GPE communication protocol

Tank Side Monitor NRF590

Inventory Control

Endress+Hauser

People for Process Automation
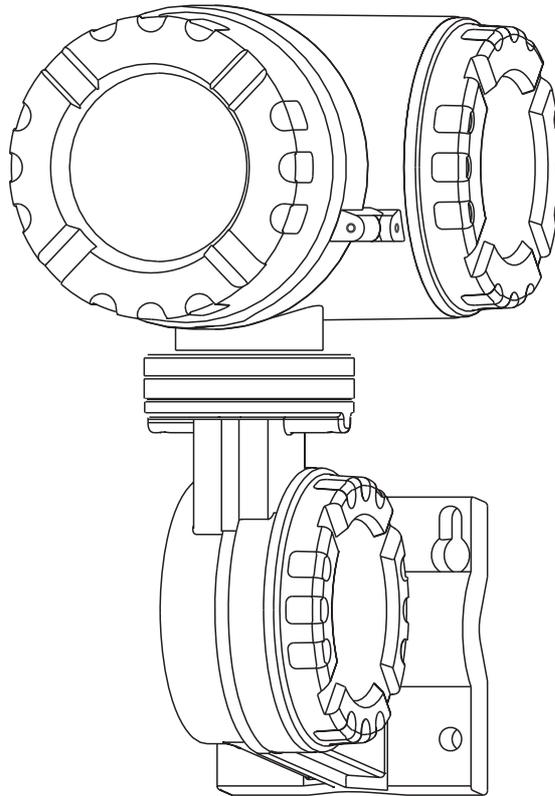
Table of contents

1 Introduction

This protocol guide explains the operation of the GPE protocol implemented in the Endress+Hauser Tank Side Monitor NRF590.

2 Implementation

The implementation of the GPE protocol for the Tank Side Monitor provides a standard form of digital communication via a current loop. An effort has been made to parallel current implementations to the greatest extent possible, so that the Tank Side Monitor communicates with existing GPE masters.

Check compatibility carefully to ensure that the Tank Side Monitor is properly configured for the data format expected by the host system or computer. Exceptions made because of the unique requirements of the Tank Side Monitor application have been noted.

Note!
This is no guarantee, however, that the interpretation made here will be the same as that followed by the GPE master.

The GPE protocol supports three modes of communication and within each mode four commands
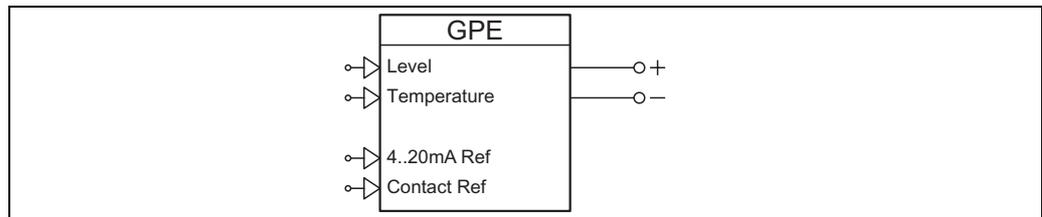
I00-nrf590-19-00-00-en-074

2.1 GPE Modes (Device Types)

Device Type (23111)	Description
Short Reply	New GPE Protocol, used by devices which incorporporate a microcontroller
Long Reply	Old GPE Protocol, used by older hardware controlled systems
1mm Reply	Expanded protocol for higher measurement resolution

2.2 GPE Functions

Function	Description
LT	Used to obtain Level and Temperature
LTA	Used to obtain Level, Temperature and 4 ... 20mA VAlue
LTC	Used to close a discrete contact and obtain Level and Temperature
LTO	Used to open a discrete contact and obtain Level and Temperature

3 Installation recommendations

Please ensure to follow the following recommendations for field installation of the NRF590 with GPE protocol variant.

- Connect the gauges using a serial topology as shown in the figure below.
- The maximum advised cable length is 10 km.

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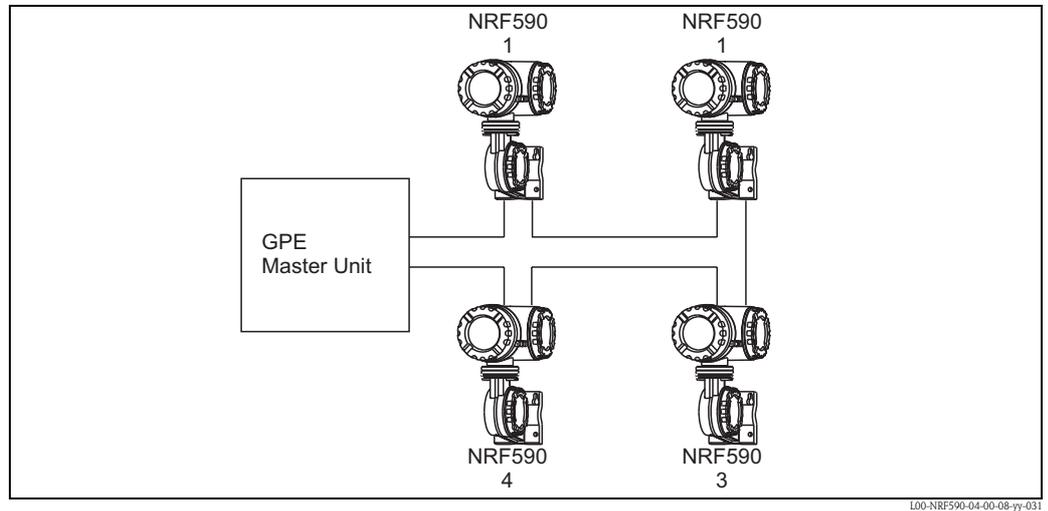
Serial connection topology for the GPE protocol

4 Configuration

The GPE port on the Tank Side Monitor must be configured to establish communications. The local Tank Side Monitor display or ToF Tool allow the user to set up the GPE parameters needed for a correct communication with a GPE master unit.

4.1 Address

Tank Side Monitor addresses provide unique identification for the host. The Tank Side Monitor address is configurable through the local display or ToF tool. This address may range from 0 to 99 and must be unique for each GPE device on a loop. A Tank Side Monitor unit will ONLY answer to a request that contains the same Address or Communication ID that the unit is set to.

4.2 Configuration settings

In order for successful communication on a GPE loop a number of configuration settings must be made to match the configuration of the loop.

4.2.1 Summary of Configuration Parameters

A summary of the configuration information required by the Tank Side Monitor is shown in the following table.

Configuration parameter	Valid Entries	Default
ID	0 ... 99	1
Baudrate	250 ... 350 baud	300
Type	■ Short Reply ■ Long Reply ■ 1mm Reply	Short Reply
Loop Mode	■ Not Checked ■ Checked	Not Checked
Loop Number	0 ... 4	0
Long Reply Type	■ Type 1 ■ Type 2 ■ Type 3	Type 1
4-20mA Ref	List of TSM parameters	IS AI Input Value
Contact Ref	DIO#x or Alarms	IS DI#1 Input Value
Conv Fact Adj	0.5 ... 1.5	1.0

4.2.2 Description of Configuration Parameters

Submenu "Basic Setup" [(921X)]

Id [(9211)]

This is the identifier value. The Tank Side Monitor will respond to requests which contain this identifier value. (Default: 1) (Protected by W&M Switch)

Baud Rate [(9212)]

Selects which of the possible baud rates communication should work at. (Default: 300) (Protected by W&M Switch)

Type [(9213)]

Parity Type: Indicates the type of reply which will be sent by the NRF590. (Default: 1mm Reply) (Protected by W&M Switch)

Loop Mode [(9214)]

Indicates if the loop number in the request should be checked or ignored; if it is checked, then only when it matches the NRF590 loop number will a reply be sent. (Default: Not Checked) (Protected by W&M Switch)

Loop Number [(9215)]

The loop number the NRF590 will respond to if checking is enabled. (Default: 0) (Protected by W&M Switch)

Submenu "Extended Setup" [(922X)]

4..20mA Ref [(9221)]

Analogue Reference: Reference to the parameter to be returned as the analogue 4..20mA value in the reply. (Default: IS AI, Value in mA)

Contact Ref [(9222)]

Contact Reference: Reference to the parameter to be returned as the contact status in the reply. (Default: IS DI #1, Value)

Conv.Adj.Fact. [(9223)]

Conversion Adjustment Factor: This value is multiplied with the level before transmission, while normally the default value is fine, changing this value can be useful to compensate for inaccurate unit conversion in host systems. (Default: 1.00 unitless) (Protected by W&M Switch)

L.Reply Type [(9224)]

Long Reply Type: Indicates which type of long reply will be sent when Type is set to Long Reply. (Default: Type 1) (Protected by W&M Switch)

Submenu "Diagnostics" [(923X)]

Output Status [(9231)]

The Communication Status Graph (CSG) provides a simple graphical overview of communication between the gauges and the control room. The height of the bar represents the activity during the last second:

- Replied to Host (largest bar)
- Received Request for this NRF590
- Request for another gauge on this bus
- Bytes were detected on the bus
- Bits were detected on the bus (smallest bar)
- Nothing detected (no bar, gap in graph)

Under normal operating conditions only the top three should be seen (with or without gaps).

5 Measured values

5.1 Measured Value Ranges

The GPE response will contain between 2 and 3 measurement values, level, temperature and 4–20mA value (LTA function only). Depending on the setting of the GPE parameters these values are subject to the following limits.

Measurement Value[1]	Reply Type			Description of Value
	Short	Long	1mm	
Level	0.000[2] ... +199.995	0.000 ... +199.999	0.0000 ... +199.9999	Value of Tank Corrected Level in current Tank Level Units
Temperature	–799 ... +799	–799 ... +799	–799.9 ... +799.9	Tank Temp in current Tank Temp Units
4-20mA	–19.99 ... +19.99	–19.99 ... +19.99	–1999.99 ... +1999.99	Value of linked parameter in its current units[3]

[1] Resolution of all values is +/- one significant figure of the specific units, except level in type "short"

[2] The smallest unit of level increment is 0.005 of the specific units.

[3] If the units are ft-in-16 or ft-in-8 the value of Level is in decimal ft.

5.2 Measured Value Error Handling

The following error handling rules are applied to all values returned in the GPE message.

1. If a value (level, temperature or 4-20mA) is below the minimum value then the minimum value is returned.

2. If a value (level, temperature or 4-20mA) is above the maximum value then the maximum value is returned.

3. If a value (level, temperature or 4-20mA) is undefined, invalid or offline the maximum is returned.

6 GPE Message Formats

6.1 Physical Layer

The GPE communication takes place on a 20mA current loop. Bits are represented by current flowing or not in the loop. These bits are generated and interpreted by a standard serial communication controller (UART) running at the selected baudrate and communication settings. Each group of bits together with their start, stop and parity represents an ASCII character forming the elements of the messages. Within each character bits 0 to 3 are used to encode decimal values, while the remaining 3 or 4 bits are used to provide additional information.

6.2 Request Message

The request is a sequence of three characters sent from the control room, these characters encode the loop number and the device whose data is requested as well as which GPE function is to be executed.

Byte	Bits 0–3	Bits 4–6 or7	Description
1st	0 to 4	0x20	Loop Number
2nd	0 to 9	0x40 ... 0x70	Address 1
3rd	0 to 9	0x40 ... 0x70	Address 10

The value of the upper bits in the 2nd and 3rd byte describes the GPE function to be executed:

Bits 4–6 or7	Function	Description
0x40	LTA	Return Level, Temperature and 4–20mA Value
0x50	LT	Return Level and Temperature
0x60	LTC	Close the discrete output and return level and temperature
0x70	LTO	Open the discrete output and return level and temperature

6.3 Reply Message

The reply from the Tank Side Monitor depends on the function requested by the control room and the Device Type configuration parameter of the Tank Side Monitor.

6.3.1 Reply to Functions LT, LTC and LTO

The reply from the Tank Side Monitor is the same for all three functions LT, LTC & LTO, the upper bits of the characters are all 0x30. However the replies do differ depending on the Device Type selected.

Reply Byte	Reply Type		
	Short	**Long**	**1mm**
1st	Address 1	Address 1	Address 1
2nd	Address 10	Address 10	Address 10
3rd	Level 0.01	Fine Level 0.001	Level 0.0001
4th	Level 0.1	Fine Level 0.01	Level 0.001
5th	Level 1	Fine Level 0.1	Level 0.01
6th	Level 10	Coarse Level 0.1	Level 0.1

Reply Byte	Reply Type		
	Short	**Long**	**1mm**
7th	Level 100[1]	Coarse Level 1	Level 1
8th	Temp 1	Coarse Level 10	Level 10
9th	Temp 10	Coarse Level 100[2]	Level 100
10th	Temp 100[3]	Temp 1	Temp 0.1
11th		Temp 10	Temp 1
12th		Temp 100[3]	Temp 10
13th			Temp 100[3]

1) This level value can only be 0 or 1. Bit 2 if set indicates an additional 0.005 should be added to the value. Bit 3 if set indicates the discrete output is closed.

2) This level value can only be 0 or 1. Bit 3 if set indicates the discrete output is closed.

3) This temperature value can only be between 0 and 7. Bit 3 if set indicates the value is a –ve temperature.

6.3.2 Reply to Functions LTA

The reply from the Tank Side Monitor for the function LTA differs not only by the contents but also by the value of the upper bits of the characters which are all 0x20. However the replies do differ depending on the Device Type selected.

Reply Byte	Reply Type		
	Short	**Long**	**1mm**
1st	Address 1	Address 1	Address 1
2nd	Address 10	Address 10	Address 10
3rd	Level 0.01	Fine Level 0.001	Level 0.0001
4th	Level 0.1	Fine Level 0.01	Level 0.001
5th	Level 1	Fine Level 0.1	Level 0.01
6th	Level 10	Coarse Level 0.1	Level 0.1
7th	Level 100[1]	Coarse Level 1	Level 1
8th	Temp 1	Coarse Level 10	Level 10
9th	Temp 10	Coarse Level 100[2]	Level 100
10th	Temp 100[3]	Temp 1	Temp 0.1
11th	4–20mA 0.01	Temp 10	Temp 1
12th	4–20mA 0.1	Temp 100[3]	Temp 10
13th	4–20mA 1	4–20mA 0.01	Temp 100[3]
14th	4–20mA 10[4]	4–20mA 0.1	4–20mA 0.01
15th		4–20mA 1	4–20mA 0.1
16th		4–20mA 10[4]	4–20mA 1
17th			4–20mA 10
18th			4–20mA 100
19th			4–20mA 1000[4]

1) This level value can only be 0 or 1. Bit 2 if set indicates an additional 0.005 should be added to the value. Bit 3 if set indicates the discrete output is closed.

2) This level value can only be 0 or 1. Bit 3 if set indicates the discrete output is closed.

3) This temperature value can only be between 0 and 7. Bit 3 if set indicates the value is a –ve temperature.

4) This 4–20mA value can only be 0 or 1. Bit 1 if set indicates the value is a –ve one.

6.3.3 Long Reply Additional Information

In the long reply the level is sent as two components, this was used due to the mechanical nature of the old devices which employed this protocol. When the Tank Side Monitor is used in this mode, these values are as follows:

	Long Reply Type		
	0	**1**	**2**
Fine Level 0.001	Level 0.001		
Fine Level 0.01	Level 0.01		
Fine Level 0.1	0	Level 0.1	Level 0.1
Coarse Level 0.1	Level 0.1	0	Level 0.1
Coarse Level 1	Level 1		
Coarse Level 10	Level 10		
Coarse Level 100	Level 100		

The Long Reply Type parameter allows you to adjust the layout so when the two values (Fine & Coarse) are combined in the control system a accurate level can be obtained.

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