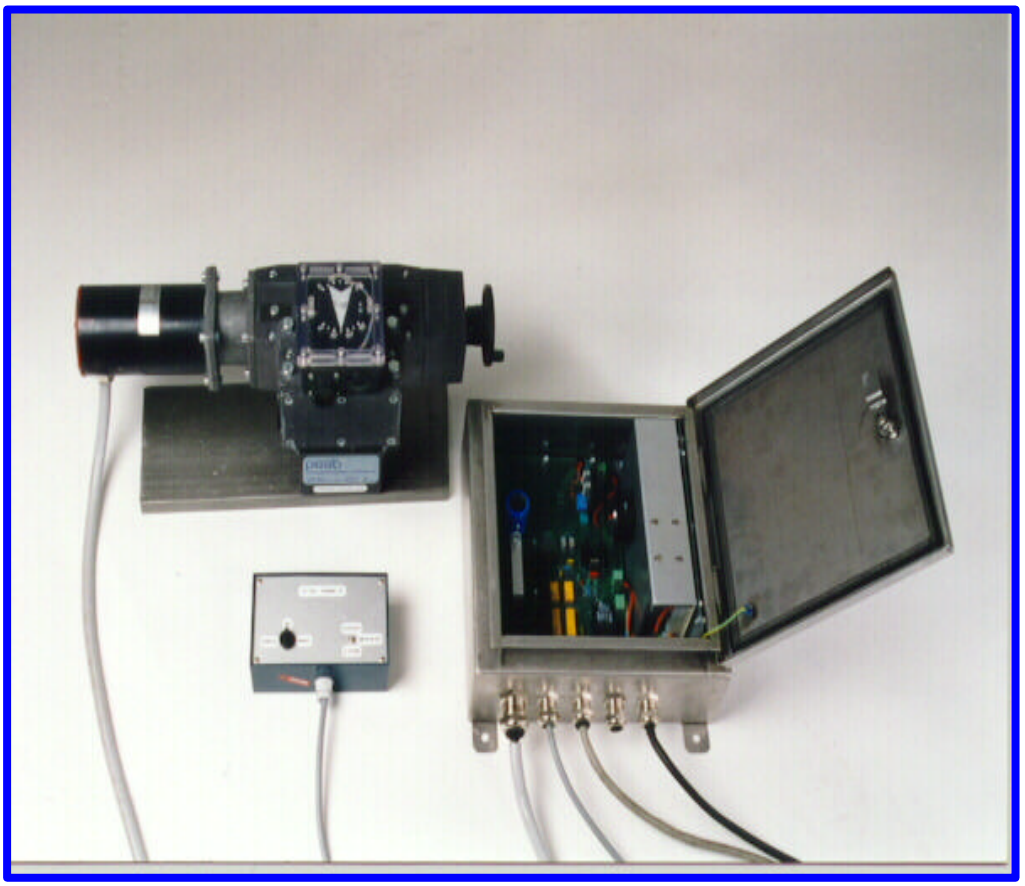
Peab IC3000

Stepmotor Interface for Control Valve Actuators



Instruction Manual

Rev 3 - April 2000

Peab Process AB

Ilanda Gard 120
S-653 50 KARLSTAD
Sweden
Phone +46-54-53 07 50
Fax +46-54-53 18 51
e-mail info@peabprocess.se
www.peabprocess.se

Instruction Manual

Peab IC3000

Step Motor Interface for Control Valve Actuators

Revision 3 - April 2000

Content Page

1. Introduction

This Manual contains full instructions how to operate, install, perform startup and maintain Peab CE-marked Step Motor Interface type **IC3000.**
If you have any questions regarding the equipment or its installation, please contact your local representative or the manufacturer (Peab Process AB, Sweden).

2. Specifications

Enclosure:

Material: SST
Dimensions: 300 x 300 x 130 mm (w x h x d)
Weight: 5 kg (2 lbs)
Encapsulation: IP65 incl. HF-sealing (EMC-prot.)
NEMA 4X

Power Requirements:

IC3000-AC: 85 - 264Vac, 47 - 440 Hz, 160W
(No range switch)
IC3000-DC: 22 - 30 Vdc, max 6A.

Control Signals:

Increase/Decrease contact inputs from relay or Open Collector Outputs supplied by 24Vdc/8 mA from the internal or from an external power supply. Switching between High and Low step speed by a contact input from relay or Open Collector supplied by 24Vdc/8 mA from the internal or from an external power supply.

Feedback Transmitter (optional):

4 - 20 mA 2-wire transmitter.
Input: 1 kohm potentiometer (other values on request)
Adjustable zero: 0 - 750 ohms
Adjustable range: 50 - 1000 ohms

System Fail Detection:

Fail detection that automatically switches off motor-currents.
Potential-free relay contact for fail indication.
Automatic and Manual Reset.

Stepping speed:

2 individual adjustable stepping speeds.
2 - 400 steps/sec. programmable half-step or full-step.

Motor Torque:

Dependent on choice of motor-size
Up to 10 Nm (90 lbf.in)

Driver Unit Output:

Bipolar driver for 2-phase Step Motors in 2 or4 wire configuration.
Voltage: 24V pulses, 2 - 400 pulses/sec.
Half-step or Full-step operation.
Current adjustment: 0,2 - 3,0A in 0,2A-steps.
Individual adjustment of step-current and steady-state current.
In Half-step operation motorcurrent is increased by 40%.
Boost-function increases motor-current by 25% of adjusted current.

Environmental Temperature:

- 20°C to + 55°C (-4°F to 131°F)

Electro Magnetic Compatibility:

IC3000 is tested according to following European standards.

ESD	EN 61000 4.2 and 4.4, crit. B
Radiated Emission	EN 55014
Conducted Emission	EN 55011 Class A
RF-EM Immunity	EN 61000-4-3 and ENV 50204
	EN 61000-4-6

3. System description

IC3000 is a compact Step Motor Interface designed in two versions – one AC-powered, called **IC3000-AC,** and one DC-powered, called **IC3000-DC.**
The unit includes only five main parts (see 10, IC3000-AC/4):

- Enclosure in stainless steel
- Power Supply Unit
- Main Printed Circuit Board incl. plug-in screw terminals
- Plug-in Step Driver Unit
- Feedback Transmitter FT-200, plug-in on main P.C.B. (option).

IC3000-DC does not include any power supply unit.
Converting from IC3000-AC to IC3000-DC can be performed in the field.
Converting from IC3000-DC to IC3000-AC can only be done by the manufacturer.

IC3000 is designed to meet the exceptional requirements for installation in industrial environments with high temperatures and humidity.

3.1 Enclosure

The enclosure is specially designed in stainless steel for corrosion resistance, NEMA 4X (IP65) protection and to meet the European EMC- and LV- Directives for CE-marking.
The box is equipped with two seals - outer for IP-protection and inner for electrical conducting HF-sealing.
Special cable-glands are installed with a union that directly ground the cable screens to the enclosure. It is important that the cables be correctly installed in the glands for good EMC-protection (see Appendix 1).

3.2 Power Supply Unit

IC3000-AC is powered from a switched, 24Vdc/110W, power supply unit (PSU). The PSU can accept input power of 85 - 264Vac .
For HF-suppression a mains-filter, MF1, is installed directly on the incoming mains. The mainsupply is fused by a 3.15A, slow-blow, 4 x 20 mm fuse (F2).
The PSU is separately mounted with plug-in screw-terminals, J4 and J5, plugged into the main Printed Circuit Board (PCB).
The PSU cover works as cooling-flange with a fan mounted for air-circulation within the enclosure. The fan is also plug-in connected to the main PCB (J3).
IC3000-DC has to be supplied from a stabilised ordinary or switched power supply.
Fused by a 6A, slow-blow, 4 x 20 mm fuse (F2).

3.3 Main Printed Circuit Board (PCB)

All electronics are mounted on a large (180 x 283 mm) PCB with plug-in screw terminals for all wires in and out (see 10, IC3000-AC/4).
The PCB is directly screwed on to grounded mounting rails with 6 off M5 screws.
Two fuses, F2 (3A) for incoming mains supply, and F1 (1A) for outgoing 24Vdc, for external use.

The PCB has following adjustable components:

- 1 off 8-pos. DIL-switch, Sw1 'CURRENT SETTING' for adjustment of motor-currents (step-current and steady-state current).
- 1 off Pushbutton, Sw2 'RESET' for manual reset of Step Driver Unit after failures.
- 1 off 4-pos. DIL-switch, Sw3, for choice of different motorinstallations.
- 1 off Potentiometer, P1 'HIGH', for adjustment of high step-speed.
- 1 off Potentiometer, P2 'LOW', for adjustment of low step-speed.

There are also two jumpers that normally do not need to be changed:

- 1 off 'H/F' for choice of Full step- or Half step-operation.
- 1 off 'Boost' to increase motorcurrent with 25%.

There are five testpoints TP1 to TP5:

TP1 +24Vdc
TP2 + 5Vdc
TP3 Pulses from High/Low-frequency oscillator.
TP4 ± For measuring 4 - 20mA signal from FT-200 transmitter. (Can also be used for permanent installation of a local mA-meter, Ri max 10 ohms).
TP5 Ground (reference for TP1, TP2 and TP3).

Card-contact, J6, for plug-in of Feedback Transmitter, FT-200.

3.4 Step Driver Unit

The Step Driver Unit, IC1, contains logic for limitations and control of the motorcurrents, max 5,3A, plus logic for stepping, half/full steps, reversing and reset functions.
The Driver Unit is protected against short circuits from phase to phase, phase to +24V and from phase to ground.
A built in logic for **Errordetection** breaks the motor currents and stops the Step Driver Unit at fail.
Following errors are detected:

- At low 24Vdc Supply , <17Vdc
- At short circuits or overload, >7Amps.
- At high case temperature, >185°F (85 °C).

Relay output at TB5-22/23/24, switches at fail and is available for Error-indication.
The Driver Unit is automatically reset when the fail is corrected, but can be reset manually as well.

Jumper 'H/F' controls Half-step or Full-step function

'H/F' closed: Full-step function. Both motorwindings energised at the same time.
'H/F' open: Half-step function. Only one motorwinding at a time is energised. Resolution is doubled.
Jumper ' Boost' closed will increase the motor currents by 25% of the adjusted currents (both Drive current and Steady State current).

3.5 Feedback Transmitter, FT-200 (option).

FT-200 is a small optional Printed Circuit Board that can be plugged into card connector J6 on the Main PCB.
FT-200 is a 2-wire transmitter for 1kohms potentiometer input and 4 - 20 mA output.
FT-200 can be supplied externally from 11 up to 35Vdc power supply or from IC3000 internal 24Vdc supply.
The output current can be externally loaded by applied DC-voltage less 11 Volts.
Example
At 24Vdc supply: (24 - 11)/20 mA = 0.650 kohm.

Output current 4 - 20 mA can be checked by a mA-meter connected to the testpoints TP4± on the main PCB. These testpoints can also be used for permanent installation of a local position- indicator (digital or analog mA-meter, Ri max 10 ohms).

Zero and Range are adjusted with two of each other independent trim-potentiometers.
Two **Jumpers J1 and J2** are used for course adjustment of Zero (see 6.2.2).

The Feedback-potentiometer can have normal or reversed function for increasing output position. There is a 4-pos. DIL-switch, **Sw1**, installed on FT-200 to choose between Normal and Reversed input function (see 6.2.1).

All active inputs and outputs have HF-filters installed and the IC3000 Main PCB.
Transient Protection installed on FT-200 PCB.

4. Functional Description

IC3000 is designed for accurate positioning of control valve actuators with a 2-phase step-motor for max. 3,5A phase-current (continuos operation).

4.1 Power Supply

IC3000-AC can be powered with 85 - 264Vac, 47 - 440Hz without any range switch for mains. Incoming mains fused by a 3.15A, slow-blow, 4 x 20 mm fuse (F2). The built-in 24V/110W switched Power Supply Unit, supplies the unit incl. a 5Vdc-regulator for the internal TTL logic's.
IC3000-DC can be supplied by 22 - 30 Vdc. Power is fused by a 6A, slow-blow, 4 x 20 mm fuse (F2).

A fused +24Vdc output on TB3-5/6 (1A, slow-blow, 4 x 20 mm fuse, F1) is available for external use (i.e. controlcircuits).

4.2 Control inputs

With 24Vdc **Increase/Decrease**-signals on TB3-8 resp. TB3-10, one can step motor forward or backward, as long as the signals appears at the terminals. The 24V signal energises the Increase-relay (RL1) or the Decrease-relay (RL2). The relay-coils resistance is 3,8 kohm and needs 6,1 mA (see 10, IC3000/3).
In series with the relays are LED's connected, one for Increase and one for Decrease, that will light when an input is energised.
In series with the relays are also internally corresponding **limitswitches** connected. The switches are normally adjusted to 0% and 100% position. The limitswitches are normally not activated and electrically closed.
When a limitswitch is activated the control signal will brake and prohibit the Step Motor to drive towards a mechanical stop.
The motor will not be damaged if a limitswitch should fail.

4.3 Reversing of motor function

The mounting position of the motor on an actuator will affect whether the motor has to rotate clockwise or counter clockwise (seen towards the shaft end) to move output shaft from 0% towards 100% position.
To allow unchanged connection of the Increase resp. Decrease signals and unchanged function of the corresponding LED's, the actual motorfunction is programmed by a 4-pos. DIL-switch, Sw3 (see 6.1.3).

4.4 Step speed

The step speed is controlled by two individually adjustable pulse frequencies. These frequencies are adjusted by two trim potentiometers, **P1 (HIGH) and P2 (LOW)** mounted on the PCB.
The motor steps with one of the frequencies as long as an Increase or Decrease signal appears (one input-relay energised).
The choice of one of the step speeds, HIGH or LOW is made by 24Vdc signal on TB3-13, that energises the input relay, RL3 (in the same way as RL1 and RL2).
RL3 is normally **deactivated** with **low step speed** connected.
When RL3 is **energised, high step speed** is connected and the LED '**HIGH**', connected in series with the relay, lights.

Normally High step speed is used for **Manual Operation** and Low speed for **Computer Operation.**
In this case the High/Low-signal on TB3-12 will be used for switching between Manual- and Computer operation.

The three input signals (TB3-8, -10 and -12) can be controlled by potential free contacts or Open Collector Outputs.
The Input circuits can be energised either from the internal IC3000-AC PSU or from an external 24Vdc power.
Different power sources can be used at the same time, for example the internal PSU for Manual Control and an external power for Computer Control.
(If this is used the minus-pole of the external power will be connected to the IC3000 ground).

4.5 Error-detection and RESET

Failures in the Drive Unit (IC1) will cause the Drive Unit to stop working and disconnect all motor currents (even Steady State Current). The LED 'ERROR' will light and the RL4 relay-contact at TB5-22/23/24 will change status. At normal operation RL4 is energised and TB5-22/23 is closed. At fail RL4 is deenergised and TB5-22/24 will close.

Error is detected:

- At low Supply Voltage, <17Vdc
- At short circuit or overload, >7Amps.
- At high case temperature, > 185°F (85°C)

The Drive Unit cannot be **reset,** and go back to normal, until the fail is corrected. The unit is automatically reset when the failure disappear, but can also be manually reset by the RESET push button Sw2.

4.6 Adjustment of Motor-currents

On the Main PCB is a 8-pos. DIL-switch, Sw1, where the motor-currents are adjusted (Drive Current and Steady State Current, see 6.1.1).
The Drive Current has to be chosen dependent on installed motor-size and required torque.
The Steady State Current is chosen with respect to the required torque to keep actuator in a fixed position.
If the used actuator is 100% self-restrained no torque is required (no Steady State Current) when the motor cannot be driven backwards from the output shaft.
Steady State Current shall be adjusted to as low value as possible without jeopardising the function.

5. Installation

IC3000 is intended for installation in the field fairly close to the actuator.
The motor-cable from the IC3000 to the Step Motors shall not exceed 50 meters (150 feet).
The step motor will move unevenly with too long cable, depending on the cable's capacitance and resistance.
The signal cables can be up to 500 meters (1500 feet).

5.1 Mechanical Installation

IC3000 can be wall-mounted by 4 external mounting holes. The door hinges are always on the right side with cable entries through the bottom (see 10, IC3000-AC/4).

5.2 Electrical Installation

Electrical connection is shown in connection diagram, IC3000/3 (see 10).
The following types of cables are recommended:

Power Cable, to TB1:	EKKL 3G1.5 (ev. shielded)
Motor Cable, to TB2:	RKFK 5 G1.5 (shielded) alt. RKFK 5G2.5 (shielded)
Control Cable, to TB3:	LiYCY 4 x 1 (shielded)
Lim.sw/pot. Cable, to TB4:	PAAR-CY 4 x 2 x 0.5 (shielded)
Signal Cable, to TB5:	PAAR-CY 2 x 2 x 0.5 (shielded)

For good EMC protection, it is very important to ground all cable screens at the IC3000 EMC cable glands (see App. 1).
If IC3000 is installed in an environment where very high RF fields can be expected, the supply cable shall also carry a braided shielding.

It is vital that the free wires from cable glands to screw terminals are as short as possible and without any coils.

The TB1-PE, (incoming ground) in IC3000 is directly connected to the enclosure ground bolt by the yellow/green, RK1.5 wire (see 10, IC3000-AC/4).

IC3000-AC has no range-switch for Mains Supply and accepts power from 85 to 264Vac.
IC3000-DC power, +(plus) have to be connected to terminal marked L and –(minus) to terminal N.

It is important that the 'Increase/Decrease' and 'High' signals are connected with the correct polarity when the input relays are of polarised type.
If IC3000's internal 24Vdc is used to power the input circuits - then TB3-6 and -7 have to be shortened (see 10, IC3000/3).

If two different supplies are used, i.e. IC3000 internal 24Vdc for Manual control and one external 24Vdc for Computer control, then the external PSU minus-pole will be direct connected to IC3000 ground.
The Limit-switches (open/closed position) are connected in series with the Increase/Decrease inputs and disconnects the signal when a limitswitch is activated.
The Limitswitches are normally not activated and electrically closed.

5.3 Feedback-Transmitter, FT-200

The Main PCB has one Circuit-Board-Contact J6, for plug-in of a FT-200 card.
The FT-200 card is plugged in with the component side to the left.
The card-contact is keyed, therefore the FT-200 card only fits in this position.
The Testpoints TP4± on the Main PCB is connected to the 4 -20 mA output for testing purposes or for connecting a local mA-meter (Ri max 10 ohms).

6. Adjustment

6.1 On IC3000 Main Board

The IC3000 Main Printed Circuit Board contains the following adjustments:

6.1.1 Adjustment of Motor Currents

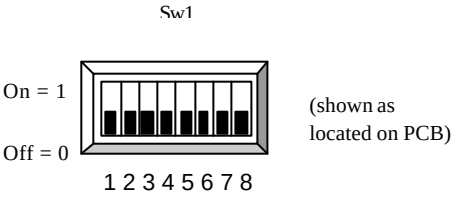
The adjustments are performed with the 8-pos. DIL-switch Sw1 according to the following table.

Sw1/ 1 - 4 Controls the Drive Current (Driving torque).
Sw1/ 5 - 8 Controls the Steady State Current (Holding torque).

Sw1/ 1 2 3 4 5 6 7 8	Current Amp
1 1 1 1	0.0
0 1 1 1	0.2
1 0 1 1	0.4
0 0 1 1	0.6
1 1 0 1	0.8
0 1 0 1	1.0
1 0 0 1	1.2
0 0 0 1	1.4
1 1 1 0	1.6
0 1 1 0	1.8
1 0 1 0	2.0
0 0 1 0	2.2
1 1 0 0	2.4
0 1 0 0	2.6
1 0 0 0	2.8
0 0 0 0	3.0

Note !! The Drive Units max. Capacity is 3.0 Amp continous and 5.3 Amp momentary operation

The 'Boost'-function increases the motor currents shown in the table by 25%.



(shown as located on PCB)

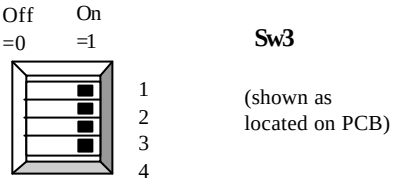
6.1.2 Adjustment for different motor mounting

In **Normal** motor operation an 'Increase' signal on TB3-8, will rotate the motor shaft clockwise (seen from the shaft) and is connected in series with the limitswitch on TB3-13/14. This switch is activated at the 100% position.
The 'Decrease' signal on TB3-10, will rotate the motor shaft counter-clockwise (seen from the shaft), and is connected in series with the limitswitch on TB3-15/16. This switch is activated at the 0% position.

In **Reversed** motor operation the 'Increase' signal on TB3-9, will rotate the motor shaft counter-clockwise (seen from the shaft) and connected in series with the limitswitch on TB3-15/16 (activated at the 100% position).
The 'Decrease' signal will rotate motor shaft clockwise (seen from the shaft) and connected in series with the limitswitch on TB3-13/14 (activated at the 100% position).

Switching between these two operations is performed by the 4-pos. DIL-switch Sw3:

Function	Sw 3/ 1 2 3 4
Normal	0 1 0 1
Reversed	1 0 1 0



6.1.3 Adjustment of Step speed

The step speeds are adjusted with the two trim potentiometers P1 and P2 on the Main PCB.
Higher speed shortens Stroking Time.
Stroking Time is measured from 0% to 100% position at continuos movement.

Low speed, normally used for '**Auto (Comp)**'-operation (input signal TB3-12 **not** activated) the step speed is adjusted with P2 until suitable Stroking Time is achieved for Computer Operation.
High speed, normally used for '**Manual**' operation (input signal TB3-12 activated, LED ' High' lit) the step speed is adjusted with P1 until suitable Stroking Time is achieved for Manual Operation.

Jumper 'H/F' controls Half-step or Full-step function.

'H/F' closed: Full-step function. Both motor windings energised at the same time.
'H/F' open: Half-step function. Only one motor winding at a time is energised.
Motor current and output torque will not change.
In Half step the Stroking Time will be doubled.

The step frequency can be adjusted (normally) within 2 to 400 steps/sec.
The step frequency can be increased further, but the output-torque from motor will decrease at increasing frequency (Contact Peab for further information if needed).
The step frequency can be measured on testpoint TP3 to TP5 (ground) using an IC3000T tester or other instrument that measures frequency.
Pulse forms can be checked by using an oscilloscope or similar instrument (see 9.1.3).

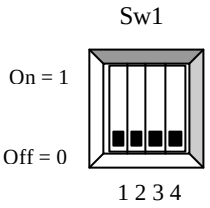
6.2 Feedback Transmitter, FT-200.

The FT-200 card allows the following adjustments.

6.2.1 Normal or Reversed Feedback potentiometer.

With the 4 pos. DIL-switch, Sw1, switching between Normal and Reversed potentiometer function is performed.
Normal function means when **increasing** resistance between TB4-17 and -18 corresponds to increasing output position.
Reversed function means when **decreasing** resistance between TB4-17 and -18 corresponds to increasing output position.

Function	Sw 1/ 1 2 3 4
Normal	0 1 0 1
Reversed	1 0 1 0



(shown as located on PCB)

6.2.2 Zero-adjustment, 4 mA.

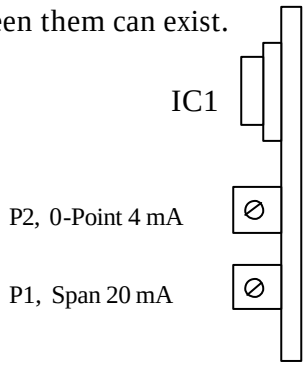
FT-200 Zero has one coarse adjustment and one fine adjustment.
Coarse adjustment is done by the **Jumpers J1 and J2.**
Using a 1000 ohms feedback potentiometer (standard) this will means:

J1 closed: Zero point can be adjusted between 0 to 400 ohms for 4 mA output.
J2 closed: Zero point can be adjusted between 350 to 750 ohms for 4 mA output.

The fine-adjustment to 4mA is done by the trim potentiometer P2.

6.2.3 Span adjustment, 20 mA.

The span (full scale) adjustment is performed by trim potentiometer P1 to 20 mA output.
The span can be adjusted within 50 to max 1000 ohms.
When adjusting the transmitter, the zero and span adjustments may have to be repeated when a minor interaction between them can exist.



Shows FT-200 PCB position on motherboard

7. Using IC3000 with SKF CRAB Actuators

7.1 Introduction

IC3000 can normally be used as a general Step Motor driving system.
However, this chapter will discuss the IC3000 connected to a SKF CRAB Actuator.

7.2 Specification

Stroking Time:

SKF CRAB Actuator, 0 – 90°, 400 – 2 steps/sec., (max – min)

	Full step		**Half step**	
	Secs/90°	**Steps/90°**	**Secs/90°**	**Steps/90°**
Size 20	14	2800	28	5600
Size 30	22	4400	44	8800
Size 40	28	5650	56	11300

Motor torque:

Dependent on choice of motor-size.
Up to 10 Nm (90 lbf.in)

Output shaft torque (with standard step motors):

Size 20	180 Nm	1590 lbf.in.
Size 30	380 Nm	3360 lbf.in.
Size 40	580 Nm	5130 lbf.in.

Feedback Potentiometer:

1 kohms, 360 degrees, 0.1% linearity. 0 to 90 degrees on output shaft gives approx. 280 ohms. Normally elevated from approx. 400 to 650 ohms.

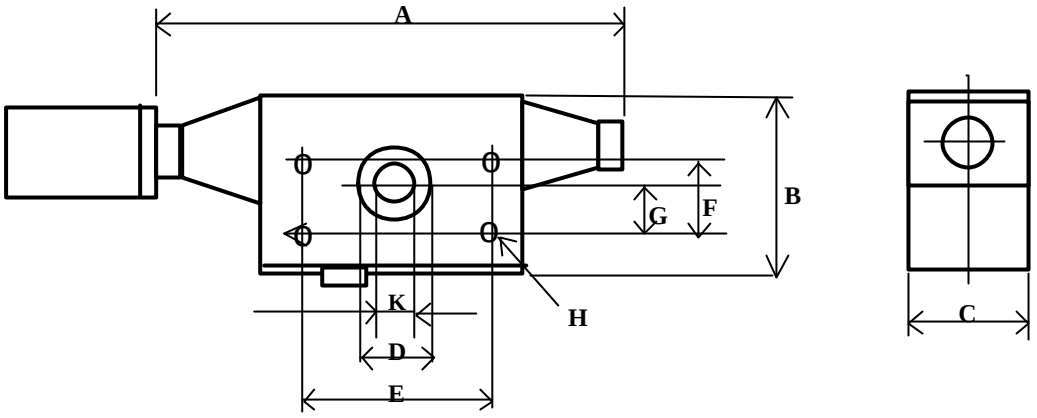
Actuator Weight (incl. yoke and motor):

Crab 20 :	(16 kg)	35 lb
Crab 30 :	(36 kg)	80 lb
Crab 40 :	(61 kg)	135 lb

Temperature range:

-20 to +60 Degree. C -4 to +140 Degree F

Dimensions:



Dim. in mm.

Crab Size	A	B	C	D	E	F	G	H	K max bore	Ratio	Eff.fact
20	306	155	90	50	120	50	35	8.5	35	1:56	0.75
30	455	228	122	80	176	85	60	10.5	65	1:88	0.75
40	565	285	134	100	230	115	80	12.5	80	1:113	0.75

Dim. in inch.

Crab Size	A	B	C	D	E	F	G	H	K max bore	Ratio	Eff.fact
20	12.05	6.10	3.54	1.97	4.72	1.97	1.38	0.33	1.38	1:56	0.75
30	17.91	8.98	4.80	3.15	6.93	3.35	2.36	0.41	2.56	1:88	0.75
40	22.24	11.22	5.28	3.94	9.06	4.53	3.15	0.49	3.15	1:113	0.75

7.3 Installation.

The **IC3000** is normally installed in the field fairly close to the actuator.
The motor cable from the IC3000 to actuator shall not exceed 50 m (150 ft).
The step motor will move unevenly with too long cable depending on the cable's capacitance and resistance.The signal cables can be up to 500 m (1500 ft).

Electrical Installation:

Following types of cables are recommended:

Power Cable, to TB1:	EKKL 3G1.5 (ev. shielded)
Motor Cable, to TB2:	RKFK 5 G1.5 (shielded)* alt. RKFK 5G2.5 (shielded)*
Control Cable, to TB3:	LiYCY 4 x 1 (shielded)
Lim.sw/pot. Cable, to TB4:	PAAR-CY 4 x 2 x 0.5 (shielded)*
Signal Cable, to TB5:	PAAR-CY 2 x 2 x 0.5 (shielded)

* These cables are normally supplied with the actuator incl. connectors.

Electrical connections are shown in drawing IC3000/3 and IC3000/6.

The Limit switch-cable (for LS1 and LS2) may have to be connected differently (see 10, IC3000/6) depending on actuator mounting to the valve (see next page).

Warning ! When changing a limit switch, be sure not to tighten the screws that hold the limit switch too much. The limit switch housing can be compressed and violate the function of the switch.

For good EMC protection it is very important to ground all cable screens at the IC3000 EMC cable glands (see App. 1).
If the IC3000 is installed in an environment where very high RF fields can be expected, the supply cable should also carry a braided shielding.

The TB1-PE, (incoming ground) in IC3000 is directly connected to the enclosure ground bolt by the yellow/green, RK1.5 wire (see 10, IC3000-AC/4).

7.4 Settings and adjustments.

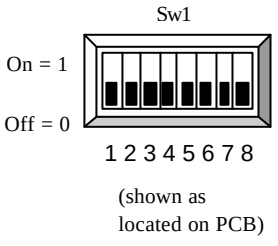
7.4.1 On IC3000 Main Board.

Setting Motor Currents.

Sw1/1-4 Sets the Drive Current.
Sw1/5-8 Sets the Steady State Current

Normal Settings are:

SKF CRAB	Sw1/ 1 2 3 4 5 6 7 8	Drive/Steady Amps
Size 20	0 0 1 0 0 1 0 1	2,2/1,0
Size 30	0 0 0 0 0 0 0 1	3,0/1,4
Size 40	0 0 0 0 0 0 0 1	3,0/1,4



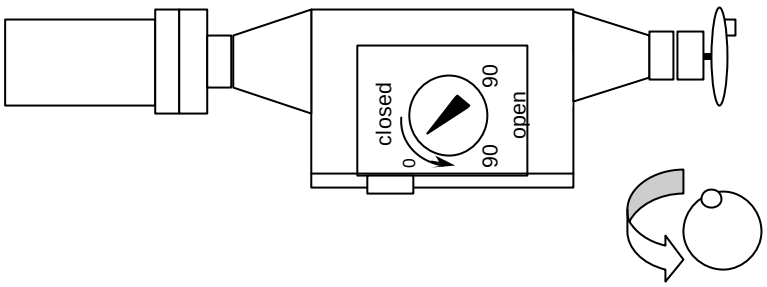
(shown as located on PCB)

Jumper 'H/F' = Open = Half Step Operation
Jumper 'Boost' = Open = No Boost Operation

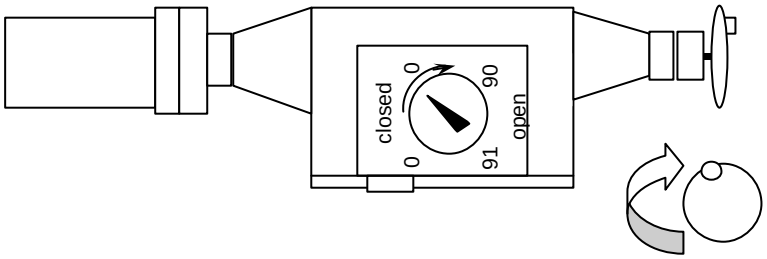
Settings for different Actuator mounting.

SKF CRAB Actuator can be mounted to the valve in four different positions.

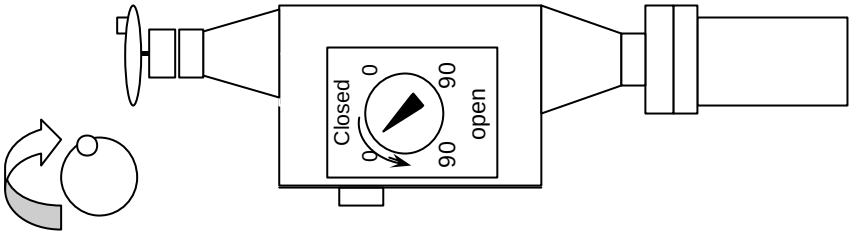
1. Motor Left hand mounted, Counter clockwise to open valve (CCW/LH).



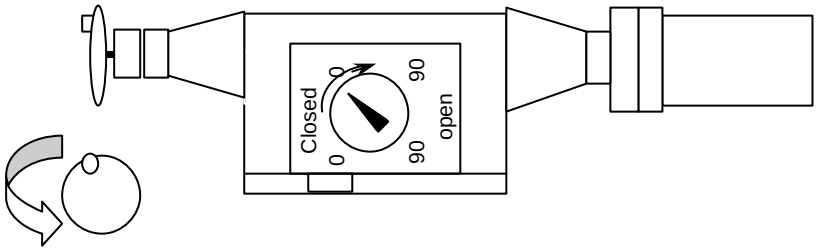
2. Motor Left hand mounted, Clockwise to open valve (CW/LH).



3. Motor Right hand mounted, Counter clock wise to open valve (CCW/RH).



4. Motor Right hand mounted, Clock wise to open valve (CW/RH).



Depending on actual configuration, switch SW3 may have to be set properly together with the connection of limit switches (see 10, IC3000/6).

Adjustment of step speeds

The relationship between step Frequency (**F** steps/sec) and stroking time (**T** secs) for CRAB Actuators are:

	Full Step operation	Half Step operation
Size 20	T = 2800 / F F = 2800 / T	T = 5600 / F F = 5600 / T
Size 30	T = 4400 / F F = 4400 / T	T = 8800 / F F = 8800 / T
Size 40	T = 5650 / F F = 5650 / T	T = 11300 / F F = 11300 / T

IC3000 is normaly delivered with following settings:

Low freq. = 25 steps/sec **High freq. = 250 steps/sec**

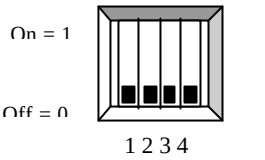
Jumper 'H/F' and Boost = Open (Half step and No Boost)

7.4.2 On FT-200 Board.

Switch Sw1:

Depending on Actuator Valve configuration (see fig 1), Sw1 have to be set as follows to always get an increasing mA-output for an increasing valve position.

Valve Opens	Motor mount.	Sw1 1 2 3 4
CCW	LH	1 0 1 0
	RH	1 0 1 0
CW	LH	0 1 0 1
	RH	0 1 0 1



(Shows as located on PCB)

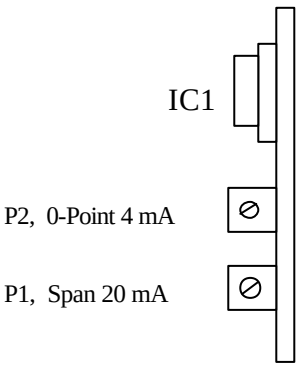
Zero Adjustment, 4 mA:

Make sure the FT-200 card is properly seated in its card connector and electrically connected according to drawning IC3000/5.
Adjust the valve to the closed position (0% open).
Adjust to 4,0 mA output with trim pot. P2.
If this is not possible, see 6.2.2 for changing Jumper J1/J2.

Span Adjustment, 20 mA.

Adjust the valve to fully open (100% open).
Adjust the trim pot. P1 to 20,0 mA output.

The zero and span adjustments need to be repeated when there is a minor interaction (especially when jumper J1/J2 have been changed).



Shows FT-200 PCB position on motherboard

8. Start up

Following startup and checkout procedure is easily performed by using a specially designed, **IC3000T Tester.**

1. Be sure that the electrical installation is OK.
2. Check that the Limit-switces are properly adjusted to 0% and 100% position. The switches shall open when activated.
3. If a FT-200 card is installed, be sure that the feedback potentiometer is correctly connected and that the card is correctly adjusted.
4. Check that all plug in screw connectors are properly seated.
5. Check that DIL-switch, Sw1 is correct adjusted for proper motor currents.
6. Check that DIL-switch, Sw3 is adjusted for actual function (motor mounting).
7. Check that the Jumpers 'Boost' and 'H/F' are correctly installed (normally open).
8. Switch on power and check that LED '+24V' and '+5V' are lit.
9. If LED 'ERROR' is lit - press 'RESET' push button. If 'ERROR' LED does not turn off, check connections of motor cable for shorts.
10. Check motor operation when applying Increase/Decrease signals (TB3-8 and -10) and check that the corresponding LED's 'Increase/Decrease' lights.

    When a limit-switch is activated the corresponding LED goes off and the motor stops. Check that the step-motor steps regulary.

    Adjust the step speed with potentiometer P2 to the appropriate stroking time. If the motor does not step regularly, decrease step speed until motor steps properly.
11. Activate the input signal for '**Manual**' operation TB3-12. LED 'High' shall light. Repeat the Increase/Decrease operations as above and adjust the potentiometer P1 to appropriate step speed for manual operation.
12. IC3000 is now ready to do its job.

9. Service and Spare Parts.

IC3000 is built up by a few main units so repair is performed by exchanging units. This type of repair can normally be executed in the field without dismounting the IC3000. Faulty units should then be returned to he manufacturer for repair and tests.
IC3000 has the following units:

1 off Power Supply Unit, PSU1 (IC3000-AC)
1 off IC3000 Main Printed Cirquit Board IC3000/2
1 off Step Driver Unit, IC1
1 off Feedback Transmitter, FT-200 (option)

9.1 Trouble shooting and repair.

Execute trouble shooting steps in the order described below:

9.1.1 Check PSU1

(see drawning IC3000-AC/2 or -DC/2).

1. Check if LED '+24V' is lit.
2. Measure Voltage between TP1 and TP5(ground) and eventually between J4-1 and J4-2.
   If +24Vdc exists but the LED does not light change the Main PCB (CR1 or R1 faulty).
3. Check incoming power between terminal L and N and that the fuse F2 (3 A for -AC or 6A for -DC) is OK.
4. **For IC3000-AC:** Check incoming power on terminal J5-1 and –2. If power exists on L and N but not on J5-1 and –2, exchange the Main PCB. (Mains Filter MF1 defect).
   If power exists on J5-1 and -2 but not 24Vdc on TP1 and TP5, check if 24Vdc exists on J4-1 and -2 when J4 is withdrawn. If so a failure exists in either the PSU1, Driver Unit IC1 or the step-motor.
   If there is no 24Vdc when incoming power is OK, then exchange the PSU1.
5. When PSU1 is dismounted (2 screws), unscrew the Cooling flange and check the Built-in fuse (F1, 5A) on the PSU board.

9.1.2 Check the Fan.

1. Be sure the Plug in contact J3 is properly seated.
2. Check that the fan rotates without any disturbing noise and that you can feel air blowing out from the fan with your bare hand.

9.1.3 Check the Step Driver Unit, IC1.

1. If LED 'ERROR' is **lit** then press 'RESET' push button. If LED does not go off proceed as follows.

a) Check existence of 24Vdc between TP1 and TP5. Must exeed +17Vdc. If it is low, check if voltage rises to normal when TB2 is withdrawn (disconnecting motor). If so, then step motor or its cable is defective.
For IC3000-AC: If voltage is still low when TB3 is withdrawn, the Driver Unit IC1 or PSU1 is defective.
Check the Exchange Driver Unit first and check if the IC3000 is working. If not, change back to the old Driver Unit and exchange the PSU1.

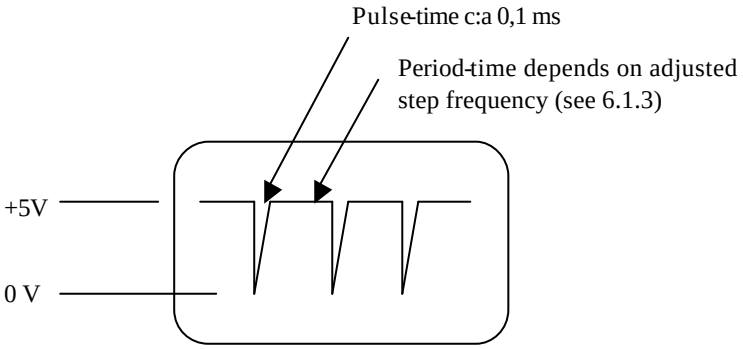
b) Check if the temperature on the Driver Unit is very high. Unit goes to 'ERROR' if the temperature is >80 - 85°C (174 - 183°F) within its case.
Check if the fan is working. The Driver Unit resets itself when the temperature goes lower than 80 - 85°C (174 - 183°F) and LED ' ERROR' goes off.

2. If LED 'ERROR' goes off but motor is not stepping, then:

a) Check the Increase/Decrease circuits and if 'INCREASE/DECREASE' LED's lights up correspondingly.

b) If IC3000 internal 24Vdc is used for the control circuits then check that fuse F1 (1A) is OK.

c) Using a **IC3000T – Tester,** check that the oscillator (IC3) generates pulses.
The pulses can also be measured with an Oscilloscope or similar instrument on TP3 to TP5 (ground).
The pulse frequency or period time depends on adjusted pulse frequency by trim potentiometers P1 and P2 (see 6.1.3) or if 'HIGH' is activated (TB3-12). The pulse shape should look like the example shown here:



If the pulse train exists approx. as above, the Drive Unit is defective and has to be exchanged.
If the pulse train does **not** exist, then the Main PCB has to be exchanged.

9.1.4 Check of Feedback Transmitter, FT-200.

1. Withdraw terminal TB4. Check that the feedback potentiometer is OK by resistance measurement between TB4-17/18 and -19 towards the potentiometer. If OK plug-in TB4.

2. Measure outgoing mA-current over TP4± (Ri max 10 ohm). If current is zero, check the current loop and power and that the external load does not exceed approx. 600 ohms.

3 Check the voltage over TB5-20 and -21. It must exceed 11Vdc at 20 mA. At lower currents the voltage is higher.

4. Measure the voltage over the feedback potentiometer at TB4-17 to -19. Shall be approx. 0.3 - 0.6Vdc (varies a bit depending on calibration).

If no voltage exists - then exchange the 16-pin chip, IC1 and check if the card is working. Otherwise, exchange the FT-200 card.

9.2 Spare parts

IC3000

Key	Label	Description	Type
1	IC1	Step Driver Unit	MSM 202 S C
2	PSU1	Switched PSU	NFS110-7624, 24V/4,5A
3	M1	Cooling-fan,12V	WEKB280DH1LP1100
4		Circuit Board 180 x 283 x 2 mm	IC3000/2
5		Enclosure, SST	P3-01-65157

FT-200:

Key	Label	Description	Type
1	FT-200	Feed-Back Transmitter	FT-200
2	IC1	Current Transmitter	XTR104AP

10. Drawings

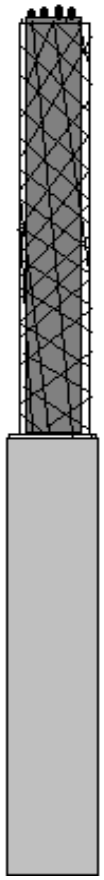
IC3000-AC/2	Circuit Diagram for IC3000 AC-version
IC3000-DC/2	Circuit Diagram for IC3000 DC-version
IC3000/3	Connection Diagram
IC3000-AC/4	Layout IC3000 AC-version
IC3000-DC/4	Layout IC3000 DC-version
IC3000/6	Connection Diagram for SKF CRAB-actuator
FT-200/1	Circuit Diagram for Feedback Transmitter
FT-200/2	PCB-layout, Feedback Transmitter
IC3000/5	Connection Diagram FT-200

Appendix 1.

Mounting instructions for cable glands

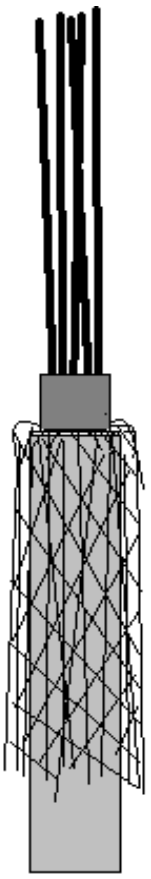
The IC3000 enclosure is equipped with grounded cable glands. The following steps show how to mount cable and shielding to these glands. This instruction shows mounting of the motor cable as an example.

Fig 1



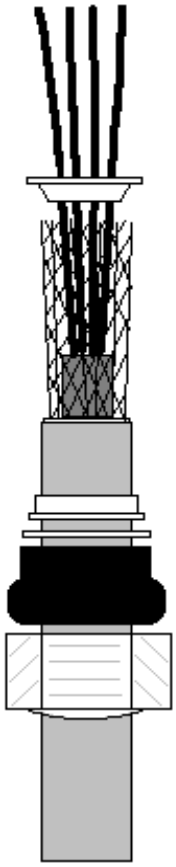
Cut off insulating of the PVC-shell to a suitable length.

Fig 2



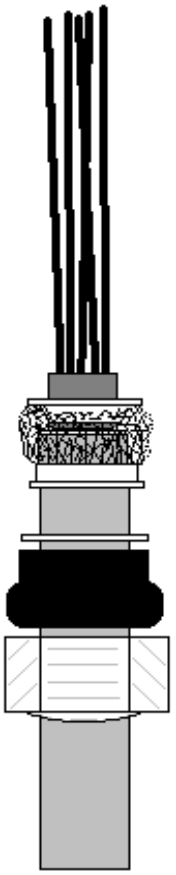
Fold shielding back and cut a second PVC layer to length specified in fig. 6

Fig 3



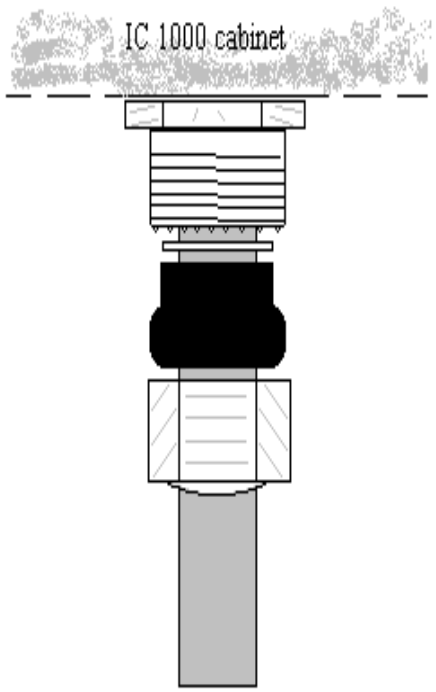
Mount cable gland parts according to fig 3.

Fig 4



Fold shielding backwards using the coned washer. Shielding is now pressed between the two bottom washers.

Fig 5



The amount of compressed shielding is importar for proper grounding.
Use as much as possible until it becomes impossible to tighten the gland nut at least one turn by hand. Then screw it together clockwise until it locks against the thorns on bottom part.

Fig 6

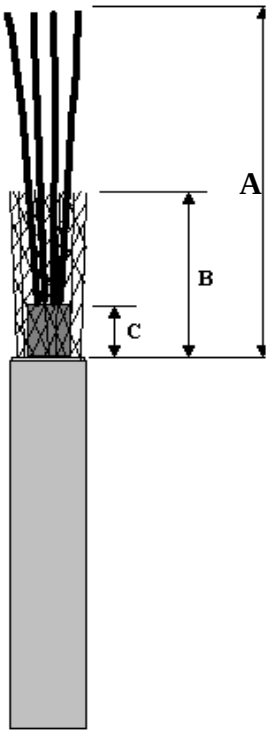


Fig 6 shows recommended steps to cut shielded cables.
On some cables, as feedback cable, there is no second PVC-layer. In those cases the C-step is not included.

Motorcable:

Type: **EKFR 5G 1,5**
alt. 5G 2,5

A: **75 mm / 3 IN**

B: **50 mm / 2 IN**

C: **20 mm / 3/4 IN**

Feedbackcable:

Type: **PAAR-CY 4x2x0,5**

A: **100 mm / 4 IN**

B: **50 mm / 2 IN**

Note: **For other cables, be sure the cable diameter fits to the cable gland.**

Appendix 2.

IC3000/mA for 4–20 mA Control Signal Input.

1. Introduction.

IC3000 can be delivered with a 3 point controller card, mounted inside the IC3000 enclosure, shown on drawing IC3000-AC/mA. This option can also be supplied to a IC3000/DC unit. The unit, IC3000/mA, will accept a 4–20 mA control signal input (setpoint). The actual actuator position, from a feedback potentiometer, is connected to the controller card as measured value input.
The controller has Increase/Decrease relay outputs that are directly connected to the IC3000 input terminals. The card is powered from IC3000 internal 24 Vdc.

2. Specifications.

Input Control signal:	4-20 mA over 500 ohms.
Power Supply:	20 - 30 Vdc, 1,5 VA
Feedback input:	Potentiometer , Standard 1000 ohms, Special 100 ohms to 10 kohms
Output:	2 off relay contacts, 250Vac/4A
Tripfunctions:	At control signal failiure (<2.8 mA), Go to 100%, stop or go to 0% (selected by Jumper J1)
Resolution:	<0,06%
Connector:	Screw terminal

3. Installation.

The 3 point Controller Card, type SRG222, has to be factory mounted, and will normally be adjusted to the highest resolution together with the actuator before delivery.

Electrical connection of a IC3000/mA is shown on drawing IC3000/12.

It is vital to check that the feedback potentiometer is connected in the right direction. Increased Control signal shall correspond to Increased Actuator position and Increased potentiometer signal to the SRG-card.

4. Adjustments.

If the IC3000/mA unit is supplied separately without an actuator, the unit will have to be adjusted together with the actual actuator to give the required accuracy.
The suitable stepspeed for the actuator is approx 20 steps/sec. Low Speed and Half or Full step operation.
To reached the trimpots on the SRG222 card, it may be necessary to dismount the card.

1. Coarse adjustment of the actuator's feedback potentiometer.

When the SRG trimpot 'A' for zero-adjustment of the feedback potentiometer has a limited range, one may need to adjust the mechanical position of the feedback potentiometer.

- Make sure the SRG trimpot A is not close to its end (to get max. adjustable range).
- Power up the system.
- Connect a current source to Control Input and set to 4mA.
- Loosen mechanically the feedback potentiometer and turn it until the actuator gets to approx. the 0% position.
- Tighten the feedback potentiometer in this position.
- Proceed with calibration as described below.

2. Adjustment of range and zero of the feedback potentiometer.

- Pull off jumper J1. Reinstall to desired fail function after completing calibration.
- During adjustment procedure the status of relays K3 and K4 can be observed on the corresponding LED's marked 'ZU' for K3 and 'AUF' for K4.
- Set control input to 0 mA. The actuator will move towards the 0% position.
- Adjust trimpot A clockwise until relay K3 deenergizes.
- Set control input to 16 mA. The actuator will move towards the 100% position. If 100% is not reached, adjust pot E clockwise until relay K4 deenergizes.
- Set control input to 20 mA. Relay K4 will energize.
- Adjust trimpot A counter-clockwise until relay K4 deenergizes but K3 is not being energized.
- If the actuator oscillates, adjust trimpot D counter-clockwise until the oscillation disappears.

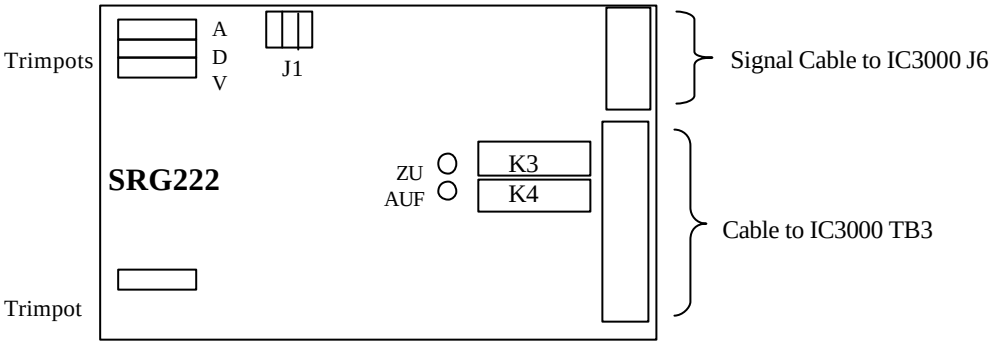
3. Final adjustment of zero and span.

- Set control signal to 4 mA. Actuator shall reach the 0% position. If K3 is still energized adjust pot A clockwise until K3 deenergizes but K4 does not energize. Adjust pot A counter-clockwise until the actuator is exactly at the 0% and neither K3 or K4 are energized.
- Set control signal to 20 mA. Actuator shall reach the 100% position. If K4 is still energized adjust pot E counter clockwise until K4 deenergizes but K3 does not energize. If K4 deenergizes before the actuator has reached the 100% adjust pot E clockwise until the actuator is exactly at the 100% and neither K3 or K4 are energized.

4. Final adjustment of deadband and filter.

- Make a final adjustment clockwise of pot D until the most accurate positioning of actuator will occur at small step changes in control signal input (0.2 – 0.5 mA) up and down without oscillations.
- Adjust finally pot V (filter) for best behavior at step changes. Filter effect is decreased at clockwise adjustments. At too high filter effect, the actuator will oscillate.

  The precision of positioning shall be better than 0.07% or +/- 0.01 mA changes.



See enclosed drawings **IC3000-AC/mA**
IC300012

For further information – please contact:

Peab Process AB

Ilanda Gård 120
S-653 50 KARLSTAD
SWEDEN

Phone **+46 54-53 07 50**
Fax **+46 54-53 18 51**

E-mail **info@peabprocess.se**