

phd PNEUCONNECT®

Seamless Integration of PHD Grippers to Universal Robots



phd
PNEUCONNECT® X2
with Freedrive



PNEUCONUR01A

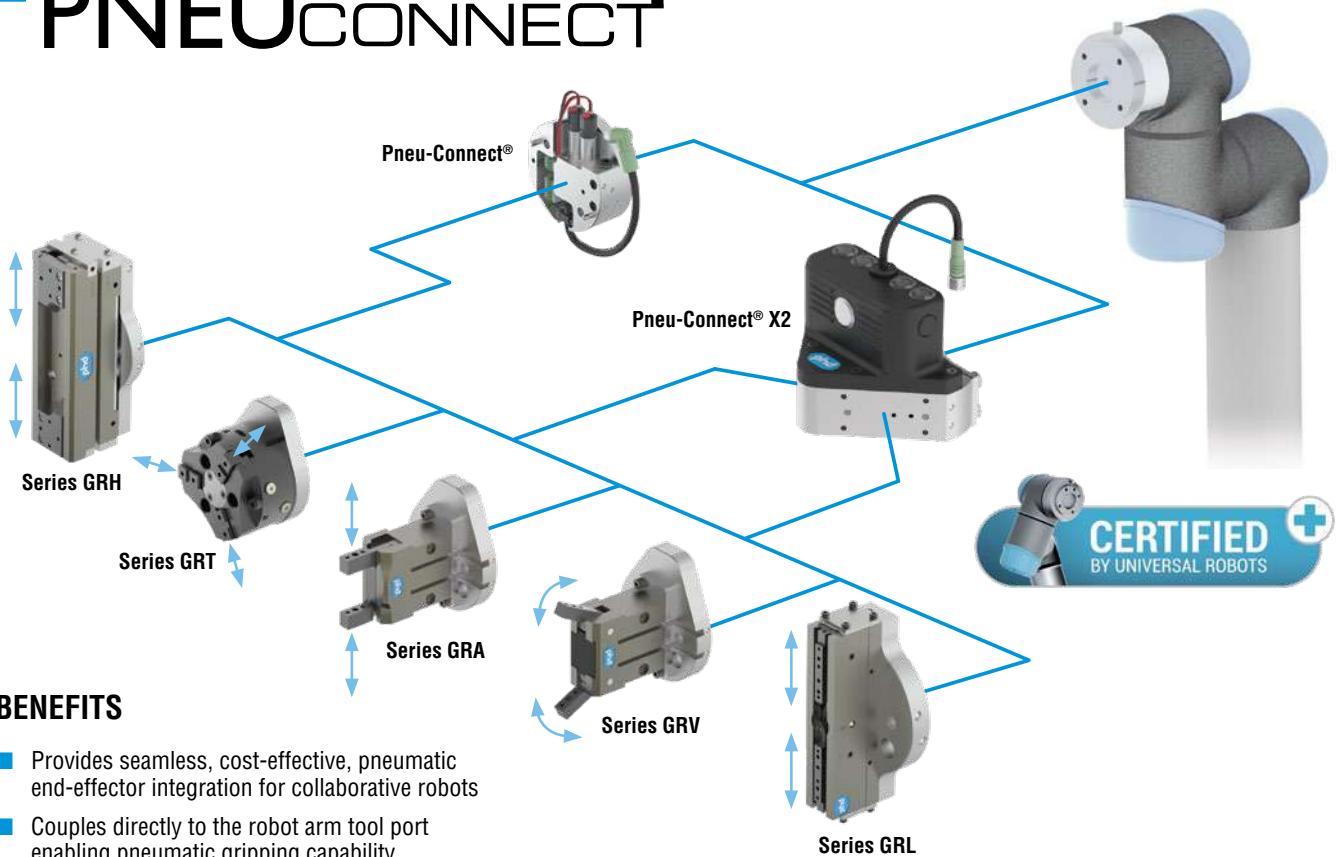


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MAC Distributor Network

phd®  SOLUTIONS FOR INDUSTRIAL AUTOMATION

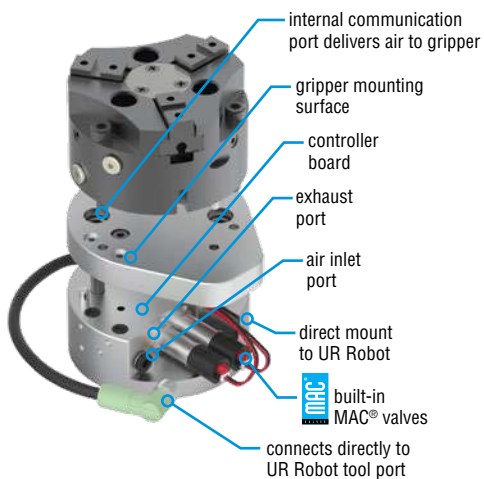
www.phdinc.com

phd PNEUCONNECT®



BENEFITS

- Provides seamless, cost-effective, pneumatic end-effector integration for collaborative robots
- Couples directly to the robot arm tool port enabling pneumatic gripping capability
- Incorporated MAC® valves
- URCap software is included for intuitive, easy setup of Pneu-Connect system (see page 15)
- Kits with GRH Grippers are available with analog sensors that provide jaw position feedback
- Pneu-Connect X2 design features the Freedrive button that interfaces with the UR for easy position programming



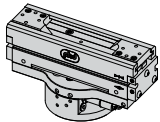
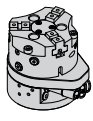
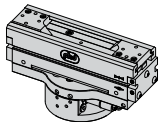
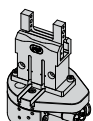
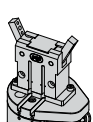
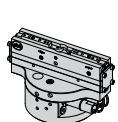
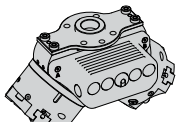
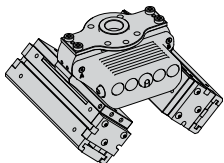
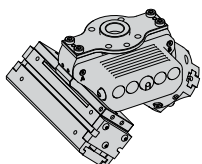
**Pneu-Connect® with Series GRT
3-Jaw Parallel Concentric Gripper**

phd PNEUCONNECT® X2 with Freedrive



**Pneu-Connect® X2 with two Series GRH
Long Jaw Travel Parallel Grippers**

ORDERING DATA: PNEU-CONNECT® KITS

	KIT INCLUDES	KIT NUMBER
SINGLE GRIPPER	 • Pneu-Connect • GRH12-5-12x75-L11-UB99 gripper • gripper mounting plate • mounting kit • 2 integrated discrete switches for sensing gripper open and close • URCap integration software	89387-01-012-0001
	 • Pneu-Connect • GRT532-1-0001 gripper • gripper mounting plate • mounting kit • URCap integration software	89387-02-050-0001
	 • Pneu-Connect • GRH12-5-12x75-L11-UB99-E3 gripper • gripper mounting plate • mounting kit • 1 integrated analog sensor for jaw position feedback • URCap integration software	89387-03-012-0001
	 • Pneu-Connect • GRA-5-20x13-L11-UB99-GR9 gripper • gripper mounting plate • mounting kit • 2 integrated discrete switches for sensing gripper open and close • URCap integration software	89387-04-020-0001
	 • Pneu-Connect • GRV-5-20x40-L11-UB99-GR9 gripper • gripper mounting plate • mounting kit • 2 integrated discrete switches for sensing gripper open and close • URCap integration software	89387-05-020-0001
	 • Pneu-Connect • GRL12-5-16x26-L11-UB99 gripper • gripper mounting plate • mounting kit • URCap integration software	89387-06-016-0001
X2 - DUAL GRIPPERS	 • Pneu-Connect • 2 GRT532-1-0001 grippers • 2 gripper mounting plates • mounting kit • URCap integration software • Freedrive	89921-0101-5050-0001
	 • Pneu-Connect • 2 GRH12-5-12x75-L11-UB99-E3 grippers • 2 gripper mounting plates • mounting kit • 2 integrated analog sensors for jaw position feedback • URCap integration software • Freedrive	89921-0202-1212-0001
	 • Pneu-Connect • GRT532-1-0001 gripper • GRH12-5-12x75-L11-UB99-E3 gripper • 2 gripper mounting plates • mounting kit • 1 integrated analog sensor for jaw position feedback on GRH Gripper • URCap integration software • Freedrive	89921-0102-5012-0001

ENGINEERING DATA: LONG JAW TRAVEL PARALLEL GRIPPER - SERIES GRH

SPECIFICATIONS	GRH12-5-12
OPERATING PRESSURE	1.4 bar min to 6.9 bar max [20 psi min to 100 psi max] air
OPERATING TEMPERATURE	-28 to +82°C [-20 to +180°F]
GRIP REPEATABILITY	±0.05 mm [±0.002 in] of original position
RATED LIFE	5 million cycles
LUBRICATION	Factory lubricated for rated life
MINIMUM TOTAL JAW TRAVEL	75 mm [2.953 in]
TOTAL GRIP FORCE AT 6 bar [87 psi]	120 N [27 lb]
GRIPPER WEIGHT	0.79 kg [1.75 lb]
ONE DIRECTION DISPLACEMENT	10.47 cm³ [0.639 in³]
CLOSE OR OPEN TIME AT 6 bar [87 psi]	0.215 sec
MAX TOOLING LENGTH	100 mm [3.94 in]
GRIP FORCE FACTOR (Gr)	20.0 [0.31]

MODEL NO.	AXIAL FORCE		MAXIMUM INDIVIDUAL MOMENTS					
	Fa		Mx		My		Mz	
	N	lb	Nm	in-lb	Nm	in-lb	Nm	in-lb
GRH12-5-12	222	50	11	95	7	65	7	65

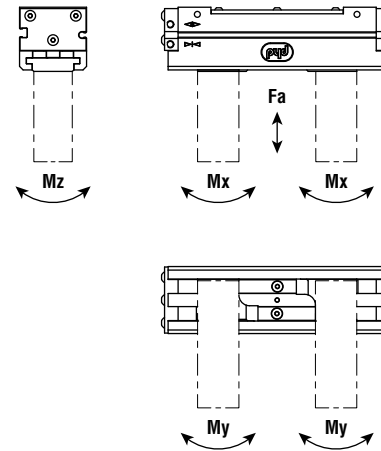
Fa: Total for both jaws

Mx: Maximum allowable moment per jaw, relative to the reference plane

My: Maximum allowable moment per jaw, relative to the geometric center of the jaw finger

Mz: Maximum allowable moment per jaw, relative to the reference plane

When calculating the value for Fa, include the tooling weight, part weight, external forces, and accelerations. When calculating values for Mx, My, and Mz, include the grip force per jaw, tooling weight, part weight, external forces, and accelerations as applicable.



TOOLING LENGTH FACTOR

As the tool center point is moved away from the jaw surface the grip force is reduced due to additional friction generated by the grip induced moment. The tooling length factor allows calculation of the grip force at any tool center point. The graph also indicates the maximum tooling length.

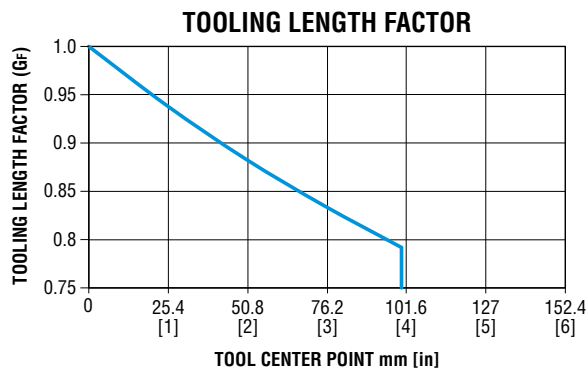
GRIP FORCE CALCULATION EQUATIONS:

METRIC:

Total Grip Force (N) = (Pressure [bar] x Gr) x Tooling Length Factor

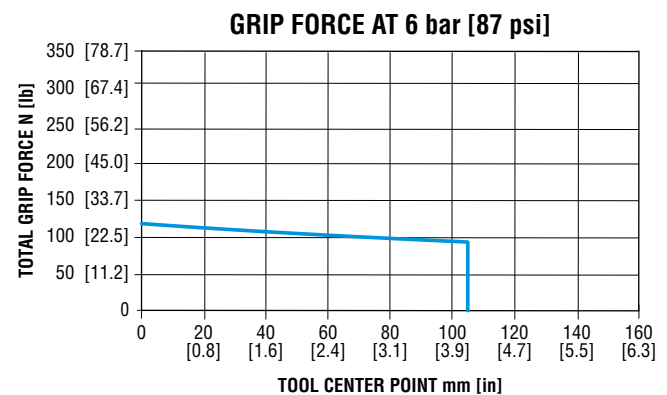
IMPERIAL:

Total Grip Force (lb) = (Pressure [psi] x Gr) x Tooling Length Factor



GRIP FORCE

Total gripping force relative to tooling length is shown below at 6 bar [87 psi] pressure. Grip force per jaw equals the total grip force divided by two. The graphs also indicate the maximum tooling length.



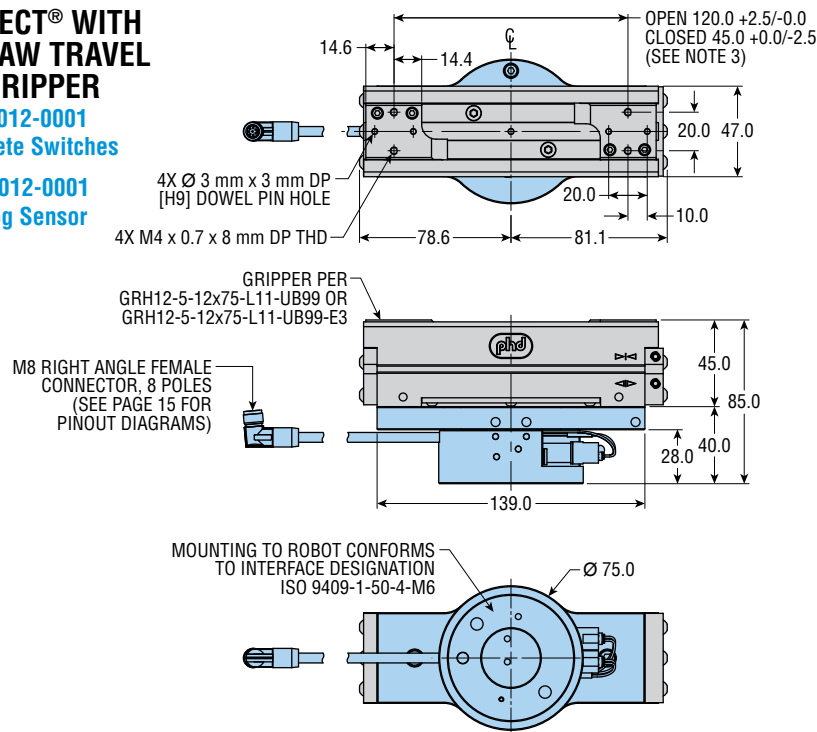
DIMENSIONS: LONG JAW TRAVEL PARALLEL GRIPPER - SERIES GRH

PNEU-CONNECT® WITH ONE LONG JAW TRAVEL PARALLEL GRIPPER

KITS: 89387-01-012-0001
with Discrete Switches

89387-03-012-0001
with Analog Sensor

Total Weight:
1.31 kg [2.88 lb]



two discrete switches

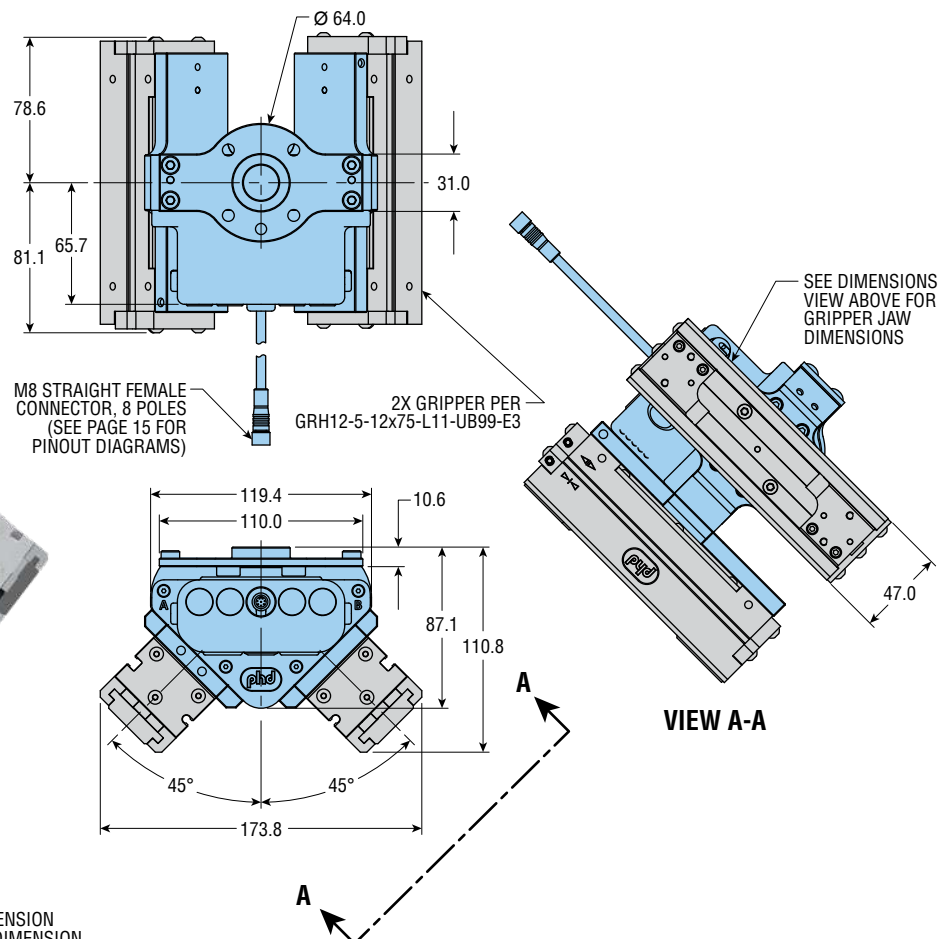


one analog sensor

PNEU-CONNECT® X2 WITH TWO LONG JAW TRAVEL PARALLEL GRIPPERS

KIT: 89921-0202-1212-0001
with two Analog Sensors

Total Weight: 2.40 kg [5.30 lb]



NOTES:

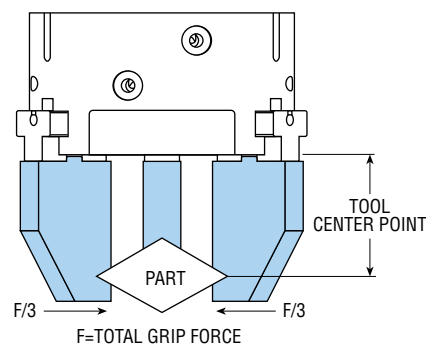
- 1) ALL DIMENSIONS ARE mm
- 2) DESIGNATED ϕ IS CENTERLINE OF UNIT
- 3) OPEN REFLECTS SMALLEST POSSIBLE OPEN DIMENSION
CLOSED REFLECTS LARGEST POSSIBLE CLOSED DIMENSION

All dimensions are reference only unless specifically tolerated.

ENGINEERING DATA: 3-JAW PARALLEL CONCENTRIC GRIPPER - SERIES GRT

SPECIFICATIONS	GRT532
OPERATING PRESSURE	2 bar min to 7 bar max [30 psi min to 100 psi max] air
OPERATING TEMPERATURE	-28° to +82°C [-20° to +180°F]
RATED LIFE	10 million cycles minimum with standard seals
GRIP REPEATABILITY	Within ±0.05 mm [±0.002 in] of original centered position
CLOSE OR OPEN TIME 6 bar [87 psi]	0.04 sec
LUBRICATION	Factory lubricated for rated life
MAINTENANCE	Field repairable
TOTAL DIAMETRAL JAW TRAVEL	12 mm [0.472 in]
TOTAL CLOSE GRIP FORCE AT 6 bar [87 psi]	747 N [168 lb]
GRIPPER WEIGHT	0.43 kg [0.95 lb]
DISPLACEMENT	12 cm ³ [0.72 in ³]
GRIP FORCE FACTOR (G _f)	
EXTERNAL GRIP	125 [1.93]
INTERNAL GRIP	136 [2.10]

MODEL NO.	TOOL CENTER POINT		TOOLING WEIGHT MAX. PER JAW	
	mm	in	kg	lb
GRT532	65	2.56	0.33	0.72



TOOLING LENGTH FACTOR

Tooling should be designed so that the tool center point is as close to the body surface as possible. When the tool center point moves away, jaw friction increases, which decreases grip force. The G_f information given to the right is for zero tooling length (body surface). The graph shows how force decreases as the grip point moves away from the body surface.

GRIP FORCE CALCULATION EQUATIONS:

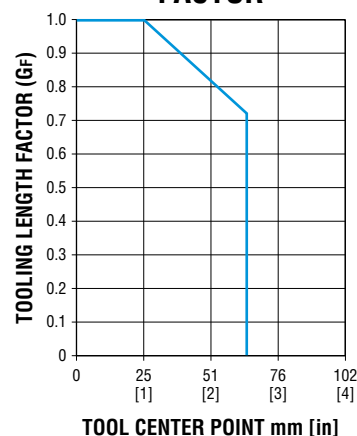
METRIC:

Total Grip Force (N) = (Pressure [bar] x G_f) x Tooling Length Factor

IMPERIAL:

Total Grip Force (lb) = (Pressure [psi] x G_f) x Tooling Length Factor

TOOLING LENGTH FACTOR

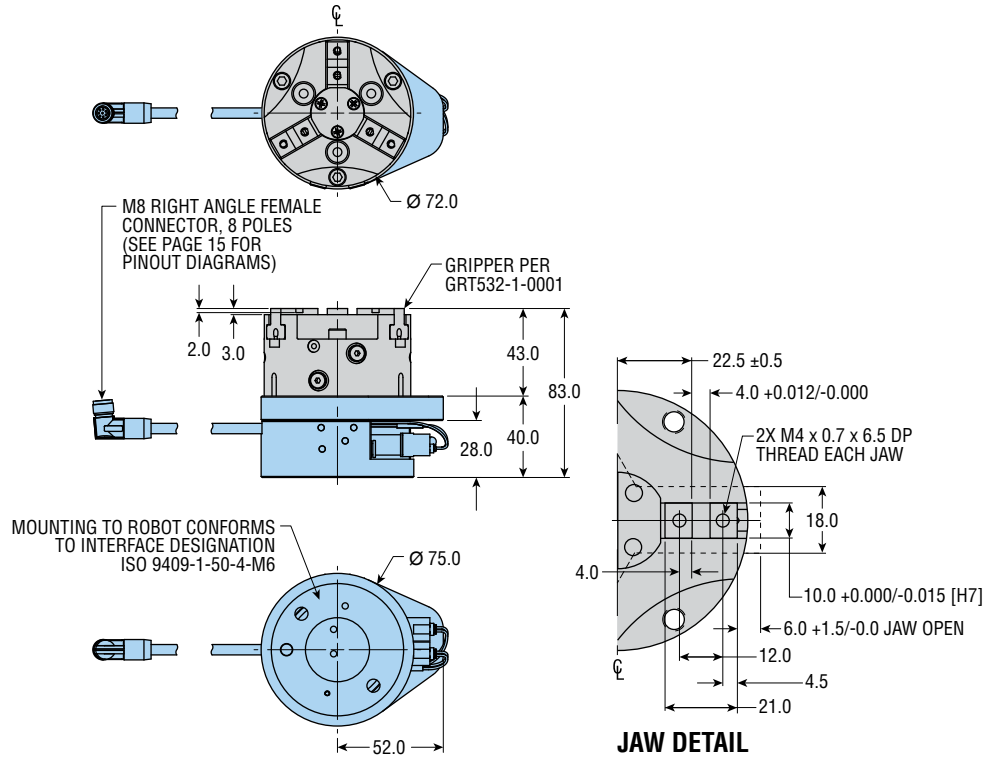


DIMENSIONS: 3-JAW PARALLEL CONCENTRIC GRIPPER - SERIES GRT

PNEU-CONNECT® WITH ONE 3-JAW PARALLEL CONCENTRIC GRIPPER

KIT: 89387-02-050-0001

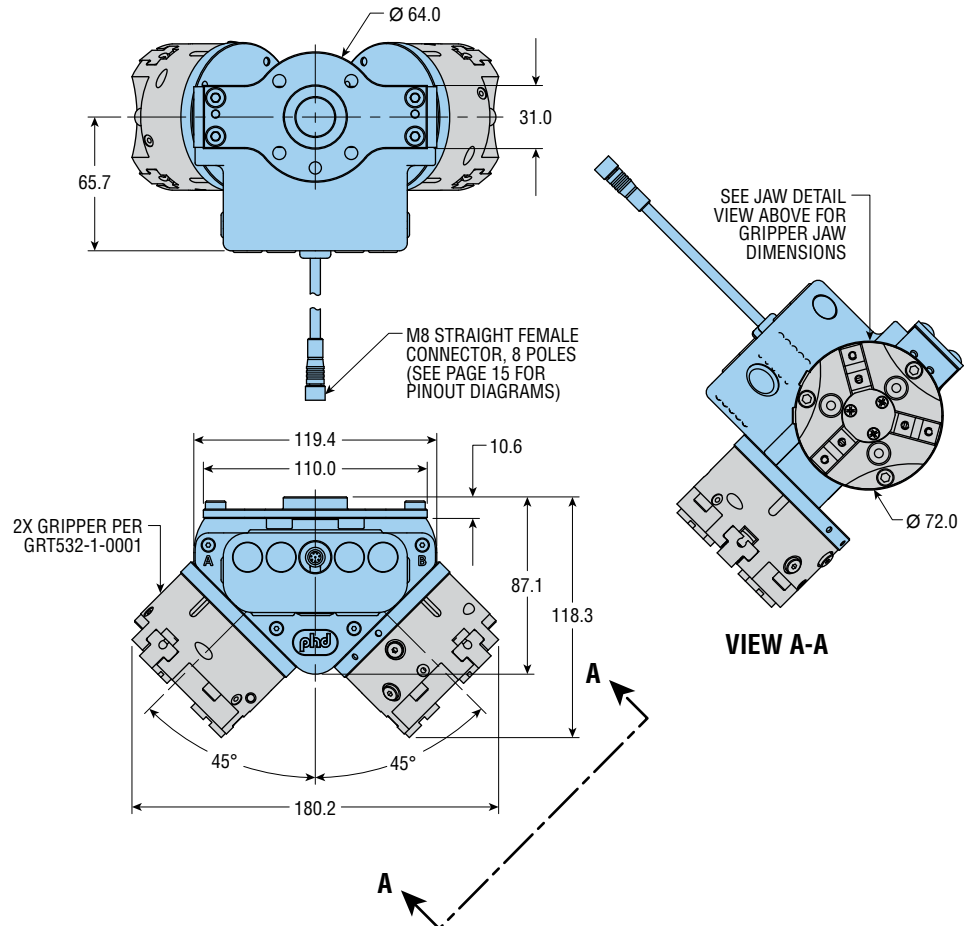
Total Weight: 0.85 kg [1.88 lb]



PNEU-CONNECT® X2 WITH TWO 3-JAW PARALLEL CONCENTRIC GRIPPERS

KIT: 89921-0101-5050-0001

Total Weight: 1.68 kg [3.70 lb]



NOTES:

- 1) ALL DIMENSIONS ARE mm
- 2) DESIGNATED ϕ IS CENTERLINE OF UNIT

All dimensions are reference only unless specifically tolerated.

ENGINEERING DATA: PARALLEL MICRO GRIPPER - SERIES GRA

SPECIFICATIONS	GRA-5-20x13
OPERATING AIR PRESSURE	2 bar min to 8.3 bar max [30 psi min to 120 psi max] air
OPERATING TEMPERATURE	-28° to +82°C [-20° to +180°F]
GRIP REPEATABILITY	10 million cycles minimum with standard seals
RATED LIFE	±0.01 mm [±0.0004 in] of original position
LUBRICATION	Factory lubricated for rated life
MINIMUM TOTAL JAW TRAVEL	13.0 mm [0.512 in]
TOTAL CLOSE GRIP FORCE AT 6 bar [87 psi]	123 N [27.7 lb]
GRIPPER WEIGHT	0.28 kg [0.62 lb]
DISPLACEMENT	2.20 cm³ [0.134 in³]
CLOSE OR OPEN TIME 6 bar [87 psi]	0.105 sec
MAXIMUM TOOLING LENGTH	100 mm [3.94 in]
GRIP FORCE FACTOR (G _F)	
INTERNAL GRIP	16.4 [0.254]
EXTERNAL GRIP	20.5 [0.318]

Fa: Total for both jaws

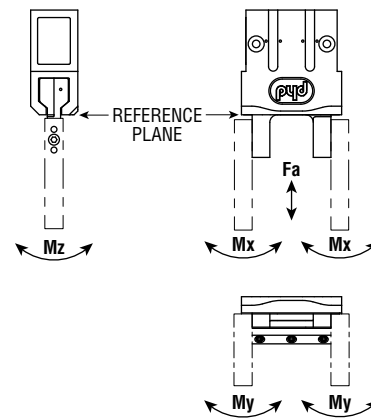
Mx: Maximum allowable moment per jaw, relative to the reference plane

My: Maximum allowable moment per jaw, relative to the geometric center of the jaw finger

Mz: Maximum allowable moment per jaw, relative to the reference plane

When calculating the value for Fa, include the tooling weight, part weight, external forces, and accelerations. When calculating values for Mx, My, and Mz, include the grip force per jaw, tooling weight, part weight, external forces, and accelerations as applicable.

MODEL NO.	AXIAL FORCE		MAXIMUM INDIVIDUAL MOMENTS					
	Fa		Mx		My		Mz	
	lb	N	in-lb	Nm	in-lb	Nm	in-lb	Nm
GRA-5-20x13	40	178	45	5.1	45	5.1	30	3.4



TOOLING LENGTH FACTOR

As the tool center point is moved away from the jaw surface, the grip force is reduced due to additional friction generated by the grip induced moment. The tooling length factor allows calculation of the grip force at any tool center point. The graph also indicates the maximum tooling length.

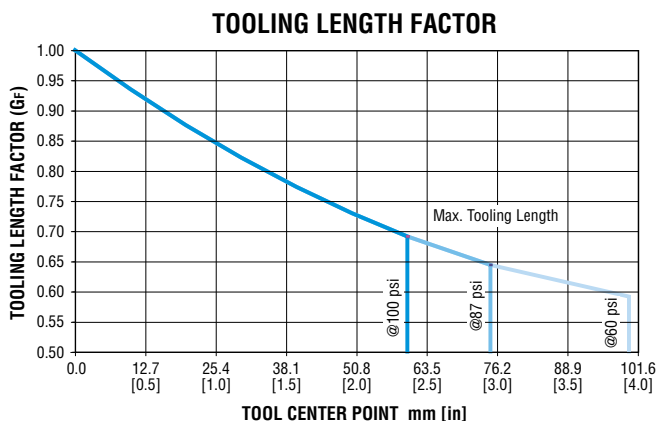
GRIP FORCE CALCULATION EQUATIONS:

METRIC:

Total Grip Force (N) = (Pressure [bar] x G_F) x Tooling Length Factor

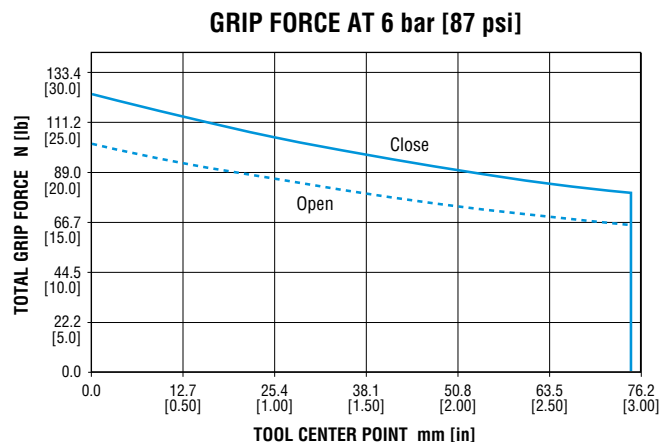
IMPERIAL:

Total Grip Force (lb) = (Pressure [psi] x G_F) x Tooling Length Factor



GRIP FORCE

Total gripping force relative to tool center point is shown below at 6 bar [87 psi] pressure. Grip force per jaw equals the total grip force divided by two. The graphs also indicate the maximum tooling length.



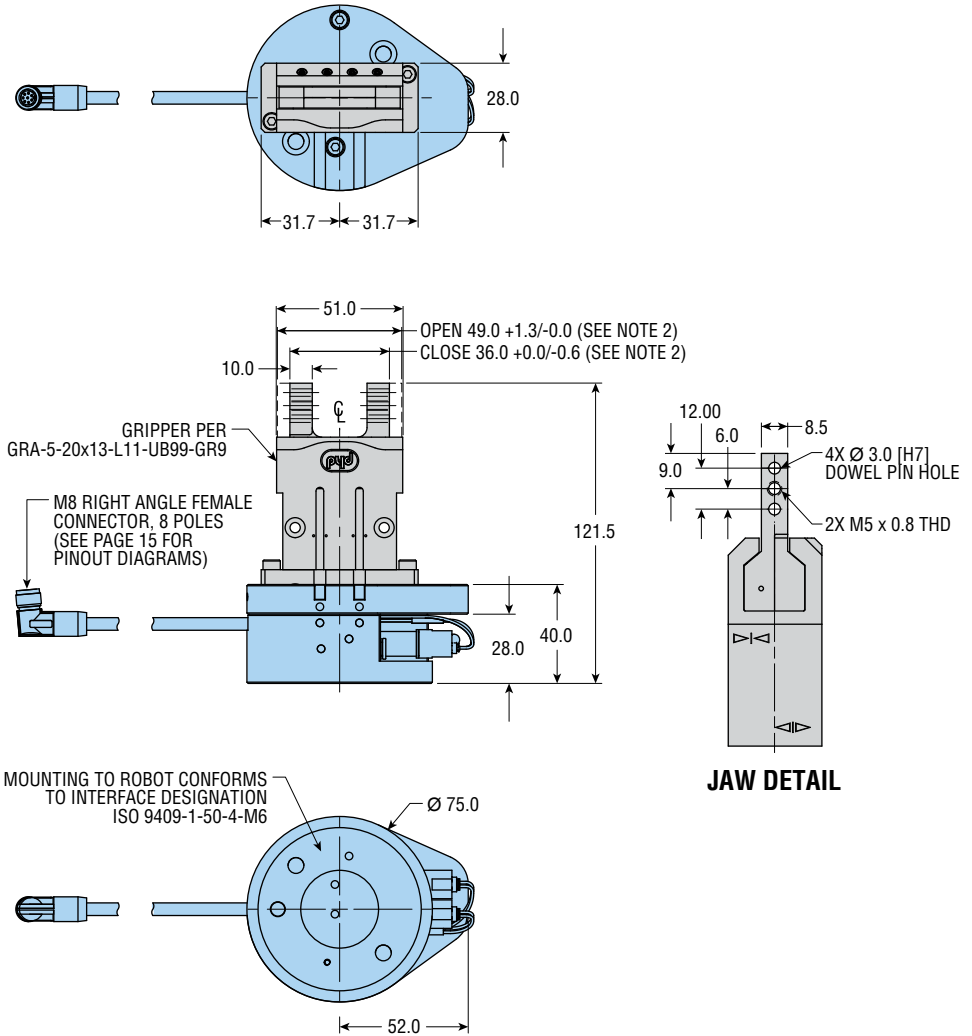
DIMENSIONS: PARALLEL MICRO GRIPPER - SERIES GRA

PNEU-CONNECT® WITH ONE PARALLEL MICRO GRIPPER

KIT: 89387-04-020-0001

with Discrete Switches

Total Weight: 0.73 kg [1.60 lb]



NOTES:

- 1) ALL DIMENSIONS ARE mm
- 2) OPEN REFLECTS SMALLEST POSSIBLE OPEN DIMENSION
CLOSE REFLECTS LARGEST POSSIBLE CLOSED DIMENSION
- 3) DESIGNATED ϕ IS CENTERLINE OF UNIT

All dimensions are reference only unless specifically tolerated.

ENGINEERING DATA: ANGULAR MICRO GRIPPER - SERIES GRV

SPECIFICATIONS	GRV-5-20x40
OPERATING AIR PRESSURE	1 bar min - 8.3 bar max [15 psi min - 120 psi max] air
OPERATING TEMPERATURE	-28 to +82°C [-20 to +180°F]
GRIP REPEATABILITY	0.025 mm [±0.001 in] of original position
RATED LIFE	5 million cycles
LUBRICATION	Factory lubricated for rated life
MINIMUM TOTAL JAW OPENING ANGLE	40°
GRIP FORCE FACTOR (Gr)	320 [0.183]
GRIPPER WEIGHT	0.244 kg [0.538 lb]
DISPLACEMENT	3.18 cm³ [0.194 in³]
CLOSE OR OPEN TIME at 6 bar [87 psi]	0.050 sec
MAXIMUM TOOLING LENGTH	80 mm [3.150 in]
MAXIMUM TOOLING INERTIA	519 kg-mm² [1.770 lb-in²]

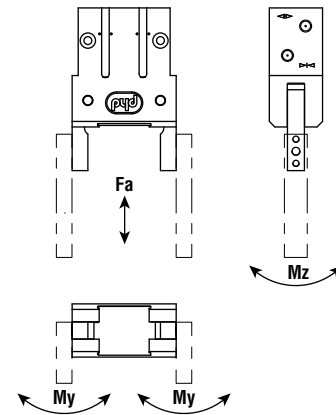
MODEL NO.	AXIAL FORCE		MAX. INDIVIDUAL MOMENTS			
	Fa		My		Mz	
	N	lb	Nm	in-lb	Nm	in-lb
GRV-5-20x40	133	30	5.1	45	3.4	30

Fa: Total for both jaws

My: Maximum allowable moment per jaw, relative to the pivot pin

Mz: Maximum allowable moment per jaw, relative to the pivot pin

When calculating the value for Fa, include the tooling weight, part weight, external forces, and accelerations. When calculating values for My and Mz, include the grip force per jaw, tooling weight, part weight, external forces, and accelerations as applicable.



RECOMMENDATIONS

Design tooling so that the tool center point is as close to the gripper surfaces as possible. The grip force factor (Gr) values given in the table above apply at 0° jaw angle only.

The maximum load that grippers can handle will vary based on: size of the part being picked up, shape of the part, texture of the part, speed at which the part is transferred, working pressure, shape of the fingers, etc.

GRIP FORCE CALCULATION EQUATIONS:

METRIC:

Total Grip Force (N) = (Pressure [bar] x Gr) / Distance from Jaw Pivot (mm)

IMPERIAL:

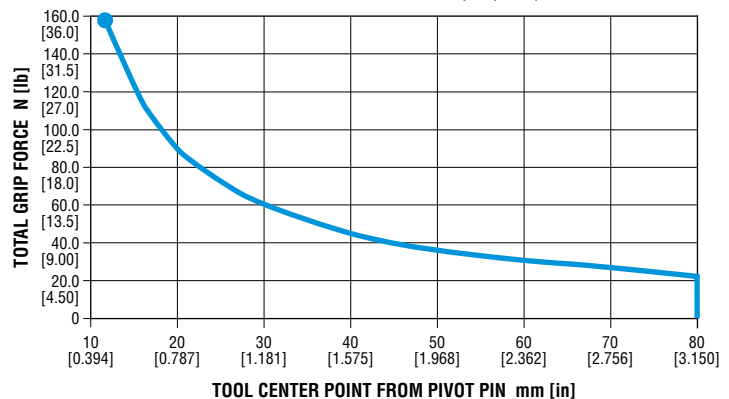
Total Grip Force (lb) = (Pressure [psi] x Gr) / Distance from Jaw Pivot (in)

GRIP FORCE

Total gripping force relative to tool center point is shown below at 6 bar [87 psi] pressure. Grip force per jaw equals the total grip force divided by two. The graphs also indicate the maximum tooling length.

GRIP FORCE AT 6 bar [87 psi] WITH 0° JAW ANGLE

Starts at 15.1 mm from center of jaw pivot point



DIMENSIONS: ANGULAR MICRO GRIPPER - SERIES GRV

PNEU-CONNECT® WITH ONE ANGULAR MICRO GRIPPER

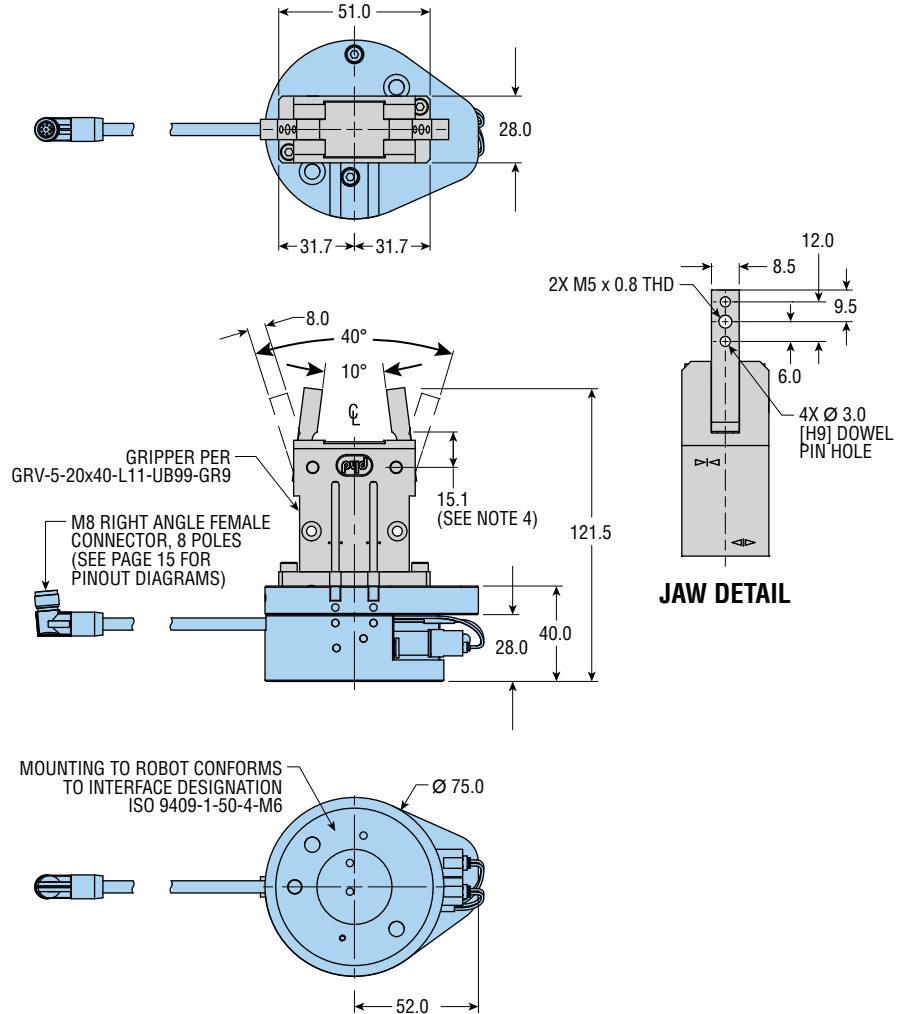
KIT: 89387-05-020-0001

with Discrete Switches

Total Weight: 0.73 kg [1.60 lb]



two discrete switches



NOTES:

- 1) ALL DIMENSIONS ARE mm
- 2) FULL OPEN REFLECTS LEAST POSSIBLE OPEN ANGLE. FULL CLOSED REFLECTS LARGEST POSSIBLE CLOSED ANGLE.
- 3) DESIGNATED $\varnothing$ IS CENTERLINE OF UNIT
- 4) MINIMUM DISTANCE TO BOTTOM OF TOOLING

All dimensions are reference only unless specifically tolerated.

ENGINEERING DATA: NARROW BODY PARALLEL GRIPPER - SERIES GRL

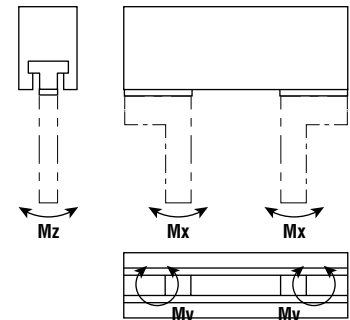
SPECIFICATIONS	GRL12-5-16x26
OPERATING PRESSURE	0.4 bar min to 7 bar max [5 psi min to 100 psi max] air
OPERATING TEMPERATURE	-28 to +82°C [-20 to +180°F]
RATED LIFE	6 million cycles minimum
GRIP REPEATABILITY	Within ±0.05 mm [±0.002 in] of original centered position
CLOSE OR OPEN TIME AT 6 bar [87 psi]	0.120 sec
LUBRICATION	Factory lubricated for rated life
MAINTENANCE	Field repairable
MINIMUM TOTAL JAW TRAVEL	26 mm [1.02 in]
TOTAL CLOSE GRIP FORCE AT 6 bar [87 psi]	182 N [41 lb]
GRIPPER WEIGHT	0.21 kg [0.47 lb]
DISPLACEMENT	5.2 cm³ [0.319 in³]
GRIP FORCE FACTOR (G _F)	30 [0.47]

MODEL NO.	MAXIMUM ALLOWABLE MOMENTS ON GRIPPER JAWS									
	M _x				M _y				M _z	
	PER JAW	TOTAL BOTH JAWS (2 x M _x)		PER JAW	TOTAL BOTH JAWS (2 x M _y)		PER JAW	TOTAL BOTH JAWS (2 x M _z)		
	Nm	in-lb	Nm	in-lb	Nm	in-lb	Nm	in-lb	Nm	in-lb
GRL12-5-16x26	6.2	55	12	110	5.2	55	12	110	5.1	45

M_x, M_z: Allowable moments per jaw. Moments measured from the body surface.

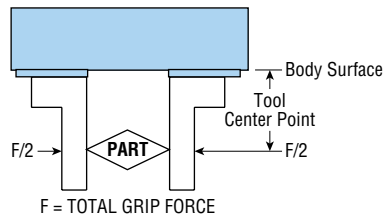
M_y: Allowable moment per jaw. Moment measured from the jaw center.

NOTE: When calculating values for M_x, M_y, and M_z, include the grip force per jaw, tooling weight, part weight, external forces, and acceleration as applicable.

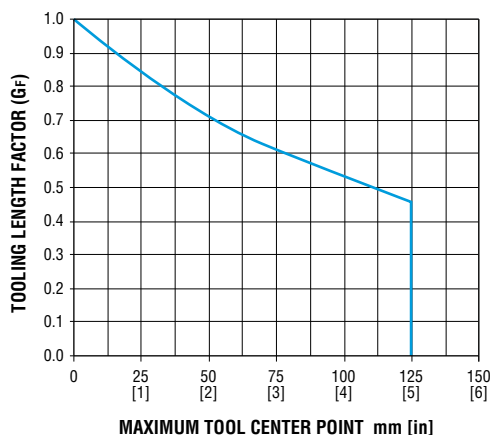


TOOLING LENGTH FACTOR

Jaw tooling should be designed so that the tool center point is as close to the body surface as possible. As the tool center point is moved away from the body surface, the applied moment causes jaw friction to increase, resulting in reduced effective grip force. The Grip Force Factor (G_F) values given in the table above are for zero tooling length (body surface).



TOOLING LENGTH FACTOR



GRIP FORCE CALCULATION EQUATIONS:

METRIC:

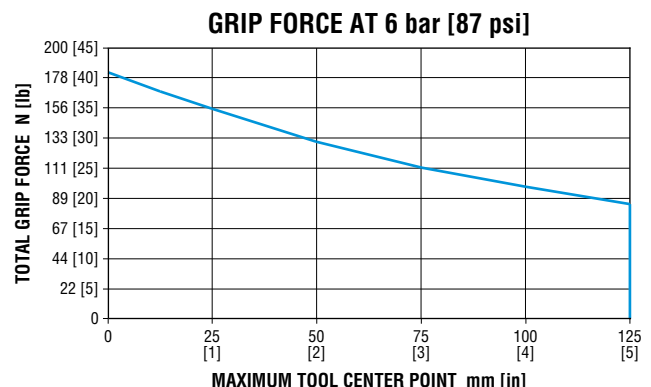
Total Grip Force (N) = (Pressure [bar] x G_F) x Tooling Length Factor

IMPERIAL:

Total Grip Force (lb) = (Pressure [psi] x G_F) x Tooling Length Factor

GRIP FORCE

Total gripping force relative to tool center point is shown below at 6 bar [87 psi] actuating pressure. Grip force per jaw equals the total grip force divided by two. The chart also indicates the maximum tooling length.

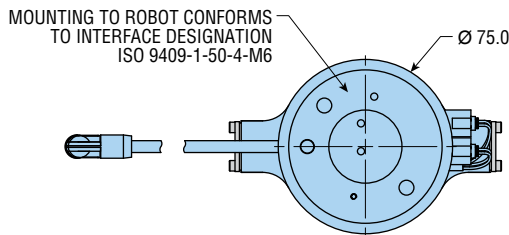
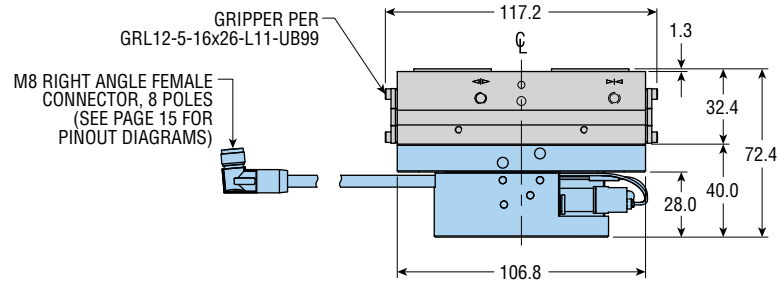
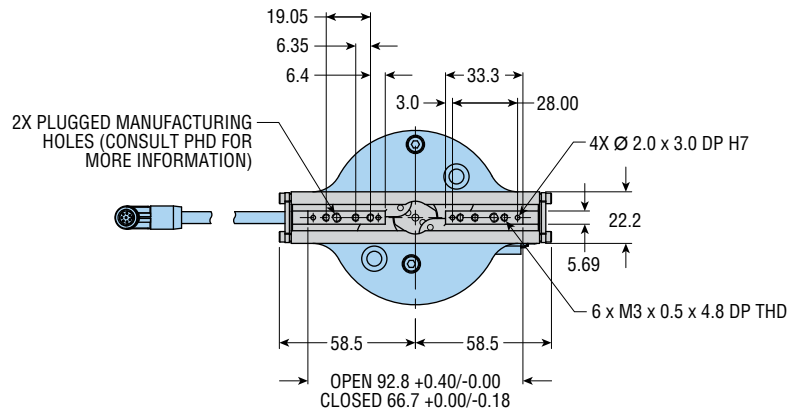


DIMENSIONS: NARROW BODY PARALLEL GRIPPER - SERIES GRL

PNEU-CONNECT® WITH ONE NARROW BODY PARALLEL GRIPPER

KIT: 89387-06-016-0001

Total Weight: 0.64 kg [1.40 lb]



NOTES:
 1) ALL DIMENSIONS ARE mm
 2) ALL DIMENSIONS ARE CENTERED ON CENTERLINE OF UNIT UNLESS OTHERWISE SPECIFIED.

All dimensions are reference only unless specifically tolerated.

DIMENSIONS: PNEU-CONNECT® X2 WITH FREEDRIVE - SERIES GRH & GRT

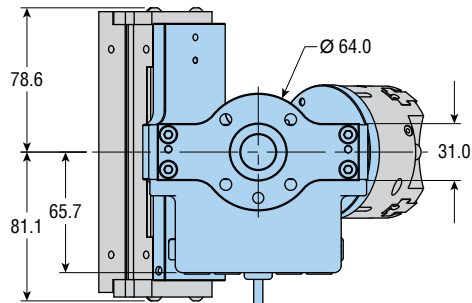
PNEU-CONNECT® X2 WITH ONE LONG JAW TRAVEL PARALLEL GRIPPER AND ONE 3-JAW PARALLEL CONCENTRIC GRIPPER

KIT: 89921-0102-5012-0001

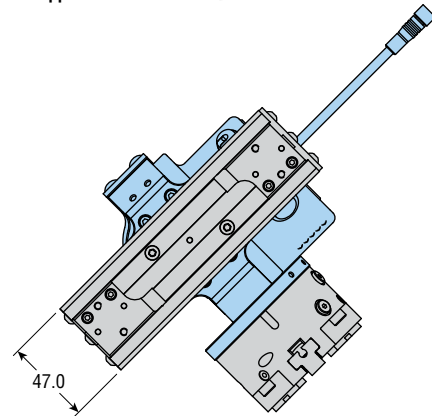
Total Weight: 2.04 kg [4.50 lb]



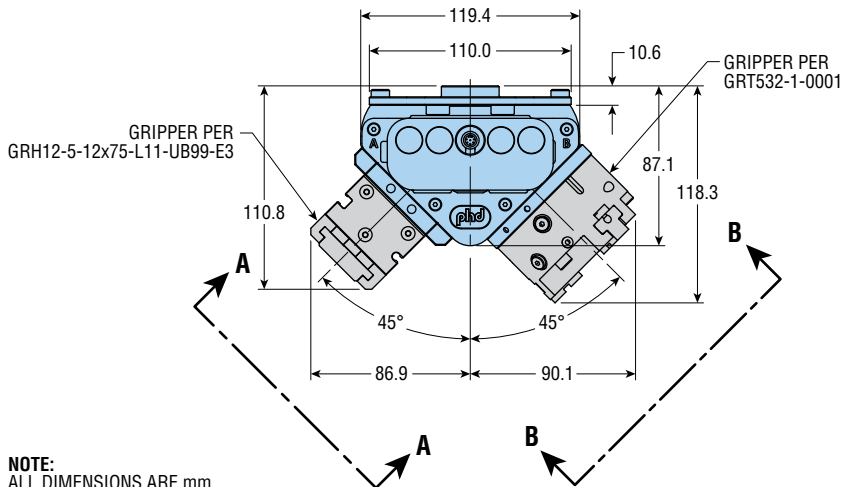
Includes one analog sensor for jaw position feedback on GRH Gripper



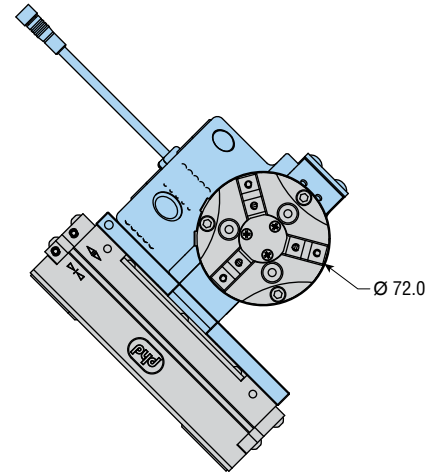
M8 STRAIGHT FEMALE CONNECTOR, 8 POLES (SEE PAGE 15 FOR PINOUT DIAGRAMS)



VIEW A-A



NOTE:
ALL DIMENSIONS ARE mm



VIEW B-B

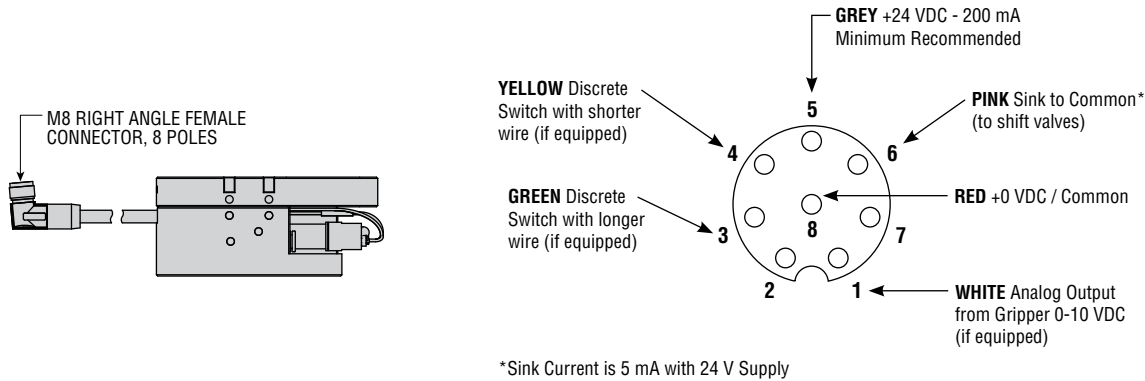
All dimensions are reference only unless specifically tolerated.

PINOUT IDENTIFICATION: PNEU-CONNECT®

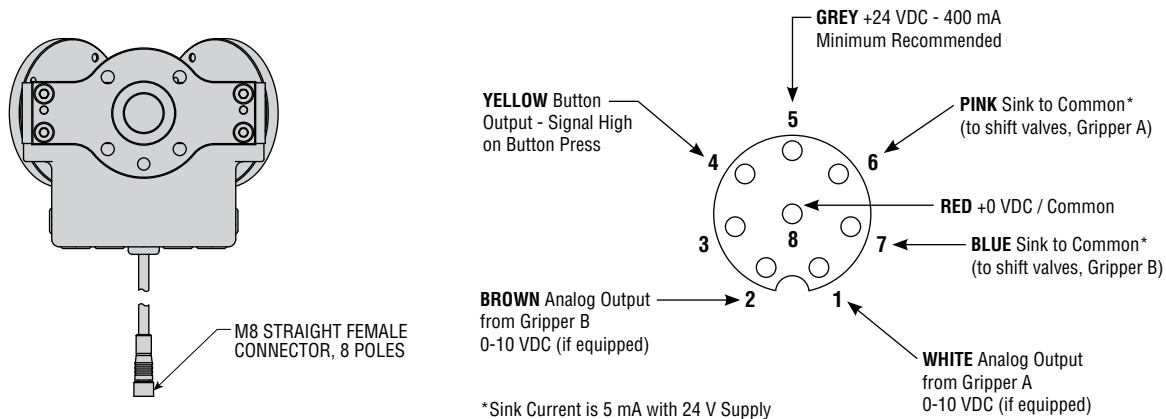
M8 FEMALE 8-PIN CONNECTOR

The pinout diagrams below provide the Pneu-Connect wire assignments for direct I/O control without the software interface.

PNEU-CONNECT® (SINGLE GRIPPER)



PNEU-CONNECT® X2 (DUAL GRIPPER)



NOTE: A mating M8 8-Pin Male Cordset is required as a flying lead to the robot controller.

Pin	Color	
1	WHITE	Analog Input
2	BROWN	Analog Input
3	GREEN	Digital Input
4	YELLOW	Digital Input
5	GREY	+24 VDC
6	PINK	Digital Output
7	BLUE	Digital Output
8	RED	+0 VDC / Common

OPERATION SEQUENCE

The Pneu-Connect has an internal circuit that requires only one output to control both valves. It also has transistors to reduce the load on the UR output pin. The valves alternate (one off while the other is on) to keep power consistent regardless of gripper state.

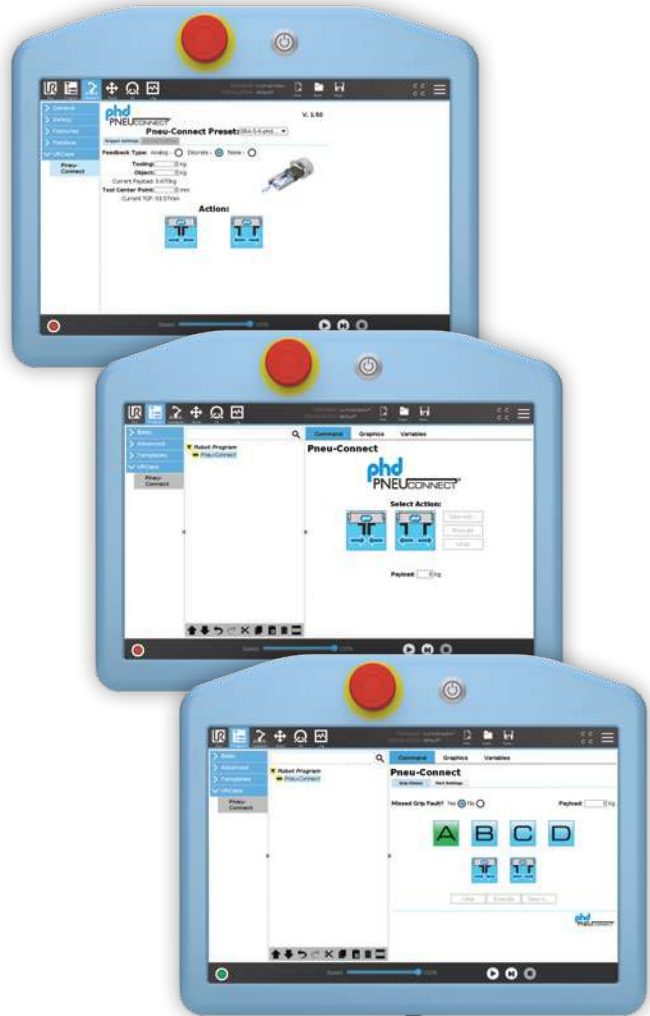
Pneu-Connect (single gripper) only needs three connections to be made to operate the valves:

5	GREY	+24 VDC
6	PINK	"Sink" to Common to shift valves
8	RED	+0 VDC / Common

INTEGRATION SOFTWARE: URCAP

Intuitive, easy setup and programming of the Pneu-Connect® end of arm devices through the UR Robot Teach Pendant. All kits include a USB flash drive with URCap software. The software is compatible with CB-Series and e-Series UR robots. Updates downloadable from the Pneu-Connect product page at phdinc.com.

NOTE: In order for the URCap to function, users must update robot software to 3.8 (CB-Series), 5.2 (e-Series), or above.



Step-by-step URCap setup instructions are available at:
litstore.phdinc.com



Watch the Pneu-Connect® product overview video at:
www.youtube.com/user/phdincdotcom



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