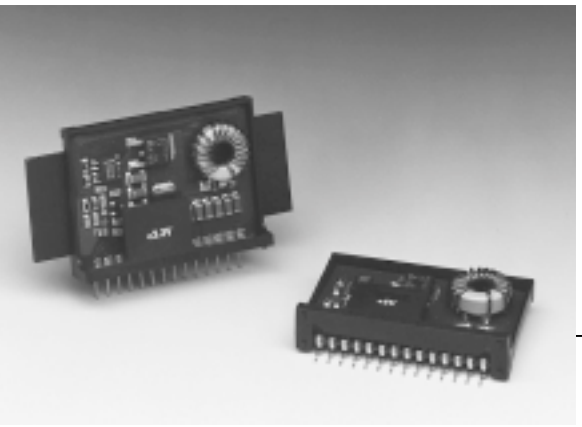
PT6680 Series

5 Amp 18-36V Input
Integrated Switching Regulator

Power Trends Products from Texas Instruments

SLTS098

(Revised 6/30/2000)

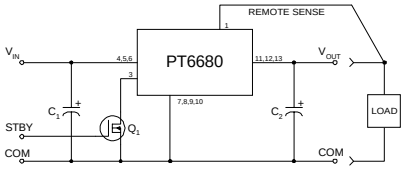


- Single Device: 5A Output
- Input Voltage Range: 18V to 36V
- Adjustable Output Voltage
- 80% Efficiency
- Remote Sense Capability
- Standby Function

The PT6680 series is a new addition to Power Trends' line of 24V bus Integrated Switching Regulators (ISRs). Designed for general purpose industrial applications requiring as much as 36V input and 5A of output current, the PT6680 is packaged in a 14-Pin SIP (Single In-line Package) and is available in a surface-mount configuration.

Only two external capacitors are required for proper operation. Please note that this product does not include short circuit protection.

Standard Application



C_1 = Required 560µF electrolytic (1)
C_2 = Required 330µF electrolytic
Q_1= NFET-or Open Collector Gate

Pin-Out Information

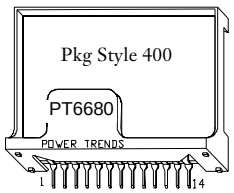
1	Remote Sense
2	Do Not Connect
3	STBY*- Standby
4	V_{in}
5	V_{in}
6	V_{in}
7	GND
8	GND
9	GND
10	GND
11	V_{out}
12	V_{out}
13	V_{out}
14	V_{out} Adjust

Ordering Information

PT6681☐ = +3.3 Volts
PT6682☐ = +2.5 Volts
PT6683☐ = +5.0 Volts
PT6684☐ = +9.0 Volts
PT6685☐ = +15.0 Volts
PT6686☐ = +12.0 Volts

PT Series Suffix (PT1234X)

Case/Pin Configuration	*Heat Spreader*	*Heat Spreader with Side Tabs*
Vertical Through-Hole	P	R
Horizontal Through-Hole	D	G
Horizontal Surface Mount	E	B



Note: Back surface of product is conducting metal

Specifications

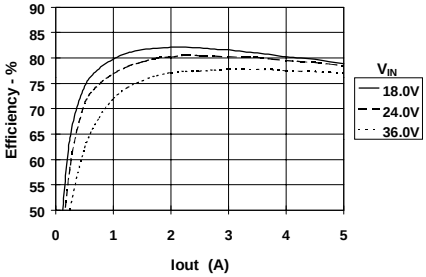
Characteristics (T_a = 25°C unless noted)	Symbols	Conditions		PT6680 SERIES Min	Typ	Max	Units
Output Current	I_o	T_a = 60°C, 200 LFM, pkg P T_a = 25°C, natural convection		0.1 (2) 0.1 (2)	— —	5.0 5.0	A
Input Voltage Range	V_{in}	0.1A ≤ I_o ≤ I_{omax}		+18V	—	+36V	V
Output Voltage Tolerance	ΔV_o	Over V_{in} range T_a = -40°C to +65°C		V_o-0.1	—	V_o+0.1	V
Output Voltage Adjust Range	V_{oadj}	Pin 14 to V_o or ground	V_o = +3.3V V_o = +2.5V V_o = +5.0V V_o = +9.0V V_o = +12V V_o = +15V	2.2 1.8 3.0 6.0 9.0 10.0	— — — — — —	4.7 4.3 6.5 10.2 13.6 17.0	V
Line Regulation	Reg_{line}	+18V≤V_{in}≤+36V, I_o = I_{omax}		—	±0.5	±1.0	%V_o
Load Regulation	Reg_{load}	V_{in} = +28V, 0.1≤ I_o≤ I_{omax}		—	±0.5	±1.0	%V_o
V_o Ripple/Noise	V_n	V_{in} = +28V, I_o = I_{omax}	V_o ≤ +6V V_o > +6V	—	50 1.0	—	mVpp %V_o
Transient Response with C_2 = 330µF	t_{tr} V_{os}	I_o step between 2.5A and 5.0A V_o over/undershoot		— —	100 100	— —	µSec mV
Efficiency	η	V_{in} = +28V, I_o = $I_{o\,max}$	V_o = +3.3V V_o = +2.5V V_o = +5.0V V_o = +9.0V V_o = +12.0V V_o = +15.0V	— — — — — —	78 73 82 87 88 90	— — — — — —	%
Switching Frequency	f_o	+18V ≤ V_{in} ≤ +36V Over I_o range		500	550	600	kHz
Maximum Operating Temperature Range	T_a	Over V_{in} range		-40	—	+85 (3)	°C
Storage Temperature	T_s	—		-40	—	+125	°C
Mechanical Shock	—	Per Mil-STD-883D, Method 2002.3		—	500	—	G's
Mechanical Vibration	—	Per Mil-STD-883D, Method 2007.2, 20-2000 Hz, soldered in a PC board		—	7.5	—	G's
Weight	—	—		—	14	—	grams

Notes *(1) The 560µF electrolytic input capacitor must be rated for 1.5Arms ripple current. Both an input and output capacitor is required for proper operation.*
(2) The ISR will operate down to no load with reduced specifications.
(3) Consult the SOA curves or contact the factory to determine the appropriate derating.

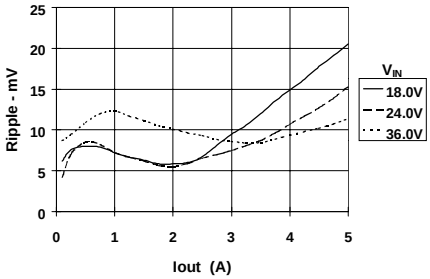
Typical Characteristics

PT6681, V_{out} =3.3V (Note A)

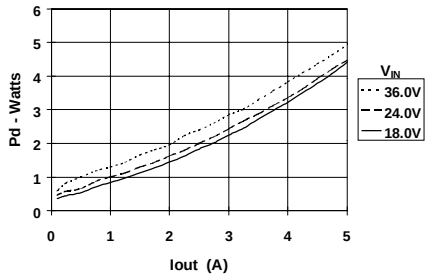
Efficiency vs Output Current



Ripple vs Output Current



Power Dissipation vs Output Current



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

Adjusting the Output Voltage of the PT6680 5Amp 18-36V Bus Converter Series

The output voltage of the Power Trends PT6680 Series ISRs may be adjusted higher or lower than the factory trimmed pre-set voltage with the addition of a single external resistor [1]. Table 1 gives the respective 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.

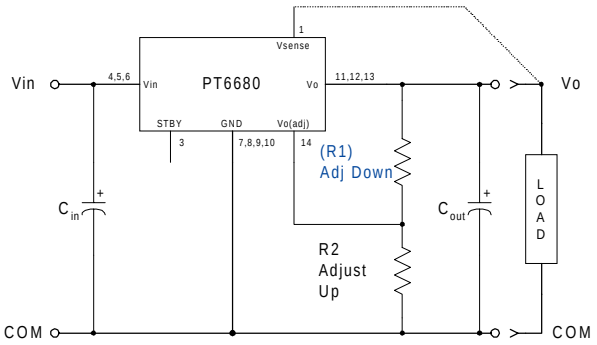
Notes:

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. For output voltages above 10.0Vdc, the maximum output current must be limited to 4Adc.
5. Adjustments to the output voltage may place additional limits on the input voltage for the part. The revised limits must comply with the following requirements.

   V_{in} (min) = (V_{out} + 3)V or 18V, whichever is higher.

   V_{in} (max) = (10 x V_{out})V or 36V, whichever is less.

Figure 1



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

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

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

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

PT6680 ADJUSTMENT AND FORMULA PARAMETERS

Series Pt #	PT6682	PT6681	PT6683	PT6684	PT6686	PT6685
V_o (nom)	2.5V	3.3V	5.0V	9.0V	12.0V	15.0V
V_a (min)	1.8V	2.2V	3.0V	6.0V	9.0V	10.0V
V_a (max)	4.3V	4.7V	6.5V	10.2V	13.6V	17.0V
R_o (kΩ)	4.99	4.22	2.49	2.0	2.0	2.0
R_s (kΩ)	2.49	4.99	4.99	12.7	12.7	12.7

Table 2

PT6680 ADJUSTMENT RESISTOR VALUES

Series Pt #	PT6682	PT6681	PT6683	Series Pt #	PT6684	PT6686	PT6685
Current	5Adc	5Adc	5Adc	Current	5Adc	4Adc	4Adc
V_o (nom)	2.5Vdc	3.3Vdc	5.0Vdc	V_o (nom)	9.0Vdc	12.0Vdc	15.0Vdc
V_a (req'd)				V_a (req'd)			
1.8	(1.4)kΩ			6.0	(6.9)kΩ		
1.9	(2.9)kΩ			6.2	(9.2)kΩ		
2.0	(5.0)kΩ			6.4	(11.9)kΩ		
2.1	(8.1)kΩ			6.6	(14.0)kΩ		
2.2	(13.3)kΩ	(1.0)kΩ		6.8	(18.6)kΩ		
2.3	(23.7)kΩ	(2.3)kΩ		7.0	(23.0)kΩ		
2.4	(54.9)kΩ	(3.9)kΩ		7.2	(28.3)kΩ		
2.5		(5.8)kΩ		7.4	(35.0)kΩ		
2.6	59.9kΩ	(8.4)kΩ		7.6	(43.5)kΩ		
2.7	28.7kΩ	(11.7)kΩ		7.8	(55.0)kΩ		
2.8	18.3kΩ	(16.5)kΩ		8.0	(71.0)kΩ		
2.9	13.1kΩ	(23.6)kΩ		8.2	(95.0)kΩ		
3.0	10.0kΩ	(35.4)kΩ	(1.6)kΩ	8.4	(135.0)kΩ		
3.1	7.9kΩ	(59.0)kΩ	(2.3)kΩ	8.6	(215.0)kΩ		
3.2	6.4kΩ	(130.0)kΩ	(3.1)kΩ	8.8	(455.0)kΩ		
3.3	5.3kΩ		(4.0)kΩ	9.0		(31.7)kΩ	
3.4	4.4kΩ	81.5kΩ	(5.1)kΩ	9.2	64.8kΩ	(36.1)kΩ	
3.5	3.8kΩ	38.3kΩ	(6.2)kΩ	9.4	26.1kΩ	(41.2)kΩ	
3.6	3.2kΩ	23.8kΩ	(7.6)kΩ	9.6	13.1kΩ	(47.1)kΩ	
3.7	2.7kΩ	16.6kΩ	(9.1)kΩ	9.8	6.7kΩ	(54.1)kΩ	
3.8	2.3kΩ	12.3kΩ	(10.9)kΩ	10.0	2.8kΩ	(62.6)kΩ	(25.8)kΩ
3.9	2.0kΩ	9.4kΩ	(13.0)kΩ	10.2	0.2kΩ	(72.8)kΩ	(28.3)kΩ
4.0	1.7kΩ	7.4kΩ	(15.6)kΩ	10.4		(85.7)kΩ	(31.1)kΩ
4.1	1.4kΩ	5.8kΩ	(18.7)kΩ	10.6		(102.0)kΩ	(34.1)kΩ
4.2	1.2kΩ	4.6kΩ	(22.6)kΩ	10.8		(124.0)kΩ	(37.3)kΩ
4.3	1.0kΩ	3.7kΩ	(27.6)kΩ	11.0		(155.0)kΩ	(40.9)kΩ
4.4		2.9kΩ	(34.2)kΩ	11.2		(201.0)kΩ	(44.9)kΩ
4.5		2.2kΩ	(43.6)kΩ	11.4		(278.0)kΩ	(49.3)kΩ
4.6		1.7kΩ	(57.6)kΩ	11.6		(432.0)kΩ	(54.3)kΩ
4.7		1.2kΩ	(80.9)kΩ	11.8		(895.0)kΩ	(59.8)kΩ
4.8			(128.0)kΩ	12.0			(66.1)kΩ
4.9			(268.0)kΩ	12.2		94.8kΩ	(73.3)kΩ
5.0				12.4		41.1kΩ	(81.6)kΩ
5.1			88.4kΩ	12.6		23.1kΩ	(91.3)kΩ
5.2			41.7kΩ	12.8		14.2kΩ	(103.0)kΩ
5.3			26.1kΩ	13.0		8.8kΩ	(117.0)kΩ
5.4			18.4kΩ	13.2		5.2kΩ	(133.0)kΩ
5.5			13.7kΩ	13.4		2.7kΩ	(154.0)kΩ
5.6			10.6kΩ	13.6		0.7kΩ	(181.0)kΩ
5.7			8.4kΩ	13.8			(217.0)kΩ
5.8			6.7kΩ	14.0			(268.0)kΩ
5.9			5.4kΩ	14.2			(343.0)kΩ
6.0			4.4kΩ	14.5			(570.0)kΩ
6.1			3.5kΩ	15.0			
6.2			2.8kΩ	15.5			42.3kΩ
6.3			2.2kΩ	16.0			14.8kΩ
6.4			1.7kΩ	16.5			5.6kΩ
6.5			1.2kΩ	17.0			1.1kΩ

R1 = (Blue) R2 = Black

IMPORTANT NOTICE

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgment, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

Customers are responsible for their applications using TI components.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.