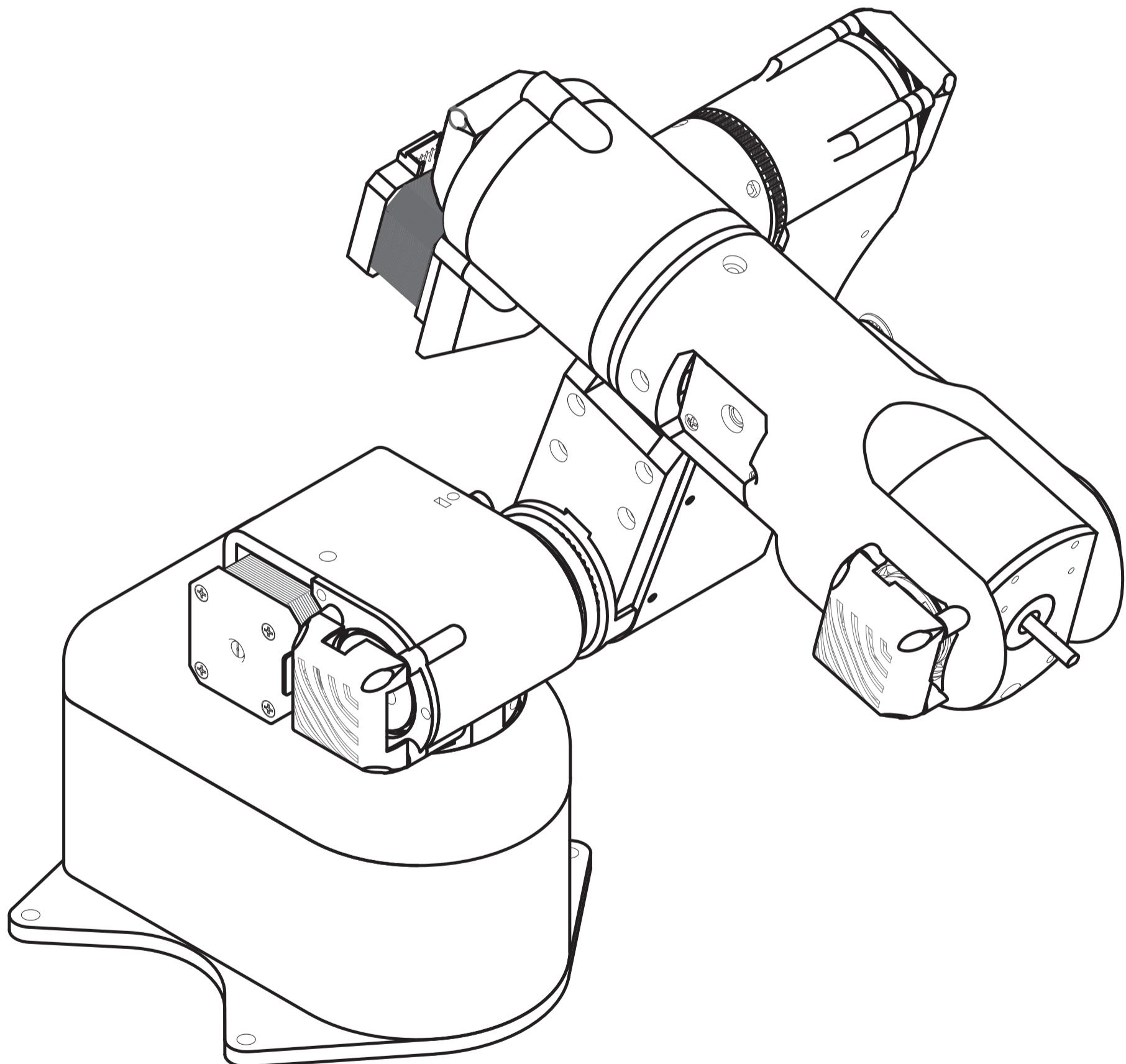


# HELENE V4

Construction Manual







# Assembly Steps

**Assembly III**

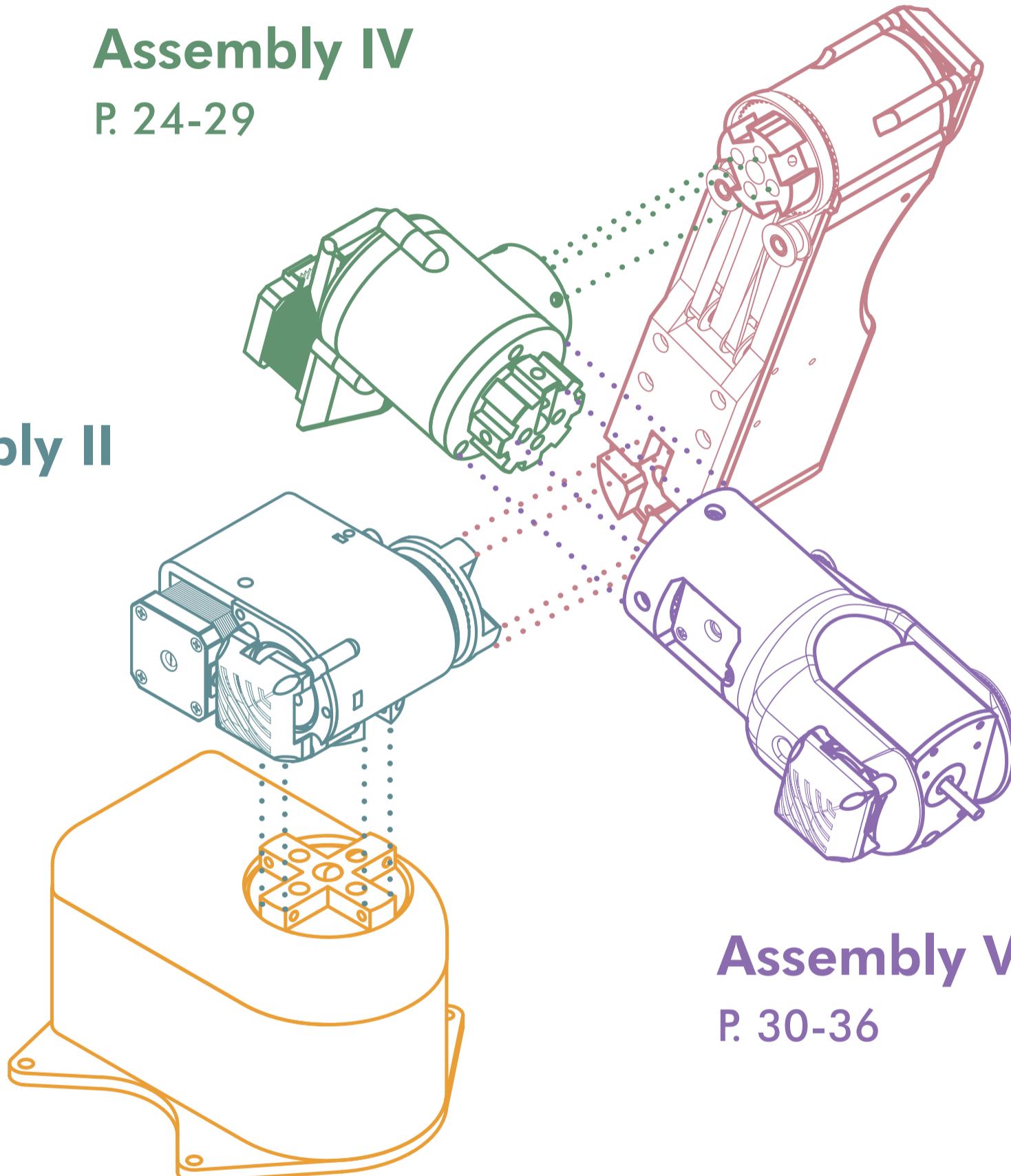
P. 18-23

**Assembly IV**

P. 24-29

**Assembly II**

P. 11-17



**Assembly I**

P. 4-10

# Component Listing

## Standardized Parts

### Threaded Inserts - CNC kitchen

M3 - M3 Threaded Insert

M3k - M3 Threaded Insert short

M4 - M4 Threaded Insert

M4k - M4 Threaded Insert short

M5 - M5 Threaded Insert

N15 - AS5048A Magnet Encoder

N16 - GT2 Pulley without teeth

N17 - Power Supply NAC3MPA

N18 - USB-Socket 2.0-Micro-B

N19 - NdFeB N45 Disc Magnet

N20 - Circuit Board

### Nuts

SM1 - M3 Hexagonal Nut

SM2 - M3 Square Nut

SM3 - M4 Hexagonal Nut

### Screws

S1 - M2,5x8 with Drill Bit

S2 - M3x5 with Drill Bit

S3 - M3x6

S4 - M3x8

S5 - M3x10

S6 - M3x12

S7 - M3x16

S8 - M3x20

S9 - M3x45

S10 - M4 Grub Screw

S11 - M4x6

S12 - M4x10

S13 - M4x16

S14 - M4x20

S15 - M4x30

S16 - M5x16

### Additional Standardized Parts

N1 - Motor Nema 23

N2 - Motor Nema 17HS15

N3 - Motor Nema 17HS4401S

N4 - Belt Drive 232mm GT2 6mm width

N5 - Belt Drive 207mm 3M 6mm width

N6 - Belt Drive 420mm 3M 6mm width

N7 - Belt Drive 267mm 3M 6mm width

N8 - Belt Drive 280mm GT2 6mm width

N9 - Ball Bearing 6009 2RS

N10 - Miniature Ball Bearing 623 ZZ/2Z

N11 - Miniature Ball Bearing 608 2RS

N12 - Ball Bearing 6806/61806 2RS

N13 - GT3 Timing Pulley 9mm 20 teeth

N14 - GT2 Timing Pulley 5mm 20 teeth

# 3D Printed Parts

## Assembly I

B1 - Base\_Main  
B2 - Base\_Shaft  
B3 - Base\_Bearing\_Cover  
B4 - Base\_Pulley\_large  
B5 - Base\_Pulley\_small  
B6 - Base\_Pulley\_small2  
B7 - Base\_Foundation  
B8 - Base\_Beltdrive\_Cover

## Assembly II

B9 - Joint 2\_Main  
B10 - Joint 2\_Pulley\_Threading\_Insert  
B11 - Joint 2\_Shaft  
B12 - Joint 2\_Bearing\_fixed  
B13 - Joint 2\_Shaft\_End  
B14 - Joint 2\_Bearing\_Cover

## Assembly III

B15 - Joint 3\_Main\_lower  
B16 - Joint 3\_Main\_upper  
B17 - Joint 3\_Shaft  
B18 - Joint 3\_Pulley  
B19 - Joint 3\_Pulley\_small  
B20 - Joint 3\_Shaft\_End  
B21 - Joint 3\_Motor\_Unit  
B22 - Joint 3\_Cover

## Assembly IV

B23 - Joint 4\_Main  
B24 - Joint 4\_Shaft  
B25 - Joint 4\_Motor\_Unit  
B26 - Joint 4\_Pulley  
B27 - Joint 4\_Bearing\_Cover  
B28 - Joint 4\_5\_Transition

## Assembly V

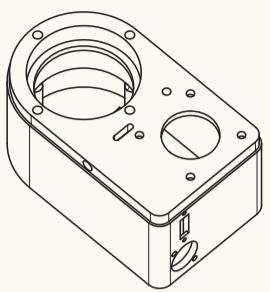
B29 - Joint 5\_Main  
B30 - Joint 5\_Shaft  
B31 - Joint 5\_Pulley  
B32 - Joint 5\_Cable\_Lead  
B33 - Joint 6\_Main  
B34 - Joint 6\_Cover

## Additional Printed Parts

B35 - Cover\_Electronics  
B36 - Bearing\_Distance

# Assembly I

1



1x B1



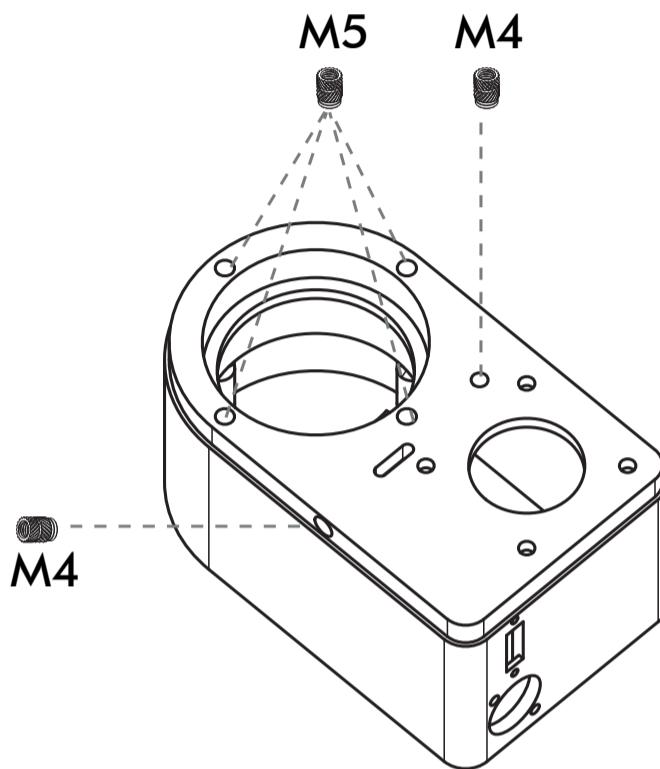
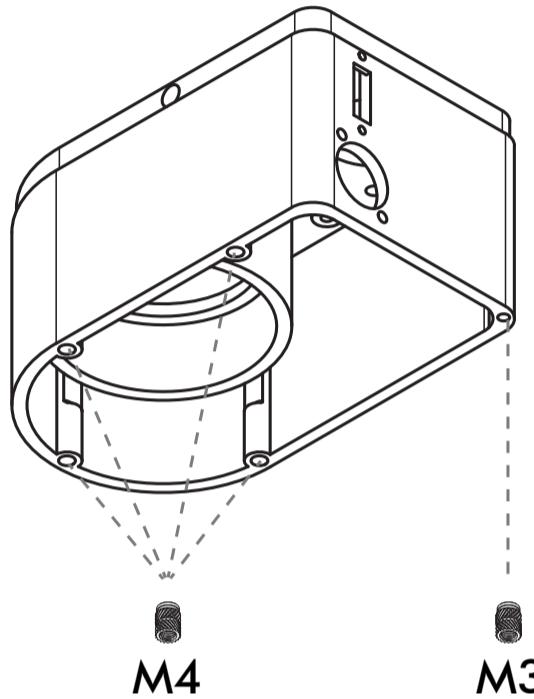
6x M4



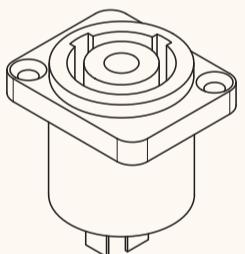
1x M3



4x M5



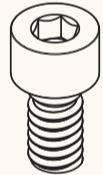
2



1x N17



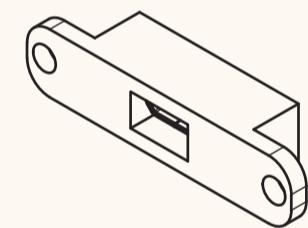
2x SM1



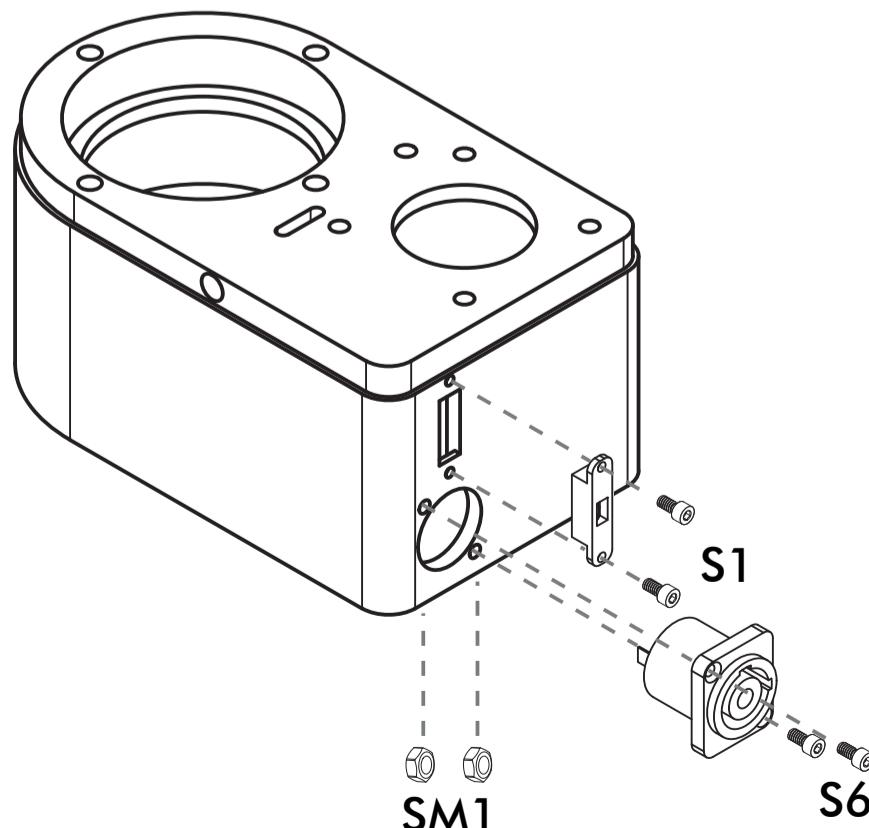
2x S6

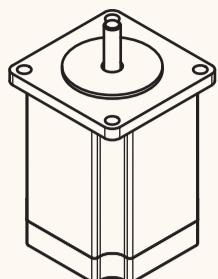


2x S1

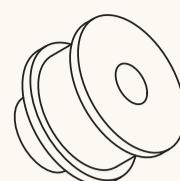


1x N18



**3**

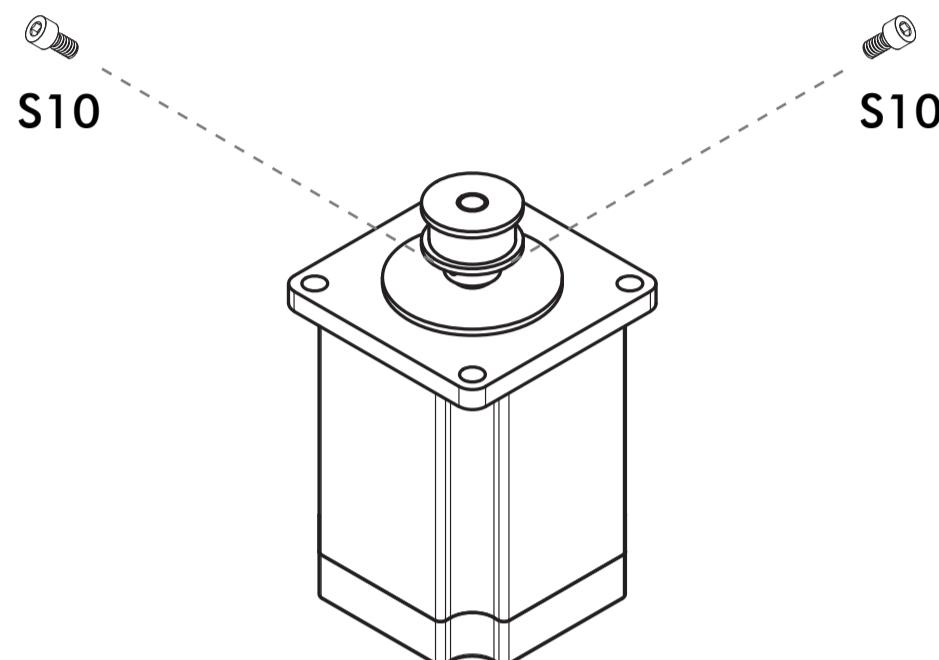
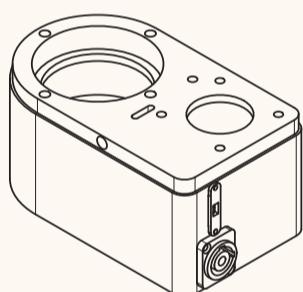
1x N1



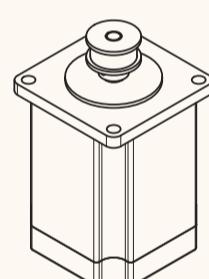
1x N13



2x S10

**4**

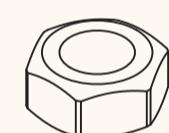
Step 2



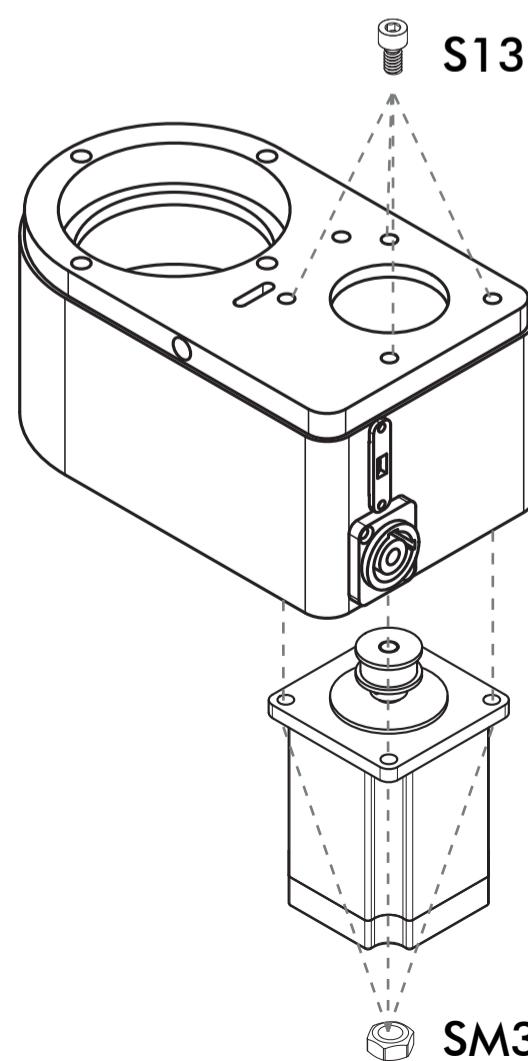
Step 3



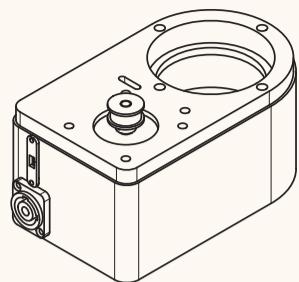
4x S13



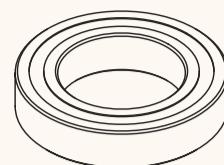
4x SM3

**Note**

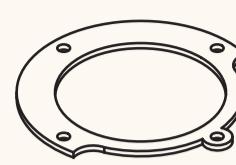
You must not completely fasten the screws yet.

**5**

Step 4



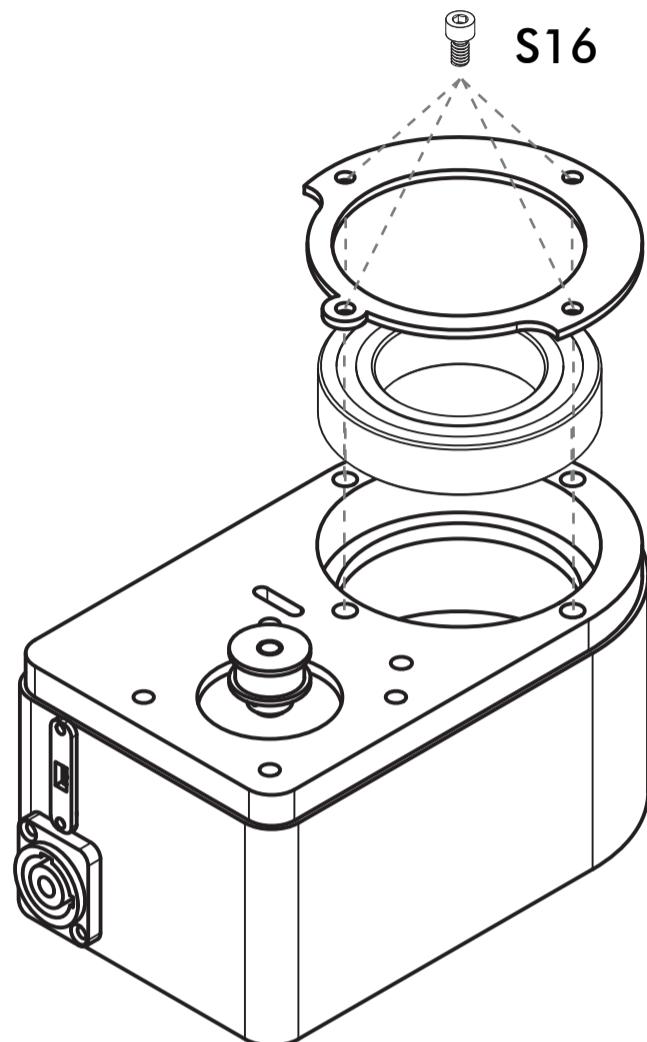
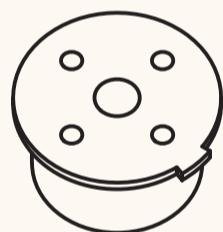
1x N9



1x B3



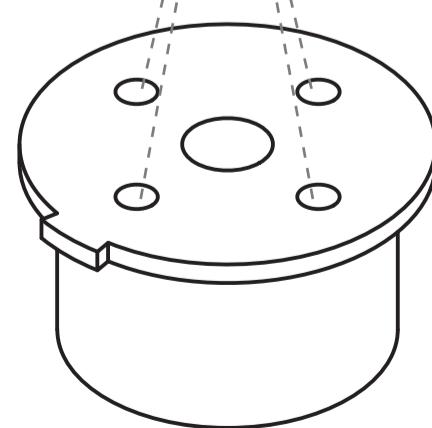
4x S16

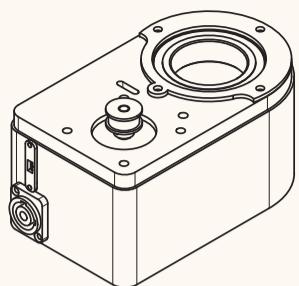
**6**

1x B2

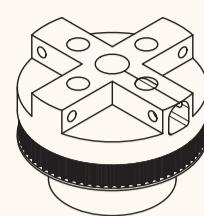


4x M4

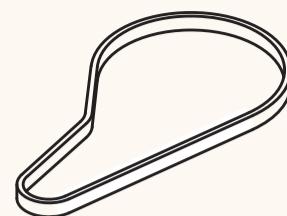


**7**

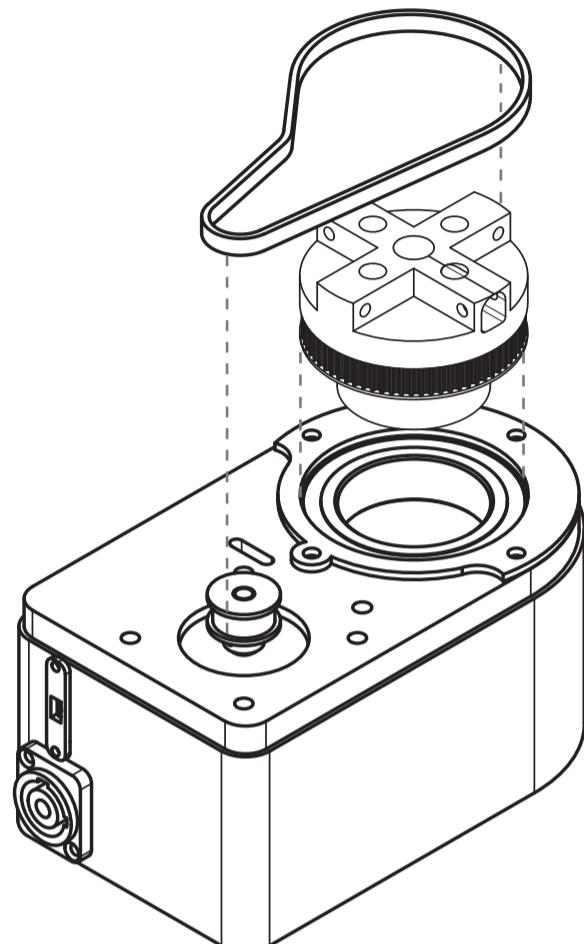
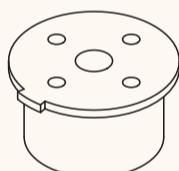
Step 5



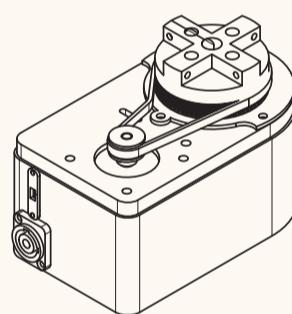
1x B4



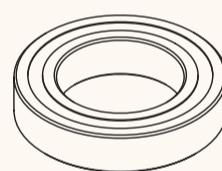
1x N4

**8**

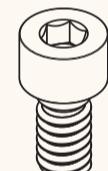
Step 6



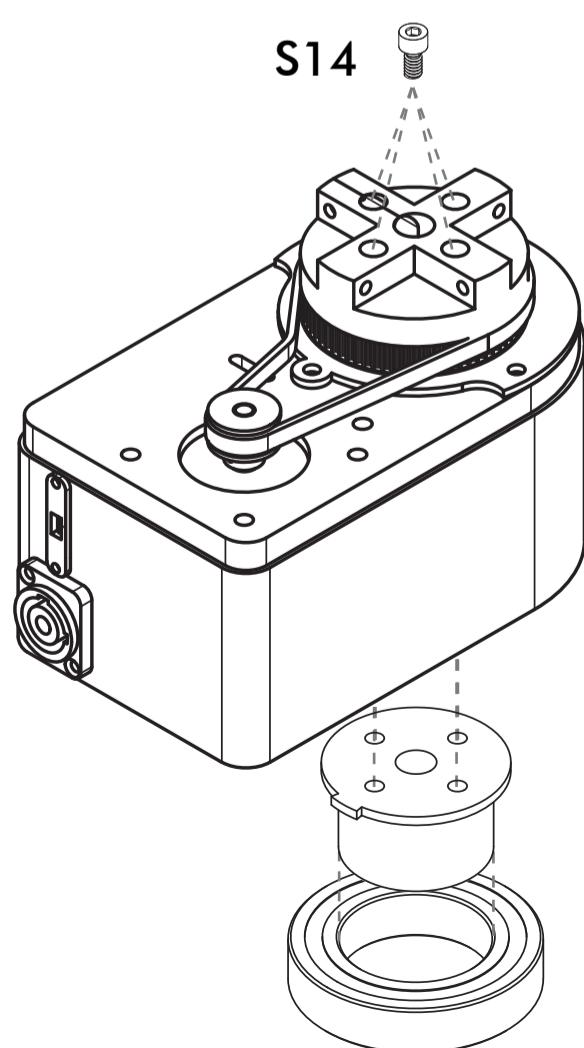
Step 7

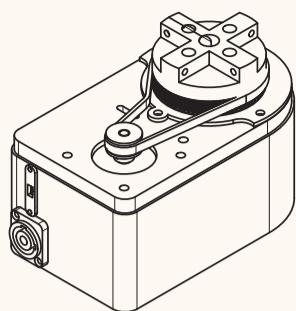


1x N9

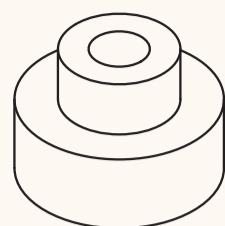


4x S14

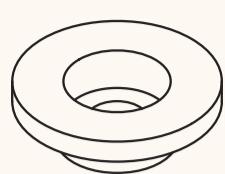


**9**

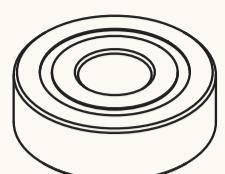
Step 8



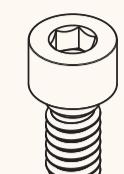
1x B5



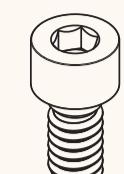
1x B6



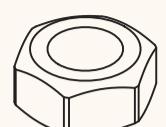
1x N11



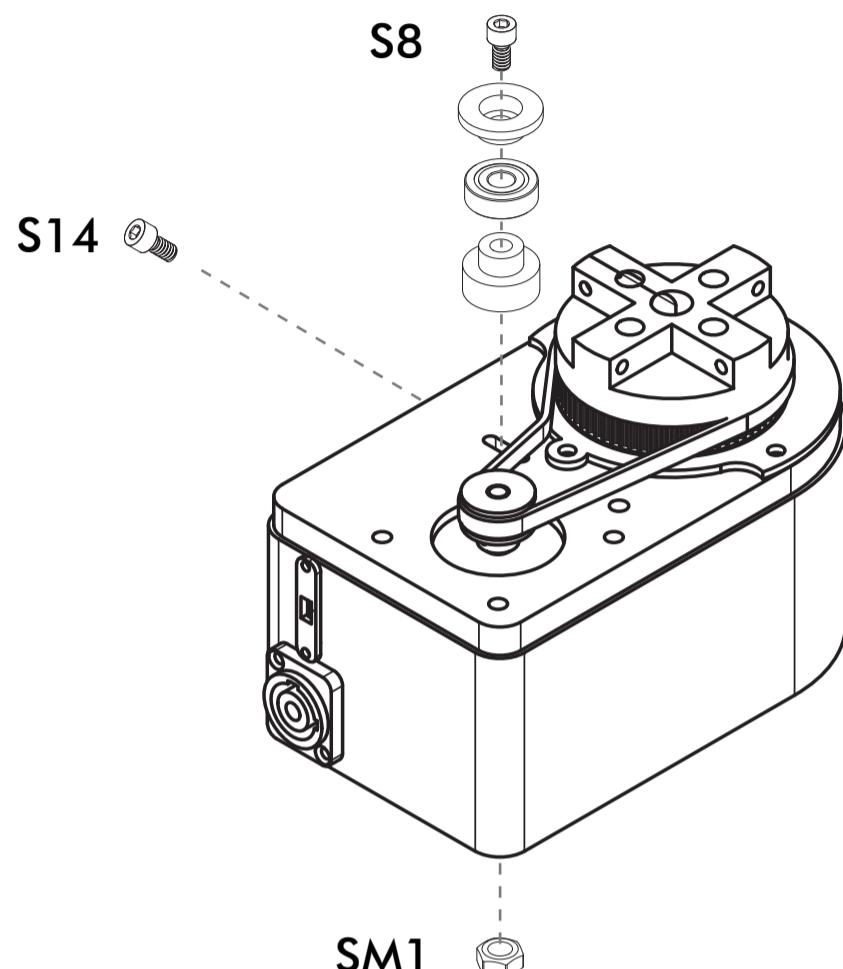
1x S14



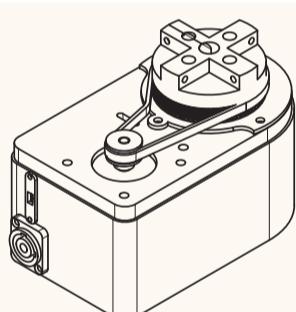
1x S8



1x SM1

**Note**

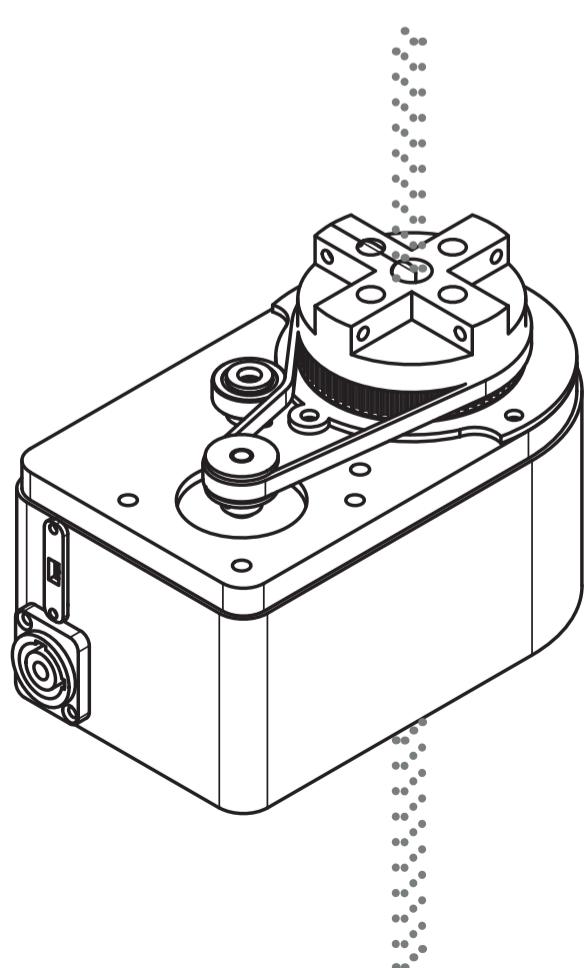
Completely fasten the screws of the motor unit (see step 4).

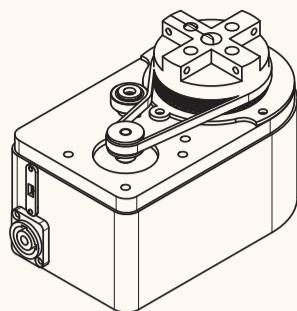
**10**

Step 9

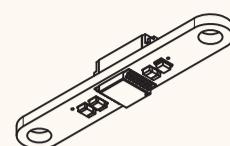
**Note**

All cables have to be fed through B2 and B4 as shown in the figure with sufficient length on both ends.



**11**

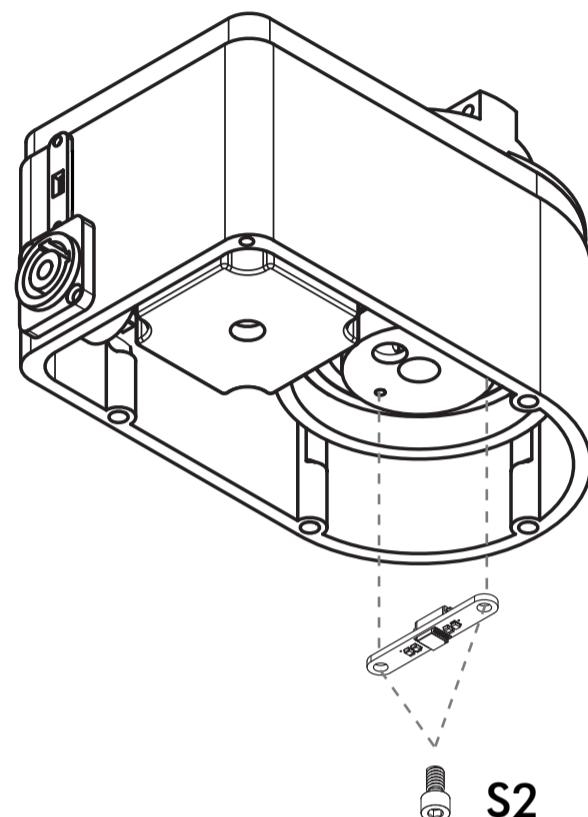
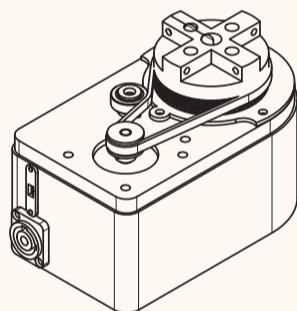
Step 10



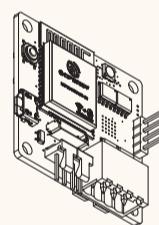
1x N15



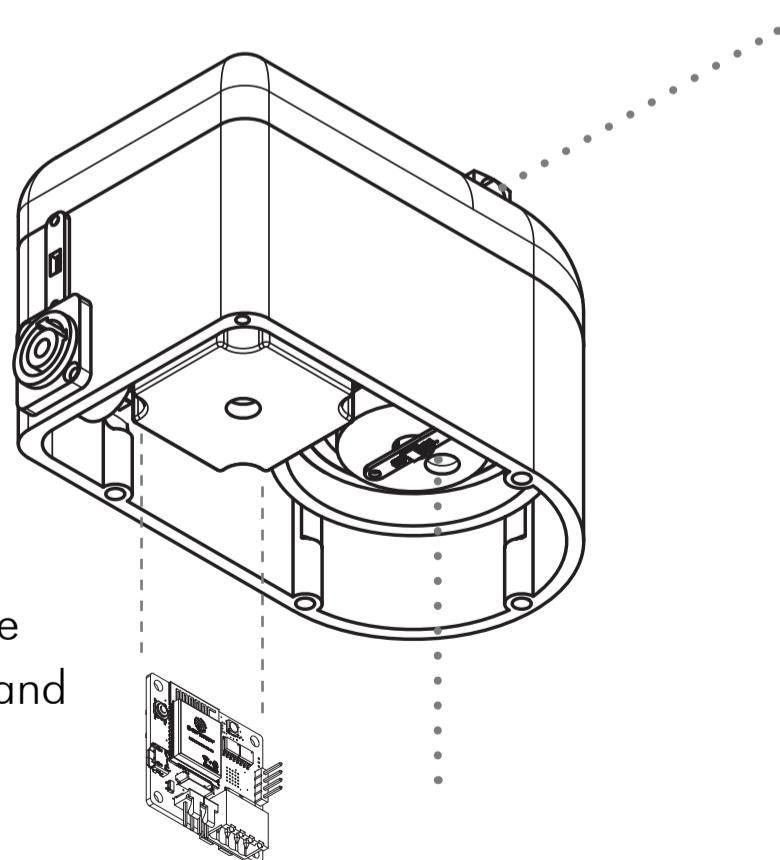
2x S2

**12**

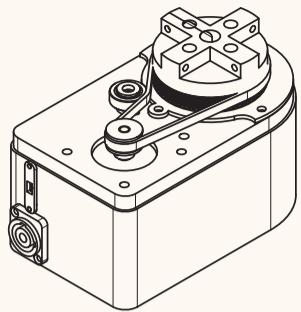
Step 11



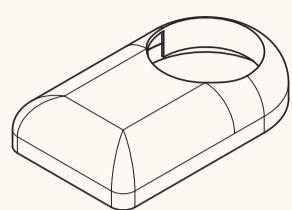
1x N20

**Note**

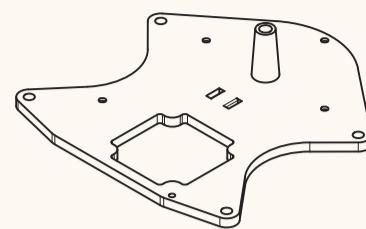
Attach the respective plugs to the cables on the down facing end and attach them to the circuit board according to the instructional video. Insert the circuit board afterwards inside of building step 11.

**13**

Step 12



1x B8



1x B7



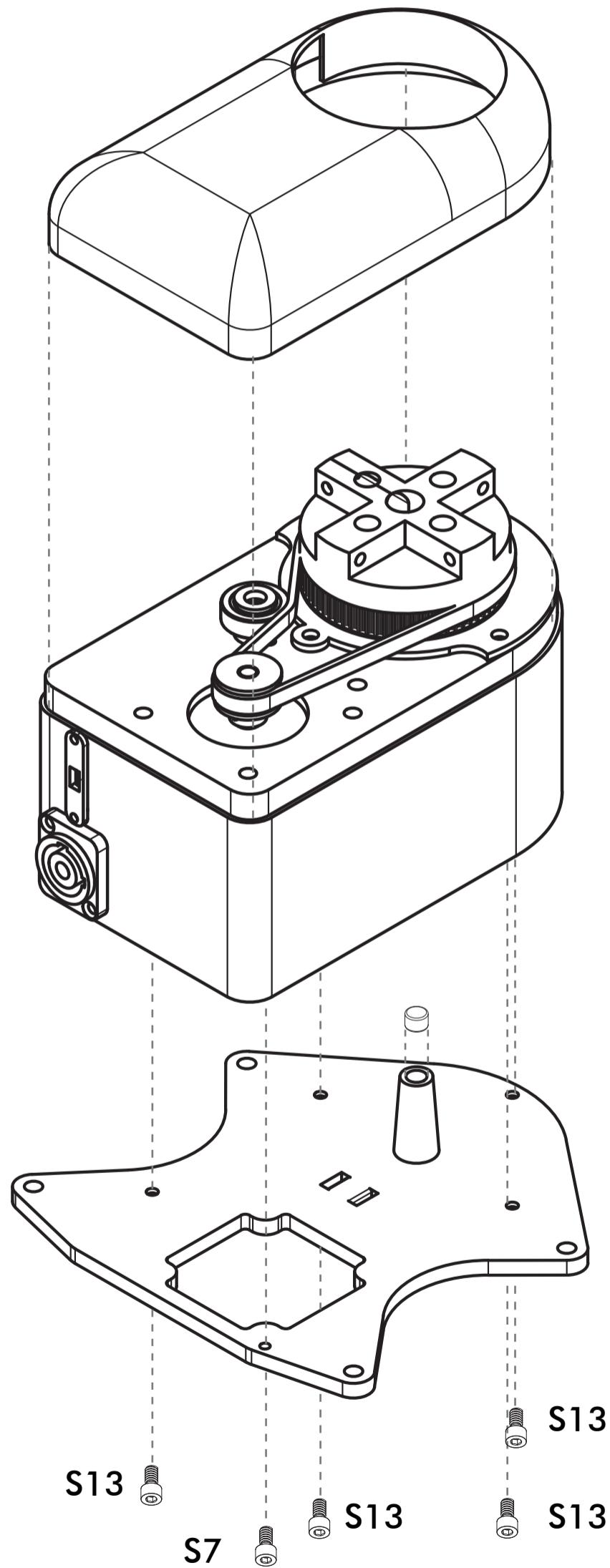
1x N19



1x S7

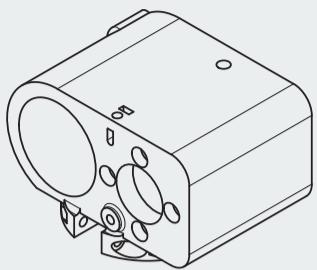


4x S13



# Assembly II

1



1x B9



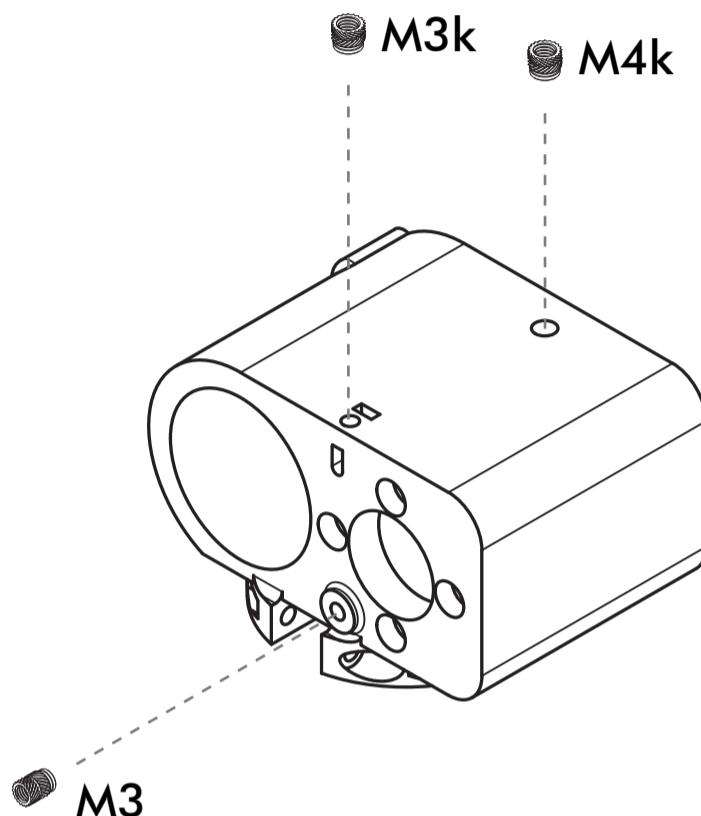
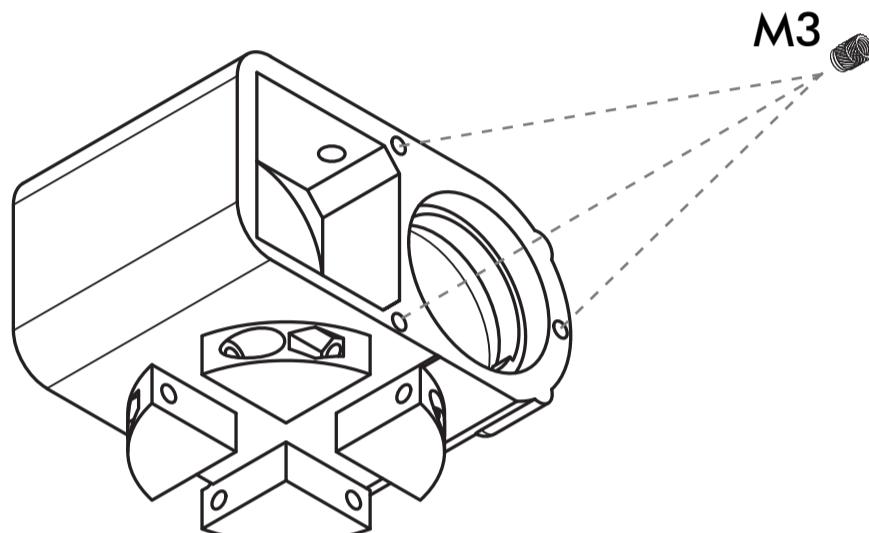
1x M3k



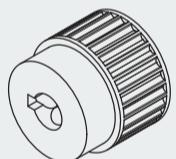
1x M4k



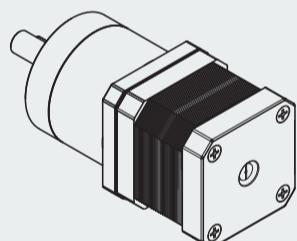
4x M3



2



1x B10



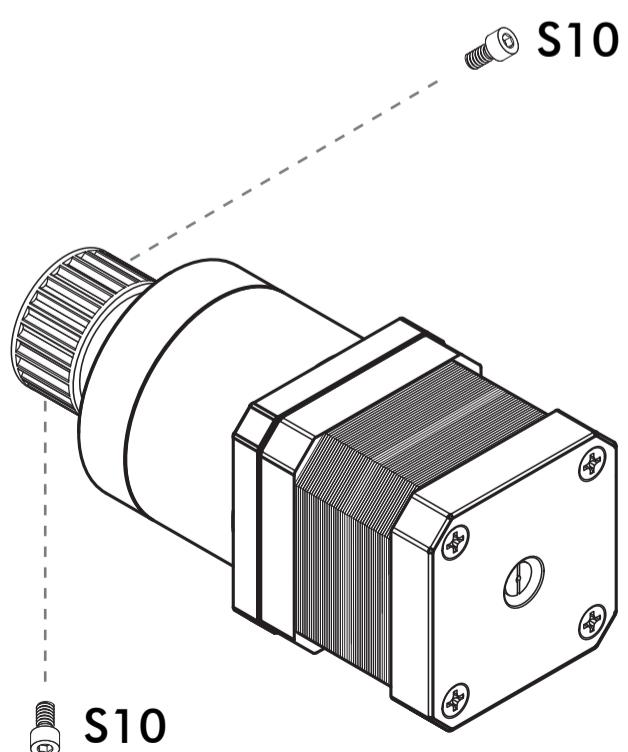
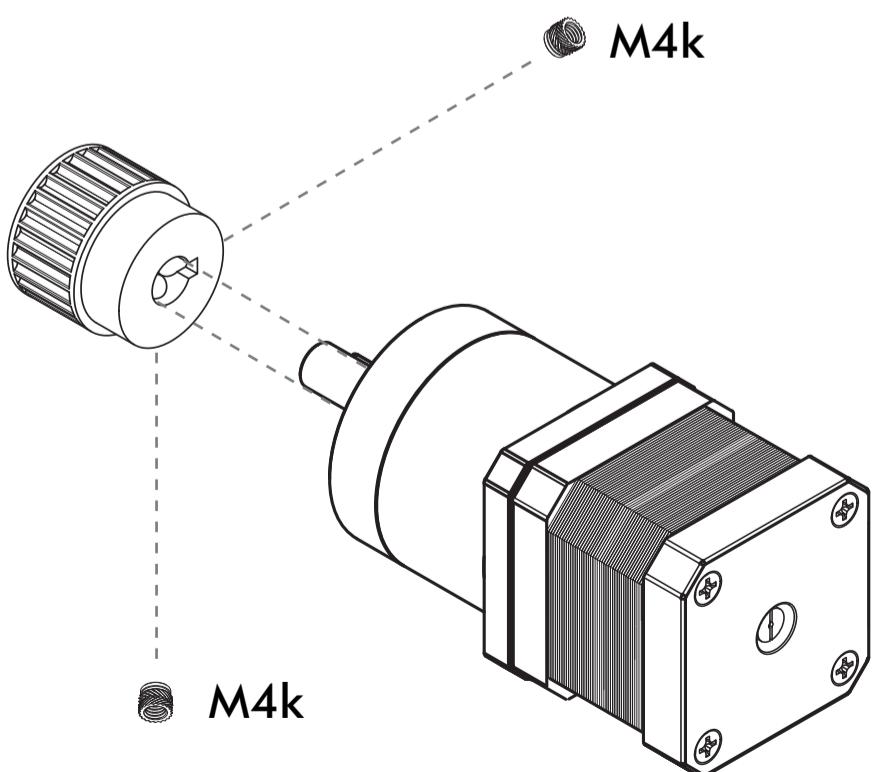
1x N2



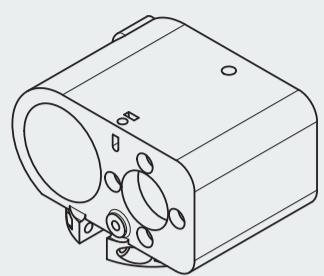
2x M4k



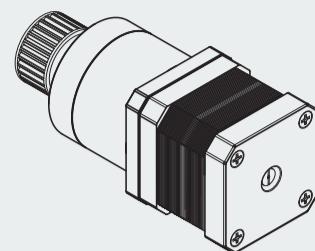
2x S10



3



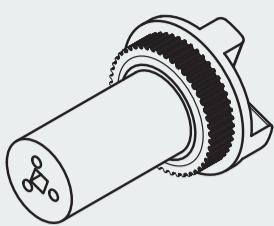
Step 1



Step 2



5



1x B11



1x B12



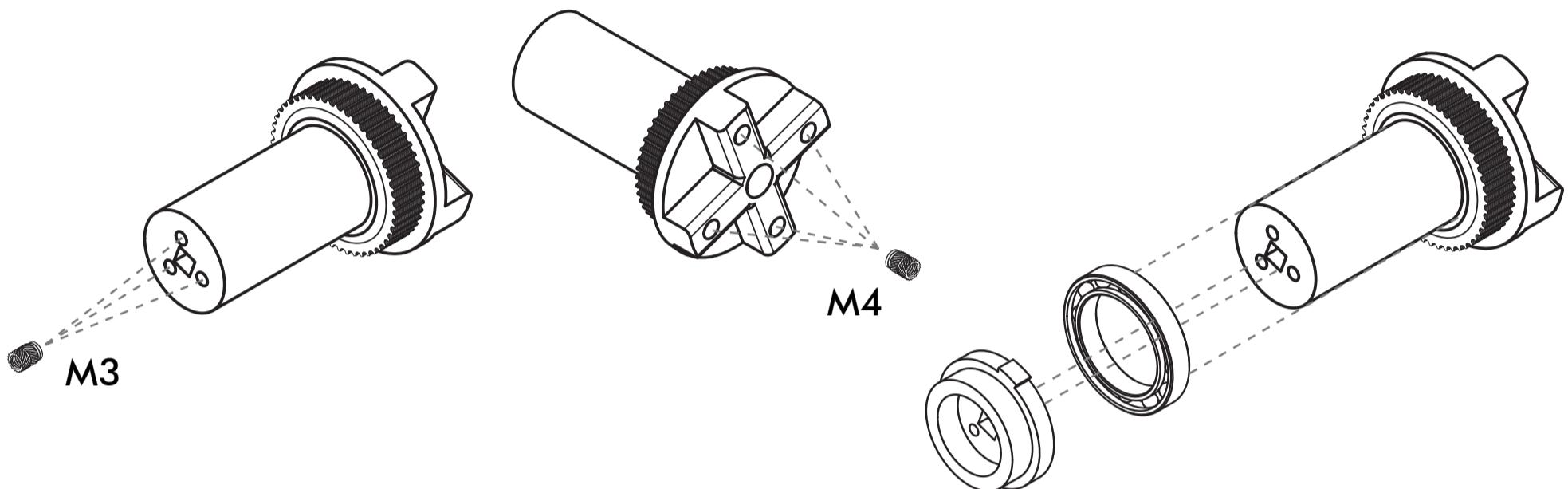
1x N12



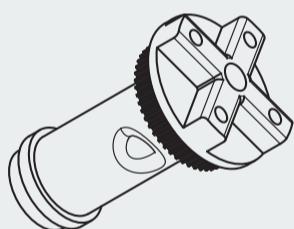
4x M4



3x M3



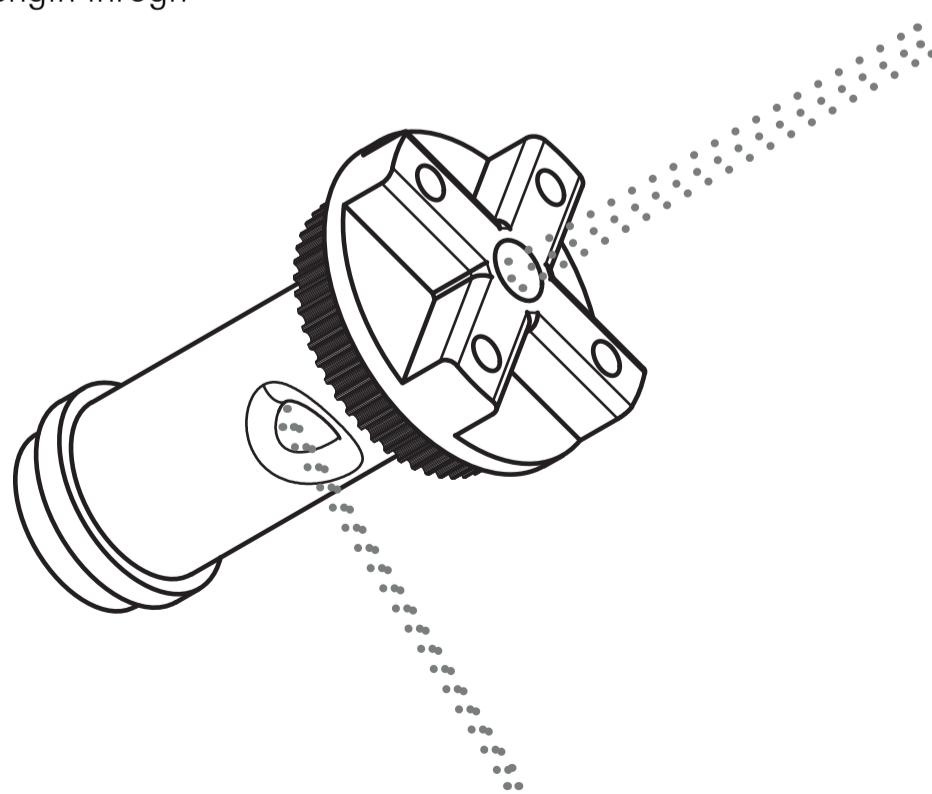
6



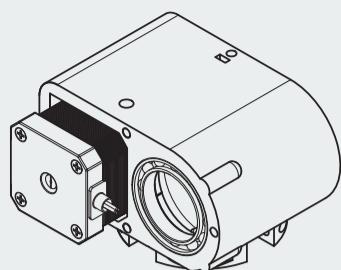
Step 5

**Note**

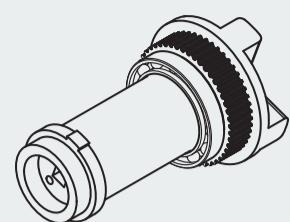
Feed the cables with sufficient length through  
B11 as shown.



7



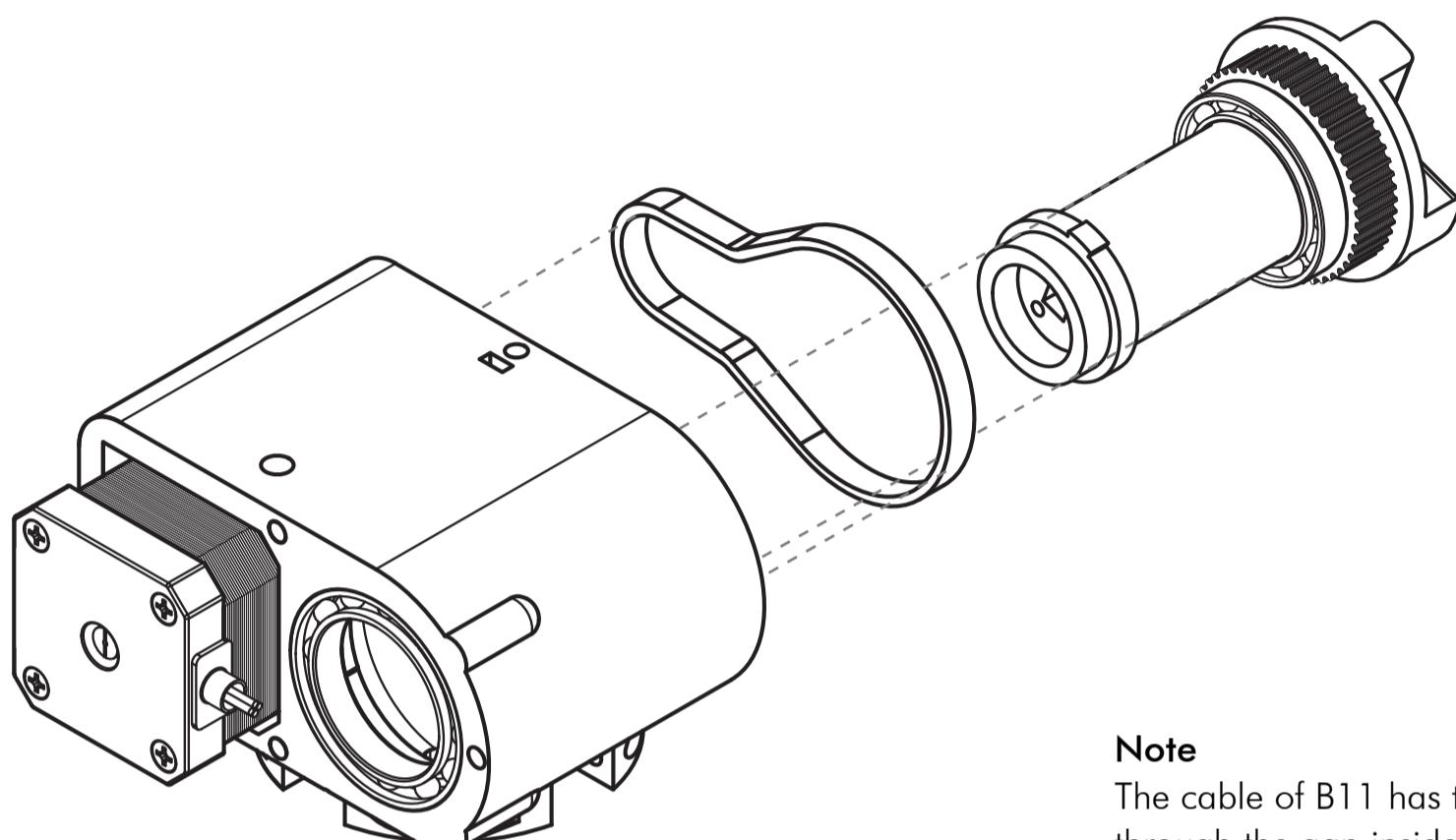
Step 4



Step 6

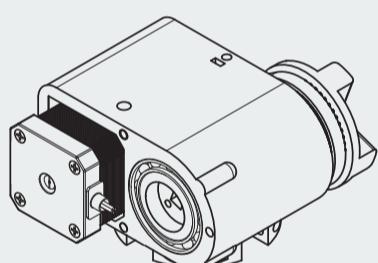


1x N5

**Note**

The cable of B11 has to be fed through the gap inside of B9.

8



Step 7



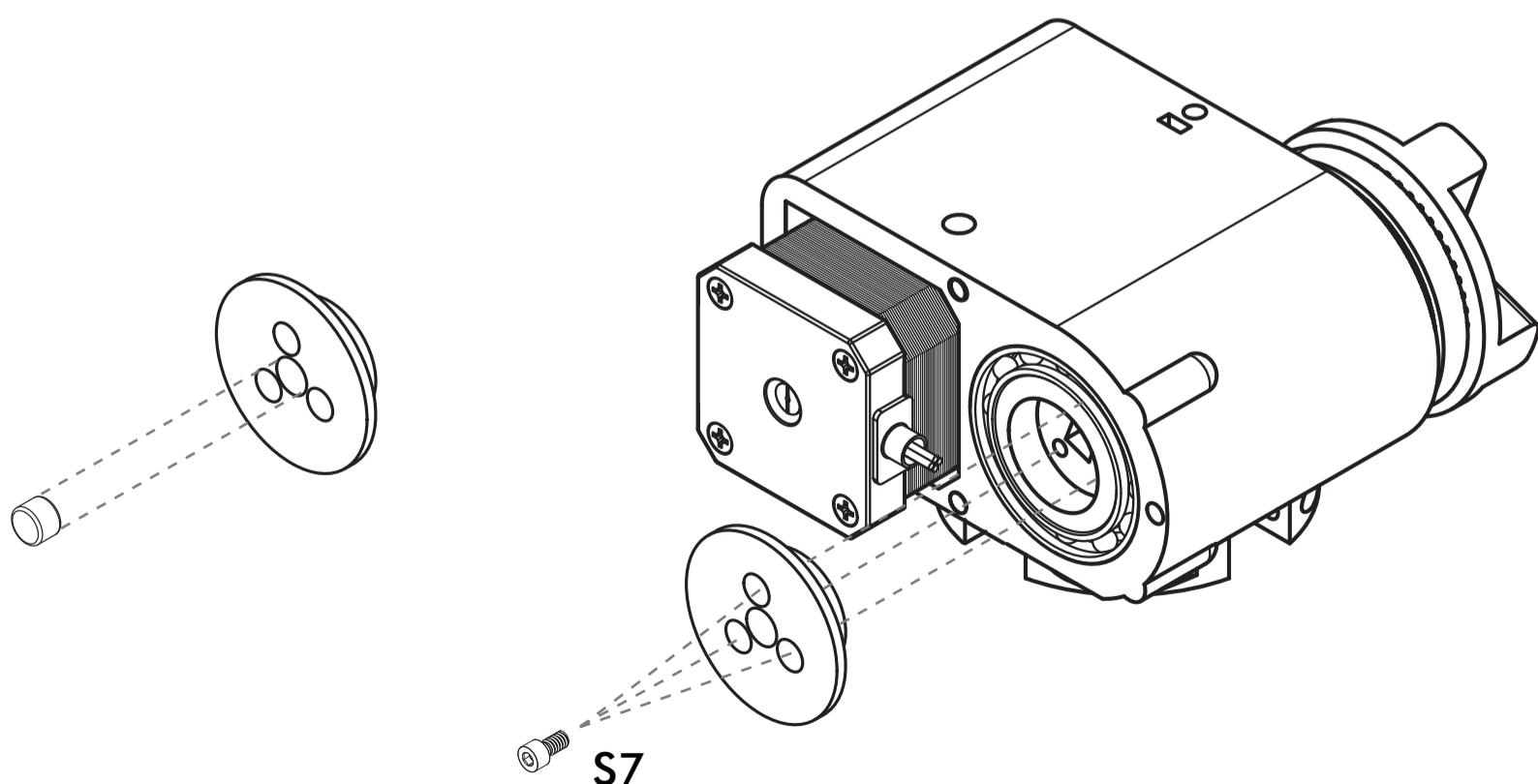
1x B13



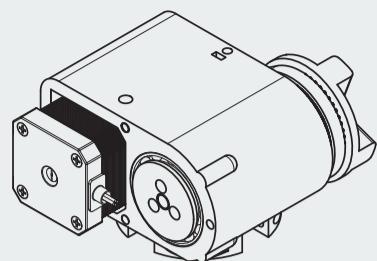
1x N19



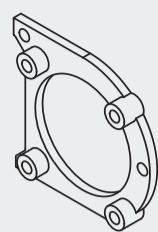
3x S7



9



Step 8



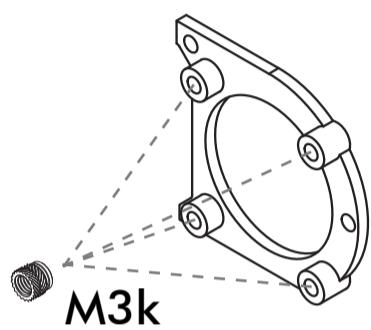
1x B14



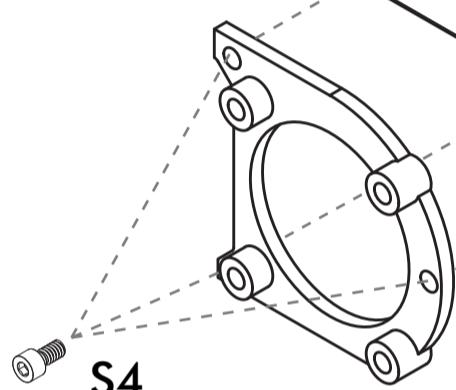
4x M3k



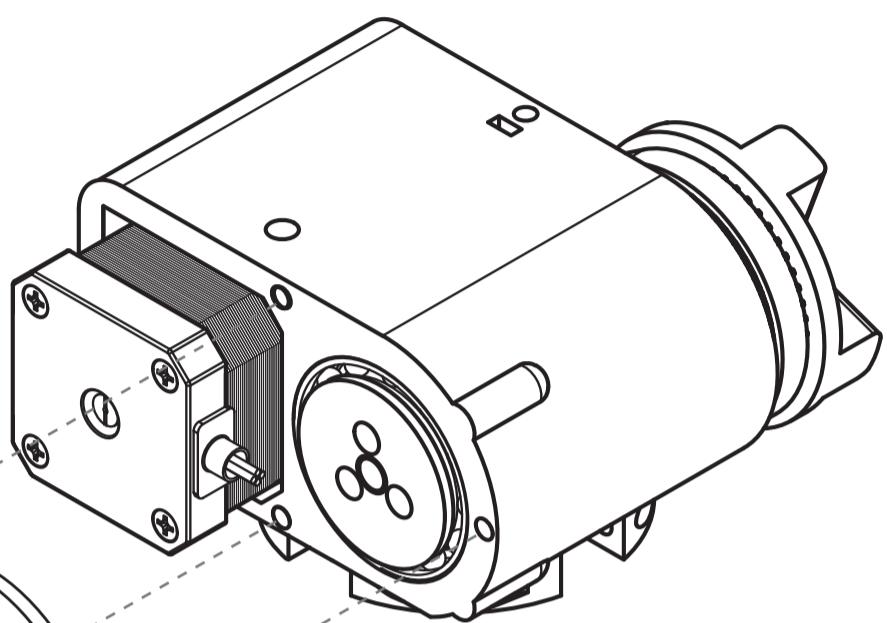
3x S4



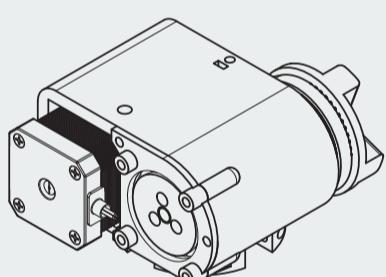
M3k



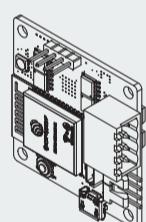
S4



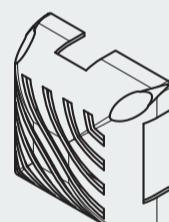
10



Step 9



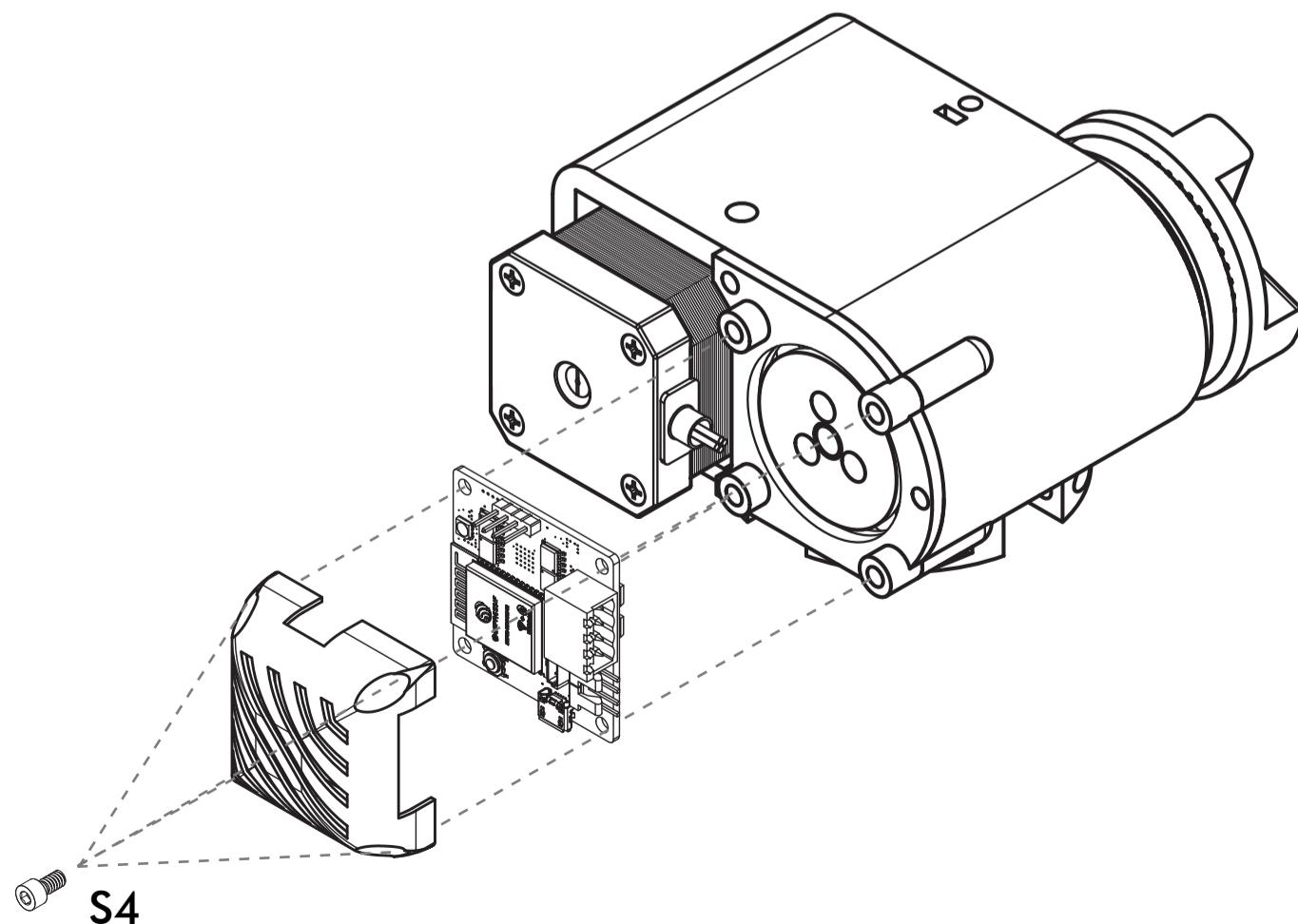
1x N20



1x B35

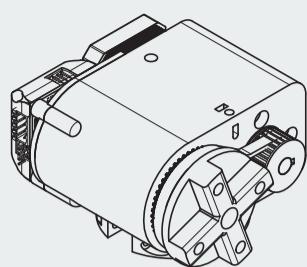


4x S4



S4

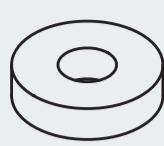
11



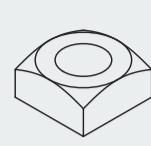
Step 10



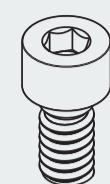
4x N10



1x B36



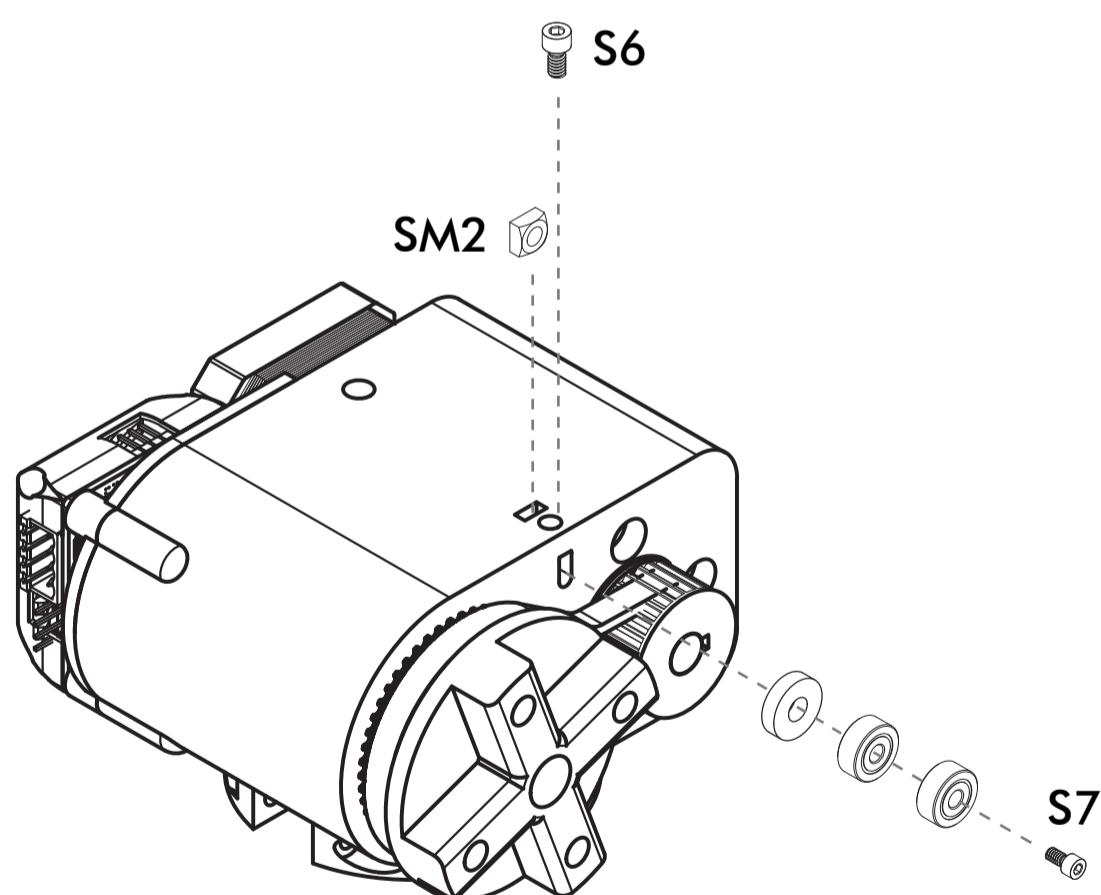
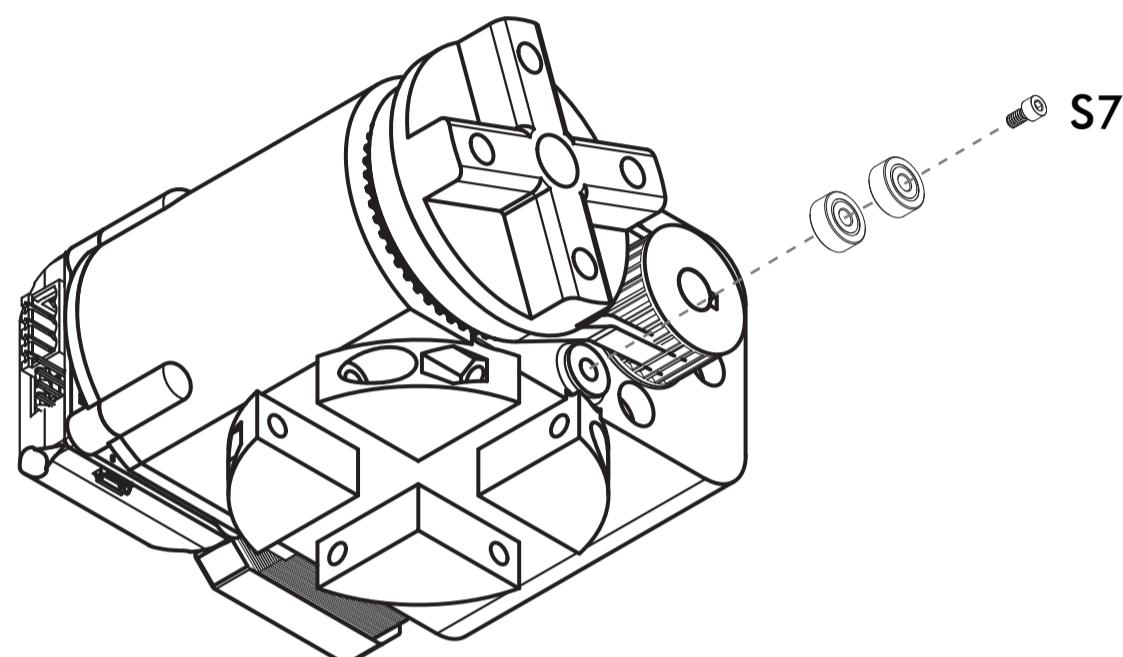
1x SM2



2x S7

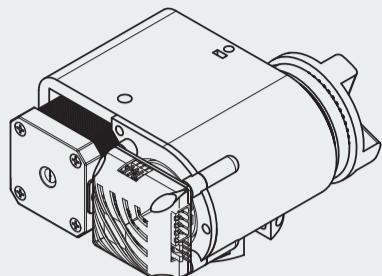


1x S6

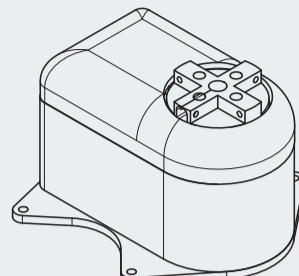
**Note**

The S7 screws have to be attached in advance of S6. Completely fasten S7 (figure below) after fastening S6.

12



Assembly I



Assembly II



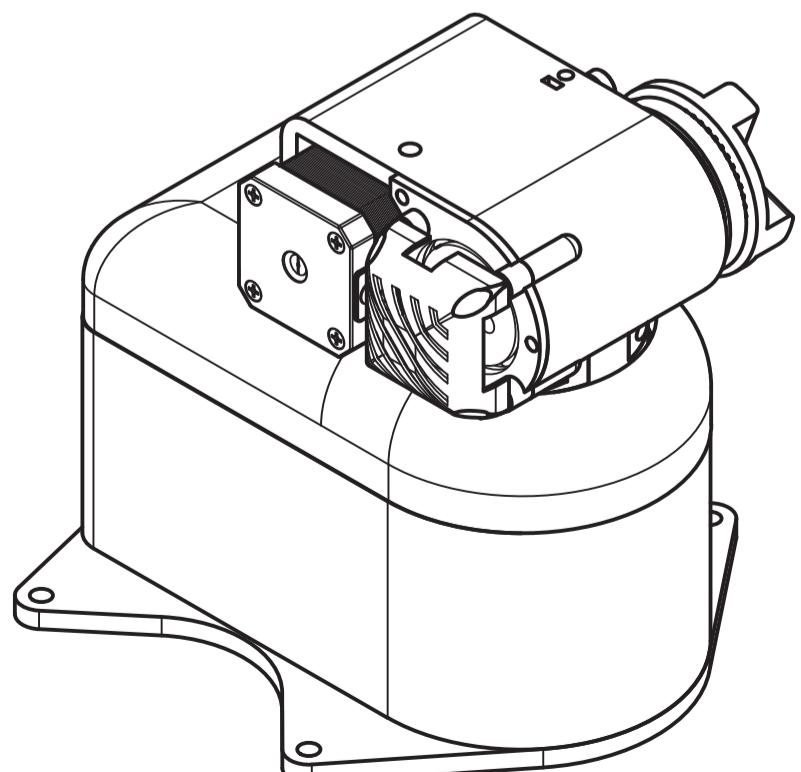
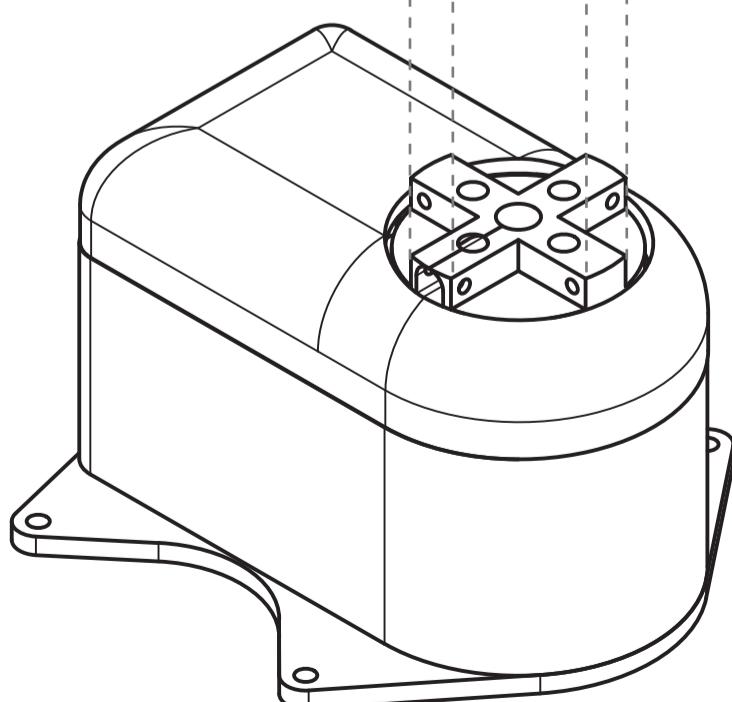
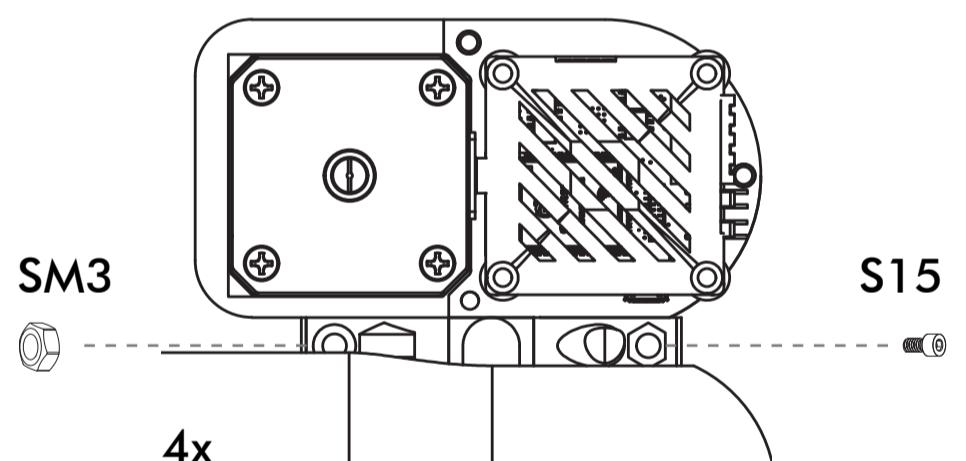
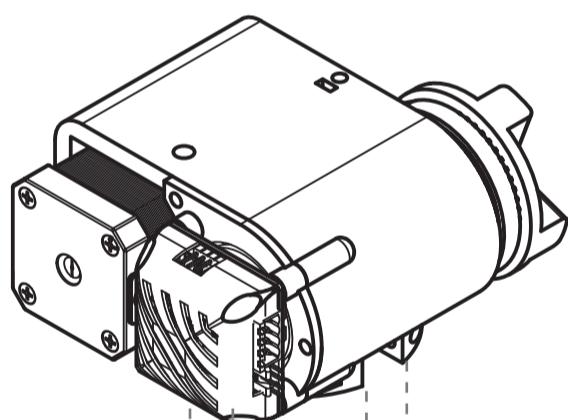
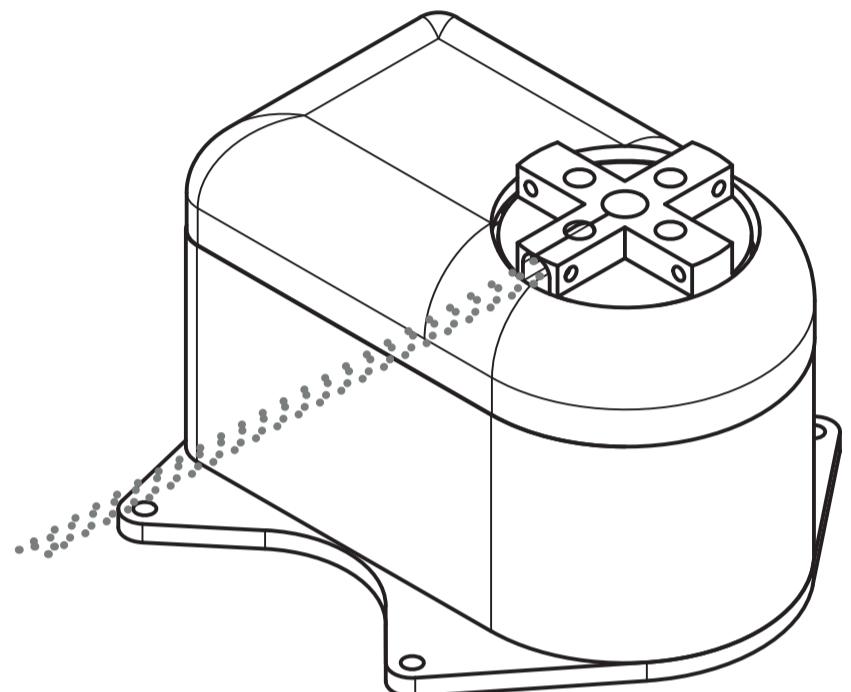
4x S15



4x SM3

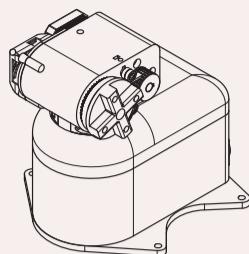
**Note**

Mind the orientation between Assembly I and Assembly II regarding the cable feed through.

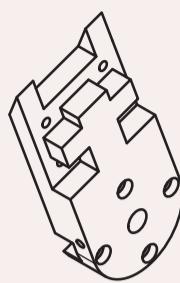


# Assembly III

1



Assembly I+II



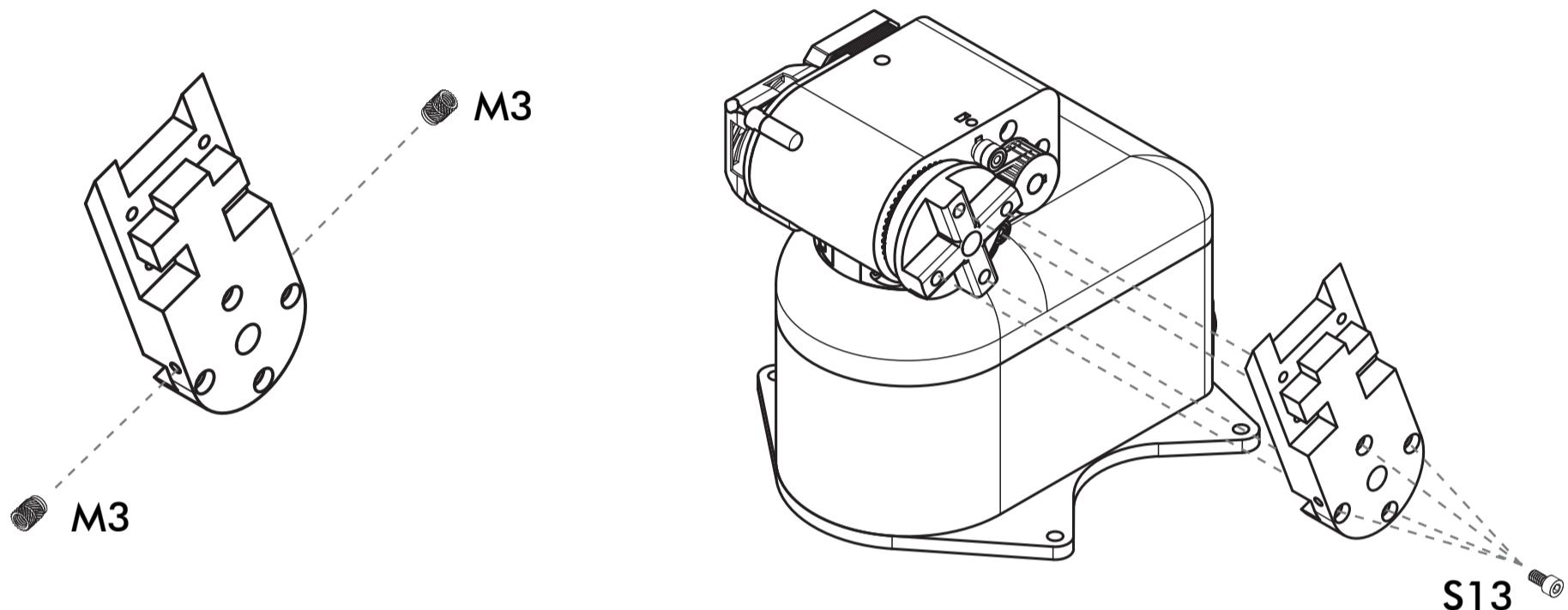
1x B15



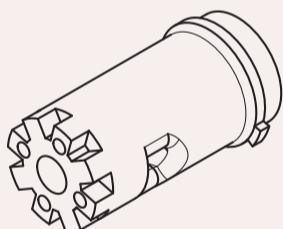
2x M3



4x S13



2



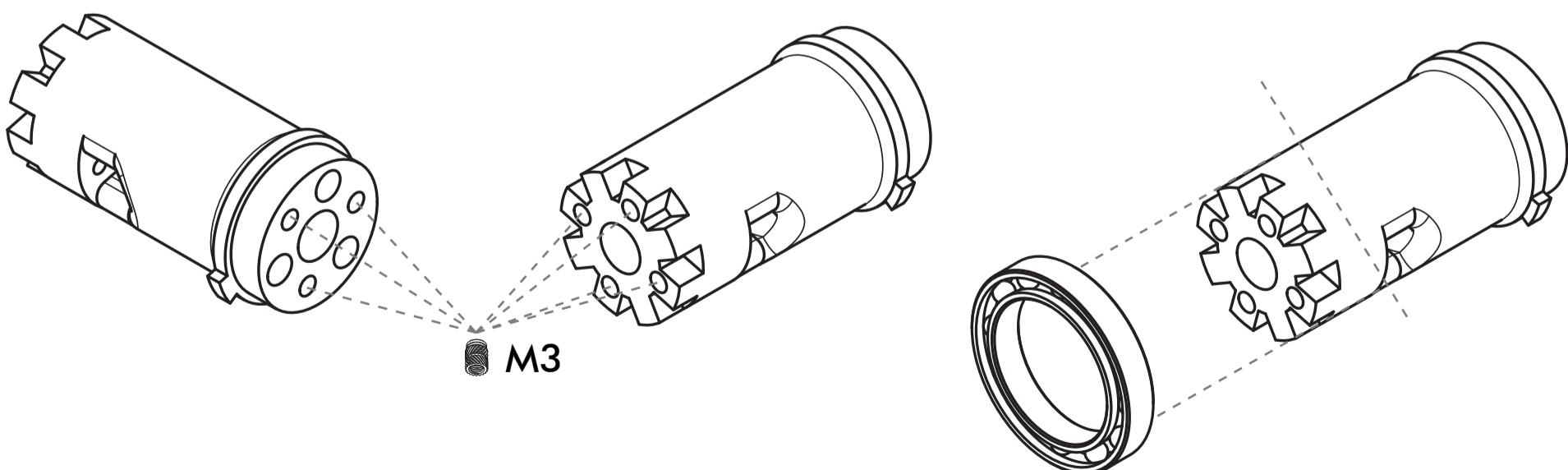
1x B17

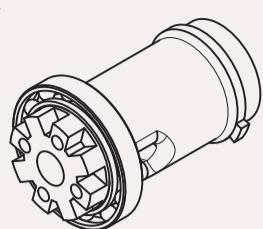


7x M3

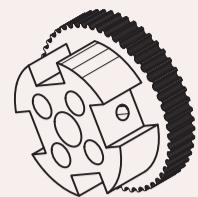


1x N12



**3**

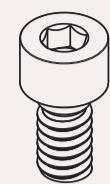
Step 2



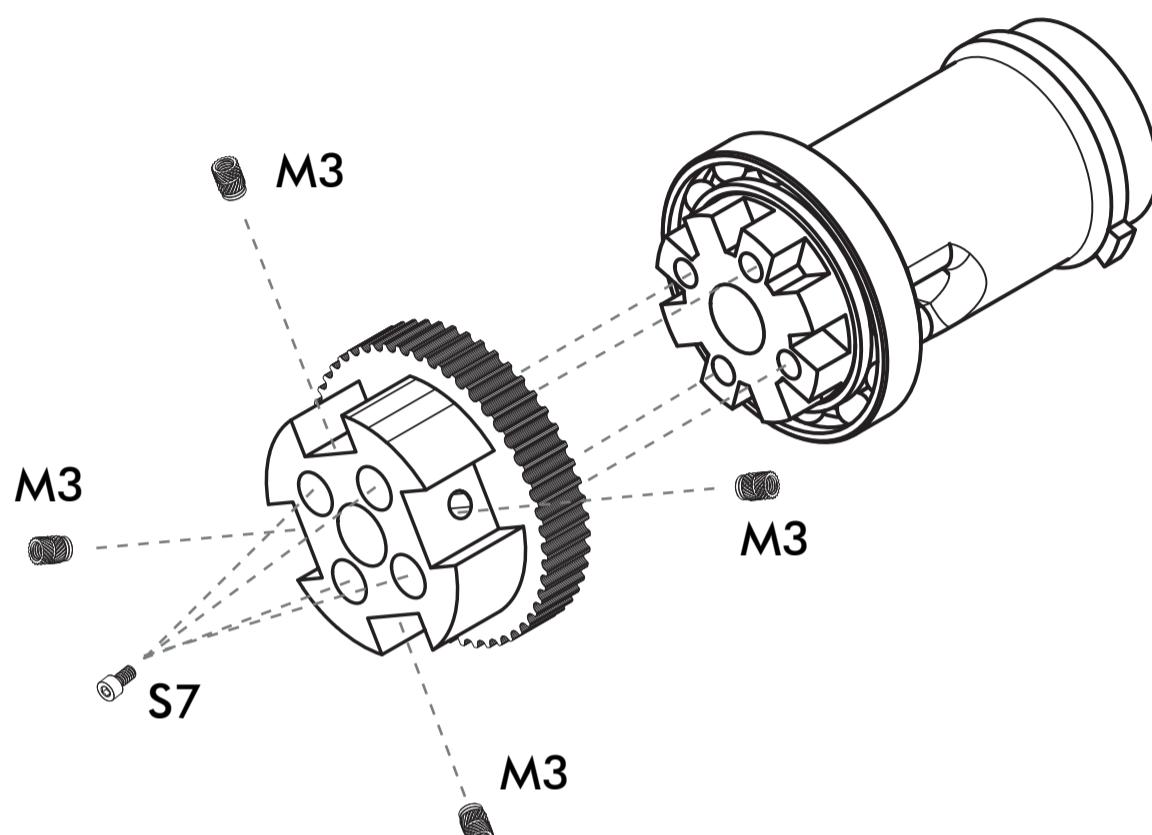
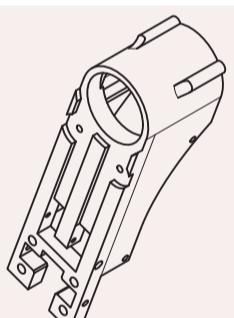
1x B18



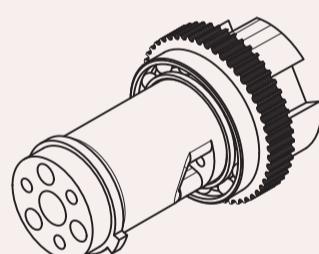
4x M3



4x S7

**4**

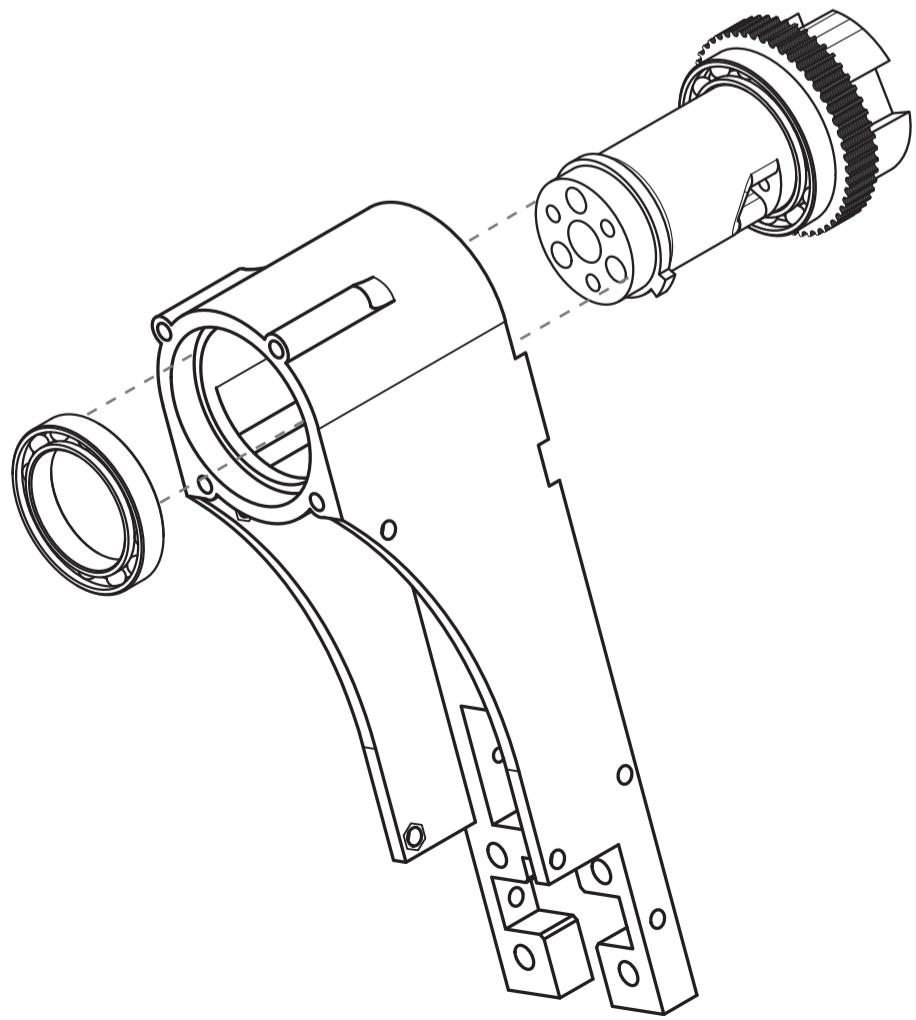
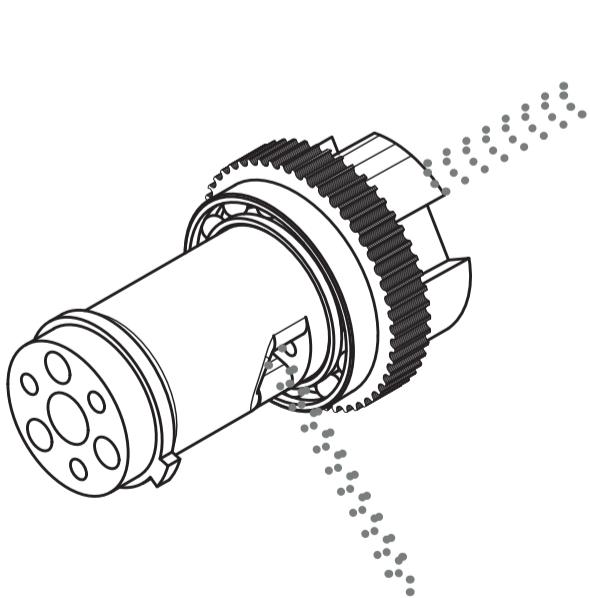
Step 3



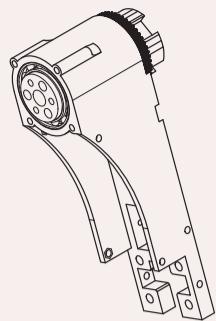
1x B16



1x N12

**Note**

Before inserting building step 3 feed the cables with sufficient length through the holes of B17 and B18 as shown.

**5**

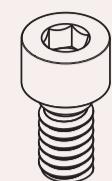
Step 4



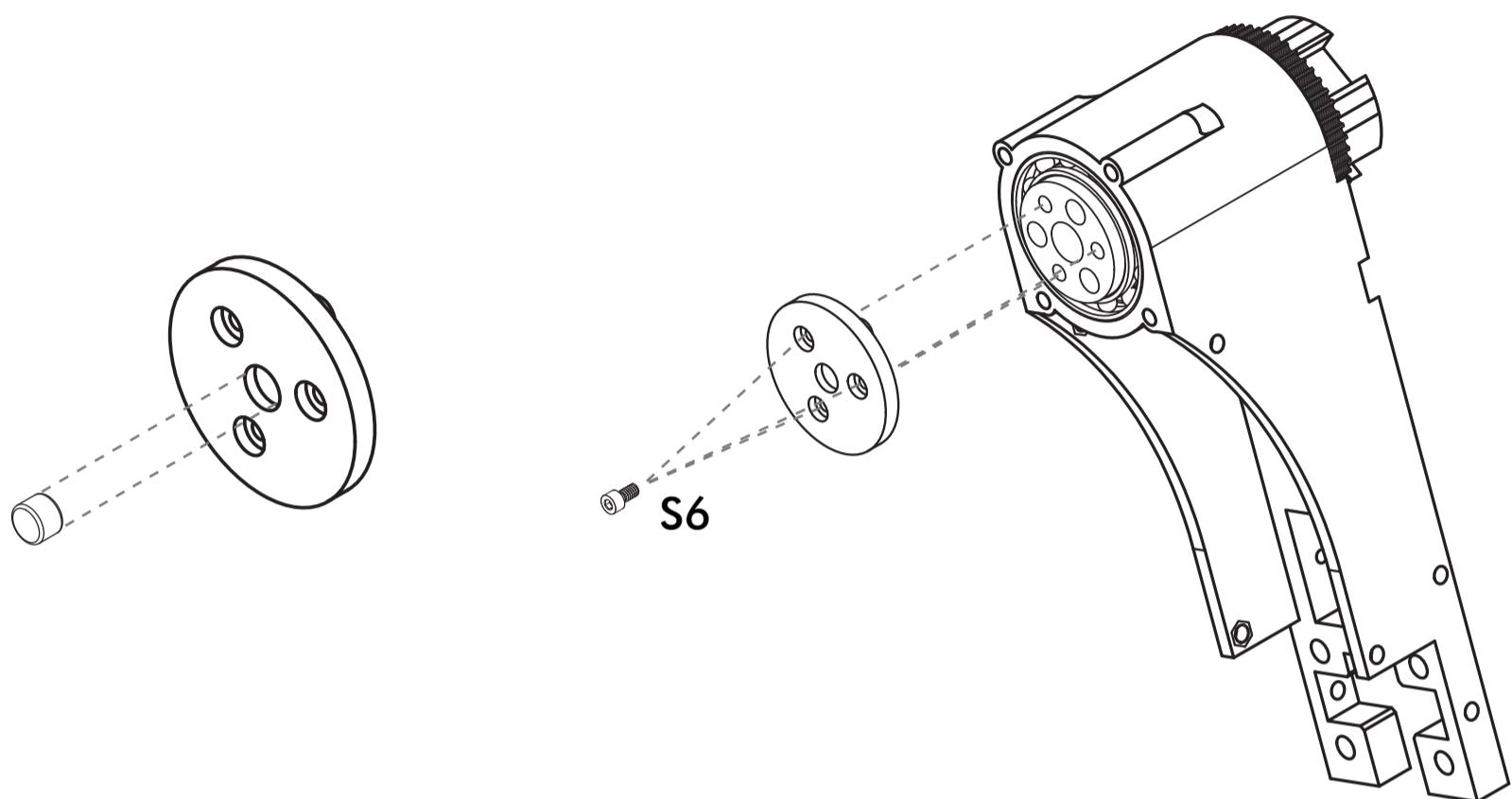
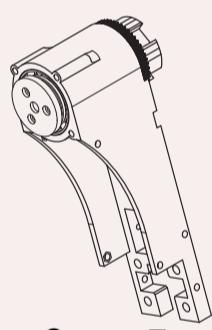
1x B20



1x N19



3x S6

**6**

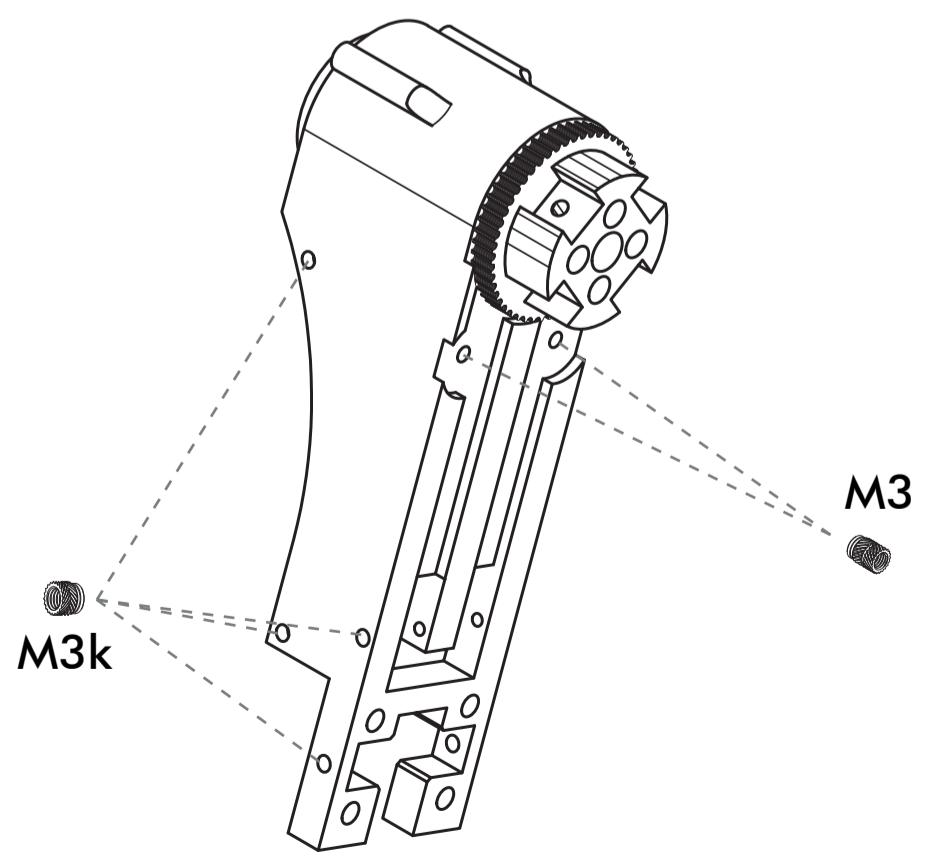
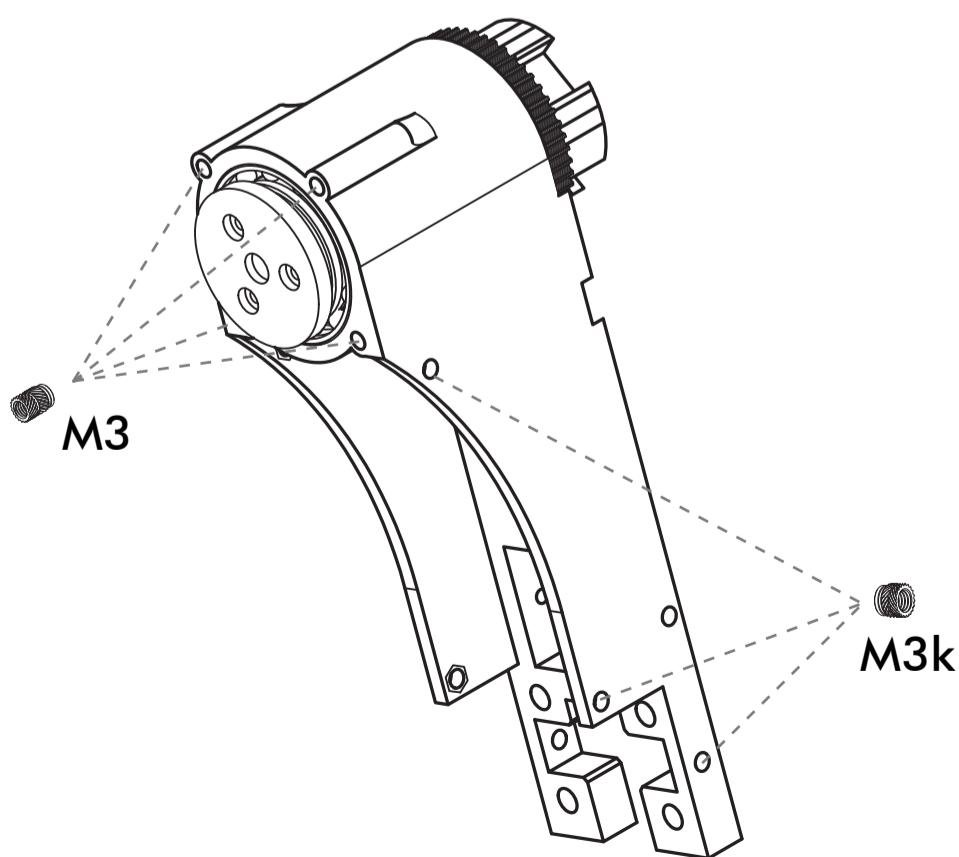
Step 5

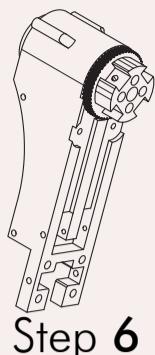


6x M3



7x M3k



**7**

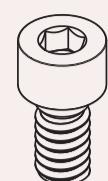
Step 6



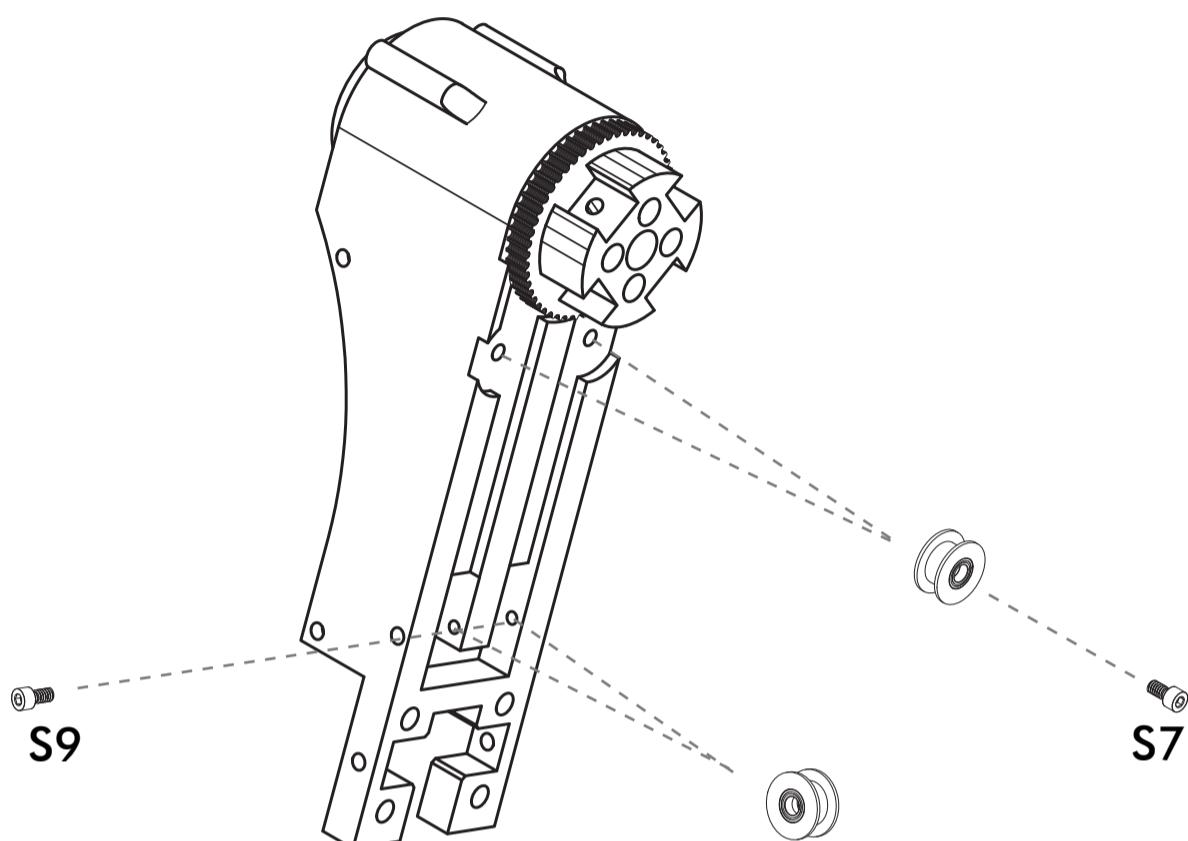
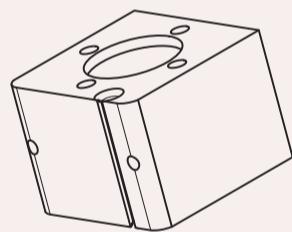
4x N16



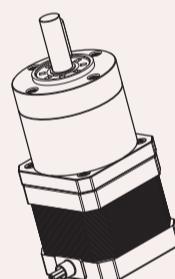
1x S9



2x S7

**8**

1x B21



1x N2



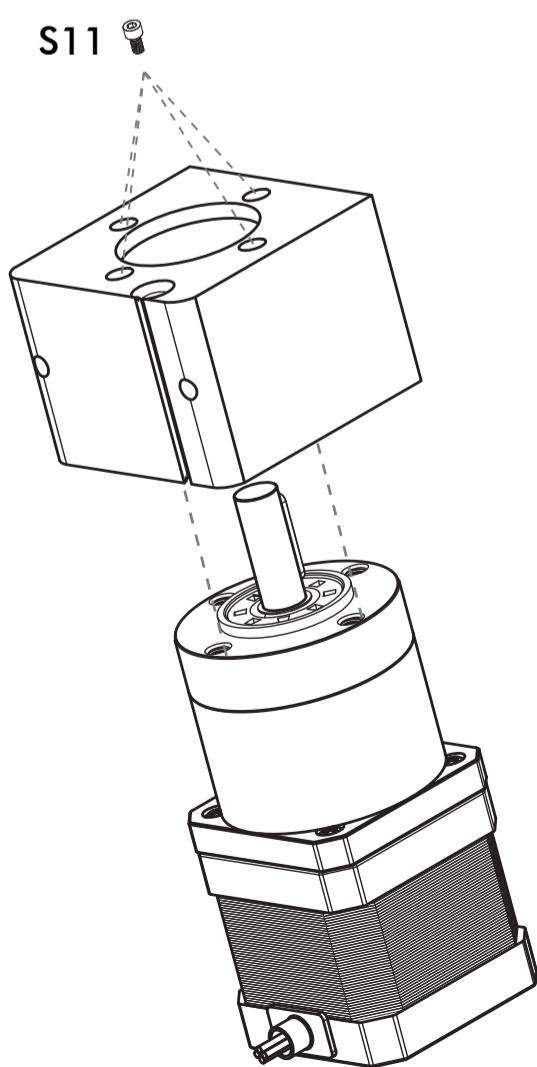
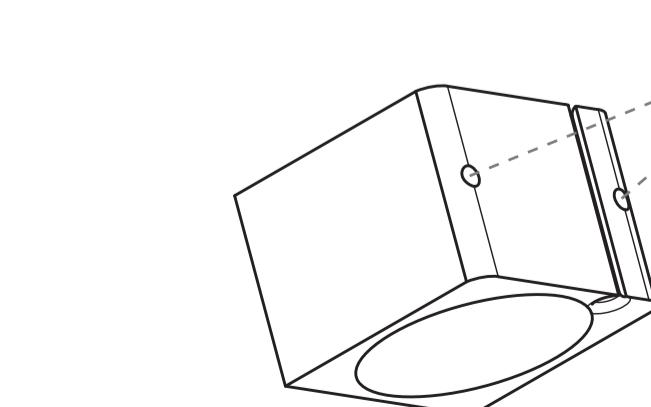
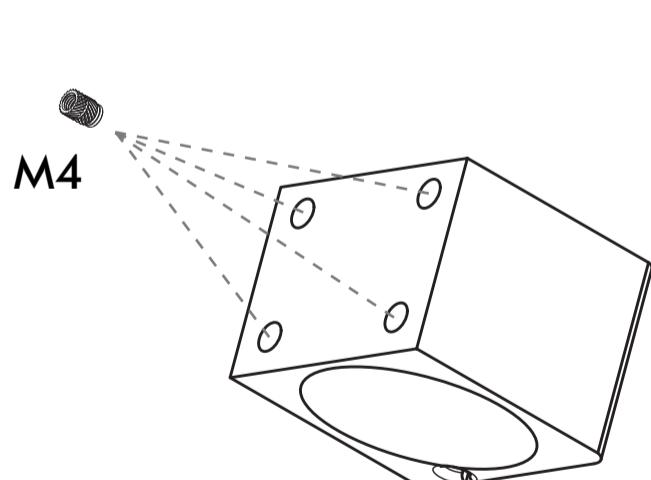
4x M4

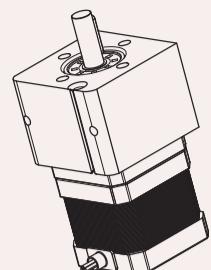


2x M3

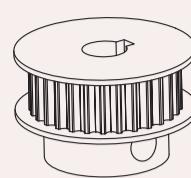


4x S11



**9**

Step 8



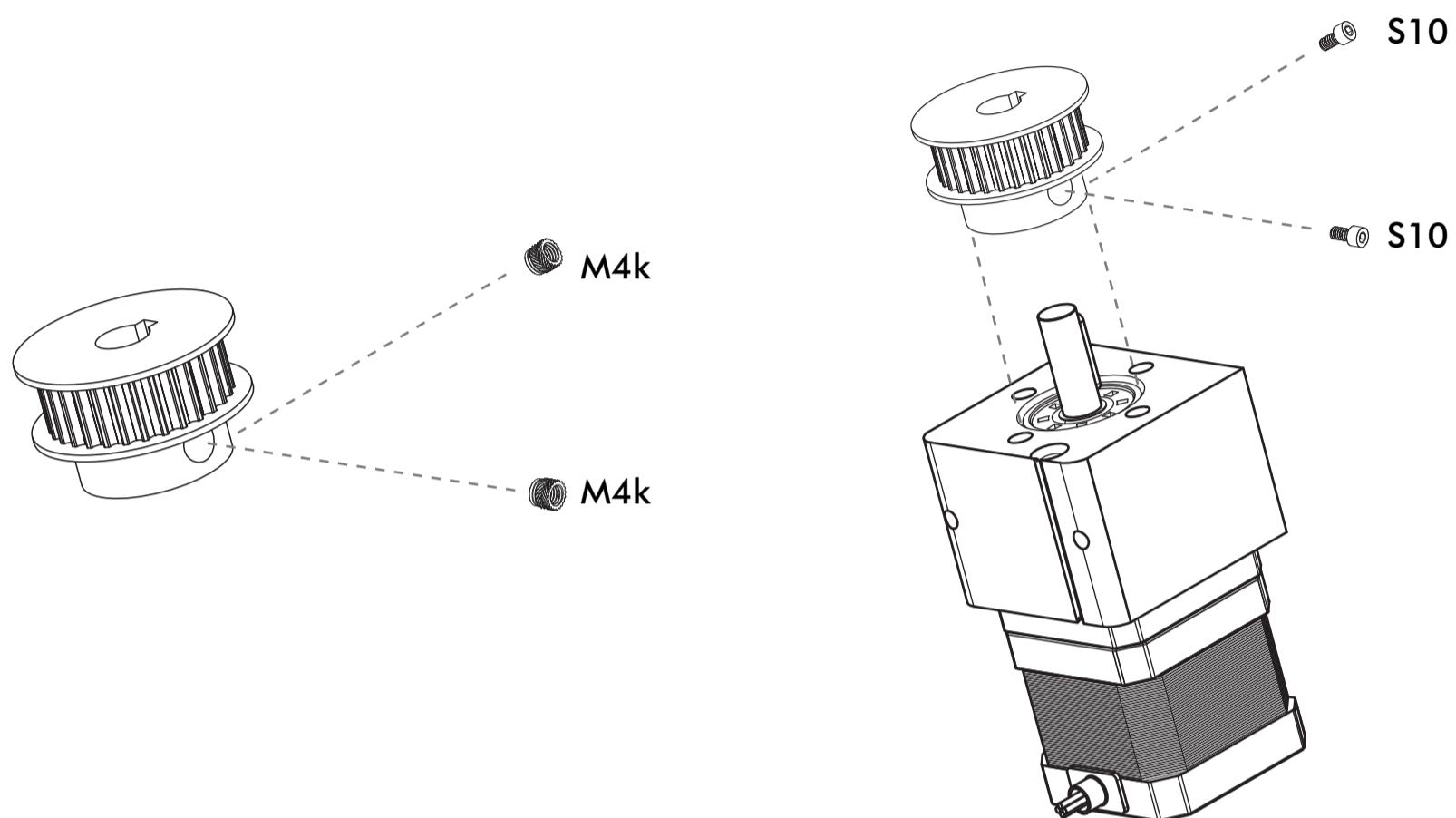
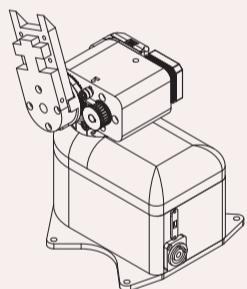
1x B19



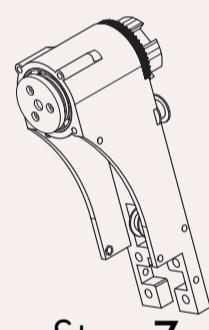
2x M4k



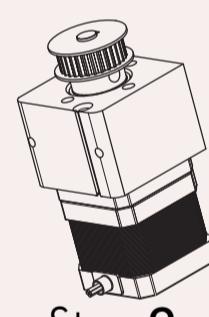
2x S10

**10**

Step 1



Step 7



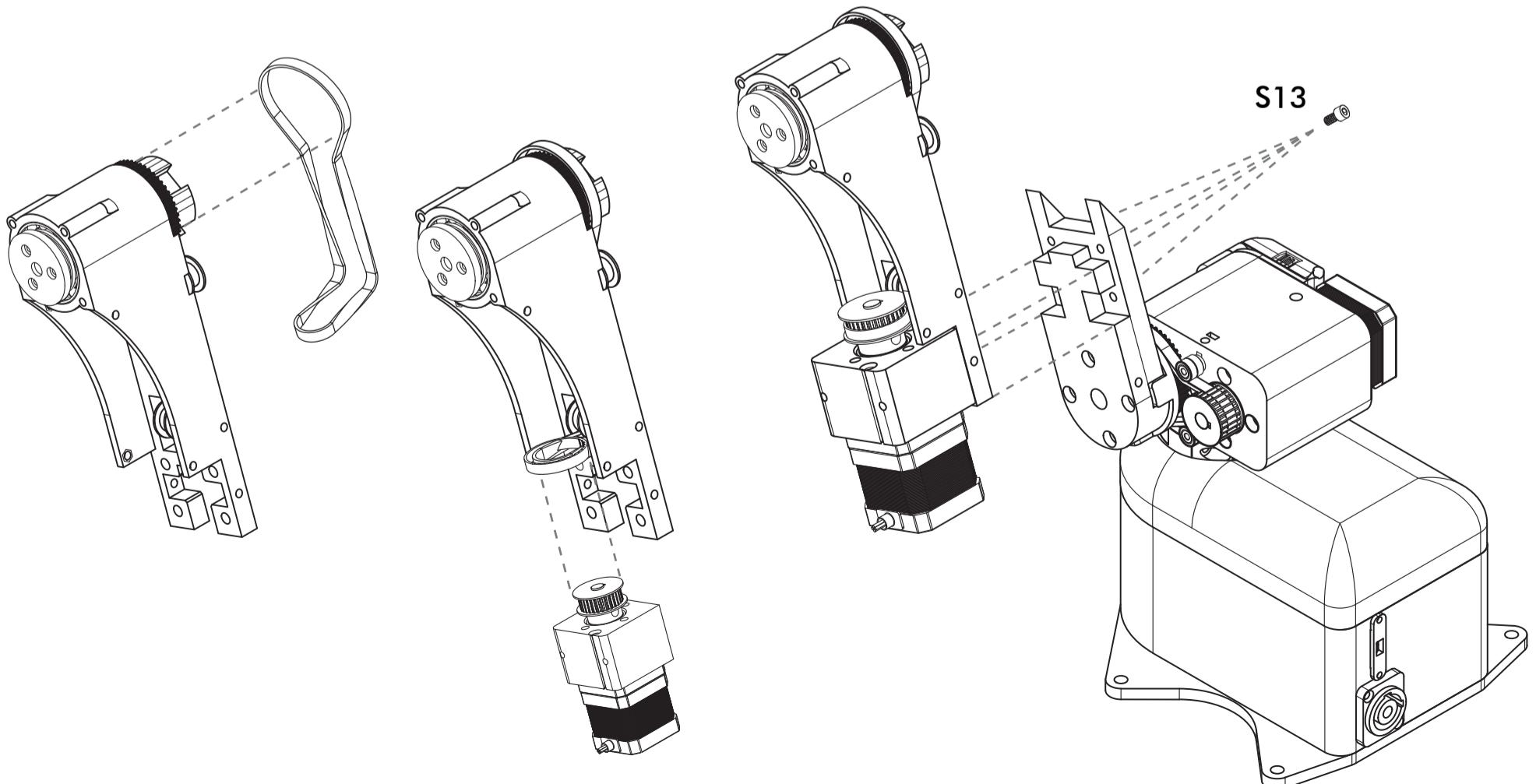
Step 9



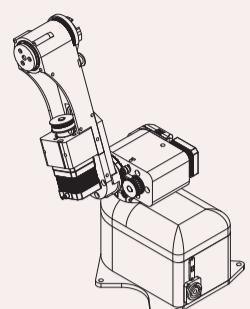
1x N6



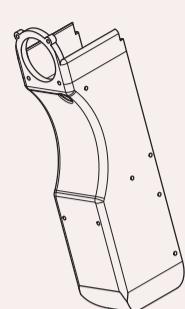
4x S13



11



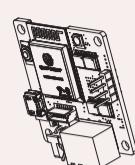
Step 10



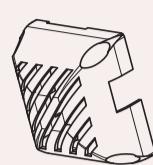
1x B22



4x B36



1x N20



1x B35



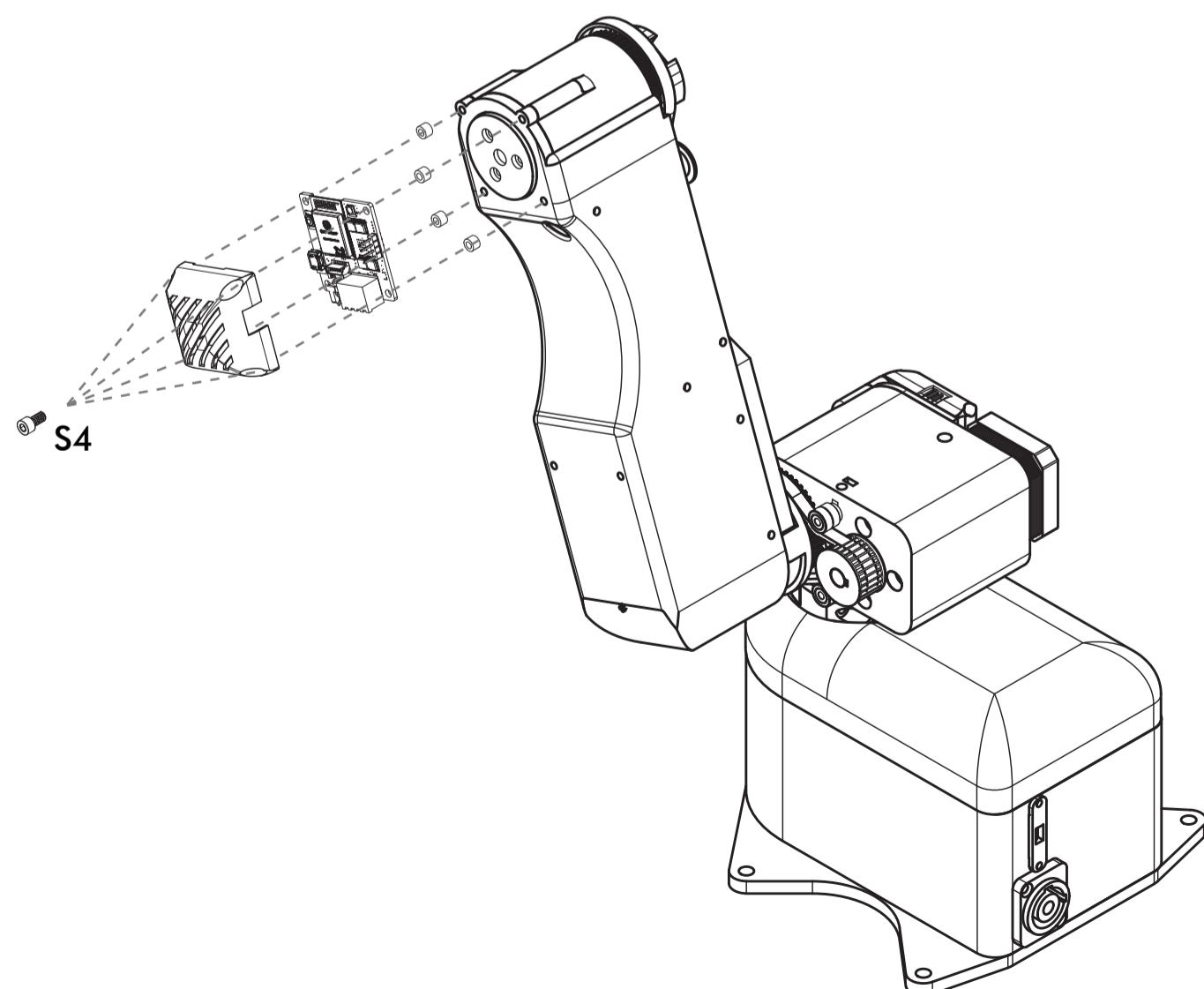
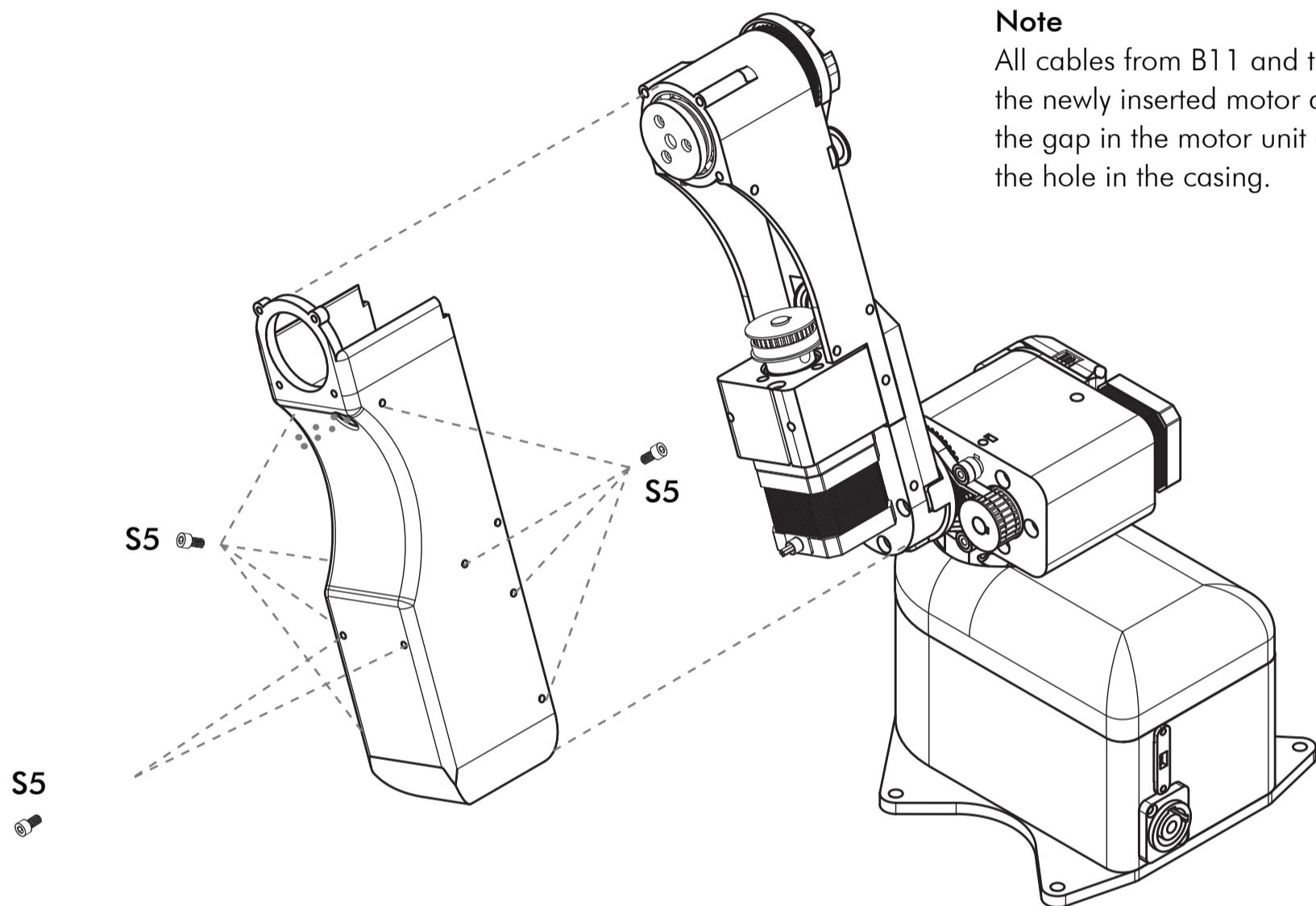
4x S4



10x S5

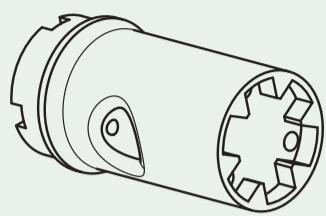
**Note**

All cables from B11 and the cables of the newly inserted motor are fed through the gap in the motor unit and through the hole in the casing.



# Assembly IV

1



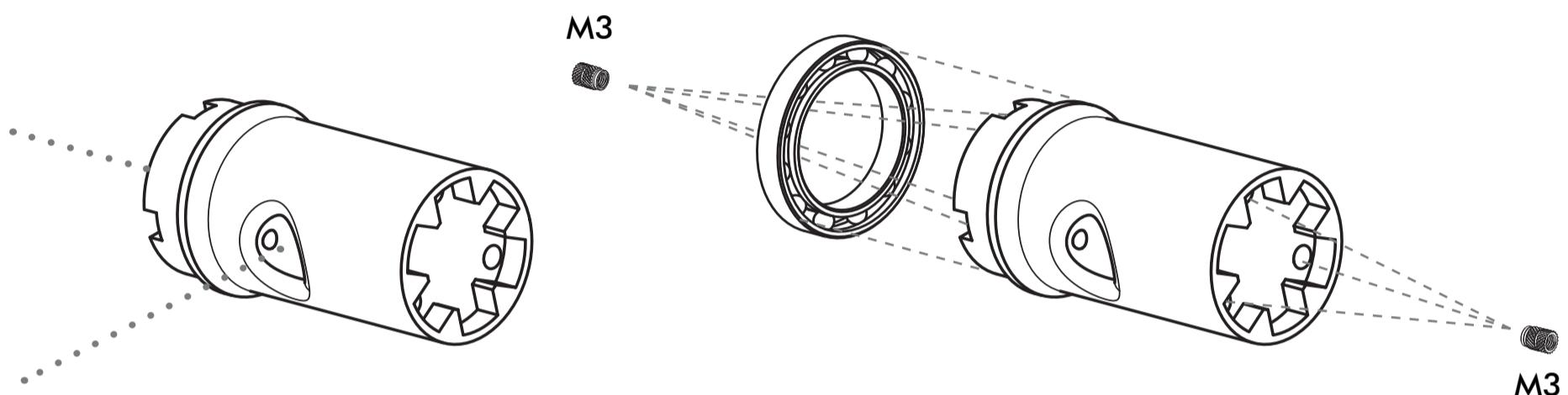
1x B24



1x N12



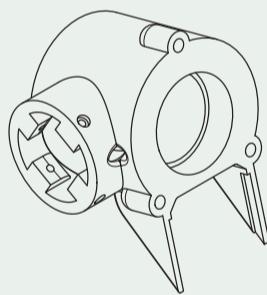
7x M3



## Note

The cables are fed through the hole in B24 with sufficient length (see Assembly V step 8).

2



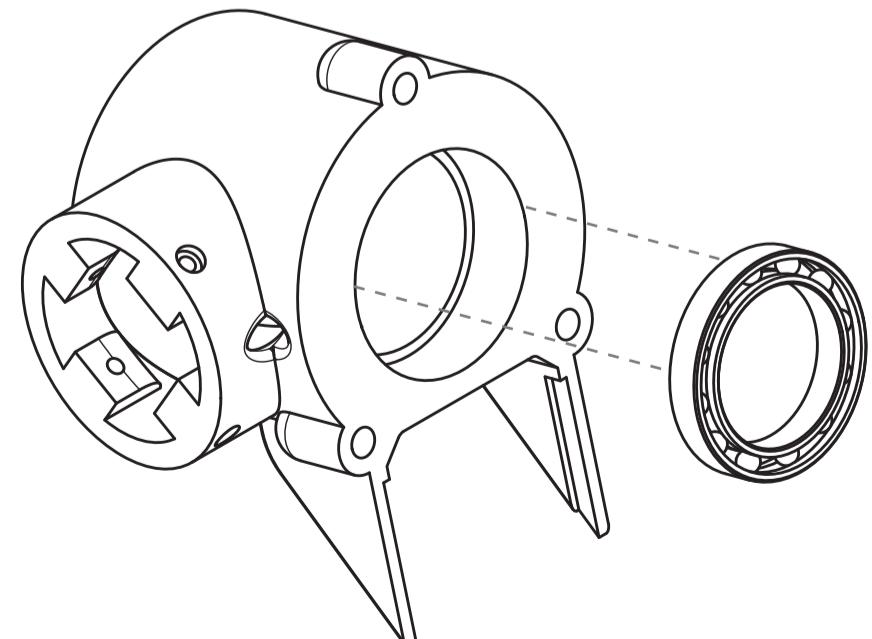
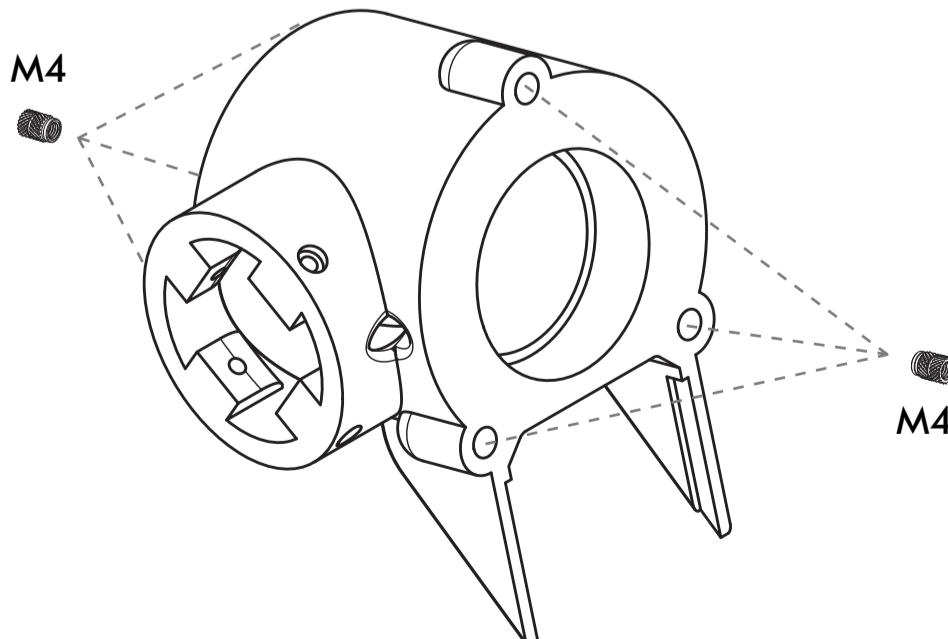
1x B23

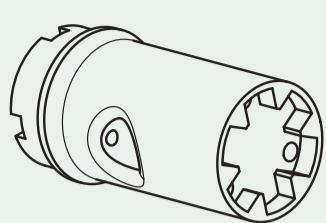


1x N12

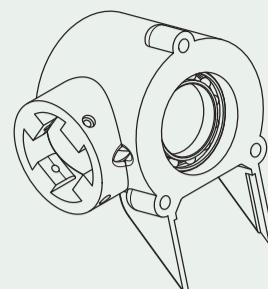


6x M4

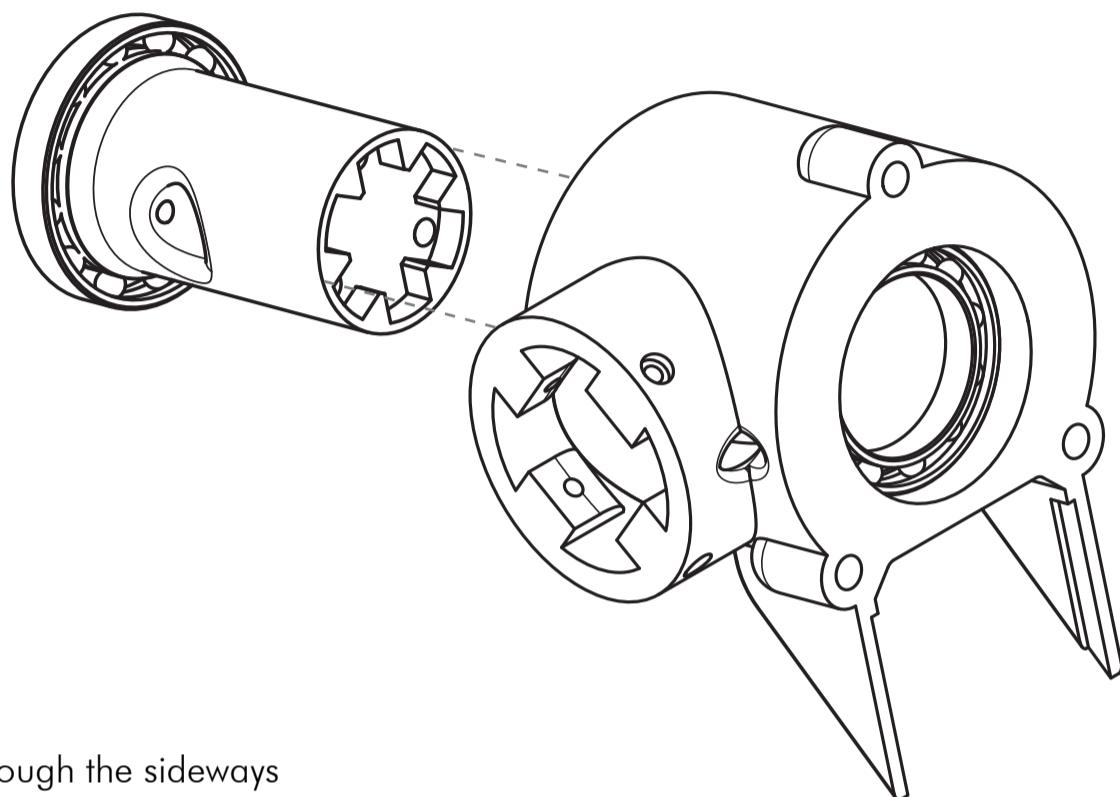


**3**

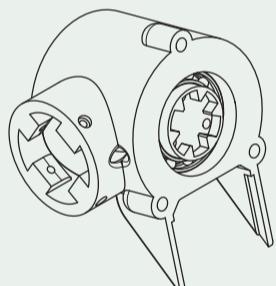
Step 1



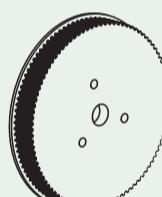
Step 2

**Note**

Feed the cables of B24 through the sideways hole in B23 before inserting.

**4**

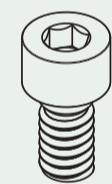
Step 3



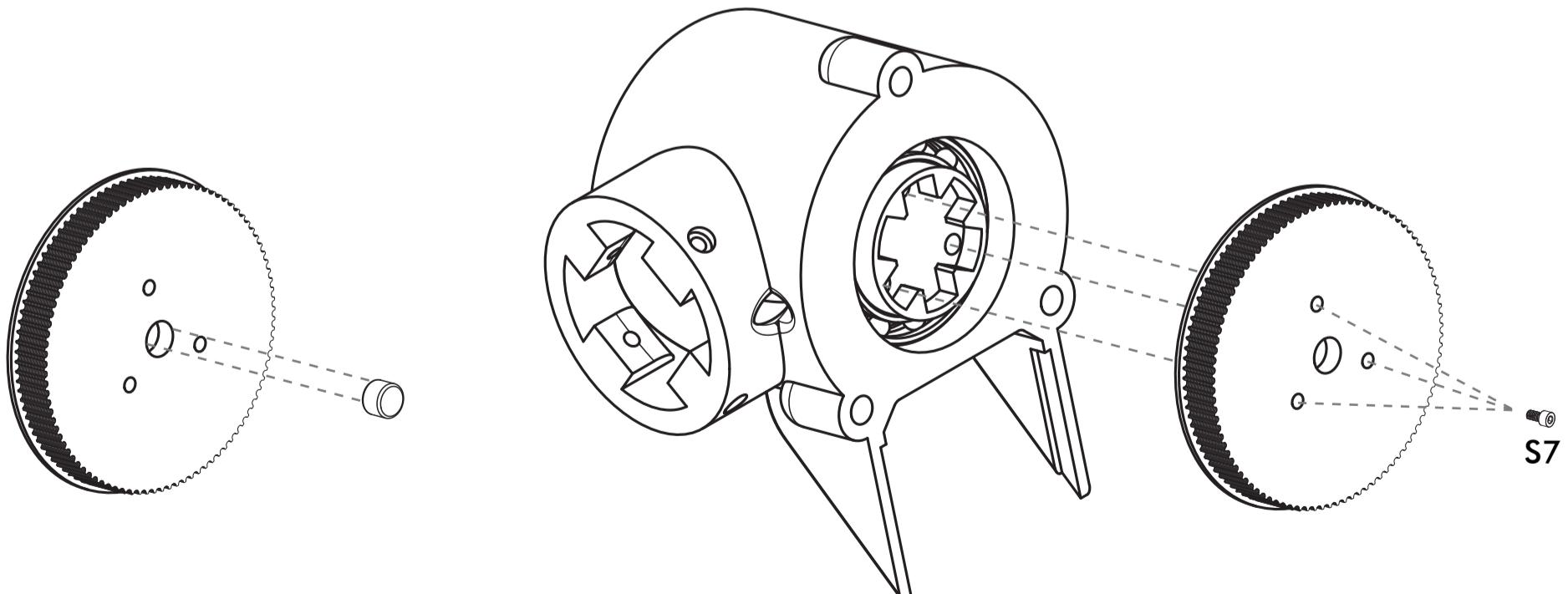
1x B26



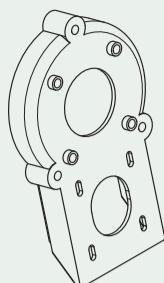
1x N19



3x S7



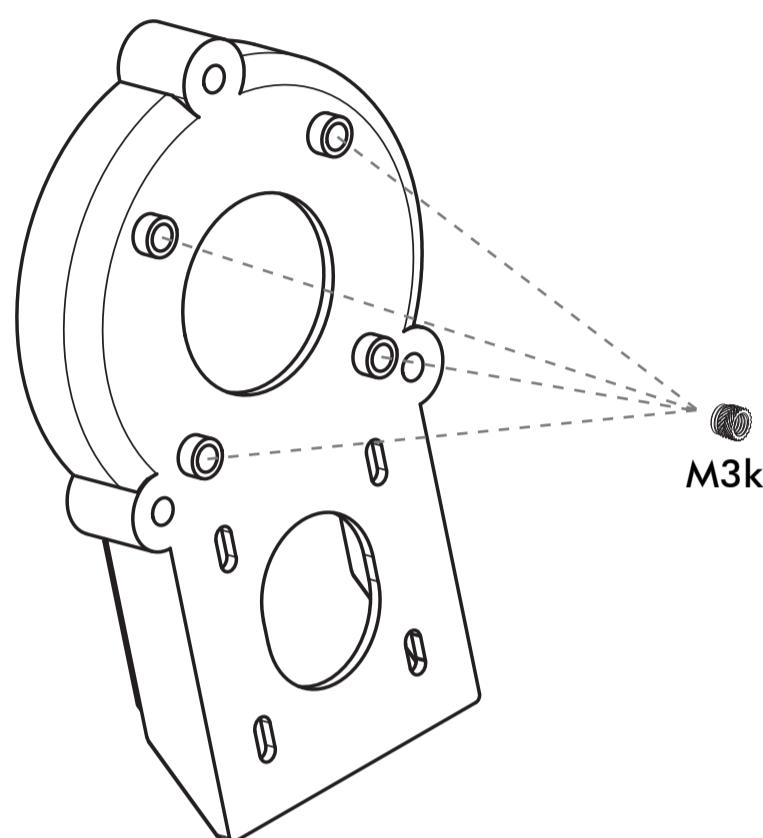
5



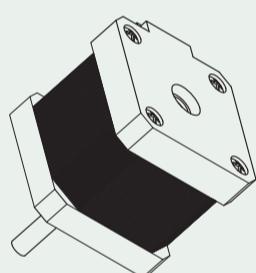
1x B25



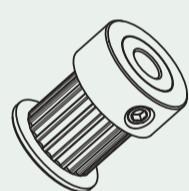
4x M3k



6



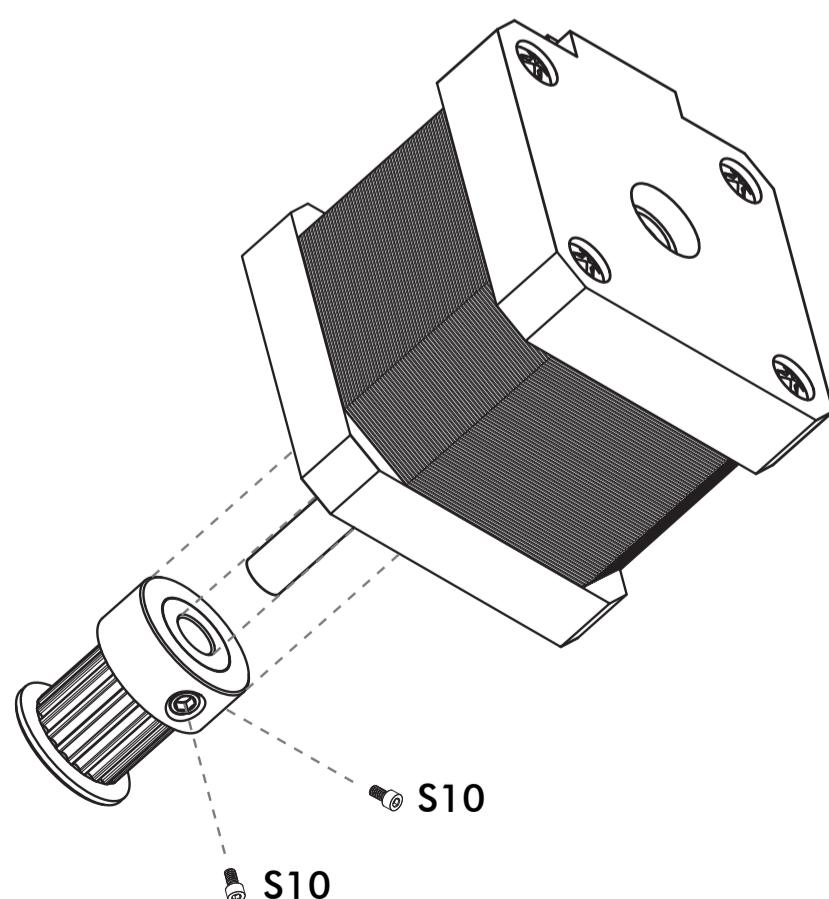
1x N3



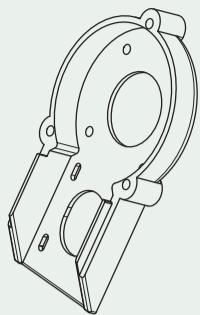
1x N14



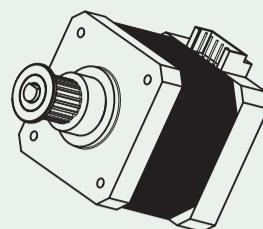
2x S10



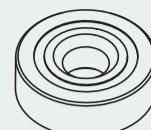
7



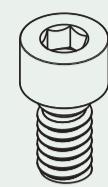
Step 5



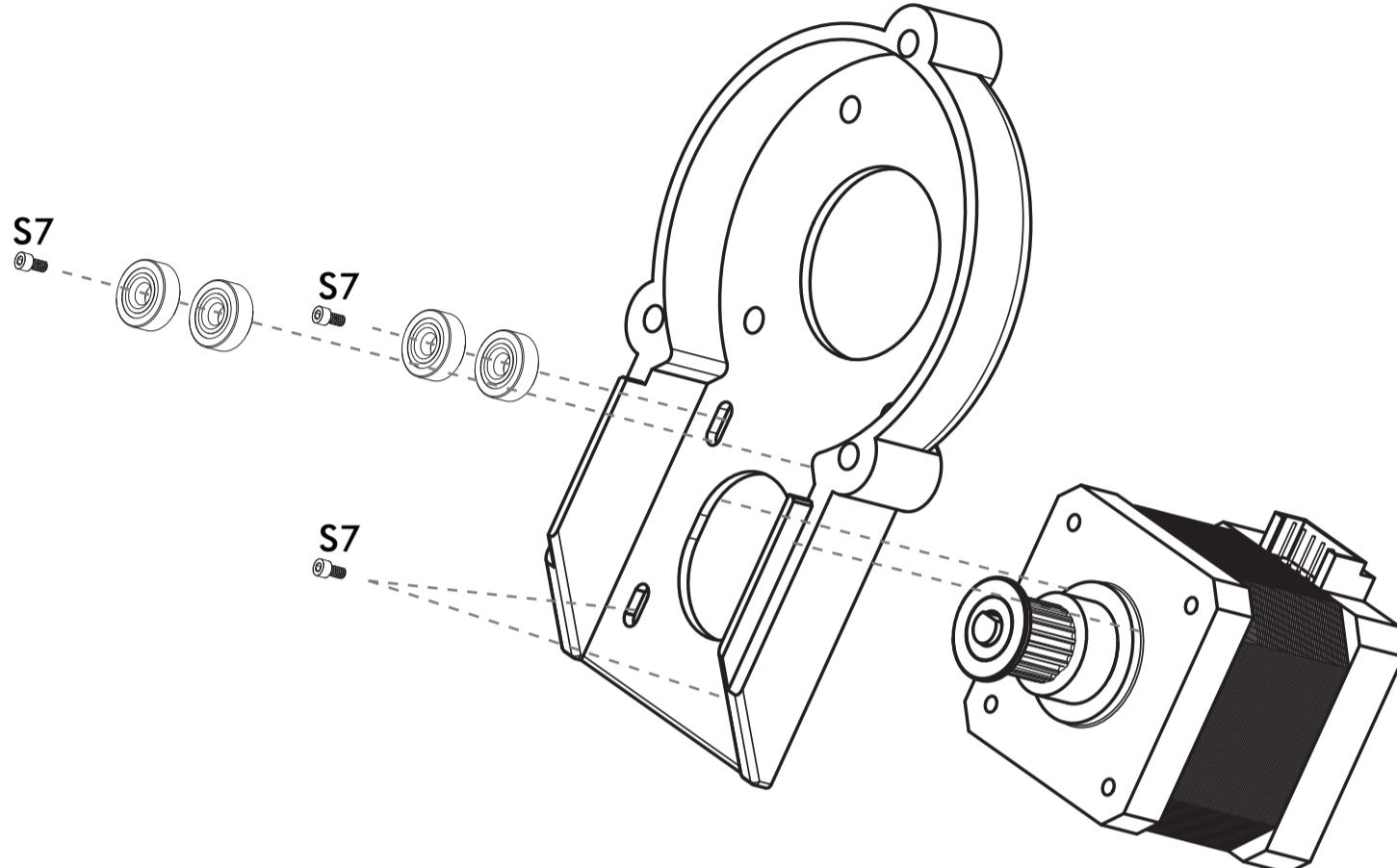
Step 6



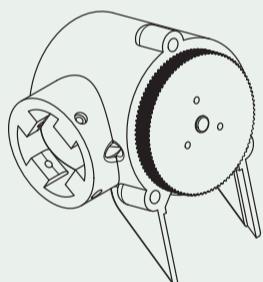
4x N10



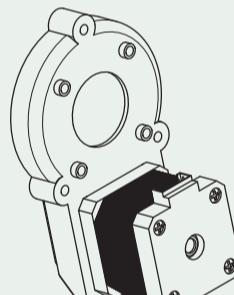
4x S7



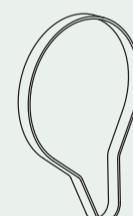
8



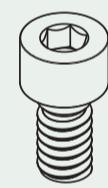
Step 4



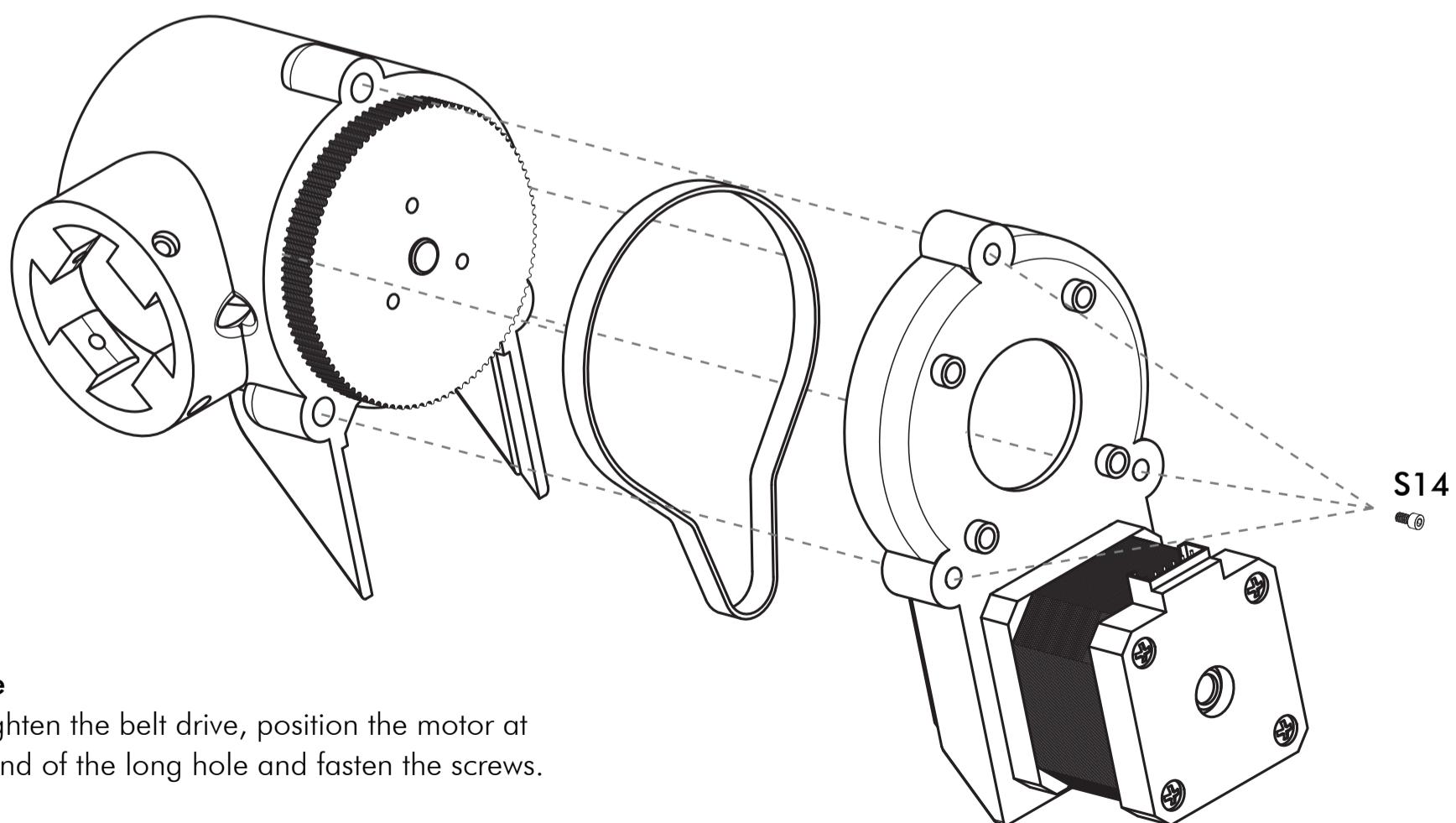
Step 7

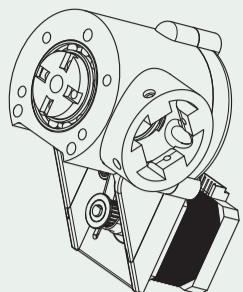


1x N7

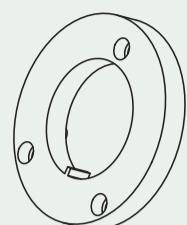


3x S14



**9**

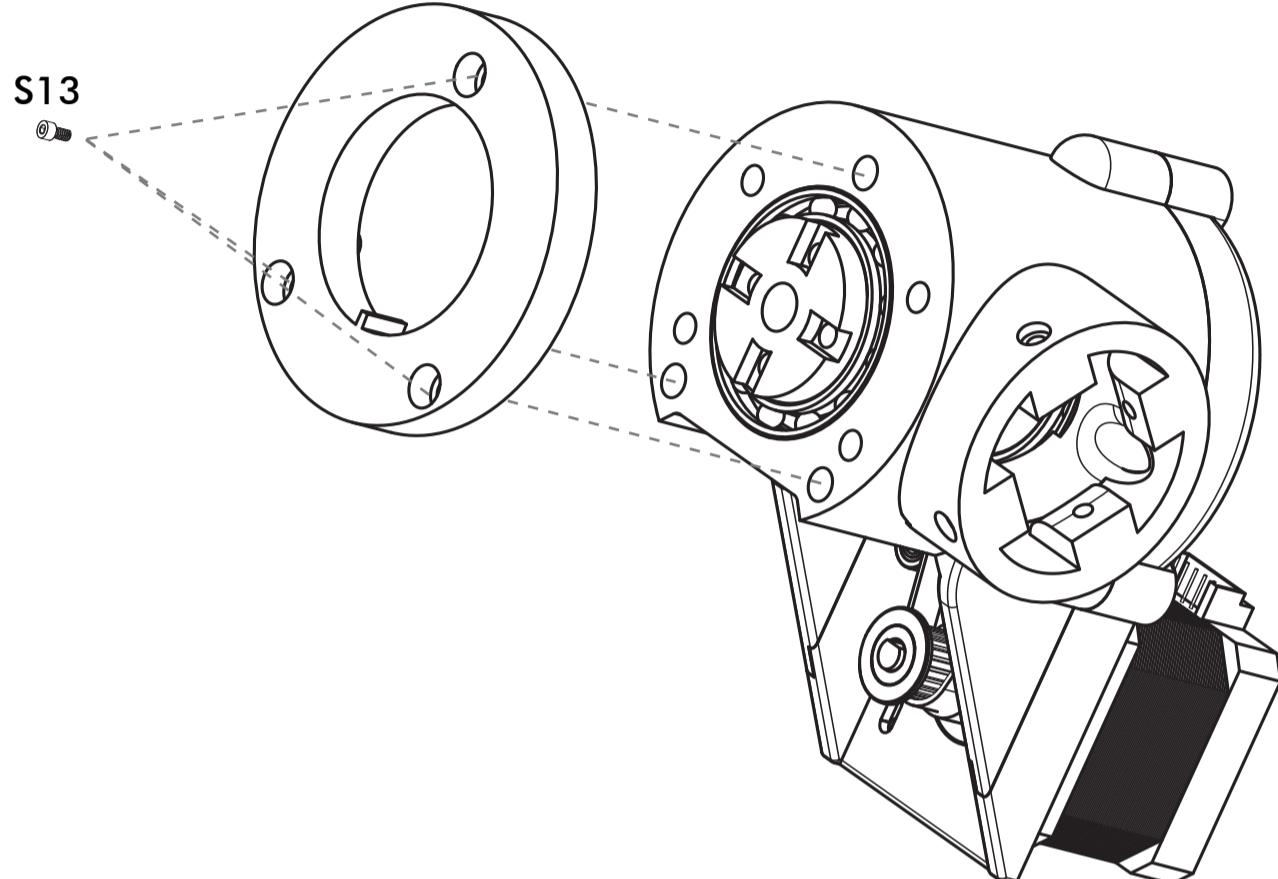
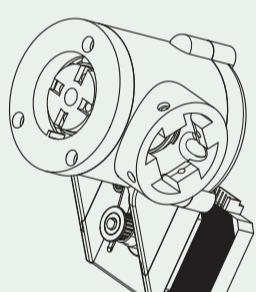
Step 8



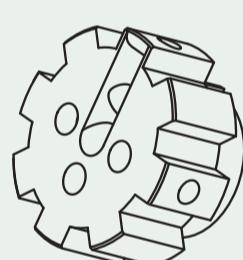
1x B27



3x S13

**10**

Step 9



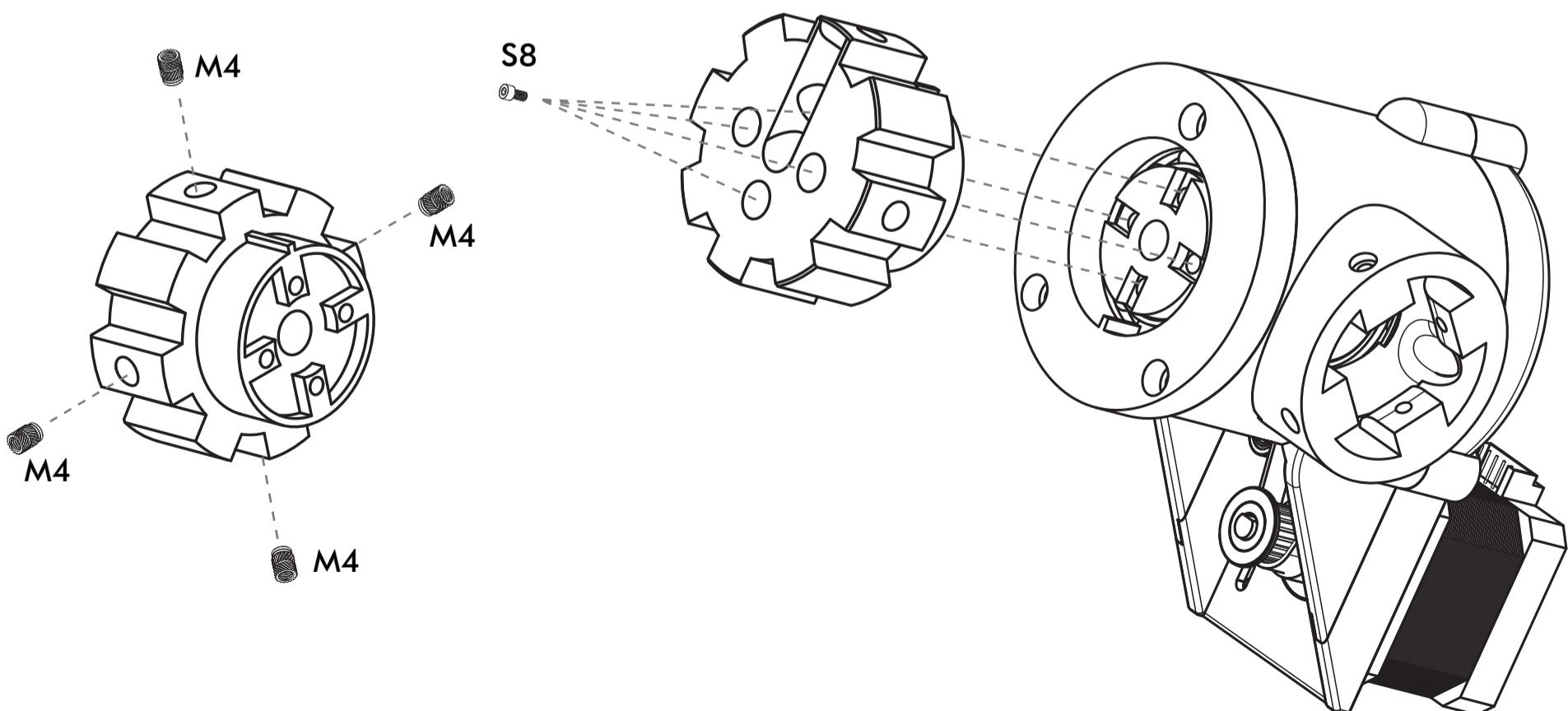
1x B28

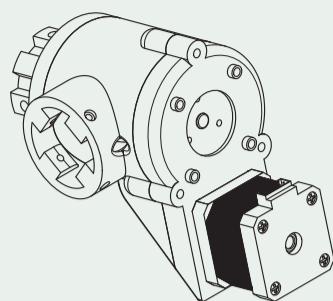


4x M4

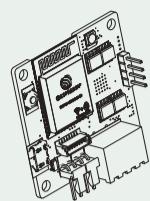


4x S8

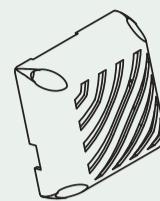


**11**

Step 10



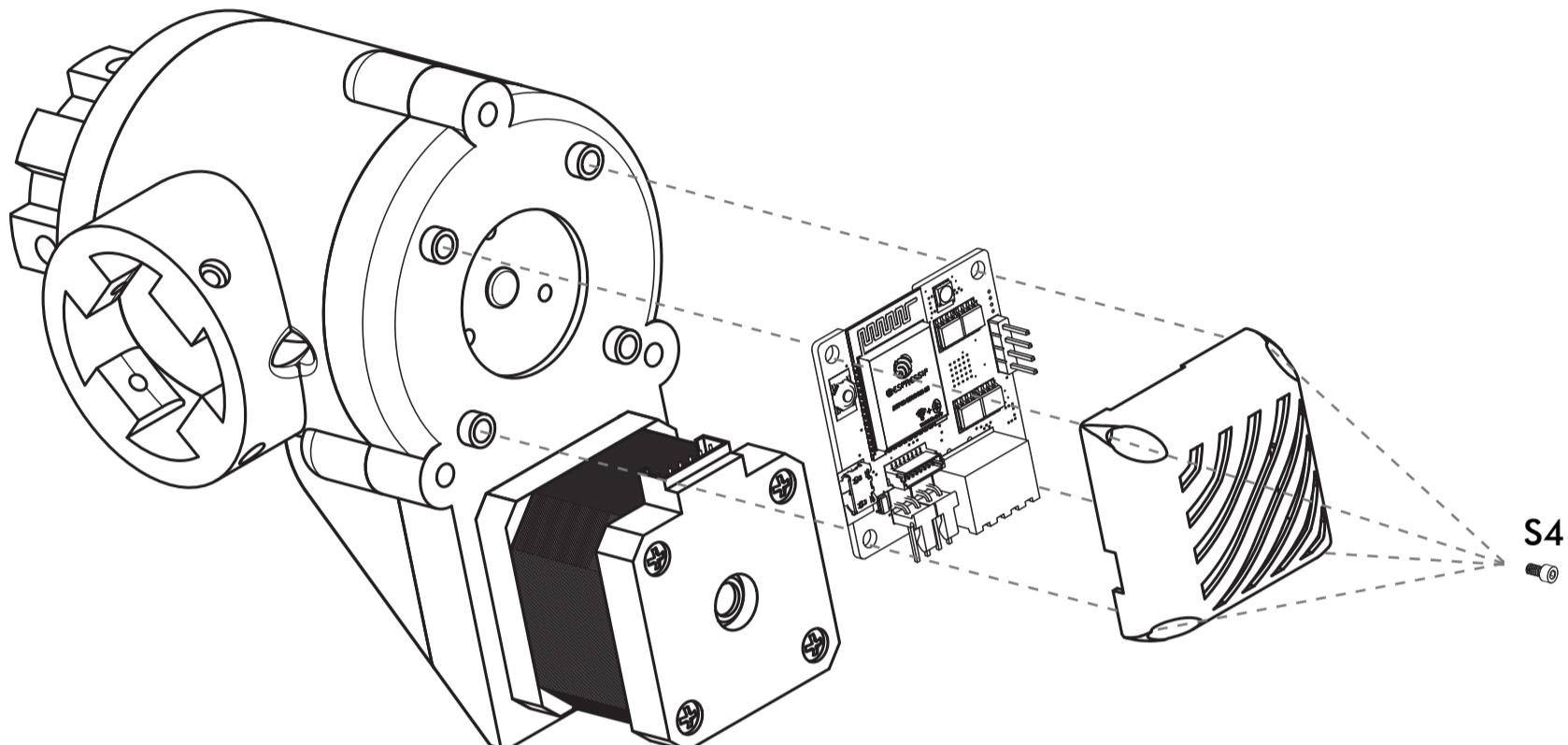
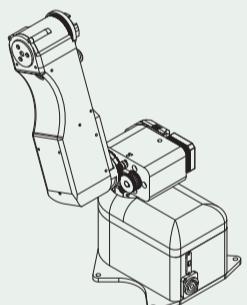
1x N20



1x B35



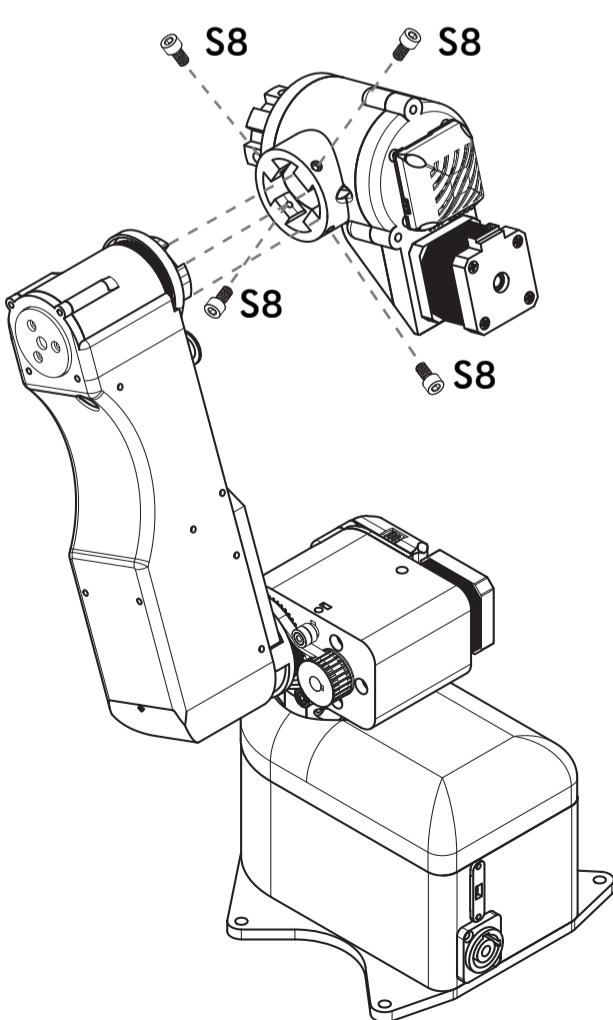
4x S4

**12**

Assembly I-III



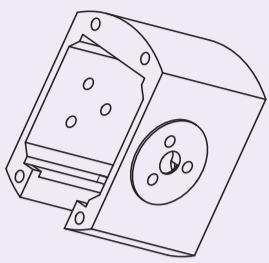
4x S8

**Note**

Before assembly, feed the cables from Assembly I-III through the hole in B23.

# Assembly V

1



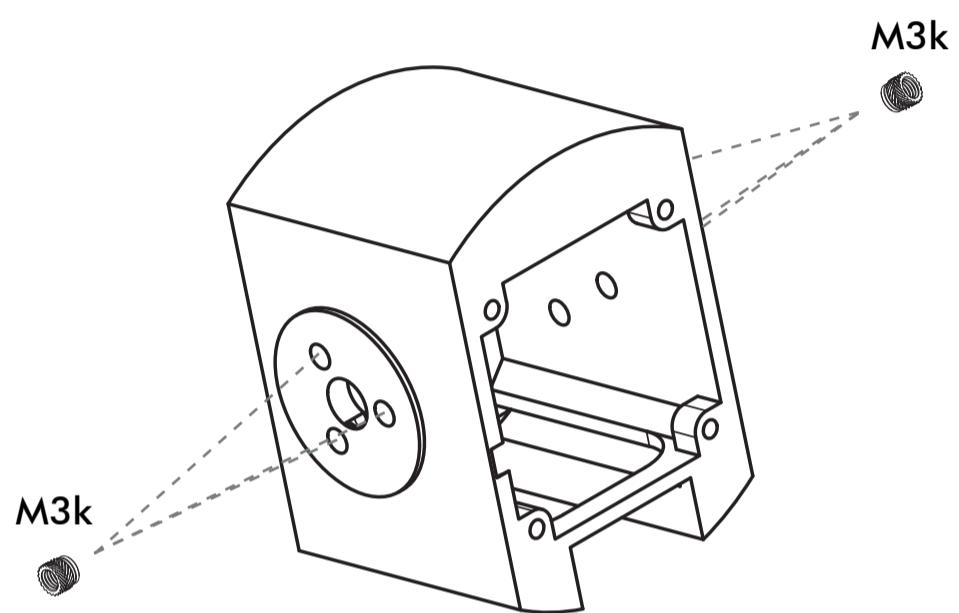
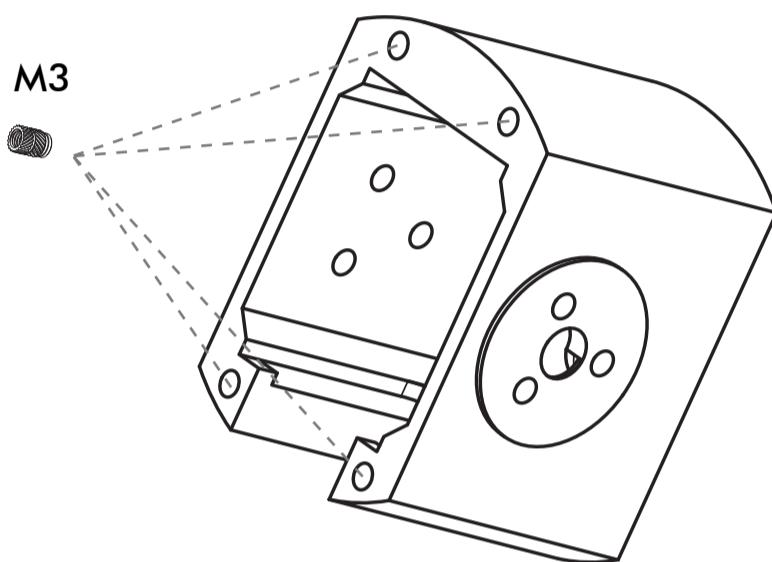
1x B33



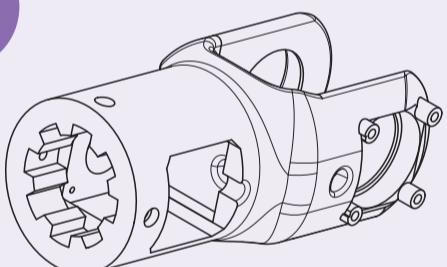
6x M3k



4x M3



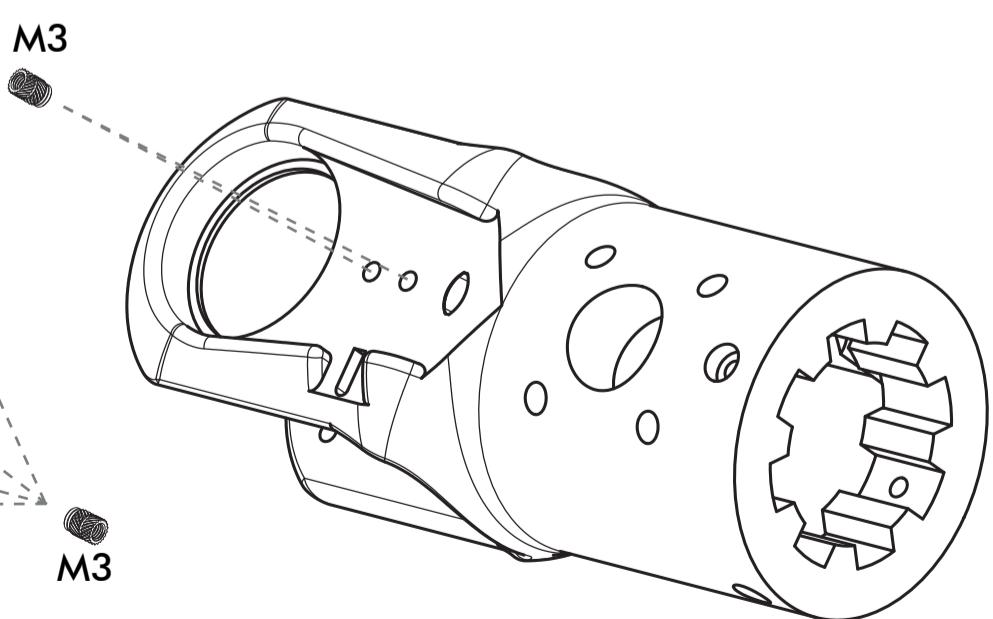
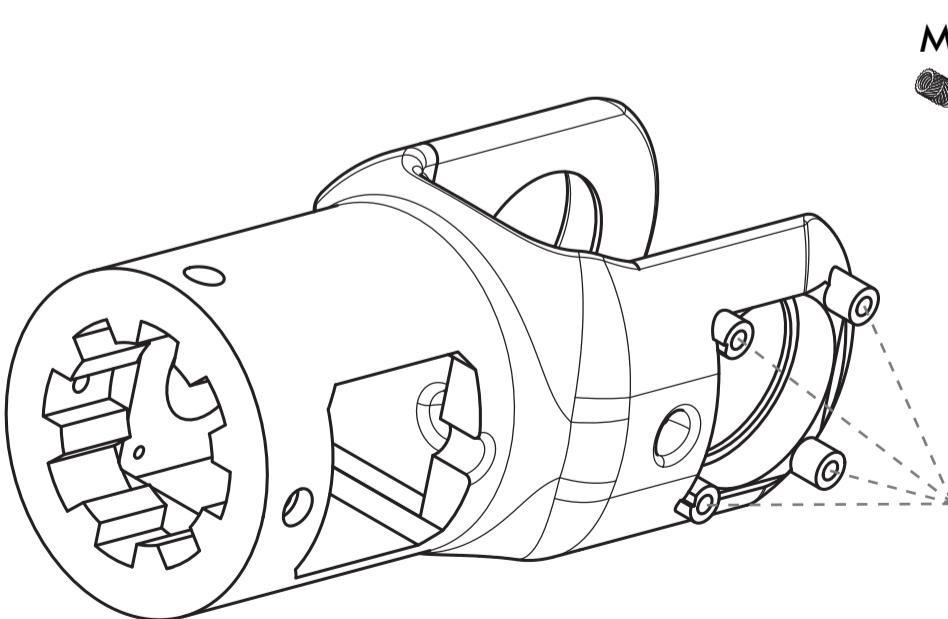
2



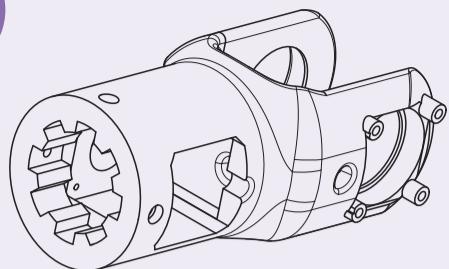
1x B29



6x M3



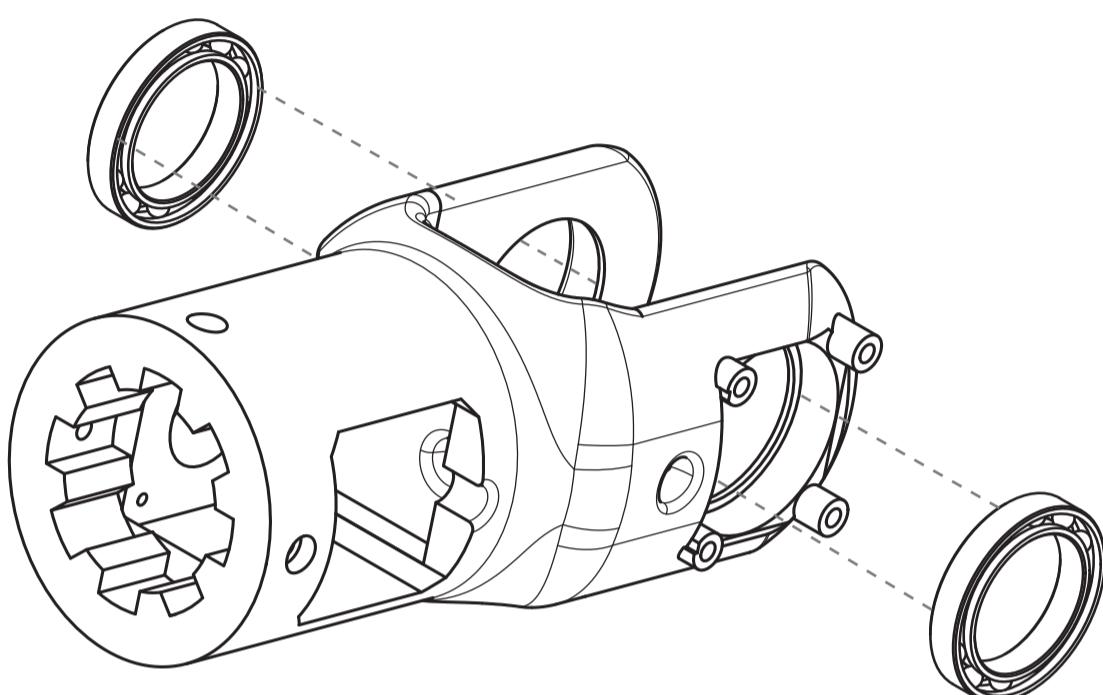
3



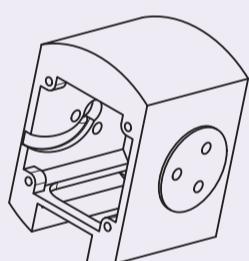
Step 2



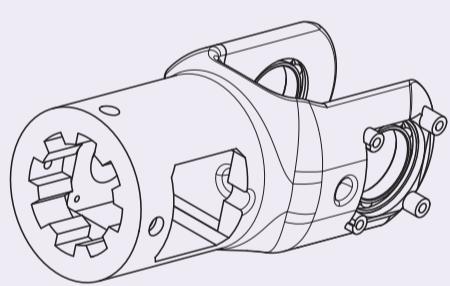
2x N12



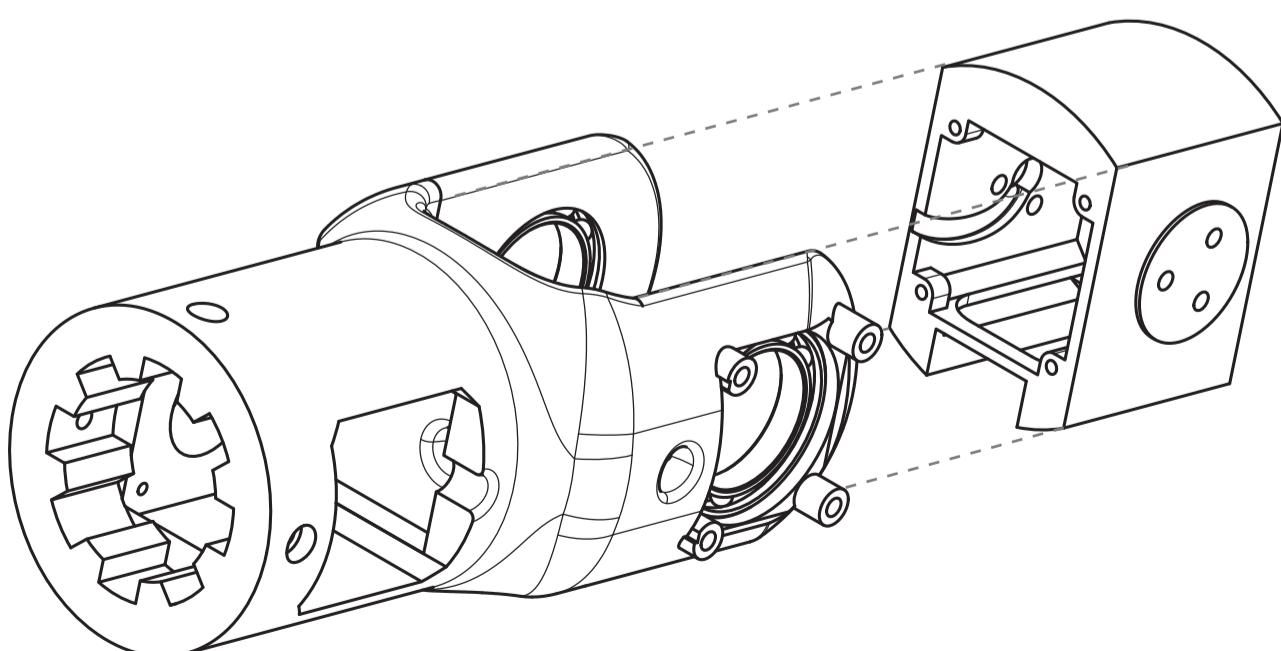
4

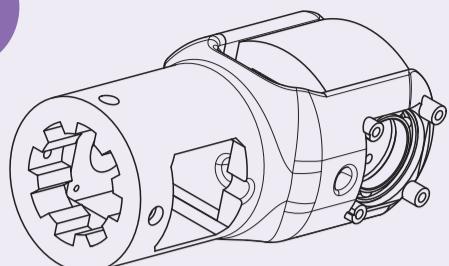


Step 1



Step 3

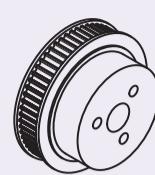


**5**

Step 4



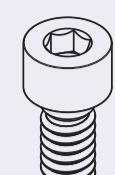
1x B30



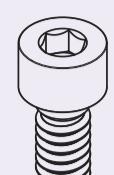
1x B31



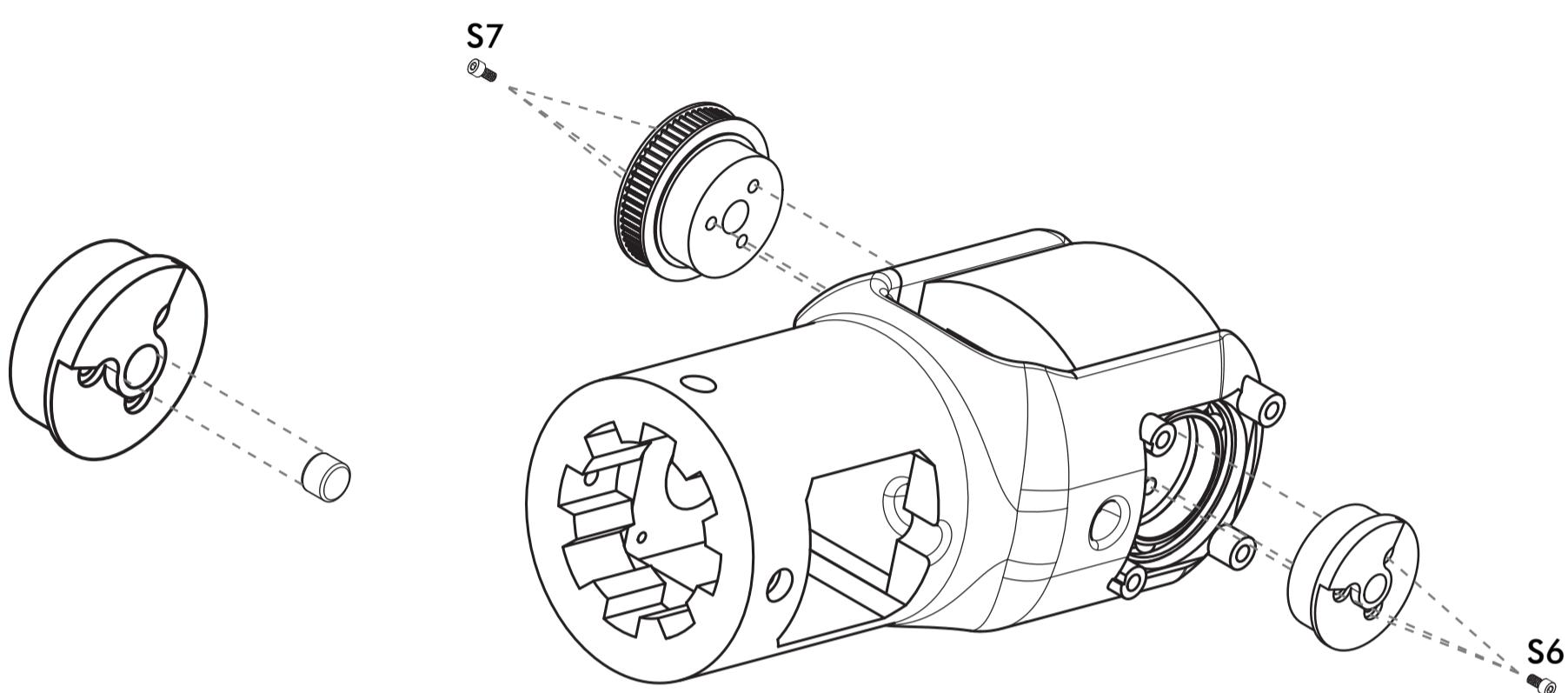
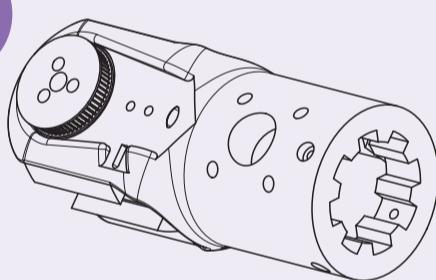
1x N19



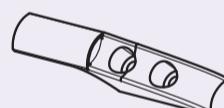
3x S6



3x S7

**6**

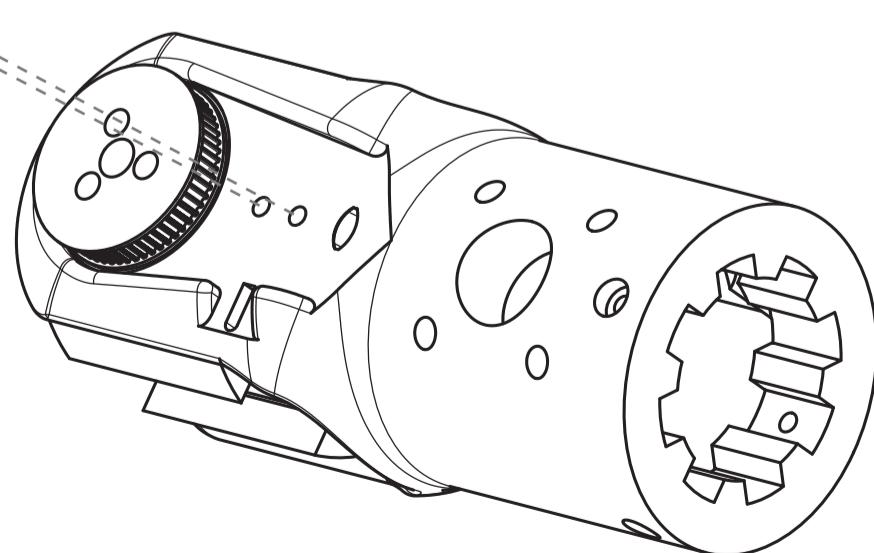
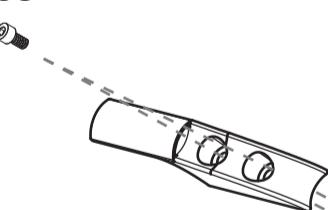
Step 5



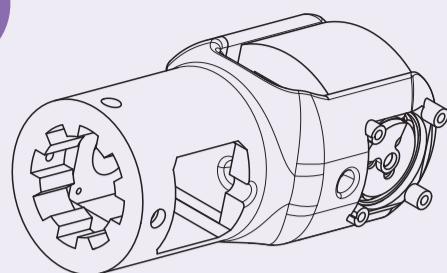
1x B32



2x S5

**S5**

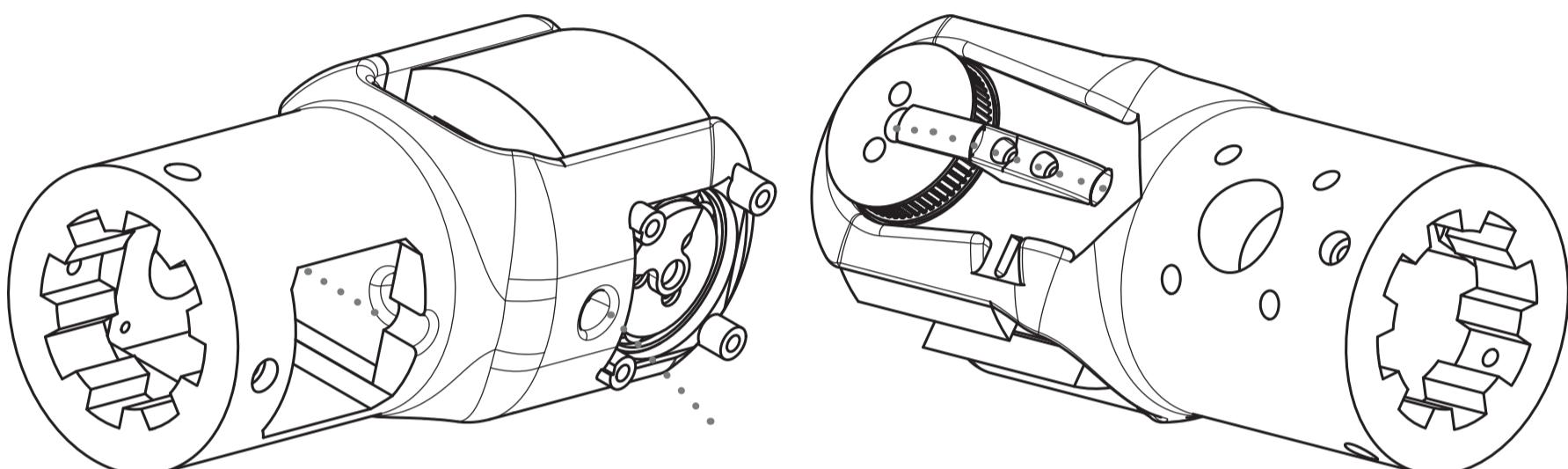
7



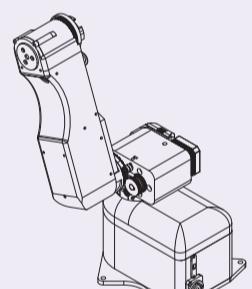
Step 6

**Note**

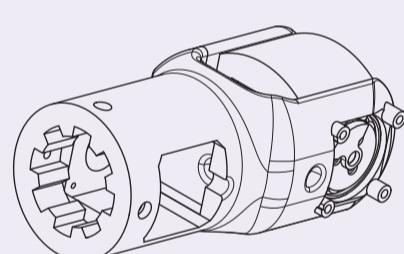
Feed the cables with sufficient length along the path shown below in between B29 and B33 through the hole in B31 to the inside.



8



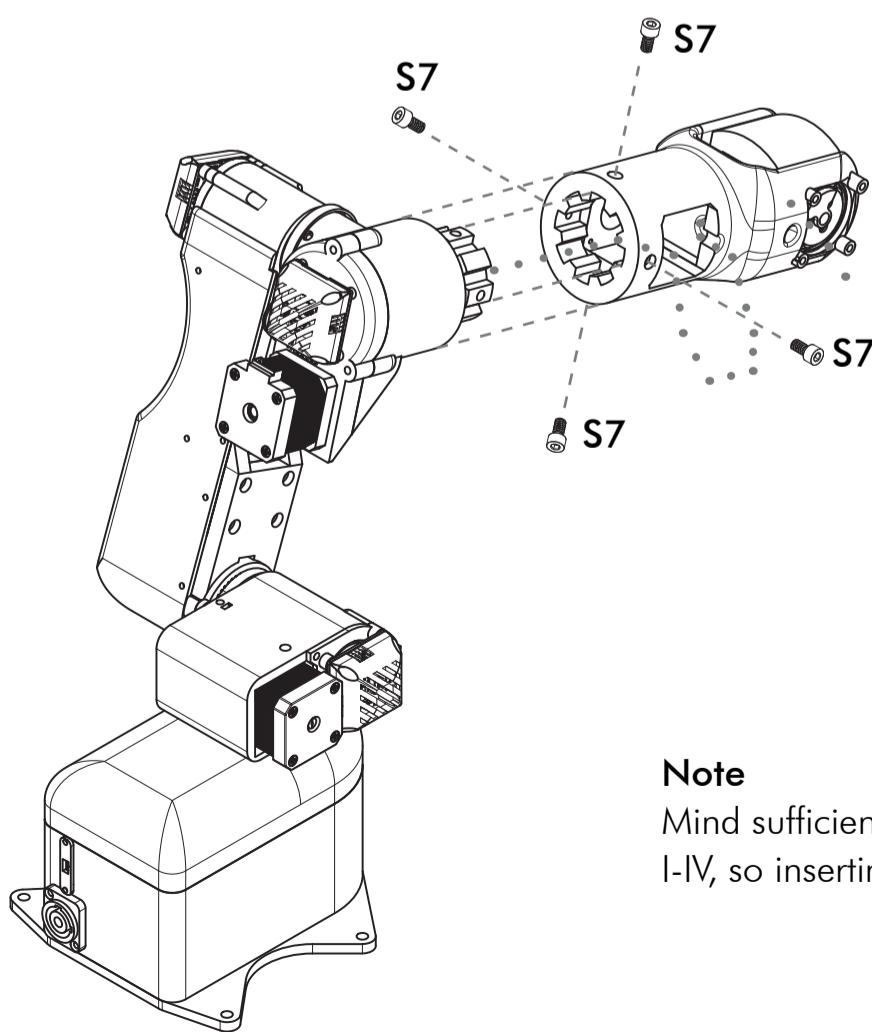
Assembly I-IV



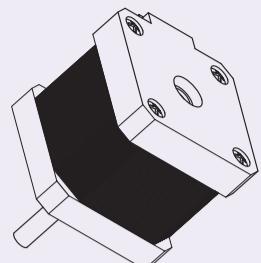
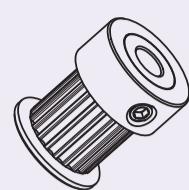
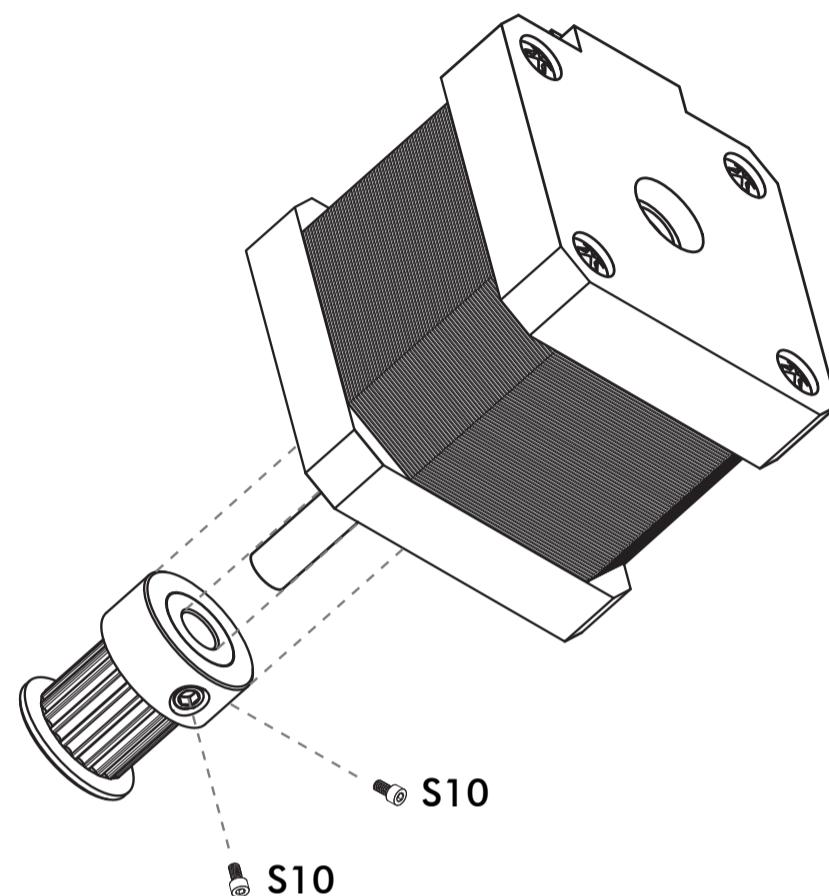
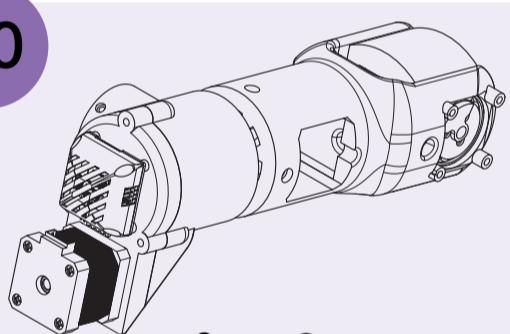
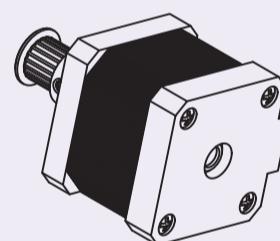
Step 7



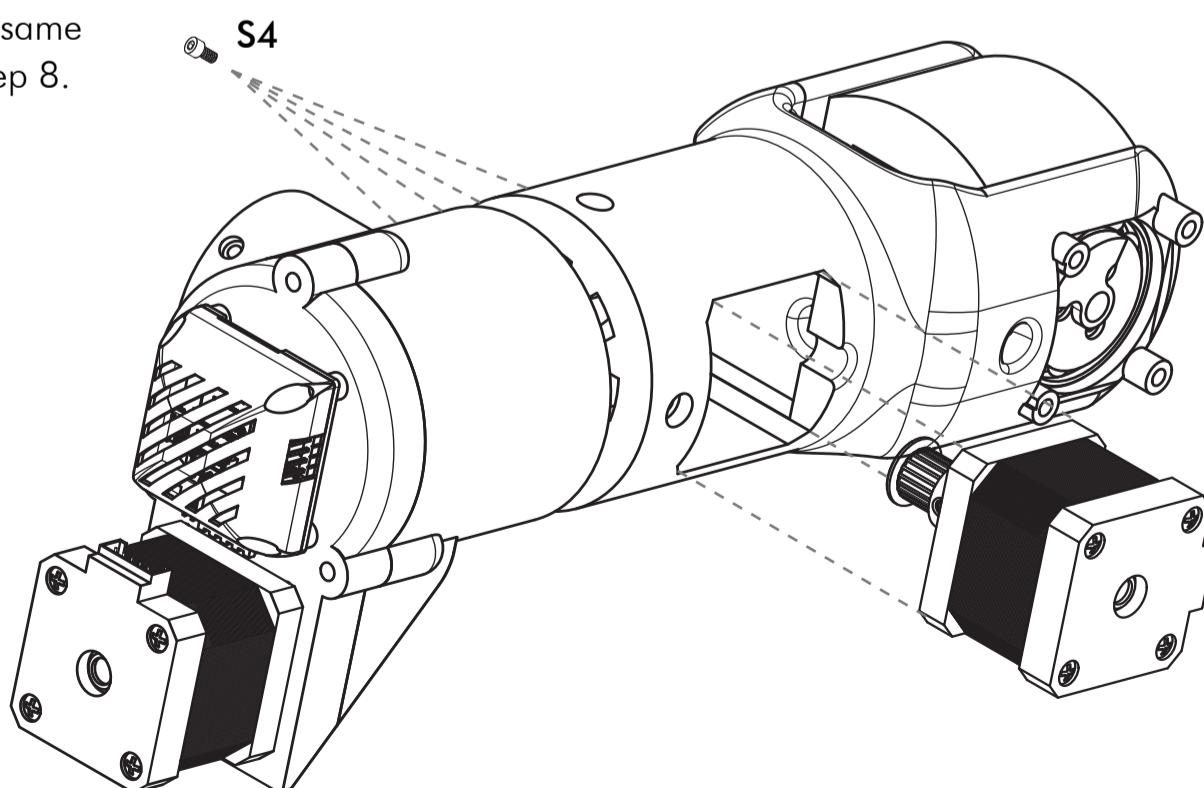
4x S7

**Note**

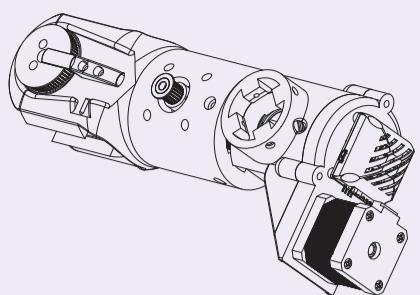
Mind sufficient length of the cables of Assembly I-IV, so inserting the motor (step 10) is possible.

**9**1x **N3**1x **N14**2x **S10****10**Step **8**Step **9**4x **S4****Note**

The cable of the motor  
are fed through the same  
hole in B29 as in step 8.



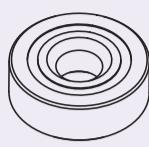
11



Step 10



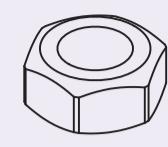
1x N8



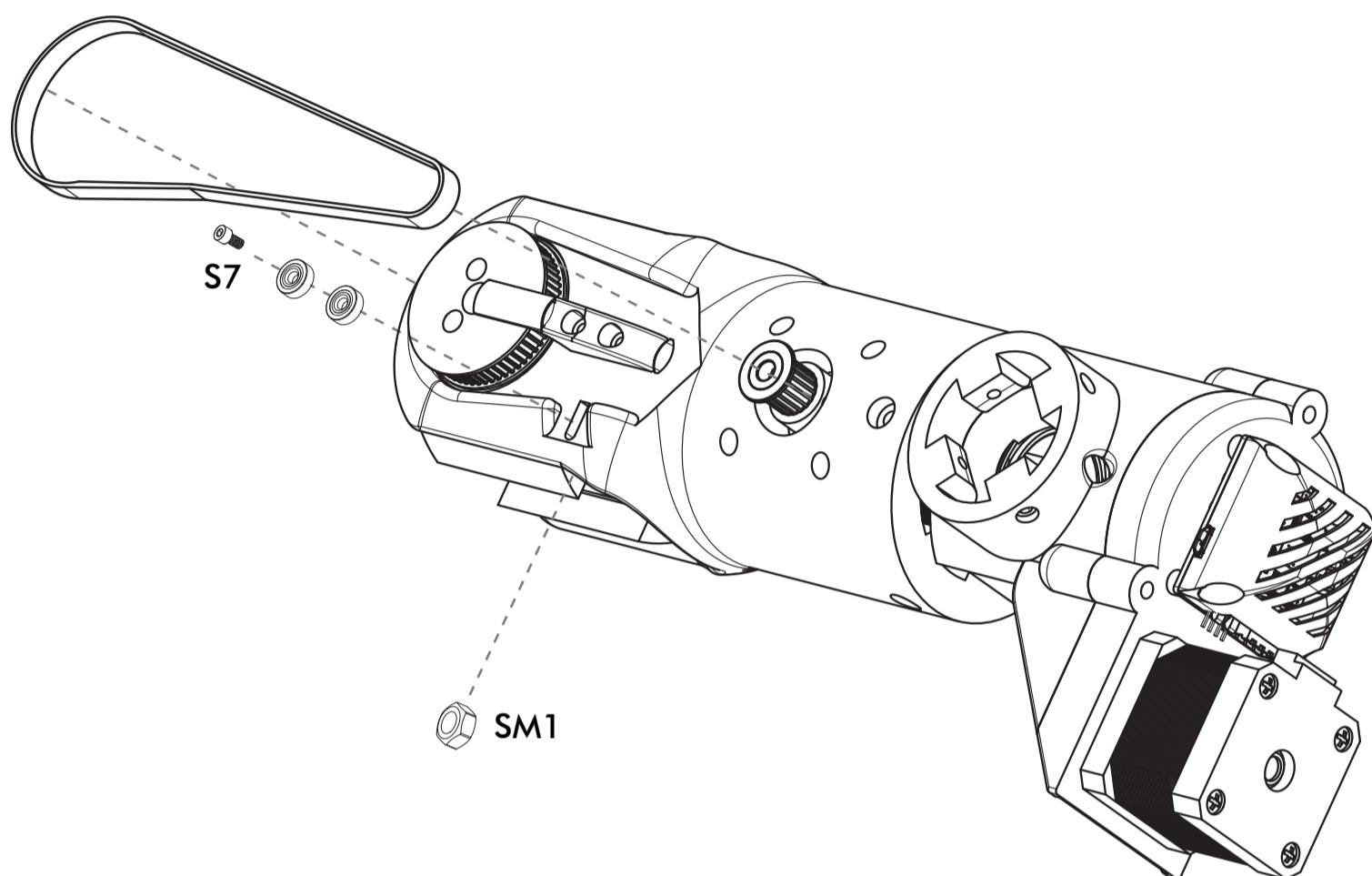
2x N10



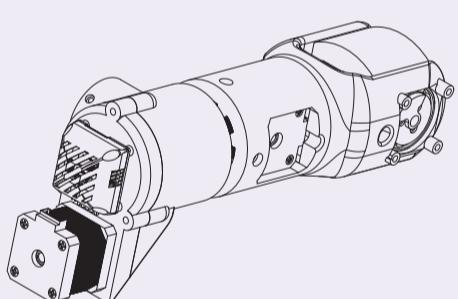
1x S7



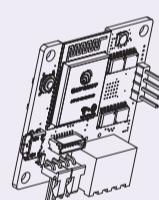
1x SM1



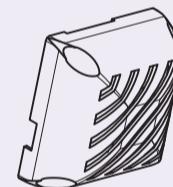
12



Step 11



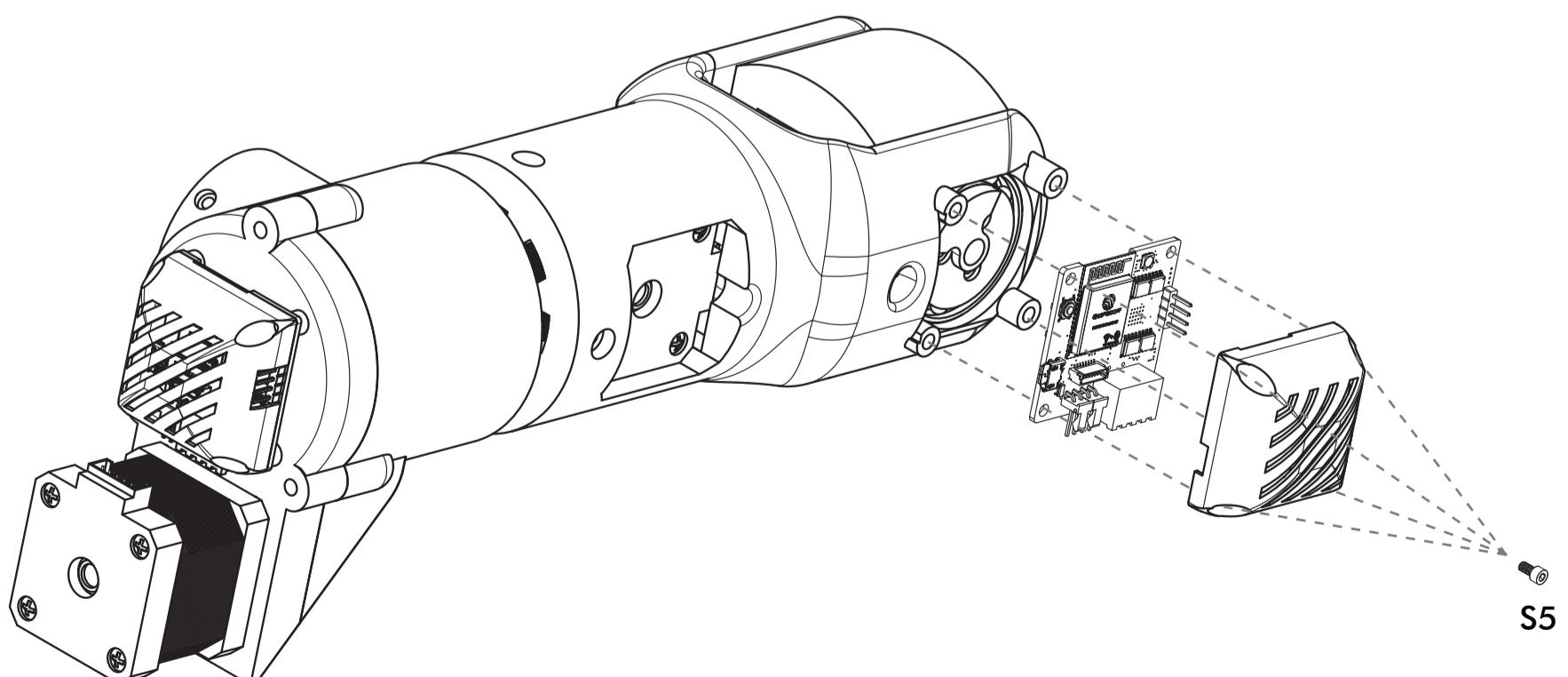
1x N20

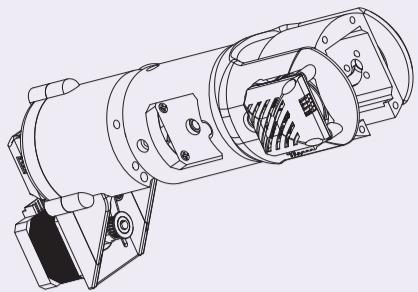


1x B35

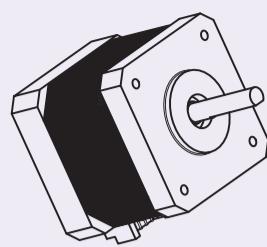


4x S5

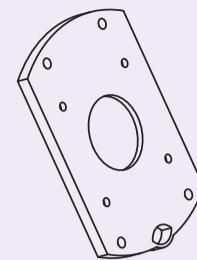


**13**

Step 12



1x N3



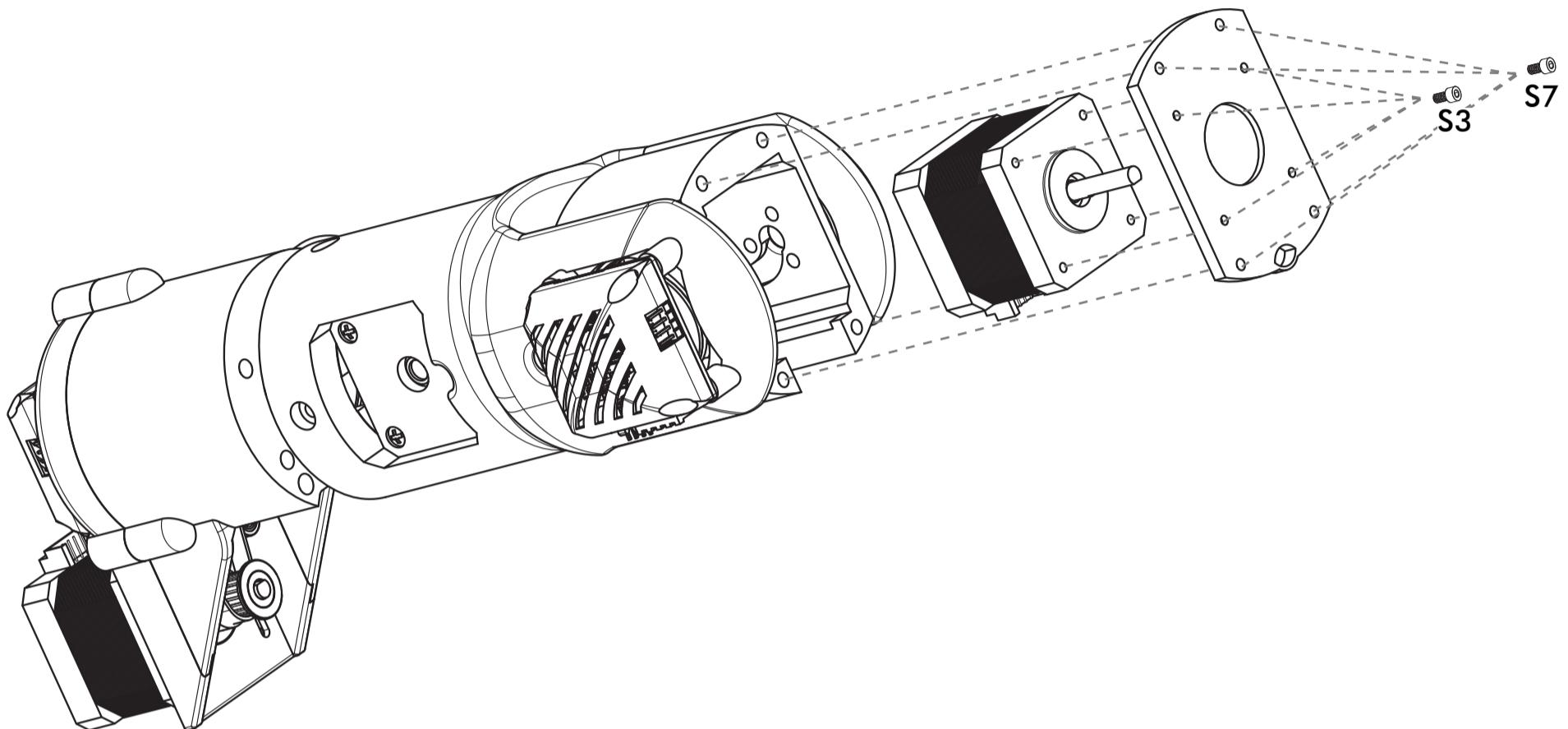
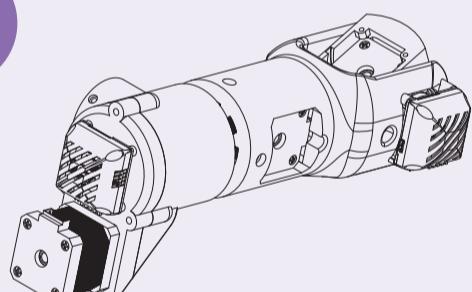
1x B34



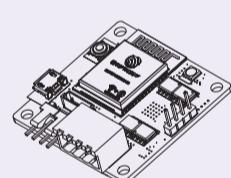
4x S7



4x S3

**14**

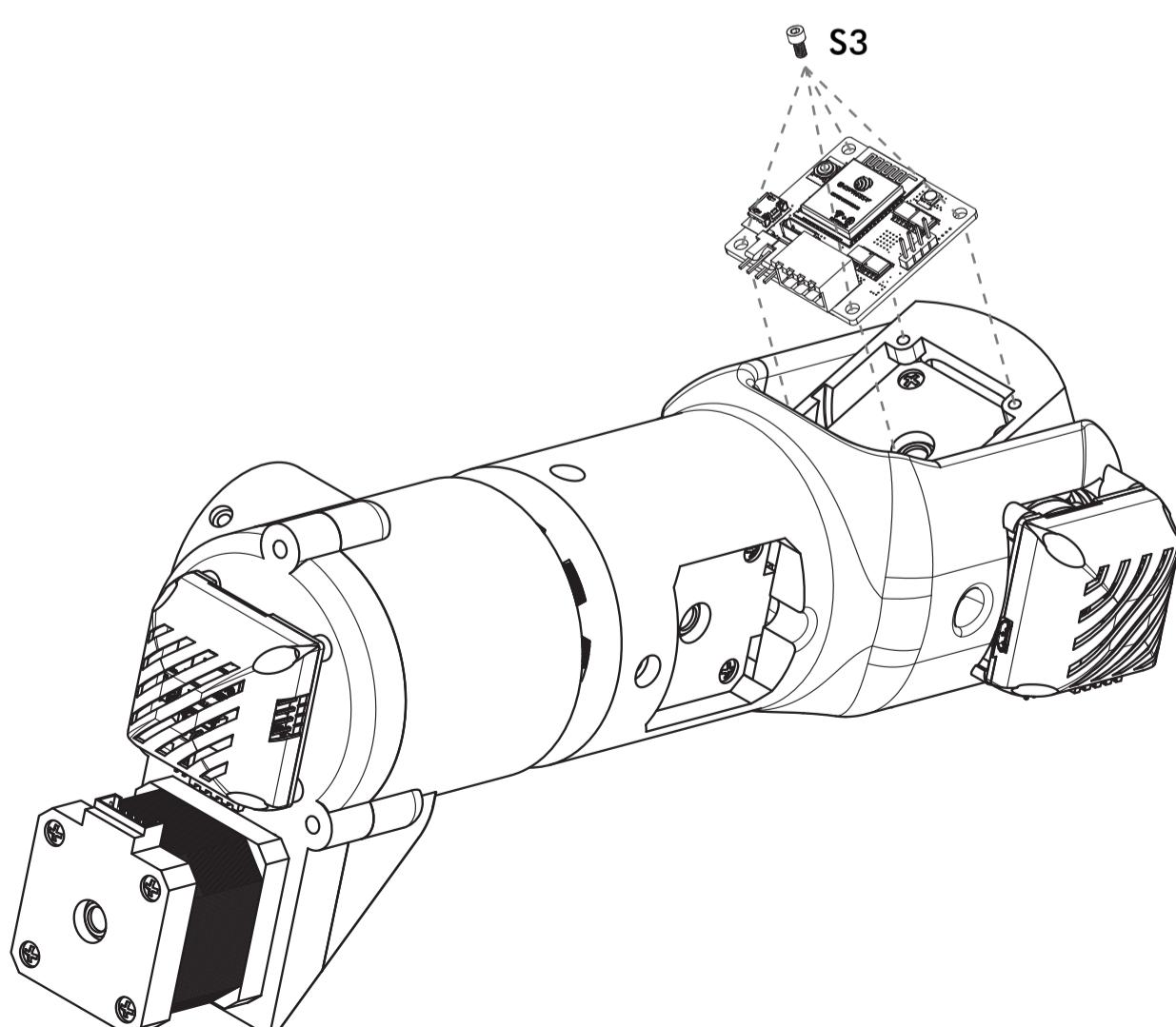
Step 13



1x N20



4x S3



# Ready.

