

# Programowanie sterowników przemysłowych

Podstawy sterowania ruchem.  
Obiekty technologiczne.  
Moduł PTO/PWM.

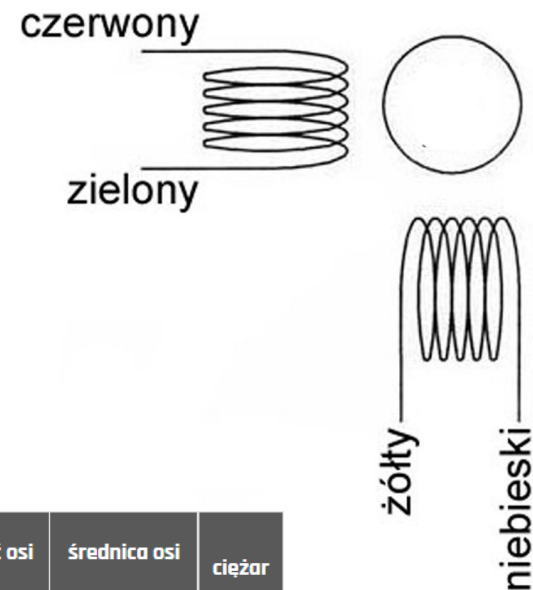
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Katedra Urządzeń Elektrycznych i Automatyki  
Politechnika Świętokrzyska

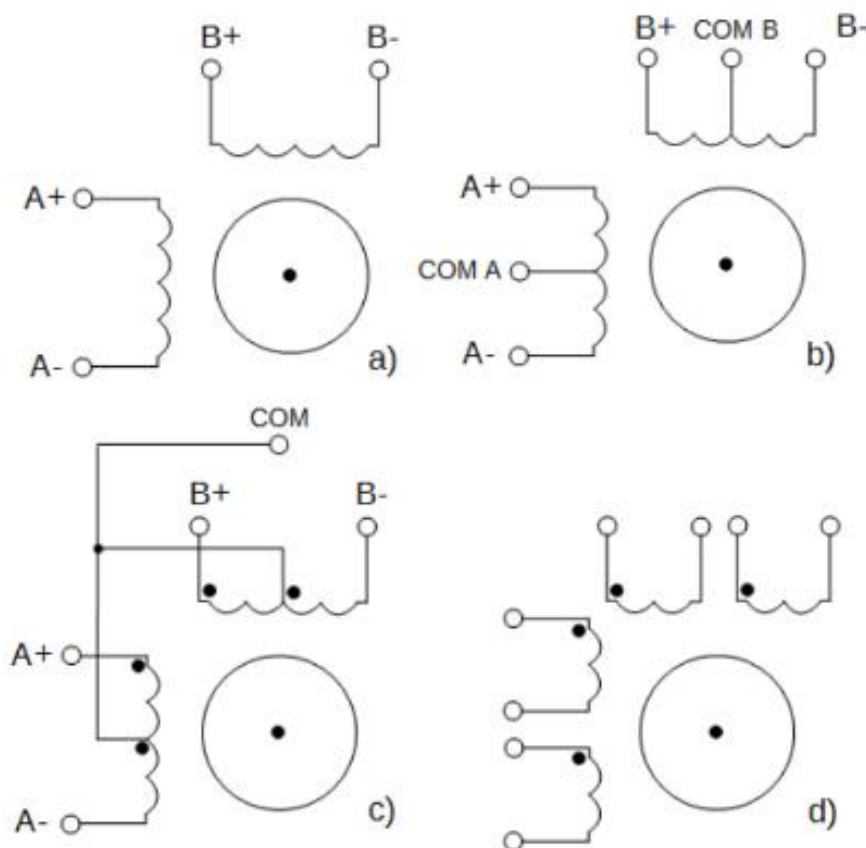


# Silnik krokowy JK57HS82-3004

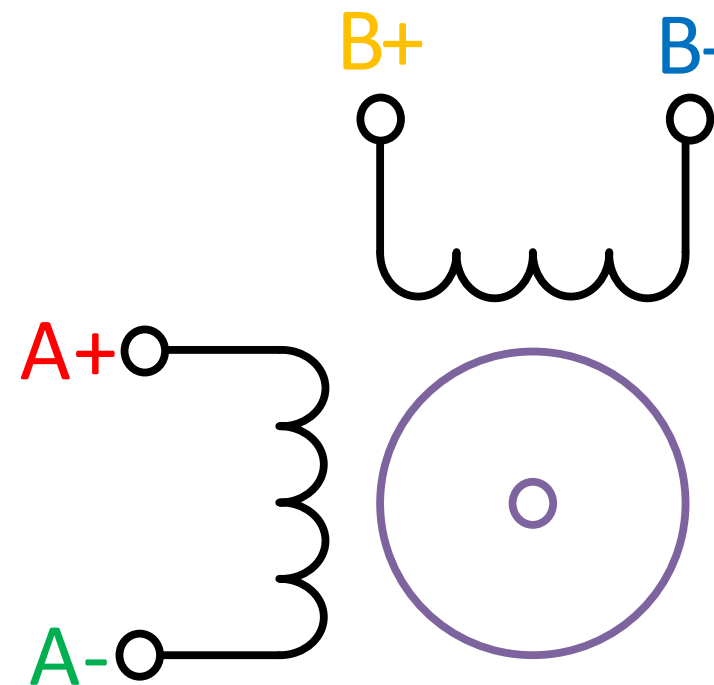
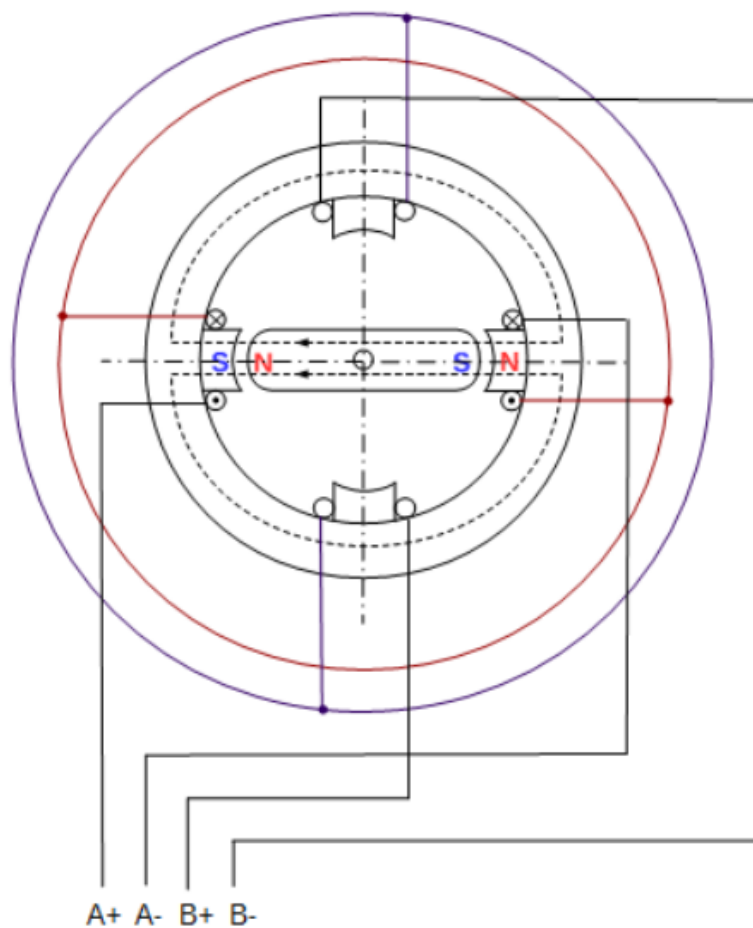


| typ silnika       | napięcie fazy<br>voltage | prąd fazy<br>phase current | rezystancja fazy<br>Phase resistance | indukcyjność fazy<br>phase in ductance | moment trzymający<br>holding torque | ilość wyprowadzeń<br>leeds | długość korpusu<br>body lenght | długość osi L1<br>shaft lenght | długość osi L2<br>shaft lenght | średnica osi<br>shaft diameter | ciężar<br>Weight |
|-------------------|--------------------------|----------------------------|--------------------------------------|----------------------------------------|-------------------------------------|----------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|------------------|
|                   | V                        | A                          | ohm                                  | mH                                     | N.m / kg.cm                         |                            | mm                             | mm                             | mm                             | mm                             | kg               |
| JK57HS56-2504-01  | 3,25                     | 2,5                        | 1,3                                  | 4,2                                    | 1 / 11                              | 4                          | 56                             | 21                             | -                              | 6,35                           | 0,7              |
| JK57HS76-2804     | 3,1                      | 2,8                        | 1,1                                  | 3,6                                    | 1,8 / 18                            | 4                          | 76                             | 21                             | -                              | 6,35                           | 1,1              |
| JK57HS82-3004     | 3,6                      | 3                          | 1,2                                  | 4                                      | 2,2 / 22,5                          | 4                          | 82                             | 21                             | -                              | 8                              | 1,14             |
| JK57HS82-3004-02B | 3,6                      | 3                          | 1,2                                  | 4                                      | 2,2 / 22,5                          | 4                          | 82                             | 21                             | 21                             | 6,35                           | 1,15             |
| JK57HS112-3004-03 | 4,8                      | 3                          | 1,6                                  | 7,5                                    | 2,7 / 28                            | 4                          | 112                            | 21                             | -                              | 8                              | 1,5              |

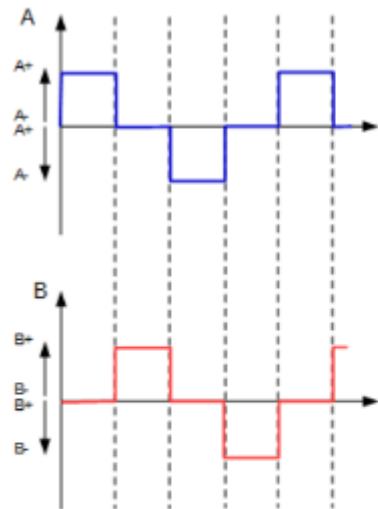
# Podział silników krokowych ze względu na sposób połączenia uzwojeń



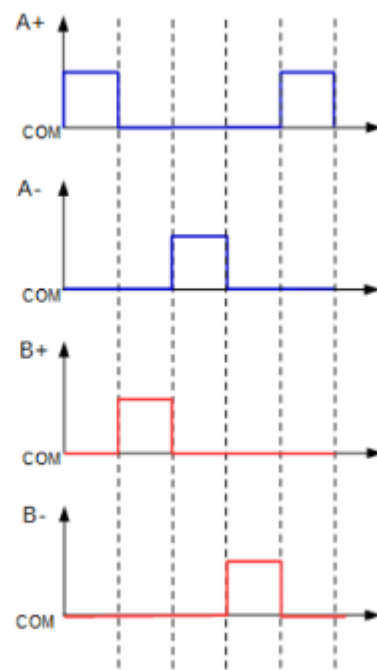
# Silnik krokowy bipolarny – budowa



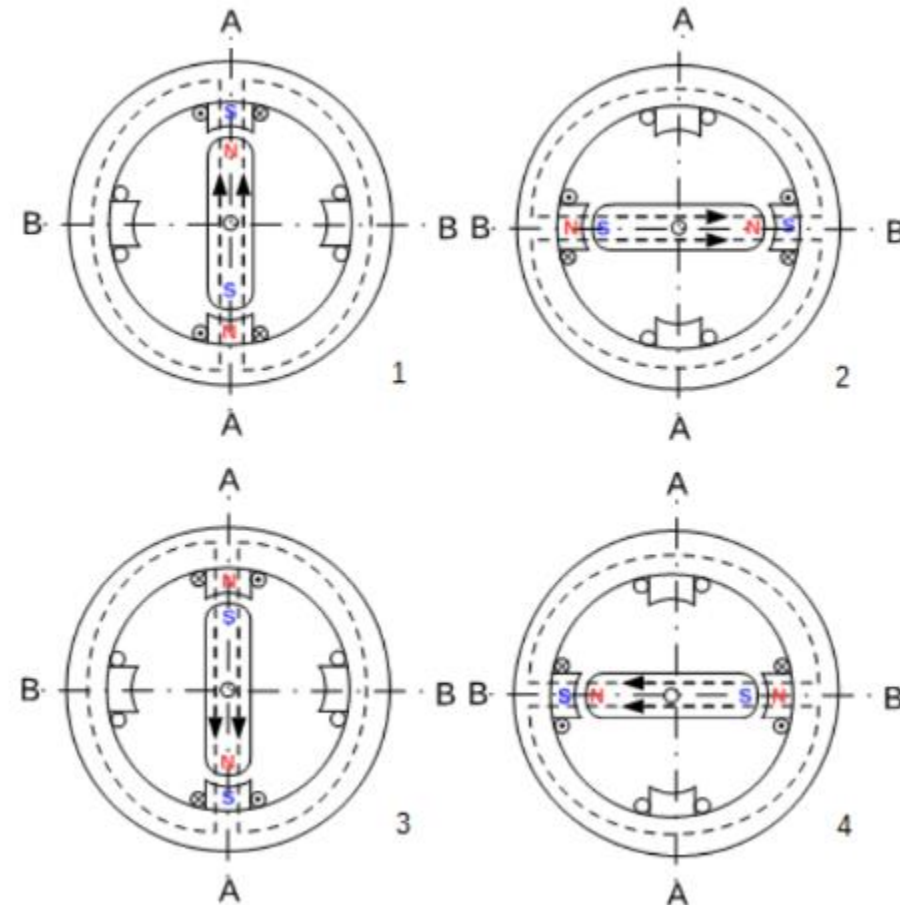
# Silnik krokowy – sterowanie pełnokrokowe



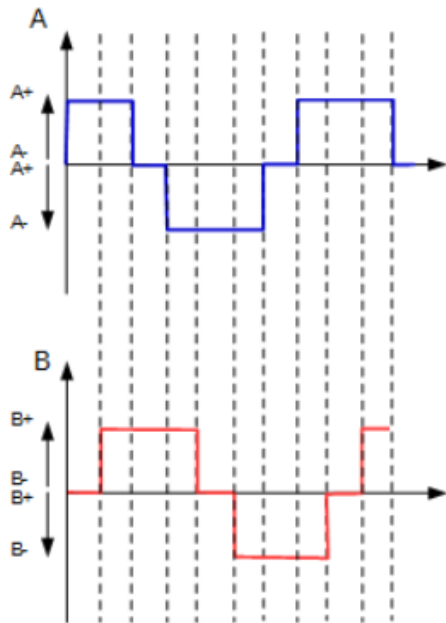
Sterowanie bipolarne



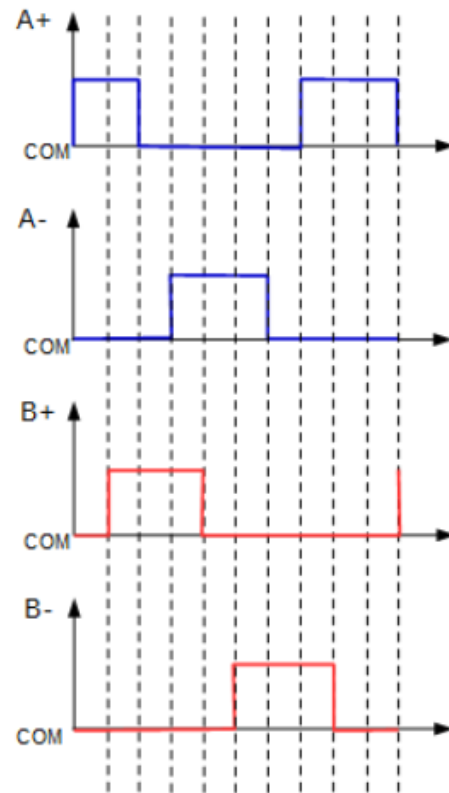
Sterowanie unipolarne



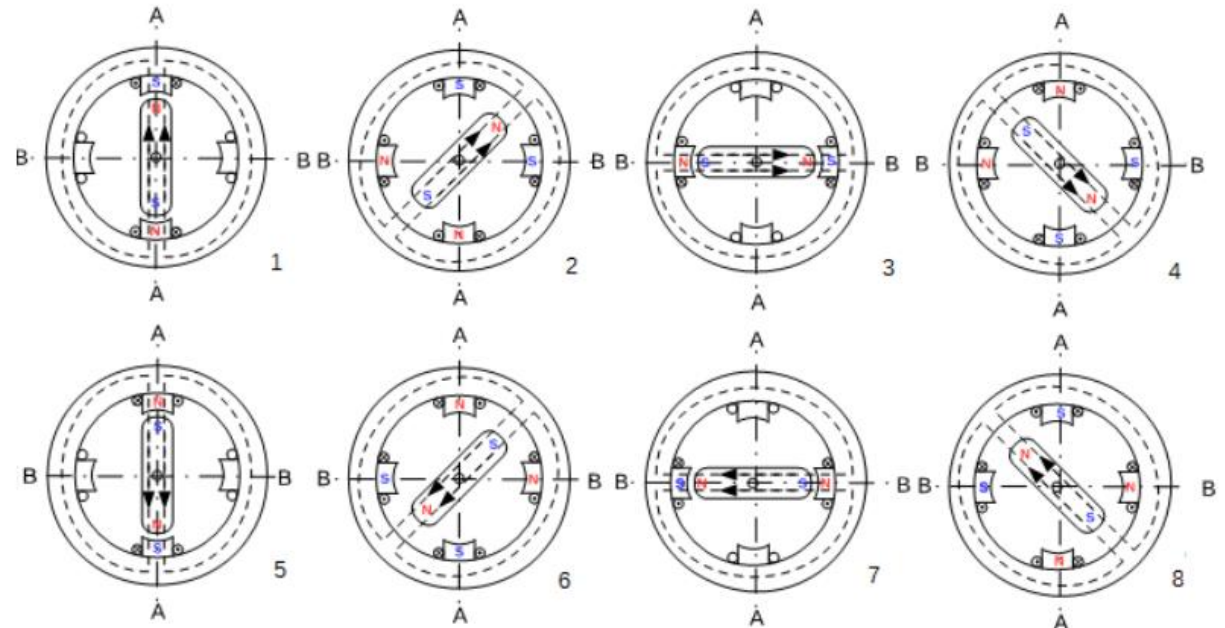
# Silnik krokowy – sterowanie półkrokowe



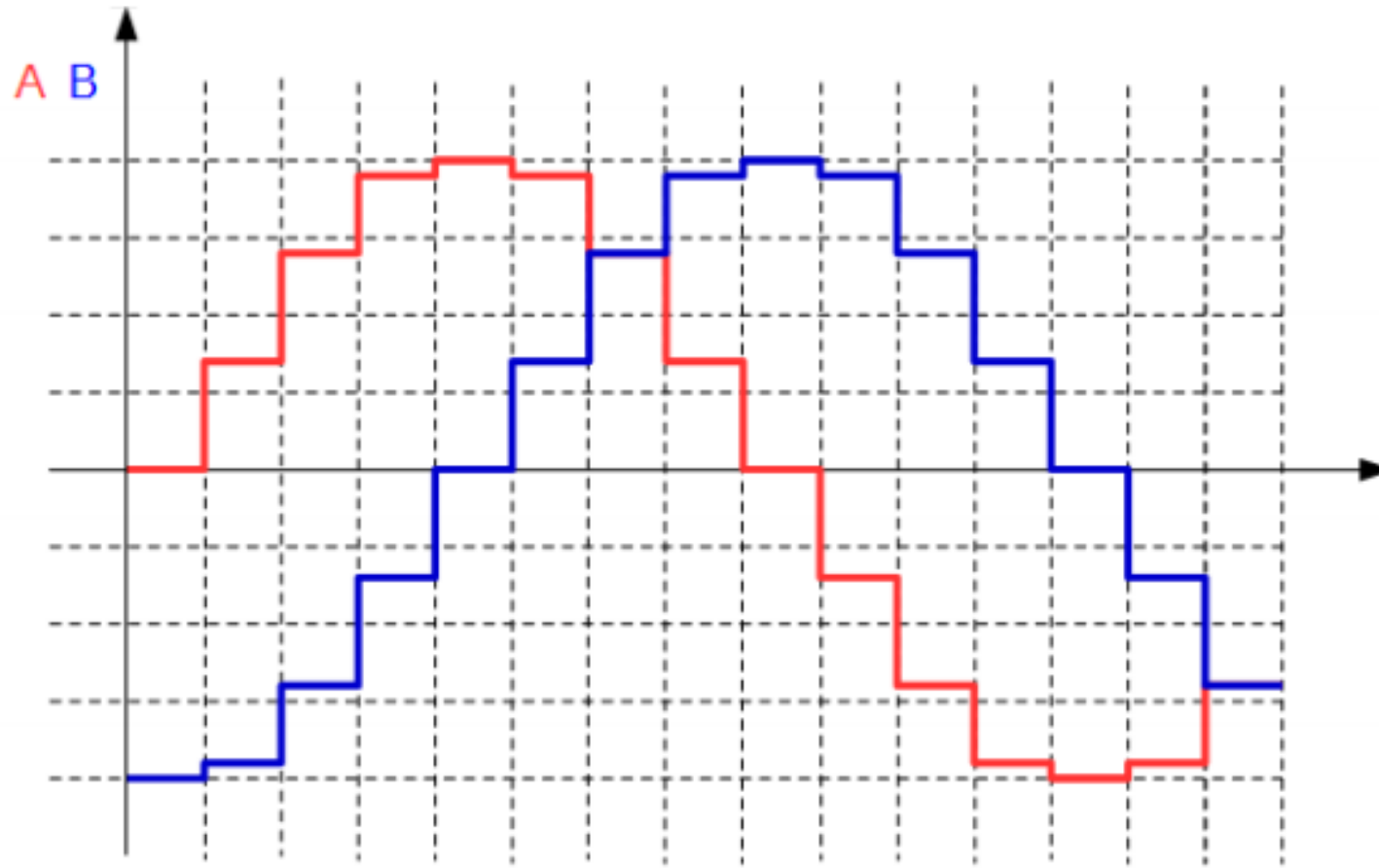
Sterowanie bipolarne



Sterowanie unipolarne



# Silnik krokowy – sterowanie mikrokrokowe



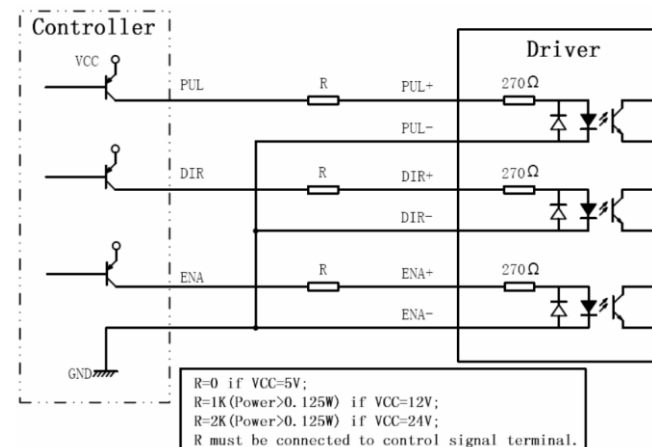
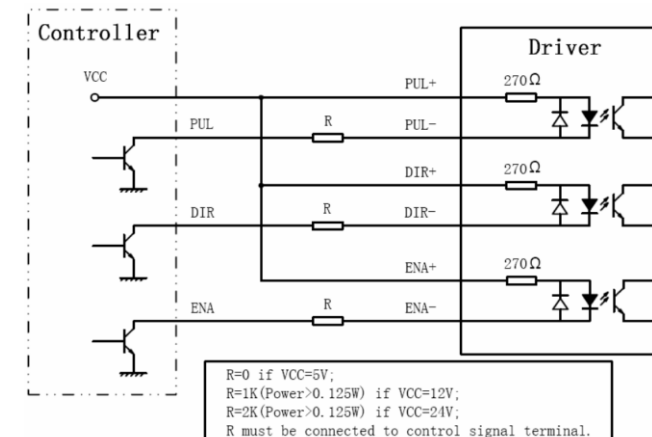
# Sterownik silnika krokowego DM556



|                       |                                   |                                         |
|-----------------------|-----------------------------------|-----------------------------------------|
| Cooling               | Natural Cooling or Forced cooling |                                         |
| Operating Environment | Environment                       | Avoid dust, oil fog and corrosive gases |
|                       | Ambient Temperature               | 0°C — 50°C (32°F — 122°F)               |
|                       | Humidity                          | 40%RH — 90%RH                           |
|                       | Operating Temperature             | 70°C (158°F) Max                        |
| Storage Temperature   | Vibration                         | 5.9m/s <sup>2</sup> Max                 |
|                       |                                   |                                         |
| Weight                | Approx. 280g (10 oz)              |                                         |

| Pin Function | Details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PUL+         | <b>Pulse signal:</b> In single pulse (pulse/direction) mode, this input represents pulse signal, each rising or falling edge active (software configurable); 4-5V when PUL-HIGH, 0-0.5V when PUL-LOW. In double pulse mode (pulse/pulse), this input represents clockwise (CW) pulse, active both at high level and low level (software configurable). For reliable response, pulse width should be longer than 2.5μs. Series connect resistors for current-limiting when +12V or +24V used. The same as DIR and ENA signals.                                                                               |
| PUL-         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| DIR+         | <b>DIR signal:</b> In single-pulse mode, this signal has low/high voltage levels, representing two directions of motor rotation; in double-pulse mode (software configurable), this signal is counter-clock (CCW) pulse, active both at high level and low level (software configurable). For reliable motion response, DIR signal should be ahead of PUL signal by 5μs at least. 4-5V when DIR-HIGH, 0-0.5V when DIR-LOW. Please note that rotation direction is also related to motor-Driver wiring match. Exchanging the connection of two wires for a coil to the Driver will reverse motion direction. |
| DIR-         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| ENA+         | <b>Enable signal:</b> This signal is used for enabling/disabling the Driver. High level (NPN control signal, PNP and Differential control signals are on the contrary, namely Low level for enabling.) for enabling the Driver and low level for disabling the Driver. Usually left <b>UNCONNECTED (ENABLED)</b> .                                                                                                                                                                                                                                                                                          |
| ENA-         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

| Pin Function | Details                                                                 |
|--------------|-------------------------------------------------------------------------|
| +Vdc         | Power supply, 20-45 VDC, Including voltage fluctuation and EMF voltage. |
| GND          | Power Ground.                                                           |
| A+, A-       | Motor Phase A                                                           |
| B+, B-       | Motor Phase B                                                           |



# Sterownik silnika krokowego DM556



| Microstep | Steps/rev.(for 1.8°motor)   | SW5 | SW6 | SW7 | SW8 |
|-----------|-----------------------------|-----|-----|-----|-----|
| 1 to 512  | Default/Software configured | ON  | ON  | ON  | ON  |
| 2         | 400                         | OFF | ON  | ON  | ON  |
| 4         | 800                         | ON  | OFF | ON  | ON  |
| 8         | 1600                        | OFF | OFF | ON  | ON  |
| 16        | 3200                        | ON  | ON  | OFF | ON  |
| 32        | 6400                        | OFF | ON  | OFF | ON  |
| 64        | 12800                       | ON  | OFF | OFF | ON  |
| 128       | 25600                       | OFF | OFF | OFF | ON  |
| 5         | 1000                        | ON  | ON  | ON  | OFF |
| 10        | 2000                        | OFF | ON  | ON  | OFF |
| 20        | 4000                        | ON  | OFF | ON  | OFF |
| 25        | 5000                        | OFF | OFF | ON  | OFF |
| 40        | 8000                        | ON  | ON  | OFF | OFF |
| 50        | 10000                       | OFF | ON  | OFF | OFF |
| 100       | 20000                       | ON  | OFF | OFF | OFF |
| 125       | 25000                       | OFF | OFF | OFF | OFF |

# Sterownik silnika krokowego DM556



| Microstep | Steps/rev.(for 1.8°motor)   | SW5 | SW6 | SW7 | SW8 |
|-----------|-----------------------------|-----|-----|-----|-----|
| 1 to 512  | Default/Software configured | ON  | ON  | ON  | ON  |
| 2         | 400                         | OFF | ON  | ON  | ON  |
| 4         | 800                         | ON  | OFF | ON  | ON  |
| 8         | 1600                        | OFF | OFF | ON  | ON  |
| 16        | 3200                        | ON  | ON  | OFF | ON  |
| 32        | 6400                        | OFF | ON  | OFF | ON  |
| 64        | 12800                       | ON  | OFF | OFF | ON  |
| 128       | 25600                       | OFF | OFF | OFF | ON  |
| 5         | 1000                        | ON  | ON  | ON  | OFF |
| 10        | 2000                        | OFF | ON  | ON  | OFF |
| 20        | 4000                        | ON  | OFF | ON  | OFF |
| 25        | 5000                        | OFF | OFF | ON  | OFF |
| 40        | 8000                        | ON  | ON  | OFF | OFF |
| 50        | 10000                       | OFF | ON  | OFF | OFF |
| 100       | 20000                       | ON  | OFF | OFF | OFF |
| 125       | 25000                       | OFF | OFF | OFF | OFF |

# Sterownik silnika krokowego DM556



| Peak Current                              | RMS Current | SW1 | SW2 | SW3 |
|-------------------------------------------|-------------|-----|-----|-----|
| Default/Software configured (0.5 to 5.6A) |             | OFF | OFF | OFF |
| 2.1A                                      | 1.5A        | ON  | OFF | OFF |
| 2.7A                                      | 1.9A        | OFF | ON  | OFF |
| 3.2A                                      | 2.3A        | ON  | ON  | OFF |
| 3.8A                                      | 2.7A        | OFF | OFF | ON  |
| 4.3A                                      | 3.1A        | ON  | OFF | ON  |
| 4.9A                                      | 3.5A        | OFF | ON  | ON  |
| 5.6A                                      | 4.0A        | ON  | ON  | ON  |

| Priority        | Time(s) of ON | Sequence wave of RED LED | Description             |
|-----------------|---------------|--------------------------|-------------------------|
| 1 <sup>st</sup> | 1             |                          | Over-current protection |
| 2 <sup>nd</sup> | 2             |                          | Over-voltage protection |
| 3 <sup>rd</sup> | 4             |                          | Phase error protection  |

# SIEMENS TIA Portal – konfiguracja PTO/PWM

**Pulse options**

Signal type:

Output source:

Time base:

Pulse duration format:

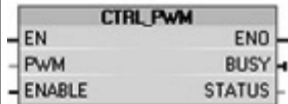
Cycle time:

Initial pulse duration:

Pulse output:

Direction output:

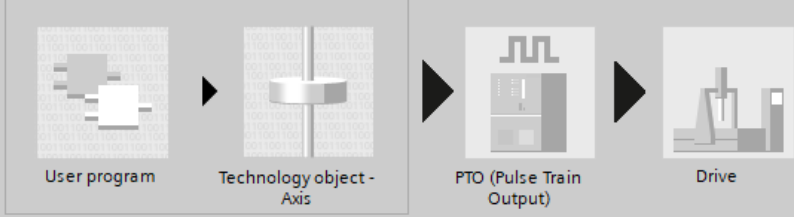
| LAD/FBD                                                                             | SCL                                                                                                                           | Opis                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <pre> ctrl_pwm_db(   PWM:=_hw_pwm_in_,   enable:=_bool_in_,   busy=&gt;_bool_out_,   status=&gt;_word_out_);           </pre> | <p>Instrukcja CTRL_PWM dotycząca modulacji szerokości impulsów PWM (<i>Pulse Width Modulation</i>) zapewnia stały okres przebiegu wyjściowego ze zmiennym współczynnikiem wypełnienia. Wyjście PWM działa przez cały czas od chwili uruchomienia generując impulsy o określonej częstotliwości (okresie). Szerokość impulsów jest zmieniana zgodnie z potrzebami, tak by uzyskać pożądany efekt sterowania.</p> |

| Opis  | Domyślne przypisanie wyjść | Impuls | Kierunek |
|-------|----------------------------|--------|----------|
| PTO 1 | Wyjścia CPU                | Q0.0   | Q0.1     |
|       | Wyjścia płytki sygnałowej  | Q4.0   | Q4.1     |
| PWM 1 | Wyjścia CPU                | Q0.0   | —        |
|       | Wyjścia płytki sygnałowej  | Q4.0   | —        |
| PTO 2 | Wyjścia CPU                | Q0.2   | Q0.3     |
|       | Wyjścia płytki sygnałowej  | Q4.2   | Q4.3     |
| PWM 2 | Wyjścia CPU                | Q0.2   | —        |
|       | Wyjścia płytki sygnałowej  | Q4.2   | —        |

# SIEMENS TIA Portal – obiekt technologiczny

**Technology object - Axis**

Axis name:



User program → Technology object - Axis → PTO (Pulse Train Output) → Drive

**Hardware interface**

Pulse generator:

Output location:

Pulse output:

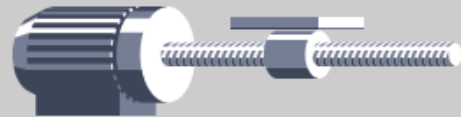
Direction output:

Assigned fast counter:

**Unit of measurement**

Position unit:

| CPU                                             |                                    |   | Drive        |
|-------------------------------------------------|------------------------------------|---|--------------|
| Enable output:                                  |                                    |   |              |
| <input type="text" value="Axis_1_DriveEnable"/> | <input type="text" value="%Q0.7"/> | → | Drive enable |
| Ready input:                                    |                                    |   |              |
| <input type="text" value="TRUE"/>               | <input type="text"/>               | ← | Drive ready  |

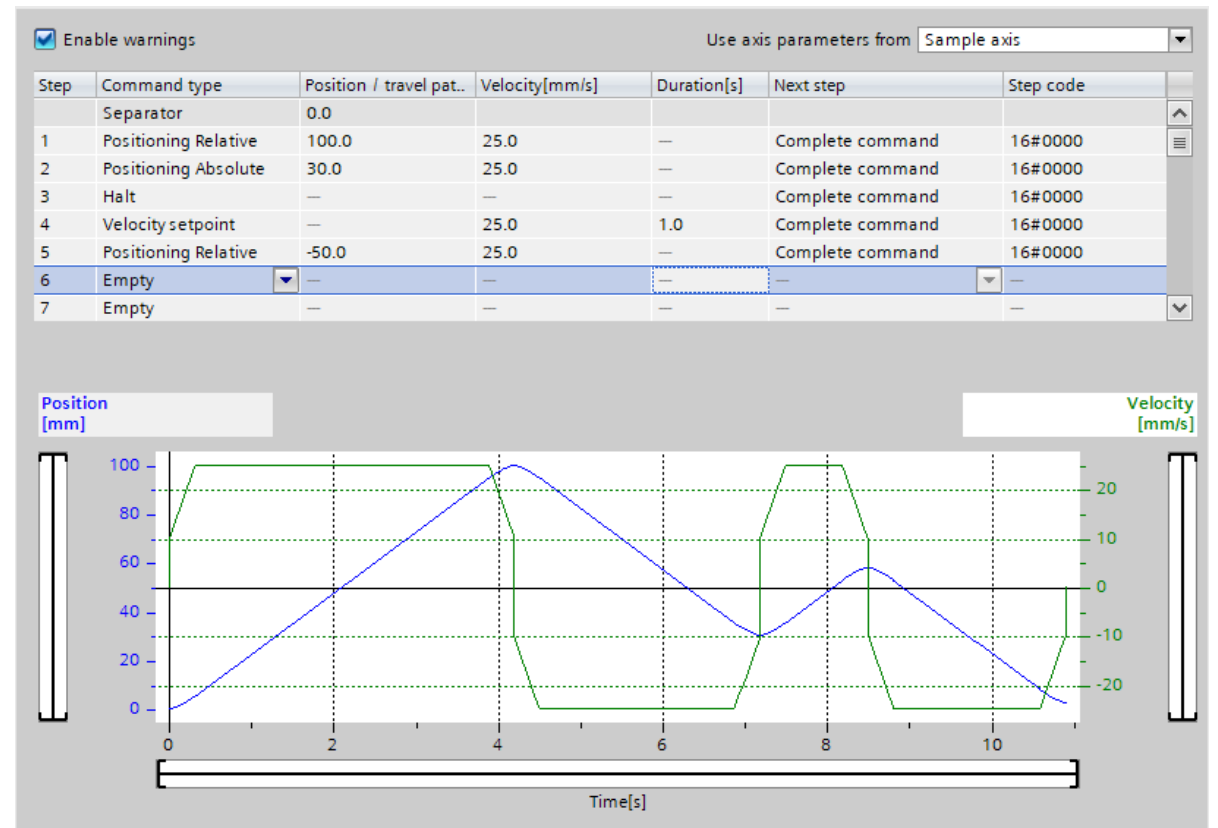
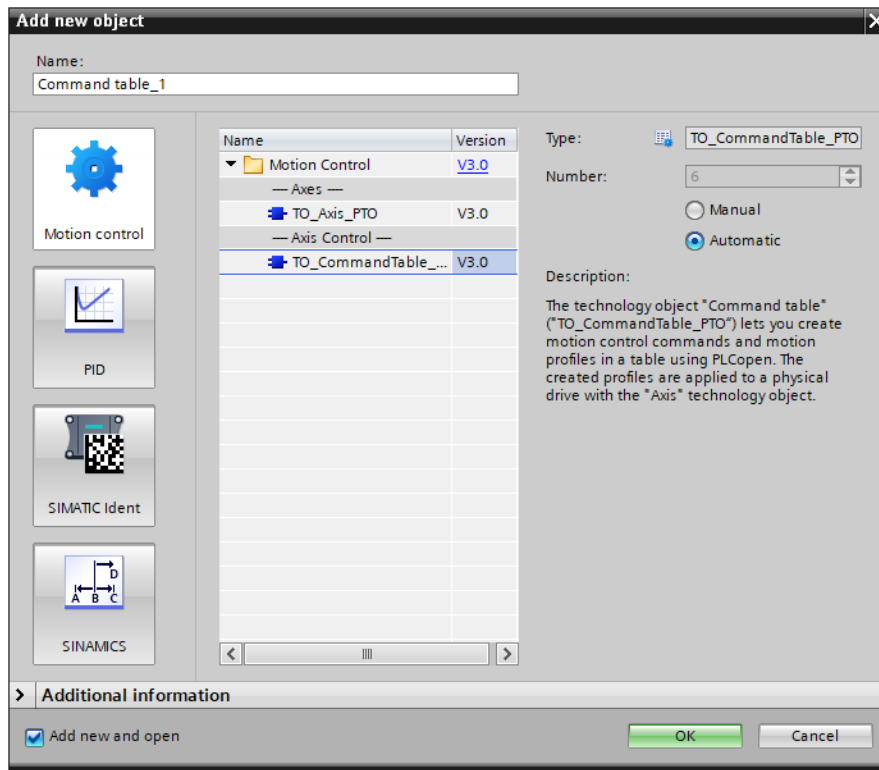


Pulses per motor revolution:

Load movement per motor revolution:

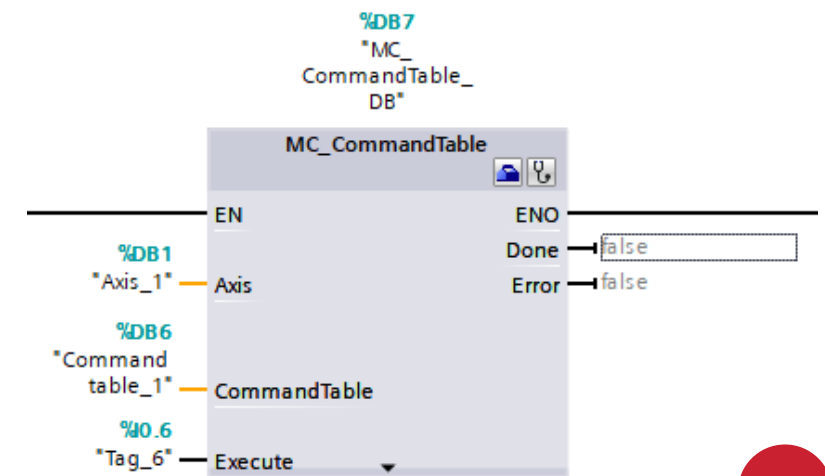
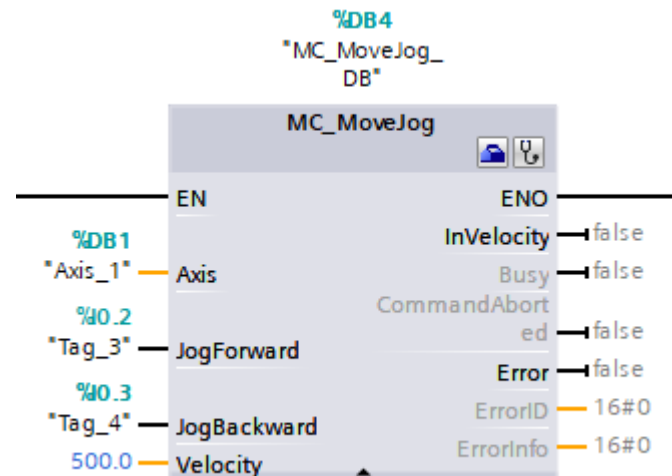
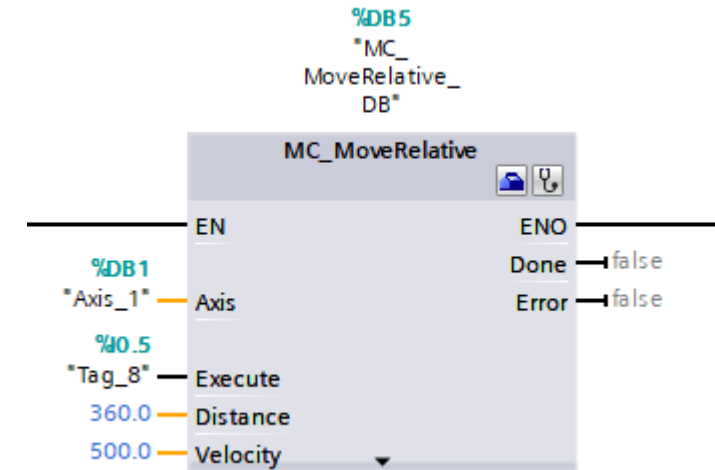
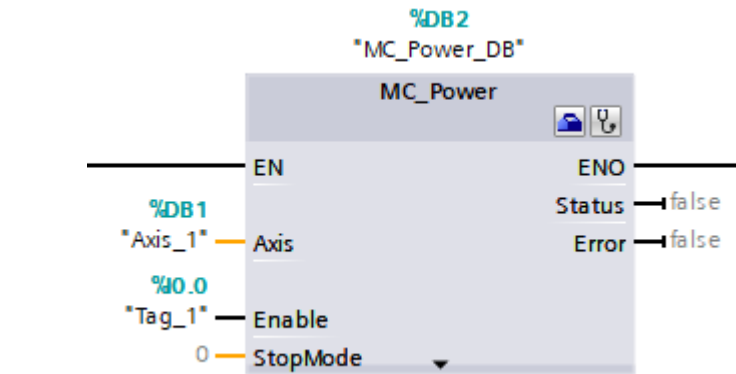
☐ Invert direction signal

# SIEMENS TIA Portal – konfigurowanie instrukcji CommandTable



# SIEMENS TIA Portal – konfigurowanie instrukcji CommandTable

|   |                  |                      |
|---|------------------|----------------------|
| ▶ | Counting         | V1.1                 |
| ▶ | PID Control      |                      |
| ▼ | Motion Control   | <a href="#">V3.0</a> |
|   | MC_Power         | V3.0                 |
|   | MC_Reset         | V3.0                 |
|   | MC_Home          | V3.0                 |
|   | MC_Halt          | V3.0                 |
|   | MC_MoveAbsolute  | V3.0                 |
|   | MC_MoveRelative  | V3.0                 |
|   | MC_MoveVelocity  | V3.0                 |
|   | MC_MoveJog       | V3.0                 |
|   | MC_CommandTable  | V3.0                 |
|   | MC_ChangeDynamic | V3.0                 |
| ▶ | SINAMICS         | V1.0                 |



# SIEMENS TIA Portal – sterowanie ruchem

|                  |                      |  |
|------------------|----------------------|--|
| ▶ Counting       | V1.1                 |  |
| ▶ PID Control    |                      |  |
| ▼ Motion Control | <a href="#">V3.0</a> |  |
| MC_Power         | V3.0                 |  |
| MC_Reset         | V3.0                 |  |
| MC_Home          | V3.0                 |  |
| MC_MoveAbsolute  | V3.0                 |  |
| MC_MoveRelative  | V3.0                 |  |
| MC_MoveVelocity  | V3.0                 |  |
| MC_MoveJog       | V3.0                 |  |
| MC_CommandTable  | V3.0                 |  |
| MC_ChangeDynamic | V3.0                 |  |
| ▶ SINAMICS       | V1.0                 |  |

