6 = 101
7 = 100

3.6.0 Leine & Linde 671

The Leine & Linde 671 encoder is a 128 resolution absolute encoder. The encoder works on 7bit that sends out in gray code and in connected to the PLC input channel a pull-up circuit [16]

3.6.1 Schneider electric XCC-AE7G10

The Schneider electric XCC-AE7G10 is a 1024 resolution absolute encoder. The encoder works on 10bit that sends out in gray code and is connected directly to the PLC input channel.

3.7 Step motor

Connected to each throttle lever is a step motor. For the purpose a 200-step 11DC SLO-SYN stepper motor have been used. The motor rotates 1.8 degree per step if full-step mode is used and 0.9 degree per step if half-step mode is used. When full-step mode is used the motor have a higher torque than in half-step mode. Full step mode maintain more current on the motor windings. To use the steps follow the input sequence diagram in the datasheet where it says how the sequence should go.
See attachment 2.

4 CoDeSys

The programming software used is CoDeSys. Development environment of CoDeSys supports different languages such as Sequential Function Chart (SFC), Function Block Diagram (FBD), Structured Text (ST), Ladder Diagrams (LD), Continuous Function Chart (CFC) and Instruction List (IL) in the model; SFC, FBD and LD and ST have been used. [18]

4.1 CoDeSys to PLC

To upload the program from CoDeSys to the PLC it important to select the right “Target setting” in CoDeSys. In this project a Wago 750-881 is selected and under “PLC

Attachment:

1. Terminal list table
2. Modbus address list
3. Signal cable list
4. XCC-AE encoder (datasheet)
5. SLO-SYN Stepper motor (datasheet)

Wednesday 27 November 2013

Control panel bridge

Connectors model	Contact terminal	Terminal nr.	PLS
Switch change captain	3	1	%IX0.0
Green light change captain	1	2	%QX0.0
Switch thruster up	3	3	%IX0.1
Green light thruster up	1	4	%QX0.1
Switch thruster down	3	5	%IX0.2
Green light thruster down	1	6	%IX0.3
Encoder for rotating thrsuter	A	7	%IX0.4
Encoder for rotating thrsuter	B	8	%IX0.5
Stepmotor relay 1	3	9	%QX0.3
Stepmotor relay 2	3	10	%QX0.4
Stepmotor relay 3	3	11	%QX0.5
Stepmotor relay 4	3	12	%QX0.6
Encoder for handler bit 1		13	%IX0.6
Encoder for handler bit 2		14	%IX0.7
Encoder for handler bit 3		15	%IX0.8
Encoder for handler bit 4		16	%IX0.9
Encoder for handler bit 5		17	%IX0.10
Encoder for handler bit 6		18	%IX0.11
Encoder for handler bit 7		19	%IX0.12
Encoder for handler bit 8		20	%IX0.13
Encoder for handler bit 9		21	%IX0.14
Encoder for handler bit 10		22	
		23	
		24	GND
GND(switch,light,encoder)		25	GND
Stepmotor relay	5	26	+11V
+24 (switch,light,encoder)		27	+24V
+24 (switch,light,encoder)		28	+24V

Control panel engine room

Connectors model	Contact terminal	Terminal nr.	PLS
Switch change captain	3	1	%IX0.0
Green light change captain	1	2	%QX0.0
Switch thruster up	3	3	%IX0.1
Green light thruster up	1	4	%QX0.1
Switch thruster down	3	5	%IX0.2
Green light thruster down	1	6	%QX0.2
Encoder for rotating thrsuter	A	7	%IX0.3
Encoder for rotating thrsuter	B	8	%IX0.4
Stepmotor relay 1	3	9	%QX0.3
Stepmotor relay 2	3	10	%QX0.4
Stepmotor relay 3	3	11	%QX0.5
Stepmotor relay 4	3	12	%QX0.6
Encoder for handler bit 1		13	%IX0.5
Encoder for handler bit 2		14	%IX0.6
Encoder for handler bit 3		15	%IX0.7
Encoder for handler bit 4		16	%IX0.8
Encoder for handler bit 5		17	%IX0.9
Encoder for handler bit 6		18	%IX0.10
Encoder for handler bit 7		19	%IX0.11
GND(switch,light,encoder)		20	GND
Stepmotor relay	5	21	+11V
+24 (switch,light,encoder)		22	+24V
+24 (switch,light,encoder)		23	

Modbus addresse list Read/Write

Read:

12288	%MW0 - inData[1]	-	Speed handler pos. from engine
12289	%MW1 - inData[2]	-	Master state from engine
12290	%MW2 - inData[3]	-	Master button from engine
12291	%MW3 - inData[4]	-	Light change captain blink slow from engine
12292	%MW4 - inData[5]	-	Light change captain blink fast from engine
12293	%MW5 - inData[6]	-	Thruster up from engine
12294	%MW6 - inData[7]	-	Thruster down from engine
12295	%MW7 - inData[8]	-	Thruster rotation pos. from engine
12296	%MW8 - inData[9]	-	
12297	%MW9 - inData[10]	-	

Write:

12298	%MW10 - outData[1]	-	Speed handler pos. to Java
12299	%MW11 - outData[2]	-	Master button to engine
12300	%MW12 - outData[3]	-	Master state to engine
12301	%MW13 - outData[4]	-	Light change captain blink slow to engine
12302	%MW14 - outData[5]	-	Light change captain blink fast to engine
12303	%MW15 - outData[6]	-	Thruster rotation pos. to engine
12304	%MW16 - outData[7]	-	Thruster Y pos. to Java
12305	%MW17 - outData[8]	-	Light thruster up to engine
12306	%MW18 - outData[9]	-	Light thruster down to engine
12307	%MW19 - outData[10]	-	Thruster rotation pos. to Java

Bridge panel

Cable nr.	Signal name	Color code
1	Thruster rotation encoder 1	White Orange
	Thruster rotation encoder 2	Orange
	Thruster up button	White Green
	Thrsuter down button	Green
	Change captain button	White Blue
	+24V	White Brown / Blue
	GND	Brown
2	Thruster up green light	White Orange
	Thruster down green light	Orange
	Change master green light	White Green
	GND	Brown
3	Speed handler relay 1	White
	Speed handler relay 2	Blue
	Speed handler relay 3	Brown
	Speed handler relay 4	Gray
	GND	Black
	(+)11V	Red
4	Bit1	Orange
	Bit2	White
	Bit3	Gray
	Bit4	Blue
	Bit5	Green
	Bit6	Fiolet
	Bit7	White Blue
	Bit8	White Green
	Bit9	White Brown
	Bit10	White Fiolet

Engine panel

Cable nr.	Signal name	Color code
1	Thruster rotation encoder 1	White Orange
	Thruster rotation encoder 2	Orange
	Thruster up button	White Green
	Thrsuter down button	Green
	Change captain button	White Blue
	+24V	White Brown / Blue
	GND	Brown
2	Thruster up green light	White Orange
	Thruster down green light	Orange
	Change master green light	White Green
	GND	Brown

3	Speed handler relay 1	White
	Speed handler relay 2	Blue
	Speed handler relay 3	Brown
	Speed handler relay 4	Gray
	GND	Black
	(+)11V	Red
4	Bit1	Brown
	Bit2	White Brown
	Bit3	Green
	Bit4	White Green
	Bit5	Orange
	Bit6	White Orange
	Bit7	Blue

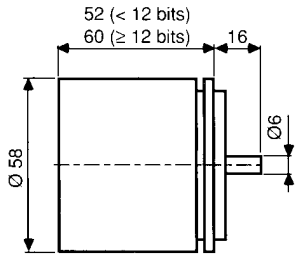
Absolute rotary encoders Ø 58

Size 23
Solid shaft Ø 6

Mechanical characteristics

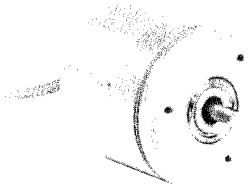
Enclosure material		Aluminium alloy
Shaft material		Stainless steel
Ambient air temperature		Operating : from 0 to + 70° C ; Storage : from - 30 to + 80° C
Shock resistance		10 g, (F = 10 to 2000 Hz) ; according to IEC 68 - 2 - 6
Shock resistance		30 g, duration 11 ms ; according to IEC 68 - 2 - 27
Max. operating speed (rpm)		6000
Max. shaft loadings (N)	Radial Axial	60 40
Max. moment of inertia of rotor/shaft (gcm^2)		45
Starting torque (N m)		IP 64 : $10x10^{-3}$; IP 68 : 15×10^{-3}
Shaft diameter (mm)		6
Number of bits (max.)		16
3 states control		See page 63

Connections



Signals	Shielded cable output Ø exterior 6,8 mm 7,5 mm Conductors: 15 (≤11 bits); 20 (≤16 bits)		Output via connector with 26 male contacts
Shield drain	Shield drain		V
0V Supply	Black	(0,22 mm^2)	W
Vdc Supply	Red	(0,22 mm^2)	X
0V Return supply			Y
Vdc Return supply			Z
MX 3 states	Brown	(0,12 mm^2)	a
LSB B1/G1	Orange	(0,12 mm^2)	A
B2/G2	White	(0,12 mm^2)	B
B3/G3	Grey	(0,12 mm^2)	C
B4/G4	Blue	(0,12 mm^2)	D
B5/G5	Green	(0,12 mm^2)	E
B6/G6	Purple	(0,12 mm^2)	F
B7/G7	White / Blue	(0,12 mm^2)	G
B8/G8	White / Green	(0,12 mm^2)	H
B9/G9	White / Brown	(0,12 mm^2)	J
B10/G10	White / Purple	(0,12 mm^2)	K
B11/G11	White / Orange	(0,12 mm^2)	L
B12/G12	White / Yellow	(0,12 mm^2)	M
B13/G13	White / Grey	(0,12 mm^2)	N
B14/G14	White / Black	(0,12 mm^2)	P
B15/G15	White / Red	(0,12 mm^2)	R
MSB B16/G16	Blue / Red	(0,12 mm^2)	S
IN Inhibition	Yellow	(0,12 mm^2)	b

Basic devices ; references to be completed



Degree of protection	Connection position	Connection	Reference	Weight Kg
IP 64	At the back	1m cable	**XCC-AE0 ✱●**	0,200
IP 64	Radial	1m cable	**XCC-AE1 ✱●**	0,200
IP 68	At the back	1m cable	XCC-AE6 ✱●	0,200
IP 68	Radial	1m cable	XCC-AE7 ✱●	0,200
IP 68 + IP 56 connector	At the back	1m cable + connector	XCC-AE8 ✱●	0,220
IP 68 +IP 56 connector	Radial	1m cable + connector	XCC-AE9 ✱●	0,230

References in bold type : short delivery products

To complete basic device references

1.Replace * by the corresponding, following letter

*	Output stage	Supply voltage (Vdc) ripple included + 5%, - 10%	Max. output voltage (Vdc)	Code	Type of link
B	**NPN**	**5**	**30**	**Gray**	**Parallel**
C	NPN	24	30	Gray	Parallel
D	NPN	5	30	Binary	Parallel
E	NPN	24	30	Binary	Parallel
G	PNP	24	24	Gray	Parallel
H	**PNP**	**24**	**24**	**Binary**	**Parallel**

2. Replace ● by the number corresponding to the standard number of points

●	04	06	07	08	09	10	11	12	13
	16	**64**	**128**	**256**	**512**	1024	2048	**4096**	8192
	Max. operating speed								
	6000	6000	6000	6000	3000	3000	1500	750	300

●	14	15	16
	16384	32768	65536
	Max. operating speed		
	300	300	150

References in bold type : short delay products

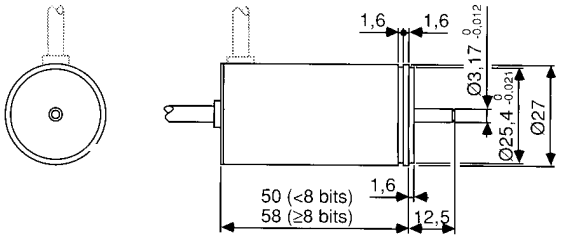
Example of order reference : XCC-AE1B12 This is an IP64 encoder; absolute, single turn; radial connection via 1m cable; NPN output; 5V supply; gray code; 4096 points/turn resolution.

Possible accessories

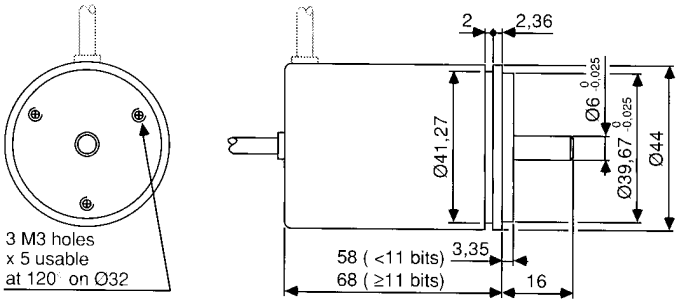
Description	Ø shaft mm	Reference	Weight Kg
Flexible shaft coupling	6 and 3,17	**XCC-ZA125**	0,012
	6 and 4	**XCC-ZA126**	0,014
	6 and 6	**XCC-ZA127**	0,015
	6 and 6,35	**XCC-ZA128**	0,016
	6 and 7	**XCC-ZA172**	0,018
	6 and 8	**XCC-ZA173**	0,021
Connections	Female plug connector	**XCC-ZC126**	0,060
	Straight sealing adaptor	**XCC-ZC326**	0,010
	Angled sealing adaptor	**XCC-ZC426**	0,010
Brackets	(lots of 3)	**XCC-ZM29**	0,006

Dimensions

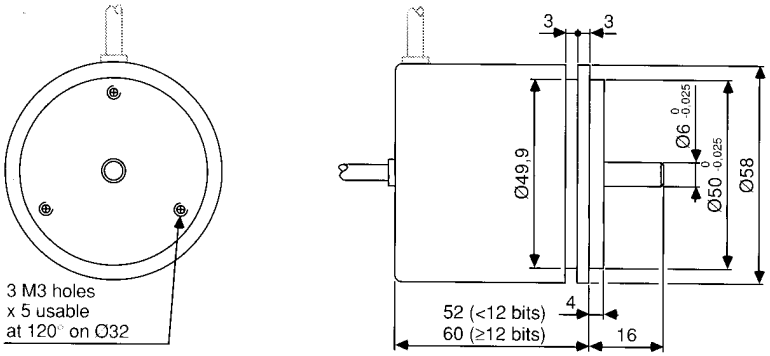
XCC-AB0•, AB1•



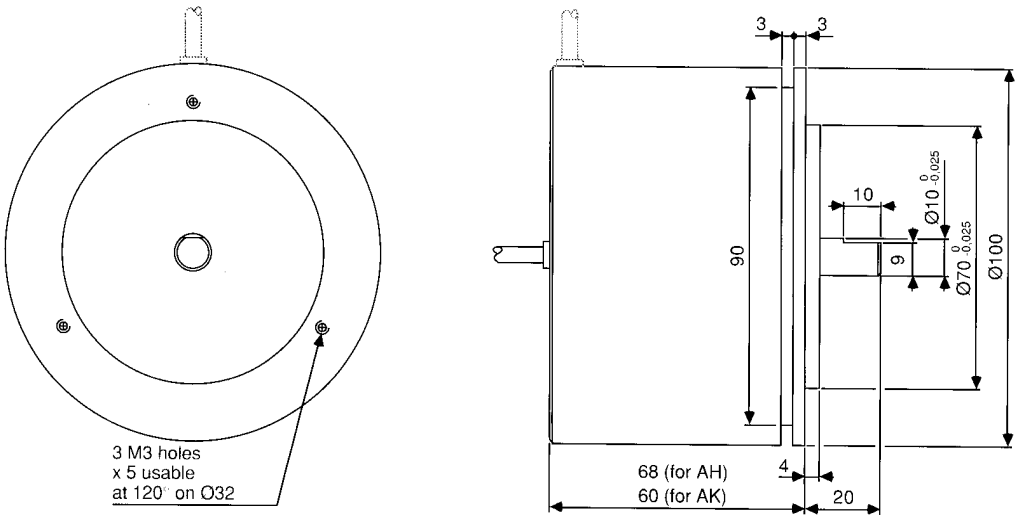
XCC-AD0•, AD1•, AD6•, AD7•, AD8•, AD9•



XCC-AE0•, AE1•, AE6•, AE7•, AE8•, AE9•



XCC-AH0•, AH1•, AH6•, AH7•
XCC-AK0•, AK1•, AK6•, AK7•



OPERATION

SLO-SYN Stepper Motors operate on phase-switched dc power. The motor shaft advances in steps of 1.8° (200 steps per revolution) when a four-step (full-step mode) input sequence is used and in steps of 0.9° (400 steps per revolution) when an eight-step (half-step mode) input sequence is used. Use of micro-stepping techniques allows step increments as small as 0.0144° (25,000 steps per revolution). Power transistors connected to flip-flops or other logic devices are normally used for switching as shown in the wiring diagrams. The four-step and eight-step switching sequences are given in the charts. The motors have high holding torque when not being stepped, because current is maintained on the motor windings.

FULL STEP (TWO PHASE ON)
ENERGIZING SEQUENCE

STEP	PHASE	
	A	B
1	+I	+I
2	+I	−I
3	−I	−I
4	−I	+I
1	+I	+I

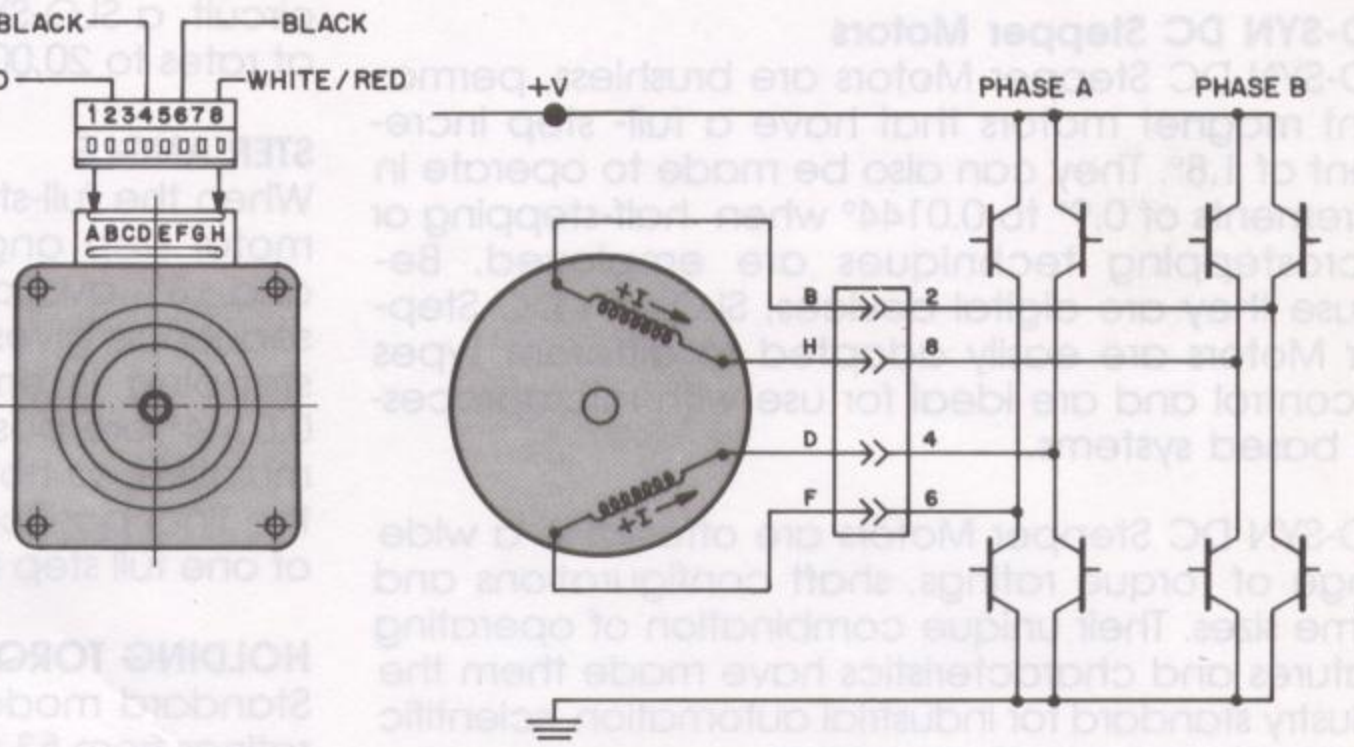
HALF STEP
PHASE ENERGIZING
SEQUENCE

STEP	PHASE	
	A	B
1	+I	+I
2	+I	0
3	+I	−I
4	0	−I
5	−I	−I
6	−I	0
7	−I	+I
8	0	+I
1	+I	+I

FULL STEP
(ONE PHASE ON)
ENERGIZING SEQUENCE

STEP	PHASE	
	A	B
1	+I	0
2	0	−I
3	−I	0
4	0	+I
1	+I	0

ROTATION IS CW AS VIEWED FROM NAMEPLATE.
FOR CCW ROTATION READ UP FROM BOTTOM.



4 LEAD CONNECTOR MOTORS

A215922 | Rev. B

CONNECTIONS AND SWITCHING SEQUENCE FOR FOUR-LEAD MOTORS

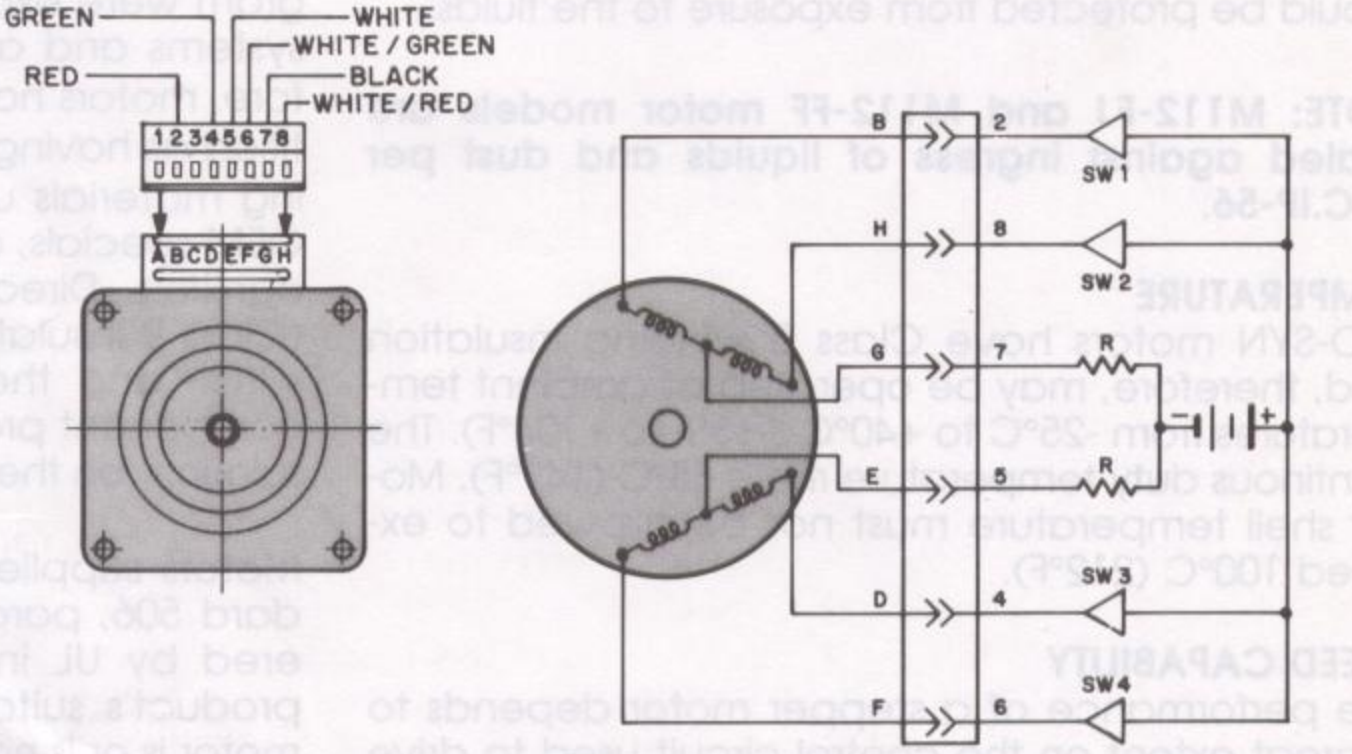
FOUR STEP INPUT SEQUENCE
(FULL STEP MODE)

STEP	SW 1	SW 2	SW 3	SW 4
1	ON	OFF	ON	OFF
2	ON	OFF	OFF	ON
3	OFF	ON	OFF	ON
4	OFF	ON	ON	OFF
1	ON	OFF	ON	OFF

EIGHT STEP INPUT SEQUENCE
(HALF STEP MODE)

STEP	SW 1	SW 2	SW 3	SW 4
1	ON	OFF	ON	OFF
2	ON	OFF	OFF	OFF
3	ON	OFF	OFF	ON
4	OFF	OFF	OFF	ON
5	OFF	ON	OFF	ON
6	OFF	ON	OFF	OFF
7	OFF	ON	ON	OFF
8	OFF	OFF	ON	OFF
1	ON	OFF	ON	OFF

ROTATION IS CW AS VIEWED FROM NAMEPLATE.
FOR CCW ROTATION READ UP FROM BOTTOM.



6 LEAD CONNECTOR MOTORS

C215462 | Rev. D

CONNECTIONS AND SWITCHING SEQUENCE FOR SIX-LEAD MOTORS