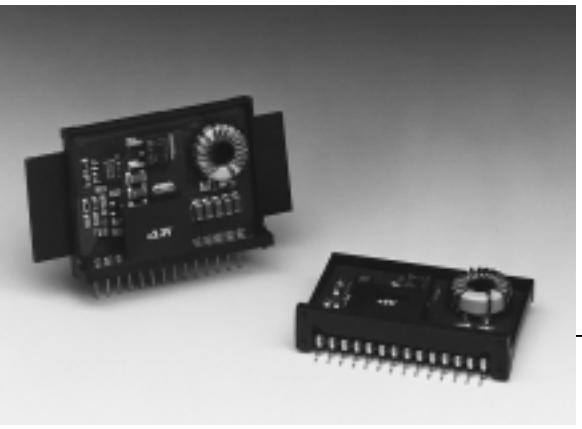
PT6680 Series

5 Amp 18-36V Input
Integrated Switching Regulator

Power Trends Products from Texas Instruments

SLTS098

(Revised 6/30/2000)

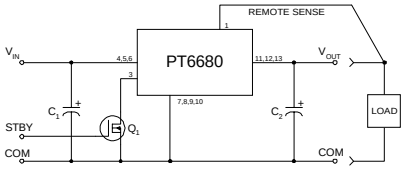


- Single Device: 5A Output
- Input Voltage Range: 18V to 36V
- Adjustable Output Voltage
- 80% Efficiency
- Remote Sense Capability
- Standby Function

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

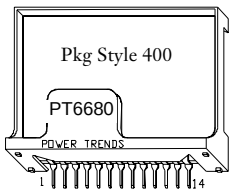
1	Remote Sense
2	Do Not Connect
3	STBY*- Standby
4	V_{in}
5	V_{in}
6	V_{in}
7	GND
8	GND
9	GND
10	GND
11	V_{out}
12	V_{out}
13	V_{out}
14	V_{out} Adjust

Ordering Information

PT 6681☐ = +3.3 Volts
PT 6682☐ = +2.5 Volts
PT 6683☐ = +5.0 Volts
PT 6684☐ = +9.0 Volts
PT 6685☐ = +15.0 Volts
PT 6686☐ = +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

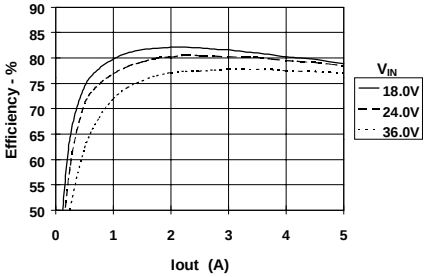
Characteristics (T_a = 25°C unless noted)	Symbols	Conditions		PT6680 SERIES Min	Typ	Max	Units
Output Current	I_o	T_a = 60°C, 200 LFM, pkg P T_a = 25°C, natural convection		0.1 (2) 0.1 (2)	— —	5.0 5.0	A
Input Voltage Range	V_{in}	0.1A ≤ I_o ≤ I_{omax}		+18V	—	+36V	V
Output Voltage Tolerance	ΔV_o	Over 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.

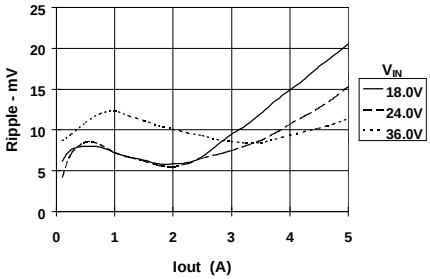
Typical Characteristics

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

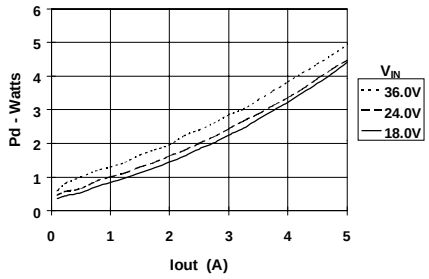
Efficiency vs Output Current



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.

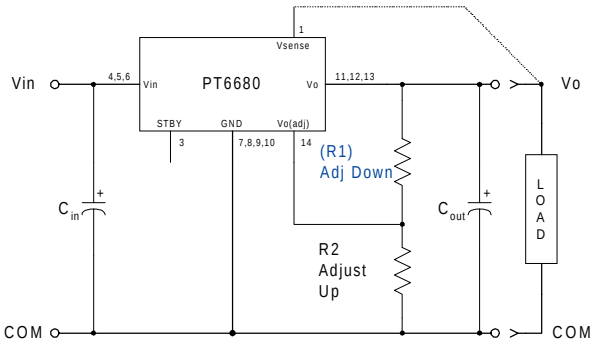
Notes:

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

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
PT6681B	OBSOLETE	SIP MODULE	EEK	14		TBD	Call TI	Call TI	-40 to 85		
PT6683P	OBSOLETE	SIP MODULE	EED	14		TBD	Call TI	Call TI	-40 to 85		
PT6685R	OBSOLETE	SIP MODULE	EEE	14		TBD	Call TI	Call TI	-40 to 85		
PT6686B	OBSOLETE	SIP MODULE	EEK	14		TBD	Call TI	Call TI	-40 to 85		

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
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Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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