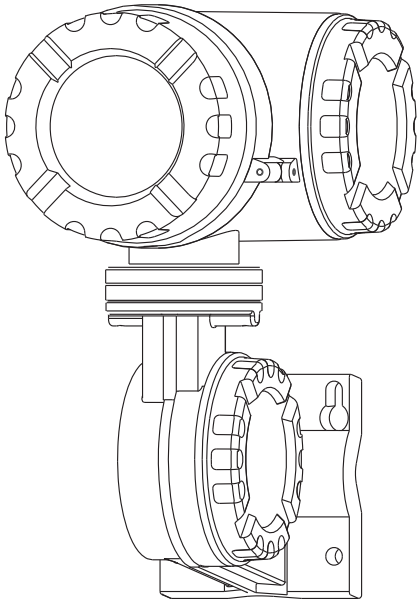
4590 Tank Side Monitor

GPE Communication Protocol

Service Manual

Software Version v2.03



Varec, Inc.
5834 Peachtree Corners East, Norcross (Atlanta), GA 30092 USA
Tel: +1 (770) 447-9202 Fax: +1 (770) 662-8939

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5834 Peachtree Corners East
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Contents

1 Introduction

This protocol guide explains the operation of the GPE protocol per Modicon document PI-MBUS-300 Rev C (1991) implemented in the Varec 4590 Tank Side Monitor (TSM).

2 Implementation

The implementation of the GPE protocol for the 4590 TSM provides a standard form of digital communication via a current loop. An effort has been made to provide the most complete and functional GPE implementation in the 4590 TSM in order to communicate with existing GPE masters.

Check compatibility carefully to ensure that the 4590 TSM is properly configured for the data format expected by the host system or computer. Due to the unique application requirements of the 4590 TSM application, exceptions have been made and noted.

Note! There is no guarantee that the interpretation made here is the same as that followed by the GPE master.

The GPE protocol supports three modes of communication and within each mode four commands.

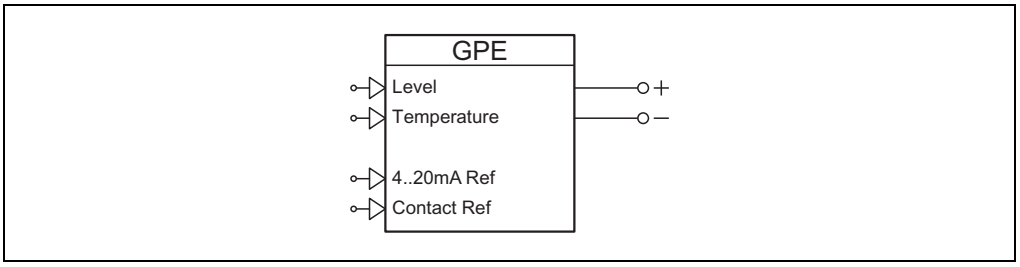


Figure 2-1: Function Block "GPE Output"

2.1 GPE Modes (Device Types)

Table 2-1 summarizes the GPE Modes (Device Types) used by the 4590 TSM.

Table 2-1: GPE Modes (Device Types)

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

2.2 GPE Functions

Table 2-2 summarizes the GPE Functions used by the 4590 TSM.

Table 2-2: GPE Functions

Function	Description
LT	Used to obtain Level and Temperature
LTA	Used to obtain Level, Temperature, and 4-20 mA 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

Follow these recommendations for field installation of the 4590 TSM with the GPE protocol variant:

- Connect the gauges using a serial topology as shown in Figure 3-1.
- The maximum advised cable length is 10 km.

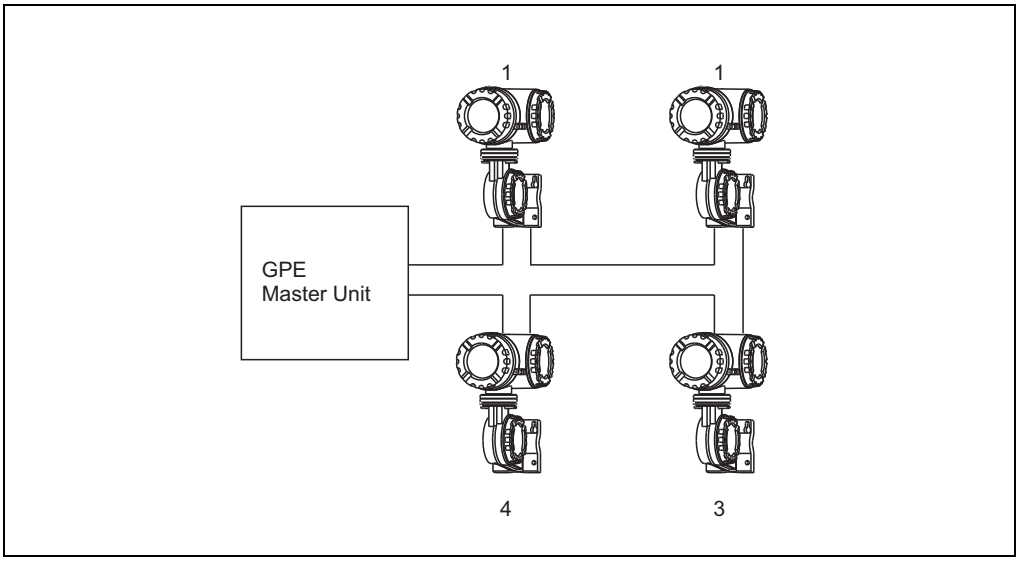


Figure 3-1: Serial Connection Topology for the GPE Protocol

4 Configuration

The GPE port on the 4590 TSM must be configured to establish communication. The local 4590 TSM display or ToF tool allows the user to set up the GPE parameters needed for correct communication with a GPE master unit.

4.1 Address

The 4590 TSM addresses provide unique identification for the host. The 4590 TSM address is configured 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 4590 TSM unit only responds to requests that contain the same Address and Communication ID that the unit is set to.

4.2 Configuration Settings

To achieve successful communication on a GPE loop, a number of configuration settings must be entered to match the configuration of the loop.

4.2.1 Summary of Configuration Parameters

Table 4-1 summarizes the configuration parameters required by the 4590 TSM.

Table 4-1: GPE Configuration Information

Configuration Parameter	Valid Entries	Default
ID	0 – 99	1
Baudrate	250 – 350 baud	300
Type	• Short Reply • Long Reply • 1 mm 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
4-20 mA 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

Table 4-2 summarizes the configuration parameters that make up the Basic Setup. The numbers in parentheses indicate the menu position.

Table 4-2: Submenu "Basic Setup" (921X)

Field	Description
Loop Number(23107)	The loop parameter forms a second part of the identification of a message. If enabled, (see Loop Mode parameter) it is compared with the value in the received message. The message is only processed if they match.
ID(9211)	This is a unique number for this device on the GPE loop. Only when the 4590 TSM receives a request message with this number is a response generated.
Baudrate(9212)	Specifies the communication speed used on the GPE loop.
Type(9213)	Specifies the format of the response generated by the 4590 TSM.
Loop Mode(9214)	Indicates if the loop value within the request message should be evaluated or not. If not, the 4590 TSM responds to all messages with its ID number no matter which loop number is in the request.
Long Reply Type(9224)	The value determines how the "Level 0.1" value is encoded into the reply "Fine Level 0.1" and "Course Level 0.1" digits. See Table 6-5, Long Reply Additional Information for more details.
4-20 mA Ref(9221)	This parameter is used to connect a calculated or measured value within the 4590 TSM to this part of the response message. There are specific limitations on the range of values which can be transmitted.
Contact Ref(9222)	This parameter selects the discrete output which is controlled by the LTC and LTO commands. The status of this output is also returned as part of the 4590 TSM response message.

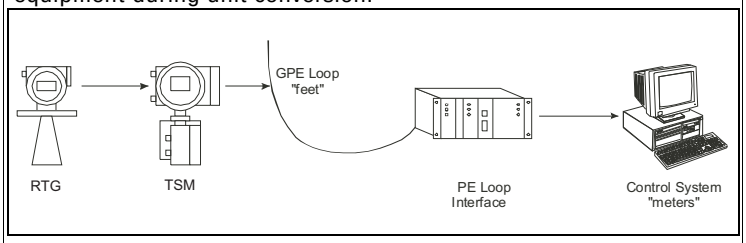
Field	Description
Conversion Factor Adjust(9223)	This parameter allows the level value transmitted on the GPE bus to be adjusted to compensate for inaccuracies in the control room equipment during unit conversion.  *Figure 4-1: Example* In this example, the 4590 TSM will be set to "feet" as the GPE loop is working in "feet". The 4590 TSM will convert the level from the 7200.7500 series Radar Tank Gauges using the correct conversion factor (1 ft = 0.3048 m). However, the GPE Loop Interface to the Control System may use an inaccurate conversion (1 ft = 0.3 m). To compensate for this inaccuracy, the "Conversion Factor Adjustment" (CFA) value is set as follows: CFA = accurate conversion factor / inaccurate conversion factor = 0.3048/0.3 =1.016 The 4590 TSM multiplies its value in by this adjustment value before sending the GPE bus. **Note!** Only the value sent on the gus is affected. The displayed value and value used for internal calculations are not changed by this parameter. The control room will have the correct value after the conversion. See Table 4-3, Conversion Table for more information.

Table 4-3 summarizes the conversion table used before sending the GPE bus to the control room.

Table 4-3: Conversion Table

	CFA = 1.000	CFA = 1.016	Remarks
FMR Value	2.540 m	2.540 m	
4590 TSM Displayed Value	8.333 ft	8.333 ft	1 ft = 0.3048 m
Value Sent to GPE Loop	8.333	8.466	= value * CFA
Control System Value	2.500 m	2.540 m	1 ft = 0.3 m

5 Measured Values

5.1 Measured Value Ranges

The GPE response contains two or three measurement values:

1. Level
2. Temperature
3. 4-20 mA value (LTA function only)

Depending on the setting of the GPE parameters, these values are subject to the following limits:

Table 5-1: GPE Response

Measurement Value [1]	Reply Type			Description of Value
	Short	Long	1 mm	
Level	0.000[2] – +199.995	0.000 – +199.999	0.000 0 – +199.9999	Value of the Tank Corrected Level in the current Tank Level Units
Temperature	-799 – +799	-799 – +799	-799.9 – +799.9	Tank Temp in the current Tank Temp Units
4-20 mA	-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 for Level 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 4-20 mA) is below the minimum value, the minimum value is returned.
2. If a value (level, temperature, or 4-20 mA) is above the maximum value, the maximum value is returned.
3. if a value (level, temperature, or 4-20 mA) is undefined, invalid, or offline, the maximum value is returned.

6 GPE Message Formats

6.1 Physical Layer

The GPE communication takes place on a 20 mA current loop. Bits are represented by current flowing (not in the loop). These bits are generated and interpreted by a standard serial communication controller (UART) running at the selected baud rate and communication settings.

Each group of bits together with the 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. The remaining 3 or 4 bits are used to provide additional information.

6.2 Request Message

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

Table 6-1 summarizes the request message sequence of three characters sent from the control room.

Table 6-1: Request Message

Byte	Bits 0–3	Bits 4–6 or 7	Description
1	0 to 4	0x20	Loop Number
2	0 to 9	0x40–0x70	Address 1
3	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 as shown in Table 6-2.

Table 6-2: GPE Function to be Executed

Bits 4–6 or 7	Function	Description
0x40	LTA	Return Level, Temperature, and 4-20 mA 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 message from the 4590 TSM depends on the function requested by the control room and the Device Type configuration parameter of the 4590 TSM.

6.3.1 Reply to Functions LT, LTG, and LTO

The reply message from the 4590 TSM is the same for functions LT, LTC, and LTO. The upper bits of the characters are all 0x30. However, the replies differ depending on the Device Type selected.

Table 6-3 summarizes the reply message to functions LT, LTG, and LTO.

Table 6-3: Reply Message to Functions LT, LTG, and LTO

Reply Byte	Reply Type		
	Short	**Long**	**1 mm**
1	Address 1	Address 1	Address 1
2	Address 10	Address 10	Address 10
3	Level 0.01	Fine Level 0.001	Level 0.0001
4	Level 0.1	Fine Level 0.01	Level 0.001
5	Level 1	Fine Level 0.1	Level 0.01
6	Level 10	Course Level 0.1	Level 0.1
7	Level 100[1)]	Course Level 1	Level 1
8	Temp 1	Course Level 10	Level 10
9	Temp 10	Course Level 100[2)]	Level 100
10	Temp 100[3)]	Temp 1	Temp 0.1
11		Temp 10	Temp 1
12		Temp 100[3)]	Temp 10
13			Temp 100[3)]

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

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

6.3.2 Reply to Functions LTA

The reply message from the 4590 TSM for function LTA differs not only in the contents, but also by the value of the upper bits of the characters which are all 0x20. However, the replies differ depending on the Device Type selected.

Table 6-4 summarizes the reply message for function LTA.

Table 6-4: Reply Message for Function LTA

Reply Byte	Reply Type		
	Short	Long	1 mm
1	Address 1	Address 1	Address 1
2	Address 10	Address 10	Address 10
3	Level 0.01	Fine Level 0.001	Level 0.0001
4	Level 0.1	Fine Level 0.01	Level 0.001
5	Level 1	Fine Level 0.1	Level 0.01
6	Level 10	Course Level 0.1	Level 0.1
7	Level 100[1)]	Course Level 1	Level 1
8	Temp 1	Course Level 10	Level 10
9	Temp 10	Course Level 100[2)]	Level 100
10	Temp 100[3)]	Temp 1	Temp 0.1
11	4-20 mA 0.01	Temp 10	Temp 1
12	4-20 mA 0.1	Temp 100[3)]	Temp 10
13	4-20 mA 1	4-20 mA 0.01	Temp 100[3)]
14	4-20 mA 10[4)]	4-20 mA 0.1	4-20 mA 0.01
15		4-20 mA 1	4-20 mA 0.1
16		4-20 mA 10[4)]	4-20 mA 1
17			4-20 mA 10
18			4-20 mA 100
19			4-20 mA 100[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 4-20 mA value can only 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 method is used due to the mechanical nature of the old devices which employ this protocol.

When the 4590 TSM is used in this mode, Table 6-5 summarizes the long reply additional information.

Table 6-5: Long Reply Additional Information

	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
Course Level 0.1	Level 0.1	0	Level 0.1
Course Level 1	Level 1		
Course Level 10	Level 10		
Course Level 100	Level 100		

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

NOTES

Your official representative

Varec®

Varec, Inc.
5834 Peachtree Corners East, Norcross (Atlanta), GA 30092 USA
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