JC 2000
Contactless Multi-axis Joystick

Creative solutions for position measurement and control
The Penny+Giles JC2000 contactless joystick controller is designed for precision fingertip control applications where safety and long trouble-free life are primary requirements. It is available in one, two or three axis configurations and can accommodate a choice of handles, including push-button switch versions. The JC2000’s compact size, low operational force and high reliability are ideal for applications which include powered wheelchairs, disabled mobility vehicles, robotic teach controllers, co-ordinate measuring machines, medical and CCTV equipment, professional camera controls and radio or infrared chest-packs.

Innovative design

Hall effect sensors facilitate a contactless single, dual or three axis sensor system which is light and sensitive to operate and offers almost limitless life. Additionally the system eliminates the flexing wires associated with fatigue failure when handle switches are not fitted.

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
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<tbody>
<tr>
<td>• Compact size</td>
<td>• Minimal footprint and weight</td>
</tr>
<tr>
<td>• Depth below panel less than 31mm</td>
<td>• Suitable for low profile control panels</td>
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<tr>
<td>• Contactless sensing system</td>
<td>• Maintenance-free operation</td>
</tr>
<tr>
<td>• No flexing wires (except for handle switch functions)</td>
<td>• Improved reliability</td>
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<tr>
<td>• Dual independent outputs on single and dual axis versions</td>
<td>• Allows failure detection by comparing outputs</td>
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<tr>
<td>• Range of handles with or without switch</td>
<td>• Additional operator control functions</td>
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<tr>
<td>• Aligned seats (low force lever guidance)</td>
<td>• Improved operator control in pure X and Y directions</td>
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<tr>
<td>• Polarised latching connector</td>
<td>• Simple installation</td>
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<tr>
<td>• CE Approved</td>
<td>• Confidence in EMC performance</td>
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</table>

Selection Guide

Penny+Giles offers the widest choice of options to suit your application.

Single axis
JC2000-T-X

The single axis JC 2000 can be supplied with all handle options and provides a forward - reverse or left - right lever movement, determined by mounting orientation.

Two axis
JC2000-T-XY

The two axis JC 2000 can be supplied with all handle options and a choice of lever restricting gates to suit particular applications and control functions.

Three axis
JC2000-T-XYZ

The three axis JC 2000 is supplied with the rotating ergonomic (E) handle options only and a choice of lever restricting gates to suit particular applications and control functions.
Aligned seats and gates - improved control

Aligned axis seats for the X and Y axis are shaped with shallow guides to give a distinct direction for the lever. Moving the lever away from the distinct direction is possible, but an increased lever force is noticed. Lever extent restricting gates guide the full deflection movement of the lever, providing a choice of options to suit specific applications.

Safety

For super critical applications the single and dual-axis controller provides two independent outputs in each axis, which can be specified with outputs the same or opposed, allowing the signals to be monitored and compared for failure detection.

Total reliability

The contactless operating system provides a highly reliable solution allowing a fit and forget installation so that zero maintenance programmes can be incorporated within equipment service schedules.

Switches

Momentary action push-button switches are available in two handle styles, providing an additional finger operated control function.

Custom design

Penny+Giles offer an extensive range of joysticks as standard and can in many cases tailor the product to meet the customers exact requirements. Please talk to our technical sales team about your application.

Rapid availability

The JC2000 joystick is designed to provide the user with a wide choice of options allowing rapid build and despatch. Call your nearest sales office for the latest information.

Handle options

- Standard tapered X & XY axes Code K1
- Ergonomic X & XY axes Code E
- Ergonomic with button X, XY & XYZ axes Code E1 - E5
- Straight X & XY axes Code S
- Straight with button X, XY axes only Code S1 - S5

Gate options

- Single axis Code 1
- Round Code R
- Square Code S
- Diamond Code D
- Cross x Code C
- Plus + Code P

Switch options

- Black button Code 1
- Red button Code 2
- Green button Code 3
- Yellow button Code 4
- Blue button Code 5

Switches introduce connecting wires through the handle.
**MECHANICAL**

**XY axes**

- **Lever operating force**
  - Breakout: 1N nominal
  - Operating: 2N nominal (full deflection)
  - Maximum allowable: 300N (XY version) 195N (XYZ version)
- **Lever mechanical angle**
  - Single axis only: ±20° forward/reverse
  - Round gate: ±20°
  - Square and Diamond gate: ±20° to corners (±14° to flats)
  - Cross and Plus gate: ±20° at extent of axes
- **Expected life**
  - 15 million operations

**Z axis**

- **Operating torque**
  - Breakout: 0.04Nm
  - Operating: 0.06Nm
  - Maximum allowable: 1.0Nm
- **Mechanical angle**
  - ±20°
- **Expected life**
  - 5 million operations
- **Weight**
  - 90g without handle fitted

**ENVIRONMENTAL**

- **Operating temperature**
  - -25°C to +70°C
- **Storage temperature**
  - -40°C to +70°C
- **Environmental protection (above the flange)**
  - IP65 BS EN 60529
- **EMC immunity level**
  - 60V/m, 25MHz to 1GHz, 1KHz 80% sine wave modulation, EN50082-2 (Sept 1995)
- **EMC emissions level**
  - Complies with EN50081-1 (1992), 30MHz - 1GHz
- **ESD immunity level**
  - EN50082-2 (1995) ±8kV Contact discharge; ±15kV Air discharge (10 discharges)

**ELECTRICAL**

- **Sensor type**
  - Hall effect
- **Resolution**
  - Infinite
- **Supply voltage range (Vs)**
  - 5Vd.c. ±0.5Vd.c. regulated transient free
  - 15Vd.c. continuous
  - 14.5Vd.c.
- **Output voltage span**
  - X and Y axis: ±25 to ±30.6% with respect to Vs/2 (on axis for R, D and P gates)
  - Z axis: ±16.5 to ±21.4% with respect to Vs/2 (on axis for S gate, extents of C gate)
  - ±22 to ±32% with respect to Vs/2
- **Output impedance**
  - 100Ω each axis
  - 50%Vs ±1%
- **Centre tap voltage (No load)**
  - X and Y axis: Within ±60mV of Vs/2 @ 20°C (±73mV over full temperature range)
  - Z axis: Within ±100mV of Vs/2 @ 20°C (±113mV over full temperature range)
- **Centre tap impedance**
  - 1.1kΩ
- **Return to centre voltage (No load)**
  - X and Y axis: Within ±50mV of Vs/2 @ 20°C
  - Z axis: Within ±125mV of Vs/2 @ 20°C
- **Current consumption**
  - 17.5mA nominal

**OUTPUT SENSE**

- **XY axes**
  - The twin outputs of the XY axes can be independently selected to be rising together in the same direction (PP) or opposed (PN). See order code
- **XYZ**
  - The three axis version can only provide a single output per axis

**CUSTOM DESIGN**

- Custom handle styles. Alternative mounting flanges. Alternative gate geometry. Please contact our technical sales team.

* Measured 50mm above upper flange face
DIMENSIONS

ELECTRICAL CONNECTIONS

Connection
Mating Connector
Termination Details

8 Pin Berg Minitek™ 90309-008 Shrouded IDC Header
8 Pin Berg Minitek™ 89361-708 IDC Connector (order separately as P302137)
or supplied with 0.5 ribbon cable fitted (order as P302138)

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Description</th>
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<tr>
<td>XY Joystick</td>
<td>XYZ Joystick</td>
</tr>
<tr>
<td>1</td>
<td>Positive voltage supply</td>
</tr>
<tr>
<td>2</td>
<td>Left/Right output 1</td>
</tr>
<tr>
<td>3</td>
<td>Zero voltage supply</td>
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<tr>
<td>4</td>
<td>Forward/Reverse output 1</td>
</tr>
<tr>
<td>5</td>
<td>Forward/Reverse output 2</td>
</tr>
<tr>
<td>6</td>
<td>Centre tap</td>
</tr>
<tr>
<td>7</td>
<td>Left/Right output 2</td>
</tr>
<tr>
<td>8</td>
<td>Switch output (NC if no switch)</td>
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</tbody>
</table>

Switch is connected between pin 1 and 8

OUTPUT DETAIL

Output difference between sensor 1 & sensor 2 (same axis) with VS = 5V

<table>
<thead>
<tr>
<th>Output Voltage</th>
<th>Reverse Left</th>
<th>Forward Right</th>
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<tbody>
<tr>
<td>0.05%</td>
<td>46%</td>
<td>54%</td>
</tr>
<tr>
<td>0.017%</td>
<td>46%</td>
<td>54%</td>
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<tr>
<td>0.017%</td>
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<td>54%</td>
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<td>0.05%</td>
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<td>50%</td>
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</tr>
<tr>
<td>49.16%</td>
<td>50%</td>
<td>54%</td>
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Sealing the joystick to the panel

See panel mounting detail on page 5 for recommended machining detail to accept the JC2000. This is interchangeable with the Penny+Giles JC200 joystick mounting, as well as other manufacturers' alternatives.

Prior to installation check that the gate (travel limiter) positioned under the gaiter at the top of the joystick is correctly located and orientated.

The joystick is sealed above the mounting surface to prevent dust and water ingress to IP65 and is supplied with mounting hardware (sealing gasket and trim plate) suitable for mounting from above the panel face. The effectiveness of the seal is dependent on the mounting surface being sufficiently rigid to compress the sealing gasket. The finish of the mounting surface is critical to achieving an adequate seal and rough surface finishes, paint chips, deep scratches etc. should be avoided. The joystick should not be used if the flexible rubber gaiter becomes perforated.

Below the mounting surface the joystick should be allowed to breathe freely but be protected from excessive dust and direct water spray. Where the joystick is mounted in a control box, the box should be allowed to breathe at its lowest point. If the box is subjected to water spray it may be necessary to provide a waterproof breather at the lowest point.

It is possible to mount the JC2000 from under the panel surface by discarding the trim plate and compressing the base of the flexible gaiter against the panel and mounting flange. This reduces the lever height above the panel, but increases the space required to accommodate the joystick body below the panel. Please contact our technical sales team for details of recommended panel hole size if using this method.

Mechanical loads

Penny+Giles joystick controllers are robust and designed to suit typical applications. System designers should ensure that the joystick is not positioned where it could be subjected to abuse loads in excess of the maximum allowable load stated in the product specification.

Modification and usage

Any modification of the joystick by the user is strongly discouraged and will invalidate the warranty and Penny+Giles
The differences are shown in the diagrams below.

and at their upper end finish at 75% of supply voltage.

The slopes at their lower end start at 25% of supply voltage.

outputs; for single output or a Z axis either output 1 or 2 can

or 'opposite sense' (N). The diagrams below show dual

designated within the joystick specification as 'same sense' (P)

manufacture in one of two possible ways. These are

Dual outputs from any joystick axis can be configured during

connector failure the output will be pulled out of range.

the X and Y outputs such that in the unlikely event of a wire or

high value pull-up or pull-down resistance should be added to

regarded as erroneous and appropriate safe action taken. A

4.030V. Any output significantly outside of this range must be

suitable 'safety margin'. (e.g. 2 x joystick centre tolerance)

machine movement should not be enabled until both outputs

specified difference plus a suitable 'safety margin'. In addition,

ensure that the difference does not exceed the maximum

recommended that both outputs are continuously compared to

inputs are within the limits 0.970V to

The JC2000 joystick is supplied by Penny+Giles fully adjusted

and ready for installation. There are no user adjustable or

maintainable parts within the joystick. Any attempt to
dismantle the joystick will invalidate the warranty and may
leave the system into which the joystick is installed in a
dangerous condition.

Safety

For a system to operate safely it must be able to differentiate
between commanded and uncommanded outputs. System

designers should take steps to detect and manage joystick

and system failures that may give rise to an erroneous output.

For safety critical functions we recommend that an

independent momentary action 'system enable' switch is used.

This switch can be incorporated into the joystick as a 'dead-

man’ switch or can be a separate foot or hand operated

momentary switch. All functions controlled by the joystick

should be disabled when this switch is released.

The control system should look for the appropriate 'system enable'

switch output before the joystick is displaced from the

neutral position. Functions controlled by the joystick

should not be enabled until this is the case.

Dual outputs - X and XY versions only

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 a suitable 'safety margin'. In addition,

machine movement should not be enabled until both outputs

from any one axis exceed the centre threshold voltage plus a

suitable 'safety margin'. (e.g. 2 x joystick centre tolerance)

The outputs in normal use are within the limits 0.970V to

4.030V. 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

can fail the output will be pulled out of range.

Dual output sense (direction)

Dual outputs from any joystick axis can be configured during

manufacture in one of two possible ways. These are

designated within the joystick specification as 'same sense' (P)

or 'opposite sense' (N). The diagrams below show dual

outputs; for single output or a Z axis either output 1 or 2 can

be chosen.

The slopes at their lower end start at 25% of supply voltage

and at their upper end finish at 75% of supply voltage.

The differences are shown in the diagrams below.

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 within limits, equal the applied voltage.

Centre tap

A centre tapping is provided as a means of verifying the

integrity of the supply voltage at the joystick. Clearly a high

resistance or open circuit in either the +ve supply or 0V

connections will affect the joystick outputs. The normal output

at the centre tap connection is 49.16% to 50.84% of the

supply voltage. A centre tap output outside this range

indicates a fault in the supply to the joystick.

Single outputs - XYZ only

Where a joystick incorporating only a single sensor per axis is

used to control safety critical functions an independent

momentary action system enable switch must be provided.

Joystick integrity check on power up

On system power-up, the system should check that all joystick

outputs are in neutral and safety critical functions controlled by

the joystick should not be enabled until this is the case.

Output impedance

The outputs at the centre position and the end of travel are

specified with an infinite load impedance or zero current. The

effect of adding a 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. The impedance of the JC2000 outputs are

specified on page 4.

Output noise

The JC2000 incorporates 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,

typically of the order of 20mV peak to peak. This noise can be

simply filtered out by the user.

Magnetic immunity

Magnetic screening minimises the sensitivity to external

magnetic fields. However the use of the joystick in close

proximity to sources of high magnetic fields is not

recommended.

Applied voltages

The JC2000 is designed to operate from a regulated 5Vdc

±0.5V supply, free from voltage transients. Under no

circumstances should voltages above 5.5V be applied to the

joystick. The outputs from the JC2000 are ratiometric and are

dependent on the input voltage.

Life

Penny+Giles joysticks are designed and tested to provide a

working life that is acceptable for the majority of applications.

System designers should be satisfied that the life stated in the

joystick specification is sufficient for the intended application.
Available from Penny+Giles

A wide range of instrumentation for measurement and control solutions in industrial and aerospace applications. Please ask for more details.

Penny+Giles quality systems meet the requirements of ISO9001, the Civil Aviation Authority and numerous customer’s certification standards.

Quality is at the heart of all our systems ensuring the reliability of our products from initial design to final despatch.

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