

## Knob Potentiometer



### FEATURES

- Test according to CECC 41000 or IEC 60393-1
- **P16** - version for professional and industrial applications (cermet)
  - 1 W at 40 °C
- **PA16** - version for professional audio applications (conductive plastic)
  - 0.5 W at 40 °C
- Compact (integrated)
- High dielectric strength: 2500 V<sub>RMS</sub>
- Fully sealed and panel sealed
- Blue, white, yellow, red, and black knob
- Several marking: dot, line, gradient, 5 graduations, 10 graduations, fan, light, volume, temperature
- Metallic or plastic knob options
- Custom knob and marking on request
- Detent option on request (haptic technology)
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



### LINKS TO ADDITIONAL RESOURCES

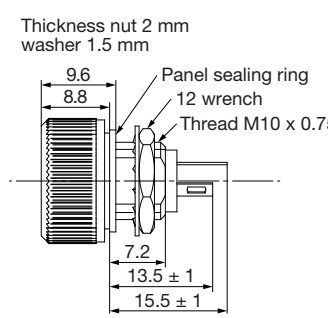
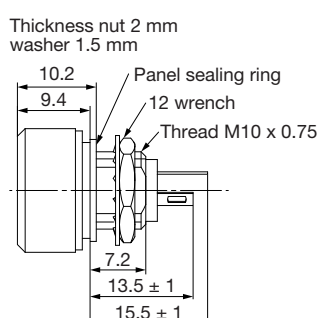
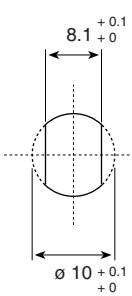
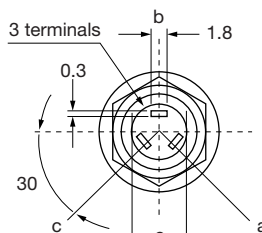
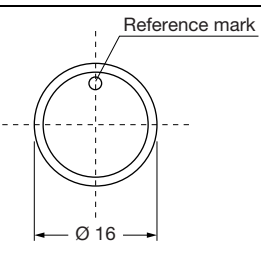


The P16 is a revolutionary concept in panel mounted potentiometers. This unique design consists of a knob driving and incorporating a cermet potentiometer. Only the mounting hardware and terminals are situated on the back side of the panel reducing to a minimum the required clearance.

### QUICK REFERENCE DATA

|                         |                                                   |
|-------------------------|---------------------------------------------------|
| Multiple module         | No                                                |
| Switch module           | Upgrade for switch version with P16S              |
| Detent module           | Yes                                               |
| Special electrical laws | A: linear, L: logarithmic, F: reverse logarithmic |
| Sealing level           | IP 67                                             |
| Lifespan                | 50K cycles                                        |

### DIMENSIONS in millimeters (± 0.5 mm)

|                                                                                                                                            |                                                                                                                                            |                                                                                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| <b>P16NP</b><br>Thickness nut 2 mm<br>washer 1.5 mm<br> | <b>P16NM</b><br>Thickness nut 2 mm<br>washer 1.5 mm<br> | <b>Panel Cutout</b><br> |
|                                                         |                                                         |                                                                                                              |



| ELECTRICAL SPECIFICATIONS                    |                                                                       |                                     |
|----------------------------------------------|-----------------------------------------------------------------------|-------------------------------------|
|                                              | P16                                                                   | PA16                                |
| Resistive element                            | Cermet                                                                | Conductive plastic                  |
| Electrical travel                            | 270° ± 10°                                                            | 270° ± 10°                          |
| Power rating chart                           |                                                                       |                                     |
| Circuit diagram                              |                                                                       |                                     |
| Taper                                        |                                                                       |                                     |
| Resistance range                             | Linear taper<br>22 Ω to 10 MΩ<br>Logarithmic taper<br>100 Ω to 2.2 MΩ | 1 kΩ to 1 MΩ<br>470 Ω to 500 kΩ     |
| Standard series E3                           | 1 - 2.2 - 4.7 and on request 1 - 2 - 5                                | 1 - 2.2 - 4.7                       |
| Tolerance                                    | Standard<br>± 20 %<br>On request<br>± 10 %                            | ± 20 %<br>± 10 % (1 kΩ to 100 kΩ)   |
| Power rating                                 | Linear<br>1 W at +40 °C<br>Logarithmic<br>0.5 W at +40 °C             | 0.5 W at +40 °C<br>0.25 W at +40 °C |
| Temperature coefficient (typical)            | ± 150 ppm/°C                                                          | ± 500 ppm/°C                        |
| Dielectric strength (RMS)                    | 2500 V                                                                | 2500 V                              |
| Limiting element voltage (linear law)        | 350 V                                                                 | 350 V                               |
| Contact resistance variation                 | 3 % Rn or 3 Ω                                                         | 2 % Rn or 3 Ω                       |
| End resistance (typical)                     | 1 Ω                                                                   | 1 Ω                                 |
| Insulation resistance (500 V <sub>DC</sub> ) | 10 <sup>6</sup> MΩ                                                    | 10 <sup>6</sup> MΩ                  |

**MECHANICAL SPECIFICATIONS**

|                                        |                 |
|----------------------------------------|-----------------|
| Mechanical travel                      | 300° ± 5°       |
| Operating torque                       | 2 Ncm typical   |
| End stop torque                        | 25 Ncm maximum  |
| Max. tightening torque of mounting nut | 180 Ncm maximum |
| Unit Weight                            | 4.5 g typical   |

**ENVIRONMENTAL SPECIFICATIONS**

|                   | METALLIC KNOB                     | PLASTIC KNOB     |
|-------------------|-----------------------------------|------------------|
| Temperature range | -40 °C to +125 °C                 | -40 °C to +85 °C |
| Climatic category | 40/100/56                         | 40/85/56         |
| Sealing           | Sealed container and panel sealed |                  |
| Protection grades | IP67                              |                  |

**MARKING**

- Ohmic value code, tolerance code and taper
- Manufacturing date code

**PACKAGING**

- Carton box of 20 pieces

Hardware: nuts, washer, and O-ring are separately supplied (not mounted on the potentiometer), in a small bag placed in the packaging.

**CONTROL KNOB**

Black metallic knob (NM).

Black plastic knob (NP).

For white, blue, red, and yellow color see "Ordering Information".

Other dimensions, shape, marking, colors of control knobs are manufactured on request - please consult Vishay.

Other reference marks (shapes, colors) and legends can be printed on plastic knob on request - please consult Vishay.

**DETENT OPTION** (haptic technology)

Detent option is a positive tactile feedback.

On request:

the detent mechanism is housed in the P16

Mechanical endurance: 10 000 cycles

One detent in CCW position (CV1D)

One detent in CW position (CV1F)

One detent in CW position and CCW position (CVDF)

Ordering information (special code):

CV1D

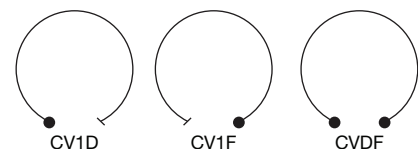
One detent in CCW position

CV1F

Detent in CW position

CVDF

Detent in CW position and CCW position





## P16 STANDARD RESISTANCE ELEMENT DATA

| STAN-<br>DARD<br>RESIS-<br>TANCE<br>VALUES | LINEAR TAPER                 |                 |                                  | LOG TAPER                    |                 |                                  |
|--------------------------------------------|------------------------------|-----------------|----------------------------------|------------------------------|-----------------|----------------------------------|
|                                            | MAX.<br>POWER<br>AT<br>40 °C | MAX.<br>VOLTAGE | MAX.<br>CUR.<br>THROUGH<br>WIPER | MAX.<br>POWER<br>AT<br>40 °C | MAX.<br>VOLTAGE | MAX.<br>CUR.<br>THROUGH<br>WIPER |
|                                            | W                            | V               | mA                               | W                            | V               | mA                               |
| 22                                         | 1                            | 4.69            | 213                              |                              |                 |                                  |
| 47                                         | 1                            | 6.85            | 146                              |                              |                 |                                  |
| 100                                        | 1                            | 10              | 100                              | 0.5                          | 7.1             | 71                               |
| 220                                        | 1                            | 14.8            | 67.4                             | 0.5                          | 10.5            | 48                               |
| 470                                        | 1                            | 21.7            | 46.1                             | 0.5                          | 15.3            | 32.6                             |
| 1K                                         | 1                            | 31.6            | 31.6                             | 0.5                          | 22.4            | 22.4                             |
| 2.2K                                       | 1                            | 46.9            | 21.3                             | 0.5                          | 33.2            | 15.1                             |
| 4.7K                                       | 1                            | 68.5            | 14.6                             | 0.5                          | 48.5            | 10.3                             |
| 10K                                        | 1                            | 100             | 10                               | 0.5                          | 70.7            | 7.07                             |
| 22K                                        | 1                            | 148             | 6.74                             | 0.5                          | 105             | 4.77                             |
| 47K                                        | 1                            | 217             | 4.61                             | 0.5                          | 153             | 3.26                             |
| 100K                                       | 1                            | 316             | 3.16                             | 0.5                          | 224             | 2.24                             |
| 220K                                       | 0.56                         | 350             | 1.59                             | 0.5                          | 332             | 1.51                             |
| 470K                                       | 0.26                         | 350             | 0.75                             | 0.26                         | 350             | 0.74                             |
| 1M                                         | 0.12                         | 350             | 0.35                             | 0.12                         | 350             | 0.35                             |
| 2.2M                                       | 0.05                         | 350             | 0.16                             | 0.056                        | 350             | 0.16                             |
| 4.7M                                       | 0.02                         | 350             | 0.07                             |                              |                 |                                  |
| 10M                                        | 0.01                         | 350             | 0.012                            |                              |                 |                                  |

## PA16 STANDARD RESISTANCE ELEMENT DATA

| STAN-<br>DARD<br>RESIS-<br>TANCE<br>VALUES | LINEAR TAPER                 |                 |                                  | LOG TAPER                    |                 |                                  |
|--------------------------------------------|------------------------------|-----------------|----------------------------------|------------------------------|-----------------|----------------------------------|
|                                            | MAX.<br>POWER<br>AT<br>40 °C | MAX.<br>VOLTAGE | MAX.<br>CUR.<br>THROUGH<br>WIPER | MAX.<br>POWER<br>AT<br>40 °C | MAX.<br>VOLTAGE | MAX.<br>CUR.<br>THROUGH<br>WIPER |
|                                            | W                            | V               | mA                               | W                            | V               | mA                               |
| 470                                        |                              |                 |                                  | 0.25                         | 10.8            | 23.1                             |
| 1K                                         | 0.5                          | 22.4            | 22.4                             | 0.25                         | 15.8            | 16                               |
| 2.2K                                       | 0.5                          | 33.2            | 15.1                             | 0.25                         | 23.5            | 11                               |
| 4.7K                                       | 0.5                          | 48.5            | 10.3                             | 0.25                         | 34.3            | 7                                |
| 10K                                        | 0.5                          | 70.7            | 7.07                             | 0.25                         | 50.0            | 5.0                              |
| 22K                                        | 0.5                          | 105             | 4.77                             | 0.25                         | 74              | 3.4                              |
| 47K                                        | 0.5                          | 153             | 3.26                             | 0.25                         | 108             | 2.3                              |
| 100K                                       | 0.5                          | 224             | 2.24                             | 0.25                         | 158             | 1.6                              |
| 220K                                       | 0.5                          | 332             | 1.51                             | 0.25                         | 235             | 1.1                              |
| 470K                                       | 0.26                         | 350             | 0.74                             | 0.25                         | 343             | 0.7                              |
| 1M                                         | 0.12                         | 350             | 0.35                             |                              |                 |                                  |

## PERFORMANCE

| TESTS                   | CONDITIONS                                                | TYPICAL VALUES AND DRIFTS |                              |                                                                                 |
|-------------------------|-----------------------------------------------------------|---------------------------|------------------------------|---------------------------------------------------------------------------------|
|                         |                                                           | $\Delta R_T/R_T$ (%)      | $\Delta R_{1-2}/R_{1-2}$ (%) | OTHER                                                                           |
| Electrical endurance    | 1000 h at rated power<br>90'/30' cycle at +40 °C          | ± 5 %                     | -                            | Insulation resistance: > 10 <sup>4</sup> MΩ<br>Contact res. variation: < 2 % Rn |
| Damp heat, steady state | 56 days<br>40 °C, 93 % HR                                 | ± 2 %                     | ± 1 %                        | Insulation resistance: > 10 <sup>4</sup> MΩ                                     |
| Mechanical endurance    | 50 000 cycles                                             | ± 5 %                     | -                            | Contact res. variation: < 2 % Rn                                                |
| Shock                   | 50 g's at 11 ms<br>3 successive shocks<br>in 3 directions | ± 0.2 %                   | ± 0.5 %                      | -                                                                               |
| Vibration               | 10 Hz to 55 Hz<br>0.75 mm or 10 g's<br>during 6 h         | ± 0.2 %                   | -                            | $\Delta V_{1-2}/\Delta V_{1-3} \leq \pm 0.5$ %                                  |

## Note

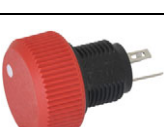
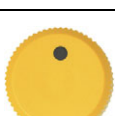
- Nothing stated herein shall be construed as a guarantee of quality or durability



## ORDERING INFORMATION

|                                                                      |                                                                                                                                                                                                         |   |   |                                                                                   |   |   |                                                           |   |                                                                                                      |   |   |                                  |                                                                                                                                                                                                                                                                                                                                                                       |  |  |  |  |
|----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|-----------------------------------------------------------------------------------|---|---|-----------------------------------------------------------|---|------------------------------------------------------------------------------------------------------|---|---|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|
| P                                                                    | 1                                                                                                                                                                                                       | 6 | N | P                                                                                 | 2 | 2 | 3                                                         | M | A                                                                                                    | B | 1 | 5                                |                                                                                                                                                                                                                                                                                                                                                                       |  |  |  |  |
| MODEL                                                                | STYLE                                                                                                                                                                                                   |   |   | OHMIC VALUE                                                                       |   |   | TOLERANCE                                                 |   | TAPER                                                                                                |   |   | PACKAGING CODE                   | SPECIAL NUMBER                                                                                                                                                                                                                                                                                                                                                        |  |  |  |  |
| <b>P16</b> =<br>cermet<br><br><b>PA16</b> =<br>conductive<br>plastic | <b>NM</b> = metallic black<br><b>NP</b> = plastic black<br><b>WM</b> = metallic white<br><b>WP</b> = plastic white<br><b>BP</b> = plastic blue<br><b>RP</b> = plastic red<br><b>YP</b> = plastic yellow |   |   | <b>223</b> = 22 kΩ<br>for ohmic value<br>range see<br>electrical<br>specification |   |   | <b>M</b> = ± 20 %<br><br>On request:<br><b>K</b> = ± 10 % |   | <b>A</b> = linear<br><b>L</b> = clockwise logarithmic<br><b>F</b> = inverse clockwise<br>logarithmic |   |   | <b>B15</b> = box of<br>20 pieces | (If applicable)<br>Given by<br>Vishay<br>for custom<br>design                                                                                                                                                                                                                                                                                                         |  |  |  |  |
|                                                                      |                                                                                                                                                                                                         |   |   |                                                                                   |   |   |                                                           |   |                                                                                                      |   |   |                                  | SPECIAL NUMBER<br>FOR OPTION                                                                                                                                                                                                                                                                                                                                          |  |  |  |  |
|                                                                      |                                                                                                                                                                                                         |   |   |                                                                                   |   |   |                                                           |   |                                                                                                      |   |   |                                  | <b>F1</b> = line marking<br><b>F2</b> = 10 graduations marking<br><b>F3</b> = 5 graduations marking<br><b>F4</b> = gradient marking<br><b>F5</b> = light marking<br><b>F6</b> = fan<br><b>F7</b> = temperature<br><b>F8</b> = volume<br><b>CV1D</b> = detent in CCW position<br><b>CV1F</b> = detent in CW position<br><b>CVDF</b> = detent in CW and<br>CCW position |  |  |  |  |

## KNOB STYLES

| STYLE               | EXAMPLE IMAGES                                                                      |                                                                                       |
|---------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| NP = black plastic  |  |  |
| WP = white plastic  |  |  |
| BP = blue plastic   |  |  |
| RP = red plastic    |  |  |
| YP = yellow plastic |  |  |



| KNOB STYLES      |                                                                                   |                                                                                     |
|------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| STYLE            | EXAMPLE IMAGES                                                                    |                                                                                     |
| NM = black metal |  |  |
| WM = white metal |  |  |

### KNOB MARKING OPTIONS

Several marking options on the top face of the knob are available.

| SPECIAL NUMBER | MARKING        | EXAMPLE IMAGES                                                                      |                                                                                     | AVAILABILITY FOR PLASTIC KNOB | AVAILABILITY FOR METALLIC KNOB |
|----------------|----------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------|--------------------------------|
| -              | Dot (standard) |    |    | Yes                           | Yes                            |
| F1             | Line           |   |   | Yes                           | Yes                            |
| F2             | 10 graduations |  |  | Yes                           | Yes                            |
| F3             | 5 graduations  |  |  | Yes                           | Yes                            |
| F4             | Gradient       |  |  | Yes                           | Yes                            |
| F5             | Light          |  |  | Yes                           | Yes                            |
| F6             | Fan            |  |  | Yes                           | Yes                            |
| F7             | Temperature    |  |  | Yes                           | Yes                            |



| SPECIAL NUMBER | MARKING         | EXAMPLE IMAGES                                                                    |                                                                                   | AVAILABILITY FOR PLASTIC KNOB | AVAILABILITY FOR METALLIC KNOB |
|----------------|-----------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------|--------------------------------|
| F8             | Volume          |  |  | Yes                           | Yes                            |
| (Special code) | Other on demand |  |  | On request                    | On request                     |

**PART NUMBER DESCRIPTION** (for information only)

|       |       |       |           |       |         |           |         |                |
|-------|-------|-------|-----------|-------|---------|-----------|---------|----------------|
| P16   | NP    | 22 kΩ | 20 %      | A     |         | BO        |         | e3             |
| MODEL | STYLE | VALUE | TOLERANCE | TAPER | SPECIAL | PACKAGING | SPECIAL | LEAD (Pb)-FREE |

**ACCESSORIES**

|                                              |                                                                        |
|----------------------------------------------|------------------------------------------------------------------------|
| Additional Accessories (to order separately) | <a href="http://www.vishay.com/doc?51051">www.vishay.com/doc?51051</a> |
|----------------------------------------------|------------------------------------------------------------------------|

**RELATED DOCUMENTS**

| APPLICATION NOTES                                                 |                                                                        |
|-------------------------------------------------------------------|------------------------------------------------------------------------|
| Potentiometers and Trimmers                                       | <a href="http://www.vishay.com/doc?51001">www.vishay.com/doc?51001</a> |
| Guidelines for Vishay Sfernice Resistive and Inductive Components | <a href="http://www.vishay.com/doc?52029">www.vishay.com/doc?52029</a> |
| Capabilities and Custom Options                                   | <a href="http://www.vishay.com/doc?48493">www.vishay.com/doc?48493</a> |



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