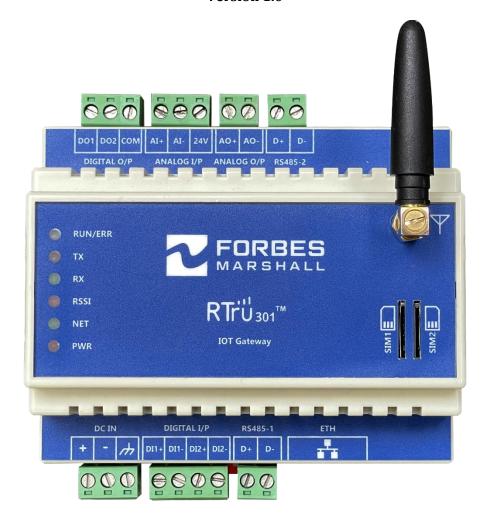# RTru301

IoT Gateway

User's Manual

Version 1.0

Forbes Marshall Pvt. Ltd.
Plot # B-85, Chakan, MIDC Phase-II
Sawardari, Tal Khed, Dist. Pune 410501. INDIA

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Purpose of this document

The purpose of this document is to equip the reader with the necessary information required for the safe installation, operation and maintenance of this device, prior to its commissioning. The information within this document is aimed towards those individuals who are technically qualified and experienced in the assembly, installation and operation/ maintenance of the device.

To avoid personal injury or property damage it is important to carefully read, understand, and follow all of the contents of this manual, including all safety cautions and warnings. If you have any questions about these instructions, contact the customer support division of the Manufacturer before proceeding.

Whilst the information in this document aims to be as accurate as possible, the Manufacturer makes no warranty or representations with respect to the information herein. The proper utilization of this information is ultimately the responsibility of the Customer.

IMPORTANT

**Read this User Manual thoroughly and understand its contents completely
Before installing and powering-up the Positioner.**

Intended use

In order to ensure optimum functionality, the device needs to be utilized solely for those purposes and in those manners as prescribed herein. The Customer is responsible for making certain that the operating conditions for the device correspond to the technical specifications defined. Furthermore, the Customer is also responsible for ensuring that any personnel that operate or maintain the device are made aware of the implications of using or operating the device in unsuitable conditions.

The Manufacturer does not assume any liability for damages resulting from the failure to use the device for its intended purpose or for damage caused by external forces or any other external factors.

Qualified Personnel

The product described in this documentation may be installed, operated and maintained only by personnel qualified for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products.

The Customer must ensure that operating personnel read and understand these instructions as well as the specified hazard statements, warning and caution notes. Furthermore, the operating personnel must be familiar with the applicable health, safety and accident prevention regulations and comply with them.

General Safety & Security

The Customer must consider the necessity of any protective clothing for its employees in the vicinity in order to provide protection against hazards of temperature (high or low), chemicals, radiation, dangers to eyes and face, noise and falling objects.

There is always a possibility of risk of injury if heavy products are handled manually. Customers are requested to analyze the risk and use appropriate handling methods by taking into consideration the task,

the individual, the working environment and the load. Furthermore, it is the Customer's responsibility to ensure that general instructions for proper use of tools and safety of equipment, piping and plant construction must also be complied with and "Warning Notices" need to be put up wherever necessary.

The Customer is solely responsible to prevent unauthorized access to its plants, systems, machines and networks, its information technology infrastructure, firewalls network, internet and appropriate security measures.

Incorrect installation, operation or maintenance of the device in potentially explosive atmospheres may lead to ignition of the atmosphere and cause risk of fatal injury, death or damage to personal property. Please note that the Customer is solely liable for any hazards, damage or injury caused to its personnel or property due to the Customer's failure to comply with the safety instructions above and as established throughout the course of this manual.

Limitation of Liability and Optimum performance

For optimum performance, the Product should only be used in conjunction with components and accessories supplied by the Manufacturer. If the product accessories and components from other manufacturers are used, these must be recommended or approved by the Manufacturer.

The Manufacturer shall not be liable and the Warranty shall not apply, if the Product (i) is used in any manner that is inconsistent with the intended purpose or design of the Product as described in user manual, product literature and/or technical documentation provided by the Manufacturer of the Product; (ii) is altered in any way; (iii) is used or maintained in any manner that is inconsistent with Manufacturer's instructions or warnings ("User Instructions") provided along with the Product; (iv) subjected to any other misuse, lack of proper storage & handling, commissioning, maintenance, faulty repair, neglect, or servicing by persons other than Manufacturer's authorized person and/or failure to operate in permissible ambient conditions.

Compliance with Laws & Directives

Observe the test certification, provisions and laws applicable in your country during connection, assembly and operation.

Product Disposal

It is necessary to dispose of this product only in accordance with local regulations at the authorized, qualified collecting point specified for equipment and its parts. Kindly refer to the components mentioned in this document. Please follow all waste disposal guidelines (Management & Handling) as published by local governing authorities and local environmental laws.

Nomenclature and symbols

Product
Product refers to the **RTru 301** IOT gateway.

Nomenclature
This manual contains notes and instructions, which the user must observe to ensure the safety of all user personnel and to protect the product and equipment connected to it. These are highlighted using specific symbols and appear based on the severity levels as follows.

⚠ DANGER

Indicates an imminently hazardous situation which if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

If used with the safety alert symbol indicates a potentially hazardous situation which if not avoided may result in minor to moderate level injury.

CAUTION

If used without the safety alert symbol indicates a potentially hazardous situation which if not avoided may result in damage to property.

NOTICE

If used without the safety alert symbol indicates a potentially hazardous situation which if not avoided may result in undesirable state or result.

☞NOTE

This highlights important information about the product, using the product or part of the documentation that will be beneficial to the user.

General Notes

☞NOTE

Dear User,

This manual does not provide for every possible contingency situation that may arise during the installation, operation and maintenance of the product.
For information or situations not covered by this manual, please contact your local Forbes Marshall Service support.
The content herein is based on the latest data available at the time of going to print and is subject to change due to ongoing product improvements in the future.

⚠ WARNING

The successful operation of this product depends on its proper handling, installation, operation and maintenance.
This product must be used for the sole purpose described in this manual.

1. INTRODUCTION

The **RTru301** IoT Gateway is used to monitor a device's interface data remotely and send it to a central location over the internet using a cellular communication network. The **RTru301** will read the data from the inbuilt I/O channels such as inputs. Additionally, it will read data from any device over Modbus or HART® protocols. The **RTru301** Device has an inbuilt cellular modem which helps to get connected to the internet over a GSM network. The **RTru301** Device can change the status of digital output and generates the analog output current (4 ~ 20mA) based on an SMS configuration.

1.1 Notice
The contents of this manual are subject to change without notice as a result of continuous improvements to the instrument's performance and functions.

Every effort has been made to ensure accuracy in the preparation of this manual. Should any errors or omissions come to your attention, however, please inform FORBES MARSHALL Sales office or sales representative. Under no circumstances may the contents of this manual, in part or in whole, be transcribed or copied in any form without our written permission.

1.2 Trademarks
Our product names or brand names mentioned in this manual are the trademarks or registered trademarks of Forbes Marshall (P) Ltd. **(hereafter referred to as Forbes Marshall)**.

Adobe®, Acrobat®, and Postscript® are either registered trademarks or trademarks of Adobe Systems Incorporated. All other product names mentioned in this user's manual are trademarks or registered trademarks of their respective companies.

1.3 Checking the contents of the package
Unpack the box and check the contents before using the product. If the product is different from which you have ordered, if any parts or accessories are missing, or if the product appears to be damaged, contact your sales representative. The User Manual is supplied in the package.

1.4 List of Accessories
The product is provided with the following accessories according to the model and suffix codes (see the table below). Check that none of them are missing or damaged.

Table 1 List of Accessories

No	Item name	Part number	Qty	Remarks
1	Cellular antenna	Part No: ET-LT3M-1L3-SMS Manufacturer: ETEILY TECHNOLOGIES	1	External

1.5 Product Ordering Code

Table 2 Product Ordering Code

Ordering Code RTru301										
Model		**Mounting**		**Input Type 1**		**Input Type 2**		**Output Type 1**		**Output Type 2**
RTru301		X		X		X				X
	D	DIN Rail	N	None	N	None	N	None	N	None
			1	AI (4~20mA)	1	Digital Input	1	AO (4~20mA)	1	Digital Output

2. SPECIFICATIONS

2.1 Technical Specification Sheet

RTru301 IoT Gateway

CPU	ARM Cortex - M4 Core, 192MHz
External Memory	4MByte (stores data when network fails)
RTC with battery backup	Yes
Battery	1 x CR2032
Internal Temperature Monitor	Yes
Expansion Connector	Yes (SPI & I2C)
LED Indication	Run/Error indication, Serial Transmit (TX), Serial Receive (RX), Cellular Signal Strength (RSSI), Server Connectivity (NET), Power Supply Indication (PWR)
Hardware Interface	1 x ETH 10/100BaseT/TX 2 x RS485 (1 Port : Standard, 1 Port : Optional) 2 x Digital Input : Optional 2 x Digital Output : Optional 1 x Analog Input with HART® Master (Isolated) : Optional 1 x Analog Output (4~20mA) : Optional
Protocol And Interface	Modbus RTU Master and firmware upgrade via RS485, DHCP server, Web Server and Telnet via Ethernet Port, MQTT and NTP via cellular
Serial Communication	Baudrate (kbps) : 9600/19200/38400/57600/115200 2 - pin plug in screw terminal
Ethernet	1 x RJ45(10 x 100Mbps)
Antenna Connector	1 x SMA Female
SIM Card Slots	2 x Micro SIM(3FF)

Cellular Communication	**4G Module**
	Frequency Band: GSM 900/1800 MHz
	        LTE-TDD B34/B38/B39/B40/B41
	        LTE-FDD B1/B3/B5/B8

Analog Input (Optional)	Input type: Current (4~20mA) Accuracy: 0.125% of full scale Input Impedance: 250 Ω HART® Master support: 4 Devices (max)
Analog Output (Optional)	Output type: Source(4~20mA) Accuracy: 0.25% of full scale Load capacity: 500 Ω @24 VDC max.
Digital Input	Input voltage range: 24 VDC (+/- 10%) External power supply
Digital Output (Optional)	Output type: Open collector (sink type) Max. Current: 50mA/output
Supply Voltage	9 to 36VDC, <10W, 3 - Pin plug - in screw terminal, reverse polarity protected
Operating Temperature Range	0°C to 55°C
Relative Humidity	0 ~ 95% RH (Non-Condensing)
Enclosure	Dimensions (mm) : 107 (W) x 88 (H) x 63 (D) Material : ABS plastic, DIN rail mount
Ingress Protection Rating	IP20
Weight (w/o antenna)	230g approx.
Certification (EMI / EMC)	EN/IEC 61326-1:2012 (Industrial)

Isolation (Withstanding voltage)
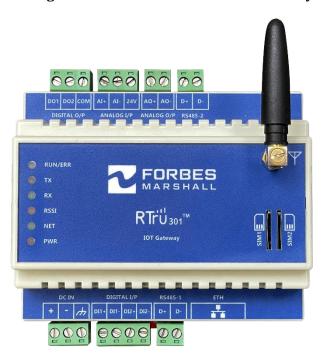
Between power supply input terminals and output terminals*: 500 VAC for 1 minute
Between power supply input terminals and ground terminal: 500 VAC for 1 minute
Between grounding terminal and analog and digital output terminals: 500 VAC for 1 minute

Insulation resistance: > 200MΩ @500VDC between power supply input terminals and output terminals

* Output terminals indicate RS485/Analog, Output/Analog, Input/Digital, Input/Digital, Ethernet

3. PRODUCT VIEW

3.1 Front View - RTru301

Figure 1 Front View - RTru301 IoT Gateway

Table 3 Terminal Connection Details

No.	Terminal Type	Description (Left to Right Direction)
1	MSTB Connector 3-pin for 24DC input power Part No:-MSTB-2.5/3-ST-5.08 (1757022) Manufacturer : Phoenix Contact	DCIN+ DCIN- EARTH
2	MSTB Connector 4-pin for Digital Input Channel Part No:-MSTB-2.5/4-ST-5.08 (1757035) Manufacturer : Phoenix Contact	DI1+(Positive) DI1-(Negative) DI2+(Positive) DI2-(Negative)
3	MSTB Connector 2-pin for RS485-1 Part No:-MSTB-2.5/2-ST-5.08 (1757019) Manufacturer : Phoenix Contact	D+ D-
4	RJ45 Socket for Ethernet Part No:-TCT-LPJK7002A98NL Manufacturer : Link-PP	For RJ45 based ethernet connection for web server
5	MSTB Connector 3-pin for Digital Output Channel Part No:-MSTB-2.5/3-ST-5.08 (1757022) Manufacturer : Phoenix Contact	DO1 DO2 COMM
6	MSTB Connector 3-pin for Analog Input(4 ~ 20mA) Part No:-MSTB-2.5/3-ST-5.08 (1757022) Manufacturer : Phoenix Contact	AI+(Positive) AI- (Negative) (24VDC)
7	MSTB Connector 2-pin for Analog Output(4 ~ 20mA) Part No:-MSTB-2.5/2-ST-5.08 (1757019) Manufacturer : Phoenix Contact	AO+(Positive) AO- (Negative)
8	MSTB Connector 2-pin for RS485-2 Part No:-MSTB-2.5/2-ST-5.08 (1757019) Manufacturer : Phoenix Contact	D+ D-

4. INSTALLATION & MOUNTING DETAIL

4.1 Safety precautions during installation

⚠️ **WARNING**

- To minimize the possibility of fire or shock hazards, do not expose this instrument to rain or excessive moisture.
- Do not use this instrument in areas under hazardous conditions such as excessive shock, vibration, dirt, moisture, corrosive gases or oil. The ambient temperature of the areas should not exceed the maximum rating specified.

⚠️ **WARNING**
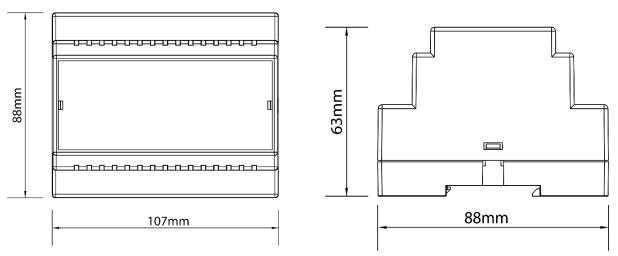
Earth the device to prevent an electric shock or fire. The protective conductor terminal is marked with a label on the product terminals with the following symbol:

⚠️ **CAUTION**

- Be sure all personnel involved in installation, servicing, and programming are qualified and familiar with electrical equipment and their ratings
- Do not install, store, or use it in the place with a lot of dust, corrosive and flammable gases, vibrations and shocks exceeding the allowed values, place low or high temperature outside of the installation condition, direct sunlight and near equipment generating strong radio waves or magnetic fields, It may cause accidents.
- This equipment can be damaged if incorrect power source voltage is applied. This equipment can be damaged if the power source is applied with incorrect polarity on its respective terminal. Never plug unit power supply connectors or power supply cables in the terminal while the main power source is ON.

4.2 Mechanical Dimension

Dimension without plug-in connector (mm): 107(W) x 88(H) x 63(D)
Dimension with connector (mm): 107(W) x 113(H) x 80(D)

4.3 DIN Rail Mount

Installing the RTru301 module on a DIN rail

👉NOTE

Before mounting **RTru301** device on a DIN rail, ensure power supply to the module connectors is turned off and remove the antenna and terminal connectors. After fitment, mount the antenna connector and terminal connectors on **RTru301** Device.

Step 1: Clip on the module on to Part A of the rail

Step 2: Fix the module on to Part B of the rail

Step 3: Press the red lock into the DIN Rail until it clicks

Un-installing the RTru301 module from a DIN rail

👉NOTE

Before removing the **RTru301** device from the DIN rail, ensure power supply to the module connectors is turned off. Remove the antenna and terminal connectors.

Step 1: Pull the red lock down from the DIN Rail.

Step 2: Pull the module away from part B of the rail

Step 3: Remove the Module from DIN Rail

5. TERMINAL CONNECTIONS

5.1 Sticker of RTru301 IoT Gateway

Figure 2 Front Sticker
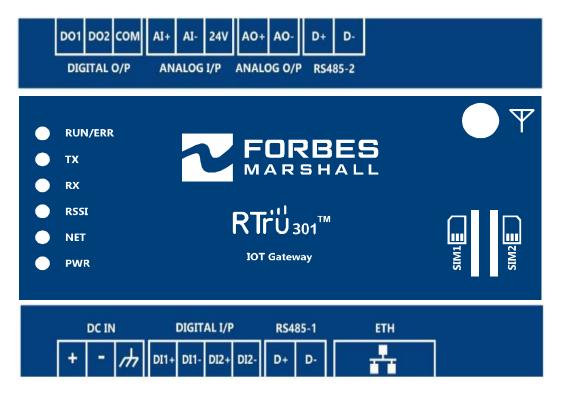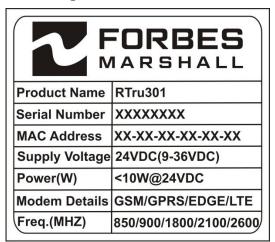
Figure 3 Serial No Sticker

Product Name	RTru301
Serial Number	XXXXXXXX
MAC Address	XX-XX-XX-XX-XX-XX
Supply Voltage	24VDC(9-36VDC)
Power(W)	<10W@24VDC
Modem Details	GSM/GPRS/EDGE/LTE
Freq.(MHZ)	850/900/1800/2100/2600

5.2 Connecting the RTru301

⚠️ **WARNING**

Before carrying out wiring, turn off the power and check that the cables to be connected are not live because there is a possibility of electric shock.

👉 **NOTE**

1. All wiring must conform to appropriate standards of good practice and local codes and regulations. Wiring must be suitable for voltage, current and operating temperature rating of the system.
2. Provide power from an external 24VDC power supply. Do not route power supply and I/O cables close to each other.
3. Use a repeater after each set of 32 slaves connected to the RS-485 Port 1(Modbus Master) communication.
4. Unused terminals should not be used as jumper points as they may be internally connected, which may cause damage to the unit.
5. Supply voltage must be below maximum voltage rating specified on the label.

Figure 4 RS485 Port 1 (Modbus Master) Connection Details

6. CONFIGURATION GUIDELINES

See the below table for RUN/Error LED indication

Table 4 RUN/ERROR LED Indication

No Error	RUN (Green) LED Glow
Configuration parameter memory not detected	Error(Red) LED will blink every 100ms
Configuration parameter file error	Error(Red) LED will blink every 500ms
Data logging memory not detected	Error(Red) LED will blink every 1500ms
RTC not detected	Error(Red) LED will blink every 3000ms
Selected SIM card Not Detected	Error(Red) LED Glow

6.1 Parameter Configuration

RTru301 IoT Gateway device offers a facility for users to configure parameters of the device using a web server. Web server pages can be obtained in PC or system by sending an HTTP request (http://192.168.100.110) to device on device IP address by a web browser such as Google Chrome®. The default device IP address is 192.168.100.110. After getting a successful response from the device, the webpage of the device is seen as shown in the image below. Ensure that the PC or system is in the same IP address network and range.

The default Username and Password for web server login are:
Username: Admin
Password: Admin
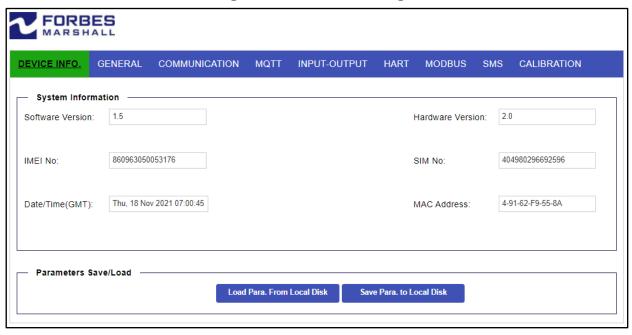
The pages in web server are:

DEVICE INFO
GENERAL
COMMUNICATION
MQTT
INPUT- OUTPUT
HART®
MODBUS
SMS
CALIBRATION

6.1.1 Device Info

This page provides configuration information of **RTru301** devices such as current hardware & software versions, cellular modem IMEI No and SIM card no

Figure 5 Device Info Web Page

The device info Configuration Page provides the information of **RTru301** devices such as current hardware & software version, cellular modem IMEI No, SIM card No and current Time and Date.

Table 5 RTru301 Device Configuration Parameters

Parameter	Description
Software Version	Software version
Hardware Version	Current Hardware Version
IMEI No	IMEI Number of Cellular modem
SIM No	IMSI number of the SIM Which is use for the cellular communication
MAC Address	MAC address
Date/Time(GMT)	Shows the current Time and Date(GMT)

'Load Para. From Local Disk' button:
This button is used for loading the Parameters configuration file from the local disk by providing the path of the config. file in the local system or PC.
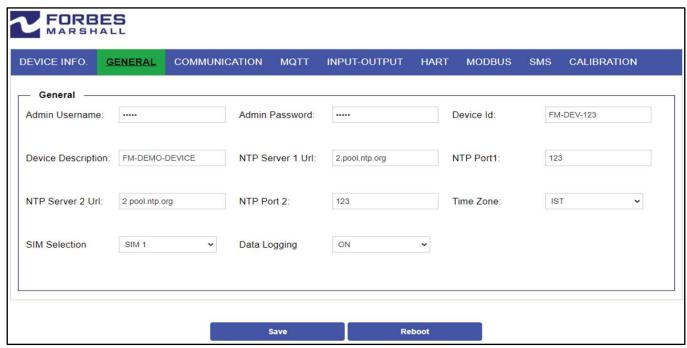
'Save Para. To Local Disk' Button:
This Button is used to download the current parameter configuration in a file in the local system or PC.

6.1.2 General

The General Configuration Page is used to configure the web server login username and password, NTP server configuration, SIM section and data logging memory option. Seen as show in the image below

Figure 6 General Web Page

Table 6 General Configuration Parameters

Parameter	Description	Format	Range	Default
Admin Username	Username for Web server Login. It is required only for web server login.	String (R/W)	1 ~ 5 characters	Admin
Admin Password	Password for Web Server Login. It is required only for web server login.	String (R/W)	1 ~ 5 characters	Admin
Device ID	Specifies the device ID. It is used for sending an SMS with Device ID and Periodic Data Frame Sending to MQTT Server with device ID.	String (R/W)	1 ~ 20 characters	FM-DEV-001
Device Description	Specifies the device Description. It is required only for identification of the device	String (R/W)	1 ~ 20 characters	FM-DEMO-DEVICE
NTP server 1 URL	Specifies the NTP server URL. It is used for synchronization of time of the device	String (R/W)	1 ~ 256 characters	2.pool.ntp.org
NTP Server Port 1	Specifies the NTP Port. It is used for synchronization of time of the device. The NTP Server Port 1.	Integer (R/W)	1 ~ 65535	123
NTP server 2 URL	Specifies the NTP server URL. It is used for to synchronize the time of the device	String (R/W)		2.pool.ntp.org
NTP Server Port 2	Specifies the NTP Port. It is used to synchronize the time of the device.	Integer (R/W)	1 ~ 65535	123
Time Zone	It is used to set the time of a device based on IST or UTC.	Option	IST/ UTC	IST
SIM Selection	Select the SIM card Option for Cellular communication.	Option	Disable/ SIM1/ SIM2/ Both	Disable
Data Logging	Enable or disable the data frame logging in case cellular network failure occurs. The device sends the logged data when the network is restored.	Option	ON/OFF	ON

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☞**NOTE**

Logged data will be erased when the Data Logging option is set to Off

6.1.3 Communication

The Communication Page is used to configure the Ethernet parameter, SIM card parameter, serial configuration and selection of Input and Output data sent to the MQTT server.
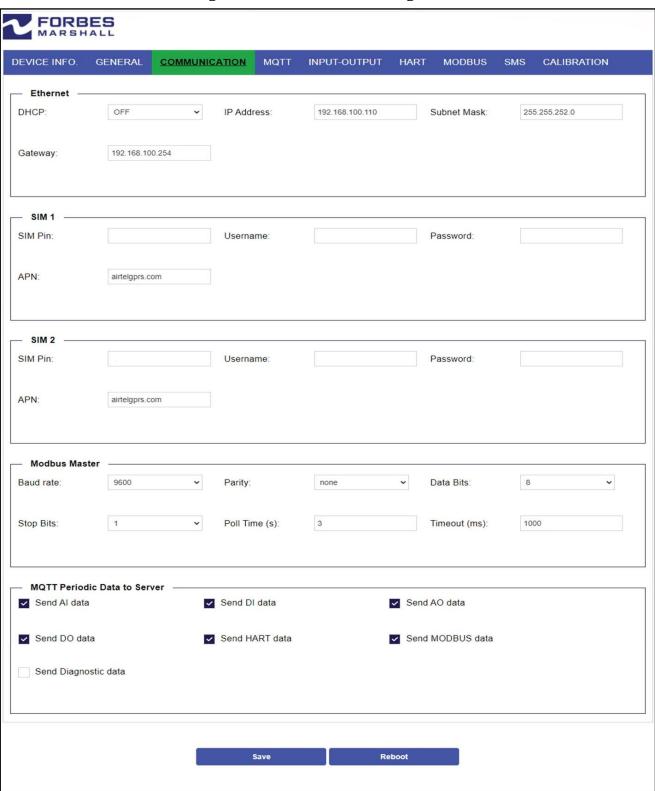
Figure 7 Communication Web Page

Table 7 Communication Parameters

Parameter	Description	Format	Range	Default
DHCP	IP address selection of RTru301	Option	ON/ OFF	OFF
IP address	IP address of RTru301 (in static mode only)	XXX.XXX.XXX.X XX(R/W)	1 ~ 15 characters	192.168.100. 110
Subnet Mask	Subnet mask address of RTru301 (in static mode only)	XXX.XXX.XXX.X XX(R/W)	1 ~ 15 characters	255.255.255. 0
Gateway	Gateway address of RTru301 (in static mode only)	XXX.XXX.XXX.X XX(R/W)	1 ~ 15 characters	192.168.100. 254
SIM PIN1	PIN for your cellular network SIM card 1. Use only when the SIM card is Locked.	String (R/W)	1 ~ 5 characters	Empty
SIM1 Username	User name for your cellular network account for SIM card 1. Use only when required by your cellular service provider.	String(R/W)	1 ~ 20 characters	Empty
SIM1 Password	Password for your cellular network account for SIM card 1. Use only when required by your cellular service provider.	String(R/W)	1 ~ 20 characters	Empty
SIM1 APN	Access Point Name (APN) of the SIM card 1 that connects your device for internet data	String(R/W)	1 ~ 30 characters	internet
SIM PIN2	PIN for your cellular network SIM card 2. Use only when the SIM card is Locked.	String(R/W)	1 ~ 5 characters	Empty
SIM2 Username	User name for your cellular network account for SIM card 2. Use only when required by your cellular service provider.	String(R/W)	1 ~ 20 characters	Empty
SIM2 Password	Password for your cellular network account for SIM card 2. Use only when required by your cellular service provider.	String(R/W)	1 ~ 20 characters	Empty
SIM2 APN	Access Point Name (APN) of the SIM card 2 that connects your device for internet data	String(R/W)	1 ~ 30 characters	internet
Modbus Baud rate	Baud rate for Modbus communication on RS485 Port 1	Option	9600/ 19200/ 38400/ 57600/ 115200	9600
Modbus Parity	Parity for Modbus communication on RS485 Port 1	Option	none/ even/ odd	none
Modbus Data Bits	Number of data bits for Modbus communication on RS485 Port 1	Option	7/8 Bit	8
Modbus Stop Bits	Number of stop bits for Modbus communication on RS485 Port 1	Option	1/2 Bit	1
Modbus Poll Time(s)	Polling time for Modbus communication on RS485 Port 1. This time is used to decide when the next Modbus master query is sent from the device to the Modbus slave device.	Integer(R/W)	1 ~ 100 (sec)	3(sec)
Modbus Timeout (ms)	Response timeout for Modbus communication on RS485 Port 1. This time decides the waiting period of Modbus slave response.	Integer(R/W)	1 ~ 10000 (ms)	1000(ms)
Send A/I Data	Send measured analog input data to the MQTT server periodically.	Check Box	Enable/ Disable	Enable
Send D/I	Send measured digital input data to the	Check Box	Enable/	Enable

Data	MQTT server periodically.		Disable	
Send A/O Data	Send measured analog output data to the MQTT server periodically.	Check Box	Enable/ Disable	Enable
Send D/O Data	Send measured digital output data to the MQTT server periodically.	Check Box	Enable/ Disable	Enable
Send HART® Data	Send HART® master data can be sent to the MQTT server.	Check Box	Enable/ Disable	Enable
Send Modbus Data	Send Modbus master data to the MQTT server.	Check Box	Enable/ Disable	Enable
Send Diagnostic Data	Send diagnostic data to the MQTT server.	Check Box	Enable/ Disable	Disable

6.1.4 MQTT

The MQTT configuration web page is used to configure the MQTT server Parameter.

Figure 8 MQTT Web Page

The MQTT configuration web page is used to configure the MQTT server parameter.

Table 8 MQTT Parameters

Parameter	Description	Format	Range	Default
MQTT URL	URL for MQTT server	String(R/W)	1 ~ 256 characters	test.mosquitto.org
MQTT Port	MQTT Port number	Integer(R/W)	1 ~ 65535	1883
Client ID	Client ID for MQTT server	String(R/W)	1 ~ 256 characters	FM DEMO CLIENT
Username	Username for MQTT server which is required for MQTT server login.	String(R/W)	1 ~ 256 characters	Empty
Password	Password for MQTT server which is required for MQTT server login.	String(R/W)	1 ~ 256 characters	Empty
Keep alive(s)	Keep Alive message time	Integer(R/W)	1 ~ 3600 (sec)	120s
Clean session	If the field "Clean Session" is checked, the last MQTT messages are deleted by the Server and the Client in case of missing ACK. If unchecked, then Server and the Client hold the last MQTT messages. In case of incorrect disconnection or missing ACK, they try to send them again since all the ACK messages are exchanged correctly (valid only for QoS 1 and QoS 2).	Check Box	Enable/ Disable	Disable
Will Flag	If the field "Will Flag" is checked, the device will publish the Will topic at the connection to the Server. With this feature, in case of incorrect disconnection, the Server will publish this topic to all the MQTT Clients that are subscribed to it.	Check Box	Enable/ Disable	Disable
Will Topic	Specify the will topic. It is used for the Will message.	String(R/W)	1 ~ 256 characters	TEST/WILL
Will Message	Specify the payload of the Will message.	String(R/W)	1 ~ 256 characters	Test Will Message
Will QoS	Set the QoS type for which the Will message is defined.	Option	0/ 1/ 2	0[ZERO]
Will Retain	In the field "Retained Will" the device will send the Will message with Retain flag enabled. In this way, the server will hold the last Will message.	Check Box	Enable/ Disable	Disable
Periodic Data Topic	Specify the Periodic Published Topic for the periodic data sent to the MQTT server.	String(R/W)	1 ~ 256 characters	TEST/PERIODIC
Alert Topic	Specify the Alert Topic for the Alert data sent to the MQTT server.	String(R/W)	1 ~ 256 characters	TEST/ALERT
QoS	In the field "QoS" the QoS type for Periodically data sent is defined.	Option	0/ 1/ 2	0[ZERO]
Diagnostic Topic	Specify the Diagnostic Topic for the Diagnostic data sent to the MQTT server.	String(R/W)	1 ~ 256 characters	TEST/DIAG
Subscribe Topic	Specify the Subscribe Topic for the Subscribe data sent to the MQTT	String(R/W)	1 ~ 256 characters	TEST/SUB

	server.			
Subscribe Topic Max. QoS	Set the QoS type Subscribe Topic.	Option	0/ 1/ 2	0[ZERO]
Periodic Data Publish Time (min)	Set the periodic publish data interval for periodic publish data sent to the MQTT server	Integer(R/W)	1 ~ 1440 (minutes)	1 (minutes)
Diagnostic Data Publish Time (min)	Set the interval for diagnostic data sent to the MQTT server	Integer(R/W)	1 ~ 1440 (minutes)	60 (minutes)
Server Authentication	Enable or Disable the server authentication. It is used for secure server login.	Check Box	Enable/ Disable	Disable
Client authentication	Enable or disable the Client authentication.	Check Box	Enable/ Disable	Disable
Server Certificate	Specify the server certificate. It Applicable when Client authentication enable	String(R/W)	1 ~ 4096 characters	Empty
Client Certificate	Specify the client certificate. It Applicable when Client authentication enable	String(R/W)	1 ~ 4096 characters	Empty
Client Key	Specify the client key. It Applicable when Client authentication enable	String(R/W)	1 ~ 4096 characters	Empty

'Save Certificate' Button:
This Button is used to save the server certificate, client certificate and Client key

👉**NOTE**

If the MQTT server does not receive the any payload from the **RTru301** device within 1.5 times of the Keep Alive time period, MQTT server disconnects the **RTru301** device.

6.1.5 Input – Output

This Input-Output Configuration is used to configure the parameters of analog input, analog output, digital input and digital output.
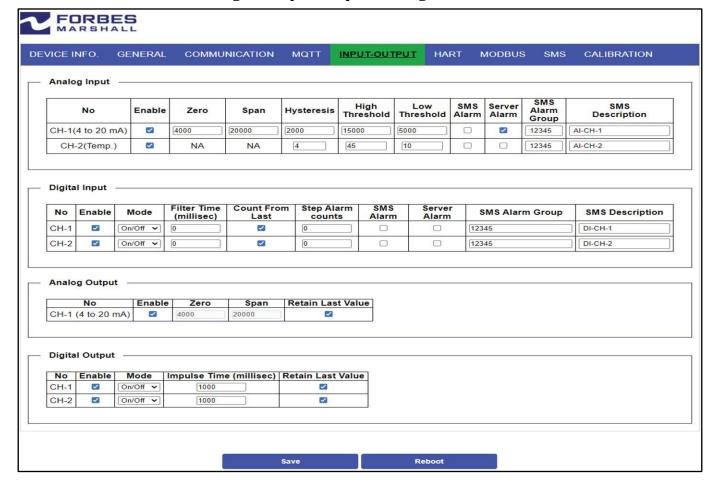
Figure 9 Input - Output Web Page

ANALOG INPUT

The following table lists configuration parameter for analog input channel 1 (4~20mA) and channel 2 (internal temperature measurement)

Table 9 Analog Input Parameters

Parameter	Description	Format	Range	Default
Interface Enable	Enables or disables the analog input source.	Check Box	Enable/ Disable	Enable
Zero	Specifies the zero value for the analog input channel 1	Integer(R/W)	-1999 to +20000 (CH1)	4000(CH-1)
Span	Specifies the span value for the analog input channel 1	Integer(R/W)	0 ~ 20000 (CH-1)	20000(CH-1)
Hysteresis	Specifies the input value to keep an alarm ON or OFF during High and Low alarm states	Integer(R/W)	0 ~ 20000 (CH-1) 0 ~ 5 (CH-2)	2000(CH-1) 4(CH-2)
High Threshold	Specifies the input value that generates a high alarm event when High Alarm is ON	Integer(R/W)	4000~20000 (CH-1) 0 ~ 100 (CH-2)	15000(CH-1) 45(CH-2)
Low Threshold	Specifies the input value that	Integer(R/W)	4000 ~ 20000	5000(CH-1)

	generates a low alarm event when Low Alarm has occurred		(CH-1) 0 ~ 100 (CH-2)	10(CH-2)
SMS alarm	Enables or disables the SMS alarm when an alarm occurs	Check Box	Enable/ Disable	Disable
Server Alarm	Enables or disables the server alarm when an alarm occurs	Check Box	Enable/ Disable	Disable
SMS alarm Group	Specify a group for the SMS alarm received. for Ex.123 means the alarm SMS send to Group No 1, 2 and 3 which are specified in SMS web page	String(R/W)	1 ~ 5 characters	12345
SMS Description	SMS alert message	String(R/W)	1 ~ 20 characters	AI-CH-1 (CH-1) AI-CH-2 (CH-2)

☞**NOTE**

-The value of Low or High Threshold is in between the value of Zero and Span in analog input channel 1
-The range of Low or High Threshold for analog input channel 2 is 0 ~ 100

DIGITAL INPUT

The following table lists configuration parameter for digital input channel. The digital input channel can be worked as ON/OFF or Counter Mode.

Table 10 Digital Input Parameters

Parameter	Description	Format	Range	Default
Interface Enable	Enables or disables the digital input source.	Check Box	Enable/ Disable	Enable
Mode	Digital input mode	Option	On/Off / Counter	On/Off
Filter Time(ms)	The Filter Time is the length of time that a newly changed input to the last state before it is accepted as a valid input. It is used only in ON/OFF mode. Applicable in On/Off mode only	Integer(R/W)	0 ~ 10000 (ms)	0(ms)
Count From Last	Enables or disables the digital input count from the last stored value	Check Box	Enable/ Disable	Enable
Step alarm count	Max. alarm count for sending alarm SMS msg	Integer(R/W)	0 ~ 65535	0
SMS alarm	Enables or disables the SMS alarm when an alarm occur	Check Box	Enable/ Disable	Disable
Server Alarm	Enables or disables the Server alarm when an alarm occur	Check Box	Enable/ Disable	Disable
SMS alarm Group	Specify a group for the SMS alarm received. for Ex.123 means the alarm SMS send to Group No 1, 2 and 3 which are specified in SMS web page	String(R/W)	1 ~ 5 characters	12345
SMS Description	SMS alert message	String(R/W)	1 ~ 20 characters	DI-CH-1(CH-1) DI-CH-2(CH-2)

👉**NOTE**

The last value of digital input as counter will be erased when the last count option in digital input configuration is disabled. In this case the digital input counter starts from zero.

ANALOG OUTPUT

The Table provides the configuration of the Analog output. The analog outputs can be generated based on last stored value on device power ON/OFF

Table 11 Analog Output Parameters

Parameter	Description	Format	Range	Default
Interface Enable	Enables or disables the Analog output	Check box	Checked/ Unchecked	Enable
Zero	Specifies the zero value for the analog output channel	Number	4000	4000 [Fixed Value]
Span	Specifies the span value for the analog output channel	Number	20000	20000 [Fixed Value]
Retained Last Value	Enables or disables the analog output generated based on last stored value	Check box	Checked/ Unchecked	Enable

👉**NOTE**

The last value of analog output will be erased when the last retained option in analog output configuration is disabled (analog output value is set to zero)

DIGITAL OUTPUT

The Table provides the configuration of the digital output channel. The Digital output can be worked as on/off or impulse mode. In Impulse mode it is in sink mode for a defined time interval.

Table 12 Digital Output Parameters

Parameter	Description	Format	Range	Default
Interface Enable	Enables or disables the Digital output source.	Check Box	Enable/ Disable	Enable
Mode	Digital output mode selection	Option	On/Off/ Impulse	On/Off
Impulse Time	Impulse Time of output	Integer(R/ W)	1 ~ 10000 (ms)	1000(ms)
Retained Last Value	Enables or disables the digital output generated based on last stored value	Check Box	Enable/ Disable	Enable

👉**NOTE**

The last value of digital output will be erased when the last retained option in digital output configuration is disabled. In this case the digital output is set to the OFF state.

6.1.6 HART®

The HART® configuration parameter can be set in the HART® configuration page.

Figure 10 HART® Web Page

Table 13 HART® Parameters

Parameter	Description	Format	Range	Default
No of Clients	No of HART® slave device or HART® Request Query for the HART® communication.	Integer(R/W)	0 ~ 15	0[ZERO]
Query Time(s)	Query Time for HART® communication. This Time is used to decide when the next HART® query is sent from the device to the HART® slave device.	Integer(R/W)	1 ~ 120 (s)	5s
Query Reponses Time out(ms)	Query Response Timeout for HART® communication. This time decides the waiting period of HART® slave response.	Integer(R/W)	100 ~ 5000 (ms)	1000(ms)
Query Attempts	Number of query retry counts for HART®	Integer(R/W)	0 ~ 3	0[ZERO]
Polling ID	HART® slave device ID for HART® communication.	Integer(R/W)	0 ~ 15	0 ~ 15
Manufacturer's	Manufacturer's ID of the HART®	String		

ID	Device. This is a 'read only' parameter.	(Read only)		
Device Type	Device type of HART® Device. This is a 'read only' parameter.	String (Read only)		
Client ID	Shows the Client ID of HART® Device. This is a 'read only' parameter.	String (Read only)		
Publishing Interval (min)	Specifies interval for HART® data published on the MQTT server with HART® data topic in minutes	Integer(R/W)	1 ~ 1440 (minutes)	1(minutes)
Publish Topic	Publish topic for HART® data published on the MQTT server.	String(R/W)	1 ~ 256 characters	TEST/HTDEV1
Change ID	This button is used to change the HART® Polling ID	'Tab'		

'Get Device Data' Button:
This Button is used to Read the Manufacturer's ID, Device Type and Client ID of the HART® Device which are configured.

6.1.7 Modbus

The Modbus Master configuration can be set in the Modbus configuration page.

Figure 11 Modbus Web Page

Table 14 Modbus Parameters

Parameter	Description	Format	Range	Default
No of Client	Number of Modbus slave devices or Modbus queries for Modbus communication.	Integer(R/W)	0 ~ 16	0
Slave ID	Modbus slave device ID for Modbus communication.	Integer(R/W)	1 ~ 247	1 ~ 16

Function Code	Function code for Modbus communication	Integer(R/W)	1 / 2 / 3 / 4 / 5 / 6 / 15 / 16	3
Reg. Start Address	Start address of Modbus query for Modbus communication	Integer(R/W)	1 ~ 65535	1
Register Length	Read Modbus register length for Uint (unsigned integer) 16	Integer(R/W)	1 ~ 64	1
Data Format	Data format for Modbus register read	Integer(R/W)	Bool / Int_16/ Uint_16/ Int_32 / Uint_32 / Float / Float_Swap / Double / Double_Swap	Uint_16
Publishing interval (min)	Time interval for Modbus data published on MQTT server with Modbus topic.	Integer(R/W)	1 ~ 1440 (minutes)	1(minutes)
Subscribe Topic	Subscribe topics for Modbus query received from the MQTT server.	Check Box	Enable/ Disable	Disable
Publish Topic	Specifies the publish topic for Modus data published on the MQTT server.	String(R/W)	1 ~ 256 characters	TEST/MBDEV1

6.1.8 SMS

The SMS page is used to specify user mobile numbers for receiving alert SMS messages

Figure 12 SMS Web Page

Table 15 SMS Parameters
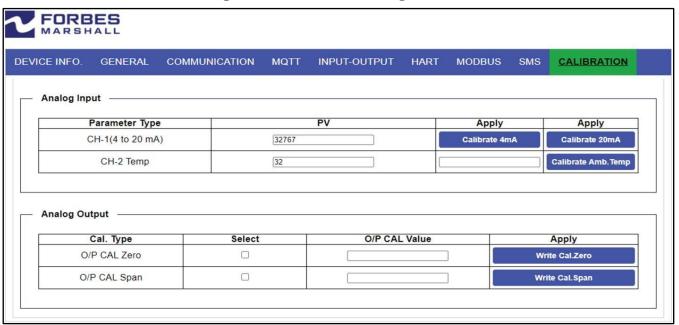
Parameter	Description	Format	Range	Default
Mobile No	User mobile number to receive alert on SMS	String(R/W)	1 ~ 13 characters	Empty

☞NOTE

-It is necessary to Press the 'Save' button after changing the any parameter in any web page. Saved parameters will have effect only after a power ON/OFF recycle is done or by pressing the 'Reboot' button.

-The **RTru301** device will reset after pressing the 'Reboot' button. If the 'Reboot' button is press then after the RUN/ERR LED will be in the OFF state

6.1.9 Calibration

Figure 13 Calibration Web Page

Table 16 Calibration Parameters

Parameter	Description	Range
Analog Input	Count corresponding to the current applied from the current source	Integer(CH-1) Number(CH-2)
Analog Output	Current value measured from the current output (4mA / 20mA) (Zero/ Span Calibration)	Number

7. INPUT OUTPUT INTERFACE CHECK

7.1 Cellular Communication

The Cellular and MQTT Configuration parameters are described in Section 6.1. Follow the step by step procedure below to set up the cellular configuration:

- Carefully insert a **pre-activated** SIM card to the device.
- Now open the web server of the **RTru301** device to configure SIM related parameters and MQTT parameters.
- Select the SIM Option in the web server
- The APN must be configured to **RTru301** device for making a data connection. An APN is provided by the cellular network service provider.
- If required, set the Username, Password and SIM PIN for the inserted SIM card.
- Configure the NTP server URL and NTP Port for the **RTru301** device time synchronization with UTC. The RTru301 device sends an NTP request to the NTP server on the cellular network. If it receives a response then the device synchronizes with UTC time. The **RTru301** device sends an NTP request to the NTP server every 12hrs for Time synchronization. Two NTP servers are provided for redundancy.
- Set the MQTT parameters for the **RTru301** Device Data publish such as periodic, diagnostic, Modbus and HART® Data.
- Select the Time format to send the Epoch timestamp with data published to MQTT server. i.e. UTC or IST
- Select the data logging option for the data logged in case of cellular network failure or server disconnection. The **RTru301** Device sends the logged data when the network or server connection is restored.
- Save all parameters of the **RTru301** device by pressing 'Save' Button and press the 'Reboot' button to reset the device.
- The IMEI and SIM nos. are shown in the device info web page when the cellular modem is powered on successfully without any error.
- Check the connectivity of the network of the **RTru301** device with help of RSSI and NET LEDs.

The RSSI or cellular signal strength can be observed based on the RSSI LED

Table 17 RSSI (Receiving Signal Strength Indication)

Good : >= -85 dbm	LED ON
Low : >= -100 to <= -86 dbm	LED blinking at 1s interval
Very low : < -100 dbm	LED OFF

The network LED shows the status of network connection and MQTT server connection.

Table 18 Network Status Indication

Both network and MQTT are connected	LED ON
No network connected	LED OFF
MQTT not connected	LED blinking at 1s interval
Cellular initialization is in progress	LED blinking at 200ms interval

7.2 Modbus Communication

Modbus is an industrial automation protocol used for sending and receiving digital information across a single, external RS-485 serial bus. The maximum 16 number of Modbus slave devices connected to the RS485 Port 1 of the **RTru301** device or the device can read a maximum of 64 registers from the Modbus slave devices.

The Modbus parameter configuration is described in Section 6.1.7. See the below step to configure Modbus parameter to read Modbus registers from the slave devices.

The following settings must match with the externally connected Modbus slave devices. Select the appropriate Modbus serial communication:

Figure 15 Modbus Communication
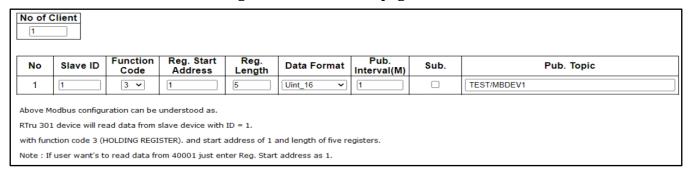
The **RTru301** device sends the query to the slave device and waits for a response from the slave devices based on the poll time and response time set.

For monitoring Modbus devices on an MQTT server, specify the no. of the client, slave ID, function code, start address, register length, data format, publish interval and publish topic in the Modbus web page configuration. Please refer Figure 16 for Modbus slave device configuration.

To read 5 Holding registers (function code 3) with addresses from 40001 ~ 40005, enter value 1 in the Reg. Start address input box and value 5 in Reg. Length.

Figure 16 Modbus web page

Table 19 Modbus Register Length Data Format

Data format	Data length	Range	
		Lower Limit	Upper Limit
Bool	1 Bit	0	1
Int 16	1 Modbus Register	-32768	32767
Uint 16	1 Modbus Register	0	65535
Int 32	1 Modbus Register	-2147483648	2147483647
Uint 32	1 Modbus Register	0	4294967295
Float	2 Modbus Registers	$1.401\ e^{-45}$	$3.403\ e^{38}$
Float Swap	2 Modbus Registers		

The Read data from the Modbus slave devices can be set to the MQTT server by enabling the Modbus data send option in the communication webpage.

Apply the configuration changes by pressing 'Save' and 'Reboot' Button. By pressing 'Reboot' Button the device is reset. The Modbus communication can be checked by monitoring the Tx and Rx LED activity on the device. The **RTru301** device sends the data to MQTT server which is defined in MQTT web page on Modbus Topic based on defined publishing interval.

See the below example for the Float (ABCD) and Swap Float conversion (CDAB)

For Float Value: 10.4802
Modbus register 0:0x4127, Modbus Register1:0xaee6

For Swap Float Value: 10.4802
Modbus register 0:0xaee6, Modbus Register1:0x4127

See the below example for Double (ABCD) and Double Swap conversion (CDAB)
For Double Value: 10.4802
Modbus register 0:0x4024,
Modbus Register1:0xf5dc,
Modbus Register2:0xc63f,
Modbus Register 3:0x1412

For Double Swap Value: 10.4802

Modbus register 0:0xF5dc,
Modbus Register1:0x4024,
Modbus Register2:0x1412,
Modbus Register3:0xc63f

See the JSON format for the payload of Modbus Topic which are sent on MQTT server

{"ts":1628937275000,"values": {"IMEI":123456789123456,"ID":"FM-DEV 001","FRAME":0, "ST":0,"S1_1":0,"S1_2":5}}

Table 20 JSON Key Description for Payload of Modbus Topic

ts	Time stamp of JSON data in epoch time in ms
IMEI	IMEI number of cellular modem in device
ID	Device ID
FRAME	Type of data in frame live data, log data 0=Live,1=Logged
ST	Status of Modbus slave 1 = connected, 0 = not connected
S1_1	Combination of Modbus slave id and register start address e.g. "S1_1 S1 = SLAVE ID 1, 1= Register number1.
S1_2	Combination of Modbus slave id and register start address e.g. "S1_1" S1 = SLAVE ID 1, 2= Register number2

7.3 HART® Communication

The HART® (Highway Addressable Remote Transducer) Protocol is an industry standard protocol for sending and receiving digital information across analog wires between field devices and control and monitoring systems. It preserves the traditional 4 ~ 20mA signal, and provides simultaneous transmission of digital communication signals on the same wiring. Thus enabling a bi-directional communication with smart instruments without disturbing the 4 ~ 20mA analog signal. In that way primary process variables and control signal information is carried by the 4 ~ 20mA, while additional process measurements, device configuration and parameter information, calibration, and diagnostics information is accessible through the HART® protocol.

HART® slave devices include sensors, transmitters and various actuators that respond to commands. Basically the HART® data is superimposed on the 4 ~ 20mA current loop making use of the frequency shift keying (FSK) principle, via a FSK modem integrated in field devices. This enables devices to communicate digitally using the HART® protocol, while analog signal transmission takes place at the same time.

HART® devices have the capability to operate in one of two network configurations: Point-to point connection or Multi drop mode. Using the polling address structure of the HART® protocol, the polling address of the field devices will vary in a range of 0 ~ 4.

1. Point to Point

In point-to-point mode the digital signals are overlaid on the 4 ~ 20mA loop current. Both the 4 ~ 20mA current and the digital signal are valid signaling protocols between the controller and measuring instrument or final control element.

The polling address of the instrument is set to "0". Only one instrument can be put on each instrument cable signal pair. One signal, generally specified by the user, is specified to be the 4 ~ 20mA signal. Other signals are sent digitally on top of the 4 ~ 20mA signal. For example, pressure can be sent as 4 ~ 20mA, representing a range of pressures, and temperature can be sent digitally over the same wires. In point-to-point mode, the digital part of the HART® protocol can be seen as a kind of digital current loop interface.

2. Multi-drop

The HART® communication protocol enables the capability to connect several two-wire measurement devices in a (typical) multi drop network configuration, depending on the protocol revision.

All the devices are supplied from one voltage source and with a constant current consumption (usually 4mA). The master represents the sum of all the analog signals belonging to the devices in the network.

The host distinguishes the field devices by their preset polling addresses that must be unique in a range of 1~4. This address can be set by sending a special command to the devices. Standard HART® commands are used to communicate with field instruments to determine process variables or device parameter information. The connection diagrams of HART® slave devices are as below:

Figure 17 2-Wire HART® Device Connection

Figure 18 3-Wire HART® Device Connection
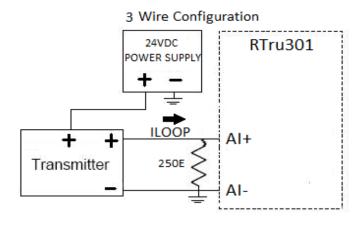
Figure 19 4 Wire HART® Device Connection
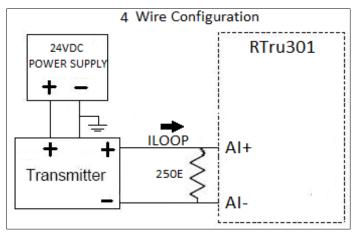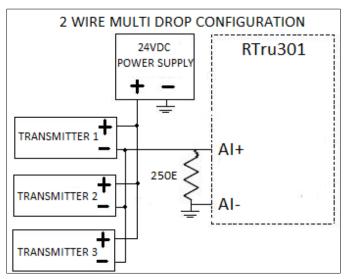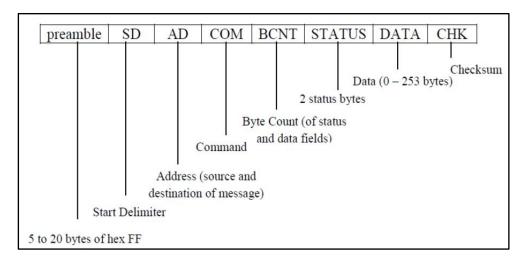
Figure 20 Multi-Drop HART® Device Connection

Packet structure

Each command or reply is a message, varying in length from 10 ~ 12 bytes to typically 20 or 30 bytes. HART® provides two telegram formats, long and short format, which use different forms of addressing. On the other hand, the HART® message structure is equal for long and short format.

The request HART® packet has the following structure:

Figure 14 HART® Packet Structure

Preamble

This element consists of 5 ∼ 20 characters. All bytes in these characters are set to the logic value 1, in such a way that each character represents the hexadecimal number 0xFF.

Start delimiter

The start byte uses for recognizing a message's start. It indicates which participant is sending (master, slave, and slave in burst mode) and whether the short frame or the long frame format is used. In case the message has the long format, the start byte will contain the hexadecimal value 82 when it is sent by a master. On the other hand, the value 81 indicates that it is a "Burst mode" message.

Table 21 Start Delimiter

Code	Meaning
0x01	Burst Mode short access
0x02	Request short access
0x06	Response short access
0x81	Burst mode long access
0x82	Request long access
0x86	Response long access

Address

Specifies the destination address implemented in one of the HART® schemes. Each HART field instrument must have a unique address. A message sent by a master contains the address of the target slave. When a telegram/message is sent on the HART network, the field device that recognizes the address as its own will read this message and send back a response.

Command

This is a one byte numerical value representing which command is to be executed

Number of data bytes

Specifies the number of communication data bytes to follow.

Status

The status field is absent for the master and is two bytes for the slave. This field is used by the slave to inform the master whether it completed the task and the current health status.

Data

Data contained in this field depends on the command to be executed.

Checksum

Checksum is composed of an XOR of all the bytes starting from the start byte and ending with the last byte of the data field, including those bytes.

The **RTru301** IoT Gateway device Read four types of HART® variable: Primary Variable (PV), Secondary Variable (SV), Third Variable (TV), and Fourth Variable (QV), unit of each variable and Loop current.

The **RTru301** device sends a request to HART® slave device based on the Polling ID set. The **RTru301** device sends a HART® request to next slave based on the time(in seconds) set in HART® Query Time parameter. The Query response time is used to set the **RTru301** waiting time for the response from the HART® slave device. The Query attempt is used to set the no. of requests sent to the HART® slave device when no response is received.
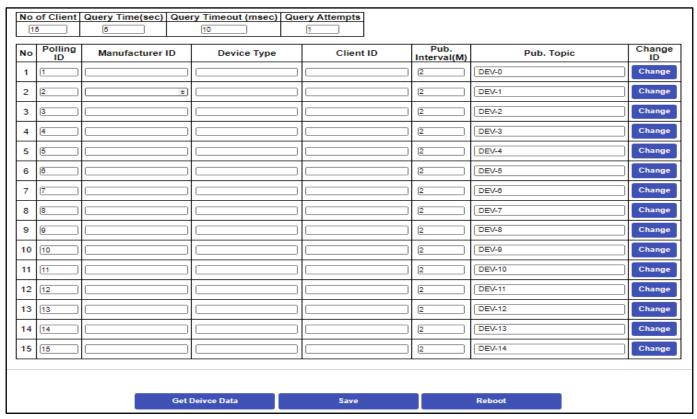
The button 'Get Device Data' is used to show information of connected devices. The **RTru301** Device can change the Polling Address of the HART® slave device.

Follow the steps below to change the polling ID of any HART® slave device:
   1) Write new Polling ID in 'Polling ID' input box that you want to change

2) Pressing the 'Change' button, the **RTru301** device changes the Polling ID of HART® slave device

Figure 15 HART® Web page

The **RTru301** Device send the Payload of HART® Publish Topic to MQTT server based on the defined publishing interval (in minutes)

See the JSON format for the payload of HART® Publish Topic which are sent on MQTT server

{"ts": 1628937275000, "values": {"IMEI": 123456789123456,"ID": "FM-DEV-123","FRAME": 0,
 "H1_ST": 0,"H1_V1": 0,"H1_V2": 0,"H1_V3": 0,"H1_V4": 0,"H1_U1": 0,"H1_U2": 0,"H1_U3": 0,
 "H1_U4": 0,"H1_LC": 0}}

Table 22 JSON Key Description for Payload of HART® Topic

ts	Time stamp of JSON data in epoch time in ms
IMEI	IMEI number of cellular modem in device
ID	Device ID
FRAME	Type of data in frame live data, log data 0=Live,1=Logged
H1_ST	Status of H1=SLAVE ID, 1 = connected, 0 = not connected
H1_V1	Combination of HART® slave id and Primary Variable e.g. "H1_V1 H1 = SLAVE ID 1, V1= Value of Variable 1.
H2_V2	Combination of HART® slave id and Primary Variable e.g. "H1_V1 H1 = SLAVE ID 1, V1= Value of Variable 1.
H3_V3	Combination of HART® slave id and Primary Variable e.g. "H1_V1 H1 = SLAVE ID 1, V1= Value of Variable 1.
H4_V4	Combination of HART® slave id and Primary Variable e.g. "H1_V1 H1 = SLAVE ID 1, V1= Value of Variable 1.
H1_U1	Combination of HART® slave id and unit of Primary Variable e.g. "H1_U1" H1 = SLAVE ID 1, U1= unit of Primary Variable
H2_U2	Combination of HART® slave id and unit of Primary Variable e.g. "H1_U1" H1 = SLAVE ID 1, U1= unit of Primary Variable
H3_U3	Combination of HART® slave id and unit of Primary Variable e.g. "H1_U1"

	H1 = SLAVE ID 1, U1= unit of Primary Variable
H4_U4	Combination of HART® slave id and unit of Primary Variable e.g. "H1_U1" H1 = SLAVE ID 1, U1= unit of Primary Variable
H1_LC	Combination of HART® slave id and Loop current of device e.g. "H1_LC" H1 = SLAVE ID 1

7.4 Analog Input Interface

There are two channels provided for analog input:

- 4 ~ 20mA analog input measurement
- Device Internal Temp measurement (Using Diode)

Enable the **RTru301** device to get the external sensor data using the analog 4 ~ 20mA input and read the device internal temperature. The configuration of Analog input channel 1 and 2 can be described in Section 6.1.5

Scaled Unit by Zero and Span
The **RTru301** Device Read the Row value from the sensor device in mA. The reading of Row data can be scaled by Zero and span value.

Alarms
Use an alarm to send the alert report to server or on user mobile number when unusual changes occur in external connected sensor devices. Alarm event occurs when the value of external sensor reading is above or below the value specified in high or low threshold respectively.

High Threshold
Send alarm event when the reading value of sensor greater than the value specified in High Threshold

Low Threshold
Send alarm event when the reading value of sensor is less than the value specified in Low Threshold

NOTE
An alarm will be generated only once when A/I value cross its High or Low threshold and no additional alarm will be generated if the A/I value remains above or below High/Low threshold. A new alarm will be generated only when the existing alarm is cleared.

Hysteresis
An externally connected sensor value may sometimes fluctuate in the High or Low alarm condition. This causes high or low alarms to be generated by the device and the device sends multiple alarm events to server or user mobile number.

Hysteresis works with the high and low alarm thresholds to tell the device when to keep an alarm on without sending additional alarm events or when to turn off an alarm event. Use this to avoid repeated alarms during reading of sensor input value fluctuations.

For example, an external sensor input value increases to the high threshold and the device sends a high alarm event. However, the sensor input value continues to increase and decrease repeatedly between normal and high thresholds during this alarm condition. If you have not set a hysteresis range, the device sends an alarm event every time the sensor input value reaches the high threshold.

Use an alarm to send the alert report to server or on user mobile number when unusual changes occur in external connected sensor devices. An alarm event occurs when the value of external sensor reading goes above or below the value specified in high or low threshold respectively. See the example below for hysteresis works for the High and low alarm.

High hysteresis

If the high threshold is 15mA and the hysteresis value is 2mA, then the High alarm hysteresis is 13mA. This means that the alarm turns ON when the sensor input value reaches 15mA and remains ON if the sensor input value stays above 13mA. No additional alarm reports are sent during this alarm condition. The alarm turns OFF when the sensor input value falls below 13mA.

Low hysteresis

If the Low threshold is 5mA and the hysteresis value is 2mA, then the Low alarm hysteresis is 7mA. This means that the alarm turns on when the sensor input value reaches 5mA and remains ON if the sensor input value stays below 5mA. No additional alarm reports are sent during this alarm condition. The alarm turns OFF when the sensor input value is above 7mA.

The analog input parameter configuration described in . See the below step to configure analog input channel measurement.

- Set the parameter for analog measurement. The analog input channel 1 and 2 can be calibrated by   the Calibration web page. For the calibration of analog input channel 1 and 2 refer to .
- Apply the configuration changes by pressing 'Save' and 'reboot' button. By pressing 'reboot' button the **RTru301** device is reset.
- The value of analog input channel 1 and 2 can be monitored on publishing periodic data based on a defined publishing interval to MQTT server when the send A/I data option is enabled in the communication web page.
- The **RTru301** device will send the alarm event on SMS to SMS alarm group number or the MQTT server based on the option selected.
- SMS format of the device sends to the user mobile number when High or Low alarm event occurs.

Figure 16 Analog Input Web page

Table 23 SMS Format - Analog Input

Device ID SMS Description AI-CH-<Channel No><:AI channel value> <DD/MM/YYYY,HH:MM:SS>	FM-DEV-001 AI-CH-1 AI-CH-1:19800 18/11/2021,12:30:45

See the JSON format for the payload of Periodic data Topic which are sent on MQTT server when the all input and output (A/I, D/I, A/O and D/O) option are enabled

{"ts": 1628937275000,"values":{"IMEI": 123456789123456,"ID": "FM-DEV-123","FRAME": 0,
 "AI1": 14000,"AI2": 29,"DI1": 0,"DI2": 0,"AO1": 5000,"DO1": 0,"DO2": 0}}

See the JSON format for the payload of Periodic data Topic which are sent on MQTT server when the only A/I option is enabled

{"ts": 1628937275000,"values":{"IMEI": 123456789123456,"ID": "FM-DEV-123","FRAME": 0,
 "AI1": 14000,"AI2": 29}}

Table 24 JSON Key Description for Payload of Periodic Data Topics for Analog Input

ts	Time stamp of JSON data in epoch time in ms
IMEI	IMEI number of cellular modem in device
ID	Device Id
FRAME	Type of data in frame live data, log data 0=Live,1=Logged

AI1	Value of A/I 1
AI2	Value of A/I 2
DI1	Value of D/I 1
DI2	Value of D/I 2
AO1	Value of A/O 1
DO1	Value of D/O 1
DO2	Value of D/O 2

See the JSON format for the payload of Alert topic which are sent on MQTT server

{"ts": 1637218845000,"values":{"IMEI": 123456789123456,"ID": "FM-DEV-123","FRAME": 0,
 "ALERT": 0,"AI1": 1980}}

Table 25 JSON Key Description for Payload of Alert Topics for Analog Input

ts	Time stamp of JSON data in epoch time in ms
IMEI	IMEI number of cellular modem in device
ID	Device Id
FRAME	Type of data in frame live data, log data 0=Live,1=Logged
ALERT	Type of Alert (0: AI-1 ALERT,1 : AI-2 ALERT, 2 : DI-1 ALERT, 3 : DI-2 ALERT)
AI1 or AI2	Value of AI1 or value of AI2

Refer the value of analog input channel 1 in different conditions:
1) Measured current > 3.6mA && Measure current < 3.8mA
   Considered as Under Measurement, value of Analog input channel 1 = 32765
2) Measured current > 20.5mA && Measured current < 21.0mA
   Considered as Over Measurement, value of Analog input channel 1 = 32766
3) Measured current <= 3.6mA && Measured current >=21.0mA
   Considered as Open Measurement, value of Analog input channel 1 = 32767
4) Measured current >= 3.8mA and   Measured   current <= 20.5mA
    Valid analog input range
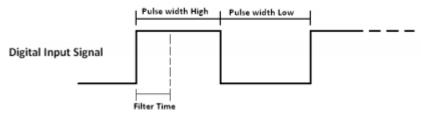
7.5 Digital Input Interface

The **RTru301** device has two isolated digital input channels. These digital Input channels can be configured as digital input (ON/OFF) or Pulse Counter.

Filter Time

The Filter Time is the length of time that a newly changed input to some channel should last for before it is accepted as a valid input. It is used to eliminate input noise. The minimum and maximum values for Filter time are 10ms and 10000ms respectively. This parameter is applicable in the ON/OFF mode **only**.

Figure 17 Digital Input Filter Time

The Digital input parameter configuration described in **Section 6.1.5**. To configure the digital input channel follow the steps below:

- Set the Parameter of Digital Input channel in the web page. Such as Filter Time, SMS alarm, Server Alarm, SMS alarm Group, SMS description. The count from the Last and Step alarm count used in counter mode of Digital Input.

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- Apply the configuration changes by pressing 'Save' and 'reboot' button. By pressing 'reboot' button the device is reset.
- If the Digital Input selected as ON/OFF mode then it senses High and low logic levels. A true event from High to Low or Low to high will be considered based on Filter Time in ms.
-If the Digital Input selected as counter mode, the counter will start to count from the last stored value of counter if the 'count form last' is enabled, otherwise the count will start from the Zero
-The SMS and Server alarm will be generated based on the Step alarm count and counter Roll over. The roll over value of the counter is 4294967294.
- The value of Digital input channel 1 and 2 can be monitored on publishing periodic data based on a defined publishing interval to MQTT server when the send D/I data option is enabled in the communication web page.
- The device will send the alarm event on SMS to SMS alarm group Number or the MQTT server based on the option selected.
- SMS format of the device sends to the user mobile no when a digital input alarm event occurs.

Figure 18 Digital Input Web page

Table 26 SMS Format - Digital Input

Device ID	FM-DEV-001
SMS Description	DI-CH-2
DI-CH-<Channel No>:1-High,0-Low	DI-CH-2:1
<DD/MM/YYYY,HH:MM:SS>	18/11/2021,12:30:45

See the JSON format for the payload of Periodic data Topic which are sent on MQTT server when the all input and output (A/I, D/I, A/O and D/O) option are selected

{"ts": 1637218845000,"values":{"IMEI": 123456789123456,"ID": "FM-DEV-123","FRAME": 0, "AI1": 32767,"AI2": 29,"DI1": 0,"DI2": 0,"AO1": 5000,"DO1": 0,"DO2": 0}}

See the JSON format for the payload of Periodic data Topic which are sent on MQTT server when the only D/I option is selected

{"ts": 1637218845000,"values":{"IMEI": 123456789123456,"ID": "FM-DEV-123","FRAME": 0, "DI1": 0,"DI2": 0}}

Table 27 JSON Key Description for Payload of Periodic Data Topics for Digital Input

ts	Time stamp of JSON data in epoch time in ms
IMEI	IMEI number of cellular modem in device
ID	Device Id
FRAME	Type of data in frame live data, log data 0=Live,1=Logged
AI1	Value of A/I 1
AI2	Value of A/I 2
DI1	Value of D/I 1
DI2	Value of D/I 2
AO1	Value of A/O 1
DO1	Value of D/O 1
DO2	Value of D/O 2

See the JSON format for the payload of Alert topic which are sent on MQTT server

{"ts": 1637218845000,"values":{"IMEI": 860936050053176,"ID": "FM-DEV-123","FRAME": 0, "ALERT": 2,"DI1": 1}}

Table 28 JSON Key Description for Payload of Alert Topics for Digital Input
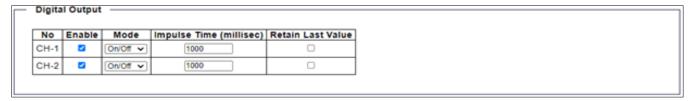
ts	Time stamp of JSON data epoch time in ms
IMEI	IMEI number of cellular modem in device
ID	Device Id
FRAME	Type of data in frame live data, log data 0=Live,1=Logged
ALERT	Type of Alert (0: AI-1 ALERT,1 : AI-2 ALERT, 2 : DI-1 ALERT, 3 : DI-2 ALERT)
DI1 or DI2	Value of DI1 or Value of DI2

7.6 Digital Output Interface

The **RTru301** device has two isolated sink type digital output channels. The digital output channels can be configured as digital output (ON/OFF) or Impulse Mode. The **RTru301** device can retain the status of digital output channel during Power ON/OFF. In Impulse mode the output is in sink mode for the defined impulse time (ms).

The Digital output parameter configuration is described in **Section 6.1.5**. The Digital Output status can be changed by sending SMS to device or command to subscription topic of device from the MQTT server. The Digital Output can be monitored on a periodic frame of MQTT server. The **RTru301** device will send the Digital output value periodically based on the defined publishing interval of MQTT when the send D/O data option is enabled in the communication web page. Apply the configuration changes by pressing 'Save' and 'reboot' Button. By pressing 'reboot' button the **RTru301** device is reset.

Figure 19 Digital Output Web page

See the SMS format for changing the status of any digital output channel of **RTru301** device

Table 29 SMS Format - Digital Output SET/RESET

SET	&DO<Channel No> #<SET/RESET>	&DO1 #SET
RESET	&DO<Channel No> #<SET/RESET>	&DO2 #RESET

See the SMS format for generate the impulse on any digital output channel of **RTru301** device

Table 30 SMS Format - Digital Output Impulse

Impulse generated	&DO<Channel No> #IMPULSE	&DO1 #IMPLUSE

See the Format of Topic published by MQTT server (Subscription Topic of Device) for changing the status (ON/OFF) of any digital output channel

Table 31 Format of Topic Published by MQTT Server- Digital Output SET/RESET

SET	{"IMEI":<IMEI No>, "<DO1/DO2>":"<SET/RESET>"}	{"IMEI":123456789123456, "DO1":"SET"}

| RESET | {"IMEI":<IMEI No>,
"<DO1/DO2>":"<SET/RESET>"} | {"IMEI":123456789123456,
 "DO1":"RESET"} |

See the Format of Topic published by MQTT server (Subscription Topic of Device) for generating impulse of any digital output channel

Table 32 Format of Topic Published by MQTT Server - Digital Output Impulse

| SET | {"IMEI":<IMEI No>,"<DO1/DO2>":"<IMPULSE>"} | {"IMEI":123456789123456,
 "DO1":"IMPULSE"} |

Note: The User receives the Invalid command response in SMS when they send the ON/OFF SMS command to the **RTru301** device and the **RTru301** device is configured on Impulse mode through the webpage or vice versa

See the JSON format for the payload of Periodic data Topic which are sent on MQTT server when the all input and output (A/I, D/I, A/O and D/O) option are enabled

{"ts": 1628937275000,"values":{"IMEI": 123456789123456,"ID": "FM-DEV-123","FRAME": 0,
 "AI1": 19800,"AI2": 29,"DI1": 0,"DI2": 0,"AO1": 5000,"DO1": 0,"DO2": 0}}

See the JSON format for the payload of Periodic data Topic which are sent on MQTT server when the only D/O option is enabled

{"ts": 1628937275000,"values":{"IMEI": 123456789123456,"ID": "FM-DEV-123","FRAME": 0,
 "DO1": 0,"DO2": 0}}

Table 33 JSON Key Description for Payload of Periodic Data Topics for Digital Output

ts	Time stamp of JSON data in epoch time in ms
IMEI	IMEI number of cellular modem in device
ID	Device Id
FRAME	Type of data in frame live data, log data 0=Live,1=Logged
AI1	Value of A/I 1
AI2	Value of A/I 2
DI1	Value of D/I 1
DI2	Value of D/I 2
AO1	Value of A/O 1
DO1	Value of D/O 1
DO2	Value of D/O 2

7.7 Analog Output Interface

The **RTru301** device has one analog output channel (4 ~ 20mA). The device can generate the analog output current based on last retained value during Power ON/OFF.

The Analog output parameter configuration described in **Section 6.1.5**. An analog output current can be generated by sending an SMS to **RTru301** device or via a command to subscription topic of device from the MQTT server. The **RTru301** device will send invalid command response over SMS when it receives an SMS command with analog value other than 3600 and 21000 or in between them. The analog Output can be monitored on a periodic frame of the MQTT server. The **RTru301** device will send the analog output value periodically based on the defined publishing interval of MQTT when the send A/O data option is enabled in the communication web page. Apply the configuration changes by pressing 'Save' and 'reboot' button. By pressing 'reboot' button the device is reset.

Figure 20 Analog Output Web page

See the SMS format for analog output generation

Table 34 SMS Format - Analog Output

18mA analog output generation	&AO #<Analog output value>	&AO1 #5000

See the MQTT Frame format for analog output generation

Table 35 Format of Topic Published by MQTT Server - Analog Output

18mA analog output generation	{"IMEI":<IMEINO>, "AO1":<value>}	{"IMEI":123456789123456, "AO1":5000}

See the JSON format for the payload of Periodic data Topic which are sent on MQTT server when the all input and output (A/I, D/I, A/O and D/O) option are enabled

{"ts": 1628937275000,"values":{"IMEI": 123456789123456,"ID": "FM-DEV-123","FRAME": 0, "AI1": 19800,"AI2": 29,"DI1": 0,"DI2": 0,"AO1": 5000,"DO1": 0,"DO2": 0}}

See the JSON format for the payload of Periodic data Topic which are sent on MQTT server when the only D/O option is enabled

{"ts": 1628937275000,"values":{"IMEI": 123456789123456,"ID": "FM-DEV-123","FRAME": 0, "DO1": 0,"DO2": 0}}

Table 36 JSON Key Description for Payload of Periodic Data Topics for Analog Output

ts	Time stamp of JSON data in epoch time in ms
IMEI	IMEI number of cellular modem in device
ID	Device Id
FRAME	Type of data in frame live data, log data 0=Live,1=Logged
AI1	Value of A/I 1
AI2	Value of A/I 2
DI1	Value of D/I 1
DI2	Value of D/I 2
AO1	Value of A/O 1
DO1	Value of D/O 1
DO2	Value of D/O 2

8. CALIBRATION

8.1 Analog Input Channel 1 (4 ~ 20mA)

- Connect the 4 ~ 20mA analog input source to analog input terminal of device.
- Apply 4mA analog input to the Analog input terminal of Device. The measured input value will be displayed on 'PV' input box on the calibration web page. Click on the 'calibrate 4mA' button. Refer the Figure 21
- Apply 20mA analog input to the Analog input terminal of Device. The measured input value will be displayed on 'PV' input box on the calibration web page. Click on the 'calibrate 20mA' button. Refer Figure 21
- Now the calibration of analog input channel 1 can be done.

8.2 Analog Input Channel 2 (Temperature)

- The internal temperature value can be displayed on 'PV' input box in the calibration web page.
- Enter the actual temperature in the 'Apply' input box and press the 'Calibrate Amb.Temp' button. Refer Figure 21
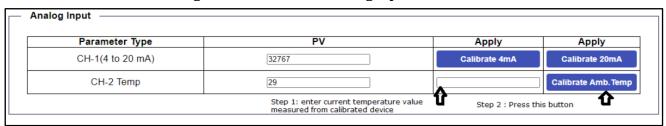- Now the calibration of analog input channel 2 can be done.

Figure 21 Calibration - Analog Input

8.3 Analog Output Calibration

- Connect the current measurement device with the A/O terminal of the device
- Tick on the select box of O/P CAL Zero and then enter the measured value in O/P CAL Value which is measured by the current measurement device. Subsequently, press the 'Write Cal. Zero' button.
- Tick on the select box of O/P CAL Span and then enter the measured value in O/P CAL Value which is measured by the current measurement device. Subsequently, press the 'Write Cal. Span' button.
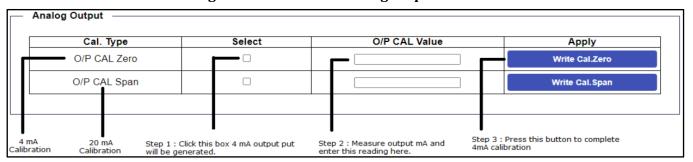- Now the calibration of the analog output channel can be done.

Figure 22 Calibration - Analog Output

9. REPLACEMENT OF BATTERY

9.1 Replacement of Battery from Battery Holder

- If the Epoch Timestamp value is received on MQTT server in the nearest range of 1420108200000 in consecutive payload of periodic data topic, then check the Data and Time of **RTru301** device on device info page of webserver.

- Do a power ON/OFF cycle at least 3 times and check the Time and Date of **RTru301** device at every Power ON/OFF cycle . If it shows the GMT time 'Thu, 01 Jan 2015 10:30:00', then check the RTC battery voltage.

- Switch off the external power supply connected to the **RTru301** device.

- -If the **RTru301** device is mounted on Din rail then remove from the Din rail. Refer the procedure for un-installing the module from a DIN rail.

- Open the **RTru301** Device and remove the battery with plastic tweezer. Refer STEP 1 in the figure below.

- Measure the Battery voltage.

Battery voltage:

Good battery: >= 3VDC
Low battery: < 2.8VDC (Replace battery)

 - If the battery voltage is low, replace the battery. Always use a battery that is compatible with the existing used part no (CR2032)

Figure 23 Battery Replacement instructions

Removing the battery from the holder	Inserting a new battery
STEP 1: Pull and Remove Battery from the holder as per direction shown below	**STEP 2:** Check +/- polarity before and then Insert new battery in holder as per direction shown below

10. TROUBLESHOOTING TIPS

Power supply healthy red LED does not glow
- Check power source and connection
- Check red LED mounting and assembly

Server (192.168.100.110) is not detected
- Check that the Ethernet cable connecter is properly fitted and Link and Activity LEDs glow
- Check RUN/ERR LED must indicate healthy status

11. REVISION HISTORY

Initial release: **V1.0 09022022**

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