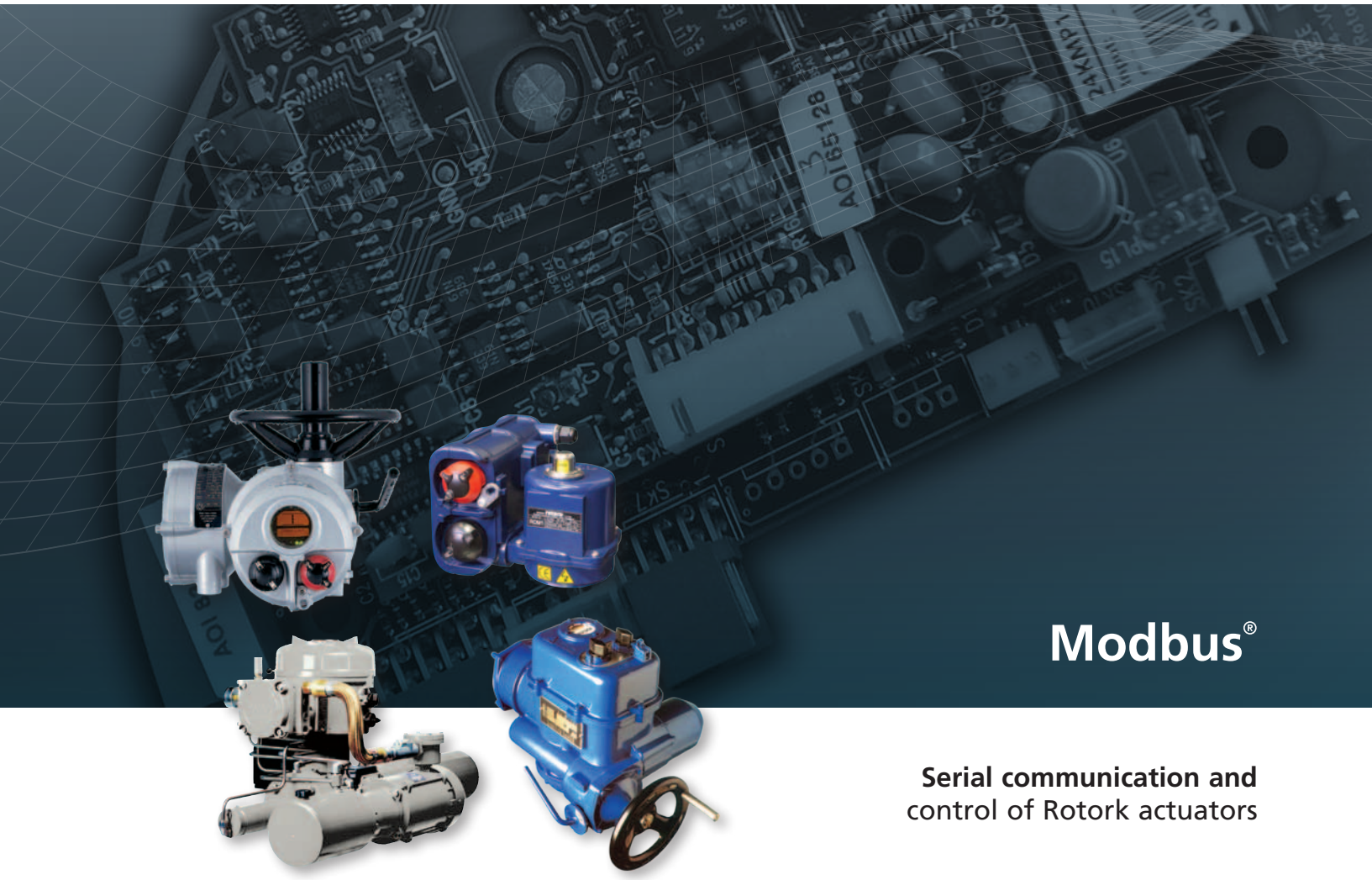
rotork®

Modbus



Serial communication and
control of Rotork actuators

Established Leaders in Actuation Technology

Contents

Rotork is the global market leader in valve actuation products, with a fifty-year track record serving the oil and gas, power, water and waste treatment industries.

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 actuation 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 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. Established leaders in actuation technology.

Introduction

Direct Modbus control of Rotork actuators by 2-wire RS485 serial communications provides a simple and reliable control strategy for valve automation.

Rotork electric actuators may be controlled over the low cost RS485 network using the Modbus RTU protocol when they are fitted with the Rotork Modbus option module.

The inherent flexibility of the Modbus RTU protocol allows the systems engineer to control the data flow on the highway as well as the registers read and written to. There are no complications with device description files or special tools needed to set up a Modbus system. The PLC and DCS drivers are all simple and easy to use.

Modbus®

Modbus® Actuator Control

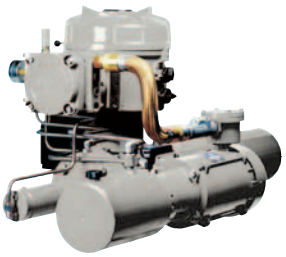
Modbus:

Modbus is the most popular communication protocol in use today. It has the widest acceptance and highest number of applied systems of any automation protocol.

- International Open Standard.
- Highly reliable standardised communications.
- Simple connectivity, easy configuration.

Rotork Modbus module:

- Compatible with all IQ, IQT, SI/EH, ROMpak and Q range actuators.
- RS485, RTU communication.
- Low installation and maintenance costs.
- High control system flexibility.
- Data transfer between 300 and 115 kbaud.
- Simple plant expansion.
- Cabling requires 2 wires only per channel provided the ground potentials are equal.
- Three versions available: Single Channel, with and without repeater and Dual Channel.



Modbus®

For more information on Modbus consult the web site at http://www.Modbus.org. Modbus was developed by Modicon in the 1980s and remains one of the leading protocols used in the field of process control and automation.

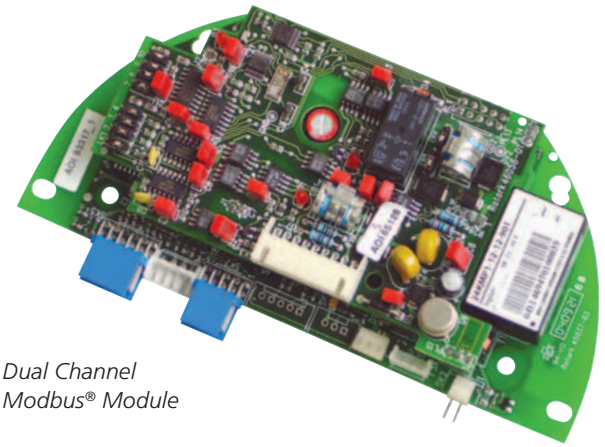
Images on this page, top to bottom: IQ Pro, EH actuator, ROMpak actuator, Q Range actuator.

Modbus® Module

The Modbus module is fitted inside the actuator electrical housing and interfaces directly with the actuator electronics. Once fitted, all the normal commands associated with moving the actuator together with feedback and some historical data become available on the Modbus RS485 highway.

There are a number of user settings to be made for the system variables and actuator performance, such as the baud rate and the slave address of the actuator. These are set by either using the infrared communication link to the actuator or by writing over the network to the appropriate registers in the module.

All the settings are held in non-volatile EEPROM memory on the card.

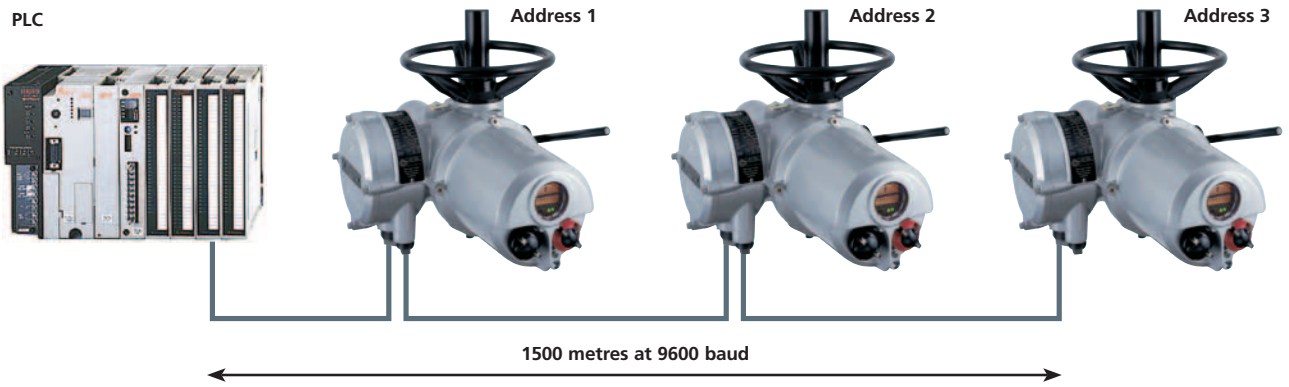


Dual Channel Modbus® Module

RS485 Communication Highway

The Modbus module is a slave device and it uses 2-wire, half duplex, RTU communications on the balanced RS485 highway. An additional connection is provided at each actuator for a 'common' wire linking all the actuators together.

The RS485 standard requires the common mode differential voltage between all the points on the highway to be less than 7 Volts. If the site wide common mode is above this level, the additional connection to a third wire should be made to ensure successful field communication.



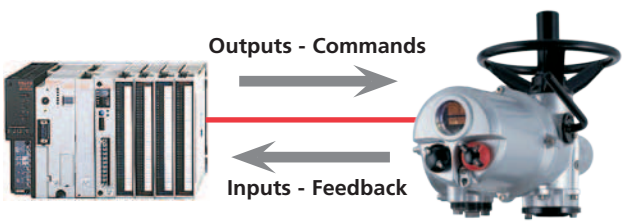
Data Rate (baud)	300	600	1k2	2k4	4k8	9k6	19k2	38k4	57k6	115k2
Maximum Cable Length	24km	12km	12km	6km	3km	1.5km	1.2km	1.0km	750m	500m
Total Spur Length	2km	1km	1km	500m	500m	500m	500m	300m	200m	100m

Note: Each actuator includes up to 0.6 m of cable spur. Calculations based on Belden 8770 cable parameters, 18 AWG, 1 mm2 cross section, 3 cores.

Modbus®

Overview

The Rotork Modbus Module is available in three forms for different applications. The Single Channel card is the simplest of the three with only one highway connection. The Dual Channel card has two independent communication channels and is usually connected to two highways with redundant communication paths. This increases the plant availability by reducing the probability of communication failure preventing the actuator from being controlled. The third option has an internal repeater so that it can be used on a single highway and allows the highway to be extended in distance or number of units without an external repeater. With this option the actuator should remain powered at all times to ensure system communications are maintained.



Modbus RTU

The protocol used for the communication is RTU (Remote Terminal Unit). This is the most common Modbus application, where each network will have one master, usually a PLC or DCS, and several slave devices. In all cases the Rotork module is a slave device and will only send a message in response to a request from the master on the system. Because all messages are under the control of the master there should never be any data collisions or interruptions. The master also controls the message retry mechanism and monitors each slave for its responses to requests for data. Only one slave device at a time sends messages on the highway.

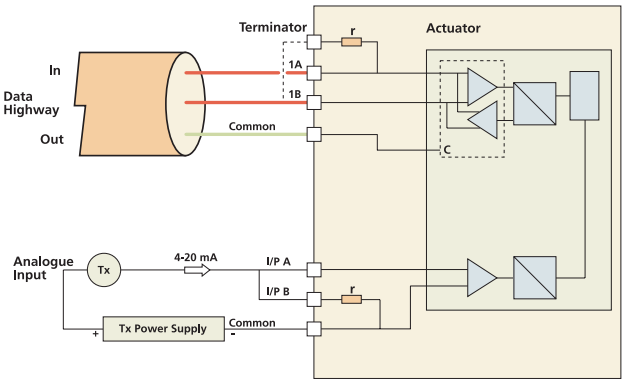
The Rotork module only supports half duplex communication. On a 2-wire RS485 Comms Highway cable the pair is used for passing messages in one direction at a time, either from the master to the slave, or vice versa. This means the master is transmitting only half of the time, hence using half duplex communication. Full duplex requires 4 wires and is more complex, while a half duplex communication system is easier to trouble shoot and keep running.

Modbus® Commands

The single channel option is the simplest implementation of the Modbus module to apply. There is only one RS485 highway connection to the actuator and only one channel inside the actuator for communication. There is also an additional input that may be connected to an instrument analogue transmitter signal for relaying the value over the network.

The module operates as an RTU slave on the network and uses only one address.

- 2-wire RS485 Single Comms Highway.
- 1 analogue input channel.
- Full actuator control and data reporting.
- Externally selectable termination components.
- Full isolation on both the RS485 connection and the Analogue channel.
- Includes full lightning protection on RS485 highway connection.
- Multiple data base for back compatibility.
- Fully network configurable.



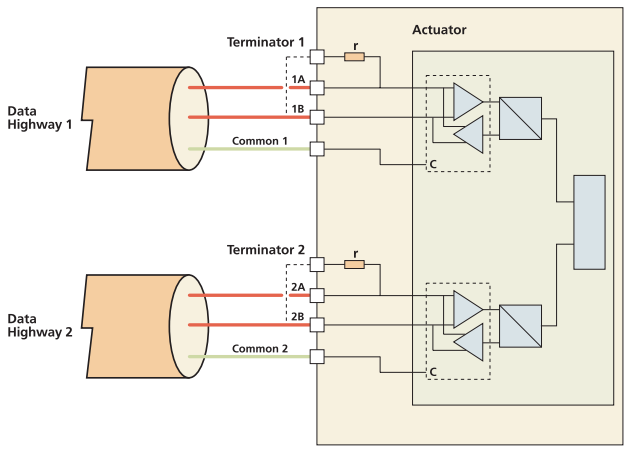
Modbus® Dual Channel Module

The dual channel version caters for those applications where redundant highways are being used for high integrity field connection. The two channels are isolated from one another and provide independent communications.

Both channels share the same processor, address and baud rate for the communications.

The ability to utilise dual highways makes this version ideal for critical installations where redundant communication paths are required.

- Two 2-wire RS485 communication highways.
- Full actuator control and data reporting.
- Externally selectable termination components.
- Full isolation on both channels and between channels.
- Includes full lightning protection on each RS485 highway connection.
- Channel 1 takes priority over Channel 2 when simultaneous messages are received.
- Fully network configurable.
- Common address between the two channels.
- Common communication speed for both channels.



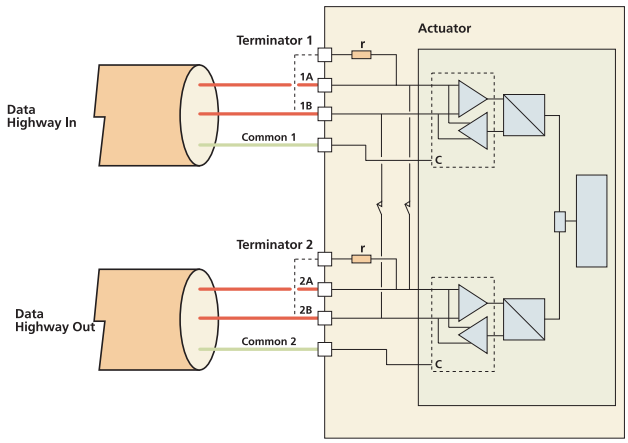
Modbus® Single Channel plus Repeater Module

The single channel with repeater Modbus module includes an internal repeater to allow the highway to be extended over greater distances, or for those applications where a ring is to be constructed. The repeater works in both directions and has minimal turn round time between transmit and receive modes.

The number of connected modules can be extended over 32 using the repeater version, however the recommendation for repeaters is that no more than 9 are used in a system. With 9 repeaters it is easy to build a system over 15 km in length that will run at 9600 baud.

The operation is similar to the single channel unit with the addition of the repeater function.

- Two connections for single RS485 highway use.
- Full isolation between the two segments.
- Minimal turn round time within the repeater to ensure maximum speed communication.
- Allows for spur and ring topology networks.
- Includes full lightning protection on each RS485 highway connection.



Modbus® Control Features

Feedback and Control

The Modbus module allows data to be collected from the actuator about the status of the valve and actuator combination. This data includes logging features when the module is in an IQ or IQT actuator.

In addition full digital and analogue control of the actuator is available without the need to add more components to the actuator.

	Control Data	IQ	IQT	Q	ROMpak	SKIL/EH
Digital Outputs:						
ACTCON	Stop	✔	✔	✔	✔	✔
	Close	✔	✔	✔	✔	✔
	Open	✔	✔	✔	✔	✔
	ESD	✔	✔	✔	✔	✔
	Relay 1*	✔	✔	✗	✗	✗
	Relay 2*	✔	✔	✗	✗	✗
	Relay 3*	✔	✔	✗	✗	✗
	Relay 4*	✔	✔	✗	✗	✗
Analogue Outputs:						
	Desired actuator position (0.1% resolution) 0 – 100%	✔	✔	✔	✔	✔

* Remote input and relay board must be fitted

Modbus® Control Features

Feedback Data	IQ	IQT	Q	ROMpak	SKIL/EH
Digital Inputs:					
Actuator moving	✔	✔	✔	✔	✔
Close limit switch	✔	✔	✔	✔	✔
Open limit switch	✔	✔	✔	✔	✔
Actuator running closed	✔	✔	✔	✔	✔
Actuator running open	✔	✔	✔	✔	✔
Remote control selected	✔	✔	✔	✔	✔
Local stop selected	✔	✔	✔	✔	✔
Local control selected	✔	✔	✔	✔	✔
Thermostat tripped	✔	✔	✔	✗	*1
Monitor relay	✔	✔	✔	✔	✔
Valve Obstructed / Jammed	✔	✔	✔	✔	✔
Manual movement	✔	✔	✔	✔	✔
Motion inhibit timer active	✔	✔	✔	✔	✔
Positioner control enabled	✔	✔	✔	✔	✔
Watchdog tripped	✔	✔	✔	✔	✔
Slow mode	✗	✔	✗	✗	✗
Open interlock input	✔	✔	✗	✗	✗
Close interlock input	✔	✔	✗	✗	*2
Battery low	✔	✔	✗	✗	✗
Aux input 1	✔	✔	✗	✗	✔
Aux input 2	✔	✔	✗	✗	✔
Aux input 3	✔	✔	✗	✗	✔
Aux input 4	✔	✔	✗	✗	✔
Analogue Inputs:					
Measured actuator position	✔	✔	✔	✔	✔
User Analogue input channel	✔	✔	✔	✗	✔
Current actuator torque value	✔	✔	✗	✗	✗

*1 Fault Relay
*2 HW partial Stroke Input

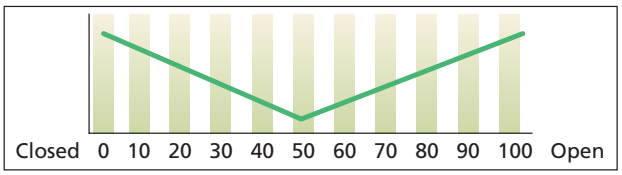
Note: The Aux input 1-4 and Relay 1-4 outputs may be used for direct actuator remote control and indication.

Data Logging

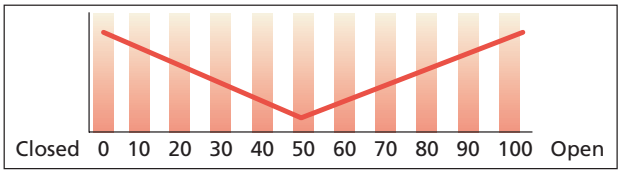
With IQ and IQT actuators the Modbus module also makes available some of the standard data logger feedback information. A torque profile is provided in each direction together with the total number of times the motor starter has been energised in each direction. There is a short delay after the actuator stops (around 2 seconds) before this data is compiled and presented to the network.

Starts - Open	**7346**
Starts - Close	**7782**

The registers containing this information can be accessed periodically to update the control system with the latest data.



Opening Direction Torque



Closing Direction Torque

Function Code Support

The Modbus module supports all the major function codes and uses a technique whereby data and commands can be read and written using more than one code. For example, all actuator control and indication can be obtained using register read/write functions 03 and 16, or discrete inputs can be read with function 02 and so on.

Full position control of the actuator can be achieved by writing a value to the position control register.

Code	Function
01	Read Output Coil status
02	Read Input status
03	Read Holding register
04	Read Input register
05	Force single coil
06	Preset single register
07	Read Exception status
08	Loopback Diagnostic test
15	Force multiple coils
16	Preset multiple registers
17	Report Slave ID

Configuration

The Modbus module requires a number of configurable parameters to be set, including the address and baud rate for communication. All the parameters may be set using the communication link itself.

In most cases, the default setting will match the valve operation. To cater for those more exacting applications, the ability to match the communication and actuator performance to the valve characteristics is invaluable.

In the case of the IQ and IQT actuator the primary parameters can be set using the actuator infra-red communication link.

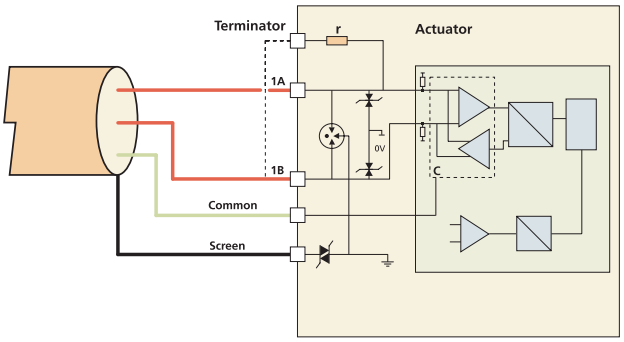
Description
Modbus Address
Baud Rate (baud) & Parity/Stop bits
Data Base Format
Actuator Tag Name
Action on Loss of Comms
Limited Range Position Min & Max
Deadband and Hysteresis
Motion Inhibit Time
Aux Input Mask & ESD DI-4/Net Disable
Valve Jammed Time
Manual Movement Travel
Watchdog Timeout & Comms Fault Timer
Analogue Input scaling

Lightning Protection

All the communications ports on each variant of the Modbus module are fitted with components designed to reduce the effect of high voltage induced signals, such as those generated by a lightning strike.

A combination of gas discharge tubes and Transorb semiconductors, together with varistors ensures that in most cases the induced voltage levels cause no damage to the communication network.

To make full use of the internal protection, the screen should be earthed and a separate common wire should be used.



Modbus® Technical Data

Interface: EIA-485 (RS485) suitable for 2-wire connection.

Number of Channels: 1 on Single channel, fully isolated from the actuator circuits.
2 on Dual channel, fully mutually isolated.
2 on Single channel with repeater, fully mutually isolated.

Address Range: 1 to 247, address 0 reserved for broadcast messages.

Data Rate: 300 to 115k2 baud, selected over the Modbus network.

Parity: Configurable, odd, even or none.

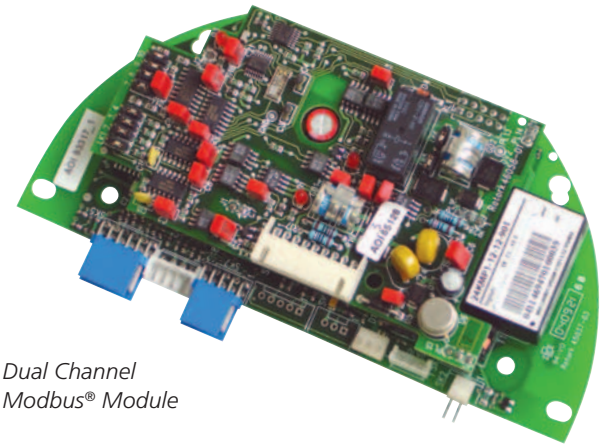
Communication Protocol: Modbus RTU (slave device).

Function Codes: All popular function codes including 01, 02, 03, 04, 05, 06, 15, 16.

Analogue Input: 1 on Single channel, 4-20 mA or 0-5 VDC, externally powered, 0.1% resolution and 1% linearity at 20 °C, fully isolated.

User Defined Digital Inputs: 4 off (IQ, IQT, SI/EH only), potential-free input contacts.

User Defined Digital Outputs: 4 off contacts 5 A, 120 VAC or 1 A, 30 VDC (IQ and IQT, requires additional relay board option).



Dual Channel Modbus® Module

Enclosure: Suitable for fitting within Rotork IQ, IQT, SI/EH, ROMpak and Q range actuators.

Environment: -40 to +70 °C, environmentally protected by Rotork actuator double-sealing to IP68 (IQ, IQT, SI/EH and Q ranges).

Power Consumption: All Modbus module power is taken from the actuator, no external supply is required.

rotork®

Electric Actuators and Control Systems
Fluid Power Actuators and Control Systems
Gearboxes and Gear Operators
Projects, Services and Retrofit

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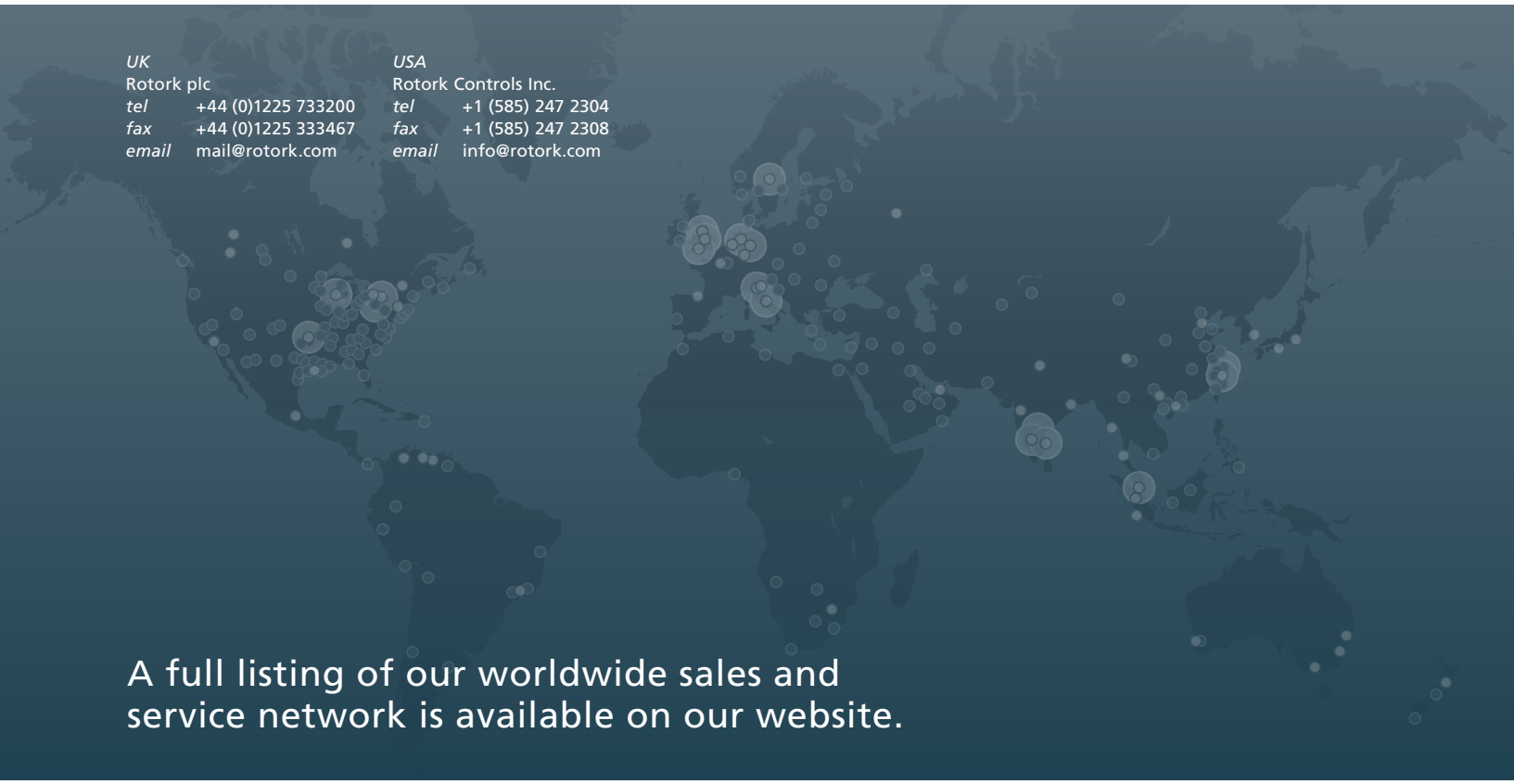

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