Installation, Operation and Maintenance Manual
MDE 254 Rev. 2
March 2023

Biffi ICON3000

HART Bus Module

HART REGISTERED

FDI REGISTERED

BIFFI

Biffi Italia s.r.l. - Strada Biffi 165, 29017 Fiorenzuola d'Arda (PC) – **Italy PH**: +39 0523 944 411 – biffi_italia@biffi.it

This page intentionally left blank.

Table of Contents

Section 9: Device Variables

Section 10: Tables

This page intentionally left blank.

Section 1: Introduction

The HRT2000v4 Module is an electronic module that allows connecting the ICON3000 actuator families to a HART® serial communication line. The module complies with HART Protocol Revision 7. It is controlled by a program stored internally. It works as a pure bus interface and does not affect the actuator control integrity. It is installed inside the actuator housing and takes the electrical power from the actuator power supply module. The HART hardware modem is located on the module board. The data lines are fully isolated from the actuator electronics.

HRT2000v4 Device Revision 1 can be mounted on ICON3000 actuator families.

HRT2000v4 Device Revision 2 can be mounted on ICON3000v2 actuator families.

The ICON3000v2 actuator can be recognized because when it is switched on, the name “ICON3000v2” appears on the local screen, as shown in Figure 1.

Figure 1

HART® is a mark owned by FieldComm Group.

Section 2: Operation and Storage

The module is designed to work and to be stored in the same environment of the actuator.

Section 3: Communication Features

Communication Protocol:	HART® Protocol Revision 7.2 (Device Revision 1) HART Protocol Revision 7.6 (Device Revision 2)
Electrical Interface:	4 to 20 mA analog loop, 2 wire communication
HART Signal:	Digital FSK Frequency Shift Keying (Bell 202 standard)
Logical "0" Frequency:	2,200 Hz
Logical "1" Frequency:	1,200 Hz
Data Rate:	Request/response mode – 2/3 updates per second Optional burst mode – 3/4 updates per second
Data Transmission:	Master/Slave and Burst communication modes
Data Byte Structure:	1 start bit, 8 data bits, 1 odd parity bit, 1 stop bit
Command Structure:	

Type of Command	**Structure**
Universal	Common to all devices
Common practice	Optional; used by many devices
Device-specific	For unique product features

HART Topology:	Point to point, Multidrop, Series Connection
Cable Lengths:	Maximum twisted pair length –10,000 ft / 3,048 m Maximum multiple twisted pair length – 5,000 ft / 1,524 m
Electrical Power:	Bus powered Max. voltage 36 V Min. voltage 0 V
Device Type:	Actuator
Device Impedance:	Low Impedance
Temperature:	-40 °C, +85 °C
Reversed Polarity Protection:	Present
Manufacturer ID Code:	183 (B7 HEX)
Device Type Code:	126 (7E HEX)

Section 4: HART Module

The module consists in a single PCB that is installed inside the actuator housing. It is connected to the Base Card via strip connector.

The internal wiring connects the HART® data lines to the actuator terminal board.

The HRT2000v4 Interface is implemented with two different electronic boards suitable to be installed in the ICON3000 or in ICON3000v2 actuators (HRT2000v4 Rev. 1 and HRT2000v4 Rev. 2, respectively).

Figure 2 Top Side – HRT2000v4 Rev. 1 Interface for ICON3000 Actuator

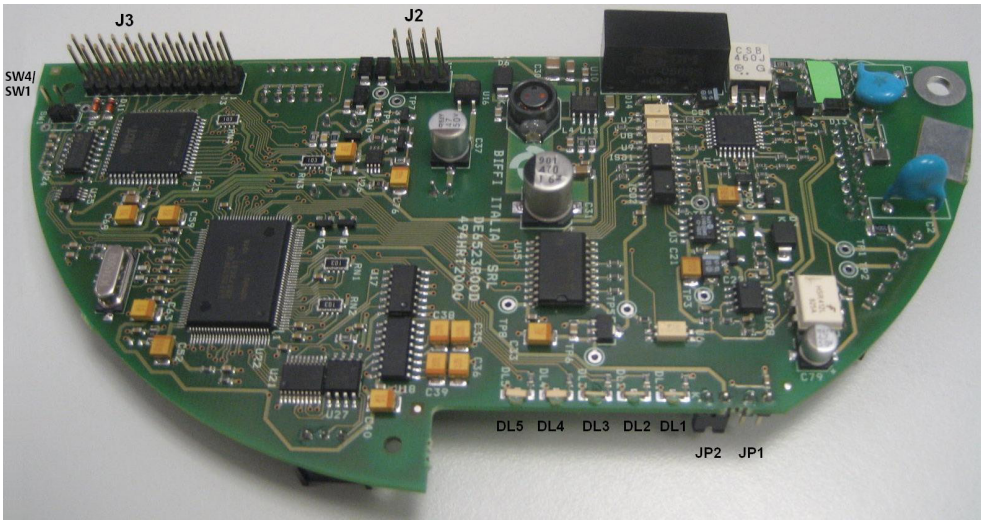
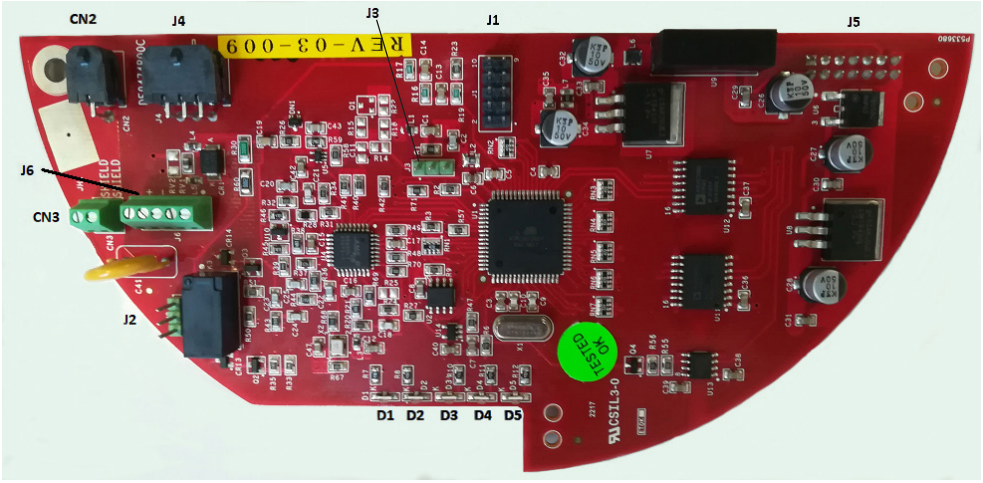


Figure 3 Top Side – HRT2000v4 Rev. 2 Interface for ICON3000v2 Actuator



HART® is a mark owned by FieldComm Group.

Figure 4 Bottom Side – HRT2000v4 Rev. 1 Interface for ICON3000 Actuator

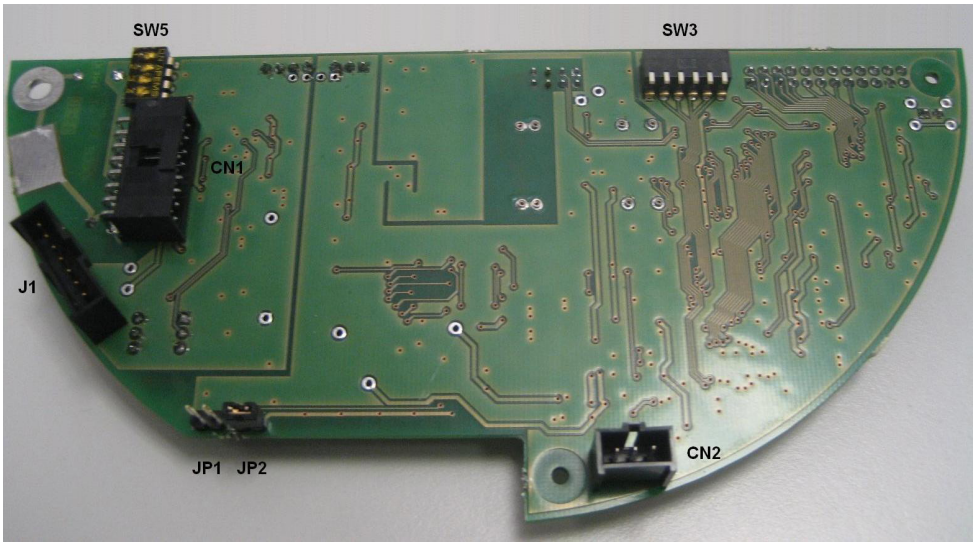
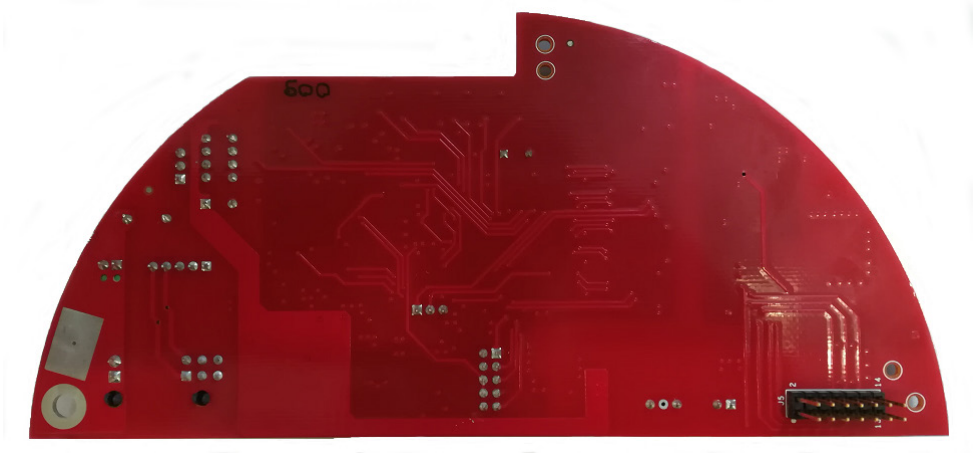


Figure 5 Bottom Side – HRT2000v4 Rev. 2 Interface for ICON3000v2 Actuator



4.1 On Board Indications and Jumpers

4.1.1 On Board Indications and Jumpers on ICON3000

Five LEDs are mounted on the HRT2000v4 rev. 1 to give the following indications for the field service. LEDs indicators are active only when jumper JP2 is closed.

DL1 (green) Power Supply:	ON: when the HRT2000v4 module is correctly powered from the main power supply
	OFF: when the HRT2000v4 module is not correctly powered from the power supply
DL2 (green) HART® Communication:	ON: Data Message received or transmitted from HRT2000v4 interface
	OFF: Silence between Data HART messages
DL3 (green) 4 to 20 mA Setup:	ON: Setup active (SW3 pin 6 in ON)
	OFF: Setup not active (SW3 pin 6 in OFF)
DL4 (red) 4 to 20 mA Input Level:	ON: Alarm, input level too low (< 2 mA)
	OFF: No Alarms
DL5 (red) Data Area Empty:	ON: when Data Area on interface card is not yet loaded
	OFF: when Data Area is completely loaded
	BLINK: when Data Area is being read from base card
JP1:	Program jumper. Used to download new firmware on microcontroller (manufacturer use only).
JP2:	LEDs Jumper. Short this jumper to power LEDs (Default ON).
SW4/SW1:	Pin Reset. Short this jumper to reset the HRT2000v4 module.

4.1.2 On Board Indication and Jumpers on ICON3000v2

Five LEDs are mounted on the HRT2000v4 Rev. 2 to give the following indications for the field service.

DL1 (red) Base Communication Status:	ON: when communication issues are faced during the communication with the logic card
	OFF: when the communication with the logic card works fine
DL2 (green) Data Area Empty:	ON: when Data area on HRT2000v4 Rev. 2 card is empty
	OFF: when Data area on HRT2000v4 Rev. 2 card is not empty
DL3 (green) Modbus Communication Status:	FIXED ON/OFF: when Modbus communication issues are faced during the communication with the logic card
	BLINK: no Modbus communication issues are faced during the communication with the logic card
DL4 (green) HART® Communication Status:	BLINK: Communication active
	FIXED ON/OFF: Communication not active
DL5 (green) Power Supply:	ON: HRT2000v4 Rev. 2 module is correctly powered from the main power supply
	OFF: HRT2000v4 Rev. 2 module is not correctly powered from the main power supply
J1:	It is used to download the FW on the microcontroller (manufacturer use only)
J2:	Reserved for manufacturer
J3:	Reserved for manufacturer

4.2 On Board Settings (Only for HRT2000v4 Rev. 1)

The HRT2000v4 Rev. 1 module is provided of dip switches to change the hardware settings of the module. The settings below are normally done in factory. Change settings only if authorized from manufacturer.

- 4 to 20 mA SETUP

  This procedure describes how to set the 4 to 20 mA limits for the HART® Card Interface.

  — 4 mA: connect 4 mA to HART+ and HART-. Move SW3 pin 5 in ON. Move SW3 pin 6 in ON. Wait 2 s. Move SW3 pin 6 and then pin 5 in OFF to store 4 mA setting in data flash memory.

  — 20 mA: connect 20 mA to HART+ and HART-. Move SW3 pin 4 in ON. Move SW3 pin 6 in ON. Wait 2 s. Move SW3 pin 6 and then pin 4 in OFF to store 20 mA setting in data flash memory.

- Filter ON/OFF

  To select analog filter type, follow the procedure below:

  — Filter OFF: Move SW3 pin 6 in ON. Move SW3 pin 3 in ON. Wait 2 s. Move SW3 pin 6 in OFF to store OFF filter selection.

  — Filter ON (default): Move SW3 pin 6 in ON. Move SW3 pin 3 in OFF. Wait 2 s. Move SW3 pin 6 in OFF to store ON filter selection.

- Default configuration (manufacturer use only)

  To select default factory settings, follow the procedure below:

  — Switch off the power supply to the card.

  — Move SW3 pin 1 to 6 in ON and then switch on power supply. Default configuration is stored in data flash memory.

  — Move SW3 pin 1 to 6 in OFF. Be careful, this procedure clears all configurations selected before. In particular, the 4 to 20 mA settings are changed and Configuration Change Counter is reset.

- Wiring mode

  This procedure describes how to set HART Wirings for the HRT2000v4 Interface, see Section 5.1.

  — Point to Point: Move SW5 pin 1 and 2 in OFF. Move SW5 pin 3 and 4 in ON.

  — Split Range: Move SW5 pin 1 and 2 in OFF. Move SW5 pin 3 and 4 in ON.

  — Multidrop: Move SW5 pin 1 and 2 ON. Move SW5 pin 3 and 4 in OFF.

See Section 11 for the Polling address, Device ID number and Mode.

See also Section 8, Universal Command 6 (Write Polling Address).

HART® is a mark owned by FieldComm Group.

4.3 Analog Control Signal

ICON3000 – HRT2000v4 Rev. 1

Maximum Current: 20.8 mA

Minimum Current: 2 mA

Multidrop Current: 4 mA

The following values are measured according to the HCF_TEST-2 rev 2.2.

Input Impedance: 495 Ω (in loop control mode)

Input Capacitance: 30,000 pF (in loop control mode)

ICON3000v2 – HRT2000v4 Rev. 2

Maximum Current: 22 mA

Minimum Current: 2 mA

Multidrop Current: 0 mA (no current flows)

The following values are measured according to the HCF_TEST-2 rev 2.2.

Input Impedance: 485 Ω (in loop control mode)

Input Capacitance: 5,000 pF (in loop control mode)

4.4 Process Variables

PV:	Analog 4 to 20 mA signal in % (position request in loop enable mode)
PV loop current:	Analog 4 to 20 mA input signal in mA
SV:	Actuator position in % of opening
TV:	Actuator torque in % of nominal torque (+ in closing, - in opening)
QV:	Temperature of electronics (°C)

In HRT2000v4 Rev. 2, the process variables can be changed by Command #51, see Section 8.2.3 for details.

Section 5: HART Protocol Previews

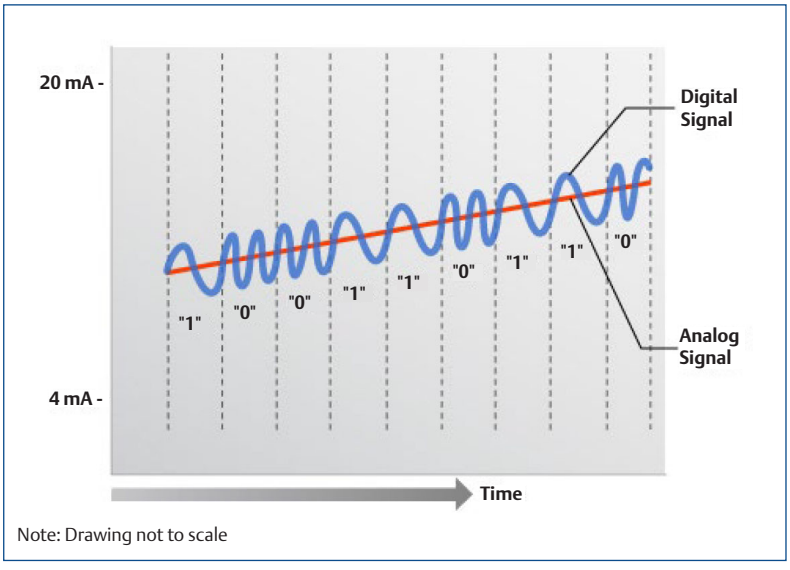
The HART® bus combines the familiarity of using the 4 to 20 mA signals with the benefits of the bus technology. In fact, by means of the simultaneous analog and digital signals, additional information can be carried out on the same pair of wires together with the analog 4 to 20 mA signal. The digital communication signal has a response time of approximately 2 to 3 data updates per second without interrupting the analog signal.

HART is typically a request-response communication protocol, which means that during normal operation (2 to 3 data updates per second), each field device communication is initiated by a host communication device. Two hosts can connect to each HART loop. The primary host is generally a distributed control system (DCS), programmable logic controller (PLC), or a personal computer (PC). Our actuator interface is a field device.

The HRT2000v4 Module supports the optional burst communication mode. Burst mode enables faster communication (3 to 4 data updates per second). In burst mode, the host instructs the field device to continuously broadcast a standard HART reply message (e.g. the value of the process variable). The host receives the message at the higher rate until it instructs the device to stop bursting.

The HART Communication Protocol is based on the Bell 202 telephone communication standard and operates using the frequency shift keying (FSK) principle. The digital signal is made up of two frequencies 1,200 Hz and 2,200 Hz representing bits 1 and 0, respectively. Sine waves of these two frequencies are superimposed on the direct current analog signal cables to provide simultaneous analog and digital communications. Because the average value of the FSK signal is always zero, the 4 to 20 mA analog signal is not affected.

Figure 6 Digital Over Analog



Note: Drawing not to scale

More information about HART is available on the website https://www.fieldcommgroup.org/.

HART® is a mark owned by FieldComm Group.

5.1 HART Wirings

According to HART® specification, the following working modes are available: point to point, split range, and multidrop.

In HRT2000v4 Rev. 2, the selection is managed by the device according with the actuator settings, see MODE and HART RELAY in Section 11.1.

In HRT2000v4 Rev. 1, the selection is done according to Table 1 by means of the dip switches SW5 on the HART module.

Table 1.

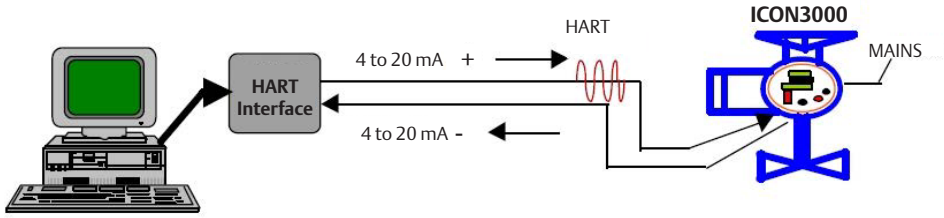
SW5 pin 1	SW5 pin 2	SW5 pin 3	SW5 pin 4	Connections Mode
OFF	OFF	ON	ON	Point to Point
OFF	OFF	ON	ON	Split Ranging
ON	ON	OFF	OFF	Multidrop

NOTE:
The factory configuration is POINT to POINT.

- **POINT TO POINT**

  In Point to Point mode, the 4 to 20 mA signal is used to communicate one process variable, while additional process variables, configuration parameters, and other device data are transferred digitally using the HART Protocol. The 4 to 20 mA analog signal is not affected by the HART signal and can be used for control. The HART communication digital signal gives access to secondary variables and other data that can be used for operations, commissioning, maintenance and diagnostic purposes.

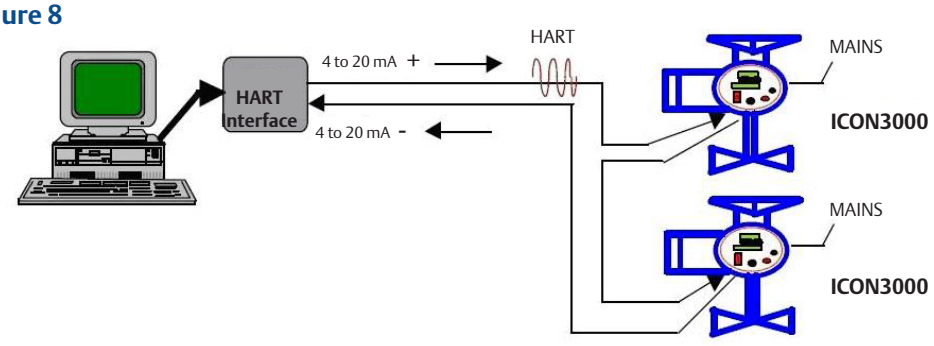
Figure 7



- **SPLIT RANGING**

  Split Range Control is a single control loop divided into two or more independent final control elements such as valves acting in different directions or in different steps. The field devices are connected in series in the same 4 to 20 mA current loop, each field device must have a unique polling address, different from each other in the range 0 to 15.

Figure 8

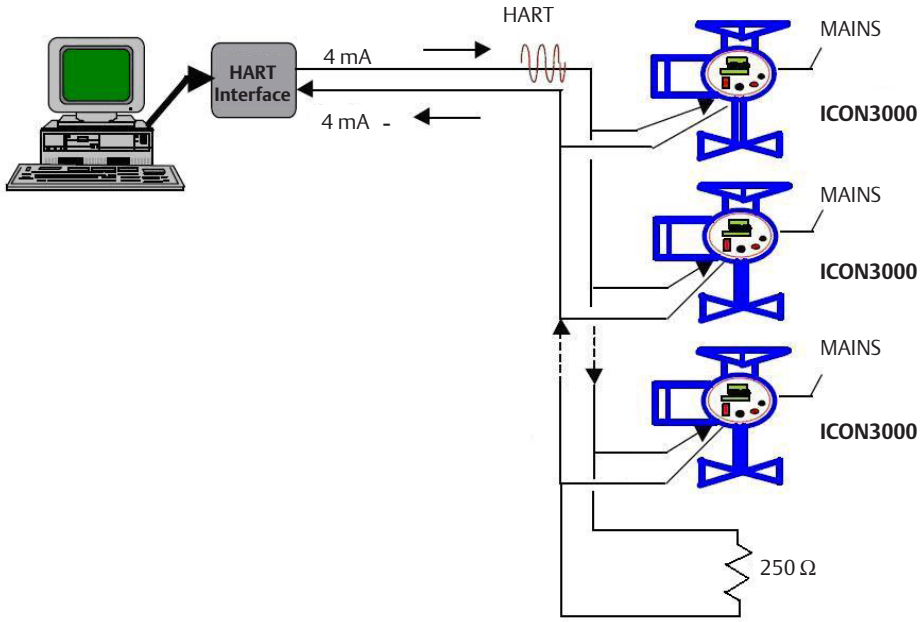


HART® is a mark owned by FieldComm Group.

- **MULTIDROP**

  The Multidrop Mode requires only a single pair of wires and can control up to 16 devices connected in parallel. All process values are transmitted digitally. In Multidrop mode, each field device must have a unique polling address, different from each other in the range 0 to 15. The current of the loop is fixed to a minimum value (typically 4 mA).

Figure 9



Only for HRT2000v4 Rev. 1

To work in Multidrop mode, the HRT2000v4 Rev. 1 module needs to set SW5 pin 1 and 2 ON, pin 3 and 4 OFF. It needs also to place a 250 Ω resistance between the terminals HART+ and HART- of the last actuator to close the 4 to 20 mA current loop. Alternatively, only in the last actuator of 4 to 20 mA current loop, set SW5 pin 1 and 2 OFF, pin 3 and 4 ON. In this case, it is not necessary to add the 250 Ω resistance to close the 4 to 20 mA loop. The other actuators of the loop must have SW5 pin 1 and 2 ON and pin 3 and 4 OFF. See also Section 8, Universal Command 6 and Device Variable 3 and Section 11.1 for the Configuration of Mode (Loop enable or Multidrop) and Polling Address.

Only for HRT2000v4 Rev. 2

To work in Multidrop mode, the HRT2000v4 Rev. 2 module needs to be configured by the local control panel of the actuator: “HART® Relay” must be set to OPEN, see Section 11.1, and the 250 Ω resistance must be placed between the terminals HART+ and HART- of the last actuator to close the 4 to 20 mA current loop. Alternatively, only in the last actuator of 4 to 20 mA current loop, the “HART Relay” can be set to CLOSE. In this case, it is not necessary to add the 250 Ω resistance to close the 4 to 20 mA loop. The other actuators of the loop must have the “HART Relay” parameter configured to OPEN.

Section 6: Wiring and Installation

In general, the installation practice for HART® communicating devices is the same as conventional 4 to 20 mA instrumentation. Individually shielded twisted pair cable, either in single-pair or multi-pair varieties is the recommended wiring practice. Unshielded cables may be used for short distances if ambient noise and cross-talk will not affect communication. The minimum conductor size is 0.51 mm diameter (#24 AWG) for cable runs less than 1,524 m / 5,000 ft and 0.81 mm diameter (#20 AWG) for longer distances.

6.1 Cable Length

Most installations are well within the 3,000 m / 10,000 ft theoretical limit for HART communication. However, the electrical characteristics of the cable (mostly capacitance) and the combination of connected devices can affect the maximum allowable cable length of a HART network. Table 2 shows the effect of cable capacitance and the number of network devices on cable length. The table is based on typical installations of HART devices in non-IS environments, i.e., no miscellaneous series impedance. Detailed information for determining the maximum cable length for any HART network configuration can be found in the HART Physical Layer Specifications.

Table 2.

No. of network devices	65 pF/m	95 pF/m	160 pF/m	225 pF/m
1	2,769 m	2,000 m	1,292 m	985 m
5	2,462 m	1,815 m	1,138 m	892 m
10	2,154 m	1,600 m	1,015 m	769 m
15	1,846 m	1,415 m	892 m	708 m

NOTE:
Cable Capacitance – pF/m Cable Length – m

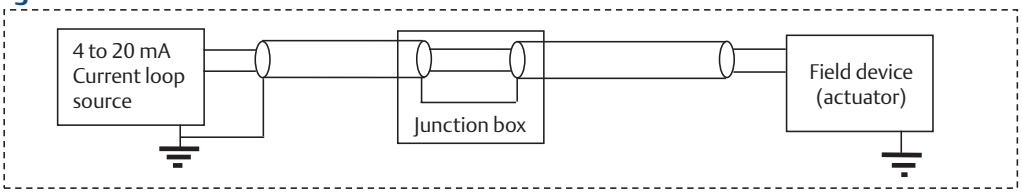
Recommended Minimum Conductor Size (Diameter):

- Below 1,785 m / 5,000 ft total length: #24 AWG (0.51 mm diameter).
- Above 1,785 m (single pair) total length: #20 AWG (0.81 mm diameter).

6.2 Shielding and Grounding

The cable shield must be grounded at one point only. This is usually done in the control room or near to the source of the current loop. Ground connection may alternatively occur in a junction box or other suitable location in the field area. The cable shield is usually left open at the field device.

Figure 10



Other grounding modes can be used if the coupling and the EMI do not damage the HART digital signal. More information can be viewed on the HART FSK Physical Layer Specification.

HART® is a mark owned by FieldComm Group.

Section 7: HART Commands

The HART® Command Set provides uniform and consistent communication for all field devices. The command set includes three classes: Universal, Common Practice and Device-Specific, refer to Table 3. Host applications may implement any of the necessary commands for a particular application.

- **UNIVERSAL**

  All devices using the HART Protocol must recognize and support the universal commands. Universal commands provide access to information useful in normal operations (e.g., read primary variable and units).

- **COMMON PRACTICE**

  Common Practice commands provide functions implemented by many, but not necessarily all HART communication devices.

- **DEVICE-SPECIFIC**

  Device-Specific commands represent functions that are unique to each field device. These commands access setup and calibration information, as well as information about the construction of the device. Information on Device-Specific commands is available from device manufacturers.

Table 3. HRT2000v4 Rev. 1 Commands

Universal Commands	Common Practice Commands	Device-Specific Commands
• Read Unique Identifier • Read Primary Variable • Read Loop Current and Percent of Range • Read Dynamic Variables and Loop Current • Write Polling Address • Read Loop Configuration • Read Dynamic Variable Classifications • Read Device Variables with Status • Read Unique Identifier Associated with Tag • Read Message • Read Tag, Descriptor, Date • Read Primary Variable Transducer Information • Read Device Information • Read Final Assembly Number • Write Message • Write Tag, Descriptor, Date • Write Final Assembly Number • Read Long Tag • Read Unique Identifier Associated with long Tag • Write Long Tag • Reset Configuration Changed Flag • Read Additional Device Status	• Perform Device Reset • Read Device Variable Inform • Write Number of Response Preamble • Read Device Communications Statistics • Write Burst Period • Write Burst Trigger • Read Burst Mode Configuration • Write Burst Device Variables • Write Burst Mode Command Number • Burst Mode Control	• Write Device Variable Value • Read Array • Write Array

HART® is a mark owned by FieldComm Group.

Table 4. HRT2000v4 Rev. 2 Commands

Universal Commands	Common Practice Commands	Device-Specific Commands
• Read Unique Identifier • Read Primary Variable • Read Loop Current and Percent of Range • Read Dynamic Variables and Loop Current • Write Polling Address • Read Loop Configuration • Read Dynamic Variable Classifications • Read Device Variables with Status • Read Unique Identifier Associated with Tag • Read Message • Read Tag, Descriptor, Date • Read Primary Variable Transducer Information • Read Device Information • Read Final Assembly Number • Write Message • Write Tag, Descriptor, Date • Write Final Assembly Number • Read Long Tag • Read Unique Identifier Associated with long Tag • Write Long Tag • Reset Configuration Changed Flag • Read Additional Device Status	• Perform Device Reset • Read Device Variable Inform • Write Number of Response Preamble • Read Device Communications Statistics • Write Burst Period • Write Burst Trigger • Read Burst Mode Configuration • Write Burst Device Variables • Write Burst Mode Command Number • Burst Mode Control • Read Dynamic Variable Assignments • Write Dynamic Variable Assignments • Read Device Variable Information	• Write Device Variable Value • Read Array • Write Array • Read Param_E Parameters • Write Param_E Parameters • Read Param_BE Parameters • Write Param_BE Parameters • Read Param_F Parameters • Write Param_F Parameters • Read Param_D Parameters • Write Param_D Parameters • Read Param_U32 Parameters • Write Param_U32 Parameters • Read Param_S32 Parameters • Write Param_S32 Parameters • Write Param_Str8 Parameters • Read Param_Str8 Parameters • Write Param_Str4 Parameters • Read Param_Str4 Parameters • Read FST Torque Curve Data Header • Read FST Torque Curve • Read PST Curve Data Header • Read PST Curve Part 1 • Read PST Curve Part 2 • Read EFS Curve Data Header • Read EFS Curve Part 1 • Read EFS Curve Part 2 • Read Event Log Data Header • Read Event Log • Read Recorder Log Data Header • Read Recorder Log • Read T-Recorder Log Data Header • Read T-Recorder Log • Read Card Report • Write Card Report • Read Alarms, Warnings and Connections Logs Data Header • Read Alarms Log • Read Warnings Log • Read Connections Log

All slave response messages return two Command Status bytes in the first two bytes of the Data field. The first byte is multiplexed and contains either the Communication Status (most significant bit is set) or the Response Code (most significant bit is reset). The second byte of a slave response message always contains Field Device Status.

The Response Data Bytes are not returned if a communication or command error is reported in the Command Status Bytes.

The Communication Status is returned if a communication error is detected by the field device.

Table 5.

Bit Mask	Communication Status Definition
0x80	**1** – This bit is always set to indicate a communication error
0x40	**Vertical Parity Error** – The parity of one or more of the bytes received by the device was not odd
0x20	**Overrun Error** – At least one byte of data in the receive buffer of the HART® was overwritten before it was read
0x10	**Framing Error** – The Stop Bit of one or more bytes received by the device was not detected by the HART
0x08	**Longitudinal Parity Error** – The Longitudinal Parity calculated by the device did not match the Check Byte at the end of the message
0x04	**Reserved** – always 0
0x02	**Buffer Overflow** – The message was too long for the receive buffer of the device.
0x01	**Reserved** – always 0

If no communication errors are detected, the first byte in the Data Field contains the Response Code. The Response Code describes the result of the executed command.

The Response Code is encoded as a 7-bit enumeration (between 0 and 127).

There are 3 Classification Response Codes:

- **Notification**: The command sent by the Master is executed properly by the Slave.
- **Warning**: The command sent by the Master is executed with the deviation as described in the response.
- **Error**: The command sent by the Master was not properly completed and the Response Code indicates the reason.

See the appropriate Response Code Table for each command.

The second data byte in a Slave-to-Master frame is a bit field table that represent the current operating status of the slave.

Table 6.

Bit Mask	Communication Status Definition
0x80	**Device Malfunction** – The device detected a serious error or failure that compromises device operation
0x40	**Configuration Changed** – An operation was performed that changed the device's configuration
0x20	**Cold Start** – A power failure or Device Reset has occurred
0x10	**More Status Available** – More status information is available via command 48, Read Additional Device Status
0x08	**Loop Current Fixed** – The Loop Current is being held at a fixed value and is not responding to process variations
0x04	**Loop Current Saturated** – The Loop Current has reached its upper (or lower) endpoint limit and cannot increase (or decrease) any further
0x02	**Non-Primary Variable Out of Limits** – A Device Variable not mapped to PV is beyond its operating limits
0x01	**Primary Variable Out of Limits** – The PV is beyond its operating limit

NOTES:
1. Device Malfunction bit is set if a generic alarm or warning is active, maintenance operation is required, one or more device variables are not loaded by the logic card or Main Voltage alarm is active.
2. Configuration Changed bit is set if one or more parameters are modified by a HART command.
3. Cold Start bit is set after a power on or reset operation has occurred.
4. More Status Available bit is set if additional device status data bytes are changed.
5. Loop Current Fixed bit is set if Loop Current Mode is disabled.
6. Loop Current Saturated, Non-Primary Variable Out of Limits, Primary variable Out of Limits bits are not used. These bits are always set to 0.

Section 8: HART Command Set

8.1 Universal Commands

Table 7.

No.	Command Description
0	Read Unique Identifier
1	Read Primary Variable
2	Read Loop Current and Percent of Range
3	Read Dynamic Variables and Loop Current
6	Write Polling Address
7	Read Loop Configuration
8	Read Dynamic Variable Classifications
9	Read Device Variables with Status
11	Read Unique Identifier Associated with Tag
12	Read Message
13	Read Tag, Descriptor, Date
14	Read Primary Variable Transducer Information
15	Read Device Information
16	Read Final Assembly Number
17	Write Message
18	Write Tag, Descriptor, Date
19	Write Final Assembly Number
20	Read Long Tag
21	Read Unique Identifier Associated with long Tag
22	Write Long Tag
38	Reset Configuration Changed Flag
48	Read Additional Device Status

8.1.1 Command #0: Read Unique Identifier

This command returns identity information about the field device including: Device Type, Revision Levels, and Device ID.

Table 8. Request Data Bytes

Byte	Format	Description
None	-	-

Table 9. Response Data Bytes

Byte	Format	Description
0	Unsigned-8	“254”– Fixed Value
1 to 2	Enum	Expanded Device Type Code (see Section 8.4, Table 248)
3	Unsigned-8	3 = Minimum number of preambles required for the request message from the Master to the Slave
4	Unsigned-8	7 = HART® Protocol Major Revision
5	Unsigned-8	Device Revision
6	Unsigned-8	Software Revision
7	Unsigned-5	MSB (5 bits) – Hardware Revision
7	Enum	LSB (3 bits) – Physical Signaling Code (see Section 8.4, Table 255)
8	Bits	Flag Assignement (see Section 8.4, Table 256)
9 to 11	Unsigned-24	Device ID
12	Unsigned-8	Minimum Number of preambles to be sent with the response message from the Slave to the Master.
13	Unsigned-8	Maximum Number of Device Variables.
14 to 15	Unsigned-16	Configuration Change Counter
16	Bits	Extended Field Device Status (see Section 8.4, Table 258)
17 to 18	Enum	Manufacturer Identification Code (see Section 8.4, Table 253)
19 to 20	Enum	Private Label Distributor Code (see Section 8.4, Table 253)
21	Enum	Device Profile (see Section 8.4, Table 263)

Table 10. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 127	-	Undefined

8.1.2 Command #1: Read Primary Variable

This command returns the Primary Variable value with its Unit Code. The Primary Variable (PV) is the percentage corresponding to the Loop Current signal.

Table 11. Request Data Bytes

Byte	Format	Description
None	-	-

Table 12. Response Data Bytes

Byte	Format	Description
0	Enum	Primary Variable Unit Codes (see Section 8.4, Table 249)
1 to 4	Float	Primary Variable

Table 13. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 5	-	Undefined
6	Error	Device-Specific Command Error
7	-	Undefined
8	Warning	Update Failure
9 to 15	-	Undefined
16	Error	Access Restricted
1 to 127	-	Undefined

8.1.3 Command #2: Read Loop Current and Percent of Range

This command reads the Loop Current and its associated Percent of Range.

Table 14. Request Data Bytes

Byte	Format	Description
None	-	-

Table 15. Response Data Bytes

Byte	Format	Description
0 to 3	Float	Primary Variable Loop Current (units of mA)
4 to 7	Float	Primary Variable Percent of Range (units of percent)

Table 16. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 5	-	Undefined
6	Error	Device-Specific Command Error
7	-	Undefined
8	Warning	Update Failure
9 to 15	-	Undefined
16	Error	Access Restricted
17 to 127	-	Undefined

8.1.4 Command #3: Read Dynamic Variables and Loop Current

This command reads the Loop Current and the four Dynamic Variables: the position request (PV – Primary Variable), the actuator position (SV – Secondary Variable), the output torque (TV – Tertiary Variable), the internal actuator temperature (QV – Quaternary Variable).

Table 17. Request Data Bytes

Byte	Format	Description
None	-	-

Table 18. Response Data Bytes

Byte	Format	Description
0 to 3	Float	Primary Variable Loop Current (units of mA)
4	Enum	Primary Variable Units Code (see Section 8.4, Table 249)
5 to 8	Float	Primary Variable
9	Enum	Secondary Variable Units Code (see Section 8.4, Table 249)
10 to 13	Float	Secondary Variable
14	Enum	Tertiary Variable Units Code (see Section 8.4, Table 249)
15 to 18	Float	Tertiary Variable
19	Enum	Quaternary Variable Units Code (see Section 8.4, Table 249)
20 to 23	Float	Quaternary Variable

Table 19. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 5	-	Undefined
6	Error	Device-Specific Command Error
7	-	Undefined
8	Warning	Update Failure
9 to 15	-	Undefined
16	Error	Access Restricted
17 to 127	-	Undefined

8.1.5 Command #6: Write Polling Address

This command permits to write the Polling Address and the Loop Current mode to the field device.

Table 20. Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Polling Address of Device
1	Enum	Loop Current Mode (see Section 8.4, Table 257)

Table 21. Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Polling Address of Device
1	Enum	Loop Current Mode (see Section 8.4, Table 257)

Table 22. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Poll Address Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Command Error
7	Error	In Write Protect Mode
8 to 11	-	Undefined
12	Error	Invalid Mode Selection
13 to 15	-	Undefined
16	Error	Access Restricted
17 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.1.6 Command #7: Read Loop Configuration

This command reads the Polling Address and the Loop Current mode.

Table 23. Request Data Bytes

Byte	Format	Description
None	-	-

Table 24. Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Polling Address of Device
1	Enum	Loop Current Mode (see Section 8.4, Table 257)

Table 25. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 15	-	Undefined
16	Error	Access Restricted
17 to 127	-	Undefined

8.1.7 Command #8: Read Dynamic Variable Classifications

This command reads the classification associated with the Dynamic Variables.

Table 26. Request Data Bytes

Byte	Format	Description
None	-	-

Table 27. Response Data Bytes

Byte	Format	Description
0	Enum	Primary Variable Classification (see Section 8.4, Table 260)
1	Enum	Secondary Variable Classification (see Section 8.4, Table 260)
2	Enum	Tertiary Variable Classification (see Section 8.4, Table 260)
3	Enum	Quaternary Variable Classification (see Section 8.4, Table 260)

Table 28. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 15	-	Undefined
16	Error	Access Restricted
17 to 127	-	Undefined

8.1.8 Command #9: Read Device Variables with Status

This command allows a Master to request the value and status of up to 8 Device or Dynamic Variables.

If the Field Device receives 1, 2, 3, 4, 5, 6, or 7 Request Data Bytes, it returns only the corresponding number of Device Variables.

Table 29.

No. of Device Variables Requested	No. of Request Data Bytes	No. of Response Data Bytes
1	1	13
2	2	21
3	3	29
4	4	37
5	5	45
6	6	53
7	7	61
8	8	69

Table 30. Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Slot 0: Device Variable Code (see Section 9.1)
1	Unsigned-8	Slot 1: Device Variable Code (see Section 9.1)
2	Unsigned-8	Slot 2: Device Variable Code (see Section 9.1)
3	Unsigned-8	Slot 3: Device Variable Code (see Section 9.1)
4	Unsigned-8	Slot 4: Device Variable Code (see Section 9.1)
5	Unsigned-8	Slot 5: Device Variable Code (see Section 9.1)
6	Unsigned-8	Slot 6: Device Variable Code (see Section 9.1)
7	Unsigned-8	Slot 7: Device Variable Code (see Section 9.1)

Table 31. Response Data Bytes

Byte	Format	Description
0	Bits	Extended Field Device Status (see Section 8.4, Table 258)
1	Unsigned-8	Slot 0: Device Variable Code (see Section 9.1)
2	Enum	Slot 0: Device Variable Classification (see Section 8.4, Table 260)
3	Enum	Slot 0: Unit Code (see Section 8.4, Table 249)
4 to 7	Float	Slot 0: Device Variable Value
8	Bits	Slot 0: Device Variable Status (see Section 9.2)
9	Unsigned-8	Slot 1: Device Variable Code (see Section 9.1)
10	Enum	Slot 1: Device Variable Classification (see Section 8.4, Table 260)
11	Enum	Slot 1: Units Code (see Section 8.4, Table 249)
12 to 15	Float	Slot 1: Device Variable Value
16	Bits	Slot 1: Device Variable Status (see Section 9.2)
17	Unsigned-8	Slot 2: Device Variable Code (see Section 9.1)
18	Enum	Slot 2: Device Variable Classification (see Section 8.4, Table 260)
19	Enum	Slot 2: Units Code (see Section 8.4, Table 249)
20 to 23	Float	Slot 2: Device Variable Value
24	Bits	Slot 2: Device Variable Status (see Section 9.2)
25	Unsigned-8	Slot 3: Device Variable Code (see Section 9.1)
26	Enum	Slot 3: Device Variable Classification (see Section 8.4, Table 260)
27	Enum	Slot 3: Units Code (see Section 8.4, Table 249)
28 to 31	Float	Slot 3: Device Variable Value
32	Bits	Slot 3: Device Variable Status (see Section 9.2)

Byte	Format	Description
33	Unsigned-8	Slot 4: Device Variable Code (see Section 9.1)
34	Enum	Slot 4: Device Variable Classification (see Section 8.4, Table 260)
35	Enum	Slot 4: Units Code (see Section 8.4, Table 249)
36 to 39	Float	Slot 4: Device Variable Value
40	Bits	Slot 4: Device Variable Status (see Section 9.2)
41	Unsigned-8	Slot 5: Device Variable Code (see Section 9.1)
42	Enum	Slot 5: Device Variable Classification (see Section 8.4, Table 260)
43	Enum	Slot 5: Units Code (see Section 8.4, Table 249)
44 to 47	Float	Slot 5: Device Variable Value
48	Bits	Slot 5: Device Variable Status (see Section 9.2)
49	Unsigned-8	Slot 6: Device Variable Code (see Section 9.1)
50	Enum	Slot 6: Device Variable Classification (see Section 8.4, Table 260)
51	Enum	Slot 6: Units Code (see Section 8.4, Table 249)
52 to 55	Float	Slot 6: Device Variable Value
56	Bits	Slot 6: Device Variable Status (see Section 9.2)
57	Unsigned-8	Slot 7: Device Variable Code (see Section 9.1)
58	Enum	Slot 7: Device Variable Classification (see Section 8.4, Table 260)
59	Enum	Slot 7: Units Code (see Section 8.4, Table 249)
60 to 63	Float	Slot 7: Device Variable Value
64	Bits	Slot 7: Device Variable Status (see Section 9.2)
65 to 68	Time	Slot 0: Data Time Stamp

Table 32. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Command Error
7	-	Undefined
8	Warning	Update Failure
9 to 13	-	Undefined
14	Warning	Dynamic Variables Returned for Device Variables
15	-	Undefined
16	Error	Access Restricted
17 to 29	-	Undefined
30	Warning	Command Response Truncated
31 to 127	-	Undefined

8.1.9 Command #11: Read Unique Identifier Associated with Tag

This command returns identity information about the field device including: Device Type, Revision levels and Device ID.

Table 33. Request Data Bytes

Byte	Format	Description
0 to 5	Packed	Tag

Table 34. Response Data Bytes

Byte	Format	Description
0	Unsigned-8	“254” – Fixed Value
1 to 2	Enum	Expanded Device Type Code (see Section 8.4, Table 248)
3	Unsigned-8	3 = Minimum number of preambles required for the request message from the Master to the Slave
4	Unsigned-8	7 = HART® Protocol Major Revision
5	Unsigned-8	Device Revision
6	Unsigned-8	Software Revision
7	Unsigned-5	MSB (5 bits) – Hardware Revision
7	Enum	LSB (3 bits) – Physical Signaling Code (see Section 8.4, Table 255)
8	Bits	Flag Assignment (see Section 8.4, Table 256)
9 to 11	Unsigned-24	Device ID
12	Unsigned-8	Minimum Number of preambles to be sent with the response message from the Slave to the Master
13	Unsigned-8	Maximum Number of Device Variables
14 to 15	Unsigned-16	Configuration Change Counter
16	Bits	Extended Field Device Status (see Section 8.4, Table 258)
17 to 18	Enum	Manufacturer Identification Code (see Section 8.4, Table 253)
19 to 20	Enum	Private Label Distributor Code (see Section 8.4, Table 253)
21	Enum	Device Profile (see Section 8.4, Table 264)

Table 35. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 127	-	Undefined

8.1.10 Command #12: Read Message

This command reads the Message contained within the field device.

Table 36. Request Data Bytes

Byte	Format	Description
None	-	-

Table 37. Response Data Bytes

Byte	Format	Description
0 to 23	Packed	Message

Table 38. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 15	-	Undefined
16	Error	Access Restricted
17 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.1.11 Command #13: Read Tag, Descriptor, Date

This command reads the Tag, Descriptor and Date contained within the field device. Only Tag is read by this command. Tag and Long Tag are completely separate data items.

Table 39. Request Data Bytes

Byte	Format	Description
None	-	-

Table 40. Response Data Bytes

Byte	Format	Description
0 to 5	Packed	Tag
6 to 17	Packed	Descriptor
18 to 20	Date	Date Code

Table 41. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 15	-	Undefined
16	Error	Access Restricted
17 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.1.12 Command #14: Read Primary Variable Transducer Information

This command reads the Transducer Serial Number, Limits/Minimum Span Units Code, Upper Transducer Limit, Lower Transducer Limit and Minimum Span for the Primary Variable Transducer.

Table 42. Request Data Bytes

Byte	Format	Description
None	-	-

Table 43. Response Data Bytes

Byte	Format	Description
0 to 2	Unsigned-24	Transducer Serial Number
3	Enum	Transducer Limits and Minimum Span units Code (see Section 8.4, Table 249)
4 to 7	Float	Upper Transducer Limit
8 to 11	Float	Lower Transducer Limit
12 to 15	Float	Minimum Span

Table 44. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 15	-	Undefined
16	Error	Access Restricted
17 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.1.13 Command #15: Read Device Information

This command reads the alarm selection code, transfer function code, range values units code, upper range value, Primary Variable lower range value, damping value and write protect code.

Table 45. Request Data Bytes

Byte	Format	Description
None	-	-

Table 46. Response Data Bytes

Byte	Format	Description
0	Enum	PV Alarm Selection Code (see Section 8.4, Table 251)
1	Enum	PV Transfer Function Code (see Section 8.4, Table 250)
2	Enum	PV Upper and Lower Range Values Units Code (see Section 8.4, Table 249)
3 to 6	Float	PV Upper Range Value
7 to 10	Float	PV Lower Range Value
11 to 14	-	PV Damping Value (units of seconds)
15	Enum	Write Protect Code (see Section 8.4, Table 252)
16	Enum	Reserved. “250”
17	Bits	PV Analog Channel Flags (see Section 8.4, Table 261)

Table 47. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 15	-	Undefined
16	Error	Access Restricted
17 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.1.14 Command #16: Read Final Assembly Number

This command reads the final assembly number associated within the field device. The Final Assembly Number is used for identifying the materials and electronics that comprise the field device.

Table 48. Request Data Bytes

Byte	Format	Description
None	-	-

Table 49. Response Data Bytes

Byte	Format	Description
0 to 2	Unsigned-24	Final Assembly Number

Table 50. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 15	-	Undefined
16	Error	Access Restricted
17 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.1.15 Command #17: Write Message

This command permits to write the Message into the field device.

Table 51. Request Data Bytes

Byte	Format	Description
0 to 23	Packed	A Message string used by the Master for record keeping

Table 52. Response Data Bytes

Byte	Format	Description
0 to 23	Packed	Message string

Table 53. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Command Error
7	Error	In Write Protect Mode
8 to 15	-	Undefined
16	Error	Access Restricted
17 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.1.16 Command #18: Write Tag, Descriptor, Date

This command permits to write the Tag, Descriptor and Date into the field device. Only the Tag is written here. The Tag and Long Tag are completely separate data items.

Table 54. Request Data Bytes

Byte	Format	Description
0 to 5	Packed	Tag
6 to 17	Packed	Descriptor used by the Master for record keeping
18 to 20	Date	A Date Code used by the Master for record keeping

Table 55. Response Data Bytes

Byte	Format	Description
0 to 5	Packed	Tag
6 to 17	Packed	Descriptor
18 to 20	Date	Date Code

Table 56. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Command Error
7	Error	In Write Protect Mode
8	-	Undefined
9	Error	Invalid Date Code Detected
10 to 15	-	Undefined
16	Error	Access Restricted
17 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.1.17 Command #19: Write Final Assembly Number

This command permits to write the Final Assembly Number into the field device.

Table 57. Request Data Bytes

Byte	Format	Description
0 to 2	Unsigned-24	Final Assembly Number

Table 58. Response Data Bytes

Byte	Format	Description
0 to 2	Unsigned-24	Final Assembly Number

Table 59. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Command Error
7	Error	In Write Protect Mode
8 to 15	-	Undefined
16	Error	Access Restricted
17 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.1.18 Command #20: Read Long Tag

This command reads the Long Tag. Only the Long Tag is read here. The Tag and Long Tag are completely separate data items.

Table 60. Request Data Bytes

Byte	Format	Description
None	-	-

Table 61. Response Data Bytes

Byte	Format	Description
0 to 31	Latin-1	Long Tag

Table 62. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 15	-	Undefined
16	Error	Access Restricted
17 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.1.19 Command #21: Read Unique Identifier Associated with Long Tag

This command returns identity information about the field device including: the Device Type, revision levels and Device ID.

Table 63. Request Data Bytes

Byte	Format	Description
0 to 31	Latin-1	Long Tag

Table 64. Response Data Bytes

Byte	Format	Description
0	Unsigned-8	“254” – Fixed Value
1 to 2	Enum	Expanded Device Type Code (see Section 8.4, Table 248)
3	Unsigned-8	3 = Minimum number of preambles required for the request message from the Master to the Slave
4	Unsigned-8	7 = HART® Protocol Major Revision
5	Unsigned-8	Device Revision
6	Unsigned-8	Software Revision
7	Unsigned-5	MSB (5 bits) – Hardware Revision
7	Enum	LSB (3 bits) – Physical Signaling Code (see Section 8.4, Table 255)
8	Bits	Flag Assignment (see Section 8.4, Table 256)
9 to 11	Unsigned-24	Device ID
12	Unsigned-8	Minimum Number of preambles to be sent with the response message from the Slave to the Master
13	Unsigned-8	Maximum Number of Device Variables
14 to 15	Unsigned-16	Configuration Change Counter
16	Bits	Extended Field Device Status (see Section 8.4, Table 258)
17 to 18	Enum	Manufacturer Identification Code (see Section 8.4, Table 253)
19 to 20	Enum	Private Label Distributor Code (see Section 8.4, Table 253)
21	Enum	Device Profile (see Section 8.4, Table 263)

Table 65. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 127	-	Undefined

8.1.20 Command #22: Write Long Tag

This command allows a Master to write the Long Tag into the field device. Only the Long Tag is written here. The Tag and Long Tag are completely separate data items.

Table 66. Request Data Bytes

Byte	Format	Description
0 to 31	Latin-1	Long Tag

Table 67. Response Data Bytes

Byte	Format	Description
0 to 31	Latin-1	Long Tag

Table 68. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Command Error
7	Error	In Write Protect Mode
8 to 15	-	Undefined
16	Error	Access Restricted
17 to 31	-	Undefined
32	Error	Busy
33	Error	Delayed Response Initiated
34	Error	Delayed Response Running
35	Error	Delayed Response Dead
36	Error	Delayed Response Conflict
37 to 127	-	Undefined

8.1.21 Command #38: Reset Configuration Changed Flag

This command allows a Master to reset the Configuration Change Flag into the field device.

Table 69. Request Data Bytes

Byte	Format	Description
0 to 1	Unsigned-16	Configuration Change Counter

Table 70. Response Data Bytes

Byte	Format	Description
0 to 1	Unsigned-16	Configuration Change Counter

Table 71. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 5	-	Undefined
6	Error	Device-Specific Command Error
7	Error	In Write Protect Mode
8	-	Undefined
9	Error	Configuration Change Counter Mismatch
10 to 15	-	Undefined
16	Error	Access Restricted
17 to 127	-	Undefined

8.1.22 Command #48: Read Additional Device Status

This command returns the device status information, device-specific status information, Extended Device Status, Device Operating Mode and Standardized Status.

Table 72. Request Data Bytes

Byte	Format	Description
0 to 5	Bits or Enum	Device-Specific Status
6	Bits	Extended Device Status
7	Bits	Device Operating Mode
8	Bits	Standardized Status 0
9	Bits	Standardized Status 1
10	Bits	Analog Channel Saturated
11	Bits	Standardized Status 2
12	Bits	Standardized Status 3
13	Bits	Analog Channel Fixed
14	Bits or Enum	Device-Specific Status

NOTE:
See table on the next page for details.

Table 73. Response Data Bytes

Byte	Format	Description
0 to 5	Bits or Enum	Device-Specific Status
6	Bits	Extended Device Status
7	Bits	Device Operating Mode
8	Bits	Standardized Status 0
9	Bits	Standardized Status 1
10	Bits	Analog Channel Saturated
11	Bits	Standardized Status 2
12	Bits	Standardized Status 3
13	Bits	Analog Channel Fixed
14	Bits or Enum	Device-Specific Status

NOTE:
See table on the next page for details.

Table 74. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 5	-	Undefined
6	Error	Device-Specific Command Error
7	-	Undefined
8	Warning	Update in Progress
9 to 15	-	Undefined
16	Error	Access Restricted
17 to 127	-	Undefined

Table 75. Request and Response Data Fields of the HRT2000v4 Rev. 1

Byte	Bit	Meaning	Class	Device Status Bits Set
0	-	Reserved	-	-
1	-	Reserved	-	-
2	-	Reserved	-	-
3	-	Reserved	-	-
4	-	Reserved	-	-
5	-	Reserved	-	-
6	0	Maintenance Required	Warning	4, 7
	1	Device Variable Alert	Warning	4, 7
	2	Not used	-	-
	3	Not used	-	-
	4	Not used	-	-
	5	Not used	-	-
	6	Not used	-	-
	7	Not used	-	-
7	-	Reserved – Not used	-	-
8	0	Not used	-	-
	1	Not used	-	-
	2	Not used	-	-
	3	Not used	-	-
	4	Not used	-	-
	5	Not used	-	-
	6	Electronic Defeat	Error	4, 7
	7	Not used	-	-
9	-	Not used	-	-
10	-	Not used	-	-
11	-	Not used	-	-
12	-	Not used	-	-
13	-	Not used	-	-
14	0	Generic Warning	Warning	4
	1	Generic Alarm	Error	4, 7
	2	Remote Control Not Available	-	4
	3	Not used	-	-
	4	Not used	-	-
	5	Not used	-	-
	6	Not used	-	-
	7	Not used	-	-

Bytes 0 to 5 are reserved for manufacturer use; they are always set to 0.
“Maintenance Required” bit is set to 1, if the date of the next maintenance operation is reached.
“Device Variable Alert” bit is set to 1, if one or more variable values is not correctly loaded by the device.
“Electronic Defeat” bit is set to 1, if the actuator is not correctly supplied.
“Generic Alarm” bit is set to 1, if one or more alarms are active.
“Generic Warning” bit is set to 1, if one or more warnings are active.
“Remote Control Not Available” bit is set to 1, if the actuator cannot be remotely controlled. The bit is to 1 when the Monitor relay is set to 0.
“Not used” bits and bytes are always set to 0.

Table 76. Request and Response Data Fields of the HRT2000v4 Rev. 2

Byte	Bit	Meaning	Set to 1 if	Class	Device Status Bits Set
0	0	Motor Thermostat	Motor Thermostat Alarm is active	Error	4, 7
	1	Hi-Hi Torque in Opening	Hi-Hi Torque in Opening Alarm is active	Error	4, 7
	2	Hi-Hi Torque in Closing	Hi-Hi Torque in Closing Alarm is active	Error	4, 7
	3	Hi-Hi Temperature	Hi-Hi Temperature Alarm is active	Error	4, 7
	4	Position Sensor	Position Sensor Alarm is active	Error	4, 7
	5	Speed Sensor	Speed Sensor Alarm is active	Error	4, 7
	6	Main Voltage	Main Voltage Alarm is active	Error	4, 7
	7	K1 Contactor	K1 Contactor Alarm is active	Error	4, 7
1	0	K2 Contactor	K2 Contactor Alarm is active	Error	4, 7
	1	Configuration	Configuration Alarm is active	Error	4, 7
	2	Hardware	Hardware Alarm is active	Error	4, 7
	3	Low Battery	Low Battery Alarm is active	Error	4, 7
	4	Lost Phase	Lost Phase Alarm is active	Error	4, 7
	5	Request Signal	Request Signal Alarm is active	Error	4, 7
	6	Hi-Hi Torque in Intermediate Position	Hi-Hi Torque Alarm in Intermediate Position is active	Error	4, 7
	7	Jammed in Closing	Jammed in Closing Alarm is active	Error	4, 7
2	0	Jammed in Opening	Jammed in Opening Alarm is active	Error	4, 7
	1	Direction Test Fail	Direction Test Alarm is active	Error	4, 7
	2	Mid-Travel in OP	Mid-Travel in OP Alarm is active	Error	4, 7
	3	Mid-Travel in CL	Mid-Travel in CL Alarm is active	Error	4, 7
	4	Alarm Extended #1	Not Used, Reserved	Error	4, 7
	5	Alarm Extended #2	Not Used, Reserved	Error	4, 7
	6	Alarm Extended #3	Not Used, Reserved	Error	4, 7
	7	Alarm Extended #4	Not Used, Reserved	Error	4, 7
3	0	Alarm Extended #5	Not Used, Reserved	Error	4, 7
	1	Alarm Extended #6	Not Used, Reserved	Error	4, 7
	2	Alarm Extended #7	Not Used, Reserved	Error	4, 7
	3	Alarm Extended #8	Not Used, Reserved	Error	4, 7
	4	NACK Motherboard	Not Used, Reserved	Error	4, 7
	5	Hardware Alarm 1	Hardware Alarm 1 is active	Error	4, 7
	6	Hardware Alarm 2	Hardware Alarm 1 is active	Error	4, 7
	7	Hardware Alarm 3	Hardware Alarm 1 is active	Error	4, 7
4	0	Hardware Alarm 4	Hardware Alarm 1 is active	Error	4, 7
	1	Hardware Alarm 5	Hardware Alarm 1 is active	Error	4, 7
	2	Hardware Alarm 6	Hardware Alarm 1 is active	Error	4, 7
	3	Hardware Alarm 7	Hardware Alarm 1 is active	Error	4, 7
	4	Hardware Alarm 8	Hardware Alarm 1 is active	Error	4, 7
	5	Hardware Alarm 9	Hardware Alarm 1 is active	Error	4, 7
	6	Hardware Alarm 10	Hardware Alarm 1 is active	Error	4, 7
	7	Hardware Alarm 11	Hardware Alarm 1 is active	Error	4, 7
5	0	Hardware Alarm 12	Hardware Alarm 1 is active	Error	4, 7
	1	Hardware Alarm 13	Hardware Alarm 1 is active	Error	4, 7
	2	EFS Mid-Travel	EFS Mid-Travel Alarm is active	Error	4, 7
	3	Not Used	-	-	-
	4	Not Used	-	-	-
	5	Not Used	-	-	-
	6	Not Used	-	-	-
	7	Not Used	-	-	-

Byte	Bit	Meaning	Set to 1 if	Class	Device Status Bits Set
6	0	Maintenance Required	The date of the next maintenance operation is reached	Warning	4, 7
	1	Device Variable Alert	One or more variable values is not correctly loaded by the device	Warning	4, 7
	2	Not Used	-	-	-
	3	Not Used	-	-	-
	4	Not Used	-	-	-
	5	Not Used	-	-	-
	6	Not Used	-	-	-
	7	Not Used	-	-	-
7	-	Reserved - Not Used	-	-	-
8	0	Not Used	-	-	-
	1	Not Used	-	-	-
	2	Not Used	-	-	-
	3	Not Used	-	-	-
	4	Not Used	-	-	-
	5	Not Used	-	-	-
	6	Electronic Defeat	The actuator is not correctly supplied	Error	4, 7
	7	Not Used	-	-	-
9	-	Not Used	-	-	-
10	-	Not Used	-	-	-
11	-	Not Used	-	-	-
12	-	Not Used	-	-	-
13	-	Not Used	-	-	-
14	0	Generic Warning	One or more warnings are active	Warning	4
	1	Generic Alarm	One or more alarms are active	Error	4, 7
	2	Remote Control Not Available	The actuator cannot be remotely controlled. The bit is set to 1 when the Monitor relay is set to 0.	-	4
	3	Hi Torque in Opening	Hi Torque in Opening warning is active	Warning	4
	4	Hi Torque in Closing	Hi Torque in Closing warning is active	Warning	4
	5	Hi Temperature	Hi Temperature warning is active	Warning	4
	6	Main Voltage	Main Voltage warning is active	Warning	4
	7	Contactor Cycles	Contactor Cycles warning is active	Warning	4
15	0	Motor Current	Motor Current warning is active	Warning	4
	1	Wrong Stroke Limits	Wrong Stroke Limits warning is active	Warning	4
	2	Bus Fail	Bus Fail warning is active	Warning	4
	3	PST Error - Over Travel	PST OV-TR warning is active	Warning	4
	4	PST Error - Max T1 (T-PST)	PST T1 warning is active	Warning	4
	5	PST Error - Max T2 (T-RET)	PST T2 warning is active	Warning	4
	6	PST Error - PST Failed	At least two of the following PST errors occurred: Over Travel, Max T1, Max T2	Warning	4
	7	Not Used	-	Warning	4

8.2 Common Practice Commands

The following common practice commands are implemented:

Table 77. Common Practice Commands Available on HRT2000v4 Rev. 1

No.	Command Description
42	Perform Device Reset
54	Read Device Variable Information
59	Write Number of Response Preambles
95	Read Device Communications Statistics
103	Write Burst Period
104	Write Burst Trigger
105	Read Burst Mode Configuration
107	Write Burst Device Variables
108	Write Burst Mode Command Number
109	Burst Mode Control

Table 78. Common Practice Commands Available on HRT2000v4 Rev. 2

No.	Command Description
42	Perform Device Reset
50	Read Dynamic Variable Assignments
51	Write Dynamic Variable Assignments
54	Read Device Variable Information
59	Write Number of Response Preamble
95	Read Device Communication Statistics
103	Write Burst Period
104	Write Burst Trigger
105	Read Burst Mode Configuration
107	Write Burst Device Variables
108	Write Burst Mode Command Number
109	Burst Mode Control

8.2.1 Command #42: Perform Device Reset

This command resets the field device. This is equivalent to cycling the power off and then back on to the field device. The field device may not respond to subsequent commands until the reset is complete.

Table 79. Request Data Bytes

Byte	Format	Description
None	-	-

Table 80. Response Data Bytes

Byte	Format	Description
None	-	-

Table 81. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 5	-	Undefined
6	Error	Device-Specific Command Error
7 to 15	-	Undefined
16	Error	Access Restricted
17 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.2.2 Command #50: Read Dynamic Variable Assignments

Responds with the Device Variable Numbers that are assigned to the Primary, Secondary, Tertiary and Quaternary Variables.

Table 82. Request Data Bytes

Byte	Format	Description
None	-	-

Table 83. Response Data Bytes

Byte	Format	Description
0	Unsigned Int-8	Device Variable assigned to Primary Variable
1	Unsigned Int-8	Device Variable assigned to Secondary Variable
2	Unsigned Int-8	Device Variable assigned to Tertiary Variable
3	Unsigned Int-8	Device Variable assigned to Quaternary Variable

Table 84. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 5	-	Undefined
6	Error	Device-Specific Command Error
7 to 15	-	Undefined
16	Error	Access Restricted
17 to 127	-	Undefined

See Command #51 Write Dynamic Variable Assignments for available Device Variable Codes.

8.2.3 Command #51: Write Dynamic Variable Assignments

Assigns Device Variables to the Primary, Secondary, Tertiary and Quaternary Variables.

Table 85. Request Data Bytes

Byte	Format	Description
0	Unsigned Int-8	Device Variable assigned to Primary Variable
1	Unsigned Int-8	Device Variable assigned to Secondary Variable
2	Unsigned Int-8	Device Variable assigned to Tertiary Variable
3	Unsigned Int-8	Device Variable assigned to Quaternary Variable

Table 86. Response Data Bytes

Byte	Format	Description
0	Unsigned Int-8	Device Variable assigned to Primary Variable
1	Unsigned Int-8	Device Variable assigned to Secondary Variable
2	Unsigned Int-8	Device Variable assigned to Tertiary Variable
3	Unsigned Int-8	Device Variable assigned to Quaternary Variable

Table 87. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Command Error
7	Error	In Write Protect Mode
8 to 15	-	Undefined
16	Error	Access Restricted
17 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

PV Codes Available:

Device Variable 71: Analog Position Request

SV, TV, QV Codes Available:

Device Variable 0: Commands
Device Variable 1: Actuator Status 1
Device Variable 2: Actuator Status 2
Device Variable 3: Position Request
Device Variable 4: Dead Band
Device Variable 5: Motion Inhibit Time
Device Variable 6: Actuator Alarms 1
Device Variable 7: Actuator Alarms 2
Device Variable 8: Actuator Warnings
Device Variable 9: AL – Opening Time
Device Variable 10: AL – Closing Time
Device Variable 11: ESD Action
Device Variable 12: ESD Percent
Device Variable 13: 2SP – Close Direction Status
Device Variable 14: 2SP – Close Direction Start Position
Device Variable 15: 2SP – Close Direction Stop Position
Device Variable 16: 2SP – Close Direction On Time
Device Variable 17: 2SP – Close Direction Off Time
Device Variable 18: 2SP – Open Direction Status
Device Variable 19: 2SP – Open Direction Start Position
Device Variable 20: 2SP – Open Direction Stop Position
Device Variable 21: 2SP – Open Direction On Time
Device Variable 22: 2SP – Open Direction Off Time
Device Variable 23: Fail-Safe Action
Device Variable 24: Fail-Safe Delay
Device Variable 25: Fail-Safe Position
Device Variable 26: Power Supply Type
Device Variable 27: Power Supply Voltage
Device Variable 28: Power Supply Frequency
Device Variable 29: Actuator Position (default SV)
Device Variable 30: Main Actuator Status
Device Variable 31: Local Mode
Device Variable 32: Off Mode
Device Variable 33: Remote Mode
Device Variable 34: Stall Alarm
Device Variable 35: Device Alarm Active

Device Variable 36: Actuator Ready
Device Variable 37: Torque (default TV)
Device Variable 38: Temperature (default QV)
Device Variable 39: Heater Status
Device Variable 40: K1 Contactor Status
Device Variable 41: K2 Contactor Status
Device Variable 42: Motor Thermostat Status
Device Variable 43: Output Contacts Status
Device Variable 44: Digital Inputs Status
Device Variable 45: User Level Logged
Device Variable 46: Motor Speed
Device Variable 47: Main Voltage
Device Variable 48: Current
Device Variable 49: Motor Temperature
Device Variable 50: Terminal Board Temperature
Device Variable 51: Position Request (Used by Logic Card)
Device Variable 52: Auxiliary Analog Input mA
Device Variable 53: Auxiliary Analog Input bit
Device Variable 54: PST Progress Counter
Device Variable 55: Last PST Status
Device Variable 56: PST Reset Conditions
Device Variable 57: Encoder Absolute Position
Device Variable 58: Encoder Status
Device Variable 59: Encoder Wheel 1
Device Variable 60: Encoder Wheel 2
Device Variable 61: Encoder Wheel 3
Device Variable 62: Encoder Communication Errors
Device Variable 63: Bus Communication Errors
Device Variable 64: Terminal Board Errors
Device Variable 65: Torque Potentiometer
Device Variable 66: Battery Voltage
Device Variable 67: HART® Interface Status
Device Variable 68: Analog Output mA
Device Variable 69: Analog Output bit
Device Variable 70: Additional Actuator Status
Device Variable 71: Analog Position Request (PV)

8.2.4 Command #54: Read Device Variable Information

This command reads the Transducer Serial Number, the Limits, Damping Value and Minimum Span of the selected Device Variable along with the corresponding engineering units.

Table 88. Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Device Variable Code (see Section 9.1)

Table 89. Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Device Variable Code (see Section 9.1)
1 to 3	Unsigned-24	Device Variable Transducer Serial Number
4	Enum	Device Variable Limits/Minimum Span Units Code (see Section 8.4, Table 249)
5 to 8	Float	Device Variable Upper Transducer Limit
9 to 12	Float	Device Variable Lower Transducer Limit
13 to 16	Float	Device Variable Damping Value
17 to 20	Float	Device Variable Minimum Span
21	Enum	Device Variable Classification (see Section 8.4, Table 260)
22	Enum	Device Variable Family (see Section 8.4, Table 259)
23 to 26	Time	Update Time Period

Table 90. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Command Error
7 to 15	-	Undefined
16	Error	Access Restricted
17 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.2.5 Command #59: Write Number of Response Preambles

This command sets the number of asynchronous 0xFF preambles bytes to be sent by a device before the start of a response message. This value may be set to no smaller than 5 and no greater than 20.

Table 91. Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Number of preambles to be sent with the response message from the Slave to the Master

Table 92. Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Number of preambles to be sent with the response message from the Slave to the Master

Table 93. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 2	-	Undefined
3	Error	Passed Parameter Too Large
4	Error	Passed Parameter Too Small
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Command Error
7	Error	In Write Protect Mode
8	Warning	Set To Nearest Possible Value
9 to 15	-	Undefined
16	Error	Access Restricted
17 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.2.6 Command #95: Read Device Communication Statistics

This command returns the field device communication statistics: the number of STX messages received by the device, the number of ACK messages sent by the device and the number of BACK sent by the device.

Table 94. Request Data Bytes

Byte	Format	Description
None	-	-

Table 95. Response Data Bytes

Byte	Format	Description
0 to 1	Unsigned-16	Count of STX messages received by this device
2 to 3	Unsigned-16	Count of ACK messages sent from this device
4 to 5	Unsigned-16	Count of BACK messages sent from this device

Table 96. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 5	-	Undefined
6	Error	Device-Specific Command Error
7 to 127	-	Undefined

8.2.7 Command #103: Write Burst Period

This command selects the minimum and maximum update period of a burst message. The minimum time must be less than or equal to the maximum time. The update time shall be selected as specified in Table 97 .

Table 97.

< 0.5 s Not Allowed	8 s
0.5 s (default)	16 s
1 s	32 s
2 s	60 to 3,600 s (any value)
4 s	> 3,600 s Not Allowed

The device corrects settings differing from these values and indicates “Update Times Adjusted” in its response message.

Table 98. Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Burst Message
1 to 4	Time	Update Period in 1 to 32 of a millisecond.
5 to 8	Time	Maximum Update Period in 1/32 of a millisecond.

Table 99. Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Burst Message
1 to 4	Time	Update Period in 1 to 32 of a millisecond.
5 to 8	Time	Maximum Update Period in 1/32 of a millisecond.

Table 100. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Command Error
7	Error	In Write Protect Mode
8	Warning	Update Times Adjusted
9	Error	Invalid Burst Message
10 to 15	-	Undefined
16	Error	Access Restricted
17 to 31	-	Undefined
32	Error	Busy (A Delayed Response could not be initiated.)
33	Error	Delayed Response Initiated
34	Error	Delayed Response Running
35	Error	Delayed Response Dead
36	Error	Delayed Response Conflict
37 to 127	-	Undefined

8.2.8 Command #104: Write Burst Trigger

This command configures the trigger that forces publishing of the Burst Message. Four trigger modes are supported: Continuous (default), Windowed, Rising and Falling.

Continuous Mode: The burst message is sent when the update period is exceeded.

Windowed Mode: The trigger value must be a positive number and is the symmetric window around the last communicated value. The burst message being published after the window was exceeded.

Rising Mode: The burst message is published when the source value exceeds the threshold established by the trigger value.

Falling Mode: The burst message is published when the source value falls below the trigger value.

In all cases, the burst message is triggered when the maximum update time is Command 103 is exceeded.

Table 101. Burst Message Trigger Source

Command	Trigger Source Value
1	PV (Position Request)
2	Loop Current Percent Range
3	PV (Position Request)
9	Device Variable in Slot 0

Table 102. Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Burst Message
1	Enum	Burst Trigger Mode Selection Code (see Section 8.4, Table 262)
2	Enum	Device Variable Classification for Trigger Level (see Section 8.4, Table 260)
3	Enum	Units Code (see Section 8.4, Table 249)
4 to 7	Float	Trigger Level

Table 103. Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Burst Message
1	Enum	Burst Trigger Mode Selection Code (see Section 8.4, Table 262)
2	Enum	Device Variable Classification for Trigger Level (see Section 8.4, Table 260)
3	Enum	Units Code (see Section 8.4, Table 249)
4 to 7	Float	Trigger Level

Table 104. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3	Error	Passed Parameter Too Large
4	Error	Passed Parameter Too Small
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Command Error
7	Error	In Write Protect Mode
8	-	Undefined
9	Error	Invalid Burst Message
10	-	Undefined
11	Error	Invalid Device Variable Classification
12	Error	Invalid Units Code

Code	Class	Description
13	Error	Invalid Burst Trigger Mode Selection Code
14 to 15	-	Undefined
16	Error	Access Restricted
17 to 31	-	Undefined
32	Error	Busy (A Delayed Response could not be initiated)
33	Error	Delayed Response Initiated
34	Error	Delayed Response Running
35	Error	Delayed Response Dead
36	Error	Delayed Response Conflict
37 to 127	-	Undefined

8.2.9 Command #105: Read Burst Mode Configuration

This command reads the Burst Mode configuration from the field device including: the Burst Mode Control Code, the command to be burst and a list of the Device Variables to be transmitted, the burst minimum and maximum update time and the condition for the maximum update time.

Table 105. Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Burst Message

Table 106. Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Burst Mode Control Code (see Section 8.4, Table 254)
1	Unsigned-8	Command Number of the response message to be transmitted
2	Unsigned-8	Device Variable Code assigned to Slot0 (see Section 9.1)
3	Unsigned-8	Device Variable Code assigned to Slot1 (see Section 9.1)
4	Unsigned-8	Device Variable Code assigned to Slot2 (see Section 9.1)
5	Unsigned-8	Device Variable Code assigned to Slot3 (see Section 9.1)
6	Unsigned-8	Device Variable Code assigned to Slot4 (see Section 9.1)
7	Unsigned-8	Device Variable Code assigned to Slot5 (see Section 9.1)
8	Unsigned-8	Device Variable Code assigned to Slot6 (see Section 9.1)
9	Unsigned-8	Device Variable Code assigned to Slot7 (see Section 9.1)
10	Unsigned-8	Burst Message
11	Unsigned-8	Total Number of Burst Messages
12 to 15	Time	Update Time in 1/32 of a millisecond
16 to19	Time	Maximum Update Time in 1/32 of a millisecond
20	Enum	Burst Trigger Mode Code (see Section 8.4, Table 262)
21	Enum	Device Variable Classification for Trigger Value (see Section 8.4, Table 260)
22	Enum	Units Code (see Section 8.4, Table 249)
23 to 26	Float	Trigger Value

Table 107. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 5	-	Undefined
6	Error	Device-Specific Command Error
7 to 8	-	Undefined
9	Error	Invalid Burst Message
10 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.2.10 Command #107: Write Burst Device Variables

This command selects the Device Variables that will be used by a bursting device to be returned by a Command 9 in Burst Mode.

If the trigger mode isn't Continuous in Command 104 and the trigger source's Device Variable Classification does not match the new Slot 0 Device Variable, the new values will be accepted and Response Code "Burst Condition Conflict" will be returned. The field device corrects the classification, unit codes, reset to Trigger Mode Continuous and publish continuously at the Update Period until it receives another Command 104.

Table 108. Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Device Variable Code assigned to Slot 0 (see Section 9.1)
1	Unsigned-8	Device Variable Code assigned to Slot 1 (see Section 9.1)
2	Unsigned-8	Device Variable Code assigned to Slot 2 (see Section 9.1)
3	Unsigned-8	Device Variable Code assigned to Slot 3 (see Section 9.1)
4	Unsigned-8	Device Variable Code assigned to Slot 4 (see Section 9.1)
5	Unsigned-8	Device Variable Code assigned to Slot 5 (see Section 9.1)
6	Unsigned-8	Device Variable Code assigned to Slot 6 (see Section 9.1)
7	Unsigned-8	Device Variable Code assigned to Slot 7 (see Section 9.1)
8	Unsigned-8	Burst Message

Table 109. Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Device Variable Code assigned to Slot 0 (see Section 9.1)
1	Unsigned-8	Device Variable Code assigned to Slot 1 (see Section 9.1)
2	Unsigned-8	Device Variable Code assigned to Slot 2 (see Section 9.1)
3	Unsigned-8	Device Variable Code assigned to Slot 3 (see Section 9.1)
4	Unsigned-8	Device Variable Code assigned to Slot 4 (see Section 9.1)
5	Unsigned-8	Device Variable Code assigned to Slot 5 (see Section 9.1)
6	Unsigned-8	Device Variable Code assigned to Slot 6 (see Section 9.1)
7	Unsigned-8	Device Variable Code assigned to Slot 7 (see Section 9.1)
8	Unsigned-8	Burst Message

Table 110. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Command Error
7	Error	In Write Protect Mode
8	Warning	Burst Condition Conflict
9	Error	Invalid Burst Message
10 to 127	-	Undefined

8.2.11 Command #108: Write Burst Mode Command Number

This command selects the response message that the device transmits while in Burst Mode.

Table 111. Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Command Number of the response message to be transmitted
1	Unsigned-8	Burst Message

Table 112. Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Command Number of the response message to be transmitted
1	Unsigned-8	Burst Message

Table 113. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Command Error
7	Error	In Write Protect Mode
8	Warning	Burst Condition Conflict
9	Error	Invalid Burst Message
10 to 127	-	Undefined

The following command can be represented in burst messages:

Table 114.

No.	Command Description
1	Read Primary Variable
2	Read Loop Current and Percent of Range
3	Read Dynamic Variables and Loop Current
9	Read Device Variables with status
48	Read Additional Device Status

8.2.12 Command #109: Burst Mode Control

This command is used to enter and exit the Burst Mode on the field device.

Table 115. Request Data Bytes

Byte	Format	Description
0	Unsigned-8	Burst Mode Control Code (see Section 8.4, Table 254)
1	Unsigned-8	Burst Message

Table 116. Response Data Bytes

Byte	Format	Description
0	Unsigned-8	Burst Mode Control Code (see Section 8.4, Table 254)
1	Unsigned-8	Burst Message

Table 117. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6	Error	Device-Specific Command Error
7	Error	In Write Protect Mode
8	Warning	Update Period Increased
9	Error	Insufficient bandwidth
10 to 15	-	Undefined
16	Error	Access Restricted
17 to 31	-	Undefined
32	Error	Busy (Delayed Response could not be initiated)
33	Error	Delayed Response Initiated
34	Error	Delayed Response Running
35	Error	Delayed Response Dead
36	Error	Delayed Response Conflict
37 to 127	-	Undefined

8.2.13 Catch Device Variable

This device does not support Catch Device Variable.

8.3 Device-Specific Commands

The following Device-Specific commands are implemented:

Table 118. Device-Specific Commands available on HRT2000v4 Rev. 1

No.	Command Description
129	Write Device Variable Value
130	Read Array
131	Write Array

Table 119. Device-Specific Commands available on HRT2000v4 Rev. 2

No.	Command Description
129	Write Device Variable Value
130	Read Array
131	Write Array
132	Read Param_E Parameters
133	Write Param_E Parameters
134	Read Param_BE Parameters
135	Write Param_BE Parameters
136	Read Param_F Parameters
137	Write Param_F Parameters
138	Read Param_D Parameters
139	Write Param_D Parameters
140	Read Param_U32 Parameters
141	Write Param_U32 Parameters
142	Read Param_S32 Parameters
143	Write Param_S32 Parameters
144	Read Param_Str8 Parameters
145	Write Param_Str8 Parameters
146	Read Param_Str4 Parameters
147	Write Param_Str4 Parameters
148	Read FST Torque Curve Data Header
149	Read FST Torque Curve
150	Read PST Curve Data Header
151	Read PST Curve Part1
152	Read PST Curve Part2
153	Read EFS Curve Data Header
154	Read EFS Curve Part1
155	Read EFS Curve Part2
156	Read Event Log Data Header
157	Read Event Log
158	Read Recorder Log Data Header
159	Read Recorder Log
160	Read T-Recorder Log Data Header
161	Read T-Recorder Log
162	Read Card Report
163	Write Card Report
164	Read Alarms, Warnings and Connection Logs Data Header
165	Read Alarms Log
166	Read Warnings Log
167	Read Connections Log

8.3.1 Command #129: Write Device Variable Value

This command allows forcing the value of one variable.

Table 120. Request Data Bytes

Byte	Format	Description
0	Enum	Device Variable Code (see Section 9.1)
1 to 4	-	Device Variable Value

Table 121. Response Data Bytes

Byte	Format	Description
0	Enum	Device Variable Code (see Section 9.1)
1 to 4	-	Device Variable Value

Table 122. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too few data bytes received
6	Error	Illegal Device Variable Value
7	Error	In Write Protect Mode
8 to 127	-	Undefined

If a master tries to write a read only variable, Response Code 7 (“In Write Protect Mode”) is generated.

NOTICE

If Loop Current Mode is active, Open Command (b0), Close Command (b1), Stop Command (b2), Positioner Enabled (b4) in Device Variable Code 0 are always set to 0 even if No Command-Specific errors.

8.3.2 Command #130: Read Array

Reads the value of one actuator array data.

Table 123. Request Data Bytes

Byte	Format	Description
0	Enum	Array Code (see Section 10.1)

Table 124. Response Data Bytes

Byte	Format	Description
0	Enum	Array Code (see Section 10.1)
1 to 28	ASCII	Array Value

Table 125. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too few data bytes received
6 to 31	-	Undefined
32	Error	Device Busy
33 to 127	-	Undefined

8.3.3 Command #131: Write Array

This command allows forcing the value of one array data.

Table 126. Request Data Bytes

Byte	Format	Description
0	Enum	Array Code (see Section 10.1)
1 to 28	ASCII	Array Value

Table 127. Response Data Bytes

Byte	Format	Description
0	Enum	Array Code (see Section 10.1)
1 to 28	ASCII	Array Value

Table 128. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 4	-	Undefined
5	Error	Too few data bytes received
6	-	Undefined
7	Error	In Write Protect Mode
8 to 16	-	Undefined
17	Error	Invalid Array Code
18 to 31	-	Undefined
32	Error	Device Busy
33 to 127	-	Undefined

If a master tries to write a read only array, response code 7 (“In Write Protect Mode”) is generated.

8.3.4 Command #132: Read Param_E Parameters

Reads the value of a Param_E Parameter.

Table 129. Request Data Bytes

Byte	Format	Description
0	Enum-8	Param_E Code (See Section 10.2)

Table 130. Response Data Bytes

Byte	Format	Description
0	Enum-8	Param_E Code (See Section 10.2)
1 to 2	Enum-16	Param_E Value

Table 131. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.3.5 Command #133: Write Param_E Parameters

This command allows forcing the value of one Param_E Parameter.

Table 132. Request Data Bytes

Byte	Format	Description
0	Enum-8	Param_E Code (See Section 10.2)
1 to 2	Enum-16	Param_E Value

Table 133. Response Data Bytes

Byte	Format	Description
0	Enum-8	Param_E Code (See Section 10.2)
1 to 2	Enum-16	Param_E Value

Table 134. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6	-	Undefined
7	Error	In Write Protect Mode
8 to 16	-	Undefined
17	Error	Invalid Param_E Code
18 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

If a master tries to write a read only parameter, response code 7 (“In Write Protect Mode”) is generated. The modification of the value of the parameters is restricted by the permissions of the user level logged, see Appendix B for details.

8.3.6 Command #134: Read Param_BE Parameters

Reads the value of a Param_BE Parameter.

Table 135. Request Data Bytes

Byte	Format	Description
0	Enum-8	Param_BE Code (See Section 10.3)

Table 136. Response Data Bytes

Byte	Format	Description
0	Enum-8	Param_BE Code (See Section 10.3)
1 to 2	Bit Enum	Param_BE Value

Table 137. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.3.7 Command #135: Write Param_BE Parameters

This command allows forcing the value of one Param_BE Parameter.

Table 138. Request Data Bytes

Byte	Format	Description
0	Enum-8	Param_BE Code (See Section 10.3)
1 to 2	Bit Enum	Param_BE Value

Table 139. Response Data Bytes

Byte	Format	Description
0	Enum-8	Param_BE Code (See Section 10.3)
1 to 2	Bit Enum	Param_BE Value

Table 140. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6	-	Undefined
7	Error	In Write Protect Mode
8 to 16	-	Undefined
17	Error	Invalid Param_BE Code
18 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

If a master tries to write a read only parameter, response code 7 (“In Write Protect Mode”) is generated. The modification of the value of the parameters is restricted by the permissions of the user level logged, see Appendix B for details.

8.3.8 Command #136: Read Param_F Parameters

Reads the value of a Param_F Parameter.

Table 141. Request Data Bytes

Byte	Format	Description
0	Enum-8	Param_F Code (See Section 10.4)

Table 142. Response Data Bytes

Byte	Format	Description
0	Enum-8	Param_F Code (See Section 10.4)
1 to 4	Float	Param_F Value

Table 143. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.3.9 Command #137: Write Param_F Parameters

This command allows forcing the value of one Param_F Parameter.

Table 144. Request Data Bytes

Byte	Format	Description
0	Enum-8	Param_F Code (See Section 10.4)
1 to 4	Float	Param_F Value

Table 145. Response Data Bytes

Byte	Format	Description
0	Enum-8	Param_F Code (See Section 10.4)
1 to 4	Float	Param_F Value

Table 146. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6	-	Undefined
7	Error	In Write Protect Mode
8 to 16	-	Undefined
17	Error	Invalid Param_F Code
18 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

If a master tries to write a read only parameter, response code 7 (“In Write Protect Mode”) is generated. The modification of the value of the parameters is restricted by the permissions of the user level logged, see Appendix B for details.

8.3.10 Command #138: Read Param_D Parameters

Reads the value of a Param_D Parameter.

Table 147. Request Data Bytes

Byte	Format	Description
0	Enum-8	Param_D Code (See Section 10.5)

Table 148. Response Data Bytes

Byte	Format	Description
0	Enum-8	Param_D Code (See Section 10.5)
1 to 3	Date	Param_D Value – Date
4 to 7	Time	Param_D Value – Time

Table 149. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.3.11 Command #139: Write Param_D Parameters

This command allows forcing the value of one Param_D Parameter.

Table 150. Request Data Bytes

Byte	Format	Description
0	Enum-8	Param_D Code (See Section 10.5)
1 to 3	Date	Param_D Value – Date
4 to 7	Time	Param_D Value – Time

Table 151. Response Data Bytes

Byte	Format	Description
0	Enum-8	Param_D Code (See Section 10.5)
1 to 3	Date	Param_D Value – Date
4 to 7	Time	Param_D Value – Time

Table 152. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6	-	Undefined
7	Error	In Write Protect Mode
8 to 16	-	Undefined
17	Error	Invalid Param_D Code
18 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

If a master tries to write a read only parameter, response code 7 (“In Write Protect Mode”) is generated. The modification of the value of the parameters is restricted by the permissions of the user level logged, see Appendix B for details.

8.3.12 Command #140: Read Param_U32 Parameters

Reads the value of a Param_U32 Parameter.

Table 153. Request Data Bytes

Byte	Format	Description
0	Enum-8	Param_U32 Code (See Section 10.6)

Table 154. Response Data Bytes

Byte	Format	Description
0	Enum-8	Param_U32 Code (See Section 10.6)
1 to 4	Unsigned Int-32	Param_U32 Value

Table 155. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.3.13 Command #141: Write Param_U32 Parameters

This command allows forcing the value of one Param_U32 Parameter.

Table 156. Request Data Bytes

Byte	Format	Description
0	Enum-8	Param_U32 Code (See Section 10.6)
1 to 4	Unsigned Int-32	Param_U32 Value

Table 157. Response Data Bytes

Byte	Format	Description
0	Enum-8	Param_U32 Code (See Section 10.6)
1 to 4	Unsigned Int-32	Param_U32 Value

Table 158. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6	-	Undefined
7	Error	In Write Protect Mode
8 to 16	-	Undefined
17	Error	Invalid Param_U32 Code
18 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

If a master tries to write a read only parameter, response code 7 (“In Write Protect Mode”) is generated. The modification of the value of the parameters is restricted by the permissions of the user level logged, see Appendix B for details.

8.3.14 Command #142: Read Param_S32 Parameters

Reads the value of a Param_S32 Parameter.

Table 159. Request Data Bytes

Byte	Format	Description
0	Enum-8	Param_S32 Code (See Section 10.7)

Table 160. Response Data Bytes

Byte	Format	Description
0	Enum-8	Param_S32 Code (See Section 10.7)
1 to 4	Signed Int-32	Param_S32 Value

Table 161. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.3.15 Command #143: Write Param_S32 Parameters

This command allows forcing the value of one Param_S32 Parameter.

Table 162. Request Data Bytes

Byte	Format	Description
0	Enum-8	Param_S32 Code (See Section 10.7)
1 to 4	Signed Int-32	Param_S32 Value

Table 163. Response Data Bytes

Byte	Format	Description
0	Enum-8	Param_S32 Code (See Section 10.7)
1 to 4	Signed Int-32	Param_S32 Value

Table164. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6	-	Undefined
7	Error	In Write Protect Mode
8 to 16	-	Undefined
17	Error	Invalid Param_S32 Code
18 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

If a master tries to write a read only parameter, response code 7 (“In Write Protect Mode”) is generated. The modification of the value of the parameters is restricted by the permissions of the user level logged, see Appendix B for details.

8.3.16 Command #144: Read Param_Str8 Parameters

Reads the value of a Param_Str8 Parameter.

Table 165. Request Data Bytes

Byte	Format	Description
0	Enum-8	Param_Str8 Code (See Section 10.8)

Table 166. Response Data Bytes

Byte	Format	Description
0	Enum-8	Param_Str8 Code (See Section 10.8)
1 to 8	ASCII	Param_Str8 Value

Table 167. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.3.17 Command #145: Write Param_Str8 Parameters

This command allows forcing the value of one Param_Str8 Parameter.

Table 168. Request Data Bytes

Byte	Format	Description
0	Enum-8	Param_Str8 Code (See Section 10.8)
1 to 8	ASCII	Param_Str8 Value

Table 169. Response Data Bytes

Byte	Format	Description
0	Enum-8	Param_Str8 Code (See Section 10.8)
1 to 8	ASCII	Param_Str8 Value

Table 170. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6	-	Undefined
7	Error	In Write Protect Mode
8 to 16	-	Undefined
17	Error	Invalid Param_Str8 Code
18 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

If a master tries to write a read only parameter, response code 7 (“In Write Protect Mode”) is generated. The modification of the value of the parameters is restricted by the permissions of the user level logged, see Appendix B for details.

8.3.18 Command #146: Read Param_Str4 Parameters

Reads the value of a Param_Str4 Parameter.

Table 171. Request Data Bytes

Byte	Format	Description
0	Enum-8	Param_Str4 Code (See Section 10.9)

Table 172. Response Data Bytes

Byte	Format	Description
0	Enum-8	Param_Str4 Code (See Section 10.9)
1 to 4	ASCII	Param_Str4 Value

Table 173. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.3.19 Command #147: Write Param_Str4 Parameters

This command allows forcing the value of one Param_Str4 Parameter.

Table 174. Request Data Bytes

Byte	Format	Description
0	Enum-8	Param_Str4 Code (See Section 10.9)
1 to 4	ASCII	Param_Str4 Value

Table 175. Response Data Bytes

Byte	Format	Description
0	Enum-8	Param_Str4 Code (See Section 10.9)
1 to 4	ASCII	Param_Str4 Value

Table 176. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6	-	Undefined
7	Error	In Write Protect Mode
8 to 16	-	Undefined
17	Error	Invalid Param_Str4 Code
18 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

If a master tries to write a read only parameter, response code 7 (“In Write Protect Mode”) is generated. The modification of the value of the parameters is restricted by the permissions of the user level logged, see Appendix B for details.

8.3.20 Command #148: Read FST Torque Curve Data Header

This command allows reading the header data of one FST Torque Curve.

Table 177. Request Data Bytes

Byte	Format	Description
0	Enum-8	FST Torque Curve ID (See Section 10.10)
1	Enum-8	FST Torque Curve Type (See Section 10.11)

Table 178. Response Data Bytes

Byte	Format	Description
0	Enum-8	FST Torque Curve ID (See Section 10.10)
1	Enum-8	FST Torque Curve Type (See Section 10.11)
2 to 4	Date	FST Date
5 to 8	Time	FST Time
9	Signed Int-8	Electronic Temperature (°C)
10	Signed Int-8	Terminal Board Temperature (°C)
11	Signed Int-8	Motor Temperature (°C)
12 to 13	Unsigned Int-16	Voltage (V)
14 to 15	Unsigned Int-16	Stroke Time (s)

Table 179. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

If the combination of the FST Torque Curve ID and the FST Torque Curve Type corresponds to a not existing FST Torque Curve, the FST Date and FST Time are fixed respectively to 6th February 2136 and 06:28:15.

8.3.21 Command #149: Read FST Torque Curve

This command allows reading the samples of one FST Torque Curve.

Table 180. Request Data Bytes

Byte	Format	Description
0	Unsigned Int-8	FST Transaction ID (0 to 2)
1	Enum-8	FST Torque Curve ID (See Section 10.10)
2	Enum-8	FST Torque Curve Type (See Section 10.11)

Table 181. Response Data Bytes (Transaction ID = 0)

Byte	Format	Description
0	Unsigned Int-8	FST Transaction ID = 0
1	Enum-8	FST Torque Curve ID (See Section 10.10)
2	Enum-8	FST Torque Curve Type (See Section 10.11)
3 to 4	Unsigned Int-16	Torque at position 0%
5 to 6	Unsigned Int-16	Torque at position 1%
7 to 8	Unsigned Int-16	Torque at position 2%
9 to 10	Unsigned Int-16	Torque at position 3%
11 to 12	Unsigned Int-16	Torque at position 4%
13 to 14	Unsigned Int-16	Torque at position 5%
15 to 16	Unsigned Int-16	Torque at position 6%
17 to 18	Unsigned Int-16	Torque at position 7%
19 to 20	Unsigned Int-16	Torque at position 8%
21 to 22	Unsigned Int-16	Torque at position 9%
23 to 24	Unsigned Int-16	Torque at position 10%
25 to 26	Unsigned Int-16	Torque at position 11%
27 to 28	Unsigned Int-16	Torque at position 12%
29 to 30	Unsigned Int-16	Torque at position 13%
31 to 32	Unsigned Int-16	Torque at position 14%
33 to 34	Unsigned Int-16	Torque at position 15%
35 to 36	Unsigned Int-16	Torque at position 16%
37 to 38	Unsigned Int-16	Torque at position 17%
39 to 40	Unsigned Int-16	Torque at position 18%
41 to 42	Unsigned Int-16	Torque at position 19%
43 to 44	Unsigned Int-16	Torque at position 20%
45 to 46	Unsigned Int-16	Torque at position 21%
47 to 48	Unsigned Int-16	Torque at position 22%
49 to 50	Unsigned Int-16	Torque at position 23%
51 to 52	Unsigned Int-16	Torque at position 24%
53 to 54	Unsigned Int-16	Torque at position 25%
55 to 56	Unsigned Int-16	Torque at position 26%
57 to 58	Unsigned Int-16	Torque at position 27%
59 to 60	Unsigned Int-16	Torque at position 28%
61 to 62	Unsigned Int-16	Torque at position 29%
63 to 64	Unsigned Int-16	Torque at position 30%
65 to 66	Unsigned Int-16	Torque at position 31%
67 to 68	Unsigned Int-16	Torque at position 32%
69 to 70	Unsigned Int-16	Torque at position 33%

Table 182. Response Data Bytes (Transaction ID = 1)

Byte	Format	Description
0	Unsigned Int-8	FST Transaction ID = 1
1	Enum-8	FST Torque Curve ID (See Section 10.10)
2	Enum-8	FST Torque Curve Type (See Section 10.11)
3 to 4	Unsigned Int-16	Torque at position 34%
5 to 6	Unsigned Int-16	Torque at position 35%
7 to 8	Unsigned Int-16	Torque at position 36%
9 to 10	Unsigned Int-16	Torque at position 37%
11 to 12	Unsigned Int-16	Torque at position 38%
13 to 14	Unsigned Int-16	Torque at position 39%
15 to 16	Unsigned Int-16	Torque at position 40%
17 to 18	Unsigned Int-16	Torque at position 41%
19 to 20	Unsigned Int-16	Torque at position 42%
21 to 22	Unsigned Int-16	Torque at position 43%
23 to 24	Unsigned Int-16	Torque at position 44%
25 to 26	Unsigned Int-16	Torque at position 45%
27 to 28	Unsigned Int-16	Torque at position 46%
29 to 30	Unsigned Int-16	Torque at position 47%
31 to 32	Unsigned Int-16	Torque at position 48%
33 to 34	Unsigned Int-16	Torque at position 49%
35 to 36	Unsigned Int-16	Torque at position 50%
37 to 38	Unsigned Int-16	Torque at position 51%
39 to 40	Unsigned Int-16	Torque at position 52%
41 to 42	Unsigned Int-16	Torque at position 53%
43 to 44	Unsigned Int-16	Torque at position 54%
45 to 46	Unsigned Int-16	Torque at position 55%
47 to 48	Unsigned Int-16	Torque at position 56%
49 to 50	Unsigned Int-16	Torque at position 57%
51 to 52	Unsigned Int-16	Torque at position 58%
53 to 54	Unsigned Int-16	Torque at position 59%
55 to 56	Unsigned Int-16	Torque at position 60%
57 to 58	Unsigned Int-16	Torque at position 61%
59 to 60	Unsigned Int-16	Torque at position 62%
61 to 62	Unsigned Int-16	Torque at position 63%
63 to 64	Unsigned Int-16	Torque at position 64%
65 to 66	Unsigned Int-16	Torque at position 65%
67 to 68	Unsigned Int-16	Torque at position 66%
69 to 70	Unsigned Int-16	Torque at position 67%

Table183. Response Data Bytes (Transaction ID = 2)

Byte	Format	Description
0	Unsigned Int-8	FST Transaction ID = 2
1	Enum-8	FST Torque Curve ID (See Section 10.10)
2	Enum-8	FST Torque Curve Type (See Section 10.11)
3 to 4	Unsigned Int-16	Torque at position 68%
5 to 6	Unsigned Int-16	Torque at position 69%
7 to 8	Unsigned Int-16	Torque at position 70%
9 to 10	Unsigned Int-16	Torque at position 71%
11 to 12	Unsigned Int-16	Torque at position 72%
13 to 14	Unsigned Int-16	Torque at position 73%
15 to 16	Unsigned Int-16	Torque at position 74%
17 to 18	Unsigned Int-16	Torque at position 75%
19 to 20	Unsigned Int-16	Torque at position 76%
21 to 22	Unsigned Int-16	Torque at position 77%
23 to 24	Unsigned Int-16	Torque at position 78%
25 to 26	Unsigned Int-16	Torque at position 79%
27 to 28	Unsigned Int-16	Torque at position 80%
29 to 30	Unsigned Int-16	Torque at position 81%
31 to 32	Unsigned Int-16	Torque at position 82%
33 to 34	Unsigned Int-16	Torque at position 83%
35 to 36	Unsigned Int-16	Torque at position 84%
37 to 38	Unsigned Int-16	Torque at position 85%
39 to 40	Unsigned Int-16	Torque at position 86%
41 to 42	Unsigned Int-16	Torque at position 87%
43 to 44	Unsigned Int-16	Torque at position 88%
45 to 46	Unsigned Int-16	Torque at position 89%
47 to 48	Unsigned Int-16	Torque at position 90%
49 to 50	Unsigned Int-16	Torque at position 91%
51 to 52	Unsigned Int-16	Torque at position 92%
53 to 54	Unsigned Int-16	Torque at position 93%
55 to 56	Unsigned Int-16	Torque at position 94%
57 to 58	Unsigned Int-16	Torque at position 95%
59 to 60	Unsigned Int-16	Torque at position 96%
61 to 62	Unsigned Int-16	Torque at position 97%
63 to 64	Unsigned Int-16	Torque at position 98%
65 to 66	Unsigned Int-16	Torque at position 99%
67 to 68	Unsigned Int-16	Torque at position 100%
69 to 70	Unsigned Int-16	Not Used

Table 184. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.3.22 Command #150: Read PST Curve Data Header

This command allows reading the header data of one PST Curve.

Table 185. Request Data Bytes

Byte	Format	Description
0	Enum-8	PST Curve ID (See Section 10.12)

Table 186. Response Data Bytes

Byte	Format	Description
0	Enum-8	PST Curve ID (See Section 10.12)
1 to 3	Date	PST Date
4 to 7	Time	PST Time
8	Signed Int-8	Electronic Temperature (°C)
9	Signed Int-8	Terminal Board Temperature (°C)
10	Signed Int-8	Motor Temperature (°C)
11	Signed Int-8	EFS Card Temperature (°C)
12 to 13	Unsigned Int-16	Voltage (V)
14	Enum-8	PST Result (See Section 10.13)
15	Enum-8	PST Direction (See Section 10.14)
16 to 19	Float	T-PST (s)
20 to 23	Float	T-RET (s)
24 to 27	Float	OV-TR (%)
28	Unsigned Int-8	PST Travel Limit (%)
29	Enum-8	PST Mode (See Section 10.15)
30	Bit Enumerated	PST Status (See Section 10.16)
31 to 34	Bit Enumerated	PST Reset Conditions (See Section 10.17)

Table 187. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

If the PST Torque Curve ID corresponds to a not existing PST Torque Curve, the PST Date and PST Time are fixed respectively to 6th February 2136 and 06:28:15.

8.3.23 Command #151: Read PST Curve Part1

This command allows reading the first 51 samples of one PST Curve.

Table 188. Request Data Bytes

Byte	Format	Description
0	Unsigned Int-8	PST Part1 Transaction ID (0 to 2)
1	Enum-8	PST Curve ID (See Section 10.12)

Table 189. Response Data Bytes (Transaction ID = 0)

Byte	Format	Description
0	Unsigned Int-8	PST Part1 Transaction ID = 0
1	Enum-8	PST Curve ID (See Section 10.12)
2 to 5	Float	T-PST: elapsed time from PST command
6 to 9	Unsigned Int-16	T-PST: elapsed time to reach position 1% (Open PST) or position 99% (Close PST)
10 to 13	Unsigned Int-16	T-PST: elapsed time to reach position 2% (Open PST) or position 98% (Close PST)
14 to 17	Unsigned Int-16	T-PST: elapsed time to reach position 3% (Open PST) or position 97% (Close PST)
18 to 21	Unsigned Int-16	T-PST: elapsed time to reach position 4% (Open PST) or position 96% (Close PST)
22 to 25	Unsigned Int-16	T-PST: elapsed time to reach position 5% (Open PST) or position 95% (Close PST)
26 to 29	Unsigned Int-16	T-PST: elapsed time to reach position 6% (Open PST) or position 94% (Close PST)
30 to 33	Unsigned Int-16	T-PST: elapsed time to reach position 7% (Open PST) or position 93% (Close PST)
34 to 37	Unsigned Int-16	T-PST: elapsed time to reach position 8% (Open PST) or position 92% (Close PST)
38 to 41	Unsigned Int-16	T-PST: elapsed time to reach position 9% (Open PST) or position 91% (Close PST)
42 to 45	Unsigned Int-16	T-PST: elapsed time to reach position 10% (Open PST) or position 90% (Close PST)
46 to 49	Unsigned Int-16	T-PST: elapsed time to reach position 11% (Open PST) or position 89% (Close PST)
50 to 53	Unsigned Int-16	T-PST: elapsed time to reach position 12% (Open PST) or position 88% (Close PST)
54 to 57	Unsigned Int-16	T-PST: elapsed time to reach position 13% (Open PST) or position 87% (Close PST)
58 to 61	Unsigned Int-16	T-PST: elapsed time to reach position 14% (Open PST) or position 86% (Close PST)
62 to 65	Unsigned Int-16	T-PST: elapsed time to reach position 15% (Open PST) or position 85% (Close PST)
66 to 69	Unsigned Int-16	T-PST: elapsed time to reach position 16% (Open PST) or position 84% (Close PST)

Table 190. Response Data Bytes (Transaction ID = 1)

Byte	Format	Description
0	Unsigned Int-8	PST Part1 Transaction ID = 1
1	Enum-8	PST Curve ID (See Section 10.12)
2 to 5	Float	T-PST: elapsed time to reach position 17% (Open PST) or position 83% (Close PST)
6 to 9	Float	T-PST: elapsed time to reach position 18% (Open PST) or position 82% (Close PST)
10 to 13	Float	T-PST: elapsed time to reach position 19% (Open PST) or position 81% (Close PST)
14 to 17	Float	T-PST: elapsed time to reach position 20% (Open PST) or position 80% (Close PST)
18 to 21	Float	T-PST: elapsed time to reach position 21% (Open PST) or position 79% (Close PST)
22 to 25	Float	T-PST: elapsed time to reach position 22% (Open PST) or position 78% (Close PST)
26 to 29	Float	T-PST: elapsed time to reach position 23% (Open PST) or position 77% (Close PST)
30 to 33	Float	T-PST: elapsed time to reach position 24% (Open PST) or position 76% (Close PST)
34 to 37	Float	T-PST: elapsed time to reach position 25% (Open PST) or position 75% (Close PST)
38 to 41	Float	T-PST: elapsed time to reach position 26% (Open PST) or position 74% (Close PST)
42 to 45	Float	T-PST: elapsed time to reach position 27% (Open PST) or position 73% (Close PST)
46 to 49	Float	T-PST: elapsed time to reach position 28% (Open PST) or position 72% (Close PST)
50 to 53	Float	T-PST: elapsed time to reach position 29% (Open PST) or position 71% (Close PST)
54 to 57	Float	T-PST: elapsed time to reach position 30% (Open PST) or position 70% (Close PST)
58 to 61	Float	T-PST: elapsed time to reach position 31% (Open PST) or position 69% (Close PST)
62 to 65	Float	T-PST: elapsed time to reach position 32% (Open PST) or position 68% (Close PST)
66 to 69	Float	T-PST: elapsed time to reach position 33% (Open PST) or position 67% (Close PST)

Table 191. Response Data Bytes (Transaction ID = 2)

Byte	Format	Description
0	Unsigned Int-8	PST Part1 Transaction ID = 2
1	Enum-8	PST Curve ID (See Section 10.12)
2 to 5	Float	T-PST: elapsed time to reach position 34% (Open PST) or position 66% (Close PST)
6 to 9	Float	T-PST: elapsed time to reach position 35% (Open PST) or position 65% (Close PST)
10 to 13	Float	T-PST: elapsed time to reach position 36% (Open PST) or position 64% (Close PST)
14 to 17	Float	T-PST: elapsed time to reach position 37% (Open PST) or position 63% (Close PST)
18 to 21	Float	T-PST: elapsed time to reach position 38% (Open PST) or position 62% (Close PST)
22 to 25	Float	T-PST: elapsed time to reach position 39% (Open PST) or position 61% (Close PST)
26 to 29	Float	T-PST: elapsed time to reach position 40% (Open PST) or position 60% (Close PST)
30 to 33	Float	T-PST: elapsed time to reach position 41% (Open PST) or position 59% (Close PST)
34 to 37	Float	T-PST: elapsed time to reach position 42% (Open PST) or position 58% (Close PST)
38 to 41	Float	T-PST: elapsed time to reach position 43% (Open PST) or position 57% (Close PST)
42 to 45	Float	T-PST: elapsed time to reach position 44% (Open PST) or position 56% (Close PST)
46 to 49	Float	T-PST: elapsed time to reach position 45% (Open PST) or position 55% (Close PST)
50 to 53	Float	T-PST: elapsed time to reach position 46% (Open PST) or position 54% (Close PST)
54 to 57	Float	T-PST: elapsed time to reach position 47% (Open PST) or position 53% (Close PST)
58 to 61	Float	T-PST: elapsed time to reach position 48% (Open PST) or position 52% (Close PST)
62 to 65	Float	T-PST: elapsed time to reach position 49% (Open PST) or position 51% (Close PST)
66 to 69	Float	T-PST: elapsed time to reach position 50% (Open PST) or position 50% (Close PST)

Table 192. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.3.24 Command #152: Read PST Curve Part2

This command allows reading the last 51 samples of one PST Curve.

Table 193. Request Data Bytes

Byte	Format	Description
0	Unsigned Int-8	PST Part2 Transaction ID (0 to 2)
1	Enum-8	PST Curve ID (See Section 10.12)

Table 194. Response Data Bytes (Transaction ID = 0)

Byte	Format	Description
0	Unsigned Int-8	PST Part2 Transaction ID = 0
1	Enum-8	PST Curve ID (See Section 10.12)
2 to 5	Float	T-RET: elapsed time to reach position 1% (Open PST) or position 99% (Close PST)
6 to 9	Float	T-RET: elapsed time to reach position 2% (Open PST) or position 98% (Close PST)
10 to 13	Float	T-RET: elapsed time to reach position 3% (Open PST) or position 97% (Close PST)
14 to 17	Float	T-RET: elapsed time to reach position 4% (Open PST) or position 96% (Close PST)
18 to 21	Float	T-RET: elapsed time to reach position 5% (Open PST) or position 95% (Close PST)
22 to 25	Float	T-RET: elapsed time to reach position 6% (Open PST) or position 94% (Close PST)
26 to 29	Float	T-RET: elapsed time to reach position 7% (Open PST) or position 93% (Close PST)
30 to 33	Float	T-RET: elapsed time to reach position 8% (Open PST) or position 92% (Close PST)
34 to 37	Float	T-RET: elapsed time to reach position 9% (Open PST) or position 91% (Close PST)
38 to 41	Float	T-RET: elapsed time to reach position 10% (Open PST) or position 90% (Close PST)
42 to 45	Float	T-RET: elapsed time to reach position 11% (Open PST) or position 89% (Close PST)
46 to 49	Float	T-RET: elapsed time to reach position 12% (Open PST) or position 88% (Close PST)
50 to 53	Float	T-RET: elapsed time to reach position 13% (Open PST) or position 87% (Close PST)
54 to 57	Float	T-RET: elapsed time to reach position 14% (Open PST) or position 86% (Close PST)
58 to 61	Float	T-RET: elapsed time to reach position 15% (Open PST) or position 85% (Close PST)
62 to 65	Float	T-RET: elapsed time to reach position 16% (Open PST) or position 84% (Close PST)
66 to 69	Float	T-RET: elapsed time to reach position 17% (Open PST) or position 83% (Close PST)

Table 195. Response Data Bytes (Transaction ID = 1)

Byte	Format	Description
0	Unsigned Int-8	PST Part2 Transaction ID = 1
1	Enum-8	PST Curve ID (See Section 10.12)
2 to 5	Float	T-RET: elapsed time to reach position 18% (Open PST) or position 82% (Close PST)
6 to 9	Float	T-RET: elapsed time to reach position 19% (Open PST) or position 81% (Close PST)
10 to 13	Float	T-RET: elapsed time to reach position 20% (Open PST) or position 80% (Close PST)
14 to 17	Float	T-RET: elapsed time to reach position 21% (Open PST) or position 79% (Close PST)
18 to 21	Float	T-RET: elapsed time to reach position 22% (Open PST) or position 78% (Close PST)
22 to 25	Float	T-RET: elapsed time to reach position 23% (Open PST) or position 77% (Close PST)
26 to 29	Float	T-RET: elapsed time to reach position 24% (Open PST) or position 76% (Close PST)
30 to 33	Float	T-RET: elapsed time to reach position 25% (Open PST) or position 75% (Close PST)
34 to 37	Float	T-RET: elapsed time to reach position 26% (Open PST) or position 74% (Close PST)
38 to 41	Float	T-RET: elapsed time to reach position 27% (Open PST) or position 73% (Close PST)
42 to 45	Float	T-RET: elapsed time to reach position 28% (Open PST) or position 72% (Close PST)
46 to 49	Float	T-RET: elapsed time to reach position 29% (Open PST) or position 71% (Close PST)
50 to 53	Float	T-RET: elapsed time to reach position 30% (Open PST) or position 70% (Close PST)
54 to 57	Float	T-RET: elapsed time to reach position 31% (Open PST) or position 69% (Close PST)
58 to 61	Float	T-RET: elapsed time to reach position 32% (Open PST) or position 68% (Close PST)
62 to 65	Float	T-RET: elapsed time to reach position 33% (Open PST) or position 67% (Close PST)
66 to 69	Float	T-RET: elapsed time to reach position 34% (Open PST) or position 66% (Close PST)

Table 196. Response Data Bytes (Transaction ID = 2)

Byte	Format	Description
0	Unsigned Int-8	PST Part1 Transaction ID = 2
1	Enum-8	PST Curve ID (See Section 10.12)
2 to 5	Float	T-RET: elapsed time to reach position 35% (Open PST) or position 65% (Close PST)
6 to 9	Float	T-RET: elapsed time to reach position 36% (Open PST) or position 64% (Close PST)
10 to 13	Float	T-RET: elapsed time to reach position 37% (Open PST) or position 63% (Close PST)
14 to 17	Float	T-RET: elapsed time to reach position 38% (Open PST) or position 62% (Close PST)
18 to 21	Float	T-RET: elapsed time to reach position 39% (Open PST) or position 61% (Close PST)
22 to 25	Float	T-RET: elapsed time to reach position 40% (Open PST) or position 60% (Close PST)
26 to 29	Float	T-RET: elapsed time to reach position 41% (Open PST) or position 59% (Close PST)
30 to 33	Float	T-RET: elapsed time to reach position 42% (Open PST) or position 58% (Close PST)
34 to 37	Float	T-RET: elapsed time to reach position 43% (Open PST) or position 57% (Close PST)
38 to 41	Float	T-RET: elapsed time to reach position 44% (Open PST) or position 56% (Close PST)
42 to 45	Float	T-RET: elapsed time to reach position 45% (Open PST) or position 55% (Close PST)
46 to 49	Float	T-RET: elapsed time to reach position 46% (Open PST) or position 54% (Close PST)
50 to 53	Float	T-RET: elapsed time to reach position 47% (Open PST) or position 53% (Close PST)
54 to 57	Float	T-RET: elapsed time to reach position 48% (Open PST) or position 52% (Close PST)
58 to 61	Float	T-RET: elapsed time to reach position 49% (Open PST) or position 51% (Close PST)
62 to 65	Float	T-RET: elapsed time to reach position 50% (Open PST) or position 50% (Close PST)
66 to 69	Float	Not Used

Table 197. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.3.25 Command #153: Read EFS Curve Data Header

This command allows reading the header data of one EFS Curve.

Table 198. Request Data Bytes

Byte	Format	Description
0	Enum-8	EFS Curve ID (See Section 10.18)

Table 199. Response Data Bytes

Byte	Format	Description
0	Enum-8	EFS Curve ID (See Section 10.18)
1 to 3	Date	EFS Curve Date
4 to 7	Time	EFS Curve Time
8	Signed Int-8	Electronic Temperature (°C)
9	Signed Int-8	Terminal Board Temperature (°C)
10	Signed Int-8	Motor Temperature (°C)
11	Signed Int-8	EFS Card Temperature (°C)
12 to 13	Unsigned Int-16	Voltage (V)
14	Unsigned Int-8	Not Used
15	Enum-8	EFS Direction (See Section 10.14)

Table 200. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

If the EFS Curve ID corresponds to a not existing EFS Curve, the EFS Curve Date and EFS Curve Time are fixed respectively to 6th February 2136 and 06:28:15.

8.3.26 Command #154: Read EFS Curve Part1

This command allows reading the first 51 samples of one EFS Curve.

Table 201. Request Data Bytes

Byte	Format	Description
0	Unsigned Int-8	EFS Part1 Transaction ID (0 to 2)
1	Enum-8	EFS Curve ID (See Section 10.18)

Table 202. Response Data Bytes (Transaction ID = 0)

Byte	Format	Description
0	Unsigned Int-8	EFS Part1 Transaction ID = 0
1	Enum-8	EFS Curve ID (See Section 10.18)
2 to 5	Float	T-EFS: elapsed time from EFS command
6 to 9	Float	T-EFS: elapsed time to reach position 1% (Open EFS) or position 99% (Close EFS)
10 to 13	Float	T-EFS: elapsed time to reach position 2% (Open EFS) or position 98% (Close EFS)
14 to 17	Float	T-EFS: elapsed time to reach position 3% (Open EFS) or position 97% (Close EFS)
18 to 21	Float	T-EFS: elapsed time to reach position 4% (Open EFS) or position 96% (Close EFS)
22 to 25	Float	T-EFS: elapsed time to reach position 5% (Open EFS) or position 95% (Close EFS)
26 to 29	Float	T-EFS: elapsed time to reach position 6% (Open EFS) or position 94% (Close EFS)
30 to 33	Float	T-EFS: elapsed time to reach position 7% (Open EFS) or position 93% (Close EFS)
34 to 37	Float	T-EFS: elapsed time to reach position 8% (Open EFS) or position 92% (Close EFS)
38 to 41	Float	T-EFS: elapsed time to reach position 9%(Open EFS) or position 91% (Close EFS)
42 to 45	Float	T-EFS: elapsed time to reach position 10% (Open EFS) or position 90% (Close EFS)
46 to 49	Float	T-EFS: elapsed time to reach position 11% (Open EFS) or position 89% (Close EFS)
50 to 53	Float	T-EFS: elapsed time to reach position 12% (Open EFS) or position 88% (Close EFS)
54 to 57	Float	T-EFS: elapsed time to reach position 13% (Open EFS) or position 87% (Close EFS)
58 to 61	Float	T-EFS: elapsed time to reach position 14% (Open EFS) or position 86% (Close EFS)
62 to 65	Float	T-EFS: elapsed time to reach position 15% (Open EFS) or position 85% (Close EFS)
66 to 69	Float	T-EFS: elapsed time to reach position 16% (Open EFS) or position 84% (Close EFS)

Table 203. Response Data Bytes (Transaction ID = 1)

Byte	Format	Description
0	Unsigned Int-8	EFS Part1 Transaction ID = 1
1	Enum-8	EFS Curve ID (See Section 10.18)
2 to 5	Float	T-EFS: elapsed time to reach position 17% (Open EFS) or position 83% (Close EFS)
6 to 9	Float	T-EFS: elapsed time to reach position 18% (Open EFS) or position 82% (Close EFS)
10 to 13	Float	T-EFS: elapsed time to reach position 19% (Open EFS) or position 81% (Close EFS)
14 to 17	Float	T-EFS: elapsed time to reach position 20% (Open EFS) or position 80% (Close EFS)
18 to 21	Float	T-EFS: elapsed time to reach position 21% (Open EFS) or position 79% (Close EFS)
22 to 25	Float	T-EFS: elapsed time to reach position 22% (Open EFS) or position 78% (Close EFS)
26 to 29	Float	T-EFS: elapsed time to reach position 23% (Open EFS) or position 77% (Close EFS)
30 to 33	Float	T-EFS: elapsed time to reach position 24% (Open EFS) or position 76% (Close EFS)
34 to 37	Float	T-EFS: elapsed time to reach position 25% (Open EFS) or position 75% (Close EFS)
38 to 41	Float	T-EFS: elapsed time to reach position 26% (Open EFS) or position 74% (Close EFS)
42 to 45	Float	T-EFS: elapsed time to reach position 27% (Open EFS) or position 73% (Close EFS)
46 to 49	Float	T-EFS: elapsed time to reach position 28% (Open EFS) or position 72% (Close EFS)
50 to 53	Float	T-EFS: elapsed time to reach position 29% (Open EFS) or position 71% (Close EFS)
54 to 57	Float	T-EFS: elapsed time to reach position 30% (Open EFS) or position 70% (Close EFS)
58 to 61	Float	T-EFS: elapsed time to reach position 31% (Open EFS) or position 69% (Close EFS)
62 to 65	Float	T-EFS: elapsed time to reach position 32% (Open EFS) or position 68% (Close EFS)
66 to 69	Float	T-EFS: elapsed time to reach position 33% (Open EFS) or position 67% (Close EFS)

Table 204. Response Data Bytes (Transaction ID = 2)

Byte	Format	Description
0	Unsigned Int-8	EFS Part1 Transaction ID = 1
1	Enum-8	EFS Curve ID (See Section 10.18)
2 to 5	Float	T-EFS: elapsed time to reach position 34% (Open EFS) or position 66% (Close EFS)
6 to 9	Float	T-EFS: elapsed time to reach position 35% (Open EFS) or position 65% (Close EFS)
10 to 13	Float	T-EFS: elapsed time to reach position 36% (Open EFS) or position 64% (Close EFS)
14 to 17	Float	T-EFS: elapsed time to reach position 37% (Open EFS) or position 63% (Close EFS)
18 to 21	Float	T-EFS: elapsed time to reach position 38% (Open EFS) or position 62% (Close EFS)
22 to 25	Float	T-EFS: elapsed time to reach position 39% (Open EFS) or position 61% (Close EFS)
26 to 29	Float	T-EFS: elapsed time to reach position 40% (Open EFS) or position 60% (Close EFS)
30 to 33	Float	T-EFS: elapsed time to reach position 41% (Open EFS) or position 59% (Close EFS)
34 to 37	Float	T-EFS: elapsed time to reach position 42% (Open EFS) or position 58% (Close EFS)
38 to 41	Float	T-EFS: elapsed time to reach position 43% (Open EFS) or position 57% (Close EFS)
42 to 45	Float	T-EFS: elapsed time to reach position 44% (Open EFS) or position 56% (Close EFS)
46 to 49	Float	T-EFS: elapsed time to reach position 45% (Open EFS) or position 55% (Close EFS)
50 to 53	Float	T-EFS: elapsed time to reach position 46% (Open EFS) or position 54% (Close EFS)
54 to 57	Float	T-EFS: elapsed time to reach position 47% (Open EFS) or position 53% (Close EFS)
58 to 61	Float	T-EFS: elapsed time to reach position 48% (Open EFS) or position 52% (Close EFS)
62 to 65	Float	T-EFS: elapsed time to reach position 49% (Open EFS) or position 51% (Close EFS)
66 to 69	Float	T-EFS: elapsed time to reach position 50% (Open EFS) or position 50% (Close EFS)

Table 205. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.3.27 Command #155: Read EFS Curve Part2

This command allows reading the last 51 samples of one EFS Curve.

Table 206. Request Data Bytes

Byte	Format	Description
0	Unsigned Int-8	EFS Part2 Transaction ID (0 to 2)
1	Enum-8	EFS Curve ID (See Section 10.18)

Table 207. Response Data Bytes (Transaction ID = 0)

Byte	Format	Description
0	Unsigned Int-8	EFS Part2 Transaction ID = 0
1	Enum-8	EFS Curve ID (See Section 10.18)
2 to 5	Float	T-EFS: elapsed time to reach position 51% (Open EFS) or position 49% (Close EFS)
6 to 9	Float	T-EFS: elapsed time to reach position 52% (Open EFS) or position 48% (Close EFS)
10 to 13	Float	T-EFS: elapsed time to reach position 53% (Open EFS) or position 47% (Close EFS)
14 to 17	Float	T-EFS: elapsed time to reach position 54% (Open EFS) or position 46% (Close EFS)
18 to 21	Float	T-EFS: elapsed time to reach position 55% (Open EFS) or position 45% (Close EFS)
22 to 25	Float	T-EFS: elapsed time to reach position 56% (Open EFS) or position 44% (Close EFS)
26 to 29	Float	T-EFS: elapsed time to reach position 57% (Open EFS) or position 43% (Close EFS)
30 to 33	Float	T-EFS: elapsed time to reach position 58% (Open EFS) or position 42% (Close EFS)
34 to 37	Float	T-EFS: elapsed time to reach position 59% (Open EFS) or position 41% (Close EFS)
38 to 41	Float	T-EFS: elapsed time to reach position 60% (Open EFS) or position 40% (Close EFS)
42 to 45	Float	T-EFS: elapsed time to reach position 61% (Open EFS) or position 39% (Close EFS
46 to 49	Float	T-EFS: elapsed time to reach position 62% (Open EFS) or position 38% (Close EFS)
50 to 53	Float	T-EFS: elapsed time to reach position 63% (Open EFS) or position 37% (Close EFS)
54 to 57	Float	T-EFS: elapsed time to reach position 64% (Open EFS) or position 36% (Close EFS)
58 to 61	Float	T-EFS: elapsed time to reach position 65% (Open EFS) or position 35% (Close EFS)
62 to 65	Float	T-EFS: elapsed time to reach position 66% (Open EFS) or position 34% (Close EFS)
66 to 69	Float	T-EFS: elapsed time to reach position 67% (Open EFS) or position 33% (Close EFS)

Table 208. Response Data Bytes (Transaction ID = 1)

Byte	Format	Description
0	Unsigned Int-8	EFS Part2 Transaction ID = 1
1	Enum-8	EFS Curve ID (See Section 10.18)
2 to 5	Float	T-EFS: elapsed time to reach position 68% (Open EFS) or position 32% (Close EFS)
6 to 9	Float	T-EFS: elapsed time to reach position 69% (Open EFS) or position 31% (Close EFS)
10 to 13	Float	T-EFS: elapsed time to reach position 70% (Open EFS) or position 30% (Close EFS)
14 to 17	Float	T-EFS: elapsed time to reach position 71% (Open EFS) or position 29% (Close EFS)
18 to 21	Float	T-EFS: elapsed time to reach position 72% (Open EFS) or position 28% (Close EFS)
22 to 25	Float	T-EFS: elapsed time to reach position 73% (Open EFS) or position 27% (Close EFS)
26 to 29	Float	T-EFS: elapsed time to reach position 74% (Open EFS) or position 26% (Close EFS)
30 to 33	Float	T-EFS: elapsed time to reach position 75% (Open EFS) or position 25% (Close EFS)
34 to 37	Float	T-EFS: elapsed time to reach position 76% (Open EFS) or position 24% (Close EFS)
38 to 41	Float	T-EFS: elapsed time to reach position 77% (Open EFS) or position 23% (Close EFS)
42 to 45	Float	T-EFS: elapsed time to reach position 78% (Open EFS) or position 22% (Close EFS)
46 to 49	Float	T-EFS: elapsed time to reach position 79% (Open EFS) or position 21% (Close EFS)
50 to 53	Float	T-EFS: elapsed time to reach position 80% (Open EFS) or position 20% (Close EFS)
54 to 57	Float	T-EFS: elapsed time to reach position 81% (Open EFS) or position 19% (Close EFS)
58 to 61	Float	T-EFS: elapsed time to reach position 82% (Open EFS) or position 18% (Close EFS)
62 to 65	Float	T-EFS: elapsed time to reach position 83% (Open EFS) or position 17% (Close EFS)
66 to 69	Float	T-EFS: elapsed time to reach position 84% (Open EFS) or position 16% (Close EFS)

Table 209. Response Data Bytes (Transaction ID = 2)

Byte	Format	Description
0	Unsigned Int-8	EFS Part1 Transaction ID = 2
1	Enum-8	EFS Curve ID (See Section 10.18)
2 to 5	Float	T-EFS: elapsed time to reach position 85% (Open EFS) or position 15% (Close EFS)
6 to 9	Float	T-EFS: elapsed time to reach position 86% (Open EFS) or position 14% (Close EFS)
10 to 13	Float	T-EFS: elapsed time to reach position 87% (Open EFS) or position 13% (Close EFS)
14 to 17	Float	T-EFS: elapsed time to reach position 88% (Open EFS) or position 12% (Close EFS)
18 to 21	Float	T-EFS: elapsed time to reach position 89% (Open EFS) or position 11% (Close EFS)
22 to 25	Float	T-EFS: elapsed time to reach position 90% (Open EFS) or position 10% (Close EFS)
26 to 29	Float	T-EFS: elapsed time to reach position 91% (Open EFS) or position 9% (Close EFS)
30 to 33	Float	T-EFS: elapsed time to reach position 92% (Open EFS) or position 8% (Close EFS)
34 to 37	Float	T-EFS: elapsed time to reach position 93% (Open EFS) or position 7% (Close EFS)
38 to 41	Float	T-EFS: elapsed time to reach position 94% (Open EFS) or position 6% (Close EFS)
42 to 45	Float	T-EFS: elapsed time to reach position 95% (Open EFS) or position 5% (Close EFS)
46 to 49	Float	T-EFS: elapsed time to reach position 96% (Open EFS) or position 4% (Close EFS)
50 to 53	Float	T-EFS: elapsed time to reach position 97% (Open EFS) or position 3% (Close EFS)
54 to 57	Float	T-EFS: elapsed time to reach position 98% (Open EFS) or position 2% (Close EFS)
58 to 61	Float	T-EFS: elapsed time to reach position 99% (Open EFS) or position 1% (Close EFS)
62 to 65	Float	T-EFS: elapsed time to reach position 100% (Open EFS) or position 0% (Close EFS)
66 to 69	Float	Not Used

Table 210. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.3.28 Command #156: Read Event Log Data Header

This command allows reading the header data of the Event Log.

Table 211. Request Data Bytes

Byte	Format	Description
None	-	-

Table 212. Response Data Bytes

Byte	Format	Description
0 to 1	Unsigned Int-16	Number of Events stored
2 to 4	Date	Recording Start Date
5 to 8	Time	Recording Start Time
9	Enum-8	Memory Mode (See Section 10.19)

Table 213. Command-Specific Response Codes

Byte	Format	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.3.29 Command #157: Read Event Log

This command allows reading one of the events stored in the Event Log.

Table 214. Request Data Bytes

Byte	Format	Description
0 to 1	Unsigned Int-16	Event Number (See Section 10.20)

Table 215. Response Data Bytes

Byte	Format	Description
0 to 1	Unsigned Int-16	Event Number (See Section 10.20)
2 to 4	Date	Event Date
5 to 8	Time	Event Time
9	Enum-8	Event Code (See Section 10.21)
10	Enum-8	Event Source (See Section 10.25)
11 to 12	Unsigned Int-16	Reserved – Not Used

Table 216. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

If Event Number is greater than the Number of Events stored (Command 156, Response Data Bytes 0 to 1), the device returns the following values:

- Event Date: 6th February 2136
- Event Time: 06:28:15
- Event Code: 255
- Event Source: 255

8.3.30 Command #158: Read Recorder Log Data Header

This command allows reading the header data of the Recorder Log.

Table 217. Request Data Bytes

Byte	Format	Description
None	-	-

Table 218. Response Data Bytes

Byte	Format	Description
0 to 1	Unsigned Int-16	Number of Recorders stored
2 to 4	Date	Recording Start Date
5 to 8	Time	Recording Start Time
9	Enum-8	Memory Mode (See Section 10.19)
10 to 11	Unsigned Int-16	Sample Interval (seconds)

Table 219. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.3.31 Command #159: Read Recorder Log

This command allows reading one of the Recorders stored in the Recorder Log.

Table 220. Request Data Bytes

Byte	Format	Description
0 to 1	Unsigned Int-16	Recorder Number (See Section 10.22)

Table 221. Response Data Bytes

Byte	Format	Description
0 to 1	Unsigned Int-16	Recorder Number (See Section 10.22)
2 to 4	Date	Recorder Date
5 to 8	Time	Recorder Time
9	Signed Int-8	Recorder Data – Electronic Temperature (°C)
10	Signed Int-8	Recorder Data – Motor Temperature (°C)
11 to 12	Unsigned Int-16	Recorder Data – Voltage (V)
13 to 14	Unsigned Int-16	Reserved – Not Used

Table 222. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

If Recorder Number is greater than the Number of Recorders stored (Command 158, Response Data Bytes 0 to 1), the device returns the following values:

- Recorder Date: 6th February 2136
- Recorder Time: 06:28:15
- Recorder Data – Electronic Temperature (°C): -1
- Recorder Data – Motor Temperature (°C): -1
- Recorder Data – Voltage (V): 65535

8.3.32 Command #160: Read T-Recorder Log Data Header

This command allows reading the header data of the T-Recorder Log.

Table 223. Request Data Bytes

Byte	Format	Description
None	-	-

Table 224. Response Data Bytes

Byte	Format	Description
0 to 1	Unsigned Int-16	Number of T-Recorders stored
2 to 4	Date	Recording Start Date
5 to 8	Time	Recording Start Time
9	Enum-8	Memory Mode (See Section 10.19)
10 to 11	Unsigned Int-16	Sample Interval (seconds)

Table 225. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.3.33 Command #161: Read T-Recorder Log

This command allows reading one of the T-Recorders stored in the T-Recorder Log.

Table 226. Request Data Bytes

Byte	Format	Description
0 to 1	Unsigned Int-16	T-Recorder Number (See Section 10.23)

Table 227. Response Data Bytes

Byte	Format	Description
0 to 1	Unsigned Int-16	T-Recorder Number (See Section 10.23)
2 to 4	Date	T-Recorder Date
5 to 8	Time	T-Recorder Time
9	Signed Int-8	T-Recorder Data – Electronic Temperature (°C)
10	Signed Int-8	T-Recorder Data – Motor Temperature (°C)
11 to 12	Unsigned Int-16	T-Recorder Data – Voltage (V)
13 to 14	Unsigned Int-16	Reserved – Not Used

Table 228. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

If T-Recorder Number is greater than the Number of T-Recorders stored (Command 160, Response Data Bytes 0 to 1), the device returns the following values:

- T-Recorder Date: 6th February 2136
- T-Recorder Time: 06:28:15
- T-Recorder Data – Electronic Temperature (°C): -1
- T-Recorder Data – Motor Temperature (°C): -1
- T-Recorder Data – Voltage (V): 65535

8.3.34 Command #162: Read Card Report

This command allows reading the Card Report of one electronic card.

Table 229. Request Data Bytes

Byte	Format	Description
0	Enum-8	Card ID (See Section 10.24)

Table 230. Response Data Bytes

Byte	Format	Description
0	Enum-8	Card ID (See Section 10.24)
1 to 10	ASCII	Card Code
11 to 12	ASCII	Not Used
13 to 14	ASCII	Production Week
15 to 16	ASCII	Production Year
17 to 22	ASCII	Serial Number
23 to 27	ASCII	Hardware Revision
28 to 32	ASCII	Firmware Revision
33 to 64	ASCII	Free Text

Table 231. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.3.35 Command #163: Write Card Report

This command allows forcing the Card Report of one electronic card.

Table 232. Request Data Bytes

Byte	Format	Description
0	Enum-8	Card ID (See Section 10.24)
1 to 10	ASCII	Card Code
11 to 12	ASCII	Not Used
13 to 14	ASCII	Production Week
15 to 16	ASCII	Production Year
17 to 22	ASCII	Serial Number
23 to 27	ASCII	Hardware Revision
28 to 32	ASCII	Firmware Revision
33 to 64	ASCII	Free Text

Table 233. Response Data Bytes

Byte	Format	Description
0	Enum-8	Card ID (See Section 10.24)
1 to 10	ASCII	Card Code
11 to 12	ASCII	Not Used
13 to 14	ASCII	Production Week
15 to 16	ASCII	Production Year
17 to 22	ASCII	Serial Number
23 to 27	ASCII	Hardware Revision
28 to 32	ASCII	Firmware Revision
33 to 64	ASCII	Free Text

Table 234. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6	-	Undefined
7	Error	In Write Protect Mode
8 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

If a master tries to write a Cart Report without the user level permissions, response code 7 (“In Write Protect Mode”) is returned. The modification of the value of the parameters is restricted by the permissions of the user level logged, see Appendix B for details.

8.3.36 Command #164: Read Alarms, Warnings, and Connection Logs Data Header

This command allows reading the number of Alarms, Warnings, and Connections stored in the Alarms Log, in the Warnings Log and in the Connections Log, respectively.

Table 235. Request Data Bytes

Byte	Format	Description
None	-	-

Table 236. Response Data Bytes

Byte	Format	Description
0 to 1	Unsigned Int-16	Number of Alarms stored in the Alarms Log
2 to 3	Unsigned Int-16	Number of Warnings stored in the Warnings Log
4 to 5	Unsigned Int-16	Number of Connections stored in the Connections Log

Table 237. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

8.3.37 Command #165: Read Alarms Log

This command allows reading one of the Alarms stored in the Alarms Log.

Table 238. Request Data Bytes

Byte	Format	Description
0 to 1	Unsigned Int-16	Alarm Number (See Section 10.26)

Table 239. Response Data Bytes

Byte	Format	Description
0 to 1	Unsigned Int-16	Alarm Number (See Section 10.26)
2 to 4	Date	Alarm Date
5 to 8	Time	Alarm Time
9	Enum-8	Alarm Code (See Section 10.28)

Table 240. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

If “Alarm Number” is greater than the “Alarms stored” (Command 164, Response Data Bytes 0 to 1), the device returns the following values:

- Date: 6th February 2136
- Time: 06:28:15
- Alarm Code: 255

8.3.38 Command #166: Read Warnings Log

This command allows reading one of the Warnings stored in the Warnings Log.

Table 241. Request Data Bytes

Byte	Format	Description
0 to 1	Unsigned Int-16	Warning Number (See Section 10.27)

Table 242. Response Data Bytes

Byte	Format	Description
0 to 1	Unsigned Int-16	Warning Number (See Section 10.27)
2 to 4	Date	Warning Date
5 to 8	Time	Warning Time
9	Enum-8	Warning Code (See Section 10.29)

Table 243. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

If “Warning Number” is greater than the “Warnings stored” (Command 164, Response Data Bytes 2 to 3), the device returns the following values:

- Date: 6th February 2136
- Time: 06:28:15
- Alarm Code: 255

8.3.39 Command #167: Read Connections Log

This command allows reading one of the Connections stored in the Connections Log.

Table 244. Request Data Bytes

Byte	Format	Description
0	Unsigned Int-8	Connection Log Transaction ID (0 to 1)
1 to 2	Unsigned Int-16	Connection Number (See Section 10.30)

Table 245. Response Data Bytes (Connection Log Transaction ID = 0)

Byte	Format	Description
0	Unsigned Int-8	Connection Log Transaction ID = 0
1 to 2	Unsigned Int-16	Connection Number (See Section 10.30)
3	Enum-8	Password Level (See Section 10.31)
4 to 51	ASCII	PC/PDA ID

Table 246. Response Data Bytes (Connection Log Transaction ID = 1)

Code	Class	Description
0	Unsigned Int-8	Connection Log Transaction ID = 1
1 to 2	Unsigned Int-16	Connection Number (See Section 10.30)
3 to 26	ASCII	Operator ID
27 to 34	Unsigned Int-8	Reserved – Not Used
35	Enum-8	Connection Type (See Section 10.32)
36 to 38	Date	Connection Date
39 to 42	Time	Connection Time

Table 247. Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1	-	Undefined
2	Error	Invalid Selection
3 to 4	-	Undefined
5	Error	Too Few Data Bytes Received
6 to 31	-	Undefined
32	Error	Busy
33 to 127	-	Undefined

If “Connection Number” is greater than the “Connections stored” (Command 164, Response Data Bytes 4 to 5), the device returns the following values:

- Password Level: 255
- PC/PDA ID: 0xFF (48 times)
- Operator ID: 255
- Reserved – Not Used: 0xFF (8 times)
- Connection Type: 255
- Connection Date: 6th February 2136
- Connection Time: 06:28:15

8.4 Common Tables

Table 248. Expanded Device Type Codes

Expanded Device Code (Hex)	Description	Company Name
B77E	HRT2000v4	Biffi
B705	HRTIMVS2000	Biffi

NOTE:
Other manufacturer devices are not listed.

Table 249. Engineering Unit Codes

Code	Description
32	Degrees Celsius
38	Hertz
39	Milliamperes
51	Seconds
57	Percent
58	Volts
251	None

NOTE:
Only Unit Codes used by HRT2000v4 are listed.

Table 250. Transfer Function Codes

Code	Transfer Function Description
0	Linear
1	Square Root
2	Square Root Third Power
3	Square Root Fifth Power
4	Special Curve
5	Square
230	Discrete (Switch)
231	Square Root Plus Special Care
232	Square Root Third Power Plus Special Curve
233	Square Root Fifth Power Plus Special Curve
240 to 250	Not Used
251	None
252	Unknown
253	Special

Table 251. Alarm Selection Codes

Code	Alarm Selection Description
0	High
1	Low
239	Hold Last Output Value
240 to 250	Not Used
251	None
252	Unknown
253	Special

Table 252. Write Protect Codes

Code	Physical Signal Definition
0	No – No Write Protected
1	Yes – Write Protected
250	Not used
251	None
252	Unknown
253	Special
253	Special

Table 253. Manufacturer Identification Codes

Code (Dec)	Code (Hex)	Company Name
183	00B7	Biffi

NOTE:
Other manufacturers are not listed.

Table 254. Burst Mode Control Codes

Code	Burst Mode Control Definition
0	Off
1	Enable Burst on Token-Passing Data Link Layer only
2	Enable Burst on TDMA Data-Link Layer only
3	Enable Burst on TDMA and Token-Passing Data Link Layers
250	Reserved
251	Reserved
252	Reserved
253	Reserved

NOTE:
Only codes 0 and 1 are supported by HRT2000v4 field device.

Table 255. Physical Signalling Codes

Code	Physical Signal Definition
0	Bell 202 current
1	Bell 202 voltage
2	RS-485
3	RS-232
4	Wireless
6	Special

Table 256. Flag Assignments

Code	Flag Assignment Definition
00	Undefined
01	Multi-Sensor Field Device
02	Eeprom Control
04	Protocol Bridge Device
08	IEEE 802.15.4 2.4GHz DSS with O-QPSK Modulation
10 to 20	Undefined
40	C8psk Capable Field Device
80	C8psk In Multidrop Only

Table 257. Loop Current Mode Codes

Code	Loop Current Mode Description
0	Disabled
1	Enabled

Table 258. Extended Device Status Codes

Code	Description
00	Undefined
01	**Maintenance Required:** This bit is set to indicated that, while the device has not malfunctioned, the Field Device requires maintenance.
02	**Device Variable Alert:** This bit is set if any Device Variable is in Alarm or Warning State. The host should identify the Device Variable(s) causing this to be set using the Device Variable Status indicators.
04	**Critical Power Failure:** For devices that can operate from stored power. This bit is set when that power is becoming critically low.
08 to 80	Undefined

Table 259. Device Variable Family Codes

Code	Device Variable Family
0 to 3	Reserved
4	Temperature
5	Pressure
6	Valve/Actuator
7	Simple PID Control
8	pH
9	Conductivity
10	Totalizer
11	Level
12	Vortex Flow
13	Mag Flow
14	Coriolis Flow
132 to 249	Reserved
250	Not Used

Table 260. Device Variable Classification Codes

Code	Device Variable Classification
0	Device Variable Not Classified
1 to 63	Reserved
64	Temperature
70	Time
80	Frequency
83	EMF (Electromagnetic Unit of Electric Potential)
91	Valve Actuator

NOTE:
Only Classification Codes used by HRT2000v4 are listed.

Table 261. Analog Channel Flags

Code	Flag Definition
0x01	This Analog Channel is a Field Device analog input channel. In other words, the Field Device has an ADC connected to this channel when this bit is set.

Table 262. Burst Message Trigger Modes

Code	Burst Message Trigger Mode Description
0	**Continuous:** The burst message is published continuously at (worst case) the minimum update period.
1	**Window:** The burst message is triggered when the source value deviates more than the specified trigger value.
2	**Rising:** The burst message is triggered when source value rises above the specified trigger value.
3	**Falling:** The burst message is triggered when the source value falls below the specified trigger value.
4	**On-Change:** The burst message is triggered when any value in the message changes.

Table 263. Device Profile Code

Code	Device Profile Code Description
1	HART® Process Automation Device
2	HART Discrete Device
3	Hybrid: Process Automation + Discrete
4	I/O System
129	WirelessHART® Process Automation Device
130	WirelessHART Discrete Device
131	WirelessHART Hybrid: Process Automation + Discrete
132	WirelessHART Gateway
141	WirelessHART Process Adapter
142	WirelessHART Discrete Adapter
144	WirelessHART-Enable Handheld/Portable Maintenance Tool

Section 9: Device Variables

9.1 List of Device Variables

Table 264. Device Variables on HRT2000v4 Rev. 1

Device Variable	Description	Classification	Unit Code	R/W	Min.	Max.	Type
0	Commands	Not Classified	None	W	0	-	ENUM_BIT
1	Status 1	Not Classified	None	R	0	-	ENUM_BIT
2	Status 2	Not Classified	None	R	0	-	ENUM_BIT
3	Position Request	Valve Actuator	Percent	W	0.0	100.0	FLOAT
4	Dead Band	Valve Actuator	Percent	RW	0.1	25.5	FLOAT
5	Motion Inhibit Time	Time	Seconds	RW	1	255	FLOAT
6	Alarms 1	Not Classified	None	R	0	-	ENUM_BIT
7	Alarms 2	Not Classified	None	R	0	-	ENUM_BIT
8	Warnings	Not Classified	None	R	0	-	ENUM_BIT
9	Act. Log – Opening Time	Time	Seconds	R	0	65535	FLOAT
10	Act. Log – Closing Time	Time	Seconds	R	0	65535	FLOAT
11	ESD Action	Valve Actuator	None	RW	0	4	ENUM
12	ESD Percent	Valve Actuator	Percent	RW	0	100	FLOAT
13	2 Speed Timer – Close Dir. Status	Valve Actuator	None	RW	0	1	ENUM
14	2 Speed Timer – Close Dir. Start Pos.	Valve Actuator	Percent	RW	0	100	FLOAT
15	2 Speed Timer – Close Dir. Stop Pos.	Valve Actuator	Percent	RW	0	100	FLOAT
16	2 Speed Timer – Close Dir. On Time	Time	Seconds	RW	2	200	FLOAT
17	2 Speed Timer – Close Dir. Off Time	Time	Seconds	RW	1	200	FLOAT
18	2 Speed Timer – Open Dir. Status	Valve Actuator	None	RW	0	1	ENUM
19	2 Speed Timer – Open Dir. Start Pos.	Valve Actuator	Percent	RW	0	100	FLOAT
20	2 Speed Timer – Open Dir. Stop Pos.	Valve Actuator	Percent	RW	0	100	FLOAT
21	2 Speed Timer – Open Dir. On Time	Time	Seconds	RW	2	200	FLOAT
22	2 Speed Timer – Open Dir. Off Time	Time	Seconds	RW	1	200	FLOAT
23	Fail-Safe Action	Valve Actuator	None	RW	0	4	ENUM
24	Fail-Safe Delay	Time	Seconds	RW	0	255	FLOAT
25	Fail-Safe Position	Valve Actuator	Percent	RW	0	100	FLOAT
26	Power Supply Type	Valve Actuator	None	R	0	2	ENUM
27	Power Supply Voltage	EMF	Volts	R	10	1000	FLOAT
28	Power Supply Frequency	Frequency	Hertz	R	50	60	FLOAT
244	Percent Range	Not Classified	Percent	R	0	100	FLOAT
245	Loop Current	Not Classified	mA	R	-	-	FLOAT
246	PV - Position Request	Not Classified	Percent	R	0.0	100.0	FLOAT
247	SV - Actuator Position	Not Classified	Percent	R	0.0	100.0	FLOAT
248	TV - Torque	Not Classified	Percent	R	-127	128	FLOAT
249	QV - Temperature	Temperature	Celsius	R	-127	128	FLOAT

It is not possible to map dynamic variables.

Table 265. Device Variables on HRT2000v4 Rev. 2

Device Variable	Description	Classification	Unit Code	R/W	User Level	Min.	Max.	Type
0	Commands	Not Classified	Percent	RW	USER	0	-	ENUM_BIT
1	Status 1	Not Classified	Percent	R	-	0	-	ENUM_BIT
2	Status 2	Not Classified	Percent	R	-	0	-	ENUM_BIT
3	Position Request	Not Classified	Percent	RW	USER	0	100	FLOAT
4	Dead Band	Not Classified	Percent	RW	USER	0.1	25.5	FLOAT
5	Motion Inhibit Time	Time	Seconds	RW	USER	1	255	FLOAT
6	Alarms 1	Not Classified	Percent	R	-	0	-	ENUM_BIT
7	Alarms 2	Not Classified	Percent	R	-	0	-	ENUM_BIT
8	Warnings	Not Classified	Percent	R	-	0	-	ENUM_BIT
9	Act- Log – Opening Time	Time	Seconds	R	-	0	65535	FLOAT
10	Act. Log – Closing Time	Time	Seconds	R	-	0	65535	FLOAT
11	ESD Action	Not Classified	Percent	RW	USER	0	4	ENUM
12	ESD Percent	Not Classified	Percent	RW	USER	0	100	FLOAT
13	2 Speed Timer – Close Dir. Status	Not Classified	Percent	RW	USER	0	1	ENUM
14	2 Speed Timer – Close Dir. Start Pos.	Not Classified	Percent	RW	USER	0	100	FLOAT
15	2 Speed Timer – Close Dir. Stop Pos.	Not Classified	Percent	RW	USER	0	100	FLOAT
16	2 Speed Timer – Close Dir. On Time	Time	Seconds	RW	USER	2	200	FLOAT
17	2 Speed Timer – Close Dir. Off Time	Time	Seconds	RW	USER	1	200	FLOAT
18	2 Speed Timer – Open Dir. Status	Not Classified	Percent	RW	USER	0	1	ENUM
19	2 Speed Timer – Open Dir. Start Pos.	Not Classified	Percent	RW	USER	0	100	FLOAT
20	2 Speed Timer – Open Dir. Stop Pos.	Not Classified	Percent	RW	USER	0	100	FLOAT
21	2 Speed Timer – Open Dir. On Time	Time	Seconds	RW	USER	2	200	FLOAT
22	2 Speed Timer – Open Dir. Off Time	Time	Seconds	RW	USER	1	200	FLOAT
23	Fail-Safe Action	Not Classified	Percent	RW	USER	0	4	ENUM
24	Fail-Safe Delay	Time	Seconds	RW	USER	0	255	FLOAT
25	Fail-Safe Position	Not Classified	Percent	RW	USER	0	100	FLOAT
26	Power Supply Type	Not Classified	Percent	RW	SERVICE	0	2	ENUM
27	Power Supply Voltage	EMF	Volts	RW	SERVICE	10	1000	FLOAT
28	Power Supply Frequency	Frequency	Hertz	RW	SERVICE	50	60	FLOAT
29	Actuator Position	Not Classified	Percent	R	-	0	100	FLOAT
30	Main Actuator Status	Not Classified	Percent	R	-	0	-	ENUM_BIT
31	Local Mode	Not Classified	Percent	R	-	0	1	ENUM
32	Off Mode	Not Classified	Percent	R	-	0	1	ENUM
33	Remote Mode	Not Classified	Percent	R	-	0	1	ENUM
34	Stall Alarm	Not Classified	Percent	R	-	0	1	ENUM
35	Device Alarm Active	Not Classified	Percent	R	-	0	1	ENUM
36	Actuator Ready	Not Classified	Percent	R	-	0	1	ENUM
37	Torque	Not Classified	Percent	R	-	0	100	ENUM
38	Temperature	Not Classified	Celsius	R	-	-127	128	FLOAT

Device Variable	Description	Classification	Unit Code	R/W	User Level	Min.	Max.	Type
39	Heater Status	Not Classified	Percent	R	-	0	-	ENUM_BIT
40	K1 Contactor Status	Not Classified	Percent	R	-	0	1	ENUM
41	K2 Contactor Status	Not Classified	Percent	R	-	0	1	ENUM
42	Motor Thermostat Status	Not Classified	Percent	R	-	0	1	ENUM
43	Output Contacts Status	Not Classified	Percent	R	-	0	-	ENUM_BIT
44	Digital Inputs Status	Not Classified	Percent	R	-	0	-	ENUM_BIT
45	User Level Logged	Not Classified	Percent	R	-	0	3	ENUM
46	Motor Speed	Velocity	RPM	R	-	0	4000	FLOAT
47	Main Voltage	EMF	Volts	R	-	0	1000	FLOAT
48	Current	Current	A	R	-	0	120	FLOAT
49	Motor Temperature	Temperature	Celsius	R	-	-40	125	FLOAT
50	Terminal Board Temperature	Temperature	Celsius	R	-	-55	125	FLOAT
51	Position Request (used by Logic Card)	Not Classified	Percent	R	-	-30	130	FLOAT
52	Auxiliary Analog Input mA	Current	mA	R	-	0	30	FLOAT
53	Auxiliary Analog Input bit	Not Classified	Percent	R	-	0	4095	FLOAT
54	PST Progress Counter	Not Classified	Percent	R	-	0	100	FLOAT
55	Last PST Status	Not Classified	Percent	R	-	0	-	ENUM_BIT
56	Last PST Reset Conditions	Not Classified	Percent	R	-	0	-	ENUM_BIT
57	Encoder Absolute Position	Not Classified	Percent	R	-	0	2196479	FLOAT
58	Encoder Status	Not Classified	Percent	R	-	0	-	ENUM_BIT
59	Encoder Wheel 1	Not Classified	Percent	R	-	0	2047	FLOAT
60	Encoder Wheel 2	Not Classified	Percent	R	-	0	2047	FLOAT
61	Encoder Wheel 3	Not Classified	Percent	R	-	0	2047	FLOAT
62	Encoder Communication Errors	Not Classified	Percent	R	-	o	65535	FLOAT
63	Bus Communication Errors Counter	Not Classified	Percent	R	-	0	65535	FLOAT
64	Terminal Board Errors Counter	Not Classified	Percent	R	-	0	65535	FLOAT
65	Torque Potentiometer	Not Classified	Percent	R	-	0	4095	FLOAT
66	Battery Voltage	EMF	Volts	R	-	0	16	FLOAT
67	HART® Interface Status	Not Classified	Percent	R	-	0	-	ENUM_BIT
68	Analog Output mA	Current	mA	R	-	0	30	FLOAT
69	Analog Output bit	Not Classified	Percent	R	-	0	4095	FLOAT
70	Additional Actuator Status	Not Classified	Percent	R	-	0	-	ENUM_BIT
71	Analog Position Request	Not Classified	Percent	R	-	-25	125	FLOAT
244	Percent Range	Not Classified	Percent	R	-	0	100	FLOAT
245	Loop Current	Not Classified	mA	R	-	-	-	FLOAT
246	PV*	-	-	-	-	-	-	-
247	SV*	-	-	-	-	-	-	-
248	TV*	-	-	-	-	-	-	-
249	QV*	-	-	-	-	-	-	-

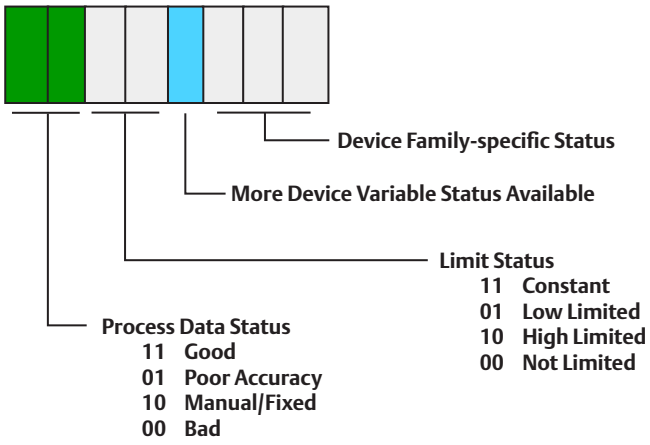
NOTES:
*It depends on field device settings with Command #51, see Section 8.2.3 for details.
PV is Analog Position Request (Device Variable 71).
Default SV is Actuator Position (Device Variable 29).
Default TV is Torque (Device Variable 37).
Default QV is Temperature (Device Variable 38).
User Level indicates the minimum user level login required to modify the variable, see Appendix B for details.

9.2 Device Variable Status Byte

All cyclical process data include a Device Variable Status byte.

The most significant two bits (bits 7 and 6) of every Device Variable Status byte return the overall status of the Device or Dynamic Variable value. The next two bits (bits 5 and 4) indicates whether the Device Variable value is limited. These four bits provide useful status about the Device Variable's value. The content of the lower 4 bits depend on the Device Variable Family. Each Device Family can have its own Device Family-specific Status defining the least significant bits. If set bit 3 indicates the additional Device Family-specific status is available via the appropriate Device Family Command.

Figure 11



HRT2000v4 does not provide Device Family-specific Status for Dynamic and Device Variables, therefore last 4 bits are always set to 0.

9.3 Device Variable 0: Commands

This variable allows sending a command to the actuator.

9.3.1 Device Variable 0 on HRT2000v4 Rev. 1

Table 266. Device Variable 0 on HRT2000v4 Rev. 1

Bit	Description	Value
b0	Open Command	ON = 1, OFF = 0
b1	Close Command	ON = 1, OFF = 0
b2	Stop Command	ON = 1, OFF = 0
b3	ESD Command	ON = 1, OFF = 0
b4	Enable Positioner	ON = 1, OFF = 0
b5	Interlock Open Command	ON = 1, OFF = 0
b6	Interlock Close Command	ON = 1, OFF = 0
b7 to b31	Not Defined	ON = 1, OFF = 0

Commands Open, Close, Stop, Enable Positioner of Device variable 0 work only if LOOP CURRENT MODE is DISABLED. The commands ESD, Interlock Open, Interlock Close are always available. If LOOP CURRENT MODE is ENABLED, the commands Open, Close, Stop and Enable Positioner are always cleared.

Open Command: the command sends an open command to actuator. The command is memorized in the HART® module interface and will be reset by Stop command or end of travel in opening.

Close Command: the command sends a close command to actuator. The command is memorized in the HART module interface and will be reset by Stop command or end of travel in closing.

Stop Command: the command stops actuator movement.

Example of sequence of Open commands:

- Set Open command
- Clear open command
- Set Stop command to stop actuator in intermediate position
- Clear Stop command before setting a new Open or Close command

If both commands Open and Close are set, the actuator stops.

ESD Command: It generates an ESD command to the actuator and overrides any other existing command (as the hardwired ESD does).

Enable Positioner: The command enables control of actuator by digital HART position request in the range 0.0 to 100.0. If Enable Positioner is active, the Open, Close and Stop commands are disabled.

Interlock Open Command: If “Interlock Mode” setting is configured as “Standard”, it inhibits the open movement. If “Interlock Mode” setting is configured as “Advanced”, it performs the PST command. The “Interlock Mode” parameter is available on restricted menu of the actuator, accessible with manufacturer login access. PST command is available only if the actuator is properly configured, see Appendix C for details.

Interlock Close Command: If “Interlock Mode” setting is configured as “Standard”, it inhibits the close movement. If “Interlock Mode” setting is configured as “Advanced”, it performs the PST command. The “Interlock Mode” parameter is available on restricted menu of the actuator, accessible with manufacturer login access. PST command is available only if the actuator is properly configured, see Appendix C for details.

9.3.2 Device Variable 0 on HRT2000v4 Rev. 2

Table 267. Device Variable 0 on HRT2000v4 Rev. 2

Bit	Description	Value
b0	Open Command	ON = 1, OFF = 0
b1	Close Command	ON = 1, OFF = 0
b2	Stop Command	ON = 1, OFF = 0
b3	ESD Command	ON = 1, OFF = 0
b4	Enable Positioner	ON = 1, OFF = 0
b5	Interlock Open Command	ON = 1, OFF = 0
b6	Interlock Close Command	ON = 1, OFF = 0
b7	PST Command	ON = 1, OFF = 0
b8	Baseline PST Command	ON = 1, OFF = 0
b9	Fail-Safe Command	ON = 1, OFF = 0
b10 to b31	Not Defined	ON = 1, OFF = 0

Commands Open, Close, Stop, Enable Positioner of Device variable 0 work only if LOOP CURRENT MODE is DISABLED. The commands ESD, Interlock Open and Interlock Close are always available.

If LOOP CURRENT MODE is ENABLED, the commands Open, Close and Stop are always cleared, and Enable Positioner is always active.

Open Command: the command sends an open command to actuator. The command is memorized in the HART® module interface and will be reset by Stop command or end of travel in opening.

Close Command: the command sends a close command to actuator. The command is memorized in the HART module interface and will be reset by Stop command or end of travel in closing.

Stop Command: the command stops actuator movement.

Example of sequence of Open commands:

- Set Open command
- Clear open command
- Set Stop command to stop actuator in intermediate position
- Clear Stop command before setting a new Open or Close command

If both commands Open and Close are set, the actuator stops.

ESD Command: It generates an ESD command to the actuator and overrides any other existing command (as the hardwired ESD does).

Enable Positioner: The command enables control of actuator by digital HART position request in the range 0.0 to 100.0. If Enable Positioner is active, the Open, Close and Stop commands are disabled.

Interlock Open Command: It inhibits the open movement.

Interlock Close Command: It inhibits the close movement.

PST Command: It generates a PST Command to the actuator. PST command is available only if the actuator is properly configured, see Appendix C for details.

Once a PST Command is sent to the actuator, the command is not automatically cleared; so, to perform a new PST Command, it is necessary to clear the PST command and resend it again. PST Command is executed only if the actuator is properly configured:

- "Interlock Mode" is set to "Advanced"
- "EFS Input Mode" is set to "PST-efs"
- "PST Mode" is set to "Manual" or "Manual Auto"

PST Command is aborted if at least one of the following conditions are not satisfied:

- A Baseline PST is never performed before
- Local Selector Position is in Remote
- Actuator is fully open or fully close
- Alarms are not present
- ESD Command is not active

Baseline PST Command: It generates a Baseline PST Command to the actuator. PST command is available only if the actuator is properly configured, see Appendix C for details. Once a Baseline PST Command is sent to the actuator, the command is not automatically cleared; so, to perform a new Baseline PST Command, it is necessary to clear the Baseline PST command and resend it again.

Baseline PST Command is executed only if the actuator is properly configured:

- "Interlock Mode" is set to "Advanced"
- "EFS Input Mode" is set to "PST-efs"
- "PST Mode" is set to "Manual" or "Manual Auto"

Baseline PST Command is aborted if at least one of the following conditions are not satisfied:

- Local Selector Position is in Remote
- Actuator is fully open or fully close
- Alarms are not present
- ESD Command is not active

Fail-Safe Command: It generates a Fail-Safe Command to the actuator.

9.4 Device Variable 1: Actuator Status (1)

This variable describes the status of the actuator. It is a bit_enumerated variable, it is not possible to write this data. The possible values are:

Table 268.

Bit	Description
b0	Close Limit
b1	Open Limit
b2	Closing
b3	Opening
b4	ESD/PST Active
b5	Local Selector in REMOTE
b6	Local Selector in LOCAL
b7	Local Selector in OFF
b8	Interlock Open Active
b9	Interlock Close Active
b10	Fail-Safe Action Active
b11	Reserved
b12	Reserved
b13	Reserved
b14	Reserved
b15	Reserved
b16	Monitor Relay
b17	Motion Inhibited
b18	DIN1
b19	DIN2
b20	DIN3
b21	DIN4
b22	DIN5
b23	DIN6
b24	AUX in Open
b25	AUX in Close
b26	AUX in Stop
b27	AUX in Bus-on
b28	Hardwired Mode Active
b29	Positioner Active
b30	Reserved
b31	Reserved

9.5 Device Variable 2: Actuator Status (2)

This variable describes the status of the actuator. It is a bit_enumerated variable, it is not possible to write this data. The possible values are:

Table 269. Device Variable 2 on HRT2000v4 Rev. 1

Bit	Description
b0	Reserved
b1	Local Configuration
b2	Reserved
b3	Reserved
b4	Reserved
b5	Close Travel Available
b6	Open Travel Available
b7	Reserved
b8	Pos >= xx
b9	Pos <= yy
b10	Reserved
b11	Reserved
b12	Reserved
b13	Reserved
b14	Reserved
b15	Reserved
b16	Intermediate Position
b17	Interlock in Progress
b18	Moving
b19	Alarms
b20	Warnings
b21	Reserved
b22	Reserved
b23	Reserved
b24	Reserved
b25	Reserved
b26	Reserved
b27	Reserved
b28	Reserved
b29	Reserved
b30	Reserved
b31	Reserved

Table 270. Device Variable 2 on HRT2000v4 Rev. 2

Bit	Description
b0	Reserved
b1	Local Configuration
b2	Reserved
b3	Reserved
b4	Reserved
b5	Close Travel Available
b6	Open Travel Available
b7	Reserved
b8	Pos >= xx
b9	Pos <= yy
b10	Reserved
b11	Reserved
b12	Reserved
b13	Reserved
b14	Reserved
b15	Reserved
b16	Intermediate Position
b17	Interlock in progress
b18	Moving
b19	Alarms
b20	Warnings
b21	STOP in Remote
b22	Maintenance Operation
b23	Reserved
b24	Reserved
b25	Reserved
b26	Reserved
b27	Reserved
b28	Reserved
b29	Reserved
b30	Reserved
b31	Reserved

9.6 Device Variable 3: Position Request

This variable permits to drive the actuator in a desired position when Loop Current Mode is Disabled or HART® topology is Multidrop.

9.7 Device Variable 4: Dead Band

This variable sets the percentage of the maximum position error without electrical commands.

9.8 Device Variable 5: Motion Inhibit Time

This variable indicates the length of the delay time between two motor cycles.

9.9 Device Variable 6: Actuator Alarms (1)

This variable shows the alarms status of the actuator. It is a bit_enumerated variable, it is not possible to write this data. The possible values are:

Table 271.

Bit	Description
b0	Motor Thermostat
b1	Hi-Hi Torque in opening
b2	Hi-Hi Torque in closing
b3	Reserved
b4	Reserved
b5	Hi-Hi Temperature
b6	Position Sensor
b7	Speed Sensor
b8	Main Voltage
b9	K1 Contactor
b10	K2 Contactor
b11	Configuration
b12	Hardware
b13	Low battery
b14	Lost phase
b15	Request signal
b16	Hi-Hi Torque in intermediate position
b17	Jammed in closing
b18	Jammed in opening
b19	Direction test fail
b20	Mid-travel alarm OP

Bit	Description
b21	Mid-travel alarm CL
b22	Reserved
b23	Reserved
b24	Alarm Extended #1
b25	Alarm Extended #2
b26	Alarm Extended #3
b27	Alarm Extended #4
b28	Alarm Extended #5
b29	Alarm Extended #6
b30	Alarm Extended #7
b31	Alarm Extended #8

In HRT2000v4 Rev. 2, the “Alarm Extended #5” indicates the “EFS Mid-Travel Alarm.”

9.10 Device Variable 7: Actuator Alarms (2)

This variable shows the alarms status of the actuator. This is a bit_enumerated variable, it is not possible to write this data. The possible values are:

Table 272. Device Variable 7 on HRT2000v4 Rev. 1

Bit	Description
b0	Reserved
b1	NACK Motherboard
b3 to b31	Reserved

Table 273. Device Variable 7 on HRT2000v4 Rev. 2

Bit	Description
b0	Reserved
b1	NACK Motherboard
b2	Hardware Alarm 1
b3	Hardware Alarm 2
b4	Hardware Alarm 3
b5	Hardware Alarm 4
b6	Hardware Alarm 5
b7	Hardware Alarm 6
b8	Hardware Alarm 7
b9	Hardware Alarm 8
b10	Hardware Alarm 9
b11	Hardware Alarm 10
b12	Hardware Alarm 11
b13	Hardware Alarm 12
b14	Hardware Alarm 13
b15 to b31	Not Defined

9.11 Device Variable 8: Actuator Warnings

This variable shows the warnings status of the actuator. This is a bit_enumerated variable, it is not possible to write this data. The possible values are:

Table 274.

Bit	Description
b0	Hi Torque in opening
b1	Hi Torque in closing
b2	Hi Temperature
b3	Main Voltage
b4	Contactor Cycles
b5	Maintenance Request
b6	Motor Current
b7	Wrong Stroke Limits
b8	Stop in Remote
b9	Hi Torque in Intermediate Position
b10	Reserved
b11	Reserved
b12	Reserved
b13	Reserved
b14	Reserved
b15	Reserved
b16	Warning Extended #1: Time PST Value Failed
b17	Warning Extended #2: Time RET Value Fixed
b18	Warning Extended #3: OV-TR Value Failed
b19	Warning Extended #4: PST Cycle Aborted
b20 to b31	Reserved

9.12 Device Variable 9: AL – Opening Time

This variable indicates the duration of the last stroke in opening. It is not possible to write this variable.

9.13 Device Variable 10: AL – Closing Time

This variable indicates the duration of the last stroke in closing. It is not possible to write this variable.

9.14 Device Variable 11: ESD Action

This variable defines the action to run in case of an ESD command. This is an enumerated variable; the possible values are:

Table 275.

Value	Description
0	Off: Function Disabled
1	Close
2	Open
3	Stay-Put
4	Go to position

9.15 Device Variable 12: ESD Percent

This variable defines the position to drive the actuator when the ESD action (Device Variable 18) is programmed to “Go to position”.

9.16 Device Variable 13: 2SP – Close Direction Status

This variable indicates the status of the timer function in closing direction. This is an enumerated variable, the possible values are:

Table 276.

Value	Description
0	Off
1	On

9.17 Device Variable 14: 2SP – Close Direction Start Position

This variable indicates the position where the timer function starts during a stroke in closing.

9.18 Device Variable 15: 2SP – Close Direction Stop Position

This variable indicates the position where the timer function stops during a stroke in closing.

9.19 Device Variable 16: 2SP – Close Direction ON Time

This variable indicates the ON time of motor in 2 Speed Timer operation in close direction.

9.20 Device Variable 17: 2SP – Close Direction OFF Time

This variable indicates the OFF time of motor in 2 Speed Timer operation in close direction.

9.21 Device Variable 18: 2SP – Open Direction Status

This variable indicates the status of the timer function in opening direction. This is an enumerated variable, the possible values are:

Table 277.

Value	Description
0	Off
1	On

9.22 Device Variable 19: 2SP – Open Direction Start Position

This variable indicates the position where the timer function starts during a stroke in opening.

9.23 Device Variable 20: 2SP – Open Direction Stop Position

This variable indicates the position where the timer function stops during a stroke in opening.

9.24 Device Variable 21: 2SP – Open Direction ON Time

This variable indicates the ON time of motor in 2 Speed Timer operation in open direction.

9.25 Device Variable 22: 2SP – Open Direction OFF Time

This variable indicates the OFF time of motor in 2 Speed Timer operation in open direction.

9.26 Device Variable 23: Fail-Safe Action

This variable indicates the action to run in case of 4 to 20 mA input signal failure. This is an enumerated variable, the possible values are:

Table 278.

Value	Description
0	Off: Function Disabled
1	Close
2	Open
3	Stay-Put
4	Go to Position

9.27 Device Variable 24: Fail-Safe Delay

This variable indicates the delay time before running the fail-safe action (Device Variable 30).

9.28 Device Variable 25: Fail-Safe Position

This variable indicates the position to drive the actuator when the fail-safe action (Device Variable 30) is programmed to “Go to position”.

9.29 Device Variable 26: Power Supply Type

This variable indicates the actuator power supply type.
In HRT2000v4 Rev. 1, it is not possible to write this data.
In HRT2000v4 Rev. 2, it can be modified only by SERVICE or MANUFACTURER user levels.
This is an enumerated variable; the possible values are:

Table 279.

Value	Description
0	AC 3 Ph
1	AC 1 Ph
2	DC

9.30 Device Variable 27: Power Supply Voltage

This variable indicates the actuator power supply voltage.
In HRT2000v4 Rev. 1, it is not possible to write this data.
In HRT2000v4 Rev. 2, it can be modified only by SERVICE or MANUFACTURER user levels.

9.31 Device Variable 28: Power Supply Frequency

This variable indicates the actuator power supply frequency.
In HRT2000v4 Rev. 1, it is not possible to write this data.
In HRT2000v4 Rev. 2, it can be modified only by SERVICE or MANUFACTURER user levels.

9.32 Device Variable 29: Actuator Position

This variable indicates the current position of the actuator. It is not possible to write this variable.

9.33 Device Variable 30: Main Actuator Status

This variable indicates the main status of the actuator. This is a bit_enumerated variable, it is not possible to write this data. The possible values are:

Table 280.

Bit	Description
b0	Open
b1	Close
b2	Opening
b3	Closing
b4	Stopped
b5 to b31	Not Used

9.34 Device Variable 31: Local Mode

This variable indicates if the Local Selector position is LOCAL. This is an enumerated variable, it is not possible to write this data. The possible values are:

Table 281.

Value	Description
0	Selector not in LOCAL
1	Selector in LOCAL

9.35 Device Variable 32: Off Mode

This variable indicates if the Local Selector position is OFF. This is an enumerated variable, it is not possible to write this data. The possible values are:

Table 282.

Value	Description
0	Selector not in OFF
1	Selector in OFF

9.36 Device Variable 33: Remote Mode

This variable indicates if the Local Selector position is REMOTE. This is an enumerated variable, it is not possible to write this data. The possible values are:

Table 283.

Value	Description
0	Selector not in REMOTE
1	Selector in REMOTE

9.37 Device Variable 34: Stall Alarm

This variable indicates if the actuator stall alarm is active. The actuator stall alarm is active if at least one of these alarms is active:

- Jammed in Opening
- Jammed in Closing
- Hi-Hi Torque in Opening
- Hi-Hi Torque in Closing

This is an enumerated variable, it is not possible to write this data. The possible values are:

Table 284.

Value	Description
0	Stall alarm not active
1	Stall alarm active

9.38 Device Variable 35: Device Alarm Active

This variable indicates if at least one alarm is active. This is an enumerated variable, it is not possible to write this data. The possible values are:

Table 285.

Value	Description
0	Device alarm not active
1	Device alarm active

9.39 Device Variable 36: Actuator Ready

This variable indicates if the actuator is ready to be driven by remote controls. This is an enumerated variable, it is not possible to write this data. The possible values are:

Table 286.

Value	Description
0	Actuator not ready
1	Actuator ready

9.40 Device Variable 37: Torque

This variable indicates the current torque measured by the actuator. It is not possible to write this data.

9.41 Device Variable 38: Temperature

This variable indicates the internal temperature of the actuator. It is not possible to write this data.

9.42 Device Variable 39: Heater Status

This variable indicates the status of the heater. This is a bit_enumerated variable, it is not possible to write this data. The possible values are:

Table 287.

Bit	Description
b0	AS8 Heater
b1	Terminal Board Heater
b2	Display Logic Card Heater
b3 to b31	Not Used

9.43 Device Variable 40: K1 Contactor Status

This variable indicates the K1 Contactor status. This is an enumerated variable, it is not possible to write this data. The possible values are:

Table 288.

Value	Description
0	K1 Contactor Open
1	K1 Contactor Closed

9.44 Device Variable 41: K2 Contactor Status

This variable indicates the K2 Contactor status. This is an enumerated variable, it is not possible to write this data. The possible values are:

Table 289.

Value	Description
0	K2 Contactor Open
1	K2 Contactor Closed

9.45 Device Variable 42: Motor Thermostat Status

This variable indicates the Motor Thermostat status. This is an enumerated variable, it is not possible to write this data. The possible values are:

Table 290.

Value	Description
0	Motor Open
1	K1 Contactor Closed

9.46 Device Variable 43: Output Contacts Status

This variable indicates the contacts status of the relays. This is a bit_enumerated variable, it is not possible to write this data. The possible values are:

Table 291.

Bit	Description
b0	AS1 Status (0 = Open, 1 = Closed)
b1	AS2 Status (0 = Open, 1 = Closed)
b2	AS3 Status (0 = Open, 1 = Closed)
b3	AS4 Status (0 = Open, 1 = Closed)
b4	AS5 Status (0 = Open, 1 = Closed)
b5	AS6 Status (0 = Open, 1 = Closed)
b6	AS7 Status (0 = Open, 1 = Closed)
b7	AS8 Status (0 = Open, 1 = Closed)
b8	Monitor Relay Status (0 = Open, 1 = Closed)
b9 to b31	Not Used

9.47 Device Variable 44: Digital Inputs Status

This variable indicates the status of Digital Inputs. This is a bit_enumerated variable, it is not possible to write this data. The possible values are:

Table 292.

Bit	Description
b0	Hardwired Open Command (0 = Low, 1 = High)
b1	Hardwired Close Command (0 = Low, 1 = High)
b2	Hardwired Stop Command (0 = Low, 1 = High)
b3	Auto/Man (0 = Low, 1 = High)
b4	Interlock Close (0 = Low, 1 = High)
b5	Interlock Open (0 = Low, 1 = High)
b6	ESD (0 = Low, 1 = High)
b7 to b31	Not Used

9.48 Device Variable 45: User Level Logged

This variable indicates the user level logged. This is an enumerated variable, it is not possible to write this data. The possible values are:

Table 293.

Value	Description
0	Observer
1	User
2	Service
3	Manufacturer

9.49 Device Variable 46: Motor Speed

This variable indicates the speed of the motor. It is not possible to write this data.

9.50 Device Variable 47: Main Voltage

This variable indicates the power supply voltage measured by the actuator. It is not possible to write this data.

9.51 Device Variable 48: Current

This variable indicates the current measured by the actuator. It is not possible to write this data.

9.52 Device Variable 49: Motor Temperature

This variable indicates the temperature of the motor. It is not possible to write this data.

9.53 Device Variable 50: Terminal Board Temperature

This variable indicates the temperature of the terminal board. It is not possible to write this data.

9.54 Device Variable 51: Position Request (Used by Logic Card)

This variable indicates the position request used by the logic card. It is not possible to write this data.

9.55 Device Variable 52: Auxiliary Analog Input mA

This variable indicates the analog input current measured on terminals B8 to B9. It is not possible to write this data.

9.56 Device Variable 53: Auxiliary Analog Input bit

This variable indicates the digital value of the analog input signal applied to terminals B8 to B9. It is not possible to write this data.

9.57 Device Variable 54: PST Progress Counter

This variable indicates the progress percentage of the PST command. It is not possible to write this data.

9.58 Device Variable 55: Last PST Status

This variable indicates the status of the last PST command executed. This is a bit_enumerated variable, it is not possible to write this data. The possible values are:

Table 294.

Bit	Description
b0	Passed (0 = Not active, 1 = Active)
b1	Failed – T-PST (0 = Not active, 1 = Active)
b2	Failed – T-RET (0 = Not active, 1 = Active)
b3	Failed – Over Travel (0 = Not active, 1 = Active)
b4	Reset (0 = Not active, 1 = Active)
b5 to b31	Not Used

9.59 Device Variable 56: PST Reset Conditions

This variable indicates the Reset Conditions of the last PST command executed. This is a bit_enumerated variable, it is not possible to write this data. The possible values are:

Table 295.

Bit	Description
b0	Selector in OFF
b1	Local Stop
b2	Remote Stop
b3	ESD
b4	Fail-Safe
b5	Configuration Alarm
b6	Position Sensor Alarm
b7	Thermostat Alarm
b8	Main Supply Alarm
b9	Lost Phase Alarm
b10	Hi Temperature Alarm
b11	Jammed Valve Alarm
b12	Hi Torque Alarm
b13	Speed Sensor Alarm
b14	K1 Contactor Alarm
b15	K2 Contactor Alarm
b16	Hardware Alarm
b17	EFS Mid-Travel
b18 to b31	Not Used

9.60 Device Variable 57: Encoder Absolute Position

This variable indicates the absolute position of the encoder. It is not possible to write this variable.

9.61 Device Variable 58: Encoder Status

This variable indicates the status of the encoder. This is a bit_enumerated variable, it is not possible to write this data. The possible values are:

Table 296.

Bit	Description
b0	Close Direction (0 = CW, 1 = CCW)
b1	Reserved – Not Used
b2	Reserved – Not Used
b3	Reserved – Not Used
b4	Reserved – Not Used
b5	Reserved – Not Used
b6	Reserved – Not Used
b7	Calibration Status (0 = Not calibrated, 1 = Calibrated)
b8	Encoder Communication Status (0 = Ok, 1 = Interrupted)
b9	CW/CCW Configuration Updated (0 = Updated, 1 = Not Updated)
b10 to b31	Not Used

9.62 Device Variable 59: Encoder Wheel 1

This variable indicates the Wheel 1 value of the encoder. It is not possible to write this data.

9.63 Device Variable 60: Encoder Wheel 2

This variable indicates the Wheel 2 value of the encoder. It is not possible to write this data.

9.64 Device Variable 61: Encoder Wheel 3

This variable indicates the Wheel 3 value of the encoder. It is not possible to write this data.

9.65 Device Variable 62: Encoder Communication Errors

This variable indicates the number of communication errors has been occurred. It is not possible to write this data.

9.66 Device Variable 63: Bus Communication Errors

This variable indicates the number of communication errors has been occurred between the logic card and the bus interface. It is not possible to write this data.

9.67 Device Variable 64: Terminal Board Errors

This variable indicates the number of communication errors occurred between the logic card and the terminal board. It is not possible to write this data.

9.68 Device Variable 65: Torque Potentiometer

This variable indicates the value of the Torque Potentiometer. It is not possible to write this data.

9.69 Device Variable 66: Battery Voltage

This variable indicates the battery voltage. It is not possible to write this data.

9.70 Device Variable 67: HART Interface Status

This variable indicates the status of the HART® interface. This is a bit_enumerated variable, it is not possible to write this data. The possible values are:

Table 297.

Bit	Description
b0	Input 4 to 20 mA status (0 = Ok, 1 = lower than 2 mA)
b1	Burst Mode Status (0 = Not active, 1 = Active)
b2	Bus Communication Status (0 = Not Active, 1 = Active)
b3 to b31	Reserved – Not Used

9.71 Device Variable 68: Analog Output mA

This variable indicates the Analog Output signal (expressed in mA) generated by the actuator. It is not possible to write this data.

9.72 Device Variable 69: Analog Output bit

This variable indicates the Analog Output signal (expressed in bit) generated by the actuator. It is not possible to write this data.

9.73 Device Variable 70: Additional Actuator Status

This variable indicates the additional status of the actuator. This is a bit_enumerated variable, it is not possible to write this data. The possible values are:

Table 298.

Bit	Description
b0	Motor Temperature Enabled (0 = Not active, 1 = Active)
b1	Pos >= yy% (DIN2 Position) (0 = Not active, 1 = Active)
b2	Pos <= xx% (DIN1 Position) (0 = Not active, 1 = Active)
b3	Bus Close Travelling Available (0 = Not active, 1 = Active)
b4	Bus Open Travelling Available (0 = Not active, 1 = Active)
b5	Local Configuration (0 = Not active, 1 = Active)
b6	Manual Operation (handwheel) (0 = Not active, 1 = Active)
b7 to b31	Reserved – Not Used

9.74 Device Variable 71: Analog Position Request

This variable indicates the percentage corresponding to the Loop Current Signal. It is not possible to write this data.

9.75 Device Variable 244: Percent Range

This variable indicates the percentage corresponding to the Loop Current signal. It is not possible to write this variable.

9.76 Device Variable 245: Loop Current

This variable indicates the value of the analog input current. It is not possible to write this variable.

9.77 Device Variable 246: Primary Variable

This variable indicates the PV. It indicates the percentage corresponding to the Loop Current Signal
For HRT2000v4 Rev. 2, it assumes the value of Device Variable 71. The PV cannot be remapped.

9.78 Device Variable 247: Secondary Variable

This variable indicates the SV.
In HRT2000v4 Rev. 1, it indicates the current position of the actuator.
In HRT2000v4 Rev. 2, the default SV is the Device Variable 29 “Actuator Position”. To select the Secondary Variable, see Section 8.2.3.

9.79 Device Variable 248: Tertiary Variable

This variable indicates the TV.
In HRT2000v4 Rev. 1, it indicates the current torque measure by the actuator.
In HRT2000v4 Rev. 2, the default TV is the Device Variable 37 “Torque”. To select the Tertiary Variable, see Section 8.2.3.

9.80 Device Variable 249: Quaternary Variable

This variable indicates the QV.
In HRT2000v4 Rev. 1, it indicates the internal temperature of the actuator.
In HRT2000v4 Rev. 2, the default TV is the Device Variable 38 “Temperature”. To select the Quaternary Variable, see Section 8.2.3.

Section 10: Tables

10.1 Array Codes

Table 299. Array Codes on HRT2000v4 Rev. 1

Code	Description
0	Name Plate – Serial Number
1	Name Plate – Actuator Size
2	Name Plate – WD
3	Name Plate – Enclosure
4	Name Plate – Certificate
5	Name Plate – Lubricant
6	Motor Data – Motor Code
7	Valve Data – Tag Name
8	Valve Data – Serial Number
9	Valve Data – Valve Manufacturer
10	Valve Data – Break to Open Torque
11	Valve Data – Break Steam Thrust
12	Valve Data – Valve Coupling Type
13 to 255	Undefined

Table 300. Array Codes on HRT2000v4 Rev. 2

Code	Description	Handling	User Level (*)
0	Name Plate – Serial Number	Read and Write	Service
1	Name Plate – Actuator Size	Read and Write	Service
2	Name Plate – WD	Read and Write	Service
3	Name Plate – Enclosure	Read and Write	Service
4	Name Plate – Certificate	Read and Write	Service
5	Name Plate – Lubricant	Read and Write	Service
6	Motor Data – Motor Code	Read and Write	Service
7	Valve Data – Tag Name	Read and Write	User
8	Valve Data – Serial Number	Read and Write	User
9	Valve Data – Valve Manufacturer	Read and Write	User
10	Valve Data – Break to Open Torque	Read and Write	User
11	Valve Data – Break Steam Thrust	Read and Write	User
12	Valve Data – Valve Coupling Type	Read and Write	User
13 to 255	Undefined	-	-

NOTE:
* "User Level" indicates the user level permissions required to modify the parameter.

10.2 Param_E Parameters Codes (Enumerated)

Table 301.

Code	Description	RW	User Level (*)	Min.	Max.	Notes
0	User	RW	Observer	0	3	0 = Observer 1 = User 2 = Service 3 = Manufacturer
1	Write Protection	RW	User	0	1	0 = Disabled 1 = Enabled
2	Backward Compatibility Mode	RW	Service	0	1	0 = Disabled 1 = Enabled
3	Reserved	RW	Service	0	1	Reserved
4	Reserved	RW	Service	0	1	Reserved
5	Local Display Language	RW	User	0	9	0 = English 1 = French 2 = Spanish 3 = Italian 4 = Portuguese 5 = Turkish 6 = Russian 7 = Norwegian 8 = Romanian 9 = German
6	Logic Board RS232 Baud Rate	RW	User	0	1	0 = 9600 bps 1 = 19200 bps
7	Wink Command	RW	User	0	1	0 = No Operation 1 = Wink Command
8	Force Local Selector	RW	Service	0	2	0 = No force selector 1 = Force Selector to OFF 2 = Force Selector to LOCAL
9	Bluetooth Name Source	RW	User	0	1	0 = Actuator Serial Number 1 = Valve Tag
10	Bluetooth Enabled	RW	User	0	1	0 = Disabled 1 = Enabled
11	Interlock Signal Type Open	RW	User	0	2	0 = Absent 1 = Present 2 = Off
12	Interlock Signal Type Close	RW	User	0	2	0 = Absent 1 = Present 2 = Off
13	Reset Alarms and Warnings Active	RW	User	0	1	0 = No Operation 1 = Execute Command
14	Clear Alarms and Warnings Logs	RW	User	0	1	0 = No Operation 1 = Execute Command
15	Torque Mode	RW	User	0	1	0 = 3 Points 1 = Standard
16	9 V Lithium Battery	RW	User	0	1	0 = Absent 1 = Present

NOTE:
* "User Level" indicates the user level permissions required to modify the parameter.

Code	Description	RW	User Level (*)	Min.	Max.	Notes
17	AS1 Relay Function	RW	User	0	29	0 = Open limit 1 = Close limit 2 = Position >= % 3 = Position <= % 4 = Closing 5 = Opening 6 = Running 7 = Blinker 8 = Mid-Travel 9 = Local Selected 10 = Remote Selected 11 = Local STOP On 12 = ESD/PST-efs 13 = Man. Operation 14 = Motor Over Temp. 15 = Hi-Hi Torque 16 = Hi-Hi Torque in opening 17 = Hi-Hi Torque in closing 18 = Jammed in Open 19 = Jammed in Close 20 = Jammed Valve 21 = Low Battery 22 = Warnings
18	AS2 Relay Function	RW	User	0	29	0 = Open limit 1 = Close limit 2 = Position >= % 3 = Position <= % 4 = Closing 5 = Opening 6 = Running 7 = Blinker 8 = Mid-Travel 9 = Local Selected 10 = Remote Selected 11 = Local STOP On 12 = ESD/PST-efs 13 = Man. Operation 14 = Motor Over Temp. 15 = Hi-Hi Torque 16 = Hi-Hi Torque in opening 17 = Hi-Hi Torque in closing 18 = Jammed in Open 19 = Jammed in Close 20 = Jammed Valve 21 = Low Battery 22 = Warnings
19	AS3 Relay Function	RW	User	0	29	0 = Open limit 1 = Close limit 2 = Position >= % 3 = Position <= % 4 = Closing 5 = Opening 6 = Running 7 = Blinker 8 = Mid-Travel 9 = Local Selected 10 = Remote Selected 11 = Local STOP On 12 = ESD/PST-efs 13 = Man. Operation 14 = Motor Over Temp. 15 = Hi-Hi Torque 16 = Hi-Hi Torque in opening 17 = Hi-Hi Torque in closing 18 = Jammed in Open 19 = Jammed in Close 20 = Jammed Valve 21 = Low Battery 22 = Warnings

NOTE:
* "User Level" indicates the user level permissions required to modify the parameter.

Code	Description	RW	User Level (*)	Min.	Max.	Notes
20	AS4 Relay Function	RW	User	0	29	0 = Open limit 1 = Close limit 2 = Position >= % 3 = Position <= % 4 = Closing 5 = Opening 6 = Running 7 = Blinker 8 = Mid-Travel 9 = Local Selected 10 = Remote Selected 11 = Local STOP On 12 = ESD/PST-efs 13 = Man. Operation 14 = Motor Over Temp. 15 = Hi-Hi Torque 16 = Hi-Hi Torque in opening 17 = Hi-Hi Torque in closing 18 = Jammed in Open 19 = Jammed in Close 20 = Jammed Valve 21 = Low Battery 22 = Warnings
21	AS5 Relay Function	RW	User	0	29	0 = Open limit 1 = Close limit 2 = Position >= % 3 = Position <= % 4 = Closing 5 = Opening 6 = Running 7 = Blinker 8 = Mid-Travel 9 = Local Selected 10 = Remote Selected 11 = Local STOP On 12 = ESD/PST-efs 13 = Man. Operation 14 = Motor Over Temp. 15 = Hi-Hi Torque 16 = Hi-Hi Torque in opening 17 = Hi-Hi Torque in closing 18 = Jammed in Open 19 = Jammed in Close 20 = Jammed Valve 21 = Low Battery 22 = Warnings
22	AS6 Relay Function	RW	User	0	29	0 = Open limit 1 = Close limit 2 = Position >= % 3 = Position <= % 4 = Closing 5 = Opening 6 = Running 7 = Blinker 8 = Mid-Travel 9 = Local Selected 10 = Remote Selected 11 = Local STOP On 12 = ESD/PST-efs 13 = Man. Operation 14 = Motor Over Temp. 15 = Hi-Hi Torque 16 = Hi-Hi Torque in opening 17 = Hi-Hi Torque in closing 18 = Jammed in Open 19 = Jammed in Close 20 = Jammed Valve 21 = Low Battery 22 = Warnings

NOTE:
* "User Level" indicates the user level permissions required to modify the parameter.

Code	Description	RW	User Level (*)	Min.	Max.	Notes
23	AS7 Relay Function	RW	User	0	29	23 = Mid-Travel Alarm 24 = EFS in manual 25 = PST Failed 26 = MAINS (only AS8) 27 = EFS Mid-Travel 28 = INTERLOCK/PST 29 = EFS Coil Off 30 = Heater (Only for AS8)
24	AS8 Relay Function	RW	User	0	30	23 = Mid-Travel Alarm 24 = EFS in manual 25 = PST Failed 26 = MAINS (Only AS8) 27 = EFS Mid-Travel 28 = INTERLOCK/PST 29 = EFS Coil Off 30 = Heater (Only for AS8)
25	AS1 Relay Contact	RW	User	0	1	0 = Break 1 = Make
26	AS2 Relay Contact	RW	User	0	1	0 = Break 1 = Make
27	AS3 Relay Contact	RW	User	0	1	0 = Break 1 = Make
28	AS4 Relay Contact	RW	User	0	1	0 = Break 1 = Make
29	AS5 Relay Contact	RW	User	0	1	0 = Break 1 = Make
30	AS6 Relay Contact	RW	User	0	1	0 = Break 1 = Make
31	AS7 Relay Contact	RW	User	0	1	0 = Break 1 = Make
32	AS8 Relay Contact	RW	User	0	1	0 = Break 1 = Make
33	EFS Automatic reset	RW	User	0	1	0 = Off 1 = On
34	Spring Action	RW	User	0	1	0 = Close
35	Electrical Command	RW	User	0	1	0 = Disabled 1 = Enabled
36	EFS Input Mode	RW	User	0	1	0 = PST-efs 1 = EFS
37	EFS Signal Type	RW	User	0	1	0 = Absent 1 = Present
38	PST Mode	RW	User	0	3	0 = Off 1 = Auto 2 = Manual 3 = Manual + Auto
39	DIN1 Function	RW	User	0	29	See “AS1 Relay Function”
40	DIN2 Function	RW	User	0	29	See “AS1 Relay Function”
41	DIN3 Function	RW	User	0	29	See “AS1 Relay Function”
42	DIN4 Function	RW	User	0	29	See “AS1 Relay Function”
43	DIN5 Function	RW	User	0	29	See “AS1 Relay Function”
44	DIN6 Function	RW	User	0	29	See “AS1 Relay Function”
45	ESD Signal Type	RW	User	0	1	0 = Absent 1 = Present
46	Positioner Polarity	RW	User	0	1	0 = Standard (4 mA = Close) 1 = Reversed (4 mA = Open)
47	Output 4 to 20 mA Signal	RW	User	0	1	0 = Position 1 = Torque
48	Output 4 to 20 mA Polarity	RW	User	0	1	0 = 4 mA Close 1 = 4 mA Open
49	Close Direction	RW	User	0	1	0 = CW 1 = CCW
50	Close Limit by	RW	User	0	1	0 = Position 1 = Torque

NOTE:
* “User Level” indicates the user level permissions required to modify the parameter.

Code	Description	RW	User Level (*)	Min.	Max.	Notes
51	Open Limit by	RW	User	0	1	0 = Position 1 = Torque
52	Remote Controls	RW	User	0	6	0 = Off 1 = 4 wires latched 2 = 3 wires push to run 3 = 3 wires latched 4 = Reserved 5 = 2 wires open if signal off 6 = 2 wires open if signal on
53	Remote Stop	RW	User	0	1	0 = Break 1 = Make
54	Local Controls – Control Mode	RW	User	0	3	0 = Latched 1 = Push to run 2 = Latched instant reverse 3 = Push to run through AS6 to AS7
55	Actuator Speed Eng. Unit	RW	Service	0	3	0 = s/90° 1 = RPM 2 = mm/s 3 = ins/s
56	Torque/Thrust Eng. Unit	RW	Service	0	3	0 = lbf 1 = Nm 2 = lb 3 = kN
57	Motor Type	RW	Service	0	2	0 = AC 3 Phase 1 = AC 1 Phase 2 = DC
58	Motor Poles	RW	Service	0	15	0 = 2 poles 1 = 4 poles 2 = 6 poles 3 = 8 poles 4 = 10 poles 5 = 12 poles 6 = 14 poles 7 = 16 poles 8 = 18 poles 9 = 20 poles 10 = 22 poles 11 = 24 poles 12 = 26 poles 13 = 28 poles 14 = 30 poles 15 = 32 poles
59	Motor Service	RW	Service	0	6	0 = S2/15 min 1 = S4/25%/60 start/h 2 = S4/25%/200 start/h 3 = S4/25%/600 start/h 4 = S4/25%/1200 start/h 5 = S4/25%/3600 start/h 6 = S9
60	Torque Sensor I24 – Frequency	RW	Service	0	1	0 = 50 Hz 1 = 60 Hz
61	Hardware Configuration	RW	Service	0	12	0 = Base Card (No bus card) 1 = LonWorks® 2 = Modbus 3 = Profibus 4 = Modbus M 5 = FF 6 = HART® 7 = ProV1 8 = ProV1_R 9 = Modbus Dewa 10 = ProV2 11 = ProV2_r 12 = Mod-1CHR
62	Software Type	RW	Service	0	4	0 = ICON/XTE 1 = F01 2 = 6K 3 = EFS 4 = EPN

NOTE:
* "User Level" indicates the user level permissions required to modify the parameter.

HART® is a mark owned by FieldComm Group.
LonWorks® is a mark owned by Echelon Corporation.

Code	Description	RW	User Level (*)	Min.	Max.	Notes
63	Logic Card Manufacturer	RW	Service	0	1	0 = Biffi 1 = Bettis
64	4 to 20 mA Card	RW	Service	0	1	0 = Absent 1 = Present
65	Sleep Mode	RW	Service	0	1	0 = Disabled 1 = Enabled
66	Monitor Relay in Sleep Mode	RW	Service	0	1	0 = Not Energized 1 = Energized
67	CMD Filter	RW	Service	0	100	0 = 1 Confirmation (Low Filter) 1 = 2 Confirmations 2 = 3 Confirmations to 30 to 99 = 31 Confirmations (High Filter) 100 = No Confirmations (No Filter)
68	ESD/Interlock Dig. Input Filter	RW	Service	0	30	0 = 0.1 s (low filter) 1 = 0.2 s 2 = 0.3 s 3 = 0.4 s 4 = 0.5 s 5 = 0.6 s 6 = 0.7 s 7 = 0.8 s 8 = 0.9 s 9 = 1 s 10 = 1.1 s 11 = 1.2 s 12 = 1.3 s 13 = 1.4 s 14 = 1.5 s 15 = 1.6 s 16 = 1.7 s 17 = 1.8 s 18 = 1.9 s 19 = 2 s 20 = 2.1 s 21 = 2.2 s 22 = 2.3 s 23 = 2.4 s 24 = 2.5 s 25 = 2.6 s 26 = 2.7 s 27 = 2.8 s 28 = 2.9 s 29 = 3 s 30 = 3.1 s (high filter)
69	Interlock Mode	RW	Service	0	1	0 = Standard 1 = Advanced
70	Direction Test Timeout	RW	Service	0	25	0 = 100 ms 1 = 400 ms 2 to 25 = 1000 ms
71	Additional Variables	RW	Service	0	1	0 = Standard 1 = Extended
72	Back Light	RW	Service	0	1	0 = Auto 1 = Always On

NOTE:
* "User Level" indicates the user level permissions required to modify the parameter.

Code	Description	RW	User Level (*)	Min.	Max.	Notes
73	Position Request From	RW	Service	0	1	0 = 4 to 20 mA 1 = Bus
74	1P Man	RW	Service	0	1	0 = Disabled 1 = Enabled
75	Positioner	RW	Service	0	1	0 = Disabled 1 = Enabled
76	Bus AN-OUT	RW	Service	0	1	0 = Torque 1 = Torque + Potentiometer
77	Fail-Safe	RW	Service	0	1	0 = Disabled 1 = Enabled
78	Serial Command	RW	Service	0	1	0 = Disabled 1 = Enabled
79	Upload New Firmware	RW	Service	0	1	0 = Off 1 = On
80	Terminal Board	RW	Service	0	4	0 = I24 1 = 5 Relays 2 = 8/9 Relays 3 = 12 Relays 4 = I24 Gold PR
81	Selector Mode	RW	Service	0	1	0 = Local 1 = Local + Remote
82	Logger Mode (**)	RW	User	0	3	0 = Off 1 = Event 2 = Recorder 3 = T-Recorder
83	Memory Mode (**)	RW	User	0	1	0 = Continuous 1 = Stop when full
84	HART® Topology	RW	User	0	1	0 = Point to Point 1 = Multidrop
85	Set Torque Profile	RW	User	0	1	0 = No Operation 1 = Execute Command
86	Clear Recent Data Log	RW	User	0	1	0 = No Operation 1 = Execute Command
87	Actuator Reset	RW	Service	0	1	0 = No Operation 1 = Perform Actuator Reset
88	Bus Monitor	RW	Service	0	1	0 = Disabled 1 = Enabled
89	Maintenance Operation Command	RW	Service	0	1	0 = Not active 1 = Active
90	4 mA Calibration Command (HART)	RW	User	0	1	0 = No Operation 1 = Set 4 mA
91	20 mA Calibration Command (HART)	RW	User	0	1	0 = No Operation 20 mA 1 = Set 20 mA

NOTES:
* "User Level" indicates the user level permissions required to modify the parameter.
**Memory Mode can be modified only if Logger Mode is set to Off.
**Logger Mode can be changed only if its current value is Off, so if Logger Mode value is different from Off, it can be modified only by setting it to Off and then to a different value.

10.3 Param_BE Parameters Codes (Bit Enumerated)

Table 302.

Code	Description	RW	User Level (*)	Notes
0	Monitor Relay Options	RW	User	b7 = 1 Low Battery b6 = 1 Jammed Valve b5 = 1 Overtorque b4 = 1 Motor Hi Temp b3 = 1 Manual Operation b2 = 1 ESD/EFS Active b1 = 1 Local Off Selected b0 = 1 Local Stop On
1	EFS Action in case of	RW	User	b1 = 1 Selector in Off b0 = 1 Power Failure

2	ESD Priority	RW	User	b6: 0 = ESD Priority < 2 Speed Timer;
				1 = ESD Priority > 2 Speed Timer
				b5: 0 = ESD Priority < Motion Inhibit;
				1 = ESD Priority > Motion Inhibit
				b4: 0 = ESD Priority < Selector in Off;
				1 = ESD Priority > Selector in Off
				b3: 0 = ESD Priority < Selector in Local;
				1 = ESD Priority > Selector in Local
				b2: 0 = ESD Priority < Local Stop pressed;
				1 = ESD Priority > Local Stop pressed
				b1: 0 = ESD Priority < Hi Torque Alarm;
				1 = ESD Priority > Hi Torque Alarm
				b0: 0 = ESD Priority < Thermostat;
				1 = ESD Priority > Thermostat

3	Local Controls – LED's color	RW	User	b2 "Alarm Led": 0 = Red; 1 = Yellow b1 "Close Led": 0 = Red; 1 = Green b0 "Open Led": 0 = Red; 1 = Green

NOTE:
* "User Level" indicates the user level permissions required to modify the parameter.

10.4 Param_F Parameters Codes (Float)

Table 303.

Code	Description	RW	User Level (*)	Unit Code	Min.	Max.
0	Adjust Open Limit	W	User	%	-5.0	5.0
1	Adjust Close Limit	W	User	%	-5.0	5.0
2	Logic Card Hardware Revision	R	-	-	0.0	9.9
3	Motor Rating	RW	Service	KW	0.1	999.9
4	Motor Current – In	RW	Service	A	0.1	99.9
5	Motor Current – Is	RW	Service	A	0.1	999.9
6	Motor Current – Icc	RW	Service	A	0.1	999.9
7	Reversal Delay	RW	Service	s	0.5	5.0
8	Speed by-pass	RW	Service	s	0.0	25.5

NOTE:
* "User Level" indicates the user level permissions required to modify the parameter.

10.5 Param_D Parameters Codes (Date)

Table 304.

Code	Description	RW	User Level (*)	Min.	Max.
0	Current Date and Time	RW	User	01/01/2000 00:00	31/12/2135 23:59
1	Next PST Date	R	-	01/01/2000 00:00	31/12/2135 23:59
2	Test Date	RW	Service	01/01/2000 00:00	31/12/2135 23:59
3	Torque Opening Profile Date	R	-	01/01/2000 00:00	31/12/2135 23:59
4	Torque Reference Opening Profile Date	R	-	01/01/2000 00:00	31/12/2135 23:59
5	Torque Closing Profile Date	R	-	01/01/2000 00:00	31/12/2135 23:59
6	Torque Reference Closing Profile Date	R	-	01/01/2000 00:00	31/12/2135 23:59
7	Last Maintenance Date	RW	User	01/01/2000 00:00	31/12/2135 23:59
8	Next Maintenance Date	RW	User	01/01/2000 00:00	31/12/2135 23:59
9	Start Up Date	RW	User	01/01/2000 00:00	31/12/2135 23:59
10	Recent Log Date	R	-	01/01/2000 00:00	31/12/2135 23:59
11	Log Start Date and Time (**)	RW	User	01/01/2000 00:00	31/12/2135 23:59

NOTES:
* "User Level" indicates the user level permissions required to modify the parameter.
** It can be modified only if Logger Mode is set to Off.
If the date entered by the user is older the current date of the actuator, the value is automatically set to the current date of the actuator.

10.6 Param_U32 Parameters Codes (Unsigned Int-32)

Table 305.

Code	Description	RW	User Level (*)	Unit Code	Min.	Max.
0	FST Open Curve Stored	R	-	-	0	100
1	FST Close Curve Stored	R	-	-	0	100
2	PST Curve Stored	R	-	-	0	16
3	Encoder Limit 0% Value	R	-	-	0	2196479
4	Encoder Limit 100% Value	R	-	-	0	2196479
5	Torque by-pass	RW	User	%	0	20
6	Jammed Valve	RW	User	s	0	100
7	AS1 Relay Position	RW	User	%	0	100
8	AS2 Relay Position	RW	User	%	0	100
9	AS3 Relay Position	RW	User	%	0	100
10	AS4 Relay Position	RW	User	%	0	100
11	AS5 Relay Position	RW	User	%	0	100
12	AS6 Relay Position	RW	User	%	0	100
13	AS7 Relay Position	RW	User	%	0	100
14	AS8 Relay Position	RW	User	%	0	100
15	Duty min of EFS Control	RW	User	%	10	100
16	EFS Reset Delay	RW	User	s	1	255
17	PST Period	RW	User	Days	1	1000
18	PST Hour	RW	User	Hour	0	23
19	PST Travel	RW	User	%	5	40
20	PST Pause	RW	User	s	2	255
21	Max OV-TR	RW	User	%	1	100
22	DIN1 Position	RW	User	%	0	100
23	DIN2 Position	RW	User	%	0	100
24	DIN3 Position	RW	User	%	0	100
25	DIN4 Position	RW	User	%	0	100
26	DIN5 Position	RW	User	%	0	100
27	DIN6 Position	RW	User	%	0	100
28	Positioner Close Position	RW	User	%	0	75
29	Positioner Open Position	RW	User	%	25	100
30	Standard Opening Torque	RW	User	%	40	100
31	Standard Closing Torque	RW	User	%	40	100
32	Torque Setup 3p Opening – Break Out	RW	User	%	40	100
33	Torque Setup 3p Opening – Peak Run	RW	User	%	40	100
34	Torque Setup 3p Opening – Ending	RW	User	%	40	100
35	Torque Setup 3p Opening – Break Out Zone	RW	User	%	0	100
36	Torque Setup 3p Opening – Ending Zone	RW	User	%	0	100
37	Torque Setup 3p Closing – Break Out	RW	User	%	40	100
38	Torque Setup 3p Closing – Peak Run	RW	User	%	40	100
39	Torque Setup 3p Closing – Ending	RW	User	%	40	100
40	Torque Setup 3p Closing – Break Out Zone	RW	User	%	0	100

NOTE:
* "User Level" indicates the user level permissions required to modify the parameter.

Code	Description	RW	User Level (*)	Unit Code	Min.	Max.
41	Torque Setup 3p Closing – Ending Zone	RW	User	%	0	100
42	Torque Sensor F01 – Potentiometer Opening 50%	RW	Service	-	0	1023
43	Torque Sensor F01 – Potentiometer Opening 100%	RW	Service	-	0	1023
44	Torque Sensor F01 – Potentiometer Closing 50%	RW	Service	-	0	1023
45	Torque Sensor F01 – Potentiometer Closing 100%	RW	Service	-	0	1023
46	Torque Sensor F01 – Factory Torque Limit Opening	RW	Service	-	0	255
47	Torque Sensor F01 – Factory Torque Limit Closing	RW	Service	-	0	255
48	Motor Reduction Gear	RW	Service	-	1	1000
49	Torque Sensor I24 – Speed Opening 0% (+5%)	RW	Service	RPM	0	5000
50	Torque Sensor I24 – Speed Opening 40% (+5%)	RW	Service	RPM	0	5000
51	Torque Sensor I24 – Speed Opening 70% (+5%)	RW	Service	RPM	0	5000
52	Torque Sensor I24 – Speed Opening 100% (+5%)	RW	Service	RPM	0	5000
53	Torque Sensor I24 – Speed Opening 40% (-5%)	RW	Service	RPM	0	5000
54	Torque Sensor I24 – Speed Opening 70% (-5%)	RW	Service	RPM	0	5000
55	Torque Sensor I24 – Speed Opening 100% (-5%)	RW	Service	RPM	0	5000
56	Torque Sensor I24 – Speed Closing 0% (+5%)	RW	Service	RPM	0	5000
57	Torque Sensor I24 – Speed Closing 40% (+5%)	RW	Service	RPM	0	5000
58	Torque Sensor I24 – Speed Closing 70% (+5%)	RW	Service	RPM	0	5000
59	Torque Sensor I24 – Speed Closing 100% (+5%)	RW	Service	RPM	0	5000
60	Torque Sensor I24 – Speed Closing 40% (-5%)	RW	Service	RPM	0	5000
61	Torque Sensor I24 – Speed Closing 70% (-5%)	RW	Service	RPM	0	5000
62	Torque Sensor I24 – Speed Closing 100% (-5%)	RW	Service	RPM	0	5000
63	Torque Sensor I24 – Voltage	RW	Service	V	10	1000
64	Torque Sensor I24 – K Temp	RW	Service	%	0	20
65	Torque Sensor I24 – Factory Torque Limit Opening	RW	Service	-	0	255
66	Torque Sensor I24 – Factory Torque Limit Closing	RW	Service	-	0	255
67	Torque Opening Profile – Break Out	R	-	%	0	255
68	Torque Opening Profile – Peak Run	R	-	%	0	255
69	Torque Opening Profile – Ending	R	-	%	0	255
70	Torque Reference Opening Profile – Break Out	R	-	%	0	255
71	Torque Reference Opening Profile – Peak Run	R	-	%	0	255
72	Torque Reference Opening Profile – Ending	R	-	%	0	255
73	Torque Closing Profile – Break Out	R	-	%	0	255
74	Torque Closing Profile – Peak Run	R	-	%	0	255
75	Torque Closing Profile – Ending	R	-	%	0	255
76	Torque Reference Closing Profile – Break Out	R	-	%	0	255
77	Torque Reference Closing Profile – Peak Run	R	-	%	0	255
78	Torque Reference Closing Profile – Ending	R	-	%	0	255
79	General Log – Contactor Cycles	R	-	-	0	-
80	General Log – Motor Run Time	R	-	Hour	0	-
81	General Log – Time without power	R	-	Hour	0	-
82	General Log – Utilization Rate	R	-	%	0	65535
83	General Log – Number of Motor Thermostat Alarms	R	-	-	0	65535
84	General Log – Number of Torque Alarms	R	-	-	0	65535
85	Recent Log – Contactor Cycles	R	-	-	0	-

NOTE:
* "User Level" indicates the user level permissions required to modify the parameter.

Code	Description	RW	User Level (*)	Unit Code	Min.	Max.
86	General Log – Motor Run Time	R	-	Hour	0	-
87	General Log – Time without power	R	-	Hour	0	-
88	General Log – Utilization Rate	R	-	%	0	65535
89	General Log – Number of Motor Thermostat Alarms	R	-	-	0	65535
90	General Log – Number of Torque Alarms	R	-	-	0	65535
91	Torque Stop Zone	RW	Service	%	0	20
92	Current Sensor 2 A	RW	Service	-	0	1023
93	Current Sensor 3,5 A	RW	Service	-	0	1023
94	Current Sensor 7 A	RW	Service	-	0	1023
95	Current Sensor 15 A	RW	Service	-	0	1023
96	Current Sensor 30 A	RW	Service	-	0	1023
97	4 to 20 mA Input Configuration – 4 mA	RW	Service	-	0	1900
98	4 to 20 mA Input Configuration – 20 mA	RW	Service	-	2100	4095
99	4 to 20 mA Output Configuration – 4 mA	RW	Service	-	0	1900
100	4 to 20 mA Output Configuration – 20 mA	RW	Service	-	2100	4095
101	Speed Band	RW	Service	-	0	255
102	Voltage Span	RW	Service	V	10	1000
103	Voltage Span (bit)	R	-	-	0	4095
104	Sample Interval	RW	User	Seconds	1	3600
105	Byte Free 0	RW	User	-	0	255
106	Byte Free 1	RW	User	-	0	255
107	Byte Free 2	RW	User	-	0	255
108	Byte Free 3	RW	User	-	0	255
109	Byte Free 4	RW	Service	-	0	255
110	Byte Free 5	RW	Service	-	0	255
111	Byte Free 6	RW	Service	-	0	255
112	Byte Free 7	RW	Service	-	0	255
113	Bit Free 0	RW	User	-	0	1
114	Bit Free 1	RW	User	-	0	1
115	Bit Free 2	RW	User	-	0	1
116	Bit Free 3	RW	User	-	0	1
117	Bit Free 4	RW	Service	-	0	1
118	Bit Free 5	RW	Service	-	0	1
119	Bit Free 6	RW	Service	-	0	1
120	Bit Free 7	RW	Service	-	0	1
121	Word Free 0	RW	User	-	0	65535
122	Word Free 1	RW	User	-	0	65535
123	Word Free 2	RW	User	-	0	65535
124	Word Free 3	RW	User	-	0	65535
125	Word Free 4	RW	Service	-	0	65535
126	Word Free 5	RW	Service	-	0	65535
127	Word Free 6	RW	Service	-	0	65535
128	Word Free 7	RW	Service	-	0	65535
129	Set Close Reference Torque Curve	RW	User	-	0	100
130	Set Open Reference Torque Curve	RW	User	-	0	100
131	Set PST Reference Curve	RW	User	-	0	16
132	Set EFS Reference Curve	RW	User	-	0	16
133	EFS Curves Stored	R	-	-	0	16
134	Max T-PST	RW	User	%	1	1000
135	Max T RET	RW	User	%	1	1000

NOTE:
* "User Level" indicates the user level permissions required to modify the parameter.

10.7 Param_S32 Parameters Codes (Signed Int-32)

Table 306.

Code	Description	RW	User Level (*)	Unit Code	Min.	Max.
0	General Log – Base Card Min. Temperature	R	-	°C	-127	128
1	General Log – Base Card Max. Temperature	R	-	°C	-127	128
2	General Log – Terminal Board Min. Temperature	R	-	°C	-127	128
3	General Log – Terminal Board Max. Temperature	R	-	°C	-127	128
4	General Log – Motor Max. Temperature	R	-	°C	-127	128
5	Recent Log – Base Card Min. Temperature	R	-	°C	-127	128
6	Recent Log – Base Card Max. Temperature	R	-	°C	-127	128
7	Recent Log – Terminal Board Min. Temperature	R	-	°C	-127	128
8	Recent Log – Terminal Board Max. Temperature	R	-	°C	-127	128
9	Recent Log – Motor Max. Temperature	R	-	°C	-127	128
10	Heater Base Reference	RW	Service	°C	-50	50
11	Heater Display Reference	RW	Service	°C	-50	50
12	Heater Terminal Board Reference	RW	Service	°C	-50	50

NOTE:
* "User Level" indicates the user level permissions required to modify the parameter.

10.8 Param_Str8 Parameters Codes (String8)

Table 307.

Code	Description	RW	User Level (*)
0	Password (**)	RW	Observer
1	Actuator Speed Value	RW	Service
2	Torque/Thrust Value	RW	Service

NOTES:
* "User Level" indicates the user level permissions required to modify the parameter.
** Always read as 0x3030303030303030 ("00000000" in ASCII).

10.9 Param_Str4 Parameters Codes (String4)

Table 308.

Code	Description	RW	User Level (*)
0	Logic Card Firmware Revision K22	R	-
1	Logic Card Firmware Revision PIC	R	-
2	Encoder Hardware Revision	R	-
3	Encoder Firmware Revision	R	-
4	Local Display Password	RW	User

NOTE:
* "User Level" indicates the user level permissions required to modify the parameter.

10.10 FST Torque Curve ID

Table 309.

Value	Description
0	Reference Torque Curve
1	Most recent FST (Not Reference) recorded by the actuator
2	2nd recent FST (Not Reference) recorded by the actuator
..	and so on
100	100th recent FST (Not Reference) recorded by the actuator

10.11 FST Torque Type

Table 310.

Value	Description
0	FST Open Torque Curve
1	FST Close Torque Curve

10.12 PST Curve ID

Table 311.

Value	Description
0	PST Reference Curve
1	Most recent PST (Not Reference) recorded by the actuator
2	2nd recent PST (Not Reference) recorded by the actuator
..	and so on
16	16th recent PST (Not Reference) recorded by the actuator

10.13 PST Result

Table 312.

Value	Description
0	Reserved – Not Used
1	Passed
2	Failed
3	Reset
4	Failed T-PST
5	Failed T-RET
6	Failed OV-TR

10.14 PST Direction/EFS Direction

Table 313.

Value	Description
0	Close (Start from 100%)
1	Open (Start from 0%)

10.15 PST Mode

Table 314.

Value	Description
0	Off
1	Auto
2	Manual
3	Manual + Auto

10.16 PST Status

Table 315.

Bits	Description
b5 to b31	Not Used
b4	1 = PST Reset
b3	1 = PST Failed – OV-TR
b2	1 = PST Failed – T-RET
b1	1 = PST Failed – T-PST
b0	1 = PST Passed

10.17 PST Reset Conditions

Table 316.

Code	Description
b18 to b31	Not Used
b17	1 = EFS Mid-Travel
b16	1 = Hardware 1 Alarm
b15	1 = K2 Contactor Alarm
b14	1 = K1 Contactor Alarm
b13	1 = Speed Sensor Alarm
b12	1 = Hi Torque Alarm
b11	1 = Jammed Valve Alarm
b10	1 = Hi Temperature
b9	1 = Lost Phase Alarm
b8	1 = Main Supply Alarm
b7	1 = Thermostat Alarm
b6	1 = Position Sensor
b5	1 = Configuration Alarm
b4	1 = Fail-Safe
b3	1 = ESD
b2	1 = Remote Stop
b1	1 = Local Stop
b0	1 = Selector in Off

10.18 EFS Curve ID

Table 317.

Value	Description
0	EFS Reference Curve
1	Most recent EFS (Not Reference) recorded by the actuator
2	2nd recent EFS (Not Reference) recorded by the actuator
..	and so on
16	16th recent EFS (Not Reference) recorded by the actuator

10.19 Memory Mode

Table 318.

Value	Description
0	Continuous
1	Stop when full

10.20 Event Number

Table 319.

Value	Description
1	Most recent event recorded by the actuator
2	2nd recent event recorded by the actuator
..	and so on
128	128th recent EFS (Not Reference) recorded by the actuator

10.21 Event Code

Table 320.

Code	Description
0	Off
1	Open
2	Close

10.22 Recorder Number

Table 321.

Value	Description
1	Most recent Recorder recorded by the actuator
2	2nd recent Recorder recorded by the actuator
..	and so on
256	256th recent Recorder recorded by the actuator

10.23 T-Recorder Number

Table 322.

Value	Description
1	Most recent T-Recorder recorded by the actuator
2	2nd recent T-Recorder recorded by the actuator
..	and so on
256	256th recent T-Recent recorded by the actuator

10.24 Card ID

Table 323.

Value	Description
0	Base Card Report
1	4 to 20 mA Card Report
2	Terminal Board Report
3	EFS Card Report
4	Bus Interface 1 Card Report

10.25 Event Source

Table 324.

Code	Description
0	None
1	Bus Command
2	Remote Command
3	Local Command
4	ESD
5	Position Calibration
6	Torque Calibration
7	Fail-Safe
8	Position Request from bus
9	Position Request from 4 to 20 mA Input
10	Serial/Bluetooth Command
11	Start Positioner Mode
12	Stop Positioner Mode
13	Movement without electrical command
14	K1 Contactor fail
15	K2 Contactor fail
16	Configuration On
17	PST
18	EFS Fail-Safe
19	Reserved
20	Reserved
21	Power Up
22	Selector Moved from REMOTE to LOCAL/OFF
23	Stop in Remote

10.26 Alarm Number

Table 325.

Value	Description
1	Most recent Alarm recorded by the actuator
2	2nd recent Alarm recorded by the actuator
..	and so on
64	64th recent Alarm recorded by the actuator

10.27 Warning Number

Table 326.

Value	Description
1	Most recent Warning recorded by the actuator
2	2nd recent Warning recorded by the actuator
..	and so on
64	64th recent Warning recorded by the actuator

10.28 Alarm Code

Table 327.

Code	Description
0	None
1	Configuration
2	Thermostat
3	Over Temperature
4	Low Battery
5	Hi-Hi torque in close
6	Hi-Hi torque in open
7	Jammed Valve in close
8	Jammed Valve in open
9	Position Signal
10	Speed Sensor
11	Main Supply
12	Lost Phase
13	K1 Contactor
14	K2 Contactor
15	Mid-Travel in close
16	Mid-Travel in open
17	Hardware 1
18	Request Signal
19	Direction Test
20	Hardware 2
21	Hardware 3
22	Hardware 4
23	Hardware 5
24	Hardware 6
25	Hardware 7
26	Hardware 8
27	Hardware 9
28	Hardware 10
29	EFS Mid-Travel
30	Hardware 11
31	Hardware 12
32	Hardware 13

10.29 Warning Code

Table 328.

Code	Description
0	None
1	Hi Torque in Opening
2	Hi Torque in Closing
3	Over Temperature
4	Main Supply
5	Max. Contactor Cycles
6	Maintenance Required
7	Motor Current
8	Wrong Stroke Limits
9	Bus
10	PST
11	PST Failed – T1 (T-PST)
12	PST Failed – T2 (T-RET)
13	PST Failed – Over Travel

10.30 Connection Number

Table 329.

Value	Description
1	Most recent Connection recorded by the actuator
2	2nd recent Connection recorded by the actuator
..	and so on
8	8th recent Connection recorded by the actuator

10.31 Password Level

Table 330.

Value	Description
0	Observer
1	User
2	Service
3	Manufacturer

10.32 Connection Type

Table 331.

Code	Description
0	Bluetooth
1	RS232

Section 11: Configuration via Local Interface

The HRT2000v4 allows connecting the ICON3000 actuators family to a HART® fieldbus. Described below are the facilities available by the **view and setup menu** of the actuator in which the HRT2000v4 is installed.

11.1 BUS Control

- DIN 1 to DIN 6: By this routine, it is possible to choose the condition associated to command 128, Device Variable 1 (actuator status) bits 7 to 12. Here below is the list of the available conditions:

Table 332.

STATUS/ALARM		
• open limit • closed limit • position <= xx % • position >= yy % • closing • opening • motor running • blinker • mid-travel position • local selected	• remote selected • local stop active • ESD signal on • manual operation • motor over-temperature • over-torque • over-torque in OP • over-torque in CL • valve jammed • warnings	• valve jammed in OP • valve jammed in CL • low battery (if present) • mid-travel alarm in CL/OP • EFS in manual • PST failed • MAINS only AS8 • EFS mid-travel

The following settings are supplied as standard:

- DIN1: mid-travel position
- DIN2: local stop active
- DIN3: motor over-temperature (motor thermostat alarm)
- DIN4: over-torque (Hi-Hi torque alarm)
- DIN5: valve jammed alarm
- DIN6: mid-travel alarm in OP/CL

- **Address:** Use this function to enter the polling address node. Each device must have its address. Each address must be associated to one only device. The available address range is from 0 to 63. Set 0 in point to point mode. Set address from 0 to 15 in multidrop mode.
- **Mode:** The available options are loop enable, loop disable and multidrop. Mode (loop enable and loop disable only) can be set also by the Universal Command 6.
  HRT2000v4 Rev. 1: Select loop enable in point to point mode and split range and if the actuator is controlled by the analog 4 to 20 mA (PV). Use loop disable in point to point and split range mode and if the actuator is controlled by the digital HART signal, see Device Variable 3.
  HRT2000v4 Rev. 2: Select loop enable if the actuator is controlled by the analog 4 to 20 mA (PV). Select loop disable or multidrop if the actuator is controlled by the digital HART signal, see Device Variable 3.

- **Device Number ID:** Use this function to set the HART device number ID. The number is normally set in factory and should not be changed. The Device Number ID must be unique for each field device.
- **HART Relay (only on HRT2000v4 Rev. 2):** The available options are open and close . Use close in point to point and split range mode.

  In multidrop mode:

  — Use open if the actuator is not the last actuator of the 4 to 20 mA current loop.

  — Use open if the actuator is the last actuator of the 4 to 20 mA current loop and it is closed by an external 250 Ω resistance placed between the signals HART+ and HART-.

  — Use close if the actuator is the last actuator of the 4 to 20 mA current loop and the external 250 Ω resistance is not placed between the signals HART+ and HART- .

Configuration procedure:

- Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions “entering the set-up mode”. When the message of display is “SET-UP MODE OK?” press YES. Press YES to select actuator set-up menu, press NO to scroll the list of available routines and then press YES to select the routine BUS.
- Press NO if the conditions DIN1 is correct. Press YES to change. Press NO to change condition to switch, press TES to select.
- Repeat the previous procedure for DIN 2 up to DIN 6.
- Press YES if the configured value of the polling node address (ADDRESS) is correct (from 1 to 63), or press NO to change, then press YES.
- Press YES if the configured value of the MODE (Loop current enable, loop current disable, multidrop) is correct, or press NO to change, then press YES.
- Press YES to confirm the configured Device number.

View procedure:

- Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions “entering the view mode”. When the message of display is “VIEW MODE OK?” press YES. Press YES to select actuator set-up menu, press NO to scroll the list of available routines and then press YES to select BUS.
- Press YES to scroll the list of BUS parameters.

11.2 Positioner Function

The function is available only on the modulating actuators. The value 0.0 of position request, received from bus, corresponds to close request and the value 100.0 corresponds to open request. The ICON3000 compares the present position % of the actuator with the position request % received from the bus (analog 4 to 20 mA HART® current loop or digital HART signal), and if the difference is greater than the dead band, the actuator is driven to reach the new requested position.

The following options can be configured via either bus or local operator interface:

- **Dead band:** Configurable from 0.1% to 25.5% of the maximum position error (difference among position request % and present position %). The configured value should be great enough to avoid “hunting” effect of the actuator.
- **Motion inhibit time:** It allows adjusting the length of the delay time between two cycles of the motor. It can be configured from 1 to 255 s and allows to set the maximum number of start/hour of electrical motor.

Configuration procedure:

- Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions “entering the set-up mode”. When the message of display is “SET-UP MODE OK?” press YES. Press YES to select actuator set-up menu, press NO to scroll the list of available routines and then press YES to select POSITIONER.
- Press YES if the configured value of the Dead Band is correct (from 0.1 to 25.5% of position error), or press NO to change, then press YES.
- Press YES if the configured value of the Motion Inhibit Time is correct (from 1 to 255 s), or press NO to change, then press YES.

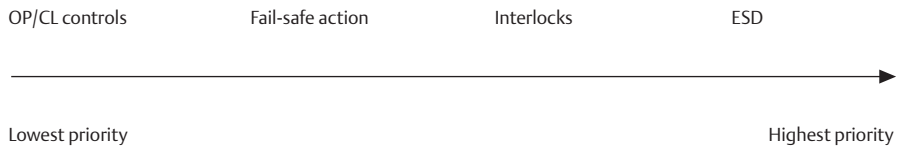
View procedure:

- Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions “entering the view mode”. When the message of display is “VIEW MODE OK?” press YES. Press YES to select actuator set-up menu, press NO to scroll the list of available routines and then press YES to select the routine (POSITIONER).
- Press YES to scroll the list of parameters.

11.3 Fail-Safe Function

This function is available only if enabled in the restricted menu of actuator. It allows configuring the action of the actuator in case of loss of the 4 to 20 mA signal HART® current loop. The action takes place only if the local selector is in REMOTE. When the 4 to 20 mA HART current loop restores, also the actuator restores at its normal functioning. The fail-safe function can be configured via either bus or local operator interface.

The hardwired controls ESD and INTERLOCKS override the Fail-Safe action according to the following diagram.



The following options can be configured:

- Fail-safe action: open, close, stay-put, go to position %, no action (OFF)
- Delay time before than the fail-safe action takes place (delay = 10 s + configured value)

Configuration procedure:

- Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions “entering the set-up mode”. When the message of display is “SET-UP MODE OK?” press YES. Press YES to select actuator set-up menu, press NO to scroll the list of available routines and then press YES to select FAIL-SAFE.
- Press YES if the configured ACTION is correct (open, close, stay-put, go to position xx%, off), or press NO to change, then press YES.
- Press YES if the configured value of the DELAY is correct (from 0 to 255 s), or press NO to change, then press YES.

View procedure:

- Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions “entering the view mode”. When the message of display is “VIEW MODE OK?” press YES. Press YES to select actuator set-up menu, press NO to scroll the list of available routines and then press YES to select the routine (FAIL-SAFE).
- Press YES to scroll the list of parameters.

HART® is a mark owned by FieldComm Group.

11.4 Viewing Transmission Info

The following procedure allows seeing the most significant info relevant to the bus data transmission:

Move the local selector to OFF or REMOTE and then press YES until the display shows NODE REPORT. Press NO to exit or press YES to scroll the lost of transmission info.

64 Bytes: Information about the HRT2000v4 Interface (Card Report)

Config. change: Configuration Change counter

STX: Number of valid messages received from the host (max. before counter reset 65535)

ACK: Number of valid messages transmitted to the host (max. before counter reset 65535)

BACK: Number of Burst messages transmitted (max. before counter reset 65535)

MB REC-COUNTER: Current number of communication error with the Logic Card

MB GEN-COUNTER: Number of communication error with the Logic Card since last power up

11.5 Actuator Terminal Board

Figure 12

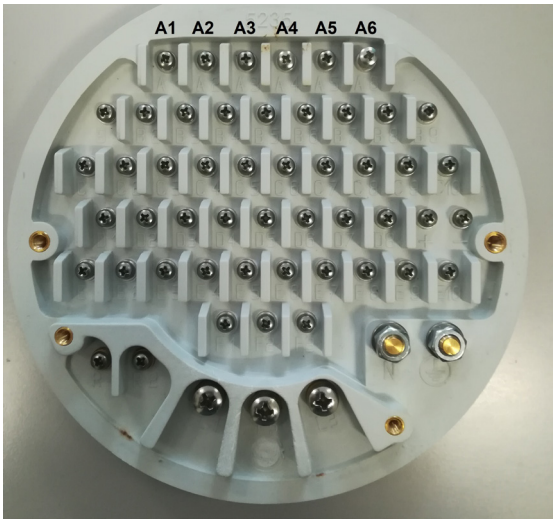


Figure 13 Terminal Board Connections up to ICON3000

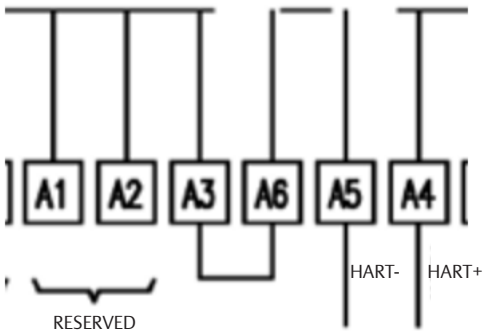


Table 333. Legend

Terminal Board	Signals
A1	Not Used
A2	Not Used
A3	Connected to A6
A4	HART®+
A5	HART-
A6	Connected to A3

HART® is a mark owned by FieldComm Group.

Figure 14 Terminal Board Connections for ICON3000v2

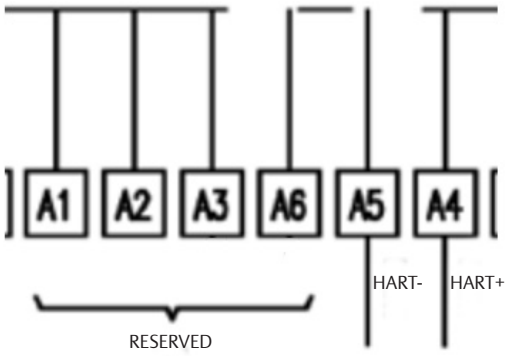


Table 334. Legend

Terminal Board	Signal	J4	J6
A1	Not Used	N/A	N/A
A2	Not Used	N/A	N/A
A3	Not Used	N/A	N/A
A4	HART®+	1	+
A5	HART-	2	-
A6	Not Used	N/A	N/A

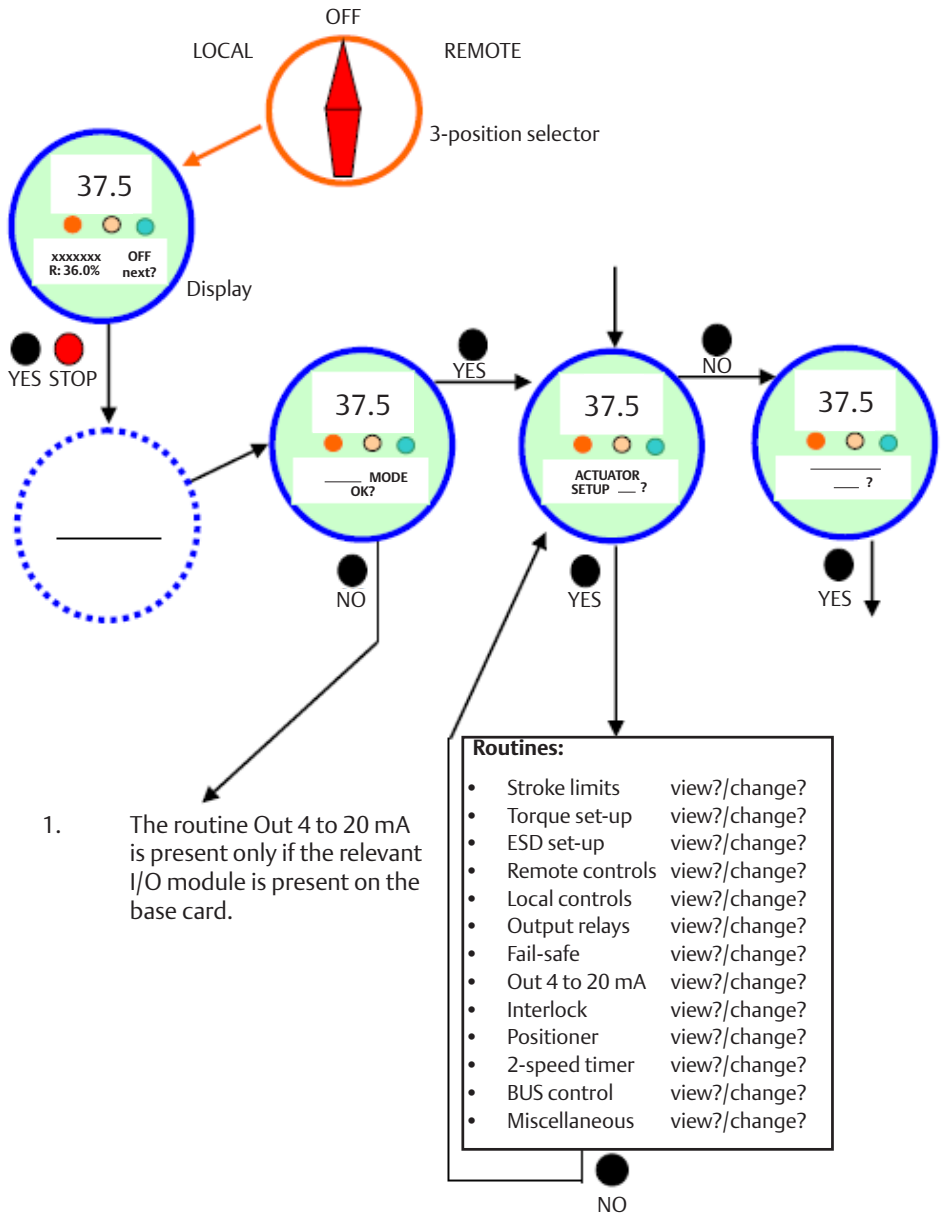
HART® is a mark owned by FieldComm Group.

11.6 Bus Signal Failure Indication

In case of loss of 4 to 20 mA signal (lower than 2 mA) and Loop Current Mode Enabled, a warning is generated. It is signalled by flashing of the relevant ALARM/WARNING LED and by indication of the local 2 lines/16 characters display.

Figure 15 shows the list of routines available in the view or setup menu.

Figure 15



1. The routine Out 4 to 20 mA is present only if the relevant I/O module is present on the base card.

Section 12: Certificate of Registration

12.1 HRT2000v4 Rev.1 Certification

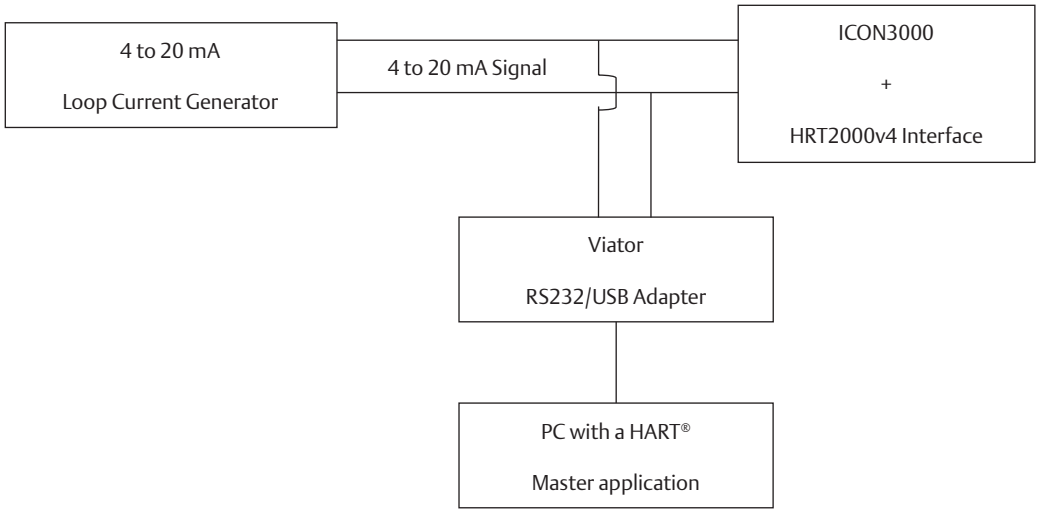
HRT2000v4 Rev. 1 is a HART® Registered device compliant with HART protocol revision 7.2. This version of the device is not FDI registered. DD Files and other information are available on FieldComm Group official website: https://www.fieldcommgroup.org.

12.2 HRT2000v4 Rev. 2 Certification

HRT2000v4 Rev. 2 is a HART Registered device compliant with HART protocol revision 7.6. This version of the device is also FDI Registered. DD Files and other information are available on FieldComm Group official website: https://www.fieldcommgroup.org.

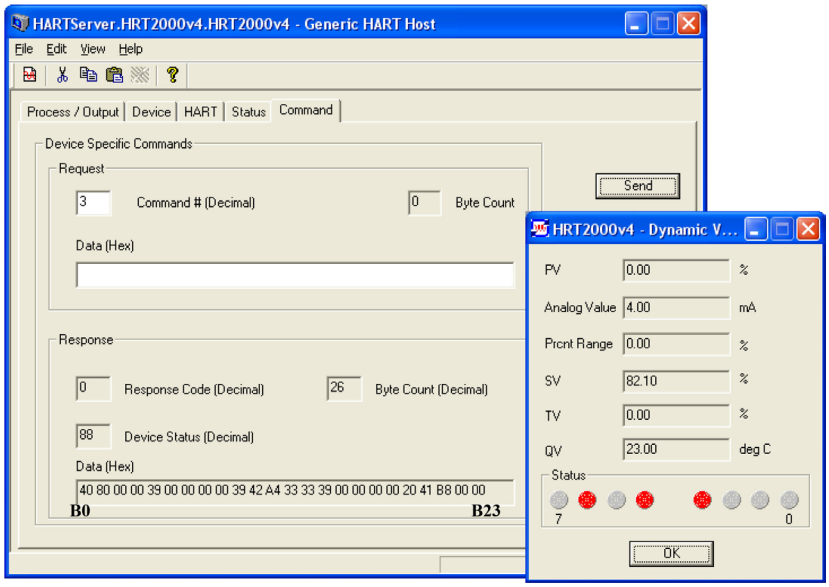
Appendix A: HART Command 3 Communication Example

Figure A-1 Block Diagram



See Section 11.5 for Terminal Board Connections.

Figure A-2 Example of HART Command 3 Communication with Dynamic Variables Values (Decimal)



The window on the right shows the decimal value of Dynamic Variables and the Field Device Status; this window can be selected from “View > Dynamic Variables”.

HART® is a mark owned by FieldComm Group.

The command sent by the master is Universal Command 3 – Read Dynamic Variables.
The response from the slave is a frame with the following values:

Table A-1.

Data Bytes	Description	Values (Hex)	Values (Decimal)*
0 to 3	Loop Current (mA)	40 80 00 00	4.00
4	PV Units Code	39	57 = Percent
5 to 8	PV Value	00 00 00 00	0.0
9	SV Units Code	39	57 = Percent
10 to 13	SV Value	42 A4 33 33	82.1
14	TV Units Code	39	57 = Percent
15 to 18	TV Value	00 00 00 00	0.0
19	QV Units Code	20	32 = Degrees Celsius
20 to 23	QV Value	41 B8 00 00	23.0

NOTE:
*Converted using IEEE-754 (IEC 559)

Appendix B: Writing Variables and Parameters Data

On HRT2000v4 Rev. 2 has been introduced a new security level: to modify the writable variables and parameters, it is necessary to correctly set the user and the password in the corresponding User (Param_E 0) and password (Param_Str8 0).

4 User levels are available:

- **OBSERVER (lower level):** able to read only all the data
- **USER:** able to read all the data and to modify the variables and the parameter that require OBSERVER or USER permissions
- **SERVICE:** able to read all the data and to modify most the variables and the parameters that require OBSERVER, USER or SERVICE permissions
- **MANUFACTURER (higher level):** able to read all the data and to modify all the variables and the parameters.

The “User Level Logged” (Device Variable 45) on the actuator indicates the permissions currently granted: its value is the result of the combination of the “User” (Param_E 0) and the “Password” (Param_Str8 0).

At the power up, the HRT2000v4 Rev. 2 login automatically as “USER” user level.

If the Master tries to modify a variable/parameter without having the minimum required permissions, the value is discarded.

The HART® Specific parameters listed below have no restrictions and they can be changed by any users:

- Polling Address (Universal Command 6)
- Loop Current Mode (Universal Command 6)
- Message (Universal Command 17)
- Tag (Universal Command 18)
- Descriptor (Universal Command 18)
- Date (Universal Command 18)
- Final Assembly Number (Universal Command 19)
- Long Tag (Universal Command 22)
- Dynamic Variables Assignments (Common Practice Command 51)
- Number of Response Preambles (Common Practice Command 59)
- Burst Mode Configuration (Common Practice Commands 103, 104, 105, 107, 108, 109)

How to login as OBSERVER
Set “User” parameter (Param_E 0) to 0x0000.
Set “Password” parameter (Param_Str8 0) to any value.

How to login as USER
Set “User” parameter (Param_E 0) to 0x0000.
Please, contact the manufacturer for “Password” values.

How to login as SERVICE or MANUFACTURER
These user levels are reserved for Service Technicians and manufacturer.

Appendix C: Configuration Requirements for PST Command

This addendum describes the configuration settings required to perform the PST command. PST command is performed by the actuator only if:

- EFS Input Mode (Param_E 36) = 0 → PST-EFS
- Interlock Mode (Param_E 69) = 1 → Advanced

If at least one of the above parameters is configured differently, the PST command is ignored and not executed.

See actuator Installation, Operation and Maintenance Manual for additional details about the PST command.

Biffi Italia s.r.l.
Strada Biffi 165
29017 Fiorenzuola d'Arda (PC)
Italy
T +39 0523 944 411

For complete list of sales and manufacturing sites, please visit
www.biffi.it or contact us at biffi_italia@biffi.it