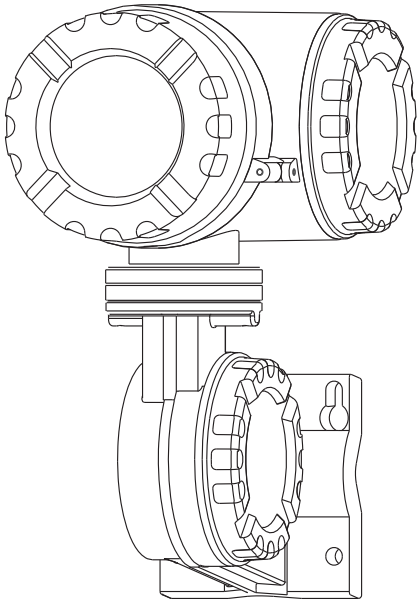
4590 Tank Side Monitor

Mark/Space Communication Protocol

Service Manual

Software Version v2.03



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Contents

1 Introduction

This protocol guide explains the operation of the Mark/Space protocol implemented in the Varec 4590 Tank Side Monitor (TSM).

2 Implementation

The implementation of the Mark/Space protocol for the 4590 TSM 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 4590 TSM communicates with existing Mark/Space 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, exceptions have been made and noted.

Note! There is no guarantee that the interpretation made here is 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.

Table 2-1 lists the two Types of Communication supported by the Mark/Space interface.

Table 2-1: ***Mark/Space Types***

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

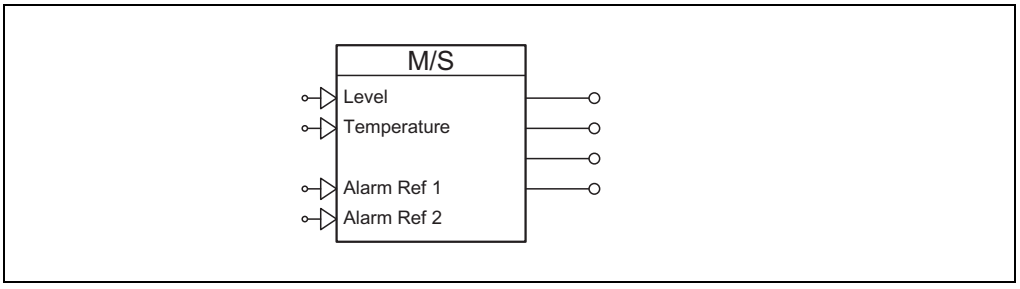

Figure 2-1: Function Block "Mark/Space Out"

3 Installation Recommendations

Follow these recommendations for field installation of the 4590 TSM with the Mark/Space protocol variant:

- Use two twisted pairs of 18 AWG wire (one power and one communication).
- Connect the units in parallel as shown in Figure 3-1.
- The maximum tested cable length is 8 km.

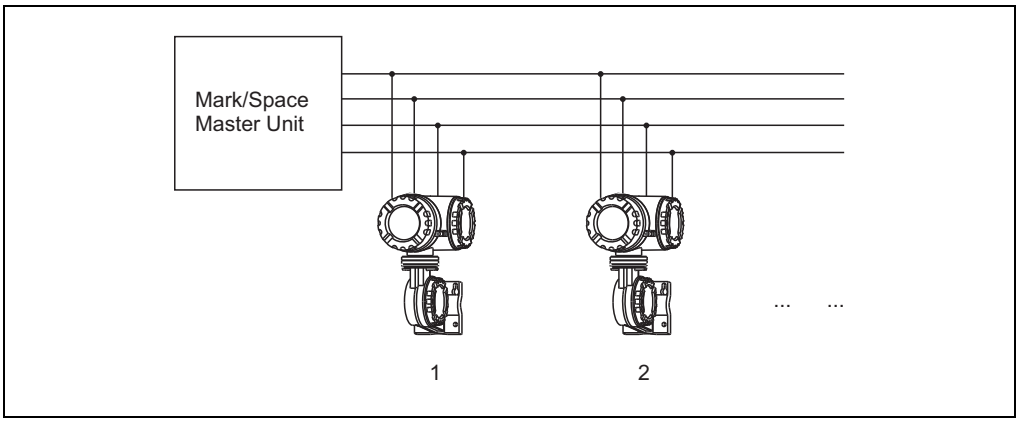

Figure 3-1: Mark/Space Master Units

4 Configuration

The Mark/Space interface on the 4590 TSM must be configured to establish communication. The local display or ToF tool allows the user to set the 4590 TSM Mark/Space interface to match the Mark/Space master settings.

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 999 and must be unique for each Mark/Space device on a bus. Each 4590 TSM only responds when a query has been sent to its unique address by the host.

4.2 Configuration Settings

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 Basic Configuration Parameters

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

Table 4-1: 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 • Fractional	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

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	Default	Protected
ID(9211)	This is the identifier value.The 4590 TSM responds to requests which contain this identifier value.	1	W&M Switch
Baud Rate(9212)	Selects which of the possible baud rates communication should work.	High	W&M Switch
Type(9213) (Device Type)	Indicates which Mark/Space device the 4590 TSM emulates.	1900	W&M Switch
Data Mode(9214)	Indicates which type of data format is used in the reply.	20 m	W&M Switch
Temperature(9215) (Temperature Mode)	Indicates if a temperature will be returned or not.	With Temp	W&M Switch
Temp. Offset(9216) (Temperature Offset)	Indicates if the temperature value returned should have the offset applied to it.	Enabled	W&M Switch

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

Table 4-3: Submenu "Extended Setup" (922X)

Field	Description	Default
Alarm Ref 1(9221) (Alarm Bit 1 Reference)	Reference to the parameter to be returned as the alarm bit 1.	IS DI #1, Value
Alarm Ref 2(9222) (Alarm Bit 2 Reference)	Reference to the parameter to be returned as the alarm bit 2.	IS DI #2, Value

Table 4-4 summarizes the configuration parameter that make up the Diagnostics Submenu.

Table 4-4: 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.	The height of the bar represents the activity during the last second: • Replied to Host (largest bar) • Received Request for this 4590 TSM • Request for another gauge on the 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

5.1 Measured Value Ranges

The Mark/Space response contains two measurement values—level and temperature as well as two alarm bits—indicating the status of the two 4590 TSM discrete IOs. Depending on the setting of the Mark/Space parameters, these values are subject to the following limits:

Table 5-1: Mark/Space Response

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

Refer to Chapter 6, Mark/Space Message Formats for a detailed description of the message formats.

5.2 Measured Values Error Handling

The following error-handling rules are applied to all values returned in the Mark/Space message:

Refer to Table 5-1 for the related minimum and maximum value ranges.

1. If the Level is not valid or is outside of the value range shown, an illegal gray code is transmitted in the level position of the reply. For details, see Chapter 6, Mark/Space Message Formats.
2. If the Temperature is greater than the maximum shown:
   - Device Type 1800: Bit 43 of the reply is set and the temperature value is ignored.
   - Device Type 1900: The maximum value is returned.
3. If the Temperature is less than the minimum shown:
   - Device Type 1800: Bit 43 & bit 40 of the reply are set and the temperature value is ignored.
   - 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 48 VDC (one called Mark and the other called Space). Bits are represented by either one or the other of these cables going low to (0 VDC)—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 into message blocks.

6.2 Request Message

The request message 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 Tank Gauge (STG).

Table 6-1 summarizes the Mark/Space Request Message for the 6500 STG.

Table 6-1: Mark/Space Request Message

Bit	Description
1	Start bit
2	Unused bit
3	Raise command (for 6500 STG)
4	Reset command (for 6500 STG)
5 – 8	Device ID 100 (bit 8 is the least significant of the BCD digit)
9 – 12	Device ID 10 (bit 12 is the least significant of the BCD digit)
13 – 16	Device ID 1 (bit 16 is the least significant of the BCD digit)

6.3 Reply Message

The reply message from the 4590 TSM depends on the Mark/Space interface settings of the 4590 TSM.

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

If the "Temperature" parameter is set to "No Temp", the reply from the 4590 TSM consists of 40 bits of information.

Table 6-2 summarizes the Reply Message from the 4590 TSM.

Table 6-2: Reply Message (if "Temperature" = "No Temp")

Bit	Description
1	Start bit
2 – 3	Unused bit
4 – 7	Device ID 100 (bit 8 is the least significant of the BCD digit)
8 – 11	Device ID 10 (bit 12 is the least significant of the BCD digit)
12 – 15	Device ID 1 (bit 16 is the least significant of the BCD digit)

Bit	Description
16	First data bit is always 0
17 – 37	Level Data
38	Alarm 1 (state of Alarm Bit 2)
39	Alarm 0 (state of Alarm Bit 1)
40	Parity bit

56-bit Response (if “Temperature” = “With Temp”)

If the “Temperature” parameter is set to “With Temp”, the reply from the 4590 TSM consists of 56 bits of information.

Table 6-3 summarizes the Reply Message from the 4590 TSM.

Table 6-3: Reply Message if "Temperature" = "With Temp"

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

Level Data

The level data, part of the reply from the 4590 TSM, consists of 21 bits of information arranged as follows depending on the Data Mode setting.

Table 6-4: Data Mode = Fractional

Bit	Description
16	First data bit is always 0
17 – 19	10 Feet
20 – 23	1 Foot
24 – 27	Inches
28 – 31	16^{ths} inch
32 – 37	Filled with zeros

Table 6-5: Data Mode = Decimal

Bit	Description
16	First data bit is always 0
17 – 19	10 Feet
20 – 23	1 Foot
24 – 27	0.1 Feet
28 – 31	0.01 Feet
32 – 37	Filled with zeros

Table 6-6: Data Mode = 20 m

Bit	Description
16	10 Meters
17 – 20	1 Meter
21 – 24	0.1 Meters
25 – 28	0.01 Meters
29 – 32	0.001 Meters
33 – 37	Filled with zeros

Table 6-7: Data Mode = 30 m

Bit	Description
16 – 17	10 Meters
18 – 21	1 Meter
22 – 25	0.1 Meters
26 – 29	0.01 Meters
30 – 33	0.001 Meters
34 – 37	Filled with zeros

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

Temperature Data

The temperature data, part of the reply from the 4590 TSM, consists of 16 bits of information arranged as follows depending on the Device Type setting.

Table 6-8: Temperature Data

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

1) These bits are inverted.

NOTES

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