# PT6910 Series

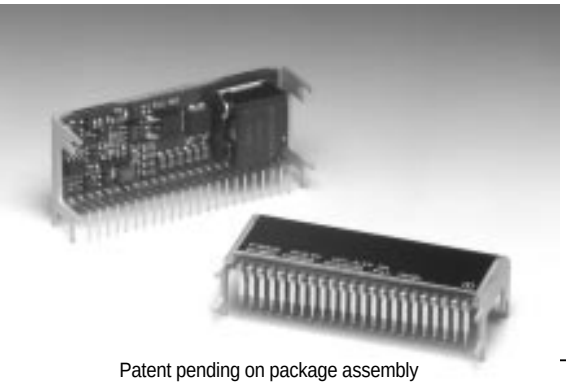
**12 Watt 5V/3.3V Input**
**Plus to Minus Voltage Converter**

EXCALIBUR

**Power Trends Products from Texas Instruments**

SLTS113

*(Revised 11/30/2000)*



Patent pending on package assembly

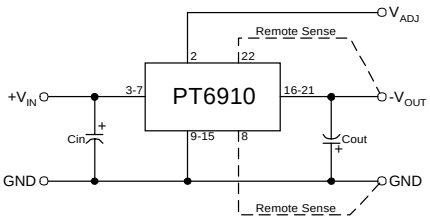
- Single-Device: +5V/3.3V input
- Remote Sense
- +5V & +3.3V Input Voltage
- Adjustable Output Voltage
- 23-pin Space-Saving Package
- Solderable Copper Case

The PT6910 series is a series of high performance 12 watt, plus to minus voltage convertors that are designed to power the latest ECL (–5.2V) and GaAs (-2.0V) ICs from an existing +5.0V or +3.3V source.

These regulators are similar to the popular PT6900 series with the added feature of Power Trends' unique solderable copper case.

A 330µF electrolytic capacitor is required on both the input and output for proper operation. Also note that this product does not include short-circuit protection.

## Standard Application




$C_{in}$ = Required 330µF electrolytic
$C_{out}$ = Required 330µF electrolytic

## Pin-Out Information

| Pin | Function | Pin | Function |
|---|---|---|---|
| 1 | Do not connect | 13 | GND |
| 2 | $V_{out}$ Adjust | 14 | GND |
| 3 | $V_{in}$ | 15 | GND |
| 4 | $V_{in}$ | 16 | $V_{out}$ |
| 5 | $V_{in}$ | 17 | $V_{out}$ |
| 6 | $V_{in}$ | 18 | $V_{out}$ |
| 7 | $V_{in}$ | 19 | $V_{out}$ |
| 8 | Remote Sense GND | 20 | $V_{out}$ |
| 9 | GND | 21 | $V_{out}$ |
| 10 | GND | 22 | Remote Sense $V_{out}$ |
| 11 | GND | 23 | Do not connect |
| 12 | GND | | |

## Ordering Information

| +5V Input | +3.3V Input | $V_{out}$ |
|---|---|---|
| PT6911❑ | PT6914❑ | = –2.0V |
| PT6912❑ | PT6915❑ | = –5.2V |
| PT6913❑ | | = –1.5V |

## 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 1300 and 1310.)*

## Specifications

| Characteristics ($T_a$= 25°C unless noted) | Symbols | Conditions | | PT6910 SERIES Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| Output Current | $I_o$ | $T_a$ = +25°C, natural convection | | | | | |
| | | $V_{in}$ =5.0V | $V_o$ = –2.0V / –1.5V | 0.1 (1) | — | 6.0 (2) | A |
| | | | $V_o$ = –5.2V | 0.1 (1) | — | 3.5 (2) | |
| | | $V_{in}$ =3.3V | $V_o$ = –2.0V | 0.1 (1) | — | 5.0 (2) | A |
| | | | $V_o$ = –5.2V | 0.1 (1) | — | 2.5 (2) | A |
| Input Voltage Range | | 0.1A ≤ $I_o$ ≤ $I_{max}$ | PT6911 PT6912/PT6913 | 4.5 | — | 5.5 | |
| | | | PT6914/PT6915 | 3.1 | — | 3.6 | V |
| Output Voltage Tolerance | $\Delta V_o$ | Nominal $V_{in}$, $I_o$ = $I_{max}$<br>0°C ≤ $T_a$ ≤ +60°C | | $V_o$ – 0.05 | — | $V_o$ + 0.05 | V |
| Output Adjust Range | $V_o$ | Pin 14 to $V_o$ or GND | $V_o$ = –2.0V | –1.4 | — | –4.4 | |
| | | | $V_o$ = –5.2V | –2.7 | — | –6.5 | V |
| | | | $V_o$ = –1.5V | –1.2 | — | –3.4 | |
| Line Regulation | $Reg_{line}$ | Over $V_{in}$ range, $I_o$ = $I_{max}$ | | — | ±0.5 | ±1.0 | % |
| Load Regulation | $Reg_{load}$ | $V_{in}$ = $V_{nom}$, 0.1 ≤ $I_o$ ≤ $I_{max}$ | | — | ±0.5 | ±1.0 | % |
| $V_o$ Ripple/Noise | $V_n$ | $V_{in}$ = $V_{nom}$, $I_o$ = $I_{max}$ | $V_o$ = –1.5V / –2.0V | — | 40 | — | mV |
| | | | $V_o$ = –5.2V | — | 50 | — | |
| Transient Response | $t_{tr}$ | $I_o$ step between 0.5x$I_{max}$ and $I_{max}$ | | — | 200 | — | µSec |
| with $C_{out}$ = 330µF | $V_{os}$ | $V_o$ over/undershoot | | — | 200 | — | mV |
| Efficiency | η | $V_{in}$ =+5V, $I_o$ =0.5x$I_{max}$ | $V_o$ = –1.5V | — | 65 | — | |
| | | | $V_o$ = –2.0V | — | 70 | — | % |
| | | | $V_o$ = –5.2V | — | 77 | — | |
| | | $V_{in}$ = +3.3V, $I_o$ =0.5x$I_{max}$ | Vo = –2.0V | — | 67 | — | % |
| | | | Vo = –5.2V | — | 75 | — | |
| Switching Frequency | $f_o$ | Over $V_{in}$ and $I_o$ ranges | | 500 | — | 600 | kHz |
| Absolute Maximum Operating Temperature Range | $T_a$ | | | 0 | — | +85 (2) | °C |
| Recommended Operating Temperature Range | $T_a$ | Over $V_{in}$ Range | | 0 | — | +60 | °C |
| Storage Temperature | $T_s$ | | | -40 | — | +125 | °C |
| Weight | — | Vertical/Horizontal | | — | 26 | — | grams |

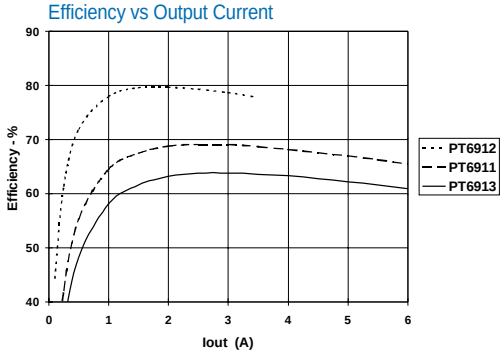
Notes: *(1) ISR-will operate down to no load with reduced specifications.*
*(2) See Safe Operating Area curves, or consult the factory for the appropriate derating.*

# Typical Characteristics

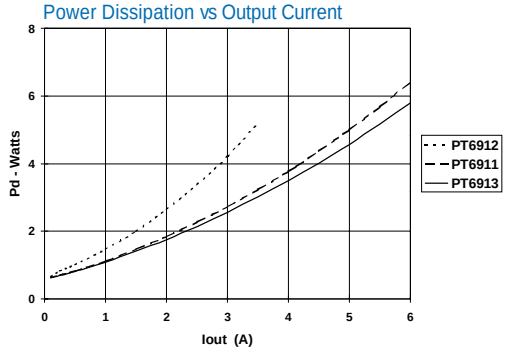
12 Watt 5V/3.3V Input
Plus to Minus Voltage Converter

## 5.0V Input Voltage (See Note A)

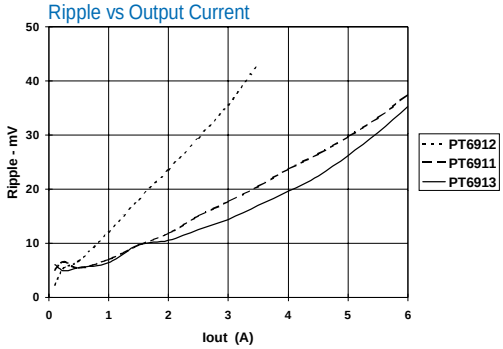
### Efficiency vs Output Current




### Power Dissipation vs Output Current

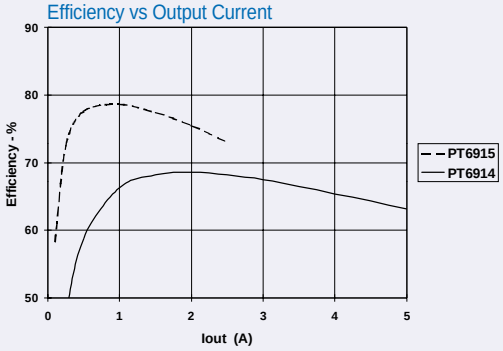



### Ripple vs Output Current

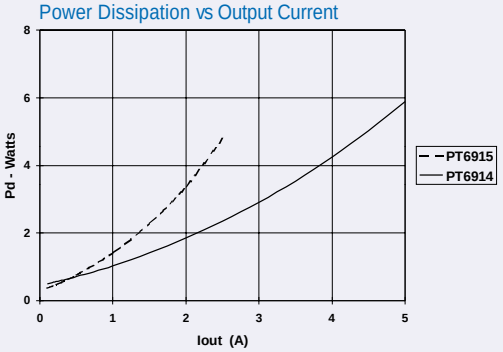



## 3.3V Input Voltage (See Note A)

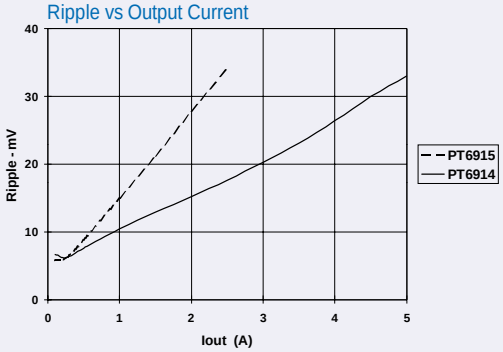
### Efficiency vs Output Current



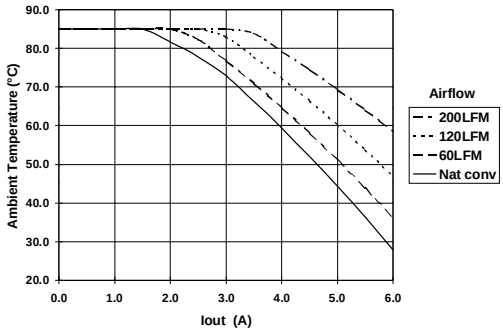

### Power Dissipation vs Output Current



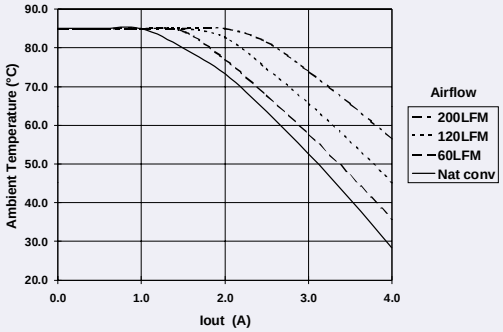

### Ripple vs Output Current




## PT6911 Safe Operating Area, Vin =5.0V (See Note B)




## PT6912 Safe Operating Area, Vin =5.0V (See Note B)




Note A: *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 DC-DC Converter.*
Note B: *SOA curves represent the condition at which internal com-ponents are at or below manufacturere's maximum operating temperature.*

## Adjusting the Output Voltage of the PT6900/PT6910 Positive to Negative Converter Series

The negative output voltage of the Power Trends PT6900 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 gives the 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 2 ($V_o$ adjust) and pin 8 (Remote Sense GND).

Adjust Down: Add a resistor (R1), between pin 2 ($V_o$ adjust) and pin 22 (Remote Sense $V_o$).

Refer to Figure 1 and Table 2 for both the placement and value of the required resistor, either (R1) or R2 as appropriate.

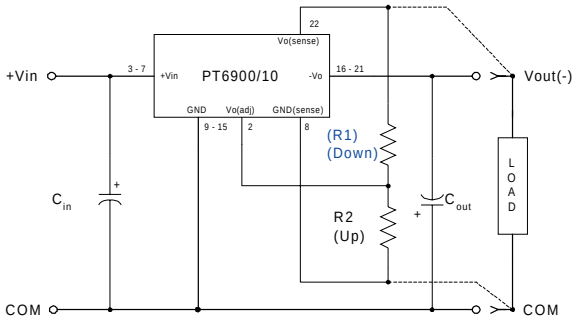
Notes:

1. Only a single 1% resistor is required in either the (R1) or R2 location. Do not use (R1) and R2 simultaneously. 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 Sense pins. Any capacitance added to the $V_o$ adjust pin will affect the stability of the ISR.
3. If the sense pins are not being used, the resistors (R1) and R2 can be connected to $V_{out}$ and GND respectively.
4. An increase in the output voltage must be accompanied by a corresponding reduction in the maximum output current. The revised maximum output current must be reduced to the equivalent of 12Watts.

i.e. $I_{out}\,(max) = \frac{12}{V_a}$ Adc,

where $V_a$ is the adjusted output voltage.

*Figure 1*




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

$$(R1) = \frac{24.9\,(V_a - V_r)}{(V_o - V_a)} - R_s \ k\Omega$$

$$R2 = \frac{24.9\,V_r}{(V_a - V_o)} - R_s \ k\Omega$$

Where:

$V_o$ = Original output voltage
$V_a$ = Adjusted output voltage
$V_r$ = Reference voltage in Table 1
$R_s$ = The resistance given in Table 1

*Table1*

PT6900/PT6910 ADJUSTMENT RANGE AND FORMULA PARAMETERS

| Series Pt # | | | |
|---|---|---|---|
| 5.0V Bus | PT6903/13 | PT6901/11 | PT6902/12 |
| 3.3V Bus | | PT6904/14 | PT6905/15 |
| Vo (nom) | -1.5V | -2.0V | -5.2V |
| Va (min) | -1.2V | -1.4V | -2.7V |
| Va (max) | -3.4V | -4.5V | -6.5V |
| Vr | -1.0V | -1.0V | -0.92V |
| Rs (kΩ) | 12.7 | 10.0 | 17.4 |

*Table 2*

PT6900/PT6910 ADJUSTMENT RESISTOR VALUES

| Series Pt # | | | |
|---|---|---|---|
| 5.0V Bus | PT6903/13 | PT6901/11 | PT6902/12 |
| 3.3V Bus | | PT6904/14 | PT6905/15 |
| $V_o$ (nom) | –1.5Vdc | –2.0Vdc | –5.2Vdc |
| $V_a$ (req'd) | | | |
| –1.2 | (3.9)kΩ | | |
| –1.3 | (24.7)kΩ | | |
| –1.4 | (86.9)kΩ | (6.6)kΩ | |
| –1.5 | | (14.9)kΩ | |
| –1.6 | 236.0kΩ | (27.4)kΩ | |
| –1.7 | 112.0kΩ | (48.1)kΩ | |
| –1.8 | 70.3kΩ | (89.6)kΩ | |
| –1.9 | 49.6kΩ | (214.0)kΩ | |
| –2.0 | 37.1kΩ | | |
| –2.1 | 28.8kΩ | 239.0kΩ | |
| –2.2 | 22.9kΩ | 115.0kΩ | |
| –2.3 | 18.4kΩ | 73.0kΩ | |
| –2.4 | 15.0kΩ | 52.3kΩ | |
| –2.5 | 12.2kΩ | 39.8kΩ | |
| –2.6 | 9.9kΩ | 31.5kΩ | |
| –2.7 | 8.1kΩ | 25.6kΩ | (0.3)kΩ |
| –2.8 | 6.5kΩ | 21.1kΩ | (2.1)kΩ |
| –2.9 | 5.1kΩ | 17.7kΩ | (4.0)kΩ |
| –3.0 | 3.9kΩ | 14.9kΩ | (6.1)kΩ |
| –3.1 | 2.9kΩ | 12.6kΩ | (8.5)kΩ |
| –3.2 | 2.0kΩ | 10.8kΩ | (11.0)kΩ |
| –3.3 | 1.1kΩ | 9.2kΩ | (13.8)kΩ |
| –3.4 | 0.4kΩ | 7.8kΩ | (16.9)kΩ |
| –3.5 | | 6.6kΩ | (20.4)kΩ |
| –3.6 | | 5.6kΩ | (24.3)kΩ |
| –3.7 | | 4.7kΩ | (28.7)kΩ |
| –3.8 | | 3.8kΩ | (33.8)kΩ |

| Series Pt # | | |
|---|---|---|
| 5.0V Bus | PT6901/11 | PT6902/12 |
| 3.3V Bus | PT6904/14 | PT6905/15 |
| $V_o$ (nom) | –2.0Vdc | –5.2Vdc |
| $V_a$ (req'd) | | |
| –3.9 | 3.1kΩ | (39.7)kΩ |
| –4.0 | 2.5kΩ | (46.5)kΩ |
| –4.1 | 1.9kΩ | (54.6)kΩ |
| –4.2 | 1.3kΩ | (64.3)kΩ |
| –4.3 | 0.8kΩ | (76.1)kΩ |
| –4.4 | 0.4kΩ | (90.9)kΩ |
| –4.5 | 0.0kΩ | (106.0)kΩ |
| –4.6 | | (135.0)kΩ |
| –4.7 | | (171.0)kΩ |
| –4.8 | | (224.0)kΩ |
| –4.9 | | (313.0)kΩ |
| –5.0 | | (491.0)kΩ |
| –5.1 | | (1020.0)kΩ |
| –5.2 | | |
| –5.3 | | 212.0kΩ |
| –5.4 | | 97.1kΩ |
| –5.5 | | 59.0kΩ |
| –5.6 | | 39.9kΩ |
| –5.7 | | 28.4kΩ |
| –5.8 | | 20.8kΩ |
| –5.9 | | 15.3kΩ |
| –6.0 | | 11.2kΩ |
| –6.1 | | 8.1kΩ |
| –6.2 | | 5.5kΩ |
| –6.3 | | 3.4kΩ |
| –6.4 | | 1.7kΩ |
| –6.5 | | 0.2kΩ |

R1 = (Blue) R2 = Black

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