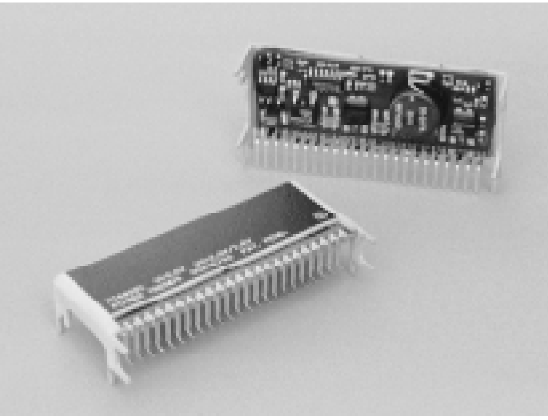
PT6935 Series

11 Amp 5V/3.3V Input Dual Output Integrated Switching Regulator

EXCALIBUR



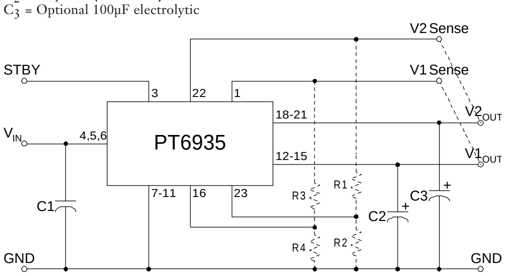
Features

- Dual Outputs
  (See Ordering Information)
- 5.0V Input (3.3V for PT6935)
- Both Outputs Adjustable
- Remote Sense
- Standby Function
- Soft-Start
- Internal Sequencing
- Short Circuit Protection
- 23-pin Space-Saving Package
- Solderable Copper Case

The PT6935/6/7 is a series of dual output ISRs designed to power the latest generation of mixed signal ICs. Both output voltages are independently adjustable with external resistors, and may also be set to at least one alternative bus voltage with a simple pin-strap. The PT6935 series has internal power sequencing to accommodate the requirements of the latest DSP chips, such as TI's 'C6000 series.

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: V_1out and V_2out can be pin-strapped to another voltage. See related application note on output voltage adjustment.

Ordering Information

PT6935❑ = +2.5/1.8 Volts
PT6936❑ = +3.3/2.5 Volts
PT6937❑ = +3.3/1.8 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		PT6935 SERIES Min	Typ	Max	Units
Output Current	I_o	T_a = +60°C, 200 LFM, pkg N; Vin =5.0V	V_1 = 3.3V V_2 = 2.5V	0.1 (2) 0	8.0 (3) 3.0 (3)	13.0 (4) 5.0 (4)	A
			V_1 =3.3V V_2 =1.8V	0.1 (2) 0	8.0 (3) 2.0 (3)	13.0 (4) 2.8 (4)	A
			V_1 =2.5V V_2 =1.8V	0.1 (2) 0	7.0 (3) 2.5 (3)	10.0 (4) 6.0 (4)	A
		T_a = +25°C, natural convection	V_1 = 3.3V V_2 =2.5V	0.1 (2) 0	8.0 (3) 3.0 (3)	13.0 (4) 5.0 (4)	A
			V_1 =3.3V V_2 =1.8V	0.1 (2) 0	8.0 (3) 2.0 (3)	13.0 (4) 3.0 (4)	A
			V_1 = 2.5V V_2 = 1.8V	0.1 (2) 0	7.0 (3) 2.5 (3)	12.0 (4) 6.0 (4)	A
Short Circuit Current Threshold	I_{sc}	V_{in} =5V, I_1+I_2 combined		12.0		22.5	A
Input Voltage Range	V_{in}	0.1A ≤ I_o ≤ I_{max}	PT6935 PT6936/PT6937	3.1 4.5	— —	5.5 5.5	V
Output Voltage Tolerance	ΔV_o	V_{in} = +5V, I_o =I_{TYP} both outputs –40°C ≤ T_a ≤ +85°C		V_o-0.03	—	V_o+0.03	V
Line Regulation	Reg_{line}	Over specifiedV_{in} range, I_o =I_{TYP}	V_1 = 3.3V V_2 = 2.5V	— —	±5 ±2	±10 ±5	mV
			V_1 =2.5V V_2 =1.8V	— —	±5 ±2	±10 ±5	mV
Load Regulation	Reg_{load}	V_{in} = +5V, 0.1 ≤ I_o ≤ I_{TYP}	V_1 = 3.3V V_2 = 2.5V	— —	±5 ±5	±10 ±10	mV
			V_1 =2.5V V_2 =1.8V	— —	±5 ±5	±10 ±10	mV
V_o Ripple/Noise	V_n	V_{in} = +5V, I_o =I_{TYP}	V_1 = 3.3V V_2 = 2.5V	— —	35 35	— —	mV
			V_1 =2.5V V_2 =1.8V	— —	35 35	— —	mV
Transient Response with C_2 = 330µF	t_{tr} V_{os}	I_o step between 0.5xI_{TYP} and I_{TYP} V_o over/undershoot	 V_1 = 3.3V V_2 = 2.5V	— — —	60 60 60	— — —	µSec mV

(Continued)

Specifications *(From previous page)*

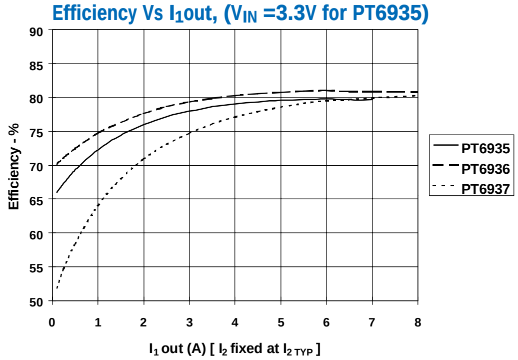
Characteristics (T_a= 25°C unless noted)	Symbols	Conditions	PT6935 SERIES Min	Typ	Max	Units
Switching Frequency	f_o	$3.1V \le V_{in} \le 5.5V$ $0.1A \le I_o \le I_{TYP}$	300	350	400	kHz
Absolute Maximum Operating Temperature Range	T_a	—	–40 (5)	—	+85 (6)	°C
Storage Temperature	T_s	—	-40	—	+125	°C
Weight	—	Vertical/Horizontal	—	29	—	grams

Notes: (1) *The PT6935 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 0.1A can be divided between both output, V_1 or V_2. The ISR will operate down to no-load with reduced specifications.*
(3) *The typical current is the load that can be simulataneously drawn from both outputs under the stated operating conditions.*
(4) *The maximum specified current is that which can be drawn from the applicable output with the other output unloaded. The total current on both outputs must never exceed the maximum load current specified for V_1out. If either output voltage is adjusted, consult the factory for guidance.*
(5) *For operating temperatures below 0°, Cin and Cout must have stable characteristics. Use either tantalum or Oscon® capacitors.*
(6) *See Safe Operating Area curves, or contact the factory for the appropriate derating.*

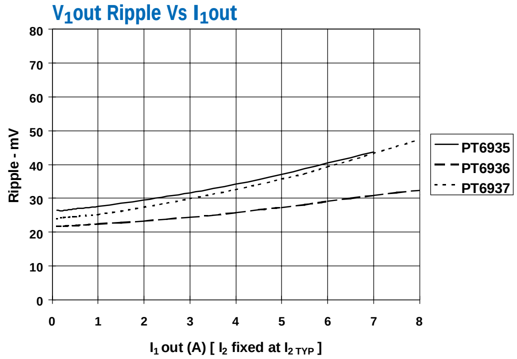
TYPICAL CHARACTERISTICS

Performance, V_{IN} =5V –Unless specified, (See Note A)

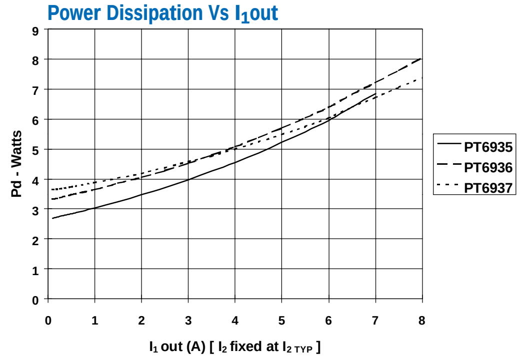
Efficiency Vs I_1out, (V_{IN} =3.3V for PT6935)



V_1out Ripple Vs I_1out

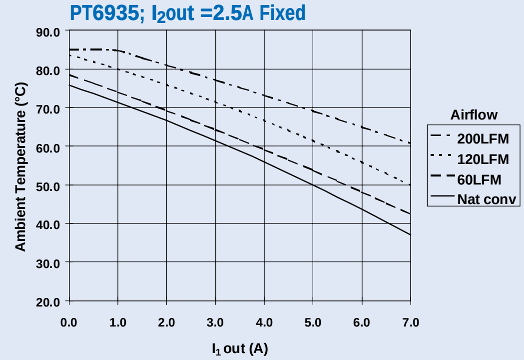


Power Dissipation Vs I_1out

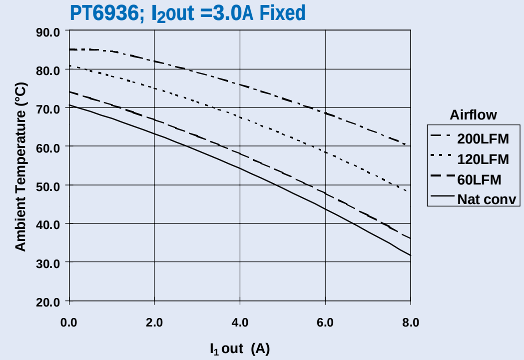


Safe Operating Area @V_{IN}=5.0V (See Note B)

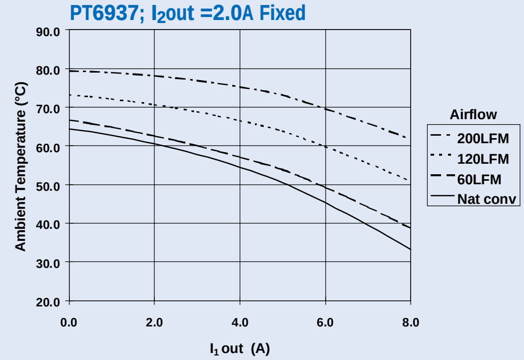
PT6935; I_2out =2.5A Fixed



PT6936; I_2out =3.0A Fixed



PT6937; I_2out =2.0A Fixed



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

Adjusting the Output Voltage of the PT6935 Dual Output Voltage ISRs

Each output voltage from the PT6935 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 [1]. 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 [2].

V_1 Adjust Up: To increase the output, add a resistor R4 between pin 16 (V_1 Adjust) and pins 7-11 (GND) [1].

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

V_2 Adjust Up: Add a resistor R2 between pin 23 (V_2 Adjust) and pins 7-11 (GND) [1].

V_2 Adjust Down: Add a resistor (R1) between pin 23 (V_2 Adjust) and pin 22 (V_2 Remote Sense) [1].

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

Notes:

1. 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.
2. V_2 must always be at least 0.2V lower than V_1.
3. Both the V_1 and V_2 may be adjusted down to an alternative bus voltage by making, (R3) or (R1) respectively, a zero ohm link. Refer to the Table 1 footnotes for guidance.
4. Adjusting the V_1out output voltage of the PT6935 (2.5V/1.8V model) higher than the factory pre-trimmed output voltage may increase the minimum input voltage specified for the part. This model must comply with the following requirements.

   PT6935:
   V_{in}(min) =(V_a + 0.6)V or 3.1V, whichever is greater.
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 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.

$$(R_1) \text{ or } (R_3) = \frac{10\,(V_a - V_r)}{V_o - V_a} - R_s \quad k\Omega$$

$$(R_2) \text{ or } (R_4) = \frac{10 \cdot V_r}{V_a - V_o} - R_s \quad k\Omega$$

Where: V_o = Original output voltage, (V_1 or V_2)
V_a = Adjusted output voltage
V_r = The reference voltage 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 (2)	
Series Pt #	PT6935	PT6936/37	PT6935/37	PT6936
Adj. Resistor	(R3)/R4	(R3)/R4	(R1)/R2	(R1)/R2
V_o(nom)	2.5V	3.3V	1.8V	2.5V
Va(min)	1.8V *	2.5V *	1.5V †	1.8V †
Va(max)	3.6V (4)	3.6V	2.4V	3.0
Vr	1.27V	1.27V	1.0V	1.0V
R_s (kΩ)	7.5	15.4	16.9	11.5

* (R3) =Zero-ohm link (3) † (R1) =Zero-ohm link (3)

Figure 1

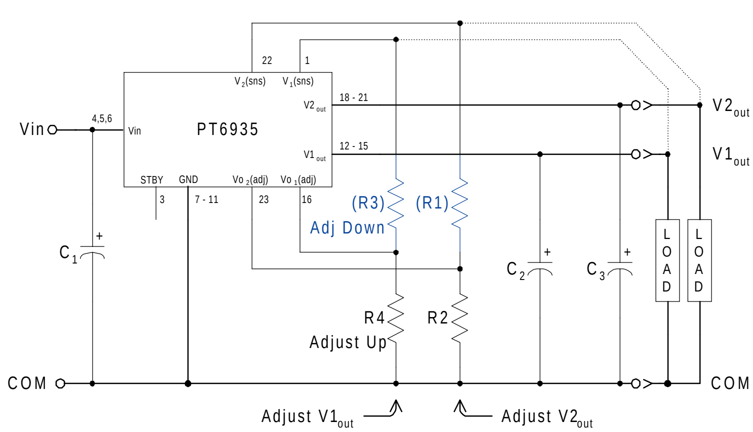


Table 2

PT6935 ADJUSTMENT RESISTOR VALUES

Output Bus	V_1 out		V_2 out	
Series Pt #	PT6935	PT6936/37	PT6935/37	PT6936
Adj. Resistor	(R3)/R4	(R3)/R4	(R1)/R2	(R1)/R2
V_o(nom)	2.5V	3.3V	1.8V	2.5V
V_a(req'd)				
1.5			(0.0)kΩ	
1.55			(5.1)kΩ	
1.6			(13.1)kΩ	
1.65			(26.4)kΩ	
1.7			(53.1)kΩ	
1.75			(133.0)kΩ	
1.8	(0.0)			(0.0)kΩ
1.85	(1.4)kΩ		183.0kΩ	(1.6)kΩ
1.9	(3.0)kΩ		83.1kΩ	(3.5)kΩ
1.95	(4.9)kΩ		49.8kΩ	(5.8)kΩ
2.0	(7.1)kΩ		33.1kΩ	(8.5)kΩ
2.05	(9.8)kΩ		23.1kΩ	(11.8)kΩ
2.1	(13.3)kΩ		16.4kΩ	(16.0)kΩ
2.15	(17.6)kΩ		11.7kΩ	(21.4)kΩ
2.2	(23.5)kΩ		8.1kΩ	(28.5)kΩ
2.25	(31.7)kΩ		5.3kΩ	(38.5)kΩ
2.3	(44.0)kΩ		3.1kΩ	(53.5)kΩ
2.35	(64.5)kΩ		1.3kΩ	(78.5)kΩ
2.4	(106.0)kΩ		0.0kΩ	(129.0)kΩ
2.45	(229.0)kΩ			(279.0)kΩ
2.5		(0.0)kΩ		
2.55	247.0kΩ	(1.7)kΩ		189.0kΩ
2.6	120.0kΩ	(3.6)kΩ		88.5kΩ
2.65	77.2kΩ	(5.8)kΩ		55.2kΩ
2.7	56.0kΩ	(8.4)kΩ		38.5kΩ
2.75	43.3kΩ	(11.5)kΩ		28.5kΩ
2.8	34.8kΩ	(15.2)kΩ		21.8kΩ
2.85	28.8kΩ	(19.7)kΩ		17.1kΩ
2.9	24.3kΩ	(25.4)kΩ		13.5kΩ
2.95	20.7kΩ	(32.6)kΩ		10.7kΩ
3.0	17.9kΩ	(42.3)kΩ		8.5kΩ
3.05	15.6kΩ	(55.8)kΩ		
3.1	13.7kΩ	(76.1)kΩ		
3.15	12.0kΩ	(110.0)kΩ		
3.2	10.6kΩ	(178.0)kΩ		
3.25	9.4kΩ	(381.0)kΩ		
3.3	8.4kΩ			
3.4	6.6kΩ	112.0k		
3.5	5.2kΩ	48.1k		
3.6	4.1kΩ	26.9k		

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