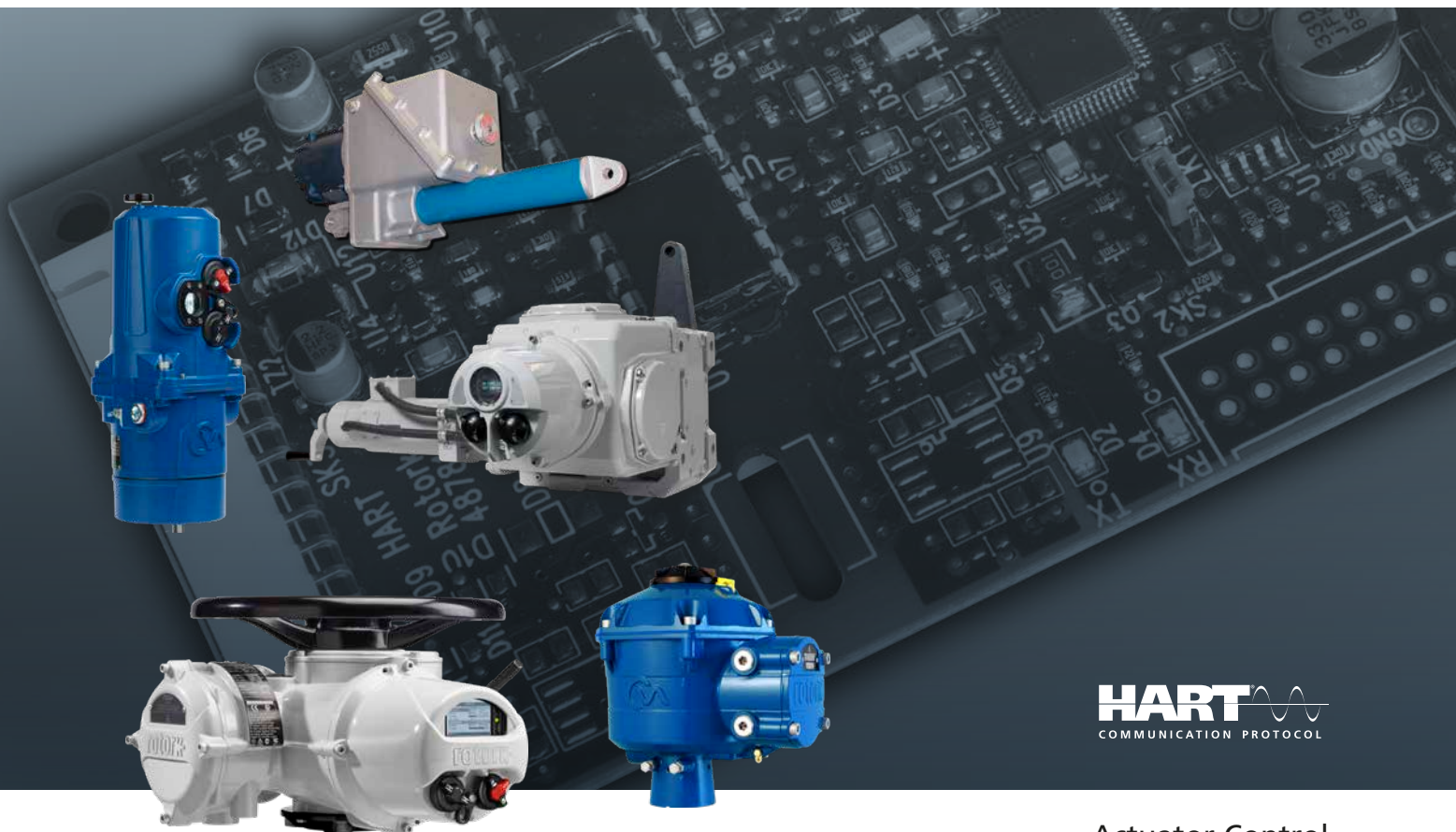


rotork[®]

Keeping the World Flowing
for Future Generations

HART



HART
COMMUNICATION PROTOCOL

Actuator Control

Reliability in critical flow control applications



› Reliable operation when it matters

Assured reliability for critical applications and environments. Whether used infrequently or continuously, Rotork products will operate reliably and efficiently.

› Quality-driven global manufacturing

We offer products that have been designed with over 60 years of industry and application knowledge.

Our research and development ensures cutting edge products are available for multiple applications across multiple industries.

› Customer focused service and worldwide support

Rotork solve customer challenges and develop new solutions that are tailored to the needs of our clients.

We offer dedicated, expert service and support from initial inquiry, to product installation, to long-term after sales care.

› Low cost of ownership

Long-term reliability prolongs service life.

Rotork helps to reduce long-term cost of ownership and provides greater efficiency to process and plant.

HART

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Comprehensive product range serving multiple industries

Rotork products offer improved efficiency, assured safety and environmental protection across sectors such as the Power, Oil & Gas, Water & Wastewater, HVAC, Marine, Mining, Pulp & Paper, Food & Beverage, Pharmaceutical and Chemical sectors.

Market leaders and technical innovators

We have been the recognised market leader in flow control for over 60 years.

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Global presence, local service

We are a global company with local support.

Manufacturing sites, service centres and sales offices throughout the world provide unrivalled customer services, fast delivery and ongoing, accessible support.

Environmental Social and Governance is at the heart of our business

We have a range of policies in place that support our performance across environmental, social and governance topics. The majority of our policies are publicly available.

Introduction

Rotork actuators fitted with HART® (Highway Addressable Remote Transducer) interface cards connect seamlessly with a standard HART communication network. They provide a wealth of control and feedback capabilities.

HART enabled actuators function as slaves to master controllers on the network. The HART protocol allows commands, position feedback and diagnostics to be sent digitally over a current loop. A maximum of 64 HART actuators, transmitters, or other field instruments, may be connected to one HART network. HART is an open standard supported by the Fieldcomm Group.

The ability to report extensive actuator feedback data as well as network system diagnostic information makes Rotork the first choice for use with HART communication systems.



HART® Actuator Control

HART Communications module:

- HART protocol Revision 6.0 or 7.1
- Compatible with LA-2400, LA-2500, SM-6000 S2, CVA (all 6.0), CK, CMA, SI3, SI4 and IQ3 (all 7.1) electric actuators
- Communication speed 1,200 bits/sec
- Single point-to-point or multi-drop topologies allowing analogue or digital positioning
- Device Descriptor file with 'methods' for simple setup
- Uses existing 4-20 mA wiring
- Monitors process data of valve
- Captures fault information supplied by actuator
- Monitors valve state



HART
COMMUNICATION PROTOCOL

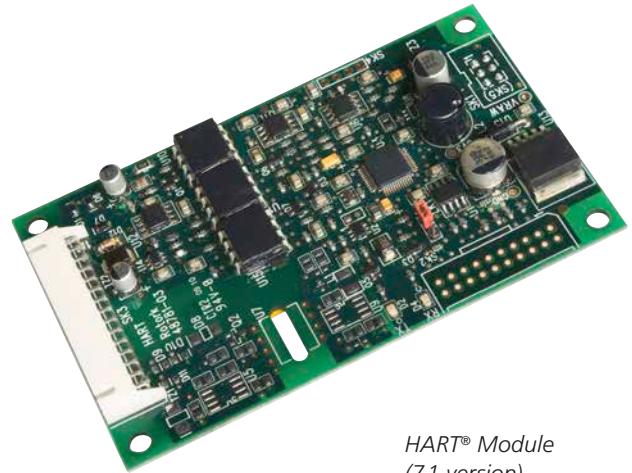
For more information on HART® communications, go to www.fieldcommgroup.org for answers to many common questions.

Images above, clockwise from top left: CVA, SI3, SI4, SM-6000-S2, CMA, IQ3 and LA-2400 actuators.

HART® Module

The HART communication module is located inside the actuator electrical housing and interfaces directly with the actuator electronics. Once fitted, the specific commands associated with moving the actuator together with feedback and diagnostics become available on the HART network.

Feedback information includes signals that are not normally available with conventional wiring.



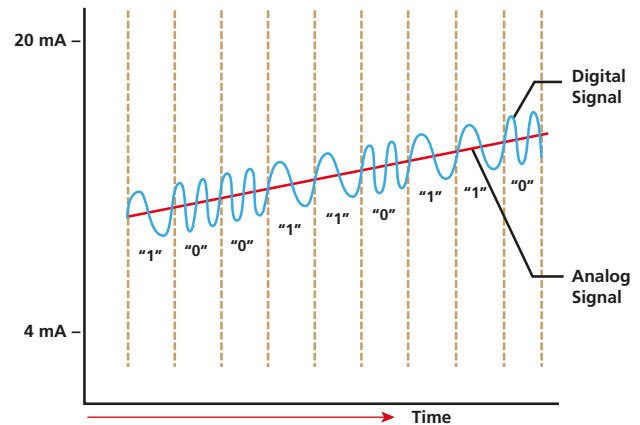
HART® Module
(7.1 version)

HART® Network

The HART network uses the existing wiring of the 4-20 mA command current loop. The HART digital data is coupled onto the analogue signal by the use of phase continuous, frequency shift keying (FSK) at a fixed baud rate of 1,200 bits per second. The command input circuitry filters this super-imposed signal so that analogue positioning (in a point-to-point network) is unaffected.

The protocol uses technology based on the Bell 202 standard, enabling cable runs of up to 1.5 km while maintaining high noise immunity. The maximum highway length is dependent on cable type, therefore low capacitance, shielded, twisted pair cable is strongly recommended.

Up to 64 field devices may be wired in parallel to one HART network. The combined impedance of the network must fall in the range of 230 to 600 Ohms. Each actuator is configured to have a unique address on the HART network. A total of two masters may be used, allowing, for example, a DCS (primary) and handheld (secondary) communicator tool to be used simultaneously.

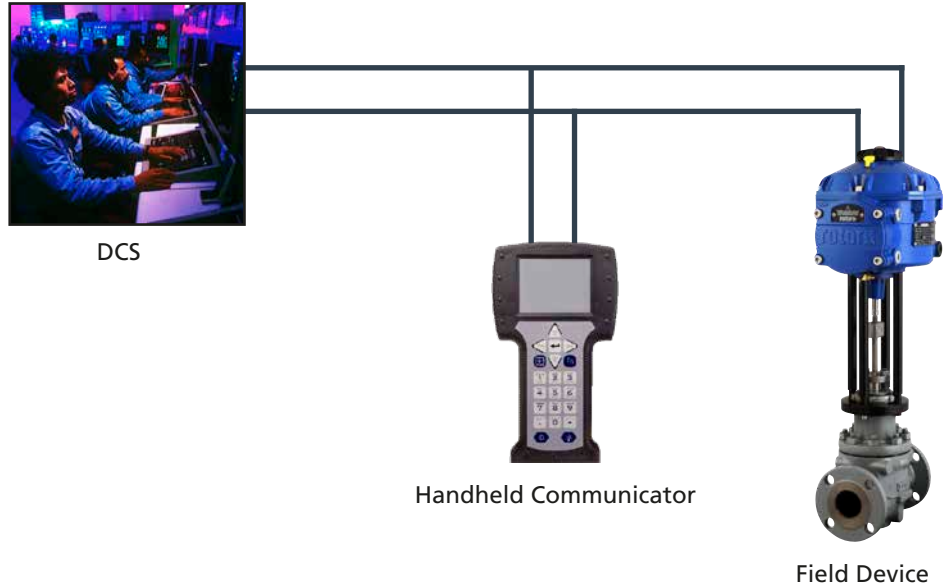


FSK Principle (source: HART®)



Point-To-Point Network

In this topology, the control system is directly connected to a single field device and is hence the most basic configuration. The actuator is typically controlled by the 4-20 mA loop with the HART communication providing simultaneous feedback to the DCS such as loop current validation, measured position and status.



Multi-Drop Network

This topology provides the ability for a DCS to communicate with up to 64 HART devices on a single network. In this configuration, the loop current is set at a fixed value, (typically at 4 mA) and the devices are controlled via specific HART commands. The Rotork HART enabled actuators may be positioned by using either discrete instructions or by writing a desired set point to the device.



HART® Commands

The data is accessed by the use of HART commands, of which there are three categories: Universal, Common Practice and Device Specific.

Universal Commands

Every HART field device must support all Universal commands. These particular commands encompass general information relating to the field device such as the manufacturer and device type. In addition, dynamic data is provided that includes both valve position and the measured loop current.

Cmd #	Description
0	Read Unique Identifier
1	Read Primary Variable
2	Read Current and Percent of Range
3	Read Dynamic Variables and Current
6	Write Polling Address
7	Read Loop Configuration
8	Read Dynamic Variable Class
9	Read Device Variables with Status
11	Read Unique Identifier
12	Read Message
13	Read Tag, Descriptor and Date
14	Read PV Transducer Information
15	Read Output Information
16	Read Final Assembly Number
17	Write Message
18	Write Tag, Descriptor and Date
19	Write Final Assembly Number
20	Read Long Tag
21	Read Unique Identifier associated with Long Tag
22	Write Long Tag
34	Write Primary Variable Damping Values (CMA does not support)
35	Write Primary Variable Range Values
38	Reset Configuration Changed Flag
40	Enter/Exit Fixed Current Mode (CMA does not support)
42	Perform Device Reset (HART option card only)
45	Trim Loop Current Zero
46	Trim Loop Current Gain
48	Read Additional Device Status
49	Write Primary Variable Transducer Serial Number
79	Write Device Variable
523	Read Condensed Status Mapping Array
524	Write Condensed Status Mapping Array
525	Reset Condensed Status Map
526	Write Status Simulation Mode
527	Simulate Status Bit

CVA Common Practice Commands

The common practice commands, specified by the Fieldcomm Group, cover functions that are applicable to a range of device families. Unlike the universal commands however, these are not mandatory.

Cmd #	Description
34	Write Primary Variable Damping Value
35	Write Primary Variable Range Values
36	Set Primary Variable Upper Range Value
37	Set Primary Variable Lower Range Value
40	Enter / Exit Fixed Current Mode
45	Trim Loop Current Zero
46	Trim Loop Current Gain
49	Write Primary Variable Transducer Serial Number
79	Write Device Variable

Device Specific Commands

A number of commands have also been specially created to provide an optimum means for both the control and configuration of the Rotork HART enabled actuators. Refer to HART technical manual (PUB092-003) for your product requirements.



HART® Control Features

The HART interface provides access to a range of data previously unavailable using conventional wiring, including actuator status and calibration information. In addition, full digital and analogue control of the actuator is available without the need to add more components.

For specific features refer to the HART technical manual for your product.

Actuator Data	LA-2400/2500	SM-6000 S2	CVA	IQ3, SI3, SI4	CMA
Configuration:					
Torque limit	X	✓	✓	✓	X
Deadband	✓	X	✓	✓	✓
Hysteresis	X	X	X	X	X
Proportional gain	✓	✓	X	X	✓
Integral gain	X	✓	X	X	✓
Current loop gain	X	✓	X	X	✓
Stall timeout	X	X	X	X	✓
Action on loss of comms	✓	✓	✓	✓	✓
Comms loss timer	✓	✓	✓	✓	✓
Comms lost position	✓	✓	✓	✓	✓
Write protect enable/disable	✓	✓	X	X	✓
Speed	✓	✓	✓	N/A	✓
Restore factory defaults	✓	X	X	X	X
Calibration of zero and span	✓	X	✓	✓	X
Calibration of input command	✓	✓	✓	✓	✓
Calibration of transmitter	✓	X	✓	X	X
Diagnostics:					
Perform self test	✓	X	✓	X	X
Actuator software revision	✓	✓	✓	✓	✓
NAMUR NE107	X	X	X	✓	✓

Notes:

NAMUR NE107

Includes diagnostic information according to NAMUR NE107. This enables the user to categorise alarms into four categories: Failure, Maintenance, Out of Spec and Function Check. There are 24 alarm bits available to be categorised including: Thermostat tripped, Actuator stalled and Valve Travel exceeded.

For each alarm bit the user can choose to set a category depending on how important that alarm is for the application.

Control

In standard configuration the Rotork actuators listed above are controlled using the analogue input.

These actuators can also be configured for operation in both directions via digital commands.

HART® Control Features

Feedback Data	LA-2400/2500	SM-6000 S2	CVA	IQ3, SI3, SI4	CMA
Digital Inputs:					
Actuator moving	✓	✓	X	✓	✓
Closed limit switch	✓	✓	✓	✓	✓
Open limit switch	✓	✓	✓	✓	✓
Actuator running closed	✓	✓	✓	✓	✓
Actuator running open	✓	✓	✓	✓	✓
Remote control selected	✓	✓	✓ RUN	✓	✓
Local control selected	✓	✓	✓ TEST	✓	✓
Monitor relay	✓	✓	X *1	✓	✓
Valve obstructed	✓	✓	✓	✓	✓
Valve jammed	✓	✓	X	✓	X
Controls contention	✓	✓	X	X	X
General Alarm	✓	✓	X *2	X	✓
Loss of feedback	✓	✓	X	X	✓
Loss of 4-20 mA†	✓	✓	✓	✓	✓
Write protect enabled/disabled	✓	✓	X	X	X
Encoder fail	✓	X	X	✓	X
Push button fail	✓	X	X	✓	X
Manual fail	✓	X	X	X	X
A/D converter fail	✓	X	X	X	X
Torque trip	X	✓	✓	✓	✓
Stall fault	✓	✓	✓	✓	✓
DI 1-4	X	X	X	✓	✓ where fitted
Digital Outputs:					
Relay Control	X	X	X	✓ R1-16 where fitted	✓ R1-2 & R5-8 where fitted
Analogue Inputs:					
Measured actuator position	✓	✓	✓	✓	✓
Loop current (measured by actuator)	✓	✓	✓	✓	✓
Temperature	X	✓	X	X	X
Asset Management:					
Actuator starts	✓	✓	X	✓	✓
Amplifier starts	✓	✓	X	X	X

† = Primary value

Notes:

CVA Alarms

*1 The CVA has a status relay that can be selected to trip on one of the following functions: Availability (similar to monitor relay), Fault, Open limit, Closed limit, Open thrust limit, Close thrust limit, Thrust limit, Supercap power, Blinker, Intermediate position, Supercap fault. The relay status can be accessed using HART.

*2 The CVA actuator includes a number of alarm flags including Non-critical fault, Critical fault, Position sensor failure, Thermostat trip and Over back drive limit. See technical manual for full list.

HART® Device Description File

Device Description files have been created specifically for the Rotork HART enabled actuator series. This file provides access to the complete command set through a user-friendly menu structure, allowing both remote calibration and control of the actuator.

The Device Description is stored on the host. Once the actuator is identified, this file is automatically loaded and communication with the actuator may commence.

Methods have also been included within the Device Description that simplify the set-up procedure of the device.

Device Type Manager (DTM)

Generic HART DTM files are also available from a number of DTM suppliers. This allows access to the device data via Field Device Tools (FDT) containers. See the FDT group website for more details - www.fdtgroup.org.



HART® Technical Data



HART® Module (CVA actuator version)

Device:	Rotork HART interface	Interface effective input resistance (CVA):	280 Ohms
Network interface:	HART, 4-20 mA current loop, FSK	Interface effective input resistance (GPSA, LA-2400/2500, SM-6000 S2):	High impedance mode: 249 Ohms Low impedance mode: 120 Ohms
Compatible products:	IQ3, SI3, SI4 CMA, CVA, SM-6000 S2, LA-2400 & LA-2500 actuators	Device Capacitance:	3 nF (CVA, IQ3, SI3, SI4, CMA) 5 nF (LA-2400/2500, SM-6000 S2, GPSA)
Data rate:	1,200 bits/sec	Data files:	Device Description File
Network compatibility:	HART protocol revision 6.0 (GPSA, SM-6000 S2, LA-2400/LA2500) HART protocol revision 7.1 (CVA, IQ3, SI3, SI4, CMA)	Power consumption:	Module is powered from actuator electronics, no external supply required other than the loop supply.
Address range:	0-63, default address is 0	Environment:	Environmentally protected by the Rotork actuator, see documentation for specific actuator for details.
Physical layer:	Two-wire, 4-20 mA current loop		
Current supply:	Operation from 1 to 23 mA		
Minimum interface operating voltage:	11 V at 20.5 mA		

rotork®



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A full listing of our worldwide sales and service network is available on our website.

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