

9QX peristaltic pump with 24 V stepper motor (Nema 14)



9QX



9QX / Pico



9QX / Encoder



9QX / Pico / Encoder

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1.0 Flow and General Technical Data

Tube Size, ID (mm) ¹	Flow per Revolution (µl)	Flow at 100 rpm (ml/min)	Flow at 300 rpm (ml/min)	Flow at 500 rpm (ml/min)
	3 / 4 / 6 roller			
Ø 0.5	16 / 15 / 13	1.6 / 1.5 / 1.3	4.8 / 4.5 / 3.9	8.0 / 7.5 / 6.5
Ø 1.0	55 / 50 / 42	5.5 / 5.0 / 4.2	16.5 / 15.0 / 12.6	27.5 / 25.0 / 21.0
Ø 2.0	190 / 160 / 120	19 / 16 / 12	57 / 48 / 36	95 / 80 / 60
Ø 3.0	340 / 290 / 200	34 / 29 / 20	102 / 87 / 60	170 / 145 / 100
Ø 3.5 ²	400 / 340 / 230	40 / 34 / 23	120 / 102 / 69	200 / 170 / 115

¹ Wall thickness 1.0 mm

² 3.5 mm ID tubing is not recommended for continuous or high speed operation

Motor Type	2 phase, hybrid, bipolar, Nema 14 Additional information below.
Power Consumption	Approx. 8.0 W
Tube Materials	Innovaprene / Innovasil (Silicone) / Pharm-a-line / Lagoprene / ED-Plex
Driver Options	
Pico	Analogue driver: 0 to 5 V DC speed input, direction and enable inputs, step input, mounted directly on motor
A2	Analogue driver: 0 to 5 V DC speed input, direction and enable inputs Additional information in sections 3.1 and 3.2.
Sensors Options	
Speed sensor	Micro reed switch, contacts close once per revolution (page 3)
Encoder	Three channel (A, B, Z) + direction Additional information in sections 4.1 and 4.2.
General Data	
Max pressure	1.0 bar
Max suction height (dry)	9.0 m H ₂ O
Motor life	>10000 hour
Weight (without driver)	245 g

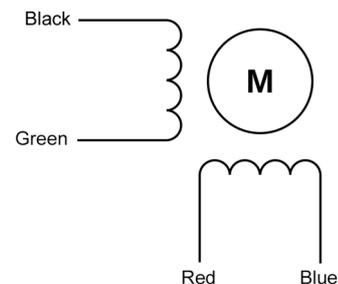
All data measured with 'run-in' Innovaprene continuous tubing and H₂O

2.0 Motor Details

Specification	
Type	2 phase, hybrid, bipolar
Size	Nema 14 / 35 mm
Step Angle	1.8 ° (200 steps per revolution)
Voltage	24 V
Phase 1 / Phase 2	Black - Green / Red - Blue (see diagram on right)
Ambient temperature range	-20 to +50 °C
Max temperature rise	80 °C
Insulation resistance	100 MΩ
Insulation class	B
Rated current ¹	1.0 A
Resistance per phase	2.7 Ω ±10%
Inductance per phase	4.3 mH ±20%
Wire gauge	26 AWG
Lead length	300 mm
Available drivers	→ Drivers
Recommended driver rating ²	2 A

¹ Rated current for stepper motors is traditionally defined as maximum holding current (zero RPM)

² A current limiter should be set at approx. 1.0 A to avoid excessive motor temperatures



3.1 Stepper Driver : Pico

Advanced stepper driver for accurate flow control:

- 0 to 5.0 V, PWM or individual step input
- 1/256 micro-stepping
- 2 speed ranges
- mounts directly on Nema 14 stepper motor via a mounting boot

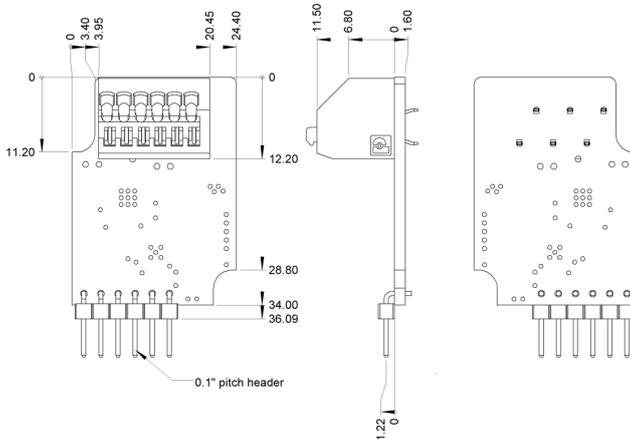
The Pico driver is generally not recommended for continuous run applications due to limited heat dissipation. In such cases, the A2 driver should be selected. See section 3.2.



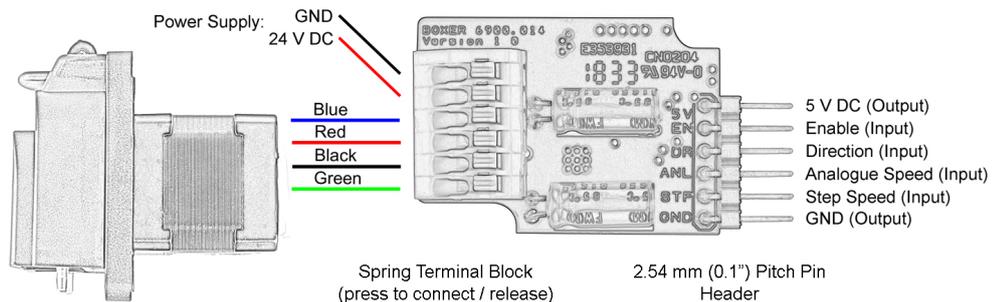
Technical Data

Driver Type	Full H-Bridge for 2 phase unipolar stepper motors
Mounting	On rear of Nema 14 motor via boot
Voltage Range	10.0 to 24.0 V DC
Max Current	1.4 and 1.0 A setting intermittent / 0.7 and 0.4 A setting continuous
Current Limiter Factory Setting	1.0 A
Control Inputs	Speed (analogue, PWM or step), Enable, Direction
Control Outputs	+5.0 V DC reference output (for use with external potentiometer for speed control)
Jumpers (on reverse side)	Speed Range, Current Limiter, Micro-Stepping, Analogue or Step Input
Micro-Stepping	1/256 or 1/16
Automatic Acceleration (during start or speed adjust)	Ramp over 0.3 seconds
Thermal Protection	Automatic / Re-setting
Weight	7.0 g

Drawing



Electrical Connection Details



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Outputs (to stepper motor):

A+ / A-	Black / Green	Phase A
B- / B+	Red / Blue	Phase B

Note: reversing polarity of A or B will cause the motor to run in the opposite direction

Inputs / Outputs (to /from driver):

V+	Supply Voltage	+ 24.0 V DC (range 10.0 to 24.0 V DC)
GND	Ground	GND
5V ¹	5V DC (Output)	For use with external potentiometer for speed control
EN ²	Enable / Disable	Open (or +5.0 V) = enabled / GND = disabled (motor coils are not energised)
DR ^{2, 3}	Direction	Open (or +5.0 V) = direction anti-clockwise / GND = direction clockwise
ANL ⁴	Analogue Speed	0 to 5.0 V or 0 to 100% PWM (resolution 1024 increments / 10 bit)
STP ⁴	Step Speed	1 pulse = 1 micro-step rotation
		1/256 micro stepping mode: 1 rotation = 51,200 (200 x 256) pulses. 51.2 kHz = 60 rpm, 512 kHz = 600 rpm
		1/16 micro stepping mode: 1 rotation = 3,200 (200 x 16) pulses. 3.2 kHz = 60 rpm, 32.0 kHz = 600 rpm
GND	GND (Output)	For use with external potentiometer

Always start a peristaltic pump at slow to medium speed (less than 300 rpm) to avoid stalling

¹ Supplied insulated. Damage will occur if connected to any voltage or GND

² Inputs are internally pulled up

³ Direction is defined as looking at the pump from the front (anti-clockwise means inlet right, outlet left)

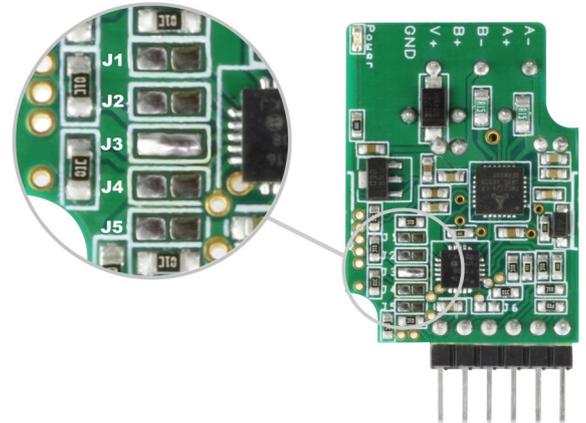
⁴ Analogue or Step Speed mode is selected by the jumper settings

Jumpers

Jumpers are provided on the reverse side as solder bridges. To close a bridge, carefully apply solder between the pads. To open a bridge, carefully use de-soldering braid. The photo below shows the default settings of J1 open, J2 open, J3 closed, J4 open and J5 open. The jumper settings are read when the driver is powered-up.

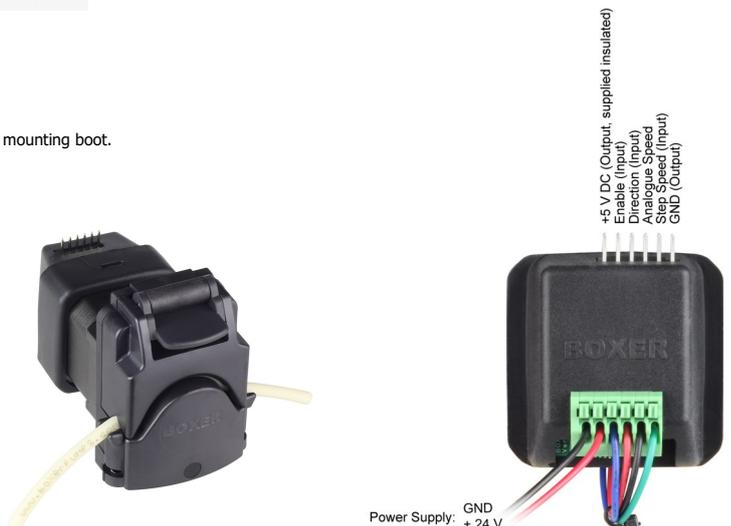
Jumper					Mode
J1	J2	J3	J4	J5	
0	-	-	-	-	Speed Range : 0 to 800 rpm
1	-	-	-	-	Speed Range 0 to 150 rpm
-	0	0	-	-	Current Limiter 0.4 A
-	1	0	-	-	Current Limiter 0.7 A
-	0	1	-	-	Current Limiter 1.0 A
-	1	1	-	-	Current Limiter 1.4 A
-	-	-	0	-	1/256 Micro-Stepping
-	-	-	1	-	1/16 Micro Stepping
-	-	-	-	0	Analogue or PWM Speed Input Mode
-	-	-	-	1	Step Speed Input Mode

Default settings shown in **bold**.



Direct Mounting

The Pico stepper driver is supplied assembled directly on the 9QX peristaltic pumps using a silicone mounting boot.



3.2 Stepper Driver : A2

Stepper driver with analogue speed control input for accurate flow control of Boxer stepper motor driven peristaltic pumps. A2 is the 2.0 amp stepper driver and is suitable for continuous operation.

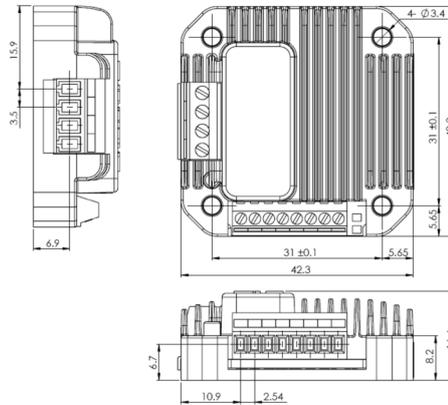
The A2 is supplied separated for the 9QX and is not mounted on the pump / motor.



Technical Data

Driver Type	Full H-Bridge for 2 phase unipolar stepper motors
Size / Mounting	Nema 17 motors (15KS/15QQ): direct on motor Nema 14 (9K, 9QQ and 9QX): separate to motor
Voltage Range	10 to 30 V DC
Max Current	2.0 A
Current Limiter Factory Setting	0.9 A
Control Inputs	Enable, run / stop, high / low speed, direction, speed
Control Outputs	5 V DC reference output (for use with external potentiometer for speed)
Jumpers (on reverse side)	For speed range adjustment
Current Limiter (on reverse side)	To reduce motor temperature
Micro-Stepping	1/16 (fixed)
Automatic Acceleration (during start or speed adjust)	Ramp over 0.3 seconds
Max Working temperature	85 °C
Weight	100 g

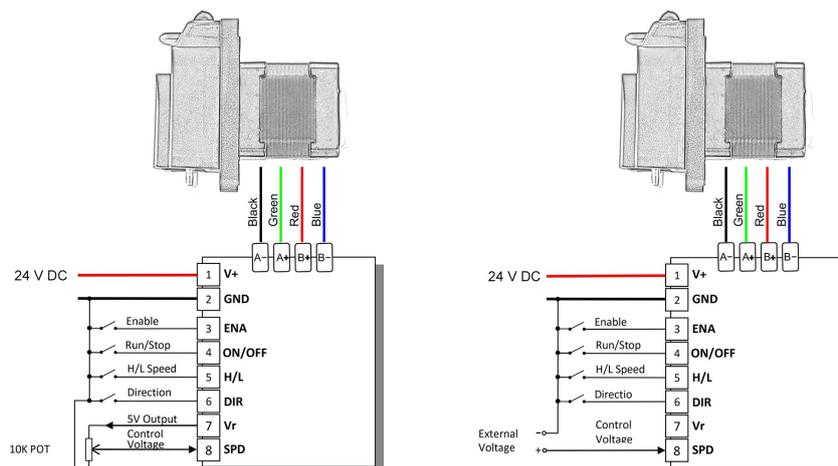
Drawing



Electrical Connection Details

① With external potentiometer

② With speed control voltage input



Damage will occur if Vr is connected to GND !

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Outputs (to stepper motor):

A- / A+	Black / Green	Phase A
B+ / B-	Red / Blue	Phase B

Note: reversing polarity of A or B will cause the motor to run in the opposite direction

Inputs (to driver):

V+	Supply Voltage	+ 24 V DC (range 10 to 30 V DC)
GND	Ground	GND
ENA ¹	Enable / Disable	Open = enabled / To GND = disabled (motor coils are not energised)
ON / OFF ¹	Run / Stop	Open = run / To GND = stopped (motor is locked with energised coils)
H/L ¹	High / Low Speed	Open = speed 0 to 1900 rpm / To GND = speed 0 to 150 rpm
DIR ^{1,2}	Direction	Open = direction clockwise (CW)/ To GND = direction anticlockwise (CCW)
Vr	+ 5 V DC output reference	For use with external potentiometer
SPD	Analogue Speed Input	0 to 5 V DC analogue only (resolution 255 steps / 8 bit) ³

Always start a peristaltic pump at slow to medium speed (less than 300 rpm) to avoid stalling

¹ Inputs are internally pulled up

² Direction is defined as looking at the pump from the front (clockwise means inlet left, outlet right)

³ PWM or any digital signal on SPD input will damage the driver

Jumpers (reverse side of driver, see diagram on next page):

Speed range can be altered through configuration of the soldered jumpers J1 and J2

J1	J2	High Speed Mode	Low Speed Mode
Open	Open	0 to 1900 rpm	0 to 150 rpm
Short	Open	0 to 480 rpm	0 to 40 rpm
Open	Short	0 to 960 rpm	0 to 80 rpm
Short	Short	0 to 1900 rpm	0 to 150 rpm

J1 Short / J2 Short is as supplied

Current Limiter

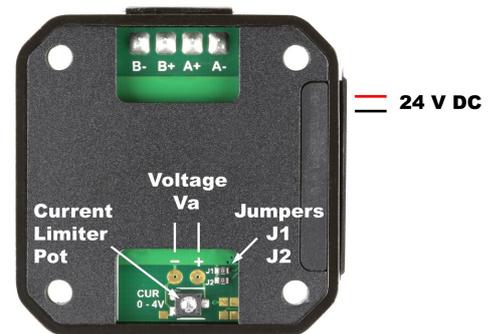
The current limiter on the reverse side of the driver is used to reduce motor temperatures. This is especially important when a peristaltic pump is run at slow speeds.

Procedure:

- connect driver to power supply.
- measure voltage Va. Adjust with pot Va as necessary¹.
- clockwise rotation decreases Va.
- disconnect power supply
- re-connect power supply (new Va value is mapped)
- test new setting

¹ Va can be varied between 0 and 4.0 V. It should be reduced until safely above the setting which will cause the motor to stall. Worse case will always be with a new tube with largest ID installed in the peristaltic pump.

Factory setting: Limiter set at 0.9A (Va = 1.8 V)



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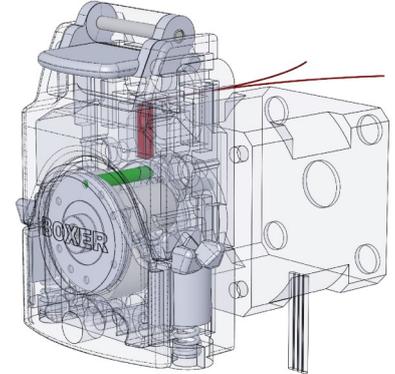
4.1 Sensor : Speed

The 9QX peristaltic pump with stepper motor is available with a speed sensor mounted inside the pump body.

A micro reed sensor (shown in red) is located on the pump back-plate. A permanent magnet (shown in green) is located on the rotor. The contacts of the micro reed sensor close when the magnet moves through the upper portion of the rotation, once per revolution.

Specification

Reed sensor type	Normally open, single pole, single throw
Contact closure	Once per revolution
Max. switching current	0.5 A
Max. switching voltage	170 V
Lead cross section area	0.06 mm ²
Lead length	27 cm



4.2 Sensor : Encoder

Alternatively the 9QX peristaltic pump is available with high definition 3 channel digit encoder mounted on the back of the stepper motor.

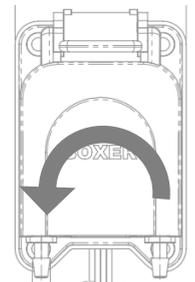
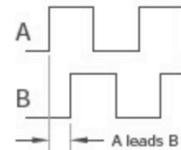
Channels A + B provide 200 pulses per revolution. Direction information is available through the phase shift between the signals of both channel. The Z channel provides a single pulse once per revolution and can be used to locate a home / starting position.

Specification

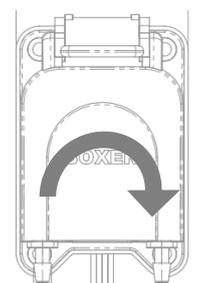
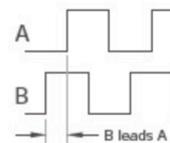
3 Channel (A, B, Z)	Channel A and B: 200 pulses per revolution Channel Z: 1 pulse per revolution
Supply voltage	+3.0 to +5.5 V DC
Supply current	Max 14 mA
High output	Supply minus 0.5 V
Low output	+0.5 V
Pins Layout (left to right)	
1 (red)	V DC Supply
2 (purple)	Channel A
3 (orange)	Unused
4 (yellow)	Channel B
5 (white)	Unused
6 (blue)	Channel Z
7 (green)	Unused
8 (black)	GND
Rotation direction	
	CCW : A leads B
	CW : B leads A
Leads	Supplied with mating connector + 30 cm leads, 28 AWG



CCW Rotation:

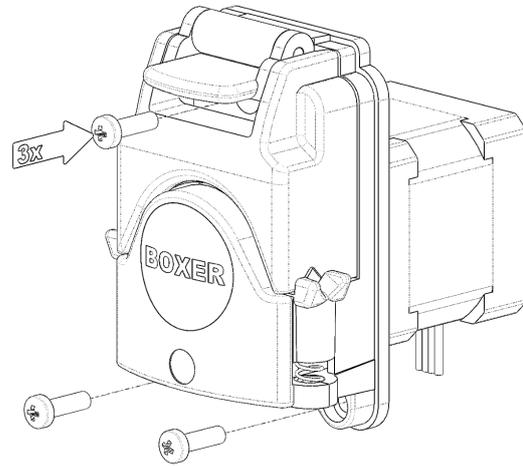
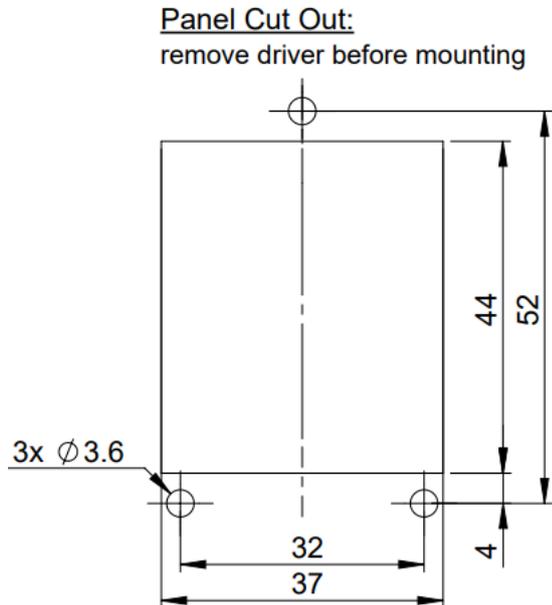


CW Rotation:



5.1 Assembly Information

The 9QX peristaltic pump with Stepper Motor is assembled to a panel cut-out using 4 x M3 bolts:



5.2 Tube Loading / Unloading

The 9QX peristaltic pump is a flip-top design. The loading and unloading of the tube is through operation of the lever:



The tube grips are sprung loaded and adjust automatically the OD of the tube. The 9QX is designed for 1.0 mm wall tubing from ID of 0.5 mm to 3.5 mm. Only tubing suitable for peristaltic pumps should be used.

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6.1 Order Information : Pumps

Pump and tubing should always be ordered separately.

Pump Configuration	Without Driver	+ Pico Driver	+ A2 Driver
9QX 24 V Stepper / 3 Roller	9800.730	9860.730	Order 'Without Driver' AND 6900.003 (supplied separately)
9QX 24 V Stepper / 3 Roller / Speed Sensor	9801.730	9861.730	
9QX 24 V Stepper / 3 Roller / Encoder	9802.730	9862.730	
9QX 24 V Stepper / 4 Roller	9800.740	9860.740	
9QX 24 V Stepper / 4 Roller / Speed Sensor	9801.740	9861.740	
9QX 24 V Stepper / 4 Roller / Encoder	9802.740	9862.740	
9QX 24 V Stepper / 6 Roller	9800.760	9860.760	
9QX 24 V Stepper / 6 Roller / Speed Sensor	9801.760	9861.760	
9QX 24 V Stepper / 6 Roller / Encoder	9802.760	9862.760	

6.2 Order Information: Tubing

Tubing is available in 3 formats:

- single lengths (each cut to 120mm)
- 1 m (or multiples of, supplied uncut)
- 15 m coils

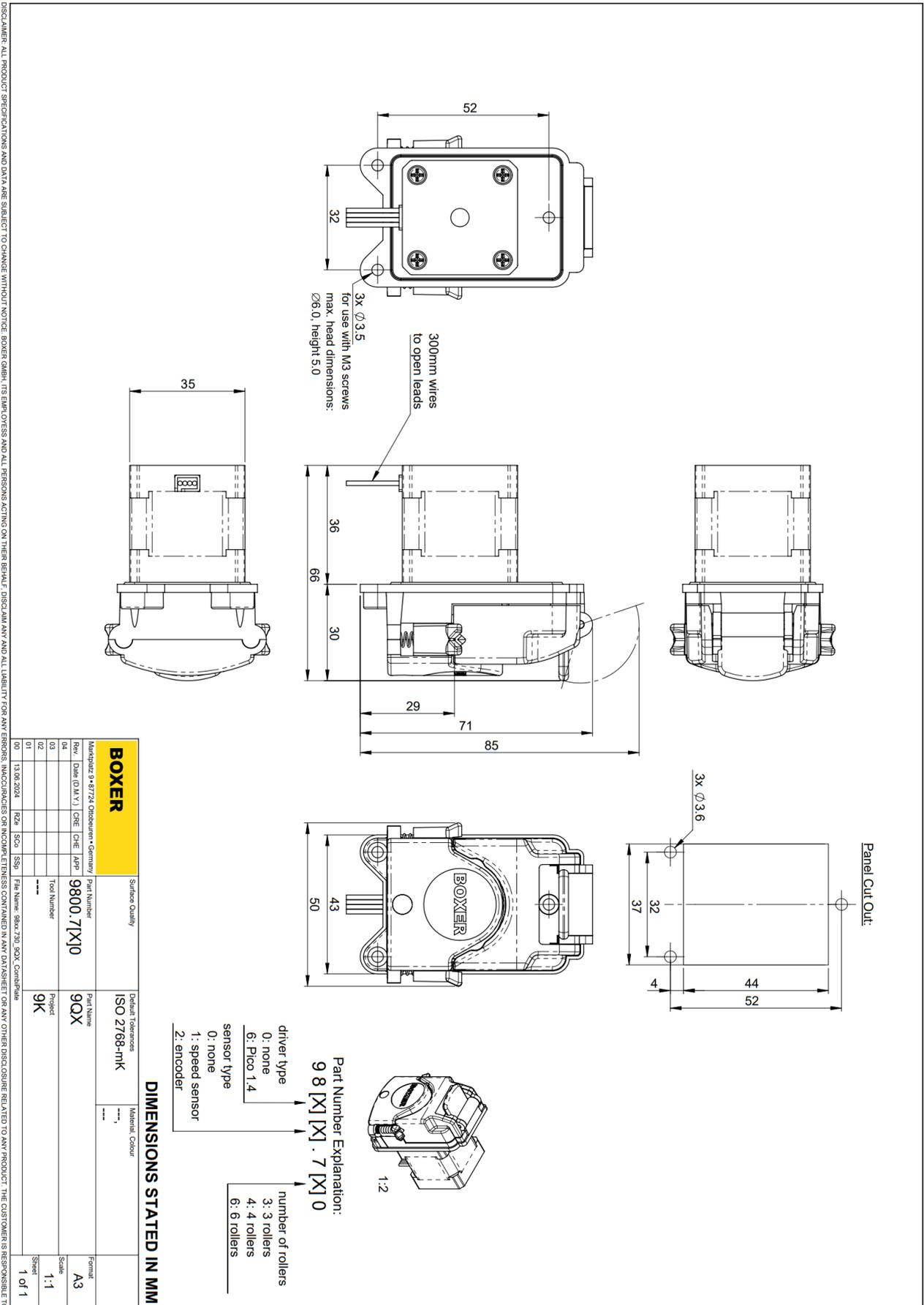
Tube Lengths			Part Number	
Tube Material	ID (mm)	Single Lengths (120mm)	1 m (or multiples of)	15 m Coil
Innovaprene P60	0.5	9000.767	80510.601	80510.615
Innovaprene P60	1.0	9000.768	81010.601	81010.615
Innovaprene P60	2.0	9000.769	82010.601	82010.616
Innovaprene P60	3.0	9000.770	83010.601	83010.615
Innovaprene P60	3.5	9000.771	83510.601	83510.615
Innovasil G60	0.5	9000.320	80510.301	80510.315
Innovasil G60	1.0	9000.321	81010.301	81010.315
Innovasil G60	2.0	9000.322	82010.301	82010.316
Innovasil G60	3.0	9000.323	83010.301	83010.315
Innovasil G60	3.5	9000.324	83510.301	83510.315

Technical information including chemical compatibility: → www.boxerpumps.com/accessories

Pharmaline, Lagoprene and ED-Plex tube sets are also available: → www.boxerpumps.com/accessories/9qx-9qq-9k



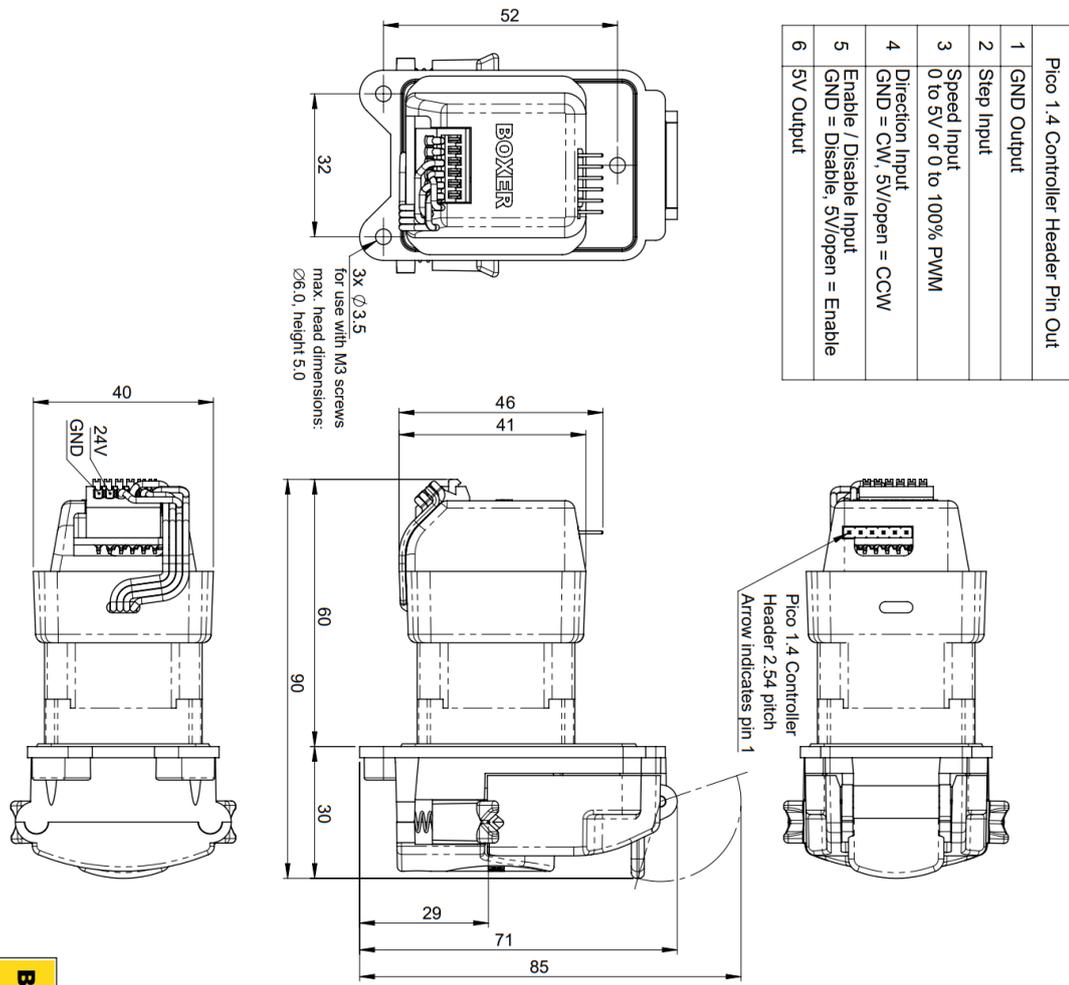
7.1 Engineering Drawing : 9QX



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7.2 Engineering Drawing : 9QX / Pico

Pico 1.4 Controller Header Pin Out	
1	GND Output
2	Step Input
3	Speed Input 0 to 5V or 0 to 100% PWM
4	Direction Input GND = CW, 5V/open = CCW
5	Enable / Disable Input GND = Disable, 5V/open = Enable
6	5V Output



Part Number Explanation:
9 8 [X] [X] . 7 [X] 0

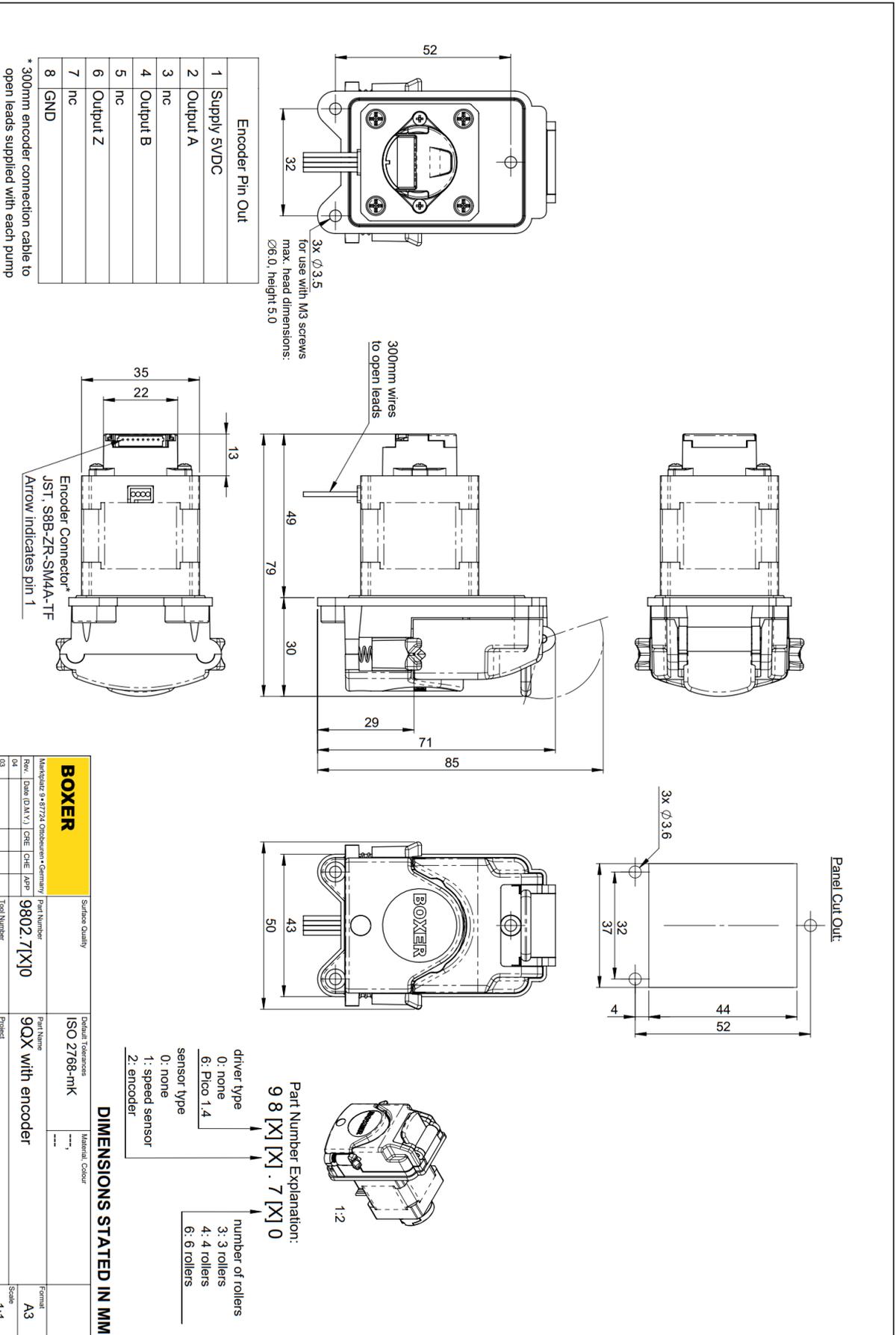
- driver type
 - 0: none
 - 6: Pico 1.4
- sensor type
 - 0: none
 - 1: speed sensor
 - 2: encoder
- number of rollers
 - 3: 3 rollers
 - 4: 4 rollers
 - 6: 6 rollers

DIMENSIONS STATED IN MM

BOXER		Supplier Quality	Default Formance	Material Colour
Manufacturer 9-87724 Odoberauer+Germany	Part Number	ISO 2766-mnk		
Raw. Date (D.M.Y.)	CRF [CHE APB]	9860.7[X]10	Part Name	9QX with driver
04			Project	9K
03			Sheet	1 of 1
02				
01				
00	13.08.2024	R24	ISO	File Name: 9860.720_9QX_Combi.dwg

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7.3 Engineering Drawing : 9QX / Encoder



BOXER		Surface Quality	Part Number	9QX with encoder	Form
Manufacture	9-47724	Originator	Germany	9802.7[X]0	A3
Rev.	Date	(D.M.Y.)	CRE	APP	Scale
01	13.08.2024	Rze	SC0	ISS	1:1
02					Sheet
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7.4 Engineering Drawing : 9QX / Pico / Encoder

Pico 1.4 Controller Header Pin Out	
1	GND Output
2	Step Input
3	Speed Input 0 to 5V or 0 to 100% PWM
4	Direction Input GND = CW, 5V/open = CCW
5	Enable / Disable Input GND = Disable, 5V/open = Enable
6	5V Output

Encoder Pin Out	
1	Supply 5VDC
2	Output A
3	nc
4	Output B
5	nc
6	Output Z
7	nc
8	GND

* 300nm encoder connection cable to open leads supplied with each pump

Panel Cut Out:
remove driver before mounting

Part Number Explanation:
9 [X] [X] [X] . 7 [X] 0

- driver type: 0: none, 6: Pico 1.4
- sensor type: 0: none, 1: speed sensor, 2: encoder
- number of rollers: 3: 3 rollers, 4: 4 rollers, 6: 6 rollers

DIMENSIONS STATED IN MM

BOXER		Surface Quality	Part Number	Material Colour
Manufacturer: 9-43724 Göttingen* Germany	Part Number	ISO 2768-mK	9QX with driver and encoder	
Rev. / Date (D.M.Y.) CHE JAP	9862.7[X]0		Project	Formal
04			9K	A3
03				Scale
02				1:1
01				Sheet
00	13.06.2024	R2e	ISO	1 of 1

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