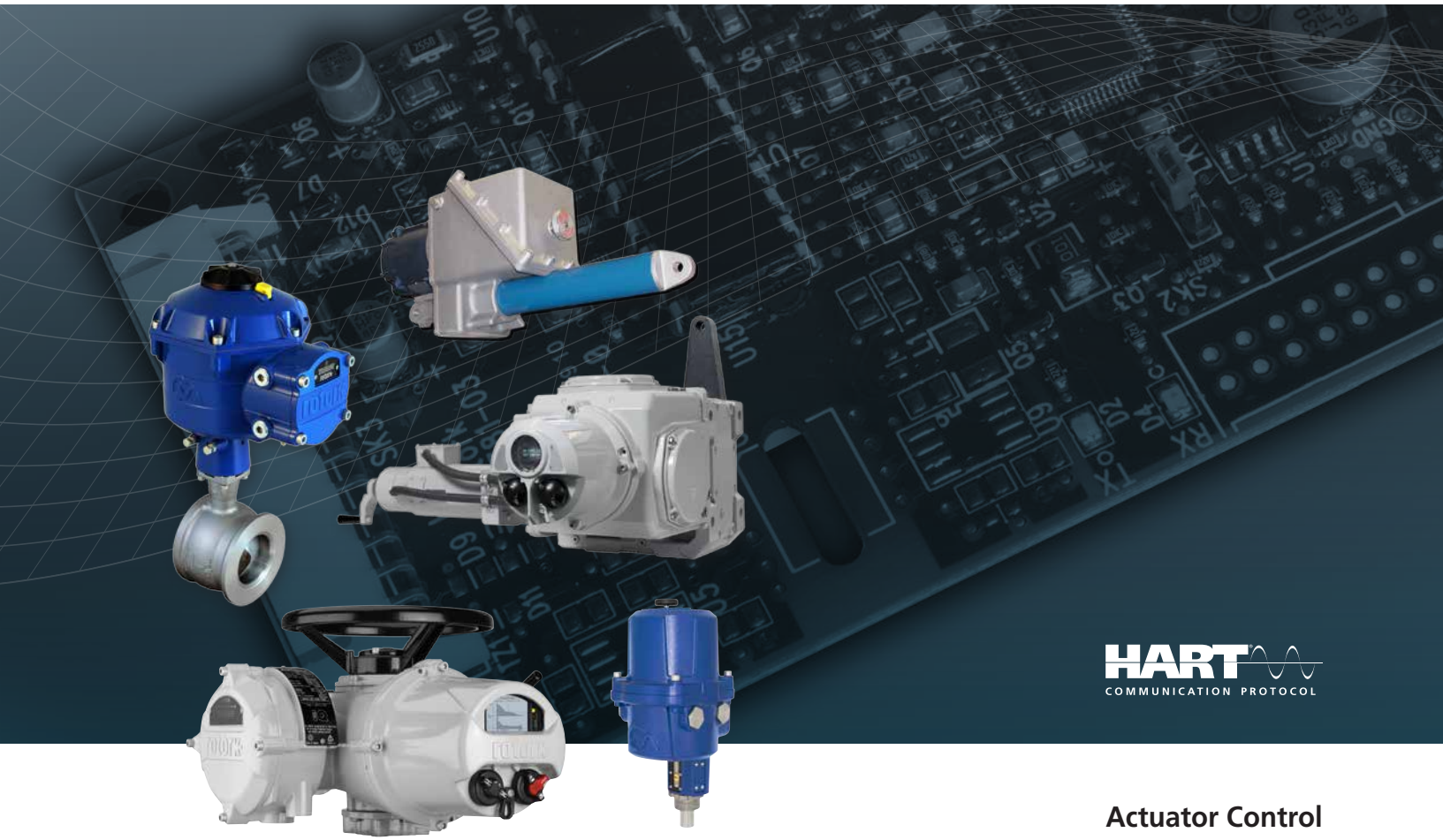
rotork®

HART



Actuator Control

Redefining Flow Control

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Rotork is the global market leader in valve automation and flow control. Our products and services are helping organisations around the world to improve efficiency, assure safety and protect the environment.

We strive always for technical excellence, innovation and the highest quality standards in everything we do. As a result, our people and products remain at the forefront of flow control technology.

Uncompromising reliability is a feature of our entire product range, from our flagship electric actuator range through to our pneumatic, hydraulic and electro-hydraulic actuators, as well as instruments, gear boxes and valve accessories.

Rotork is committed to providing first class support to each client throughout the whole life of their plant, from initial site surveys to installation, maintenance, audits and repair. From our network of national and international offices, our engineers work around the clock to maintain our position of trust.

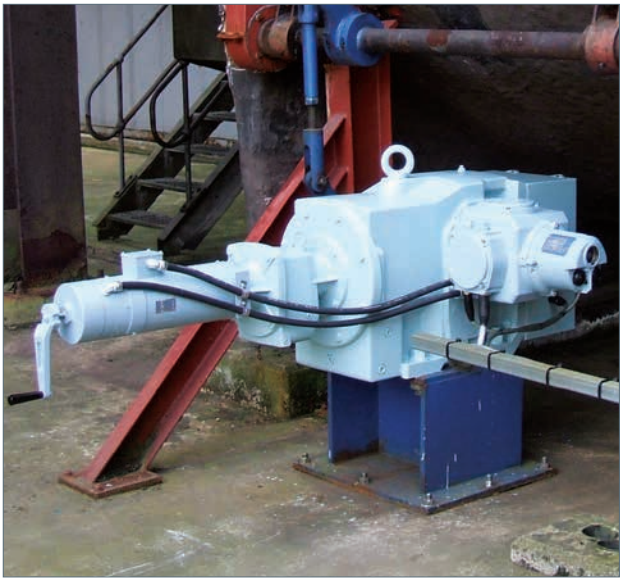
Rotork. Redefining flow control.

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 HART Communication Foundation.

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, GPSA, CVA (all 6.0), CMA and IQ3 (all 7.1) electric actuators.
- Utilises existing 4-20 mA wiring.
- 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.
- Monitor process data of valve.
- Capture fault information supplied by actuator.
- Monitor valve state.

HART COMMUNICATION PROTOCOL

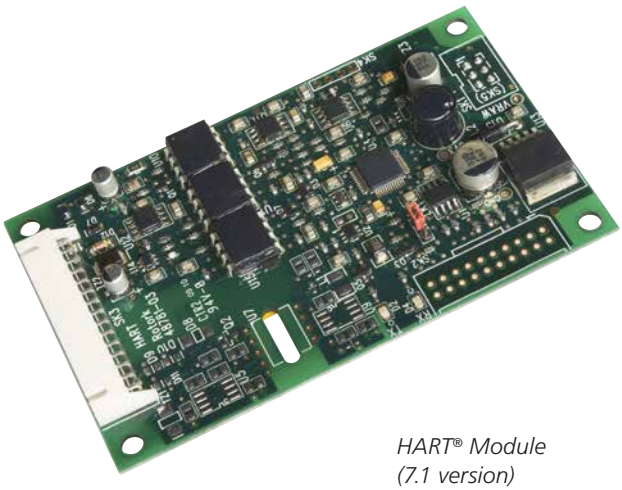
For more information on HART® communications, go to www.hartcomm.org for answers to many common questions.

Images on this page, top to bottom: GPSA, CVA, LA-2400, SM-6000-S2, IQ3 and CMA 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.



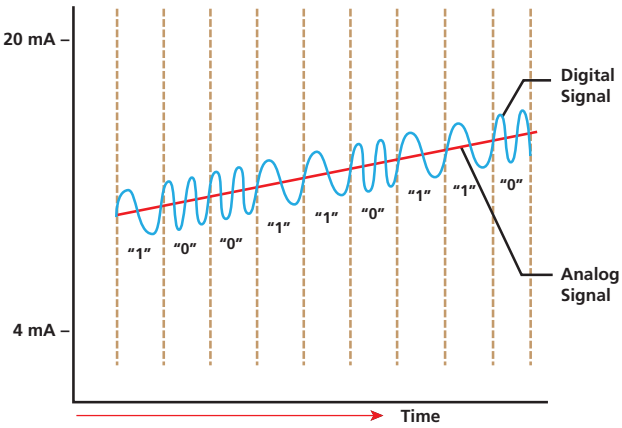
HART® Module (7.1 version)

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 analog 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 utilizes 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.

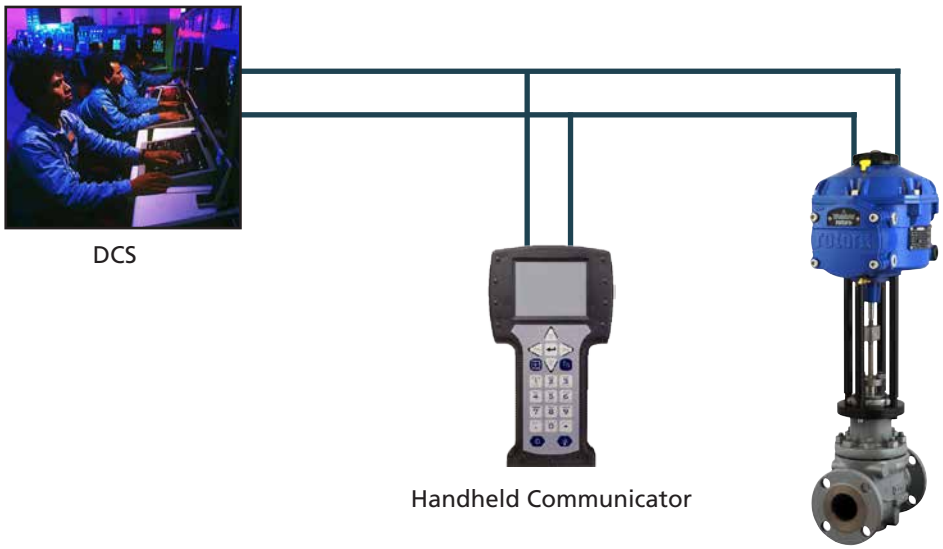
Up to 64 field devices may be wired in parallel to one HART network. The combined impedance of the network must fall in the range of 230 to 600 Ohms. Each actuator is configured to have a unique address on the HART network. A total of two masters may be used, allowing for example a DCS (primary) and 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 Current and Dynamic
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 Sensor 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
38	Reset Configuration Changed Flag
48	Read Additional Device Status

CVA Common Practice Commands

The common practice commands, specified by the HART foundation, 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 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	GPSA	CVA	IQ3	CMA
Configuration:						
Torque limit	✗	✔	✗	✔	✔	✗
Deadband	✔	✗	✔	✔	✔	✔
Hysteresis	✗	✗	✔	✗	✗	✗
Proportional gain	✔	✔	✔	✗	✗	✔
Integral gain	✗	✔	✗	✗	✗	✔
Current loop gain	✗	✔	✗	✗	✗	✔
Stall timeout	✗	✗	✔	✗	✗	✔
Action on loss of comms	✔	✔	✔	✔	✔	✔
Comms loss timer	✔	✔	✔	✔	✔	✔
Comms lost position	✔	✔	✔	✔	✔	✔
Write protect enable/disable	✔	✔	✔	✗	✗	✔
Speed	✔	✔	✔	✔	N/A	✔
Restore factory defaults	✔	✗	✔	✗	✗	✗
Calibration of zero and span	✔	✗	✗	✔	✔	✗
Calibration of input command	✔	✔	✗	✔	✔	✔
Calibration of transmitter	✔	✗	✗	✔	✗	✗
Diagnostics:						
Perform self test	✔	✗	✗	✔	✗	✗
Actuator software revision	✔	✔	✔	✔	✔	✔
NAMUR NE107	✗	✗	✗	✗	✔	✔

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

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

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