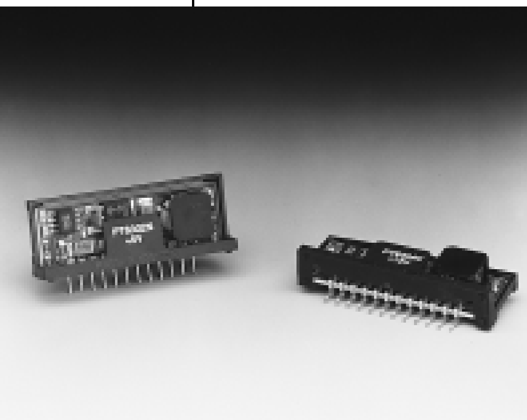
PT6300 Series

3 AMP ADJUSTABLE POSITIVE STEP-DOWN INTEGRATED SWITCHING REGULATORS

Revised 5/15/98

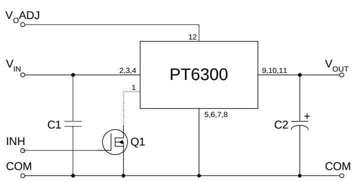


- 90% Efficiency
- Adjustable Output Voltage
- Internal Short Circuit Protection
- Over-Temperature Protection
- On/Off Control (Ground Off)
- Small SIP Footprint
- Wide Input Range

The PT6300 Series is a line of High-Performance 3 Amp, 12-Pin SIP (Single In-line Package) Integrated Switching Regulators (ISRs) designed to meet the on-board power conversion needs of battery powered or other equipment requiring high efficiency and small size. This high performance ISR family offers a unique combination of features combining 90% typical efficiency with open-collector on/off control and adjustable output voltage.

Quiescent current in the shutdown mode is typically less than 100µA.

Standard Application



C_1 = Optional 1µF ceramic
C_2 = Required 100µF electrolytic
Q_1 = NFET

Pin-Out Information

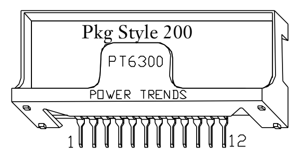
Pin	Function
1	Inhibit (30V max)
2	V_{in}
3	V_{in}
4	V_{in}
5	GND
6	GND
7	GND
8	GND
9	V_{out}
10	V_{out}
11	V_{out}
12	V_{out} Adj

Ordering Information

PT6302☐ = +5 Volts
PT6303☐ = +3.3 Volts
PT6304☐ = +12 Volts

PT Series Suffix (PT1234X)

Case/Pin Configuration	
Vertical Through-Hole	N
Horizontal Through-Hole	A
Horizontal Surface Mount	C



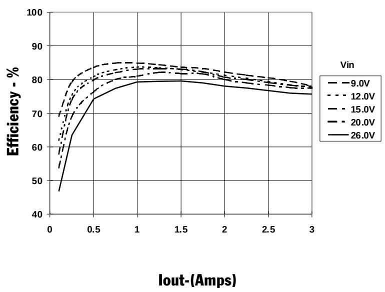
Specifications

Characteristics (T_a=25°C unless noted)	Symbols	Conditions	PT6300 SERIES Min	Typ	Max	Units
Output Current	I_o	Over V_{in} range	0.1*	—	3.0	A
Short Circuit Current	I_{sc}	$V_{in} = V_o + 5V$	—	5.0	—	Apk
Input Voltage Range *(Note: inhibit function cannot be used above 30V.)*	V_{in}	$0.1 \le I_o \le 3.0$ A; $V_o = 3.3V$ / $V_o = 5V$ / $V_o = 12V$	9 / 9 / 16	— / — / —	26 / 30/38** / 30/38**	V / V / V
Output Voltage Tolerance	ΔV_o	Over V_{in} Range, I_o = 3.0 A; T_a = 0°C to +60°C	—	±1.0	±2.0	$\%V_o$
Line Regulation	Reg_{line}	Over V_{in} range	—	±0.25	±0.5	$\%V_o$
Load Regulation	Reg_{load}	$0.1 \le I_o \le 3.0$ A	—	±0.25	±0.5	$\%V_o$
V_o Ripple/Noise	V_n	$V_{in} = V_{in}$ min, I_o = 3.0 A	—	±2	—	$\%V_o$
Transient Response with C_o = 100µF	t_{tr} / V_{os}	50% load change / V_o over/undershoot	— / —	100 / 5.0	200 / —	µSec / $\%V_o$
Efficiency	η	V_{in}=9V, I_o = 0.5 A, V_o = 3.3V / V_{in}=9V, I_o = 0.5 A, V_o = 5V / V_{in}=16V, I_o = 0.5 A, V_o = 12V	— / — / —	84 / 89 / 91	— / — / —	% / % / %
Switching Frequency	f_o	Over V_{in} and I_o ranges, V_o = 3.3V/5V / V_o = 12V	400 / 600	500 / 750	600 / 900	kHz / kHz
Shutdown Current	I_{sc}	V_{in} = 15V	—	100	—	µA
Quiescent Current	I_{nl}	I_o = 0A, V_{in} =10V	—	10	—	mA
Output Voltage Adjustment Range	V_o	Below V_o / Above V_o	See Application Notes.			
Absolute Maximum Operating Temperature Range	T_a		-40	—	+85	°C
Recommendated Operating Temperature Range	T_a	Free Air Convection, (40-60LFM) At V_{in} = 24V, I_o = 2.5A	-40	—	+80***	°C
Thermal Resistance	θ_{ja}	Free Air Convection (40-60LFM)	—	30	—	°C/W
Storage Temperature	T_s	—	-40	—	+125	°C
Mechanical Shock		Per Mil-STD-883D, Method 2002.3, 1 msec, Half Sine, mounted to a fixture	—	500	—	G's
Mechanical Vibration		Per Mil-STD-883D, Method 2007.2, 20-2000 Hz,Soldered in a PC board	—	10	—	G's
Weight	—	—	—	6.5	—	grams

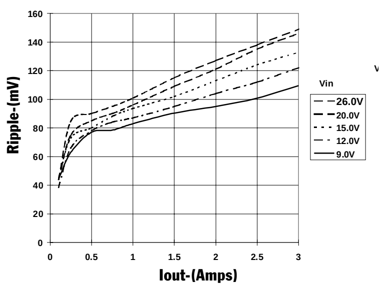
* ISR will operate to no load with reduced specifications.
** Input voltage cannot exceed 30V when the inhibit function is used. *** See Thermal Derating chart.
Note: *The PT6300 Series requires a 100µF electrolytic or tantalum output capacitor for proper operation in all applications.*

PT6303, 3.3 VDC (See Note 1)

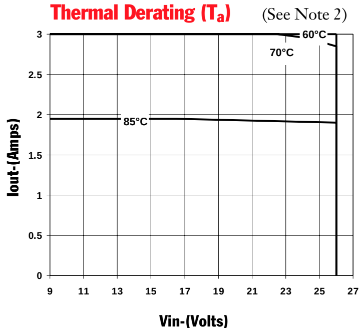
Efficiency vs Output Current



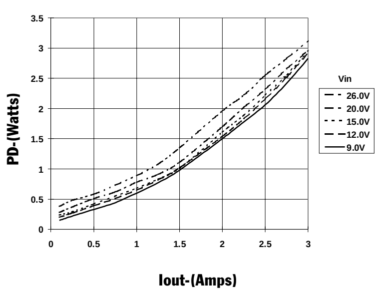
Ripple vs Output Current



Thermal Derating (T_a) (See Note 2)

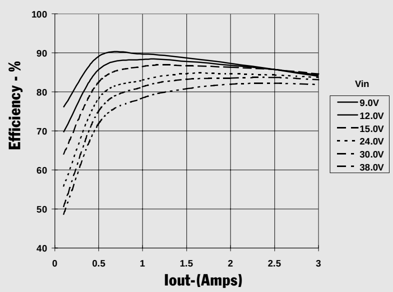


Power Dissipation vs Output Current

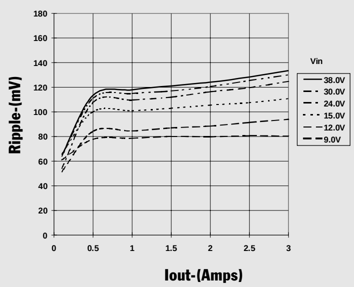


PT6302, 5.0 VDC (See Note 1)

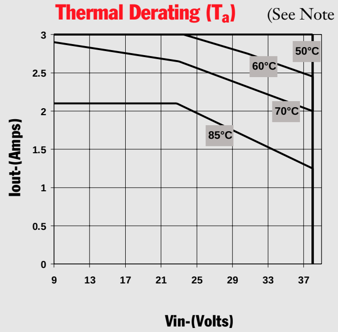
Efficiency vs Output Current



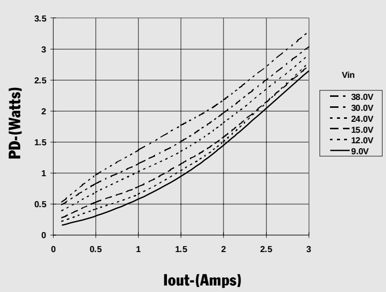
Ripple vs Output Current



Thermal Derating (T_a) (See Note 2)

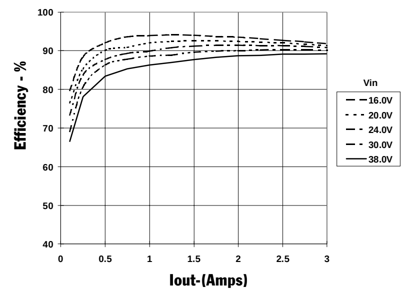


Power Dissipation vs Output Current

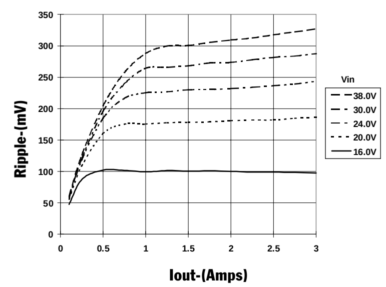


PT6304, 12.0 VDC (See Note 1)

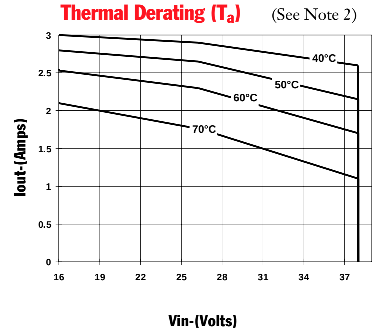
Efficiency vs Output Current



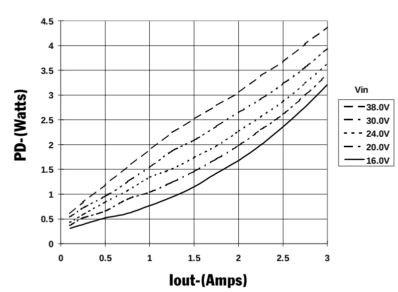
Ripple vs Output Current



Thermal Derating (T_a) (See Note 2)



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*
Note 2: *Thermal derating graphs are developed in free air convection cooling of 40-60 LFM. (See Thermal Application note.)*

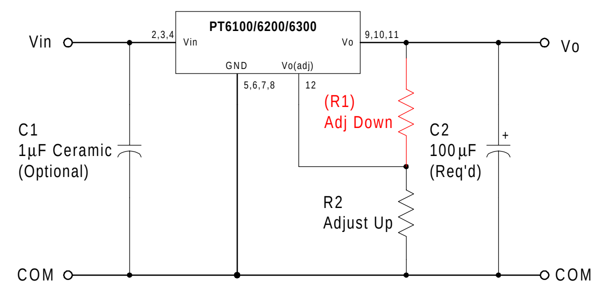
Adjusting the Output Voltage of the Wide Input Range Bus ISRs

The output voltage of the Power Trends' Wide Input Range 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 for either 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 12 (V_o adjust) and pins 5-8 (GND).

Adjust Down: Add a resistor (R1), between pin 12 (V_o adjust) and pins 9-11(V_{out}).

Figure 1



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 or V_{out}. Any capacitance added to the V_o adjust pin will affect the stability of the ISR.
4. Adjustments to the output voltage may place additional limits on the maximum and minimum input voltage for the part. The revised maximum and minimum input voltage limits must comply with the following requirements. Note that the minimum input voltage limits are also model dependant.

   V_{in} (max) = $(8 \times V_a)$V or *30/38V, whichever is less.

   PT6x0x/PT6x1x series:
   V_{in} (min) = $(V_a + 4)$V or 9V, whichever is highest.

   PT6x2x series:
   V_{in} (min) = $(V_a + 2.5)$V or 7.5V, whichever is highest.

* Limit is 30V when inhibit function is used.

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

$$(R1) = \frac{R_o (V_a - 1.25)}{V_o - V_a} \quad k\Omega$$

$$R2 = \frac{1.25\, R_o}{V_a - V_o} \quad k\Omega$$

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

Table 1

ISR ADJUSTMENT RANGE AND FORMULA PARAMETERS

1Adc Rated	**PT6102**	**PT6101**		**PT6103**
	PT6122	**PT6121**		
2Adc Rated	**PT6213**		**PT6212**	**PT6214**
	PT6223		**PT6222**	
3Adc Rated	**PT6303**		**PT6302**	**PT6304**
	PT6323		**PT6322**	
V_o (nom)	3.3	5.0	5.0	12.0
V_a (min)	1.89	1.88	2.18	2.43
V_a (max)	6.07	11.25	8.5	22.12
R_o (kΩ)	66.5	150.0	90.9	243.0

Table 2

ISR ADJUSTMENT RESISTOR VALUES

1Adc Rated	**PT6102**	**PT6101**		**PT6103**
	PT6122	**PT6121**		
2Adc Rated	**PT6213**		**PT6212**	**PT6214**
	PT6223		**PT6222**	
3Adc Rated	**PT6303**		**PT6302**	**PT6304**
	PT6323		**PT6322**	
V_o (nom)	**3.3**	**5.0**	**5.0**	**12.0**
V_a (req.d)				
1.9	(30.9)kΩ	(31.5)kΩ		
2.0	(38.4)kΩ	(37.5)kΩ		
2.1	(47.1)kΩ	(44.0)kΩ		
2.2	(57.4)kΩ	(50.9)kΩ	(30.8)kΩ	
2.3	(69.8)kΩ	(58.3)kΩ	(35.4)kΩ	
2.4	(85.0)kΩ	(66.3)kΩ	(40.2)kΩ	
2.5	(104.0)kΩ	(75.0)kΩ	(45.5)kΩ	(32.0)kΩ
2.6	(128.0)kΩ	(84.4)kΩ	(51.1)kΩ	(34.9)kΩ
2.7	(161.0)kΩ	(94.6)kΩ	(57.3)kΩ	(37.9)kΩ
2.8	(206.0)kΩ	(106.0)kΩ	(64.0)kΩ	(40.9)kΩ
2.9	(274.0kΩ	(118.0)kΩ	(71.4)kΩ	(44.1)kΩ
3.0	(388.0)kΩ	(131.0)kΩ	(79.5)kΩ	(47.3)kΩ
3.1	(615.0)kΩ	(146.0)kΩ	(88.5)kΩ	(50.5)kΩ
3.2	(1300.0)kΩ	(163.0)kΩ	(98.5)kΩ	(53.8)kΩ
3.3		(181.0)kΩ	(110.0)kΩ	(57.3)kΩ
3.4	831.0kΩ	(202.0)kΩ	(122.0)kΩ	(60.8)kΩ
3.5	416.0kΩ	(225.0)kΩ	(136.0)kΩ	(64.3)kΩ
3.6	227.0kΩ	(252.0)kΩ	(153.0)kΩ	(68.0)kΩ
3.7	208.0kΩ	(283.0)kΩ	(171.0)kΩ	(71.7)kΩ
3.8	166.0kΩ	(319.0)kΩ	(193.0)kΩ	(75.6)kΩ
3.9	139.0kΩ	(361.0)kΩ	(219.0)kΩ	(79.5)kΩ
4.0	119.0kΩ	(413.0)kΩ	(250.0)kΩ	(83.5)kΩ
4.1	104.0kΩ	(475.0)kΩ	(288.0)kΩ	(87.7)kΩ
4.2	92.4kΩ	(533.0)kΩ	(335.0)kΩ	(91.9)kΩ
4.3	83.1kΩ	(654.0)kΩ	(396.0)kΩ	(96.3)kΩ
4.4	75.6kΩ	(788.0)kΩ	(477.0)kΩ	(101.0)kΩ
4.5	69.3kΩ	(975.0)kΩ	(591.0)kΩ	(105.0)kΩ
4.6	63.9kΩ	(1260.0)kΩ	(761.0)kΩ	(110.0)kΩ
4.7	59.4kΩ	(1730.0)kΩ	(1050.0)kΩ	(115.0)kΩ
4.8	55.4kΩ		(1610.0)kΩ	(120.0)kΩ
4.9	52.0kΩ			(125.0)kΩ
5.0	48.9kΩ			(130.0)kΩ
5.1	46.2kΩ	1880.0kΩ	1140.0kΩ	(136.0)kΩ
5.2	43.8kΩ	937.0kΩ	568.0kΩ	(141.0)kΩ
5.3	41.6kΩ	625.0kΩ	379.0kΩ	(147.0)kΩ
5.4	39.6kΩ	469.0kΩ	284.0kΩ	(153.0)kΩ
5.5	37.8kΩ	375.0kΩ	227.0kΩ	(159.0)kΩ
5.6	36.1kΩ	313.0kΩ	189.0kΩ	(165.0)kΩ
5.7	34.6kΩ	268.0kΩ	162.0kΩ	(172.0)kΩ
5.8	33.3kΩ	234.0kΩ	142.0kΩ	(178.0)kΩ
5.9	32.0kΩ	208.0kΩ	126.0kΩ	(185.0)kΩ
6.0	30.8kΩ	188.0kΩ	114.0kΩ	(192.0)kΩ

R1 = (Red)   R2 = Black

ISR ADJUSTMENT RESISTOR VALUES (Cont)

1Adc Rated	**PT6101**		**PT6103**
	PT6121		
2Adc Rated		**PT6212**	**PT6214**
		PT6222	
3Adc Rated		**PT6302**	**PT6304**
		PT6322	
V_o (nom)	**5.0**	**5.0**	**12.0**
V_a (req.d)			
6.2	156.0kΩ	94.7kΩ	(207.0)kΩ
6.4	134.0kΩ	81.2kΩ	(223.0)kΩ
6.6	117.0kΩ	71.0kΩ	(241.0)kΩ
6.8	104.0kΩ	63.1kΩ	(259.0)kΩ
7.0	93.8kΩ	56.8kΩ	(279.0)kΩ
7.2	85.2kΩ	51.6kΩ	(301.0)kΩ
7.4	78.1kΩ	47.3kΩ	(325.0)kΩ
7.6	72.1kΩ	43.7kΩ	(351.0)kΩ
7.8	67.0kΩ	40.6kΩ	(379.0)kΩ
8.0	62.5kΩ	37.9kΩ	(410.0)kΩ
8.2	58.6kΩ	35.5kΩ	(444.0)kΩ
8.4	55.1kΩ	33.4kΩ	(483.0)kΩ
8.6	52.1kΩ		(525.0)kΩ
8.8	49.3kΩ		(573.0)kΩ
9.0	46.9kΩ		(628.0)kΩ
9.5	41.7kΩ		(802.0)kΩ
10.0	37.5kΩ		(1060.0)kΩ
10.5	34.1kΩ		(1500.0)kΩ
11.0	31.3kΩ		
11.5			
12.0			
12.5			608.0kΩ
13.0			304.0kΩ
13.5			203.0kΩ
14.0			152.0kΩ
14.5			122.0kΩ
15.0			101.0kΩ
15.5			86.8kΩ
16.0			75.9kΩ
16.5			67.5kΩ
17.0			60.8kΩ
17.5			55.2kΩ
18.0			50.6kΩ
18.5			46.7kΩ
19.0			43.4kΩ
19.5			40.5kΩ
20.0			38.0kΩ
20.5			35.7kΩ
21.5			33.8kΩ
21.5			32.0kΩ
22.0			30.4kΩ

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