## GB10

Bidirectional Gear Box with one hand with 1° resolution.
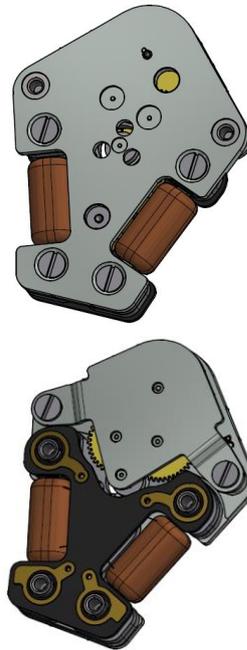
| | | |
|---|---|---|
| Issued | 11.10.2019 | fl5223 |
| Modified | 19.11.2020 | fl5223 |
| Modification No. | 40041 | |
| Released | Yes | |

| | | |
|---|---|---|
| Hands | | 1      A4 |
| Motors | | 1 |
| Jewels | | 0 |
| Operating temperature | | 0…50 °C |
| Resistance to magnetic fields * | | 18.8 Oe |
| Shock resistance * | | NIHS 91 - 10 |
| Direction of rotation | | bidirectional |
| Rotation angle / pulse | J | 1° |
| Number of pulses for a complete rotation (360°) | J | 360 |
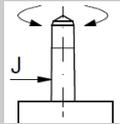
* By using driving methods mentioned on pages 4 and 5.

## Principle for the driver electronics

Dial side

Gear side
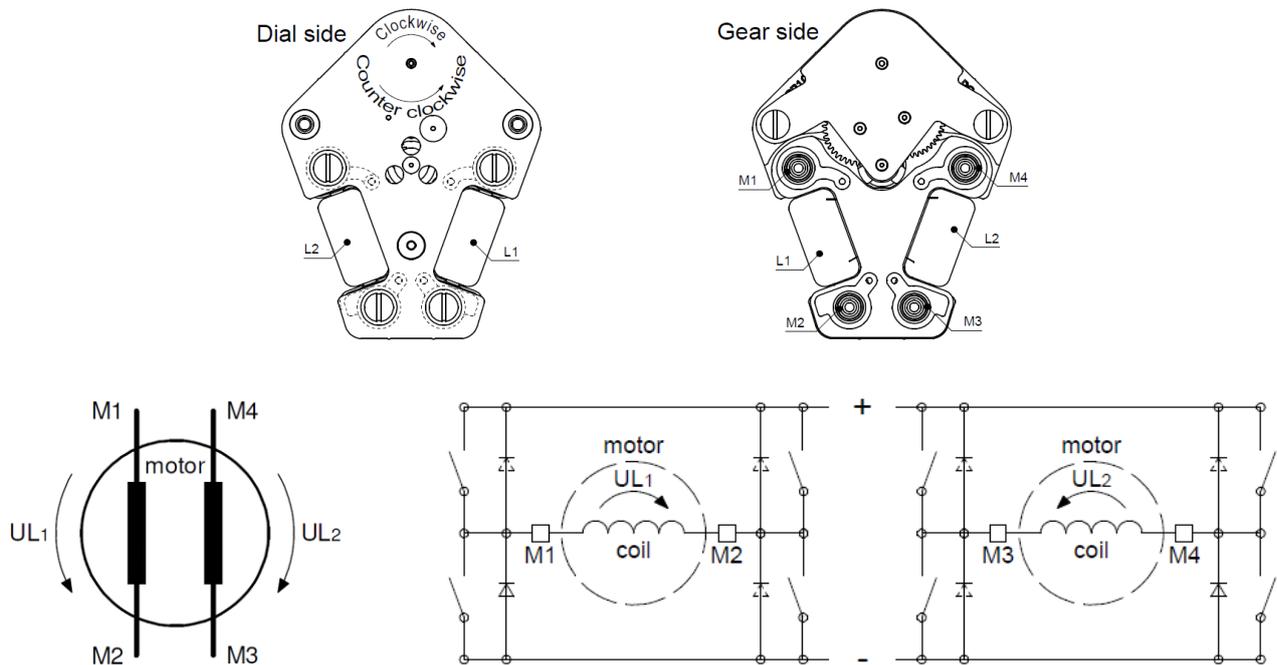
| Motor connection no. 1 | | | M1 |
|---|---|---|---|
| Motor connection no. 2 | | | M2 |
| Motor connection no. 3 | | | M3 |
| Motor connection no. 4 | | | M4 |
| Coil no. 1 | | | L1 |
| Coil no. 2 | | | L2 |
| Resistance of the coil – typical | Condition | T=20 °C | 1'600 Ohm |
| Inductance of the coil – typical | Condition | f=1 kHz | 1.5 H |

## Recommended driving method
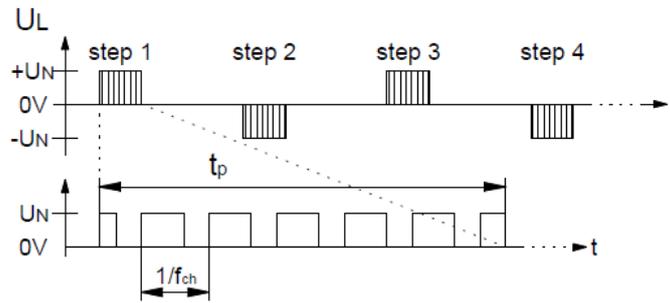


| Nominal voltage | $U_N$ | 3.0 | 3.0 | 3.7 | V |
|---|---|---|---|---|---|
| Voltage range | $U_{min}$ $U_{max}$ | 2.80 3.20 | 2.20 3.50 | 2.90 4.50 | V |
| Duty cycle | PWM | 100% | 100% | 100% | |
| Pulse width [4] | $t_p$ | 3.0 | 4.0 | 3.5 | ms |
| Maximal frequency of motor steps [1), 3), 4] | $f_{Step}$ | 60 | 60 | 60 | steps/s |
| Chopper frequency | $f_{ch}$ | - - - | - - - | - - - | Hz |
| Current consumption ($f_{Step}$ = 1 step/s) [2), 4] | $I_{mot}$ | 4.0 | 6.0 | 6.6 | µA |
| Current consumption ($f_{Step}$ = 60 step/s) [2), 4] | $I_{mot}$ | 240 | 360 | 396 | µA |
| Torque [2), 4] | M | 50 | 50 | 80 | µNm |

Key:
[1]   Condition: $U_L = U_N$, T=20 °C
[2]   typical
[3]   Tested maximum frequency of motor steps. Higher frequencies may be possible depending on the application.
[4]   Motor driving with higher frequency: see page 7.

## Recommended driving method

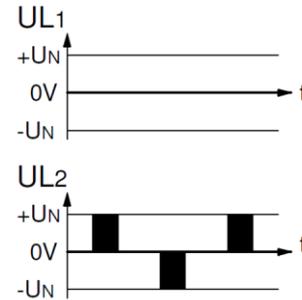### Motor driving in one direction
The following two examples show the motor driving pulses of 3 motor steps to drive the motor in one direction. The motor must be driven by alternating motor pulses.

| Direction = clockwise (CW) Sequence of 3 motor steps | Direction = counter clockwise (CCW) Sequence of 3 motor steps |
|---|---|
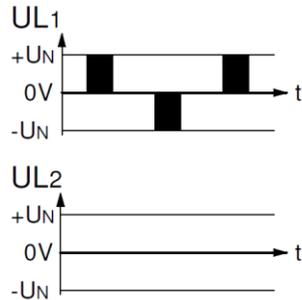
UL₁ graphs and UL₂ graphs

### Change of direction
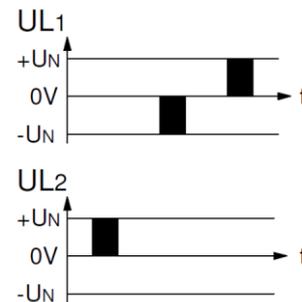The following examples show the motor driving pulses for a change of direction

**CW → CCW**
last pulse of a pulse sequence driving the motor CW (ending with a positive voltage pulse) followed by 2 pulses CCW (starting with a negative voltage pulse)
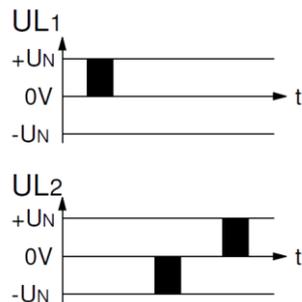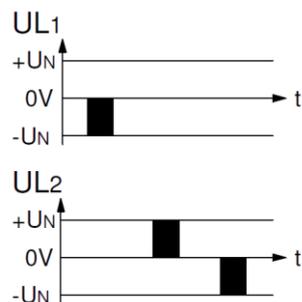
**CCW → CW**
last pulse of a pulse sequence driving the motor CCW (ending with a positive voltage pulse) followed by 2 pulses CW (starting with a negative voltage pulse)
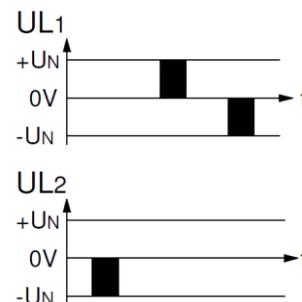
**CW → CCW**
last pulse of a pulse sequence driving the motor CW (ending with a negative voltage pulse) followed by 2 pulses CCW (starting with a positive voltage pulse)
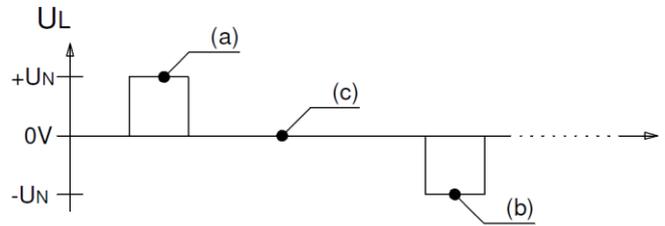
**CCW → CW**
last pulse of a pulse sequence driving the motor CCW (ending with a negative voltage pulse) followed by 2 pulses CW (starting with a positive voltage pulse)

## Example: recommended driving method
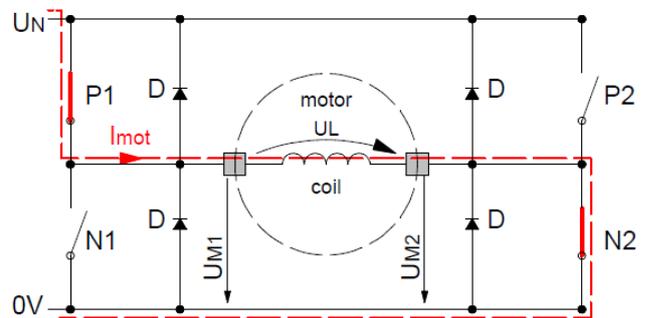


## Switching states

### (a) positive pulse

$$U_L = +U_N$$
$$U_L = U_{M1} - U_{M2}$$

P1, N2 = closed
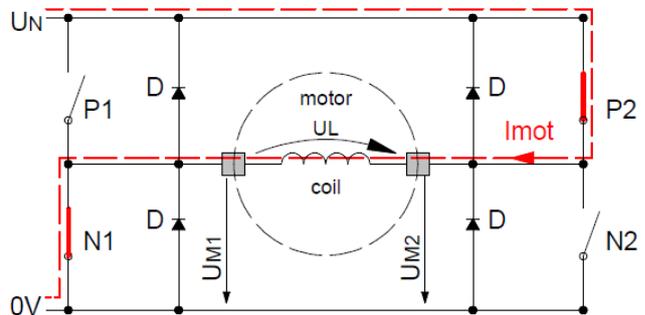P2, N1 = open

D = fly back diode



### (b) negative pulse

$$U_L = -U_N$$

P1, N2 = open
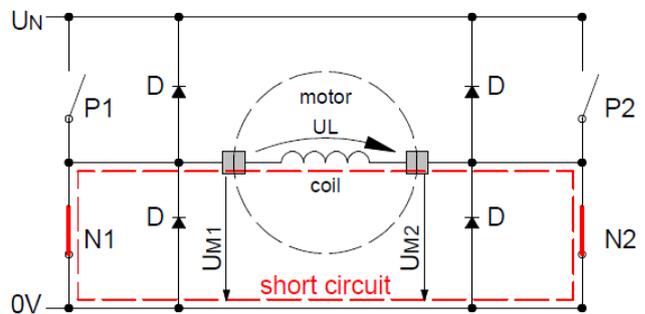P2, N1 = closed

D = fly back diode
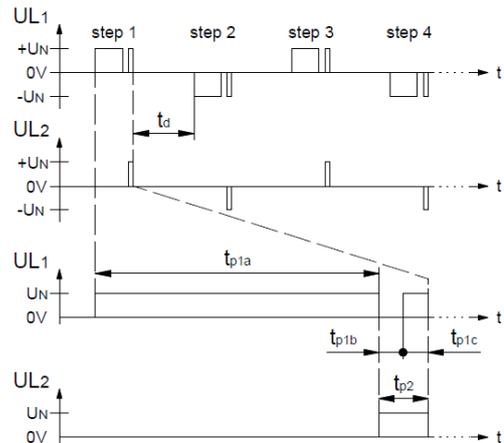


### (c) short circuit

$$U_L = 0V$$

P1, P2 = open
N1, N2 = closed

D = fly back diode

## Motor driving method for higher frequency

$t_{p1a}$ = 3.00 ms
$t_{p1b}$ = 0.25 ms
$t_{p1c}$ = 0.25 ms
$t_{p2}$ = $t_{p1b}$ + $t_{p1c}$ = 0.50 ms
$t_d$ ≥ 2.50ms

### Motor driving in one direction
The following two examples show the motor driving pulses of 3 motor steps to drive the motor in one direction. The motor must be driven by alternating motor pulses.

| **Direction = clockwise (CW)** Sequence of 3 motor steps | **Direction = counter clockwise (CCW)** Sequence of 3 motor steps |
|---|---|

| | | | |
|---|---|---:|---:|
| Maximal frequency of motor steps [1], [3] | $f_{Step}$ | 167 | steps/s |
| Current consumption (fStep = 1 step/s) [2] | $I_{mot}$ | 5.0 | µA |
| Current consumption (fStep = 167 step/s) [2] | $I_{mot}$ | 835 | µA |
| Torque [2] | M | 30 | µNm |

Key:
[1] Condition: $U_L$ = $U_N$, T=20 °C
[2] typical
[3] Tested maximum frequency of motor steps.