

- Electronic Limit Switches
- Very Accurate
- Easy to use
- Robust
- Dependable
- High Resolution
- Non Contact Measurement
- Wide Temp. Range

## EPS 02 Operating Instructions RACO Electronic Position Sensor

## **Introduction**

The RACO electronic positioning system EPS 02 has been especially designed for end of stroke limit switch detection in electromechanical linear actuators. The operating principal is based on a non contact coupling through a magnetic field. It detects angular movement of the rotating motor shaft or actuator screw in relationship to the stationary sensor on the printed circuit board and converts this signal into an absolute linear position signal.



the motor drive shaft. If the actuator is

hand wheel, etc.,

will be mounted in

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auxiliary equipment

position

the

The electronic position sensor EPS 02 is typically integrated into the actuators accessory housing "A" mounted at the opposite side of



EPS 02 in rear housing type G

the lateral accessory housing "D" located at the coupling housing connecting the actuator screw with the drive motor.

In the EPS 02 the two end of stroke limits can be set via on board push buttons and / or the TTL level communication interface. In addition an optional external reference limit switch can be used. Three on board LED's will guide the user through the initial setup procedure and will function thereafter as operation control signals.

## Function

The EPS 02 consists of two potential free relay contacts, an input channel for the motor over-temperature switch, and the optional external reference limit switch.

## Motor Over-Temperature Switch

To protect the RACO actuator motor from overheating, for example from frequent starts and stops or excessive overloading of the actuator, the opening of the motor thermal switch will be monitored. If the motor thermal switch is wired into terminals X1 pin 4 and pin 5, both limit switch relay contacts will open up in the event of an over temperature. The red LED will blink on and off to indicate that condition.

## External Reference Switch

An optional external reference switch can be used to indicate the retracted position. The external device has to be a normally open limit switch or a PNP proximity switch. The switch will be connected between terminal X1 pin 3 and pin 4. In the mode external reference switch, the actuator will retract until the external switch is made. With the rising voltage edge at the input X1 Pin 3 the internal EPS 02 position reference point will be set to zero each time. The extended stroke limit position is defined by the stored stroke length and the above described zero position. Make sure that the external reference switch is positioned in front of the





- EPS 02 Circuit Board Layout

## - Pluggable Connections

- Manual Push Button Setup
- LED Indicator
- Backup Battery

mechanical limit of the actuator or the attached equipment. Failure hereof can cause mechanical damage of the actuator or the equipment. Please be advised that by moving the external reference switch the extended position will be moved as well by the same distance in the same direction. The stroke is stored as a fixed length with the zero position defined by the external limit switch.

## Connection

The EPS 02 is equipped with a four pole pluggable X2 connector for the limit switch output relay contacts and a five pole pluggable X1 connector for the 24V DC power supply, external limit switch and the motor thermal switch. For the physical layout please refer to the connection diagram.

## Power Supply Connector X1

The five pole female connector is equipped with screw terminals for easy interface to customers control wires. Each terminal will accept one # 16 AWG wire.

Pin 1 GND
Pin 2 +24V DC
Pin 3 External reference switch
Pin 4 Aux 24V DC supply
Pin 5 Motor Over temperature switch

## **Relay Contact Plug**

There are two potential free relay output contacts available to shut down the actuator. The contacts should be hard wired into the reversing motor starter or VFD control circuit to provide reliable end of stroke protection. Within the permissible stroke range of the actuator the contacts are closed. Relay output contact landed on terminal X2 pin 1+2 will be opened if the selected retract position is reached or if 24V DC on the external reference switch input X1 pin 3 is present. Relay output contact landed on

terminal X2 pin 3+4 will be opened if the selected extend position is reached.

X2 pin 1+2: Limit retract X2 pin 3+4: Limit extend

Note: If the 24V DC supply power is turned off both relay output contacts will open up.

### **Technical Data**

EPS 02 Power Supply requirement: Voltage: 24V DC Range: +20% / -30 % Current: 50 mA

Output relay Contact: Max Voltage: 250V AC @ 5A 30V DC @ 5A

Digital Input: Voltage level: 24V DC Range: +20% / -30%

Motor Over Temperature Protection: Input Type: Thermal Switch

Position Accuracy: Stroke Length / 10 Bit \* RPM on Sensor Shaft

Data Storage Duration: 10 Years Battery: Lithium 1.2Ah

Operating Temperature: -40° F to 185° F Protective Rating: IP 00, circuit board sealed Enclosure: Without Connector: Pluggable terminal connection

## LED Display

The operating status of the EPS 02 will be indicated via three on board LED's.

### LED yellow:

LED is on steady if the actuator is in its selected stroke range. The LED is off if

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**EPS 02 Mounted in "A" Housing** 



EPS 02 Mounted in "A" Housing

the actuator has reached its retracted end position or the external limit switch signal is on.

#### LED green:

LED is on steady if the actuator is in its selected stroke range. The LED is off if the actuator has reached its extended end position.

### LED red:

LED is on steady if the motor over temperature switch is open or not connected. The LED is flashing if the rotating motor axis has an offset to one side or another.

If all LED's are flashing in the rotating order yellow, green, red the printed circuit board is not mounted properly. As a result the distance between the magnet on the rotating shaft may be too large or too small or not pointing to the center of the sensor. The mounting of the printed circuit board should be checked. Without proper mechanical adjustment the board is not operational, therefore, a reliable function of the limit switches can not be guaranteed.

Further LED display patterns are described in the below manual setup procedure.

## Manual Setup Procedure

The EPS 02 limit switch function can be configured via the two onboard push buttons. This is only necessary during startup or maintenance of the actuator if end of stroke limits have to be changed or if changes to the working condition, mounting position or operational changes have to be made. In general the push buttons have fixed functions.

Push button S1 is used to advance from one function to the next.

Push button S2 is used to select the value in each of the selected function.

There are two settings which can be made independent from each other:

- 1) Setting of the end of stroke position in the retracted position and
- 2) Setting of the end of stroke position in the extended position

Please find below the manual set up procedure to adjust the retracted and extended end of stroke position.

Note: The EPS 02 comes factory preset with the maximum stroke length and a safety limit on both sides. As well the actuator dependant settings for clock wise or counter clock wise operation, and the activation of the external limit switch function.

To activate the manual setup mode both push buttons S1 & S2 have to be simultaneously pushed down for more than 8 seconds. To acknowledge entering the manual setup mode all three LED's will flash at the same time. Release both push buttons at the same time and the yellow LED will remain flashing and the green and red LED will turn off. You are now in mode 1.

#### Mode 1 Adjustment retracted position:

Note for units with external limit switch: As mentioned before, do not make any adjustments in mode 1 if the unit is configured for an external limit switch. Always start out with the desired retracted position since this is your reference point for the setting of the stroke length.

If no adjustment to the retracted position is required, go to the section "Change to Mode 2".

If adjustments are required the actuator should be jogged to the desired retracted position. To store the value of that position hold down the push button S2 for 0.5 to 1 seconds.



### **Manual Position Setting Diagram**



Yellow LED ON: Actator in operating stroke limits Yellow LED OFF: Actator in retracted position

Green LED ON: Actator in operating stroke limits Green LED OFF: Actator in extended position

Red LED ON: Motor over temperature or thermal switch not connected

Red LED Flashing: Check the axes between the magnet and the sensor Red, Yellow, Green LED in rotational order: Check distance and allignment

## **TTL Level Communication Interface**

The EPS02 is equipped with a TTL level communication interface. To connect the unit to a standard RS232 interface or USB interface, a signal converter is required. It is recommended, especially in harsh and noisy environments, to use a galvanic isolated converter to protect the RS232 serial or USB port of your laptop or computer from transient voltage spikes or other magnetic fields which can be introduced into the connection cable. In modest environmental conditions a straight through TTL to USB can be used. The 10 pin square post connector as well as the 4 pole plug connector provide the +5V to power up the optically isolated side of the converter. The other side of the converter will be powered up by the RS232 or USB port of the laptop or computer.

## **EPS 02**



Pin Layout for EPS02 with double Row 10pin square Post Connector



Pin Layout for EPS02 with 4 pin connector

#### RACO TTL to RS232 Signal Converter



Straight Cable

**Galvanic Isolated** 

If a previously stored value for the retract position does not allow you to jog to the new desired retracted position, hold down the push button S2 for longer than one second. The retracted limit switch function is now disabled. Pay close attention to the physical end limits of the actuator and as well the attached equipment.

To store the value of that position hold down the push button S2 for 0.5 to 1 second.

### Change to Mode 2

Press push button S1 for 0.5 to 1 second. The LED pattern will change to a flashing green LED and the yellow LED will turn off.

#### Mode 2 Adjustment extended position:

If no adjustment to the extended position is required go to the section "Change to Operating Mode".

If adjustments are required the actuator should be jogged to the desired extended position. To store the value of that position hold down the push button S2 for 0.5 to 1 seconds.

If a previously stored value for the extended position does not allow you to jog to the new desired extended position, hold down the push button S2 for longer than one second. The extended limit switch function is now disabled. Pay close attention to the physical end limits of the actuator and as well the attached equipment.

To store the value of that position hold down the push button S2 for 0.5 to 1 second.

### **Operating Mode**

Hold down the push button S1 for 0.5 to 1 second. The LED pattern will change to its normal operational condition. See above "LED Display" section.



## Cylinder Setting Screen with the RACO Tools Software:

## **Display Functions:**

Absolute Position Status of Binary Inputs Reed Switch Diagnostic Angular Position Connection Status Sensor Head Alignment

## **Input Functions:**

Stroke length of Actuator Relationship of Stroke length to Number of Rotations Set Counter Zero Position Clockwise or Counter Clockwise Direction Set Zero Position Read Parameters from EPS 02 Write Parameters to EPS02



## **Cylinder Setting**

The first screen displays the essential functions of the EPS 02 and ties the actuator specific parameters to the sensor unit. In most cases the following parameters are already factory set. Starting at the left hand corner:

**Cylinder max Stroke:** Nominal stroke length of the purchased actuator in millimeters.

**Number of Motor Turns for max Stroke:** This value represents the number of rotations at the EPS 02 sensor head to account for the full nominal stroke of the actuator.

**Clockwise or Counter Clockwise Direction:** The physical location of the EPS02 position sensor, in the "A" or "D" accessory housing, "C" design or number of stages in the utilized gearbox if so equipped, decides the direction of rotation at the sensor head in relation to the stroke direction. A counting direction will be selected with the radio buttons.

**External Reference Function:** If an external reference switch is used, this selector box will be enabled. The positive edge of the external reference switch will set the absolute position to 0mm.

**Input Status Display Windows:** The below six input status display windows indicate the binary input channel conditions:

- Push Button S1, S2 (EPS02 only)
- Input 1, 2; Time Delay Extend / Retract
- Input 3; External Reference Switch
- Over Temperature Switch

**Set Zero Position:** In the center of the screen, below the angular rotation display, the set zero push button is located. By pushing this button the absolute position will be set to 0mm and stored in the battery backed up RAM. The factory set zero position represents the physical retracted end position. This position should never be reached under normal operating conditions.

## Sensor Misaligned:

If the distance or alignment between the sensor head and the rotating magnet is out of range the normally gray field will turn purple.

**Speed 0 RPM:** Displays the RPM value on the sensor head.

**Read Parameter Block** / Send **Parameter Block:** By pressing the button read or send parameter block, the upload or download RACO Tool software function will be initiated and all parameters will be exchanged via the USB and / or TTL communication interface between the EPS 02 and the





EPS 02 with TTL to USB communication cable



EPS 02 mounted behind motor brake with extended shaft in submersible housing

service computer. Parameter sets can be stored and read via the "Values" control bar pull down menu at the top of the screen on the hard drive. To store the changed data from the screen into the EPS02, the "Send Parameter Block" button needs to be pushed. This refers to all configuration screens.

**Reed switch sector:** The reed switch sector display block is for diagnostic and functional supervision of the imbedded reed switches.

Absolute position: The absolute position indication is a calculated value out of the predefined "Number of Turns for max Stroke", the "Cylinder max Stroke" values, and the selection of the "Set zero Position". The slide bar output and numerical value is updated immediately as the sensor changes its rotational position.



External EPS 02 setup via IP68 plugable TTL to USB connection cable



## Digital Output Configuration Screen:

## **Display Functions:**

Absolute Position On / Off selection of Outputs Limit Positions

## **Input Functions:**

Setting of End of Stroke Limits Setting of Intermediate Limits Selection of Output function On/Off or Off/On Enable PWM (only EPS06) Width of Hysteresis

RACO Setup Tool V1.8.4 Setup Values COM3 Connected 10:38:58 AM www.raco.de Absolute Position Cylinder Settings Digital Output Configuration Analog Output Configuration Thrust Overload 249.90mm Function Output6 OFF OF OF OFF Output5 OFF Output4 ON ON ON ON ON ON Output3 ON ON Output2 ON Output1 ON ON ON ON Hysteresis 10.00 20.00 100.00 495.00 505.00 700.00 ,980.00 ,990.00 0.10 mm Cylinder Switch Positions [mm] Т 1000mm Impulses per Revolution of Square Wave Signal at Outputs 5+6: Function of Output 4: Digital Output 👻 32 👻 RACO SCHWELM Read Parameter-Block Send Parameter-Block

**Digital output configuration:** The screen provides an easy selection of assigning stroke limit switching points over the entire stroke length of the actuator. Each of the two output channels have a selection of up to nine independent switching points for up to eight independent stroke setpoints. The selection of each switching point can be active high or active low. If not all switching points are used a negative one in the field switch position will turn off the associate fields.

**Hysteresis:** The selected hysteresis number provides a negative and positive band around the selected switching point. This number should be selected large enough to avoid shattering of the output signal and small enough to provide the desired position accuracy.

Function of Output 4 (EPS06 only): Output channel four can be switched from a position limit output signal to a Pulse Width Modulation (PWM) output signal. The signal parameters are selected in the following "Analog Output Configuration" screen description. The PWM signal has a carrier frequency of 1kHz and the "on" and "off" time of the square pulse signal is proportional to the selected stroke length. The signal output is immune to noise and an inexpensive alternative to analog input channels on customers PLC control equipment.

#### Impulses per Revolution of Square Wave Signal at Output 5+6 (EPS06 only):

The frequency of the 90° phase shifted A B encoder signal can be selected from 32, 64, 128, 256 pulses per revolution of the sensor head. This gives the user a wide range to adapt the encoder to VFD or PLC input cards.



Analog Output Configuration Screen (EPS06 only):

## **Display Functions:**

Absolute Position Selected Analog signal Scaling of Analog Signal

## **Input Functions:**

Selection of Analog Signal Scaling of min Position Scaling of max Position

RACO Setup Tool V1.8.4			
Setup Values			
COM3 Connected 10:41:12 AM			www.raco.de
Cylinder Settings Digital Output Configuration S Analog Output Function 4.20mA	Analog Output Configuration	Thrust Overload	Absolute Position
RACO SCHWELM	Read Parameter-Block	Send Parameter-Block	
			14

Analog Output Function: With the pull down menu "Analog Output Function" the following selections can be made: 0-10V, 10-0V, 0-20mA, 20-0mA, 4-20mA and 20-4mA. Based on the selection "Cylinder max Stroke" from the main screen the "Limits for Analog Output Signal" slide bar is initialized. The two slide potentiometers on the left and right side of the slide bar make it very easy to adjust the offset and gain of the analog output signal in relation to the desired stroke length. In most cases, the end of stroke limit switch "Switch Position" and the potentiometer slide values coincide.



Thrust Overload Screen (EPS06 only):

## **Display Functions:**

Speed Sensor Function Enabled or Disabled Shut off RPM Setting Startup Delay Time Forward Startup Delay Time Reverse

## **Input Functions:**

Enable Thrust Overload Function Disable Thrust Overload Function Set Startup Delay Time Forward Set Startup Delay Time Reverse

RACO Setup Tool V1.8.4				
COM3 Connected 10:43:46 AM			www.raco.de	
Cylinder Settings Digital Output Configuration	n Analog Output Configuration	Thrust Overload		Absolute Position
Thrust Overload Function Disabled Enabled Thrust Limit RPM Value: Motor Rush in Time Delay Extend: Motor Rush In Time Delay Retract:	682 <u>+</u> RPM	0.5s		249.90mm
RACD SCHWELM	Read Parameter-Block	Send Parameter	Block	

Thrust Overload Function: The thrust overload function screen enables and disables the thrust overload protection of the actuator. With the "Thrust Overload Function" enabled the sensor head RPM value will be constantly compared with the preset "Thrust Limit RPM Value". The user command signals "Extend" and "Retract" have to be wired into the binary input signals X101 pin 1 and 2 of the EPS06. As soon as the forward or reverse auxiliary contacts of the reversing motor contactor or VFD circuit are pulled in, the on-delay timer with the predefined "Motor Rush in Time Delay Retract / Extend" time setpoint is started. As soon as the retract / extend time delay is expired, which is the startup time of the actuator motor, the RPM value will be

supervised until the reversing motor starter is turned off. If during this time period the actual RPM value dips below the setpoint both end of stroke limit output signals will be turned off, which will turn off the power supplied to the actuator via the reversing motor starter or VFD. The "Thrust Limit RPM Value" is factory set and varies by actuator size, nominal thrust rating, selected motor size and operating conditions. Readjusting these values may defeat the thrust overload protection of the actuator and the attached equipment.

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Software Installation

**COM Port Setting** 

**Connection Problems** 

**Trouble Shooting** 

## Installation and Help in Case of Connection Problems

The latest version of the RACO Tools setup software can be downloaded from the RACO website www.racointernational.com under Products / Actuator Accessories / Electronic Limit Switches in form of a ZIP file. Download the ZIP file and store the content in a separate folder. Extract the file with all subfolders. To install RACO Tools onto your laptop double click the Setup.EXE file under administrative privileges. Please be advised that with Microsoft Windows operating systems Vista and Windows 7, user rights have been changed. To properly install the RACO Tools software the user has to be locked in with administrative rights. After starting the setup.exe software with the right mouse click and selecting in the pull down menu the setting install as administrator, the RACO Tools software will be installed hereafter automatically. Follow the instructions during setup.

After installation of the RACO Tools software, please check out the connectivity between your laptop and the EPS02/EPS06 Electronic Position Sensor. Power up the EPS02/EPS06 with a 24V DC power supply and connect the TTL port (EPS02) / the USB ports (EPS06) with an appropriate USB cable. Start the RACO Tools application program via the icon or the start program menu.

The connection is made successfully if the LED symbol next to the text COM X Connection in the upper left hand corner of the main cylinder setting screen changes from red to green.

## Connection Problem Trouble Shooting

The most common problem is the incorrect selection of the COM Port. With the EPS02/EPS06 connected and powered up please check under Control Panel / System / Hardware / Device Manager / Universal Serial Bus Controllers that the communication driver CP210x USB Composite Device is loaded. Now click on Ports (COM & LPT). The CP210x USB to UART Bridge Controller should be loaded and be pointing to the selected COM port number. Use this COM port number in conjunction with the RACO Tool software. In the main RACO Tools desktop window select the Setup pull down command / Comport which will open up a popup screen. Under Please choose COM-Port select the assigned COM port number and hit OK. The LED symbol should change to green. COM port numbers should be single digit.

IF after the TTL / USB connection cable is plugged into both the laptop and the EPS02 / ESP06, and the CP210x USB Composite Device is not loaded in the device manager's screen. the communication driver has to be installed manually. Please select the subfolder USB and based on your laptop's operating system the appropriate driver subfolder. Find the file PreInstaller.exe and execute that program. Follow the instructions of the driver. Please make sure that you have administrative rights.

There may be other vendor programs installed on your laptop which may bind the UART Controller to a driver program during startup even if the main program is not launched. These programs are typically programs which rely on a serial connection to talk to an external device. One remedy is to deinstall that particular program or use a different laptop.



**Wiring Diagram** 

## Examples



The EPS 02 limit switch contacts are hard wired into the reversing motor starter circuit.



The EPS 02 output signals are wired as permissive signals into the control circuit of a variable frequency drive.

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