

# ZSH 57 to 107

phytron

## 2-Phase Hybrid Stepper Motor

### ZSH Precision Stepper Motors

The highly dynamic ZSH 2-phase hybrid stepper motors are constructed for operation in industrial environment.

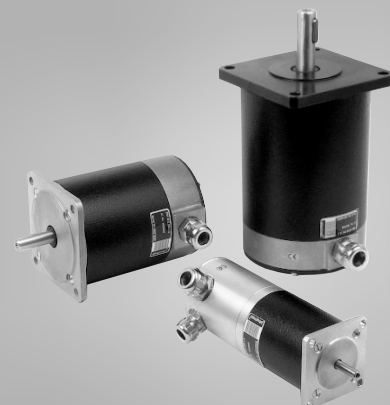
Holding torques: 0.45 to 17 Nm.

ZSH stepper motors are available in size 57, 87, 88 or 107 mm in diameter. Each motor size includes 3 or 4 motor types of the same diameter but different length. Furthermore, each motor type can be delivered with 2 or 3 different standard windings.

When installed and wired correctly, ZSH stepper motors meet the requirements of the EMC and Low Voltage Directives.

### Overview: Extensions

- **Stepper motor**
- **Stepper motor with motor brake**  
Permanent magnet brake for 24V<sub>DC</sub> supply
- **Stepper motor with encoder**  
Resolution: 50, 200 or 500 lines  
2 or 3 channels
- **Stepper motor with encoder and motor brake**
- **Stepper motor with low-backlash planetary gear**  
1, 2 or 3 stages  
Reduction ratios from 3:1 to 512:1



### Types / Mechanical Characteristics

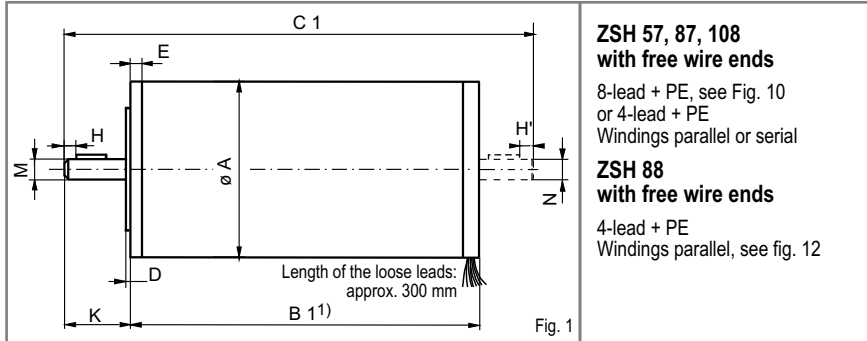
| Stepper motor type | Standard winding <sup>1),2)</sup> | Holding torque <sup>1)</sup> | Detent torque | Rotor mass inertia | Permissible bearing load |        | Weight | Key           | Flange and shaft |              |
|--------------------|-----------------------------------|------------------------------|---------------|--------------------|--------------------------|--------|--------|---------------|------------------|--------------|
|                    |                                   |                              |               |                    | axial                    | radial |        |               | metric version   | inch version |
|                    |                                   |                              |               |                    |                          |        |        |               |                  |              |
| ZSH 57/1           | 1.4 / 4.2 / 5.5                   | 0.45                         | 0.01          | 0.125              | 80                       | 150    | 0.6    | <sup>3)</sup> |                  |              |
| ZSH 57/2           | 2.1 / 2.8 / <b>4.2</b>            | 0.85                         | 0.017         | 0.25               | 80                       | 150    | 1      |               | ■                |              |
| ZSH 57/3           | 2.1 / 4.2 / <b>6.5</b>            | 1.25                         | 0.025         | 0.375              | 80                       | 150    | 1.35   |               |                  |              |
| ZSH 87/1           | 2.3 / 4.2 / <b>7</b>              | 1.8                          | 0.026         | 0.65               | 180                      | 280    | 1.7    |               |                  |              |
| ZSH 87/2           | 5 / <b>6.5</b> / <b>8.4</b>       | 3.6                          | 0.05          | 1.3                | 180                      | 280    | 2.65   | ■             | ■                | □            |
| ZSH 87/3           | 5 / 8.4 / 10                      | 5.4                          | 0.08          | 1.95               | 180                      | 280    | 3.65   |               |                  |              |
| ZSH 88/1           | 2 / 4 / 8                         | 3                            | 0.042         | 1.35               | 180                      | 280    | 1.7    |               |                  |              |
| ZSH 88/2           | 2 / 4 / <b>8</b>                  | 6                            | 0.08          | 2.7                | 180                      | 280    | 2.65   | ■             | ■                | □            |
| ZSH 88/3           | 4 / 8 / 12                        | 9                            | 0.13          | 4.05               | 180                      | 280    | 3.65   |               |                  |              |
| ZSH 107/1          | 7 / 8 / 12.5                      | 5                            | 0.11          | 4                  | 400                      | 650    | 4.3    |               |                  |              |
| ZSH 107/2          | 8 / 10 / <b>12.5</b>              | 9                            | 0.21          | 8                  | 400                      | 650    | 7.2    | ■             | ■                | □            |
| ZSH 107/3          | 10 / 12.5                         | 13                           | 0.3           | 12                 | 400                      | 650    | 9.8    |               |                  |              |
| ZSH 107/4          | 12.5                              | 17                           | 0.4           | 16                 | 400                      | 650    | 12.5   |               |                  |              |

<sup>1)</sup> Bipolar operation mode      ■ standard   □ optional  
<sup>2)</sup> red. = popular type      <sup>3)</sup> Optional for size 57: Woodruff key (DIN 6888)

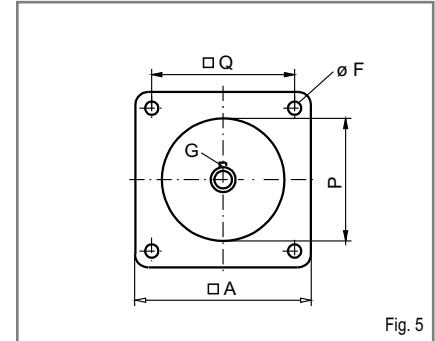
### Technical Information

- 2-phase hybrid stepper motors
- Number of steps: 200 / step angle: 1,8°
- Standard version: 4-leads, parallel windings, with terminal box
- Holding torques from 0.45 to 17 Nm
- Protection class: IP 54, optional: IP 68
- Permiss. operation temperature: -30 to +80 °C (up to 100 °C for short time)
- Design voltage: 250 V<sub>AC</sub> acc. to EN 60034
- Insulation class F acc. to VDE 0530
- Test voltage: 1800 V<sub>AC</sub> (1 sec)
- High permissible axial and radial bearing loads
- Step accuracy: ±3% (ref. to 1.8° step angle, not cumulative)
- Optional:
  - 2nd shaft (IP 41)
  - Free wire ends (IP 41)
  - Different types of flange and shaft (mm or inch)
  - Motor brake
  - Encoder
  - Low-backlash planetary gear

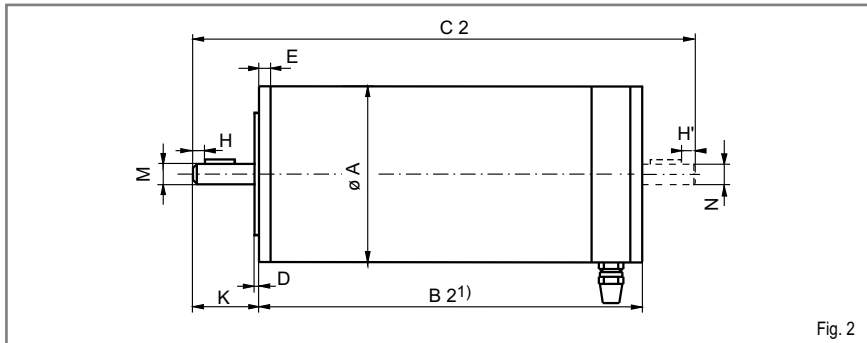
## ZSH Stepper Motor with Free Wire Ends (optional)



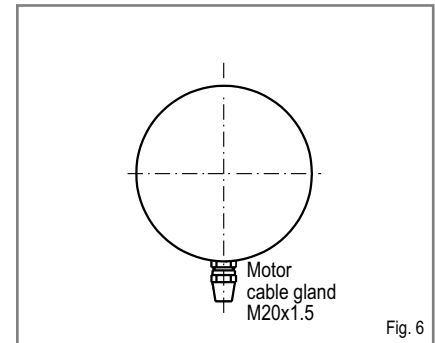
## Standard Flange



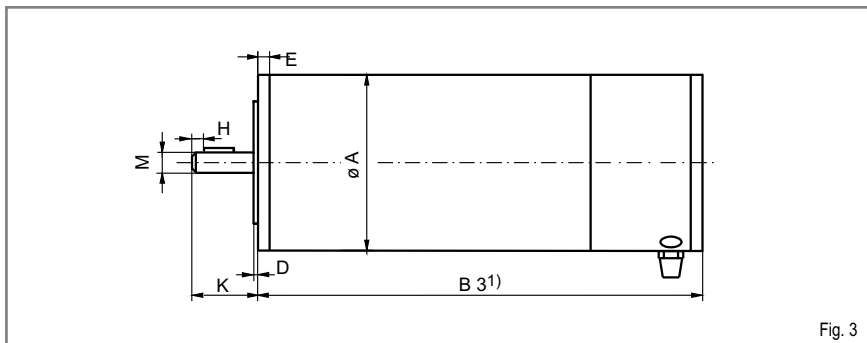
## ZSH Stepper Motor with Terminal Box (Standard Design)



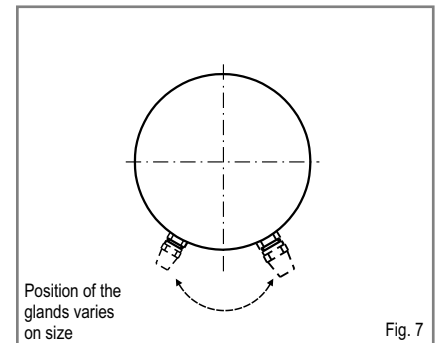
## Rear View: Motor with Terminal Box



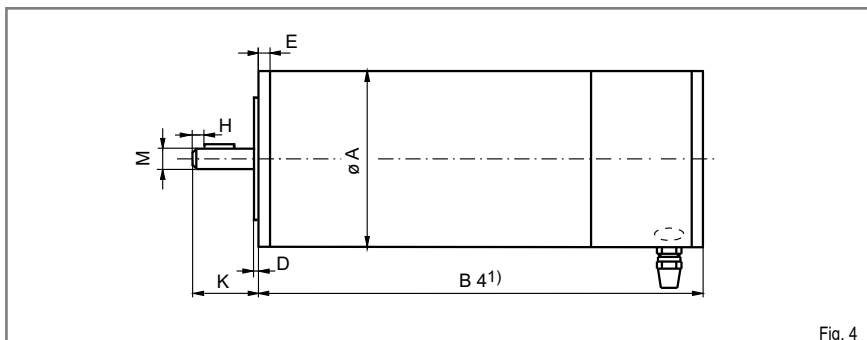
## ZSH Stepper Motor with Brake (optional)



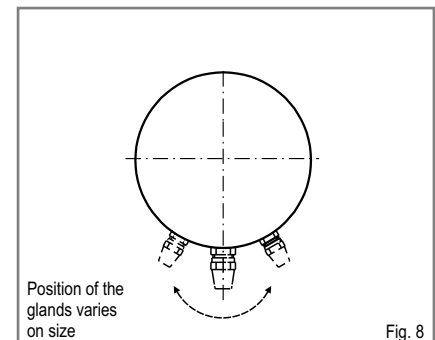
## Rear View: Motor with Brake/Encoder



## ZSH Stepper Motor with Encoder (optional)



## Rear View: Motor with Encoder and Brake



1) Required space for terminal box cover fixing screws: up to 2 mm

## Dimensions Stepper Motor / Brake / Encoder / Cable Glands

### Dimensions<sup>1)</sup> Stepper Motor / Brake / Encoder

| Stepper motor | Ø Motor | ZSH with free wire ends | ZSH with terminal box | ZSH + KEB | ZSH + E50 | ZSH + H200/500 | ZSH + KEB + E50 | ZSH + KEB + H200/500 |     |     |     |     |     |        |
|---------------|---------|-------------------------|-----------------------|-----------|-----------|----------------|-----------------|----------------------|-----|-----|-----|-----|-----|--------|
|               | A       | ±0.5 B1                 | ±0.5 B2               | ±0.5 B3   | ±0.5 B4   | ±0.5 B5        | ±0.5 B6         | ±0.5 B7              | C1  | C2  | D   | E   | F   | +0.5 K |
| ZSH 57/1      | 56.5    | 50                      | 76                    | 116       | 88        | 98             | 128             | 137.5                | 90  | 108 | 1.5 | 5   | 5.3 | 21     |
| ZSH 57/2      | 56.5    | 76                      | 102                   | 142       | 114       | 124            | 154             | 163.5                | 116 | 134 | 1.5 | 5   | 5.3 | 21     |
| ZSH 57/3      | 56.5    | 104                     | 130                   | 170       | 142       | 152            | 182             | 191.5                | 144 | 162 | 1.5 | 5   | 5.3 | 21     |
| ZSH 87/1      | 86      | 60.5                    | 85.5                  | 131       | 85.5      | 104            | 131             | 153                  | 137 | 137 | 1.5 | 5.7 | 6.5 | 31.5   |
| ZSH 87/2      | 86      | 92.5                    | 117.5                 | 163       | 117.5     | 136            | 163             | 185                  | 169 | 169 | 1.5 | 5.7 | 6.5 | 31.5   |
| ZSH 87/3      | 86      | 124.5                   | 149.5                 | 195       | 149.5     | 168            | 195             | 217                  | 201 | 201 | 1.5 | 5.7 | 6.5 | 31.5   |
| ZSH 88/1      | 86      | 68.5                    | 93.5                  | 139       | 93.5      | 112            | 139             | 161                  | 145 | 145 | 1.5 | 5.7 | 6.5 | 31.5   |
| ZSH 88/2      | 86      | 100.5                   | 125.5                 | 171       | 125.5     | 144            | 171             | 193                  | 177 | 177 | 1.5 | 5.7 | 6.5 | 31.5   |
| ZSH 88/3      | 86      | 132.5                   | 157.5                 | 203       | 157.5     | 176            | 203             | 225                  | 209 | 209 | 1.5 | 5.7 | 6.5 | 31.5   |
| ZSH 107/1     | 108     | 89.5                    | 111                   | 161       | 111       | 136            | 161             | 193                  | –   | 170 | 1.5 | 9   | 8.5 | 32     |
| ZSH 107/2     | 108     | 139.5                   | 161                   | 211       | 161       | 186            | 211             | 243                  | –   | 238 | 1.5 | 9   | 8.5 | 50     |
| ZSH 107/3     | 108     | 189.5                   | 211                   | 261       | 211       | 236            | 261             | 293                  | –   | 288 | 1.5 | 9   | 8.5 | 50     |
| ZSH 107/4     | 108     | 239.5                   | 261                   | 311       | 261       | 286            | 311             | 343                  | –   | 338 | 1.5 | 9   | 8.5 | 50     |

<sup>1)</sup> Dimensions in mm

### Dimensions Key / Flange / Shaft

| Stepper motor | Key DIN 6885 T1                         |   |     | Flange / shaft: mm |           |           |           | Flange / shaft: inch |               |               |               |
|---------------|---|---|-----|--------------------|-----------|-----------|-----------|----------------------|---------------|---------------|---------------|
|               | G                                       | H | H'  | -0.02 M            | -0.02 N   | -0.05 P   | Q         | -0.02 M              | -0.02 N       | -0.05 P       | Q             |
|               | mm                                      |   |     | mm                 |           |           |           | mm (inch)            |               |               |               |
| ZSH 57/1      | 2)                                      |   |     |                    |           |           |           | <b>6.35</b>          | <b>6.35</b>   | <b>38.1</b>   | <b>47</b>     |
| ZSH 57/2      |   |   |     |                    |           |           |           | <b>(0.25)</b>        | <b>(0.25)</b> | <b>(1.5)</b>  | <b>(1.85)</b> |
| ZSH 57/3      |   |   |     |                    |           |           |           |                      |               |               |               |
| ZSH 87/1      | up to Ø10: A3x3x15<br>from Ø12: A4x4x15 | 6 | 1.5 | <b>10</b>          | <b>10</b> | <b>73</b> | <b>70</b> | 9.52                 | 9.52          | 73            | 70            |
| ZSH 87/2      |   |   |     | 12                 | 12        |           |           | (0.375)              | (0.375)       | (2.87)        | (2.76)        |
| ZSH 87/3      |   |   |     |                    |           |           |           |                      |               |               |               |
| ZSH 88/1      | up to Ø10: A3x3x15<br>from Ø12: A4x4x15 | 6 | 1.5 | <b>12</b>          | <b>12</b> | <b>73</b> | <b>70</b> | 9.52                 | 9.52          | 73            | 70            |
| ZSH 88/2      |   |   |     | 10                 | 10        |           |           | (0.375)              | (0.375)       | (2.87)        | (2.76)        |
| ZSH 88/3      |   |   |     |                    |           |           |           |                      |               |               |               |
| ZSH 107/1     | A5x5x20                                 | 5 | 5   | <b>12</b>          | <b>10</b> | <b>60</b> | <b>90</b> | 12.7 (0.5)           |               |               |               |
| ZSH 107/2     |   |   |     | <b>16</b>          | <b>10</b> |           |           | 15.87 (0.625)        |               |               |               |
| ZSH 107/3     |   |   |     | <b>16</b>          | <b>12</b> |           |           | 15.87 (0.625)        | 12.7 (0.5)    | 55.54 (2.186) | 88.9 (3.5)    |
| ZSH 107/4     |   |   |     | <b>16</b>          | <b>12</b> |           |           | 15.87 (0.625)        |               |               |               |

<sup>2)</sup> Optional for size 57: Woodruff key 2x2.6 DIN 6888

**Bold = standard version**

### Metric Cable Glands<sup>1)</sup>

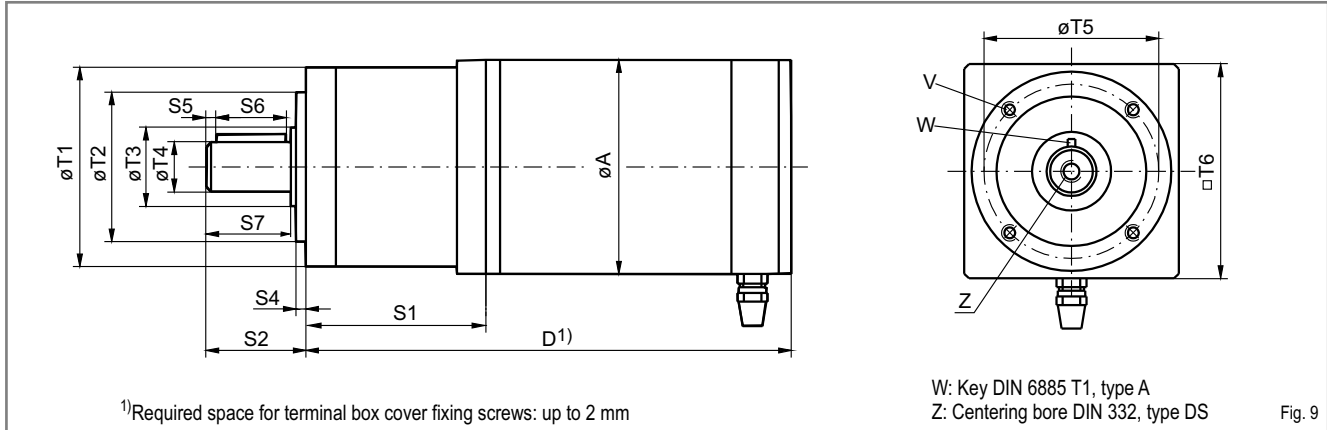
|                          | Cable Ø | Wrench size |
|--------------------------|---------|-------------|
| Stepper motor connection | 9 – 13  | 22          |
| Encoder connection       | 5 – 9   | 17          |
| Motor brake connection   | 5 – 9   | 17          |

- For shielded cables
- Material: nickel plated brass
- Protection class: IP 68 up to 5 bar
- Nitril rubber sealing rings
- Nitril rubber O-ring on external thread
- Test standard EN 50262 / UL 514B

<sup>1)</sup> Dimensions in mm

# Stepper Motor with PLE Low-backlash Planetary Gear

## ZSH 57 / 87 / 88 / 107 Stepper Motor with PLE Planetary Gear



### Dimensions Stepper Motor / Gear

| Gear    | Stages | Dimensions in mm |   |           |           |           |       |    |     |    |    |    |     |    |    |    |     |         |            |            |          |
|---------|--------|------------------|---|-----------|-----------|-----------|-------|----|-----|----|----|----|-----|----|----|----|-----|---------|------------|------------|----------|
|         |        | A                | Total length gear/motor with terminal box D |           |           |           | S1    | S2 | S4  | S5 | S6 | S7 | T1  | T2 | T3 | T4 | T5  | T6      | V          | W          | Z        |
| PLE 60  | 1      | 56.5             | ZSH 57/1                                    | ZSH 57/2  | ZSH 57/3  | 55        | 35    | 3  | 2.5 | 25 | 30 | 60 | 40  | 17 | 14 | 52 | 60  | M5 x 8  | 5 x 5 x 25 | M5 x 12    |          |
|         | 2      |                  | 131   | 157       | 185       |           |       |    |     |    |    |    |     |    |    |    |     |         |            |            |          |
|         | 3      |                  | 143   | 169       | 197       |           |       |    |     |    |    |    |     |    |    |    |     |         |            |            |          |
| PLE 80  | 1      | 86               | ZSH 87/1                                    | ZSH 87/2  | ZSH 87/3  | 72        | 40    | 3  | 4   | 28 | 36 | 80 | 60  | 25 | 20 | 70 | 86  | M6 x 10 | 6 x 6 x 28 | M6 x 16    |          |
|         | 2      |                  | 157.5                                       | 189.5     | 221.5     |           |       |    |     |    |    |    |     |    |    |    |     |         |            |            |          |
|         | 3      |                  | 174.5                                       | 206.5     | 238.5     |           |       |    |     |    |    |    |     |    |    |    |     |         |            |            |          |
|         | 1      |                  | ZSH 88/1                                    | ZSH 88/2  | ZSH 88/3  | 72        | 40    | 3  | 4   | 28 | 36 | 80 | 60  | 25 | 20 | 70 | 86  | M6 x 10 | 6 x 6 x 28 | M6 x 16    |          |
|         | 2      |                  | 165.5                                       | 197.5     | 229.5     |           |       |    |     |    |    |    |     |    |    |    |     |         |            |            |          |
|         | 3      |                  | 182.5                                       | 214.5     | 246.5     |           |       |    |     |    |    |    |     |    |    |    |     |         |            |            |          |
| PLE 120 | 1      | 108              | ZSH 107/1                                   | ZSH 107/2 | ZSH 107/3 | ZSH 107/4 | 131.5 | 55 | 4   | 5  | 40 | 50 | 115 | 80 | 35 | 25 | 100 | 115     | M10 x 16   | 8 x 7 x 40 | M10 x 22 |
|         | 2      |                  | 242.5                                       | 292.5     | 342.5     | 392.5     |       |    |     |    |    |    |     |    |    |    |     |         |            |            |          |
|         | 3      |                  | 269.5                                       | 319.5     | 369.5     | 419.5     |       |    |     |    |    |    |     |    |    |    |     |         |            |            |          |

### Mechanical Gear Characteristics

| Gear    | Stages | Torsional stiffness | Absolute backlash | Efficiency  | Weight without motor | Maximum axial load <sup>2)</sup> | Maximum radial load <sup>2)</sup> |
|---------|--------|---------------------|-------------------|-------------|----------------------|----------------------------------|-----------------------------------|
|         |        | Nm/arcmin           | angular minutes   | % (approx.) | kg                   | N                                | N                                 |
| PLE 60  | 1      | 2.3                 | <20               | 96          | 0.65                 | 600                              | 500                               |
|         | 2      | 2.5                 | <25               | 94          | 0.82                 |                                  |                                   |
|         | 3      | 2.5                 | <30               | 90          | 1                    |                                  |                                   |
| PLE 80  | 1      | 6                   | <12               | 96          | 1.6                  | 1200                             | 950                               |
|         | 2      | 6.5                 | <17               | 94          | 2.2                  |                                  |                                   |
|         | 3      | 6.3                 | <22               | 90          | 2.8                  |                                  |                                   |
| PLE 120 | 1      | 12                  | <8                | 96          | 6.5                  | 2800                             | 2000                              |
|         | 2      | 13                  | <12               | 94          | 9                    |                                  |                                   |
|         | 3      | 12                  | <16               | 90          | 11.5                 |                                  |                                   |

<sup>2)</sup> referred to center of output shaft

### PLE Planetary Gear

- Low-backlash / high efficiency
- Torque shaft bearing: ball bearing
- Lifetime lubrication
- Recommended operation temperature range: -25 to +90 °C
- Mounting position: any
- Standard protection class: IP 54
- Optional: protection class IP 65  
These gears are specially sealed. Output shaft and keyway are made of stainless steel.
- Angled gears on request

## Mechanical Characteristics

| Gear   | Stages      | Reduction Ratio | Permissible gear output torque | Mass inertia (without motor) <sup>1)</sup> |
|--------|-------------|-----------------|--------------------------------|--|
|        |             |                 | Nm                             | 10 <sup>-4</sup> kg m <sup>2</sup>         |
|        |             |                 | <b>ZSH 57</b>                  |  |
| PLE 60 | 1           | 3:1             | 28                             | 6.5  |
|        |             | <b>4:1</b>      | 38                             | 3.3  |
|        |             | 5:1             | 40                             | 2.2  |
|        |             | <b>8:1</b>      | 18                             | 1.2  |
|        | 2           | 9:1             | 44                             | 7.2  |
|        |             | 12:1            | 44                             | 7  |
|        |             | 15:1            | 44                             | 2.4  |
|        |             | 16:1            | 44                             | 3.4  |
|        |             | 20:1            | 44                             | 2.4  |
|        |             | 25:1            | 40                             | 2.3  |
|        |             | 32:1            | 44                             | 1.2  |
|        | <b>40:1</b> | 40              | 1.2                            |  |
|        | 64:1        | 18              | 1                              |  |
|        | 3           | 60:1            | 44                             | 2.4  |
|        |             | 80:1            | 44                             | 2.4  |
| 100:1  |             | 44              | 2.4                            |  |
| 120:1  |             | 44              | 1.2                            |  |
| 160:1  |             | 44              | 0.1                            |  |
| 200:1  |             | 40              | 0.1                            |  |
| 256:1  |             | 44              | 0.1                            |  |
| 320:1  |             | 40              | 0.1                            |  |
| 512:1  |             | 18              | 0.1                            |  |
|        |             |                 | <b>ZSH 87</b>                  |  |
| PLE 80 | 1           | 3:1             | 85                             | 63   |
|        |             | <b>4:1</b>      | 115                            | 25   |
|        |             | 5:1             | 110                            | 14   |
|        |             | <b>8:1</b>      | 50                             | 8  |
|        | 2           | 9:1             | 130                            | 63   |
|        |             | 12:1            | 120                            | 26   |
|        |             | 15:1            | 110                            | 62   |
|        |             | 16:1            | 120                            | 25   |
|        |             | 20:1            | 120                            | 15   |
|        |             | 25:1            | 110                            | 15   |
|        |             | 32:1            | 120                            | 8  |
|        | <b>40:1</b> | 110             | 8                              |  |
|        | 64:1        | 50              | 6                              |  |
|        | 3           | 60:1            | 110                            | 25   |
|        |             | 80:1            | 120                            | 18   |
| 100:1  |             | 120             | 15                             |  |
| 120:1  |             | 110             | 60                             |  |
| 160:1  |             | 120             | 8                              |  |
| 200:1  |             | 110             | 8                              |  |
| 256:1  |             | 120             | 8                              |  |
| 320:1  |             | 110             | 6                              |  |
| 512:1  |             | 50              | 6                              |  |

| Gear    | Stages      | Reduction Ratio | Permissible gear output torque | Mass inertia (without motor) <sup>1)</sup> |
|---------|-------------|-----------------|--------------------------------|--|
|         |             |                 | Nm                             | 10 <sup>-4</sup> kg m <sup>2</sup>         |
|         |             |                 | <b>ZSH 88</b>                  |  |
| PLE 80  | 1           | 3:1             | 85                             | 63   |
|         |             | <b>4:1</b>      | 115                            | 25   |
|         |             | 5:1             | 110                            | 14   |
|         |             | <b>8:1</b>      | 50                             | 8  |
|         | 2           | 9:1             | 130                            | 63   |
|         |             | 12:1            | 120                            | 26   |
|         |             | 15:1            | 110                            | 62   |
|         |             | 16:1            | 120                            | 25   |
|         |             | 20:1            | 120                            | 15   |
|         |             | 25:1            | 110                            | 15   |
|         |             | 32:1            | 120                            | 8  |
|         | <b>40:1</b> | 110             | 8                              |  |
|         | 64:1        | 50              | 6                              |  |
|         | 3           | 60:1            | 110                            | 25   |
|         |             | 80:1            | 120                            | 18   |
| 100:1   |             | 120             | 15                             |  |
| 120:1   |             | 110             | 60                             |  |
| 160:1   |             | 120             | 8                              |  |
| 200:1   |             | 110             | 8                              |  |
| 256:1   |             | 120             | 8                              |  |
| 320:1   |             | 110             | 6                              |  |
| 512:1   |             | 50              | 6                              |  |
|         |             |                 | <b>ZSH 107</b>                 |  |
| PLE 120 | 1           | 3:1             | 115                            | 2.6  |
|         |             | <b>4:1</b>      | 155                            | 1.79                                       |
|         |             | 5:1             | 195                            | 1.63                                       |
|         |             | <b>8:1</b>      | 120                            | 1.32                                       |
|         | 2           | 9:1             | 210                            | 2.62                                       |
|         |             | 12:1            | 260                            | 2.56                                       |
|         |             | 15:1            | 230                            | 2.53                                       |
|         |             | 16:1            | 260                            | 1.75                                       |
|         |             | 20:1            | 260                            | 1.5  |
|         |             | 25:1            | 230                            | 1.49                                       |
|         |             | 32:1            | 260                            | 1.3  |
|         | <b>40:1</b> | 230             | 1.3                            |  |
|         | 64:1        | 120             | 1.3                            |  |
|         | 3           | 60:1            | 260                            | 2.57                                       |
|         |             | 80:1            | 260                            | 1.5  |
| 100:1   |             | 260             | 1.5                            |  |
| 120:1   |             | 230             | 2.5                            |  |
| 160:1   |             | 260             | 1.3                            |  |
| 200:1   |             | 230             | 1.3                            |  |
| 256:1   |             | 260             | 1.3                            |  |
| 320:1   |             | 230             | 1.3                            |  |
| 512:1   |             | 120             | 1.3                            |  |

## Motor/Gear Output Torque

The output torque of the motor/gear combination can be calculated as follows:

Motor torque at the required speed (see frequency characteristics) multiplied with reduction ratio and gear efficiency.

Red = popular type

<sup>1)</sup>Mass inertia referred to motor shaft

## Electrical Characteristics

| Stepper motor type     | Standard winding 1 <sup>2)</sup>     |                                     |                                      |                                       | Standard winding 2 <sup>2)</sup>     |                                     |                                      |                                       | Standard winding 3 <sup>2)</sup>     |                                     |                                      |                                       |
|------------------------|--------------------------------------|-------------------------------------|--------------------------------------|---------------------------------------|--------------------------------------|-------------------------------------|--------------------------------------|---------------------------------------|--------------------------------------|-------------------------------------|--------------------------------------|---------------------------------------|
|                        | <sup>3)</sup> Phase current unipolar | <sup>3)</sup> Phase current bipolar | <sup>4)</sup> Resistance per winding | <sup>5)</sup> Inductivity per winding | <sup>3)</sup> Phase current unipolar | <sup>3)</sup> Phase current bipolar | <sup>4)</sup> Resistance per winding | <sup>5)</sup> Inductivity per winding | <sup>3)</sup> Phase current unipolar | <sup>3)</sup> Phase current bipolar | <sup>4)</sup> Resistance per winding | <sup>5)</sup> Inductivity per winding |
|                        | A                                    | A                                   | Ω                                    | mH                                    | A                                    | A                                   | Ω                                    | mH                                    | A                                    | A                                   | Ω                                    | mH                                    |
| ZSH 57/1               | 1                                    | <b>1.4</b>                          | 5.5                                  | 9                                     | 3                                    | <b>4.2</b>                          | 0.7                                  | 1                                     | 3.9                                  | <b>5.5</b>                          | 0.5                                  | 0.64                                  |
| ZSH 57/2               | 1.5                                  | <b>2.1</b>                          | 4.1                                  | 9                                     | 2                                    | <b>2.8</b>                          | 2.6                                  | 5                                     | 3                                    | <b>4.2</b>                          | 1.1                                  | <b>2.6</b>                            |
| ZSH 57/3               | 1.5                                  | <b>2.1</b>                          | 4.3                                  | 9                                     | 3                                    | <b>4.2</b>                          | 1.6                                  | 3                                     | <b>4.6</b>                           | <b>6.5</b>                          | <b>0.8</b>                           | <b>1.2</b>                            |
| ZSH 87/1               | 1.6                                  | <b>2.3</b>                          | 3                                    | 6                                     | 3                                    | <b>4.2</b>                          | 0.8                                  | 1.6                                   | <b>5</b>                             | <b>7</b>                            | <b>0.3</b>                           | <b>0.7</b>                            |
| ZSH 87/2               | 3.5                                  | <b>5</b>                            | 0.8                                  | 3                                     | <b>4.6</b>                           | <b>6.5</b>                          | <b>0.5</b>                           | <b>1.5</b>                            | <b>6</b>                             | <b>8.4</b>                          | <b>0.3</b>                           | <b>1</b>                              |
| ZSH 87/3               | 3.5                                  | <b>5</b>                            | 1.1                                  | 5                                     | 6                                    | <b>8.4</b>                          | 0.5                                  | 1.7                                   | 7                                    | <b>10</b>                           | 0.4                                  | 1                                     |
| ZSH 88/1 <sup>1)</sup> | –                                    | <b>2</b>                            | 1.88                                 | 11.1                                  | –                                    | <b>4</b>                            | 0.5                                  | 2.5                                   | –                                    | <b>8</b>                            | 0.13                                 | 0.75                                  |
| ZSH 88/2               | –                                    | <b>2</b>                            | 3.61                                 | 26                                    | –                                    | <b>4</b>                            | 0.74                                 | 5.5                                   | –                                    | <b>8</b>                            | <b>0.21</b>                          | <b>1.5</b>                            |
| ZSH 88/3               | –                                    | <b>4</b>                            | 1.14                                 | 10.9                                  | –                                    | <b>8</b>                            | 0.29                                 | 2.6                                   | –                                    | <b>12</b>                           | 0.14                                 | 1                                     |
| ZSH 107/1              | 5                                    | <b>7</b>                            | 0.3                                  | 1.6                                   | 5.7                                  | <b>8</b>                            | 0.2                                  | 1.2                                   | 8.8                                  | <b>12.5</b>                         | 0.1                                  | 0.55                                  |
| ZSH 107/2              | 5.7                                  | <b>8</b>                            | 0.4                                  | 2.4                                   | 7.1                                  | <b>10</b>                           | 0.3                                  | 1.6                                   | <b>8.8</b>                           | <b>12.5</b>                         | <b>0.2</b>                           | <b>1.15</b>                           |
| ZSH 107/3              | 7.1                                  | <b>10</b>                           | 0.4                                  | 2.7                                   | 8.8                                  | <b>12.5</b>                         | 0.3                                  | 1.9                                   |                                      |                                     |                                      |                                       |
| ZSH 107/4              | 8.8                                  | <b>12.5</b>                         | 0.4                                  | 2.7                                   |                                      |                                     |                                      |                                       |                                      |                                     |                                      |                                       |

<sup>1)</sup> Size 88 for bipolar operation only

red = popular types

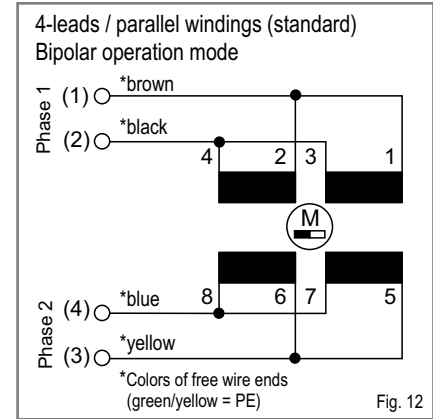
<sup>2)</sup> The current value given in the ordering data (e. g. ZSH 107/2.200.8) refers to the bipolar mode (parallel windings).

<sup>3)</sup> Current in unipolar mode = 0.7 x current in bipolar mode

<sup>4)</sup> Resistance per phase in bipolar mode = 0.5 x resistance per winding

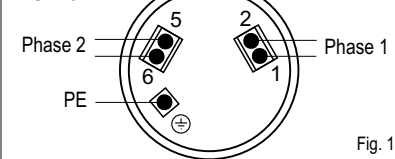
<sup>5)</sup> The inductivity values apply for each single winding as well as for two parallel windings. For series mounted windings, the inductivity is multiplied by 4.

## Motor Connection Diagram (Standard)

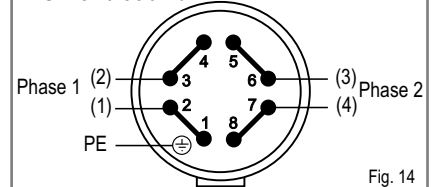


## Terminal Box

### ZSH 57



### ZSH 87 / 88 / 107

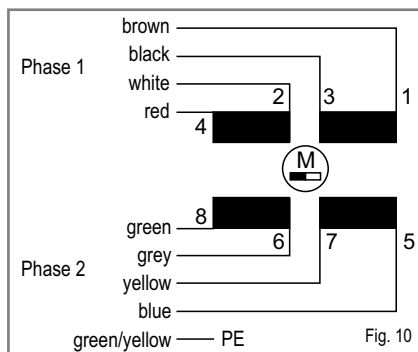


The drawings above show the standard terminal box wiring of ZSH motors with parallel connected windings.

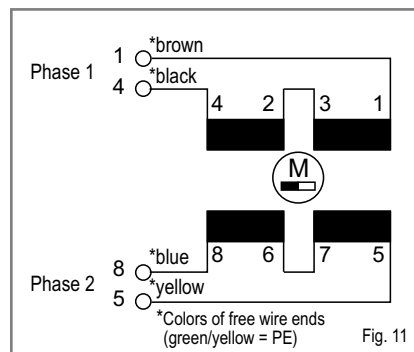
Operation mode: bipolar

For more information please download the ZSH motor connection leaflet from the phytron homepage [www.phytron.de](http://www.phytron.de).

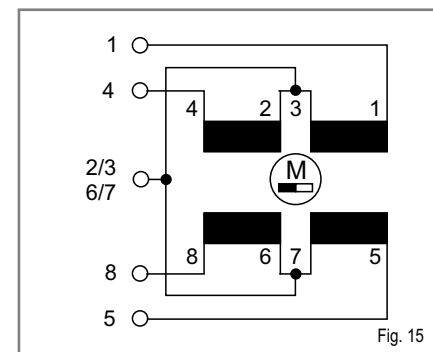
## Motor Connection Diagram 8-lead / Free Wire Ends



## Motor Connection Diagram 4-lead / Serial / Bipolar Mode



## Motor Connection Diagram 5-lead / Unipolar Mode



## Frequency Characteristics

The curves correspond to the limit values of the operational characteristics as a function of the control pulses (frequency/speed), for two different supply voltages ( $U_b$ ).

The motor windings are connected in parallel (fig. 11), the motors are powered by bipolar stepper motor power stages in the half-step mode.

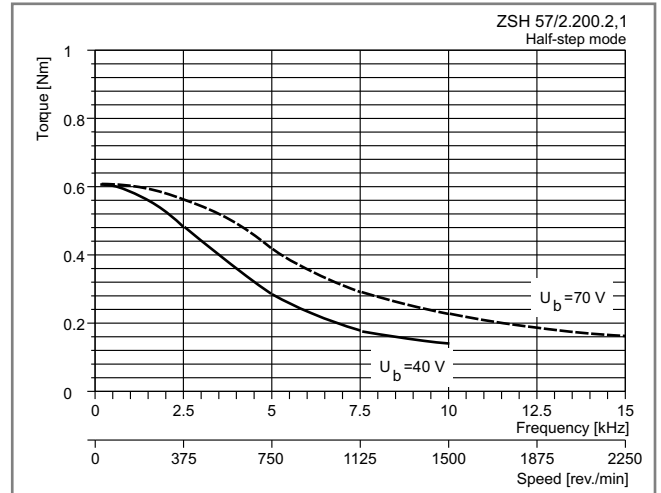


Fig. 17

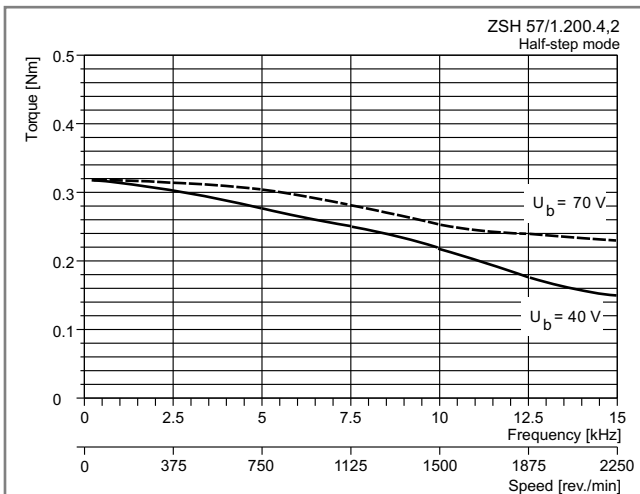


Fig. 15

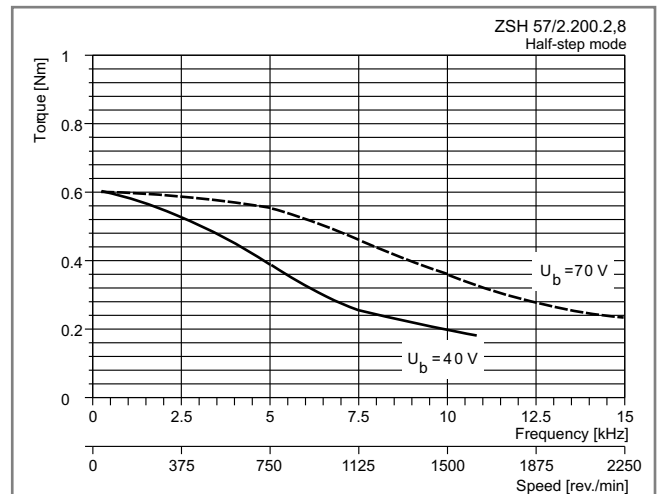


Fig. 18

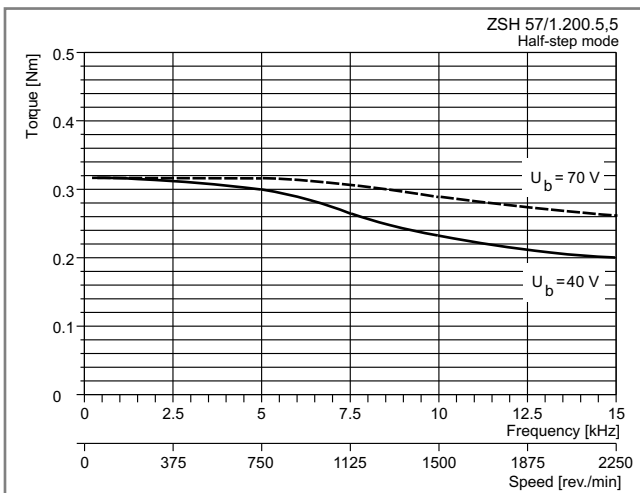


Fig. 16

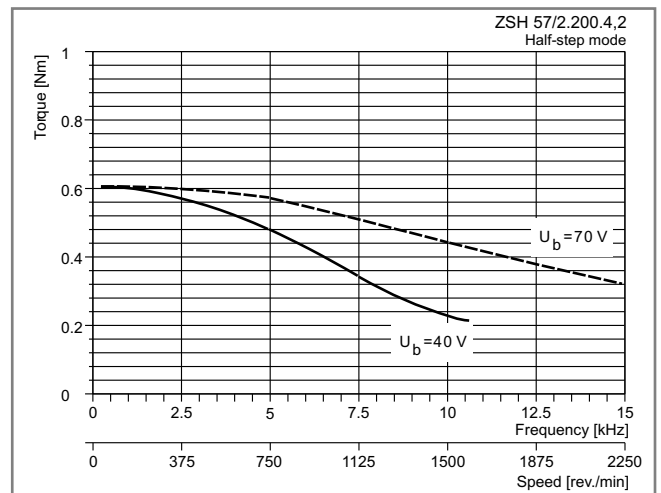


Fig. 19

# Frequency Characteristics

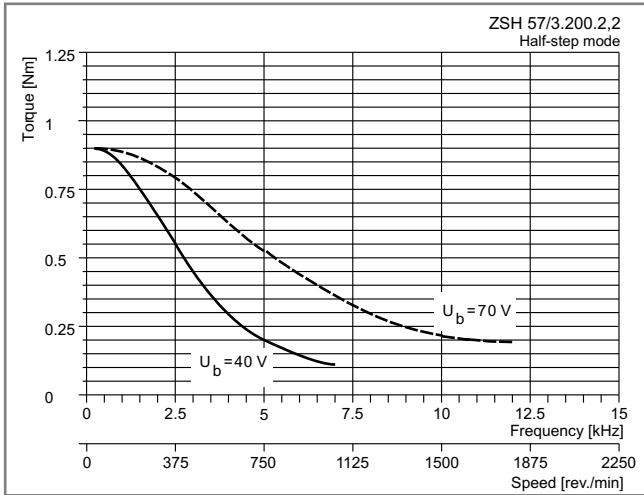


Fig. 21

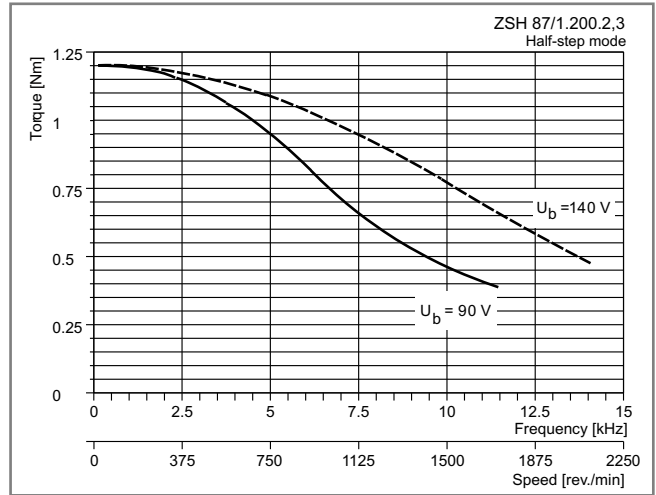


Fig. 24

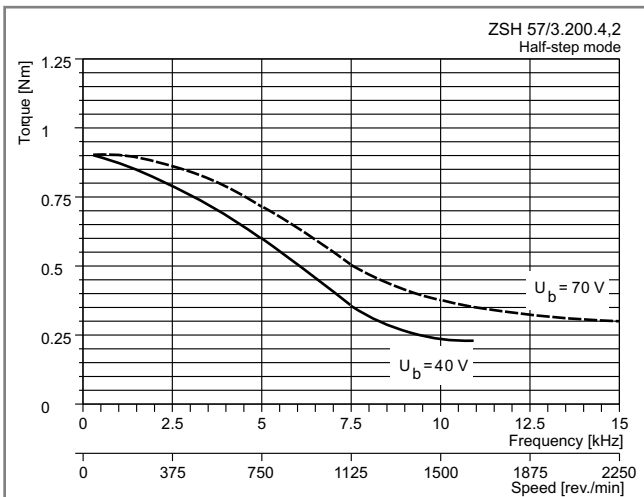


Fig. 22

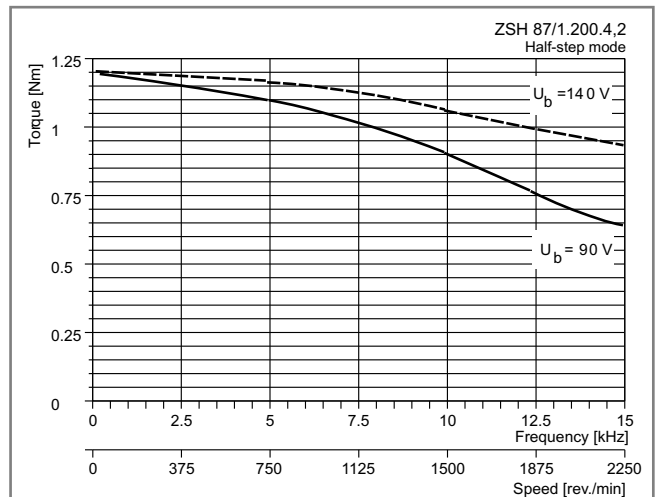


Fig. 25

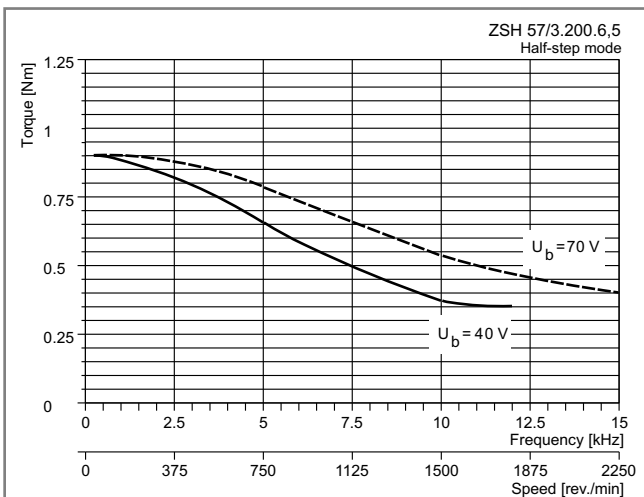


Fig. 23

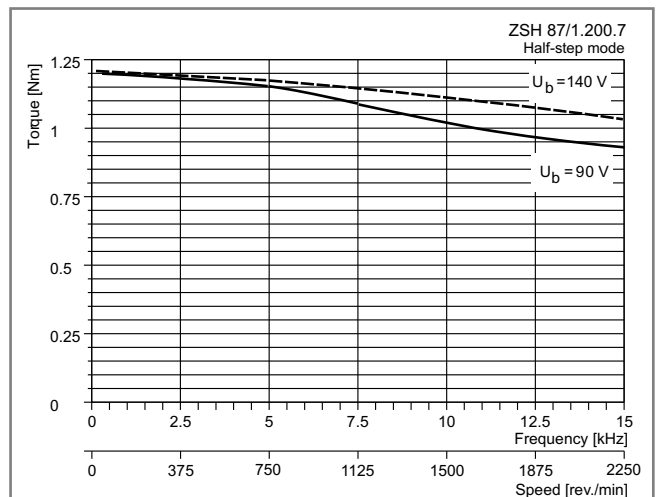


Fig. 26



# Frequency Characteristics

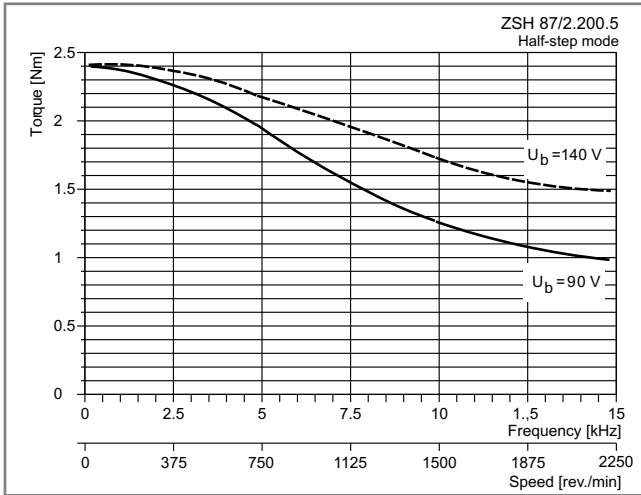


Fig. 27

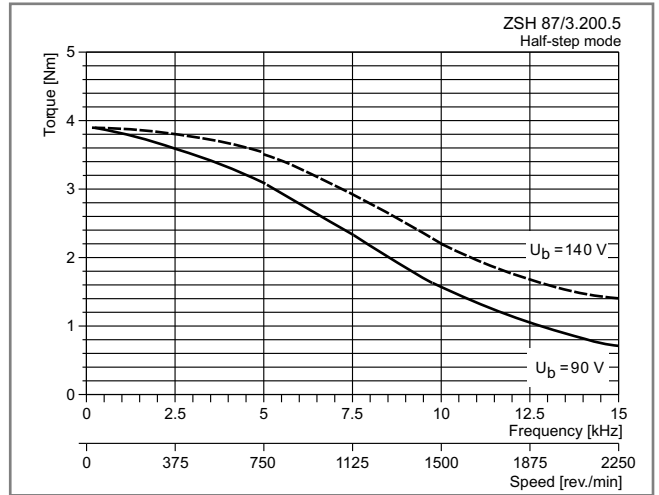


Fig. 30

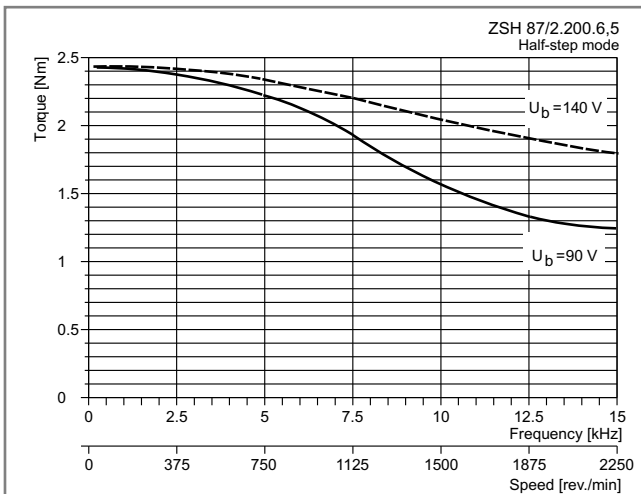


Fig. 28

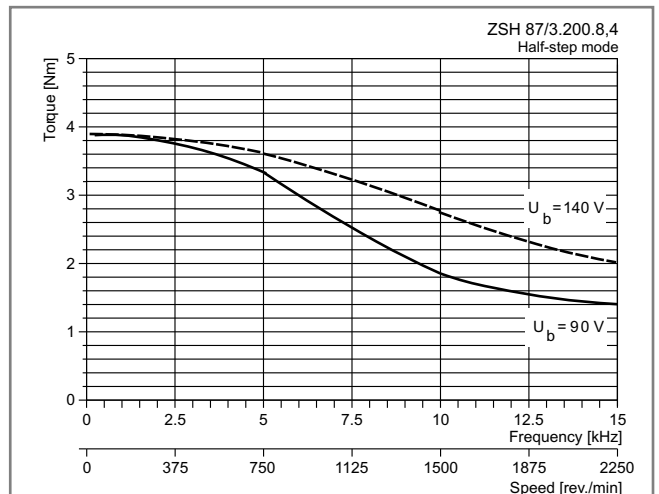


Fig. 31

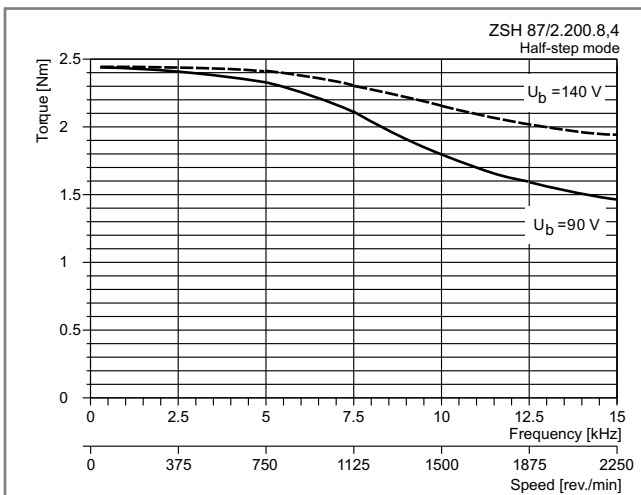


Fig. 29

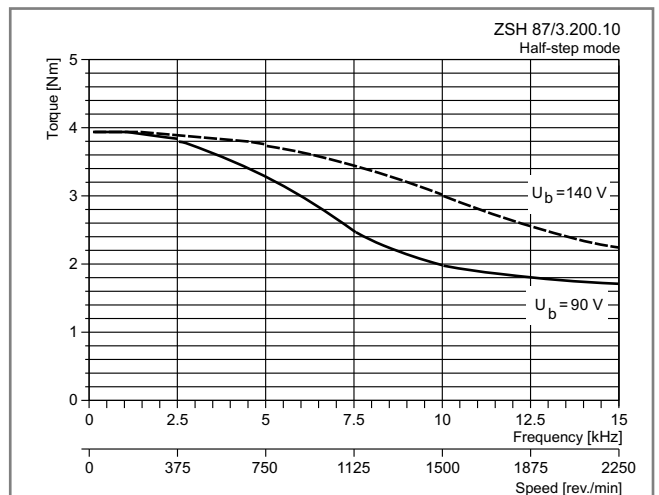


Fig. 32

# Frequency Characteristics

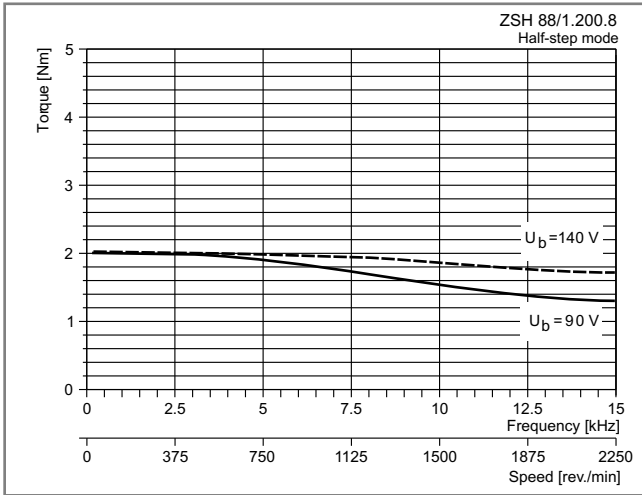


Fig. 33

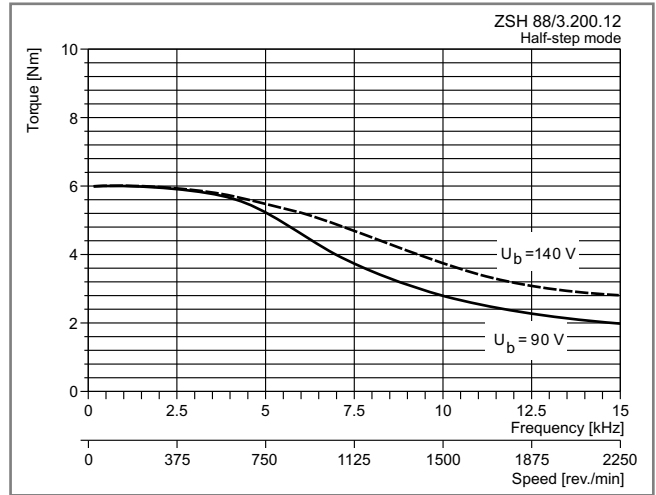


Fig. 36

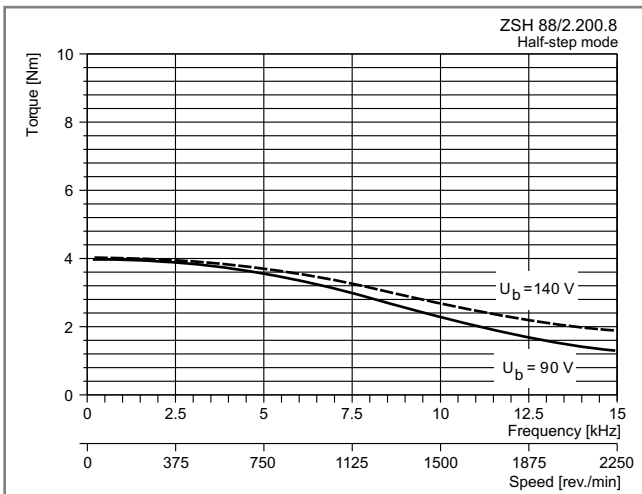


Fig. 34

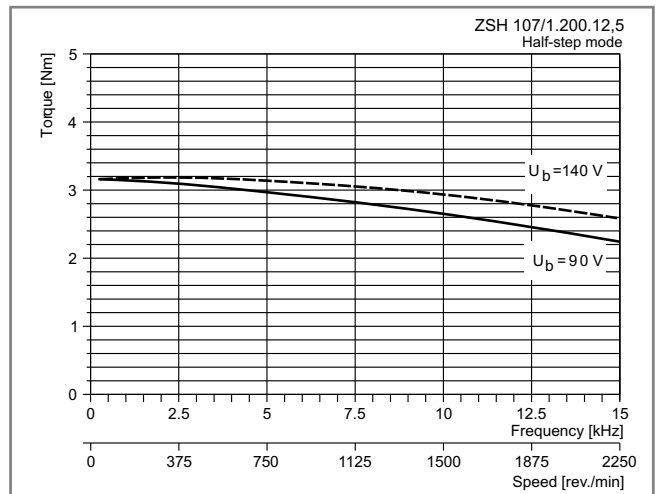


Fig. 37

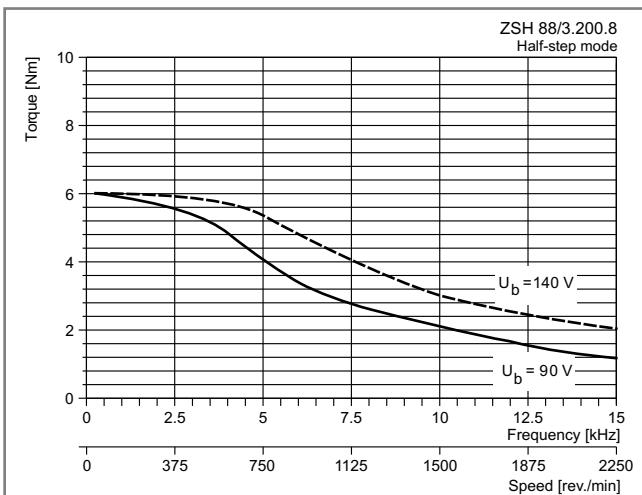


Fig. 35

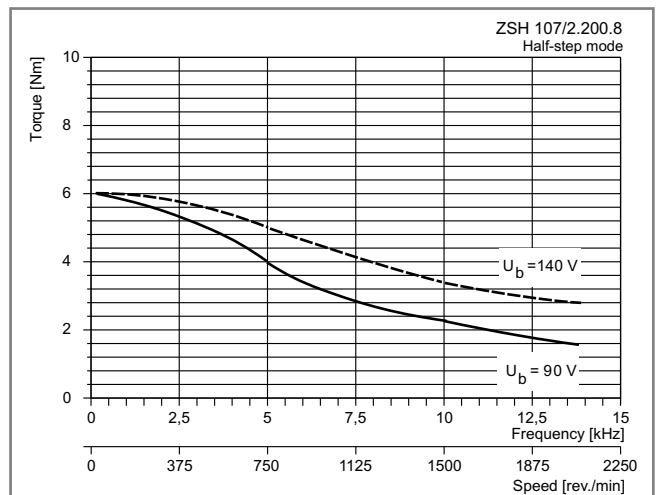


Fig. 38

# Frequency Characteristics

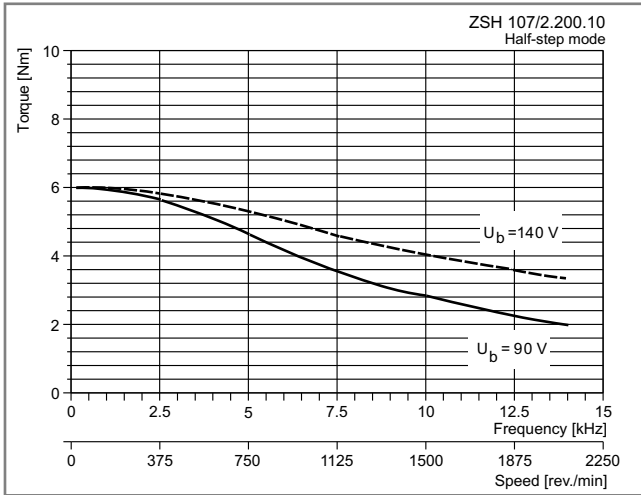


Fig. 39

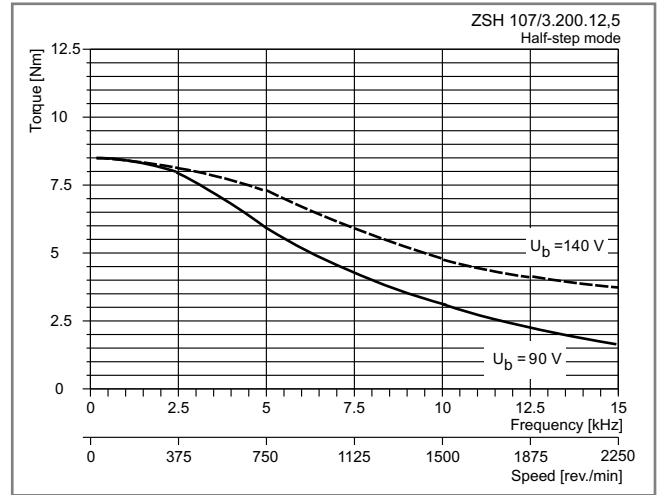


Fig. 42

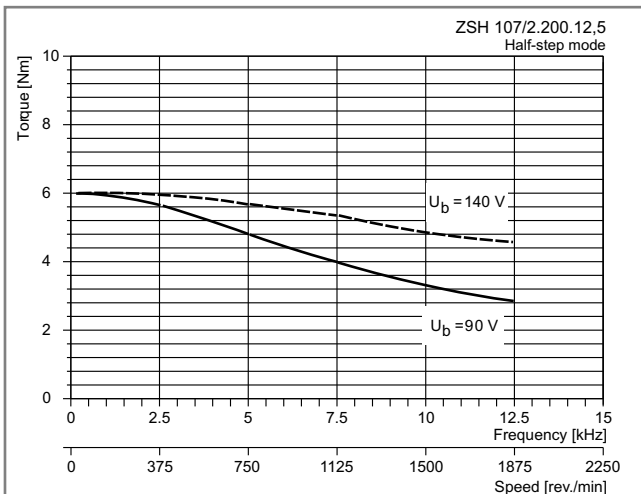


Fig. 40

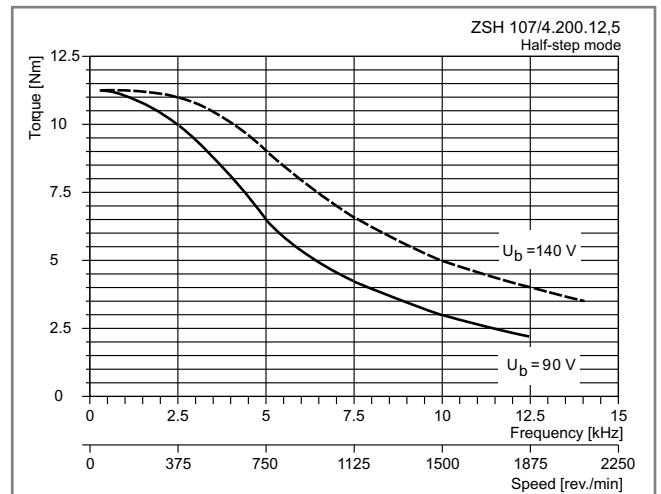


Fig. 43

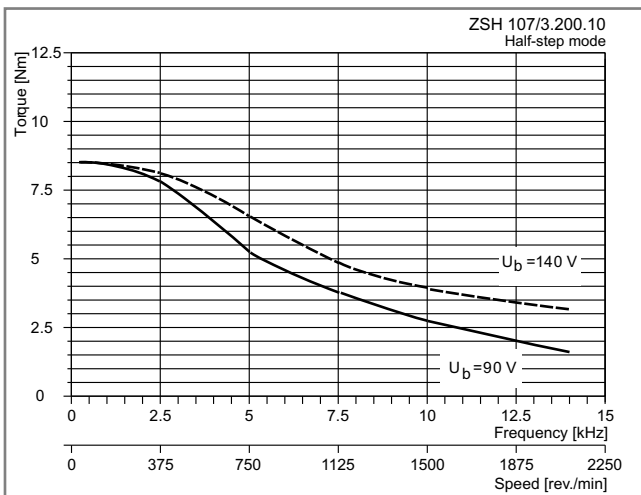


Fig. 41

## Optional: PLE Low-backlash Planetary Gear

The use of a gear box is recommended if a high resolution of the drive system or a low output speed is required.

The overall unit – motor with planetary reducing gear – has a higher output torque and reduced mass inertia.

- 1-stage, 2-stage or 3-stage gear with reduction ratios from 3:1 to 512:1
- High driving torque up to 260 Nm, depend. on motor size and reduction ratio
- High torsional stiffness
- Low torsional backlash:  
< 8 to <30 angular minutes depend. on gear size and reduction ratio
- High permissible axial and radial shaft loads
- Low running noise
- Temperature range –25 to +90 °C
- Lifetime grease lubrication

Drawings, dimensions and mechanical characteristics see page 4/5.

## EU-Directives and CE marking

When installed appropriately, ZSH stepper motors meet the requirements of the EMC and Low Voltage Directives. ZSH stepper motors are marked CE and comply with EN 60034-1 European standard.

When wired correctly, ZSH stepper motors meet the requirements of the EMC Directive. Information concerning the connection of the motor cable to the control unit or the power stage is given in the corresponding manuals.

According to the Machine Directive, the stepper motor is only a part of a machine. The machine manufacturer must take appropriate measures to ensure that the entire system meets the requirements of the applicable EU-Directives.

## Optional: KEB Motor Brake

For vertically mounted positioning systems, stepper motors with brake are recommended.

The permanent magnet brake is activated when the brake is de-energized. The permanent magnet pulls a rotor disk in the axial direction towards the contact surface, thus creating a friction-tight junction, free of rotatory backlash.

When the current is activated, the force acting on the rotor disk is suppressed. The contact surfaces are separated without a residual friction moment by means of a riveted spring.

- Supply voltage 24 V<sub>DC</sub>
- Electrical connection by means of a metrical cable gland.
- Current consumption  
KEB 02: approx. 350 mA  
KEB 05: approx. 450 mA  
KEB 06: approx. 550 mA

For drawings and dimensions, please refer to pages 2 and 3.

## Optional: E 50, H 200 or H 500 Encoder

ZSH stepper motors with mounted encoder are specially adapted for applications with variable speed drives or to monitor the drive.

Short-circuit-proof RS 422 line driver

### E 50 Encoder

- Supply voltage: 5 to 24 V<sub>DC</sub>
- Resolution: 50 lines
- Output signals:  
Channels A and B,  $\bar{A}$  and  $\bar{B}$   
The A and B ( $\bar{A}$  and  $\bar{B}$ ) signals are 90° phase-shifted.

### H 200 / H 500 Encoder

- Supply voltage: 5 V<sub>DC</sub> ± 5%
- Resolution: 200 / 500 lines
- Output signals:  
Channels A and B,  $\bar{A}$  and  $\bar{B}$   
The A and B ( $\bar{A}$  and  $\bar{B}$ ) signals are 90° phase-shifted.
- 0 und  $\bar{0}$  reference pulses

For drawings and dimensions, please refer to pages 2 and 3.

## Ordering Code

|                            | ZSH 87 / 3 . 200 . 10 - H200 - PLE/12:1 - IP68 - 4s   |
|----------------------------|---|
| Stepper motor series       | ZSH   |
| Size                       | 57 / 87 / 88 / 107  |
| Length                     | 1 / 2 / 3 / 4   |
| Number of steps            | 200   |
| Winding                    | available windings see page 1   |
| Optional:                  |   |
| Ø Shaft/Flange             | not specified = standard design   |
| 2nd shaft                  | E   |
| Free wire ends             | FD (FD and E can be combined)   |
| Motor brake                | B   |
| Encoder                    | E50 / H200 / H500   |
| Encoder and motor brake    | E50-B / H200-B / H500-B   |
| Gear/reduction ratio       | PLE 12:1 (reduction ratios see page 5)  |
| Protection class IP 68     | not specified = standard protection class IP 54   |
| Connection of the windings | not specified = standard wiring scheme: 4-lead/parallel windings<br>4s = 4-lead/serial windings, 5 = 5-lead, 8 = 8-lead |