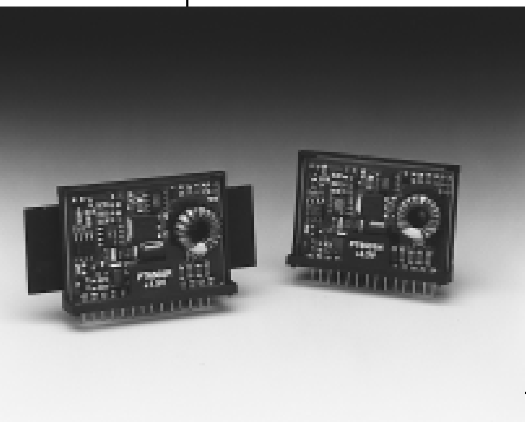
PT6500 Series

8 AMP ADJUSTABLE ISR WITH SHORT-CIRCUIT PROTECTION

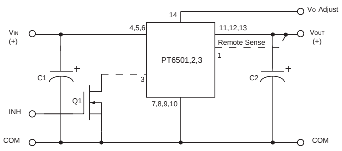
Application Notes
Mechanical Outline
Product Selector Guide



- 8A Single Device Power
- Up to 90% efficiency (PT6501)
- Small SIP Footprint
- Standby Function
- Internal Short Circuit Protection
- Over-Temperature Protection
- Adjustable Output Voltage

The PT6500 series is Power Trends' new high performance +3.1 to 6V input, 8 Amp, 14-Pin SIP (Single In-line-Package) Integrated Switching Regulator (ISR). This high-performance ISR allows easy integration of high-speed, low-voltage Pentium processors and their support logic into existing 3.3V or 5V systems without redesigning the central power supply. The high-performance PT6502 solves the problem of providing the low terminating voltages required by BTL/ Futurebus+, CTT, HP, and GTL Buses from existing 3.3V or 5V power rails without redesigning the central power supply.

Standard Application



C_1 = Required 330µF electrolytic
C_2 = Required 330µF electrolytic

Pin-Out Information

Pin	Function
1	Remote Sense
2	Do not connect
3	STBY*-Standby
4	V_{in}
5	V_{in}
6	V_{in}
7	GND
8	GND
9	GND
10	GND
11	V_{out}
12	V_{out}
13	V_{out}
14	V_{out} Adjust

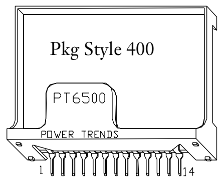
Ordering Information

PT6501□ = 3.3 Volts
† **PT6502□** = 1.5 Volts
PT6503□ = 2.5 Volts
PT6504□ = 3.6 Volts
† **PT6505□** = 1.2 Volts
† **PT6506□** = 1.8 Volts
† **PT6507□** = 1.3 Volts
† **PT6508□** = 1.7 Volts

†3.3V Input Bus Capable

PT Series Suffix (PT1234X)

Case/Pin Configuration	Heat Tab Configuration: *None*	Heat Tab Configuration: *Side*
Vertical Through-Hole	N	R
Horizontal Through-Hole	A	G
Horizontal Surface Mount	C	B



Specifications

Characteristics (T_a=25°C unless noted)	Symbols	Conditions	PT6500 SERIES Min	Typ	Max	Units
Output Current	I_o	Over V_{in} range	0.1*	—	8.0	A
Current Limit	I_{cl}	V_{in}=+5V	—	13.0	20.0	A
Short Circuit Current	I_{sc}	V_{in}=+5V	—	15.0	—	Apk
Input Voltage Range	V_{in}	$0.1 \le I_o \le 8.0A$ V_o=2.5V and 3.3V V_o=1.5V, 1.2V, 1.3V V_o=3.6V	4.5 3.1 4.8	— — —	6 6 6	V V V
Output Voltage Tolerance	ΔV_o	V_{in} = +5V, I_o = 8.0A T_a = 0 to +70°C	V_o-0.1	—	V_o+0.1	V
Output Adjust Range	V_o	V_{nom} = 3.3V V_{adj} = (PT6501) V_{nom} = 1.5V V_{adj} = (PT6502) V_{nom} = 2.5V V_{adj} = (PT6503) Pin 14 to V_o or GND V_{adj} = (PT6504)	2.25 1.27 1.80 2.50	— — —	4.20 2.65 3.50 4.30	V_{in}min=3.1V or Vo+1.2V (whichever is greater)
Line Regulation	Reg_{line}	$4.5V \le V_{in} \le 6.0V$, I_o = 8.0A (PT6501/4) $3.1V \le V_{in} \le 6.0V$, I_o = 8.0A (PT6502) $4.5V \le V_{in} \le 6.0V$, I_o = 8.0A (PT6503)	— —	±7 ±3 ±7	±17 ±8 ±13	mV
Load Regulation	Reg_{load}	$0.1 \le I_o \le 8.0A$, V_{in} = +5V (PT6501/4) (PT6502) (PT6503)	— —	±17 ±12 ±13	±33 ±23 ±25	mV
V_o Ripple/Noise	V_n	V_{in} = +5V, I_o = 8.0 Amp	—	50	—	mVpp
Transient Response with C_o = 330µF	t_{tr} V_{os}	I_o step from 4A to 8.0A V_o over/undershoot	— —	100 150	— —	µsec mV
Efficiency	η	V_{in} = +5V, I_o = 3.0A (PT6501/6504) (PT6502) (PT6503) V_{in} = +5V, I_o = 8.0A (PT6501/6504) (PT6502) (PT6503)	— — — — — —	90 76 85 83 68 76	— — — — — —	% % % % % %

* ISR will operate down to no load with reduced specifications.

Note: *The PT6500 Series requires a 330µF electrolytic or tantalum input and output capacitor for proper operation in all applications. See PT6000/7000 Series Capacitor application note.*

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Specifications *(continued)*

Characteristics (T_a=25°C unless noted)	Symbols	Conditions	PT65000 SERIES Min	Typ	Max	Units
Switching Frequency	f_o	Over V_{in} and I_o ranges	475	600	725	KHz
Absolute Maximum Operating Temperature Range	T_a		0	—	+85	°C
Recommended Operating Temperature Range	T_a	V_{in} = +5V, I_o = 6.0A Free Air Convection (40-60LFM)	0	—	+70**	°C
Thermal Resistance	θ_{ja}	Free Air Convection (40-60LFM)	—	15	—	°C/W
Storage Temperature	T_s	—	-40	—	+125	°C
Mechanical Shock		Per Mil-STD-883D, Method 2002.3, 1msec, half sine, fixture mounted	—	500	—	G's
Mechanical Vibration			—	7.5	—	G's
Weight			—	23	—	grams

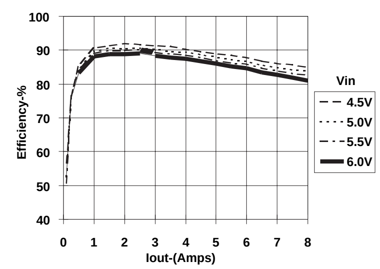
** See Thermal Derating charts.
Note: *The PT6500 Series requires a 330µF electrolytic or tantalum input and output capacitor for proper operation in all applications.*

CHARACTERISTIC DATA

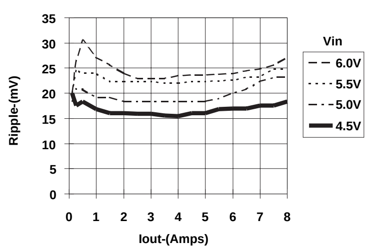
PT6501, 3.3 VDC, V_{in}=5.0V

(See Note 1)

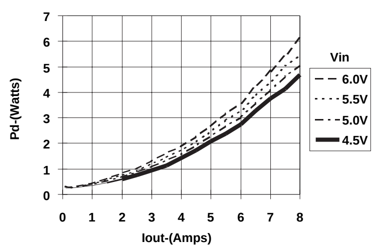
Efficiency vs Output Current



Ripple vs Output Current



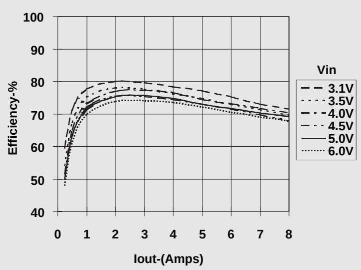
Power Dissipation vs Output Current



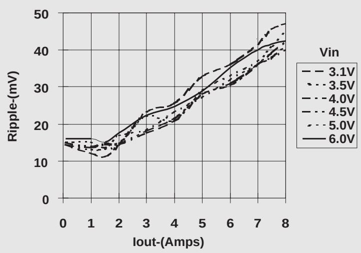
PT6502, 1.5 VDC, V_{in}=5.0V

(See Note 1)

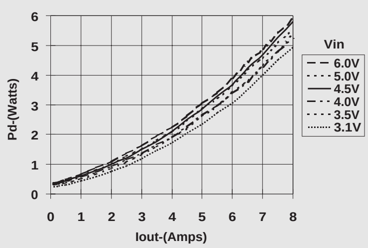
Efficiency vs Output Current



Ripple vs Output Current



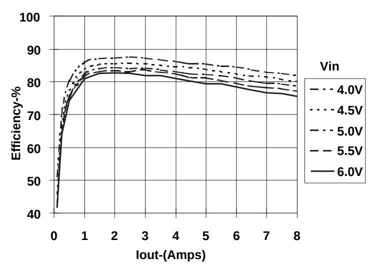
Power Dissipation vs Output Current



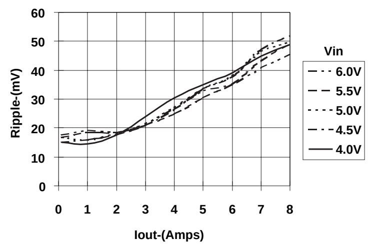
PT6503, 2.5 VDC, V_{in}=5.0V

(See Note 1)

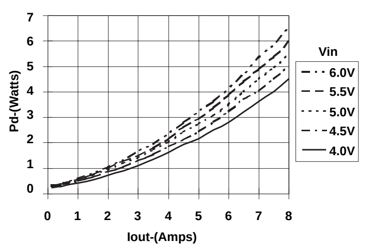
Efficiency vs Output Current



Ripple vs Output Current



Power Dissipation vs Output Current



Note 1: *All data listed in the above graphs, except for derating data, has been developed from actual products tested at 25°C. This data is considered typical data for the ISR.*

PT6500 THERMAL DATA

THERMAL DERATING CURVES

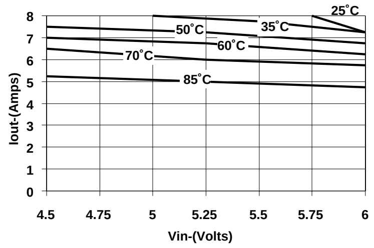
Air Flow (LFM)

60	200	300

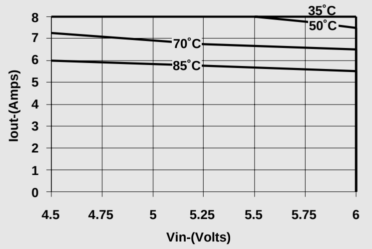
PT6501 (See Note 1)

No Heat Tab

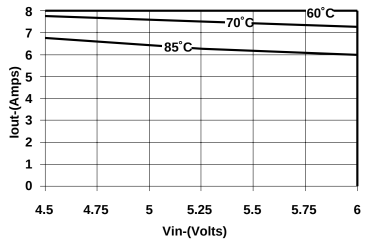
Thermal Derating (T_a) (See Note 2)



Thermal Derating (T_a) (See Note 2)

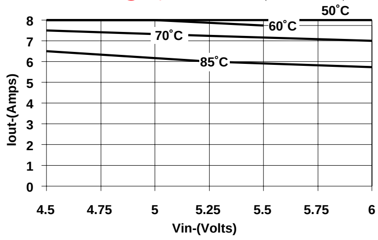


Thermal Derating (T_a) (See Note 2)

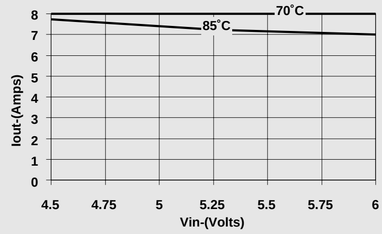


Heat Tab

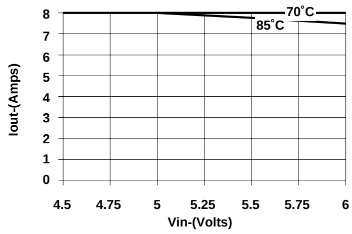
Thermal Derating (T_a) (See Note 2)



Thermal Derating (T_a) (See Note 2)



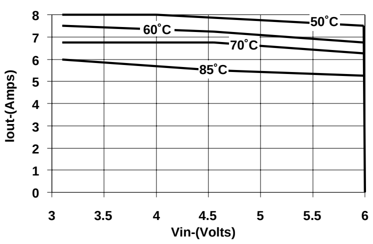
Thermal Derating (T_a) (See Note 2)



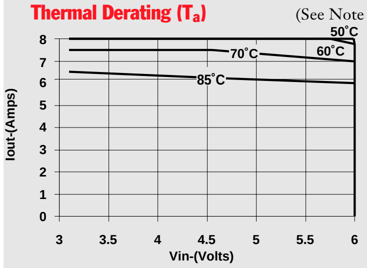
PT6502 (See Note 1)

No Heat Tab

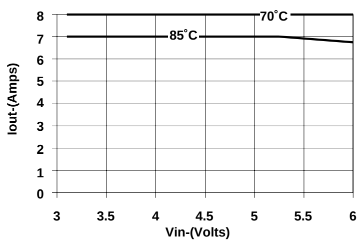
Thermal Derating (T_a) (See Note 2)



Thermal Derating (T_a) (See Note 2)

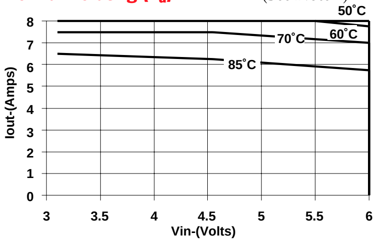


Thermal Derating (T_a) (See Note 2)

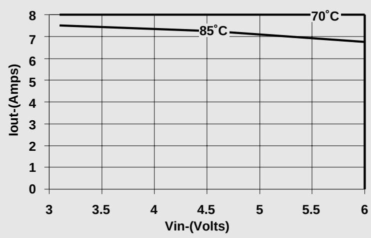


Heat Tab

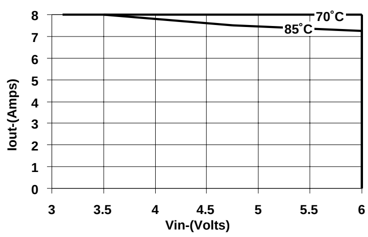
Thermal Derating (T_a) (See Note 2)



Thermal Derating (T_a) (See Note 2)



Thermal Derating (T_a) (See Note 2)



Note 1: *All data listed in the above graphs, except for derating data, has been developed from actual products tested at 25°C. This data is considered typical data for the ISR.*
Note 2: *Thermal derating graphs are developed in different air flow rates as indicated on each graph, with or without the heat tab, soldered in a printed circuit board. (See Thermal Application Notes.)*

PT6500 THERMAL DATA

THERMAL DERATING CURVES

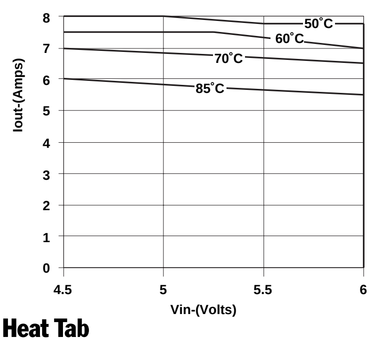
Air Flow (LFM)

60 **200** **300**

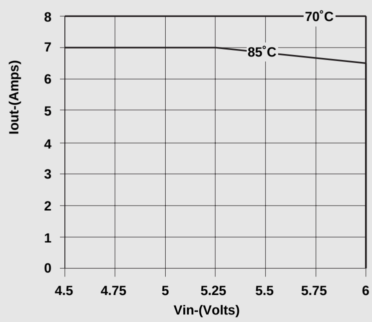
PT6503 (See Note 1)

No Heat Tab

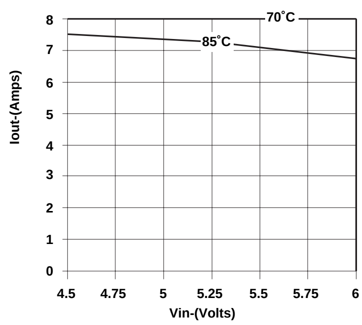
Thermal Derating (T_a) (See Note 2)



Thermal Derating (T_a) (See Note 2)

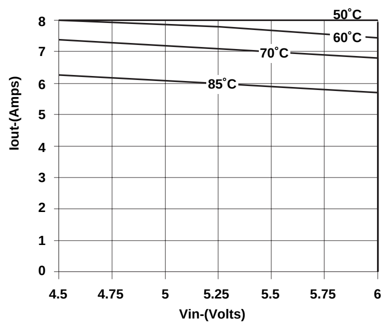


Thermal Derating (T_a) (See Note 2)

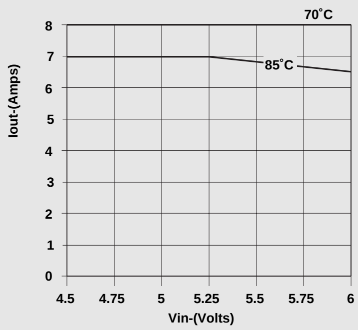


Heat Tab

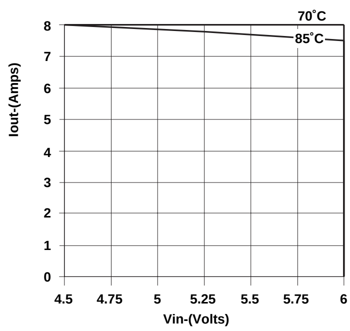
Thermal Derating (T_a) (See Note 2)



Thermal Derating (T_a) (See Note 2)



Thermal Derating (T_a) (See Note 2)



Note 1: *All data listed in the above graphs, except for derating data, has been developed from actual products tested at 25°C. This data is considered typical data for the ISR.*
Note 2: *Thermal derating graphs are developed in different air flow rates as indicated on each graph, with or without the heat tab, soldered in a printed circuit board. (See Thermal Application Notes.)*

Adjusting the Output Voltage of the PT6500 and PT6600 5V Bus Converters

The output voltage of the Power Trends PT6500/PT6600 Series ISRs may be adjusted higher or lower than the factory trimmed pre-set voltage with the addition of a single external resistor. Table 1 accordingly gives the allowable adjustment range for each model in the series as V_a (min) and V_a (max).

Adjust Up: An increase in the output voltage is obtained by adding a resistor R2, between pin 14 (V_o adjust) and pins 7-10 (GND).

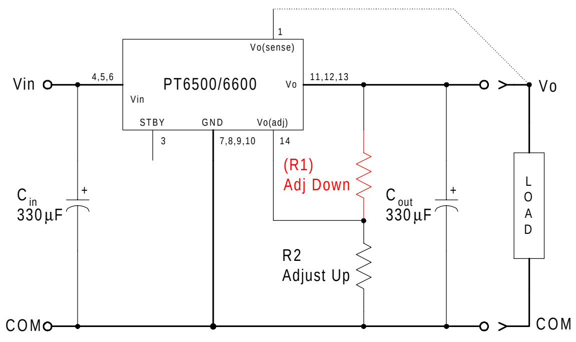
Adjust Down: Add a resistor (R1), between pin 14 (V_o adjust) and pins 11-13 (V_{out}).

Refer to Figure 1 and Table 2 for both the placement and value of the required resistor, either (R1) or R2 as appropriate.

Notes:

1. Use only a single 1% resistor in either the (R1) or R2 location. Place the resistor as close to the ISR as possible.
2. Never connect capacitors from V_o adjust to either GND, V_{out}, or the Remote Sense pin. Any capacitance added to the V_o adjust pin will affect the stability of the ISR.
3. If the Remote Sense feature is being used, connecting the resistor (R1) between pin 14 (V_o adjust) and pin 1 (Remote Sense) can benefit load regulation.
4. The minimum input voltage required by the part is V_{out} + 1.2 or 3.1V, whichever is higher.

Figure 1



The values of (R1) [adjust down], and R2 [adjust up], can also be calculated using the following formulae.

$$(R1) = \frac{R_o (V_a - 1.0)}{(V_o - V_a)} - R_s \quad k\Omega$$

$$R2 = \frac{R_o}{V_a - V_o} - R_s \quad k\Omega$$

Where: V_o = Original output voltage
V_a = Adjusted output voltage
R_o = The resistance value in Table 1
R_s = The series resistance from Table 1

Table 1

PT6500/6600 ADJUSTMENT AND FORMULA PARAMETERS

Series Pt #	PT6505	PT6507	PT6502	PT6508	PT6506	PT6503	PT6501	PT6504
	PT6605	PT6607	PT6602	PT6608	PT6606	PT6603	PT6601	PT6604
V_o (nom)	1.2	1.3	1.5	1.7	1.8	2.5	3.3	3.6
V_a (min)	1.14	1.19	1.27	1.36	1.4	1.8	2.25	2.5
V_a (max)	2.35	2.45	2.65	2.85	2.95	3.5	4.2	4.3
R_o (kΩ)	2.49	2.49	2.49	2.49	2.49	4.99	12.1	10.0
R_s (kΩ)	2.0	2.0	2.0	2.0	2.0	4.22	12.1	12.1

Table 2

PT6500/PT6600 ADJUSTMENT RESISTOR VALUES

Series Pt #	**PT6505**	**PT6507**	**PT6502**	**PT6508**	**PT6506**	**PT6503**	**PT6501**	**PT6504**
	PT6605	**PT6607**	**PT6602**	**PT6608**	**PT6606**	**PT6603**	**PT6601**	**PT6604**
V_o (nom)	**1.2**	**1.3**	**1.5**	**1.7**	**1.8**	**2.5**	**3.3**	**3.6**
V_a (req'd)								
1.15	(5.5)kΩ							
1.2		(3.0)kΩ						
1.25	47.8kΩ	(10.5)kΩ						
1.3	22.9kΩ		(1.7)kΩ					
1.35	14.6kΩ	47.8kΩ	(3.8)kΩ					
1.4	10.5kΩ	22.9kΩ	(8.0)kΩ	(1.3)kΩ	(0.5)kΩ			
1.45	8.0kΩ	14.6kΩ	(20.4)kΩ	(2.5)kΩ	(1.2)kΩ			
1.5	6.3kΩ	10.5kΩ		(4.2)kΩ	(2.2)kΩ			
1.55	5.1kΩ	8.0kΩ	47.8kΩ	(7.1)kΩ	(3.5)kΩ			
1.6	4.2kΩ	6.3kΩ	22.9kΩ	(12.9)kΩ	(5.5)kΩ			
1.65	3.5kΩ	4.1kΩ	14.6kΩ	(30.4)kΩ	(8.8)kΩ			
1.7	3.0kΩ	4.2kΩ	10.5kΩ		(15.4)kΩ			
1.75	2.5kΩ	3.5kΩ	8.0kΩ	47.8kΩ	(35.4)kΩ			
1.8	2.2kΩ	3.0kΩ	6.3kΩ	22.9kΩ		(1.5)kΩ		
1.85	1.8kΩ	2.5kΩ	5.1kΩ	14.6kΩ	47.8kΩ	(2.3)kΩ		
1.9	1.6kΩ	2.2kΩ	4.2kΩ	10.5kΩ	22.9kΩ	(3.3)kΩ		
1.95	1.3kΩ	1.8kΩ	3.5kΩ	8.0kΩ	14.6kΩ	(4.4)kΩ		
2.0	1.1kΩ	1.6kΩ	3.0kΩ	6.3kΩ	10.5kΩ	(5.8)kΩ		
2.05	0.9kΩ	1.3kΩ	2.5kΩ	5.1kΩ	8.0kΩ	(7.4)kΩ		
2.1	0.8kΩ	1.1kΩ	2.2kΩ	4.2kΩ	6.3kΩ	(9.5)kΩ		
2.15	0.6kΩ	0.9kΩ	1.8kΩ	3.5kΩ	5.1kΩ	(12.2)kΩ		
2.2	0.5kΩ	0.8kΩ	1.6kΩ	3.0kΩ	4.2kΩ	(15.7)kΩ		
2.25	0.4kΩ	0.6kΩ	1.3kΩ	2.5kΩ	3.5kΩ	(20.7)kΩ	(2.3)kΩ	
2.3	0.3kΩ	0.5kΩ	1.1kΩ	2.2kΩ	3.0kΩ	(28.2)kΩ	(3.6)kΩ	
2.35	0.2kΩ	0.4kΩ	0.9kΩ	1.8kΩ	2.5kΩ	(40.7)kΩ	(5.1)kΩ	
2.4		0.3kΩ	0.8kΩ	1.6kΩ	2.2kΩ	(65.6)kΩ	(6.7)kΩ	
2.45		0.2kΩ	0.6kΩ	1.3kΩ	1.8kΩ	(140.0)kΩ	(8.5)kΩ	
2.5			0.5kΩ	1.1kΩ	1.6kΩ		(10.6)kΩ	(1.5)kΩ
2.55			0.4kΩ	0.9kΩ	1.3kΩ	95.6kΩ	(12.9)kΩ	(2.7)kΩ
2.6			0.3kΩ	0.8kΩ	1.1kΩ	45.7kΩ	(15.6)kΩ	(3.9)kΩ
2.65			0.2kΩ	0.6kΩ	0.9kΩ	29.0kΩ	(18.6)kΩ	(5.3)kΩ
2.7				0.5kΩ	0.8kΩ	20.7kΩ	(22.2)kΩ	(6.8)kΩ
2.75				0.4kΩ	0.6kΩ	15.7kΩ	(26.4)kΩ	(8.5)kΩ
2.8				0.3kΩ	0.5kΩ	12.4kΩ	(31.5)kΩ	(10.4)kΩ
2.85				0.2kΩ	0.4kΩ	10.0kΩ	(37.6)kΩ	(12.6)kΩ
2.9					0.3kΩ	8.3kΩ	(45.4)kΩ	(15.0)kΩ
2.95					0.2kΩ	0.9kΩ	(55.3)kΩ	(17.9)kΩ
3.0						5.8kΩ	(68.6)kΩ	(21.2)kΩ
3.1						4.1kΩ	(115.0)kΩ	(29.9)kΩ
3.2						2.9kΩ	(254.0)kΩ	(42.9)kΩ
3.3						2.0kΩ		(64.6)kΩ
3.4						1.3kΩ	109.0kΩ	(108.0)kΩ
3.5						0.8kΩ	48.4kΩ	(238.0)kΩ
3.6							28.2kΩ	
3.7							18.2kΩ	87.9kΩ
3.8							12.1kΩ	37.9kΩ
3.9	4/. V_{out} >3.8Vdc requires V_{in} >5.0Vdc !						8.1kΩ	21.2kΩ
4.0							5.2kΩ	12.9kΩ
4.1							3.0kΩ	7.9kΩ
4.2							1.3kΩ	4.6kΩ
4.3								2.2kΩ

R1 = (Red) R2 = Black

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