Switchgear Electrical Nodes Cloud IoT Wireless Temp. Monitoring

Wireless Temperature Monitoring, for switchgear, IoT cloud & local temperature display & alarm, electrical nodes temp.

Ver. Date: Dec, 15th 2023

Acrel Co., Ltd.

No.253 Yulv Road, Jiading District, Shanghai, China

2023/12/15 Ver.

0. Application Scenario

(1) This wiressless temperature monitoring solution was majorly designed for monitoring and alarming the temperature of crucial electrical connection nodes in switchgear like busbar, power cable, cable&busbar connection, CB's fixed contact, CB's moving contact and etc.

(2) Such electrical connection nodes have the potential threat of fire hazard due to the aging of material, slackness of connection and etc. Thus a real-time temperature monitoring and alarm system will be necessary to prevent it from potential fire hazard caused by the rising of temperature.

(3) Solution here was major designed for both cloud & local temperature display and alarm. Distinguish from other Acrel wireless temperature monitoring soloution which has only local temperature display and alarm.

(4) Unlike the traditional wired temperature monitoring solution, wireless temperature monitoring solution make the connection between temeperature sensor and temperature transceiver wireless. This will largely ease the installation and make the overall solution more flexible.

Busbar

Cable&Busbar Connect

Power Cable

CB Fixed Contact

CB Moving Contact
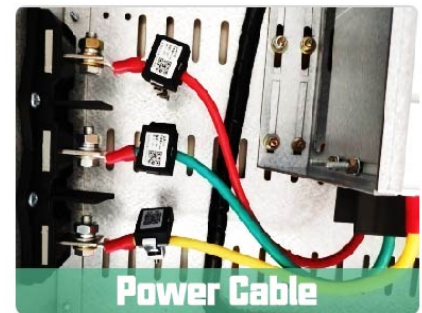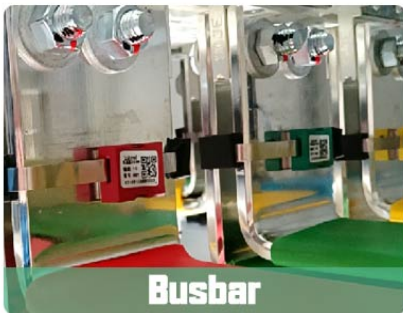
(1) Major Temperature Monitoring Nodes Showcase

GFSK

Wireless Temperature Sensor

Wireless Temperature Transceiver and Display Unit

(4) WIreless Connection for esasy installation

0. Solution Selection Logic

Judging by final data upstream methods which was decided by site network condition [4G, WiFi, Ethernet]. And request for temp. data display&alarm methods - either both Cloud& Local Temp. Display&Alarm or just only Cloud Temp. Display&Alarm. The standard solutions could be devided into 4 basic solutions [Cloud display&alarm here means computer or mobile accessed IoT system platform temperature for display and alarm]:

(1) Switchgear 4G IoT Cloud&Local Wireless Temperature Monitoring Solution [with both Cloud&Local Temp. Display&Alarm, 4G based, **AWT200-1E4S-4GHW+ARTM-Pn+ATE400**]

(2) Switchgear WiFi&Ethernet IoT Cloud&Local Wireless Temperature Monitoring Solution [with both Cloud&Local Temp. Display&Alarm, WiFi&Ethernet based, **AWT200-1E4S-WiFi+ ARTM-Pn+ATE400**]

(3) Switchgear 4G IoT Cloud Wireless Temperature Monitoring Solution [with only Cloud Temp. Display&Alarm, 4G based, **AWT200-1E4S-4GHW+ATC600+ATE400**]

(4) Switchgear IoT Cloud Wireless Temperature Monitoring Solution [with only Cloud Temp. Display&Alarm, WiFi&Ethernet based, **AWT200-1E4S-WiFi+ATC600+ATE400**]
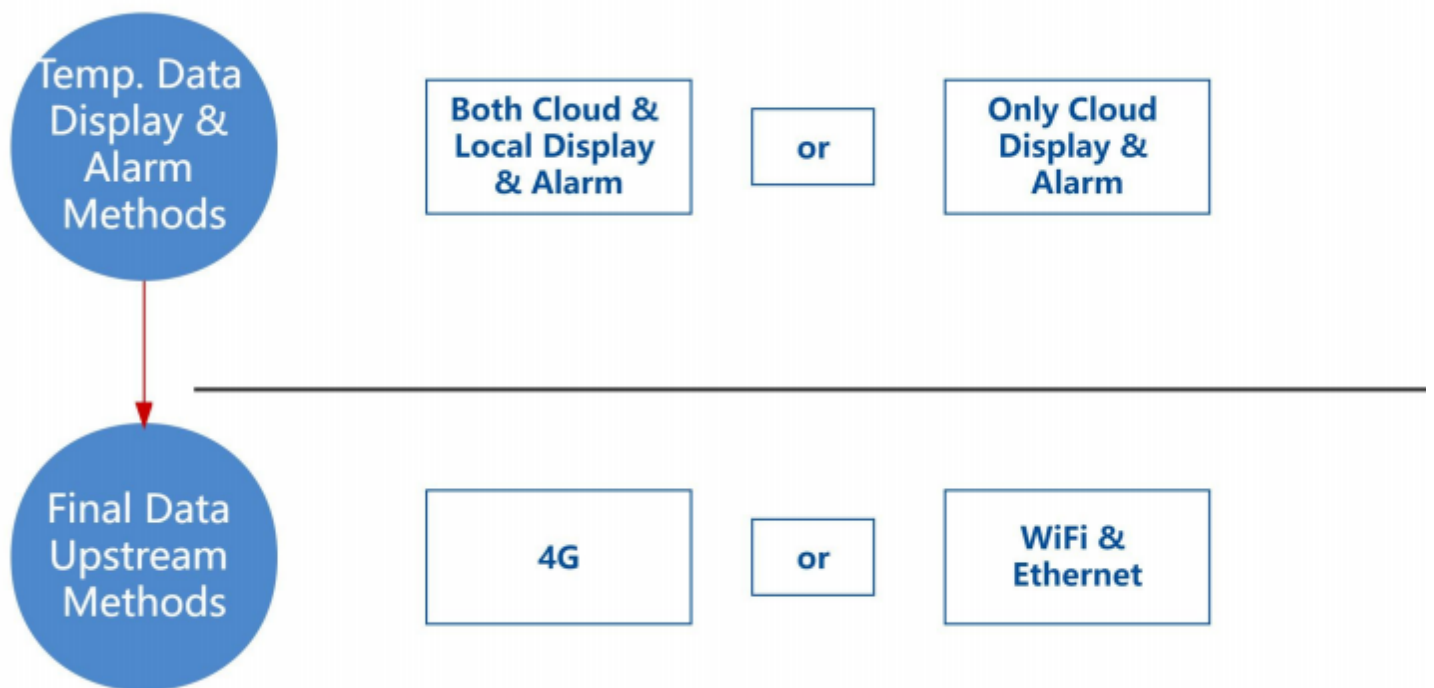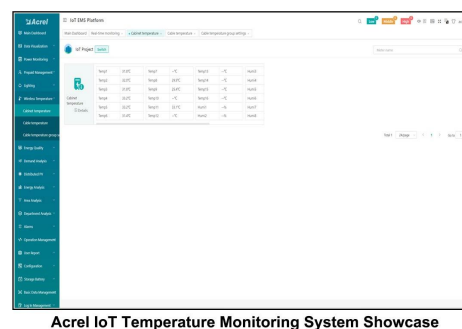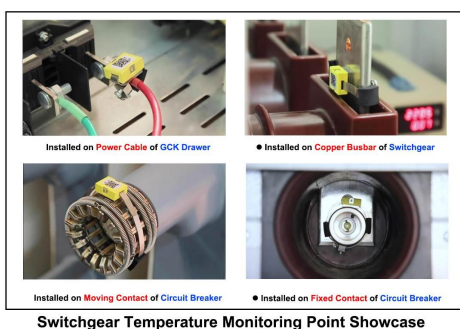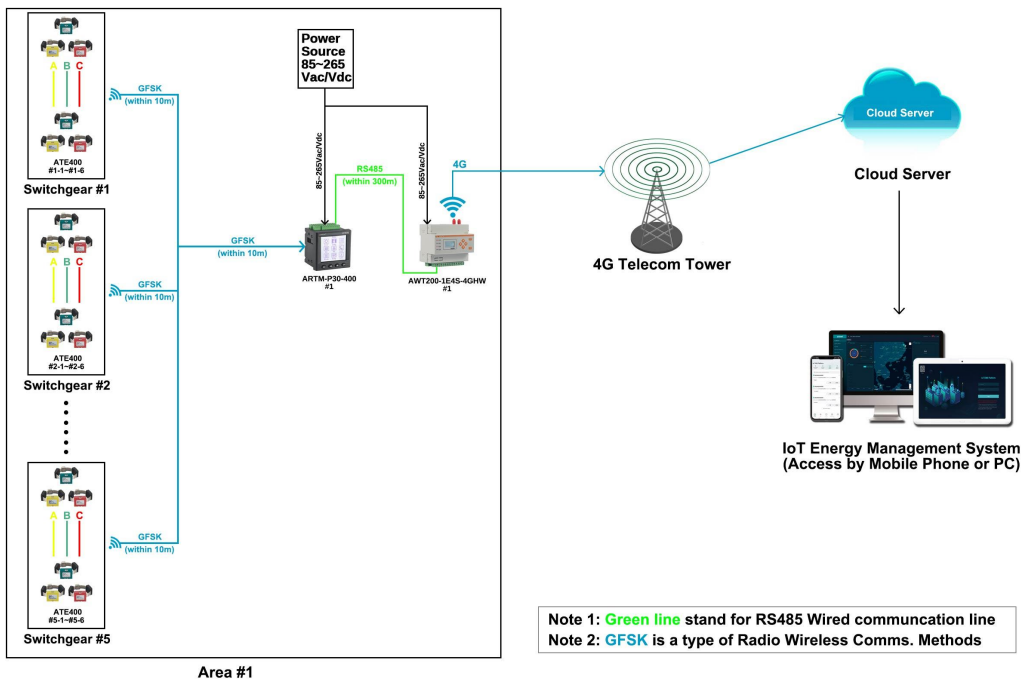

(1) Solution Selection Logic

Acrel®

1. Scenario Preset [4G IoT Cloud&Local Wireless Temperature Monitoring Solution]

(1) The target was to monitor and alarm the temperature of 5 switchgears deployed in a single room. Both IoT cloud & local display and alarm of temperature was requested.
(2) Each switchgear require 6 temperature moniotoring points for electrical connection nodes. Thus there will be 30 temperature monitoring points in total.
(3) The system voltage of switchgear will be 10kV. Network with stable 4G Comms.
(4) For all temperature monitoroing points, there will be current going through when it's in normal operation. [more than 5A, since starting current of ATE400 need to be more than 5A]

1. Devices Deployment [4G IoT Cloud&Local Wireless Temperature Monitoring Solution]

Area #1 - Switchgear #1 ~ #5:
- 1* AWT200-1E4S-4GHW IoT Gateway [For further uploading the data from ARTM-Pn to Acrel IoT Cloud System via 4G Comms.]
- 1* ARTM-P30-400 Wireless Temperature Transceiver and Display Unit [For collecting, displaying and alarming for all temperature data collected from ATE400]
- 30* ATE400 Wireless Temperature Sensor [For monitoring the temperature of electrical connection nodes and send the data to ARTM-P30-400 via GFSK wirelesss Comms.]
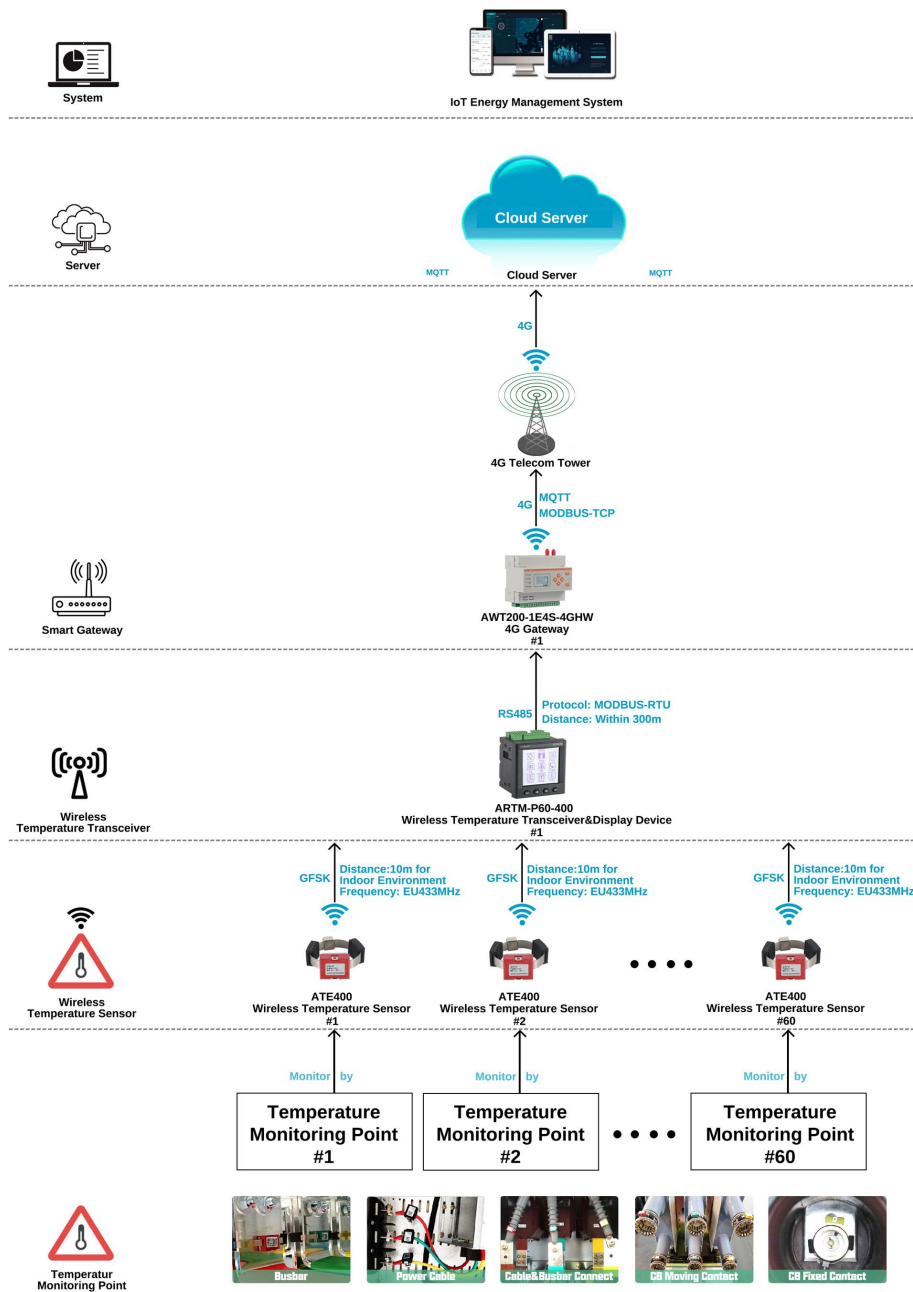

Note 1: Green line stand for RS485 Wired communcation line
Note 2: GFSK is a type of Radio Wireless Comms. Methods

Installed on Power Cable of GCK Drawer ● Installed on Copper Busbar of Switchgear
Installed on Moving Contact of Circuit Breaker ● Installed on Fixed Contact of Circuit Breaker

Switchgear Temperature Monitoring Point Showcase

Acrel IoT Temperature Monitoring System Showcase

(1) Devices deployment plan Illustraton

1. Comm. Structure & Logic [4G IoT Cloud&Local Wireless Temperature Monitoring Solution]

(1) Between ATE400 wireless temperature sensor and ARTM-P30-400 wireless temperature transceiver and display unit, we are using a radio wireless communications called GFSK. The communication distance is within 100m [when in open area] and is within 10m [when in indoor environment and penetrate 1 layer of metal cover of switchgear]. The communication protocol is self defined protocol. [1 pcs ARTM-Pn can support up to 60 pcs ATE400 if comms. distance allowed.]

(2) Between AWT200-1E4S-4GHW IoT Gateway and ARTM-Pn, the communication will be RS485 wired Comms. based on MODBUS-RTU protocol. The RS485 Comms. distance between these 2 devices was recommend to be within 300m when we are using 2x1.5mm² RVSP cable for RS485 connection wiring.

(3) Between AWT200-1E4S-4GHW IoT gateway and Acrel IoT system, we are using 4G comms. methods based on either MQTT or MODBUS-TCP protocol.
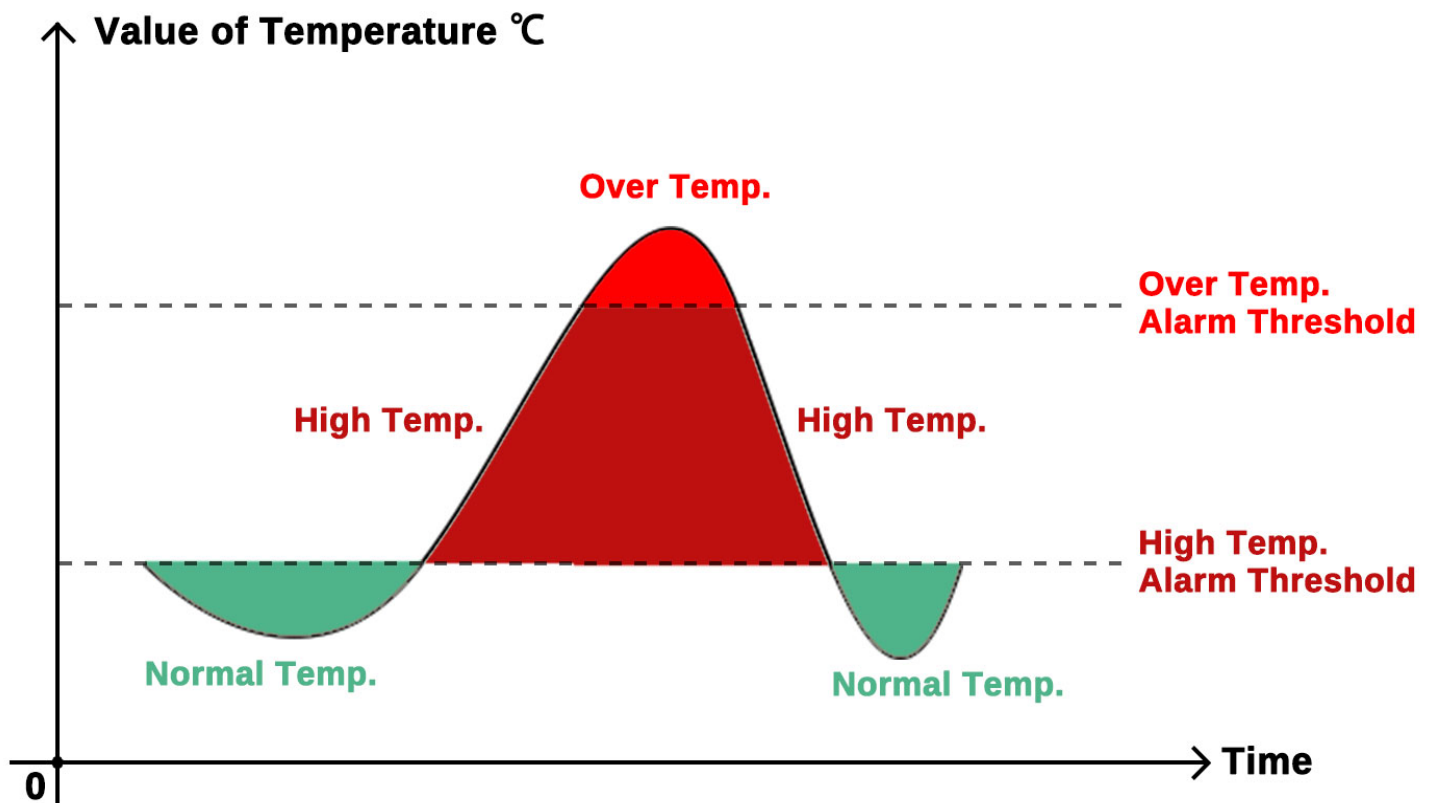
1. Devices Temp. Alarm Function&Logic [4G IoT Cloud&Local Wireless Temp. Monitoring Solution]

ARTM-Pn Seires Wireless Tempearture Transceiver and Display Devices support 4 types of major temperature alarm logic. When any of the below alarm logic was set and triggered, it will give a DO output to other indication devices like buzzer or LED light.

(1) High Temperature Alarm: When temperature of certain monitoring node was higher than a certain preset threshold value, this will twigger high temperature alarm. And eventually, this will trigger 1st way DO alarm output of ARTM-Pn. [Normally, High Temperature Alarm was used as a pre-alarm for mentioning related person should take care of temperature rising issue in monitoring places]

(2) Over Temperature Alarm: Similar like high temperature alarm, but over temperature alarm normally will be preset a higher alarm threshold. And once alarm was triggered, this will also trigger 2nd way DO alarm output of ARTM-Pn. [Normally, Over Temperature Alarm was used for alarming the related person that there are severe temperature rising issue happened and need to be solved immediately]
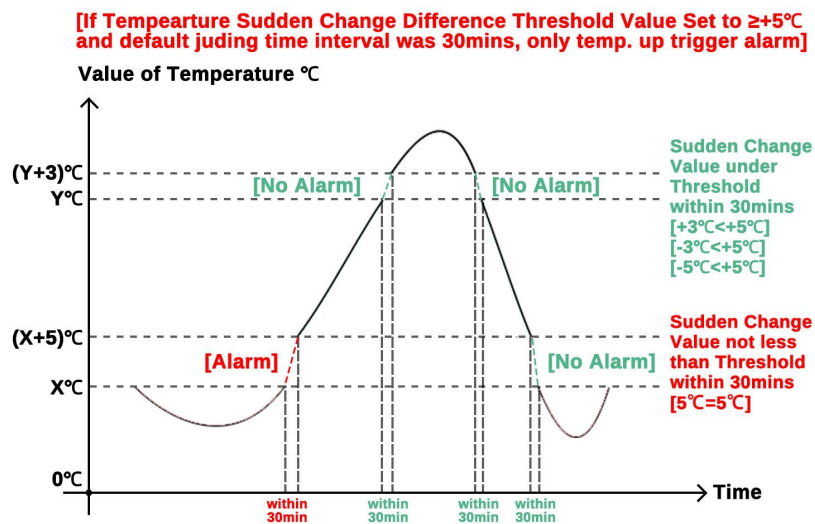
(1&2) High&Over Temperature Alarm

1. Devices Temp. Alarm Function&Logic [4G IoT Cloud&Local Wireless Temp. Monitoring Solution]
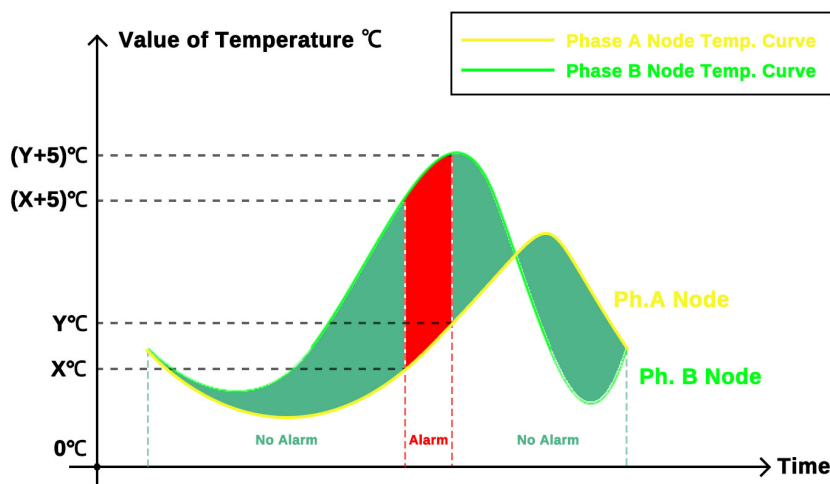
ARTM-Pn Seires Wireless Tempearture Transceiver and Display Devices support 4 types of major temperature alarm logic. When any of the below alarm logic was set and triggered, it will give a DO output to other indication devices like buzzer or LED light.

(3) Temperature Sudden Rising Change Alarm: When during a certain period [within 30mins], if there was large temperature sudden change happened, then it will trigger temperature sudden change alarm. [like +10 temperature rising during 5 mins for example, also, this temperature sudden change alarm threshold value could be set by customer between 0~125] Eventually, this will trigger 2nd way DO alarm output of ARTM-Pn. [Noted: This temperature sudden change alarm will only last for 5 mins at most once triggered.]

(4) Temperature imbalance alarm between 3* temperature monitoring nodes of certain circuit 3-phase: When the temperature difference between 3 monitoring nodes of cetain circuit 3-phase [like between phase A&B&C temperature monitoring nodes of circuit #1] was larger than a certain preset threshold value [take 10 temperature difference between any 2 of phase A&B&C temperature monitoring nodes of circuit #1 for example] This will trigger temperature imbalance alarm and eventually trigger 2nd way DO alarm output of ARTM-Pn.
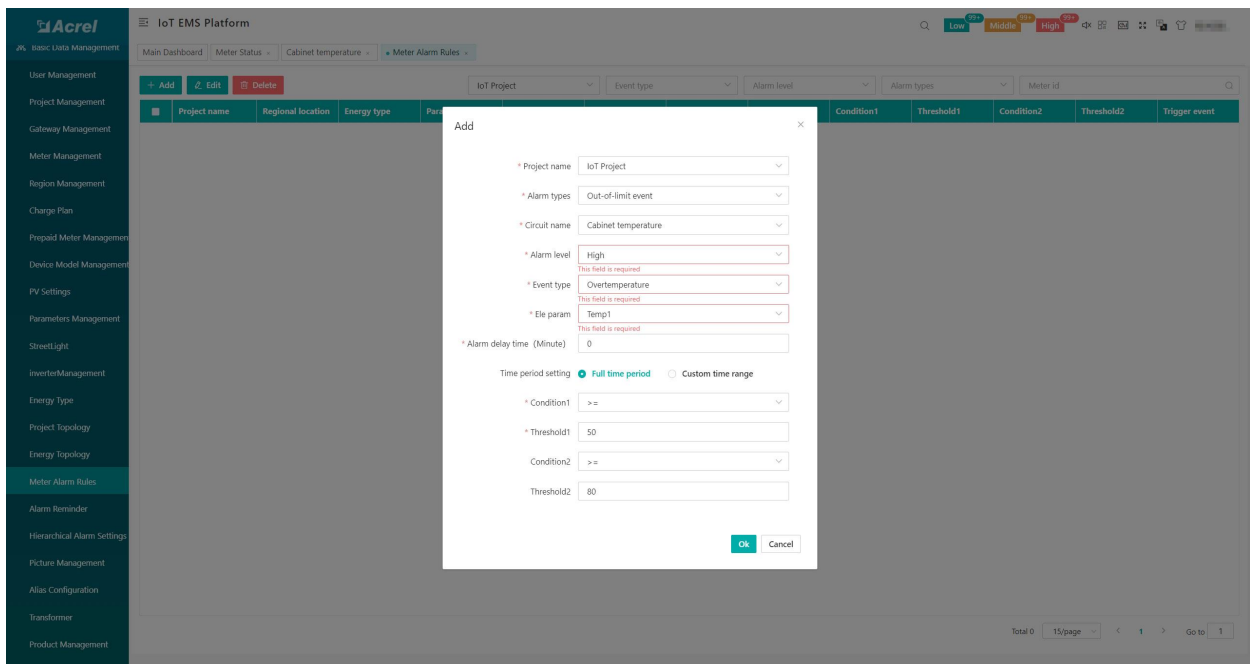

(3) Temperature Sudden Rising Change Alarm

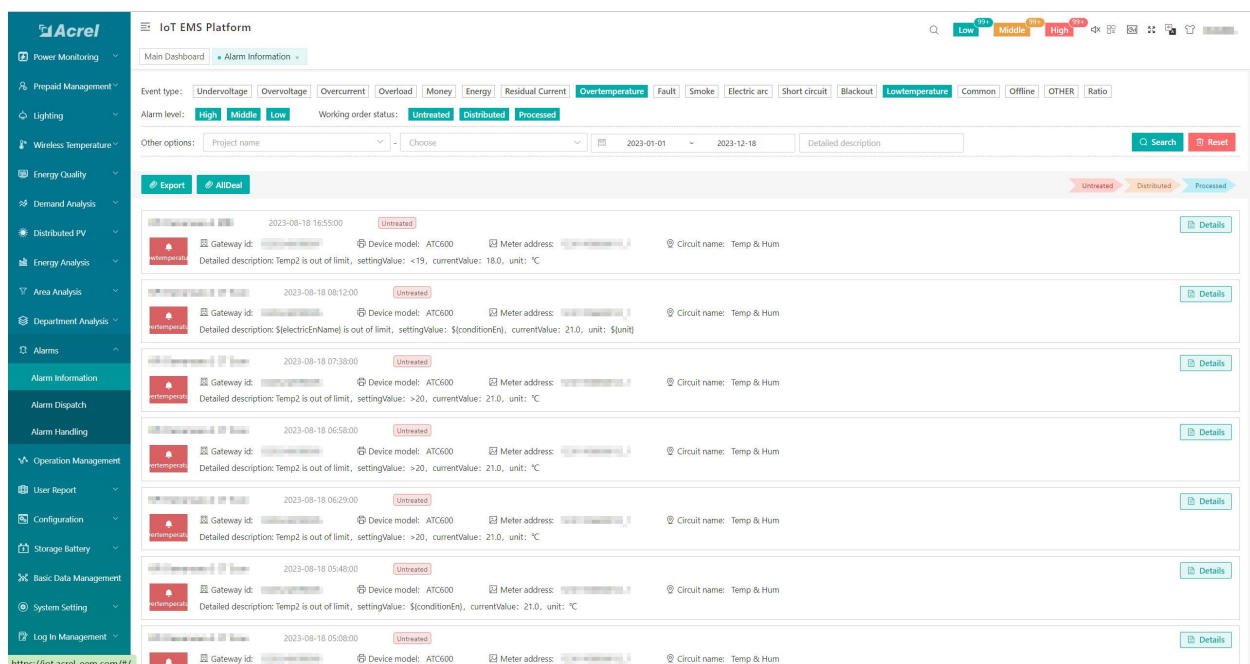(4) Temperature Imbalance Alarm Logic

1. Cloud IoT Platform Temperature Alarm Function&Logic [4G IoT Cloud&Local Wireless Temp. Monitoring Solution]

Once the temperature data was collected by Acrel IoT Cloud System Platform. We could also do the high/over temperature alarm rule setting on cloud system and receive the high/over temperature alarm warning information via WEB/APP/SMS/E-mail. [SMS/E-mail warning will be only supported when using buy-out service of Acrel IoT System.]

(1) High/Over Temperature Alarm: First we set the high/over temperature alarm rule on platform, then once the monitoring temperature was higher/lower than a certain preset threshold value, this will trigger the alarm and send the alarm warning information via assigned WEB/APP/SMS/E-mail.

(1) Set the over/high temperature alarm rule

(2) Receive and check alarm information

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1. Hardware Devices Overview [4G IoT Cloud&Local Wireless Temperature Monitoring Solution]

Model 1: ATE400 Wireless Temperature Sensor
- Temperature Measuring Range: -50℃~+125℃
- Measuring Accuracy: ±1℃
- Wireless Comms: GFSK Radio Comms. [self-defined protocol]
- GFSK Comms. Distance: 100m [open area] & 10m [indoor environment, penetrate 1 layer of metal cover of cover]
- Insulation Voltage: suitable for 35kV and below
- Max Working Current: up to 5000A
- Power Supply: CT Sensing Power [starting current >=5A]
- Lifespan: >= 10 years

GFSK Wireless · **Temp. Sensor** · **-50℃~+125℃ [±1℃]** · **35kV&5000A below**
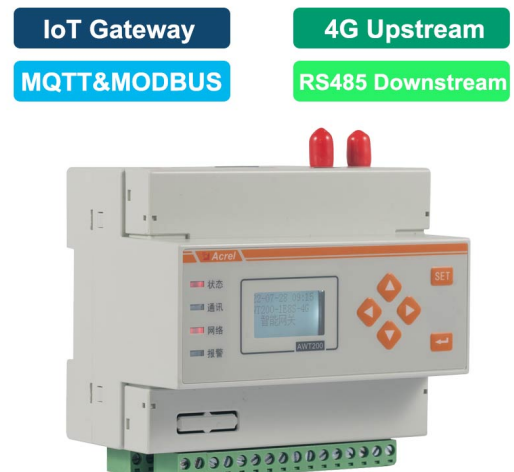
Model 2: ARTM-Pxx-400 Wireless Temperature Transceiver and Display Unit
- Wireless Comms.: GFSK Radio Comms.
- GFSK Comms. Distance: 10m [indoor environment, penetrate 1 layer of metal cover of cover]
- Wired Comms.: 1-way RS485 [MODBUS-RTU protocol]
- Support: up to 60 pcs ATE series Wireless Temperature Sensors based on GFSK
- Alarm Function: High temperature Alarm, Temperature sudden change alarm and etc.
- I/O Function: 2-way DO output, 4-way DI input
- Power Supply: 85~265Vac or 100~300Vdc
- Working Temperature: -20℃ ~ +55℃
- Working Humidity: <=95%

GFSK Wireless · **Transceiver&Display** · **Up to 60 Sensors** · **RS485 (MODBUS)**
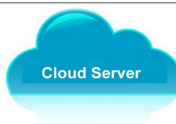
Model 3: AWT200-1E4S-4GHW IoT Smart Gateway
- Upstream Comms.: 4G&Ethernet Comms. [MQTT& MODBUS-TCP protocol]
- Downstream Comms.: RS485 [MODBUS-RTU protocol]
- Power Supply: 85~265Vac/Vdc
- Working Temperature: -20℃ ~ +55℃
- Working Humidity: <=95%

IoT Gateway · **4G Upstream** · **MQTT&MODBUS** · **RS485 Downstream**

Cloud Wireless Temperature Monitoring Solution [Local&Cloud, IoT]

1. Overall Model Selection&Quoation [4G IoT Cloud&Local Wireless Temperature Monitoring Solution]

(1) This Quotation doesn't include freight charge. To gain a complete quotation, please refer the actual quantity that you want to request for the actual order, once we receiving it. We will issue a Official Proforma Invoice with Acrel Stamps on it for later procedure.

System Software

Name	Description	System Price	Remark (Choose Host Service or Buy-out Service after 3-month Free Trial of Cloud IoT System)
Acrel Cloud IoT Energy Management System	1.System support all the meters across the country whose data has been sent to cloud server through **4G,WiFi or Ethernet**. 2.Remote meter reading and data collection. 3.Provide **IoT APP** for **mobile phone** side and **IoT WEB** for **PC** side. 4.Generate energy data report of daily, monthly and annually period with year-on-yeay and period-on-period energy analysis. 5.Provide various alarm function to ensure a stable operation of the system and protect your property. 6.Offer 3-month free trial of system with full technical support as for a test phase or pilot project.	$0 (recommended in pilot projtect)	3-month Free Trail (Users don't need to rent a cloud server))
		$xxx/Year (For 30 Points) (Price for Host Service Only, recommended in pilot projtect)	$xx to buy Hosting Service for 1 monitoring points connected to the system 1 year (Users don't need to rent a cloud server)
		$xxxx/Permanent (Limitless Points) (Price for Buy-out Service Only,recommended in late projtect)	1-time charging of $xxxx for Buy-out Service of permanent use (Limitless monitoring points and a cloud server need to be rent by users)

Cloud Server

Name	Description	Server Renting Price (For Reference Only)	Remark
Cloud Server	1.Cloud Server could be rent on the cloud server provider like Amazon Cloud. 2.Users of **Cloud IoT Energy Management System** only need to rent cloud server when they choose **buy-out** service of our **Cloud IoT System**. And if they are using **hosting service** or **3-month free trial** of our Cloud IoT System, we will use our own cloud server which has been rent on Amazon so that users don't need to rent a cloud server. 3.The quotation of Cloud Server is only a reference price that we have rent on Amazon Cloud.	According to Specs of Rented Cloud Server	Below cloud server specs could support 1000~2000 monitoings points connected to the system (Server: 8 core 16G Operation System: windows server 2016)

4G Smart Gateway

Overview Picture	USAGE&MODULE NAME	DESCRIPTION & SPECIFICATION	QUANTITY	FOB UNIT PRICE (USD)	AMOUNT (USD)
	Smart Gateway **AWT200-1E4S-4GHW**	**Upstream:** 4G, Ethernet [MQTT, MODBUS, etc] **Downstream:** RS485 (MODBUS-RTU) **Support:** up to **80~100** RS485 Devices within 400m using RS485 Wired Communication **Adjustment:** Via RJ45 or RS485 Port. **Power Supply:** 85~265Vac/Vdc (via power adpter) **HS Code:** 8517699000	1 pcs	/	/

Wireless Temperature Transceiver and Display Unit

Overview Picture	USAGE&MODULE NAME	DESCRIPTION & SPECIFICATION	QUANTITY	FOB UNIT PRICE (USD)	AMOUNT (USD)
	Temperature Transceiver **ARTM-Pn**	**Comms.:** RS485 (MODBUS-RTU); GFSK [Wireless Comms. with Sensor] **Support:** Up to 60 ATE series Transceiver. **Auxiliary Power Supoply:** 85~265Vac L-N **Alarm Function:** High temperature Alarm, Temperature sudden change alarm and etc **HS Code:** 9025191010	1 pcs	/	/

Wireless Temperature Sensor

Overview Picture	USAGE&MODULE NAME	DESCRIPTION & SPECIFICATION	QUANTITY	FOB UNIT PRICE (USD)	AMOUNT (USD)
	Wireless Temperature Sensor **ATE400**	**Communication:** GSFK (EU433 MHz) **Measuring Range:** -50℃~+125℃ **Power Supply:** CT sensing power supply (starting current>5A) **HS Code:** 9025191010	30 pcs	/	/

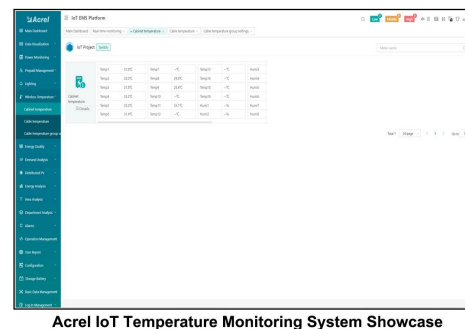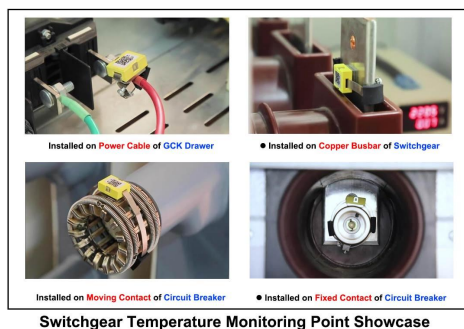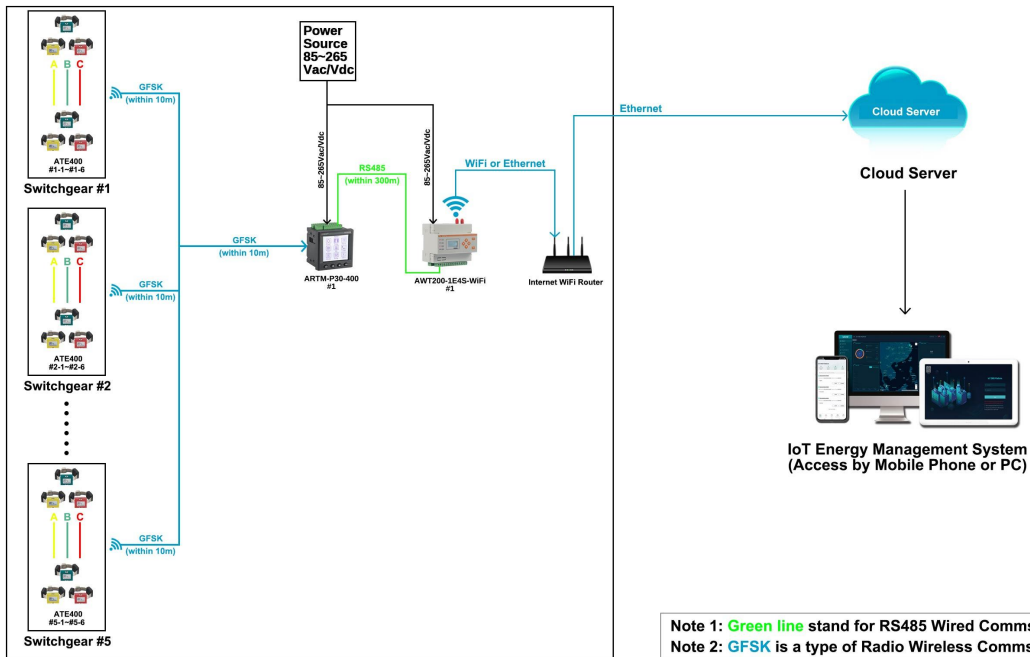## 2. Scenario Preset [WiFi&Ethernet IoT Cloud&Local Wireless Temperature Monitoring Solution]

(1) The target was to monitor and alarm the temperature of 5 switchgears deployed in a single room. Both IoT cloud & local display and alarm of temperature was requested.
(2) Each switchgear require 6 temperature moniotoring points for electrical connection nodes. Thus there will be 30 temperature monitoring points in total.
(3) The system voltage of switchgear will be 10kV. Network with stable WiFi or Ethernet
(4) For all temperature monitoroing points, there will be current going through when it's in normal operation. [more than 5A, since starting current of ATE400 need to be more than 5A]

2. Devices Deployment [WiFi&Ethernet IoT Cloud&Local Wireless Temperature Monitoring Solution]

Area #1 - Switchgear #1 ~ #5:
- 1* AWT200-1E4S-WiFi IoT Gateway [For further uploading the data from ARTM-Pn to Acrel IoT Cloud System via WiFi or Ethernet Comms.]
- 1* ARTM-P30-400 Wireless Temperature Transceiver and Display Unit [For collecting, displaying and alarming for all temperature data collected from ATE400]
- 30* ATE400 Wireless Temperature Sensor [For monitoring the temperature of electrical connection nodes and send the data to ARTM-P30-400 via GFSK wirelesss Comms.]


(1) Devices deployment plan Illustraton

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2. Comm. Structure&Logic [WiFi&Ethernet IoT Cloud&Local Wireless Temperature Monitoring Solution]

(1) Between ATE400 wireless temperature sensor and ARTM-P30-400 wireless temperature transceiver and display unit, we are using a radio wireless communications called GFSK. The communication distance is within 100m [when in open area] and is within 10m [when in indoor environment and penetrate 1 layer of metal cover of switchgear]. The communication protocol is self defined protocol. [1 pcs ARTM-Pn can support up to 60 pcs ATE400 if comms. distance allowed.]

(2) Between AWT200-1E4S-WiFi IoT Gateway and ARTM-Pn, the communication will be RS485 wired Comms. based on MODBUS-RTU protocol. The RS485 Comms. distance between these 2 devices was recommend to be within 300m when we are using 2x1.5mm² RVSP cable for RS485 connection wiring.

(3) Between AWT200-1E4S-WiFi IoT gateway and Acrel IoT system [final data upstream step], we are using either WiFi or Ethernet comms. methods based on either MQTT or MODBUS-TCP protocol.
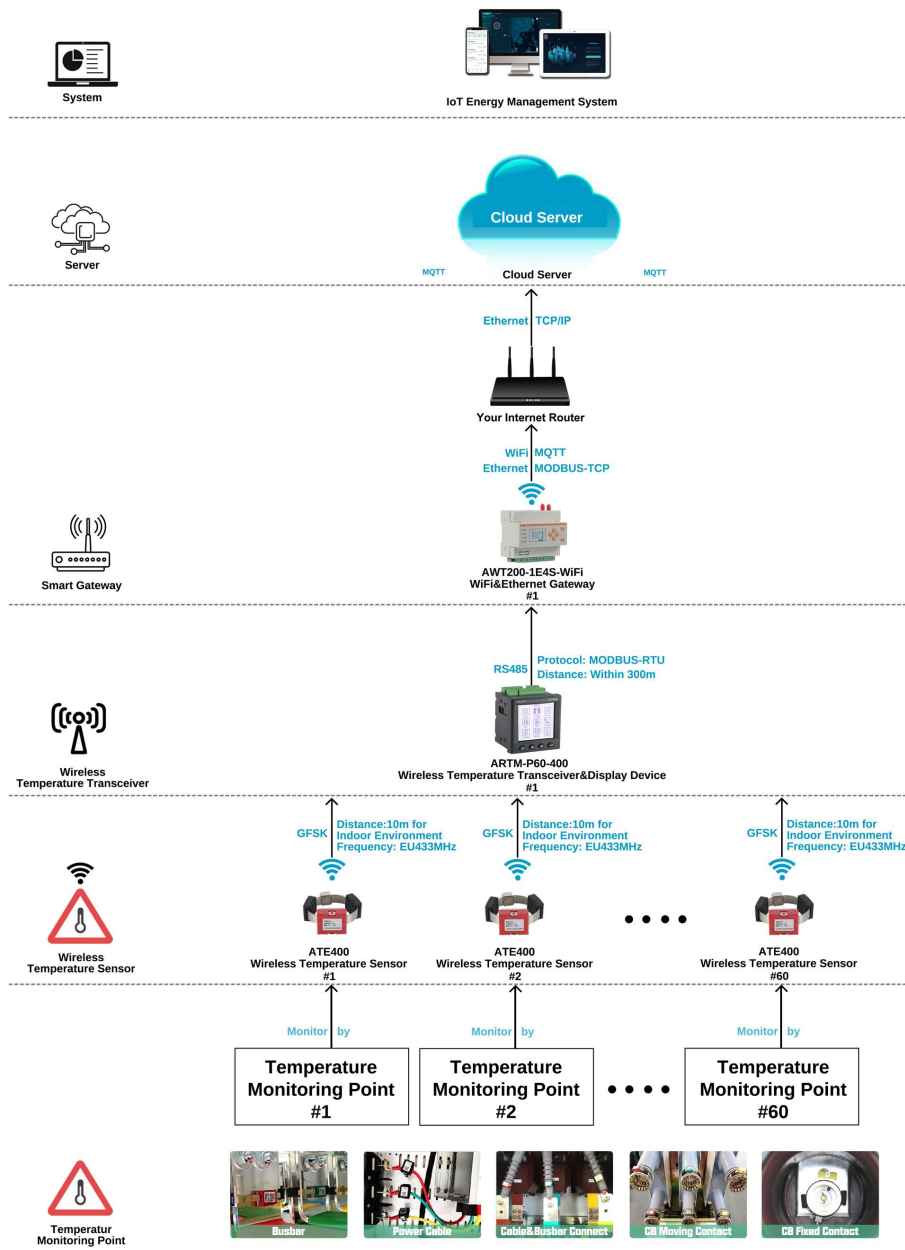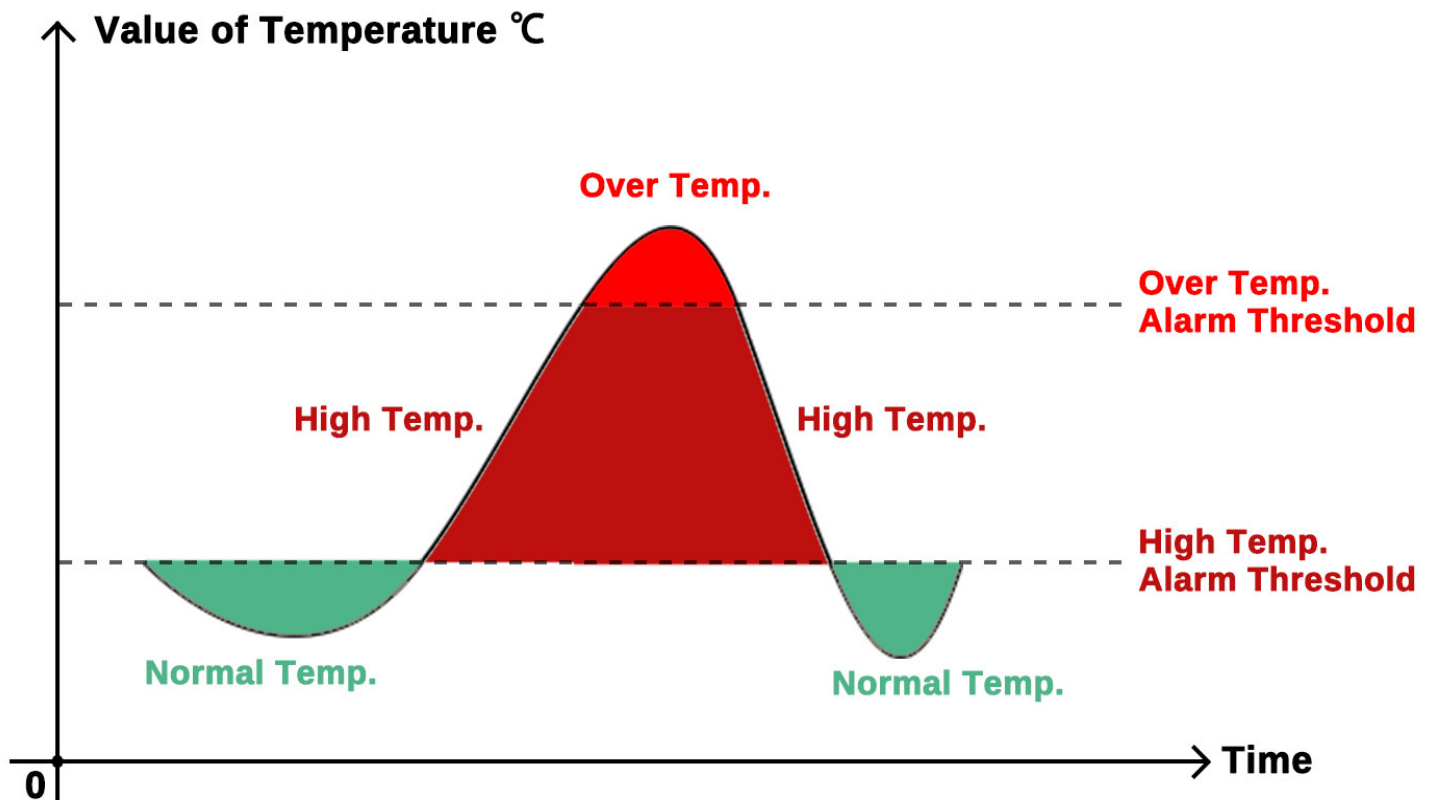

(1) Communication Structure

2. Devices Temp. Alarm Function&Logic [WiFi&Ethernet IoT Cloud&Local Wireless Temperature Monitoring Solution]

ARTM-Pn Seires Wireless Tempearture Transceiver and Display Devices support 4 types of major temperature alarm logic. When any of the below alarm logic was set and triggered, it will give a DO output to other indication devices like buzzer or LED light.

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(2) Over Temperature Alarm: Similar like high temperature alarm, but over temperature alarm normally will be preset a higher alarm threshold. And once alarm was triggered, this will also trigger 2nd way DO alarm output of ARTM-Pn. [Normally, Over Temperature Alarm was used for alarming the related person that there are severe temperature rising issue happened and need to be solved immediately]
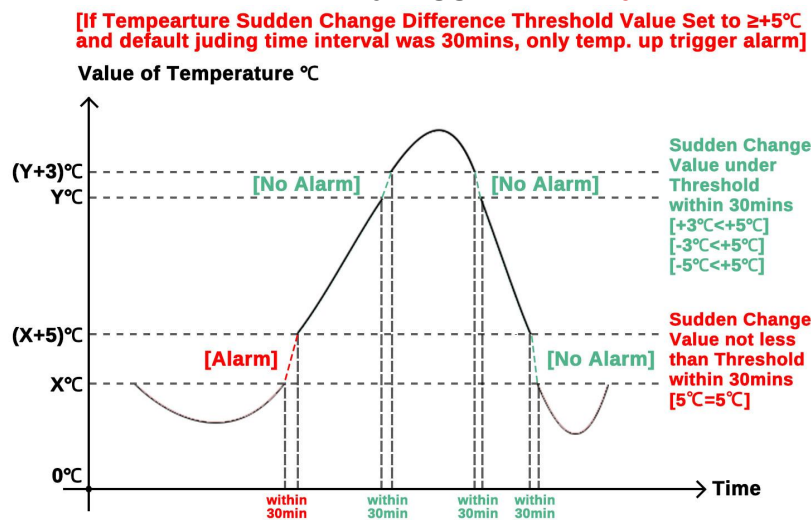

(1&2) High&Over Temperature Alarm

2. Devices Temp. Alarm Function&Logic [WiFi&Ethernet IoT Cloud&Local Wireless Temperature Monitoring Solution]

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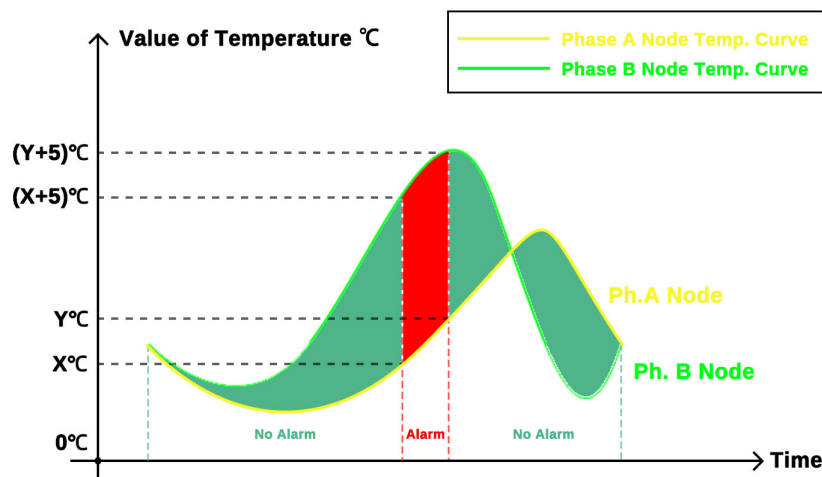
(3) Temperature Sudden Rising Change Alarm: When during a certain period [within 30mins], if there was large temperature sudden change happened, then it will trigger temperature sudden change alarm. [like +10℃ temperature rising during 5 mins for example, also, this temperature sudden change alarm threshold value could be set by customer between 0~125℃] Eventually, this will trigger 2nd way DO alarm output of ARTM-Pn. [Noted: This temperature sudden change alarm will only last for 5 mins at most once triggered.]

(4) Temperature imbalance alarm between 3* temperature monitoring nodes of certain circuit 3-phase: When the temperature difference between 3 monitoring nodes of cetain circuit 3-phase [like between phase A&B&C temperature monitoring nodes of circuit #1] was larger than a certain preset threshold value [take 10℃ temperature difference between any 2 of phase A&B&C temperature monitoring nodes of circuit #1 for example] This will trigger temperature imbalance alarm and eventually trigger 2nd way DO alarm output of ARTM-Pn.
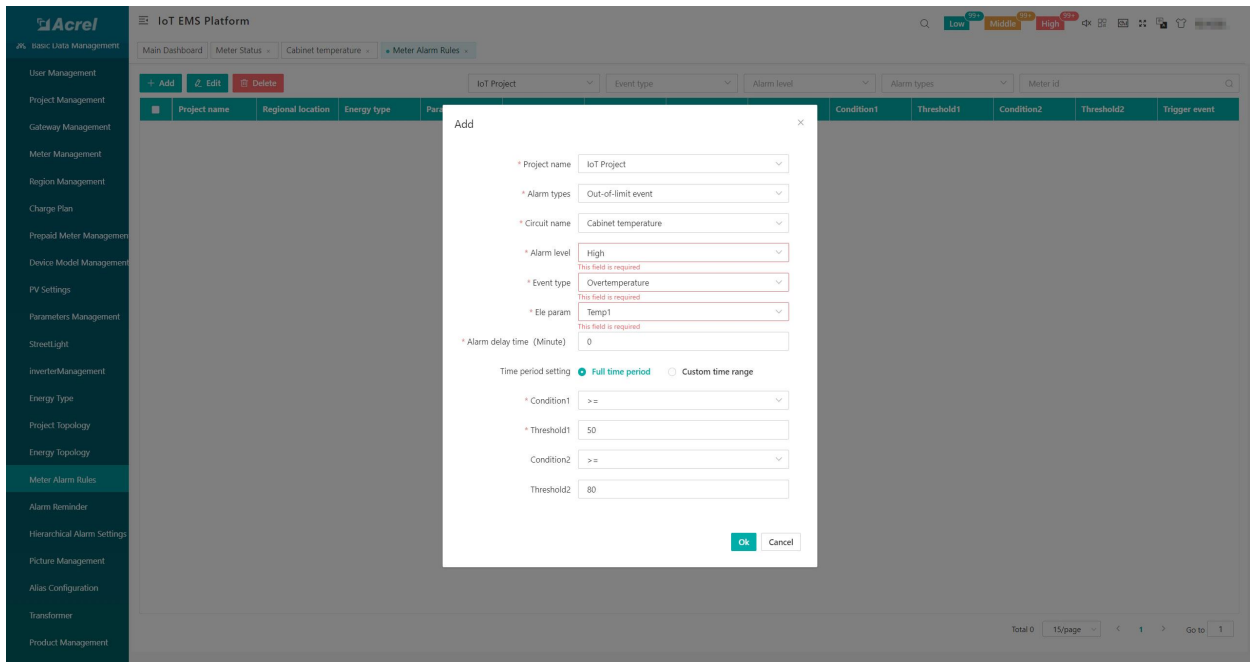
(3) Temperature Sudden Change Alarm

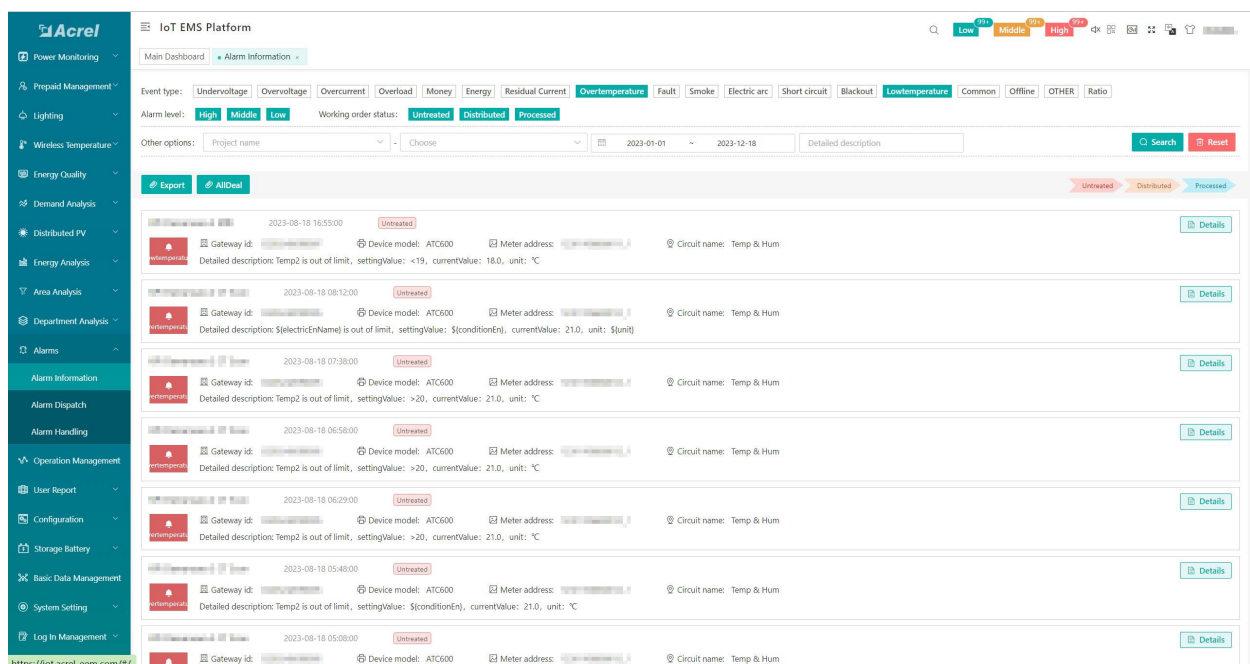(4) Temperature Imbalance Alarm Logic

2. Cloud IoT Platform Temperature Alarm Function&Logic [WiFi&Ethernet IoT Cloud&Local Wireless Temperature Monitoring Solution]

Once the temperature data was collected by Acrel IoT Cloud System Platform. We could also do the high/over temperature alarm rule setting on cloud system and receive the high/over temperature alarm warning information via WEB/APP/SMS/E-mail. [SMS/E-mail warning will be only supported when using buy-out service of Acrel IoT System.]

(1) High/Over Temperature Alarm: First we set the high/over temperature alarm rule on platform, then once the monitoring temperature was higher/lower than a certain preset threshold value, this will trigger the alarm and send the alarm warning information via assigned WEB/APP/SMS/E-mail.

(1) Set the over/high temperature alarm rule

(2) Receive and check alarm information

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2. Hardware Device Overview [WiFi&Ethernet Cloud&Local Wireless Temperature Monitoring Solution]

Model 1: ATE400 Wireless Temperature Sensor
- Temperature Measuring Range: -50℃~+125℃
- Measuring Accuracy: ±1℃
- Wireless Comms: GFSK Radio Comms. [self-defined protocol]
- GFSK Comms. Distance: 100m [open area] & 10m [indoor environment, penetrate 1 layer of metal cover of cover]
- Insulation Voltage: suitable for 35kV and below
- Max Working Current: up to 5000A
- Power Supply: CT Sensing Power [starting current >=5A]
- Lifespan: >= 10 years

GFSK Wireless | **-50℃~+125℃ [±1℃]**
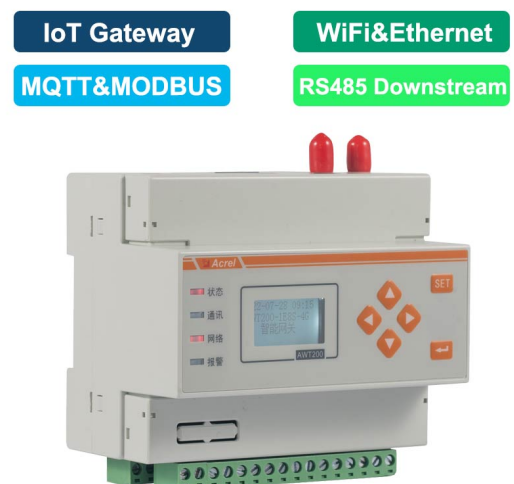**Temp. Sensor** | **35kV&5000A below**

Model 2: ARTM-Pxx-400 Wireless Temperature Transceiver and Display Unit
- Wireless Comms.: GFSK Radio Comms.
- GFSK Comms. Distance: 10m [indoor environment, penetrate 1 layer of metal cover of cover]
- Wired Comms.: 1-way RS485 [MODBUS-RTU protocol]
- Support: up to 60 pcs ATE series Wireless Temperature Sensors based on GFSK
- Alarm Function: High temperature Alarm, Temperature sudden change alarm and etc.
- I/O Function: 2-way DO output, 4-way DI input
- Power Supply: 85~265Vac or 100~300Vdc
- Working Temperature: -20℃~+55℃
- Working Humidity: <=95%

GFSK Wireless | **Up to 60 Sensors**
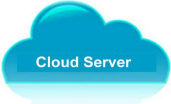**Transceiver&Display** | **RS485 (MODBUS)**

Model 3: AWT200-1E4S-WiFi IoT Smart Gateway
- Upstream Comms.: WiFi&Ethernet Comms. [MQTT& MODBUS-TCP protocol]
- Downstream Comms.: RS485 [MODBUS-RTU protocol]
- Power Supply: 85~265Vac/Vdc
- Working Temperature: -20℃~+55℃
- Working Humidity: <=95%

IoT Gateway | **WiFi&Ethernet**
MQTT&MODBUS | **RS485 Downstream**

2. Overall Model Selection&Quoation [WiFi&Ethernet IoT Cloud&Local Wireless Temperature Monitoring Solution]

(1) This Quotation doesn't include freight charge. To gain a complete quotation, please refer the actual quantity that you want to request for the actual order, once we receiving it. We will issue a Official Proforma Invoice with Acrel Stamps on it for later procedure.

System Software

Name	Description	System Price	Remark (Choose Host Service or Buy-out Service after 3-month Free Trial of Cloud IoT System)
Acrel Cloud IoT Energy Management System	1.System support all the meters across the country whose data has been sent to cloud server through 4G,WiFi or Ethernet. 2.Remote meter reading and data collection. 3.Provide IoT APP for mobile phone side and IoT WEB for PC side. 4.Generate energy data report of daily, monthly and annually period with year-on-yeay and period-on-period energy analysis. 5.Provide various alarm function to ensure a stable operation of the system and protect your property. 6.Offer 3-month free trial of system with full technical support as for a test phase or pilot project.	$0 (recommended in pilot projtect)	3-month Free Trail (Users don't need to rent a cloud server))
		$xxx/Year (For 30 Points) (Price for Host Service Only, recommended in pilot projtect)	$xx to buy Hosting Service for 1 monitoring points connected to the system 1 year (Users don't need to rent a cloud server)
		$xxxx/Permanent (Limitless Points) (Price for Buy-out Service Only,recommended in late projtect)	1-time charging of $xxxx for Buy-out Service of permanent use (Limitless monitoring points and a cloud server need to be rent by users)

Cloud Server

Name	Description	Server Renting Price (For Reference Only)	Remark
Cloud Server	1.Cloud Server could be rent on the cloud server provider like Amazon Cloud. 2.Users of Cloud IoT Energy Management System only need to rent cloud server when they choose buy-out service of our Cloud IoT System. And if they are using hosting service or 3-month free trial of our Cloud IoT System, we will use our own cloud server which has been rent on Amazon so that users don't need to rent a cloud server. 3.The quotation of Cloud Server is only a reference price that we have rent on Amazon Cloud.	According to Specs of Rented Cloud Server	Below cloud server specs could support 1000~2000 monitoings points connected to the system (Server：8 core 16G Operation System： windows server 2016)

WiFi&Ethernet Smart Gateway

Overview Picture	USAGE&MODULE NAME	DESCRIPTION & SPECIFICATION	QUANTITY	FOB UNIT PRICE (USD)	AMOUNT (USD)
	Smart Gateway AWT200-1E4S-WiFi	Upstream: WiFi, Ethernet [MQTT, MODBUS, etc] Downstream: RS485 (MODBUS-RTU) Support: up to 80~100 RS485 Devices within 400m using RS485 Wired Communication Adjustment: Via RJ45 or RS485 Port. Power Supply: 85~265Vac/Vdc (via power adpter) HS Code: 8517699000	1 pcs	/	/

Wireless Temperature Transceiver and Display Unit

Overview Picture	USAGE&MODULE NAME	DESCRIPTION & SPECIFICATION	QUANTITY	FOB UNIT PRICE (USD)	AMOUNT (USD)
	Temperature Transceiver ARTM-Pn	Comms.: RS485 (MODBUS-RTU); GFSK [Wireless Comms. with Sensor] Support: Up to 60 ATE series Transceiver. Auxiliary Power Supoply: 85~265Vac L-N Alarm Function: High temperature Alarm, Temperature sudden change alarm and etc HS Code: 9025191010	1 pcs	/	/

Wireless Temperature Sensor

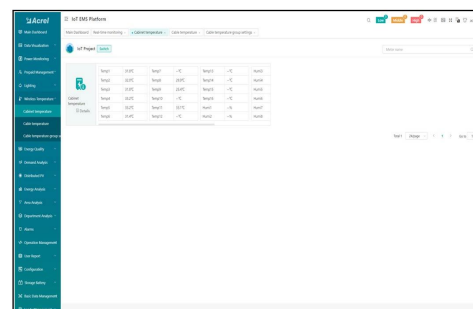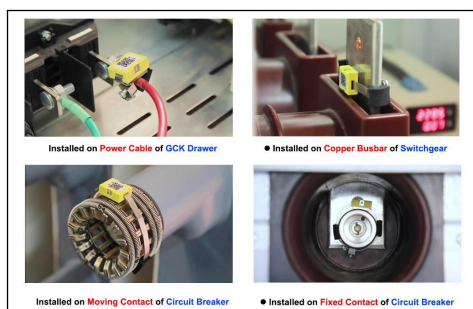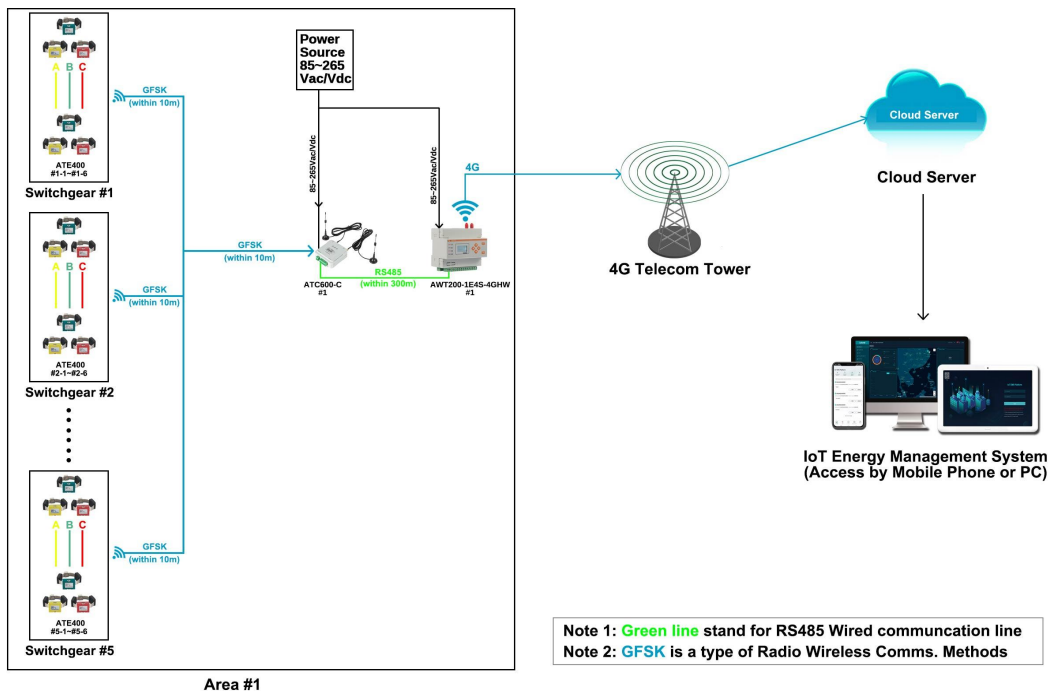| Overview Picture	USAGE&MODULE NAME	DESCRIPTION & SPECIFICATION	QUANTITY	FOB UNIT PRICE (USD)	AMOUNT (USD)
	Wireless Temperature Sensor ATE400	Communication: GSFK (EU433 MHz) Measuring Range: -50℃~+125℃ Power Supply: CT sensing power supply (starting current>5A) HS Code: 9025191010	30 pcs	/	/

3. Scenario Preset [4G IoT Cloud Wireless Temperature Monitoring Solution]

(1) The target was to monitor and alarm the temperature of 5 switchgears deployed in a single room. Only IoT cloud display and alarm of temperature was requested.

(2) Each switchgear require 6 temperature moniotoring points for electrical connection nodes. Thus there will be 30 temperature monitoring points in total.

(3) The system voltage of switchgear will be 10kV. Network with stable 4G Comms.

(4) For all temperature monitoroing points, there will be current going through when it's in normal operation. [more than 5A, since starting current of ATE400 need to be more than 5A]

3. Devices Deployment [4G IoT Cloud Wireless Temperature Monitoring Solution]
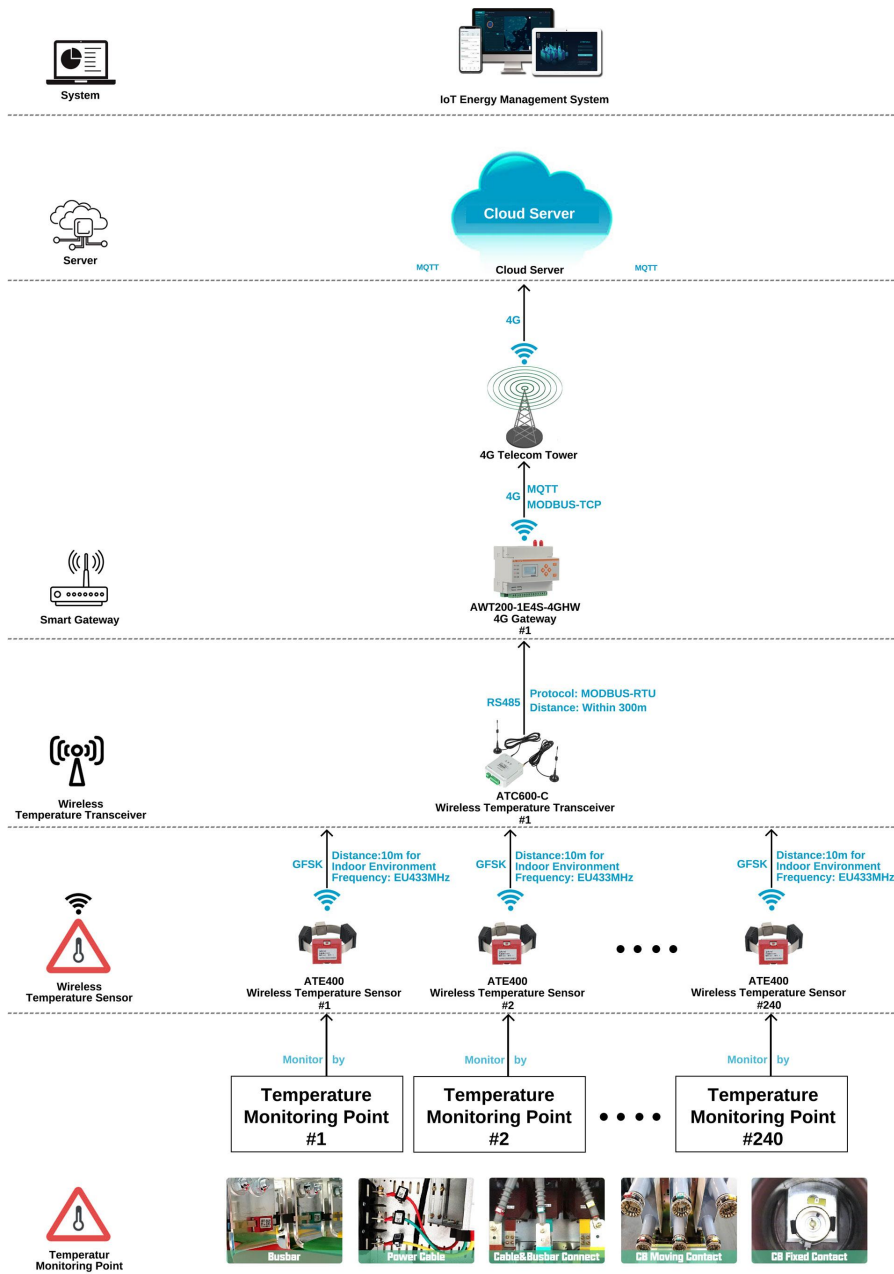
Area #1 - Switchgear #1 ~ #5:

- 1* AWT200-1E4S-4GHW IoT Gateway [For further uploading the data from ATC600-C to Acrel IoT Cloud System via 4G Comms.]

- 1* ATC600-C Wireless Temperature Transceiver [For collecting the temperature data from ATE400 via GFSK and further send to AWT200-1E4S-4GHW gateway via RS485]

- 30* ATE400 Wireless Temperature Sensor [For monitoring the temperature of electrical connection nodes and send the data to ATC600-C via GFSK wirelesss Comms.]

(1) Devices deployment plan Illustraton

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3. Comm. Structure & Logic [4G IoT Cloud Wireless Temperature Monitoring Solution]

(1) Between ATE400 wireless temperature sensor and ATC600-C wireless temperature transceiver, we are using a radio wireless communications called GFSK. The communication distance is within 100m [when in open area] and is within 10m [when in indoor environment and penetrate 1 layer of metal cover of switchgear]. The communication protocol is self defined protocol. [1 pcs ATC600-C can support up to 240 pcs ATE400 if Comms. distance allowed.]

(2) Between AWT200-1E4S-4GHW IoT Gateway and ATC600-C, the communication will be RS485 wired Comms. based on MODBUS-RTU protocol. The RS485 Comms. distance between these 2 devices was recommend to be within 300m when we are using 2x1.5mm² RVSP cable for RS485 connection wiring.

(3) Between AWT200-1E4S-4GHW IoT gateway and Acrel IoT system, we are using 4G comms. methods based on either MQTT or MODBUS-TCP protocol.
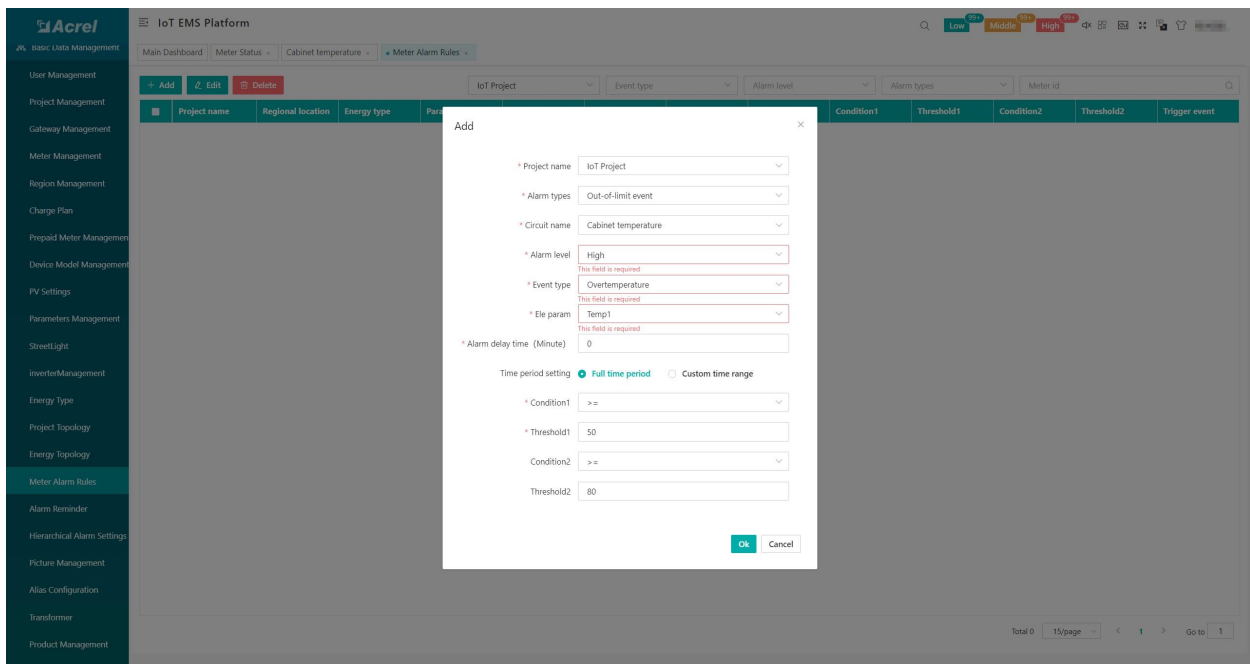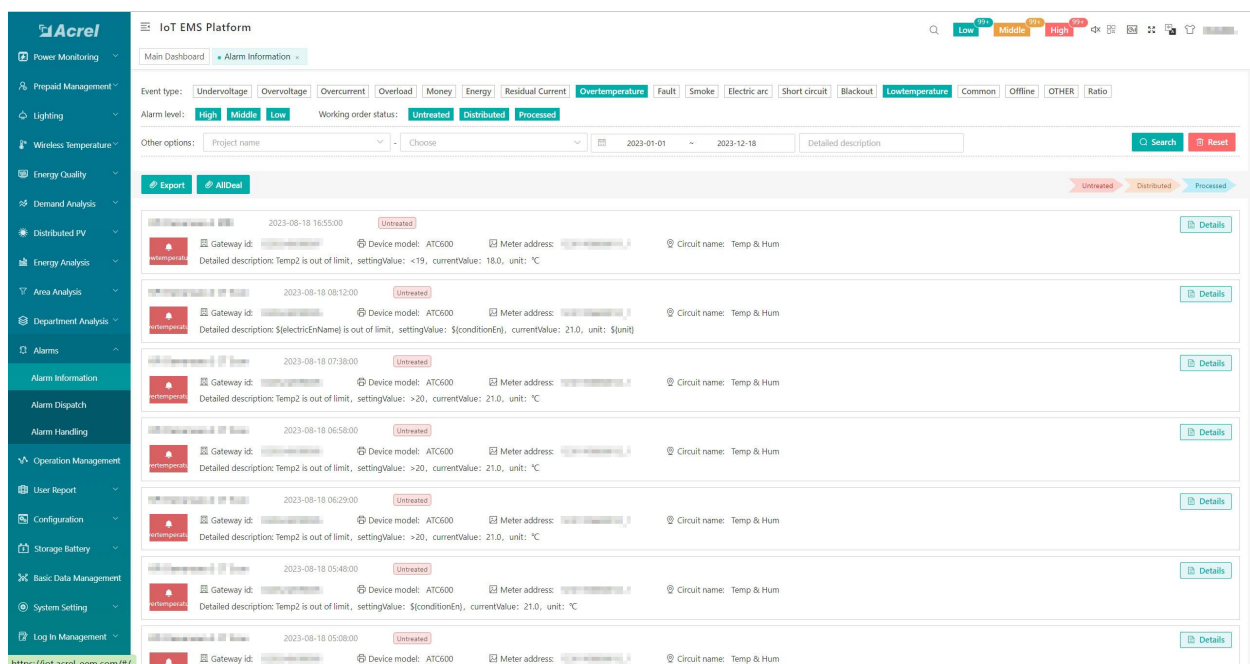
(1) Communication Structure

18

3. Cloud IoT Platform Temperature Alarm Function&Logic [4G IoT Cloud Wireless Temperature Monitoring Solution]

Once the temperature data was collected by Acrel IoT Cloud System Platform. We could also do the high/over temperature alarm rule setting on cloud system and receive the high/over temperature alarm warning information via WEB/APP/SMS/E-mail. [SMS/E-mail warning will be only supported when using buy-out service of Acrel IoT System.]

(1) High/Over Temperature Alarm: First we set the high/over temperature alarm rule on platform, then once the monitoring temperature was higher/lower than a certain preset threshold value, this will trigger the alarm and send the alarm warning information via assigned WEB/APP/SMS/E-mail.

(1) Set the over/high temperature alarm rule

(2) Receive and check alarm information

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3. Hardware Devices Overview [4G IoT Cloud Wireless Temperature Monitoring Solution]

Model 1: ATE400 Wireless Temperature Sensor
- Temperature Measuring Range: -50℃~+125℃
- Measuring Accuracy: ±1℃
- Wireless Comms: GFSK Radio Comms. [self-defined protocol]
- GFSK Comms. Distance: 100m [open area] & 10m [indoor environment, penetrate 1 layer of metal cover of cover]
- Insulation Voltage: suitable for 35kV and below
- Max Working Current: up to 5000A
- Power Supply: CT Sensing Power [starting current >=5A]
- Lifespan: >= 10 years

GFSK Wireless **Temp. Sensor** **-50℃~+125℃ [±1℃]** **35kV&5000A below**
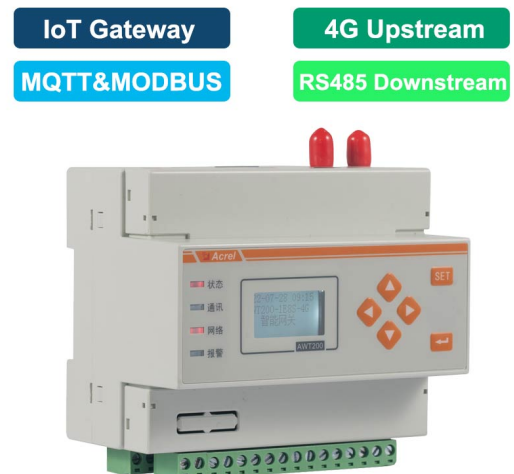

Model 2: ATC600-C Wireless Temperature Transceiver
- Wireless Comms.: GFSK Radio Comms. [self-defined protocol]
- GFSK Comms. Distance: 100m [open area] & 10m [indoor environment, penetrate 1 layer of metal cover of cover]
- Wired Comms.: 1-way RS485 [MODBUS-RTU protocol]
- Support: up to 240 pcs ATE series Wireless Temperature Sensors based on GFSK
- I/O Function: 2-way DO output
- Power Supply: 100~265Vac/Vdc
- Working Temperature: -20℃~+55℃
- Working Humidity: <=95%

Temp. Transceiver **GFSK Wireless** **Up to 240 Sensors** **1-way RS485**

Model 3: AWT200-1E4S-4GHW IoT Smart Gateway
- Upstream Comms.: 4G&Ethernet Comms. [MQTT& MODBUS-TCP protocol]
- Downstream Comms.: RS485 [MODBUS-RTU protocol]
- Power Supply: 85~265Vac/Vdc
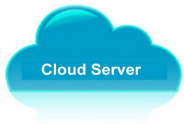- Working Temperature: -20℃~+55℃
- Working Humidity: <=95%

IoT Gateway **MQTT&MODBUS** **4G Upstream** **RS485 Downstream**

3. Overall Model Selection&Quoation [4G IoT Cloud Wireless Temperature Monitoring Solution]

(1) This Quotation doesn't include freight charge. To gain a complete quotation, please refer the actual quantity that you want to request for the actual order, once we receiving it. We will issue a Official Proforma Invoice with Acrel Stamps on it for later procedure.

System Software

Name	Description	System Price	Remark (Choose Host Service or Buy-out Service after 3-month Free Trial of **Cloud IoT System**)
Acrel Cloud IoT Energy Management System	1.System support all the meters across the country whose data has been sent to cloud server through **4G,WiFi or Ethernet**. 2.Remote meter reading and data collection. 3.Provide **IoT APP** for **mobile phone** side and **IoT WEB** for **PC** side. 4.Generate energy data report of daily, monthly and annually period with year-on-yeay and period-on-period energy analysis. 5.Provide various alarm function to ensure a stable operation of the system and protect your property. 6.Offer 3-month free trial of system with full technical support as for a test phase or pilot project.	$0 (recommended in pilot projtect)	3-month Free Trail (Users don't need to rent a cloud server))
		$xxx/Year (For 30 Points) (Price for Host Service Only, recommended in pilot projtect)	$xx to buy Hosting Service for 1 monitoring points connected to the system 1 year (Users don't need to rent a cloud server)
		$xxxx/Permanent (Limitless Points) (Price for Buy-out Service Only,recommended in late projtect)	1-time charging of $xxxx for Buy-out Service of permanent use (Limitless monitoring points and a cloud server need to be rent by users)

Cloud Server

Name	Description	Server Renting Price (For Reference Only)	Remark
Cloud Server	1.Cloud Server could be rent on the cloud server provider like Amazon Cloud. 2.Users of **Cloud IoT Energy Management System** only need to rent cloud server when they choose **buy-out** service of our **Cloud IoT System**. And if they are using **hosting service** or **3-month free trial** of our Cloud IoT System, we will use our own cloud server which has been rent on Amazon so that users don't need to rent a cloud server. 3.The quotation of Cloud Server is only a reference price that we have rent on Amazon Cloud.	According to Specs of Rented Cloud Server	Below cloud server specs could support 1000~2000 monitoings points connected to the system (Server：8 core 16G Operation System：windows server 2016)

4G Smart Gateway

Overview Picture	USAGE&MODULE NAME	DESCRIPTION & SPECIFICATION	QUANTITY	FOB UNIT PRICE (USD)	AMOUNT (USD)
	Smart Gateway **AWT200-1E4S-4GHW**	**Upstream:** 4G, Ethernet [MQTT, MODBUS, etc] **Downstream:** RS485 (MODBUS-RTU) **Support:** up to **80~100** RS485 Devices within 400m using RS485 Wired Communication **Adjustment:** Via RJ45 or RS485 Port. **Power Supply:** 85~265Vac/Vdc (via power adpter) **HS Code:** 8517699000	1 pcs	/	

Wireless Temperature Transceiver

Overview Picture	USAGE&MODULE NAME	DESCRIPTION & SPECIFICATION	QUANTITY	FOB UNIT PRICE (USD)	AMOUNT (USD)
	Temperature Transceiver **ATC600-C**	**Upstream:** RS485 (MODBUS-RTU) **Downstream:** GFSK (EU433 MHz) **Support:** Up to 240 ATE series wireless temperature sensors using GFSK communication. **Power Supply:** 100~265Vac **HS Code:** 9025191010	1 pcs	/	/

Wireless Temperature Sensor

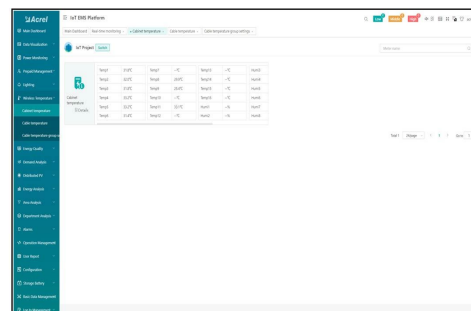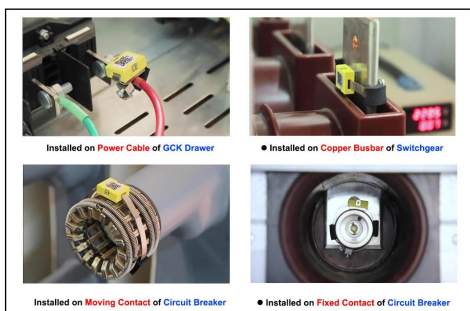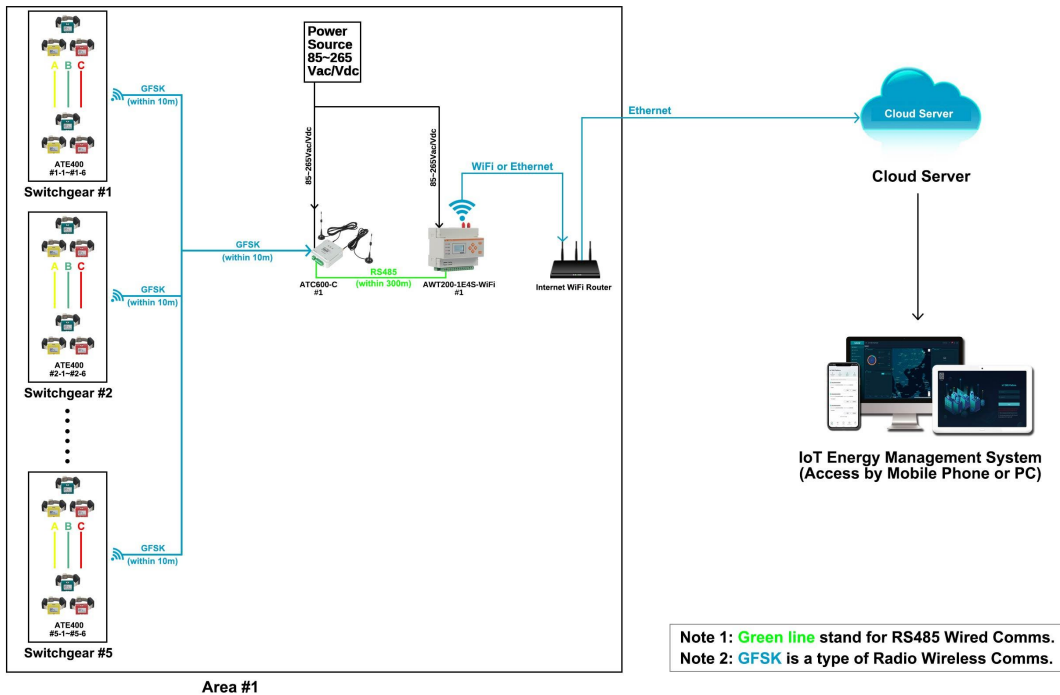| Overview Picture	USAGE&MODULE NAME	DESCRIPTION & SPECIFICATION	QUANTITY	FOB UNIT PRICE (USD)	AMOUNT (USD)
	Wireless Temperature Sensor **ATE400**	**Communication:** GSFK (EU433 MHz) **Measuring Range:** -50℃~+125℃ **Power Supply:** CT sensing power supply (starting current>5A) **HS Code:** 9025191010	30 pcs	/	/

4. Scenario Preset [WiFi&Ethernet IoT Cloud Wireless Temperature Monitoring Solution]

(1) The target was to monitor and alarm the temperature of 5 switchgears deployed in a single room. Only IoT cloud display and alarm of temperature was requested.
(2) Each switchgear require 6 temperature moniotoring points for electrical connection nodes. Thus there will be 30 temperature monitoring points in total.
(3) The system voltage of switchgear will be 10kV. Network with stable WiFi or Ethernet
(4) For all temperature monitoroing points, there will be current going through when it's in normal operation. [more than 5A, since starting current of ATE400 need to be more than 5A]

4. Devices Deployment [WiFi&Ethernet IoT Cloud Wireless Temperature Monitoring Solution]
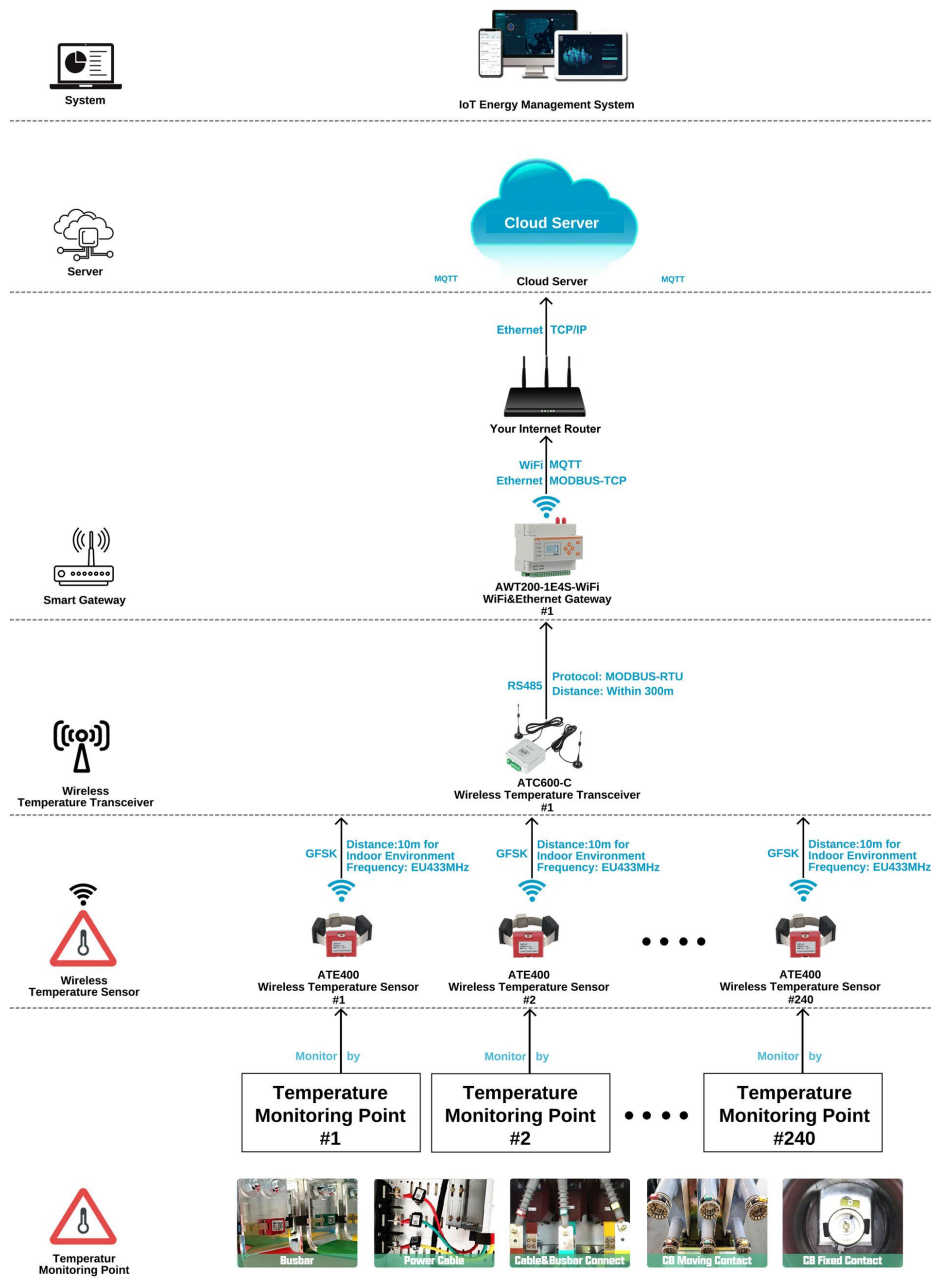
Area #1 - Switchgear #1 ~ #5:
- 1* AWT200-1E4S-WiFi IoT Gateway [For further uploading the data from ATC600-C to Acrel IoT Cloud System via WiFi or Ethernet Comms.]
- 1* ATC600-C Wireless Temperature Transceiver [For collecting the temperature data from ATE400 via GFSK and further send to AWT200-1E4S-WiFi gateway via RS485]
- 30* ATE400 Wireless Temperature Sensor [For monitoring the temperature of electrical connection nodes and send the data to ATC600-C via GFSK wirelesss Comms.]

Note 1: Green line stand for RS485 Wired Comms.
Note 2: GFSK is a type of Radio Wireless Comms.

Switchgear Temperature Monitoring Point Showcase

Acrel IoT Temperature Monitoring System Showcase

(1) Devices deployment plan Illustraton

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4. Comm. Structure & Logic [WiFi&Ethernet IoT Cloud Wireless Temperature Monitoring Solution]

(1) Between ATE400 wireless temperature sensor and ATC600-C wireless temperature transceiver, we are using a radio wireless communications called GFSK. The communication distance is within 100m [when in open area] and is within 10m [when in indoor environment and penetrate 1 layer of metal cover of switchgear]. The communication protocol is self defined protocol. [1 pcs ATC600-C can support up to 240 pcs ATE400 if Comms. distance allowed.]

(2) Between AWT200-1E4S-WiFi IoT Gateway and ATC600-C, the communication will be RS485 wired Comms. based on MODBUS-RTU protocol. The RS485 Comms. distance between these 2 devices was recommend to be within 300m when we are using 2x1.5mm² RVSP cable for RS485 connection wiring.

(3) Between AWT200-1E4S-WiFi IoT gateway and Acrel IoT system, we are using either WiFi or Ethernet comms. methods based on either MQTT or MODBUS-TCP protocol.
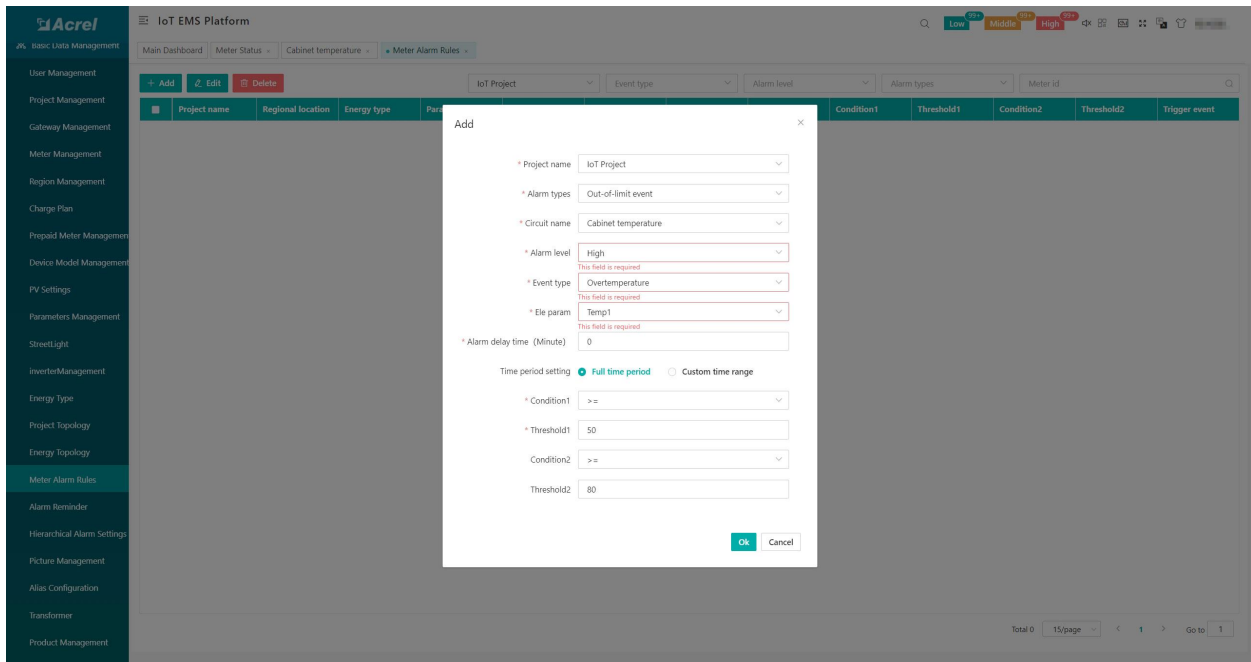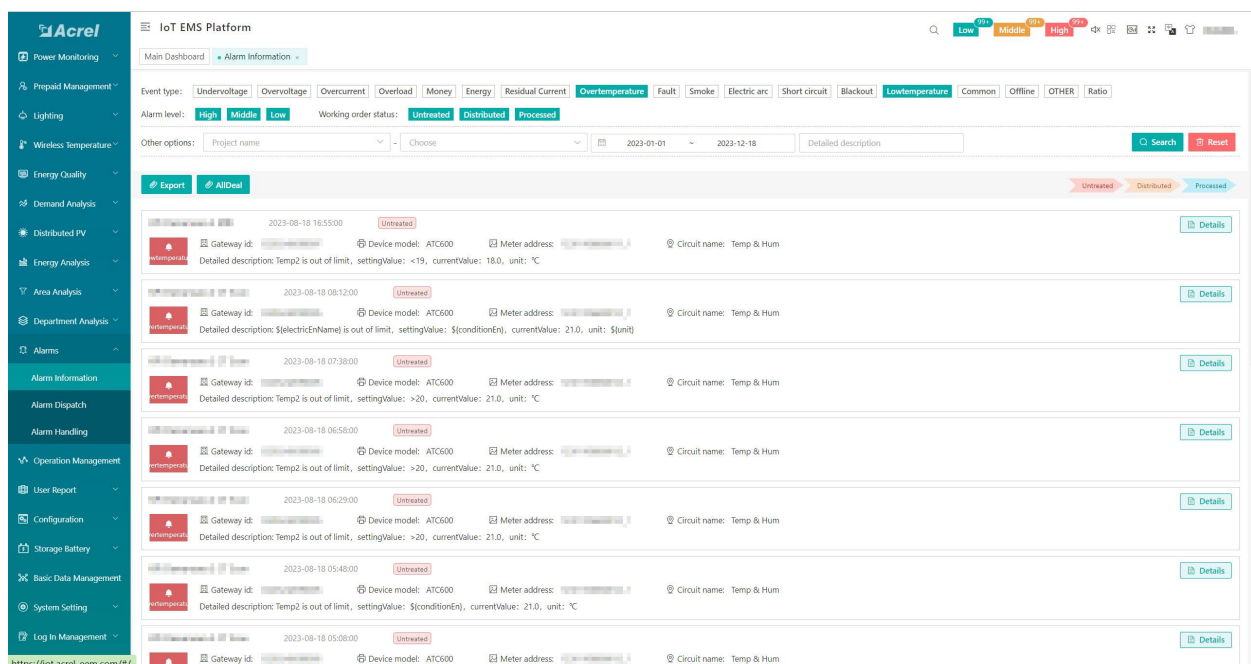

(1) Communication Structure

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4. Cloud IoT Platform Temperature Alarm Function&Logic [WiFi&Ethernet IoT Cloud Wireless Temperature Monitoring Solution]

Once the temperature data was collected by Acrel IoT Cloud System Platform. We could also do the high/over temperature alarm rule setting on cloud system and receive the high/over temperature alarm warning information via WEB/APP/SMS/E-mail. [SMS/E-mail warning will be only supported when using buy-out service of Acrel IoT System.]

(1) High/Over Temperature Alarm: First we set the high/over temperature alarm rule on platform, then once the monitoring temperature was higher/lower than a certain preset threshold value, this will trigger the alarm and send the alarm warning information via assigned WEB/APP/SMS/E-mail.

(1) Set the over/high temperature alarm rule

(2) Receive and check alarm information

24

4. Hardware Devices Overview [WiFi&Ethernet IoT Cloud Wireless Temperature Monitoring Solution]

Model 1: ATE400 Wireless Temperature Sensor
- Temperature Measuring Range: -50℃~+125℃
- Measuring Accuracy: ±1℃
- Wireless Comms: GFSK Radio Comms. [self-defined protocol]
- GFSK Comms. Distance: 100m [open area] & 10m [indoor environment, penetrate 1 layer of metal cover of cover]
- Insulation Voltage: suitable for 35kV and below
- Max Working Current: up to 5000A
- Power Supply: CT Sensing Power [starting current >=5A]
- Lifespan: >= 10 years

GFSK Wireless | **-50℃~+125℃ [±1℃]**
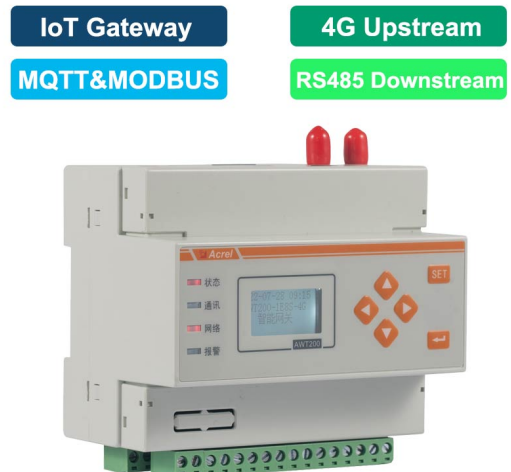**Temp. Sensor** | **35kV&5000A below**

Model 2: ATC600-C Wireless Temperature Transceiver
- Wireless Comms.: GFSK Radio Comms. [self-defined protocol]
- GFSK Comms. Distance: 100m [open area] & 10m [indoor environment, penetrate 1 layer of metal cover of cover]
- Wired Comms.: 1-way RS485 [MODBUS-RTU protocol]
- Support: up to 240 pcs ATE series Wireless Temperature Sensors based on GFSK
- I/O Function: 2-way DO output
- Power Supply: 100~265Vac/Vdc
- Working Temperature: -20℃+55℃
- Working Humidity: <=95%

Temp. Transceiver | **Up to 240 Sensors**
GFSK Wireless | **1-way RS485**

Model 3: AWT200-1E4S-WiFi IoT Smart Gateway
- Upstream Comms.: WiFi&Ethernet Comms. [MQTT& MODBUS-TCP protocol]
- Downstream Comms.: RS485 [MODBUS-RTU protocol]
- Power Supply: 85~265Vac/Vdc
- Working Temperature: -20℃+55℃
- Working Humidity: <=95%

IoT Gateway | **4G Upstream**
MQTT&MODBUS | **RS485 Downstream**

4. Overall Model Selection&Quoation [WiFi&Ethernet IoT Cloud Wireless Temperature Monitoring Solution]

(1) This Quotation doesn't include freight charge. To gain a complete quotation, please refer the actual quantity that you want to request for the actual order, once we receiving it. We will issue a Official Proforma Invoice with Acrel Stamps on it for later procedure.

System Software

Name	Description	System Price	Remark (Choose Host Service or Buy-out Service after 3-month Free Trial of **Cloud IoT System**)
Acrel Cloud IoT Energy Management System	1.System support all the meters across the country whose data has been sent to cloud server through **4G,WiFi or Ethernet**. 2.Remote meter reading and data collection. 3.Provide **IoT APP** for **mobile phone** side and **IoT WEB** for **PC** side. 4.Generate energy data report of daily, monthly and annually period with year-on-yeay and period-on-period energy analysis. 5.Provide various alarm function to ensure a stable operation of the system and protect your property. 6.Offer 3-month free trial of system with full technical support as for a test phase or pilot project.	$0 (recommended in pilot projtect)	3-month Free Trial (Users don't need to rent a cloud server))
		$xxx/Year (For 30 Points) (Price for Host Service Only, recommended in pilot projtect)	$xx to buy Hosting Service for 1 monitoring points connected to the system 1 year (Users don't need to rent a cloud server)
		$xxxx/Permanent (Limitless Points) (Price for Buy-out Service Only,recommended in late projtect)	1-time charging of $xxxx for Buy-out Service of permanent use (Limitless monitoring points and a cloud server need to be rent by users)

Cloud Server

Name	Description	Server Renting Price (For Reference Only)	Remark
Cloud Server	1.Cloud Server could be rent on the cloud server provider like Amazon Cloud. 2.Users of **Cloud IoT Energy Management System** only need to rent cloud server when they choose **buy-out** service of our **Cloud IoT System**. And if they are using **hosting service** or **3-month free trial** of our Cloud IoT System, we will use our own cloud server which has been rent on Amazon so that users don't need to rent a cloud server. 3.The quotation of Cloud Server is only a reference price that we have rent on Amazon Cloud.	According to Specs of Rented Cloud Server	Below cloud server specs could support 1000~2000 monitoings points connected to the system (Server：8 core 16G Operation System： windows server 2016)

WiFi Smart Gateway

Overview Picture	USAGE&MODULE NAME	DESCRIPTION & SPECIFICATION	QUANTITY	FOB UNIT PRICE (USD)	AMOUNT (USD)
	Smart Gateway **AWT200-1E4S-WiFi**	**Upstream:** WiFi, Ethernet [MQTT, MODBUS, etc] **Downstream:** RS485 (MODBUS-RTU) **Support:** up to **80~100** RS485 Devices within 400m using RS485 Wired Communication **Adjustment:** Via RJ45 or RS485 Port. **Power Supply:** 85~265Vac/Vdc (via power adpter) **HS Code:** 8517699000	1 pcs	/	/

Wireless Temperature Transceiver

Overview Picture	USAGE&MODULE NAME	DESCRIPTION & SPECIFICATION	QUANTITY	FOB UNIT PRICE (USD)	AMOUNT (USD)
	Temperature Transceiver **ATC600-C**	**Upstream:** RS485 (MODBUS-RTU) **Downstream:** GFSK (EU433 MHz) **Support:** Up to 240 ATE series wireless temperature sensors using GFSK communication. **Power Supply:** 100~265Vac **HS Code:** 9025191010	1 pcs	/	/

Wireless Temperature Sensor

Overview Picture	USAGE&MODULE NAME	DESCRIPTION & SPECIFICATION	QUANTITY	FOB UNIT PRICE (USD)	AMOUNT (USD)
	Wireless Temperature Sensor **ATE400**	**Communication:** GSFK (EU433 MHz) **Measuring Range:** -50℃~+125℃ **Power Supply:** CT sensing power supply (starting current>5A) **HS Code:** 9025191010	30 pcs	/	/

Acrel®

5. Project Sample #1 - Italy Enel Green Power Project

(1) Project Overview:
· **Customer:** SEL S.P.A [Switchgear Complete set factory]
· **Country:** Italy
· **Project Aim:** Integrate Acrel wireless temperature monitoring devices with switchgear s produced by SEL S.P.A for adding satety feature to their switchgear products.
· **Project Amount:** About 400.000 USD

Wireless Temperature Sensor

GFSK

Wireless Temperature Transceiver and Display Unit

(1) Customer: SEL S.P.A
[Switchgear Complete set factory]

(1) Project Aim:
Switchgear Wireless Temperature Monitoring

(2) Applied Product Combination:
- **ARTM-P30-400 Wireless Temperature Transceiver and Display Unit**
[For collecting, displaying and alarming for all temperature data collected from ATE400]
- **ATE400 Wireless Temperature Sensor**
[For monitoring the temperature of electrical connection nodes and send the data to ARTM-P30-400 via GFSK wirelesss Comms.]
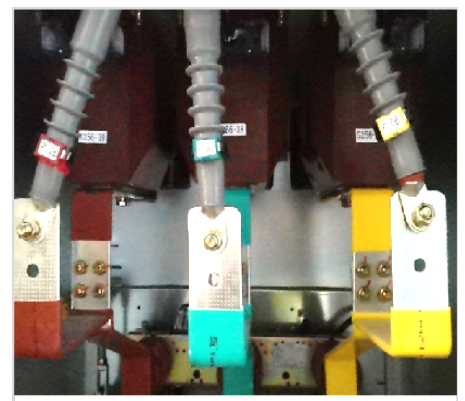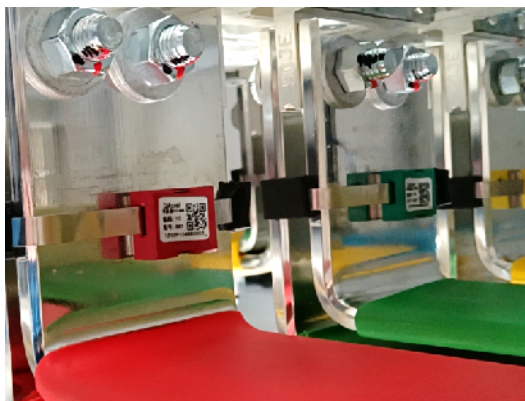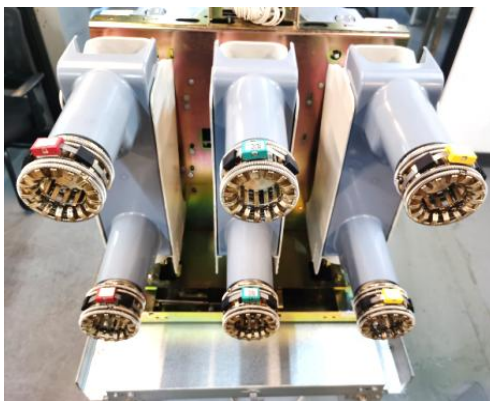
(2) Site Installation Picture

5. Project Sample #2 - Vietnam Lotte Mart Project

(1) Project Overview:
· **Customer:** V.T.E.C.H Electrical Technology Co., Ltd , EPC [Party A]
· **Country:** Vietnam
· **Project Aim:** Client use Acrel complete Cloud Wireless Temperature Monitoring Solution for monitoring and alarming electric cabinet in Lotte Mart to ensure electricity safety.
· **Project Amount:** About 100.000 USD

Wireless Temperature Sensor → (GFSK) → Wireless Temperature Transceiver

(1) Customer: V.T.E.C.H Electrical Technology Co., Ltd , EPC [Party A]

(1) Project Aim:
Online IoT based Wireless Temperature Monitoring&Alarming

(2) Applied Product Combination:
- AWT100-CEHW Ethernet IoT Gateway
- AWT100-POW Power Supply Module
- ATC600-C Wireless Temperature Transceiver
- ATE400 Wireless Temperature Sensor
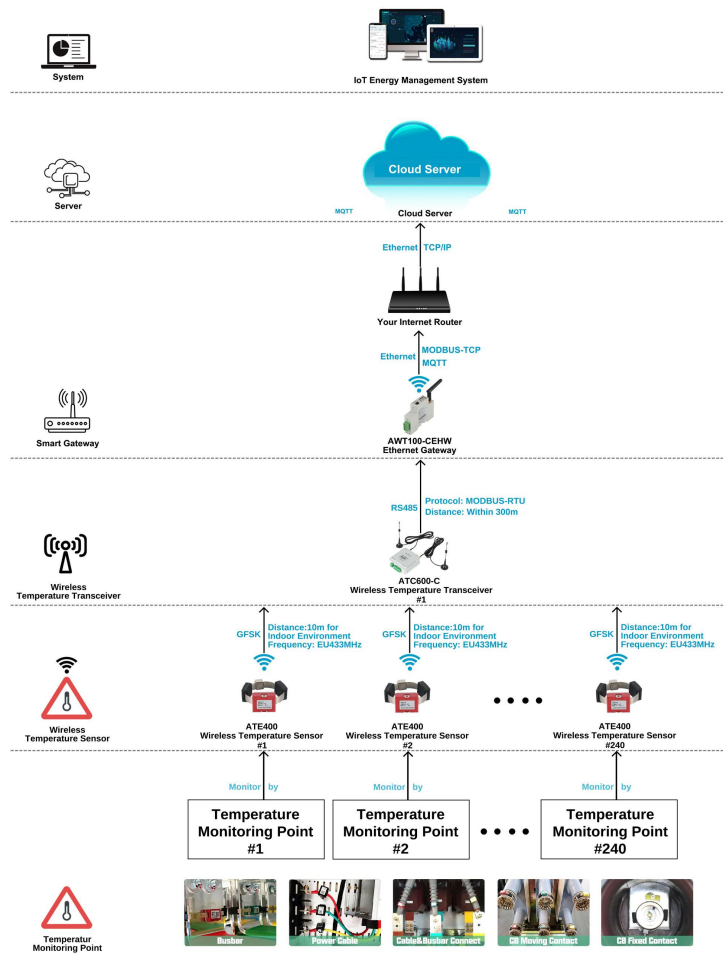
(2) Site Picture Gallery

(2) Solution Overall Structure