

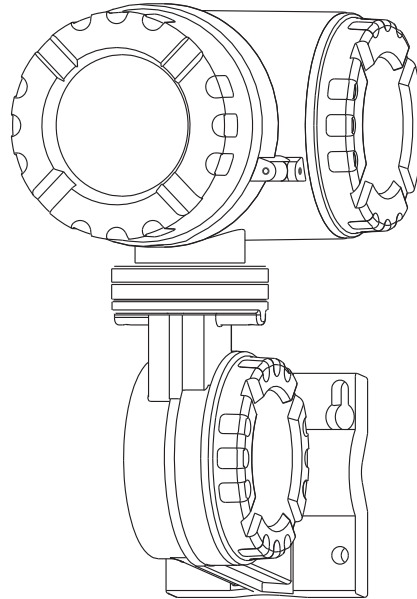
4590 Tank Side Monitor

BPM Communication Protocol



Service Manual

Software Version v2.03



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1 Introduction

This protocol guide explains the operation of the ENRAF BiPhaseMark (BPM) protocol implemented in the Varec 4590 Tank Side Monitor (TSM).

2 Implementation

The implementation of the ENRAF BiPhaseMark (BPM) protocol for the 4590 TSM provides compatibility to existing ENRAF Systems by emulating the ENRAF GPU-BPM and GPP-BPM slave devices as produced by ENRAF. It is based on a transformer coupled fieldbus interface principle.

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, exceptions have been made and noted.

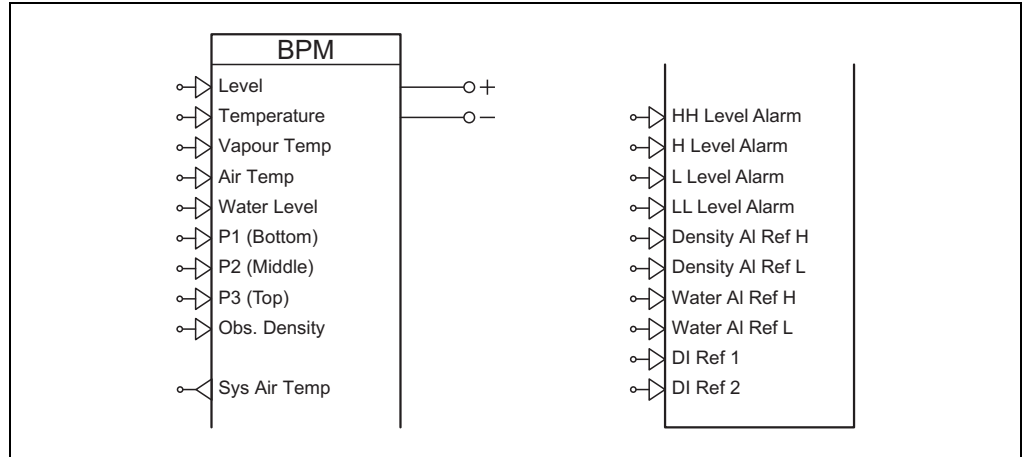


Figure 2-1: Function Block "BPM Output"

3 Installation Recommendations

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

- Cable with twisted and shielded pairs.
- If multiple loops are within one cable, all pairs must be individually shielded and twisted.
- The maximum resistance is 200 Ohm per line.
- The maximum capacitance maximum is 1 micro Farad differential and common.
- The preferred cable topology for better performance is a star topology as shown in Figure 3-1.
- The maximum cable length is 10 km (tested topology: staggered network: 10 field devices, and one master unit 1 km spurs) as shown in Figure 3-2.
- The maximum suggested field devices are 10 (excluding the master unit).

3.1 Example of a Star Topology Installation

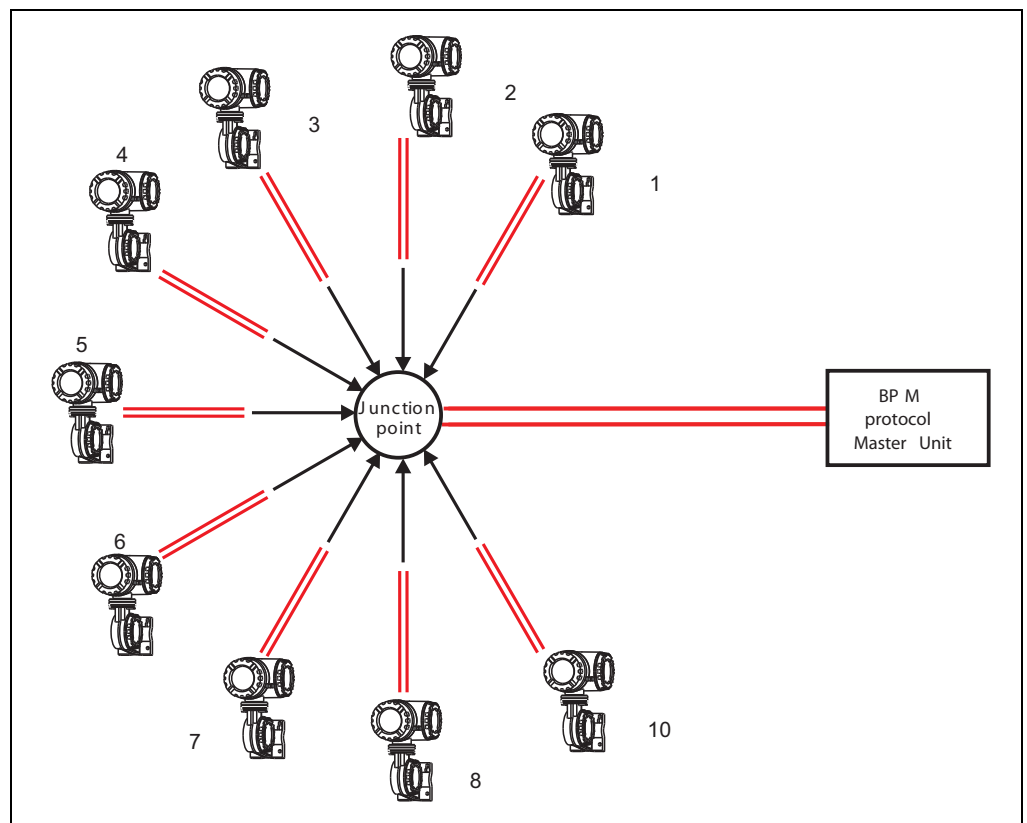


Figure 3-1: Example of a Star Topology Installation

3.2 Example of a Staggered Network with the Maximum Cable Length

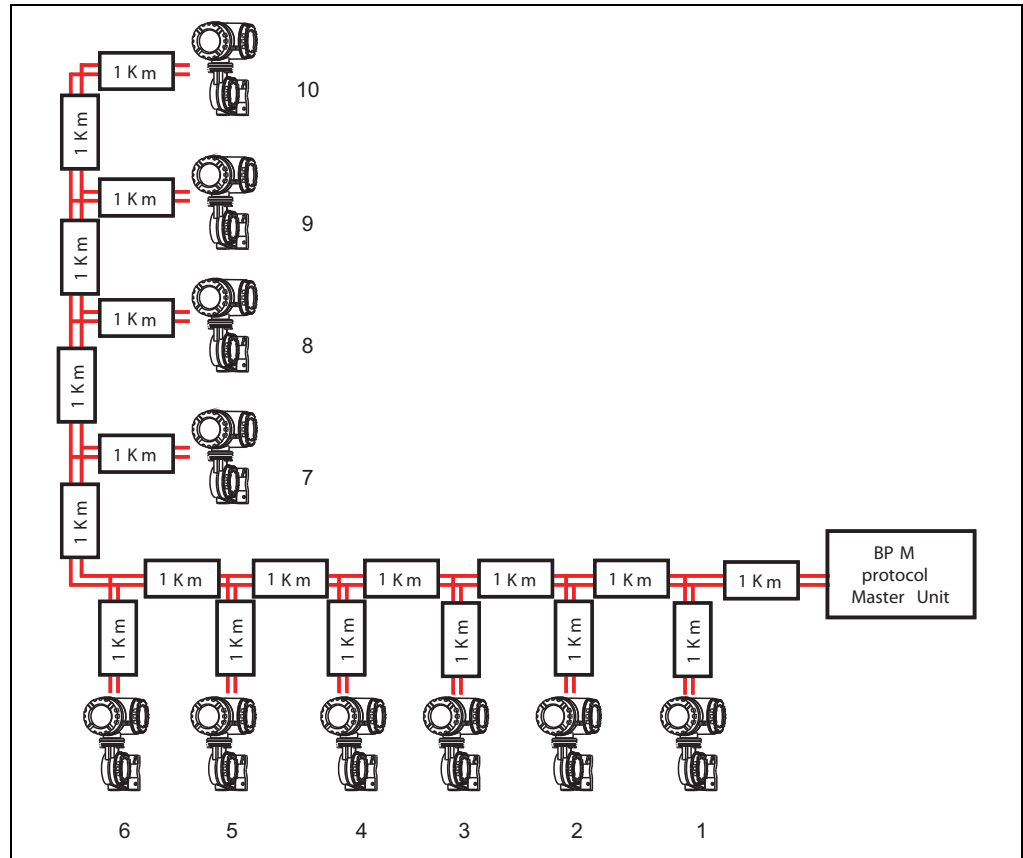


Figure 3-2: Example of a Staggered Network with the Maximum Cable Length

Note! The 4590 TSM BPM implementation was tested and compared to the original Enraf equipment—both field devices and host devices, such as the CIU. It either matched in performance, and in most cases even exceeded the original performance.

4 Configuration

The implementation of the BPM protocol on the 4590 TSM supports a variety of commands represented by a Type of Request (TOR) and some of them further by an item. All of them are defined by an ASCII character on the request frame.

Note! Not all of the commands are supported in every Type of Instrument (TOI). Therefore, some commands are exclusive to specific TOIs.

Table 4-1 summarizes the supported commands on the 4590 TSM implementation of the BPM protocol.

Table 4-1: *Different Types of Requests (TOR) and their Descriptions within the BPM*

TOR	Item	Description
A	-	Alarm Request Record
B	-	Level Request Record
C	-	Temperature Request Record
D	-	Combined Level and Temperature Request Record
E	-	Stored Level Request Record
F	-	Stored Combined Data Request Record
L	-	High Resolution Level Request Record
M	-	Water Request Record
N	-	Block the Displacer ¹⁾
O	-	Raise the Displacer Continuously ¹⁾
Q	-	Quit Water Bottom Measurement ¹⁾
S	-	Store Alarm Status, Level, and Temperature
T	-	Test Gauge Command ¹⁾
U	-	Unlock Command ¹⁾
W	-	Water Dip ¹⁾
X	-	Identification Record
Z	AG	Vapor Temperature Request Record
	DQ	HTMS/HTG Density Answer Record
	LQ	Old HR Level Request Record
	P1	Hydrostatic Head Pressure Request Record
	P3	Vapor Pressure Request Record
	P7	Corrected Pressure Request Record
	QQ	HTMS/HTG Density Request Record
	SC	Servo Density Request
M7	Ambient Temperature Data Read/Write	

1) These commands were intended for particular servo gauge functions which are not implemented on the 4590 TSM. Nevertheless, the 4590 TSM gives back a proper communication answer but always with an ASCII character "A" TOR (Type of Request) to confirm the reception of the command. This command returns the actual status of the 4590 TSM alarms. If no alarm is present, a normal status is returned and nothing else.

4.1 Configuration Settings

For successful communication with the BPM master, the 4590 TSM should be configured with a set of communication parameters.

Table 4-2 summarizes the relevant communication parameters required by the 4590 TSM.

Table 4-2: Configuration Settings and their Possible Values on the BPM 4590 TSM Menu

Configuration Parameter	Valid Entries	Default
ID Length	2 or 3 Bytes	2 Bytes
ID	0 - 99 ----- 000 - 999	00
Baudrate	1200, 2400 Baud	1200 Baud
TOI	B, C, D, E, ACCEPT ALL	ACCEPT ALL
Device No.	0 - 999	590
Device Type	A - Z	A
Gain	1 - 63	1
Reply to C	Disabled/Enabled	Disabled
Ext1Ref	Any discrete signal [DI/O, Alarm]	IS DI #1
Ext2Ref		IS DI #2
PSI Type	Type "S" or Type "I"	Type "S"
No. Preambles (Service Parameter)	0 - 32	11
DI Ref 1	Any discrete signal [DI/O, Alarm]	Undefined
DI Ref 2		
Density Alarm Ref H		
Density Alarm Ref L		
Water Alarm Ref H		
Water Alarm Ref L		

4.2 Description of Configuration Parameters

The BPM has a set of settings which are crucial for correct communication with the host. The numbers in parentheses indicate the menu position.

Table 4-3 summarizes the configuration parameters that make up the Basic Setup.

Table 4-3: Submenu "Basic Setup"^(921X)

Field	Description	Default	Protected
ID Length ⁽⁹²¹¹⁾	Specifies if 2-digit or 3-digit long identifier values are used.	2 Digits	W&M Switch
ID ⁽⁹²¹²⁾ (Identifier Value)	This is the identifier value. The 4590 TSM responds to requests which contain this identifier value. ?????(2-digit or 3-digit value)	0	W&M Switch???
Baud Rate ⁽⁹²¹³⁾	Selects at which of the two possible baud rates the communication will work.	1200	W&M Switch
TOI ⁽⁹²¹⁴⁾ (Type of Instrument)	The "Type of Instrument" (TOI) is used to differentiate between various device specific protocol variations. By changing this value, the system can match the capabilities of the host system.	Accept All	W&M Switch
Device No [dn] (Device Number)	This device number can be used by the host for additional information.	590	W&M Switch
Dev. Type [dt] (Device Type)	The device type identifies the type of equipment the 4590 TSM is emulating.	"A" refers to the 854ATX gauge.	W&M Switch

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

Table 4-4: Submenu "Extended Setup"^(922X)

Field	Description	Default
D1 Ref 1 ⁽⁹²²¹⁾ (External #1 Reference)	Indicates which discrete value is to be transmitted as an Enraf External value number 1.	IS DI #1, Value
D1 Ref 2 ⁽⁹²²²⁾ (External #2 Reference)	Indicates which discrete value is to be transmitted as an Enraf External value number 2.	IS DI #2, Value
Sys Air Temp ⁽⁹²²⁷⁾ (System Air Temperature)	System supplied Air Temperature. (Read Only)	
No PreDetect ⁽⁹²³⁹⁾ (Number of Detected Pre-ambles)	Indicates the number of pre-ambles we were able to measure in the previous request received. (Read Only)	

Table 4-5 summarizes the configuration parameters that make up the Diagnostics Submenu. The numbers in parentheses indicate the menu position.

Table 4-5: Submenu "Diagnostics"^(923X)

Field	Description	Height of Bar
Output Status ⁽⁹²³¹⁾	The Communication Status Graph (CSG) provides a simple graphical overview of communication between the gauges and the control room.	<p>The height of the bar represents the activity during the last second:</p> <ul style="list-style-type: none"> • Replied to Host (largest bar) • Received Request for this 4590 TSM • 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 first three items should be seen (with or without gaps).

5 Measured Values

The BPM response contains a number of measurement values—level, temperature, percentage, density, pressure, and more. These values are subject to the following limits:

5.1 Unit Mapping

In the case of some BPM protocol responses, a number of measurement values are included in them which are subject to unit mapping. Within the BPM protocol, only some units are supported. All other units should be mapped to the ones supported before being sent to the communication line. This means that the BPM code will automatically make the proper conversion from the 4590 TSM display units to the BPM supported ones.

Table 5-1 summarizes the unit mapping between the displayed 4590 TSM defined units and the BPM protocol units.

Table 5-1: Unit Mapping Between the 4590 TSM Display Units and the BPM Supported Units

Unit Type	4590 TSM Display Unit	BPM Unit Mapping
Density	Kg/m ³	Kg/m ³
	g/ml	Kg/m ³
	°API	°API
	Lbs/ft ³	Lbs/ft ³
Level	mm	m
	cm	m
	m	m
	ft	ft
	in	in
	16 ^{ths}	in
	ft-in-8	ft-in-16
ft-in-16	ft-in-16	
Pressure	Pa	Pa
	kPa	kPa
	MPa	kPa
	mbar	Pa
	bar	kPa
	inH2O	Psi "S" variant
	Psi	Psi "S" variant
	(depending on ENRAF menu group PSI Type selection)	

Unit Type	4590 TSM Display Unit	BPM Unit Mapping
Temperature	°C	°C
	°F	°F

5.2 Value Ranges

Table 5-2 summarizes the value ranges of the BPM units.

Note! At start-up, the units used in communication are the ones set in the 4590 TSM as default.

Table 5-2: Value Ranges Within Different Command Answers of the BPM Protocol in the 4590 TSM

Type (Used in answer command records)	Minimum Possible Value	Maximum Possible Value	Granularity	ENRAF BiPhaseMark (BPM) Units
Level [B,D,E,F]	-999.999	999.999	0.001	Meter
	-999.999	999.999	0.001	Feet
	-9999.99	9999.99	0.01	Inches
	-99'11"15	99'11"15	0'00"01	ft-in-16
Level, Water Level [L,M]	-999.9999	999.9999	0.0001	Meter
	-9999.999	9999.999	0.001	Feet
	-99999.99	99999.99	0.01	Inches
	-99'11"15	99'11"15	0'00"01	ft-in-16
Level [ZLQ]	-999.9999	999.9999	0.0001	Meter
	-9999.999	9999.999	0.001	Feet
	-99999.99	99999.99	0.01	Inches
	-99'11"15	99'11"15	0'00"01	ft-in-16
Product Temperature, Vapor Temperature, Ambient Temperature [C,D,F,ZAG,ZM7]	-999.99	999.99	0.01	°C
	-999.99	999.99	0.01	°F
Density [ZDQ, ZSC]	-99999.99	99999.99	0.01	Kg/m ³
	-9999.999	9999.999	0.001	°API
	-999.9999	999.9999	0.0001	Lbs/ft ³
Pressure [ZP1, ZP3, ZP7]	-999999.9	999999.9	0.1	Pa
	-9999.999	9999.999	0.001	Kpa
	-99.99999	99.99999	0.00001	Psi "S" variant
	-9999.999	9999.999	0.001	Psi "I" variant

5.3 Measured Values Error Handling

The following error-handling rules are applied to all values returned in the BPM units message:

Refer to Table 5-2 for the related minimum and maximum values.

1. If a value (level, temperature, or any other) is below the minimum value, the minimum value is returned.
2. If a value (level, temperature, or any other) is above the maximum value, the maximum value is returned.
3. If a value (level, temperature, or any other) is undefined, invalid, or offline, it is pointed out by the respective error bit or byte information (consisting normally of a status field filled with ASCII "F" characters) depending on the type of value.

NOTES

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