# 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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### 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 |

1. **Expanded Device Type Code**

Manufacturer Identification Code: Mettler Toledo 142

Manufacturer’s Device Type Code: Transmitter 2220 X 127

[Transmitter 7220 X 126](#_TOC_250000)

Transmitter 4220 X 125

### 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)

### Conformance and Command Class Summary

CONFORMANCE CLASS #1

* 1. Read Unique Identifier
  2. Read Primary Variable CONFORMANCE CLASS #1A

0 Read Unique Identifier

* UNIVERSAL
* UNIVERSAL

2 Read P. V. Current and Percent of Range

CONFORMANCE CLASS #2

- UNIVERSAL

1. Read Unique Identifier Associated with Tag
2. Read Message
3. Read Tag, Descriptor, Date
4. Read Primary Variable Sensor Information
5. Read Primary Variable Output Information
6. 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

1. Write Primary Variable Range Values
2. Set Primary Variable Upper Range Value
3. Set Primary Variable Lower Range Value
4. Reset Configuration Changed Flag
5. Enter/Exit Fixed Primary Variable Current Mode
6. Perform Transmitter Self Test

66 Enter/Exit Fixed Analog Output Mode

CONFORMANCE CLASS #5

6 Write Polling Address

1. Write Message
2. Write Tag, Descriptor, Date

- UNIVERSAL

1. Write Final Assembly Number

- COMMON-PRACTICE

51 Write Dynamic Variable Assignments

59 Write Number of Response Preambles

- TRANSMITTER-SPECIFIC

1. Read One Transmitter-Specific Variable
2. Write One Transmitter-Specific Variable
3. Read Actual Usage-No., Options and Variable-No. of Output 2
4. Product Calibration TAKE
5. Product Calibration CALCULATE

### Additional Response Code Information

FIRST BYTE

### 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

### 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)

### CONFIGURATION CHANGED

Bit #6

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

### MORE STATUS AVAILABLE

Bit #4

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

### 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.

### 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.

### 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.

### 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.

### General Transmitter Information

* 1. **DAMPING IMPLEMENTATION**

The transmitter has a fixed damping value.

### 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.

### MULTIDROP OPERATION

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

### BURST MODE

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

### UNIT CONVERSIONS

All temperatures are based of degrees Celsius.

### 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.

### 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.

### 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.

### 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

### 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.

### COMMAND #42 - PERFORM MASTER RESET

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

### 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 Bit 2.1 - Fail Hi ‘’  Bit 2.2 - Fail Lo Dyn. Variable #1 | | pH pH mV | S/cm S/cm Conc | O2-Sat O2-Sat 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. | pO2 |
|  | Bit 2.7 - Fail Hi ‘’ | | ORP | Cell. | pO2 |
| 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 O2 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 Bit 16.1 - Warn Hi ‘’  Bit 16.2 - Warn Lo Dyn. Variable #1 | | pH pH mV | S/cm S/cm Conc | O2-Sat O2-Sat 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. | pO2 |
|  | Bit 16.7 - Warn Hi ‘’ | | ORP | Cell. | pO2 |
| 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 | | VISO | - | - |
|  | Bit 18.3 - Warn Hi ‘’ | | VISO | - | 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 O2-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.

### TRANSMITTER-SPECIFIC COMMANDS

* 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  XMTR VAR CODE | #1  UNITS |  | |
|  | #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

* 1. No Command-Specific Errors
  2. Undefined
  3. Invalid Selection
  4. - 4 Undefined

1. Too Few Data Bytes Received
2. - 15 Undefined
3. Access Restricted
4. - 127 Undefined

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

REQUEST DATA BYTES

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| DATA BYTES | #0  XMTR VAR CODE | #1  UNITS |  |  |
|  | #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

RESPONSE DATA BYTES

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| DATA BYTES | #0  XMTR VAR CODE | #1  UNITS |  | |
|  | #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

1. No Command-Specific Errors
2. Undefined
3. Invalid Selection
4. Passed parameter too large
5. Passed parameter too small
6. Too Few Data Bytes Received
7. Undefined
8. In Write Protect Mode
9. – 11 Undefined
10. Invalid Units Code
11. – 31 Undefined
12. Busy
13. – 127 Undefined

### 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  OPTION MSB | #2 | #3 | #4  OPTION 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

1. No Command-Specific Errors
2. – 127 Undefined

### 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

1. No Command-Specific Errors
2. – 4 Undefined
3. Too Few Data Bytes Received
4. Undefined
5. In Write Protect Mode
6. – 15 Undefined
7. Access Restricted (device in calibration mode)
8. – 127 Undefined

### 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

1. No Command-Specific Errors
2. Undefined
3. Value out of range
4. Passed parameter too large
5. Passed parameter too small
6. Too Few Data Bytes Received
7. Undefined
8. In Write Protect Mode
9. – 15 Undefined
10. Access Restricted (device in calibration mode, or no sample taken)
11. – 127 Undefined

### TRANSMITTER-SPECIFIC TABLES

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

### 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 |

### USED TRANSMITTER-SPECIFIC UNIT CODES

rH mV/pH p/min

|  |  |
| --- | --- |
| 240 | - |
| 241 | - |
| 242 | - |
| 243 | - |
| 244 | - |
| 245 | - |

%/K cm-1

nA/mbar

### 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

### TRANSMITTER VARIABLE CODES

|  |  |  |  |
| --- | --- | --- | --- |
| 0 | **2220X**  pH | **7220X**  S/cm | **4220X**  O2-SAT |
| 1 | mV | Concentration | Concentration |
| 2 | Temperature | Temperature | Temperature |
| 3 | ORP | Cell Constant\* | O2-Pressure pO2 |
| 4 | rH | Controller Output | Pressure |
| 5 | Ref-El | Ω⋅cm (HW 2 only) | *Undefined* |
| 6 | Glas-El | *Undefined* | Zero Point\* |
| 7 | Zero Point\* | : | Slope\* |
| 8 | Slope\* | : | Cal Time |
| 9 | Isotherm Pot. VISO\* | : | Controller Output |
| 10 | Cal Time | : | *Undefined* |

1. Controller Output : :
2. *Undefined* : :

13 : : :

14 : : :

|  |  |  |  |
| --- | --- | --- | --- |
| 15 | *Undefined* | *Undefined* | *Undefined* |
| 16 | Time | Time | Time |
| 17 | Date | Date | Date |
| 18  : 249 | *Undefined*  :  *Undefined* |  |  |
| 250 | *Reserved* |  |  |
| 251 | *Reserved* |  |  |
| 252 | *Reserved* |  |  |
| 253 | *Reserved* |  |  |
| 254 | *Reserved* |  |  |
| 255 | *Reserved* |  |  |

\* transmitter variable also writeble with Command #129

### RELEASE NOTES

* 1. **Preliminary Release**

### 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

### Revision 1.2

* + - Selection of Transmitter Variables via keypad in Section 7.1.
    - New Transmitter Variable 10 for Transmitter 4220X in Section 10.4

### Revision 2.0

* + - Additional Transmitterspecific Variable #5 for Transmitter 7220X

### Revision 2.1

* + - Additional Message in Byte #14.3 of Command #48 in Section 8.5

### 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  #1 to #4 | * PV Units Code (See Common Table II) * Primary Variable | *(Value for Current 1)* |
| 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  #4 to #7 | * P.V. Current [mA] * P.V. Percent of Range [%] | *(Value OUTP1)* |
| 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 = FAHEX (not used), Value = 7FA00000HEX (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  #3  #4 to #7  #8 to #11  #12 to #15 | -  -  -  -  - | P.V. Sensor Serial Number *(000000)*  P.V. Sensor Units Code *(Current 1, Variable)*  P.V. Upper Sensor Limit  P.V. Lower Sensor Limit  P.V. Minimum Span  **Parameters not used:**  Units Code = FAHEX (not used), Value = 7FA00000HEX (NaN) |
| Response Codes | #0 | - | No Command-Specific Errors |

**Command #15** - Read Primary Variable Output Information

|  |  |  |  |
| --- | --- | --- | --- |
| Request Data Bytes | None | | |
| Response Data Bytes | #0  #1  #2  #3 to #6  #7 to #10  #11 to #14  #15  #16 | -  -  -  -  -  -  -  - | Alarm Select Code (See Common Table VI)  P.V. Transfer Function Code (See Common Table III)  P.V. Range Units Code *(Current 1, Variable)*  P.V. Upper Range Value *(Current 1, End)*  P.V. Lower Range Value *(Current 1, Begin)*  P.V. Damping Value [s] *(NaN)*  Write Protect Code (See Common Table VII)  Private Label Distributor Code (See Common Table VIII)  **Parameters not used:**  Units Code = FAHEX (not used), Value = 7FA00000HEX (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  #6 to #17  #18 to #20 | -  -  - | Tag (Packed-ASCII = 8 Character) *(Measurement Point)* Descriptor (Packed-ASCII = 16 Character) *(Note)* Date [dd.mm.yy] |
| Response Data Bytes | #0 to #5  #6 to #17  #18 to #20 | -  -  - | Tag Descriptor 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  #1  #2  #3 | -  -  -  - | Transmitter Variable assigned Transmitter Variable assigned Transmitter Variable assigned Transmitter Variable assigned | to to to to | Slot Slot Slot Slot | #0  #1  #2  #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  #2  #5 | -  -  - | No Command-Specific Errors Invalid Selection  Too Few Data Bytes Received | | | |
| Note | - Truncated Request is possible | | | | | |

**Command #35** - Write Primary Variable Range Values

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Request Data Bytes | #0  #1 to  #5 to | #4  #8 | -  -  - | P.V. Range Units Code  P.V. upper range value  P.V. lower range value | *(must be Variable of Current 1)*  *(Current 1, End)*  *(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 *(0 = normal)*  #7 - Operating Mode #2 *(0 = normal)*  #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) |
| 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  #1  #2  #3 | * Transmitter Variable to be assigned to Primary Variable * Transmitter Variable to be assigned to Secondary Variable * Transmitter Variable to be assigned to Tertiary Variable * Transmitter Variable to be assigned to 4th Variable |
| Response Data Bytes | #0  #1  #2  #3 | * Transmitter Variable assigned to Primary Variable * Transmitter Variable assigned to Secondary Variable * Transmitter Variable assigned to Tertiary Variable * Transmitter Variable assigned to 4th Variable |
| Response Codes | #0  #2  #5  #7  #32 | * No Command-Specific Errors * Invalid Selection * Too Few Data Bytes Received * In Write Protect Mode * 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 *(000000)*  #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 |
| 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  #1  #2 to #5  #6 to #9 | * Analog Output Number * Unit Code * Analog Output Level * Analog Output Percent of Range [%] |
| Response Codes | #0  #2  #5 | * No Command-Specific Errors * Invalid Selection * Too Few Data Bytes Received |

**Command #63** - Read Analog Output Information

|  |  |  |  |
| --- | --- | --- | --- |
| Request Data Bytes | #0 | - | Output Number (1 or 2) |
| Response Data Bytes | #0  #1  #2  #3  #4 to #7  #8 to #11  #12 to #15 | -  -  -  -  -  -  - | Output Number Alarm Selection Code  Transfer Function Code (See Common Tables III)  Units Code *(Current n, Variable)*  Upper Range Value *(Current n, End)*  Lower Range Value *(Current n, Begin)*  Damping Value [s]  **Parameters not used:**  Units Code = FAHEX (not used), Value = 7FA00000HEX (NaN) |
| Response Codes | #0  #2  #5 | -  -  - | No Command-Specific Errors Invalid Selection  Too Few Data Bytes Received |

**Command #66** - Enter/Exit Fixed Analog Output Mode

|  |  |  |
| --- | --- | --- |
| Request Data Bytes | #0  #1  #2 to #5 | * Output Number (1 or 2) * Output Units [mA] = 39 * Fixed Analog Output Level [mA]   7FA00000HEX (NaN) = Exits the Fixed Analog Output Mode |
| Response Data Bytes | #0  #1  #2 to #5 | * Output Number (1 or 2) * Output Units [mA] = 39 * Actual Fixed Analog Output Level [mA] |
| Response Codes | #0  #3  #4  #5  #7  #11  #12  #15 | * No Command-Specific Errors * Passed Parameter too Large *(Current > 22mA)* * Passed Parameter too Small *(Current < 0(4)mA)* * Too Few Data Bytes Received * In Write Protect Mode * In Multidrop Mode * Invalid Units Code *(valid is only code 39)* * Invalid Analog Output Number Code |
| Note | Output 1  Output 2 | * 4 to 22 mA (in Multidrop Mode: Fixed 4 mA) * 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  #1  #2 to #5 | * Transmitter Variable * Units Code for Transmitter Variable * Data for selected Transmitter Variable, IEEE 754 format |
| Response Codes | #0  #2  #5 | * No Command-Specific Errors * Invalid Selection * Too Few Data Bytes Received |

**Command #129** - Write One Transmitter-Specific Variable

|  |  |  |
| --- | --- | --- |
| Request Data Bytes | #0  #1  #2 to #5 | * Transmitter Variable, 8-bit unsigned integer. Refer to Transmitter Variable Code Table 10.4 in this document * Units code for transmitter variable * Data for selected transmitter cariable, IEEE 754 format |
| Response Data Bytes | #0  #1  #2 to #5 | * Transmitter Variable * Units Code for Transmitter Variable * 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  #3  #4  #5  #7  #16 | -  -  -  -  -  - | No Command-Specific Errors Passed parameter too large Passed parameter too small Too Few Data Bytes Received In Write Protect Mode  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). | | |