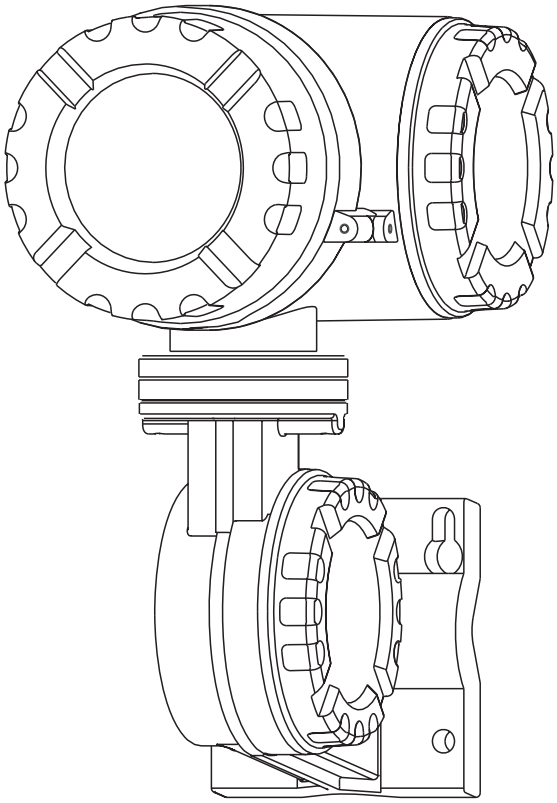
Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

WM550 communication protocol

Tank Side Monitor NRF590

Inventory Control



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Endress+Hauser

People for Process Automation

Table of contents

1 Introduction

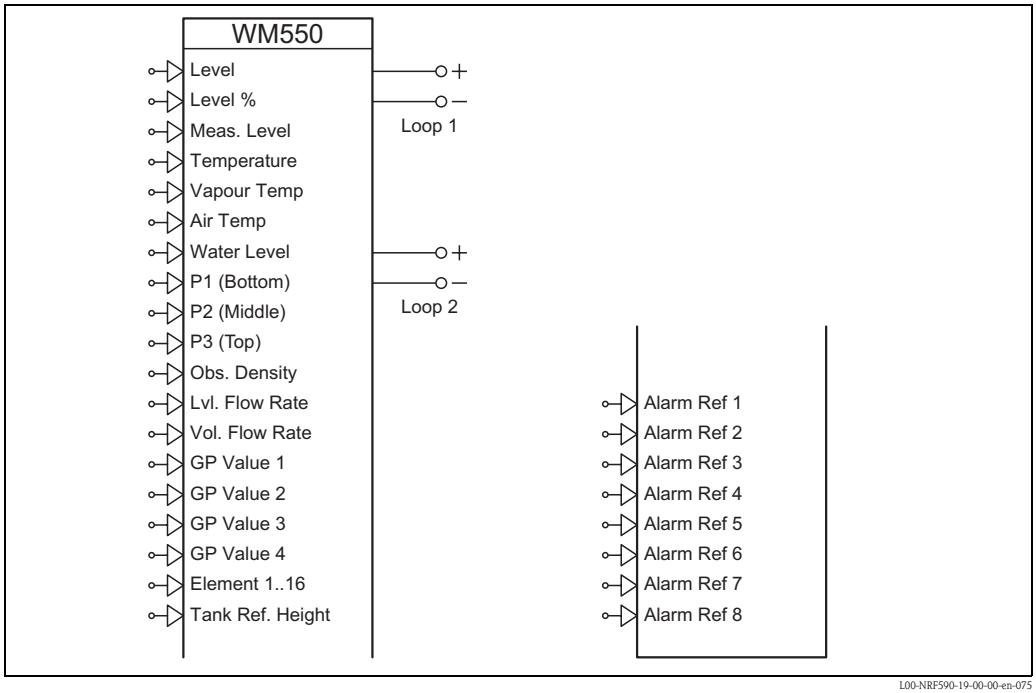
This protocol guide explains the operation of the WM550 protocol implemented in the Endress+Hauser Tank Side Monitor NRF 590.

2 Implementation

The implementation of the WM550 protocol for the Tank Side Monitor provides a standard form of digital communication via dual current loops. An effort has been made to provide the most complete and functional WM550 implementation in the Tank Side Monitor in order to provide communication with the existing 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. Some implementation exceptions were made because of the unique requirements of the Tank Side Monitor application and are pointed out in this document.

Note!
This is no guarantee, however, that the interpretation made here will be the same as that followed by the WM550 master.

The Tank Side Monitor implementation of the WM550 protocol supports a variety of tasks. For a detailed description refer to → Chap. 6.2.



3 Installation recommendation

3.1 Cable specifications for the WM550 protocol

Please ensure to follow the following recommendations for field installation of the NRF590 with the WM550 protocol variant:

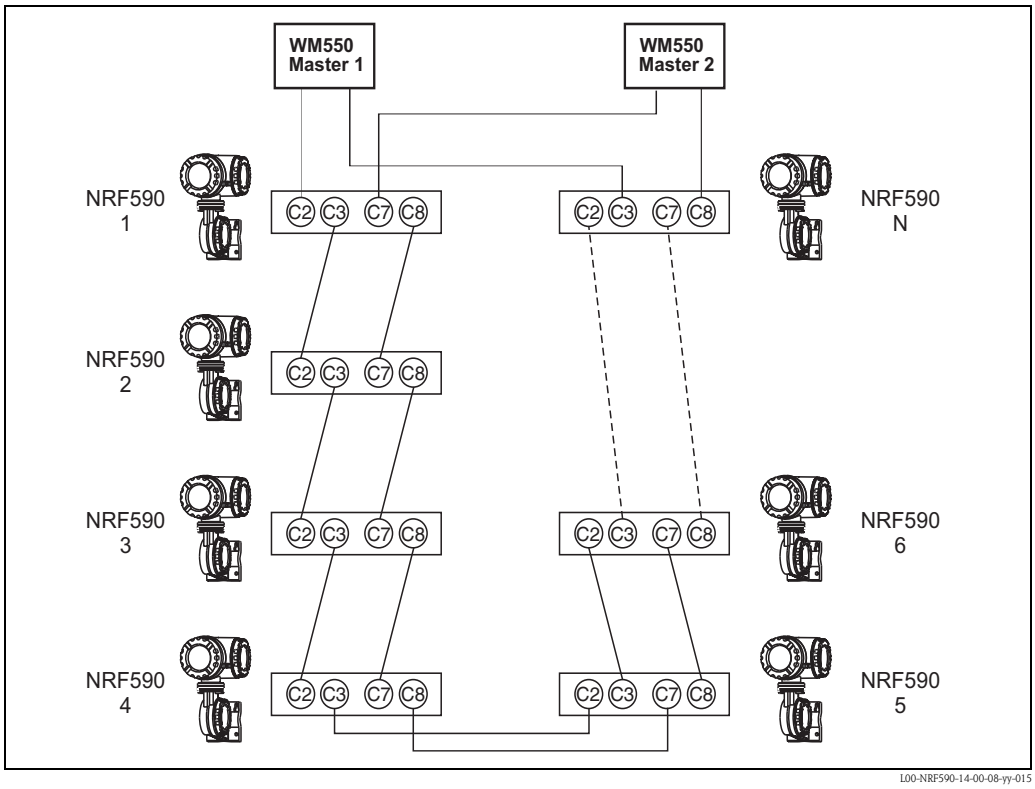
- Cable with twisted and non-shielded pairs
- Cable with at least 0.5 mm^2 section
- Maximum total cable resistance: 250 Ω
- Cable with low capacitance
- The maximum numberof field devices for the WM550 protocol is 16 (excl. master unit)

Table 1 below gives the physical characteristics of 3 typical cables. The use of a cable with a large cross section is advised for long cable length, but may require the use of a slower baud rate (because of the higher capacitance).

Table1: Typical cable specifications

	Cross section [mm^2]	Resistance [Ω/km]	Capacitance [nF/km]
Cable 1	0.5	39.2	60
Cable 2	0.75	24.6	65
Cable 3	1.3	14.2	75

3.2 Example topology



4 Configuration

The WM550 ports (loop 1 and loop 2) on the Tank Side Monitor must each be configured to establish communications. The local display or ToF tool allows the user to set the Tank Side Monitor WM550 ports to match the WM550 master.

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 63 and must be unique for each WM550 device on a loop. 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 to achieve successful communication on a WM550 loop a number of configuration settings must be entered to match the configuration of the loop. A summary of the configuration information required by the Tank Side Monitor is shown in → Chap. 2.

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.

WM550 configuration information

Configuration Item	Valid Entries	Default
ID	0 ... 63	1
Baudrate	■ 150 ■ 300 ■ 600 ■ 1200 ■ 1800 ■ 2400 ■ 4800	2400
Loop 2	As loop 1, Different	As Loop 1
Baudrate 2	■ 150 ■ 300 ■ 600 ■ 1200 ■ 1800 ■ 2400 ■ 4800	2400
Software ID	0 ... 9999	2000
Alarm 1	■ Reference to any discrete or alarm value inside the TSM	Level Alarm HH
Alarm 2		Level Alarm H [1)]
Alarm 3		Level Alarm L [2)]
Alarm 4		Level Alarm LL
Alarm 5	■ Reference to any discrete or alarm value inside the TSM	Undefined [3)]
Alarm 6		Undefined [3]
Alarm 7		Undefined [3]
Alarm 8		Undefined [3]

1) If an alarm bit is set to AAL#1 High, it will be set for both AAL#1 High and AAL#1 High-High alarm conditions.

2) If an alarm bit is set to AAL#1 Low, it will be activated for both AAl#1 Low and AAl#1 Low-Low alarm conditions.

3) These parameters are not currently in use and are present for future expansion only.

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: 2400) (Protected by W&M Switch)

Software Id (9213)

Software Identification Value: Describes which parity type will be used for the communication (Default: 2000) (Protected by W&M Switch)

Submenu "Extended Setup" (922X)

Alarm Ref 1 (9221)

Alarm No 1 Reference: Indicates which discrete value will be transmitted as Alarm Bit 1 (Default: Level Alarm, Alarm HH Active)

Alarm Ref 2 (9222)

Alarm No 2 Reference: Indicates which discrete value will be transmitted as Alarm Bit 2 (Default: Level Alarm, Alarm H Active)

Alarm Ref 3 (9223)

Alarm No 3 Reference: Indicates which discrete value will be transmitted as Alarm Bit 3 (Default: Level Alarm, Alarm L Active)

Alarm Ref 4 (9224)

Alarm No 4 Reference: Indicates which discrete value will be transmitted as Alarm Bit 4 (Default: Level Alarm, Alarm LL Active)

Alarm Ref 5 (9225)

Alarm No 5 Reference: Indicates which discrete value will be transmitted as Alarm Bit 5 (Default: Undefined)

Alarm Ref 6 (9226)

Alarm No 6 Reference: Indicates which discrete value will be transmitted as Alarm Bit 6 (Default: Undefined)

Alarm Ref 7 (9227)

Alarm No 7 Reference: Indicates which discrete value will be transmitted as Alarm Bit 7 (Default: Undefined)

Alarm Ref 8 (9228)

Alarm No 8 Reference: Indicates which discrete value will be transmitted as Alarm Bit 8 (Default: Undefined)

Submenu "Loop 2" (923X)

Loop 2 (9231)

Loop 2 Operation Mode: Specifies if both loops use the same baud rate or not. (Default: As Loop 1) (Protected by W&M Switch)

Baud Rate (2) (9232)

Baud Rate (Loop 2): Selects which of the possible baud rates the second loop will communication with if loop mode is set to different, otherwise both loops will use the normal baud rate. (Default: 2400) (Protected by W&M Switch)

Submenu "Diagnostics" (924X)

Output Status (9241)

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 the same 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).

Submenu "Diagnostics 2" (925X)

Output Status (9251)

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 the same 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 WM550 response will contain a number of measurement values, level, temperature, percentage, density and pressure. These values are subject to the following limits.

Measured Value	Minimum	Maximum	Granularity	Units	Tank Parameter [1]
Level	0	65000	1	mm	Level
Temperature	-400.0	+400.0	0.1	°C	Temperature
Percentage [2]	0.00	100.00	0.01	%	Percentage Level[2]
Pressure	0.0	25.0	0.1	bar	P3 (Top) Pressure
Density	0.0	9999.9	0.1	kg/m^3	Obs. Density
Tank Height	0	65000	1	mm	Tank Ref Hght
BSW	0	9999	1	mm	Water Level
Element Temps	-200.0	+200.0	0.1	°C	NMT Element Temps [3]

1) This column indicates the source of the value return by the WM550 communication.

2) The percentage is calculated from the Level and Reference Height values.

3) Element temperatures can only be provided if a NMT multi-element temperature device is connected to the Tank Side Monitor. In this case the first value returned is the NMT Element #1 temperature value, the second is NMT Element #2, etc.

5.2 Measured Value Error Handling

The following error handling rules are applied to all values returned in the WM550 message. Refer to → Chap. 5.1 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) invalid or offline the appropriate WM550 invalid bit or code is returned for that value along with the appropriate diagnostic code.

Note!
If an Endress + Hauser FMR radar is connected to the Tank Side Monitor and used for level values, a "in safety distance" or "echo lost" error condition will cause a maximum level value to be returned on the WM550 bus and not a data invalid. The FMR and Tank Side Monitor must be properly configured for alarm handling, refer to Tank Side Monitor documentation for details.

6 WM550 Message Formats

6.1 Physical Layer

The WM550 communication takes place on a 20mA current loop. Bits are represented by current flowing or not in the loop. These bits are generated and interpreted by a standard serial communication controller (UART) running at the selected baudrate and communication settings (see → Chap. 4.2.2).
Each group of 7 or 8 bits together with there start, stop and parity if required represents an ASCII character forming the elements of the messages.

6.2 Protocol Layer

The request messages on the bus (called Tasks) instruct the device what data or action is required, the device will then reply with the appropriate response.
Below you will find information for the supported tasks which shows the value returned by the Tank Side Monitor to the given request. It is not intended to fully describe the WM550 protocol which can be found in the "Whessoe Varec Fieldbus Protocol Definition" document (1st January 1997).
The following table shows an overview of the Different tasks and subtasks supported by the NRF590.

WM550 supported tasks

Task	Sub Task	Task Name
1		Status Report
4		Alarms, Level, Temperature
6		Percentage Level
9		Stow Command
11		Unstow Command
12		Programmed Tank Height
13		Averaging Temperature Data
17	3	BSW value
	10	Datum, Position, Value
	11	Average Density
18	3	BSW Value
	4	Density
27		Alarms, Level, Temperature, Percentage Level
28		Alarms, Level, Temperature, Percentage Level
30		Alarms, Level, Temperature, Percentage Level, Pressure
31		Alarms, Level, Temperature, Percentage Level, Pressure
32		Software Identification and Date
36		Alarms, Level, Temperature, Percentage Level, Pressure, Head Status, Position
38		Intelligent Sensing Head Command

6.2.1 Task 1 (Status Report)

Value	Type	Value Returned	Notes
Gauge Servoing	bit	0	
Gauge Stowed	bit	0	
Stow Received on Port 1	bit	0	
Stow Received on Port 2	bit	0	
NOVRAM corrupted	bit	0	
Multi-element Thermometer fitted	bit	■ 0 if no NMT53x conntected ■ 1 if NMT53x conntected	
Selected Element of Thermometer	number	■ 0 if no NMT53x conntected ■ 1 if NMT53x conntected	
Ref. Voltage	number	0	
Ref. Voltage is DN	bit	0	
Calibration	2 bits	0	

6.2.2 Tasks 4 (Alarms, Level, Temp), 9 (Stow), 11 (Unstow)

Value	Type	Value Returned	Notes
Alarm No 1	bit	1 if linked discrete IO or alarm is on.	
Alarm No 2	bit	1 if linked discrete IO or alarm is on.	
Alarm No 3	bit	1 if linked discrete IO or alarm is on.	
Alarm No 4	bit	1 if linked discrete IO or alarm is on.	
Servo Check	bit	1 if a dip freeze is in progress	
Level	number	from Tank Corr. Level	in mm
Temperature	number	from Tank Temp.	in 0.1 °C

6.2.3 Task 6 (Percentage Level)

Value	Type	Value Returned	Notes
Percentage Level	number	from Tank Percent Range	in 0.01%

6.2.4 Task 12 (Programmed Tank Height)

Value	Type	Value Returned	Notes
Alarm No 1	bit	1 if linked discrete IO or alarm is on.	
Alarm No 2	bit	1 if linked discrete IO or alarm is on.	
Alarm No 3	bit	1 if linked discrete IO or alarm is on.	
Alarm No 4	bit	1 if linked discrete IO or alarm is on.	
Servo Check	bit	1 if a dip freeze is in progress	
Tank Height Level	number	From Tank Ref Hght.	in mm

6.2.5 Task 13 (Averaging Thermometer Data)

If an NMT53x is connected to the Tank Side Monitor this task returns the element numbers and temperature for each element in the device.

Value	Type	Value Returned	Notes
Element Number	number	1 ... 15	
Element Temperature	number	from NMT Element #1 ... #15	in 0.1 °C

6.2.6 Task 17 (Density and BSW Probe Data)

Sub-Task 3 (BSW Value)

Value	Type	Value Returned	Notes
BSW	number	from Tank Water Level	in mm

Sub-Task 10 (Datum Position Value)

Value	Type	Value Returned	Notes
Datum	number	0	

Sub-Task 11 (Density Value)

Value	Type	Value Returned	Notes
Density	number	from Tank Obs. Density	in 0.1 kg/m^3
Temperature	number	from Tank Temp.	in 0.1 °C

6.2.7 Task 18 (Density and BSW Probe Data)

Sub-Task 3 (BSW Value)

Value	Type	Value Returned	Notes
BSW	number	from Tank Water Level	in mm

Note!
The Tank Side Monitor doesn't allow this task to modify the Water Level. If the host tries to set the value of the parameter (eight frames request) the TSM will simply ignore the command and echo back the received value.

Sub-Task 4 (Density Value)

Value	Type	Value Returned	Notes
Density	number	from Tank Obs. Density	in 0.1 kg/m^3

Note!
The Tank Side Monitor doesn't allow this task to modify the Density value. If the host tries to set the value of the parameter (eight frames request) the TSM will simply ignore the command and echo back the received value.

6.2.8 Tasks 27 and 28 (Alarms, Level, Temperature, Percent Level)

Value	Type	Value Returned	Notes
Alarm No 1	bit	1 if linked discrete IO or alarm is on.	
Alarm No 2	bit	1 if linked discrete IO or alarm is on.	
Alarm No 3	bit	1 if linked discrete IO or alarm is on.	
Alarm No 4	bit	1 if linked discrete IO or alarm is on.	
Servo Check	bit	1 if a dip freeze is in progress	
Level	number	from Tank Corr. Level	in mm
Temprature	number	from Tank Temp.	in 0.1 °C
Percentage Level	number	from Tank Percent Range	in 0.01%

6.2.9 Tasks 30 and 31 (Alarms, Level, Temperature, Percent Level, Pressure)

Value	Type	Value Returned	Notes
Alarm No 1	bit	1 if linked discrete IO or alarm is on.	
Alarm No 2	bit	1 if linked discrete IO or alarm is on.	
Alarm No 3	bit	1 if linked discrete IO or alarm is on.	
Alarm No 4	bit	1 if linked discrete IO or alarm is on.	
Servo Check	bit	1 if a dip freeze is in progress	
Level	number	from Tank Corr. Level	in mm
Temprature	number	from Tank Temp.	in 0.1 °C
Percentage Level	number	from Tank Percent Range	in 0.01%
Pressure	number	from Tank P3 (Top) Pressure	in 0.1 bar

6.2.10 Task 32 (Software Identification and Date)

Value	Type	Value Returned	Notes
Software ID	number	from Wm550 Software ID	
Software Date	number	day, month, year	

6.2.11 Task 36 (Alarms, Level, Temperature, Percent level, Pressure, Head Status, Positions

Value	Type	Value Returned	Notes
Alarm No 1	bit	1 if linked discrete IO or alarm is on.	
Alarm No 2	bit	1 if linked discrete IO or alarm is on.	
Alarm No 3	bit	1 if linked discrete IO or alarm is on.	
Alarm No 4	bit	1 if linked discrete IO or alarm is on.	
Servo Check	bit	1 if a dip freeze is in progress	
Level	number	from Tank Corr. Level	in mm
Temprature	number	from Tank Temp.	in 0.1 °C
Percentage Level	number	from Tank Percent Range	in 0.01%
Pressure	number	from Tank P3 (Top) Pressure	in 0.1 bar
Seeking Level	bit	0	
Doing Profile	bit	0	
Doing Dip	bit	0	
Finding BSW	bit	0	
Following BSW	bit	0	
Finding Datum	bit	0	
Following Level	bit	0	
Density Sensor	bit	0	
Temperature Sensor	bit	0	
BSW Sensor	bit	0	
Datum Sensor	bit	0	
1 Minute Warning	bit	0	
Configuration Warning	bit	0	
Liquid State (1=Homogenous)	bit	0	
Liquid State Unknown	bit	0	
ISH fitted	bit	0	
Sensor Positions	number	invalid value	

6.2.12 Task 38 (Intelligent Sensing Head Command)

Same data is returned as in Task 36. The command and control information in the request is ignored.

6.2.13 Un-supported Tasks

If a request is received by the Tank Side Monitor for a task which it does not support, a "Task 0: Error Return" message is sent as a reply with the error number "1".

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