International
IOR Rectifier

PD 6.126

PRELIMINARY

IRPT1065A

POWIRTRAIN™

Power Module for 1 hp Motor Drives

- 1 hp (0.75 kW) power output
  Industrial rating at 150% overload for 1 minute
- 180-240V AC single-phase input, 50/60 Hz
- Single-phase rectifier bridge
- 3-phase, short circuit rated, ultrafast IGBT inverter
- HEXFRED ultrafast soft recovery freewheeling diodes
- Brake IGBT and diode
- Low inductance (current sense) shunts in positive and negative DC rail
- NTC temperature sensor
- Pin-to-baseplate isolation 2500V rms
- Easy-to-mount two-screw package
- Case temperature range -25°C to 125°C operational

Figure 1. IRPT1065A Power Module

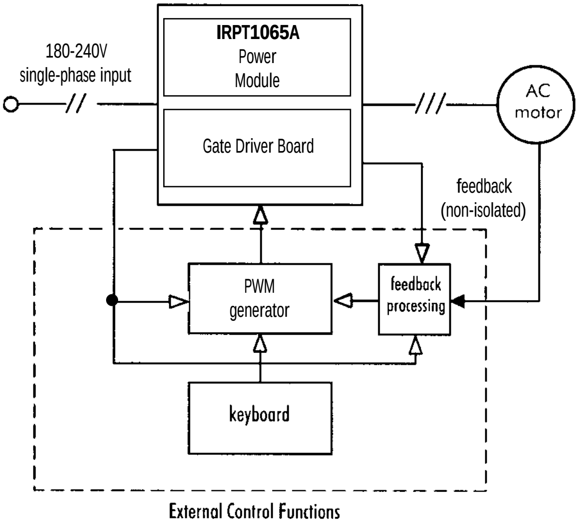

Figure 2. The IRPT1065A power module within a motor control system

The IRPT1065A Power Module

The IRPT1065A power module, shown in figure 1, is a chip and wire epoxy encapsulated module. It houses input rectifiers, brake IGBT and freewheeling diode, output inverter, current sense shunts and NTC thermistor. The single-phase input bridge rectifiers are rated at 800V. The inverter section uses 600V, short circuit rated, ultrafast IGBTs and ultrafast freewheeling diodes. Current sensing is achieved through 75 mΩ low inductance shunts provided in the positive and negative DC bus rail. The NTC thermistor provides temperature sensing capability. The lead spacing on the power module meets UL840 pollution level 3 requirements.

The power circuit and layout within the module are carefully designed to minimize inductance in the power path, to reduce noise during inverter operation and to improve the inverter efficiency. The driver board required to run the inverter can be soldered to the power module pins, thus minimizing assembly and alignment. The power module is designed to be mounted to a heat sink with two screw mount positions, in order to insure good thermal contact between the module substrate and the heat sink.

Specifications

PARAMETERS	VALUES	CONDITIONS
Input Power		
Voltage	220V, -15%, +10%, 1-phase	
Frequency	50/60 Hz	
Current	10.12A rms @ nominal output	T_A = 40°C, R_{thSA} = 1.16°C/W
I_{FSM}	150A	10 ms half-cycle, non-repetitive surge
Output Power		
Voltage	0 - 230V rms	defined by external PWM control
Nominal motor hp (kW)	1 hp (0.75 kW) nominal full load power 150% overload for 1 minute	V_{in} = 220V AC, f_{pwm} = 4 kHz, f_o = 60 Hz, T_A = 40°C, R_{thSA} = 1.16°C/W
Nominal motor current	4.4A rms nominal full load CURRENT 6.6A rms 150% overload for 1 minute	
DC Link		
DC link voltage	425V maximum	
Brake		
Current	7.9A	
Sensor		
Temp. sense resistance	50kOhms ±5% 3.1kOhms ±10%	@ T_{NTC} = 25°C @ T_{NTC} = 100°C
Current sense	75mOhms ±5%	@ T_{SHUNT} = 25°C
Protection		
IGBT short circuit time	10 µs	DC bus = 425V, V_{GE} = 15V, line to line short
Recommended short circuit-shutdown current	20A peak	
Gate Drive		
Q_G	34 nC (typical)	V_{GE} = 15V, refer figure 4b
Recommended gate driver	IR2132J (refer figure 9)	
Module		
Isolation voltage	2500V rms	pin to baseplate, 60 Hz, 1 minute
Operating case temperature	-25°C to 125°C	95% RH max. (non-condensing)
Mounting torque	1 Nm	M4 screw type
Storage temperature range	-40°C to 125°C	
Soldering temperature for 10 sec.	260°C maximum	at the pins (.06" from case)

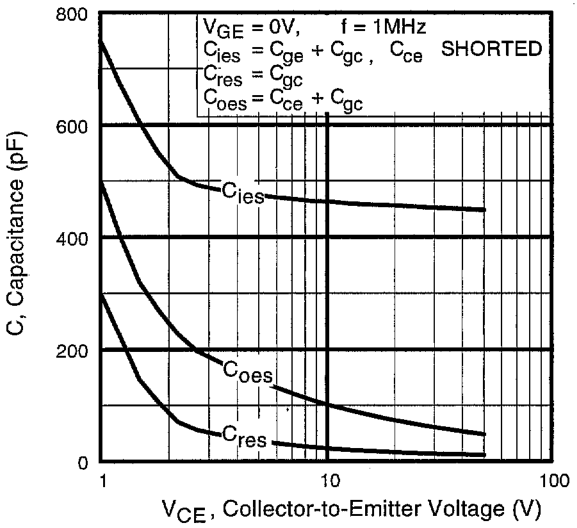

Figure 4a. Typical Capacitance vs Collector-to-Emitter Voltage

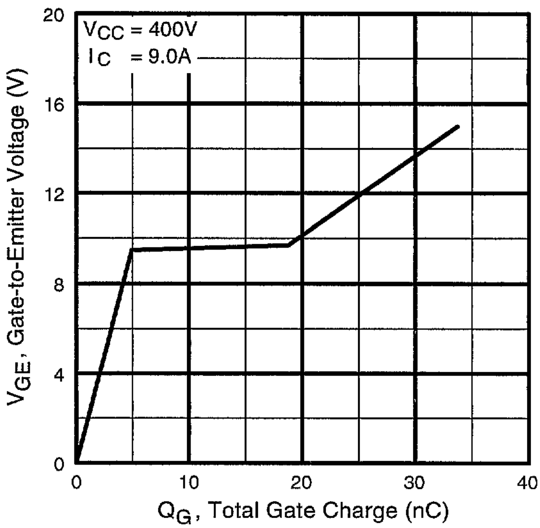

Figure 4b. Typical Gate Charge vs Gate-to-Emitter Voltage

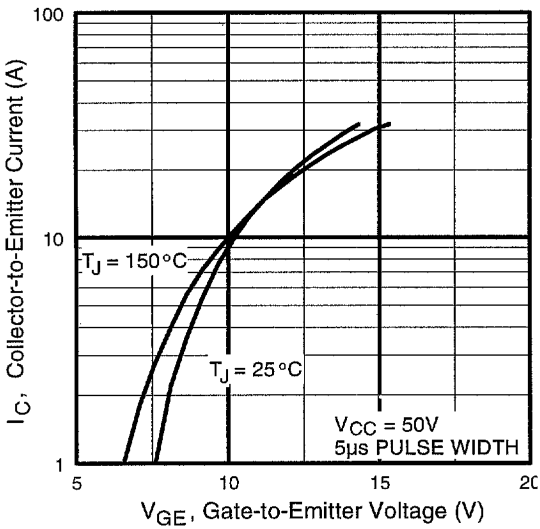

Figure 4c. Typical Transfer Characteristics

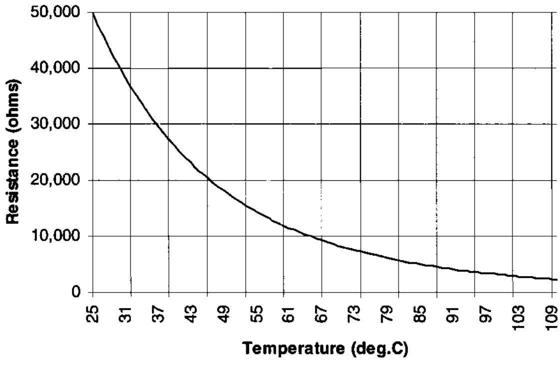

Figure 5. Nominal R-T Characteristics of the NTC Thermistor

Mounting Procedure

Mounting

1. Connect the driver board and the IRPT1065A power module.
2. Remove all particles and grit from the heat sink and power substrate.
3. Spread a .004" to .005" layer of silicone grease on the heat sink, covering the entire area that the power substrate will occupy. Recommended heat sink flatners is .001 inch/inch and Total Indicator Readout (TIR) of .003 inch below substrate.
4. Place the power substrate onto the heat sink with the mounting holes aligned and press it firmly into the silicone grease.
5. Place the 2 M4 mounting screws through the PCB and power module and into the heat sink and tighten the screws to 1 Nm torque.

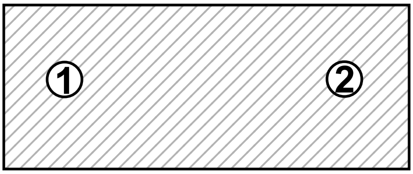

Figure 6. Power Module Mounting Screw Sequence

Power Connections

The power module pin designation, function and other details can be obtained from the package outline in Figure 7 and circuit diagram in Figure 8. Single phase input connections made to pins S and T and inverter output connections are made to pins U, V and W. Positive rectifier output and positive inverter bus are brought out to pins RP and P respectively in order to provide DC bus capacitor soft charging implementation option. The current shunt terminals are connected to pins IS1, IS2 and IS3, IS4 on the positive and negative DC rails respectively.

Functional Information

Heat Sink Requirements

Figures 3a-3b show the thermal resistance of the heat sink required for various output power levels and Pulse-Width-Modulated (PWM) switching frequencies. Maximum total losses of the unit are also shown. This data is based on the following key operating conditions:

- The maximum continuous combined losses of the rectifier and inverter occur at full pulse-width-modulation. These maximum losses set the maximum continuous operating temperature of the heat sink.
- The maximum combined losses of the rectifier and inverter at full pulse-width-modulation under overload set the incremental temperature rise of the heat sink during overload.
- The minimum output frequency at which full load current is to be delivered sets the peak IGBT junction temperature.
- At low output frequency, IGBT junction temperature tends to follow the instantaneous fluctuations of the output current. Thus, peak junction temperature rise increases as output frequency decreases.

Over Temperature Protection

Over temperature can be detected using the NTC thermistor included in the power module for thermal sensing. Protection circuit that initiates a shutdown if the temperature of the IMS substrate exceeds a set level can be implemented. The nominal resistance vs. temperature characteristic of the thermistor is given in Figure 5.

Voltage Rise During Braking

The motor will feed energy back to the DC link during regenerative braking, forcing the DC bus voltage to rise above the level defined by the input line voltage. Deceleration of the motor must be controlled by appropriate PWM control to keep the DC bus voltage within the rated maximum value.

NOTE: Dimensions are in inches (millimeters)

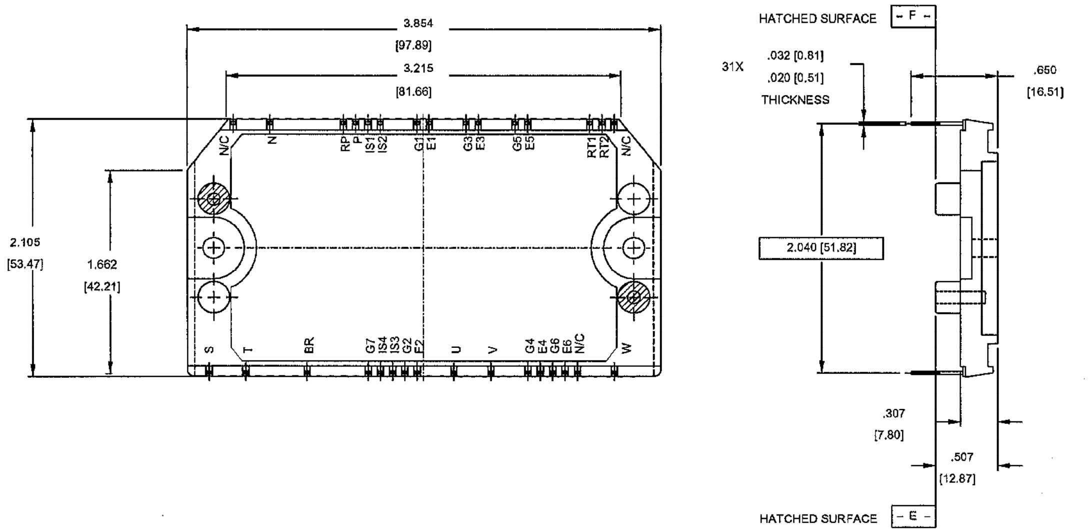

Figure 7a. Power Module Package Outline

NOTE: Dimensions are in inches (millimeters)

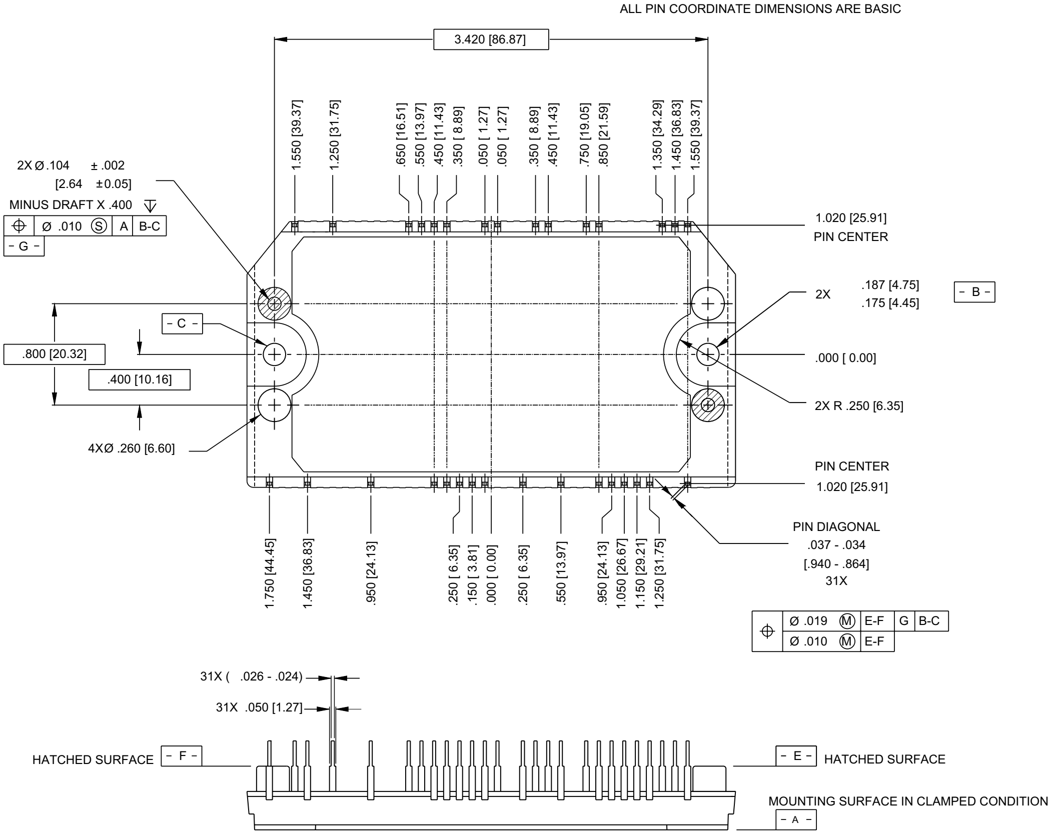

Figure 7b. Power Module Package Outline

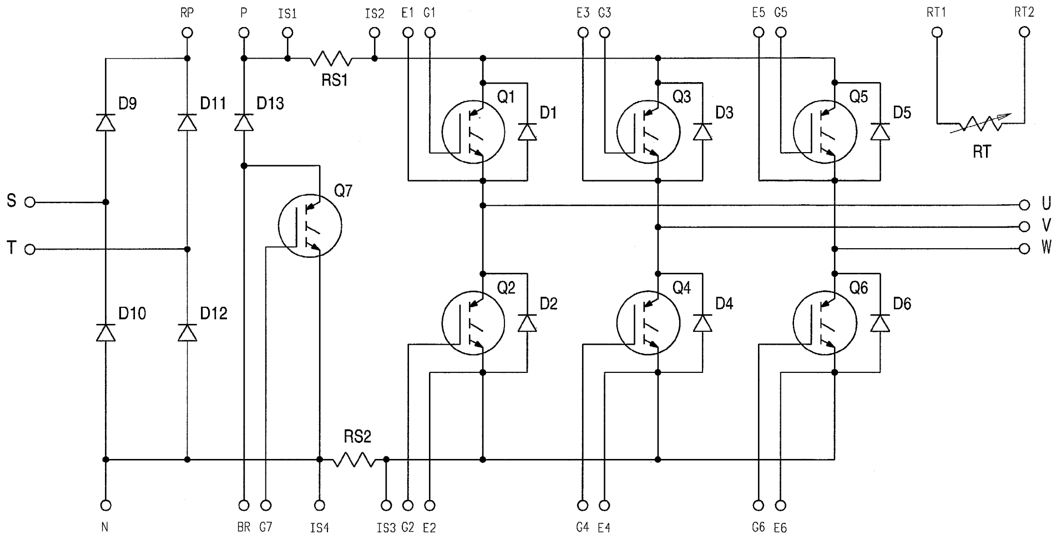

Figure 8. Power Module Circuit Diagram

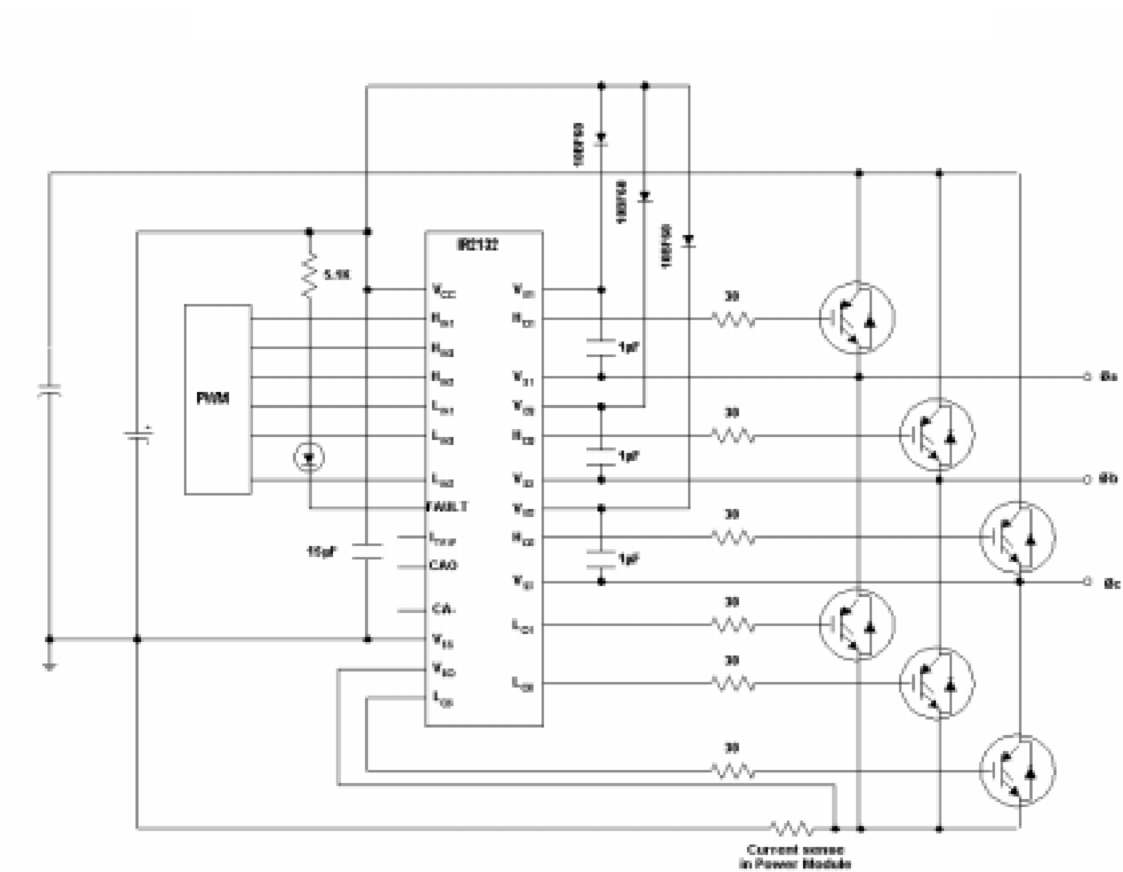

Figure 9. Recommended Gate Drive Circuit

Part Number Identification and Ordering Instructions

IRPT1065A Power Module

Chip and wire epoxy encapsulated module with 800V input rectifiers, 600V short-circuit rated, ultra-fast IGBT inverter with ultra-fast freewheeling diodes, temperature sensing NTC thermistor and current-sensing low-inductance shunts.

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