International
IOR Rectifier

# IRAMS10UP60B
# iMOTION™ Series
# 10A, 600V
## with Internal Shunt Resistor

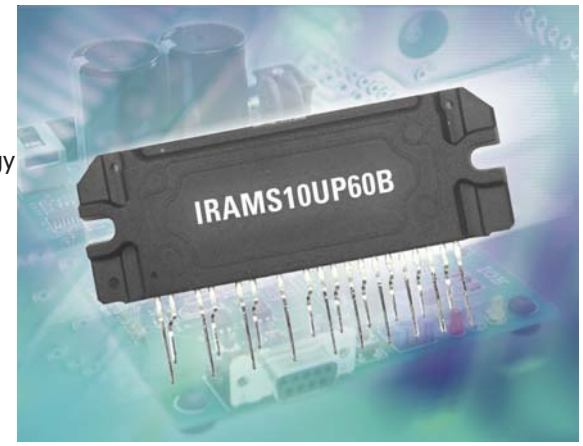
Integrated Power Hybrid IC for
Appliance Motor Drive Applications.

## Description

International Rectifier's IRAMS10UP60B is an Integrated Power Module developed and optimized for electronic motor control in appliance applications such as washing machines and refrigerators. Plug N Drive technology offers an extremely compact, high performance AC motor-driver in a single isolated package for a very simple design. An internal shunt is also included and offers easy current feedback and overcurrent monitor for precise and safe operation. A built-in temperature monitor and over-current protection, along with the short-circuit rated IGBTs and integrated under-voltage lockout function, deliver high level of protection and fail-safe operation. The integration of the bootstrap diodes for the high-side driver section, and the single polarity power supply required to drive the internal circuitry, simplify the utilization of the module and deliver further cost reduction advantages.

## Features

- Internal Shunt Resistor
- Integrated Gate Drivers and Bootstrap Diodes
- Temperature Monitor
- Fully Isolated Package
- Low $V_{CE(on)}$ Non Punch Through IGBT Technology
- Undervoltage lockout for all channels
- Matched propagation delay for all channels
- Schmitt-triggered input logic
- Cross-conduction prevention logic
- Lower di/dt gate driver for better noise immunity
- Motor Power range 0.4~0.75kW / 85~253 Vac
- Isolation 2000$V_{RMS}$/1min and CTI > 600V
- Recognized by UL (E252584), RoHS Compliant

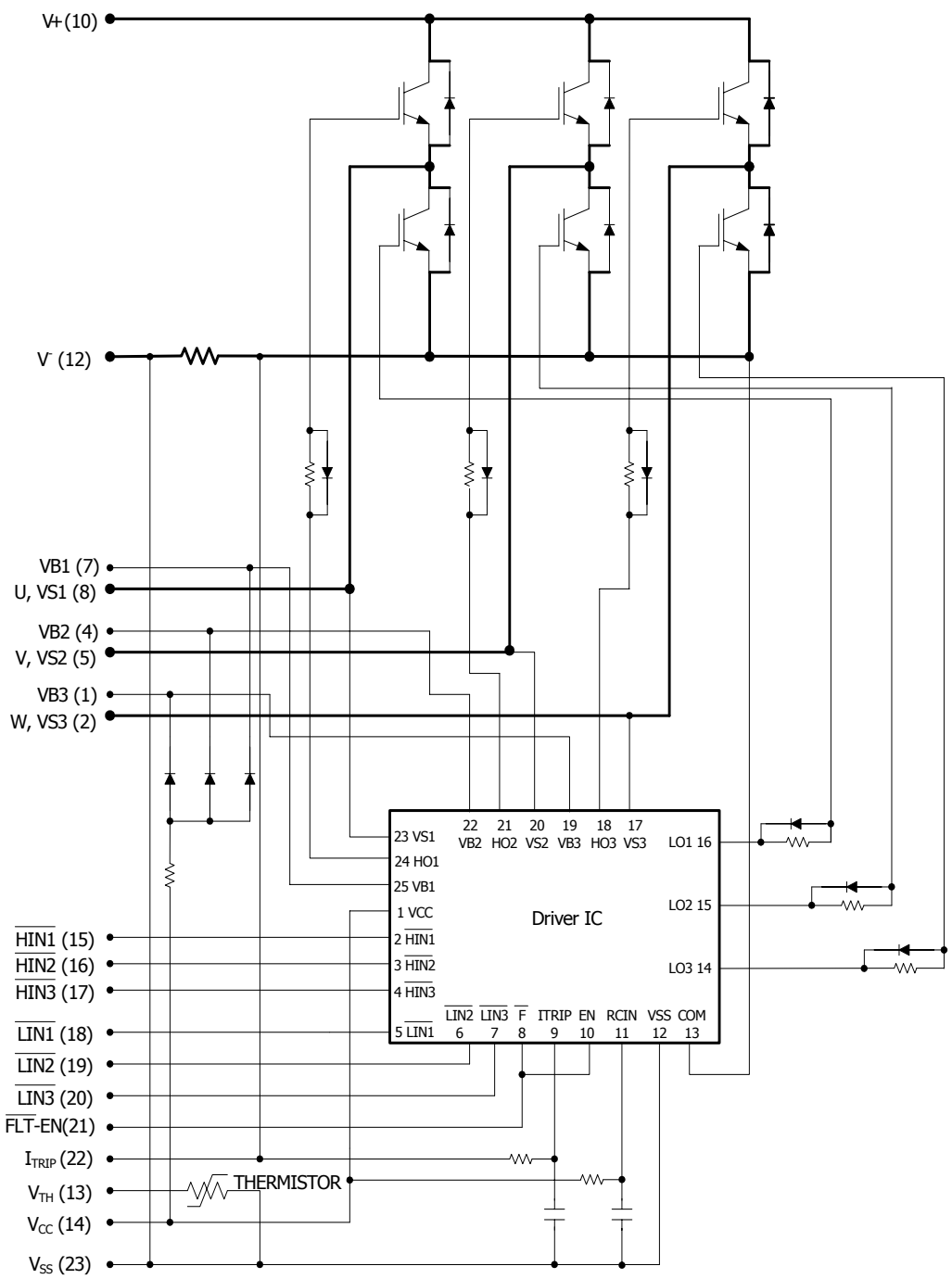



## Absolute Maximum Ratings

| Parameter | Description | Value | Units |
|---|---|---|---|
| $V_{CES}$ / $V_{RRM}$ | IGBT/Diode Blocking Voltage | 600 | V |
| $V^+$ | Positive Bus Input Voltage | 450 | |
| $I_O$ @ $T_C$=25°C | RMS Phase Current (Note 1) | 10 | A |
| $I_O$ @ $T_C$=100°C | RMS Phase Current (Note 1) | 5 | |
| $I_O$ | Pulsed RMS Phase Current (Note 2) | 15 | |
| $F_{PWM}$ | PWM Carrier Frequency | 20 | kHz |
| $P_D$ | Power dissipation per IGBT @ $T_C$ =25°C | 27 | W |
| $V_{ISO}$ | Isolation Voltage (1min) | 2000 | $V_{RMS}$ |
| $T_J$ (IGBT & Diodes) | Operating Junction temperature Range | -40 to +150 | °C |
| $T_J$ (Driver IC) | Operating Junction temperature Range | -40 to +150 | |
| T | Mounting torque Range (M3 screw) | 0.5 to 1.0 | Nm |

Note 1: Sinusoidal Modulation at $V^+$=400V, $T_J$=150°C, $F_{PWM}$=20kHz, Modulation Depth=0.8, PF=0.6, See Figure 3.
Note 2: $t_P$<100ms; $T_C$=25°C; $F_{PWM}$=20kHz. Limited by $I_{BUS-ITRIP}$, see Table "Inverter Section Electrical Characteristics"

## Internal Electrical Schematic - IRAMS10UP60B



## Absolute Maximum Ratings (Continued)

| Symbol | Parameter | Min | Max | Units | Conditions |
|---|---|---|---|---|---|
| $I_{BDF}$ | Bootstrap Diode Peak Forward Current | --- | 4.5 | A | $t_P$= 10ms, $T_J$ = 150°C, $T_C$=100°C |
| $P_{BR\ Peak}$ | Bootstrap Resistor Peak Power (Single Pulse) | --- | 80 | W | $t_P$=100µs, $T_C$ =100°C ESR / ERJ series |
| $V_{S1,2,3}$ | High side floating supply offset voltage | $V_{B1,2,3}$ - 25 | $V_{B1,2,3}$ +0.3 | V | |
| $V_{B1,2,3}$ | High side floating supply voltage | -0.3 | 600 | V | |
| $V_{CC}$ | Low Side and logic fixed supply voltage | -0.3 | 20 | V | |
| $V_{IN}$, $V_{EN}$, $V_{ITRIP}$ | Input voltage LIN, HIN, EN, $I_{Trip}$ | -0.3 | Lower of ($V_{SS}$+15V) or $V_{CC}$+0.3V | V | |

## Inverter Section Electrical Characteristics @$T_J$= 25°C

| Symbol | Parameter | Min | Typ | Max | Units | Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)CES}$ | Collector-to-Emitter Breakdown Voltage | 600 | --- | --- | V | $V_{IN}$=5V, $I_C$=250µA |
| $\Delta V_{(BR)CES}$ / $\Delta T$ | Temperature Coefficient of Breakdown Voltage | --- | 0.57 | --- | V/°C | $V_{IN}$=5V, $I_C$=1.0mA (25°C - 150°C) |
| $V_{CE(ON)}$ | Collector-to-Emitter Saturation Voltage | --- | 1.70 | 2.00 | V | $I_C$=5A, $V_{CC}$=15V |
| | | --- | 2.00 | 2.40 | | $I_C$=5A, $V_{CC}$=15V, $T_J$=150°C |
| $I_{CES}$ | Zero Gate Voltage Collector Current | --- | 5 | 80 | µA | $V_{IN}$=5V, $V^+$=600V |
| | | --- | 10 | --- | | $V_{IN}$=5V, $V^+$=600V, $T_J$=150°C |
| $V_{FM}$ | Diode Forward Voltage Drop | --- | 1.80 | 2.35 | V | $I_C$=5A |
| | | --- | 1.30 | 1.70 | | $I_C$=5A, $T_J$=150°C |
| $V_{BDFM}$ | Bootstrap Diode Forward Voltage Drop | -- | -- | 1.25 | V | $I_F$=1A |
| | | --- | --- | 1.10 | | $I_F$=1A, $T_J$=150°C |
| $R_{BR}$ | Bootstrap Resistor Value | --- | 2 | --- | Ω | $T_J$=25°C |
| $\Delta R_{BR}/R_{BR}$ | Bootstrap Resistor Tolerance | --- | --- | ±5 | % | $T_J$=25°C |
| $I_{BUS_TRIP}$ | Current Protection Threshold (positive going) | 13.1 | --- | 16.4 | A | $T_J$=-40°C to 125°C See fig. 2 |

## Inverter Section Switching Characteristics @ $T_J$= 25°C

| Symbol | Parameter | Min | Typ | Max | Units | Conditions |
|---|---|---|---|---|---|---|
| $E_{ON}$ | Turn-On Switching Loss | --- | 200 | 235 | µJ | $I_C$=5A, $V^+$=400V<br>$V_{CC}$=15V, L=2mH<br>Energy losses include "tail" and diode reverse recovery<br>See CT1 |
| $E_{OFF}$ | Turn-Off Switching Loss | --- | 75 | 100 | | |
| $E_{TOT}$ | Total Switching Loss | --- | 275 | 335 | | |
| $E_{REC}$ | Diode Reverse Recovery energy | --- | 15 | 25 | | |
| $t_{RR}$ | Diode Reverse Recovery time | --- | 70 | 100 | ns | |
| $E_{ON}$ | Turn-On Switching Loss | --- | 300 | 360 | µJ | $I_C$=5A, $V^+$=400V<br>$V_{CC}$=15V, L=2mH, $T_J$=150°C<br>Energy losses include "tail" and diode reverse recovery<br>See CT1 |
| $E_{OFF}$ | Turn-off Switching Loss | --- | 135 | 165 | | |
| $E_{TOT}$ | Total Switching Loss | --- | 435 | 525 | | |
| $E_{REC}$ | Diode Reverse Recovery energy | --- | 30 | 40 | | |
| $t_{RR}$ | Diode Reverse Recovery time | --- | 100 | 145 | ns | |
| $Q_G$ | Turn-On IGBT Gate Charge | --- | 29 | 44 | nC | $I_C$=15A, $V^+$=400V, $V_{GE}$=15V |
| RBSOA | Reverse Bias Safe Operating Area | FULL SQUARE | | | | $T_J$=150°C, $I_C$=5A, $V_P$=600V<br>$V^+$= 450V<br>$V_{CC}$=+15V to 0V See CT3 |
| SCSOA | Short Circuit Safe Operating Area | 10 | --- | --- | µs | $T_J$=150°C, $V_P$=600V,<br>$V^+$= 360V,<br>$V_{CC}$=+15V to 0V See CT2 |
| $I_{CSC}$ | Short Circuit Collector Current | --- | 47 | --- | A | $T_J$=150°C, $V_P$=600V, $t_{SC}$<10µs<br>$V^+$= 360V, $V_{GE}$=15V<br>$V_{CC}$=+15V to 0V See CT2 |

## Recommended Operating Conditions Driver Function

The Input/Output logic timing diagram is shown in Figure 1. For proper operation the device should be used within the recommende conditions. All voltages are absolute referenced to COM/$I_{TRIP}$. The $V_S$ offset is tested with all supplies biased at 15V differential (Note 3)

| Symbol | Definition | Min | Max | Units |
|---|---|---|---|---|
| $V_{B1,2,3}$ | High side floating supply voltage | $V_S$+12 | $V_S$+20 | V |
| $V_{S1,2,3}$ | High side floating supply offset voltage | Note 4 | 450 | |
| $V_{CC}$ | Low side and logic fixed supply voltage | 12 | 20 | V |
| $V_{ITRIP}$ | $I_{TRIP}$ input voltage | $V_{SS}$ | $V_{SS}$+5 | |
| $V_{IN}$ | Logic input voltage LIN, HIN | $V_{SS}$ | $V_{SS}$+5 | V |
| $V_{EN}$ | Logic input voltage EN | $V_{SS}$ | $V_{SS}$+5 | V |

Note 3: For more details, see IR21363 data sheet

Note 4: Logic operational for $V_s$ from COM-5V to COM+600V. Logic state held for $V_s$ from COM-5V to COM-$V_{BS}$. (please refer to DT97-3 for more details)

## Static Electrical Characteristics Driver Function

$V_{BIAS}$ ($V_{CC}$, $V_{BS1,2,3}$)=15V, unless otherwise specified. The $V_{IN}$ and $I_{IN}$ parameters are referenced to COM/$I_{TRIP}$ and are applicable to all six channels. (Note 3)

| Symbol | Definition | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| $V_{INH}$ , $V_{ENH}$ | Logic "0" input voltage | 3.0 | --- | --- | V |
| $V_{INL}$ , $V_{ENL}$ | Logic "1" input voltage | --- | --- | 0.8 | V |
| $V_{CCUV+}$, $V_{BSUV+}$ | $V_{CC}$ and $V_{BS}$ supply undervoltage Positive going threshold | 10.6 | 11.1 | 11.6 | V |
| $V_{CCUV-}$, $V_{BSUV-}$ | $V_{CC}$ and $V_{BS}$ supply undervoltage Negative going threshold | 10.4 | 10.9 | 11.4 | V |
| $V_{CCUVH}$, $V_{BSUVH}$ | $V_{CC}$ and $V_{BS}$ supply undervoltage lock-out hysteresis | --- | 0.2 | --- | V |
| $V_{IN,Clamp}$ | Input Clamp Voltage (HIN, LIN, $I_{TRIP}$) $I_{IN}$=10µA | 4.9 | 5.2 | 5.5 | V |
| $I_{QBS}$ | Quiescent $V_{BS}$ supply current $V_{IN}$=0V | --- | --- | 165 | µA |
| $I_{QCC}$ | Quiescent $V_{CC}$ supply current $V_{IN}$=0V | --- | --- | 3.35 | mA |
| $I_{LK}$ | Offset Supply Leakage Current | --- | --- | 60 | µA |
| $I_{IN+}$, $I_{EN+}$ | Input bias current $V_{IN}$=5V | --- | 200 | 300 | µA |
| $I_{IN-}$, $I_{EN-}$ | Input bias current $V_{IN}$=0V | --- | 100 | 220 | µA |
| $I_{TRIP+}$ | $I_{TRIP}$ bias current $V_{ITRIP}$=5V | --- | 30 | 100 | µA |
| $I_{TRIP-}$ | $I_{TRIP}$ bias current $V_{ITRIP}$=0V | --- | 0 | 1 | µA |
| V($I_{TRIP}$) | $I_{TRIP}$ threshold Voltage | 440 | 490 | 540 | mV |
| V($I_{TRIP}$, HYS) | $I_{TRIP}$ Input Hysteresis | --- | 70 | --- | mV |
| $R_{ON,FLT}$ | Fault Output ON Resistance | --- | 50 | 100 | ohm |

## Dynamic Electrical Characteristics

Driver only timing unless otherwise specified.)

| Symbol | Parameter | Min | Typ | Max | Units | Conditions |
|---|---|---|---|---|---|---|
| $T_{ON}$ | Input to Output propagation turn-on delay time (see fig.11) | --- | 590 | --- | ns | $V_{CC}$=$V_{BS}$= 15V, $I_C$=10A, $V^+$=400V |
| $T_{OFF}$ | Input to Output propagation turn-off delay time (see fig. 11) | --- | 700 | --- | ns | |
| $T_{FLIN}$ | Input Filter time (HIN, LIN) | 100 | 200 | --- | ns | $V_{IN}$=0 & $V_{IN}$=5V |
| $T_{BLT-Trip}$ | $I_{TRIP}$ Blancking Time | 100 | 150 | | ns | $V_{IN}$=0 & $V_{IN}$=5V |
| $D_T$ | Dead Time ($V_{BS}$=$V_{DD}$=15V) | 220 | 290 | 360 | ns | $V_{BS}$=$V_{CC}$=15V |
| $M_T$ | Matching Propagation Delay Time (On & Off) | --- | 40 | 75 | ns | $V_{CC}$= $V_{BS}$= 15V, external dead time> 400ns |
| $T_{ITrip}$ | $I_{Trip}$ to six switch to turn-off propagation delay (see fig. 2) | --- | --- | 1.75 | µs | $V_{CC}$=$V_{BS}$= 15V, $I_C$=10A, $V^+$=400V |
| $T_{FLT-CLR}$ | Post $I_{Trip}$ to six switch to turn-off clear time (see fig. 2) | --- | 7.7 | --- | ms | $T_C$ = 25°C |
| | | --- | 6.7 | --- | | $T_C$ = 100°C |

## Thermal and Mechanical Characteristics

| Symbol | Parameter | Min | Typ | Max | Units | Conditions |
|---|---|---|---|---|---|---|
| $R_{th(J-C)}$ | Thermal resistance, per IGBT | --- | 4.2 | 4.7 | °C/W | Flat, greased surface. Heatsink compound thermal conductivity 1W/mK |
| $R_{th(J-C)}$ | Thermal resistance, per Diode | --- | 5.5 | 6.5 | | |
| $R_{th(C-S)}$ | Thermal resistance, C-S | --- | 0.1 | --- | | |
| $C_D$ | Creepage Distance | 3.2 | --- | --- | mm | See outline Drawings |

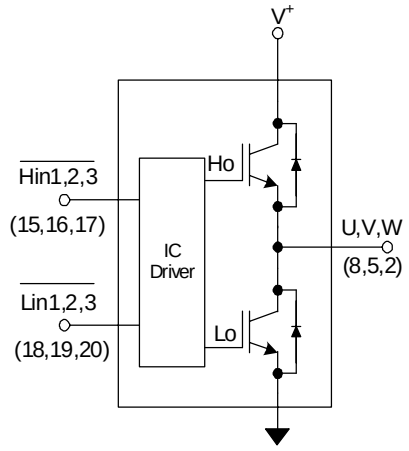
## Internal Current Sensing Resistor - Shunt Characteristics

| Symbol | Parameter | Min | Typ | Max | Units | Conditions |
|---|---|---|---|---|---|---|
| $R_{Shunt}$ | Resistance | 33.0 | 33.3 | 33.7 | mΩ | $T_C$ = 25°C |
| $T_{Coeff}$ | Temperature Coefficient | 0 | --- | 200 | ppm/°C | |
| $P_{Shunt}$ | Power Dissipation | --- | --- | 2.2 | W | -40°C< $T_C$ <100°C |
| $T_{Range}$ | Temperature Range | -40 | --- | 125 | °C | |

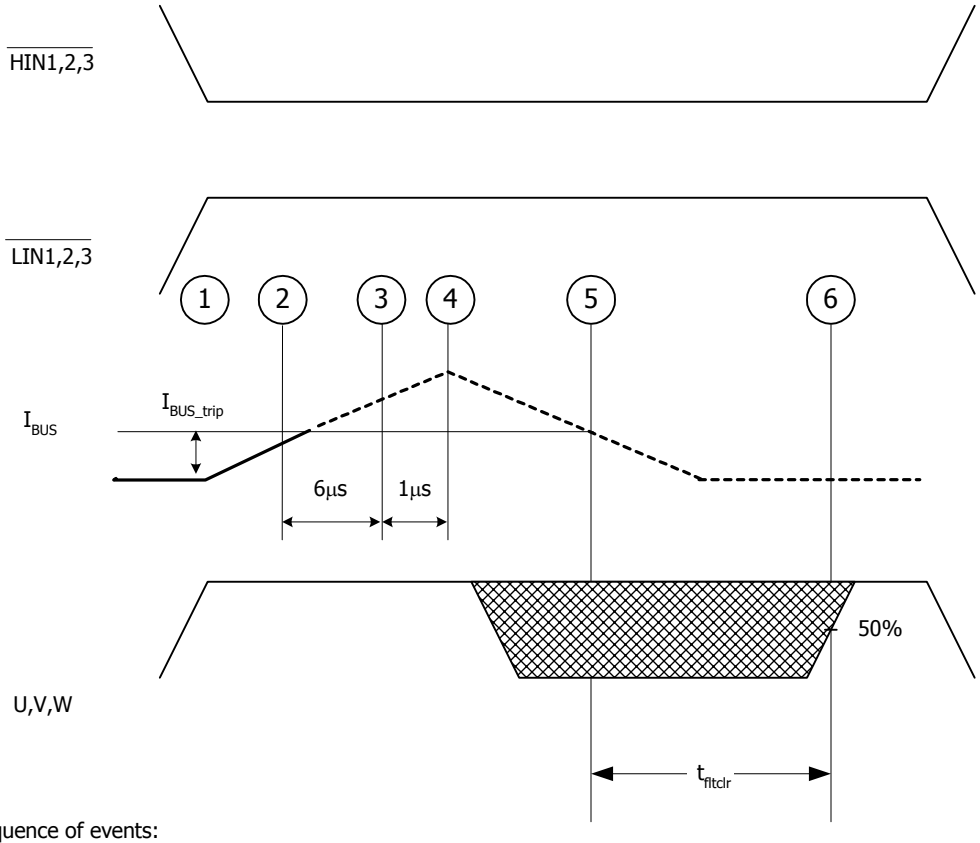
## Internal NTC - Thermistor Characteristics

| Parameter | Definition | Min | Typ | Max | Units | Conditions |
|---|---|---|---|---|---|---|
| $R_{25}$ | Resistance | 97 | 100 | 103 | kΩ | $T_C$ = 25°C |
| $R_{125}$ | Resistance | 2.25 | 2.52 | 2.80 | kΩ | $T_C$ = 125°C |
| B | B-constant (25-50°C) | 4165 | 4250 | 4335 | k | $R_2 = R_1 e^{[B(1/T2 - 1/T1)]}$ |
| Temperature Range | | -40 | | 125 | °C | |
| Typ. Dissipation constant | | | 1 | | mW/°C | $T_C$ = 25°C |

## Input-Output Logic Level Table




| FLT- EN | $I_{TRIP}$ | $\overline{HIN1,2,3}$ | $\overline{LIN1,2,3}$ | U,V,W |
|---|---|---|---|---|
| 1 | 0 | 0 | 1 | $V^+$ |
| 1 | 0 | 1 | 0 | 0 |
| 1 | 0 | 1 | 1 | Off |
| 1 | 1 | X | X | Off |
| 0 | X | X | X | Off |




Sequence of events:
1-2) Current begins to rise
2) Current reaches $I_{BUS_Trip}$ level
2-3) Current is higher than $I_{BUS_Trip}$ for at least 6µs. This value is the worst-case condition with very low over-current. In case of high current (short circuit), the actual delay will be smaller.
3-4) Delay between driver identification of over-current condition and disabling of all outputs
4) Current starts decreasing, eventually reaching 0
5) Current goes below $I_{BUS_trip}$, the driver starts its auto-reset sequence
6) Driver is automatically reset and normal operation can resume (over-current condition must be removed by the time the drivers automatically resets itself)

Figure 2. $I_{Trip}$ Timing Waveform

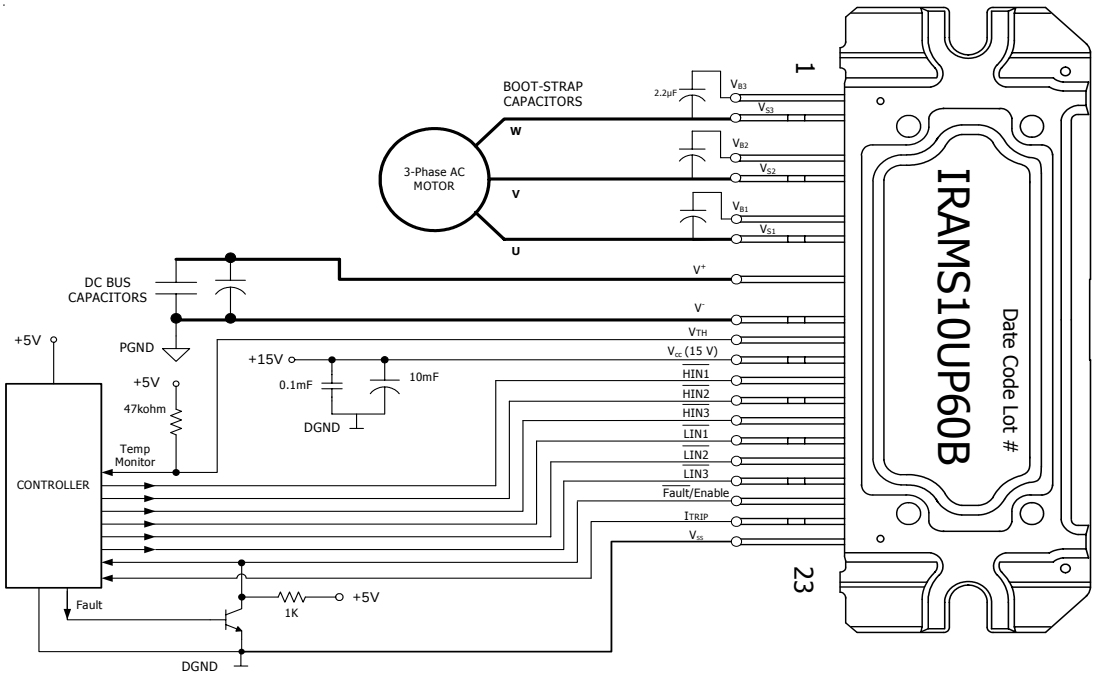
Note 5: The shaded area indicates that both high-side and low-side switches are off and therefore the half-bridge output voltage would be determined by the direction of current flow in the load.

## Module Pin-Out Description

| Pin | Name | Description |
|---|---|---|
| 1 | $V_{B3}$ | High Side Floating Supply Voltage 3 |
| 2 | W,$V_{S3}$ | Output 3 - High Side Floating Supply Offset Voltage |
| 3 | NA | none |
| 4 | $V_{B2}$ | High Side Floating Supply voltage 2 |
| 5 | V,$V_{S2}$ | Output 2 - High Side Floating Supply Offset Voltage |
| 6 | NA | none |
| 7 | $V_{B1}$ | High Side Floating Supply voltage 1 |
| 8 | U, $V_{S1}$ | Output 1 - High Side Floating Supply Offset Voltage |
| 9 | NA | none |
| 10 | $V^+$ | Positive Bus Input Voltage |
| 11 | NA | none |
| 12 | $V^-$ | Negative Bus Input Voltage |
| 13 | $V_{TH}$ | Temperature Feedback |
| 14 | $V_{CC}$ | +15V Main Supply |
| 15 | $\overline{H_{IN1}}$ | Logic Input High Side Gate Driver - Phase 1 |
| 16 | $\overline{H_{IN2}}$ | Logic Input High Side Gate Driver - Phase 2 |
| 17 | $\overline{H_{IN3}}$ | Logic Input High Side Gate Driver - Phase 3 |
| 18 | $\overline{L_{IN1}}$ | Logic Input Low Side Gate Driver - Phase 1 |
| 19 | $\overline{L_{IN2}}$ | Logic Input Low Side Gate Driver - Phase 2 |
| 20 | $\overline{L_{IN3}}$ | Logic Input Low Side Gate Driver - Phase 3 |
| 21 | $\overline{FLT}$/Enable | Fault Output and Enable Pin |
| 22 | $I_{TRIP}$ | Current Sense and Itrip Pin |
| 23 | $V_{SS}$ | Negative Main Supply |



## Typical Application Connection IRAMS10UP60B




1. Electrolytic bus capacitors should be mounted as close to the module bus terminals as possible to reduce ringing and EMI problems. Additional high frequency ceramic capacitor mounted close to the module pins will further improve performance.

2. In order to provide good decoupling between $V_{CC}$-$V_{SS}$ and $V_{B1,2,3}$-$V_{S1,2,3}$ terminals, the capacitors shown connected between these terminals should be located very close to the module pins. Additional high frequency capacitors, typically 0.1µF, are strongly recommended.

3. Value of the boot-strap capacitors depends upon the switching frequency. Their selection should be made based on IR design tip DN 98-2a, application note AN-1044 or Figure 9. Bootstrap capacitor value must be selected to limit the power dissipation of the internal resistor in series with the $V_{CC}$. (see maximum ratings Table on page 3).

4. Current sense signal can be obtained from pin 22 and pin 23. Care should be taken to avoid having inverter current flowing through pin 22 to mantain required current measurement accuracy.

5. After approx. 8ms the FAULT is reset. (see Dynamic Characteristics Table on page 5).

6. PWM generator must be disabled within Fault duration to garantee shutdown of the system, overcurrent condition must be cleared before resuming operation.

7. $\overline{\text{Fault}}$/Enable pin must be pulled-up to +5V.

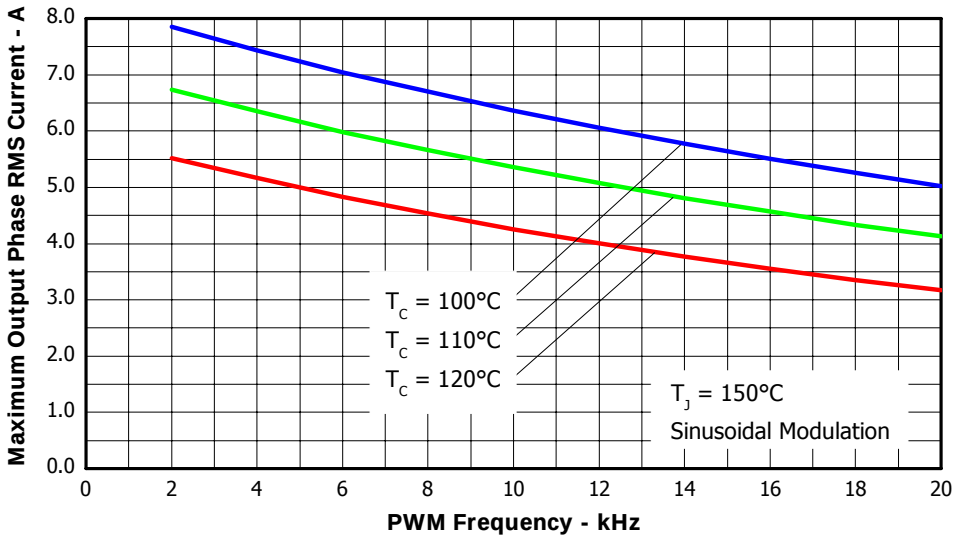



Figure 3. Maximum Sinusoidal Phase Current vs. PWM Switching Frequency
$V^+$=400V , $T_J$=150°C, Modulation Depth=0.8, PF=0.6

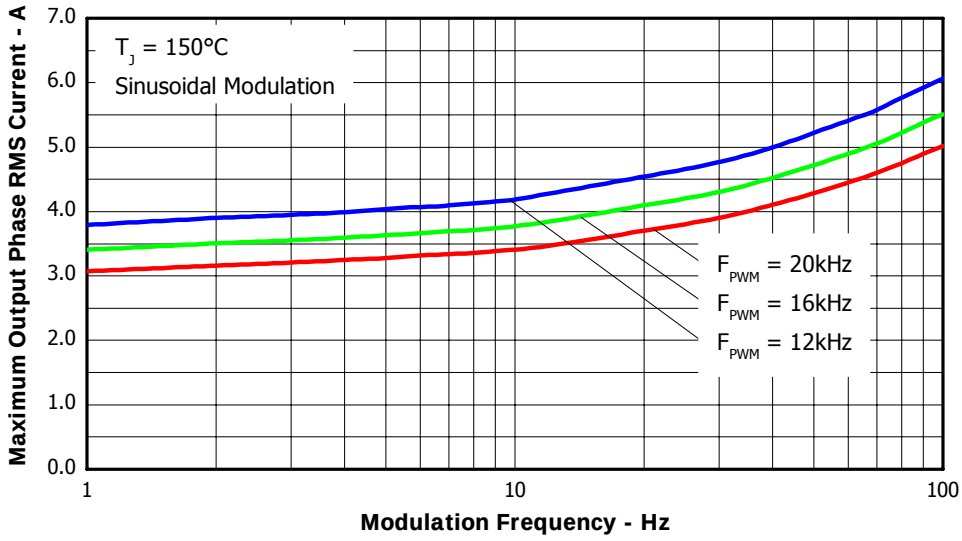



Figure 4. Maximum Sinusoidal Phase Current vs. Modulation Frequency
$V^+$=400V, $T_J$=150°C, $T_C$=100°C, Modulation Depth=0.8, PF=0.6

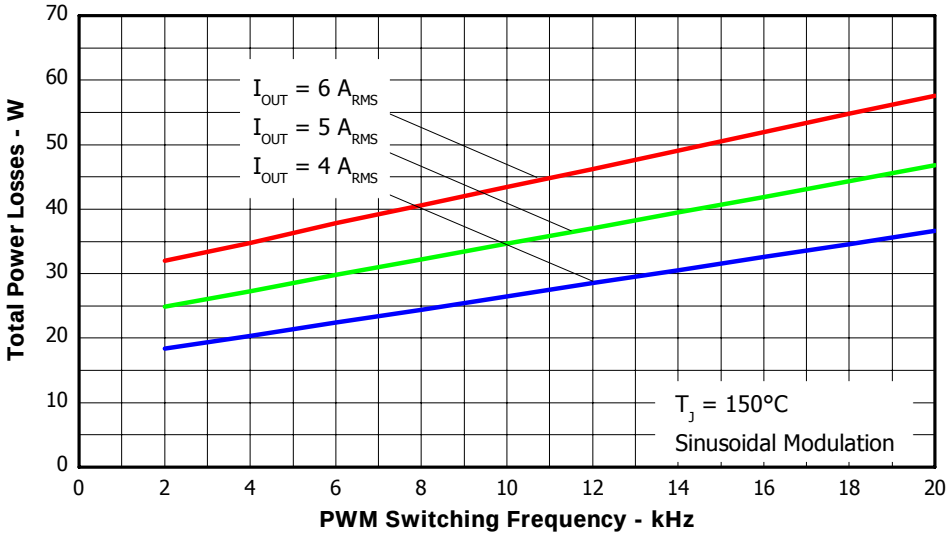



Figure 5. Total Power Losses vs. PWM Switching Frequency, Sinusoidal modulation
$V^+$=400V , $T_J$=150°C, Modulation Depth=0.8, PF=0.6

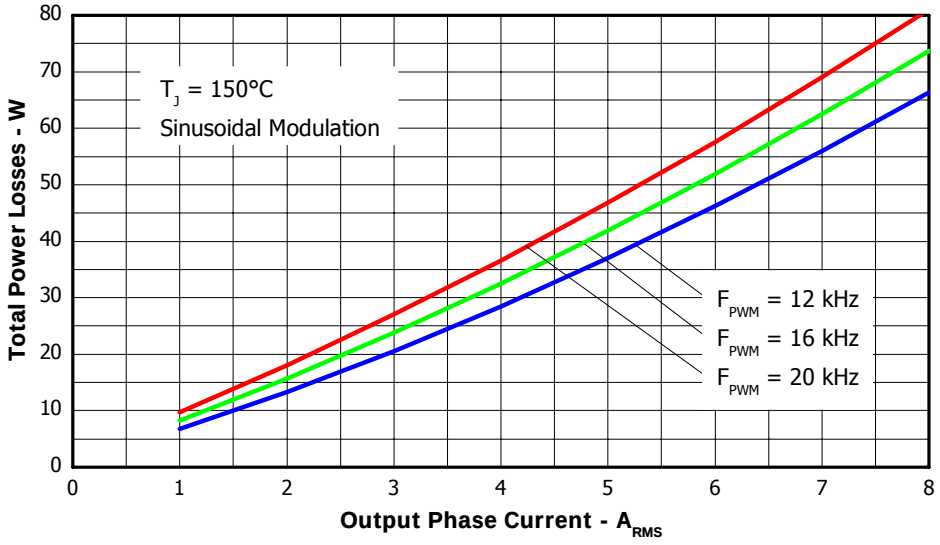



Figure 6. Total Power Losses vs. Output Phase Current, Sinusoidal modulation
$V_{BUS}$=400V , $T_J$=150°C, Modulation Depth=0.8, PF=0.6

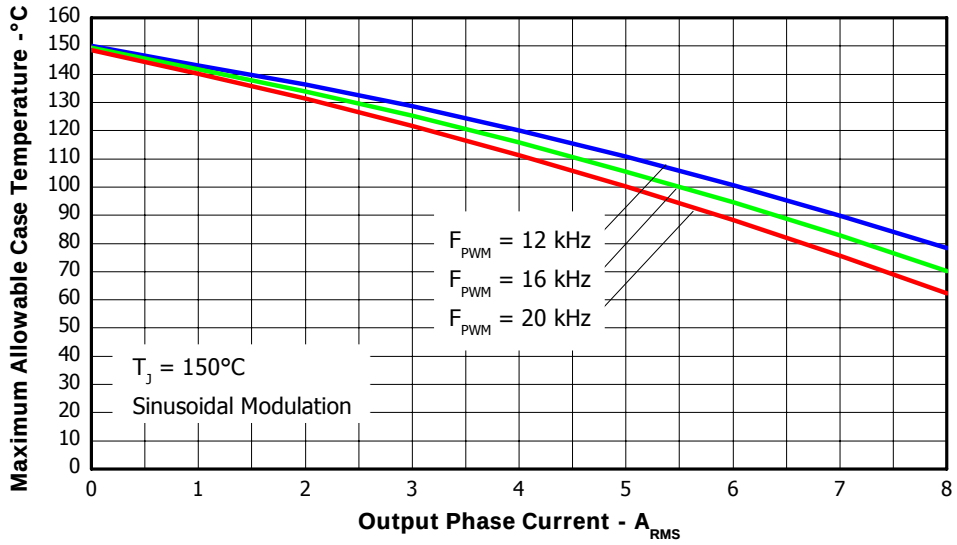



Figure 7. Maximum Allowable Case temperature vs. Output RMS Current per Phase

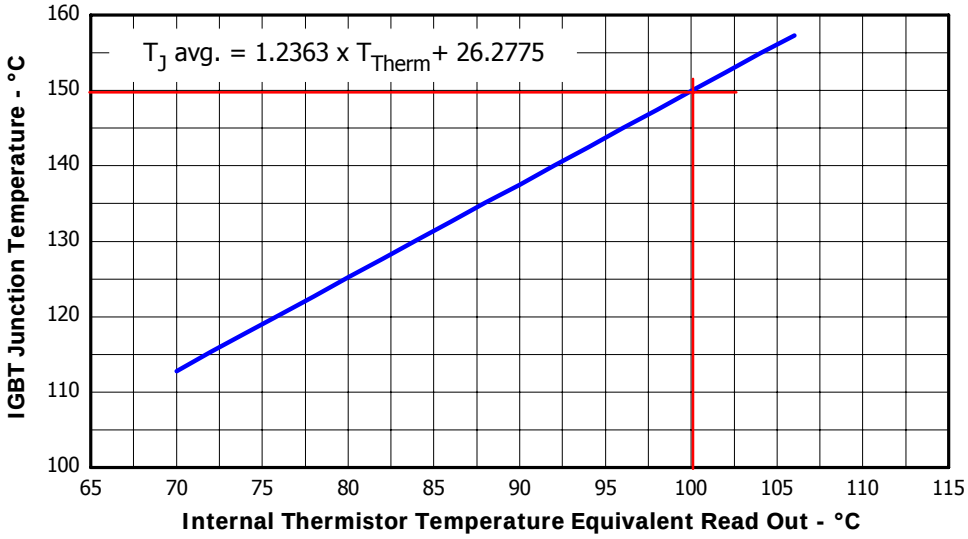
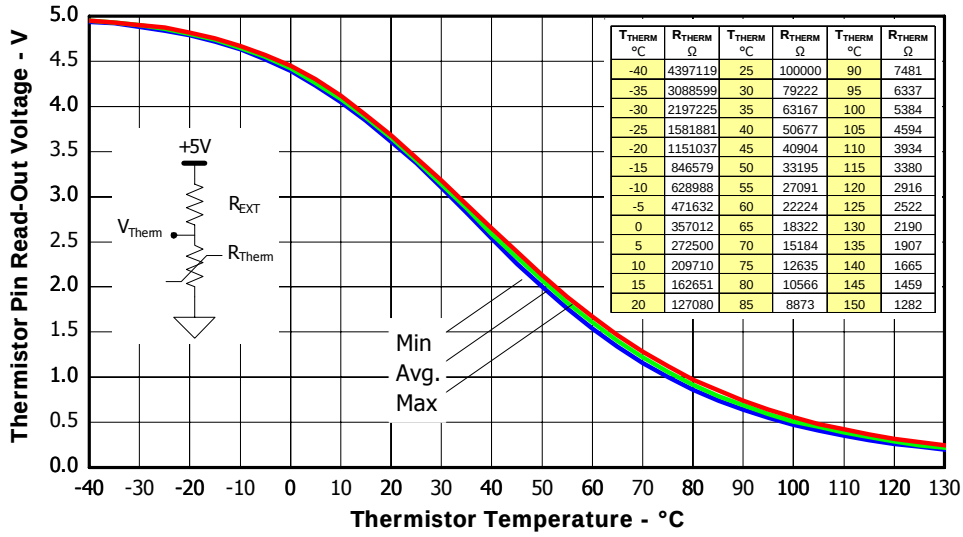



Figure 8. Estimated Maximum IGBT Junction Temperature vs. Thermistor Temperature




| $T_{THERM}$ °C | $R_{THERM}$ Ω | $T_{THERM}$ °C | $R_{THERM}$ Ω | $T_{THERM}$ °C | $R_{THERM}$ Ω |
|---|---|---|---|---|---|
| -40 | 4397119 | 25 | 100000 | 90 | 7481 |
| -35 | 3088599 | 30 | 79222 | 95 | 6337 |
| -30 | 2197225 | 35 | 63167 | 100 | 5384 |
| -25 | 1581881 | 40 | 50677 | 105 | 4594 |
| -20 | 1151037 | 45 | 40904 | 110 | 3934 |
| -15 | 846579 | 50 | 33195 | 115 | 3380 |
| -10 | 628988 | 55 | 27091 | 120 | 2916 |
| -5 | 471632 | 60 | 22224 | 125 | 2522 |
| 0 | 357012 | 65 | 18322 | 130 | 2190 |
| 5 | 272500 | 70 | 15184 | 135 | 1907 |
| 10 | 209710 | 75 | 12635 | 140 | 1665 |
| 15 | 162651 | 80 | 10566 | 145 | 1459 |
| 20 | 127080 | 85 | 8873 | 150 | 1282 |

Figure 9. Thermistor Readout vs. Temperature (47kohm pull-up resistor, 5V) and Nominal Thermistor Resistance values vs. Temperature Table.

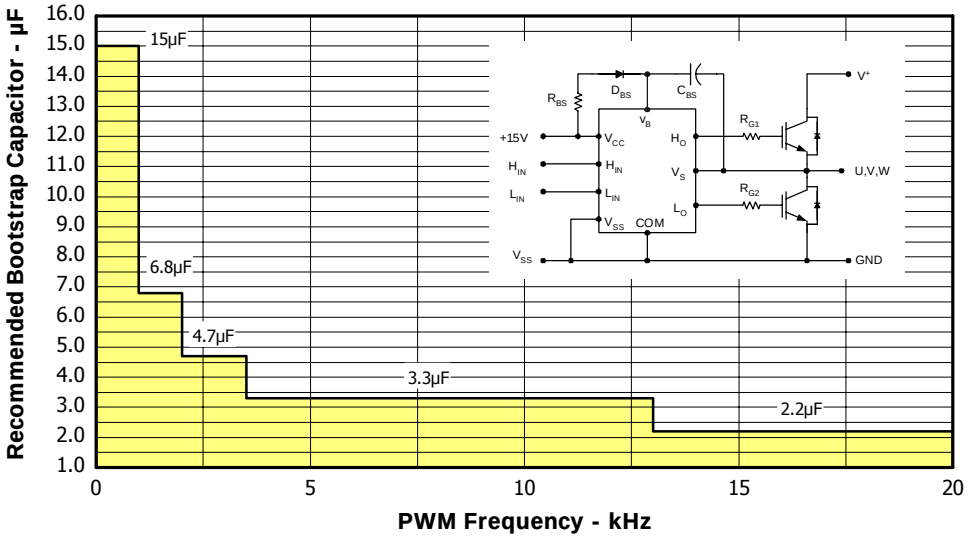



Figure 10. Recommended Bootstrap Capacitor Value vs. Switching Frequency

Figure 11. Switching Parameter Definitions

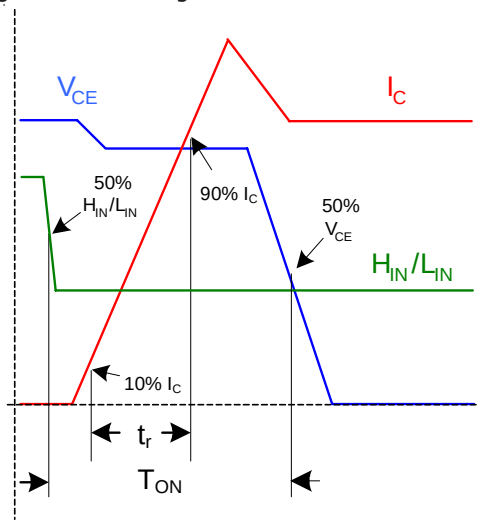



Figure 11a. Input to Output Propagation turn-on Delay Time

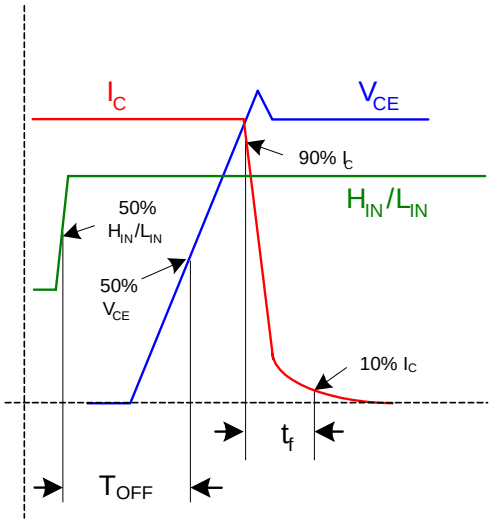



Figure 11b. Input to Output Propagation turn-off Delay Time

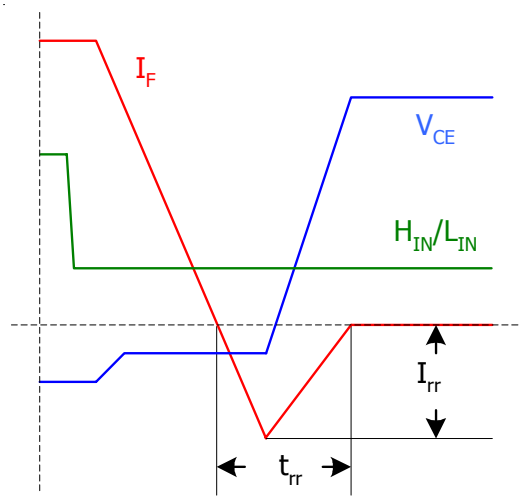



Figure 11c. Diode Reverse Recovery

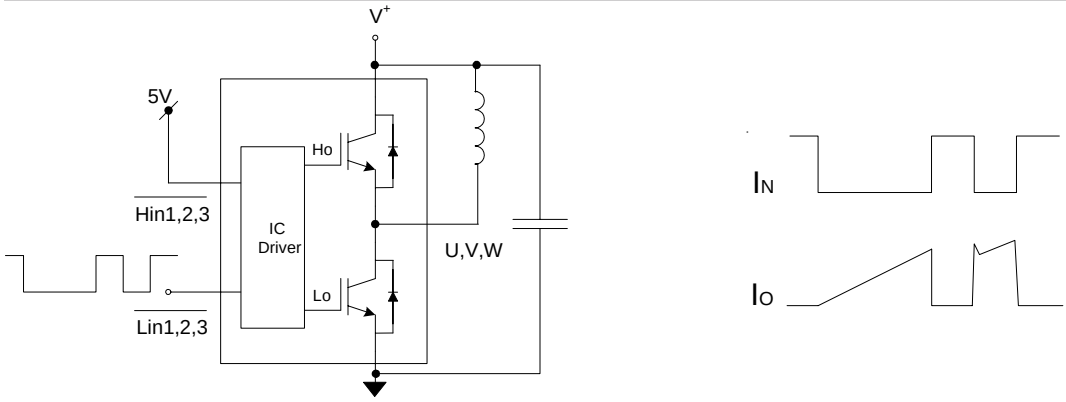



Figure CT1. Switching Loss Circuit

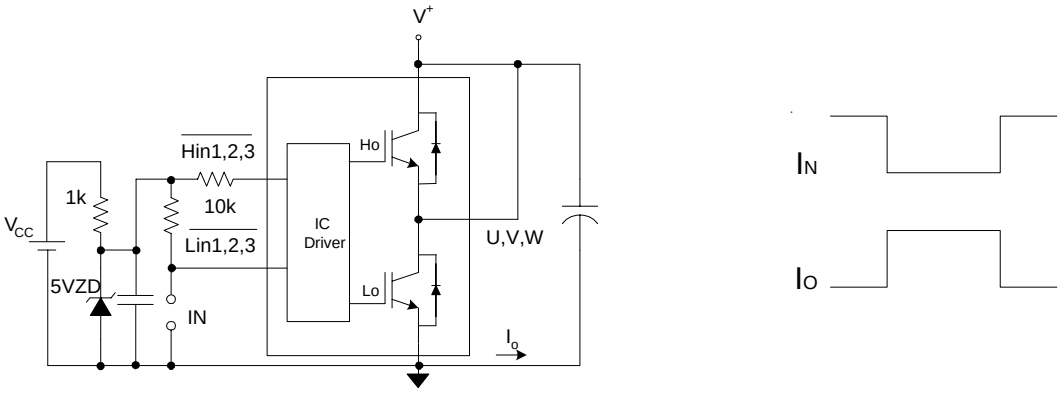



Figure CT2. S.C.SOA Circuit

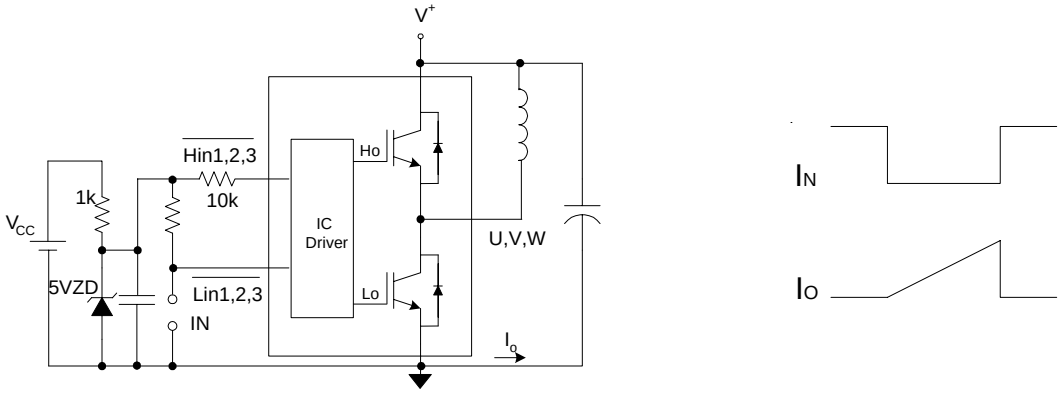
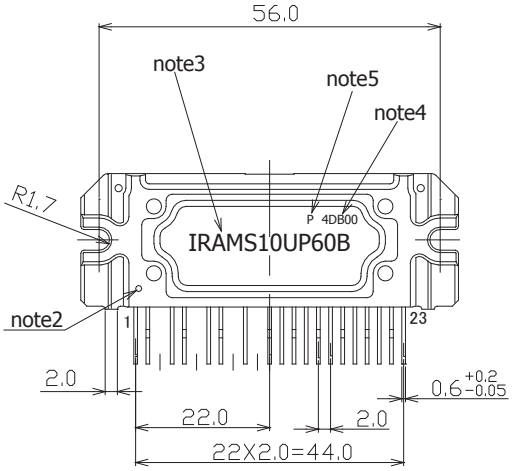
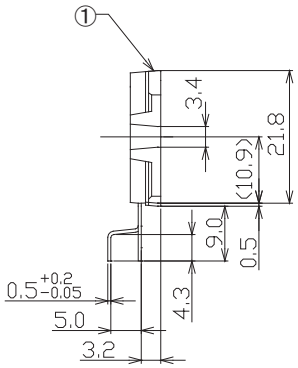


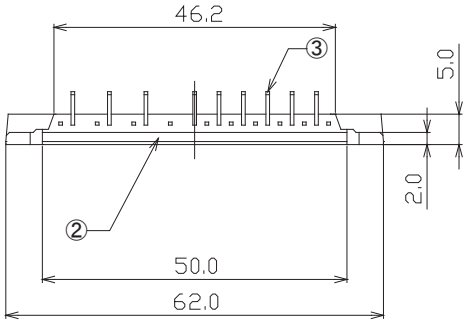

Figure CT3. R.B.SOA Circuit

## Package Outline IRAMS10UP60B

missing pin : 3,6,9,11




note1: Unit Tolerance is ±0.5mm,
Unless Otherwise Specified.

note2: Mirror Surface Mark indicates Pin1 Identification.

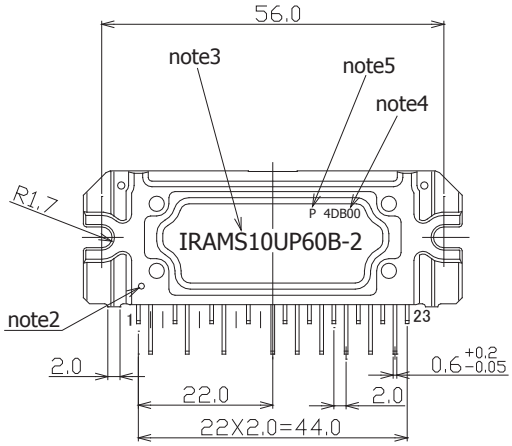
note3: Part Number Marking.
Characters Font in this drawing differs from Font shown on Module.

note4: Lot Code Marking.
Characters Font in this drawing differs from Font shown on Module.

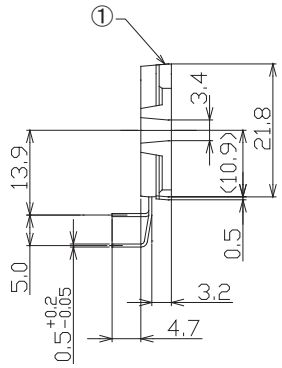
note5: "P" Character denotes Lead Free.
Characters Font in this drawing differs from Font shown on Module.

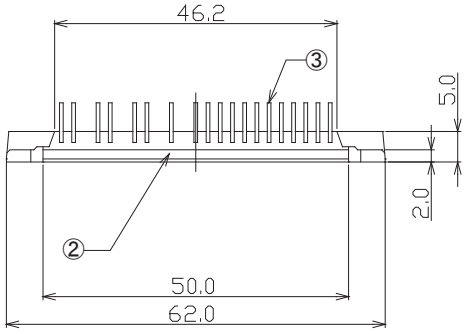
Dimensions in mm
For mounting instruction see AN-1049

## Package Outline IRAMS10UP60B-2




missing pin : 3,6,9,11




note1: Unit Tolerance is ±0.5mm,
Unless Otherwise Specified.
note2: Mirror Surface Mark indicates Pin1 Identification.
note3: Part Number Marking.
Characters Font in this drawing differs from
Font shown on Module.
note4: Lot Code Marking.
Characters Font in this drawing differs from
Font shown on Module.
note5: "P" Character denotes Lead Free.
Characters Font in this drawing differs from
Font shown on Module.

Dimensions in mm
For mounting instruction see AN-1049


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2012-12-19

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- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
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- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
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- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

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