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Integrated Systems Engineering & Products

PROTOCOL CONVERTER

MODBUS RTU TO NOTIFIER 2020 FACP

Technical Manual

DOCUMENTED BY  
ISEP

Updated: 19 Nov 2001

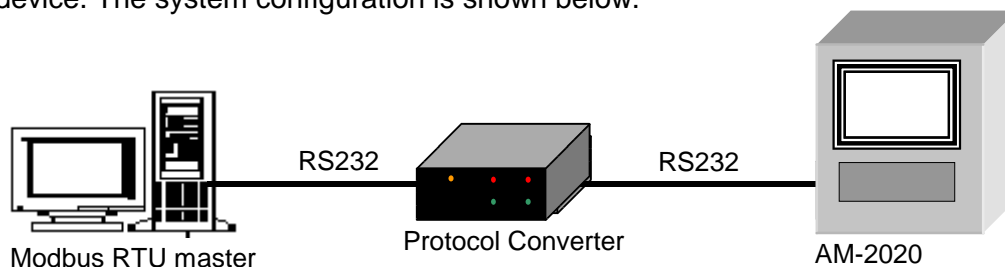
# Table of Content

<b>1</b>	<b>INTRODUCTION .....</b>	<b>2</b>
<b>2</b>	<b>CONVERTER DESCRIPTION AND CONFIGURATION .....</b>	<b>2</b>
<b>3</b>	<b>OVERVIEW OF COMMUNICATION PROCESS .....</b>	<b>4</b>
<b>4</b>	<b>DESCRIPTION OF AM-2020 FACP PROTOCOL .....</b>	<b>5</b>
<b>5</b>	<b>MESSAGE FORMATS AND DESCRIPTIONS .....</b>	<b>6</b>
<b>6</b>	<b>DESCRIPTION OF MODBUS RTU .....</b>	<b>8</b>
<b>7</b>	<b>STATE MACHINE DIAGRAM .....</b>	<b>9</b>
<b>8</b>	<b>FLOW CHART OF THE PROTOCOL CONVERTER .....</b>	<b>9</b>
<b>9</b>	<b>MODBUS INPUT STATUS BUFFER FOR THE MODBUS RTU MASTER .....</b>	<b>10</b>
<b>9.1</b>	<b>Common Bit positions in the Modbus Input Status buffer .....</b>	<b>10</b>

## 1 Introduction

The MODBUS RTU to AM-2020 FACP (NOTIFIER) Protocol Converter by ISEP facilitates data communications between a MODBUS RTU master and an AM-2020 FACP device. Upon receipt of an AM-2020 FACP message, the converter decodes it and stores the values into the internal data buffers. It waits for MODBUS RTU queries and return a response encoded with values in data buffers.

In the monitoring system, an AM-2020 FACP device is monitored. A PC is used as the MODBUS RTU master. The AM-2020 FACP device is the slave device. One RS232 port of the converter is connected to MODBUS RTU master and the converter responds to MODBUS RTU queries as a slave. The other RS232 port is connected to AM-2020 FACP device. The system configuration is shown below.



## 2 Converter Description and Configuration

The converter is designed to sit on a 35 mm DIN Rail. There are two serial ports on the converter .

**Port 1 : Configuration port & Modbus port .**

( Note :- Once the converter is configured the same port can be used for connecting the Modbus device.)

**Port 2: Notifier port.**

On power up, Converter enters into Configuration mode and requests for the set up configuration of the Modbus port through the port1. These requests can be viewed through the Hyper-terminal of the PC connected to port 1 of the Converter. Hyper-terminal should be connected at 19200 baud, 8 databit ,1 stop bit and parity None. HyperTerminal displays the existing configuration

**Baud-rate = 9600 baud**

**data-bit = 8**

**parity = None**

**Time-out = 001 minutes.**

**Do you wish to continue configuration ?**

Press “Y” or “y” and wait for few seconds until the Converter enters into configuration mode. DO not enter “Enter Key” after pressing “Y” or ”y” on the keyboard.

If the user doesn't wish to change any configuration simply enter "any key" other than "Y" or "y" to exit out of configuration mode.

Once in the configuration mode, Converter requests for the following values :

User can enter the corresponding new values followed by "Enter Key" or simply enter the "Enter Key " to use the existing values

Enter the baud rate.

Please use 6 digits to enter baud rate followed by "Enter Key".

( e.g :- "019200" followed by "Enter Key")

Enter the Databit.

Please enter "8" or "7" followed by "Enter Key".

Enter the Parity.

Please use 1 Capital letter to enter Parity.

(e.g :- "E" for Even, "O" for Odd & "N" for None followed by "Enter Key".)

Enter the Timeout in minutes.

Please use 3 digits to enter baud rate followed by "Enter Key".(e.g :- "002" for 2 minutes followed by "Enter Key".)

Time out is the time in minutes the converter monitors to inform the user whether the communication between the Notifier and the converter is healthy or not. i.e if there are no messages from the notifier, after 2 min the timeout bit will go high (1) . Once the converter receives any message from Notifier the timeout bit will go low(0).

Once the user finishes the configuration, the Converter will prompt again to correct any of the values

Do you wish to continue the configuration ?

Enter "any key" other than "Y" or "y" to exit out of configuration mode.

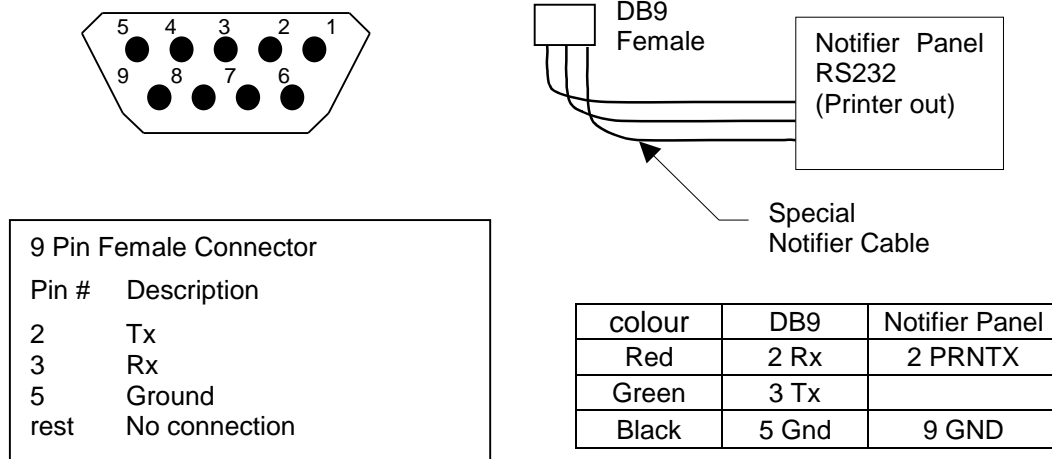
Converter then displays the last entered values.

Converter will take the last entered values for setting up the Modbus port. Now disconnect the Hyper-terminal of the PC and connect the Modbus device to Port 1. Converter establishes a connection with Modbus device and enters into communication mode.

Notifier port(Port 2) is pre-configured for 2400 baud, 7 databit, Even parity and 1 stop bit. Notifier port configuration cannot be changed by the user.

During the communication mode, for any reason if the user wants to change any configuration of the Modbus port, A power off and Power up of the Converter is required. The Converter will start the communication process automatically. During normal operation, If there is a power failure and recovery, the Converter will automatically start-up and will use the last set communication parameters to establish communication automatically.

The pin description for the 9 pin D connector is shown below. The configuration of AM-2020 FACP port and MODBUS port are the same.



### 3 Overview of Communication Process

This section provides an overview of the communication processes that takes place within the AM-2020 FACP device, the MODBUS RTU master and the protocol converter.

The AM-2020 FACP device continuously sends 80 character output message to the converter. The terminator for an 80 character output message is a carriage return followed by a line feed. Upon receipt of a valid AM-2020 FACP message, the converter decodes it and stores the values into the internal data buffers.

Please refer the table for the Modbus Input Status buffer for bit positions.

If there is an Alarm for the Detector or Module, the converter will make the Alarm bit(10000 – 11023),(12048 – 13071) and the corresponding Unacknowledged Alarm bit(11024 – 12047) ,(13071 – 14095)high(1). Once the alarm is acknowledged the Unacknowledged bit goes low(0), but the Alarm bit remains high. Alarm bit goes low only when the Notifier sends a clear alarm message. Same applies for Detector or Module Trouble .

If there is a Supervisory Trouble it will make the supervisory bit(18204) high(1) . When there is a Clear Trouble for supervisory signal the supervisory bit goes low(0).

The converter accepts only the messages corresponding to the Modbus Input Status buffer(refer the table ).All other irrelevant messages are ignored. Status bit (18205) goes high(1) if there are any ignored messages.

All Systems normal bit(18206) is high(1) when the Notifier sends All Systems Normal message. The moment the converter receives any Alarm or Trouble message from the Notifier, the bit goes low.

On System Reset, the system reset bit(18207) goes high(1) momentarily and then goes low.

Time out is the time in minutes the converter monitors to inform the user whether the communication between the Notifier and the converter is healthy or not. i.e if there are no messages from the notifier, after the configured time is elapsed the timeout bit(18208) goes high (1). Once the converter receives any message from Notifier the timeout bit goes low(0).

On the Notifier panel when there is an Alarm or trouble it generates audible alarm, which can be silenced using the silencer key on the panel. When the signal is silenced the signal silence bit(18209) goes high momentarily and goes low after some time.

On the MODBUS RTU side, the valid request is **Read Input Table**. The converter will ignore any queries other than those stated above. The converter will monitor the MODBUS RTU port continuously for queries. It will only respond to messages with the function codes 2 that correspond to the request mentioned above. Upon receipt of a valid request, the converter will generate a response with values stored in buffer and transmits it to the MODBUS RTU master.

For MODBUS port of the converter, the converter will do the error check first after a query is received. The CRC are used for error check. If a query with error is received from the MODBUS RTU master, this query will be ignored and the converter will wait for next query.

If the timeout bit in the converter is one, that means the converter has lost communication with AM-2020 FACP device and the converter is trying to establish a connection with AM-2020 FACP device.

If the converter can't respond to the MODBUS RTU query, power off the converter and power up again. The converter will start the communication process described above automatically.

## 4 Description of AM-2020 FACP Protocol

The AM-2020 FACP protocol is as follows:

- serial communications
- 2400 BAUD
- full duplex
- 1 start bit
- 7 data bits
- 1 parity bit
- even parity
- 1 stop bit

The general output characters are as follows:

<u>Characters</u>	<u>Hexadecimal codes</u>
A - Z	41 – 5A
0 – 9	30 – 39
Space	20
“	22
#	23
(	28
)	29
*	2A
+	2B
‘	2C
-	2D
.	2E
/	2F
:	3A
=	3D
?	3F
Carriage Return	0D
Line Feed	0A
ESCape	1B
X	78
NULL	00

## 5 Message Formats and Descriptions

This section describes some examples of different types of 80 character message strings produced by the AM-2020 FACP. These are shown using 2 line by 40 character format displayed on the DIA-1 LCD.

In the following messages, “-“ indicates a space, and “HH:MMA MM/DD/YY “ represents the time (hours, minutes, Am/Pm indicator) and date(month,day, year).

### 6.1 All Systems Normal Message

```
1234567890123456789012345678901234567890
Line 1:  <<<<<<<<<<<<CUSTOM USER LABEL>>>>>>>>>>>>
Line 2:  _ ALL _SYSTEMS NORMAL _HH:MMA_MM/DD/YY
```

1. "CUSTOM USER LABEL " is the 40 character custom label defined by the user.
2. "ALL SYSTEMS NORMAL " is a fixed field.

### 6.2 Alarm Message

```
1234567890123456789012345678901234567890
Line 1:  STATUS_<<DEV TYPE>> <<<DEVICE LABEL>>>
Line 2:  <<< ZONE LABEL>>> _HH:MMA_MM/DD/YY_LDD
```

1. "STATUS " can be one of the following : ALARM:,ACK AL,CLR AL,or ACL AL.
2. "DEV TYPE" can be either a detector or a monitor module.
3. "DEVICE LABEL" & "ZONE LABEL" is the custom label assigned to the device.
4. "LDD" is the loop number (1-9,0=10), and the detector or device number(1-99).

### 6.3 Trouble Message

```
1234567890123456789012345678901234567890
Line 1:  STATUS_<<DEV TYPE>> <<<DEVICE LABEL>>>
Line 2:  <<< ZONE LABEL>>> _HH:MMA_MM/DD/YY_LDD
```

1. "STATUS " can be one of the following : TROUBL,ACK TB,CLR TB,or ACL TB.
2. "DEV TYPE" can be either a detector or a monitor module.
3. "DEVICE LABEL" & "ZONE LABEL" is the custom label assigned to the device.
5. "LDD" is the loop number (1-9,0=10), and the detector or device number(1-99).

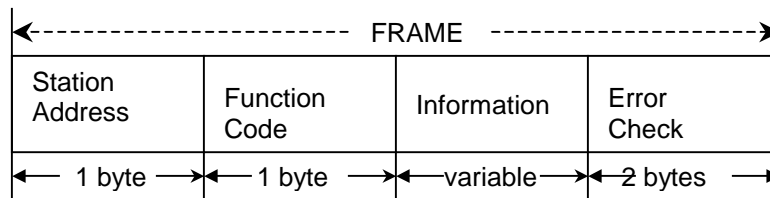
### 6.4 System Reset Message

```
1234567890123456789012345678901234567890
Line 1:  _SYSTEM RESET_____ACTIVATED_____
Line 2 :  _____HH:MMA_MM/DD/YY
```

## 6 Description of MODBUS RTU

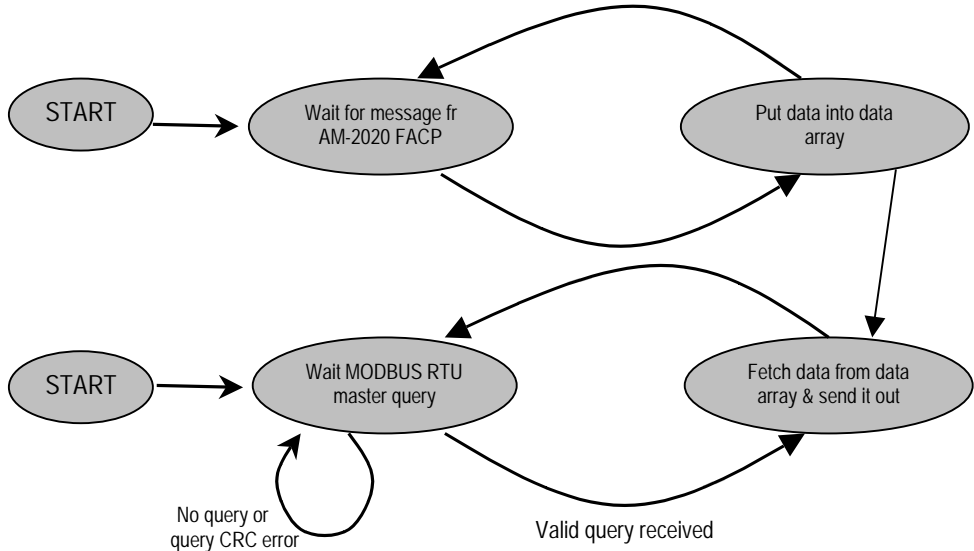
RTU protocol is a query – response protocol for communication between an RTU device and a host computer capable of communicating using protocol. The host computer is the master device and it transmits a query to a RTU slave, in this case the protocol converter, which responds to the master. The protocol converter as the RTU slave is not allowed to query but only respond to the master.

The RTU data transferred consists of 8-bit binary characters with an optional parity bit. No control characters are added to the data block; however, an error check (Cyclic Redundancy Check) included as the final field of each query and response to ensure accurate transmission of data. The message fields for a typical message are shown below:

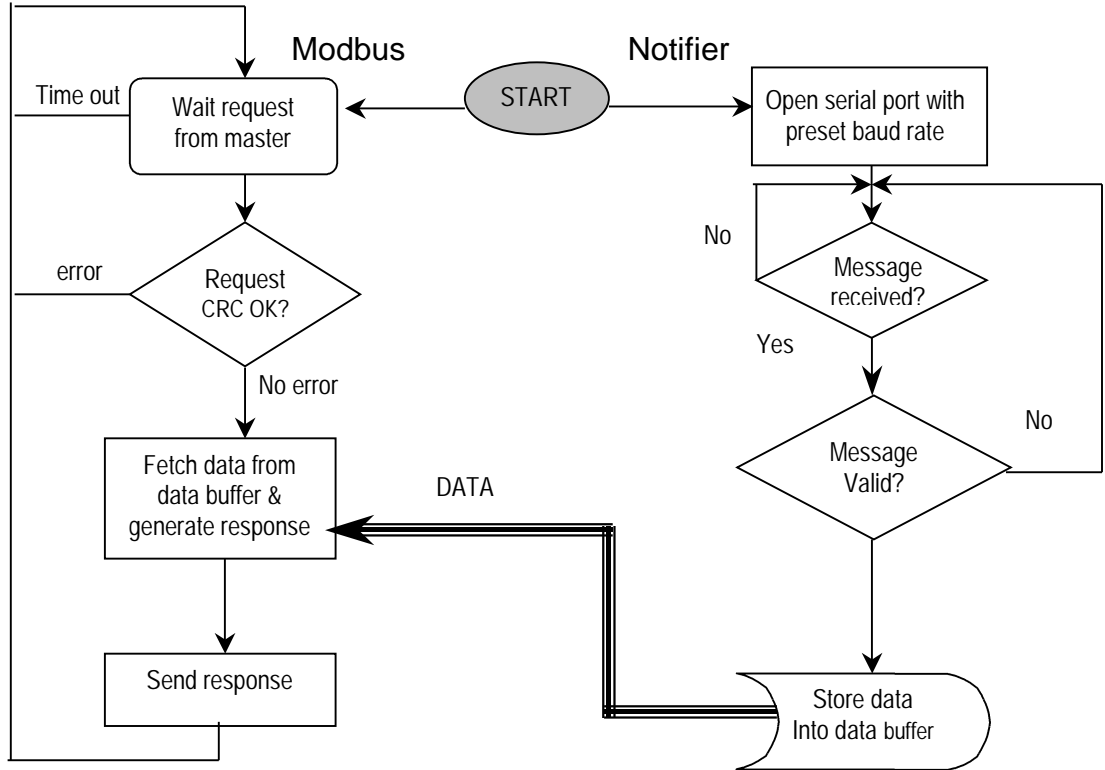


Only function code 2 is implemented in this protocol converter.

7 State machine Diagram



8 Flow Chart of the Protocol Converter



## 9 Modbus Input status buffer for the MODBUS RTU master

Status Bit positions in Modbus Input Status buffer.	
Data Array Location	Parameters
10000 - 11023	Detector Alarms
11024 - 12047	Detector Alarms Unacknowledged
12048 - 13071	Module Alarms
13072 - 14095	Module Alarms Unacknowledged
14096 - 15119	Detector Trouble
15120 - 16143	Detector Trouble Unacknowledged
16144 - 17167	Module Trouble
17168 - 18191	Module Trouble Unacknowledged
18192 - 18208	Common Bits

### Formula to calculate Status Bit position is:

Where: Loop = 1 – 10 “(if loop = 10, loop = 0)”	
Detector = 1 – 99	
Detector Alarm location	= 10000 + (Loop) x 100 + Detector.
Detector Alarm Unack location	= 11024 + (Loop) x 100 + Detector
Modular Alarm location	= 12048 + (Loop) x 100 + Module.
Modular Alarm Unack location	= 13071+ (Loop) x 100 + Module.
Detector Trouble location	= 14096 + (Loop) x 100 + Detector.
Detector Trouble Unack location	= 15120 + (Loop) x 100 + Detector.
Module Trouble location	= 16144 + (Loop) x 100 + Module.
Module Trouble Unack location	= 17168 + (Loop) x 100 + Module.

### 9.1 Common Bit positions in the Modbus Input Status buffer

Status Bit	Parameters
18192	Detector Alarms
18193	Detector Alarms Unacknowledged
18194	Module Alarms

18195	Module Alarms Unacknowledged
18196	Detector Trouble
18197	Detector Trouble Unacknowledged
18198	Module Trouble
18199	Module Trouble Unacknowledged
18200	Alarms
18201	Alarms Unacknowledged
18202	Trouble
18203	Trouble Unacknowledged
18204	Supervise Sent
18205	Ignored Message
18206	All Systems Normal
18207	System Reset
18208	Time out (No Communication)
18209	Signal Silence