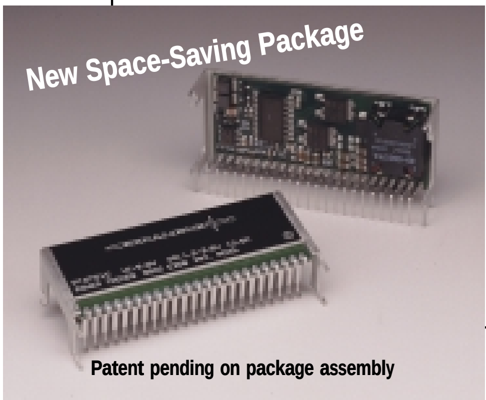
PT6930 Series

5V TO 3.3V/2.5V 25 WATT DUAL OUTPUT INTEGRATED SWITCHING REGULATOR

Application Notes
Mechanical Outline
Product Selector Guide



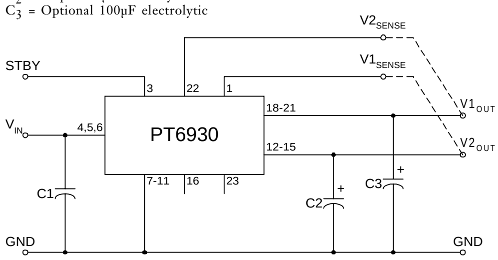
Features

- Dual Outputs:
  +3.3V/6A
  +2.5V/2.2A or +1.8V/1.5A
- Adjustable Output Voltage
- Remote Sense (both outputs)
- Standby Function
- Over-Temperature Protection
- Soft-Start
- Internal Sequencing
- 23-pin Excalibur™ Package

The PT6930 is a new series of 25W dual output ISRs designed to power the latest generation DSP chips. Both output voltages are independently adjustable with external resistors. In addition, the second output voltage of the PT6931 can be selected for either 2.5V or 1.8V to accommodate the next generation of DSP chips. The internal power sequencing of both outputs meet the requirements of TI's 'C6000 series DSPs.

Standard Application

C_1 = Req'd 560µF electrolytic (1)
C_2 = Req'd 330µF electrolytic (1)
C_3 = Optional 100µF electrolytic



Pin-Out Information

Pin	Function	Pin	Function
1	V_1 Remote Sense	13	V_{1out}
2	Do Not Connect	14	V_{1out}
3	STBY	15	V_{1out}
4	V_{in}	16	V_1 Adjust
5	V_{in}	17	Do Not Connect
6	V_{in}	18	V_{2out}
7	GND	19	V_{2out}
8	GND	20	V_{2out}
9	GND	21	V_{2out}
10	GND	22	V_2 Remote Sense
11	GND	23	V_2 Adjust*
12	V_{1out}		

*Note: for PT6931 only:
with pin 23 open, V2out=2.5V
with pin 23 shorted to pin 22, V2out=1.8V

Ordering Information

PT6931❑ = +3.3 Volts
+2.5/+1.8 Volts
PT6932❑ = +3.3 Volts
+1.5 Volts

PT Series Suffix (PT1234X)

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

(For dimensions and PC board layout, see Package Styles 1320 and 1330.)

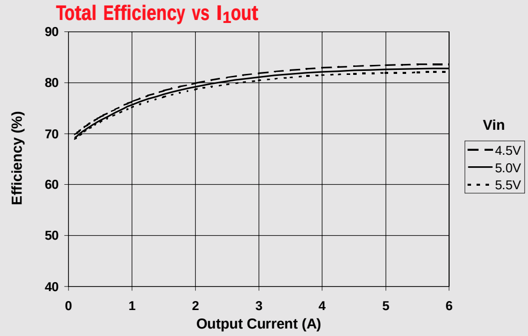
Preliminary Specifications

Characteristics (T_a= 25°C unless noted)	Symbols	Conditions		PT6930 SERIES Min	Typ	Max	Units
Output Current	I_o	T_a = +60°C, 200 LFM, pkg N	V_1 = 3.3V V_2 = 2.5V V_2 = 1.8V V_2 = 1.2V	0.1 (2) 0 0 0	— — — —	5.5 (3) 2.2 (3) 1.75 (3) 1.2 (3)	A
		T_a = +25°C, natural convection	V_1 = 3.3V V_2 = 2.5V V_2 = 1.8V V_2 = 1.2V	0.1 0 0 0	— — — —	6.0 2.2 1.75 1.2	A
Input Voltage Range	V_{in}	$0.1A \le I_o \le I_{max}$		4.5	—	5.5	V
Output Voltage Tolerance	ΔV_o	V_{in} = +5V, $I_o = I_{max}$, both outputs 0°C ≤ T_a ≤ +65°C		Vo-0.1	—	Vo+0.1	V
Line Regulation	Reg_{line}	$4.5V \le V_{in} \le 5.5V$, $I_o = I_{max}$	V_1 = 3.3V V_2 = 2.5V	— —	±7 ±7	±17 ±13	mV
Load Regulation	Reg_{load}	V_{in} = +5V, $0.1 \le I_o \le I_{max}$	V_1 = 3.3V V_2 = 2.5V	— —	±17 ±4	±33 ±10	mV
V_o Ripple/Noise	V_n	V_{in} = +5V, $I_o = I_{max}$	V_1 = 3.3V V_2 = 2.5V	— —	50 25	— —	mV
Transient Response with C_2 = 330µF	t_{tr} V_{os}	I_o step between $0.5xI_{max}$ and I_{max} V_o over/undershoot	 V_1 = 3.3V V_2 = 2.5V	— — —	25 60 60	— — —	µSec mV
Efficiency	η	V_{in} = +5V, I_o = 4A total		—	75	—	%
Switching Frequency	f_o	$4.5V \le V_{in} \le 5.5V$ $0.1A \le I_o \le I_{max}$		475	600	725	kHz
Absolute Maximum Operating Temperature Range	T_a	—		-40 (4)	—	+85 (5)	°C
Storage Temperature	T_s	—		-40	—	+125	°C
Weight	—	Vertical/Horizontal		—	29	—	grams

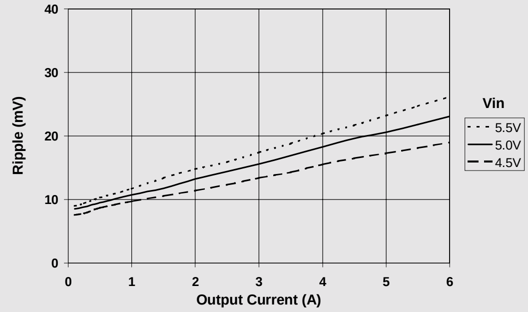
Notes: (1) *The PT6930 series requires a 560µF electrolytic capacitor on the input and a 330µF electrolytic capacitor on the output for proper operation in all applications.*
(2) *$I_o$min current of 0.25A can be divided btween both outputs; V_1, or V_2. The ISR will operate down to no-load with reduced specifications.*
(3) *$I_o$max listed for each output assumes the maximum current drawn simultaneously on both outputs. Consult the factory for the absolute maximum.*
(4) *For operating temperatures below 0°C, use tantalum type capacitors on both the input and output.*
(5) *See Safe Operating Area curves for appropriate derating.*

PT6931, V2out = 2.5V, I2out = 2.2A (See Foot Note)

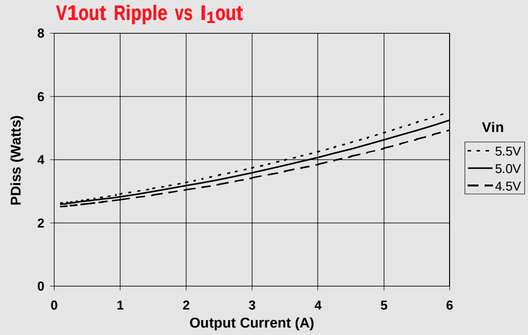
Total Efficiency vs I_1out



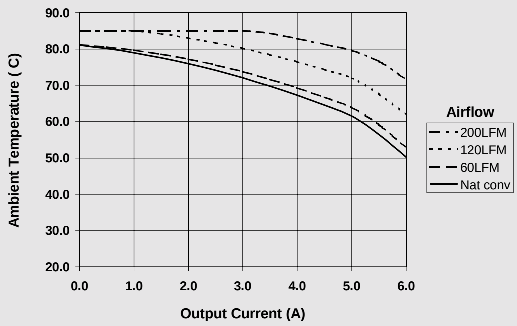
Total Power Dissipation vs I_1out



V1out Ripple vs I_1out



Safe Operating Area vs I_1out



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

Adjusting the Output Voltage of the PT6920 and PT6930 Dual Output Voltage ISRs

Each output voltage from the PT6920 and PT6930 series of ISRs can be independantly adjusted higher or lower than the factory trimmed pre-set voltage. V_1 (the voltage at V_1out), or V_2 (the voltage at V_2out) may each be adjusted either up or down using a single external resistor [2]. Table 1 gives the adjustment range for both V_1 and V_2 for each model in the series as V_a(min) and V_a(max). Note that V_2 must always be lower than V_1 [3].

V_1 Adjust Up: To increase the output, add a resistor R4 between pin 16 (V_1 Adjust) and pins 7-11 (GND) [2].

V_1 Adjust Down: Add a resistor (R3), between pin 16 (V_1 Adjust) and pin 1 (V_1 Remote Sense) [2].

V_2 Adjust Up: Add a resistor R2 between pin 23 (V_2 Adjust) and pins 7-11 (GND) [2].

V_2 Adjust Down: Add a resistor (R1) between pin 23 (V_2 Adjust) and pin 22 (V_2 Remote Sense) [2].

Refer to Figure 1 and Table 2 for both the placement and value of the required resistor.

Notes:

1. The output voltages, V_1out and V_2out, may be adjusted independantly.
2. Use only a single 1% resistor in either the (R3) or R4 location to adjust V_1, and in the (R1) or R2 location to adjust V_2. Place the resistor as close to the ISR as possible.
3. V_2 must always be at least 0.2V lower than V_1.
4. V_2 on both the PT6921 and PT6931 models may be adjusted from 2.5V to 1.8V by simply connecting pin 22 (V_2 Remote Sense) to pin 23 (V_2 Adjust). For more details, consult the data sheet.
5. If V_1 is increased above 3.3V, the minimum input voltage to the ISR must also be increased. The minimum required input voltage must be (V_1 + 1.2)V or 4.5V, whichever is greater. Do not exceed 5.5V
6. Never connect capacitors to either the V_1 Adjust or V_2 Adjust pins. Any capacitance added to these control pins will affect the stability of the respective regulated output.
7. Adjusting either voltage (V_1 or V_2) may increase the power dissipation in the regulator, and correspondingly change the maximum current available at either output. Consult the factory for application assistance.

The adjust up and adjust down resistor values can also be calculated using the following formulas. Be sure to select the correct formula parameter from Table 1 for the output and model being adjusted.

$$(R1) \text{ or } (R3) = \frac{R_o (V_a - 1)}{V_o - V_a} - R_s \quad k\Omega$$

$$R2 \text{ or } R4 = \frac{R_o}{V_a - V_o} - R_s \quad k\Omega$$

Where: V_o = Original output voltage, (V_1 or V_2)
V_a = Adjusted output voltage
R_o = The resistance value from Table 1
R_s = The series resistance from Table 1

Table 1

PT6920 ADJUSTMENT RANGE AND FORMULA PARAMETERS

Output Bus	V_1 out	V_2 out	
Series Pt #			
Standard Case	PT6921/22	PT6921	PT6922
Excalibur Case	PT6931/32	PT6931	PT6932
Adj. Resistor	(R3)/R4	(R1)/R2	(R1)/R2
V_o(nom)	3.3V	2.5V	1.5
Va(min)	2.3V	1.8V	1.2
Va(max)	3.6V	3.0V	3.0
R_o (kΩ)	12.1	10.0	9.76
R_s (kΩ)	12.1	11.5	6.49

Figure 1

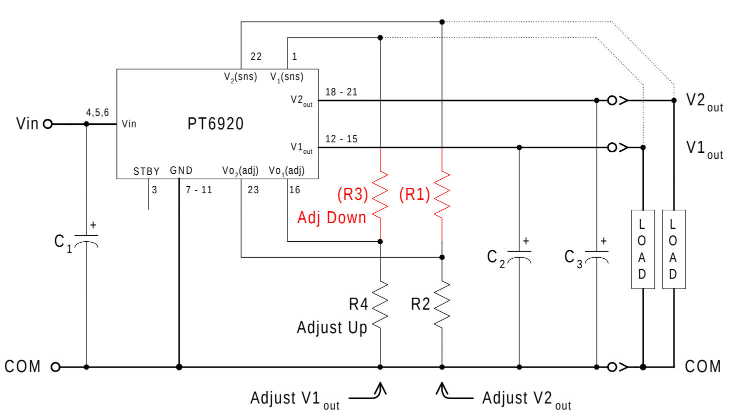


Table 2

PT6920/PT6930 ADJUSTMENT RESISTOR VALUES

Output Bus	V_1out	V_2out	
Series Pt#			
Standard Case	PT6921/6922	PT6921	PT6922
Excalibur Case	PT6931/6932	PT6931	PT6932
Adj Resistor	(R3)/R4	(R1)/R2	(R1)/R2
V_o(nom)	3.3Vdc	2.5Vdc	1.5Vdc
V_a(req'd)			
1.2			(0.0)kΩ
1.25			(3.3)kΩ
1.3			(8.2)kΩ
1.35			(16.3)kΩ
1.4			(32.6)kΩ
1.45			(81.4)kΩ
1.5			
1.55			189.0kΩ
1.6			91.1kΩ
1.65			58.6kΩ
1.7			42.3kΩ
1.75			32.6kΩ
1.8		(0.0)kΩ	26.0kΩ
1.85		(1.6)kΩ	21.4kΩ
1.9		(3.5)kΩ	17.9kΩ
1.95		(5.8)kΩ	15.2kΩ
2.0		(8.5)kΩ	13.0kΩ
2.05		(11.8)kΩ	11.3kΩ
2.1		(16.0)kΩ	9.8kΩ
2.15		(21.4)kΩ	8.5kΩ
2.2		(28.5)kΩ	7.5kΩ
2.25		(38.5)kΩ	6.5kΩ
2.3	(3.6)kΩ	(53.5)kΩ	5.7kΩ
2.35	(5.1)kΩ	(78.5)kΩ	5.0kΩ
2.4	(6.7)kΩ	(129.0)kΩ	4.4kΩ
2.45	(8.5)kΩ	(279.0)kΩ	3.8kΩ
2.5	(10.6)kΩ		3.3kΩ
2.55	(12.9)kΩ	189.0kΩ	2.8kΩ
2.6	(15.6)kΩ	88.5kΩ	2.4kΩ
2.65	(18.6)kΩ	55.2kΩ	2.0kΩ
2.7	(22.2)kΩ See Note 3	38.5kΩ	1.6kΩ
2.75	(26.4)kΩ	28.5kΩ	1.3kΩ
2.8	(31.5)kΩ	21.8kΩ	1.0kΩ
2.85	(37.6)kΩ	17.1kΩ	0.7kΩ
2.9	(45.4)kΩ	13.5kΩ	0.5kΩ
2.95	(55.3)kΩ	10.7kΩ	0.2kΩ
3.0	(68.6)kΩ	8.5kΩ	0.0kΩ
3.05	(87.1)kΩ		
3.1	(115.0)kΩ		
3.15	(161.0)kΩ		
3.2	(254.0)kΩ		
3.25	(532.0)kΩ		
3.3			
3.4	109.0kΩ See Note 5		
3.5	48.4kΩ		
3.6	28.2kΩ		

R1/R3 = (Red)   R2/R4 = Black

Power Trends, Inc. 27715 Diehl Road, Warrenville, IL 60555 **(800) 531-5782** Fax: (630) 393-6902 **http://www.powertrends.com**

Using the Standby Function on the PT6920 and PT6930 Dual Output Voltage Converters

Both output voltages of the 23-pin PT6920/6930 dual output converter may be disabled using the regulator's standby function. This function may be used in applications that require power-up/shutdown sequencing, or wherever there is a requirement to control the output voltage On/Off status with external circuitry.

The standby function is provided by the *STBY** control, pin 3. If pin 3 is left open-circuit the regulator operates normally, and provides a regulated output at both V_1out (pins 12–15) and V_2out (pins 18–21) whenever a valid supply voltage is applied to V_{in} (pins 4, 5, & 6) with respect to GND (pins 7-11). If a low voltage[2] is then applied to pin-3 both regulator outputs will be simultaneously disabled and the input current drawn by the ISR will typcially drop to less than 30mA (50mA max). The standby control may also be used to hold-off both regulator outputs during the period that input power is applied.

The standby pin is ideally controlled using an open-collector (or open-drain) discrete transistor (See Figure 1). It may also be driven directly from a dedicated TTL[3] compatible gate. Table 1 provides details of the threshold requirements.

Table 1 Inhibit Control Thresholds [2,3]

Parameter	Min	Max
Enable (V_{IH})	1.8V	Vin
Disable (V_{IL})	–0.1V	0.8V

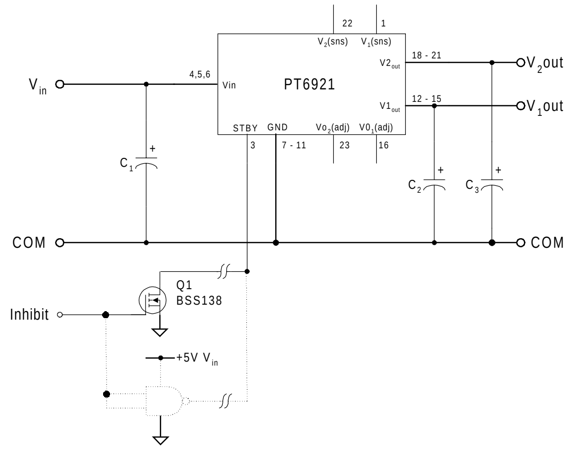
Notes:

1. The Standby/Inhibit control logic is similar for all Power Trends' modules, but the flexibility and threshold tolerances will be different. For specific information on this function for other regulator models, consult the applicable application note.

2. The Standby control pin is ideally controlled using an open-collector (or open-drain) discrete transistor and requires no external pull-up resistor. To disable the regulator output, the control pin must be pulled to less than 0.8Vdc with a low-level 0.5mA sink to ground.

3. The Standby input on the PT6920/6930 series may be driven by a differential output device, making it directly compatible with TTL logic. The control input has an internal pull-up to the input voltage V_{in}. A voltage of 1.8V or greater ensures that the regulator is enabled. *Do not* use devices that can drive the Standby control input above 5.5V or V_{in}.

Figure 1



Turn-On Time: Turning Q_1 in Figure 1 off removes the low-voltage signal at pin 3 and enables both outputs from the PT6920/6930 regulator. Following a delay of about 5–10ms, V_1out and V_2out rise together until the lower voltage, V_2out, reaches its set output. V_1out then continues to rise until both outputs reach full regulation voltage. The total power-up time is less than 15ms, and is relatively independant of load, temperature, and output capacitance. Figure 2 shows waveforms of the input current I_{in}, and output voltages V_1out and V_2out, for a PT6921 (3.3V/2.5V). The turn-off of Q_1 corresponds to t =0 secs. The waveforms were measured with a 5Vdc input voltage, and with resistive loads of 5.5A and 2.2A at the V_1out and V_2out outputs respectively.

Figure 2