



# 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>
- 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)
- Construction: fully sealed
- Professional grade
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



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## 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                | 200K cycles                                       |

| DIMENSIONS in millimeters (± 0.5 mm)                            |   |                            |
|---|---|----------------------------|
| <p><b>P16NP</b></p> <p>Thickness nut 2 mm<br/>washer 1.5 mm</p> | <p><b>P16NM</b></p> <p>Thickness nut 2 mm<br/>washer 1.5 mm</p> | <p><b>Panel Cutout</b></p> |
|   |   |                            |



| ELECTRICAL SPECIFICATIONS                    |                                   |  |
|--|-----------------------------------|--|
|  | P16                               | PA16                                   |
| Resistive element                            | Cermet                            | Conductive plastic                     |
| Electrical travel                            | 270° ± 10°                        | 270° ± 10°                             |
| Power rating                                 | Linear<br>Logarithmic             | 1 W at +40 °C<br>0.5 W at +40 °C       |
|  |                                   | 0.5 W at +40 °C<br>0.25 W at +40 °C    |
|  |                                   |  |
| Circuit diagram                              |                                   |  |
| Taper  |                                   |  |
| Resistance range                             | Linear taper<br>Logarithmic taper | 22 Ω to 10 MΩ<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>On request            | ± 20 %<br>± 10 %                       |
|  |                                   | ± 10 % (1 kΩ to 100 kΩ)                |
| 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   |
|---|
| <ul style="list-style-type: none"> <li>• Ohmic value code, tolerance code and taper</li> <li>• Manufacturing date code</li> </ul> |

| PACKAGING  |
|--|
| <ul style="list-style-type: none"> <li>• Carton box of 20 pieces</li> </ul>  |
| Hardware: nuts, washer, and O-ring are separately supplied (not mounted on the potentiometer), in a small bag placed in the packaging. |

| CONTROL KNOB  |
|---|
| <p>Black metallic knob (NM).</p> <p>Black plastic knob (NP).</p> <p>For white, blue, red, and yellow color see "Ordering Information".</p> <p>Other dimensions, shape, marking, colors of control knobs are manufactured on request - please consult Vishay.</p> <p>Other reference marks (shapes, colors) and legends can be printed on plastic knob on request - please consult Vishay.</p> |

| DETENT OPTION (haptic technology)  |  |  |
|--|--|--|
| <p>Detent option is a positive tactile feedback.</p> <p>On request:<br/>the detent mechanism is housed in the P16</p> <p>Mechanical endurance: 10 000 cycles</p> <p>One detent in CCW position (CV1D)</p> <p>One detent in CW position (CV1F)</p> <p>One detent in CW position and CCW position (CVDF)</p> | <p>Ordering information (special code):</p> <p><u>CV1D</u><br/>One detent in CCW position</p> <p><u>CV1F</u><br/>Detent in CW position</p> <p><u>CVDF</u><br/>Detent in CW position and CCW position</p> |  |



| 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 (no load) | 200 000 cycles  | ± 2 %                     | -                            | Contact res. variation: < 3 % Rn<br>Independent linearity: ≤ ± 5 %              |
| 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





| OPTION RELATIVE TO APPLICATION   |
|--|
| “K14” OPTION for AMS applications (avionics, military, and space)  |
| “K17” OPTION for MEDICAL applications  |
| Option guarantees: <ul style="list-style-type: none"> <li>Reinforced incoming inspection on raw material</li> <li>Traceability of all materials used in the composition of the product</li> <li>50-year traceability (AMS market) / 20-year traceability (MEDICAL market)</li> <li>Customer information for any process or product modification having an impact on the function, mountability, shape or reliability of the product</li> <li>Periodic product monitoring</li> <li>Dedicated technical specification</li> </ul> |



| 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> = cermet<br><br><b>PA16</b> = conductive 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 range see electrical 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 logarithmic |   | <b>B15</b> = box of 20 pieces |   | (If applicable)<br>Given by Vishay for custom design |  |                |  |  |  |  |  |  |
|   |   |  |   |             |   |   |   |   |                               |   |  | SPECIAL NUMBER 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 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  |  |
|--|--|
| Potentiometers are delivered with accessories (nut, washer...) |  |
| Additional Accessories (to order separately)                   | <a href="http://www.vishay.com/doc?51051">www.vishay.com/doc?51051</a> |
| Control knobs  | <a href="http://www.vishay.com/doc?51101">www.vishay.com/doc?51101</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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