

DUAL-OUTPUT, 48-V INPUT ISOLATED DC/DC CONVERTER for xDSL

FEATURES

- Dual Outputs (Independently Regulated)
- Input Voltage Range: 36 V to 75 V
- Power-Up/Down Sequencing
- 1500 VDC Isolation
- Over-Current Protection
- Over-Temperature Shutdown
- Under-Voltage Lockout
- Fixed Frequency Operation
- Temp Range: –40°C to 85°C
- Industry Standard Outline
- Operates with PTB4851x for Complete AC7 Power Solution
- Powers up to 64 DSL Ports
- Safety Approvals:
 - UL/cUL 60950
 - EN 60950



DESCRIPTION

The PTB4850x power modules are a dual-output isolated DC/DC converter, designed to provide the logic supply voltages for AC-7 based xDSL applications. The PTB48500 is rated for 13 A of total output current, making it suitable for 32-channel xDSL applications. The PTB48501 and PTB48502 provide output current for powering up to 64 xDSL channels. The PTB48501 is rated for 16.5 A total output current, and the PTB48502, 21 A. The PTB48502 incorporates 10 W of additional capacity for powering peripheral circuitry. Any of these converters can be used for other applications with similar power requirements.

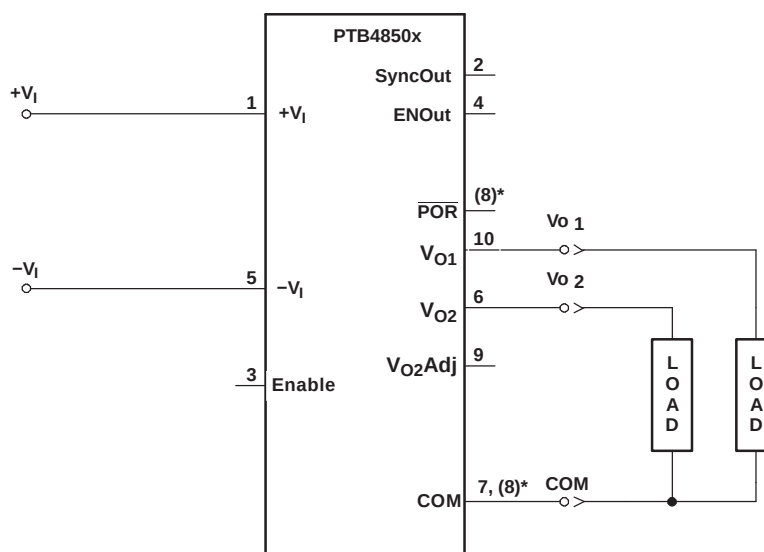
The modules operate from a standard telecom (–48 V) central office (CO) supply and include an *on/off* enable control, output current limit, over-temperature protection, input under-voltage lockout (UVLO). The PTB48500 and PTB48501 also incorporate a power-up reset (POR) output.

The modules are designed to operate with one of the PTB4851x DC/DC converter modules. The combination of PTB4850x and PTB4851x converter provides the complete the power supply for an AC7 chipset. The *EN Out* and *Sync Out* pins provide compatible output signals for controlling both the power up sequence and switching frequency the PTB48510.

The PTB4850x modules employ double-sided surface mount construction, and are an industry standard size.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

STAND-ALONE APPLICATION

* Pin 8 is COM on PTB48502

ORDERING INFORMATION

Base Part No. (PTB4850_xxx)			Output Voltage (PTB4850x_xx)		Package Options (PT4850xx_ _)		
Order Prefix	Description		Code	Voltage	Code	Description	Pkg Ref. ⁽¹⁾
PTB48500xxx	13 A	(32-Ports)	A	3.3 V / 1.2 V	AH	Horiz. T/H	(ERH)
PTB48501xxx	16.5 A	(48/64-Ports)			AS	SMD, Standard ⁽²⁾	(ERJ)
PTB48502xx	21 A	(64-Ports + 10 W)			AZ	SMD, Pb-free	(ERJ)

(1) Reference the applicable package reference drawing for the dimensions and PC board layout.

(2) Standard option specifies 63/37, Sn/Pb pin solder material.

Environmental and General Specifications(Unless otherwise stated, all voltages are with respect to $-V_I$)

			VALUE	UNIT	
V _I	Input Voltage Range	Over output load range	36 to 75	VDC	
	Isolation Voltage	Input-output/input/case	1500	V	
	Capacitance	Input to output	1500	pF	
	Resistance	Input to output	10	mΩ	
T _A	Operating Temperature Range	Over V _{in} Range	−40 to 85	° C	
OTP	Over-Temperature Protection	Shutdown threshold	115	°C	
		Hysterisis	10		
T _{reflow}	Solder Reflow Temperature	Surface temperature of module body or pins	235 ⁽¹⁾	°C	
T _s	Storage Temperature		−40 to 125	°C	
	Mechanical Shock	Per Mil-STD-883D, Method 2002.3 1 msec, 1/2 Sine, mounted	500	G	
	Mechanical Vibration Mil-STD-883D	Method 2007.2	Suffix H	20	G
		20-2000 Hz	Suffix C	5	
	Weight			grams	
	Flammability	Meets UL 94V-O			

(1) During reflow of SMD package version do not elevate peak temperature of the module, pins or internal components above the stated maximum.

ELECTRICAL CHARACTERISTICS (PTB48500A)(Unless otherwise stated, $T_A = 25^\circ\text{C}$, $V_I = 48\text{ V}$, $C_I = 0\text{ }\mu\text{F}$, $C_O = 0\text{ }\mu\text{F}$, and $I_O = 50\% I_{O,\text{max}}$)

PARAMETER		TEST CONDITIONS		PTB48500A			UNIT
				MIN	TYP	MAX	
P_{O1}, P_{O2}	Output Power		$V_{O1} (3.3\text{ V})$			19.8	W
			$V_{O2} (1.2\text{ V})$			8.4	
$P_{O\text{ total}}$	Both outputs					28	W
I_{O1}, I_{O2}	Output Current	Over V_I range	$V_{O1} (3.3\text{ V})$	0		6 ⁽¹⁾	A
			$V_{O2} (1.2\text{ V})$	0		7 ⁽¹⁾	
$I_{O1} + I_{O2}$		Total (both outputs)		0		13	A
V_{O1}	Output Voltage	Includes set point, line, load, $-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$		3.2	3.3	3.4	V
V_{O2}				1.16	1.2	1.24	
$\Delta\text{Reg}_{\text{temp}}$	Temperature Variation	$-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$, $I_O = I_{O\text{ min}}$	V_{O1}		± 0.5		% V_O
			V_{O2}		± 0.8		
$\Delta\text{Reg}_{\text{line}}$	Line Regulation	Over V_I range	V_{O1}, V_{O2}		± 1	± 10	mV
$\Delta\text{Reg}_{\text{load}}$	Load Regulation	Over I_O range	V_{O1}, V_{O2}		± 3	± 12	mV
$\Delta\text{Reg}_{\text{cross}}$	Cross Regulation	$I_{O\text{ min}} \leq I_{O2} \leq I_{O\text{ max}}$, $I_{O1} = 1\text{ A}$	ΔV_{O1}			10	mV
		$I_{O\text{ min}} \leq I_{O1} \leq I_{O\text{ max}}$, $I_{O2} = 1\text{ A}$	ΔV_{O2}			10	
η	Efficiency	$I_{O1}, I_{O2} = I_{O\text{ max}}$			82%		
V_r	V_O Ripple (pk-pk)	20 MHz bandwidth	V_{O1}		20	50	mV _{pp}
			V_{O2}		20	50	
t_{tr}	Transient Response	1 A/ μs load step, 50% to 100% $I_{O\text{ max}}$			30		μs
ΔV_{tr}		V_{O1}, V_{O2} over/undershoot			± 2.0		% V_O
$I_{O\text{ trip}}$	Over Current Threshold	$V_I = 36\text{ V}$, reset followed by auto-recovery	$I_{O1} + I_{O2}$	13.5	16		A
V_{adj}	Output Voltage Adjust Range	V_{O2} only		-10		20	% V_O
f_s	Switching Frequency	Over V_I and I_O ranges		500	550	600	kHz
$V_{I\text{ on}}$	Under-Voltage Lockout	V_I increasing			34		V
$V_{I\text{ off}}$		V_I decreasing			32		
V_{IH}	On/Off Enable (pin 3)	Referenced to $-V_I$ (pin 5)		3.6		75 ⁽²⁾	V
V_{IL}	Input High Voltage						
V_{IL}	Input Low Voltage			-0.2		0.8	
I_{IL}	Input Low Current				-1		mA
$I_{I\text{ standby}}$	Standby Input Current	Pins 3 and 5 connected			2		mA
C_I	Internal Input Capacitance				2		μF
C_{O1}	External Output Capacitance			0 ⁽³⁾		5000	μF
C_{O2}				0 ⁽³⁾		5000	
MTBF	Reliability	Per Telcordia SR-332 50% stress, $T_A = 40^\circ\text{C}$, ground benign		1.5			10^6 Hrs

- (1) See Safe Operating Area curves or contact the factory for the appropriate derating.
- (2) The On/Off Enable (pin 3) has an internal pull-up and may be controlled with an open-collector (or open-drain) transistor. The input is diode protected and may be connected to $+V_I$. The maximum open-circuit voltage is 7 V. If it is left open circuit the converter will operate when input power is applied.
- (3) An output capacitor is not required.

ELECTRICAL CHARACTERISTICS (PTB48501A)(Unless otherwise stated, $T_A = 25^\circ\text{C}$, $V_I = 48\text{ V}$, $C_I = 0\text{ }\mu\text{F}$, $C_O = 0\text{ }\mu\text{F}$, and $I_O = 50\% I_{O\text{max}}$)

PARAMETER		TEST CONDITIONS		PTB48501A			UNIT
				MIN	TYP	MAX	
P_{O1}, P_{O2}	Output Power		$V_{O1} (3.3\text{ V})$			19.8	W
			$V_{O2} (1.2\text{ V})$			12.6	
$P_{O\text{total}}$	Both outputs					32.4	W
I_{O1}, I_{O2}	Output Current	Over V_I range	$V_{O1} (3.3\text{ V})$	0		6 ⁽¹⁾	A
			$V_{O2} (1.2\text{ V})$	0		10.5 ⁽¹⁾	
$I_{O1} + I_{O2}$		Total (both outputs)		0		16.5	A
V_{O1}	Output Voltage	Includes set point, line, load, $-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$		3.2	3.3	3.4	V
V_{O2}				1.16	1.2	1.24	
$\Delta\text{Reg}_{\text{temp}}$	Temperature Variation	$-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$, $I_O = I_{O\text{min}}$	V_{O1}		± 0.5		% V_O
			V_{O2}		± 0.8		
$\Delta\text{Reg}_{\text{line}}$	Line Regulation	Over V_I range	V_{O1}, V_{O2}		± 1	± 10	mV
$\Delta\text{Reg}_{\text{load}}$	Load Regulation	Over I_O range	V_{O1}, V_{O2}		± 3	± 12	mV
$\Delta\text{Reg}_{\text{cross}}$	Cross Regulation	$I_{O\text{min}} \leq I_{O2} \leq I_{O\text{max}}$, $I_{O1} = 1\text{ A}$	ΔV_{O1}			10	mV
		$I_{O\text{min}} \leq I_{O1} \leq I_{O\text{max}}$, $I_{O2} = 1\text{ A}$	ΔV_{O2}			10	
η	Efficiency	$I_{O1}, I_{O2} = I_{O\text{max}}$			81%		
V_r	V_O Ripple (pk-pk)	20 MHz bandwidth	V_{O1}		20	50	mV _{pp}
			V_{O2}		20	50	
t_{tr}	Transient Response	1 A/ μs load step, 50% to 100% $I_{O\text{max}}$			30		μs
ΔV_{tr}		V_{O1}, V_{O2} over/undershoot			± 2.0		% V_O
$I_{O\text{trip}}$	Over Current Threshold	$V_I = 36\text{ V}$, reset followed by auto-recovery	$I_{O1} + I_{O2}$		24		A
V_{adj}	Output Voltage Adjust Range	V_{O2} only		-20		10	% V_O
f_s	Switching Frequency	Over V_I and I_O ranges		500	550	600	kHz
$V_{I\text{on}}$	Under-Voltage Lockout	V_I increasing			34		V
$V_{I\text{off}}$		V_I decreasing			32		
V_{IH}	On/Off Enable (pin 3)	Referenced to $-V_I$ (pin 5)		3.6		75 ⁽²⁾	V
V_{IL}	Input High Voltage						
V_{IL}	Input Low Voltage			-0.2		0.8	
I_{IL}	Input Low Current				-1		mA
I_{standby}	Standby Input Current	Pins 3 and 5 connected			2		mA
C_I	Internal Input Capacitance				2		μF
C_{O1}	External Output Capacitance			0 ⁽³⁾		5000	μF
C_{O2}				0 ⁽³⁾		5000	
MTBF	Reliability	Per Telcordia SR-332 50% stress, $T_A = 40^\circ\text{C}$, ground benign		1.5			10^6 Hrs

- (1) See Safe Operating Area curves or contact the factory for the appropriate derating.
- (2) The On/Off Enable (pin 3) has an internal pull-up and may be controlled with an open-collector (or open-drain) transistor. The input is diode protected and may be connected to $+V_I$. The maximum open-circuit voltage is 7 V. If it is left open circuit the converter will operate when input power is applied.
- (3) An output capacitor is not required.

ELECTRICAL CHARACTERISTICS (PTB48502A)(Unless otherwise stated, $T_A = 25^\circ\text{C}$, $V_I = 48\text{ V}$, $C_I = 0\text{ }\mu\text{F}$, $C_O = 0\text{ }\mu\text{F}$, and $I_O = 50\% I_{O\text{max}}$)

PARAMETER		TEST CONDITIONS		PTB48502A			UNIT
				MIN	TYP	MAX	
P_{O1}, P_{O2}	Output Power		$V_{O1} (3.3\text{ V})$			33	W
			$V_{O2} (1.2\text{ V})$			15.6	
$P_{O\text{ total}}$	Both outputs					45	W
I_{O1}, I_{O2}	Output Current	Over V_I range	$V_{O1} (3.3\text{ V})$	0		$10^{(1)}$	A
			$V_{O2} (1.2\text{ V})$	0		$13^{(1)}$	
$I_{O1} + I_{O2}$		Total (both outputs)		0		21	A
V_{O1}	Output Voltage	Includes set point, line, load, $-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$		3.2	3.3	3.4	V
V_{O2}				1.16	1.2	1.24	
$\Delta\text{Reg}_{\text{temp}}$	Temperature Variation	$-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$, $I_O = I_{O\text{ min}}$	V_{O1}		± 0.5		% V_O
			V_{O2}		± 0.8		
$\Delta\text{Reg}_{\text{line}}$	Line Regulation	Over V_I range	V_{O1}, V_{O2}		± 1	± 10	mV
$\Delta\text{Reg}_{\text{load}}$	Load Regulation	Over I_O range	V_{O1}, V_{O2}		± 3	± 12	mV
$\Delta\text{Reg}_{\text{cross}}$	Cross Regulation	$I_{O\text{ min}} \leq I_{O2} \leq I_{O\text{max}}$, $I_{O1} = 1\text{ A}$	ΔV_{O1}			10	mV
		$I_{O\text{ min}} \leq I_{O1} \leq I_{O\text{max}}$, $I_{O2} = 1\text{ A}$	ΔV_{O2}			10	
η	Efficiency	$I_{O1}, I_{O2} = I_{O\text{max}}$			82%		
V_r	V_O Ripple (pk-pk)	20 MHz bandwidth	V_{O1}		20	50	mV _{pp}
			V_{O2}		20	50	
t_{tr}	Transient Response	1 A/ μs load step, 50% to 100% $I_{O\text{max}}$			30		μs
ΔV_{tr}		V_{O1}, V_{O2} over/undershoot			± 2.0		% V_O
$I_{O\text{trip}}$	Over Current Threshold	$V_I = 36\text{ V}$, reset followed by auto-recovery	$I_{O1} + I_{O2}$		24		A
V_{adj}	Output Voltage Adjust Range	V_{O2} only		-20		10	% V_O
f_s	Switching Frequency	Over V_I and I_O ranges		500	550	600	kHz
$V_{I\text{ on}}$	Under-Voltage Lockout	V_I increasing			34		V
$V_{I\text{ off}}$		V_I decreasing			32		
V_{IH}	On/Off Enable (pin 3)	Referenced to $-V_I$ (pin 5)		3.6		$75^{(2)}$	V
V_{IL}	Input High Voltage			-0.2		0.8	
I_{IL}	Input Low Voltage				-1		mA
$I_{I\text{ standby}}$	Standby Input Current	Pins 3 and 5 connected			2		mA
C_I	Internal Input Capacitance				2		μF
C_{O1}	External Output Capacitance			$0^{(3)}$		5000	μF
C_{O2}				$0^{(3)}$		5000	
MTBF	Reliability	Per Telcordia SR-332 50% stress, $T_A = 40^\circ\text{C}$, ground benign		1.5			10^6 Hrs

- (1) See Safe Operating Area curves or contact the factory for the appropriate derating.
- (2) The On/Off Enable (pin 3) has an internal pull-up and may be controlled with an open-collector (or open-drain) transistor. The input is diode protected and may be connected to $+V_I$. The maximum open-circuit voltage is 7 V. If it is left open circuit the converter will operate when input power is applied.
- (3) An output capacitor is not required.

DEVICE INFORMATION

TERMINAL FUNCTIONS

TERMINAL		DESCRIPTION
NAME	NO.	
+V _I ⁽¹⁾	1	The positive input supply for the module with respect to –V _I . When powering the module from a –48 V telecom central office supply, this input is connected to the primary system ground.
–V _I	5	The negative input supply for the module, and the 0 VDC reference for the <i>Enable</i> , <i>EN Out</i> , and <i>Sync Out</i> signals. When the module is powered from a +48-V supply, this input is connected to the 48-V Return.
V _{O1}	10	The higher regulated power output voltage, which is referenced to the COM node.
V _{O2}	6	The lower regulated power output voltage, which is referenced to the COM node.
COM	7	The secondary return reference for the module's two regulated output voltages. It is dc isolated from the input supply pins.
V _{O2} Adjust	9	Using a single resistor, this pin allows V _{O2} to be adjusted higher or lower than the preset value. If not used, this pin should be left open circuit.
Enable ⁽²⁾	3	This is an open-collector (open-drain) positive logic input that enables the module output. This pin is referenced to –V _I . A logic 0 at this pin disables the module's outputs, and a high impedance enables the outputs. If not used the pin should be left unconnected.
EN Out	4	This open-collector output may be used to enable the output of other DC/DC converters in applications where the power-up sequence of the related voltages must be precisely controlled. The output is used principally to control the startup up of a PTB4851xx module when powering ADSL circuits based on the AC7 chipset. The signal is referenced to –V _I , and is active low. It is initially <i>off</i> (high impedance), and turns <i>on</i> when the output voltage, V _{O1} , has risen to its nominal set-point voltage.
Sync Out	2	The signal generated by this pin is designed to be used exclusively with the PTB48510 in AC7 ADSL applications. When the <i>Sync Out</i> of this converter is connected directly to the <i>Sync In</i> pin of the PTB48510, both modules will operate at the same switch conversion frequency.
POR ⁽³⁾ /COM ⁽⁴⁾	8	(POR: Available to PTB48500 and PTB48501 only.) This pin produces an active-low power-on reset signal that may be used to reset logic circuitry. The output is set low during power up just as the output voltage from V _{O1} starts to rise. It remains low for 10 ms after the voltage at V _{O1} has reached its nominal set-point voltage. This signal is referenced to the COM node, and has a 3.3-kΩ internal pull-up resistor to V _{O1} .

(1) Shaded functions indicate signals that are referenced to –V_I.

(2) Denotes positive logic: Open = Normal operation, –V_I = Outputs Off

(3) Denotes negative logic: High = Normal operation, Low = Reset

(4) This pin is COM on the PTB48502.

TYPICAL CHARACTERISTICS (1)(2)(3)

CHARACTERISTIC DATA (PTB48500A)

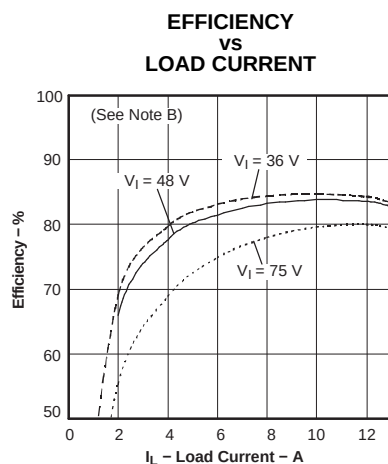


Figure 1.

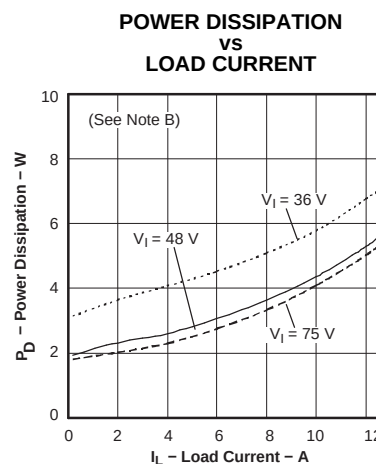


Figure 2.

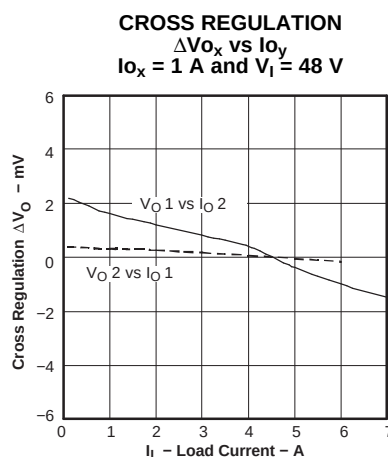


Figure 3.

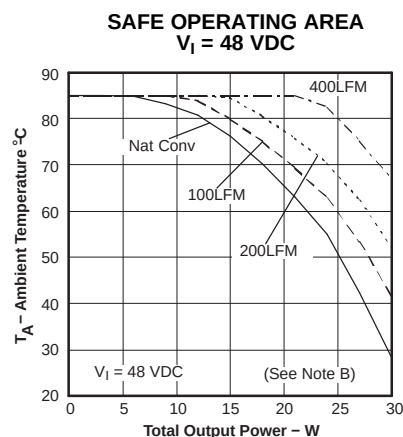


Figure 4.

- (1) A. Characteristic data has been developed from actual products tested at 25°C. This data is considered typical data for the converter.
- (2) B. Load current is increased proportionally from both outputs, up to the indicated maximum value of each respective output.
- (3) C. SOA curves represent the conditions at which internal components are at or below the manufacturer's maximum operating temperatures. Derating limits apply to modules soldered directly to a 4 in. × 4 in. double-sided PCB with 1 oz. copper.

TYPICAL CHARACTERISTICS (1)(2)(3)

PTB48501A CHARACTERISTIC DATA (PTB48501A)

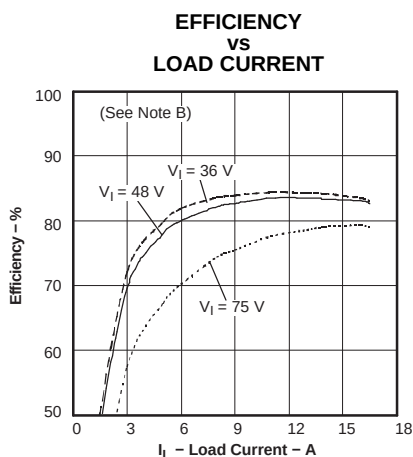


Figure 5.

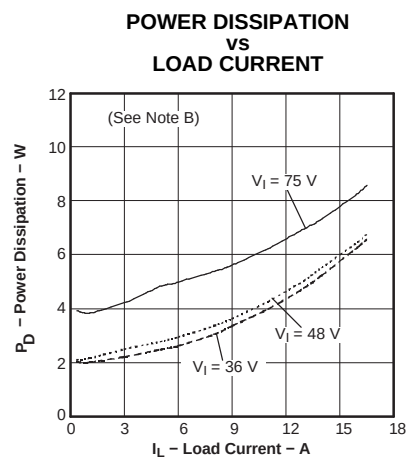


Figure 6.

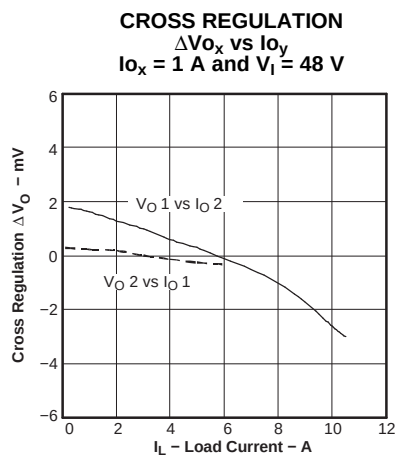


Figure 7.

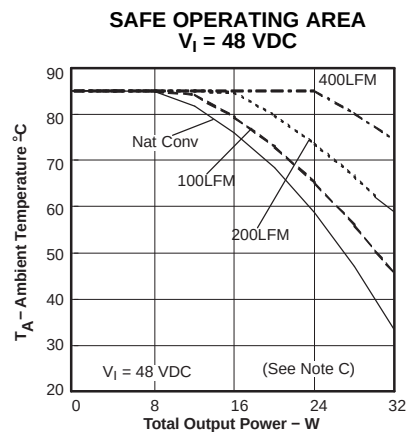


Figure 8.

- (1) A. Characteristic data has been developed from actual products tested at 25°C. This data is considered typical data for the converter.
- (2) B. Load current is increased proportionally from both outputs, up to the indicated maximum value of each respective output.
- (3) C. SOA curves represent the conditions at which internal components are at or below the manufacturer's maximum operating temperatures. Derating limits apply to modules soldered directly to a 4 in. × 4 in. double-sided PCB with 1 oz. copper.

TYPICAL CHARACTERISTICS (1)(2)(3)

CHARACTERISTIC DATA (PTB48502A)

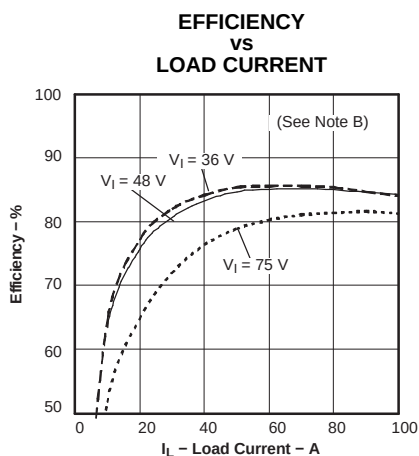
[$I_{O1} = 10\text{ A}$, $I_{O2} = 10\text{ A}$ represents 100% load]

Figure 9.

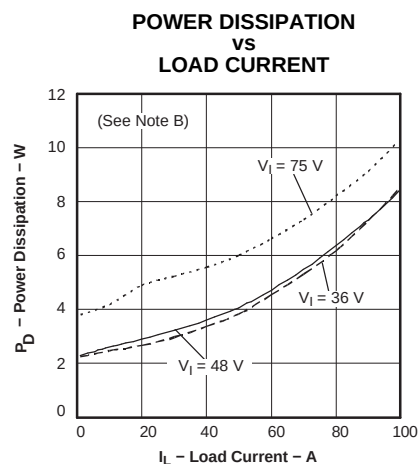


Figure 10.

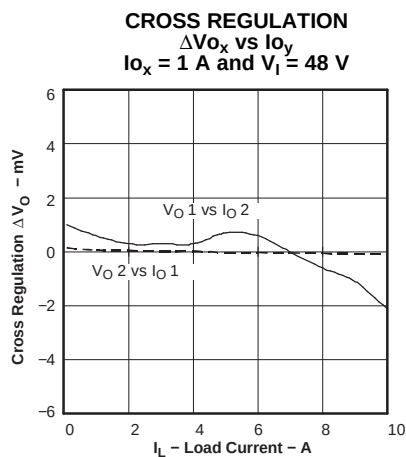


Figure 11.

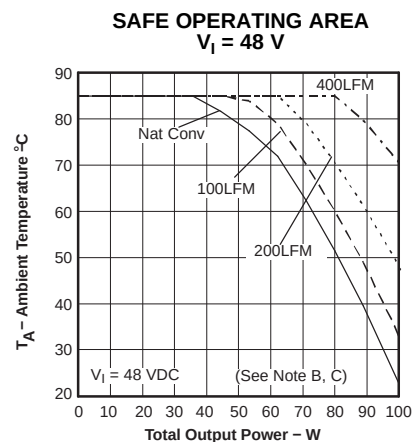


Figure 12.

- (1) A. Characteristic data has been developed from actual products tested at 25°C. This data is considered typical data for the converter.
- (2) B. Load current is increased proportionally from both outputs, up to the indicated maximum value of each respective output.
- (3) C. SOA curves represent the conditions at which internal components are at or below the manufacturer's maximum operating temperatures. Derating limits apply to modules soldered directly to a 4 in. × 4 in. double-sided PCB with 1 oz. copper.

TYPICAL CHARACTERISTICS (1)(2)(3)

CHARACTERISTIC DATA (PTB48502A) [$I_{O1} = 8\text{ A}$, $I_{O2} = 10\text{ A}$ represents 100% load]

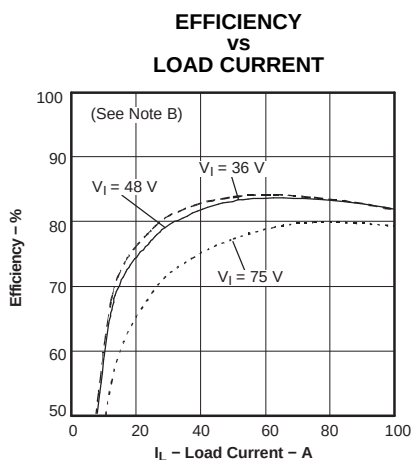


Figure 13.

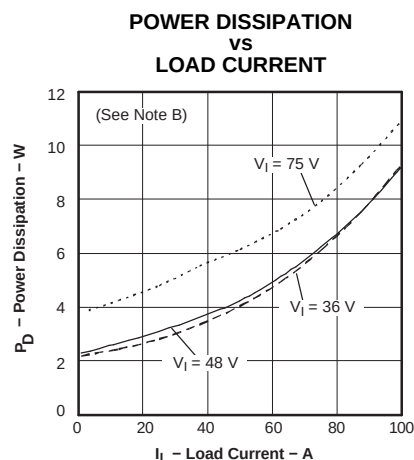


Figure 14.

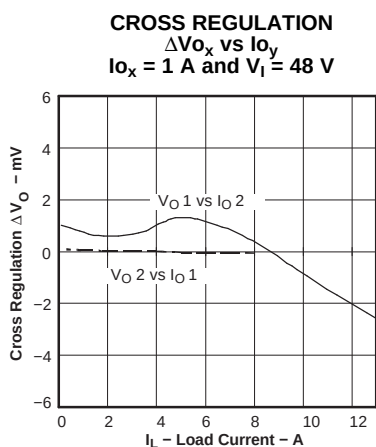


Figure 15.

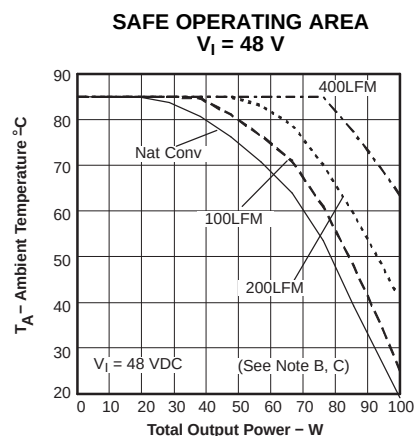


Figure 16.

- (1) A. Characteristic data has been developed from actual products tested at 25°C. This data is considered typical data for the converter.
- (2) B. Load current is increased proportionally from both outputs, up to the indicated maximum value of each respective output.
- (3) C. SOA curves represent the conditions at which internal components are at or below the manufacturer's maximum operating temperatures. Derating limits apply to modules soldered directly to a 4 in. × 4 in. double-sided PCB with 1 oz. copper.

APPLICATION INFORMATION

ADJUSTING THE LOWER OUTPUT VOLTAGE OF THE PTB4850x

The PTB4850x series of DC/DC converters are designed to produce two logic-level supply voltages for use with the AC-7 ADSL chipset. The magnitude of lowest output voltage (V_{O2}) can be adjusted higher or lower by up to 10% or –20% of the nominal. The adjustment method uses a single external resistor.¹ The value of the resistor determines the amount of adjustment, and its placement determines whether the voltage is increased or decreased. The resistor values can be calculated using the appropriate formula (see Equation 1 and Equation 2), or simply selected from the range of values given in Table 2. The placement of each resistor is as follows.

Adjust Up: To increase the magnitude of both output voltages, place a resistor R_1 between V_{O2} Adj (pin 9) and the V_{O2} (pin 6) voltage rail; see Figure 17.

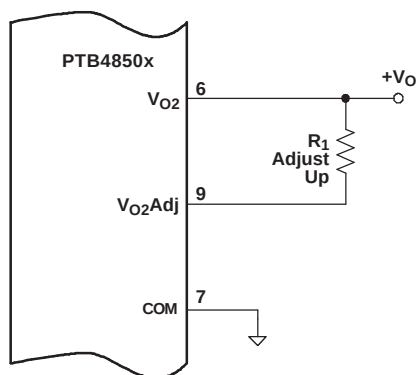


Figure 17. Adjust Up

Adjust Down: To decrease the magnitude of both output voltages, add a resistor (R_2), between V_{O2} Adj (pin 9) and the COM (pin 7) voltage rail; see Figure 18.

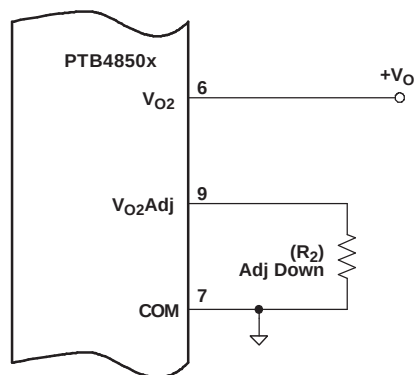


Figure 18. Adjust Down

CALCULATION OF THE ADJUST RESISTOR

The value of the adjust resistor is calculated using one of the following equations. Use the equation for R_1 to adjust up, or (R_2) to adjust down.

$$R_1 [\text{Adjust Up}] = R_p \times \frac{V_a}{(V_a - V_o)} - R_s \text{ k}\Omega \quad (1)$$

$$(R_2) [\text{Adjust Down}] = R_n \times \frac{V_a}{(V_o - V_a)} - R_s \text{ k}\Omega \quad (2)$$

Where:

V_o = Magnitude of the original output voltage

V_a = Magnitude of the adjusted voltage

R_p = Adjust-up constant from Table 1

R_n = Adjust-down constant from Table 1

R_s = Internal series resistor from Table 1

Table 1. Adjustment Range and Formula Parameters

Part No.	PTB48500(1)A	PTB48502A
$V_o(\text{nom})$	1.2 V	1.2 V
$V_a(\text{min})$	0.96 V	0.84 V
$V_a(\text{max})$	1.32 V	1.32 V
R_p (k Ω)	1.648	1.196
R_n (k Ω)	4.624	3.598
R_s (k Ω)	18.2V	13.0

NOTES:

1. A 0.05 W rated resistor may be used. The tolerance should be 1%, with a temperature stability of 100 ppm/°C or better. Place the resistor in either the R_1 or (R_2) location, as close to the converter as possible.
2. Never connect capacitors to the V_{O2} Adj pin. Capacitance added to this pin can affect the stability of the regulated output.

Table 2. Adjust Resistor Values

Part No.		PTB4850xA	PTB48502A
% Adjust	V_a (V)	$R_1 / (R_2)^{(1)}$	$R_1 / (R_2)^{(1)}$
–21	0.848	N/A	(0.5) k Ω
–20	0.960	(0.3) k Ω	(1.4) k Ω
–19	0.972	(1.5) k Ω	(2.3) k Ω
–18	0.984	(2.9) k Ω	(3.4) k Ω
–17	0.996	(4.4) k Ω	(4.6) k Ω
–16	1.008	(6.1) k Ω	(5.9) k Ω
–15	1.020	(8.0) k Ω	(7.4) k Ω
–14	1.032	(10.2) k Ω	(9.1) k Ω

(1) R_1 = Adjust up, (R_2) = Adjust down

Table 2. Adjust Resistor Values (continued)

Part No.		PTB4850xA	PTB48502A
% Adjust	V _a (V)	R ₁ / (R ₂) ⁽¹⁾	R ₁ / (R ₂) ⁽¹⁾
–13	1.044	(12.7) kΩ	(11.1) kΩ
–12	1.056	(15.7) kΩ	(13.4) kΩ
–11	1.068	(19.2) kΩ	(16.1) kΩ
–10	1.080	(23.4) kΩ	(19.4) kΩ
–9	1.092	(28.6) kΩ	(23.4) kΩ
–8	1.104	(35) kΩ	(28.4) kΩ
–7	1.116	(43.2) kΩ	(34.8) kΩ
–6	1.128	(54.2) kΩ	(43.4) kΩ
–5	1.140	(69.7) kΩ	(55.4) kΩ
–4	1.152	(92.8) kΩ	(73.4) kΩ
–3	1.164	(131) kΩ	103.0) kΩ
–2	1.176	(208) kΩ	163.0) kΩ
–1	1.188	(440) kΩ	343.0) kΩ
0	1.200		
+1	1.212	148 kΩ	108.0 kΩ
+2	1.224	65.8 kΩ	48.0 kΩ
+3	1.236	38.4 kΩ	28.1 kΩ
+4	1.248	24.6 kΩ	18.1 kΩ
+5	1.260	16.4 kΩ	12.1 kΩ
+6	1.272	10.9 kΩ	8.1 kΩ
+7	1.284	7 kΩ	5.3 kΩ
+8	1.296	4.1 kΩ	3.2 kΩ
+9	1.308	1.8 kΩ	1.5 kΩ
+10	1.320	0 kΩ	0.2 kΩ

CONFIGURING THE PTB4850X AND PTB4851X FOR DSL APPLICATIONS

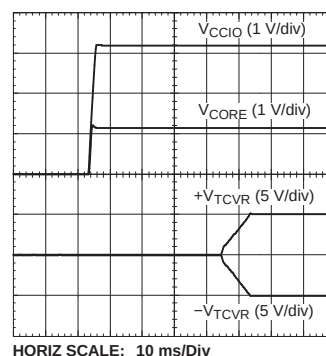
When operated as a pair, the PTB4850x and PTB4851x converters are specifically designed to provide all the required supply voltages for powering xDSL chipsets. The PTB4850x produces two logic voltages. They include a 3.3-V source for logic and I/O, and a low-voltage for powering a digital signal processor core. The PTB4851x produces a balanced pair of complementary supply voltages that is required for the xDSL transceiver ICs. When used together in these types of applications, the PTB4850x and PTB4851x may be configured for power-up sequencing, and also synchronized to a common switch conversion frequency. [Figure 20](#) shows the required cross-connects between the two converters to enable these two features.

SWITCHING FREQUENCY SYNCHRONIZATION

Unsynchronized, the difference in switch frequency introduces a beat frequency into the input and output AC ripple components from the converters. The beat frequency can vary considerably with any slight variation in either converter's switch frequency. This results in a variable and undefined frequency spectrum for the ripple waveforms, which would normally require separate filters at the input of each converter. When the switch frequency of the converters are synchronized, the ripple components are constrained to the fundamental and higher. This simplifies the design of the output filters, and allows a common filter to be specified for the treatment of input ripple.

POWER-UP SEQUENCING

The desired power-up sequence for the AC7 supply voltages requires that the two logic-level voltages from the PTB4850x converter rise to regulation prior to the two complementary voltages that power the transceiver ICs. This sequence cannot be guaranteed if the PTB4850x and PTB4851x are allowed to power up independently, especially if the 48-V input voltage rises relatively slowly. To ensure the desired power-up sequence, the *EN Out* pin of the PTB4850x is directly connected to the activelow *Enable* input of the PTB4851x (see [Figure 20](#)). This allows the PTB4850x to momentarily hold off the outputs from the PTB4851x until the logic-level voltages have risen first. [Figure 19](#) shows the power-up waveforms of all four supply voltages from the schematic of [Figure 20](#).

**Figure 19. Power-Up Sequencing Waveforms**

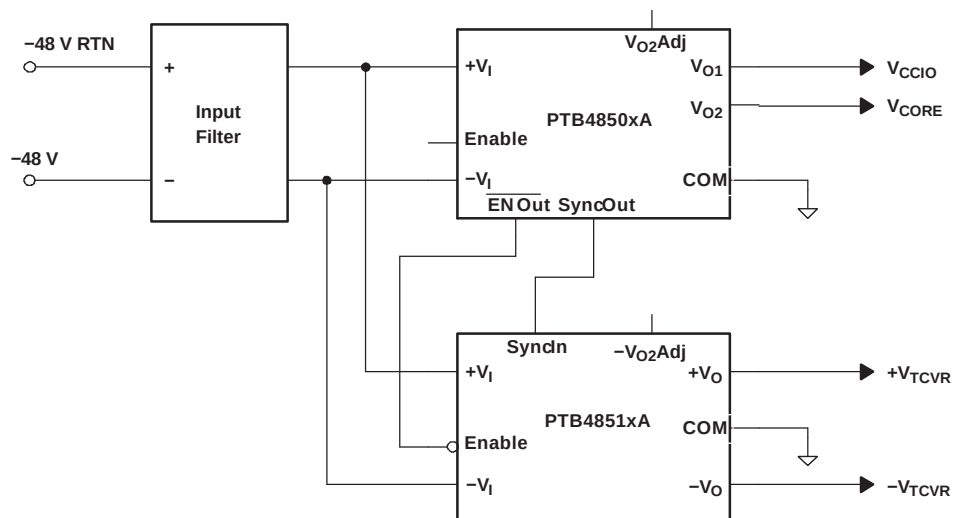


Figure 20. Example of PTB4850x and PTB4851x Modules Configured for DSL Applications

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
PTB48502AAZ	NRND	Production	Surface Mount Module (ERJ) 10	9 TIW TRAY	In-Work	SNAGCU	Level-3-260C-168 HR	-40 to 85	
PTB48502AAZ.B	NRND	Production	Surface Mount Module (ERJ) 10	9 TIW TRAY	In-Work	SNAGCU	Level-3-260C-168 HR	-40 to 85	

⁽¹⁾ **Status:** For more details on status, see our [product life cycle](#).

⁽²⁾ **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

⁽⁴⁾ **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

⁽⁶⁾ **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

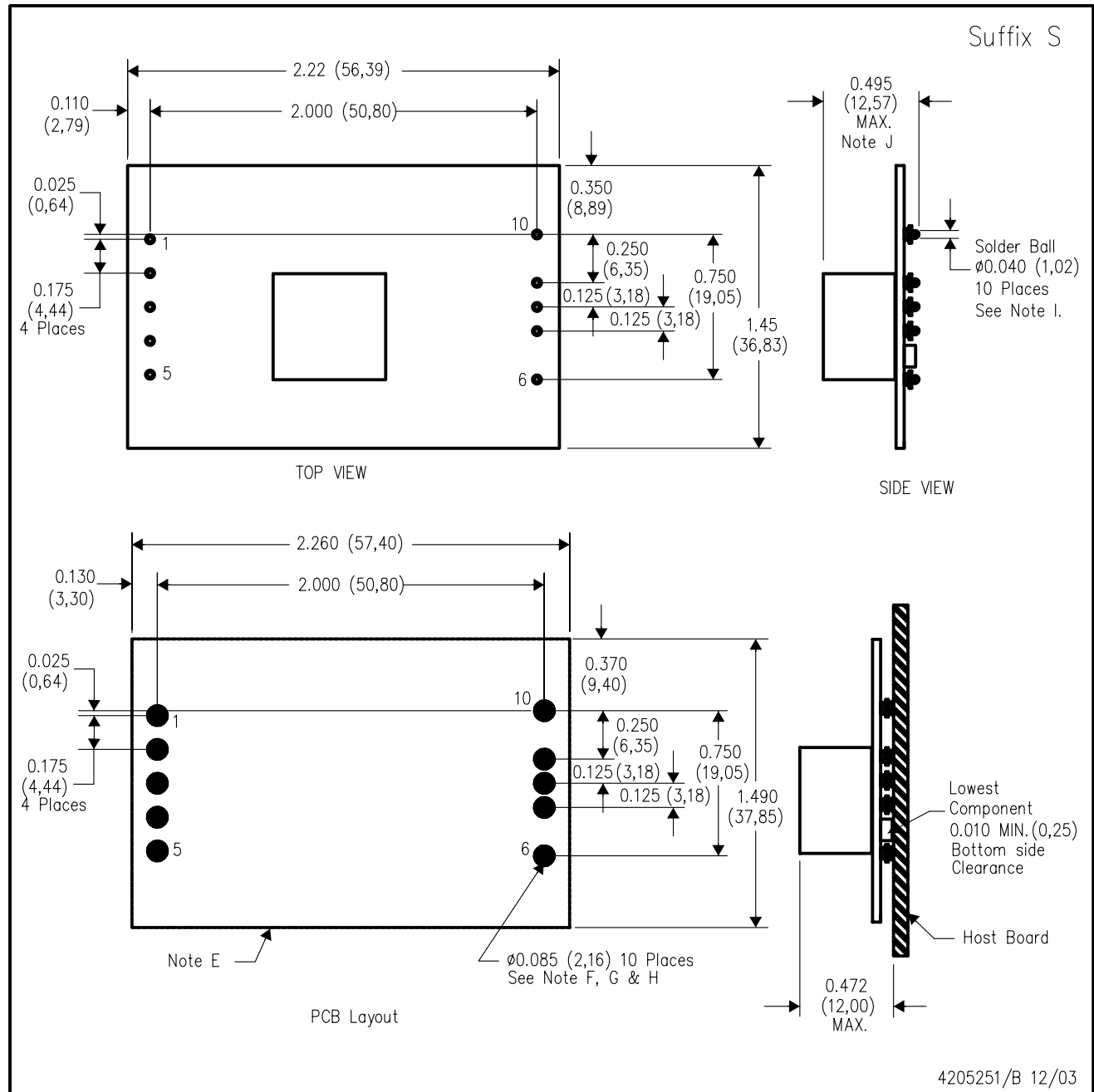
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "-" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

ERJ (R-PDSS-B10)

DOUBLE SIDED MODULE



IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on [ti.com](https://www.ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2025, Texas Instruments Incorporated