

Electric Actuators and Control Systems

rotork® Process Controls

Established Leaders in Valve Actuation

HART
COMMUNICATION PROTOCOL

HART

Actuator Control

Publication S1110E Issue 12/09



Rotork actuators have been in use all around the world for over 50 years. In this time Rotork has grown to become the leader in the valve automation industry. With manufacturing, service centres, offices and representatives throughout the world, Rotork is able to offer global service solutions to your company.

In the 50 years since the company was founded, Rotork has become a byword for excellence in the field of valve, sluice gate and damper actuation products for the oil, gas, power, water and waste treatment industries - worldwide.

We owe our success to an uncompromising focus on quality at every stage - and at every level - of Rotork's operations.

From initial site survey, specification and design, through to materials, manufacturing and testing, installation, commissioning and after-sales service we accept nothing but the best.

At the heart of the company is an exceptional workforce - the highly trained, forward-thinking engineers, technicians and support staff who each have a crucial role to play in maintaining Rotork's unrivalled reputation for innovation, reliability and first class customer support.

The Rotork family of products also includes pneumatic, hydraulic and electro-hydraulic actuators as well as a comprehensive range of gearboxes and valve accessories. Rotork's bespoke Pakscan digital control system offers market leading features whilst all our actuators offer the ability to interface with other digital control systems.

Rotork. Established leaders in valve actuation technology.

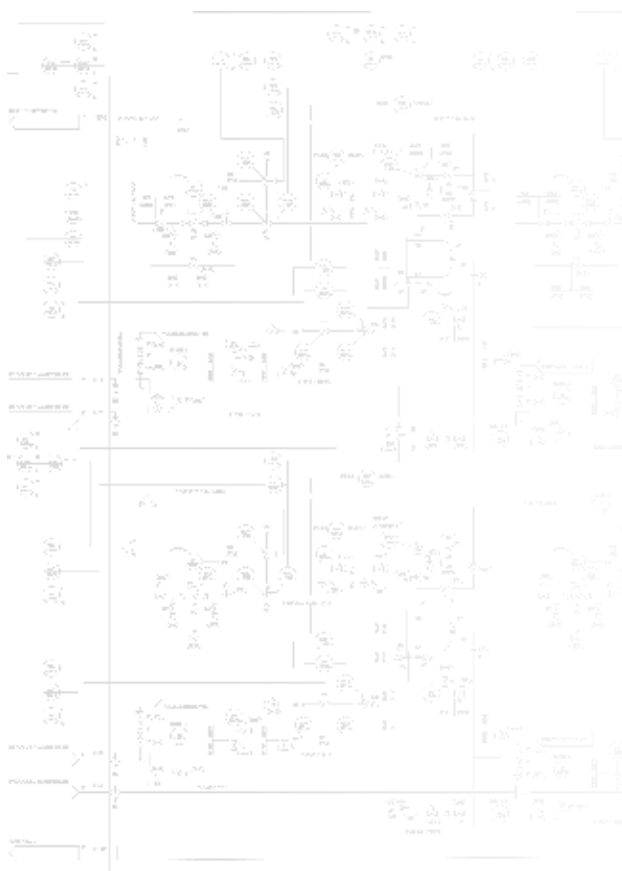
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Contents



Contents

Actuator Control	4
HART® Module	5
HART® Network	5
Point-To-Point Network	6
Multi-Drop Network	6
Commands	7
Control Features	8
Device Description File	9
Technical Data	10

Rotork Process Controls 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 Process Controls the first choice for use with HART® communication systems.



HART® Actuator Control



HART® Communications module:

- HART® protocol Revision 6.0 or 7.1 (7.1 – CVA only).
- Compatible with LA-2400, LA-2500, SM-6000 S2 and GPSA and CVA 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.



*Images on this page, top to bottom:
GPSA actuator, CVA actuator, LA-2400 actuator,
SM-6000-S2 actuator.*

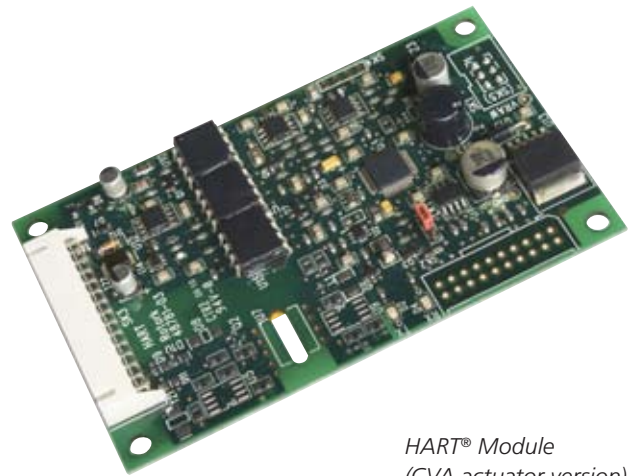


*For more information on HART® communications, go to
www.hartcomm.org for answers to many common questions.*

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.

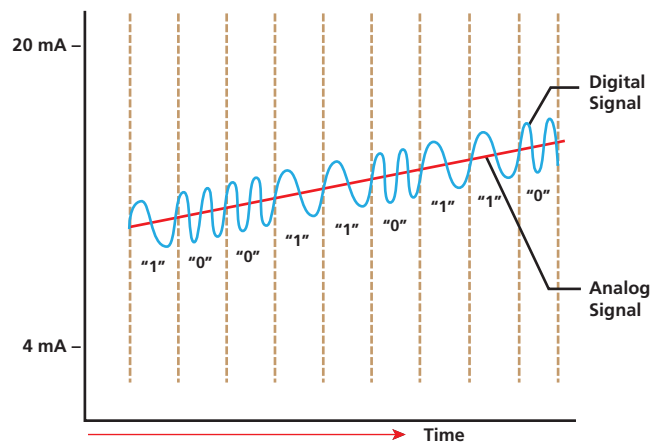


*HART® Module
(CVA actuator version)*

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.

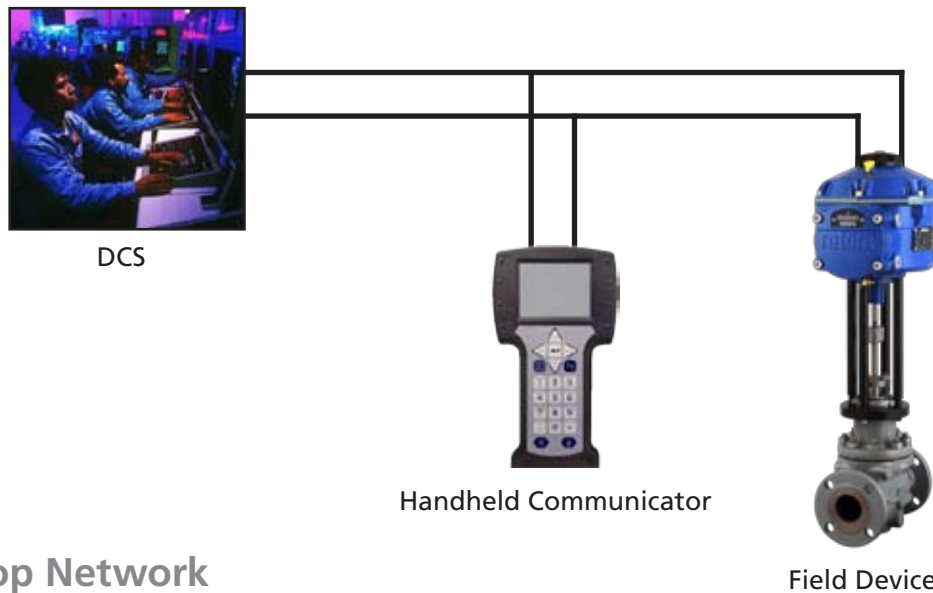


FSK Principle (source: HART®)

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.

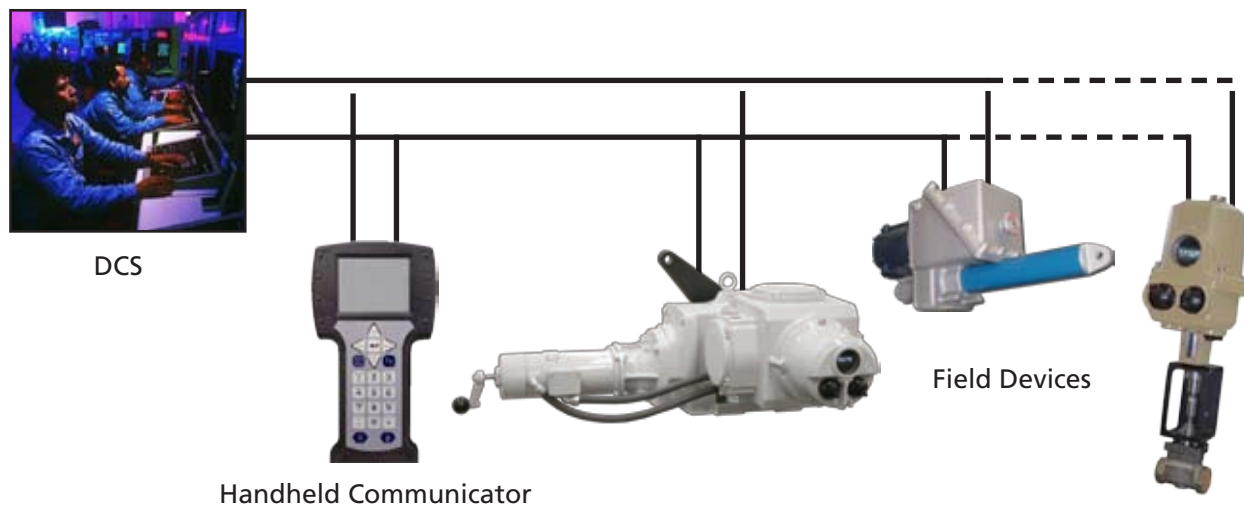
Point-To-Point Network

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 Process Controls HART® enabled actuators may be positioned by using either discrete instructions or by writing a desired set point to the device.



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
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
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 Process Controls 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.

Configuration:	Actuator Data	LA-2400/2500	SM-6000 S2	GPSA	CVA
Torque limit	X	✓	✓	X	✓
Deadband	✓	X	X	✓	✓
Hysteresis	X	X	X	✓	X
Proportional gain	✓	✓	✓	✓	X
Integral gain	X	✓	X	X	X
Current loop gain	X	✓	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
Speed	✓	✓	✓	✓	✓
Restore factory defaults	✓	X	X	✓	X
Calibration of zero and span	✓	X	X	X	✓
Calibration of input command	✓	✓	✓	X	✓
Calibration of transmitter	✓	X	X	X	✓
Diagnostics:					
Perform self test	✓	X	X	X	✓
Actuator software revision	✓	✓	✓	✓	✓

	Feedback Data	LA2400/2500	SM6000	GP5A	CVA
Digital Inputs:					
Actuator moving	✓	✓	✓	X	
Close limit switch	✓	✓	✓	X	
Open limit switch	✓	✓	✓	✓	
Actuator running closed	✓	✓	✓	✓	
Actuator running open	✓	✓	✓	✓	
Remote control selected	✓	✓	✓	✓	
Local control selected	✓	✓	✓	✓ TEST	
Monitor relay	✓	✓	✓	✓	
Valve obstructed	✓	✓	✓	✓	
Valve jammed	✓	✓	✓	✓	
Positioner control actuator	✓	✓	✓	X	
Controls contention	✓	✓	✓	X	
General Alarm	✓	✓	✓	✓	
Loss of feedback	✓	✓	✓	X	
Loss of 4-20mA*	✓	✓	✓	✓	
Write protect enabled/disabled	✓	✓	✓	X	
Encoder fail	✓	X	X	X	
Push button fail	✓	X	X	X	
Manual fail	✓	X	X	X	
A/D converter fail	✓	X	X	X	
Torque trip on increment	X	✓	X	✓ Open	
Torque trip on decrement	X	✓	X	✓ Close	
Stall fault	✓	✓	✓	✓	
Analogue Inputs:					
Measured actuator position	✓	✓	✓	✓	
Loop current (measured by actuator)	✓	✓	✓	✓	
Temperature	X	✓	✓	✓	
Asset Management:					
Actuator starts	✓	✓	✓	X	
Amplifier starts	✓	✓	✓	X	

* = Primary value

Alarms

The CVA actuator includes a number of alarms including Position sensor failure; Thermostat trip; Valve obstructed and Over back drive limit. See technical manual for full list.

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® Device Description File

Device Description files have been created specifically for the Rotork Process Controls 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.

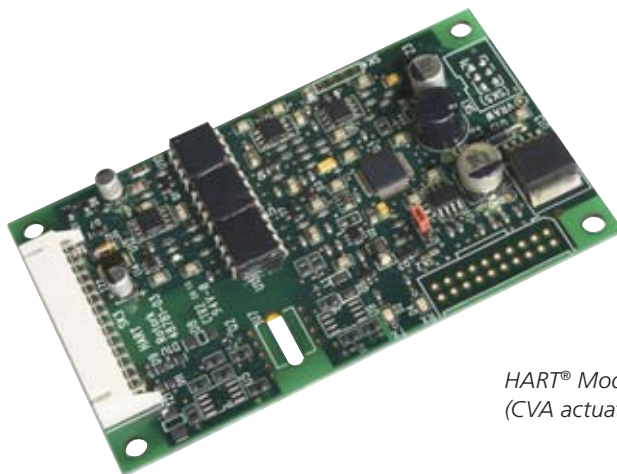
Device Type Manager (DTM)

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



HART® Module
(CVA actuator version)

Device:	Rotork Process Controls 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:	CVA, GPSA, SM-6000 S2, LA-2400 & LA-2500 actuators	Device Capacitance:	3 nF (CVA) 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 HART® protocol revision 7.1 (7.1 – CVA only)	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		



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

UK
Rotork plc
tel +44 (0)1225 733200
fax +44 (0)1225 333467
email mail@rotork.com

USA
Rotork Controls Inc.
tel +1 (585) 247 2304
fax +1 (585) 247 2308
email info@rotork.com

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