Gen™X

500W ERT® Module Technical Reference Guide

Gen5 500W ERT Module Technical Reference Guide
December 14, 2022
LDI-0132 REV 003

Confidentiality Notice

Trademark Notice

For more information about Itron or Itron products, go to **www.itron.com**

For more information about Itron trademarks, go to **itron.com/na/legal/trademarks**

For product help, contact Itron Technical Support Services.

Contact

Email: **support@itron.com**

Itron Customer Center: **customer.itron.com**

Products and documentation: **products.itron.com**

Itron Technical Support North America: 1-877-487-6602

For regional technical support, go to **www.itron.com** and select your country and language.

For suggestions, questions, or other feedback concerning Itron product documentation, contact us at: **ItronDocumentation@itron.com**

Table of Contents

New in This Document

Revision	Date	Description
REV 003	December 14, 2022	Updates to Data Storage on page 13.
REV 002	November 22, 2022	Added Events and Alarms on page 32.
REV 001	November 21, 2022	Updated Firmware Functionality on page 1.
REV 000	July 19, 2022	First date of publication.

1 Introduction

The Gen™5 500W Encoder, Receiver, Transmitter (ERT®) Module is a radio-frequency (RF) water device that, when programmed in network mode, connects to the Gen™5 network as a leaf on a continuously powered device (CPD). It is read over the Gen5 network, or by Itron Mobile Radio (IMR) readers and FC300 handheld readers, using a pull request and push data notification or trap. The same process is used for recurring and on-demand reads. The module retrieves the following data:

- Configuration tag
- Daily register read
- Interval data
- Event log
- Current index (on-demand reads only)

The module is supported and managed by the UtilityIQ® head end, however, it is not directly IP addressable from the UtilityIQ head end. The UtilityIQ head end supports the listed functionality:

- Data collection
- Remote configuration
- Firmware upgrades
- Reported events and alarms

The 500W ERT Module achieves such network operations by:

- **Encoding.** 500W ERT Modules record consumption and alarm/event information and encode that information.
- **Receiving.** 500W ERT Modules receive radio signals for module programming, reads, and commands.
- **Transmitting.** 500W ERT Modules transmit encoded information to a collection device.

The 500W ERT Module chooses one CPD as a gateway to the Gen5 network. The CPD communication with the module is based on a Limited Listening Schedule (LLS). The CPD handles the module's messages, forwarding and transmitting the module's messages. The module read data requires a secure trap environment. If a secure trap is not available, the CPD does not send the data. Advanced Metering Manager (AMM) discards any unsecured data.

The 500W ERT Module can communicate in mobile mode to support a ready-to-secure installation when a third-party work order system is used. The utility configures the module to switch to the network mode. The switch to network mode can be configured to make the operation mode switch up to 30 days in the future.

500W ERT Modules can be read by the Gen5 network, Itron Mobile Radio readers, and FC300 handheld readers.

About this Document

This document provides information about 500W ERT Modules for field dispatchers, utility personnel, Itron personnel, and customers. This guide includes descriptions of the features and functionality of the 500W ERT Modules and focuses on the high-level network architecture, system operations, theory supporting IoT technology, and supporting software.

Related Documents

The following documents may be of use to you. All documents can be viewed and accessed at https://products.itron.com.

- *Advanced Metering Manager (AMM) Events*
- *Gen™5 500W ERT® Module Pit Installation Guide*
- *Gen™5 500W ERT® Module Remote Installation Guide*
- *500W Modules Ordering Guide*
- *Field Deployment Manager (FDM) Tools Application Guide*
- *Field Deployment Manager (FDM) Tools Configuration Guide*
- *Field Deployment Manager (FDM) Field Representative's Guide*
- *First article review form*
- *Gen™5 500W ERT® Module Specification Sheet*
- *Water Meter and Telemetry Module Compatibility Matrix*

Operational Life

The 500W ERT Module uses a either a 2-pack or a 4-pack Li-Mn-O2 (Lithium Manganese dioxide) battery pack, which features low self-discharge and low impedance. The expected 20-year battery life is a function of the current and voltage requested from the battery due to the operation of the module. Itron applies a twofold approach to determine battery life: theoretical/lab experimental data and field data.

The theoretical approach is based on models to simulate the failure mechanism. In a typical battery, the various failure mechanisms are as follows:

- Exhaustion of battery capacity, relative self-discharge and voltage drop due to the operating conditions.
- Integrity of the mechanical can (that is, battery packaging).

Itron has developed battery life models based on battery chemistry to simulate the preceding failure mechanisms. Itron also conducts accelerated lab tests to simulate the preceding failure modes. These experiments include discharge under various conditions as well as micro-calorimetry to determine the pertinent model parameters.

Operational and Network Impacts to Battery Life

Two main factors, in combination, affect the battery life of the endpoint:

- The metering application itself and how often meter data is collected, the number of on-demand requests, and the number of firmware updates. These can be considered operational impacts.
- The network connectivity and the quality of the communication link. These can be considered network impacts.

Operational Impacts

Utility users look beyond meter reading and require a more sophisticated solution that increases their overall operational efficiency . This has led to more features and flexibility in the use of those features in the endpoints, demonstrated by examples such as configurable tampers, alarms, low-latency commands, and variable intervals.

As a result, battery consumption, and therefore battery lifetime, can vary dramatically depending on the endpoint configuration, types of features enabled, and duty cycle of these features. Utilities are also looking to connect and interact with a variety of devices to support their distribution operations. These telemetry devices may have dramatically different usage profiles and battery capacity than the traditional meter endpoint.

The typical use case for water metering applications includes:

- Collecting hourly interval data from residential meters and collecting 15 minute data from C&I meters, providing 95% of the population collecting hourly data and 5% of the population collecting 15 minute data.
- On average one-way command to the endpoint four times a year. For example, a move-in/out and on-demand read after alarm notification.
- Firmware download five times over the expected 20-year life of the module.
- Network discovery once per week (50x annually)

Network Impacts

The network connectivity or the quality of the link also impacts battery life. The Gen5 network solution provides an intelligent link control that is designed to provide a reliable link across an inherently dynamic RF environment .

The network manages the RF link at a device level to achieve long range, low latency, high throughput, and high capacity. This allows the overall network to be optimized, thus providing optimal RF link quality for each endpoint. For example, devices that have a high link quality to the network do not need to retry the transmissions as often, and therefore do not consume as much battery life. The result of variation in network impact is that two devices connected to the network may have different battery lifetimes, even if they are within the same device family and have the same application usage profile. An endpoint's signal quality and signal strength are the primary two network determinants of the variations in battery life. For more information, see Operational and Network Impacts to Battery Life on page 8.

For network mode, the additional network attribute defaults include those described in the following table.

Attribute	Description and default
Network topology	The type of topology endpoint is configured for.
Sampling interval	The interval size (or length or width) in minutes. For example, 60 minute intervals for residential, 15 minute intervals for commercial, 1 minute intervals for load study surveys. The endpoint is assumed to be in this interval size for the duration of its battery. Default is **60** minutes.
Data collection frequency	How often is the device interrogated to retrieve data for the day. For example, twice a day for 12 hours each, thrice a day for 8 hours each. Default is once per day.
Meter Configuration	Default is **Encoded register**.

The following table describes battery life calculations for 500W ERT Modules reporting Load Profile, Register, Events, and Alarms Data on a Mesh network topology. It assumes 1 alarm per month.

Interval minutes	Collection schedule (recommended)	Battery Life (years)
60	3x daily	20
15	3x daily	20
60	2x daily	20
15	2x daily	20

Interval minutes	Collection schedule (recommended)	Battery Life (years)
60	2x daily	20
15	2x daily	20

Standard Device Configuration

The 500W ERT Module is capable of configurations that reduce battery life. Standard battery life is based on the module's configuration, which varies based on network. Configuration often includes the following:

- Standard reading profile (3 times a day, 8 hours of 1 hour interval data)
- Two-way on demand command once per week
- 98% read rate
- FWDL (5 FWDL customer downloads)
- RF at capacity (20 500W ERT Modules for each CPD)
- Minimal operations after installation

Configuration

Important! The battery life description in this document is dependent on the 500W ERT Module being deployed in a standard configuration.

The following configurations are supported in the 500W ERT Module:

- **Manufacturing configuration**. Manufacturing configurations are parameters programmed during the manufacturing process. During the build-to-order process, manufacturing supports:
  - Field Deployment Manager (FDM) parameters programmed through a File Snapshot.
  - Remote application configuration programmed in manufacturing. Remote application configuration is completed using a file produced by Itron Independent Configurator (IIC).
- **Local in-field configuration**. Local in-field configuration is completed using FDM Tools, or a third-party work order system.

Note: Most customers do not require local in-field configuration since the module can auto-detect the encoder. For module installations with a new meter, the 500W ERT Module automatically detects the meter values (read values, consumption values, etc.). When retrofitting the 500W ERT Module to meters already installed in the field, the 500W ERT Module can auto-detect when attached to an encoded register. If retrofitting to a meter with a pulse output, local in-field configuration is required.

- **Remote configuration from the head end.** Remote configuration is completed using IIC and MPC.

  > **Note:** This is a rare use case.

- **Third-party work order installation**. The third-party work order installation requires the following configuration during the manufacturing process:
  - Programmed with a Network ID/SSID
  - Injected with the utility's wanted security (from the utility's ISM)
  - Shipment from the factory in mobile mode in a ready-to-secure level.

500W ERT Modules may be shipped from the factory in a ready-to-secure mobile mode or a fully-secured network mode.

Registration

The 500W ERT Module requires Field Deployment Manager (FDM) to query or display registration on the network, view the module's network status, and capture the module's first data information. AMM displays the 500W ERT Module's current network state which may be:

- New
- Installed
- Discovered
- Initializing
- Initialized
- Active

The Network Center application, which is part of the UtilityIQ suite, displays the 500W ERT Module's CPD parent and the last time a read or registration was received from the 500W ERT Module. Discovery and registration typically takes from 30 minutes to four hours. Itron recommends allowing up to two days before investigating a possible issue.

Transmission Modes

500W ERT Modules support IPv6 open standards and report their consumption and alarm or event information through a transmitted message collected using an Itron collection method. The 500W ERT Module transmits in one of two modes: network mode and mobile mode. For more information about transmission modes, see Transmission Modes on page 15.

Data Collection

500W ERT Modules can be read over the Network (IOT) or by ChoiceConnect™ mobile readers. For more information about reading devices for your system or hardware and software requirements, reference the appropriate product specification sheet. For more information about data collection in specific transmission modes, see Transmission Modes on page 15.

Module Reading Cycles

Itron modules convert consumption or status data to a radio transmission, providing an efficient solution for collecting utility meter reading data without having a field technician physically inspect each individual installation location. 500W ERT Modules are IPv6 open-standards-based to be read over the radio network.

> **Note:** Any modules using Itron Security Manager (ISM) to manage system security require Field Deployment Manager (FDM) Endpoint Tools.

The 500W ERT Module can be read over a Star or Mesh network when in network mode or by a ChoiceConnect handheld device when the 500W ERT Module is configured for mobile mode.

This section describes the module reading cycles used to collect monthly data or status reads.

Transmit and Receive Cycle

The module's cycle of encoding, transmitting, and receiving support a two-way messaging structure to transmit data in response to requests from data collection devices.

The 500W ERT Module reading cycle is outlined in the following steps.

1. The water meter provides consumption data to the 500W ERT Module.
2. A data collection device or network collects meter reading and status data.
3. The data is uploaded and stored in the UtilityIQ head end system. Customer bills are calculated and generated from the gathered data. Status information is also available in the data upload.
4. The process completes each month or on demand.

The 500W ERT Module records consumption by either reading consumption data provided by the water meter's encoded protocol or by counting pulses in response to meter dial rotations. Instead of a meter reader visually reading the meter and recording the data, the module collects and electronically transmits the meter reading data to a data collection device. The module transmits its meter reading data using radio frequencies, so data collection reads are obtained from all meters in a neighborhood in a very short time.

Mobile Mode

When operating in mobile mode, the device bubbles up with a message that contains the current register read (Standard Consumption Messages (SCM+)). When an Itron Mobile Radio (IMR) receives an SCM+ message, it can optionally request more historical information from the device, including the following read requests:

- **Read one day of hourly interval data**. This request prompts the module to return one day of hourly interval data ending at the specified hour offset. The hour offset is the number of hours back from the current hour.
- **Read 40 days of daily interval data**. This request prompts the module to return 40 days of daily interval data measured at the specified hour offset. The hour offset is the number of hours back from the current hour.
- **Read 40 days of hourly interval data (960 intervals)**. This request prompts the module to return 40 days of hourly interval data for the hours specified. Due to the amount of data requested, the ERT module sends this data in multiple packets. This request method requires a multi-packet message (more than one response).

Network Mode

In network mode, the 500W ERT Module supports transmission of a single beacon. The available read requests are dependent on the 500W ERT Module's firmware version.

> **Note:** For more information about the reading functionality available in your 500W ERT Module firmware, reference Firmware Functionality on page 1.

Data Storage

In mobile mode, the 500W ERT Module continually stores and updates the last 3,840 intervals of data (160 days of hourly data). As the 500W ERT Module collects new data, it overwrites the oldest interval data such that the most recent 3,840 intervals are preserved.

In network mode, the 500W ERT Module supports 5,952 native intervals (8 months of hourly interval data). Due to battery life considerations, the module’s default configuration is hourly block intervals.

Optionally, in network mode, the 500W ERT Module features customer configurable interval data options of 5-, 15-, 30- and 60-minute data intervals. This increased granularity supports temporary load studies, which enables utilities to conduct detailed investigations and meter right sizing.

Time Management

The 500W ERT Module maintains a 24-hour clock for hourly data. The 500W ERT Module head end system allows the user to set the time with most two-way downlink commands without affecting the system performance. Whenever the time is adjusted, a flag is set in the hourly consumption field to indicate a time adjustment event. The maximum time drift is

less than ± five minutes per month when read monthly by mobile. If greater accuracy is required, update the module at more regular intervals.

Network Mode Retry Algorithm

The 500W ERT Module alternates between searching for the Star network and a Mesh network. The default setting is for the device to search for a Star network first, and then to search for a Mesh network after the retry cycle has completed. The default of the device searching for a Star network first can only be changed with custom programming (using an FDM snapshot file) at the time the device is ordered. Custom programming is completed at the time the device is manufactured. This default setting cannot be changed in the field with FDM.

The 500W ERT Module's default behavior is significant due to the retry algorithm on the initial release. The algorithm contains a back-off sequence that is designed to conserve battery life while the device continues the attempts to join the network. This sequence is intentionally randomized to create the best opportunity for multiple devices to successfully join the network. This process can take days to complete a retry cycle, depending on the device's randomized timing for the network joining attempts.

Once the retry cycle has completed, the device repeats the cycle of searching for the other network type (if the device started by searching for Star network, it would then switch to look for a Mesh network). Since this cycle can take days to complete, Itron recommends that customers order the device programmed to look for the correct network type so they can join the network in the most efficient manner possible.

Firmware Functionality

The following tables describe firmware functionality for the 500W ERT Module by module type.

Part number	Global software release (GSR) version	FDM Check Endpoint firmware version	Over-the-Air firmware part number	Firmware functionality
FMW-1606-001	2.0	6.6.0.0	DFW-1606-001	■ Firmware download ■ 100S mobile modes ■ 5-, 15-, 30-, 60-minute interval data ■ Extended meter alarms
FMW-1606-002	2.0	6.6.2.0	DFW-1606-002	■ Supports all functionality described for firmware FMW-1606-001 for the 2-battery 500W ERT Module

2 Transmit and Receive Operations

This section describes the 500W ERT Module transmit and receive communications. The communications features described in this chapter may be dependent on the firmware version. To verify the firmware version of your device, see Firmware Functionality on page 14.

Transmission Modes

The 500W ERT Module supports IPv6 open standards and reports their consumption and alarm or event information through a transmitted message collected using an Itron collection method. The 500W ERT Module transmits in one of two modes: network mode or mobile mode.

Network Mode

This is the normal operating mode for 500W ERT Module. In network mode, the module attempts to connect and register with the Gen5 network when the module is not in factory ship mode.

Transmission and Data Collection

In network mode, the 500W ERT Module emits a beacon following the configured transmission schedule. After the module receives the request, it prepares the requested data and transmits it in the configured time period.

Mobile Mode

Mobile mode is provided on the 500W ERT Module to support installation by third-party work order systems. An Itron API integrates with the third-party work order systems to allow programming of site-specific installation parameters. Installation requires the module to be configured to switch to network mode.

> **Note:** Configuration of the module switch to network mode can be immediate or up to 30 days in the future based on the third-party installation parameters. This allows the module to be audited by the third-party work order system.

To support any third-party work orders, the following parameters are required:

- The module must be manufactured following build-to-order (BTO) requirements, ship from manufacturing in ready-to-secure mobile mode, and have the Product security material injected and set to allow a ready-to-secure switch to network mode.
- Third-party work orders must use the Itron API to program the site-specific parameters.

> **Note:** Only parameters available in mobile mode are available for programming (index reading, PCOMP, multiplier, and Product ID). Installers must perform a **`Check ERT`** following programming to verify configuration.

- Additional parameters must be programmed through the BTO process.
- After the installation, the third-party work order must program the 500W ERT Module to switch to network mode.
- The customer is responsible for the installation file imported into Advanced Metering Manager (AMM).

> **Note:** During the mobile mode operation (delay), the 500W ERT Module is ready-to-secure and open to risk. Completion of a switch from mobile mode to network mode clears the interval data and reading history. The 500W ERT Module is not intended to operate in mobile mode for an extended period of time.

Transmission

In mobile mode, the 500W ERT Module transmits (bubbles up) an SCM+ message an average of every 15, 30, or 60 seconds depending on the exact mode as defined in the preceding sections. Each time it transmits, it does so on 1 of 50 channels the 500W ERT Module picks pseudo-randomly. If there are several 500W ERT Modules in close proximity, it's likely that two 500W ERT Modules transmit at the same time. Even though two 500W ERT Modules may transmit at the same time, it's most likely that they do not transmit on the same channel. To eliminate the likelihood of transmissions ending up on top of each other repeatedly, the transmit time is varied randomly by +2 seconds. For example, in mobile and handheld mode, the 500W ERT Module bubbles up every 13 to 17 seconds.

The frequency (channel) hopping and time dithering combined with the bubble-up rate and the likelihood of being in range to receive multiple messages provide for highly reliable communication between the 500W ERT Module and the data collection method.

To transmit daily or hourly interval data, the 500W ERT Module receives a specific request from the reader. When it sends interval data, the 500W ERT Module sends the index reads at the end of each interval.

The total consumption sent in an interval packet is the same as the SCM+ (processed for pressure compensation, rate multiplier, and initial consumption), but the reading is not adjusted for rollover. Intervals are sent as the raw count value and the multiplier; compensation and rollover are included.

To calculate the value at a prior interval, the reader can sum the subsequent interval values and then apply the rate multiplier and compensation to get a consumption offset.

The consumption offset can be subtracted from the total sent consumption with the remainders adjusted for rollover. This approach eliminates complex or time-consuming math in the 500W ERT Module and transfers it to the reader, where more powerful resources can process the data.

Data Collection

When 500W ERT Modules are programmed to mobile mode, they can be read by Itron mobile reading systems to leverage existing reader investments and allow utilities to mix of 500W and 100W+ endpoints while the utility moves to an IoT networking solution.

Transmit Operation

When the 500W ERT Module is taken out of factory ship mode, it starts bubbling-up SCM+ messages. The SCM+ messages enables larger data fields with event and alarm status information in the expanded beacon that allows Itron modules to communicate data such as a battery status indicator.

Operating Modes

Normal operation mode for the 500W ERT Module supports network and mobile mode communication. Transmission for normal operation mode is summarized in the following table.

Operation mode	Transmission rate	Output power	Battery life
Network mode	N/A	+27 dBm (500 milliwatts)	20 years
High power mobile	60 seconds	+24 dBm (250 milliwatts)	20 years
Mobile/handheld	15 seconds	+10 dBm (10 milliwatts)	20 years
(*Optional*) Hard to read Mobile/Handheld	30 seconds	+24 dBm (250 milliwatts)	15 years

Note: Optimum battery life is dependent on the device operating in a standard configuration. For standard configuration settings, see Standard Device Configuration on page 10. Hard-to-read mode reduces battery life from 20 to 15 years. Itron recommends this mode only for exceptionally hard-to-read applications such as meters on a roof or in a sub-basement.

The 500W ERT Module has the following operating modes.

- **Factory ship mode**
  - Modules are shipped from the factory in factory ship mode.
  - The module's transmitter is turned off.
  - The module's receiver listens for a programming command.
  - Modules attempt to read the register every hour.
  - Register Error Detected and Register Error alarm or event flags may be set when a register is not connected.
  - If the 500W ERT Module reads a connected register, the module automatically moves to run mode.

  - The module can be configured via an FDM snapshot file to wake from factory ship mode to run in either network mode or mobile mode.

- **Audit mode**
  - Audit mode reduces the normal read latency time associated with standard modes of operation and is often used after initial installation.
  - This mode is useful in network installations where the normal bubble rate is very slow.
  - Audit mode remains active for 30 days and then reverts to the initial programmed mode.
  - Audit mode is intended to be used once.
- **Run mode**
  - 500W ERT Module's normal operation mode.
  - In network mode, the module's transmission operation is dependent on the factory settings for standard transmission + contingency message (beacon).
  - In mobile mode, the SCM+ bubble-up rate and power are dependent on its programming at install.
  - In mobile mode, the 500W ERT Module's default bubble-up rate is 15 seconds.
- **Meter quiet mode**
  - The 500W ERT Module can be configured in the factory through a FDM Snapshot file to transition to run mode only after seeing positive consumption from a meter.
  - The remote 500W ERT Module is awakened from meter quiet mode and enters run mode in one of two ways:
    - The 500W ERT Module is connected to a meter and there has been positive consumption of the least significant dial greater than two.
    - Receiving a two-way command, such as a **Check Endpoint** using FDM.

  If a 500W ERT Module installed in meter quiet mode is not bubbling up SCM+ messages, it may be due to zero consumption on the module, such as a vacant or vacation home. Initiate a two-way command (for example, perform a **Check Endpoint** with FDM) to test for normal functionality before removing the unit.

Local Communications

Receive Operation

The 500W ERT Module receives commands in the Industrial-Scientific-Medical (ISM) band in the range of 902–926.85 MHz. When 500W ERT Modules are manufactured, they are left in factory ship mode with the transmitter off. While modules are in factory ship

mode, the receiver turns on every 60 seconds to listen for a **Program Endpoint** or **Check Endpoint** command at 908 MHz.

About a second after each transmission, the module turns on its receiver, tuned to the transmission channel, for a duration of approximately two milliseconds. The 500W ERT Module can receive commands at that time.

In a two-way communication mode, the module responds to a specific command from the reading method. The reading method transmits a command during the time the module has its receiver on. The module must conserve power so its receive time is set to a minimum. The module leaves its receiver on just long enough to detect a message command. When a message is heard from a programmer, a two-minute timer is set. If no other command operation from the module is required, the reader does not send any additional messages. When the module fails to detect a command message, it reverts to listening for a command.

Message Exchange

The 500W ERT Module bubbles up (transmits) SCM+ messages on 83 discrete channels. After transmitting over the Gen5 network, the module listens for commands from the network.

The 500W ERT Module can be configured for two different modes. The bubble-up rate and output power are unique for each operation mode. Users may utilize two-way messaging commands to assist in network management.

> **Note:** The 500W ERT Module supports interval data messaging. Reference the product specification sheet and support documentation for proper use and application.

SCM+ Messages

The 500W ERT Module SCM+ includes the information that the 500W ERT Module transmits to a data collection device or head end system. Network contingency SCM+ occurs every 60 seconds.

The message contains the following data:

- Module ID
- Module type
- Meter reading value
- Event and alarm values
- Valve state

Time Management

500W ERT Modules use application time to time stamp collected data. The 500W ERT Module receives periodic time updates as the module maintains its connection to its network and corrects device application time deviations back to the correct time over paced increments (any data time stamps during the correction period are flagged as adjusted). Network time is used by the MAC layer to achieve network synchronization and facilitate consistent broadcast reception.

Time stamps on data collection that occurs prior to network registration is not reliable. The initial time is set in the 500W ERT Module at that time of installation.

Note: Network time is only available after the endpoint has registered with the network.

Caution: If the 500W ERT Module device was installed using zero touch deployment (ZTD), the time drift between manufacture and deployment may be significant until the device self-adjusts based on the time received from the network.

3 Security

The 500W ERT Module follows the Gen5 Network security that includes a complete system knowledge of the content and purpose of each message. Security-related decisions (such as which key type—reading or command—to use when securing a message) are based on the function of the command. After a 500W ERT Module is installed and the appropriate keys are injected, the module begins secure operations.

The 500W ERT Module's network communications are protected by the Gen5 network security. Network security is applied at the network and application layers. The CPD supports:

- The existing GenX application security
- GenX application security
- Added support for:
  - Secure Traps between CPD and BOS
  - LLS security based on BC/DL certificate chains

The 500W ERT Module supports the following security models, dependent on the operating mode:

- Mobile mode: ChoiceConnect Security. ChoiceConnect Security is used mobile mode (locally and in mobile system).
  - Ready to Secure (ISM not required)
  - Command or Full Secure (ISM required)
- Network system mode (remotely): LLS Security based on GenX Network Security
  - Birth Certificate/Manufacturing/INS Root
  - Drivers License/Operator/DLCA certificate chains using DLCA and First Capture
  - LLS Security is session key based (time expiring)

Manufacturing and Installation

500W ERT Module security features are determined by the device's operation mode (for more information about operating modes, see Operating Modes on page 17).

In mobile mode, the security features of the 500W ERT Modules are determined by the presence or absence of one or more key types. Enhanced security operation begins in manufacturing where two unique factory keys (utility factory key and Itron factory key) are

injected into each module. The utility factory key and Itron factory key are created and managed by the Gen5 network. The key generator server/network maintains the association between the module ID and its unique factory keys. With just the factory keys in place, the module operates in the basic security mode.

As part of a 500W ERT Module shipment or upon subsequent customer requests, an enhanced security key transfer file (SKTF) is provided to the utility. This file contains the 500W ERT Module ID/utility factory key pairings. After the utility receives the file, the utility customer imports the file into their ISM server and then the 500W ERT Modules with enhanced security are activated and installed.

Field Deployment Manager (FDM) Endpoint Tools Enhanced can be used to install and set the module security state. When in mobile mode, FCS can also be used to set the security state. A module is moved from a basic security state to an enhanced security state by injecting keys. The state change is requested from the Gen5 network by the appropriate utility personnel or assigned during key import based on the network configuration. After the request is made, the network generates the appropriate keys based on the wanted security level and creates key exchange commands secured by the utility factory key of the module.

The key exchange commands can be retrieved by the FDM Application Server when the installation work order for the module is created. The FDM Mobile Application performs the installation workflow and sends the key exchange commands to the module. After the module successfully receives and processes the key exchange commands, the module is in enhanced security mode. FDM returns the completed work orders and notifies the network of the completed key exchange commands. The server updates the state of the newly generated keys from pending to active and operation with enhanced security begins.

In network mode, 500W ERT Modules can be built to order. Device security configuration parameters are determined by the manufacturing type.

Build-to-Order

Modules that are build-to-order have their public keys and customer-supplied NMS, AAA Server CA, and device birth certificates injected during the manufacturing process eliminating the need to inject a large portion of the required key set during device installation or a mobile mode to IoT system mode/network mode switch.

Secured Operations

After a 500W ERT Module is installed and the appropriate keys are injected, the module begins secure operations. The listed reading and programming operations are secured for all 500W ERT Modules.

> **Note:** In network mode, security is required. In mobile mode, enhanced security operation is optional.

- **Bubble-Up Data Collection**. The 500W ERT Modules enhanced security in bubble-up messages utilizes the reading key. A field in the message is used to identify the particular reading key. The point where the message security is removed by the collection system differs for modules operating in either network mode or mobile mode systems.
  - For modules operating in mobile mode, the reading keys for the modules are downloaded to the module reading application.

    > **Note:** While the intent is for the utility to use a common reading key, through the key update processes, it is likely that some modules within the utility may have a different reading key than others. For this reason, the module reading application obtains up to 16 of the most recent reading keys issued to modules and downloads that list to the data collection application. The radio uses the key identifier in the bubble-up message to determine which reading key to use to decipher the secure message. This allows the module reading applications to process the secure message following Itron existing reading methods.

- **Two Way Operations**. Programming commands issued to a module are secured by the Gen5 network security application utilizing a command key that resides in the target module. The use of the active command key is recommended. The command operations are similar throughout the network solution.

When a two-way command is requested at the application server—either through a user request or through an internal job—the application server creates a command, formats the command packet, inserts a unique tracking ID, and sends the command to the network to be secured using the module's command key.

The application server forwards the secure command message to the appropriate data collection application which sends it to the 500W ERT Module. The module validates the command message, executes the command, and logs the command instance, identifying it by the command tracking ID. If Reading Keys are present, then the response is encrypted and is transmitted to the collection application. The application receives the response. Security is deciphered dependent on the application type.

Modules operating in mobile mode can generate commands at the application level and secure commands using the reading key. The collection method inspects the bubble-up message from the target 500W ERT Module to identify the module's reading key. The reading key allows the collection method to secure a pending read command using the identified key. The collection method can also inject the current time into the reading command prior to securing the message to force the module to update its time, thus ensuring the ad-hoc reading operation of the collection device is maintained even in a secure environment.

4 Programming and Reading

When a 500W ERT Module ships from the factory as a build-to-order device, all programmable parameters are set to their manufacturing default values. At the time the modules are installed and/or as a build-to-order device, the module must be programmed for use with the utility equipment and collection methods. A configuration file defines the module's programming parameters. Units can be shipped pre-programmed using this configuration file. If a user chooses not to use a configuration file, the device is programmed with factory defaults, as outlined in Default Values on page 1.

Default Values

This section shows the default values for a 500W ERT Module that does not utilize a configuration file. If a Check Endpoint was performed prior to programming, these values would be read and returned. The following table describes a partial list of the default values set in the 500W ERT Module when it's manufactured.

Parameter	Value
Module type	500W ERT Module
Bubble up	OMR (15 seconds)
Utility ID	Customer specific
RF output power	OMR (+10 dBm)
SSID	Customer specific
Meter Configuration	Encoded Register

Programming Parameters

The 500W ERT Module has the following general programming parameters:

- **Manufacturer system parameters**. Manufacturer parameters are set by Itron and cannot be changed by the utility. See Manufacturer System Parameters on page 25.
- **Utility-specific parameters**. All 500W ERT Modules are build-to-order; they can be built with FDM and OWCM configuration files provided by the customer during the ordering process. Utility system parameters are common to a family of modules for a specific utility. See Utility System Parameters on page 25.

- **Meter-specific parameters**. Meter-specific parameters vary by the meter type connected to the module. Modules are programmed using a handheld programmer. See Meter-specific Parameters on page 27.

Manufacturer System Parameters

The manufacturer system parameters contain the information required for basic device operation. Some of these parameters include:

- Bubble-up timings
- Firmware Settings
- Power Levels
- SSID
- Utility ID

Utility System Parameters

The 500W ERT Module's utility system parameters contain information required for the utility's system operation. Generally, all 500W ERT Modules within a defined group are programmed with the same utility system's parameters. The utility system parameters for the 500W ERT Module include:

- Meter configuration
- Utility ID
- SSID (Network ID)
- Security lock level (No lock, hard lock)

Itron sets the utility system parameters for use by a specific utility. They are designed to provide proper communication and 500W ERT Module security for all the utility's 500W ERT Modules.

When a 500W ERT Module is programmed, the new parameters take effect immediately.

> **Note:** When a 500W ERT Module is programmed, the utility ID and security lock level are set, which defines how subsequent reprogramming is performed. When the 500W ERT Module is programmed and set for Hard Lock security level, the 500W ERT Module cannot be unlocked.

Utility ID

> **Note:** The utility ID is used during mobile mode operation only.

The utility ID parameter specifies the unique, utility-specific security code that prevents an unauthorized individual from communicating with the module.

Itron assigns the utility ID, which ranges from 0 through 255. The utility ID is contained in the Meter Configuration File loaded into the Field Deployment Manager (FDM) application.

Without the correct utility ID, a data collection method can read the beacon (network mode) or SCM+ (mobile mode), but it cannot alter the parameters or display the module's encoded data. With the correct utility ID, an operator can perform the following functions.

- Program the module
- Read the module's programmed parameters
- Read the tamper value. For more information, reference the product specification sheet for your module.

Security Lock Level (Mobile Mode Only)

The security lock level parameter controls module reprogramming. The 500W ERT Module uses the following security lock levels:

- **No lock**. A module programmed with this lock level can be reprogrammed with a compatible programming method and the correct utility ID.

  > **Note:** Itron recommends No lock whenever possible for greater flexibility.

- **Soft lock**. The soft lock security level provides the same functions as no lock: however, the **Unlock Endpoint** functions must be successful before the module can be reprogrammed.
- **Hard lock**. If a module is programmed with this lock level, billing parameters such as consumption or number of dials cannot be reprogrammed. System parameters, such as operation mode (mobile mode or network mode) can be reprogrammed.

  The 500W ERT Module may be programmed for mobile mode for a limited time to enable third-party device programming. After 30 days, the 500W ERT Module must be switched to network mode.

Normal Mode Operating Settings

This parameter specifies the 500W ERT Module's normal transmission environment and specifies how the module is read:

- Network mode
- Mobile mode
  - Mobile/handheld mode
  - Mobile high power mode
  - Hard-to-read mobile/handheld mode

  > **Note:** For more information, reference Operating Modes on page 17.

Meter-specific Parameters

A 500W ERT Module's meter-specific parameters contain information required for modules to operate properly with a certain meter type or model. Meter-specific parameters are different for all meters. There are two types of meter outputs that the 500W ERT Module is compatible with:

- **Encoded Output**: The 500W ERT Module auto-detects a water meter's encoded protocol to read the meter's consumption and/or event data.
- **Pulse Output**: The 500W ERT Module must be programmed with the meter type and its initial reading (Refer to the *Field Deployment Manager (FDM) Tools User Guide* for more information).

Programming Modules

An Itron programming device is used to program 500W ERT Modules. The programming device utilizes Field Deployment Manager (FDM) Tools software. Reference your product's specification sheet or programming guide for the correct FDM version. FDM supports programming for all 500W ERT Modules.

Programming Itron 500W ERT Modules requires an understanding of:

- Your meter's configuration and the number of dials
  - The configuration and number of dials is important for programming the module to count correctly and roll over to zero at the correct time.
- How your system interprets the meter reading
  - Some systems modify the consumption reading with the collection software. Other times, the billing system is used to make modifications. If modifications are made in both systems, issues may cause consumption reading errors.

It is important to understand your system before the 500W ERT Modules are programmed.

Program the 500W ERT Module in network mode using a compatible programming device loaded with a compatible version of Field Deployment Manager (FDM) Tools.

Program the 500W ERT Module in mobile mode using an approved programming device loaded with a compatible version of Field Deployment Manager (FDM) Tools.

To enable enhanced security and for more complete programming information, see the *Field Deployment Manager (FDM) Tools Configuration Guide* (for documentation information, see Related Documents on page 7).

Standard Configuration

For information about configuration, see Standard Device Configuration on page 10.

Best Practices and Considerations

For initial module programming, Itron recommends holding the handheld programmer within 6 feet of the target module.

If you are reprogramming or performing a **Check Endpoint** for a module installed in the field longer than 30 days (out of audit mode), hold the handheld programmer approximately six feet away from the module to accommodate power levels.

> **Note:** Hold the handheld programmer approximately six feet from the module and as upright as possible when checking or re-programming the module.

Time to Program

The time required to program the 500W ERT Module (in mobile mode only) is dependent on the operating mode.

Time to Program in Normal Operation

In mobile mode normal operation, the module bubbles up an SCM+ message every 15 or 60 seconds (30 seconds for mobile mode hard-to-read mobile/handheld mode). The handheld programmer does not have an opportunity to send a command (program) to the module until it receives the SCM+ message. It could take 60 seconds before the handheld computer receives the message and has an opportunity to transmit back. On average, the handheld programmer receives the module's message within half the bubble-up rate time (for example, 7.5 seconds for mobile mode).

The programming process completes a few seconds after the handheld programmer successfully receives the module's message.

Time to Program in Factory Ship Mode

In factory ship mode normal operation, the initial programming takes approximately 15 seconds (if success is achieved on the first attempt). A failed programming attempt takes approximately 1 minute 25 seconds.

The handheld programmer reads the 500W ERT Module's mobile mode and listens for an SCM+ message for 65 seconds before timing out.

Itron Programs and Software Variables

This section defines and clarifies possible system variables you may encounter in programming 500W ERT Modules.

Programming Example

See the *Field Deployment Manager (FDM) User Guide* for examples on programming endpoints.

5 Meter Display and Encoding Consumption Data

The primary operation a 500W ERT Module performs is recording the amount of water flowing through a pipe to a place of use that is reported by a water meter.

Using a typical ultrasonic water meter as an example: ultrasonic signals are sent with and against the flow of water to determine the velocity of water flow, which is used to calculate consumption.

The 500W ERT Module is connected to the water meter via a ILC cable (Inline Connector). The 500W ERT Module reads the water meter's encoded protocol at the top of every hour to gather consumption data.

A reed switch, close to the shaft containing the magnet, is used to count revolutions generated by the meter's drive dog. As the magnet rotates near the reed switch contained in the sensing device, the reed switch closes. When the reed switch closes, a pulse is sent to the 500W ERT Module.

In mobile mode, the hourly interval count data is stored in a data array in flash memory within the module. The data is overwritten every 960 intervals (40 days) in a round-robin fashion. By definition, the first interval is the latest written interval and the last interval is the one written 40 days ago.

In network mode, the interval data is configurable dependent on the 500W ERT Module's firmware version. For more information about the module's firmware functionality, see Firmware Functionality on page 1.

Status, Events, and Alarms

The primary encoding function of a module is to count the consumption of a utility product (typically gas, water, or electricity). Itron 500W ERT Modules also report their status in the system and detect when someone tampers with the meter or module (tamper events in mobile mode or events and alarms in network mode). Tamper or event and alarm values, interpretations, status information, and tamper or event and alarm reporting may differ among various 500W ERT Module types.

Important! Tampers are available when the 500W ERT Module is operating in mobile mode. Events and alarms are available when the 500W ERT Module is operating in network mode. The available events and alarms are dependent on the module's firmware and head end versions.

The tamper or event and alarm detect when an endpoint or meter event occurs. The endpoint then increments the tamper or event or alarm counters.

Tip: The module tamper or event or alarm counters increment at each event.

AMM translates the events to system event codes. See *Advanced Metering Manager (AMM) Events* for more information about event codes. 500W ERT Module events are configurable in the listed ways.

- An event can be enabled or disabled.
  - If the event is disabled, it is not detected or reported.
  - If the event is enabled, the event is logged in an event log and retrieved in the event log during a read. If an event is enabled and configured as an Alarm, the event is immediately sent to the BOS as a trap.
- Event configuration is set up in IIC and can be programmed during manufacturing, locally with FDM, or remotely using MPC.
- All supported events are enabled by default.
- Legally relevant events cannot be disabled.
- Some events include Events Details or additional information included in the event log.

Tamper Counters

Tamper counter handling is dependent on the 500W ERT Module's communication mode.

Network Mode

- **Events.** Events captured within the 500W ERT Module during normal daily monitoring must be configured for them to be logged. Configured events support event notification and troubleshooting. Configuration of events using the ConfiguredEventCodes object alerts the 500W ERT Module of the need to store events in logs. These logs are available for data collection using the standard interrogation process.
- **Alarms.** Alarms are configured such that the alarm event is delivered to AMM immediately requiring configuration to perform the asynchronous delivery of captured alarms.

Important! In network mode, set only critical events as alarms to prevent risk of battery life impacts.

Mobile Mode

The tamper counters track each tamper event. The least significant bits (LSB) are reported in the standard consumption message (SCM/SCM+).The 500W ERT Module uses the tamper counters to know if there is an active tamper being reported.

Battery Low Warning

The 500W ERT Module includes a battery life estimator. The estimator is based on the number of bubble-up data packets sent at the various power levels and the age (self-discharge) of the module. The battery low warning allows the utility to easily identify which modules are nearing the end of life in a mixed population. This advanced warning gives the utility the opportunity to schedule module replacement. The battery low warning is a single bit flag set when the battery has less than 10% remaining capacity, typically two years life remaining. Battery life is evaluated daily at midnight.

A Events and Alarms

Event Code	Event Name	Description
1	Inter Digit	Corrupt digit in the encoded register reading
2	Register Error	No Communication with Register
3	Invalid Read	Register is not sending a valid read. ■ Invalid Read occurrences are logged following a good reading or on an initial read of the endpoint / new encoder when an invalid read occurs. ■ This event is logged on installation / meter change out if an invalid read is received when reading the register the first time. ■ After one logged occurrence, if another invalid read is received before the next good read, it is not be logged. ■ If a good read is received, and is followed by an invalid read, this new instance of invalid read is logged. **Note:** Invalid reads are still marked for all occurrences in the interval data / reading status.
5	Magnetic detected	500W ERT Module has detected an external magnetic field. When the device is a 500W Remote mount, this event indicates a Cut Cable rather than a Magnetic tampering situation.
6	Endpoint - Low Battery	500W ERT Module has a low battery warning. 10% battery life remaining.
7	Consumer Leak detected	500W ERT Module has detected continuous flow over a set period of time Is an alarm by default. Qualifies as an active event.
8	Consumer Leak end	500W ERT Module has detected the end of continuous flow after having reported a leak
9	Reverse Flow detected	500W ERT Module has detected reverse flow. Qualifies as an active event.
10	Reverse Flow end	500W ERT Module has detected the end of reverse flow after having reported reverse flow.
11	Leak Sensor Ok	500W ERT Module detects a leak sensor attached and it is working properly (triggered when state was previously unknown or previously not working properly).
12	Leak Sensor No Comms	500W ERT Module detects a leak sensor is attached but it not working properly.

Event Code	Event Name	Description
13	Leak Sensor Detached	500W ERT Module does not detect a Leak Sensor attached after having previously having one attached.
14	Valve OK	500W ERT Module detects a disconnect valve attached and it is working properly (triggered when state was previously unknown or previously not working properly).
15	Valve No Comms	500W ERT Module detects a disconnect valve is attached but it not working properly.
17	Pulse Mismatch	The 500W ERT Module has detected an internal pulse mismatch.
18	Cut Cable detected	Physical Cut Cable detected by the 500W ERT Module.
19	Cut Cable end	Physical Cut Cable no longer detected by the 500W ERT Module.
20	High Flow detected	500W ERT Module detects consumption has exceeded the high flow threshold. Is an alarm by default. Qualifies as an active event.
21	High Flow end	500W ERT Module detects consumption has dropped below the high flow threshold after having been in a High Flow state. **Note:** If the device is in a High Flow detected state and high flow detection is disabled then this event should be logged immediately.
28	Encoder Micro Reset	Device has detected that the Encoder Micro has reset unexpectedly.
500	Critical error (internal)	Catch-all for critical internal error not covered in other events
501	Right Sizing started	Client has requested Right Sizing operation in 500W ERT Module. **Note:** Right sizing operations are not supported when the device is operating in network mode. However, if the device is operating in mobile (100S) mode and right sizing is started this event is logged in the COSEM event log.
502	Right Sizing completed	Right Sizing operation is complete. **Note:** Right sizing operations are not supported when the device is operating in network mode. However, if the device is operating in Mobile (100S) mode and right sizing is completed this event is logged in the COSEM event log.
503	Right Sizing cancelled	Right Sizing operation was canceled by client. **Note**: Right sizing operations are not supported when the device is operating in metwork mode. However, if the device is operating in mobile (100S) mode and right sizing is canceled this event is logged in the COSEM event log.
504	Flash Data Error	A flash error has been detected.

Event Code	Event Name	Description
505	Meter Quiet Mode Exit	Occurs when the 500W ERT Module first gets pulses, or detects consumption and wakes from meter quiet mode (not factory ship mode).
506	Entering Network Mode	The device has been changed to network mode.
507	Battery Parameters Set	Any change to the BatteryUseParameters structure results in this event.
508	Set Meter Right Sizing Params	Meter right sizing parameters have been changed. **Note:** Right sizing operations are not supported when the device is operating in network mode. However, if the device is operating in Mobile (100S) mode and right sizing is completed this event is logged in the COSEM event log.
509	Key Update Succeeded	Key has been updated in the device
510	Device Not Communicating	Application has not received any incoming data which indicates the device may not be communicating on the network
511	Load Profile Cleared	Load Profile object has been cleared. The specific causes of this event are: ■ Transitioning from 100S (Run, Factory, Quiet) to IoT mode, or from IoT to 100S mode. ■ Setting Interval size to a new value (IoT mode only) ■ Setting count rate, initial index, PCOMP, Rollover, EncoderDrivertype (100S or COSEM) to a new value.
512	Manual Time Sync	Time has been changed manually. This event is also logged the first time the device ever joins a network after 'birth' (first time startup followed by first time it EVER gets network time).
514	Legally Relevant Event Log nearly full	Triggers when the Legally Relevant Event Log is at 90% of total capacity.
515	Time Outside Automatic Sync Threshold	Time change is greater than warning level threshold – INITIAL DETECTION Qualifies as an active event.
516	Time Outside Automatic Sync Threshold Ended	Time change is greater than warning level threshold – END – back below threshold.
517	Entering 100S Mode	The device has been changed from network mode to 100S mode (also known as mobile mode).
531	EFC State Changed	The EFCState (0.128.96.9.50.255) current_state (attribute 2) has changed.

Event Code	Event Name	Description
541	Corrupt Alarm Data Received From Meter	The endpoint has received a corrupt data character in the Alarm Flags field of the encoded frame from the attached meter. For the Diehl Hydrus Meters the corrupt data characters are '-' (if all characters are corrupt) and '?' (if only one character is corrupt). The endpoint should log this event as soon as it receives the corrupt data character from the meter. The event in the endpoint will not be logged again for the remainder of the current day (day ends at midnight UTC endpoint time). This results in a maximum of one of this event being logged per day. **Note:** This event should NOT be logged if the corrupt data character is received as a part of the volume field. If the "-" character is received in the consumption/volume field, the 500W shall log "Invalid Read" event 3. If the "?" character is received in the consumption/volume field, the 500W shall log "Inter Digit" event 1.
542	Fixed Network Connection Check Enable Changed	The FixedNetworkConnectionCheckEnable (0.128.96.1.15.255) FNCC_Enable (attribute 2) has changed.
1000	Badger Meter - Register Removal	Badger Extended Alarm: Bit 0 = register removal.
1001	Badger Meter - Temperature Alarm	Badger Extended Alarm: Bit 1 = temperature alarm.
1002	Badger Meter - End of meter life	Badger Extended Alarm: Bit 2 = end of life alarm.
1003	Badger Meter - Zero Consumption Detected	Badger Extended Alarm: Bit 3 = no usage alarm.
1004	Badger Meter - Reverse Flow Meter	Badger Extended Alarm: Bit 4 = reverse flow alarm.
1005	Badger Meter - Leak Meter Alarm	Badger Extended Alarm: Bit 5 = leak alarm Is an alarm by default. .
1006	Badger Meter - Encoder Programming	Badger Extended Alarm: Bit 6 = program alarm.
1007	Badger Meter - Tamper	Badger Extended Alarm: Bit 7 = tamper.
1500	Kamstrup Meter - Active Reverse Flow	Kamstrup Extended Alarm Byte1: Bit 0 = Active reverse flow.

Event Code	Event Name	Description
1501	Kamstrup Meter - Historic Reverse Flow	Kamstrup Extended Alarm Byte1: Bit 1 = Historic Reverse (Active info-code within the last 30 days, no matter how long the info-code was active).
1502	Kamstrup Meter - Active Empty Pipe	Kamstrup Extended Alarm Byte1: Bit 2 = Active Dry (meter is in a current empty pipe state). Is an alarm by default.
1503	Kamstrup Meter - Historic Empty Pipe	Kamstrup Extended Alarm Byte1: Bit 3 = Historic Dry (Active info-code within the last 30 days, no matter how long the infocode was active).
1504	Kamstrup Meter - Active Burst	Kamstrup Extended Alarm Byte1: Bit 4 = Active burst (meter is currently in a high flow state outside of the meter parameters). Is an alarm by default.
1505	Kamstrup Meter - Historic Burst	Kamstrup Extended Alarm Byte1: Bit 5 = Historic Burst (Active info-code within the last 30 days, no matter how long the infocode was active).
1506	Kamstrup Meter - Encoder Programming	Kamstrup Extended Alarm Byte1: Bit 6 = Encoder setup has been changed one or more times since production.
1507	Kamstrup Meter - Active Leak Alarm	Kamstrup Extended Alarm Byte2: Bit 0 = The meter is in an active leak state. Is an alarm by default.
1508	Kamstrup Meter - Historic Leak Alarm	Kamstrup Extended Alarm Byte2: Bit 1 = Historic Leak (Active info-code within the last 30 days, no matter how long the infocode was active).
1509	Kamstrup Meter - Low Temperature Alarm	Kamstrup Extended Alarm: Minimum meter temperature detected. Trigger on <36F indication from Kamstrup meter.
1510	Kamstrup Meter - High Temperature Alarm	Kamstrup Extended Alarm: Maximum meter temperature detected. Trigger on >125F indication from Kamstrup meter.
1513	Kamstrup Meter - Zero Consumption Detected	Kamstrup Extended Alarm: The meter has detected no usage

Event Code	Event Name	Description
1800	Diehl Meter - Air in Tube Error	Diehl Hydrus 1.3 Meter: Is an alarm by default. Extended Alarm bit 12: Err7 (Air in Tube). Air in supply system, flow rate measurement not possible.
		Diehl Hydrus 2.0 Meter: Extended Alarm bit 11: E07 Air in pipe Meter raises if air is detected in the pipe for 1 minute. Meter lowers if no air in the pipe is detected for 1 minute.
1801	Diehl Meter - Leak Alarm	Diehl Hydrus 1.3 Meter: Is an alarm by default. Extended Alarm bit 15: Alarm5 - The Diehl meter activates this alarm once per 24 hrs. The meter resets the alarm 15 minutes after the leakage has been cleared.
		Diehl Hydrus 2.0 Meter: Extended Alarm bit 3: A05 Leakage detection Meter raises if the 15 minute average consumption is always above the leakage threshold for 24 consecutive hours. Meter lowers 3 days after the 15 minute average consumption is below the leakage threshold.
1802	Diehl Meter - Checksum Error	Diehl Hydrus 1.3 Meter: Extended Alarm bit 9: C-1 Checksum Error Electronic error, the meter must be replaced.
		Diehl Hydrus 2.0 Meter: Extended Alarm bit 0: A01 Checksum error Meter raises if any data in flash or RAM is corrupted or was manipulated in any way. Meter lowers 3 days after raised. **Note:** This is considered a "fatal" error and the meter should be replaced if this is encountered.
1803	Diehl Meter - Temperature Measurement Error	Diehl Hydrus 1.3 Meter: Extended Alarm bit 11: Err1 - Temperature Measurement Error. Medium temperature too low or too high < 22°F / > 212°F (< - 30 °C / > 100 °C), or cable temperature sensor disconnected or cut off.
		Diehl Hydrus 2.0 Meter: No meter alarm will cause this event to be logged.

Event Code	Event Name	Description
1804	Diehl Meter - Ultrasonic Hardware Error	Diehl Hydrus 1.3 Meter: Extended Alarm bit 10: Err4 - US-Hardware Error Ultrasonic hardware error, ultrasonic transducer defective or short-circuit, or cable ultrasonic transducers disconnected or cut off.
		Diehl Hydrus 2.0 Meter: Extended Alarm bit 1: A04 Hardware flow. Meter raises if a flow measuring error occurs or an ultrasonic sensor defect is detected. Meter lowers 3 days after there is ultrasonic measurement for 1 minute without error.
1805	Diehl Meter - Power Consumption out of limit Error	Diehl Hydrus 1.3 Meter: Extended Alarm bit 13: Err5 – Power Consumption out of limit Error Communication not possible (too frequent reading over optical interface).
		Diehl Hydrus 2.0 Meter: Extended Alarm bit 15: E00 Too much communication. Meter raises if there is too much communication on the DMEI or optical interfaces in a short period of time. If the communication capacity reaches 0 Bytes the communication is temporarily paused. Meter lowers after the minimum communication threshold (default 500 Bytes) is reached (regenerated by 100 Bytes per minute), then communication is released again.
1806	Diehl Meter - Overflow Error	Diehl Meter Extended Alarm bit 6: ErrH - Overflow Error Diehl Hydrus 1.3 Meter:
		Diehl Hydrus 2.0 Meter: Extended Alarm bit 10: E11 Undersized meter. Meter raises if flow is above the undersized meter threshold for one minute. Meter lowers if the flow is below the undersized meter threshold for one minute.
1807	Diehl Meter - Temperature-Hardware Error	Diehl Hydrus 1.3 Meter: Extended Alarm bit 14: TMH - Temperature-Hardware Error
		Diehl Hydrus 2.0 Meter: Extended Alarm bit 2: A02 Hardware temperature. Meter raises if a hardware temperature error is detected for 1 minute, e.g. temperature cable is cut or damaged. Meter lowers 3 days after no hardware temperature error is detected for 1 minute.

Event Code	Event Name	Description
1808	Diehl Meter - Reverse Flow Alarm	Diehl Hydrus 1.3 Meter: Extended Alarm bit 4: Alarm1 - Reverse Flow Alarm The Diehl meter activates this alarm if the consumption was below the limit configured for the meter. If the alarm has no longer occurred for 30 days, the meter resets the alarm.
		Diehl Hydrus 2.0 Meter: Extended Alarm bit 5: A06 Back flow volume. Meter raises if the 15 minute average flow is below the backflow (negative flow) threshold. Meter lowers 3 days after the 15 minute average flow is above the backflow (negative flow) threshold.
1809	Diehl Meter - No Usage Alarm	Diehl Hydrus 1.3 Meter: Extended Alarm bit 3: Alarm3 - No Usage Alarm The Diehl meter activates this alarm once per 30 days. The meter resets the alarm as soon as 15 minutes after the issue is resolved.
		Diehl Hydrus 2.0 Meter: Extended Alarm bit 12: E12 No usage. Meter raises if the 15 minute average consumption is below the no usage threshold for 30 days. Meter lowers if the 15 minute average consumption is above the no usage threshold.
1810	Diehl Meter - Measurement Alarm	Diehl Hydrus 1.3 Meter: Extended Alarm bit 7: Alarm4 - Measurement Alarm The Diehl meter activates this alarm if both error Err4 and error TMH are active in 8 consecutive minutes. The meter resets the alarm after 30 days if the issue is resolved.
		Diehl Hydrus 2.0 Meter: Extended Alarm bit 7: A22 Measurement interference. Meter raises after 7 consecutive days of the measurement being disturbed by influences of cavitation, air water mixture, or heavy electromagnetic or mechanic interferences (vibration), e.g. caused by pumps, other heavy duty equipment close to the meter. Meter lowers three days after the if the heavy electromagnetic, or mechanic interferences (vibration) have stopped.

Event Code	Event Name	Description
1811	Diehl Meter - Low Temperature Alarm	Diehl Hydrus 1.3 Meter: Extended Alarm bit 1: Alarm6 - Low Temperature Alarm The Diehl meter activates this alarm if the temperature is less than 3 °C after 4 consecutive temperature measurements (every 16 seconds) and the meter detect Err4 at the same time. The meter resets the alarm after 30 days if the issue is resolved.
		Diehl Hydrus 2.0 Meter: Extended Alarm bit 8: A14 Freezing risk. Meter raises if the medium temperature is less than 3 degrees Celsius for 60 consecutive minutes. Meter lowers 3 days after the medium temperature is not less than 3 degrees Celsius for 60 consecutive minutes.
1812	Diehl Meter - Empty Pipe Alarm	Diehl Hydrus 1.3 Meter: Extended Alarm bit 0: Alarm7 - The Diehl meter activates this alarm if Err7 is active. The meter resets the alarm after 30 days without air.
		Diehl Hydrus 2.0 Meter: No meter alarm will cause this event to be logged.
1813	Diehl Meter - Overflow Alarm	Diehl Meter Extended Alarm bit 5: AlarmH - Overflow Alarm Diehl Hydrus 1.3 Meter: **Note:** Diehl Hydrus 1.3 meter does not support Alarm bit 5.This event will never be logged by a 500W ERT Module connected to a Hydrus 1.3 meter.
		Diehl Hydrus 2.0 Meter: Extended Alarm bit 4: A11 Undersized meter. Meter raises if flow is above the undersized meter threshold for 30 consecutive minutes. Meter lowers 3 days after the flow is below the undersized meter threshold for one minute.
1814	Diehl Meter - End of Life Alarm	Diehl Hydrus 1.3 Meter: Extended Alarm bit 2: Alarm9 - End of Life Alarm The Diehl meter activates this alarm if the calculated battery life is less than 400 days. The alarm is deactivated when the calculated battery life is greater than 400 days. The endpoint should log this event when it sees the meter indicate the alarm, and then only log it again if it sees the meter alarm go away and then reappear.
		Diehl Hydrus 2.0 Meter: Extended Alarm bit 17: E09 Low battery. Meter raises if calculated battery life is less than 400 days. Meter lowers if calculated battery life is greater than 400 days. The endpoint should log this event when it sees the meter indicate the alarm, and then only log it again if it sees the meter alarm go away and then reappear.

Event Code	Event Name	Description
1815	Diehl Meter - High Temperature Alarm	Diehl Hydrus 1.3 Meter: No meter alarm will cause this event to be logged.
		Diehl Hydrus 2.0 Meter: Extended Alarm bit 9: A13 High medium temperature. Meter raises if the measured medium temperature is greater than 90 degrees Celsius for 60 consecutive minutes. Meter lowers three days after the measured medium temperature is less than or equal to 90 degrees Celsius for 60 consecutive minutes.
1816	Diehl Meter – Fallback Mode	Diehl Hydrus 1.3 Meter: No meter alarm will cause this event to be logged.
		Diehl Hydrus 2.0 Meter: Extended Alarm bit 6: A17 Fallback mode. Meter raises if a significant deviation of the measurement in the two measuring paths occur. Meter lowers 3 days after the deviation of the measurement in the two measuring paths goes away. **Note:** This only applies to the Hydrus 2.0 Bulk (DN50 (2") and bigger) meters.
1817	Diehl Meter – Metrological Log Access	Diehl Hydrus 1.3 Meter: No meter alarm will cause this event to be logged.
		Diehl Hydrus 2.0 Meter: Extended Alarm bit 16: E18 Metrological log access. Meter raises when an entry is made into the metrological log (only for LAB Role). The meter never lowers this flag. The endpoint should log this event when it sees the meter indicate the alarm, and then only log it again if it sees the meter alarm go away and then reappear.
3000	Device Reconfigured	The HES configuration has changed in the device.
3001	Event Log Cleared	The Itron Event Log has been reset.
3002	DST Periods Exhausted	The DST Calendar has reached its end - new DST calendar should be downloaded. This event should be logged when the daylight_savings_start date in the last element of the transitions array in the DaylightSavingsTransitions object is reached.
3003	Configuration Downloaded	A new HES configuration has been downloaded.
3004	System Reboot	Watchdog error - reboot.
3005	System Restart	Planned restart of 500W ERT Module (example - after FWDL).

Event Code	Event Name	Description
3006	Improper Installation Detected	500W ERT Module could not adopt configuration information.
3007	Service Disconnect Succeeded	Disconnect was received and has completed.
3008	Service Disconnect Failed	Disconnect was received but failed to execute. Event detail will contain the verbose_result attribute of the DisconnectControl object.
3011	Service Connect Succeeded	Reconnect was received and has completed. Event detail will contain the verbose_result attribute of the DisconnectControl object.
3012	Service Connect Failed	Reconnect was received but failed to execute. Event detail will contain the verbose_result attribute of the DisconnectControl object.
3013	Flow Restriction Setting Changed	Restrict / service limit was received and has completed. Event detail will contain the verbose_result attribute of the DisconnectControl object.
3014	Flow Restriction Setting Failed	Restrict / service limit was received but failed to execute. Event detail will contain the verbose_result attribute of the DisconnectControl object.
3015	Decryption or Authentication Failure	Application level security failure - authentication.
3016	Access Control Failed	Application level security failure - access control.
3017	Key Rollover Succeeded	Key rollover command received.
3018	Signing Key Update Success	Application level security failure - certificate.
3019	Takeover Package Accepted	A Takeover Package was presented and accepted by the 500W ERT Module.
3020	Takeover Package Rejected	A Takeover Package was presented, but rejected by the 500W ERT Module.
3021	Replay Attack Detected	Application level security failure - Replay.
3022	RMA Signed Authorization Received	A Signed Authorization with issued-to “Itron-RMA” has been received.

Event Code	Event Name	Description
3039	DHCP Address Index Changed	A change has been made to one of the DHCP address indexes. (OBIS 0.128.96.1.10.255 or 0.128.96.1.11.255).
3040	High Flow Threshold Configuration Changed	A change has been made to the HighFlowEventConfiguration (OBIS 0.0.96.128.3.255) high_flow_threshold.
6000	Cellular Communications stopped	Communications reliability is inadequate and communications have been aborted. This could occur due to poor signaling conditions (bad coverage area) or to exceeding the battery threshold for transmission.
6001	Modem Reset	Modem has been reset. Reason code for reset condition and anticipated modem OFF time in minutes listed in Details.
6002	No Comms	Modem has not passed a paging request in >15 hours 45 minutes when in eDRX cellular operating mode; 24 hours when in PSM cellular operating mode. See clarifications in Section 1.2.3.2. Is an alarm by default.
6003	Non-Transmit Battery Spike Count	Battery spikes have occurred during the day.
6004	Cell ID Change Count	Cell ID (Tower/Sector) has changed through the day. This event provides a count of incidents (if non-zero) along with the latest Cell ID value.
6005	Low Temperature Shutoff Started	The device has detected that ambient temperature has dropped below -20C/-4F.
6006	Low Temperature Shutoff Ended	The device has detected that ambient temperature is back in operating range and debounce parameter thresholds have been met allowing normal operations to resume.
6007	Low Voltage Shutoff Started	The device has detected voltage has dropped below the low voltage threshold. Only one event shall be logged when voltage is recognized to be below threshold – it should not be logged continuously.
6008	Low Voltage Shutoff Ended	The device has detected that voltage in the device has recovered to the recovery voltage threshold, allowing normal operations to resume.
10000	PCOMP Changed	Metrology parameter (PCOMP) changed.
10001	Count Rate Changed	Metrology parameter (Count Rate) changed.
10002	Rollover Count Changed	Metrology parameter (Rollover Count) changed.

Event Code	Event Name	Description
10003	Count Sample Debounce Changed	Metrology parameter (Count Sample Configuration – debounce parameters) changed.
10004	Encoder Driver Type Changed	Metrology parameter (Encoder Driver Type) changed.
10005	Prescaler changed	Metrology parameter (Prescaler) changed.
10006	Initial Index	Metrology parameter (Initial Index) changed.
10007	Image transfer initiated (enabled)	Self-descriptive.
10008	Image transfer canceled (disabled)	Self-descriptive.
10009	Image transfer cancel failed	Self-descriptive.
10010	Image verification initiated	Self-descriptive.
10011	Image verification successful	Self-descriptive.
10012	Image verification failed	Self-descriptive.
10013	Image activation initiated	Self-descriptive.
10014	Image activation successful	Self-descriptive.
10015	Image activation failed	Self-descriptive.
10019	Load Profile Interval Changed	A change has been made to the CompressedLoadProfile object (OBIS A.128.100.0.1.255) capture_period (attribute 7).
10020	Count Sample Width Changed	Metrology parameter (Count Sample Configuration – sample width parameters) changed.
10021	Count Sample Rate Changed	Metrology parameter (Count Sample Configuration – sample width parameters) changed.