PT4310 Series —48V

6-W Low-Profile Dual-Output Isolated DC/DC Converter

Features

- Dual Complimentary Outputs
- Wide Input Voltage: 38 V to 75 V
- 1,500 VDC Isolation
- 9 Pin DIP Package
- Low-Profile (8mm)
- Pin-compatible with PT4300 Series
- No External Components Required
- Safety Approvals: UL / cUL 60950
  EN 60950

Description

The PT4310 modules are a low-power series of isolated DC/DC converters that produce a dual complimentary output. The PT4310 series is pin-compatible with the PT4300 series, and has improved temperature compensation. These modules are an ideal alternative to the PT4300 for both new and existing designs.

Applications include Telecom and Datacom systems where both board space and height are a premium.

The PT4310 series is offered in an open-frame lightweight package, and is available in both through-hole or SMD-DIP package types. Models include the standard output voltages, ±5 V, ±12 V, and ±24 V. The output voltages are adjustable by up to 5%.

Ordering Information

PT4311❑ = ±5 V/1.2 A
PT4313❑ = ±12 V/0.5 A
PT4314❑ = ±24 V/0.25 A

PT Series Suffix (PT1234x)

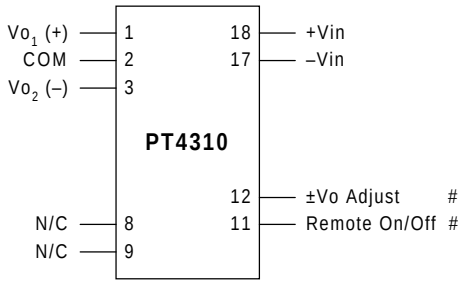
Case/Pin Configuration	Order Suffix	Package Code
Horizontal	**A**	(EGK)
SMD	**C**	(EGL)

(Reference the applicable package code drawing for the dimensions and PC board layout)

Pin-Out Information

Pin	Function
1	Vo_1 (+)
2	COM
3	Vo_2 (–)
8	N/C
9	N/C
11	Remote On/Off #
12	±Vout Adjust #
17	–Vin
18	+Vin

Package Top View



For more information on the Remote On/Off control and output voltage adustment, refer to the application notes.

Environmental Specifications

Characteristic	Symbol	Conditions	PT4310 Series Min	Typ	Max	Units
Operating Temperature Range	T_a	Over V_{in} range	–40	—	+85 (i)	°C
Solder Reflow Temperature	T_{reflow}	Surface temperature of module, case or pins	—	—	215	°C
Storage Temperature	T_s	—	–40	—	+125	°C
Reliability	MTBF	Per Bellcore TR-332 50% stress, T_a =40°C, ground benign	4.0	—	—	10^6 Hrs
Mechanical Shock	—	Per Mil-Std-883D, method 2002.3, 1 mS, half-sine, mounted to a fixture	—	500	—	G's
Mechanical Vibration	—	Per Mil-Std-883D, method 2007.2, 20-2000 Hz, soldered in a PC board	—	20	—	G's
Weight	—	—	—	10	—	grams
Flammability	—	Materials meet UL 94V-0				

Notes: *(i) See Safe Operating Area curves or contact the factory for the appropriate derating.*
(ii) During solder reflow of SMD package version, do not elevate the module, case, pins, or internal component temperatures above a peak of 215°C. For further guidance refer to the application note, "Reflow Soldering Requirements for Plug-in Power Surface Mount Products," (SLTA051).

Pin Descriptions

+Vin: The positive input supply for the module with respect to $-V_{in}$. When powering the module from a –48-V telecom central office supply, this input is connected to the primary system ground.

–Vin: The negative input supply for the module, and the 0-VDC reference for the '*Remote On/Off*' and '*±Vo Adjust*' control inputs. When the module is powered from a +48-V supply, this input is connected to the input source return.

Remote On/Off: This is an open-collector (open-drain) negative logic input that enables the module output. The input is referenced to –Vin. Applying a low-level ground signal to this pin disables the module's outputs. A high impedance enables the module's outputs. If not used the pin should be left unconnected.

Vo_1: The positive regulated power output voltage, which is referenced to the COM node.

Vo_2: The negative regulated power output voltage, which is referenced to the COM node.

COM: The secondary return reference for the module's two regulated output voltages. It is dc isolated from the +Vin and –Vin input supply pins.

±Vo Adjust: Using a single resistor, this pin allows the module's complementary output voltages to be adjusted higher or lower than their preset value. If not used, this pin should be left open circuit. Consult the related application note for further information.

Specifications (Unless otherwise stated, T_a =25°C, V_{in} =53 V, C_{out} =0 µF, and $Io_1 = |Io_2| = Io_{typ}$)

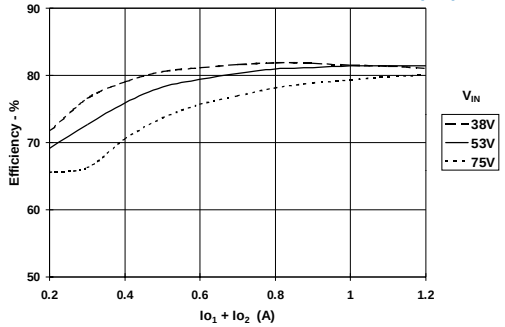
Characteristic	Symbol	Conditions		PT4310 Series Min	Typ	Max	Units
Ouput Power	$Po_{(tot)}$			—	—	6	W
Output Current	Io_1, $\|Io_2\|$ (1)	Over V_{in} range (any one output)	PT4311 (±5 V)	0.2 (2)	0.6	1	A
			PT4313 (±12 V)	0.05 (2)	0.25	0.45	
			PT4314 (±24 V)	0.02 (2)	0.125	0.125	
	$Io_1 + \|Io_2\|$ (1)	Over V_{in} range (sum-total from both outputs)	PT4311	0.4	—	1.2	A
			PT4313	0.1	—	0.5	
			PT4314	0.04	—	0.25	
Input Voltage Range	V_{in}	Over I_o range		38	—	75	V
Set Point Voltage	Vo_1, $\|Vo_2\|$ (1)		PT4311	4.95	5.05	5.15	V
			PT4313	11.85	12	12.15	
			PT4314	23.28	24	24.72	
Temperature Variation	Reg_{temp}	–40 >T_a> +85°C	PT4311	—	±0.5	—	%V
			PT4313	—	±1	—	
			PT4314	—	±1	—	
Line Regulation	Reg_{line}	Over V_{in} range		—	±25	±40	mV
Load Regulation	Reg_{load}	$\|Io_x\|$ =0.6 A, 0.2 A ≤ $\|Io_y\|$ ≤ 0.6 A	PT4311	—	100	150	mV
		$\|Io_x\|$ =0.25 A, 0.05 A ≤ $\|Io_y\|$ ≤ 0.25 A	PT4313	—	250	350	
		$\|Io_x\|$ =0.125 A, 0.02 A ≤ $\|Io_y\|$ ≤ 0.125 A	PT4314	—	275	500	
Total Output Voltage Variation	ΔVo_{tot}	Over V_{in} and load range	PT4311, PT4314	—	±5	—	$\%V_o$
		–40°C >T_a> +85°C	PT4313	—	±4	—	
No-load Output Voltage	$Vo_{(no\text{-}load)}$	$Io_1 = \|Io_2\| = 0$	PT4311	—	5.4	5.9	V
			PT4313	—	12.7	17	
			PT4314	—	24.8	29	
Efficiency	η		PT4311	—	82	—	%
			PT4313	—	85	—	
			PT4314	—	82	—	
V_o Ripple (pk-pk)	Vr	20 MHz bandwidth	PT4311	—	50	100	mV_{pp}
			PT4313, PT4314	—	90	150	
Transient Response	t_{tr}	20% ≤ $\|Io_y\|$ ≤ 75% of Io_{typ}, 25%load step $\|Io_x\|$		—	250	—	µs
	ΔV_{tr}	$\|Vo_x\|$ over/undershoot	PT4311	—	±75	—	mV
			PT4313	—	±200	—	
			PT4314	—	±500	—	
Output Voltage Adjust Range	Δ±Vo_{adj}	Both outputs adjusted simulatenously		—	5	—	$\%V_o$
Current Limit Threshold	I_{Lim}	Over V_{in} range, ΔV_o=10%$V_o$nom	PT4311, PT4313	—	2.5	—	A
			PT4314	—	0.4	—	
Short Circuit Current	I_{sc}		PT4311, PT4313	—	1	—	A
			PT4314	—	0.25	—	
Inrush Current	I_{ir}	On start-up		—	0.5	—	A
	t_{ir}			—	1	—	ms
Switching Frequency	f_o	Over V_{in} range		400	—	520	kHz
Under-Voltage Lockout	UVLO			—	36	—	V
Remote On/Off (Pin 11)		Referenced to –V_{in} (pin 17)					
Input High Voltage	V_{IH}			5	—	Open (3)	V
Input Low Voltage	V_{IL}			–0.1	—	+1	
Input Low Cunrrent	I_{IL}			—	–0.2	–	mA
Standby Input Current	I_{in} standby	pins 11 & 17 connected		—	10	—	mA
Internal Input Capacitance	C_{in}			—	1	—	µF
External Output Capacitance	C_{out}	Sum-total capacitance, connected from both outputs to COM (pin 2)	PT4311	0	—	120 (4)	µF
			PT4313	0	—	47 (4)	
			PT4314	0	—	20 (4)	
Isolation Voltage		Input - output		1500	—	—	V
Capacitance				—	1100	—	pF
Resistance				10	—	—	MΩ

Notes: *(1) $|Io_2|$ and $|Vo_2|$ indicates the magnitudes of the negative output parameters. Parameters within vertical brackets are quoted absolute.*
(2) The DC/DC converter will operate at no load with reduced specifications. See "No-load Output Voltage" specification.
(3) The Remote On/Off (pin 11) has an internal pull-up. If the pin is left open the module will operate when input power is applied. Refer to the application notes for interface considerations.
(4) Output capacitors are not required for proper operation. If added, Oscon® or tantalum types are recommended for operation below 0°C ambient.

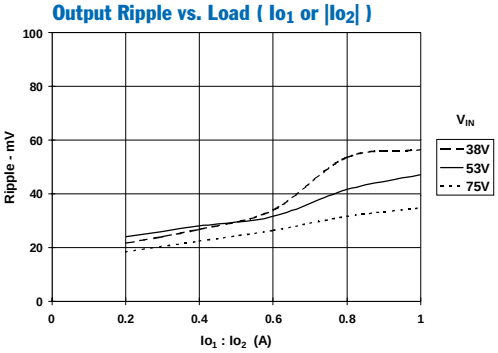
Typical Characteristics

PT4311 (±5V) Characteristic Data (See Note A)

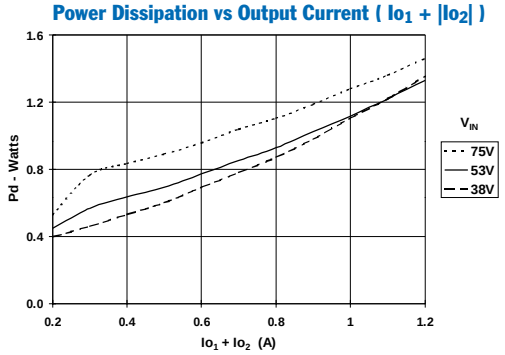
Efficiency vs. Total Output Current (Io_1 + $|Io_2|$)



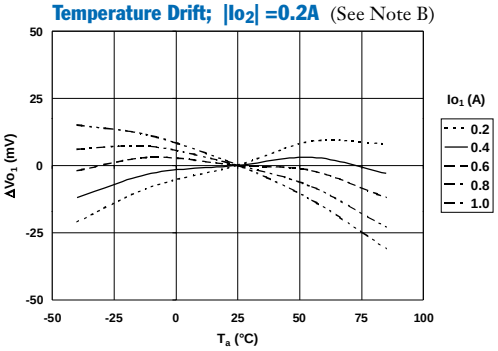
Output Ripple vs. Load (Io_1 or $|Io_2|$)



Power Dissipation vs Output Current (Io_1 + $|Io_2|$)

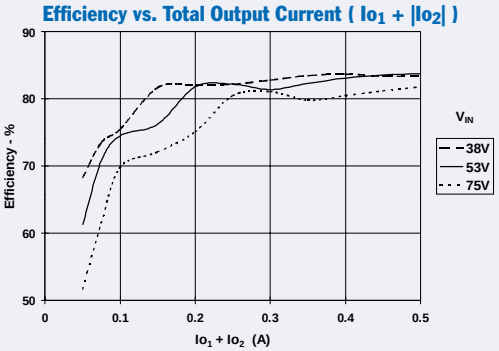


Temperature Drift; $|Io_2|$ =0.2A (See Note B)

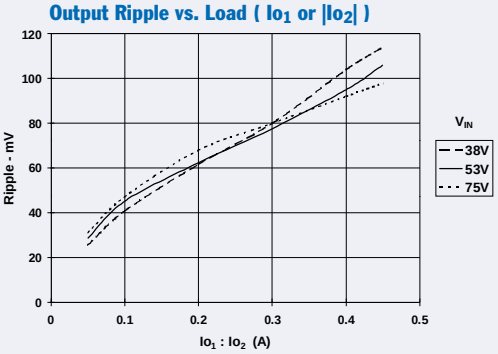


PT4313 (±12V) Characteristic Data (See Note A)

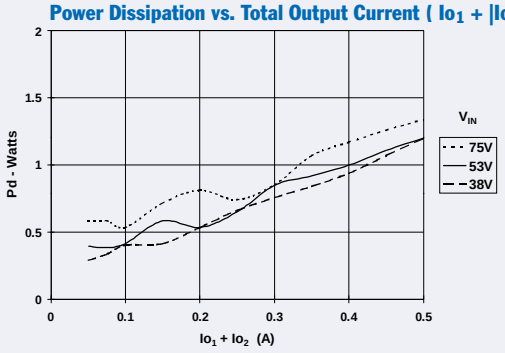
Efficiency vs. Total Output Current (Io_1 + $|Io_2|$)



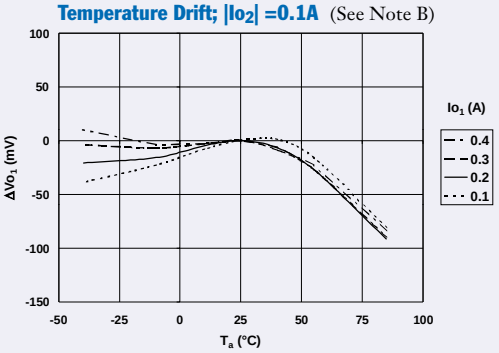
Output Ripple vs. Load (Io_1 or $|Io_2|$)



Power Dissipation vs. Total Output Current (Io_1 + $|Io_2|$)



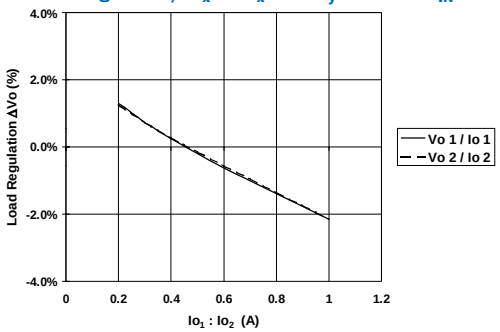
Temperature Drift; $|Io_2|$ =0.1A (See Note B)



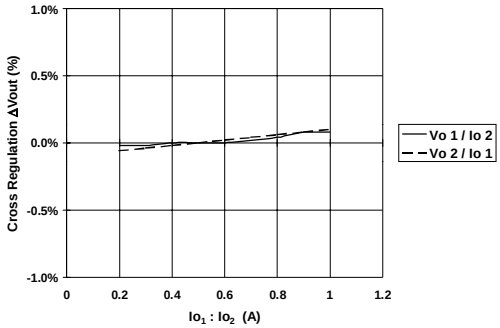
Note A: *Characteristic data has been developed from actual products tested at 25°C. This data is considered typical data for the Converter.*
Note B: *Drift with temperature is normalized to the static output voltage measured at 25°C.*

PT4311 (±5 V) Characteristic Data (See Note A)

Load Regulation, Vo_x vs Io_x with Io_y =0.2 A & V_{IN} =53 V

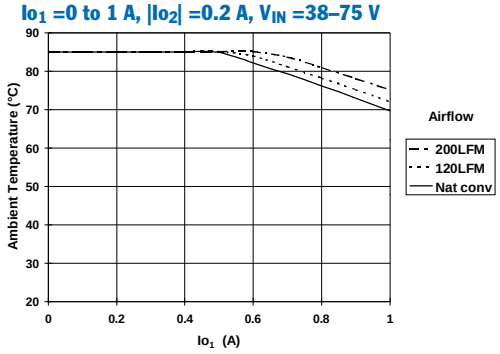


Cross Regulation, Vo_x vs Io_y with Io_x =0.2 A & V_{IN} =53 V

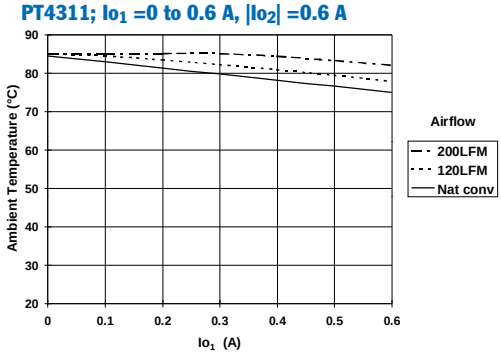


PT4311 Safe Operating Area Curves (See Note C)

Io_1 =0 to 1 A, $|Io_2|$ =0.2 A, V_{IN} =38–75 V

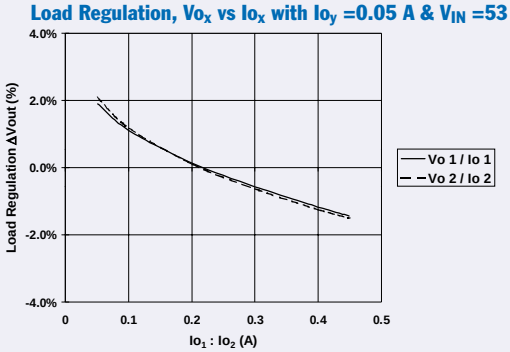


PT4311; Io_1 =0 to 0.6 A, $|Io_2|$ =0.6 A

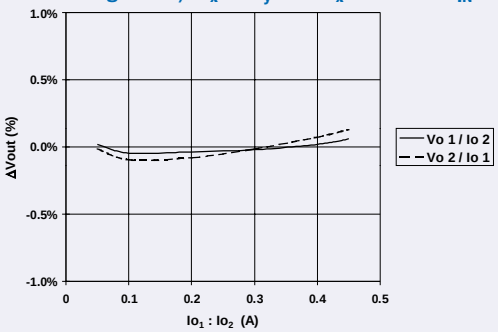


PT4313 (±12 V) Characteristic Data (See Note A)

Load Regulation, Vo_x vs Io_x with Io_y =0.05 A & V_{IN} =53 V

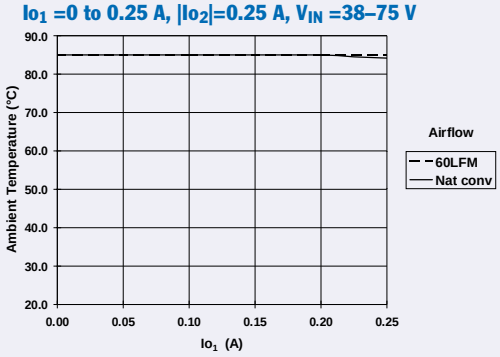


Cross Regulation, Vo_x vs Io_y with Io_x =0.05 A & V_{IN} =53 V

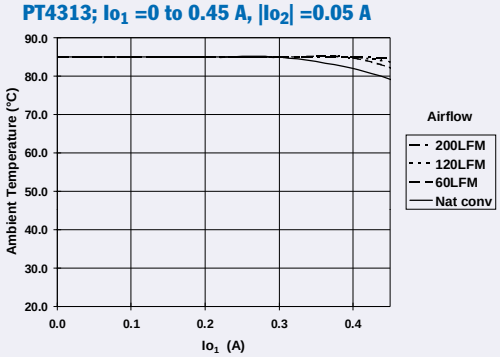


PT4313 Safe Operating Area Curves (See Note C)

Io_1 =0 to 0.25 A, $|Io_2|$=0.25 A, V_{IN} =38–75 V



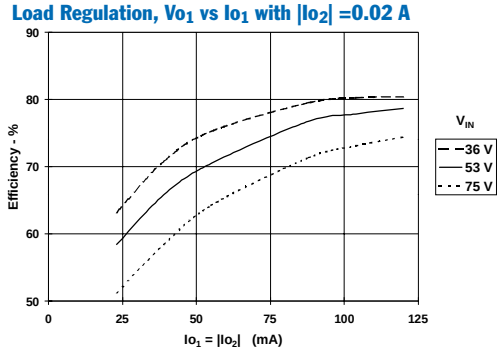
PT4313; Io_1 =0 to 0.45 A, $|Io_2|$ =0.05 A



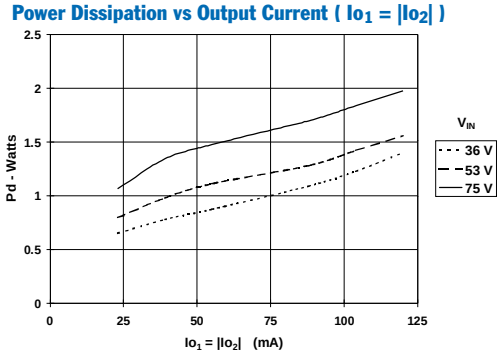
Note A: *The above characteristic data has been developed from actual products tested at 25°C and Vin =53V. This data is considered typical data for the converter.*
Note C: *SOA curves represent operating conditions at which internal components are at or below manufacturer's maximum rated operating temperatures.*

PT4314 (±24 V) Characteristic Data (See Note A)

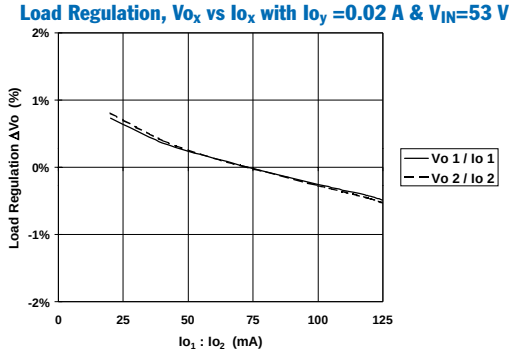
Load Regulation, Vo_1 vs Io_1 with $|Io_2|$ =0.02 A



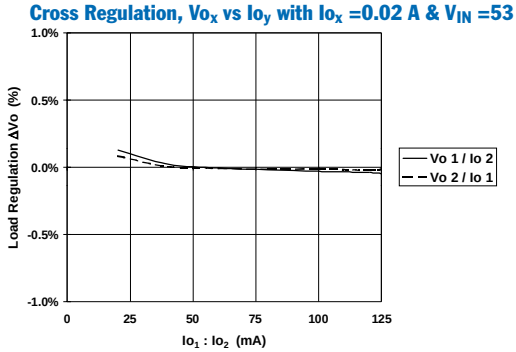
Power Dissipation vs Output Current (Io_1 = $|Io_2|$)



Load Regulation, Vo_x vs Io_x with Io_y =0.02 A & V_{IN}=53 V

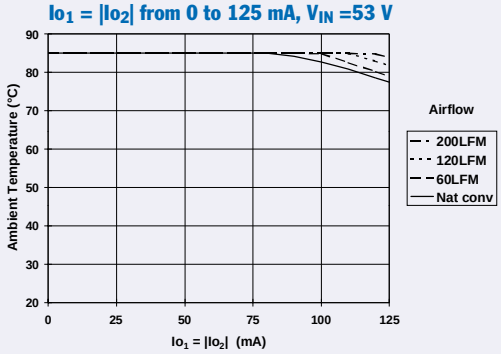


Cross Regulation, Vo_x vs Io_y with Io_x =0.02 A & V_{IN} =53 V



PT 4314 Safe Operating Area Curves (See Note C)

Io_1 = $|Io_2|$ from 0 to 125 mA, V_{IN} =53 V



Note A: *The above characteristic data has been developed from actual products tested at 25°C and Vin =53V. This data is considered typical data for the converter.*
Note C: *SOA curves represent operating conditions at which internal components are at or below manufacturer's maximum rated operating temperatures.*

Adjusting the Output Voltage of the PT4310 Series of Isolated DC/DC Converters

The PT4310 is a series of 6-watt isolated dual-output DC/DC converters. The PT4310 series is functionally similar and pin-compatible with the former PT4300 series, but the adjustment of the output voltages is different [1].

The $\pm V_o$ output voltages of the PT4310 series may be adjusted higher or lower than the factory trimmed value. The adjustment method uses a single external resistor to adjust the magnitude of both output voltages by as much as ±5%. When adjusting the output voltages to a lower value, an external bias voltage, referenced to the $-V_{in}$ (primary), is also required. [2]

Figure 1-1 gives a suggested schematic for the PT4310 output voltage adjustment. The components (R_3) and (VR_1) are only required with (R_1). [3]

Adjust Up: Add a resistor, R_2, between V_o Adjust (pin 12) and $-V_{in}$ (pin 17).

Adjust Down: An increase in the $\pm V_{out}$ output voltages is obtained by adding a resistor, (R_1), between V_o Adjust (pin 12) and a +5 VDC external voltage source. The voltage source must be referenced to $-V_{in}$ (pin 17). A simple external voltage source may be implemented by adding the components (R_3) and (VR_1) in Figure 1-1.

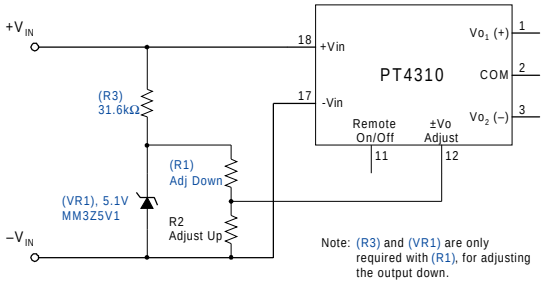
Refer to Table 1-1 for the value of the external adjust resistors, R_2, or (R_1) required to adjust each model of the PT4310 series, up or down respectively by the stated percentage. See Figure 1-1 for the placement of (R_1), R_2, and other components.

Table 1-1

DC/DC CONVERTER ADJUSTMENT RESISTOR VALUES			
Series Pt #	**PT4311**	**PT4313**	**PT4314**
V_o (nom)	**±5 V**	**±12 V**	**±24 V**
$(Io_1+\|Io_2\|)$max [4]	**1.2 A**	**0.5 A**	**0.25 mA**
|±Vo|% Adjust			
–5.0%	(90.9 kΩ)	(0 kΩ)	(220 kΩ)
–2.5%	(750 kΩ)	(511 kΩ)	(950 kΩ)
0.0%			
+2.5%	750 kΩ	511 kΩ	950 kΩ
+5.0%	90.9 kΩ	0 kΩ	220 kΩ

R1 = (Blue) R2 =Black

Figure 1-1



Notes

1. In most stand-alone applications the PT4310 series is a direct substitute for the PT4300 series. However, the method of output voltage adjustment differs between the two series. For existing applications that use a PT4300 part, a modification to the circuit will be necessary if the output voltage is required to be adjusted to a value other than the pre-trimmed factory setting.
2. The adjustment control input, V_o Adjust (pin 12) is referenced to $-V_{in}$ (pin 17).
3. (R_3) and (VR_1) provide a +5 VDC external bias voltage that is required for (R_1) to adjust the output voltages down. If the outputs are to be adjusted up, only the R_2 is required.
4. The PT4310 series is rated for 6 watts total output. An increase in the output voltage will require a corresponding reduction in the maximum allowed total output current ($Io_1 + |Io_2|$) max in Table 1-1. The total current from both outputs must comply with the following equation:-

$$Io_1 + |Io_2| = \frac{6}{V_a} \text{ Adc} \quad \text{or } (Io_1 + |Io_2|)\text{max, whichever is less.}$$

Where, V_a = the new (adjusted) output voltage.

Using the Remote On/Off Function on the PT4310 Isolated Dual Output DC/DC Converters

For applications requiring output voltage On/Off control, the PT4310 DC/DC converter series incorporates a "*Remote On/Off*" control (pin 11). This feature can be used when there is a requirement for the module to be switched off without removing the applied input source voltage.

The converter operates normally with Pin 11 open-circuit, and produces a regulated output voltage when a valid source voltage is applied to $+V_{in}$ (pin 18), with respect to $-V_{in}$ (pin 17). When a low-level [1] ground signal is applied to pin 11, the converter output will be turned off.

Figure 2-1 shows an application schematic, which details the typical use of the *Remote On/Off* function. Note the discrete transistor (Q_1). The control pin has its own internal pull-up, and must be controlled with an open-collector or open-drain device (See notes 2 & 3). Table 2-1 gives the input requirements.

When placed in the "Off" state, the standby current drawn from the input source is typically reduced to less than 1 mA.

Table 2-1; Remote On/Off Control Requirements [1]

Parameter	Min	Typ	Max
Disable	–0.1 V	—	1 V
Enable	5 V [3]	—	Open-Circuit [2]
$V_{o/c}$ [Open-Circuit]	—	—	10 V
I_{in} [pin 11 at $-V_{in}$]	—	–200 µA	—

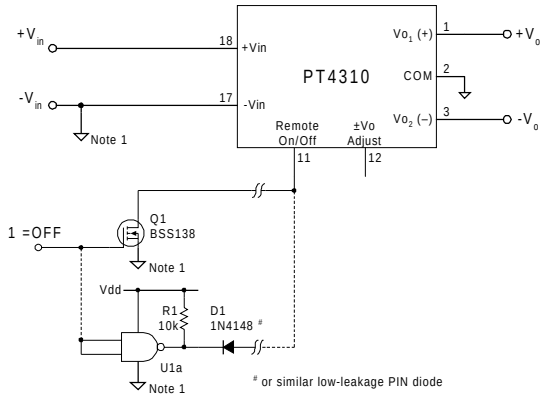
Notes:

1. The *Remote On/Off* control uses $-V_{in}$ (pin 17) as its ground reference. All voltages specified are with respect to $-V_{in}$.
2. Use an open-collector device (preferably a discrete transistor) for the *Remote On/Off* input. Do not connect a pull-up resistor directly to pin 11.
3. The *Remote On/Off* pin may be controlled with devices that have a totem-pole output providing that a blocking diode is used. The blocking diode is required to prevent current from being injected into On/Off control pin. *Note: For TTL devices a pull-up may be required on the cathode side of the blocking diode. This is to guarantee a minimum enable voltage at pin 11 (See Figure 2-1).*
4. The PT4310 converters incorporate an "Under-Voltage Lockout" (UVLO). The UVLO will keep the module off when the input voltage to the converter is low, regardless of the state of the *Remote On/Off* control. Table 2-2 gives the UVLO input voltage thresholds.

Table 2-2; UVLO Thresholds [4]

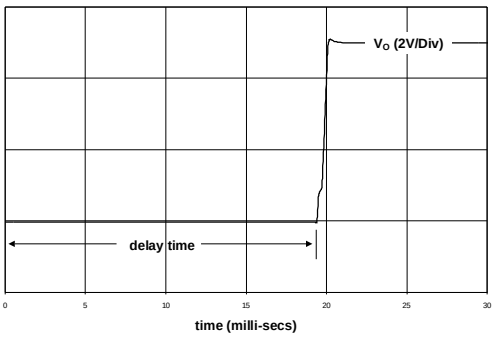
Series	V_{in} Range	UVLO Threshold
PT4310	38 – 75 V	36 ±2 V

Figure 2-1



Turn-On Time: In the circuit of Figure 2-1, turning Q_1 on applies a low-voltage to pin 11 and disables the converter output. Correspondingly, turning Q_1 off allows the converter to power up and produce a regulated output voltage within 50 ms. Although the rise-time of the output is short (<1ms), the delay time will vary depending upon the input voltage and the module's internal timing. Figure 2-2 shows response of the +5-V output from the PT4311 (±5 V), following the turn-off of Q_1 at time t =0. The waveform was measured with a 48 Vdc input voltage, and 0.25-Adc resistive load at both the positive and negative outputs.

Figure 2-2



PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
PT4311A	LIFEBUY	DIP MODULE	EGK	9	16	TBD	Call TI	Level-1-215C-UNLIM			
PT4313A	LIFEBUY	DIP MODULE	EGK	9	16	TBD	Call TI	Level-1-215C-UNLIM			
PT4314A	LIFEBUY	DIP MODULE	EGK	9	16	TBD	Call TI	Level-1-215C-UNLIM	-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.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
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) Only one of markings shown within the brackets will appear on the physical device.

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