



**THE DATASHEET OF
PT4223C**





Features

- 10W Output Power
- Input Voltage: 36V to 75V
- Output Voltages: 1.2V to 13.2V
- 1500 VDC Isolation
- Temp Range: -40°C to +85°C
- Remote On/Off Control
- Undervoltage Lockout
- Output Current Limit
- Short-Circuit Protection
- Low-Profile Package (8mm)
- Space Saving Package
- Solderable Copper Case
- Safety Agency Approvals:
UL 60950
CSA 22.2 60950

Description

The PT4220 power modules are a series of DC/DC converters housed in an ultra-low profile (8mm) solderable copper case. The series includes a number of preset output voltages ranging from 1.3V[†] up to 12V, all fully approved for Telecom use. They may also be used in many other applications that require input-output isolation over an extended temperature range. The modules are an ideal choice for low-power digital and analog circuits, including DSPs and microcontrollers. The flexibility of input-output isolation also allows the output to be configured for negative voltage operation.

The PT4220 series is made available in both horizontal and vertical pin configurations, including surface mount.

Ordering Information

| | | |
|-----------|---------------------------|--------|
| PT4221□ | =1.8V/3A | (5.4W) |
| PT4222□ | =3.3V/3A | |
| PT4223□ | =5.0V/2A | |
| PT4224□ | =12.0V/0.85A | |
| PT4225□ | =2.5V/3A | (7.5W) |
| PT4226□ | =1.5V/3A | (4.5W) |
| † PT4227□ | =1.3V/3A | (3.9W) |
| † | <i>Adjustable to 1.2V</i> | |

PT Series Suffix (PT1234 x)

| Case/Pin Configuration | Order Suffix | Package Code |
|------------------------|--------------|--------------|
| Vertical | N | (EPE) |
| Horizontal | A | (EPF) |
| SMD | C | (EPG) |

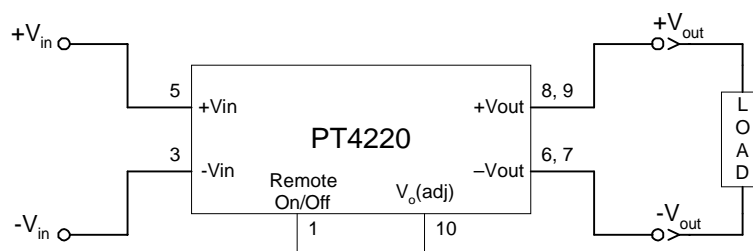
(Reference the applicable package code drawing for the dimensions and PC board layout)

Pin-Out Information

| Pin | Function |
|-----|----------------------|
| 1 | Remote On/Off * |
| 2 | Do not connect |
| 3 | -V _{in} |
| 4 | Do not connect |
| 5 | +V _{in} |
| 6 | -V _{out} |
| 7 | -V _{out} |
| 8 | +V _{out} |
| 9 | +V _{out} |
| 10 | V _o Adj * |

* For further information, see application notes.

Standard Application



PT4220 Series

10-W Low-Profile 48V-Input Isolated DC/DC Converter

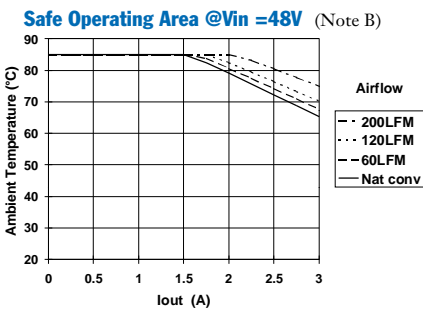
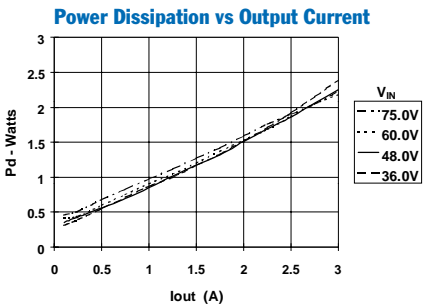
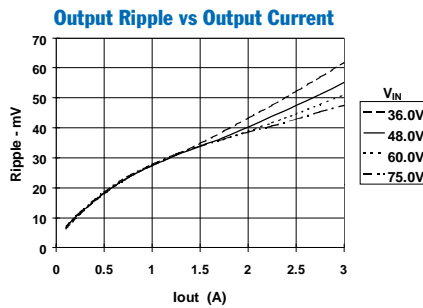
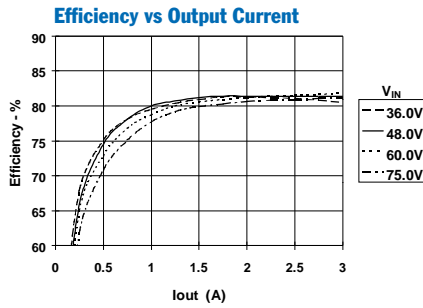
Specifications (Unless otherwise stated, $T_a = 25^\circ\text{C}$, $V_{in} = 48\text{V}$, $C_{in} = 0\mu\text{F}$, $C_{out} = 0\mu\text{F}$, and $I_o = I_{o,max}$)

| Characteristic | Symbol | Conditions | PT4220 SERIES | | | Units |
|--|---------------------|--|--|---------------------------------|--|---------------------------------|
| | | | Min | Typ | Max | |
| Output Current | I_o | Over V_{in} range | $V_o \leq 3.3\text{V}$ $V_o = 5.0\text{V}$ $V_o = 12\text{V}$ | 0.1 (1) 0.1 (1) 0.1 (1) | — 2 0.85 | 3 |
| Input Voltage Range | V_{in} | Over I_o Range | | 36.0 | 48.0 | 75.0 |
| Set Point Voltage Tolerance | $V_o \text{ tol}$ | | | — | ± 1 | ± 2 |
| Temperature Variation | Reg_{temp} | $-40^\circ \leq T_a \leq +85^\circ\text{C}$, $I_o = I_{o,min}$ | | — | ± 0.2 | — |
| Line Regulation | Reg_{line} | Over V_{in} range | | — | ± 1 | — |
| Load Regulation | Reg_{load} | Over I_o range | | — | ± 5 | — |
| Total Output Voltage Variation | $\Delta V_{o,tot}$ | Includes set-point, line, load, $-40^\circ \leq T_a \leq +85^\circ\text{C}$ | | — | ± 1.5 | ± 3 |
| Efficiency | η | | $V_o = 12\text{V}$ $V_o = 5.0\text{V}$ $V_o = 3.3\text{V}$ $V_o = 2.5\text{V}$ $V_o = 1.8\text{V}$ $V_o = 1.5\text{V}$ $V_o = 1.3\text{V}$ | — — — — — — — | 87 85 81 78 73 71 65 | — — — — — — — |
| V_o Ripple (pk-pk) | V_r | 20MHz bandwidth | $V_o \leq 5.0\text{V}$ $V_o = 12\text{V}$ | — — | 50 100 | — — |
| Transient Response | t_{tr} | 1A/ μs load step, 50% to 100% $I_{o,max}$ | | — | 75 | — |
| | ΔV_{tr} | V_o over/undershoot | $V_o \leq 5.0\text{V}$ $V_o = 12\text{V}$ | — — | ± 150 ± 350 | — — |
| Output Voltage Adjust | V_{adj} | | $V_o \geq 2.5\text{V}$ | ± 10 | — | — |
| Current Limit Threshold | I_{lim} | $V_{in} = 36\text{V}$, $\Delta V_o = -1\%$ | | — | 150 | — |
| Switching Frequency | f_s | Over V_{in} range | | 250 | 300 | 350 |
| Under-Voltage Lockout | UVLO | | | — | 32 | — |
| Remote On/Off (Pin 1) | | Referenced to $-V_{in}$ (pin 3) | | | | |
| Input High Voltage | V_{IH} | | | 4.5 | — | Open (3) |
| Input Low Voltage | V_{IL} | | | -0.2 | — | +0.8 |
| Input Low Current | I_{IL} | | | — | -0.5 | — |
| Standby Input Current | $I_{in, standby}$ | pins 1 & 3 connected | | — | 1 | — |
| Internal Input Capacitance | C_{in} | | | — | 0.66 | — |
| External Output Capacitance | C_{out} | | $V_o \leq 5.0\text{V}$ | 0 (5) | — | 1000 |
| | | | $V_o = 12\text{V}$ | 0 (5) | — | 330 |
| Isolation Voltage Capacitance Resistance | | Input-output/input-case | | 1500 | — | — |
| | | Input to output | | — | 1,100 | — |
| | | Input to output | | 10 | — | — |
| Operating Temperature Range | T_a | Over V_{in} range | | -40 | — | +85 (4) |
| Storage Temperature | T_s | — | | -40 | — | +125 |
| Reliability | MTBF | Per Bellcore TR-332 50% stress, $T_a = 40^\circ\text{C}$, ground benign | | 4.7 | — | — |
| Mechanical Shock | — | Per Mil-Std-883D, method 2002.3, 1mS, half-sine, mounted to a fixture | | — | 500 | — |
| Mechanical Vibration | — | Mil-Std-883D, Method 2007.2 20-2000Hz, all case styles soldered to PC | | — | 20 (6) | — |
| Weight | — | — | | — | 20 | — |
| Flammability | — | Materials meet UL 94V-0 | | — | — | — |

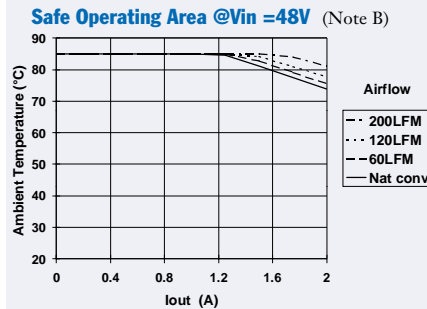
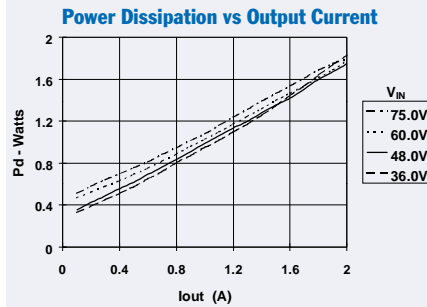
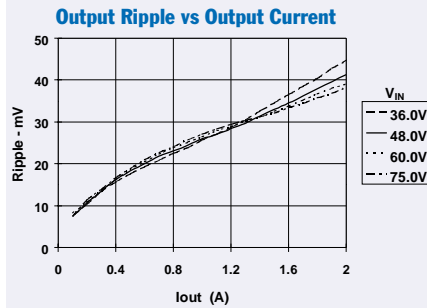
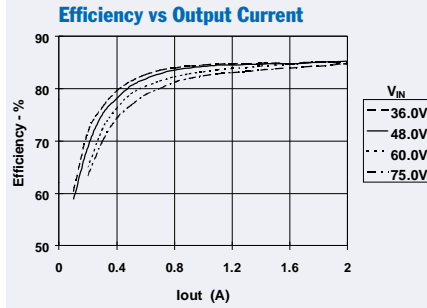
- Notes:**
- (1) The DC/DC converter will operate at no load with reduced specifications.
 - (2) The maximum output current reduces the output power of the following devices to less than 10W:-
PT4225 = 7.5W; PT4221 = 5.4W; PT4226 = 4.5W; PT4227 = 3.9W.
 - (3) The Remote On/Off (pin 1) has an internal pull-up, and if it is left open circuit the converter will operate when input power is applied. The open-circuit voltage is typically 5V. Refer to the application notes for interface considerations.
 - (4) See Safe Operating Area curves or contact the factory for the appropriate derating.
 - (5) An output capacitor is not required for proper operation.
 - (6) The case pins on through-hole pin configurations (N & A) must be soldered. For more information see the applicable package outline drawing.

10-W Low-Profile 48V-Input Isolated DC/DC Converter

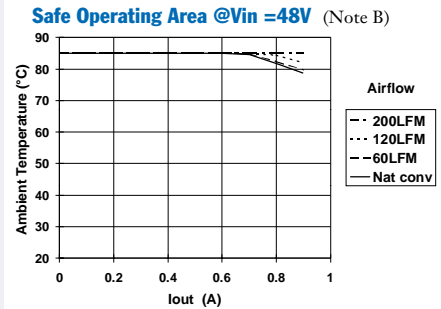
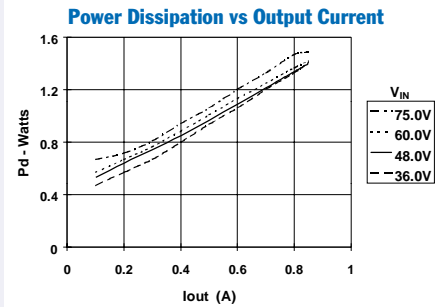
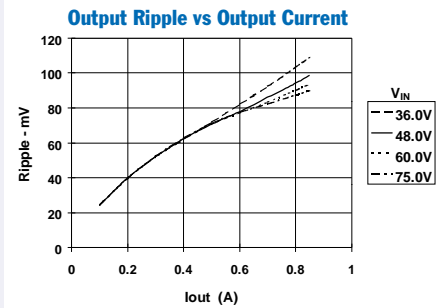
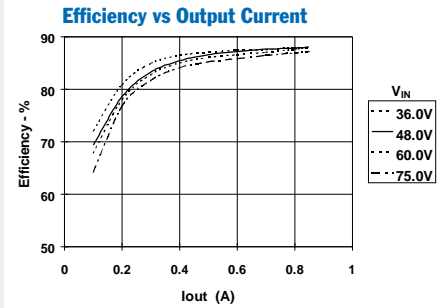
PT4222, $V_o = 3.3\text{VDC}$ (See Note A)



PT4223, $V_o = 5.0\text{VDC}$ (See Note A)



PT4224, $V_o = 12.0\text{VDC}$ (See Note A)



Note A: Characteristic data has been developed from actual products tested at 25°C. This data is considered typical data for the Converter.
 Note B: SOA curves represent the conditions at which internal components are at or below the manufacturer's maximum operating temperatures

Using the Remote On/Off with the PT4220/4240 Isolated 10W Excalibur™ DC/DC Converters

For applications requiring output voltage On/Off control, the PT4220/4240 DC/DC converter series incorporates a “Remote On/Off” control (pin 1). This feature can be used to switch the module off without removing the applied input source voltage.

The converter functions normally with Pin 1 open-circuit, providing a regulated output voltage when a valid source voltage is applied to $+V_{in}$ (pin 5), with respect to $-V_{in}$ (pin 3). When a low-level¹ ground signal is applied to pin 1, the converter output will be turned off.

Figure 1 shows an application schematic, which details the typical use of the *Remote On/Off* function. Note the discrete transistor (Q1). The pin has its own internal pull-up, allowing it to be controlled with an open-collector or open-drain device (See notes 2 & 3). Table 1 gives the threshold requirements.

When placed in the “Off” state, the standby current drawn from the input source is typically reduced to less than 1mA.

Table 1; Pin 1 Remote On/Off Control Parameters¹

| Parameter | Min | Typ | Max |
|--------------------------------|------|------|--------|
| Enable (V_{IH}) | 4.5V | — | — |
| Disable (V_{IL}) | — | — | 0.8V |
| $V_{O/c}$ [Open-Circuit] | — | 5.0V | — |
| I_{in} [pin 1 at $-V_{in}$] | — | — | -0.5mA |

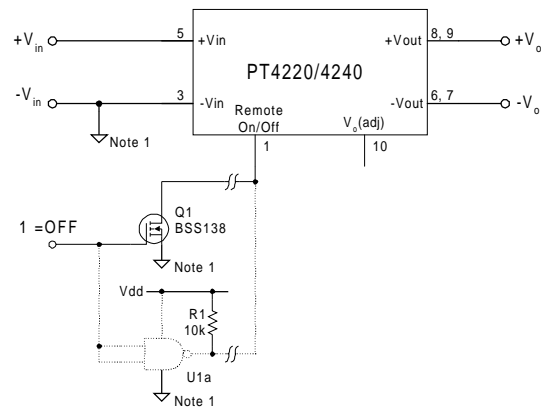
Notes:

1. The *Remote On/Off* control uses $-V_{in}$ (pin 3) as its ground reference. All voltages specified are with respect to $-V_{in}$.
2. Use an open-collector device (preferably a discrete transistor) for the *Remote On/Off* input. A pull-up resistor is not necessary. To disable the output voltage, the control pin should be pulled low to less than +0.8VDC.
3. The *Remote On/Off* pin may be controlled with devices that have a totem-pole output. This is provided the drive voltage meets the threshold requirements in Table 1. Do not apply more than +20V. If a TTL gate is used, a pull-up resistor may be required to the logic supply voltage.
4. The PT4220/4240 converters incorporate an “Under-Voltage Lockout” (UVLO). The UVLO will keep the module off when the input voltage to the converter is low, regardless of the state of the *Remote On/Off* control. Table 2 gives the UVLO input voltage thresholds.

Table 2; UVLO Thresholds⁴

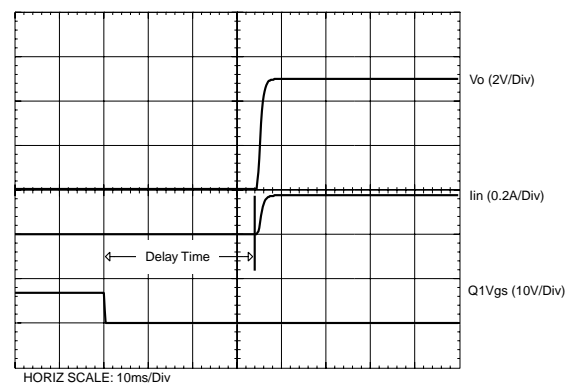
| Series | V_{in} Range | UVLO Threshold |
|--------|----------------|----------------|
| PT4220 | 36 – 75V | 32V \pm 2V |
| PT4240 | 18 – 36V | 15.8V \pm 2V |

Figure 1



Turn-On Time: In the circuit of Figure 1, turning Q1 on applies a low-voltage to pin 1 and disables the converter output. Correspondingly, turning Q1 off allows pin 1 to be pulled high by an internal pull-up resistor. The converter produces a regulated output voltage within 60ms. Figure 2 shows the output response of a PT4223 (5.0V) following the turn-off of Q1. The turn off of Q1 corresponds to the drop in Q1 Vgs. Although the rise-time of the output voltage is short (<5ms), the indicated delay time will vary depending upon the input voltage and the module’s internal timing. The waveform was measured with a 48Vdc input voltage, and a 1.4A resistive load.

Figure 2



Adjusting the Output Voltage of the 10W-Rated Excalibur™ Series of Isolated DC/DC Converters

The factory pre-set output voltage of Power Trends' 10W Excalibur series of isolated DC-DC converters may be adjusted over a narrow range. This is accomplished with the addition of a single external resistor. For the input voltage range specified in the data sheet, Table 1 gives the allowable adjustment range for each model as V_o (min) and V_o (max).

Adjust Up: An increase in the output voltage is obtained by adding a resistor, R_2 between pin 10 (V_o adjust), and pins 6 & 7 ($-V_{out}$).

Adjust Down: Add a resistor (R_1), between pin 10 (V_o adjust) and pins 8 & 9 ($+V_{out}$).

Refer to Figure 1 and Table 2 for both the placement and value of the required resistor, (R_1) or R_2 .

The values of (R_1) [adjust down], and R_2 [adjust up], can also be calculated using the following formulas.

$$(R_1) = \frac{56.2 (V_a - 1.225)}{V_o - V_a} - R_s \quad \text{k}\Omega$$

$$R_2 = \frac{68.845}{V_a - V_o} - R_s \quad \text{k}\Omega$$

Where, V_o = Original output voltage
 V_a = Adjusted output voltage
 R_s = Internal resistance (Table 1)

Notes:

1. Use only a single 1% resistor in either the (R_1) or R_2 location. Place the resistor as close to the ISR as possible.
2. Never connect capacitors to V_o adjust. Any capacitance added to the V_o adjust control pin will affect the stability of the ISR.
3. The output power is limited to 10W. If the output voltage is increased, the maximum load current must be derated according to the following equation.

$$I_o(\text{max}) = \frac{10}{V_a}$$

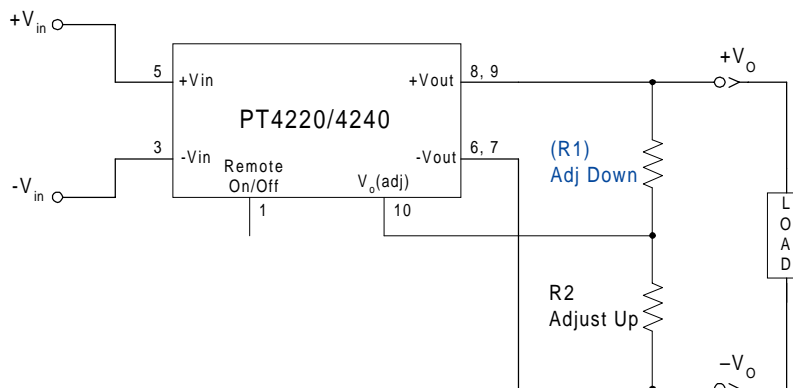
In any instance, the load current must not exceed the converter's rated current (See Table 1).

Table 1

DC/DC CONVERTER ADJUSTMENT RANGE AND FORMULA PARAMETERS

| Series Pt # | PT4247 | PT4246 | PT4241 | PT4245 | PT4242 | PT4243 | PT4244 |
|----------------------------|--------|--------|--------|--------|--------|--------|--------|
| 24V Bus | PT4247 | PT4246 | PT4241 | PT4245 | PT4242 | PT4243 | PT4244 |
| 48V Bus | PT4227 | PT4226 | PT4221 | PT4225 | PT4222 | PT4223 | PT4224 |
| Rated Current ³ | 3A | 3A | 3A | 3A | 3A | 2A | 0.85A |
| V_o (nom) | 1.3V | 1.5V | 1.8V | 2.5V | 3.3V | 5.0V | 12.0V |
| V_o (min) | 1.2V | 1.45V | 1.7V | 2.25V | 2.95V | 4.5V | 10.8V |
| V_o (max) | 1.4V | 1.65V | 1.98V | 2.75V | 3.65V | 5.5V | 13.2V |
| R_s (k Ω) | 340.0 | 243.0 | 243.0 | 187.0 | 187.0 | 110.0 | 49.9 |

Figure 1



PT4220/4240 Series

Table 2

DC/DC CONVERTER ADJUSTMENT RESISTOR VALUES

| Series Pt # | | | | | | | |
|-----------------------------|-----------|----------|-----------|------------|------------|-----------------------------|------------|
| 24V Bus | PT4247 | PT4246 | PT4241 | PT4245 | PT4242 | PT4243 | PT4244 |
| 48V Bus | PT4227 | PT4226 | PT4221 | PT4225 | PT4222 | PT4223 | PT4224 |
| V_o(nom) | 1.3V | 1.5V | 1.8V | 2.5V | 3.3V | 5.0V | 12.0V |
| V_a(req'd) | | | | | | V_a(req'd) | |
| 1.2 | (0.0)kΩ | | | | | 4.5 | (258.0)kΩ |
| 1.25 | (340.0)kΩ | | | | | 4.6 | (364.0)kΩ |
| 1.3 | | | | | | 4.7 | (541.0)kΩ |
| 1.35 | 340.0kΩ | | | | | 4.8 | (895.0)kΩ |
| 1.4 | 0.0.0kΩ | | | | | 4.9 | (1960.0)kΩ |
| 1.45 | | (9.9)kΩ | | | | 5.0 | |
| 1.5 | | | | | | 5.1 | 578.0kΩ |
| 1.55 | | 1130.0kΩ | | | | 5.2 | 234.0kΩ |
| 1.6 | | 445.0kΩ | | | | 5.3 | 119.0kΩ |
| 1.65 | | 216.0kΩ | | | | 5.4 | 62.1kΩ |
| 1.7 | | | (23.9)kΩ | | | 5.5 | 27.7kΩ |
| 1.75 | | | (347.0)kΩ | | | 10.8 | (399.0)kΩ |
| 1.8 | | | | | | 11.0 | (499.0)kΩ |
| 1.85 | | | 1130.0kΩ | | | 11.5 | (1110.0)kΩ |
| 1.9 | | | 445.0kΩ | | | 12.0 | |
| 1.95 | | | 216.0kΩ | | | 12.5 | 87.8kΩ |
| 2.25 | | | | (43.4)kΩ | | 13.0 | 18.9kΩ |
| 2.3 | | | | (115.0)kΩ | | 13.2 | 7.5kΩ |
| 2.35 | | | | (235.0)kΩ | | | |
| 2.4 | | | | (473.0)kΩ | | | |
| 2.45 | | | | (1190.0)kΩ | | | |
| 2.5 | | | | | | | |
| 2.55 | | | | 1190.0kΩ | | | |
| 2.6 | | | | 501.0kΩ | | | |
| 2.65 | | | | 272.0kΩ | | | |
| 2.7 | | | | 157.0kΩ | | | |
| 2.75 | | | | 88.4kΩ | | | |
| 2.95 | | | | | (90.0)kΩ | | |
| 3.0 | | | | | (146.0)kΩ | | |
| 3.05 | | | | | (223.0)kΩ | | |
| 3.1 | | | | | (340.0)kΩ | | |
| 3.15 | | | | | (534.0)kΩ | | |
| 3.2 | | | | | (923.0)kΩ | | |
| 3.25 | | | | | (2090.0)kΩ | | |
| 3.3 | | | | | | | |
| 3.35 | | | | | 1190.0kΩ | | |
| 3.4 | | | | | 501.0kΩ | | |
| 3.45 | | | | | 272.0kΩ | | |
| 3.5 | | | | | 157.0kΩ | | |
| 3.55 | | | | | 88.4kΩ | | |
| 3.6 | | | | | 42.5kΩ | | |
| 3.65 | | | | | 9.7kΩ | | |

R₁ = (Blue) R₂ = Black

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