Features

- Triple Logic Voltage Outputs *(Independently Regulated !)*
- Input Voltage Range: 36V to 75V
- 1500VDC Isolation
- Over-Current Protection
- Over-Voltage Protection
- Over-Temperature Shutdown
- Under-Voltage Lockout
- Independently Adjustable Outputs
- Dual Logic On/Off Control
- Fixed Frequency Operation
- Solderable Space Saving Package: 1.97 sq. in. PCB Area (suffix N)
- IPC Lead Free 2
- Safety Approvals Pending:
  UL60950
  CSA 22.2 950
  VDE EN60950

Description

The PT4850 Excalibur™ power modules are a series of isolated triple-output DC/DC converters that operate from a standard (–48V) central office supply. These modules are rated for a combined output of up to 25A, and were designed for powering mixed logic applications. The triple-output voltage provides a compact multiple-output power supply in a single DC/DC module.

Output voltage options include a low-voltage output for a DSP or ASIC core, and two additional supply voltages for the I/O, and other functions.

The PT4850 series incorporates many features to simplify system integration. These include a flexible On/Off enable control, input under-voltage lockout and over-temperature protection. All outputs are current limited and short-circuit protected, and are internally sequenced to meet the power-up and power-down requirements of popular DSP ICs.

The PT4850 series is housed in a space-saving solderable case. The module requires no external heat sink. Both vertical and horizontal pin configurations are available, including surface mount.

Ordering Information

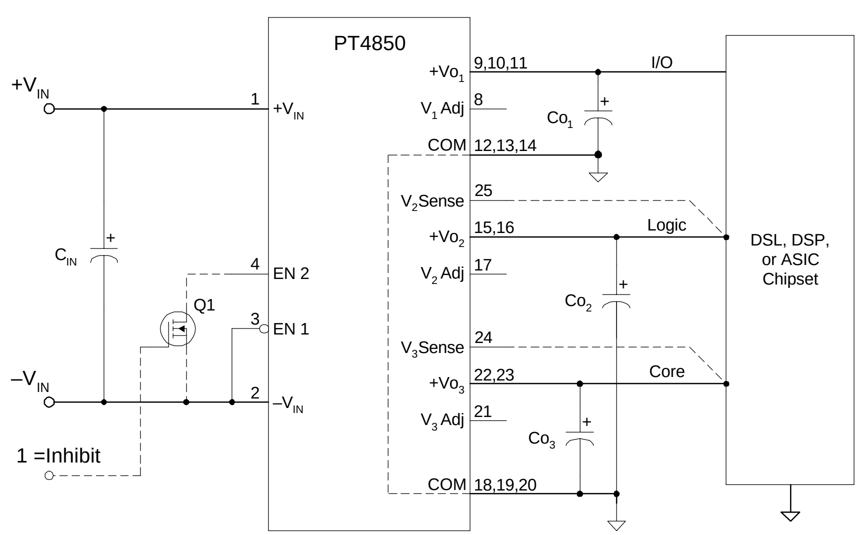
PT4851❑ = +3.3/+2.5/+1.5V
PT4852❑ = +3.3/+1.8/+1.5V
PT4853❑ = +3.3/+2.5/+1.2V
PT4854❑ = +3.3/+1.8/+1.2V
PT4855❑ = +3.3/+1.5/+1.2V
PT4856❑ = +5.0/+3.3/+1.5V

PT Series Suffix (PT1234x)

Case/Pin Configuration	Order Suffix	Package Code
Vertical	N	(EKD)
Horizontal	A	(EKA)
SMD	C	(EKC)

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

Standard Application



C_{in} =Optional
Co_1, Co_2, Co_3 =Optional. See specifications
EN1 & EN2 operation: See application notes

Environmental Specifications

Characteristics	Symbols	Conditions		Min	Typ	Max	Units
Operating Temperature Range	T_a	Over V_{in} Range		–40	—	+85 (i)	°C
Case Temperature	T_c			—	—	105	°C
Storage Temperature	T_s	—		–40	—	+125	°C
Over Temperature Protection	OTP	Case temperature		—	110	125	°C
Mechanical Shock		Per Mil-STD-883D, Method 2002.3 1 msec, ½ Sine, mounted		—	500	—	G's
Mechanical Vibration		Mil-STD-883D, Method 2007.2 20-2000 Hz	Suffix N Suffix A, C	— —	10 (ii) 20 (ii)	— —	G's
Weight	—	Vertical/Horizontal		—	90	—	grams
Flammability	—	Meets UL 94V-O					

Notes: (i) *See SOA curves or consult factory for appropriate derating.*
(ii) *The case pins on through-hole pin configurations (N & A) must be soldered. For more information see the applicable package outline drawing.*

Pin Configuration

Pin	Function	Pin	Function	Pin	Function
1	+Vin	10	+Vo1	19	COM
2	–Vin	11	+Vo1	20	COM
3	EN 1	12	COM	21	Vo3 Adjust
4	EN 2	13	COM	22	+Vo3
5	TEMP	14	COM	23	+Vo3
6	Pin Not Present	15	+Vo2	24	Vo3 Rem Sense
7	Do Not Connect	16	+Vo2	25	Vo2 Rem Sense
8	Vo1 Adjust	17	Vo2 Adjust	26	Do Not Connect
9	+Vo1	18	COM		

Note: Shaded functions indicate those pins that are at primary-side potential.

On/Off Enable Logic

Pin 3	Pin 4	Output Status
1	×	Off
0	1	On
×	0	Off

Notes:
Logic 1 =Open circuit
Logic 0 = –Vin (pin 2) potential

For positive Enable function, connect pin 3 to pin 2 and use pin 4.

For negative Enable function, leave pin 4 open and use pin 3.

Pin Descriptions

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

–Vin: The negative input supply for the module, and the 0VDC reference for the EN 1, and EN 2 inputs. When powering the module from a +48V supply, this input is connected to the 48V(Return).

EN 1: The negative logic input that activates the module output. This pin must be connected to –Vin to enable the module's outputs. A high impedance disables the module's outputs.

EN 2: The positive logic input that activates the module output. If not used, this pin should be left open circuit. Connecting this input to –Vin disables the module's outputs.

TEMP: This pin produces an output signal that tracks a temperature that is approximately the module's metal case. The output voltage is referenced to –Vin and rises approximately 10mV/°C from an intital value of 0.1VDC at –40°C. The signal is available whenever the module is supplied with a valid input voltage, and is independant of the enable logic status. (**Note:** *A load impedance of less than 1MΩ will adversly affect the module's over-temperature shutdown threshold. Use a high-impedance input when monitoring this signal.)*

Vo 1: The highest regulated output voltage, which is referenced to the COM node.

Vo 2: The regulated output that is designed to power logic circuitry. It is referenced to the COM node.

Vo 3: The low-voltage regulated output that provides power for a µ-processor or DSP core, and is referenced to the COM node.

COM: The secondary return reference for the module's three regulated output voltages. It is DC isolated from the input supply pins.

$Vo_{(n)}$ Adjust: Using a single resistor, this pin allows the associated output $Vo_{(n)}$ to be adjusted higher or lower than the preset value. If not used, this pin should be left open circuit.

$Vo_{(n)}$ Rem Sense: An external remote sense input is provided for the two lowest voltage outputs, +Vo2 and +Vo3. Connecting the remote sense pins improves the load regulation of the applicable output by allowing the regulation circuit to compensate for voltage drop between the converter and load. If desired these inputs may be left disconnected.

Electrical Specifications

(Unless otherwise stated, the operating conditions are:- T_a =25°C, V_{in} =48V, and I_o =0.5$I_o$max)

Characteristics	Symbols	Conditions	PT4850 Series (Except PT4856) Min	Typ	Max	Units
Output Current	I_o	Each output Io_1 / Io_2 / Io_3	0 / 0 / 0	— / — / —	15 / 10 / 10	A
	$I_o$tot	Total (all three outputs)	—	—	25	A
Input Voltage Range	V_{in}	Continuous / Surge (1 minute)	36 / —	— / —	75 / 80	V
Set-Point Voltage Tolerance	$V_o$tol		—	—	1.5	%V_o
Temperature Variation	ΔReg_{temp}	–40°C ≤T_a ≤+85°C, Io_1 =Io_2 =Io_3 =$I_o$min	—	±0.5	—	%V_o
Line Regulation	ΔReg_{line}	All outputs, Over V_{in} range	—	±0.2	±0.5	%V_o
Load Regulation	ΔReg_{load}	Each output, 0≤I_o≤$I_o$max	—	±5	±10	mV
Cross Regulation	ΔReg_{cross}	Any output vs. another	—	—	±10	mV
Total Output Voltage Variation	ΔV_o tol	Includes set-point, line, load, –40°C≤T_a≤+85°C	—	±2	±3 (1)	%V_o
Efficiency	η	Io_1 =10A, Io_2 =5A, Io_3 =5A	—	85	—	%
V_o Ripple (pk-pk)	V_r	20MHz bandwidth, Io_1 =Io_2 =Io_3 =5A; V_o=5.0V / V_o=3.3V / V_o=1.8V/2.5V / V_o≤1.5V	— / — / — / —	50 / 20 / 20 / 15	75 / 50 / 30 / 25	mV_{pp}
Transient Response	t_{tr} / V_{os}	0.1A/µs load step, 50% to 75% $I_o$max / V_o over/undershoot	— / —	200 / 5	— / —	µSec / %V_o
Output Adjust Range	$V_o$adj	Vo_1/Vo_2/Vo_3	—	±10	—	%V_o
Current Limit Threshold	I_{LIM}	ΔV_o = –1%; Vo_1 / Vo_2 / Vo_3	— / — / —	20 / 15 / 15	— / — / —	A
Output Over-Voltage Protection	OVP	All outputs; module shutdown and latch off	—	125 (2)	—	%V_o
Switching Frequency	f_s	Over V_{in} and I_o ranges	280	320	340	kHz
Under Voltage Lockout	V_{on} / V_{off}	V_{in} increasing / V_{in} decreasing	— / 30	34 / 32	36 / —	V
Enable Control (pins 3 & 4)		Referenced to –V_{in} (pin 2)				
High-Level Input Voltage	V_{IH}		3.5	—	Open (3)	V
Low-Level Input Voltage	V_{IL}		–0.2	—	0.8 (3)	V
Low-Level Input Current	I_{IL}		—	0.5	—	mA
Standby Input Current	I_{in} standby	pins 3 & 4 open circuit	—	2.5	4 (1)	mA
Internal Input Capacitance	C_{int}		—	2	—	µF
External Output Capacitance	C_{out}	Per each output	0	—	5,000	µF
Primary/Secondary Isolation	V_{iso} / C_{iso} / R_{iso}		1500 / — / 10	— / 2,200 / —	— / — / —	V / pF / MΩ
Temperature Sense	V_{temp}	Output voltage at temperatures:- –40°C / 100°C	— / —	0.1 (4) / 1.5 (4)	— / —	V

Notes: (1) *Limits are specified by design.*

(2) *This is a fixed parameter. Adjusting Vo_1 or Vo_2 higher will increase the module's sensitivity to over-voltage detection. For more information, see the application note on output voltage adjustment.*

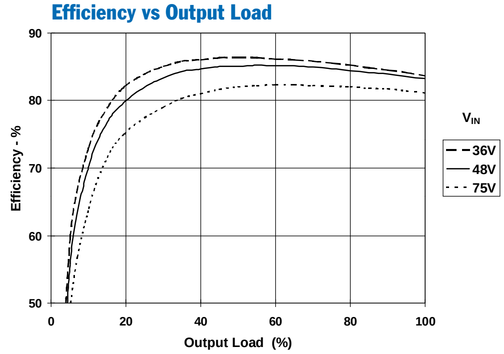
(3) *The Enable inputs (pins 3 & 4) have internal pull-ups. Leaving pin 4 open-circuit and connecting pin 3 to –V_{in} (pin 2) allows the the converter to operate when input power is applied. The maximum open-circuit voltage for the Enable inputs is 5.4V.*

(4) *Voltage output at "TEMP" pin is defined by the equation:- V_{TEMP} = 0.5 + 0.01·T, where T is in °C. See pin descriptions for more information.*

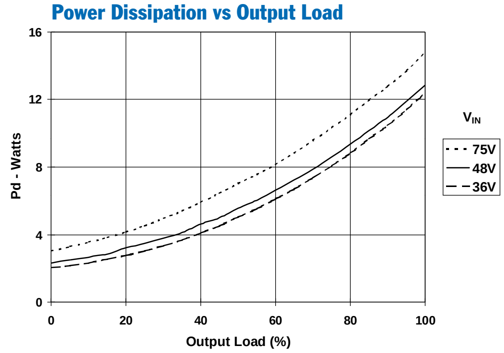
PT4851 Performance Characteristics (See Note A)

(Io_1 =10A, Io_2 =7.5A, Io_3 =7.5A represents 100% Load)

Efficiency vs Output Load



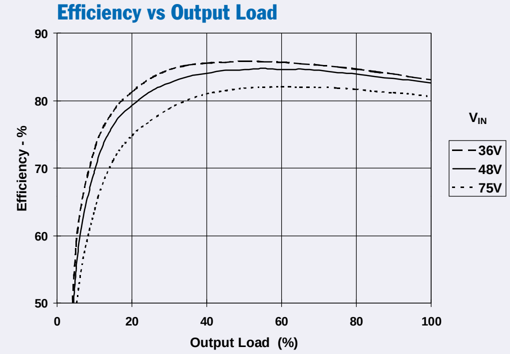
Power Dissipation vs Output Load



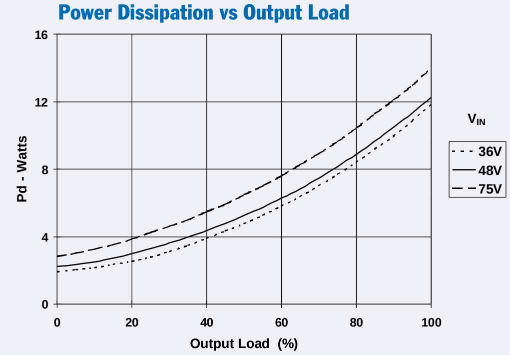
PT4852 Performance Characteristics (See Note A)

(Io_1 =10A, Io_2 =7.5A, Io_3 =7.5A represents 100% Load)

Efficiency vs Output Load



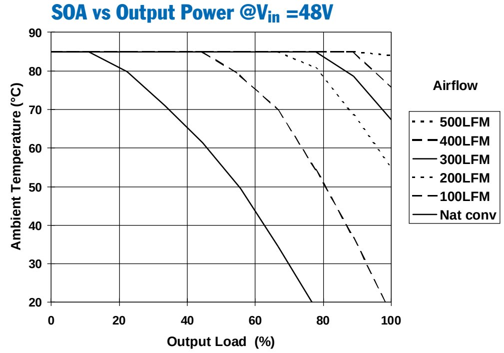
Power Dissipation vs Output Load



PT4851 Safe operating Area Curves (See Note B)

(Io_1 + Io_2 + Io_3 =25A, represents 100% load)

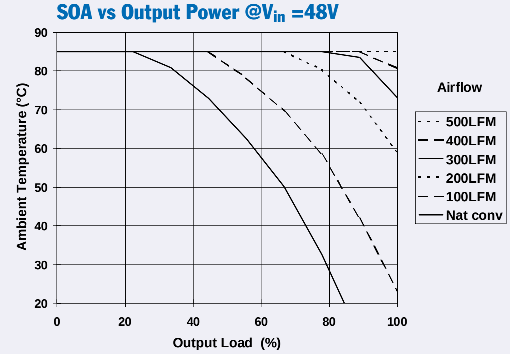
SOA vs Output Power @V_{in} =48V



PT4852 Safe operating Area Curves (See Note B)

(Io_1 + Io_2 + Io_3 =25A, represents 100% load)

SOA vs Output Power @V_{in} =48V

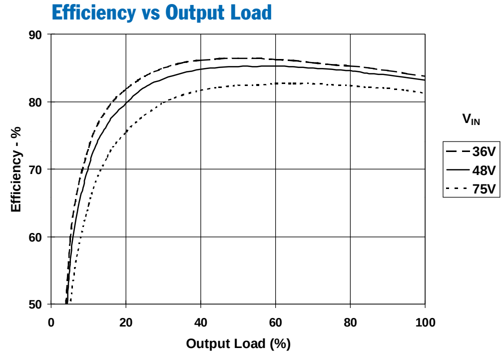


Note A: *All Characteristic data in the above graphs has been developed from actual products tested at 25°C. This data is considered typical data for the ISR.*
Note B: *SOA curves represent operating conditions at which the internal components are at or below the manufacturer's maximum rated operating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

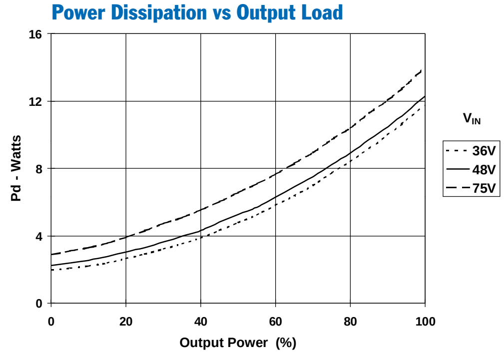
PT4853 Performance Characteristics (See Note A)

(Io_1 =10A, Io_2 =7.5A, Io_3 =7.5A represents 100% Load)

Efficiency vs Output Load



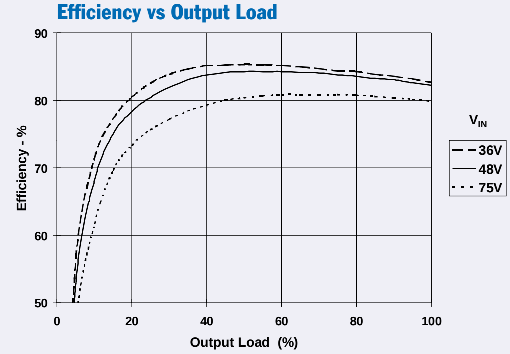
Power Dissipation vs Output Load



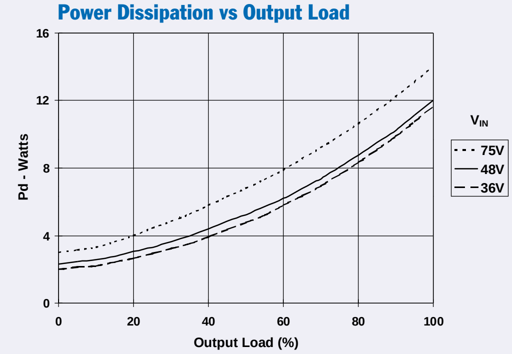
PT4854 Performance Characteristics (See Note A)

(Io_1 =10A, Io_2 =7.5A, Io_3 =7.5A represents 100% Load)

Efficiency vs Output Load



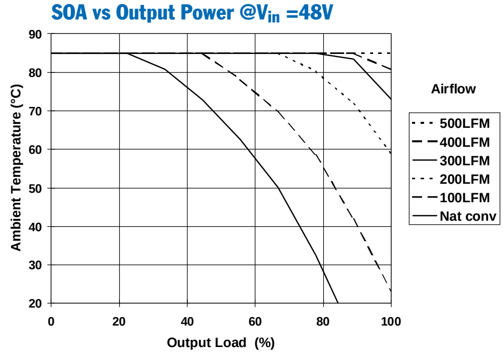
Power Dissipation vs Output Load



PT4853 Safe operating Area Curves (See Note B)

(Io_1 + Io_2 + Io_3 =25A, represents 100% load)

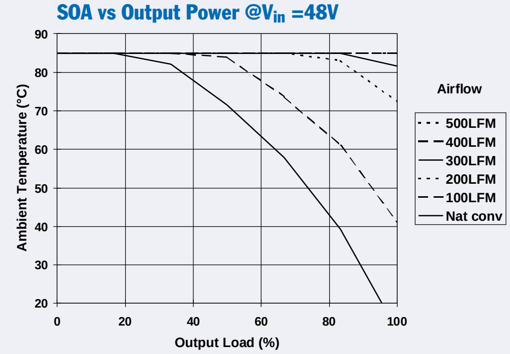
SOA vs Output Power @V_{in} =48V



PT4854 Safe operating Area Curves (See Note B)

(Io_1 + Io_2 + Io_3 =25A, represents 100% load)

SOA vs Output Power @V_{in} =48V

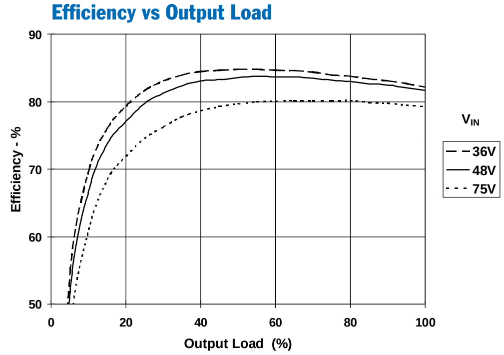


Note A: *All Characteristic data in the above graphs has been developed from actual products tested at 25°C. This data is considered typical data for the ISR.*
Note B: *SOA curves represent operating conditions at which the internal components are at or below the manufacturer's maximum rated operating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

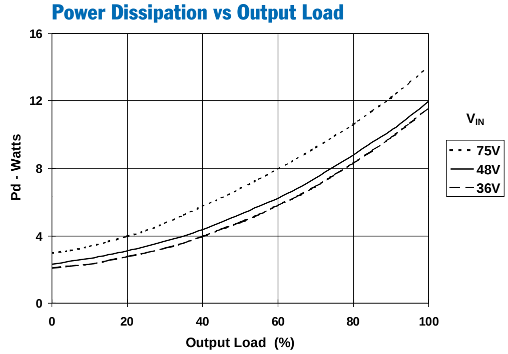
PT4855 Performance Characteristics (See Note A)

(Io_1 =10A, Io_2 =7.5A, Io_3 =7.5A represents 100% Load)

Efficiency vs Output Load



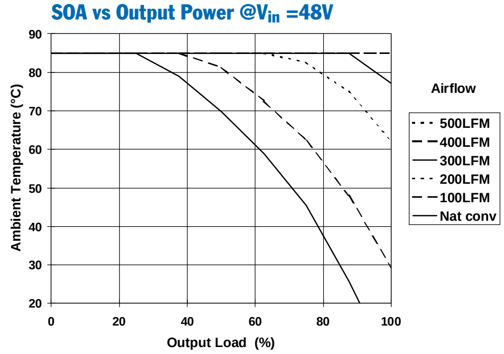
Power Dissipation vs Output Load



PT4855 Safe operating Area Curves (See Note B)

(Io_1 + Io_2 + Io_3 =25A, represents 100% load)

SOA vs Output Power @V_{in} =48V



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

PT4856 Electrical Specifications

(Unless otherwise stated, the operating conditions are:- T_a =25°C, V_{in} =48V, and I_o =0.5$I_o$max)

Characteristics	Symbols	Conditions		PT4856 (Only) Min	Typ	Max	Units
Output Current	I_o	Each output	Io_1 Io_2 Io_3	0 0 0	— — —	10 10 10	A
	$I_o$tot	Total (all three outputs)		—	—	25	A
Input Voltage Range	V_{in}	Continuous Surge (1 minute)		36 —	— —	75 80	V
Set-Point Voltage Tolerance	$V_o$tol			—	—	1.5	%V_o
Temperature Variation	ΔReg_{temp}	–40°C ≤T_a ≤+85°C, Io_1 =Io_2 =Io_3 =$I_o$min		—	±0.5	—	%V_o
Line Regulation	ΔReg_{line}	All outputs, Over V_{in} range		—	±0.2	±0.5	%V_o
Load Regulation	ΔReg_{load}	Each output, 0≤I_o≤$I_o$max		—	±5	±10	mV
Cross Regulation	ΔReg_{cross}	Any output vs. another		—	—	±10	mV
Total Output Voltage Variation	ΔV_o tol	Includes set-point, line, load, –40°C≤T_a ≤+85°C		—	±2	±3 (1)	%V_o
Efficiency	η	Io_1 =7A, Io_2 =5A, Io_3 =5A		—	88	—	%
V_o Ripple (pk-pk)	V_r	20MHz bandwidth, Io_1 =Io_2 =Io_3 =5A	V_o=5.0V V_o=3.3V V_o=1.5V	— — —	50 20 15	75 50 25	mV_{pp}
Transient Response	t_{tr} V_{os}	0.1A/µs load step, 50% to 75% $I_o$max V_o over/undershoot		— —	200 5	— —	µSec %V_o
Output Adjust Range	$V_o$adj		Vo_1/Vo_2/Vo_3	—	±10	—	%V_o
Current Limit Threshold	I_{LIM}	ΔV_o = –1%	Vo_1 Vo_2 Vo_3	— — —	20 15 15	— — —	A
Output Over-Voltage Protection	OVP	All outputs; module shutdown and latch off		—	125 (2)	—	%V_o
Switching Frequency	f_s	Over V_{in} and I_o ranges		280	320	340	kHz
Under Voltage Lockout	V_{on} V_{off}	V_{in} increasing V_{in} decreasing		— 30	34 32	36 —	V
Enable Control (pins 3 & 4) High-Level Input Voltage Low-Level Input Voltage	 V_{IH} V_{IL}	Referenced to –V_{in} (pin 2)		 3.5 –0.2	 — —	 Open (3) 0.8 (3)	V
Low-Level Input Current	I_{IL}			—	0.5	—	mA
Standby Input Current	I_{in} standby	pins 3 & 4 open circuit		—	2.5	4 (1)	mA
Internal Input Capacitance	C_{int}			—	2	—	µF
External Output Capacitance	C_{out}	Per each output		0	—	5,000	µF
Primary/Secondary Isolation	V_{iso} C_{iso} R_{iso}			1500 — 10	— 2,200 —	— — —	V pF MΩ
Temperature Sense	V_{temp}	Output voltage at temperatures:-	–40°C 100°C	— —	0.1 (4) 1.5 (4)	— —	V

Notes: (1) *Limits are specified by design.*

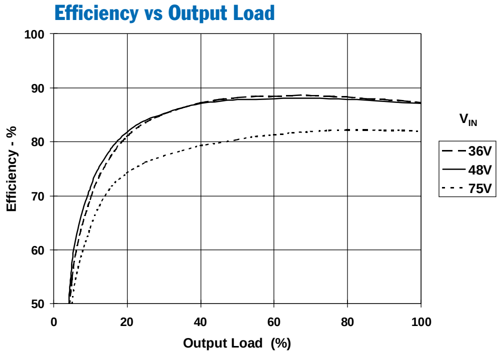
(2) *This is a fixed parameter. Adjusting Vo_1 or Vo_2 higher will increase the module's sensitivity to over-voltage detection. For more information, see the application note on output voltage adjustment.*

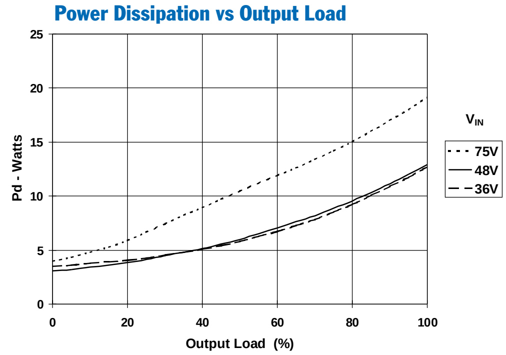
(3) *The Enable inputs (pins 3 & 4) have internal pull-ups. Leaving pin 4 open-circuit and connecting pin 3 to –V_{in} (pin 2) allows the the converter to operate when input power is applied. The maximum open-circuit voltage for the Enable inputs is 5.4V.*

(4) *Voltage output at "TEMP" pin is defined by the equation:- V_{TEMP} = 0.5 + 0.01·T, where T is in °C. See pin descriptions for more information.*

PT4856 Performance Characteristics (See Note A)

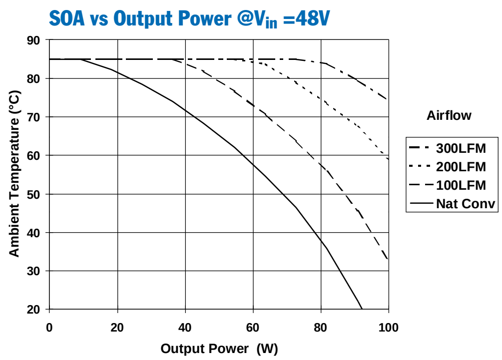
(Io$_1$ =10A, Io$_2$ =7.5A, Io$_3$ =7.5A represents 100% Load)





PT4856 Safe operating Area Curves (See Note B)

(Io$_1$ + Io$_2$ + Io$_3$ =24A, represents 100% load)



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

Operating Features of the PT4850 Triple-Output DC/DC Converters

Over-Current Protection

The PT4850 series of DC/DC converters provide three independently regulated logic output voltages, Vo_1, Vo_2, and Vo_3. Each output is current limited to protect against load faults. The module will not be damaged by a continuous load fault applied to any output. Current will continue to flow into the fault but is reduced as the voltage across the fault decreases towards zero.

Applying a load fault above the current limit threshold to any output causes the affected output to significantly drop. Also load faults applied to Vo_1 will affect Vo_2 and Vo_3, once Vo_1 drops to within 0.2V of either of these voltages. However, load faults applied to Vo_2 or Vo_3 will not affect the other outputs.

Over-Temperature Protection

The PT4850 DC/DC converter series have an internal temperature sensor, which monitors the temperature of the module's metal case. If the case temperature exceeds the specified limit the converter will shut down. The converter will automatically restart when the sensed temperature returns to within the normal operating range. The analog voltage generated by the sensor is also made available at the 'TEMP' output (pin 5), and can be monitored by the host system for diagnostic purposes. Consult the 'Pin Descriptions' section of the data sheet for more information on this feature.

Under-Voltage Lock-Out

The Under-Voltage Lock-Out (UVLO) circuit prevents operation of the converter whenever the input voltage to the module is insufficient to maintain output regulation. The UVLO has approximately 2V of hysterisis. This is to prevent oscillation with a slowly changing input voltage. Below the UVLO threshold the module is off and the enable control inputs, EN1 and EN2 are inoperative.

Primary-Secondary Isolation

The PT4850 series of DC/DC converters incorporate electrical isolation between the input terminals (primary) and the output terminals (secondary). All converters are production tested to a withstand voltage of 1500VDC. The isolation complies with UL60950 and EN60950, and the requirements for operational isolation. This allows the converter to be configured for either a positive or negative input voltage source.

The regulation control circuitry for these modules is located on the secondary (output) side of the isolation barrier. Control signals are passed between the primary and secondary sides of the converter via a proprietory magnetic coupling scheme. This eliminates the use of opto-couplers. The data sheet 'Pin Descriptions' and 'Pin-Out Information' provides guidance as to which reference (primary or secondary) that must be used for each of the external control signals.

Fuse Recommendations

If desired an input fuse may be added to protect against the application of a reverse input voltage.

Using the On/Off Enable Controls on the PT4850 Series of Triple Output DC/DC Converters

The PT4850 (48V input) series of 25-A, triple-output DC/DC converters incorporate two output enable controls. EN1 (pin 3) is the *Negative Enable* input, and EN2 (pin 4) is the *Positive Enable* input. Both inputs are electrically referenced to -V_{in} (pin 2) on the primary or input side of the converter. A pull-up resistor is not required, but may be added if desired. Voltages of up to 70V can be safely applied to the either of the *Enable* pins.

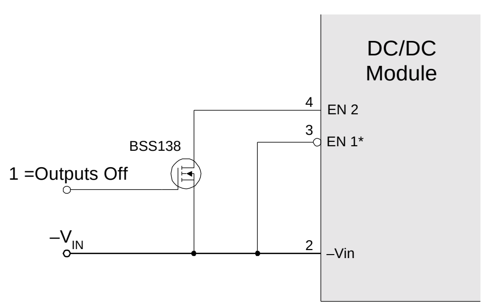
Automatic (UVLO) Power-Up

Connecting EN1 (pin 3) to -V_{in} (pin 2) and leaving EN2 (pin 4) open-circuit configures the converter for automatic power up. (See data sheet "Typical Application"). The converter control circuitry incorporates an "Under Voltage Lockout" (UVLO) function, which disables the converter until the minimum specified input voltage is present at ±V_{in}. (See data sheet Specifications). The UVLO circuitry ensures a clean transition during power-up and power-down, allowing the converter to tolerate a slow-rising input voltage. For most applications EN1 and EN2, can be configured for automatic power-up.

Positive Output Enable (Negative Inhibit)

To configure the converter for a positive enable function, connect EN1 (pin 3) to -V_{in} (pin 2), and apply the system On/Off control signal to EN2 (pin 4). In this configuration, a low-level input voltage (-V_{in} potential) applied to pin 4 disables the converter outputs. Figure 1 is an example of this configuration.

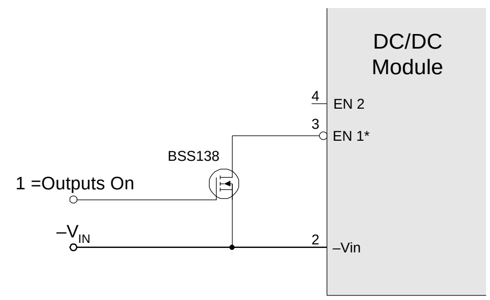
Figure 1; Positive Enable Configuration



Negative Output Enable (Positive Inhibit)

To configure the converter for a negative enable function, EN2 (pin 4) is left open circuit, and the system On/Off control signal is applied to EN1 (pin 3). A low-level input voltage (-V_{in} potential) must then be applied to pin 3 in order to enable the outputs of the converter. An example of this configuration is detailed in Figure 2. *Note: The converter will only produce and output voltage if a valid input voltage is applied to ±V_{in}.*

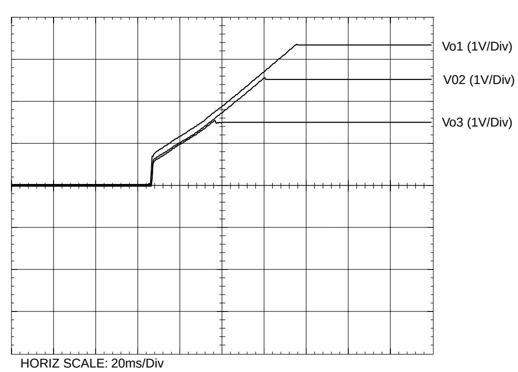
Figure 2; Negative Enable Configuration



On/Off Output Voltage Sequencing

The power-up characteristic of the PT4850 series of DC/DC converters meets the requirements of microprocessor and DSP chipsets. All three outputs from the converter are internally sequenced to power up in unison. Figure 3 shows the waveforms from a PT4851 after power is applied to the input of the converter. During power-up, all three output voltages rise together until each reaches their respective output voltage. The waveforms of Figure 3 were measured with loads of approximately 50% on each output, with an input source of 48VDC. The converter typically produces a fully regulated output within 150ms.

Figure 3; Vo_1, Vo_2, Vo_3 Power-Up Sequence



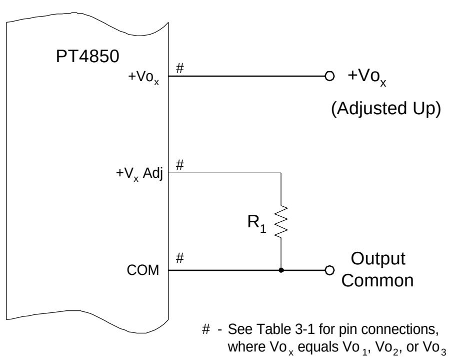
During turn-off, all outputs drop rapidly due to the discharging effect of actively switched rectifiers. The voltage at Vo_2 remains higher than Vo_3 during this period. The discharge time is typically 100µs, but will vary with the amount of external load capacitance.

Adjusting the Output Voltages of the PT4850 Triple-Output DC/DC Converters

The output voltages of the PT4850 series of triple-output DC/DC converters, Vo_1, Vo_2 and Vo_3, are independently adjustable. The adjustment method uses a single external resistor, [1] which may be used to adjust a selected output by up to ±10% from the factory preset value. The value of the resistor determines the magnitude of adjustment, and the placement of the resistor determines the direction of adjustment (up or down). The resistor values can be calculated using the appropriate formula (see below), using the constants provided in Table 3-2. Alternatively the resistor value may be selected directly from Table 3-3 and Table 3-4, for Vo_1 and Vo_2/Vo_3 respectively. The placement of each resistor is as follows.

Adjust Up: To increase a specific output, add a resistor R_1 between the appropriate V_x *Adj* (V_1 Adj, V_2 Adj, or V_3 Adj) and the output common (COM). See Figure 3-1(a) and Table 3-1 for the resistor placement and pin connections.

Figure 3-1a



Adjust Down: Add a resistor (R_2), between the appropriate V_x *Adj* (V_1 Adj, V_2 Adj, or V_3 Adj) and the output being adjusted, $+Vo_x$. See Figure 3-1(b) and Table 3-1 for the resistor placement and pin connections.

Figure 3-1b

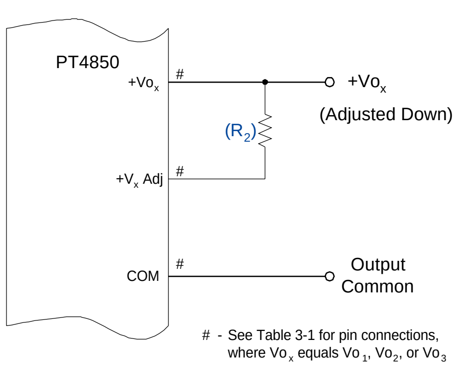


Table 3-1; Adjust Resistor Pin Connections

	To Adjust Up Connect R_1		To Adjust Down Connect (R_2)	
	from Vo_x Adj	to COM	from Vo_x Adj	to Vo_x
Vo_1	8	12	8	9
Vo_2	17	18	17	16
Vo_3	21	18	21	22

Calculation of Adjust Values

The adjust resistor value may also be calculated using an equation. In each case, the equation for R_1 [Adjust Up] is different to that for (R_2) [Adjust Down]. For the PT4850 series, the following points should be noted.

- Vo_1 uses different equations to Vo_2 and Vo_3. The equations are defined for the desired output voltage.
- The equations for Vo_2 and Vo_3 are based on the percentage of desired adjustment. Both Vo_2 and Vo_3 use the same constants, which are common for all output voltages.

Vo_1 Adjust:

$$R_1 \text{ [Adjust Up]}^3 = \frac{2.5\, R_o}{V_a - V_o} - R_s \quad k\Omega$$

$$(R_2) \text{ [Adjust Down]}^3 = \frac{R_o\,(V_a - 2.5)}{V_o - V_a} - R_s \quad k\Omega$$

Where: V_o = Original output voltage
V_a = Adjusted output voltage
R_o = The resistance value in Table 3-2
R_s = The series resistance from Table 3-2

Vo_2 / Vo_3 Adjust:

$$R_1 \text{ [Adjust Up]}^3 = \frac{50 \cdot R_o}{n\%} - R_s \quad k\Omega$$

$$(R_2) \text{ [Adjust Down]}^3 = R_o \cdot \frac{(50 - n\%)}{n\%} - R_s \quad k\Omega$$

Where: R_o = The resistance value in Table 3-2
R_s = The series resistance from Table 3-2
n% = The desired adjustment from the nominal (in percent)

Notes:

1. Use only a single 1% (or better) tolerance resistor in either the R_1 or (R_2) location to adjust a specific output. Place the resistor as close to the ISR as possible.
2. Never connect capacitors to any of the 'Vo$_x$ Adj' pins. Any capacitance added to these control pins will affect the stability of the respective regulated output.
3. Adjustments made to any output must also comply with the following limitations.

   $Vo_1 \geq (Vo_2 + 0.5V)$, and
   $Vo_1 \geq (Vo_3 + 0.5V)$

Table 3-2

ADJUSTMENT RANGE AND FORMULA PARAMETERS

	Vo_1 Bus		Vo_2 / Vo_3 Bus
V_o(nom)	5.0V	3.3V	All
V_a(min)	4.5V	2.97V	Vnom – 10%
V_a(max)	5.5V	3.63V	Vnom + 10%
R_o (kΩ)	4.99	4.42	2.1
R_s (kΩ)	4.99	4.99	4.99

Table 3-3

ADJUSTMENT RESISTOR VALUES FOR Vo_1 Bus

Adj. Resistors	R_1/(R_2)	
V_o(nom)	3.3V	5.0V
V_a(req'd)		
3.0	(2.4)kΩ	
3.05	(4.7)kΩ	
3.1	(8.3)kΩ	
3.15	(14.2)kΩ	
3.2	(26.0)kΩ	
3.25	(61.3)kΩ	
3.3		
3.35	216.0kΩ	
3.4	106.0kΩ	
3.45	68.7kΩ	
3.5	50.3kΩ	
3.55	39.2kΩ	
3.6	31.8kΩ	
•		
4.5		(15.0)kΩ
4.6		(21.2)kΩ
4.7		(31.6)kΩ
4.8		(52.4)kΩ
4.9		(115.0)kΩ
5.0		
5.1		120.0kΩ
5.2		57.4kΩ
5.3		36.6kΩ
5.4		26.2kΩ
5.5		20.0kΩ

R_1 = Black, R_2 = (Blue)

Table 3-4

ADJUSTMENT RESISTOR VALUES FOR Vo_2 / Vo_3 Buses

V_o (nom)	3.3V	2.5V	1.8V	1.5V	1.2V	
% Adjust	Adjusted Output Voltage					R_1/(R_2)
−10	2.97	2.25	1.62	1.35	1.08	(3.4)kΩ
− 9	3.003	2.275	1.638	1.365	1.092	(4.6)kΩ
− 8	3.036	2.3	1.656	1.38	1.104	(6.0)kΩ
− 7	3.069	2.325	1.674	1.395	1.116	(7.9)kΩ
− 6	3.102	2.35	1.692	1.41	1.128	(10.4)kΩ
− 5	3.135	2.375	1.71	1.425	1.14	(13.9)kΩ
− 4	3.168	2.4	1.728	1.44	1.152	(19.2)kΩ
− 3	3.201	2.425	1.746	1.455	1.64	(27.9)kΩ
− 2	3.234	2.45	1.764	1.47	1.176	(45.4)kΩ
− 1	3.267	2.475	1.782	1.485	1.188	(97.9)kΩ
0	3.3	2.5	1.8	1.5	1.2	
+ 1	3.333	2.525	1.818	1.515	1.212	100.0kΩ
+ 2	3.366	2.55	1.836	1.53	1.224	47.5kΩ
+ 3	3.399	2.575	1.854	1.545	1.236	30.0kΩ
+ 4	3.432	2.6	1.872	1.56	1.248	21.3kΩ
+ 5	3.465	2.625	1.89	1.575	1.26	16.0kΩ
+ 6	3.498	2.65	1.908	1.58	1.272	12.5kΩ
+ 7	3.531	2.675	1.926	1.605	1.284	10.0kΩ
+ 8	3.564	2.7	1.944	1.62	1.296	8.1kΩ
+ 9	3.597	2.725	1.962	1.635	1.308	6.7kΩ
+10	3.630	2.75	1.98	1.65	1.32	5.5kΩ

R_1 = Black, R_2 = (Blue)

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/ Ball Finish	MSL Peak Temp (3)	Samples (Requires Login)
PT4851A	NRND	SIP MODULE	EKA	26	6	TBD	Call TI	Level-1-215C-UNLIM	
PT4851C	OBSOLETE	SIP MODULE	EKC	26		TBD	Call TI	Call TI	
PT4851N	OBSOLETE	SIP MODULE	EKD	26		TBD	Call TI	Call TI	
PT4852A	OBSOLETE	SIP MODULE	EKA	26		TBD	Call TI	Call TI	
PT4853C	OBSOLETE	SIP MODULE	EKC	26		TBD	Call TI	Call TI	
PT4853N	OBSOLETE	SIP MODULE	EKD	26		TBD	Call TI	Call TI	
PT4854A	OBSOLETE	SIP MODULE	EKA	26		TBD	Call TI	Call TI	
PT4854C	OBSOLETE	SIP MODULE	EKC	26		TBD	Call TI	Call TI	
PT4854N	NRND	SIP MODULE	EKD	26	6	TBD	Call TI	Level-1-215C-UNLIM	
PT4855C	OBSOLETE	SIP MODULE	EKC	26		TBD	Call TI	Call TI	
PT4856C	OBSOLETE	SIP MODULE	EKC	26		TBD	Call TI	Call TI	
PT4856N	OBSOLETE	SIP MODULE	EKD	26		TBD	Call TI	Call TI	

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

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