

H-824 Hexapod Microrobots

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Introduction

Precision-Class 6-Axis Positioning System

Parallel-kinematic design for six degrees of freedom making it significantly more compact and stiff than serial-kinematic systems, higher dynamic range, no moved cables: Higher reliability, reduced friction

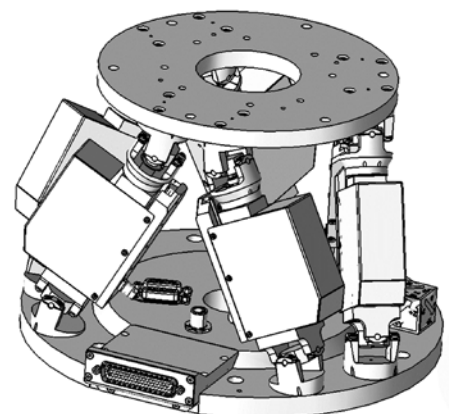
Model Overview

H-824.G2 Compact Hexapod Microrobot, DC Motor Gearhead, 1 mm/s, 10 kg Load, Sub-D Connector, Cable Set 3 m

H-824.D2 Compact Hexapod Microrobot, Direct Drive, 25 mm/s, 5 kg Load, Sub-D Connector, Cable Set 3 m

H-824.G2V Compact Hexapod Microrobot, DC Motor Gearhead, 0.5 mm/s, 5 kg Load, Vacuum-Compatible to 10^{-6} hPa, Sub-D Connector, 2 m Vacuum-Side Cable, Feedthrough, 3 m Air-Side Cable

H-824.D2V Compact Hexapod Microrobot, Direct Drive, 12.5 mm/s, 2.5 kg Load, Vacuum-Compatible to 10^{-6} hPa, Sub-D Connector, 2 m Vacuum-Side Cable, Feedthrough, 3 m Air-Side Cable



Recommended Controller (to be ordered separately)

C-887.5xx 6D Hexapod Controller, TCP/IP, RS-232, Bench-Top Device, Control of Two Additional Servo-Motor Axes Included; various models available

Other Applicable Documents

Description	Document
H-824 Hexapod Microrobot	<p>MS200E user manual for H-824.G1, .GV, .D1 and .DV Hexapod models.</p> <p>This manual is also valid for H-824.G2, .G2V, .D2 and .D2V Hexapod models, except for the information superseded by the H824T0005 Technical Note (this document).</p> <p>➤ Refer to the MS200E user manual for the following information:</p> <ul style="list-style-type: none"> – Safety instructions and product description – Instructions for unpacking, installation, start-up, and maintenance of the Hexapod – Overview for troubleshooting
C-887.5xx Hexapod Controller	<p>Technical Notes for the individual controller models</p> <p>MS204E user manual</p> <p>Documentation for the PC software that comes with the Hexapod controller</p>

Scope of Delivery

Order Number	Items
H-824	Hexapod according to your order
Cable set	<p>With H-824.G2 and .D2 models:</p> <ul style="list-style-type: none"> ▪ K040B0241 Data transmission cable, HD Sub-D 78 f/m, 1:1, 3 m ▪ K060B0111 Power supply cable, M12m 180° to M12f 90°, 3 m <p>With H-824.G2V and .D2V models:</p> <ul style="list-style-type: none"> ▪ K040B0254 Data transmission cable for vacuum, HD Sub-D 78 m/f, 1:1, 2 m ▪ 4668 Vacuum feedthrough for data transmission, HD Sub-D 78 m/f ▪ K040B0241 Data transmission cable on the air side, HD Sub-D 78 f/m, 1:1, 3 m ▪ K060B0132 Power supply cable for vacuum, LEMO 2-pin (m) 180° to 2-pin (f) 90°, 2 m ▪ C887B0002 Vacuum feedthrough for power supply, LEMO 2-pin (f) to M12 (m) ▪ K060B0111 Power supply cable on the air side, M12 (m) 180° to M12 (f) 90°, 3 m
000015165	Steward snap-on ferrite suppressor
Packaging, consisting of:	
–	<p>Transport lock consisting of:</p> <ul style="list-style-type: none"> ▪ 2 struts, length 291 mm ▪ 2 struts, length 225 mm ▪ 1 strut, length 130 mm ▪ 9 M6x20 screws ▪ 4 plastic flat washers
000012251	Internal cushion, bottom
000012252	Internal cushion, cover

2016-01-22

H824T0005, valid for H-824.G2, H-824.G2V, H-824.D2, H-824.D2V

Order Number	Items
000012899	Inner box with handle, 560 mm x 560 mm x 400 mm
000012323	Outer box with soft foam cushions
2026	Pallet
Documentation, consisting of:	
H824T0005	Technical Note for H-824.G2, .G2V, .D2 and .D2V Hexapod models (this document)
H824T0001	Technical Note in printed form on unpacking the Hexapod
MS200E	User manual for the Hexapod
Screw sets:	
000034605	Mounting accessories: <ul style="list-style-type: none"> ▪ 6 M6x30 hex-head cap screws ISO 4762 ▪ 1 Allen wrench 5.0 DIN 911
000036450	Accessories for connection to the grounding system: <ul style="list-style-type: none"> ▪ 1 M4x8 flat-head screw with cross recess ISO 7045 ▪ 2 washers, form A-4.3 DIN 7090 ▪ 2 safety washers, Schnorr Ø 4 mm N0110

Connecting the Hexapod to the C-887 Hexapod Controller

Only H-824.G2V and H-824.D2V models: Installing vacuum feedthroughs

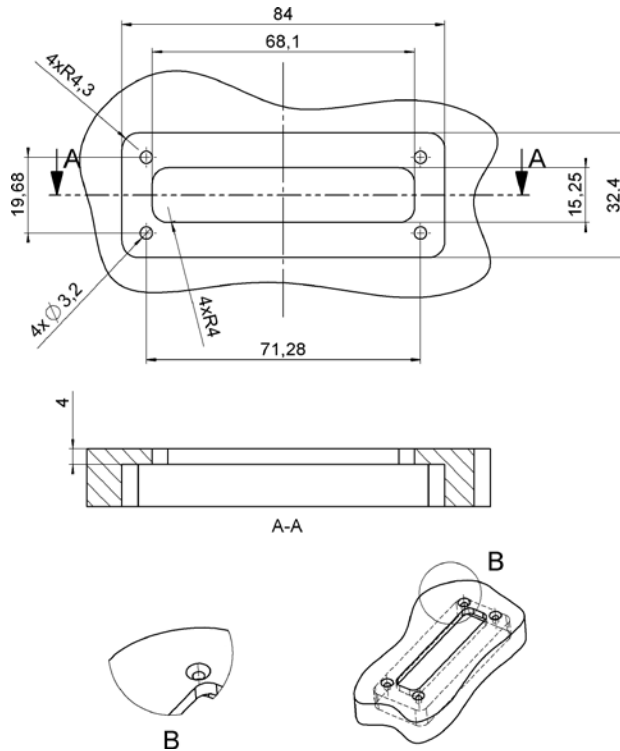


Figure 1: Dimensions of the vacuum feedthrough for data transmission (4668) (dimensions in mm)

B 4 holes 45°xØ6 for M3 countersunk screw

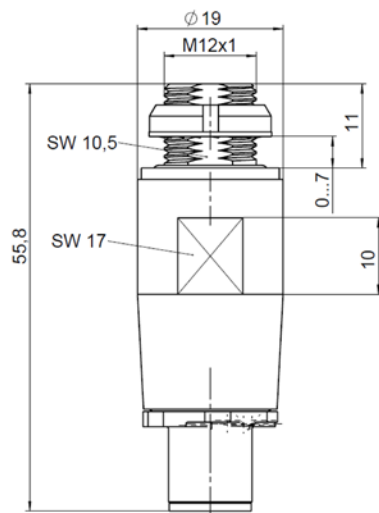


Figure 2: Dimensions of the vacuum feedthrough for Hexapod power supply (C887B0002) (dimensions in mm)

1. See the above figures for the dimensions of the vacuum feedthroughs.
2. Provide the vacuum chamber with suitable openings.
3. Install the vacuum feedthroughs:
 - a) Install the vacuum feedthrough for data transmission (4668) so that the HD Sub-D socket 78 (f) is in the vacuum chamber.
 - b) Install the vacuum feedthrough for Hexapod power supply (C887B0002) so that the 2-pin LEMO socket is in the vacuum chamber.

Connecting the Hexapod to the C-887 with the Cable Set

1. Read and observe the following installation instructions:
 - Instructions in the user manual of the Hexapod, especially sections „General Notes on Installation“, „Determining the Permissible Load and Working Space“, „Attaching the Snap-On Ferrite Suppressor“, „Grounding the Hexapod“, „Mounting the Hexapod on a Surface“ and „Affixing the Load to the Hexapod“.
 - Instructions in the user manual of the Hexapod controller, especially sections „General Notes on Installation“ and „Determining the Working Space and Permissible Load of the Hexapod“.
2. Make sure that the Hexapod controller is switched off (see user manual of the Hexapod controller).
3. Connect the Hexapod to the Hexapod controller as shown in the figure that belongs to your Hexapod model, see below.

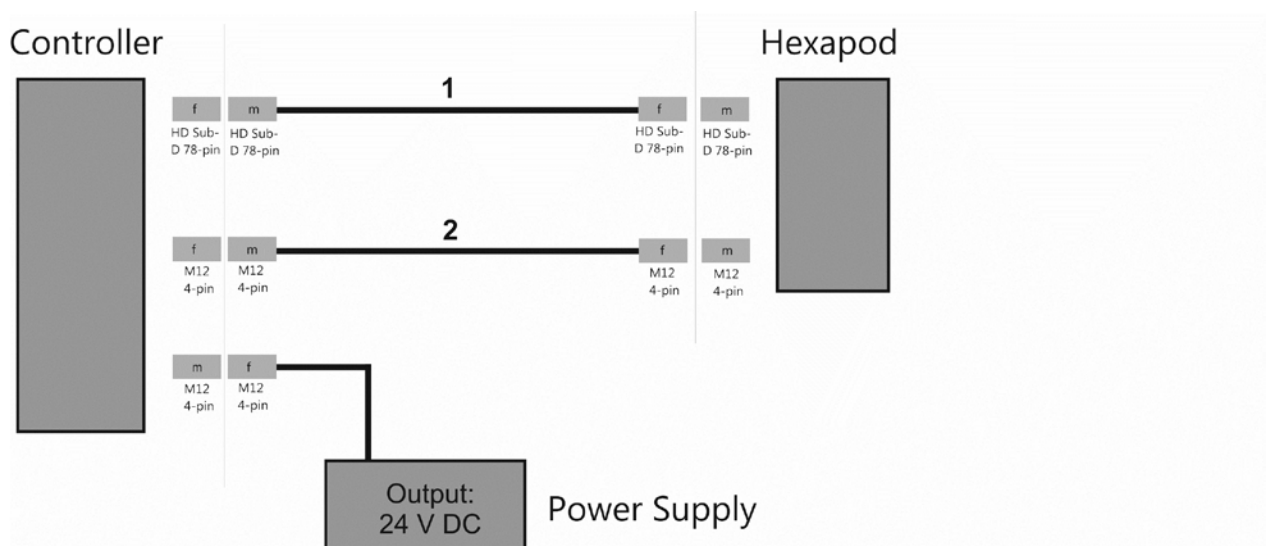


Figure 3: Connection diagram for H-824.G2 and H-824.D2 Hexapod models

<i>Controller</i>	<i>C-887.5x or C-887.5xx Hexapod controller</i>
<i>Hexapod</i>	<i>H-824.G2 or H-824.D2 Hexapod</i>
<i>Power Supply</i>	<i>C-887.5PS power supply, included with the Hexapod controller</i>
<i>1</i>	<i>K040B0241 Data transmission cable, HD Sub-D 78 (m) to HD Sub-D 78 (f), 3 m</i>
<i>2</i>	<i>K060B0111 Power supply cable, M12 (m) to M12 (f), 3 m</i>

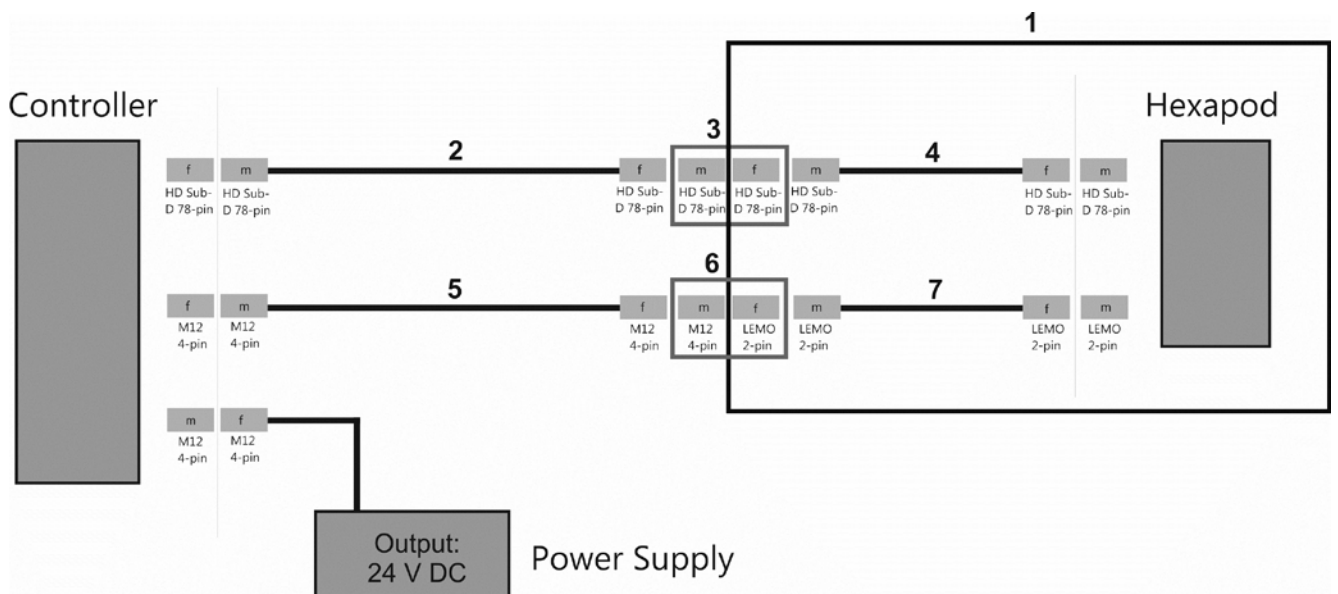
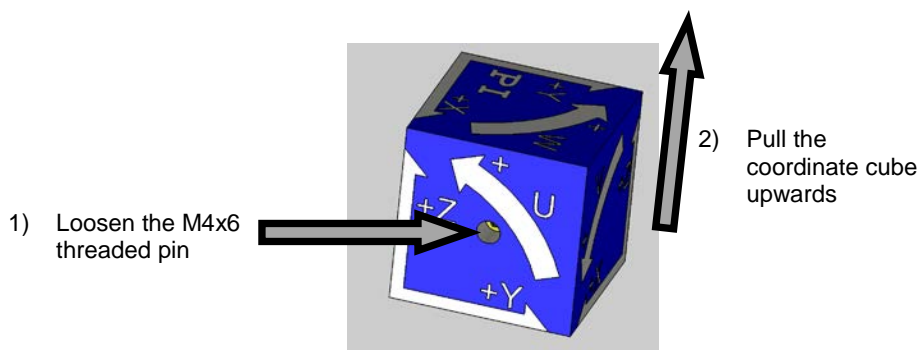


Figure 4: Connection diagram for H-824.G2V and H-824.D2V Hexapod models

- Controller C-887.5x or C-887.5xx Hexapod controller
- Hexapod H-824.G2V or H-824.D2V Hexapod
- Power Supply C-887.5PS power supply, included with the Hexapod controller
- 1 Vacuum chamber
- 2 K040B0241 Data transmission cable on the air side, HD Sub-D 78 (m) to HD Sub-D 78 (f), 3 m
- 3 4668 Vacuum feedthrough for data transmission, HD Sub-D 78 m/f
- 4 K040B0254 Data transmission cable on the vacuum side, HD Sub-D 78 (m) to HD Sub-D 78 (f), 2 m
- 5 K060B0111 Power supply cable on the air side, M12 (m) to M12 (f), 3 m
- 6 C887B0002 Vacuum feedthrough for power supply, M12 (m) to LEMO 2-pin (f)
- 7 K060B0132 Power supply cable on the vacuum side, LEMO 2-pin (m) to LEMO 2-pin (f), 2 m

Optional: Removing the Coordinate Cube

You can remove the coordinate cube from the base plate of the H-824 Hexapod.



Dimensions

All figures show the Hexapod in the reference position. Dimensions in mm. Note that the decimal places are separated by a comma in the drawings.

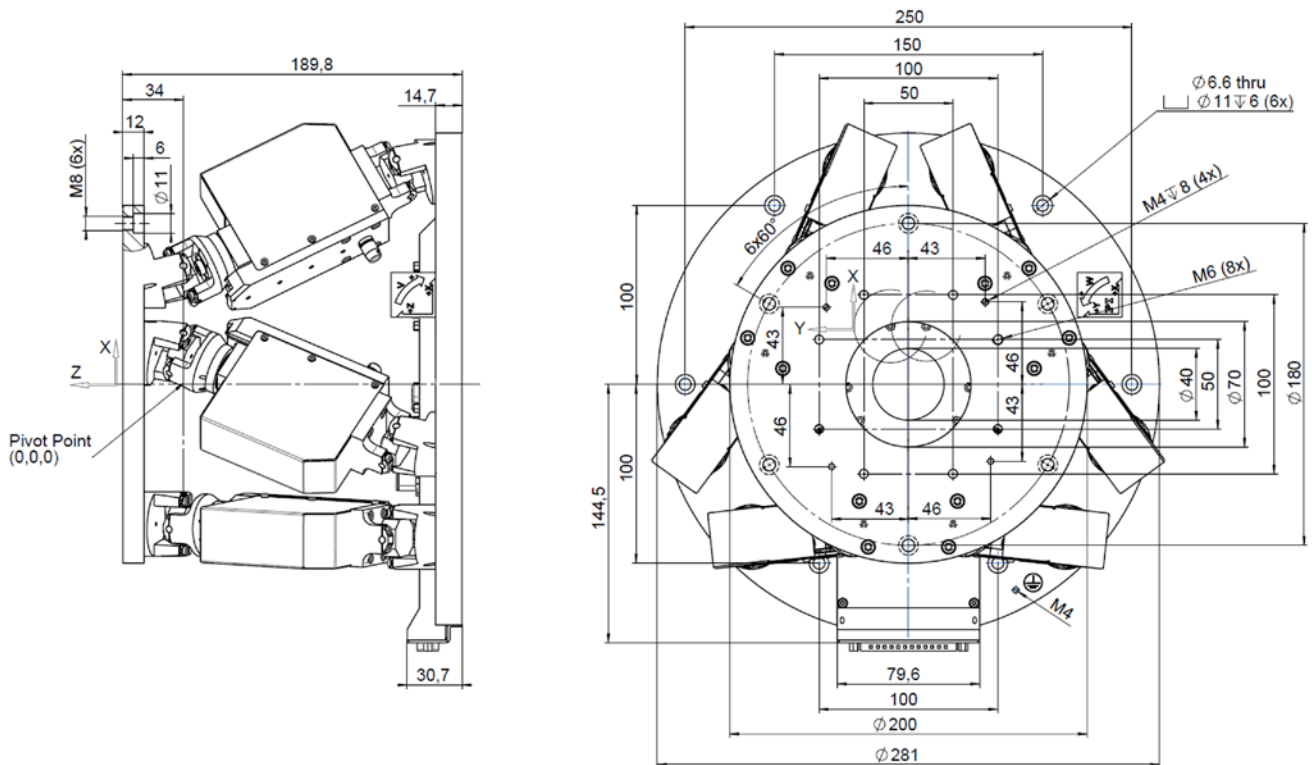


Figure 5: Dimensions of H-824.D2, .D2V, .G2, .G2V Hexapods

The (0,0,0) coordinates refer to the origin of the XYZ coordinate system. When the default settings of the Hexapod controller are used and the Hexapod is in the reference position, the pivot point is located at the origin of the XYZ coordinate system.

Technical Data

Data Table

	H-824.G2	H-824.D2	Unit	Tolerance
	for higher resolution and load	for higher velocity		
Active axes	X, Y, Z, θ_x , θ_y , θ_z	X, Y, Z, θ_x , θ_y , θ_z		
Motion and positioning				
Travel range* X, Y	±22.5	±22.5	mm	
Travel range* Z	±12.5	±12.5	mm	
Travel range* θ_x , θ_y	±7.5	±7.5	°	
Travel range* θ_z	±12.5	±12.5	°	
Single-actuator design resolution	0.007	0.5	µm	
Min. incremental motion X, Y, Z	0.3	1	µm	typ.
Min. incremental motion θ_x , θ_y , θ_z	3.5	12	µrad	typ.
Backlash X, Y	3	1	µm	typ.
Backlash Z	1	1	µm	typ.
Backlash θ_x , θ_y	20	15	µrad	typ.
Backlash θ_z	25	25	µrad	typ.
Repeatability X, Y	±0.5	±0.5	µm	typ.
Repeatability Z	±0.1	±0.1	µm	typ.
Repeatability θ_x , θ_y	±2	±2	µrad	typ.
Repeatability θ_z	±2.5	±2.5	µrad	typ.
Max. velocity X, Y, Z	1	25	mm/s	
Max. velocity θ_x , θ_y , θ_z	11	270	mrads	
Typ. velocity X, Y, Z	0.5	10	mm/s	
Typ. velocity θ_x , θ_y , θ_z	5.5	55	mrads	
Mechanical properties				
Stiffness X, Y	1.7	1.7	N/µm	
Stiffness Z	7	7	N/µm	
Load (base plate horizontal / any orientation)	10 / 5	5 / 2.5	kg	max.
Holding force, de-energized (base plate horizontal / any orientation)	100 / 50	15 / 5	N	max.
Motor type	DC gear motor	DC motor		
Miscellaneous				
Operating temperature range	-10 to 50	-10 to 50	°C	
Material	Aluminum	Aluminum		
Mass	8	8	kg	±5 %
Cable length	3	3	m	±10 mm

Vacuum versions to 10^{-6} hPa are available under the following ordering numbers: H-824.G2V, H-824.D2V. Specifications for vacuum versions can differ, see p. 9.

Technical data specified at $20 \pm 3^\circ\text{C}$.




* The travel ranges of the individual coordinates (X, Y, Z, θ_x , θ_y , θ_z) are interdependent. The data for each axis in this table shows its maximum travel, where all other axes are at their zero positions. If the other linear or rotational coordinates are not zero, the available travel may be less.

Specifications for Vacuum Versions

	H-824.G2V	H-824.D2V	Unit	Tolerance
Motion and positioning				
Velocity X, Y, Z	0.5	12.5	mm/s	max.
Velocity θ X, θ Y, θ Z	5.5	135	mrad/s	max.
Velocity X, Y, Z	0.2	5	mm/s	typ.
Velocity θ X, θ Y, θ Z	2.3	28	mrad/s	typ.
Mechanical properties				
Load (base plate horizontal / any orientation)	5 / 2.5	2.5 / 1.25	kg	max.
Holding force (base plate horizontal / any orientation)	50 / 25	15 / 5	N	max.
Drive and sensor				
Motor	Manufacturer: Faulhaber Motor type: DC, 2224R036SR			
Gearhead	H-824.G2V only: 22/5 Reduction ratio 69:1			
Encoder	Manufacturer: Faulhaber Encoder type: magnetic encoder, IE2-512			
Reference point switch	Magnetic, vacuum-compatible			
Limit switches	Magnetic, vacuum-compatible			
Materials used				
Machine-made parts	94% of the machine-made parts, i.e., base plate, struts, moving platform: AlMg4.5Mn0.7 (3.3547) chemically nickel-plated, stainless steel 1.4310, 1.4305 6% of the machine-made parts, e.g., coupling elements: Various vacuum-compatible materials			
Bearing	Stainless steel			
Drivetrain elements	Drive screw: Stainless steel Drive belt: Polyurethane and Kevlar			
Electrical components	Cable insulation: Teflon (PTFE, FEP) Shrink tubing: Kynar, PTFE Solder: Sn95.5Ag3.8Cu0.7 Connector types: AMP HD20, Lemo PCB's: Adapter board, limit switch board, PWM board			
Grease	Molykote HP-300, Klüber Barrierta L55/2			
Sealing compound and adhesive	Araldite 2014-1 (Huntsmann)			
Other				
Bakeout temperature	80 °C (176 °F)			

Maximum Ratings

The Hexapod is designed for the following operating data:

Maximum operating voltage 	Maximum operating frequency (unloaded) 	Maximum current consumption 
24 V DC	---	5 A

Ambient Conditions and Classifications

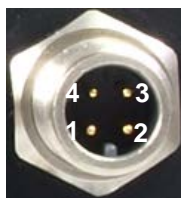
Degree of pollution:	2
Transport temperature:	-25°C to +85°C
Storage temperature:	0 °C to 70 °C
Humidity:	Maximum relative humidity of 80% at temperatures of up to 31°C, linearly decreasing until relative humidity of 50% at 40°C
Degree of protection according to IEC 60529:	IP20
Area of application:	For indoor use only
Maximum altitude:	2000 m

Pin Assignment

Power Supply

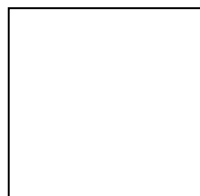
H-824.D2, H-824.G2: 4-pin M12 panel plug

Pin	Function
1	GND
2	GND
3	24 V DC
4	24 V DC



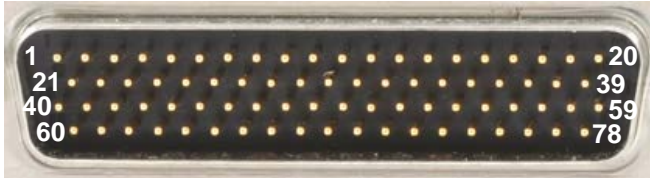
H-824.D2V, H-824.G2V: 2-pin LEMO panel plug, male, type ECJ.1B.302.CLD

Pin	Function
1	GND
2	24 V DC



Data Transmission

HD Sub-D 78 (m)



Pin*	Pin*	Signal*
1		CH1 Sign
	21	CH1 Ref
2		CH1 VDD
	22	CH1 A+
3		CH1 A-
	23	GND
4		CH2 Sign
	24	CH2 Ref
5		CH2 VDD
	25	CH2 A+
6		CH2 A-
	26	GND
7		CH3 Sign
	27	CH3 Ref
8		CH3 VDD
	28	CH3 A+
9		CH3 A-
	29	GND
10		CH4 Sign
	30	CH4 Ref
11		CH4 VDD
	31	CH4 A+
12		CH4 A-
	32	GND
13		CH5 Sign
	33	CH5 Ref
14		CH5 VDD
	34	CH5 A+
15		CH5 A-
	35	GND
16		CH6 Sign
	36	CH6 Ref
17		CH6 VDD

Pin*	Pin*	Signal*
40		CH1 MAGN
	60	CH1 LimP
41		CH1 LimN
	61	CH1 B+
42		CH1 B-
	62	GND
43		CH2 MAGN
	63	CH2 LimP
44		CH2 LimN
	64	CH2 B+
45		CH2 B-
	65	GND
46		CH3 MAGN
	66	CH3 LimP
47		CH3 LimN
	67	CH3 B+
48		CH3 B-
	68	GND
49		CH4 MAGN
	69	CH4 LimP
50		CH4 LimN
	70	CH4 B+
51		CH4 B-
	71	GND
52		CH5 MAGN
	72	CH5 LimP
53		CH5 LimN
	73	CH5 B+
54		CH5 B-
	74	GND
55		CH6 MAGN
	75	CH6 LimP
56		CH6 LimN

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H824T0005, valid for H-824.G2, H-824.G2V, H-824.D2, H-824.D2V

Pin*	Pin*	Signal*
	37	CH6 A+
18		CH6 A-
	38	GND
19		Reserved
	39	GND
20		24 V output

Pin*	Pin*	Signal*
	76	CH6 B+
57		CH6 B-
	77	GND
58		Brake/Enable drive
	78	GND
59		Power good 24 V input

* Pin assignment of the C-887.5xx Hexapod controller. Since not all signals are required for all Hexapod models, some pins may be not assigned with your Hexapod model.