### PD 6.118

# International **TOR** Rectifier

# IRPT1061A

# POWRTRAIN

### 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 input, 50/60 Hz
- · 3-phase rectifier bridge
- · 3-phase 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

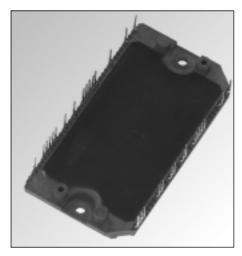
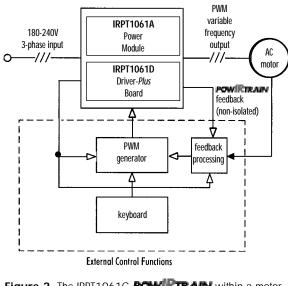


Figure 1. IRPT1061A Power Module



IRPT1061C POWRTRAIN

PRELIMINARY

Figure 2. The IRPT1061C **POWIRTRAIN** within a motor control system

### The IRPT1061A Power Module

The IRPT1061A 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 3-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 m $\Omega$  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-*Plus* 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.

### **POWIRTRAIN** and Design Kit

The IRPT1061A **POWRTRAIN** (Figure 3) provides the complete power conversion function for a 1 hp (0.75 kW) variable voltage, variable frequency AC motor controller. The **POWRTRAIN** combines the Power Module (IRPT1061A) with a Driver-*Plus* Board (IRPT1061D). The **POWRTRAIN** Design Kit, IRPT1061E includes the following:

- Complete **POW RTRAIN** integrated power stage
- · Specification and operating instructions
- Bill of materials
- · Electrical schematic
- · Mechanical layout for Driver-Plus Board
- · Software transferrable file for easy design integration
- · Application information and layout considerations

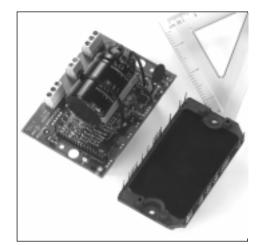


Figure 3. IRPT1061C POW RTRAIN

### Specifications

| Input Power         220V, .15%, +10%, 3-phase           Voltage         220V, .15%, +10%, 3-phase           Frequency         50/60 Hz           Current         6.2A rms @ nominal output $T_A = 40^\circ C, R_{hSA} = 1.24^\circ C/W$ Isst         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         V <sub>in</sub> = 220V AC, f <sub>pwm</sub> = 4 kHz, f <sub>0</sub> = 60 Hz,           Nominal motor current         4.4A rms nominal full load power $T_A = 40^\circ C, R_{mSA} = 1.24^\circ C/W$ DC Link         -         -           DC Link voltage         425V maximum         -           Brake         -         -           Current         7.9A         -           Sensor         -         -           Temp. sense resistance         50kOhms ±5%         @ T <sub>NTC</sub> = 25°C           3.1kOhms ±10%         -         T <sub>MIC</sub> = 100°C           Current sense         75mOhms ±5%         @ T <sub>NTC</sub> = 15V, line to line short           Gabe Drive         -         -           Q <sub>G</sub> 34 nC (typical)         V <sub>GE</sub> = 15V, refer figure 5b </th <th>PARAMETERS</th> <th>VALUES</th> <th>CONDITIONS</th>  | PARAMETERS                 | VALUES                                 | CONDITIONS   |
|---|----------------------------|--|--|
| Frequency50/60 HzCurrent6.2A rms @ nominal output $T_A = 40^\circ C, R_{BSA} = 1.24^\circ C/W$ $I_{FSM}$ 150A10 ms half-cycle, non-repetitive surge $Output Power$ Voltage0 - 230V rmsdefined by external PWM controlNominal motor hp (kW)1 hp (0.75 kW) nominal full load power<br>150% overload for 1 minute $V_{in} = 220V AC, f_{pwm} = 4 kHz, f_0 = 60 Hz, f_0 $  | Input Power                |  |  |
| Current6.2A rms @ nominal output $T_A = 40^\circ C, R_{mSA} = 1.24^\circ C/W$ $I_{FSM}$ 150A10 ms half-cycle, non-repetitive surgeOutput Power  | Voltage                    | 220V, -15%, +10%, 3-phase              |  |
| Isom150A10 ms half-cycle, non-repetitive surgeOutput Power110 ms half-cycle, non-repetitive surgeVoltage0 - 230V rmsdefined by external PWM controlNominal motor hp (kW)1 hp (0.75 kW) nominal full load power<br>150% overload for 1 minute $V_{in} = 220V AC, f_{pvm} = 4 kHz, f_{0} = 60 Hz, f_{0} = 60$  | Frequency                  | 50/60 Hz                               |  |
| JamJunctionOulput Power0 · 230V rmsdefined by external PWM controlNominal motor hp (kW)1 hp (0.75 kW) nominal full load power<br>150% overload for 1 minute $V_{In} = 220V AC, f_{pwm} = 4 kHz, f_{o} = 60 Hz, T_{A} = 40°C, R_{mSA} = 1.24°C/W$ Nominal motor current4.4A rms nominal full load power<br>6.6A rms 150% overload for 1 minute $T_{A} = 40°C, R_{mSA} = 1.24°C/W$ DC LinkDC Link voltage425V maximum $T_{A} = 40°C, R_{mSA} = 1.24°C/W$ DC Link voltage425V maximum $G$ $T_{NTC} = 25°C$ Sensor $G$ $T_{NTC} = 25°C$ $G$ Temp. sense resistance50kOhms ±5% $@ T_{NTC} = 25°C$ Surrent sense $75mOhms \pm5\%$ $@ T_{SHUNT} = 25°C$ Protection $G$ $G$ beakSuldown current $20A$ peakGale Drive $Q_{G}$ $34$ nC (typical)Qc $G$ $34$ nC (typical)Necommended got driverIR2132J (refer figure 10)IRel Drive $G$ Qc $2500V$ rmspin to baseplate, 60 Hz, 1 minuteOperating case temperature $-25°C$ to $125°C95% RH max. (non-condensing)Mounting torqueNoturing torque1 NmM4 screw type$   | Current                    | 6.2A rms @ nominal output              | $T_{A} = 40^{\circ}C, R_{thSA} = 1.24^{\circ}C/W$  |
| Voltage $0 \cdot 230V \text{ rms}$ defined by external PWM controlNominal motor hp (kW)1 hp (0.75 kW) nominal full load power<br>150% overload for 1 minute $V_{in} = 220V AC, f_{pwm} = 4 kHz, f_o = 60 Hz, T_A = 40°C, R_{thSA} = 1.24°C/W$ Nominal motor current $4.4A \text{ rms nominal full load power6.6A \text{ rms 150% overload for 1 minute}}T_A = 40°C, R_{thSA} = 1.24°C/WDC LinkDC link voltage425V maximumBrakeCurrent7.9ASensorTemp. sense resistance50kOhms \pm 5\%@ T_{NIC} = 25°C3.1kOhms \pm 10\%@ T_{SHUNT} = 25°CProtectionIGBT short circuit time10 µsDC bus = 425V, V_{GE} = 15V, line to line shortRecommended short circuit-shutdown current20A peakQ_G34 nC (typical)V_{GE} = 15V, refer figure 5bRecommended gate driverIR2132J (refer figure 10)refer to design kit IRPT1061EModuleIsolation voltage2500V rmspin to baseplate, 60 Hz, 1 minuteOperating case temperature-25°C to 125°C95% RH max. (non-condensing)Mounting torque1 NmM4 screw type$  | IFSM                       | 150A                                   | 10 ms half-cycle, non-repetitive surge             |
| Nominal motor hp (kW)1 hp (0.75 kW) nominal full load power<br>150% overload for 1 minute $V_{in} = 220V AC, f_{pwm} = 4 kHz,$<br>$f_o = 60 Hz,$<br>$T_A = 40°C, R_{thSA} = 1.24°C/W$ Nominal motor current4.4A rms nominal full load power<br>6.6A rms 150% overload for 1 minute $T_A = 40°C, R_{thSA} = 1.24°C/W$ DC LinkDC link voltage425V maximumBrakeCurrent7.9ASensorTemp. sense resistance50kOhms ±5% $@ T_{NIC} = 25°C$<br>$3.1kOhms ±10%$ Gurrent sense75mOhms ±5% $@ T_{SHUNT} = 25°C$ ProtectionIGBT short circuit time10 µsDC bus = 425V, V_{GE} = 15V, line to line shortRecommended short circuit-<br>shutdown current20A peakQG34 nC (typical)V <sub>GE</sub> = 15V, refer figure 5bRecommended gote driverIR2132J (refer figure 10)refer to design kit IRPT1061EModuleIsolation voltage2500V rmspin to baseplate, 60 Hz, 1 minuteOperating case temperature-25°C to 125°C95% RH max. (non-condensing)Mounting torque1 NmM4 screw type   | Output Power               |  |  |
| 150% overload for 1 minute $f_o = 60$ Hz,<br>$T_A = 40°C, R_{hSA} = 1.24°C/W$ Nominal motor current4.4A rms nominal full load power<br>6.6A rms 150% overload for 1 minute $T_A = 40°C, R_{hSA} = 1.24°C/W$ DC link voltage425V maximumBrakeCurrent7.9ASensor© T_NTC = 25°C<br>3.1kOhms ±10%© T_NTC = 100°CCurrent sense50kOhms ±5%<br>3.1kOhms ±10%© T_NTC = 100°CCurrent sense75mOhms ±5%<br>0.02 Momb ±5%© T_SHUNT = 25°CProtectionIGBI short circuit<br>shutdown current10 µs<br>0.02 A peakDC bus = 425V, V_{GE} = 15V, line to line shortQ_G34 nC (typical)V_{GE} = 15V, refer figure 5bRecommended gote driverIR2132J (refer figure 10)refer to design kit IRPT1061EModuleIsolation voltage2500V rmspin to baseplate, 60 Hz, 1 minuteOperating case temperature-25°C to 125°C95% RH max. (non-condensing)Mounting torque1 NmM4 screw type  | Voltage                    | 0 - 230V rms                           | defined by external PWM control                    |
| Nominal motor current4.4A rms nominal full load power<br>6.6A rms 150% overload for 1 minute $T_A = 40^{\circ}C$ , $R_{thSA} = 1.24^{\circ}C/W$ DC LinkImage: DC Link voltage425V maximumImage: DC Link voltage425V maximumBrakeImage: DC Link voltage425V maximumImage: DC Link voltage1.24^{\circ}C/WBrakeImage: DC Link voltage425V maximumImage: DC Link voltage1.24^{\circ}C/WBrakeImage: DC Link voltage425V maximumImage: DC Link voltage1.24^{\circ}C/WBrakeImage: DC Link voltage250KOhms ±5%Image: DC Link voltage1.24^{\circ}C/WCurrent sense50KOhms ±5%Image: DC Link voltageImage: DC Link voltage1.24^{\circ}CCurrent sense75mOhms ±5%Image: DC Link voltageImage: DC Link voltageImage: DC Link voltageIGBT short circuit10 $\mu$ sDC Link voltage250A peakImage: DC Link voltage15V, line to line shortQG34 nC (typical)VGE = 15V, refer figure 5bImage: DC Link voltage1520V rmsImage: DC Link voltage1500V rmsModuleImage: DC Link voltage2500V rmsImage: Di Link voltage2500V rmsImage: Di Link voltage1000 Link voltage1000 Link voltageOperating case temperature250°C to 125°C95% RH max. (non-condensing)Mut screw typeStorage temperature range-40°C to 125°C   | Nominal motor hp (kW)      | 1 hp (0.75 kW) nominal full load power | $V_{in} = 220V AC$ , $f_{pwm} = 4 kHz$ ,           |
| 6.6A rms 150% overload for 1 minuteDC LinkDC link voltage425V maximumBrakeCurrent7.9ASensorTemp. sense resistance $50kOhms \pm 5\%$ $@T_{NTC} = 25°C$ $3.1kOhms \pm 10\%$ $@T_{NTC} = 100°C$ Current sense $75mOhms \pm 5\%$ $@T_{SHUNT} = 25°C$ ProtectionIGBT short circuit time10 µsDC bus = 425V, V_{GE} = 15V, line to line shortRecommended short circuit<br>shutdown current $20A$ peakGate DriveQ <sub>G</sub> $34$ nC (typical) $V_{GE} = 15V$ , refer figure 5bRecommended gate driverIR2132J (refer figure 10)refer to design kit IRPT1061EModuleIsolation voltage $2500V rms$ pin to baseplate, 60 Hz, 1 minuteOperating case temperature $-25°C$ to $125°C$ 95% RH max. (non-condensing)Mounting torque1 NmM4 screw typeStorage temperature range $-40°C$ to $125°C$   |                            | 150% overload for 1 minute             | $f_o = 60 \text{ Hz},$                             |
| DC link voltage $425V$ maximumBrakeImage: Current7.9ACurrent7.9ASensorImage: Construct of the sense sensistance $50kOhms \pm 5\%$<br>$3.1kOhms \pm 10\%$ $Image: Construct of the sense se$   | Nominal motor current      | 4.4A rms nominal full load power       | $T_A = 40^{\circ}C$ , $R_{thSA} = 1.24^{\circ}C/W$ |
| Brake   | DC Link                    |  |  |
| Current7.9ASensor $\ensuremath{\mathbb{C}}$ Temp. sense resistance50kOhms ±5% $\ensuremath{\mathbb{C}}$ T <sub>NTC</sub> = 25°C3.1kOhms ±10% $\ensuremath{\mathbb{C}}$ T <sub>NTC</sub> = 100°CCurrent sense75mOhms ±5% $\ensuremath{\mathbb{C}}$ T <sub>SHUNT</sub> = 25°CProtection $\ensuremath{\mathbb{C}}$ $\ensuremath{\mathbb{C}}$ BT Short circuit time10 $\mbox{\mbox{\mbox{$\mu$}}$ IGBT short circuit time10 $\mbox{$\mu$}$ DC bus = 425V, V <sub>GE</sub> = 15V, line to line shortRecommended short circuit-<br>shutdown current20A peak $\ensuremath{\mathbb{C}}$ $Gate Drive$ $\ensuremath{\mathbb{C}}$ $\ensuremath{\mathbb{C}}$ $Q_G$ 34 nC (typical) $V_{GE}$ = 15V, refer figure 5bRecommended gote driverIR2132J (refer figure 10)refer to design kit IRPT1061EModule $\ensuremath{\mathbb{C}}$ $\ensuremath{\mathbb{C}}$ Isolation voltage2500V rmspin to baseplate, 60 Hz, 1 minuteOperating case temperature-25°C to 125°C95% RH max. (non-condensing)Mounting torque1 NmM4 screw typeStorage temperature range-40°C to 125°C $\ensuremath{\mathbb{C}}$  | DC link voltage            | 425V maximum                           |  |
| Sensor $\ensuremath{\mathbb{C}}$ <t< td=""><td>Brake</td><td></td><td></td></t<>  | Brake                      |  |  |
| Temp. sense resistance50kOhms $\pm$ 5% $@ T_{NTC} = 25^{\circ}C$ 3.1kOhms $\pm$ 10% $@ T_{NTC} = 100^{\circ}C$ Current sense75mOhms $\pm$ 5% $@ T_{SHUNT} = 25^{\circ}C$ ProtectionIGBT short circuit time10 $\mu$ sDC bus = 425V, V_{GE} = 15V, line to line shortRecommended short circuit-<br>shutdown current20A peakGate DriveQ <sub>G</sub> 34 nC (typical)V <sub>GE</sub> = 15V, refer figure 5bRecommended gate driverIR2132J (refer figure 10)refer to design kit IRPT1061EModuleIsolation voltage2500V rmspin to baseplate, 60 Hz, 1 minuteOperating case temperature-25^{\circ}C to 125^{\circ}C95% RH max. (non-condensing)Mounting torque1 NmM4 screw typeStorage temperature range-40^{\circ}C to 125^{\circ}C  |                            | 7.9A                                   |  |
| $3.1kOhms \pm 10\%$ $@ T_{NIC} = 100^{\circ}C$ Current sense $75mOhms \pm 5\%$ $@ T_{SHUNT} = 25^{\circ}C$ Protection $I$ $I$ IGBT short circuit time $10 \ \mu s$ DC bus = 425V, $V_{GE} = 15V$ , line to line shortRecommended short circuit-<br>shutdown current $20A \ peak$ $I$ $Gate Drive$ $I$ $I$ $Q_G$ $34 \ nC$ (typical) $V_{GE} = 15V$ , refer figure 5bRecommended gate driverIR2132J (refer figure 10)refer to design kit IRPT1061EModule $I$ $I$ Isolation voltage $2500V \ rms$ pin to baseplate, 60 Hz, 1 minuteOperating case temperature $-25^{\circ}C \ to 125^{\circ}C$ $95\% \ RH \ max.$ (non-condensing)Mounting torque $1 \ Nm$ $M4 \ screw \ type$ Storage temperature range $-40^{\circ}C \ to 125^{\circ}C$ $I$   | Sensor                     |  |  |
| Current sense $75mOhms \pm 5\%$ $@T_{SHUNT} = 25^{\circ}C$ ProtectionIGBT short circuit time $10  \mu s$ DC bus = 425V, $V_{GE} = 15V$ , line to line shortRecommended short circuit-<br>shutdown current $20A  peak$ DC bus = 425V, $V_{GE} = 15V$ , line to line short $Gate Drive$ $Q_G$ $34  nC$ (typical) $V_{GE} = 15V$ , refer figure 5bRecommended gate driverIR2132J (refer figure 10)refer to design kit IRPT1061EModule $2500V  rms$ pin to baseplate, 60 Hz, 1 minuteOperating case temperature $-25^{\circ}C  to  125^{\circ}C$ $95\%  RH  max.$ (non-condensing)Mounting torque1 NmM4 screw typeStorage temperature range $-40^{\circ}C  to  125^{\circ}C$ $1000000000000000000000000000000000000$  | Temp. sense resistance     | 50kOhms ±5%                            | @ T <sub>NTC</sub> = 25°C                          |
| ProtectionJusticeIGBT short circuit time10 $\mu$ sDC bus = 425V, V <sub>GE</sub> = 15V, line to line shortRecommended short circuit-<br>shutdown current20A peakGate Drive0Q <sub>G</sub> 34 nC (typical)V <sub>GE</sub> = 15V, refer figure 5bRecommended gate driverIR2132J (refer figure 10)refer to design kit IRPT1061EModule01000000000000000000000000000000000000  |                            | 3.1kOhms ±10%                          | @ T <sub>NTC</sub> = 100°C                         |
| IGBT short circuit time10 $\mu$ sDC bus = 425V, V_{GE} = 15V, line to line shortRecommended short circuit-<br>shutdown current20A peakGate DriveQ_G34 nC (typical)VGE = 15V, refer figure 5bRecommended gate driverIR2132J (refer figure 10)refer to design kit IRPT1061EModuleIsolation voltage2500V rmsOperating case temperature-25°C to 125°CMounting torque1 NmStorage temperature range-40°C to 125°C   | Current sense              | 75mOhms ±5%                            | @ T <sub>SHUNT</sub> = 25°C                        |
| Recommended short circuit-<br>shutdown current       20A peak         Gate Drive       20A         Q <sub>G</sub> 34 nC (typical)         V <sub>GE</sub> = 15V, refer figure 5b         Recommended gate driver       IR2132J (refer figure 10)         Module         Isolation voltage       2500V rms         Operating case temperature       -25°C to 125°C         Mounting torque       1 Nm         Storage temperature range       -40°C to 125°C   | Protection                 |  |  |
| shutdown currentImage: Constraint of the state of the stat |                            | •                                      | DC bus = 425V, $V_{GE}$ = 15V, line to line short  |
| Q <sub>G</sub> 34 nC (typical)     V <sub>GE</sub> = 15V, refer figure 5b       Recommended gate driver     IR2132J (refer figure 10)     refer to design kit IRPT1061E       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     1000000000000000000000000000000000000   |                            | 20A peak                               |  |
| Recommended gate driver       IR2132J (refer figure 10)       refer to design kit IRPT1061E         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       95%   | Gate Drive                 |  |  |
| Module         pin to baseplate, 60 Hz, 1 minute           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         95%   | Q <sub>G</sub>             | 34 nC (typical)                        | V <sub>GE</sub> = 15V, refer figure 5b             |
| 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     -40°C to 125°C   | Recommended gate driver    | IR2132J (refer figure 10)              | refer to design kit IRPT1061E                      |
| 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         M4 screw type  | Module                     |  |  |
| Mounting torque         1 Nm         M4 screw type           Storage temperature range         -40°C to 125°C         -40°C to 125°C  | Isolation voltage          | 2500V rms                              | pin to baseplate, 60 Hz, 1 minute                  |
| Storage temperature range -40°C to 125°C  | 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                         |  |
|   |                            | 260°C maximum                          | at the pins (.06" from case)                       |

International

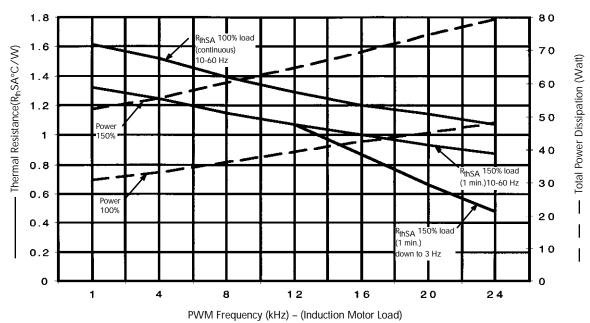
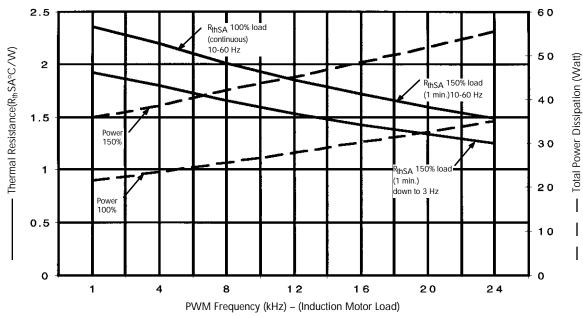


Figure 4a. 1 hp/4.4A Output Heat Sink Thermal Resistance and Power Dissipation vs. PWM Frequency





NOTE: For Figures 4a and 4b: Operating Conditions: Vin = 230 Vrms, MI = 1.15, PF = 0.8, TA = 40°C,  $Z_{thSA}$ limits  $\Delta T_c$  rise during 1 minute overload to 10°C

# International **IOR** Rectifier

### IRPT1061A

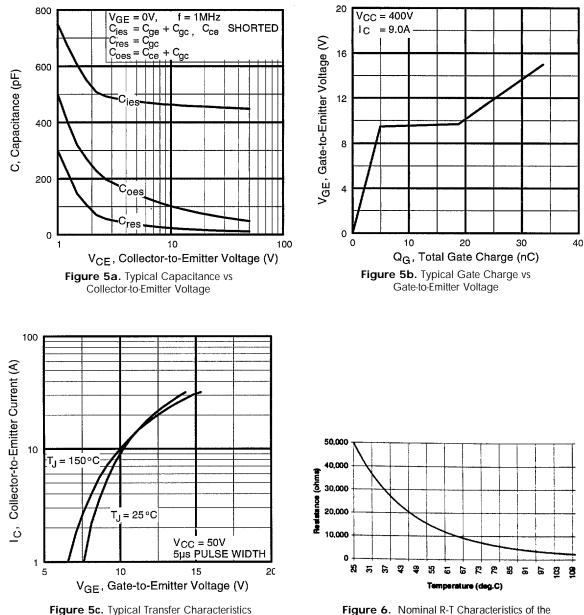


Figure 6. Nominal R-T Characteristics of the NTC Thermistor

### **Mounting Procedure**

### Mounting

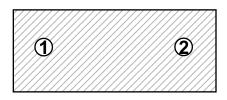
1. Connect the driver board and the IRPT1061A power module.

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.





#### **Power Connections**

The power module pin designation, function and other details can be obtained from the package outline in Figure 8 and circuit diagram in Figure 9. Three phase input connections made to pins R, 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**

Figure 4 shows 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 6.

### 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.

# International

### IRPT1061A

#### NOTE: Dimensions are in inches (millimeters)

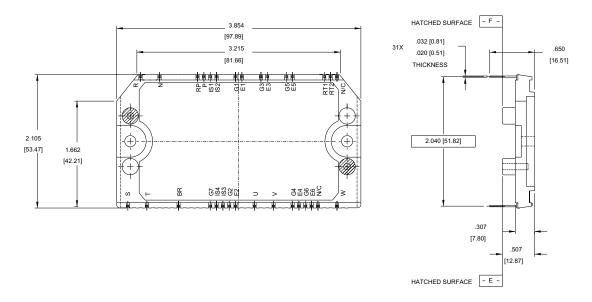


Figure 8a. Power Module Package Outline

#### NOTE: Dimensions are in inches (millimeters)

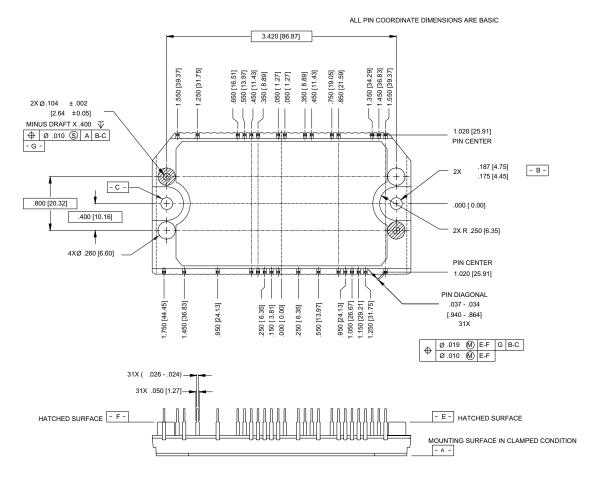


Figure 8b. Power Module Package Outline

# International **ISR** Rectifier

### IRPT1061A

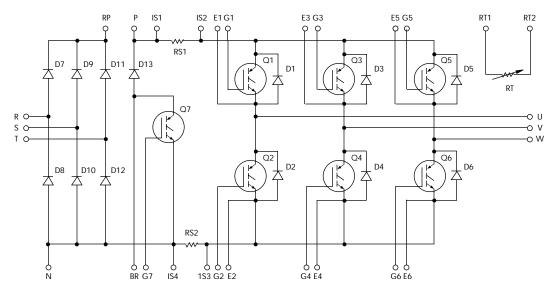


Figure 9. Power Module Circuit Diagram

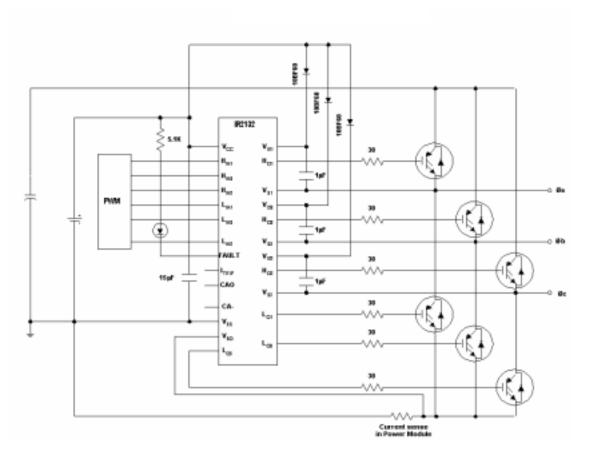


Figure 10. Recommended Gate Drive Circuit

### Part Number Identification and Ordering Instructions

### **IRPT1061A** Power Module

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

### IRPT1061C POWIRTRAIN

Integrated Power Module (IRPT1061A) and Driver-*Plus* Board (IRPT1061D) pre-assembled and tested to meet all system specifications.

### IRPT1061D Driver-Plus Board

Printed circuit board assembled with DC link capacitors, NTC in-rush limiting thermistors, high-power terminal blocks, surge suppression MOVs, IGBT gate drivers, protection circuitry and low power supply. The PCB is functionally tested with standard power module to meet all system specifications.

### **IRPT1061E Design Kit**

Complete **PowerRTRAIN** (IRPT1061C) with full set of design documentation including schematic diagram, bill of material, mechanical layout of Driver-*Plus* Board, schematic files, Gerber files and design tips.

# International

 WORLD HEADQUARTERS:
 233 Kansas St., El Segundo, California 90245, Tel: (310) 322 3331

 EUROPEAN HEADQUARTERS:
 Hurst Green, Oxted, Surrey RH8 9BB, UK Tel: ++ 44 1883 732020

 IR CANADA:
 7321 Victoria Park Ave., Suite 201, Markham, Ontario L3R 2Z8, Tel: (905) 475 1897

 IR GERMANY:
 Saalburgstrasse 157, 61350 Bad Homburg Tel: ++ 49 6172 96590

 IR ITALY:
 Via Liguria 49, 10071 Borgaro, Torino Tel: ++ 39 11 451 0111

 IR FAR EAST:
 171 (K&H Bldg.), 3-30-4 Nishi-ikebukuro 3-Chome, Toshima-ku, Tokyo Japan Tel: 81 3 3983 0086

 IR SOUTHEAST ASIA:
 315 Outram Road, #10-02 Tan Boon Liat Building, Singapore 0316 Tel: 65 221 8371

 http://www.irf.com/
 Data and specifications subject to change without notice.