



TYPE: Configured JC6000 Robust Joystick Controller

SPECIFICATION: JC6000-GEN

ISSUE: 25

DATE: 24th February 2015

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Introduction

The JC6000 Joystick offers many mechanical and electrical variations and option, which are defined in this specification. It has been designed to provide a wide range of unique features that provide excellent functionality. For example, the sensing technology can be either Hall Effect or Potentiometer. It can also contain Hall Effect sensors with directional track switches for increased safety.

The JC6000 has a metal construction with a large diameter stainless operating rod, an innovative ball and socket Gimbal design manufactured from pressure die cast zinc alloys, and a custom material is utilised for the moulded centre return cone . These design and manufacturing combinations offer an extremely long life product with very little operational degradation .

Hall Effect and Potentiometer Products are fitted with a die cast case, and is rated to IP40, which offers strength and rigidity whilst providing protection from Electro-magnetic radiation.

CanBUS products are fitted with a Plastic case and breather and has an IP65 rating.

There are Patents pending on many of the features within this specification.

Whilst Penny and Giles has designed this joystick to meet a range of applications it is the responsibility of the customer to ensure it meets their specific requirement.

Please take care to ensure correct fitting and sealing of the joystick into your panel using the screws supplied, noting the following: -

- ❖ The panel material type, thickness, strength and rigidity. The panel thickness should be a minimum of 3.5mm and maximum of 6mm, this will allow the mounting screws to correctly clamp the gaiter.
- ❖ The screw torque applied to ensure sufficient and even clamping force on the gaiter.
- ❖ Whilst Penny and Giles has designed this joystick to meet the IP66 Rating (Handle dependent) , it is the final responsibility of the customer to approve the product in the application.

The user should ensure that the mounting flange of this unit is connected to the vehicle chassis or reference plane, (normally zero volts)

The product configuration string is defined below and will be shown at the end of each section. The area of the string that is applicable in that page will be **highlighted bold**.

JC6000- XX - XXX - X - X - XX - X - XXX - XXXX- X - X

Additional Note: -

Some options are still under development, for clarity a “Currently Available” column has been added to each table.

2.0 Product functionality

2.1 Functional operation

The JC6000 joystick is available in either a single, Y-axis SY (Heavy to medium duty) or NY & HY (Light duty) or dual, X-Y axis (XY) configuration. The positive and negative directions for the handle lever movement of a given axis are noted in Figure 1 & 2 and 3 with respect to the orientation mark. The single, Y-axis (SY) is assembled with the heavy-duty single axis main body shown in Figure 1. This requires the use of the larger gaiter as shown in Section 5.2. The single Y axis (NY) is assembled with the dual axis main body as shown in Figure 2 and this can use the standard gaiter as shown in Section 5.1.

Figure 1 SY

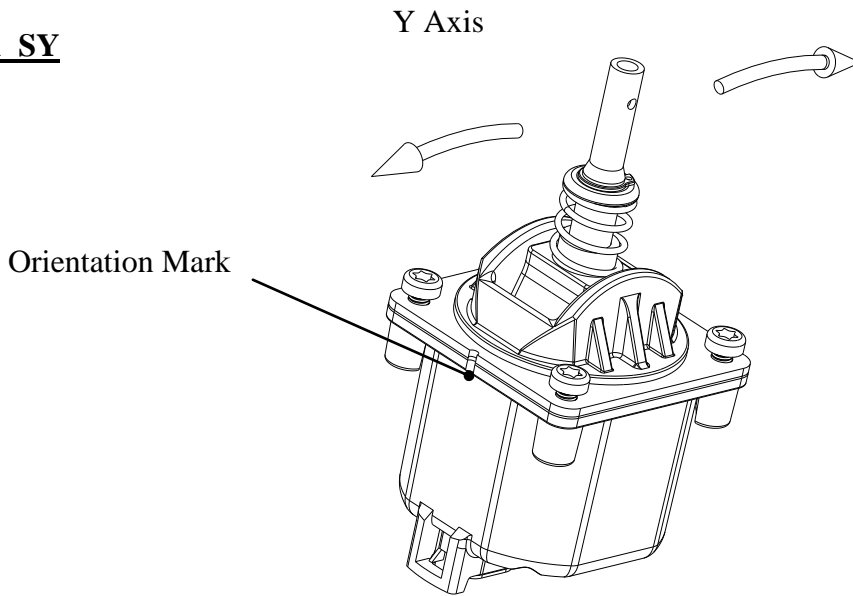


Figure 2 NY
(HY not shown in illustration)

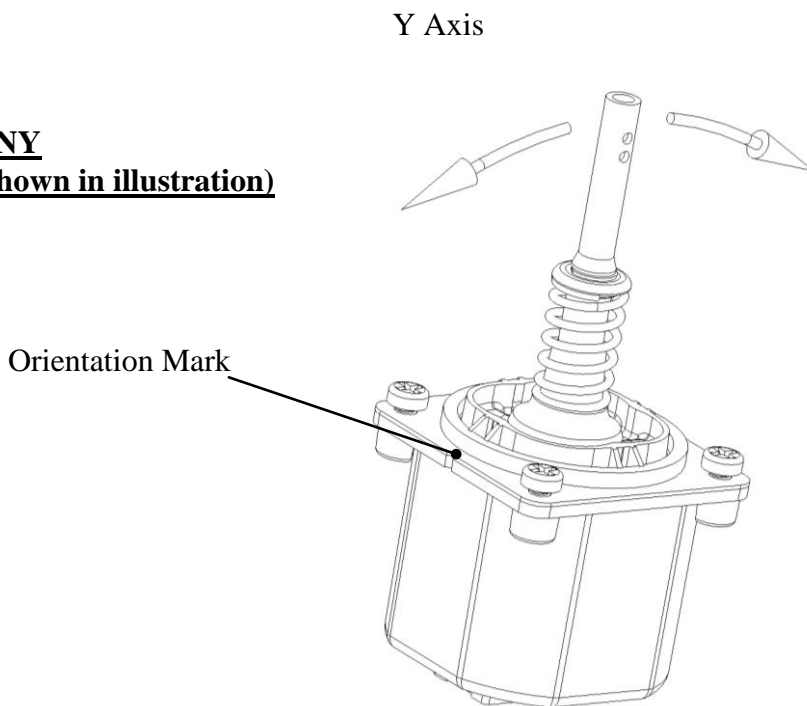
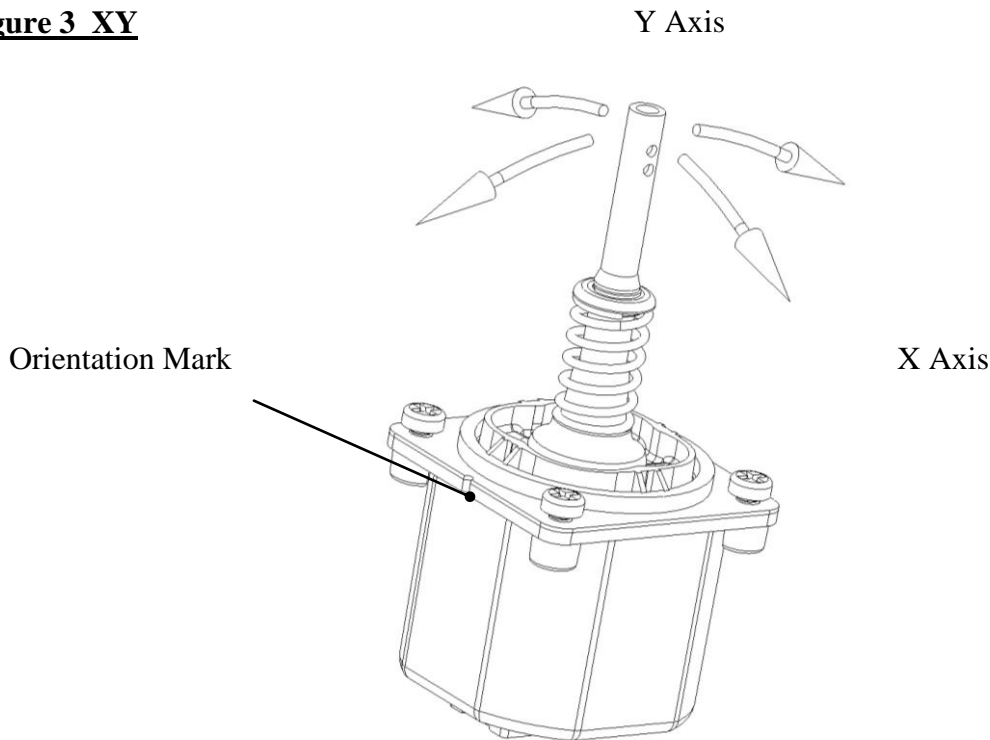


Figure 3 XY



- Single Axis (**NY**)
- Single Axis Heavy Duty (**SY**)
- Dual Axis (**XY**)
- Heavy Friction (**HY**)

Single axis product, add “**NY**” in the place of the lower string bold character.

Single axis heavy duty product, add “**SY**” in the place of the lower string bold character

Single axis Heavy friction product, add “**HY**” in the place of the lower string bold characters.

Dual axis product, add “**XY**” in the place of the lower string bold characters.

JC6000- **XY** - XXX - X - X - XX - X - XXX - XXXX-X - X

2.2 Sensing Options

Select the sense technology and output characteristics, Potentiometer or Hall Effect Sensing, as follows.

2.2.1 Potentiometer Elements

A single output per axis is fitted as standard, with dual outputs available as an option (see overleaf, 2.2.1.5). The output is ratiometric and the absolute output voltage is dependent on the supply voltage.

The Potentiometer electrical connections are made via a 16 way AMP “040” series multi-lock connector mounted on the base of the unit. The mating AMP connector part number is 174046-2, and the loose piece contacts are 175062-1 or the complete harness is available to the Penny & Giles Part number P49780. See *Figure 1 below and Figure 4.*

When the joystick returns to centre the output will be between 48 & 52% of the applied voltage unless the centre tap is connected to a reference voltage.

Min Load Impedance:	1MΩ Recommended
Maximum wiper current:	5mA
Maximum voltage:	32Vdc.
Centre Tap/switch Alignment:	Within 0.5°
Potentiometer electrical angle is:	±18°
The centre tap angle is:	±2.5°
Insulation Resistance @ 50V DC;	
Between isolated pins:	>15MΩ
Between all pins and a common ground or the case:	>50MΩ
Directional and centre on/off switches;	
Maximum load current:	200 mA resistive

2.2.1.1 Centre Tap

A centre tap is standard on all tracks, where 50% of the input voltage should be supplied. Where the centre tap is not connected there will be a centre dead band (where the voltage output does not change with initial deflection of the handle) and the output voltage will be between 48 & 52% of the applied voltage.

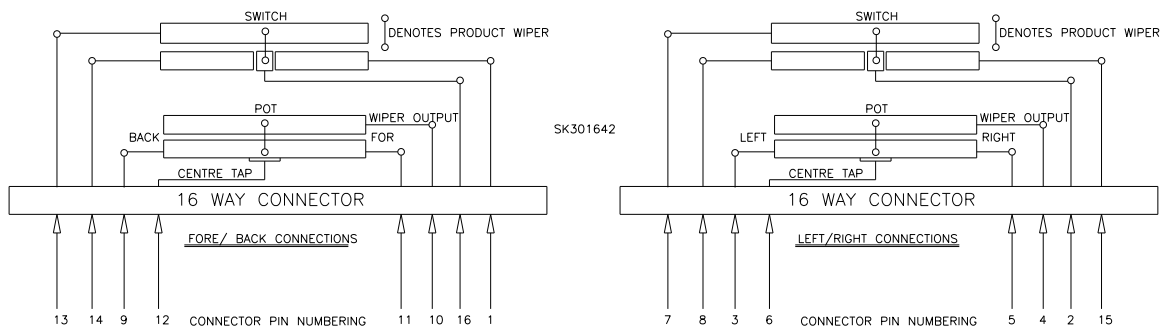
2.2.1.2 Padding Resistors

The Q, R, S, T and U tracks have resistors placed in series with the main resistive element and are used to reduce the output voltage at full mechanical deflection. This is a safety feature where the machine control system can be used to determine a broken wire or short circuit to full voltage or ground. The degree to which the output voltage is reduced can be chosen from the table of potentiometric outputs on page 6.

2.2.1.3 Joystick Switches

The potentiometer elements are also fitted with directional and normally closed “centre on” position switches. The directional switches operate as shown in the table below. The switches are connected independently of the potentiometric elements on each axis and can be terminated to provide directional and centre on/off data to the control system. See circuit diagram below: -

Figure 1



2.2.1.4 Potentiometric Outputs

For the Potentiometer product, add “P” followed by the “Letter” from the “Order Character” column of the following table, the first character referring to the X axis. The chosen output voltage will apply both tracks on an XY joystick i.e. you cannot select different tracks for each

axis. Potentiometer option “P” with reduced voltage tracks “R” is the preferred standard and is included in the lower string as an example, note **R** is shown twice, one for each of the chosen axes. Where Single (Y) axis is required a (O) will appear in the extra space instead of a letter.

Minimum Output Volt % of Vs	Maximum Output Volt % of Vs	Switch Track Angle	Resistance kΩ	Order Character
10% ± 2%	90% ± 2%	±1.5°	1.6-2.4	R
0 – 1%	99 - 100%	±5°	1.4-2.2	N
25% ± 2%	75% ± 2%	±1.5°	2.2-3.6	Q
10% ± 2%	90% ± 2%	±5°	1.6-2.4	S
25% ± 2%	75% ± 2%	±5°	2.2-3.6	T
0-1%	99 – 100%	±5°	8-12	L
0-1%	99 – 100%	±5°	4-6	E

2.2.1.5 Dual Potentiometer Outputs per Axis

This option is available with independent inputs and outputs; the secondary potentiometer outputs are terminated on the 8-way connector. Standard 10% linearity between potentiometer outputs is offered. Secondary potentiometer outputs do not provide secondary directional and centre switches. *Hall sensing and dual potentiometer outputs are not available.*

Where single (Y) axis is required a “0” will appear in the extra space instead of a letter.

Minimum Output Volt % of Vs	Maximum Output Volt % of Vs	Switch Track Angle	Resistance kΩ	Order Character
10% ± 2%	90% ± 2%	±1.5°	1.6-2.4	U

JC6000- XX - PRR - X - X - XX - X - XXX - XXXX -X - X

2.2.2 Hall Sensing Option

The Hall Effect option offers two independent output signals (from two separate sensors) per axis. The sensors require a regulated 5V supply for them to operate correctly.

There are two different power supply options, the first operates by using two conditioned and regulated 5V supplies (customers may choose to feed from a single source). Having a separate voltage supply enables independent operation of each axis and allows for redundancy.

The second operates using a single conditioned voltage source supply between 10-40Volts. The output is not ratiometric and is 5 Volt based.

The Hall Effect sensing electrical connections are made via a 12 way Amp “040” series multi lock connector mounted on the base of the unit. The mating AMP connector part number is 174045-2, and the loose piece contacts are 175062-1.

For the Hall Effect Sensor option, add “H” followed by the “Letter” from the order character column of the table shown overleaf. Note the letter is shown twice, one for each of the chosen axes.

Where Single axis (Y) is required an “N” will appear in the extra space instead of a letter.

The chosen voltage outputs will apply to both outputs on the XY joystick i.e. you cannot select different outputs for each axis.

2.2.2.1 Hall Sensor Outputs

Min Load Impedance:	5k Ω Recommended
Insulation Resistance @ 50V DC;	
Between isolated pins:	>15M Ω
Between all pins and a common ground or the case:	>50M Ω
Maximum current consumption:	6.5mA per sensor.

Output Voltages are shown at full deflection and ratios of stable 5V input supply.

Supply Voltage Range	Minimum Output Voltage	Centre Voltage	Maximum Output Voltage	Order Character
5V Regulated	10% ± 4%	50% ± 2%	90% ± 4%	M
5V Regulated	25% ± 4%	50% ± 2%	75% ± 4%	K
5V Regulated	20% ± 4%	50% ± 2%	80% ± 4%	L
10 to 40V Supply	1.05-1.45V	2.4-2.6V	3.55-3.95V	O
10 to 40V Supply	0.8-1.2V	2.4-2.6V	3.8-4.2V	P
10 to 40V Supply	0.3-0.7V	2.4-2.6V	4.3-4.7V	V

Options **O, P and V** have additional electronic circuitry included in the joystick that internally supplies the Hall Effect Sensors with a 5 Volt regulated supply.

Hall Effect sensors are affected by temperature, as a result the output of this product changes temporarily by 9% and permanently by 1.5% when subjected to the -25 to 80 temperature cycle. It is the customer’s responsibility to ensure their system limits are set to perform under these conditions.

JC6000- XX – **HMM** - X - X - XX - X - XXX - XXXX –X – X

2.2.2.2 CAN and CAN Plus

The JC6000 is available with its Hall Effect outputs converted to CAN and CAN Plus signals .This option must be chosen at this stage to enable later selection of protocols etc. Refer 2.3.6.3

There is only one choice of sensors when selecting a CAN, defined as:-

JC6000- XX – **HC*** - X – X – XX – X – XXX – XXXX –X – X

There is only one choice of sensors when selecting a CAN Plus, defined as:-

JC6000- XX – **HP*** - X – X – XX – X – XXX – XXXX –X – X

*“The * field will be completed automatically by the Penny & Giles order system and is driven by the number of axes on the chosen product 1 for a single axis and 2 for dual axes.*

2.2.3 Dual Sensing Option (Hall Effect with switches)

This product is available with Hall Effect sensing and additional directional switching. The Hall Effect Devices will offer the proportional output. The low current potentiometer switches (see Figure 1) can be used to define a system trigger or Valve “hop on” position.

The “B” signifies Both and will configure the product with dual hall sensors and both a Directional and Normally Closed centre switch for each axis, with the switch operating at an angle of $\pm 1.5^\circ$.

Electrical connections of the directional switches will be made via the 8 way AMP “040” series multi lock connector mounted on the base of the unit. The mating AMP connector part number is 174044-2, and the loose piece contacts are 175062-1.

For Both Hall Effect Sensing and directional switching choose “B” then add a “Letter” from the order character column of the table above.

JC6000- XX - **BMM** - X - X - XX - X - XXX - XXXX -X - X

2.2.4 Environmental Capability- Hall Sensor Specific

ESD:

Meets the requirements of IEC61000-4-2 LEVEL 4 8kV contact discharge, 15kV air discharge.

EMC:

EN50082 part 2:1995 (EN 61000-6-2: 1999) INDUSTRIAL ENVIRONMENT

Radiated susceptibility 30MHz to 1000MHz 80% sine modulated field strength 100V/m

Magnetic susceptibility 30A/m EN 61000-4-8 50,60,400Hz only for units containing magnetically susceptible devices.

EN 50081 part 2 1993 INDUSTRIAL ENVIRONMENT

Enclosed radiated emissions from 150kHz to 30MHz, Level B.

Min. Load impedance should be 5K (for hall product only)

Note : Radiated susceptibility 100V/m in the frequency range 30-1000MHz 80% sine modulation, harness lead length needs to be $\leq 20\text{cm}$.

2.3 Mechanical Data

2.3.1 General

Mechanical angle: $\pm 20^\circ$

Maximum overload XY unit only: 5 cycles only @ 490 N (measured 130mm above the mounting surface)

Maximum operating load XY unit only: 390 N (measured 130mm above the mounting surface).

Maximum downward loading: 2,450 N

Maximum torque: 15 N/m

Mechanical life (X and Y axes only): 7.5×10^6 cycles **

Seat: Heavy Biased axis

Mass: 750 g (without handle fitted)

Maximum dimensions: *See Figure 6*

Below panel dimensions: *See Figure 6*

**One cycle is defined as a complete operation of the unit on axis, from centre to extreme, returning past the centre to the other extreme and back to centre. This is based on a test frequency of 2 cycle per second.

Note.

The values quoted above are for Generic XY centre return joysticks. Refer to the values given in the relevant sections below for values applicable to specific variants.

In the case of a **NY** single axis joystick only, the joystick has been tested in the non-working direction to a B50 of 1000000 cycles where one cycle consists of movement in the none working axis (i.e. not fully reversed) with a load of 50N (measured 130mm above the mounting surface).

Additionally, a second requirement of B50 of 40,000 cycles at a load 90N (measured 130mm above the mounting surface) has been tested.

2.3.2 Centre Return Spring Option

This is the spring that returns the joystick to its centre position when the handle is released by the operator and provides the physical resistance to handle movement when the joystick is operated. There are two levels of spring force available, Heavy, Medium selected by choosing a “**Letter**” from the “Order Character” column of the following table, which also defines the load values. *Heavy duty “H” is the preferred standard and is included in the following string as an example.*

Functional Operation	Spring Option	Breakout Load on Axis	Load at Full Deflection	Spring Colour Ref.	Order Character
XY	Heavy Duty Spring	0.65 – 1.05Nm	1.71-2.59Nm	Natural Zinc plated	H
SY	Single Axis Spring	0.25 -0.75Nm	0.75-1.75Nm	-	S
NY & XY	Medium Duty	0.33-0.47Nm	0.85-1.26NM	Yellow	M
NY	Heavy Duty Spring	0.65 – 1.05Nm	1.71-2.59Nm	Natural Zinc plated	H

Note: It should be considered that the spring choice affects the unit’s ability to resist system vibrations. Each of the following springs give a different product harmonic range. This, in combination with the critical mass differences as a result of handle choice, will result in each system (joystick and machine) having different vibration characteristics. With this in mind it is suggested that where applicable the customer considers the vibration range of the system and determines whether any resonance is found in the joystick. Resonance gives rise to dither and has a significant effect on product life.

For further spring options please discuss your requirements with a sales representative.

Note

The SY option is suitable for use in medium to heavy applications.

The NY option is suitable for use in light applications.

The loads required to deflect the joystick are measured 55mm from the joystick mounting surface and perpendicular to the operating rod, throughout the operating angle.

JC6000- XX - XXX - **H** - X - XX - X - XXX - XXXX -X - X

2.3.3 Mechanical Gate Option

The JC6000 XY product is only available with a square gate which enables full outputs on X & Y axes when the joystick operating rod is fully deflected into the corners of the gate.

Func	Gate Option	Characteristics	Order Character
XY	Square	± 20° Mechanical Travel (on axis)	S
NY HY SY	Single axis	± 20° Mechanical Travel	/

JC6000- XX - XXX - X - **S** - XX - X - XXX - XXXX -X - X

2.3.4 Friction Hold Options

- **Friction Hold F1 & F2** is friction held in the Y-axis where the operating lever/handle can be moved and left in any Y-axis position (put & stay) This version of put & stay is single axis only. Centre location is maintained by a detent mechanism that provides feedback to the operator as to when the joystick lever exits and returns to centre position

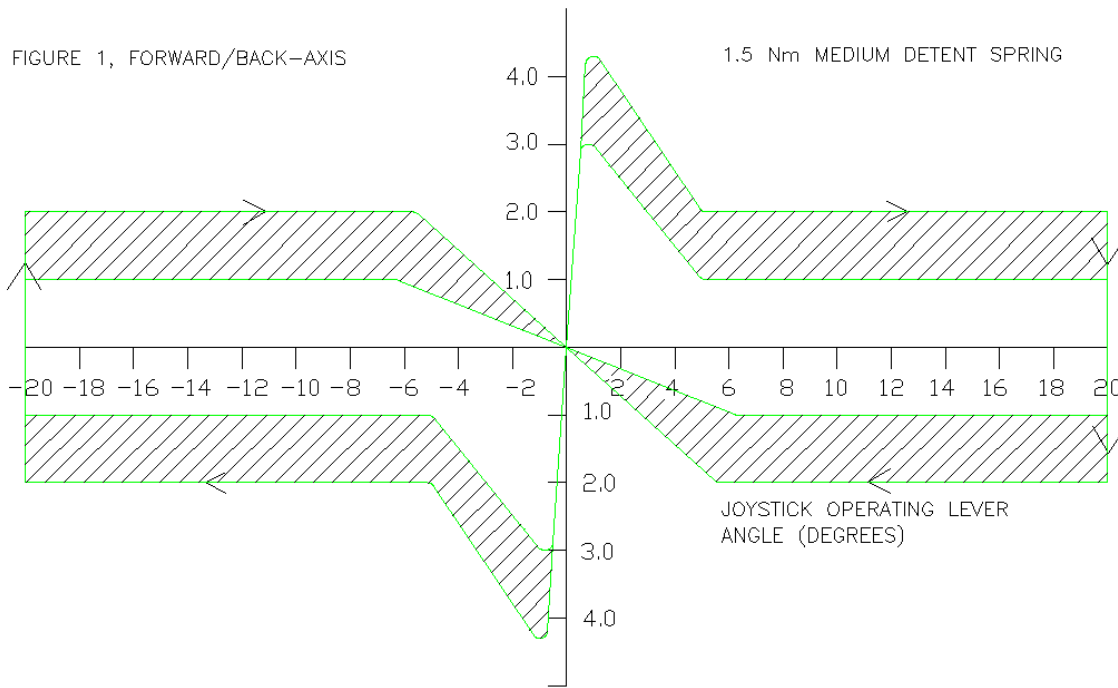
Friction Hold Y Axis	
Breakout Torque (Out of detent) Nm	F1 2.75 Nm +/-0.70 Nm (medium detent spring) F2 3.75 Nm +/-0.80 Nm (heavy detent spring)
Operating Torque Nm Nominal	F1 1.5 Nm F2 1.5 Nm
Operating Torque Tolerance	F1 0.75 - 1.75 Nm
	F2 0.95 - 1.95 Nm
Function	
Operating angle	±20°
Operating angle to break out of detent	±5°
Centre hysteresis	±1°
Mechanical Life	
Operating	1 x 10 ⁶ cycles **

Note: See section 5.2 (Product installation dimensions) for details of the gaiter fitted to the Friction hold F1, F2 and F3 options.

The HE handle is not an option with friction hold.

F1 1.5Nm Medium Detent Spring

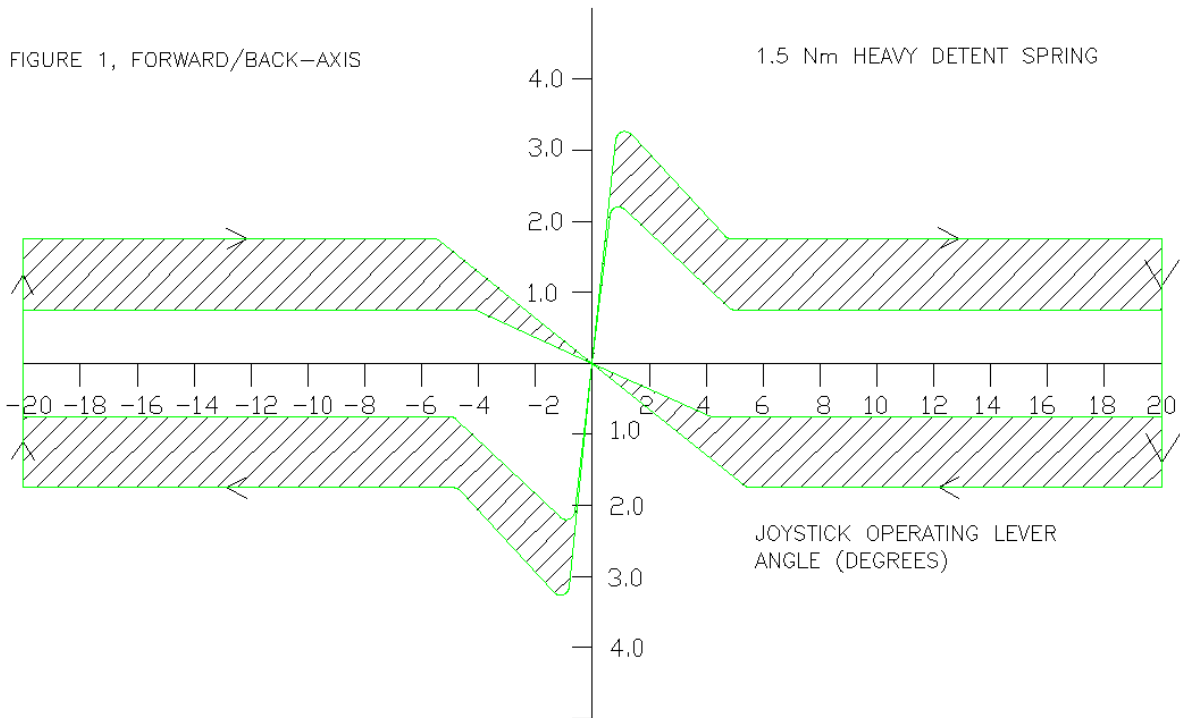
FIGURE 1, FORWARD/BACK-AXIS



 HATCHED AREA SHOWS TOLERANCE BAND OF JOYSTICK FORCE

F2 1.5Nm Heavy Detent Spring

FIGURE 1, FORWARD/BACK-AXIS



 HATCHED AREA SHOWS TOLERANCE BAND OF JOYSTICK FORCE

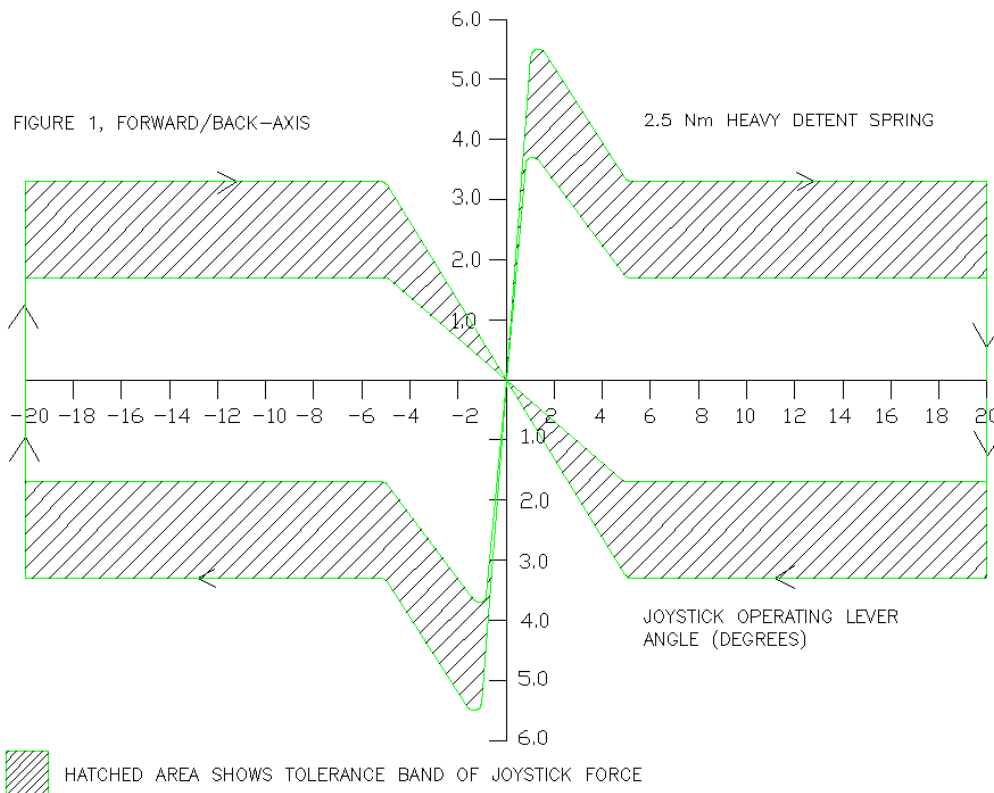
** One cycle is defined as a complete operation of the unit on axis, from centre to extreme, returning past the centre to the other extreme and back to centre. This is based on a test frequency of 1 cycle per second.

- Friction Hold F3** is friction held in the Y-axis where the operating lever/handle can be moved and left in any Y-axis position (put & stay) This version of put & stay is single axis only. Centre location is maintained by a detent mechanism that provides feedback to the operator as to when the joystick lever exits and returns to centre position

Friction Hold Y Axis	
Breakout Torque (Out of detent) Nm	4.65 Nm +/-1.10 Nm
Operating Torque Nm Nominal	2.50 Nm.
Operating Torque Tolerance	1.60 - 3.30 Nm
Function	
Operating angle	±20°
Operating angle to break out of detent	±5°
Centre hysteresis	±1°
Mechanical Life	
Operating	1 x 10 ⁶ cycles **

Note: See section 5.2 (Product installation dimensions) 6 for details of the gaiter fitted to the Friction hold F1, F2 and F3 options.

F3 2.5Nm Heavy Detent Spring



** One cycle is defined as a complete operation of the unit on axis, from centre to extreme, returning past the centre to the other extreme and back to centre. This is based on a test frequency of 1 cycle per second.

Choose the appropriate “**Letters**” from the “Order Character” column in the table below. *No Lock “NL” is the preferred standard and is included in the configuration code as an example.*

Mechanical option		Mechanical option description	Order Character
Spring Return		No change to mechanical function, spring return to centre	NL
Type	Axis	Friction	
Friction	1	Friction held throughout range of Y-axis motion (1.5 Nm operating force put & stay with a medium spring centre detent)	F1
Friction	2	Friction held throughout range of Y-axis motion (1.5 Nm operating force put & stay with a heavy spring centre detent)	F2
Friction	3	Friction held throughout range of Y-axis motion (2.5 Nm operating force put & stay with centre detent)	F3

JC6000- XX - XXX - X - X - NL - X - XXX - XXXX -X - X

2.3.5 Microswitch Option

Microswitch option, choose the “**Letter**” from the “Order Character” column of the following table. The choice is either “**Yes**” for microswitch “**No**” for none. *No microswitch “N” is the preferred standard and is included in the lower string as an example.*

Microswitches are available on the **F1**, **F2** and **F3** options.

Microswitch Option	Mechanical function description	Order Character
Without microswitch	No switches fitted	N
Microswitch	Microswitches fitted	Y

The microswitch outputs will replace the low current switching of the potentiometer tracks in a potentiometric (contacting) joystick. The output pin allocations can be found on the “16 way” connector pin detail, shown in Figure 3. There are two switches per chosen axis and the switches are configured as normally open at the centre.

In a Hall effect (non-contacting) joystick the microswitch outputs are in addition to the Hall Effect sensor outputs and they terminate on the “8-way” connector. For pin details see Figure 4.

The Honeywell microswitch electrical details follow; these details are taken directly from the switch manufacturer's specification. Further details are available from their Website

Microswitch operates at a mechanical deflection of 2 – 5 degrees in any direction.

Contact ratings are 3A @ 125 VAC, 2A @ 30 VDC.

Life of 100,000 cycles minimum (@ a cycling frequency of 1Hz) at 1A 12 VDC.

Operating Temperature range is -25°C to 85°C (when fitted, the joystick temperature is limited to this range)

JC6000- XX - XXX - X - X - XX - N - XXX - XXXX -X - X

2.3.6 Interface Option

This option defines the joystick interface requirement, whether Standard (*no electronics*), PWM or CANbus. Select the “Letters” from the “Order Character” column of the following table. *Standard “STN” is the preferred option and is included in the lower string as an example.*

Interface Option	Order Character
Standard interface.	STN
Pulse width modulation output	PWM
Controlled Area Network	See Below

2.3.6.1 Standard (STN)

This interface is offered without electronics and gives a direct output from the internal Potentiometer, Micro-Switch or Hall Effect Sensors.

2.3.6.2 Pulse Width Modulation (PWM)

The PWM option offers a Microprocessor controlled solution with a PWM frequency from 75 to 250Hz, settable at intervals of 25Hz and is in-built within the structure of the base of the joystick. The PWM output is controlled by potentiometer sensor technology.

The unit is available with factory settings that, by means of a software User Interface, can be changed by the customer to meet specific needs.

Refer to Specific JC6000 PWM Specification for details.

2.3.6.2.1 PWM Environmental Specification

Refer to Specific JC6000 PWM Specification for full environmental details.

2.3.6.3 Controlled Area Network (CANbus)

The CAN option is offered with the addition of a sealed plastic case, with an integral 6-way Deutsch connector for CAN and an integral 18-way Deutsch connector for CAN +.

CAN+ version allows the value and state of up to eleven digital or seven digital and four analog inputs from external-to-the-joystick sources to be broadcast in CAN messages in addition to the standard CAN joystick base and grip messages.

These connections are used to provide the electrical interface and mechanical interface to the mating connector.

The chosen will terminate to the CAN board, the handle outputs will then be processed within the CAN circuitry and digitally output on the CAN bus.

It should be noted this CAN board only functions where the JC6000 is chosen to have hall effect sensor outputs and is currently not available on the potentiometer output product.

The full detailed specification for the CAN bus products can be found in the Penny and Giles document JC6000-CAN-DETAIL.doc. The document details CAN with additional IO and includes the Extended connector detail for the 18-way connector interface.

The CANbus options for the JC6000 product are electronically configurable at Penny and Giles. This configuration will be dependant upon the customer order and the product will be “personalised” at the manufacturing stage.

2.3.6.3.1 CANbus Electrical characteristics

Supply Voltage, 12 and 24 V Systems:	9 to 36 V
Reversed Polarity Protection:	-9 to -36V
Short-Circuit Protection:	All signals withstand continuous short-circuit
EMC, Directive 89/336/ECC	
EMC Emission, EN 61000-6-3 and EN 12895	
EMC Immunity, EN 61000-6-2:	100V/m including 1kHz AM 80%
Automotive Transients, ISO 7637/1-2:	Pulses 1a, 2a 2b, 3a, 4 and 5
Automotive Transients, ISO 7637/3	

CAN Only

Maximum Current Draw (base only): 90 mA

CAN Plus Only

Maximum Current draw (base only): 140 mA
Sensor Supply: 5V+/- 0.15 VDC output
50 mA output

(The internal power supply circuitry will convert this supply voltage to 5 ± 0.1 Volts)

The Microcontroller will stop and start after power up/down in a controlled safe manner regardless of dV/dt and Power outages/brownout will be ridden through without ‘random’ data shall being transmitted onto the CAN. The Joystick includes internal protection against Voltage transients.

The joystick has two Hall effect sensors per axis. These sensors are mounted such that the outputs of the primary and secondary sensors are crossed.

The resolution of the joystick is determined by the Analogue to Digital converter, which is a 10-bit processor (1024 steps).

External Digital Inputs (CAN Plus)

Attribute	Minimum	Maximum	Comments
Allowed voltage at pin	0 V	36 V	
Rising voltage threshold	2.48 V	3.5 V	Digital input will be read as “high” if voltage is greater than 3.5 V
Falling voltage threshold	1 V	2.25 V	Digital input will be read as low if voltage is less than 1 V
CAN output latency	6 ms	24 ms	Limited by update rate of application software
Response to voltage below minimum			Non-damaging, non-latching: reading saturates to low limit
Response to voltage above maximum			Non-damaging, non-latching: reading saturates to high limit

External Analog Inputs (CAN Plus)

Attribute	Minimum	Maximum	Comments
Allowed voltage at pin	0 V 0 V	36 V 5.8 V	
Maximum discernable voltage	4.915 V	5.085 V	
Minimum discernable voltage	0 mV	85 mV	
Response to input below minimum voltage			Effect on other inputs; non-damaging, non-latching reading saturates to low limit
Response to input above minimum voltage			Effect on other inputs; non-damaging, non-latching reading saturates to high limit
Response to open input			Pull down = 0 v

2.3.6.3.2 CANbus Protocol

There are three characters required to correctly define the product. The character is shown in the first column of each of the tables:

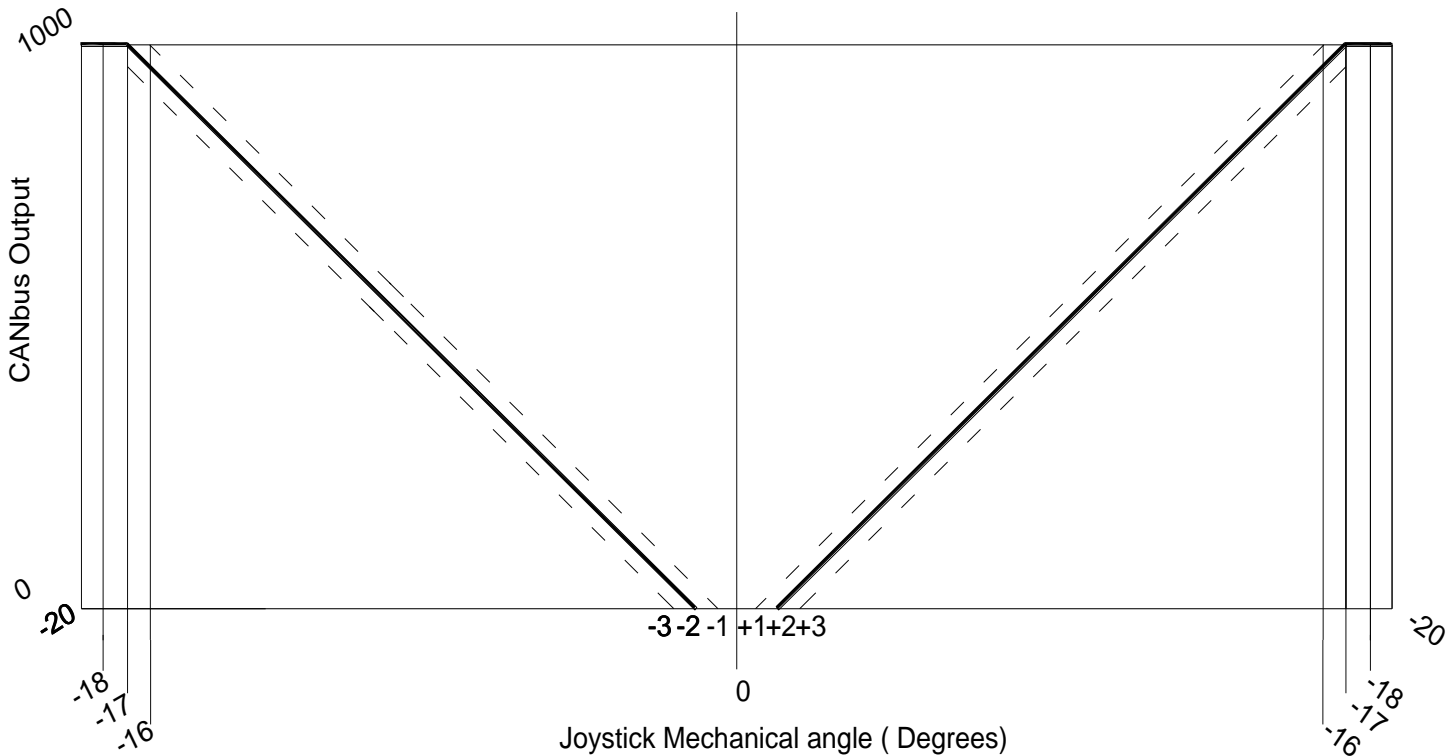
One protocol option (*First character*) must be chosen from the following table: -

D1	CANbus Protocol
J	CAN WITH J1939 PROTOCOL

CAN Output characteristics
CAN

2.0b is used with J1939 as the protocol.

The lever position indicated by the CAN message shall change linearly within the active



range. Refer to diagram below for the accuracy definition when displaced from centre to full travel.

- Nominal Mechanical Angle of Joystick: +/-20 Degrees
- Minimum Mechanical Angle of Joystick: +/-18.8 Degrees
- Minimum Angle to achieve 1000 CAN counts: 16 Degrees

Hysteresis will always converge to within 1 & 3 Degrees at centre and 16 & 17 Degrees at 1000 CAN counts.

Linearity is defined as Independent.

The change from CAN 0 to Non CAN 0 will always occur between 1 & 3 Degrees.

The change to CAN 1000 will occur between 16 & 18 Degrees. Return to centre Hysteresis will always be within 100 CAN counts.

The change from Non CAN 0 to CAN 0 will occur between 1 & 3 Degrees.

2.3.6.3.3 CANbus Redundant Sensor Processing

An on board software algorithm adds the values from a primary and secondary sensor for each axis and assures the sum falls within a window. The error check window is determined during the joystick's calibration.

In the event of a sensor failure an error message will be transmitted and the effected axis will shutdown, but all other functions will be operational.

2.3.6.3.4 CANbus General Communication Specifications

The joystick is capable of supporting CAN specification 2a and 2b (11 and 29 bit identifier).

Data rate capability is 250Kilobits/second Min.

J1939 Protocol

The Joystick supports SAEJ1939 protocol. For Diagnostics Reference SAEJ1939-73

Application Layer Diagnostics for Vehicle Application Layer Reference SAEJ1939-71

Upon power up Joystick performs an Address Claim per SAE J1939-81 section 4.2

Network Management Procedure.

Upon reception of DIAGNOSTIC MESSAGE 13 DM13 the joystick will stop/start broadcasting messages.

When transmit is stopped the Joystick will continue to poll the CAN Bus to check for DM13 Start broadcast.

Once broadcast is started the JS shall stop only if it receives the DM13 STOP Broadcast message. Reference SAEJ1939-73 section 5.7.13

J1939 Options

It is not possible to have two joysticks on the same CAN bus that have the same source address, if this is a requirement contact Penny and Giles sales for advice.

J1939 specifies that the output from a joystick should be 0 – 1000 CAN counts on each axis.

2.3.6.3.5 CANbus Environmental specification

With the following additions/amendments the CAN joystick will perform to the environmental specification as detailed in section 6.0.

EMI/RFI Rating:	EMC generic standard for immunity, industrial environment @ 100 VPM; 150kHz – 200mHz bulk current injection, CW and 1kHz AM at 80%.
VIBRATION/Shock:	25g @ 10ms 500 in each of six directions. 40g @ 5ms, 500 in each of six directions.
ESD to each pin:	ESD per EN 61000-4-2 at 15kv air discharge with direct contact discharge to 8kv.
Sealing:	IEC 529 rating IP66 above and below the flange (above is dependant on type of handle fitted).
Drop test:	BS2011part 2.1IEC: 1977
Temperature / Humidity:	JDQ53.2

2.3.6.3.6 CANbus Customer Interface (Electrical Connection)

CAN Connection Details

The connector is a gold plated pin connector Deutsch DTM04-6 P.

The electrical pin out and wiring information is shown in the table below.

Pin	Connection
Pin 1	Ground
Pin 2	Power
Pin 3	CAN High
Pin 4	CAN Low
Pin 5	CAN Shield
Pin 6	No Connection

CAN Plus Connection Details

The connector is a gold plated pin connector Deutsch DTM04-18 P.

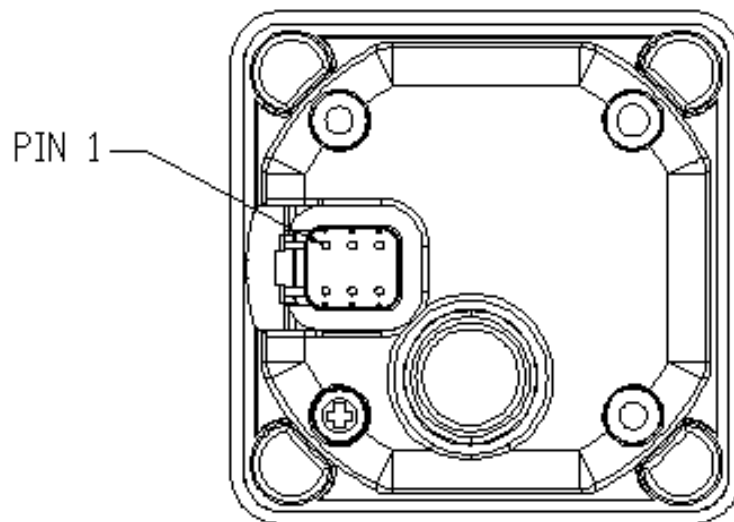
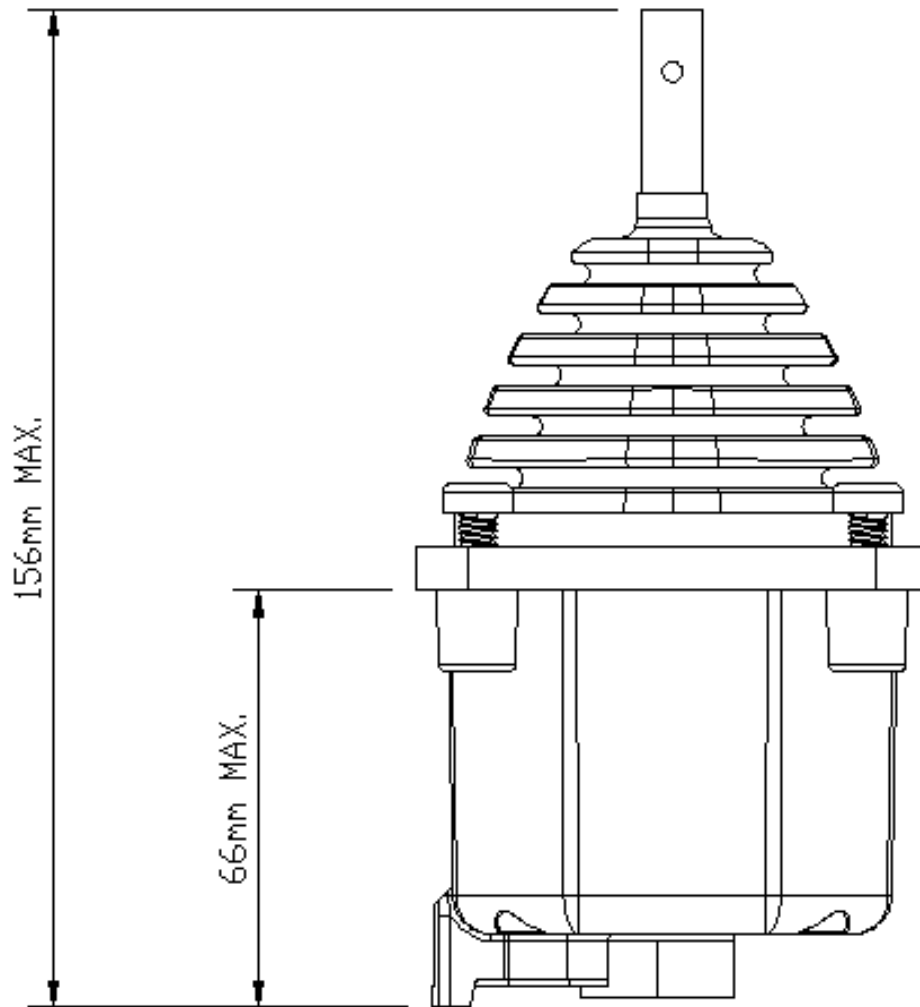
The electrical pin out and wiring information is shown in the table below.

Pin	Connection
Pin 1	Ground
Pin 2	Power
Pin 3	CAN High
Pin 4	CAN Low
Pin 5	CAN Shield
Pin 6	Operator present /DIN11
Pin 7	Sensor Ground -
Pin 8	5 Vdc sensor power +
Pin 9	AIN1/DIN7
Pin 10	AIN2/DIN8
Pin 11	AIN3/DIN9
Pin 12	AIN4/DIN10
Pin 13	DIN1
Pin 14	DIN2
Pin 15	DIN3
Pin 16	DIN4
Pin 17	DIN5
Pin 18	DIN6

2.3.6.3.7

CAN Product installation Diagram (without adapter plate)

With the following additions/amendments the CAN joystick will have the same dimensions, handle choice, installation heights, etc as detailed in section 5.0.

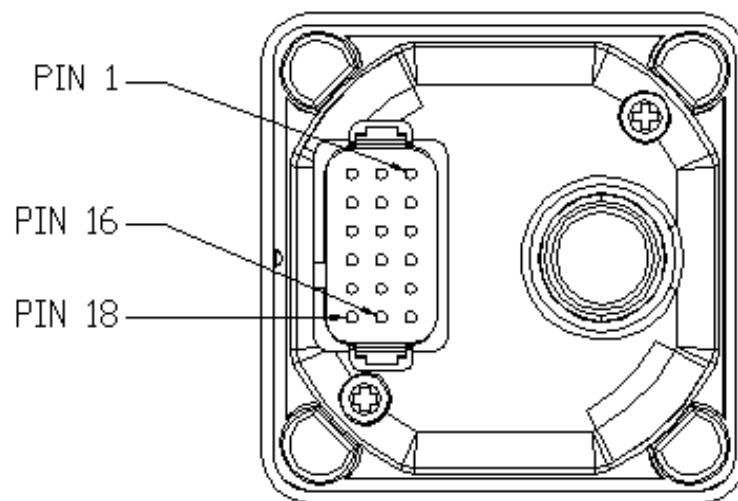
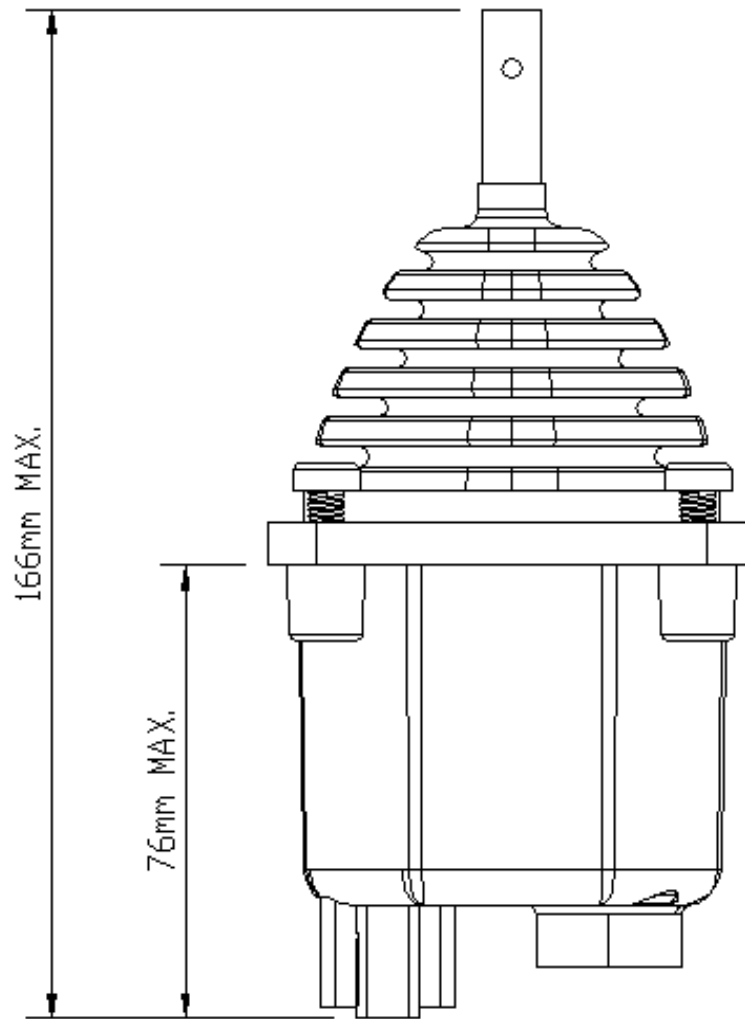


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2.3.6.3.8

CAN Plus Product installation Diagram (without adapter plate)

With the following additions/amendments the CAN Plus joystick will have the same dimensions, handle choice, installation heights, etc as detailed in section 5.0.



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2.3.6.3.9 CANbus Source Address (Identifier)

CANbus Joysticks must have unique source addresses, where there is more than one joystick on the same CANbus. For each joystick ordered for a single integrated system there must be a different character chosen, thus giving a different address and a unique configuration string.

One source address option (*second character*) must be chosen from the following table: -

D2	CANbus Source Address (Identifier)	DECIMAL SA	HEX SA
R	RIGHT HAND JOYSTICK, SOURCE ADDRESS	51	33
L	LEFT HAND JOYSTICK, SOURCE ADDRESS	52	34
C	CENTER JOYSTICK, SOURCE ADDRESS	53	35
A	AUXILARY JOYSTICK, SOURCE ADDRESS	54	36

2.3.6.3.10 CANbus Count Output

The product is available with differing numbers of CAN counts, the different counts required are dependent upon the application into which the joystick is to be placed.

One CANbus count option (*Third character*) must be chosen from the following table: -

D3	CAN Count Output
1	FULL SCALE OUTPUT = 1000 CAN COUNTS - IN EACH HALF AXIS
2	FULL SCALE OUTPUT = 250 CAN COUNTS - IN EACH HALF AXIS (FOR USE WITH DIRECT VALVE COMMUNICATION)


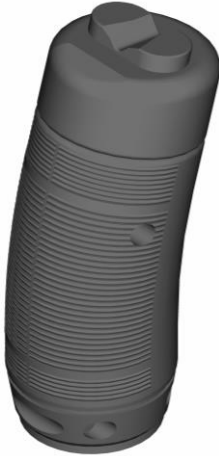

JC6000- XX - XXX - X - X - XX - X – **JR1**- XXXX –X - X




3.0

Handles

This JC6000 Generic specification contains data related solely to the joystick controller. Handle connections and dimensional details should be reviewed from the relevant handle specification available from Penny and Giles.

Handle images are shown below to aid the selection process, the handle choice codes are indicated alongside. Choose the desired handle type and enter the code in the string as shown below.

<u>Option Codes</u>	<u>Description</u>	<u>Handle Image</u>
<i>HKN</i>	<p>Push On Handle, No Switches</p> <p>(60N Minimum Retention Force)</p>	
<i>MG</i>	<p>The “MG” Multi-function handle is designed to provide a simplistic ergonomic approach to a “Person Present” handle whilst offering the flexibility of having switch options available in its top.</p> <p>(See MG Handle Specification for further information)</p>	
<i>HB</i>	<p>No Function or Rocker Switch or Deadman’s switch.</p> <p>(See HB Handle Specification for further information)</p>	

<p style="text-align: center;"><i>AMF</i></p>	<p>Configurable number of functions. This product offers handle based third and fourth axes of proportional control. Multiple handle switch configurations and a forward facing trigger switch which can be used as a “Person Present” feature.</p> <p>(See AMF Handle Specification for further information)</p>	
<p style="text-align: center;"><i>NH</i></p>	<p style="text-align: center;">No Handle</p>	<p style="text-align: center;"><i>See Figure 6 for custom handle / mounting detail.</i></p>
<p style="text-align: center;"><i>NHF</i></p>	<p>No Handle just Flying Leads, this will allow the customer to fit their own handle.</p> <p>(See NHF Specification for further information)</p>	<p style="text-align: center;"><i>See NHF Specification for details.</i></p>
<p style="text-align: center;"><i>W</i></p>	<p>The “W” Multi-function handle, offers a configurable number of functions, with 1- 4 rocker switches available in its head and the option of a “Person Present” trigger switch.</p> <p>(See WMF Handle Specification for further information)</p>	
<p style="text-align: center;"><i>HE</i></p>	<p>The “HE” Multi-function handle offers a configurable number of functions. These range from switches to proportional control. An integrated trigger and lever design are also offered of which the lever can be utilised as a “Person Present” feature. Also, the gaiter interfaces with the handle flange such that it is easily serviceable.</p> <p>(See HE-GEN Handle Specification for further information)</p>	

Any customer specific handle can be designed to fit onto the operating rod, the dimensions of which can be seen in Figure 6.

JC6000- XX - XXX - X - X - XX - X - XXX - ~~XXXX~~ -X - X

When the AMF and HE handles are chosen there are further options for various other functions, these options are clearly identified in the appropriate handle specification.

Where an “AMF” handle with “Z” rocker potentiometer(s) is chosen, the output(s) are chosen by default. They will be the same as the output chosen for the main product “Y” axis output detailed on page 6/7. This output will be indicated in the main character string with the appropriate letter. The final character in the string denotes the type of profile on the rocker (AMF Handle only). “S” will identify that it is a standard waveform profile; “V” will identify that it is a “V” shaped profile.

Where no rocker is chosen “0” will be used in the final two character areas.

Different outputs between the “Y” axis and handle choice are not a standard option, but they can be made available for specific requests, contact Penny and Giles Sales for advice and support.

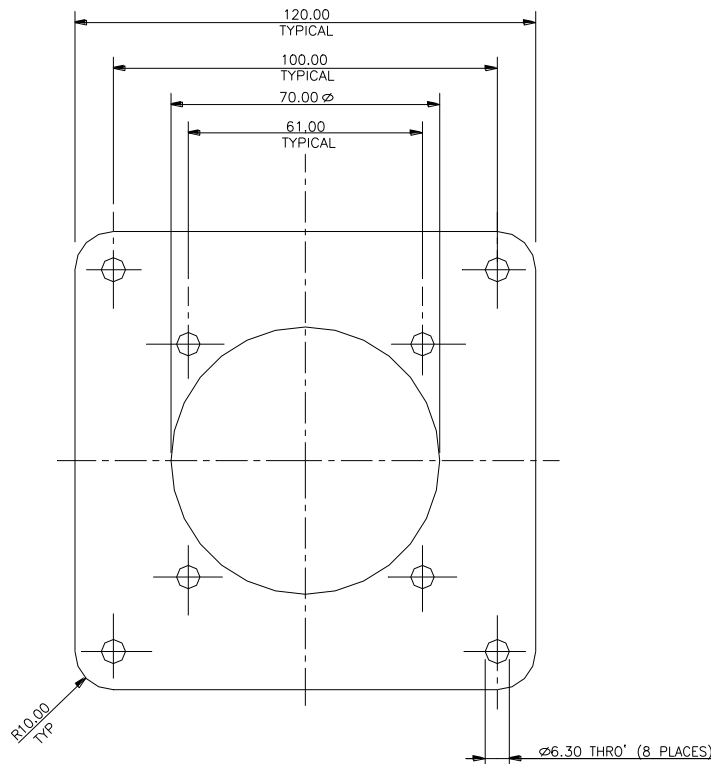
JC6000- XX - XXX - X - X - XX - X - XXX - **A10D** – **0** – **0**

Where a HE handle is selected characters defined in the HE-GEN specification will follow after the HE characters in the configuration string.

JC6000- XX - XXX - X - X - XX - X - XXX - **HE** –-.....

3.1 Handle Adapter plate

An adapter plate is offered for use with any of the available handles. This enables the fitting of custom handles that are too large to pass through the specified mounting hole. The adapter plate can also be used to mount the joystick from above the panel, however, please note that the adapter plate does not have a membrane to seal to the panel.

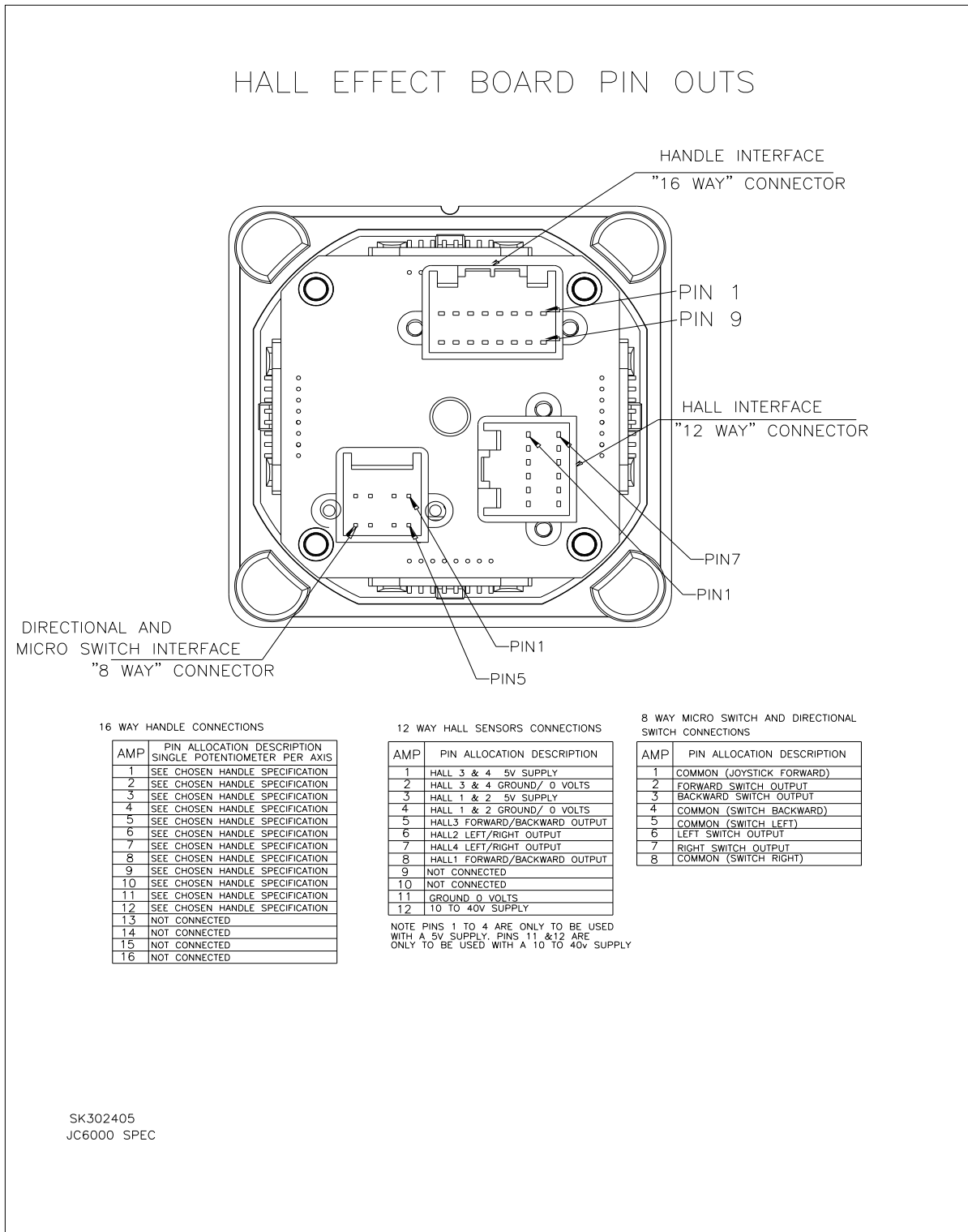


4.0

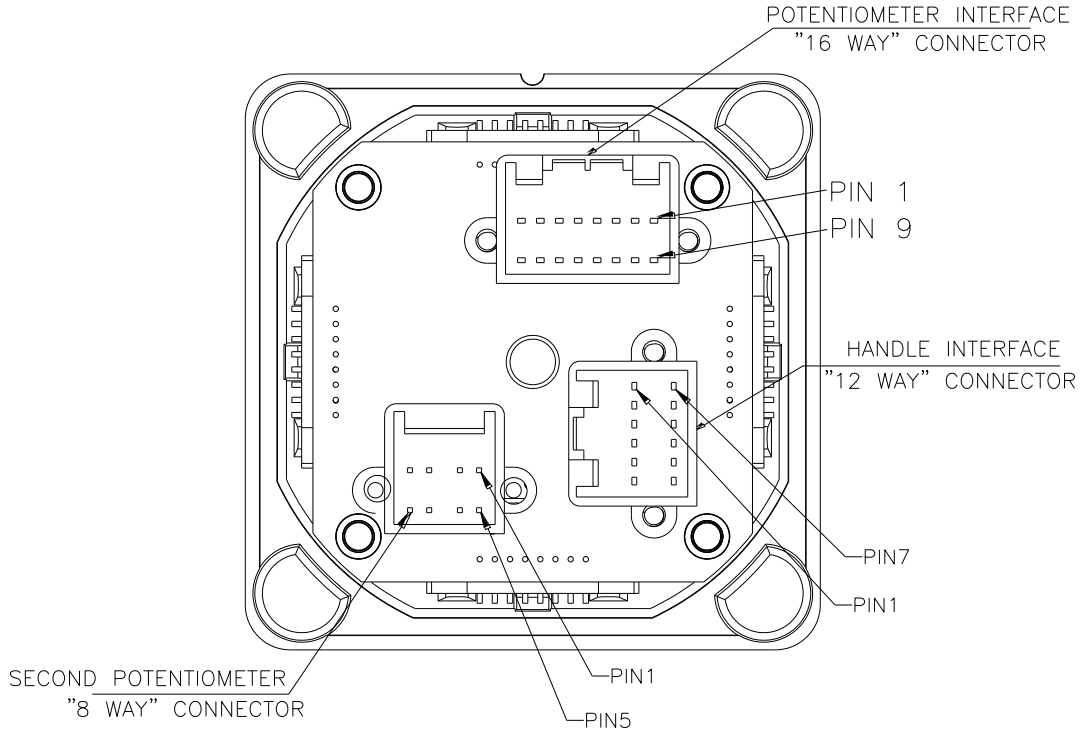
Connector Configuration and Pin Allocation Detail

4.1

Connector configuration and pin allocation detail for Hall effect units



POTENTIOMETER BOARD PIN OUTS



16 WAY PRIMARY POTENTIOMETER CONNECTIONS

AMP	PIN ALLOCATION	DESCRIPTION
1	Y SWITCH TRACK	FORWARD
2	X SWITCH TRACK	"CENTRE ON"
3	X POT TRACK	LEFT
4	X POT TRACK	SIGNAL
5	X POT TRACK	RIGHT
6	X POT TRACK	CENTRE TAP
7	X SWITCH TRACK	COMMON
8	X SWITCH TRACK	LEFT
9	Y POT TRACK	BACK
10	Y POT TRACK	SIGNAL
11	Y POT TRACK	FORWARD
12	Y POT TRACK	CENTRE TAP
13	Y SWITCH TRACK	COMMON
14	Y SWITCH TRACK	BACK
15	X SWITCH TRACK	RIGHT
16	Y SWITCH TRACK	"CENTRE ON"

12 WAY HANDLE CONNECTIONS

AMP	PIN ALLOCATION	DESCRIPTION
1	SEE CHOSEN HANDLE	SPECIFICATION
2	SEE CHOSEN HANDLE	SPECIFICATION
3	SEE CHOSEN HANDLE	SPECIFICATION
4	SEE CHOSEN HANDLE	SPECIFICATION
5	SEE CHOSEN HANDLE	SPECIFICATION
6	SEE CHOSEN HANDLE	SPECIFICATION
7	SEE CHOSEN HANDLE	SPECIFICATION
8	SEE CHOSEN HANDLE	SPECIFICATION
9	SEE CHOSEN HANDLE	SPECIFICATION
10	SEE CHOSEN HANDLE	SPECIFICATION
11	SEE CHOSEN HANDLE	SPECIFICATION
12	SEE CHOSEN HANDLE	SPECIFICATION

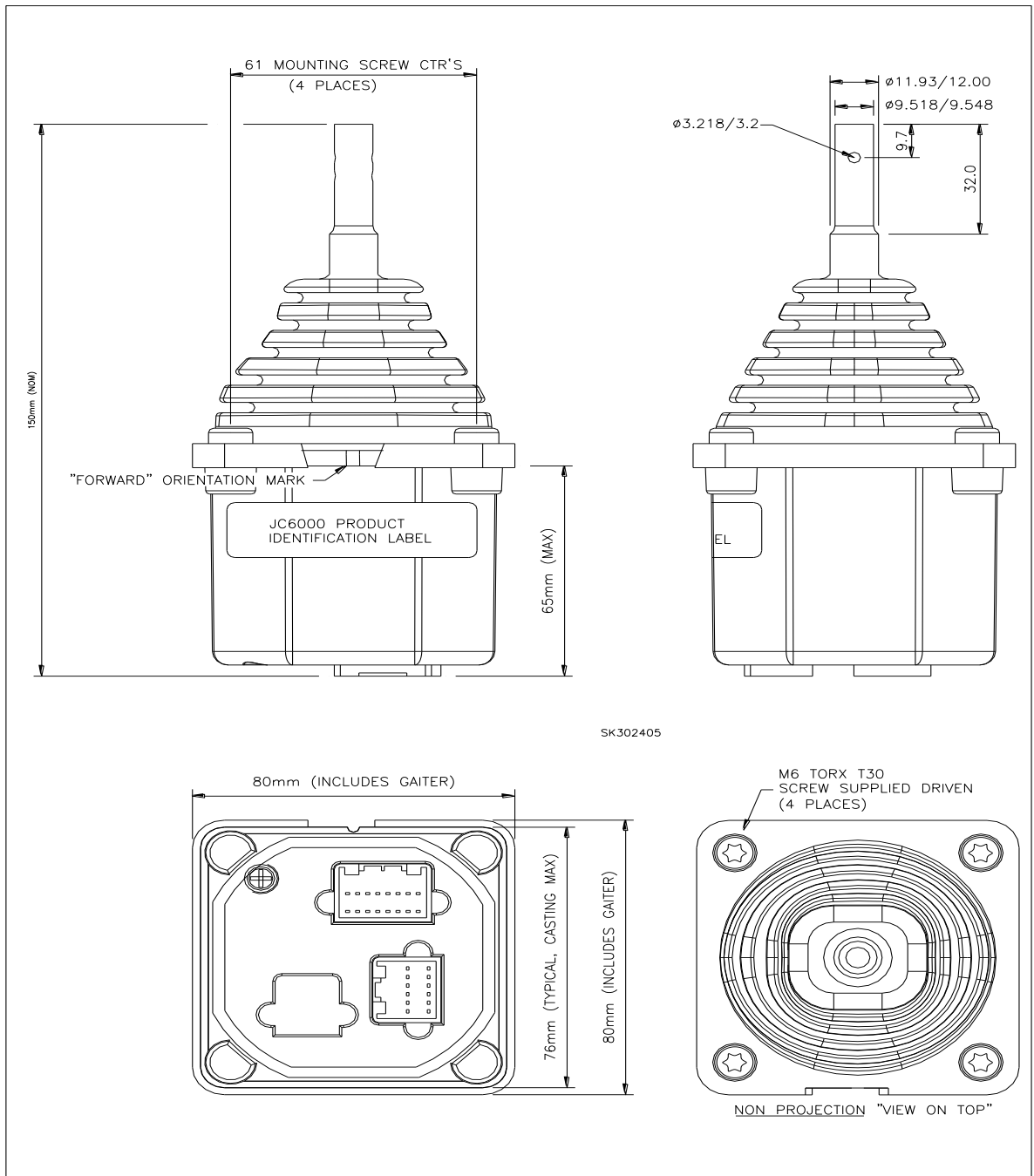
8 WAY SECONDARY POTENTIOMETER CONNECTIONS

AMP	PIN ALLOCATION	DESCRIPTION
1	SECOND "Y" AXIS TRACK	BACKWARD
2	SECOND "Y" AXIS	CENTRE TAP
3	SECOND "Y" AXIS	OUTPUT SIGNAL
4	SECOND "Y" AXIS	TRACK FORWARD
5	SECOND "X" AXIS	TRACK RIGHT
6	SECOND "X" AXIS	OUTPUT SIGNAL
7	SECOND "X" AXIS	CENTRE TAP
8	SECOND "X" AXIS	TRACK LEFT

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5.0 Product installation Dimensions (without adapter plate)

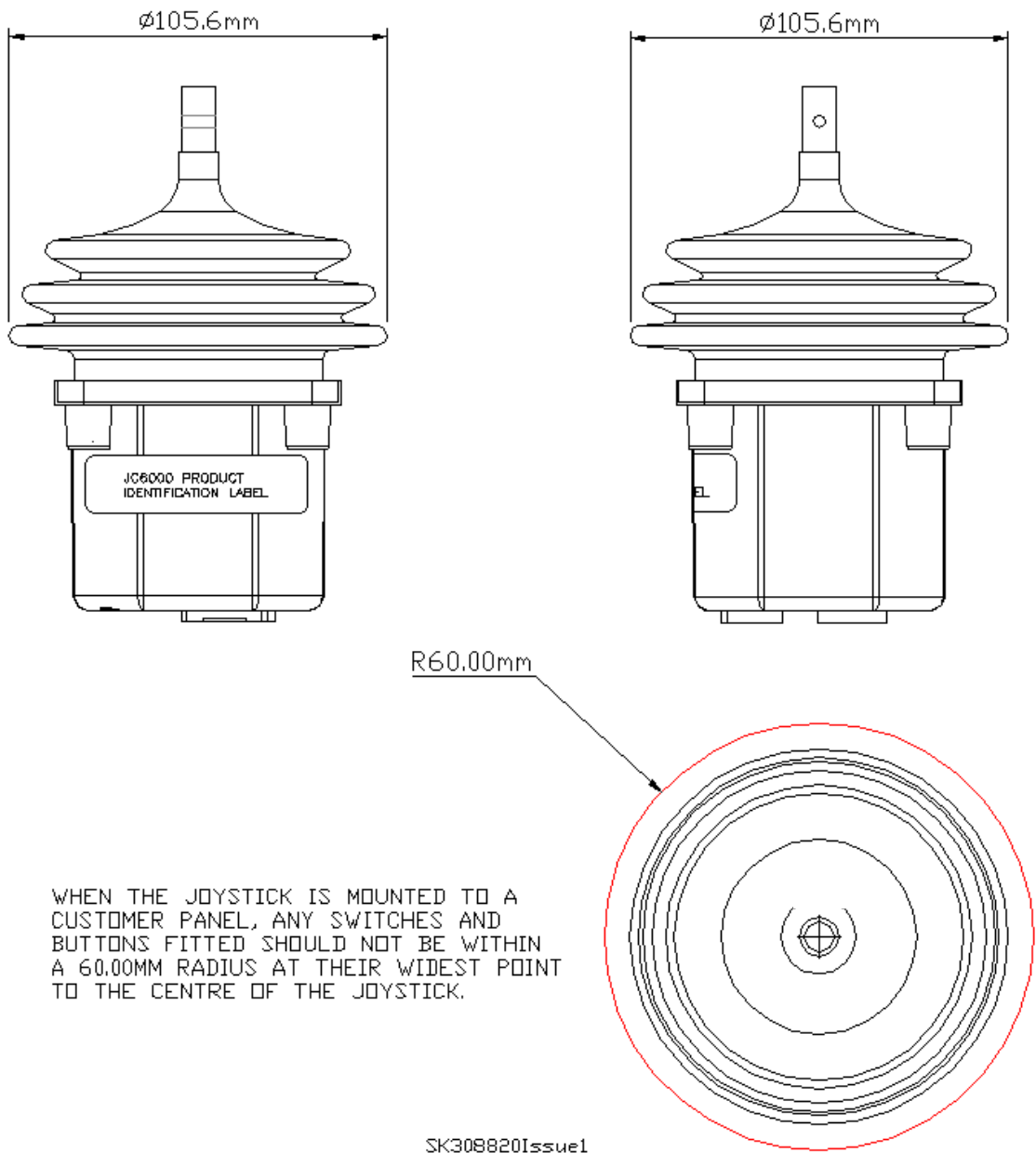
5.1 Single Axis (Option code NY)Dual Axis (Option code XY)Installation Diagram



The Joystick is designed to be fitted from below the panel, through a 70mm diameter panel hole (See Page 3 for panel type, material and thickness)

Fixing screws can be driven to a maximum torque of 5Nm when clamped against a 3.5mm thick panel. The joystick flange mounting hole depth is 12.6mm. For through hole mounting the screws can be driven at a torque of 3.5Nm directly through the blind cast holes to remove the cast covers.

Single Axis (Option code SY*) & Friction Hold (Option code HY) Product Installation Diagram



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* When the HE handle is chosen the gaiter shape will be as shown on page 27.

6.0 Environmental Specification

- 6.1 Operating temperature range : -25°C to +80°C
- 6.2 Storage temperature range : -40°C to +85°C
- 6.3 Sealing (above mounting panel) : BS-EN 60529 Rating IP66 with HKN handle fitted (Note, where an alternative handle is chosen the handle will dictate the joysticks “above mounting panel” sealing protection). Where no handle is fitted, it is the responsibility of the customer to ensure the joystick is sealed correctly.
- 6.4 Sealing (below mounting panel) : BS-EN 60529 Rating IP40.
- 6.5 Vibration (Sinusoidal) *** : Level +/- 3G peak
Frequency Range 10 to 200 Hz
(Duration 1 hour each axis Random) Level 3.6G rms. Frequency Range 10 to 200 Hz
Duration 2 hours each axis
- *** Please note that the vibration tests were conducted without a handle and fitted with the “H” heavy-duty spring. It is advised that performance testing should be carried out for each specific application.
- 6.6 Shock : Level 20G Type 1/2 sine 6ms
Number of shocks 1350 each axis
- 6.7 Damp Heat Cycle : BS2011 Pt 2.1 dB Severity 2, Variant 1, 6 Cycles, Upper Temperature 55° C.
- 6.8 Temperature /Humidity : BS2011 Pt2.1 Z/AD
- 6.9 Gaiter material : 50 Shore Neoprene.

Notes

Hall Effect Outputs can change under some of the above environmental conditions. For additional information contact Penny and Giles.

7.0 Product Identification

A label will be fixed to the case, its location centrally placed under the orientation mark, see figure 5. This label will contain detail to identify the product and must include product information such as JC6000-GEN-0001 and the job number.

Type Number: -

Issue Number: -

Batch Number: -

8.0 Records of Revision

Specification Prepared by: W. Edmunds Engineer Date: 30/09/03

Approved by: M. Hulett Engineering Manager Date 30/09/03

Approved by: A. Harris Quality Manager Date: 01/10/03

<u>Revisions</u>	<u>Change Note No</u>	<u>Prepared</u>	<u>Approved</u>	<u>Quality</u>	<u>Date</u>
1	N/A	WE	MH	ACH	1/10/03
2	ECR9603	PE	MH	ACH	12/11/03
3	ECR9926	AO	MH	DA	15/06/04
4	ECR10148	AO	MH	ACH	10/08/04
5	ECR10357	WE	MH	ACH	13/10/04
6	ECR10488	AO	MH	ACH	16/02/05
7	ECR10959	MG	MH	ACH	22/08/05
8	ECR10745/ECR11260	PE	MH	ACH	10/11/05
9	ECR 11726	WE	MH	DA	22/06/06
10	ECR 11871	WE	MH	DA	22/07/06
11	ECR 12001	JD	RPD	ACH	20/12/06
12	ECR 12136	WL	RPD	ACH	29/01/07
13	ECR 11968	GE	MH	ACH	21/02/07
14	ECR11068	CND	RPD	ACH	15/06/07
15	ECR12567	MJR	RPD	ACH	28/08/07
16	ECR 12598	GE	RPD	ACH	12/09/07
17	ECR 12598	GE	MH	ACH	18/09/07
18	ECR 12613	GE	SFT	ACH	22/10/07
19	ECR 12448	MG	RPD	ACH	28/04/08
20	ECR132030/ECR13105	RMD	RD	DA	03/11/08
21	ECR13640	CND	MH	DA	30/03/09
22	ECR 13735	CND	RPD	ACH	21/05/09
23	ECR13791	WL	MH	DA	07/06/10
24	ECR15421	MG	MH	DA	20/03/12
25	ECR16616	WL	SFT	DA	24/02/15