



**PRODUCT DESCRIPTION**

The LRBH5010T is an Application Specific Power Module (ASPM) that integrates all the necessary power functions to build a converter, up to 3kW, with a 220/240V AC input. System design is dramatically reduced due to the integration of:

- A full wave bridge rectifier for AC single phase input.
- A boost configuration with associated gate driver for a PFC function.
- A full H-bridge consisting of four 500 volt / 0.100 ohm MOSFETs and four associated gate drivers.

The close proximity of the gate drivers along with the use of direct bonded copper (DBC) on ceramic substrates allow trouble free 100kHz operation, using a Phase Shifted Zero Volt Transition (ZVT) Controller. Using a ceramic substrate provides 2500V AC isolation.

M3 screw-on terminals are provided for the power connections, the signal I/O pins are compatible with a male connector on 0.1" (2.54mm) centers.

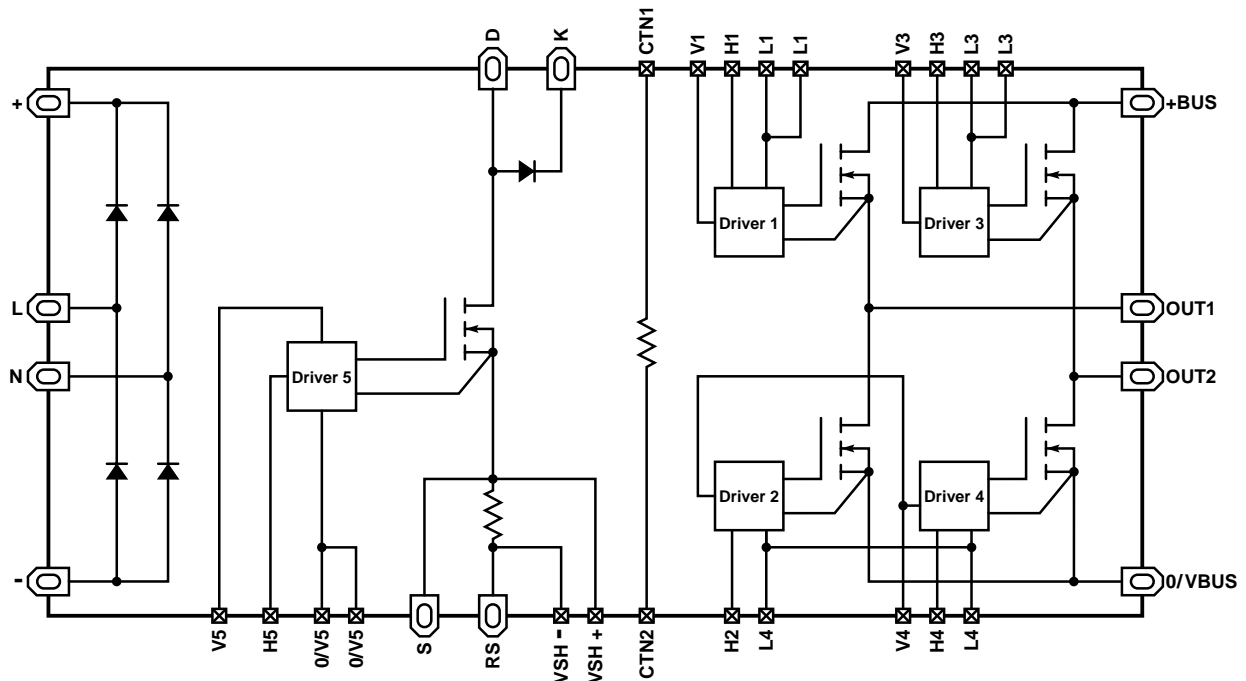
**PRODUCT FEATURES**

- Up to 3kW Output Power
- 220V/240V AC Single Phase Input
- High Switching Frequency (up to 100kHz using a Phase Shifted ZVT Controller)
- Power Factor Correction Circuit
- Input Bridge Rectifier
- Avalanche Rated MOSFET H-Bridge With Gate Drivers
- Isolated Package

**PRODUCT APPLICATIONS**

- High Frequency Power Supply
- Battery Charger
- UPS
- Welder Power Stage
- High Power Class 'D' Amplifier

**LRBH5010T BLOCK DIAGRAM**



APT Reserves the right to change, without notice, the specifications and information contained herein.

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**BOOST SWITCH STATIC ELECTRICAL CHARACTERISTICS**

 All Ratings:  $T_J = 25^\circ\text{C}$  unless otherwise specified.

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$BV_{DSS}$	Drain-Source Breakdown Voltage ( $V_{GS} = 0V, I_D = 1.0mA$ )	500			Volts
$I_D$	Continuous Drain Current @ $T_C = 25^\circ\text{C}$			50	Amps
$I_{DM}$	Pulsed Drain Current ①			240	
$P_D$	Total Power Dissipation @ $T_C = 25^\circ\text{C}$			410	Watts
$R_{DS(on)}$	Drain-Source On-State Resistance ( $V_{GS} = 10V, 0.5 I_{D(Cont.)}$ ) ①			70	mOhms
$R_{SH}$	Shunt Resistor Value	9.5	10	10.5	
$P_{SH}$	Shunt Resistor Power @ $T_C = 80^\circ\text{C}$			10	Watts
$R_{\theta JC}$	Junction to Case Thermal Resistance			0.30	$^\circ\text{C/W}$

 ① Pulse Test: Pulse width < 380  $\mu\text{s}$ , Duty Cycle < 2%

**BOOST SWITCH DYNAMIC CHARACTERISTICS**

 All Ratings:  $T_J = 25^\circ\text{C}$  unless otherwise specified.

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
$t_{(r)}$	Rise Time	$V_{in} = 15V, V_{BUS} = 250V$ $I_D = 25A$		100	200	ns
$t_{(f)}$	Fall Time			60	100	

**BOOST SWITCH BODY DIODE CHARACTERISTICS**

 All Ratings:  $T_J = 25^\circ\text{C}$  unless otherwise specified.

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
$I_S$	Continuous Source Current (Body Diode)			50	Amps
$V_{SD}$	Diode Forward Voltage ( $V_{GS} = 0V, I_S = -50A$ )			1.3	Volts
$t_{rr}$	Reverse Recovery Time ( $I_S = -50A, di_S/dt = 300A/\mu\text{s}$ )		510		ns
$Q_{rr}$	Reverse Recovery Charge ( $I_S = -50A, di_S/dt = 300A/\mu\text{s}$ )		10		$\mu\text{C}$

**BOOST SWITCH DRIVER ELECTRICAL CHARACTERISTICS**

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
V5	Operating Auxiliary Supply Voltage	13	15	16	Volts
IV5	Operating Auxiliary Supply Current ( $F_{out} = 100\text{kHz}, V_5 = 15V$ )		140		mA
$H5_{(max)}$	Maximum Input Voltage	-0.5		$V_5 + 0.5$	Volts
$H5_{(th+)}$	Positive Going Threshold Voltage ( $V_5 = 15V$ )	6.8	8.8	10.8	
$H5_{(th-)}$	Negative Going Threshold Voltage ( $V_5 = 15V$ )	4.0	5.8	7.4	
$H5_{(hys)}$	Hysteresis Voltage ( $V_5 = 15V$ )	1.6	2.1	5.0	
ZH5	Input Impedence		1.0		k $\Omega$
$td_{(on)}$	Total Turn on Delay Time (driver + MOSFET)		220	300	ns
$td_{(off)}$	Total Turn off Delay Time (driver + MOSFET)		1300	1500	

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**BOOST DIODE CHARACTERISTICS**

 All Ratings:  $T_J = 25^\circ\text{C}$  unless otherwise specified.

Symbol	Characteristic / Test Conditions		MIN	TYP	MAX	UNIT
$V_{RRM}$	Maximum Peak Repetitive Reverse Voltage		600			Volts
$V_F$	Diode Forward Voltage ( $I_F = 30\text{A}$ )				1.8	
$I_{F(av)}$	Maximum Average Forward Current ( $T_C = 100^\circ\text{C}$ , Duty Cycle = 0.5)				30	Amps
$I_{RRM}$	Reverse Recovery Current	$di_F/dt = -240\text{A}/\mu\text{s}$		7.5		
$t_{rr}$	Reverse Recovery Time	$I_F = 30\text{A}$ , $V_R = 350\text{V}$		155		ns
$R_{\theta JC}$	Junction to Case Thermal Resistance				1.5	$^\circ\text{C}/\text{W}$

**BRIDGE RECTIFIER STATIC ELECTRICAL CHARACTERISTICS** All Ratings:  $T_J = 25^\circ\text{C}$  unless otherwise specified.

Symbol	Characteristic / Test Conditions (Single Diode)	MIN	TYP	MAX	UNIT
$V_{RRM}$	Maximum Peak Repetitive Reverse Voltage	1200			Volts
$V_F$	Diode Forward Voltage ( $I_F = 40\text{A}$ )			1.3	
$I_{F(AV)}$	Average Rectifier Forward Current			40	Amps
$R_{\theta JC}$	Junction to Case Thermal Resistance			1	$^\circ\text{C}/\text{W}$

**FULL BRIDGE STATIC ELECTRICAL CHARACTERISTICS**

 All Ratings:  $T_J = 25^\circ\text{C}$  unless otherwise specified.

Symbol	Characteristic (Single Switch)	MIN	TYP	MAX	UNIT
$BV_{DSS}$	Drain-Source Breakdown Voltage ( $V_{GS} = 0\text{V}$ , $I_D = 1.0\text{mA}$ )	500			Volts
$I_D$	Continuous Drain Current @ $T_C = 25^\circ\text{C}$			35	Amps
$I_{DM}$	Pulsed Drain Current <sup>①</sup>			140	
$P_D$	Total Power Dissipation @ $T_C = 25^\circ\text{C}$			312	Watts
$R_{DS(on)}$	Drain-Source On-State Resistance ( $V_{GS} = 10\text{V}$ , $0.5 I_{D(Cont.)}$ ) <sup>①</sup>			0.100	Ohms
$R_{\theta JC}$	Junction to Case Thermal Resistance			0.40	$^\circ\text{C}/\text{W}$

**FULL BRIDGE DYNAMIC CHARACTERISTICS**

 All Ratings:  $T_J = 25^\circ\text{C}$  unless otherwise specified.

Symbol	Characteristic (Single Switch)	Test Conditions	MIN	TYP	MAX	UNIT
$t_{(r)}$	Rise Time	$V_{in} = 15\text{V}$ , $V_{BUS} = 250\text{V}$ $I_D = 8\text{A}$		150	250	ns
$t_{(f)}$	Fall Time			80	150	

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**FULL BRIDGE BODY DIODE CHARACTERISTICS**

 All Ratings:  $T_J = 25^\circ\text{C}$  unless otherwise specified.

Symbol	Characteristic / Test Conditions (Single Switch)	MIN	TYP	MAX	UNIT
$I_S$	Continuous Source Current (Body Diode)			35	Amps
$V_{SD}$	Diode Forward Voltage ( $V_{GS} = 0V$ , $I_S = -35A$ )			1.3	Volts
$t_{rr}$	Reverse Recovery Time ( $I_S = -35A$ , $di_S/dt = 100A/\mu s$ )		620		ns
$Q_{rr}$	Reverse Recovery Charge ( $I_S = -35A$ , $di_S/dt = 100A/\mu s$ )		14.7		$\mu C$

**FULL BRIDGE TRANSISTOR DRIVER ELECTRICAL CHARACTERISTICS**

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
$V_i$	Operating Auxiliary Supply Voltage ( $i=1,3,4$ )	13	15	16	Volts
$I_{Vi}$	Operating Auxiliary Supply Current ( $F_{out} = 100kHz$ , $V_i = 15V$ , $i=1,3,4$ )		100		mA
$H_i$	Maximum Input Voltage ( $i=1,2,3,4$ )	-16		16	Volts
$H_{i(th+)}$	Positive Going Threshold Voltage ( $V_{aux} = 15V$ , $i=1,2,3,4$ )	7.5	9.5	11.5	
$H_{i(th-)}$	Negative Going Threshold Voltage ( $V_{aux} = 15V$ , $i=1,2,3,4$ )	4.7	6.5	8.1	
$ZH_{i(hys)}$	Hysteresis Voltage ( $V_{aux} = 15V$ , $i=1,2,3,4$ )	1.6	2.1	5.0	
$ZH_i$	Input Impedence ( $i=1,2,3,4$ )		1.0		k $\Omega$
$td_{(on)}$	Total Turn on Delay Time (driver + MOSFET)		280	400	ns
$td_{(off)}$	Total Turn off Delay Time (driver + MOSFET)		600	1000	

**PACKAGE CHARACTERISTICS**

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
$V_{isol}$	Isolation Voltage (RMS, 50-60Hz, 1 min)	2.5			KV
$T_J$	Operating Junction Temperature Range	-25		150	$^\circ\text{C}$
$T_A$	Operating Ambient Temperature Range	-25		70	
$T_{ASTG}$	Ambient Storage Temperature Range	-40		90	
$Wt$	Package Weight		530		gm
			18.7		oz
Torque	Maximum Torque for Mounting Screws and Screw-on Terminals	Mounting		3	N•m
		Screw-on		0.5	
		Mounting		26.6	lb•in
		Screw-on		4.4	

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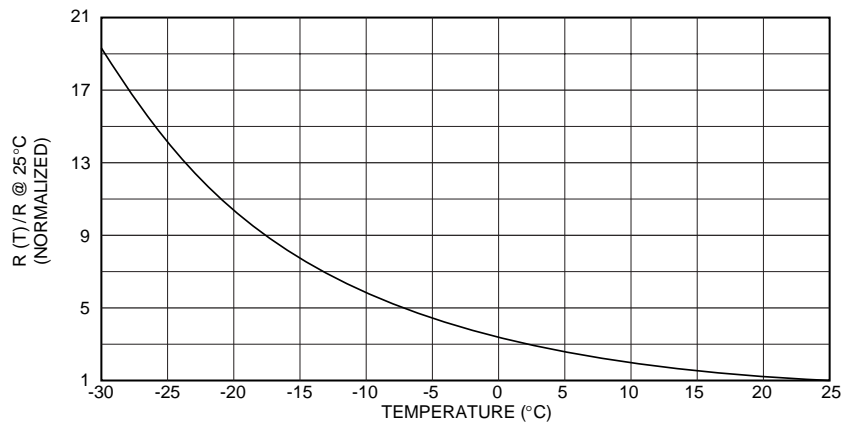
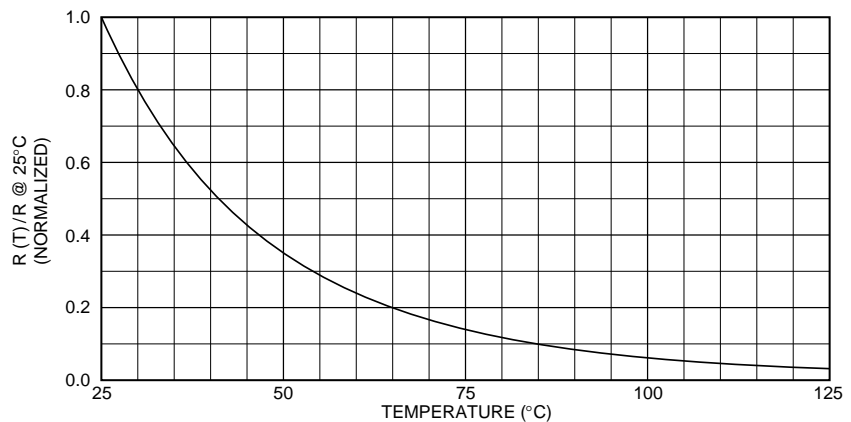
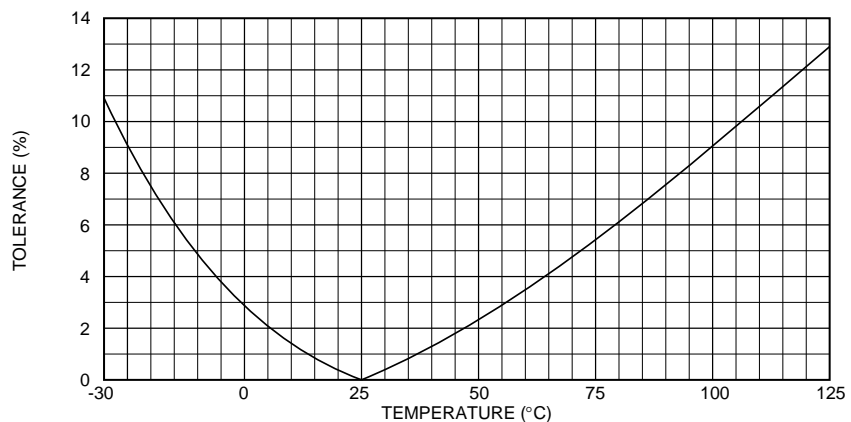
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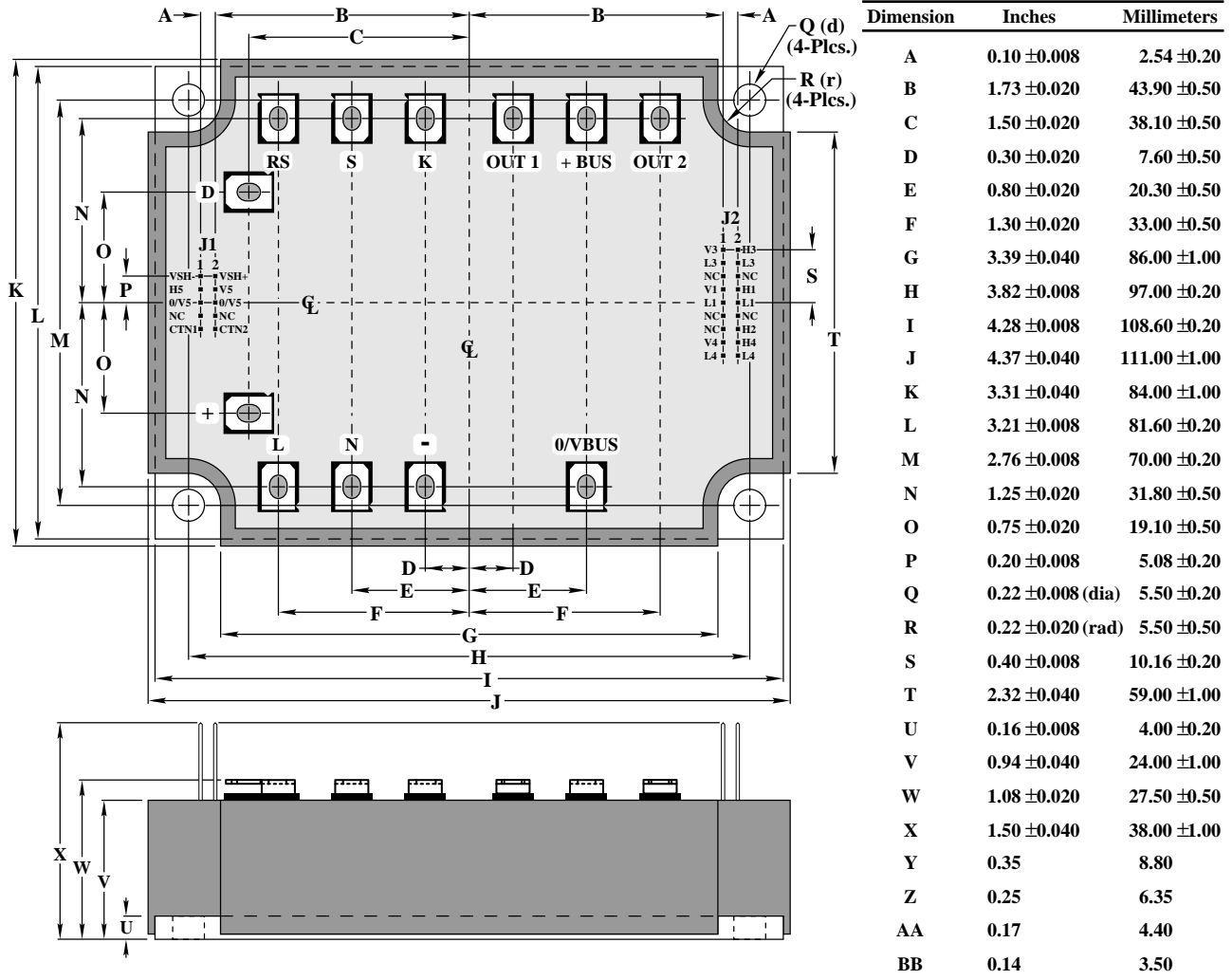
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Temperature (°C)	R(T)/R@25°C <sup>①</sup>	Tolerance
-30	19.330	10.9
-25	14.120	9.1
-20	10.410	7.5
-15	7.758	6.1
-10	5.834	4.9
-5	4.426	3.8
0	3.387	2.9
5	2.614	2.1
10	2.033	1.4
15	1.593	0.9
20	1.258	0.4
25	1.000	0.0
30	0.8004	0.4
35	0.6448	0.8
40	0.5228	1.3
45	0.4264	1.8
50	0.3497	2.3
55	0.2885	2.9
60	0.2392	3.5
65	0.1994	4.1
70	0.1671	4.8
75	0.1406	5.5
80	0.1189	6.2
85	0.1010	6.9
90	0.08617	7.6
95	0.07381	8.3
100	0.06347	9.1
105	0.05480	9.8
110	0.04748	10.6
115	0.04129	11.3
120	0.03603	12.1
125	0.03155	12.9

**TABLE 1, NTC CHARACTERISTICS**
**NOTE:**
<sup>①</sup>R@25°C = 68kΩ ± 5%

**FIGURE 1, NORMALIZED NTC CHARACTERISTICS - 30°C to 25°C**

**FIGURE 2, NORMALIZED NTC CHARACTERISTICS 25°C to 125°C**

**FIGURE 3, NTC TOLERANCE vs TEMPERATURE**

**MECHANICAL DIMENSIONS AND PINOUT LOCATION**



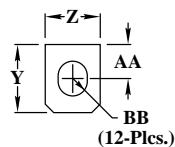
**MECHANICAL MOUNTING**

4 ea. - M5 Screw & Washer  
 Maximum Torque: 26.6 lb•in (3 N•m)

Base plate flatness: 8mils (200µm) max.

**ELECTRICAL MOUNTING**

**POWER TERMINALS:**



M3 Screw & Washer  
 Maximum Torque: 4.4 lb•in (0.5 N•m)  
 All terminals are on the same plane ±0.01" (±0.25mm)

**SIGNAL TERMINALS:**

□ 0.025" (0.6mm) square pin on 0.100" (2.54mm) centers.  
 Centers of pins 5 & 6 of J1 and 9 & 10 of J2 are on the package center line (horizontal dashed line).

TOLERANCE BETWEEN AXIS OF ELECTRICAL TERMINALS ±0.02" (±0.5mm)

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