

ENGINEERING
TOMORROW



Technical Information

Joysticks

JS2000 Joystick



Revision history

Table of revisions

Date	Changed	Rev
May 2017	Updated to Engineering Tomorrow design	0102
November 2015	Converted to Danfoss layout	0101
March 2005	First edition	AA

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Overview

Description

The JS2000 contactless sensor joystick is a compact device designed for precision fingertip control applications where safety and long, trouble-free life are primary requirements. The compact design is ideal for mounting in low clearance locations such as seating armrests and chest packs. It is suitable for installation in the harsh environments of today's mobile machine operating environment.

This joystick is available with one, two or three axis of control and can accommodate a variety of grips including push-button switch versions.



Features and options

- Redundant sensors
- Contactless Hall effect sensing
- One, two or three axis control
- Multiple gate options
- Spring return to center
- Compact size
- Low operating forces
- Easy installation
- Operating life > 15 M operations
- IP 65 sealing above panel
- CE approved
- Multiple grip options, including twist Z axis

Product configuration model code

The product configuration model code specifies particular features when ordering the JS2000. The model code begins with the product family name and the remaining fields are filled in to configure the product with the desired features.

Model code summary

Product configuration model code

A					B		C					D		E		F	G	
J	S	2	0	0	0	X	Y	P	P	P	P	O	2	5	E	5	S	P

A—Product series

Code	Description
JS2000	Series JS2000 Joystick

B—Single or dual axis options

Code	Description
X	Single axis
XY	Dual axis

C—Axis and sensor options





Code	Description	Axis option
PPOOO	Dual sensor output—same sense	X axis
PNOOO	Dual sensor output—opposite sense	X axis
PPPPO	Dual sensor output—same sense each axis	XY axis
PPNNO	Dual sensor output—same sense X, opposite sense Y	XY axis
PNPNO	Dual sensor output—opposite sense each axis	XY axis
POPOP	Single sensor output—same sense each axis	XYZ axis
PONOP	Single sensor output—same sense X and Z, opposite sense Y	XYZ axis
PONON	Single sensor output—same sense Y and Z, opposite sense X	XYZ axis
NONON	Single sensor output—opposite sense each axis	XYZ axis

D—Output span

Code	Description	Axis Option
40	0.5 to 4.5 V DC nominal	X and XY


Product configuration model code

E—Grip options

Code	Description	Axis Option
<p>K1</p> 	Standard tapered grip	X and XY
<p>E</p> 	Ergonomic grip	X,XY,XYZ
<p>E1 - E5</p> 		
E1	Ergonomic grip w/ black push button	X, XY, XYZ
E2	Ergonomic grip w/ red push button	X, XY, XYZ
E3	Ergonomic grip w/ green push button	X, XY, XYZ
E4	Ergonomic grip w/ yellow push button	X, XY, XYZ
E5	Ergonomic grip w/ blue push button	X, XY, XYZ
<p>S</p> 	Straight grip	X and XY


Product configuration model code


E—Grip options (continued)


Code	Description	Axis Option
S1 - S5		
S1	Straight grip w/ black push button	X and XY
S2	Straight grip w/ red push button	X and XY
S3	Straight grip w/ green push button	X and XY
S4	Straight grip w/ yellow push button	X and XY
S5	Straight grip w/ blue push button	X and XY


F—Gate options


Code	Description	Axis Option
1	Single axis	X
R	Round	XY, XYZ
S	Square	XY, XYZ
D	Diamond	XY, XYZ
C	Cross X	XY, XYZ
P	Plus +	XY, XYZ



Single axis
Code 1


Round
Code R



Square
Code S


Diamond
Code D


Cross x
Code C


Plus +
Code P

Switch color option

	Code	Button
	1	Black
	2	Red
	3	Green
	4	Yellow
	5	Blue

G—Guided or non-guided option

Code	Description	Axis Option
N	Non-guided feel	X, XY, XYZ
P	Guided feel	XY, XYZ

Product configuration model code

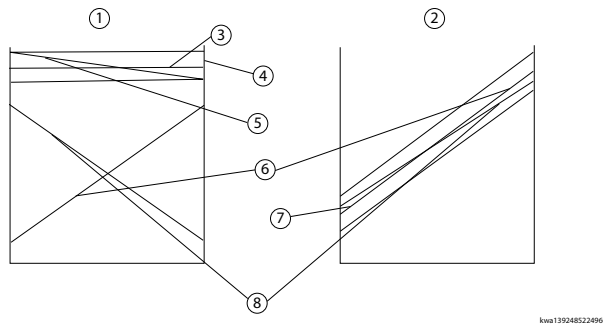
Output sense (direction)

The dual outputs from any JS2000 joystick can be configured in one of two possible ways. These are designated within the joystick model code as *same sense* (P) or *opposite sense* (N). Refer to the following *Output sense (direction) diagram* for clarification.

The slopes at the lower end start at 20% of supply voltage range (Vs) and at the upper end finish at 80% of Vs.

In the *same sense* configuration, the outputs of an axis can be directly compared to determine the serviceability of the joystick. In the *opposite sense* configuration, the sum of the outputs from any axis should be equal to the applied voltage.

Output sense (direction) diagram



- | | | | |
|----------|--|----------|---|
| 1 | Oposite sense | 5 | Sum of outputs 1 and 2 |
| 2 | Same sense | 6 | Output 1 |
| 3 | Maximum difference sum to supply voltage | 7 | Maximum difference between output 1 and 2 |
| 4 | Supply voltage | 8 | Output 2 |

Dual JS2000 output signals (X and XY options)

Each joystick axis is equipped with two outputs and it is recommended that both outputs are continuously compared to ensure that the difference does not exceed the maximum specified difference plus an appropriate safety margin. In addition, machine movement should not be enabled until both outputs from any one axis exceed the center threshold voltage plus a suitable safety margin (for example twice the joystick center deadband).

The outputs in normal use should be within the limits 0.35 to 4.65 V DC. Any output significantly outside of this range must be regarded as erroneous and appropriate safe action taken. A high value pull-up or pull-down resistance should be added to the X and Y outputs such that in the unlikely event of a wire or connector failure, the output will be pulled out of range.

Single outputs (XYZ option)

Where a joystick incorporating only a single sensor per axis is used to control safety critical functions, an independent momentary action system enable switch should be provided.

Center tap

A center tap is provided as a means of verifying the integrity of the Vs at the joystick. Clearly a high resistance or open circuit in either the Vs or ground connections will affect the joystick outputs. The normal output at the center tap connection is 49.16 to 50.84% of Vs. A center tap output outside this range indicates a fault in the supply to the joystick Hall sensors.

Product configuration model code

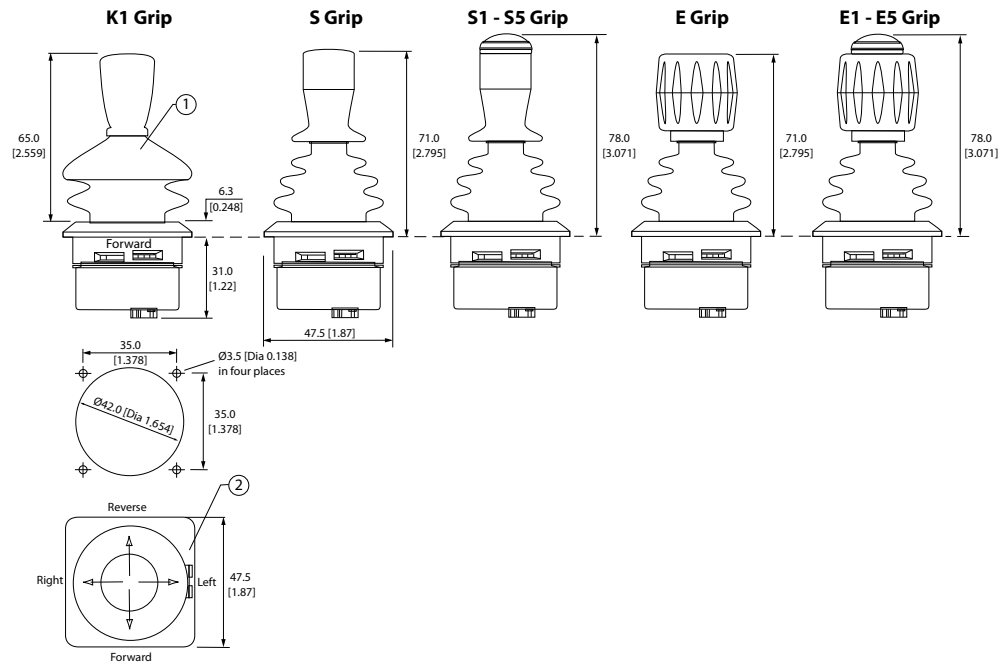
Output impedance

Joystick outputs at the center position and the end of travel are specified with infinite load impedance or zero current. The effect of adding finite load impedance will be to source or sink current through the joystick output impedance. The voltage dropped through the joystick output impedance must be taken into account when the system threshold voltages are being defined.

Product installation

Dimensions and mounting

Mounting dimensions in millimeters [inches]



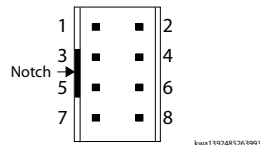
kwa1392485256163

- 1 Optional boot protector supplied on K1 only
- 2 Flange dimension 44.3 [1.744] square (with trim plate removed)
 4 off through holes Ø3.3 [Dia 0.13], countersunk on top surface

Product installation

Connector pin assignments

Bottom view of joystick connector



Pinout and wiring information

Pin	XY Joystick	XYZ Joystick
1	Supply voltage	
2	Left/Right output 1	Left/Right output
3	Ground	
4	Forward/Reverse output 1	Forward/Reverse output
5	Forward/Reverse output 2	5 V DC
6	Center tap	
7	Left/Right output 2	Z axis output
8	Switch output (NC if no switch)	

! Caution

Red lead on Danfoss mating connector kit is assigned to pin 8.

Mating connector details

Mating connector

Connector	Ordering number
8-pin FCI Minitek	98414-F06-08U shrouded IDC header
8-pin FCI Minitek	89361-708 IDC connector

Mating connector assembly

Type	Danfoss ordering number
Connector with 400 mm [15.75 in] ribbon cable	10102031

Product installation

Machine wiring guidelines

- Protect wires from mechanical abuse, run wires in flexible metal or plastic conduits.
- Use 85° C (185° F) wire with abrasion resistant insulation and 105° C (221° F) wire should be considered near hot surfaces.
- Use a wire size that is appropriate for the module connector.
- Separate high current wires such as solenoids, lights, alternators or fuel pumps from sensor and other noise-sensitive input wires.
- Run wires along the inside of, or close to, metal machine surfaces where possible, this simulates a shield which will minimize the effects of EMI/RFI radiation.
- Do not run wires near sharp metal corners, consider running wires through a grommet when rounding a corner.
- Do not run wires near hot machine members.
- Provide strain relief for all wires.
- Avoid running wires near moving or vibrating components.
- Avoid long, unsupported wire spans.
- Ground electronic modules to a dedicated conductor of sufficient size that is connected to the battery (-).
- Power the sensors and valve drive circuits by their dedicated wired power sources and ground returns.
- Twist sensor lines about one turn every 10 cm (4 in).
- Use wire harness anchors that will allow wires to float with respect to the machine rather than rigid anchors.

Warning

Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. The module will be powered up if battery voltage is applied to the module's output pin. To protect against unintended movement, secure the machine.

Caution

Warranty will be voided if module is damaged.
Avoid significant current driven back through an output pin.

Joystick safety critical functions

For a system to operate safely it must be able to differentiate between commanded and uncommanded inputs. Take steps to detect and manage joystick and system failures that may cause an erroneous output.

For safety critical functions Danfoss recommends you use an independent momentary action system enable switch. You can incorporate this switch into the joystick as an operator presence switch or can be a separate foot or hand operated momentary switch. Disable all joystick functions that the joystick controls when this switch is released.

Ensure the control system looks for the appropriate system enable switch input before the joystick is displaced from its neutral position. Enable functions only after receiving this input.

Applications using CAN joysticks should continuously monitor for the presence of the CAN messages on periodic basis. Messages are to be checked frequently enough for the system or operator to react if the CAN messages lose priority or are no longer received.

Product installation

Output Noise

The JS2000 incorporated Hall effect sensors to detect the position of each of the joystick axes. A side effect of the use of these sensors is electrical noise superimposed on the output signal, nominally 20 mV peak to peak. The application program can filter out this noise.

Magnetic immunity

The use of the JS2000 in close proximity to sources of high magnetic fields is not recommended.

Supply voltage

The JS2000 is designed to operate from a regulated 5 V DC \pm 0.5 V DC supply that is free from transients. Joystick outputs are ratiometric and are therefore a function of the input voltage.

Product specifications

Mechanical characteristics

XY Axis

Shaft operation force (applied at top of grip)

Breakout	1 N (0.22 lbf) nominal
Operating	2 N (0.45 lbf) nominal, full deflection
Maximum allowable	300 N (67.44 lbf) XY option, 195 N (43.84 lbf) XYZ option

Shaft mechanical angle

Single axis option	± 20° forward/reverse
Round gate, XY option	± 20°
Square and Diamond gate, XY option	± 20° to corners, ± 14° to flats
Cross and plus gate, XY option	± 20° at extent of axes

Expected life

Expected life	15 M operations
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Weight

Weight	90 g (0.20 lb) base without grip
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Z Axis

Operating torque

Breakout	0.04 N.m (0.03 ft.lb)
Operating	0.06 N.m (0.04 ft.lb)
Maximum allowable	1.0 N.m (0.74 ft.lb)

Mechanical angle

Mechanical angle	± 20°
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Expected life

Expected life	5 M operations
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Product specifications

Electrical characteristics

Electrical

Sensor type	Hall effect
Resolution	Infinite
Supply voltage range (Vs)	5 V DC \pm 0.5 V DC, regulated
Over voltage, maximum	15 V DC
Reverse voltage, maximum	14.5 V DC
Output voltage range X and XY, \pm 40% span	Nominal 0.5 to 4.5 V DC
Output voltage range XYZ, \pm 25% span	Nominal 1.1 to 3.0 V DC
Output impedance	100 Ω each axis
Center tap voltage (no load)	50% Vs \pm 1%
Center tap impedance	1.1 k Ω
Return to center voltage (no load)	X and Y axis—within \pm 60 mV of Vs/2 at 20°C (68°F), \pm 73 mV over full temperature range Z axis—within \pm 100 mV of Vs/2 @ 20°C (68°F), \pm 100 mV over full temperature range
Current consumption	17.5 mA, nominal
Output sense, XY axis	The twin outputs of the XY axis can be independently selected to be rising together in the same direction (PP) or opposed (PN).
Output sense, Z axis	The three axis option can only provide a single output per axis.

Environmental characteristics

Environmental

Operating temperature	-25°C (-13°F) to 70°C (158°F)
Storage temperature	-40°C (-40°F) to 70°C (158°F)
Ingress Protection (IP) rating	IP 65, above panel
EMC immunity level	60 V/m (25 MHz to 1 GHz, 1 kHz sine wave modulation)
EMC emissions level	Complies with EN50081-1 (1992), 30 MHz to 1 GHz
ESD immunity level	\pm 8 kV Contact discharge; 15 kV air discharge (10 discharges)

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