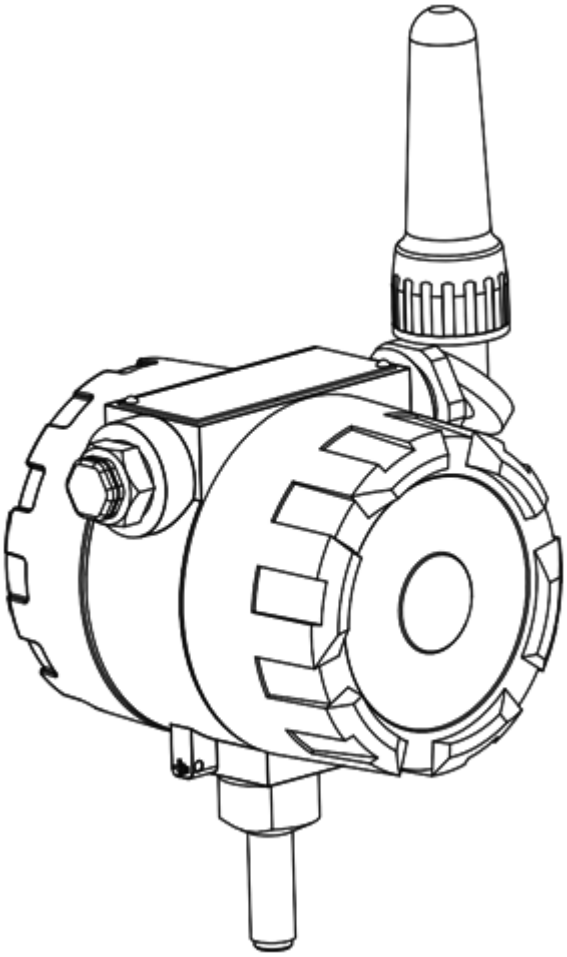
AIM® Model: ST6700 Armstrong Intelligent Monitoring Installation, Operation and Maintenance Manual



AIM™
ARMSTRONG INTELLIGENT MONITORING

Please read and save these instructions

Armstrong®

260-EN-V1.2

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Safety

Icon Legend:

 **— DANGER! … Injury or death and property damage are *imminent*.**

 **— WARNING! … Injury or death and property damage are *possible*.**

 **— CAUTION! … Potential property damage, expensive repairs, and/or voiding the equipment warranty *may result*.**

 **— BURN HAZARD! … BURN HAZARD! Direct exposure to steam, hot water, or hot metal surfaces can cause severe skin burns. Skin contact with 140°F (60°C) water or metal for only five (5) seconds may cause a second-degree burn.**

Failure to comply with instructions following a safety icon may result in adverse consequences including, property damage, personal injury, or, in extreme cases, death.

General Safety Guidelines:

1. Inappropriate use of this product (beyond typical, intended use) could cause damage to the product and other property. It may also result in personal injury or, in extreme cases, death.
2. Only designated, qualified, and competent personnel should conduct installation, maintenance, and service in accordance with the directions in this product instruction manual.
3. Installation shall comply with all applicable federal, state, and local, electrical and construction, regulatory codes.
4. Improper installation, start-up, operation, maintenance, or service may void the product warranty.
5. When installing, commissioning or servicing this product:

    a. ALWAYS select and wear appropriate personal protective equipment (PPE) before carrying out any physical work at the job site. Appropriate PPE may include hard hats, safety glasses, gloves, boots or shoes w/ non-slip soles and toe guards, and protective overalls.

    b. ALWAYS scan the work area and take note of potential hazards before entering. Adjust your travel path or work position to avoid hazards and personal injury.

    c. ALWAYS observe designated safety procedures when working in hazardous locations (areas containing explosive and combustible gases, vapors, and dusts) and confined spaces (locations where the breathable air supply may be limited or variable or where entrapment could occur).

    d. ALWAYS use appropriate lockout-tagout procedures to disconnect power sources and de-energize machinery before conducting installation, service, and repair.

    e. ALWAYS use great care and appropriate safety gear when working above ground level, especially on ladders and platforms or in the presence of overhead, electrical power lines.

    f. ALWAYS ensure that all “live” steam, water supply, and condensate return lines are isolated before breaking or loosening any plumbing joints.

    g. ALWAYS carefully relieve any residual internal pressure in the system or connecting pipe work before breaking or loosening any plumbing joints.

    h. ALWAYS allow hot parts to cool before commencing work to avoid the risk of skin burns.

Warnings and Cautions

Warning! Explosion Hazard

Please review product design certifications when installing transmitter in explosive or potentially explosive atmospheres. This transmitter must be installed in accordance with appropriate local, national and international standards, codes and practices.

Warning! Sparking Hazard

Risk of electrostatic sparking when installed in explosive atmosphere, clean the outside surface of the monitor with a damp cloth before servicing.

Warning! Maintenance Safety

Use industrial standard safety protocol when installing, removing, or performing authorized maintenance procedures on Armstrong Intelligent Monitoring™ transmitter on, or near, process equipment (This includes, but is not limited to, steam traps, relief valves, hot pipes, and equipment).

Caution: Lithium Batteries and Shipping

Armstrong Intelligent Monitoring™ products use lithium batteries as power source. Lithium batteries are regulated in transportation by the U.S. Department of Transportation and are also covered by IATA (International Air Transportation Association), ICAO (International Civil Aviation Organization), and ADR (2009 European agreement concerning International Carriage of Dangerous Goods). Confirm transmitters are packaged and shipped in accordance with all shipping regulations.

Caution: Damaged Transmitter

If the transmitter becomes damaged, immediately remove from service. Do not attempt repair or maintenance. Contact Armstrong Smart Services Group at:

+12692731415
Armstrong International, Inc.
816 Maple St.
Three Rivers, MI 49093

Caution: Environment

It is the responsibility of the end user to verify that the process and environment that the transmitter is placed in is free of hazards that will damage the transmitter. Proper conditions are outlined in this document and should be followed to ensure the transmitter does not sustain damage.

Notice: Compliance

This transmitter complies with electromagnetic emissions and immunity requirements. Operation is subject to the following condition:

- This transmitter may not cause harmful interference.
- This transmitter must accept any interference received, including interference that may cause undesired operations.

Notice: Usage

This manual should be used by experienced personnel as a guide to the installation of the Model ST6700 Armstrong Intelligent Monitoring™ System. Selection or installation of equipment should always be accompanied by competent technical assistance. You are encouraged to contact Armstrong International or its local sales representative for additional information.

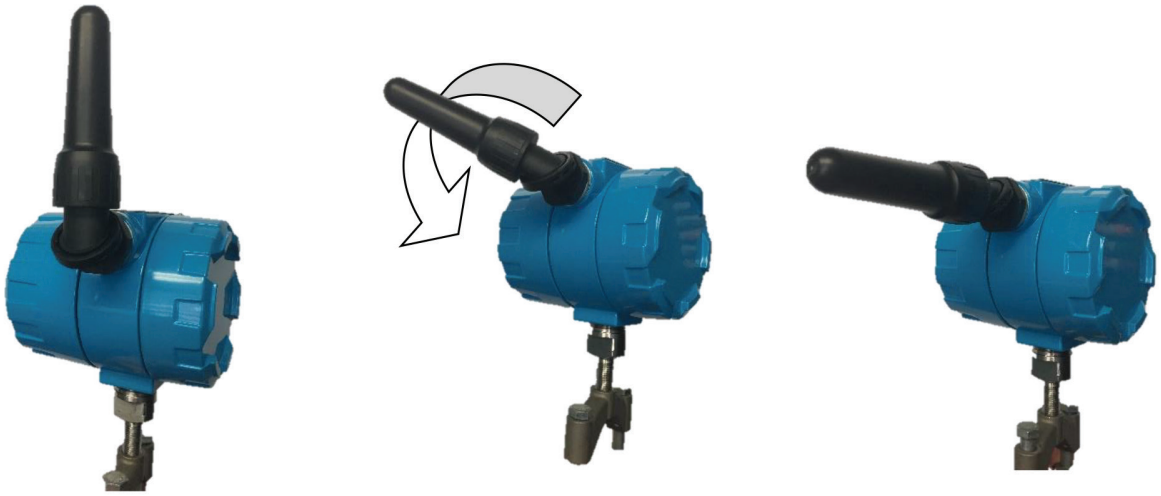
Notice: Maintenance (Battery)

Authorized maintenance to the transmitter(s) is limited to replacing the battery. All other maintenance should be performed only by Armstrong Smart Services Group. Do not attempt any other maintenance aside from changing the battery and contact Armstrong Smart Services Group for repair:

+12692731415
Armstrong International, Inc.
816 Maple St.
Three Rivers, MI 49093

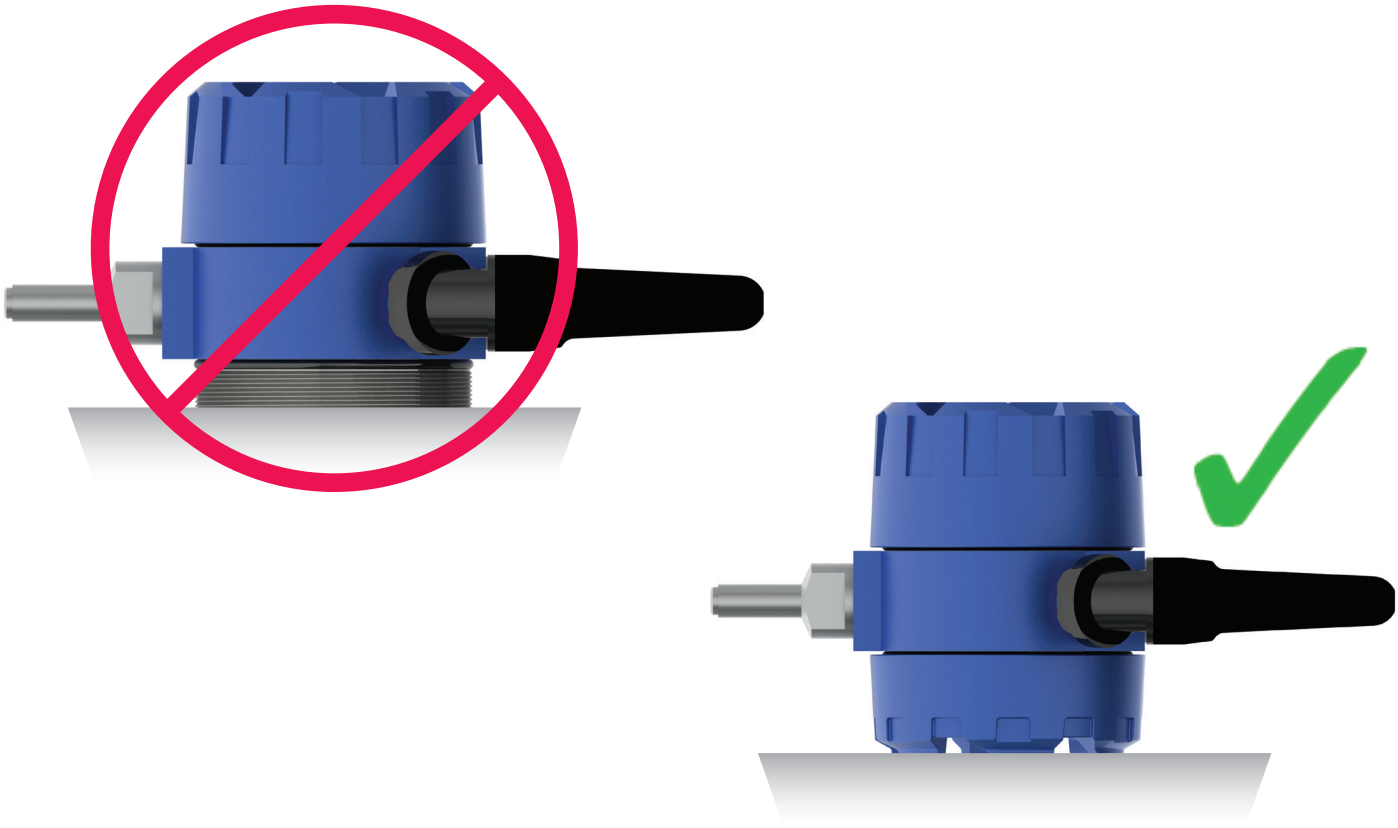
Warnings and Cautions – continued

Notice: Do not exceed 360° of rotation. Rotating the antenna more than 360° can cause the antenna to become disconnected internally.



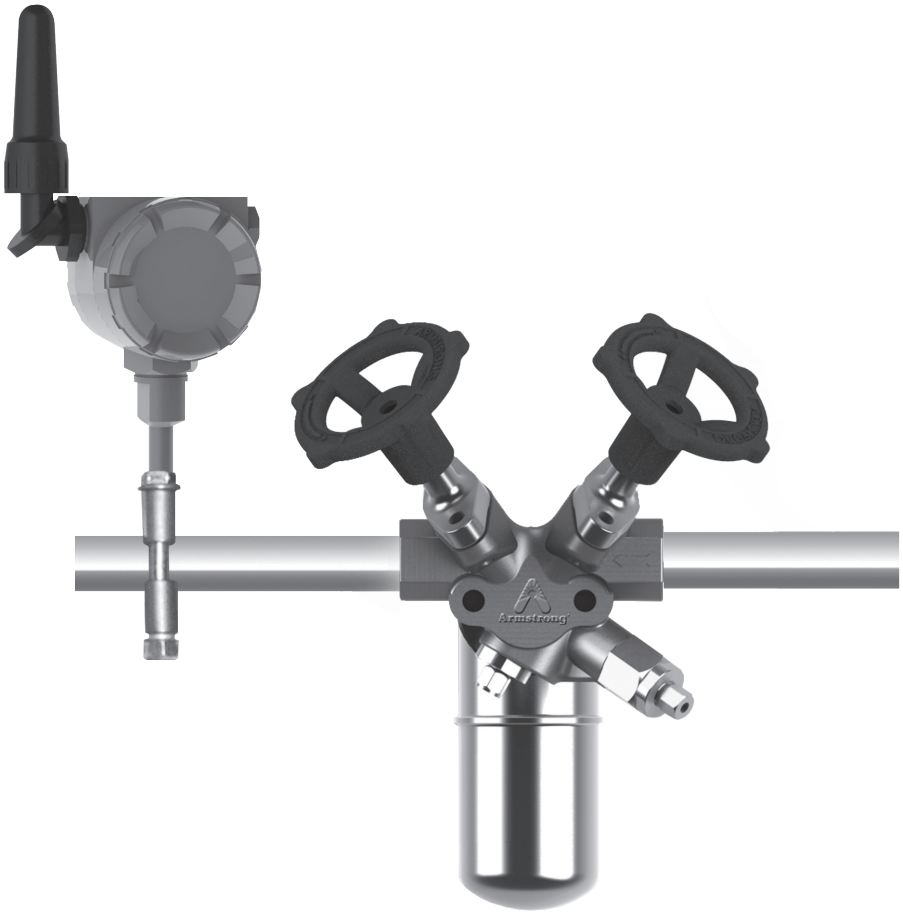
360° (1 rotation) Maximum

Notice: Do not lay the monitor flat on a table or bench without the front cover. Contact with a hard surface can cause damage to internal components.



Introduction

Armstrong Intelligent Monitoring Model ST6700 is wireless monitoring technology that efficiently monitors and evaluates steam trap operation. The AIM® ST6700 identifies the conditions of a steam trap to determine significant problems that could put your operation at risk. The AIM® ST6700 can accurately detect potential issues such as plugged and blow-through steam traps, which can cause a range of issues including, but not limited to failed equipment, loss of product, and safety concerns. Immediate failure notification from the AIM® ST6700 helps identify the root cause while minimizing production losses and reducing energy consumption. Using nonintrusive technology combined with ISA100, the AIM® ST6700 is the ideal solution for any temporary or permanent 24/7 steam trap monitoring.



AIM®
ARMSTRONG INTELLIGENT MONITORING

ISA100 WIRELESS™

Theory of Operation

The Armstrong ST6700 AIM® transmitter is designed to continuously monitor any type of steam trap. It utilizes a combination of hardware and integrated algorithms to accurately detect steam trap conditions. The hardware consists of an acoustic sensor (Piezo) and a temperature sensor (Thermistor). The integrated algorithms are patented, proprietary code designed by Armstrong to provide actual steam trap conditions based on inputs from the hardware. When applied to a steam trap, the device wirelessly transmits the current condition of the steam trap.

Armstrong ST6700 Measurements

	Honeywell	Yokogawa	Nivis/Nexcom
Trap Condition	Channel_9	Piezo Status	Channel_9
Stem Temperature	Channel_10	Temperature	Channel_10
Temperature Set Point	Channel_11	Temperature Setpoint	Channel_11

The ST6700 has built-in algorithms, which perform a series of diagnostic checks in order to determine the condition of the steam trap.

The first stage validates the surface temperature of the steam line and compares it with the configurable temperature set point. The temperature sensor located in the stem of the monitor detects the skin temperature at the inlet of the steam trap. The Stem Temperature is compared to the Temperature Set Point.

If Stem Temperature is less than the Temperature Set Point, then the steam trap is cold/plugged. This could be due to a failed plugged steam trap, or there is no steam distributed to the steam trap. If the steam trap is cold/plugged, the transmitter will return a Trap Condition value 2. A Trap Condition of “2” means the steam trap is in a cold/plugged condition.

If the Stem Temperature is greater than the Temperature Set Point, the monitor assumes there is steam being distributed to the trap causing the device to go into the second stage of diagnostics.

In the second stage, the ST6700 listens to the operation of the trap to determine if there is steam loss through the steam trap’s internal orifice. The Piezo sensor has been tuned to detect a trap passing live steam while filtering out background noise. This acoustic signature is analyzed by Armstrong’s patented algorithm to determine if the steam trap is in a blow-thru condition (i.e. - losing live steam).

If the algorithm determines that the trap is in normal operation, then the ST6700 will publish a Trap Condition value of 1. A Trap Condition value of “1” means the trap is in a good condition.

If the algorithm determines that the trap is losing live steam, the ST6700 will publish a Trap Condition value of 3. A Trap Condition value of “3” means the trap is in a blow-thru condition.

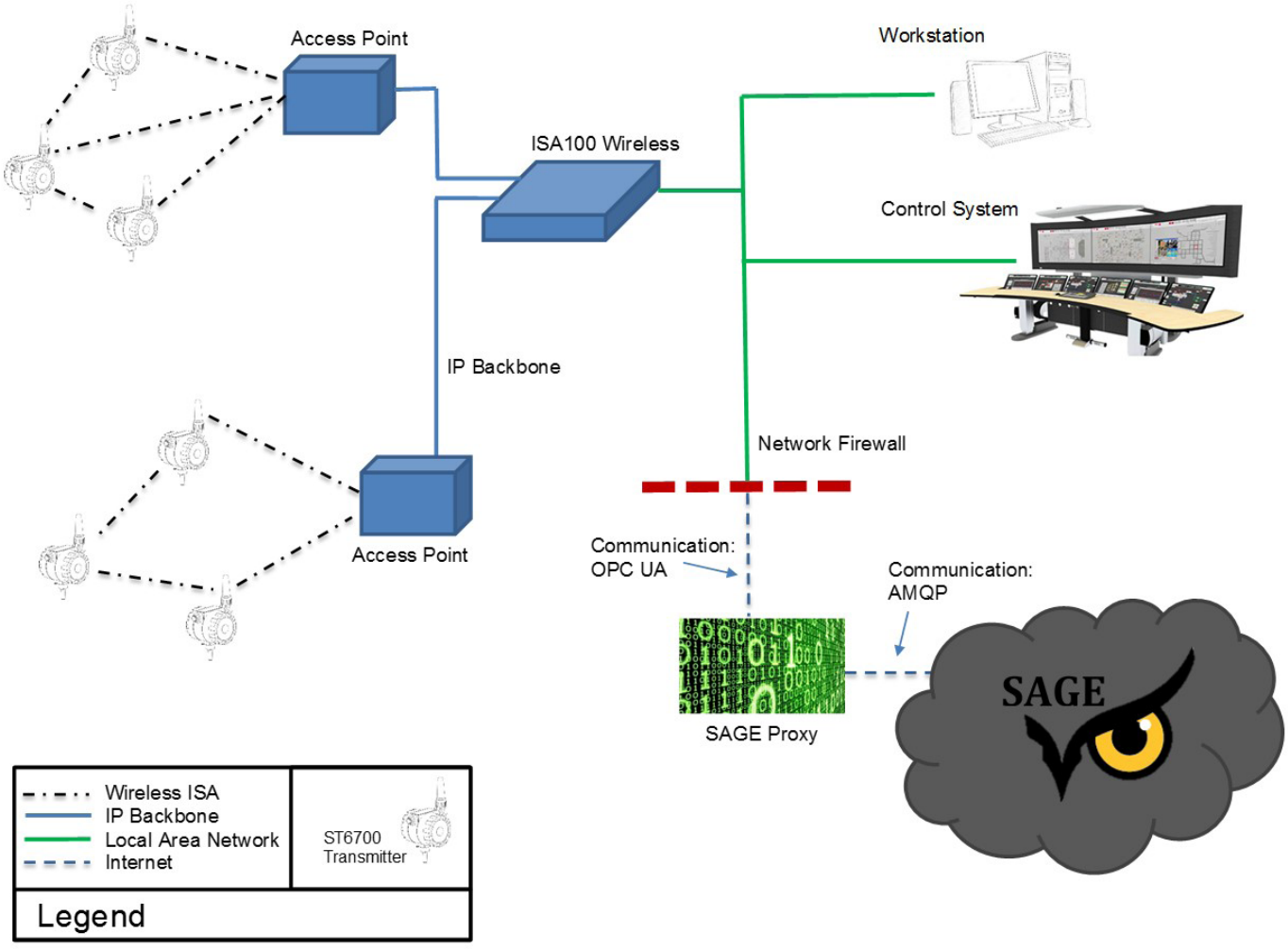
Trap Condition	Definition
1	OK Steam Trap
2	Cold/Plugged Steam Trap
3	Blow Through Steam Trap

Communication Overview

Armstrong offers a variety of tools to help manage steam trap populations. A primary tool offered by Armstrong is SAGE®. SAGE® is an online trap management tool that lets you keep all you trap information in one place. The data in SAGE® is accessible through a standard computer with a web browser, or it can be accessed with a mobile device like a phone or tablet.

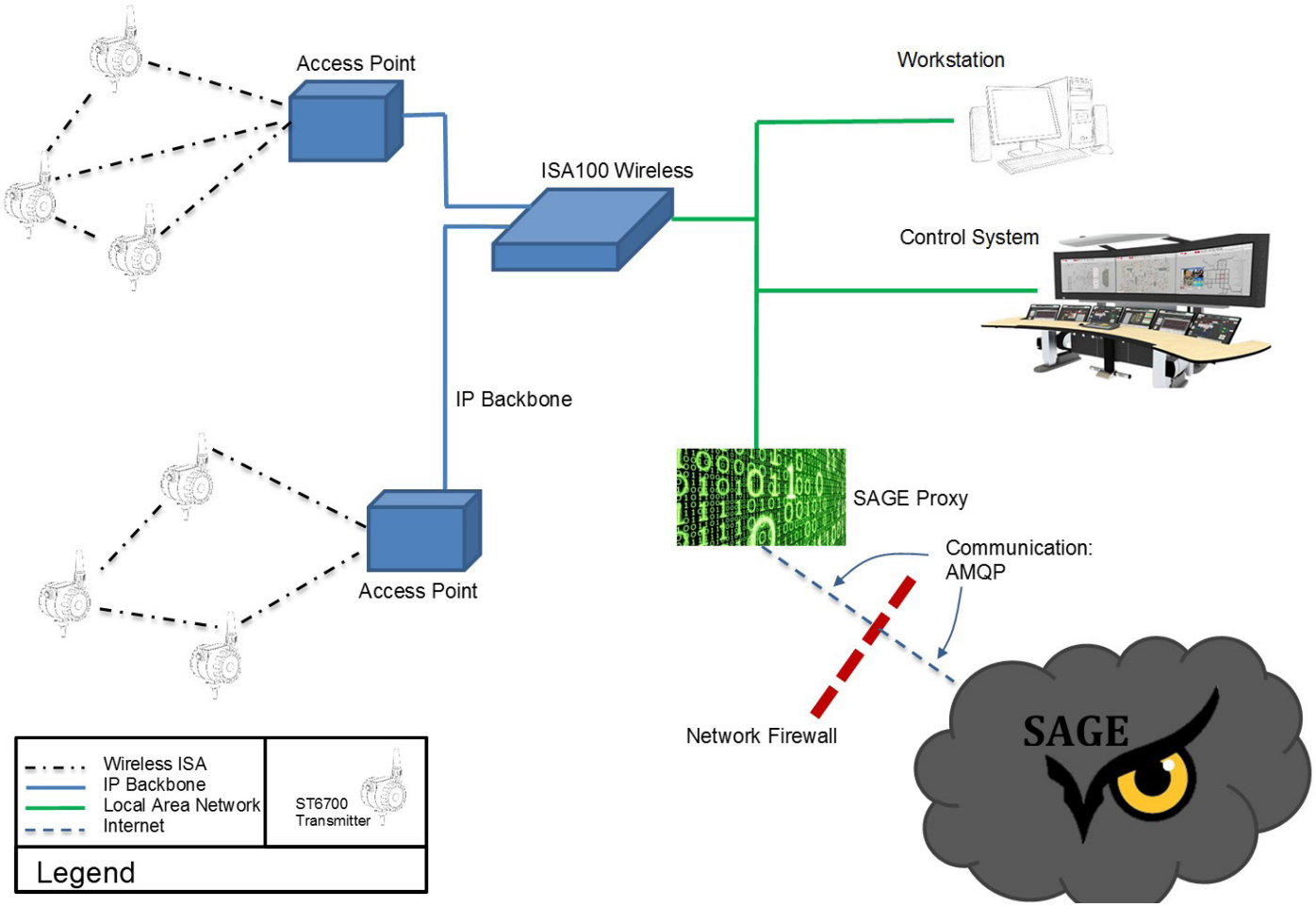
The AIM® system is compatible with the SAGE® system and the data it collects can be sent to SAGE® for real time reporting. Note: SAGE® is not required for your AIM® system to function properly. It is merely an option to take trap management to the next level. If you are interested in learning more about SAGE® go to https://www.armstronginternational.com/sage. Below are communication options for setting up SAGE® to communicate with the AIM® system.

Communication Map – SAGE® Proxy in the Cloud

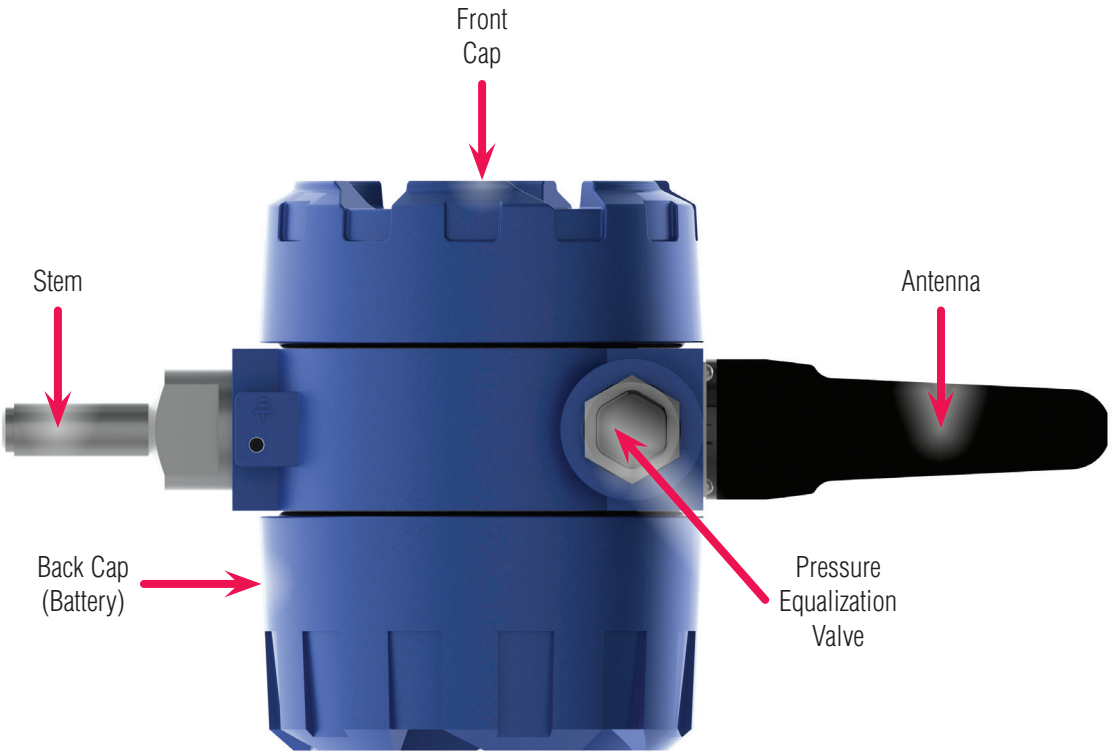


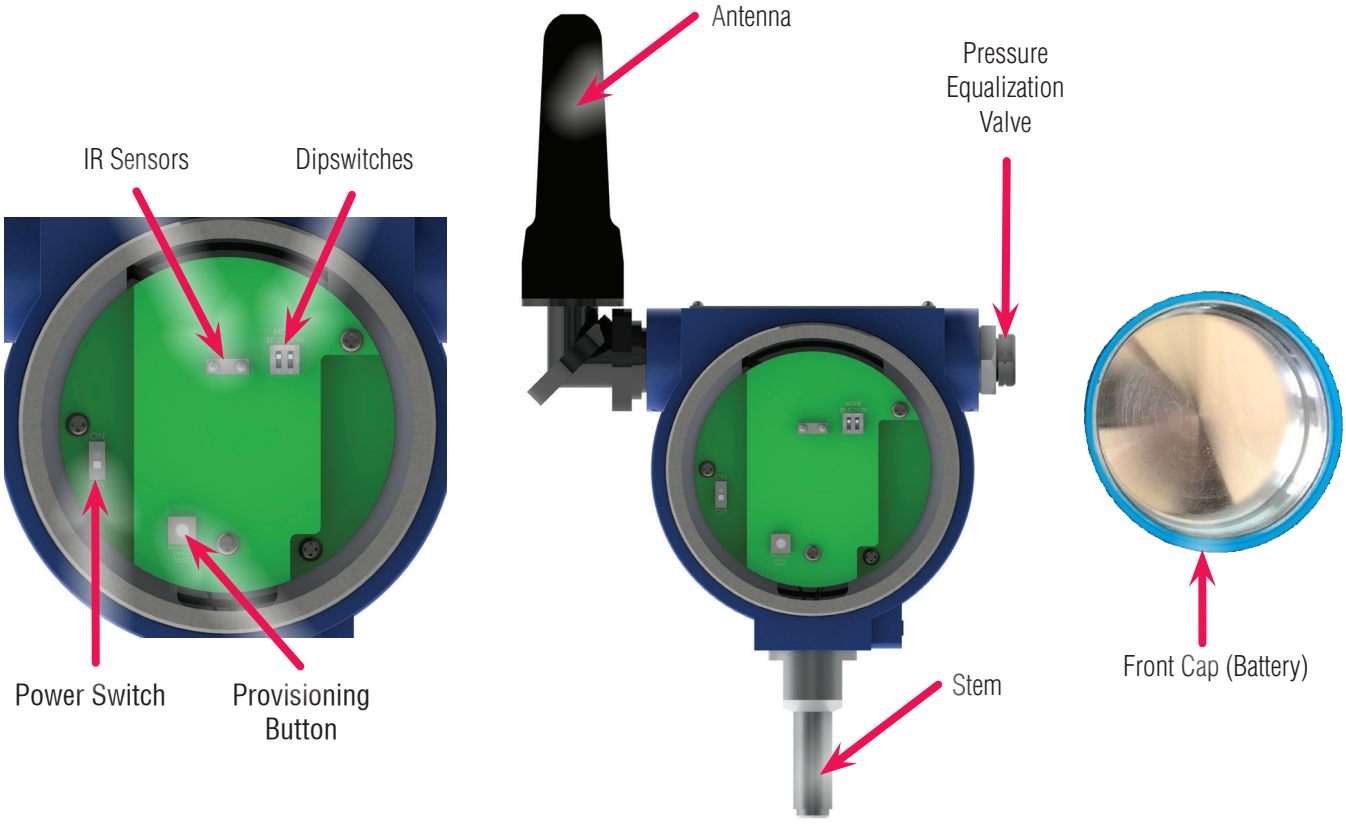
Communication Overview - continued

Communication Map – On Site SAGE® Proxy

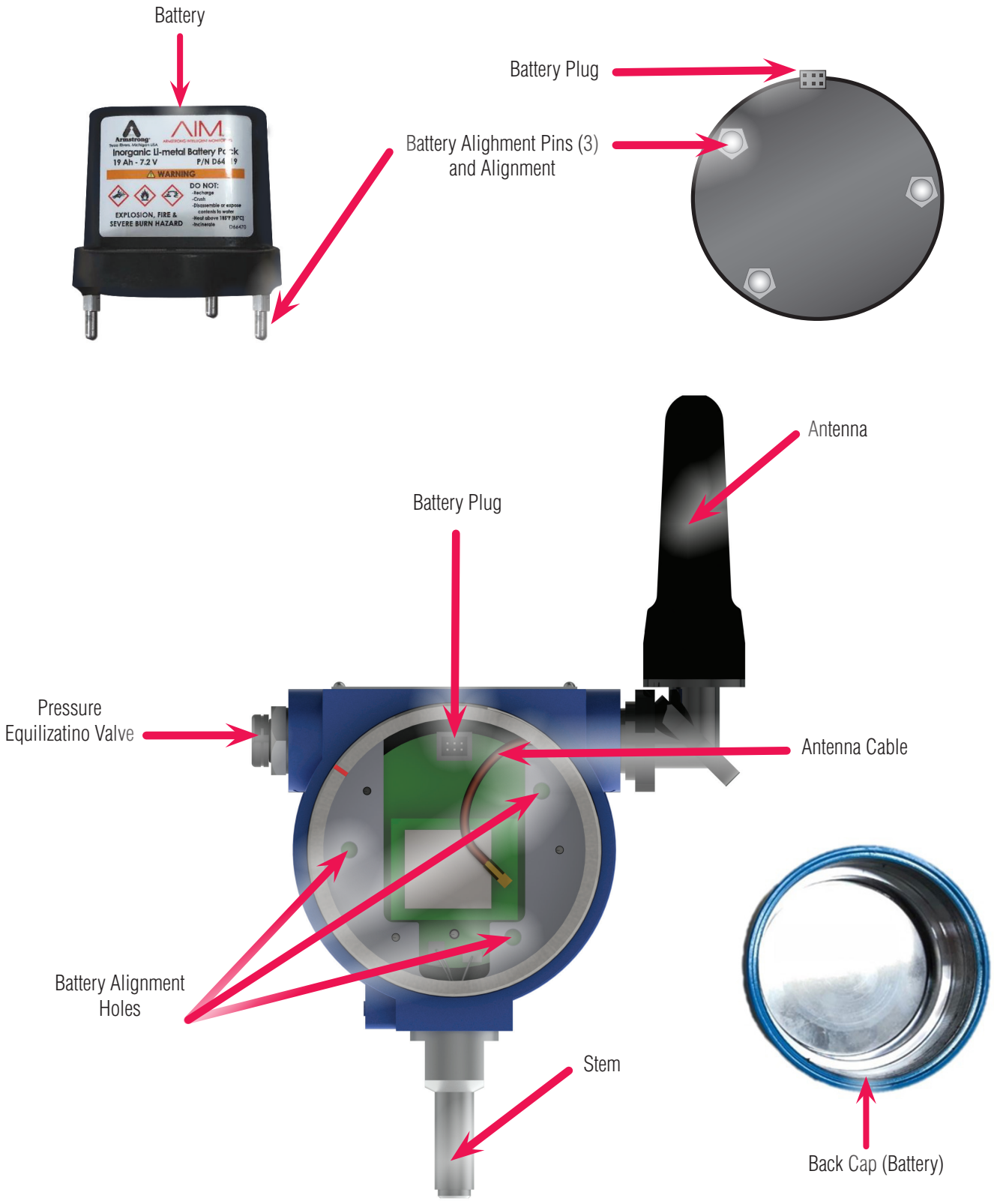


ST6700 Overview





ST6700 Overview – continued



Install Steam Trap Transmitter

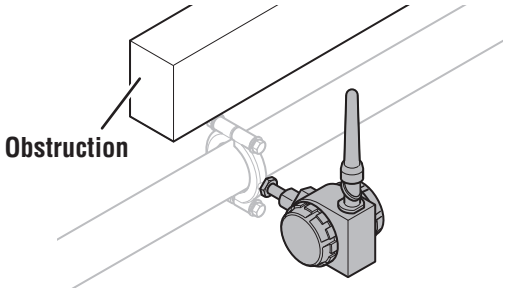
Preparation

Clearance

- Make sure Waveguide is oriented so that enough clearance is available to install transmitter.

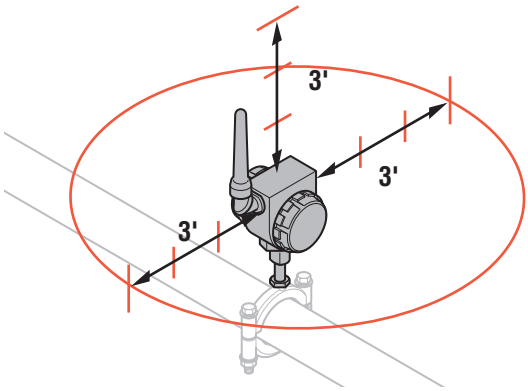
  Note: Install antenna in vertical position for optimal performance.

Important: To prevent damage, do not rotate antenna more than 180 degrees.



- **Recommendation:** Install transmitter at least 3 ft. (1 m) from any large structure for optimal performance.

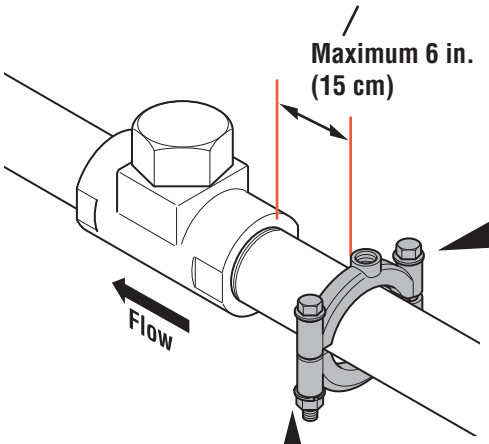
  Note: Install the transmitter so that hazards do not interfere with or damage the transmitter. Examples of physical hazards include, but are not limited to: blowing steam or condensate directly onto the transmitter, high temperature pipes, installation in pathways where the transmitter could be struck by personnel or vehicles, etc.

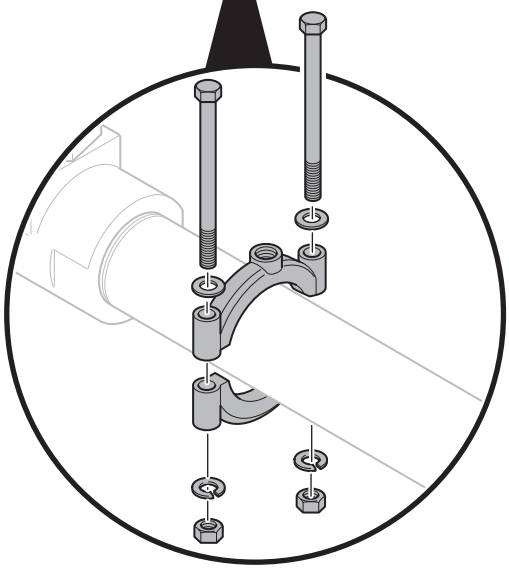


Install Steam Trap Transmitter – continued

BURN HAZARD! Pipe and fittings may be hot. To avoid contact burns, shut off the steam flow to the installation point and allow piping to cool before installing the transmitter wave guide. Otherwise, use appropriate PPE and extreme care to help avoid serious burns.

1 Position Waveguide no greater than 6 in (15 cm) from the steam trap inlet



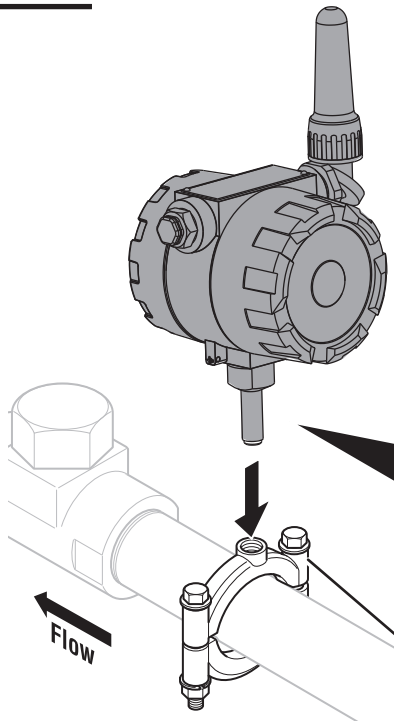


2 Install Waveguide:

- Assemble Waveguide around pipe.
- Torque Waveguide bolts:

  For 5/16 in - 18 size bolts, 11.5 ft-lb (15.6 N-m).

  For 3/8 in - 16 size bolts, 20.6 ft-lb (27.9 N-m).



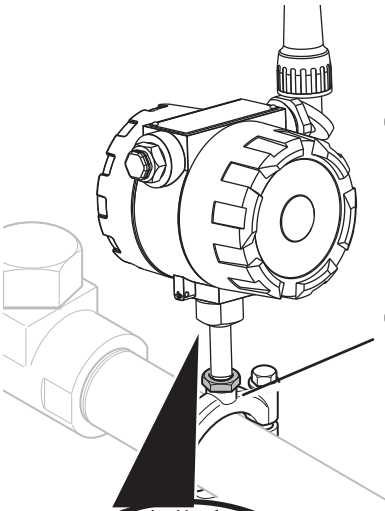
3 Refer to page 13-14 to determine the proper installation orientation.

Note: If heat sink required, make sure cup side of heat sink is up.

Note: Thread heat sink to the top.

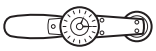
4 Carefully thread steam trap transmitter stem into Waveguide.

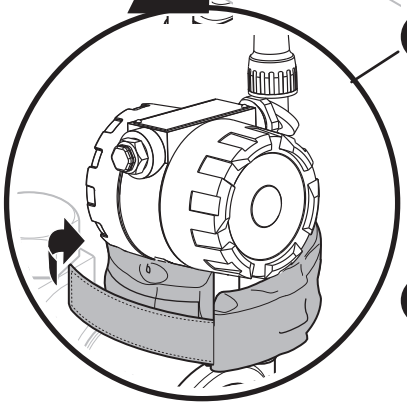
Note: Do not cross-thread stem.



5 Torque transmitter to 45 ft-lb (61 N-m).

6 Tighten jam nut to 45 ft-lb (61 N-m).

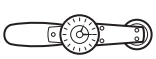




7 Install insulation jacket on transmitter(s) where accelerated heat loss may occur.

Consult Factory if needed.

8 Confirm caps are tightened to 25 ft-lb (34 N-m).

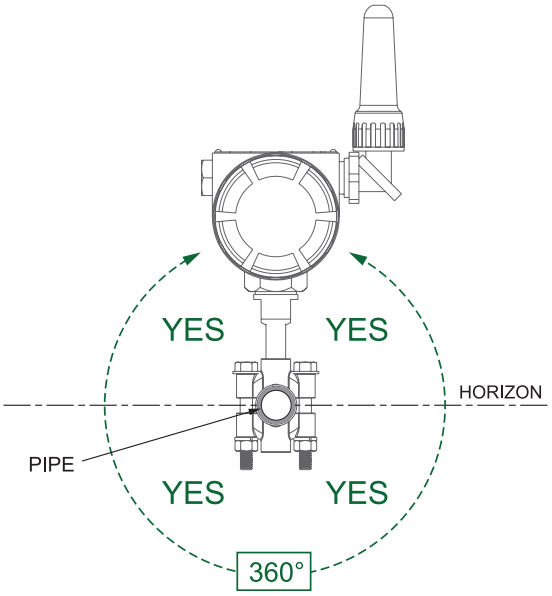


Proper Transmitter Positioning

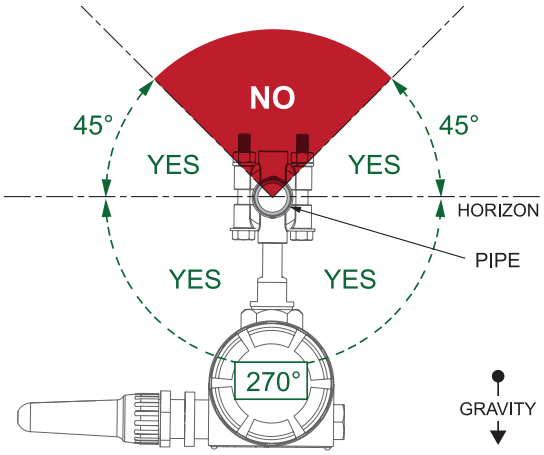
Pipe application temperature determines the correct transmitter mounting configuration. The transmitter may have angular mounting restrictions on horizontally running pipe.

There are no angular mounting restrictions on vertical piping.

Pipe Temperature	0-160 ºC / 32-320 ºF
Corresponding Saturated Steam Pressure	5.2 barg/75psig



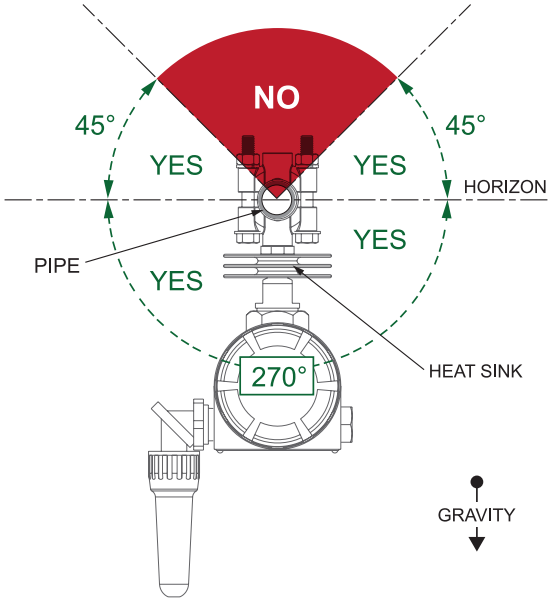
Pipe Temperature	160-195 ºC / 320-383 ºF
Corresponding Saturated Steam Pressure	5.2-13 barg / 75-188 psig



Proper Transmitter Positioning – continued

Pipe Temperature	195-255 °C / 383-491 °F
Corresponding Saturated Steam Pressure	13- 42.2 barg / 188-612 psig

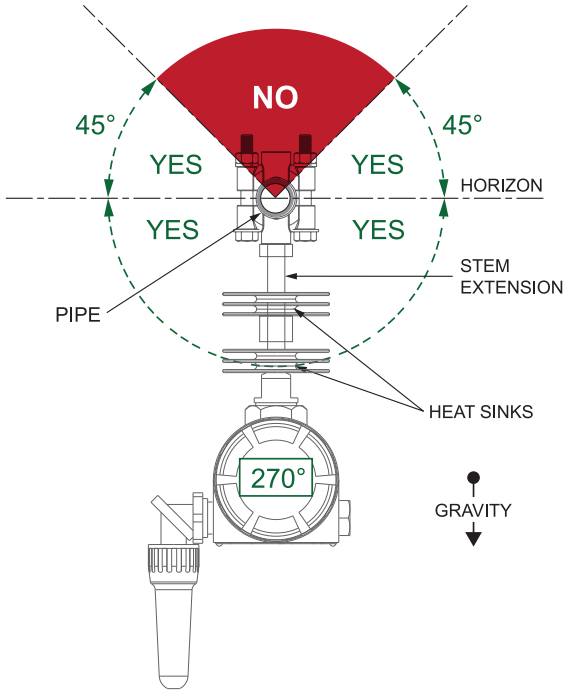
Note: A single heat sink is required.



Pipe Temperature	255-440 °C / 491-824 °F
Corresponding Saturated Steam Pressure	42.2-* barg / 612-* psig

*Steam is superheated at this temperature.

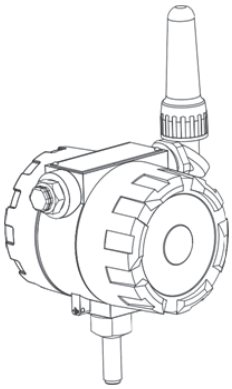
Note: Dual heat sinks and a stem extension are required.



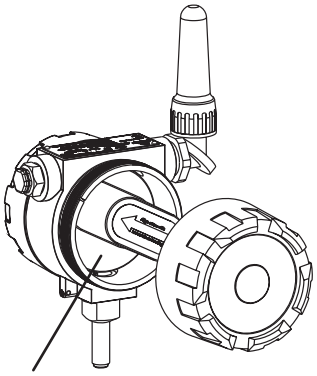
Battery Installation and Replacement

Warning: Sparking Hazard
If replacing a battery in the field, especially in areas where explosive or potentially explosive atmospheres may exist, wipe down the exterior of the monitor enclosure and antenna with a damp cloth to remove dust and debris to help prevent static electricity discharge.

Recommendation: When initially installing or replacing batteries, first install or replace the battery in the monitor that is locate closest to the access point (or gateway, as the case may be). Then install or replace the battery in the next closest monitor to the access point. Continue this process of working outward from the access point. This battery replacement technique will help the monitors in the system to learn the existence of network neighbors more quickly.

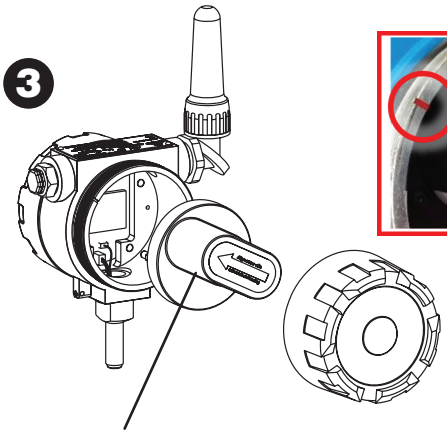


Rules and Regulations:
This transmitter is designed for live maintenance in hazardous environments. All maintenance should be performed by experienced personnel in accordance with local, national, and international standards and codes.



1. Remove tall housing cap.

2. Inspect O-ring:
   - Replace if worn or damaged.
   - Lubricate if necessary.

3. 

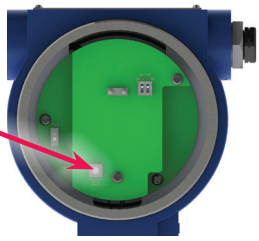
Orient red arrow on battery label to point towards red slot in enclosure. Insert battery pack into housing until it makes a firm connection with the housing.

Note: Use only Armstrong Model D64519 lithium metal battery pack. Use caution when installing battery not to damage or bend any components.

4. 

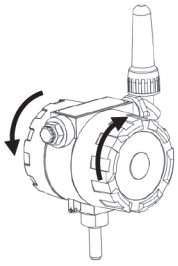
If the monitor is new or has been out of service for awhile, confirm that the sliding DIP switch, located on the main printed circuit board (PCB), is set in the “ON” position. (Note: The main PCB can only be viewed from the opposite side of the monitor w/ the short housing cap removed.)

5. Reset the Battery Life (when Installing a Replacement Battery ONLY)
   - Remove short cover
   - Press and hold the provisioning button for 10 - 15 seconds to reset the battery life
   - When resetting battery in the gateway, see gateway specific battery reset instructions in the Gateway Appendix

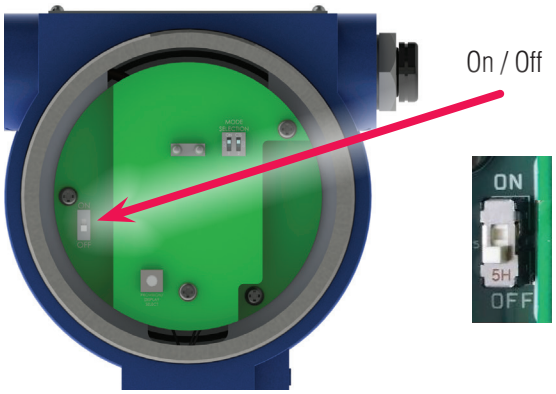


6. Reinstall all housing caps – torque 25 ft-lb (34 N-m).

Note: Properly tighten caps to avoid water leakage into housing. Water leakage will cause electronic failure. Improper tightening of the caps will void the warranty.

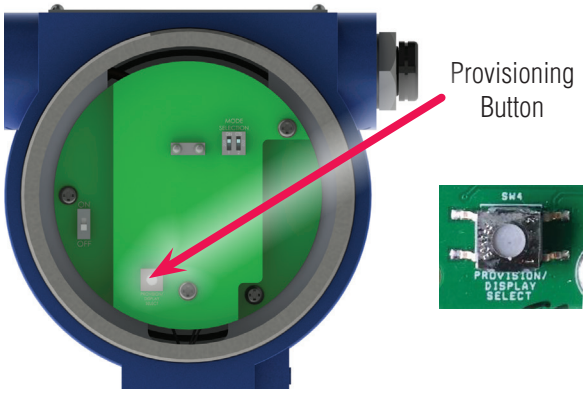


Maintenance and Service



ON/OFF Switch Functions

The power switch is a small white toggle on the left side of the internal board. It controls the unit's power and must be toggled to "on" or up for the unit to operate and function. Shown in "off" position below.



Provisioning Button

The provisioning button is located on the bottom of the board inside the ST6700. It has multiple functions based on how many times it is pressed or held. The button is highlighted to the right.

• Resetting Battery Life

One function of the provisioning button is resetting battery life after changing the battery. Press and hold the provisioning button for 10-15 seconds and battery life will be reset in the unit.

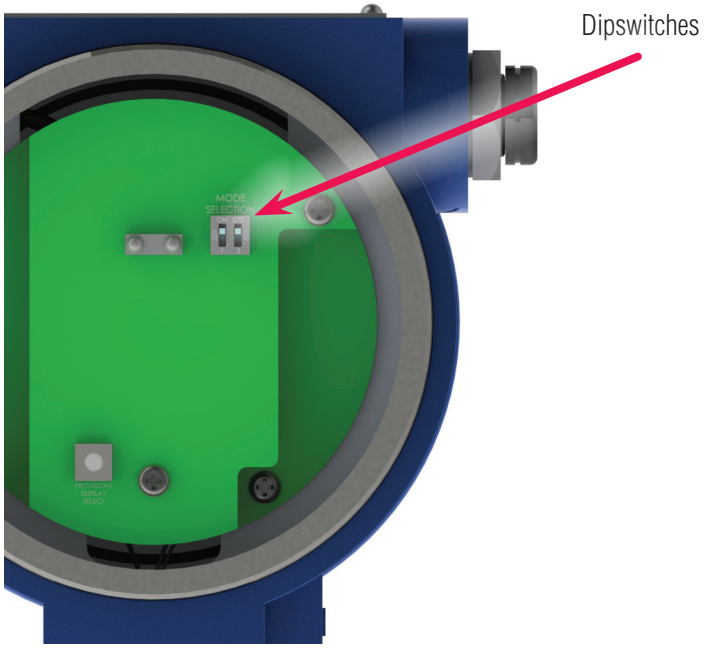
• Resetting Provisioning

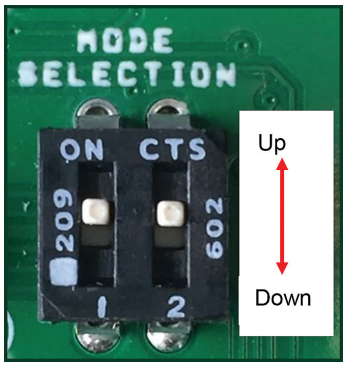
To clear all provisioning, press and hold the provisioning button for 30-35 seconds.

• Initiate Publishing

To allow broadcasting on all channels during setup press and release the provisioning button 5 times. It is important not to press and release it too fast or too slow. The procedure should be completed in a timeframe of approximately 2-4 seconds.

Dip Switch Mode Selection





	Switch		Device Operation Mode	
	1	2	Code 1.0C and Older	1.13 or Newer
Switch Position	Up	Up	Normal Operation	Normal Operation / Units - Imperial
	Up	Down	Burst	Burst / Units - Imperial
	Down	Up	Burst	Normal Operation / Units - Metric
	Down	Down	Test (Factory use only)	Test (Factory use only)

The ST6700 performs a series of diagnostic checks to determine the condition of the steam trap. The position of the dip switches pictured above determine how often the standard diagnostics are performed.

1. **Normal Operation Mode** – Use this mode in the field to maximize battery life while maintaining accuracy. Normal Operation mode is programmed to sample the trap condition every 60 minutes.

   Burst Mode – Samples the trap condition at the same rate as the Update Rate (See device details for Update Rate values). Notice: Using the device in this mode will cause decreased battery life and in some situations decreased steam trap testing accuracy.

   Test Mode – Samples the trap condition every 2 seconds. Notice: Test Mode is used only in the factory for functionality testing and should never be used in the field. Test mode will cause significantly reduced battery life and decreased trap testing accuracy.

Product Specifications

ST6700 Specifications

Weight	1.9 Kg (4.1 lbs)
Ingress Protection Rating	IP66
Output Signal	ISA 100.00a 2.4 GHz
Operating Temperature	-40 °C to 70 °C (-40 °F to 158 °F)
Materials of Construction	Housing - Aluminum (<0.4% copper) Paint - Powder Coat O-ring - EPDM Stem - 304 Stainless Steel Antenna - Nylon 6,6 Nameplate - 316 Stainless Steel
Battery	Type - Encapsulated, Lithium Metal Cells Battery Life - 3 Years* Part Number - D64519 Capacity - 19 Ah Voltage - 7.2 V
Update Rate	Honeywell - Configurable (Default 60 seconds) Yokogawa - Fixed (60 seconds) Nivis/Nexcom - Configurable (Default 300 seconds)
Radio Power	15 (adjustable 1-15)
Default Role	Honeywell - Non-routing Yokogawa - Non-routing Nivis/Nexcom - Routing

* Assumptions of typical operating conditions (see variables impacting battery life)
  - Non-routing device with good signal status with access point
  - 5-minute Update Rate
  - 21 ºC (70 °F) Ambient Temperature
  - 10 years is shelf life of lithium cell
  - +/- 10% capacity for temperature and network variation

Variables impacting battery life include:
  - Initialization connects and re-connects to the system (i.e., system shutdowns, power outages, maintenance disconnect, etc.)
  - Communications transmission retries due to poor RF connectivity
  - Device radio power level
  - Data transmission update rate frequency
  - System requested polling of dynamic parameters (i.e., radio diagnostics, counters, etc.)
  - System activity rate related to operator configuration changes or manual device parameter data requests
  - Routing of information from other downstream field devices
  - Environmental effects such as operating temperature and humidity

    NOTE: Extreme temperatures are detrimental to battery life and can cause as much as a 30% reduction in life for units at -30 ºC (-22 ° F) or at 70 ºC (158 ºF) ambient temperatures, compared to those at a nominal 25 ºC (77 ºF). Installers should protect transmitters from very hot or very cold processes and consider shading them from direct sunlight.
  - Battery construction quality, born-on date/shelf time, and storage temperature

Product Specifications - continued

Battery Specifications

Part Number: D64519

Performance Specifications	Operating Temperature -40 °C to 70 °C (-40 °F to 158 °F) Humidity Limits - 0-100% non-condensing Output voltage - 7.2 VDC Capacity - 19 Ah
Physical Specifications	Weight - 0.32 kg (0.71 lb) Type - dry cell, lithium-thionyl chloride (LI-SOCL2) with integrated power control circuitry Material - Electrical-grade epoxy resin polymer compound
Storage Information	Storage Life - 10 years (1) Storage Temperature Limits - 5 °C to 30 °C (41 °F to 86 °F)
Approved Devices	AIM® ST6700
Design Certifications for Ordinary (non-hazardous) and Hazardous Locations:	The Armstrong battery pack P/N D64519 is designed and approved only for use within the AIM-ISA Model ST6700 steam trap monitor. The ST6700 steam trap monitor carries limited design certifications for specific hazardous locations under UL (US and Canada), ATEX, and IECEx (refer to the instruction manual 261-EN for a complete listing of the standards and conditions to which the monitor design conforms.) By extension, the ST6700 steam trap monitor is also suitable for use in most ordinary locations wherein the environment is satisfactory, i.e. the operating temperature falls within the limits listed above and moisture exposure does not exceed the monitor enclosure rating of IP66.

Notes: Estimate based on date of manufacturing and storage following recommended conditions

Product Certifications

Underwriters Laboratories (UL) Approval	
United States	Intrinsic Safe for Class I/II/III, Division 1, Groups A, B, C, D, E, F, and G Zone 0, for Class I, Group IIC Temperature Code: T4 [275ºF (135ºC)] Ambient Temperature Range: T_{amb} -40ºC to 70ºC (-40ºF to 158ºF) For use with Armstrong model D64519 lithium ion battery only Standards used for Certification: UL 913, Ed. 8; UL 60079-0, Ed. 6; UL 60079-11, Ed. 6
Canada	Intrinsic Safe for Class I/II/III, Division 1, Groups A, B, C, D, E, F, and G Zone 0, for Class I, Group IIC Temperature Code: T4 [275ºF (135ºC)] Ambient Temperature Range: T_{amb}-40ºC to 70ºC (-40ºF to 158ºF) For use with Armstrong model D64519 lithium ion battery only Standards used for Certification: CAN/CSA C22.2 No. 157-92, Ed. 3; CAN/CSA C22.2 No. 60079-0:11, Issue date: 2011/12/01; CAN/CSA C22.2 No. 60079-11:14, Ed. 2
European Certification	ATEX Intrinsic Safety Zone 0, Group IIC Temperature Code: T4 [275ºF (135ºC)] Ambient Temperature Range: T_{amb} -40ºC to 70ºC (-40ºF to 158ºF) For use with Armstrong model D64519 lithium ion battery only Standards used for Certification: CENELEC EN60079-0, Issue date: 2013/01/01; CENELEC EN60079-11, Issue date: 2012/01/01; CENELEC EN60079-26, Issue date: 2007/03/01
IECEx Certification	Equipment Protection Level: Ga Zone 0, Group IIC Temperature Code: T4 [275ºF (135ºC)] Ambient Temperature Range: T_{amb} -40ºC to 70ºC (-40ºF to 158ºF) For use with Armstrong model D64519 lithium ion battery only Standards used for Certification: IEC 60079-0, Ed. 6; IEC 60079-11, Ed. 6; IEC 60079-26, Ed. 2

EMC Compliance

FCC Part 15 Subpart B, Class A; EN55011 Group 1, Class A; EN61000-6.2 Immunity.

CE Mark	
EU Directives	**Test Standards**
ATEX 2014/34/EU	CENELEC EN60079-0 (2013/01/01) CENELEC EN60079-11 (2012/01/01) CENELEC EN60079-26 (2007/03/01)
EMC 2004/108/EC	IEC 61326-1 2012
LVD 2006/95/EC	IEC 60950-1 2015 (2nd Ed.) + AM 1: 2009 + AM 2: 2013
R & TTE 1999/5/EC	(ETSI) EN 300 328 V1.9.1 (2015-02) (ETSI) EN 301 489-1 V1.9.2 (2011-09) (ETSI) EN 301 489-17 V2.2.1 (2012-09)

Product Certifications - Continued

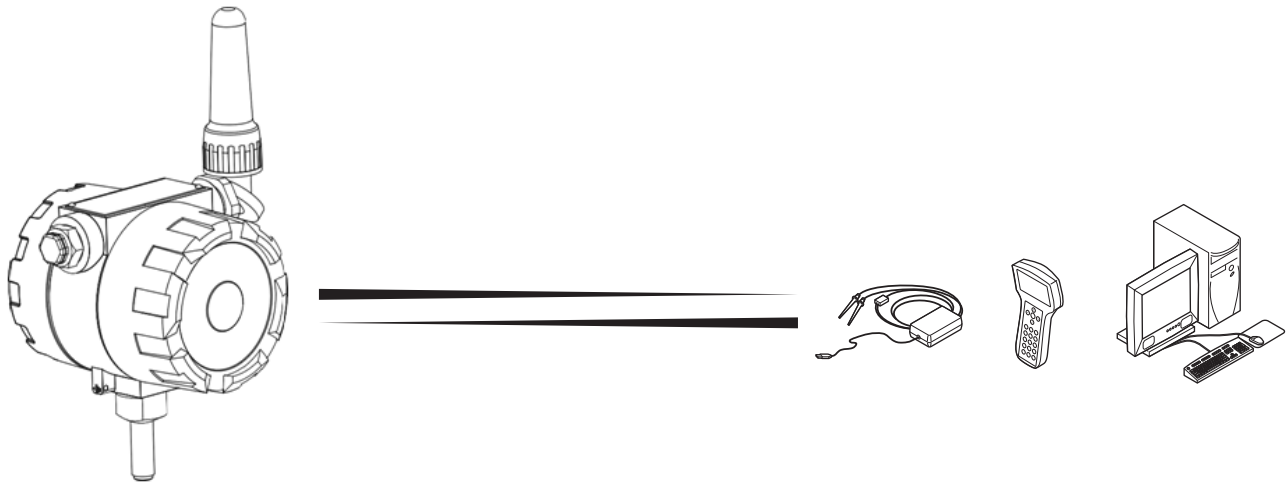
North American

Hazardous Location / Explosive Atmosphere

Ratings Class I, II, III; Division 1; Group A,B,C,D,E,F,G

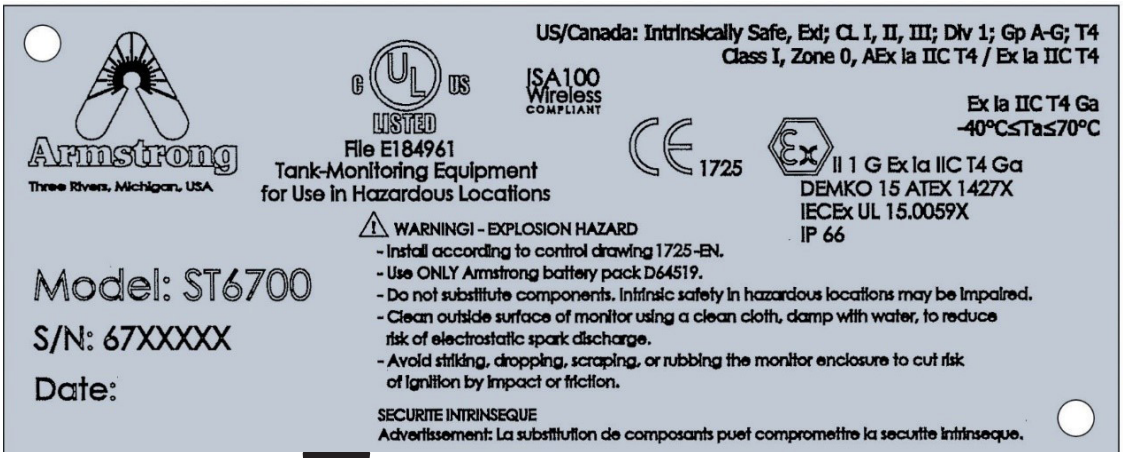
Zone 0; Group IIC, IIB, IIA

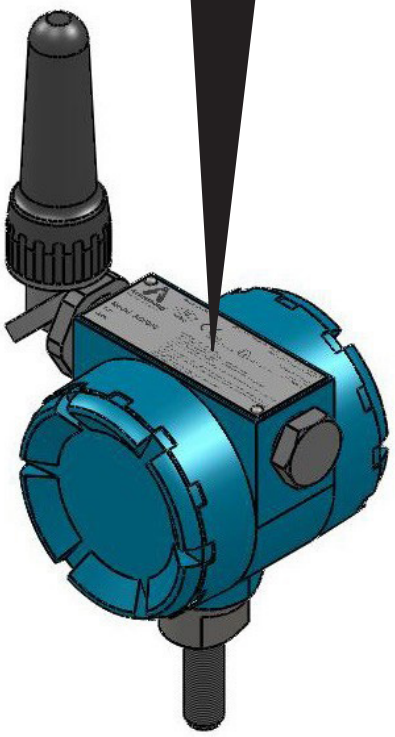
T4 at T ambient = -40ºC to 70ºC (-40ºF to 158ºF)

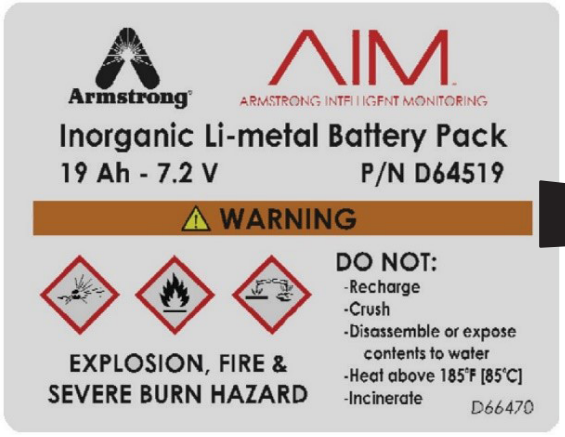


Notes: Install per the National Electrical Code, ANSI/ISA-RP12.06.01, the Canadian Electrical Code, and applicable European or other international installation codes, including BS EN / IEC 60079-14, as applicable.

Product Labels







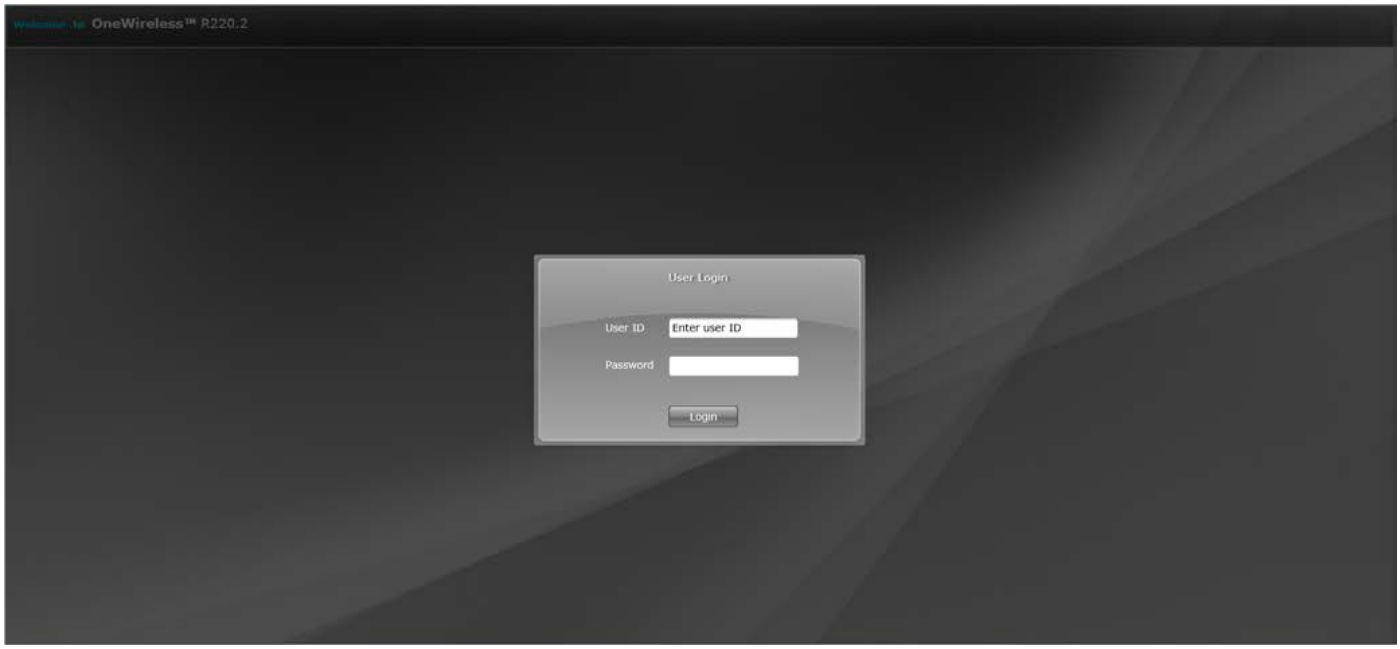
Connecting the Armstrong ST6700 to the Honeywell WDM - Table of Contents

This document does not contain information about how to configure the WDM. See WDM literature for configuration procedure.

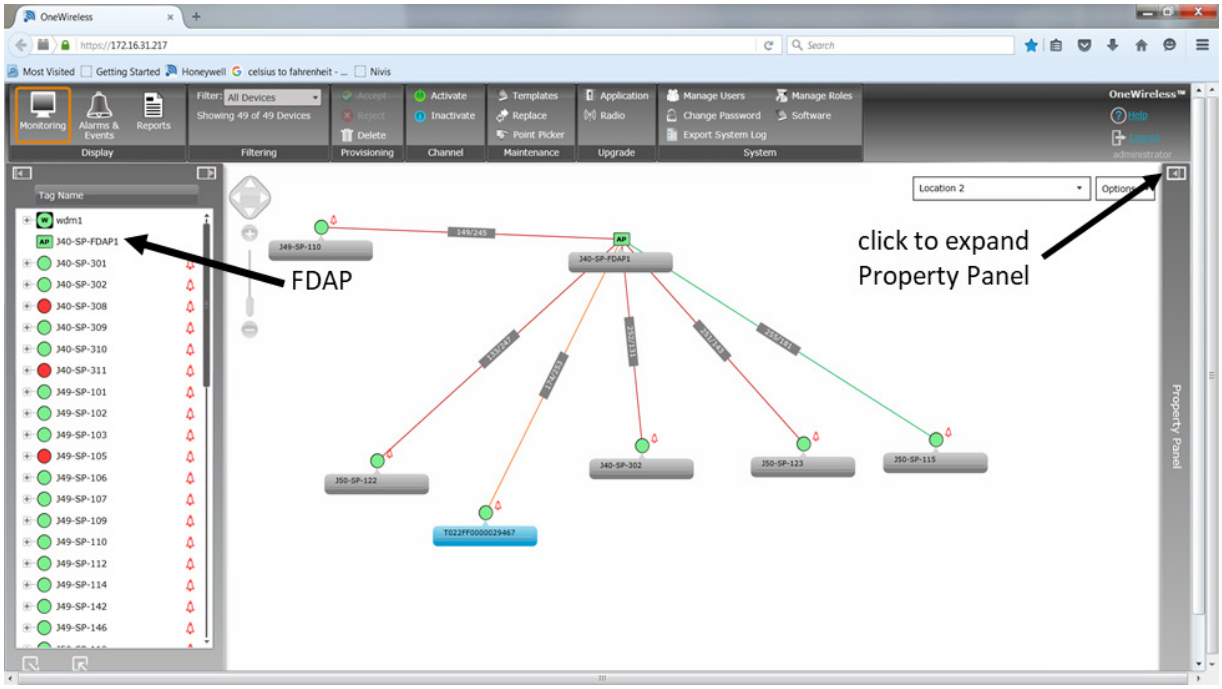
1.0 Over The Air (OTA) Armstrong ST6700 Provisioning and Joining

OneWireless (includes the Configurator tool) is the software used to configure the WDM and FDAP. To configure the network please use the following steps:

1. Start Internet Explorer, navigate and login to OneWireless via assigned IP address.

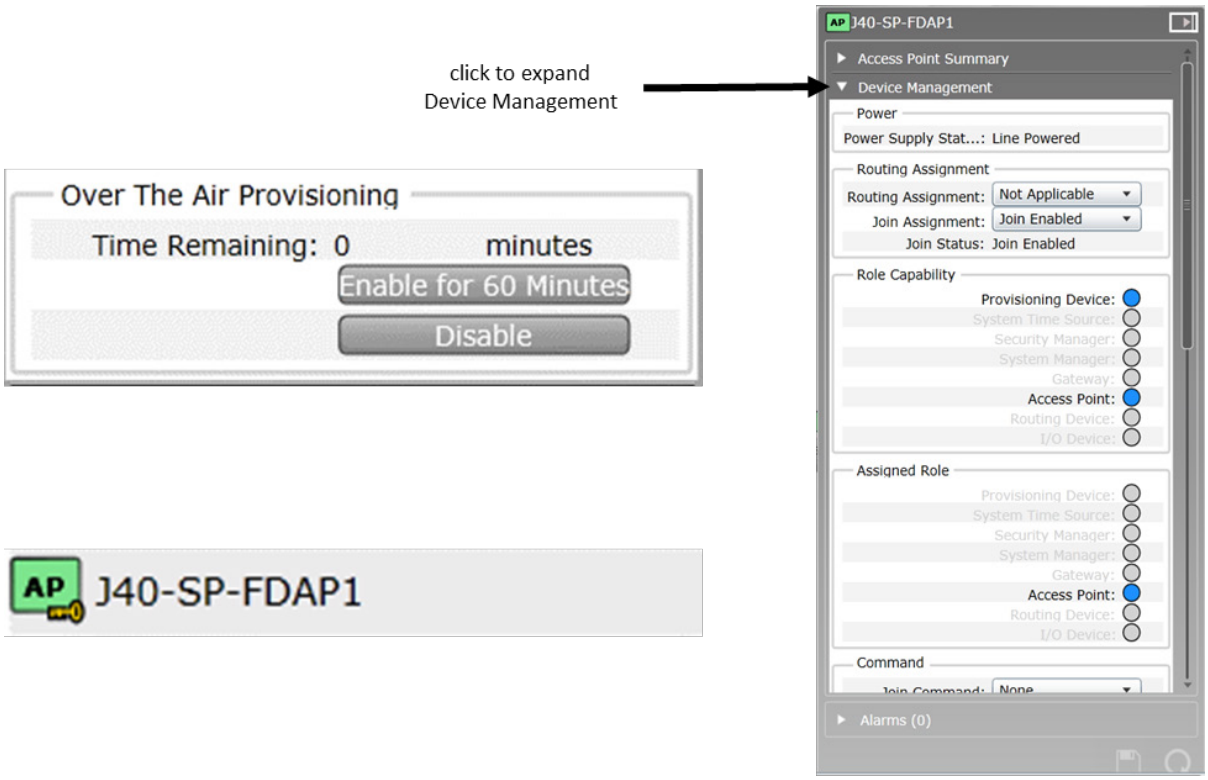


2. In the device list, click to select FDAP. Next, expand the Property Panel on the right.

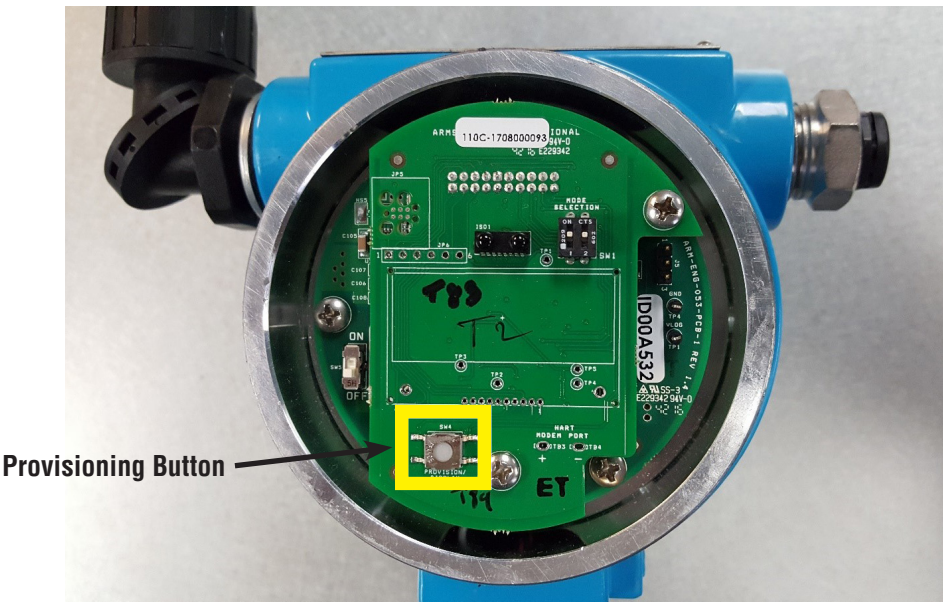


1.0 Over The Air (OTA) Armstrong ST6700 Provisioning and Joining - continued

3. In the FDAP Property Panel, click to select/expand Device Management. Next, scroll down to locate Over The Air Provisioning and click Enable for 60 Minutes . Ensure FDAP in the device list now has key icon.

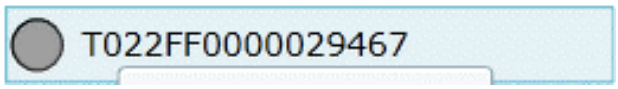


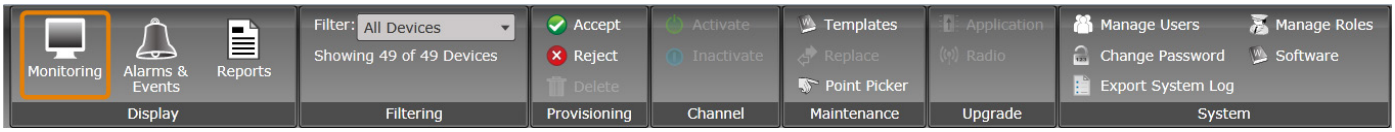
4. If ST6700 isn't already powered on, power it on. The power switch is a small white toggle on the left side of the internal board. It controls the unit's power and must be toggled to "on" or up for the unit to operate and function. Shown in "off" position below. Next, clear any previous provisioning by pressing & holding the provisioning button for 35 seconds.



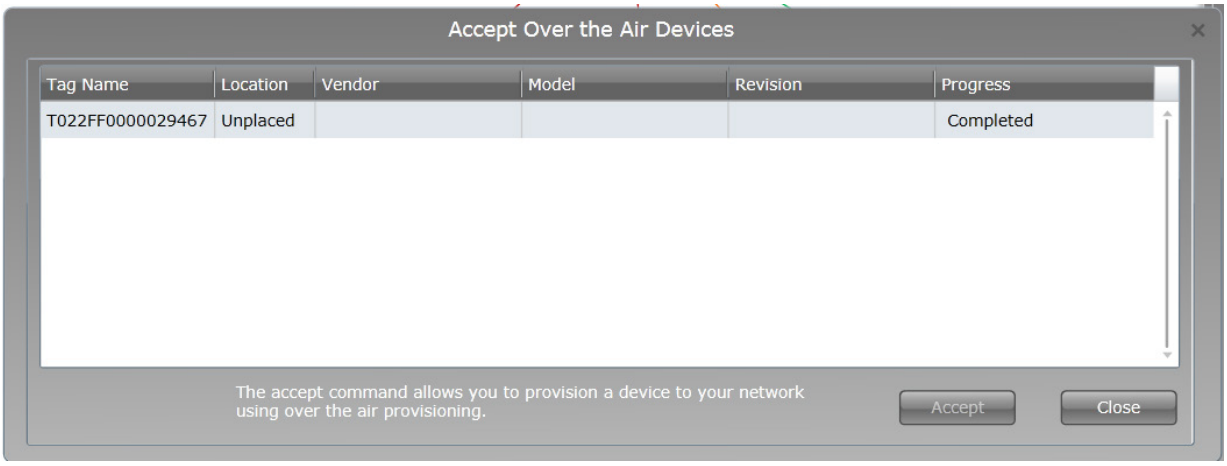
1.0 Over The Air (OTA) Armstrong ST6700 Provisioning and Joining - continued

5. Shortly, the ST6700 should appear on the device list with a ◯ icon. Click to select the ST6700 and on the top menu bar on the Provisioning tab click Accept

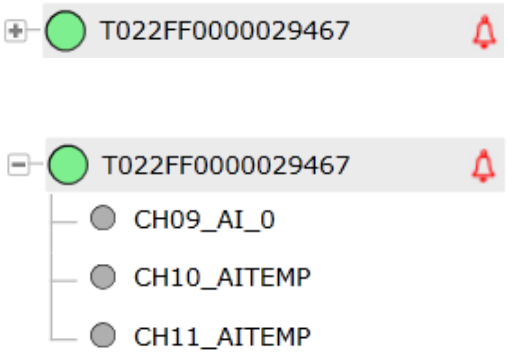




6. Next the "Accept Over the Air Devices" window appears, click Accept and the ST6700 provisioning will process. If successful, a Progress status of Completed will appear. Click Close when completed.



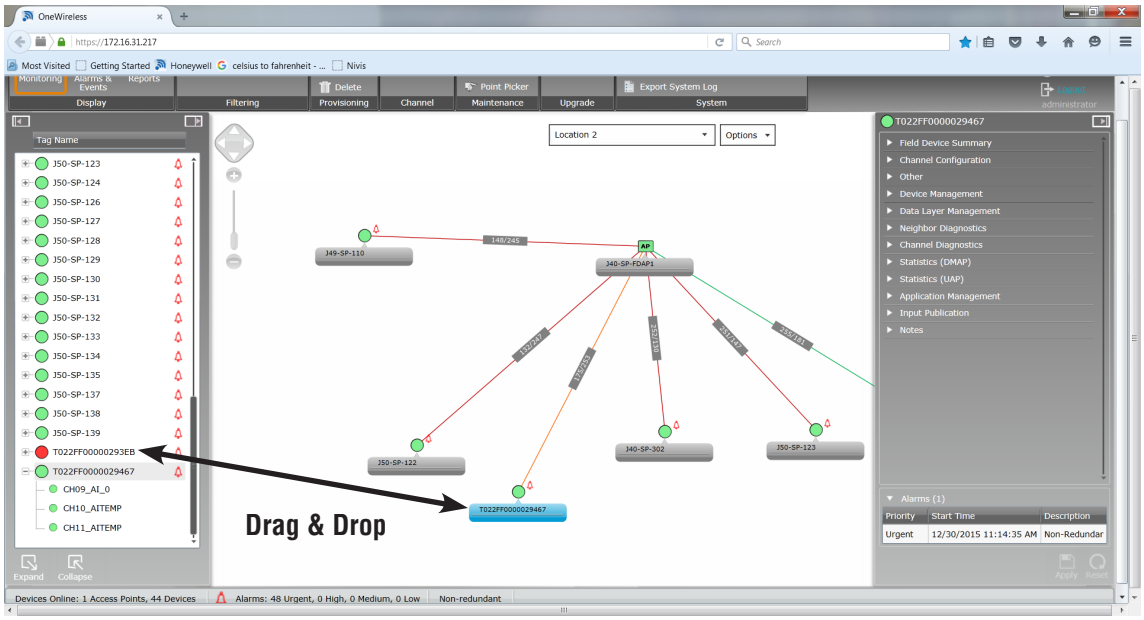
7. The ST6700 should now appear on the device list with a ◯ icon. Shortly, a ⊞ will appear next to the ST6700. Click the icon ⊞ to expand the ST6700's Channels list. Next, quickly press and release the Provisioning button 5 times consecutively, within 2-4 seconds. This will initiate publishing of data on all channels.

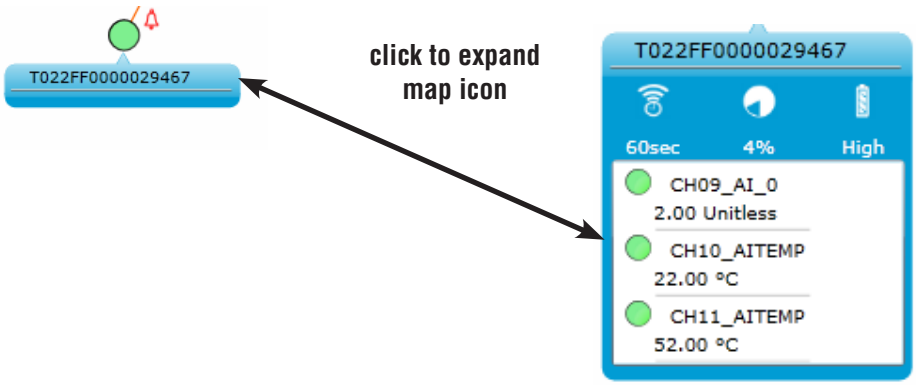


1.0 Over The Air (OTA) Armstrong ST6700 Provisioning and Joining - continued

8. The ST6700's channels will cycle from a ⚪ icon to a 🟢 icon. Once all 3 channels have a 🟢 icon, drag & drop the ST6700 onto the map. Clicking on the ST6700's map icon will expand its window showing:

   - CH09 = Trap Status
   - CH10 = Temperature
   - CH11 = Temperature Set Point

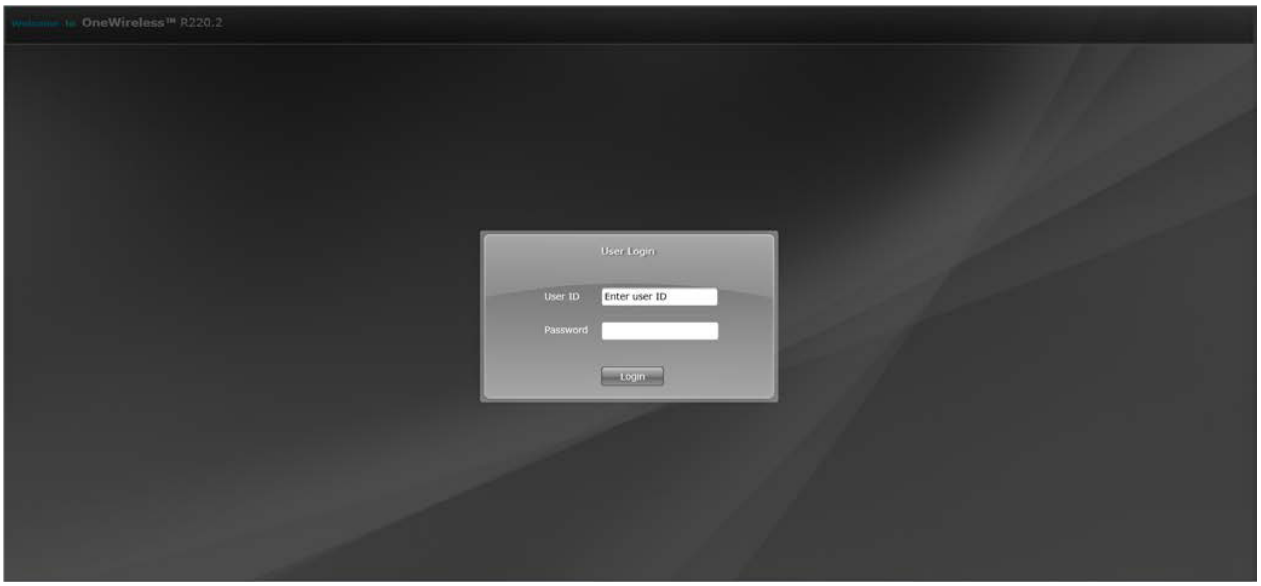




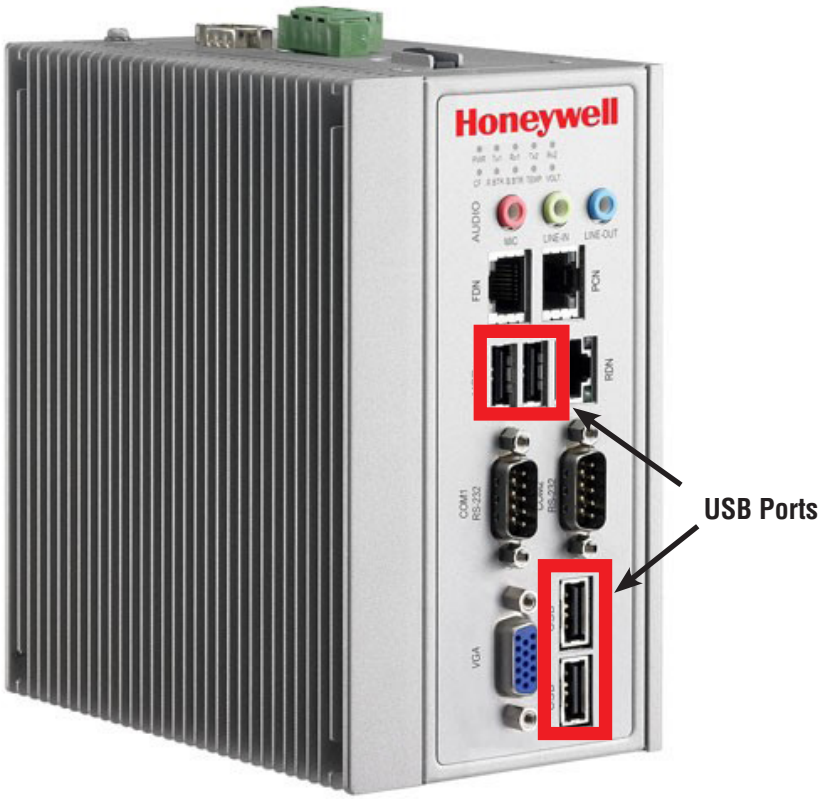
9. The ST6700 Monitor has been added the list of Field Devices.

2.0 Infrared (IR) Armstrong ST6700 Provisioning and Joining

1. Start Internet Explorer, navigate and login to OneWireless via assigned IP address.

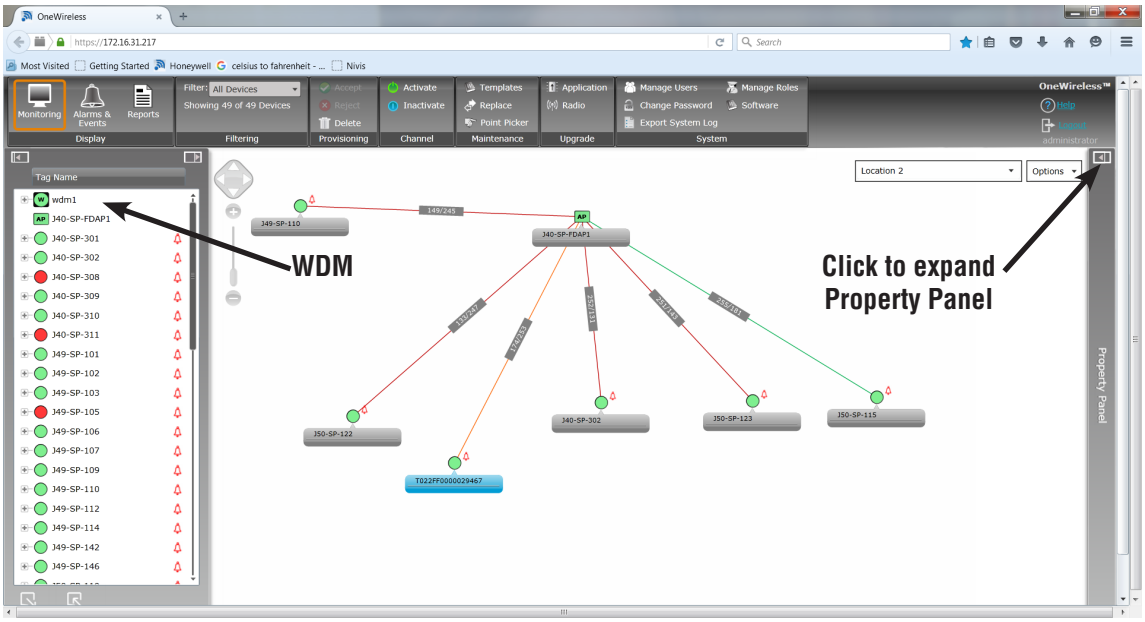


2. Connect the Provisioning Device handheld's power supply, and its docking station to the USB port on the WDM.

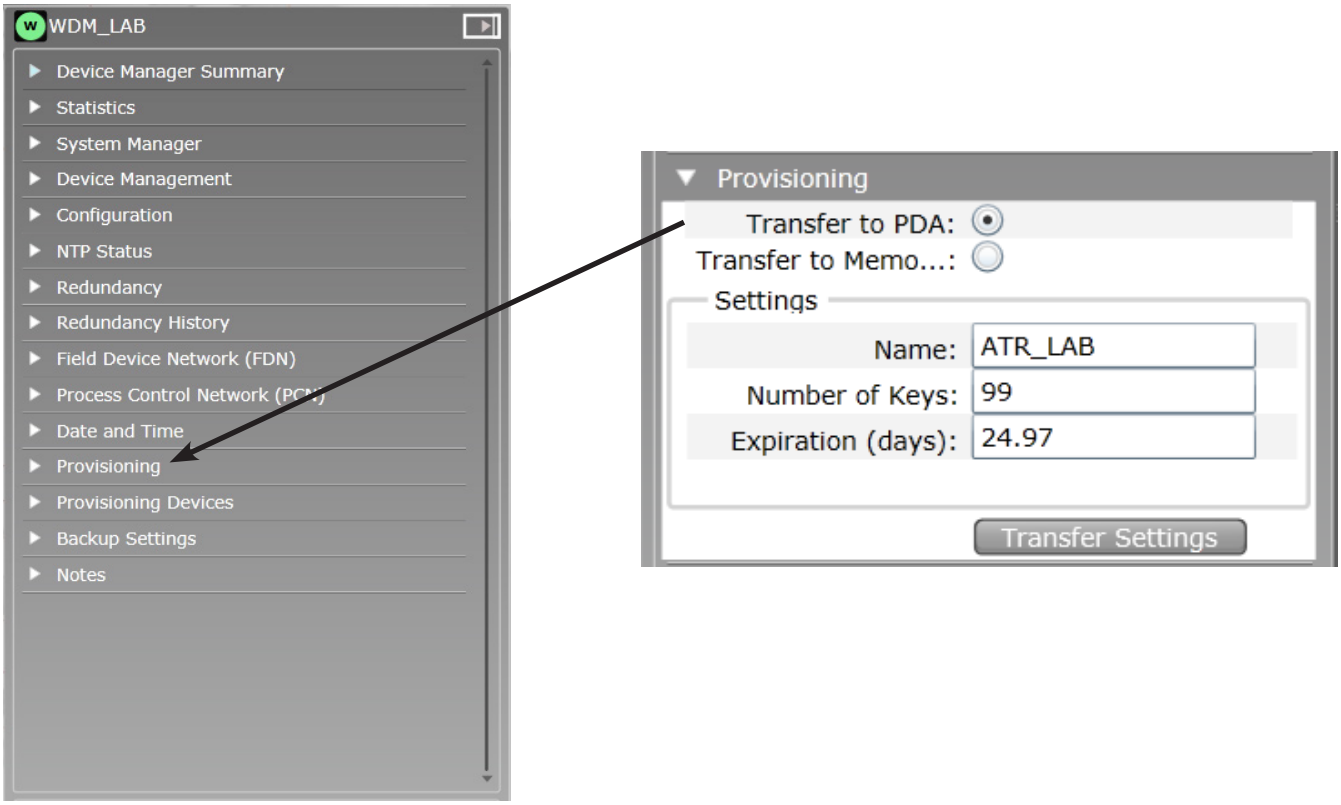


2.0 Infrared (IR) Armstrong ST6700 Provisioning and Joining - continued

3. In the device list, click to select WDM. Next, expand the Property Panel on the right.

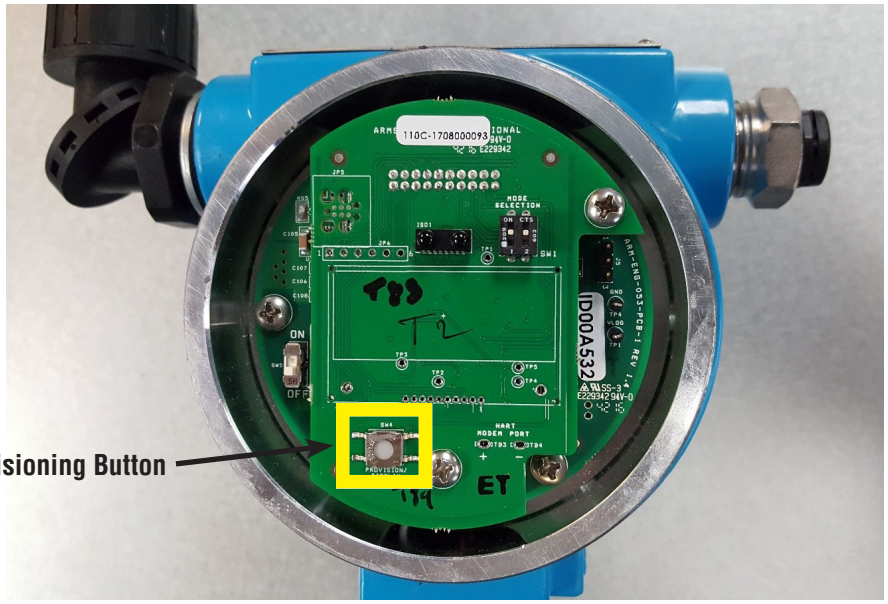


4. On the Property Panel, expand Provisioning. Check Transfer to PDA, and complete the following information under Settings. Name=handheld name, Number of Keys=100 max, Expiration (days)=31 max. When completed, Click Transfer Settings to transfer the security keys to the Provisioning Device handheld, then remove it from the docking station.

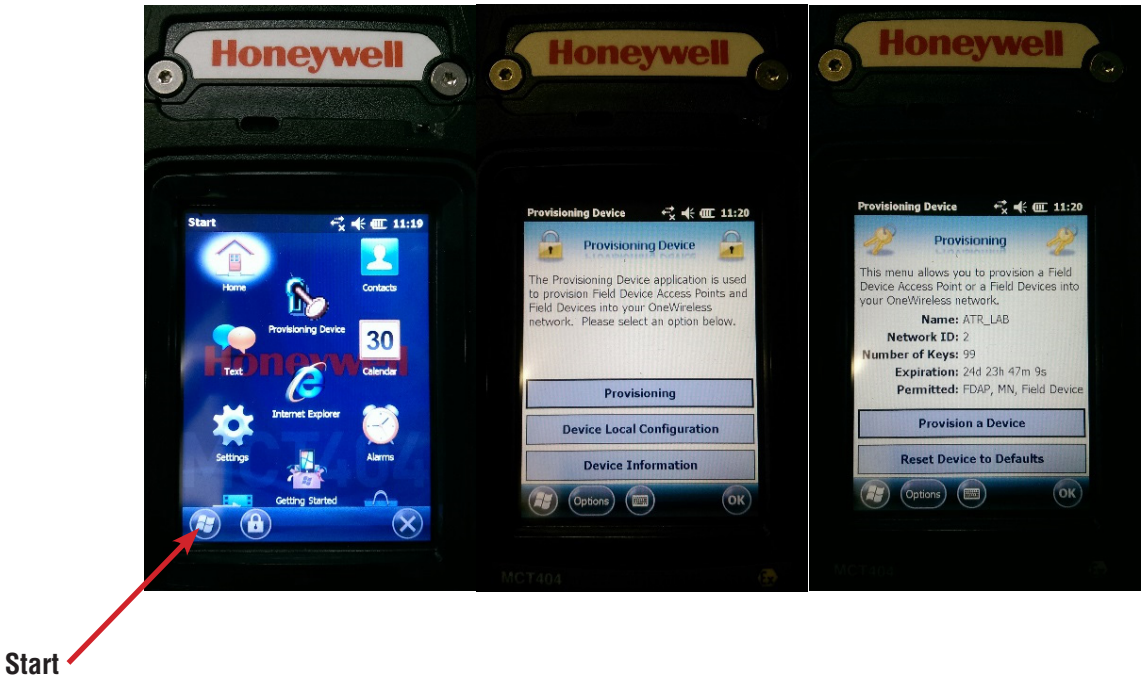


2.0 Infrared (IR) Armstrong ST6700 Provisioning and Joining - continued

5. If ST6700 isn't already powered on, power it on. Next, clear any previous provisioning by pressing & holding the provisioning button for 35 seconds.

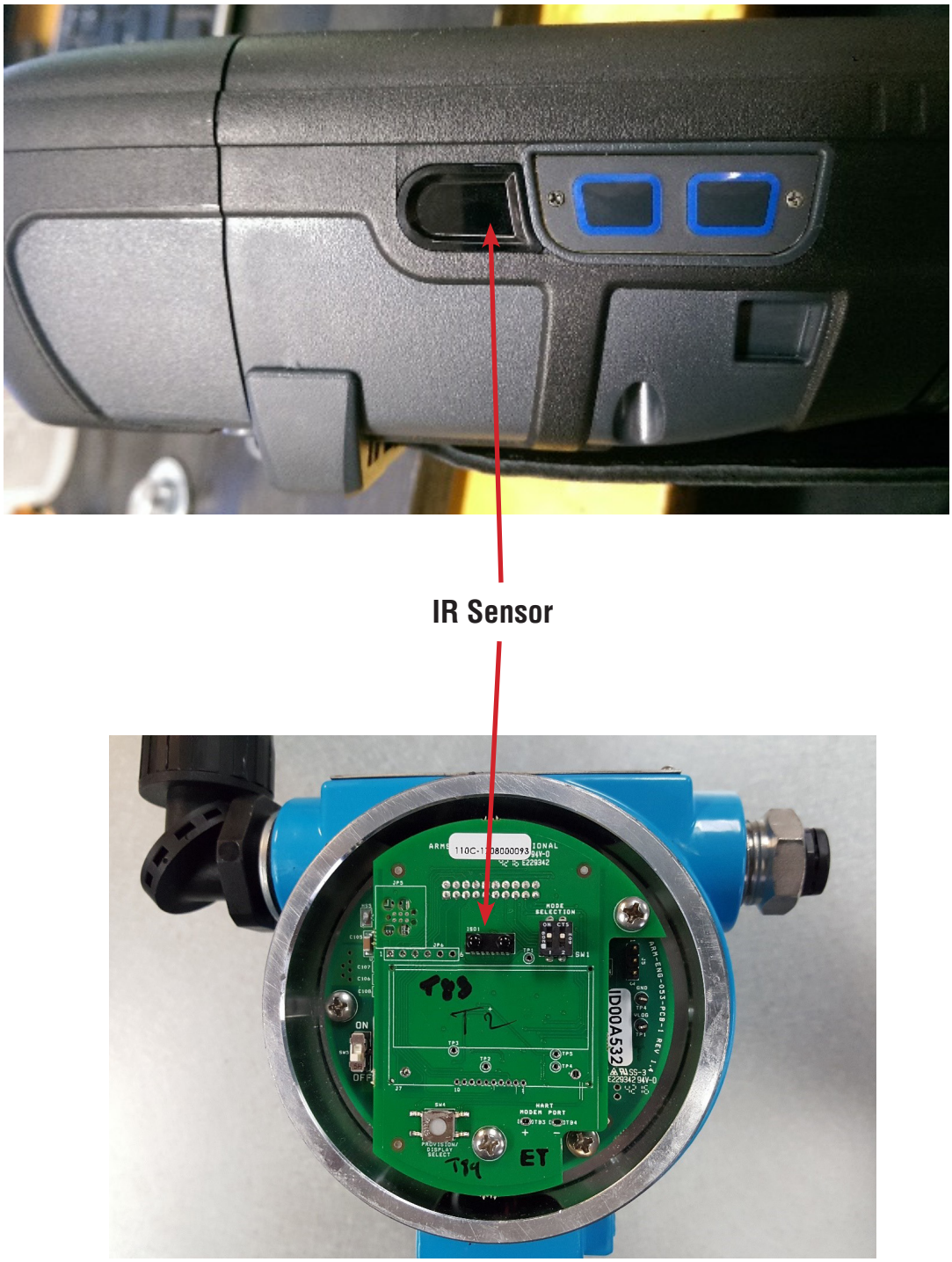


6. On the Provisioning Device handheld, select Start > Provisioning Device > Provisioning, the Provisioning screen appears.



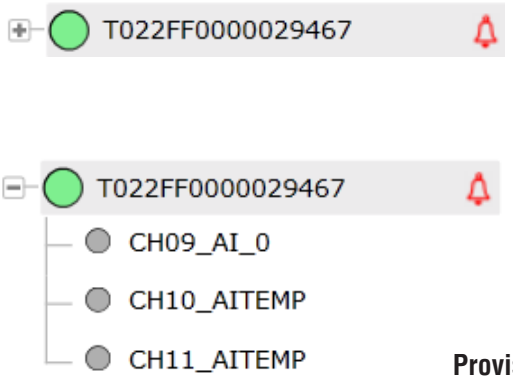
2.0 Infrared (IR) Armstrong ST6700 Provisioning and Joining - continued

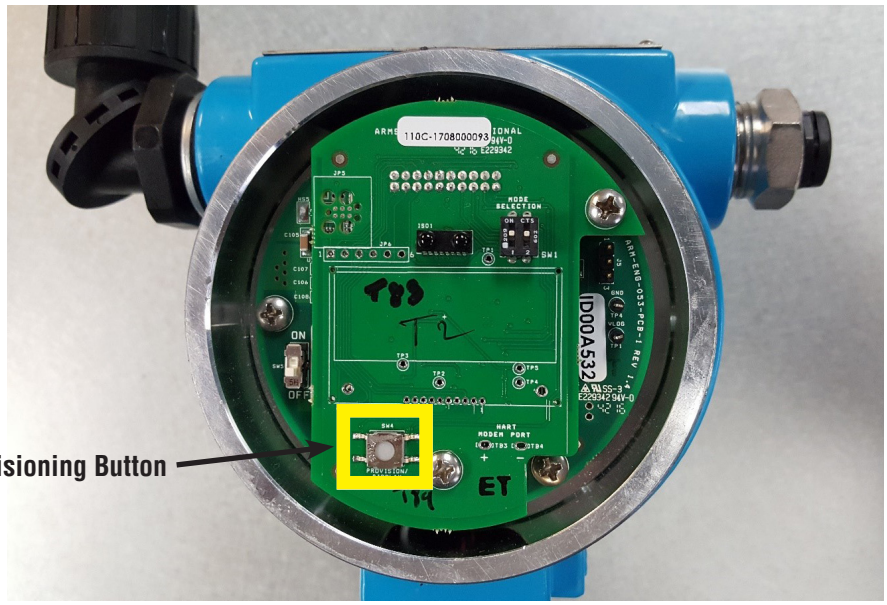
7. Hold the Provisioning Device's IR sensor in line with the IR sensor of the ST6700 and tap "Provision A Device". If successful, the device provisioned successfully message appears, tap Ok.



2.0 Infrared (IR) Armstrong ST6700 Provisioning and Joining - continued

8. The ST6700 should now appear on the device list with a icon. Shortly, a will appear next to the ST6700. Click the Graphic icon to expand the channels list. Next, quickly press and release the Provisioning button 5 times consecutively, within 2-4 seconds. This will initiate publishing of data on all channels.



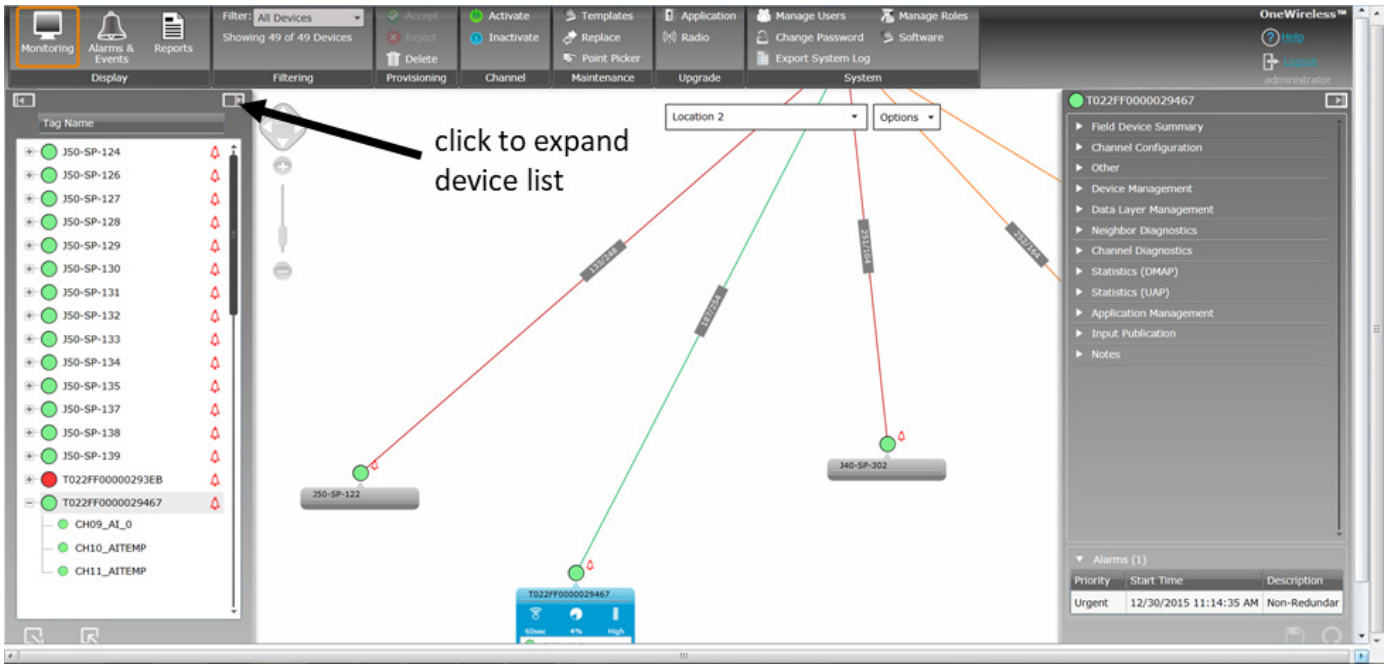


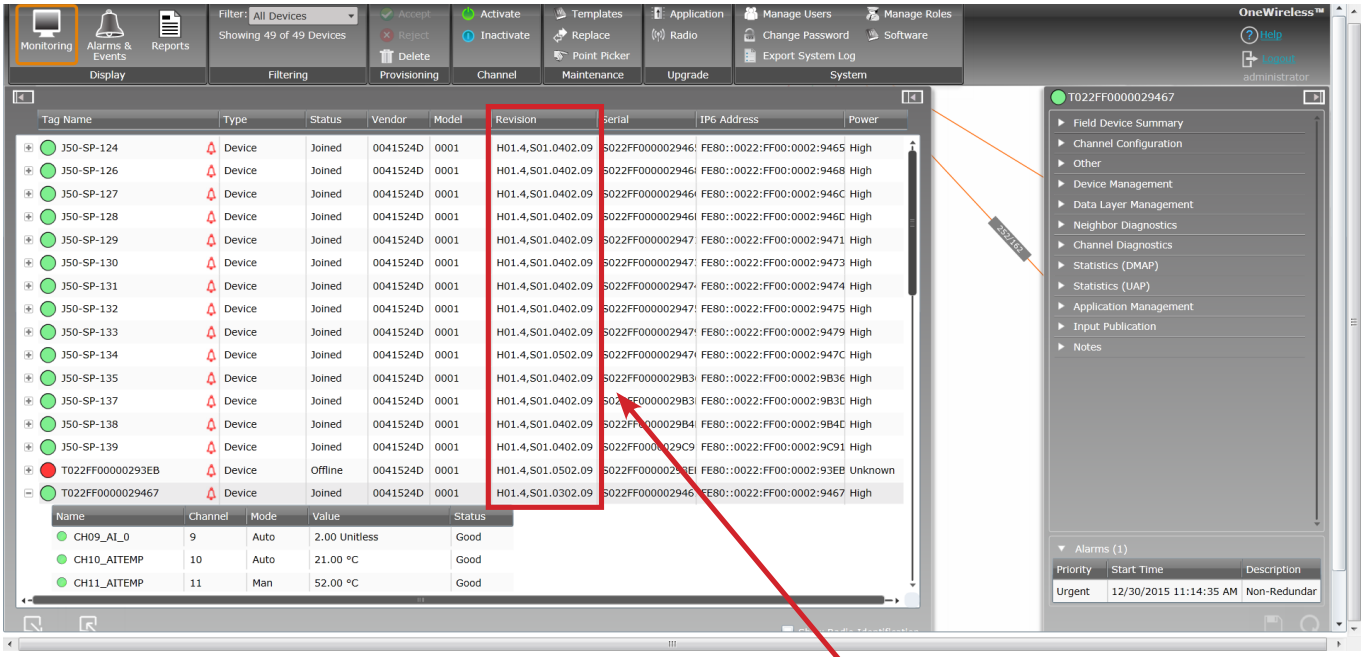
9. The ST6700's channels will cycle from a icon to a icon. Once all 3 channels have a icon, drag and drop the ST6700 onto the map. Clicking on the ST6700's map icon will expand its window window showing:

- CH09 = Trap Status
- CH10 = Temperature
- CH11 = Temperature Set Point

3.0 Checking ST6700 Software Revision

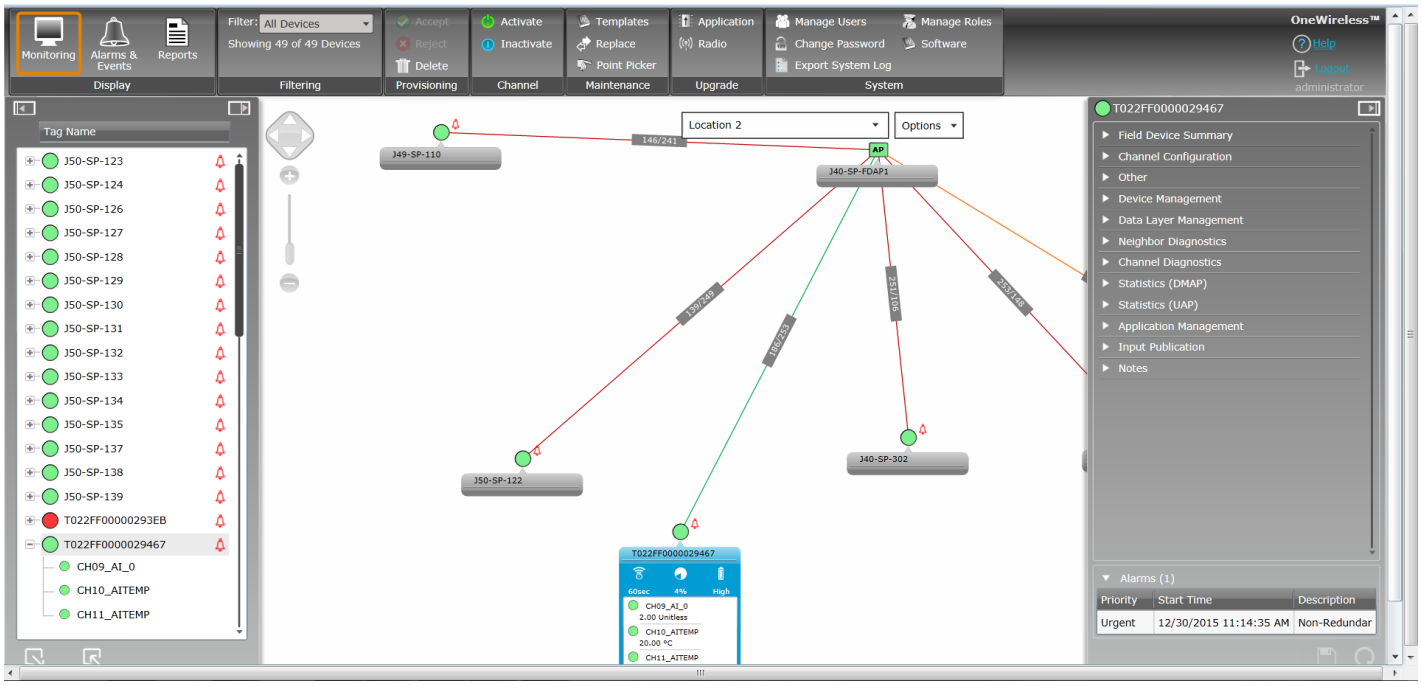
1. One way to determine a ST6700's software revision is to click the device list  icon, expanding the list. Once expanded, scroll through the list and locate the desired ST6700's row. Determine its software revision in the Revision column.

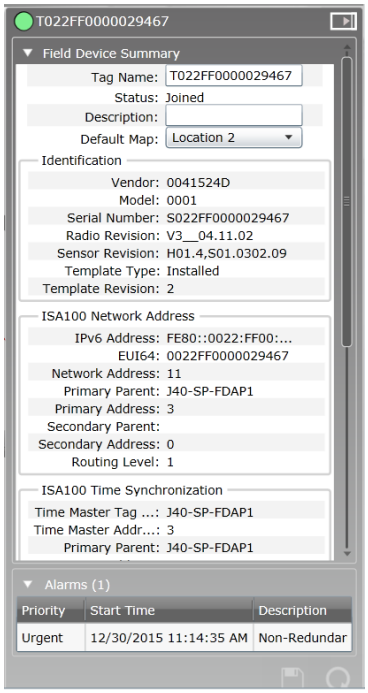




3.0 Checking ST6700 Software Revision - continued

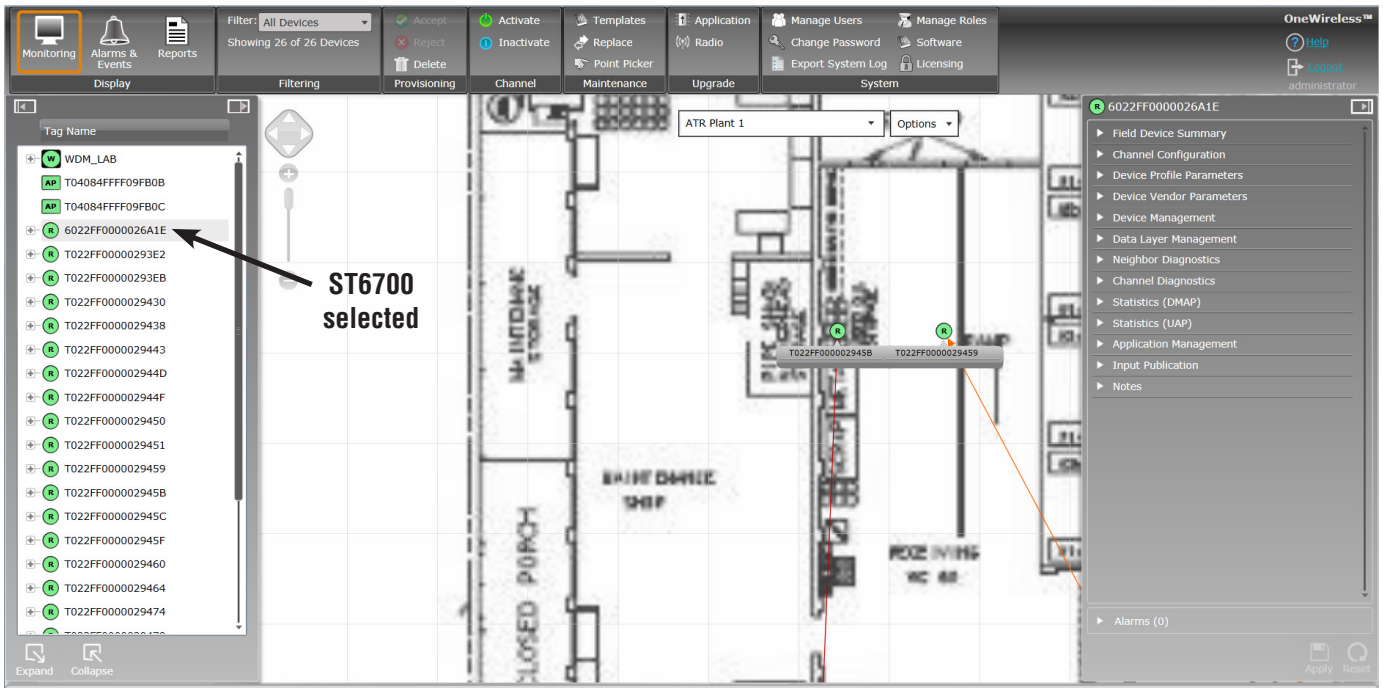
2. Another way to determine a ST6700's software revision is to select the desired ST6700 from the device list. Once selected, expand the Property Panel and click **Field Device Summary** in the Identification section will be **Sensor Revision: H01.S01.0302.09**

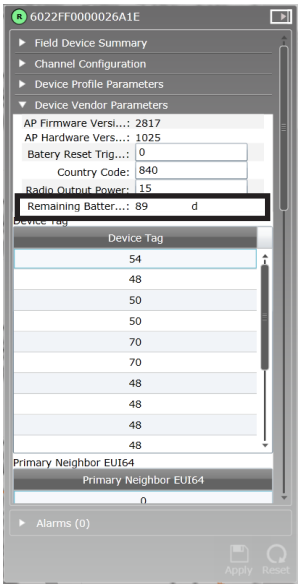




4.0 Checking ST6700 Battery Life

1. To determine a ST6700's remaining battery life, select the desired ST6700 from the device list. Once selected, expand the Property Panel and click **Device Vendor Parameters**. Scroll down and locate **Remaining Battery.**

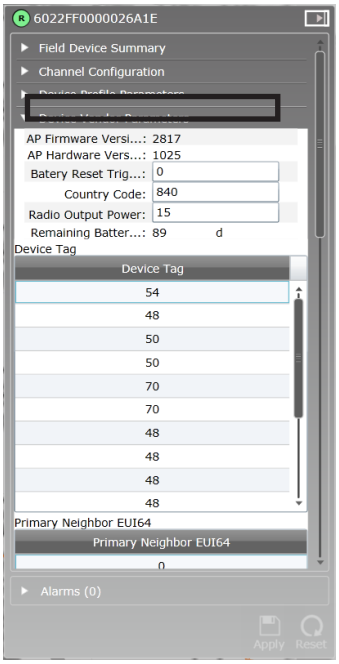




4.1 Resetting Battery Life Through WDM

After installing a new battery the battery life indicator needs to be reset. Follow the instructions below to reset the battery life. Note: resetting the battery life when the battery is not new or isn't replaced with a new battery will cause the remaining battery life to display incorrectly. ONLY RESET THE BATTERY LIFE WHEN INSTALLING A NEW BATTERY.

1. Select the desired ST6700 from the device list. Once selected, expand the Property Panel and click **Device Vendor Parameters**. Scroll down and locate **Battery Reset Trig…:** as highlighted below



2. Set the value to 1 and click the save button. The unit will reboot and reset the counter for the battery life.

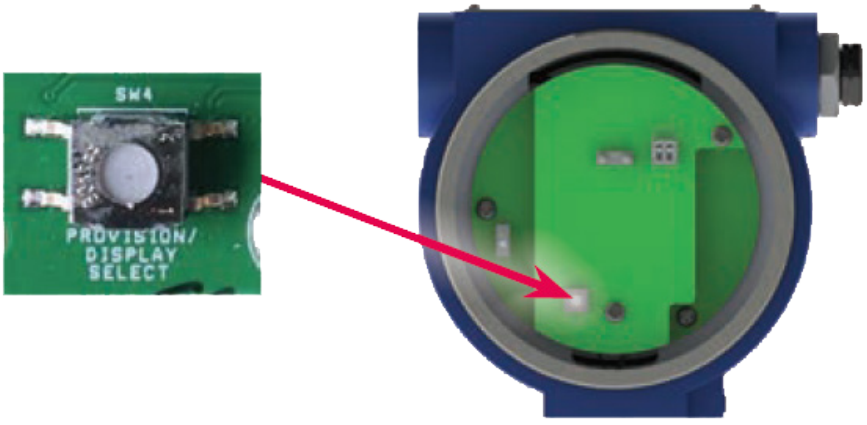
3. To perform a battery reset on the device consult the battery reset section of general IOM on page 16.

4.2 Resetting Battery Life From the Monitor

1. To reset the battery life, remove the short cover to reveal the "Provision/Display Select" button.

2. Press and hold the "Provision/Display Select" button for 10-15 seconds.

NOTE: To avoid inaccurate battery life readings, DO NOT reset the battery life unless a new a new/undegraded battery is installed.



5.0 Modbus Register Content

No.	Description	Name	Data format	Details		
0	YFGW410.GW_STATUS	Data Status	Unsigned 16	0x0080: Good Status		
1		Device Status	Unsigned 16	Status of the field wireless device (0: connected, 2: not connected)		
2			Integer 16	Battery life (0>: days, <0: hours, 0x7FFF: external power source)		
3			Unsigned 16	0 (Reserved bits)		
4						
5						
6						
7						
8						
9	T022FF000002A532.DEV_STATUS	Data Status	Unsigned 16	0x0080: Good Status		
10		Device Status	Unsigned 16	Status of the field wireless device (0: connected, 2: not connected)		
11			Integer 16	Battery life (0x05B4 (1460 dec)) days - normal starting point		
12			Unsigned 16	Usually 0 (Reserved bits)		
13						
14						
15						
16						
17						
18	T022FF000002A532.UAP02.UAPMO(“STEAMTRAP_UAPMO’).DIAG_STATUS	Data Status	Unsigned 16	0x0080: Good Status		
19		Diagnostic Status	Bit String	Binary (See example #1)		
20						
21	T022FF000002A532.UAP02.AI_01(“PIEZO STATUS AIO”).PV	Data Status	Unsigned 16	0x0080: Good Status		
22		Piezo Status	Floating	Good Trap	Cold Trap	Blow Through
23				3F80	4000	4040
				0000	0000	0000
24	T022FF000002A532.UAP02.AI_02(“TEMPERATURE AIO”).PV	Data Status	Unsigned 16	0x0080: Good Status		
25		Temperature	Floating	32 bit hexadecimal representation (See example #2)		
26						
27	T022FF000002A532.UAP02.AI_03(“TEMPERATURE SETPOINT AIO”).PV	Data Status	Unsigned 16	0x0080: Good Status		
28		Temperature Set Point	Floating	32 bit hexadecimal representation (See example #3)		
29						

5.1 Translating (“STEAMTRAP_UAPMO’).DIAG_STATUS

Active Bit	Diagnostic Status
31	Failure Status
30	Function Check Status
29	Out of Specification Status
28	Maintenance Required Status
27	Fault In Electronics
26	Faults in sensor or actuator element
25	Installation, calibration problem
24	Out of service
23	Outside sensor limits
22	Environmental conditions out of devices specifications
21	Fault prediction: Maintenance required
20	Power is critical low: maintenance need short term
19	Power is low: maintenance need mid-term
18	Software update incomplete
17	Simulation is active
16	Faults due to process influence
15	Faults due to non-complainant operating conditions
14	Other faults
13	WCI reserved 13
12	WCI reserved 12
11	WCI reserved 11
10	WCI reserved 10
9	WCI reserved 9
8	Watchdog reset
7	Vendor configuration active
6	Cold Trap
5	Incompatible firmware
4	High battery use
3	Communication error
2	Trap Blow Thru
1	Vendor Defined 1
0	Detailed information available

Examples																																	
Register	19																20																
Bit	31	30	29	28	27	26	25	24	26	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Result #1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Result #2	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Result #1 “Function Check Status” & “Cold Trap”

Result #2 “Maintenance Required Status” & “Power is critical low: maintenance need short term”

5.2 Translating ("TEMPERATURE AIO").PV and ("TEMPERATURE SETPOINT AIO").PV

Example #2			
Register	Result	Combine	Convert 32 HEX to Floating Point
25	41C8	41C80000	25.00000
26	0000		

Example #3			
Register	Result	Combine	Convert 32 HEX to Floating Point
28	428C	428C0000	70.00000
29	0000		

5.3 Device Self-Diagnosis Status Flags

Category 1: Failure Diagnostics

Diagnostic: Fault in Electronics

Functional Behavior:
The following diagnostic flags are set: "Failure Status" and "Fault in Electronics" (Bit 31 and Bit 27 are set to 1).

Causes and Triggers:
Critical memory failure, security violations, WDT password violation, Flash password violation, PMM password violation, Peripheral area fetch (stack overflow, pointer access or other logical problem in the code.

Diagnostic: Faults In Sensor Or Actuator Element

Functional Behavior:
The following diagnostic flags are set: "Failure Status" and "Faults in sensor or actuator element" (Bit 31 and Bit 26 are set to 1).

Causes and Triggers:
Damaged (open or shorted) thermistor resulting in 0.1 Ohm > R or R > 1M Ohm. Damaged (open or shorted) piezo-electric transducer resulting in 0.1 Ohm > R or R
> 1M Ohm.

Diagnostic: Faults Due To Process Influence

Functional Behavior:
The following diagnostic flags are set: "Failure Status" and "Faults due to process influence" (Bit 31 and Bit 16 are set to 1).

Causes and Triggers:
Excessively high process temp is detected can detect resulting in 290 deg C < Temp < 350 deg C.

Diagnostic: Faults Due To Non-Compliance With Specified Operating Conditions

Functional Behavior:
The following diagnostic flags are set: "Failure Status" and "Faults due to non- compliant operating conditions" (Bit 31 and Bit 15 are set to 1).

Causes and Triggers:
This diagnostics flag will be set when the on-board oscillator experiences a fault frequency, namely when the frequencies generated drops below the minimum allowed specification.

Diagnostic: Other Faults

Functional Behavior:
The following diagnostic flags are set: “Failure Status” and “Watchdog Reset” (Bit 31 and Bit 8 are set to 1).

Causes and Triggers:
The diagnostic flag is set if the result of ProbeTempReadObjId, ProbeTempSetObjId, PiezoStatusUAPObjId registration not successful. This is more like an extra software validation method to assure that all the channels have a right object attached to it and there is no duplicate registration.

Diagnostic: Watchdog triggered device reset

Functional Behavior:
The following diagnostic flags are set: “Failure Status” and “Faults due to non- compliant operating conditions” (Bit 31 and Bit 15 are set to 1).

Causes and Triggers:
The diagnostic flag is set if the application processor was reset due to a watchdog expiration. This can be detected based on SYSRSTIV Register of the MSP430F5438A micro-controller.

Category 2: Functional Check

Diagnostic: Installation, Calibration Problem

Functional Behavior:
The following diagnostic flags are set: “Function Check Status” and “Installation, calibration problem” (Bit 30 and Bit 25 are set to 1).

Causes and Triggers:
The diagnostic flag is set if one of the following conditions has been met.

- Low output from thermistor where T < -40°
- High output from thermistor where T > 200°
- Low output from piezo-electric transducer where there is no voltage output or Vout-piezo <= 1 mV
- RSQI with primary neighbor is low RSQI < 63.
- High PER (Packet Error Rate) where PER > 50%.

Diagnostic: Out of Service

Functional Behavior:
The following diagnostic flags are set: “Function Check Status” and “Out of service” (Bit 30 and Bit 24 are set to 1).

Causes and Triggers:
The diagnostic flag is set if actual mode of AI Objects is Out Of Service.

Diagnostic: Software Update Incomplete

Functional Behavior:
The following diagnostic flags are set: “Function Check Status” and “Software Update Incomplete” (Bit 30 and Bit 18 are set to 1).

Causes and Triggers:
The diagnostic flag is set when the remote OTA upgrade process of the application processor (through UD mechanism) fails due to any reasons (ex. invalid image firmware, RF connection lost etc).

Diagnostic: Simulation is Active

Functional Behavior:
The following diagnostic flags are set: “Function Check Status” and “Simulation is active”
(Bit 30 and Bit 17 are set to 1).

Causes and Triggers:
The diagnostic flag is set when the simulation mode /function of any process channel (AI object) is active.

Diagnostic: Cold Trap Detected (Armstrong specific)

Functional Behavior:
The following diagnostic flags are set: “Function Check Status” and “Cold trap” (Bit 30 and Bit 6 are set to 1).

Causes and Triggers:
The diagnostic flag is set if the average output from thermistor is approximately equal to the ambient temp over a period of time of 10 minutes.

Diagnostic: Firmware incompatible (Armstrong specific)

Functional Behavior:
The following diagnostic flags are set: “Function Check Status” and “Incompatible Firmware
(Bit 30 and Bit 5 are set to 1).

Causes and Triggers:
The diagnostic flag is set when after a remote firmware upgrade, the new application processor firmware version (reflected by UPAMO’s VersionRevision attribute) is older than or equal with the previous one.

Diagnostic: High-Battery Use Detected (Armstrong specific)

Functional Behavior:
The following diagnostic flags are set: “Function Check Status” and “High battery use”
(Bit 31 and Bit 8 are set to 1).

Causes and Triggers:
The diagnostic flag is set when the rate of change of battery life prediction exceeds discharge rate threshold specified value over a time period.

Diagnostic: Trap “Blow-Through” (Armstrong specific)

Functional Behavior:
The following diagnostic flags are set: “Failure Status” and “Faults due to non- compliant operating conditions”
(Bit 30 and Bit 2 are set to 1).

Causes and Triggers:
The diagnostic flag is set if the Analog Input PV (process value) reflecting the piezo-electric transducer becomes equals 3 (CH09_AI_0’s PV = 3). The status flag will be cleared as soon as the Analog Input PV attribute value changes to 1 or 2.

Category 3: Out of Specification

Diagnostic: Outside Sensor Limits

Functional Behavior:
The following diagnostic flags are set: “Out of Specification Status” and “Environmental Conditions Out of Device Specification” (Bit 29 and Bit 23 are set to 1).

Causes and Triggers:
The diagnostic flag is set if the internal reading of the A/D converter present in the application processor is out of range. This indicates that the internal temperature sensor present in the application processor cannot be read, and there is no way of knowing if the instruments is operating within the advertised environmental specifications (temperature). If the value read is within 200 mV below or 200 mV above the lowest/highest possible ADC reading value this flag will be set.

Diagnostic: Environmental conditions out of device specification

Functional Behavior:
The following diagnostic flags are set: “Out of Specification Status” and “Outside Sensor Limits” (Bit 29 and Bit 22 are set to 1).

Causes and Triggers:
The diagnostic flag is set if the internal reading of the A/D converter present in the application processor indicates that the instrument is operating in temperatures that are below -40° or above 85°.

Category 4: Maintenance Required

Diagnostic: Fault Prediction

Functional Behavior:
The following diagnostic flags are set: “Maintenance Required Status” and “Fault Prediction Maintenance Required” (Bit 28 and Bit 21 are set to 1).

Causes and Triggers:
The diagnostic flag is set if the device resets due to a brownout. Since the device is battery powered, this indicates a drop in voltage, meaning that somethings is wrong with the power supply system.

Diagnostic: Power Is Critical Low

Functional Behavior:
The following diagnostic flags are set: “Maintenance Required Status” and “Power Is Critical Low: Maintenance is needed short-term” (Bit 28 and Bit 20 are set to 1).

Causes and Triggers:
The diagnostic flag is set if the remaining battery capacity (DLMO.PowerSupplyStatus = 3) is less than 25% and battery life (DLMO.EnergyLeft) is less than 10 days.

Diagnostic: Power Is Low

Functional Behavior:

The following diagnostic flags are set: “Maintenance Required Status” and “Power Is Low: Maintenance is needed mid-term” (Bit 28 and Bit 19 are set to 1).

Causes and Triggers:

The diagnostic flag is set if the remaining battery capacity (DLMO.PowerSupplyStatus = 3) is less than 25% and battery life (DLMO.EnergyLeft) is more than 10 days.

Diagnostic: Communication Error (Armstrong specific)

Functional Behavior:

Diagnostic: Communication error (Armstrong specific) (Bit 28 and Bit 3 are set to 1).

Causes and Triggers:

The diagnostic flag is set if the API communication between application processor and stack radio module is not working. If no Radio API Request/Response will be received by the application processor during last 5 minutes the flag is set. If an API Request/Response is received the Communication error flag remains active for 5 minutes, but the internal counter will be reset for the next 5 minutes.

Connecting the Armstrong ST6700 to the Yokogawa YFGW410 - Table of Contents

This document does not contain information about how to configure the YFGW510 AP. See YFGW510 AP literature for configuration procedure.

1.0 Required Software

The following table lists the required software for ST6700 device integration with the Yokogawa environment:

No.	Software	Scope	Required steps
1	Internet Explorer	Communication with the YFGW410	Included with all Windows based machine
2	Field Wireless Management Console	Wireless Network Configuration and monitoring	Web based application integral to the YFGW410. Available via the YFGW410 assigned IP address.
3	FieldMate (Lite/ Advanced)	Wireless Field Device configuration, data display	Install the software from the Field Mate DVD, or download from Yokogawa website.
4	CF/DD file	Field Wireless Device Registration	The DD files should be saved to the recommended folder below: C:\Program Files (x86)\Yokogawa\DTM\DTMev\EV\ISA100\ 0041524D\ https://www.armstronginternational.com/sites/default/files/resources/files/Yogogawa%20YFGW410%20CF%2BDD%20Files.zip

1.2 Required Hardware

For IR Provisioning the following infrared adapter is required and must be purchased separately:

Vendor Name	ACTiSYS
Model Name	IR224UN
Model No.	ACT-IR224UN-LN96-LE
Baud Rate	9600bps

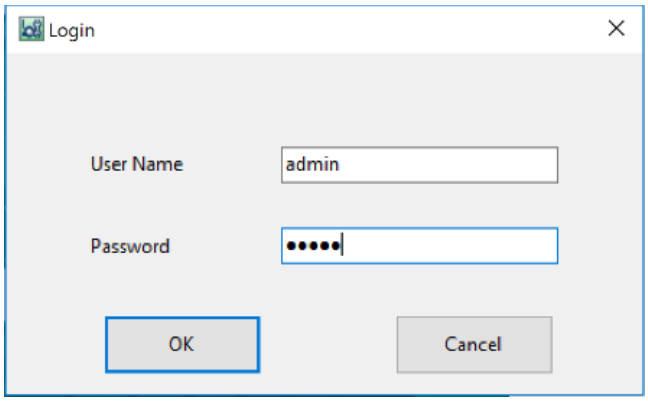
2.0 Wireless System Configuration

Field Wireless Management Console (includes the Configurator tool) is the software used to configure the Field Wireless System. To configure the network please use the following steps:

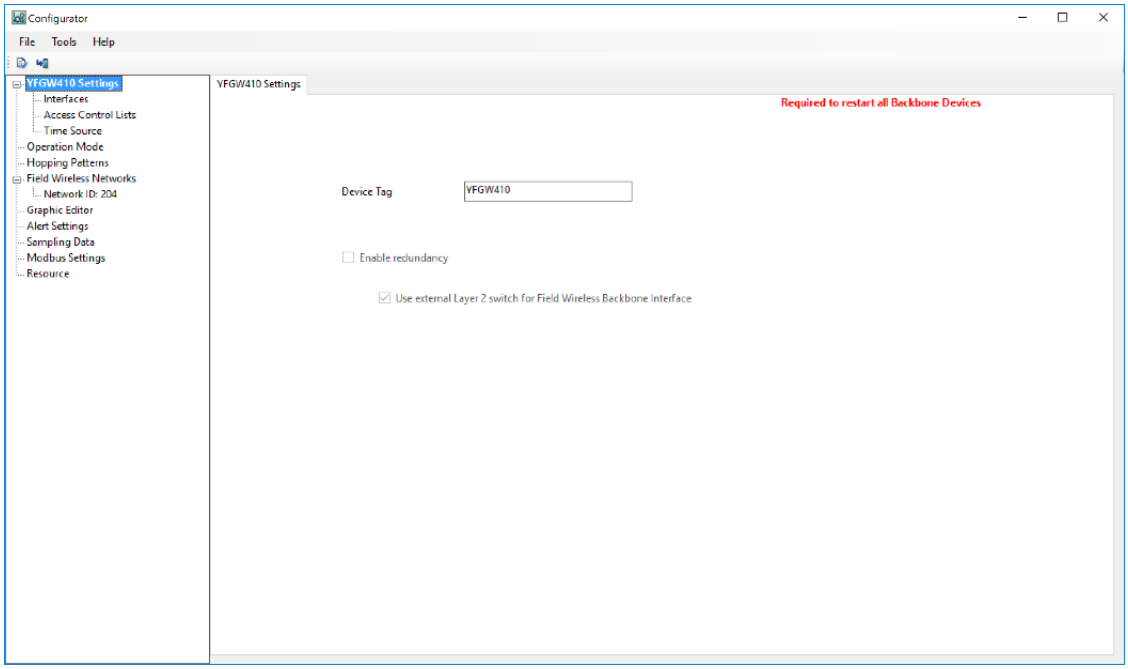
1. Start Internet Explorer and enter assigned IP (Default http://192.168.0.101:8080) in the web browser navigation field.
2. Click “Configurator” and the login dialog will appear.

2.0 Wireless System Configuration – continued

3. Follow the login steps (if it is the first time, the default login user is “admin” and password “admin”).

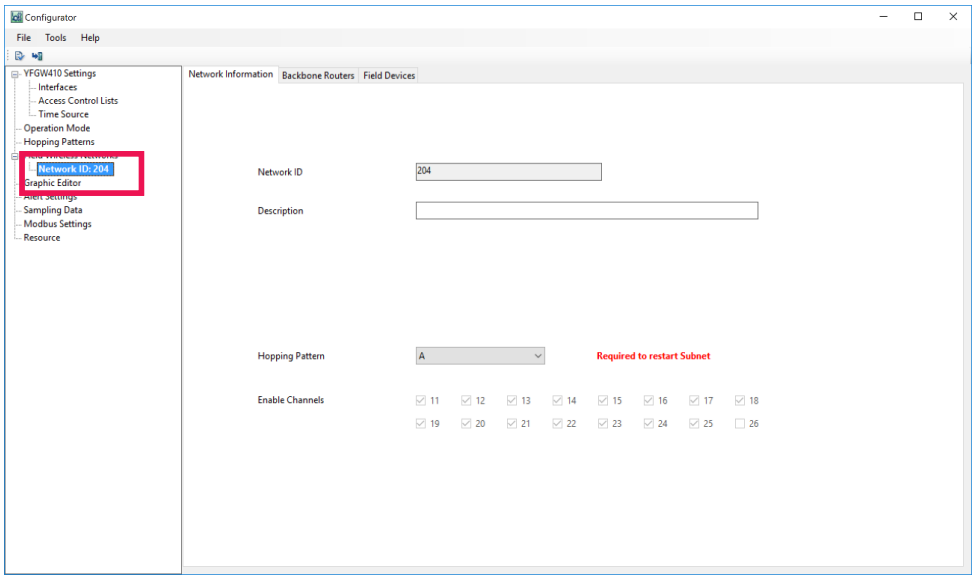


4. A valid login opens the configurator tool.

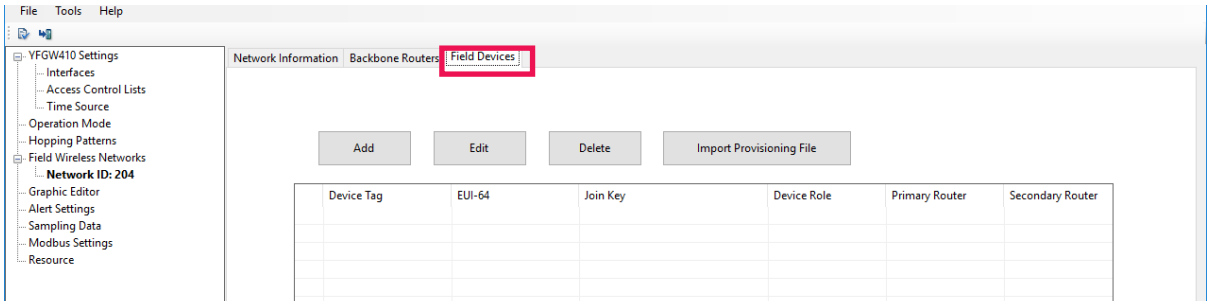


2.0 Wireless System Configuration – continued

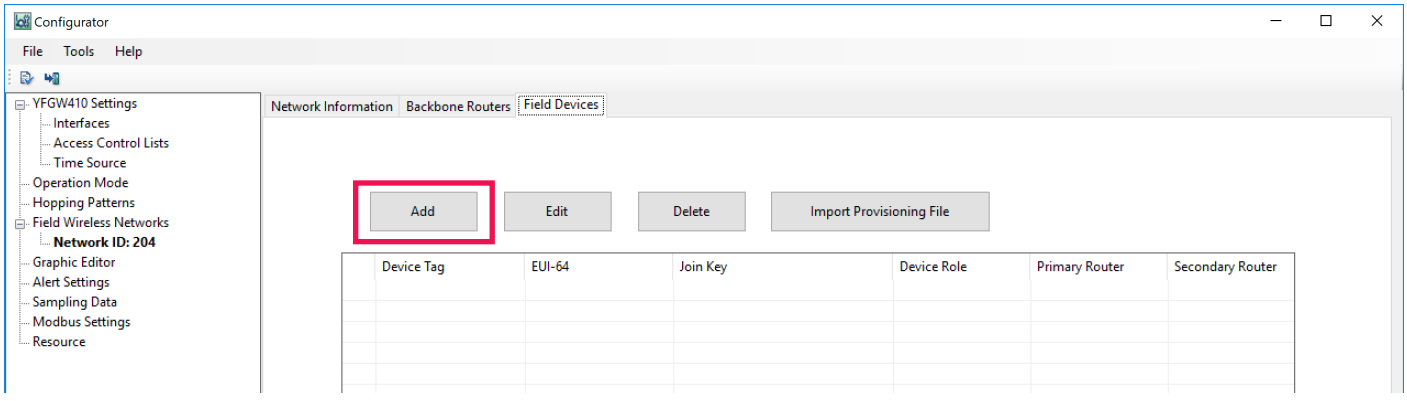
5. Select “Network ID” in the navigation pane on the left side of the screen (example Network ID: 204).



6. Select the “Field Devices” tab.

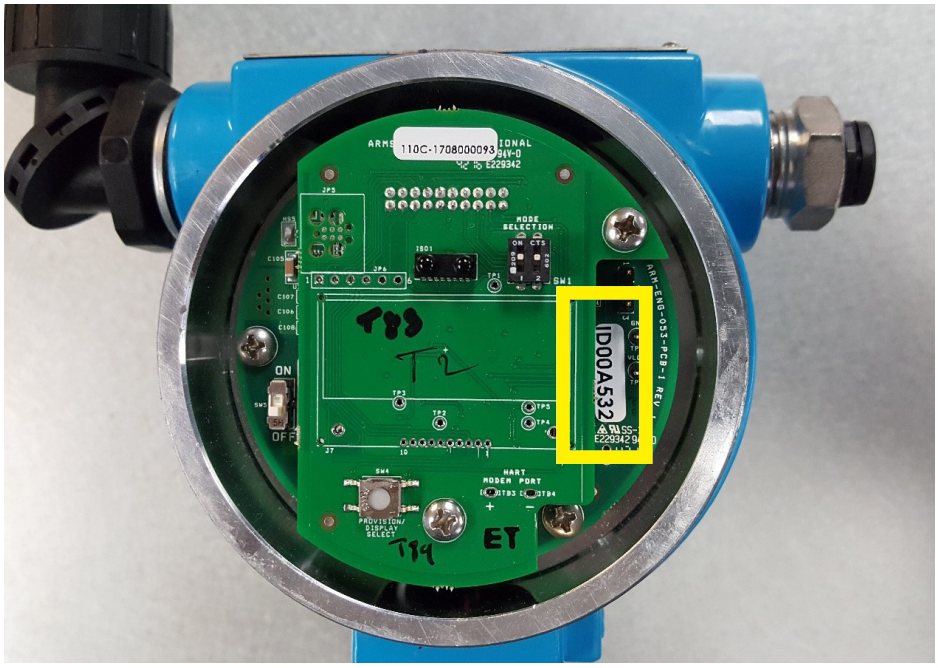


7. Click “Add” to prepare connection for a Field Wireless Device.

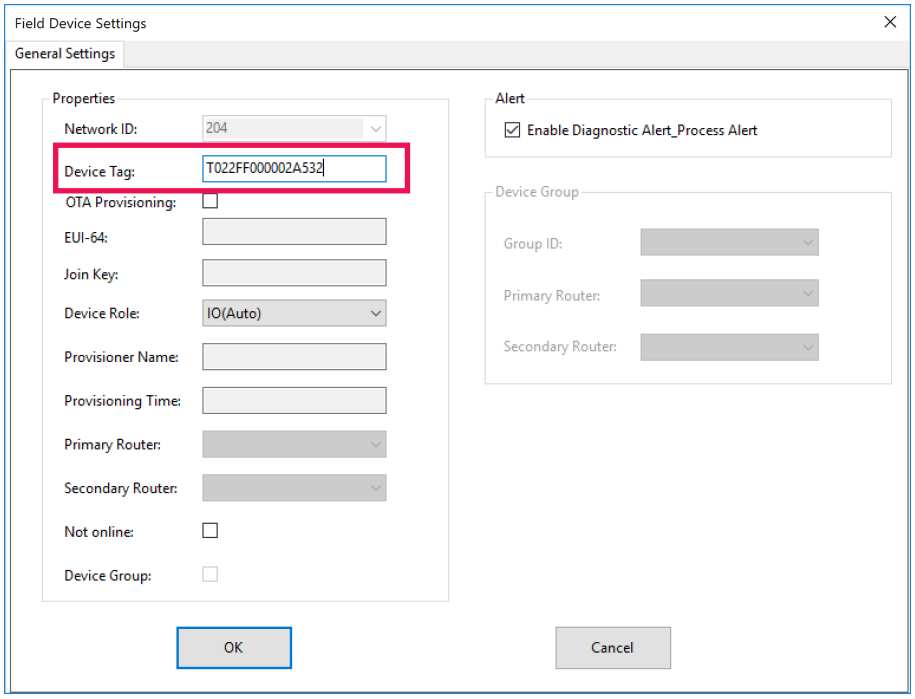


2.0 Wireless System Configuration – continued

8. Obtain the Device Tag from the ST6700.
   - Remove the front cover
   - Record the last 4 characters on the device ID tag (highlighted below)
   - In this example they are “A532”

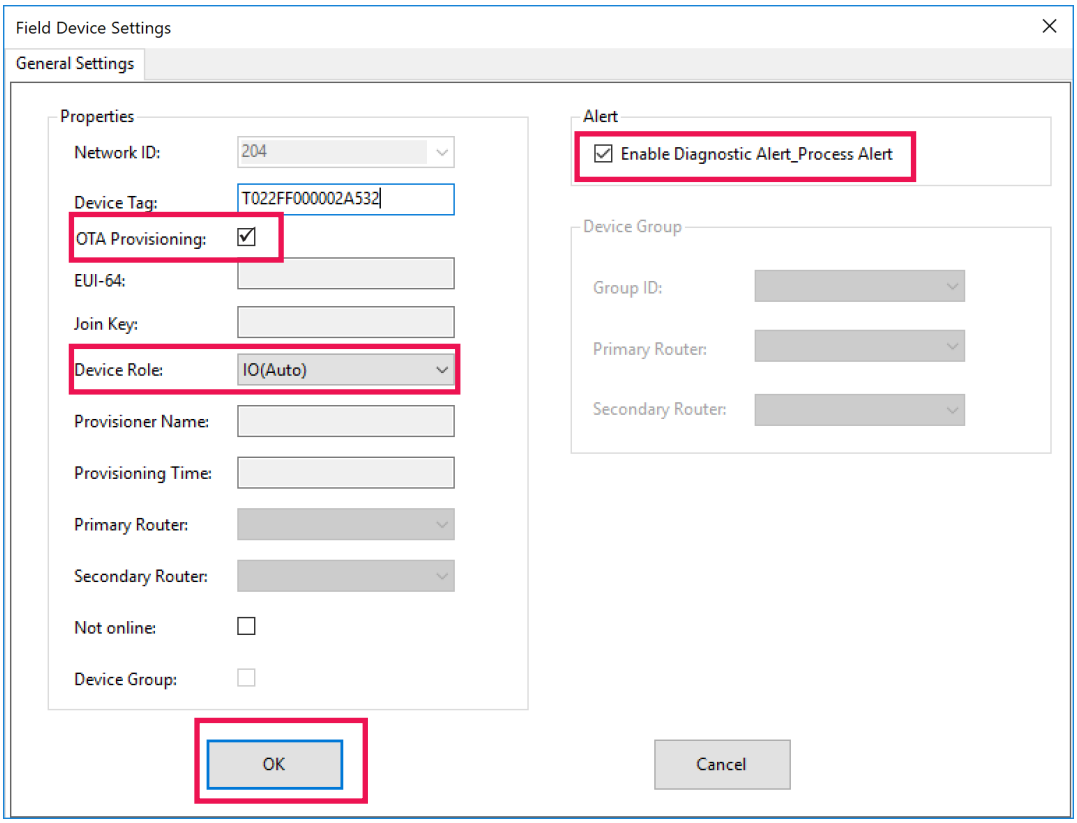


9. Fill out the “Device Tag” field with T022FF000002 followed by the recorded 4 characters.
   - In this example the Device Tag will be T022FF000002A532

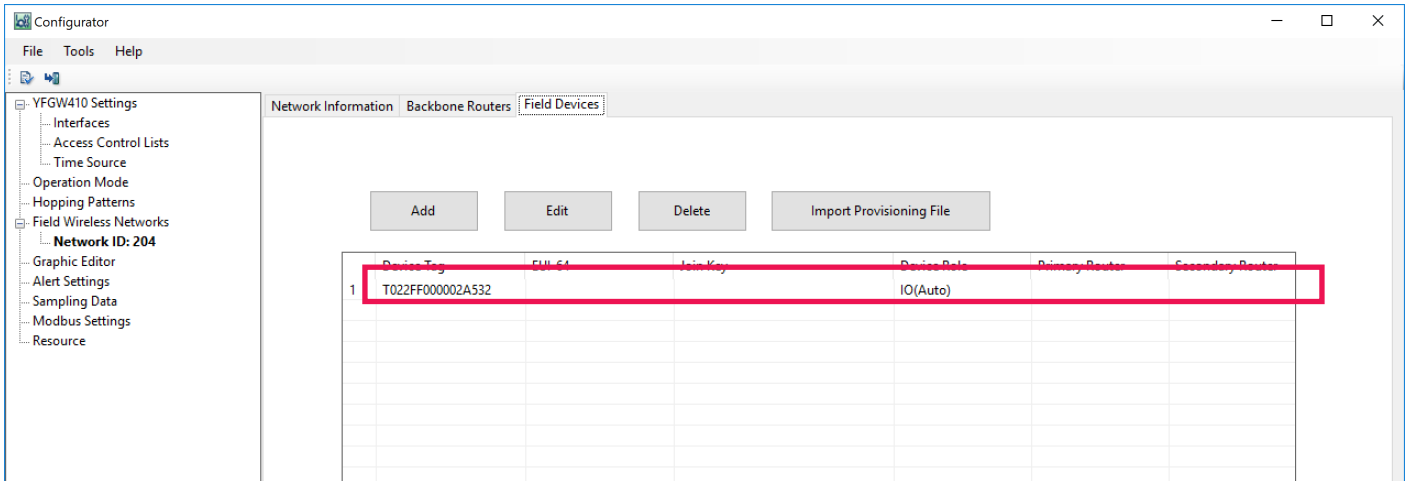


2.0 Wireless System Configuration – continued

10. Verify the following and select OK.
    - The “OTA Provisioning” check box is selected (for both OTA and IR Provisioning methods)
    - The device role is selected in the desired function (Default: “IO(Auto)”)
    - The “Enable Diagnostic Alert_Process Alert” check box is selected

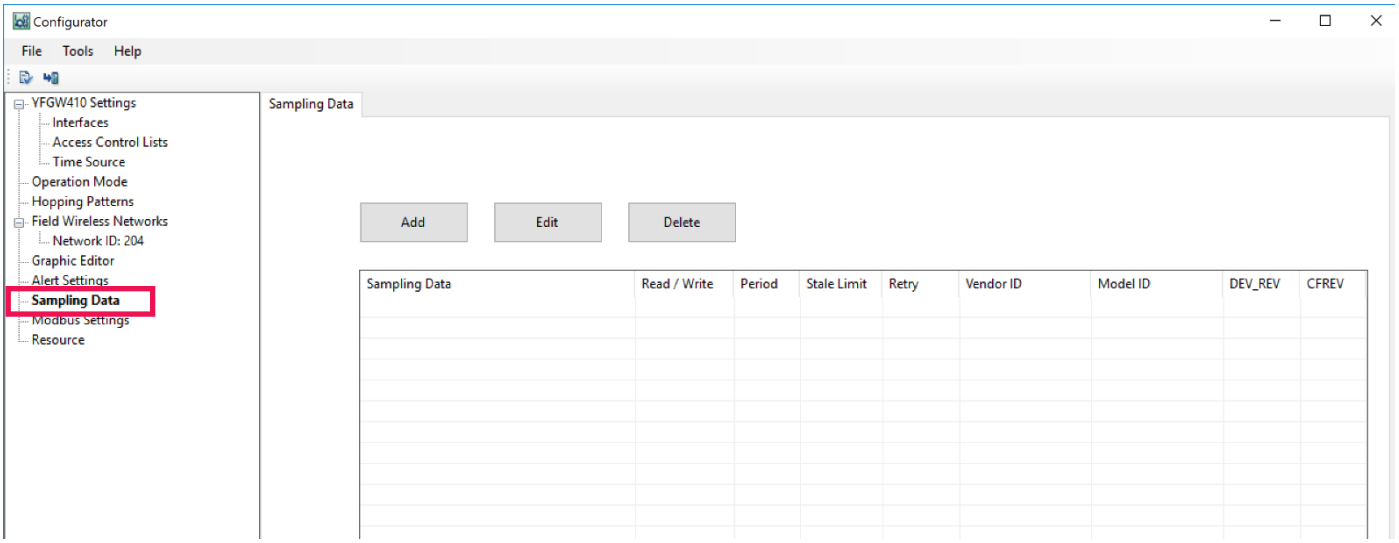


11. The ST6700 Monitor has been added to the list of Field Devices.

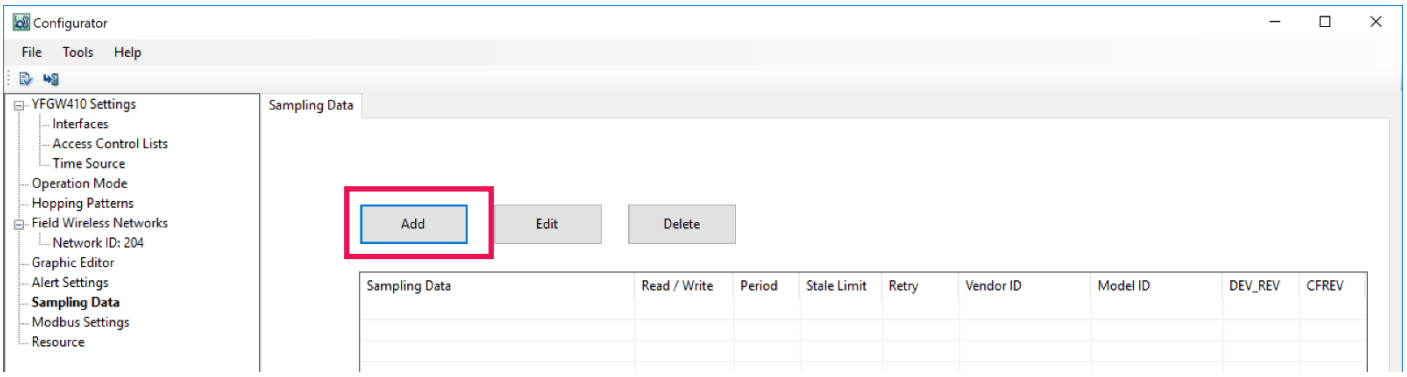


2.0 Wireless System Configuration – continued

12. Select “Sampling Data” in the navigation pane on the left side of the screen.

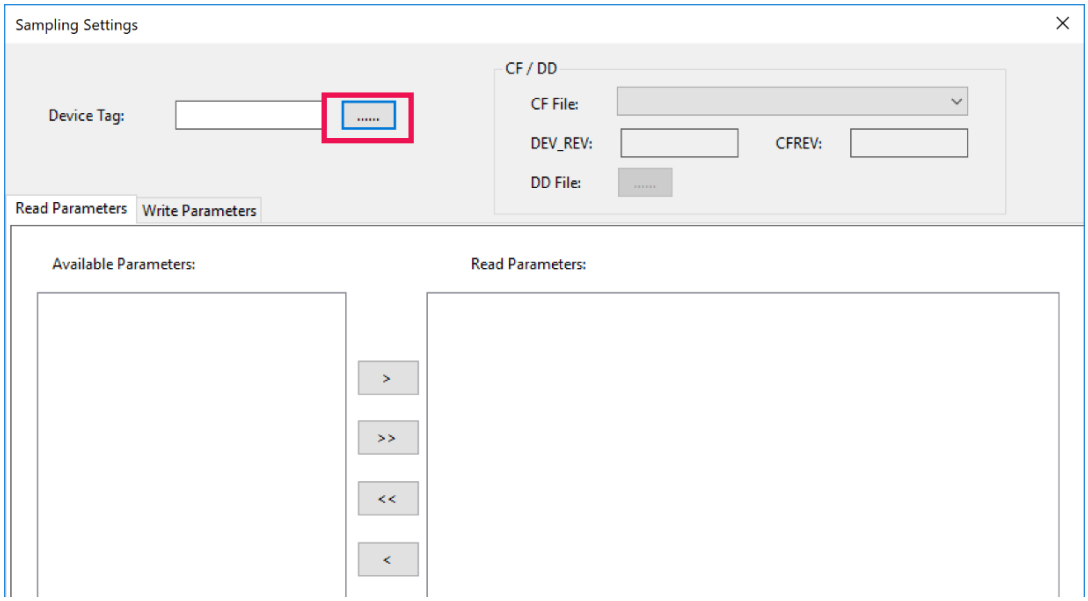


13. Click “Add” to configure Sampling Data.



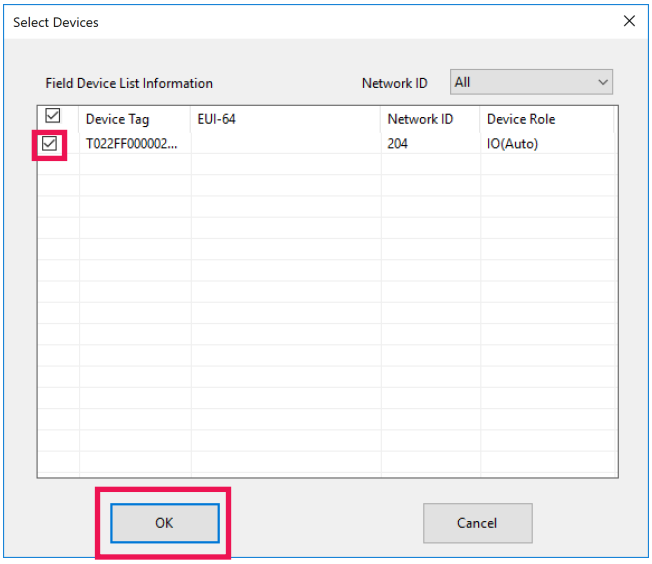
14. Select the device to configure

- Click the ..... button

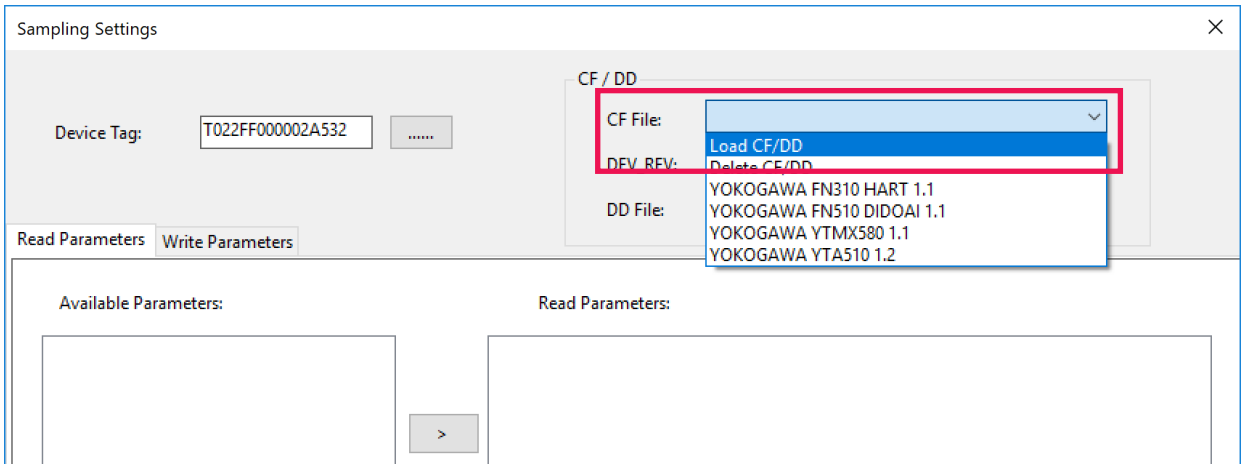


2.0 Wireless System Configuration – continued

15. Select the check box of the device to be configured and click OK.

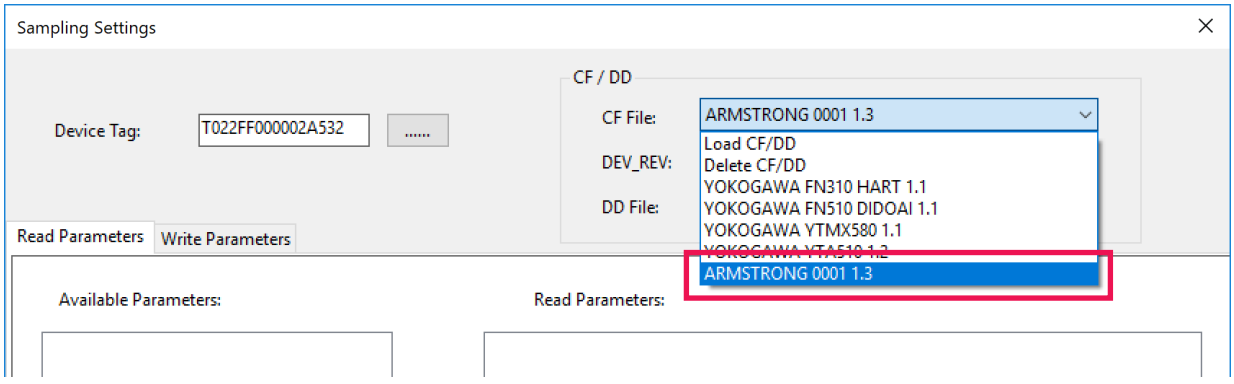


16. Select “Load CF/DD” from the CF File dropdown.



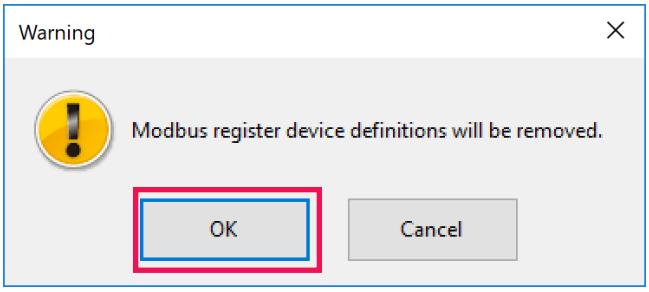
17. Navigate to folder containing the Armstrong *.cff file and open the file (The device driver package is available at www.armstronginternational.com).

18. Select the “ARMSTRONG 0001 1.3” from the CF File Dropdown.

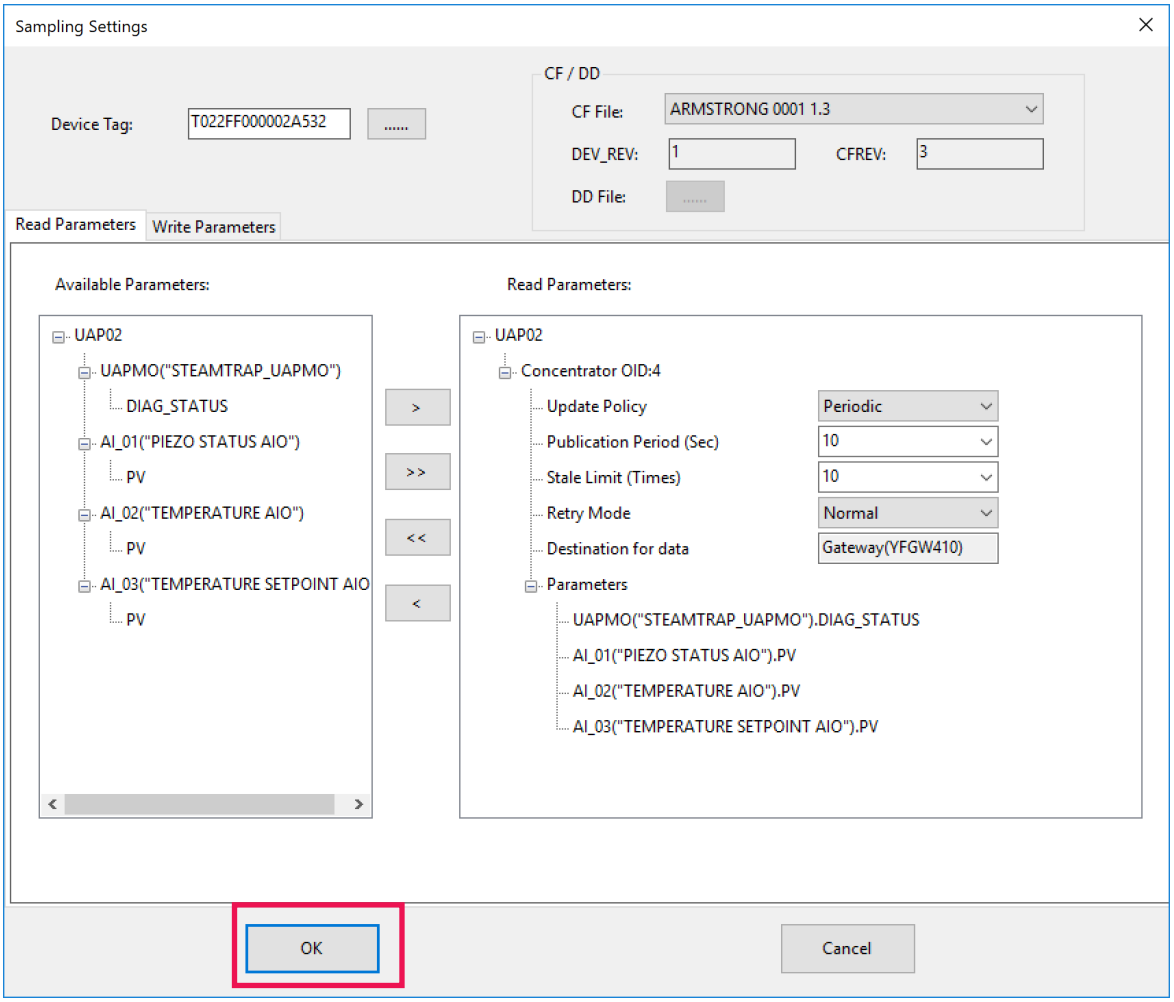


2.0 Wireless System Configuration – continued

19. If a warning for register device definitions appears, select OK to close the window.

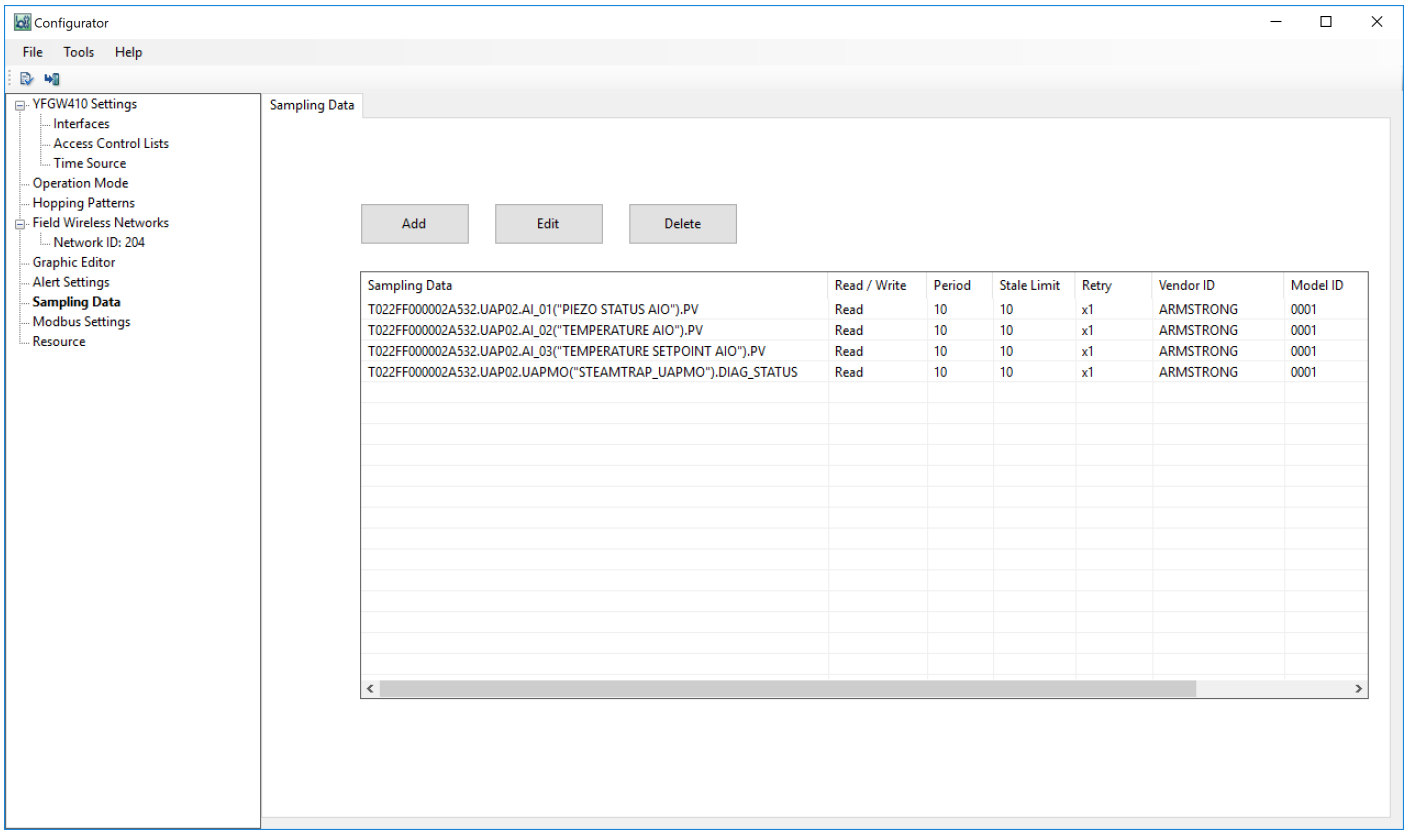


20. Click OK to confirm the Sampling Data configuration.

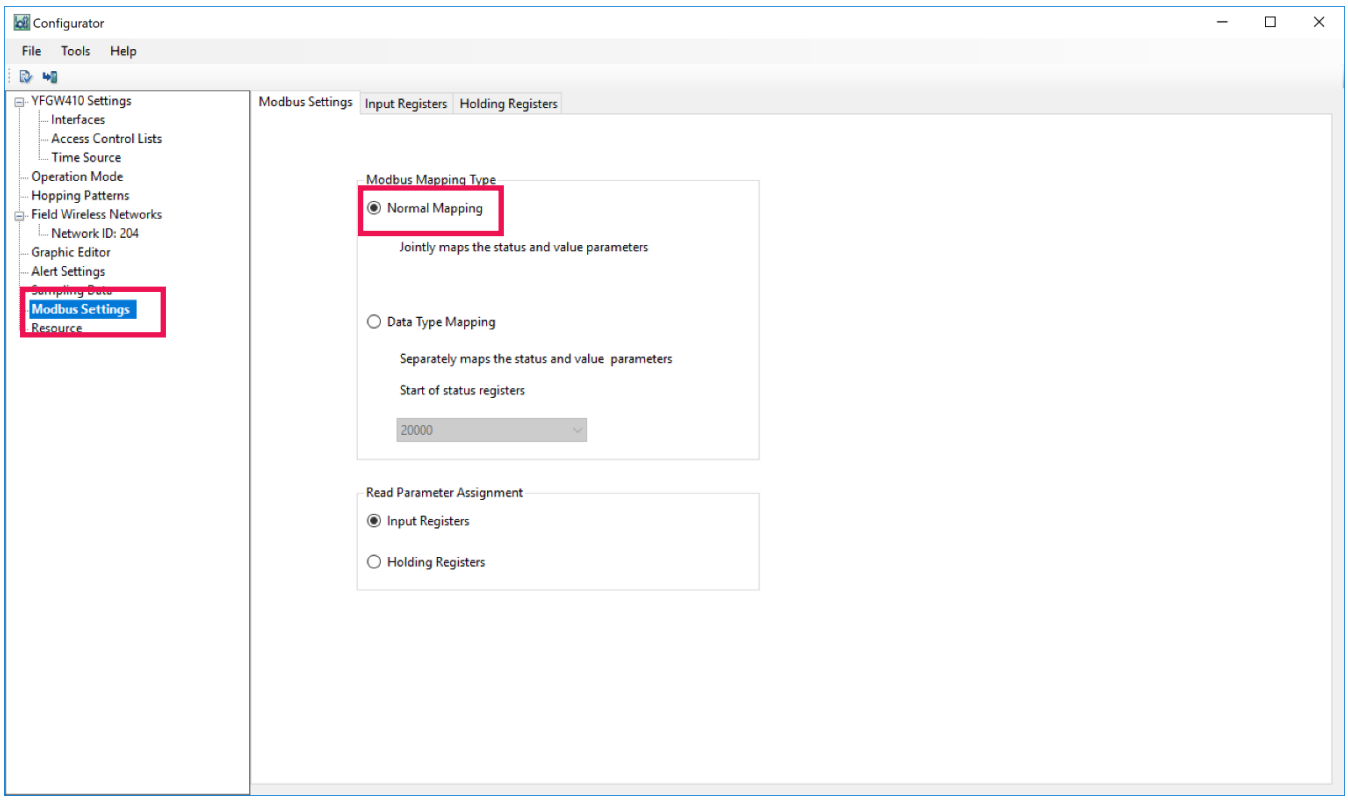


2.0 Wireless System Configuration – continued

21. After clicking OK sampling data table will be displayed.

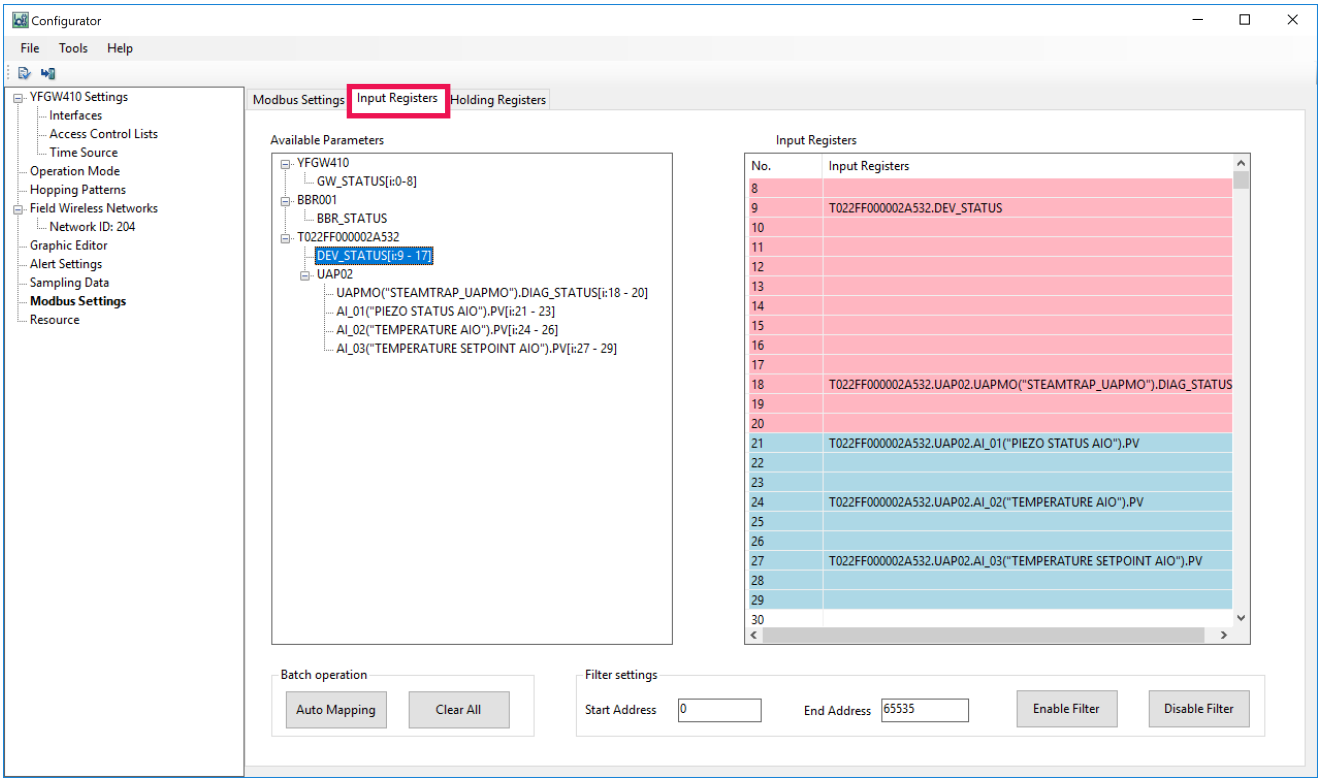


22. Select Modbus settings and verify “Normal Mapping” is selected.

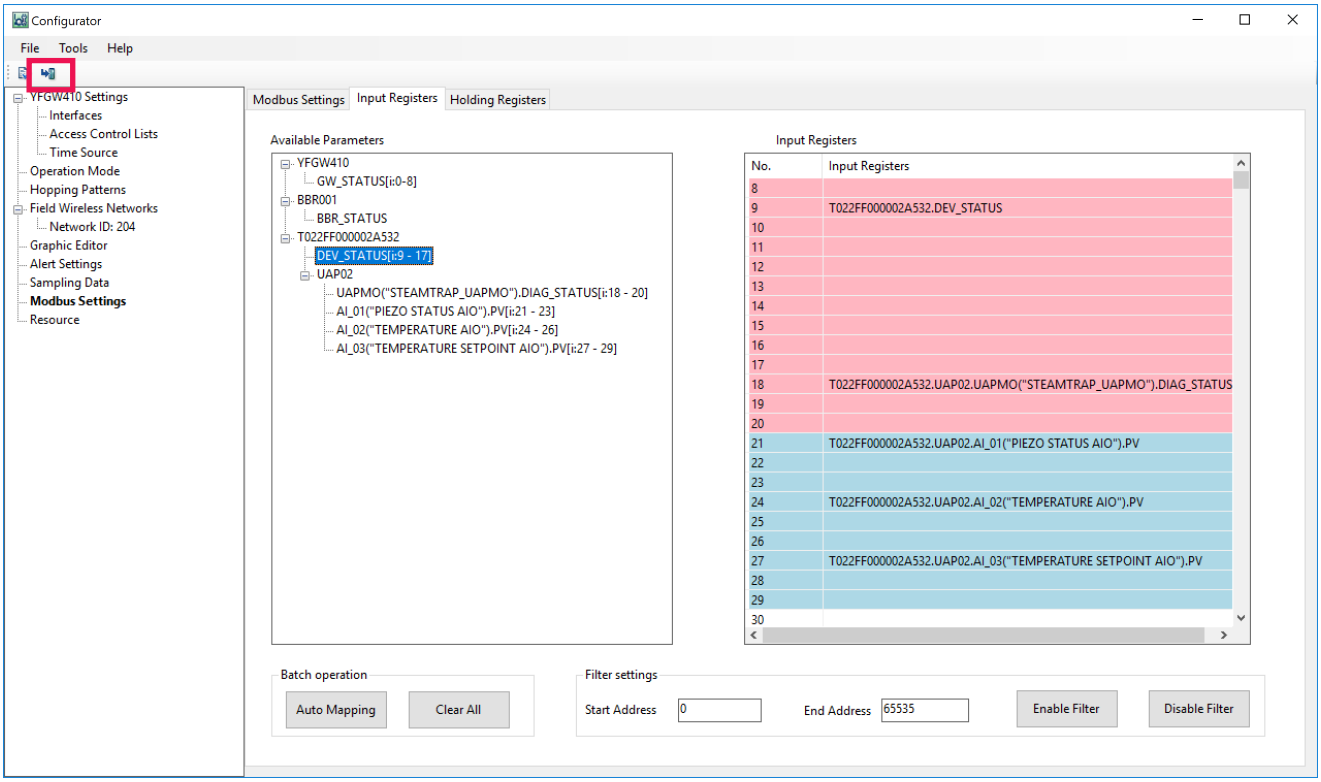


2.0 Wireless System Configuration – continued

23. Select “Input Register” tab and drag and drop the device parameters desired to the “Input Registers”.

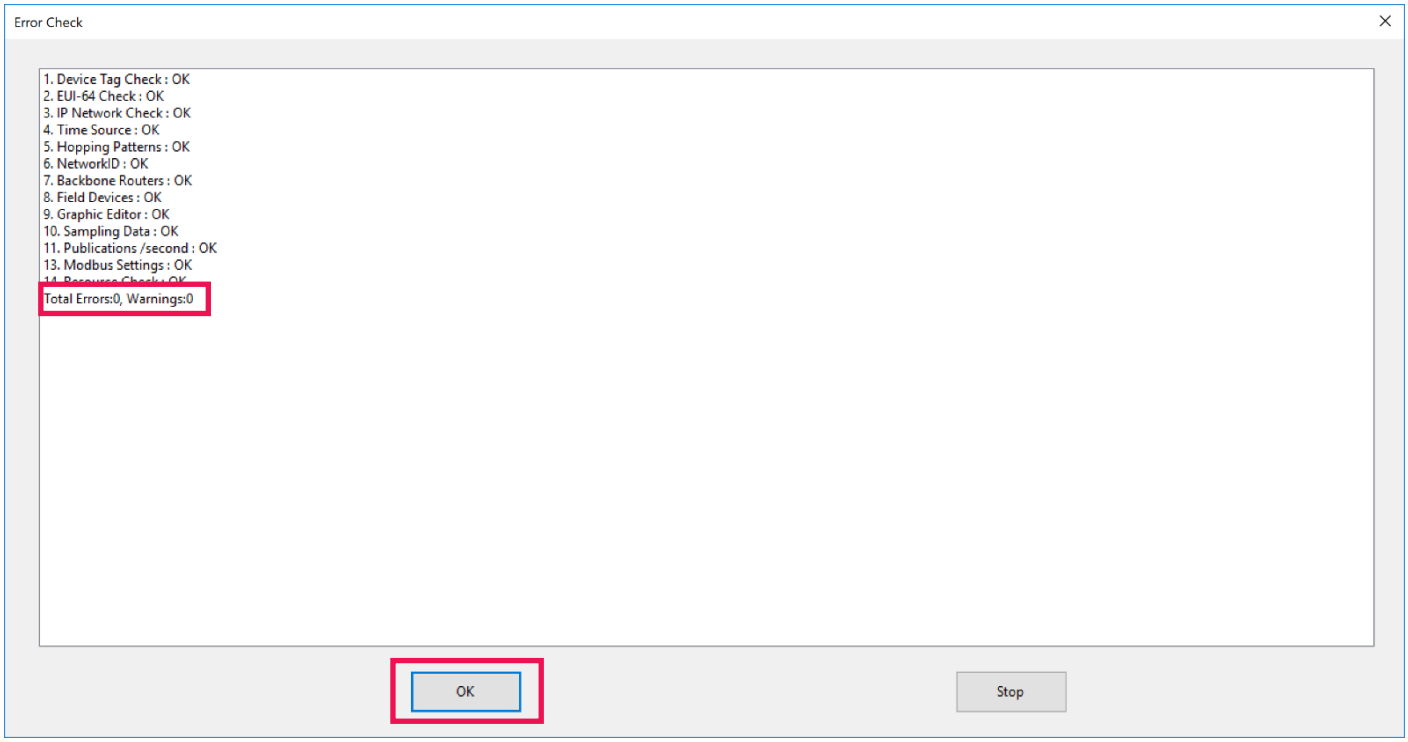


24. Repeats steps 6 – 23 for multiple devices, if all devices have been configured select the download button 

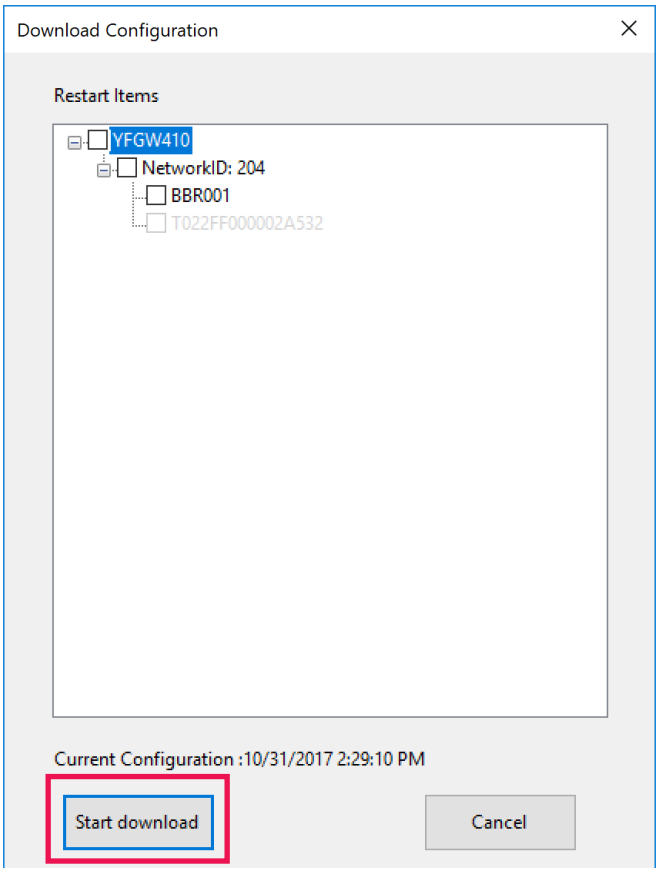


2.0 Wireless System Configuration – continued

25. Confirm that Total Errors and Warnings are 0. Click “OK” to start the download process.

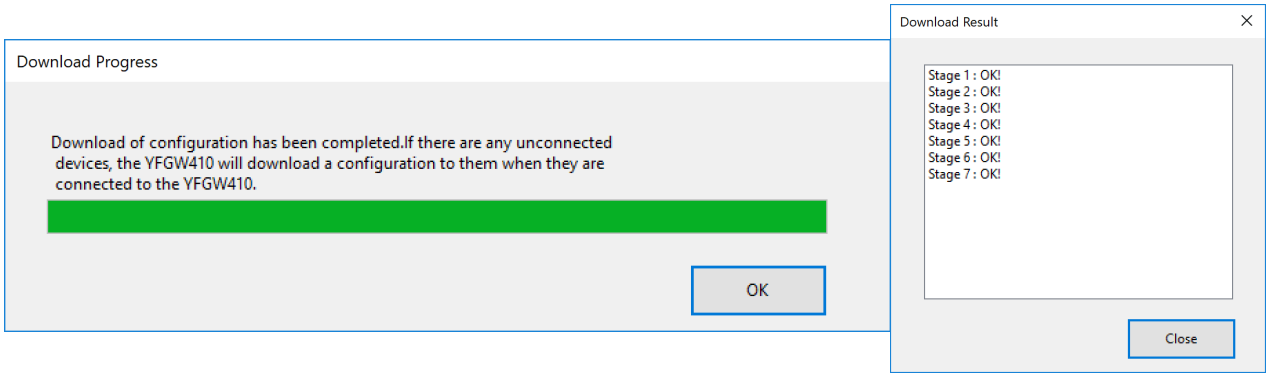


26. Click “Start Download”.



2.0 Wireless System Configuration – continued

27. Confirm and close the dialog boxes.



28. Configure additional devices.

2.1 OTA Armstrong ST6700 Provisioning and Joining

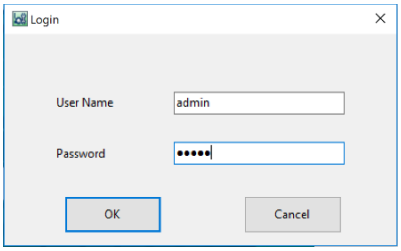
The Yokokawa environment supports two methods of provisioning and joining. The first one is out of band provisioning that requires an infrared adaptor and the second method is the over the air provisioning.

Below are the steps required for over the air provisioning:

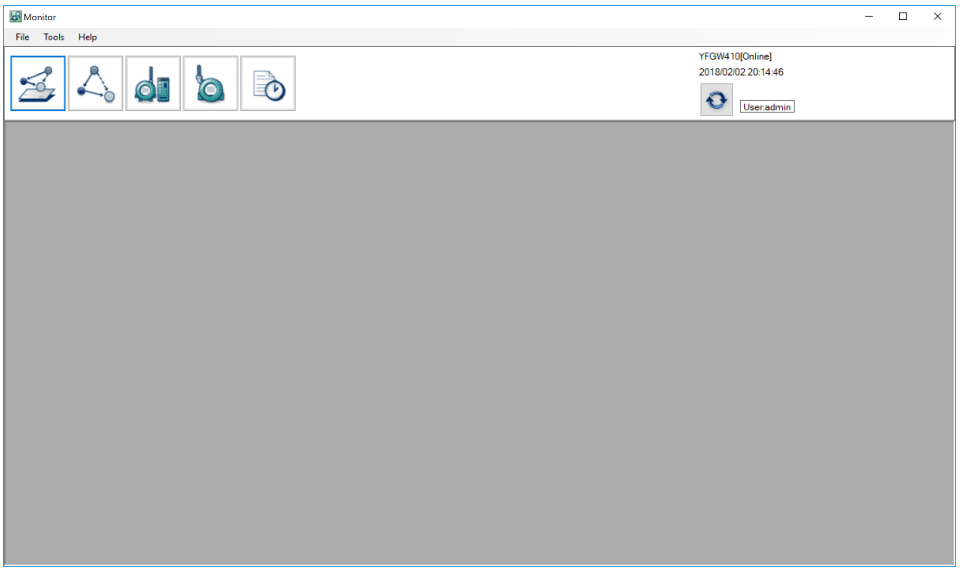
1. Start Internet Explorer and enter assigned IP (Default http://192.168.0.101:8080) in the web browser navigation field.
2. Click “Monitor” and the login dialog will appear.

2.1 OTA Armstrong ST6700 Provisioning and Joining – continued

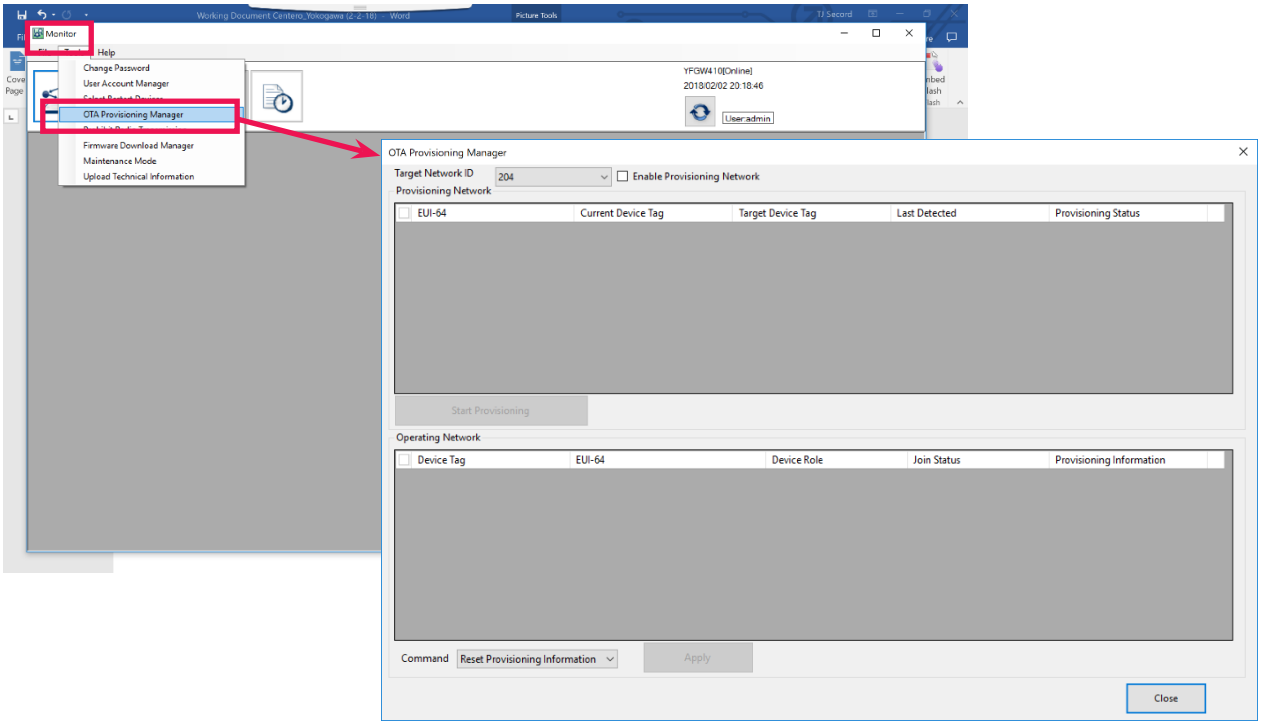
3. Follow the login steps (if it is the first time, the default login user is “admin” and password “admin”).



4. After a successful login the following window will become available:

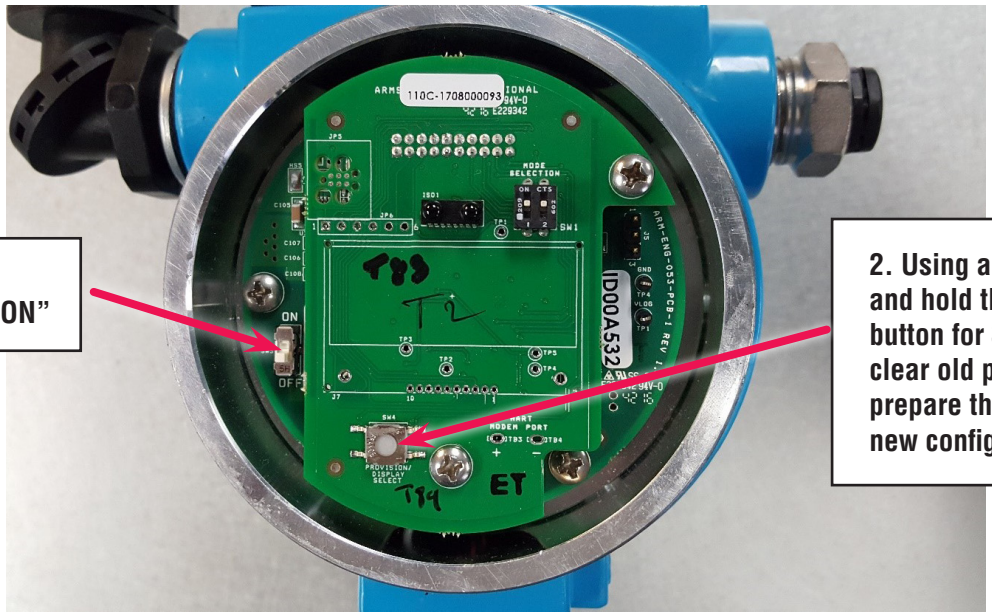


5. From tab menu select “Tools -> OTA Provisioning Manager”:

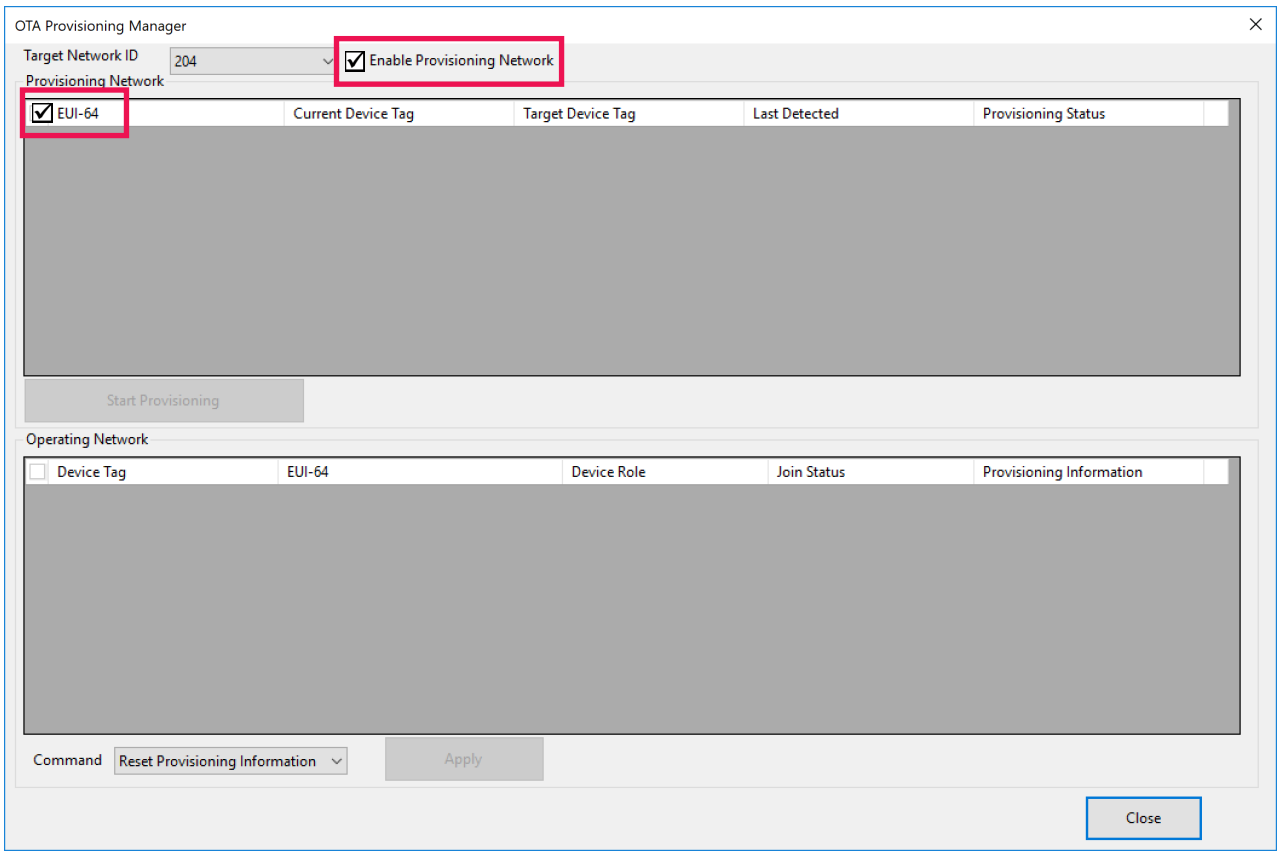


2.1 OTA Armstrong ST6700 Provisioning and Joining – continued

6. Turn on the ST6700 and clear provisioning.

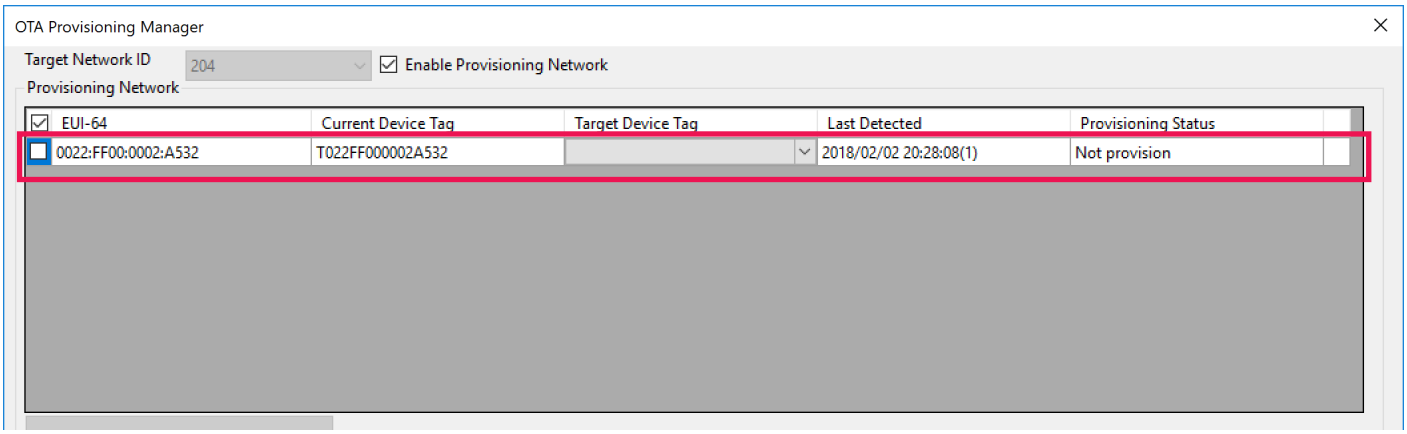


7. Select the checkbox for “Enable Provisioning Network” and “EUI-64”.

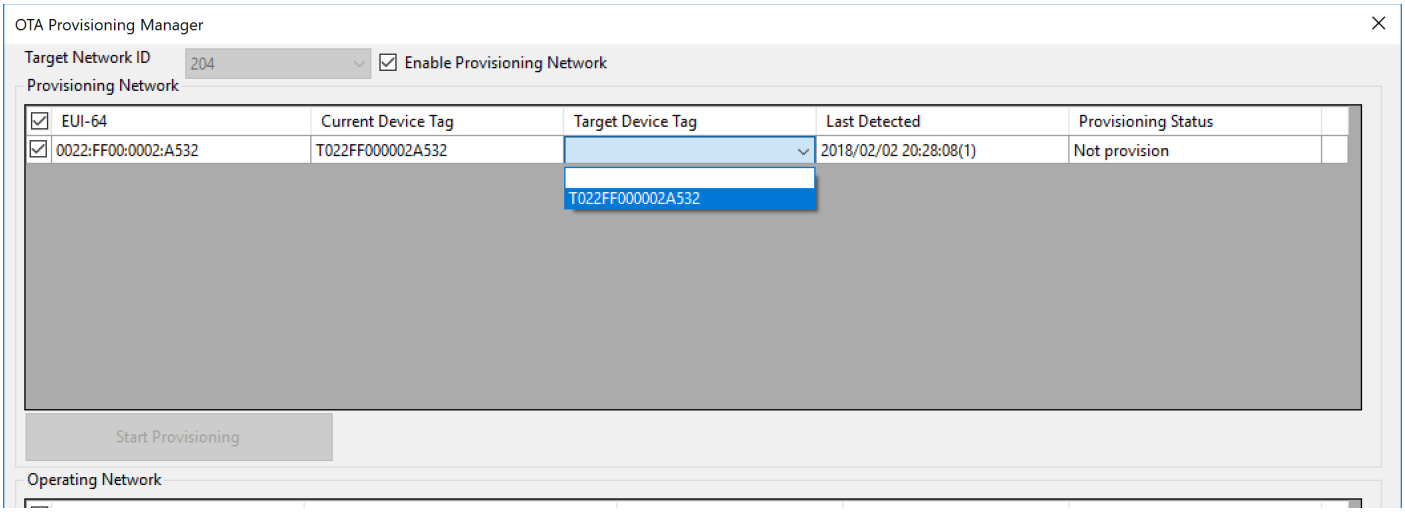


2.1 OTA Armstrong ST6700 Provisioning and Joining – continued

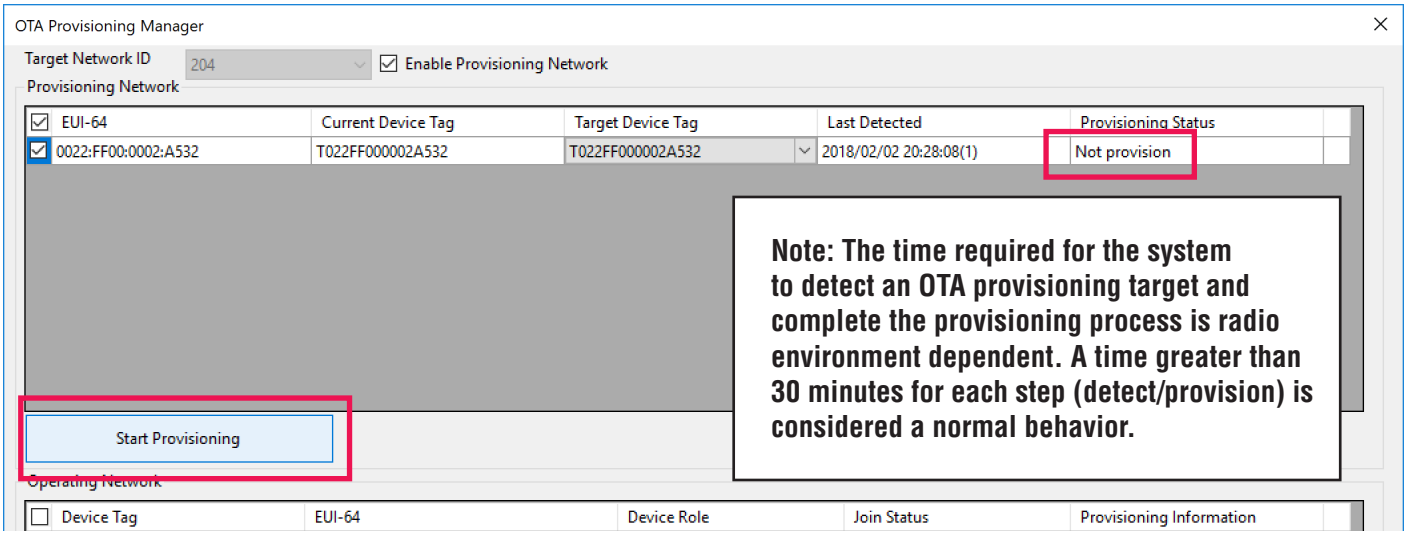
8. Wait until the “Provisioning Network” window is populated.



9. Under “Provisioning Network” select the device, then in “Target Device Tag” dropdown select the tag being provisioned.

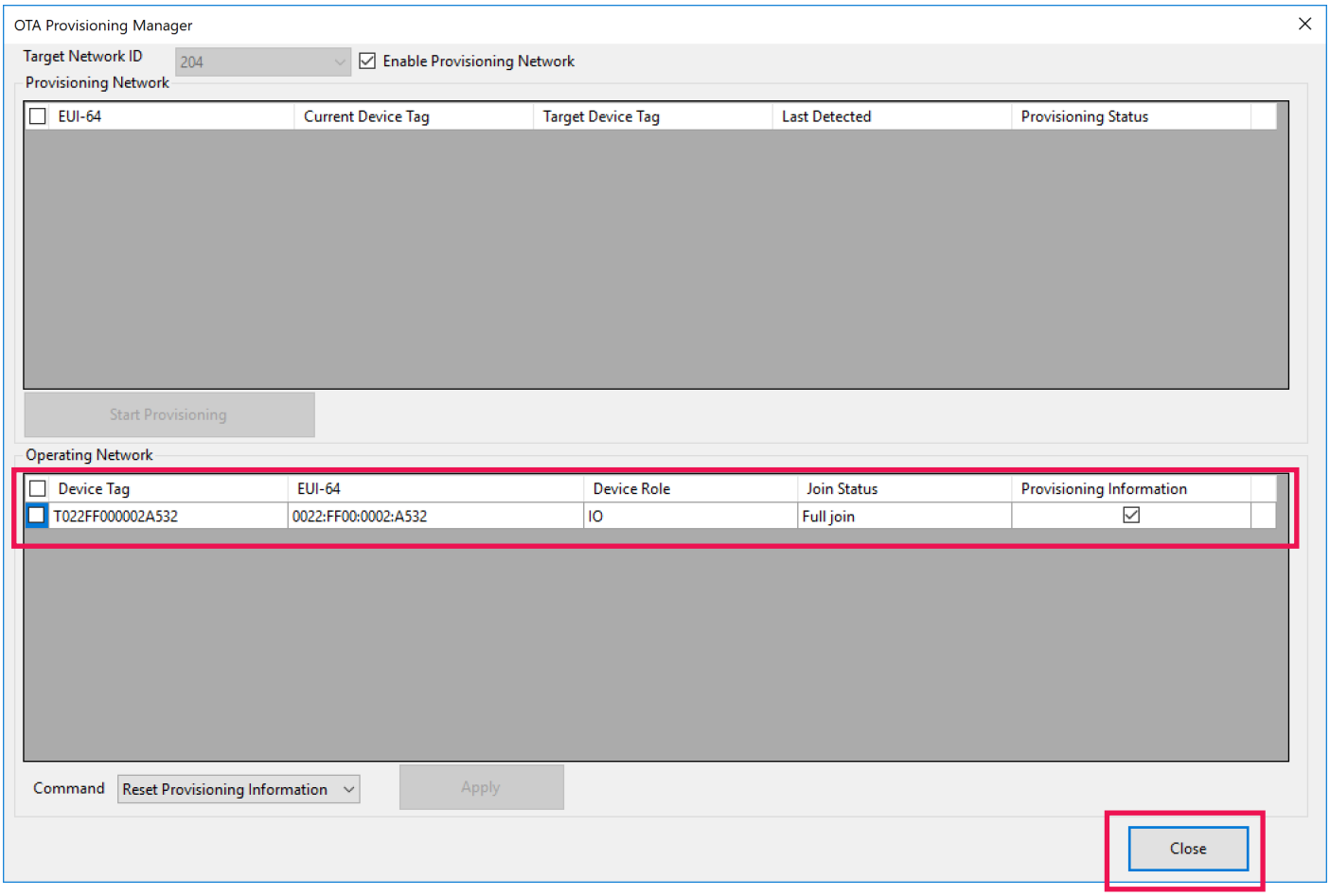


10. Click “Start Provisioning” button to initiate OTA provisioning mechanism. The “Provisioning Status” indication to monitor will update based on the current stage of the provisioning process (Expected steps: not provision -> waiting-> now provisioning -> provisioned).



2.1 OTA Armstrong ST6700 Provisioning and Joining – continued

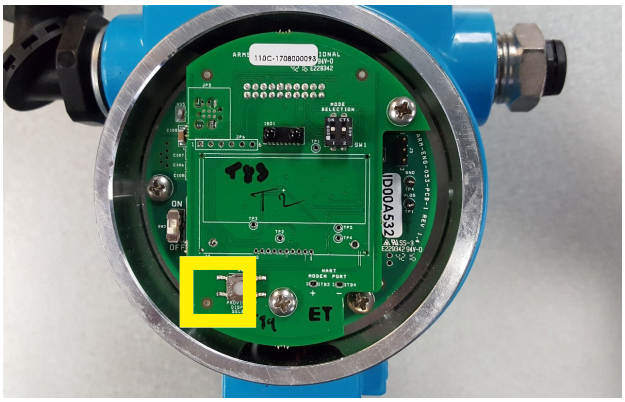
11. The procedure is considered completed, when the device is removed from the “Provisioning Network” window and the status in the “Operation Network” window is set to “Full Join”. Click “Close” when complete.



12. On the ST6700 quickly press and release the Provisioning button 5 times consecutively, within 2-4 seconds. This will initiate publishing of data on all channels.

Note: (1) The Device will disconnect from the system momentarily.

(2) Once the device is disconnected, initiate a power cycle of the device and it will rejoin faster than waiting through the normal process.



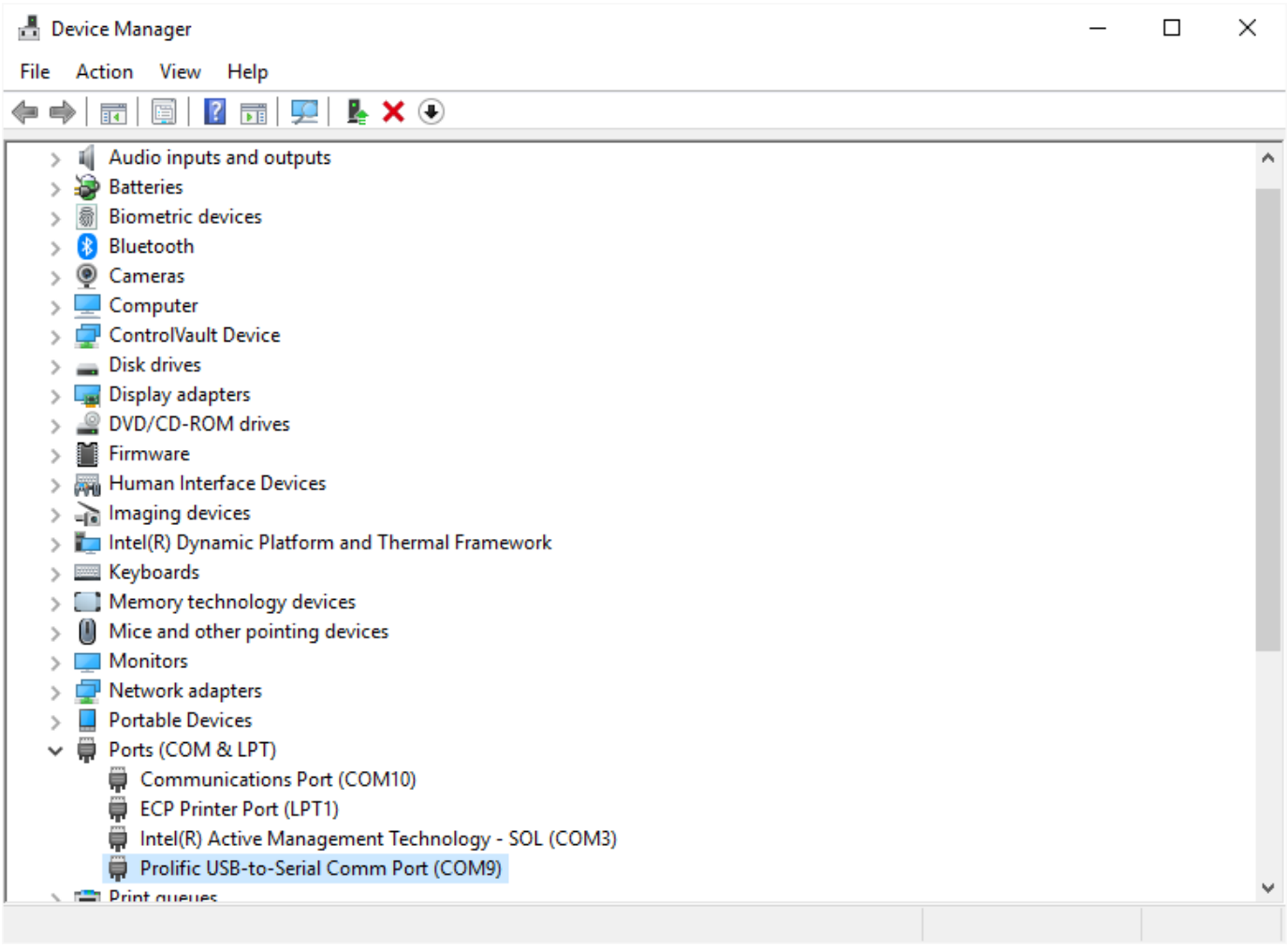
2.2 IR Armstrong ST6700 Provisioning and Joining

The Yokokawa environment supports two methods of provisioning and joining. Section 2.1 above covered one method using over the air provisioning. The second method is out of band provisioning (IR Provisioning) that requires an infrared adaptor. This manual assumes the configuration of the infrared adapter (ACTiSYS IR224UN) has been completed. If not, please refer to Yokogawa manual IM 01R01A01-01E 16th Edition, section N.

Below are the steps required for out of band (IR) provisioning:

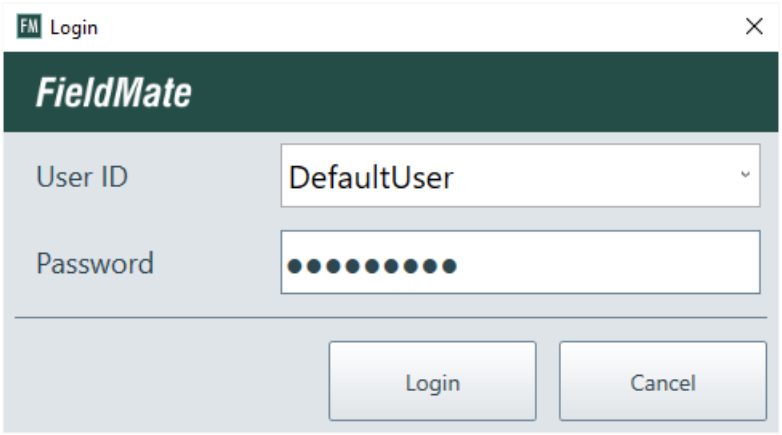
1. Device Check

Open “Device Manager” on the PC to determine the COM port of the installed infrared adapter, in the below example the COM port is set to COM9.

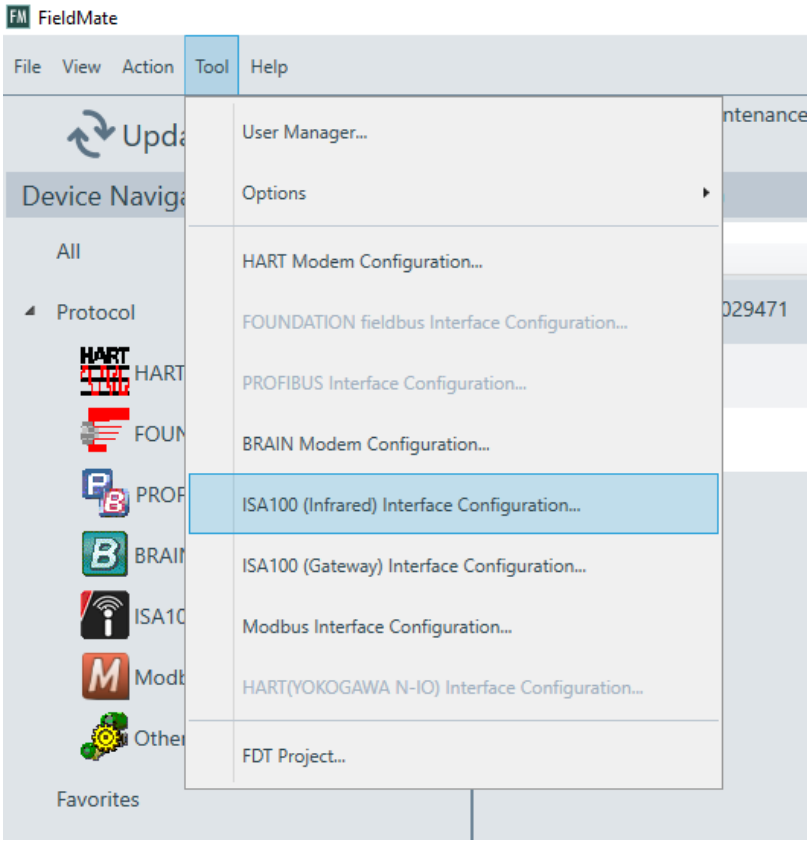


2.2 IR Armstrong ST6700 Provisioning and Joining – continued

2. Start the FieldMate software and follow the login steps (if it is the first time, the default login user is “DefaultUser” and Default password is auto filled).

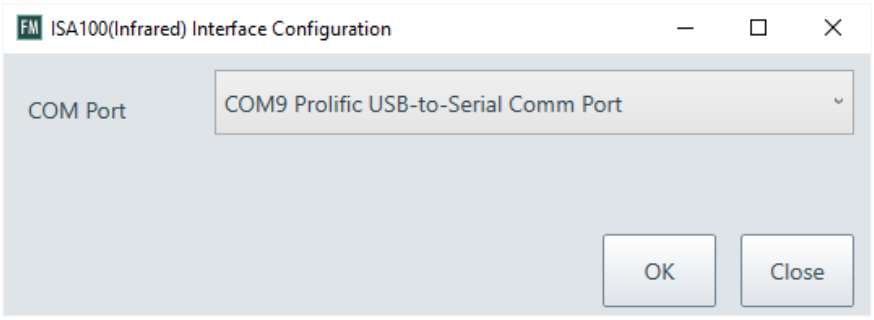


3. Select Tool -> select ISA100 (Infrared) Interface Configuration.

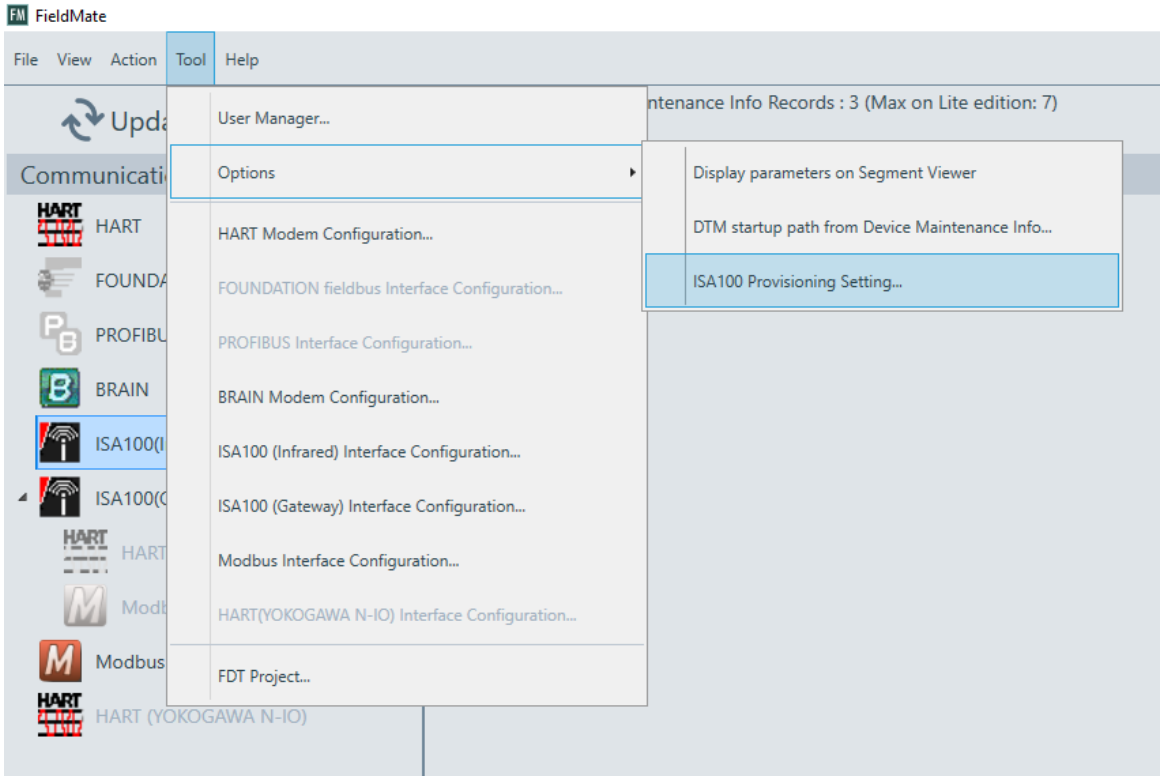


2.2 IR Armstrong ST6700 Provisioning and Joining – continued

4. Verify the COM Port has been selected with "Prolific USB-to-Serial Comm Port" has been selected and press "OK"

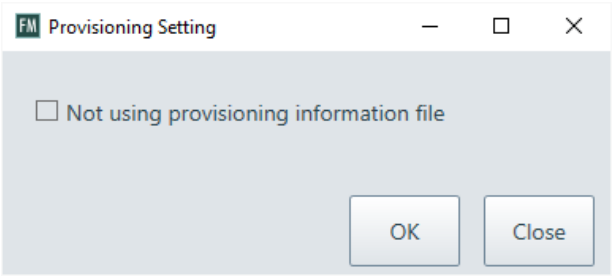


5. Verify that FieldMate is set to use Provisioning Information file Select Tool --> Options --> ISA100 Provisioning Setting

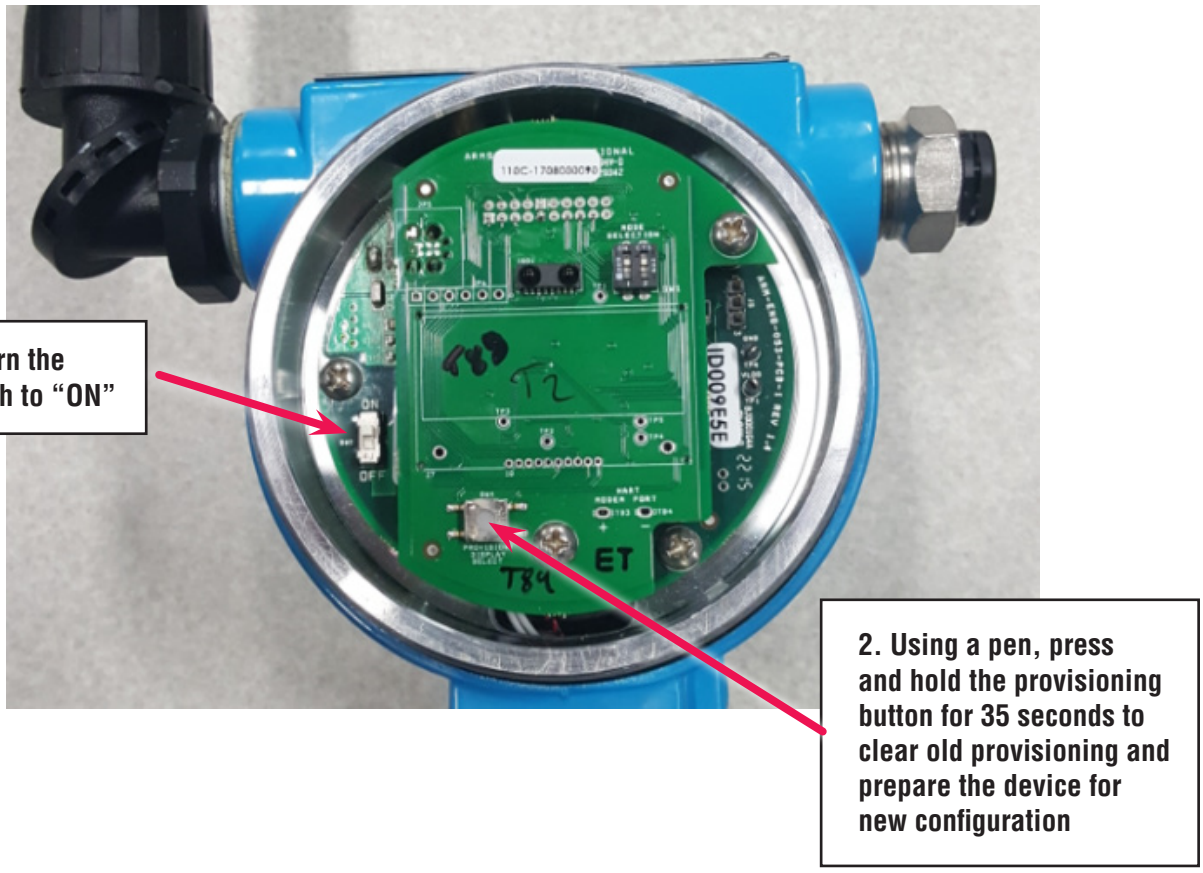


2.2 IR Armstrong ST6700 Provisioning and Joining – continued

The following settings page will open, verify check box is NOT selected as shown below, select “OK”.



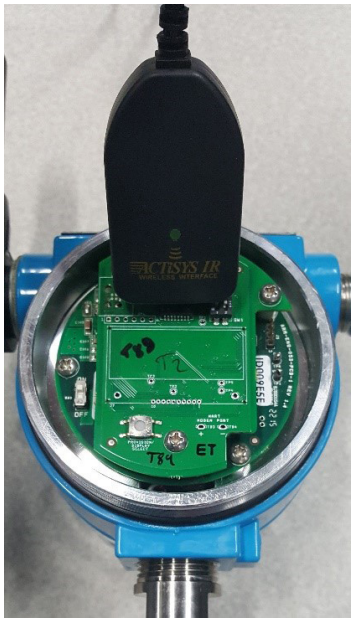
6. Turn on the ST6700 and clear provisioning.

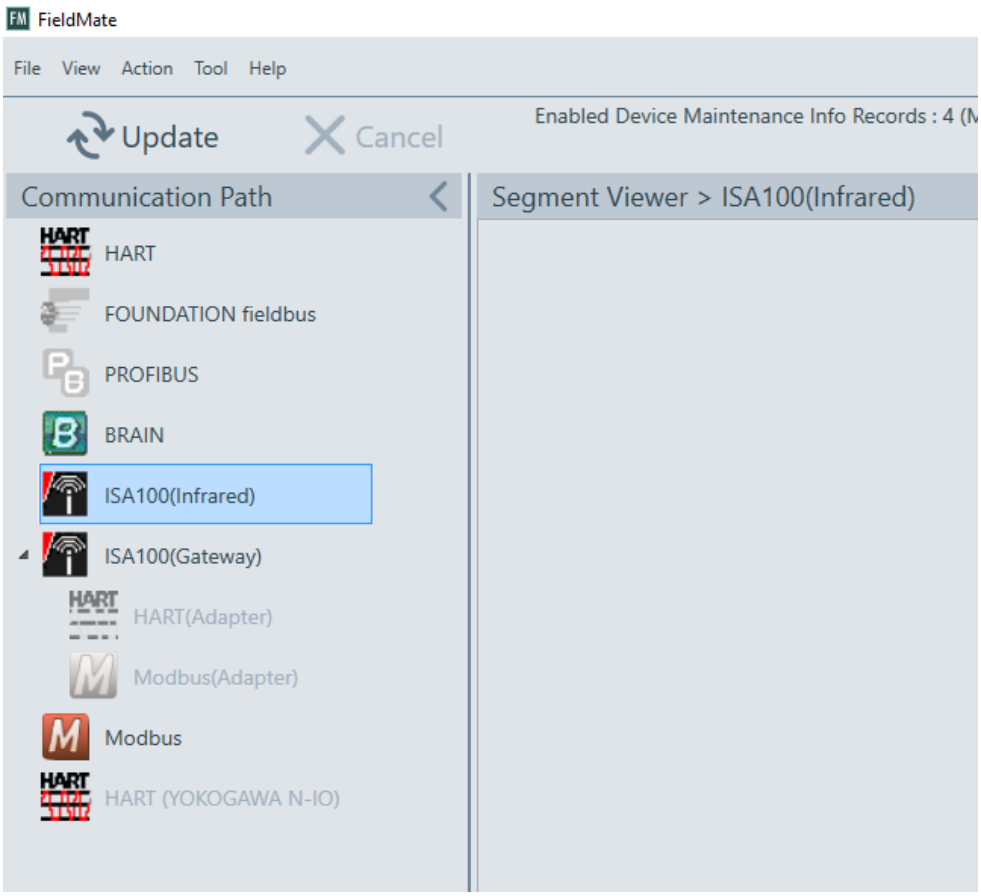


2.2 IR Armstrong ST6700 Provisioning and Joining – continued

7. Start Provisioning Function

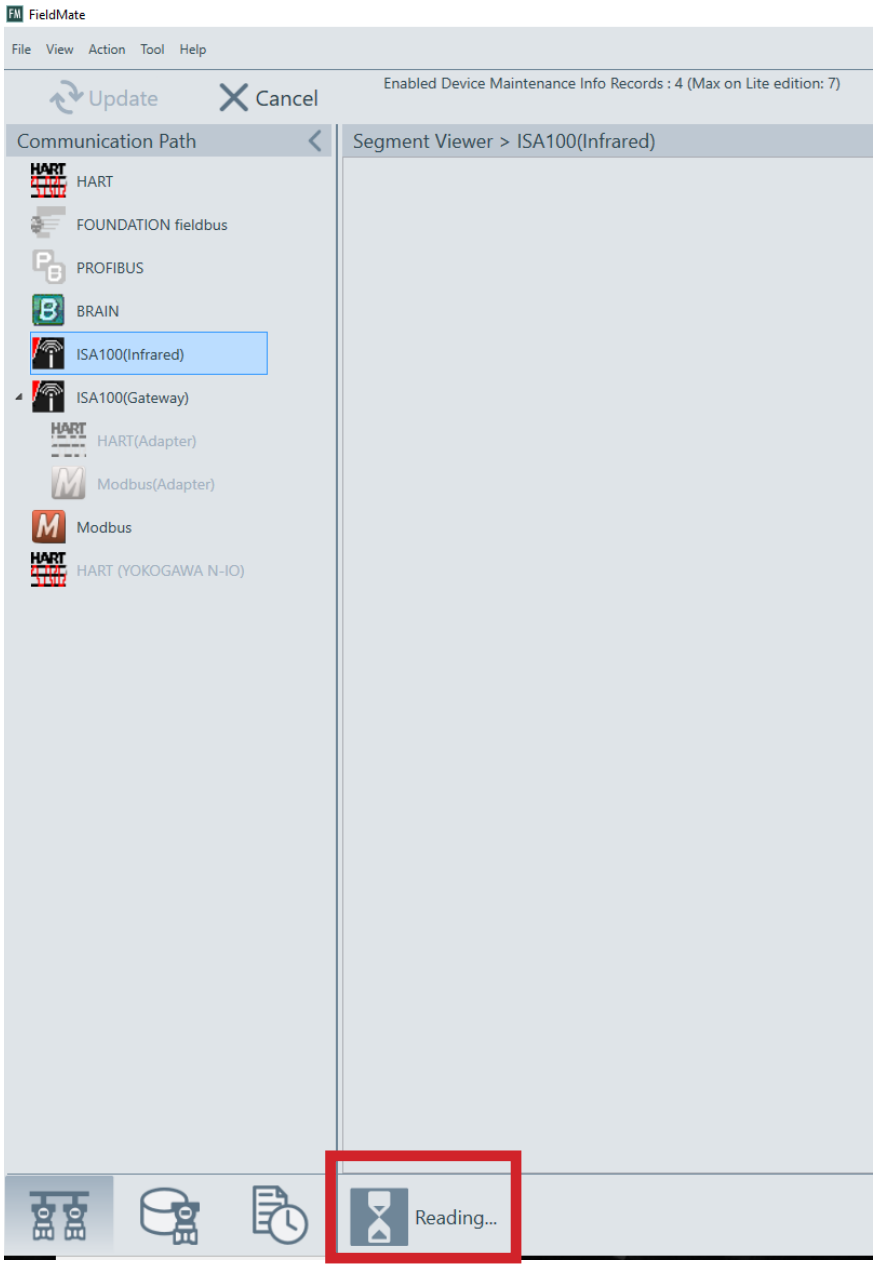
Holding the IR adapter close to the IR port on the ST6700 device select ISA100(Infrared) in the segment viewer, select Update, while reading do not remove the adapter from the device.





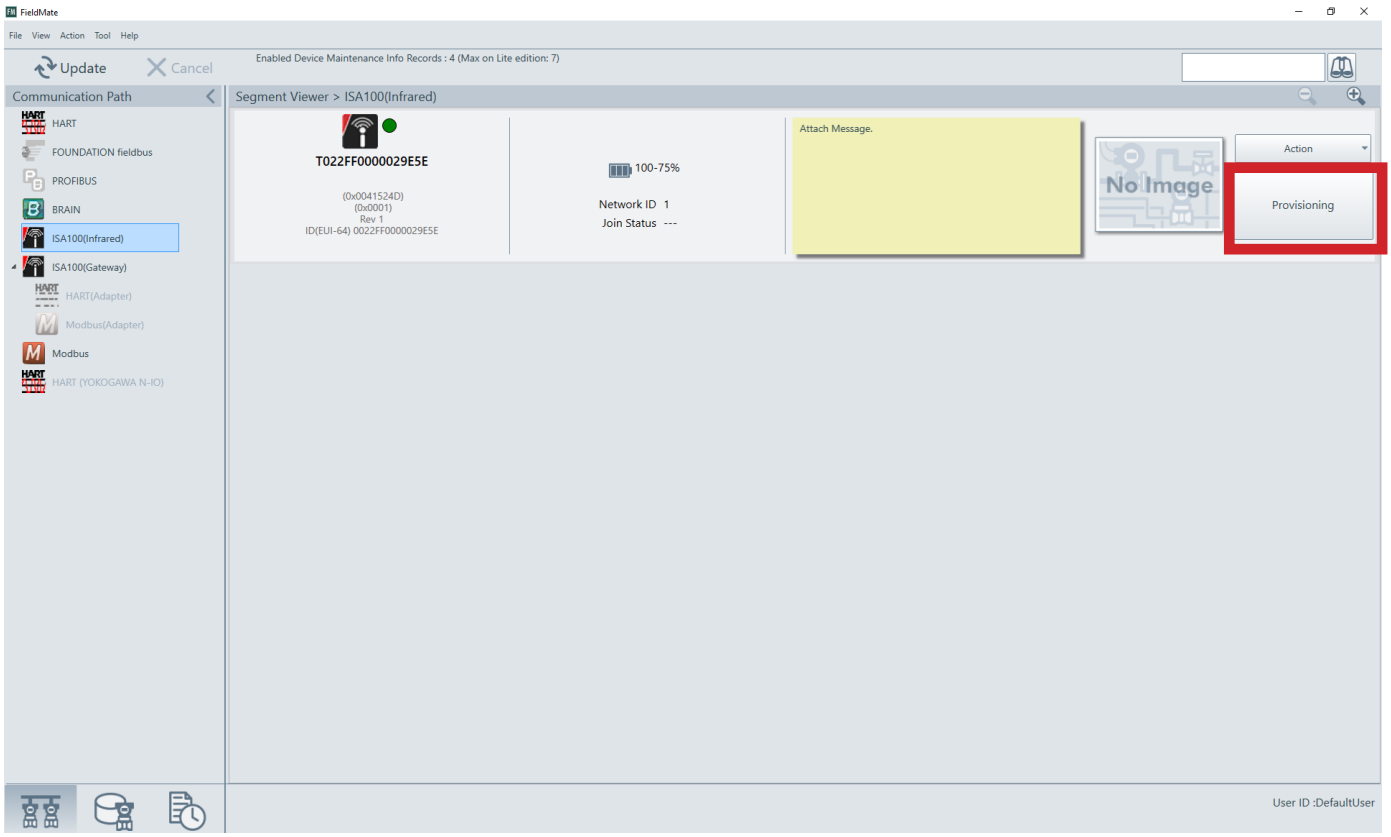
2.2 IR Armstrong ST6700 Provisioning and Joining – continued

8. Reading” will be displayed near the bottom of the page while discovering the ST6700 device.



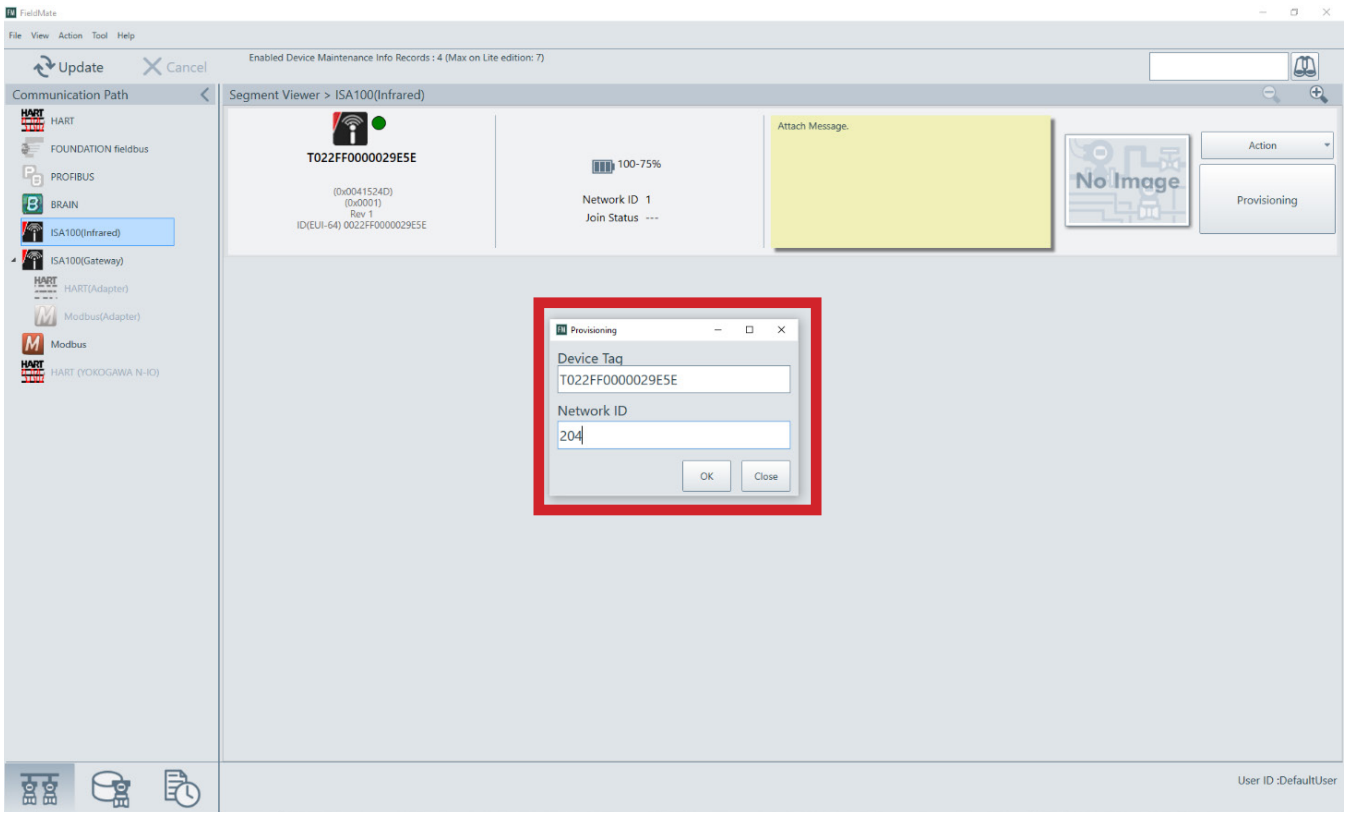
2.2 IR Armstrong ST6700 Provisioning and Joining – continued

9. The device information for the ST6700 being configured will be displayed once the “Reading” process has completed.

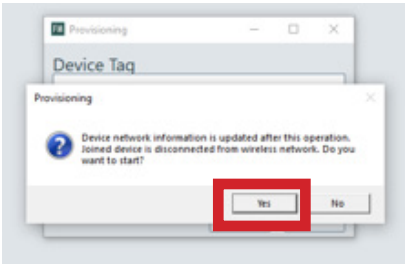


2.2 IR Armstrong ST6700 Provisioning and Joining – continued

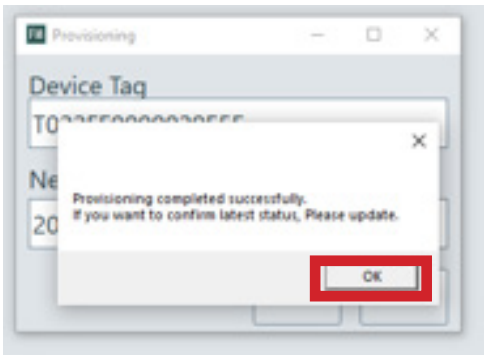
10. Select the “Provisioning” button, the “Provisioning” configuration pop up will display, verify the proper device tag is entered and update to the proper Network ID from step 5 of section 2.0, select “OK”



11. A pop up dialog box will appear, select “Yes”.

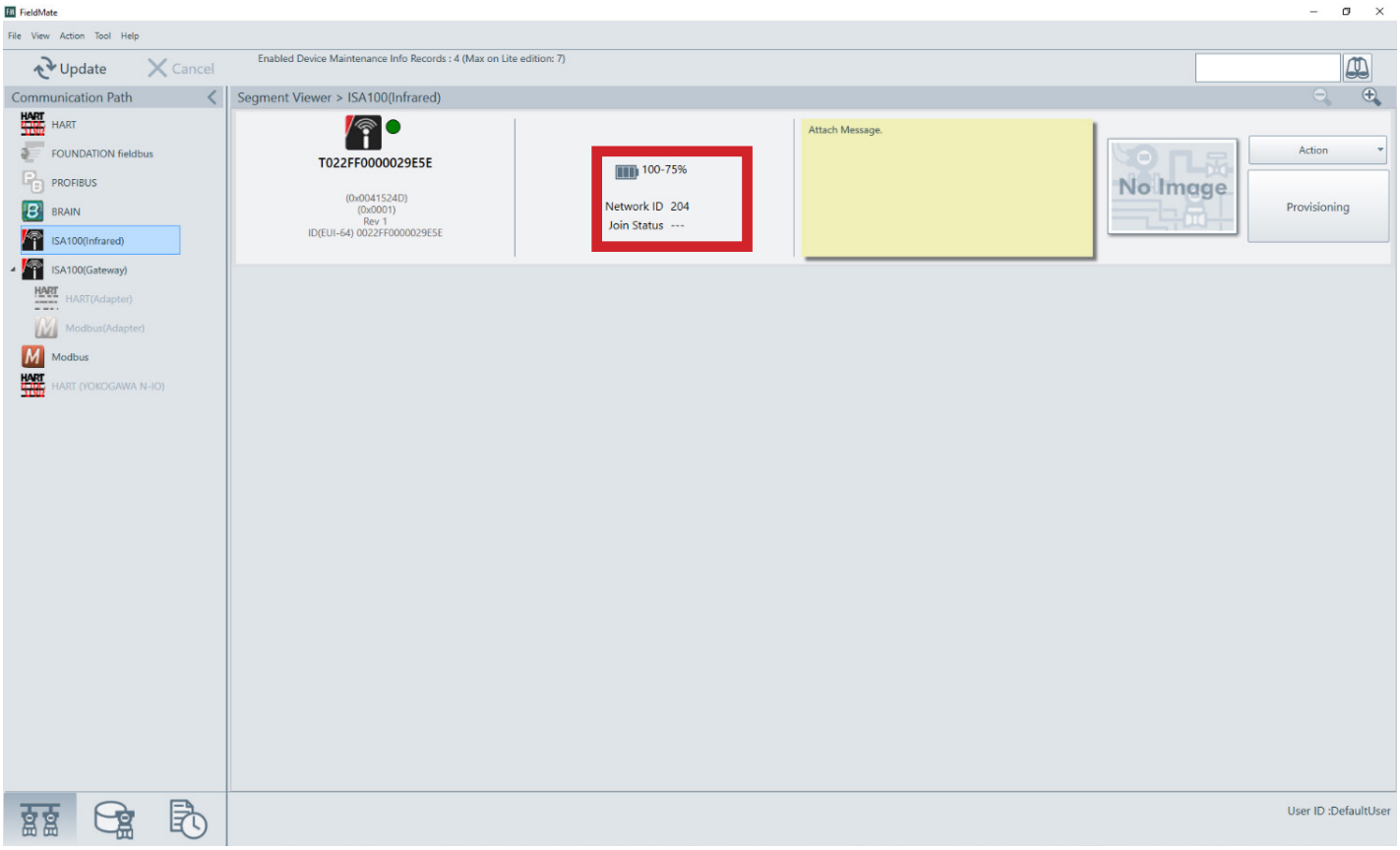


12. A pop up dialog box will appear when the provisioning process has been completed stating “Provisioning Completely Successfully”, select “OK” to continue.



2.2 IR Armstrong ST6700 Provisioning and Joining – continued

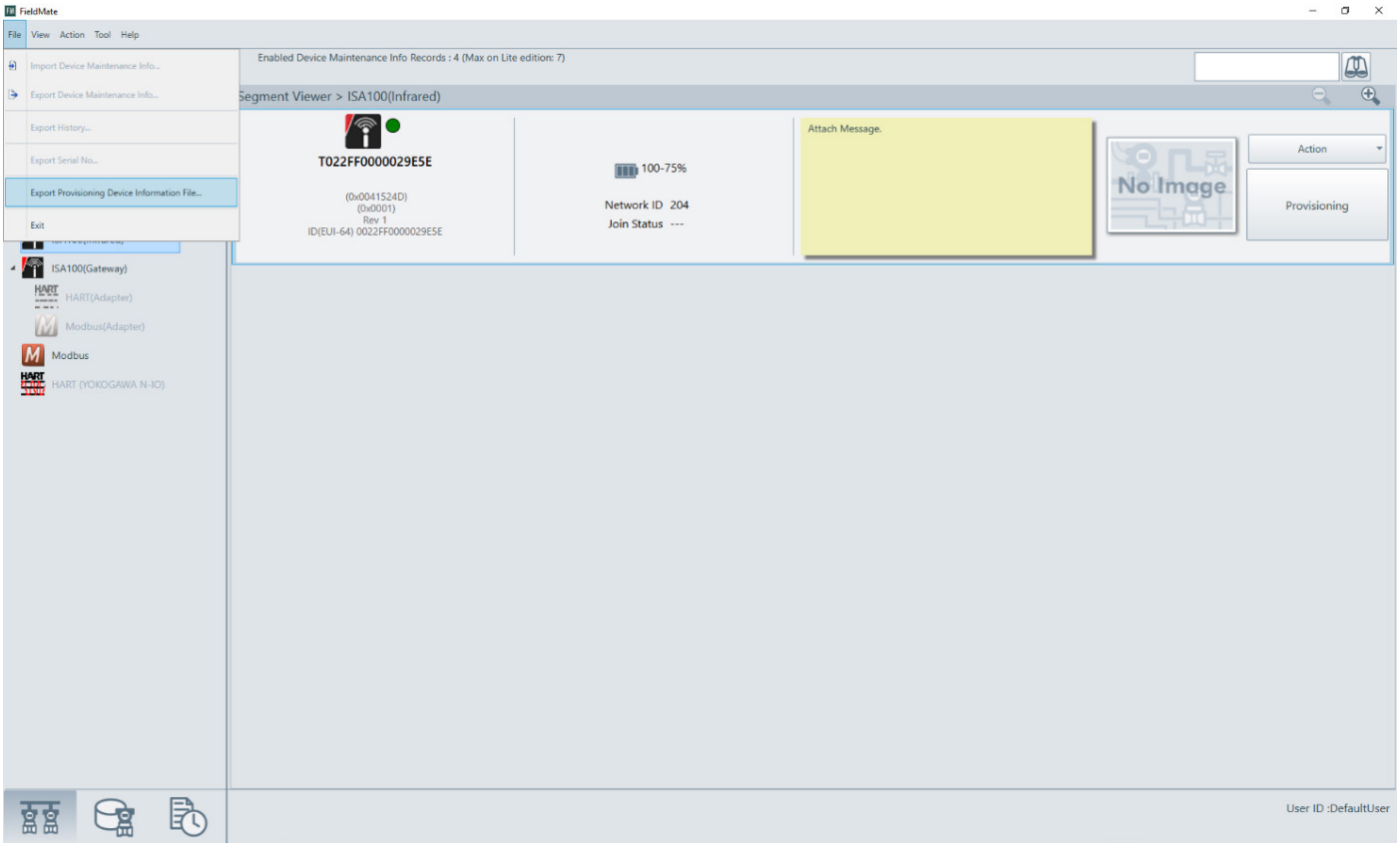
13. Note the Network ID has updated for the device.



14. Once all the devices have been provisioned, the Provisioning Device Information file needs to be exported.

2.2 IR Armstrong ST6700 Provisioning and Joining – continued

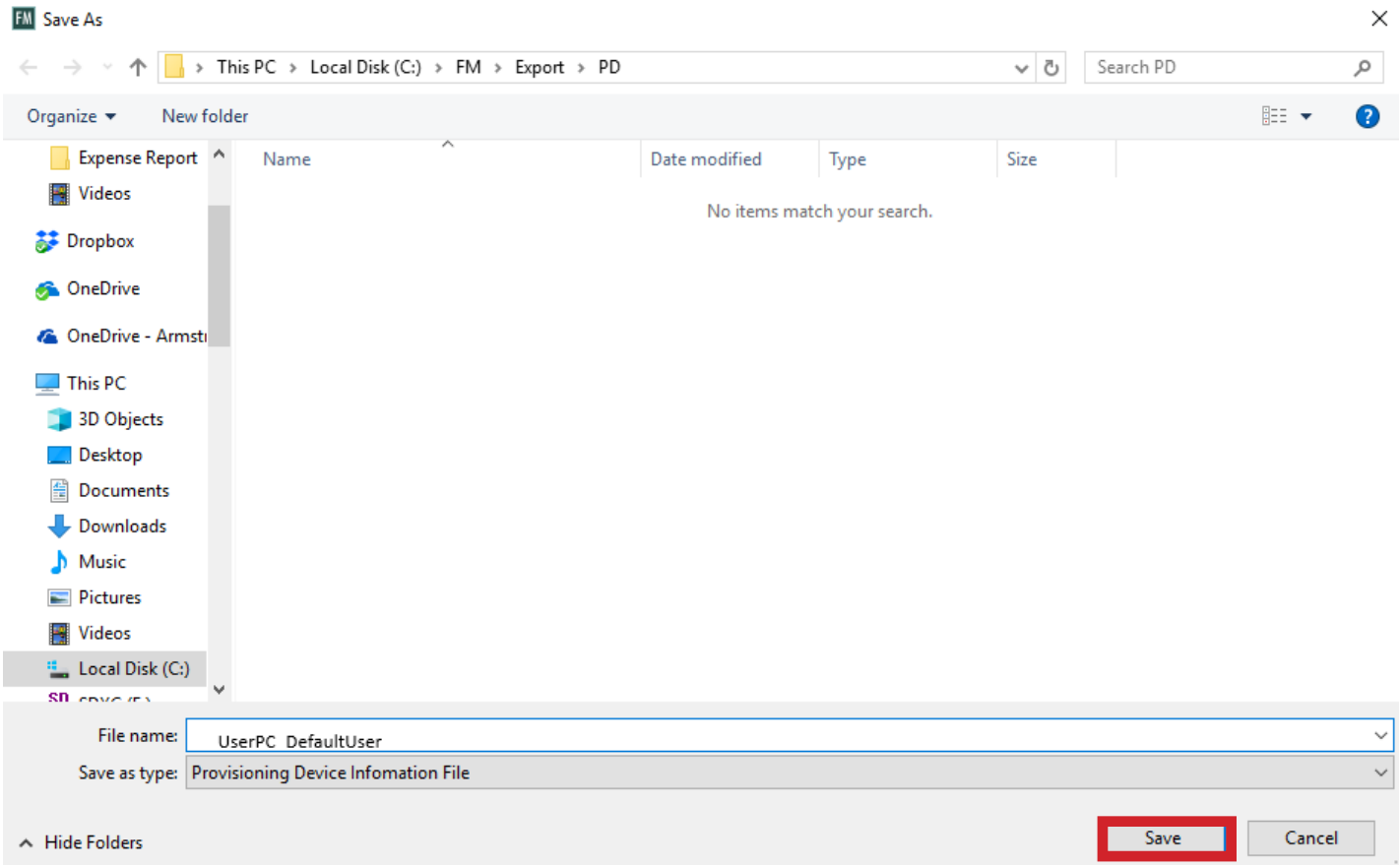
15. Select File -> Export Provisioning Device Information File.



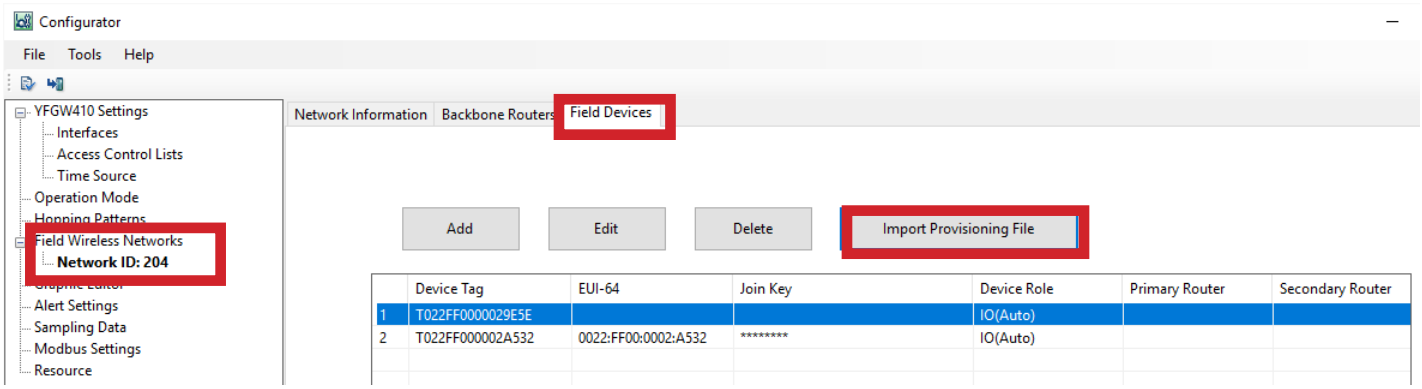
2.2 IR Armstrong ST6700 Provisioning and Joining – continued

16. The Save As window will be displayed, the default save location will be:
    FieldMate installed drive:\FM\Export\PD
    File name: PC computer name_FieldMate user name.ypif

    In this example we are saving to C:\ FM\Export\PD with file name UserPC_DefaultUser.ypif

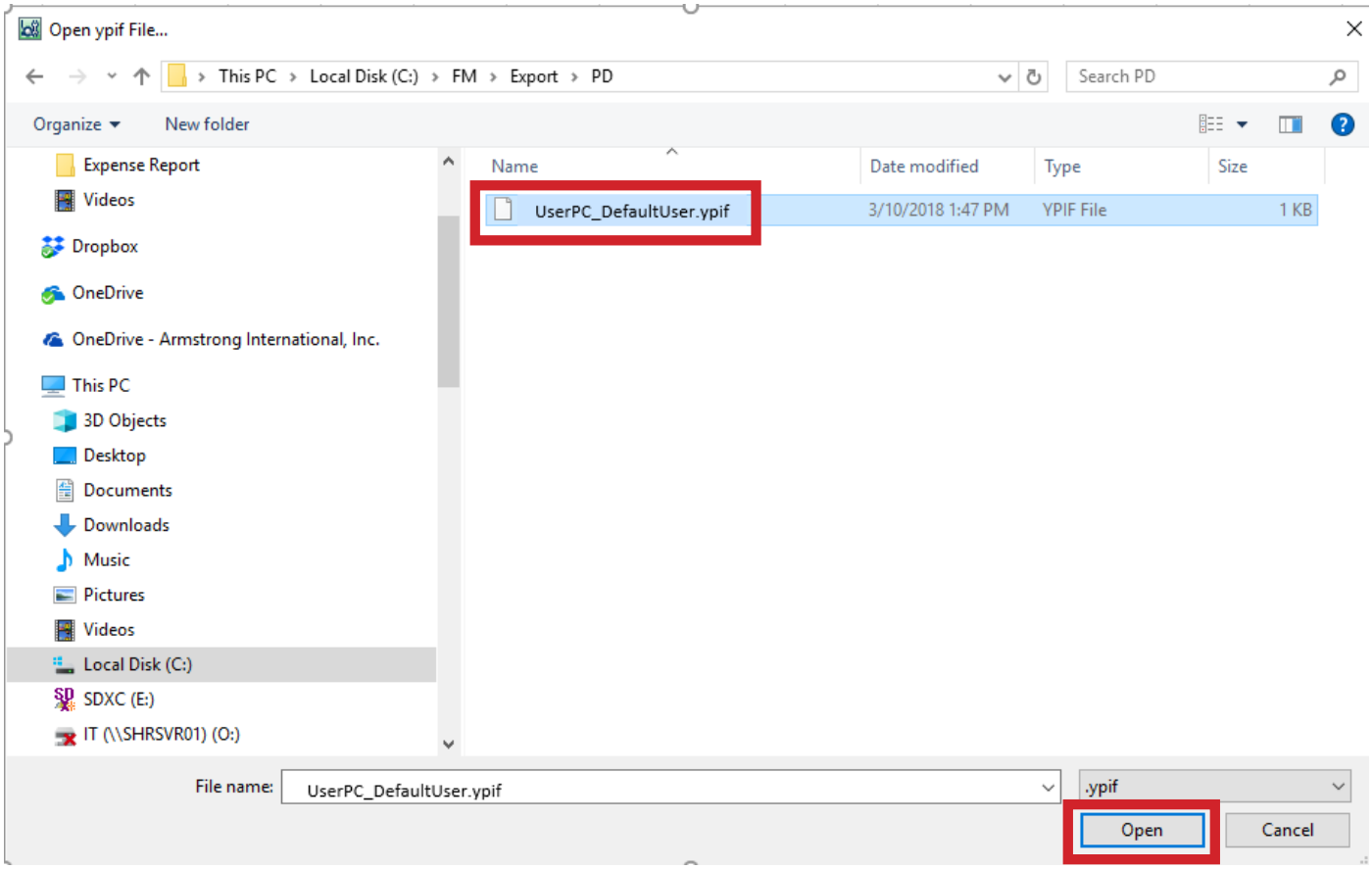


17. Following steps 1-6 under section 2.0 System Configuration, navigate to the Field devices tab under Network ID and select the Import Provisioning File button.



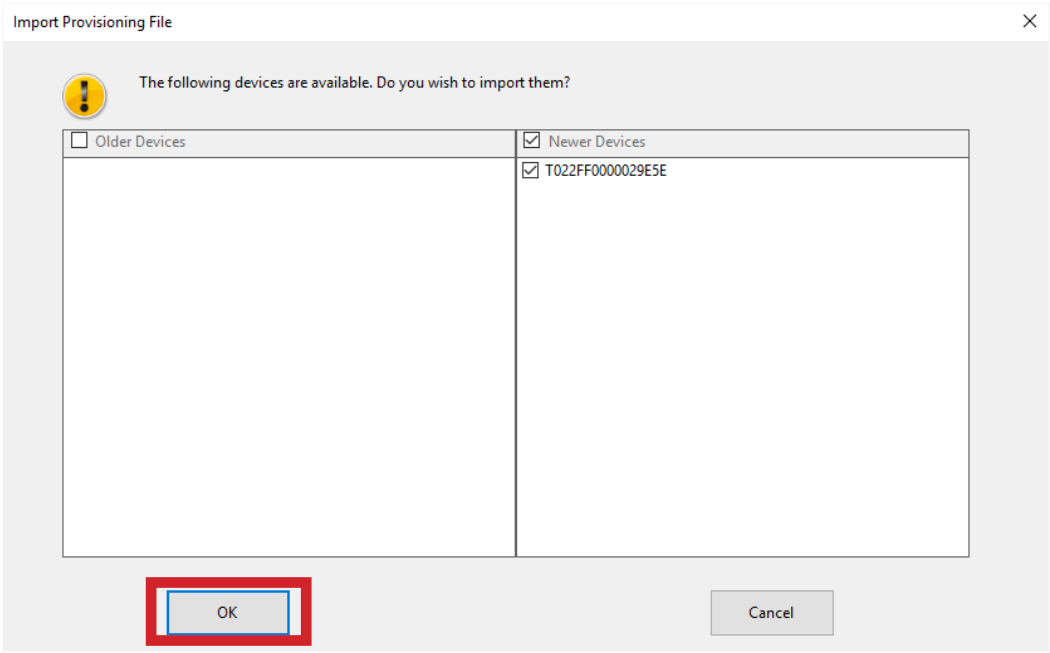
2.2 IR Armstrong ST6700 Provisioning and Joining – continued

18. The Open ypif File dialog window will open, navigate to the location where the file was saved in step In this example C:\ FM\Export\PD with file name UserPC_DefaultUser.ypif. Select the file name and select Open.

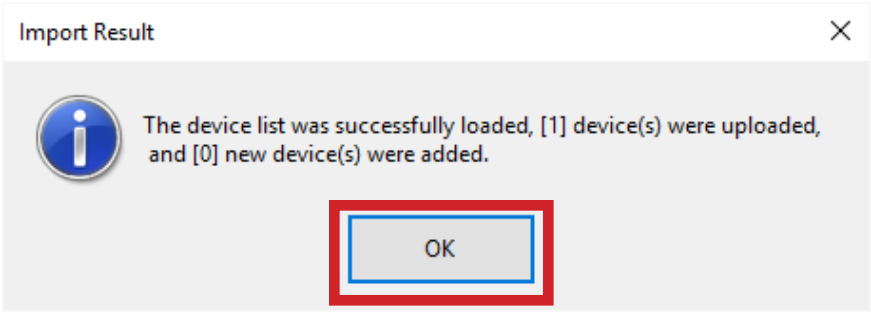


2.2 IR Armstrong ST6700 Provisioning and Joining – continued

19. The Import Provisioning File dialog window will open showing the list of new devices to be imported into the YFGW410. Verify all new devices are listed, then select Ok

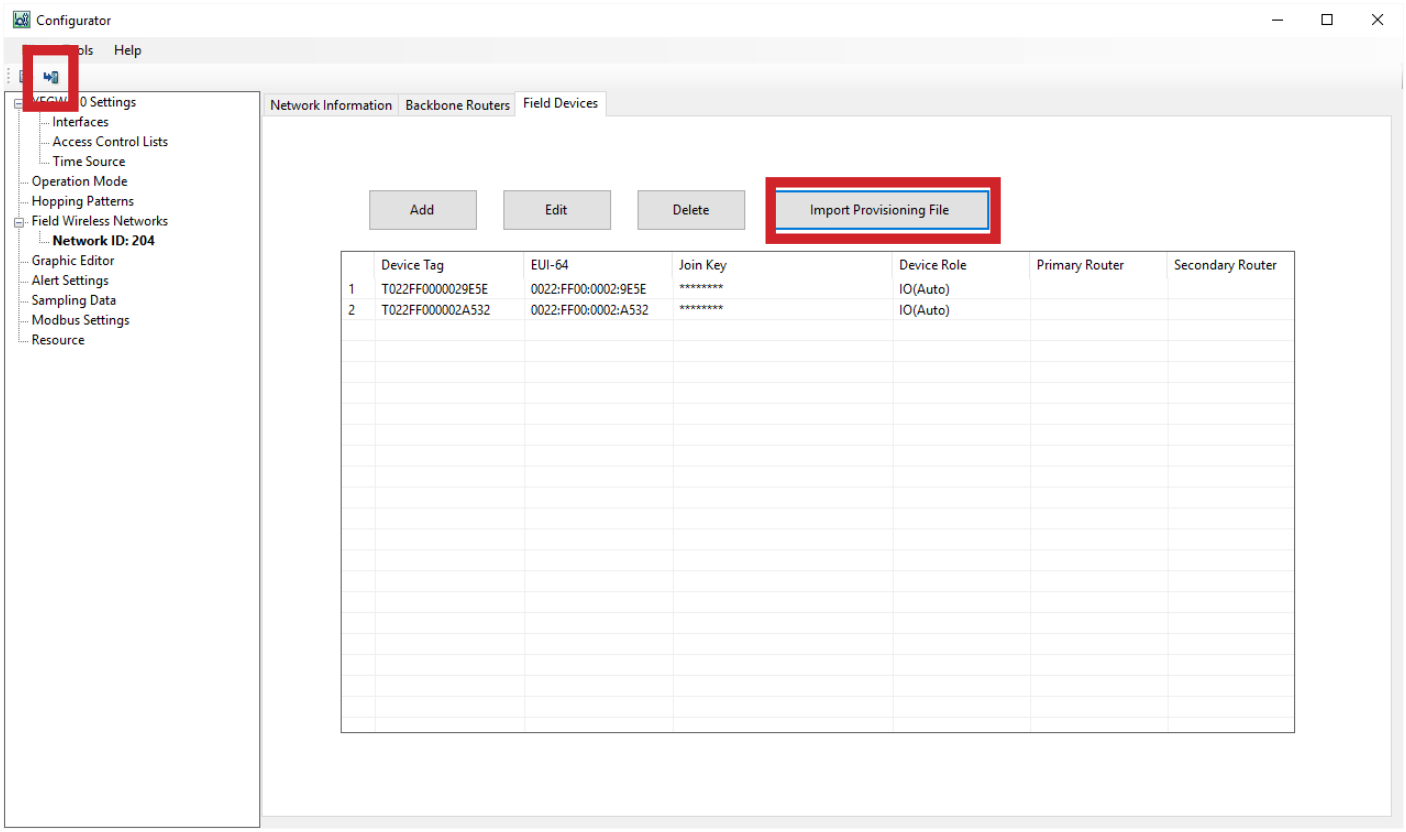


The Import Result dialog will be displayed showing the number of devices loaded successfully, select OK.

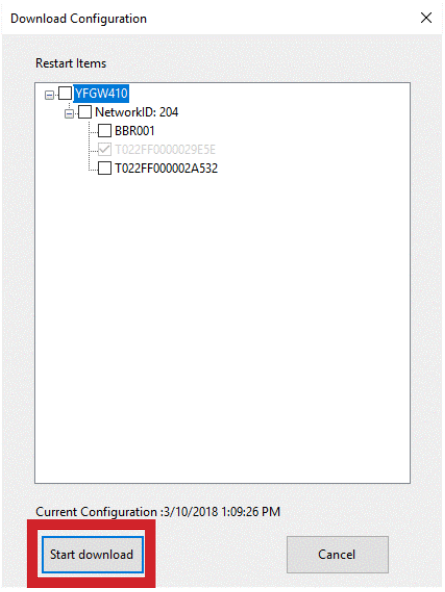


2.2 IR Armstrong ST6700 Provisioning and Joining – continued

20. Verify the Join Key is displayed for the newly added devices in the Configurator Field Devices page. Select the Download button to send the information to the YFGW410 Gateway

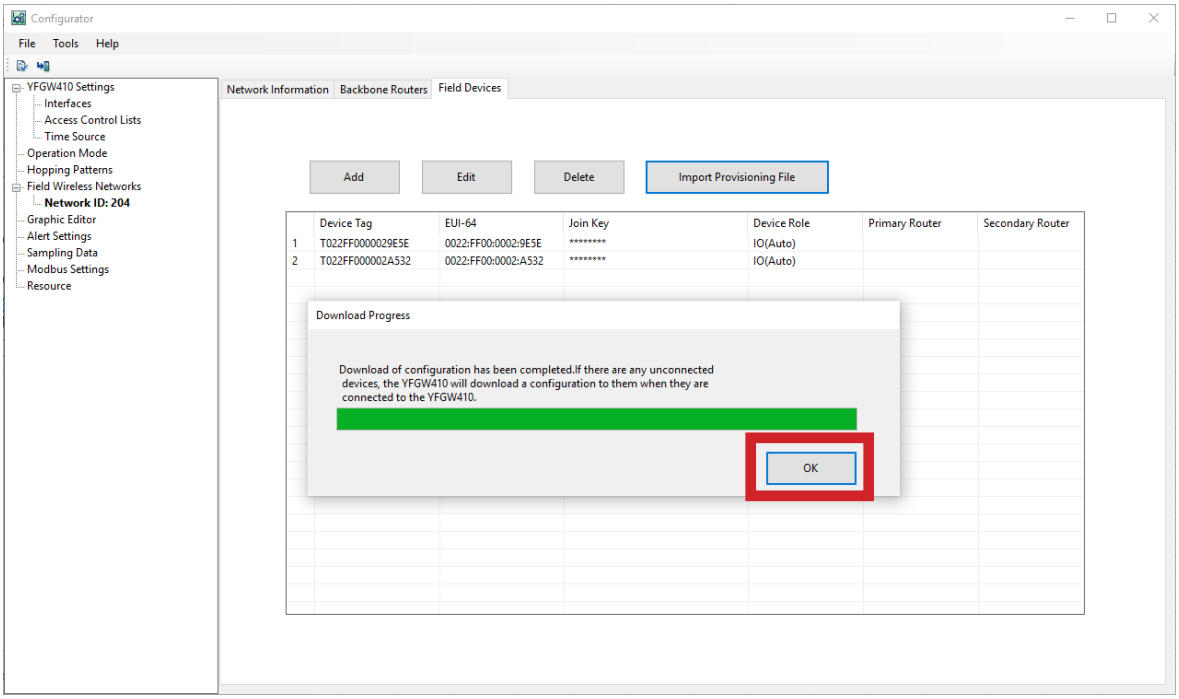


The Download Configuration dialog window will appear, select “Start Download”



2.2 IR Armstrong ST6700 Provisioning and Joining – continued

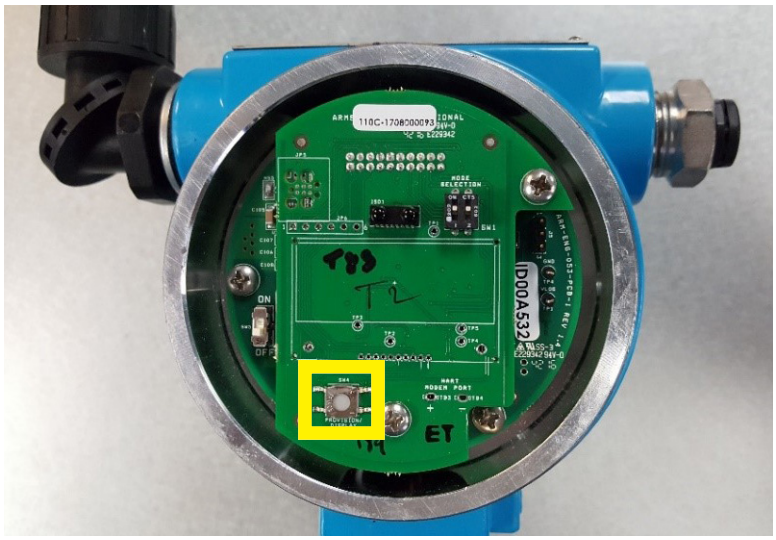
The Download Progress dialog window will display and state completed, select the OK button.



21. On the ST6700 quickly press and release the Provisioning button 5 times consecutively, within 2-4 seconds. This will initiate publishing of data on all channels.

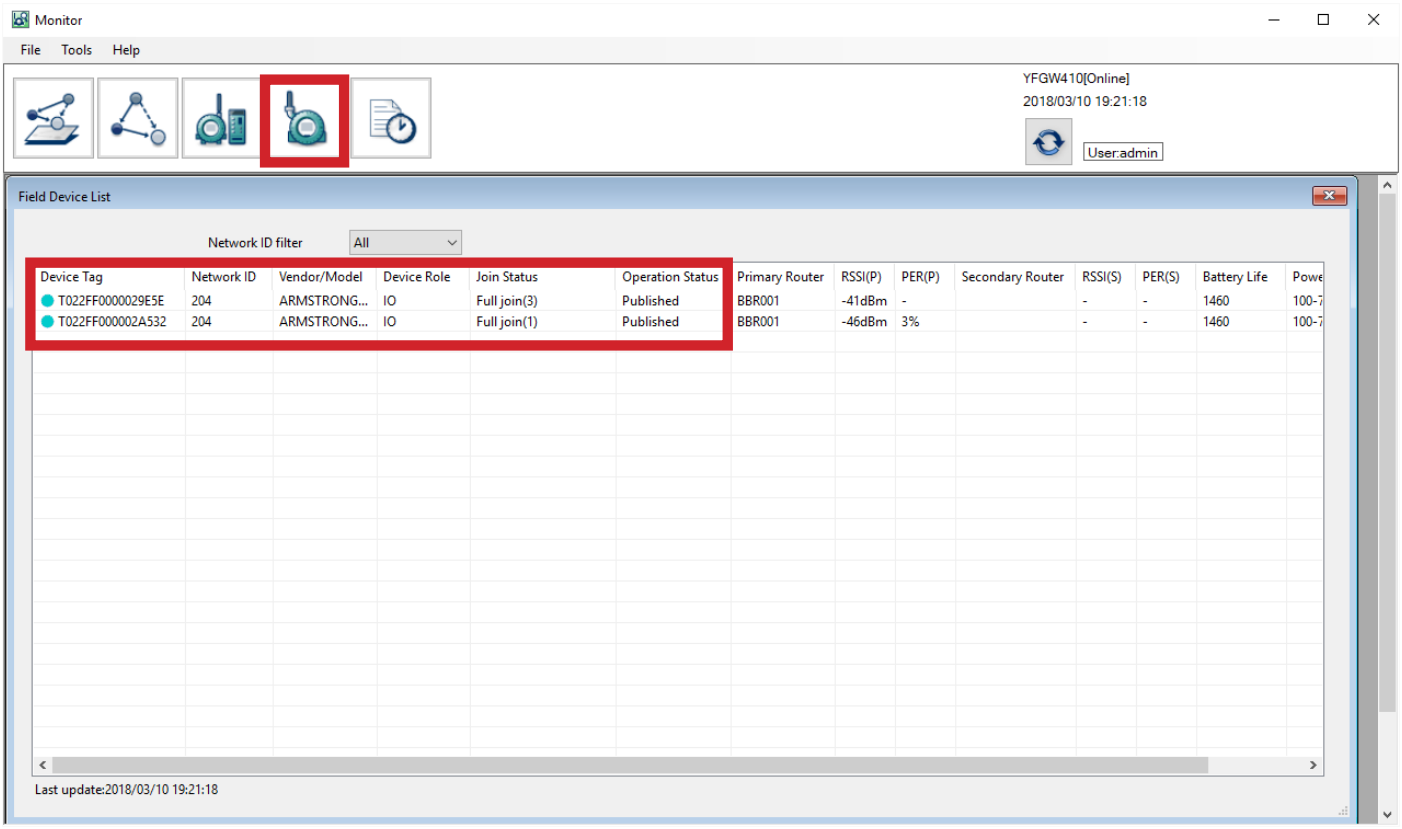
    Note: (1) The Device will disconnect from the system momentarily

    (2) Once the device is disconnected, initiate a power cycle of the device and it will rejoin faster than waiting through the normal process.



2.2 IR Armstrong ST6700 Provisioning and Joining – continued

22. Allow up to 30 minutes for the devices to fully join the network and begin publishing. Following steps 1-4 under Section 2.1, log onto the "Monitor" option of the Field Wireless Management Console. Select the Field Device List and verify the added devices show a Join Status of “Full Join” and an Operation Status of “Published”.



2.3 Viewing Device Data – Field Wireless Management Console

The Monitor tool enables the monitoring and operation status of Field Wireless System. In addition to the provisioning method, three other essential functions are available:

Topology Viewer - displays the field wireless network topology.

Field Device List – provides communication health reports such as RSSI (Received Signal Strength Indicator) and PER (Packet Error Rate).

Other proprieties of the devices can be selected by right-clicking a device icon. The following functions will be available:

Device proprieties - display device detail information;

Candidate neighbors – display neighbor devices;

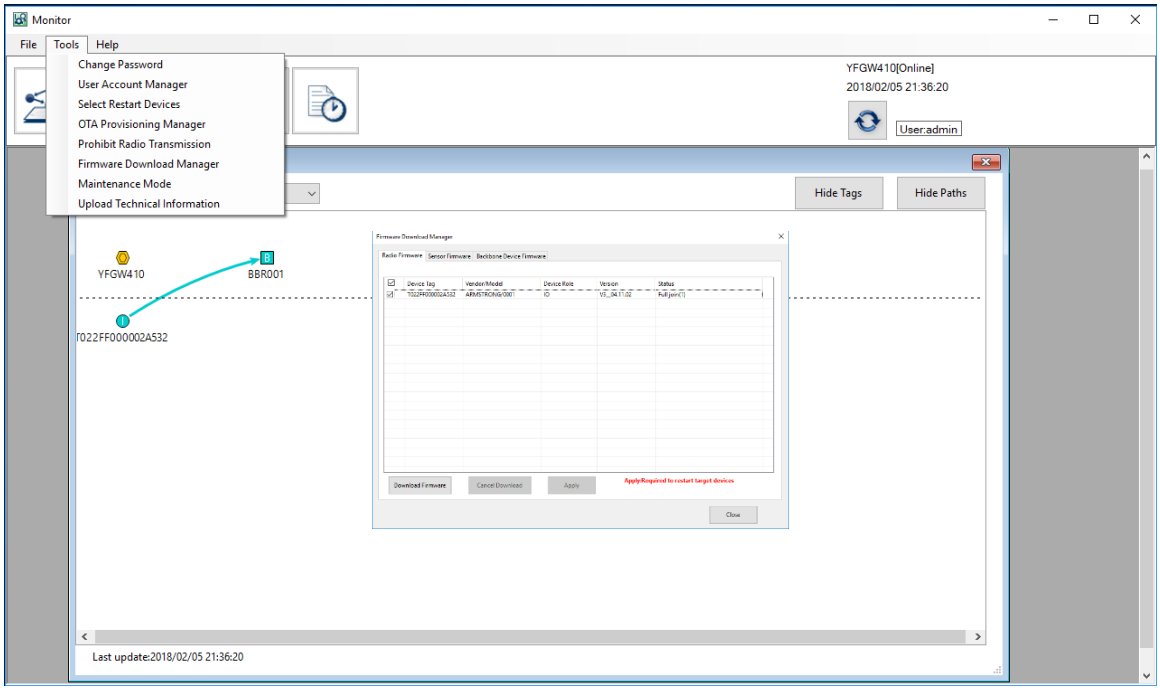
Restart device – two options: Warm restart and Restart as provisioned based on the ISA 100 specification;

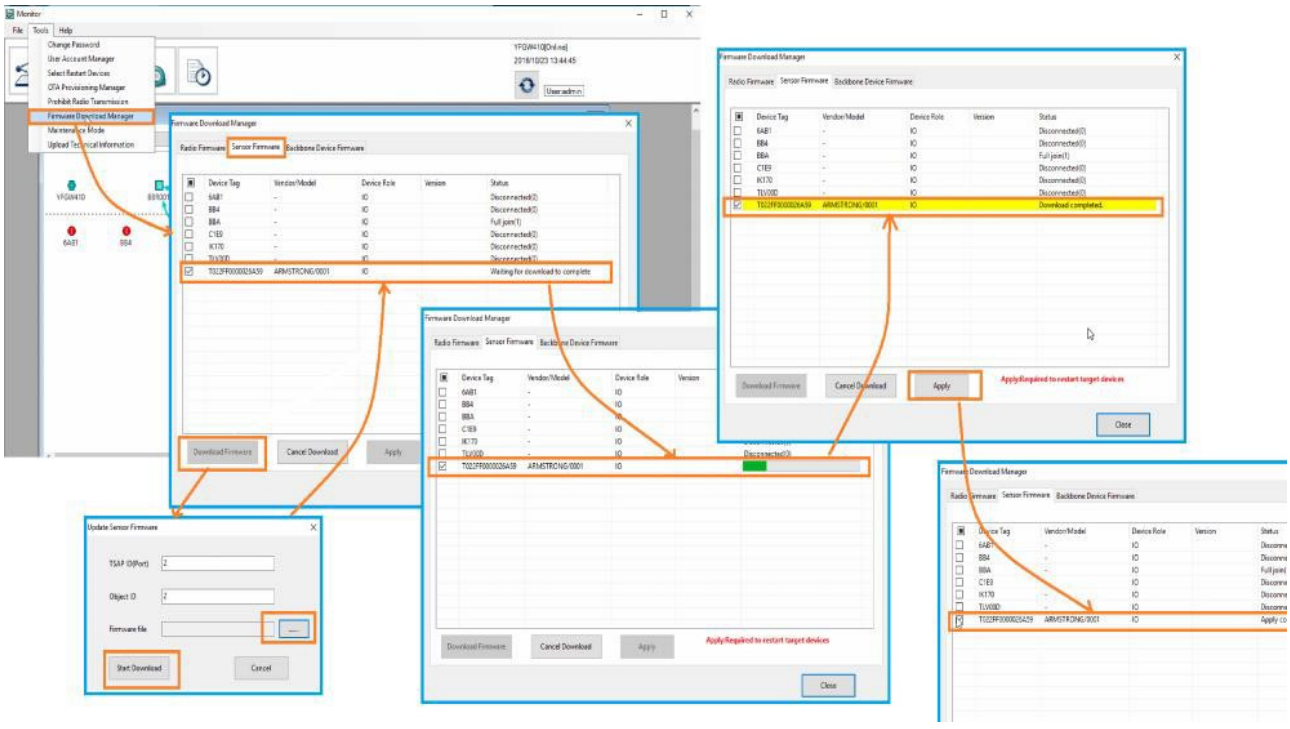
Read object attribute – read out device parameters

TSAP ID	Object ID	Attribute ID	Description ACTiSYS
2	1 (UAPMO)	102	Software Version
		103	Hardware Version
		104	Battery Energy Reset
		105	Country Code
		106	Radio Output Power
		107	Remaining Battery Life
		108	Device Tag
		109	Primary Neighbor Address EU164
		110	Primary Neighbor RSQI
		111	Primary Neighbor TX SUCCESS
		112	Primary Neighbor TX FAIL
		113	Secondary Neighbor Address EU164
		114	Secondary Neighbor RSQI
		115	Secondary Neighbor TX SUCCESS
		116	Secondary Neighbor TX FAIL
		117	Total Radio Charge
		118	Last Hour Radio Charge
		119	Battery Used Duration
		120	Total Device Charge
		121	Remaining Battery Life Percentage
		122	Radio Reset Command

2.3 Viewing Device Data – Field Wireless Management Console – continued

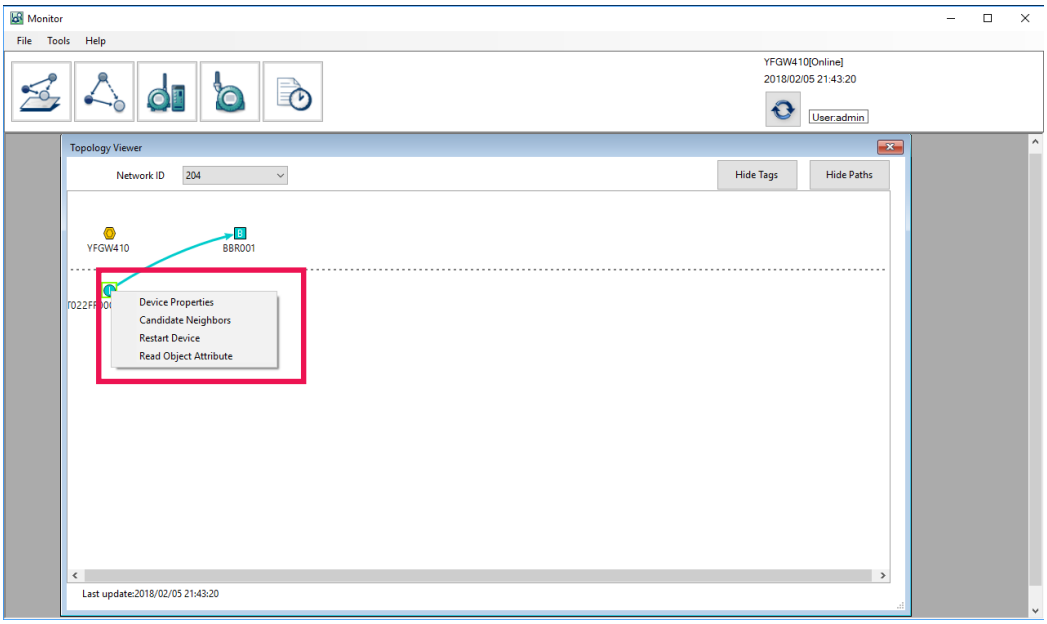
Tools -> Firmware Download Manager – used for over the air upgrade.





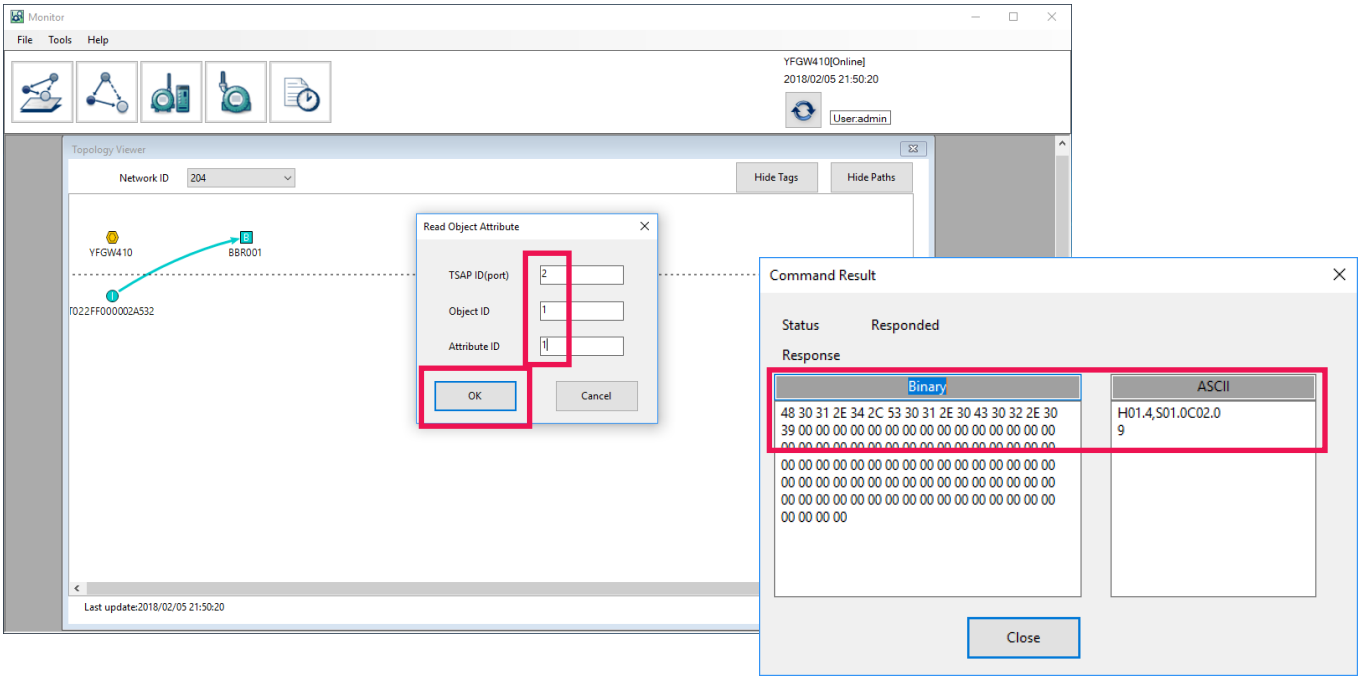
Monitor tool. Over the air sensor firmware update.

2.3 Viewing Device Data – Field Wireless Management Console – continued



Monitor tool. Other Functions.

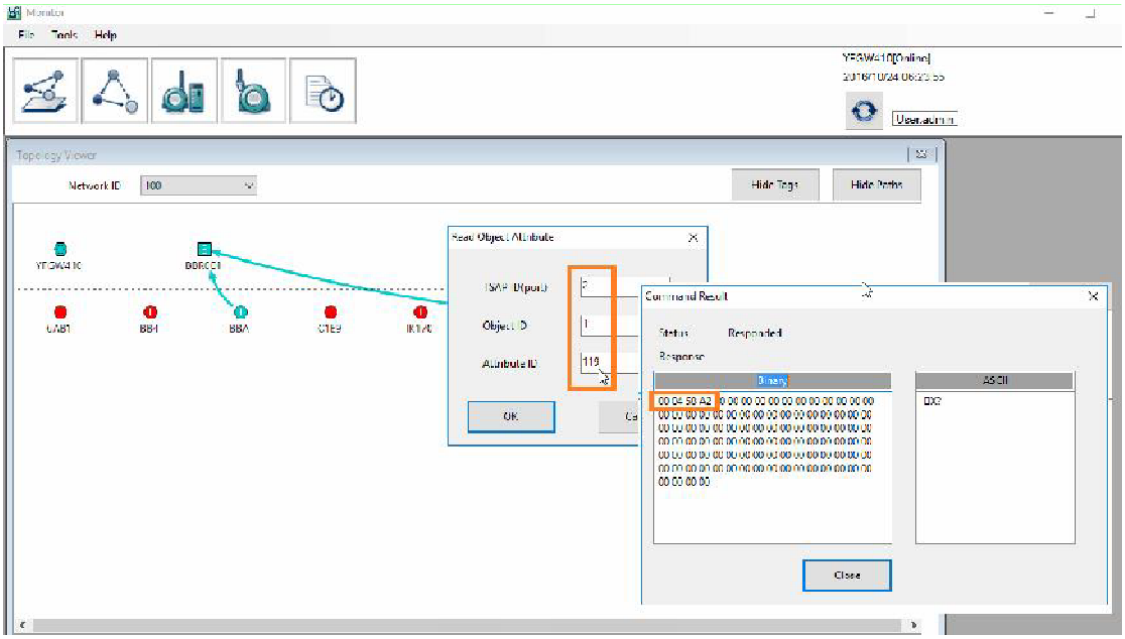
The function “Read object attribute” allows to read a specified ISA100.11a standard parameter or other vendor attributes. It requires three Ids to read the data: TSAP Id, Object Id and Attribute Id.



Monitor tool. Read Software version.

(TSAP Id = 2, Object Id = 1 (UAPMO), Attribute Id = 1).

2.3 Viewing Device Data – Field Wireless Management Console – continued



Read Battery used duration attribute.

(TSAP Id = 2, Object Id = 1 (UAPMO), Attribute Id = 119).

3.0 DTM Tool: Configuring Yokogawa FieldMate Tool

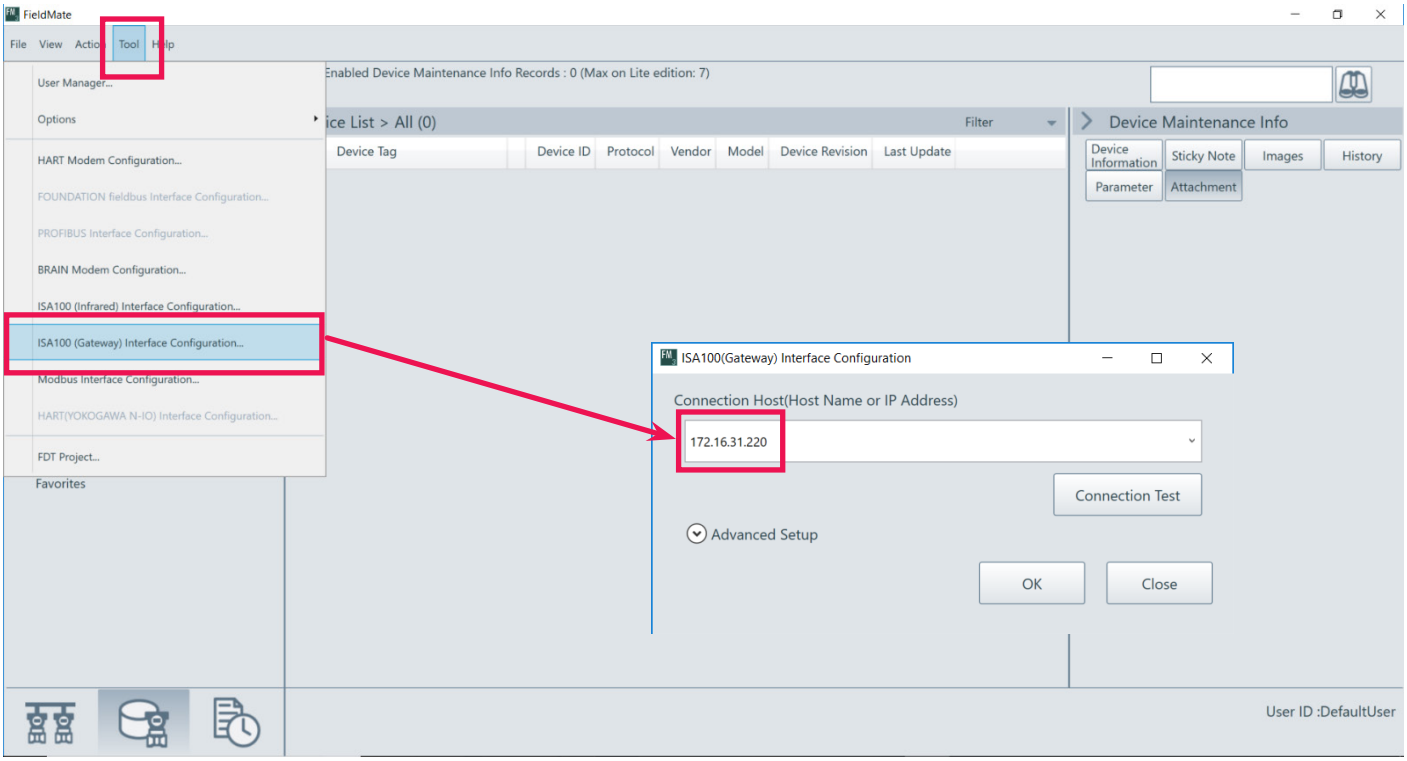
The Yokogawa FieldMate is a tool used for monitoring, configuring and adjusting field wireless devices according to the ISA100.11a standard. The version of the tool referred in this document is the FieldMate Lite Edition, version R3.02.

The tool supports infrared communication and communication via gateways.

Below are the steps required to get the information from a Field Wireless Device (ST6700 Armstrong monitor) via gateway. The setup used is the same one, presented in figure 2.

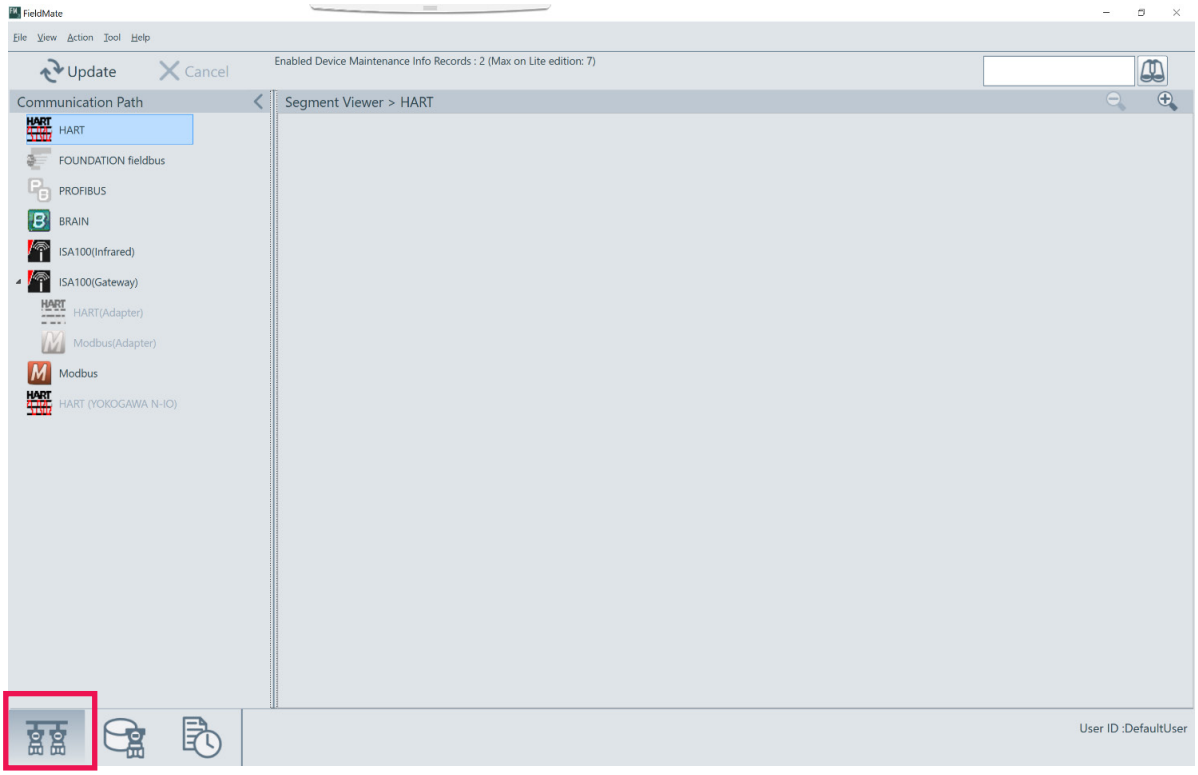
1. Launch FieldMate tool and login.

2. Setup “ISA100 (Gateway) Interface Configuration”.
   - From the menu bar select “Tool” -> “ISA100 (Gateway) Interface Configuration”
   - A new window will become available. Complete the IP address of the Gateway and press OK button.

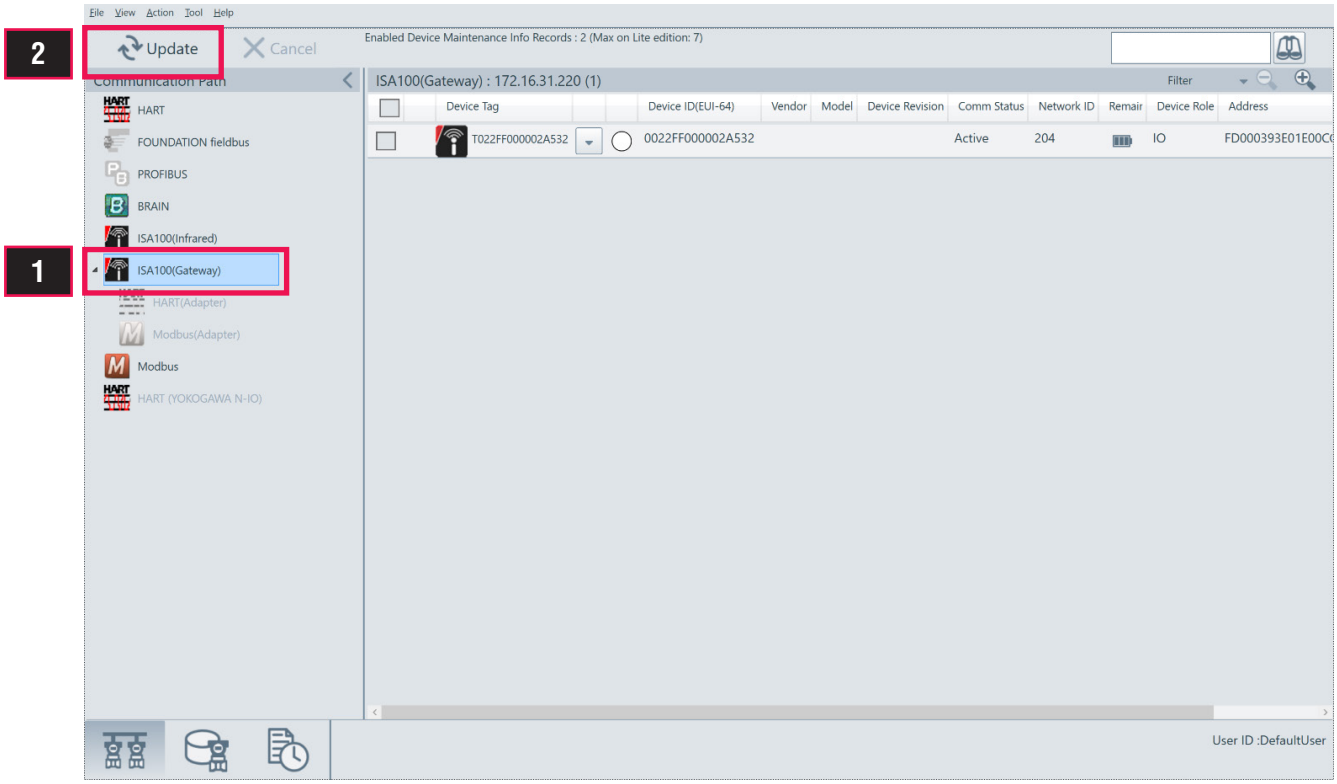


3.0 DTM Tool: Configuring Yokogawa FieldMate Tool – continued

3. Select the “Communication Path” pane by selecting the button in the lower left corner



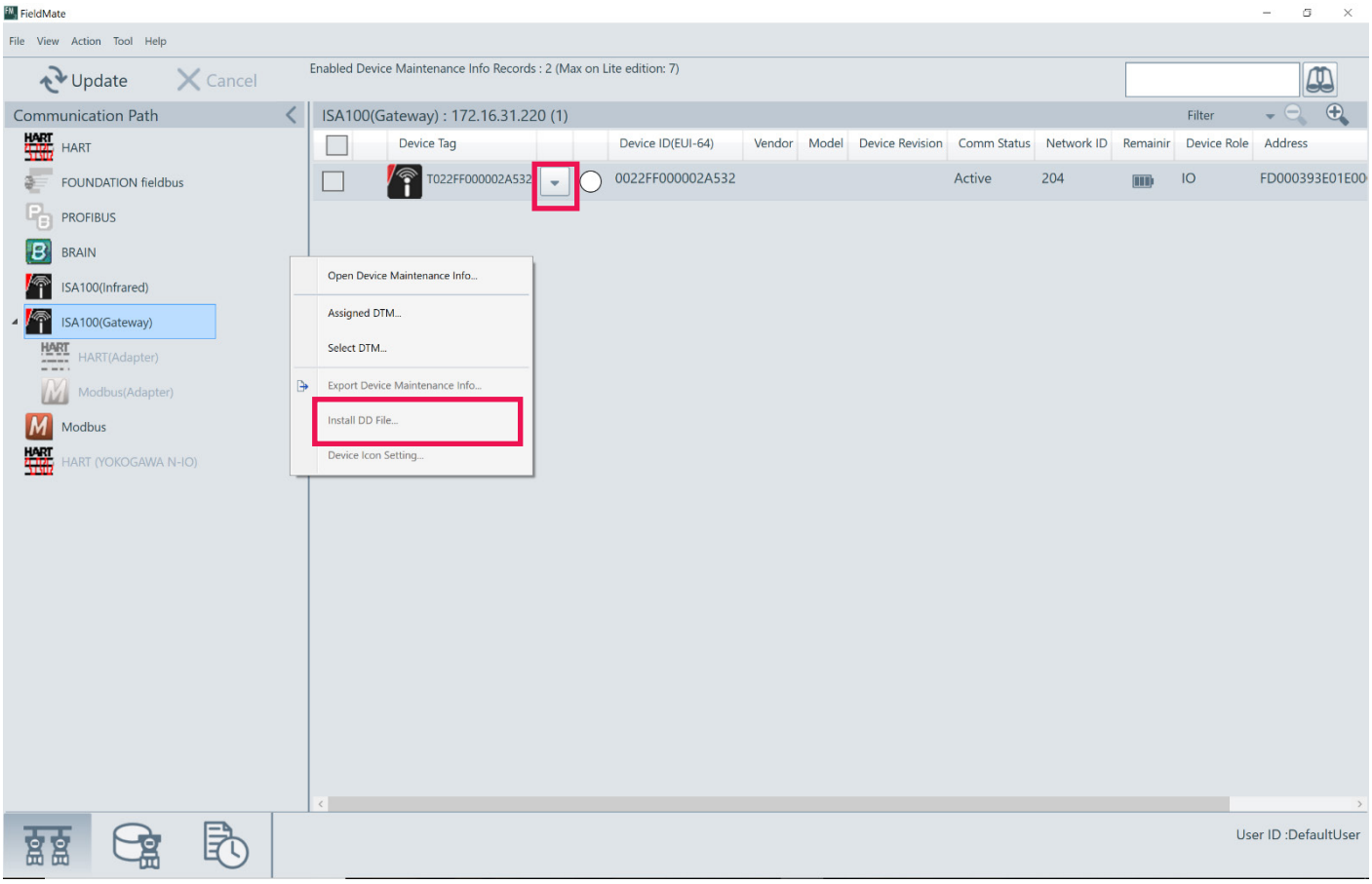
4. To obtain the field device list associated to the configured gateway
   - Click “ISA100(Gateway)
   - Click “Update”



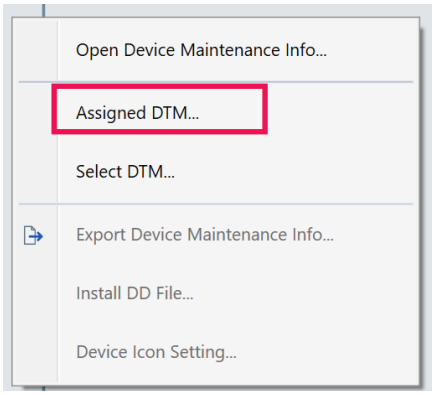
3.0 DTM Tool: Configuring Yokogawa FieldMate Tool – continued

5. Select the ST6700 monitor and install DD file.

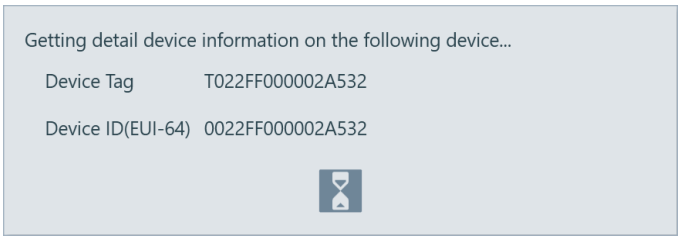
• In the Instrumentation List, select the target device and click the dropdown arrow next to the “Device Tag”.

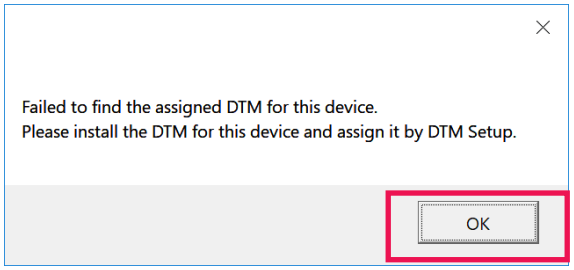


• If “Install DD File…” is gray and un-selectable as in the example above then click “Assigned DTM…”



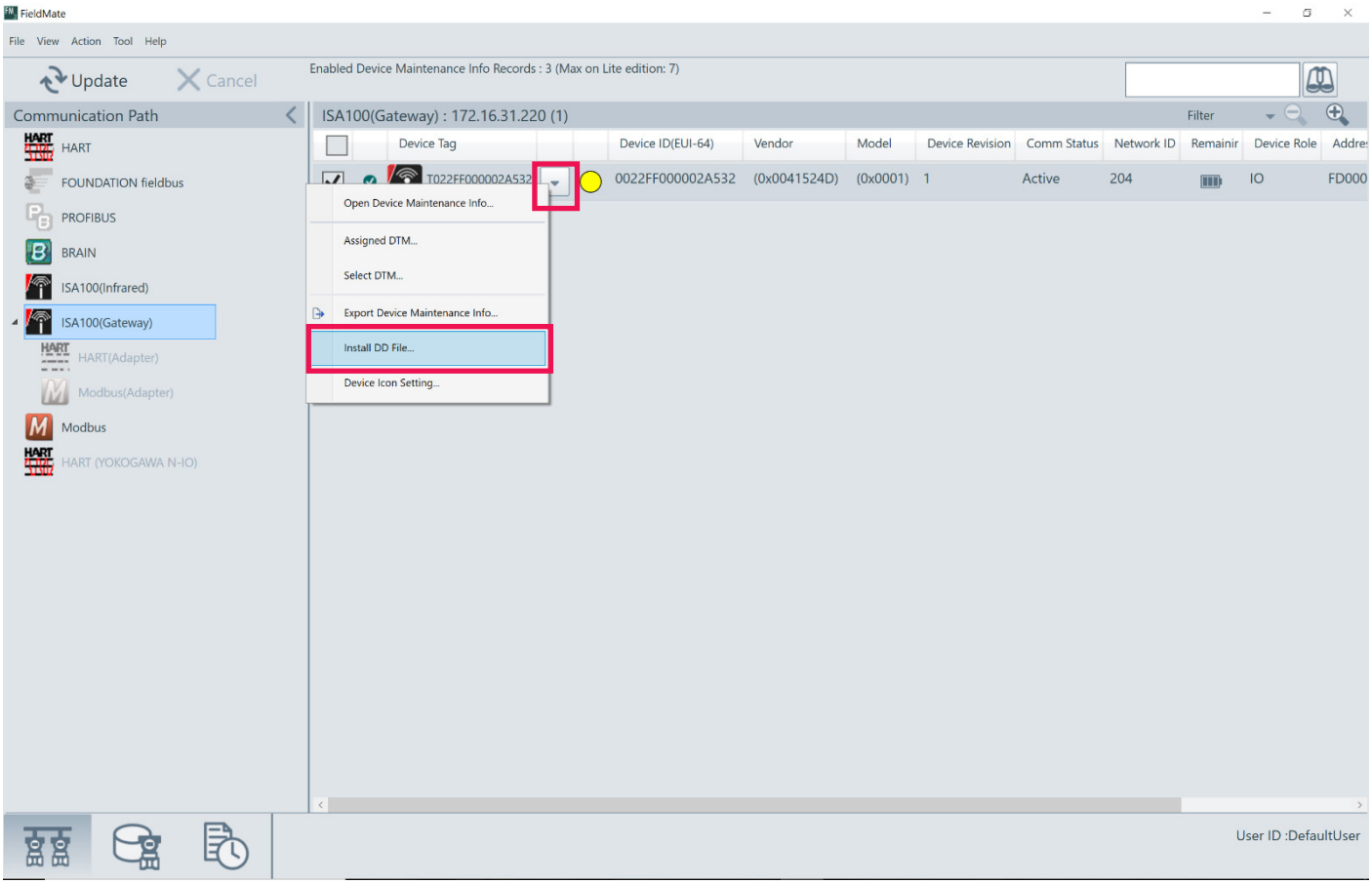
The following windows and error messages are expected behavior. Click OK.



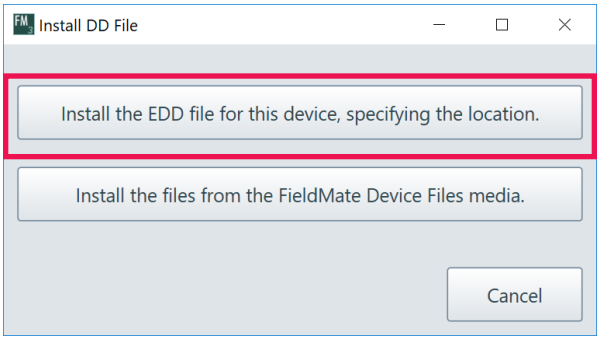


3.0 DTM Tool: Configuring Yokogawa FieldMate Tool – continued

- Reselect the dropdown arrow and “Install DD File…” should now be selectable. Select “Install DD File…”

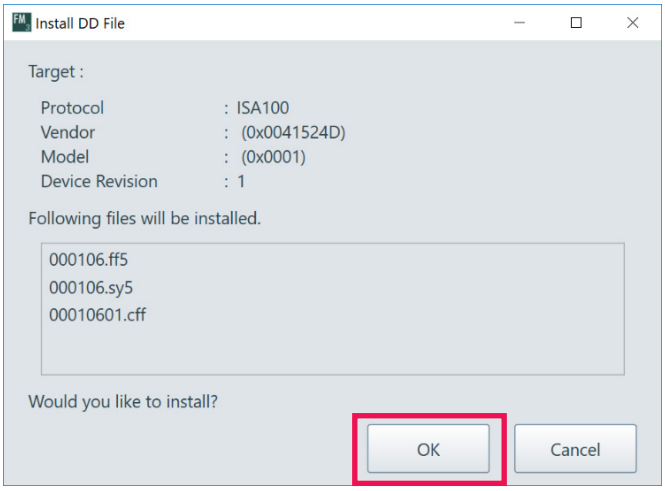


- Select “Install the EDD file for this device, specifying the location and select the location on the PC of the EDD file.



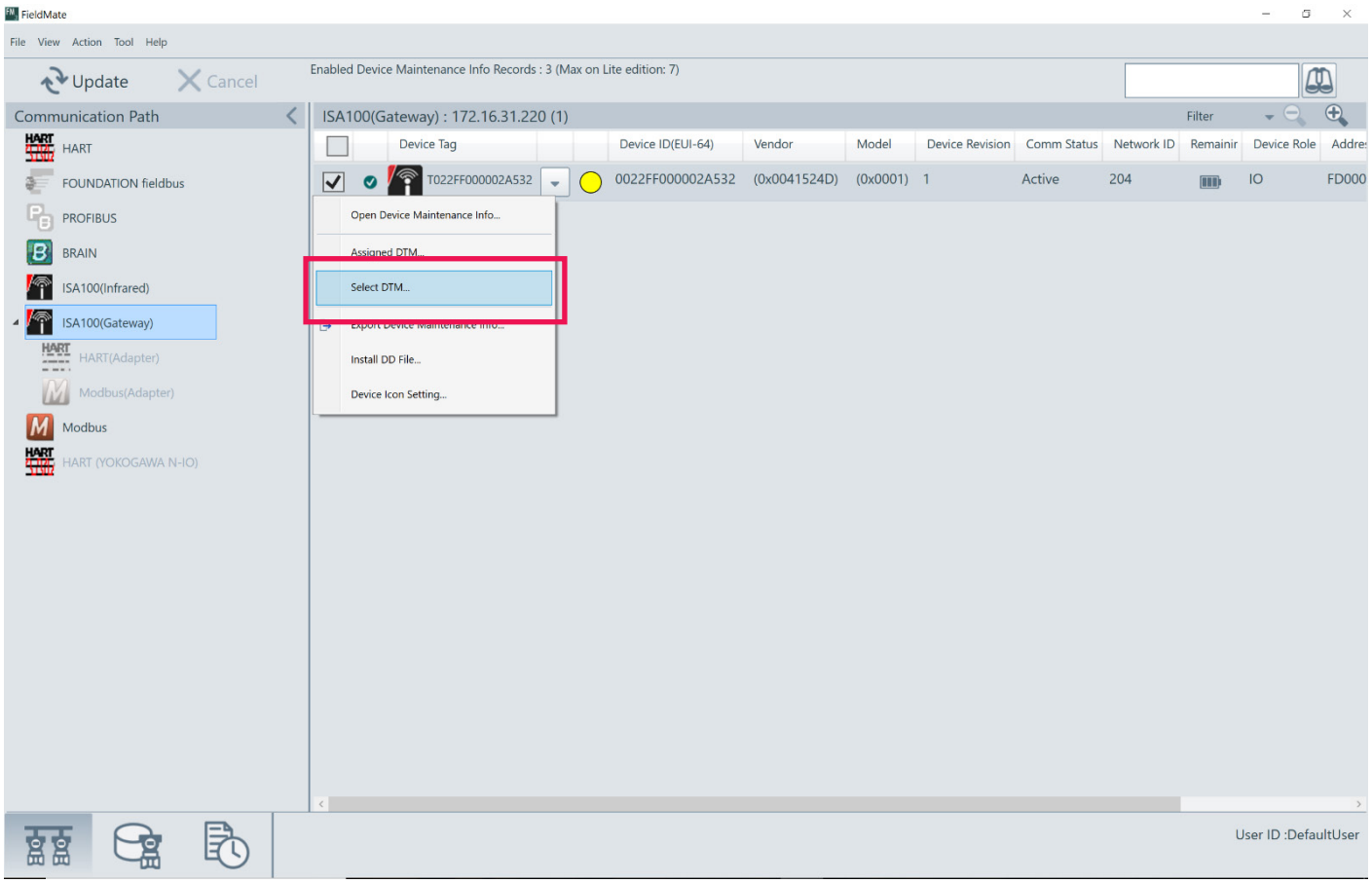
3.0 DTM Tool: Configuring Yokogawa FieldMate Tool – continued

• Confirm the installation of the EDD by selecting “OK”.



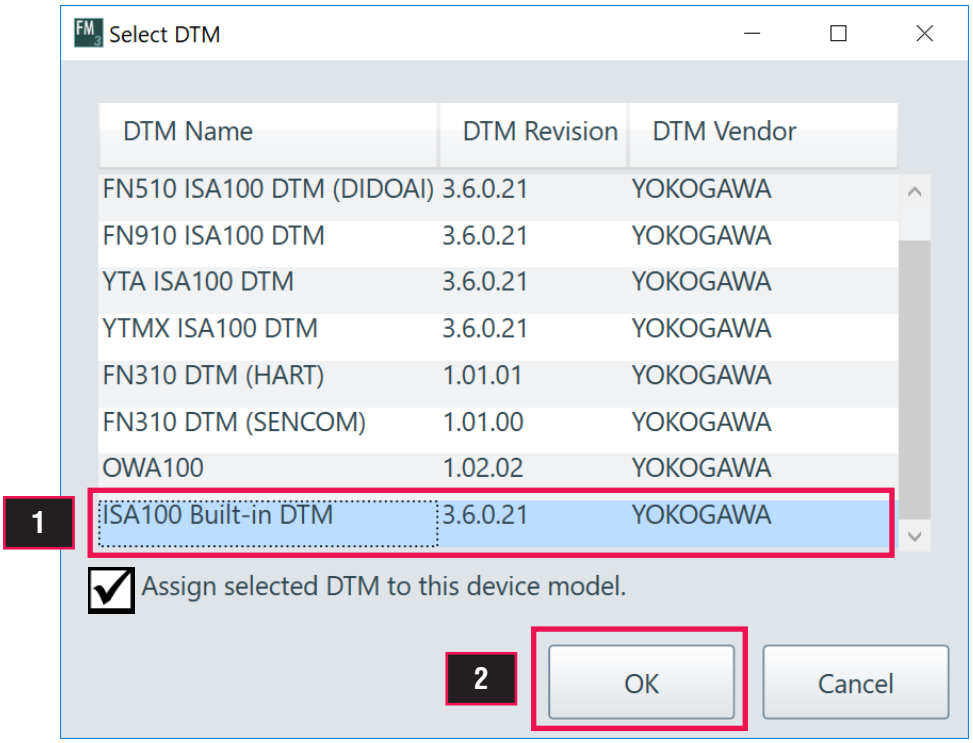
6. Install the DTM file for the selected ST6700 monitor.

• In the Instrumentation List click the dropdown of the device and select “Select DTM…”

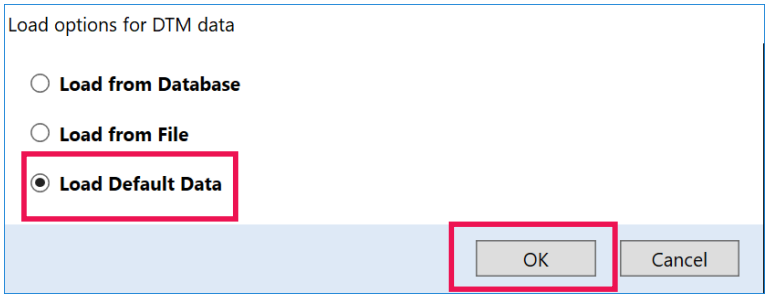


3.0 DTM Tool: Configuring Yokogawa FieldMate Tool – continued

- Select the “ISA100 Built-in DTM” and select the check box to “Assign selected DTM to this device model” and select “OK”.

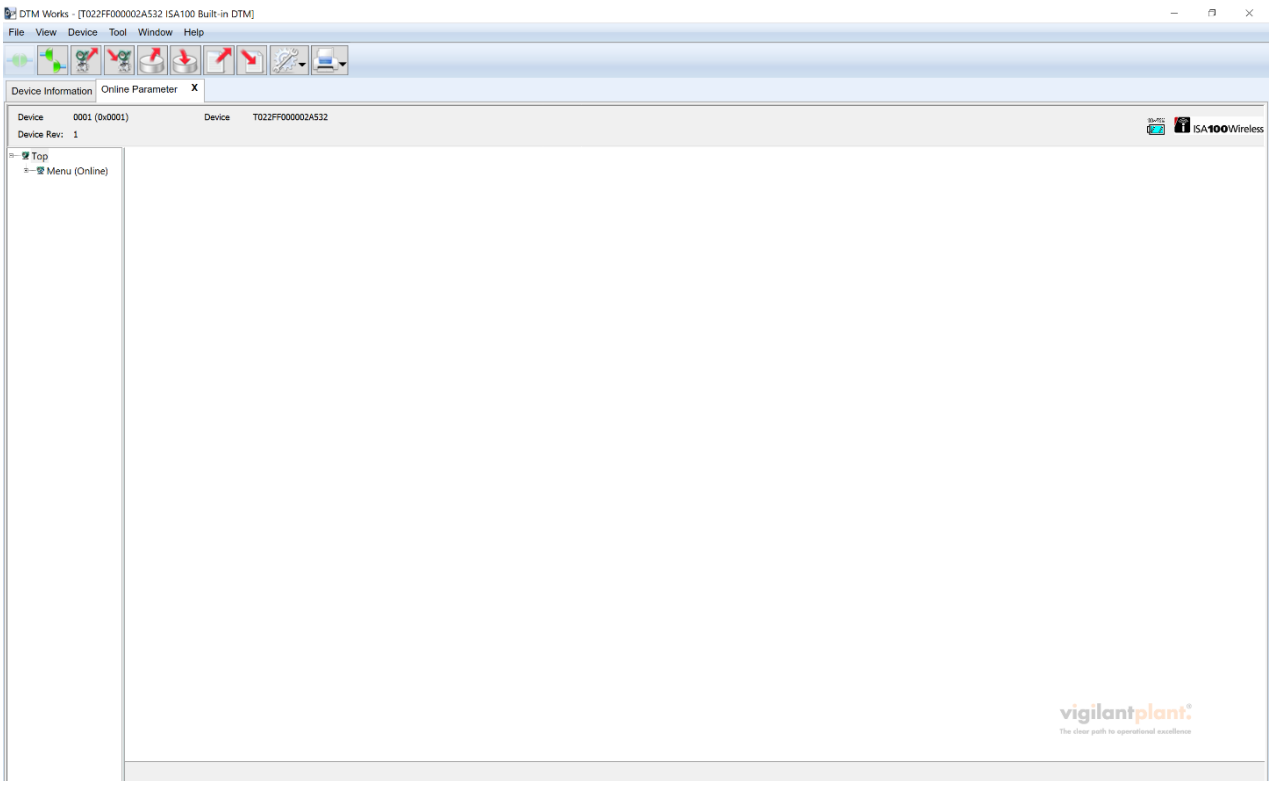


- “DTM Works” will launch automatically.
- In DTM Works – select “Load Default Data” and select “OK”.



3.0 DTM Tool: Configuring Yokogawa FieldMate Tool – continued

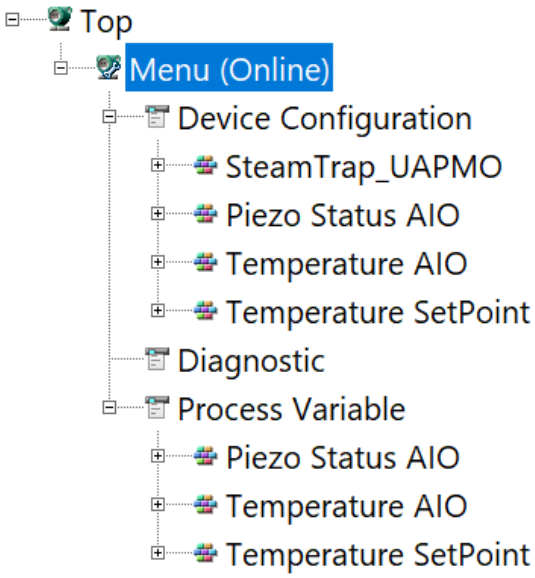
- The DTM Works screen will be display



3.1 DTM Tool: Viewing Device Data in the DTM Tool

Manage the ST6700 Monitor.

- The following selections are available in the menu screen.



- Device Configuration
  - Steam Trap_UAPMO - contains the device profile parameters and device vendor parameters; According to the device implementation some parameters are read only.
  - Piezo Status AIO – used to display/modify Piezo Status attributes: process value, mode, transducer scale, simulation info.
  - Temperature AIO – used to display/modify Temperature object attributes: process value, mode, transducer scale, simulation info.
  - Temperature Setpoint AIO – used to display/modify Temperature SetPoint object attributes: process value, mode, transducer scale, simulation info.

- Process Variables
  - Piezo Status AIO – used to display process value for Piezo status object.
  - Temperature AIO – used to display process value for Temperature object.
  - Temperature Setpoint AIO – used to display process value for Temperature Set Point object.

4.0 Device Configuration

4.1 Changing the Temperature Setpoint

The AIM® device has built-in algorithms, which perform a series of diagnostic checks to determine the condition of the steam trap.

The first diagnostic validates the surface temperature of the steam line and compares it with the configurable **temperature set point**.

The temperature sensor detects the skin temperature at the inlet of the steam trap. That value is compared to the configurable **temperature set point**.

The **temperature set point** is the temperature below which the steam trap is considered COLD.
By default, Armstrong uses 160°F or 70°C but it can be changed by the user.
Best practice recommendation is to be at least 40°F (22°C) above the highest ambient temperature.

Highest Ambient Temperature		Set Temperature	
104°F	40°C	144°F	62°C
122°F	50°C	162°F	72°C

Overview:

Step 1 – Change Mode – Target – from Man to Auto

Step 2 – Change Simulation Switch from 00 to 01

Step 3 – Change Simulation Value – Update to desired Set value

Step 4 – Change Mode – Target from Auto to Man

Step 5 – Change Simulation Switch from 01 to 00

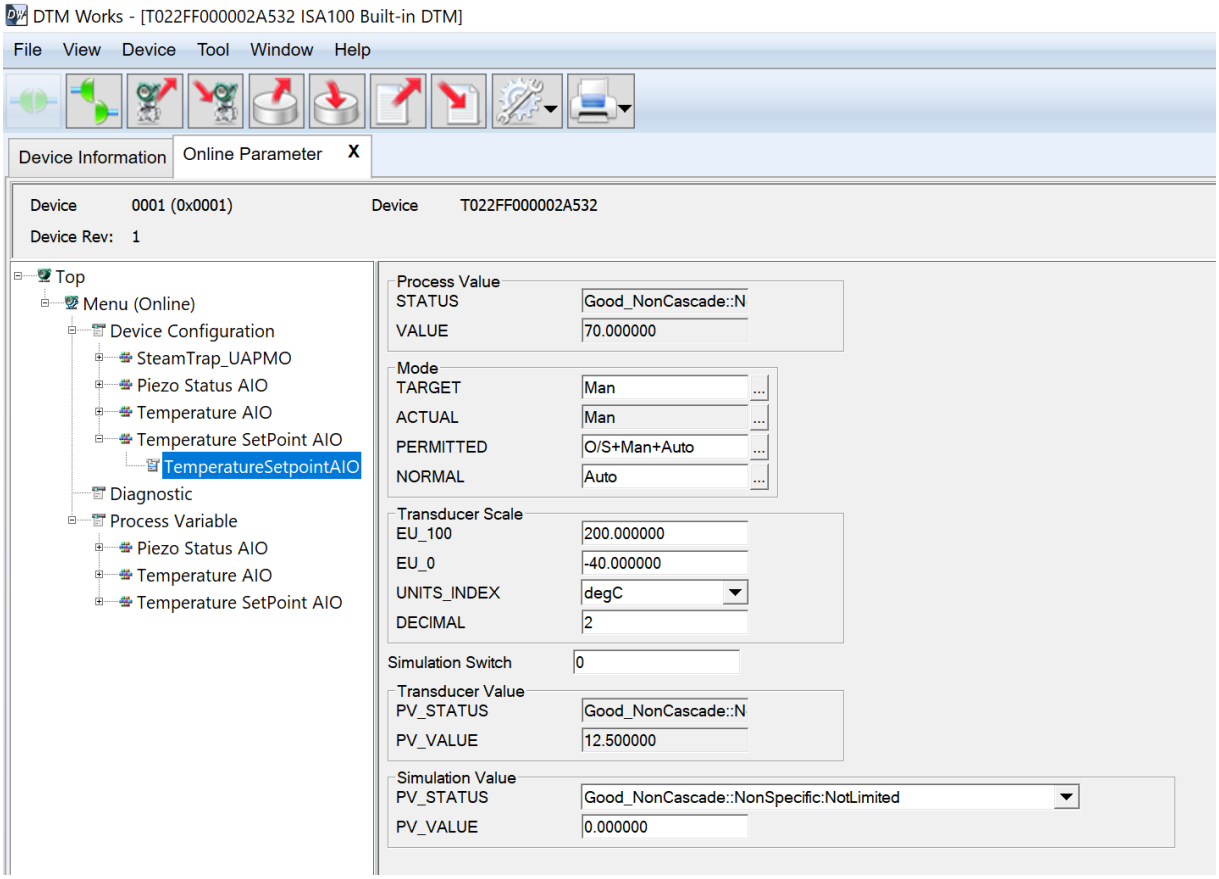
Note: “Download to device” after every step

See next page for full details to change the temperature set point.

4.1 Changing the Temperature Setpoint – continued

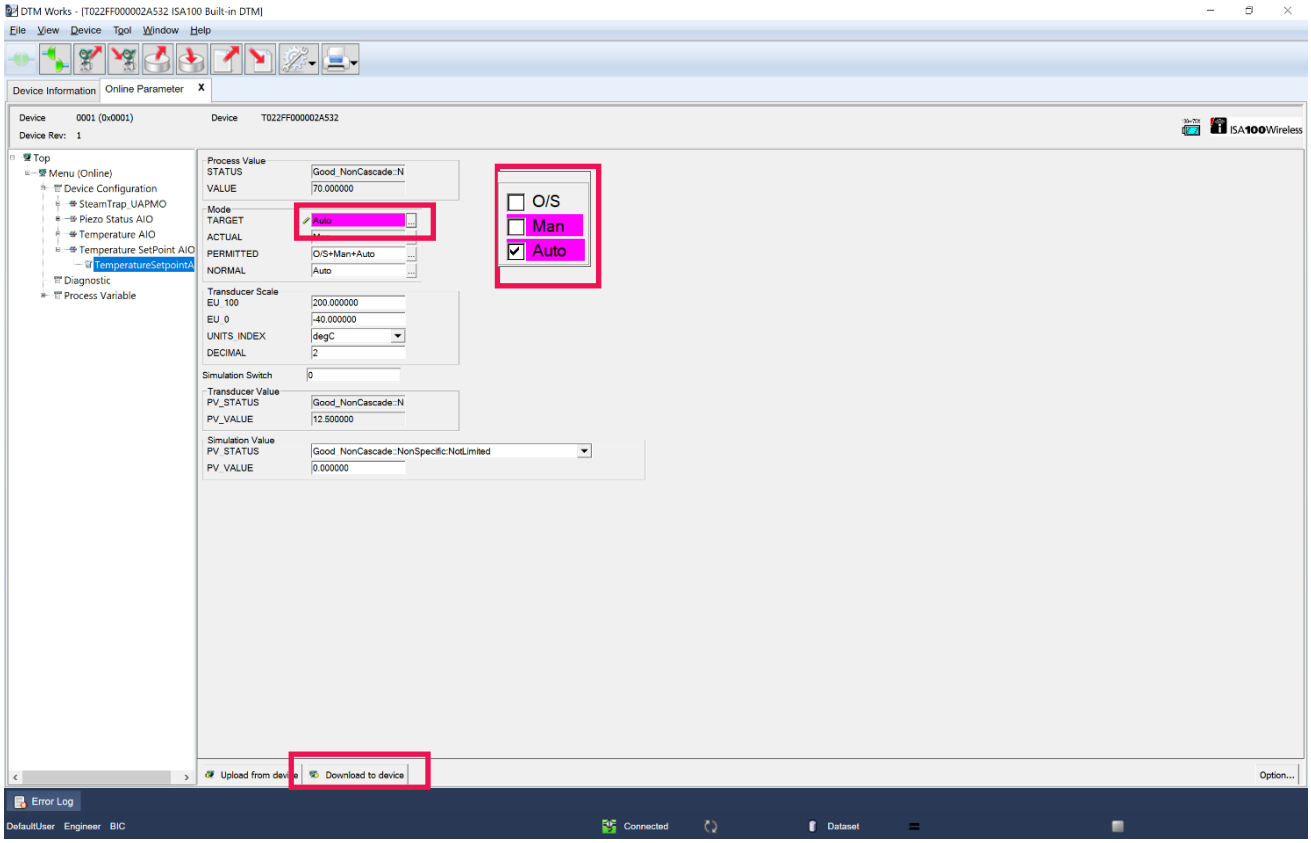
Detailed Instructions to Change the Temperature Setpoint:

1. Open FieldMate
2. Open DTM Works (See DTM Tool – Viewing Device Data in DTM Tool)
3. From the menu select “Menu/Device Configuration/Temperature SetPoint AIO/TemperatureSetpointAIO

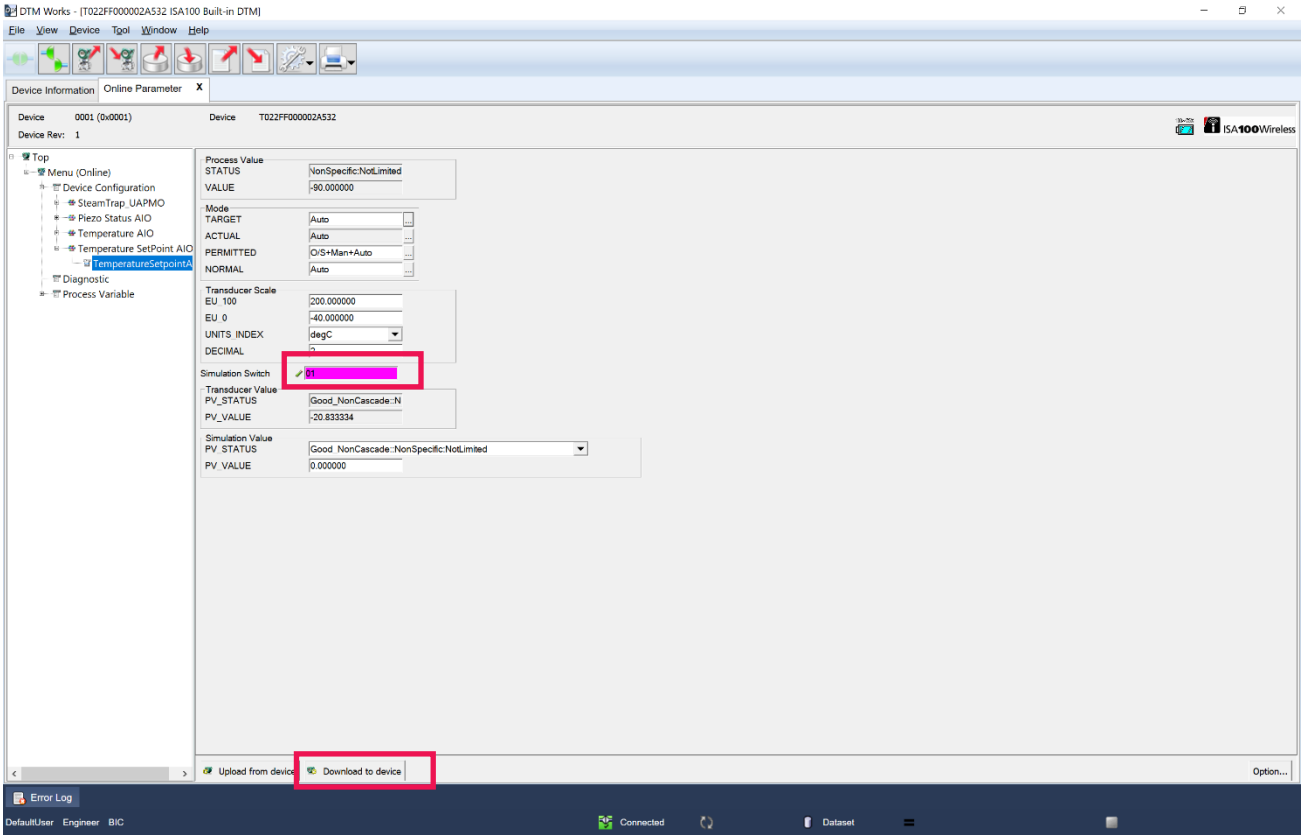


4.1 Changing the Temperature Setpoint – continued

4. Change Mode – Target – from Man to Auto and select “Download to device”.



5. Change Simulation Switch from 00 to 01.



4.1 Changing the Temperature Setpoint – continued

6. Change Simulation Value – Update to desired Set value.

   a. Identify the new temperature set point and apply it to the following formula $\left(\frac{x+40}{240}\right) * 100 = \mathrm{Sp}$

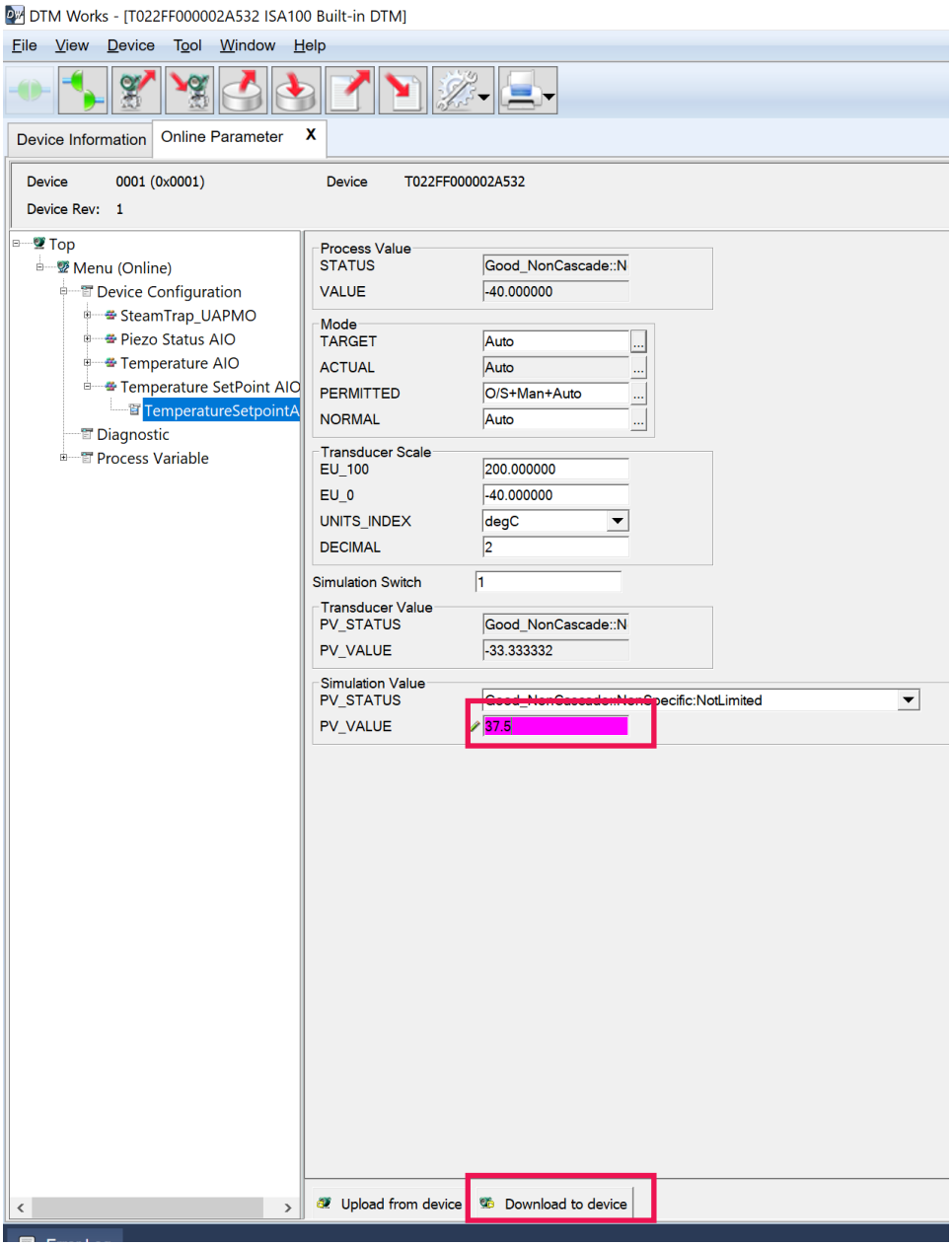
   x = Desired temperature setting
   Sp = Set point value to be entered into DTW

   Example:

   x = 50 C = Desired Setpoint

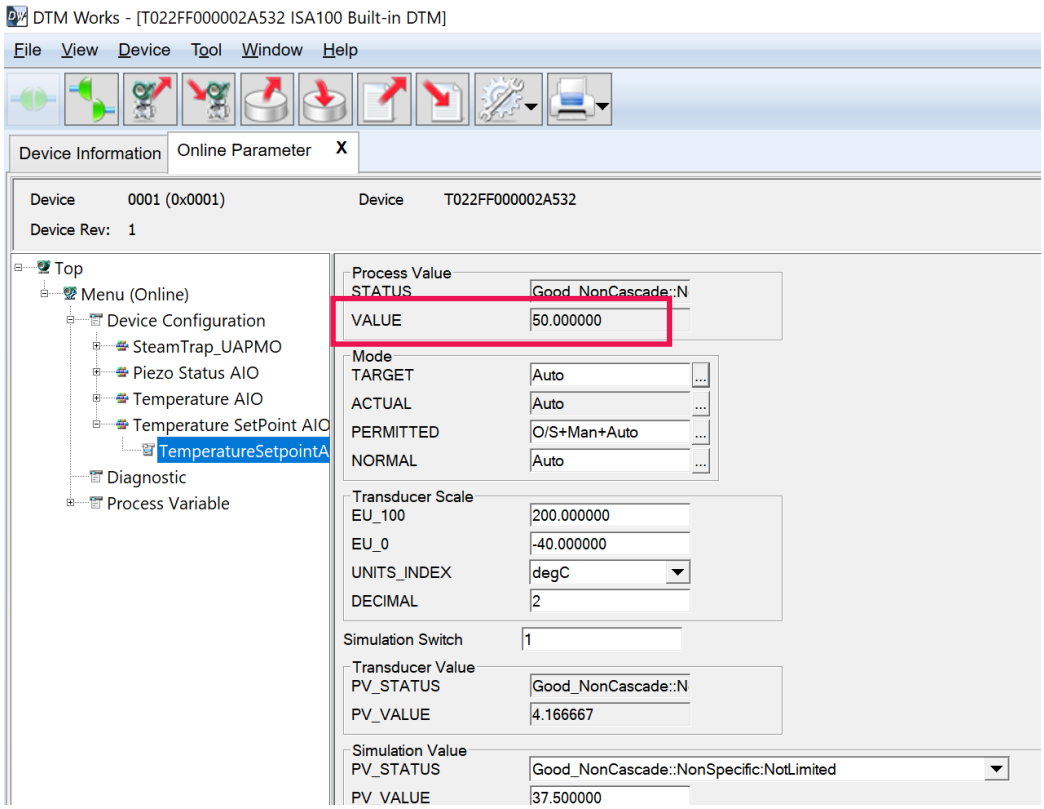
   $$\left(\frac{50+40}{240}\right) * 100 = 37.5$$

   b. Enter the formula result into the PV_VALUE in the “Simulation Value” section and select “Download to device”

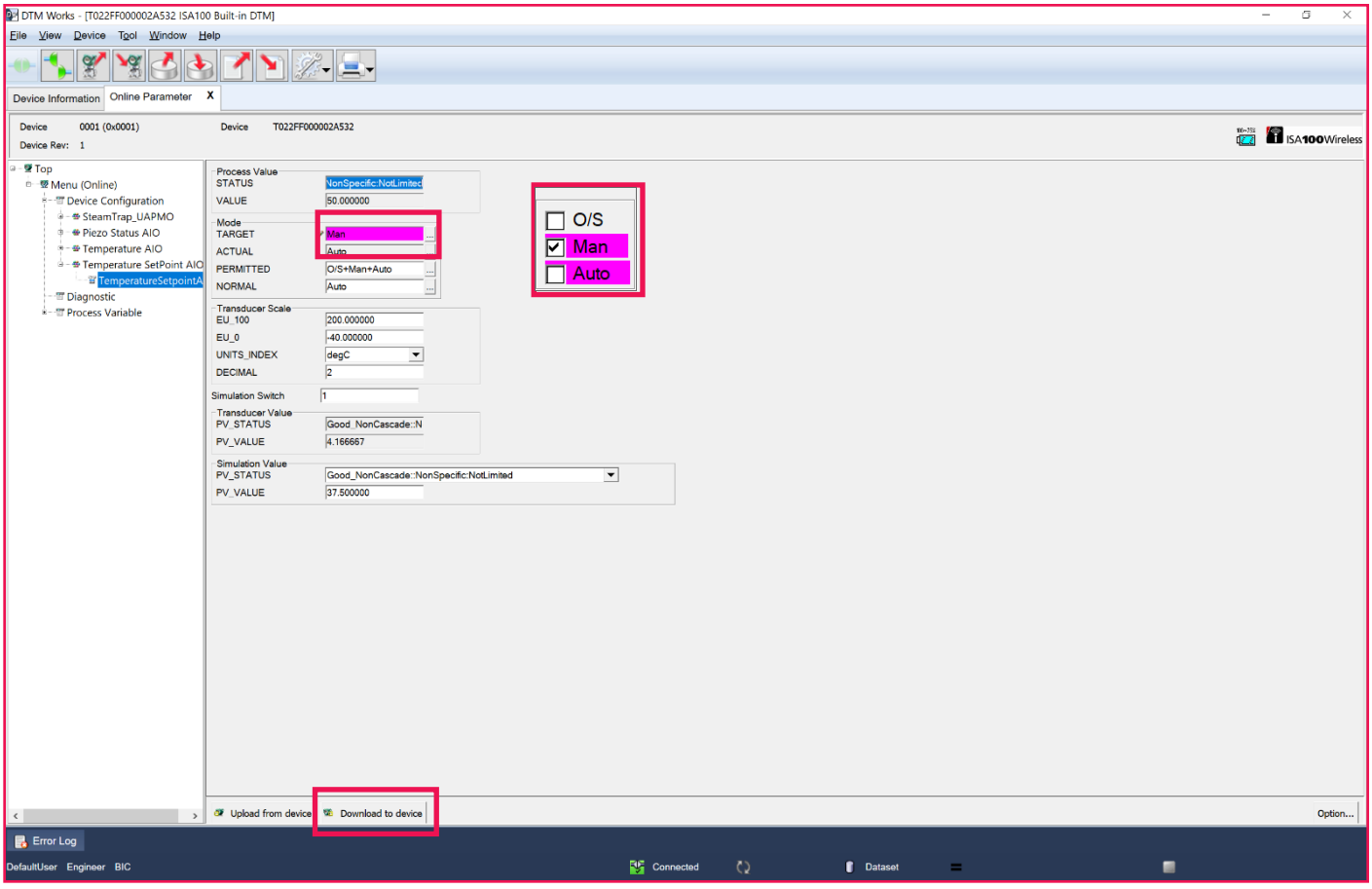


4.1 Changing the Temperature Setpoint – continued

c. Verify the Temperature Setpoint Value updated.

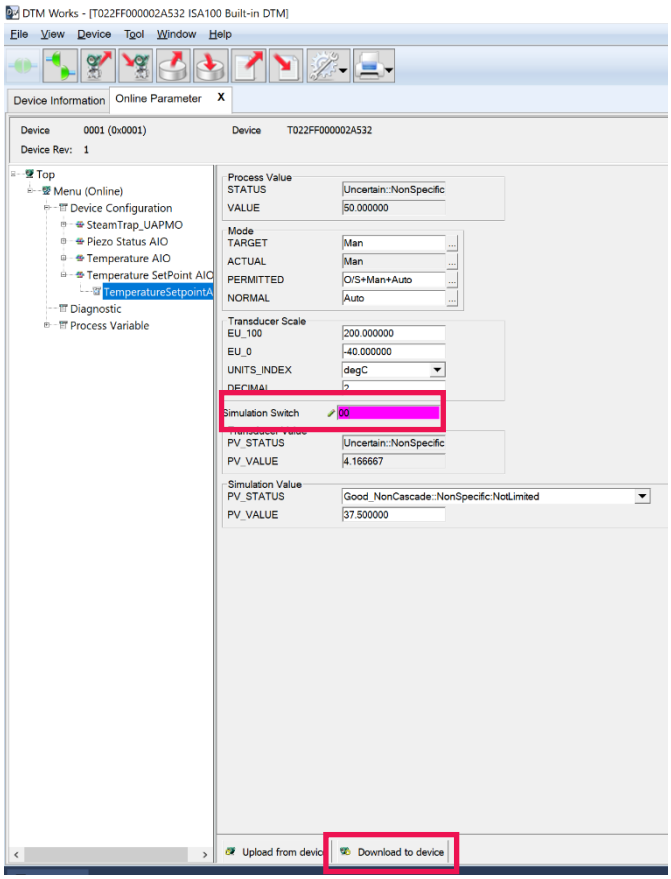


7. Change Mode – Target – from Auto to Man and select "Download to device".

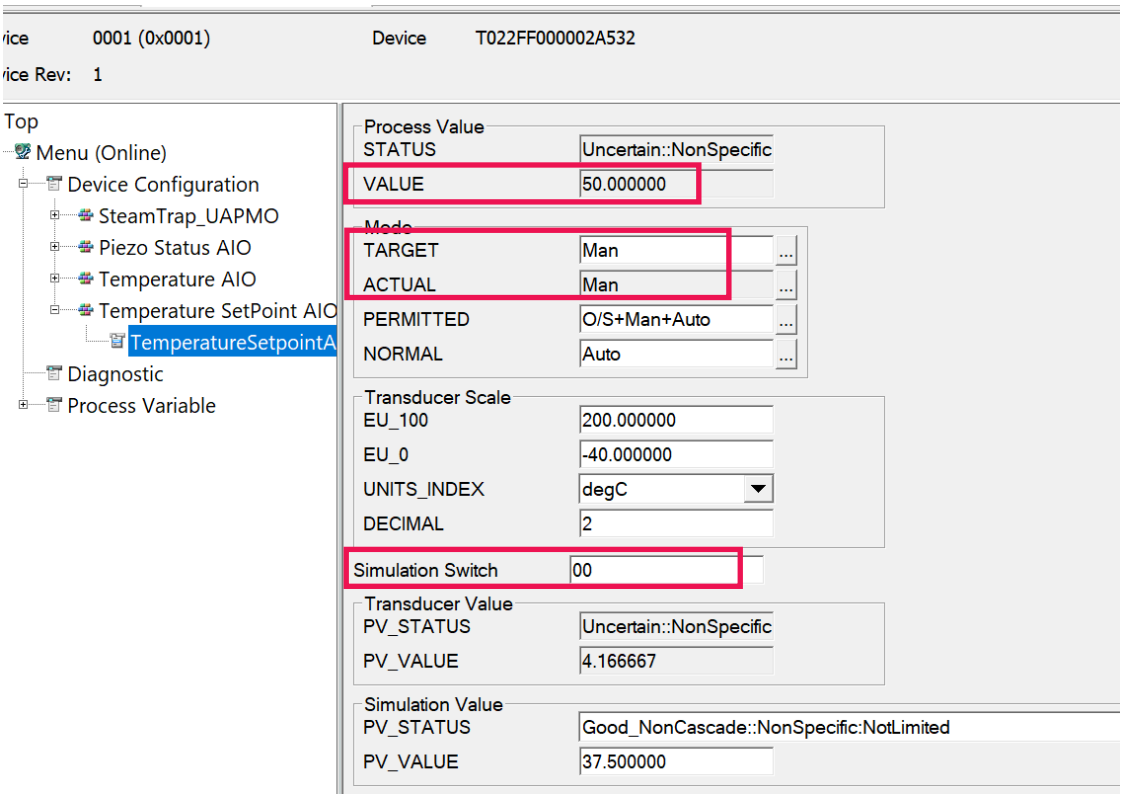


4.1 Changing the Temperature Setpoint – continued

8. Change Simulation Switch from 01 to 00 and select “Download to device”.



9. Verify the Value is the desired setpoint. Verify the Mode is in “Man” for both TARGET and ACTUAL. Verify the Simulation Switch is “00”.



4.2 Simulation the Piezo Status (PV_Value)

The purpose of Simulation Mode is to push steam trap state changes through to DCS or SAGE® software, for loop testing.

Overview:

Step 1 – Change Simulation Switch from 00 to 01

Step 2 – Change Simulation Value – Update the Piezo Status to the desired simulation value (see table below)

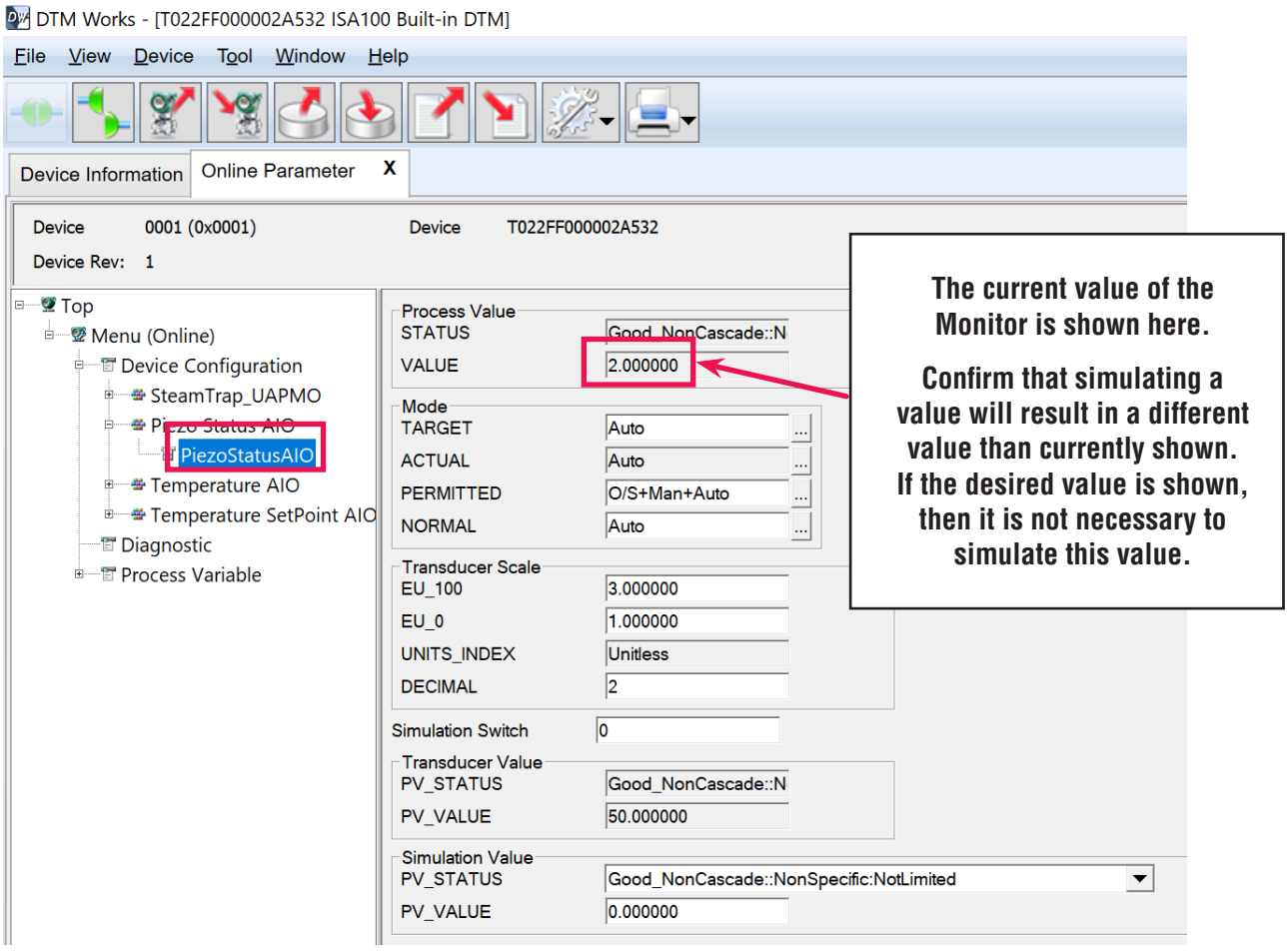
Step 3 – Change Simulation Switch from 01 to 00

Note: "Download to device" after every step

Simulation Value		
Steam Trap Status	Process Value	PV_Value
Good	1	0
Cold	2	50
Blow Thru	3	100

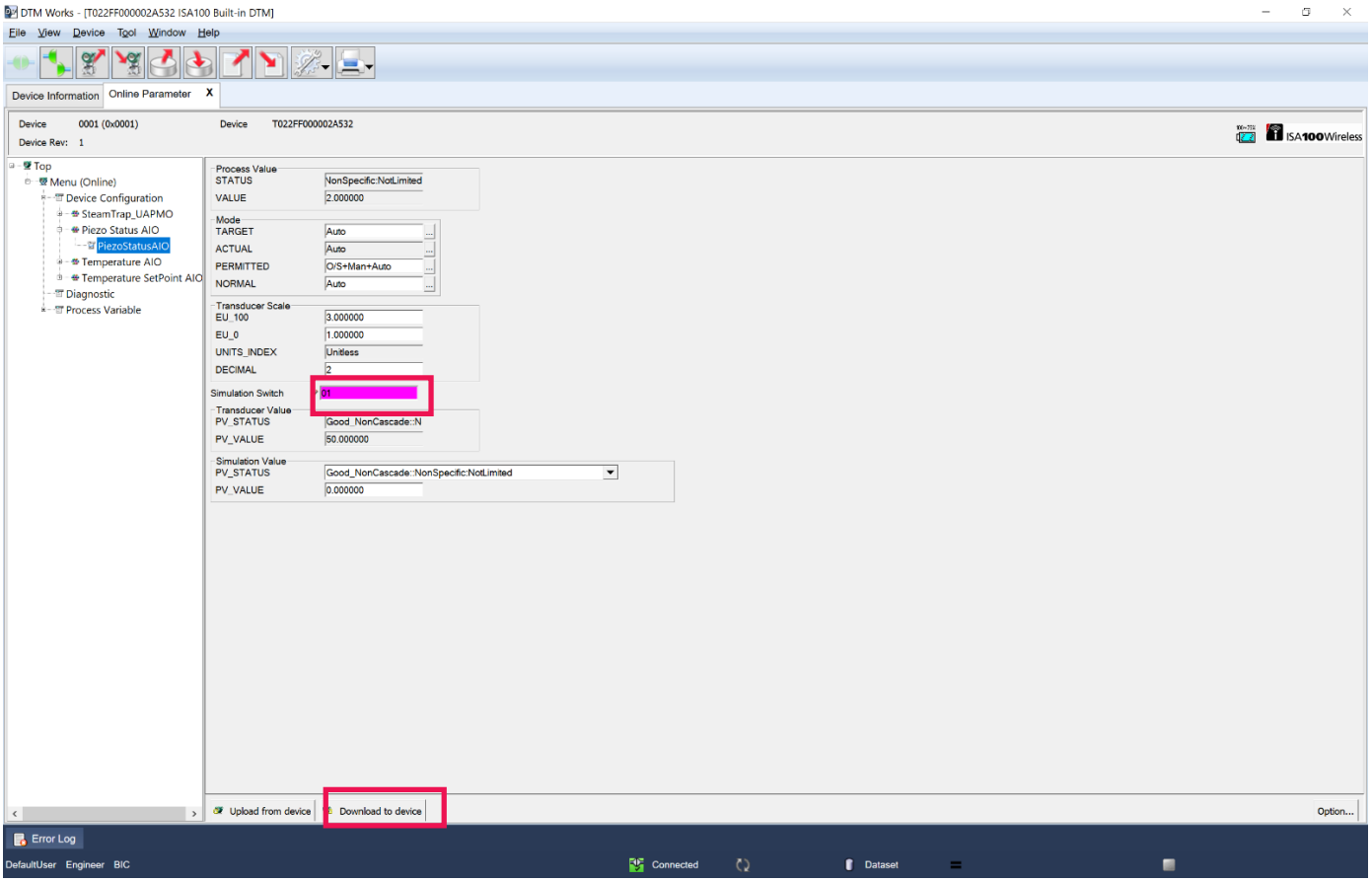
Detailed Instructions to change the operation mode of the device to "Simulation Mode"

1. Open FieldMate
2. Open DTM Works (See DTM Tool – Viewing Device Data in DTM Tool)
3. From the menu select Menu/Device Configuration/Piezo Status AIO/PiezoStatusAIO



4.2 Simulation the Piezo Status (PV_Value) – continued

4. Change Simulation Switch from 00 to 01 and select “Download to device”.

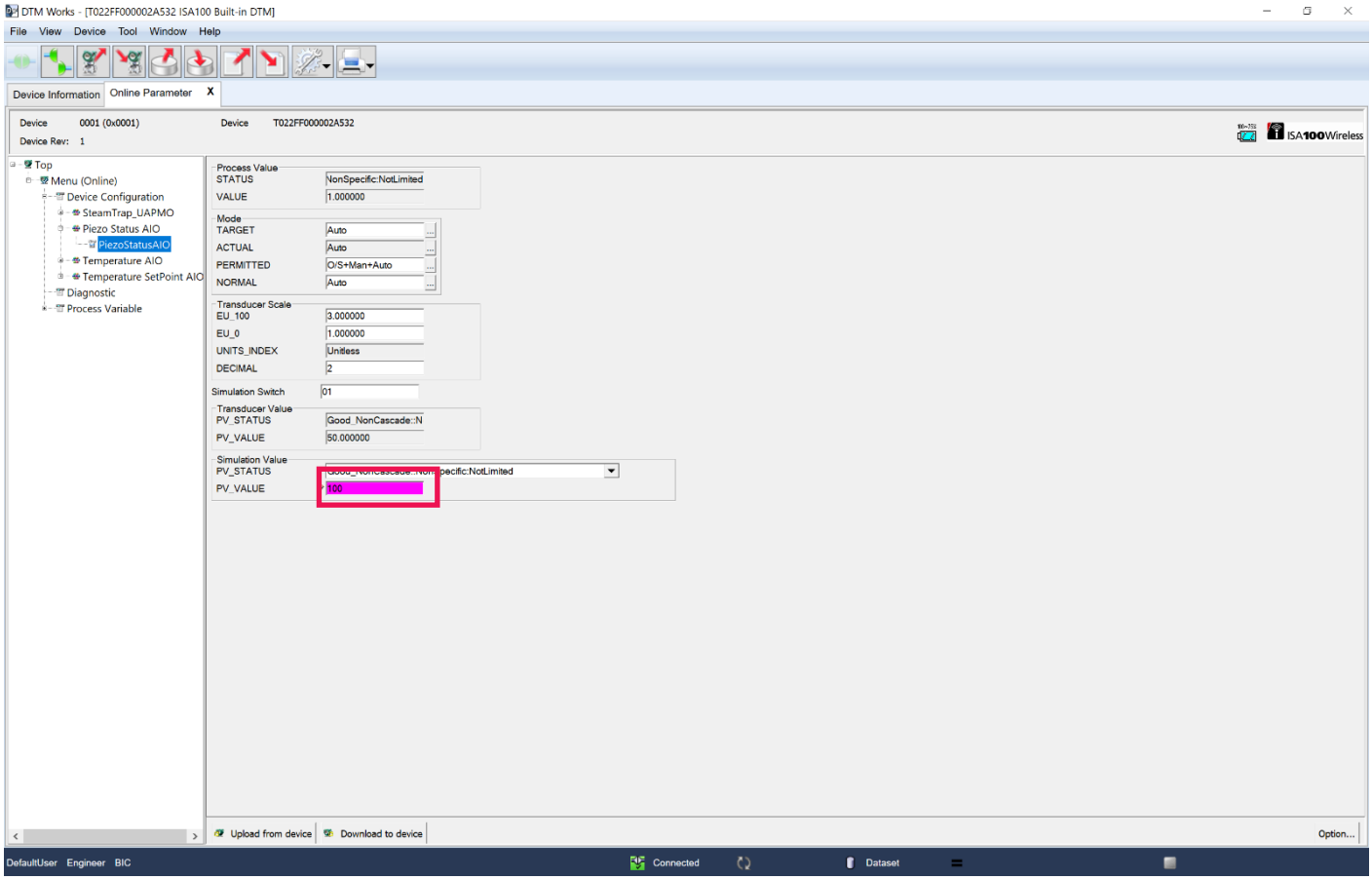


Note: When the device is in Simulation Mode, the Piezo Status AIO will default to 1 (OK trap condition).

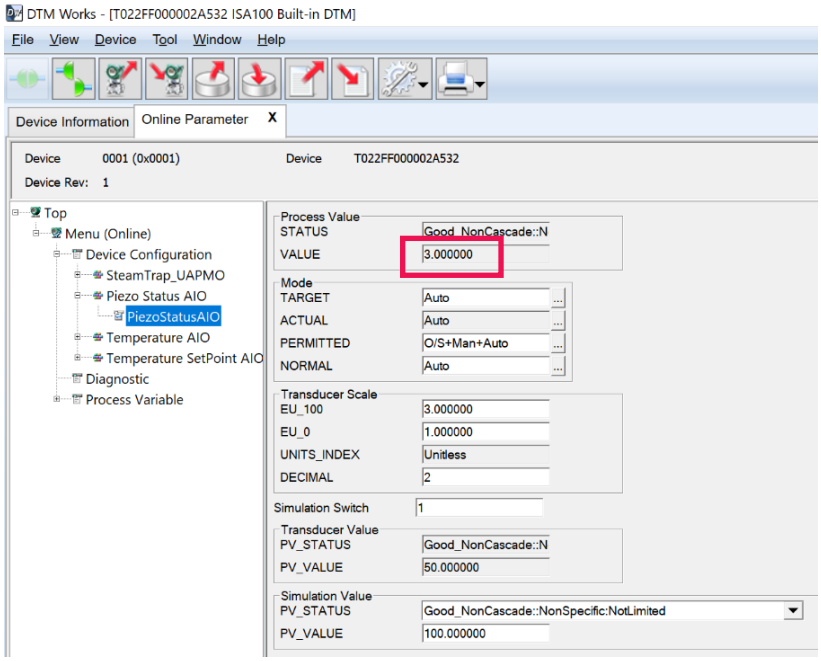
4.2 Simulation the Piezo Status (PV_Value) – continued

5. Change Simulation Value – Update the Piezo Status to the desired simulation value (see table at the beginning of this section).

   In this example the desired Simulation Value is Blow Through. From the Simulation Value table on page 38, the PV_Value column should be 100.

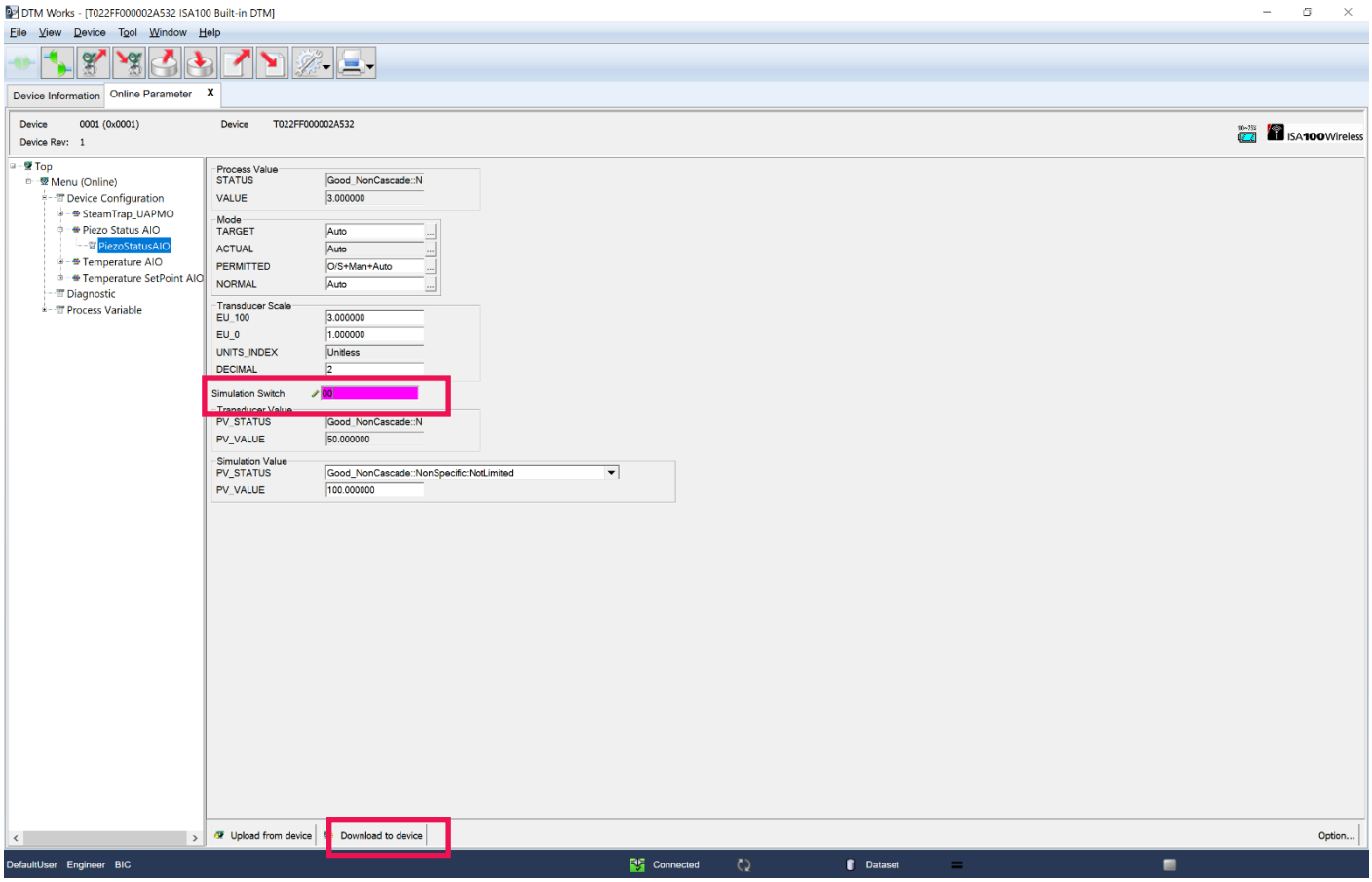


6. Verify the Process Value is displaying the desired value. In this example 3 = Blow Through.

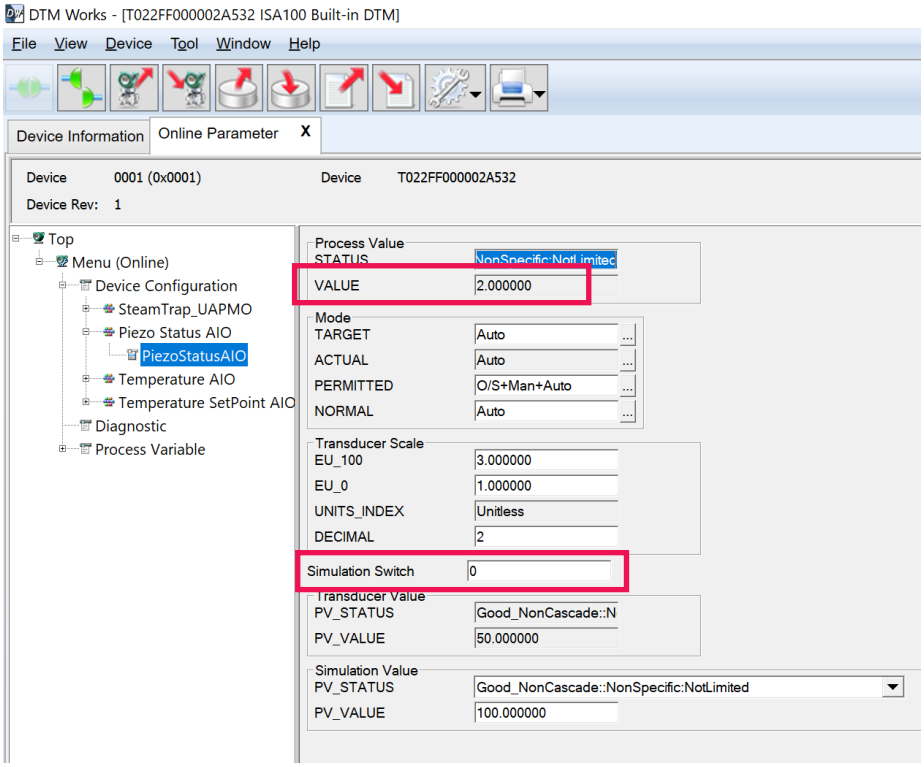


4.2 Simulation the Piezo Status (PV_Value) – continued

7. Return the Monitor to Standard Operation - Change Simulation Switch from 01 to 00 and select “Download to device”.

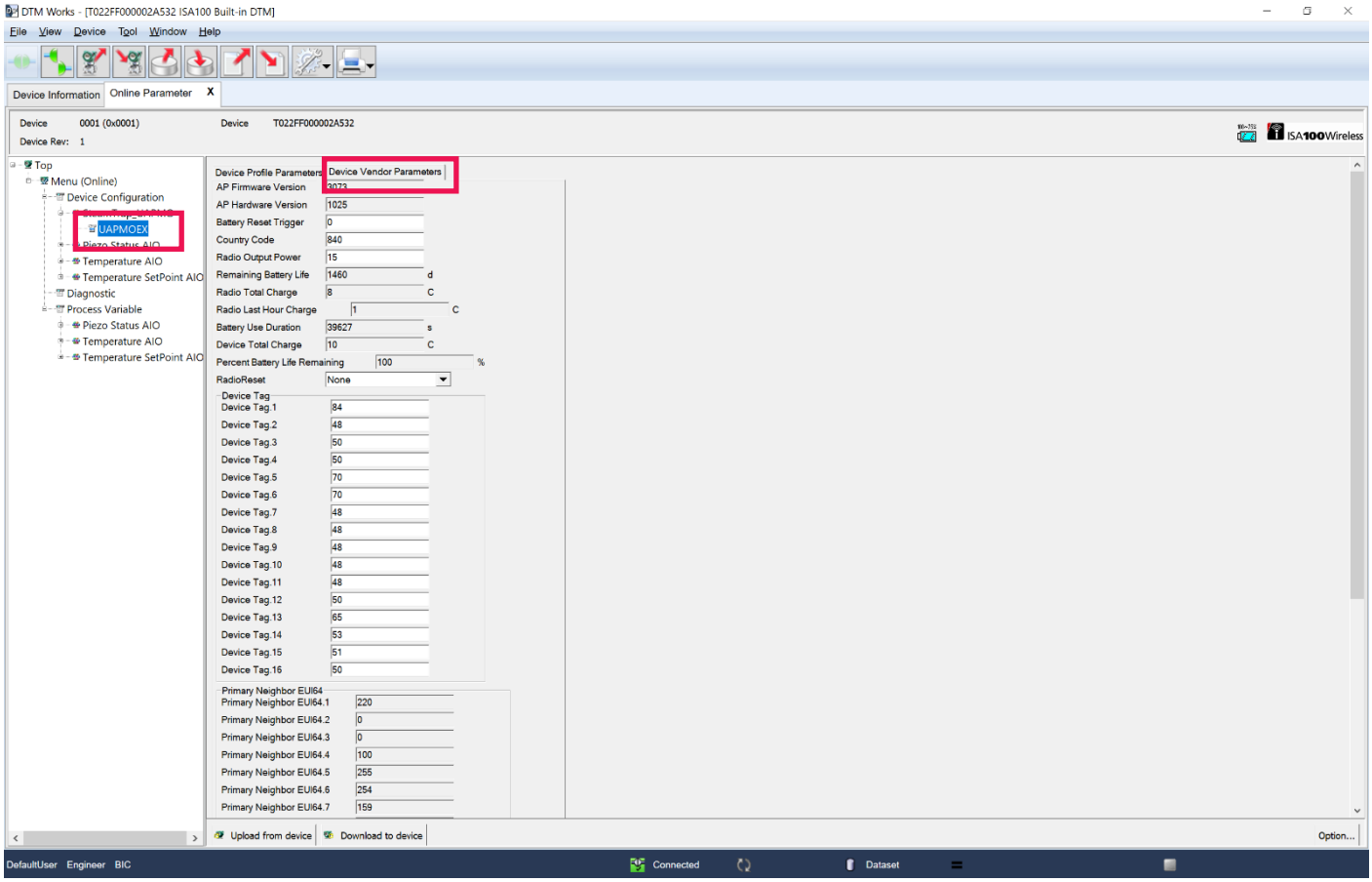


8. Confirm the device is back in Standard operation mode



4.3 Device Vendor Parameters

1. Open FieldMate.
2. Open DTM Works (See DTM Tool – Viewing Device Data in DTM Tool).
3. From the menu select Menu/Device Configuration/Steam Trap_UAPMO/UAPMOEX.
4. Select the “Device Vendor Parameters” Tab.



- AP Firmware Version – Current Firmware installed in the monitor
- AP Hardware Version – Version of the monitor hardware
- Battery Reset Trigger – Enables user to reset battery life after a battery change (See Battery Life Reset for battery resetting instructions)
- Country Code – Enables the user to define the country the monitor is installed

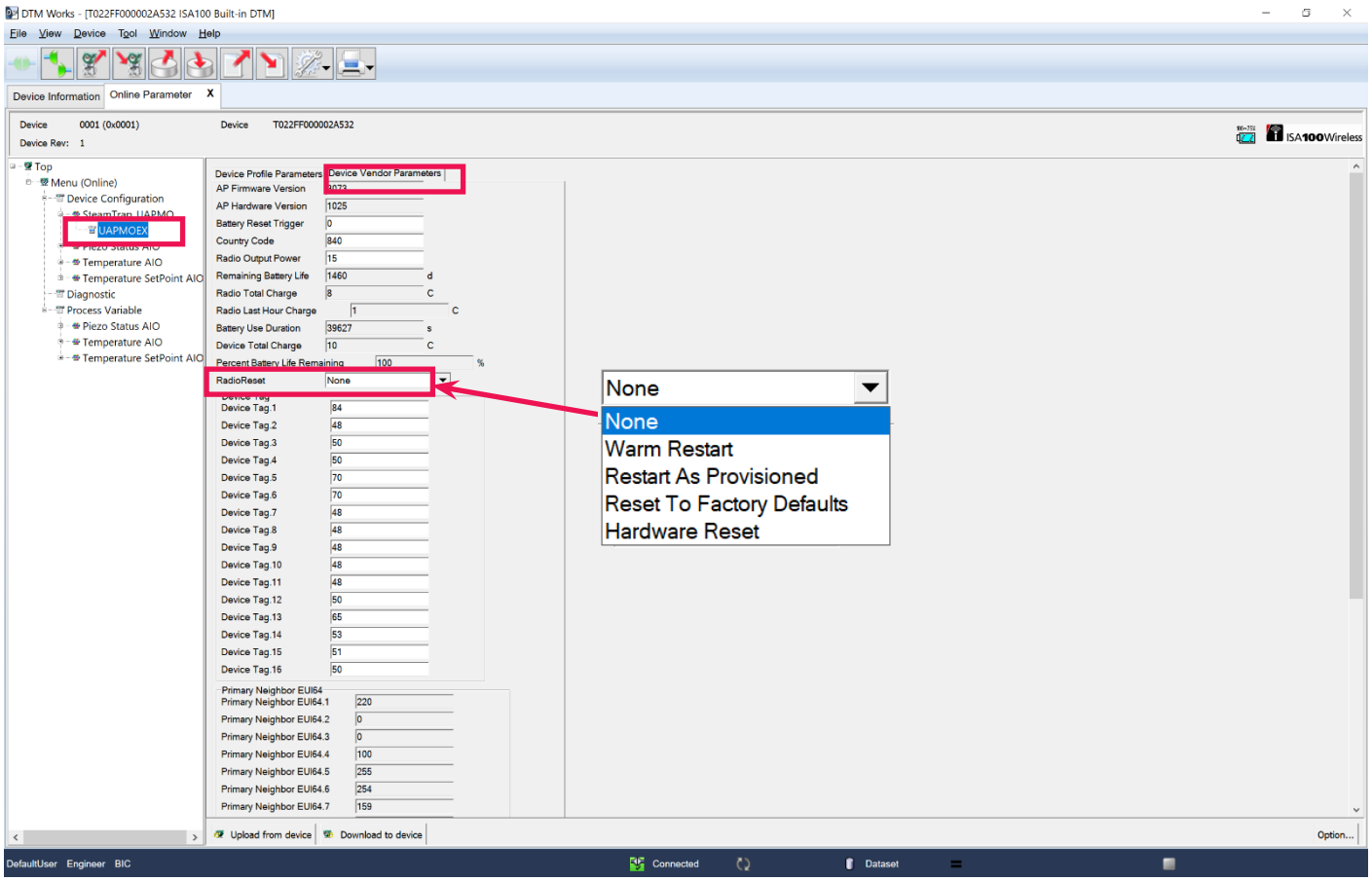
  A list of current country codes can be found at https://en.wikipedia.org/wiki/ISO_3166-1
- Radio Output Power – Transmission power of the radio transmitter
  - 0 – Minimum power
  - 15 or 17 - Maximum Power (Firmware/Hardware dependent)
- Remaining Battery Life – Estimated number of days remaining before the battery is depleted
- Radio Total Charge – Total Energy consumed by the radio since battery reset
- Radio Last Hour Charge – Energy consumed by the radio in the last hour
- Battery Use Duration – Device up time in seconds
- Device Total Charge – Total energy consumed by the monitor since battery reset

4.3 Device Vendor Parameters – continued

- Percent Battery Life Remaining – Remaining battery life in percent
- RadioReset – Allows the user to remotely restart the monitor
- Device Tag – Hexadecimal representation of the device tag ASCII characters
- Primary Neighbor EUI64 – MAC address of the primary source clock neighbor
- Primary Neighbor RSQI – The Received Signal Quality Indicator of the Primary Neighbor
- Primary Neighbor Tx Success – Number of successful transmissions with the Primary Neighbor since last device restart
- Primary Neighbor Tx Fail – Number of failed transmissions with the Primary Neighbor since the last device restart
- Secondary Neighbor EUI64 – MAC address of the Secondary source clock neighbor
- Secondary Neighbor RSQI – The Received Signal Quality Indicator of the Secondary Neighbor
- Secondary Neighbor Tx Success – Number of successful transmissions with the Secondary Neighbor since last device restart
- Secondary Neighbor Tx Fail – Number of failed transmissions with the Secondary Neighbor since the last device restart

4.4 Restarting the Monitor

1. Open FieldMate
2. Open DTM Works (See DTM Tool – Viewing Device Data in DTM Tool)
3. From the menu select Menu/Device Configuration/Steam Trap_UAPMO/UAPMOEX
4. Select the “Device Vendor Parameters” Tab
5. Select dropdown of “RadioReset”



	Device Management Application Process (DMAP) Attributes	User-Application Process (UAP) Attributes	Device Provisioning Object (DPO) Attributes
Warm Restart	Keep	Keep	Keep
Restart As Provisioned	Clear	Keep	Keep
Reset to Factory Defaults	Clear	Keep	Keep
Hardware Reset	Clear	Clear	Clear

4.5 Attributes List

TSAP ID	Object ID	Attribute ID	Description	Type	Comments:
2	3	64	Device Identification Number	Array of Unsigned8 (8 Bytes – Byte 0..3 – Vendor ID, Byte 4..5 Model ID, Byte 6..7 Device Revision)	
		67	DIAG_STATUS	Unit32	See Diag_Status decoding
		102	Software Version	Uint16	
		103	Hardware Version	Uint16	
		104	Battery Energy Reset	Uint8	
		105	Country Code	Uint16	
		106	Radio Output Power	Uint8	
		107	Remaining Battery Life	Uint16	
		108	Device Tag	Uint8[16]	
		109	Primary Neighbor EUI64 Address	Uint8[8]	
		110	Primary Neighbor RSQI	Uint8	
		111	Primary Neighbor TX SUCCESS	Uint32	
		112	Primary Neighbor TX FAIL	Uint32	
		113	Secondary Neighbor EUI64 Address	Uint8[8]	
		114	Secondary Neighbor RSQI	Uint8	
		115	Secondary Neighbor TX SUCCESS	Uint32	
		116	Secondary Neighbor TX FAIL	Uint32	
		117	Total Radio Charge	Uint32	Units are Coulombs.
		118	Last Hour Radio Charge	Uint32	Units are Coulombs.
		119	Battery Used Duration	Uint32	Units are seconds.
		120	Total Device Charge	Uint32	Units are Coulombs.
		121	Remaining Battery Life Percentage	Uint8	Units are percentage of battery energy left.
		122	Radio Reset Command	Uint8	0X00 – None
					0X01 – Warm Restart
					0X02 – Restart As Provisioned
					0X03 – Reset To Factory Defaults
					0X04 – Hardware Reset

4.6 Armstrong Specific Attributes

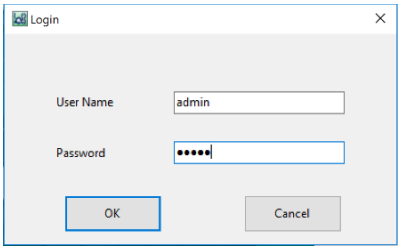
The following table contains a vendor specific attribute list for Armstrong ST 6700 instrument. Each of them could be displayed based on the “Read Object attribute” function.

TSAP ID	Object ID	Attribute ID	Description
2	1 (UAPMO)	102	Software version
		103	Hardware version
		104	Battery Energy Reset
		105	Country Code
		106	Radio Output Power
		107	Remaining Battery Life
		108	Device Tag
		109	Primary Neighbor EUI64 Address
		110	Primary Neighbor RSQI
		111	Primary Neighbor TX SUCCESS
		112	Primary Neighbor TX FAIL
		113	Secondary Neighbor EUI64 Address
		114	Secondary Neighbor RSQI
		115	Secondary Neighbor TX SUCCESS
		116	Secondary Neighbor TX FAIL
		117	Total Radio Charge
		118	Last Hour Radio Charge
		119	Battery Used Duration
		120	Total Device Charge
		121	Remaining Battery Life Percentage
		122	Radio Reset Command

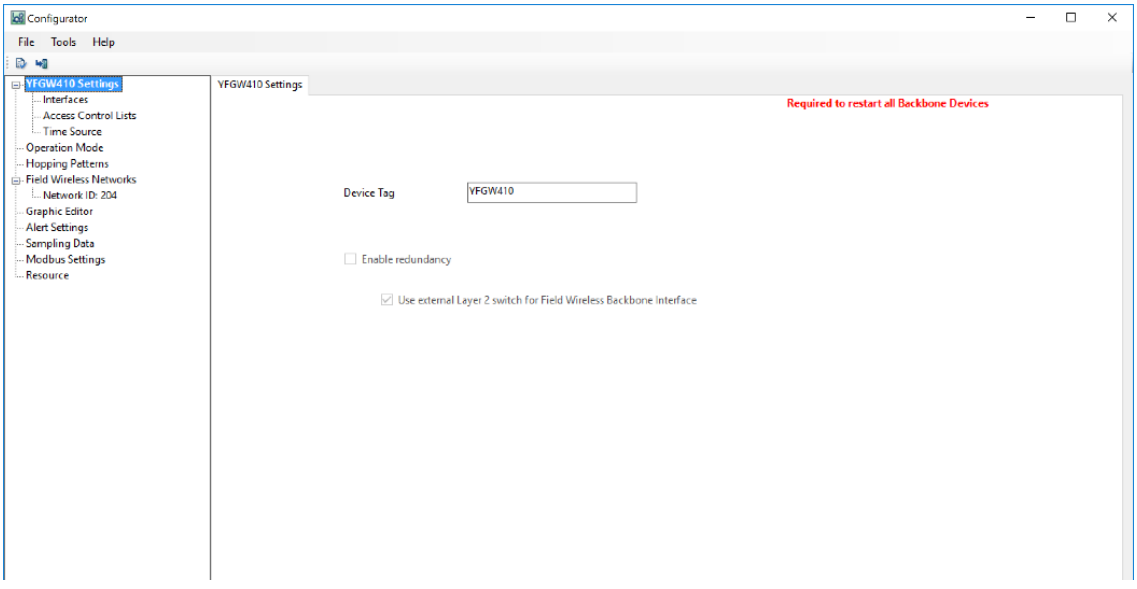
5.0 Viewing the Modbus Registers of the Monitor

1. Start Internet Explorer and enter assigned IP (Default http://192.168.0.101:8080) in the web browser navigation field.
2. Click “Configurator” and the login dialog will appear.

3. Follow the login steps (if it is the first time, the default login user is “admin” and password “admin”).

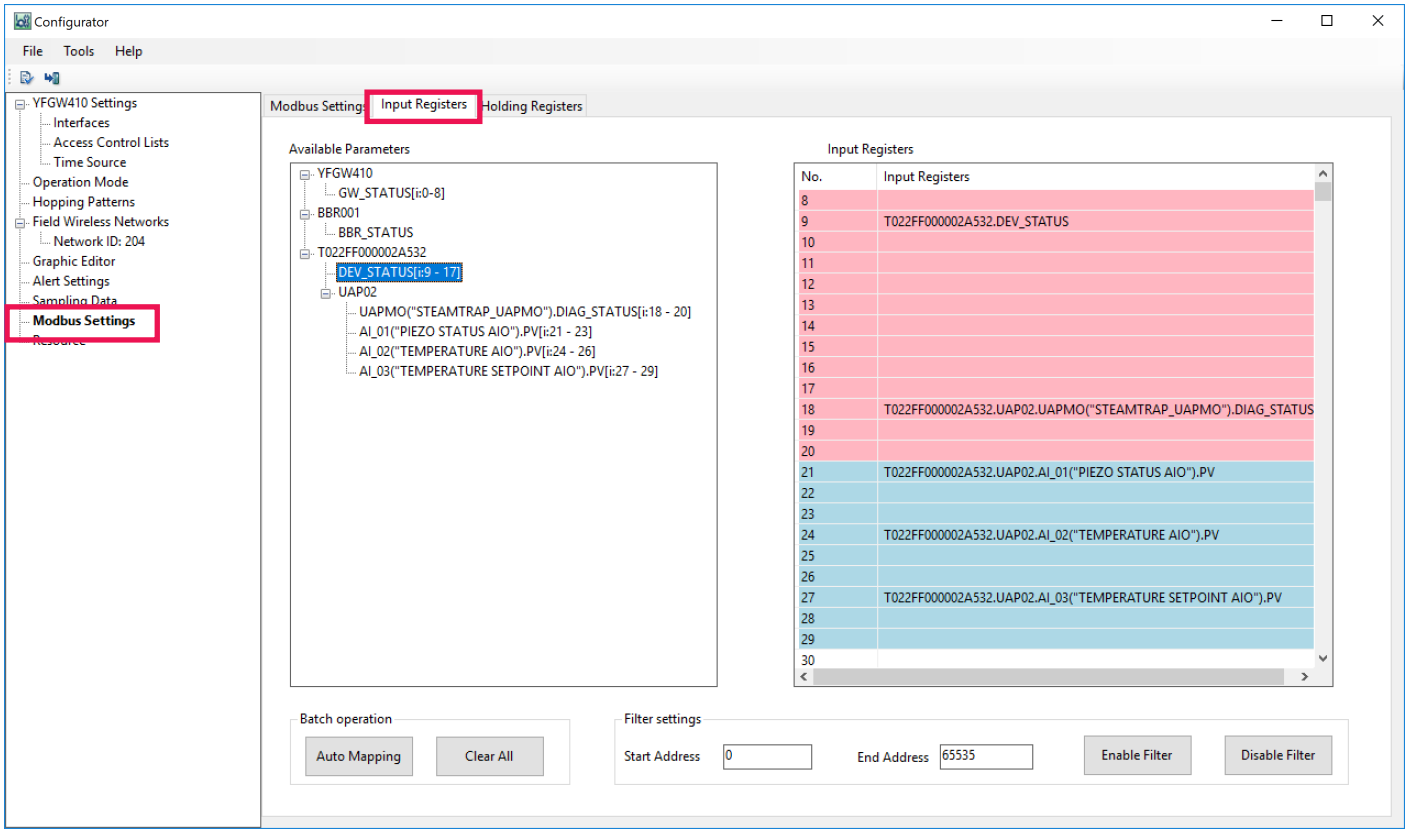


4. A valid login opens the configurator tool.



5.0 Viewing the Modbus Registers of the Monitor – continued

5. Select “Modbus Settings” and the “Input Registers” tab.



6.0 Modbus Register Content

No.	Description	Name	Data format	Details		
0	YFGW410.GW_STATUS	Data Status	Unsigned 16	0x0080: Good Status		
1		Device Status	Unsigned 16	Status of the field wireless device (0: connected, 2: not connected)		
2			Integer 16	Battery life (0>: days, <0: hours, 0x7FFF: external power source)		
3			Unsigned 16	0 (Reserved bits)		
4						
5						
6						
7						
8						
9	T022FF000002A532.DEV_STATUS	Data Status	Unsigned 16	0x0080: Good Status		
10		Device Status	Unsigned 16	Status of the field wireless device (0: connected, 2: not connected)		
11			Integer 16	Battery life (0x05B4 (1460 dec)) days - normal starting point		
12			Unsigned 16	Usually 0 (Reserved bits)		
13						
14						
15						
16						
17						
18	T022FF000002A532.UAP02.UAPMO(“STEAMTRAP_UAPMO’).DIAG_STATUS	Data Status	Unsigned 16	0x0080: Good Status		
19		Diagnostic Status	Bit String	Binary (See example #1)		
20						
21	T022FF000002A532.UAP02.AI_01(“PIEZO STATUS AIO”).PV	Data Status	Unsigned 16	0x0080: Good Status		
22		Piezo Status	Floating	Good Trap	Cold Trap	Blow Through
				3F80	4000	4040
23				0000	0000	0000
24	T022FF000002A532.UAP02.AI_02(“TEMPERATURE AIO”).PV	Data Status	Unsigned 16	0x0080: Good Status		
25		Temperature	Floating	32 bit hexadecimal representation (See example #2)		
26						
27	T022FF000002A532.UAP02.AI_03(“TEMPERATURE SETPOINT AIO”).PV	Data Status	Unsigned 16	0x0080: Good Status		
28		Temperature Set Point	Floating	32 bit hexadecimal representation (See example #3)		
29						

6.1 Translating (“STEAMTRAP_UAPMO’).DIAG_STATUS

Active Bit	Diagnostic Status
31	Failure Status
30	Function Check Status
29	Out Of Specification Status
28	Maintenance Required Status
27	Fault In Electronics
26	Faults in sensor or actuator element
25	Installation, calibration problem
24	Out of service
23	Outside sensor limits
22	Environmental conditions out of devices specifications
21	Fault prediction: Maintenance required
20	Power is critical low: maintenance need short term
19	Power is low: maintenance need mid-term
18	Software update incomplete
17	Simulation is active
16	Faults due to process influence
15	Faults due to non-complainant operating conditions
14	Other faults
13	WCI reserved 13
12	WCI reserved 12
11	WCI reserved 11
10	WCI reserved 10
9	WCI reserved 9
8	Watchdog reset
7	Vendor configuration active
6	Cold Trap
5	Incompatible firmware
4	High battery use
3	Communication error
2	Trap Blow Thru
1	Vendor Defined 1
0	Detailed information available

Examples																																		
Register	19																20																	
Bit	31	30	29	26	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Result #1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Result #2	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Result #1 “Function Check Status” & “Cold Trap”

Result #2 “Maintenance Required Status” & “Power is critical low: maintenance need short term”

6.2 Translating ("TEMPERATURE AIO").PV and ("TEMPERATURE SETPOINT AIO").PV

Example #2			
Register	Result	Combine	Convert 32 HEX to Floating Point
25	41C8	41C80000	25.00000
26	0000		

Example #3			
Register	Result	Combine	Convert 32 HEX to Floating Point
28	428C	428C0000	70.00000
29	0000		

6.3 Device Self-Diagnosis Status Flags

Category 1: Failure Diagnostics

Diagnostic: Fault in Electronics

Functional Behavior:
The following diagnostic flags are set: "Failure Status" and "Fault in Electronics" (Bit 31 and Bit 27 are set to 1).

Causes and Triggers:
Critical memory failure, security violations, WDT password violation, Flash password violation, PMM password violation, Peripheral area fetch (stack overflow, pointer access or other logical problem in the code.

Diagnostic: Faults In Sensor Or Actuator Element

Functional Behavior:
The following diagnostic flags are set: "Failure Status" and "Faults in sensor or actuator element" (Bit 31 and Bit 26 are set to 1).

Causes and Triggers:
Damaged (open or shorted) thermistor resulting in 0.1 Ohm > R or R > 1M Ohm. Damaged (open or shorted) piezo-electric transducer resulting in 0.1 Ohm > R or R > 1M Ohm.

Diagnostic: Faults Due To Process Influence

Functional Behavior:
The following diagnostic flags are set: "Failure Status" and "Faults due to process influence" (Bit 31 and Bit 16 are set to 1).

Causes and Triggers:
Excessively high process temp is detected can detect resulting in 290 deg C < Temp < 350 deg C.

Diagnostic: Faults Due To Non-Compliance With Specified Operating Conditions

Functional Behavior:
The following diagnostic flags are set: "Failure Status" and "Faults due to non- compliant operating conditions" (Bit 31 and Bit 15 are set to 1).

Causes and Triggers:
This diagnostics flag will be set when the on-board oscillator experiences a fault frequency, namely when the frequenciesgenerated drops below the minimum allowed specification.

Diagnostic: Other Faults

Functional Behavior:
The following diagnostic flags are set: “Failure Status” and “Watchdog Reset” (Bit 31 and Bit 8 are set to 1).

Causes and Triggers:
The diagnostic flag is set if the result of ProbeTempReadObjId, ProbeTempSetObjId,PiezoStatusUAPObj Id registration not successful. This is more like an extra software validation method to assure that all the channels have a right object attached to it and there is no duplicate registration.

Diagnostic: Watchdog Triggered Device Reset

Functional Behavior:
The following diagnostic flags are set: “Failure Status” and “Faults due to non- compliant operating conditions”
(Bit 31 and Bit 15 are set to 1).

Causes and Triggers:
The diagnostic flag is set if the application processor was reset due to a watchdog expiration. This can be detected based on SYSRSTIV Register of the MSP430F5438A micro-controller.

Category 2: Functional Check

Diagnostic: Installation, Calibration Problem

Functional Behavior:
The following diagnostic flags are set: “Function Check Status” and “Installation, calibration problem”
(Bit 30 and Bit 25 are set to 1).

Causes and Triggers:
The diagnostic flag is set if one of the following conditions has been met.

- Low output from thermistor where T < -40°
- High output from thermistor where T > 200°
- Low output from piezo-electric transducer where there is no voltage output or Vout-piezo <= 1 mV
- RSQI with primary neighbor is low RSQI < 63.
- High PER (Packet Error Rate) where PER > 50%.

Diagnostic: Out Of Service

Functional Behavior:
The following diagnostic flags are set: “Function Check Status” and “Out of service”
(Bit 30 and Bit 24 are set to 1).

Causes and Triggers:
The diagnostic flag is set if actual mode of AI Objects is Out Of Service.

Diagnostic: Software Update Incomplete

Functional Behavior:
The following diagnostic flags are set: “Function Check Status” and “Software Update Incomplete”
(Bit 30 and Bit 18 are set to 1).

Causes and Triggers:
The diagnostic flag is set when the remote OTA upgrade process of the application processor (through UDO mechanism) fails due to any reasons (ex. invalid image firmware, RF connection lost etc).

6.3 Device Self-Diagnosis Status Flags – continued

Diagnostic: Simulation Is Active

Functional Behavior:
The following diagnostic flags are set: “Function Check Status” and “Simulation is active” (Bit 30 and Bit 17 are set to 1).

Causes and Triggers:
The diagnostic flag is set when the simulation mode/function of any process channel (AI object) is active.

Diagnostic: Cold Trap Detected (Armstrong Specific)

Functional Behavior:
The following diagnostic flags are set: “Function Check Status” and “Cold trap” (Bit 30 and Bit 6 are set to 1).

Causes and Triggers:
The diagnostic flag is set if the average output from thermistor is approximately equal to the ambient temp over a period of time of 10 minutes.

Diagnostic: Firmware Incompatible (Armstrong Specific)

Functional Behavior:
The following diagnostic flags are set: “Function Check Status” and “Incompatible Firmware (Bit 30 and Bit 5 are set to 1).

Causes and Triggers:
The diagnostic flag is set when after a remote firmware upgrade, the new application processor firmware version (reflected by UPAMO’s VersionRevision attribute) is older than or equal with the previous one.

Diagnostic: High-Battery Use Detected (Armstrong Specific)

Functional Behavior:
The following diagnostic flags are set: “Function Check Status” and “High battery use” (Bit 31 and Bit 8 are set to 1).

Causes and Triggers:
The diagnostic flag is set when the rate of change of battery life prediction exceeds discharge rate threshold specified value over a time period.

Diagnostic: Trap “Blow-Through” (Armstrong Specific)

Functional Behavior:
The following diagnostic flags are set: “Failure Status” and “Faults due to non- compliant operating conditions” (Bit 30 and Bit 2 are set to 1).

Causes and Triggers:
The diagnostic flag is set if the Analog Input PV (process value) reflecting the piezo-electric transducer becomes equals 3 (CH09_AI_0’s PV = 3). The status flag will be cleared as soon as the Analog Input PV attribute value changes to 1 or 2.

6.3 Device Self-Diagnosis Status Flags – continued

Category 3: Out of Specification

Diagnostic: Outside Sensor Limits

Functional Behavior:
The following diagnostic flags are set: “Out of Specification Status” and “Environmental Conditions Out of Device Specification” (Bit 29 and Bit 23 are set to 1).

Causes and Triggers:
The diagnostic flag is set if the internal reading of the A/D converter present in the application processor is out of range. This indicates that the internal temperature sensor present in the application processor cannot be read, and there is no way of knowing if the instruments is operating within the advertised environmental specifications (temperature). If the value read is within 200 mV below or 200 mV above the lowest/highest possible ADC reading value this flag will be set.

Diagnostic: Environmental Conditions Out Of Device Specification

Functional Behavior:
The following diagnostic flags are set: “Out of Specification Status” and “Outside Sensor Limits” (Bit 29 and Bit 22 are set to 1).

Causes and Triggers:
The diagnostic flag is set if the internal reading of the A/D converter present in the application processor indicates that the instrument is operating in temperatures that are below -40° or above 85°.

Category 4: Maintenance Required

Diagnostic: Fault Prediction

Functional Behavior:
The following diagnostic flags are set: “Maintenance Required Status” and “Fault Prediction Maintenance Required” (Bit 28 and Bit 21 are set to 1).

Causes and Triggers:
The diagnostic flag is set if the device resets due to a brownout. Since the device is battery powered, this indicates a drop in voltage, meaning that somethings is wrong with the power supply system.

Diagnostic: Power Is Critical Low

Functional Behavior:
The following diagnostic flags are set: “Maintenance Required Status” and “Power Is Critical Low: Maintenance is needed short-term” (Bit 28 and Bit 20 are set to 1).

Causes and Triggers:
The diagnostic flag is set if the remaining battery capacity (DLMO.PowerSupplyStatus = 3) is less than 25% and battery life (DLMO.EnergyLeft) is less than 10 days.

Diagnostic: Power Is Low

Functional Behavior:
The following diagnostic flags are set: “Maintenance Required Status” and “Power Is Low: Maintenance is needed mid-term” (Bit 28 and Bit 19 are set to 1).

Causes and Triggers:
The diagnostic flag is set if the remaining battery capacity (DLMO.PowerSupplyStatus = 3) is less than 25% and battery life (DLMO.EnergyLeft) is more than 10 days.

6.3 Device Self-Diagnosis Status Flags – continued

Diagnostic: Communication Error (Armstrong Specific)

Functional Behavior:
Diagnostic: Communication error (Armstrong specific) (Bit 28 and Bit 3 are set to 1).

Causes and Triggers:
The diagnostic flag is set if the API communication between application processor and stack radio module is not working. If no Radio API Request/Response will be received by the application processor during last 5 minutes the flag is set. If an API Request/Response is received the Communication error flag remains active for 5 minutes, but the internal counter will be reset for the next 5 minutes.

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