Itron

OpenWay Riva®

550G ERT® Module and Gas Disconnect Technical Reference Guide

550G ERT Module and Gas Disconnect Technical Reference Guide

15 November 2019

815-XXXX-XX

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1 Document Scope

This OpenWay Riva 500S Module Technical Reference Guide provides information about OpenWay Riva modules for field dispatchers, utility personnel, and Itron internal users. This guide includes descriptions of the features and functionality of the communications modules and sensors and focuses on the high-level network architecture, systems, operations, theory supporting IoT technology, and supporting software.

Related Documents

For more information about your OpenWay Riva communications module, see your product's documentation. For technology information about OpenWay Riva 550G ERT Module operation in Mobile Mode, see the *100G Series Technology Guide*.

Document	Itron part number
100G Series Technology Guide	TDC-0825-XXX
100 Series and CENTRON Bridge Meter Tamper Reference Guide	TDC-1028-XXX
OpenWay Riva 550G ERT Module, Direct Mount	TDC-1671-XXX
OpenWay Riva 550G ERT Module, Remote Mount	TDC-1678-XXX
OpenWay Riva Gas Disconnect Installation Guide	TDC-1759-XXX
OpenWay Riva Events and Alarms Reference Guide	TDC-1746-XXX
Customer setup to order secured OpenWay Riva modules	TDC-1748-XXX
First article review form	TDC-1749-XXX
Gas and Telemetry Module Meter Compatibility List	PUB-0117-002
OpenWay Riva Gas Devices Ordering Guide	PUB-0117-006
OpenWay Riva Gas Disconnect Specification Sheet	
OpenWay Riva 550G ERT Module Specification Sheet	101510SP-XX
Field Deployment Manager Tools Application Guide	TDC-1713-XXX
Field Deployment Manager Tools Configuration Guide	TDC-1711-XXX
Field Deployment Manager Field Representative's Guide	TDC-1714-XXX

Note: XXX refers to the document revision level. Documents are subject to change without notice.

2 Concepts and Technology

This chapter provides a general overview of the 500S series, ERT, and telemetry modules operational concepts and technology.

> **Important!** The battery life listed in the sections contained in this technical reference guide are dependent on the device being deployed in a standard configuration.

Standard 550G and Gas Disconnect device configuration

The OpenWay Riva 550G ERT Module and Gas Disconnect are capable of configurations that reduce battery life. Standard battery life is based on the following configuration:

- Hourly interval data (550G ERT Module).
- Interrogations of 3 times per day.
- 60 second receiver wakeup.
- Five firmware downloads over the life of the ERT module or OpenWay Riva Gas Disconnect.
- Network management and security overhead set to default timing.
- RF at capacity (2,000 maximum per cell).
- Average of one two-way command/response per week.

550G ERT Module Overview

The OpenWay Riva 550G ERT Module is an encoder, receiver, and transmitter (ERT).

- **Encode.** ERT modules record consumption and alarm/event information and encodes that information.
- **Transmit.** ERT modules transmit encoded information to a collection device or method.
- **Receive.** ERT modules receive radio signals for module programming or initiating an ERT module reading.

OpenWay Riva 550G ERT Modules are designed with the following characteristics:

- **RF device**. The module is a radio frequency (RF) device that attaches to a gas meter to collect usage (consumption) data and alarm or event (tamper) alerts. The ERT module encodes and transmits the data and alerts to the collection device or method.

  - The module records consumption by counting the number of times the index rotates. The number of rotations indicates the amount of gas consumed.
- **Datalogging**. The module stores and logs the hourly consumption data.
  - In 100S Mobile Mode, the ERT module stores the preceding 40 days of hourly data.
  - In OpenWay Riva Network Mode, the ERT module stores 3840 configurable data buckets.
- **Security**. Itron ISM offers enhanced network security with authentication and encryption when the module is read by Itron collection equipment.

Gas Disconnect overview

The OpenWay Gas Disconnect is a 500S device that operates in an OpenWay Riva network to support remote and auto disconnect for gas, remote and local basic valve operations and status, and an *(optional)* external sensor capable of detecting flood water to support automatic shut-off in flood conditions. In the case of an auto-disconnect, the OpenWay Riva Gas Disconnect sends an alarm to the head-end system.

The OpenWay Gas Disconnect has no metering functionality. The initial release of OpenWay Riva Gas Disconnect uses a Star network to communicate over the OpenWay Riva Network.

Firmware Functionality

This section lists the 550G ERT Module firmware information and lists functionality by version.

Firmware part number	Global software release (GSR) version	FDM *Check Endpoint* firmware version	Over-the-air firmware part number	Firmware Functionality
Direct Mount: FMW-7004-005 Remote Mount: FMW-7014-005	5.0	4.13.15	N/A	■ GSR 4.1 functionality ■ 5, 15, 30-minute interval data ■ High flow alarm ■ Low battery alarm ■ Gas Day Take ■ Local auditing for dial and drive rate
Direct Mount: FMW-7002-012 Remote Mount: FMW-7012-012	4.5	2.2.6	N/A	■ GSR 4.1 functionality ■ 3,840 buckets of configurable interval data – Interval options are 5, 15, and 30-minute intervals ■ High flow alarm ■ Low battery alarm ■ Gas day take ■ Local auditing

Note: For more information about alarms and events, see the *OpenWay Riva Collection Manager Device Interface Guide* (TDC-1786-XXX).

500S Transmission Modes

500S 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 500S modules transmit in one of two modes.

- **OpenWay Riva Network Mode**. The OpenWay Riva 550G and Gas Disconnect both have the listed OpenWay Riva Network characteristics.
  - Output power in OpenWay Riva Network Mode is +27 dBm (500 milliwatts).
  - Modules are designed to transmit up to 3 times a day while retaining their 20-year battery life.
  - Modules are read by the network or programming device.
  - The 550G ERT Module has the listed additional OpenWay Riva Network Mode characteristics.
    - Provides 3,840 buckets of interval data.
    - Configurable data. Interval options are 5, 15, and 30 minute intervals.

      > **Note:** In OpenWay Riva Network Mode, the data options are dependent on the module's firmware version. For more information about your firmware version's features, see**Firmware Functionality**.

- **Mobile Mode**. 550G ERT Modules can be configured to work in Mobile Mode. Mobile transmission modes have the listed characteristics.

  > **Important!** Mobile Mode is available only in the 550G ERT Module.

  - In Mobile Mode, the module provides 960 buckets of hourly interval data. and can be configured to transmit in Mobile High Power, Mobile and Handheld, or Hard-to-Read Mobile and Handheld Mode.
    - Mobile High Power Mode. The 550G ERT Module transmits a medium-powered RF message every 60 seconds. Output power in this mode is in Mobile High Power Mode is 250 milliwatts or +24 dBm. The expected battery life is 20 years.
    - Mobile and Handheld Mode. The 550G ERT Module transmits a medium-powered RF message every 15 seconds. Output power in Mobile and Handheld Mode is10 milliwatts or +10 dBm. The expected battery life is 20 years.
    - *(Optional)* Hard-to-Read. The 550G ERT Module transmits a high-powered RF message every 30 seconds. Output power in this mode is 250 milliwatts or +24 dBm. In Hard-to-Read Mode, the expected battery life decreases to 15 years. This mode should only be used for exceptionally difficult to read installations: for example, meters installed on rooftops or in sub-basements.

> **Caution:** If you perform a mode Switch (OpenWay Riva Network Mode to Mobile Mode or Mobile Mode to OpenWay Riva Network Mode), it results in a loss of interval data.

550G ERT Module OpenWay Riva Network Mode Retry Algorithm

In the initial release of the OpenWay Riva Network Mode, 500S device communications are transmitted and received over a Star network.

> **Note:** The OpenWay Riva Gas Disconnect does not attempt to join a Mesh Network.

In the Star network, the 550G 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 500S default of the device searching for a Star Network first can only be changed with custom programming 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 550G ERT Module's device default behavior is significant due to the retry algorithm. 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 from two to four days to complete a complete retry cycle dependent on the device's randomized timing for the network joining attempts, Once the retry cycle has completed, the device will repeat 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 up to four days, Itron recommends that customers order the device programmed in the correct mode so they can join the network in the most efficient manner possible.

Data Collection

Itron OpenWay Riva 550G ERT Modules and Gas Disconnect devices can be read over the OpenWay Riva 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. (See**Related Documents**).

- **OpenWay Riva Network**
  - When the 550G ERT Module or Gas Disconnect device is programmed to OpenWay Riva Network Mode, the device uses IPv6 open standards based protocol that can be read by the Itron Connected Grid Router (CGR) in a point-to-point star network. The Itron OpenWay Riva electricity meter mesh network can read the 550G ERT Module in areas where gas and electric systems overlap.

    > **Note:** The OpenWay Riva Gas Disconnect cannot join the mesh network.

- **Mobile**
  - When 550G devices are programmed to Mobile Node, they can be read by Itron legacy reading options to leverage existing reader investments and allow utilities to mix 550G and 100G endpoints while the utility moves to an IoT networking solution.

    Note: The OpenWay Riva Gas Disconnect cannot be read in Mobile Mode.

Module Reading Cycles

Itron modules convert consumption or status data to an RF signal, providing an efficient solution for collecting utility meter reading or OpenWay Riva Gas Disconnect system status data without having a field technician physically inspect each individual installation location. Itron 500S modules are IPv6 open standards based to be read over the Itron OpenWay Riva Network.

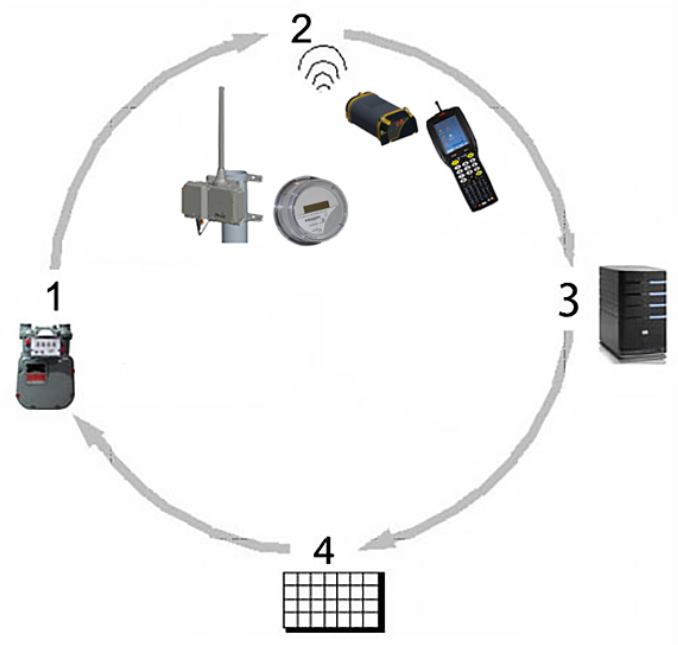
Note: Any modules using Itron Security Manager (ISM) to manage system security require Field Deployment Manager (FDM) Endpoint Tools.

The 550G ERT Module can be read over an electric mesh or star configuration or by a Cisco Connected Grid Router (CGR) with CAM (CGR ACT Module); or by a ChoiceConnect Handheld when the 550G ERT Module is configured for Mobile Mode. The OpenWay Riva Remote Disconnect is read with an FC300 or Itron Mobile Radio connected to a user-supplied computer.

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

550G ERT Module Reading Cycle

The OpenWay Riva 550G ERT Module reading cycle is outlined in the diagram and legend table.



Designator	Cycle step
1	The meter gears rotate while the ERT module counts the revolutions and monitors the installation.
2	A data collection device or network collects meter reading and status data.
3	The data in the OWOC-CM is uploaded to the 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.

The gears in a meter rotate and turn a dial recording consumption. Instead of a meter reader visually reading the meter and recording the data, the 550G ERT Module collects and electronically transmits the meter reading data to a data collection device. The ERT 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.

The meter reading cycle for daily and hourly data follows the same fundamental principles as previously discussed utilizing a two-way messaging format. Daily and hourly data is transmitted upon request from the reader. Consumption, event and alarm, and extended status data is sent after the device receives a request. Along with the legacy month ending SCM+, daily or hourly consumption, event and alarm, and extended status data may be read in one of the listed requests.

In Mobile Mode the following read requests are available.

- **Read one day of hourly interval data**. This request prompts the ERT 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 ERT 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 ERT 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).

In OpenWay Riva Network Mode, the 550G ERT Module supports transmission of a single 500S beacon. The available read requests are dependent on the 550G ERT Module's firmware version.

- Continually stores and updates the last 3,840 intervals of data (160 days of hourly data or 40 days of 15 minute data etc) which can be read by the network or programming device.

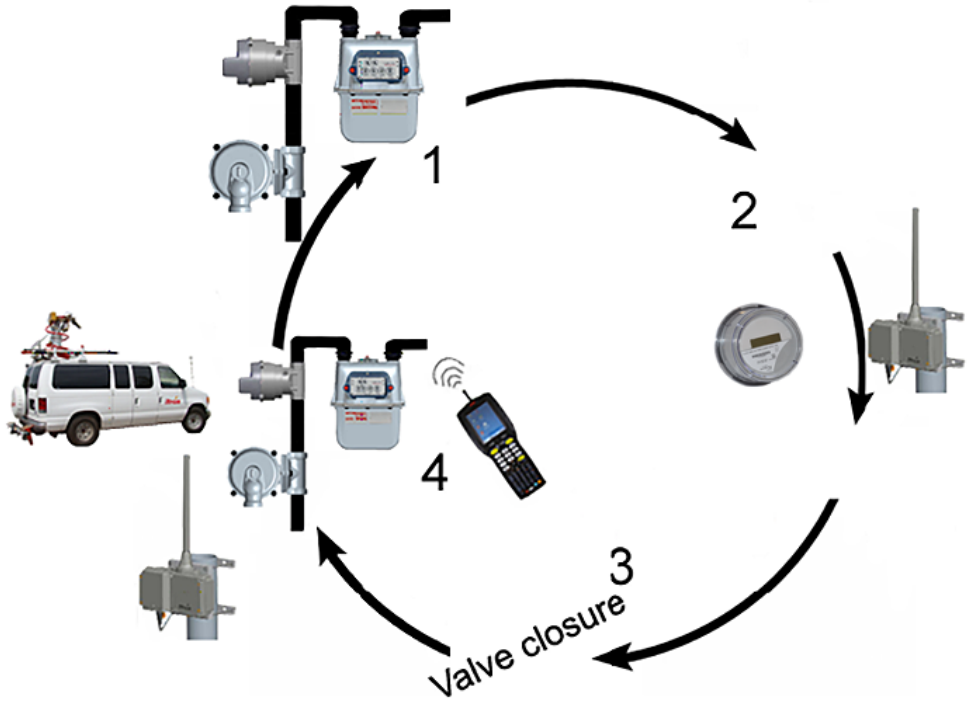
- Programmable interval data from 1 minute to 1 hour for increased granularity to support investigations, and load studies along with meter right sizing support (any interval length evenly divisible by 60 minutes).

> **Note:** For more information about the reading functionality available in your 550G ERT Module firmware, reference the **Firmware Functionality**.

The 550G ERT Module maintains a 24-hour clock for hourly data. The 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.

OpenWay Riva Gas Disconnect Reading Cycle

The OpenWay Riva Gas Disconnect reading cycle is described in this section.



Designator	Cycle step
1	The OpenWay Riva Gas Disconnect is deployed in the gas line.
2	The technician uses the tool to open the valve and the configured network reading method to arm the valve.
3	The OpenWay Riva Gas Disconnect is read by the OpenWay Riva Network.

Designator	Cycle step
4	The valve is closed due to non-payment or a system or environmental event.
5	Steps 2 and 3 are repeated to return the valve to an operational status.

In OpenWay Riva Network, the OpenWay Riva Gas Disconnect supports transmission of a single 500S bubble-up beacon.

Caution: In the event that the OpenWay Riva Gas Disconnect valve is closed, an Itron programming device loaded with FDM Endpoint Tools Enhanced (locally) or OWOC-CM (remotely) is required to return the valve to an operational status. The OpenWay Riva Gas Disconnect must be armed using FDM locally, and then an on-site technician uses the OpenWay Riva Gas Disconnect tool to open the valve. The technician must verify that the system is operational both through visual observation and the use of the FDM Tools > **Valve Status**.

Operational Life of the Itron Module

The operational parameters of the Itron module are programmable and allow for repeated use. By merely reprogramming a module, the utility can install the module in a different location, extending the module's operational life instead of recycling the module if an installation is upgraded, exchanged, or removed.

Gas ERT modules attach externally to gas meters. OpenWay Riva Gas Disconnect modules are installed in the piping leading to the gas meter. Gas ERT modules can be installed on new meters during the manufacturing process or retrofitted to installed meters. The OpenWay Riva 550G ERT Module adds functionality in Itron utility AMR and AMI systems by providing consumption, event and alarm, and extended status information. The OpenWay Riva Gas Disconnect module installation is dependent on the utility's deployment strategies.

Itron Module 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.

500S Itron Security Manager (ISM) Enhanced Security

This section provides an overview of the 500S Itron Security Manager (ISM) enhanced security. The enhancement of secure communications provides greater protection for bubble-up and two-way messaging to prevent unauthorized users from gaining access to the system. Enhancing encrypted communications helps prevent others from monitoring user information and increases user privacy.

OpenWay Riva Network Security Fundamentals

500S enhanced security applies to the RF communications between the Itron data collection devices and the 500S module. ISM, the devices in the system and the head-end use two fundamental security processes to ensure confidentiality and validity of the communications across the RF link.

- **Authentication**. Authentication is the process of confirming that an artifact is genuine or valid. ISM authentication is the process of verifying that the request is from a valid source and that the request is in its original form.
- **Encryption**. Encryption is the process of transforming information to make it unreadable to anyone who does not possess the required security key. There are two types of encryption: symmetric and asymmetric. Symmetric uses a shared key to decrypt/encrypt information. Asymmetric uses a private key to encrypt and a public key to decrypt. ISM uses asymmetric encryption in our enhanced security solution.

Itron 500S modules provide both authentication and encryption. Privacy is maintained on data collection messages from 500S modules with enhanced security through encryption. Messages from the 500S modules are authenticated by the data collection systems. Two-way commands from the data collection systems are authenticated by the 500S modules to ensure that the source of the data is valid. Command messages are used to manage ERT and telemetry module security keys. New security keys can be injected or updated with Itron ISM key control.

Key and Certificate Types

OpenWay Riva 550G ERT Modules can be set to operate in Mobile Mode or OpenWay Riva Network Mode.

When the modules are operating in Mobile Mode, nine security keys are maintained for each 550G ERT Module. Module ISM security keys include the following key types.

- **Two reading keys**. Reading keys are used to secure and remove decipher reading data. For the 500S modules, this includes bubble-up messages and two-way data logging commands.
- **Two command/programming keys**. Command/programming keys are used to secure commands that modify both the metrology and non-metrology state of a 500S module.
- **Two revocation keys**. Revocation keys are used to perform key exchanges. 500S module key exchanges support adding new keys, exchanging one key for another, or removing reading keys.
- **One recovery key**. The recovery key is a special revocation key. The recovery key is a customer-generated and managed key that does not participate in the active/standby rollover operations as the other two revocation keys do. The intent of this key is to allow the customer to set a key aside in a secure location for use in the event that the revocation keys are lost.

When security is removed from a module, configuration tools include a delete all non-factory keys method that must be secured using the recovery key.

- **One utility factory key**. The utility factory key is injected during the manufacturing process into non-volatile memory and is used to manage security keys in the 500S module while the device is operating in an unsecured mode. When the 500S modules are operating in the enhanced security mode, this key is non-functional.
- **One Itron factory key**. The factory key is a permanent key that is injected in non-volatile memory during the manufacturing process. The sole purpose of this key is to allow Itron to change the utility factory key using an RF-based command. Changing the utility factory key is typically completed as a step in the returned sales order process (RSO). Like the utility factory key, this key is non-functional when 500S modules are operating in enhanced security mode.

When the OpenWay Riva 550G ERT Module or OpenWay Riva Gas Disconnect are operating in OpenWay Riva Network Mode, security is applied at the network and application layers.

> **Note:** The OpenWay Riva device's injected security credentials are dependent on whether the devices are built to stock or built to order.

- **Birth Certificate Chain**: Used to authenticate the device to the utility's network domain when joining a network.
- **AAA CA Certificate**: Used as a trust anchor when authenticating the utility's network domain during the join process.

The network layer includes a set of certificates injected during the mfg process. These certificates include At the application layer, the following sets of credentials are managed:

- **OpenWay Enhanced Security Key set**: Used to secured application messages between OWOC-CM and the device. Also, used in part during communication sessions between FDM and the device.
- **FND CA Certificate**: Used to authenticate messages sent from IoT FND to the device.

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- **FND CA Certificate**: Used to authenticate messages sent from IoT FND to the device.

The reading keys for all OpenWay Riva Network repeaters at a utility are shared by all 500S modules in a utility's installation. For clarification, the reading key list for the 500S modules is different than the reading key list used by the OpenWay Riva Network repeaters. All other key types are unique for each 500S module. The device ISM security keys include the following types.

- **Four command keys**. Command keys are shared keys that are used to digitally sign command messages sent to OpenWay Riva devices.
- **Two revocation keys**. Revocation keys are shared keys that are used to digitally sign commands to update public keys.
- **One recovery key**. The recovery key is unique for the device and is used to encrypt symmetric key materials during key updates.
- **Two system keys**. System keys are shared keys that are used to encrypt and authenticate multicast messages sent to OpenWay Riva devices.
- **Two device keys**. Device keys are unique for the device are used to encrypt and authenticate unicast messages sent to OpenWay Riva devices. Device keys are also used to encrypt and authenticate messages sent from OpenWay Riva devices to OWOC.
- **Session keys**. Session keys are limited lifetime keys that are unique for each local access session. The session keys are not maintained by ISM.
- **One rollover nonce key**. The rollover nonce key is a unique key used during the rollover process that updates symmetric keys.
- **One firmware encryption key**. The firmware encryption key is a shared key (between all devices of a specific type, for example: OpenWay Riva Water modules or 550G ERT Modules) used to encrypt device firmware images.
- **One firmware signing key**. The firmware signing key is a shared key (between all devices of a specific type, for example: OpenWay Riva Water modules or 550G ERT Modules) used to digitally sign device firmware images.

Manufacturing and Installation

OpenWay Riva 550G ERT Module security features are determined by the device's operation mode.

In Mobile Mode, the security features of the 550G 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 ISM key generator server. The key generator server 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 550G ERT Module shipment or upon subsequent customer requests, an enhanced security Itron key transfer file (SKTF) is provided to the utility. This file contains the 550G 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 550G ERT Modules with enhanced security activated are installed.

Field Deployment Manager (FDM) Endpoint Tools Enhanced is used to install and set the module 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 ISM server by the appropriate utility personnel or assigned during key import based on the ISM configuration. After the request is made, the ISM server generates the appropriate keys based on the desired 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 ISM server of the completed key exchange commands. The ISM server updates the state of the newly generated keys from pending to active and operation with enhanced security begins.

OpenWay Riva 550G ERT Modules and Gas Disconnect devices that will be operating in OpenWay Riva Network Mode can be built to stock or to order. OpenWay Riva device security configuration parameters are determined by the manufacturing type. The Injected Keys Configurations table provides the configurations possible for OpenWay Riva device security.

Table 1: Injected Key Configurations

Description	100S keys (550G ERT Modules only)	IoT keys
Build to stock	Itron default factory	Itron default factory
Build to order (100S-550G ERT Modules only)	Customer keys	Itron default factory
Build to order (IoT)	Itron default factory	Customer keys
Build to order (100S [550G ERT Modules only] and IoT)	Customer keys	Customer keys

Build to Stock

Devices that are build to stock are manufactured with default security parameters while devices that are build to order are manufactured with the customer's prescribed configurations.

> **Note:** Customers who will initially operate their OpenWay Riva devices in Mobile Mode but intend to switch to OpenWay Riva Network Mode, may have the default IoT keys injected at the time the devices are manufactured.

Build to Order

Devices 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 100S to IoT system mode switch.

Enhanced Security Module Secured Operations

After a 500S module is installed and the appropriate keys are injected, the module begins secure operations. The listed reading and programming operations are secured.

> **Note:** In OpenWay Riva Network Mode, security is required. In 100S Mobile Mode, enhanced security operation is optional.

- **Bubble-Up Data Collection**. The 500S 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 OpenWay Riva 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 ISM 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 OpenWay Riva 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 ISM 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 500S module. The module validates the command message, executes the command, and logs the command instance, identifying it by the command tracking ID. The module then formulates a secure response using the active reading key and transmits the response 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 500S 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.

550G ERT Module Security

The 550G ERT Module follows the OpenWay Riva Network security managed by Itron Security Manager (ISM) 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.

Encoding Principles

This section describes the principles for encoding consumption, status and extended status, and events and alarms.

550G ERT Module Encoding

The 550G ERT Module encodes the following types of information.

> **Note:** The encoded information type is dependent on the operating mode, OpenWay Riva Network Mode or Mobile Mode.

- **OpenWay Riva Network Mode**
  - Configurable interval data reports consumption, status and extended status, and events and alarms notifications.

    > **Note:** Interval data configuration is dependent of the 550G ERT Module firmware version. For more information about your module's firmware functionality, see **Firmware Functionality**.

- **Mobile Mode**
  - Data reports consumption, status and extended status, and tamper status and information.

Encoding 550G Consumption Data

> **Tip:** Consumption data count parameters include count rate, rollover, and pressure compensation (PCOMP).

The primary operation a gas ERT module performs is recording the amount of gas flowing through a pipe to a place of use.

Using a typical residential, diaphragm gas meter as an example: as gas flows within the meter, it moves a measuring device that rotates a drive shaft. The drive shaft connects to the meter index, which displays the amount of flow.

A gas meter that employs a direct-mount ERT module has a shaft with a magnet attached. The shaft mechanically engages with the meter drive. As the meter drive rotates, so does the shaft and magnet.

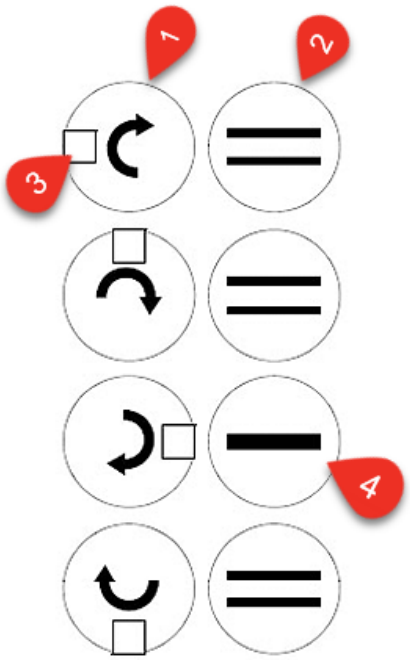
A reed switch, close to the shaft containing the magnet, is used to count revolutions generated by the meter's drive dog. As the magnet rotates near the reed switch contained in the sensing device, the reed switch closes. When the reed switch closes, a pulse is sent to the ERT module.

In 100S 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 OpenWay Riva Network Mode, the interval data is configurable dependent on the ERT module's firmware version. For more information about the module's firmware functionality, see **Firmware Functionality**.

The ERT module actually counts the number of times that the ERT module detects a signal, known as a pulse. The method used to provide the pulse is known as the pulse initiator. The process is shown in the following illustration and the process is defined in the legend table.



Designator	Description
1	The module shaft turns with the gas flow.
2	The reed switch inside of the 500S module detects the movement.
3	The magnet initiates the pulse indication.
4	The process records a pulse.

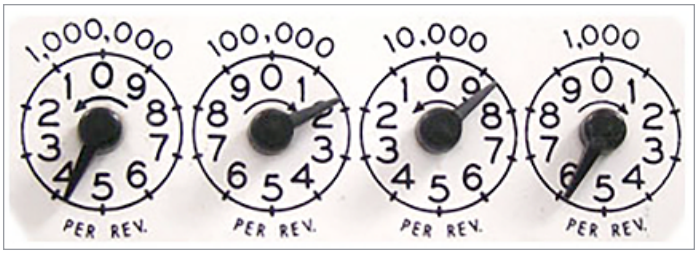
Meter Index Dials and 550G ERT Module Consumption Counting

Utility meters vary in the number of mechanical dials they have: 4, 5, or 6 dials. How does the meter's mechanical dial reading correspond to the 550G ERT Module reading? This section describes how the ERT module reading corresponds to a gas meter's mechanical dial reading for 4, 5, and 6 dials.

The correspondence depends on the number of the meter's mechanical dials. The fewer the number of dials, the more right-most (or least significant) 550G ERT Module reading digits are available to represent fractions of a usage billing unit. This fraction corresponds to the partial rotations of the meter's mechanical dial from one digit to the next.

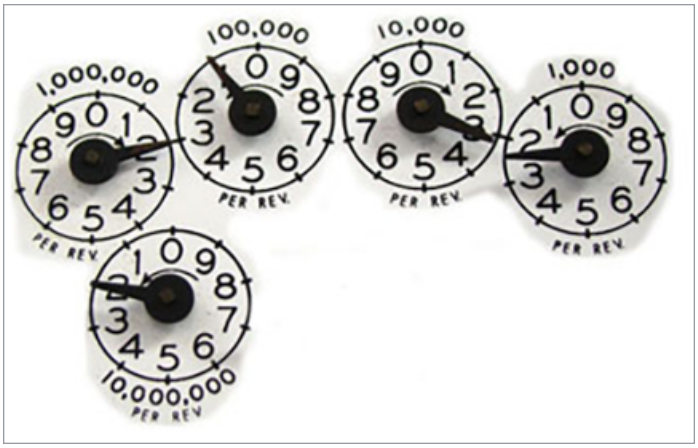
> **Note:** The 550G ERT Module reading is programmed to roll over with the reading of the meter's mechanical dials.

4 dial meter index



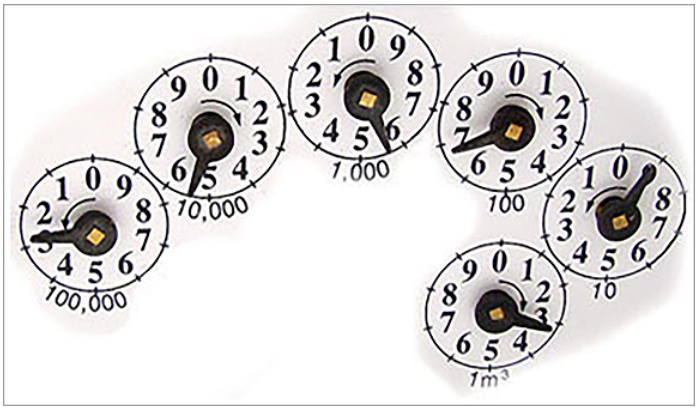
Reading type	Billing reading	Fractional billing units truncated by the meter reading software for customer billing
Meter index	4185	
550G	4185.42	.42

5 dial meter index



Reading type	Billing reading	Fractional billing units truncated by the meter reading software for customer billing
Meter index	22132	
550G ERT Module	22132.22	.22

6 dial meter index



Reading type	Billing reading	Fractional billing units truncated by the meter reading software for customer billing
Meter index	255693	
550G ERT Module	255693.6	.6

Encoding 550G Status, Event, and Alarm Data

The primary encoding function of an ERT module is to count the consumption of a utility product (typically gas, water, or electricity). Itron 550G ERT Modules also report their status in the system and detect when someone tampers with the gas meter or module (tamper events in Mobile Mode or events and alarms in OpenWay Riva Network Mode). Tamper or event and alarm values, interpretations, status information, and tamper or event and alarm reporting may differ among various ERT module types.

Important! Tampers are available when the 550G ERT Module is operating in Mobile Mode. Events and Alarms are available when the 550G ERT Module is operating in OpenWay Riva Network Mode. The available Events and Alarms are dependent on the module's firmware version.

The tamper or event and alarm sensors detect when a meter event occurs. The sensors then signal the tamper or event or alarm counters to increment.

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

For more information about the tampers or events and alarms available in your 550G ERT Module, the OpenWay Riva Events and Alarms Reference Guide provides a listing of all Mobile Mode tampers or OpenWay Riva Network Mode events and alarms. (See **Related Documents** for document information.)

500S Gas ERT Module Tamper or Event or Alarm Detection

Magnetic tamper (or event) detection occurs through a reed switch close to the count switch. If a magnet is placed close to the 550G ERT Module for theft purposes, the count switch may stay closed as the shaft rotates. Placing this magnet close to the module will also close the tamper (event or alarm) reed switch, which will increment the magnetic tamper (event or alarm) counter and indicate an event.

Magnetic Tamper (Event or Alarm) and Battery Low Warning

> **Note:** For detailed information about 550G tampers while the module is operating in Mobile Mode, see the *100 Series and CENTRON Bridge Meter Tamper Reference Guide*. For 550G events and alarms (OpenWay Riva Network Mode), see the *OpenWay Riva Events and Alarms Reference Guide*. See **Related Documents** for document information.

Magnetic tamper or event detection occurs through a reed switch close to the count switch. If a magnet is placed close to the module for theft purposes, the count switch may stay closed as the shaft rotates. Placing this magnet close to the module will also close the tamper reed switch, which will then increment the magnetic tamper (event or alarm) counter and indicate an event.

In 550G ERT Modules, a Mechanical System (MEMS) accelerometer reports a tilt tamper. The MEMS device senses when its position changes and reports the change in orientation. The 550G ERT Modules monitor the outputs of the MEMS device looking for a change in orientation. The device is configured to flag a change in state when tilted 45 degrees or more in any direction from its normally positioned axis. The counters within the module increment when the module is being tilted past 45 degrees and also increment when the module is tilted back to its normal position.

> **Note:** The tilt tamper counters do not automatically reset to zero when the module is reprogrammed. 550G ERT Module counters increment at each tamper or event and alarm. On 550G remote-mount modules, the cut cable tamper or event replaces the magnetic tamper or event. The cut cable tamper or event features an electrical break, sensed with the integrated circuit (ASIC) located on the module's primary circuit board.

Tamper Counters

Tamper counter handling is dependent on the 550G communication mode.

Mobile Mode The tamper counters track each tamper event. The two-tamper counter least significant bits (LSB) are reported in the standard consumption message (SCM/SCM+) and can be detected when a Check Endpoint is performed using Field Deployment Manager (FDM) software. The end user sees values ranging from 0 to 3 when they perform a Check Endpoint.

To read the tamper counters, perform a Read Tamper operation using FDM. Reference the appropriate specification sheet or programming guide to verify the software version for your module.

> **Note:** Opening and closing the sensor switch increments the tamper counter. A single tamper event may increment the tamper counter by two.

OpenWay Riva Network Mode

- **Events.** Events captured within the 500S device during the course of normal daily monitoring must be configured in order for them to be logged. Configured events support event notification and troubleshooting. Configuration of events using the ConfiguredEventCodes object alerts the 500S endpoint of the need to store events in logs. These logs are available for data collection using the standard interrogation process. To read the event counters, perform a Read Tamper operation. By default, all events described in the *OpenWay Riva Events and Alarms Reference Guide* (see **Related Documents** for document information) should be configured for delivery. Additionally, events can be configured as priority alarms, enabling asynchronous delivery on detection to the Collection Manager. The logs in the 500S device use a profile generic class structure allowing for selective access.
- **Alarms.** Alarm delivery (to Collection Manager) is separate from normal interrogations. Alarms are configured such that the alarm event is delivered to Collection Manager immediately requiring configuration to perform the asynchronous delivery of captured alarms.

Extended Status Notifications

- **Battery Low Warning**

The 550G 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 2-years life remaining. Battery life is evaluated daily, at midnight.

Gas Disconnect Encoding

The OpenWay Riva Gas Disconnect encodes the listed types of data.

> **Note:** For more information about OpenWay Riva Gas Disconnect events and alarms, reference the OpenWay Riva Events and Alarms Reference Guide (see **Related Documents** for document information.

- Valve event and alarms
- Returned status information

Encoding OpenWay Riva Gas Disconnect Status Data

The primary operation of an OpenWay Riva Gas Disconnect is monitoring and reporting device status information. OpenWay Riva Gas Disconnect modules also feature extended status reporting.

The OpenWay Riva Gas Disconnect controls the flow of gas to the meter with an internal, remotely-controlled gas flow valve. The OpenWay Riva Gas Disconnect monitors the status of the valve and reports events and alarms.

> **Note:** For more information about OpenWay Riva Gas Disconnect events and alarms, reference the OpenWay Riva Events and Alarms Reference Guide (see **Related Documents** for document information.

Gas Disconnect Event and Alarm, Event Logging, and Module Status

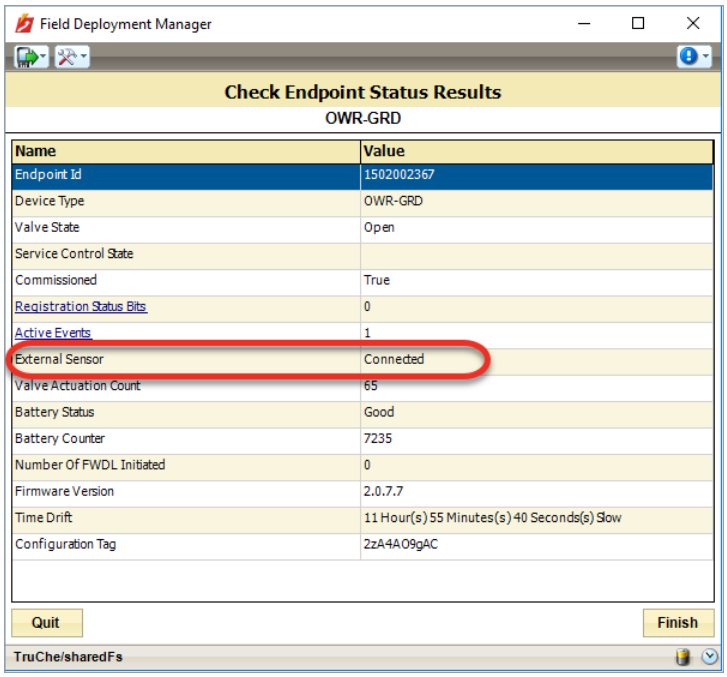
TheOpenWay Riva Gas Disconnect module operates only in OpenWay Riva Network Mode. For more information about the events and alarms available in your OpenWay Riva Gas Disconnect, the OpenWay Riva Events and Alarms Reference Guide provides a listing of all OpenWay Riva Network Mode events and alarms. (See **Related Documents** for document information.)

Event Information

OpenWay Riva Gas Disconnect modules contain a snapshot of any active events or alarms and the module's current operational status. The event log provides an indication of the OpenWay Riva Gas Disconnect module's operational state and or alarms that may be present.

- **Valve state**.
  - Valve open. The valve is open and gas is flowing to the meter.
  - Valve closed. The valve is closed; the gas flow is blocked to the meter.
- **Control state**
  - Disconnected
  - Armed
  - Connected
  - Unknown
  - Override disconnected
  - Override armed
  - Override connected
- **External connection status**. The external connection status reports if an external sensor is connected through the in-line connector port.

- **FDM External Sensor**
  - The External Sensor field displays "Connected" if a flood sensor is connected.



  - The External Sensor field is blank if a flood sensor is not connected.

- **OWOC-CM Peripheral Type**
  - The Peripheral Type field displays Auto Disconnect Sensor if a flood sensor is connected.
  - The Peripheral Type field does not display if a flood sensor is not connected.

- **Temperature Status**
  - Temp warning. The OpenWay Riva Gas Disconnect is operating outside the recommended temperature range.
  - Temp OK. The OpenWay Riva Gas Disconnect is operating within the recommended temperature range.

- **Battery Status**. Battery status reports on the OpenWay Riva Gas Disconnect battery life using one of two states.
  - Battery good. Battery parameters and battery life are within acceptable operational boundaries.
  - Battery bad. One or both batteries have reached the end of operational life.

3 Transmit and Receive Operations

This section describes the OpenWay Riva 550G ERT Module and Gas Disconnect 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 OpenWay Riva device, see **Standard 550G and Gas Disconnect device configuration**.

Message Exchange

The 500S module bubbles-up (transmits) SCM+ messages on fifty discrete channels. After transmitting on each of these channels, the module listens for commands from a reader or programming device on the same channel.

The 500S module can be configured for different modes for specific applications. 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 500S module supports interval data messaging. Interval data may be utilized in a Mobile Collection environment. These messages are sent frequency modulated at a higher data rate than legacy consumption messages. In Mobile Mode, advanced messaging and functionalities require specific hardware and software revisions. Specific product specification sheets and support documentation must be referenced for proper use and application.

500S Module Receive Operation

The 500S module receives commands in the Industrial-Scientific-Medical (ISM) band in the range of 903—926.85 MHz. When 500S modules are manufactured, they are left in Factory Mode with the transmitter off. While modules are in Factory 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 2 ms. The 500S 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 will not send any additional messages. When the module fails to detect a command message, it reverts to listening for a command.

500S Modules Transmit Operation

When the 500S module is taken out of factory ship mode, it starts bubbling-up beacons. The beacon 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.

500S Module Beacon

The 500S beacon includes the information that the 500S module transmits to a data collection device or head-end system. The message contains the following data.

- Module ID
- Module type
- Meter reading value (550G ERT Module only)
- Tamper (Mobile Mode only) or event and alarm (OpenWay Riva Network Mode) values
- Valve state (OpenWay Riva Gas Disconnect only)

550G ERT Module Gas Day Take (GDT)

Gas Day Take (GDT) data is a critical to many natural gas utility companies, allowing them to manage deregulated gas purchases. While the daily GDT read can be used for varying operations within the gas utility, the primary time constrained business operation is the daily balancing of deregulated (transport) customers. This function requires that GDT data be captured from a portion of the utility's customers (typically a maximum of 10%) at 9:00 Central Clock Time (CCT) and that all of the collected GDT be prepared for presentation to deregulated Marketers and customers by 11:00 AM CCT to support the gas utility's deregulated tariff. If a deregulated marketer or customer under or over burns what they nominated for a given day, a daily penalty may be associated with the imbalance. Further, customers need the previous day's GDT data so they can adjust their nomination for the next day to avoid a penalty.

> **Note:** The default setting for GDT is off. To receive GDT messages at a specified time, you must enable the GDT function. For FDM or OWOC Gas Day Take parameters, reference the documentation for your data collection type (see **Related Documents**).

OpenWay Riva Network Time Management

500S devices use application time to timestamp collected data. The 500S device receives a periodic network and absolute time broadcast from the OpenWay Riva network. Network time is used by the MAC layer to achieve network synchronization and facilitate consistent broadcast reception.

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

Timestamps on data collection that occurs prior to network registration is not dependable. The initial time is set in the 500S device at that time of installation using FDM.

Caution: If the 550G 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 OpenWay Riva network. (The OpenWay Riva Gas Disconnect does not support ZTD.)

550G ERT Module Transmission Modes

The 550G ERT Module supports OpenWay Riva Network and Mobile transmission modes. For more information about the 550G transmission modes, see **500S Transmission Modes**.

550G ERT Module Operating Modes

Normal operation mode for the 550G ERT Module supports OpenWay Riva Network and Mobile Mode communication. Transmission for normal operation mode is summarized in the following table.

Operation mode	Transmission rate	Output power	Battery life
OpenWay Riva Network		+27 dBm (500 milliwatts)	20 years
Mobile (100S) ■ High power mobile ■ Mobile/handheld ■ (*optional*) Hard to read Mobile/Handheld	■ 60 seconds ■ 15 seconds ■ 30 seconds	■ +24 dBm (10 milliwatts) ■ +10 dBm (10 milliwatts) ■ +24 dBm (250 milliwatts)	■ 20 years ■ 20 years ■ 15 years

Note: Optimum battery life is dependent on the OpenWay Riva device operating in a standard configuration. For standard configuration settings, see **Standard 550G and Gas Disconnect device configuration**. 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.

Normal Mode

The 550G is in bubble-up mode, emitting a beacon (Riva Network Mode) or an SCM+ (Mobile Mode) at configured intervals.

Factory Ship Mode

When the 550G ERT Module is manufactured, it is set to Factory Ship Mode. In Factory Mode, the module does not transmit messages. In Factory Mode, the ERT module turns on its receiver every 4 seconds set for the 908 MHz programming channel. It remains quiet until it receives a command message.

Audit Mode

When the module is programmed, it enters Audit Mode for up to 30 days. While the module is in Audit Mode, the module bubbles up messages every 4 seconds between its normal mode bubble-ups of +10 dBm every 15 seconds for Mobile/Handheld Mode. The module turns on its receiver after each Audit Mode transmission. The module exits Audit mode after an inactivity timeout expires (Mobile Mode) or after the Signed Authorization session ends.

550G ERT Module Transmission Characteristics

The 550G ERT Module transmits messages in a bubble-up fashion.

Mobile Mode

In Mobile mode, the ERT module transmits (bubbles-up) an SCM+ message an average of every 15 seconds. Each time it transmits, it will do so on 1 of 50 channels the ERT module picks pseudo-randomly. If there are several ERT modules in close proximity, it's likely that two ERT modules will transmit at the same time. Even though two ERT modules may transmit at the same time, it's most likely that they will 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. In Mobile Mode, the ERT module will bubble-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 very reliable communication between the 550G ERT Module and the data collection method.

To transmit daily or hourly interval data, the ERT module must receive a specific request from the reader. When it sends interval data, the ERT module must send the current consumption so the interval is related to the consumption value to determine the actual consumption at the prior interval. The ERT module cannot send raw count data because consumption is a combination of raw counts and initial consumption. The ERT module does not have the processing power to recalculate raw counts from an initial offset.

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 ERT module and transfers it to the reader, where more powerful resources can process the data.

OpenWay Riva Network Mode

In OpenWay Riva Network Mode, the module emits a beacon following the configured transmission schedule. The default behavior is for the head-end to send an interrogation request every 8 hours. After the module receives the request, it prepares the requested data and transmits it in the configured time period.

Gas Disconnect Transmit Operation

The OpenWay Riva Gas Disconnect bubbles-up (transmits) an OpenWay Riva Network beacon on discrete channels. After the transmission completes on each channel, the device listens for commands from the reading or data collection method on the same channel. OpenWay Riva Gas Disconnect manages and reports valve related status, events and alarms, and supports programming commands.

Gas Disconnect Messaging

The OpenWay Riva Remote Disconnect provides module status and control information relating to the operation and state of the remotely-controlled valve. The OpenWay Riva Gas Disconnect valve operation is provided through a two-way request.

The OpenWay Riva Gas Disconnect transmits a bubble-up beacon message that is read by the OpenWay Riva Network. The bubble-up message includes the listed information.

- Module type
- OpenWay Riva Gas Disconnect module ID
- Extended event and alarm field
- Utility ID
- Sequence number
- Network configuration
- Word
- Time
- Valve status

Alarm Bubble-up Messages

When critical alarms are detected, the OpenWay Riva Gas Disconnect module enters the alarm state and begins transmission of required alarm details. If a critical alarm is detected within the OpenWay Riva Gas Disconnect, all appropriate alarms are set and transmitted within all bubble-up messages. The alarms remain active until the event causing the alarm is cleared or corrected.

While the alarm window is active, any scheduled normal bubble-up messages are not transmitted. Dependent on whether the OpenWay Riva Gas Disconnect receives an alarm acknowledgment, the module completes this message action.

- If an acknowledgment is received, the module returns to its normal bubble-up transmission schedule. The module transmits normal bubble-up messages with the appropriate event or alarm flags set in the message.
- If an acknowledgment is not received, the module returns to its normal bubble-up transmission schedule. The OpenWay Riva Gas Disconnect transmits normal mobile bubble-up messages with the appropriate alarms set. An alarm bubble-up message contains the following information.
  - Alarm ID defining in detail the alarm cause
  - Module ID
  - Utility ID
  - Current extended event field values include the following:
    - Module type
    - OpenWay Riva Gas Disconnect module ID
    - Extended event field
      - Critical alarm bit set
      - Critical alarm ID
    - Utility ID
    - Sequence number
    - Network configuration word
    - Time
    - Bubble-up indicator

Gas Disconnect Operating Mode

The Gas Disconnect operates in OpenWay Riva Network Mode to provide the listed functions.

- OpenWay Riva Network message. The OpenWay Riva Gas Disconnect supports a normal bubble-up message with status and events or alarms data.
- Two-way commands. The OpenWay Riva Gas Disconnect supports the ability to remotely control the gas disconnect valve by controlling the state of the OpenWay Riva Gas Disconnect valve. The valve may exist in one of four control states.
  - Disconnected (closed). Prevents the flow of gas.
  - Armed. Control state of connected. Requires a technician to manually open the valve.
  - Connected (open). Allows the flow of gas.
  - Unknown/error. The state of the valve is unknown or the valve is in an error state.
- Auto-disconnect. The OpenWay Riva Gas Disconnect supports an external sensor that detects flood conditions, automatically closes the valve which stops the flow of gas, and sends an alarm to the head-end system.
  - In an emergency situation, you can bypass a previous override including an auto disconnect by the flood sensor, a temperature out of operating range, or a low battery endpoint restriction (such as a set temperature range required for connecting or disconnecting a gas device) by using the Emergency Override option from Collection Manager or FDM. This option applies only to OpenWay Riva Gas Disconnect devices.

    Caution: Forcing an emergency override could result in a damaged valve or failure to perform the requested action.

Emergency Override

In an emergency situation, operation of the valve under conditions outside of normal operating parameters or following a flood related auto-closure is possible by acknowledging the warning pop-up in FDM. Itron assumes no liability for failure of the OpenWay Riva Gas Disconnect to perform the requested action when the emergency override option is selected. The use of the emergency override option voids any remaining warranty on the OpenWay Riva Gas Disconnect.

Caution: Forcing an emergency override could result in damage to the valve or failure of the valve to operate.

FDM offers the option to perform an Override action (Close or Arm) if any of the listed conditions are reported by the OpenWay Riva Gas Disconnect.

- Previous auto-disconnect due to immersion of an attached flood sensor in water.
- The current valve temperature is outside of the specified operating parameters (for example, less than 32° F [0° C] or greater than 212° [100° C]).
- Valve actuation count exceeded 80.

After an Override action is performed, all future valve closure or arming requests will result in an override warning and a corresponding logged event.

4 Programming and Reading 500S Modules

When a 500S module ships from the factory as a build to stock 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.

500S Module Programming Parameters

There are three general programming parameters for the 500S modules.

- **Manufacturer system parameters**. Manufacturer parameters are set by Itron and cannot be changed by the utility.
- **Utility-specific parameters**. Utility system parameters are common to a family of modules for a specific utility.
- **Meter-specific parameters**. Meter-specific parameters vary by the meter type connected to the module. Modules are programmed using a handheld programmer. You can program the 550G ERT Module in OpenWay Riva Network Mode or the 550G ERT Module in Mobile Mode.

Manufacturer System Parameters

The manufacturer system parameters contain the information required for basic device operation.

The tamper or event debounce parameter specifies the amount of time for the mechanical contact on the tilt switch to settle before a signal from the switch is considered valid by the 500S gas ERT or OpenWay Riva Gas Disconnect. This configurable parameter is used to adjust the sensitivity of the meter removal tamper or event indicator.

550G ERT Module Default Values

This section shows the default values for a 550G ERT Module not yet programmed. If a Check Endpoint was performed prior to programming, these values would be read and returned. These are the default values set in the ERT module when it's manufactured.

Parameter	Value
Module type	550G
Count rate	1

Parameter	Value
Rollover	2
Bubble-up	OMR (15 seconds)
PCOMP	None (1.000)
Utility ID	0
Lock level	No lock (lock level 1)
RF output power	OMR (+10 dBm)
Network Mode	Star, Mesh
SSID	42834

If the 550G ERT Module is programmed with a configuration other than the values shown above, such as a utility ID, and the above values still appear for the ERT module, the values indicate that the ERT module was not successfully programmed.

550G ERT Module Utility System Parameters

The 550G ERT Module's utility system parameters contain information required for the utility's system operation. Generally, all ERT modules within a defined group are programmed with the same utility system's parameters. The utility system parameters for the 550G ERT Module include

- Utility 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 550G ERT Module security for all the utility's 550G ERT Modules.

When a 550G ERT Module is programmed, the new parameters take effect immediately.

> **Note:** When an ERT module is programmed, the utility ID and security lock level are set, which defines how subsequent reprogramming is performed. When the 550G ERT Module is programmed and set for Hard Lock security level, the 550G ERT Module cannot be unlocked.

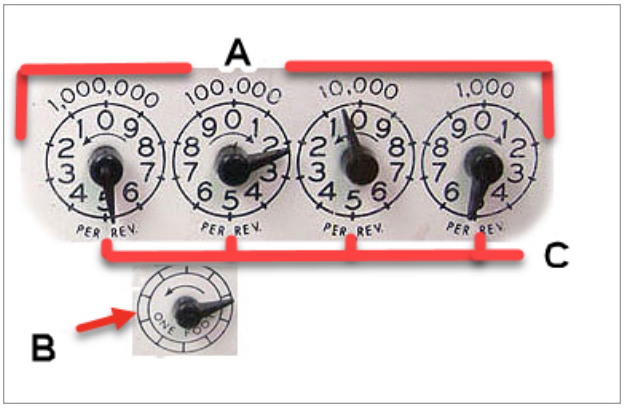
550G ERT Module Meter-specific Parameters

A 550G ERT Module's meter specific parameters contain information required for the ERT module to operate properly with a certain meter type or model. Meter-specific parameters are different for all meters.

The following parameters are common to most meters.

- Initial reading
- Count rate/pulse factor
- Rollover (number of dials)

The listed parameters correspond to the following features on a typical mechanical meter dial.



	Parameter	Description
A	Initial reading	Specifies the ERT module's meter reading during installation. This is the number from which an ERT module begins counting consumption.
B	Count rate and pulse factor	Specifies the gas flow amount required to deliver a pulse to the ERT module.
C	Rollover	Specifies the number of the meter's mechanical dials that indicate the meter reading. This parameter synchronizes the ERT module reading with the mechanical register reading.

A list of meter configurations is available when you program the ERT module with Field Deployment Manager (FDM). In the case of the above example, the user would select 4-dial, 1 cu ft. and would not be required to enter a count rate or rollover value. These values are predetermined when the configuration is selected. Also, considering the example above, the user would enter 5205 for the initial reading.

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 (OpenWay Riva Network Mode) or SCM+ (550G ERT Module 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 value of the tamper. For more information, reference the product specification sheet for your module (see **Related Documents**for product documentation information).

Security Lock Level (550G ERT Module Mobile Mode only)

The security lock level parameter controls module reprogramming.

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

The 550G 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.
- **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, number of dials, drive rate, or pressure compensation (PCOMP) cannot be reprogrammed. System parameters, such as operation mode (Mobile Mode or OpenWay Riva Network Mode) can be reprogrammed.

> **Important!** Measurement Canada requires a Canadian utility to use a locked security level for gas meter ERT modules.

Normal Mode Operating Settings

This parameter specifies the 500S module's normal transmission environment and specifies how the module will be read:

- OpenWay Riva Network Mode
- Mobile Mode
  - Mobile/handheld Mode
  - Mobile High Power Mode
  - Hard-to-read Mobile/handheld Mode

Note: For more information, reference **550G ERT Module Operating Modes**.

Programming 500S Modules

Important! You must program the 500S module prior to use.

An Itron programming device is used to program 500S modules. Programming requires technology with an ISM (Industrial-Scientific-Medical) transmitter. The programming device utilizes Field Deployment Manager (FDM) Tools software. Reference your product's specification sheet or programming guide for the correct FDM version (see **Related Documents**). FDM supports programming for all 500S modules.

Programming OpenWay Riva 550G ERT Modules

Programming Itron 550G ERT Modules requires an understanding of:

- Your meter's drive rate and the number of dials
  - The drive rate and number of dials is important for programming the module to count correctly and roll over to zero at the correct time. For example, a four-dial, 2 cubic-feet meter configuration will count two cubic-feet for each rotation and roll over to zero after 9999.99 where the ones place is equivalent to 100 cubic-feet.
- 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 ERT modules are programmed.

Program the 550G ERT Module in OpenWay Riva Network Mode using a compatible programming device loaded with Field Deployment Manager (FDM) Tools version 4.0.1or higher.

Program the 550G ERT Module in Mobile Mode using an approved programming device loaded with Field Deployment Manager (FDM) Tools software version 4.0 or higher.

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

Important! Modules ordered pre-programmed with security injected and specified as Zero Touch Deployment require that the installer to rotate the wriggler five (5) times to activate the module to join the network if installing in a location with little or no gas flow.

Programming OpenWay Riva Gas Disconnect devices

Program the 550G ERT Module in OpenWay Riva Network Mode using a compatible programming device loaded with Field Deployment Manager (FDM) Tools version 4.0.1or higher.

> **Note:** Perform programming only after the OpenWay Riva Gas Disconnect is installed in the piping system and the flood sensor (if used) is attached. Commissioning the OpenWay Riva Gas Disconnect involves antenna selection based on the valve orientation.

Standard 500S Module Configuration

The OpenWay Riva 500S module is capable of configurations that reduce battery life.

The 20-year standard battery life is based on this listed configuration.

- Hourly interval data (550G ERT Module).
- 80 valve actuations (OpenWay Riva Gas Disconnect).
- Interrogations of 3 times per day.
- 60-second receiver wakeup.
- Five firmware downloads over the life of the module.
- Network management and security overhead set to default timing.
- RF at capacity (2,000 maximum per cell).
- Average of one two-way command/response per week.

Programming 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 FC300 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 550G ERT Module (in Mobile Mode only) is dependent on the operating mode.

Time to Program in Normal Operation

During 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 FC300 handheld computer will 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 Mode

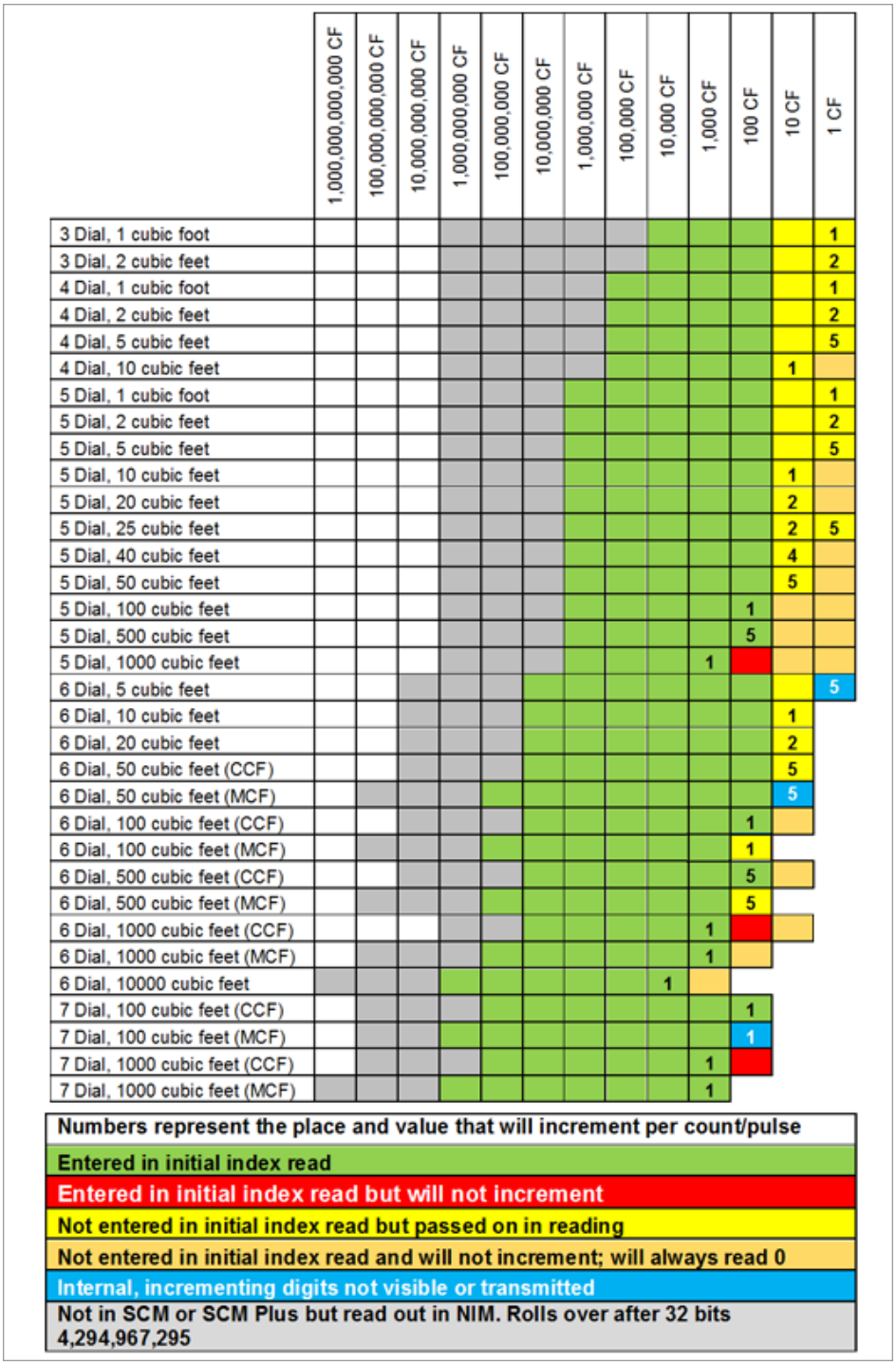
When the module is in Factory Mode, initial programming takes approximately 15 seconds (if success is achieved on the first attempt). Since the handheld programmer reads the module's operation mode (OpenWay Riva Network Mode or Mobile Mode: Mobile/handheld Mode, High Power Mobile Mode, Hard-to-Read Mode), it listens for a command beacon (OpenWay Riva Network) or SCM+ message (550G ERT Module in Mobile Mode. Since the module could be in Mobile Mode High Power Mobile Mode (only bubbling up every 60 seconds), the handheld programmer listens for 65 seconds before timing out.) A failed programming attempt takes approximately 1 minute 25 seconds.

Itron Programs and Software Variables

This section defines and clarifies possible system variables you may encounter in programming 550G ERT Modules.

Field Deployment Manager (FDM)

The following tables illustrate various FDM programming configurations and the endpoint response to each setting.



	1,000,000,000,000 CF	100,000,000,000 CF	10,000,000,000 CF	1,000,000,000 CF	100,000,000 CF	10,000,000 CF	1,000,000 CF	100,000 CF	10,000 CF	1,000 CF	100 CF	10 CF	1 CF
3 Dial, 1 cubic foot													1
3 Dial, 2 cubic feet													2
4 Dial, 1 cubic foot													1
4 Dial, 2 cubic feet													2
4 Dial, 5 cubic feet													5
4 Dial, 10 cubic feet												1	
5 Dial, 1 cubic foot													1
5 Dial, 2 cubic feet													2
5 Dial, 5 cubic feet													5
5 Dial, 10 cubic feet												1	
5 Dial, 20 cubic feet												2	
5 Dial, 25 cubic feet												2	5
5 Dial, 40 cubic feet												4	
5 Dial, 50 cubic feet												5	
5 Dial, 100 cubic feet											1		
5 Dial, 500 cubic feet											5		
5 Dial, 1000 cubic feet										1			
6 Dial, 5 cubic feet													5
6 Dial, 10 cubic feet												1	
6 Dial, 20 cubic feet												2	
6 Dial, 50 cubic feet (CCF)												5	
6 Dial, 50 cubic feet (MCF)												5	
6 Dial, 100 cubic feet (CCF)											1		
6 Dial, 100 cubic feet (MCF)											1		
6 Dial, 500 cubic feet (CCF)											5		
6 Dial, 500 cubic feet (MCF)											5		
6 Dial, 1000 cubic feet (CCF)										1			
6 Dial, 1000 cubic feet (MCF)										1			
6 Dial, 10000 cubic feet									1				
7 Dial, 100 cubic feet (CCF)											1		
7 Dial, 100 cubic feet (MCF)											1		
7 Dial, 1000 cubic feet (CCF)										1			
7 Dial, 1000 cubic feet (MCF)										1			

Numbers represent the place and value that will increment per count/pulse

Entered in initial index read

Entered in initial index read but will not increment

Not entered in initial index read but passed on in reading

Not entered in initial index read and will not increment; will always read 0

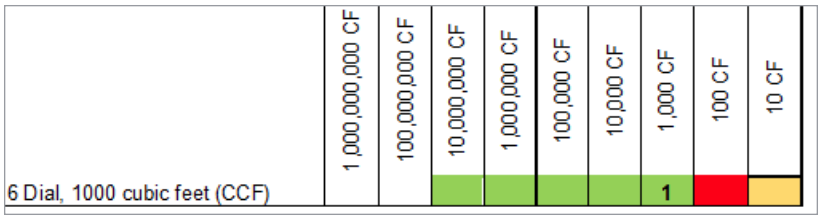
Internal, incrementing digits not visible or transmitted

Not in SCM or SCM Plus but read out in NIM. Rolls over after 32 bits 4,294,967,295

	100,000,000 M³	10,000,000 M³	1,000,000 M³	100,000 M³	10,000 M³	1,000 M³	100 M³	10 M³	M³	0.1 M³	0.01 M³
5 Dial, 0.05 cubic meter											5
6 Dial, 0.10 cubic meter										1	
6 Dial, 1 cubic meter									1		
6 Dial, 10 cubic meters								1			
6 Dial, 100 cubic meters							1				
7 Dial, 10 cubic meters								1			
7 Dial, 100 cubic meters							1				

Programming example: Endpoint programmed for 6 dial, 1000 cubic feet CCF.

1. Enter the initial index read. For this example, the initial read is 123456 where 6 = 600 cubic feet. After the initial programming, an endpoint read will result in a reading of 1234560 where the least significant digit is in 10's of cubic feet. Since counting is with a drive rate of 1000 cubic feet and the reading is transmitted in 10's of cubic feet, the last two digits of the reading will not change.
2. Program the endpoint to 123456.
3. Read the endpoint. The result should be 1234560 with the zero added to put the reading in 10's of cubic feet.
4. Add one count. The result should be 12346**60**. Notice that the last two digits of **60** do not change.



Mercury X-Blank options

Endpoints (ERT modules) can be programmed with one of the Mercury X-Blank options. There are 1, 2, 3, and 4 blank option available. Blank options are set up as a *what-you-see-is-what-you-get* (WYSIWYG) configuration. The values are not set in cubic feet or cubic meter standards. The Mercury X-Blank options are used in configurations where the system receives pulses from a corrector or instrument that can change pulse values and has configurable display digits. The Mercury-X Blank options allow users to program the endpoint to match the configuration of the corrector or instrument.

Check Endpoint functions

The FDM Check Endpoint function triggers users to input the number of dials and drive rate if a Check Endpoint is requested for an endpoint programmed for 5, 6, or 7-dial meter configurations. The request to input the dial and drive rate information happens only if the system has more than one option using the same count rate and rollover variable enabled in their FDM business unit.

> **Note:** Itron recommends that users only enable the configurations used by your business unit. Having only one meter configuration option enabled (with the endpoint variable being checked in the FDM business unit) eliminates the need to enter the number of dials.

Field Collection System (FCS) (Mobile Mode only)

In FCS, a Read Type Code can be assigned to a meter session. The Read Type Code in conjunction with the Endpoint Type is used to determine how the endpoint reading is formatted

using the Endpoint Translation table in FCS. The Endpoint Translation table is a configurable table that is used to determine the truncation factor and multiplier for each reading. A default Endpoint Translation is defined for each type of endpoint supported by FCS (ReadType of 00 for each EndpointType). If the default Endpoint Translation is not formatting the read correctly, an additional Endpoint Translation can be defined to properly format the read.

Since the Endpoint Translation Code is based on the Read Type Code and the Endpoint Type, changing from a 40-series endpoint to a 100-series endpoint can cause the reading to be truncated differently. If you are having issues with your reading after a change out, check your Read Type Codes and Endpoint Translation Codes.

OpenWay Operation Center (OWOC)

The OpenWay Operation Center (OWOC) collects the raw reading and passes it on without making any formatting changes.

Itron Enterprise Edition (IEE) Meter Data Management

The standard unit of measure (UOM) in IEE is cubic feet for gas endpoints. The reading passed on by the gas endpoint is not in cubic feet if endpoints with 6 and 7-dial meter configurations are programmed, so adjustments are required to set the correct unit of measure. If you are having issues with your readings in IEE but your endpoint and meter index match, check your unit of measure within IEE.

5 Ordering 550G ERT Modules

> **Note:** This ordering information applies to 550G ERT Modules with GSR 4.1 functionality. See the OpenWay Riva Gas Devices Ordering Guide for information to order modules with GSR 4.5 and higher (for documentation information, see **Related Documents**).

The 550G provides flexible deployment strategies, giving customers the option to deploy in OpenWay Riva Network Mode or legacy Mobile Mode. With the ability to deploy 550G ERT Modules in Mobile Mode so modules function like a 100G DLS, customers can install modules before they are ready to be read in the OpenWay Riva Network. To take advantage of a Mobile Mode deployment with the 550G, all prerequisites for future network transitions must be known. To run in the OpenWay Riva Network Mode, the 550G requires security certificates, ISM files, and an SSID at the time they are manufactured. To set the required certificates, files, and SSID into the module, requires that the customer's network environment is setup. The information from the environment is required by manufacturing so the customer specific certificates and keys can be injected at the time of manufacturing. This information is required for "S" or "PS" part number ordering.

To support 500S deployment strategies, Itron offers modules with security injected at the factory, custom programmed modules, programmed and secured modules, and build to stock units. Determining which endpoint is right for the utility's deployment strategy is very important to ensure that our customers experience a successful deployment.

- **Build to stock**. 550G ERT Module with default configurations. These modules require meter-specific parameters programmed into them before they are installed. Build to stock modules must have security injected into them before they can join a network.
- **Custom programmed (P)**. 550G ERT Module with meter-specific parameters (initial consumption, drive rate, etc.) and an SSID programmed into them at the time they are manufactured.
  Note: This option is only available for modules attached to indexes without consumption (0). Customer programmed modules must have security injected into them before they can join a network.
- **Built with customer security settings (S)**. 550G ERT Modules manufactured using the customer specific security certificates, security keys, and an SSID. These modules require meter specific programming (initial consumption, drive rate) prior to deployment, but the security settings are already set. An initial order for modules with customer security settings injected at the time they are manufactured requires a *First Article* verification.

- **Custom programmed/customer-specific security injected (PS)**. 550G with customer-specific security certificates, security keys, an SSID, and meter-specific parameters programmed (initial consumption, drive rate) at the time they are manufactured.
  Note: This option is only available for modules attached to indexes without consumption (0). Customer programmed modules must have security injected into them before they can join a network.
  With the PS option, modules deployed in network mode can be set to Zero Touch Deployment. With Zero Touch Deployment, (auto wake on pulses) modules start searching for a network after the module shaft senses three rotations (direct-mount modules) or three pulses (remote-mount module). The PS option can also be used to get the security settings injected into the module and program the modules for deployment in Mobile Mode.

Itron part number	Description	ISM UP-K	ISM shared key file	AAA certificate (required for network authentication)	IoT FND ECC key certificate (required to authenticate commands from IoT to FND)	SSID (required to find the network)	Meter configuration (drive rate, rollover, pressure compensation)	Owoc file (sets OWOC configurations in the module)
ERG-7000-XXX	Build-to-stock	No	No	No	No	No	No	No
ERG-7000-XXXP*	Custom programmed	No	No	No	No	Yes	Yes	Optional
ERG-7000-XXXS	Built with customer security settings	Yes	Yes	Yes	Yes	Yes**	No	No
ERG-7000-XXXP-S*	Custom programmed and customer-specific security injected	Yes	Yes	Yes	Yes	Yes**	Yes	Optional

Note:

- *Custom programming cost is $1 per module.
- **The SSID is set with the S part number as of October 2017 for gas ERT modules.

First Article

Injecting security into the modules secures them for a specific customer. It is important that the security settings are correct. To ensure the settings are correct, Itron requires a *First Article review form* (TDC-1749) for modules ordered with security injected during manufacturing.

Switching network modes

When customers are ready to switch the network mode from Mobile to OpenWay Riva Network, it can be done using drive-by with FCS v4.0.3 or higher only if the modules have the network security credentials set. Injecting security into the module is free of charge and saves time in the field. Itron recommends ordering 550G ERT Modules with security. Deploying modules in Mobile Mode without security injected and later switching to OpenWay Riva Network Mode will require an additional visit to each module. Changing modes from Mobile to OpenWay Riva Network becomes a costly task.

Beginning deployment in OpenWay Riva Network Mode

For Itron customers that want to begin deployment reading in a network, we offer custom programming and security options that allows the customer to deploy 550G ERT Modules in OpenWay Riva Network mode and automatically join the network when the modules detect flow. This option is available for meter indexes with an initial read of zero only. Field retrofit installations that use existing indexes can be configured to join the network at the time they are installed. In both of these scenarios, ensure that you are ordering modules with factory-injected security.