Transmitter-Specific Command Specification

for

Transmitter 2220 X
Transmitter 4220 X
Transmitter 7220 X

using the HART® Communications Protocol

Revision 3.0

TE-196.100-MTE02

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1. Reference Documents

Document Title	Revision	Document Number
HART® - FSK Physical Layer Specification	8.0	HCF_SPEC-54
HART® - Data Link Layer Specification	7.1	HCF_SPEC-81
HART® - Command Summary Specification	7.1	HCF_SPEC-99
HART® - Universal Command Specification	5.2	HCF_SPEC-127
HART® - Common Practice Command Specification	7.1	HCF_SPEC-151
HART® - Common Tables	9.0	HCF_SPEC-183
Appendix 1 - Command Specific Response Code Definitions	4.1	HCF_SPEC-307
Application Layer Guideline on HART Status Information	1.0	HCF_LIT-5

2.   Expanded Device Type Code

Manufacturer Identification Code: Mettler Toledo   142

Manufacturer's Device Type Code: Transmitter 2220 X   127
                                   Transmitter 7220 X   126
                                   Transmitter 4220 X   125

3.   Physical Layer Information

Field Device Category   A   (Field Instruments sink direct current from Network
                                          and receive operating power from the Network)

Capacitance Number (CN)   2   (approx. 2 x 5000 pF)

4.   Conformance and Command Class Summary

CONFORMANCE CLASS #1
- UNIVERSAL
0   Read Unique Identifier
1   Read Primary Variable

CONFORMANCE CLASS #1A
- UNIVERSAL
0   Read Unique Identifier
2   Read P. V. Current and Percent of Range

CONFORMANCE CLASS #2
- UNIVERSAL
11   Read Unique Identifier Associated with Tag
12   Read Message
13   Read Tag, Descriptor, Date
14   Read Primary Variable Sensor Information
15   Read Primary Variable Output Information
16   Read Final Assembly Number

CONFORMANCE CLASS #3
- UNIVERSAL
3   Read Dynamic Variables and P. V. Current
- COMMON-PRACTICE
33   Read Transmitter Variables
48   Read Additional Transmitter Status
50   Read Dynamic Variable Assignments
54   Read Transmitter Variable Information
60   Read Analog Output and Percent of Range
63   Read Analog Output Information

CONFORMANCE CLASS #4
-COMMON-PRACTICE
35   Write Primary Variable Range Values
36   Set Primary Variable Upper Range Value
37   Set Primary Variable Lower Range Value
38   Reset Configuration Changed Flag
40   Enter/Exit Fixed Primary Variable Current Mode
41   Perform Transmitter Self Test
66   Enter/Exit Fixed Analog Output Mode

CONFORMANCE CLASS #5
- UNIVERSAL
6   Write Polling Address
17   Write Message
18   Write Tag, Descriptor, Date
19   Write Final Assembly Number
- COMMON-PRACTICE
51   Write Dynamic Variable Assignments
59   Write Number of Response Preambles
- TRANSMITTER-SPECIFIC
128   Read One Transmitter-Specific Variable
129   Write One Transmitter-Specific Variable
130   Read Actual Usage-No., Options and Variable-No. of Output 2
131   Product Calibration TAKE
132   Product Calibration CALCULATE

5.   Additional Response Code Information

FIRST BYTE

5.1. BUSY
Response Code #32

The Busy Response Code is implemented for Commands #6, #18, #35, #36, #37, #51 and #59. A confirming response is made before execution begins. The Busy Response Code is returned when a command is received during the execution.

SECOND BYTE

5.2. FIELD DEVICE MALFUNCTION
Bit #7

Malfunctions detected by the transmitter:
◊   CRC-Error in internal Configuration Data of the transmitter.
◊   After Reset or Power up
     (See HCF_LIT-5: Application Layer Guideline on HART Status Information)

5.3. CONFIGURATION CHANGED
Bit #6

When the Parameter Setting Data changed, this Bit will be set. The Command #38 resets the Flag.

5.4. MORE STATUS AVAILABLE
Bit #4

This Bit is set if more status information can be read with Command #48.

5.5. PRIMARY VARIABLE ANALOG OUTPUT FIXED
Bit #3

This bit is set if output current 1 has been frozen by corresponding operation at the transmitter or if the output has been fixed via HART with the Command #40 or #66 or in the case of reset or power failure during start-up.

5.6. PRIMARY VARIABLE ANALOG OUTPUT SATURATED
Bit #2

This flag is set whenever the Primary Variable Analog Output saturates below 4.0 milliamperes and above 20 milliamperes.

5.7. NON-PRIMARY VARIABLE OUT OF LIMITS
Bit #1

This flag is set whenever the Non-Primary Variable exceeds the transmitter operating limits. Command #48, Read Additional Transmitter Status, provides additional information.

5.8. PRIMARY VARIABLE OUT OF LIMITS
Bit #0

This flag is set whenever the Primary Variable exceeds the Sensor Limits returned with Command #14, Read Primary Variable Sensor Information.

6. General Transmitter Information

6.1. DAMPING IMPLEMENTATION

The transmitter has a fixed damping value.

6.2. NONVOLATILE MEMORY DATA STORAGE

The Flags Byte of Command #0 referenced in the Universal Command Specification document, will have Bit #1 (Command #39, EEPROM Control, Required) set to 0, indicating that all data sent to the transmitter will be saved automatically in the nonvolatile memory upon receipt of the Write or Set Command. Command #39, EEPROM Control, is not implemented.

6.3. MULTIDROP OPERATION

This revision of the Transmitter 2220X, 4220X, 7220X supports Multidrop Operation.

6.4. BURST MODE

This revision of the Transmitter 2220X, 4220X, 7220X does **not** support Burst Mode.

6.5. UNIT CONVERSIONS

All temperatures are based of degrees Celsius.

7. Additional Universal Command Specification

This section contains information pertaining to those commands that require clarification

7.1. COMMAND #3 - READ DYNAMIC VARIABLES AND P. V. CURRENT

The Primary Variable provides the measured value assigned to output current 1 (current 1, measured variable).

Variables 2 - 4 can be selected from the available Transmitter Variables (see 10.4) with Command #51.

8. Additional Common-Practice Command Specification

The Transmitter 2220X, 4220X, 7220X implements a subset of the Common-Practice Commands specified in the Common-Practice Command Specification document. This section contains information pertaining to those commands that require clarification.

8.1. COMMAND #35 - WRITE PRIMARY VARIABLE RANGE VALUES

The Primary Variable Range Unit Code accepted by this transmitter is only the current Unit Code for the Primary Variable.

8.2. COMMAND #38 - RESET CONFIGURATION CHANGED FLAG

This command is not only for the Primary Master, also Secondary Masters can reset the flag when no write protection is enabled.

Refer to HCF_LIT-5: Application Layer Guideline on HART Status Information

8.3. COMMAND #41 - PERFORM TRANSMITTER SELF TEST

The Transmitter Self Test (Device Diagnostics) starts immediately after execution of this command. The transmitter display shows the test progress. This has no effect on measurement. A RAM test, EPROM test (program module) and EEPROM test (parameter memory, transmitter calibration data) are performed. The test takes about 90 seconds. In the first 10 seconds (RAM Test) the HART communication with Transmitter 2220X, 4220X, 7220X can be disturbed.
The result can then be retrieved with Command #48, Read Additional Transmitter Status, bit 23.1.

8.4. COMMAND #42 - PERFORM MASTER RESET

This revision of the Transmitter 2220X, 4220X, 7220X does **not** support Master Reset.

8.5. COMMAND #48 - READ ADDITIONAL TRANSMITTER STATUS

This Command returns the Global Device Status, the Function Mode, Alarms and Errors, the results of a Transmitter Self Test and other transmitter information.

Byte #0   Global Status (NAMUR Status)
        Bit 0.0   - Failure
        Bit 0.1   - Warning
        Bit 0.2   - Function Check
        Bit 0.3   - Limit Contact
        Bit 0.4   - Frozen Outputs
        Bit 0.5   - Wash Contact
        Bit 0.6   - Service Request Status
        Bit 0.7   - Undefined

Byte #1   Global Alarm Status
        Bit 1.0   - Failure with Delay
        Bit 1.1   - Warning with Delay
        Bit 1.2   - Function Check with Fall delay
        Bit 1.3   - Undefined
        Bit 1.4   - Undefined
        Bit 1.5   - Alarm on Output Current 1
        Bit 1.6   - Alarm on Output Current 2
        Bit 1.7   - Alarm on Alarm Contact

Byte #2	Failure Messages #1		**2220X**	**7220X**	**4220X**
	Bit 2.0	- Fail Lo Dyn. Variable #0	pH	S/cm	O_2-Sat
	Bit 2.1	- Fail Hi ''	pH	S/cm	O_2-Sat
	Bit 2.2	- Fail Lo Dyn. Variable #1	mV	Conc	Conc
	Bit 2.3	- Fail Hi ''	mV	Conc	Conc
	Bit 2.4	- Fail Lo Dyn. Variable #2	°C	°C	°C
	Bit 2.5	- Fail Hi ''	°C	°C	°C
	Bit 2.6	- Fail Lo Dyn. Variable #3	ORP	Cell.	pO_2
	Bit 2.7	- Fail Hi ''	ORP	Cell.	pO_2

Byte #3	Failure Messages #2		**2220X**	**7220X**	**4220X**
	Bit 3.0	- Fail Lo Dyn. Variable #4	rH	-	Press
	Bit 3.1	- Fail Hi ''	rH	Feed	Press
	Bit 3.2	- Fail Lo Dyn. Variable #5	Ref-El	-	Imped.
	Bit 3.3	- Fail Hi ''	Ref-El	-	Imped.
	Bit 3.4	- Fail Lo Dyn. Variable #6	Glas-El	-	Zero
	Bit 3.5	- Fail Hi ''	Glas-El	-	Zero
	Bit 3.6	- Fail Lo Dyn. Variable #7	Zero	-	Slope
	Bit 3.7	- Fail Hi ''	Zero	-	Slope

Byte #4	Failure Messages #3		**2220X**	**7220X**	**4220X**
	Bit 4.0	- Fail Lo Dyn. Variable #8	Slope	-	-
	Bit 4.1	- Fail Hi ''	Slope	-	CTime
	Bit 4.2	- Fail Lo Dyn. Variable #9	-	-	-
	Bit 4.3	- Fail Hi ''	-	-	Feed
	Bit 4.4	- Fail Lo Dyn. Variable #10	-	-	-
	Bit 4.5	- Fail Hi ''	CTime	-	-
	Bit 4.6	- Fail Lo Dyn. Variable #11	-	-	-
	Bit 4.7	- Fail Hi ''	Feed	-	-

Byte #5	Failure Messages #4		**2220X**	**7220X**	**4220X**
	Bit 5.0	- Fail Lo Dyn. Variable #12	-	-	-
	Bit 5.1	- Fail Hi ''	-	-	-
	Bit 5.2	- Fail Lo Dyn. Variable #13	-	-	-
	Bit 5.3	- Fail Hi ''	-	-	-
	Bit 5.4	- Fail Lo Dyn. Variable #14	-	-	-
	Bit 5.5	- Fail Hi ''	-	-	-
	Bit 5.6	- Fail Lo Dyn. Variable #15	-	-	-
	Bit 5.7	- Fail Hi ''	-	-	-

Byte #6   Operating Mode #1   (Refer to Common Table XIV)
Byte #7   Operating Mode #2   (Refer to Common Table XIV)

Byte #8   Analog Output Saturated
    Bit 8.0   - Analog Output Number 1 saturated
    Bit 8.1   - Analog Output Number 2 saturated
    Bit 8.2 to 7 - Undefined

Byte #9   Bit 9.0 to 7   - Undefined
Byte #10   Bit 10.0 to 7 - Undefined

Byte #11   Analog Output Fixed
    Bit 11.0   - Analog Output Number 1 fixed
    Bit 11.1   - Analog Output Number 2 fixed
    Bit 11.2 to 7 - Undefined
Byte #12   Bit 12.0 to 7 - Undefined
Byte #13   Bit 13.0 to 7 - Undefined

Byte #14   Failure Messages #5
    Bit 14.0   - Fail System Failure
    Bit 14.1   - Fail CRC Error
    Bit 14.2   - Fail Sensor Failure
    Bit 14.3   - Fail Sensor Data
    Bit 14.4   - Undefined
    Bit 14.5   - Undefined
    Bit 14.6   - Undefined
    Bit 14.7   - Undefined

Byte #15   Failure Messages #6
    Bit 15.0   - Fail Concentration
    Bit 15.1   - Fail TC Range
    Bit 15.2   - Fail O_2 Input Range
    Bit 15.3   - Fail Hi conductance
    Bit 15.4   - Undefined
    Bit 15.5   - Undefined
    Bit 15.6   - Undefined
    Bit 15.7   - Undefined

Byte #16 Warning Messages #1		**2220X**	**7220X**	**4220X**
Bit 16.0	- Warn Lo Dyn. Variable #0	pH	S/cm	O_2-Sat
Bit 16.1	- Warn Hi ''	pH	S/cm	O_2-Sat
Bit 16.2	- Warn Lo Dyn. Variable #1	mV	Conc	Conc
Bit 16.3	- Warn Hi ''	mV	Conc	Conc
Bit 16.4	- Warn Lo Dyn. Variable #2	°C	°C	°C
Bit 16.5	- Warn Hi ''	°C	°C	°C
Bit 16.6	- Warn Lo Dyn. Variable #3	ORP	Cell.	pO_2
Bit 16.7	- Warn Hi ''	ORP	Cell.	pO_2

Byte #17 Warning Messages #2		**2220X**	**7220X**	**4220X**
Bit 17.0	- Warn Lo Dyn. Variable #4	rH	-	Press
Bit 17.1	- Warn Hi ''	rH	Feed	Press
Bit 17.2	- Warn Lo Dyn. Variable #5	Ref-El	-	-
Bit 17.3	- Warn Hi ''	Ref-El	-	-
Bit 17.4	- Warn Lo Dyn. Variable #6	Glas-El	-	Zero
Bit 17.5	- Warn Hi ''	Glas-El	-	Zero
Bit 17.6	- Warn Lo Dyn. Variable #7	Zero	-	Slope
Bit 17.7	- Warn Hi ''	Zero	-	Slope

Byte #18 Warning Messages #3		**2220X**	**7220X**	**4220X**
Bit 18.0	- Warn Lo Dyn. Variable #8	Slope	-	-
Bit 18.1	- Warn Hi ''	Slope	-	CTime
Bit 18.2	- Warn Lo Dyn. Variable #9	V_{ISO}	-	-
Bit 18.3	- Warn Hi ''	V_{ISO}	-	Feed
Bit 18.4	- Warn Lo Dyn. Variable #10	-	-	-
Bit 18.5	- Warn Hi ''	CTime	-	-
Bit 18.6	- Warn Lo Dyn. Variable #11	-	-	-
Bit 18.7	- Warn Hi ''	Feed	-	-

Byte #19 Warning Messages #4		**2220X**	**7220X**	**4220X**
Bit 19.0	- Warn Lo Dyn. Variable #12	-	-	-
Bit 19.1	- Warn Hi ''	-	-	-
Bit 19.2	- Warn Lo Dyn. Variable #13	-	-	-
Bit 19.3	- Warn Hi ''	-	-	-
Bit 19.4	- Warn Lo Dyn. Variable #14	-	-	-
Bit 19.5	- Warn Hi ''	-	-	-
Bit 19.6	- Warn Lo Dyn. Variable #15	-	-	-
Bit 19.7	- Warn Hi ''	-	-	-

Byte #20   Warning Messages #5   (Output Current)
    Bit 20.0   - Warn Current1 Span
    Bit 20.1   - Warn Current1 < 4 mA
    Bit 20.2   - Warn Current1 > 20 mA
    Bit 20.3   - Reserved
    Bit 20.4   - Warn Current2 Span
    Bit 20.5   - Warn Current2 <0/4 mA
    Bit 20.6   - Warn Current2 > 20 mA
    Bit 20.7   - Reserved

Byte #21   Warning Messages #6   (Calibration)
    Bit 21.0   - Warn Buf Unknown
    Bit 21.1   - Warn Identical Buffers / Identical Media
    Bit 21.2   - Warn Buf Interchanged / Media Interchged
    Bit 21.3   - Warn Cal Temp
    Bit 21.4   - Warn Sensor Unstable
    Bit 21.5   - Warn Variable Unstable
    Bit 21.6   - Warn Cell Const
    Bit 21.7   - HART Product Calibration failed, Data ignored

Byte #22   Warning Messages #7
    Bit 22.0   - Warn Current Par
    Bit 22.1   - Warn TC
    Bit 22.2   - Warn Ref Temp
    Bit 22.3   - Warn Control Parameters
    Bit 22.4   - Warn Sensocheck
    Bit 22.5   - Warn Temp O_2-Conc/SAT
    Bit 22.6   - Undefined
    Bit 22.7   - Undefined

Byte #23   Warning Messages #8   (System Messages)
    Bit 23.0   - Warn Time/Date
    Bit 23.1   - Warn Device Diagnostics
    Bit 23.2   - Warn Write Protection
    Bit 23.3   - Undefined
    Bit 23.4   - Undefined
    Bit 23.5   - Undefined
    Bit 23.6   - Undefined
    Bit 23.7   - Undefined

Byte #24   Function Check Status
    Bit 24.0   - Setting opl, adm active (par)
    Bit 24.1   - Calibration active (cal)
    Bit 24.2   - Calibration sample taken
    Bit 24.3   - Maintenance active (maint)
    Bit 24.4   - Undefined
    Bit 24.5   - Undefined
    Bit 24.6   - Undefined
    Bit 24.7   - Undefined

NOTE: Bit 0.0 is formed by the OR (centralized message) of all failure messages in bytes #2 - #5, #14 and #15.
Bit 1.0 has an additional delay (user-defined).

Bit 0.1 is formed by the OR (centralized message) of all warning messages in bytes #16 - #23.
Bit 1.1 has an additional delay (user-defined).

Bit 0.2 is formed by the OR (centralized message) of function check messages in byte #24.
Bit 1.2 has an additional fall delay (user-defined).

Bit 8.0 is formed by the OR (centralized message) of current 1 messages in byte #20, bits 20.0 to 20.2.

Bit 8. is formed by the OR (centralized message) of current 2 messages in byte #20, bits 20.4 to 20.6.

9. TRANSMITTER-SPECIFIC COMMANDS

9.1. COMMAND #128 - READ ONE TRANSMITTER-SPECIFIC VARIABLE

REQUEST DATA BYTES

DATA BYTES	#0
	XMTR
	VAR
	CODE

Data Byte #0   : Transmitter Variable, 8-bit unsigned integer, Refer to Transmitter Variable Code Table 10.4.

RESPONSE DATA BYTES

DATA BYTES	#0	#1
	XMTR	UNITS
	VAR	
	CODE	

	#2	#3	#4	#5
	DATA			DATA
	MSB			LSB

Data Byte #0   : Transmitter Variable, 8-bit unsigned integer, Refer to Transmitter Variable Code Table 10.4.

Data Byte #1   : Units Code, 8-bit unsigned integer, Refer to Table II; Unit Codes

Data Byte #2 - #5 : Data for selected Transmitter Variable, IEEE 754

COMMAND-SPECIFIC RESPONSE CODES

0	No Command-Specific Errors
1	Undefined
2	Invalid Selection
3 - 4	Undefined
5	Too Few Data Bytes Received
6 - 15	Undefined
16	Access Restricted
17 - 127	Undefined

9.2. COMMAND #129 - WRITE ONE TRANSMITTER-SPECIFIC VARIABLE

REQUEST DATA BYTES

DATA BYTES	#0 XMTR VAR CODE	#1 UNITS		
	#2 DATA MSB	#3	#4	#5 DATA LSB

Data Byte #0   : Transmitter Variable, 8-bit unsigned integer, Refer to Transmitter Variable Code Table 10.4.

Data Byte #1   : Units Code, 8-bit unsigned integer, Refer to Table II; Unit Codes

Data Byte #2 - #5 : Data for selected Transmitter Variable, IEEE 754

RESPONSE DATA BYTES

DATA BYTES	#0 XMTR VAR CODE	#1 UNITS		
	#2 DATA MSB	#3	#4	#5 DATA LSB

Data Byte #0   : Transmitter Variable, 8-bit unsigned integer, Refer to Transmitter Variable Code Table 10.4.

Data Byte #1   : Units Code, 8-bit unsigned integer, Refer to Table II; Unit Codes

Data Byte #2 - #5 : Data for selected Transmitter Variable, IEEE 754

COMMAND-SPECIFIC RESPONSE CODES

0	No Command-Specific Errors
1	Undefined
2	Invalid Selection
3	Passed parameter too large
4	Passed parameter too small
5	Too Few Data Bytes Received
6	Undefined
7	In Write Protect Mode
8 – 11	Undefined
12	Invalid Units Code
13 – 31	Undefined
32	Busy
33 – 127	Undefined

9.3. COMMAND #130 -   READ ACTUAL USAGE-NO., OPTIONS AND VARIABLE-NO. OF OUTPUT 2

NOTE

internal command, used for optimation of device description

REQUEST DATA BYTES

DATA BYTES   NONE

RESPONSE DATA BYTES

DATA BYTES   #0
                    USAGE
                    NO.

                    #1   #2   #3   #4
                    OPTION   OPTION
                    MSB   LSB

                    #5
                    XMTR
                    VAR
                    CODE

Data Byte #0   : Actual Usage-No.

Data Byte #1 - #4   : Device Options

Data Byte #5   : Number of transmitter variable assigned to output current 2

COMMAND-SPECIFIC RESPONSE CODES

        0   No Command-Specific Errors
        1 – 127   Undefined

9.4. COMMAND #131 - PRODUCT CALIBRATION – T A K E –

NOTE   The currently measured process value is stored. Immediately afterwards, you
take a sample from the process.

REQUEST DATA BYTES

DATA BYTES   NONE

RESPONSE DATA BYTES

DATA BYTES   NONE

COMMAND-SPECIFIC RESPONSE CODES

0	No Command-Specific Errors
1 – 4	Undefined
5	Too Few Data Bytes Received
6	Undefined
7	In Write Protect Mode
8 – 15	Undefined
16	Access Restricted (device in calibration mode)
17 – 127	Undefined

9.5. COMMAND #132 - PRODUCT CALIBRATION   – C A L C U L A T E –

NOTE   The Transmitter 2220X, 4220X, 7220X calculates the sensor calibration value(s) from the difference between the process value and the lab value (this method only allows one-point calibration).

If an error occures, Byte #21.7 in the additional transmitter status ist set at the end of calibration. (see Command #48).

REQUEST DATA BYTES

DATA BYTES	#0	#1	#2	#3
	DATA			DATA
	MSB			LSB

Data Byte #0 - #3 : Lab value, IEEE 754

RESPONSE DATA BYTES

DATA BYTES	#0	#1	#2	#3
	DATA			DATA
	MSB			LSB

Data Byte #0 - #3 : Lab value, IEEE 754

COMMAND-SPECIFIC RESPONSE CODES

0	No Command-Specific Errors
1	Undefined
2	Value out of range
3	Passed parameter too large
4	Passed parameter too small
5	Too Few Data Bytes Received
6	Undefined
7	In Write Protect Mode
8 – 15	Undefined
16	Access Restricted (device in calibration mode, or no sample taken)
17 – 127	Undefined

10. TRANSMITTER-SPECIFIC TABLES

Refer to the Common Tables Document for all references in this section to 'Subset of Table'.

10.1. USED COMMON UNIT CODES
Subset of Table II, Unit Codes

8	-	mbar
32	-	°C
36	-	mV
37	-	Ohm
38	-	Hz
39	-	mA
50	-	min
51	-	sec
52	-	h
56	-	µMho (µS)
57	-	%
59	-	pH
97	-	g/l
105	-	% by wt.
106	-	Vol%
139	-	ppm
250	-	not used
251	-	none
253	-	special

10.2. USED TRANSMITTER-SPECIFIC UNIT CODES

240	-	rH
241	-	mV/pH
242	-	p/min
243	-	%/K
244	-	cm^{-1}
245	-	nA/mbar

10.3. USED SPECIAL VARIABLE FORMATS

TIME (**Transmitter** variable 16)

DATA BYTES	#0	#1	#2	#3
	Hours	Minutes	Seconds	always 00

Hours, Minutes, Seconds: 8-bit unsigned integer

DATE (Transmitter variable 17)

DATA BYTES	#0 to #2	#3
	Day, Month, Year	always 00

Day, Month, Year: 8-bit unsigned integer
Sequence depending on Date Format setting,
e. g.: DD/MM/YY

10.4. TRANSMITTER VARIABLE CODES

	2220X	**7220X**	**4220X**
0	pH	S/cm	O_2-SAT
1	mV	Concentration	Concentration
2	Temperature	Temperature	Temperature
3	ORP	Cell Constant*	O_2-Pressure pO_2
4	rH	Controller Output	Pressure
5	Ref-El	$\Omega \cdot$cm (HW 2 only)	*Undefined*
6	Glas-El	*Undefined*	Zero Point*
7	Zero Point*	:	Slope*
8	Slope*	:	Cal Time
9	Isotherm Pot. V_{ISO}*	:	Controller Output
10	Cal Time	:	*Undefined*
11	Controller Output	:	:
12	*Undefined*	:	:
13	:	:	:
14	:	:	:
15	*Undefined*	*Undefined*	*Undefined*
16	Time	Time	Time
17	Date	Date	Date
18	*Undefined*		
:	:		
249	*Undefined*		
250	*Reserved*		
251	*Reserved*		
252	*Reserved*		
253	*Reserved*		
254	*Reserved*		
255	*Reserved*		

* transmitter variable also writeble with Command #129

11. RELEASE NOTES

11.1. Preliminary Release

11.2. Revision 1.1
- Update of Reference Document Versions in Section 1.
- Additional comments in Section 8.3
- More used Unit Codes in Section 10.1
- Corrections in Byte #17 of Command #48 in Section 8.5
- Explanation of Used Special Variable Formats in Section 10.4
- Correction of Transmitter Variable 5 of Transmitter 4220X

11.3. Revision 1.2
- Selection of Transmitter Variables via keypad in Section 7.1.
- New Transmitter Variable 10 for Transmitter 4220X in Section 10.4

11.4. Revision 2.0
- Additional Transmitterspecific Variable #5 for Transmitter 7220X

11.5. Revision 2.1
- Additional Message in Byte #14.3 of Command #48 in Section 8.5

11.6. Revision 3.0
- New Transmitter-Specific Commands #129, #130, #131 and #132
- Additional Messages in Byte #0.5, Byte #21.7 and Byte #24.2 of Command #48 in Section 8.5

Command Summary

Universal Commands

Command #0 - Read Unique Identifier

Request Data Bytes	None
Response Data Bytes	#0　　　　- 254 #1　　　　- Manufacturer Id = 142　　　　　　　　　*(Mettler Toledo)* #2　　　　- Manufacturer Device Type (See Chap. 2) #3　　　　- Number of Preambles #4　　　　- Univ Cmd Rev #5　　　　- Trans Spec Rev #6　　　　- Soft Rev　　　　　　　　　　　　　　*(10 for Version 1.0)* #7　　　　- Hard Rev (See Universal Command Spec. Cmd #0) #8　　　　- Flags #9 to #11 - Device Id Number (24-bit unsigned int)　　*(Serial Number)*
Response Codes	#0　　　　- No Command-Specific Errors

Command #1 - Read Primary Variable

Request Data Bytes	None
Response Data Bytes	#0　　　　- PV Units Code (See Common Table II)　*(Value for Current 1)* #1 to #4　- Primary Variable
Response Codes	#0　　　　- No Command-Specific Errors

Command #2 - Read P.V. Current and Percent of Range

Request Data Bytes	None
Response Data Bytes	#0 to #3　- P.V. Current [mA]　　　　　　　　　*(Value OUTP1)* #4 to #7　- P.V. Percent of Range [%]
Response Codes	#0　　　　- No Command-Specific Errors

Command #3 - Read Dynamic Variables and P.V. Current

Request Data Bytes	None
Response Data Bytes	#0 to #3　- P.V. Current [mA]　　　　　　　　　*(Value OUTP1)* #4　　　　- P.V. Units Code (See Common Table II)　*(Units Current 1)* #5 to #8　- Primary Variable　　　　　　　　*(Value for Current 1)* #9　　　　- S.V. Units Code #10 to #13 - Secondary Variable #14　　　- T.V. Units Code #15 to #18 - Tertiary Variable #19　　　- 4th V. Units Code #20 to #23 - 4th Variable **Variables not used:** Units Code = FA_{HEX} (not used), Value = $7FA00000_{HEX}$ (NaN)
Response Codes	#0　　　　- No Command-Specific Errors
Note	- For assignment of Transmitter Variables to Dynamic Variables see Command #51

Command #6 - Write Polling Address

Request Data Bytes	#0　- Polling Address of Device
Response Data Bytes	#0　- Polling Address of Device
Response Codes	#0　- No Command-Specific Errors #2　- Invalid Selection　　　　　　　　　*(Address > 15)* #5　- Too Few Data Bytes Received #7　- In Write Protect Mode #32 - Busy

Command #11 - Read Unique Identifier associated with Tag

Request Data Bytes	#0 to #5 - Tag (6 Byte Packed-ASCII = 8 Char.) *(Measurement Point)*
Response Data Bytes	#0 - 254
	#1 - Manufacturer Id = 142 *(Mettler Toledo)*
	#2 - Manufacturer Device Type (See Chap. 2)
	#3 - Number of Preambles
	#4 - Univ Cmd Rev
	#5 - Trans Spec Rev
	#6 - Soft Rev *(10 for Version 1.0)*
	#7 - Hard Rev (See Universal Command Spec. Cmd #0)
	#8 - Flags
	#9 to #11 - Device Id Number (24-bit unsigned int) *(Serial Number)*
Response Codes	#0 - No Command-Specific Errors
Note	- Response only if Tag corresponds
	- Only valid for Broadcast Frames

Command #12 - Read Message

Request Data Bytes	None
Response Data Bytes	#0 to #23 - Message (24 Byte Packed-ASCII = 32 Character)
Response Codes	#0 - No Command-Specific Errors

Command #13 - Read Tag, Descriptor, Date

Request Data Bytes	None
Response Data Bytes	#0 to #5 - Tag (Packed-ASCII = 8 Char.) *(Measurement Point)*
	#6 to #17 - Descriptor (Packed-ASCII = 16 Char.) *(Note)*
	#18 to #20 - Date [dd.mm.yy]
Response Codes	#0 - No Command-Specific Errors

Command #14 - Read Primary Variable Sensor Information

Request Data Bytes	None
Response Data Bytes	#0 to #2 - P.V. Sensor Serial Number *(000000)*
	#3 - P.V. Sensor Units Code *(Current 1, Variable)*
	#4 to #7 - P.V. Upper Sensor Limit
	#8 to #11 - P.V. Lower Sensor Limit
	#12 to #15 - P.V. Minimum Span
	Parameters not used:
	Units Code = FA_{HEX} (not used), Value = $7FA00000_{HEX}$ (NaN)
Response Codes	#0 - No Command-Specific Errors

Command #15 - Read Primary Variable Output Information

Request Data Bytes	None
Response Data Bytes	#0 - Alarm Select Code (See Common Table VI)
	#1 - P.V. Transfer Function Code (See Common Table III)
	#2 - P.V. Range Units Code *(Current 1, Variable)*
	#3 to #6 - P.V. Upper Range Value *(Current 1, End)*
	#7 to #10 - P.V. Lower Range Value *(Current 1, Begin)*
	#11 to #14 - P.V. Damping Value [s] *(NaN)*
	#15 - Write Protect Code (See Common Table VII)
	#16 - Private Label Distributor Code (See Common Table VIII)
	Parameters not used:
	Units Code = FA_{HEX} (not used), Value = $7FA00000_{HEX}$ (NaN)
Response Codes	#0 - No Command-Specific Errors

Command #16 - Read Final Assembly Number

Request Data Bytes	None
Response Data Bytes	#0 to #2 - Final Assembly Number (24-bit unsigned int)
Response Codes	#0 - No Command-Specific Errors

Command #17 - Write Message

Request Data Bytes	#0 to #23 - Message (24 Byte Packed-ASCII = 32 Character)
Response Data Bytes	#0 to #23 - Message
Response Codes	#0 - No Command-Specific Errors #5 - Too Few Data Bytes Received #7 - In Write Protect Mode

Command #18 - Write Tag, Descriptor, Date

Request Data Bytes	#0 to #5 - Tag (Packed-ASCII = 8 Character) *(Measurement Point)* #6 to #17 - Descriptor (Packed-ASCII = 16 Character) *(Note)* #18 to #20 - Date [dd.mm.yy]
Response Data Bytes	#0 to #5 - Tag #6 to #17 - Descriptor #18 to #20 - Date
Response Codes	#0 - No Command-Specific Errors #5 - Too Few Data Bytes Received #7 - In Write Protect Mode #32 - Busy

Command #19 - Write Final Assembly Number

Request Data Bytes	#0 to #2 - Final Assembly Number (24-bit unsigned int)
Response Data Bytes	#0 to #2 - Final Assembly Number
Response Codes	#0 - No Command-Specific Errors #5 - Too Few Data Bytes Received #7 - In Write Protect Mode

Common Practice Commands

Command #33 - Read Transmitter Variables

Request Data Bytes	#0 - Transmitter Variable assigned to Slot #0 #1 - Transmitter Variable assigned to Slot #1 #2 - Transmitter Variable assigned to Slot #2 #3 - Transmitter Variable assigned to Slot #3
Response Data Bytes	#0 - Transmitter Variable in Slot #0 #1 - Slot #0 Units Code #2 to #5 - Slot #0 Data for selected Transmitter Variable #6 - Transmitter Variable in Slot #1 #7 - Slot #1 Units Code #8 to #11 - Slot #1 Data for selected Transmitter Variable #12 - Transmitter Variable in Slot #2 #13 - Slot #2 Units Code #14 to #17 - Slot #2 Data for selected Transmitter Variable #18 - Transmitter Variable in Slot #3 #19 - Slot #3 Units Code #20 to #23 - Slot #3 Data for selected Transmitter Variable
Response Codes	#0 - No Command-Specific Errors #2 - Invalid Selection #5 - Too Few Data Bytes Received
Note	- Truncated Request is possible

Command #35 - Write Primary Variable Range Values

Request Data Bytes	#0 - P.V. Range Units Code *(must be Variable of Current 1)*
	#1 to #4 - P.V. upper range value *(Current 1, End)*
	#5 to #8 - P.V. lower range value *(Current 1, Begin)*
Response Data Bytes	#0 - P.V. Range Units Code
	#1 to #4 - P.V. upper range value
	#5 to #8 - P.V. lower range value
Response Codes	#0 - No Command-Specific Errors
	#2 - Invalid Selection *(wrong Units Code)*
	#5 - Too Few Data Bytes Received
	#7 - In Write Protect Mode
	#32 - Busy

Command #36 - Set Primary Variable Upper Range Value   (actual value => Current 1, End)

Request Data Bytes	None
Response Data Bytes	None
Response Codes	#0 - No Command-Specific Errors
	#7 - In Write Protect Mode
	#32 - Busy

Command #37 - Set Primary Variable Lower Range Value   (actual value => Current 1, Begin)

Request Data Bytes	None
Response Data Bytes	None
Response Codes	#0 - No Command-Specific Errors
	#7 - In Write Protect Mode
	#32 - Busy

Command #38 - Reset Configuration Changed Flag

Request Data Bytes	None
Response Data Bytes	None
Response Codes	#0 - No Command-Specific Errors
	#7 - In Write Protect Mode

Command #40 - Enter/Exit Fixed Primary Variable Current Mode

Request Data Bytes	#0 to #3 - Fixed P.V. Current Level [mA]
	0.0 = Exits the Fixed P.V. Current Mode
Response Data Bytes	#0 to #3 - Actual Fixed P.V. Current Level [mA]
Response Codes	#0 - No Command-Specific Errors
	#3 - Passed Parameter too Large *(Current > 22mA)*
	#4 - Passed Parameter too Small *(Current < 4mA)*
	#5 - Too Few Data Bytes Received
	#7 - In Write Protect Mode
	#11 - In Multidrop Mode

Command #41 - Perform Transmitter Self Test

Request Data Bytes	None
Response Data Bytes	None
Response Codes	#0 - No Command-Specific Errors
Note	- In the first 10 seconds the communication can be disturbed.

Command #48 - Read Additional Transmitter Status

Request Data Bytes	None	
Response Data Bytes (See 8.6)	#0 to #5 - Transmitter-Specific Status (See Chap. 8.5) #6 - Operating Mode #1 #7 - Operating Mode #2 #8 to #10 - Analog Output Number X Saturated #11 to #13 - Analog Output Number X Fixed #14 to #24 - Transmitter-Specific Status (See Chap. 8.5)	 *(0 = normal)* *(0 = normal)*
Response Codes	#0 - No Command-Specific Errors	

Command #50 - Read Dynamic Variable Assignment

Request Data Bytes	None
Response Data Bytes	#0 - Transmitter Variable assigned to Primary Variable #1 - Transmitter Variable assigned to Secondary Variable #2 - Transmitter Variable assigned to Tertiary Variable #3 - Transmitter Variable assigned to 4th Variable
Response Codes	#0 - No Command-Specific Errors

Command #51 - Write Dynamic Variable Assignment

Request Data Bytes	#0 - Transmitter Variable to be assigned to Primary Variable #1 - Transmitter Variable to be assigned to Secondary Variable #2 - Transmitter Variable to be assigned to Tertiary Variable #3 - Transmitter Variable to be assigned to 4th Variable
Response Data Bytes	#0 - Transmitter Variable assigned to Primary Variable #1 - Transmitter Variable assigned to Secondary Variable #2 - Transmitter Variable assigned to Tertiary Variable #3 - Transmitter Variable assigned to 4th Variable
Response Codes	#0 - No Command-Specific Errors #2 - Invalid Selection #5 - Too Few Data Bytes Received #7 - In Write Protect Mode #32 - Busy
Note	- Truncated Request is possible - Primary Variable controls output current 1 and therefore cannot be assigned differently. The Units Codes must correspond, otherwise Response Code #2 is returned.

Command #54 - Read Transmitter Variable Information

Request Data Bytes	#0 - Transmitter Variable (See Chap. 10.4)	
Response Data Bytes	#0 - Transmitter Variable #1 to #3 - Transmitter Variable Sensor Serial Number #4 - Units Code for Limits and Minimum Span #5 to #8 - Upper Limit #9 to #12 - Lower Limit #13 to #16 - Damping Value #17 to #20 - Minimum Span	 *(000000)*
Response Codes	#0 - No Command-Specific Errors #2 - Invalid Selection #5 - Too Few Data Bytes Received	

Command #59 - Write Number of Response Preambles

Request Data Bytes	#0	- Number of Preambles to be sent with the Response message from Slave to the Master
Response Data Bytes	#0	- Number of Preambles
Response Codes	#0	- No Command-Specific Errors
	#3	- Passed Parameter too Large *(Preambles > 20)*
	#4	- Passed Parameter too Small *(Preambles < 2)*
	#5	- Too Few Data Bytes Received
	#7	- In Write Protect Mode
	#32	- Busy

Command #60 - Read Analog Output and Percent of Range

Request Data Bytes	#0	- Analog Output Number (1 or 2)
Response Data Bytes	#0	- Analog Output Number
	#1	- Unit Code
	#2 to #5	- Analog Output Level
	#6 to #9	- Analog Output Percent of Range [%]
Response Codes	#0	- No Command-Specific Errors
	#2	- Invalid Selection
	#5	- Too Few Data Bytes Received

Command #63 - Read Analog Output Information

Request Data Bytes	#0	- Output Number (1 or 2)
Response Data Bytes	#0	- Output Number
	#1	- Alarm Selection Code
	#2	- Transfer Function Code (See Common Tables III)
	#3	- Units Code *(Current n, Variable)*
	#4 to #7	- Upper Range Value *(Current n, End)*
	#8 to #11	- Lower Range Value *(Current n, Begin)*
	#12 to #15	- Damping Value [s]
		Parameters not used:
		Units Code = FA_{HEX} (not used), Value = $7FA00000_{HEX}$ (NaN)
Response Codes	#0	- No Command-Specific Errors
	#2	- Invalid Selection
	#5	- Too Few Data Bytes Received

Command #66 - Enter/Exit Fixed Analog Output Mode

Request Data Bytes	#0	- Output Number (1 or 2)
	#1	- Output Units [mA] = 39
	#2 to #5	- Fixed Analog Output Level [mA]
		$7FA00000_{HEX}$ (NaN) = Exits the Fixed Analog Output Mode
Response Data Bytes	#0	- Output Number (1 or 2)
	#1	- Output Units [mA] = 39
	#2 to #5	- Actual Fixed Analog Output Level [mA]
Response Codes	#0	- No Command-Specific Errors
	#3	- Passed Parameter too Large *(Current > 22mA)*
	#4	- Passed Parameter too Small *(Current < 0(4)mA)*
	#5	- Too Few Data Bytes Received
	#7	- In Write Protect Mode
	#11	- In Multidrop Mode
	#12	- Invalid Units Code *(valid is only code 39)*
	#15	- Invalid Analog Output Number Code
Note	Output 1	- 4 to 22 mA *(in Multidrop Mode: Fixed 4 mA)*
	Output 2	- 0 to 22 mA *(only if Output Current 2 is active)*

Transmitter-Specific Commands

Command #128 - Read One Transmitter-Specific Variable

Request Data Bytes	#0	- Transmitter Variable, 8-bit unsigned integer. Refer to Transmitter Variable Code Table 10.4 in this document
Response Data Bytes	#0	- Transmitter Variable
	#1	- Units Code for Transmitter Variable
	#2 to #5	- Data for selected Transmitter Variable, IEEE 754 format
Response Codes	#0	- No Command-Specific Errors
	#2	- Invalid Selection
	#5	- Too Few Data Bytes Received

Command #129 - Write One Transmitter-Specific Variable

Request Data Bytes	#0	- Transmitter Variable, 8-bit unsigned integer. Refer to Transmitter Variable Code Table 10.4 in this document
	#1	- Units code for transmitter variable
	#2 to #5	- Data for selected transmitter cariable, IEEE 754 format
Response Data Bytes	#0	- Transmitter Variable
	#1	- Units Code for Transmitter Variable
	#2 to #5	- Data for selected Transmitter Variable, IEEE 754 format
Response Codes	#0	- No Command-Specific Errors
	#2	- Invalid Selection
	#3	- Passed parameter too large
	#4	- Passed parameter too small
	#5	- Too Few Data Bytes Received
	#7	- In Write Protect Mode
	#12	- Invalid Units Code
	#32	- Busy

Command #130 - Read Actual Usage-No., Options and Variable-No. of Output 2

Request Data Bytes	None	
Response Data Bytes	#0	- Actual Usage-No.
	#1 to #4	- Device Options
	#5	- Number of transmitter variable assigned to output current 2
Response Codes	#0	- No Command-Specific Errors
Note		internal command, used for optimation of device description

Command #131 - Product Calibration TAKE

Request Data Bytes	None	
Response Data Bytes	None	
Response Codes	#0	- No Command-Specific Errors
	#5	- Too Few Data Bytes Received
	#7	- In Write Protect Mode
	#16	- Access Restricted (device in calibration mode)
Note		The currently measured process value is stored. Immediately afterwards, you take a sample from the process.

Command #132 - Product Calibration CALCULATE

Request Data Bytes	#0 to #3	- lab value, IEEE 754 format
Response Data Bytes	#0 to #3	- lab value, IEEE 754 format
Response Codes	#0	- No Command-Specific Errors
	#3	- Passed parameter too large
	#4	- Passed parameter too small
	#5	- Too Few Data Bytes Received
	#7	- In Write Protect Mode
	#16	- Access Restricted (device in calibration mode)
Note		The Transmitter 2220X, 4220X, 7220X calculates the sensor calibration value(s) from the difference between the process value and the lab value (this method only allows one-point calibration).