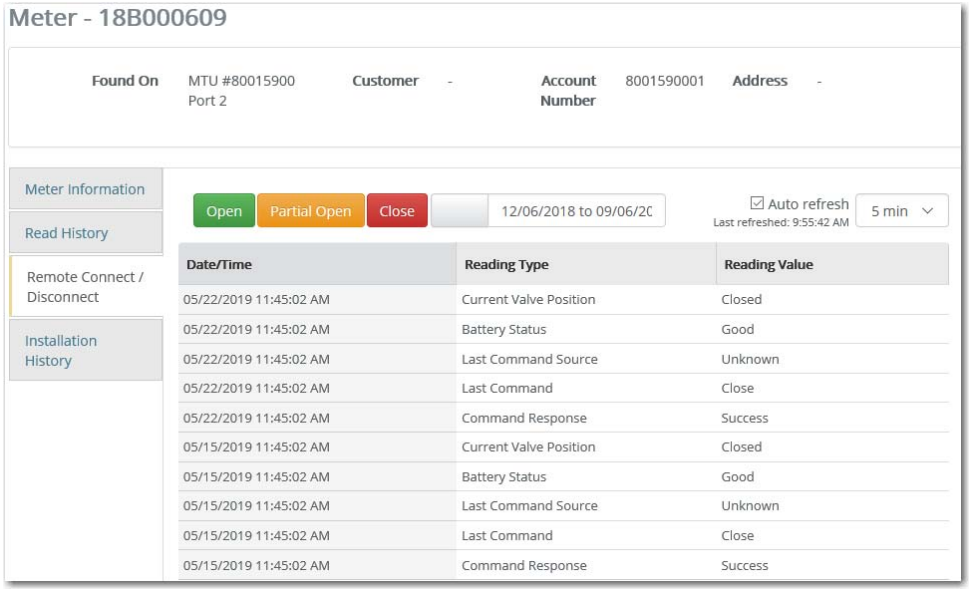
1. Follow the menu path ***AclaraONE > STAR > Equipment > MTUs*** to view the ports associated with the MTU.
2. Locate the Meter Type column, and then identify the port associated with the Meter Type SETflow Smart Valve Remote Control Device. In this cases it is Port 2.
3. Click the number in the MTU ID column associated with the RDD port.



4. In the Port 2 Device panel, click **View Details**.



5. Click **Remote Connect / Disconnect** to view the Remote Connect / Disconnect window.



From here you can issue RDD commands.