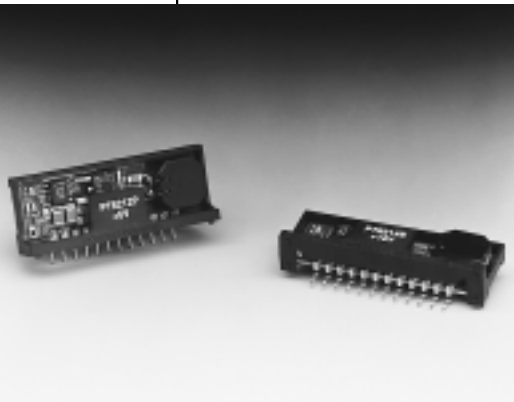


PT6210 Series

2 AMP ADJUSTABLE POSITIVE STEP-DOWN INTEGRATED SWITCHING REGULATOR

Revised 5/15/98

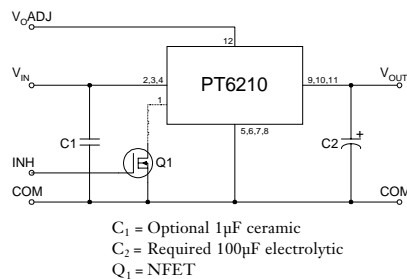


- 90% Efficiency
- Adjustable Output Voltage
- Internal Short Circuit Protection
- Over-Temperature Protection
- On/Off Control (Ground Off)
- Small SIP Footprint
- Wide Input Range

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 shut-down mode is typically less than 100µA.

The PT6210 Series is a line of High-Performance 2 Amp, 12-Pin SIP (Single In-line Package) Integrated

Standard Application



Pin-Out Information

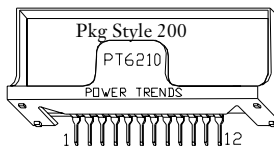
Pin	Function
1	Inhibit (30V max)
2	V _{in}
3	V _{in}
4	V _{in}
5	GND
6	GND
7	GND
8	GND
9	V _{out}
10	V _{out}
11	V _{out}
12	V _{out} Adj

Ordering Information

PT6211□	= +5.1 Volts
PT6212□	= +5.0 Volts
PT6213□	= +3.3 Volts
PT6214□	= +12 Volts

PT Series Suffix (PT1234X)

Case/Pin Configuration	
Vertical Through-Hole	P
Horizontal Through-Hole	D
Horizontal Surface Mount	E



Note: Heat spreaders are not electrically connected to product.

Note: Back surface of product is conducting metal.

Specifications

Characteristics (T _a = 25°C unless noted)	Symbols	Conditions	PT6210 SERIES			Units
			Min	Typ	Max	
Output Current	I _o	Over V _{in} range	0.1*	—	2.0	A
Short Circuit Current	I _{sc}	V _{in} = V _{in} min	—	5.0	—	Apk
Input Voltage Range (Note: inhibit function cannot be used with V _{in} above 30V.)	V _{in}	0.1 ≤ I _o ≤ 2.0 A	9	—	26	V
			9	—	30/38**	V
			16	—	30/38**	V
Output Voltage Tolerance	ΔV _o	Over V _{in} Range, I _o = 2.0 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 ≤ I _o ≤ 2.0 A	—	±0.25	±0.5	%V _o
V _o Ripple/Noise	V _n	V _{in} = V _{in} min	—	±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 _{in} =9V, I _o = 0.5 A V _{in} =16V, I _o = 0.5 A	—	84 89 91	— — —	% % %
Switching Frequency	f _o	Over V _{in} and I _o ranges	450	—	900	kHz
Shutdown Current	I _{sc}	V _{in} = 16V	—	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
Recommended Operating Temperature Range	T _a	Free Air Convection, (40-60LFM) At V _{in} = 24V, I _o =1.5A	-40 -40	— —	+85*** +75***	°C °C
Thermal Resistance	θ _{ja}	Free Air Convection (40-60LFM)	—	40	—	°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	—	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 PT6210 Series requires a 100µF electrolytic or tantalum output capacitor for proper operation in all applications.

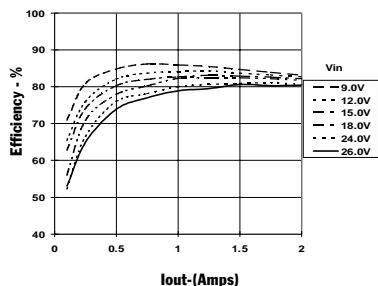
PT6210 Series

CHARACTERISTIC DATA

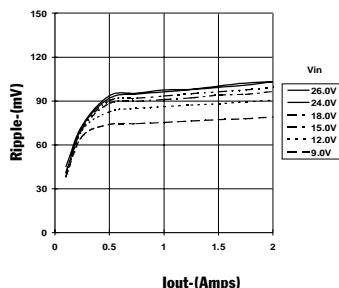
Wide Input Range Products
DATA SHEETS

PT6213, 3.3 VDC (See Note 1)

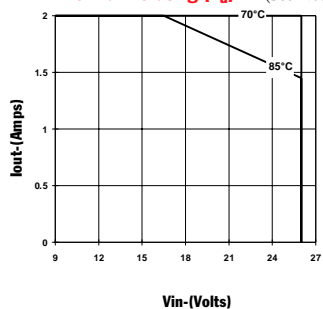
Efficiency vs Output Current



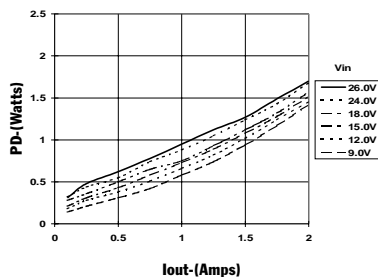
Ripple vs Output Current



Thermal Derating (Ta) (See Note 2)

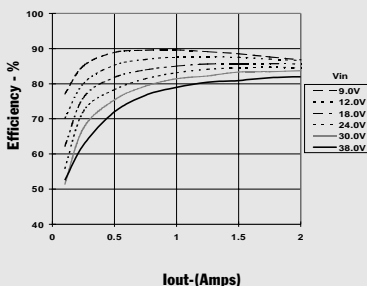


Power Dissipation vs Output Current

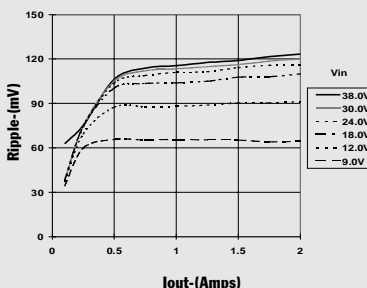


PT6212, 5.0 VDC (See Note 1)

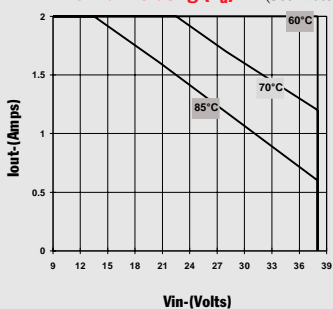
Efficiency vs Output Current



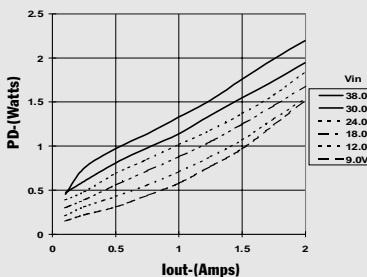
Ripple vs Output Current



Thermal Derating (Ta) (See Note 2)

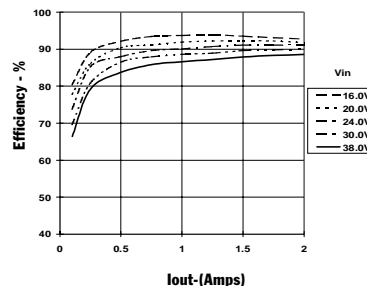


Power Dissipation vs Output Current

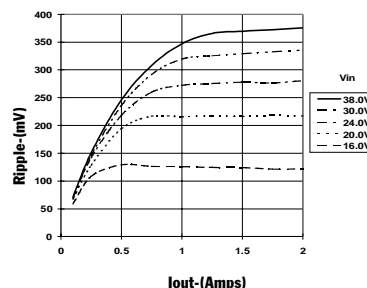


PT6214, 12.0 VDC (See Note 1)

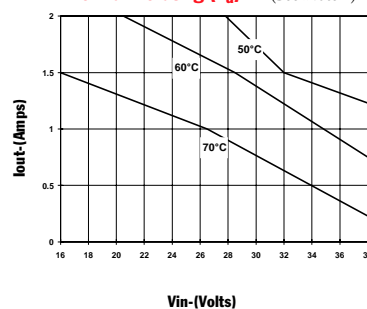
Efficiency vs Output Current



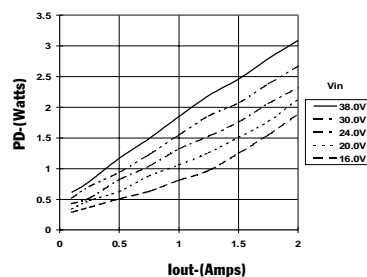
Ripple vs Output Current



Thermal Derating (Ta) (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 Notes).

Application Notes

PT6100/6120/6210/6220/6300/6320 Series

[More Application Notes](#)

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}).

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 dependent.

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

PT6x0x/PT6x1x series:

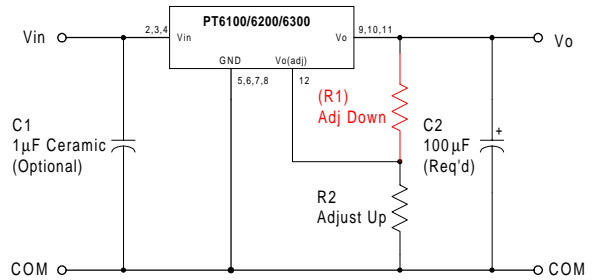
$$V_{in}(\min) = (V_a + 4)V \text{ or } 9V, \text{ whichever is highest.}$$

PT6x2x series:

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

* Limit is 30V when inhibit function is used.

Figure 1



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

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

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

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				
1A dc Rated	PT6102	PT6101		PT6103
	PT6122	PT6121		
2A dc Rated	PT6213		PT6212	PT6214
	PT6223		PT6222	
3A dc 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 (k Ω)	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	(274.0)kΩ	(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