McCROMETER

HART® Protocol User Manual

30121-84 Rev. 1.0
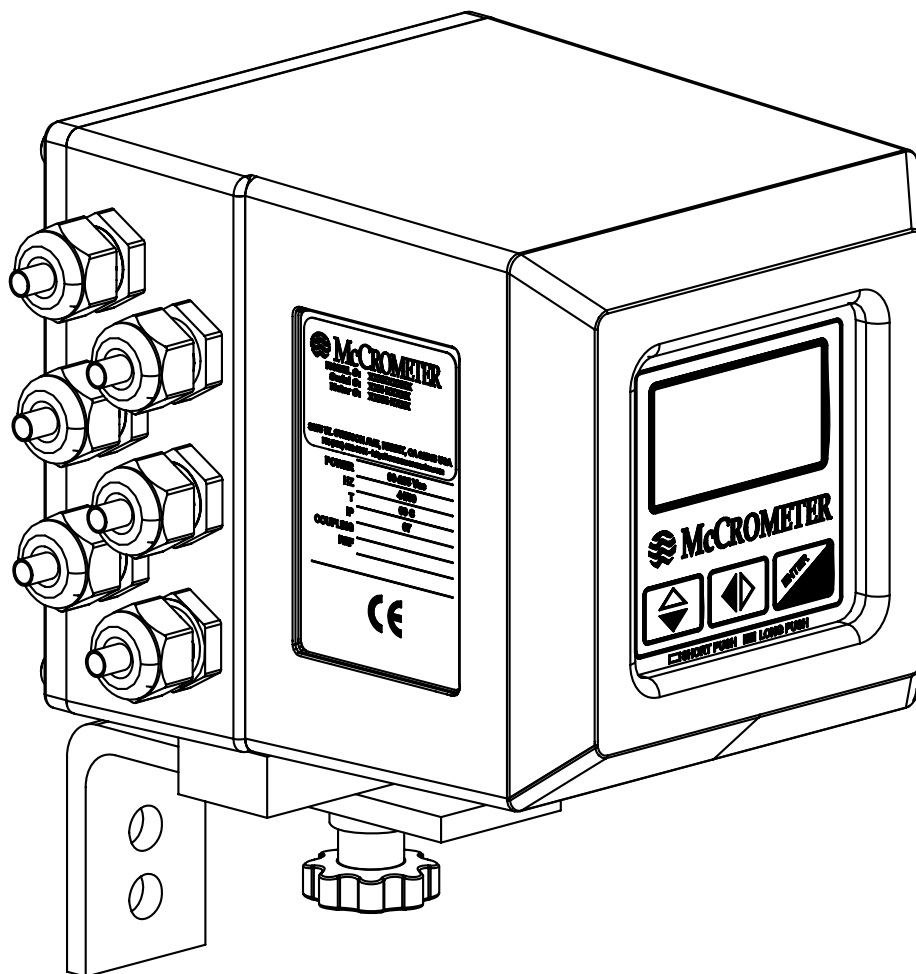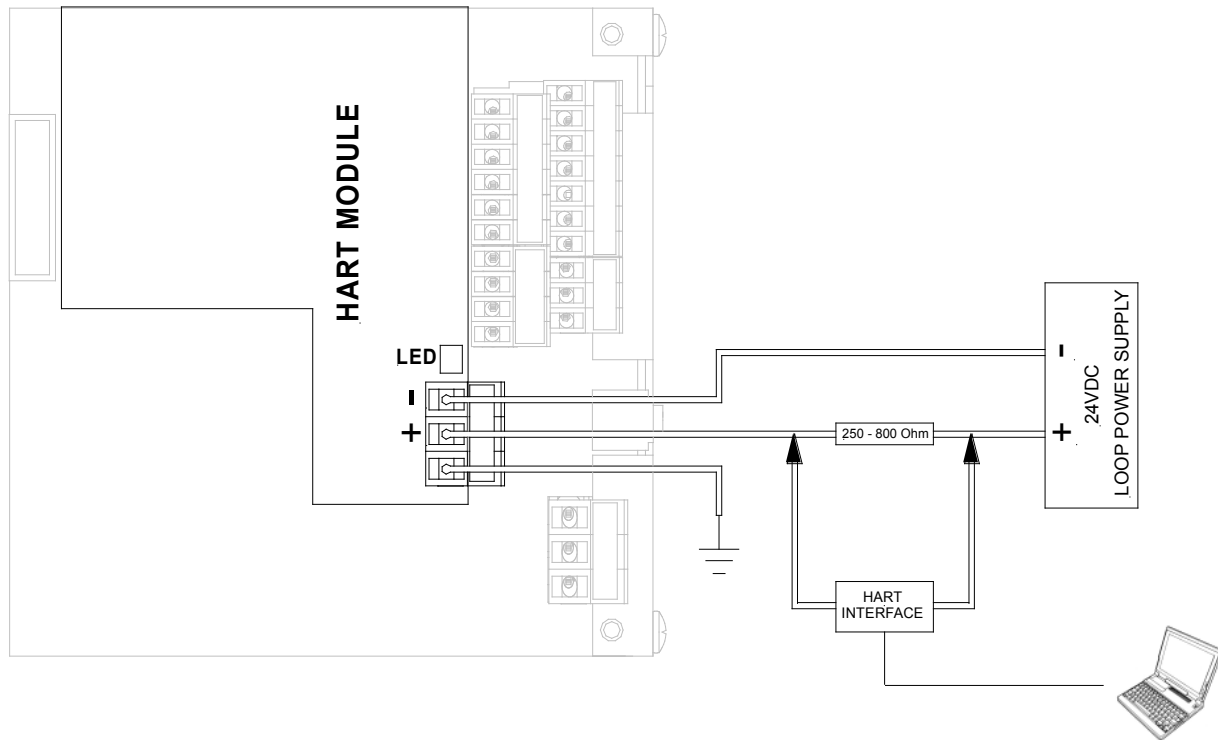December, 2014

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LED indication

The HART communication module has a LED that can display the following status:

- At start when power supply goes on, the LED remain fixed on.

- After five second, if the module is OK the LED blinking three times.

- At this point the LED flash on-off only during its transmission.

General Description

HART (acronmimous of Highway Addressable Remote Transducer) was developed by Rosemount in the mid-1980s, as microprocessor-based digital 'smart' instruments were first appearing.

HART allowed digital data to be superimposed on to conventional 4-20mA cable loops without disturbing analogue signals since its average is zero.

HART is a master-slave protocol which means that a field device only replies when it is spoken to. It is used to communicate digitally with the outside world for remote configuration, diagnostics and management purposes.
HART can provide many *'fieldbus-like'* functions and it retains full backwards-compatibility with existing control strategies.When this option is installed it is possible to read the process data from the Flow meter.

The HART protocol uses the Bell 202 standard frequency shift keying (FSK) signal to communicate at 1200 baud.

The module supports HART commands including Universal, Common Practice and Device Specific Command.

The Hart protocol implemented in the module is conforms to Hart revision 7.0.

The HART module mounted in the Electromagnetic Flow Meter is used for to connect the converter to the HART fieldbus network.

The HART slave can be addressed by two Masters for example a permanent master and a temporary Master like a hand held communicator.

When the HART fieldbus is in digital mode configuration (multi-drop) there can be two masters (e.g.a control system and a hand-held communicator) and up to 15 devices connected to the same bus.

The HART module mounted in the Electromagnetic Flow Meter does not implement the HART Burst mode.

Wiring

Signal wiring not need be shielded, but twisted pair should be used for best results.In order to ensure reliable communication, the wiring should be 24 AWG or larger and should not exceed 1 mile in length.
NOTE : Do not run signal wiring in conduit or open trays with power wiring, or near heavy electrical equipment or motors or generators.

Signal wiring may be grounded at any one point in the signal loop, or it may be left ungrounded.

The negative terminal of the power supply is a recommended grounding point.

Device Description File

To communicate with the converter with the HART module a Device Description File (DD file) compatible with the Smart Device Communicator SDC 625 relased by the Hart Communication Foundation is required. You can download the DD file at http://www.mccrometer.com/support/hart. asp .

In the following pictures there are the aspects of the data presented by the DD file in the SDC 625 communicator.
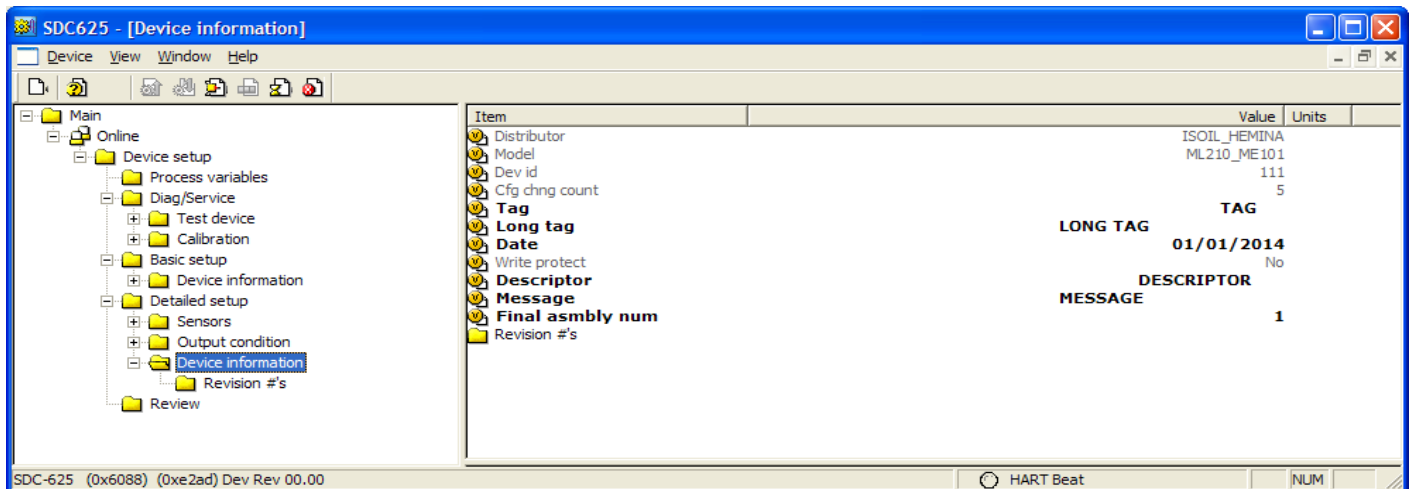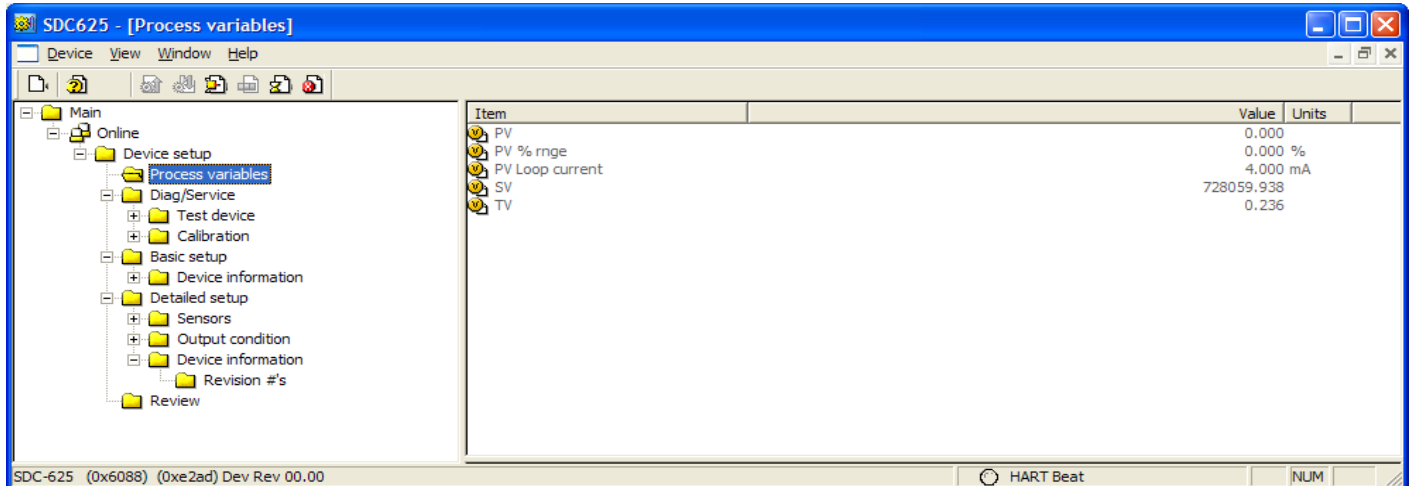
HART Universal commands description

The following section contain the description of the HART Universal commands implemented in the module.

COMMAND 00
Read Unique Identifier

Description:
This command gets the long address of the HART device plus other manufacturer information like Manufacturer Id, Device Type Code, Software Revision, Hardware Revision, etc.

Write Parameters:

NONE

Data Returned:

Description	HART Data Type	Data size
Constant "254"	"254"	UNSIGN (1 BYTE)
EXPANDED DEVICE TYPE	EXPAND DEV TYPE	ENUM (2 Byte)
MINIMUM PREAMBLES - REQUEST	MIN # PREAMBLES	UNSIGN (1 BYTE)
HART PROTOCOL MAJOR REV	HART PROTOCOL REV	UNSIGN (1 BYTE)
DEVICE REVISION LEVEL	DEV. REV LEVEL	UNSIGN (1 BYTE)
DEVICE SOFTWARE REVISION LEVEL	SOFTWARE REV. LEVEL	UNSIGN (1 BYTE)
ELECTRONICS REVISION LEVEL (HARDWARE)	ELECTRONICS REV. LEVEL	UNSIGN (1 BYTE)
PHYSICAL SIGNALING CODE	STACK SOFT. REV	ENUM (1 Byte)
FLAGS	FLAGS	ENUM (1 Byte)
DEVICE ID	DEV. ID NUMB.	UNSIGN (3 BYTE)
MINIMUM PREAMBLES - RESPONSE		UNSIGN (1 BYTE)
MAXIMUM # OF VARIBLES	MAX # VARIABLES	UNSIGN (1 BYTE)
CONFIGURATION CHANGE COUNTER	CONFIG CHANGE COUNT	UNSIGN (2 BYTE)
EXTENDED FIELD DEVICE STATUS		UNSIGN (1 BYTE)
MANUFACTURER ID CODE		ENUM (2 Byte)
PRIVATE LABEL DIST. CODE		ENUM (2 Byte)
DEVICE PROFILE CODE		ENUM (2 Byte)

COMMAND 01

Read Primary Variable

Description:

This command gets the device Primary Variable that correspond to the flow rate.

Write Parameters:

NONE

Data Returned:

Description	HART Data Type	Data size
READ PV VARIABLE (FLOW UNITS, & FLOW VALUE)	PV UNITS CODE	CHAR (1 BYTE)
	PV VALUE	FLOAT (4 BYTE)

NOTE: The measure unit is the same of the display of the converter.

COMMAND 02
Read Current And Percent Of Range

Description:
This command gets the current of the loop that is forced by the HART device and the Percent of Range of the Current.
The value of the current loop is linked to the flow rate.

Write Parameters:
NONE

Data Returned:

Description	HART Data Type	Data size
READ PV CURRENT AND % RANGE	PV I VALUE (mA)	FLOAT (4 BYTE)
	% PV VALUE	FLOAT (4 BYTE)

COMMAND 03
Read Dynamic Variables

Description:
This command gets the current and four (predefined) dynamic variables.
The PV correspond to the flow rate of the converter.
The SV correspond to the totalizer positive of the converter.
The TV correspond to the totalizer negative of the converter.
The FV is not used.

Write Parameters:
NONE

Data Returned:

Description	HART Data Type	Data size
READ PV CURRENT OUT & ALL DYNAMIC VARIABLE	PV I VALUE (mA)	FLOAT (4 BYTE)
	PV UNITS CODE	CHAR (1 BYTE)
	PV VALUE	FLOAT (4 BYTE)
	SV VALUE	FLOAT (4 BYTE)
	TV VALUE	FLOAT (4 BYTE)
	FV VALUE (not used)	FLOAT (4 BYTE)

NOTE: The measure unit is the same of the display of the converter.

COMMAND 06
Write Polling Address

Description:
This command writes the polling address of the HART device.
Extreme care should be taken when you use this command because you can loose the comunication with the device.

The polling address can be readed and changed with the menu Comunication → Address of the Converter.
See the menu Comunication in the Converter.

When modify the polling address with the HART command 06, the menu Address in the menu Comunication of the Converter is updated.

Write Parameters:

Description	HART Data Type	Data size
WRITE NODE ID (WRITE POLLING ADDRESS)	POLLING ADDRS	CHAR (1 BYTES)
	LOOP CUR MODE	CHAR (1 BYTES)

Data Returned:

Description	HART Data Type	Data size
POLLING ADDRESS	POLLING ADDRS	CHAR (1 BYTES)

COMMAND 07
Read loop configuration

Description:
This command gets loop current mode status.

Write Parameters:
NONE

Data Returned:

Description	HART Data Type	Data size
READ LOOP CONFIGURATION	POLLING ADDRS	CHAR (1 BYTES)
	LOOP CUR MODE	CHAR (1 BYTES)

COMMAND 08
Read Dynamic Variables classification

Description:
This command gets the classification of the four (predefined) dynamic variables.

Write Parameters:
NONE

Data Returned:

Description	HART Data Type	Data size
READ DYNAMIC VARIABLE CLASSIFICATIONS	ENUM	(4 BYTES)

COMMAND 09
Read Device variable with status

Description:
This command read the device variables with status.

Write Parameters:
NONE

Data Returned:

Description	HART Data Type	Data size
EXTENDED FIELD DEVICE STATUS	BITMAP	BITS (1 BYTE)
SLOT X DEV. VARIABLE CODE		UNSIGNED (1 BYTE)

SLOT X DEV. VARIABLE CLASS		ENUM (1 BYTE)
SLOT X UNITS COD		ENUM (1 BYTE)
SLOT X DEV. VARIABLE VALUE		FLOAT (4 BYTE)
SLOT X DEV. VARIABLE STATUS		BITS (1 BYTE)
SLOT X DATA TIME STAMP		UNSIGNED (4 BYTE)

COMMAND 11
Read unique Identifier associated with (short) TAG

Description:
This command read the Identifier Device information of HART command 00 by inserting the TAG parameter.

Write Parameters:

Description	HART Data Type	Data size
READ UNIQUE IDENTIFIER ASSOCIATED WHIT TAG	UNIQ. ID (TAG)	BITSTRING (6 BYTES)

Data Returned:
      This command return the same block data of command "0".

COMMAND 12
Read user Message

Description:
This command reads an ASCII message contained in the HART Device and written by the Write Message command 17.

Write Parameters:
NONE

Data Returned:

Description	HART Data Type	Data size
READ USER MESSAGE	MESSAGE	ASCII BIT STRING (24 BYTES)

COMMAND 13
Read Tag, Descriptor and Date

Description:
This command reads an ASCII Tag which identifies the device, an ASCII descriptor of the device and the last Date it has been configured.
Data can be write with Command 18.

Write Parameters:
NONE

Floating Point Data Returned:
NONE

Data Returned:

Description	HART Data Type	Data size
READ TAG	TAG	ASCII BIT STRING (6 BYTES)
READ DESCRIPTOR	DESCRIPTOR	ASCII BIT STRING (12 BYTES)
READ DATE CODE	DATE	ASCII BIT STRING (3 BYTES)

COMMAND 14
Read PV sensor information

Description:
This command reads the PV sensor limit and span. The command is implemented for the HART protocol conformance but the data are not used for the flow meter application.

Write Parameters:
NONE

Data Returned:

Description	HART Data Type	Data size
SENSOR SERIAL NUMBER	SENSOR S/N	UNSIGNED (3 BYTES)
LIMITS UNITS CODE - PV	LIMITS UNITS CODES	ENUM (1BYTE)
UPPER SENSOR LIMIT - PV	UPPER SENSOR LIMIT	FLOAT (4 BYTES)
LOWER SENSOR LIMIT - PV	LOWER SENS LIMITS	FLOAT (4 BYTES)
MIN SPAN - PV	MIN SPAN	FLOAT (4 BYTES)

COMMAND 15
Read PV output sensor information

Description:
This command reads the PV sensor range and damp val. The command is implemented for the HART protocol conformance but the data are not used for the flow meter application.

Write Parameters:
NONE

Data Returned:

Description	HART Data Type	Data size
ALARM SELECT CODE	ALRM SEL. CODE	ENUM (1BYTE)
TRANSFER FUNCTION CODE	TRN. FUNC. CODE	CHAR (1BYTE)

FLOW RANGE UNITS CODE	RNG UNITS CODE	CHAR (1BYTE)
FLOW UPPER-RANGE VAL	UP RANG VALUE	FLOAT (4 BYTES)
FLOW LOWER-RANGE VAL	LO RANG VALUE	FLOAT (4 BYTES)
FLOW DAMPING VALUE	DAMPING VALUE	FLOAT (4 BYTES)
WRITE PROTECT CODE	W PROTECT CODE	ENUM (1BYTE)
RESERVED (SET TO 250)	RESERVED	ENUM (1BYTE)

COMMAND 16
Read Final Assembly Number

Description:
This command reads the final assembly number of the HART device.
Data can be write with Command 19.

Write Parameters:
NONE

Data Returned:

Description	HART Data Type	Data size
ASSEMBLY NUMBER	ASSEMB. #	UNSIGNED (3 BYTES)

COMMAND 17
Write Message

Description:
This command writes an ASCII message contained in the HART Device and that
can be read with command 12.

Write Parameters:

Description	HART Data Type	Data size
WRITE USER MESSAGE	MESSAGE	ASCII BIT STRING (24 BYTES)

Data Returned:
NONE

COMMAND 18
Write Tag, Descriptor and Date

Description:
This command writes an ASCII Tag which identifies the device, an ASCII
descriptor of the device and the last Date it has been configured.
Data can be read with Command 13.

Write Parameters:

Description	HART Data Type	Data size
READ TAG	TAG	ASCII BIT STRING (6 BYTES)
READ DESCRIPTOR	DESCRIPTOR	ASCII BIT STRING (12 BYTES)
READ DATE CODE	DATE	ASCII BIT STRING (3 BYTES)

Data Returned:

Description	HART Data Type	Data size
READ TAG	TAG	ASCII BIT STRING (6 BYTES)
READ DESCRIPTOR	DESCRIPTOR	ASCII BIT STRING (12 BYTES)
READ DATE CODE	DATE	ASCII BIT STRING (3 BYTES)

COMMAND 19
Write Final Assembly Number

Description:
This command writes the final assembly number of the HART device.
Data can be read with Command 16.

Write Parameters:

Description	HART Data Type	Data size
ASSEMBLY NUMBER	ASSEMB. #	UNSIGNED (3 BYTES)

Data Returned:

Description	HART Data Type	Data size
ASSEMBLY NUMBER	ASSEMB. #	UNSIGNED (3 BYTES)

COMMAND 20
Read Long Tag

Description:
This command read the Long Tag.
Data can be read with Command 22.

Write Parameters:
NONE

Data Returned:

Description	HART Data Type	Data size
READ LONG TAG	LONG TAG	BITSTRING (32 BYTES)

COMMAND 21
Read unique ID associated with Long Tag

Description:
This command read the Long Tag.
Data can be read with Command 22.

Write Parameters:

Description	HART Data Type	Data size
READ UNIQUE IDENTIFIER ASSOCIATED WHIT LONG TAG	UNIQ. ID (TAG)	BITSTRING (32 BYTES)

Data Returned:
This command return the same block data of command "0".

COMMAND 22
Write Long Tag

Description:
This command write the Long Tag.
Data can be write with Command 20.

Write Parameters:

Description	HART Data Type	Data size
READ LONG TAG	LONG TAG	BITSTRING (32 BYTES)

Data Returned:

Description	HART Data Type	Data size
READ LONG TAG	LONG TAG	BITSTRING (32 BYTES)

COMMAND 38
Reset configuration change flag

Description:
This command reset the "Configuration change" flag.

Write Parameters:

Description	HART Data Type	Data size
RESET "CONFIGURATION CHANGE" flag	RESET CONFIG. CHANGE counter	UNSIGN (2BYTE)

Data Returned:

Description	HART Data Type	Data size
RESET "CONFIGURATION CHANGE" flag	RESET CONFIG. CHANGE counter	UNSIGN (2BYTE)

COMMAND 48
Read additional device status

Description:
This command read the additional device status bytes. There are 9 additional status bytes but there is only a bit used that is the bit 0 of the Byte 0. When this bit is set to 1 the converter is in excitation fail status and the bit "Device malfunction" is on.

Write Parameters:
NONE

Data Returned:

Description	HART Data Type	Data size
READ ADDITIONAL DEVICE STATUS	EXTENDED DEVICE STATUS	9 BYTE

HART Common Practice commands description

In the following section there is a description of the Common Practice commands implemented in the module

COMMAND 40
Enter Exit Fixed Current Mode

Description:
The device is placed in the Fixed Primary Variable Current Mode with the Primary Variable Current set to the value received.

The value are returned in the Response Bytes.

A level of "0" exits the Fixed Primary Variable Current Mode.
Fixed Primary Variable Current Mode is also exited when power is removed from the device.

Write Parameters:

Description	HART Data Type	Data size
ENTER/EXIT FIXED CURRENT MODE (IN mA)	I MODE SELECT	FLOAT (4 BYTES)

Data Returned:

Description	HART Data Type	Data size
ENTER/EXIT FIXED CURRENT MODE (IN mA)	I MODE SELECT	FLOAT (4 BYTES)

HART Device specific commands description

COMMAND 128
Set reset Write protected mode

Description:
This command set or reset the write protected mode.

Write Parameters:

Description	HART Data Type	Data size
SET-RESET WRITE PROTECTED MODE		UNSIGN (1BYTE) 0=RESET WRITE PROTECTED MODE 1=SET WRITE PROTECTED MODE

Data Returned:

Description	HART Data Type	Data size
SET-RESET WRITE PROTECTED MODE		UNSIGN (1BYTE) 0=RESET WRITE PROTECTED MODE 1=SET WRITE PROTECTED MODE

OTHER McCROMETER PRODUCTS INCLUDE:

Propeller Meter   Propeller Flowmeters

Water Specialties Propeller Meter   Propeller Flowmeters

Ultra Mag   Magnetic Flowmeters

FPI Mag   Magnetic Flowmeters

FPI-X   Magnetic Flowmeters

SPI Mag   Magnetic Flowmeters

Mag 3000   Magnetic Flowmeters

McCrometer Connect   Wireless Monitoring Systems

VCone   Differential Pressure Flowmeters

VM VCone   Differential Pressure Flowmeters

Wafer-Cone   Differential Pressure Flowmeters