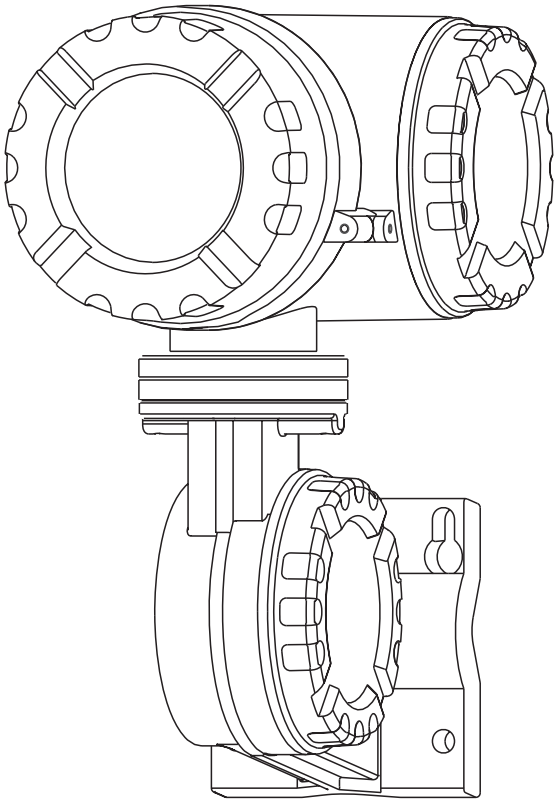
Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

Mark/Space communication protocol

Tank Side Monitor NRF590

Inventory Control



KA249F/00/en/11.06
71001229

Valid as of software version:
V 02.03

Endress+Hauser

People for Process Automation

Table of contents

1 Introduction

This protocol guide explains the operation of the Mark/Space protocol implemented in the Endress+Hauser Tank Side Monitor NRF 590.

2 Implementation

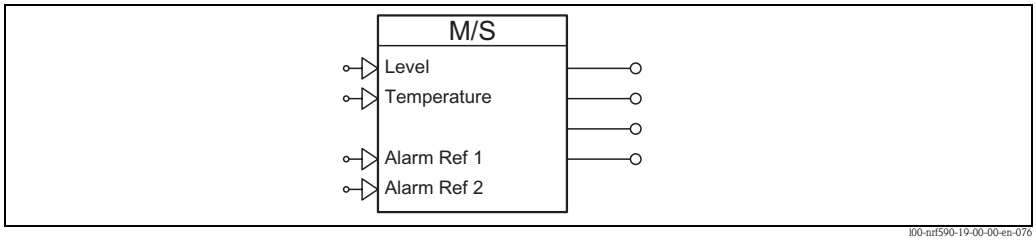
The implementation of the Mark/Space protocol for the Tank Side Monitor provides a standard form of digital communication via a voltage mode bus. An effort has been made to parallel current implementations to the greatest extent possible, so that the Tank Side Monitor communicates with existing Mark/Space 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 Mark/Space master.

The Mark/Space interface supports two types of communication which are based on the emulation of older devices.

Mark/Space Types

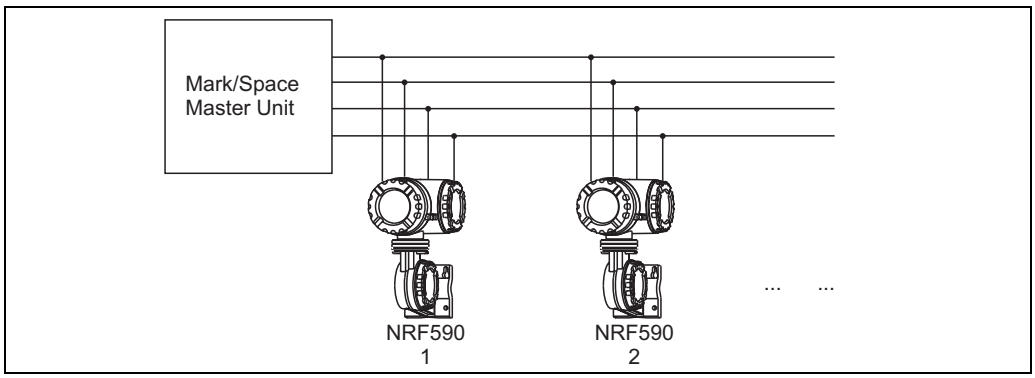
Device Type	Description
1900	Emulates the Model 1900 transmitter
1800	Emulates the Model 1800 transmitter



3 Installation recommendations

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

- Use two twisted pairs (one power, one communication) of 18 AWG wire.
- Connect the units in parallel as shown in the figure below.
- Maximum tested cable length is 8 km.



L00-NRF590-04-00-08-yy-030

4 Configuration

The Mark/Space interface on the Tank Side Monitor must be configured to establish communications. The local display or ToF tool allows the user to set the Tank Side Monitor Mark/Space interface to match the Mark/Space master settings.

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 999 and must be unique for each Mark/Space device on a bus. Each Tank Side Monitor only responds when a query has been sent to its unique address by the host.

4.2 Configuration settings

In order for successful communication on a Mark/Space bus a number of configuration settings must be made to match the configuration of the bus.

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.

Mark/Space configuration parameters

Configuration parameter	Valid Entries	Default
ID	0 ... 999	1
Type	■ 1900 ■ 1800	1900
Baudrate	■ High ■ Low	High
Data Mode	■ 20 m ■ 30 m ■ Decimal ■ Fracional	20 m
Temperature	■ With Temp ■ No Temp	With Temp
TempOffset	■ Enable ■ Disable	Disable
Alarm Ref 1	Any Discrete Value	IS Digital In 1
Alarm Ref 2	Any Discrete Value	IS Digital In 2

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: High) (Protected by W&M Switch)

Type (9213)

Device Type: Indicates which Mark/Space device the NRF590 will emulate. (Default: 1900) (Protected by W&M Switch)

Data Mode (9214)

Indicates which type of data format will be used in the reply. (Default: 20 m) (Protected by W&M Switch)

Temperature (9215)

Temperature Mode: Indicates if a temperature will be returned or not. (Default: With Temp) (Protected by W&M Switch)

Temp. Offset (9216)

Temperature Offset: Indicates if the temperature value returned should have the offset applied to it. (Default: Enabled) (Protected by W&M Switch)

Submenu "Extended Setup" (922X)

Alarm Ref 1 (9221)

Alarm Bit 1 Reference: Reference to the parameter to be returned as the alarm bit 1. (Default: IS DI #1, Value)

Alarm Ref 2 (9222)

Alarm Bit 2 Reference: Reference to the parameter to be returned as the alarm bit 2. (Default: IS DI #2, Value)

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 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 Mark/Space response will contain 2 measurement values; level and temperature as well as 2 alarm bits indicating the status of the two Tank Side Monitor discrete IOs. Depending on the setting of the Mark/Space parameters these values are subject to the following limits.

5.1.1 Level

Measurement Value	Mode/Type	Value Range	Units
Level [1)]	Fractional	0-0-0 ... 79-11-15	ft-in-16^{ths}
	Decimal	0.0 ... 79.99	ft
	20 meters	0.0 ... 19.999	m
	30 meters	0.0 ... 32.699	m
Temperature [2)]	1800	-199.9 ... +199.9	Tank Temp Units
	1900	-799.9 ... +799.9	Tank Temp Units
Alarm 0	State Alarm Ref 1		
Alarm 1	State Alarm Ref 2		

1) The level is obtained from the Level value.

2) The temperature is obtained from the TANK Temperature value.

For a detailed description of the message formats see→ Page 9 ff.

5.2 Measured Value Error Handling

The following error handling rules are applied to all values returned in the Mark/Space message. Refer to the Table → Chap. 1.1.1 for related minimum and maximum values.

1. If the Tank Corrected Level is not valid or outside of the value range shown an illegal gray code is transmitted in the level position of the reply. For details see → Page 9 ff.
2. If the Tank Temperature is greater than the maximum shown then
   a. for Device Type = 1800: Bit 43 of the reply is set and the temperature value should be ignored.
   b. for Device Type = 1900: The maximum value is returned.
3. 3. If the Tank Temperature is less than the minimum shown then
   a. for Device Type = 1800: Bit 43 & bit 40 of the reply are set and the temperature value should be ignored.
   b. for Device Type = 1900: The minimum value is returned.

6 Mark/Space Message Formats

6.1 Physical Layer

The Mark/Space communication takes place on a pair of voltage mode cables normally at 48VDC (one called Mark the other called Space). Bits are represented by either one or the other of these cables going low to (0VDC), logic 1 if it is the Mark line or logic 0 if it is the Space line. The width of the pulses and the gaps between them are determined by the Mark/Space "Speed Mode" parameter.
These bits are then assembled in to message blocks.

6.2 Request Message

The request is a sequence of 16 data bits sent from the control room, these bits encode the device whose data is requested as well as special function bits for the 6500 servo gauge.

Mark/Space Request Message

Bit	Description
1st	Start bit
2nd	Unused bit
3rd	Raise command (for 6500 servo gauge)
4th	Reset command (for 6500 servo gauge)
5th ... 8th	Device ID 100 (bit 8 is the least significant of the BCD digit)
9th ... 12th	Device ID 10 (bit 12 is the least significant of the BCD digit)
13th ... 16th	Device ID 1 (bit 16 is the least significant of the BCD digit)

6.3 Reply Message

The reply from the Tank Side Monitor depends on the Mark/Space interface settings of the Tank Side Monitor.

6.3.1 40-bit Response (if "Temperature" = "No Temp")

If the "Temperature" parameter is set to "No Temp", the reply from the Tank Side Monitor consists of 40 bits of information arranged as follows.

Bit	Description
1st	Start bit
2nd and 3rd	Unused bit
4th ... 7th	Device ID 100 (bit 8 is the least significant of the BCD digit)
8th ... 11th	Device ID 10 (bit 12 is the least significant of the BCD digit)
12th ... 15th	Device ID 1 (bit 16 is the least significant of the BCD digit)
16th	First data bit always 0
17th ... 37th	Level Data
38th	Alarm 1 (state of Alarm Bit 2)
39th	Alarm 0 (state of Alarm Bit 1)
40th	Parity bit

6.3.2 56-bit Response (if "Temperature" = "With Temp")

If the "Temperature" parameter is set to "With Temp", the reply from the Tank Side Monitor consists of 56 bits of information arranged as follows.

Bit	Description
1st	Start bit
2nd and 3rd	Unused bit
4th ... 7th	Device ID 100 (bit 8 is the least significant of the BCD digit)
8th ... 11th	Device ID 10 (bit 12 is the least significant of the BCD digit)
12th ... 15th	Device ID 1 (bit 16 is the least significant of the BCD digit)
16th	First data bit always 0
17th ... 37th	Level Data
38th	Alarm 1 (State of Alarm Ref 2)
39th	Alarm 0 (State of Alarm Ref 1)
40th ... 55th	Temperature Data
56th	Parity bit

6.3.3 Level Data

The level data part of the reply from the Tank Side Monitor consists of 21 bits of information arranged as follows depending on the Data Mode setting.

Data Mode = Fractional

Bit	Description
16th	First data bit always 0
17th ... 19th	Feet 10
20th ... 23rd	Feet 1
24th ... 27th	Inches
28th ... 31st	16ths inch
32nd ... 37th	filled with 0

Data Mode = Decimal

Bit	Description
16th	First data bit always 0
17th ... 19th	Feet 10
20th ... 23rd	Feet 1
24th ... 27th	Feet 0.1
28th ... 31st	Feet 0.01
32nd ... 37th	filled with 0

Data Mode = 20m

Bit	Description
16th	Meters 10
17th ... 20th	Meters 1
21st ... 24th	Meters 0.1
25th ... 28th	Meters 0.01
29th ... 32nd	Meters 0.001
33rd ... 37th	filled with 0

Data Mode = 30m

Bit	Description
16th ... 17th	Meters 10
18th ... 21st	Meters 1
22nd ... 25th	Meters 0.1
26th ... 29th	Meters 0.01
30th ... 33rd	Meters 0.001
34th ... 37th	filled with 0

Each level digit is encoded using reflected binary gray pulse coding.

6.3.4 Temperature Data

The temperature data part of the reply from the Tank Side Monitor consists of 16 bits of information arranged as follows depending on the Device Type setting:

Bit	Device Type = 1800	Device Type = 1900
40th	Error bit	Temperature 100 (bit 0)[1]
41st	Sign (1 = +ve Temperature)	Sign (1 = +ve Temperature)
42nd	Unused	Temperature 100 (bit 1)[1]
43rd	Error bit	Temperature 100 (bit 2)[1]
44th ... 47th	Temperature 10	Temperature 10
48th ... 51st	Temperature 1	Temperature 1
52nd ... 55th	Temperature 0.1	Temperature 0.1

[1]These bits are inverted.

www.endress.com/worldwide

Endress+Hauser

People for Process Automation

KA249F/00/en/11.06
71001229
CCS/FM+SGML 6.0/ProMoDo

71001229