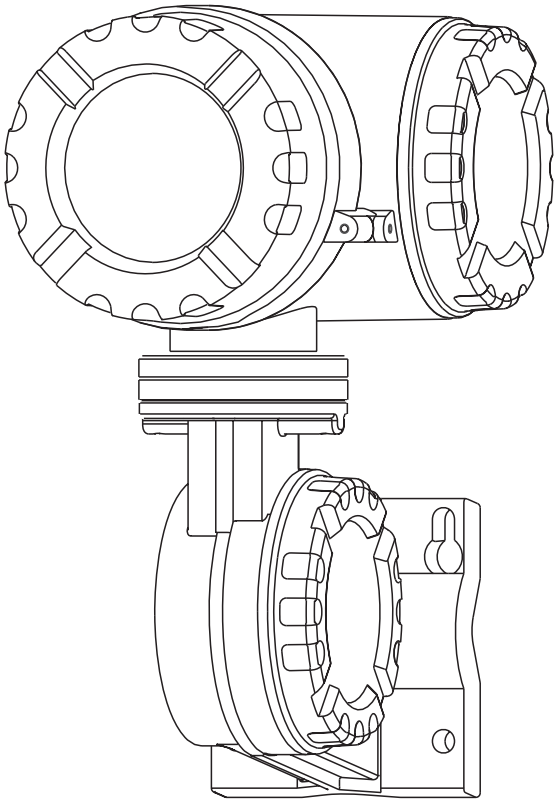
Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

BiPhaseMark (BPM) communication protocol

# Tank Side Monitor NRF590

## Inventory Control



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V 02.03

Endress+Hauser
People for Process Automation

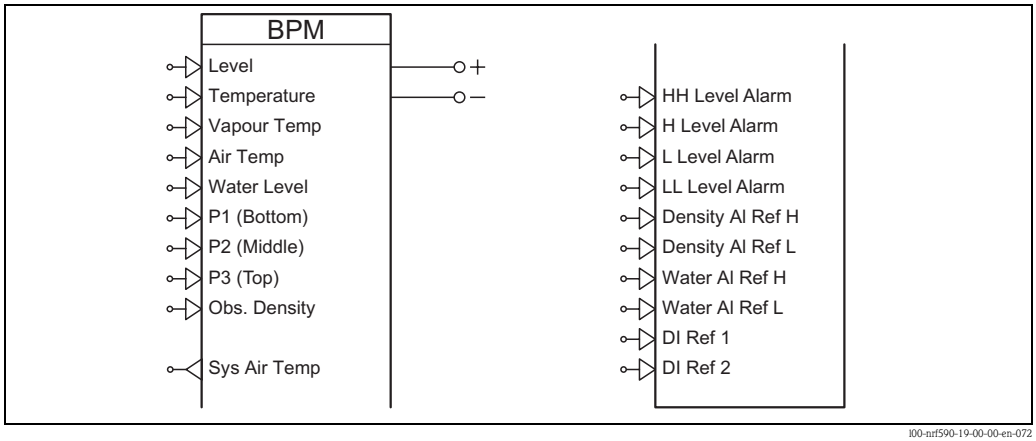
# Table of contents

# 1 Introduction

This protocol guide explains the operation of the Endress+Hauser ENRAF BiPhaseMark (BPM protocol implemented in the Endress+Hauser Tank Side Monitor NRF590.

# 2 Implementation

The ENRAF BiPhaseMark (BPM) communication protocol is implemented on the NRF590 and provides compatibility to the 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 NRF590 is properly configured for the right communication and data formats. Exceptions, as well as not supported features have been noted because of the unique requirements of the NRF590 application.




# 3 Installation recommendation

Please ensure to follow the following recommendations for field installation of the NRF590 with BPM Enraf protocol variant:

- Cable with twisted and shielded pairs.
- If multiple loops are within one cable, then all pairs must be individually shielded & twisted.
- Max resistance: 200 Ohm per line.
- Max Capacitance max: 1 micro Farad differential and common.
- The preferred cable topology for a better performance is a star topology (refer to figure 1).
- The maximum cable length is 10 km (tested topology: staggered network: 10 field devices, one Master Unit, 1 km spurs) (refer to figure 2).
- The maximum suggested field devices: 10 (excl. master unit).

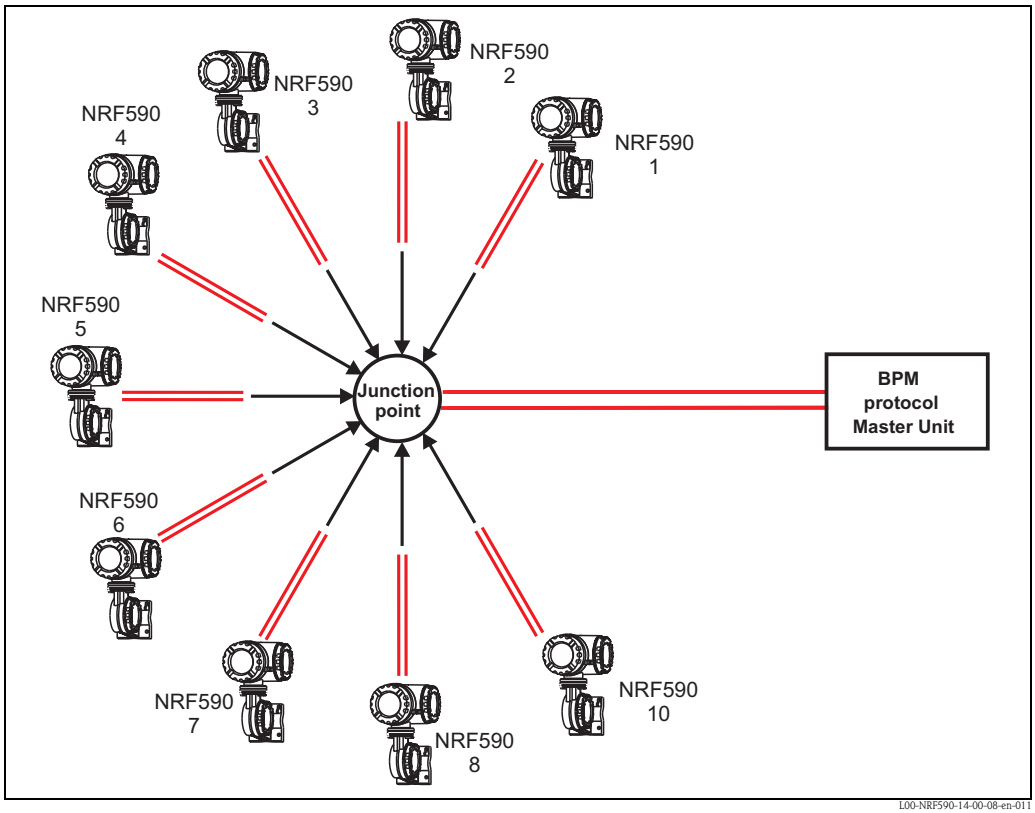



*Fig. 1: Example of a Star Topology installation*

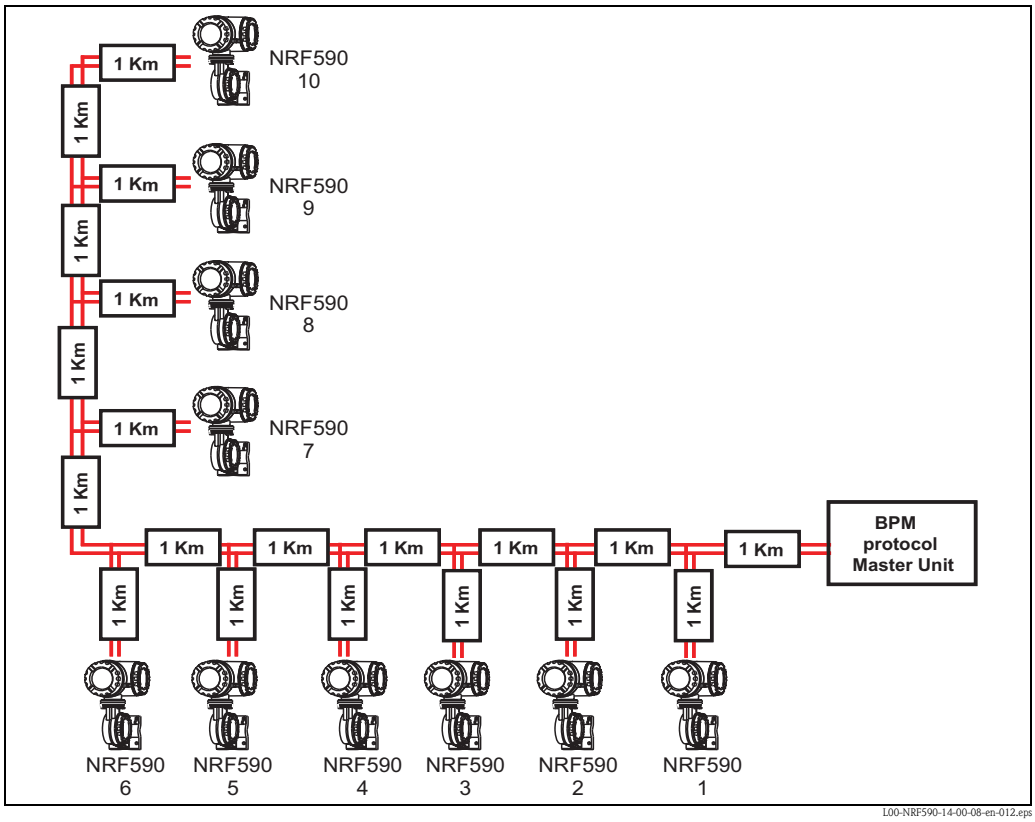



*Fig. 2: Staggered network example with maximum cable length*

Note!
The TSM BPM implementation was tested and compared with 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 ENRAF BiPhaseMark (BPM) protocol on the NRF590 supports a variety of commands represented by a TOR (Type of Request) and some of them further by an item. All of them are defined by an ASCII character on the request frame.

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

The supported commands on the NRF590 implementation of the ENRAF BiPhaseMark (BPM) protocol are listed here:

**Table 1:**
Different Types of Request (TOR) and their description within the ENRAF BiPhaseMark (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 | Vapour Temperature Request Record |
| | DQ | HTMS/HTG Density Answer Record |
| | LQ | Old HR Level Request Record |
| | P1 | Hydrostatic Head Pressure Request Record |
| | P3 | Vapour 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 NRF590, nevertheless, the NRF590 will give back a proper communication answer but always with an “A” ASCII character TOR (Type Of Request) to confirm the reception of the command. This command will just return the actual status of the NRF590 alarms (if no alarm is present a normal status is returned) and nothing else.

## 4.1 Configuration settings

In order to properly communicate with the ENRAF BiPhaseMark (BPM) master, the NRF590 should be configured with a set of communication parameters. A list of the relevant communication parameters required by the NRF590 is shown here:

**Table 2:**
Configuration settings and their possible values on the ENRAF BiPhaseMark (BPM) NRF590 menu

| Configuration Item | Valid Entries | Default |
|---|---|---|
| ID length | 2 or 3 (Bytes) | 2 (Bytes) |
| ID | 00 to 99<br>000 to 999 | 00 |
| Baudrate | 1200, 2400 Baud | 1200 Baud |
| TOI | B, C, D, E, ACCEPT ALL | ACCEPT ALL |
| Device No. | 0 to 999 | 590 |
| Device Type | A-Z | A |
| Gain | 1 to 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<br>(Service Parameter) | 0 to 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 Configuration Parameters

The ENRAF BiPhaseMark (BPM) has a set of the following settings which are crucial for the correct communication with the host.

### 4.2.1 Submenu "Basic Setup" (921X)

**Id Length (9211)**

Specifies if 2-digit or 3-digit long identifier values are used. (Default: 2 Digits) (Protected by W&M Switch)

**Id (9212)**

Identifier value. The Tank Side Monitor will respond to requests which contain this identifier value. (2-digit value) (Default: 0) (Protected by W&M Switch)

**Id (9212)**

This is the identifier value. The Tank Side Monitor will respond to requests which contain this identifier value. (3-digit value) (Default: 0)

**Baud Rate (9213)**

Selects at which of the two possible baud rates the communication will work at. (Default: 1200) (Protected by W&M Switch)

**TOI (9214)**

Type of Instrument: The "Type Of Instrument" (TOI) is used for differentiating between various device specific protocol variations. By changing this value the systen can be matched the capabilities of the host system. (Default: Accept All) (Protected by W&M Switch)

**Device No [dn]**

Device Number: The device number can be used by the host system for additional identification. (Default: 590) (Protected by W&M Switch)

**Dev. Type [dt]**

Device Type: The device type identifies the type of equipment the NRF590 is emulating. The default value 'A' refers to the 854ATX gauge. (Default: 'A') (Protected by W&M Switch)

### 4.2.2 Submenu "Extended Setup" (922X)

**DI Ref 1 (9221)**

External #1 Reference: Indicates which discrete value will be transmitted as Enraf External value number 1. (Default: IS DI #1, Value)

**DI Ref 2 (9222)**

External #2 Reference: Indicates which discrete value will be transmitted as Enraf External value number 2. (Default: IS DI #2, Value)

**Sys Air Temp (9227)**

System Air Temperature: System supplied Air Temperature (Read Only)

**No PreDetect (9239)**

Number of Deteced Pre-ambles: Indicates the number of pre-ambles we were able to measure in the previous request we received. (Read Only)

### 4.2.3 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 acitivity 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

The V1 response will contain a number of measurement values, level, temperature, percentage, density, pressure etc. These values are subject to the following limits.

## 5.1 Unit mapping

In the case of some ENRAF BiPhaseMark (BPM) protocol responses, a number of measurement values are included in them which are subject to unit mapping. Within the ENRAF BiPhaseMark (BPM) protocol only some units are supported, all others units should be mapped to the ones supported before being sent to the communication line. This means that the ENRAF BiPhaseMark (BPM) code will automatically make the proper conversion from the NRF590 display units to the ENRAF BiPhaseMark (BPM) supported ones. In the following table, the unit mapping between the displayed NRF590 defined units and the ENRAF BiPhaseMark (BPM) protocol units is shown.

**Table 3:**
Unit mapping between the NRF590 display units and the ENRAF BiPhaseMark (BPM) supported units

| Unit Type | NRF590 Display Unit | ENRAF BiPhaseMark (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 |
| | 16ths | 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<br>(depending on ENRAF menu group PSI Type selection) | Psi 'S' variant |
| Temperature | °C | °C |
| | °F | °F |

## 5.2 Value ranges

In the next table the value ranges of the ENRAF BiPhaseMark (BPM) units are presented. Please note that at start-up, the units used in the communication are the ones set in the NRF590 as default.

**Table 4:**
Value ranges within the different command answers of the ENRAF BiPhaseMark (BPM) protocol in the NRF590

| 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 ENRAF BiPhaseMark (BPM) Units message. Refer to the above table for related minimum and maximum values.

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

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